2020

STATISTICS — HONOURS — PRACTICAL

Paper : DSE-B-1P

(Operations Research)

Full Marks : 30

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

(Notations and Symbols are as usual)

Answer ***all*** questions.

1. A firm produces two products. These products are processed on three different machines. The time required to manufacture one unit of each of the two products and the daily capacity of the three machines are given in the following table (a blank in the table indicates that the corresponding product does not require processing in that particular machine).

	Time per unit (in minutes)		Machine capacity (minutes per day)
Machine	Product A	Product B	
M1	–	3	441
M2	4	–	472
M3	2	5	430

It is required to determine the daily number of units to be manufactured for each product. The profits per unit for product A and B (in thousand Rs) are respectively 4 and 3. It is assumed that all the amounts produced are consumed in the market. The objective is to maximize the daily profit. Formulate the problem as an LPP and solve it. 14

2. Consider the following 3 persons and 4 Jobs assignment problem where the elements in the matrix are respective net returns of assignment, in suitable units. Find the optimum assignment schedule such that the total net return is maximized. 8

Person	Job			
	J1	J2	J3	J4
A	20	25	22	28
B	15	18	23	17
C	19	17	21	24

3. Solve the following two person zero-sum game. 8

Player A		Player B			
		B1	B2	B3	B4
	A1	2	2	3	–1
	A2	4	3	2	6

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Paper : DSE-B-1P

(Stochastic Processes and Queuing Theory)

Full Marks : 30

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Suppose n stands for 1 plus the last digit of your roll number if it is between 1 and 9 (e.g. if your roll number ends with 1, then $n = 2$; if it is 5, then $n = 6$; if it is 9 then $n = 10$ etc.), and $n = 11$ if your roll number ends with 0. The one step transition probability matrix $P = ((p_{xy}))$ of a Markov chain with state space $\{d, e, f\}$ is given below. Find (a) the 3-step transition probability matrix and (b) the steady state distribution of the chain.

$$P = \begin{array}{c} \\ \text{d} \\ \text{e} \\ \text{f} \end{array} \begin{array}{c} \begin{array}{ccc} \text{d} & \text{e} & \text{f} \end{array} \\ \begin{pmatrix} \frac{n-1}{n} & \frac{1}{n} & 0 \\ 0 & \frac{n-1}{n} & \frac{1}{n} \\ \frac{n-1}{n} & 0 & \frac{1}{n} \end{pmatrix} \end{array} \qquad 2+6$$

2. Define n as the last digit of your roll number if other than 0, and $n = 10$ if the last digit is 0. Keeping 4 significant digits, use the supplied table (as available from Fundamentals of Statistics, Vol-2) to simulate observations from U[0,1] (as many as required), give their values, and use a suitable transformation to generate a Poisson process $(N_t)_{0 \le t \le T}$ with intensity parameter $\lambda = \frac{1}{n}$ per hour, up to time $T = 7.5n$ hours. What is the value of N_T for your process? 8+2

3. In a certain clearance counter 15 passengers arrive per hour. The average processing time for each passenger is 3 minutes. Under appropriate assumptions (to be stated clearly), find

(a) the expected number of passengers to be processed every hour,

(b) the average number of passengers per day (assuming 24 hours schedule) for whom the processing time exceeds five minutes,

(c) the expected amount of time per day the counter remains idle (assuming 24 hours schedule),

(d) the average number of passengers in the queue and in the system,

(e) the average waiting time for a passenger in the queue and in the system.

Suppose the authority contemplates to open another counter provided the average waiting time of a customer to get the final clearance exceeds 20 minutes. Find the arrival rate for which the authority has to open another counter. (1+1+2+2+2)+4

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RANDOM SAMPLING NUMBERS *

4652	3819	8431	2150	2352	2472	0043	3488
9031	7617	1220	4129	7148	1943	4890	1749
2030	2327	7353	6007	9410	9179	2722	8445
0641	1489	0828	0385	8488	0422	7209	4950
8479	6062	5593	6322	9439	4996	1322	4918
9917	3490	5533	2577	4348	0971	2580	1943
6376	9899	9259	5117	1336	0146	0680	4052
7287	0983	3236	3252	0277	8001	6058	4501
0592	4912	3457	8773	5146	2519	3931	6794
6499	9118	3711	8838	0691	1425	7768	9544
0769	1109	7909	4528	8772	1876	2113	4781
8678	.4873	2061	1835	0954	5026	2967	6560
0178	7794	6488	7364	4094	1649	2284	7753
3392	0963	6364	5762	0322	2592	3452	9002
0264	6009	1311	5873	5926	8597	9051	8995
4089	7732	8163	2798	1984	1292	0041	2500
9376	7365	7987	1937	2251	3411	6737	0367
3039	3780	2137	7641	4030	1604	2517	9211
8971	8653	1855	5285	5631	2649	6696	5475
0373	4153	5199	5765	2067	6627	3100	5716
9092	4773	0002	7000	7800	2292	2933	6125
2464	1038	3163	3569	7155	2029	2538	7080
3027	6215	3125	5856	9543	3660	0255	5544
5754	9247	1164	3283	1865	5274	5471	1346
4358	3716	6949	8502	1573	5763	5046	7135
7178	8324	8379	7365	4577	4864	0629	5100
5035	5939	3665	2160	6700	7249	1738	2721
3318	0220	3611	9887	4608	8664	2185	7290
9058	1735	7435	6822	6622	8286	8901	5934
7886	5182	7595	0305	4903	3306	8088	3899
3354	8454	7386	1333	5345	6565	3159	3991
3415	7671	0846	7100	1790	9449	6285	2525
3918	5872	7898	6125	2268	1898	0755	6034
6138	9045	6950	8843	6533	0917	6673	5721
3825	1704	2835	4677	4637	7329	3156	3291
1349	0417	9311	9787	1284	0769	8422	1077
4234	0248	7760	6504	2754	4044	0842	9080
6880	3201	7044	3657	5263	0374	7563	6599
0714	5008	5076	1134	5342	1608	5179	0967
3448	6421	3304	0583	1260	0662	7257	0766
5711	7343	7539	3684	9397	5335	4031	1486
2588	3301	0553	2427	3598	2580	7017	9176
8581	4253	7404	5264	5411	3431	3092	8573
8475	6322	3949	9675	6533	1133	8776	2216
0272	5624	8549	5552	7469	2799	2822	9620
7383	7795	7939	2652	4456	6993	2950	8573
5126	2089	7729	0943	3901	4445	7117	8186
2064	3760	0939	7319	5939	3432	2030	4752
9315	8185	7805	6294	7072	6491	4012	1016
6814	8752	3462	6001	3302	3895	7371	3432