Econ 522 Macroeconomics: Midterm

1. The exam lasts from 1 p.m. on Thursday, March 13, to 1 p.m. on Saturday, March 15.
2. Define any notations you use that are different from the lecture.
3. This is an open-book exam.
4. You are allowed to use your laptop.
5. You are allowed to email your excel file to the grader: $shcho@ku.edu$

Short Questions

Question 1. (10 points)

In the 2100s, the labor force is significantly replaced by robots. People spend much more time on leisure than in the 2000s. The future government starts imposing a proportional tax on leisure. For example, if you watch Netflix longer, you need to pay more due to the leisure tax. Explain how the leisure tax affects household **optimal consumption, leisure and labor supply decisions** using the income and substitution effects. To be specific, you should predict how the income effect affects (c^*, l^*, N^{s*}), respectively. Similarly, predict how the substitution effect affects (c^*, l^*, N^{s*}), respectively. Combine the two effects to finalize the effect of the introduction of a leisure tax on (c^*, l^*, N^{s*}) assuming the substitution effect dominates the income effect.

Question 2. (10 points)

The big tech firms have made a lot of revenue over a recent boom. The Biden administration starts increasing taxes on the firm revenue to pay off existing debt. Based on the firm's problem, explain how the tax hike on revenue affects **labor demand** by the firm. Specifically, you should explain first how the marginal product of labor (MPN) changes in response to the subsidy and then how changes in MPN affect the labor demand.

Question 3. (20 points)

Jayhawk initiates an IT start-up that creates mobile applications and games by hiring programmers. The company's production function is given by $Y = 4KN^{0.5}$ where N is the number of programmers. The current wage of a programmer is $w = 2$ and the amount of capital (aggregation of computers, software, etc) is $K = 1$.

1. Write down the firm's problem.

2. Find the optimal labor demand to maximize the profit. You can solve this by hand or using Excel.

3. Jayhawk receives an angel investment and thus capital level jumps into $K = 2$. What is a new optimal labor demand? Explain the reason for the change in labor demand.

Question 4. (20 points)

You need to find optimal exercise hours for your healthy life. Suppose you have the following utility function

$$U = 2\ln(H) - (E)^2 \tag{0.1}$$

where H refers to your level of health that gives increases your utility by preventing potential illness and E refers to the time you spend on exercise. Here, the negativity in front of $(E)^2$ represents disutility from exercise.

You choose the amount of time you want to spend on exercise. You also "choose" the health level that you would like (implicitly). Your health levels of course depend on how much time you spend exercising. Mathematically:

$$H = 9 * E. \tag{0.2}$$

Here 9 can be interpreted as a productivity term: you increase your health by 9 by exercising one hour more.

1. Using the above information, determine how many hours you should spend on **exercise** and what should be your **optimal health level** in terms of numbers (you should provide numerical values). You can solve this by hand or using Excel.

2. Assume that the productivity increases to 16 after using a commercial application for health management. Find new optimal exercise hours and health levels. Explain the change using the income or substitution effects.

Long Question (40 points)

Suppose the representative household has the following utility function:

$$U(c,l) = \ln c + \frac{1}{2}\ln l$$

where c is consumption and l is leisure. Let h be the total hours available to a household. Recall that the worker should split his time h into leisure l and working N such that $h = l + N$. The household spends on consumption, earns labor income, receives dividend income π and pays proportional labor income tax τ_w instead of lump-sum tax T. Let the wage rate per hour worked be w.

1. Write down **the household's problem.**

2. Solve for **optimal** c^*, N^{s*} **and** l^* when $h = 1$, $w = 2$, $\pi = 0$, and $\tau_w = 0.3$ (30%). You can solve this by hand or using Excel.

3. How do c^*, l^* and N^{s*} change when τ_w falls to 0.2 (20%)? You can solve this by hand or using Excel. Explain this result using income and substitution effects.

4. The federal government decides to increase spending on public goods such as public health care by increasing a labor income tax. Analyze how this policy change affects the economic decisions (c^*, l^*, and N^{s*}) of Americans based on your results above. Explain this result using income and substitution effects.

Long Question (40 points)

Extra Page

Extra Page