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OFFICE OF THE DEPUTY PRINCIPAL

ACADEMICS, STUDENT AFFAIRS AND RESEARCH

UNIVERSITY EXAMINATIONS

2018 /2019 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER REGULAR EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE IN APPLIED STATISCTICS WITH COMPUTING

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COURSE CODE: STA 212

COURSE TITLE: MATHEMATICAL STATISTICS 1

DATE: 13 DECEMBER, 2018 **TIME: 9.00 AM – 12.00 PM**

INSTRUCTION TO CANDIDATES

- SEE INSIDE

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STA 212: MATHEMATICAL STATISTICS 1

STREAM: BSc (Applied Statistics with Computing) **DURATION: 3 Hours**

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INSTRUCTION TO CANDIDATES

Answer **ALL** questions from section A and **ANYTHREE** Questions in section B.
All questions in section B carry Equal Marks
Duration of the examination: 3 hours

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QUESTION ONE (16 Marks)

a) Let X and Y have joint pdf

$$f(x,y) = \begin{cases} k(x+y)I_{(0,1)}(x)I_{(0,1)}(y) \\ 0, & elsewhere \end{cases}$$

i. Obtain k [3Mks]

ii. Determine if X and Y are independent [3Mks]

iii. Find $E(Y/x)$ [3Mks]

b) If X and Y have joint pdf

$$f(x,y) = \begin{cases} 4\exp\{-2(x+y)\}, 0 < x < \infty, 0 < y < \infty \\ 0, & elsewhere \end{cases}$$

i) Obtain the joint moment generating function $M_{X,Y}(t_1 t_2)$ [3Mks]

ii) Hence or otherwise show that $cov(X,Y) = 0$ [3Mks]

iii) Find the distribution of X [1Mk]

QUESTION TWO (15Marks)

In an experiment three fair coins are tossed. If X is the number of heads in the first and third coins and Y is the number of heads from the second and third coins. Find the;

a) Joint probability mass function of X and Y [5Mks]

b) Correlation between X and Y [5Mks]

c) Joint cumulative distribution function $F_{X,Y}(x,y)$[5Mks]

SECTION B (39 marks)

QUESTION THREE (13marks)

a) Let X and Y be two continuous random variables with joint pdf $f(x,y)$. Prove that X and Y are stochastically independent if and only if $f(x,y)$ can be written as a product of non-negative function of x and non-negative function of y. [5Mks]

b) Let X and Y be two random variables such that

$$f_X(x) = I_{(0,1)}(x)$$

$f(y/x) = \binom{n}{y} x^y (1-x)^{n-y}$, y=0,1,2,…,n

i) Find $f_Y(y)$ [5Mks]

ii) Workout $E[E\ Y/x]$ [3Mks]

QUESTION FOUR(13marks)

a) If (X,Y) follows a bivariate normal distribution(assume usual notation), show that the conditional density of Y given X is also normal. [7Mks]

b) Let X denote the height in centimeter and Y the weight in kilograms of male college students. Assume that X and Y have a bivariate normal distribution with parameters $\mu_x = 185, \mu_y = 84, \sigma^2{}_x = 100, \sigma^2{}_y = 64$ and $\rho = \frac{3}{5}$

i) Obtain the conditional distribution of Y, given X=190 [2Mks]

ii) Find Pr $(86.4 < Y < 95.36/X = 190)$ [4Mks]

QUESTION FIVE(13marks)

If the joint density function of X and Y is given by

$$f(x,y) = \begin{cases} cxy, & 2 < x < y < 4 \\ 0, & elsewhere \end{cases}$$

i) Find c [3Mks]

ii) Obtain $f(y/x)$ [4Mks]

iii) Work out $Var(Y/x)$ [6Mks]

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QUESTION SIX(13marks)

If X and Y have the trinomial distribution

$$f(x,y) = \frac{n!}{x!\,y!\,(n-x-y)!} p^x q^y (1-p-q)^{n-x-y}$$

For $x, y = 0,1,2,\dots,n$ and $x + y \le n, 0 \le p, 0 \le q, p + q \le 1$

i) Find the conditional density of Y given X [5Mks]

ii) Obtain the correlation between X and Y [8Mks]

QUESTION SEVEN(13marks)

If X and Y have the joint density

$$f(x,y) = \begin{cases} c\exp -\frac{1}{2}(2x^2 + y^2 - 4x - 4y + 6) - \infty < x < \infty, -\infty < y < \infty \\ 0, \qquad elsewhere \end{cases}$$

i) Find c[4Mks]

ii) Find $f(y/x)$ [4Mks]

iii) Find $f(y)$ [3Mks]

iv) From your answers in parts ii) and iii) above what can you say about the correlation between X and Y [2Mks]

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