Summary Table for Statistical Techniques

	Inference	Parameter	Statistic	Type of Data	Examples	Analysis	Minitab Command	Conditions
1	Estimating a mean	One population mean μ	Sample mean $\bar{x}$	Numerical	What is the average weight of adults? What is the average cholesterol level of adult females?	1-sample t-interval $\bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}}$	Stat > Basic statistics > 1-sample t	Data approximately normal OR Have a large sample size ($n \geq 30$)
2	Test about a mean	One population mean μ	Sample mean $\bar{x}$	Numerical	Is the average GPA of juniors at Penn State higher than 3.0? Is the average Winter temperature in State College less than 42˚F?	$H_o: \mu = \mu_o$ $H_a: \mu \neq \mu_o$ or $H_a: \mu > \mu_o$ or $H_a: \mu < \mu_o$ The one sample t test: $t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}}$	Stat > Basic statistics > 1-sample t	Data approximately normal OR Have a large sample size ($n \geq 30$)
3	Estimating a proportion	One population proportion p	Sample proportion $\hat{p}$	Categorical (binary)	What is the proportion of males in the world? What is the proportion of students that smoke?	1-proportion Z-interval $\hat{p} \pm z_{\alpha/2} \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$	Stat > Basic statistics > 1-sample proportion	Have at least 5 in each category
4	Test about a proportion	One population proportion p	Sample proportion $\hat{p}$	Categorical (binary)	Is the proportion of females different from 0.5? Is the proportion of students who fail Stat200 less than 0.1?	$H_o: p = p_o$ $H_a: p \neq p_o$ or $H_a: p > p_o$ or $H_a: p < p_o$ The one proportion Z-test: $z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$	Stat > Basic statistics > 1-sample proportion	$n\,p_o \geq 5$ and $n\,(1-p_o) \geq 5$

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5	Estimating the difference of two means	Difference in two population means μ_1-μ_2	Difference in two sample means $\bar{x}_1 - \bar{x}_2$	Numerical	How different are the mean GPAs of males and females? How many fewer colds do vitamin C takers get, on average, than non vitamin C takers?	2-sample t-interval $(\bar{x}_1 - \bar{x}_2) \pm t^* \times s.e.(\bar{x}_1 - \bar{x}_2)$	Stat > Basic statistics > 2-sample t	Independent samples from the two populations Data in each sample are about normal or large samples
6	Test to compare two means	Difference in two population means μ_1-μ_2	Difference in two sample means $\bar{x}_1 - \bar{x}_2$	Numerical	Do the mean pulse rates of exercisers and non-exercisers differ? Is the mean EDS score for dropouts greater than the mean EDS score for graduates?	$H_o: \mu_1 = \mu_2$ $H_a: \mu_1 \neq \mu_2$ or $H_a: \mu_1 > \mu_2$ or $H_a: \mu_1 < \mu_2$ The two sample t test: $t = \frac{(\bar{x}_1 - \bar{x}_2) - 0}{s.e.(\bar{x}_1 - \bar{x}_2)}$ See text, page 445, for the s.e. of the difference	Stat > Basic statistics > 2-sample t	Independent samples from the two populations Data in each sample are about normal or large samples
7	Estimating a mean with paired data	Mean of paired difference μ_D	Sample mean of difference $\bar{d}$	Numerical	What is the difference in pulse rates, on the average, before and after exercise?	paired t-interval $\bar{d} \pm t_{\alpha/2} \frac{s_d}{\sqrt{n}}$	Stat > Basic statistics > Paired t	Differences approximately normal OR Have a large number of pairs ($n \geq 30$)
8	Test about a mean with paired data	Mean of paired difference μ_D	Sample mean of difference $\bar{d}$	Numerical	Is the difference in IQ of pairs of twins zero? Are the pulse rates of people higher after exercise?	$H_o: \mu_D = 0$ $H_a: \mu_D \neq 0$ or $H_a: \mu_D > 0$ or $H_a: \mu_D < 0$ $t = \frac{\bar{d} - 0}{s_d / \sqrt{n}}$	Stat > Basic statistics > Paired t	Differences approximately normal OR Have a large number of pairs ($n \geq 30$)

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9	Estimating the difference of two proportions	Difference in two population proportions p1- p2	Difference in two sample proportions $\hat{p}_1 - \hat{p}_2$	Categorical (binary)	How different are the percentages of male and female smokers? How different are the percentages of upper- and lower-class binge drinkers?	two-proportions Z-interval $(\hat{p}_1 - \hat{p}_2) \pm$ $z_{\alpha/2} \times s.e.(\hat{p}_1 - \hat{p}_2)$	Stat > Basic statistics > 2 proportions	Independent samples from the two populations. Have at least 5 in each category for both populations.
10	Test to compare two proportions	Difference in two population proportions p1- p2	Difference in two sample proportions $\hat{p}_1 - \hat{p}_2$	Categorical (binary)	Is the percentage of males with lung cancer higher than the percentage of females with lung cancer? Are the percentages of upper- and lower-class binge drinkers different?	$H_o: p_1 = p_2$ $H_a: p_1 \neq p_2$ or $H_a: p_1 > p_2$ or $H_a: p_1 < p_2$ The two proportion z test: $z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\hat{p}(1-\hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$ $\hat{p} = \frac{x_1 + x_2}{n_1 + n_2}$	Stat > Basic statistics > 2 proportions	Independent samples from the two populations. Have at least 5 in each category for both populations.
11	Relationship in a 2-way table	Relationship between two categorical variables OR Difference in two or more population proportions	The observed counts in a two-way table	Categorical	Is there a relationship between smoking and lung cancer? Do the proportions of students in each class who smoke differ?	H_o: The two variables are not related H_a: The two variables are related The chi-square statistic: $\chi^2 = \sum_{\substack{all \\ cells}} \frac{(Observed - Expected)^2}{Expected}$	Stat >Tables > CrossTabulation > Chi-Square analysis	All expected counts should be greater than 1 At least 80% of the cells should have an expected count greater than 5

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12	Test about a slope	Slope of the population regression line β_1	Sample estimate of the slope b_1	Numerical	Is there a linear relationship between height and weight of a person?	$H_o: \beta_1 = 0$ $H_a: \beta_1 \neq 0$ or $H_a: \beta_1 > 0$ or $H_a: \beta_1 < 0$ The t test with n-2 degrees of freedom: $t = \frac{b_1 - 0}{s.e.(b_1)}$	Stat > Regression > Regression	The form of the equation that links the two variables must be correct The error terms are normally distributed The errors terms have equal Variances The error terms are independent of each other
13	Test to compare several means	Population means of the *t* populations $\mu_1, \mu_2, \ldots, \mu_t$	Sample mean of the t populations $x_1, x_2, \ldots, x_t$	Numerical	Is there a difference between the mean GPA of Freshman, Sophomore, Junior and Senior classes?	$H_o: \mu_1 = \mu_2 = \cdots = \mu_t$ H_a: not all the means are equal The F test for one-way ANOVA: $F = \frac{MSTR}{MSE}$	Stat >ANOVA > Oneway	Each population is normally Distributed Independent samples from the *t* populations Equal population standard deviations
14	Test of Strength & Direction of Linear Relationship of 2 Quantitative Variables	Population Correlation ρ "rho"	Sample correlation r	Numerical	Is there a linear relationship between height and weight?	$H_o: \rho = 0$ $H_a: \rho \neq 0$ $t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$	Stat > Basic Statistics > Correlation	2 variables are continuous Related pairs No significant outliers Normality of both variables Linear relationship between the variables
15	Test to Compare Two Population Variances	Two population variances σ_1^2, σ_2^2	Sample variances of 2 populations s_1^2, s_2^2	Numerical	Are the variances of length of lumber produced by Company A different from those produced by Company B	$H_o: \sigma_1^2 = \sigma_2^2$ $H_a: \sigma_1^2 \neq \sigma_2^2$ $F = s_1^2 / s_2^2$	Stat > Basic statistics > 2 variances	Each population is normally Distributed Independent samples from the 2 populations