# RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SECOND SEMESTER EXAMINATION, MAY 2018 FIRST YEAR [BATCH 2017-20] STATISTICS (General) Paper : ||

Date : 26/05/2018 Time : 11 am - 1 pm

### [Use a separate Answer Book for each group]

## Group - A

1. Answer **any two** questions :

a) Suppose the three variables  $x_1$ ,  $x_2$  and  $x_3$  satisfy the relation  $a_1x_1 + a_2x_2 + a_3x_3 = K$ , then prove that  $r_{12} = \frac{a_3^2S_3^2 - a_1^2S_1^2 - a_2^2S_2^2}{2a_1a_2S_1S_2}$ , where symbols have their usual meanings. Also prove that all the partial correlation coefficients will be equal to -1, provided  $a_1, a_2, a_3$  are of same sign. [4+1]

- b) Prove that the standard error of estimate in case of multiple regression satisfies:  $S_{1\cdot23}^2 = (1 - r_{1\cdot23}^2)S_1^2$  where symbols have their usual meaning.
- c) In a trivariate distribution, it is found that  $r_{12} = 0.41$ ,  $r_{13} = 0.71$  and  $r_{23} = 0.5$ . Obtain the multiple correlation coefficient  $r_{1.23}$  and partial correlation coefficients  $r_{12.3}$  and  $r_{13.2}$ . [2+1.5+1.5]
- d) Define Correlation index. Show that the value of correlation index increases with degree of the polynomial taken as regression equation. [2+3]
- 2. Answer **any one** question :
  - a) What is an attribute? What is contingency table? How can you get an idea about the association of attributes from the contingency table?
     State three measures of association of attributes with their ranges. Write your idea about binary response and logistic regression. [2+2+3+6+2]
  - b) What do you mean by 'multiple correlation Coefficient'? Taking three variables express multiple correlation coefficient in terms of simple correlation coefficients. In a trivariate distribution it is found that  $r_{12} = 0.578$ ,  $r_{13} = 0.726$ ,  $r_{12\cdot3} = -0.221$ . Find  $r_{23}$ ,  $r_{13\cdot2}$ ,  $r_{1\cdot23}$ . [3+6+6]

## Group - B

- 3. Answer **any two** questions :
  - a) Let  $X \frown Poisson(\lambda)$ . For what value of X, is the p.m.f of X maximized? [5]
  - b) i) X & Y jointly follow bivariate Normal distribution. Show that X & Y are independent if the correlation coefficient between them is zero. [2]
    - ii) Find the density function of  $Y = e^{Z}$ , where  $z \smile N(\mu, \sigma^2)$ .
  - c) Let  $X \smile N(\mu, \sigma^2)$ . Find the value of c in terms of  $\sigma$  such that  $P(\mu c \le X \le \mu + c) = 0.95$ .

[Given, 
$$\int_{0}^{1.96} \frac{1}{\sqrt{2\pi}} e^{-\frac{t^2}{2}} dt = 0.475$$
] [5]

[2×5]

Full Marks : 50

[5]

[1×15]

[2×5]

[3]

- d) i) A fair coin is thrown once, if it lands heads up, it is thrown a second time. Find the probability distribution of the total number of heads. [3]
  - ii) If there is a war every 15 years on an average, find the probability that there will be no war in 25 years.

[1×15]

[4]

[5]

[5]

#### Answer <u>any one</u> question between <u>Question no. 4 & 5</u> :

- 4. a) For two jointly distributed random variable X & Y, prove E(Y) = EE(Y | X).
  - b) Find out the points of inflection of the normal distribution with the density function :

$$f(x) = \frac{1}{\sqrt{18\pi}} e^{-\frac{(x-7)^2}{18}}, -\infty < x < \infty.$$
[3]

c) In a normal distribution, 46% of the items are over 40 and 90% are under 75. Find the mean and standard deviation of the distribution.

(Given that 
$$\int_{-\infty}^{x} \frac{1}{\sqrt{2\pi}} e^{-\frac{t^2}{2}} dt = 0.54$$
 or 0.90 according as  $x = 0.10$  or 1.28) [8]

- 5. a) Use Normal approximation to the binomial distribution to determine the probability that number of heads lies between 6 & 8 in 16 flips of a balanced coin.
  - b) An oil company conducts a geological study that indicates that an exploratory oil well should have a 20% chance of striking oil. What is the probability that the third strike comes on the seventh well drilled?
  - c) Buses arrive a bus stop according to an exponential distribution with rate  $\lambda = 4$  buses/hour. If you arrived at 8.00am at the bus stop, what is the expected time of the next bus? [5]

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FUNDAMENTALS OF STATISTICS Ordinates and Areas of the Distribut	STANDARD NORMAL VARIABLE*	$\phi(r)  \phi(r)  r  \phi(r)  \phi(r)$	15:1	·5039894 ·51 ·3502919 ·6949743 1·01 ·2395511 ·8437524	·5079783 ·52 ·3484925 ·6984682 1·02 ·2371320 ·8461358 1	1 00563430 02064270 02064101 02461010 02464050 020 02061100 1 005804280 02062560 001 010461010 02180420 020 02061100	· 5199388 · 55 · 3429439 · 7088403 1-05 · 2298821 · 8531409	·5239222 ·56 ·3410458 ·7122603 1·06 ·2274696 ·8554277	·5279032 ·57 ·3391243 ·7156612 1·07 ·2250599 ·8576903 1	·5318814 ·58 ·3371799 ·7190427 1.08 ·2226535 ·8599289 1	·5358564 ·59 ·3352132 ·7224047 1.09 ·2202508 ·8621434 1	·5398278 ·60 ·3332246 ·7257469 1·10 ·2178522 ·8643339 1	1 1000000 7904017 11.1 1600671 1417100 10. 0041040	-63 -3271330 -7356527 1-13 -2106856 -8707619	0 · · · · · · · · · · · · · · · · · · ·	·3229724 ·7421539 1·15 ·2059363 ·8749281 1	1	·68 ·3165929 ·7517478 1·18 ·1988631	·3144317 ·7549029 1·19 ·1965205 ·3122539 ·7580363 1·20 ·1941861	· 71 · 3100603 · 7611479 1·21 · 1918602 ·	· 3078513 ·7642375 1·22 ·1895432 ·	· 74 · 3033893 · 7703500 1.24 · 1849373	·3011374 ·7733726 1.25 ·1826491 ·	· 77 · 2965948 · 7793501 1.20 · 1781038	·78 ·2943050 ·7823046 1·28 ·1758474	22002011. 22.1 1022281. 8200222.	·81 ·2873689 ·7910299 1·31 ·1691468	- 78250364 -7938919 1-32 -1669370 - - 78256945 -7967306 1-32 -1647307 -	·84 ·2803438 ·7995458 1·34 ·1625551	·2779849 ·8023375 1·35 ·1603833	- 2732444 - 8078498 1.37 - 1560797	· · · · · · · · · · · · · · · · · · ·	7202021 04-1 02020218- 4/12020- 2660812 04-1 02020218- 220202-	· -91 -2636880 -8185887 1-41 -1476385	·92 ·2612863 ·8212136 1·42 ·1455641 ·	· 2588805 ·8238145 1·43 ·1435046 ·	- 0004141. 44.1 2160020. 01/4002. 44.	· · · · · · · · · · · · · · · · · · ·	·97 ·2492277 ·8339768 1·47 ·1354181 ·	·6843863 ·98 ·2468095 ·8364569 1·48 ·1334353 ·
FUNDAMENTALS OF STATISTICS Ordinates and Areas of the Distribut	STANDARD NORMAL VARIABLE*	$\varphi(\tau)$ $\tau$ $\phi(\tau)$ $\varphi(\tau)$ $\tau$ $\phi(\tau)$ $\varphi(\tau)$		·5039894 ·51 ·3502919 ·6949743 1·01 ·2395511 ·8437524	·5079783 ·52 ·3484925 ·6984682 1·02 ·2371320 ·8461358 1	1 00080539 0000110 054610/0 1/000460 500 00061100 0 1 00080539 00000000 0001 00010 000000 0000000000	· 5199388 · 55 · 3429439 · 7088403 1-05 · 2298821 · 8531409	·5239222 ·56 ·3410458 ·7122603 1·06 ·2274696 ·8554277	·5279032 ·57 ·3391243 ·7156612 1·07 ·2250599 ·8576903 1	·5318814 ·58 ·3371799 ·7190427 1.08 ·2226535 ·8599289 1	·5358564 ·59 ·3352132 ·7224047 1.09 ·2202508 ·8621434 1	·5398278 ·60 ·3332246 ·7257469 1·10 ·2178522 ·8643339 1	1 10 000000 7904017 11.1 1600671 1417100 10. 0061040	·5517168 ·63 ·3271330 ·7356527 1·13 ·2106856 ·8707619	· · · 5556700 · · 64 · · 3250623 · 7389137 1 · 14 · · 2083078 · 8728568 1	· 5596177 · 65 · 3229724 · 7421539 1·15 · 2059363 · 8749281 1	5674949 67 -3187371 -7485711 1-17 -2012135 -8789995	·5714237 ·68 ·3165929 ·7517478 1·18 ·1988631	·5753454 ·69 ·3144317 ·7549029 1·19 ·1965205 ·5792597 ·70 ·3122539 ·7580363 1·20 ·1941861	· 5831662 ·71 ·3100603 ·7611479 1·21 ·1918602 ·	· 5870644 · 72 · 3078513 · 7642375 1·22 · 1895432 ·	· 5948349 ·74 ·3033893 ·7703500 1·24 ·1849373	· 5987063 · 75 · 3011374 · 7733726 1·25 · 1826491 ·	· 6064199 · 77 · 2965948 · 7793501 1.20 1781038	-6102612 778 ·2943050 ·7823046 1·28 ·1758474	0140419 11 027203 052200 0120 1120 1120 11200 1200 1200 1	·6217195 ·81 ·2873689 ·7910299 1·31 ·1691468 ·	- 052000 - 051000 - 0510000 - 05100000 - 05000000 - 05000000 - 0500000000	· •6330717 · 84 · 2803438 · 7995458 1· 34 · 1625551 ·	6368307 ·85 ·2779849 ·8023375 1·35 ·1603833	-6443088 -87 -2732444 -8078498 1-37 -1560797	0 6480273 88 2708640 8105703 1.38 1539483	- 201/317 - 89 -2084/14 -81/326/1 1:39 -15/8308 - 2777011 - 00 - 2660857 -81/50200 1:40 - 00 - 71/57308	· 6590970 · 91 · 2636880 · 8185887 1·41 · 1476385	-6627573 -92 -2612863 -8212136 1-42 -1455641 -	· · · · · · · · · · · · · · · · · · ·	- 0004141. 44.1 2160020. 01/4002. 46. 41000/0. Anthorn 2020020. 340501. 3210020. 3026302.	-6772419 -96 -2516443 -8314724 1-46 -1374165	-6808225 -97 -2492277 -8339768 1-47 -1354181 -	·6843863 ·98 ·2468095 ·8364569 1·48 ·1334353 ·
TABLE I ORDINATES AND AREAS OF THE DISTRIBUTION OF	STANDARD NORMAL VARIABLE*	$\tau \phi(\tau) \phi(\tau) \tau \phi(\tau) \phi(\tau)$		·5039894 ·51 ·3502919 ·6949743 1·01 ·2395511 ·8437524	1008625 50/9/83 52 3484925 6984682 1-02 2311320 8461358	1 0548495 851452 501 0546107 1/000465 505 11 10 10 10 10 10 10 10 10 10 10 10 10	· 5199388 · 55 · 3429439 · 7088403 1•05 · 2298821 · 8531409	· 3982248 · 5239222 · 56 · 3410458 · 7122603 1·06 · 2274696 · 8554277	·5279032 ·57 ·3391243 ·7156612 1·07 ·2250599 ·8576903 1	·5318814 ·58 ·3371799 ·7190427 1.08 ·2226535 ·8599289 1	·5358564 ·59 ·3352132 ·7224047 1.09 ·2202508 ·8621434 1	· · · · · · · · · · · · · · · · · · ·	1 1000000 7904017 11.1 1600671 1417100 10. 0041040	·5517168 ·63 ·3271330 ·7356527 1·13 ·2106856 ·8707619	· · · 5556700 · · 64 · · 3250623 · 7389137 1 · 14 · · 2083078 · 8728568 1	·65 ·3229724 ·7421539 1·15 ·2059363 ·8749281 1	5674949 67 -3187371 -7485711 1-17 -2012135 -8789995	·5714237 ·68 ·3165929 ·7517478 1·18 ·1988631	-69 -3144317 -7549029 1-19 -1965205 -70 -3122539 -7580363 1-20 -1941861	· 5831662 ·71 ·3100603 ·7611479 1·21 ·1918602 ·	· · ·72 ·3078513 ·7642375 1·22 ·1895432 ·	· 5948349 ·74 ·3033893 ·7703500 1·24 ·1849373	75 ·3011374 ·7733726 1·25 ·1826491 ·	· 6064199 · 77 · 2965948 · 7793501 1.20 1781038	·78 ·2943050 ·7823046 1·28 ·1758474	0140419 11 027203 052200 0120 1120 1120 11200 1200 1200 1	·6217195 ·81 ·2873689 ·7910299 1·31 ·1691468	- 2850364 - 7938919 1-32 - 1669370	· •6330717 · 84 · 2803438 · 7995458 1·34 · 1625551 ·	· · · · · · · · · · · · · · · · · · ·	-6443088 -87 -2732444 -8078498 1-37 -1560797	0 6480273 88 2708640 8105703 1.38 1539483	- 80 - 2084/14 - 81326/1 1-39 - 1518308	· 6590970 · 91 · 2636880 · 8185887 1·41 · 1476385	-6627573 -92 -2612863 -8212136 1-42 -1455641 -	-6664022 -93 -2588805 8238145 1-43 -1435046 - 6700214 -04 -2564713 -825912 1-44 -1414500	- 0004141. 44.1 2160020. 01/4002. 44.	-6772419 -96 -2516443 -8314724 1-46 -1374165 -	·6808225 ·97 ·2492277 ·8339768 1·47 ·1354181 ·	-98 -2468095 -8364569 1-48 -1334353 -

#### FUNDAMENTALS OF STATISTICS

TABLE I (Contd.)

τ)	φ(τ)	Φ(τ)	τ	φ(τ)	Φ(τ)	( <b>t</b> )	φ(τ)	Φ(τ)
3.01	.0043007	-9986938	3.21	·0023089	.9993363	3.41	·0011910	·9996752
3.02	·0041729	·9987361	3.22	·0022358	.9993590	3.42	.0011510	.9996869
3.03	·0040486	·9987772	3.23	·0021649	.9993810	3.43	.0011122	.9996982
3.04	·0039276	·9988171	3.24	·0020960	.9994024	3.44	.0010747	.9997091
3.05	·0038098	·9988558	3.25	·0020290	·9994230	3.45	.0010383	.9997197
3.06	·0036951	·9988933	3.26	.0019641	·9994429	3.46	.0010030	·9997299
3.07	.0035836	·9989297	3.27	.0019010	.9994623	3.47	.0009689	.9997398
3.08	·0034751	·9989650	3.28	.0018397	·9994810	3.48	.0009358	.9997493
3.09	.0033695	·9989992	3.29	.0017803	·9994991	3.49	.0009037	.9997585
3.10	.0032668	·9990324	3.30	.0017226	·9995166	3.50	.0008727	.9997674
3.11	.0031669	·9990646	3.31	.0016666	.9995335	3.51	.0008426	.9997759
3.12	.0030698	·9990957	3.32	.0016122	·9995499	3.52	.0008135	.9997842
3.13	·0029754	·9991260	3.33	.0015595	.9995658	3.53	.0007853	.9997922
3.14	.0028835	·9991553	3.34	.0015084	.9995811	3.54	.0007581	.9997999
3.15	·0027943	·9991836	3.35	.0014587	.9995959	3.55	.0007317	.9998074
3.16	·0027075	·9992112	3.36	.0014106	.9996103	3.56	.0007001	.9998146
3.17	·0026231	·9992378	3.37	.0013639	.9996242	3.57	.0006814	-9998215
3.18	·0025412	·9992636	3.38	-0013187	.9996376	3.58	.0006575	.9998282
3.15	.0024615	·9992886	3.39	.0012748	.9996505	3.59	·0006343	.9998347
3.20	·0023841	·9993129	3.40	.0012322	.9996631	3.60	.0006119	·9998409

\*Abridged from Table 1 of *Biometrika Tables for Statisticians*, vol. I, with the kind permission of the Biometrika Trustees.

0303370 9883962 20770 0086852 9981972 0206346 9886962 52780 0093697 9472621

113 - 0014910 - 9913437 288 0063007 - 9980116

TABLE II STANDARD NORMAL DISTRIBUTION Values of  $\tau_{\alpha}$ 

			a state of the state of the		
255 Ω 11342	0.02	0.025	0.01	0.005	189
	1.645	1.960	2.326	2.576	्रप्रदेश इ.स.
	928572 2295 00 9928572 2295 00 9930531 2296 00 9932445 2207 00	ALISED TOLED TOLED	14419 245 150021 245 245 245	0595947 0595947 0582407 0573035	N N

602