

Descriptive Statistics
Sample Mean: $\bar{x} = \frac{\sum x_i}{n}$
Weighted Mean: $\bar{x} = \sum w_i x_i$
Percentile Location: $L_p = (n+1) \frac{p}{100}$
$Range = Max - Min$
Sample Variance: $s^2 = \frac{\sum (x_i - \bar{x})^2}{n-1}$ (or use calculator functions)
Sample Standard Deviation: $s = \sqrt{s^2}$ (or use calculator functions)
Coefficient of Variation: $CV = \frac{\text{standard deviation}}{\text{mean}}$
Sharpe's Ratio for Investment I and risk free rate f : $Sharpe\ Ratio = \frac{\bar{x}_I - \bar{R}_f}{s_I}$
z-score: $z = \frac{x - \text{mean}}{\text{standard deviation}}$

Probability
Complement Rule: $P(A^c) = 1 - P(A)$
Addition Rules: $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ $P(A \cup B) = P(A) + P(B)$ for mutually exclusive events
Conditional Probability: $P(A B) = \frac{P(A \cap B)}{P(B)}$
Multiplication Rules: $P(A \cap B) = P(A B)P(B)$ $P(A \cap B) = P(A) \times P(B)$ for independent events
Total Probability Rule $P(A) = P(A B)P(B) + P(A B^c)P(B^c)$
Bayes' Theorem (for k mutually exclusive events $A_1, A_2, \dots, A_k$) $P(A_1 B) = \frac{P(A_1)P(B A_1)}{P(A_1)P(B A_1) + P(A_2)P(B A_2) + \dots + P(A_k)P(B A_k)}$

Probability			
Prior	Conditional	Joint	Posterior
$P(A_1)$	$P(B A_1)$	$P(B \cap A_1)$	$P(A_1 B)$
$P(A_2)$	$P(B A_2)$	$P(B \cap A_2)$	$P(A_2 B)$
$P(A_3)$	$P(B A_3)$	$P(B \cap A_3)$	$P(A_3 B)$
.....			
$P(A_k)$	$P(B A_k)$	$P(B \cap A_k)$	$P(A_k B)$
$\sum P(A_i) = 1$		$\sum P(B \cap A_i) = P(B)$	$\sum P(A_i B) = 1$

Discrete Probability Distributions	
Expected Value of a Discrete Random Variable $E(X) = \mu = \sum x_i P(X = x_i)$	Poisson Distribution $P(X = x) = \frac{e^{-\mu} \mu^x}{x!}$
Variance of a Discrete Random Variable $Var(X) = \sigma^2 = \sum (x_i - \mu)^2 P(X = x_i)$	Expected Value of a Poisson Random Variable $E(X) = \mu$
Standard Deviation of a Discrete Random Variable $SD(X) = \sigma = \sqrt{\sigma^2}$	Variance of a Poisson Random Variable $Var(X) = \sigma^2 = \mu$
Binomial Distribution $P(X = x) = \frac{n!}{x!(n-x)!} p^x (1-p)^{n-x}$	Standard Deviation of a Poisson Random Variable $SD(X) = \sigma = \sqrt{\mu}$
Expected Value of a Binomial Random Variable $E(X) = \mu = np$	
Variance of a Binomial Random Variable $Var(X) = \sigma^2 = np(1-p)$	
Standard Deviation of a Binomial Random Variable $SD(X) = \sigma = \sqrt{np(1-p)}$	

Normal Probability Distributions	Sampling and Sampling Distributions
Standard Transformation of the Normal Random Variable $Z = \frac{X - \mu}{\sigma}$	Expected Value of the Sample Mean: $E(\bar{X}) = \mu$
Inverse Transformation of the Normal Random Variable $X = \mu + Z\sigma$	Standard Error of the Sample Mean: $se(\bar{X}) = \frac{\sigma}{\sqrt{n}}$
	Standard Transformation of the Sample Mean: $Z = \frac{\bar{X} - \mu}{\sigma/\sqrt{n}}$
	Expected Value of the Sample Proportion: $E(\bar{P}) = p$
	Standard Error of the Sample Proportion: $se(\bar{P}) = \sqrt{\frac{p(1-p)}{n}}$
	Standard Transformation of the Sample Proportion: $Z = \frac{\bar{P} - p}{\sqrt{\frac{p(1-p)}{n}}}$

Interval Estimation	Hypothesis Testing
Confidence Interval for μ when σ is Known: $\bar{x} \pm z_{\alpha/2} \frac{\sigma}{\sqrt{n}}$	Test Statistic for μ when σ is Known: $z = \frac{\bar{x} - \mu_0}{\sigma/\sqrt{n}}$
Confidence Interval for μ when σ is Unknown: $\bar{x} \pm t_{\alpha/2, df} \frac{s}{\sqrt{n}} ; \quad df = n - 1$	Test Statistic for μ when σ is Unknown: $t_{df} = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} ; \quad df = n - 1$
Confidence Interval for p : $\bar{p} \pm z_{\alpha/2} \sqrt{\frac{\bar{p}(1-\bar{p})}{n}}$	Test Statistic for p : $z = \frac{\bar{p} - p_0}{\sqrt{p_0(1-p_0)}/n}$
Required Sample Size when Estimating the Population Mean: $n = \left(\frac{z_{\alpha/2} \hat{\sigma}}{E} \right)^2$	If the p-value is $< \alpha$ reject H_0 If the p-value is $\geq \alpha$ do not reject H_0
Required Sample Size when Estimating the Population Proportion: $n = \left(\frac{z_{\alpha/2}}{E} \right)^2 \hat{p}(1-\hat{p})$	

Hypothesis Testing Involving 2 Means
Test Statistic for $\mu_1 - \mu_2$ if σ_1^2 and σ_2^2 are known: $z = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}}$
Test Statistic for $\mu_1 - \mu_2$ if σ_1^2 and σ_2^2 are unknown and be assumed unequal: $t_{df} = \frac{(\bar{X}_1 - \bar{X}_2)}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}};$ $df = \frac{(s_1^2/n_1 + s_2^2/n_2)^2}{(s_1^2/n_1)^2/(n_1-1) + (s_2^2/n_2)^2/(n_2-1)} ; \quad (\text{round down})$
Test Statistic for μ_D : $t_{df} = \frac{\bar{d}}{s_D/\sqrt{n}} ; \quad df = n - 1$

Hypothesis Testing Involving More Than 2 Means

One-way ANOVA Test:

$$F_{(df_1, df_2)} = \frac{MSTR}{MSE}$$

Where: $MSTR = \frac{SSTR}{c-1}$; $MSE = \frac{SSE}{n_T - c}$; $df_1 = c-1$ and $df_2 = n_T - c$

(see general format of ANOVA table below)

Source of Variation	SS	DF	MS	F	p-value
Between Groups (treatment)	SSTR	$df_1 = c - 1$	MSTR	$F = \frac{MSTR}{MSE}$	
Within Groups (error)	SSE	$df_2 = n_T - c$	MSE		
Total	SST	$n_T - 1$			

Hypothesis Testing Involving Proportions

Test Statistic for Testing $p_1 - p_2$

$$z = \frac{\bar{p}_1 - \bar{p}_2}{\sqrt{\bar{p}(1-\bar{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \text{ where } \bar{p} = \frac{x_1 + x_2}{n_1 + n_2}$$

Hypothesis Testing for Independence

Expected Frequencies for a Test of Independence:

$$e_{ij} = \frac{(\text{Row } i \text{ total})(\text{Column } j \text{ total})}{\text{Sample Size}}$$

Test Statistic for a Test of Independence:

$$\chi^2_{df} = \sum_i \sum_j \frac{(o_{ij} - e_{ij})^2}{e_{ij}} ; \quad df = (r-1)(c-1)$$

Regression Analysis

Simple Linear Regression Equation: $\hat{y} = b_0 + b_1x$
(use calculator functions)

Standard Error of the Estimate: $se(b_j)$
(will be provided)

Coefficient of Correlation: r
Coefficient of Determination: r^2
(use calculator functions and/or regression analysis output)

Test Statistic for the Test for linear relationship:

$$t_{df} = \frac{b_1}{seb_1} ; \quad df = n-2$$

SUMMARY OUTPUT

Regression Statistics				
Multiple R				
R square				
Standard Error				
Observations				
variables	coefficients	std. error	t	p-value
Intercept	b_0			
x-variable	b_1	$se(b_1)$	t-stat	