

**MAHARASHTRA AGRICULTURAL UNIVERSITIES EXAMINATION BOARD, PUNE  
SEMESTER END THEORY EXAMINATION**

**B.Sc. (Hons.) Agriculture**

Semester	: III (New)	Term	: First	Academic Year	: 2023-24
Course No.	: STAT 231	Title	: Statistical Methods		
Credits	: 2 (1+1)				
Day & Date	:	Time (hrs.)	: 2 hrs.	Total Marks	: 40

- Note :**
1. Solve **ANY EIGHT** questions from **SECTION 'A'**.
  2. All questions from **SECTION 'B'** are compulsory.
  3. All questions carry equal marks.
  4. Draw neat diagrams wherever necessary.

**SECTION 'A'**

**Q.1** Define statistics. Write its applications in Agriculture and limitations.. Marking scheme

**Ans:** Definition : Any one definition of Statistics  
e.g It is Science of collection, classification, analysis and interpretation of data 02 marks

Applications in Agriculture : 1. To determine fertilizer dose 2. In the process of Release of varieties 3) Comparison of various treatments like varieties, fertilizers, chemicals, machines etc. 4) Growth rates 5) Study of market rates 6) Prediction of whether etc 01 mark

Limitations 1. It does not deal with individual measurements  
2. It deals only with quantitative characteristics. 01 mark  
3. Its results are true only on an average.  
4. Statistics is only one of the methods of studying a problems

**Q.2** Define various measures of central tendency for ungroup data. Write its merits and demerits.

**Ans:** Various measures like mean, median, mode, Geometric mean , Harmonic mean with formulas for ungroup data 02 marks

Merits and Demerits

1. Mean –  
Merits – rigidly defined, based on all observations, Useful for further mathematical treatment etc 02 marks

Demerits – Very small & large items affect mean, not useful for open end class etc

2. Median –  
Merits – useful in open end classes, extreme value does not affect, not useful for further mathematical treatment etc

Demerits- arrangement of data, positional avg., not based on all observation , not appropriate measure etc

3. Mode-  
 Merits- most typical value, – useful in open end classes, extreme value does not affect, not useful for further mathematical treatment, etc  
 Demerits- positional avg., not based on all observation , not appropriate measure, etc

4. Geometric mean-  
 Merits – To compute average of rates, ratios, percentages etc.  
 Demerit: Cannot be calculated if any of the observation is zero, Not easy to calculate etc.

5. Harmonic mean:-  
 Merits – rigidly defined, based on all observations, Useful for further mathematical treatment, Give more weightage to smaller values as compare to larger one  
 Demerits – Not easy to understand, Calculations not easy and not possible if observations include zero. etc

Q.3 Enlist any four sampling methods and explain any two in detail.

**Ans:** Simple Random Sampling, Stratified Random Sampling, Cluster Sampling, Systematic Random Sampling - 2 marks

Details of any two methods 2 marks

Simple Random Sampling- Every unit of the population has an equal chance of selection

Stratified Random Sampling – used when population is heterogeneous

Cluster sampling- In this method cluster of population is selected randomly and each of unit is included in the sample.

Systematic Sampling – In this method Sample is selected at regular interval

Q.4 Define various absolute measures of dispersion for ungroup data. Describe importance of coefficient of variation.

**Ans:** Various absolute measures like Range, Mean Deviation, Standard Deviation, Variance with formulas 3 marks

1. RANGE = Highest Value - Lowest Value

2. Mean Deviation =  $\sum \text{Abs}(x_i - \bar{x}) / n$

3. S.D. =  $1/n \sum (x_i - \bar{x})^2$

Variance =  $(SD)^2$  Importance of CV –It is used for comparing variation in data with different units.

Coefficient of variation(C.V)=  $\frac{\text{Std.Deviation}}{\text{Mean}} * 100 = \frac{\sigma}{\bar{x}} * 100$  1 marks

Q.5 Define Correlation . Write formula and properties of Karl Pearson's correlation coefficient.

Ans: Definition of correlation :- Linear relationship between two variables

1 marks

Formula of Karl Pearson's correlation coefficient. Denoted by  $r_{xy}$

1 Mark

$$r_{xy} = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n \sum x^2 - (\sum x)^2][n \sum y^2 - (\sum y)^2]}}$$

Properties of Karl Pearson's correlation coefficient.

1) It ranges from -1 to +1 2) Not affected by change of origin and scale 2 marks

3)  $r_{xy} = 0$  No correlation 4)  $r_{xy} > 0$  +ve correlation 5)  $r_{xy} < 0$

Negative correlation etc

Q.6 Define Binomial and Poisson distribution.

Ans: Definition i.e. Probability Mass Function of Binomial

2 marks each

A discrete random variable X is said to follow Binomial Distribution iff

$$P(x) = \binom{n}{x} q^{n-x} p^x \quad \text{Where,}$$

$p$  = Probability of success in a single trial,  $q = 1 - p$ ,  $n$  = Number of trials  
 $x$  = Number of successes in  $n$  trials and

A discrete random variable X taking values 0,1,2,... is said to follow Poisson distribution with parameter  $m$  if its probability mass function is given by

$$P[X = x] = \frac{e^{-m} m^x}{x!}; x = 0, 1, 2, \dots$$

$= 0$ ; otherwise

Q.7. Explain various types of 't' tests with formulas and test procedure.

Ans: One sample, Two sample and Paired 't' test with formulas and test procedure

4 marks

Test Procedure: If  $t(\text{cal}) \leq t(\text{table})$  accept  $H_0$  Otherwise Reject  $H_0$

Q.8 Define regression coefficient. What are advantages of regression over correlation?

Ans: Regression coefficient – Change in value of dependant Variable per unit change in value of independent variable or  $b_{xy} = r(\sigma_x/\sigma_y)$ ,  $b_{yx} = r(\sigma_y/\sigma_x)$

02 Marks

Advantages

02 Marks

1. Regression is used for prediction purpose whereas correlation will not used of prediction.
2. Regression can study non-linear relation but correlation can study linear relation only. etc.

Q.9 Define normal distribution and write its properties.

Ans: Normal distribution(N.D.) –definition- p.d.f.

02 Marks

A Continuous random variable  $x$  is said to follow normal distribution iff its PDF is given by  $f(x, \mu, \sigma) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$ .

Properties – bell shape curve, Symmetric, Mean= Median = Mode =  $\mu$ ,

02 Marks

Variance=  $\sigma^2$ , Area under curves = 1, It is continuous distribution,  $-\infty \leq X \leq \infty$  etc

Q.10 Write structure of ANOVA table for one way classification with its assumptions.

Ans: Structure of ANOVA

02 Marks

Source of Variation	D.F.	S.S.	M.S.S.	F cal	F table
Treatment	t-1	SS due to Treatment = SST	MSS due to Treatment = MST	MST/MSE	Table F at (t-1, N-t) df
Error	N-t	SS due to Error = SSE	MSS due to Error = MSE	---	
Total	N-1	Total S.S			

02 Marks

Assumptions : 1. Parent population is normal 2. Errors are independent

3. All the samples are random 4. Various effects are Additive

Q.11 Do as directed

1) Define null hypothesis :- Hypothesis of no difference, It is denoted by  $H_0$

2) State Addition theorem of probability -  $P(A \cup B) = P(A) + P(B) - P(A \cap B)$   
 $\cap$ -Intersection

3) 'Z' test is small sample test - State true or false - **False**

4) Define type-I Error : – Rejecting null hypothesis when it is true

1 mark  
each for  
correct  
answer

Q.12 Fill in the blanks

1) The range of probability is between 0 to 1

2) The standard deviation of 5,5,5,5,5, is 0 (Zero)

3) Goodness of fit is tested by **Chi-Square test**.

4) **Histogram** is used to determine mode graphically.

1 mark  
each for  
correct  
answer

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