EEE-05, 2014

Series 05

Time. 3 hours **Maximum marks.** 100

General Instructions: Please read the following instructions carefully

- Check that you have a bubble-sheet and an answer book accompanying this examination booklet. Do **not** break the seal on this booklet until instructed to do so by the invigilator.
- Immediately on receipt of this booklet, fill in your Signature, Name and Roll number in the space provided below.
- Do **not** disturb your neighbours at any time.
- Make sure you do **not** have **mobile, papers, books, etc.**, on your person. The exam does not require use of a calculator. However, you can use non-programmable, non-alpha-numeric memory simple calculator. **Anyone engaged in illegal practices will be immediately evicted and that person's candidature will be canceled.**
- When you finish the examination, hand in this **booklet and the answer book** to the invigilator. You are **not allowed to leave** the examination hall during the first 30 minutes and the last 15 minutes of the examination time.
- **Only after the invigilator announces the start of the examination**, break the seal of the booklet. Check that this booklet has pages 1 through 8. Report any missing pages to the invigilator.

Signature ______________________________

Name ______________________________

Roll number ______________________________

Part I

Instructions for Part I

- This part of the examination will be **checked by a machine.** Therefore, it is very important that you follow the instructions on the bubble-sheet.
- Fill in the required information in Boxes on the bubble-sheet. **Do not write anything in Box 3 - the invigilator will sign in it.**
- This part of the exam consists of 20 multiple-choice questions. Each question is followed by four possible answers, at least one of which is correct. If more than one choice is correct, choose **only the 'best one'**. The 'best answer' is the one that implies (or includes) the other correct answer(s). Indicate your chosen best answer on the **bubble-sheet** by shading the appropriate bubble.
- For each question, you will get: 2 marks if you choose only the best answer; 0 mark if you choose none of the answers. **However, if you choose something other than the best answer or multiple answers, then you will get $-2/3$ mark for that question.**
- To do **'rough work'** for this part, you can use the last pages of the separate answer book provided to you. Your rough work will be neither read nor checked.

Question 1. Consider the linear regression model: $y_i = \beta_1 D1_i + \beta_2 D2_i + \varepsilon_i$, where $D1_i = 1$ if $1 < i < N$ and $D1_i = 0$ if $N+1 < i < n$ for some $i < N < n$; and $D2_i = 1 - D1_i$. Can this model be estimated using least squares?

(a) No, because $D1$ and $D2$ are perfectly collinear

(b) Yes, and it is equivalent to running two separate regressions of y on $D1$ and y on $D2$, respectively.

(c) No, because there is no variability in $D1$ and $D2$

(d) Yes, provided an intercept term is included.

Question 2. Consider the least squares regression of y on a single variable x. Which of the following statements is true about such a regression?

(a) The coefficient of determination R^2 is always equal to the squared correlation coefficient between y on x

(b) The coefficient of determination R^2 is equal to the squared correlation coefficient between y on x only if there is no intercept in the equation

(c) The coefficient of determination R^2 is equal to the squared correlation coefficient between y on x only if there is an intercept in the equation

(d) There is no relationship between the coefficient of determination R^2 and the squared correlation coefficient between y on x

Question 3. An analyst runs two least squares regressions: first, of y on a single variable x, and second, of x on y. In both cases, she decides to include an intercept term. Which of the following is true of what she finds?

(a) The slope coefficient of the first regression will be the inverse of the slope coefficient of the second regression; this will also be true of the associated t-ratios

(b) The slope coefficients will be different, the associated t- ratios will also be different, but the R^2 from the two regressions will be the same

(c) The slope coefficients will be different, but the associated t-ratios and the R^2 from the two regressions will be the same

(d) The slope coefficients will be the inverse of each other, the associated t-ratios will also be the inverse of each other, but the R^2 from the two regressions will be the same.

Question 4. Consider the two regression models

(i) $y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + u$

(ii) $y = \gamma_0 + \gamma_1 Z_1 + \gamma_2 Z_2 + v$,

where variables Z_1 and Z_2 are distinct from X_1 and X_2. Assume $u \sim N(0, \sigma_u^2)$ and $v \sim N(0, \sigma_v^2)$ and the models are estimated using ordinary least squares. If the true model is (i) then which of the following is true?

(a) $E[\hat{\beta}_1] = E[\hat{\gamma}_1] = \beta_1$ and $E[\hat{\sigma}_v^2] = \sigma_u^2$.

(b) $E[\hat{\sigma}_v^2] \geq \sigma_u^2$.

(c) $E[\hat{\sigma}_v^2] \leq \sigma_u^2$.

(d) None of the above as the two models cannot be compared

Question 5. Ms. A selects a number X randomly from the uniform distribution on $[0, 1]$. Then Mr. B repeatedly, and independently, draws numbers $Y_1, Y_2, ...$ from the uniform distribution on $[0, 1]$, until he gets a number larger than $X/2$, then stops. The expected number of draws that Mr. B makes equals

(a) $2 \ln 2$

(b) $\ln 2$

(c) $2/e$

(d) $6/e$

Question 6. Sania's boat is at point A on the sea. The closest point on land, point B, is 2 km. away. Point C on land is 6 k.m. from point B, such that triangle (ABC) is right-angled at point B. Sania wishes to reach point C, by rowing to some point P on the line BC, and jog the remaining distance to C. If she rows 2 km. per hour and jogs 5 km. per hour, at what distance from point B should she choose her landing point P, in order to minimize her time to reach point C?

(a) $21/\sqrt{4}$

(b) $4/\sqrt{21}$

(c) $4/\sqrt{12}$

(d) $21/\sqrt{21}$

The following information is the starting point for the next Two questions. Consider an exchange economy with two goods. Suppose agents i and j have the same preferences. Moreover, suppose their preferences have the following property: if (a, b) and (c, d) are distinct bundles that are indifferent to each other, then the bundle $((a+c)/2, (b+d)/2)$ is strictly preferred to (a, b) and (c, d).

Question 7. In a Pareto efficient allocation, i and j

(a) will get the same bundle
(b) may get different bundles
(c) will get the same bundle, provided their endowments are identical
(d) will get the same bundle, provided their endowments are identical and the preferences are monotonically increasing

Question 8. In a competitive equilibrium allocation, i and j
(a) will get the same bundle
(b) may get different bundles
(c) will get the same bundle, if their endowments are identical
(d) will get the same bundle, only if their endowments are identical and the preferences are monotonically increasing

The following information is the starting point for the next Three questions. Two firms produce the same commodity. Let x_1 and x_2 be the quantity choices of firms 1 and 2 respectively. The total quantity is $X = x_1 + x_2$. The inverse demand function is $P = a - bX$, where P is the market price, and a and b are the intercept and slope parameters respectively. Firms 1 and 2 have constant average costs equal to c_1 and c_2 respectively. Suppose $b > 0$, $0 < c_1 < c_2 < a$ and $a + c_1 > 2c_2$.

Question 9. In a Cournot equilibrium,
(a) firm 1 has the larger market share and the larger profit
(b) firm 2 has the larger market share and the larger profit
(c) firm 1 has the larger market share and the smaller profit
(d) firm 2 has the larger market share and the smaller profit

Question 10. If a increases, then
(a) the market share of firm 1 increases and price increases
(b) the market share of firm 1 decreases and price increases
(c) the market share of firm 1 increases and price decreases
(d) the market share of firm 1 decreases and price decreases

Question 11. If b decreases, then
(a) the price and market share of firm 1 increase
(b) the price and market share of firm 1 decrease
(c) the market shares are unchanged but price increases
(d) neither price, nor market shares, change

Question 12. Consider an economy consisting of $n \geq 2$ individuals with preference relations defined over the set of alternatives X. Let $S = \{a, b, c, d, e\}$ and $T = \{a, b, c, d\}$ be two subsets of X. Now consider the following statements:

- A. If a is Pareto optimal (PO) with respect to set S, then a is PO with respect to set T.
- B. If a is PO with respect to set T, then a is PO with respect to set S.

- C. If a is PO with respect to set S and b is *not* PO with respect to set T, then a is Pareto superior to b.
- D. If a is the only PO alternative in set S and b is *not* with respect to set S, then a is Pareto superior to b.

How many of the above statements are necessarily correct?

(a) 1
(b) 2
(c) 3
(d) All are correct.

Question 13. A two-person two-commodity economy has social endowment of $x = 1$ unit of food and $y = 1$ unit of wine. Agents preferences are increasing in own consumption but decreasing in wine consumption of the other person. Preferences of agents A and B are as follows,

$$u_A(x_A, y_A, y_B) = x_A[1 + \max(y_A - y_B, 0)], \quad u_B(x_B, y_B, y_A) = x_B[1 + \max(y_B - y_A, 0)]$$

where A consumes x_A and y_A units of x and y respectively, similarly B's consumption is x_B and y_B.
Which of the following is a Pareto optimum allocation.

(a) $x_A = \frac{1}{4}, x_B = \frac{3}{4}$, $y_A = y_B = \frac{1}{2}$
(b) $x_A = x_B = \frac{1}{2}$, $y_A = \frac{1}{4}, y_B = \frac{3}{4}$
(c) $x_A = \frac{1}{4}, x_B = \frac{3}{4}$, $y_A = 1, y_B = 0$
(d) $x_A = \frac{1}{4}, x_B = \frac{3}{4}$, $y_A = 0, y_B = 1$

Question 14. Under the 'Ricardian Equivalence' principle, government bonds
(a) constitute net wealth to the households since these generate future interest income
(b) do not constitute net wealth to the households since they entail future taxation
(c) do not constitute net wealth to the households since they entail future prise rise
(d) constitute net wealth to the households since they increase future productivity of the economy

Question 15. Under the Cagan monetary model with forward looking (rational) expectations, an 'anticipated' permanent increase in money supply at some future date T
(a) leaves the current price level unchanged
(b) leads to a immediate and equi-proportionate increase in the current price level
(c) leads to a gradual increase in the price level until time T such that current price level increases a little but not equi-proportionately
(d) none of the above

The next Five questions are based on the following information: Please read them carefully before you proceed to answer.

Consider an economy consisting of N identical firms producing a single final commodity to be used for consumption as well as investment purposes. Each firm is endowed with a Cobb-Douglas production technology, such that

$$Y_t^i = \left(K_t^i\right)^\alpha \left(L_t^i\right)^{1-\alpha}; 0 < \alpha < 1,$$

where K_t^i and L_t^i denote the amounts of capital and labour employed by the i-th firm at time period t. The final commodity is the numeraire; wage rate for labour (w_t) and the rental rate for capital (r_t) are measured in terms of the final commodity. The firms are perfectly competitive and employ labour and capital so as to maximize their profits - taking the factor prices as given. The aggregate output produced is thus given by:

$$Y_t = \sum_{i=1}^{N} \left(K_t^i\right)^{\alpha} \left(L_t^i\right)^{1-\alpha} = \left(K_t\right)^{\alpha} \left(L_t\right)^{1-\alpha},$$

where $K_t = \sum_{i=1}^{N} K_t^i$ and $L_t = \sum_{i=1}^{N} L_t^i$ are the total capital and labour employed in the aggregate economy in period t.

Labour and capital on the other hand are provided by the households. There are H identical households, each endowed with k_t^h units of capital and 1 unit of labour at the beginning of period t. Capital stock of the households gets augmented over time due to the savings and investments made by the households. In particular, each household saves and invests exactly half of its total income y_t^h - (which includes its labour as well as capital income) in every period and consumes the rest, such that $\frac{dk_t^h}{dt} = \frac{1}{2} y_t^h$ (There is no depreciation of capital).

The entire capital endowment at the beginning of every period is supplied inelastically to the market at the given rental rate (r_t). Labour supply however is endogenous and responds to the market wage rate. Out of the total endowment of 1 unit of labour, a household optimally supplies l_t^h units so as to maximise its utility:

$$U_t^h = w_t l_t^h - \left(l_t^h\right)^{\delta}; \delta > 1,$$

where the first term captures the (indirect) utility derived from labour earnings while the second term captures the dis-utility of labour.

Question 16. The labour demand schedule for the aggregate economy is given by the following function:

(a) $L_t = \left[\frac{1}{w_t}\right]^{1/\alpha} K_t$

(b) $L_t = N \left[\frac{1-\alpha}{w_t}\right]^{1/\alpha} K_t$

(c) $L_t = \left[\frac{1-\alpha}{w_t}\right]^{1/\alpha} K_t$

(d) None of the above.

Question 17. The aggregate labour supply schedule by the households is given by the following function:

(a) $L_t^S = \begin{cases} H \left[\frac{w_t}{\delta}\right]^{1/(\delta-1)} & \text{for } w_t < \bar{w} \equiv (\delta)^{1/(\delta-1)} \\ H & \text{for } w_t \geq \bar{w} \end{cases}$

(b) $L_t^S = \begin{cases} H \left[\frac{w_t}{\delta}\right]^{1/(\delta-1)} & \text{for } w_t < \hat{w} \equiv \delta \\ H & \text{for } w_t \geq \hat{w} \end{cases}$

(c) $L_t^S = \begin{cases} \left[\frac{Hw_t}{\delta}\right]^{1/(\delta-1)} & \text{for} \quad w_t < \hat{w} \equiv \delta \\ 1 & \text{for} \quad w_t \geq \hat{w} \end{cases}$

(d) None of the above.

Question 18. The market clearing wage rate in the short run (period t) is given by:

$$(a)\ w_t^* = \begin{cases} \left[\frac{K_t\ (1-\alpha)^{1/\alpha}}{H}\right]^{\frac{\alpha(\delta-1)}{\alpha+\delta-1}} & \text{for } K_t < \frac{H}{\delta} \equiv \hat{K} \\ \left[\frac{K_t\ (1-\alpha)^{1/\alpha}}{H}\right]^{\alpha} & \text{for } K_t \geq \hat{K} \end{cases}$$

$$(b)\ w_t^* = \begin{cases} \left[\frac{K_t\ (1-\alpha)^{1/\alpha}}{H}\right]^{\frac{\alpha(\delta-1)}{\alpha+\delta-1}} & \text{for } K_t < H\left(\frac{\delta}{1-\alpha}\right)^{1/\alpha} \equiv \bar{K} \\ \left[\frac{K_t\ (1-\alpha)^{1/\alpha}}{H}\right]^{\alpha} & \text{for } K_t \geq \bar{K} \end{cases}$$

$$(c)\ w_t^* = \begin{cases} \left[\frac{K_t\ (1-\alpha)^{1/\alpha}\ (\delta)^{1/(\delta-1)}}{H}\right]^{\frac{\alpha(\delta-1)}{\alpha+\delta-1}} & \text{for } K_t < H\left(\frac{\delta}{1-\alpha}\right)^{1/\alpha} \equiv \bar{K} \\ \left[\frac{K_t\ (1-\alpha)^{1/\alpha}}{H}\right]^{\alpha} & \text{for } K_t \geq \bar{K} \end{cases}$$

(d) None of the above.

Question 19. Equilibrium output in the short run (period t):

(a) is a strictly convex function of K_t for $K_t < H\left(\frac{\delta}{1-\alpha}\right)^{1/\alpha} \equiv \bar{K}$; and is a strictly concave function of K_t for $K_t \geq \bar{K}$.

(b) is a strictly concave function of K_t for all values of K_t.

(c) is a strictly convex function of K_t for all values of K_t.

(d) is a linear function of K_t for all values of K_t.

Question 20. Over time the aggregate output in this economy

(a) initially increases until $K_t < \bar{K}$, and then reaches a constant value within finite time when $K_t \geq \bar{K}$.

(b) initially increases (until $K_t < \bar{K}$) and then reaches a constant value within finite time when $K_t \geq \bar{K}$.

(c) keep increasing at a decreasing rate and approaches a constant value only in the very long run (when $t \to \infty$).

(d) increases at a constant rate until $K_t < \bar{K}$; increases at a decreasing rate when $K_t \geq \bar{K}$ and approaches a constant value only in the very long run (when $t \to \infty$).

End of Part I. Proceed to Part II of the examination on the next page.

Part II

Instructions for Part II

- Attempt any **FOUR** questions, in the separate **answer book** provided to you for this part.
- Each question carries 15 marks. The allocation of marks is provided alongside.
- If you attempt more than four questions, only the first four will be counted.
- Fill in your Name and Roll Number on the detachable slip of the answer book.

---

1. Discuss the role of Inada conditions in the neoclassical growth model of Solow. Does the existence of a unique stable (non-trivial) steady state depend on the Inada conditions? Given suitable examples/ counter examples (whichever is applicable) in terms of a specific production function to argue your case. [15]

2. In the Dornbusch exchange rate over-shooing model, if the assumption of rational expectations is replaced by the assumption of static expectations (i.e., agents hold static expectations about the future exchange rate) would one still retain the overshooting behaviour of the exchange rate in response to a monetary policy shock? Explain your answer. [15]

3. In evaluating public programs, two common measures of impact are the *Average Treatment Effect (ATE)* and the *Average Treatment Effect on the Treated (ATE_1).*

   (a) Formally define these and discuss some common ways in which they are estimated. [$4\frac{1}{2}$]

   (b) Suppose we are interested in estimating the impact of a mid-day meal program in government primary schools on child health in one city in India. What would be your preferred measure of this impact and why? How would you expect the ATE and ATE_1 to differ? [6]

   (c) Using the same example, explain the meaning of the word *average* in these treatment effects. When do you think these average effects are good measures of policy impact? [$4\frac{1}{2}$]

4. (a) Consider the regression $Y_i = \beta_1 + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i$. Suppose we are interested in testing the joint null hypothesis that the slope coefficients are zero. To do this, demonstrate that using the individual t-values pertaining to the slope coefficients 'one at a time' would be erroneous. [$7\frac{1}{2}$]

   (b) Comparing a multiple regression with a linear regression, explain the concept of omitted variable bias and the conditions under which it may arise. [$7\frac{1}{2}$]

5. Let x_1, x_2 and x be three lotteries with cumulative distribution functions F_1, F_2 and G, respectively. Assume that $\gamma F_1 + (1-\gamma)F_2$ dominates G in the first degree for some $\gamma \in [0, 1]$.

(a) Show that for a decision maker who maximizes expected utility with utility function $u(x)$ satisfying $u'(x) > 0$ for all x, a choice between the lotteries $F1$ and $F2$ is weakly preferred to G. [6]

(b) Define certainty equivalent for a decision maker who faces a lottery y with mean μ and maximizes expected utility with utility function u and initial wealth w. Show that certainty equivalent will be smaller than μ if $u'(x) > 0$ and $u''(x) \leq 0$ for all x. [6]

(c) Using the above result, explain why a trade is possible between a risk averse car buyer and risk neutral car insurer. [3]

6. Consider a market for a homogeneous good with the inverse demand function given by $P = a - X$, where $a > 0$ and X is the industry output. There are only two firms, 1 and 2. The total cost of production for the ith firm is $C_i(x_i) = cx_i$, where x_i is output of the ith firm. Assume $5c > a > c > 0$.

(a) Suppose the owners of firms choose quantities in a sequence to maximise their respective profits. Firm 1 chooses quantity first and firm 2 chooses its quantity next after observing the choice of firm 1. What would be the equilibrium quantity choices for both firms? [$4\frac{1}{2}$]

(b) Suppose we change the quantity competition in the following manner. Consider a two stage game where in the first stage firm 1 chooses to delegate the choice of quantity to a manager and ask the manager to maximise the following objective function while choosing quantity in the second stage,

$$\max_{x_1} \{\alpha\pi_1 + (1 - \alpha)\pi_1 S_1\},$$

Where π_1 and S_1 are respectively the profit and the sale revenue of firm 1, and $\alpha \in [0, 1]$. Firm 1 chooses α in the first stage of the game. For simplicity ignore the hiring cost of the manager. In the second stage, the manager of firm 1 and the owner of firm 2 chooses quantities simultaneously in order to maximise their objective functions. Determine the equilibrium values of α, and the quantities of the two firms in the market. [$7\frac{1}{2}$]

(c) Compare the outcomes obtained in question (a) and question (b). Interpret your answer. [3]

End of Part II