

BITS , PILANI – DUBAI CAMPUS  
KNOWLEDGE VILLAGE

TEST – II (OPEN BOOK)

DATE: 18.04.04

COURSE NO: AAOC UC 312

COURSE TITLE: OPERATIONS RESEARCH

TIME: 50 minutes

MAX. MARKS: 25

1. It is decided that a new text will be adopted for a course only if it is approved that it produces final exam scores which have a standard deviation in excess of 5 units (percent). An experimental class of 21 randomly selected students were taught with the new text and their final examination scores yielded  $s = 6\%$ .

(a) Should the new text be adopted? Use  $\alpha = 0.05$ .

(b) What assumption you have made about the distribution of the scores? (3 + 1 = 4 marks)

2. Two sample polls of votes for two candidates A and B for a public office are taken, from rural and urban areas. The results are:

Area	Votes for	
	A	B
Rural	620	380
Urban	550	450

Examine whether the nature of the area is related to voting preference in this election. Use 5% level of significance. (4 marks)

3. Let  $p$  be the probability that a coin will fall head in a single toss in order to test  $H_0: p=0.5$  against  $H_1: p= 0.75$ . The coin is tossed 5 times and  $H_0$  is rejected if more than 3 heads are obtained.

(a) Find the probability of type I error.

(b) Find the power of the test. (5 marks)

4. Test whether the following data could have come from a uniform distribution on  $[2,4]$ . Use the Kolmogorov – Smirnov test at 5% level of significance.

2.5, 2.1, 3.4, 2.3, 2.8, 3.5, 3.9, 2.6.

(5 marks)

PTO

5. The speed (no. of words typed per minute) of 8 randomly chosen typists on electric and ordinary typewriters were recorded as under:

Typist	1	2	3	4	5	6	7	8
Speed on electric type-writer	75	89	79	85	102	115	97	69
Speed on ordinary type-writer	79	62	54	67	81	78	66	73

Use signed rank sum test at 5% level test the null hypothesis of no difference with the alternative that the electric type-writers help in achieving higher speed. (4 marks)

6. A professor awarded the following grades to a class of 60 students:

Grades:	A	B	C	D	E
No. of students:	9	13	18	12	8

Are the data consistent with the assumption that the professor is in the habit of awarding all grades equally? Use  $\alpha = 0.10$ . (3 marks)

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COMPREHENSIVE EXAMINATION

COURSE NO: AAOC UC 312

COURSE TITLE: OPERATIONS RESEARCH

DATE: 03.06.04

TIME: 3 HOURS

MAX. MARKS: 40

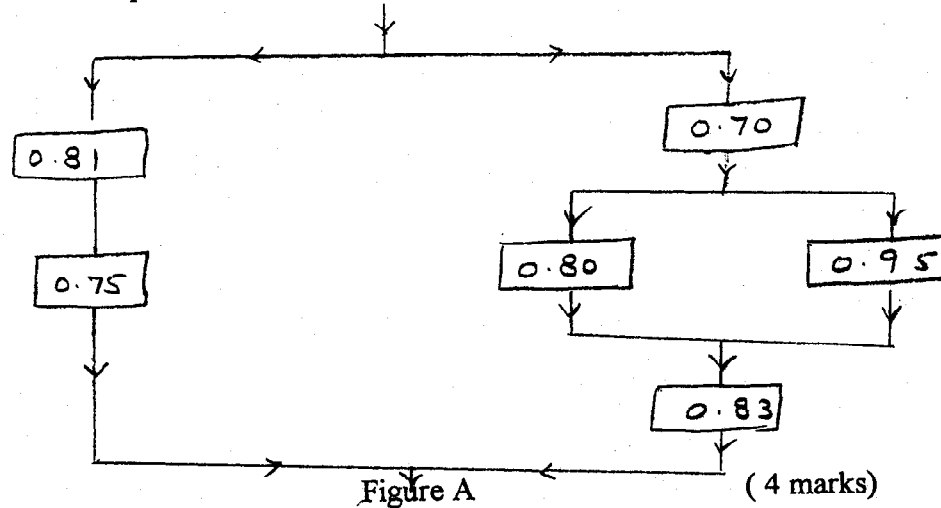
WEIGHTAGE: 40

1. A die was rolled 180 times and the following frequency distribution resulted:  
No. showing on top face:      1      2      3      4      5      6  
Frequency                            25    35    32    27    24    37  
Test the hypothesis  $H_0$ : The die is unbiased at 5% level of significance.  
(2 marks)
2. The following figures give the number of defectives in 10 samples, each containing 200 items: 40, 44, 22, 34, 24, 32, 28, 32, 34 and 30. Calculate the values for central line, Upper control limit and lower control limit for p-chart. Draw the p-chart and comment if the process can be regarded in control.  
(4 marks)
3. Samples of two types of electric light bulbs were tested for length of life and following data were obtained:  

	Type I	Type II
Sample No.	$n_1 = 8$	$n_2 = 7$
Sample Means	$\bar{x}_1 = 1234$ hrs	$\bar{x}_2 = 1036$ hrs
Sample standard deviations	$s_1 = 36$ hrs	$s_2 = 40$ hrs.

Is the difference in the means sufficient to warrant that type I is superior to type II regarding length of life?  
(3 marks)
4. The following observations were obtained in a random sample from a population with an unknown cdf  $F(x)$  :  
0.5, 4.6, 2.8, 1.6, 3.7  
Use the Kolmogorov- Smirnov test at  $\alpha = 0.05$  to test the null hypothesis,  
 $H_0: F(x) = F_0(x)$  where  
$$F_0(x) = \begin{cases} 0, & x < 0 \\ \frac{1}{3}x, & 0 \leq x < 1 \\ \frac{x+1}{6}, & 1 \leq x \leq 5 \\ 1 & \text{for } x > 5 \end{cases}$$
  
(4 marks)

5. a) Generate a value of a geometric random variable with parameter  $p = 0.3$ . Use the random numbers 0.54, 0.38, 0.49, 0.75, 0.84.  
 b) Use the random numbers 0.75, 0.86, 0.56, 0.66, 0.97 generate one observation of the binomial random variable  $X$  with  $n = 5$ ,  $p = 0.5$ . (2 + 2 = 4 m)
6. Consider the system shown in Figure A. The numbers inside the boxes are reliabilities and the numbers outside the boxes are component numbers. Assume that the components are mutually independent, find the reliability of the system.



7. The following table gives two independent samples of final examination scores of two sections of Operations Research course.

Section A: 55, 59, 61, 64, 70, 73, 75, 76, 82, 83, 95

Section B: 65, 70, 75, 80, 85, 87, 89, 91, 93.

Use the Wilcoxon's rank-sum test at 5% level to test

$H_0$ : 'Sections are alike in scores', against the two-sided alternative.

(4 marks)

8. A company wants to purchase cars for its own use. The choice was to be made out of four makes A, B, C & D available in the market. For this the four cars of each make are assigned to four drivers to run on four different routes. The allocation is done by using Latin square design. The efficiency of cars is measured in terms of time in hours. The layout and time consumed is as given below:

Routes	Drivers			
	1	2	3	4
1	18(C)	12(D)	16(A)	20(B)
2	26(D)	34(A)	25(B)	X(C)
3	15(B)	22(C)	10(D)	28(A)
4	30(A)	20(B)	15(C)	9(D)

Analyse these data at 5% level, for the effects of makes of cars, routes and drivers.

(5 marks)

9. At a cycle repair shop, on an average a customer arrives every five minutes and on an average, the service time is 4 minutes per customer. Suppose that the interarrival time and the service time are exponentially distributed. Assume that there is only one server.
- Find the fraction of time the server is busy.
  - Find the expected number of customers in the system.
  - Find the mean time a customer spends in the system.

( 3 marks)

10. The purchase price of a commodity depends on the quantity purchased as shown below:

Lot Size	Purchase Cost (Rs.)
$100 \leq x < 500$	20
$500 \leq x < 1000$	18
$1000 \leq x < 1500$	16
$1500 \leq x < 2000$	14
$2000 \leq x$	12

The demand for the commodity is constant and uniform at a rate of 900 per year. The holding cost is Rs. 2 per unit inventory per year. The cost of ordering is Rs. 400 per order. No shortages are allowed. The arrival rate is 1200 per year. What is the optimal lot size?

( 4 marks)

11. If  $x \geq 1$  is the critical region for testing  $H_0: \theta = 2$  against the alternative  $\theta = 1$ , on the basis of the single observation from the population,  
 $f(x, \theta) = \theta \exp(-\theta x)$ ,  $0 \leq x < \infty$ ,  
 obtain the values of type I and type II errors.

( 3 marks)

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TABULATED VALUES:

$$D_{5,0.05} = 0.563$$

$$F_{3,6,0.95} = 4.7571$$

$$F_{3,5,0.95} = 5.4095$$

$$t_{13,0.95} = 1.77$$

$$\chi^2_{5,0.95} = 11.07$$

$$\chi^2_{5,0.05} = 1.145$$


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**BITS , PILANI – DUBAI CAMPUS  
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TEST – I (CLOSED BOOK)

DATE: 7.03.04

COURSE NO: AAOC UC 312

COURSE TITLE: OPERATIONS RESEARCH

TIME: 50 minutes

MAX. MARKS: 15

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1. Vehicles pass through a toll gate at a rate of 90 per hour. The average time to pass through the gate is 36 seconds. The arrival rate and service rate follow Poisson distribution. There is a complaint that the vehicles wait for long duration. The authorities are willing to install one more gate to reduce the average time to pass through the toll gate to 30 seconds if the idle time of the toll gate is less than 10% and the average queue length at the gate is more than 5 vehicles. Check whether the installation of the second gate is justified. (3 marks)
  
2. Monthly demand for a commodity is 800 units. The holding cost is Re.1 per unit per month, and the ordering cost is Rs.400. The delivery is instantaneous. The price structure for the quantity which is not freely available in the open market is given as follows:  
$$\begin{aligned} &= 8.75 && ; && 0 < Q \leq 500 \\ &= 9.25 && ; && 500 < Q \leq 950 \\ &= 10.00 && ; && Q > 950 \end{aligned}$$
Find the optimal order size. (3 marks)
  
3. A firm has several machines and wants to install its own service facility for the repair of its machines. The average breakdown rate of the machines is 4 per day. Assume the inter arrival times are independent exponential variates. The repair time has exponential distribution, the loss incurred due to the lost time of an inoperative machine is Rs. 50 per day. There are two repair facilities available. Facility A has an installation cost of Rs.25000 and facility B costs Rs. 45000. With Facility A, the total labour cost is Rs 6000 per year and with facility B the total labour cost is Rs. 11000 per year. Facility A can repair 5 machines per day and the the facility B can repair 7 machines per day. Both facilities have a life of 5 years. Which facility should be installed? (4 marks)

4. An item costs Rs.180 and it can be produced at a rate of 150 per month and it is sold at a rate of 50 per month . The holding cost is Rs. 15 per unit per month and the set up cost is Rs. 800. The back ordering is allowed with a cost of Rs.100 per unit of back order per month.. Make a comparison between the TCU with and without the policy of backordering. Analyse your answer. ( 3 marks)

5. The instantaneous demand X of an item has discrete distribution

X:	1	2	3	4
Probability:	0.1	0.3	0.4	0.2

The purchase cost of the item is Rs 4 per unit and it is sold for Rs 6 per unit. If the item is not sold, it is estimated that it will cost Rs 2 per unit to hold it for the next order cycle.

Assume that there were 5 units of the item left over in the previous order cycle. What is the optimal number of items that should be purchased in the present order cycle. Assume that the set up cost is zero. (2 marks)

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