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DAMT : Assignment-6.

1) Given data represent the time, in minutes, No of patient has to wait during 12 visits to a doctor's office.

17 15 20 20 32 28
12 26 25 25 35 24.

Let us take 'M' be the median waiting time for a patient

$H_0 : M = 20$

$H_1 : M < 20$

The data is the level 0.05 level of significance. To test the doctor's claim that the median Than 20 with the (+)ve. sign and observation equal to 20 with zero.

Waiting time ~~17 15 20 20 32 28 12 26 25 25~~

sign

waiting time 17 15 20 20 32 28 12 26 25 25 35 34

sign - - 0 0 + + - + + + + +

total number of positive sign = 7

total number of negative signs = 3

n = no of +ve and -ve signs

n = 10

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Test Statistics

$K = \min(A, B)$

$k = 3$

P-value $= P[x \le k / n = 10, P = 0.5]$ {where $x \sim B(n, P)$ $n = 10, P = 0.5$}

$= P[x \le 3 / n = 10, P = 0.5]$

So given

$P = 0.5$. where we have only 50% chance for both more than and less than median value.

P-value $= P[x \le 3 / n = 10, P = 0.5]$

$=$ BINOMDIST(3, 10, 0.5, TRUE)

$= 0.1719$ (using Excel).

Here, P-value, α, so, $0.1719 > 0.05$

So, we can rejection of Ho is not done.

So from the problem the median waiting time for patients is not different from 20 where $\alpha = 0.05$.

2. The given following data - the weights, in kilograms of personal luggage carried on various flights by members of a baseball

So, the given data is,

$\tilde{u}_1$ and $\tilde{u}_2$ are the median luggage weights

$Ho = \tilde{u}_1 = \tilde{u}_2$

$H_1 = \tilde{u}_1 \neq \tilde{u}_2$ $\alpha = 0.05$

Critical region $n_1 = 12$ $n_2 = 21$

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$\mu_{U_1} = \frac{n_1 n_2}{2} = \frac{(2 \times 2)}{2} = 126$

$\sigma_{U_1} = \sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}} = 26.72078$

$Z = \frac{U - \mu_{U_1}}{\sigma_{U_1}}$

$= \frac{U - 126}{26.72078}$

So the critical region is $Z \in (-\infty, -1.96) \cup (1.96, \infty)$

The observations are arranged in ascending order and rank from 1 to n_1 to n_2 and is equal to 33.

Basketball

$w_1 = 1 + 3.5 + 5.5 + 4.5 + 11.5 + 14.5 + 17.5 + 17.5 + 11 + 24.5 + 26.5 + 30 = 182.5$

$w_2 = \frac{33(34)}{2} - 182.5$

$= 378.5$

$\mu_1 = 182.5 - \frac{12(13)}{2} = 104.5$

$\mu_2 = 378.5 - \frac{21(22)}{2} = 149.5$

$\mu = \min(\mu_1, \mu_2) = 104.5$

∴ we get the value of test statistics as

$Z = \frac{104.5 - 126}{26.72} = -0.8406$

∴ we do not reject the null hypothesis.

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3. The given textbook cost $89, $99, $119, $139, $189, $199 and $229. During his Senior year he had to pay $109, $159 $179, $209, $219, $259, $279, $299 and $309.

Freshman (F)

89 99 119 139 189 199 229

Sampler	Sampler	total	Sample order		Rank.
			Smallest		
		S_1	S_2	S_1	S_2
89	109	89		1	
99	159	99		2	
119	179		109		3
139	209	119		4	
189	219	139		5	
199	259		159		6
229	279		179		7
	299	189		8	
	309	199		9	
			209		10
			219		11
		229		12	
			259		13
			279		14
			299		15
			309		16

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Hypothesis

H_0 : median cost of text book is same
H_1 : median cost of book is rising.

$$U_1 = n_1 n_2 + \frac{n_1(n_1+1)}{2} - R_1$$

$$U_2 = n_1 n_2 + \frac{n_2(n_2+1)}{2} - R_2$$

where R_1 & R_2 are sum of ranks for sample 1 and 2 respectively

$R_1 = 1+2+4+5+8+9+12 = 41$
$R_2 = 3+6+7+10+11+13+14+15+16 = 95$

$$U_1 = 7\times9 + \frac{7\times8}{2} - 41$$

$$= 50$$

$$U_2 = 7\times9 + \frac{9\times10}{2} - 95$$

$$U = (\min(50, 13)) = 13$$

$n_1 = 7, n_2 = 9$ at 5% = 0.5 (given)
Reject H_0 if $U < 12$
$U = 13$

we accept H_0 it means there is no significant evidence that median cost of text books is rising.

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(4) A die is tossed 180 times with the following.

x	1	2	3	4	5	6
f	28	36	36	30	27	23

Let H_0: The die is balanced (uniform)
H_1: The die is not balanced (not uniform)

By using Decision Rule:-

$$\chi^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

We reject H_0 if $\chi^2 \geq \chi^2_{\alpha, n-p-k-1}$

Where n = number of classes
P = number of parameter estimated
k = number of pooling done.

x	f	P_i	$E_i = NP_i$	$\frac{(O_i - E_i)^2}{E_i}$
1	28	0.1667	30	0.1333
2	36	0.1667	30	1.2000
3	36	0.1667	30	1.2000
4	30	0.1667	30	0.0000
5	27	0.1667	30	0.3000
6	23	0.1667	30	1.6333
Total	180	1.0000	180	4.4667.

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So, we have the probability of each outcome = 1/6 when there are 6 faces to a die & the balanced die should have equal probability of getting each

$$X^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

$$X^2 = 4.4667$$

for the critical value:

$$n = 6, P = 0, K = 0$$

$$X^2_{\alpha, n-p-k-1} = X^2_{0.01, 6-0-0-1}$$

$$= 15.086$$

$\therefore X^2 (4.667) < X^2_{\alpha, n-p-k-1} (15.086)$, hence we failed to reject H_0 at 0.01 level of significance

$\therefore$ we concluded that the die is balanced.