In the 1990s, the state of Georgia introduced Hope Scholarships, a financial aid program for Georgia public colleges and universities funded by a state lottery. When fully phased in 1995, Hope Scholarships had the following regulations:

- Any student who graduates a Georgia high school with a GPA of 3.0 or better is eligible, regardless of family income.
- The program pays all tuition and fees at any Georgia public university or college to which the student has been admitted.

The program has other regulations as well - e.g. a student has to apply for any federal grants for which they are eligible - but they do not concern us here.

Your job is to evaluate whether Hope Scholarships caused Georgia high school graduates to acquire more education and thereby have higher earnings. What you have at the moment is a multi-year data set that contains annual earnings for individuals by age and by state. Unfortunately, the data set has no information on the individual's years of education.

a) Explain the points on which you agree and disagree with the following strategies for using these data to answer your question. In your answers, assume for simplicity that all people continue to live in the state where they attended high school.

   i) Compare the average earnings of Georgia residents who were 27-28 in 2005 with the average earnings of Georgia residents who were 27-28 in 1995. If earnings for 2005 were higher than the earnings for 1995, it suggests the Hope Scholarships were working.

   Answer: The good point of this comparison is that it focuses on differences between Georgia residents who got the treatment and Georgia residents who didn’t (because they were too old). The bad point is that it ignores the possibility that wages for everyone in the economy rose over time so that a similar comparison in other states who didn’t have the Hope Scholarships would show the same result.

   ii) Compare the average earnings of Georgia residents who were 27-28 in 2005 with the 2005 average earnings of 27-28 year-old residents of the four surrounding states - Tennessee, Florida, South Carolina and Florida.
If the earnings in Georgia are higher than earnings in the surrounding states, it suggests the Hope Scholarships were working.

Answer: This is the opposite problem. The good point here is that by comparing to other states, you eliminate the possibility of an overall trend that affected wages of young persons in all states. But your result could reflect a trend in Georgia that affected all age groups in Georgia that included older people who did not have a Hope Scholarship.

b) Design and explain your own strategy for analyzing the data set to examine whether the Hope Scholarships were effective.

Answer: You need to compare both kinds of differences simultaneously – what is called differences in differences or “difs in difs”. Begin by comparing the average earnings of Georgia workers who were 27-28 in 1995 with the average earnings of workers in neighboring states who were 27-28 in 1995 and calculate the difference between the groups (i.e. Georgia – other states). Then compare the average earnings of Georgia workers who were 27-28 in 2005 with the average earnings of Georgia workers in neighboring states who were 27-28 in 2005 and compute the difference between these two groups.

If the 1995 gap was positive (i.e. Georgia residents earned more) and the Hope Scholarships had their desired effect, the 2005 gap should be positive and larger than 1995.

If the 1995 gap was negative (i.e. Georgia residents earned less) and the Hope Scholarships had their desired effect, the 2005 gap should be less negative or positive.

2) The typical auto repair shop has employees of three different skill levels:

- Expert diagnosticians who can follow any set of rules and can, if necessary, solve any new problem including extremely hard ones.

- Good diagnosticians who can follow any set of rules and can, if necessary, solve simple new problems.

- "Lube Boys" who do only routine maintenance including oil changes and brake checks.

a) Make up an example of a "hard car problem" and describe the cognitive processes by which an expert diagnostician might solve it. Explain what, if any, relationship your description has to the deGroot chess experiments in the reading "How Experts from Novices."
Answer: A hard problem might begin with an electrical malfunction – say, you press all the right buttons to set the car alarm but the alarm won’t set. The normal procedure is to use electronic testing equipment to check for breaks in the wiring, a faulty switch, etc. The problem gets hard when the circuits appear to pass all the tests but the problem still exists. An expert diagnostician might remember another electrical problem where two circuits were somehow connected and a faulty part in the first circuit caused an “unexplained” failure in the second. The diagnostician would then start looking to see if there was any similar connected circuits here.

The deGroot experiments show the ability of a chess expert to look at a chess board in the middle of a game and recall the patterns of relevant games that he/she has seen before. The same thing is operating here – the diagnostician is recognizing a pattern of characteristics in the current problem that matches up with characteristics of a problem he solved some time ago.

b) Increasingly, automakers are offering technicians incentives to write up and submit previously unsolved problems - for example, a problem that emerges on a 2006 model. When a technician submits a solution, a group of experts will evaluate it to see if it is really new and whether the technician has a good solution. If the problem/solution is approved, the technician receives a cash bonus and the solution is included in the next update of the company's repair manual. (These manuals are now on DVD's and new editions are sent out monthly). Explain why this process might increase or decrease the fraction of all workers who are expert diagnosticians. (I.E. explain why the effect might go in either direction.)

Answer: From the automaker’s perspective, the system increases the value of an expert because an expert’s solution gets out to all mechanics quickly and so mechanics do not waste a lot of time trying to solve the new problem on their own. This may result in automaker having lower warranty costs, etc and if the savings are big enough, the automaker might offer big enough incentives for dealerships to employ more experts. On the other hand, if once an expert’s solution is distributed over the web, a formerly hard problem becomes an easy problem that no longer requires an expert. Individual car dealerships may feel they have fewer problems that need an expert and so they may cut down on the number of experts.

3) a) When you are in the middle of a clothing transaction on www.landsend.com, you can contact a live person by voice or instant messenger by clicking on "contact us" and then clicking on "Lands' End Live". When you are in the middle of a book or CD transaction on Amazon.com, there are no options for contacting a live person. If we assume that both on-line retailers are following optimal strategies, explain why this difference might arise.

Answer: Purchasing a piece of clothing often involves gathering more last minute information than purchasing a book or a CD. In the case of a book or CD, Amazon
assumes that most people come to their web site knowing more or less what they want. Amazon helps this process along with web based information that requires no human: reviews of other users, showing a few pages of the book, letting the customer hear 30 seconds of the CD. The implication is this is enough information to decide on a purchase and a long talk with an operator (who might not know a lot about the book) won’t generate many more sales.

A piece of clothing is more likely to raise a number of very specific questions: is the picture on the web the right color, how does it compare with the size I ordered for my 16 year old son last year, etc. These questions are too idiosyncratic to answer with a “frequently asked questions” menu so Lands’ End starts you off ordering from the web (with the hope that you can complete your order there) but if offers you help if you need it.

b) In the late 1990s, many people argued that web-based stock trading would totally eliminate stock brokers and personal financial analysts. Using your knowledge of the readings for this week including “Planning for the Five Great Goals of Life”, explain why this prediction was likely overstated. Be as complete as you can about what is exchanged in person-to-person communication that is not exchanged over a web page.

Answer: The answer here with the point made at the end of Tuesday’s class last week: human decisions involve emotional as well as a rational components. In particular, emotions play big role in whether you trust an information source. “Planning for the Five Great Goals of Life” argues a typical investor wants money for some goal – to help their kids, to provide for a vision of retirement, maybe just to “be somebody” – and that goal is something they care deeply about. In other words, the goal has emotional meaning to them. A good broker will discover that goal and keep referring to it during financial discussions. As a result, many customers will feel the broker identifies with them in a way that establishes trust and emotional contact - something a website can’t replicate. Stockbrokers have a saying about this: “They don’t care what you know until they know that you care.”

4) Suppose we want to estimate the equation

\[ \ln(\text{wage}) = \beta_0 + \beta_1 \text{age} + \beta_2 \text{age}^2 + \beta_3 \text{education} + \varepsilon_i \]

for a sample of men but that we’re unable to control for any measure of ability. For each of the following potential instruments for education, explain why or why not you think it would make a good instrument:

a) Powerball lottery number (assuming everyone in the sample indeed played the lottery)
b) a dummy variable for being born in the first quarter of the year
(assuming the men were educated in the United States in the middle of the 20th century)

c) mother’s level of education

Answer: Recall from recitation on March 3rd the two requirements for an instrumental variable: (1) it should be correlated with the variable you’re instrumenting for (technically, it should be correlated with the variable you’re instrumenting for even after controlling for the other righthand-side variables) and (2) it should be uncorrelated with \( \varepsilon \).

Someone’s powerball lottery number is essentially random and, thus, uncorrelated with things. So it should meet requirement 2, but this also means that it won’t meet requirement 1.

Quarter of birth is the instrument used by Angrist and Krueger which was discussed in recitation. The idea was that this is correlated with education because of compulsory schooling laws, and it may make some sense that it would uncorrelated with the error term (if it doesn’t affect any of the other things that affect earnings).

Mother’s level of education would most likely meet the first requirement, but it’s not so clear that it would meet the second. In other words, it may have an effect on earnings other than through your own level of education. Even though a more-educated mother might encourage you to go through more education, she might also, for example, know more about job opportunities and be able to hook you up with a high-paying job. Or perhaps a more-educated mother would raise you better, and this could affect your earnings apart from the effect through the number of years you went to school. Or perhaps a more-educated mother will pass on better genes or marry someone who has better genes, which may directly affect your ability (which is contained in the error term).

5) Suppose that a group of recent high school graduates is about to enter the work force. One-fourth of these students have taken an easy curriculum, one-half have taken a medium curriculum, and one-fourth have taken a hard curriculum. A student who has taken the easy curriculum would be worth $20,000 to an employer and has a reservation income (the minimum income needed for him to work rather than do something else) of $18,000, a student who has taken the medium curriculum would be worth $26,000 to an employer and has a reservation income of $22,000, and a student who has taken the hard curriculum would be worth $32,000 to an employer and has a reservation income of $28,000. Suppose that the employers can’t verify which curriculum a given individual has taken but that they know the distribution of types in the population. Also assume that employers are trying to maximize expected profits and that the labor market is competitive (in the sense that an employees’ income is bid up to his expected product).

a) Which workers would you expect to see working, and what income would they receive?
Answer: Note that, since the employers can’t distinguish between the different types of people, everyone who is working will make the same amount (which is equal to the average value to the employers of the people who are working). Also note that if one type is working, then every type lower than that type will also want to work.

With these things in mind, there are only three potential equilibria: (1) everyone works and earns 
\[(.25*20000)+(.5*26000)+(.25*32000)=26000,\]
(2) the easy and medium types work and earn 
\[(1/3)*20000+(2/3)*26000=24000,\]
or (3) only the easy type works and they earn 20000.

Possibility (1) can be ruled out because the hard curriculum types only earn 
$26,000, and so they will not want to work (they need to have at least $28,000 in order to work). Possibility (2) describes an equilibrium because the types who are working are making at least their reservation wage while the type that is not is also behaving optimally. If ‘equilibrium’ is defined to mean that workers are paid the expected product of those who are working and that workers work if and only if they receive at least their reservation wage, then possibility (3) is also an equilibrium. However, even though no worker has an incentive to unilaterally change his behavior under possibility (3), this possibility may not be as likely since there is another equilibrium that Pareto dominates it (both easy and medium curriculum workers are strictly better off under possibility (2)).

b) Suppose you are one of these students and that an outside accrediting agency comes along and offers to verify to potential employers what type of curriculum you (and only you) have taken. How much would you be willing to pay for this service if you have taken the hard curriculum? How much would you be willing to pay for it if you’ve taken the medium curriculum? And how much would you be willing to pay for it if you’ve taken the easy curriculum?

Answer: Someone who could verify that he has taken the hard curriculum could earn $32,000, and so he would pay up to $4,000 to do this (he was not working before, and his reservation income is $28,000; so if he pays any amount up to $4,000, his net income will exceed his reservation income). Assuming we were in possibility (2) before, a medium curriculum worker would pay up to $2,000 for the verification (he was making $24,000 before, and he could make $26,000 if he is able to verify with employers that he is a medium type). The easy curriculum types would not be willing to pay anything for the verification (and in fact, if we were in possibility (2) before, they would be willing to pay up to $4,000 to avoid having their type verified, since having their type verified would lower their income to $20,000).

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