The Kruskal-Wallis Test

BIOS 6611

CU Anschutz

Week 11

The Kruskal-Wallis Test

Motivation

The one-way ANOVA can be used to compare the means of J groups ($J \geq 2$). It assumes that each population is normally distributed, but what if this assumption is not valid?

One option is consider transformations of the outcome, Y, such as $\log(Y)$.

Another is to use the **Kruskal-Wallis test**, which is often thought of as a *nonparametric* ANOVA.

The Kruskal-Wallis Test

The Kruskal-Wallis test is a multiple group extension of the Mann-Whitney U test (which was equivalent to the Wilcoxon rank sum test).

The hypotheses are similar to the two-sample format:

H_0 : the mean ranks of the groups are the same

H_1 : at least one group has a different mean rank

Or, equivalently:

H_0 : the samples come from populations with the same distribution

H_1 : at least one sample comes from a pop. with a different distribution

If, and only if, we assume the shapes and scale of the distribution are identical for each group can we state it as a test of the medians!!

Post-hoc Testing for Kruskal-Wallis

If we reject H_0 for the global hypothesis that all mean groups are the same, we may wish to conduct post-hoc testing to identify what groups are significantly different.

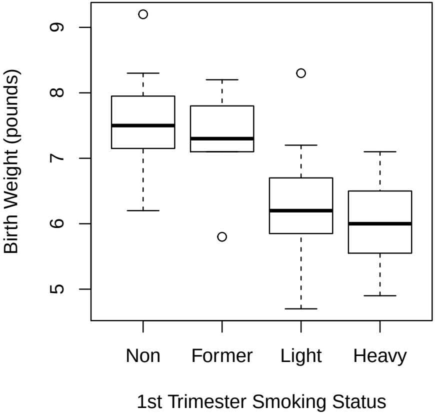
Dunn's test is the proper test to use for our nonparametric ANOVA. Recall from our one-way ANOVA post-hoc testing slides, it employs a strategy similar to a Bonferroni correction. A `SAS` macro is provided on our course page to implement it in our nonparametric context, while `R` has functions we can use.

Kruskal-Wallis Example

Motivating Example

Our motivating example will be infant birthweight (pounds) and smoking status of mother during the first trimester, but assume we are not comfortable assuming normality.

	Smoking Status			
i	**Non**	**Former**	**Light**	**Heavy**
1	7.5	5.8	5.9	6.2
2	6.2	7.3	6.2	6.8
3	6.9	8.2	5.8	5.7
4	7.4	7.1	4.7	4.9
5	9.2	7.8	8.3	6.2
6	8.3		7.2	7.1
7	7.6		6.2	5.8
8				5.4
$\bar{R}$	7.8	10.3	16.5	19.6



Kruskal-Wallis Example Code

In SAS we can implement these our nonparametric approach as follows:

```
PROC NPAR1WAY DATA = BWT WILCOXON ANOVA;
    CLASS momsmoke;
    VAR birthwt;
RUN;

FILENAME DUNN '~/dunn macro.sas';
%INCLUDE DUNN;

%DUNN(BWT,momsmoke,birthwt,0.05);
RUN;
```

In R we can use functions in the DescTools and stats packages:

```
BWT <- read.csv('birthweight_smoking_dataset.csv', header=T)
kruskal.test( birthwt ~ momsmoke, data=BWT)
DescTools::DunnTest(birthwt ~ momsmoke, data=BWT)
```

Kruskal-Wallis Example

```
BWT <- read.csv('birthweight_smoking_dataset.csv', header=T)
kruskal.test( birthwt ~ momsmoke, data=BWT)
```

```
##
##  Kruskal-Wallis rank sum test
##
## data:  birthwt by momsmoke
## Kruskal-Wallis chi-squared = 10.081, df = 3, p-value = 0.01789
```

Dunn's Post-hoc Test Example

```
DescTools::DunnTest(birthwt ~ momsmoke, data=BWT)
```

```
##
##  Dunn's test of multiple comparisons using rank sums : holm
##
##                mean.rank.diff   pval
## Heavy-Former      -9.262500 0.1960
## Light-Former      -6.200000 0.5414
## Non-Former         2.514286 0.9083
## Light-Heavy        3.062500 0.9083
## Non-Heavy         11.776786 0.0240 *
## Non-Light          8.714286 0.1960
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```