# Probability
using python.

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# Expected

is defined as the mean of a random variable

# Variance

$$\sigma^2 = E(x^2) - \mu^2 \tag{1}$$

remember that $\sum_x f(x)x = \mu$ and $\sum_x f(x) = 1$

$$\sigma^2 = \sum_x (x - \mu)^2 f(x)$$
$$= \sum (x^2 f(x) - 2x\mu f(x) + \mu^2 f(x)) \tag{2}$$

Applying the algebra we find $\sum x^2 f(x) - \mu^2$.

# Theorem 1

$X$ is a random variable with a pdf $f(x)$ then $\mu$ of $g(x)$ is

$$\mu_{g(x)} = E(g(x)) = \sum g(x)f(x) \tag{3}$$

Example of income and the probability of sell a product.

# Theorem

$X$ is a random variable with pdf $f(x)$ then then variance of $g(x)$ will be:

$$\sigma^2_{g(x)} = E((g(x) - \mu_{g(x)})^2 \tag{4}$$

this is equation is derived of the definition of variance of a random variable, remember that $g(x)$ is a random variable with mean $\mu_{g(x)}$.

# Join distribution

until now we try $\Omega$ in $\mathbf{R}^1$ and we can be interested in find the probability of occurrence of two simultaneous random variables.

$$f(x, y) = P(X = x, Y = y) \qquad (5)$$

Some intuitive properties are:

- $f(x, y) \geq 0$
- $\sum_x \sum_y f(x, y) = 1$

### Excercise

Suppose the bag model with $n$ balls and there there are $r$ balls and $w$ balls where $r + w = n$ find the probability of get $x, y$ balls respectively.

# Marginal distribution

$$g(x) = \sum_y f(x, y) \tag{6}$$

$$h(y) = \sum_x = f(x, y) \tag{7}$$

# Expected value of two random variables

let be $X, Y$ two random variables with joint probability function distribution $f(x, y)$ the mean of $g(X, Y)$ is:

$$\mu_{g(X,Y)} = E[g(X, Y)] = \sum_x \sum_y g(x, y) f(x, y) \tag{8}$$

# Covariance

**Insights**

$$\sigma_{X,Y} = E[(X - \mu_x)(Y - \mu_y)]$$
$$= \sum_x \sum_y (x - \mu_x)(y - \mu_y)f(x,y) \qquad (9)$$

is a measure of association between two variables

# Variance

From here we refer we refer to the population mean as $\mu$ and estimated mean as $\hat{\mu}$.
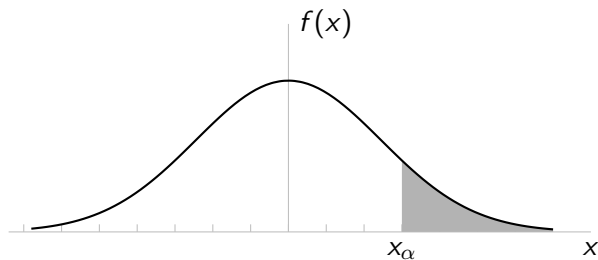
# Shapiro wilk

# P -values

# Hypothesis testing

**Hypothesis** as idea or believe about a issue.

# Null hypothesis

$H_0$ describe the current believe, and $H_1$ is a option if there is enough evidence to reject $H_0$.

# One tailed test

# Two tailed test

*$H_1 \neq value$*

# Test statistic

test statistics is a value that allow us reject the null hypothesis, this uses
the sampling statistics ( proportion, mean, or standard deviation) in a
value of $z, t$ or $\chi^2$.3

# ANOVA test

# t-test

# $\chi^2$ test

# Person

# Spearman

# Table one

It is a useful algorithm to present working papers or give us insights about the problem.