RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FOURTH SEMESTER EXAMINATION, AUGUST 2021

SECOND YEAR (BATCH 2019-22)

STATISTICS (General)

Time : 11.00 am – 1.00 pm

Date : 13/08/2021

Paper : IV

Group - A

Answer **any six** questions of the following :

- 1. Show that the sample mean is an unbiased estimator for the population mean, where the population is normally distributed.
- 2. Derive the *MLE* of μ , when the observations X_1, X_2, \dots, X_n are drawn from $N(\mu, \sigma^2)$.
- 3. What are sufficient conditions for an estimator to be consistent? Give an example of an estimator which is both unbiased and consistent.
- 4. Explain, using the appropriate diagram, why the probability of type-I error increases when the probability of type -II error decreases.
- 5. When and how is the paired-t test used?
- 6. Suppose a random sample of size 10, drawn from a normal population, has mean 40 & s.d. 12. Find 99 % confidence limits for the population mean (Given $t_{0.005} = 3.25$ for 9 df.)
- 7. If X_1, X_2, \dots, X_n is a random sample drawn from

$$f(x) = \frac{1}{\sqrt{2\pi\theta}} e^{-\frac{x^2}{2\theta}}; -\infty < x < \infty$$

Show that $\frac{\sum X_i^2}{n}$ is an unbiased estimator of θ .

Group - B

Answer **any four** questions of the following :

8. Why is it necessary to attach weights to price relatives to get a proper index number?

Why are the weights used in Laspeyres' index number considered more meaningful than those considered in Paasche's index number?

- 9. Let the price index numbers computed by Laspeyres' and Paasche's methods be denoted respectively by L(p) and P(p). Let similar quantities for quantity indices be defined and denoted as L(q) and P(q). Prove that if the values of any three of the above are known, the remaining one can be calculated.
- 10. What is the purpose of stratification in sampling? Discuss bias in sample survey? Why is the method of systematic sampling widely used in Practice? Illustrate your answer with some practical situations.
- 11. List the main components of a time series. With which component of time series would you associate each of the following? Why?
 - i) The rainfall that occurred in Calcutta for four days in February, 1981;
 - ii) A decline in ice cream sales during November to March;

[6×5]

Full Marks: 75

[4×5]

(2+3)

(3+2)

- iii) An era of prosperity;
- iv) Increase in garment sales in October.
- 12. Suppose a simple random sample of size 2 is drawn from a finite population (y_1, y_2, y_3) . Corresponding to the three possible samples $S_1 = (y_1, y_2)$, $S_2 = (y_2, y_3)$ and $S_3 = (y_1, y_3)$ a linear estimator l(S) for estimating the population mean is defined as $l(S_1) = \frac{2}{3}y_1 + \frac{1}{2}y_2$, $l(S_2) = \frac{1}{2}y_2 + \frac{1}{2}y_3$, $l(S_3) = \frac{1}{3}y_1 + \frac{1}{2}y_3$

Show that the estimator l(S) is unbiased estimator of population mean and obtain its variance.

Group - C

Answer **any one** question from the following :

13. i) Ten individuals are selected at random from a normal population and the heights are found to be in inches : 63, 66, 63, 67, 68, 69, 70, 71,68, 71. In the light of these date, carry out the test that population mean height is 66 inches. i.e. test

 $H_0:mean = 66$ $H_1:mean \neq 66$

[Take level of significance as 0.05. You're provided with the information that $t_{0.025,9} = 2.262$]

ii) Two random sample of sizes 9 and 8 give the sum of squares of deviations for the respective mean, equal to 180 and 100 respectively. Can they be regarded as drawn from the same normal populations. [Given $F_{8,7} = 6.84$ at $\alpha = 0.01$]

14. A die is thrown 120 times and the frequencies of different faces observed are as follows :

Face	1	2	3	4	5	6	Total
Observed Frequency	25	17	15	23	24	16	120

Test the hypothesis that the die is fair using a significance level 0.05.

[Given $P[\chi^2 > 11.1] = 0.05$ for 5df.]

Group - D

Answer **any one** question from the following :

15. A sample of size 20 is to be drawn from a population of size 300, using systematic sampling technique and find an unbiased estimator of the population mean and an unbiased estimator of its variance.

[1×5]

[1×10]

(5+5)

16. The following figures give the production of commodity of a country from 2001 to 2007:

Year	Production (in thousand metric tonnes)
2001	4.7
2002	5.9
2003	7.2
2004	7.9
2005	7.6
2006	7.0
2007	7.9

Obtain the trend values by a four year moving average method.

Answer any one question from the following :

17. A sequence of price indices was constructed with 2001 as base year and from 2004, the base year was changed to 2003. Using the data given below, splice the first series (with base 2001) to second series (with base 2003) and then calculate new indices by shifting the base to 2004.

Year	2001	2002	2003	2004	2005	2006
IN ₂₀₀₁	100	125	118.75	-	-	-
IN ₂₀₀₃	-	-	100	115	124.2	130.41

18. A simple random sample of 25 households was drawn from a city area containing 13745 households. The number of persons per household in the sample were as follows: 5, 6, 3, 4, 2, 3, 3, 3, 4, 4, 3, 2, 7, 4, 7, 6, 4, 4, 1, 4, 3, 4, 5, 6, 3.

Estimate the total number of people in the area and also compute the variance of estimate.

[1×10]

	and the state	RANDOM	1 SAMPL	E VI	MBERS *		
4652	3819	8431	2150	2352	2472	0043	3488
9031	7617	1220	4129	7148	1943	4890	1749
2030	2327	7353	6007	9410	9179	2722	8445
0641	1489	0828	0385	8488	0422	7209	4950
8479	6062	5593	6322	9439	4996	1322	4918
9917	3490	5533	2577	4348	0971	2580	1943
6376	9899	9259	5117	1336	0146	0680	4052
7287	0983	3236	3252	0277	8001	6058	4501
0592	4912	3457	8773	5146	2519	3931	6794
6499	9118	3711	8838	0691	1425	7768	9544
0769	1109	7909	4528	8772	1876	2113	4781
8678	4873	2061	1835	0954	5026	2967	6560
0178	7794	6488	7364	4094	1649	2284	7753
3392	0963	6364	5762	0322	2592	3452	9002
0264	6009	1311	5873	5926	8597	9051	8995
4089	7732	8163	2798	1984	1292	0041	2500
9376	7365	7987	1937	2251	3411	6737	0367
3039	3780	2137	7641	4030	1604	2517	9211
8971	8653	1855	5285	5631	2649	6696	5475
0373	4153	5199	5765	2067	6627	3100	5716
9092	4773	0002	7000	7800	2292	2933	6125
2464	1038	3163	3569	7155	2029	2538	7080
3027	6215	3125	5856	9543	3660	0255	5544
5754	9247	1164	3283	1865	5274	5471	1346
4358	3716	6949	8502	1573	5763	5046	7135
7178	8324	8379	7365	4577	4864	0629	5100
5035	5939	3665	2160	6700	7249	1738	2721
3318	0220	3611	9887	4608	8664	2185	7290
9058	1735	7435	6822	6622	8286	8901	5534
7886	5182	7595	0305	4903	3306	8088	3899
3354	8454	7386	1333	5345	6565	3159	3991
3415	7671	0846	7100	1790	9449	6285	2525
3918	5872	7898	6125	2268	1898	0755	6034
6138	9045	6950	8843	6533	0917	6673	5721
3825	1704	2835	4677	4637	7329	3156	3291
1349 4234 6880 0714 3448	0417 0248 3201 5008	9311 7760 7044 5076	9787 6504 3657 1134 0583	1284 2754 5263 5342 1260	0769 4044 0374 1608 0662	8422 0842 7563 5179 7257	1077 9080 6599 0967 0766
5711 2588 8581 8475 0272	7343 3301 4253 6322	7539 0553 7404 3949	3684 2427 5264 9675	9397 3598 5411 6533 7469	5335 2580 3431 1133 2799	4031 7017 3092 8776 2822	1486 9176 8573 2216 9620
7383 5126 2064 9315 6814	5624 7795 2089 3760 8185	8549 7939 7729 0939 7805	2652 0945 7319 6294	4456 3901 5939 7072	6993 4445 3432 6491 3895	2950 7117 2030 4012 7371	8573 8186 4752 1016 3432
	4652 9031 2030 0641 8479 9917 6376 7287 0592 6499 0769 8678 0178 3392 0264 4089 9376 3039 8971 0373 9092 2464 3027 5754 4358 7178 5035 3318 9058 7886 3354 3354 3354 3354 3354 3354 3358 7886 3354 3358 7886 3354 3354 3354 3358 7886 3354 3358 7886 3354 3354 3354 3354 3354 3358 7886 3354 3354 3354 3354 3354 3354 3354 335	4652 3819 9031 7617 2030 2327 0641 1489 8479 6062 9917 3490 6376 9899 7287 0983 0592 4912 6499 9118 0769 1109 8678 4873 0178 7794 3392 0963 0264 6009 4089 7732 9376 7365 3039 3780 8971 8653 0373 4153 9092 4773 2464 1038 3027 6215 5754 9247 4358 3716 7178 8324 5035 5939 3318 0220 9058 1735 7886 5182 3354 8454 3415 7671 3918 5872 6138 9045 3825	RANDON 4652 3819 8431 9031 7617 12327 0641 1489 0828 8479 6062 5593 9376 9899 9259 7287 0983 3236 0592 4912 3457 6499 9118 3711 0769 1109 7909 86778 4873 2061 0178 7794 6488 3392 0963 6364 0264 6009 1311 4089 7732 8163 9376 7365 7987 3039 3780 2137 8971 8653 1855 0373 4153 5199 9092 4773 0002 2464 1038 3163 3027 6215 3125 5754 9247 1164 4358 3716 6949 7178 8	4652 3819 8431 2150 9031 7617 1220 4129 2031 7617 1220 4129 2031 7617 1220 4129 9031 7617 1220 4129 2031 7617 1220 4129 9031 7617 1220 4129 9037 3490 9523 2577 6499 9118 3711 8838 0769 1109 7909 4528 8678 4873 2061 1835 3392 0963 6364 5762 0264 6009 1311 5873 4089 7732 8163 27987 3039 3780 2137 7641 8971 8653 1855 5285 9092 4773 0002 7000 2464 1038 3163 3569 3027 6215 3125 5856	TABLE VI RANDOM SAMPLING NUM 46552 3819 8431 2150 2352 2030 72277 7323 6007 9410 96971 14899 9828 0385 8488 96976 34900 5533 2577 4348 6377 4990 5533 2577 4348 6376 9899 9259 5117 1336 6499 9118 3711 8838 0691 0769 1109 7909 4528 8772 0178 77943 2061 1835 0954 0178 77923 8163 2798 1984 30392 0963 63644 5762 0322 4089 7732 8163 2798 1984 30393 3780 2137 7641 4030 0373 4153 5195 5265 5631 0373 3173 5155 5285 5631	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	TABLE YI RANDOM SAMPLING NUMBERS - 46557 3819 8431 2150 2352 2472 4043 2030 7327 12323 4129 7148 1943 0443 2034 1489 9828 6007 9410 9173 27202 8479 0480 5533 6322 9439 4996 1322 6626 5593 6325 9439 4996 1322 6627 9917 3490 5533 2577 4348 0462 2519 6678 99118 3711 8573 5146 2519 3931 0769 1099 7909 4528 8772 1876 2113 0769 1093 7365 7987 1937 2251 1409 22844 0322 0963 6364 5762 0322 29923 3452 0264 6009 1311 5875 5285 5631 2649 66966 <tr< th=""></tr<>

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