Fall 2015

You have 24 hours from the point you download this exam to complete it. It must be returned by the end of the exam period (noon on December 18, 2015) at the latest. Please do not discuss the exam with anyone prior to December 22, 2015. The exam is open book, open notes, and outside materials (including web based materials) may be consulted; however, no other person may be consulted in the development of your answers.

(30 potential points)
1. In an employment discrimination class action case, using data on wages for 5,000 of the firm's 40,000 employees chosen at random, the following regression is estimated:

$$w_i = a + b \cdot female_i + c \cdot tenure_i + d \cdot evaluation_i + g \cdot management_i$$

Where w represents the annual pay rate the defendant company paid person i; female is a dummy variable that takes the value of 1 if person i is a woman (0 otherwise); tenure measures how long the person has worked for the defendant firm in years; evaluation measures person i's average semi-annual evaluation score (min = 1; max = 5) during his/her tenure with the defendant firm; and management is a dummy variable which takes the value of 1 if person i works in a management position (0 otherwise).

The defendant's expert presents the following output from the regression above:

a = 20,000   SE = 8,000
b = -2,000   SE = 1,100
c = 3,000   SE = 1,200
d = 900   SE = 300
g = 10,000   SE = 4,000

1.a   If the plaintiffs' claim alleges that the defendant firm's compensation policy is unfairly discriminatory toward women, given the results above, what argument can the defendant make?

The defendant can argue that the estimated female coefficient is not statistically different from zero (i.e., evidence is consistent with no differential treatment of women).

1.b   How can the plaintiffs respond?

The plaintiff might argue that a one-tailed test is appropriate, in which case the estimated female effect is statistically significant at conventional levels. Also, the plaintiff may argue that the subjective evaluation scores are themselves subject to sex discrimination and, therefore should not have been "controlled for." If these scores

had been left out of the regression, the female effect would have been larger in magnitude. A similar argument could be made for the management control.

1.c   What difference to the arguments in 1.a and 1.b might it make depending on whether the evaluation scores are objectively based (e.g., quantifiable metrics of productivity) or subjectively based (e.g., a supervisor's qualitative impression)?

Objective metrics are less susceptible to the plaintiffs' concern stated in 1b.

1.d   If the firm's work force is equally divided between men and women, but the share of management positions held by men is 65%, how would this fact affect the plaintiff's argument?

This might indicate discrimination through the process of assigning management positions and, so, the female discrimination effect is understated if just the female coefficient is used to examine discrimination.

How might the defendant respond?

Perhaps the women working for the firm did not possess other "objective" characteristics necessary to perform management functions. Also, perhaps, women did not indicate a desire to take on management positions.

1.e   Assume these data span a 10 year period (so drop the assumption that the dataset represents 5,000 of the firm's 40,000 employees) such that the 5,000 observations are random draws of a given employee's pay (and control variable) value in a particular year during that 10 year period. Further, assume that pay has risen in general over those ten years, and assume that it is known that in the first few years of this 10 year period, the firm employed very few women, while by the end of the period, its split was 50-50 between men and women. Do these new assumptions strengthen/weaken either party's argument? Why? How might you account for these new assumptions statistically?

In such a case, an omitted variable bias exists. Given the facts as stated, it is likely that the female coefficient understates discrimination because the women in the dataset are being compared to a male average that includes relatively more low pay years. Thus, accounting for this background trend probably will help the plaintiffs. To account for this, one might include a trend variable of some kind (linear, quadratic, etc).

(30 potential points)
2. Read the article "Mobile Phones and Crime Deterrence: An Underappreciated Link" available at .

2.a   State the hypothesis tested in the article.

The introduction and proliferation of cell phones led to a decline in crime through a deterrence mechanism whereby victims were able to more quickly and accurately report crimes.

2.b   Describe the research design and how it attempts to address the hypothesis described in 2.a

The research design uses state and year fixed effects to pull out idiosyncratic state baseline differences in crime, as well as any national background trend. It also controls for some other covariates (such as income, etc) to help isolate the residual correlation between cell phone use and crime.

2.c   Suggest alternate hypotheses consistent with the results and offer potential ways to distinguish the paper's claims about the results in it from your suggested alternatives.

Any general omitted variable hypothesis would suffice. For example, perhaps cell phone use is correlated with changes in other precautions taken by potential victims (perhaps through a wealth channel). To account for this, including data on other precautions or wealth might mitigate the bias.

2.d   Assuming the paper's basic conclusion is correct, propose an argument that the paper's estimates might actually be understated.

Presumably, cell phones increase the reporting of crimes (i.e., in pre-cell phone times, perhaps many more assaults and rapes went unreported).

2.e   Assuming the paper's empirical conclusion is correct, if your firm were hired by the mobile phone trade association (CTIA) to lobby against an increase in mobile phone taxes, how might this research be helpful in that effort? If you worked for the relevant legislative/administrative/regulatory body that was being lobbied on this issue, would the CTIA's arguments be compelling (still assume that the paper's conclusion is correct)? Explain your answer.

The crime reduction effect of phones is a positive externality and so a subsidy (or at least reduced taxes) might be warranted. However, as seen in the paper, cell phone ownership rates are at (or above) 100% in much of the US even with existing taxes, so reducing taxes is unlikely to generate much additional benefit.

(30 potential points)
3. Choose one of the following options: 1) Count question 1 (including its subparts) to count double (i.e., multiply your total points for question 1 X 2 before adding that amount to the points for your other questions to generate your total exam points); 2) Count question 2 (including its subparts) to count double (i.e., multiply your total points for question 2 X 2 before adding that amount to the points for your other questions to generate your total exam points); or 3) multiply the points from each of questions 1 and 2 (including their subparts) by 1.5. Make sure to indicate your choice clearly, otherwise your total for questions 1-3 will be just the sum of

your points for question 1 (i.e., without multiplying by either 2 or 1.5) and 2 (i.e., without multiplying by either 2 or 1.5).

(10 potential points)
4. Using statistical concepts/intuitions, explain your rationale for the choice you made in question 3 above.

   Basic expected value rationale. If you believe you are more likely to have done well on one question than on the other, you should overweight it. However, risk preferences may lead you to "diversify."