

JK Lakshmipat University Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, December 2025
B. Tech. (All branches), Semester V, 2025-26

Roll No.....

AS1202: ADVANCED STATISTICS

Time: 2 hours 30 min

Max. Marks: 30

Instructions to students:

1. Do not write anything other than your roll number on question paper.
 2. Mention all the assumptions for your answers clearly.
 3. Use of non-programmable calculators is allowed.
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- Q. 1.1 A cloud server handles a sequence of independent tasks. The time taken to complete each task is random and follows an exponential distribution with a mean of 2 milliseconds. Assume all task times are independent and identically distributed. If the server processes 50 tasks in sequence, what will be the approximate distribution of the total processing time for all 50 tasks? Justify your answer. 2.0
(CO3)
- Q. 1.2 Let $X = aZ + b$, where Z is a standard normal random variable, and a, b are two unknown constants. It is given that $E[X] = 1$, $E[(X - E[X])Z] = -2$ and $E[(X - E[X])^2] = 4$, where $E[X]$ denotes the expectation of random variable X . Then, find the values of a, b . 2.0
(CO1, 2)
- Q. 1.3 Two random variables X and Y have means $\bar{X} = 1$ and $\bar{Y} = 2$, variances $\sigma_X^2 = 4$, $\sigma_Y^2 = 1$ and correlation coefficient $\rho_{XY} = 0.4$. New random variables V and W are defined by $V = -X + 2Y$ and $W = X + 3Y$, then find the variance of V and correlation coefficient of V and W . 2.0
(CO1, 4)
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- Q. 2.1 A private owned liquor store operates both a drive in – facility and a walk-in facility on a randomly selected day, let X and Y , respectively, be the proportions of the time that the drive-in and walk-in facilities are in use, the joint density function of these random variables is 5.0
(CO1, 2,)
- $$f(x, y) = \begin{cases} \frac{2}{3}(x + 2y) & ; \quad 0 \leq x \leq 1, 0 \leq y \leq 1 \\ 0 & ; \quad \text{elsewhere} \end{cases}$$
- a. Calculate the marginal density function for random variable Y .
 - b. Find the probability that the drive-in facility is busy for half of the time.
 - c. Find the probability distribution of the proportions of the time that the drive-in facility is in use.
- Q. 2.2 Let X denote number of times a numerical machine will malfunction: 1, 2 or 3 times on any given day. Let Y denote the number of times a technician is called on an emergency call. The joint probability distribution of the process is given as: 5.0
(CO1, 2, 3)

		X		
		1	2	3
Y	1	0.05	0.05	0.1
	2	0.05	0.1	0.35
	3	0	0.2	0.1

- Compute the mean and variance of X.
- Write the marginal distributions of the times a numerical machine will malfunction and emergency call made to a technician and thus explain the meaning of marginal distribution.
- Write the cumulative probability distribution of the number of times a technician is called on an emergency call.
- Calculate the probability distribution of an emergency call given the machine malfunctions 2 times.
- Compute the probability of calling a technician 2 times on an emergency call given the machine malfunction for 3 times.

Q. 3 A cloud data center monitors the network latency experienced by user requests. A request passes through two independent routers, each contributing a random delay (in milli seconds). 6.0
(CO3)

- The delay added by Router A, denoted by X, is uniformly distributed

$$\text{between 1 ms and 5 ms as } f_X(x) = \begin{cases} \frac{1}{4} & ; 1 \leq x \leq 5 \\ 0 & ; \text{elsewhere} \end{cases}$$

- The delay added by Router B, denoted by Y, is uniformly distributed

$$\text{between 2 ms and 10 ms as } f_Y(y) = \begin{cases} \frac{1}{8} & ; 2 \leq x \leq 10 \\ 0 & ; \text{elsewhere} \end{cases}$$

Both routers operate independently. The total network latency for a request is $Z=X+Y$.

- Determine the probability density function (pdf) of the total latency Z.
- Plot the pdf of Z.
- Based on the computed pdf, identify the most likely range of total latency and explain the distribution of Z.

Q. 4 Officials of a small transit system with only five buses want to evaluate four types of tires with respect to wear. Each of the buses runs a different route so the terrain and driving conditions differ from bus to bus. To control the effect of this extraneous variable, a randomized complete block design is appropriate. Each bus constitutes a block, and each tire type constitutes a treatment. One tire of each type is placed on each bus, with the wheel positions being assigned front and rear. The tires run for 15000 miles, after which the tread wear, in millimeters, is measured. The data obtained along with pertinent summary statistics are given below. 8.0
(LO 5)

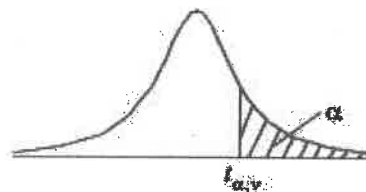
	Tyre type				
	Buses	T1	T2	T3	T4
Front Position	B1	9.1	17.1	20.8	11.8
	B2	13.4	20.3	28.3	16.0
	B3	15.6	24.6	23.7	16.2
	B4	11.0	18.2	21.4	14.1
	B5	12.7	19.8	25.1	15.8
Rear Position	B1	10.1	15.1	15.8	13.8
	B2	8.4	13.3	18.3	14.0
	B3	12.6	20.6	21.7	13.2
	B4	12.0	14.2	15.4	16.1
	B5	10.7	15.8	21.1	11.8

- Construct a statistical model for this data.
- State the appropriate method and null and alternative hypotheses for that model.
- Test your hypothesis for significance at the 5% level
- Explain: whether the performance of different tire types significantly depends upon the position of installation or not.

all the best!

Table of the Student's *t*-distribution

The table gives the values of $t_{\alpha, v}$ where
 $\Pr(T_v > t_{\alpha, v}) = \alpha$, with v degrees of freedom



α	0.1	0.05	0.025	0.01	0.005	0.001	0.0005
v							
1	3.078	6.314	12.076	31.821	63.657	318.310	636.620
2	1.886	2.920	4.303	6.965	9.925	22.326	31.598
3	1.638	2.353	3.182	4.541	5.841	10.213	12.924
4	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	1.319	1.714	2.069	2.500	2.807	3.485	3.767
24	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	1.296	1.671	2.000	2.390	2.660	3.232	3.460
120	1.289	1.658	1.980	2.358	2.617	3.160	3.373
∞	1.282	1.645	1.960	2.326	2.576	3.090	3.291