

Exam #1 Answer Key

Economics 435

Spring 2002

1 The lazy professor (12 pts)

- a) Let actual understanding be u . The variance of $u - \hat{s}$ is higher than the variance of $u - s$. I'll also accept a claim that \hat{s} is not a consistent estimate of u , because the number of questions used to construct the grade is fixed even as the number of questions on the exam goes up.
- b) Everyone will do the exam in pen, and will work very hard on the first question and skip the rest.
- c) No. Because everyone will use a pen, there will be no way to estimate β_1 - one of the Gauss-Markov assumptions is violated.

2 Cigarette taxes (12 pts)

- a) Fifty.
- b) If smokers are told that there will be a large tax increase the next day, they will run out to the store and stock up on cigarettes. As a result, sales will be unusually high on Tuesday, and unusually low on Wednesday. As a result, this study will dramatically overstate the effect of the tax change.
- c) My suggestion is to wait a few months. Look at cigarette sales 6 months before the tax increase, and 6 months after. At this point Tuesday's "stocking up" will have run its course.

3 Forecasting hydro demand (16 pts)

- a) Since p has gone up by 0.3 cents, we would expect sales to go up by $0.3\hat{\beta}_1$ kilowatt-hours. Of course $\hat{\beta}_1$ will likely be negative, so sales will go down.
- b) $\ln p$ will go up from $\ln 5.7$ to $\ln 6.0$, for a total change of 0.0513. Therefore $\ln e$ will go down by 0.0513. The new demand is $\exp^{\ln 900 - 0.00513} \approx 855$. So sales will go down by about 45 kilowatt-hours per household.
- c) No. Each econometrician is estimating a slightly different model.
- d) If $\gamma_1 > -1$, then a price increase will lead to an increase in revenue.

4 Absolute convergence (28 pts)

- a) The null hypothesis is $H_0 : \beta_1 = 0$, and the alternative is $H_1 : \beta_1 < 0$. The test statistic is $t = \frac{\hat{\beta}_1}{\widehat{se}(\hat{\beta}_1)} = \frac{-0.995}{0.394} = 2.52$. The test statistic has an asymptotic $N(0, 1)$ distribution, so we reject the null at the 5 percent level of significance if $t < -1.645$. Therefore we reject the null.
- b) The p-value is $1 - 0.9938 = 0.0062$.
- c) A 95% confidence interval is

$$\begin{aligned} CI &= [\hat{\beta}_1 - 1.96 * \widehat{se}(\hat{\beta}_1), \hat{\beta}_1 + 1.96 * \widehat{se}(\hat{\beta}_1)] \\ &= [-0.995 - 1.96 * 0.394, -0.995 + 1.96 * 0.394] \\ &= [-1.767, -0.223] \end{aligned}$$

- d) It does not matter if we have oversampled countries that were rich in 1870, because we are already conditioning on that variable. So this issue will not lead to biased results.
- e) This problem will lead to results which are biased in favor of convergence. Among the set of initially rich countries, most countries would still be rich in 1979 and thus would have 1870 data. Among initially poor countries, only those countries that grew rapidly (and thus had high 1979 income) would be included in the sample. This will bias the result in favor of finding that initially poor countries grew faster.
- f) This will also lead to results which are biased in favor of convergence. Initially poor countries will have measured growth rates which are higher than their real growth rates (since their real 1870 incomes are all above their imputed 1870 incomes).
- g) Yes. Even with a bias in favor of the convergence hypothesis, the data reject this hypothesis.

5 Miscellaneous questions (16 pts)

- a) No.
- b) The test statistic would be

$$\frac{\hat{\beta}_1 - 2\hat{\beta}_2}{\widehat{se}(\hat{\beta}_1 - 2\hat{\beta}_2)} = \frac{\hat{\beta}_1 - 2\hat{\beta}_2}{\sqrt{\widehat{var}(\hat{\beta}_1) + 4\widehat{var}(\hat{\beta}_2) - 4\widehat{cov}(\hat{\beta}_1, \hat{\beta}_2)}} \quad (1)$$

- c)

$$F(x) = \begin{cases} 0 & x \in (-\infty, 0) \\ 0.125 & x \in [0, 1) \\ 0.5 & x \in [1, 2) \\ 0.875 & x \in [2, 3) \\ 1 & x \in [3, \infty) \end{cases}$$

6 Teen drinking (16 pts)

a) The total number of drinks consumed by respondents would be $10 * 25,500 = 255,000$. So the total number of drinks consumed by underaged respondents would be 25 percent of this, or 63,750. Since there are 9,759 underaged respondents, their average consumption would be $63,750/9.759$ or 6.53 drinks.

b) The flaw that the liquor industry complained about was that the number was calculated by dividing total consumption by the underaged *in the sample* by total consumption in the sample. Because of the oversampling, the underaged are a much larger proportion of the sample than they are of the real-world population. To see this, suppose that the survey “oversampled” teenagers by so much that everyone in the sample was underaged. In that case, this methodology would lead the researchers to say “100% of alcohol is consumed by the underaged.” Clearly this is a flawed methodology.

Some students pointed out that the underaged will tend to lie about their drinking. For this I will give partial but not full credit. It is a flaw of the research methodology, but it is unlikely that the liquor industry would call attention to it (since it implies that teen drinking is understated by the study).

c) First we need to calculate the average number of drinks consumed by adults in the sample. That would be $(255,000 - 63,750)/(25,500 - 9,759) = 12.15$. So underage drinkers would account for $(0.19*6.53)/(0.81*12.15+0.19*6.53) = 0.111$, or 11.1% of all drinking.

d) None of them.