7. (a) Define simple random sampling i) with replacement, ii) without replacement from a finite population. Derive the unbiased estimates of the population mean and its variance based on the above two methods.

   (b) How does sampling without replacement differ from that with replacement ? Which of them gives a lower value of the standard deviation of the sample mean ? Explain by considering sample of size 2 from a population consisting of the five numbers 2, 3, 6, 8, 11. 5+5

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Ex/MATH/STAT/22/11STAT/2019(OLD)

BACHELOR OF SCIENCE EXAMINATION, 2019

(2nd Year, 2nd Semester, Old Syllabus)

MATHEMATICS (HONOURS)

Sample Survey and Design of Experiments

Paper : 11 STAT

Time : Two hours Full Marks : 50

Figures in the margin indicate full marks.
Symbols and Notations have their usual meanings.

Answer any ***five*** questions.

1. Describe the following three fundamental principles. i) randomisation, ii) replication, iii) local control. Discuss how the efficiency of an experiment can be increased by increased replication and local control. 10

2. What is meant by a Randomised block design (RBD)? Give the analysis of variance for the design. Obtain the efficiency of this design compared to completely randomised design (CRD). Discuss the advantages and disadvantages of RBD. 10

3. A varietal trial was conducted at a Research Station. The design adopted for the same was five randomised blocks of 6 plots each. The yields in lb. per plot (of 1/20th of an acre) obtained from the experiment is as under : varieties

Blocks	Varieties					
	V_1	V_2	V_3	V_4	V_5	V_6
I	30	23	34	25	20	13
II	39	22	28	25	28	32
III	56	43	43	31	49	17
IV	38	45	36	35	32	20
V	44	51	23	58	40	30

given that $F_{0.05}(4,20) = 2.87$, $F_{0.05}(5,20) = 2.71$. Analyse the design and comment on your findings. 10

4. Discuss about the layout, analysis, advantage and disadvantages of Latin Square Design (LSD). 10

5. An experiment was carried out to determine the effect of claying the ground on the field of barley grains; amount of clay used were as follows :

   A : No clay; B: clay at 100 per acre;

   C: clay at 200 per acre; D: clay at 300 per acre.

   The yields were in plots of 8 meters by 8 meters and layout were :

Row ↓ / Column →	I	II	III	IV	Row total R_i
I	D 29.1	B 18.9	C 29.4	A 5.7	83.1
II	C 16.4	A 10.2	D 21.2	B 19.1	66.9
III	A 5.4	D 38.8	B 24.0	C 37.0	105.2
IV	B 24.9	C 41.7	A 9.5	D 28.9	105.0
Column Total (C_i)	75.8	109.6	84.1	90.7	360.2

(a) Perform the ANOVA and calculate the critical difference for the treatment mean yields.

(b) Calculate the efficiency of the above LSD over i) RBD and ii) CRD. 5+5

6. Define 'factorial experiments'. State the advantages of a factorial experiment over a simple experiment.

   What is a treatment contrast ? When are two such contrasts said to be orthogonal ? Show that in 2^3-experiment the main effects and interactions are mutually orthogonal. 10