2.2 Binomial distribution:

The binomial distribution can arise from two ways.

1. $\boldsymbol{X_1 \sim P(\lambda_1), X_2 \sim P(\lambda_2), X_1}$ **and** $\boldsymbol{X_2}$ **are independent. Then**

$$\boldsymbol{X_1 + X_2 \sim P(\lambda_1 + \lambda_2).}$$

The conditional probability

$$\boldsymbol{P(X_1 = y | X_1 + X_2 = m) = \binom{m}{y} \pi^y (1 - \pi)^{m-y}}$$

is distributed as $\boldsymbol{B(m, \pi)}$**, where**

$$\boldsymbol{\pi = \frac{\lambda_1}{\lambda_1 + \lambda_2}.}$$

2. $\boldsymbol{Z_i \sim B(1, \pi), i = 1, \cdots, m,}$ **are independent. Then,**

$$\boldsymbol{Y = \sum_{i=1}^{m} Z_i \sim B(m, \pi).}$$