

## 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  $\lambda$ . 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

$$\overline{X_n} = \frac{1}{n} \sum_{i=1}^n X_i.$$

Variance of the Mean:

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

Expectation of the mean:

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

## 4 Law of large Numbers

## 5 Central Limit theorem

## 6 Statistical models

## 7 Estimators

## 8 Confidence intervals

### Onesided

### Twosided

### Delta Method

## 9 Hypothesis tests

### Onesided

### Twosided

### P-Value