NBS TECHNICAL NOTE 1068-1

U.S. DEPARTMENT OF COMMERCE / National Bureau of Standards

Introduction to STARPAC

The Standards Time Series and Regression Package

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Introduction to STARPAC

The Standards Time Series and Regression Package

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Issued October 1983

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National Bureau of Standards Technical Note 1068-1
Natl. Bur. Stand. (U.S.), Tech. Note 1068-1, 24 pages (Oct. 1983)
CODEN: NBTNAE

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON: 1983

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402
Price $3.00
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No warranties, express or implied, are made by the distributors or developers that STARPAC or its constituent parts are free of error. They should not be relied upon as the sole basis for solving a problem whose incorrect solution could result in injury to person or property. If the programs are employed in such a manner, it is at the user's own risk and the distributors and developers disclaim all liability for such misuse.

Computers have been identified in this paper in order to adequately specify the sample programs and test results. Such identification does not imply recommendation or endorsement by the National Bureau of Standards, nor does it imply that the equipment identified is necessarily the best available for the purpose.

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Preface

STARPAC, the Standards Time Series and Regression Package, is a library of Fortran subroutines for statistical data analysis developed by the Statistical Engineering Division (SED) of the National Bureau of Standards (NBS), Boulder, Colorado. Earlier versions of this library were distributed by the SED under the name STATLIB [Tryon and Donaldson, 1978]. STARPAC incorporates many changes to STATLIB, including additional statistical techniques, improved algorithms and enhanced portability.

We are releasing STARPAC source code in segments and the documentation as a series of NBS Technical Notes. This will allow us to make the new capabilities of STARPAC available more quickly and to facilitate the release of future changes. This Note gives an overview of the STARPAC library, defines conventions used in the documentation, provides an example using STARPAC subroutines, and presents general background material. It includes information which is essential for using the STARPAC library, and users should be familiar with its contents before attempting to use any STARPAC subroutine.

The STARPAC code segments consist of subroutines for nonlinear least squares regression, time series analysis (in both time and frequency domains), line printer graphics, basic statistical analysis, linear least squares regression, and nonlinear optimization. Users may obtain a list of the available code segments and their associated documentation from their local installer of STARPAC, or directly from the author.

STARPAC subroutines feature:

- ease of use, alone and with other Fortran subroutine libraries;
- extensive error handling facilities;
- comprehensive printed reports;
- no problem size restrictions other than effective machine size; and
- portability.

Notation, format, and naming conventions will remain constant throughout the series of Technical Notes documenting STARPAC, allowing the documentation for each code segment to be used alone or in conjunction with the documentation for another.

The code for STARPAC was developed at the U.S. Department of Commerce Boulder Laboratories on a CDC CYBER 170/750 under NOS 1.4, and all examples presented in this documentation were executed in this environment using the FTN 4.8+552 compiler with rounding. STARPAC has also been tested on the following equipment.

Computer	Facility
IBM 4340 VAX 11/780	National Center for Atmospheric Research, Boulder, Colorado
Sperry 1100/82	National Bureau of Standards, Gaithersburg, Maryland
Perkin-Elmer 3230	National Bureau of Standards, Boulder, Colorado
Data General ECLIPSE S/140	Forest Fire Laboratory, Riverside, California

STARPAC is written in Fortran '66. Adherence to a portable subset of ANSI Fortran [1966] has been verified by the PFORT Verifier [Ryder, 1974]. Workspace and machine-dependent constants are supplied using subroutines based on the Bell Laboratories "Framework for a Portable Library" [Fox et al., 1978a]. We have also used subroutines from LINPACK [Dongarra et al., 1979], from the "Basic Linear Algebra Subprograms for Fortran Usage" [Lawson et al., 1979], and from DATAPAC [Filliben, 1977]. The printed report generated by the statistical analysis subroutines has been adapted from OMNITAB II [Hogben et al., 1971].

Computer facilities for the STARPAC project have been provided in part by the NOAA Computer Services Division, Boulder, Colorado, and we gratefully acknowledge their support. The STARPAC subroutine library is the result of the programming efforts of Janet R. Donaldson and John E. Koontz, with assistance from Ginger A. Caldwell, Steven M. Keefer, and Linda L. Mitchell. Valuable contributions have also been made by each of the members of the Statistical Engineering Division in Boulder, and from many within the STARPAC user community. We are grateful for the many valuable comments that we have received on early drafts of the STARPAC documentation; we wish especially to thank Paul T. Boggs, Ginger A. Caldwell, Sally E. Howe, John E. Koontz, James T. Ringland, Ralph M. Slutz, and Dominic F. Vecchia. Finally, we wish to thank Lorna Buhse for excellent manuscript support.

Janet R. Donaldson
Peter V. Tryon (deceased)
September 1983

Contents

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Introduction

to

STARPAC

The Standards Time Series and Regression Package

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STARPAC, the Standards Time Series and Regression Package, is a library of Fortran subroutines for statistical data analysis developed by the Statistical Engineering Division (SED) of the National Bureau of Standards (NBS), Boulder, Colorado. Earlier versions of this library were distributed by the SED under the name STATLIB [Tryon and Donaldson, 1978]. STARPAC incorporates many changes to STATLIB, including additional statistical techniques, improved algorithms and enhanced portability.

STARPAC emphasizes the statistical interpretation of results, and, for this reason, comprehensive printed reports of auxiliary statistical information, often in graphical form, are automatically provided to augment the basic statistical computations performed by each user-callable STARPAC subroutine. STARPAC thus provides the best features of many stand-alone statistical software programs within the flexible environment of a subroutine library.

STARPAC documentation is being published as a series of Technical Notes. This Note is the first in the series. It gives an overview of the STARPAC library, defines conventions used in the documentation, provides an example using STARPAC subroutines, and presents general background material. This Note includes information which is essential for using the STARPAC library, and users should be familiar with its contents before attempting to use any STARPAC subroutine.

Key words: data analysis; STARPAC; STARPAC overview; statistical computing; statistical subroutine library; STATLIB.

CHAPTER 1

INTRODUCTION TO USING STARPAC

A. Overview of STARPAC and Its Contents

STARPAC is a portable library of approximately 150 user-callable ANSI '66 Fortran subroutines for statistical data analysis. Designed primarily for time series analysis and for nonlinear least squares regression, STARPAC also includes subroutines for normal random number generation, line printer plots, basic statistical analyses, linear least squares regression, and nonlinear optimization. Emphasis has been placed on facilitating the interpretation of statistical analyses, and, for this reason, comprehensive printed reports of auxiliary statistical information, often in graphical form, are automatically provided to augment the basic statistical computations performed by each user-callable STARPAC subroutine. STARPAC thus provides the best features of many stand-alone statistical software programs within the flexible environment of a subroutine library.

STARPAC is designed to be easy to use; in many situations, only a few lines of elementary Fortran code are required for the users' main programs. A fundamental STARPAC philosophy is to provide two or more user-callable subroutines for each method of analysis: one which minimizes the complexity of the CALL statement, automatically producing a comprehensive printed report of the results; and one or more others which provide user control of the computations, allow suppression of all or part of the printed reports, and/or provide storage of computed results for further analyses.

STARPAC has been developed and is maintained by the Statistical Engineering Division of the National Bureau of Standards, Boulder, Colorado. It is intended that STARPAC be a continually evolving library that will keep pace with new developments in statistical methods, and will respond to the ever-changing needs of the National Bureau of Standards. Users' comments and suggestions, which have had significant impact already, are highly valued and always welcomed. Comments and suggestions should be directed to:

Janet R. Donaldson
National Bureau of Standards
Mail Code 714
325 Broadway
Boulder, CO 80303.

B. Documentation Conventions

The documentation for the various STARPAC subroutines is being published as a series of Technical Notes. Each Note in the series provides a standard format description of the information needed to use a STARPAC subroutine, including one or more examples.

References to chapter sections within the STARPAC documentation are made using the symbol §, and refer to the identified section within the current chapter of the current Note unless explicitly stated otherwise. Figures are identified by the section in which they occur. For example, figure C-2 refers to the second figure in §C of the current chapter of this Note.

Names of INTEGER and REAL STARPAC subroutine arguments are consistent with the implicit Fortran convention for specifying variable type. That is, variable names beginning with I through N are type INTEGER while all others are type REAL unless otherwise explicitly typed DOUBLE PRECISION or COMPLEX. All dimensioned variables are explicitly declared in STARPAC documentation by means of INTEGER, REAL, DOUBLE PRECISION, or COMPLEX statements, as appropriate. The convention used to specify the dimensioning statements is discussed below in §D.2.

The STARPAC library is available in either single or double precision versions, and users should consult with their computing center staff or appropriate local documentation to determine which version they are using. The precision of the STARPAC library is also indicated in the printed reports generated by STARPAC: an S following the STARPAC version number in the output heading indicates the single precision version is being used, while a D indicates the double precision version. The STARPAC documentation is designed for use with both the single and double precision versions. Subroutine arguments which are double precision in both versions are declared DOUBLE PRECISION; similarly, arguments which are single precision in both versions are declared REAL. Arguments whose precision is dependent upon the precision of the version of STARPAC being used are declared <real>. If the double precision version of the STARPAC library is being used, then the user should substitute DOUBLE PRECISION for <real>; if the single precision version is being used, then the user should substitute REAL for <real>. Other precision dependent features are discussed as they occur.

C. A Sample Program

The sample program shown in figure C-1 illustrates the use of STARPAC subroutines. This example was executed on the CYBER 170/750 at the U.S. Department of Commerce Boulder Laboratories under the NOS 1.4 operating system using a single precision version of the STARPAC library. The code shown is portable ANSI '66 Fortran, except for the PROGRAM statement which is required by most Fortran compilers on CDC machines. Section D below uses this example to discuss Fortran programming as it relates to STARPAC.

The data used in this example are 84 relative humidity measurements taken at Pikes Peak, Colorado. STARPAC subroutine PP plots the data versus time-order (fig. C-2) and STARPAC subroutine STAT prints a comprehensive statistical analysis of the data (fig. C-3).

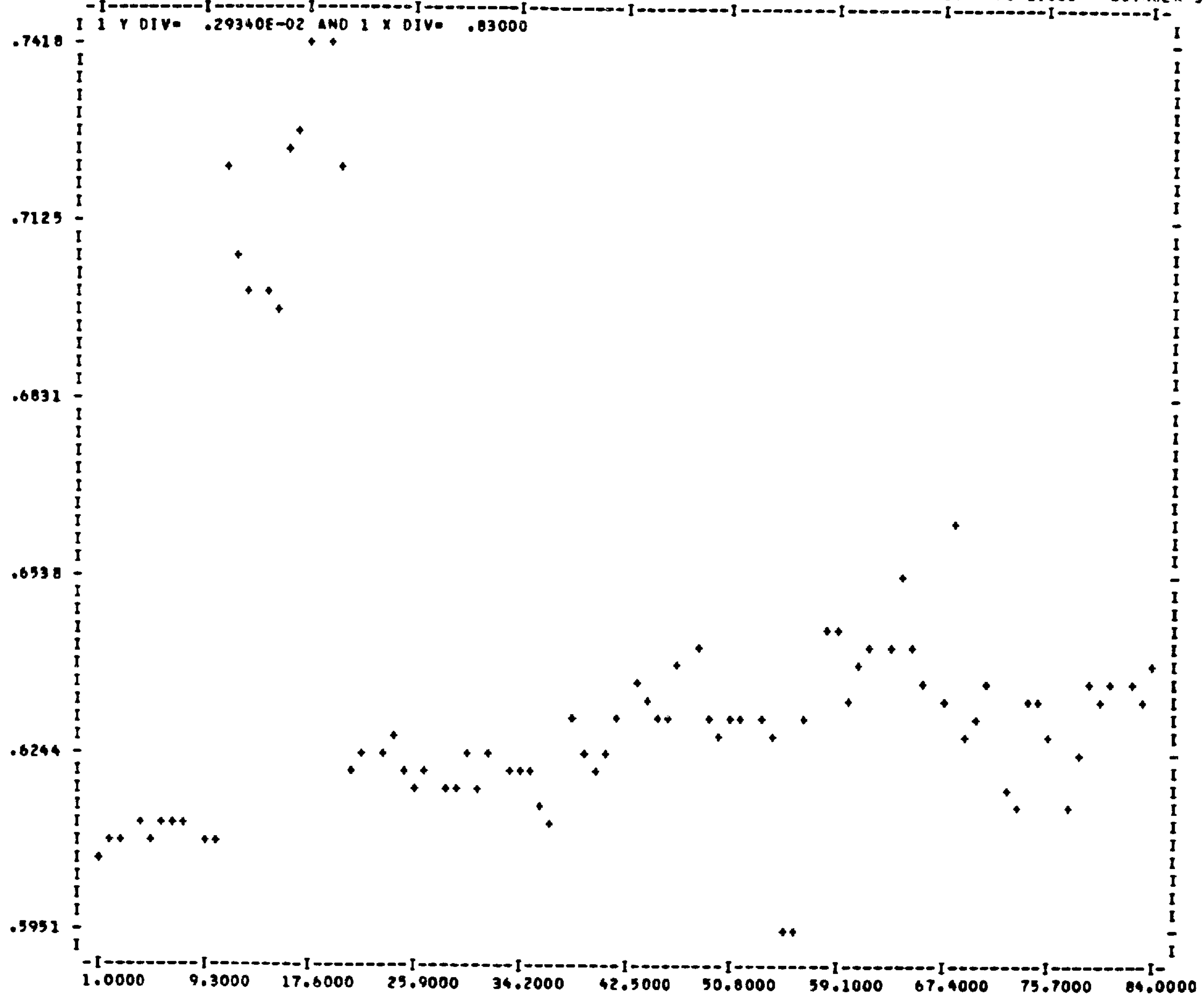
```
MAIN PROGRAM:        PROGRAM EXAMPL (INPUT, OUTPUT, TAPE5 = INPUT, TAPE6 = OUTPUT)
               C
                     REAL Y(100), X(100)
                     DOUBLE PRECISION DSTAK(100)
               C
                     COMMON /CSTAK/ DSTAK
                     COMMON /ERRCHK/ IERR
               C
               C     DEFINE LDSTAK, THE LENGTH OF DSTAK
               C
                     LDSTAK = 100
               C
               C     READ NUMBER OF OBSERVATIONS INTO N, AND DATA INTO VECTOR Y
               C
                     READ (5, 100) N
                     READ (5, 101) (Y(I), I=1,N)
               C
               C     CREATE A VECTOR OF ORDER INDICES IN X
               C
                     DO 10 I=1,N
                        X(I) = FLOAT(I)
                  10 CONTINUE
               C
               C     PRINT TITLE, PLOT OF DATA, AND ERROR INDICATOR
               C
                     WRITE (6, 102)
                     CALL PP (Y, X, N)
                     WRITE (6, 103) IERR
               C
               C     PRINT TITLE, STATISTICAL ANALYSIS OF DATA, AND ERROR INDICATOR
               C
                     WRITE (6, 102)
                     CALL STAT (Y, N, LDSTAK)
                     WRITE (6, 103) IERR
                     STOP
               C
               C     FORMAT STATEMENTS
               C
                 100 FORMAT (I5)
                 101 FORMAT (12F6.4)
                 102 FORMAT (1H1, 48HDAVIS-HARRISON PIKES PEAK RELATIVE HUMIDITY DATA)
                 103 FORMAT (8H IERR = , I1)
                     END

DATA:       84
       .6067 .6087 .6086 .6134 .6108 .6138 .6125 .6122 .6110 .6104 .7213 .7078
       .7021 .7004 .6981 .7242 .7268 .7418 .7407 .7199 .6225 .6254 .6252 .6267
       .6218 .6178 .6216 .6192 .6191 .6250 .6188 .6233 .6225 .6204 .6207 .6168
       .6141 .6291 .6231 .6222 .6252 .6308 .6376 .6330 .6303 .6301 .6390 .6423
       .6300 .6260 .6292 .6298 .6290 .6262 .5952 .5951 .6314 .6440 .6439 .6326
       .6392 .6417 .6412 .6530 .6411 .6355 .6344 .6623 .6276 .6307 .6354 .6197
       .6153 .6340 .6338 .6284 .6162 .6252 .6349 .6344 .6361 .6373 .6337 .6383
```

Figure C-1

STARPAC sample program and data

DAVIS-HARRISON PIKES PEAK RELATIVE HUMIDITY DATA

STARPAC 1.00S - OCTOBER 3, 1983



IERR = 0

Figure C-2

Example of PP output

H

DAVIS-HARRISON PIKES PEAK RELATIVE HUMIDITY DATA

STARPAC 1.00S - OCTOBER 3, 1983

STATISTICAL ANALYSIS N = 84

FREQUENCY DISTRIBUTION (1-6) 5 25 35 8 1 0 0 4 4 2

MEASURES OF LOCATION (2-2)

UNWEIGHTED MEAN	=	6.3734048E-01
WEIGHTED MEAN	=	6.3734048E-01
MEDIAN	=	6.2915000E-01
MID-RANGE	=	6.6845000E-01
25 PCT UNWTD TRIMMED MEAN	=	6.2885952E-01
25 PCT WTD TRIMMED MEAN	=	6.2885952E-01

MEASURES OF DISPERSION (2-6)

STANDARD DEVIATION	=	3.2405213E-02
S.D. OF MEAN	=	3.5356987E-03
RANGE	=	1.4670000E-01
MEAN DEVIATION	=	2.1076417E-02
VARIANCE	=	1.0500979E-03
COEFFICIENT OF VARIATION	=	5.0844430E+00

A TWO-SIDED 95 PCT CONFIDENCE INTERVAL FOR MEAN IS 6.3030811E-01 TO 6.4437284E-01 (2-2)
A TWO-SIDED 95 PCT CONFIDENCE INTERVAL FOR S.D. IS 2.8136742E-02 TO 3.8213792E-02 (2-7)

LINEAR TREND STATISTICS (5-1)

SLOPE	=	-2.4736661E-04
S.D. OF SLOPE	=	1.4414086E-04
SLOPE/S.D. OF SLOPE = T	=	-1.7161450E+00
PROB EXCEEDING ABS VALUE OF OBS T	=	.090

TESTS FOR NON-RANDOMNESS

NO OF RUNS UP AND DOWN	=	47
EXPECTED NO OF RUNS	=	55.7
S.D. OF NO OF RUNS	=	3.82
MEAN SQ SUCCESSIVE DIFF	=	3.6382337E-04
MEAN SQ SUCC DIFF/VAR	=	.346

DEVIATIONS FROM WTD MEAN

NO OF + SIGNS	=	22
NO OF - SIGNS	=	62
NO OF RUNS	=	14
EXPECTED NO OF RUNS	=	33.5
S.D. OF RUNS	=	3.51
DIFF./S.D. OF RUNS	=	-5.550

OTHER STATISTICS

MINIMUM	=	5.9510000E-01
MAXIMUM	=	7.4180000E-01
BETA ONE	=	3.7288258E+00
BETA TWO	=	5.9283926E+00
WTD SUM OF VALUES	=	5.3536600E+01
WTD SUM OF SQUARES	=	3.4208200E+01
WTD SUM OF DEV SQUARED	=	8.7158122E-02
STUDENTS T	=	1.8025871E+02
WTD SUM ABSOLUTE VALUES	=	5.3536600E+01
WTD AVE ABSOLUTE VALUES	=	6.3734048E-01

NOTE - ITEMS IN PARENTHESES REFER TO PAGE NUMBER IN NBS HANDBOOK 91 (NATRELLA, 1966)
IERR = 0

Figure C-3

Example of STAT output

D. Using STARPAC

The following subsections provide general information needed when using STARPAC, including a discussion of Fortran programming as it relates to STARPAC usage. Although only elementary knowledge of Fortran is required to use STARPAC, users may still have to consult with a Fortran test and/or their computing center staff when questions arise.

D.1 The PROGRAM Statement

The PROGRAM statement, which is required by most Fortran compilers on CDC machines, serves two purposes: the first is to name the user's main program; and the second is to specify the files (devices) which will be used for reading and writing information during execution of the user's program. In figure C-1, the PROGRAM statement is

```
PROGRAM EXAMPL (INPUT, OUTPUT, TAPE5 = INPUT, TAPE6 = OUTPUT).
```

The name EXAMPL is assigned to the main program in this example. The program name cannot be the name of any variable in the user's main program and, in addition, cannot be the name of any other subroutine or function called during execution of the user's code. Specifically, it cannot be the name of any subroutine within STARPAC. To ensure that the name of a STARPAC subroutine is not inadvertently chosen for the name of the main program, users should consult with the local installer of STARPAC to obtain a list of the STARPAC subroutine names.

The file declaration function of the program statement is machine dependent. The files declared in the program statements used in this example and throughout the STARPAC documentation are those required when using STARPAC on the CYBER 170/750 at the U.S. Department of Commerce Boulder Laboratories under the NOS 1.4 operating systems. Users at other installations should consult §D.4 and the local installer of STARPAC for additional information on controlling file specification.

D.2 The Dimensioning Statements

The user's program must include dimensioning statements to define the sizes and types of the vectors (1-dimensional arrays) and matrices (2-dimensional arrays) required by each STARPAC subroutine used; STARPAC itself has no inherent upper limit problem size.

Within the STARPAC documentation for the subroutine declaration and CALL statements, italicized lowercase identifiers in the dimensioning statements represent integer constants which must equal or exceed the value of the identically spelled uppercase argument. For example, if the documentation specifies the minimum dimension of a variable as <real> XM(*n*,*m*), and if the number of observations N is 15, and the number of columns of data M is 3, then (assuming the single precision version of STARPAC is being used) the minimum array size is given by the dimensioning statement REAL XM(15,3).

The exact dimensions assigned to some vectors and matrices must be supplied in the CALL statements to some STARPAC subroutines. For example, the argument IXM is defined as "the exact value of the first dimension of the matrix XM as declared in the calling program." Continuing the example from the preceding paragraph, if the statement REAL XM(20,5) is used to dimension the matrix XM for a particular subroutine, and IXM is an argument in the CALL statement, then IXM must have the value 20 regardless of the value assigned to the variable N.

Many STARPAC subroutines require a work area for internal computations. This work area is provided by the DOUBLE PRECISION vector DSTAK. The rules for defining DSTAK are as follows.

1. Programs which call subroutines requiring the work vector DSTAK must include both the statement

   COMMON /CSTAK/ DSTAK

   and the DOUBLE PRECISION statement dimensioning DSTAK.

2. Since all STARPAC subroutines use the same work vector, the length of DSTAK must equal or exceed the longest length required by any of the individual STARPAC subroutines called by the user's program.

3. The length, LDSTAK, of the work vector DSTAK must be specified in the CALL statement of any STARPAC subroutine using DSTAK to enable STARPAC to verify that there will be sufficient work area for the problem.

It is recommended that a variable LDSTAK be set to the length of DSTAK, and that this variable be used in each CALL statement requiring the length of DSTAK to be specified. Then, if a future modification to the user's program requires the length of DSTAK to be changed, the only alterations required in the existing code would be to the DOUBLE PRECISION dimensioning statement and to the statement which assigns the length of DSTAK to LDSTAK.

STARPAC manages its work area using subroutines modeled after those in ACM Algorithm 528: Framework for a Portable Library [Fox et al., 1978a]. Although STARPAC and the Framework share the same COMMON for their work areas, there are differences between the STARPAC management subroutines and those of the Framework. In particular, the STARPAC management subroutines re-initialize DSTAK each time the user invokes a STARPAC subroutine requiring work area, destroying all data previously stored in DSTAK; the Framework only initializes DSTAK the first time any of its management subroutines are invoked, preserving work area allocations still in use. Thus, users must be cautious when utilizing STARPAC with other libraries which employ the Framework, such as PORT [Fox et al., 1978b].

The sample program shown in figure D-1 provides an example of the use of dimensioned variables with STARPAC. The REAL vector Y, used by both subroutines PP and STAT, contains the 84 relative humidity measurements; its minimum length, N (the number of observations), is 84. The REAL vector X used by subroutine PP contains the corresponding time order indices of the data;

its minimum length is also 84. The DOUBLE PRECISION vector DSTAK contains the work area needed by STAT for intermediate computations; its minimum length is 49 in this case. In this example, the dimensions of Y, X, and DSTAK, are each 100, exceeding the required minimum values.

D.3 The CALL Statements

The STARPAC CALL statement arguments provide the interface for specifying the data to be used, controlling the computations, and providing space for any returned results. The CALL statements used in the example are CALL PP(Y, X, N) and CALL STAT(Y, N, LDSTAK). Note that scalar arguments may be specified either by a variable preset to the desired value, as was done in figure C-1, or by the actual numerical values. For example, CALL PP(Y, X, 84) and CALL STAT(Y, 84, 100) could have been used instead of the forms shown. We recommend using variables rather than the actual numerical values in order to simplify future changes in the program. When variables are used, changes need to be made in only one place; numerical values have to be changed every place they occur. In addition, the use of variables can also clarify the meaning of the program.

D.4 STARPAC Output

Most STARPAC subroutines produce extensive printed reports, freeing the user from formatting and printing each statistic of interest. The standard output device is used for these reports. The user has the options of titling the reports and changing the output device.

The first page of the report from each STARPAC subroutine does not start on a new page. This allows the user to supply titles. For example,

```
    WRITE (6, 100)
100 FORMAT (1H1, 48HDAVIS-HARRISON PIKES PEAK RELATIVE HUMIDITY DATA)
    CALL PP (Y, X, N)
```

will print the title DAVIS-HARRISON PIKES PEAK RELATIVE HUMIDITY DATA on the top line of a new page, immediately preceding the plot as shown in figure C-2. Users should note that titles more than one line in length can cause a printed report designed for one page to extend beyond the bottom of the page.

The unit number, IPRT, of the output device used by STARPAC is returned by STARPAC subroutine IPRINT. Users can change the output device unit number by including with their program a subroutine IPRINT which will supersede the STARPAC subroutine of the same name. The subroutine must have the form

```
SUBROUTINE IPRINT(IPRT)
IPRT = u
RETURN
END
```

where u is an integer value specifying the output unit to which all STARPAC output will be written.

D.5 STARPAC Error Handling

STARPAC provides extensive error-checking facilities which include both printed reports and a program-accessible error flag variable. There are essentially two types of errors STARPAC can detect.

The first type of error involves incorrect problem specification, i.e., one or more of the input arguments in the subroutine statement has an improper value. For example, the number of observations, N, might have an obviously meaningless non-positive value. In the case of improper problem specification STARPAC generates a printed report identifying the subroutine involved, the error detected, and the proper form of the subroutine CALL statement. The latter is provided because improper input is often the result of an incorrectly specified subroutine argument list.

A second type of error can be thought of as a computation error: either the results from the called subroutine are questionable, or the initiated calculation cannot be completed. For example, when one or more of the standardized residuals from a least squares fit cannot be computed because the standard deviation of the residual is zero, the results of the error estimates from the least squares regression may be questionable; if the least squares model is found to be singular, then the desired computations cannot be completed. In the case of a computation error, STARPAC generates a report which identifies the computation error, and, to aid the user in determining the cause of the error, summarizes the completed results in a printed report.

STARPAC error reports cannot be suppressed, even when the normal output from the STARPAC subroutine has been suppressed.† Because of this, users seldom have to consciously consider handling error conditions in their code.

When proper execution of the user's program depends on knowing whether or not an error has been detected, the error flag can be examined from within the user's code. When access to the error flag is desired, the statement

```
COMMON /ERRCHK/ IERR
```

must be placed with the Fortran declaration statements in the user's program. Following the execution of a STARPAC subroutine, the variable IERR will be set to zero if no errors were detected, and to a nonzero value otherwise; the value of IERR may indicate the type of error [e.g., see Donaldson and Tryon, 1983, chapter 1, §D, argument IERR]. If the CALL statement is followed with a statement of the form

```
IF (IERR .NE. 0) STOP
```

then the program will stop when an error is detected. (In figure C-1, the value of IERR has been printed following each CALL statement to show the value returned.)

---

†STARPAC output must be directed to a separate output device [see §D.4] when users do not want any STARPAC reports displayed under any conditions.

D.6 Common Programming Errors When Using STARPAC

STARPAC error checking procedures catch many programming errors and print informative diagnostics when such errors are detected. However, there are some errors which STARPAC cannot detect. The more common of these are discussed below.

1. The most common error involves array dimensions which are too small. Although certain arguments are checked by STARPAC to verify that array dimensions are adequate, if incorrect information is supplied to STARPAC, or if the dimension of an array which is not checked is too small, the program will produce erroneous results and/or will stop prematurely. Users should check the dimensioning statements in their program whenever difficulties are encountered in using STARPAC.

2. The second most common error involves incorrect CALL statements, that is, CALL statements in which the STARPAC subroutine name is misspelled, the arguments are incorrectly ordered, one or more arguments are omitted, or the argument types (INTEGER, REAL, DOUBLE PRECISION, and COMPLEX) are incorrect. Users having problems using STARPAC should carefully check their declaration and CALL statements to verify that they agree with the documentation.

3. The third most common error involves incorrect specification of the work vector DSTAK. Programs which call STARPAC subroutines requiring work area must include both the DOUBLE PRECISION statement dimensioning DSTAK and the COMMON /CSTAK/ DSTAK statement.

4. The final common error involves user-supplied subroutines which have the same name as a subroutine in the STARPAC library. Users should consult with the local installer of STARPAC to obtain a list of all STARPAC subroutine names. This list can then be used to ensure that a STARPAC subroutine name has not been duplicated.

Users who have not found the cause of a problem after checking the possibilities mentioned above should consult with their computing center advisers.

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NBS-114A (REV. 2-80)

U.S. DEPT. OF COMM. **BIBLIOGRAPHIC DATA SHEET** *(See instructions)*	1. PUBLICATION OR REPORT NO. NBS TN-1068-1	2. Performing Organ. Report No.	3. Publication Date October 1983

4. TITLE AND SUBTITLE

Introduction to STARPAC, The Standards Time Series and Regression Package

5. AUTHOR(S) Janet R. Donaldson and Peter V. Tryon

6. PERFORMING ORGANIZATION *(If joint or other than NBS, see instructions)*

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11. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)*

STARPAC, the Standards Time Series and Regression Package, is a library of Fortran subroutines for statistical data analysis developed by the Statistical Engineering Division (SED) of the National Bureau of Standards (NBS), Boulder, Colorado. Earlier versions of this library were distributed by the SED under the name STATLIB [Tryon and Donaldson, 1978]. STARPAC incorporates many changes to STATLIB, including additional statistical techniques, improved algorithms and enhanced portability. STARPAC emphasizes the statistical interpretation of results, and, for this reason, comprehensive printed reports of auxiliary statistical information, often in graphical form, are automatically provided to augment the basic statistical computations performed by each user-callable STARPAC subroutine. STARPAC thus provides the best features of many stand-alone statistical software programs within the flexible environment of a subroutine library. STARPAC documentation is being published as a series of Technical Notes. This Note is the first in the series. It gives an overview of the STARPAC library, defines conventions used in the documentation, provides an example using STARPAC subroutines, and presents general background material. This Note includes information which is essential for using the STARPAC library, and users should be familiar with its contents before attempting to use any STARPAC subroutine.

12. KEY WORDS *(Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)*

data analysis; STARPAC; STARPAC overview; statistical computing; statistical subroutine library; STATLIB.

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