

Indian Statistical Institute, Bangalore

MS (QMS) First Year

Second Semester - Statistics for Decision Making II

Final Exam
Maximum marks: 50

Date: May 09, 2018
Duration: 3 hours

This paper has 60 Marks. Answer as many questions as you can, but the maximum score is limited to 50.

1. For the One Way ANOVA, consider the model $y_{ij} = \mu + \alpha_i + \varepsilon_{ij}$, (for all $i=1,2,\dots,a$ & $j=1,2,\dots,n$), [10]
Where μ = Overall Population Mean,
 α_i = Effect of the i th class ($i=1,2,\dots,a$) and
 ε_{ij} = Error for the j th observation in the i th class ($j=1,2,\dots,n$), and
 ε_{ij} 's (for each $i=1,2,\dots,a$ & $j=1,2,\dots,n$) are independently normally distributed with zero mean and constant variance $= \sigma^2$.
Show that Mean square error (MSE) is an unbiased estimator of σ^2

2. The chlorine residual in a swimming pool at various times after being cleaned is as given: [10 + 2 = 12]

Time (hr)	Chlorine Residual (pt/million)
2	1.80
4	1.50
6	1.45
8	1.42
10	1.38
12	1.36

Fit a curve of the form $Y \approx ae^{-bx}$

What would you predict for the chlorine residual 15 hours after a cleaning?

3. The following data show the frequencies of sunset colours observed on a day and whether each was followed by rain next day. [10]

Sky Color	Number of Observations	Number Followed by Rain
Red	61	26
Mainly red	194	52
Yellow	159	81
Mainly yellow	188	86
Red and yellow	194	52
Gray	302	167

Test the hypothesis that whether it rains tomorrow is independent of the colour of today's sunset.

4. The life of a particular type of generator is thought to be influenced by the material used in its construction and also by the temperature at the location where it is utilized. The following table represents lifetime data on 24 generators made from three different types of materials and utilized at two different temperatures. Do the data indicate that the material and the temperature do indeed affect the lifetime of a generator? Is there evidence of an interaction effect? [10]

Temperature

Material	10°C	18°C
1	135, 150 176, 85	50, 55 64, 38
2	150, 162 171, 120	76, 88 91, 57
3	138, 111 140, 106	68, 60 74, 51

5. 300 light bulbs are tested for their burning time t (in hours), and the result is shown in the following Table. [10]

Sample values for Burning time, t	Number
$t < 100$	121
$100 < t < 200$	78
$200 < t < 300$	43
$300 < t$	58
	$n = 300$

Suppose that random burning time T is postulated to be exponentially distributed with mean burning time $1/\lambda = 200$ hours; i.e $\lambda = 0.005$ per hour and

$$f_T(t) = 0.005e^{-0.005t}$$

Test this hypothesis by using the chi -square test at the 5% significance level.

6. A question of medical importance is whether jogging leads to a reduction in one's pulse rate. To test this hypothesis, 8 non-jogging volunteers agreed to begin a 1-month jogging program. After the month their pulse rates were determined and compared with their earlier values. If the data are as follows, can we conclude that jogging has had an effect on the pulse rates? [8]

Subject	1	2	3	4	5	6	7	8
Pulse Rate Before	74	86	98	102	78	84	79	70
Pulse Rate After	70	85	90	110	71	80	69	74