

OLLSCOIL NA hÉIREANN, GAILLIMH  
NATIONAL UNIVERSITY OF IRELAND, GALWAY

Semester 1 Examinations 2000/2001

**Techniques of Analysis in the Social Sciences (EC 222)**

2<sup>nd</sup> B.A. (Economic and Social Studies) – St. Angela's College, Sligo

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**Time Allowed: TWO HOURS**

**Marks: 300**

**Instructions:** This exam consists of six sections. You must answer questions from all six sections. Please read carefully the instructions for each section.

- Section A: Answer **ONE** question (worth 45 marks)
- Section B: Answer **ONE** question (worth 35 marks)
- Section C: Answer **TWO** questions (worth 35 marks each)
- Section D: Answer **ONE** question (worth 30 marks)
- Section E: Answer **ONE** question (worth 60 marks)
- Section F: Answer **ONE** question (worth 60 marks)

**Section A**

1. A market researcher for a consumer electronics company wishes to study television viewing habits of residents of a particular small city. A random sample of 40 respondents is selected, and each respondent is instructed to keep a detailed record of all television viewing in a particular week. The results are as follows:

- Viewing time per week:  $\bar{X} = 15.3$  hours,  $S = 3.8$  hours
- 27 respondents watch the evening news on at least three weeknights

- a. Set up a 95% confidence interval estimate for the average amount of television watched per week in this city.
- b. Set up a 90% confidence interval estimate for the proportion of respondents who watch the evening news on at least three nights per week.

Assuming the market researcher wants to take another survey in a different city

- c. What sample size is required if he wishes to be 95% confident of being correct to within  $\pm 2$  hours and assumes the population standard deviation is equal to 5 hours?

2. An orange juice producer buys all his oranges from a large orange orchard. The amount of juice squeezed from these oranges is approximately normally distributed with a mean of 4.7 ounces and a standard deviation of 0.4 ounces.
  - a. What is the probability that a randomly selected orange will contain between 4.7 and 5 ounces of juice?
  - b. 70% of oranges will contain at least (i.e. more than) how many ounces of juice?
  - c. If a sample of 25 oranges is selected, what is the probability that the **sample mean** will be greater than 4.6 ounces?

### Section B

1. The finance society at a college of business at a large state university would like to determine whether there is a relationship between a student's interest in finance and his or her ability in maths. A random sample of 200 students is selected and they are asked whether their interest in finance and ability in maths are low, average or high. The results are as follows:

Interest in Finance	Ability in Maths			
	Low	Average	High	Total
Low	60	15	15	90
Average	15	45	10	70
High	5	10	25	40
Total	80	70	50	200

- a. Give an example of a simple event
  - b. Give an example of a joint event
  - c. If a student is selected at random, what is the probability that he or she
    - (i) has a high ability in maths?
    - (ii) has an average interest in finance?
    - (iii) has a high interest in finance and a high ability in maths?
    - (iv) Has a low interest in finance or a low ability in maths?
  - d. Given that the person selected has a high ability in maths. What is the probability that the person has a high interest in finance?
2. Suppose that the likelihood that someone who logs onto a particular site in a "shopping centre" on the internet will purchase an item is 0.20. If the site has 10 people accessing it in the next minute, what is the probability that
    - a. none of the individuals will purchase an item?
    - b. exactly two individuals will purchase an item?
    - c. at most two individuals (i.e. two or less) will purchase an item?

### Section C

1. A manufacturer of detergent claims that the mean weight of a particular box of detergent is 3.25 pounds. A random sample of 64 boxes reveals a sample average of 3.28 pounds and a sample standard deviation of 0.117 pounds. Using the 0.01 level of significance, is there evidence that the average weight of the boxes is different from 3.25 pounds?

2. The inspection division of the Lee County Weights and Measures Department is interested in estimating the actual amount of soft drink that is placed in 2 litre bottles at the local bottling plant of a large nationally known soft-drink company. The bottling plant has informed the inspection division that the standard deviation for 2 litre bottles is 0.05 litres. A random sample of 100 2 litre bottles obtained from this bottling plant indicates a sample average of 1.99 litres.
  - a. Set up a 95% confidence interval estimate of the true average amount of soft drink in each bottle.
  - b. Explain why an observed value of 2.02 litres is not unusual, even though it is outside the confidence interval you calculated.
3. The Giansante Company, provider of extermination services, claims that no more than 15% of its customers need repeated treatment after a 90-day warranty period. To determine the validity of this claim, a consumer organisation selects a sample of 100 customers and finds that 22 needed repeat treatment after the 90-day warranty period. Is there evidence at the 0.05 level of significance that the claim is not valid (i.e., that the proportion needing repeated treatment is greater than 0.15)?

#### Section D

1. Consider the following basic Keynesian model of the macro economy:

$$Y = C + I_0 + G_0$$

$$C = a + bY$$

where Y and C are endogenous,  $I_0$  and  $G_0$  are exogenous constants,  $a > 0$ , and  $0 < b < 1$ .

Use Cramer's Rule to solve for Y and C.

2. A consumer's utility function is given as:

$$U = f(A,B) = 10A + 30B - A^2 - B^2 + 5AB$$

where U represents total utility

A represents units of product A consumed

B represents units of product B consumed

- (i) Find the first-order partial derivatives.
- (ii) Find the second-order partial derivatives.
- (iii) Find the total differential.
- (iv) Explain the meaning of answers (i) and (iii).

### Section E

1. a. A firm has an average cost function

$$AC = 10 - 3Q + Q^2$$

Write down the equations for total cost (TC) and marginal cost (MC).

- b. The demand and total cost functions for a good are given by the equations:

$$P = 50 - 2Q$$

$$TC = 160 + 2Q$$

- (i) Write down the equations for total revenue (TR), marginal revenue (MR), average cost (AC) and profit.
- (ii) Determine the number of goods which must be produced and sold to maximise profit. Hence calculate maximum profit.

2. A firm has a total cost function:

$$TC = 10Q - 3Q^2 + Q^3$$

- a. Write down the equations for AC and MC.
- b. Determine the values of Q at which (i) MC and (ii) AC are minimised.
- c. Confirm algebraically that AC and MC are equal when AC is at a minimum.

### Section F

1. Using matrix methods solve the following system of equations for x, y and z.

$$\begin{aligned} 4y + 8z &= 26 - x \\ 5x + 7y - 38 &= 0 \\ 8x + 12y &= 66 - z \end{aligned}$$

2. Assume the following total cost function

$$TC = 20 + 3x^2 + 2y^2 - 0.5xy$$

where x and y represent the output of two products. If the firm faces perfect competition with market prices of 10 for x and 5 for y, determine the profit-making combination of output.