

Stat 403 - Solution to Assignment 9

We will go over on Thursday, December 7, 2000

1. The data below were collected by W. F. Woodward, shortstop of the 1970 Cincinnati Reds National League baseball team. The question of interest was whether the way a runner rounded first base made a difference in the time it took to get to second base. The three methods were “round out”, “narrow angle” and “wide angle”.
 - (a) There is a lot of variability from player to player in terms of natural running speed. By having each player use all three methods we can account for these natural differences in the analysis.
 - (b) From the Analysis of Variance table we see that the F statistic for Method is $F=6.29$ with an associated P-value of 0.004. This indicates that there are statistically significant differences in the mean times for some of the methods. With an overall, experiment wise, error rate of 6%, we can compute an adjusted LSD as follows:

$$adjLSD = 2.4185\sqrt{0.00745}\sqrt{\left(\frac{1}{22} + \frac{1}{22}\right)} = 0.0629$$

Comparisons	Difference in Means	Significant?
Narrow & Round Out	$5.543 - 5.534 = 0.009$	No
Narrow & Wide	$5.534 - 5.459 = 0.075$	Yes
Round Out & Wide	$5.543 - 5.459 = 0.084$	Yes

The Wide Angle is significantly different from either the Narrow Angle or the Round Out.

- (c) Rank each method from 1 to 3 within each player.

Player	Methods		
	Round out	Narrow angle	Wide angle
1	5.40 (1)	5.50 (2)	5.55 (3)
2	5.85 (3)	5.70 (1)	5.75 (2)
3	5.20 (1)	5.60 (3)	5.50 (2)
4	5.55 (3)	5.50 (2)	5.40 (1)
5	5.90 (3)	5.85 (2)	5.70 (1)
6	5.45 (1)	5.55 (2)	5.60 (3)
7	5.40 (2.5)	5.40 (2.5)	5.35 (1)
8	5.45 (2)	5.50 (3)	5.35 (1)
9	5.25 (3)	5.15 (2)	5.00 (1)
10	5.85 (3)	5.80 (2)	5.70 (1)
11	5.25 (3)	5.20 (2)	5.10 (1)
12	5.65 (3)	5.55 (2)	5.45 (1)
13	5.60 (3)	5.35 (1)	5.45 (2)
14	5.05 (3)	5.00 (2)	4.95 (1)
15	5.50 (2.5)	5.50 (2.5)	5.40 (1)
16	5.45 (1)	5.55 (3)	5.50 (2)
17	5.55 (2.5)	5.55 (2.5)	5.35 (1)
18	5.45 (1)	5.50 (2)	5.55 (3)
19	5.50 (3)	5.45 (2)	5.25 (1)
20	5.65 (3)	5.60 (2)	5.40 (1)
21	5.70 (3)	5.65 (2)	5.55 (1)
22	6.30 (2.5)	6.30 (2.5)	6.25 (1)
	$R_1 = 53$	$R_2 = 47$	$R_3 = 32$

$$S = (53 - 44)^2 + (47 - 44)^2 + (32 - 44)^2 = 81 + 9 + 144 = 234$$

$$Q = \frac{12S}{kn(n+1)} = \frac{12(234)}{22(3)(4)} = 10.64$$

P-value from the χ^2 distribution with 2 degrees of freedom is between .001 and .01. Reject the null hypothesis that all methods are the same. Conclude that some of the methods are significantly different.

- (d) Using an overall, experiment wise, error rate of 6% the corresponding z^* value is 2.326. The cutoff for the difference in rank sums is:

$$z^* \sqrt{\frac{kn(n+1)}{6}} = 2.326 \sqrt{\frac{22(3)(4)}{6}} = 2.326(6.633) = 15.4$$

Comparisons	Difference in rank sums	Significant?
Narrow & Round Out	53 - 47 = 6	No
Narrow & Wide	47 - 32 = 15	No
Round Out & Wide	53 - 32 = 21	Yes

The Wide Angle is significantly different from the Round Out.