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B.E (Full Time) DEGREE END SEMESTER EXAMINATIONS, NOV 2013

MATERIAL SCIENCE AND ENGINEERING

III - Semester

MA8352 – APPLIED STATISTICS

(Regulation 2012)

Time: 3 Hours

Answer ALL Questions

Max. Marks 100

PART-A (10 x 2 = 20 Marks)

- Tests performed with a random sample of 40 diesel engines produced by a large manufacturer show that they have a mean thermal efficiency of 30.1% with a standard deviation of 1.2%. At the 0.01 level of significance, test the null hypothesis $\mu = 31.5\%$ against the alternative hypothesis $\mu \neq 31.5\%$.
- An airline claims that only 6% of all luggage is never found. If, in a random sample, 15 of 190 pieces of lost luggage are not found, test the null hypothesis $p = 0.06$ against the alternative hypothesis $p > 0.06$ at the 0.05 level of significance.
- What is the main advantage of using nonparametric tests?
- Can we use the run test to test the randomness of samples consisting of numerical data? Justify Your answer.
- State the identity equation for one –way analysis of variance.
- Write down the ANOVA table for 2^2 factorial design.
- A soft drink machine is designed to dispense 12 oz. of a certain soft drink into an aluminium can. A random sample of $n=75$ cans was selected, and the content of each can was accurately weighed. The sample yielded an average of 11.9 oz. with a standard deviation of 0.2 oz. Assuming a normal distribution, find a 95% tolerance interval for 90% of the population.
- Write the formulae for control values (Central line, UCL and LCL) of a c-chart.
- Calculate four yearly moving average of the following data relating to bank deposits:

Year	1960	1961	1962	1963	1964	1965	1966	1967
Deposits(in crores of Rs)	960	976	974	996	1,024	1,040	1,688	1,128

10. What are the different methods which are used for measuring seasonal variations?

Part – B (5 x 16 = 80 marks)

11. i) Construct a control chart for mean and the range for the following data on the basis of fuses, samples of 5 being taken every hour (each set of 5 has been arranged in ascending order of magnitude). Comment on whether the production seems to be under control, assuming that these are the first data. (10)

20	37	43	52	62	19	17	70	66	62
25	55	52	75	65	21	32	110	92	79
81	70	58	76	74	28	41	114	95	95
86	78	60	89	97	43	64	119	111	113
94	85	79	123	140	61	86	154	114	140

ii) Twenty successive samples of 100 castings each, taken from a production line, contained, respectively, 4, 5, 2, 0, 10, 3, 6, 3, 2, 5, 6, 3, 4, 5, 6, 1, 0, 8, 7 and 4 defectives. If the fraction defective is to be maintained at 0.02, construct a p chart for these data and state whether or not this standard is being met. (6)

12. a) i) The following are measurements of the breaking strength of a certain kind of 2-inch cotton ribbon in pounds: 163, 165, 160, 189, 161, 171, 158, 151, 169, 162, 163, 139, 172, 165, 148, 166, 172, 163, 187 and 173. Use the sign test to test the null hypothesis $\tilde{\mu} = 160$ against the alternative hypothesis $\tilde{\mu} > 160$ at the 0.05 level of significance. (8)

ii) Franklin tests were performed to determine the insulation properties of grain-oriented silicon steel specimens that were annealed in five different atmospheres with the following results:

Atmosphere	Test Results (amperes)						
1	0.58	0.61	0.69	0.79	0.61	0.59	
2	0.37	0.37	0.58	0.40	0.28	0.44	0.35
3	0.29	0.19	0.34	0.17	0.29	0.16	
4	0.81	0.69	0.75	0.72	0.68	0.85	0.57 0.77
5	0.26	0.34	0.29	0.47	0.30	0.42	

Use the H test at the 0.05 level of significance to decide whether or not these five samples can be assumed to come from identical populations. (8)

(OR)

b) i) The following is an arrangement of men M and women W lined up to purchase tickets for a rock concert:

M W M W M M M W M W M M M W W M M M W W M W
M M W M M M W W W M W M M M W M W M M M M W W

Test for randomness at the 0.05 level of significance.

(8)

ii) The following are data on the breaking strength (in pounds) of two kinds of material:

Material 1	198	180	165	197	183	133	182	176	194	186
Material 2	164	170	189	161	159	185	164	169	134	154

Use the U test at the 0.05 level of significance to test the claim that the strength of Material 1 is stochastically larger than the strength of Material 2. (8)

13. a) Four different, though supposedly equivalent, forms of a standardized reading achievement test were given to each of five students, and the following are the scores which they obtained:

	Student 1	Student 2	Student 3	Student 4	Student 5
Form A	76	74	60	70	85
Form B	84	73	57	71	93
Form C	87	62	54	73	89
Form D	74	68	63	80	96

Perform a two-way analysis of variance to test at the level of significance $\alpha = 0.01$ whether it is reasonable to treat the four forms as equivalent. (16)

(OR)

- b) The following data resulted from an experiment to compare three burners A, B and C. A Latin square design was used, as the tests were made on three engines and were spread over three days.

	Engine 1	Engine 2	Engine 3
Day 1	A 16	B 17	C 20
Day 2	B 16	C 21	A 15
Day 3	C 15	A 12	B 13

Test the hypothesis that there is no difference between the burners at 0.05 level of significance. (16)

14. a) i) Measuring specimens of nylon yarn taken from two spinning machines, it was found that eight specimens from the first machine had a mean denier of 9.67 with a standard deviation of 1.81 while 10 specimens from the second machine had a mean denier of 7.43 with a standard deviation of 1.48. Assuming that the populations sampled are normal and have the same variance, test the null hypothesis $\mu_1 - \mu_2 = 1.5$ against the alternative hypothesis $\mu_1 - \mu_2 > 1.5$ at the 0.05 level of significance. (8)
- ii) A large electronics firm that hires many handicapped workers wants to determine whether their handicaps affect such worker's performance. Use the level of significance $\alpha = 0.05$ to decide on the basis of the sample data shown in

the following table whether it is reasonable to maintain that the handicaps have no effect on the worker's performance:

	Performance		
	Above Average	Average	Below Average
Blind	19	62	14
Deaf	14	47	11
No handicap	26	91	25

(8)

(OR)

b) i) Two different lighting techniques are compared by measuring the intensity of light at selected locations in areas lighted by the two methods. If 15 measurements in the first area had a standard deviation of 2.7 foot-candles and 21 measurements in the second area had a standard deviation of 4.2 foot-candles, can it be concluded that the lighting in the second area is less uniform? [Use a 0.01 level of significance].

(8)

ii) Playing 10 rounds of golf on his home course, a golf professional averaged 71.3 with a standard deviation of 1.32. Test the null hypothesis that the consistency of his game on his home course is actually measured by $\sigma = 1.20$, against the alternative hypothesis that he is less consistent. Use the level of significance $\alpha = 0.05$.

(8)

15. a) The population of a state at ten-yearly intervals are given below:

Year	1881	1891	1901	1911	1921	1931	1941
Population(in millions)	3.9	5.3	7.3	9.6	12.9	17.1	23.2

i) Fit an exponential trend $Y = ab^x$ to the above data by the method of least squares.

ii) Find the trend values.

iii) Estimate the population in 1951.

(16)

(OR)

b) The following table gives the production of cotton fabric (in mts) by a manufacturer for the years 2001 to 2005. Compute the seasonal indices by ratio to trend method.

Year	1 st Quarter	2 nd Quarter	3 rd Quarter	4 th Quarter
2001	80	106	96	90
2002	90	138	133	117
2003	106	154	143	128
2004	143	202	180	165
2005	239	244	231	217

(16)

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