14.01 Problem Set 1

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 September 29th, 2023
Late problem sets are **not** accepted.

1 Positive and Normative Statements [10 points]

Please classify the following statements as either positive or normative. Briefly explain the reasoning for your choice.

1. *(2 points)* The unemployment rate in the US is currently 4 percent.

2. *(2 points)* The government should increase the minimum wage.

3. *(2 points)* Inflation is always and everywhere caused by an increase in government spending.

4. *(2 points)* Tax cuts for businesses stimulate growth.

5. *(2 points)* Tax cuts for businesses are good for the people of the US.

2 Indifference Curves [20 points]

In each of the following examples, the consumer consumes only two goods, x and y. Based on the information given in each statement, sketch a plausible set of indifference curves (draw at least two curves on a set of labeled axes and indicate the direction of higher utility). Then, write down a possible form of the utility function $u(x, y)$ that is consistent with your graph.

1. *(5 points)* Pedro is thirsty can choose between buying store-brand bottled water (x) or premium-brand bottled water (y). For him, these two types of bottled water are perfect substitutes, and he always chooses the cheaper option without any consideration for the brand name.

2. *(5 points)* Andrew is a well-known collector of Air Jordans. When considering buying a new model, he needs one right shoe (x) and one left shoe (y) of that model. Just one without the other one is useless to him.

3. *(5 points)* Joshua wants good grades (x) but does not like studying (y). He will trade one extra hour of study for ten more points in the exam.

4. *(5 points)* Jon likes consuming apples (x) and bananas (y), but only cares about the one he consumes the greatest quantity.

3 Utility Maximization [30 points]

Tai consumes only wine (x) and cheese (y). His preferences can be expressed by the following utility function: $U(x, y) = xy^3$. The price of wine is p_x, the price of cheese is p_y, and Tai has an income of m dollars.

1. *(2 points)* Write down Tai's budget constraint.

2. *(4 points)* Calculate the Marginal Rate of Substitution (MRS) at an arbitrary bundle (x, y).

3. *(4 points)* Compute Tai's demand for wine and cheese as a function of p_x, p_y, and m.

4. *(4 points)* Repeat parts 2 and 3, but this time assuming Tai's preferences are $U(x, y) = x + 3y$.

Return to the original preferences given by $U(x, y) = xy^3$. Suppose that the government imposes a tax on wine, such that if the price of a wine is p_x, the consumer must pay $(1 + \tau)p_x$.

5. *(2 points)* What is the new budget constraint? In an xy graph, plot the budget constraint before and after the implementation of the tax on wine.

6. *(4 points)* What is the new demand function for wine? Draw the demand curve before and after the tax and briefly explain intuitively the difference between them (You don't need to plot specific values of m, τ, but make sure your graph is qualitatively accurate).

Return to the case without taxes and recall preferences are given by $U(x, y) = xy^3$. Suppose Tai has a 50 percent discount coupon for the first 5 bottles of wine he purchases.

7. *(5 points)* Assume that $\frac{m}{p_x} > 5$. Write down Tai's new budget set. Draw the new budget set on an xy graph.

8. *(5 points)* Let $p_x = 2$, $p_y = 1$ and $m = 40$. How many wine and cheese will Tai consume?

4 Market for Gas [20 points]

Consider the following demand function for gas among Cambridge residents

$$Q_d = \alpha + \beta P_g + \gamma P_t$$

where P_g is the price for gas, and P_t is the price of a one-way subway ticket.

1. *(2 points)* What sign would you expect γ to have? Provide an economic intuition.

2. *(3 points)* Suppose $\alpha = 10$, $\beta = -2$, $\gamma = 1$, and $P_t = 1$ and supply is given by

$$Q_s = 10 + P_g$$

Solve for the equilibrium price P^* and quantity Q^*. In an xy axis plot the demand and supply curves, and show where the market equilibrium is.

3. *(5 points)* Suppose the price of the subway ticket decreases to $P_t' = 0.5$. Solve for the new equilibrium price $P^{*'}$ and quantity $Q^{*'}$. How do they compare with their previous values? Provide an economic intuition. In an xy graph, plot the old and new demand curves, and show the old and new equilibria.

4. *(5 points)* Return to the original demand curve where $P_t = 1$. Suppose supply decreases to $Q_s = 5 + P_g$. Solve for the new equilibrium price $P^{*'}$ and quantity $Q^{*'}$. How do they compare with P^* and Q^*? Provide an economic intuition. In an xy graph, plot the old and new supply curves, and show the old and new equilibria.

5. *(5 points)* Suppose that in response to the decrease in supply the government puts a cap on gas prices. In particular, suppose the government places a price cap $\bar{P}$ lower than the equilibrium value from part 4. Under this policy, is the market for gas in equilibrium? If the answer is negative, show whether there is excess demand or excess supply. In an xy graph, plot what happens to the market for gas under this policy.

5 Income and Substitution Effects [20 points]

Ben consumes only apples (x) and t-shirts (y). His preferences can be represented by the following utility function: $U(x, y) = x^2y^3$ The price of apples is p_x, the price of t-shirts is p_y, and Ben has an income of m dollars.

1. *(5 points)* Find the demand for apples and t-shirts as a function of p_x , p_y and m.

2. *(5 points)* What is the price elasticity of the demand for apples? What is the cross-price elasticity of the demand for apples with respect to the price of t-shirts?

3. *(5 points)* Draw the Engel curve for t-shirts. Are t-shirts an inferior or a normal good? What is the income elasticity of the demand for t-shirts?

4. *(5 points)* True or False? Provide an explanation: *Since Ben's demand of t-shirts does not depend on the price of apples then a change in the price of apples has no substitution nor income effect on the demand for t-shirts.*

6 Income and Substitution Effect Concepts [25 points]

1. *(7 points)* In a world with only two goods, can it be that both of these goods are inferior? In a world with two goods, can both of them be normal? Explain.

2. *(8 points)* Suppose there is an increase in prices and consumption decreases. Given this information, the good must be a normal good. True or false? Explain.

Suppose a consumer desires only two goods, x and y, and her prefereces are represented by the utility function $U(x, y) = x + y$. In addition, suppose that $p_y = 3$ and her income is $m = 6$.

3. *(2 points)* Suppose $p_x = 4$, how much does the consumer demand of each good?

4. *(2 points)* Suppose p_x decreases from $p_x = 4$ to $p'_x = 2$. How much does the consuemr demand of each good?

5. *(2 points)* Suppose $p'_x = 2$ to $p''_x = 1$. How much does the consumer demand of each good?

6. *(4 points)* True or False? Provide an explanation: when p_x changes from $p_x = 4$ to $p'_x = 2$ there are both income and substitution effects, whereas when p_x changes from $p'_x = 2$ to $p''_x = 1$ there is no substitution effect.

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