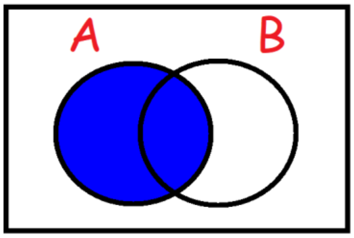
Probability Formula Sheet:

$\boldsymbol{P(A)}$



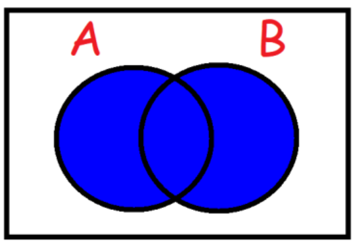
Marginal Probability:

$$P(A) = \frac{Number\ of\ Successful\ Outcomes}{Total\ Possible\ Outcomes}$$

$$0 \le P(A) \le 1$$

$$P(A') = 1 - P(A)$$

$\boldsymbol{P(A \cup B)}$

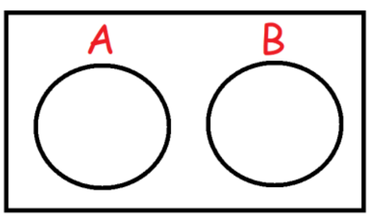


Union Probability: $\boldsymbol{P(A \cup B) = P(A\ or\ B)}$

Addition Rule:

$$P(A\ or\ B) = P(A) + P(B) - P(A\ and\ B)$$

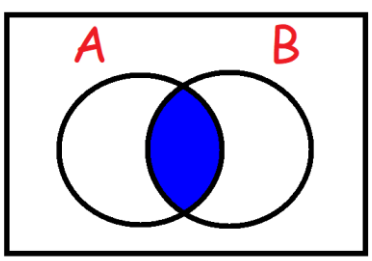
$\boldsymbol{P(A \cap B) = 0}$



Mutually Exclusive Events:

$$P(A\ or\ B) = P(A) + P(B)$$

$\boldsymbol{P(A \cap B)}$



Joint Probability: $\boldsymbol{P(A \cap B) = P(A\ and\ B)}$

Multiplication Rule:

$$P(A\ and\ B) = P(A/B) \times P(B)$$

$$P(A\ and\ B) = P(B/A) \times P(A)$$

Note: $P(A/B) \times P(B) = P(B/A) \times P(A)$

Independent Events:

$$P(A\ and\ B) = P(A) \times P(B)$$

$$P(A/B) = P(A) \quad and \quad P(B/A) = P(B)$$

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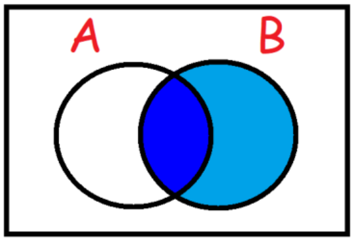
$P(A/B)$

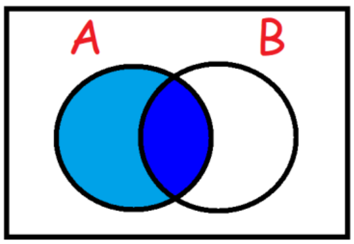


Conditional Probability:

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

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

$P(B/A)$

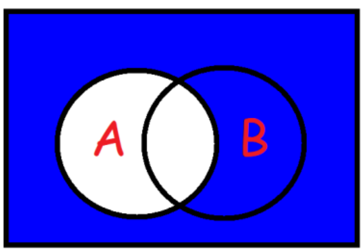


Bayes Theorem:

$$P(A/B) = \frac{P(B/A) \times P(A)}{P(B)}$$

$$P(B/A) = \frac{P(A/B) \times P(B)}{P(A)}$$

$P(A')$



The Complement / Negation:

$$P(A') = 1 - P(A)$$

Things to Know:

P(AB) → 1st A, then B
P(BA) → 1st B, then A

P(A and B):
A and B occur simultaneously.

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

Compound Probability:

"**Independent Events** – With Replacement"

$$P(AB) = P(A) \times P(B)$$

Dependent Events: "Without Replacement"

$$P(AB) \neq P(BA)$$

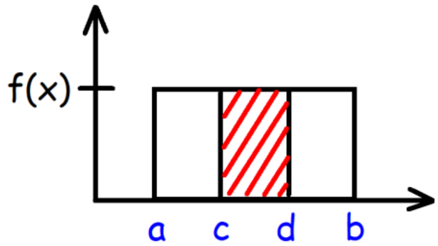
Expected Value:

$$E(X) = X_1P_1 + X_2P_2$$

X_1 → Positive Value of Winning
X_2 → Negative Value of Losing
P_1 → Probability of Winning (decimal)
P_2 → Probability of Losing (decimal)

Binomial Distribution: P(x) → Probability of 'x' successes in 'n' trials. p → Probability of a successful event. q → Probability that the event will fail.	**Probability:** $P(x) = \binom{n}{x} p^x q^{n-x}$ $P(x) = \frac{n!}{(n-x)!\,x!} p^x q^{n-x}$ $u = np$ $\sigma = \sqrt{npq}$ $q = 1 - p$
Geometric Distribution: P(x) → Probability that the nth event will succeed. n → number of 1st successful trial. P(4) → Probability that the 4th event will be successful.	**Probability:** $P(X = n) = q^{n-1} * p$ $P(X > n) = q^n$ $P(X \geq n) = q^{n-1}$ $P(X \leq n) = 1 - q^n$ $P(X < n) = 1 - q^{n-1}$ $\sigma^2 = \frac{1}{p}\left(\frac{1}{p} - 1\right)$ $\sigma = \frac{\sqrt{1-p}}{p}$ $u = 1/p$ $q = 1 - p$
Geometric Probability:	$P = \frac{Shaded\ Area}{Total\ Area}$
Poisson Distribution: Mean: $u = \lambda = np$ Variance: $\sigma^2 = np$ Standard Deviation: $\sigma = \sqrt{np} = \sqrt{\lambda}$	**Probability:** $P(X = n) = \frac{u^n e^{-u}}{n!}$ OR $P(X = n) = \frac{\lambda^n e^{-\lambda}}{n!}$ $P(X > n) = 1 - e^{-u}\left[\sum_{x=0}^{n} \frac{u^n}{n!}\right]$ $P(X \leq n) = e^{-u}\left[\sum_{x=0}^{n} \frac{u^n}{n!}\right]$

Uniform Distribution: **(Area = 1)**



$$Area = f(x)(b-a)$$

$$f(x) = \frac{1}{b-a}$$

Probability:

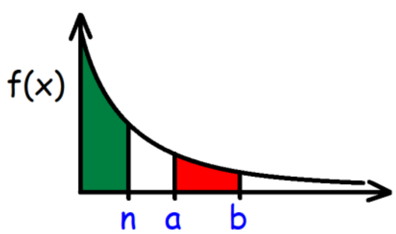
$$P(c \le x \le d) = \frac{d-c}{b-a}$$

$$P(a \le x \le c) = \frac{c-a}{b-a}$$

$$P(c \le x \le b) = \frac{b-c}{b-a}$$

$$u = \frac{a+b}{2} \qquad \sigma = \frac{b-a}{\sqrt{12}}$$

Exponential Distribution: **(Area = 1)**



$\lambda \to Rate\ Parameter$
$u \to Average\ time\ between\ occurences$

$$u = \frac{1}{\lambda} \qquad \sigma^2 = \frac{1}{\lambda^2} \qquad f(x) = \lambda e^{-\lambda x}$$

Probability:

$$A_L = P(X \le n) = 1 - e^{-\lambda n}$$

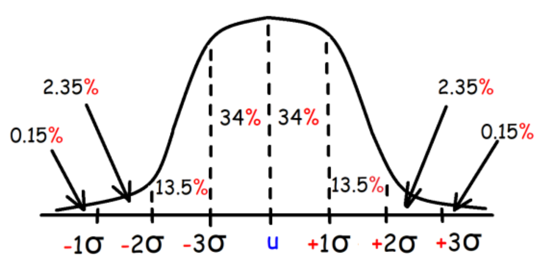
$$A_R = P(X \ge n) = e^{-\lambda n}$$

$$P(a \le x \le b) = e^{-\lambda a} - e^{-\lambda b}$$

$$A_L = \int_0^n \lambda e^{-\lambda x} dx = 1 - e^{-\lambda n} \qquad A_R = \int_n^\infty \lambda e^{-\lambda x} dx = e^{-\lambda n}$$

$$P(a \le x \le b) = P(a < x < b) \quad and \quad P(X = a) = 0$$

Standard Normal Distribution:



$$Area = \int_a^b f(x)dx$$

Probability:

$$z = \frac{x-u}{\sigma} \qquad x = u + z\sigma$$

$$u = np \qquad \sigma = \sqrt{npq}$$

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{1}{2}\left(\frac{x-u}{\sigma}\right)^2}$$

$$P(a \le x \le b) = \int_a^b \frac{e^{-\frac{1}{2}\left(\frac{x-u}{\sigma}\right)^2}}{\sigma\sqrt{2\pi}} dx = Area$$