

What are the similarities and differences between Binomial and Poisson distributions?

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The Binomial and Poisson distributions are two commonly used probability distributions in statistics. Both distributions are discrete and involve counting the number of occurrences of an event. However, there are some key differences between the two.

The main similarity between the Binomial and Poisson distributions is that they both deal with discrete data, meaning that the data can only take on certain values. Additionally, both distributions are used to model the probability of a certain number of events occurring within a given time or space.

One key difference between the two distributions is that the Binomial distribution is used when there are a fixed number of trials or experiments, and each trial has a binary outcome (success or failure). On the other hand, the Poisson distribution is used when the number of events occurring in a given time or space is unknown and can range from zero to infinity.

Another difference is that the Binomial distribution requires a specific probability of success for each trial, while the Poisson distribution only requires the average rate of events occurring.

In summary, while both the Binomial and Poisson distributions involve counting events, they are used in different scenarios and have different requirements for their parameters. Understanding these similarities and differences is crucial for choosing the appropriate distribution for a given dataset.

Binomial vs. Poisson Distribution: Similarities & Differences

Two distributions that are similar in statistics are the and the .

This tutorial provides a brief explanation of each distribution along with the similarities and differences between the two.

The Binomial Distribution

The Binomial distribution describes the probability of obtaining k successes in n .

If a random variable X follows a binomial distribution, then the probability that $X = k$ successes can be found by the following formula:

$$P(X=k) = nCk * p^k * (1-p)^{n-k}$$

where:

n : number of trials
 k : number of successes
 p : probability of success on a given trial
 nCk : the number of ways to obtain k successes in n trials

For example, suppose we flip a coin 3 times. We can use the formula above to determine the probability of obtaining 0 heads during these 3 flips:

$$P(X=0) = 3C0 * .50 * (1-.5)^{3-0} = 1 * 1 * (.5)^3 = 0.125$$

The Poisson Distribution

The Poisson distribution describes the probability of experiencing k events during a fixed time interval.

If a random variable X follows a Poisson distribution,

then the probability that $X = k$ events can be found by the following formula:

$$P(X=k) = \frac{\lambda^k * e^{-\lambda}}{k!}$$

where:

λ : mean number of successes that occur during a specific interval
 k : number of successes
 e : a constant equal to approximately 2.71828

For example, suppose a particular hospital experiences an average of 2 births per hour. We can use the formula above to determine the probability of experiencing 3 births in a given hour:

Similarities & Differences

The Binomial and Poisson distribution share the following similarities:

Both distributions can be used to model the number of occurrences of some event. In both distributions, events are assumed to be independent.

The distributions share the following key difference:

In a **Binomial** distribution, there is a fixed number of trials (e.g. flip a coin 3 times) In a **Poisson** distribution, there could be any number of events that occur during a certain time interval (e.g. how many customers will arrive at a store in a given hour?)

Practice Problems: When to Use Each Distribution

In each of the following practice problems, determine whether the random variable follows a **Binomial** distribution or **Poisson** distribution.

Problem 1: Network Failures

A tech company wants to model the probability that a certain number of network failures occur in a given week. Suppose it's known that an average of 4 network failures occur each week. Let X be the number of network failures in a given week. What type of distribution does the random variable X follow?

Answer: X follows a **Poisson** distribution because we're interested in modeling the number of network failures in a given week and there is no upper limit on the number of failures that could occur. This is not a **Binomial** distribution because there is not a fixed number of

trials.

Problem 2: Shooting Free-Throws

Tyler makes 70% of all free-throws he attempts. Suppose he shoots 10 free-throws. Let X be the number of times Tyler makes a basket during the 10 attempts. What type of distribution does the random variable X follow?

Answer: X follows a Binomial distribution because there is a fixed number of trials (10 attempts), the probability of "success" on each trial is the same, and each trial is independent.