

Homework 17: ECO220Y – SOLUTIONS

Problems:

(1) Can simply eye-ball these (can calculate the s.e. of the sample mean):

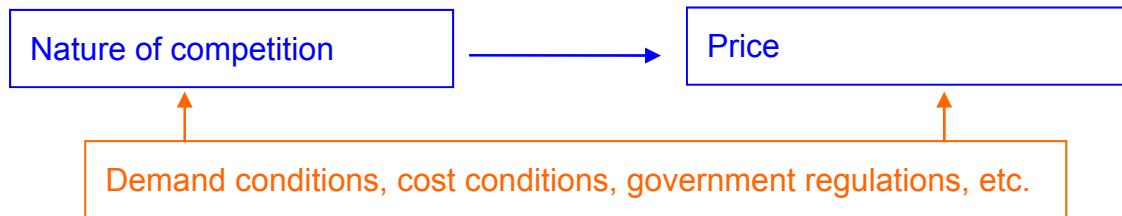
- a. fail to reject null
- b. reject null in favor of research hypothesis
- c. reject null in favor of research hypothesis
- d. fail to reject null

(2) The point estimate of μ is the sample mean. This estimator is unbiased and consistent. You can figure out the point estimate of the population mean is -1.4. It is DEFINITELY NOT -1.

(3) (a) Hypothesis testing is most appropriate for Q1 and confidence interval estimation is most appropriate for Q2. You explain.

(b) These data are cross-sectional: different markets at the same point in time. These data are also observational. The presence of a monopolist or competition in a particular market has neither been randomly assigned by a researcher (as in experimental data) nor randomly assigned by other external forces (as in a natural experiment). In fact, firms *choose* whether or not to enter a market and compete, which means that the presence of a monopolist or competition in a particular market is not randomly set. This is the defining feature of observational data.

(c) Here is a diagram that illustrates what we are trying to find and the confounding effects.



(d) The effect that we are interested in is the blue arrow: how does the nature of competition (monopoly or competition) affect the price in a particular market. The confounding effects are that across different geographic markets the demand conditions, cost conditions and government regulations will vary. These differences would not be a problem if they only affected price, but we know that they will also affect the nature of competition because firms choose whether or not to enter a market based on demand conditions, cost conditions, government regulations, etc. It is the presence of the first orange arrow that makes these data observational and makes the nature of competition an endogenous variable. Unfortunately, this means that bias will creep into our inference about the magnitude of the blue arrow, which represents our research question. If we attribute all of the differences in price across markets to the presence or absence of a monopolist, we will have a biased estimate. The reason is that the other things (orange box) are systematically different among monopolized and competitive markets and part of the differences in price is attributable to these factors. Hence attributing all of the differences in price to the nature of competition would be wrong.

(e) Suppose that isolated rural areas tend to be monopolized and have high input costs (expensive to ship gasoline) or that cities tend to have many competitors but high prices due to high taxes and expensive land. This illustrates how locations may not be otherwise comparable and how the confounding factors will affect price and the nature of competition. This leaves us with the troubling question: If two locations comparable why is one monopolized while other has competition? Without using more advanced techniques (you would learn in a 300-level statistics/econometrics course) it will be impossible to isolate the effect we are interested in: the confounding effects will be tangled up and cause bias.

(f) [OPTIONAL] Define μ_1 as the average price in all monopolized rural retail gasoline markets (population mean). Define μ_2 as the average price in all competitive rural retail gasoline markets (population mean).

$$H_0: (\mu_1 - \mu_2) = 0$$

$$H_1: (\mu_1 - \mu_2) > 0$$

$$t = \frac{(\bar{X}_1 - \bar{X}_2) - (\mu_1 - \mu_2)}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{(1.87 - 1.80) - (0)}{\sqrt{\frac{0.026^2}{4} + \frac{0.091^2}{8}}} = \frac{0.07}{0.035} = 2.02$$

$$v = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{\left(\frac{(s_1^2/n_1)^2}{n_1 - 1} + \frac{(s_2^2/n_2)^2}{n_2 - 1} \right)} = \frac{(0.026^2/4 + 0.091^2/8)^2}{\left(\frac{(0.026^2/4)^2}{3} + \frac{(0.091^2/8)^2}{7} \right)} \approx 9$$

Rejection region at a 5% significance level is $(1.83, \infty)$. Hence we would reject the null and conclude that prices are higher, in a statistically significant way, in markets that are monopolized compared to competitive. [Note: You may have also answered using the P-value approach and found that the P-value given the test statistic of 2.02 is between 0.05 and 0.025.] This is NOT the same question as Q1. Q1 is the causal research question. The question asked for part (f) is simply a descriptive question. There is a HUGE conceptual difference between asking whether prices are statistically different and asking about what caused that difference.

(g) No. No, we cannot conclude that monopolies cause higher prices. We have observational data and we believe that our control variable (the nature of competition) is endogenous. Hence, our sample means will be systematically different from each other not only because of the nature of competition but also because of other systematic differences across markets (cost structure, demand structure, etc.). Our statistical analysis above does not control for these other differences. It simply compares the raw means: the average in the monopolized markets and the average in the competitive markets. Further it attributes ALL differences in these means to either sampling noise or to differences in the nature of competition. But we know that other things cause a difference in the mean prices and differences in the nature of competition. Hence, our analysis is biased. Despite a small P-value (which would be great if we did not have an endogenous control variable) we cannot conclude that monopolies cause higher prices. All we can say is that monopolized markets tend to have higher prices than competitive markets but that could be due to not only the nature of competition but also to other unobserved factors like demand structure and costs.

(If the other factors (cost structure, demand structure, etc.) did not cause differences in firms' choices about entering market and hence the nature of competition, then we would NOT have a problem and we could conclude causality. It is OK if these other factors affect price, but it is not OK that they also affect the nature of competition. Unfortunately it is entirely implausible to suggest that the nature of competition is exogenous and hence we cannot infer causality in this example.)