

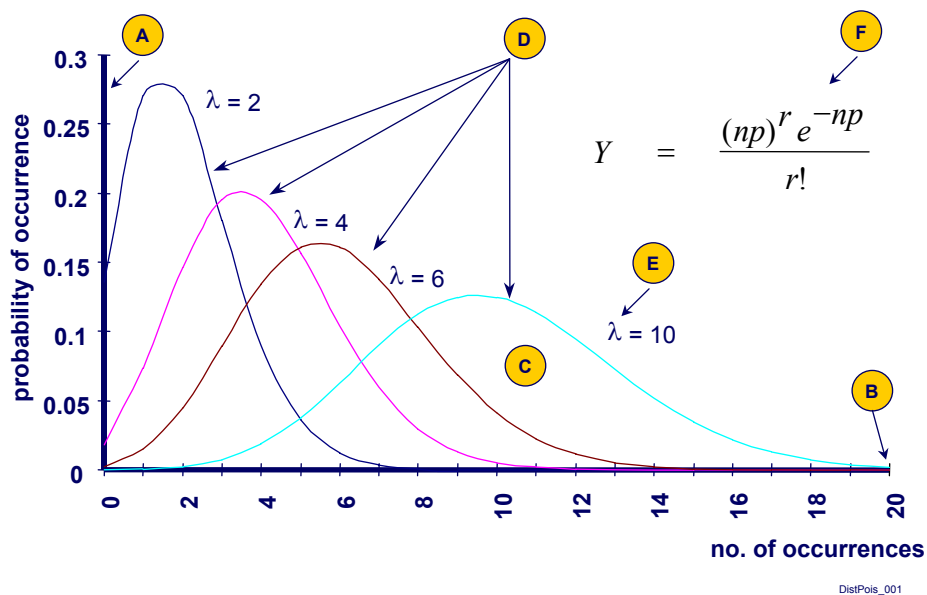
Distribution - Poisson

Purpose

To calculate the probability of occurrence of an event in a population when there are many opportunities, but the probability of each trial is low (less than 0.10). To describe the behavior of discrete variables when the above conditions are met. A discrete random variable only takes whole values.

Anatomy

Poisson Distribution for Different Values of λ



Reference: Juran's Quality Control Handbook - Ch. 23, P. 29

Terminology

- A. Vertical axis - Scale to measure the probability of occurrence of an event.
- B. Horizontal axis - Scale of measure the number of occurrences.
- C. Probability - The area under the curve represents the probability of occurrence of an event. The total area under the curve is equal to one (1).
- D. Curve of the Poisson distribution for various levels of lambda (λ) - The Poisson distribution is a probability distribution for the number of occurrences per unit interval which can be a unit of time or space. The Poisson distribution is a good approximation of the binomial distribution for the case where n is large and p is small.

- E. Lambda (λ). Parameter which represents the average number of occurrences per interval. It is defined as $\lambda = np$ where n = no. of trials and p = probability of occurrence. Probability Function:

$$Y = \frac{(np)^r e^{-np}}{r!}$$

Major Considerations

Applicable when sample size is at least 16, the population size is at least 10 times the sample size and the probability of occurrence p on each trial is less than 0.1.

Events occur at random order and they are roughly proportional to the length of time, volume of space or area under study. Also, there is no overlapping of events (“clumping”).

Application Cookbook

1. Use Excel functions to calculate the probability of an occurrence for a discrete variable that follows the Poisson distribution. For example, the probability that 12 or less occurrences of an event that has an average number of occurrences of 5.2 is equal to 0.997.
2. In Minitab use the following menu to generate a Poisson distribution. CALC>PROBABILITY DISTRIBUTIONS>POISSON
3. Alternatively, the tables printed at the end of most statistics books can be used.