**One Sample Means – Confidence Intervals and Hypothesis Tests**

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| Confidence Interval | Hypothesis Test |
| (where S/√N = standard error) | Ho:   a: < or > or ≠  This depends on the question. Null hypothesis must contain equal sign as it is the status quo |
| n= sample size ; x-bar = sample mean  s = sample standard deviation  t\* from chart using df= n-1 | Test statistic = |
| **Assumptions**   1. We have a simple random sample – the researcher select XXX mean from a simple random sample 2. Data comes from a normal population – the date is normally distributed  * check this by making a normal probability plot of the data; * central limit theorem, the sample mean from an independent sample tends to follow the normal distribution when n(>30) is large. | |
| *p-value is the probability of obtaining this sample or one or extreme if the null is true. Therefore if p-value < given level of significance, we reject the null hypothesis* | |
| *Type 1 error, reject the null BUT the null was true – this would suggest XXX – (explain!)*  *Type II error, fail the reject the null BUT the null was false – this would suggest XXX* | |

**Match Pairs or Dependent Samples - Confidence Intervals and Hypothesis Tests**

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| Confidence Interval | Hypothesis Test |
| (where S/√N = standard error) | Ho: d  a: d< or > or ≠  This depends on the question. Null must equal 0 as testing that there is no differnce |
| n = number of pairs  x-bard = sample mean difference,  Sd = sample standard deviation of the differences; t\* from chart using df= n-1 | Test statistic = |
| **Assumptions**   1. The sample of differences are randomly selected – explain it like #1 2. Sample differences comes from a normal population of differences – as #1  * check this by making a normal probability plot of the differences * central limit theorem, the sample mean from an independent sample tends to follow the normal distribution when n(>30) is large. | |

**Two independent samples** - **Confidence Intervals and Hypothesis Tests**

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| Confidence Interval | Hypothesis Test |
|  | Ho: 12  a: 1< 2 **or** > 2 **or** ≠ 2  This depends on the question. Null must contain equal sign as it is the status quo |
| where x1 is sample mean group 1 and x2 is sample mean of group 2, s2 sub 1 is sample variance of group 1, s2 sub 2 is sample variance of group 2,  t\* from chart using smallest of df= n1-1 or n2-1 | Test  Statistic=    μ1 - μ2= 0 as we expect μ1 = μ2 |
| **Assumptions**   1. The groups are independent – two group’s data are independent from each other 2. BOTH are randomly selected – state this assumption for each group separately 3. BOTH samples comes from a normal populations - state this assumption for each group separately  * check this by making normal probability plots ***FOR BOTH GROUPS***! | |

**Interpret the Confidence Intervals**

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| -We can be \*\*% confident that the population mean XXX for \*\*\* is among (XXX, YYY)  or  -We can be \*\*% confident that the population mean XXX for \*\*\* is at least XXX and at most YYY |
| It is not clear that there would be a difference in the population mean XXX of \*\*\* and \*\*\* since at \*\*% confident level, the confidence interval contains 0 so the mean can be either negative or positive |

**Graphics and Others**

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| Histogram | Check - Y, X axis; Title |
| Boxplot | 1, Shape - symmetric or not?  2, Center - the median of sample, are they similar or not?  3, Spread - is the spread different or similar? List the range(xxx, yyy)  4, Outlier - is there any outlier in the graph?  \* *Outlier : (Q1+(IQR \* 1.5), Q3+(IQR \* 1.5)) , anything outside is an outlier)*  *\* IQR = Q3 – Q1* |
| Other things being equal, the margin of error of a confidence interval decreases as the 1,confidence level decreases 2, the sample size *n* increases 3,the population standard deviation *σ* decreases. | |
| The SD is a measure of the dispersion of the data around the mean within your data set | |
| The SE is important to calculate the confidence interval for the population mean. SE is considered the level of error (dispersion) of your data from a population mean | |

**Hypothesis Test – read the question, find the parameter interest and give definition**

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| μ1 : Mean of XXX (Control Group) μ2 : Mean of XXX (Observing Group) μ1 - μ2 : Mean difference between two means H0 : μ1 - μ2 = 0 HA : μ1 - μ2 ≠ 0 or > or < 0 | σ12 : Variance of \*\*\*  σ22 : Variance of \*\*\*  σ12/σ22 : Ratio of two variances  *(where the σ12 is the bigger one)* H0 : σ12/σ22 = 1 HA : σ12/σ22 ≠ 1 |
| **Assumptions**  - Find assumptions as above in proper situation | |

**Significance Test ( T and F test )**

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| T test | -Examine the differences between the means (population parameter) of two groups -Determine whether the mean of a population significantly differs from a *hypothesized mean* or from the mean of another population.   * One sample v.s Two sample     (where S/√N is standard error)  Find p value using T table   * P > 0.05 or other significance level(a), fail to reject the null * P < 0.05 or other significance level(a), reject the null |
| F test | -Examine whether any variance exist within the samples or compare two population variances.  **Ho: s1 2=s2 2 test against Ha: s1 2≠ s2 2** (> or < in alternative condition)  **F-test = ratio of variance of two sample *=*** (s1= the bigger one of two variance)  -Calculate the F value then we find F(n1-1, n2-1) in F table.  -Find the critical value using ⎨a-level-significance(usually 0.05)⎬ F table and compare the F value from calculation with the critical value we found   * Reject the null if   F(v1-1, v2-1) > Fa [or Fa/2 in the case of a two tailed test]   * Fail to reject the null if   F(v1-1, v2-1) < Fa [or Fa/2 in the case of a two tailed test]  Or find the p value from statistic software and   * Reject null if p < à * Fail to reject the null if p > à |
| Assumption for both T; F | We have independent simple random samples from two normal distribution – check this by QQplot (assumption need to be satisfied before testing) |