Econ 3180 – Midterm, Feb. 24th, 2015

You may use a calculator. Answer all questions in the answer book provided. The exam is 75 minutes long and consists of 100 marks.

A formula sheet, and a table of probabilities from the standard Normal distribution, are provided at the back of the exam booklet.

NAME:	
STUDENT #:	

DO NOT OPEN THIS BOOKLET UNTIL INSTRUCTED TO DO SO.

HAND IN THIS BOOKLET AT THE END OF THE EXAM.

Part A – Multiple Choice – 5 marks each

1. Let Y be the result of a die roll, where the numbers on the sides of the die are 1, 2, 3, 4, 5, and 6. In class, we showed that the variance of Y was 2.92. Suppose that we have a different die, where the numbers on the sides are 2, 4, 6, 8, 10, and 12. Let the result of this die roll be Z. What is the variance of Z?

a) 2.92
b) 5.83
c) 11.67
d) impossible to determine.

2. The probability of an outcome

a) is the proportion of times that the outcome occurs in the long run.
b) equals $M \times N$, where M is the number of occurrences and N is the population size.
c) is the number of times that the outcome occurs in the long run.
d) equals the sample mean divided by the sample standard deviation.

3. Let $\hat{\mu}_Y$ be an estimator for the population mean of the random variable Y (that is, $\hat{\mu}_Y$ is an estimator of μ_Y). The estimator $\hat{\mu}_Y$ is unbiased if

a) $\hat{\mu}_Y = \mu_Y$.
b) $\hat{\mu}_Y$ has the smallest variance of all estimators.
c) $E(\hat{\mu}_Y) = \mu_Y$.
d) $\hat{\mu}_Y$ is inconsistent.

4. A type I error is

a) always the same as (1-type II) error.
b) the error you make when rejecting the null hypothesis when it is true.
c) the error you make when rejecting the alternative hypothesis when it is true.
d) always 5%.

5. Among all unbiased estimators that are weighted averages of $Y_1, \ldots, Y_n, \bar{Y}$ is

a) the only consistent estimator of μ_Y.
b) the most efficient estimator of μ_Y.
c) a number which, by definition, cannot have a variance.
d) the most unbiased estimator of μ_Y.

6. The OLS estimator is derived by

a) connecting the Y_i corresponding to the lowest X_i observation with the Y_i corresponding to the highest X_i observation.
b) making sure that the standard error of the regression equals the standard error of the slope estimator.
c) minimizing the sum of absolute residuals.
d) minimizing the sum of squared residuals.

Part B – Short Answer

7. Using diagrams if necessary, describe a situation where:

a) $R^2 = 0$

[8 marks]

b) $R^2 = 1$

[8 marks]

8. Use the following data for this question:

$Y = \{0, 5, 6, 3\}$ $X = \{2, 4, 6, 8\}$

where Y is the dependent variable, and X is the independent variable. The population model is:

$$Y_i = \beta_0 + \beta_1 X_i + u_i$$

The estimated model (by OLS) is:

$$\hat{Y}_i = 1 + 0.5X_i$$

Calculate the OLS residual for $X = 2$. Show your work.

[5 marks]

9. Consider the population model from class:

$$TestScore = \beta_0 + \beta_1 \times STR + u_i$$

a) In economics terms, what is β_1?

b) What is the interpretation of β_0 in this model?

c) Describe one other factor that might be inside of u_i.

[3 marks each]

Part C – Long Answer – each part is worth 8 marks

10. The following question uses real data from the U.S. The two variables in the data are *cheese* – the per capita consumption of mozzarella cheese in pounds, and *civil* – the number of civil engineering doctorate degrees (PhDs) awarded. The data was collected annually from the year 2000 to 2009.

	Year									
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
cheese	9.3	9.7	9.7	9.7	9.9	10.2	10.5	11	10.6	10.6
civil	450	501	540	552	547	622	655	701	712	708

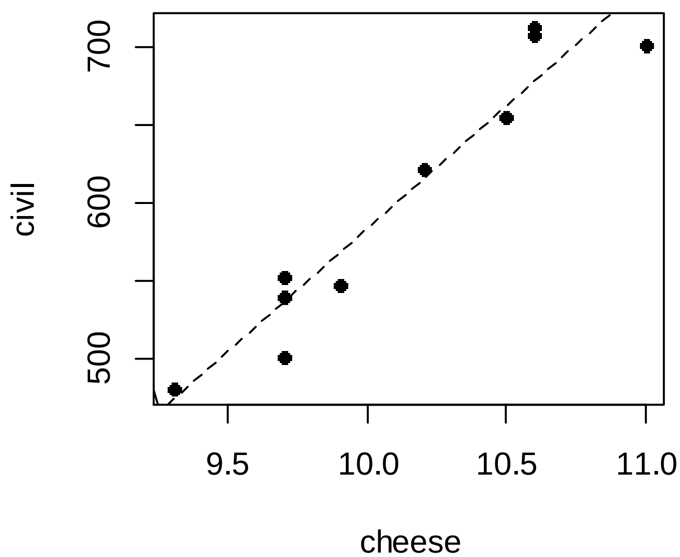
The population model is:

$$civil_i = \beta_0 + \beta_1 \times cheese_i + u_i$$

The fitted model, estimated by OLS, is:

$$\underset{}{\widehat{civil}_i} = \underset{(167.10)}{-988.15} + \underset{(16.49)}{157.11} \times cheese_i \quad , \quad R^2 = 0.919$$

Below is a plot of the data, where the dashed line indicates the OLS fitted model:



a) Explain what the R^2 means.

b) Suppose that in 2015, cheese experts predict that the per capita consumption of cheese will be 9.9. Using the fitted (estimated) model, determine the predicted number of civil engineering doctorate degrees awarded for 2015.

c) Construct a 95% confidence interval around the estimated intercept.

d) Conduct a formal hypothesis test to determine whether or not per capita cheese consumption affects the number of civil engineering doctorates awarded. (Assume your test statistic follows the standard normal distribution, even though the sample size is small.)

e) Based on your answer in part (d), and on your knowledge of statistics/econometrics, comment on the validity of the population model. That is, do you think that *cheese* causes *civil*?

END.