Poisson Distribution

Poisson Distribution

- Discrete probability distribution over a continuous interval
  - The outcomes are discrete/countable
    - Ex: number of defects, number of customers
  - The interval is continuous
    - Most typically time, length, area, volume
  - To be Poisson, a rate must be given in the problem
    - Ex: Defects occur on a cable at a rate of 0.1 per meter

Poisson Distribution Examples

Poisson

- Number of baskets made in next 10 minutes
- Number of defects in 100 square meters of carpet

Not Poisson

- Number of baskets made in next 10 attempts
- Number of defective items in 100 sampled

Poisson Formula and Properties

- Formula: $P(x) = \frac{e^{-\lambda}\lambda^x}{x!}$
  - x is the number of successes in the outcome
  - Lambda (λ) is the rate for the problem
    - It is also the mean for the probability distribution AND the variance for the distribution!
    - May be given directly or calculated by λ =np
  - Excel: =Poisson.dist(x,lambda,cumulative indicator)

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Example

The expected number of defects per meter of cable is 0.25. What is the probability that a 10-meter cable will have no more than 1 defect?

$$P(x) = \frac{e^{-\lambda}\lambda^x}{x!}$$

x = 0 or 1

λ = 0.25/m*10m=2.5

$$P(0) = \frac{e^{-2.5}2.5^0}{0!} \quad P(1) = \frac{e^{-2.5}2.5^1}{1!}$$

P(0,1) = P(0)+P(1)=0.0821+0.2052 = 0.2873

=Poisson.dist(x,mean,cumulative)

P(x≤1)=POISSON.DIST(1,2.5,TRUE) = 0.2873

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Embedded Question

The expected number of “bird droppings” per square foot on the top of a certain parking garage is 0.025 over a typical day. What is the probability that your car will have no such “droppings” from parking on the top of that deck for a day, if the area of the top of your car is 30 square feet?

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