Economics 341
Introduction to Econometrics

Problem Set 1

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General Instructions

1. **Due: Thursday 15th February 2018 by 11:30 a.m.**
2. Read and follow all instructions/directions carefully. **An inability to follow instructions/directions will result in points being deducted.**
3. All problems sets submitted must be in person, stapled, typed in LaTeX, include the cover page, and be well-formatted.
4. Support your answers as thoroughly as possible. Label all graphs fully and completely; i.e., axes, intersections, curves, etc. State and define any concept utilized and list and name any equation used. In other words, show all of your work.
5. Do not copy from another student or source. Reference the penalty for cheating in the syllabus.
6. For the True/False/Uncertain short-answer questions clearly indicate your choice by writing either "True", "False", or "Uncertain" underneath the respective question.
7. Unless explicitly instructed otherwise, a justification is required to receive credit.
8. For the multiple choice questions, choose the "best" answer and mark the letter in the spaces provided. Only clearly written letters in the allocated space will be graded. No explanation necessary for multiple choice questions.
9. For all questions requiring R, provide the R code using the LaTeX `listing` environment on a separate page at the end of the problem set.

Original Score (%)	
Adjustment (%)	
Actual Score (%)	

1. In 2016, Chinese decision-makers relaxed the more than four-decade-old family planning policy to allow, if not encourage, all Chinese couples to have a second child.[1]

   (a) China is considering offering financial rewards to encourage couples to have a second child, as surveys show many are reluctant to expand their families due to economic constraints.[2] What general economic concept does this illustrate? Explain.

   ANSWER HERE

   (b) Some argue the sex of the first child provides information about whether parents will have a second child. Below is a table that lists the probabilities of the sex of a couple's first child and whether a couple will have a second. For example, 14.9% of parents have a boy on the first child and never have a second.

	Did the Couple Have a Second Child		
Sex of First Child	No	Yes	Total
Boy	0.149	0.339	0.488
Girl	0.157	0.355	0.512
Total	0.306	0.694	1.000

   Using the table above, answer the following questions:

   i. What is the probability of having a second child?

   $$\Pr(\text{Have a second child})$$

   ANSWER HERE

   ii. What is the probability of having a second child given the first child is a boy?

   $$\Pr(\text{Have a second child} \mid 1^{\text{st}} \text{ child is a boy})$$

   ANSWER HERE

   iii. What is the probability of having a second child given the first child is a girl?

   $$\Pr(\text{Have a second child} \mid 1^{\text{st}} \text{ child is a girl})$$

   ANSWER HERE

   iv. Using the results from (a), (b), and (c) above, are the events 'have a second child' and 'sex of the first child' independent events. Why or why not?

   ANSWER HERE

   (c) Data have been published which indicate that the more children a couple has, the less likely the couple is to get a divorce. Does this indicate that increases in the number of children are related causally to the likelihood of divorce? Explain.

   ANSWER HERE

[1] *The New York Times*, "China Ends One-Child Policy, Allowing Families Two Children, by Buckley, 29 October 2015"
[2] According to *chinadaily.com.cn*.

2. During the 1960s there was a great deal of interest in the hallucinogenic drug lysergic acid diethylamide (LSD); *much* interest, from Timothy Leary[3], to government intelligence organizations[4], to scientists, to individuals, to reporters writing about the 1960s scene.[5]

   One of the issues surrounding the use of LSD was what it did to mind performance – enhance, detract, alter? Thus, there were a number of studies conducted to measure the effects of LSD on mental processes. One study, Wagner, et. al (1968)[6], attempted to see if there was a correlation between a subject's ability to perform simple arithmetic tasks and the concentration of LSD in the tissues of the body.

   Use the table below containing the data from Wagner, et. al (1968) to answer the following questions.

Tissue Concentration	Math Score
1.17	78.93
2.97	58.20
3.26	67.47
4.69	37.47
5.83	45.65
6.00	32.92
6.41	29.97

   Description: A group of volunteers was given LSD, their mean scores on a math exam and tissue concentrations of LSD were obtained at n=7 time points.

   (a) Which variable is exogenous? Which variable is endogenous? Explain.

   ANSWER HERE

   (b) Load the data into R manually as a data.frame(). Name Tissue Concentration as "*conc*" and Math Score as "*score*".

   See R code at the end of Problem Set 1. Note: Use the given snippet to save time in R and on the next question; e.g., calculating the median.

   (c) Calculate the mean, median, minimum, maximum, variance, and standard deviation "by-hand" (i.e., manually showing your work in the align environment in LaTeX) and R for *conc* and only use R for *score*. Besides reviewing important statistical concepts along with their calculations, the purpose of this question is to appreciate what R does nearly instantaneously. Remember: The most dangerous aspect of statistical/econometric work is loading data into a program, typing some commands, and running the code without understanding what you are doing. As a demonstration, and to avoid completely annoying you, some of the initial equations are provided in blue. Round to two decimal places.

   - *conc*
     See R code at the end of Problem Set 1.

[3] *Time Magazine*, "Was Timothy Leary Right?", 19 April 2007, by J. Cloud
[4] History.com, "MK-ULTRA"
[5] They say that if you can remember the 60s then you did not live the 60s. If you could, then you weren't stoned enough.
[6] Wagner, J. G., G. K. Aghajanian, and O. H. L. Bing. 1968. "Correlation of Performance Test Scores with 'Tissue Concentration' of Lysergic Acid Diethylamide in Human Subjects. *Clinical Pharmacology and Therapeutics*. 9(5) : 635–638.

$$\begin{aligned}\overline{conc} &= \frac{1}{n}\sum_{i=1}^{n} conc_i \\ &= ? \\ &= ? \\ \overline{conc} &= ?\end{aligned}$$

median DEFINE

$$\text{median } conc = ?$$

$\min(conc)$ DEFINE

$$\min(conc) = ?$$

$\max(conc)$ DEFINE

$$\max(conc) = ?$$

$$\begin{aligned}Var(conc) &= \frac{1}{n-1}\sum_{i=1}^{n}(conc_i - \overline{conc})^2 \\ &= ? \\ &= ? \\ &= ? \\ Var(conc) &= ?\end{aligned}$$

$$\begin{aligned}SD(conc) &= ? \\ &= ? \\ SD(conc) &= ?\end{aligned}$$

- *score*
  See R code at the end of Problem Set 1.

(d) Calculate the covariance and correlation "by-hand" (i.e., manually showing your work in the align environment in LaTeX) and R for *conc* and *score*.

- See R code at the end of Problem Set 1.

$$\begin{aligned}Cov(conc, score) &= \frac{1}{n-1}\sum_{i=1}^{n}(conc_i - \overline{conc})(score_i - \overline{score}) \\ &= \ldots\end{aligned}$$

$$\begin{aligned}Corr(conc, score) &= \frac{Cov(conc, score)}{\sqrt{Var(conc)}\sqrt{Var(score)}} \\ &= \frac{Cov(conc, score)}{SD(conc)SD(score)} \\ &= \ldots\end{aligned}$$

(e) Using R, provide a scatter diagram with the exogenous variable on the horizontal axis and endogenous variable on the vertical axis. Include the variables' means as vertical and horizontal lines, respectively.

ANSWER HERE

3. Some years ago, a new brand of toothpaste was introduced in the United States. According to its advertisements, studies showed that it had "considerable success" in improving the health of a person's teeth. Suppose that these studies were designed in the following way. The manufacturer of this toothpaste chose three samples of seven people; the first sample agreed to use the new brand, the second sample used Brand A, and the third sample used Brand B. After six months, a dentist examined each person's teeth and scored the health of his or her teeth on a scale of 0 (lowest possible score) to 100 (highest possible score). The results were as follows:

New Brand	Brand A	Brand B
65	58	54
71	60	38
53	63	43
55	90	61
34	95	94
82	89	96
77	62	82

The manufacturer of the new toothpaste says that the average score for the new brand is 2 points higher than for Brand A and 4 points higher than for Brand B. Would you agree with the manufacturer's advertisements? Explain.

ANSWER HERE

4. According to a post-World War II report, "[t]here were more civilian than military amputees during the war. During the period of the war, 120,000 civilians suffered amputations, but only 18,000 military personnel." Does this prove that civilians were more likely to suffer amputations? Explain.

ANSWER HERE

5. In 1973, the total net income per farm was \$19,685 in Iowa and \$19,456 in Minnesota. Base on these data, a television commentator maintains that Iowa farmers were better-off than Minnesota farmers in 1973. Do you consider the statement to be very meaningful? What sort of pitfall is present here? What would be a better way of interpreting the data concerning these two states?

ANSWER HERE

6. A fair die is rolled twice. What is the probability of getting

   (a) a total of 6;

   ANSWER HERE

   (b) a total of less than 6;

   ANSWER HERE

   (c) a total of 7 or more?

   ANSWER HERE

7. In 1981, mean sales of the top 20 cigarette brands was 28.22 billion cigarettes. The standard deviation of these brands' sales was 28.37 billion cigarettes.[7] Based on these data, a market researcher wanted to estimate the number of brands that sold over 30 billion cigarettes in 1981. Assuming that the sales of these brands were normally distributed, he calculated the proportion of brands with sales exceeding 30 billion. Since the point on the standard normal distribution corresponding to 30 billion is 0.06, he found the area under the standard normal curve to the right of 0.06, which is 0.4761. Then he multiplied 0.4761 times 20 (the number of brands), the result being about 10. Thus, he estimated that 10 brands sold over 30 billion cigarettes in 1981. Do you agree with this result? Explain.

   ANSWER HERE

8. The IQs of students at a particular university are normally distributed with mean equal to 125 and standard deviation equal to 10. Determine the percentage of the students with IQs

   (a) below 115.

   ANSWER HERE

   (b) above 140.

   ANSWER HERE

   (c) between 120 and 130. Provide a shaded curve from R.

   ANSWER HERE

[7] Source: *Business Week*, "How Cigarette Makers Aim to Fire Up Sales", 7 December 1981

9. Suppose that you purchased a one-day general admission pass to Lollapalooza for $120 months prior to the event. The week before the concert someone invites you to a baseball game on the same night as Lollapalooza. You would much rather go to the baseball game than Lollapalooza. You have tried unsuccessfully to sell the Lollapalooza ticket. Which of the following statements regarding this situation is correct?

   (A) The $120 you paid for the Lollapalooza ticket is relevant to the decision, as this represents the opportunity cost of attending the baseball game.

   (B) You should base your decision on whether or not the baseball game will provide you with more than $120 in satisfaction.

   (C) The $120 you paid for the Lollapalooza ticket should be irrelevant in your decision making, because it is a sunk cost.

   (D) The $120 Lollapalooza ticket should be irrelevant in your decision making, because it represents the marginal cost of attending the baseball game.

   (E) All of the above.

Answer: _____

10. You are eating at Sushi Tokoro in Chicago, an all-you-can-eat sushi restaurant. Assume it charges $35 for its all-you-can-eat sushi special. The marginal cost (ignoring any potential physical discomfort) of your 10^{th} piece of sushi is

    (A) $0.

    (B) $17.50

    (C) $35.

    (D) $350.

    (E) $3,500.

Answer: _____

11. Experimental research in small cities suggests that mandating work for welfare recipients increases their income. Therefore, we should mandate work requirements for all welfare recipients. This statement is an example of

    (A) fallacy of inductive reasoning.

    (B) *ceteris paribus* fallacy.

    (C) fallacy of composition.

    (D) *post hoc, ergo prompter hoc* fallacy.

    (E) Both C and D.

Answer: _____

12. The government should extend the duration of unemployment benefits to those workers who lost their jobs due to outsourcing. This statement is best described as

    (A) an example of marginalism.

    (B) an example of the fallacy of composition.

    (C) a normative statement.

    (D) a positive statement.

    (E) All of the above.

Answer: _____

13. Which of the following is a positive statement?

(A) An unemployment rate of 9 percent is a national disgrace.
(B) Unemployment is a more important problem than inflation.
(C) When the national unemployment rate is 9 percent, the unemployment rate for inner-city youth is often close to 40 percent.
(D) Unemployment and inflation are equally important problems.
(E) All of the above.

Answer: _____

14. You have the choice of going on vacation to Las Vegas for one week, staying at work for the week, or spending the week doing fix-up projects around your house. If you decide to go to Las Vegas, the opportunity cost of the trip is

(A) working and doing fix-up projects.
(B) working or doing fix-up projects, depending on which you would have done otherwise.
(C) working, because you would be giving up dollars.
(D) nothing because you will enjoy the trip to Las Vegas.
(E) All of the above.

Answer: _____

15. Your employer has asked you to start working overtime and has offered to pay $24 per hour for every hour you work beyond forty hours a week. The wage rate for each of the first forty hours will continue to be the usual $20 per hour. In terms of dollars, what is the marginal benefit of working each hour of overtime?

(A) zero
(B) $4.00
(C) $20.00
(D) $24.00
(E) The entire weeks salary.

Answer: _____

16. A direct (positive) relationship exists between two variables if

(A) one variable has "positively" no effect on the other variable.
(B) a reduction in one variable is associated with an increase in the other variable.
(C) a reduction in one variable is associated with a decrease in the other variable.
(D) both variables are inflation-distorted.
(E) one variable changes as a result of a change in the other variable.

Answer: _____

17. If you study 3 hours for an exam, you can raise your score by 30 points. If you study for another 3 hours your score increases by 10 points. And if you study for another 3 hours, your score will increase by 5 more points. A graph displaying this relationship between the number of hours studied and your total exam score would show

(A) a positive linear relationship.
(B) an upward-sloping curve that becomes less steep.
(C) a negative linear relationship.
(D) an upward-sloping curve that becomes more steep.
(E) no relationship.

Answer: _____

18. All economic questions are about

(A) how to make money.
(B) what to produce.
(C) how to cope with scarcity.
(D) how to satisfy all our wants.
(E) All of the above.

Answer: _____

19. Which of the following is a normative statement?

(A) The unemployment rate is too high.
(B) Forty percent of the public believes that the unemployment rate is too high.
(C) The unemployment rate rose last month.
(D) The Chicago Cubs will win the World Series in 2018.
(E) None of the above are normative statements.

Answer: _____

20. You explain to your friend Alice, who runs a catering service, about an economic theory which asserts that consumers will purchase less of a product at higher prices than they will at lower prices. She contends that the theory is incorrect because over the past two years she has raised the price of her catered meals and yet has seen a strong increase in sales. How would you respond to Alice?

(A) Alice is right; she has evidence to back her claim. The theory must be erroneous.
(B) I will explain to her that she is making the error of reverse causality: it is the increase in demand that has enabled her to raise her prices.
(C) I will explain to her that there are some omitted variables that have contributed to an increase in her sales such as changes in income.
(D) Alice is making the mistake of assuming that correlation implies causation.
(E) None of the above.

Answer: _____

21. You won a free ticket to see an Eric Clapton concert (which has no resale value). Bob Dylan is performing on the same night and is your next-best alternative activity. Tickets to see Dylan cost $40. On any given day, you would be willing to pay up to $50 to see Dylan. Assume there are no other costs of seeing either performer. Based on this information, what is the opportunity cost of seeing Eric Clapton?

(A) $0
(B) $10
(C) $40
(D) $50
(E) $–50

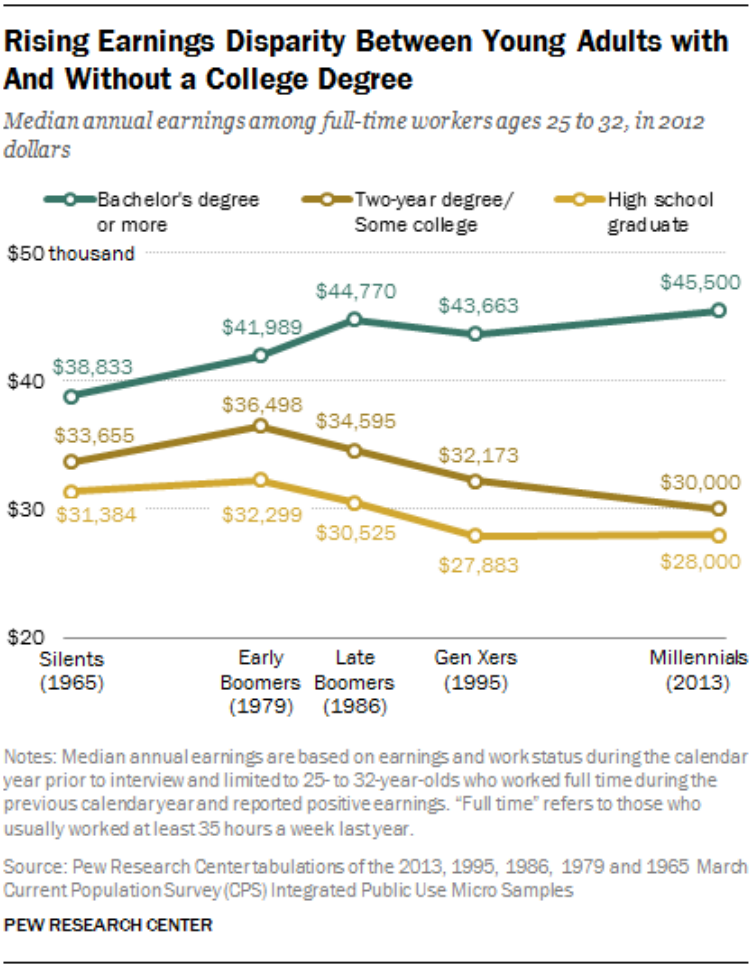
Answer: _____

22. Which of the following claims is most likely to suffer from reverse causality?

(A) Higher income increases consumption.
(B) Relatively wealthy people tend to be relatively healthy.
(C) More hours of study are likely to lead to better results.
(D) Crime rate is seen to be lower in countries having a higher level of poverty.
(E) Both B and D.

Answer: _____

23. Use the graph below from the Pew Research Center[8] to answer the following questions.



(a) The percent change in earnings of young adults with a bachelor's degree or more from 1965 to 2013 is _____ and the percent change in earnings of young adults that are only high school graduates from 1965 to 2013 is _____ .

(A) −17.2 percent; 10.8 percent
(B) −14.6 percent; 12.1 percent
(C) 14.6 percent; −12.1 percent
(D) 17.2 percent; −10.8 percent
(E) None of the above.

Answer: _____

(b) From 1965 to 2013, the earnings of young adults with a bachelor's degree increased by how much more compared to young adults that are only high school graduates?

(A) 26.7 percentage points
(B) 28 percentage points
(C) 26.7 percent
(D) 28 percent
(E) None of the above.

Answer: _____

[8] Pew Research Center, "The Rising Cost of Not Going to College", 11 February 2014 [Retrieved: 21 December 2017]

```
TissueConcentration <- cbind(1.17, 2.97, 3.26, 4.69, 5.83, 6.00, 6.41)
MathScore <- cbind(78.93, 58.20, 67.47, 37.47, 45.65, 32.92, 29.97)

```

R CODE HERE