RESPIRATORY METABOLISM OF THE
STREAM CADDISFLY GLOSSOSOMA NIGRIOR BANKS
(TRICHOPTERA: GLOSSOSOMATIDAE)¹

MASTER

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Note for AEC Review

This paper represents one of three (TD-C00-2002-17 through -19) on Glossosoma that are in preparation for submission to appropriate journals. Although some portions of the data and discussion were previously included in TD-C00-2002-3, it has been necessary to completely reorganize the information and rewrite the text material, not only to accomodate new data but also to produce a manuscript of sufficiently condensed form for publication.

To avoid unnecessary and costly duplication of effort, the paper is presented here in extended outline form, rather than as a part of the Progress Report per se (TD-C00-2002-20).

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Experimental Vessels

Controls

Fig. 1. Outline of methods for respiration experiments (Gilson differential respirometer). Respiration measured at temperature at which animals were collected and maintained. *Vessels with and without KOH are run in pairs (containing equal substrate, cases and animals). The actual uncorrected CO₂ produced is determined as: gas volume change in vessel with KOH (due to O₂ uptake) minus gas volume change in the vessel without KOH (due to O₂ uptake less the effect of CO₂ production).

Fig. 2. Plot of $\log_{10}$ respiration ($\mu\text{O}_2/\text{mg dry wt/hr}$) vs. mg dry wt/individual at 5, 11 and 16°C. Log-normal least squares fit; all regression coefficients significantly different from zero ($p < .05$). See Table 1 and text for further explanation.

Fig. 3. Plot of Augusta Creek *G. nigrilor* respiration ($\mu\text{O}_2/\text{mg dry wt}/\text{individual}/\text{hr}$) vs. temperature ($^{\circ}\text{C}$) by age class. (See Table 3.)

Table 1. Summary of regression ($y = \alpha + Bx$) analysis of Augusta Creek *G. nigrilor* respiration ($\mu\text{O}_2/\text{mg dry wt/hr}$). Log_{10} respiration regressed against mg dry weight/individual. N = number of determinations; B = regression coefficient; SE = standard error; α = y intercept significance; S = coefficient significantly different from zero at 95% level ($p < .05$); NS = not significant. (See Fig. 2)

Temp. (°C)	N	B	SE of B	Significance		$\bar{x}$ Log_{10} respiration
5.0	83	-0.3059	.0535	S	0.1288	-0.2808
9.0	36	-0.0514	.1498	NS	-	-
11.0	36	-0.3431	.0549	S	0.5890	-0.2218
14.0	8	-0.2519	.1349	NS	-	-
14.5	7	-1.0642	.4900	NS	-	-
15.0	15	-0.1600	.2087	NS	-	-
15.5	16	-0.0287	.0715	NS	-	-
16.0	64	-0.3122	.0427	S	0.5698	0.1608

Table 2. Corrected respiration estimates ($\mu\text{lo}_2/\text{mg/hr}$ and standard error) for G. nigrior size classes at various temperatures.

Size Class (instar)	Respiration and SE by Temperature ($^{\circ}\text{C}$)															
	5	SE	9	SE	11	SE	14	SE	14.5	SE	15	SE	15.5	SE	16	SE
I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.76	.97
II	-	-	-	-	-	-	-	-	-	-	-	-	1.78*	-	5.86	.45
III	1.72	.33	-	-	3.81	.99	-	-	-	-	-	-	-	-	-	-
IV	1.47	.15	1.33	0.17	3.25	.25	2.80	.10	.91	.60	2.02	0.19	5.27	.06	3.75	.64
V	0.72	.06	0.60	0.05	1.72	.25	2.06	.30	.63	.08	-	-	1.78	.19	1.06	.12
Prepupae	0.19	.05	0.05	0.01	-	-	-	-	-	-	-	-	-	-	.47	.05
Pupae	0.11	.01	-	-	-	-	-	-	-	-	(.56)*	-	-	-	-	-

* 1 determination

Table 3. Corrected Augusta Creek G. nigrrior respiration by temperature and size class for data with significant regressions. (See Fig. 2.)

Size class (instar)	Mean dry wt (mg)	Respiration $\mu\text{l}/\text{mg}/\text{hr}$	
		Estimate for winter calculation (5 °C)	Estimate for summer calculation (11-16 °C)
I	0.0144*	1.3317	6.7587
II	0.0277*	1.3192	5.8678
III	0.0851	1.2670	3.8037
IV	0.2854	1.1002	3.5010
V	0.8481	0.7401	1.3882
Prepupae	1.517	0.4620	0.4663
Pupae	1.937	0.1092	0.1085*

* Calculated values

Table 4. Comparison of Glossosoma nigrior respiration values with invertebrate data from the literature

Organism	Reference	Temp. (°C)	Volume O ₂ consumed/unit dry wt/hr			
			μl(mm ³)/gm/hr	ml(cc)/gm/hr	ml(cc)/mg/hr	μl/mg/hr
<u>Glossosoma nigrior</u>	1	5	740	0.740	0.0007	0.740
<u>Polycentropus flavomaculatus</u>	Collardeau, 1961	4	400	0.400	0.0004	0.400
<u>Plectrocnemia conspersa</u>		4	262	0.262	0.0003	0.262
<u>Limnephilus rhombicus</u>		4	296	0.296	0.0003	0.296
<u>Chloeon dipterum</u>	Fox and Simmonds, 1933	10	600	0.600	0.0006	0.600
<u>Baetis rhodani</u>		10	2571	2.571	0.0026	2.571
<u>Leptodora kindtii</u>	Moshiri et al.; 1969	5	1600	1.600	0.0016	1.600
<u>Orconectes immunis</u> ²	Weins and Armistage, 1960	16	132	0.132	0.0001	0.132
<u>Pacifastacus leniusculus</u> ³	Moshiri et al.; 1970	5	700	0.700	0.0007	0.700
<u>Diaptomus siciloides</u> ⁴	Comita, 1968	10	2237	2.237	0.0022	2.237
<u>Calanus finmarchicus</u> ⁵	Marshall et al., 1935	5	2800	2.800	0.0028	2.800
<u>Ephemera simulans</u>	Eriksen, 1963	13	230	0.230	0.0002	0.230
<u>Hexagenia limbata</u>		13	660	0.660	0.0007	0.660
<u>Tipula abdominalis</u> ⁶	Vannote, pers. comm.	5	330	0.300	0.0003	0.300

Notes

1. Data from work with the Gilson respirometer, instar V.
2. Assuming approx. 70% water in converting to dry wt.
3. Assuming approx. 20% ash in converting to dry wt.
4. Taking wt of 1 individual as 7.6 μg (0.0076 mg).
5. Taking wt of 1 individual as 100 μg (Leptodora size).
6. Terminal instar ♂ and ♀ larvae ($\bar{x}$ 80 mg).

Table 3. Corrected Augusta Creek G. nigrilor respiration by temperature and size class for data with significant regressions. (See Fig. 2.)

Size class (instar)	Mean dry wt (mg)	Respiration $\mu\text{l}/\text{mg}/\text{hr}$	
		Estimate for winter calculation (5 °C)	Estimate for summer calculation (11-16 °C)
I	0.0144*	1.3317	6.7587
II	0.0277*	1.3192	5.8678
III	0.0851	1.2670	3.8037
IV	0.2854	1.1002	3.5010
V	0.8481	0.7401	1.3882
Prepupae	1.517	0.4620	0.4663
Pupae	1.937	0.1092	0.1085*

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Notes

1. Data from work with the Gilson respirometer, instar V.
2. Assuming approx. 70% water in converting to dry wt.
3. Assuming approx. 20% ash in converting to dry wt.
4. Taking wt of 1 individual as 7.6 μg (0.0076 mg).
5. Taking wt of 1 individual as 100 μg (Leptodora size).
6. Terminal instar ♂ and ♀ larvae ($\bar{x}$ 80 mg).

Table 7. Comparison of Augusta Cr. and Linesville Cr. data on *G. nigrior* to Phillipson (1971) "best estimate" method. (Oxycalorific conversion = 4.825 Kcal/l O₂)

Generation	Average generation time (days) ¹		Total biomass (g/m ²) ¹		Mean stream temperature (°C)		"Best estimate" for generation at $\bar{x}$ stream temperature (μ l O ₂ /mg)		Annual respiratory expenditure from "best estimate"			
									liters O ₂ /m ² ⁴		Kcal/m ² ⁴	
	Augusta Cr.	Linesville Cr.	Augusta Cr.	Linesville Cr.	Augusta Cr.	Linesville Cr.	Augusta Cr.	Linesville Cr.	Augusta Cr.	Linesville Cr.	Augusta Cr.	Linesville Cr.
Summer		153		0.379		16.1		4584.0 ²		3.85		18.58
Winter		212		0.356		6.9		3323.7 ³		2.62		12.67

¹Means of two years

²Based on regression for 16°C ($\log y = 0.1288 + wt (-0.3059)$)

³Based on regression for 5°C ($\log y = 0.5698 + wt (-0.3122)$)

⁴Values for 4500 cm² converted to m² (x 2.22)

Table 7. Continued

Annual respiratory metabolism from Tables 5 and 6			
liters O_2/m^2		Kcal/ m^2	
Augusta Cr.	Linesville Cr.	Augusta Cr.	Linesville Cr.
Summer			14.30
Winter			5.44

SUMMARY OF RESPIRATION FOR
GLOSSOSOMA NIGRIOR RESPI

TEMP	SIZE CLASS	MICROLITERS/MG		DRY WGT/HR		
		MEAN	SD	SE	CV	N
5.0	3	1.8862 (CORRECTED)	1.4473	0.5117	76.73	8
		1.7219	0.8153	0.3328	47.35 ✓	6
5.0	4	1.6385 (CORRECTED)	0.9170	0.3057	55.96	9
		1.4702	0.3599	0.1469	24.48 ✓	6
5.0	5	0.8596 (CORRECTED)	0.5846	0.0853	68.01	47
		0.7246	0.3442	0.0574	47.50 ✓	36
5.0	6	0.3144 (CORRECTED)	0.3228	0.1318	102.68	6
		0.1891	0.1123	0.0502	59.35 ✓	5
5.0	7	0.1015 (CORRECTED)	0.0399	0.0126	39.31	10
		0.1092	0.0306	0.0116	28.04 ✓	7
5.0	36	0.1834 (CORRECTED)	0.1421	0.0820	77.48	3
		0.2639	0.0375	0.0265	14.23	2

> REGRESSION ANALYSIS COORDINATES FOR ABOVE TEMPERATURE

>	WEIGHT / IND	RESPIRATION IN UL/MG/HR
>	1	0.0683 2.6054
>	2	0.0783 1.1912
>	3	0.1683 3.2367
>	4	0.1750 2.1066
>	5	0.1867 1.7570
>	6	0.2100 0.5293
>	7	0.2150 4.6913
>	8	0.2200 0.4621
>	9	0.2400 0.0828
>	10	0.2600 0.4096
>	11	0.2767 0.9486
>	12	0.3050 2.9642
>	13	0.3350 2.8253
>	14	0.3667 0.8214
>	15	0.3800 0.8219
>	16	0.4800 2.1340
>	17	0.5000 1.1139
>	18	0.5300 0.3532
>	19	0.5667 0.0674
>	20	0.5667 1.9158
>	21	0.5750 0.9963
>	22	0.6200 1.3077
>	23	0.7133 0.9834
>	24	0.7200 1.3146
>	25	0.7333 0.6476
>	26	0.7900 0.4984
>	27	0.8275 1.2260
>	28	0.8333 1.6935
>	29	0.8650 1.3060
>	30	0.8667 0.2693
>	31	0.9333 1.3751
>	32	1.0200 2.1481
>	33	1.1067 1.9184
>	34	1.1480 1.3903
>	35	1.1900 0.7360
>	36	1.2333 0.7313
>	37	1.2400 0.5149
>	38	1.2633 0.5739
>	39	1.2825 1.3803
>	40	1.3367 0.4089
>	41	1.3500 0.3383
>	42	1.3875 0.6157
>	43	1.4067 0.8355
>	44	1.4400 1.7418
>	45	1.4833 0.9130
>	46	1.5333 1.4802
>	47	1.6133 0.5730
>	48	1.6333 0.5842
>	49	1.6333 1.0448
>	50	1.6500 1.6887
>	51	1.6600 0.9407
>	52	1.6750 0.0222
>	53	1.6833 0.0697
>	54	1.7000 1.0174

>	55	1.7100	1.2666
>	56	1.7667	0.5698
>	57	1.7920	0.2905
>	58	1.8250	0.1399
>	59	1.8333	0.3118
>	60	1.8800	0.2375
>	61	1.8875	0.2174
>	62	1.9000	1.6249
>	63	1.9000	0.5628
>	64	1.9175	0.1299
>	65	1.9175	0.1298
>	66	1.9200	0.2631
>	67	1.9333	0.3599
>	68	1.9450	0.0680
>	69	2.0050	0.0490
>	70	2.0125	0.0480
>	71	2.0167	0.1761
>	72	2.0600	0.5828
>	73	2.1000	0.3512
>	74	2.1700	0.3372
>	75	2.2150	0.0861
>	76	2.2150	0.2374
>	77	2.2333	0.0839
>	78	2.3000	0.3210
>	79	2.3933	0.0774
>	80	2.4950	0.1530
>	81	2.6000	0.1335
>	82	3.1000	0.4454
>	83	5.8000	0.1108

> REGRESSION ANALYSIS FOR NORMAL DATA

> MEANS OF X AND Y COORDINATES
 > MEAN X = 1.338785
 > MEAN Y = 0.887802

> REGRESSION COEFFICIENT
 > B = -0.503756
 > Y INTERCEPT
 > A = 1.562223
 > CORRELATION COEFFICIENT
 > R = -0.518419
 > STANDARD ERROR OF REGRESSION COEFFICIENT
 > SE = 0.092327
 > CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT
 > TS = -5.45623
 > 95% CONFIDENCE LIMITS OF REGRES.COEF.
 > L1 = -0.688409
 > L2 = -0.319102

>	ANALYSIS OF VARIANCE			
>	SOURCE OF VARIATION	DF	SS	MS
>	EXPLAINED DUE TO			
>	LINEAR REGRESSION	1	16.2370	16.2370

UNEXPLAINED ERROR
AROUND REGRESSION
LINE

81. 44.1780 0.5454

TOTAL

82. 60.4150

> REGRESSION ANALYSIS FOR LOG-NORMAL DATA

> FORM $\log Y = \log A + X \cdot \log B$ OR $Y = AB^{**}X$

MEANS OF X AND Y COORDINATES

MEAN X = 1.338785

MEAN Y = -0.280872

REGRESSION COEFFICIENT

B = -0.305995

Y INTERCEPT

A = 0.128789

CORRELATION COEFFICIENT

R = -0.536204

STANDARD ERROR OF REGRESSION COEFFICIENT

SE = 0.053522

CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

TS = -5.71722

95% CONFIDENCE LIMITS OF REGRES.COEF.

L1 = -0.413038

L2 = -0.198952

ANALYSIS OF VARIANCE

SOURCE OF VARIATION

DF

SS

MS

EXPLAINED DUE TO
LINEAR REGRESSION

1

5.9909

5.9909

UNEXPLAINED ERROR
AROUND REGRESSION
LINE

81.

14.8460

0.1833

TOTAL

82.

20.8370

> REGRESSION ANALYSIS FOR LOG-LOG FIT DATA

> FORM $\log Y = \log A + B \cdot \log X$ OR $Y = AX^{**}B$

MEANS OF X AND Y COORDINATES

MEAN X = 0.001119

MEAN Y = -0.280872

REGRESSION COEFFICIENT

B = -0.662102

Y INTERCEPT

A = -0.280131

CORRELATION COEFFICIENT

R = -0.504740

STANDARD ERROR OF REGRESSION COEFFICIENT

SE = 0.125823

CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

TS = -5.26215

95% CONFIDENCE LIMITS OF REGRES.COEF.

L1 = -0.913749

L2 = -0.410455

ANALYSIS OF VARIANCE		DF	SS	MS
SOURCE OF VARIATION				
EXPLAINED DUE TO LINEAR REGRESSION		1	5.3085	5.3085
UNEXPLAINED ERROR AROUND REGRESSION LINE		81.	15.5285	0.1917
TOTAL		82.	20.8370	

TEMP	SIZE CLASS	MICROLITERS/MG		DRY WGHT/HR		N
		MEAN	SD	SE	CV	
9.0	3	0.2016				
9.0	4	1.3050 (CORRECTED)	0.6402	0.2614	49.06	6
		1.3296	0.3475	0.1737	26.13	4
9.0	5	0.6886 (CORRECTED)	0.5133	0.1027	74.55	25
		0.6014	0.2271	0.0496	37.76	21
9.0	6	0.0439 (CORRECTED)	0.0235	0.0117	53.46	4
		0.0536	0.0159	0.0092	29.72	3

> REGRESSION ANALYSIS COORDINATES FOR ABOVE TEMPERATURE

	WEIGHT / IND	RESPIRATION IN UL/MG/HR
1	0.1520	0.2016
2	0.3167	1.7110
3	0.3217	2.1723
4	0.3733	0.9242
5	0.3733	0.8724
6	0.4950	1.5131
7	0.5000	0.9387
8	0.7800	1.1556
9	0.7800	0.3393
10	0.8500	0.0841
11	0.8750	0.0146
12	0.8750	0.0642
13	0.9000	0.2152
14	0.9167	0.4025
15	0.9167	2.3584
16	0.9556	0.2765
17	0.9556	1.1018
18	1.1000	0.4739
19	1.1182	0.0353
20	1.1182	0.0614
21	1.1500	0.4735

>	22	1.2000	0.7950
>	23	1.2333	0.7107
>	24	1.2333	0.3897
>	25	1.3571	0.5850
>	26	1.3571	0.7685
>	27	1.4333	1.9893
>	28	1.5500	0.4927
>	29	1.6500	0.6552
>	30	1.7000	0.7057
>	31	1.8667	0.4658
>	32	1.9000	0.7516
>	33	2.0500	0.1530
>	34	2.1000	0.4027
>	35	2.3125	0.7376
>	36	2.3250	0.4294

> REGRESSION ANALYSIS FOR NORMAL DATA

> MEANS OF X AND Y COORDINATES

> MEAN X = 1.141424
 > MEAN Y = 0.706153

> REGRESSION COEFFICIENT

> B = -0.269477

> Y INTERCEPT

> A = 1.013740

> CORRELATION COEFFICIENT

> R = -0.259307

> STANDARD ERROR OF REGRESSION COEFFICIENT

> SE = 0.172129

> CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

> TS = -1.56555

> 95% CONFIDENCE LIMITS OF REGRES.COEF.

> L1 = -0.613735

> L2 = 0.074781

> ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	0.8434	0.8434
UNEXPLAINED ERROR AROUND REGRESSION LINE	34.	11.6996	0.3441
TOTAL	35.	12.5430	

> REGRESSION ANALYSIS FOR LOG-NORMAL DATA

> FORM $\log Y = \log A + X \cdot \log B$ OR $Y = AB^{**X}$

> MEANS OF X AND Y COORDINATES

> MEAN X = 1.141424

> MEAN Y = -0.350250

> REGRESSION COEFFICIENT
 > B = -0.051429
 > Y INTERCEPT
 > A = -0.291548
 > CORRELATION COEFFICIENT
 > R = -0.058775
 > STANDARD ERROR OF REGRESSION COEFFICIENT
 > SE = 0.149805
 > CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT
 > TS = -0.34331
 > 95% CONFIDENCE LIMITS OF REGRES.COEF.
 > L1 = -0.351039
 > L2 = 0.248180

ANALYSIS OF VARIANCE			
SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	0.0307	0.0307
UNEXPLAINED ERROR AROUND REGRESSION LINE	34.	8.8617	0.2606
TOTAL	35.	8.8924	

> REGRESSION ANALYSIS FOR LOG-LOG FIT DATA
 > FORM $\log Y = \log A + B * \log X$ OR $Y = AX^{*B}$

> MEANS OF X AND Y COORDINATES
 > MEAN X = -0.011138
 > MEAN Y = -0.350250

> REGRESSION COEFFICIENT
 > B = -0.217985
 > Y INTERCEPT
 > A = -0.352678
 > CORRELATION COEFFICIENT
 > R = -0.117780
 > STANDARD ERROR OF REGRESSION COEFFICIENT
 > SE = 0.315197
 > CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT
 > TS = -0.69158
 > 95% CONFIDENCE LIMITS OF REGRES.COEF.
 > L1 = -0.848380
 > L2 = 0.412409

ANALYSIS OF VARIANCE			
SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	0.1234	0.1234
UNEXPLAINED ERROR AROUND REGRESSION LINE	34.	8.7690	0.2579
TOTAL	35.	8.8924	

	TEMP	SIZE CLASS	MICROLITERS/MG DRY WGHT/HR				
			MEAN	SD	SE	CV	N
>	11.0	3	3.8037	1.4043	0.9930	36.92	2
>			(CORRECTED)				
>			3.8037	1.4043	0.9930	36.92	2
>	11.0	4	3.7913	1.5324	0.5418	40.42	8
>			(CORRECTED)				
>			3.2531	0.5635	0.2520	17.32	5
>	11.0	5	1.9105	1.4861	0.2914	77.79	26
>			(CORRECTED)				
>			1.7171	1.0104	0.2526	58.84	16

> REGRESSION ANALYSIS COORDINATES FOR ABOVE TEMPERATURE

	WEIGHT / IND	RESPIRATION IN UL/MG/HR
--	--------------	-------------------------

>	1	0.0850	2.8107
>	2	0.1100	4.7967
>	3	0.1467	5.4035
>	4	0.1767	3.8719
>	5	0.2000	3.2458
>	6	0.2533	2.4687
>	7	0.2533	3.2304
>	8	0.2933	3.3600
>	9	0.4100	4.6675
>	10	0.4200	6.6263
>	11	0.4333	0.5460
>	12	0.4500	4.2522
>	13	0.4900	3.8878
>	14	0.4950	2.0352
>	15	0.6000	2.1099
>	16	0.6000	2.9495
>	17	0.6150	2.8707
>	18	0.6500	2.3382
>	19	0.6500	3.5382
>	20	0.6500	2.0514
>	21	0.7250	3.4496
>	22	0.8400	0.8115
>	23	0.8500	4.4348
>	24	1.0000	2.9506
>	25	1.0333	0.6650
>	26	1.6000	0.4552
>	27	1.8000	0.2994
>	28	1.9000	2.4662
>	29	1.9200	1.2545
>	30	2.0200	0.3252
>	31	2.3167	0.0820
>	32	2.3500	0.9051
>	33	2.4500	0.6999
>	34	2.9333	0.3451
>	35	3.2200	1.0388
>	36	3.6000	0.3667

> REGRESSION ANALYSIS FOR NORMAL DATA

> MEANS OF X AND Y COORDINATES

> MEAN X = 1.070556
 > MEAN Y = 2.433617

> REGRESSION COEFFICIENT

> B = -1.206971

> Y INTERCEPT

> A = 3.725746

> CORRELATION COEFFICIENT

> R = -0.692576

> STANDARD ERROR OF REGRESSION COEFFICIENT

> SE = 0.215592

> CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

> TS = -5.59840

> 95% CONFIDENCE LIMITS OF REGRES.COEF.

> L1 = -1.638155

> L2 = -0.775786

> ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	47.6016	47.6016
UNEXPLAINED ERROR AROUND REGRESSION LINE	34.	51.6384	1.5188
TOTAL	35.	99.2401	

> REGRESSION ANALYSIS FOR LOG-NORMAL DATA

> FORM $\log Y = \log A + X \cdot \log B$ OR $Y = AB^{**X}$

> MEANS OF X AND Y COORDINATES

> MEAN X = 1.070556

> MEAN Y = 0.221779

> REGRESSION COEFFICIENT

> B = -0.343056

> Y INTERCEPT

> A = 0.589040

> CORRELATION COEFFICIENT

> R = -0.730918

> STANDARD ERROR OF REGRESSION COEFFICIENT

> SE = 0.054934

> CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

> TS = -6.24492

> 95% CONFIDENCE LIMITS OF REGRES.COEF.

> L1 = -0.452924

> L2 = -0.233189

> ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
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>	EXPLAINED DUE TO			
>	LINEAR REGRESSION	1	3.8456	3.8456
>	UNEXPLAINED ERROR			
>	AROUND REGRESSION			
>	LINE	34.	3.3526	0.0986
>	TOTAL	35.	7.1982	

> REGRESSION ANALYSIS FOR LOG-LOG FIT DATA
 > FORM $\log Y = \log A + B * \log X$ OR $Y = AX^{**}B$

> MEANS OF X AND Y COORDINATES
 > MEAN X = -0.156485
 > MEAN Y = 0.221779

> REGRESSION COEFFICIENT
 > B = -0.743545
 > Y INTERCEPT
 > A = 0.105425
 > CORRELATION COEFFICIENT
 > R = -0.706922
 > STANDARD ERROR OF REGRESSION COEFFICIENT
 > SE = 0.127583
 > CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT
 > TS = -5.82791
 > 95% CONFIDENCE LIMITS OF REGRES.COEF.
 > L1 = -0.998712
 > L2 = -0.488378

>	ANALYSIS OF VARIANCE			
>	SOURCE OF VARIATION	DF	SS	MS
>	EXPLAINED DUE TO			
>	LINEAR REGRESSION	1	3.5972	3.5972
>	UNEXPLAINED ERROR			
>	AROUND REGRESSION			
>	LINE	34.	3.6010	0.1059
>	TOTAL	35.	7.1982	

TEMP	SIZE CLASS	MICROLITERS/MG DRY WGHT/HR				N
		MEAN	SD	SE	CV	
14.0	3	4.6497				
14.0	4	2.6407	1.5508	0.7754	58.73	4
		(CORRECTED)				
		2.7995	0.1388	0.0982	4.96	2
14.0	5	2.5714	0.9371	0.5410	36.44	3
		(CORRECTED)				
		2.0598	0.4308	0.3046	20.91	2

> REGRESSION ANALYSIS COORDINATES FOR ABOVE TEMPERATURE
 > WEIGHT / IND RESPIRATION IN UL/MG/HR

1	0.0800	4.3652
2	0.0875	4.6497
3	0.3367	2.8977
4	0.6250	2.7014
5	0.7867	3.5947
6	1.1467	0.5984
7	1.1667	2.3644
8	2.1350	1.7552

> REGRESSION ANALYSIS FOR NORMAL DATA

> MEANS OF X AND Y COORDINATES
 > MEAN X = 0.795521
 > MEAN Y = 2.865837

> REGRESSION COEFFICIENT
 > B = -1.450583
 > Y INTERCEPT
 > A = 4.019807
 > CORRELATION COEFFICIENT
 > R = -0.742819
 > STANDARD ERROR OF REGRESSION COEFFICIENT
 > SE = 0.533740
 > CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT
 > TS = -2.71777
 > 95% CONFIDENCE LIMITS OF REGRES.COEF.
 > L1 = -2.518062
 > L2 = -0.383104

> ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	6.9611	6.9611
UNEXPLAINED ERROR AROUND REGRESSION LINE	6	5.6546	0.9424
TOTAL	7	12.6158	

> REGRESSION ANALYSIS FOR LOG-NORMAL DATA
 > FORM $\log Y = \log A + X \cdot \log B$ OR $Y = AB^{**X}$

> MEANS OF X AND Y COORDINATES

> MEAN X = 0.795521
 > MEAN Y = 0.393972

> REGRESSION COEFFICIENT

> B = -0.251903

> Y INTERCEPT

> A = 0.594365

> CORRELATION COEFFICIENT

> R = -0.606350

> STANDARD ERROR OF REGRESSION COEFFICIENT

> SE = 0.134868

> CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

> TS = -1.86777

> 95% CONFIDENCE LIMITS OF REGRES.COEF.

> L1 = -0.521639

> L2 = 0.017834

> ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	0.2099	0.2099
UNEXPLAINED ERROR AROUND REGRESSION LINE	6.	0.3610	0.0602
TOTAL	7.	0.5710	

> REGRESSION ANALYSIS FOR LOG-LOG FIT DATA

> FORM $\log Y = \log A + B \cdot \log X$ OR $Y = AX^{**B}$

> MEANS OF X AND Y COORDINATES

> MEAN X = -0.310031

> MEAN Y = 0.393972

> REGRESSION COEFFICIENT

> B = -0.361334

> Y INTERCEPT

> A = 0.281947

> CORRELATION COEFFICIENT

> R = -0.667106

> STANDARD ERROR OF REGRESSION COEFFICIENT

> SE = 0.164731

> CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

> TS = -2.19349

> 95% CONFIDENCE LIMITS OF REGRES.COEF.

> L1 = -0.690795

> L2 = -0.031873

> ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	0.2541	0.2541
UNEXPLAINED ERROR AROUND REGRESSION LINE	6.	0.3169	0.0528
TOTAL	7.	0.5710	

TEMP	SIZE CLASS	MICROLITERS/MG DRY WGHT/HR		SE	CV	N
		MEAN	SD			
14.5	4	1.9127	2.1789	1.0895	113.92	4
		(CORRECTED)				
		0.9079	1.0315	0.5956	113.62	3
14.5	5	0.6278	0.1103	0.0780	17.57	2
		(CORRECTED)				
		0.6278	0.1103	0.0780	17.57	2
14.5	6	1.5691				

REGRESSION ANALYSIS COORDINATES FOR ABOVE TEMPERATURE

	WEIGHT / IND	RESPIRATION IN UL/MG/HR
1	0.3200	0.7058
2	0.4000	4.9270
3	0.5200	2.0967
4	0.5667	0.5498
5	0.6000	1.5691
6	0.8400	0.3785
7	1.2000	0.2486

REGRESSION ANALYSIS FOR NORMAL DATA

MEANS OF X AND Y COORDINATES

MEAN X = 0.635238
 MEAN Y = 1.496500

REGRESSION COEFFICIENT

B = -2.801365

Y INTERCEPT

A = 3.276034

CORRELATION COEFFICIENT

R = -0.504924

STANDARD ERROR OF REGRESSION COEFFICIENT

SE = 2.141669

CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

TS = -1.30803

95% CONFIDENCE LIMITS OF REGRES.COEF.

L1 = -7.084702

L2 = 1.481973

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	4.1971	4.1971
UNEXPLAINED ERROR AROUND REGRESSION LINE	5	12.2654	2.4531
TOTAL	6	16.4625	

> REGRESSION ANALYSIS FOR LOG-NORMAL DATA
 > FORM $\log Y = \log A + X \cdot \log B$ OR $Y = AB^{**}X$

> MEANS OF X AND Y COORDINATES

> MEAN X = 0.635238
 > MEAN Y = -0.032540

> REGRESSION COEFFICIENT

> B = -1.064187

> Y INTERCEPT

> A = 0.643473

> CORRELATION COEFFICIENT

> R = -0.696716

> STANDARD ERROR OF REGRESSION COEFFICIENT

> SE = 0.490012

> CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

> TS = -2.17176

> 95% CONFIDENCE LIMITS OF REGRES.COEF.

> L1 = -2.044211

> L2 = -0.084163

> ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	0.6057	0.6057
UNEXPLAINED ERROR AROUND REGRESSION LINE	5.	0.6421	0.1284
TOTAL	6.	1.2478	

> REGRESSION ANALYSIS FOR LOG-LOG FIT DATA

> FORM $\log Y = \log A + B \cdot \log X$ OR $Y = AX^{**}B$

> MEANS OF X AND Y COORDINATES

> MEAN X = -0.234550

> MEAN Y = -0.032540

> REGRESSION COEFFICIENT

> B = -1.542622

> Y INTERCEPT

> A = -0.394361

> CORRELATION COEFFICIENT

> R = -0.649011

> STANDARD ERROR OF REGRESSION COEFFICIENT

> SE = 0.808688

> CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

> TS = -1.90756

> 95% CONFIDENCE LIMITS OF REGRES.COEF.

> L1 = -3.159999

> L2 = 0.074754

> ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	0.5256	0.5256
UNEXPLAINED ERROR AROUND REGRESSION LINE	5.	0.7222	0.1444
TOTAL	6.	1.2478	

TEMP	SIZE CLASS	MICROLITERS/MG DRY WGHT/HR				N
		MEAN	SD	SE	CV	
15.0	5	1.8910	1.2572	0.3360	66.48	14
		(CORRECTED)				
		2.0198	0.5834	0.1945	28.88	9
15.0	7	0.5591				

> REGRESSION ANALYSIS COORDINATES FOR ABOVE TEMPERATURE
 WEIGHT / IND RESPIRATION IN UL/MG/HR

1	0.3333	0.5591
2	0.3400	2.0175
3	0.3800	0.1408
4	0.5450	4.0721
5	0.7333	2.7404
6	0.7550	1.8924
7	0.7950	3.8115
8	0.8000	0.1715
9	0.8533	0.0996
10	0.8833	1.4928
11	1.1000	2.4202
12	1.1233	2.9331
13	1.6800	1.3243
14	1.8000	1.3638
15	2.9400	1.9935

> REGRESSION ANALYSIS FOR NORMAL DATA

MEANS OF X AND Y COORDINATES
 MEAN X = 1.004111
 MEAN Y = 1.802173

REGRESSION COEFFICIENT
 B = 0.076901
 Y INTERCEPT
 A = 1.724957
 CORRELATION COEFFICIENT
 R = 0.041962
 STANDARD ERROR OF REGRESSION COEFFICIENT
 SE = 0.507827
 CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT
 TS = 0.15143
 95% CONFIDENCE LIMITS OF REGRES.COEF.
 L1 = -0.938753
 L2 = 1.092553

ANALYSIS OF VARIANCE			
SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	0.0391	0.0391
UNEXPLAINED ERROR AROUND REGRESSION LINE	13.	22.1627	1.7048
TOTAL	14.	22.2018	

> REGRESSION ANALYSIS FOR LOG-NORMAL DATA
 > FORM LOG Y = LOG A + X*LOG B OR Y = AB**X

> MEANS OF X AND Y COORDINATES

> MEAN X = 1.004111
 > MEAN Y = 0.061380

> REGRESSION COEFFICIENT

> B = 0.160018

> Y INTERCEPT

> A = -0.099296

> CORRELATION COEFFICIENT

> R = 0.208023

> STANDARD ERROR OF REGRESSION COEFFICIENT

> SE = 0.208679

> CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

> TS = -0.76681

> 95% CONFIDENCE LIMITS OF REGRES.COEF.

> L1 = -0.257340

> L2 = 0.577376

> ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	0.1693	0.1693
UNEXPLAINED ERROR AROUND REGRESSION LINE	13.	3.7424	0.2879
TOTAL	14.	3.9117	

> REGRESSION ANALYSIS FOR LOG-LOG FIT DATA

> FORM LOG Y = LOG A +B * LOG X OR Y = AX**B

> MEANS OF X AND Y COORDINATES

> MEAN X = -0.077646

> MEAN Y = 0.061380

> REGRESSION COEFFICIENT

> B = 0.469931

> Y INTERCEPT

> A = 0.097868

> CORRELATION COEFFICIENT

> R = 0.237882

> STANDARD ERROR OF REGRESSION COEFFICIENT

> SE = 0.532172

> CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

> TS = 0.88304

> 95% CONFIDENCE LIMITS OF REGRES.COEF.

> L1 = -0.594413

> L2 = 1.534274

> ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	0.2214	0.2214
UNEXPLAINED ERROR AROUND REGRESSION LINE	13.	3.6903	0.2839
TOTAL	14.	3.9117	

>	TEMP	SIZE CLASS	MICROLITERS/MG DRY WGHT/HR				N
			MEAN	SD	SE	CV	
>	15.5	2	1.7874				
>	15.5	4	5.2689	0.0865	0.0611	1.64	2
>			(CORRECTED)				
>			5.2689	0.0865	0.0611	1.64	2
>	15.5	5	2.1494	1.2668	0.3657	58.94	12
>			(CORRECTED)				
>			1.7694	0.5762	0.1921	32.57	9
>	15.5	7	1.8959				

> REGRESSION ANALYSIS COORDINATES FOR ABOVE TEMPERATURE

>	WEIGHT / IND	RESPIRATION IN UL/MG/HR
>	1	0.2200
>	2	0.2600
>	3	0.3300
>	4	0.3450
>	5	0.3500
>	6	0.3700
>	7	0.7000
>	8	0.8000
>	9	1.1000
>	10	1.1500
>	11	1.2500
>	12	1.4450
>	13	1.5000
>	14	1.6333
>	15	1.7550
>	16	4.0400

> REGRESSION ANALYSIS FOR NORMAL DATA

> MEANS OF X AND Y COORDINATES

>	MEAN X =	1.078021
>	MEAN Y =	2.500869

> REGRESSION COEFFICIENT

> B = -0.321828

> Y INTERCEPT

> A = 2.847806

> CORRELATION COEFFICIENT

> R = -0.199945

> STANDARD ERROR OF REGRESSION COEFFICIENT

> SE = 0.421492

> CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

> TS = -0.76355

> 95% CONFIDENCE LIMITS OF REGRES.COEF.

> L1 = -1.164811

> L2 = 0.521155

ANALYSIS OF VARIANCE			
SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	1.4129	1.4129
UNEXPLAINED ERROR AROUND REGRESSION LINE	14.	33.9293	2.4235
TOTAL	15.	35.3422	

> REGRESSION ANALYSIS FOR LOG-NORMAL DATA
 > FORM $\log Y = \log A + X \cdot \log B$ OR $Y = AB^{**}X$

> MEANS OF X AND Y COORDINATES
 > MEAN X = 1.078021
 > MEAN Y = 0.325913

> REGRESSION COEFFICIENT
 > B = -0.028659
 > Y INTERCEPT
 > A = 0.356808
 > CORRELATION COEFFICIENT
 > R = -0.106461
 > STANDARD ERROR OF REGRESSION COEFFICIENT
 > SE = 0.071537
 > CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT
 > TS = -0.40062
 > 95% CONFIDENCE LIMITS OF REGRES.COEF.
 > L1 = -0.171733
 > L2 = 0.114415

ANALYSIS OF VARIANCE			
SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	0.0112	0.0112
UNEXPLAINED ERROR AROUND REGRESSION LINE	14.	0.9774	0.0698
TOTAL	15.	0.9886	

> REGRESSION ANALYSIS FOR LOG-LOG FIT DATA
 > FORM $\log Y = \log A + B \cdot \log X$ OR $Y = AX^{**}B$

> MEANS OF X AND Y COORDINATES
 > MEAN X = -0.107945
 > MEAN Y = 0.325913

> REGRESSION COEFFICIENT
 > B = -0.119724
 > Y INTERCEPT
 > A = 0.312989
 > CORRELATION COEFFICIENT
 > R = -0.170525
 > STANDARD ERROR OF REGRESSION COEFFICIENT
 > SE = 0.184893
 > CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT
 > TS = -0.64753
 > 95% CONFIDENCE LIMITS OF REGRES.COEF.
 > L1 = -0.489510
 > L2 = 0.250062

> ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	0.0287	0.0287
UNEXPLAINED ERROR AROUND REGRESSION LINE	14.	0.9598	0.0686
TOTAL	15.	0.9886	

TEMP	SIZE CLASS	MICROLITERS/MG DRY WGHT/HR				N
		MEAN	SD	SE	CV	
16.0	1	6.7587	1.3734	0.9712	20.32	2
		(CORRECTED)				
		6.7587	1.3734	0.9712	20.32	2
16.0	2	6.1306	2.3819	1.0652	38.85	5
		(CORRECTED)				
		5.8678	0.7771	0.4487	13.24	3
16.0	4	3.7662	2.0005	0.8167	53.12	6
		(CORRECTED)				
		3.7488	1.2962	0.6481	34.58	4
16.0	5	1.7568	1.7776	0.2566	101.19	48
		(CORRECTED)				
		1.0592	0.7401	0.1170	69.87	40
16.0	6	0.3412	0.2233	0.1289	65.44	3
		(CORRECTED)				
		0.4663	0.0758	0.0536	16.26	2

✓ REGRESSION ANALYSIS COORDINATES FOR ABOVE TEMPERATURE

✓ WEIGHT / IND RESPIRATION IN UL/MG/HR

✓	1	0.0067	5.7876
✓	2	0.0107	7.7299
✓	3	0.0129	6.2003
✓	4	0.0130	3.2871
✓	5	0.0130	9.7628
✓	6	0.0210	4.9797
✓	7	0.0210	6.4233
✓	8	0.1000	1.8927
✓	9	0.1214	3.8351
✓	10	0.2778	1.0653
✓	11	0.2950	4.7372
✓	12	0.3000	6.3418
✓	13	0.3100	6.5364
✓	14	0.3275	3.9580
✓	15	0.3283	4.4574
✓	16	0.3400	1.3945
✓	17	0.4025	0.0909
✓	18	0.4200	6.7843
✓	19	0.5075	2.4587
✓	20	0.5140	4.0223
✓	21	0.5200	4.1536
✓	22	0.6500	5.7244
✓	23	0.6600	0.9614
✓	24	0.7560	4.5304
✓	25	0.8500	3.4454
✓	26	0.9060	3.3492
✓	27	1.0750	6.5137
✓	28	1.1000	0.7804
✓	29	1.1225	1.5603
✓	30	1.2250	0.7578
✓	31	1.2286	1.1858
✓	32	1.2425	0.5094
✓	33	1.2475	1.7048
✓	34	1.3250	0.9642
✓	35	1.4000	2.4663
✓	36	1.4925	0.9981
✓	37	1.5250	0.2287
✓	38	1.5400	0.7832
✓	39	1.6000	0.4534
✓	40	1.6250	0.4232
✓	41	1.7000	0.5166
✓	42	1.7500	0.7450
✓	43	1.7833	0.9838
✓	44	1.7833	1.9770
✓	45	1.8000	0.9190
✓	46	1.9950	0.6190
✓	47	1.9960	0.4127
✓	48	2.0250	0.7380
✓	49	2.0600	1.1384
✓	50	2.1000	0.9045
✓	51	2.1250	0.8343
✓	52	2.2400	0.7863
✓	53	2.2900	0.7446

>	54	2.3500	0.6020
>	55	2.3500	0.8014
>	56	2.3550	1.1698
>	57	2.4000	0.6495
>	58	2.4725	1.0027
>	59	2.6000	0.2511
>	60	2.8000	0.7006
>	61	2.8250	0.7541
>	62	3.1500	0.5199
>	63	3.2500	0.5601
>	64	4.2000	0.5460

> REGRESSION ANALYSIS FOR NORMAL DATA

> MEANS OF X AND Y COORDINATES

>	MEAN X =	1.309891
>	MEAN Y =	2.376803

> REGRESSION COEFFICIENT

>	B =	-1.650555
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> Y INTERCEPT

>	A =	4.538850
---	-----	----------

> CORRELATION COEFFICIENT

>	R =	-0.693343
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> STANDARD ERROR OF REGRESSION COEFFICIENT

>	SE =	0.217864
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> CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT

>	TS =	-7.57608
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> 95% CONFIDENCE LIMITS OF REGRES.COEF.

>	L1 =	-2.086282
>	L2 =	-1.214827

> ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	165.6225	165.6225
UNEXPLAINED ERROR AROUND REGRESSION LINE	62.	178.9047	2.8856
TOTAL	63.	344.5273	

> REGRESSION ANALYSIS FOR LOG-NORMAL DATA

> FORM $\log Y = \log A + X \cdot \log B$ OR $Y = AB^{**X}$

> MEANS OF X AND Y COORDINATES

>	MEAN X =	1.309891
>	MEAN Y =	0.160883

> REGRESSION COEFFICIENT

>	B =	-0.312230
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> Y INTERCEPT

> A = 0.569871
 > CORRELATION COEFFICIENT
 > R = -0.680381
 > STANDARD ERROR OF REGRESSION COEFFICIENT
 > SE = 0.042712
 > CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT
 > TS = -7.31017
 > 95% CONFIDENCE LIMITS OF REGRES.COEF.
 > L1 = -0.397654
 > L2 = -0.226807

ANALYSIS OF VARIANCE			
SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	5.9266	5.9266
UNEXPLAINED ERROR AROUND REGRESSION LINE	62.	6.8762	0.1109
TOTAL	63.	12.8028	

> REGRESSION ANALYSIS FOR LOG-LOG FIT DATA
 > FORM $\log Y = \log A + B * \log X$ OR $Y = AX^{**}B$

> MEANS OF X AND Y COORDINATES
 > MEAN X = -0.164254
 > MEAN Y = 0.160883

> REGRESSION COEFFICIENT
 > B = -0.432907
 > Y INTERCEPT
 > A = 0.089777
 > CORRELATION COEFFICIENT
 > R = -0.674513
 > STANDARD ERROR OF REGRESSION COEFFICIENT
 > SE = 0.060175
 > CRITICAL VALUE OF T FOR REGRESSION COEFFICIENT
 > TS = -7.19409
 > 95% CONFIDENCE LIMITS OF REGRES.COEF.
 > L1 = -0.553258
 > L2 = -0.312556

ANALYSIS OF VARIANCE			
SOURCE OF VARIATION	DF	SS	MS
EXPLAINED DUE TO LINEAR REGRESSION	1	5.8249	5.8249
UNEXPLAINED ERROR AROUND REGRESSION LINE	62.	6.9779	0.1125
TOTAL	63.	12.8028	