Formula Sheet

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Definition 3.9 – Negative Binomial Distribution

The negative binomial distribution is the distribution of the number of trials needed to get r^{th} successes. The negative binomial distribution helps in finding r success in x trials.

$$p(y) = \begin{matrix}(y-1)\\(r-1)\end{matrix} p^r q^{y-r}$$

$$E(Y) = \frac{r}{p}$$

$$V(Y) = \frac{r(1-p)}{p^2}$$

Definition 3.10 – Hypergeometric Distribution

The hypergeometric distribution describes the number of successes in a sequence of *n* trials from a finite population without replacement.

$$p(y) = \frac{\begin{matrix}(r)(N-r)\\(y)(n-y)\end{matrix}}{\begin{matrix}(N)\\(n)\end{matrix}}$$

$$E(Y) = \frac{nr}{N}$$

$$V(Y) = n(\frac{r}{n})(\frac{N-r}{N})(\frac{N-n}{N-1})$$

3.8 Poisson Probability Distributions

The Poisson Distribution gives the probability of an event happening a certain number of times (k) within a given interval of time or space. The Poisson distribution has only one parameter, λ (lambda), which is the mean number of events.

$$p(y) = \left(\frac{\lambda^y}{y!}\right) e^{-\lambda}$$

3.11 Chebyshev's Theorem

Chebyshev's Theorem estimates the minimum proportion of observations that fall within a specified number of standard deviations from the mean.

$$P(|Y - \mu| < k\sigma) \geq 1 - \frac{1}{k^2}$$

4.2 Probability Distribution for a Continuous Random Variable

A probability distribution for a continuous random variable is a function, called a probability density function (PDF), that assigns probabilities to intervals of values on the real number line, where the probability of a continuous variable falling within a specific range is represented by the area under the curve of the PDF within that range

$$: F(y) = \int_{-\infty}^{\infty} f(y)dy$$

Probability Density Function: f(y) = $\frac{dF(y)}{dy} = F'(y)$

4.3 Expected Values for Continuous Random Variables

$$\int_{-\infty}^{\infty} yf(y)dy$$

4.4 The Uniform Probability Distribution

A uniform probability distribution is a statistical distribution where every possible outcome within a specified range has an equal likelihood of occurring.

$$\begin{cases} \dfrac{1}{\theta_2 - \theta_1} & , \theta_1 \leq y \leq \theta_2 \\ 0, \quad elsewhere \end{cases}$$

4.6 Exponential Distribution

An exponential distribution is a continuous probability distribution that models the time elapsed between events occurring at a constant average rate

$$\mathbf{f\ (y) =} \begin{cases} \frac{1}{\beta}\ e^{-\frac{y}{\beta}} & , 0 \leq y \leq \infty \\ 0 \end{cases}$$

5.2 Bivariate and Multivariate Probability Distributions

A "bivariate probability distribution" describes the probability of different combinations of outcomes for two random variables occurring together, while a "multivariate probability distribution" extends this concept to the joint probabilities of three or more random variables occurring simultaneously.

$$p(y_1,y_2) = P(Y_1 = y_1, Y_2 = y_2), -\infty < y_1 < \infty, -\infty < y_2 < \infty$$