(1) Given Median time is 20 minutes.

Now, signed ranked test we have to test the claim that the median waiting time is not more than 20 minutes before being admitted to the examination room.

Null Hypothesis $H_0: \bar{\mu} = 20$.

Alternative Hypothesis $H_a: \bar{\mu} \leq 20$

level of significance $\alpha = 0.05$

Critical region since $n = 10$, after discarding the one measurement that equals 20, the table value or the critical region is found to be $W_{critical} = 11$.

Waiting time	Difference $(x-20)$	Ranks
17	-3	1
15	-5	4
20	0	
20	0	
32	12	9
28	8	7.5
12	-8	7.5
26	6	6
25	5	4
25	5	4
35	15	10
24	4	2

$w_+ = T_+ = 9 + 7.5 + 6 + 4 + 4 + 10 + 2 = 42.5$

$w_- = T_- = 1 + 4 + 7.5 = 12.5$

$\text{Min}(w_+, w_-) \Rightarrow 12.5 \Rightarrow w > w_{critical}$

Here we fail to reject the null hypothesis, since the caluculated sum of the ranks is greater than the critical for a 0.05 significance level and conclude that the median waiting time is not significantly diffrent from 20 minutes

(2) Null Hypothesis H_0: Two athletes carry the same amount of luggage.

$$H_0 : \bar{\mu}_1 - \bar{\mu}_2 = 0.$$

Altenate Hypothesis H_a: They do not carry same amount amount of luggage

$$H_a : \bar{\mu}_1 - \bar{\mu}_2 \neq 0.$$

level of significance $\alpha = 0.05$

critical region: Here the sample size $n_1 = 21$ and $n_2 = 12$ are greater than 8.

Basketball player	Ranks	Basketball player	Ranks
16.3	17.5	15.4	11.5
18.1	26.5	17.7	24.5
15.9	14.5	18.6	30
14.1	5.5	12.7	1
17.7	24.5	15	9.5
16.3	17.5	15.9	14.5
13.2	2	16.3	17.5
20	33	18.1	26.5
15	9.5	16.8	21
18.6	30	14.1	5.5
14.5	7	13.6	3.5
19.1	32	16.3	17.5
13.6	3.5		
17.2	22		
18.6	30		
15.4	11.5		
15.6	13		
18.3	28		
17.4	23		
14.8	8		
16.5	20		

$w_1 = 378.5$ $\quad\quad$ $w_2 = 182.5$

Sum of rank of brand A $w_1 = 378.5$ and for brand B $w_2 = 182.5$

$$u_1 = w_1 - \frac{n_1(n+1)}{2} \Rightarrow 378.5 - \frac{21(21+1)}{2}$$

$$\Rightarrow 147.5$$

$$u_2 \Rightarrow w_2 - \frac{n_2(n_2+1)}{2}$$

$$\Rightarrow 182.5 - \frac{12(12+1)}{2}$$

$$\Rightarrow 104.5$$

The Wilcoxon test static is

$$U = u = \min(u_1, u_2)$$

$$= \min(147.5, 104.5)$$

$$= 104.5$$

Mean $\mu_{v_1} = \frac{n_1 \times n_2}{2} = \frac{21 \times 21}{2} = 126.$

Variance $\sigma_v^2 = \frac{n_1 n_2 (n_1 + n_2 + 1)}{12} = \frac{21 \times 12 (21 + 12 + 1)}{12} = 714$

Now the test static 'z' is $z = \frac{u_1 - u_{v_1}}{\sigma_{v_1}}$

$$= \frac{104.5 - 126}{\sqrt{714}}$$

$$= \boxed{-0.8046}$$

Since $z = -0.8046$, we fail to reject null hypothesis. Two athletes carry same amount of luggage.

(3) Null Hypothesis $H_0 : \mu_F - \mu_S = 0$

Alternate Hypothesis $H_a : \mu_F < \mu_S$

Level of significance $\alpha = 0.05$

Critical region

Samples $n_1 = 6 < 10 \Rightarrow$ less Samples

Freshman	Rank	Senior	Rank
89	1	109	3
99	2	159	6
119	4	179	7
139	5	209	10
189	8	219	11
199	9	259	13
229	12	279	14
		299	15
		309	16
	$\Sigma = 14$		$\Sigma = 95$

1	89
2	99
3	109
4	119
5	139
6	159
7	179
8	189
9	199
10	209
11	219
12	229
13	259
14	279
15	299
16	309

$U_F = 41 - \frac{7(7+1)}{2} = 41 - 28 = 13$

$U_S = 95 - \frac{9(9+1)}{2} = 95 - 45 = 50.$

$U_{STAT} = 13$

$U_{critical} = 12$

$P \in (0.025, 0.05)$

$U_{STAT} > U_{critical}$ we fail to reject null hypothesis

$\therefore$ The Mean of textbook costs is same for freshman & Senior Years.