Homework 1 (40 Points)

Problem 1 (4 Points)

Which of the following statements represent positive analysis and which represent normative analysis?

1. A 50-cent-per-pack tax on cigarettes will lead to a 12 percent reduction in smoking by teenagers.
2. The government should spend more on AI research.
3. Rising paper prices will increase textbook prices.
4. The price of housing in China is too high.

Problem 2 (4 Points)

The company that you manage has invested $5 million in developing a new product, but the development is not quite finished. At a recent meeting, your salespeople report that the introduction of competing products has reduced the expected sales of your new product to $3 million.

1. If it would cost $1 million to finish development and make the product, should you go ahead and do so? Why? (2 Points)
2. What is the most that you should pay to complete development? (2 Points)

Problem 3 (6 Points)

You are given two choices after college: work or go to law school. Suppose law school takes one year to complete and the tuition is $50,000. Having a law degree will increase your lifetime earnings by $100,000. Studying law, however, is hard and you value the "enjoyment" of studying for one year at -$10,000. Suppose, on the other hand, that if you do not go to law school, you can work at a firm that pays you $60,000 per year. Suppose there are no other costs and benefits involved.

1. What is your opportunity cost of going to law school? (2 Points)
2. What is your opportunity cost of working? (2 Points)
3. Suppose your friend Tom faces the same two choices after college and he chooses to go to law school. What does Tom's choice say about how much he enjoys studying law? (2 Points)

Problem 4 (6 Points)

The Stanford marshmallow test was a study conducted by Walter Mischel and Ebbe Ebbesen at Stanford University in 1970. In this study, children aged 3 to 5 were give a marshmallow and two choices: either they could eat the marshmallow immediately, or, if they wait 15 minutes without eating the marshmallow, they would be awarded with a second marshmallow so that they could have two.

Let u_1 be the enjoyment of eating one marshmallow immediately, u_2 be the enjoyment of eating one marshmallow after 15 minutes, and c be the cost of waiting 15 minutes.

1. What is the opportunity cost of eating the marshmallow immediately? (2 Points)
2. What is the opportunity cost of choosing to wait 15 minutes and then eat two marshmallows? (2 Points)
3. Assuming children behaved "rationally," what conclusion can you draw about the children who behaved differently (some chose to eat immediately, others chose to wait)? (2 Points)

Problem 5 (2 Points)

In economics, enjoyment is also called **utility**. For example, the enjoyment of watching a movie can be written as $u\,(\text{movie})$ – the utility of watching the movie. When facing choice A and B, we choose A if $u\,(A) > u\,(B)$.

Often, a choice can generate different outcomes with different probabilities. For example, a lottery L gives us \$100 with 50% probability and \$0 with 50% probability. In this case, we say the **expected utility** of L is $u\,(L) = u\,(\$100) \times 0.5 + u\,(\$0) \times 0.5$, where $u\,(\$100)$ means the utility of receiving \$100.

Using the utility framework, can you define what it means to be risk-averse, risk-neutral, and risk-loving?

Problem 6 (4 Points)

Xiao Ming's enjoyment of wealth can be written as $u\,(x) = \sqrt{x}$, where x denotes wealth. In other words, Xiao Ming's enjoyment of having \$100 is 10 and his enjoyment of having \$10000 is 100.

1. Prove that Xiao Ming has **decreasing marginal utility** of wealth, i.e. the more wealth he has, the less enjoyment each additional dollar will bring him. (2 Points)

2. Is Xiao Ming risk-averse, risk-neutral, or risk-loving when it comes to wealth? (2 Points)

Problem 7 (2 Points)

Pascal's Wager: Blaise Pascal argues that we should all believe in God because the expected utility of believing in God is infinity, as long as the probability of God existing is larger than zero. Suppose if God exists, then you will go to heaven after you die if and only

if you believe in God. Then the expected utility of believing in God is:

$$\begin{aligned} u\left(\text{believe in God}\right) &= u\left(\text{heaven}\right) p\left(\text{God}\right) + u\left(\text{no heaven}\right)\left(1 - p\left(\text{God}\right)\right) \\ &= \infty \qquad \text{if } u\left(\text{heaven}\right) = \infty \text{ and } p\left(\text{God}\right) > 0 \end{aligned}$$

, where $p\left(\text{God}\right)$ denotes the probability of God existing.

Therefore, $u\left(\text{believe in God}\right) > u\left(\text{does not believe in God}\right)$ as long as $p\left(\text{God}\right) > 0$. Pascal thus concludes that no matter how small you think the probability of God existing is, as long as it is larger than 0, you should believe in God. Do you agree with his argument?

Problem 8 (8 Points)

Economist Gary Becker made foundational contributions to many areas of social sciences by applying the rational choice model to studying various non-market behavior that were traditionally not analyzed by economics. For example, Becker models crime as a consequence of rational decisions by criminals: if the benefit of committing a crime is larger than its opportunity cost, then it is rational to commit the crime. Therefore, to reduce crime, we need to understand the benefits and costs criminals face and try to either lower the benefits or increase the costs. Becker also studied family. Noting that people in rich countries have fewer children, Becker argued that it is because the opportunity cost of having children is higher in rich economies, while the benefit is lower. Noting that female labor force participation had increased significantly in the U.S. during his time, Becker argued that it is because "technological progress in the household sector", i.e. the invention of household appliances like the microwave, dishwasher, and dryer, significantly decreased the opportunity cost of work for women.

1. What is the opportunity cost of having a child? What is the benefit of having a child? (2 Points)

2. Consider China today: do you think the opportunity cost of having children is increasing or decreasing? How about the benefit? (2 Points)

3. In general, why do people in rich countries tend to have fewer children? (2 Points)

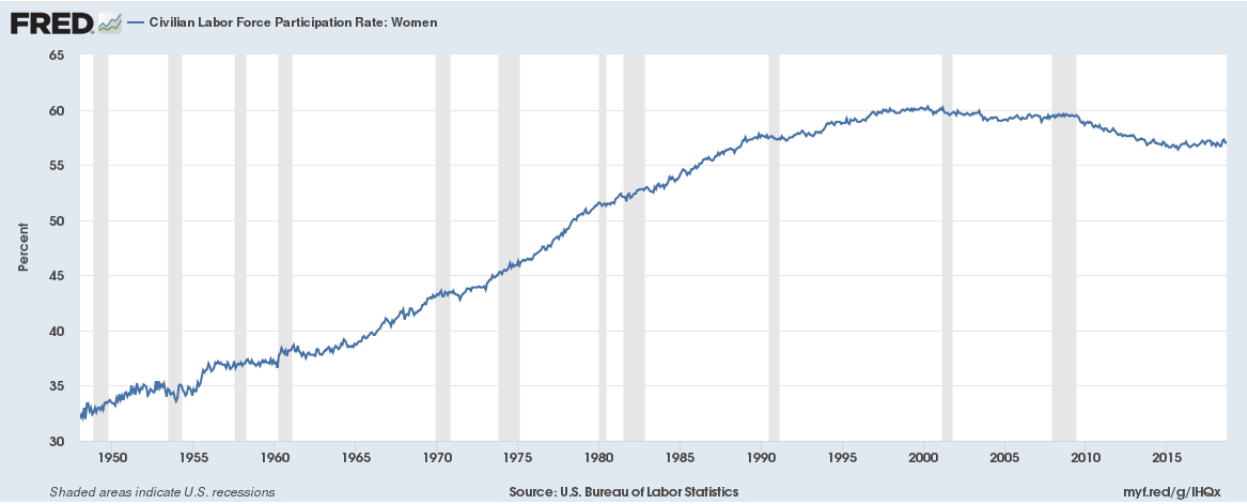

Figure 1: U.S. Female Labor Force Participation Rate. Source.

4. According to Becker's analysis, women participate in labor force when the opportunity cost of working is smaller than the benefit of working. Do you think this theory can explain the patterns of female labor force participation in the U.S. and in China as shown in figure 1 and figure 2? (2 Points)

Problem 9 (4 Points)

Economists have been using economic models to recommend the best policy to deal with climate change. For example, the Dynamic Integrated Climate-Economy (DICE) model built by William Nordhaus computes the optimal carbon emission level by calculating the marginal benefit and marginal cost of carbon emission. The model then recommends the optimal carbon tax that would result in the optimal level of carbon emission.

1. What are carbon emission's marginal benefit and marginal cost to the society? (2 Points)

2. Explain why determining optimal carbon emission and carbon tax is a normative exercise, not a positive one. In particular, note that normative statements contain value judgement that cannot be judged using data alone. What value judgement or moral choice is involved in computing optimal carbon emission and carbon tax? (2 Points)

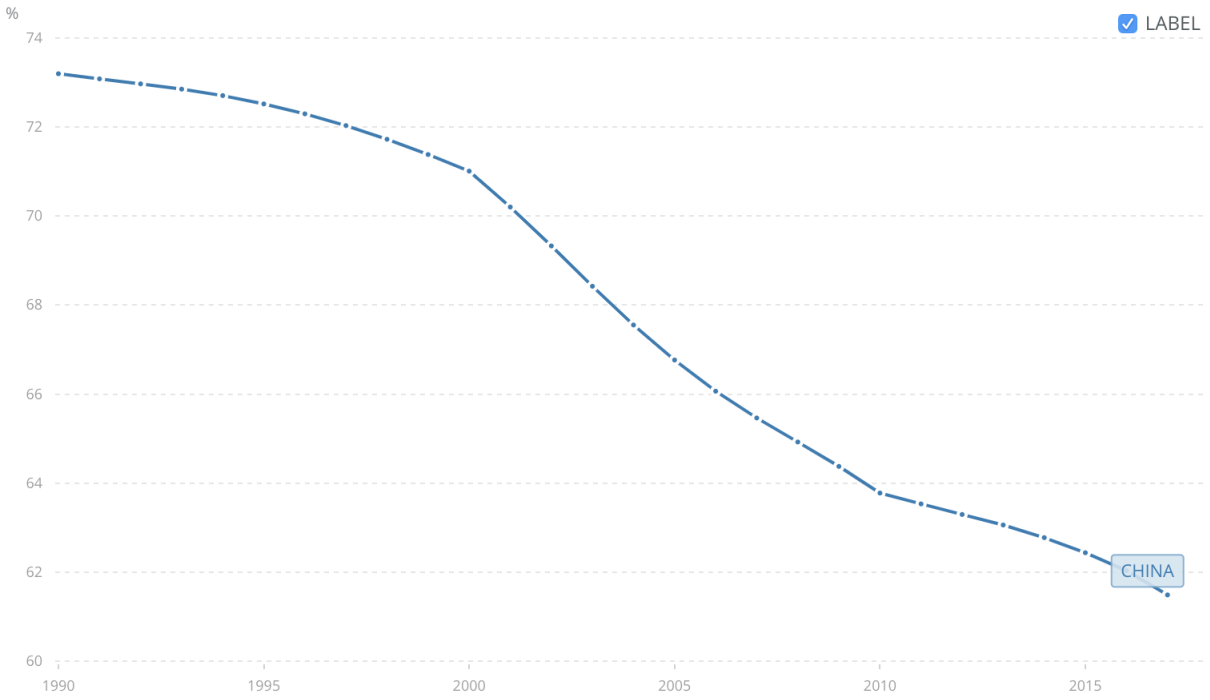

Figure 2: China Female Labor Force Participation Rate. Source.