

PPSAS205
Introduction and Modelling in R

Times: 2 Hours

Marks: 60

Note:

- 1) The candidate has the option to either attempt question 3A or question 3B. Rest all questions are mandatory.
- 2) Numbers on the right indicate full marks.
- 3) The candidate will be provided with the formula sheet and graph papers [if required] for the examination.
- 4) Use of approved scientific calculators is allowed.

Q1. Attempt the following:

15 Marks.

- A.** Given a sample variance of 127 from a set of 9 observations, construct a 95% confidence interval for the population variance.

5 Marks

Formula for confidence interval:

$$((n - 1) * s^2) / \chi^2(a/2, n - 1) \leq \sigma^2 \leq ((n - 1) * s^2) / \chi^2(1 - a/2, n - 1)$$

where n is the sample size, s^2 is the sample variance, χ^2 is the chi-squared distribution function, and a is the level of significance (0.05 for a 95% confidence interval).

- B.** The following sample of eight observations is from an infinite population with a normal distribution.

75.3 76.4 83.2 91 80.1 77.5 84.8 81.0

i. Find the sample mean

1 Mark.

ii. Estimate population standard deviation

1 Mark

iii. Construct a 98% confidence interval for the population means

3 Marks.

- C.** Connie Rodrigues, the dean of students at Midstate college, is wondering about grade distributions at the school. She has heard grumblings that GPAs in business school are about 0.25 percent lower than those in college of arts and sciences. A quick random sampling produced the following GPAs. Do these data indicate there is a factual basis for the grumblings? State and test appropriate hypothesis at $\alpha = 0.02$

5 Marks

Business	2.86	2.77	3.18	2.80	3.14	2.87	2.19	3.24
Science & Arts	3	3.44	2.9	3	3.33	3.46	3.7	3.8

2.9

Q2. Attempt the following:**15 Marks.**

- A.** A study compared the effects of four 1-month point-of-purchase promotions on sales. The unit sales for five stores using all four promotions in different months follow:

Free Sample	78	87	81	89	85
One gift Pack	94	91	87	90	88
Cents Off	73	78	69	83	76
Refund by email	79	83	78	69	81

Check whether there is an effect on promotions on sales.

- i. Create a matrix "sale" similar to the above table **1 Mark**
- ii. Print sales matrix **1 Mark**
- iii. Test the hypothesis to check the effect of promotions on sales **3 Marks**

- B.** Perform a correlation test for the below data **5 Marks**

```
test_1 <- c(3, 5, 6, 7, 8, 10)
test_2 <- c(4, 6, 7, 8, 9, 12)
```

- C.** Using the data given below
- i. Plot the scatter diagram
 - ii. Develop the estimating equation that best describes the data
 - iii. Predict Y for X = 5,6,7

X	16	6	10	5	12	14
Y	-4.4	8	2.1	8.7	0.1	-2.9

5 Marks

Q3 Attempt question 3A or question 3B. Rest all

Q3 A.

In economics, the demand function for a product is often estimated by regressing the quantity sold (Q) and the price (P). The Bamsy company is trying to estimate the demand function for new doll “Annabelle” and has collected the following data:

p	20	17.5	16	14	12.5	10	8	6.5
q	125	156	183	190	212	238	250	276

30 Marks

- i. Create a dataframe and plot the data **7 Marks**
- ii. Calculate the value of the least square regression **8 Marks**
- iii. Provide the equation that best fits the model **7 Marks**
- iv. Predict the amount of dolls sold when price is 15 **8 Marks**

OR

Q3 B

The mtcars dataset contains information on various car models. We are interested in exploring the relationship between miles per gallon (mpg) and several other variables. Answer the following sub-questions using a glm in R:

- i. Load the mtcars dataset into R and create a new binary variable high_mpg that indicates whether a car has an mpg value greater than or equal to 20 (1 if yes, 0 if no). **10 Marks**
- ii. Fit a glm model to predict high_mpg using the variables wt, hp, drat, and qsec. **5 Marks**
- iii. Interpret the coefficients of the model. **7 Marks**
- iv. Use the model to predict the probability that a car with a weight of 3.5, horsepower of 120, drat of 3.9, and qsec of 17 will have an mpg value greater than or equal to 20. **8 Marks**