379
N81d
No. 2024

SHORT-TO-MEDIUM TERM ENROLLMENT PROJECTION BASED ON CYCLE REGRESSION ANALYSIS

DISSERTATION

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

Mohammad Chizari, B.S., M.B.A.
Denton, Texas

August, 1983

wkb

Chizari, Mohammad, Short-To-Medium Term Enrollment Projection Based on Cycle Regression Analysis. Doctor of Philosophy (Educational Research), August, 1983, 262 pp., 4 figures, 121 tables, bibliography, 87 titles.

Short-to-medium projections were made of student semester credit hour enrollments for North Texas State University and the Texas Public and Senior Colleges and Universities (as defined by the Coordinating Board, Texas College and University System). Undergraduate, Graduate, Doctorate, Total, Education, Liberal Arts, and Business enrollments were projected. Fall + Spring, Fall, Summer I + Summer II, Summer I were time periods for which projections were made.

A new regression analysis called "cycle regression" which employs nonlinear regression techniques to extract multifrequential phenomena from time-series data was employed for the analysis of the enrollment data. The heuristic steps employed in cycle regression analysis are similar to those used in fitting polynomial models. A trend line and one or more sin waves (cycles) are simultaneously estimated using a partial F test. The process of adding cycle(s) to the model continues until no more significant terms can be estimated.

An 11-year string of historical enrollment data, starting from academic year 1965, was used for the analysis by the cycle regression technique for each category of data at each time period. Of the seven models which were estimated for

each category of data at each time period, the best one was chosen and its equation was presented for future enrollment forecasting. The projected semester credit hour enrollments were compared with actual values, and their deviations and percentage deviations were computed and tabulated. The cycle regression projections were also compared with the projections made by two other approaches.

The cycle regression was found to be a useful and effective forecasting tool in enrollment projection. Consequently its use for universities and state-wide enrollment forecasting was recommended.

TABLE OF CONTENTS

LIST OF TABLES

Table Page

Table | Page

Table | Page

Table | Page

Table Page

Table Page

LIST OF FIGURES

CHAPTER I

INTRODUCTION

One of the most important aspects of every university system management is estimation of the resource needs as well as provision and allocation of resources to meet these needs. Forecasting student enrollment demands represents a critical input into management's planning activities. In addition to simple aggregated enrollment estimates, future student population attributes are also important in assessing specific resource needs (2, p. 53).

Educational and management science literature includes descriptions of a number of forecasting models, some of which have already been applied to the projection of enrollment (14). Some forecasts also are made strictly on a qualitative basis when the known models fail to project with sufficient accuracy, when appropriate statistical data are not available, or when school administrators are ignorant of the mathematical models which might be applied to the problem (4, p. 13).

There are two general approaches to enrollment projection. The first uses census data and demographic information from the local community. There are many problems associated with this approach. Among them is the difficulty of obtaining consistent accurate census and demographic data. The other general approach is to make projections based solely on past enrollment data. Koulouianos (6) uses a different classification scheme, paediometric and economic. Within this scheme, projection models concerned with the dynamics of education occurring without any influence from the economy as a whole are referred to as paediometric, whereas economic models are specifically concerned with the dynamic interrelationship of education and the economy.

Most of the enrollment projection models are concerned only with the accurate and reliable forecast of future student population rather than with establishing the interrelationship between the state of the economy and the dynamics of student population of a higher education institution, even though the higher education enrollment has been found to be related to economic activity (7, pp. 7-26). In her doctoral dissertation, Dorothy Lynn Brooks (3) has demonstrated the interrelationship of enrollment of two Texas universities with some parameters of the national as well as local economies. The incorporation of economic parameters into an enrollment forecasting model not only suggest an interrelationship between enrollment and specific economic parameters but also utilizes that known relationship for an effective, accurate projection of enrollment with the least error.

There are numerous methods used for the purpose of projecting the size and/or structure of the student body of educational institutions. Depending on the size, complexity of the activities, financial standing, technical expertise available, need for planning and the type of institutional leadership, one or the other of these techniques may be more appropriate or economically feasible to fulfill goals of the different educational institutions.

A brief introduction of the following techniques is presented in Chapter II; Markov Chain Model, Freeman's Recursive Adjustment Model, A Poisson Distribution Model, Random Walk Simulation Model, Bayesian Decision Theory in Enrollment Forecasting, Exponential Smoothing Model, Cohort Survival Method, Trend Analysis and Multiple Regression.

Of the above techniques, trend analysis and multiple regression (with utilization of Box-Jenkins methodology) are of greatest interest. Salley's (8, 9) and Brooks' (3) models are analyzed on a more detailed basis.

The quest for the model with the least difficulty and cost and with an effective reliable forecasting ability is not yet over. In this analysis a new procedure in treatment of time series enrollment data will be used and its strengths and weaknesses examined.

Statement of the Problem

The problem of this study was to evaluate a short-to-medium term projection model of student semester credit hour (SCH) on a full-time equivalent (FTE) basis at the following levels for North Texas State University (NTSU) and Texas Public Senior Colleges and Universities (TPSU) based on cycle regression (10, 11, 12, 13) treatment of time series data:

Total SCH Over-All Program Areas

1. Undergraduate
2. Master
3. Doctorate
4. Total (all above categories combined), and

Total SCH by Following Program Areas

5. Education
6. Liberal Arts
7. Business Administration

Statement of the Purposes

1. The first purpose of the study was to evaluate the utility of the cycle regression analysis in enrollment projection.

2. The second purpose was to use cycle regression algorithm to extract trend from each set of historical enrollment data defined in statement of the problem.

3. The third purpose is to decompose the residuals resulted from detrended data into as many cyclic components as is possible within the framework of cycle regression technique.

4. The fourth purpose was to establish an explanatory equation for projection of enrollment for each set of data defined in statement of the problem.

5. The fifth purpose was to use resultant explanatory equations to project enrollment for at least one fiscal year ahead (starting from fiscal year 1976).

6. The sixth purpose was to compare actual enrollment with projected enrollment in all defined sets.

7. The seventh purpose was to compare cycle regression student semester credit hour enrollment (SCH) projections for the North Texas State University (NTSU) in the following categories; total, undergraduate, and graduate with the same categories' projections provided by the Brooks' method for the time period of Fall 1979, Fall 1980, Spring 1980, Spring 1981, Summer 1980, and Summer 1981 (see 3, p. 78).

8. The eighth purpose was to compare cycle regression total student semester credit hour enrollment projections (Total-SCH) with the same categories' projections made by the Coordinating Board, Texas Colleges and University System for the Fall, Spring, and Summer semesters of 1976 through 1981.

Definition of the Terms

For the purpose of this study, the following terms are defined.

Time series is a chronological sequence of observation on a particular variable (1, p. 7).

Trend refers to the upward or downward movement that characterizes a time series over a period of time. Thus, it reflects the long-run growth or decline in the time series (1, p. 6).

Cycle refers to recurring up and down movements around trend levels with a duration of anywhere from 2 to 10 years as measured from peak to peak or through to through (1, p. 7).

Seasonal variations are periodic patterns in a time series that complete themselves within the period of a calendar year and are then repeated on a yearly basis (1, p. 8).

Irregular fluctuations are erratic movements in a time series that follow no recognizable or regular pattern (1, p. 8).

Decomposition of time series is the separating of a time series into its basic components: trend, seasonal, cyclical, and irregular or error terms (3, p. 6).

"Cycle Regression" procedure (10, 11, 12, 13) is a new regression analysis algorithm employed in this analysis.

Program Area (PA) refers to the educational reporting categories as has been specified by the Coordinating Board, Texas College and University System. (For a list of program areas, see Appendix B of 5.)

SCH refers to semester credit hour enrollment.

TPSU refers to Texas Public Senior Colleges and Universities that are all bachelor granting four year state colleges and universities as have been identified by the Coordinating Board, Texas College and University System. (For a recent list, see 5).

NTSU refers to North Texas State University.

A statistically significant term refers to a term which, if included in the regression equation the value of F statistic of incremental R^2 will be greater than 2.

A significant cycle refers to a cycle, in the context of cycle regression terminology, which if included in the regression equation, the value of F statistic of incremental R^2 will be greater than 2.

Delimitation

Delimitations of this study are as follows.

1. Enrollment projections were made only for those categories defined in the statement of the problem.

2. Enrollment projections were made using a moving 11-year string of historical enrollment data in each defined category.

3. Enrollment data utilized were those provided by North Texas State's Office of Institutional Research and Coordinating Board of Texas College and University System.

4. Analysis of enrollment data was limited to cycle regression technique.

Limitations

The projections of student semester credit hour (SCH) enrollment in each category are not expected to be equal to actual semester credit hour enrollments due to the random error of predictions.

Assumptions

It was assumed that historical student semester credit hour enrollments (SCH's) contain trend effects and different cyclical variations.

A small percentage of total variation in the historical data that cannot be accounted for after extraction of the trend and different cyclical components would be assumed to be error of prediction.

It was assumed also that reliable (consistent prediction over time and across different sets of data) short-to-medium term projections of student semester credit hour enrollments can be made using cycle regression analysis of historical enrollment data.

CHAPTER BIBLIOGRAPHY

1. Bowerman, Bruce L. and Richard T. O'Connel, Forecasting and Time Series, California, Duxbury Press, 1979.

2. Britney, Robert R., "Forecasting Educational Enrollment: Comparison of a Markov Chain and Circuitless Flow Network Model," Socio-Economic Planning Science, 9 (June, 1975), 53-60.

3. Brooks, Dorothy Lynn, "Short Term Enrollment Projections Based on Traditional Time Series Analysis," doctoral dissertation, North Texas State University, December 1981.

4. Brown, Daniel J., "A Smoothing Solution to the School District Enrollment Projection Problem," Educational Planning, 2 (May, 1975), 13-26.

5. Educational Data Reporting System for Public Senior Colleges and Universities, Coordinating Board, Texas College and University System, September, 1981.

6. Koulouianos, D. T., Educational Planning for Economic Growth, Technical Report 23, Center for Research in Management Science, University of California, Berkeley, California, February, 1967.

7. Kraetsch, Gayla A., Methodology and Limitations of Ohio Enrollment Projections, The Association for Institutional Research Professional File No. 4, edited by Richard R. Perry, Tallahassee, Florida, Winter, 1979-1980.

8. Salley, Charles D., "Predicting Next Year's Resources--Short-Term Enrollment Forecasting for Accurate Budget Planning," Atlanta, Georgia State University, 1978, a paper presented to the Association for Institutional Research Annual Forum, Houston, Texas, 1978.

9. _______________, Helping Administrators Identify Shifts in Enrollment Patterns, Atlanta, Georgia State University, 1977. (ERIC Ed. 136-716).

10. Simmons, L. F. and D. R. Williams, "A Cycle Regression Analysis Algorithm for Extraction Cycles from Time-Series Data," unpublished manual, Management Science Department, College of Business, North Texas State University, 1980.

11. ________________, An Algorithm for Cycle Regression Analysis, Southwestern AIDS Proceedings, March, 1980.

12. ________________, "A Cycle Regression Analysis Algorithm for Extracting Cycles from Time-Series Data," Computers and Operations Research, An International Journal, IX (No. 3, 1982), 243-254.

13. ________________, "The Use of Cycle Regression Analysis to Predict Civil Violence," Journal of Interdisciplinary Cycle Research, Forthcoming.

14. Wasik, John L., A Review and Critical Analysis Used for Estimating Enrollments in Educational Systems, Center for Occupational Education, North Carolina State University at Raleigh, 1971. (ERIC Ed. 059-545.) and A. J. Taffe, Handbook of Statistical Procedures for Long-Range Projection of Public School Enrollment, U. S. Office of Education, 1969. (ERIC Ed. 058-668).

CHAPTER II

BACKGROUND, RELATED LITERATURE AND SIGNIFICANCE OF THE STUDY

Enrollment and the size of the student body of colleges and universities is a prime concern of all institutions of higher education, especially in periods of economic slow-downs. Most institutions of higher education are experiencing limited growth, no growth, or even declining enrollments (2).

The annual enrollment growth of 10 per cent, which was typical of the 1960s, shrank to only 3 per cent by the 1970s. In the decade of the '70s, most institutions of higher education experienced practically no growth. This in return has affected sectors of the economy which draw heavily on college graduates (8, p. 50). Minter suggests that slowing down of enrollment growth is a dominant factor in higher education (22, p. 19).

The financial hardship faced by institutions of higher education as a consequence of the state of the national economy are serious (3, p. 149). In the face of these difficulties, careful planning and new management strategies are extremely important factors for survival of higher education institutions (16, p. 1). University administrators seek to devise strategies to develop and maintain effective programs within existing budgetary constraints (14, p. 55). There are, however, many difficulties involved in developing a planning system for a college or university, considering the magnitude and diversity of higher education institutions. To provide a sound rational basis for the decision making process, a vast pool of analytical and statistical procedures can be utilized. The benefits accrued from appropriate analyses and projections are self-evident in administrative decision making. Enrollment projection plays an important role in planning and allocation of resources of a university.

There are a considerable number of mathematical and statistical techniques used for enrollment projection purposes. In order for a model to be used it must provide concise, relevant information for the decision maker (1, p. B148; 25, p. 903). A summary of the most notable methods used in enrollment projection will provide the merits as well as fallacies of each method.

Markov Chain Model

In the Markov chain model, the flow of students through an education system is seen as a series of events subject to random fluctuations and proceeding with time such that the development of the system depends only on its state at the present time and on input to the system.

The Markov chain model is based on a matrix of transition probabilities whose elements are the probabilities of passage between states within the system. The states of the Markov chain representing the educational system are: the school's grade levels within the system, dropout and graduation. One of the assumptions of this model is that all new entrants enter level one. The time variable has also been assumed to be discrete; therefore the transition probabilities apply only at given points in time (15).

These deficiencies are notable in the model:

1. Constancy overtime of transition probabilities (transition probabilities from grade to grade remain constant);

2. Dependence of the model on some accurate census projections (i.e., birth projection);

3. The necessity of accurate projection of the age distributions of new entrants.

Freeman's Recursive Adjustment Model

Freeman's (10) three-equation Recursive Adjustment Model has been successfully tested and used at the Massachusetts Institute of Technology Center for Policy Alternatives for analyzing the supply and demand factors in the college-level professions. Freeman's three-equation will predict: supply of freshmen to college (FRSH), the number of bachelor's graduates (BA), and a weighted average of college starting salaries in accounting, engineering, general business, and sales and marketing (CSAL).

The main equations are

$$FRSH = a_1 + b_1 \text{ POP} + C_1 \text{ (CSAL - ASAL)} + d_1 \text{ FRSH (-1)}$$

$$BA = a_2 + b_2 \text{ FRSH (-4)} + C_2 \text{ FRSH (-5)}$$

where

FRSH = the number of first-degree, credit-enrolled males

BA = number of bachelor's graduates

POP = the number of 18- to 19-year-old men

CSAL = a weighted average of college graduate starting salaries

ASAL = the average annual earnings of full-time workers in the U.S.

FRSH(-1) = one year lagged of variable FRSH

FRSH(-4) = four year lagged of variable FRSH

FRSH(-5) = five year lagged of variable FRSH

a, b, c, d, represent the estimated regression coefficients.

In his model, Freeman included only United States males and variables are in logarithmic form.

In validating Freeman's model, Wish and Hamilton (32) replicated his model by using data for the entire United States, the state of Oregon, and the University of Oregon, with two micro entities which consisted of the University of

Oregon College of Business Administration and the Department of Psychology; and they concluded that while r^2 and F statistics of the model tend to be larger for the larger micro entities, nonetheless, the model fits the data very well and is an effective tool in analyzing major determinates in college attendance.

Error Estimation in Forecasting Poisson Distribution

Following the work of Sidney Suslow and colleagues in the office of Institutional Research at the Berkeley Campus of the University of California, Marshall and Oliver (20) used the longitudinal data on student enrollment to determine variance and confidence bounds on student enrollment forecast, in addition to finding forecasts themselves. In their model they assumed that enrollments follow a Poisson distribution and that entering cohorts contain large numbers of students. Based on that assumption, they developed statements about the approximate behavior of the conditional distribution of the total number of students in attendance at a given time as well as a set of complex equations used in the model.

Random Walk Simulation Model

Grace and Kyung (12) analyzed student enrollment and movements within the Alberta Education System to produce a simulation model. The procedure isolated the component variables and formulated the mathematical rules governing their interaction. Students were classified by age, grade, sex, and their entry to movement through and graduation from the system. Enrollment is then projected under various changes in parameters, exogeneous variables, status variables, and operating characteristics of the system.

Bayesian Decision Theory in Enrollment Forecasting

In this method the university is divided into homogeneous subpopulations, and the university forecast is obtained by totaling estimates from these subpopulations (18). Subjective enrollment estimates are made for each of the homogeneous subpopulations for the upcoming academic year using the opinion of experts in the field. Assuming a normal probability distribution for each subpopulation and using standard normal equations $Z = \frac{X - \mu}{\sigma}$
where:

Z is the standardized score

X is the value of raw score

μ is the population mean

σ is the estimated standard deviation.

The probability of enrollment exceeding a value other than the mean is estimated, then the variance for the university is calculated by adding the variance for each college. This method would provide also for conversion to full-time equivalent (FTE) enrollment. The application of subjective probability to enrollment forecasting at the University of Toledo has provided reasonable results. But the model is basically a judgmental model with some probability statements attached to it.

Exponential Smoothing

Brown (6, p. 14) suggests the use of an exponential smoothing model. Exponential smoothing is used in forecasting of time series data with no trend.

The implementation of an exponential procedure consists of several stages. One of these stages involves the choice of an "appropriate" smoothing constant. In cases where forecasting procedure is not providing accurate forecasts, perhaps because of a change in the underlying pattern of the time series, corrective actions such as changing of smoothing constant must be taken (4, p. 117).

Exponential smoothing approach to forecasting of time series, however, assumes that random error components in the time series model are statistically independent of each other. That is to say that successive observations of the time series are also independent from each other. If the successive error terms are statistically dependent upon each other, then so are the successive observations, which will be called autocorrelated. Models that will express their dependent variable (Y_t) as a function of present and prior random error components (e_i) can accomplish the best results with autocorrelated observations.

This model was employed by Box-Jenkins and is often called Box-Jenkins methodology (4, pp. 235-237). Box-Jenkins methodology offers a systematic approach to building, analyzing, and forecasting with time series models. However, this methodology also has several drawbacks. First, sampling intervals need to be small. Second, a minimum of 50 to 100 interval observations must be secured to build a good Box-Jenkins model. (For a complete discussion of Box-Jenkins methodology see 18.) Wheelwright and Makridakis (30) also argue that the cost of using Box-Jenkins methodology makes it unattractive for the average schools and that consequently a simple more straightforward method like exponential smoothing may be a better solution (also see 11 and 31).

Cohort Survival Method

Cohort Survival Method, as has been explained by Englehardt (9) and Leggett (17), employs the birth rate to first-grade enrollment ratio to project future first-grade enrollment. This procedure has been criticized by Alspaugh (2) for difficulty of obtaining consistent census and lack of match between district boundaries and area boundaries for recording births.

Trend Analysis and Multiple Regression

Salley (23, 24) applied the classic time series analysis to the study credit hour enrollment pattern in Georgia State University (GSU). He made the following assumptions:

1. Seasonal variation would occur quarterly
2. Trend variation would be historical growth path
3. Cyclical variation may relate to the cyclical behavior of the economy, and
4. Random variation would be unique events such as the initiation of a new academic program or non-degree work.

Using a moving average technique, Salley deseasonalized the GSU historical enrollment data. The seasonally adjusted data then was used to fit a least-squares curve to account for trend variation. The latter residual was considered to contain cyclical and random variations. The evident cyclical behavior was then investigated further to see if it was parallel with the cyclical behavior in other time-series data.

Correlation with other time series was checked on a lagged basis. Salley chose the National Bureau of Economic Research's (NBER) index of coincidental indicators and concluded that economic activity does effect GSU enrollment variation in an inverse manner, that is to say, that an increase in economic activity appeared to have a dampening effect on credit hour enrollment.

To establish a precise relationship, Salley used simple regression to measure exact correlation coefficients between credit hour residual and various measures of local, state, and national economic activity. However, he concluded that although a pattern for short-run variation can be established, no contribution was made to the projection of long-run growth trends.

Working on Salley's findings, Campbell and Greenberg (7) utilized trend analysis and a multiple regression approach to enrollment forecasting for Florida International University. They used four independent variables: trend, seasonal variations, cyclical variation, and a dummy variable (for opening of a new campus) to account for fluctuation in the dependent variable (total university FTE enrollment) and concluded that the resultant regression equations yield predictions of enrollment up to one year in advance with residual error within a tolerable range.

Generally, time series regression analysis, which takes advantage of the interrelationship of enrollment data with some economic parameters to project future enrollment data, has some major drawbacks. One of the most important problems inherent in the time-series regression model with economic parameter as one of its independent variables is the inability of the model to make beyond one or two time-period projections. This is because of the lack of availability of the value(s) for the economic parameter(s) to be fed into the model. In other words, the economic data are not available far enough in advance to make projection of enrollment when economic cycle leads enrollment cycle by one or two periods. However, most often this is exactly the case (see 5, p. 76). In this situation, when long-term projections are not possible, one merely has to depend on the trend component of the model to get a crude estimate(s) of the future enrollment data.

Furthermore, the projection(s) of the model must be reevaluated each time period to determine if the known relationship between dependent and independent variables still holds. If the projection equation(s) no longer represent the true relationship between the variables, then the whole cumbersome calculation and selection of the economic indexes needs to be repeated.

Following Sally's work, Brooks used a similar analysis to build projection equations for student semester credit hour enrollments at two universities in the North Central Texas area. She used three sets of enrollment data for the two universities. First the raw student semester credit hour enrollment figures were deseasonalized. Next a trend line was fitted to the seasonally adjusted data. The residuals from the last step were assumed to contain cyclical components of the enrollment data.

She then correlated detrended data with seven economic cycles with a lag of zero, one, two, and three. Economic cycles with highest correlation coefficients with a cycle of enrollment were then chosen to be included in a multiple linear regression equation which were used to project future semester credit hour enrollment. The economic cycles were chosen from national, state, and regional economies. Thus, the projection equations contained a trend component, b_1x_1, a seasonal component, b_2x_2, and a cyclical component, b_3x_3 (5, p. 71).

Brooks also studied the residuals of the equations and found that residuals for both of the universities for the regular academic year (Fall and Spring semesters) are over time roughly linear (with a positive slope for Fall and Spring and negative slope for Summer) rather than being random as it was expected (5, p. 88). Correlation between members of series of observations ordered in time has been termed autocorrelation. One of the assumptions of the classical linear regression model is that the autocorrelation of the residual does not exist (13, p. 219).

In classical linear regression terminology the presence of autocorrelation would result in the Ordinary Least Square estimators' being no longer efficient (minimum variance). Also, usual t and F tests of significance are no longer valid and, if applied, would result in seriously misleading conclusions about the statistical significance of the regression coefficients (13, p. 226).

Since autocorrelation is a serious problem in context of a least square regression model, several methods of detecting autocorrelation are used. One is the study of population disturbances u_i or their proxies, the residuals e_i. The graphical method which is used to detect autocorrelation of the residuals is often supplemented by a test statistic, Durbin-Watson d.

One of the assumptions underlying the d statistic is that the regression model should not include lagged value(s) of the dependent variable as one of the explanatory variables (13, p. 235). The reason for this is that lagged values of dependent variable (Yt-1) is highly correlated with zero order Y.

In Salley's as well as in Brooks' model, it seems plausible that by including a highly correlated economic variable with the dependent variable in the model the essence of the Durbin-Watson d statistic's assumption has been violated. Therefore there is a built-in bias in the model against discovering serial correlation using the d statistic which in cases like those above would often have a value around 200, indicating the absence of first-order autocorrelation (31, p. 238).

Brooks reported a Durbin-Watson d values of approximately 2 in most cases (indicating absence of autocorrelation) while plots of her residuals suggest presence of autocorrelations in all of the models. This inconsistency can be attributed to the violation of assumption underlying Durbin-Watson d statistic.

The presence of linear trend (positive or negative) in final residuals of the Brooks' model suggest that not all of the variability in the data has been effectively explained by the independent variable(s) in the model. To remove linear trend in the residual one has to use either another independent variable(s) or some sort of transformation or polynomial function(s) of the existing independent variable(s) in the model.

Introduction of Cycle Regression Analysis

"Cycle Regression" is a new regression analysis algorithm, which employs nonlinear regression techniques to extract multifrequential phenomena from time-series data. This algorithm permits the simultaneous estimation of all parameters instead of one cycle at a time and does not require equally spaced data. Cycle regression is particularly well suited to any time-series data which contain sinusoidal cycles that are related in additive manner. Sinusoidal cycles are cycles in the time series data that can best and adequately (in regression least square error terminology) be expressed with a sine term in its regression equation.

There are two types of variation or "cycles" in time series data. The first is additive cycles. If a time series displays additive cycles, the magnitude of the "cycle swing" is independent of the average level as determined by the trend. The second type is multiplicative variations or "cycles." If a time series displays multiplicative variations, the magnitude of the "cycle swing" of the time series is proportional to the average level as determined by the trend (4, p. 209).

In estimation of non-linear parameters most algorithms use either of the following two approaches. The Model either is expanded as a Taylor series which on the assumption of local linearity, corrections to the several parameters are made at each iteration. The other approach is to use several modifications of steepest-descent method. Both methods run into serious problems, the Taylor series method because of divergence of the successive iterates, the steepest-descent (or gradient) methods because of slow convergence after the first few iterations.

Marquardt's compromise method is a maximum neighborhood approach which performs an optimum interpolation between Taylor series method and gradient method (19, p. 431). The "Cycle Regression" procedure assumes the possibility of the presence of more than one periodic component in data. The cycle regression algorithm repeatedly employs Marquardt's compromise method and some heuristic procedures to develop a regression model consisting of a linear trend and several sine functions (26, 27, 28, 29).

The general cycle regression analysis model for K cycles is given by

$$Y_t = B_o + B_1 + \sum_{i=1}^{K} \{B_{3i-1} \text{ Sin } [B_{3i}(t-B_{3i+1})]\}+e_t$$

where:

- $B_o + B_1$ represents linear trend
- B_{3i-1} represents amplitude of the ith cycle
- sin sine
- B_{3i} represents angular frequency of the ith cycle
- B_{3i+1} represents phase of the ith cycle
- e_t represents a random variable normally distributed with mean of 0 and standard deviation σ.

The B_j parameters are estimated using cycle regression analysis. Their estimates are denoted

$$b_j \text{ (for } j = 0,1,2,....,3i+1).$$

The heuristic steps employed in cycle regression analysis are similar to those employed in fitting polynomial models. In polynomial regression a polynomial term of higher degree is added to the model and a partial F test is made. This process is repeated until the partial F indicates that the last polynomial term is not significant. Likewise in cycle regression a term $B_{3i-1}\text{Sin}[B_{3i}(t+B_{3itl})]$

is repeatedly added to the model until the last term is not found to be significant.

The steps in the heuristic structure of cycle regression analysis for two cycles are as follows:

Step 0

(Trend)

$Y_t = B_o + B_1 t + e_t$ is fitted to the data and correlation or residual is computed.

Step 1

(Trend + cycle 1)

$Y_t = B_o + B_1 t + B_2 \text{ Sin } [B_3(t = B_4)] + e_t$

is fitted using Marquardt's compromise method. Estimate of parameter $B_j(b_j)$ are initialized as follows:

B_o and B_1 with estimates of Step 0

B_2 and B_4 as zeros.

B_3 from auto-correlation of Step 0

Partial F is computed to see if Cycle 1 is significant. If Cycle 1 is significant auto-correlation of residual is computed and Step 2 starts. Otherwise estimate of B_j are those of Step 1.

Step 2

(Trend + Cycle 1 + Cycle 2)

Marquardt's compromise method is used to fit

$Y_t = B_o + B_1 t + B_2 \text{ Sin } [B_3(t + B_4)] + B_5 \text{ Sin } [B_6(t+B_7)]$
$+ e_t$

$B_o = B_o$ from Step 1

$B_1 = B_1$ from Step 1

$B_2 = B_2/2$ from Step 1

$B_3 = B_3$ from Step 1

$B_4 = B_4$ from Step 1

$B_5 = B_2/2$ from Step 1

B_6 = estimate from auto-correlation of residual of Step 1

$B_7 = 0$

Partial F is computed. If Cycle 2 is significant, auto-correlation of residual is computed and Step 3 starts. Otherwise the model obtained in Step 1 is used (29, pp. 244-246).

CHAPTER BIBLIOGRAPHY

1. Ackoff, Russell L., Scientific Method: Optimizing Applied Research Decisions, New York, John Wiley and Sons, Inc., 1962.

2. Alspaugh, John W., "Accuracy of School Enrollment Projections Based Upon Previous Enrollments," Educational Research Quarterly, 6 (No.2, 1981), 61-67.

3. Bowen, William G., "The Effects of Inflation/Recession on Higher Education," Educational Record, 56 (Summer, 1975), 149-155.

4. Bowerman, Bruce L. and Ricahrd T. O'Connel, Forecasting and Time Series, California, Duxbury Press, 1979.

5. Brooks, Dorothy Lynn, "Short-Term Enrollment Projections Based on Traditional Time Series Analysis," doctoral dissertation, North Texas State University, December, 1981.

6. Brown, Daniel J., "A Smoothing Solution to the School District Enrollment Projection Problem," Educational Planning, 2 (May, 1975), 13-26.

7. Campbell, S. Duke and Greenberg, Barry, "The Use of Multiple Regression and Trend Analysis to Understand Enrollment Fluctuations," paper presented to Annual Forum of the Association for Institutional Research, 19th, San Diego, California, May 13-17, 1979.

8. Centra, John A., "Reading the Enrollment Barometer," Change, 11 (April, 1974), 50-62.

9. Englehardt, N. L., "How to Estimate Your Future Enrollment," School Management, 17 (July, 1973), 39-41.

10. Freeman, R. B., "A Cobweb Model of the Supply and Starting Salary of New Engineers," Industrial & Labor Relation Review, 29 (January, 1976), 236-248.

11. Geoffreon, L. "A Summary of Exponential Smoothing," Journal of Industrial Engineering, XIII (July - August, 1952), 223-226.

12. Grace, M. and Kyung, S. Bay, "A Random Walk Simulation Model for Enrollment Projections," Journal of Educational Data Processing, 12 (No. 2, 1975), 10-42.

13. Gujarati, Damodar, Basic Econometrics, New York, McGraw-Hill Book Company, 1978.

14. Gunell, James B., "Resource Allocation for Maximum Program Effectiveness," New Directions for Institutional Research, 24 (1979), 55-63.

15. Hanson, M. J. and P. Tronnelen, "Markov Chain Model for Enrollment Projections," Journal of Educational Data Processing, 12 (No. 2, 1975), 1-9.

16. Hollander, T. Edward, "Planning for Changing Demographic Trends in Public and Private Institutions," New Directions for Institutional Research, 6 (Summer, 1975), 1-12.

17. Legell, S., "How to Forecast School Enrollments Accurately and Years Ahead," American School Board Journal, 160 (1973), 25-31.

18. Lind, Douglas A., "Bayosian Decision Theory in Enrollment Forecasting," paper presented at the Annual Forum of the Association for Institutional Research, 19th, San Diego, California, May 13-17, 1979.

19. Marguardt, D. W., "An Algorithm for Least Squares Estimation of Nonlinear Parameters," Journal of Social, Industrial and Applied Math, 2 (1963), 431-441.

20. Marshall, K. T. and R. M. Oliver, "Estimating Errors in Student Enrollment Forecasting," paper presented at the Annual Forum of the Association for Institutional Research, 19th, San Diego, California, May 13-17, 1979.

21. Mayhew, Lewis B., "The Steady Seventies," Journal of Higher Education, 45 (March, 1974), 163-173.

22. Minter, W. John, "Current Economic Trends in American Higher Education," Change, 11 (February, 1979), 19-25.

23. Salley, Charles D., "Predicting Next Year's Resources--Short-Term Enrollment Forecasting for Accurate Budget Planning," Atlanta, Georgia State University, 1978, a paper presented to the Association for Institutional Research Annual Forum, Houston, Texas, 1978.

24. ________________, Helping Administrators Identify Shifts in Enrollment Patterns, Atlanta, Georgia State University, 1977. (ERIC Ed. 136-716.)

25. Schroeder, Roger G., "Survey of Management Science in University Operation," Management Science, 19 (April, 1973), 895-906.

26. Simmons, L. F. and D. R. Williams, "A Cycle Regression Analysis Algorithm for Extraction Cycles from Time-Series Data," unpublished manual, Management Science Department, College of Business, North Texas State University, 1980.

27. ______________________________, An Algorithm for Cycle Regression Analysis, Southwestern AIDS Proceedings, March 1980.

28. ______________________________, "A Cycle Regression Analysis Algorithm for Extracting Cycles from Time-Series Data," Computers and Operations Research, An International Journal, IX (No. 3, 1982), 243-254.

29. ______________________________, "The Use of Cycle Regression Analysis to Predict Civil Violence," Journal of Interdisciplinary Cycle Research, Forthcoming.

30. Wheelwright, S. C. and S. Makridakis, Forecasting Methods for Management, New York, Wiley-Interscience, 1973.

31. Winters, P. R., "Forecasting Sales by Exponentially Weighted Moving Averaged," Management Science, VI (April, 1969), 324-342.

32. Wish, John R. and William P. Hamilton, "Replicating Freeman's Recursive Adjustment Model of Demand for Higher Education," paper presented at Annual Forum of Association for Institutional Research, 19th, San Diego, California, May 13-17, 1979.

CHAPTER III

DATA STRUCTURE, ORGANIZATION OF THE ANALYSIS, AND METHOD AND PROCEDURE

Introduction

The first objective of this chapter was to provide a detailed description of the data structure. Different categories of NTSU and TPSU enrollment data that were the subject of the analysis and their corresponding time periods were discussed. The second objective was to provide a picture of how the analyses were organized. Four distinct phases of the analyses were discussed. In the last section of this chapter, an attempt has been made to demonstrate a step-by-step treatment of one set of data in one time period by the cycle regression approach.

Data Structure

NTSU SCH data used in this analysis was for the following categories and semesters:

Categories

Undergraduate

Masters

Doctorate

Total

Education

Liberal Arts

Business

Semesters

Fall semesters of 1965 through 1981

Spring semesters of 1966 through 1982

Summer I semesters of 1966 through 1982

Summer II semesters of 1966 through 1982

See Table XIX and XX in Appendix.

TPSU SCH data which were used contained the following categories and semesters.

Categories

Undergraduate

Masters

Doctorate

Total

Education

Liberal Arts

Business

Semesters

Fall semesters of 1965 through 1981

Spring semesters of 1966 through 1982

Summer semesters of 1966 through 1981

See Table XXI and XXII in Appendix.

Organization of the Analysis

In order to facilitate the analysis of data, fulfill the purposes of the study, and present the results of employing cycle regression approach to projection of SCH's, Chapter IV was divided into four distinct phases.

Phase I and II were conducted to fulfill the first five purposes defined in the statement of the purposes for NTSU and TPSU enrollment data respectively. In conjunction with these two phases all NTSU and TPSU projected semester credit hour enrollments (SCH's) in each category at each time period were compared with the corresponding actual semester credit hour enrollment data available at the time of this study. Thus the sixth purpose of the study was fulfilled.

Phase III of Chapter IV was conducted to accomplish the seventh purpose defined in the statement of the purposes. The eighth purpose defined in the statement of the purposes was fulfilled in Phase IV of Chapter IV. A complete detailed description of each phase is presented next.

Phase I

Phase I of this study exclusively deals with estimation of projection equations for the seven different categories of North Texas State University enrollment data. In each category of data (e.g., Undergraduate) seven uniform steps were taken to estimate seven projection models, each time with a different 11-year string of data. This process was repeated for each category of data in four different time periods, combined Fall and Spring, Fall, combined Summer I and Summer II, and finally Summer I.

The objective of estimating seven models for each category of data in each time periods was twofold. First, it was possible to evaluate how many time periods in future cycle regression can predict with reasonable accuracy. Second, an assessment of cycle regression performance in regard to different time periods was possible. Actual NTSU semester credit hour enrollment data along with different models' corresponding projected SCH were summarized in appropriate tables presented in appendix. Also deviations and percentage deviations of projected SCH values from actual semester credit hours for each category of data at each time period were tabulated and presented in appendix next to corresponding projection tables.

Combining Fall and Spring data, as well as Summer I and Summer II data was primarily a variance-reduction method. It also provided a general yearly and summer enrollment outlook which might be of interest from a budgetary point of view. Furthermore, it was possible to evaluate, although subjectively, projection capability of cycle regression in a variance-reduced environment. Now, a detailed description of the seven steps employed in Phase I is in order.

Step 1. The semester credit hour enrollment equations were estimated by the cycle regression algorithm using first 11-year string of data in each category. Table I summarizes the data used to estimate projection equations as well as time periods for which projections were made.

Step 2. Using cycle regression the second 11-year strings of data (one piece of data was dropped at the lower end, while another was added to the upper end of strings of data used in Step 1) were used to build projection equations. Step 2 was summarized in Table II.

TABLE I

DATA BASE OF STEP 1

Time Period	Categories							# of Time Period in Advance Projection
	Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	
Combined Fall & Spring SCH	* From 1965 thru 1975 ** For 1976 thru 1984							9
Fall SCG	* From 1965 thru 1975 ** For 1976 thru 1984							9
Combined Summer I & Summer II SCH	* From 1966 thru 1976 ** For 1977 thru 1985							9
Summer I SCH	* From 1966 thru 1976 ** For 1977 thru 1985							9

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

TABLE II

DATA BASE OF STEP 2

Time Period	Categories: Under-Graduate, Masters, Doctorate, Total, Education, Liberal Arts, Business	# of Time Period in Advance Projection
Combined Fall & Spring SCH	* From 1966 thru 1976 ** For 1977 thru 1984	8
Fall SCH	* From 1966 thru 1976 ** For 1977 thru 1984	8
Combined Summer I & Summer II SCH	* From 1967 thru 1977 ** For 1978 thru 1985	8
Summer I SCH	* From 1967 thru 1977 ** For 1978 thru 1985	8

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

Step 3. Third 11-year strings of data (one piece of data was dropped at the lower end, while another was added to the upper end of strings of data used in Step 2) were used to build projection equations. Step 3 was summarized in Table III.

Step 4. Using cycle regression the fourth 11-year strings of data (one piece of data was dropped at the lower end, while another was added to the upper end of the strings of data used in Step 3) were used to build projection equations. Step 4 was summarized in Table IV.

TABLE III

DATA BASE OF STEP 3

Time Period	Categories							# of Time Period in Advance Projection
	Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	
Combined Fall & Spring SCH	* From 1967 thru 1977 ** For 1978 thru 1984							7
Fall SCH	* From 1967 thru 1977 ** For 1978 thru 1984							7
Combined Summer I & Summer II SCH	* From 1968 thru 1978 ** For 1979 thru 1985							7
Summer I SCH	* From 1968 thru 1978 ** For 1979 thru 1985							7

*String of data from which projection equation was estimated.
**Time periods for which SCH projection were made.

TABLE IV

DATA BASE OF STEP 4

Time Period	Categories							# of Time Period in Advance Projection
	Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	
Combined Fall & Spring SCH	* From 1968 thru 1978 ** For 1979 thru 1984							6
Fall SCH	* From 1968 thru 1978 ** For 1979 thru 1984							6
Combined Summer I & Summer II SCH	* From 1969 thru 1979 ** For 1980 thru 1985							6
Summer I SCH	* From 1969 thru 1979 ** For 1980 thru 1985							6

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

TABLE V

DATA BASE OF STEP 5

Time Period	Categories							# of Time Period in Advance Projection
	Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	
Combined Fall & Spring SCH	* From 1969 thru 1979 ** For 1980 thru 1984							5
Fall SCH	* From 1969 thru 1979 ** For 1980 thru 1984							5
Combined Summer I & Summer II SCH	* From 1970 thru 1980 ** For 1981 thru 1985							5
Summer I SCH	* From 1970 thru 1980 ** For 1981 thru 1985							5

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

TABLE VI

DATA BASE OF STEP 6

Time Period	Categories							# of Time Period in Advance Projection
	Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	
Combined Fall & Spring SCH	* From 1970 thru 1980 ** For 1981 thru 1984							4
Fall SCH	* From 1970 thru 1980 ** For 1981 thru 1984							4
Combined Summer I & Summer II SCH	* From 1971 thru 1981 ** For 1982 thru 1985							4
Summer I SCH	* From 1971 thru 1981 ** For 1982 thru 1985							4

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

Step 5. Projection equations were estimated from fifth 11-year string of data (one piece of data was dropped at the lower end while another was added to the upper end of the strings of data used in Step 4). Summary of Step 5 was presented in Table V.

TABLE VII

DATA BASE OF STEP 7

Time Period	Categories							# of Time Period in Advance Projection
	Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	
Combined Fall & Spring SCH	* From 1971 thru 1981 ** For 1982 thru 1984							3
Fall SCH	* From 1971 thru 1981 ** For 1982 thru 1984							3
Combined Summer I & Summer II SCH	* From 1972 thru 1982 ** For 1983 thru 1985							3
Summer I SCH	* From 1972 thru 1982 ** For 1983 thru 1985							3

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

Step 6. Sixth 11-year strings of data (one piece of data was dropped at the lower end while another was added to the upper end of the strings of data used in Step 5) were used to build projection equations. Summary of Step 6 was presented in Table VI.

Step 7. The last step was to estimate SCH projection equations with the seventh 11-year string of data (as before, one piece of data was dropped at the lower end, while another was added to the upper end of the strings of data which were used in Step 6). Step 7 was summarized in Table VII.

Phase II

Phase II deals exclusively with estimating projection equations for TPSU enrollment data. The seven steps which were undertaken for each of the seven categories of data resemble those of Phase I. Since the TPSU enrollment data for the Summer was not available in Summer I and Summer II segments, only the following time periods were considered; combined Fall and Spring, Fall, and Summer.

Objectives of Phase II were as of those mentioned earlier in Phase I. Also it is worth remembering that because sets of TPSU enrollment data are sums of the same categories of enrollment data of all the colleges and universities in TPSU system there is a built-in reduction of variance in TPSU enrollment data. Consequently, cycle regression is expected to make better projections (smaller deviation of projected from actual SCH's). Actual TPSU semester credit hour enrollment data long with different models' corresponding projected SCH were summarized in appropriate tables presented in the Appendix. Also deviations and percentage deviation of projected SCH values from actual semester credit hours for each category of data at each time period were tabulated and presented in Appendix next to each projection tables. The seven steps of Phase II are as follow.

Step 1. The semester credit hour enrollment equation was estimated by the cycle regression algorithm using first 11-year string of data in each category. The data which were used to estimate projection equations as well as time periods for which projections were made, were summarized in Table VIII.

TABLE VIII

DATA BASE OF STEP 1

Time Period	Categories							# of Time Period in Advance Projection
	Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	
Combined Fall & Spring SCH	* From 1965 thru 1975 ** For 1976 thru 1984							9
Fall SCH	* From 1965 thru 1975 ** For 1976 thru 1984							9
Combined Summer I & Summer II SCH	* From 1966 thru 1976 ** For 1977 thru 1985							9

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

Step 2. Using cycle regression the second 11-year strings of data (as before one piece of data was dropped at the lower end, while another was added to the upper end of the strings of data employed in Step 1) were used to estimate projection equations. Step 2 was summarized in Table IX.

TABLE IX

DATA BASE OF STEP 2

Time Period	Categories							# of Time Period in Advance Projection
	Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	
Combined Fall & Spring SCH	* From 1966 thru 1976 ** For 1977 thru 1984							8
Fall SCH	* From 1966 thru 1976 ** For 1977 thru 1984							8
Summer SCH	* From 1967 thru 1977 ** For 1978 thru 1985							8

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

Step 3. Third 11-year strings of data (one piece of data was dropped at the lower end, while another was added to the upper end of strings of data used in Step 2) were employed to estimate projection equations. Step 3 was summarized in Table X.

Step 4. Using cycle regression, the fourth 11-year strings of data (one piece of data was dropped at the lower end, while another was added to the upper end of the strings of data used in Step 3) were employed to estimate projection equations. Step 4 was summarized in Table XI.

TABLE X

DATA BASE OF STEP 3

Time Period	Categories: Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	# of Time Period in Advance Projection
Combined Fall & Spring SCH	* From 1967 thru 1977 ** For 1978 thru 1984							7
Fall SCH	* From 1967 thru 1977 ** For 1978 thru 1984							7
Summer SCH	* From 1968 thru 1978 ** For 1979 thru 1985							7

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

Step 5. Projection equations were estimated from 11-year string of data (one piece of data was dropped at the lower end, while another was added to upper end of the strings of data used in Step 4). Step 5 was summarized in Table XII.

Step 6. The sixth 11-year strings of data (one piece of data was dropped at the lower end, while another was added to the upper end of the strings of data used in Step 5) were used to estimate projection equations. Step 6 was summarized in Table XIII.

TABLE XI

DATA BASE OF STEP 4

Time Period	Categories: Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	# of Time Period in Advance Projection
Combined Fall & Spring SCH	* From 1968 thru 1978 ** For 1979 thru 1984							6
Fall SCH	* From 1968 thru 1978 ** For 1979 thru 1984							6
Summer SCH	* From 1969 thru 1979 ** For 1980 thru 1985							6

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

<u>Step 7</u>. In the last step of the Phase II of the analysis, projection equations were estimated using the seventh 11-year strings of data (as before, one piece of data was dropped at the lower end, while another was added to the upper end of the strings of data which were used in Step 6). Step 7 was summarized in Table XIV.

Phase III

Phase III of this analysis was an evaluation of the projection ability of cycle regression technique versus the

TABLE XII

DATA BASE OF STEP 5

Time Period	Categories							# of Time Period in Advance Projection
	Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	
Combined Fall & Spring SCH	* From 1969 thru 1979 ** For 1980 thru 1984							5
Fall SCH	* From 1969 thru 1979 ** For 1980 thru 1984							5
Summer SCH	* From 1970 thru 1980 ** For 1981 thru 1985							5

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

TABLE XIII

DATA BASE OF STEP 6

Time Period	Categories							# of Time Period in Advance Projection
	Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	
Combined Fall & Spring SCH	* From 1970 thru 1980 ** For 1981 thru 1984							4
Fall SCH	* From 1970 thru 1980 ** For 1981 thru 1984							4
Summer SCH	* From 1971 thru 1981 ** For 1982 thru 1985							4

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

TABLE XIV

DATA BASE OF STEP 7

Time Period	Categories: Under-Graduate	Masters	Doctorate	Total	Education	Liberal Arts	Business	# of Time Period in Advance Projection
Combined Fall & Spring SCH	* From 1971 thru 1981 ** For 1982 thru 1984							3
Fall SCH	* From 1971 thru 1981 ** For 1982 thru 1984							3
Summer SCH	1982 Summer SCH Data Not Available							None

*String of data from which projection equation was estimated.
**Time periods for which SCH projections were made.

model employed by Brooks (2, p. 78). Table XV in Chapter IV was presented to fulfill this purpose of the study.

Phase IV

In Phase IV of this study, the projected total semester credit hour enrollments (SCH's) for five time periods were compared with corresponding projections made by the coordinating board of Texas colleges and university system as well as with the actual semester credit hour enrollment data. Table XVI in Chapter IV is an attempt to evaluate projections estimated by the two methods.

Method and Procedure

Model building procedure and some of the most notable characteristics of cycle regression were briefly presented in Chapter II. It must be noted, however, that a theoretical evaluation of cycle regression was not a concern of this study. However, for the purpose of introduction, some aspects of cycle regression technique and its terminology were touched upon.

In this section the objective was to present a step-by-step treatment of a set of data (as it has been used in this study) which has to be followed to estimate a projection equation. Since the only unknown variable in final projection equation is time, future Y_t values can be estimated simply by entering the t values in the model (in this study projection equations were estimated only by an 11-period of historical enrollment data, so simply by giving a value of 12, 13, 14, ... to t it was possible to estimate 1, 2, 3, ... in advance projections for the Y_t).

Cycle regression algorithm was developed and written in Fortran language by Dr. L. F. Simons of North Texas State University. This algorithm which was used in this study is part of the local statistical package of NTSU Computing Center (see note 1 of Chapter Bibliography).

Before demonstrating the step-by-step procedure in model building, it was necessary to clarify one more piece of terminology, namely Sinusoidal cycles, which cycle regression attempts to extract from time series data.

Sinusoidal Cycles. The estimation of sinusoidal cycles are based upon the mathematical fact that any time-varying quantity can be decomposed into a sum of several sine and cosine functions (1, p. 1; 6, p. 83). In other words, a curve of any particular shape can be constructed by adding several sine functions with different amplitudes, periods, and phases (7, p. 10; 5, p. 18; 6, p. 83). Figure 1, illustrates this concept, where a linear trend and three sine waves at the bottom of figure are added to obtain the curve at the top. Now it is imperative to introduce terminology associated with the sinusoidal function. A sinusoidal function may be written as $Y(t)=R \sin(\omega t + \Phi)$. Where R is the amplitude (the height of the peak), ω is the frequency measured in radian per unit of time (number of cycles per unit of time), and Φ refers to the phase (the distance of the beginning of sin wave from the time origin). Period or cycle length is the distance between similar positions on a sine curve. The following relationship represents the period of a cycle with a frequency ω (4, p. 166-170; 3, p. 115-124).

$$\text{Period} = \frac{2.\pi}{\omega}$$

Figure 2 schematically illustrates terminology associated with a sinusoidal function.

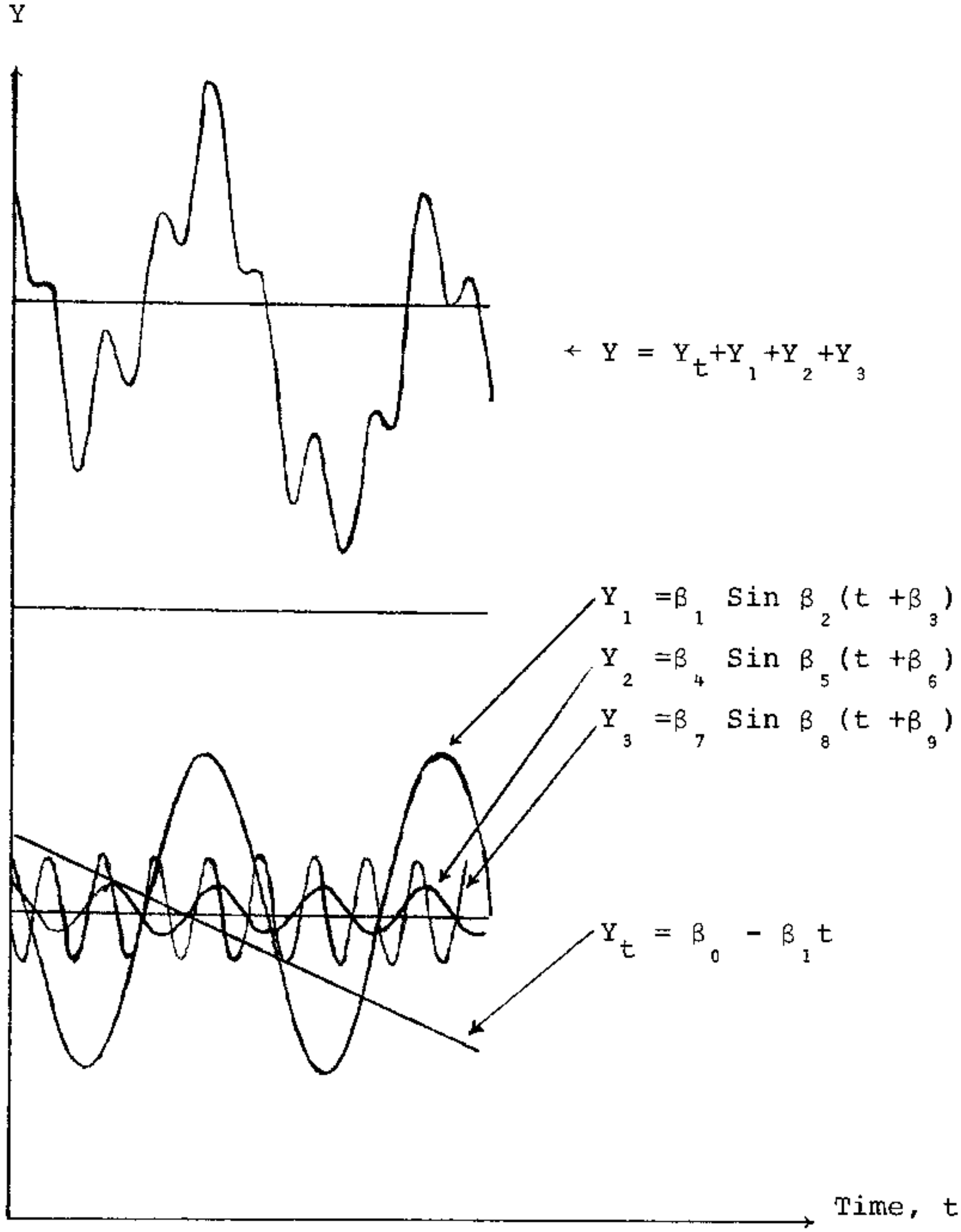

Figure 1. Sum of Sinusoidal Functions.

<u>Model building in cycle regression</u>. The steps in the heuristic structure of cycle regression analysis for the Model 6 of Table XXI in Appendix were:

<u>Step 0</u> (Trend)

$Y_t^* = B_1 + B_0 t + e_t$ was fitted to the data and autocorrelations of residuals were computed. The resulting equation obtained was

$Y_t = 332.807 - 1.673\ t$

$R^2 = .596$

<u>Step 1</u> (Trend + Cycle 1)

$Y_t = B_0 + B_1 t + B_2 \sin[B_3 (t + B_4)] + e_t$ was fitted and autocorrelations of residuals were computed. B_i was initialized with the following values.

$B_0 = 332.807$ (B_0 value at step 0)

$B_1 = -1.673$ (B_1 value at step 0)

$B_2 = 0$ (set 0)

$B_3 = \frac{6.2832}{6} = 1.047$ (calculated from autocorrelation of residual as follow. $B_3 = \frac{2\pi}{T}$ where T is the cycle length--the time required for the autocorrelations to drop to a significant negative value followed by an increase in the autocorrelations to a significant positive value)

$B_4 = 0$ (set 0)

---

*All Y_t values in Chapter III and IV should be multiplied by 1000.

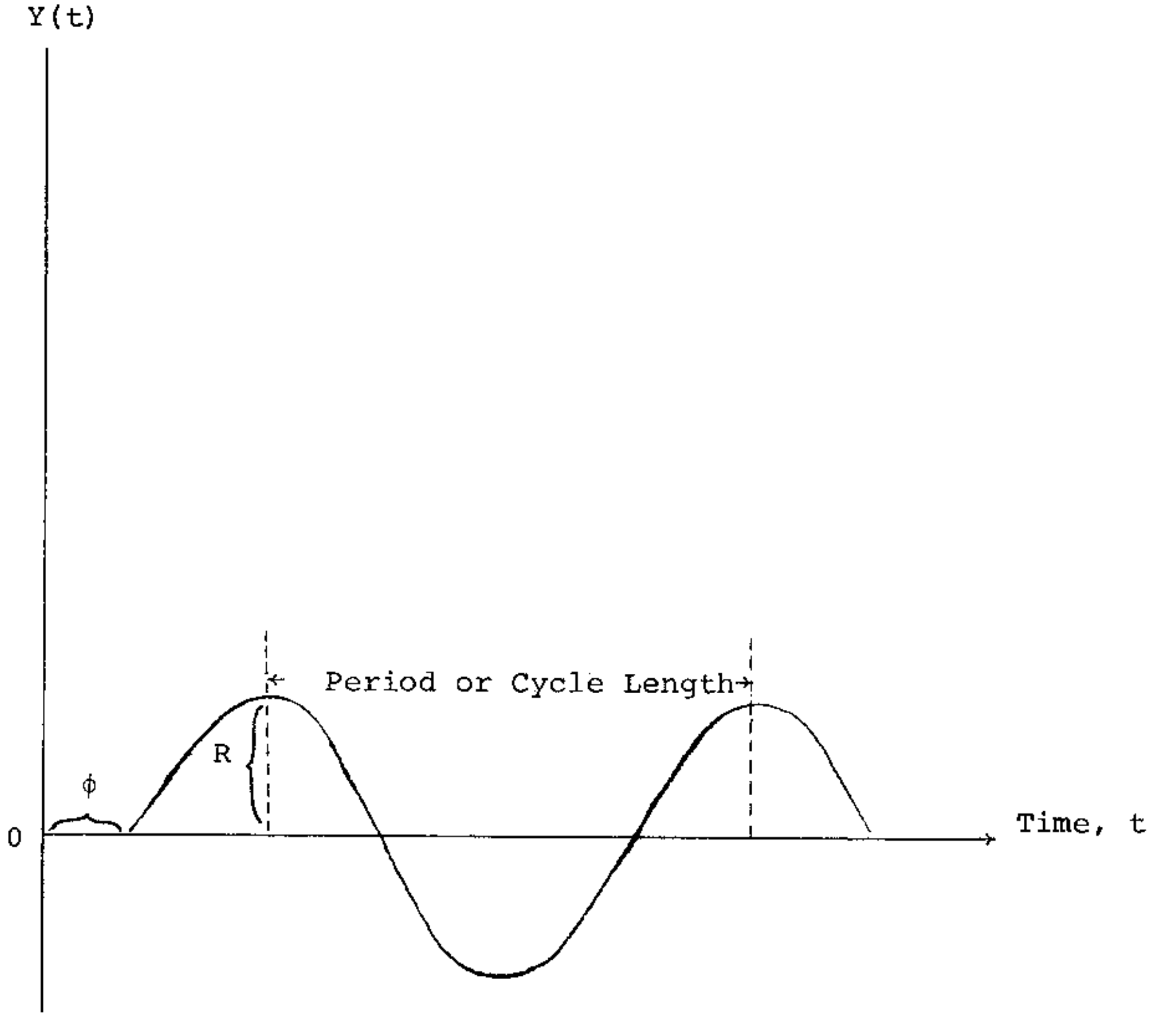

Figure 2: Amplitude (R), Phase (ϕ), and period of a Sine Function.

The model obtained in Step 1 was

Y_t = 331.805 - 1.686t + 5.319 sin [.81(t + .344)]

R_2 + .884

Partial F = 4.986

The value for test statistic F is calculated from the following formula.

$$F = \frac{\{SSE(Step\ 0) - SSE(Step\ 1)\} /3}{\{SSE(Step\ 1) / (N - 5)\}}$$

Where SSE(Step 0) and SSE(Step 1) refer to the sum of squares of residuals obtained in Step 0 and Step 1, respectively. Three (3) represents number of B_i added at Step 1. N is number of observations in the series (in above example it was 11). Five (5) is the total number of B_i in the model.

Partial F-test for determining significance of the kth cycle is as follow

$$F = \frac{\{SSE(Step\ K\text{-}1) - SSE(Step\ K)\} /3}{\{SSE(Step\ K) / (N - 3D\text{-}2)\}}$$ where K refers to step number.

In hypothesis testing, this calculated partial F value should be checked against the Table F value at specific level of significance (α) with df = 3, N-3K-2. The cycle regresion algorithm compares the calculated partial F values with a constant F value of 2.

Step 2 (Trend + Cycle 1 + Cycle 2)

$Y_t = B_0 + B_1 t + B_2 \sin [B_3 (t+B_4)] + B_5 \sin [B_6 (t+B_7)]$

$B_2 = 2.874$ (sum of B_2 and B_5 divided by 3)

$B_3 = .881$ (B_3 value from Step 2)

$B_4 = -.189$ (B_4 value from Step 2)

$B_5 = 2.874$ (sum of B_2 and B_5 divided by 3)

$B_6 = 1.424$ (B_6 value from Step 2)

$B_7 = 3.363$ (B_7 value from Step 2)

$B_8 = 2.874$ (sum of B_2 and B_5 divided by 3)

$B_9 = 3.142$ (estimated from autocorrelation of residual of Step 2)

$B_{10} = 0$ (set 0)

The model obtained in Step 3 was

$$Y_t = 329.123 - 1.334t + 10.092 \sin [1.045(t - 1.423)] + 8.037 \sin [1.246(t + 5.024)] - 4.321 \sin [3.082(t + .192)]$$

$R = 0.993$

Partial F = 0.0

Since Step 3 was not found to be significant, the model obtained in Step 2 was used. Using the model obtained in Step 2 the value of Y_t (estimated NTSU undergraduate combined Fall and Spring SCH) were

Period	t	Y_t
81	12	307,498
82	13	301,911
83	14	305,211
84	15	312,165

was fitted and autocorrelations of residuals were estimated. Initial values set for B_i were:

B_0 = 331.805 (B_0 value from Step 1)

B_1 = -1.686 (B_1 value from Step 1)

B_2 = 2.660 (B_2 value of Step 1 divided by 2)

B_3 = .81 (B_3 value from Step 1)

B_4 = .344 (B_4 value from Step 1)

B_5 = 2.660 (B_2 value of Step 1 divided by 2)

B_6 = 1.571 (estimated from autocorrelations of residuals of Step 1)

B_7 = 0 (set 0)

cycle regression estimated the following equation:

$$Y_t = 331.003 - 1.601\,t + 5.585 \sin [.881(t - .189)] + 3.038 \sin [1.424(t + 3.363)]$$

R^2 = .967

Partial F = 2.553

Step 3 (Trend = Cycle 1 + Cycle 2 + Cycle 3)

The following model was fitted and correlation of residual estimated

$$Y_t = B_0 + B_1 t + B_2 \sin [B_3 (t+B_4)] + B_5 \sin [B_6 (t+B_7)] + B_8 \sin [B_9 (t+B_{10})]$$

B_i initial values were

B_0 = 331.003 (B value from Step 2)

B_1 = -1.601 (B value from Step 2)

All other models presented in Chapter IV of this study were estimated by the above procedure.

CHAPTER BIBLIOGRAPHY

1. Bloomfield, P., Fourier Analysis of Time Series: An Introduction, New York, John Wiley & Sons, 1976.

2. Brooks, Dorothy Lynn, "Short-Term Enrollment Projections Based on Traditional Time Series Analysis," doctoral dissertaton, North Texas State University, December, 1981.

3. Heineman, E. R., Plane Trigonometry with Tables, New York, McGraw-Hill Book Company, 1974.

4. Hutchinson, M. R., The Elementary Functions, Columbus, Ohio, Charles E. Merrill Publishing Co., 1974.

5. Rayner, J. N., An Introduction to Spectral Analysis, London Pion Limited, 1971.

6. Sollberger, A., "Problems in Statistical Analysis of Short Periodic Time Series," Journal of Interdisciplinary Cycle Research, I (No. 1, 1970), 49-88.

7. Stuart, R. D., An Introduction to Fourier Analysis, London, Methuen's Monographs, 1961.

NOTES

1. For cycle regression algorithm contact, Dr. L. F. Simmons, Business, Computer and Information Systems Department, College of Business, North Texas State University, Denton, Texas, 76203.

CHAPTER IV

ANALYSIS OF DATA

Phase I: Analysis of the NTSU SCH Data

As it was described in Chapter III, the focal point of Phase I was to use cycle regression technique to analyze NTSU SCH data, estimate projection equations, use projection equations to estimate in advance SCH projection, and finally calculate deviations and percentage deviations of each SCH projection from its corresponding actual value.

NTSU SCH data had seven distinct categories, Undergraduate, Master, Doctorate, Total, Education, Liberal Arts, and Business. All these categories of NTSU SCH data were subject of the cycle regression analyses in four time periods. Fall + Spring (yearly), Fall, Summer I + Summer II (Summer), and Summer I. Because of the abundance of the projection and deviation tables, they were presented in the appendix and not in this chapter.

For each category of NTSU data at each time period a cycle regression projection equation was provided and its projected SCH was compared with the corresponding actual SCH value. The possible reason(s) for overestimated or underestimated projected SCH was also briefly discussed.

Undergraduate: Fall + Spring SCH

To get a perspective on undergraduate SCH on a yearly basis, Fall and Spring semester credit hours of each academic year from 1965 through 1981 were added together, and the resultant data were used to estimate seven models. Models I through VII generated 9 periods to 3 periods in advance yearly SCH predictions respectively. The results were summarized in Table XXIV in appendix.

As it is evident from the results presented in the Table XXIV, no significant cycle was found in models III or model VII. In these two models cycle regression failed to fit anything better than a straight line. The R^2 obtained by the two models were .783 and .243 respectively. When cycle regression fits only a straight line to the data, either or both of the following two reasons hold. In some cases most of the variability in data is explained by a straight line, as it could be observed from high R^2 for the trend line, then the remaining variability would not warrant addition of a new term(s), in this case a cycle, to the equation. In other words, addition of cycle(s) to the straight line equation would not be statistically significant (incremental R^2 not significant).

In some other cases the R^2 of the straight line is relatively small, as in model seven, meaning that the remaining variability in the data is still high. Yet cycle regression failed to add any cycles to the straight line. It can be argued that the variability in data has been randomly distributed, and thus addition of no further significant term(s), cycle(s), to the straight line equation was possible.

Examination of Table XXIV also reveals that a relatively stable short cycle of 4-year length was present in the data. The longer cycle was not stable and had a 7- to 17-year length. Instability of the cycle length was due to the fact that the base data length in the models was 11-year. Undoubtedly extraction of a cycle with length greater than data base length could not be stable. Stability of the cycle(s) with length longer than data base length could only be verified with a longer data base.

R^2 which represents the amount of explained variation in historical data ranges from a minimum of .905 (in model V where there was only one significant cycle) to a maximum of .984 (in model II). Deviation (D) and percentage deviation (%D) of the projected SCH from actual yearly undergraduate SCH were presented in the Table XXV of the appendix. As a general rule deviation and percentage deviation of projected SCH from actual SCH should be greater in far-in-advance projections (e.g., 4-year in advance D and %D greater than 2-year in advance D and %D).

One-year-in-advance %D was as small as 0.47% (model I) and as big as 5.69% (model VI). Two-year-in-advance %D had the same pattern, ranging from 0.92% (model II) to 6.09% (model V).

For all the projected SCH, %D were not greater than 9.43% (5-year in advance SCH projection of Model I). The overall model %D ranged from 1.54% to 5.49%, meaning that projected SCHs' were over or off from actual SCH' by a mere 5.0%. Of the seven models constructed to project NTSU yearly undergraduate SCH, the last model with significant cycle(s) is the best to use for future SCH projections (model VI in this case).

Selection of the last model with a significant cycle(s) as future projection equation was not without a reason. The last model was estimated on the basis of the most recent 11-year string of data and thus it was expected to extrapolate the most recent characteristics of data into the future.

A common assumption underlying all types of projection equations based on time series data is that the interrelationship between variables in the equation will hold in the future. In other words, projections are nothing more than extrapolation of the past into the future. If the interrelationships between dependent and independent variables change, or new independent variable(s) affect the state of dependent variable, the equation estimating the relationship between variables is no longer valid.

One of the interesting features of cycle regression technique is that the only variable in the model is time (t) which carries with itself the pooled effects of all the unknown independent variables on the dependent variable. Consequently, if a new independent variable affects the behavior of the dependent variable on a long-term basis, and not an erratic one-time effect, cycle regression would take its effect into consideration, although on a lagged-basis.

This is a very effective feature of cycle regression that virtually eliminates the cumbersome task of reevaluation and reestimation of a new equation as is the case in other approaches (i.e., Salley and Brooks approaches).

The undergraduate yearly projection equation was (model 6, Table XXIV).

$$Y_t = 331.003 - 1.601\ t + 5.585 \sin [.881(t - .189)] - 3.038 \sin [1.424(t + 1.159)]$$

Where t values are	SCH projections are
12 for Fall + Spring 1981	307,498
13 for Fall + Spring 1982	301,911
14 for Fall + Spring 1983	305,211

and so on.

Undergraduate: Fall SCH

The actual undergraduate SCH for Fall semester of 1965 through 1981 was the base data to generate the seven models with 9 periods to 3 periods in-advance SCH projections. The results are summarized in Table XXVI of Appendix. As it is evident from that table, again models III and VII did not generate any significant cycles (with R^2 of .811 and .369 respectively). Like the yearly case, model V had only one significant cycle (with R^2 of .864). R^2 of the remaining models with two significant cycles ranged from .963 (model I) to .995 (model VI). A stable short cycle with length of approximately 4 years was present in the data. The long cycle had a length of 7 to 16 years and thus was not stable.

Table XXVII in appendix tabulates deviation and percentage deviation of the models SCH projections from actual undergraduate Fall SCH. The %D of one-semester-in-advance projections ranged from 0.22% to 5.41%. Excluding %D of five and six semester in-advance projections of model I (which were over about 12.0%, %D's were stable at about 2.0%.

The equation selected for the projection of Fall undergraduate SCH was of model VI with two significant cycles as follows.

$$Y_t = 173.336 - .858t + 2.865 \sin [.895(t - .226)] - 1.825 \sin [1.536(t + .622)]$$

Where t values are	SCH projections are
12 for Fall 1981	159,531
13 for Fall 1982	157,988
14 for Fall 1983	161,469

and so on.

Undergraduate: Summer I + Summer II SCH

To get a perspective on undergraduate SCH for Summer terms, undergraduate SCH of Summer I and Summer II of year 1966 through 1982 were added together. On the basis of resultant data seven models were generated by the cycle regression approach with 9 periods to 3 periods in-advance Summer SCH projections. The results are presented in Table XXVIII of appendix.

Examination of the table reveals that cycle regression did not generate any significant cycle for models IV, V, and VI (with R^2 of .701, .880, and .878 respectively). Model VII had only one significant cycle with R^2 of .904. The first three models each had two significant cycles (with R^2 of .917, .975, and .973 respectively). A stable short cycle of length 4-year and a long-cycle of length 11-to-14-year were observable. Table XXIX in appendix shows deviations and percentage deviations of each model projected SCH from the corresponding actual SCH.

It should be noted that Summer SCH projections had a much higher %D compared with the yearly or Fall projections in the same category. Percentage deviations were as low as 1.75% (for one-semester in advance projections of model I) to as high as 28.33% (for two-semester-in-advance projection of model II).

The selected model for projection of undergraduate Summer SCH was model VII with the following equation.

$Y_t = 52.180 - .558\ t + 4.267 \sin [.451(t + 2.433)]$

Where t values are	SCH projections are
12 for Summer I + Summer II 1983	46,460
13 for Summer I + Summer II 1984	47,616
14 for Summer I + Summer II 1985	48,233

and so on.

Undergraduate: Summer I SCH

The pattern observed in estimating undergraduate SCH for combined Summer I and Summer II data was also observable in Summer I data (see Table XXX in appendix). Here again cycle regression did not find any significant cycle for models III, IV, V, and VI (R^2 for these models were .549, .754, .907, and .862 respectively). Model VII with R^2 of .914 had only one significant cycle. In models with two significant cycles (models I and II) a short cycle with a length of 4 and a long one with a length of approximately 12 years were present. The deviation and percentage deviation of projected Summer I SCH from actual SCH are presented in Table XXXI. Percentage deviation ranges from a low of 0.86% (for 2-semester-in-advance projection of model I) to high of 21.22% (for 2-semester-in-advance projection of model II).

Model VII with one significant cycle and R^2 of .914 was chosen for future undergraduate Summer I projections. Its equation was

$Y_t = 28.219 - .172t + 2.712 \sin [.493\ (t + 1.486)]$

Where t values are	SCH projections are
12 for Summer I 1983	27,137
13 for Summer I 1984	28,047
14 for Summer I 1985	28,466
and so on.	

Master: Fall + Spring SCH

For the purpose of analysis of yearly Master SCH, Fall and Spring SCH of each academic year from 1965 through 1981 were added together. The new set of data served as a base to develop seven models (the procedure followed is fully described in Chapter III). Models I through VII generated 9, 8, 7, . . . , 3 yearly in-advance projections. Table XXXII in the appendix presents the results. Analysis of the table reveals that apart from model IV which did not have any significant cycle (R^2 of model V was .899), other models extracted one to two significant cycles. However, the length of cycles were not stable, (cycle length varied from approximately 3 to 6 years for short cycles, and 8 to 16 years for the long cycles) pointing to the fact that data base did not have a very stable pattern, and thus model projections should be interpreted more cautiously. R^2 of the models ranged from a low of .955 to high of .999. From Table XXXIII which tabulates deviations and percentage deviations of projected yearly Master SCH from corresponding actual SCH, it can be observed why the model SCH projections had to be taken with reservation. Percentage deviations of the first five models from the actual SCH were fairly large (from 6.27% for 1-year-in-advance projection of model II to the 46.94% for 2-year-in-advance projection of model I). It was only after model V that the cycle regression started to respond to overestimations of the previous models (model VI %D was only 0.66%).

The equation for the yearly projection of Master SCH was (model VII equation)

$$Y_t = 28.147 + 1.048\ t - 3.329 \sin [.806(t + .319)]$$

Where t values are	SCH projections are
12 for Fall + Spring 1982	42,329
13 for Fall + Spring 1983	44,985
14 for Fall + Spring 1984	45,663

and so on.

Master: Fall SCH

Seven cycle regression models were also estimated for the Master SCH on the basis of Fall 1965 through 1981 data. The results were summarized in Table XXXIV in the appendix. Two models with R^2 of .967 and .909 did not have any significant cycles (models II and IV). Models I and VII with R^2 of .994 and .989 each had two significant cycles. But the length of their cycles were not stable. Models III, V, and VI with R^2 of .984, .950, and .927 respectively, each had one significant instable cycle. As mentioned before, wider instability of cycle(s) could be interpreted as having wider-margin of error in models' SCH predictions. This fact can be readily observed in Table XXXV which registers deviations and percentage deviations of the projected Fall Master SCH from actual SCH. The problem of projected SCH overestimation was only overcome in model VI, which has 0.65 percentage deviation from actual SCH.

The last model with two significant cycles chosen to be used for projection of Fall Master SCH was model VII with R^2 of .989 and following equation.

$Y_t = 14.389 + .552\ t + 1.873 \sin [.858(t + 3.341)] +.794 \sin [2.575(t + 3.032)]$

Where t values are	SCH projections are
12 for Fall 1982	22,739
13 for Fall 1983	23,087
14 for Fall 1984	23,381

and so on.

Master: Summer I + Summer II SCH

Master SCH for Summer I and Summer II of 1966 were added together to produce a picture of Master Summer credit hours. The process was repeated for each Summer I and each Summer II thereafter, through 1982. As before, models I through VII were estimated (the procedure was explicitly explained in Chapter III). The results were summarized in Table XXXVI of the appendix. Models I and III with R^2 of .889 and .670 did not show any significant cycles, while model II with R^2

of .954 had one short cycle. Models IV, V, VI, and VII each had two statistically significant cycles (R^2 of the models were .982, .978, .980, and .968 respectively). Length of short cycles were relatively stable, while long cycles' length varied (from approximately 8 to 16 years).

From Table XXXVII of the appendix which tabulate deviations and percentage deviations of the projected Master SCH from actual SCH for the 1977 through 1982, with few exceptions, large D and %D can be observed (maximum of 43.9% for 6-year-in-advance projection of model I).

The reason behind the large deviation of Master projected SCH from actual SCH is fairly obvious. There is a period of steady growth (1966 through 1975) followed by a period of no growth (1976 through 1978), and a period of decline in Master SCH data (1979 through 1982). The data in the first few models consisted of the growth data. Therefore a growth pattern was projected by these models. As soon as data of period of no growth and period of decline entered the models, the projection got closer and closer to the actual SCH values. In other words, 11-year data base used for model estimations had not been long enough to cover ups and downs of the data in one model.

Model VII with R^2 of .968 and two significant cycles covered not only period of growth but also period of decline of the data, thus making it the most appropriate model for

Master SCH Summer projections. Its equation follows:

Y_t = 17.509 -.207 t + 1.350 sin [.813(t + 4.332)]

+.699 sin [1.344(t = 1.974)]

Where t values are	SCH projections are
12 for Summer I + Summer II 1983	15,858
13 for Summer I + Summer II 1984	16,838
14 for Summer I + Summer II 1985	15,939

and so on.

Master: Summer I SCH

Seven cycle regression models were also estimated for the Master SCH of Summer I data. Models I, III, and IV (see Table XXXVIII of the appendix) had no statistically significant cycles, thus straight lines were fitted (R^2 of the models were .907, .830, and .556 respectively). While models II, V, VI, and VII with R^2 of .940, .806, .770, and .847 each had one significant cycle although the length of these cycles varied widely from approximately 2 to 13 years). Deviations and percentage deviations of the models' projected SCH from actual values were tabulated in Table XXXIX of appendix. Only models V and VI showed a relatively small D and %D (from 1.86% to 7.43%). Here again, the last model with a significant cycle (model VII) was deemed to be appropriate for the Summer I Master SCH projection. Its equation was

Y_t = 10.038 - .067 - .580 sin [.784(t + .512)]

Where t values are	SCH projections are
12 for Summer I 1983	9,456
13 for Summer I 1984	9,704
14 for Summer I 1985	9,641
and so on.	

Doctorate: Fall & Spring SCH

Doctorate SCH of Fall and Spring of academic year 1965 were added together. This was also done for each academic year thereafter through 1981. The resulting data were used to estimate seven models. The equation of model I was used to project 9-year in-advance Doctorate SCH projections. Each of the next models had one less Doctorate SCH projections (8, 7, . . ., 3-year in-advance projections).

Out of the seven models, only model IV had two statistically significant cycles (with R^2 of .999). The rest of the models each had one significant cycle (R^2's were .997, .995, .988, .989, .993, and .994 respectively). Table XL in appendix tabulates the results. The cycles' length varied from approximately 6 to 10 years, indicating lack of stability in the data base pattern. Deviations and percentage deviations of the projected yearly Doctorate SCH from actual SCH were summarized in Table XLI of appendix.

Examination of that table reveals that the last two models (models VI and VII) are the most appropriate for projection of yearly Doctorate SCH's (model VI had only 0.65

percentage deviation). The equation for model VII was

$Y_t = 12.112 + .637\ t - 1.066 \sin[.797(t - .637)]$

Where t values are	SCH projections are
12 for Fall + Spring 1982	19,373
13 for Fall + Spring 1983	20,838
14 for Fall + Spring 1984	22,035

and so on.

Doctorate: Fall SCH

Doctorate SCH for the Fall of 1965 through Fall of 1981 were also the subject of examination with the conventional seven models used in this study (the procedure, data-base in each model, as well as its projections was described in Chapter III). Fall actual Doctorate and seven models' projected SCH were presented in Table XLII of appendix.

Except for model II which had two statistically significant cycles (with R^2 of .999), and model IV with no significant cycle (R^2 of .936), the other models, namely models I, III, V, VI, and VII each had one significant cycles (R^2's were .993, .975, .977, .972, and .971 respectively).

Length of cycles (in models with one cycle) varied moderately from approximately 6 to 8 years. Therefore in Table XLIII of appendix which tabulates deviation and percentage deviation of Fall projected SCH from actual SCH, a moderate D and %D can be observed (from minimum of 0.05% for 1-period in-advance projection of model VI to maximum of 25.66% for 4-periods in-advance projection of model I).

Model VII with one significant cycle and R^2 of .971 is recommended to be used for projection of Fall Doctorate SCH. Model VII had the following equation

Y_t = 5.893 + .342 t -.526 sin [.842 (t -1.175)]

Where t values are	SCH projections are
12 for Fall 1982	9,836
13 for Fall 1983	10,605
14 for Fall 1984	11,196

and so on.

Doctorate: Summer I + Summer II SCH

Doctorate SCH's of the Summer of 1966 through 1982 (which were obtained by adding SCH of Summer I, and Summer II of each academic year) were used to generate the seven conventional models of this study. The first three models (see Table XLIV of the appendix) each had two statistically significant cycles (with R^2 of .997, .998, and .998 respectively). Models IV and VII each had only one significant cycle (R^2 of .918 and .858) while models IV and VI did not have any (with R^2 of .813, and .782).

Length of the short cycles of the models I, II, and III were about 2 years while the long cycles' length were around 8 years (both cycle seemed to be stable). This stability was reflected in small to moderate D and %D (see Table XLV of appendix). The length of the model IV cycle was about 6 years (which is close to length of long cycles of the first three models), and its D and %D were within tolerable range (1 to 12 percent). Deviation and percentage deviation of models V and VI were disregarded, although they were moderate (from 3.02% to 14.50%).

Model VII with R^2 of .858 and one significant cycle had the following equation.

$Y_t = 5.646 + .116\ t - .510\ \sin\ [.634(t - .258)]$

Where t values are	SCH projections are
12 for Summer I + Summer II 1983	6,577
13 for Summer I + Summer II 1984	6,662
14 for Summer I + Summer II 1985	6,941

and so on.

Doctorate: Summer I SCH

The results of the SCH projections of the seven models estimated on the basis of Summer I Doctorate SCH were summarized in Table XLVI of appendix. Except for the first two models which had two significant cycles (with R^2 of .991 and .994 respectively), the rest of the models each had only one cycle. R^2 of these models ranged from minimum of .890 (model VII) to maximum of .980. Neither the length of the short cycles, which varied from 2 to 4 years, nor the long ones, which varied from approximately 6 to 9 years, were stable.

Deviations and percentage deviations of Summer I projected Doctorate SCH from the actual SCH were summarized in

Table XLVII of the appendix. The %D varied from minimum of 1.90% (model V 1-period in-advance projection) to maximum of 25.38% (model VI 1-period in-advance projection).

The last model with a significant cycle was model VII which was recommended to be used for Summer I projection of Doctorate SCH. Its equation was

$$Y_t = 3.304 + .082\ t - .403\ \sin\ [.729(t - .991)]$$

Where t values are	SCH projections are
12 for Summer I 1983	3,891
13 for Summer I 1984	4,118
14 for Summer I 1985	4,474

and so on.

Total: Fall + Spring SCH

One of the most important yearly credit hour projections were that of Total SCH. Here again Total SCH of Spring and Fall of each academic year from 1965 through 1981 were obtained. Then on the basis of these data seven models were estimated (as was described in Chapter III). It can be observed from the results (Table XLVIII of the appendix) that not only the number of significant cycles in the models were varied (from no cycle for models III and IV, to one cycle for models V and VII and two cycles for models I, II, and VI), but also the lengths of the cycles were not stable. However, it must be noted that variance in the data-base had been greatly reduced, and therefore the projections of the models were expected to be close to the actual SCH. The effect of built-in variance-reduced data can be easily observed in Table XLIX of appendix which tabulates the deviations and percentage deviations of projected yearly Total SCH from its corresponding actual SCH.

Except for the model I, which was estimated on the basis of the data with a strong upward trend (and no downward flactuation), and thus its D's and %D's were moderately high (from 1.11% to 12.86%), the remaining models' percentage deviations were reasonably low (from minimum of 0.07% to maximum of 6.66%).

Model VII of Table XLVIII of appendix with one significant cycle and R^2 of .772 had the following equation and is recommended to be used for yearly Total SCH projections.

$Y_t = 365.794 + .942\ t + 6.023 \sin [1.17(t + .342)]$

Where t values are	SCH projections are
12 for Fall + Spring 1982	382,834
13 for Fall + Spring 1983	378,573
14 for Fall + Spring 1984	373,667
and so on.	

Total: Fall SCH

Fall Total SCH of year 1965 through 1981 was the base-data for estimation of another seven models (see Table L of the appendix).

Model I of that table with R^2 of .856 had one significant cycle with the length of approximately 12 years. Model II with R^2 of .946 produced two significant cycles with the length of 4 and 8 years (rounded). While the next three models (models III, IV, and V) did not have any statistically significant cycles. This was despite the fact that the R^2 of one of the models (model III) was only .119 (while R^2 of model IV was .748, and that of model V .643).

The case of models III, IV, and V was a curious one, because in spite of low to moderate R^2, the %D values were about 1.0% (see Table LI of the appendix).

It must be noted that higher R^2 of a model do not automatically mean a better projection ability for the model, but only a better fit to the historical data. Models with a straight line equation could have good projection ability only if the data randomly, but also closely, fluctuate around the straight line. This was exactly the case in models III, IV, and V, where historical data fluctuated randomly, but very closely, around the straight line (hence low R^2), yet the projection values of the models were also very close to the actual values (the latter could be due to the fact that data behavior remained rather stable).

However, cycle regression extracted two statistically significant cycles in models VI and VII, indicating that with the last two data points (values for 1980, and 1981) in the model the fluctuation of the data around straight line was no longer random. One of the cycles had a length of almost 4 years while the other one was varied from 1 to 5 years.

As before, the last model with a significant cycle (model VII) is recommended to be used for projection of Fall Total SCH. The equation of model VII was

$$Y_t = 189.983 + .562\ t + 3.338 \sin [1.207(t - .026)] + 2.089 \sin [1.760(t - .642)]$$

Where t values are	SCH projections are
12 for Fall 1982	201,809
13 for Fall 1983	197,956
14 for Fall 1984	192,716

and so on.

Total: Summer I + Summer II SCH

Total SCH for the Summer I and Summer II of each academic year from 1966 through 1982 were added together to provide a picture of Total SCH for the Summer of each year. On the basis of that data seven models were estimated (the procedure was detailed in Chapter III).

The first three models each had two statistically significant cycles and R^2 of .932, .935, and .907 respectively. There was a stable short cycle with a length of approximately 4, and a long cycle with a length of 11 years in these models. However, cycle regression did not generate any significant cycles for models IV, V, VI, and VII. R^2 of the straight lines fitted to the data were .714, .358, .837, and .764 (see Table LII of appendix).

Deviation and percentage deviation of the SCH projected values for the Summer from actual SCH were tabulated in Table LIII of appendix. SCH projections of the models I, II, and III were generally overestimated between 6.06% and 25.93%. The data in these models had a strong upward trend which in turn was intropolated into future as were visible from over-estimated projections. But the last four models could not find a clear pattern for the data, thus, straight lines were fitted.

The last model with a significant cycle was model III with the following equation. The projection of this model must be treated cautiously (on the face of 14.0% over-estimation) until a better model can be estimated by inclusion of more recent data.

$$Y_t = 73.527 + .051t + 3.154 \sin [1.484(t + 1.099)] - 3.458 \sin [.568(t + 3.242)]$$

Where t values are	SCH projections are
15 for Summer I + Summer II 1982	74,081
16 for Summer I + Summer II 1983	78,531
17 for Summer I + Summer II 1984	80,555

and so on.

Total: Summer I SCH

The last segment of analysis with the Total SCH was that of Summer I data. The results of the seven models' estimation on the basis of Summer I data were identical to the analysis of combined Summer I and Summer II data (see Table LIV of the appendix).

The first three models (with R^2 of .968, .974, and .963 respectively) each had two statistically significant cycles. The short cycles had a length of approximately 4 years, while the long cycles' length were 11 years (these were the same results obtained with combined Summer I and Summer II data).

The only significant difference between Summer I models and those of combined Summer I and II was model V, which with R^2 of .885 had one significant cycle. The rest of the models, namely models IV, VI, and VII (with R^2 of .367, .833, and .731) did not produce any significant cycles (just like models estimated on the basis of combined Summer I and II data).

Table LV of the appendix which tabulates deviations and percentage deviation of projected Summer I Total SCH from corresponding actual values reveals overestimation of the first three models, while D and %D for other models varied from underestimations to overestimations.

The equation for the last model with a significant cycle (model V) was

$$Y_t = 43.136 - .484t - 2.059 \sin [.376(t + 7.719)]$$

Where t values are	SCH projections are
13 for Summer I 1982	34,788
14 for Summer I 1983	34,393
15 for Summer I 1984	34,271
and so on.	

On the face of underestimation of about 100% of this model, its projection must be taken cautiously. Clearly models estimated on the basis of 11-year string of historical data did not work well for Summer data. A longer period of historical data may produce better results.

Education: Fall + Spring SCH

Yearly Education SCH data (combined Fall and Spring Education SCH of each academic year) from 1965 through 1981 were the basis of estimating seven projection models. (For a detailed description of the data-base and projections of each model, see Chapter III). The results of the analysis were summarized in Table LVI and LVII of the appendix.

In models I through VII a progressively declining SCH entered each model, making the projections of each model swing from overestimations to underestimations. Here again the 11-year base-data was not long enough to cover both ups and downs in data. Therefore, the properties of the models estimated were not stable. Models III and IV with uncharacteristically low R^2 did not have any significant cycles. While models I, II, V, VI (with R^2 of .943, .861, .857, and

.975 respectively) each had one significant cycle although the length of these cycles varied from minimum of approximately 5 years to maximum of 17 years. Model VII with R^2 of .999 had two significant cycles with the length of 3 and 14 years.

Once more, it must be noted that taking the shorter than necessary string of data and resultant instability of estimated models into consideration no close yearly Education SCH projections were expected although model V and VI deviations and percentage deviations were relatively low, 3 to 12 percent. Projection equation of model VII was as follows:

$$Y_t = 51.576 - 1.341t + 7.794 \sin [.425(t + 12.699)] + .793 \sin [1.985(t - .755)]$$

Where t values are	SCH projections are
12 for Fall + Spring 1982	28,379
13 for Fall + Spring 1983	25,788
14 for Fall + Spring 1984	26,211

and so on.

Education: Fall SCH

The Fall Education SCH data which was the base for estimating seven separate models almost followed the same pattern as yearly Education data. From 1965 to 1975 the data had an upward trend; from 1976 to 1977 a no growth pattern existed and from 1978 to 1981 a downward trend was observable (see Table LVIII of the appendix). The models estimated on the basis of any segments of the data, understandably would reflect the main theme of data in its projections. That was why the models' projections swung from overestimations to underestimations (see Table LIX of the appendix).

Projections of these models can only be dependable on a short term basis (one to two semester in-advance projections). Model VII with R^2 of .981 and one statistically significant cycle had the following equation that could be used to project Fall Education SCH on a short term basis.

$Y_t = 26.898 - .788t - 3.781 \sin [.417(t + 4.910)]$

Where t values are	SCH projections are
12 for Fall 1982	14,808
13 for Fall 1983	13,150
14 for Fall 1984	12.093

and so on.

Education: Summer I + Summer II SCH

Education SCH for the Summer (combined Summer I and II data) was also investigated with the cycle regression algorithm and this study's conventional seven models. The actual SCH data and models' projections were presented in Table LX of the appendix. Except for the model III, which had R^2 of .245 and no significant cycle, the rest of models, namely models I, II, IV, V, VI, and VII (with R^2 of .776,

.850, .883, .946, .968, and .976 respectively) each had one significant cycle which had a length of approximately 10 to 16 years.

Examination of Table LXI of the appendix which tabulates deviations and percentage deviations of each model's projected SCH from its corresponding actual SCH, shows that short-term projections (one to two year in-advance projections) were generally much closer to actual SCH values than long-term projections.

Also models V, VI, and VII which were based on more recent 11-year string of data clearly were superior (smaller D and %D) to the other models. The equation for model VII which can be used to project Education SCH for the Summer was:

$Y_t = 22.371 - .703t - 1.521 \sin [.586(t + 3.035)]$

Where t values are	SCH projections are
12 for Summer I + Summer II 1983	13,048
13 for Summer I + Summer II 1984	13,177
14 for Summer I + Summer II 1985	13,322

and so on.

Education: Summer I SCH

Summer I Education SCH data was the last segment of Education data that was used to estimate the seven models. Except for model IV with R^2 of .960 that had two significant cycles, the remaining models each had one significant cycle. R^2 of these models ranged from low of .887 (model I) to high of .990 (model VII).

The case of overestimations for the first three models and underestimations for the models IV through VII were observable (see Tables LXII and LXIII in appendix). But models based on more recent 11-year string of data generally had smaller deviations and percentage deviations. Also deviations of the short-term projections of all the models were smaller than those of the long-term projections.

For projection of Summer I Education SCH model VII equation can be used. Model VII had the following equation:

$Y_t = 13.633 - .498t - .732 \sin [.717(t + .842)]$

Where t values are	SCH projections are
12 for Summer I 1983	7,500
13 for Summer I 1984	7,511
14 for Summer I 1985	7,349

and so on.

Liberal Arts: Fall + Spring SCH

To get a perspective on Liberal Arts SCH on a yearly basis, Fall and Spring semester credit hours of each academic year from 1965 through 1981 were added together, and the resultant data was used to generate seven models. Models I through VII were used to generate 9 year to 3 year in-advance SCH predictions respectively. Table LXIV of appendix summarizes the results.

As it is evident from that table, the first three models with R^2 of .399, .778, and .881 respectively did not have any statistically significant cycles. Yet the projections' deviations of models I, II, and III were low to moderate (%D was from low of 0.3% to high of 11.82%), indicating a rather smooth constant upward trend (see Table LXV of the appendix). The rest of the models except model VI, which had two significant cycles, each had one statistically significant cycle. R^2 of models IV, V, VI, and VII were .957, .916, .999, and .952 respectively. Neither length of the cycles nor D and %D were stable. The upward trend of the actual data was generally stronger than was projected. The underestimations of the projections continued through model VI (from low of 1.44% to high of 15.39%).

Model VII with R^2 of .952 and one significant cycle had the following equation that can be used to project yearly Liberal Arts SCH.

$$Y_t = 178.190 - .769t + 22.486 \sin [.244(t + 13.207)]$$

Where t values are	SCH projections are
12 for Fall + Spring 1982	165,955
13 for Fall + Spring 1983	170,658
14 for Fall + Spring 1984	175,215
and so on.	

Liberal Arts: Fall SCH

The actual Liberal Arts SCH from Fall of 1965 through Fall of 1981 was the base data from which seven models with 9-year to 3-year in-advance SCH projections were estimated.

The results were summarized in Table LXVI of the appendix. Examination of that table reveals that models I, II, and VI each had two significant cycles and R^2 of .964, .981, and .996 respectively. While models III and VII with R^2 of .961 and .932 each had one significant cycle. Models IV and V with R^2 of .882 and .754 did not have any significant cycles. Short cycles had a stable 4 years length, while the length of the long cycles were instable and varied from approximately 4 to 22 years.

Table LXVII of the appendix tabulates the deviations and percentage deviations of projected Fall SCH from its corresponding actual SCH. Except for the model I which had an overestimated %D of about 5.0%, the rest of the models underestimated actual SCH's from low of 3.41% to high of 14.04%. A stronger than expected trend which was observed in yearly Liberal Arts SCH was also apparent in Fall Liberal Arts data.

Since model VII was based on the last 11-year string of data, its projections had a stronger upward trend. Future Liberal Art projection can be estimated from the following equation (model VII equation).

$$Y_t = 91.241 - .454t + 8.777 \sin [.281(t + 10.596)]$$

Where t values are	SCH projections are
12 for Fall 1982	86,445
13 for Fall 1983	88,396
14 for Fall 1984	90,107

and so on.

Liberal Arts: Summer I + Summer II SCH

To acquire a perspective on Liberal Arts SCH for the Summer, seven models were estimated on the basis of combined Summer I and II SCH of 1965 through 1981. Actual Summer Liberal Arts SCH and the models' projected SCH were presented in Table LXVIII of the appendix. Model I with R^2 of .956 had two statistically significant cycles. Models IV, V, and VII with R^2 of .913, .980, and .897 respectively, each had one significant cycle, while models I, II, and VI only fitted a straight lines to the data. An approximately 4-year short cycle appeared whenever models had significant cycles. Also a long cycle of length 11 to 15 years was inconsistently present in some models (models I and VII).

In terms of deviations and percentage deviations of models' SCH projections from actual SCH values a mixed result of SCH overestimations gradually moving to underestimated SCH were observable in all the models except model I (see Table LXIX of appendix). Examination of actual Summer Liberal Arts SCH reveals that a strong downward trend from 1976 was stabilized in 1980, and a weak upward trend started. The models' SCH projections come short of actual SCH in latter part of the projection period because the strong downward trend embodied in the early period of the historical data did not continue in its latter part.

However model VII was estimated on both, up-and-downward trend of the data, and thus it was presumed to provide a better projection. The equation of model VII with one significant cycle and R^2 of .897 was

$$Y_t = 29.246 - .461t + 2.789 \sin [.413(t + 3.897)]$$

Where t values are	SCH projections are
12 for Summer I + Summer II 1983	24,505
13 for Summer I + Summer II 1984	25,051
14 for Summer I + Summer II 1985	25,295

and so on.

Liberal Arts: Summer I SCH

The Summer I Liberal Arts SCH of 1966 through 1982 was also the base data for construction of seven models. The actual Summer I Liberal Arts SCH and the projections of the estimated models were summarized in Table LXX of the appendix. Models II, III, and IV did not have any significant cycles, only a straight line was fitted in each case (models' R^2 were .346, .548, and .796 respectively). From cycle regression point of view the projections of these models are not of interest. Fluctuation of actual SCHs around straight line SCH projections are random and thus statistically nonsignificant (see models II, III, and IV deviations and percentage deviations in Table LXXI of the appendix).

Models I, V, VI, and VII, however, each had one statistically significant cycle (models' R^2 were .738, .978, .937, and .922 respectively). The cycle length of these models were stable and varied from approximately 5 to 18 years. Instability of the cycles' lengths were manifested in instability of models' SCH projections. While model I projections were highly overestimated, models V and VI had gradually improving underestimated SCH projections (see Table of the appendix).

Model VII with R^2 of .922 and one significant cycle was assumed to produce the best (from cycle regression point of view) projections. Model VII had the following equation:

$$Y_t = 15.761 - .025t + 2.531 \sin [.353(t + 5.217)]$$

Where t values are	SCH projections are
12 for Summer I 1983	14,961
13 for Summer I 1984	15,826
14 for Summer I 1985	16,642

and so on.

Business: Fall + Spring SCH

The last category of NTSU SCH data that was analyzed with cycle regression algorithm was Business semester credit hours from 1965 through 1981. First the combined values for the Fall and Spring SCH of each academic year were obtained. On the basis of that data seven models were estimated by cycle regression procedure (the string of data from which the models were estimated, as well as number of each model's projections were fully described in Chapter III).

Combined Fall and Spring actual Business SCH along with the seven models' projections were summarized in Table LXXII of the appendix. Models I, II, III with R^2 of .978, .978, and .973 each had one significant cycle with a stable cycle length of about 8 years. But patterns observable in the 11-year string of historical data from which the first three model were estimated contain both weak upward and downward trends, that change to a strong upward trend after 1975. Therefore, the models' projections were grossly underestimated (see Table LXXIII of the appendix).

Models II, V, and VI with R^2 of .998, .999, and .999 respectively, each had two significant cycles. The short cycle of length of about 5 years was relatively stable, while the long cycle's length varied from 11 to 18 years. Models IV, V, and VI interestingly enough, had much closer to actual SCH projections. The stronger trend at the upper end of 11-year strings of data wuickly affected models' SCH projections.

Model VII with R^2 of .989 and one significant cycle which can be used for projection of yearly Business SCH had the following equation

$$Y_t = 48.643 + 2.070t + 5.834 \sin [.400(t + 7.872)]$$

Where t values are	SCH projections are
12 for Fall + Spring 1982	79,284
13 for Fall + Spring 1983	80,673
14 for Fall + Spring 1984	81,251

and so on.

Business: Fall SCH

On the basis of Fall Business SCH from 1965 through 1981 this study's conventional seven models were estimated. Actual Fall Business SCHs along with models' projected SCHs were summarized in Table LXXIV of the appendix. Models I, III, IV, and V with R^2 of .977, .979, .984, and .998 each had two statistically significant cycles. Short cycles had a length of about 2 years, while long cycles' lengths varied from approximately 10 to 20 years. Projections' deviation and percentage deviations in above mentioned models were relatively smaller in the short-periods than the long ones (see Table LXXV of the appendix).

Models II, VI, and VII with R^2 of .847, .983, and .983 each had only one significant cycle. The length of that cycle varied from 8 to 19 years. Underestimation of the model I projections were even more pronounced in models II and III, while from model IV projected SCH got closer and closer to the actual SCH. It was presumed that model VII, which was estimated on the basis of the most recent 11-year string of NTSU Business data and had the R^2 of .983 with one significant cycle, would make the best projected SCH. Model VII had the following equation

$$Y_t = 30.034 + .318t + 5.451 \sin [.338(t - 7.512)]$$

Where t values are	SCH projections are
12 for Fall 1982	39,298
13 for Fall 1983	39,406

14 for Fall 1984 38,921

and so on.

Business: Summer I + Summer II SCH

Combined Summer I and II Business SCH was the basis of estimating seven cycle regression models. Cycle regression only fitted a straight line to models I, III, IV, and V (no significant cycles were found). The R^2 of these models varied from low of .257 to high of .427 (see Table LXXVI of appendix). Model II with R^2 of .924, however, had two significant cycles, while models VI, and VII (with R^2 of .880, and .950 respectively) had only one. SCH projections of models with no cycles generally underestimated the actual SCH, indicating a positive change in magnitude of the trend present in the historical data. Model II had mixed results, overestimated short-period projections and underestimated long-period projections (see Table LXXVII of the appendix).

The magnitude of underestimated projections' deviations decreased to about 4.0% in model VI. The stronger trend in latter part of the data (1979 to 1982) made models VI and VII SCH projections more realistic and closer to actual values.

Model VII with R^2 of .950 and one significant cycle can be used for the Summer Business SCH projections with the following equation

$$Y_t = 8.786 + .607t + 1.603 \sin [.306(t + 8.330)]$$

Where t values are	SCH projections are
12 for Summer I + Summer II 1983	15,964
13 for Summer I + Summer II 1984	17,057
14 for Summer I + Summer II 1985	18,115

and so on.

Business: Summer I SCH

Business SCH data was also analyzed for Summer I periods of 1966 through 1982. Actual Summer I Business SCH along with the corresponding projected SCH values were summarized in Table LXXVIII of the appendix. Model I with R^2 of .817 had one significant cycle while model II with R^2 of .920 had two significant cycles. No significant cycles were found in models III, IV, and V (with R^2 of .375, .503, and .574 respectively). Model VI had one, and model VII had two statistically significant cycles (R^2 of the last two models were .910 and .990).

Obviously the Summer I Business SCH data had a very instable pattern (see Table LXXIX of the appendix). Variations of the data in some models (models III, IV, and V) were found to be purely random, while in other models the number of cycles as well as its length varied. In the face of random variations and/or instable patterns in the data-base, the projections of any models must be taken with reservation.

Model VII, which was estimated on the basis of the most recent 11-year string of data, can be assumed to be the best model if the patterns and characteristic of the last 11-year string of data would remain constant. Model VII had the following equation.

$$Y_t = 3.278 + .665t + 1.661 \sin [.304(t + 6.493)] -.320 \sin [3.948(t -1.154)]$$

Where t values are	SCH projections are
12 for Summer I 1983	10,533
13 for Summer I 1984	11,231
14 for Summer I 1985	12,364
and so on.	

Phase II: Analysis of TPSU SCH Data

As it was described in Chapter III, phase II of this study was devoted to analyses of TPSU SCH data with cycle regression technique. TPSU SCH data like NTSU SCH, had seven categories, Undergraduate, Master, Doctoral, Total, Education, Liberal Arts, and Business. These TPSU SCH categories were analyzed in three different time periods, Fall + Spring, Fall, and Summer.

For each category of TPSU data at each time period a cycle regression projection equation was estimated, and its projected SCH was compared with the corresponding actual SCH value. The possible reason(s) for overestimated or underestimated projected SCH was also briefly discussed.

The only notable difference of TPSU SCH data with NTSU SCH was that Summer data in TPSU case was not partitioned in Summer I and Summer II segments. It must also be mentioned that because of the variance-reduced nature of TPSU SCH data, a better fit (higher R^2), and lower deviations and percentage deviations of projected SCH from actual SCH values were expected.

Undergraduate: Fall + Spring SCH

To provide a yearly outlook for TPSU Undergraduate SCH, Fall and Spring SCH of each academic year from 1965 through 1981 were added. This yearly historical Undergraduate SCH was used to estimate seven cycle regression models with 9 years to 3 years in-advance projected Undergraduate SCHs. The results were summarized in Table LXXX of the appendix. Models I, IV, VI, and VII with R^2 of 1.000, .999, .998, and .998 respectively, each had two statistically significant cycles. While models II, III, and V each had one significant cycles (with R^2 of .994, .997, and .997). The length of the long cycle varied from 6 to 9 years, while a 4-year short cycle was also visible.

Deviation and percentage deviations of projected SCH from actual one were tabulated in Table LXXXI of the appendix. Percentage deviation varied from low of .18% (%D of one-year in-advance projection of model III) to high of 8.41% (%D of four-year in-advance projection of model I). Cycle regression performed extremely well both in fitting the historical SCH data (lowest R^2 was .994) and in models' projected SCH (generally %D were less than 5.0%).

Model VII with R^2 of .998 and two significant cycles had the following equation that can be used for projection of yearly undergraduate SCH.

$$Y_t = 5508.031 + 128.943t + 180.127 \sin [.715(t - 4.432)] + 89.449 \sin [1.343(t + .217)]$$

Where t values are	SCH projections are
12 for Fall + Spring 1982	6,859,629
13 for Fall + Spring 1983	7,076,238
14 for Fall + Spring 1984	7,430,066

and so on.

Undergraduate: Fall SCH

TPSU Undergraduate Fall SCH from 1965 through 1981 was the base-data for estimation of seven cycle regression models (see Chapter II for a description of data in the models, as well as number of in-advance projected SCH). Table LXXXII of the appendix summarizes the results. Models I, IV, VII with R^2 of 1.000, .999, and .998, each had two significant cycles. Other models, namely II, III, V, and VI, had only one statistically significant cycle (models' R^2 were .995, .996, .997, and .996 respectively). The length of the long cycles, as in yearly Undergraduate case, varied from approximately 6 to 9 years. The length of the short cycle varied from approximately 3 to 5 years (unlike the length of the short cycle of the models estimated in the TPSU yearly undergraduate data).

Examination of corresponding deviation and percentage deviation table (Table LXXXIII of the appendix) reveals the %D values ranged from minimum of 0.02% (for the first period in-advance projection of model III) to maximum of 8.62% (for the third-term in-advance projection of model I). Models' R^2 were not less than .995, and SCH projections made by cycle regression treatment of the data produced values trailing actual SCH by about 5.0%.

Model VII with R^2 of .998 and two statistically significant cycles had the following equation that can be employed for projection of future Fall Undergraduate SCH.

$$Y_t = 2{,}859.218 + 66.188t + 87.741 \sin [.708(t + 4.155)] + 44.173 \sin [1.328(t + .179)]$$

Where t values are	SCH projections are
12 for Fall 1982	3,553,885
13 for Fall 1983	3,640,136
14 for Fall 1984	3,809,311

and so on.

Undergraduate: Summer SCH

TPSU Summer Undergraduate data from 1966 through 1981 was used to estimate six cycle regression models. Actual Summer Undergraduate SCH data and each model's corresponding projected SCH were summarized in Table LXXXIV of appendix. Models I, II, and III with R^2 of .994, .993, and .982 each had two significant cycles. The length of the short cycles was stable at about 4 years, with long cycles' length varying from 8 to 12 years. Percentage deviation of first three models' projected SCH from actual values (see Table LXXXV of appendix) shows an overestimation of up to 27.51%. The reason behind the relatively high overestimation is the fact that the Summer SCH downtrend which was started from 1976 had not affected the projections of these models. Models IV and VI with R^2 of .865 and .856 each had one significant cycle, while model V with R^2 of .496 fitted only a straight line to the data.

One point that must be noted is that more than often variability of Summer SCH data was random, and therefore no statistically significant pattern could be established (see projection and deviation tables of both NTSU and TPSU for Summer sessions).

Model VI with R^2 of .856 and one significant cycle which can be used for future Summer SCH projection had the following equation.

$$Y_t = 900.397 + 5.097t + 21.536 \sin [1.036(t + 1.342)]$$

Where t values are	SCH projections are
12 for Summer 1982	982,001
13 for Summer 1983	982,903

14 for Summer 1984 967,879

and so on.

Master: Fall + Spring SCH

For the purpose of analysis of TPSU yearly Master SCH, Fall and Spring SCH of each academic year from 1965 through 1981 were added together. The new set of yearly Master SCH served as a base to estimate seven cycle regression models (the procedure followed is fully described in Chapter III).

Models I through VI generated 9, 8, 7, . . ., 3 yearly in-advance SCH projections respectively. Table LXXXVI in the appendix presents the results. Analysis of the table reveals that except for model III, which only fitted a straight line to the data, the remaining models had one or two significant cycles. Models I, II, and VI with R^2 of .996, .991, and .993 each had one statistically significant cycle. The length of that cycle, however, was not stable and varied from approximately 8 to 17 years. Models IV, V, and VII with R^2 of .999, .999, and .998 each had two statistically significant cycles with instable long cycle's length of 8 to 15 years and stable short cycle's length of about 5 years.

As it has been discussed earlier in the chapter, instability in the number of significant cycles and their corresponding length is a signal that neither the pattern in the historical data is stable, nor the models SCH projections.

Table LXXXVII of appendix which tabulate deviations and percentage deviations of yearly Master SCH from their corresponding values demonstrates that observation. A strong upward trend present from 1965 through 1976 in the historical data suddenly loses its momentun, and a short downward trend starts in 1977 only to be replaced with another upward trend in 1979. Since data in the first four models do not contain variability of the latter part of the string of data, projections of these models suffer from overestimation (see Table LXXXVII of the appendix). Although the last three models were estimated on the basis of data strings containing both upward and downward trends, models' projections must be treated cautiously.

Model VII with R^2 of .998 and two significant cycles had the following equation that can be used to project future yearly Master SCH.

$$Y_t = 437.366 + 25.658t + 96.507 \sin [.400(t + 13.463)] + 37.863 \sin [1.136(t + 1.822)]$$

Where t values are	SCH projections are
12 for Fall + Spring 1982	678,693
13 for Fall + Spring 1983	648,037
14 for Fall + Spring 1984	671,09;

and so on.

Master: Fall SCH

Seven cycle regression models were also estimated for the TPSU Fall Master SCH of 1965 through 1981 data. The actual TPSU Fall Master SCH data along with seven models' corresponding SCH projections were summarized in Table LXXXVIII of the appendix. As in the case of yearly Master SCH models, model III with R^2 of .971 only fitted a straight line to the data. Models II, and IV with R^2 of .990 and .998 each had one statistically significant cycle. Models I, V, VI, and VII with R^2 of 1.000, .999, .998, and .996 respectively each had two significant cycles. The length of the short cycles were relatively stable at 4 to 5 years while long cycles' length varied from 6 to 26 years.

Examination of Table LXXXIX of the appendix which tabulates the deviations and percentage deviations of projected TPSU Master SCH from their corresponding actual SCH values reveals overestimated projections for the first four models (as was observed in yearly case). Model V in that table had a moderate underestimated SCH projections, while moderate overestimation was repeated for the model VI.

Model VII with R^2 of .996 and two significant cycles which was estimated on the basis of most recent 11-year string of historical data can be used for future Fall Master SCH. Its equation was

$$Y_t = 222.778 + 16.393t + 33.888 \sin [.639(t + 6.365)] + 9.794 \sin [1.311(t + 1.242)]$$

Where t values are	SCH projections are
12 for Fall 1982	384,513
13 for Fall 1983	427,388
14 for Fall 1984	475,513
and so on.	

Master: Summer SCH

TPSU Summer Master data from 1966 through 1981 was used to estimate six cycle regression models. Actual Summer Master SCH data and each model's corresponding projected SCH were summarized in Table XC of the appendix. Models I, II, III, IV, V, and VI with respective R^2 values of .997, .999, .999, .999, .999, and .995 each had two statistically significant cycles. Short cycles were relatively stable with an approximate length of 4 to 5 years. The long cycles, however, were not as stable in length as the short ones. The long cycles' length varied from approximately 6 to 14 years. This could be interpreted as models' ability to make a better (smaller %D) short term projection than long one.

Table XCI of the appendix tabulates the deviations and percentage deviations of TPSU projected Summer Master SCHs from their corresponding actual values. Examination of that table reveals that both over-and-underestimation of the models projected SCH values increase with the time (%D of short in-advance projections are smaller than long ones). Model VI with R^2 of .999 and two statistically significant cycles had the following equation that can be used for future TPSU Summer Master SCH

$$Y_t = 191.269 + 6.673t + 33.583 \sin [.463(t + 11.295)] + 9.424 \sin [1.211(t + 1.695)]$$

Where t values are	SCH projections are
12 for Summer 1982	231,292
13 for Summer 1983	237,258
14 for Summer 1984	260,701

and so on.

Doctorate: Fall + Spring SCH

On the basis of yearly TPSU Doctorate SCH data from 1965 through 1981 seven cycle regression models were estimated (the procedure is fully described in Chapter III) to provide a yearly outlook of that data. Actual TPSU yearly Doctorate SCH and projections of each model were summarized in Table XCII of appendix. Models I and II with R^2 of .999 and .999 each had two significant cycles. The SCH projections of these two models were moderately overestimated (see Table XCIII of the appendix). The only other model which had a significant cycle was model IV with R^2 of .997 and low overestimated SCH projection of about 5.0%. Models III, V, VI, and VII with respective R^2 of .992, .985, .986, and .988 only fitted straight lines to the data. Also, these models had the best projected SCH (least overall %D). The high R^2 of the models with no significant cycles, and the fact that they had the least overall %D may be taken as indication of random fluctuation of actual SCH values along positively sloped lines. To go along with procedure set in this study the equation of the last model with a significant cycle (model IV) may cautiously be used to project TPSU yearly SCH. Model IV had the following equation.

$$Y_t = 68.759 + 6.300t + 2.044 \sin [1.493(t + 1.052)]$$

Where t values are	SCH projections are
15 for Fall + Spring 1982	156,804
16 for Fall + Spring 1983	162,296
17 for Fall + Spring 1984	167,788

and so on.

Doctorate: Fall SCH

Identical results were achieved with the TPSU Doctorate SCH for the Fall of 1965 through 1981 (see Table XCIV of the appendix). Models I and II with R^2 of .999 and .999 each had two significant cycles, as was the case in the analysis of the TPSU yearly Doctorate data. The deviations and percentage deviations of projected SCH values of these two models from corresponding actual SCH were moderate.

The %D varied from low of 1.20% to high of 19.86%, averaging about 10.0% (see Table XCV of the appendix). Models III, V, and VII with respective R^2 of .993, .990, and .992 did not have any significant cycles, while their %D were relatively low (%D varied from minimum of 0.48% to maximum of

4.37%). Model IV with R^2 of .998 had one significant cycle, and a maximum %D of 3.53%. Model VI with R^2 of .997 and one significant cycle was the only model different from corresponding yearly model (which only fitted a straight line). The equation for the model VI which can be used for projection of future Fall TPSU Doctorate SCH was

$$Y_t = 40.729 + 2.929t - 1.030 \sin [1.332(t + .750)]$$

Where t values are	SCH projections are
13 for Fall 1982	79,321
14 for Fall 1983	80,989
15 for Fall 1984	83,786

and so on.

Doctorate: Summer SCH

TPSU Doctorate SCH values for the Summer of 1966 through 1981 was the base-data to estimate six cycle regression models. The actual TPSU Doctorate SCH along with models' corresponding projected SCH values were summarized in Table XCVI of the appendix. Models I, II, III with respective R^2 of .977, .982, and .984 each had one statistically significant cycle with instable length of 8 to 13 years. Percentage deviations of these models' projected SCH from their corresponding actual SCH values were smaller for short-period projections than long-ones (see Table XCVII of the appendix). Models IV and V with R^2 of .957 and .960 did not have any significant cycles. Still the %D of these two models did not exceed 3.24%. The last model (model VI) with R^2 of .998 and two statistically significant cycles had the following equation that could be used for projection of future TPSU Summer Doctorate SCH

$$Y_t = 30.584 + 1.269t + .884 \sin [.606(t + 3.522)] -.596 \sin [3.733(t - .336)]$$

Where t values are	SCH projections are
12 for Summer 1982	46,081
13 for Summer 1983	46,682
14 for Summer 1984	47,121

and so on.

Total: Fall + Spring SCH

To provide a yearly outlook for TPSU Total SCH, Fall and Spring SCH of each academic year from 1965 through 1981 were added. This yearly historical Total SCH was used to estimate seven cycle regression models. The yearly actual Total SCH and models' corresponding projected SCH were summarized in Table XCVIII of the appendix.

Except for the model III, with R^2 of .996 which only had one significant cycle, the rest of the models each had two statistically significant cycles (models' R^2 were not less than .998). The length of the short cycles were between 4 to 5 years (generally stable), while the long cycles' length varied from 6 to 9 years (except for the length of the long cycle of model V which was 12 years).

Deviations and percentage deviations of projected yearly Total SCH from their corresponding actual SCH values were summarized in Table XCIX of the appendix. Percentage deviation varied from a minimum of 0.07% (%D of one year in-advance projection of model III). Generally %D was about or less than 5.0%. Also the pattern observed in other deviation tables was observable in this table too. Examination of Table XCIX of the appendix reveals that the magnitude of %D increases with time and models estimated on more recent 11-year string of data have smaller %D.

Model VII with R^2 of .998 and two significant cycles can be used to project future TPSU yearly Total SCH. Model VII had the following equation

$$Y_t = 6063.090 + 163.184t + 241.377 \sin [.682(t - 5.058)] + 101.497 \sin [1.330(t + .378)]$$

Where t values are	SCH projections are
12 for Fall + Spring 1982	7,758,332
13 for Fall + Spring 1983	8,037,594
14 for Fall + Spring 1984	8,477,516
and so on.	

Total: Fall SCH

Actual TPSU Total SCH for the Fall of 1965 through 1981 was the base data to estimate seven cycle regression models with 9 periods of 3 periods in-advance projections. The results were summarized in Table C of the appendix. Models I, III, and VII with respective R^2 of 1.000, .999, and .998 each had two statistically significant cycles. Neither of the two cycles had a stable length. Length of the short cycle varied between approximately 3 to 5 years, while long cycles' length fluctuated between 6 to 9 years. Models II, IV, V, and VI with respective R^2 of .996, .997, .996, and .992 each had one significant cycle with moderately stable length of 6 to 7 years.

Deviations and percentage deviations of TPSU projected Fall Total SCH from their corresponding actual SCH value were tabulated in Table CI of the appendix. Examination of that table reveals that the %D varied between minimum of 1.13% (%D of one-term in-advance projection of model III) to maximum of 9.67% (%D of six-term in-advance projection of model I). Percentage deviation values were generally about 5.0% and their magnitudes increased with time.

Model VII with R^2 of .998 and two statistically significant cycles can be used for future TPSU Fall Total SCH projections. Model VII had the following equation

$$Y_t = 3136.906 + 83.404t + 117.367 \sin [.671(t + 4.948)] + 49.570 \sin [1.316(t + .338)]$$

Where t values are	SCH projections are
12 for Fall 1982	4,003,063
13 for Fall 1983	4,113,895
14 for Fall 1984	4,321,855

and so on.

Total: Summer SCH

TPSU Summer Total SCH from 1966 through 1981 was used to estimate six cycle regression models with 9 periods to 4 periods in-advance SCH projections. The results were summarized in Table CII of the appendix. Models I, II, and III of that table with respective R^2 of .997, .998, and .994 each estimated two statistically significant cycles with instable lengths. Model IV with R^2 of .771 only fitted a straight line to the data. Models V and VI with R^2 of .903 and .943 each had one significant cycle with instable lengths.

As it was discussed earlier in the chapter, instability of the estimated cycles' lengths generally indicate a possibility of over-and-underestimations in models SCH projections. In the case of TPSU Summer Total SCH projections (see Table CIII of the appendix) a moderate overestimation in Model I continued with a decreasing magnitude through model V (average %D was about 18.96% in model I, while it decreased to 14.69% in model II and to a mere 0.40% in model V).

Model VI with R^2 of .943 and one significant cycle had the following equation which can be used for projection of future TPSU Total Summer SCH

$$Y_t = 1140.760 + 12.234t - 37.749 \sin [.800(t - .132)]$$

Where t values are	SCH projections are
12 for Summer 1982	1,290,557
13 for Summer 1983	1,328,882
14 for Summer 1984	1,349,577
and so on.	

Education: Fall + Spring SCH

In order to provide a yearly outlook for TPSU Education SCH, Fall and Spring SCH of each academic year from 1965 through 1981 were added. This yearly TPSU Education data was used to estimate seven cycle regression model with 9 years to 3 years in-advance projected Education SCH. The results were summarized in Table CIV of the appendix. Models I and IV with R^2 of .980 and .876 only fitted straight lines to the data. It can be observed that after removal of trend variation from the data, very little variation (2.00% to 12.4%) remains to be explained. In case of models I and IV the remaining variation (after removal of the trend) is random (no statistically significant cycles were found).

Models II, III, V, VI, and VII with respective R^2 of .994, .991, .981, .924, and .983 each had one significant cycle with a length of 14 to 16 years. Deviations and percentage deviations of TPSU yearly projected Education SCH from their corresponding actual SCH were summarized in Table CV of the appendix.

Percentage deviations of the models with no significant cycles varied from minimum of 5.67% (for one-year in-advance SCH projection of model I) to maximum of 65.46% (for the seven-year in-advance SCH projection of model I). Other models' percentage deviations averaged about 19.96% (for model II) to a mere 1.14% (for model VI). Models estimated on the basis of more recent 11-year strings of historical data had a smaller %D.

For future TPSU yearly Education SCH projections model VII with R^2 of .983 and one significant cycle can be used. Model VII had the following equation

$Y_t = 638.928 - 2.111t - 89.810 \sin [.460(t + 4.075)]$

Where t values are	SCH projections are
12 for Fall + Spring 1982	533,228
13 for Fall + Spring 1983	521,674
14 for Fall + Spring 1984	528,776

and so on.

Education: Fall SCH

The results obtained in estimation of seven cycle regression models using TPSU Fall Education data were identical to the estimated models based on TPSU yearly education SCH data (see Table CVI of the appendix). Models I and IV with R^2 of .984 and .899 only fitted straight lines to the data, while models II, III, V, VI, and VII with respective R^2 of .993, .992, .981, 1977 and .976 each had one statistically significant cycle (just as was the case in TPSU yearly Education models). The length of the cycles were estimated to be between approximately 15 to 16 years.

Deviations and percentage deviations of projected TPSU Fall Education SCH from their corresponding actual SCH values were summarized in Table CVII of appendix. Average %D of models I and IV of this table, as in yearly case, were greater than other models' percentage deviations. Models I and IV %D were as low as 6.42% (for the first-semester in-advance projection of model I) and as high as 63.38% (for the sixth-semester in-advance projection of model I). Models II, III, V, and VI %D varied between low of 1.12% (for the first-semester in-advance projection of model VI) and high of 40.03% (for the fifth-semester in-advance projection of model II). It also can be observed that models estimated on the basis of more recent 11-year strings of data have smaller average %D.

For future TPSU Fall Education SCH projections model VII with R^2 of .976 and one significant cycle can be used. Model VII had the following equation

$$Y_t = 321.500 - 2.535t - 52.447 \sin [.403(t + 5.094)]$$

Where t values are	SCH projections are
12 for Fall 1982	261,352
13 for Fall 1983	244,247
14 for Fall 1984	234,233

and so on.

Education: Summer SCH

The last part of the analyses of TPSU Education data was to use TPSU Summer Education data from 1966 through 1981 to estimate six cycle regression models (the procedure was fully described in Chapter III). The actual TPSU Summer Education SCH along with corresponding models' projections were summarized in Table CVIII of the appendix. Models I and II of that table with respective R^2 of .990 and .992 each only had one significant cycle. Other models, namely models III, IV, V, and VI which had R^2 of .996, .997, .995, and .992 respectively, each estimated two statistically significant cycles. The length of the short cycles were about 4 years while the long cycles' length varied between approximately 11 to 17 years.

Percentage deviations of the projected Summer Education SCH from their actual SCH were smaller for the short-term than the long ones (see Table CIX of the appendix). Examination of the Table CIX of the appendix also reveals that large overestimation of model I and underestimation of the model II were dissipated by small to medium fluctuation in other models.

For projection of TPSU future Summer Education SCH model VI can be used which had the following equation

$$Y_t = 223.938 + 1.062t + 32,104 \sin [.431(t + 13.550)] + 6.963 \sin [1.252(t + 1.867)]$$

Where t values are	SCH projections are
12 for Summer 1982	197,645
13 for Summer 1983	207,212
14 for Summer 1984	224,372
and so on.	

Liberal Arts: Fall + Spring SCH

In order to provide a yearly outlook for TPSU Liberal Arts SCH, Fall and Spring SCH of each academic year from 1965 through 1981 were added. This yearly TPSU Liberal Arts data was then used to estimate seven cycle regression models with 9 years to 3 years in-advance projected Liberal Arts SCH. The results were summarized in Table CX of the appendix. Models II, III, IV, and VI with respective R^2 of .977, .983, .988 and .982 each had one significant cycle which varied in length from approximately 6 to 9 years. Models I, V and VII which had the R^2 of .999, .999 and .991 each estimated two statistically significant cycles. The length of their short cycles varied from 3 to 5 years while the long cycle length of these models were estimated to be between 6 to 9 years.

Deviation and percentage deviations of the TPSU yearly projected Liberal Arts SCH from their corresponding actual SCH values were summarized in Table CXI of the appendix. The %D fluctuated between low of 0.06% (for the one-year in-advance projection of model III) to high of 16.04% (for the one-year in-advance projection of model III) to high of 16.04% (for the four-year in-advance projection of model I). Here again short-term percentage deviations were smaller than long-term %D in each model. Also, as before, models based on more recent 11-year string of data produced a better result (as is reflected in their lower %D) than other models.

Model VII with R^2 of .991 and two significant cycles can be used to project future TPSU yearly Liberal Arts SCH. Equation for model VII was

$$Y_t = 2811.509 + 33.420t + 78.743 \sin[.737(t + 4.088)] + 68.726 \sin[1.300(t + .485)]$$

Where t values are	SCH projections are
12 for Fall + Spring 1982	3,128,336
13 for Fall + Spring 1983	3,180,592
14 for Fall + Spring 1984	3,329,914

and so on.

Liberal Arts: Fall SCH

TPSU Fall Liberal Arts SCH data from 1965 through 1981 was used to estimate seven cycle regression models with 9 years to 3 years in-advance SCH projection for the Fall semesters. The actual TPSU Fall Liberal Arts SCH along with models' projected SCH values were summarized in Table CXII of appendix. Models I and VII of that table with R^2 of 1.000 and .991 each estimated two statistically significant cycles.

While models II, III, IV, V, and VI, which had R^2 of .983, .981, .990, .985, and .987 respectively, each estimated only one significant cycle.

A long cycle with a length of approximately 8 to 11 years was visible in at least three models (models I, II, and VII), but a short cycle with an approximate length of 4 to 6 years was even more visible (see models I, III, IV, V, VI, and VII of Table CXII of the appendix).

Deviations and percentage deviations of the projected Fall Liberal Arts SCH from their corresponding actual SCH values were as low as 0.15% and as high as 15.21% (see Table CXIII of the appendix). Apart from models I and II %D's (which ranged in magnitude from 5 to 15 percent) the other models' percentage deviations were at or below 5.0%.

Model VII with R^2 of .991 and two significant cycles can be used to project future TPSU Fall Liberal Arts SCH. Equation for the model VII was

$$Y_t = 1487.384 + 14.170t + 43.430 \sin [.596(t + 5.739)] + 37.832 \sin [1.246(t + .556)]$$

Where t values are	SCH projections are
12 for Fall 1982	1,620,322
13 for Fall 1983	1,593,788
14 for Fall 1984	1,629,657
and so on.	

Liberal Arts: Summer SCH

The last part of the analyses of TPSU Liberal Arts data was to use TPSU Summer Liberal Arts from 1966 through 1981 as the basis to estimate six cycle regression models. The results were summarized in Table CXIV of appendix. From that table it can be observed that the first three models (models I, II, and III) each had two significant cycles (R^2 of these models were .995, .987, and .957 respectively). Models IV and V with R^2 of .850 and .752 each estimated one statistically significant cycle, while the last model (model VI) with R^2 of .336 only fitted a straight line to the data. The short cycle with a length of about 4 to 5 years showed itself up in all the models where a significant cycle was found. A long cycle with an approximate length of 9 to 15 years was only visible in the first three models.

The percentage deviations of models I, II, and III ranged in magnitude from 6.90% to 43.20%. The relatively high %D of the first three models, however, did not continue in models IV and V which had a maximum %D of 7.75% (see Table CXV of the appendix).

The last model with R^2 of .752 and one significant cycle (model V) can cautiously be used to estimate future TPSU Summer Liberal Arts SCH. Model V had the following equation

$$Y_t = 497.554 - .750t - 20.189 \sin [1.26(t + 1.400)]$$

Where t values are	SCH projections are
13 for Summer 1982	500,646
14 for Summer 1983	476,131
15 for Summer 1984	466,799
and so on.	

Business: Fall + Spring SCH

The last category of TPSU semester credit hour data that was analyzed with cycle regression algorithm was TPSU Business SCH from 1965 through 1981. First, the combined values for the Fall and Spring SCH of each academic year were obtained. Second, seven cycle regression models were estimated on the basis of historical yearly TPSU Business data.

Combined Fall and Spring actual Business SCH along with the corresponding seven models' SCH projections were summarized in Table CXVI of the appendix. Models I, II, IV, and V, which had R^2 of .998, .998, .999, and .999 respectively, each estimated two statistically significant cycles. Models III and VI with R^2 of .997 and .996 each only had one significant cycle. And finally model VII with R^2 of .992 only fitted a straight line to the data. A short cycle with the length of 4 to 5 years and an instable long cycle with the length of approximately 6 to 15 years were visible.

Percentage deviations of short term projected yearly Business SCH from actual values were generally about 5.0%, while for long term projections this value was up to 18.0%. Projected semester credit hour values underestimated actual SCH in almost all the models (except one case in model IV). But the models performance improved as estimation of the SCH were shifted to a more recent 11-year strings of historical data (see Table CXVII of the appendix).

Model VI with R^2 of .996 and one significant cycle can be used to project future TPSU yearly Business SCH. Model VI had the following equation

$$Y_t = 583.464 + 42.950t + 64.545 \sin [.428(t + 7.437)]$$

Where t values are	SCH projections are
13 for Fall + Spring 1982	1,239,538
14 for Fall + Spring 1983	1,298,890
15 for Fall + Spring 1984	1,358,242

and so on.

Business: Fall SCH

The study of the TPSU Business SCH was also extended to Fall semesters of 1965 through 1981. Based on these data seven cycle regression models were estimated, and their projected SCH along with corresponding actual SCH values were summarized in Table CXVIII of the appendix. Models I, II, and V which had R^2 of .998, .998, and .999 respectively, each estimated two statistically significant cycles. Models III and IV with R^2 of .995 and .994 each had one significant cycle, while the last two models (models VI and VII) with R^2

of .977 and .989 only fitted straight lines to the data. Length of the short cycles were about 4 to 5 years while long cycles' lengths varied between 6 to 15 years.

Projected SCH was underestimated by as little as 0.71% (for the one-semester in-advance projection of model I) and as much as 18.28% (for the three-semester in-advance projection of model II). But the magnitude of %D progressively decreased as more recent 11-year strings of data were used for models' estimations (see Table CXIX in the appendix).

Model V with R^2 of .999 and two significant cycles can cautiously be used for projection of future TPSU Fall Business SCH. Model V had the following equation

$$Y_t = 299.026 + 17.345t + 40.679 \sin [.430(t + 7.056)]$$
$$-8.736 \sin [1.597(t -.0006)]$$

Where t values are	SCH projections are
14 for Fall 1982	559,710
15 for Fall 1983	564,774
16 for Fall 1984	553,759
and so on.	

Business: Summer SCH

Estimation of six cycle regression models was also conducted, based on the TPSU Summer Business SCH of 1966 through 1981. Actual TPSU Summer Business SCH along with corresponding models' projected SCH values were summarized in Table CXX of the appendix. Models I and III with R^2 of .986

and .988 only fitted straight lines to the data. Models II, IV, V, and VI which had R^2 of .994, .996, .996 and .994 respectively, each had one statistically significant cycle. The length of the cycle varied between 4 to 5 years.

Percentage deviations of the projected SCH from their actual SCH values were generally less than 5.0% (see Table CXXI of the appendix). The %D of underestimated projected SCH ranged from minimum of 0.11% to maximum of 6.50%.

Model VI with R^2 of .994 and one significant cycle can be used for future TPSU projections of Summer Business SCH. The equation for model VI was

$$Y_t = 94.487 + 10.177t + 4.600 \sin [1.385(t + .122)]$$

Where t values are	SCH projections are
12 for Summer 1982	212,564
13 for Summer 1983	223,893
14 for Summer 1984	239,942

and so on.

Phase III: Comparison of Cycle Regression's and Brooks' SCH Projections

One of the stated purposes of this study was to compare SCH predictions made by multiple regression approach of Brooks (3) and SCH projections resulted from cycle regression treatment of the NTSU enrollment data. Brooks' SCH projections were made for only three categories of NTSU enrollment data, Total, Undergraduate, and Graduate. The periods of projections were Fall 1979, Spring 1980, Summer 1980, Fall 1980, Spring 1981, and Summer 1981.

Before comparing the projections of the two methods, significant differences in methodology and techniques employed are worth mentioning. An integral part of the projection equation developed by Brooks was inclusion of some economic factors. These factors (independent variables) were chosen among a pool of national, regional and local economic indicators highly correlated with enrollment data (dependent variable) on a lagged basis. Although such equations have shown to make sound SCH projections, (3, p. 81) the use of them are restricted to availability of data for the economic factors embedded in the projection equations. Thus SCH projections can be made only one or at most two periods ahead of time. The number of in-advance projections with this method is directly related to economic factor in projection equation that has the smallest lag with Y (i.e., if the smallest lag is zero, no in-advance projections can be made, if that is one, only one period in-advance projection is possible).

Apart from the difficulty of obtaining these economic data, unpredictable change in interrelationship of Y and economic factor because of the shifts in the economy is quite possible, as Brooks herself noted (3, p. 111). In that case the process of selection of the economic factors and estimation of the equation must be redone.

None of these potential problems exist, if one employs cycle regression technique. The only variable in cycle regression equation is time (t). So there are no limits in how many in-advance projections can be made. Although the magnitude of cycle regression projection error probably increases the farther in time the projections are made, the precision of cycle regression projections also largely depends on the continuation of the patterns present in historical data. Clearly erratic behavior in data cannot be predicted by any method.

Table XV presents the categories and time periods for which projections were made by Brooks' and cycle regression's methods. In five out of six projections made for category "Total" cycle regression did a better job than Brooks' multiple regression. Incidently, Brooks complicated equations did no better job in Total SCH projections than a straight line equation (cycle regression did not find any significant cycles, thus a straight line was estimated for each sets of Fall, Spring, and Summer data).

In two out of six projections made for Undergraduate SCH, cycle regression had smaller percentage deviations, and in three cases trailed the smaller %D of the Brooks' projections. Percentage deviation of the Summer 1981 Undergraduate projection was much smaller in Brooks' projection than that of cycle regression (10.56% for cycle regression to 1.16% for the Brooks).

TABLE XV

BROOKS' REGRESSION VERSUS CYCLE REGRESSION COMPARISON OF THE PROJECTIONS

Category	Semester	Actual SCH	Lynn Brooks Projection	Lynn Brooks % D	Cycle Regression Projection	Cycle Regression		
						% D	R^2	# of Cycle
Total	Fall 79	194,118	192,807	- .68	194,688	+ .27	.823	0
	Spr. 80	177,403	180,369	+ 1.67	178,851	+ .82	.792	0
	Sum. 80	63,968	71,445	+ 11.69	67,849	+ 6.07	.357	0
	Fall 80	192,998	193,519	+ .27	194,625	+ .84	.985	0
	Spr. 81	177,283	181,554	+ 2.41	178,562	+ .72	.433	0
	Sum. 81	66,478	72,629	+ 9.25	64,047	- 3.66	.716	0
Under-graduate	Fall 79	167,782	165,051	- 1.63	165,750	- 1.21	.853	1
	Spr. 80	157,999	150,588	- .93	149,263	- 1.80	.721	0
	Sum. 80	42,365	45,073	+ 6.39	43,255	+ 2.10	.701	0
	Fall 80	165,466	164,519	- .57	163,409	- 1.24	.771	0
	Spr. 81	151,194	150,083	- .73	148,260	- 1.94	.904	1
	Sum. 81	45,067	44,542	- 1.16	40,307	- 10.56	.881	0
Graduate	Fall 79	26,336	26,862	+ 2.00	31,188	+ 18.42	.937	0
	Spr. 80	25,404	26,368	+ 3.79	27,841	+ 9.59	.988	1
	Sum. 80	21,603	23,889	+ 10.58	21,610	+ .03	.896	1
	Fall 80	27,532	28,266	+ 2.67	30,702	+ 11.51	.862	0
	Spr. 81	26,089	28,010	+ 7.36	24,649	- 5.52	.965	1
	Sum. 81	21,411	25,294	+ 18.14	20,760	- 3.04	.855	1

Of the six point estimates made for the NTSU graduate SCH, three cycle regression projections' %D were smaller (Summer 1980, Spring 1981, and Summer 1981) while in three other cases (Fall 1979, Spring 1980, and Fall 1980) Brooks made a better (smaller %D) SCH projection.

In all, cycle regression made ten out of eighteen (56%) and Brooks' method eight out of eighteen (44%) point estimates for NTSU SCH with smaller percentage deviations from the actual values. Obviously without using any economic variables in its projection equations, cycle regression SCH projections were as close or closer to the actual SCH values as were those of the Brooks' method.

Phase IV: Comparison of Cycle Regression's and TPSU Coordinating Board's SCH Projections

The foremost objective of this phase of the study was simply to compare some specific Total SCH projections made by the coordinating board, versus the ones made by cycle regression technique. It had to be noted though, that TPSU coordinating board is the institution in charge of and responsible for the task of forecasting SCH projections for the state of Texas higher education institutions. Forecasting of SCH by TPSU coordinating board is a crucial ingredient upon which educational planning is made, policy decisions are formulated and alternatives evaluated (7). Thus, enrollment predictions, because of their bearing on state-level administrative decision, have never been more critical (6, p. 1; 8, p. 40).

There are two important factors in educational planning: one is the reliability of the forecast upon which planning is made; the other is how far in advance projection of enrollment and revenues can effectively be made (1, p. 95; 4, p. 45). If an institution has reliable enrollment projections far enough in advance, there will be adequate time for exploring various options and initializing needed change (9, p. 653). The need for educational planning and reliable enrollment forecasts is vividly obvious. The question is what forecasting technique can best serve the purpose with least cost. The forecasting model used by TPSU coordinating board is based upon analysis of college attendance patterns and on populations by age in different Texas counties (2). This model is less elaborate than the one used by the state of Ohio, which has been called the most advanced statewide model (5, p. 8).

Statewide forecasting models can be quite sophisticated and require a detailed and comprehensive data base classified consistently from a pool of educational and academic data throughout the state. Maintaining an up-to-date data bank in that scale may well be quite costly and techniques of enrollment projection sophisticated.

Instead of using a multitude of factors and techniques, cycle regression approach depends only on historical enrollment data to provide short as well as long term enrollment projections. Thus cycle regression technique may be a suitable and cost effective approach in enrollment projections.

The SCH projections made on the basis of TPSU enrollment data and its subsequent analysis presented in phase II of this chapter prove the potential of cycle regression in enrollment forecasting. Table XVI tabulates a comparison of five most recent coordinating board Total SCH projections for the Fall semester versus the ones made by cycle regression technique. One point that must be mentioned is that coordinating board projections are headcounts rather than semester credit hours employed in this study. Headcount projections of coordinating board, therefore, was converted to SCH using SCH/headcount ratio (conversion was done by Dr. Naugher of University Planning and Analysis of NTSU). In three out of the five cases (Fall of 1978, 1979, and 1982) cycle regression made a better projection (smaller D and %D). For the Fall of 1979 and 1980 coordinating board Total SCH projection were closer to the actual SCH values than those of cycle regression.

Summary

Since the number of enrollment categories and time periods used in this study and the subsequent resultant tables were enormous, an attempt became necessary to bring about an

TABLE XVI

COORDINATING BOARD APPROACH VERSUS CYCLE REGRESSION COMPARISON OF THE PROJECTIONS

Category	Semester	Actual Total SCH	*Most recent SCH projections made by Coordinating Board of TPSU	Coordinating Board of TPSU %D of projected SCH from actual values	** Most recent cycle regression SCH projections	Cycle regression %D of projected SCH from actual values	# of cycles estimated by cycle regression approach
Total	Fall 1978	3,846,499	3,895,122	+1.26	3,889,851	+1.13	2
Total	Fall 1979	3,867,733	4,042,552	+4.52	3,928,787	+1.58	1
Total	Fall 1980	3,953,835	3,911,166	-1.08	4,079,899	+3.19	1
Total	Fall 1981	3,974,672	3,924,984	-1.25	4,145,691	+4.30	1
Total	Fall 1982	4,090,899	3,904,251	-4.56	4,003,063	-2.15	2

*The data of this column was extracted from Table XIII of the appendix compiled by Dr. Jimmie R. Naugher of University Planning and Analysis of North Texas State University.

**See Table C of the appendix.

overall picture of the characteristics as well as performance of the cycle regression algorithm in regard to the projection of enrollment data. This was done with the construction of two summary tables (Table XVII and XVIII). All important parameters relevant to the NTSU enrollment data were summarized in the first table (Table XVII), while the same parameters for the TPSU enrollment data were tabulated in the second one (Table XVIII). In these tables all categories of data and all time periods were taken into consideration. Selected parameters of the seven cycle regression models which were performed for each category of data at each time period were: Median R^2, range of the short cycles, range of the long cycles, and median percentage deviation. R^2, length of the short cycle, length of the long cycle, and number of cycle(s) were tabulated also for each projection equation. Using projection equations, SCH values for 1983, 1984, and 1985 were forecasted and shown in correspondence with each category of enrollment data at each time period.

Although the tables are self-explanatory the following observations can be made. In a majority of the cases a four-to-five year short cycle, and a seven-to-fifteen year long cycle was visible. This means that in an upward or downward long cycle two or three short cycles can occur. Figure 3 and 4 demonstrate the concept schematically.

TABLE XVII

SUMMARY OF CYCLE REGRESSION ANALYSES OF NTSU SCH ENROLLMENT DATA

Category of Data	*Time Period	Seven Models			Selected Model						
		Median R^2	**Range of SC	*** Range of LC	Median %D	R^2	**SC	***LC	**** # of C	SCH Projection for 1983	1984	1985
Under-graduate	F+S	.967	4	7-17	3.60	.967	4	7	2	305,211	312,165	305,538
	F	.963	4	7-17	2.85	.995	4	7	2	161,469	163,859	159,521
	SI+SII	.904	-	4-14	13.00	.904	-	14	1	46,460	47,616	48,233
	SI	.907	-	4-13	10.61	.914	-	13	1	27,137	28,047	28,466
Master	F+S	.990	4-6	4-11	25.02	.966	-	8	1	44,985	45,663	43,155
	F	.967	2-6	7-15	23.99	.989	2	7	2	23,087	23,381	23,752
	SI+SII	.968	4-5	8-16	24.30	.968	5	8	2	15,858	16,838	15,939
	SI	.830	-	2-13	19.52	.847	-	8	1	9,456	9,704	9,641
Doctor-ate	F+S	.994	2	6-8	10.98	.994	-	8	1	20,838	22,035	21,455
	F	.975	3	6-8	9.77	.971	-	7	1	10,605	11,196	10.917
	SI+SII	.918	2	6-9	11.13	.858	-	10	1	6,577	6,662	6,941
	SI	.974	2-4	6-9	5.04	.890	-	9	1	3,891	4,118	4,474
Total	F+S	.772	1-4	5-15	1.39	.772	-	5	1	378,573	373,667	381,782
	F	.856	1-4	4-12	.26	.976	4	5	2	197,956	192,716	200,341
	SI+SII	.837	4	11	10.07	.907	4	11	2	78,531	80,555	75,929
	SI	.885	4	11-17	9.61	.885	-	17	1	34,393	34,271	34,373
Educa-tion	F+S	.857	3	5-17	32.87	.999	3	15	2	25,788	26,211	33,427
	F	.975	2-8	5-21	20.98	.981	-	15	1	13,150	12,093	14,532
	SI+SII	.883	-	11-17	9.48	.976	-	11	1	13,048	13,177	13,322
	SI	.953	7	8-20	23.88	.990	-	9	1	7,500	7,511	7,349

TABLE XVII--Continued

Category of Data	*Time Period	Seven Models			Selected Model						
									SCH Projection for		
		Median R2	**Range of SC	***Range of LC	Median %D	R^2	**SC	***LC	****# of C	1983	1984	1985
Liberal Arts	F+S	.916	5	6-26	6.40	.952	-	26	1	170,658	175,215	169,350
	F	.961	4	8-13	8.08	.932	-	22	1	88,396	90,107	85,530
	SI+SII	.897	4	11-15	13.82	.897	-	15	1	24,505	25,051	25,295
	SI	.796	5	9-18	10.45	.922	-	18	1	14,961	15,826	16,642
Business	F+S	.989	5-6	8-18	15.01	.989	-	16	1	80,673	81,251	80,621
	F	.983	2	9-20	6.22	.983	-	19	1	39,406	38,921	35,045
	SI+SII	.427	4	8-21	13.80	.950	-	21	1	15,964	17,057	18,115
	SI	.817	2	5-21	17.66	.990	2	21	2	10,533	11,231	12,364

Source of the Summary Table: Tables XXIV through LXXIX of the appendix.

*F+S, F, SI+SII, and SI refer to Fall + Spring, Fall, Summer I + Summer II, and Summer I respectively.

**Length of short cycle(s) in years, rounded to the nearest whole number.

***Length of long cycle(s) in years, rounded to the nearest whole number.

****Number of cycle(s).

TABLE XVIII

SUMMARY OF CYCLE REGRESSION ANALYSES OF TPSU SCH ENROLLMENT DATA

Category of Data	*Time Period	Seven Models				Selected Model						
		Median R^2	**Range of SC	***Range of LC	Median 1% Dl	R^2	**SC	***LC	****# of C	SCH Projection for 1983	1984	1985
Under-graduate	F+S	.998	4-5	6-9	3.91	.998	5	9	2	7,076,238	7,430,066	7,497,095
	F	.997	3-5	6-9	3.87	.998	5	9	2	3,640,136	3,809,311	3,887,835
	SUM	.924	3-5	6-12	13.41	.856	-	6	1	982,903	967,879	956,649
Master	F+S	.996	5-6	8-17	18.33	.998	6	16	2	648,037	671,091	853,683
	F	.996	4-6	8-26	17.13	.996	5	10	2	427,388	475,513	480,229
	SUM	.999	4-5	6-14	16.66	.995	5	14	2	237,258	260,701	287,613
Doctor-ate	F+S	.992	1-4	13	4.28	.997	4	-	1	170,205	177,843	183,133
	F	.997	4-5	15-22	3.02	.997	5	-	1	80,989	83,786	87,202
	SUM	.980	2	8-13	7.34	.998	2	10	2	46,682	47,121	49,335
Total	F+S	.998	4-6	6-13	4.89	.998	5	9	2	8,037,594	8,477,516	8,574,815
	F	.997	3-5	6-9	4.52	.998	5	9	2	4,113,895	4,321,855	4,432,240
	SUM	.969	3-4	8-27	7.49	.943	-	8	1	1,328,882	1,349,577	1,347,509
Educa-tion	F+S	.981	-	14-16	17.26	.983	-	14	1	521,674	528,776	593,563
	F	.977	-	15-16	16.16	.976	-	16	1	244,247	234,233	276,087
	SUM	.993	4-5	11-18	14.16	.992	5	15	2	207,212	224,372	237,175
Liberal Arts	F+S	.988	3-5	6-9	5.35	.991	5	9	2	3,180,592	3,329,914	3,355,602
	F	.987	4-5	6-11	3.62	.991	5	11	2	1,593,788	1,629,657	1,721,787
	SUM	.904	4-5	9-15	14.44	.752	5	-	1	472,052	469,030	466,008

TABLE XVIII--Continued

Category of Data	* Time Period	Seven Models				Selected Model						
										SCH Projection for		
		Median R^2	**Range of SC	*** Range of LC	Median 1% Dl	R^2	**SC	***LC	**** # of C	1983	1984	1985
Business	F+S	.998	4-5	6-15	6.07	.996	-	15	1	1,201,235	1,216,822	1,281,907
	F	.995	4-6	6-15	7.98	.999	4	15	2	564,774	553,759	597,209
	SUM	.994	4-5	-	3.74	.994	5	-	1	223,893	239,942	251,141

Source of the Summary Table: Tables LXXX through CXXI of the appendix.

*F+S, F, and SUM refer to Fall + Spring, Fall, and Summer respectively.

**Length of the short cycle(s) in years, rounded to the nearest whole number.

***Length of the long cycle(s) in years, rounded to the nearest whole number.

****Number of cycles.

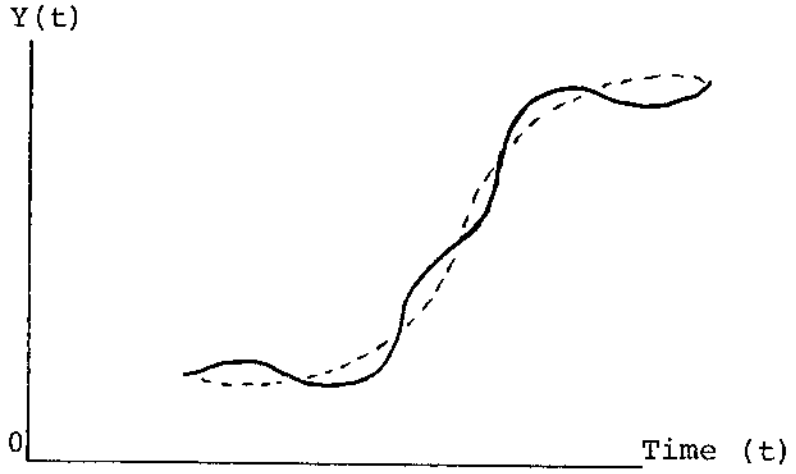

Figure 3. An upward long cycle with three short cycles.

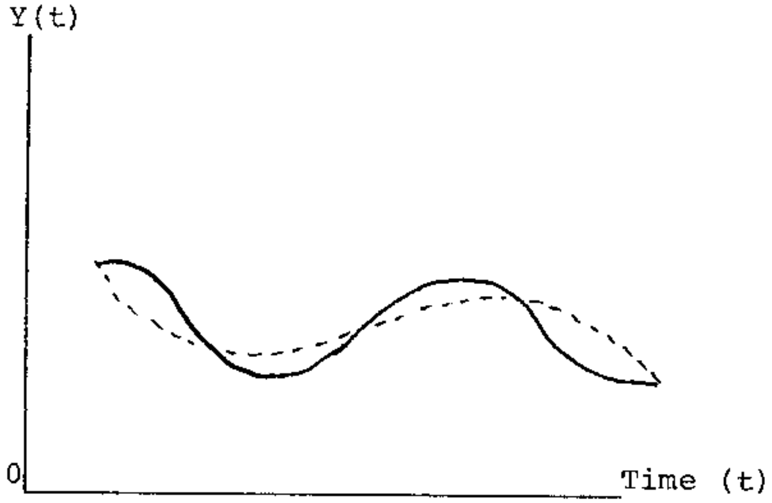

Figure 4. A downward long cycle with two short cycles.

Categories or time periods which generated the largest average percentage deviations were the same in both sets of data (NTSU and TPSU enrollment data sets). Average %D for TPSU SCH projections were generally smaller than average %D for the same projections of NTSU data. Incidentally, two points must be remembered in regard to median %D of the two tables. First, %D's were averages of deviations of up to seven years in-advance projections. Second, average %D were calculated over absolute values (over-and-underestimations were treated equally). Hence, one-half of median %D should be taken as expected percentage deviation in either direction (over or under actual SCH values).

Finally, in comparison to Brooks' and the State Coordinating Board's approaches to enrollment forecasting, the cycle regression technique did as good a forecast as either of those methods (see details in phase III and IV of this chapter).

CHAPTER BIBLIOGRAPHY

1. Alper, P., P. H. Armitage and C. S. Smith, "Educational Models, Manpower, Planning and Control," Operational Research Quarterly, 18 (June, 1967), 93-103

2. Ashworth, Kenneth H., Unpublished memorandum and enclosures to Presidents and Chancellors of Public Senior Colleges and Universities of Texas, Austin, Texas, May 30, 1980.

3. Brooks, Dorothy Lynn, "Short Term Enrollment Projections Based on Traditional Time Series Analysis,: doctoral dissertation, North Texas State University, December, 1981.

4. Freeman, Jack E., "Comprehensive Planning in Higher Education," New Directions for Higher Education, 19 (Autumn, 1977), 33-52.

5. Kraetsch, Gayla A., Methodology and Limitations of Ohio Enrollment Projections, The Association for Institutional Research Professional File No. 4, edited by Richard R. Perry, Tallahassee, Florida, Winter, 1979-1980.

6. Magelson, Wayne L., Donald M. Norris, and Nick L. Poulson, Projecting College and University Enrollments: Analyzing the Past and Focusing on Future, Ann Arbor, Center for the Study of Higher Education, School of Education, The University of Michigan, January, 1974.

7. Seminar on Approaches to Academic Planning, The University of Texas System Institute of Higer Education Management, Austin, Texas, March 18-20, 1981.

8. Suslow, Sidney, "Benefits of a Cohort Survival Projection Model," New Direction for Institutional Research, 13 (Spring, 1977), 19-42.

9. Wharton, James H., Jerry J. Baudin, and Ordell Griffith, "The Importance of Accurate Enrollment Projections for Planning," Phi Delta Kappa, 62 (May, 1981), 652-655.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Overview of Study

An important input of planning for higher education institutions is enrollment projections. For the purpose of enrollment projections a pool of statistical and forecasting techniques have been used. These techniques vary from subjective and qualitative judgment to different curve fitting techniques (i.e., moving overages, exponential smoothing, polynomial models) and causal models such as cohort-survival models, ratio methods, Markov chain model, and multiple correlation and regression method.

A number of recent enrollment forecasting techniques have taken advantage of the demonstrated interrelationship between economic activities and enrollments (2, 4). Salley's (4) and Brooks' (2) approaches to enrollment forecasting are among those methods that have proven to be quite effective. There are, however, several major drawbacks associated with time series regression models which employ economic parameters as their independent variables. First, in advance enrollment projections of more than one or two time periods are not possible, because of unavailability of economic data that must be fed into projection equations (most often with a lag value of one or two). Second, although the selection of the appropriate economic parameters and estimation of the projection equations are rather cumbersome, the whole process may need to be repeated if the assumed relationship between enrollment and selected economic factor does not hold. The third problem is of a technical nature. The pattern of residual of both Salley and Brooks projection show presence of auto-correlation (2, p. 88). Ordinary Least Square estimators are no longer efficient and statistical significance of the regression coefficients are misleading if final residuals of equation are auto-correlated (3, p. 226).

In this study a state-of-art forecasting technique was employed that was originally developed for use in disciplines other than education. Cycle regression approach to forecasting poses none of the problems cited above that are associated with other forecasting techniques. To examine the potential of cycle regression in projection of enrollments two separate sets of data were used. They were NTSU and TPSU historical enrollment data in seven distinct categories. The categories were; Undergraduate, Graduate, Doctorate, Total, Education, Liberal Arts, and Business. For NTSU enrollment data, projection equations were estimated for Fall and Spring (yearly), Fall, Summer I and Summer II (Summer) and Summer I periods. Projection equation for TPSU enrollment data were estimated for Fall and Spring (yearly), Fall, and Summer periods. For each set of data at each time period seven projection equations were estimated (except for TPSU summer data which had six projection equations). Projection equations with the best fit (highest R^2) and least percentage deviation were selected to be used for future enrollment projections. Projected SCH enrollments along with actual SCH data and deviations and percentage deviations of projected SCH from actual data were tabulated in appropriate tables. Also, comparisons were made between cycle regression projected SCH enrollments with those of Brooks' and TPSU Coordinating Board's.

Results and Conclusions

The first purpose of the study was to evaluate usefullness of cycle regression in enrollment projections. This was accomplished by using cycle regression with different categories of data in different time periods and exhibiting ability of cycle regression in effective SCH projections under various circumstances.

The second purpose was to extract trend from historical enrollment data. Step zero of equation estimation in cycle regression which estimates a trend line fulfilled this purpose.

The third purpose was to decompose the remaining residual (after estimation of trend) into as many cycle components as possible. Step 1, 2, 3, ... and cycle regression algorithem which estimate 1, 2, 3, ... statistically significant cycles embedded in data accomplished this purpose. Some of the enrollment data used in the study had only a significant trend line while others possessed one or two statistically significant cycles.

The fourth purpose was to estimate a projection equation for each set of data at each time period. Twenty-eight such equations were estimated for NTSU (4 equations for each of the 7 enrollment categories), and 21 for TPSU enrollment data (3 equations for each of the 7 enrollment categories). A total of 49 enrollment projection equations were presented in Chapter IV.

The fifth purpose was to use explanatory equations to project SCH enrollment at least one fiscal year ahead (starting from 1976). This purpose was accomplished and the results were summarized in appropriate tables of the appendix. The selected equation of each table estimates at least three periods in advance SCH projections (up to 1984 or 1985).

The sixth purpose was to compare actual enrollment with the projected one in all defined categories. Deviation and percentage deviation of each set of data at each time period were computed and tabulated in 49 tables continued in the appendix (28 D and %D tables for NTSU and 21 for TPSU enrollment data).

The seventh purpose was to compare cycle regression SCH projections for the Undergraduate, Graduate, and Total categories of NTSU made for Fall 1979 and 1980, Spring 1980 and 1981, and Summer 1980 and 1981 with the same projections made by Brooks. Out of 18 projections, cycle regression had 10 and Brooks had 8 projections with a smaller percentage deviation.

The eighth purpose was to compare cycle regression TPSU Fall Total SCH projections with the same projections made by the State Coordinating Board. Five most recent TPSU Fall Total SCH projections were compared with the same projection made by cycle regression technique. In three cases cycle regression had the better projections (smaller D and %D).

Generally, SCH projections of cycle regression models built on most recent 11-year string of data had smaller deviations and percentage deviations from actual values than projections of the models based on older data. In other words, behavior of future enrollment data have most resemblance to more recent historical enrollment data than older ones. Also better fit (higher R^2) and better projections were made for categories like Total and time periods like Fall and Spring which had a built-in variance reduced character. When equations were estimated for Total category in Fall and Spring time periods the best fit (highest R^2) and the best projections (least D and %D) were achieved.

Although in this study the summer enrollment data were analyzed separately, as was recommended by Brooks (2, p. 118), the fit was least desirable (lowest R^2) and models' SCH projections had highest D and %D. Often cycle regression showed no statistically significant pattern for the summer enrollment data other than a trend line. This is to say that data fluctuation around trend line had no statistically significant or recognizable pattern and thus was considered erratic.

Enrollment categories like Doctorate, Education, Liberal Arts, and Business seemed to be more prone to the changing environment affecting higher education. This could mean less dependability on long term SCH projections for these categories. Since cycle regression analyzes the net effects of factors affecting enrollment data, any changes would eventually be taken into consideration, but only after they happened. This may make a subjective adjustment of cycle regression enrollment projections necessary in times of drastic economical, administrative or technological changes, or for long term in-advance enrollment projections. New or changing pattern in enrollment data under analysis can be observed by an output criteria of cycle regression algorithm. Unstability of cycles' lengths estimated by cycle regression technique for observable cycles can be interpreted as an indication of change in historical patterns.

In other words, the more unstable the observable historical patterns, the less dependable the enrollment projections become.

On the whole, based on observation of cycle regression performance in this study, the following conclusions can be drawn from phase I and II of Chapter IV.

1. For a majority of the enrollment categories in a majority of the time periods, a maximum of 5.0% over-or-underestimations for up to two time periods in-advance projections can be expected.

2. Over-or-underestimation of cycle regression projected SCH values for more than two and less than five periods in-advance projections are normally about 10.0%.

3. Deviations of cycle regression projected SCH values can be up to 25.0% for more than five periods in-advance projections (in times of substantial changes the stated deviation value may be higher).

4. Cycle regression SCH projections are more accurate for an academic year than for Fall, Spring, or Summer periods. SCH projections are closer to actual values in Fall than Spring and the latter than Summer periods.

5. As it was expected, cycle regression enrollment projections for categories of data which are sums of other categories (i.e., Total) are more accurate than for specialized categories (i.e., Education).

6. Cycle regression equations estimated on the basis of more recent enrollment historical data have more accurate SCH projections.

7. Instability of estimated cycles' lengths can be interpreted as changes in historical patterns and thus the possibility of increased projection error.

8. Cycle regression is very responsive to the net effects of environmental factors affecting enrollment, but only when historical data reflect them. Some type of subjective adjustment may be helpful when substantial educational, economic, social, administrative or technological changes are in sight.

9. As is the case in other forecasting techniques, the farther in time enrollment projections are made using cycle regression, the greater are probabilities of errors (under-or-overestimations).

10. Utilizing time (t) as its only variable cycle regression equations estimated as accurate SCH enrollment projections as either the Brooks' or Coordinating Board's method, without having those methods drawbacks.

11. Although the sampling intervals of historical data on which most of the time series forecasting models are based must be fairly long (50 to 100 observations) to provide sufficient data for the models (1, p. 336), this study only employed 11-year intervals of historical enrollment data.

Despite the lack of long history, cycle regression most often diagnosed and extracted one or two cycles in data.

12. In cases where cycle regression fitted only trend lines to the data under analyses, the reasons were short history or random distribution of the observations, or both.

Recommendations

Three major recommendations emerge from this study. The first one is to examine more closely the behavior of summer and other time periods enrollment data in which cycle regression only fitted trend lines. The aim is to discover if improvement in forecasting capability of cycle regression for those data categories or time periods is possible.

The second recommendation is to employ some sort of subjective adjustments in cycle regression projected SCH enrollments in times of expected drastic economic, administrative, technological or other changes that affect the state of certain disciplines or time periods.

The last recommendation is to construct and establish a permanent enrollment data bank with incorporation of cycle regression algorithm as its forecasting tool. The data bank can be updated as soon as new enrollment data become available. Enrollment projections for any time periods or data category then are only push-of-a-button away. Obviously this recommendation can be as helpful to a university as to the state. After construction of the necessary computer package the cost of updating and running the system is trivial while the benefits are unproportionally high.

CHAPTER BIBLIOGRAPHY

1. Bowerman, Bruce L. and Richard T. O'Connel, Forecasting and Time Series, California, Duxbury Press, 1979.

2. Brooks, Dorothy Lynn, "Short-Term Enrollment Projections Based on Traditional Time Series Analysis," doctoral disserataion, North Texas State University, December, 1981.

3. Gujarati, Damodar, Basic Econometrics, New York, McGraw-Hill Book Company, 1978.

4. Salley, Charles D., "Predicting Next Year's Resources--Short-Term Enrollment Forecasting for Accurate Budget Planning," Atlanta, Georgia State University, 1978, a paper presented to the Association for Institutional Research Annual Forum, Houston, Texas, 1978.

APPENDIX

TABLE XIX

NORTH TEXAS STATE UNIVERSITY
TOTAL SEMESTER CREDIT HOUR
(SCH) OVER ALL
PROGRAM AREAS

Fiscal Year	Undergraduate	Master	Doctorate	Total
Fall 1965	168,797	5,894	1,591	176,282
Spr 1966	151,254	6,276	1,665	159,195
Sum I 1966	28,797	7,667	1,840	38,304
Sum II 1966	21,037	5,611	1,155	27,803
Fall 1966	174,527	7,005	2,212	183,744
Spr 1967	153,963	7,247	2,222	163,432
Sum I 1967	29,407	7,919	2,052	39,378
Sum II 1967	22,925	5,560	1,203	29,688
Fall 1967	178,029	8,151	3,102	189,282
Spr 1968	158,897	8,336	3,435	170,668
Sum I 1968	29,613	8,002	2,217	39,832
Sum II 1968	23,738	5,685	1,625	31,048
Fall 1968	179,550	8,008	4,345	191,903
Spr 1969	163,780	8,677	4,572	177,029
Sum I 1969	29,672	8,000	2,408	40,080
Sum II 1969	22,890	5,711	1,981	30,582
Fall 1969	178,778	9,859	4,993	193,630
Spr 1970	160,517	10,508	5,142	176,167
Sum I 1970	30,791	8,470	2,720	41,981
Sum II 1970	23,970	5,722	2,164	31,856
Fall 1970	173,282	11,056	6,070	190,408
Spr 1971	159,873	11,346	6,083	177,302
Sum I 1971	32,736	8,387	3,113	44,236
Sum II 1971	26,521	6,738	2,402	35,661
Fall 1971	175,649	13,103	6,330	195,082
Spr 1972	159,550	12,751	5,970	178,271
Sum I 1972	31,417	9,614	3,353	44,384
Sum II 1972	26,128	5,881	2,032	34,041
Fall 1972	174,155	14,159	6,170	194,484
Spr 1973	158,844	14,002	6,571	179,417
Sum I 1973	29,676	9,023	3,320	42,019
Sum II 1973	23,527	6,334	2,470	32,331
Fall 1973	167,549	14,867	6,630	189,046
Spr 1974	150,635	14,101	6,181	170,917
Sum I 1974	28,800	9,730	3,011	41,541
Sum II 1974	21,848	6,745	2,120	30,713
Fall 1974	165,187	15,669	6,516	187,372
Spr 1975	152,526	16,993	7,667	177,186
Sum I 1975	30,004	9,937	3,373	43,314
Sum II 1975	23,781	8,524	2,681	34,986

TABLE XIX--Continued

Fiscal Year	Undergraduate	Master	Doctorate	Total
Fall 1975	167,075	19,665	7,807	194,547
Spr 1976	151,119	18,413	7,900	177,432
Sum I 1976	27,091	10,595	3,467	41,153
Sum II 1976	21,578	6,919	2,292	30,789
Fall 1976	167,851	18,935	8,606	195,392
Spr 1977	152,377	17,905	8,381	178,663
Sum I 1977	25,743	9,919	4,164	39,826
Sum II 1977	20,427	6,886	2,746	30,059
Fall 1977	167,063	19,440	8,478	194,981
Spr 1978	152,961	17,216	8,858	179,035
Sum I 1978	25,155	9,624	4,388	39,167
Sum II 1978	19,657	6,406	2,610	28,673
Fall 1978	167,317	18,148	9,007	194,472
Spr 1979	152,566	16,955	8,898	178,419
Sum I 1979	23,563	9,462	4,104	37,129
Sum II 1979	18,742	5,937	2,754	27,433
Fall 1979	167,261	17,536	8,800	193,597
Spr 1980	151,451	16,882	8,522	176,855
Sum I 1980	23,488	8,940	4,124	36,552
Sum II 1980	18,820	5,644	2,895	27,359
Fall 1980	164,975	18,631	8,901	192,507
Spr 1981	151,194	17,508	8,581	177,283
Sum I 1981	25,672	8,884	4,261	38,817
Sum II 1981	19,395	5,487	2,779	27,661
Fall 1981	168,662	19,285	9,133	197,080
Spr 1982	157,380	19,032	9,024	185,436
Sum I 1982	26,045	8,996	3,763	38,804
Summ II 1982	19,345	5,303	2,822	27,470

TABLE XX

NORTH TEXAS STATE UNIVERSITY
TOTAL SEMESTER CREDIT HOUR
(SCH) BY PROGRAM AREAS

Fiscal Year	Education	Liberal Art	Business
Fall 1965	20,224	86,370	23,139
Spr 1966	20,223	74,008	22,884
Sum I 1966	11,138	15,624	4,334
Sum II 1966	8,143	11,740	3,235
Fall 1966	21,920	89,891	24,848
Spr 1967	19,360	78,151	23,309
Sum I 1967	9,993	16,985	4,959
Sum II 1967	7,430	12,929	4,088
Fall 1967	21,661	92,222	27,091
Spr 1968	22,464	79,385	25,732
Sum I 1968	10,347	16,348	5,610
Sum II 1968	10,347	16,348	5,610
Sum II 1968	8,024	13,167	4,339
Fall 1968	23,869	91,979	27,271
Spr 1969	24,062	80,337	26,533
Sum I 1969	10,634	16,842	5,418
Sum II 1969	8,023	12,955	4,335
Fall 1969	23,977	90,579	28,441
Spr 1970	23,972	78,199	27,369
Sum I 1970	11,111	20,612	5,850
Sum II 1970	8,353	13,468	4,617
Fall 1970	24,090	86,116	27,002
Spr 1971	24,285	78,328	26,277
Sum I 1971	11,494	18,958	6,036
Sum II 1971	8,912	15,088	5,281
Fall 1971	23,721	89,394	26,302
Spr 1972	23,501	80,646	23,167
Sum I 1972	12,373	18,223	5,580
Sum II 1972	8,364	14,073	4,629
Fall 1972	24,443	88,037	24,740
Spr 1973	24,554	78,317	23,052
Sum I 1973	12,086	16,444	5,337
Sum II 1973	8,349	12,420	4,273
Fall 1973	25,245	83,912	26,370
Spr 1974	24,404	74,021	21,924
Sum I 1974	11,774	15,865	5,309
Sum II 1974	8,714	11,300	4,171
Fall 1974	25,433	80,510	25,294
Spr 1975	26,475	73,263	25,815
Sum I 1975	12,040	16,157	6,240
Sum II 1975	9,843	13,021	4,696

TABLE XX--Continued

Fiscal Year	Education	Liberal Art	Business
Fall 1975	26,816	81,645	28,068
Spr 1976	26,592	71,357	26,634
Sum I 1976	11,566	14,636	6,013
Sum II 1976	8,099	11,072	4,589
Fall 1976	25,604	80,773	29,193
Spr 1977	24,823	72,645	28,040
Sum I 1977	11,322	13,564	6,051
Sum II 1977	8,013	10,511	4,720
Fall 1977	25,151	79,099	31,183
Spr 1978	23,646	71,896	29,685
Sum I 1978	10,874	13,275	6,854
Sum II 1978	7,447	9,773	4,992
Fall 1978	23,427	79,435	33,948
Spr 1979	22,460	71,749	32,442
Sum I 1979	9,561	12,820	6,689
Sum II 1979	6,879	9,540	4,950
Fall 1979	20,929	81,640	35,765
Spr 1980	19,836	72,905	34,459
Sum I 1980	8,368	12,666	7,726
Sum II 1980	6,348	9,677	5,084
Fall 1980	19,957	82,049	36,227
Spr 1981	16,322	73,668	35,262
Sum I 1981	8,157	14,287	8,330
Sum II 1981	6,072	9,924	5,674
Fall 1981	16,464	84,713	39,121
Spr 1982	16,317	77,845	39,199
Sum I 1982	7,506	13,926	9,026
Sum II 1982	5,539	9,676	5,886

TABLE XXI

TEXAS PUBLIC SENIOR COLLEGES AND UNIVERSITIES
TOTAL SEMESTER CREDIT HOUR (SCH)
BY PROGRAM AREAS

Fiscal Year	Education	Liberal Art	Business
Fall 1965	192,340	1,097,272	203,364
Spr 1966	199,221	995,069	193,509
Summer 1966	155,129	360,760	60,966
Fall 1966	186,677	1,174,170	225,892
Spr 1967	183,246	1,057,841	210,126
Summer 1967	157,378	398,663	64,679
Fall 1967	201,111	1,272,374	241,730
Spr 1968	204,779	1,159,688	235,519
Summer 1968	166,247	438,837	74,039
Fall 1968	222,715	1,371,014	268,584
Spr 1969	223,221	1,258,267	261,999
Summer 1969	175,784	460,030	88,123
Fall 1969	239,494	1,442,098	294,467
Spr 1970	237,642	1,302,947	281,271
Summer 1970	191,073	480,791	95,747
Fall 1970	265,594	1,488,237	307,375
Spr 1971	269,175	1,369,156	296,046
Summer 1971	222,099	520,998	112,631
Fall 1971	285,674	1,501,681	322,750
Spr 1972	284,970	1,357,451	299,614
Summer 1972	231,829	509,026	116,001
Fall 1972	301,998	1,475,960	327,263
Spr 1973	307,320	1,335,621	314,572
Summer 1973	249,929	482,700	121,978
Fall 1973	320,736	1,450,893	342,261
Spr 1974	316,788	1,306,388	331,211
Summer 1974	264,766	474,508	129,449
Fall 1974	332,053	1,499,208	375,593
Spr 1975	339,524	1,394,216	372,924
Summer 1975	267,958	510,301	149,214
Fall 1975	360,870	1,598,515	424,644
Spr 1976	362,104	1,479,965	412,645
Summer 1976	252,309	510,468	154,922
Fall 1976	350,427	1,622,192	438,951
Spr 1977	357,169	1,494,084	432,682
Summer 1977	241,576	498,467	160,892
Fall 1977	355,063	1,636,749	473,504
Spr 1978	347,755	1,478,947	466,869
Summer 1978	237,963	486,015	173,939

TABLE XXI--Continued

Fiscal Year	Education	Liberal Art	Business
Fall 1978	347,641	1,606,426	508,479
Spr 1979	338,664	1,444,354	501,152
Summer 1979	226,353	469,918	186,748
Fall 1979	329,107	1,614,565	539,137
Spr 1980	314,764	1,455,801	526,530
Summer 1980	220,175	478,490	200,258
Fall 1980	305,597	1,653,639	570,446
Spr 1981	295,383	1,491,311	558,234
Summer 1981	203,177	484,368	210,716
Fall 1981	283,550	1,656,486	592,644
Spr 1982	277,659	1,492,912	585,597

TABLE XXII

TEXAS PUBLIC SENIOR COLLEGES AND UNIVERSITIES
TOTAL SEMESTER CREDIT HOUR (SCH)
OVER ALL PROGRAM AREAS

Fiscal Year	Undergraduate	Master	Doctorate	Total
Fall 1965	2,101,307	93,229	20,054	2,214,590
Spr 1966	1,940,285	93,512	21,300	2,055,097
Summer 1966	623,670	124,504	15,580	764,754
Fall 1966	2,247,413	115,943	24,140	2,387,496
Spr 1967	2,063,359	110,477	25,746	2,199,582
Summer 1967	668,228	129,547	15,898	817,173
Fall 1967	2,411,108	127,525	32,047	2,570,680
Spr 1968	2,244,751	128,224	33,564	2,406,539
Summer 1968	728,944	139,665	22,787	891,396
Fall 1968	2,593,353	136,985	36,467	2,766,805
Spr 1969	2,417,591	135,486	37,556	2,590,633
Summer 1969	771,300	146,195	25,437	942,932
Fall 1969	2,742,042	156,230	39,540	2,937,812
Spr 1970	2,513,753	160,302	39,950	2,714,005
Summer 1970	817,421	163,180	26,666	1,007,267
Fall 1970	2,844,505	184,710	42,890	3,072,105
Spr 1971	2,652,216	186,728	44,636	2,883,580
Summer 1971	918,479	177,597	31,846	1,127,922
Fall 1971	2,924,557	207,172	46,433	3,178,162
Spr 1972	2,679,610	207,426	48,556	2,935,592
Summer 1972	907,587	193,076	33,069	1,133,732
Fall 1972	2,923,968	219,352	50,968	3,194,288
Spr 1973	2,699,404	225,048	52,194	2,976,646
Summer 1973	895,000	213,475	34,119	1,142,594
Fall 1973	2,937,398	256,789	52,088	3,246,275
Spr 1974	2,702,490	260,203	53,117	3,015,810
Summer 1974	889,403	250,030	33,962	1,173,395
Fall 1974	3,039,341	300,384	54,434	3,394,159
Spr 1975	3,039,341	300,384	54,434	3,241,936
Summer 1975	949,063	265,964	36,884	1,251,911
Fall 1975	3,253,549	349,129	58,439	3,661,117
Spr 1976	3,061,606	346,234	61,870	3,469,710
Summer 1976	949,916	263,574	37,170	1,250,650
Fall 1976	3,349,598	348,650	62,740	3,760,988
Spr 1977	3,138,059	349,595	64,661	3,552,315
Summer 1977	947,125	257,444	39,823	1,244,392
Fall 1977	3,409,117	354,759	64,187	3,828,063
Spr 1978	3,163,958	341,210	64,349	3,569,517
Summer 1978	937,820	255,959	41,612	1,235,391

TABLE XXII--Continued

Fiscal Year	Undergraduate	Master	Doctorate	Total
Fall 1978	3,416,588	362,509	67,402	3,846,499
Spr 1979	3,146,247	307,881	69,481	3,568,609
Summer 1979	925,711	252,856	42,393	1,220,960
Fall 1979	3,439,715	359,549	68,469	3,867,733
Spr 1980	3,173,234	341,460	68,853	3,583,547
Summer 1980	944,739	255,059	44,317	1,244,115
Fall 1980	3,512,198	368,977	72,660	3,953,835
Spr 1981	3,240,674	357,236	72,133	3,670,043
Summer 1981	952,552	241,226	44,780	1,238,558
Fall 1981	3,534,265	365,300	75,107	3,974,672
Spr 1982	3,264,124	353,706	76,586	3,694,416

TABLE XXIII

SCH AND HEADCOUNT DATA FOR PUBLIC SENIOR COLLEGES AND UNIVERSITIES IN TEXAS
COMPILED BY UNIVERSITY PLANNING AND ANALYSIS
NORTH TEXAS STATE UNIVERSITY, MARCH 1983

	Actual Data			Coordinating Board Headcount Projections			*Headcount Converted to SCH		
	Semester Credit Hours (SCH)	Head-count (HD)	SCH:HD Ratio	Made in 1978	Made in 1980	Made in 1982	From 1978 Pro-jection	From 1980 Pro-jection	From 1982 Pro-jection
Fall 1978	3,846,499	328,616	11.705148	332,770	--------	--------	3,895,122	----------	----------
Fall 1979	3,867,733	330,868	11.689655	345,823	--------	--------	4,042,552	----------	----------
Fall 1980	3,953,835	339,053	11.661407	351,047	335,394	--------	4,093,702	3,911,166	----------
Fall 1981	3,974,672	342,130	11.617432	354,530	337,853	--------	4,138,426	3,924,984	----------
Fall 1982	4,090,899	355,706	11.500713	357,837	339,479	--------	4,115,387	3,904,251	----------
Fall 1983				360,597	340,967	--------			----------
Fall 1984				363,366	342,112	--------			----------

TABLE XXIII--Continued

	Actual Data			Coordinating Board Headcount Projections			*Headcount Converted to SCH		
	Semester Credit Hours (SCH)	Head-count (HD)	SCH:HD Ratio	Made in 1978	Made in 1980	Made in 1982	From 1978 Pro-jection	From 1980 Pro-jection	From 1982 Pro-jection
Fall 1985	————	————	————	366,161	342,805	361,005	————	————	---------

*Multiply projected headcount by SCH:Headcount ratio to convert to projected semester credit hours.

Sources: Actual headcount and semester credit hours are from various Coordinating Board Reports, except that data for 1982 were received by telephone. Forecasts are from the three following documents from the Coordinating Board, Texas College and University System:

1. "Fall Headcount Forecast, Texas Senior Colelges and Universities, 1978-1987," March, 1978.
2. "Forecasts of Fall Headcount Enrollment, Texas Postsecondary Institutions, 1980-1990," July 1980.
3. "Fall Headcount Enrollment Forecasts to 1995, Texas Institutions of Higher Education, Study Paper 27," Revised July 1982. This report has projections for 1985, 1990, and 1995.

TABLE XXIV

PROJECTION OF UNDERGRADUATE SCH BASED ON COMBINED FALL & SPRING DATA
NTSU

Year	Actual SCH	Model						
		I	II	III	IV	V	VI	VII
65	320,051							
66	328,490							
67	336,926							
68	343,330							
69	339,295							
70	333,155							
71	335,199							
72	332,999							
73	318,184							
74	317,713							
75	318,194							
76	320,228	318,723						
77	320,024	316,803	316,365					
78	319,883	324,545	322,824	312,947				
79	318,712	338,200	332,657	310,328	327,375			
80	316,169	345,995	332,344	307,709	328,159	312,262		
81	326,042	351,650	328,678	305,090	320,207	306,175	307,498	
82	NA	364,307	331,809	302,471	314,643	301,947	301,911	316,373
83	NA	376,731	331,886	299,852	314,287	300,845	305,211	315,415
84	NA	378,776	321,323	297,233	309,792	302,321	312,165	314,457
R^2		.977	.984	.783	.977	.905	.967	.243
# of cycles		2	2	0	2	1	2	0
cycle 1 length		16.769	12.283	0.000	10.816	8.035	7.129	0.000
cycle 2 length		3.827	3.740	0.000	3.956	0.000	4.515	0.000

TABLE XXV

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTION UNDERGRADUATE SCH FROM ACTUAL SCH - COMBINED FALL & SPRING DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Movel V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	-1,505	-.47	-	-	-	-	-	-	-	-	-	-
77	-3,221	-1.01	-3,659	-1.14	-	-	-	-	-	-	-	-
78	4,662	1.46	2,941	.92	-6,936	-2.17	-	-	-	-	-	-
79	19,488	6.11	13,945	4.37	-8,384	-2.63	8,663	-2.72	-	-	-	-
80	29,826	9.43	16,175	5.12	-8,460	-2.67	11,990	3.79	-3,907	-1.24	-	-
81	25,608	7.85	2,636	.81	-20,952	-6.43	-5,835	-1.79	-19,867	-6.09	-18,544	-5.69
Total 'D'	74,858		32,038		-44,732		14,818		-23,774		-18,544	
Total 'SCH'	1,921,058		1,600,830		1,280,806		960,923		642,211		326,042	
%D		3.90		2.00		-3.49		1.54		-3.70		-5.69

TABLE XXVI

PROJECTION OF UNDERGRADUATE SCH BASED ON FALL DATA
NTSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
65	168,797							
66	174,527							
67	178,029							
68	179,550							
69	178,778							
70	173,282							
71	175,649							
72	174,155							
73	167,549							
74	165,187							
75	167,075							
76	167,851	169,667						
77	167,063	170,010	164,651					
78	167,317	171,823	165,304	163,413				
79	167,261	178,523	168,745	161,949	171,490			
80	164,975	186,148	166,815	160,485	169,854	164,614		
81	168,662	189,890	161,209	159,021	164,299	161,668	159,531	
82	NA	192,087	159,827	157,557	162,752	158,951	157,988	164,703
83	NA	196,894	160,320	156,093	162,917	157,277	161,469	164,082
84	NA	201,716	156,299	154,629	158,819	156,944	163,859	163,461
R^2		.963	.984	.811	.984	.864	.995	.369
# of cycles		2	2	0	2	1	2	0
cycle 1 length		16.666	3.793	0.000	10.007	8.767	7.022	0.000
cycle 2 length		4.179	10.05	0.000	3.756	0.000	4.089	0.000

TABLE XXVII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED UNDERGRADUATE SCH OVER ACTUAL SCH FALL DATA NTSU

Year	Model I D	Model I %D	Model II D	Model II %D	Model III D	Model III %D	Model IV D	Model IV %D	Model V D	Model V %D	Model VI D	Model VI %D
76	1,816	1.08	-	-	-	-	-	-	-	-	-	-
77	2,947	1.76	-2,412	-1.44	-	-	-	-	-	-	-	-
78	4,506	2.69	-2,013	-1.20	-3,904	-2.33	-	-	-	-	-	-
79	11,262	6.73	1,484	0.89	-5,312	-3.18	4,229	2.53	-	-	-	-
80	21,173	12.83	1,840	1.12	-4.490	-2.72	4,879	2.96	-361	-.22	-	-
81	21,228	12.59	-7,453	-4.42	-9,641	-5.72	-4,363	-2.59	-6,994	-4.15	-9,131	-5.41
Total 'D'	62,932		-8,554		-23,347		4,745		-7,355		-9,131	
Total 'SCH'	1,003,129		835,278		668,215		500,898		333,637		168,662	
%D		6.27		-1.02		-3.49		.95		2.20		-5.41

TABLE XXVIII

PROJECTION OF UNDERGRADUATE SCH BASED ON COMBINED SUM I & SUM II DATA
NTSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
66	49,834							
67	52,332							
68	53,351							
69	52,562							
70	54,761							
71	59,257							
72	57,545							
73	53,203							
74	50,648							
75	53,785							
76	48,669							
77	46,170	45,363						
78	44,812	46,945	49,469					
79	42,305	50,061	54,288	49,288				
80	42,308	49,940	53,818	50,723	43,201			
81	45,067	49,587	52,879	49,428	41,860	40,268		
82	45,390	52,899	56,142	51,609	40,519	38,593	39,411	
83	NA	55,882	57,197	56,798	39,178	36,918	37,740	46,460
84	NA	53,834	51,895	57,904	37,837	35,243	36,069	47,616
85	NA	50,313	47,723	54,334	36,496	33,568	34,398	48,233
R^2		.917	.975	.973	.701	.880	.878	.904
# of cycles		2	2	2	0	0	0	1
cycle 1 length		12.060	10.553	4.069	0.000	0.000	0.000	13.921
cycle 2 length		3.993	3.849	13.241	0.000	0.000	0.000	0.000

TABLE XXIX

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED UNDERGRADUATE SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	-807	-1.75	-	-	-	-	-	-	-	-	-	-
78	2,133	4.76	4,657	10.39	-	-	-	-	-	-	-	-
79	7,756	18.33	11,983	28.33	6,983	16.51	-	-	-	-	-	-
80	7,632	18.04	11,510	27.21	8,415	19.89	893	2.11	-	-	-	-
81	4,520	10.03	7,812	17.33	4,361	9.68	-3,207	-7.12	-4,799	-10.65	-	-
82	7,509	16.54	10,752	23.69	6,219	13.70	-4,871	-10.73	-6,797	-14.97	-5,979	-13.17
Total 'D'	28,743		46,714		25,978		-7,185		-11,596		-5,979	
Total 'SCH'	266,052		219,882		175,070		132,765		90,457		45,390	
%D		10.80		21.25		14.84		-5.41		-12.82		-13.17

TABLE XXX

PROJECTION OF UNDERGRADUATE SCH BASED ON SUM I DATA
NTSU

Year	Actual SCH	Model						
		I	II	III	IV	V	VI	VII
66	28,797							
67	29,407							
68	29,613							
69	29,672							
70	30,791							
71	32,736							
72	31,417							
73	29,676							
74	28,800							
75	30,004							
76	27,091							
77	25,743	25,198						
78	25,155	25,371	26,872					
79	23,563	26,937	28,564	26,033				
80	23,488	27,103	28,246	25,513	24,110			
81	25,672	26,509	28,355	24,993	23,361	22,506		
82	26,045	27,641	30,766	24,473	22,612	21,583	22,292	
83	NA	29,607	32,395	23,953	21,863	20,660	21,411	27,137
84	NA	29,408	31,154	23,433	21,114	19,737	20,530	28,047
85	NA	27,392	29,987	22,913	20,365	18,814	19,649	28,466
R^2		.937	.975	.549	.754	.907	.862	.914
# of cycles		2	2	0	0	0	0	1
cycle 1 length		12.261	12.828	0.000	0.000	0.000	0.000	12.739
cycle 2 length		4.104	3.900	0.000	0.000	0.000	0.000	0.000

TABLE XXXI

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED UNDERGRADUATE SCH OVER ACTUAL SCH SUM I DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	-545	2.12	-	-	-	-	-	-	-	-	-	-
78	216	.86	1,717	6.83	-	-	-	-	-	-	-	-
79	3,374	14.32	5,001	21.22	2,470	10.48	-	-	-	-	-	-
80	3,615	15.39	4,758	20.26	2,025	8.62	622	2.65	-	-	-	-
81	837	3.26	2,683	10.45	-679	-2.64	-2,311	-9.00	-3,166	-12.33	-	-
82	1,596	6.13	4,721	18.13	-1,572	-6.04	-3,433	-13.18	-4,462	-17.13	-3,753	-14.41
Total 'D'	9,093		18,880		2,244		-5,122		-7,628		-3,753	
Total 'SCH'	149,666		123,923		98,768		75,205		51,717		26,045	
%D		6.08		15.24		2.27		-6.81		-14.75		-14.41

TABLE XXXII

PROJECTION OF MASTER SCH BASED ON COMBINED FALL & SPRING DATA
NTSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
65	12,170							
66	14,252							
67	16,487							
68	16,685							
69	20,367							
70	22,402							
71	25,854							
72	28,161							
73	28,968							
74	32,662							
75	38,078							
76	36,840	43,585						
77	36,656	47,737	38,953					
78	35,103	49,682	42,450	45,514				
79	34,418	50,574	46,363	47,765	41,766			
80	36,139	52,173	48,058	42,940	43,852	30,028		
81	38,317	55,101	48,954	49,405	45,938	24,128	38,064	
82	NA	58,428	51,929	58,138	48,024	21,068	41,430	42,329
83	NA	60,932	56,064	53,092	50,110	19,621	44,886	44,985
84	NA	62,635	58,320	52,520	52,196	16,472	47,440	45,663
R^2		.997	.990	.999	.899	.993	.955	.966
# of cycles		2	1	2	0	2	1	1
cycle 1 length		5.816	4.234	3.659	0.000	16.222	9.177	7.796
cycle 2 length		11.483	0.000	3.295	0.000	4.013	0.000	0.000

TABLE XXXIII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED MASTER SCH FROM ACTUAL SCH - COMBINED FALL & SPRING DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	6,745	18.31	-	-	-	-	-	-	-	-	-	-
77	11,081	30.23	2,297	6.27	-	-	-	-	-	-	-	-
78	14,579	41.53	7,347	20.93	10.409	29.65	-	-	-	-	-	-
79	16,156	46.94	8,945	25.99	13,347	38.78	7,348	21.35	-	-	-	-
80	16,034	44.37	11,919	32.98	6,801	18.82	7,713	21.34	-6,111	-16.91	-	-
81	16,784	43.80	10,637	27.76	11,088	28.94	7,621	19.89	-14,189	-37.03	-253	-.66
Total 'D'	81,379		41,145		41,645		22,682		-20,300		-253	
Total 'SCH'	217,473		180,633		143,977		108,874		74,456		38,317	
%D		37.42		22.78		28.92		20.83		-27.26		-.66

TABLE XXXIV

PROJECTION OF MASTER SCH BASED ON FALL DATA
NTSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
65	5,894							
66	7,005							
67	8,151							
68	8,008							
69	9,859							
70	11,056							
71	13,103							
72	14,159							
73	14,867							
74	15,669							
75	19,665							
76	18,935	23,468						
77	19,440	26,918	20,504					
78	18,148	28,360	21,793	21,221				
79	17,536	27,832	23,082	23,574	21,750			
80	18,631	26,797	24,371	24,888	22,907	16,517		
81	19,285	27,015	25,660	25,139	24,064	15,423	19,160	
82	NA	29,215	26,949	26,224	25,221	14,592	20,714	22,739
83	NA	32,652	28,238	28,534	26,378	14,216	22,546	23,087
84	NA	35,880	29,527	30,243	27,535	14,408	24,168	23,381
R^2		.994	.967	.984	.909	.950	.927	.989
# of cycles		2	0	1	0	1	1	2
cycle 1 length		6.360	0.000	4.260	0.000	14.990	9.519	7.320
cycle 2 length		10.247	0.000	0.000	0.000	0.000	0.000	2.440

TABLE XXXV

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED MASTER SCH OVER ACTUAL SCH - FALL DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	4,533	23.94	-	-	-	-	-	-	-	-	-	-
77	7,478	38.47	1,064	5.47	-	-	-	-	-	-	-	-
78	10,212	56.27	3,645	20.08	3,070	16.93	-	-	-	-	-	-
79	10,296	58.71	5,546	31.63	6,038	34.43	4,214	24.03	-	-	-	-
80	8,166	43.83	5,740	30.81	6,257	33.58	4,276	22.95	-2,114	-11.35	-	-
81	7,730	40.08	6,375	33.06	5,854	30.36	4,779	24.78	-3,862	-20.03	-125	-.65
Total 'D'	48,415		22,370		21,222		13,269		-5,976		-125	
Total 'SCH'	111,975		93,040		73,600		55,452		37,916		19,285	
%D		43.24		24.04		28.83		23.93		15.76		-.65

TABEL XXXVI

PROJECTION OF MASTER SCH BASED ON COMBINED SUM I & SUM II DATA
NTSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
66	13,278							
67	13,479							
68	13,687							
69	13,711							
70	14,192							
71	15,125							
72	15,495							
73	15,357							
74	16,475							
75	18,461							
76	17,514							
77	16,805	18,116						
78	16,030	18,608	18,689					
79	15,699	19,100	19,773	17,987				
80	14,584	19,592	19,298	18,366	13,515			
81	14,371	20,084	19,394	18,745	10,683	13,774		
82	14,299	20,576	20,957	19,124	9,236	14,979	16,065	
83	NA	21,068	21,716	19,503	8,582	16,437	17,241	15,858
84	NA	21,560	21,135	19,882	7,024	16,607	17,104	16,838
85	NA	22,052	21,574	20,261	5,414	16,814	17,291	15,939
R^2		.889	.954	.670	.982	.978	.980	.968
# of cycles		0	1	0	2	2	2	2
cycle 1 length		0.000	3.806	0.000	15.836	9.973	9.028	7.731
cycle 2 length		0.000	0.000	0.000	4.035	3.823	3.701	4.675

TABLE XXXVII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED MASTER SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	1,311	7.80	-	-	-	-	-	-	-	-	-	-
78	2,578	16.08	2,659	16.59	-	-	-	-	-	-	-	-
79	3,401	21.66	4,074	25.95	2,288	14.57	-	-	-	-	-	-
80	5,008	34.34	4,714	32.32	3,782	25.93	-1,069	-7.33	-	-	-	-
81	5,713	39.75	5,023	34.95	4,374	30.44	3,688	-25.66	-597	-4.15	-	-
82	6,277	43.90	6,658	46.56	4,825	33.74	-5,063	-35.41	680	4.76	1,766	12.35
Total 'D'	24,288		23,128		15,269		-9,820		83		1,766	
Total 'SCH'	91,788		74,983		58,953		43,254		28,670		14,299	
%D		26.46		30.84		25.90		-22.70		.29		12.35

TABLE XXXVIII

PROJECTION OF MASTER SCH BASED ON SUM I DATA
NTSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
66	7,667							
67	7,919							
68	8,002							
69	8,000							
70	8,470							
71	8,387							
72	9,614							
73	9,023							
74	9,730							
75	9,937							
76	10,595							
77	9,919	10,538						
78	9,624	10,820	11,083					
79	9,462	11,102	10,357	10,597				
80	8,940	11,384	11,549	10,828	10,396			
81	8,884	11,666	10,962	11,059	10,572	8,568		
82	8,996	11,948	12,015	11,290	10,748	8,328	8,829	
83	NA	12,230	11,567	11,521	10,924	8,273	9,027	9,456
84	NA	12,512	12,895	11,752	11,100	8,413	9,387	9,704
85	NA	12,794	12,172	11,983	11,276	8,715	9,819	9,641
R^2		.907	.940	.830	.556	.806	.770	.847
# of cycles		0	1	0	0	1	1	1
cycle 1 length		0.000	2.000	0.000	0.000	13.396	11.962	8.013
cycle 2 length		0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE XXXIX

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED MASTER SCH OVER ACTUAL SCH SUM I DATA NTSU

Year	Model I D	Model I %D	Model II D	Model II %D	Model III D	Model III %D	Model IV D	Model IV %D	Movel V D	Movel V %D	Model VI D	Model VI %D
77	619	6.24	-	-	-	-	-	-	-	-	-	-
78	1,196	12.43	1,459	15.16	-	-	-	-	-	-	-	-
79	1,640	17.33	895	9.46	1,135	12.00	-	-	-	-	-	-
80	2,444	27.34	2,609	29.18	1,888	21.12	1,456	16.29	-	-	-	-
81	2,782	31.31	2,078	23.39	2,175	24.48	1,688	19.00	-316	-3.56	-	-
82	2,952	32.81	3,019	33.56	2,294	25.50	1,752	19.48	-668	-7.43	-167	-1.86
Total 'D'	11,633		10,060		7,492		4,896		-984		-167	
Total 'SCH'	55,825		45,906		36,282		26,820		17,880		8,996	
%D		20.84		21.91		20.65		18.26		-5.50		-1.86

TABLE XL

PROJECTION OF DOCTORATE SCH BASED ON COMBINED FALL & SPRING DATA
NTSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
65	3,256							
66	4,434							
67	6,537							
68	8,917							
69	10,135							
70	12,153							
71	12,300							
72	12,741							
73	12,811							
74	14,183							
75	15,707							
76	16,987	17,901						
77	17,336	19,987	19,442					
78	17,905	21,536	21,488	17,571				
79	17,322	22,364	23,091	18,091	18,047			
80	17,482	22,671	24,110	19,540	19,525	19,002		
81	18,157	22,934	24,638	21,349	20,982	20,700	18,039	
82	NA	23,652	24,973	22,575	22,285	22,000	19,111	
83	NA	25,084	25,489	22,881	22,537	22,416	20,500	20,838
84	NA	27,108	26,488	22,883	22,758	22,387	21,790	22,035
R^2		.997	.995	.988	.999	.989	.993	.994
# of cycles		1	1	1	2	1	1	1
cycle 1 length		8.419	9.664	5.877	5.794	5.855	8.272	7.884
cycle 2 length		0.000	0.000	0.000	2.037	0.000	0.000	0.000

TABLE XLI

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED DOCTORATE SCH FROM ACTUAL SCH COMBINED FALL & SPRING DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	914	5.38	-	-	-	-	-	-	-	-	-	-
77	2,651	15.29	2,106	12.15	-	-	-	-	-	-	-	-
78	3,631	20.28	3,583	20.01	-334	1.87	-	-	-	-	-	-
79	5,042	29.11	5,769	33.30	769	4.44	725	4.18	-	-	-	-
80	5,189	29.68	6,628	37.71	2,058	11.77	2,043	11.69	1,520	8.69	-	-
81	4,777	26.31	6,481	35.69	3,192	17.58	2,825	15.56	2,543	14.01	-118	-.65
Total 'D'	22,204		24,567		5,685		5,593		4,063		-118	
Total 'SCH'	105,189		88,202		70,866		52,961		35,639		18,157	
%D		21.11		27.85		8.02		10.56		11.40		-.65

TABLE XLII

PROJECTION OF DOCTORATE SCH BASED ON FALL DATA
NTSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
65	1,591							
66	2,212							
67	3,102							
68	4,345							
69	4,993							
70	6,070							
71	6,330							
72	6,170							
73	6,630							
74	6,516							
75	7,807							
76	8,606	8,756						
77	8,478	9,850	9,538					
78	9,007	10,658	10,649	8,648				
79	8,800	11,058	10,524	8,758	9,443			
80	8,901	11,153	10,916	9,442	9,881	9,389		
81	9,133	11,212	10,918	10,444	10,319	10,278	9,585	
82	NA	11,524	11,084	11,181	10,757	11,021	10,390	9,836
83	NA	12,239	12,287	11,340	11,195	11,280	11,068	10,605
84	NA	13,287	12,909	11,208	11,633	11,225	11,377	11,196
R^2		.993	.999	.975	.936	.977	.972	.971
# of cycles		1	2	1	0	1	1	1
cycle 1 length		8.285	8.009	5.896	0.000	5.853	6.749	7.463
cycle 2 length		0.000	2.536	0.000	0.000	0.000	0.000	0.000

TABLE XLIII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED DOCTORATE SCH OVER ACTUAL SCH FALL DATA NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	150	1.74	-	-	-	-	-	-	-	-	-	-
77	1,372	16.18	1,060	12.50	-	-	-	-	-	-	-	-
78	1,651	18.33	1,642	18.23	-359	-3.99	-	-	-	-	-	-
79	2,258	25.66	1,724	19.59	-42	-.48	643	7.31	-	-	-	-
80	2,252	25.30	2,015	22.64	541	6.08	980	11.01	488	5.48	-	-
81	2,079	22.76	1,785	19.54	1,311	14.35	1,186	12.99	1,145	12.54	452	.05
Total 'D'	9,762		8,226		1,451		2,809		1,633		452	
Total 'SCH	32,925		44,319		35,841		26,834		18,034		9,133	
%D		18.44		18.56		4.05		10.47		9.06		0.05

TABLE XLIV

PROJECTION OF DOCTORATE SCH BASED ON COMBINED SUM I & SUM II DATA
NTSU

Year	Actual SCH	Model						
		I	II	III	IV	V	VI	VII
66	2,995							
67	3,255							
68	3,842							
69	4,389							
70	4,884							
71	5,515							
72	5,385							
73	5,790							
74	5,131							
75	6,054							
76	5,759							
77	6,910	7,141						
78	6,998	6,893	6,982					
79	6,858	8,344	7,832	7,885				
80	7,019	7,607	7,670	7,784	6,807			
81	7,040	8,733	7,809	7,930	6,940	7,324		
82	6,585	7,606	7,788	7,921	7,401	7,540	7,426	
83	NA	8,819	7,798	7,853	7,963	7,756	7,626	6,577
84	NA	7,926	8,526	8,554	8,306	7,972	7,826	6,662
85	NA	9,626	8,678	8,653	8,313	8,188	8,026	6,941
R^2		.997	.998	.998	.918	.813	.782	.858
# of cycles		2	2	2	1	0	0	1
cycle 1 length		8.574	7.935	8.144	6.214	0.000	0.000	9.917
cycle 2 length		1.946	1.853	2.177	0.000	0.000	0.000	0.000

TABLE XLV

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED DOCTORATE SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	231	3.34	-	-	-	-	-	-	-	-	-	-
78	-105	-1.50	-16	-.23	-	-	-	-	-	-	-	-
79	1,486	21.67	974	14.20	1,027	14.96	-	-	-	-	-	-
80	588	8.38	651	9.27	765	10.90	-212	-3.02	-	-	-	-
81	1,693	24.05	769	10.92	890	12.64	-100	-1.42	284		-	-
82	1,021	15.50	1,203	18.27	1,336	20.29	816	12.39	955		841	12.77
Total 'D'	4,914		3,581		4,018		504		1,239		841	
Total 'SCH'	41,410		34,500		27,502		20,644		13,625		6,585	
%D		11.87		10.38		14.61		2.44		9.09		12.77

TABLE XLVI

PROJECTION OF DOCTORATE SCH BASED ON SUM I DATA
NTSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
66	1,840							
67	2,052							
68	2,217							
69	2,408							
70	2,720							
71	3,113							
72	3,353							
73	3,320							
74	3,011							
75	3,373							
76	3,467							
77	4,164	3,621						
78	4,388	3,901	4,121					
79	4,104	4,370	4,513	4,300				
80	4,124	4,633	4,026	4,156	4,019			
81	4,261	4,523	4,413	4,183	4,136	4,180		
82	3,763	4,409	4,214	4,504	4,550	4,598	4,718	
83	NA	4,550	5,051	4,965	4,991	5,059	5,161	3,891
84	NA	4,737	4,991	5,278	5,162	5,260	5,278	4,118
85	NA	4,844	5,585	5,298	5,041	5,158	5,120	4,474
R^2		.991	.994	.980	.974	.969	.966	.890
# of cycles		2	2	1	1	1	1	1
cycle 1 length		8.177	6.498	6.195	5.937	5.981	5.791	8.624
cycle 2 length		4,012	2.076	0.000	0.000	0.000	0.000	0.000

TABLE XLVII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED DOCTORATE SCH OVER ACTUAL SCH SUM I DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	-543	-13.04	-	-	-	-	-	-	-	-	-	-
78	-487	-11.10	-267	-6.08	-	-	-	-	-	-	-	-
79	266	6.48	409	9.97	196	4.78	-	-	-	-	-	-
80	509	12.34	-98	-2.38	32	.78	-105	-2.55	-	-	-	-
81	262	6.15	152	3.57	-78	-1.83	-125	-2.93	-81	-1.90	-	-
82	646	17.17	451	11.91	741	19.69	787	20.91	835	22.19	955	25.38
Total 'D'	653		647		891		557		754		955	
Total 'SCH'	24,804		20,640		16,252		12,148		8,024		3,763	
%D		2.63		3.13		5.48		4.59		9.40		25.38

TABLE XLVIII

PROJECTION OF TOTAL SCH BASED ON COMBINED FALL & SPRING DATA
NTSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
65	335,477							
66	347,176							
67	359,950							
68	368,932							
69	369,797							
70	367,797							
71	373,353							
72	373,901							
73	359,963							
74	364,558							
75	371,979							
76	374,055	374,465						
77	374,016	377,030	374,985					
78	372,891	391,135	387,089	373,164				
79	370,452	408,782	395,138	373,870	372,478			
80	369,790	417,353	389,325	374,576	372,874	368,523		
81	382,516	425,514	386,043	375,282	373,270	372,453	377,652	
82	NA	440,981	390,658	375,988	373,666	377,327	384,064	382,834
83	NA	451,455	387,836	376,694	374,062	378,880	377,314	378,573
84	NA	449,896	380,682	377,400	374,458	376,097	370,955	373,667
R^2		.981	.978	.190	.083	.570	.912	.772
# of cycles		2	2	0	0	1	2	1
cycle 1 length		15.054	9.751	0.000	0.000	6.071	5.463	5.367
cycle 2 length		3.770	3.639	0.000	0.000	0.000	1.402	0.000

TABLE XLIX

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED TOTAL SCH FROM ACTUAL SCH - COMBINED FALL & SPRING DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	410	.11	-	-	-	-	-	-	-	-	-	-
77	3,014	.81	969	.26	-	-	-	-	-	-	-	-
78	18,244	4.89	14,198	3.81	273	.07	-	-	-	-	-	-
79	38,330	10.35	24,686	6.66	3,418	.92	2,026	.55	-	-	-	-
80	47,563	12.86	19,535	5.28	4,786	1.29	3,084	.83	-1,267	-.34	-	-
81	42,998	11.24	3,527	.92	-7.234	-1.89	-9,246	-2.42	-10,063	2.63	-4,864	-1.27
Total 'D'	150,559		62,915		1,243		-4,136		-11,330		-4,864	
Total 'SCH	2,243,720		1,869,665		1,495,649		1,122,758		752,306		382,516	
%D		6.71		3.36		0.08		-0.37		-1.51		-1.27

TABLE L

PROJECTION OF TOTAL SCH BASED ON FALL DATA
NTSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
65	176,282							
66	183,744							
67	189,282							
68	191,903							
69	193,630							
70	190,408							
71	195,082							
72	194,484							
73	189,046							
74	187,372							
75	194,547							
76	195,392	196,606						
77	194,981	201,912	193,678					
78	194,472	207,741	195,984	194,182				
79	193,597	213,128	199,413	194,483	194,206			
80	192,507	217,224	195,682	194,784	194,433	194,261		
81	197,080	219,515	190,683	195,085	194,660	195,471	193,107	
82	NA	219,955	193,431	195,386	194,887	194,681	198,619	201,809
83	NA	218,982	197,940	195,687	195,114	194,891	200,749	197,956
84	NA	217,398	196,898	195,988	195,341	195,101	195,869	192,716
R^2		.856	.946	.119	.748	.643	.958	.976
# of cycles		1	2	0	0	0	2	2
cycle 1 length		12.190	3.757	0.000	0.000	0.000	3.726	5.207
cycle 2 length		0.000	7.902	0.000	0.000	0.000	.547	3.569

TABLE LI

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED TOTAL SCH OVER ACTUAL SCH FALL DATA NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	1,214	.62	-	-	-	-	-	-	-	-	-	-
77	6,931	3.55	-1,303	-.67	-	-	-	-	-	-	-	-
78	13,269	6.82	1,512	.78	-290	-.15	-	-	-	-	-	-
79	19,531	10.09	5,816	3.00	886	.46	609	.31	-	-	-	-
80	24,717	12.84	3,175	1.65	2,277	1.18	1,926	1.00	1,754	.91	-	-
81	22,435	11.38	-6,397	-3.25	-1,995	-1.01	-2,420	-1.23	-2,609	-1.32	-3,973	-2.02
Total 'D'	88,097		2,803		878		115		-855		-3,973	
Total 'SCH'	1,168,029		972,637		777,656		583,184		389,587		197,080	
%D		7.54		.29		.11		0.02		-.22		-2.02

TABLE LII

PROJECTION OF TOTAL SCH BASED ON COMBINED SUM I & SUM II DATA
NTSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
66	66,107							
67	69,066							
68	70,880							
69	70,662							
70	73,837							
71	79,897							
72	78,425							
73	74,350							
74	72,254							
75	78,300							
76	71,942							
77	69,885	68,666						
78	67,840	71,949	74,614					
79	64,562	77,723	80,800	73,472				
80	63,911	78,070	80,483	76,269	64,008			
81	66,478	77,193	80,602	74,221	62,627	67,807		
82	66,274	81,465	86,619	74,081	61,246	66,957	62,258	
83	NA	85,133	89,689	78,531	59,865	66,107	60,697	62,266
84	NA	81,436	84,815	80,555	58,484	65,257	59,136	60,913
85	NA	76,533	81,540	75,929	57,103	64,407	57,575	59,560
R^2		.932	.935	.907	.714	.358	.837	.764
# of cycles		2	2	2	0	0	0	0
cycle 1 length		10.846	11.324	4.235	0.000	0.000	0.000	0.000
cycle 2 length		3.932	3,842	11.066	0.000	0.000	0.000	0.000

TABLE LIII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED TOTAL SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	-1,219	-1.74	-	-	-	-	-	-	-	-	-	-
78	4,109	6.06	6,774	9.99	-	-	-	-	-	-	-	-
79	13,161	20.38	16,238	25.15	8,910	13.80	-	-	-	-	-	-
80	14,159	22.15	16,572	25.93	12,358	19.34	97	.12	-	-	-	-
81	10,715	16.12	14,124	21.25	7,743	11.65	-3,851	-5.79	1,329	2.00	-	-
82	15,191	22.92	20,345	30.70	7,807	11.78	-5,028	-7.59	683	1.03	-4,016	-6.06
Total 'D'	56,116		74,053		36,818		-8,782		2,012		-4,016	
Total 'SCH'	398,950		329,065		261,225		196,663		132,752		66,274	
%D		14.07		22.50		14.09		-4.47		1.52		-6.06

TABLE LIV

ROJECTION OF TOTAL SCH BASED ON SUM I DATA
NTSU

Year	Actual SCH	Model						
		I	II	III	IV	V	VI	VII
66	38,304							
67	39,378							
68	39,832							
69	40,080							
70	41,981							
71	44,236							
72	44,384							
73	42,019							
74	41,541							
75	43,314							
76	41,153							
77	39,826	39,342						
78	39,167	39,815	41,247					
79	37,129	42,377	44,168	41,612				
80	36,552	43,610	44,846	43,131	38,922			
81	38,817	43,280	44,671	42,750	38,518	35,470		
82	38,804	44,266	46,652	43,182	38,114	34,788	36,308	
83	NA	46,538	48,717	45,523	37,710	34,393	35,569	36,422
84	NA	46,776	47,540	46,811	37,306	34,271	34,830	35,785
85	NA	44,481	45,235	45,175	36,902	34,373	34,091	35,148
R^2		.968	.974	.963	.367	.885	.833	.731
# of cycles		2	2	2	0	1	0	0
cycle 1 length		11.345	11.282	4.226	0.000	16.729	0.000	0.000
cycle 2 length		4.137	3.964	11.907	0.000	0.000	0.000	0.000

TABLE LV

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED TOTAL SCH
OVER ACTUAL SCH SUM I DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	-484	-1.22	-	-	-	-	-	-	-	-	-	-
78	648	1.65	2,080	5.31	-	-	-	-	-	-	-	-
79	5,248	14.13	7,039	18.96	4,483	12.07	-	-	-	-	-	-
80	7,058	19.31	8,294	22.96	6,579	18.00	2,370	6.48	-	-	-	-
81	4,463	11.50	5,854	15.08	3,933	10.13	-299	-.77	-3,347	-8.62	-	-
82	5,462	14.08	7,848	20.22	4,378	11.28	-690	-1.78	-4,016	-10.35	-2,496	-6.43
Total 'D'	22,395		31,115		19,373		1,381		-7,363		-2,496	
Total 'SCH'	230,295		190,469		151,302		114,173		77,621		38,804	
%D		9.72		16.34		12.80		1.21		-9.49		-6.43

TABLE LVI

PROJECTION OF EDUCATION SCH BASED ON COMBINED FALL & SPRING DATA
NTSU

Year	Actual SCH	Model						
		I	II	III	IV	V	VI	VII
65	40,447							
66	41,280							
67	44,125							
68	47,931							
69	47,949							
70	51,375							
71	47,222							
72	48,997							
73	49,649							
74	51,908							
75	53,408							
76	50,427	56,619						
77	48,797	57,753	50,914					
78	45,887	57,588	52,705	52,159				
79	40,765	56,978	55,750	52,643	48,495			
80	36,279	57,079	57,234	53,127	48,444	35,129		
81	32,781	58,566	56,243	53,611	48,393	28,795	33,936	
82	NA	61,194	54,874	54,095	48,342	22,361	33,265	28,379
83	NA	63,952	55,687	54,579	48,291	16,328	34,197	25,788
84	NA	65,746	58,583	55,063	48,240	11,146	35,872	26,211
R^2		.943	.861	.399	.006	.857	.975	.999
# of cycles		1	1	0	0	1	1	2
cycle 1 length		7.464	5.376	0.000	0.000	17.210	10.328	14.784
cycle 2 length		0.000	0.000	0.000	0.000	0.000	0.000	3.165

TABLE LVII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED EDUCATION SCH
FROM ACTUAL SCH - COMBINED FALL & SPRING DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	6,192	12.28	-	-	-	-	-	-	-	-	-	-
77	8,956	18.35	2,117	4.34	-	-	-	-	-	-	-	-
78	11,701	25.50	6,818	14.86	6,272	13.67	-	-	-	-	-	-
79	16,213	39.77	14,985	36.76	11,878	29.14	7,730	18.96	-	-	-	-
80	20,800	57.33	20,955	57.76	16,848	46.44	12,165	33.53	-1,150	-3.17	-	-
81	25,785	78.66	23,462	71.57	20,830	63.54	15,612	47.62	-3,986	-12.16	1,155	3.52
Total 'D'	89,647		68,337		55,828		35,507		-5,136		1,155	
Total 'SCH'	254,936		204,509		155,712		109,825		69,060		32,781	
%D		35.16		33.41		35.85		32.33		- 7.44		3.52

TABLE LVIII

PROJECTION OF EDUCATION SCH BASED ON FALL DATA
NTSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
65	20,224							
66	21,920							
67	21,661							
68	23,869							
69	23,977							
70	24,090							
71	23,721							
72	24,443							
73	25,245							
74	25,433							
75	26,816							
76	25,604	26,892						
77	25,151	28,007	26,636					
78	23,427	26,946	26,389	26,332				
79	20,929	28,283	28,302	27,564	22,183			
80	19,957	27,562	28,276	28,262	21,605	17,686		
81	16,464	29,811	28,726	28,033	21,941	13,773	18,856	
82	NA	29,384	28,327	27,581	22,965	9,368	18,714	14,808
83	NA	31,395	28,581	27,877	24,162	4,687	19,252	13,150
84	NA	30,285	29,898	29,003	25,016	*	20,140	12,093
R^2		.985	.983	.891	.925	.961	.975	.981
# of cycles		2	2	1	2	1	1	1
cycle 1 length		7.049	5.514	5.456	13.032	20.994	10.820	15.058
cycle 2 length		2.105	1,828	0.000	7.809	0.000	0.000	0.000

TABLE LIX

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED EDUCATION SCH
OVER ACTUAL SCH FALL DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	1,288	5.03	-	-	-	-	-	-	-	-	-	-
77	2,856	11.36	1,485	5.90	-	-	-	-	-	-	-	-
78	3,519	15.02	2,962	12.64	2,905	12.40	-	-	-	-	-	-
79	7,354	35.14	7,373	35.23	6,635	31.70	1,254	5.92	-	-	-	-
80	7,605	38.11	8,319	41.68	8,305	41.61	1,648	8.26	-2,271	-11.38	-	-
81	13,347	81.07	12,262	74.48	11,569	70.27	5,477	33.27	-2,691	-16.34	2,392	14.53
Total 'D'	35,969		32,401		29,414		8,379		-4,962		2,392	
Total 'SCH'	131,532		105,928		80,777		57,350		36,421		16,464	
%D		27.35		30.59		36.41		14.61		-13.62		14.53

TABLE LX

PROJECTION OF EDUCATION SCH BASED ON COMBINED SUM I & SUM II DATA
NTSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
66	19,281							
67	17,423							
68	18,371							
69	18,657							
70	19,464							
71	20,406							
72	20,737							
73	20,435							
74	20,488							
75	21,883							
76	19,665							
77	19,335	19,197						
78	18,321	18,312	18,647					
79	16,440	17,592	17,891	18,858				
80	14,716	17,181	17,265	18,806	15,452			
81	14,229	17,153	16,855	18,754	14,372	13,248		
82	13,045	17,493	16,713	18,702	13,602	11,935	13,691	
83	NA	18,107	16,855	18,650	13,206	10,990	13,751	13,048
84	NA	18,833	17,257	18,598	13,192	10,468	14,033	13,177
85	NA	19,488	17,856	18,546	13,504	10,353	14,225	13,322
R^2		.776	.85	.245	.883	.946	.968	.976
# of cycles		1	1	0	1	1	1	1
cycle 1 length		13.053	16.527	0.000	15.560	15.176	10.605	10.726
cycle 2 length		0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE LXI

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED EDUCATION SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	-138	-.71	-	-	-	-	-	-	-	-	-	-
78	-9	-.05	326	1.78	-	-	-	-	-	-	-	-
79	1,152	7.01	1,451	8.83	2,418	14.71	-	-	-	-	-	-
80	2,465	16.75	2,549	17.32	4,090	27.79	736	5.00	-	-	-	-
81	2,924	20.55	2,626	18.46	4,525	31.80	143	1.01	-981	-6.89	-	-
82	4,448	34.10	3,668	28.12	5,657	43.37	557	4.27	-1,110	-8.51	646	4.95
Total 'D'	10,842		10,620		16,690		1,436		-2,091		646	
Total 'SCH'	96,086		76,751		58,430		41,990		27,274		13,045	
%D		11.28		13.84		28.56		3.42		-7.67		4.95

TABLE LXII

PROJECTION OF EDUCATION SCH BASED ON SUM I DATA
NTSU

Year	Actual SCH	Model						
		I	II	III	IV	V	VI	VII
66	11,138							
67	9,993							
68	10,347							
69	10,634							
70	11,111							
71	11,494							
72	12,373							
73	12,086							
74	11,774							
75	12,040							
76	11,566							
77	11,322	11,823						
78	10,874	12,360	11,331					
79	9,561	12,984	11,531	10,807				
80	8,368	13,420	11,929	10,870	8,040			
81	8,157	13,506	12,435	11,128	6,578	7,359		
82	7,506	13,285	12,930	11,536	5,629	6,191	7,153	
83	NA	12,980	13,294	12,013	5,318	5,079	6,524	7,500
84	NA	12,866	13,451	12,464	5,426	4,090	6,083	7,511
85	NA	13,103	13,388	12,799	5,595	3,276	5,845	7,349
R^2		.887	.946	.917	.960	.953	.964	.990
# of cycles		1	1	1	2	1	1	1
cycle 1 length		7.975	11.074	12.924	15.130	20.068	16.769	8.763
cycle 2 length		0.000	0.000	0.000	6.654	0.000	0.000	0.000

TABLE LXIII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED EDUCATION SCH OVER ACTUAL SCH SUM I DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	501	4.43	-	-	-	-	-	-	-	-	-	-
78	1,486	13.67	457	4.20	-	-	-	-	-	-	-	-
79	3,423	35.80	1,970	20.60	1,246	13.03	-	-	-	-	-	-
80	5,052	60.37	3,561	42.55	2,502	29.90	-328	-3.92	-	-	-	-
81	5,349	65.58	4,278	52.45	2,971	36.42	-1,579	-19.36	-798	-9.78	-	-
82	5,779	76.99	5,424	72.26	4,030	53.69	-1,877	25.01	-1,315	-17.52	-353	-4.70
Total 'D'	21,590		15,690		10,749		-3,784		-2,113		-353	
Total 'SCH'	55,788		44,466		33,592		24,031		15,663		7,506	
%D		38.70		35.29		32.00		-15.75		-13.49		-4.70

TABLE LXIV

PROJECTION OF LIBERAL ART SCH BASED ON COMBINED FALL & SPRING DATA
NTSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
65	160,378							
66	168,042							
67	171,607							
68	172,316							
69	168,778							
70	164,443							
71	170,040							
72	166,354							
73	157,933							
74	153,773							
75	153,002							
76	153,418	156,299						
77	150,995	154,975	151,447					
78	151,184	153,651	149,420	147,914				
79	154,545	152,327	147,393	145,556	142,704			
80	155,717	151,003	145,366	143,198	138,114	152,264		
81	162,558	149,679	143,339	140,840	137,538	148,999	149,098	
82	NA	148,355	141,312	138,482	138,577	144,500	138,353	165,955
83	NA	147,031	139,285	136,124	136,971	140,140	134,141	170,658
84	NA	145,707	137,258	133,766	131,508	137,230	140,946	175,215
R^2		.399	.778	.881	.957	.916	.999	.952
# of cycles		0	0	0	1	1	2	1
cycle 1 length		0.000	0.000	0.000	5.545	8.832	6.863	25.757
cycle 2 length		0.000	0.000	0.000	0.000	0.000	4.939	0.000

TABLE LXV

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED LIBERAL ART SCH FROM ACTUAL SCH COMBINED FALL & SPRING DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	2,881	1.88	-	-	-	-	-	-	-	-	-	-
77	3,980	2.63	452	.30	-	-	-	-	-	-	-	-
78	2,467	1.63	-1,764	1.17	-3,270	-2.16	-	-	-	-	-	-
79	-2,218	-1.44	-7,152	-4.63	-8,989	-5.82	-11,841	-7.66	-	-	-	-
80	-4,714	-3.03	-10,351	-6.65	-12,519	-8.04	-17,603	-11.30	-3,453	-2.22	-	-
81	-12,879	-7.92	-19,219	-11.82	-21,718	-13.36	-25,020	-15.39	-13,559	-8.34	-13,460	-8.28
Total 'D'	-10,483		-38,034		-46,496		-54,464		-17,012		-13,460	
Total 'SCH'	928,417		774,999		624,004		472,820		318,275		162,558	
%D		-1.13		-4.91		-7.45		-11.52		-5.35		-8.28

TABLE LXVI

PROJECTION OF LIBERAL ART SCH BASED ON FALL DATA
NTSU

Year	Actual SCH	Model						
		I	II	III	IV	V	VI	VII
65	86,370							
66	89,891							
67	92,222							
68	91,979							
69	90,579							
70	86,115							
71	89,394							
72	88,037							
73	83,912							
74	80,510							
75	81,645							
76	80,773	84,326						
77	79,099	84,523	76,405					
78	79,435	82,825	74,602	75,696				
79	81,640	83,564	76,842	76,314	76,619			
80	82,049	87,038	76,750	76,277	75,276	77,240		
81	84,713	88,514	73,038	72,823	73,933	76,157	77,551	
82	NA	85,680	71,848	70,160	72,590	75,074	73,037	86,445
83	NA	82,295	73,746	70,823	71,247	73,991	72,961	88,396
84	NA	82,046	72,342	70,718	69,904	72,908	75,049	90,107
R^2		.964	.981	.961	.882	.754	.996	.932
# of cycles		2	2	1	0	0	2	1
cycle 1 length		4.496	3.916	3.979	0.000	0.000	7.562	22.334
cycle 2 length		12.803	12.104	0.000	0.000	0.000	4.284	0.000

TABLE LXVII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED LIBERAL ART SCH OVER ACTUAL SCH - FALL DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	3,553	4.40	-	-	-	-	-	-	-	-	-	-
77	5,424	6.86	-2,694	-3.41	-	-	-	-	-	-	-	-
78	3,390	4.27	-4,833	-6.08	-3,739	-4.71	-	-	-	-	-	-
79	1,924	2.36	-4,798	-5.88	-5,326	-6.52	-5,021	-6.15	-	-	-	-
80	4,989	6.08	-5,299	-6.46	-5,772	-7.03	-6,773	-8.25	-4,809	-5.86	-	-
81	3,801	4.49	-11,675	-13.78	-11,890	-14.04	-10,780	-12.73	-8,556	-10.10	-7,162	-8.45
Total 'D'	23,081		-29,299		-26,727		-22,574		-13,365		-7,162	
Total 'SCH	487,709		406,936		327,837		248,402		166,762		84,713	
%D		4.73		-7.20		-8.15		-9.09		-8.01		-8.45

TABLE LXVIII

PROJECTION OF LIBERAL ART SCH BASED ON COMBINED SUM I & SUM II DATA
NTSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
66	27,364							
67	29,914							
68	29,515							
69	29,797							
70	34,080							
71	34,046							
72	32,296							
73	28,864							
74	27,165							
75	29,178							
76	25,708							
77	24,075	23,904						
78	23,048	25,938	25,958					
79	22,360	30,158	25,365	23,701				
80	22,343	31,577	24,772	22,836	23,431			
81	24,211	30,580	24,179	21,971	20,531	18,900		
82	23,602	31,318	23,586	21,106	17,473	16,887	20,013	
83	NA	33,358	22,993	20,241	17,483	17,084	18,905	24,505
84	NA	32,188	22,400	19,376	18,648	16,698	17,797	25,051
85	NA	27,718	21,807	18,511	17,117	14,001	16,689	25,295
R^2		.956	.390	.602	.913	.980	.835	.897
# of cycles		2	0	0	1	1	0	1
cycle 1 length		11.482	0.000	0.000	4.462	4.235	0.000	15.201
cycle 2 length		4.213	0.000	0.000	0.000	0.000	0.000	0.000

TABLE LXIX

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED LIBERAL ART SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	-171	-.71	-	-	-	-	-	-	-	-	-	-
78	2,890	12.54	2,910	12.63	-	-	-	-	-	-	-	-
79	7,798	34.87	3,005	13.44	1,341	6.00	-	-	-	-	-	-
80	9,234	41.33	2,429	10.87	493	2.21	1,088	4.87	-	-	-	-
81	6,369	26.31	-32	-.13	-2,240	-9.25	-3,680	-15.20	-5,311	-21.94	-	-
82	7,716	32.69	-16	-.07	-2,496	-10.58	-6,129	-25.97	-6,715	-28.45	-3,589	-15.21
Total 'D'	33,836		8,296		-2,902		-8,721		-12,026		-3,589	
Total 'SCH	139,639		115,564		92,516		70,156		47,813		23,602	
%D		24.23		7.18		-3.14		-12.43		-25.15		-15.21

TABLE LXX

PROJECTION OF LIBERAL ART SCH BASED ON SUM I DATA
NTSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
66	15,624							
67	16,985							
68	16,348							
69	16,842							
70	20,612							
71	18,958							
72	18,223							
73	16,444							
74	15,865							
75	16,157							
76	14,636							
77	13,564	16,126						
78	13,275	17,289	14,706					
79	12,820	18,147	14,360	13,485				
80	12,666	18,252	14,014	12,991	12,134			
81	14,287	17,511	13,668	12,497	11,469	10,899		
82	13,926	16,230	13,322	12,003	10,804	9,613	13,688	
83	NA	14,972	12,976	11,509	10,139	9,259	14,072	14,961
84	NA	14,287	12,630	11,015	9,474	9,162	14,376	15,826
85	NA	14,455	12,284	10,521	8,809	8,241	14,508	16,642
R^2		.738	.346	.548	.796	.978	.937	.922
# of cycles		1	0	0	0	1	1	1
cycle 1 length		8.957	0.000	0.000	0.000	4.621	15.780	17.776
cycle 2 length		0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE LXXI

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED LIBERAL ART SCH
OVER ACTUAL SCH SUM I DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	2,562	18.89	-	-	-	-	-	-	-	-	-	-
78	4,014	30.24	1,431	10.78	-	-	-	-	-	-	-	-
79	5,327	41.55	1,540	12.01	665	5.19	-	-	-	-	-	-
80	5,586	44.10	1,348	10.64	325	2.57	-532	-4.20	-	-	-	-
81	3,224	22.57	-619	-4.33	-1,790	-12.53	-2,818	-19.72	-3,388	-23.71	-	-
82	2,304	16.54	-604	-4.34	-1,923	-13.81	-3,122	-22.42	-4,313	-30.97	-238	-1.71
Total 'D'	23,017		3,096		-2,723		-6,472		-7,701		-238	
Total 'SCH'	80,538		66,974		53,699		40,879		28,213		13,926	
%D		28.58		4.62		-5.07		-15,83		-27.30		-1.71

TABLE LXXII

PROJECTION OF BUSINESS SCH BASED ON COMBINED FALL & SPRING DATA
NTSU

Year	Actual SCH	Model						
		I	II	III	IV	V	VI	VII
65	46,023							
66	48,157							
67	52,823							
68	53,804							
69	55,810							
70	53,279							
71	49.469							
72	47,792							
73	48,294							
74	51,109							
75	54,702							
76	57,233	57,025						
77	60,868	56,648	57,032					
78	66,390	53,996	54,519	60,238				
79	70,224	50,870	51,370	58,110	71,426			
80	71,489	49,364	49,675	55,315	74,745	71,583		
81	78,320	50,564	50,633	53,476	74,263	70,905	71,023	
82	NA	53,863	53,818	53,760	70,783	70,084	70,383	79,284
83	NA	57,345	57,440	56,323	67,290	68,948	69,084	80,673
84	NA	58,979	59,440	60,235	66,584	65,897	65,462	81,251
R^2		.978	.978	.973	.998	.999	.999	.989
# of cycles		1	1	1	2	2	2	1
cycle 1 length		7.734	7.813	8.916	11.203	16.210	17.579	15.701
cycle 2 length		0.000	0.000	0.000	5.834	4.576	4.520	0.000

TABLE LXXIII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED BUSINESS SCH FROM ACTUAL SCH - COMBINED FALL & SPRING DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	-208	-0.36	-	-	-	-	-	-	-	-	-	-
77	-4,220	-6.93	-3,836	6.30	-	-	-	-	-	-	-	-
78	-12,394	-18.67	-11,871	-17.88	-6,152	-9.27	-	-	-	-	-	-
79	-19,354	-27.56	-18,854	-26.85	-12,114	-17.25	1,202	1.71	-	-	-	-
80	-22,125	-30.95	-21,814	-30.51	-16,174	-22.62	3,256	4.55	94	.13	-	-
81	-27,756	-35.44	-27,687	-35.35	-24,844	-31.72	-4,057	-5.18	-7,415	-9.47	-7,297	-9.32
Total 'D'	-86,057		-84,062		-59,284		401		-7,321		-7,297	
Total 'SCH'	404,524		347,291		286,423		220,033		149,809		78,320	
%D		-21.27		-24.20		-20.70		.18		-4.89		-9.32

TABLE LXXIV

PROJECTION OF BUSINESS SCH BASED ON FALL DATA
NTSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
65	23,139							
66	24,848							
67	27,091							
68	27,271							
69	28,441							
70	27,002							
71	26,302							
72	24,740							
73	26,370							
74	25,294							
75	28,068							
76	29,193	28,668						
77	31,183	32,210	30,449					
78	33,948	31,946	30,672	31,396				
79	35,765	34,286	30,033	31,418	35,058			
80	36,227	32,213	28,965	30,552	37,188	39,070		
81	39,121	33,233	28,101	29,264	36,426	39,390	36,711	
82	NA	30,371	27,981	29,213	37,529	41,998	36,310	39,298
83	NA	31,751	28,797	28,720	35,486	41,609	35,483	39,406
84	NA	29,996	30,314	30,793	35,924	42,087	34,568	38,921
R^2		.977	.847	.979	.984	.998	.983	.983
# of cycles		2	1	2	2	2	1	1
cycle 1 length		10.549	9.058	9.624	12.895	19.504	13.010	18.587
cycle 2 length		2.045	0.000	1.869	1.825	1.761	0.000	0.000

TABLE LXXV

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED BUSINESS SCH OVER ACTUAL SCH FALL DATA NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	-525	-1.80	-	-	-	-	-	-	-	-	-	-
77	1,027	3.29	-734	-2.35	-	-	-	-	-	-	-	-
78	-2,002	-5.90	-3,276	-9.65	-2,550	-7.51	-	-	-	-	-	-
79	-1,479	-4.14	-5,732	-16.03	-4,347	-12.15	-707	-1.98	-	-	-	-
80	-4,014	-11.08	-7,262	-20.05	-5,675	-15.67	961	2.65	2,843	7.85	-	-
81	-5,888	-15.05	-11,020	-28.17	-9.857	-25.20	-2,695	-6.89	269	.69	-2,410	-6.16
Total 'D'	-12,881		-28,024		-22,429		-2,441		3,112		-2,410	
Total 'SCH	205,437		176,244		145,061		111,113		75,348		39,121	
%D		-6.27		-15.90		-15.46		-2.20		4.13		-6.16

TABLE LXXVI

PROJECTION OF BUSINESS SCH BASED ON COMBINED SUM I & SUM II DATA
NTSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
66	7,569							
67	9,047							
68	9,949							
69	9,753							
70	10,467							
71	11,317							
72	10,209							
73	9,610							
74	9,480							
75	10,936							
76	10,602							
77	10,771	11,039						
78	11,846	11,228	12,080					
79	11,639	11,417	12,266	11,125				
80	12,810	11,606	10,983	11,238	11,442			
81	14,004	11,795	10,524	11,351	11,502	12,044		
82	14,912	11,984	11,364	11,464	11,722	12,238	14,313	
83	NA	12,173	11,633	11,577	11,862	12,432	14,758	15,964
84	NA	12,362	11,504	11,690	12,002	12,626	15,007	17,057
85	NA	12,551	12,528	11,803	12,142	12,820	15,047	18,115
R^2		.356	.924	.257	.337	.427	.880	.950
# of cycles		0	2	0	0	0	1	1
cycle 1 length		0.000	7.800	0.000	0.000	0.000	18.575	20.545
cycle 2 length		0.000	3.711	0.000	0.000	0.000	0.000	0.000

TABLE LXXVII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED BUSINESS SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	268	2.49	-	-	-	-	-	-	-	-	-	-
78	-618	-5.22	234	1.98	-	-	-	-	-	-	-	-
79	-222	-1.91	627	5.39	-514	-4.42	-	-	-	-	-	-
80	-1,204	-9.40	-1,827	-14.26	-1,572	-12.27	-1,368	-10.68	-	-	-	-
81	-2,209	-15.77	-3,480	-24.85	-2,653	-18.94	-2,502	-17.87	-1,960	-14.00	-	-
82	-2,928	-19.64	-3,548	-23.79	-3,448	-23.12	-3,190	-21.39	-2,674	-17.93	-599	-4.02
Total 'D'	-6,913		-7,994		-8,187		-7,060		-4,634		-599	
Total 'SCH'	75,982		65,211		53,365		41,726		28,916		14,912	
%D		-9.10		-12.26		-15.34		-16.92		16.03		-4.02

TABLE LXXVIII

PROJECTION OF BUSINESS SCH BASED ON SUM I DATA
NTSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
66	4,334							
67	4,959							
68	5,610							
69	5,418							
70	5,850							
71	6,036							
72	5,580							
73	5,337							
74	5,309							
75	6,240							
76	6,013							
77	6,051	6,749						
78	6,854	7,190	5,514					
79	6,689	7,447	5,502	6,354				
80	7,726	7,483	6,013	6,433	6,611			
81	8,330	7,354	6,086	6,524	6,722	7,130		
82	8,026	7,183	6,476	6,609	6,833	7,293	8,778	
83	NA	7,110	5,667	6,694	6,944	7,456	9,277	10,533
84	NA	7,236	5,845	6,773	7,055	7,619	9,692	11,231
85	NA	7,579	5,709	6,864	7,166	7,782	10,002	12,364
R^2		.817	.920	.375	.503	.574	.910	.990
# of cycles		1	2	0	0	0	1	2
cycle 1 length		9.630	5.492	0.000	0.000	0.000	18.355	20.652
cycle 2 length		0.000	1.774	0.000	0.000	0.000	0.000	1.592

TABLE LXXIX

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED BUSINESS SCH
OVER ACTUAL SCH SUM I DATA
NTSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
77	698	11.54	-	-	-	-	-	-	-	-	-	-
78	336	4.90	-1,340	-19.55	-	-	-	-	-	-	-	-
79	758	11.33	-1,187	-17.75	-335	-5.00	-	-	-	-	-	-
80	-243	-3.15	-1,713	-22.17	-1,293	-16.74	-1,115	-14.43	-	-	-	-
81	-975	-11.72	-2,244	-26.94	-1,806	-21.68	-1,608	-19.30	-1,200	-14.41	-	-
82	-1,843	-20.42	-2,550	-28.25	-2,417	-26.78	-2,193	-24.30	-1,733	-19.20	-248	-2.75
Total 'D'	-1,269		-9,034		-5,851		-4,916		-2,933		-248	
Total 'SCH'	44,676		38,625		31,771		25,082		17,356		9,026	
%D		-2.84		-23.39		-18.42		-19.60		-16.90		-2.75

TABLE LXXX

PROJECTION OF UNDERGRADUATE SCH BASED ON COMBINED FALL & SPRING DATA
TPSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
65	4,041,592							
66	4,310,772							
67	4,655,859							
68	5,010,944							
69	5,255,795							
70	5,496,721							
71	5,604,167							
72	5,623,372							
73	5,639,888							
74	5,911,726							
75	6,315,155							
76	6,487,657	6,680,258						
77	6,573,075	6,904,539	6,844,188					
78	6,562,835	7,055,492	6,998,711	6,574,477				
79	6,612,949	7,168,898	7,055,184	6,660,781				
80	6,752,872	7,221,008	7,099,391	6,915,172	6,706,289			
81	6,798,389	7,286,719	7,224,852	7,248,820	6,907,566	6,925,598		
82	NA	7,525,941	7,473,754	7,494,551	7,167,129	7,271,078	6,788,934	
83	NA	7,946,754	7,810,258	7,572,098	7,455,992	7,489,176	6,804,379	6,859,629
84	NA	8,343,699	8,143,164	7,567,445	7,630,570	7,523,090	6,978,137	7,067,238
					7,618,949	7,509,273	7,328,598	7,430,066
R^2		1.000	.994	.997	.999	.997	.998	.998
# of cycles		2	1	1	2	1	2	2
cycle 1 length		7.771	7.685	6.038	6.191	5.843	9.341	8.790
cycle 2 length		4.235	0.000	0.000	3.970	0.000	4.691	4.678

TABLE LXXXI

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED UNDERGRADUATE SCH OVER ACTUAL SCH COMBINED FALL & SPRING DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	192,601	2.97	-	-	-	-	-	-	-	-	-	-
77	331,464	5.04	271,113	4.12	-	-	-	-	-	-	-	-
78	492,657	7.51	435,876	6.64	11,642	.18	-	-	-	-	-	-
79	555,949	8.41	442,235	6.69	47,832	.72	93,340	1.41	-	-	-	-
80	468,136	6.93	346,519	5.13	162,300	2.40	154,694	2.29	172,726	2.56	-	-
81	488,330	7.18	426,463	6.27	450,431	6.63	368,740	5.42	472,689	6.95	-9,455	-.14
Total 'D'	2,529,137		1,922,206		672,205		616,774		645,415		-9,455	
Total 'SCH'	39,787,777		33,300,120		26,720,045		20,164,210		13,551,261		6,798,389	
%D		6.36		5.77		2.52		3.06		4.76		-.14

TABLE LXXXII

PROJECTION OF UNDERGRADUATE SCH BASED ON FALL DATA
TPSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
65	2,101,307							
66	2,247,413							
67	2,411,108							
68	2,593,353							
69	2,742,042							
70	2,844,505							
71	2,924,557							
72	2,923,968							
73	2,937,398							
74	3,039,341							
75	3,253,549							
76	3,349,598	3,513,868						
77	3,409,117	3,688,870	3,540,572					
78	3,416,588	3,711,114	3,639,633	3,415,918				
79	3,439,715	3,644,723	3,680,484	3,440,697	3,452,675			
80	3,512,198	3,633,450	3,697,916	3,547,666	3,527,413	3,554,846		
81	3,534,265	3,771,095	3,740,828	3,714,243	3,699,947	3,721,883	3,692,240	
82	NA	4,020,770	3,842,767	3,860,901	3,869,099	3,857,339	3,839,956	3,553,885
83	NA	4,258,180	4,001,703	3,927,144	3,912,572	3,908,436	3,910,272	3,640,136
84	NA	4,388,012	4,181,246	3,929,296	3,899,763	3,906,744	3,913,981	3,809,311
R^2		1.000	.995	.996	.999	.997	.996	.998
# of cycles		2	1	1	2	1	1	2
cycle 1 length		7.442	7.881	6.153	6.116	6.001	6.121	8.881
cycle 2 length		5.466	0.000	0.000	3.469	0.000	0.000	4.730

TABLE LXXXIII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED UNDERGRADUATE SCH OVER ACTUAL SCH FALL DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	164,270	4.90	-	-	-	-	-	-	-	-	-	-
77	279,753	8.21	131,455	3.86	-	-	-	-	-	-	-	-
78	294,526	8.62	233,045	6.53	-670	-.02	-	-	-	-	-	-
79	205,008	5.96	240,769	7.00	982	.03	12,960	0.38	-	-	-	-
80	121,252	3.45	185,718	5.29	35,468	1.01	15,215	0.43	42,648	1.21	-	-
81	236,830	6.70	206,563	5.84	179,978	5.09	165,682	4.69	187,618	5.31	157,975	4.47
Total 'D'	1,301,639		987,550		215,758		193,857		230,266		157,975	
Total 'SCH'	20,661,481		17,311,883		13,902,766		10,486,178		7,046,463		3,534,265	
%D		6.30		5.70		1.55		1.85		3.27		4.47

TABLE LXXXIV

PROJECTION OF UNDERGRADUATE SCH BASED ON COMBINED SUM I & SUM II DATA
TPSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
66	623,670							
67	668,228							
68	728,944							
69	771,300							
70	817,421							
71	918,479							
72	907,587							
73	895,000							
74	889,403							
75	949,063							
76	949,916							
77	947,125	1,003,358						
78	937,820	1,104,774	1,012,158					
79	925,711	1,156,533	1,120,329	999,211				
80	944,739	1,143,781	1,182,986	1,082,051	1,011,063			
81	952,552	1,154,808	1,214,633	1,120,312	1,037,122	966,807		
82	NA	1,180,282	1,287,187	1,114,502	1,005,745	975,180	982,001	
83	NA	1,169,576	1,369,753	1,124,299	988,940	983,553	982,903	
84	NA	1,189,713	1,381,089	1,169,497	1,035,378	991,926	967,879	
85	NA	1,284,990	1,351,435	1,199,212	1,092,451	1,000,299	956,649	
R^2		.994	.993	.982	.865	.496	.856	
# of cycles		2	2	2	1	0	1	
cycle 1 length		8.005	12.224	4.623	4.586	0.000	6.067	
cycle 2 length		3.557	3.978	10.553	0.000	0.000	0.000	

TABLE LXXXV

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED UNDERGRADUATE SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V	
	D	%D	D	%D	D	%D	D	%D	D	%D
-	-	-	-	-	-	-	-	-	-	-
77	56,233	5.94	-	-	-	-	-	-	-	-
78	166,954	17.80	74,338	7.93	-	-	-	-	-	-
79	230,822	24.93	194,618	21.02	73,500	7.94	-	-	-	-
80	199,042	21.07	238,247	25.22	137,312	14.53	66,324	7.02	-	-
81	202,256	21.23	262,081	27.51	167,760	17.61	84,570	8.88	14,255	1.50
Total 'D'	855,307		769,284		378,572		150,894		14,255	
Total 'SCH	4,707,947		3,760,822		2,823,002		1,897,291		955,552	
%D		18.17		20.46		13.41		7.95		1.50

TABLE LXXXVI

PROJECTION OF MASTER SCH BASED ON COMBINED FALL & SPRING DATA
TPSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
65	186,801							
66	226,420							
67	255,749							
68	272,471							
69	316,532							
70	371,438							
71	414,598							
72	444,400							
73	516,992							
74	612,259							
75	695,363							
76	698,245	782,633						
77	695,969	873,232	754,662					
78	670,390	959,997	784,179	788,066				
79	701,009	1,039,391	812,715	839,199	733,532			
80	726,213	1,108,871	847,922	890,332	859,375	739,345		
81	719,006	1,167,228	894,996	941,465	984,217	761,235	809,202	
82	NA	1,214,752	954,771	992,598	1,040,915	772,917	897,141	678,693
83	NA	1,253,195	1,023,410	1,043,731	1,025,375	814,544	966,619	648,037
84	NA	1,285,527	1,093,814	1,094,864	997,210	905,203	999,085	671,091
R^2		.996	.991	.969	.999	.999	.993	.998
# of cycles		1	1	0	2	2	1	2
cycle 1 length		17.022	10.198	0.000	7.752	11.670	8.195	15.704
cycle 2 length		0.000	0.000	0.000	5.650	5.217	0.000	5.530

TABLE LXXXVII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED MASTER SCH OVER ACTUAL SCH COMBINED FALL & SPRING DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	84,388	12.09	-	-	-	-	-	-	-	-	-	-
77	177,263	25.47	58,693	8.43	-	-	-	-	-	-	-	-
78	289,607	28.96	113,789	16.97	117,676	17.55	-	-	-	-	-	-
79	338,382	48.27	111,706	15.93	138,190	19.71	32,523	4.64	-	-	-	-
80	382,658	52.69	121,709	16.76	164,119	22.60	133,162	18.34	13,132	1.81	-	-
81	448,222	62.34	175,990	24.48	222,459	30.94	265,211	36.89	42,229	5.87	90,196	12.54
Total 'D'	1,720,520		581,887		642,444		430,896		55,361		90,196	
Total 'SCH	4,210,832		3,512,587		2,816,618		2,146,228		1,445,219		719,006	
%D		40.86		16.57		22.81		20.08		3.83		12.54

TABLE LXXXVIII

PROJECTION OF MASTER SCH BASED ON FALL DATA
TPSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
65	93,229							
66	115,943							
67	127,525							
68	136,985							
69	156,230							
70	184,710							
71	207,172							
72	219,352							
73	256,789							
74	300,384							
75	349,129							
76	348,650	390,209						
77	354,759	440,112	379,283					
78	362,509	506,346	394,884	395,200				
79	359,549	575,874	408,157	421,041	420,307			
80	368,977	635,241	422,582	446,882	465,909	328,465		
81	365,300	691,581	441,274	472,723	495,232	295,134	413,260	
82	NA	757,888	465,983	498,564	505,867	289,256	462,326	384,513
83	NA	828,128	496,538	524,405	515,275	296,393	488,679	427,388
84	NA	885,321	530,900	550,246	542,219	293,300	511,569	475,513
R^2		1.000	.990	.971	.988	.999	.998	.996
# of cycles		2	1	0	1	2	2	2
cycle 1 length		25.504	10.966	0.000	5.800	14.272	8.320	9.840
cycle 2 length		4.382	0.000	0.000	0.000	4.187	3.525	4.793

TABLE LXXXIX

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED MASTER SCH OVER ACTUAL SCH FALL DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	41,559	11.92	-	-	-	-	-	-	-	-	-	-
77	85,353	24.06	24,524	6.91	-	-	-	-	-	-	-	-
78	143,837	39.68	32,375	8.93	32,691	9.02	-	-	-	-	-	-
79	216,325	60.17	48,608	13.52	61,492	17.10	60,758	16.90	-	-	-	-
80	266,264	72.16	53,605	14.53	77,905	21.11	96,932	26.27	-40,512	-10.98	-	-
81	326,281	89.32	75,974	20.80	107,423	29.41	129,932	35.57	-70,166	-19.21	47,960	13.13
Total 'D'	1,079,619		235,086		279,511		287,622		-110,678		47,960	
Total 'SCH	2,159,744		1,811,094		1,456,335		1,093,826		734,277		365,300	
%D		49.99		12.98		19.19		26.30		-15.07		13.13

TABLE XC

PROJECTION OF MASTER SCH BASED ON COMBINED SUM I & SUM II DATA
TPSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
66	124,504							
67	129,547							
68	139,665							
69	146,195							
70	163,180							
71	177,597							
72	193,076							
73	213,475							
74	250,030							
75	265,964							
76	263,574							
77	257,444	265,316						
78	255,959	271,790	287,194					
79	252,856	291,400	340,063	250,093				
80	255,059	316,114	368,481	230,947	239,486			
81	241,226	336,832	353,069	213,818	235,246	281,420		
82	NA	353,439	335,013	217,098	254,203	315,226	231,292	
83	NA	371,076	362,180	235,258	282,745	334,013	237,258	
84	NA	389,527	421,953	250,599	302,449	344,638	260,701	
85	NA	401,717	457,296	263,045	318,190	354,266	287,613	
R^2		.997	.999	.999	.999	.999	.995	
# of cycles		2	2	2	2	2	2	
cycle 1 length		8.714	5.647	13.083	11.397	8.861	13.576	
cycle 2 length		5.111	4.648	4.639	4.209	3.658	5.188	

TABLE XCI

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED MASTER SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V	
	D	%D	D	%D	D	%D	D	%D	D	%D
-	-	-	-	-	-	-	-	-	-	-
77	7,872	3.06	-	-	-	-	-	-	-	-
78	15,831	6.18	31,235	12.20	-	-	-	-	-	-
79	38,544	15.24	87,207	34.49	-2,763	-1.09	-	-	-	-
80	61,055	23.94	113,422	44.47	-24,112	-9.45	-15,573	-6.11	-	-
81	95,606	39.63	111,843	46.36	-27,408	-11.36	-5,980	-2.48	40,194	16.66
Total 'D'	218,908		343,707		-54,283		-21,553		40,194	
Total 'SCH'	1,262,544		1,005,100		749,141		496,285		241,226	
%D		17.34		34.20		-7.25		-4.34		16.66

TABLE XCII

PROJECTION OF DOCTORATE SCH BASED ON COMBINED FALL & SPRING DATA
TPSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
65	41,354							
66	49,886							
67	65,611							
68	74,023							
69	79,490							
70	87,526							
71	94,989							
72	103,162							
73	105,205							
74	112,110							
75	120,309							
76	127,401	129,706						
77	128,536	136,418	133,213					
78	136,883	145,902	143,134	138,573				
79	137,322	158,916	156,283	145,027	145,569			
80	144,793	170,043	166,496	151,481	152,396	147,578		
81	151,693	177,282	174,635	157,935	156,021	153,494	151,769	
82	NA	185,073	186,023	164,389	161,376	159,410	157,394	156,804
83	NA	195,088	198,663	170,843	170,205	165,326	163,019	162,296
84	NA	202,762	206,629	177,297	177,843	171,242	168,644	167,788
R^2		.999	.999	.992	.997	.985	.986	.988
# of cycles		2	2	0	1	0	0	0
cycle 1 length		13.160	0.939	4.209	0.000	0.000	0.000	0.000
cycle 2 length		4.081	3.927	0.000	0.000	0.000	0.000	0.000

TABLE XCIII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED DOCTORATE SCH OVER ACTUAL SCH COMBINED FALL & SPRING DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	2,305	1.81	-	-	-	-	-	-	-	-	-	-
77	7,882	6.13	4,677	3.64	-	-	-	-	-	-	-	-
78	9,019	6.59	6,251	4.57	1,690	1.23	-	-	-	-	-	-
79	21,594	15.73	18,961	13.81	7,705	5.61	8,247	6.00	-	-	-	-
80	25,250	17.44	21,703	14.99	6,688	4.62	7,603	5.25	2,785	1.92	-	-
81	25,589	16.87	22,942	15.12	6,242	4.11	4,328	2.85	1,801	1.19	76	.05
Total 'D'	91,639		74,534		22,325		20,178		4,586		76	
Total 'SCH'	826,628		699,227		570,691		433,808		296,486		151,693	
%D		11.09		10.66		3.91		4.65		1.55		.05

TABLE XCIV

PROJECTION OF DOCTORATE SCH BASED ON FALL DATA
TPSU

Year	Actual SCH	Model						
		I	II	III	IV	V	VI	VII
65	20,054							
66	24,140							
67	32,047							
68	36,467							
69	39,540							
70	42,890							
71	46,433							
72	50,968							
73	52,088							
74	54,434							
75	58,439							
76	62,740	63,515						
77	64,187	66,988	66,358					
78	67,402	70,562	69,967	68,270				
79	68,469	76,550	76,007	71,463	70,422			
80	72,660	83,380	83,521	74,656	74,559	73,006		
81	75,107	88,204	90,027	77,849	77,762	75,968	76,860	
82	NA	91,851	95,861	81,042	79,842	78,930	79,321	78,137
83	NA	96,885	103,334	84,235	82,444	81,892	80,989	80,964
84	NA	102,489	112,235	87,428	86,360	84,854	83,786	83,791
R^2		.999	.999	.993	.998	.990	.997	.992
# of cycles		2	2	0	1	0	1	0
cycle 1 length		14.812	21.532	0.000	4.531	0.000	4.716	0.000
cycle 2 length		4.160	4.252	0.000	0.000	0.000	0.000	0.000

TABLR XCV

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED DOCTORATE SCH
OVER ACTUAL SCH FALL DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	755	1.20	-	-	-	-	-	-	-	-	-	-
77	2,801	4.36	2,171	3.38	-	-	-	-	-	-	-	-
78	3,160	4.69	2,565	3.81	868	1.29	-	-	-	-	-	-
79	8,081	11.80	7,538	11.01	2,994	4.37	1,953	2.85	-	-	-	-
80	10,720	14.75	10,861	14.95	1,996	2.75	1,899	2.61	346	.48	-	-
81	13,097	17.44	14,920	19.86	2,742	3.65	2,655	3.53	861	1.15	1,753	2.33
Total 'D'	38,614		38,055		8,600		6,507		1,207		1,753	
Total 'SC	410,565		347,825		283,638		216,236		147,767		75,107	
%D		9.41		10.94		3.03		3.01		.82		2.33

TABLE XCVI

PROJECTION OF DOCTORATE SCH BASED ON COMBINED SUM I & SUM II DATA
TPSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
66	16,580							
67	15,898							
68	22,787							
69	25,437							
70	26,666							
71	31,846							
72	33,069							
73	34,119							
74	33,962							
75	36,884							
76	37,170							
77	39,823	40,218						
78	41,612	43,582	42,910					
79	42,393	47,193	46,725	44,877				
80	44,317	50,467	50,995	47,285	44,599			
81	44,780	52,961	55,360	48,973	46,230	45,846		
82	NA	54,589	59,439	50,009	47,861	47,398	46,081	
83	NA	55,477	62,915	50,809	49,492	48,950	46,682	
84	NA	56,262	65,605	51,917	51,123	50,502	47,121	
85	NA	57,480	67,501	53,710	52,754	52,054	49,335	
R^2		.977	.982	.984	.957	.960	.998	
# of cycles		1	1	1	0	0	2	
cycle 1 length		9.644	13.200	8.392	0.000	0.000	10.371	
cycle 2 length		0.000	0.000	0.000	0.000	0.000	1.683	

TABLE XCVII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED DOCTORATE SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V	
	D	%D	D	%D	D	%D	D	%D	D	%D
-	-	-	-	-	-	-	-	-	-	-
77	395	.99	-	-	-	-	-	-	-	-
78	1,970	4.73	1,298	3.12	-	-	-	-	-	-
79	4,800	11.32	4,332	10.22	2,484	5.86	-	-	-	-
80	6,150	3.88	6,678	15.07	2,968	6.70	282	.64	-	-
81	8,181	18.27	10,580	23.63	4,193	9.36	1,450	3.24	1,066	2.38
Total 'D'	21,496		22,888		9,645		1,732		1,066	
Total 'SCH'	212,925		173,102		131,490		89,097		44,780	
%D		10.10		13.22		7.34		1.94		2.38

TABLE XCVIII

PROJECTION OF TOTAL SCH BASED ON COMBINED FALL & SPRING DATA
TPSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
65	4,269,687							
66	4,587,078							
67	4,977,219							
68	5,357,438							
69	5,651,817							
70	5,955,685							
71	6,113,754							
72	6,170,934							
73	6,262,085							
74	6,636,095							
75	7,130,827							
76	7,313,303	7,516,148						
77	7,397,580	7,710,695	7,600,512					
78	7,415,108	7,850,121	7,693,164	7,529,195				
79	7,451,280	8,014,102	7,787,707	7,719,375	7,692,949			
80	7,623,878	8,172,246	7,999,914	7,971,961	8,052,652	7,746,813		
81	7,669,088	8,372,051	8,351,422	8,375,297	8,340,688	8,038,152	7,674,629	
82	NA	8,740,121	8,752,391	8,748,070	8,558,984	8,172,406	7,774,820	7,758,332
83	NA	9,234,539	9,073,422	8,833,359	8,765,566	8,174,797	8,092,820	8,037,594
84	NA	9,607,938	9,249,059	8,810,637	8,926,484	8,248,344	8,547,266	8,477,516
R^2		1.000	.996	1.000	.999	.998	.998	.998
# of cycles		2	1	2	2	2	2	2
cycle 1 length		7.335	6.775	6.033	6.227	5.600	9.200	9.209
cycle 2 length		4.271	0.000	3.655	4.387	12.661	4.571	4.723

TABLE XCIX

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED TOTAL SCH
FROM ACTUAL SCH COMBINED FALL & SPRING DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	202,845	2.77	-	-	-	-	-	-	-	-	-	-
77	313,115	4.23	202,932	2.74	-	-	-	-	-	-	-	-
78	435,013	5.87	278,056	3.75	114,087	1.54	-	-	-	-	-	-
79	562,822	7.55	336,427	4.52	268,095	3.60	241,669	3.24	-	-	-	-
80	548,368	7.19	376,036	4.93	348,083	4.57	428,774	5.62	122,935	1.61	-	-
81	702,963	9.17	682,334	8.89	706,209	9.21	671,600	8.76	369,064	4.81	5,541	.07
Total 'D'	2,765,126		1,875,785		1,436,474		1,342,043		491,999		5,541	
Total 'SCH'	44,870,237		37,556,934		30,159,354		22,744,246		15,292,966		7,669,088	
%D		6.16		4.99		4.76		5.90		3.22		.07

TABLE C

PROJECTION OF TOTAL SCH BASED ON FALL DATA
TPSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
65	2,214,590							
66	2,387,496							
67	2,570,680							
68	2,766,805							
69	2,937,812							
70	3,072,105							
71	3,178,162							
72	3,194,288							
73	3,246,275							
74	3,394,159							
75	3,661,117							
76	3,760,988	3,941,761						
77	3,828,063	4,098,109	3,935,976					
78	3,846,499	4,096,895	4,002,633	3,889,851				
79	3,867,733	4,052,722	4,042,614	3,955,370	3,928,787			
80	3,953,835	4,123,410	4,116,984	4,068,329	4,098,551	4,079,899		
81	3,974,672	4,359,129	4,261,203	4,289,191	4,297,750	4,291,941	4,145,691	
82	NA	4,659,496	4,458,684	4,485,023	4,436,180	4,433,957	4,335,598	4,003,063
83	NA	4,877,836	4,653,176	4,528,320	4,486,141	4,473,148	4,473,207	4,113,895
84	NA	4,958,664	4,790,645	4,537,293	4,510,930	4,484,418	4,530,375	4,321,855
R^2		1.000	.996	.999	.997	.996	.992	.998
# of cycles		2	1	2	1	1	1	2
cycle 1 length		7.120	7.041	6.074	5.907	5.848	6.830	9.371
cycle 2 length		5.386	0.000	3.490	0.000	0.000	0.000	4.773

TABLE CI

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED TOTAL SCH OVER ACTUAL SCH FALL DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	180,773	4.81	-	-	-	-	-	-	-	-	-	-
77	270,046	7.05	107,913	2.82	-	-	-	-	-	-	-	-
78	250,396	6.51	156,134	4.06	43,352	1.13	-	-	-	-	-	-
79	184,989	4.78	174,881	4.52	87,637	2.27	61,054	1.58	-	-	-	-
80	169,575	4.29	163,149	4.13	114,494	2.90	144,716	3.66	126,064	3.19	-	-
81	384,457	9.67	286,531	7.21	314,519	7.91	323,078	8.13	317,269	7.98	171,019	4.30
Total 'D'	1,440,236		888,608		560,002		528,848		443,333		171,019	
Total 'SC	23,231,790		19,470,802		15,642,739		11,796,240		7,928,507		3,974,672	
%D		6.20		4.56		3.58		4.48		5.59		4.30

TABLE CII

PROJECTION OF TOTAL SCH BASED ON COMBINED SUM I & SUM II DATA
TPSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
66	764,754							
67	817,173							
68	891,396							
69	942,932							
70	1,007,267							
71	1,127,922							
72	1,133,732							
73	1,142,594							
74	1,173,395							
75	1,251,911							
76	1,250,650							
77	1,244,392	1,337,942						
78	1,235,391	1,456,995	1,311,794					
79	1,220,960	1,496,584	1,407,273	1,293,947				
80	1,244,115	1,504,313	1,450,869	1,327,630	1,320,741			
81	1,238,558	1,560,181	1,494,565	1,312,018	1,347,969	1,243,479		
82	NA	1,591,536	1,614,166	1,314,687	1,375,197	1,261,535	1,290,557	
83	NA	1,590,252	1,748,824	1,380,990	1,402,425	1,290,604	1,328,882	
84	NA	1,666,322	1,819,202	1,454,801	1,429,653	1,329,103	1,349,577	
85	NA	1,783,090	1,882,126	1,480,893	1,456,881	1,373,597	1,347,509	
R^2		.997	.998	.994	.771	.903	.943	
# of cycles		2	2	2	0	1	1	
cycle 1 length		7.785	17.870	4.277	0.000	14.058	7.854	
cycle 2 length		3.440	3.929	26.779	0.000	0.000	0.000	

TABLE CIII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED TOTAL SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V	
	D	%D	D	%D	D	%D	D	%D	D	%D
-	-	-	-	-	-	-	-	-	-	-
77	93,550	7.52	-	-	-	-	-	-	-	-
78	221,604	17.94	76,403	6.18	-	-	-	-	-	-
79	275,624	22.57	186,313	15.26	72,987	5.98	-	-	-	-
80	260,198	20.91	206,754	16.62	83,515	6.71	76,626	6.16	-	-
81	321,623	25.97	256,007	20.67	73,460	5.93	109,411	8.83	4,921	.40
Total 'D'	1,172,599		725,477		229,962		186,037		4,921	
Total 'SCH'	6,183,416		4,939,024		3,703,633		2,482,673		1,238,558	
%D		18.96		14.69		6.21		7.49		.40

TABLE CIV

PROJECTION OF EDUCATION SCH BASED ON COMBINED FALL & SPRING DATA
TPSU

Year	Actual SCH	Model						
		I	II	III	IV	V	VI	VII
65	391,561							
66	369,923							
67	405,890							
68	445,936							
69	477,136							
70	534,769							
71	570,644							
72	609,318							
73	637,524							
74	671,577							
75	722,974							
76	707,596	747,693						
77	702,818	783,865	735,787					
78	686,305	820,037	749,787	711,663				
79	643,871	856,209	764,174	710,511	778,238			
80	600,980	892,381	781,064	712,364	780,420	622,529		
81	561,209	928,553	802,201	720,391	807,602	597,750	554,758	
82	NA	964,725	828,696	736,783	834,784	583,226	514,535	533,228
83	NA	1,000,897	860,861	762,416	861,966	582,629	485,829	521,674
84	NA	1,037,069	898,167	796,706	889,148	597,322	472,687	528,776
R^2		.980	.994	.991	.876	.981	.924	.983
# of cycles		0	1	1	0	1	1	1
cycle 1 length		0.000	16.177	15.723	0.000	15.317	15.724	13.665

TABLE CV

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED EDUCATION SCH OVER ACTUAL SCH FALL & SPRING DATA TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	40,097	5.67	-	-	-	-	-	-	-	-	-	-
77	81,047	11.53	32,969	4.69	-	-	-	-	-	-	-	-
78	133,732	19.49	63,482	9.25	25,358	3.69	-	-	-	-	-	-
79	212,338	32.98	120,303	18.68	66,640	10.35	134,367	20.87	-	-	-	-
80	291,401	48.49	180,084	29.97	111,384	18.53	179,440	29.86	21,549	3.59	-	-
81	367,344	65.46	240,992	42.94	159,182	28.36	246,393	43.90	36,541	6.51	-6,451	-1.14
Total 'D'	1,155,959		637,830		362,564		560,200		58,090		-6,451	
Total 'SCH'	3,902,779		3,195,183		2,492,365		1,806,060		1,162,189		561,209	
%D		29.62		19.96		14.55		31.02		5.00		-1.14

TABLE CVI

PROJECTION OF EDUCATION SCH BASED ON FALL DATA
TPSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
65	192,340							
66	186,677							
67	201,111							
68	222,715							
69	239,494							
70	265,594							
71	285,674							
72	301,998							
73	320,736							
74	332,053							
75	360,870							
76	350,427	372,907						
77	355,063	390,978	364,110					
78	347,641	409,049	370,433	359,959				
79	329,107	427,120	377,304	362,237	390,489			
80	305,597	445,191	385,883	366,091	404,324	321,515		
81	283,550	463,262	397,053	372,808	418,159	311,640	286,726	
82	NA	481,333	411,276	383,232	431,994	306,188	268,471	261,532
83	NA	499,404	428,519	397,627	445,829	306,842	255,742	244,247
84	NA	517,475	448,257	415,640	459,664	314,296	250,489	234,233
R^2		.984	.993	.992	.899	.981	.977	.976
# of cycles		0	1	1	0	1	1	1
cycle 1 length		0.000	15.485	15.815	0.000	15.504	15.565	15.599
cycle 2 length		0.000	0.000	0.000	0.000	0.000	0.000	0.000

TABLE CVII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED EDUCATION SCH OVER ACTUAL SCH FALL DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	22,480	6.42	-	-	-	-	-	-	-	-	-	-
77	35,915	10.12	9,047	2.55	-	-	-	-	-	-	-	-
78	61,408	17.66	22,792	6.56	12,318	3.54	-	-	-	-	-	-
79	98,013	29.78	48,197	14.64	33,130	10.07	61,382	18.65	-	-	-	-
80	135,594	45.68	80,286	26.27	60,494	19.80	98,727	32.31	15,918	5.21	-	-
81	179,712	63.38	113,503	40.03	89,258	31.48	134,609	47.47	28,090	9.91	3,176	1.12
Total 'D'	533,122		273,825		195,200		294,718		44,008		3,176	
Total 'SCH'	1,971,385		1,620,958		1,265,895		918,254		589,147		283,550	
%D		27.04		16.89		15.42		32.10		7.47		1.12

TABLE CVIII

PROJECTION OF EDUCATION SCH BASED ON COMBINED SUM I & SUM II DATA
TPSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
66	155,129							
67	157,378							
68	166,247							
69	175,784							
70	191,073							
71	222,099							
72	231,829							
73	249,929							
74	264,766							
75	267,958							
76	252,309							
77	241,576	254,166						
78	237,963	252,320	216,353					
79	226,353	256,416	187,027	228,411				
80	220,175	267,806	155,306	221,823	222,778			
81	203,177	285,619	124,412	233,678	241,708	231,944		
82	NA	307,032	97,468	255,783	263,211	253,945	197,645	
83	NA	328,126	77,110	272,184	276,116	269,315	207,212	
84	NA	345,076	65,171	288,674	295,733	287,858	224,372	
85	NA	355,323	62,452	311,738	316,492	316,806	237,175	
R^2		.990	.992	.996	.997	.995	.992	
# of cycles		1	1	2	2	2	2	
cycle 1 length		11.242	17.868	12.110	11.263	12.841		
cycle 2 length		0.000	0.000	3.744	3.556	3.742		

TABLE CIX

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED EDUCATION SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA

TPSU

Year	Model I		Model II		Model III		Model IV		Model V	
	D	%D	D	%D	D	%D	D	%D	D	%D
-	-	-	-	-	-	-	-	-	-	-
77	12,590	5.21	-	-	-	-	-	-	-	-
78	14,357	6.03	-21,610	-9.08	-	-	-	-	-	-
79	30,063	13.28	-39,326	-17.37	2,058	.91	-	-	-	-
80	47,631	21.63	-64,869	-29.46	1,648	.75	2,603	1.18	-	-
81	82,442	40.58	-78,765	-38.77	30,501	15.01	38,531	18.96	28,767	14.16
Total 'D'	187,083		-204,570		34,207		41,134		28,767	
Total 'SCH'	1,129,244		887,668		649,705		423,352		203,177	
%D		16.57		-23.05		5.27		9.72		14.16

TABLE CX

PROJECTION OF LIBERAL ART SCH BASED ON COMBINED FALL & SPRING DATA
TPSU

Year	Actual SCH	Model						
		I	II	III	IV	V	VI	VII
65	2,092,341							
66	2,232,011							
67	2,432,062							
68	2,629,281							
69	2,745,045							
70	2,857,393							
71	2,859,132							
72	2,811,581							
73	2,757,281							
74	2,893,424							
75	3,078,480							
76	3,116,276	3,257,115						
77	3,115,696	3,408,653	3,366,081					
78	3,050,780	3,534,537	3,498,180	3,052,672				
79	3,070,366	3,562,754	3,554,953	3,066,138	3,064,679			
80	3,144,950	3,489,510	3,548,397	3,196,909	3,188,477	3,261,585		
81	3,149,398	3,451,774	3,521,654	3,359,887	3,336,011	3,378,275	3,313,569	
82	NA	3,549,019	3,527,790	3,436,666	3,398,560	3,394,713	3,399,317	3,128,336
83	NA	3,722,152	3,603,705	3,397,985	3,357,585	3,357,776	3,376,938	3,180,592
84	NA	3,891,497	3,751,985	3,333,990	3,304,404	3,293,499	3,314,087	3,329,914
R^2		.999	.977	.983	.988	.999	.982	.991
# of cycles		2	1	1	1	2	1	2
cycle 1 length		8.232	8.770	5.890	5.806	5.551	5.951	8.530
cycle 2 length		3.944	0.000	0.000	0.000	2.750	0.000	4.842

TABLE CXI

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED LIBERAL ART SCH OVER ACTUAL SCH COMBINED FALL & SPRING DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	140,839	4.52	-	-	-	-	-	-	-	-	-	-
77	292,957	9.40	250,385	8.04	-	-	-	-	-	-	-	-
78	483,757	15.86	447,400	14.67	1,892	.06	-	-	-	-	-	-
79	492,388	16.04	484,587	15.78	-4,642	-.15	-5,687	-.19	-	-	-	-
80	344,560	10.96	403,447	12.83	51,959	1.65	43,527	1.38	116,635	3.71	-	-
81	302,376	9.60	372,256	11.82	210,489	6.68	186,613	5.93	228,877	7.27	164,171	5.21
Total 'D'	2,056,877		1,958,075		259,698		224,453		345,512		164,171	
Total 'SCH'	18,647,466		15,531,190		12,415,494		9,364,714		6,294,348		3,149,398	
%D		11.03		12.61		2.09		2.40		5.49		5.21

TABLE CXII

PROJECTION OF LIBERAL ART SCH BASED ON FALL DATA
TPSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
65	1,097,272							
66	1,174,170							
57	1,272,374							
68	1,371,014							
69	1,442,098							
70	1,488,237							
71	1,501,681							
72	1,475,960							
73	1,450,893							
74	1,499,208							
75	1,598,515							
76	1,622,192	1,709,317						
77	1,636,749	1,788,423	1,747,121					
78	1,606,426	1,836,712	1,821,998	1,608,865				
79	1,614,565	1,860,181	1,859,900	1,600,276	1,598,782			
80	1,653,639	1,852,721	1,862,661	1,649,098	1,645,722	1,658,868		
81	1,656,486	1,828,667	1,848,816	1,731,707	1,720,977	1,734,753	1,735,988	
82	NA	1,837,853	1,844,799	1,791,171	1,771,503	1,779,748	1,780,769	1,620,322
83	NA	1,915,832	1,872,368	1,793,376	1,769,319	1,771,905	1,771,396	1,593,788
84	NA	2,035,511	1,938,269	1,760,659	1,739,870	1,744,269	1,743,465	1,629,657
R^2		1.000	.983	.981	.990	.985	.987	.991
# of cycles		2	1	1	1	1	1	2
cycle 1 length		8.354	8.926	6.047	5.956	5.869	5.810	10.545
cycle 2 length		4.391	0.000	0.000	0.000	0.000	0.000	5.043

TABLE CXIII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED LIBERAL ART SCH OVER ACTUAL SCH FALL DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	87,125	5.37	-	-	-	-	-	-	-	-	-	-
77	151,674	9.27	110,372	6.74	-	-	-	-	-	-	-	-
78	230,286	14.34	215,572	13.42	2,439	.15	-	-	-	-	-	-
79	245,616	15.21	245,335	15.20	-14,289	-.89	-15,783	-.98	-	-	-	-
80	199,082	12.04	209,022	12.64	-4,541	-.27	-7,917	-.48	2,382	.14	-	-
81	172,181	10.39	192,330	11.61	75,221	4.54	64,491	3.89	78,267	4.72	79,502	4.80
Total 'D'	1,085,964		972,631		58,830		40,791		80,649		79,502	
Total 'SCH'	9,790,057		8,167,865		6,531,116		4,924,690		3,310,125		1,656,486	
%D		11.09		11.91		.90		.83		2.44		4.80

TABLE CXIV

PROJECTION OF LIBERAL ART SCH BASED ON COMBINED SUM I & SUM II DATA
TPSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
66	360,760							
67	398,663							
68	438,837							
69	460,030							
70	480,791							
71	520,998							
72	509,026							
73	482,700							
74	474,508							
75	510,301							
76	510,468							
77	498,467	532,884						
78	486,015	588,744	543,235					
79	469,918	623,774	616,902	512,660				
80	478,490	610,046	664,437	555,554	508,458			
81	484,368	600,906	693,633	571,408	521,918	507,300		
82	NA	611,982	752,864	555,876	499,783	500,646	475,074	
83	NA	602,339	823,060	547,370	476,422	476,131	472,052	
84	NA	590,635	846,660	566,821	488,054	466,799	469,030	
85	NA	628,383	837,044	586,220	518,053	484,581	466,008	
R^2		.995	.987	.957	.850	.752	.336	
# of cycles		2	2	2	1	1	0	
cycle 1 length		8.729	14.503	4.720	4.748	4.982	0.000	
cycle 2 length		3.652	3.985	11.086	0.000	0.000	0.000	

TABLE CXV

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED LIBERAL ART SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V	
	D	%D	D	%D	D	%D	D	%D	D	%D
-	-	-	-	-	-	-	-	-	-	-
77	34,417	6.90	-	-	-	-	-	-	-	-
78	102,729	21.14	57,220	11.77	-	-	-	-	-	-
79	153,856	32.74	146,984	31.28	42,742	9.10	-	-	-	-
80	131,556	27.49	185,947	38.86	77,064	16.11	29,968	6.26	-	-
81	116,538	24.06	209,265	43.20	87,040	17.97	37,550	7.75	22,932	4.73
Total 'D'	539,096		599,416		206,846		67,518		22,932	
Total 'SCH'	2,417,258		1,918,791		1,432,776		962,858		484,368	
%D		22.30		31.24		14.44		7.01		4.73

TABLE CXVI

PROJECTION OF BUSINESS SCH BASED ON COMBINED FALL & SPRING DATA
TPSU

		Model						
Year	Actual SCH	I	II	III	IV	V	VI	VII
65	396,873							
66	436,018							
67	477,249							
68	530,583							
69	575,738							
70	603,421							
71	622,364							
72	641,835							
73	673,472							
74	748,517							
75	837,289							
76	871,633	841,980						
77	940,373	816,827	923,482					
78	1,009,631	827,260	974,552	962,487				
79	1,065,667	912,154	1,024,433	978,700	1,072,391			
80	1,128,680	1,015,208	1,053,284	999,288	1,097,471	1,073,151		
81	1,178,241	1,051,758	1,062,098	1,037,367	1,102,201	1,077,455	1,156,771	
82	NA	1,019,170	1,079,616	1,096,382	1,124,541	1,100,358	1,182,683	1,239,538
83	NA	1,003,528	1,129,639	1,168,208	1,168,362	1,106,704	1,201,235	1,298,890
84	NA	1,069,704	1,202,526	1,237,638	1,207,131	1,083,625	1,216,822	1,358,242
R^2		.998	.998	.997	.999	.999	.996	.992
# of cycles		2	2	1	2	2	1	0
cycle 1 length		5.752	9.973	8.248	11.610	15.120	14.694	0.000
cycle 2 length		4.805	4.874	0.000	4.453	3.994	0.000	0.000

TABLE CXVII

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED BUSINESS SCH OVER ACTUAL SCH COMBINED FALL & SPRING DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	-29,653	-3.40	-	-	-	-	-	-	-	-	-	-
77	-123,546	-13.14	-16,891	-1.80	-	-	-	-	-	-	-	-
78	-182,371	-18.06	-35,079	-3.47	-47,144	-4.67	-	-	-	-	-	-
79	-153,513	-14.41	-41,234	-3.87	-86,967	-8.16	6,724	.63	-	-	-	-
80	-113,472	-10.05	-75,396	-6.68	-129,392	-11.46	-31,209	-2.77	-55,529	-4.92	-	-
81	-126,483	-10.73	-116,143	-9.86	-140,874	-11.96	-76,040	-6.45	-100,786	-8.55	-21,470	-1.82
Total 'D'	-729,038		-284,743		-404,377		-100,525		-156,315		-21,470	
Total 'SCH'	6,194,225		5,322,592		4,382,219		3,372,588		2,306,921		1,178,241	
%D		-11.77		-5.35		-9.23		-2.98		-6.78		-1.82

TABLE CXVIII

PROJECTION OF BUSINESS SCH BASED ON FALL DATA
TPSU

Year	Actual SCH	Model I	II	III	IV	V	VI	VII
65	203,364							
66	225,892							
67	241,730							
68	268,584							
69	294,467							
70	307,375							
71	320,750							
72	327,263							
73	342,261							
74	375,593							
75	424,644							
76	438,951	435,851						
77	473,504	424,344	439,459					
78	508,479	418,474	430,286	484,426				
79	539,137	450,187	440,566	492,437	519,454			
80	570,446	508,954	481,417	503,083	530,049	542,753		
81	592,644	548,622	535,321	522,929	541,269	545,449	587,589	
82	NA	540,894	570,119	553,199	558,586	559,710	615,393	623,290
83	NA	512,974	568,873	589,064	584,723	564,774	643,197	652,722
84	NA	519,705	547,634	622,445	618,424	553,759	671,001	682,154
R^2		.998	.998	.995	.994	.999	.977	.989
# of cycles		2	2	1	1	2	0	0
cycle 1 length		5.789	6.044	8.037	9.174	14.610	0.000	0.000
cycle 2 length		5.235	6.752	0.000	0.000	3.933	0.000	0.000

TABLE CXIX

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED BUSINESS SCH OVER ACTUAL SCH FALL DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V		Model VI	
	D	%D	D	%D	D	%D	D	%D	D	%D	D	%D
76	-3,100	-.71	-	-	-	-	-	-	-	-	-	-
77	-49,160	-10.38	-34,045	-7.19	-	-	-	-	-	-	-	-
78	-90,005	-17.70	-78,193	-15.38	-24,050	-4.73	-	-	-	-	-	-
79	-88,950	-16.50	-98,571	-18.28	-46,700	-8.66	-19,683	-3.65	-	-	-	-
80	-61,492	-10.78	-89,029	-15.61	-67,363	-11.81	-40,397	-7.08	-27,693	-4.85	-	-
81	-44,022	-7.43	-57,323	-9.67	-69,715	-11.76	-51,375	-8.67	-47,195	-7.96	-5,055	-.85
Total 'D'	-336,729		357,161		-207,828		-111,455		74,888		-5,055	
Total 'SCH'	3,123,161		2,684,210		2,210,706		1.702,227		1,163,090		592,644	
%D		-10.78		-13.31		-9.40		-6.55		6.44		-.85

TABLE CXX

PROJECTION OF BUSINESS SCH BASED ON COMBINED SUM I & SUM II DATA
TPSU

Year	Actual SCH	Model I	Model II	Model III	Model IV	Model V	Model VI	Model VII
66	60,966							
67	64,679							
68	74,039							
69	88,123							
70	95,747							
71	112,631							
72	116,001							
73	121,978							
74	129,449							
75	149,214							
76	154,922							
77	160,892	164,097						
78	173,939	173,753	167,862					
79	186,748	183,409	178,635	182,702				
80	200,258	193,065	192,587	192,290	190,664			
81	210,716	202,721	203,701	201,878	197,016	202,163		
82	NA	212,377	209,705	211,466	211,901	209,926	212,564	
83	NA	222,033	215,070	221,054	223,111	225,752	223,893	
84	NA	231,689	225,110	230,642	226,537	238,887	239,942	
85	NA	241,345	238,970	240,230	235,228	243,461	251,141	
R^2		.986	.994	.988	.996	.996	.994	
# of cycles		0	1	0	1	1	1	
cycle 1 length		0.000	5.135	0.000	3.755	4.251	4.538	
cycle 2 length		0.000	0.000	0.000	0.000	0.000		

TABLE CXXI

DEVIATION (D) & PERCENTAGE DEVIATION (%D) OF PROJECTED BUSINESS SCH OVER ACTUAL SCH COMBINED SUM I & SUM II DATA
TPSU

Year	Model I		Model II		Model III		Model IV		Model V	
	D	%D	D	%D	D	%D	D	%D	D	%D
-	-	-	-	-	-	-	-	-	-	-
77	3,205	1.99	-	-	-	-	-	-	-	-
78	-186	-.11	-6,077	-3.49	-	-	-	-	-	-
79	-3,339	-1.79	-8,113	-4.34	-4,046	-2.17	-	-	-	-
80	-7,193	-3.59	-7,671	-3.83	-7,968	-3.98	-9,594	-4.79	-	-
81	-7,995	-3.79	-7,015	-3.33	-8,838	-4.19	-13,700	-6.50	-8,553	-4.06
Total 'D'	-15,508		-28,876		-20,852		-23,294		-8,553	
Total 'SCH	932,553		771,661		597,722		410,974		210,716	
%D		-1.66		-3.74		-3.49		-5.67		-4.06

BIBLIOGRAPHY

Books

Ackoff, Russell L., Scientific Method: Optimizing Applied Research Decisions, New York, John Wiley and Sons, Inc., 1962.

Bloomfield, P., Fourier Analysis of Time Series: An Introduction, New York, John Wiley & Sons, 1976.

Bowerman, Bruce L. and Richard T. O'Connel, Forecasting and Time Series, California, Duxbury Press, 1979.

Gujarati, Damodar, Basic Econometrics, New York, McGraw-Hill Book Company, 1978.

Heineman, E. R., Plane Trigonometry with Tables, New York, McGraw-Hill Book Company, 1974.

Hutchinson, M. R., The Elementary Functions, Columbus, Ohio, Charles E. Merrill Publishing Co., 1974.

Magelson, Wayne L., Donald M. Norris, and Nick L. Poulson, Projecting College and University Enrollments: Analyzing the Past and Focusing on Future, Ann Arbor, Center for the Study of Higher Education School of Education, the University of Michigan, January, 1974.

Rayner, J. N., An Introduction to Spectral Analysis, London Pion Limited, 1971.

Stuart, R. D., An Introduction to Fourier Analysis, London, Methuen's Monographs, 1961.

Wheelwright, S. C. and S. Makridakis, Forecasting Methods for Management, New York, Wiley-Interscience, 1973.

Articles

Alper, P., P. H. Armitage and C. S. Smith, "Educational Models, Manpower, Planning and Control," Operational Research Quarterly, 18 (June, 1967), 93-103.

Alspaugh, John W., "Accuracy of School Enrollment Projections Based Upon Previous Enrollments," Educational Research Quarterly, 6 (No. 2, 1981), 61-67.

Bowen, William G., "The Effects of Inflation/Recession on Higher Education," Educational Record, 56 (Summer, 1975), 149-155.

Britney, Robert R., "Forecasting Educational Enrollment: Comparison of a Markov Chain and Circuitless Flow Network Model," Socio-Economic Planning Science, 9 (June, 1975), 53-60.

Brown, Daniel J., "A Smoothing Solution to the School District Enrollment Projection Problem," Educational Planning, 2 (May, 1975), 13-26.

Centra, John A., "Reading the Enrollment Barometer," Change, 11 (April, 1974), 50-62.

Englehardt, N. L., "How to Estimate Your Future Enrollment," School Management, 17 (July, 1973), 39-41.

Freeman, Jack E., "Comprehensive Planning in Higher Education," New Directions for Higher Education, 19 (Autumn, 1977), 33-52.

Freeman, R. B., "A Cobweb Model of the Supply and Starting Salary of New Engineers," Industrial & Labor Relation Review, 29 (January, 1976), 236-248.

Geoffreon, L., "A Summary of Exponential Smoothing," Journal of Industrial Engineering, XIII (July-August, 1952), 223-226.

Grace, M. and Kyung, S. Bay, "A Random Walk Simulation Model for Enrollment Projections," Journal of Educational Data Processing, 12 (No. 2, 1975), 10-42.

Gunell, James B., "Resource Allocation for Maximum Program Effectiveness," New Directions for Institutional Research, 24 (1979), 55-63.

Hanson, M. J. and P. Tronnelen, "Markov Chain Model for Enrollment Projections," Journal of Educational Data Processing, 12 (No. 2, 1975), 1-9.

Hollander, T. Edward, "Planning for Changing Demographic Trends in Public and Private Institutions," New Directions for Institutional Research, 6 (Summer, 1975), 1-12.

Legell, S., "How to Forecast School Enrollments Accurately and Years Ahead," American School Board Journal, 160 (1973), 25-31.

Marguardt, D. W., "An Algorithm for Least Squares Estimation of Nonlinear Parameters," Journal of Social, Industrial and Applied Math, 2 (1963), 431-441.

Mayhew, Lewis B., "The Steady SEventies," Journal of Higher Education, 45 (March, 1974), 163-173.

Minter, W. John, "Current Economic Trends in American Higher Education," Change, 11 (February, 1979), 19-25.

Schroeder, Roger G., "Survey of Management Science in University Operation," Management Science, 19 (April, 1973), 895-906.

Simmons, L. F. and D. R. Williams, "A Cycle Regression Analysis Algorithm for Extracting Cycles from Time-Series Data," Computers and Operations Research, An International Journal, IX (No. 3, 1982), 243-254.

________________________________, "The Use of Cycle Regression Analysis to Predict Civil Violence," Journal of Interdisciplinary Cycle Research, Forthcoming.

Sollberger, A., "Problems in Statistical Analysis of Short Periodic Time Series," Journal of Interdisciplinary Cycle Research, I (No. 1, 1970), 49-88.

Suslow, Sidney, "Benefits of a Cohort Survival Projection Model," New Direction for Institutional Research, 13 (Spring, 1977), 19-42.

Wharton, James H., Jerry J. Baudin, and Ordell Griffith, "The Importance of Accurate Enrollment Projections for Planning," Phi Delta Kappa, 62 (May, 1981), 652-655.

Winters, P. R., "Forecasting Sales by Exponentially Weighted Moving Averaged," Management Science, VI (April, 1969), 324-342.

Reports

Educational Data Reporting System for Public Senior Colleges and Universities, Coordinating Board, Texas College and University System, September 1981.

Koulouianos, D. T., Educational Planning for Economic Growth, Technical Report 23, Center for Research in Management Science, University of California, Berkeley, California, February, 1967.

Kraetsch, Gayla A., Methodology and Limitations of Ohio Enrollment Projections, The Association for Institutional Research Professional File No. 4, edited by Richard R. Perry, Tallahassee, Florida, Winter, 1979-1980.

Salley, Charles D., Helping Administrators Identify Shifts in Enrollment Patterns, Atlanta, Georgia State University, 1977. (ERIC Ed. 136-716.)

Simmons, L. F. and D. R. Williams, An Algorithm for Cycle Regression Analysis, Southwestern AIDS Proceedings, March, 1980.

Wasik, John L., A Review and Critical Analysis Used for Estimating Enrollments in Educational Systems, Center for Occupational Education, North Carolina State University at Raleigh, 1971. (ERIC Ed. 059-545.) and A. J. Taffe, Handbook of Statistical Procedures for Long-Range Projection of Public School Enrollment, U. S. Office of Education, 1969. (ERIC Ed. 058-668.)

Unpublished Material

Ashworth, Kenneth H., Unpublished memorandum and enclosures to Presidents and Chancellors of Public Senior Colleges and Universities of Texas, Austin, Texas, May 30, 1980.

Brooks, Dorothy Lynn, "Short Term Enrollment Projections Based on Traditional Time Series Analysis," doctoral dissertation, North Texas State University, December, 1981.

Campbell, S. Duke and Greenberg, Barry, "The Use of Multiple Regression and Trend Analysis to Understand Enrollment Fluctuations," paper presented to Annual Forum of the Association for Institutional Research, 19th, San Diego, California, May 13-17, 1979.

Lind, Douglas A., "Bayosion Decision Theory in Enrollment Forecasting," paper presented at the Annual Forum of the Association for Institutional Research, 19th, San Diego, California, May 13-17, 1979.

Marshall, K. T. and R. M. Oliver, "Estimating Errors in Student Enrollment Forecasting," paper presented at the Annual Forum of the Association for Institutional Research, 19th, San Diego, California, May 13-17, 1979.

Salley, Charles D., "Predicting Next Year's Resources--Short-Term Enrollment Forecasting for Accurate Budget Planning," Atlanta, Georgia State University, 1978, a paper presented to the Association for Institutional Research Annual Forum, Houston, Texas, 1978.

Seminar on Approaches to Academic Planning, The University of Texas System Institute of Higher Education Management, Austin, Texas, March 18-20, 1981.

Simmons, L. F. and D. R. Williams, "A Cycle Regression Analysis Algorithm for Extraction Cycles from Time-Series Data," unpublished manual, Management Science Department, College of Business, North Texas State University, 1980.

Wish, John R. and William P. Hamilton, "Replicating Freeman's Recursive Adjustment Model of Demand for Higher Education," paper presented at Annual Forum of Association for Institutional Research, 19th, San Diego, California, May 13-17, 1979.