00170

# Sri Lanka Institute of Information Technology

## B.Sc. Honours Degree in Information Technology

Final Examination
Year 2, Semester 2 (2022)

## IT2110 – Probability and Statistics

Duration: 2 Hours

November 2022

Instructions to Candidates:

- You have **10 minute** 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 provide in the exam.
- Calculators are allowed.
- Electronic devices capable of storing and retrieving text, including mobile phones are not allowed.

## Question 01 — 25 Marks

a) In an experiment, it is given that $P(A) = 0.53$, $P(B) = 0.31$ and $P(A \cup B) = 0.6757$.

i. Are $A$ and $B$ mutually exclusive? Give the proof. **(3 marks)**
ii. Are $A$ and $B$ independent? Give the proof. **(3 marks)**

b) The loaves of bread distributed to local stores in Western province of Sri Lanka by a certain bakery have an average length of $28cm$ and a standard deviation of $2.5cm$. Assuming that the lengths are normally distributed,

i. What percentage of the loaves of breads are in between $27.3cm$ and $31.8cm$ in length? **(6 marks)**
ii. At which length of breads, 30% of breads are lengthier than this length? **(6 marks)**
iii. A researcher has drawn a random sample of 35 breads. What is the probability that mean length of breads is less than $27cm$? **(7 marks)**

## Question 02 — 25 Marks

a) In a random sample of five measurements, the mean diameter of a sphere was recorded by a scientist as $6.34cm$ with a standard deviation of $0.021cm$. Construct 95% confidence interval for true mean diameter of the sphere and interpret (Round up the answer up to 2 decimal places). **(10 marks)**

b) In one of popular American journals, researchers reported that individuals who practice Transcendental Meditation (TM) lower their blood pressure significantly. After the mediation, if a random sample of 300 female TM practitioners shows a mean blood pressure of 115 *mm Hg* with a standard deviation of 3 *mm Hg*, does it suggests that, on average, females who practice TM meditate lower their blood pressure than 120 *mm Hg*? Test at 5% level of significance. (Round up the test statistic up to 2 decimal places) **(15 marks)**

## Question 03 — 25 Marks

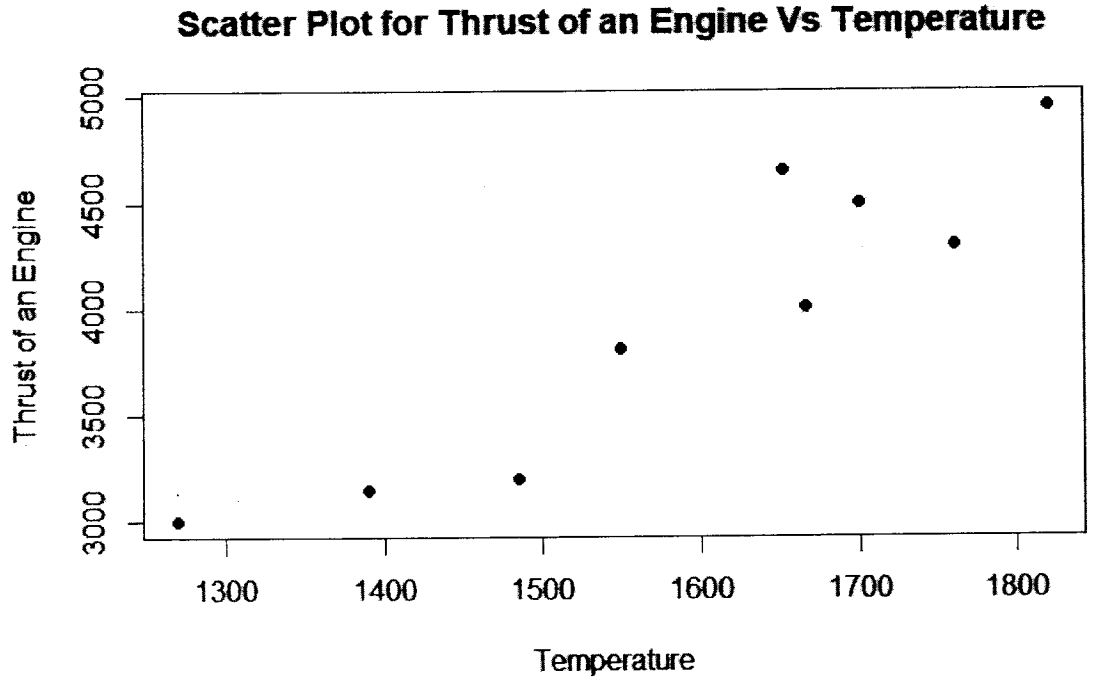
a) In an experiment with peas, it was observed that 310 were round and yellow, 107 were round and green, 105 were wrinkled and yellow, and 37 were wrinkled and green. According to the theory of heredity, the probability distribution of peas should be as follows. Is there any evidence to doubt the theory at 0.05 level of significance? (Round up the test statistic up to 4 decimal places)

| Peas Type | Round and Yellow | Round and Green | Wrinkled and Yellow | Wrinkled and Green |
|---|---|---|---|---|
| Count | 310 | 107 | 105 | 37 |
| Probability | 7/16 | 3/16 | 5/16 | 1/16 |

**(25 marks)**

## Question 04 — 25 Marks

The thrust of an engine ($y$) in newton is a function of exhaust temperature ($x$) in ${}^0F$ when other important variables are held constant. To determine the relationship between thrust of an engine and temperature data was collected at nine different temperatures. Figure below displays the scatter plot for the data (Give all of your answers in four decimal places).



R outputs of the regression model are shown below.

**Regression Model**

**Coefficients**

| Intercept | Temperature |
|---|---|
| -1847.633 | 3.653 |

**Analysis of Variance Table**

Response: Thrust of an Engine

| | Df | Sum Sq | Mean Sq | F Value | Pr(>F) |
|---|---|---|---|---|---|
| **Temperature** | A | D | 3447373 | G | 0.0003513*** |
| **Residuals** | B | 580603 | F | | |
| **Total** | C | E | | | |

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a) What can be concluded using the scatterplot? **(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 thrust of an engine will change if temperature increase by $1^0F$. **(4 marks)**

d) Find the coefficient of determination and interpret. **(5 marks)**

e) Use the regression equation to predict the thrust of an engine if temperature is $1500^0F$. **(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:

$$X^2 = \sum_{all\ i} \frac{(O_i - E_i)^2}{E_i}$$

- Pearson's Product Moment Correlation Coefficient:

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