SSR Degree and PG College (Autonomous)

Department of Statistics

Sem-III Int-I Question Bank

Part A: Multiple Choice Questions

1. A point estimator is: [ ]

A) A range of values used to estimate a parameter

B) A single numerical value used to estimate a population parameter

C) A graph representing sample data

D) A hypothesis about a parameter

Answer: B

2. Which of the following is a desirable property of a good estimator? [ ]

A) Bias

B) Inconsistency

C) Efficiency

D) Randomness

Answer: C

3. An estimator is said to be unbiased if: [ ]

A) Its variance is zero

B) Its expected value equals the true parameter

C) It always overestimates the parameter

D) It has minimum variance

Answer: B

4. Which method estimates parameters by equating sample moments to population moments? [ ]

A) Maximum Likelihood Method

B) Least Squares Method

C) Method of Moments

D) Bayesian Method

Answer: C

5. The Maximum Likelihood Estimator (MLE) maximizes: [ ]

A) Sample variance

B) Probability density of the observed sample

C) Population variance

D) Sample size

Answer: B

6. Which estimator generally possesses the asymptotic property of efficiency? [ ]

A) Method of Moments Estimator

B) Maximum Likelihood Estimator

C) Median Estimator

D) Range Estimator

Answer: B

7. An estimator is consistent if: [ ]

A) It is unbiased

B) It converges in probability to the true parameter as sample size increases

C) It has minimum variance

D) It is always normally distributed

Answer: B

8. A statistic is sufficient for a parameter if it: [ ]

A) Depends only on the parameter

B) Contains all the sample information about the parameter

C) Has zero variance

D) Is always unbiased

Answer: B

9. Which theorem is commonly used to verify sufficiency? [ ]

A) Bayes' Theorem

B) Rao-Blackwell Theorem

C) Neyman-Fisher Factorization Theorem

D) Central Limit Theorem

Answer: C

10. Which family includes Normal, Poisson, and Binomial distributions? [ ]

A) Uniform Family

B) Exponential Family

C) Gamma Family

D) Weibull Family

Answer: B

11. A probability distribution belongs to the exponential family if it can be expressed in: [ ]

A) Polynomial form

B) Logarithmic form

C) Exponential form

D) Trigonometric form

Answer: C

12. The likelihood function is viewed as a function of: [ ]

A) Sample observations

B) Parameters

C) Variance only

D) Population size

Answer: B

13. Which estimator is generally easier to compute? [ ]

A) Method of Moments Estimator

B) Bayesian Estimator

C) Jackknife Estimator

D) Bootstrap Estimator

Answer: A

14. The modal unbiased estimator is based on: [ ]

A) Mean

B) Median

C) Mode

D) Variance

Answer: C

15. Which estimator minimizes mean squared error among unbiased estimators? [ ]

A) Efficient estimator

B) Inconsistent estimator

C) Biased estimator

D) Sufficient estimator

Answer: A

16. Which property ensures that larger samples produce estimates closer to the true parameter? [ ]

A) Sufficiency

B) Consistency

C) Efficiency

D) Completeness

Answer: B

17. Efficiency , e = _____

A) V1

B) V1/V2

C) T1/T2

D) 1

Answer: B

18. Which of the following is not necessarily unbiased?

A) Sample Mean

B) Sample Proportion

C) Maximum Likelihood Estimator

D) Sample Variance (with denominator n−1)

Answer: C

19. The factorization theorem is primarily used for:

A) Finding confidence intervals

B) Testing hypotheses

C) Finding sufficient statistics

D) Finding sample variance

Answer: C

20. For a normal population with known variance, the MLE of the mean is:

A) Population Mean

B) Sample Mean

C) Sample Median

D) Sample Mode

Answer: B

Part B: Fill in the Blanks

1.A_____ estimator gives a single value estimate of a population parameter.

Answer: point

2.An estimator whose expected value equals the parameter is called an _____ estimator.

Answer: unbiased

3.An estimator converging in probability to the true parameter is called _____.

Answer: consistent

4.The _____ method equates sample moments with population moments.

Answer: method of moments

5.MLE stands for Maximum _____ Estimator.

Answer: Likelihood

6.The logarithm of the likelihood function is called the _____ likelihood.

Answer: log

7.A statistic containing all information about a parameter is called a _____ statistic.

Answer: sufficient

8.The Neyman-Fisher _____ theorem provides a criterion for sufficiency.

Answer: Factorization

9.The Normal distribution belongs to the _____ family of distributions.

Answer: exponential

10.The sample mean is an unbiased estimator of the population _____.

Answer: mean

11.The expected value of an unbiased estimator equals the true _____.

Answer: parameter

12.The score function is the derivative of the _____ likelihood function.

Answer: log

13.An efficient estimator has the _____ variance among unbiased estimators.

Answer: minimum

14.The sample median estimates the population _____.

Answer: median

15.A modal unbiased estimator is related to the population _____.

Answer: mode

16.Method of moments usually requires solving _____ equations.

Answer: moment

17.The MLE is obtained by maximizing the _____ function.

Answer: likelihood

18.A sufficient statistic reduces loss of _____ about the parameter.

Answer: information

19.Consistency is an _____ property. Answer: asymptotic

20.Exponential family distributions have a common _____ form.

Answer: exponential

Part C: Short Answer Questions

1. Define a point estimator and point estimation.

Answer:

A **point estimator** is a statistic calculated from sample data that is used to estimate an unknown population parameter. A **point estimate** is the numerical value obtained from the estimator for a particular sample.

Example:

The sample mean $\bar{X}$ is a point estimator of the population mean μ. If $\bar{X}=25$, then 25 is the point estimate of μ.

2. Explain the concept of an unbiased estimator with an example.

Answer:

An estimator is **unbiased** if its expected value is equal to the true value of the population parameter. Mathematically,

$E(\hat{\theta})=\theta$

where $\hat{\theta}$ is the estimator and θ is the parameter.

Example:

The sample mean $\bar{X}$ is an unbiased estimator of the population mean μ because $E(\bar{X})=\mu$.

3. What is meant by consistency of an estimator? State its importance.

Answer:

An estimator is **consistent** if it converges in probability to the true parameter as the sample size increases indefinitely.

Mathematically,

$\hat{\theta} \to P(\theta)$ as $n \to \infty$.

Importance:

- Produces more accurate estimates as sample size increases.
- Ensures reliability in large-sample inference.
- It is one of the most desirable properties of an estimator.

4. Define the exponential family of distributions. Write its general form.

Answer:

A probability distribution belongs to the **exponential family** if it can be expressed in the form

$f(x;\theta)=h(x)\exp[\eta(\theta)T(x)-A(\theta)]$,

where:

- $h(x)$ depends only on the observation,
- $\eta(\theta)$ is the natural parameter,
- $T(x)$ is the sufficient statistic,
- $A(\theta)$ is the normalizing function.

Examples: Normal, Binomial, Poisson, Gamma, and Exponential distributions.

5. Explain the method of moments for estimating parameters.

Answer:

The **Method of Moments (MOM)** estimates unknown parameters by equating sample moments to the corresponding population moments.

Steps:

1. Find the population moments.
2. Calculate the sample moments.
3. Equate sample moments to population moments.
4. Solve the resulting equations to estimate the parameters.

Advantage: Easy to apply.
Disadvantage: Estimates may not be the most efficient.

6. Describe the principle of maximum likelihood estimation.

Answer:
The **Maximum Likelihood Estimation (MLE)** method estimates parameters by choosing the values that maximize the likelihood of obtaining the observed sample.
For a sample X1,X2,…,Xn,
$L(\theta)=\pi f(x_i;\theta)$.
Usually, the log-likelihood is used:
$\ell(\theta)=\log L(\theta)$.
The MLE is obtained by solving
$d\ell(\theta)/d\theta=0$
and verifying that it gives a maximum.

7. What is a sufficient statistic? State the Neyman–Fisher Factorization Theorem.

Answer:
A **sufficient statistic** is a statistic that contains all the information in the sample about the unknown parameter.
Neyman–Fisher Factorization Theorem:
A statistic T(X) is sufficient for parameter θ if and only if the joint probability density (or mass) function can be written as
$f(x_1,\ldots,x_n;\theta)=g[T(x),\theta]\,h(x)$,
where: g(T(x),θ) depends on the data only through T(x),

h(x) does not depend on θ.

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8. What are median unbiased and modal unbiased estimators? Explain briefly.

Answer:
Median Unbiased Estimator:
An estimator θ^ is **median unbiased** if the median of its sampling distribution equals the true parameter.

$P(\theta\hat{} \leq \theta) \geq 1/2$, $P(\theta\hat{} \geq \theta) \geq 1/2$.

Modal Unbiased Estimator:

An estimator is **modal unbiased** if the mode (the most probable value) of its sampling distribution is equal to the true parameter.

These concepts are useful when the sampling distribution is asymmetric or when mean unbiasedness is not appropriate.

9. Find sufficient statistic for exponential distribution?

10.Find the estimator of p in binomial distribution by using method of moments?