

This exam is designed to test your broad knowledge of microeconomics. There are three sections: one required and two choice sections. You must complete all three problems in the required section (Section A) and one choice problem in each of the two choice sections (Sections B and C), giving you a total of five problems to complete during the allotted time. If you should answer more than one choice question in a section, only the first will be considered.

IMPORTANT. You are expected to adhere to the following guidelines in completing the exam:

- **Write legibly. Number all pages and organize your answers to questions in the same order as they were given to you in the exam. Begin your answer to each question on a new page and identify the question number.**
- Provide clear, concise discussion to your answers.
- Explicitly state all assumptions you make in a problem. Graders will not take unstated assumptions for granted. Do not make so many assumptions as to trivialize or assume the problem away.
- Define any notation you use in a problem and label all graphs completely.
- Explain your steps in any mathematical derivations. Simplify your final answers completely.
- Answers that do not include the above will not be considered complete and will be evaluated accordingly.

## PART A

All of the problems in Part A (A1, A2, and A3) are required. Answer all parts of all questions.

### QUESTION A1

The current economic conditions are making it more difficult for many NM families to be able to afford the basics, resulting in an increase in the number of families below the poverty level. Many of those families are finding it difficult to afford their monthly rent. Lieutenant Governor Diane Denish, as part of her campaign to become the next Governor, wants to find a way to help these families pay their rent and keep a roof over their heads. The Lieutenant Governor's economic advisors have presented her with two alternatives:

- (i) Provide a family with a monthly fixed amount of money,  $Y$ , or
- (ii) Subsidize housing by paying one-half of a family's monthly rent, or  $P/2$ , where  $P$  is the monthly rent.

Lieutenant Governor Denish has asked you to analyze these two alternatives. Focus on a single family that may either spend money on housing ( $H$ ) or on Other Commodities ( $X$ ). Let the per unit price of  $X$  be normalized to \$1. Assume that the household acts as a single agent with well-behaved tastes and preferences. Suppose further that the household has Cobb-Douglas preferences with respect to  $H$  and  $X$  where the coefficients on  $H$  and  $X$  are  $\alpha$  and  $\beta$ , respectively, and that the household's monthly budget for  $H$  and  $X$  is  $I$ .

- a) Find this agent's demand for housing under each of these proposals. At what point will the agent buy more housing under proposal (i) than under (ii)?
- b) Find the income and substitution effects for these two policies. Discuss and compare the income effect between the two.
- c) What is the maximum monthly amount this household will be willing to pay for policy (ii) to be enacted? (Hint: assume the status quo is neither policy in place.)
- d) Suppose the state is interested in relative impact on the household when the cost to the state would be the same under either policy: that is,  $Y = \frac{P}{2}$ . Either mathematically or graphically, show which policy the rational household would prefer and explain your answer.

## QUESTION A2

Gracie Grad Student has invented a device that allows students to sleep while sitting upright and looking attentive. She is the exclusive seller of the FakeAwake on campus, where demand for the FakeAwake is:

$$Demand(price) = 100 - 0.2Price.$$

Gracie's costs to manufacture the FakeAwake are given by:

$$Total\ Costs = 50 + 2q^2 - 4q \text{ where } q \text{ is the quantity produced.}$$

- a) If Gracie is a myopic profit maximizer, what price should she charge? How many will she sell? How much profit will Gracie earn?
- b) Sam Slacker, who attends the same school as Gracie, has figured out the trick to the FakeAwake and knows that he can produce them according to the following cost function: (Assume that they are identical, so face the same market demand.)

$$Total\ Costs_{Sam} = 30 + 3q^2 - 2q$$

What will be the prices, quantities, and profits if Sam and Gracie behave as Cournot duopolists?

- c) What will be the prices, quantities, and profits if Gracie behaves as a Stackelberg Leader if Sam were to enter her market?
- d) Will Gracie deter Sam's entry? If not, why not? If so, what will Gracie do to deter entry? To answer this question you must write out conditions necessary for effective and incentive compatible entry deterrence.

### QUESTION A3

- a) Let  $f(x_1, x_2)$  be nondecreasing and homogeneous of degree one. Demonstrate mathematically that the isoquants of  $f$  are radially parallel, with equal slope at all points along any given ray from the origin. Explain this property intuitively.
- b) Assume the production function  $f$  is continuous, strictly increasing, strictly quasiconcave, and  $f(0)=0$ . Prove that for positive price ( $p$ ) and positive input prices ( $w$ ) that the profit function is homogeneous of degree one in  $(p, w)$ . In your proof, clearly identify any other required properties of cost and demand functions.
- c) Show mathematically that when average cost is declining, marginal cost must be less than average cost; when average cost is constant, marginal cost must equal average cost; and when average cost is increasing, marginal cost must be greater than average cost. Sketch a graph that illustrates this and explain the result intuitively (is if to a Principles of Microeconomics student).

d) **PART B**

**Answer question B1 or B2. If you complete more than one problem, only the first will be considered.**

**QUESTION B1**

Pat and Chris are cellmates with no access to the outside world and no means of production. They are allowed two fully divisible commodities (use your imagination!) over which they have the following utility functions:

Pat:  $U_{\text{Pat}} = u(x_1, x_2)$  where  $x_1$  and  $x_2$  are the two consumption goods.  $U_{\text{Pat}} = x_1^{0.5} x_2^{0.5}$

Chris:  $U_{\text{Chris}} = x_1^{1/3} x_2^{2/3}$

- a) 1 unit of each good has been placed in Chris and Pat's cell. What are all of the Pareto Efficient allocations of  $x_1$  and  $x_2$ ?
- b) To reduce cell block violence, the warden has decided to specifically allocate the goods to individuals and allow voluntary trade. The warden has given Pat 1 unit of  $x_1$  and has given Chris 1 unit of  $x_2$ . What are the resulting Walrasian Equilibrium allocations and prices?
- c) The following day, the warden gives Chris 1 unit of  $x_1$  and Pat 1 unit of  $x_2$ . Now what are the resulting Walrasian Equilibrium allocations and prices?
- d) Draw a single Edgeworth Box diagram illustrating the economies generated in Parts (b) and (c) and explain any similarities and differences in the results. In your explanation, apply the First and Second Theorems of Welfare Economics and show whether or not these theorems hold in these cases.

## QUESTION B2

- a) Graphically, using indifference curve analysis for two goods,  $x_1$  and  $x_2$ , differentiate between the Hicksian compensating variation (CV) and the Hicksian equivalent variation (EV) measures for the case of a price decrease in  $x_1$  from  $p_1'$  to  $p_1''$ . Also, identify the Hicksian compensating surplus measure for the same price decrease. (Hint: Recall that CS measures do not allow optimal readjustment of the quantity bundle.)
- b) Express CV and EV for the price decrease in  $x_1$  explicitly using expenditure functions and implicitly using indirect utility functions.
- c) Individuals are asked to state their maximum willingness to pay (WTP) for two strictly positive bundles of goods. They are first asked to state their WTP for bundle A. They are then asked to state their WTP for bundle A *plus* bundle B. They are observed to state the same WTP for both questions. What axioms of consumer behavior, if any, are violated by these responses.
- d) Assume that your utility is increasing in the number of wolves in Yellowstone and that ranchers in the Yellowstone area have increased costs from the presence of wolves. For the three following statements, determine if the question elicits EV or CV and why.

Statement 1: "What is the most money that you would be willing to pay to have more wolves in Yellowstone?"

Statement 2: "What is the most money you would be willing to pay so that ranchers will not kill Yellowstone wolves?"

Statement 3: "What is the least amount of money you would you be willing to accept instead of having an increase in Yellowstone wolves?"

## PART C

**Answer question C1 or C2. If you complete more than one problem, only the first will be considered.**

### QUESTION C1

Suppose there are two types of insurance customers, high-risk types and low-risk types. For both types, utility as a function of wealth,  $w$ , is specified as:

$$U(w) = 100 \left[ 1 - \frac{1}{w} \right].$$

Both types have starting wealth of 50 and face a possible loss of 30. For high-risk types, the probability of that loss is 30%. For low-risk types the probability of loss is 10%.

- a) What are the Arrow-Pratt measures of risk aversion for this utility function? Calculate both the Arrow-Pratt measure of Absolute Risk Aversion and the Arrow-Pratt measure of Relative Risk Aversion. What can you say about these individuals based on what you have calculated?
- b) If the insurance company can perfectly identify types, what is the maximum premium that it can charge the high-risk customers for full insurance (assuming no competition in the market)? What is the minimum premium that it can charge the high-risk customers for full insurance? Explain your answer.
- c) If the insurance company can perfectly identify types, what is the maximum premium that it can charge the low-risk customers for full insurance (assuming no competition in the market)? What is the minimum premium that it can charge the low-risk customers for full insurance? Explain your answer.
- d) Suppose the insurance company cannot distinguish types. Let  $p$  equal the percentage of the population that is high-risk. What is the pooling premium? Calculate the threshold  $p$  that supports a pooling equilibrium. Is that  $p$  a maximum or a minimum? Explain.

## QUESTION C2

Professor Plum is in her final year as an untenured assistant professor at Prestige University. If Professor Plum is tenured, her salary will be a function of the number of publications she has produced. If Professor Plum is not tenured she will be fired from Prestige U. Her only back-up plan is to work as an instructor at the local community college for a salary equal to \$45,000 per year with no requirement to publish. (Assume that, except for the publication requirement, all other job characteristics are the same.)

The Dean of Arts and Sciences at Prestige U. gains recognition and bonuses valued at \$5000 for each publication produced by a faculty member in the college. (You should assume that the Dean receives this in a lump sum if and when tenure is granted. You should also assume that this benefit accrues each year that the professor remains at Prestige – that is, solve this as if the Dean's annual payoff is this benefit minus one year's salary.) The Dean decides whether or not to grant tenure. A faculty member denied tenure yields no costs and no benefits to the Dean.

Salaries for recently tenured faculty members equal:

$$\$30,000 + m \times \text{publications},$$

where  $m$  = merit pay for each publication, a value that is set by the Dean.

Assume that salaries come out of the Dean's budget and so reduce the Dean's payoff.

Prof Plum finds publishing challenging. Her disutility for publishing is

$$100 (\text{publications}^2)$$

Publications must be whole numbers. NO FRACTIONS!

- What are the constraints faced by each person in this scenario? Describe what they mean. Will they bind?
- What should Professor Plum do? How many publications will Professor Plum produce (as a function of other variable(s) at this point)?
- What should the Dean do? Recall that the Dean sets  $m$  and determines tenure. Explain.
- Will Professor Plum get tenure? How many publications will Professor Plum produce? Explain.