Sri Lanka Institute of Information Technology

B.Sc. Honours Degree in Information Technology

Final Examination
Year 2, Semester 2 (2023)

IT2110 – Probability and Statistics

Duration: 2 Hours

June 2023

Instructions to Candidates:

- You have **10 minutes** reading time.
- This paper has **4** questions.
- Answer **all** questions in the booklet given.
- The total marks for the paper is 100 which contributed to 50% of final grade. **Please show your work for full credit.**
- This paper contains **5 pages**, including the cover page and the equation sheet.
- Statistical tables will be provided.
- Calculators are allowed.
- Electronic devices capable of storing and retrieving text, including mobile phones are not allowed.

Question 01 — 25 Marks

a) Give an example for each of the event below.

i. Mutually exclusive events **(3 marks)**
ii. Collectively exhaustive events. **(3 marks)**

b) Measurements of scientific systems are always subject to variation. Suppose the measurement error (X) of a certain physical quantity is decided by the density function given below.

$$f_X(x) = \begin{cases} k(1-x), & 0 < x < 1 \\ 0, & otherwise \end{cases}$$

i. Find the value of k? **(4 marks)**
ii. What is the probability that measurement error exceeds 0.8? **(5 marks)**
iii. What is the expected measurement error $(E(X))$? **(4 marks)**
iv. What is the variance of X? **(6 marks)**

Question 02 — 25 Marks

a) A random sample of 25 tablets which give for high fever contains on average, 321.25 mg of aspirin per tablet with a standard deviation of 0.8 mg. Construct 95% confidence interval for true mean aspirin content per tablet and interpret (Round up the answer up to 2 decimal places). **(10 marks)**

b) In Chemical Engineering, an important property of fiber is its water absorbency and a researcher believes that it should be more than 18% for cotton fiber. To check his belief, he randomly selected 35 pieces of cotton fiber and the average percent absorbency of those pieces were found to be 20% with a standard deviation of 1.5%. Is there strong evidence that the true mean percent absorbency of cotton fiber is significantly higher than 18%? Test at 5% level of significance. (Round up the test statistic up to 2 decimal places) **(15 marks)**

Question 03 — 25 Marks

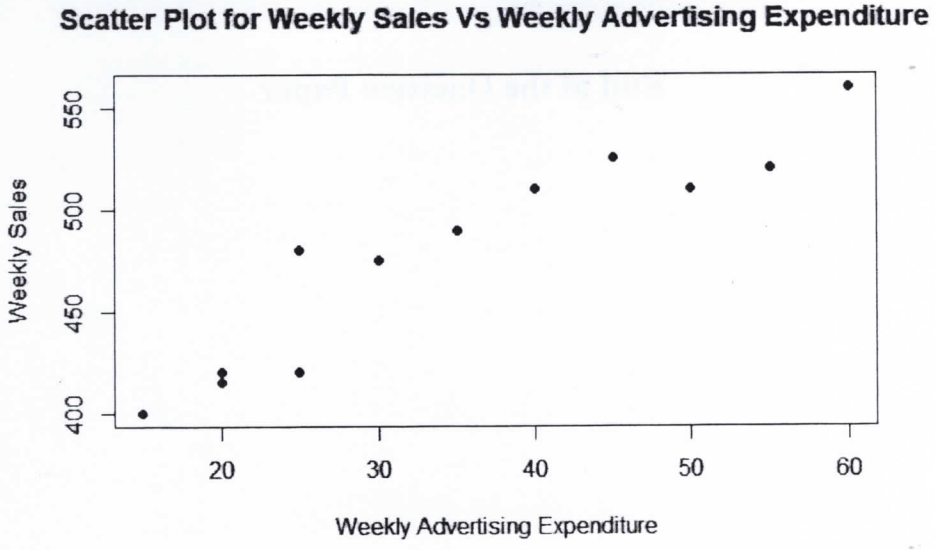
A survey was conducted to determine whether the age of a driver has any effect on number of automobile accidents in which he is involved (including all minor accidents). Results of 2320 automobile accidents occurred in Colombo in past month are given in the table below. Test the hypothesis that the number of accidents is independent of the age of the driver. Consider 5% level of significance. (Round up the test statistic up to 4 decimal places)

Number of Accidents	Age of Driver			Total
	21-30	31-40	>40	
0	584	620	674	1878
1	126	109	98	333
2	38	29	21	88
>2	7	9	5	21
Total	755	767	798	2320

(25 marks)

Question 04 — 25 Marks

A study was made by a retail merchant to determine the relationship between weekly advertising expenditures *($)* and weekly sales *($)*. He collected data for 12 weeks to identify how weekly sales change according to the weekly advertising expenditure. Figure below displays the scatter plot for the data. (Note: Give all of your answers in four decimal places)



R outputs of the regression model are shown below.

Regression Model

Coefficients

Intercept	Weekly Advertising Expenditure
363.512	3.245

Analysis of Variance Table

Response:	**Weekly Sales**				
	df	**Sum Sq**	**Mean Sq**	**F Value**	***Pr(>F)***
Weekly Advertising Expenditure	*A*	25797	*F*	*G*	9.915e-06 ***
Residuals	*B*	*D*	387.6		
Total	*C*	*E*			

Signif. Codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

a) What can be concluded using the scatter plot? **(2 marks)**

b) Find values marked *A, B, C, D, E, F* and *G* in the ANOVA table (Show your work). **(10 marks)**

c) Write down the estimated regression equation and find in how much weekly sales will change if weekly advertising expenditure increases by 1*$*. **(4 marks)**

d) Find the correlation coefficient between weekly sales and weekly advertising expenditure and interpret. **(5 marks)**

e) Use the regression equation to predict the weekly sales if weekly advertising expenditure is 28*$*. **(4 marks)**

End of the Question Paper

Probability and Statistics (IT2110)

Equation Sheet

- Transformation of Normal random variable (X) into Standard normal random variable (Z):

$$Z = \frac{X - \mu}{\sigma}$$

- Chi Squared Test Statistic:

$$X^2 = \sum_{all\ i} \sum_{all\ j} \frac{(O_{ij} - E_{ij})^2}{E_{ij}}$$

- Pearson's Product Moment Correlation Coefficient:

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{(n(\sum x^2) - (\sum x)^2) * (n(\sum y^2) - (\sum y)^2)}}$$