14.01 Problem Set 7

Please note that this problem set is due over two weeks
and is worth 1.5x the credit of a weekly pset, so plan ahead for it to
take longer than a weekly pset

Due at 5pm on December 1st, 2023
Late problem sets are **not** accepted.

1 True or False? (12 Points)

True or False? Justify your answer

1. *(4 Points)* Imagine an economy with two countries, Argentina and Brazil, and two goods, meat and wine. Argentina's cost of producing meat and wine is lower than Brazil's. Then, Argentina can never gain from opening to trade with Brazil.

2. *(4 Points)* Suppose there are two goods: computers and clothes. In Canada, producing a computer requires 100 units of labor and producing cars requires 1000 units of labor. Then, if the price of a car is 1000 price and the price of a computer is 200 Canada will export computers.

3. *(4 Points)* Consider a gamble that pays 10 dollars with probability p and 0 dollars with probability $1-p$. Then, if this individual does not like risk he is willing to accept a certain payment of less than 5 dollars to this gamble.

2 Portfolio Diversification (25 Points)

Pedro has wealth $M = 1$ that he wants to invest. He can either invest in

- A risk-free bond, which yields a return of r with no uncertainty.
- The stock market, which is has an uncertain return.

The price of both the risk free bond and the stock is equal to one. With probability p, the price of the stock becomes $1+\theta$ and becomes $1-\theta$ with probability $1-p$. We assume that $\theta > r$. Finally, assume Pedro only consumes next year, and his utility function is

$$U(c) = -e^{-\sigma c}$$

where $c = W$, and W is Pedro's wealth in the second period..

1. *(5 Points)* Plot $U(c)$ for different values of σ. How does $U(c)$ depend on σ? How is σ related to Pedro's dislike for risk?

2. *(5 Points)* Let $x \in (0,1)$ denote the fraction of Pedro's wealth that he puts on Tesla stocks (Pedro is not allowed to short the stock market nor take leverage, which is why x is between zero and one). Write down Pedro's budget constraint on the second period.

3. *(5 Points)* Write down Pedro's (expected) utility maximiation problem. Solve for Pedro's optimal allocation of wealth on the stock market x^*. Hint: replace W in both states using the budget constraint.

4. *(5 Points)* How would your answer change if $\theta < r$? Provide an economic intuition.

5. *(5 Points)* How does x^* depend on p and σ? Provide an economic intuition.

3 Insurance (30 Points)

Andrew has just bought a car, and has wealth W. He crashes his car with probability θ. If he crashes his car, the total costs of repairing his car are r. Andrew is looking to purchase insurance for his car. Cambridge Insurance offers coverage of x dollars in case of a crash for a price of p independente of whether Andrew crashes his car or not. Andrew's utility function is equal

$$U(W) = \log W$$

1. *(5 Points)* Let I denote the amount of insurance Andrew purchases. Write down Andrew's budget constraint both when he crashes his car and when he does not.

2. *(5 Points)* Solve for Andrew's optimal amount of insurance.

3. *(5 Points)* How does Andrew's choice of insurance change with θ, r and p? Provide an economic intuition.

4. *(5 Points)* Write down an expression for Cambridge Insurance's expected profits from Andrew's contract.

5. *(5 Points)* Find the price of the contract such that Cambridge Insurance makes zero expected profits from Andrew's contract. How does it depend on θ? Provide an economic intuition. This price is called the actuarially fair price.

6. *(5 Points)* Show that, when the price is the actuarially fair price then Andrew purchases full coverage of insurance. That is, his wealth when he crashes is equal to his wealth when he does not crash.

4 Trade and Welfare (35 Points)

Listenbourg is a fictional country located in an extension of the Iberian Peninsula. Listenbourg's market for wine consist in the following aggregate demand and supply

$$Q_D = 1 - p$$
$$Q_S = p$$

1. *(5 Points)* Suppose Listerbourg does not trade with the rest of the world. Find the equilibrium price and quantity, p^A and Q^A.

Now suppose the Prime Minister of Listenbourg decides to open up to trade. The international price of wine is $p^* = \frac{1}{4}$.

2. *(5 Points)* How does consumption and domestic production change in response to to Listenbourg opening to trade? Calculate the consumption, production and imports of wine.

3. *(10 Points)* In labeled axes, plot the demand and supply curves for wine. Show the equilibrium price and quantity under autarky and under trade, as well as the old and new consumer and producer surplus (For this part, follow the method used in class: label the different areas of the graph and then show in a separate table which areas correspond to consumer and producer surplus both before and after).

4. *(5 Points)* What is the consumer and **domestic** producer surplus before and after Listerbourg opens up to trade? Are both consumer and producers better off? Provide an economic intuition.

Opening to trade has brought protests from the local wine producers. They argue that since the international price is lower than the price under autarky then many workers were laid off because they could not compete with the foreign producers. In response, the Prime Minister concedes them a tariff of $t = \frac{1}{8}$, so that now the local price of wine becomes $p^* + t = \frac{3}{8}$. To compensate consumers for the increase in prices, the government announced that it will redistribute any proceedings from the tariff directly to the consumer's pockets.

5. *(10 Points*) In labeled axes, plot the demand and supply curves for wine. Show the equilibrium quantities before and after the implementation of the tariff, as well as the old and new consumer and producer surplus and the revenue from the tariff. Suppose the revenue for the tariff goes back to consumers, is it enough to compensate them for the tariff? Provide an economic intuition. You don't need to provide exact calculations of the magnitudes. A correct qualitative graph and explanation is enough.

5 Trade and the Production Possibilities Frontier (28 Points)

Consider the production of rice and wheat from India and Ukraine. Labor is the only input for production. The table below gives the number of necessary hours to produce a ton of each

	India	Ukraine
Rice	10	20
Wheat	20	10

1. *(5 Points)* For each good, which country has an absolute advantage? Which country has a comparative advantage?

2. *(5 Points)* For each country, what is the relative price such if they were in autarky? Assume all markets are perfectly competitive.

3. *(5 Points)* If India and Ukraine fully specialized, which country would export which good? What is the range of price ratios at which both countries are willing to trade with each other.

4. *(5 Points)* Suppose both countries are still in autarky. Draw the production possibility frontier for each country for a one-hour period. That is, the combinations of quantities of each good they could produce in one hour. Draw your graph with rice on the x axis and wheat on the y axis.

5. *(8 Points)* Suppose India and Ukraine agree to trade at a rate of one ton of wheat for one ton of rice. Are both countries better off? Provide an economic intuition. Draw the old production possibility frontier and the new consumption set for each country.

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