Point Estimation – Quiz

Probability & Statistics

Question 1

What is a point estimator?

A. A single number that estimates a population parameter
B. An interval of possible values
C. The true population value
D. A hypothesis test result

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Answer: A

A point estimator is a function of sample data that produces a single number (point estimate) to estimate an unknown population parameter.

Question 2

The symbol theta-hat represents:

A. The true population parameter
B. An estimator of the population parameter
C. The sample size
D. The standard error

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Answer: B
The 'hat' notation theta-hat denotes an estimator of the parameter theta, computed from sample data.

Question 3

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B. Expected value equal to the true parameter
C. The smallest possible MSE
D. No sampling error

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Answer: B
An unbiased estimator has E[theta-hat] = theta. On average, it equals the true parameter value.

Question 4

Bias of an estimator is defined as:

A. Var(theta-hat)
B. E[theta-hat] - theta
C. MSE - Variance
D. Standard error

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Answer: B
Bias = E[theta-hat] - theta. It measures the systematic difference between the expected estimate and the true value.

Question 5

MSE (Mean Squared Error) equals:

A. Variance only
B. Bias only
C. Variance + Bias squared
D. Variance x Bias

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Answer: C
MSE = Var(theta-hat) + (Bias)^2. It combines both precision (variance) and accuracy (bias).

Question 6

The bias-variance trade-off suggests:

A. Unbiased estimators are always best
B. A slightly biased estimator may have lower total error if it has much lower variance
C. Variance doesn't matter
D. Bias and variance are unrelated

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C. Variance doesn't matter
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Answer: B
Sometimes accepting a small bias in exchange for greatly reduced variance leads to lower overall MSE.

Question 7

The sample mean x-bar is an unbiased estimator of:

A. Population variance
B. Population median
C. Population mean
D. Population mode

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B. Population median
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Answer: C
E[x-bar] = mu. The sample mean is an unbiased estimator of the population mean.

Question 8

Why do we divide by (n-1) instead of n when computing sample variance?

A. To make calculations easier
B. To correct for bias (make it unbiased)
C. To reduce variance
D. It's just a convention

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Answer: B
Dividing by (n-1) instead of n corrects for the downward bias that would occur otherwise, making S^2 an unbiased estimator of sigma^2.

Question 9

The Method of Moments estimation involves:

A. Maximizing likelihood
B. Matching sample moments to population moments
C. Minimizing variance
D. Using Bayes' theorem

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Answer: B
Method of Moments equates sample moments (like sample mean, variance) to their population counterparts and solves for parameter estimates.

Question 10

Maximum Likelihood Estimation (MLE) finds the parameter that:

A. Minimizes the sample mean
B. Maximizes the probability of observing the data
C. Sets bias to zero
D. Equals the median

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Answer: B
MLE finds the parameter value that maximizes the likelihood function - the probability of observing the actual data.

Question 11

For large samples, MLE estimators are:

A. Always biased
B. Approximately unbiased and have minimum variance
C. Inconsistent
D. Undefined

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C. Inconsistent
D. Undefined

Answer: B
MLE has desirable large-sample (asymptotic) properties: approximately unbiased, consistent, and achieves the minimum variance among consistent estimators.

Question 12

A consistent estimator:

A. Has zero bias for any n
B. Converges to the true parameter as n approaches infinity
C. Has constant variance
D. Is always unbiased

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Answer: B
Consistency means theta-hat converges in probability to theta as sample size grows. It may be biased for finite n.

Question 13

An efficient estimator:

A. Is computed quickly
B. Has the smallest variance among all unbiased estimators
C. Has zero bias
D. Uses the most data

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Answer: B
Efficiency refers to variance: an efficient estimator has the minimum variance among all unbiased estimators for that parameter.

Question 14

For normal data, comparing sample mean and sample median as estimators of mu:

A. Median has smaller variance
B. Mean has smaller variance
C. They have equal variance
D. Neither can estimate mu

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A. Median has smaller variance
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C. They have equal variance
D. Neither can estimate mu

Answer: B
For normal data, the sample mean is more efficient than the median - it has smaller variance and thus is a better estimator of mu.

Question 15

A sufficient statistic:

A. Uses all the data
B. Contains all information about the parameter that the data contains
C. Is always the sample mean
D. Eliminates all error

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Answer: B
A sufficient statistic captures all the information in the data relevant to estimating the parameter - no information is lost by using just this statistic.

Question 16

In the dart analogy, high bias and low variance means:

A. Darts scattered randomly around the bullseye
B. Darts clustered together but away from the bullseye
C. Darts clustered at the bullseye
D. Darts scattered far from each other

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Answer: B
High bias = consistently off-target, low variance = clustered together. The darts are precise (low variance) but not accurate (high bias).

Question 17

If bias = 2 and variance = 5, what is MSE?

A. 7
B. 9
C. 3
D. 10

Question 17

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A. 7

B. 9

C. 3

D. 10

Answer: B

MSE = Variance + Bias^2 = 5 + 2^2 = 5 + 4 = 9.

Question 18

The likelihood function is:

A. The probability of the parameter given data
B. The probability of the data given the parameter
C. The prior probability
D. The posterior probability

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Answer: B
The likelihood L(theta — data) is the probability of observing the data given a particular parameter value. MLE maximizes this.

Question 19

For flipping a coin 10 times and getting 7 heads, the MLE for p is:

A. 0.5
B. 0.3
C. 0.7
D. 1.0

Question 19

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A. 0.5
B. 0.3
C. 0.7
D. 1.0

Answer: C
MLE for proportion is simply the sample proportion: p-hat $= 7/10 = 0.7$.

Question 20

Which property is NOT a desirable property of estimators?

A. Unbiasedness
B. Consistency
C. Efficiency
D. Maximum variance

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B. Consistency
C. Efficiency
D. Maximum variance

Answer: D
We want minimum (not maximum) variance. Unbiasedness, consistency, and efficiency are all desirable properties.