# Statistics Advance Part 1 Answers

## What is a random variable in probability theory?

A random variable is a numerical outcome of a random process or experiment. It assigns numerical values to each possible outcome.

## What are the types of random variables?

There are two main types: (1) Discrete random variables (finite or countable outcomes), and (2) Continuous random variables (infinite, measurable outcomes).

## What is the difference between discrete and continuous distributions?

Discrete distributions deal with countable outcomes (e.g., number of heads), while continuous distributions deal with measurable outcomes (e.g., height, weight).

## What are probability distribution functions (PDF)?

PDF is a function that provides the probability that a continuous random variable falls within a particular range of values.

## How do cumulative distribution functions (CDF) differ from probability distribution functions (PDF)?

CDF gives the probability that a variable takes a value less than or equal to x, while PDF gives the probability of the variable falling within a specific interval.

## What is a discrete uniform distribution?

A discrete uniform distribution assigns equal probabilities to all outcomes in a finite set.

## What are the key properties of a Bernoulli distribution?

It models a binary outcome (success/failure), has two outcomes (0 or 1), and one parameter p which is the probability of success.

## What is the binomial distribution, and how is it used in probability?

It models the number of successes in a fixed number of independent Bernoulli trials. It is used in situations with repeated binary outcomes.

## What is the Poisson distribution and where is it applied?

It models the number of events in a fixed interval of time or space and is used when events occur independently and with a known constant mean rate.

## What is a continuous uniform distribution?

A continuous uniform distribution has equal probability for all values in a continuous interval [a, b].

## What are the characteristics of a normal distribution?

It is bell-shaped, symmetric, defined by its mean and standard deviation, and most data falls within 3 standard deviations from the mean.

## What is the standard normal distribution, and why is it important?

It is a normal distribution with mean 0 and standard deviation 1, used as a reference for calculating probabilities and Z-scores.

## What is the Central Limit Theorem (CLT), and why is it critical in statistics?

CLT states that the distribution of sample means approaches a normal distribution as sample size increases, regardless of population shape. It justifies the use of normal models in many cases.

## How does the Central Limit Theorem relate to the normal distribution?

It explains why sample means tend to follow a normal distribution, enabling inference even when the population distribution is unknown.

## What is the application of Z statistics in hypothesis testing?

Z-statistics are used to determine whether to reject a null hypothesis, especially when population standard deviation is known.

## How do you calculate a Z-score, and what does it represent?

Z = (X - μ) / σ; it represents how many standard deviations an observation X is from the population mean μ.

## What are point estimates and interval estimates in statistics?

Point estimates give a single best guess of a parameter (e.g., mean), while interval estimates provide a range (e.g., confidence interval) within which the parameter likely falls.

## What is the significance of confidence intervals in statistical analysis?

They provide a range of values that likely contain the population parameter and indicate the reliability of the estimate.

## What is the relationship between a Z-score and a confidence interval?

Z-scores define the bounds of a confidence interval in standard normal distribution (e.g., ±1.96 for 95% CI).

## How are Z-scores used to compare different distributions?

Z-scores standardize values, allowing comparison across different distributions by measuring distance from the mean in terms of standard deviations.

## What are the assumptions for applying the Central Limit Theorem?

Assumptions include independent observations, identically distributed samples, and sufficient sample size (n ≥ 30 is common rule).

## What is the concept of expected value in a probability distribution?

Expected value is the weighted average of all possible outcomes, where weights are the probabilities.

## How does a probability distribution relate to the expected outcome of a random variable?

It provides the probabilities for all outcomes, which are used to calculate the expected (average) value of the random variable.