Subject: Statistics
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Statistics: Hypothesis Tests: When to use Which Test?

Drawing Inference About One Population Mean		
Situation	**Test**	**Notes**
When the population is normal and σ is known	z test	
When the population is normal but σ is unknown	t test	
When the population is non normal but the sample size is ≥ 30 and σ is known	z test	
When the population is non normal but the sample size is ≥ 30 and σ is unknown	z test	replace σ by s i.e. replace population standard deviation with sample standard deviation
When the population is non normal and the sample size is < 30		Beyond our scope at this point

This handout will work as a basic reference sheet for Statistics Tutors and/or students to decide which statistical test is appropriate for use in a particular scenario and the purpose for conducting the tests.

Drawing Inferences About Two Population Means			
Situation	**Assumptions**	**Test**	**Notes**
Independent Samples	--Population distributions are normal with equal variances --The two random samples are independent		
a. When the 2 populations are normal and σ_1 and σ_2 are known		a. z test	
b. When the 2 populations are normal and σ_1 and σ_2 are unknown but we assume that the variances are equal		b. pooled t test	
c. When the 2 populations are normal and σ_1 and σ_2 are unknown but we assume that variances are unequal i.e., $\sigma_1 \neq \sigma_2$		c. approximate t test	
d. When 2 populations are non normal but the 2 samples n_1 and n_2 are ≥ 30 and if σ_1 and σ_2 are known		d. z test	
e. When the 2 populations are non normal but the 2 samples n_1 and n_2 are ≥ 30 and if σ_1 and σ_2 are unknown		e. z test	
f. When the 2 populations are non normal but the 2 samples n_1 and n_2 are < 30			take either σ_1\hat = s_1, σ_2\hat = s_2 ; or σ_1\hat = σ_2\hat = s_p

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	--Independent random samples --The population distributions are identical	f. Wilcoxon Rank Sum Test	(i) When n_1 , n_2 are $\leq$ 10 – Wilcoxon Rank Sum Test (ii) When n_1 , n_2 are > 10 – Wilcoxon Rank Sum Test: Normal Approximation
Inferences About μ_1 and μ_2 : Paired Data Here each measurement in one sample is matched with a particular measurement in the other sample.	--Normal Population --Dependent Samples --population distribution of the difference is non normal --population distribution of differences should be symmetric about the unknown median M	Paired t-test Wilcoxon Signed-Rank Test	Here the 2 samples are dependent. Therefore no other t-tests would give the best result.

Tests for Drawing Inferences about More Than Two Populations Means			
Situation	**Assumptions**	**Test**	**Notes**
When there are 3 or more normal populations with equal variances and the observations are drawn from independent random samples from their respective populations	--normal population --equal variances --independent random samples	ANOVA	Instead of performing numerous t tests, an efficient way to deal with 3 or more populations is to perform ANOVA.
When there are 3 or more non normal populations with equal variances and the observations are drawn from independent random samples from their respective populations	--non normal population --equal variance --independent random samples	Kruskal-Wallis Test	It is an extension of Wilcoxon Rank Sum Test (a non parametric test) for more than 2 samples.

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Remember: If the variability between the sample means is large in comparison to the within-sample variation, we may conclude intuitively that the corresponding population means are different.

Procedures To Perform Pairwise Comparison Among 3 or More Population Means	
As a result of ANOVA if we find that there is a significant difference among the groups, then we may use one of the following procedures to find which among the groups are significantly different and which are not.	
Procedure	**When to use?**
Fisher's LSD Procedure	1. Used when we are concerned about failing to declare a pair of agents significantly different when the population means are different 2. Can be used when the groups have different sample sizes
Tukey's W Procedure	1. Used when we are concerned about falsely declaring any pair of agents significantly different 2. Can not be used when one group has more observations than others (in other words, unequal sample sizes)
Dunnet's Procedure	1. Used when we want to determine which of the new agents or groups produced a significantly larger means in comparison to the standard agent or the control group 2. Requires all the samples to be of the same size as that of the control group

Tests for Drawing Inferences About Population Variances		
Situation	**Assumptions**	**Test**
Estimation and Tests for 1 Population Variance	-- Normal population -- Random sample	Chi-Square Test
Estimation and Tests For Comparing 2 Population Variances or For Evaluating Equal Variance Condition i.e., $\sigma_1^2 = \sigma_2^2$	-- Random samples -- Independently drawn -- Samples should be drawn from two normally distributed populations	F Test

Tests for Drawing Inferences About Population Proportions

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Situation	Conditions to be met	Test	Notes
Inferences About 1 Population Proportion (π)	-- $n\pi_0$ should be ≥ 5 and -- $n(1- \pi_0)$ should be ≥ 5 When these conditions are met only then one can compute the large sample "z" test statistic.	One Proportion Test	[Minitab > Stat > Basic Statistics > 1 Proportion]
Inferences About Difference Between 2 Population Proportions $\pi_1 - \pi_2$	--$n_1\pi_1$\hat, $n_2\pi_2$\hat, $n_1(1- \pi_1$\hat), and $n_2(1-\pi_2$\hat) should be all greater than or equal to 10 If any of these four is not equal to 10, one can not use the large sample approximation to the distribution of the test statistic for comparing 2 proportions. Instead one has to use Fisher's Exact Test.	Two Proportion Test	[Minitab > Stat > Basic Statistics > 2 Proportion]
Inference About Several Proportions	-- Variables should be categorical -- All the trials should be independent -- All expected cell counts (Ei) should be > 1 -- Not more than 20 % of Eis should be < 5	Chi-Square Goodness of Fit Test	[Minitab > Stat > Tables > Chi-square Goodness of Fit Test one variable]

Assessment of Independence / Dependence In Sample Data Presented In a Contingency Table		
Situation	**Conditions to be met**	**Notes**
When given a contingency table.	Same as $\chi 2$ Goodness of Fit test	[Minitab > Stat > Tables > Cross Tabulation and Chi-Square > For Rows: Categorical > For Columns: Numerical > Frequencies are in: Observed > Display: ✓ Counts ✓ Row Percents ✓ Column Percents > Chi-Square: ✓ Chi-Square analysis ✓ Expected cell counts]

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