Stat 296 Fall 2007
Comparing Two Ranking Systems

Consider Problem #5 on Assignment #4 concerning the ranking of countries at the Olympics.

The "official" ranking as done by the IOC is to rank countries by the colour of the medals won. That is, countries are first ranked by gold medals, then by silver medals, and finally by bronze medals. In contrast, the CBC chose to rank countries on the basis of total medals won. Although the CBC ranking system is "unofficial," it has the advantage that Canada places third overall in comparison to its fifth place finish in the IOC rankings.

Based on the data for the 2006 Winter Olympics in Turin, can we decide statistically which of two proposed ranking systems (the CBC rank or the IOC rank) more fairly determines the winner?

Ranking By Total Medals Won (CBC Rank)

Country	Gold	Silver	Bronze	TOTAL	Rank
Germany	11	12	6	29	1
United States	9	9	7	25	2
Canada	7	10	7	24	3
Austria	9	7	7	23	4
Russia	8	6	8	22	5
Norway	2	8	9	19	6
Sweden	7	2	5	14	7.5
Switzerland	5	4	5	14	7.5
China	2	4	5	11	10
Italy	5	0	6	11	10
South Korea	6	3	2	11	10
Finland	0	6	3	9	13
France	3	2	4	9	13
Netherlands	3	2	4	9	13
Czech Republic	1	2	1	4	15
Croatia	1	2	0	3	16.5
Estonia	3	0	0	3	16.5
Australia	1	0	1	2	19
Poland	0	1	1	2	19
Ukraine	0	0	2	2	19
Belarus	0	1	0	1	24.5
Bulgaria	0	1	0	1	24.5
Great Britain	0	1	0	1	24.5
Japan	1	0	0	1	24.5
Latvia	0	0	1	1	24.5
Slovakia	0	1	0	1	24.5

Ranking By Colour (IOC Rank)

Country	Gold	Silver	Bronze	Rank
Germany	11	12	6	1
United States	9	9	7	2
Austria	9	7	7	3
Russia	8	6	8	4
Canada	7	10	7	5
Sweden	7	2	5	6
South Korea	6	3	2	7
Switzerland	5	4	5	8
Italy	5	0	6	9
France	3	2	4	10.5
Netherlands	3	2	4	10.5
Estonia	3	0	0	12
Norway	2	8	9	13
China	2	4	5	14
Czech Republic	1	2	1	15
Croatia	1	2	0	16
Australia	1	0	1	17
Japan	1	0	0	18
Finland	0	6	3	19
Poland	0	1	1	20
Belarus	0	1	0	22.5
Bulgaria	0	1	0	22.5
Great Britain	0	1	0	22.5
Slovakia	0	1	0	22.5
Ukraine	0	0	2	25
Latvia	0	0	1	26

Paired Ranks

Country	CBC Rank	IOC Rank
Germany	1	1
United States	2	2
Canada	3	5
Austria	4	3
Russia	5	4
Norway	6	13
Sweden	7.5	6
Switzerland	7.5	8
China	10	14
Italy	10	9
South Korea	10	7
Finland	13	19
France	13	10.5
Netherlands	13	10.5
Czech Republic	15	15
Croatia	16.5	16
Estonia	16.5	12
Australia	19	17
Poland	19	20
Ukraine	19	25
Belarus	24.5	22.5
Bulgaria	24.5	22.5
Great Britain	24.5	22.5
Japan	24.5	18
Latvia	24.5	26
Slovakia	24.5	22.5

Question: Is there a difference between the two ranking systems? Does one system more fairly determine the "winner" than the other system?

To answer this question we will conduct a non-parametric test for paired comparisons based on ranks. That is, we will conduct a Wilcoxon Signed-Rank Test (see Section 4.2 and notes from October 23). Unfortunately, we did not discuss the case of ties in the data and so we cannot do any calculations by hand. However, we can have SAS perform the test!

```
data olympics;
input pair CBC IOC @@;
diff=CBC-IOC;
datalines;
1 1 2 2 3 5 4 3 5 4 6 13 7.5 6 7.5 8 10 14 10 9 10 7 13 19
13 10.5 13 10.5 15 15 16.5 16 16.5 12 19 17 19 20 19 25
24.5 22.5 24.5 22.5 24.5 22.5 24.5 18 24.5 26 24.5 22.5
;
proc univariate data=olympics;
var diff;
run;
```

The UNIVARIATE Procedure
Variable: diff

Moments

N	17	Sum Weights	17
Mean	-0.9705882	Sum Observations	-16.5
Std Deviation	3.17446151	Variance	10.0772059
Skewness	0.24777045	Kurtosis	1.16619641
Uncorrected SS	177.25	Corrected SS	161.235294
Coeff Variation	-327.06573	Std Error Mean	0.76992001

Basic Statistical Measures

Location		Variability	
Mean	-0.97059	Std Deviation	3.17446
Median	-1.00000	Variance	10.07721
Mode	-2.00000	Range	13.50000
		Interquartile Range	3.00000

The UNIVARIATE Procedure
Variable: diff

Tests for Location: Mu0=0

Test	-Statistic-		-----p Value------	
Student's t	t	-1.26064	Pr > |t|	0.2255
Sign	M	-3	Pr >= |M|	0.2101
Signed Rank	S	-26.5	Pr >= |S|	0.1768

Quantiles (Definition 5)

Quantile	Estimate
100% Max	6.5
99%	6.5
95%	6.5
90%	2.0
75% Q3	1.0
50% Median	-1.0
25% Q1	-2.0

```
                    The UNIVARIATE Procedure
                         Variable:  diff

                    Quantiles (Definition 5)
                     Quantile      Estimate
                     10%               -6.0
                     5%                -7.0
                     1%                -7.0
                     0% Min            -7.0

                      Extreme Observations

              ----Lowest----        ----Highest---
              Value      Obs        Value      Obs
               -7.0        4          1.0       13
               -6.0        8          1.5       17
               -4.0        6          2.0       12
               -2.5        9          2.0       14


                    The UNIVARIATE Procedure
                         Variable:  diff

                      Extreme Observations

              ----Lowest----        ----Highest---
              Value      Obs        Value      Obs
               -2.0       15          6.5       16
```

Hence, the test of H_0: no difference between the two systems and H_A: some difference between the two systems procuces a two-sided p-value of 0.1768. This does not provide signicant evidence against H_0 and so our conclusion is that we cannot reject H_0. Hence, based on this data, there is no significant difference between the two systems.

We need to be a little concerned about the results, however, because of the ties in the data. Notice that there are two types of ties: (i) ties in rank within a given system, and (ii) the same rank in both system. In the second case, SAS chooses to ignore the differences of 0. As noted in our text, this can be problematic.