

INDIAN STATISTICAL INSTITUTE
Mid-Semestral Examination: 2015-16

Course name: MSQE II
Subject name: Incentives and Organisations
Date: 7.9.15
Maximum marks: 30
Duration: 2 hours

Q1. There is a firm (principal) and a large group of workers (agents) of measure 1. A worker's productivity or ability level, θ , is private information, and $\theta = 1$ or $\theta = 2$. The proportion of workers that have high productivity ($\theta = 2$) is $\alpha \in (0, 1)$. A worker can be hired at any output level $q \geq 0$. A worker's payoff is $u(q, w; \theta) = w - \frac{q^2}{2\theta}$, where the second term is the cost of producing output q , and w is wage. The firm's profit is $v(q, w; \theta) = q - w$ for a worker hired at w to produce q . If the firm does not hire any workers, it earns 0 profits. Any worker has payoff 0 if not hired.

Suppose the principal offers a two-item menu of contracts, one for each type, and each agent decides whether to reject or accept. The firm has the capacity to hire all the workers.

- a) Derive the optimal full employment and shutdown contracts. [5]
- b) When does the principal prefer full employment? [5]
- c) Suppose there were two competing firms with no capacity constraints, each simultaneously offering contract menus. Any agent can choose to accept a contract from any one firm, or reject both. Consider a symmetric subgame perfect equilibrium with full employment and separating contracts. Suppose in this equilibrium both firms make zero profits overall, i.e., on both items in the menu together. Show that each firm then must make zero profit on each item on the menu. [5]

Q2. As in the Akerlof framework, suppose there are many identical risk-neutral price-taking firms producing a homogeneous good with price = 1 using a CRS production function. Labor is the only input. There are many workers, of measure 1. The number of units a worker can produce if employed by a firm, θ , is private information. $[\underline{\theta}, \bar{\theta}]$ is the set of possible worker types, where $0 \leq \underline{\theta} < \bar{\theta}$. The proportion of workers with productivity of θ or less is given by the increasing and continuously differentiable distribution function $F(\theta)$, with derivative $f(\theta)$. The outside option for workers is given by $r(\theta)$.

Suppose $r(\cdot)$ is a continuous and increasing function and that there exists $\hat{\theta} \in (\underline{\theta}, \bar{\theta})$ such that $r(\theta) < \theta$ for $\theta < \hat{\theta}$, while $r(\theta) > \theta$ for $\theta > \hat{\theta}$.

- a) Derive the competitive equilibrium with observable worker types. [10]
- b) Show that a competitive equilibrium with unobservable worker types will be Pareto inefficient. [5]

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Indian Statistical Institute
Mid-Semester Examination: 2015-2016
MS(QE) II: 2015-2016
Industrial Organization

Date: ~~4~~7/09/2015

Maximum Marks: 40

Duration: 3 Hours

Answer any FOUR questions.

1. (a) Let the market demand function be $Q = Ap^{-\varepsilon}$, $\varepsilon > 1, A > 0$. The cost function of the monopolist is linear. A consumer at a distance $x \geq 0$ from the monopolist's trading centre requires to pay tx ($t > 0$) as transport cost per unit of output to be bought. Under price discrimination what f.o.b. price will the monopolist charge to the consumer? If x goes up, find its effect on the f.o.b. price. Interpret the result.

(b) Suppose value of an object, v , is distributed uniformly over $[0, 1]$. The buyers valuation for the object is $U_B = \theta_B v$ and that for the sellers, $U_S = \theta_S v$. Suppose the sellers know the quality of the good, but buyers do not; buyers form a belief about the quality of the product based on the price charged by the seller. Show that if $\theta_B < 2\theta_S$ the market for the product will cease to exist.

[5+5=10]

2. A monopolist produces a durable good which does not depreciate in the first period but lasts for only two periods, and resale market exists in the second period, that is, the goods purchased in the first period can be sold in the second period. Assume that the cost of production is zero and both the monopolist and the consumers have the same time-preference given by the discount factor δ where $0 < \delta \leq 1$. The consumption demand for the good in period t is given by the function $X_t = 1 - p_t$, where p_t is the user price (that is, the marginal willingness to pay for consumption or use of the good).

(a) If x_1 and x_2 be the monopoly sales in two periods under "selling" strategy, derive the optimal time consistent monopoly sales and ownership prices in two periods.

(b) Would the monopolist gain by leasing the products instead of selling?

[6+4=10]

3. A restaurant sells mixed fried rice (R) and chili chicken (C). The marginal costs of each plate of R and C are respectively Rs 40 and Rs 20. There are five types of customers: A, B, C, D and E; however, each type has the same number of customers. Each customer buys at most one plate of R and C provided that the price of the product of any item does not exceed its reservation price. The reservation prices of each type customers are given below:

<u>Customer Types</u>	<u>Res. Price for R</u>	<u>Res. Price for C</u>
A	Rs 40	Rs 10
B	Rs 50	Rs 30
C	Rs 70	Rs 30
D	Rs 20	Rs 60
E	Rs 50	Rs 50

- (a) Find the profit maximizing prices of R and C when these are sold separately.
 (b) If the restaurant sells R and C only in a 'Value Meal' bundle consisting one unit of each, find the profit maximizing price of a Value Meal.
 (c) Suppose the restaurant sells R and C both separately as well as in a Value Meal bundle. Find the respective profit-maximizing prices of each of R and C and that of a Value Meal.

[3+3+4=10]

4. Suppose two firms, 1 and 2, produce one good each at marginal cost c_i ($i = 1, 2$). Each firm has a monopoly power in the production of its goods. The demand curve is $q = D(p)$ where $p \equiv p_1 + p_2$ is the price of the composite good and p_i is the price of good i ($i = 1, 2$). Let $c \equiv c_1 + c_2$ and $\varepsilon = -D'p/D$ be the price elasticity of demand. Answer the following.

- (a) Derive the optimal p for the horizontally integrated structure in terms of c and ε .
 (b) Consider the non-integrated structure and suppose that that firm 1 chooses its price first and takes into account the effect of its choice on firm 2's price. Show that the composite price in this case will be given by $p = c/(1 - \frac{1}{\varepsilon})^2$.
 (c) Suppose now that the two firms choose their prices simultaneously and non-cooperatively. Show that $p = c/(1 - \frac{2}{\varepsilon})$.

[3+3+4=10]

5. Consider a monopoly manufacturer which sells its products to a retailer which in turn resells these products to the final users. The market demand for the product is linear and is given by $p = a - bq$, $a, b > 0$. The unit cost of producing the goods by the manufacturer is c , $0 < c < a$; the retailer has no additional retailing cost.

- (a) Suppose the manufacturer gives a linear contract $\{r\}$ under which the retailer can buy any amount of the good at price r per unit. Find the optimal values of r , p and profits of the manufacturer and the retailer.
- (b) Suppose the manufacturer gives a two-part tariff contract $\{F, r\}$ where F is a fixed fee and r is the price charged per unit. Again solve for F , r , p and profits of the manufacturer and the retailer.
- (c) If both the firms integrate to form a single firm, what will happen to industry profits and consumers' welfare compared to (a) and (b) above?

[3+4+3=10]

INDIAN STATISTICAL INSTITUTE
Mid Semestral Examination: (2015-2016)
MS (Q.E.) II Year
International Economics I

Date: 09.09.2015

Maximum Marks 40

Duration 3 hours

Answer all questions

1. Consider a two-country-two-good Ricardian model of international trade where the home country has a comparative advantage in good 1. Also assume that one-half of world income is spent on good 1 and the remaining one-half on good 2. Show that
- (a) If both countries are completely specialized in trade equilibrium, their incomes are equal.

- (b) If the foreign country produces both goods in trade equilibrium we must have

$$L^*/L > a_{L1}^*/a_{L1}$$

- (c) International trade expands the world production possibility frontier.

- (d) Both countries cannot produce both goods in trade equilibrium.

[5+5+5+5]

2. Show that in a two agent setting, Walras stability guarantees that the recipient of a transfer necessarily gains.

[10]

3. Consider a 2 country, 2 commodity trading world, with perfectly competitive markets and show that imposing an ad- valorem export tax is the same as imposing an ad- valorem import tariff when the government redistributes all tax and tariff revenues lump sum. Also derive the optimal export tax.

[Note: An export tax on good i means the following: $p_i(1 + \tau) = p_i^*$, where p_i is the domestic price and p_i^* is the international price of good i and τ is the ad valorem export tax rate.]

[10]

INDIAN STATISTICAL INSTITUTE
Mid-Semester Examination: (2015-2016)

MS(QE) II

Selected Topics I

Date: 14. 09. 2015 Maximum Marks: 40 Duration: 2 hrs 30 minutes

- (1) Consider the labor market signaling model where the marginal productivity of a worker is $\theta \in \{2, 6\}$ and $Pr(\theta = 6) = \frac{1}{2}$. The cost of education is $c(e, \theta) = \frac{e^2}{2\theta}$ for all $e \geq 0$. Let $u(w, e; \theta) = w - c(e, \theta)$ be the utility of a worker of type θ who chooses education level e and receives wage w . Assume that both worker types earn zero by staying home, that is $r(2) = r(6) = 0$.

- (a) Consider the belief function

$$\mu^a(e) = \begin{cases} 1 & \text{if } e \geq e^*, \\ 0 & \text{if } 0 \leq e < e^*. \end{cases}$$

Find all possible values of e^* for which we can have a separating equilibrium. Justify your answer. **(6)**

- (b) Consider the belief function $\mu^b(e) = \frac{e - \max(0, e-4)}{4}$ for all $e \geq 0$. Can you find a separating equilibrium for the belief function $\mu^b(e)$? Justify your answer. **(7)**

- (2) In the two-stage screening game with unknown worker types, show that in any equilibrium (separating or pooling), firms earn zero profits. Then show that in this game we cannot have any pooling equilibrium. **(7+5)**

- (3) Consider the labour market model where the effort level of the tenant is neither observable nor verifiable. Derive the second best contract. **(15)**

INDIAN STATISTICAL INSTITUTE
Mid Semestral Examination: (2015-2016)
MS (Q.E.) II Year
Macroeconomics II

Date 16.09.15

Maximum Marks: 40

Duration: 3 hours

Answer all questions

1. Explain how in a world with rational expectations, monetary policy is ineffective, even though there is a positive correlation between output and money supply. What features of the model are unrealistic in your opinion?

[15]

2. Using a suitable diagram explain pro-cyclical movements of real wages when the price level is rigid.

[5]

3. a) Show that all paths other than the convergent one in the Ramsey model would either violate the transversality condition or one of the other necessary conditions for an optimum.

Show that the No Ponzi condition together with optimality delivers what is required by the transversality condition

- b) Assuming a Cobb-Douglas production function, work out the transitional dynamics of the savings rate in the Ramsey model.

[5+5] = [10]

4. In an infinite horizon model, work out the dynamics of per capita asset accumulation for a small open economy, facing a constant rate of interest in the world capital market.

In this context discuss the problems associated with either a very low or a very high rate of interest.

[10]

INDIAN STATISTICAL INSTITUTE
Mid-Semester Examination: 2015-2016
M.S. (Q.E.), 2nd Year
Econometric Applications I

Date: 18 September 2015

Maximum marks: 100

Duration: 3 hours

[Answer question no. 1 and any **three** from the rest of the questions.]

1. Suppose monthly per capita expenditures (x) of households in urban India follow Pareto law with inequality parameter $v = 2.2$ and the threshold parameter $c = \text{Rs. } 500$. Find
 - (i) the average monthly per capita expenditure of all households,
 - (ii) the average monthly per capita expenditure of households spending more than Rs. 600/- and less than Rs. 700/- per capita per month. [5+20=25]
2. State Pareto law. Give your comments on the universality of Pareto law stating the evidences for and against this law. How can you graphically test whether a given set of data is coming from a Pareto distribution? Derive Lorenz Curve and Lorenz Ratio of Pareto distribution. [2+6+5+12=25]
3. (i) Describe how one can construct Lorenz Curve and hence Lorenz Ratio graphically and numerically given grouped data. What happens if raw data are given instead of grouped data?
 - (ii) State the Law of Proportionate Effect proposed by Kapteyn. Also state its modification due to Kalecki leading to lognormal distribution. [15+10=25]
4. Define lognormal distribution. State and prove its properties including moments, quantiles, skewness, kurtosis and moment distribution. [25]
5. Write short notes on any two of the following:
 - (a) Positive measures of inequality.
 - (b) Properties of Lorenz Curve of Lognormal distribution.
 - (c) Estimation of parameter of lognormal distribution.
 - (d) Desirable properties for a measure of inequality. [12½+12½=25]

3 (ii) Describe different types of data that are faced by applied econometricians. What are the different problems with data? Describe in short how we resolve these problems.

INDIAN STATISTICAL INSTITUTE
First Semestral Examination: (2015-2016)

MS (Q.E.) II Year

Macroeconomics II

Date: 16.11.2015 Maximum Marks 60

Duration 3 hours

Answer all questions

1. Show, in terms of a suitable model, that the welfare of the society is higher when the government can pre-commit to a monetary policy in comparison with the situation where it cannot. What could be possible ways in which the government can pre-commit to a monetary policy?

[13+2=15]

2. Consider a financial economy with a single good and two consumers. The consumers are price takers. There are two periods. In period 0, the consumers can buy securities which pay returns in period 1. One of two possible states emerges in period 1. There are two securities and the returns of the securities are state contingent. Similarly, endowments of the consumers, which are obtained in period 1, are also state contingent. Let ω_s^h be the endowment of consumer h ($h = 1,2$) in state s ($s = 1,2$) and let r_s^j be the return of security j ($j = 1,2$) in state s ($s = 1,2$). We have

$$(\omega_1^1, \omega_2^1) = (4,2)$$

$$(\omega_1^2, \omega_2^2) = (1,3)$$

$$(r_1^1, r_2^1) = (1,1)$$

$$(r_1^2, r_2^2) = (1,2)$$

State 1 occurs with probability 1/3 and state 2 occurs with probability 2/3 and this is common knowledge. Consumers have identical utility functions given by

$$U(x_s^h) = \ln x_s^h,$$

where x_s^h is the consumption of consumer h in state s .

- (a) Compute the equilibrium values of consumption and portfolios of the consumers as well as the security prices and spot prices.
- (b) Show that the equilibrium is Pareto Optimal.

[10+5=15]

3. Consider a two period OLG model which can potentially accommodate money in equilibrium. Assume that agents live for two periods and are endowed with Y units of good in the first period when they are young and earn nothing in the second period of their life; when they are old. These agents can potentially carry over the first period endowment of goods in the second period, in which case they will get in the second period $\frac{1}{1+\delta}$ times what they carry over from the first period, where $-1 < \delta$.

Agents have a two period utility function given by $U = \ln c_t^y + \frac{1}{1+\rho} \ln c_{t+1}^o$, where c_t^y and c_{t+1}^o denote the consumption of an young agent in period t and the consumption of the agent in period $t+1$ (when she is old) respectively and $0 < \rho$. The old agent also gets a transfer from the government financed through seigniorage, where the real transfer to the old in period $t+1$ denoted by $T_{t+1} = \frac{M_{t+1} - M_t}{P_{t+1}}$, where M_{t+1} and P_{t+1} denote the money supply and price level in period $t+1$. The government follows a simple monetary rule given by $M_{t+1} = (1 + \alpha)M_t$, with $0 < \alpha$.

Derive the condition on the rate of inflation for which agents would hold money in equilibrium.

Also show that, in such a case where money is held in equilibrium, the rate of inflation is equal to the growth rate of money.

[15]

4. In the Blanchard-Yaari model with cohort dependent wage, what would be the effect of a sharper decline in wage with respect to age on the steady state capital accumulation?

Consider the same model, but now with zero population growth, cohort *independent* wages and open to international asset market with a constant rate of interest. Can you show that the aggregate savings in this model is negatively related to the level of assets?

[Savings = Total income – Total Consumption, where Total income = wage income + interest income on assets. Also assume that the steady state exists in the model.]

[10+5]

INDIAN STATISTICAL INSTITUTE
 First Semester Examination: 2015-16
 M.S. (Q.E.), 2nd Year, Semester I
 Econometric Applications I

18 November, 2015

Maximum marks: 100

Duration: 3 hours

Note: Answer Question 1 and any **three** from the rest of the questions

Suppose the mean income of people in a community is Rs. 1000/- and the share of income of the poor people is 30%. Assume that income distribution follows a two-parameter lognormal distribution and the poverty line happens to be the same as the median income. Find the Gini Coefficient and the Gap Ratio. What is the ratio of mean income of poor and non-poor people? Also find the share of income of the bottom 10% people. [25]

Describe the problems in estimating poverty line. Also give a brief account of the different poverty measures that are used to find the poverty situation in a country. [15+10=25]

Describe in detail the economic and statistical criteria of choosing an Engel Curve. [25]

Describe how you will estimate Engel elasticity using Specific Concentration Curve. (You must show the derivations of the associated results.) [25]

Consider the following production function $Q = f(K,L)$ with two factors of production – capital (K) and labour (L). Define elasticity of substitution (σ). Prove that the following conditions for σ are equivalent.

$$\sigma = \frac{R(LR + K)}{KL(R \frac{\partial R}{\partial K} - \frac{\partial R}{\partial L})} = \frac{R(LR + K)}{KL(\frac{d^2K}{dL^2})} = \frac{Q_K Q_L (KQ_K + LQ_L)}{-KLT}$$

where $L = Q_K Q_L + Q_L^2 Q_{LL} + Q_L^2 Q_{KK} - 2Q_K Q_L Q_{KL}$ and R is the marginal rate of technical substitution. Hence prove that σ can be simplified to $\sigma = Q_K Q_L / (Q Q_{KL})$, if the production function is homogeneous of degree 1. [25]

Write short notes on any two of the following:

Three parameter lognormal distribution.

Linear Expenditure System.

Treatment of household size in Engel Curve.

Measures of concentration in business and industry.

[12½+12½=25]

[Additional Assignments.]

INDIAN STATISTICAL INSTITUTE
First Semestral Examination: (2015-2016)

MS (Q.E.) II Year

International Economics I

Date: 20.11.2015

Maximum Marks 60

Duration 3 hours

Answer all questions

1. Indicate whether the following statements are *True*, *False* or *Uncertain* giving reasons for your answer:

- (a) In a two country, two good Ricardian model of trade, a rise in home endowment of labour increases the welfare of both countries.
- (b) The relative supply curve is vertical in a two good, two factor Heckscher-Ohlin framework if factor intensities in the two sectors are the same.
- (c) A country inhabited by risk averse consumers and producing one risky and one safe good is unambiguously worse off if free international trade opens up.
- (d) A rise in sector specific capital endowment in one of the sectors reduces output and employment in the other sector in a two good, three factor specific factors model.

[5+5+5+5 = 20]

2. Consider a dynamic economy with n produced goods and p non-produced goods. There are m linear activities producing the n goods using produced and non produced goods as factors. Show that this economy gains from free international trade.

[10]

3. Show that in a three-agent setting, a transfer paradox might occur even when the equilibrium is Walras stable. In this context discuss the role of substitution effects in ensuring normal results.

[15]

PTO

4. Show that even the scarce factor can gain on opening up trade, when trade is driven by increasing returns to scale and love for variety.

[15]

INDIAN STATISTICAL INSTITUTE

Semestral Examination: (2015-2016)

MS(QE) II

Selected Topics I

Date: 23.11.2015

Maximum Marks: 60

Duration: 3 hrs.

- (1) Consider the social aggregation problem, where $A = \{x, y\}$ is the set of alternatives, $|A| = 2$, N is the finite set of agents and $|N| \geq 2$.
- (a) Define non-triviality, symmetry, neutrality and positive responsiveness of a social welfare function.
 - (b) Show that if a social welfare function satisfies symmetry, neutrality and positive responsiveness, then it must be the majority rule social welfare function.
 - (c) Can you find a social welfare function that satisfies non-triviality and positive responsiveness but fails to satisfy Pareto? Justify your answer. **(8+10+5=23)**
- (2) Consider the social aggregation problem, where A is the set of alternatives, $|A| \geq 3$, N is the finite set of agents and $|N| \geq 2$.
- (a) Define 'almost decisiveness' and 'decisiveness'.
 - (b) A social ordering satisfies *positive responsiveness* if the following holds: If $R_i = R'_i \forall i \in N \setminus \{j\}$ and either $(yP_jx$ and $xR'_jy)$ or $(xI_jy$ and $xP'_jy)$, then xRy implies $xP'y$. Show that if a social ordering satisfies unrestricted domain and positive responsiveness, then 'almost decisiveness' and 'decisiveness' are equivalent. **(5+15=20)**
- (3) Define the pivotal mechanism for the pure public goods problem. Show that this mechanism is dominant strategy incentive compatible and feasible. **(2+10+5=17)**

INDIAN STATISTICAL INSTITUTE
Final Examination: 2015-16

Course name: MSQE II
Subject name: Incentives and Organisations
Date: 27.11.15.
Maximum marks: 50
Duration: 3 hours

Answer all questions

Q1. Suppose there is a risk-averse agent who has wealth w , and can face a damage d , with $w > d > 0$. Damage is observable. There are two possible types of agents, 1 and 2, depending on the probability of facing the damage. Let p_1 and p_2 be the respective probabilities for the two types of agents, with $0 < p_1 < p_2 < 1$, and $a \in (0, 1)$ be the probability the agent is of type 1. Suppose also there is a risk-neutral monopoly insurer who can offer insurance to the agent.

(a) Suppose the agent's type is publicly observable. Characterize the optimal contract. [5]

(b) Suppose the agent's type is not publicly observable, but is private information to the agent. Characterize the optimal contract. [15]

Q2. (i) Consider the binary-effort hidden-action model with a risk-averse agent and a risk-neutral principal. The cost to the agent of high effort ($e = 1$) is c , and the agent's outside option gives utility 0. There are two possible output levels q_h and q_l , with $q_h > q_l > 0$. Output is publicly observable, and the probability of getting q_h is π_e , with $1 > \pi_1 > \pi_0 > 0$.

(a) Characterize the optimal contract for implementing high effort (with hidden action). [10]

(ii) Suppose the principal can observe an extra signal y of the agent's effort, which is independent of output, conditional on effort. y can be either y_h or y_l , with $y_h > y_l > 0$. The probability of observing y_h , in the event the principal wishes to obtain this extra signal, is β_e , with $1 > \beta_1 > \beta_0 > 0$. Obtaining this signal costs k , and the decision to obtain the signal has to be made before any contract is offered.

(b) Define a contract in this environment. [5]

(c) When will the principal choose to obtain this extra signal, given that he wishes to implement the high effort? [15]

Indian Statistical Institute
Semestral Examination: 2015-2016
MS(QE) II: 2015-2016
Industrial Organization

Date: 30/11/2015

Maximum Marks: (20+40)

Duration: $3/(2\frac{1}{2})$ Hours

Group A: [Only for those candidates who have not submitted assignments in time]

1. Consider a duopoly market with market demand for the product given by $p = 2 - x_1 - x_2$, where x_i is output of firm i . Firm 1's MC is 1 and this is common knowledge. However firm 2's MC is determined by Nature. It is $5/4$ with probability $1/2$ and $3/4$ with probability $1/2$. Firms choose quantities simultaneously and non-cooperatively. Find the expected payoff of each firm prior to nature's move in the following cases;
- (i) At the stage of production neither firm knows firm 2's cost. [7]
 - (ii) At the stage of production firm 2's cost is private information.[7]
 - (iii) At the stage of production both firms know their costs and this is common knowledge. [6]

Group B: Answer ALL questions

[Maximum $2\frac{1}{2}$ Hours for answering this group]

2. Suppose that firms build only an integer number of plants, 0, 1, 2, Building $k > 0$ number of plants costs $3.5k$. Each plant can produce exactly one unit of output. There is no variable cost of production. The market demand for the product is $p = 6 - X$, where X is the industry total output.
- (i) If there is a single firm, how many plants will the monopolist install? [3]
 - (ii) If there are two firms to decide the number of plants simultaneously, how many plants will each firm build in equilibrium? [3]
 - (iii) Out of these two firms if firm 1 builds plant first before firm 2, how many plants will they install? [4]

3. Consider the following leader-follower structure when firms choose quantities. The market demand function for the homogenous good is given by $p = \frac{1}{X}$, where X is industry output. Each firm has $MC=1$. The firms first simultaneously decide whether they will choose Stackelberg leader output or Stackelberg follower output, and in the second stage they play accordingly. Solve the game. (Consider only the first order conditions.) [10]
4. Consider the Hotelling linear city model. Consumers are uniformly distributed over the unit length of a city and each consumer buys at most one unit of a product supplied by two private firms. Price of the product is fixed at p higher than the unit cost of production. But the consumers are to pay a transport cost. If a consumer located at a distance x from the left, buys a product from firm I located at a distance l_i from the left, the transport cost is $t|x - l_i|$. So firms compete in market shares.
- (a) Find the optimal locations of the firms. What is the total transport cost to be incurred by the consumers all together? [5]
- (b) If the social planner decides the location of the firms to minimize the total transport cost incurred by all consumers together, what will be the optimal locations of the firms? [5]
5. Consider an n -firm Cournot model with homogeneous goods; $n \geq 2$. The market demand function is linear and there is no cost of production. Now consider formation of a k - firm cartel; $1 < k \leq n$. Thus the game is played among $(n - k)$ independent firms and the cartel of k firms.
- (i) Derive the payoffs of each independent firm and each cartel member. [3]
- (ii) Now examine the following proposition. If there are at least three firms in the industry, a stable cartel cannot be formed, hence all firms will remain independent; if there are just two firms in the industry, the two firms form a cartel. [7]

Indian Statistical Institute

Mid-semester Examination 2016

Course name: **Political Economy**

Subject name: **Economics**

Date: **23 February 2016**

Maximum marks: **40**

Duration: **2 hours 30 minutes**

1. This question pertains to direct aggregation of individual preferences $\{\succsim_i\}_i$ over alternatives in some set X to obtain a social preference by applying the majority rule, \succsim_{MR} . For simplicity, you may assume $X \subseteq R$, discrete and finite. Either prove or give a counterexample for each of the following three statements, clearly indicating whether you are proving or giving a counterexample: **(5 x 3 = 15 points)**

(i) If \succsim_{MR} is intransitive over any $x, y, z \subseteq X$, then exactly one of the following must hold:

(a) $x \succsim_{MR} y \succsim_{MR} z \succsim_{MR} x$

(b) $y \succsim_{MR} x \succsim_{MR} z \succsim_{MR} y$.

(ii) If \succsim_i is complete $\forall i$, then \succsim_{MR} is complete.

(iii) If individual preferences are *single-peaked* (SP), then \succsim_{MR} is transitive. That is, SP $\implies \succsim_{MR}$ transitive.

2. Suppose preferences of individuals for a service consists of two dimensions, p_1 and p_2 . Suppose there are three individuals, a 'low' consumer, a 'middle' consumer and a 'high' consumer with bliss points (1, 1), (2, 3) and (4, 4) respectively. Suppose individuals can directly vote on alternative pairs. Prove or argue otherwise whether a 'median-voter' analogue may still hold good. That is, is it true that the (2, 3) alternative will beat all other alternatives in pairwise majority voting? Argue briefly (you may use diagrams). **(5 points)**

3. This question pertains to indirect aggregation of individual preferences in the context of a model of representative democracy as discussed in class. The standard assumptions of such a model remain the same, namely, there are n individuals in the economy each having well-behaved preferences over policy denoted by $\{\succsim_1, \succsim_2, \dots, \succsim_n\}$. Moreover these preferences satisfy *extremal restriction* (ER). For simplicity, you may assume $X \subseteq R$, discrete and finite.

There are two candidates/parties/representatives, A and B who try to maximize objective functions u_A and u_B . However now, let the objective function of the representative be *net plurality* (NPL). For instance, candidate A 's objective is to maximize

$$u_A = \#\{i : x_A \succ_i x_B\} - \#\{i : x_B \succ_i x_A\}.$$

We can define u_B likewise. Let $G_{NPL} := (\{A, B\}, X, \{u_A, u_B\})$. Consider the mixed extension of G_{NPL} and denote it by G'_{NPL} . Then show that

- (i) G'_{NPL} has a Nash equilibrium. **(5 points)**
- (ii) Any Nash equilibrium (p_A, p_B) of G'_{NPL} has $\text{support}(p_k) \subseteq X^*$, $k = A, B$, where X^* is the set of Condorcet winners in X . **(10 points)**

4. This question pertains to part of the proof of the Sen and Pattanaik theorem (1969) as discussed in class.

Assume that individual preferences satisfy *extremal restriction* (ER). Suppose \exists an individual i with strict preference between three alternatives x, y, z , such that $x \succ_i y \succ_i z$. Moreover assume that social ordering according to the majority rule satisfies the "forward cycle", that is, $x \succ_{MR} y \succ_{MR} z \succ_{MR} x$. Under these circumstances, which kinds of individual preferences are feasible? **(5 points)**

(Note: The assumptions mentioned above are inconsistent and as we know, will lead to a contradiction. However, this question *does not* ask you to complete the proof and reach the contradiction.)

Economic Development
Mid-Semester Examination
MSQE I & II

Date: 24.2.16
Maximum Marks: 40
Time: 2 hours

Answer question 1 and either 2 or 3.

1. Determine the short run decision to acquire education for different levels of initial wealth (inheritance) and the long run distribution of wealth in the economy in the Galor-Zeira model for the following cases:
 - (a) The government makes education completely free (in Galor-Zeira notation $c = 0$).
 - (b) Education is costly ($c > 0$), but the government gives a loan ($c - x$) at a rate of interest i which is *less than* the rate of interest r which a lender gets by lending to the market, provided the level of inheritance x of an agent satisfies $c > x$. Assume inheritance levels are publicly observable. Also assume that $w_s > c(1 + i) + 2w_n$ where notations follow the Galor-Zeira paper.

[10 + 10]

2. An economy has two sectors. There is a constant returns sector where return to capital is constant. In particular, it is independent of the amount of capital employed in that sector or the state of the economy. Return to capital in this sector is normalized to zero. There is another sector exhibiting increasing returns where the return to capital is given by $r = f(K, z)$, $f_K > 0$, $f_z > 0$. Here K is the total capital stock employed in the increasing returns sector and z is a random variable taking values in $[0,1]$ and representing the state of the economy. The economy is endowed with \bar{K} units of capital and each individual in the economy has 1 unit of capital. Finally assume that there exist \bar{z} and \underline{z} in the support of z , with $\bar{z} > \underline{z}$, such that $f(\bar{K}, \underline{z}) = f(0, \bar{z}) = 0$.
 - (a) First assume that z is perfectly observable by all agents. Find the set of equilibrium strategy of an agent for all possible values of z .
 - (b) Next suppose that z is observable with a noise. In particular, an agent observes a signal x uniformly distributed in the interval $[z - \varepsilon, z + \varepsilon]$ for some $\varepsilon > 0$. Find the unique equilibrium strategy of an agent.

[5+15 = 20]

3. Show that in a two-sector model, with increasing returns in one sector and constant returns in the other, both history and expectations can play important roles in determining the long run equilibrium of the economy. Indicate how the relative strengths of the parameters of the model decide whether the long run adjustment path would be dictated by history or by expectations.

[10 + 10]

INDIAN STATISTICAL INSTITUTE
Mid-Semestral Examination: 2015-2016
MS (Q.E.) II Year

Sample Survey: Theory and Practice

Date: 26/02/16

Maximum Marks 30

Duration 1.30 hours

All notations are self-explanatory. You can answer any part of any question.

- (1) Consider the setup of SRSWOR with sampling units $\{U_1, U_2, U_3\}$, $N = 3$, $n = 2$ and consider the estimator

$$\begin{aligned}\hat{Y}^* &= \frac{Y_1}{2} + \frac{Y_2}{2} && \text{if sample space } s = \{U_1, U_2\}, \\ &= \frac{Y_1}{2} + \frac{2Y_3}{3} && \text{if sample space } s = \{U_1, U_3\}, \\ &= \frac{Y_2}{2} + \frac{Y_3}{3} && \text{if sample space } s = \{U_2, U_3\}.\end{aligned}$$

Show that $E(\hat{Y}^*) = \bar{Y}$ and then find $V(\hat{Y}^*)$. [8+10=18]

2. Suppose that the population of size N (assuming that $N = nk$, n and k being integers) into n strata where the stratum h contains units with labels

$$G_n = \{(h-1)k + j, j = 1, 2, \dots, k\}, h = 1, 2, \dots, n$$

and one unit is selected from each stratum randomly to get a sample of size n . The population values are modelled by the relation,

$$Y_i = a + bi, i = 1, \dots, N$$

where a and b are constants. Find the variance of the population total. [20]

Indian Statistical Institute
Mid Semestral Examination: (2015 – 2016)
M.S. (QE) – II year
Econometric Applications II

Date: 29.02.2016

Maximum Marks – 60

Duration: 2 hours

(Answer any three questions)

1. (a) Suppose the income variate x follows a Gamma distribution with density function

$$f(x) = \frac{1}{\Gamma\alpha} e^{-x} x^{\alpha-1}, \quad x \geq 0$$

Find the Lorenz curve and Lorenz Ratio.

- (b) Let the Lorenz curve $L(p)$ ($0 \leq p \leq 1$) of a continuous type income distribution be given by

$$L(p) = 1 - (1-p)^{1-\frac{1}{a}}.$$

Find the underlying distribution.

- (c) Given the individual utilities

$$u(x_i) = \begin{cases} C + D \frac{x_i^{1-\varepsilon}}{1-\varepsilon}, & \varepsilon \neq 1 \\ C + D \log x_i, & \varepsilon = 1 \end{cases}$$

write down the expression for Atkinson's measure of inequality.

[7 + 7 + 6 = 20]

2. (a) Consider two income profiles $x = (x_1, x_2, \dots, x_n)$ and $y = (y_1, y_2, \dots, y_n)$ with $x_1 \leq x_2 \leq \dots \leq x_n$ and $y_1 \leq y_2 \leq \dots \leq y_n$.
- (i) Define Lorenz dominance of x with respect to y . State the assumptions clearly.
- (ii) Why is the ordering of income profiles, generated by the LC comparison, a quasi-ordering? Illustrate with an example.

- (iii) What is a generalized Lomez curve (GLC)? What is the advantage of GLC over LC?
- (b) What do you mean by a “Bistochastic” matrix?
 Suppose the income distribution $y = (1,6)$ is obtained from a distribution $x = (2,5)$ through income transfer. What kind of transfer is it?
 Show that if we write $y = Ax$, then A can not be Bistochastic.
- (c) Define ‘hazard rate’ and ‘proportional failure rate’ (PFR) in the context of income distribution. Show that the Pareto distribution has constant PFR throughout the domain.

[9+6+5=20]

3. (a) Discuss the different techniques of fitting a specified model $f(x, \theta)$, θ being the vector of parameters, to a (grouped) income distribution data.
- (b) How do you judge the goodness of fit of the fitted model?

[8+12=20]

4. (a) What is a ‘Price Index Number’? What is the use of a ‘Price Index Number’ in the context of time series data?
- (b) Show that Laspeyres’ price index is larger than Paasche’s price index.
- (c) What is “Purchasing Power Parity” (PPP)? How do you estimate PPP between two countries given their domestic price and quantity vectors?

[4 + 6 + (2+8) = 20]

INDIAN STATISTICAL INSTITUTE

Mid-Semester of Second Semester Examination: 2015-16

Course Name: M.S. (QE) I Year & M.S. (QE) II Year

Subject Name: Environmental Economics

Date: March 1, 2016

Maximum Marks: 40

Duration: 2 hours

1. Argue whether the following statements are true/false/uncertain (*any five*): $3 \times 5 = 15$
 - (a) "Technological progress can always enhance the carrying capacity of the global eco-system and allow the economic sub-system to grow in a sustainable way without any limit".
 - (b) "Economists tend to search for instruments of public policy that can fix one market essentially by introducing another, allowing each to operate efficiently on its own".
 - (c) "Most externalities can be recast as a private good for which property rights have not yet been assigned".
 - (d) "It's immoral to buy the right to pollute".
 - (e) "Both economic efficiency and inter-generational equity require that benefits and costs experienced in future years be given less weight in decision-making than those experienced today".
 - (f) "To control environmental pollution a tax and a subsidy policy should yield identical solution in the absence of any other distortion in the system".

2. Answer *any five* of the following: $5 \times 5 = 25$
 - (a) Show that in an economy free from all sorts of transaction cost except pollution externality in production, the allocative efficiency can be restored through introduction of an emission fee equaling the marginal value of the total social damage caused by the pollution.
 - (b) Discuss the importance of Marginal Abatement Cost (MAC) in designing a pollution control instrument under *taxes and standard* approach and derive an empirically estimable expression of an MAC.
 - (c) Suppose that old cars and new cars are required to pass identical emissions tests in West Bengal. Cars that fail must reduce emissions and old cars can reduce emissions at a marginal cost of Rs.10 per kg of emissions. New cars can reduce emissions at Rs.5 per kg.
 - i. Does the emissions test regulation reduce emissions in the least costly way?
 - ii. Explain how to use vintage differentiated regulation to achieve the same emissions at lower cost. Which type of car should have stricter emissions tests?
 - iii. Indicate one possible problem with vintage differentiated regulation in this context.

- (d) Write down the optimization problem to be solved for obtaining the efficient solution under Ambient Permit System and Emission Permit System of Tradable Pollution Permit. Which one is expected to yield socially more desirable result in terms of pollution off-set? Explain.
- (e) Do you believe that a pollution tax will unconditionally produce double dividend to the society? Argue your case critically.
- (f) Why would a pure instrument be inadequate to manage the municipal solid waste efficiently? What type of mixed instrument would you like to propose in this context? Be specific.

INDIAN STATISTICAL INSTITUTE
 Semestral Examination: 2015-2016
 M.S. (Q.E.) II Year
Sample Survey: Theory and Practice

Date: 6th May, 2016

Maximum Marks 50

Duration 2 hours

All notations are self-explanatory. This question paper carries a total of 55 marks. You can answer any part of any question. But the maximum that you can score is 50. Marks allotted to each question are given within parentheses.

1. Consider a finite population of $2N$ units. Let Y be a variable taking values Y_i for $i = 1, \dots, 2N$.

It is proposed to select $2n$ units according to either design A or design B which are given below.

Design A:

Select $2n$ units from $2N$ units by SRSWR.

Design B:

Divide the $2N$ units into two equal groups $\{1, \dots, N\}$ and $\{N+1, \dots, 2N\}$. Select two SRSWR samples of size n from each group separately.

It is proposed to use the sample mean of the units in the sample to estimate the population mean. Which of the two designs would you use? Justify your answer by comparing the variances of the estimator for the two designs. [15]

2. An unbiased coin is to be used to select a Probability Proportional to Size

i	1		2	3
X_i	2		4	1

With Replacement (PPSWR) sample in 2 draws from the above population of 3 units, where X is the size measure. Consider the following procedure.

- a) Toss the coin thrice independently.
- b) If the outcome is $\{HHH\}$ or $\{HHT\}$, select the first unit.
- c) If the outcome is $\{HTH\}$, $\{HTT\}$, $\{THH\}$ or $\{THT\}$, then select the second unit.
- d) If the outcome is $\{TTH\}$, then select the third unit.
- e) If the outcome is $\{TTT\}$, do not select any of the units, go back to (a) above.
- f) Continue till a unit is selected.

Show that the above procedure is a PPS method. If W = number of tosses required to select a unit, find $E(W)$. [5+20=25]

3. Consider a pond with N (unknown) number of fish. Propose an appropriate sampling scheme and then an estimator of N and find its variance. [7+8=15]

Indian Statistical Institute
Second Semestral Examination: 2015 –2016
M.S. (Q.E) – II Year
Econometric Applications II

Date: 22.4.2016

Maximum Marks: 100

Duration: 3 hrs.

(Answer any four questions)

1. (a) What do you mean by the ‘relative’ and the ‘absolute’ measures of income inequality? Give examples.
- (b) State and explain the desirable properties that an inequality index should satisfy.
- (c) Examine the following inequality index in the light of the above properties.

$$I(x) = \frac{\sqrt{\frac{1}{n} \sum_{i=1}^n (x_i - \mu)^2}}{\mu}$$

[5 + 8 + 12 = 25]

2. (a) Define homothetic preferences. Show that under linear homogeneity of preferences, the cost function is of the form

$$C(u, p) = \alpha(p)u^*$$

where $u^* = f(u)$ and $\alpha(p)$ is linearly homogeneous in p , the vector of prices.

- (b) Suppose you are given the cost function

$$C(u, p) = \alpha(p) \exp\left(\frac{b(p)}{1/\ln u - \lambda(p)}\right),$$

where $\alpha(p)$ is homogeneous of degree one in prices, $b(p)$ and $\lambda(p)$ are homogeneous of degree zero in prices and u is the level of utility, with

$$\ln \alpha(p) = \alpha_0 + \sum_{i=1}^n \alpha_i \ln p_i + \frac{1}{2} \sum_{i=1}^n \sum_{j=1}^n \delta_{ij} \ln p_i \ln p_j,$$

$$b(p) = \prod_{i=1}^n p_i^{\beta_i} \quad \text{and} \quad \lambda(p) = \sum_{i=1}^n \lambda_i \ln p_i.$$

- (i) Obtain the appropriate restrictions on the parameters for the homogeneity conditions to be satisfied.

(ii) Derive the budget share function for item i .

- (c) What are 'exact' and 'consistent' aggregations in the context of consumer demand analysis? For each type of aggregation, give an example of a demand system conforming to the respective type.

[7 + (5+5) + 8 = 25]

3. (a) Describe the Ramsey-Samuelson-Diamond-Mirlees approach to the determination of optimal commodity taxation.

(b) Assuming that consumer's demand behaviour is captured through the Linear Expenditure System, examine the redistributive impact and the effect of taxation on the worst-off household assuming that taxation is purely a redistributive mechanism amongst households.

- (c) Explain the 'double hurdle model' (with discrete random preference regimes) for modelling 'zero expenditure'.

[12 + 5 + 8 = 25]

4. (a) Define True Cost of Living Index (TCLI). What is the difference between a TCLI and a standard price index number?

- (b) Given the dynamic model for 'clothing'

$$q(t) = \alpha + \beta s(t) + \gamma x(t)$$

where $q(t)$: rate of demand at time t

$x(t)$: income during the same time

$s(t)$: inventory of 'clothing' at time t .

and assuming that the stock is used up at a constant depreciation rate δ , find the short and long term derivatives of consumption with respect to income.

- (c) What is 'sample selection bias'? Give an example of a bivariate sample selection model with a participation and an outcome equation. How would you estimate the parameters using Heckman's procedure?

[3+10+12=25]

5. (a) Define the input and output oriented measures of ‘technical efficiency’ due to Debreu-Farrell (D-F) and Koopmans.
- (b) “D-F technical efficiency is necessary, but not sufficient for Koopmans technical efficiency”—explain this statement diagrammatically for both input and output oriented measures.
- (c) Show (diagrammatically) that the input and output oriented measures of technical efficiency are equal under constant returns to scale (use a single input single output set up).
- (d) Describe the Corrected Least Squares (COLS) method of estimating technical efficiency from cross section data using a deterministic production frontier.
- (e) Describe the Modified Least Squares (MOLS) method of estimating technical efficiency from cross section data using a deterministic production frontier and a Half Normal distribution of efficiency (u).

$$[u \sim \text{HalfNormal}(0, \sigma_u^2) \Rightarrow f(u) = \frac{2}{\sigma_u \sqrt{2\pi}} \exp(-u^2 / 2\sigma_u^2)]$$

[5 + 6 + 4 + 5 + 5 = 25]

INDIAN STATISTICAL INSTITUTE

Second Semester Examination: 2015-16

Course Name: M.S. (QE) I Year & M.S. (QE) II Year

Subject Name: Environmental Economics

Date: April 26, 2016

Maximum Marks: 60

Duration: 3 hours

A. Answer any four of the following:

5x4 = 20

1. A builder proposes a skyscraper that would block sunlight to the neighboring houses. The building would have net benefits to the builder of Rs.100,000.00. The neighbors, who use some solar heating, would face reduced property values and increased heating costs totaling Rs.80,000.00.
 - (a) The law clearly stipulates that the neighbors have the right to solar access. Is a welfare-improving exchange possible? What do you expect the outcome to be?
 - (b) Suppose the neighbors' association hires an attorney to negotiate at a fee of Rs.25,000.00. Is a welfare-improving exchange possible? What do you expect the outcome to be?
 - (c) How, if at all, would the outcome be different if the builder had the right to construct the skyscraper, even if it blocked solar access?
 - (d) Now suppose that the builder has the rights, and the costs of the lawyer (still Rs.25,000.00) belong to the neighbors. Is a welfare-improving exchange possible? What do you expect the outcome to be?
 - (e) Compare and comment on the outcomes of cases (a) – (d). [1+1+1+1+1]

2. Consider a simple economy with one consumer who maximizes net utility from driving. The benefit from driving is (μs) , where s is the size of the car, and $\mu > 0$ is a constant. The cost to the driver is (βs^2) , and the damage to the road is (λs^3) , ($\beta > 0$ and $\lambda > 0$ are constants).
 - (a) What size of car is chosen by this driver in the absence of any regulation?
 - (b) What is the socially optimal size of the car?
 - (c) Compare these two and interpret the differences.
 - (d) Design a toll system that induces the driver to choose the socially optimal car size. [1+1+1+2]

3. Suppose the newly elected member of the Mayor Council in charge of municipal solid waste management in Kolkata is approaching you for your expert opinion on the two alternative solutions to the following problem:
 - (a) In the local community there is a strong social norm for not dumping household waste in the neighbor's doorstep. When someone is caught dumping solid waste by violating this norm he is compelled to sweep the community pavements in

broad daylight and in terms of opportunity cost of time, the length of pavement to be cleaned is proportional to the cost of transporting the illegally disposed waste to the landfill.

- (b) The new member of the Mayor Council thinks that this informal arrangement is not effective. To ensure efficient outcome he wants to install a guard in the locality to keep eye on proper waste disposal and in case of detection of any illegal dumping wants to impose a flat fine of Rs.100.00.

Compare option (a) and (b) critically and recommend the one that is more likely to be effective. [5]

4. Consider two thermal power plants, each emitting 20 units of SO_2 into the environment making a total of 40 units in the region. The Pollution Control Board sets a standard of 20 units for the region. The abatement cost function of the polluters are as follows:
Plant I: $C_1 = 10 + 0.75(\text{SO}_2)^2$, Plant II: $C_2 = 5 + 0.5(\text{SO}_2)^2$.

- (a) Suppose the PCB allocates abatement responsibility equally such that each plant must abate 10 units of SO_2 . What will be the total abatement cost of the region?
(b) If the government, following the advice of the PCB, imposes an emission fee of Rs.16.00 per unit of SO_2 emission beyond the allowable limit of 10 units per plant how much of pollution each plant will abate?
(c) If instead, the government used a tradable pollution permit system, what permit price would achieve a cost-effective allocation of abatement?
(d) Compare the "allocation of abatement" suggested by options (a), (b) & (c). Which one would you prefer from the stand point of economic efficiency? Explain. [1+1+1+2]

5. For each of the following, does the revenue recycling effect tend to increase, decrease, or have no effect on optimal emissions? Also, for each does the tax-interaction tend to increase, decrease, or have no effect on optimal emissions? Finally, for each effect, let E solve $MC(E) = MD(E)$. Is optimal emission greater than, less than, or equal to E, or is the answer ambiguous?

- (a) An emissions standard for SPM (Suspended Particulate Matter);
(b) A gasoline tax to reduce SPM emissions;
(c) A permit market on SPM where the permits are initially given away free of charge. [1+2+2]

B. Answer any five of the following:

6x5 = 30

6. Two companies require identical skills and training from their workers. Both employ 10,000 people. On average, Safety First has one worker fatality per year, while Safety

Second has two worker fatalities per year. Jobs at Safety First pay Rs.50,000.00/year, while jobs at Safety Second pay Rs.50,500.00/year.

- (a) Why do these jobs with identical requirements pay different salaries? Justify on the basis of the information presented here.
- (b) What is the risk for a worker of a fatal accident at each company? What is the pay premium associated with the higher risk?
- (c) The value of a statistical life is the difference in wage divided by the difference in risk. What is the value of a statistical life for workers with these skills and training? [2+2+2]

7. The Forest Service is deciding how to allocate its recreational funding. It can increase fishing opportunities in an area (for instance, by stocking), or it can build more hiking trails. It presents several options in a survey:

Option	Fish Stocked (Hundreds of Fish)	Hiking Trails (Miles)	Cost (Rs.)
A	1	9	50
B	3	2	100
C	3	9	125

- (a) In the first round, the survey respondent was asked to rank each option without regard to cost; in the next round, the survey respondent was given the cost information and then asked to rank the options while considering those costs.
- (b) In the first round, one respondent ranked alternative C as best, and ranked A as tied with B. Plot the different combinations on a graph, with Fish Stocked on the horizontal axis and Miles of Hiking Trails on the vertical axis. Draw indifference curves that reflect this set of preferences. Do these indifference curves reflect more is better, slope downward, and not cross, as indifference curves should?
- (c) Based on the comparison of alternatives A and B, what is this respondent's trade-off between fish stocking and hiking trails? In other words, if he were to give up one hundred fish stocked, about how many miles of hiking trails would he need to get in compensation? What does this comparison tell you about how this respondent values fish stocking compared to hiking trails?
- (d) When the respondent was presented with the cost information, he changed his ranking so that A was best, C was second-best, and B was least preferred. Does the fact that A and B are no longer equally preferred mean that the respondent is inconsistent in his preferences? Why or why not?
- (e) Compare alternatives A and C. What can you say about how much the respondent is willing to pay for three hundred additional fish stocked when there are already one hundred stocked? [1+1+1+1+2]

8. If a consumer buys non-recycled paper when recycled paper is available at the same price, the consumer reveals that she prefers the non-recycled paper; in addition, she would be worse off if non-recycled paper were not available.
- Suppose the price of recycled paper is higher than the price of non-recycled paper. A consumer buys the non-recycled paper. Would requiring that all paper be recycled make her worse off? Why or why not?
 - Suppose the price of recycled paper is higher than the price of non-recycled paper. A consumer buys the recycled paper anyway. Is this consumer irrational? Why or why not? Is she made worse off by the presence of non-recycled paper? Why or why not?
 - A university is considering requiring the use of recycled paper, although it is more expensive than recycled paper. Students are either like the consumer in (a), and would buy cheaper non-recycled paper if it is available, or like the consumer in (b), who buy more expensive recycled paper. What is the total effect on student well-being if recycled paper is required—that is, does consumers' surplus increase or decrease?
 - What is the effect of greater availability of choices on consumer well-being? That is, in economic modeling, do additional choices make people better off or worse off? Why? [1+1+2+2]
9. (a) SB resides in Delhi and she plans a trip to Keoladeo National Park (KNP) which is 100 kilometers away from Delhi. The entry fee in the park is Rs.100.00 and it takes 3 hours to travel from Delhi to KNP. The transport cost is Rs.10.00 per kilometer. She likes to spend 6 hours inside the park. SB works in an MNC for Rs.2, 92,000.00 per annum. Calculate her revealed willingness to pay for the visit. (In your calculation if you make any assumption, then specify it clearly).
- (b) Suppose you are interested in applying Hedonic Price Theory to assess the effect of environmental degradation on house rent where in the presence of rent control only the information on nominal rent is observable and no information is available on the lump-sum down payment. Suggest a method to arrive at the correct estimation of actual rent. [3+3]
10. Suppose a consumer cares for both the composite good X and the health stock H , where H is sensitive to both the amount of medical care (M) and the quality of environment (α). Both X and M are marketed goods with unit price p_x and p_m , respectively. The consumer enjoys earned income w , T_w , w being the market wage rate and asset income A . Moreover, she makes her optimal choice subject to both the income and time budget constraints. Time (T) is spent for work (T_w), for consumption of X (T_x), for consumption of M (T_m) and may be in illness (T_L).
- Formulate the model.
 - Derive an expression for consumers' marginal willingness to pay (WTP) for an improvement in α .

- (c) What problem would you encounter in estimating this expression empirically?
- (d) Suggest a way out. [1+2+1+2]

11. Answer the following questions with reference to a contingent valuation survey:

- (a) Explain the notion of Closed-ended-referendum.
- (b) How would you estimate the average maximum willingness to pay from the bid responses collected in this case?
- (c) Comment on the importance of randomization of the asked bid in applying this estimation technique successfully.
- (d) What are the commonly encountered biases from which your estimation may suffer? [1+2+1+2]

C. Answer any two of the following:

2x5 = 10

12. Consider two countries A & B between which trade has opened up involving two goods X & Y, where X is a dirty good and Y is a clean good and country A has (natural) comparative advantage in X whereas country B has the same in Y. Assume that the pollution externality for dirty good X originates during the process of production.

- (a) Decompose the effect of trade on the production of X in country A into scale, composition and technique effect.
- (b) Show how your answer will change if the pollution externality is experienced at the level of consumption of X instead. [3+2]

13. Differences in environmental regulations entail a pattern of international specialization in which dirty industries have a tendency to gravitate towards the South.

- (a) How do you argue theoretically in favor of this claim?
- (b) Do empirical findings corroborate this claim? Suggest a suitable method to examine this claim. [3+2]

14. Consider the statement that “the transboundary pollution is difficult to control” and briefly comment on the suitability of each one of the following lines of action to control the problem.

- (a) Victim country levying tariffs on imports from the country generating the pollution.
- (b) Linking international agreements between the two countries on totally unrelated issues to control the pollution problem.
- (c) Forge international agreements on pollution control like different protocols. [1½+1½+2]

INDIAN STATISTICAL INSTITUTE
SEMESTRAL EXAMINATION, 2014-2015
M.S. (Q.E.) I, II Years and M. Math. II Year
Game Theory II

Date: 29.04.2016

Maximum Marks: 100

Time: 3 hours

Note: Answer Parts (A) and (B) in separate answer scripts. Clearly explain the symbols you use and state all the assumptions you need for any derivation. The paper carries 110 marks. You may attempt any part of any question. The maximum you can score is 100.

A

1. Define a voting game. Establish a necessary and sufficient condition for non-emptiness of the core of such a game in terms of a blocker. (10)
2. Consider the problem of allocating costs for providing some service to a set of customers. Assume that the following conditions hold: (a) all non-users of the service do not pay for it but all users should be charged equally; (b) the total cost of using the service is the sum of capital and operating costs, and (c) the service provider will recover the entire cost from the customers. Clearly demonstrate that there is a unique solution to this cost recovery game. (12)
3. Identify the relation between the nucleolus and the kernel of a coalition form game for the grand coalition structure by giving necessary preliminaries. (10)
4. State and prove the Bondareva-Shapley theorem by defining all necessary concepts. (16)
5. Formulate a bankruptcy situation, where there are $n > 1$ claims against an estate and the sum of the claims exceeds the estate's worth, as a coalition form game. Show that such a game is convex. (10)

P.T.O

6. Let $N = \{A_1, A_2, A_3\}$ be a set of 3 firms producing a homogenous output whose price function is $10 - x_{A_1} - x_{A_2} - x_{A_3}$, x_{A_i} being the output of firm A_i . The maximum output a firm can produce is 3. The cost function of firm A_i is $(1 + x_{A_i})$. The worth of any non-empty coalition $S \in 2^N$ is defined as

$$v(S) = \max_{x_{A_i}, A_i \in S} \min_{x_{A_j}, A_j \notin S} \sum_{A_i \in S} x_{A_i} (10 - x_{A_1} - x_{A_2} - x_{A_3}) - \left(\sum_{A_i \in S} (1 + x_{A_i}) \right). \text{ Determine the numerical value of worth of each non-empty coalition. Also identify the set of core elements. (20)}$$

7. (a) Show that the solution to the two-person bargaining problem satisfying the Nash axioms exists and is unique. (7)
- (b) When do you say that a marriage matching is stable? (5)

B

- 1.(a) Show that for a weighted majority game, the problem of finding the number of swings for a particular player can be reduced to SUBSET SUM problem. Hence, determine the time complexity of finding the number of swings for a particular player.
- (b) Suppose that the Gale-Shapley “men propose” algorithm is modified whereby in a round each unmatched man proposes to the second most preferred woman in his current list. Will this modified algorithm also result in a stable matching? Explain your answer.
- © Assuming that the “men propose” strategy results in the best partners for men show that it results in the worst partners for women. (8+6+6)

Indian Statistical Institute

Second-semester Examination 2016

Course name: MSQE II year

Subject name: Political Economy

Date: 2 May 2016

Maximum marks: 60

Duration: 3 hours

Instructions: Answer all questions.

1. Within the Palfrey-Rosenthal framework of strategic voting as discussed in class, and using simple numerical figures for team sizes, demonstrate the forces of “competition” and “free-riding” that individuals face when deciding whether or not to vote. (You may assume the coin-toss rule for breaking ties and all individuals facing an identical voting cost given by c .) (10 points)

(Hint: Consider using simple 2x2 games and their Nash equilibria to make your point.)

2. This question pertains to the characterization of “mixed-pure” equilibria as discussed by Palfrey and Rosenthal in the context of strategic voting. Suppose $M, N > 1$. (Recall M and N are the number of members in teams 1 and 2 respectively.) Let $k \in \mathbb{N}$ be such that $k \leq \min\{M - 1, N\}$. Recall that c is the exogenously given cost of voting for each player. We know that if $c \leq \binom{M-1}{k} \left(\frac{k}{M}\right)^k \left(1 - \frac{k}{M}\right)^{M-1-k}$, then there is an equilibrium of G_2 (status-quo rule) in which exactly k members of team 2 vote and all team 1 members vote with probability q . Show that q satisfies $c = \binom{M-1}{k} q^k (1 - q)^{M-1-k}$. (5 points)

(Hint: This question only asks you to demonstrate the best response of a team 1 member, given the strategy of the other team - it *does not* ask you for the proof of the proposition.)

3. What is the expected turnout in a “ $q - k$ ” or “mixed-pure” equilibrium as discussed by Palfrey and Rosenthal? What are its drawbacks when positive voting costs of individuals and large electorates are considered? (5 points)

4. This question pertains to a parameterized version of Feddersen and Sandroni’s ethical voting model. Let the fraction of ethical agents in groups 1 and 2, \hat{q}_1 and \hat{q}_2 respectively, be

independently and identically distributed as $U[0, 1]$. Let the fraction of the population in group 1 be deterministic and be given by $k \in (0, 1/2]$. Let cost of voting for each individual be random and be drawn from $U[0, \bar{c}]$. Let the payoff from ‘doing one’s part’, D , be $> \bar{c}$. Let the social cost function be linear, that is $v(x) = x$. Recall w to be the parameter capturing the ‘importance of election’. Also let parameters \bar{c} , w and k satisfy $\frac{\bar{c}}{w} > \frac{1}{\sqrt{k(1-k)}}$.

(i) Show that the equilibrium fraction of ethical agents who vote in each group is given by:

$$\sigma_1^* = \left(\sqrt{\frac{w}{\bar{c}}} \right) \cdot \frac{1}{k^{1/4}(1-k)^{1/4}},$$

$$\sigma_2^* = \left(\sqrt{\frac{w}{\bar{c}}} \right) \cdot \frac{k^{1/4}}{(1-k)^{3/4}}.$$

(12 points)

(ii) From (i), what can you conclude about the participation rates of the minority and the majority? **(4 points)**

(iii) From (i), what can you conclude about the chances of winning of the minority versus that of the majority? **(4 points)**

5. This question deals with lobbying as discussed by Grossman and Helpman. They conclude that “both the policymaker and the interest group may benefit from having lobbying not be free.” Consider a single interest group, a single policy variable and two possible states of the world, to elucidate the above statement. **(20 points)**

Indian Statistical Institute
MSQE I and II
Economic Development I
Semestral Examination

Maximum Marks 60

Time 3 hours

Date 4.5.2016

Answer question 1 and any two from the rest.

1. Consider risk neutral borrowers and lenders. The lenders are perfectly competitive and earn zero profits in equilibrium. Each borrower has two alternative projects, a risky project and a safe project. Each project requires one unit of capital, the opportunity cost of which is $\rho > 0$ to the lender. A safe project yields an income Y_s with certainty. A risky project yields Y_r with probability p and zero with probability $(1 - p)$. We assume that

$$Y_r > Y_s = \rho > pY_r$$

The lender offers a contract specifying the gross rate of interest r which the borrower may or may not accept. The reservation payoff of each borrower is zero. There is limited liability so that in case the yield is zero, the borrower pays nothing. Finally assume that the lender cannot influence the project choice of the borrower.

- (a) What is the socially optimal project choice?
- (b) Suppose the lender lends on the basis of individual liability. Show that in equilibrium the borrower will always choose the risky project.
- (c) Now suppose the lender lends on the basis of joint liability to a group of two borrowers. In particular, a borrower is liable to pay not only his own interest but also the interest of his defaulting partner in case he has enough funds to do so. Find the equilibrium project choice when choices are made non-cooperatively.
- (d) Suppose in (c) above project choices are cooperatively made. Show that the equilibrium outcome is socially optimal.

[2+3+7+8 = 20]

2. Two political parties are engaged in a political competition. There are two types of voters: non-strategic voters who vote on the basis of their perception about the realized

state of the economy and strategic voters who vote for personal benefits and for the party they choose to be affiliated with. Show that the higher is the proportion of the strategic voters, the lower is the level of effort expended by the ruling party.

[20]

3. Show how reciprocity can be a basis of informal insurance. Under what circumstances would this informal insurance differ from the first best?

[17+3 = 20]

4. A trader-cum-money lender enters into an interlinked contract with a farmer according to which the farmer takes a production loan from the trader-cum-money lender at a contracted rate of interest and sells the output to him at a contracted price. Show that the optimal contract exhibits a subsidized rate of interest and will be Pareto efficient. Give the economic reason behind the subsidization of the rate of interest.

[15+5 = 20]