Mann Whitney Test

Sample Size:	Test Statistics	Critical Value	Decision
Small Size: n1 ≤ and n2 ≤ 10 n1 + n2 ≤ 20	U_o = minmum if {$U_{1\text{ and }}U_2$} where U_1 and U_2 = n1.n2 $U_1 = n_1.n_2 + \frac{n1(n1+1)}{2} - R1$ $U_2 = n_1.n_2 + \frac{n2(n1+1)}{2} - R2$	$\boldsymbol{Ua, (n1, n2)}$	If Uo > $\boldsymbol{Ua, (n1, n2)}$ Do not reject **H_o** else reject Ho
		From man whitney table find p value for n1, n2 and U_o For two tailed, p-value = $2p_o$, for one tailed p-value = P_o	If p-value > a, then we do no reject H_o, otherwise reject H_o
Large Size: n1 > , n2 > 10 n1 + n2> 20	For large samples size, the distribution of U_o is approximated to normal distn with mean = $\frac{n1.n2}{2}$ and variance = $\frac{n1.n2(n1+n2+1)}{12}$ Test statistics: $$z = \frac{Uo - \frac{n_1 \cdot n_2}{2}}{\sqrt{\frac{n1n2(n1+n2+1)}{12}}}$$ In case of tied observation, corrected sd: $$\sigma_u = \sqrt{\frac{n_1 n_2}{n(n-1)}\left[\frac{n^3-n}{12} - \frac{\sum(t_i^3 - t_i)}{12}\right]}$$ Where n = n1 + n2 and t_i = number for times ith rank is repeated	**Z_a** from z-table	If Z_a table > Z calc, We accept H_o, else reject H_o

Median Test

Sample Size:	Test Statistics	Critical Value	Decision
Small Size: n1 ≤ and n2 ≤ 10 n1 + n2 ≤ 20	‘a’ Test statistics is obtained as follows: Combine both samples and arrange them in ascending order of magnitude such that n = n1 + n2 calculate the median of the combined sampled and count the no of observations less than or equal to the median in the first sample This is ‘a’ K = $\frac{n1+n2}{2}$	Po = P(A≥a); $P(A=a) = \frac{{}^{n_1}C_a \, {}^{n_2}C_{k-a}}{{}^{n1+n2}C_k}$ $P_0 = \sum_a^k \frac{{}^{n_1}C_a \, {}^{n_2}C_{k-a}}{{}^{n1+n2}C_k}$	For two tailed: If $2P_o > a$, accept H_o, else reject H_o For one tailed: If $P_o > a$, accept H_o, else reject H_o

<table>
<tr>
<td>Large Size:
n1 > 10 and
n2 > 10
n1 + n2 > 20</td>
<td>
<table>
<tr><td></td><td>No of obs <= Md</td><td>No of obs > Md</td><td>Total</td></tr>
<tr><td>Sample I</td><td>a</td><td>b</td><td>a+b</td></tr>
<tr><td>Sample II</td><td>c</td><td>d</td><td>C+d</td></tr>
<tr><td>Total</td><td>A+c</td><td>B+d</td><td>A+b+c+d</td></tr>
</table>
$\chi^2 = \frac{(ad-bc)^2}{(a+b)(c+d)(a+c)(b+d}$
</td>
<td>Extract X^2 value from X^2 table for 1 degree of freedom and a level of significance

$X^2_{\alpha,1}$</td>
<td>If X^2_{cal} > X^2_{tab}, we reject H_o, else accept.</td>
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Kolomogorov Smirnov Test

One Sample: To check if there is a significant difference between observed and expected frequency.	Test Statistics $D_o = \text{Max} \mid F_e(x) - F_o(x) \mid$ Where, $F_e(x) = \frac{\text{CFe}}{\text{n}}$ Cfe = expected cumulative frequency Fe = expected frequency $= np_i = \frac{\Sigma f}{no\ of\ categories}$ $F_o(x) = \frac{\text{CFo}}{\text{n}}$ Cf_o = observed cumulative frequency	Critical Value $D_{tabulated} = D_{n,\,\alpha}$	Decision If **$D_o > D_{n,\alpha}$** Then we reject H_0 otherwise we do not reject H_0.

Two sample: Small sample n1 ≤ = n2 ≤ 40 n1 != n2 ≤ 20	For two tailed D_o = Max | F(x) – F(y)| Where, F(x) = $\frac{CFx}{n1}$, F(y) = $\frac{CFy}{n2}$ For two tailed D_o = Max | F(x) – F(y)|	$D_{tabulated} = D_{(n1,n2), \alpha}$ $D_{tabulated} = D_{(n1,n2), \alpha}$	If **$D_{n1,n2,a} > D_o$**, Then we do not reject H_0 otherwise we reject H_0. If **$D_{n1,n2,a} > D_o$**, Then we do not reject H_0 otherwise we reject H_0.
Large sample n1, n2 > 40 for n1 = n2 and n1,n2 > 20 for n1!=n2	$X^2 = 4D_o^2(\frac{n1n2}{n1+n2})$	X^2 calculated = $X^2_{(\alpha, 2)}$ degree of freedom	If $X^2_{cal} > X^2_{tab}$, we reject H_o, else accept

Wilcoxo Matched Pair Sign Rank Test (used for small sample, n<=20)

One Sample: Use for small sample size	Test Statistics	Critical Value	Decision
	T = min {s(+), s(-), Where S(+) = sum of ranks of difference with '+' sign S(-) = sum of ranks of difference with '-' sign	$T_{tabulated} = T_{a, ne}$ n_e = effective sample size = n – t t = no of difference with zero	If $T_{a, ne} >= T$, we reject H_o, else accept

Kruskal Walis H test

One Sample: Small sample: n <= 5 and k = 3	Test Statistics $$H = \frac{12}{n(n+1)}(\sum_{i=1}^{k} \frac{R_i^2}{n_i}) - 3(n+1)$$ where, n = n1 + n2 + ... + n_k if there is tie in observation, then corrected H, $H_{corr} = \frac{H}{C.F}$ $$C.F = 1 - \frac{\sum(t_i^3 - t_i)}{n^3 - n}$$	Critical Value Obtain p-values	Decision If p- value > a we accept H_o, else reject
Large sample: $n_i > 5$ and k > 3	Same as above	X^2 tabulated = X^2 a, (k-1) (degree of freedom)	If H < X^2_{tab}, Accept h_o else reject H_o

Freidman F-Test

K= number of samples, n = size of each sample

Sample: Small sample: 2 <= n <= 5 and k = 4	Test Statistics $$F_r = \frac{12}{nk(k+1)}(\sum_{i=1}^{k} R_i^2) - 3n(k+1)$$ if there is tie in observation, then corrected F_r is used, $F_{r\ corrected} = \frac{Fr}{C.F}$	Critical Value Obtain p-values from table	Decision If p- value > a we accept H_o, else reject H_o

	$$C.F = 1 - \frac{\sum(t_i^3 - t_i)}{n(k^3 - k)}$$ t_i = no time ith rank is repeated		
Large Sample $n > 5$ & $k > 3$	Same as above	$X^2_{tabulated} = X^2_{a, (k-1)}$ (degree of freedom)	If $F_r < X^2_{tab}$, Accept h_o else reject H_o