Math 159 – Spring 2010
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warm-up # 4

Name: _____

Violence in television. See handout. [Hollander & Wolfe, "Nonparametric Statistical Anaylsis," page 124.] Is there evidence to indicate that children who watched violent TV (The Karate Kid) take longer to seek help? Use a Wilcoxon Rank Sum test. (Additionally, find a 95% CI for the difference in mean amount of time for the violent TV watchers compared to the sports TV watchers.)

Solution:

X = number of seconds to get an adult for Karate Kid watchers
Y = number of seconds to get an adult for Olympics watchers
n=m=21, N=42, N(N+1)/2 = 903

- $$\begin{aligned} H_0: &\quad E(X) \geq E(Y) \\ H_1: &\quad E(X) < E(Y) \\ T &= \sum_{i=1}^{n} R(X_i) = 395.5 \\ &\quad \sum_{j=1}^{m} R(Y_j) = 507.5 \\ Z &= \frac{T - \frac{n(N+1)}{2}}{\sqrt{\frac{nm(N+1)}{12}}} \\ &= \frac{395.5 - \frac{21*43}{2}}{\sqrt{\frac{21*21*43}{12}}} \\ &= -1.4087 \\ p-value &= P(Z \leq -1.4087) = 0.08 \end{aligned}$$

  What if we want to consider the effect of ties?

  $$\begin{aligned} T_1 &= \frac{T - \frac{n(N+1)}{2}}{\sqrt{\frac{nm}{N(N-1)} \sum_{i=1}^{N} R_i^2 - \frac{nm(N+1)^2}{4(N-1)}}} \\ &= -1.443 \\ p-value &= P(Z \leq -1.443) = 0.074 \end{aligned}$$

  Not very convincing evidence to say that Karate Kid produces less reactive child-care watchers.

- Witnessing violence data (Olympics versus Karate Kid on TV): n=21, N=42,

$$\begin{aligned}
\omega_{\alpha/2} &= \frac{n(N+1)}{2} + z_{\alpha/2}\sqrt{\frac{nm(N+1)}{12}} \\
&= \frac{21 \cdot 43}{2} - 1.96\sqrt{\frac{21 \cdot 21 \cdot 43}{12}} = 373.6 \\
\omega_{1-\alpha/2} &= \frac{21 \cdot 43}{2} + 1.96\sqrt{\frac{21 \cdot 21 \cdot 43}{12}} = 529.4
\end{aligned}$$

$$\begin{aligned}
&\text{reject } H_0 \text{ if} \qquad k < 373.6 - \frac{n(n+1)}{2} = 142.6 \\
&\text{reject } H_0 \text{ if} \qquad k > 529.4 - \frac{n(n+1)}{2} = 298.4
\end{aligned}$$

  - Notice that 141^{st} difference is -30min, 144^{th} difference is -29min.
    If we add -30 to all $Y_j \Rightarrow k = 140$, don't reject
    If we add -29 to all $Y_j \Rightarrow k = 143$, don't reject
    If we add anything less than -30 (say, -30.5), we reject.
  - Notice that 296^{th} difference is 4min, 299^{th} difference is 5min.
    If we add 4 to all $Y_j \Rightarrow k = 298$, don't reject
    If we add 5 to all $Y_j \Rightarrow k = 300$, reject
    If we add anything bigger than 5 (say 4.5), we don't reject.

A 95% CI for $E(X) - E(Y)$ is: [-30min, 5min]