Microeconomics Comprehensive Exam, **Part One**

June, 2025

Department of Economics, University of Houston

1 *60 pts.* Producer's Problem–Studying and Resting

X, Y, and Z are T by 1 vectors for time inputs spent studying, time inputs spent resting, and exam outcomes over T periods.

1. *12 pts.* $T = 1$. Notsuoh proposes the production function $Z = f(X, Y) = a \cdot X + b \cdot Y + c \cdot X \cdot Y$. Analyze properties of f, consider input substitutability/complementarity.
2. *12 pts.* $T = 1$. Saxet proposes the CES production function $g(X, Y)$. Contrast g and f, consider restrictions that the functional forms impose on input–output relationships.
3. *12 pts.* Suppose $T = 2$, $h_1(\cdot)$ and $h_2(\cdot)$ are period-specific production functions. Propose functional forms for h_1 and h_2, analyze properties, and consider restrictions imposed on intra- and inter-temporal input–output relationships.
4. *12 pts.* Given what you propose, write down the production function at any date $t > 1$ when $T > 1$, and analyze the determinants of persistence and change between Z_{t-1} and Z_t.
5. *12 pts.* Given what you propose, set up a dynamic study–rest optimization problem. Analyze optimality conditions and the optimal time-use path if only Z_T (the qualifying exam) matters or if the sum of all exams matters $\sum_{t=1}^{T} Z_t$.

2 *60 pts.* Household's problem–Let's Move

The government launches a "Let's Move!" campaign to advance "healthy lifestyle".

1. *12 pts.* Discuss the determinants of variations in exercise levels within individual (across time) and across individuals. What "policy levers" are available to shift exercise choices?
2. *12 pts.* Propose a one-period utility maximization problem with associated preferences, resource, and production relationships that induces heterogeneous choices of exercise levels and health outcomes across individuals with differing resources and preferences.
3. *12 pts.* Consider extensive margin (whether or not) and intensive margin (how much) optimality conditions, and solve your model to the extent possible.
4. *12 pts.* A survey includes individual exercise levels, demographic attributes (e.g., age, gender, etc.), the distance to the closest gym, and the price of gym membership. Data on resources are not available. Instead of using the full utility maximization set-up, propose value/indirect-utility functions for alternative exercise levels as a function of demographic attributes as well as the costs of gym exercise. Compare solutions with the prior set-up, consider the set of counterfactual policies that the models allow.
5. *12 pts.* Set up a gym's profit maximization problem that generates a membership supply curve that is increasing in price. The government plans to spend a fixed amount of money on an exercise voucher program to pay for gym memberships. Use the models you have set up to consider the effects of this program in equilibrium.

Microeconomics Comprehensive Exam, **Part Two**

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Read all questions carefully before you begin. All eleven parts are worth an equal amount, but some parts are more difficult than others. Be strategic and judicious with your time. Think slowly and calmly. Good luck!

1. In this question, we will study a simple non-linear pricing setup: A firm produces unit goods of quality q which are sold at a price of t. A consumer of type θ has utility over quality given by $u_\theta(q) = \theta q - t$. The firm's profit is given by $\pi = t - c(q)$ where $c' > 0$ and $c'' > 0$. A *mechanism* is a process or set of rules that determines the allocation of goods (and money) between two sides of a market. In this question you will prove that the following two mechanisms that are designed by the firm are equivalent:

   - **Revelation Mechanism**
     - Firm asks consumer their type
     - Consumer reports $\tilde{\theta}$, which is not necessarily their true θ
     - The mechanism specifies a contract $q\left(\tilde{\theta}\right), t\left(\tilde{\theta}\right)$
     - *Objective: Design a mechanism such that it is optimal for the consumer to report* $\tilde{\theta} = \theta$
   - **Taxation Mechanism**
     - Firm offers a menu of contracts $T(q)$
     - A consumer, who privately knows their type, chooses their most favorable contract
     - *Objective: Design a menu such that* $T(q)$ *maximizes the firm's expected profit*

   (a) In the real world, which mechanism is more common? Why do you think that is?

   (b) We will now prove that the revelation principle $\implies$ taxation principle. The revelation principle, as we all remember from class, means that the revelation mechanism $q(\cdot), t(\cdot)$ is incentive compatible. Provide the menu $T(q)$ that corresponds to this mechanism and argue that this maximizes the firm's expected profit.

   (c) We will now prove that the taxation principle $\implies$ revelation principle. Argue that customer of type θ finds it optimal to report $\tilde{\theta} = \theta$. (Hint: For any menu $T(q)$, define $q(\theta) = \max_q \{\theta q - T(q)\}$ and $t(\theta) = T(q(\theta))$. Use this to show that the optimal menu of contracts from the firm's perspective is incentive compatible from the consumer's perspective.)

   (d) In class, which mechanism did we use to study the optimal non-linear pricing problem and why? Discuss this in the context of your answers to parts (a)-(c) of this question in 2-4 sentences.

   (e) Set up (but do not solve) the optimal non-linear pricing problem using the taxation mechanism. How might you approach solving this problem? Propose a potential approach. What parts do you think will be hard?

2. You are a risk-averse person with increasing and concave utility for money $u(\cdot)$. Your initial wealth W_0, but you face the risk of getting into an accident and losing an amount x of your wealth. Luckily, you also have access to a perfectly competitive market of risk-neutral insurers who offer a menu $R(x)$ of repayments (net of the insurance premium). You can also make efforts to prevent an accident. Assume that the distribution of x, which depends on the amount of effort you make to prevent an accident, a, is as follows:

$$f(0,a) = 1 - p(a) \tag{1}$$
$$f(x,a) = p(a)\, g(x) \;\; x > 0 \tag{2}$$

where $\int g(x)\, dx = 1$ and $p(\cdot)$ is strictly decreasing and convex. Your cost of effort, separable from your utility of money, is $c(a)$ where $c' > 0$ and $c'' > 0$.

(a) Write out your total utility with insurance.

(b) Suppose there is no insurance market. What action $\hat{a}$ do you take?

(c) Suppose that a is contractible. Describe the first-best payment schedule $R(x)$ and the effort choice $a^\star$. (Hint: You should express your answer in terms of $R(0)$).

(d) Suppose a is not contractible. Describe the second-best payment schedule $R(x)$. (Hint: You should express your answer in terms of $R(0)$).

(e) Would you ever have an incentive to hide an accident? (i.e., report $x = 0$ when $x > 0$)

(f) Come up with two complexities in the real world that are not captured in this simple model. Show mathematically how you would incorporate both of these complexities in the model and conjecture how each of these complexities (and potentially their interaction) would affect the results in a few sentences.