Homework 1
Due February 10, 2009
Chapters 1-4, and 18-24

Make sure your graphs are scaled and labeled correctly. Note important points on the graphs and label them. Also be sure to label the axis on all of your graphs. The numbers in parenthesis are the point values for the question. Partial credit will be given.

1. Suppose that we are trying to find the returns to education in the labor market. In other words, our primary interest is to estimate the impact of an additional year of schooling on the wage rate of the individual. For this purpose, we conduct a survey in among workers asking them about their years of schooling (educ) and wage rates (wage). The data is available at on the E-Learning website under the Assignment folder. Instructions for doing a regression are included in the file.

(a) First, look at the dataset in Sheet1 where the survey results for the entire sample are provided. The first column gives the reported hourly wage rates for the workers whereas the second column provides their years of schooling. Make a scatter-plot of the two variables where the y-axis is the wage rate and the x-axis is the years of schooling. What kind of a relationship can you see between wage rates and years of schooling in this graph? (3)

They look like they are positively correlated. I.E. an increase in education is correlated with an increase in the wage rate.

(b) Given that you are all good economists aware that a simple scatter-plot can not provide a formal answer to the question of interest, you decide to conduct a regression analysis. Formally, you are trying to estimate the following model using ordinary least squares:

\[ y_i = \beta_0 + \beta_1 X_i + \varepsilon_i \]

where \( i \) denotes the workers, \( y_i \) denotes the wage rate for worker \( i \), \( \beta_0 \) is the constant term, \( X_i \) is the years of schooling for worker \( i \), \( \beta_1 \) is the returns to schooling (parameter of interest) and \( \varepsilon_i \) is the error term. In the new sheet where the regression results are provided, the estimate of \( \beta_1 \) is given under ‘Coefficients’ right next to the ‘X variable’. Does the sign of \( \beta_1 \) confirm your prediction about the relationship between wage rate and years of schooling? What is the impact of an additional year of schooling on the wage rate of the workers? In other words, how much does an extra year of schooling increase/decrease the wage rate? (4)

The coefficient is positive .599. This confirms the positive relationship between schooling and education. The impact of an additional year of schooling is a 59.9 cent rise in your wage rate all other things being equal.

(c) Having obtained these results, you thought that the returns to schooling might be different for different professions. For this purpose, you created two subsamples. Sheet2 provides the data for the construction workers in the dataset. Repeat the same analysis in (b) using this dataset and answer the same questions. Does the estimate of \( \beta_1 \) you obtained for the entire sample in (b) overestimate or underestimate the impact of schooling for the construction workers? (2.5)
The coefficient is positive .449. This again confirms the positive relationship between schooling and education. The impact of an additional year of schooling is now only a 44.9 cent rise in your wage rate all other things being equal. So the estimate from part (b) OVERestimates the actual impact of education for construction workers (ie education is less important than for an average person).

\[ \text{wage}_i = 2.666 + .449 \text{educ}_i + \varepsilon_i \]

(d) Sheet3 provides the data for the workers in finance in the dataset. Repeat the same analysis in (b) using this dataset and answer the same questions. Does the estimate of \( \beta_1 \) you obtained for the entire sample in (b) overestimate or underestimate the impact of schooling for the finance workers? (2.5)

The coefficient is positive 1.3843. This again confirms the positive relationship between schooling and education. The impact of an additional year of schooling is now a $1.38 rise in your wage rate all other things being equal. So the estimate from part (b) UNDERestimates the actual impact of education for finance workers (ie education is more important than for an average person).

\[ \text{wage}_i = -6.723 + 1.3843 \text{educ}_i + \varepsilon_i \]

(e) Can you think of a cause for concern in this analysis? In other words, is there a reason to think that there might be another factor causing both higher years of schooling and higher wage rates, which would lead to biased estimates? If so, what is the other factor? (there is no unique answer to this question) (3)

Yes a third thing might be causing and increase in both education and higher wages. Maybe something like ability. We cant measure ability but having more ability might cause you to get more education and it might cause you to have a higher wage. Thus having more education may not necessarily be causing a higher wage it may just be an artifact of you having more ability.

2. Suppose that the demand for new flat screen computer monitors is given by \( Q = 800 - 5P \) and the long run supply of the monitors is \( Q = 4P - 280 \)

(a) Suppose the government comes in and institutes a tax of $36 per monitor on the consumers. What is the consumer price paid and the producer price received? (3)

Add the $36 into the price the consumers pay and then solve

\[ 800 - 5(P + 36) = 4P - 280 \implies 9P = 900 \implies P = 100 \]

Consumers pay \( P = 100 + 36 = 136 \)

(b) What is the statutory and economic incidences of the tax? (2)

The statutory incidence is $36 all on the consumers because they pay it. To answer the second part of the question you need to know what the price was before. Set the supply equal to the demand and solve.

\[ 800 - 5P = 4P - 280 \implies 9P = 1080 \implies P = 120 \]
Sub in to either the demand or supply function to solve for $Q$

\[ Q = 800 - 5(120) = 200 \quad Q = 4(120) - 280 = 200 \]

So the economic incidence is that the consumers pay \$136 - \$120 = \$16 of the tax and the producers pay \$120 - \$100 = \$20 of the tax.

(c) Graph the tax situation labeling all key points and areas, (3)

(d) What is the tax revenue? What is the dead weight loss? (2)

\[ TR = 36 \times 120 = 4,320 \quad DWL = \frac{1}{2}(136 - 100)(200 - 120) = 1,440 \]

3. Suppose that you can earn \$16 per hour before taxes and can work up to 80 hours per week. Consider two income tax rates, 10% and 20%.

(a) On the same diagram, draw the two weekly consumptionleisure budget constraints reflecting the two different tax rates. (4)
(b) Draw a set of representative indifference curves such that the income effect of the tax increase outweighs the substitution effect. (3)

(c) Draw a set of representative indifference curves such that the substitution effect of the tax increase outweighs the income effect. (3)

4. Consider a model in which individuals live for two periods. There are two individuals, John and Jules, and both have utility functions of the form \( U = \ln(C_1) + \ln(C_2) \). John earns $100 in the first period and saves \( S \) to finance consumption in the second period. Jules will receive $110 in the second period, and she borrows \( B \) to finance consumption in the first period. The interest rate \( r \) is 10%.

(a) Set up each individuals lifetime utility maximization problem. Solve for the optimal \( C_1, C_2, \) and \( S \) (or \( B \)) for Jules and John. (Hint: Do like we did a question in class.) (5)

For John, consumption in the second period is given by

\[
C_2 = S(1 + r) = (100 - C_1)(1 + 0.1)
\]

(i.e., the amount he saves plus interest). For Jules, consumption in the first period is financed entirely by borrowing, and she must pay back \( (1 + r)B \) in the second period. Hence, it must
be that
\[ C_2 = 110 - (1 + r)B = 110 - (1 + r)C_1 \]
for Jules. Rearranging (with \( r = 0.1 \)), we calculate that
\[ C_2 = (100 - C_1)(1 + 0.1). \]

Hence, John and Jules have the same budget constraint. Since they have the same preferences as well, they will have the same consumption in each period. To find the consumption, use the relationship from above in John’s (or Jules’s) maximization problem:
\[
\max_{C_1} \ln(C_1) + \ln(1.1(100 - C_1))
\]
Taking a derivative, setting it equal to zero, and rearranging gives
\[
\frac{1}{C_1} = \frac{1.1}{1.1(100 - C_1)} \implies 100 - C_1 = C_1 \implies C_1 = 50.
\]
Hence, \( C_1 = 50, S = 50, C_2 = 50(1.1) = 55, \) and \( B = 50. \)

(b) The government now imposes a 20% tax on interest income. Solve for John’s new optimum level of \( S. \) (Hint: What is the new after-tax interest rate?) Explain how your answer relates to the saving you found for John in (a), paying attention to any income and substitution effects. (5)

Writing the relationship between savings and second-period consumption for John is now slightly more complicated:
\[ C_2 = S(1 + r) - 0.2rS = S(1 + 0.8r) = (100 - C_1)(1.08) \]
The maximization problem thus reads
\[
\max_{C_1} \ln(C_1) + \ln(1.08(100 - C_1))
\]
Taking a derivative, setting it equal to zero, and rearranging gives
\[
\frac{1}{C_1} = \frac{1.08}{1.08(100 - C_1)} \implies 100 - C_1 = C_1 \implies C_1 = 50.
\]
just as in (a). Savings and first-period consumption are the same as in (a). (\( C_2 \) is now 54, lower than before.) Savings is unchanged in spite of the tax because of perfectly offsetting income and substitution effects. The substitution effect makes John want to save less and consume more in the first period (the rate of return is lower), but the income effect makes John poorer, so he consumes less in each period.

(c) Suppose that the government also provides a 20% tax credit on interest, so if Jules borrows \$10 and consequently owes \$1 in interest the government will give her \$0.20 back. Solve for Jules’s now-optimum level of \( B. \) Explain how your answer related to the borrowing you found in (a), paying attention to any income and substitution effects. (5)

For Jules, we now have
\[ C_2 = 110 - [(1 + r)B - 0.2rB] = 110 - (1.08)B \]
(Note that this is not the same as John’s part b budget constraint.) Her maximization problem reads
\[
\max_{C_1} \ln(C_1) + \ln(100 - 1.08C_1)
\]
Taking a derivative, setting it equal to zero, and rearranging gives
\[
\frac{1}{C_1} = \frac{1.08}{110 - 1.08C_1} \implies 110 - 1.08C_1 = 1.08C_1 \implies C_1 \approx 50.93
\]
This change leads Jules to borrow more and consume more than than in (a). (Note, however, that she has the same \(C_2\) as in (a).) We can understand this easily as well: the substitution effect makes her consume more in the first period (it is cheaper to borrow). The income effect makes her richer, since for any given first-period consumption, she has to pay less back and thus gets to consume more in the second period. Hence, the income effect also leads her to consume more.

5. Suppose that new machines cost $504, and the marginal benefit from new machines is \(MB = 246 - 6K\), where \(K\) is the number of machines purchased. The depreciation rate is 15% and the dividend yield is 10%.

(a) What amount of capital will you purchase? Why? (4)

The rule to follow in determining the optimal investment is set the marginal benefit equal to the marginal cost. In this case, the marginal cost is the sum of depreciation and required returns (dividends, here). For each machine, this cost is \((0.15 + 0.1)\times 504 = $126\). The marginal benefit is \(246 - 6K\). Setting the two equal and solving for \(K\) yields \(K = 20\).

(b) What amount of capital would you purchase if there were a 25% tax rate on cash earnings minus labor costs? (6)

The tax on earnings reduces the return to capital (the marginal benefit) by 25%. We now solve \(126 = (1 - 0.25)(246 - 6K)\). Solving yields \(K = 13\). The tax thus reduces investment by 7 units.