

Final exam

12/16/2013

Instructions: Point values for each question are as marked. The exam is out of 100 points.

Refer to the provided probability tables as necessary. You may use a calculator, and three sheets of notes. You will never be penalized for showing work, but if what is asked for can be computed directly, points awarded will depend primarily on the correctness of your numerical answer. Good luck!

Problem 1 (10 points) Let X be a normal random variable, with mean 6 and standard deviation .4.

a. Find $P(5.40 \leq X \leq 6.92)$

b. Find $P(6.56 < X)$

c. Let \bar{X} denote the average of 64 draws from X . Find $P(5.9 < \bar{X} < 6.1)$.

d. Let \bar{X} denote the average of 100 draws from X . Find $P(5.9 < \bar{X} < 6.1)$.

Problem 2 (10 points) Let X be a Poisson random variable, with mean 10.

a. Find $P(5 \leq X \leq 7)$

b. Find $P(2 \leq X)$

c. Let \bar{X} denote the average of 64 draws from X . Use the Central Limit Theorem to approximately find $P(9 \leq \bar{X} \leq 11)$ (hint: the variance of a Poisson random variable is equal to its mean).

d. Let \bar{X} denote the average of 225 draws from X . Use the Central Limit Theorem to approximately find $P(9 \leq \bar{X} \leq 11)$.

Problem 3 (5 points) 20% of students enrolled in Eco 201 at UK will drop the course during the semester. Your section begins with 25 students in it. What is the probability it will end with 20 or fewer students?

Problem 4 (8 points) Demographers in certain countries are becoming concerned about a “demographic winter” occurring if the average birthrate among women falls below the replacement level of 2. A Belgian demographer takes a sample of 250 women and finds an average birthrate of 1.964, with a standard deviation of 0.3.

a. Test at significance $\alpha = .05$ whether there is sufficient evidence to conclude that the birthrate in Belgium is below the replacement level.

b. What is the p-value of the test in a.?

Problem 5 (10 points) You wish to estimate the average number of times a UK freshman calls home during the fall semester. You conduct a survey of 156 freshman and determine that the sample mean is 29.2, with a standard deviation of 9.14

a. Give a 95% confidence interval for the average number of calls during the fall semester.

b. Give a 90% confidence interval for the average number of calls during the fall semester.

c. If the sample standard deviation stays constant, calculate the minimum sample size necessary so that the distance between the lower and upper limits of your 95% confidence interval is 2 or less.

Problem 6 (10 points) Each year in the US, there are about 12 suicides per 100,000 people. In a December 12, 2013 article on slate.com, two economists describe their research studying the link between gun ownership and number of suicides. Their research relies on a regression of the gun suicides per capita on the percentage of individuals living in households with at least one gun, across states.

$$Suicide_rate_i = \beta_0 + \beta_1 * Guns_i + \epsilon \quad (1)$$

where $Suicide_rate_i$ is state i 's number of suicides per 100,000 people, and $Guns_i$ is state i 's percentage of individuals living in households with at least one gun. For example, if 45.6% of Kentuckians live in a household with at least one gun, $Guns_i = 45.6$ for Kentucky.

The authors obtain the following estimates:

	Regression		Statistics	
	F statistic		134.479	
	R Square		134.479	
	Observations		50	
	coefficients	Standard error	t stat	P-value 95%
Intercept	11.456	.5879	19.4863	5.46E-89
Guns	.06	.028571	.3524	.0357

a. Do the authors find a significant effect of gun ownership on the number of suicides? Explain.

b. Interpret the estimate of β_1 in plain English. (hint: be very careful with the units.)

c. Suggest one “control variable” which could be added to equation (1) to account for factors which affect both guns and suicides. Explain.

Problem 7 (10 points) The following questions refer to “Medical marijuana laws, traffic fatalities, and alcohol consumption,” by Anderson, Hansen, and Rees.

a. Summarize the main points of the article.

b. The authors were especially interested in whether alcohol and marijuana are complements or substitutes. Why?

c. Reference one piece of evidence the authors cited as to the complementarity or substitutability of marijuana and alcohol.

Problem 8 (10 points) The following table is taken from Klick and Tabarrok, “Using terror alert levels to estimate the effect of police on crime”. (1) and (2) denote two separate regressions run by the authors.

	(1)	(2)
High alert	-7.316*	-6.046*
	(2.877)	(2.537)
Log(midday ridership)		17.341**
		(5.309)
R^2	.14	.17

NOTE: The dependent variable is the daily total number of crimes in Washington D.C. during the period March 12, 2002–July 30, 2003. Both regressions contain day-of-the-week fixed effects. The number of observations is 506. Standard errors are in parentheses.

* Significantly different from zero at the 5 percent level.

** Significantly different from zero at the 1 percent level.

a. In specification (1), interpret the coefficient estimate in plain English. Is it significant? What does it tell us?

b. Why did the authors choose midday ridership (on the DC subway system) as a control variable in specification (2)?

Problem 9 (6 points) The following questions refer to “Prison conditions, capital punishment, and deterrence,” by Katz, Levitt, and Shustorovich.

a. The authors offered both theoretical and empirical views on the death penalty’s deterrent effect on crime. Describe either.

b. How did the authors choose to measure prison conditions, and why?

Problem 10 (6 points) Lana Sociologist is interested in the effect of breast feeding on the cognitive development of infants. She randomly samples 10,000 US 40-year old adults, finds that 6,000 of them were breast fed as babies, while 4,000 of them were not. She finds that the average annual income of the first group is \$64,000, while the average annual income of the second group is \$52,000. The standard deviations are low enough to reject a hypothesis test with the null hypothesis that $\mu_1 = \mu_2$, so she concludes that breast feeding does indeed increase cognitive development, as reflected in the labor market earnings of adults (a wide variety of prior studies have found a positive link between intelligence and labor market earnings).

a. Give one alternative explanation for the phenomenon Lana observes.

b. Discuss how you would test to determine which explanation is correct.

Problem 11 (5 points) Describe the concept of regression to the mean, in your own words.

Problem 12 (5 points) “Despite all the attention given to the dangers of drunk driving, only 40% of all fatal accidents involve alcohol. This is another case of overblown fear.” Relate this statement to the material discussed in the final two class periods.

Problem 13 (5 points) Give a thorough explanation of Simpson’s paradox, using examples, and, if necessary, numbers.