Economics 55D Summer Term I 2010 – Midterm 1

Name: ANSWER KEY

Please answer all questions in the space provided (including the sheets following each question). Feel free to use the back of each sheet if you need to. You are not permitted to use any books or notes. You may use a 4-function calculator and a ruler.

Unless otherwise stated, assume that tastes satisfy the usual rationality, monotonicity, continuity, and convexity assumptions and that all goods are essential. Do not assume anything more specific about tastes unless you are specifically asked to do so.

There are 100 points on the exam, and you have 1 hour and 15 minutes to complete the exam. The total number of points for each part is indicated in each question.

Make sure you have 11 pages in your exam (including the cover sheet).

Before starting the exam, you must sign the following statement:

I pledge to obey the Duke University Honor Code during this exam.
Signed: Instructor - Erika Martinez
1. A Two-Period Consumption Story - The Smith Family:

Mr. and Mrs. Smith have twin children, Brad and Angelina. Brad and Angelina will graduate from high school soon and Mr. and Mrs. Smith want to give them each $D as a graduation gift. Unfortunately the Smith’s do not have enough money to give them both $D at once so instead they decide to give one child his/her gift the first period after graduation and the other her/his gift the period after. Since ladies go first they give Angelina the choice and she decides to get the money in the first period and make her brother wait until the next period to receive his money. Suppose the Smith’s find some way to set up a trust that will give Angelina her gift in the first period and give Brad his gift in the second. Assume there is some way for Angelina (Brad) to save (borrow) at the same interest rate $r_1$ and that neither child has any additional money or income.

The Smith’s are very practical and fair people. Even though they can’t afford to give both Brad and Angelina their gifts in the same period they still want to ensure it is possible for both their children to enjoy equal levels of consumption in both periods. They realize this will not be possible if they give Angelina $D this period and Brad $D the next period.

(a) How much will the Smith’s have to gift Brad in the next period to ensure he will have the opportunity to consume the same as Angelina in both periods? Draw two graphs, one for Brad and one for Angelina, label each with $C_1$ ($s$ of Period 1 Consumption) on the horizontal axis and $C_2$ ($s$ of Period 2 Consumption) on the vertical axis. Clearly indicate the intercepts, slopes, and endowment points on each graph. (4 points)

The Smith’s will gift Brad $D(1+r_1)$ in period 2. See Graphs 1-a1 and 1-a2

(b) Even though Brad and Angelina are not identical twins they have identical preferences and also have already made their consumption decisions for the 2 periods. Each has chosen the same levels of consumption in periods 1 and 2, consumption levels $A_1$ in period 1 and $A_2$ in period 2. Unfortunately, after the Smith’s set up the trust and before Brad and Angelina are able to access their money the interest goes up to $r_2$.

On the same graphs from (a) label Brad and Angelina’s optimal bundles, A, before the interest rate increased and draw the corresponding indifference curves. Also illustrate and label the intercepts of the new budget constraints the Smith siblings face. (4 points)

See Graph 1-a1 and 1-a2

(c) We know when Brad and Angelina choose their new optimal bundles after the interest increases from $r_1$ to $r_2$ they will choose a bundle somewhere on their new budget constraints. In this type of model what assumptions do we usually apply, with regard to period 1 consumption and period 2 consumption, in order to limit where those final consumption bundles will lie? (4 points)

In class we have repeatedly said that, unless we state otherwise we can use the assumption that consumption is normal in both periods to limit where the choices our consumer will make when faced with a change in the interest rate. In your text this same assumption is applied.

(d) Based on you answer in part (c), explain whether or not the following statement is true or false: As outlined in the problem Brad and Angelina Smith have identical preferences, began with the same set of feasible consumption choices, faced the same interest rates, and made the same consumption choice before the increase in interest rates. Therefore, although
it will likely not be by the same amount, after the interest rate increases both Brad and Angelina will choose to decrease their consumption in period 1. (6 points)

FALSE. It depends how large, in absolute value, the substitution effect is relative to the income effect. Brad will definitely decrease his consumption in period 1 because the income and substitution effects move in the same direction. For Angelina however, they do not. Therefore if the substitution effect is bigger than the income effect in absolute value she, like her brother, will decrease her period 1 consumption. If however the substitution effect is smaller than the income effect in absolute value she will increase her consumption in periods 2 AND 1.

(e) Maintaining the assumption described in your answer in part (c) use new graphs to illustrate the regions Brad and Angelina’s optimal bundles must lie. (5 points)

See Graphs 1-e1, 1-e2, and 1-e3

(f) Below your graphs in part (e) illustrate the relevant supply or demand curve for capital. Make sure you label the axes of the new graphs correctly, with the interest rate and either supply of capital or demand of capital. If you do not have enough information to definitively determine the slope of either curve explain, in words or with the use of multiple graphs, the circumstances for which this is the case. (6 points)

As noted in the answer to (e) Brad will decrease his consumption in period 1 giving rise to a negatively sloping demand for capital curve, See Graph 1-f2. However, depending on the size of the substitution effect Angelina may decrease (increase) her consumption in period 1 giving rise to a upward (downward) sloping supply of capital curve. See Graphs 1-f1 1-f2, and 1-f3

2. Biodiesel Tax Credit:

For some years, soybean farmers have enjoyed a 25 cent per-bushel tax credit when the soybean is used as a feedstock for biodiesel fuel.

Assume that a typical soybean farmer has 200 acres of farm land and he cannot buy more (i.e., assume that the farmer is endowed with this number of acres). Each year the farmer can either choose to grow soybean or simply have a larger “backyard” and assume there are no additional costs associated with preparing additional acreage for the crop (i.e., there is no extra cost to the farmer if he decides to consume more backyard space or plant more soybean than in the previous year). The total yield of soybean per acre is 50 bushels. He will sell every bushel on the market and make $6.50 per bushel of soybean off of the sale. Assume throughout the problem that the tax credit is $.25 per bushel and that the farmer would receive this amount for each acre of soybean he registers for biodiesel in a given year. Finally, assume throughout that the farmer has no other source of income than what he derives from soybean and he sells the entire yield soybean at the market.

(a) Describe in words what opportunity cost the typical farmer faces when deciding whether or not to consume backyard acreage if the credit is not renewed. Based on the information given above what is the dollar value of this opportunity cost? (5 points)

As defined in the text, the opportunity cost of any action is the next best alternative one gives up by undertaking this action. In this case the opportunity cost of choosing to consume an extra acre of backyard space is a registered acre of soybean farm. 1 acre produces 50 bushels which would be sold for $6.50 each. Therefore the dollar value of this opportunity cost is $325.
(b) Unfortunately for farmers, the Senate failed to renew the tax credit this year due to their preoccupation with the healthcare debate and a partisan dispute over extending the estate tax. At Peter Cremer, an oleochemical producer in Cincinnati with capacity to make 60 million gallons a year of biodiesel, “the plant has been shut down for biodiesel pending resumption of the tax credit,” say Mack Findley, vice president of sales. “I don’t know of much production anywhere in North America.”

As a result the American Soybean Association and other organizations began urging farmers to contact their senators. They worry that failure to reinstate the tax credit will mean decreased production throughout America.

In a graph that has “b” (Number of Backyard Acres Per Year) on the horizontal axis and “y” ($s of Other Consumption) on the vertical axis, illustrate the two budget constraints the typical farmer faces, one with the tax credit and the one without the tax credit. Carefully label the slopes and intercepts of these two budget lines. (5 points)

See Graph 2-b

(c) One typical farmer, Ol’ McDonald, is observed to register 50 acres each year when the tax credit was in effect. If the tax credit is not renewed will the associations’ fears come true? i.e. will soybean production for biodiesel fuel decrease? More specifically, will Ol’ McDonald register more or less than 50 acres of soybean per year if the tax credit is not renewed? If you do not have enough information to give a definitive answer to this question, explain under exactly what circumstances the farmer will register more soybean and less soybean acreage if the tax credit is not renewed. (7 points)

The associations fears may or may not come true. You cannot tell whether Ol’ MacDonald will register more or fewer acres of soybean in response to the tax credit. It depends on the nature of the income effect of the price change, i.e., whether backyard space is a normal or an inferior good for Ol’ McDonald, and how large, in absolute value, the substitution effect is relative to the income effect. See Graphs 2-c1 and 2-c2, where we assume that backyard space is a normal good. (Note that when backyard space is a normal good, the income and substitution effects move in the opposite direction.) In Graph 2-c1, the substitution effect is bigger in absolute value than the income effect, so Ol’ McDonald would register more than 50 acres of soybean farm per year as a result of the tax credit. Alternatively, if, as in Graph 2-c2, the substitution effect is smaller in absolute value than the income effect, then Ol’ McDonald would register less than 50 acres of soybean farm per year as a result of the tax credit. If backyard space were an inferior good for Ol’ McDonald, then the substitution and income effects would move in the same direction and Ol’ MacDonald would register more acres of soybean (and consume less backyard space) each year in response to the tax credit. (See Graph 2-c3.)

(d) You find out about two other typical farmers that live down the hill from Ol’ McDonald, Mr. Jack and Ms. Jill. Like Ol’ MacDonald, Mr. Jack and Ms. Jill both register 50 acres per year when the tax credit was in effect. You learn that Mr. Jack and Ms. Jill have different preferences for backyard space. Mr. Jack is very unwilling to give up backyard space (b) to get more consumption of other goods (y). Quite unlike Mr. Jack, Ms. Jill is very willing to reduce her backyard space (b) in return for consuming more of other goods (y). Finally, assume that both farmers have quasilinear preferences for backyard space.
Given the above information, do you expect Mr. Jack will register more or less soybean acreage than Ms. Jill if the soybean acreage if the tax credit is not renewed? Explain your answer and illustrate it using one or more clearly labeled graphs, showing the preferences of each of the two farmers. (7 points)

See Graphs 2-d1 and 2-d2 for Mr. Jack and Ms. Jill, respectively. As illustrated, Mr. Jack has indifference curves that are less flat than those for Ms. Jill, indicating that Mr. Jack is less willing to substitute backyard space for other consumption goods compared to Ms. Jill. Given that both farmers have quasi-linear preferences in backyard space, the renewal of the tax credit generates only a substitution effect. It should be clear that since Mr. Jack is unwilling to give up backyard space, meaning he is not going to do much substitution, then he will have a much smaller substitution effect than Ms. Jill. For Mr. Jack, this effect is the horizontal distance between A and B’ in Graph 2-d1 and the corresponding distance between A and C’ for Ms. Jill in Graph 2-d2. Since both Mr. Jack and Ms. Jill start at the same point (A), this implies that Mr. Jack would end up registering more soybean acreage than Ms. Jill if the tax credit were not renewed.

(c) Lastly you hear tale of Ms. Bow Peep who lost her sheep. Since they never came home she converted her 200 acre herding land to a soybean farm. She too registered 50 acres of soybean when the tax credit was in effect. Also suppose that for Ms. Bow Peep backyard space is an inferior good. Draw a new graph and indicate her optimal choice of backyard space with and without the tax credit. If you do not have enough information to give a definitive answer to this question, explain under exactly what circumstances Ms. Bow Peep will register more soybean and less soybean acreage when she receives the tax credit. (6 points)

Since backyard space is an inferior good for Ms. Bow Peep, she would increase her number of registered soybean acreage. See Graph 2-e

(f) Beneath your graph in (f), draw a supply curve for acres of soybean that is fully consistent with the indifference curves you drew in (f). (6 points)

See Graph 2-f

3. The NBA Luxury Tax

The NBA has penalties for exceeding the League’s salary cap. During the 2009-2010 season, a luxury tax payment was required of any teams whose payroll exceeded roughly $70 million. Teams exceeding the cap are punished by being forced to pay $1 to the League for each $1 over the cap. While most teams avoid the tax, each season there are a few teams who have payrolls at luxury tax levels.

Assume “star players” are a luxury service (or good) and each cost the team $15 million a season. Further assume the typical team can carry 3 star players without exceeding the payroll cap (i.e. with 3 players they still have enough money remaining to pay the additional players needed to ‘field’ a team without going over the cap) but once they hire more than 3 star players the luxury tax is enforced. Thus the decision to hire 3 star players effectively will cost the team $30 million for each star player thereafter. Finally, assume the typical team has budgeted a fixed amount of money each season, I, to spend on payroll.

(a) On a graph that has “x (number of star players a season)” on the horizontal axis and “y ($ of All Other Payroll Costs per season)” on the vertical axis, illustrate the budget line for
the typical team in the NBA. Be sure to label the slope and the intercepts. On this graph illustrate the location of the optimal consumption bundle for a team who falls subject to the luxury tax. Label the optimal bundle A and the corresponding consumption on the x-axis $x_A$, also display the indifference curve associated with this bundle. (6 points)

See Graph 3-a

(b) On the graph you constructed for Part a, indicate the location of the optimal bundle, B, and corresponding level of star player consumption, $x_B$, for this team if there were no payroll tax. (7 points)

See Graph 3-a. This may be a little tricky, first note if there is no tax the BC would no longer have a kink and the slope is $-15$ mil. Bundle B must lie on a curve that is tangent to the BC with slope $-15$ mil and in a position that is true for a normal good that is also a LUXURY.

(c) In a second graph, directly below the graph you drew for Parts a/b, draw the compensated demand curve - or marginal willingness to pay curve - for number of star players, x, associated with the optimal bundle chosen under the luxury tax and label this curve as the “MWTPA” - where the superscript refers to the team’s player decision when they fall subject to the luxury tax. Be sure to label the relevant prices on the vertical axis and consumption levels on the horizontal axis. (6 points)

See Graph 3-c

(d) On your second graph in the $(p, x)$ space, indicate the areas underneath the MWTPA curve that denote the Total Williness to Pay (TWTP) and the Team’s Surplus (TS) associated with having to pay the luxury tax. Briefly explain what each of these surplus’ measure in this particular context. (7 points)

See Graph 3-c. TWTP at a particular price ($30$ million under the luxury tax) is the total amount that a consumer (or team in this case) would be willing to pay for being able to hire as many star players as they choose at a given price. It is all the area under the MWTPA curve, note that this amount what the team actually paid $(b + c)$. In graph 3-d TWTP is $(a + b + c)$. Team Surplus is the difference between the total willingness to pay and what they actually paid, i.e. the area a.

(e) Suppose somehow you land an internship position with the NBA during the 2010-2011 season. Being the budding economist you are you realize the NBA is missing out on a huge opportunity here. They can easily make more money by getting rid of the $1 for $1 luxury tax and replacing it with a one time luxury fee. Work through a proposal to illustrate to the NBA executive how they can get more money from the typical team who pays the luxury tax without making them less happy. Re-copy the graphs from Parts a/b and c. Use these graphs to help illustrate your claims; specifically indicate exactly how much more the League could be making from this tax. Provide a clear but succinct explanation of your proposal. (9 points)

See Graph 3-e. In this case the luxury fee is just like a lump sum tax. The vertical distance between the BC without a luxury tax, with slope $-15$mil, and the compensated BC is the highest luxury fee the League could charge that would leave the typical team who is currently paying the luxury tax no worse off; i.e. the team would be indifferent between paying the luxury tax and paying the luxury fee because both leave the team with utility $u_1$. This distance is the vertical distance between alpha and beta on the top graph. However, the amount of revenue generated from the luxury fee, denoted LF in the graph, is much larger then the revenue generated from the luxury tax, denoted LT. So while the team is indifferent the League
would be much better off if they instituted a fee instead of the tax, $LF > LT$. Conversely - you could have used the bottom graph to denote the teams surplus under the tax is area $b$ but with the fee it is area $(b + d)$. Correct use of either or both graphs in your explanation is sufficient for full credit.

ALL graphs are on the following page.
Graph 1-a1
Angelina

Graph 1-a2
Brad

Graph 1-e1
Angelina | SE > IE

Graph 1-e2
Angelina | SE < IE

Graph I-f1
Savings

Graph I-f2
Savings

upward sloping

alternative downward sloping
Graph 1-e3

Demand for capital
Graph 2-b

b is a
(normal good)
\|SE| > |IE|

Graph 2-c1

b is a
(normal good)
\|SE| > |IE|

Graph 2-c2

b is a
(normal)
\|SE| < |IE|

Graph 2-c3

b is an
(inferior good)