BINDURA UNIVERSITY OF SCIENCE EDUCATION

FACULTY OF COMMERCE

DEPARTMENT OF ECONOMICS

PROGRAMMES: BSc HONOURS DEGREE IN ECONOMICS

EC 108: STATISTICS FOR ECONOMISTS 2

DURATION: 3 HOURS

JUN 2025

INSTRUCTIONS:

a. Attempt all questions.

b. Each question carries 25 marks.

c. NO CELLPHONES ALLOWED IN THE EXAMINATION ROOM.

Question 1

a. A faulty electric bulb batch is believed to have 20% defective bulbs. A random sample of 100 bulbs will be used to estimate the proportion of faulty bulbs.

   i. Find the sampling distribution of $\bar{p}$ for this study assuming that indeed 30% of the bulbs are defective. **(5 marks)**

   ii. Calculate the probability that the sample proportion will be between 0.20 and 0.40. **(4 marks)**

   iii. Calculate the probability that the sample proportion will be between 0.20 and 0.22. **(4 marks)**

   iv. Explain what is meant by sampling distribution of a statistic. **(3 marks)**

b. Suppose you have selected a random sample of n=81 observations from population with mean equal to 56 and standard deviation equal to 8. It is known that the population is not extremely skewed.

   i. Sketch the relative frequency distributions for the population and for the sampling distribution of the sample mean, $\overline{X}$ **(4 marks)**

ii. Find the probability that $\overline{X}$ will be larger than 62. **(5 marks)**

Question 2

The average duration for spontaneous labour for expecting mothers at a local clinic is 4.5 hours and the average for induced labour is 3hours. Using these values as the population means for induced and spontaneous labour and assuming that the population standard deviation is 1.4hours for both mothers. Suppose a random sample of 23 spontaneous pregnancies and another simple random sample of 15 induced pregnancies will be taken.

i. Show the sampling distribution for spontaneous pregnancies. **(4 marks)**

ii. Find the probability that the sample mean is within 1.5hours of the population mean for the sample of spontaneous pregnancies. **(4 marks)**

iii. What is the probability that the sample mean is within 1.5hours of the population mean for the sample of induced pregnancies? **(4 marks)**

iv. In which case, part (ii) or part (iii), is the probability of obtaining a sample mean within 1.5hours of the population mean higher? Why? **(5 marks)**

v. Show mathematically that $E(\overline{X}) = \mu$ and $\sigma_{\overline{X}} = \frac{\sigma}{\sqrt{n}}$ for an infinite population. **(8 marks)**

Question 3

a. In an attempt to find fertility rates per litter of imported pig breed, a simple random sample with n =44 provided a sample mean 14.5 and a sample standard deviation of 3.4. The country of origin for the pig breed argues that the fertility standard deviation is 3 piglets.

i. Suppose you doubt the assertion about the standard deviation from the country of origin, develop a 95% confidence interval for the population mean. **(4 marks)**

ii. Develop a 99% confidence interval for the population mean. What happens to the margin of error and the confidence interval as the confidence level is increased? **(4 marks)**

iii. How large a sample should be selected to provide a 95% confidence interval with a margin of error of 10? Assume that the population standard deviation is 4. **(4 marks)**

b. Explain any three other sampling methods besides simple random sampling and explain the rationale behind their use. **(9 marks)**

c. Explain why large samples give smaller margins of error for interval estimates. **(5 marks)**

Question 4

a. Suppose you are hired for production consultancy by a local firm. A new production method is being proposed but will only be implemented if a hypothesis test supports the conclusion that the new method reduces the mean operating cost per hour.

i. State the appropriate null and alternative hypotheses if the mean cost for the current production method is $450 per hour. **(4 marks)**

ii. What is the Type I error in this situation? What are the consequences of making this error? **(5 marks)**

iii. What is the Type II error in this situation? What are the consequences of making this error? **(5 marks)**

b. A local car dealer advertises that mean fuel mileage for his new hybrid luxury SUV vehicle is 33.8km per liter of city driving. You find that on social media people doubt the claim anticipating that the mean fuel mileage is well below the one advertised.

i. Develop appropriate hypotheses such that rejection of null hypothesis will support the dealer's claim. **(4 marks)**

ii. A sample of 40 cars provides a sample mean mileage of 23.1km with a sample standard deviation of 4.9km. Calculate the *p*-value and comment on whether you could reject the null hypothesis at the 5% significance level. **(7 marks)**

END OF PAPER