

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

ODD Semester Mid-term Examination, 2023-24

Course Code: ECO541

Full Marks: 25

Course Name: Probability Theory for Engineering Applications

Time: 90 Mins

Question Paper No.: NITDGP/ECO541/1

Date of Exam: xx/xx/xxxx

Instructions: Answer all the questions.

Question No.	Body of the Question	Marks	Mapped CO															
1	<p>(a) The transmission time X of messages in a communication system obeys the exponential probability law with $P(X > x) = e^{-\lambda x}$ for $x > 0$. Find the CDF and pdf of X.</p> <p>Find $P[T < X \leq 2T]$ where $T = \frac{1}{\lambda}$.</p> <p>(b) Find the mean and variance of binomial distribution.</p>	3+2=5	CO1; CO2															
2	<p>Let the joint distribution between X and Y is as follows:</p> <table><tr><td>x</td><td>-1</td><td>-0.5</td><td>0.5</td><td>1</td></tr><tr><td>y</td><td>-2</td><td>-1</td><td>1</td><td>2</td></tr><tr><td>$f(x,y)$</td><td>0.125</td><td>0.2</td><td>0.5</td><td>0.175</td></tr></table> <p>Determine the correlation and covariance for the joint probability distribution.</p>	x	-1	-0.5	0.5	1	y	-2	-1	1	2	$f(x,y)$	0.125	0.2	0.5	0.175	5	CO2
x	-1	-0.5	0.5	1														
y	-2	-1	1	2														
$f(x,y)$	0.125	0.2	0.5	0.175														
3	<p>A batch contains 50 bacteria cells and 15 of the cells are not capable of cellular replication. Suppose that you examine three bacteria cells selected at random without replacement. What are the mean and variances of the number of cells in the sample that can replicate? What is the probability that at least one of the selected cells cannot replicate?</p>	5	CO1															
4	<p>The fill volume of an automated filling machine used for filling cans of carbonated beverage is normally distributed with a mean of 3.7 cc and a standard deviation of 5.5 cc. What is the probability that a fill volume is less than 360 cc? If all cans less than 365 cc or greater than 375 cc are scrapped, what proportion of cans is scrapped? Determine specifications that are symmetric about the mean that includes 99% of all cans.</p>	5	CO1															
5	<p>The number of views of a page on a web site follows a Poisson distribution with a mean 1.8 per minute. What is the probability of two or fewer views in 30 minutes? Does the answer to the previous question depend on whether there were no views over last 10 minute? Explain.</p>	5	CO1															

Course Outcomes

CO1: Characterize probability models and random variables

CO2: Evaluate moments, correlation, and understand the concept of point estimation, hypothesis testing, inequalities and probabilistic limits.