

1 Algebra

Absolute Value Inequalities

$$|f(x)| < a \Rightarrow -a < f(x) < a.$$

$$|f(x)| > a \Rightarrow f(x) > a \text{ or } f(x) < -a$$

2 Important probability distributions

Bernoulli

Parameter $p \in [0, 1]$. Discrete, describes the success or failure in a single trial.

$$p_x(k) = \begin{cases} p, & \text{if } k = 1 \\ (1-p), & \text{if } k = 0 \end{cases}$$

$$E[X] = p$$

$$Var(X) = p(1-p)$$

Exponential

Parameter λ . Continuous

$$f_x(x) = \begin{cases} \lambda \exp(-\lambda x), & \text{if } x \geq 0 \\ 0, & \text{o.w.} \end{cases}$$

$$F_x(x) = \begin{cases} 1 - \exp(-\lambda x), & \text{if } x \geq 0 \\ 0, & \text{o.w.} \end{cases}$$

$$E[X] = \frac{1}{\lambda}$$

$$Var(X) = \frac{1}{\lambda^2}$$

Gaussian

Poisson

Uniform

3 Expectation and Variance

Expectation

Variance

Covariance

Variance and expectation of mean of n iid random variables

Let $X_1, \dots, X_n \stackrel{iid}{\sim} P_\mu$, where $E(X_i) = \mu$ and $Var(X_i) = \sigma^2$ for all $i = 1, 2, \dots, n$ and $\bar{X} = \frac{1}{n} \sum_{i=1}^n X_i$.

Variance of the Mean:

$$Var(\bar{X}) = \left(\frac{\sigma^2}{n}\right) Var(X_1 + X_2, \dots, X_n) = \frac{\sigma^2}{n}.$$

Expectation of the mean:

$$E[\bar{X}] = \frac{1}{n} E[X_1 + X_2, \dots, X_n] = \mu.$$

4 Law of large Numbers

5 Central Limit theorem

6 Statistical models

7 Confidence intervals

Onesided

Twosided

Delta Method

8 Hypothesis tests

Onesided

Twosided

P-Value