STAT 170 – Regression and Time Series
Drake University, Fall 2024
William M. Boal

EXAMINATION 2 ANSWER KEY
"Two-Variable Regression"

Version A

I. Multiple choice
(1)b. (2)d. (3)b. (4)a. (5)b. (6)c. (7)c. (8)b. (9)a.

II. Short answer

(1)	a. true	b. false	c. false	d. true	
(2)	a. 12	b. 0.48			
(3)	a. 5	b. 0	c. 0		
(4)	a. not req'd	b. not req'd	c. not req'd	d. required	e. not req'd
(5)	a. not req'd	b. not req'd	c. required	d. required	e. required
(6)	a. not req'd	b. required	c. required	d. required	e. required
(7)	a. false	b. true	c. false	d. true	
(8)	a. true	b. false	c. false	d. true	
(9)	a. 1392 (no change)		b. -3700	c. 0.25 (no change)	
	d. -7.4 (no change)				

III. Problems

(1) a. 65 + 22×70 = \$1605.
b. Δy = 10×22 = \$220.
c. 95% confidence interval for intercept = 65 ± 1.96×20 = 65 ± 39.2 = (25.8, 140.2) .
d. test statistic = 4.4, critical point = 1.645, can reject null hypothesis at 5%.

(2) a. DOF = 22-2 = 20.
b. 90% confidence interval for slope = 18 ± 1.725×0.05 = 0.18 ± 0.08625 = (0.0938, 0.2663) .
c. Should transform x variable (income) by subtracting \$400.
d. Predicted food expenditures = intercept of transformed equation = \$85.9.
e. Standard error of prediction error = $\sqrt{9.5^2 + 682} = 27.79$.
f. 95% prediction interval = 85.9 ± 2.086×27.79 = 85.9 ± 57.97 = (27.9, 143.9) .

IV. Critical thinking

(1) The two most important reasons why we should care whether the error term is distributed as normal are as follows. First, if the error term is normal, one can compute standard errors, confidence intervals, and t-tests even *when the sample is small*, using the t-distribution. Second, if the error term is normal, then one can compute *prediction intervals*. A less important reason is that least squares estimators become *maximum likelihood* estimators if the error terms are

normal, which implies that they are best (lowest-variance) among all unbiased estimators ("BUE").

(2) One should *disagree* with this statement. Ordinary least squares is not limited to fitting linear relationships ($y = \beta_1 + \beta_2\, x$) if one first *transforms the variables*. For example, least squares can easily fit these nonlinear relationships:

$$log(y) = \beta_1 + \beta_2\, x$$
$$y = \beta_1 + \beta_2\, (1/x)$$

Version B

I. Multiple choice

(1)e. (2)b. (3)d. (4)b. (5)a. (6)c. (7)d. (8)d. (9)b.

II. Short answer

(1)	a. false	b. true	c. true	d. true	
(2)	a. 18	b. 0.6			
(3)	a. 0	b. 1	c. 1		
(4)	a. not req'd	b. required	c. not req'd	d. not req'd	e. not req'd
(5)	a. not req'd	b. required	c. required	d. not req'd	e. required
(6)	a. not req'd	b. required	c. required	d. required	e. required
(7)	a. false	b. false	c. true	d. false	
(8)	a. false	b. true	c. true	d. false	
(9)	a. 16704	b. -444	c. 0.25 (no change)		
	d. -7.4 (no change)				

III. Problems

(1)
a. 65 + 22×80 = $1825.
b. Δy = 5×22 = $110.
c. 90% confidence interval for intercept = 65 ± 1.645×20 = 65 ± 32.9 = (32.1, 97.9) .
d. test statistic = 4.4, critical point = 1.282, can reject null hypothesis at 5%.

(2)
a. DOF = 17-2 = 15.
b. 95% confidence interval for slope = 18 ± 2.131×0.05 = 0.18 ± 0.106555 = (0.0735, 0.2866) .
c. Should transform x variable (income) by subtracting $600.
d. Predicted food expenditures = intercept of transformed equation = $122.3.
e. Standard error of prediction error = $\sqrt{6.5^2 + 682} = 26.91$.
f. 95% prediction interval = 122.3 ± 2.131×26.91 = 122.3 ± 57.35 = (64.95, 179.65) .

IV. Critical thinking

Same as Version A.

[end of answer key]