Economics & Econometrics: Second round sample problems

Part 1: multiple-choice questions.

Microeconomics: choose one answer

1. (2 points) If the demand for a good is elastic, an increase in the price will:

   a. cause the total spending on the good to increase.
   b. cause the total spending on the good to decrease.
   c. leave the total spending the same but reduce the quantity of the good demanded.
   d. leave the total spending the same but increase the quantity of the good demanded.
   e. cause the total spending on the good to increase but reduce the quantity demanded

2. (3 points) The total cost function of a monopolist is $c(Q) = 3Q$. The inverse demand function for the monopolist's products is $p(Q) = 12 - Q$. Consider the following statements:
   I. At the output level $Q = 4$, the monopolist's marginal revenue exceeds marginal costs.
   II. The equilibrium price is 8.
   III. The monopolist's equilibrium price is lower than that in perfect competition.

   Which of the above is correct?

   a. only I
   b. I and II but not III
   c. I and III but not II
   d. I, II and III
   e. only II

3. (3 points) Two firms, Alpha and Beta, compete in the Internet services market. The market demand function is $Q = 16 - p$, where p is the price of 1Mb of data. The marginal (and average) cost of 1Mb of data is \$1 for both companies. Alpha and Beta compete in Bertrand fashion. Consumers want to buy from the firm with the lowest price (since the Internet services are a homogeneous good and no consumer search costs are involved). If Alpha and Beta charge the same price, consumers demand is split evenly between them. What is the equilibrium level of Internet services consumption?

   a. 15.5Mb
   b. 8Mb
   c. 16Mb
   d. 14Mb

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   e. 15Mb

4. (3 points) Adverse selection leads to:

   a. **the emergence of Akerlof's market for lemons**
   b. post-contract opportunism;
   c. the emergence of inferior goods;
   d. the Condorcet paradox;
   e. the free-rider problem.

5. (3 points) The production function of a firm is $Q(L,K) = LK^2$, where Q units of output are produced using L units of labor services and K units of capital. Consider the following statements:
   I. At the point ($L = 1, K = 2$) the marginal rate of technical substitution $MRTS_{LK} = 1$.
   II. Technology ensures increasing returns to scale.
   III. Combinations of the factors ($L = 1, K = 2$) and ($L = 2, K = 1$) lie on the same isoquant.

   Which of the above are correct?
   a. only III
   b. only I
   c. II and III but not I
   d. **I, II but not III**
   e. I and III but not II

Macroeconomics: choose one answer

6. (3 points) On the IS-LM graph, the point above the IS curve and below the LM curve is associated with

   a. an excess demand for money, an excess supply of goods and an excess demand for bonds
   b. **an excess demand for money, an excess supply of goods and an excess supply of bonds**
   c. an excess supply of money, an excess demand for goods and an excess demand for bonds
   d. an excess demand for money, an excess demand for goods and an excess supply of bonds
   e. an excess supply of money, an excess demand for goods and an excess supply of bonds

7. (2 points) Consider the Baumol-Tobin model of the transactions demand for money. When transaction costs increase,

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a. **both the interval between bank visits and demand for money increase;**
b. the interval between bank visits decreases, and the demand for money increases;
c. the interval between bank visits decreases along with the demand for money;
d. the interval between bank visits increases and the demand for money decreases;
e. the interval between bank visits changes ambiguously and the demand for money increases.

8. (2 points) The rational expectations theory holds that:
   a. economic agents do not make forecast errors;
   b. **economic agents use all available information when forecasting the future;**
   c. economic agents maximize utility functions under a budget constraint;
   d. aggregate output cannot deviate from its potential level;
   e. all the above.

9. (3 points) Consider a closed economy with consumers making their consumption decisions according to the permanent income theory. They estimate their permanent (expected) income as the previous permanent income YP_{t-1} plus the adjustment coefficient 0.2 multiplied by the forecast error (that is, the deviation of the actual income from the expected one): $YP_t = YP_{t-1} + 0.2 \times (Y_t - YP_{t-1})$. Investment in the economy is constant: $I_t = \bar{I} = 1000$; government procurement is constant too: $G_t = \bar{G} = 200$. The consumer demand function is $C_t = 0.6 \cdot YP_t$. In the long run, the equilibrium level of consumption will reach:

   a. 800
   b. 1440
   c. **1800**
   d. 3600
   e. 2400

10. (3 points) Singapore has a dirty float system. In 2018 the exchange rate changed from 1.373 Singapore dollars per US dollar to 1.366 Singapore dollars per US dollar. The Singapore dollar:

    a. **depreciated by 2.17%**
    b. strengthened by 3.23%
    c. was devalued by 2.17%
    d. was revalued by 3.23%
    e. depreciated by 3.12%

Econometrics: choose one answer

11. (2 points) The figure shows a scatterplot of y_i vs x_i.
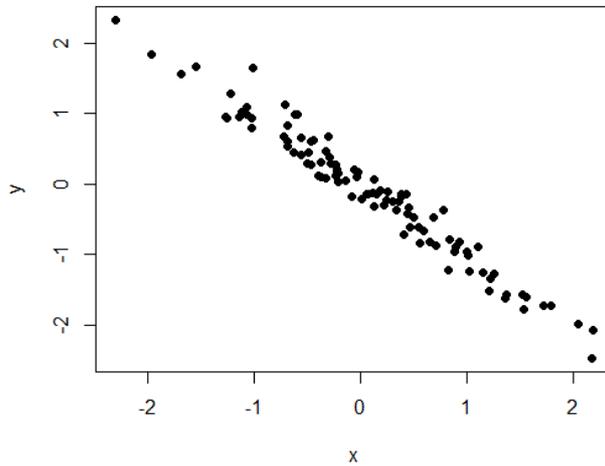
What is the most plausible R-squared value of the regression of y_i on x_i .

   a. −96%   b. −24%   c. 3%   d. 24%   **e. 96%**

12. (2 points) The true regression equation is written as $y_i = 2.1 + 3.2x_i + \varepsilon_i$; the regression equation estimated by least squares, as $y_i = 2.2 + 2.9x_i + e_i$. The expected value of the estimate of the constant term is:

   **a. 2.1**   b. 2.2   c. 2.9   d. 3.2   e. 0

13. (3 points) The sum of x_i, $i=1,…30$ is 120. The sum of x_i^2 is 750. What is the standard deviation of x?

   a. 3   **b. 4**   c. 5   d. 9   e. 16

14. (3 points) If the coefficient before x_j in a linear regression with the dependent variable y has a t statistic of (−6.5),
    - a. x_j is a poor explanatory variable for y; it can be dropped from the regression,
    - b. there is a non-linear relationship between x_j and y,
    - c. the F statistic for this regression is also negative,
    - **d. the corresponding p-value should be small,**
    - e. a 1%-increase in x_j leads to a 6.5% decrease in y.

15. (3 points) Which of the following best describes the plot below?
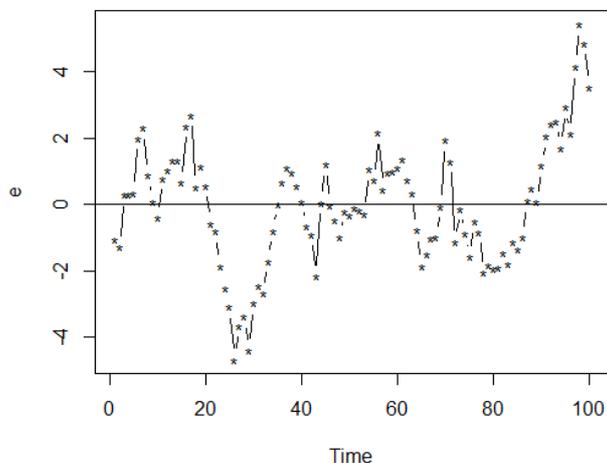
a. heteroscedasticity,
b. non-linearity,
c. unbiasedness,
d. serial correlation,
e. endogeneity.

Part 2: Problems.

16. **(Microeconomics)** (20 points) One thousand farmers supply potatoes to a perfectly competitive market. The production function of each farmer is defined by the equation $TP = 10L - \frac{L^2}{2}$, where TP is the volume of potato production in tons, and L is the amount of labor used. The wage rate is $w = 30$. The function of market demand for potatoes is written as: $Q^D = 50000 - 3600P$, where P is the price of a ton of potatoes.

A) (10 points) Write the individual supply function for potatoes.

B) (3 points) Find the equilibrium price in the potato market.

C) (2 points) Find the equilibrium quantity in the potato market.

D) (2 points) Find the amount of labor used by each farmer.

E) (3 points) Find consumer surplus.

Solution

A) The individual supply function can be determined from the equation $P = MC$, where $MC = \frac{dTC}{dq}$.

The production function determines the relationship $L(q)$: if $0 < L \leq 10$, $L = 10 - \sqrt{100 - 2q}$; if $10 < L \leq 20$, $L = 10 + \sqrt{100 - 2q}$. The firm operates within $0 < L \leq 10$, i.e. the total product function TP(L) is increasing.

$$TC = 30 \cdot \left(10 - \sqrt{100 - 2q}\right) = 300 - 30 \cdot \sqrt{100 - 2q}$$

$$MC = \frac{30}{\sqrt{100 - 2q}}$$

$$P = \frac{30}{\sqrt{100 - 2q}} \quad \rightarrow \quad q = 50 - \frac{450}{P^2}$$

B) $Q_S = 50000 - \frac{450000}{P^2}$

$50000 - \frac{450000}{P^2} = 50000 - 3600P \quad \rightarrow P = 5$

C) $Q_D(5) = Q_D(5) = 32000$

D) $q = \frac{32000}{1000} = 32 \quad \rightarrow \quad L(32) = 10 - \sqrt{100 - 2 \cdot 32} = 4$

E) $CS = \frac{32000 \cdot \left(\frac{50000}{3600} - 5\right)}{2} = \frac{1280000}{9} \approx 142222.2$

17. **(Macroeconomics)** (20 points) Consider the Solow growth model with the Cobb-Douglas production function $Y = K^\alpha (AL)^{1-\alpha}$; the technology and population growth rates are $\frac{\dot{A}}{A} = g$, $\frac{\dot{L}}{L} = n$ respectively. The capital accumulation equation is $\dot{K} = sY - \delta K$. The savings rate $s = 0.24$; the depreciation rate $\delta = 0.19$; the population growth rate $n = 0.02$; the technological progress rate $g = 0.03$; the share of capital in national income $\alpha = {}^1/_2$.

a) Define in the internal (non-zero) steady state:

    i.   (3 points) capital per unit of effective labor, $\hat{k}_0^*$

$$\hat{k}_0^* = \left(\frac{s}{n + \delta + g}\right)^{\frac{1}{1-\alpha}} = \left(\frac{0.24}{0.02 + 0.19 + 0.03}\right)^{\frac{1}{1-\frac{1}{2}}} = 1$$

    ii.   (3 points) output per unit of effective labor, $\hat{y}_0^*$

$$\hat{y}_0^* = \left(\hat{k}_0^*\right)^\alpha = (1)^{\frac{1}{2}} = 1$$

    iii.   (3 points) consumption per unit of effective labor, $\hat{c}_0^*$

$$\hat{c}_0^* = (1 - s)\hat{y}_0^* = (1 - 0.24) \cdot 1 = 0.76$$

    iv.   (3 points) investment per unit of effective labor, $\hat{\imath}_0^*$

$$\hat{\imath}_0^* = s\left(\hat{k}_0^*\right)^\alpha = 0.24 \cdot (1)^{\frac{1}{2}} = 0.24$$

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b) (8 points) Does the savings rate meet the "golden rule"? If not, how should it be changed to do so? What will happen to consumption per unit of effective labor during the transition to a new steady state? Briefly explain your answer.

The savings rate does not meet the "golden rule" since

$$s_{GR} = \alpha = \frac{1}{2} > 0.24 = s$$

To reach the "golden rule" the savings rate has to be changed to $s^{new} = s_{GR} = \alpha = \frac{1}{2}$.

After this change in the savings rate during the transition to a new steady state, the level of consumption per unit of effective labor will first fall since the savings and the savings rate will grow and consumption will decline since output per unit of effective labor will stay the same (capital per effective labor does not change immediately).

Since net investment per unit of effective labor (due to the growth of savings) becomes greater than zero, capital per unit of effective labor and output per unit of effective labor increase, thus raising consumption per effective labor.

Together with an increase in capital per unit of effective labor and its movement to a new steady-state, the level of consumption per unit of effective labor approaches (by increasing after the initial fall) a new steady state. In the new steady-state consumption per unit of effective labor will be greater than in the old one, because

$$s^{new} = s_{GR} = \alpha = \frac{1}{2} > 0.24 = s$$

18. **(Econometrics)** (20 points) Data of 550 people from a population survey were used to analyze factors affecting wages. The country was divided into three regions – X, Y and Z. The basic regression model (Model A) includes the following explanatory variables:

Ed = years of study,

Ex = years of work experience,

Fm = 1/0 dummy for females,

Un = 1/0 dummy for trade union members,

Y = 1/0 dummy for residents of region Y,

Z = 1/0 dummy for residents of region Z,

Mg = 1/0 dummy for manager position.

The dependent variable is Wage (wages in US dollars per hour). The table shows the coefficients and their standard errors for four alternative models. RSS is the residual sum of squares.

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	Model A	Model B	Model C	Model D
Constant	-4.31 (1.29)	-4.14 (1.28)	-3.51 (1.19)	9.02 (0.22)
Ed	0.86 (0.08)	0.86 (0.08)	0.88 (0.08)	-
Ex	0.11 (0.02)	0.11 (0.02)	0.11 (0.02)	-
Fm	-2.26 (0.38)	-2.27 (0.38)	-2.25 (0.38)	-
Un	0.48 (0.40)	-	-	-
Y	0.50 (1.01)	0.48 (1.01)	-	-
Z	0.90 (0.58)	0.95 (0.58)	-	-
Mg	2.32 (0.64)	2.36 (0.64)	2.35 (0.64)	-
RSS	10172	10199	10254	14077

   a. (4 points) Interpret the coefficients for Ed and Fm in Model A.
   b. (2 points) Find the coefficient of determination for Model A.
   c. (4 points) What is the Model B wage prediction for a female nurse, a resident of region Y, who completed six years of study and has 25 years of working experience?
   d. (6 points) Which of the four models would you choose? Explain your choice.
   e. (4 points) Suppose that *fit* is the vector of fitted values from Model A. The residuals for *fit*<8 (US dollars per hour) have a sample variance of 4.7, whereas the residuals for *fit*>11 have a sample variance of 27.2. What can be concluded from this observation?

Solution

a. A 1-year increase in Ed translates in a 0.86 dollars increase in wages. Women earn 2.26 US dollars less than men (ceteris paribus).

b. R^2=1-10172/14077=27.7%.

c. -4.14+0.86*6+0.11*25-2.27+0.48=1.98

d. The simplest approach is to use the adjusted R^2, which points to Model A:

model A: 1-10172/14077*(550-1)/(550-8)=26.8%

model B: 1-10199/14077*(550-1)/(550-7)=26.7%

model C: 1-10254/14077*(550-1)/(550-5)=26.6%

model C: 1-14077/14077*(550-1)/(550-1)=0%.

(It is also legitimate to use AIC or BIC here. These criteria are "tighter".)

It is possible to use the t-statistic 0.48/0.40=1.2 to discriminate between A and B. For example, Un is insignificant at 5% (the critical value is about 1.96). Thus, this approach points to B as the preferred option.

Y and Z are not significant at 5% in Model B, the t-statistic suggests. The F-statistic should be used to test the significance of Y and Z jointly. A plausible guess is that they are insignificant at 5% and Model C is preferable.

In model C variable Ed is highly significant according to the t-statistic 0.88/0.08=11. Other variables are also significant, so Model D should be dismissed.

(Overall the choice between A, B and C is not evident but practical modelling may require doing just that. This question gives the contestants an opportunity to show how they understand the logic of the process.)

e. Different residual variances for different values of *fit* can be interpreted as a sign of heteroscedasticity of errors. (Technically, the Goldfeld–Quandt homoscedasticity test can be employed. The difference in variances is, however, so dramatic that the test is not needed.)