Name	**Formula**	**Additional Notes**
Sample Mean	$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$	x_i: observation, n: sample size
Relative Frequency	$f_i = (F_i)/n = (\text{Abs. Freq. of } x_i)/n$	f_i: relative frequency of x_i
Weighted Mean	$\bar{x}_w = \frac{\sum_{i=1}^{n} w_i x_i}{\sum_{i=1}^{n} w_i}$ and if $w_i = f_i$; $\bar{x}_w = \sum_{i=1}^{n} f_i x_i$	w_i: weight, f_i: relative frequency
Sample Variance	$s^2 = \frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2$	(with Bessel's Correction)
Weighted Variance	$s_w^2 = \frac{1}{n-1}\sum_{i=1}^{n} f_i\,(x_i - \bar{x})^2$	f_i: weight as relative freq. (w/ Bessel's Corr.)
Std. Deviation	$s = \sqrt{s^2}$	
Range	$\text{Range} = x_{\max} - x_{\min}$	
Quartiles	$Q_1 = X_{\left(\frac{n+1}{4}\right)}, \quad Q_2 = \text{Median}, \quad Q_3 = X_{\left(\frac{3(n+1)}{4}\right)}$	For even n, average adjacent ranks (i.e., $Q_j = [X_{(k)} + X_{(k+1)}]/2$)
Interquartile Range	$IQR = Q_3 - Q_1$	
Median	$\tilde{x} = \begin{cases} X_{\left(\frac{n+1}{2}\right)}, & \text{odd } n \\ [X_{\left(\frac{n}{2}\right)} + X_{\left(\frac{n}{2}+1\right)}]/2, & \text{even } n \end{cases}$	Where $X_{(k)}$ represents the k-th ranked obs.
Outlier	Values outside $[\,Q_1 - 1.5 \cdot IQR,\ Q_3 + 1.5 \cdot IQR\,]$	
Coeff. of Variation	$CV = s/\bar{x}$	
Bin Size (Histogram)	$\text{Bin Width} = \text{Range}/K$	K: number of bins
Mutually Exclusive	$E_1 \cap E_2 = \varnothing$	Also def. as: "*Disjoint Events.*"
Classical Probability	$P(E) = \lvert E\rvert/\lvert S\rvert$. $\lvert E\rvert$: total elements in E, $\lvert S\rvert$: total outcomes.	Applies when each outcome is equally likely. S is the sample space, E is an event.
Joint Probability	$P(A \cap B) = \lvert A \cap B\rvert/\lvert S\rvert$	Probability that both A and B occur
Conditional Probability	$P(A \mid B) = P(A \cap B)/P(B)$	
Independence	$P(A \mid B) = P(A)$ or $P(B \mid A) = P(B)$	
Multiplication Rule	$P(A \cap B) = P(A \mid B)\cdot P(B) = P(B \mid A)\cdot P(A)$	If A, B are indep. then, $P(A \cap B) = P(A)P(B)$.
Addition Rule	$P(A \cup B) = P(A) + P(B) - P(A \cap B)$	If A, B are disjoint then, $P(A \cap B) = 0$
Complement	$P(A^c) = 1 - P(A)$	Derived from $P(S) = P(A \cup A^c) = 1$
Law of Total Probability	$P(A) = \sum_i P(A \cap B_i) = \sum_i P(A \mid B_i)\,P(B_i)$	$\{B_i\}$ is a partition of S, i.e. $B_1 \cup B_2 \cup \cdots B_K = S$, and for any i, j: $B_j \cup B_i = \varnothing$.
Bayes' Theorem	$P(B \mid A) = [P(A \mid B)\,P(B)]/P(A)$	You can replace $P(A)$ using the law of total prob.
PMF (Discrete)	$P(X = x) \quad \rightarrow \quad$ Probabilty of $X = x$.	Note: $P(X = x) = \lvert\{s \in S \mid X(s) = x\}\rvert/\lvert S\rvert, \quad$ if $\forall s \in S, P(s) = 1/\lvert S\rvert$
CDF (Discrete)	$F(x) = CDF(x) = P(X \leq x) = \sum_{t \leq x} P(X = t)$	Note, $P(a < X \leq b) = CDF(b) - CDF(a)$. $P(X > c) = 1 - CDF(c)$.
Expectation (Discrete)	$E(X) = \sum x\,P(X = x)$	Note, $E(aX + bY + c) = aE(X) + bE(Y) + c$
Variance (Discrete)	$V(X) = \sum (x - E(X))^2\,P(X = x)$	Note, $SD(X) = \sqrt{V(X)}$. If X, Y are indep.; $V(aX + bY + c) = a^2V(X) + b^2V(Y)$
Uniform (Discrete)	$P(X = x) = 1/n$	$x \in \{1, 2, \ldots, n\}$. $E(X) = \frac{n+1}{2}$, $V(X) = \frac{n^2-1}{12}$
Bernoulli	$P(X = x) = p^x(1-p)^{1-x}$	$x \in \{0, 1\}$. $E(X) = p$, $V(X) = p(1-p)$
Binomial	$P(X = x) = \binom{n}{x} p^x(1-p)^{n-x}$	$x \in \{1, 2, \ldots, n\}$. $E(X) = np$, $V(X) = np(1-p)$
Normal PDF	$f(x) = \frac{1}{\sigma\sqrt{2\pi}}\, e^{-\frac{(x-\mu)^2}{2\sigma^2}}$	$E(X) = \mu$, $V(X) = \sigma^2$. Std. normal: $\mu = 0$, $\sigma = 1$
Z-score	$Z = (X - \mu)/\sigma$	Note that, given $Z_{x^*, \bar{x}, s}$, we can find $x^* = \bar{x} + s \cdot Z$.
Normal Probability	$P(X \leq x) = P\Big(Z \leq (X - \mu)/\sigma\Big)$	Use standard normal CDF tables