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## Midterm 1

You have until 1:50pm to complete the exam, be certain to use your time wisely. Answer all questions directly on the exam. You must show all of your work to receive full credit. Calculators may be used although you may leave answers as fractions. Unless a problem says otherwise, you can assume that individuals can consume fractions of units. Remember to put your name on the exam. Good luck!

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**Name:**

1. (25 points) Anthony enjoys baking biscuits. His biscuit recipe requires one part buttermilk to two parts flour. So if Anthony uses two cups of buttermilk, he must use four cups of flour. If he uses half a cup of buttermilk, he must use one cup of flour. Anthony's utility increases with the number of biscuits he is able to bake.
  - (a) Write down a utility function that gives Anthony's utility in terms of cups of buttermilk ( $B$ ) and cups of flour ( $F$ ).
  - (b) Suppose that a cup of buttermilk costs \$4 and a cup of flour costs \$1. If Anthony has \$100 to spend, how many cups of buttermilk will Anthony buy and how many cups of flour will he buy?
  - (c) If the price of flour rises to \$2 a cup, how much will Anthony's demand for flour change? You should be able to give an exact number.
  - (d) Use a graph to decompose this change in flour into the change due to the income effect and the change due to the substitution effect. Be certain to clearly label all relevant budget lines, indifference curves and bundles, using numerical values when possible.

2. (25 points) For each scenario below, write down an equation capturing Betsy's budget constraint and graph Betsy's budget line. For the budget equation, use numerical values wherever possible. For the graph, be certain to clearly label the axes and label all slopes, intercepts and kinks with their numerical values if possible. Use a separate graph for each scenario.
- (a) Betsy has 5,000 frequent flyer miles. These miles can be redeemed for flights ( $F$ ), with 500 miles needed for each flight, or they can be used for song downloads ( $S$ ), with 10 miles needed for each song download.
  - (b) Betsy has joined a gym. With her membership she gets four free yoga classes ( $Y$ ) each month. She needs to pay for each yoga class after that and for each zumba class ( $Z$ ) she takes at the gym. Yoga classes and zumba classes each cost \$5 a class. Betsy's monthly budget for classes is \$100.
  - (c) Betsy buys fruit ( $F$ ) at Farm Fresh and vegetables ( $V$ ) at Food Lion. Farm Fresh charges \$1 for each piece of fruit. Food Lion charges \$2 for each vegetable. Farm Fresh has a special promotion where you receive 20% off of your entire fruit order when you spend \$20 or more (before the discount is applied). Betsy has a total of \$100 to spend on fruit and vegetables.
  - (d) Betsy has two hours between classes to respond to emails ( $E$ ) and browse websites ( $W$ ). Each website takes ten minutes to browse. If Betsy spends all of her time responding to emails, she can get through fifty emails in the two hours. As she responds to more emails, she gets quicker at typing responses. So the tenth email response takes less time than the fifth email response did. *Note: there are multiple correct ways to write the budget constraint and draw the graph for this scenario, you just need to make sure your equation and graph are consistent with the information given.*

3. (25 points) There are three types of consumers for hamburgers ( $H$ ) and soda ( $S$ ) with the following demand functions for hamburgers in terms of the price of a hamburger,  $p_H$ , and the price of a soda,  $p_S$ :

$$H_A(p_H, p_S, I_A) = \frac{I_A}{p_H + p_S} \quad (1)$$

$$H_B(p_H, p_S, I_B) = \frac{I_B}{p_H + 2p_S} \quad (2)$$

$$H_C(p_H, p_S, I_C) = \frac{I_C}{p_H + 3p_S} \quad (3)$$

where  $I_A$ ,  $I_B$  and  $I_C$  are the individual incomes of consumers of type  $A$ ,  $B$  and  $C$ , respectively. There are five consumers of each type for a total of fifteen consumers in the market.

- Based on the demand functions above, determine whether hamburgers are normal or inferior, whether they are ordinary or Giffen, and whether soda is a substitute or complement. Be certain to fully justify your answers.
- Will the market demand curve have kinks in it? If so, at what prices will these kinks occur? If not, explain why there are no kinks.
- Suppose that the price of a soda is \$2 and that the income of a type  $A$  consumer is \$100, the income of a type  $B$  consumer is \$150 and the income of a type  $C$  consumer is \$200. Derive the an expression for the aggregate market demand for hamburgers as a function of the price of hamburgers.
- Let's simplify things and assume that there is only one consumer of hamburgers and that consumer is of type  $A$ . The consumer's income is \$100 and the price of a soda is still \$2. Find an expression for the elasticity of demand for hamburgers with respect to price and use it to determine whether a restaurant's revenues from burgers will increase or decrease if they raise the price of a hamburger by a small amount. Your expression for the elasticity should contain only numerical constants and the price of hamburgers.

4. (25 points) Clyde's marginal utility from watching hockey games,  $MU_H$ , and his marginal utility from watching curling matches,  $MU_C$ , are given by:

$$MU_H = 20HC^{\frac{1}{2}} \quad (4)$$

$$MU_C = \frac{5H^2}{C^{\frac{1}{2}}} \quad (5)$$

where  $H$  is the number of hockey games he watches and  $C$  is the number of curling matches he watches. Each hockey game takes two hours to watch. Each curling match takes one hour to watch. Clyde's has  $T$  hours of total time to watch hockey and curling.

- (a) Determine which of the following properties hold for Clyde's preferences, giving a brief explanation in each case: diminishing marginal rate of substitution, monotonicity, convexity.
- (b) Derive an expression for the amount of hockey Clyde will watch as a function of his total time  $T$  and an expression for how much curling he will watch as a function of  $T$ .
- (c) On a graph with hockey on the horizontal axis and curling on the vertical axis, show the price offer curve generated by varying the amount of time a curling match takes (you can think of this as NBC deciding to edit curling matches so they take less than one hour, this editing does not affect Clyde's enjoyment of the match). Show at least three points on the price offer curve and the corresponding budget lines and indifference curves. There is no need for numerical values but the shapes of the curves should be consistent with the information given in the problem.