$$P(A \mid B) = \frac{P(A \cap B)}{P(B)}$$

$$P(A \mid B) = P(A) \text{ and } P(B \mid A) = P(B)$$

$$P(A \mid B) = P(A)$$

$$P(B \mid A) = P(B)$$

$$P(A \cap B) = P(A)P(B)$$

$$\chi^2 = \sum_{rows} \sum_{columns} \frac{(Observed - Expected)^2}{Expected}$$

$$Y \sim exp(1/10)$$

$$f_Y(y) = \begin{cases} (1/10)e^{-y/10} & y > 0 \\ 0 & otherwise \end{cases}$$

$$P(Y > 2) = \int_2^\infty (1/10)e^{-y/10} dy = 0.8187$$

$$P(Y > 2) = 1 - P(Y \leq 2) = 1 - F(2) = 1 - (1 - e^{-2/10})$$

$$P(Y \leq y) = \int_{-\infty}^y f(y)dy = \begin{cases} 0 & y \leq 0 \\ \int_0^y \lambda e^{-\lambda t} dt = 1 - e^{-\lambda y} & y > 0 \end{cases}$$

$$Y \sim \chi^2(k)$$

$$f(y) = \begin{cases} \frac{1}{2^{k/2}\Gamma(k/2)} y^{k/2} e^{-y/2} & y > 0 \\ 0 & otherwise \end{cases}$$

$$P(Cell_{i,j}) = P(row_i)P(column_j)$$

$$E(Cell_{i,j}) = n \left(\frac{row_i \ total}{n} \right) \left(\frac{column_j \ total}{n} \right)$$

$$E(Cell_{i,j}) = \frac{(row_i \ total) * (column_j \ total)}{n}$$

$$\chi^2 = \sum_{i=1}^{I} \sum_{j=1}^{J} \frac{(Cell_{i,j} - E(Cell_{i,j}))^2}{E(Cell_{i,j})}$$

$$\chi^2 = \sum_{i=1}^{I} \sum_{j=1}^{J} \frac{(Cell_{i,j} - E(Cell_{i,j}))^2}{E(Cell_{i,j})} \sim \chi^2_{(I-1)(J-1)}$$

$$\chi^2 = \frac{(586 - 432)^2}{432} + \frac{(785 - 939)^2}{939} + ... + \frac{(1255 - 969)^2}{969} = 540.94$$

$$P(\chi^2(4) \geq 540.94) = \int_{540.94}^\infty \frac{1}{2^{4/2}\Gamma(4/2)} y^{4/2-1} e^{-y/2} dy \approx 0$$