1. Signaling

Let v_t be the true value of a type t consultant wher $t \in T = \{1, 2\}$. There are just two possible types. The consultant's value is either low ($v_1 = 1$ million) or high ($v_2 = 3$ million). Only the consultant knows her value. However a type t consultant can signal by achieving an education level x at a cost of $C_1(t, x) = x / t$.

(a) Show that there are many Nash Equilibria. What is the Cho-Kreps Intuitive Criterion? Explain why only one of the Nash Equilibria satisfies this criterion.

(b) Show that this equilibrium is $x(t) = \begin{cases} 0, & t = 1 \\ 2, & t = 2 \end{cases}$.

(c) Next suppose that there is a second potential signaling activity y with cost $C_2(t, y) = y / t^2$. Does the separating equilibrium of part (b) still satisfy the Intuitive Criterion? If so explain. If not what Nash Equilibrium does satisfy this criterion?

(d) Suppose next that a consultant can choose any $(x, y) \in \mathbb{R}_+^2$ and that the cost is $C(t, x, y) = \frac{x}{t} + \frac{y}{t^2}$ .What Nash Equilibrium (if any) satisfies the Intuitive Criterion?

2) Consider the following model of entry and exit. All firms draw from distribution G and every period maintain their shock with probability ρ and redraw from G with probability $(1-\rho)$. Suppose G has support in the interval $[0,1]$. Production function is given by sk^{θ} where k denotes the capital of the firm. Capital costs c per unit but once invested it cannot be sold and it depreciates at rate δ. In addition firms have an outside option with value v_0 that can be exercised at any point by exiting the industry. There is no additional cost of entry. All firms produce a homogenous good and the market inverse demand is given by $D(Q)$ where Q is total industry output.

1. Write down the dyamic programming problem defining the value of a firm. Discuss properties of the optimal solution.
2. Define a stationary equilibrium. Discuss whether a stationary equilibrium will have entry and exit.
3. What implications does the model have on firm dynamics concerning size, productivity and age? (respond intuitively, as precise as you can)
4. Suppose now that investment in capital is fully reversible and that the equilibrium displays entry and exit. What impact will a reduction of the cost c have on turnover in the industry?

3)Take a Lucas span of control model where the production function is sn^{α} and $\alpha < 1$. Choose the shape of the distribution of span of control $F(s)$ to match US size (employment) distribution.

1. Analyze the implications of this model for managerial compensation.
2. Take the distribution F that you found from your previous analysis and consider now a production function Asn^{α} where $A > 1$. What will happen to the size distribution of firms? What will happen to managerial compensation and to wages?

4) Consider the following Cobb-Douglas production function in logs

$$y_{it} = \beta_0 + \beta_1 k_{it} + \beta_2 l_{it} + \beta_3 m_{it} + \omega_{it} + \epsilon_{it}$$

where y_{it}, k_{it}, l_{it} and m_{it} are logs of output and the respective inputs (m_{it} represents intermediate inputs), and ω_{it} and ϵ_{it} are two econometric unobservables. As in class, suppose that ω_{it} is potentially observed by firms when making their input choices, while ϵ_{it} is just measurement error that is uncorrelated with input choices. Suppose that the econometrician observes y_{it}, k_{it}, l_{it} and m_{it}.

a) Carefully describe the first stage of the Levinsohn-Petrin (2003) estimation procedure.

b) What does the Ackerberg-Caves-Fraser (2006) paper point out about this first stage estimation procedure? More specifically, under what data-generating processes (i.e. assumptions) does the Levinsohn-Petrin first stage produce a valid estimate of the labor coefficient β_2.

c) What do Ackerberg-Caves-Fraser (2006) suggest as an alternative?

5) Consider the Rust model of capital replacement, as studied in class. In each period t the firm decides whether to replace their capital stock ($i_t = 1$) or not replace their capital stock ($i_t = 0$). Single period profits are given by

$$\pi(x_t, i_t, \epsilon_t; \theta) = \begin{cases} \pi(x_t, 0; \theta) + \epsilon_{0t} & \text{if } i_t = 0 \\ \pi(x_t, 1; \theta) + \epsilon_{1t} & \text{if } i_t = 1 \end{cases}$$

where x_t is a state variable that is serially correlated (in a first order Markov sense) over time and whose evolution depends on i_t. $\epsilon_t = (\epsilon_{0t}, \epsilon_{1t})$ are state variables that may or may not be serially correlated over time. β is the discount factor.

a) Write down the Bellman equation characterizing optimal investment choice.

b) Consider two possible assumptions on ϵ_t:

i) ϵ_t are independent across time

ii) ϵ_t are serially correlated across time (again, assume first order Markov)

According to the Rust methodology, why is solving the dynamic programming problem much simpler under Assumption i) than under Assumption ii)? Be specific.

6) Set of Shorter Questions:

a) In a logit model with

$$U_{ij} = X_j\beta - \alpha \ln(p_j) + \epsilon_{ij}$$

what are formulas for own-price and cross-price elasticities?

b) In Bresnahan's Conjectural Variation model, "demand rotators" played a crucial role in identification. How would the role of these "demand rotators" change if Bresnahan made the assumption that marginal cost does not depend on quantity produced?

c) Give an example of the Lucas Critique