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SCHOOL OF MATHEMATICS AND COMPUTER APPLICATIONS

MCA-III Year; CA-022; Statistics and Combinatorics

End Semester Examination; December 2006; Time: 3 Hours; Max Marks: 100

Note: Attempt any five problems. All the problems carry equal marks. Please attempt the parts of a problem at one place.

1(a)	A random variable X follows the discrete probability distribution: $\{(x_i, p_i): (0, 1/3), (1, 1/6), (2, 1/2)\}$. Write a procedure to generate 50 random deviates for X. Mention all the intermediate steps, if any.	10
1(b)	Prove that, if $A \subseteq B$, then $P(A) \leq P(B)$. Suppose that a sample space is given by $S = \{s: -\infty < s < \infty\}$ and $A \subseteq S$ is a set for which the integral, $\int \exp(-\lvert x \rvert)\, dx$ exists, (Integral is taken over the set A). Decide whether this integral can be taken as a probability density function for a random variable whose domain is S or not. If not, modify this integral suitably so that it can be used as a probability density function.	10
2(a)	A shipment of 8 similar PCs to a retail outlet consists of 3 defective ones. If our School purchases 2 of these computers randomly, find the probability distribution for the number of defective PCs.	6
2(b)	The joint probability density function of (X, Y) is given by: $f(x,y) = \begin{cases} 4xy, & 0 < x < 1;\ 0 < y < 1 \\ 0, & elsewhere. \end{cases}$ Find (i) $P(0 < X < 0.5 \text{ and } \frac{1}{4} < Y < \frac{1}{2})$ and (ii) $P(X < Y)$.	7
2(c)	The life span in hours of the RAMs is a random variable with cumulative distribution function $F(x) = \begin{cases} 1 - e^{-x/50}, & x > 0 \\ 0, & elsewhere. \end{cases}$ Find (i) the probability density function for the life span and (ii) the probability that the life span of RAMs exceeds 70 hr.	7
3(a)	Suppose that (X, Y) is uniformly distributed over the triangle formed by the vertices (0, 0), (1, 3) and (-1, 3). Find the variance of X and variance of Y. Also find the coefficient of correlation between X and Y.	15
3(b)	Define the sample variance and show that it is an unbiased estimate of population variance.	5
4(a)	Describe the Binomial process precisely. Show that Poisson distribution is a limiting case of the Binomial distribution clearly defining the limits that are forced. If the random variable X has a Poisson distribution and if $P(X = 2) = 2*P(X = 1)/3$. Find $P(X = 2)$ and $P(X=3)$.	10
4(b)	Define the Standard Normal distribution and the Chi-Square distribution. Show that, if X is a standard normal variate then X^2 is a Chi-Square variate with parameter 1. Establish the intermediate result, if any.	10

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5(a)	Find the normal equations in order to fit a quadratic curve to the data given by $\{(X_i, Y_i), i = 1, 2, 3, \ldots, n\}$. Fit a curve of the form of $y = a.b^x$ to the data $\{(X, Y)$: (0, 1), (1, 2), (2, 5), (3, 10), (4, 17), (5, 26), (6, 30)$\}$.	16
5(b)	State the central limit theorem.	4
6(a)	State the principle of inclusion and exclusion giving a suitable example.	7
6(b)	Define the generating function. Find the generating functions for the following sequences. (i) {1, 0, 1, 0, ...} (ii) {1, 1, 1/2!, 1/3!, ...}	6
6(c)	Define a linear recurrence relation and find the general solution of the recurrence relation, $a_n - 6a_{n-1} + 9a_{n-2} = 0$, $a_0 = 5$, $a_1 = 12$.	7

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