

FIRST MIDTERM EXAMINATION
ECON 103, STATISTICS FOR ECONOMISTS

OCTOBER 3, 2012

You will have 70 minutes to complete this exam. Graphing calculators, notes, and textbooks are not permitted.

I pledge that, in taking and preparing for this exam, I have abided by the University of Pennsylvania's Code of Academic Integrity. I am aware that any violations of the code will result in a failing grade for this course.

Name: _____

Student ID #: _____

Signature: _____

Question:	1	2	3	4	5	6	7	8	9	10	11	Total
Points:	10	15	10	10	20	10	10	10	10	20	15	140
Score:												

Instructions: Answer all questions in the space provided. Should you run out of space, continue on the back of the page. Show your work for full credit but be aware that writing down irrelevant information will not gain you points. Be sure to sign the academic integrity statement above and to write your name and student ID number on *each page* in the space provided. Make sure that you have all pages of the exam before starting.

1. A survey collected the following information on new college graduates. Classify each variable as nominal, ordinal, or numerical. You do not need to explain your answers.
- (a) (2 points) Sex
 - (b) (2 points) Age at graduation
 - (c) (2 points) Future plans (graduate school, employment, indefinite)
 - (d) (2 points) Class rank
 - (e) (2 points) Grade point average
2. A long time ago, the graduate school at a famous university admitted 4000 of their 8000 male applicants versus 1500 of their 4500 female applicants.
- (a) (3 points) Calculate the difference in admission rates between men and women. What does your calculation suggest?

- (b) (7 points) To get a better sense of the situation, some researchers broke these data down by area of study. Here is what they found:

	Men		Women	
	# Applicants	# Admitted	# Applicants	# Admitted
Arts	2000	400	3600	900
Sciences	6000	3600	900	600
Totals	8000	4000	4500	1500

Calculate the difference in admissions rates for men and women studying Arts. Do the same for Sciences.

Name: _____

Student ID #: _____

- (c) (5 points) Compare your results from part (a) to part (b). Explain the discrepancy using what you know about observational studies.
3. The 10-90 percentile range is a measure of dispersion that we did not cover in class. It is given by the difference $P_{90} - P_{10}$ where P_{10} is the 10th and P_{90} the 90th percentile of the sample.
- (a) (5 points) Would you expect the 10-90 percentile range to be more or less sensitive to outliers than the range? Explain.
- (b) (5 points) Consider these three measures of dispersion: the 10-90 percentile range, the interquartile range, and the range. Which is the largest, and which is the smallest?
4. Let a be the intercept and b be the slope in the linear regression $y_i = a + bx_i + e_i$ where y is earnings in dollars and x is years of education.
- (a) (2 points) Write down the formula for calculating b from the data.
- (b) (2 points) Write down the formula for calculating a from the data and b .

(c) (3 points) What are the units of b ? Explain briefly.

(d) (3 points) What are the units of a ? Explain briefly.

5. Suppose we want to estimate a linear, least squares regression with a set equal to zero, that is $y_i = bx_i + e_i$.

(a) (5 points) Write down the optimization problem we need to solve and explain it.

(b) (10 points) Solve the optimization problem you wrote down for part (a) to find the formula for b .

Name: _____

Student ID #: _____

- (c) (5 points) Suppose that we wanted to predict y from x using a *quadratic* relationship, namely $y_i = bx_i^2 + e_i$. How would your answers to parts (a) and (b) change?
6. (10 points) Major League Baseball honors its most outstanding first-year player with the title “Rookie of the Year.” The overall major league batting average is around .260, compared to .290 for Rookies of the Year. In their second year, however, Rookies of the Year have an overall batting average of only .275 – a comparatively disappointing performance. This is sometimes called the “sophomore slump.” It has been argued that the publicity, endorsement deals, and tv appearances that come from being named Rookie of the Year distract players from the game, and that this explains the “sophomore slump.” Do you agree? Answer yes or no and explain briefly.
7. Suppose A and B are events, i.e. $A, B \subseteq S$ where S is the sample space.
- (a) (2 points) Write down the three axioms (aka postulates) of probability from class.

Name: _____

Student ID #: _____

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- (b) (2 points) Are A and A^c collectively exhaustive?
- (c) (2 points) Are A and A^c mutually exclusive?
- (d) (4 points) Using parts (a)–(c), derive the Complement Rule.
8. Three percent of *Tropicana* brand oranges are already rotten when they arrive at the supermarket. In contrast, six percent of *Sunkist* brand oranges arrive rotten. A local supermarket buys forty percent of its oranges from *Tropicana* and the rest from *Sunkist*. Let R be the event that an orange is rotten and T be the event that it is a *Tropicana*.
- (a) (3 points) What is the probability that a randomly chosen orange in the supermarket is a *Tropicana* and is rotten?
- (b) (3 points) What is the probability that a randomly chosen orange is rotten?

(c) (4 points) Suppose we randomly choose an orange from the supermarket and see that it is rotten. What is the probability that it is a *Tropicana*?

9. Suppose a couple decides to have three children. Assume that the sex of each child is independent, and the probability of a girl is 0.48. (Both of these assumptions are approximately correct for US data.) Note that order matters in this example.

(a) (3 points) How many basic outcomes are there for this experiment?

(b) (3 points) Are the basic outcomes equally likely? Why or why not?

(c) (4 points) What is the probability that the couple has *at least one* girl?

Name: _____

Student ID #: _____

10. You have been entered into a very strange tennis tournament. To get the \$10,000 Grand Prize you must win at least two sets *in a row* in a three-set series to be played against your Econ 103 professor and Venus Williams alternately: professor-Venus-professor or Venus-professor-Venus according to your choice. Let p be the probability that you win a set against your professor and v be the probability that you win a set against Venus. Naturally $p > v$ since Venus is much better than your professor! Assume that each set is independent.
- (a) (5 points) Let W indicate win and L indicate lose, so that the sequence WWW means you win all three sets, WLW means you win the first and third set but lose the middle one, and so on. Which sequences of wins and losses land you the Grand Prize?
- (b) (5 points) If you elect to play the middle set against Venus, what is the probability that you win the Grand Prize?

Name: _____

Student ID #: _____

(c) (5 points) If you elect to play the middle set against your professor, what is the probability that you win the Grand prize?

(d) (5 points) To maximize your chance of winning the prize, should you choose to play the middle set against Venus or your professor?

Name: _____

Student ID #: _____

11. This question refers to commands from the R statistical package that you used in the homework. Suppose I have a dataframe called `gradebook` containing the following columns in order from left to right: `student.name`, `major`, and `GPA`. (That is, for each student, the dataframe contains the student's name, major and grade point average.)
- (a) (3 points) Suppose I want to display the information from all columns for the student in row ten of the dataframe. What command should I use?
- (b) (3 points) Suppose I want to calculate the mean of the GPA column, which contains numeric data. What command should I use? (You may assume that there are no missing values in the dataframe.)
- (c) (3 points) When I enter the command `class(gradebook$major)`, I get "factor" as my result. What does this mean?
- (d) (3 points) Suppose I want to display names and grade point averages *only* for the students in rows two, seven, and thirteen of the dataframe. What command should I use?
- (e) (3 points) What is the name of the command for calculating percentiles in R?

Name: _____

Student ID #: _____