



# ASQ CRE Prep course

Lesson II. A. 3. c.

Probability Distributions

Discrete Distributions

A sunset scene over the ocean. The sun is a bright orange circle on the horizon, partially obscured by clouds. The sky is filled with horizontal bands of orange and yellow clouds. The water is dark with a shimmering reflection of the sun. In the foreground, there is a large, dark rock on the right and a smaller one on the left. A small bird is perched on the smaller rock.

Dealing with attribute data

# DISCRETE DISTRIBUTIONS

# Binomial Probability Distribution

**n** Number of trials

$$n \in \{1, 2, \dots, \infty\}$$

**p** Probability of success

$$0 \leq p \leq 1$$

$$f(k) = \binom{n}{k} p^k (1-p)^{n-k}$$

$$\binom{n}{k} = C_k^n = \frac{n!}{k!(n-k)!}$$



# Binomial Probability Distribution

**Use when**

- 1. Number of observation,  $n$ , is fixed**
- 2. Observations are independent**
- 3. Each observation is a Bernoulli trial**
- 4. Probability of Success,  $p$ , is constant**

# Binomial Probability Distribution

**Check out the tables**

$$F(k) = \sum_{j=0}^k \binom{n}{j} p^j (1-p)^{n-j}$$

**If  $n \geq 20$  and  $p \leq 0.05$ , or  
 $n \geq 100$  and  $np \leq 10$ ,  
Approximate with Poisson.**

$$F(k) \cong e^{-\mu} \sum_{j=0}^k \frac{\mu^j}{j!}, \text{ where } \mu = np$$

**If  $np \geq 10$  and  $np(1-p) \geq 10$ ,  
Approximate with  
Standard Normal**

$$Z = \frac{Y - np}{\sqrt{np(1-p)}}$$

# Poisson Probability Distribution

$\mu$  Shape Parameter

$$\mu > 0$$

$\mu = \lambda t$  (failure data)

$$f(k) = \frac{\mu^k}{k!} e^{-\mu} = \frac{(\lambda t)^k}{k!} e^{-\lambda t}$$

$$F(k) = e^{-\mu} \sum_{j=0}^k \frac{\mu^j}{j!}$$

# Hypergeometric Probability Distribution

**k Success in  
n Bernoulli trials from  
N population containing  
m successes  
without replacement**

$$f(k; n, m, N) = \frac{\binom{m}{k} \binom{N-m}{n-k}}{\binom{N}{n}}$$

The mean is  $\mu = \frac{nm}{N}$

There are more,  
can you deal  
with them?





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Probability Distributions

Bathtub Curve