Repeated Measures (RM-ANOVA) Adding a Predictor

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Read in the minneapolis.csv data

```
## Read in the data
> mpls = read.csv("http://www.tc.umn.edu/~zief0002/Data/minneapolis.csv")
```

Packages Needed

- **ez**
- **ggplot2**
- **reshape2**

```
> mpls2 = mpls[complete.cases(mpls), ]
```

Remove rows with missing data

Reshape Wide to Long Data

```
## Use the reshape2 package
> library(reshape2)

## Melt the data to the long format
> mplsLong = melt(
    mpls2,
    id = c("studentID", "female"),
    measure = c("grade.5", "grade.6", "grade.7", "grade.8")
    )
```

> **The id= argument**
>
> keep these variables as columns

> **The measure= argument**
>
> Change these variables into two new ones...variable and value

```
> head(mplsLong)

  studentID female variable value
1         1      1   read.5   172
2         3      0   read.5   191
3         5      1   read.5   207
4         6      0   read.5   191
5         7      0   read.5   199
6         9      1   read.5   149
```
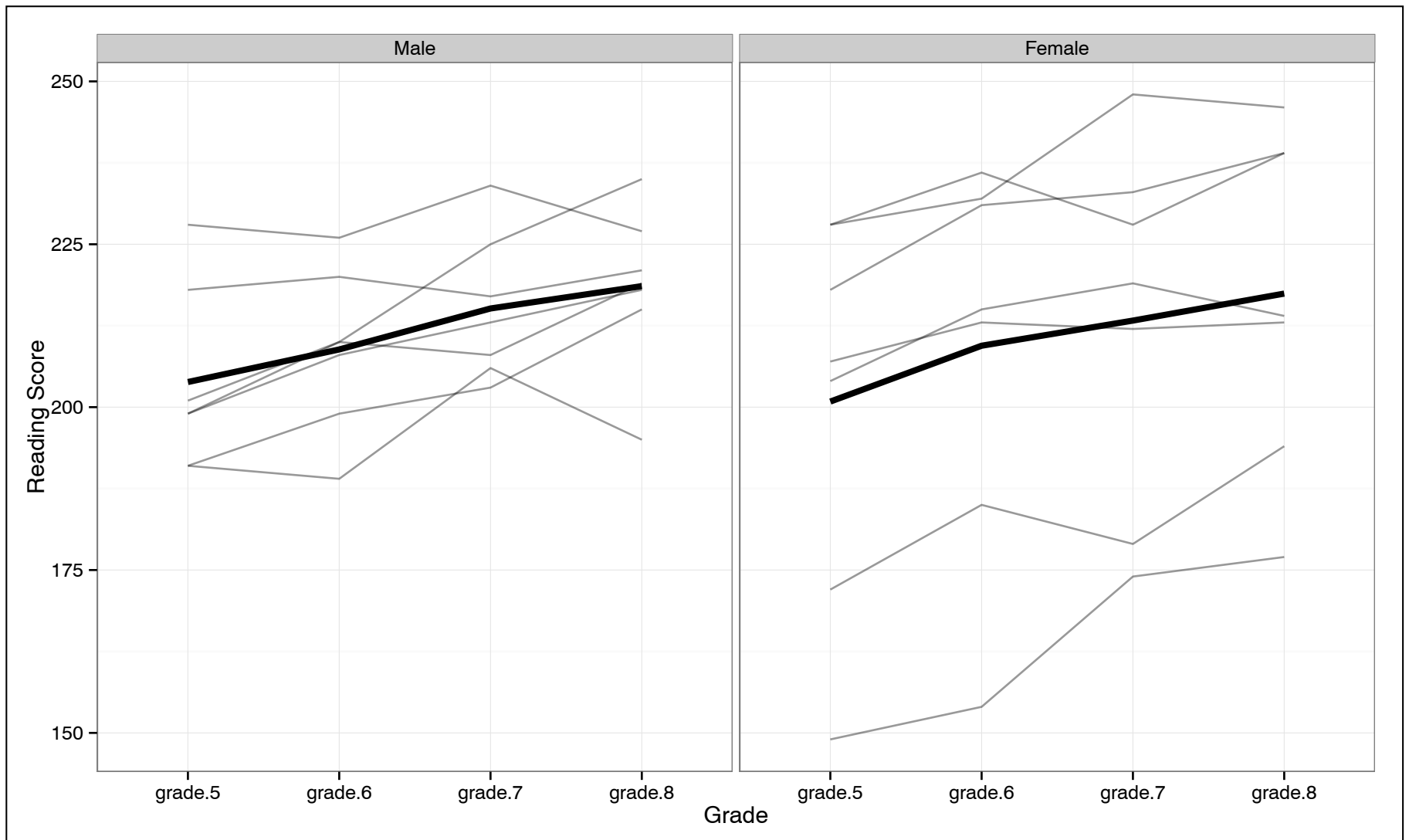
- Change the column names from "variable" and "value" (to "grade" and "read")

- Change the level names of the new "grade" column

- Coerce "female" into a factor

- Coerce "studentID" into a factor

```
> head(mplsLong)

  studentID female   grade read student
1         1 Female grade.5  172       1
2         3   Male grade.5  191       3
3         5 Female grade.5  207       5
4         6   Male grade.5  191       6
5         7   Male grade.5  199       7
6         9 Female grade.5  149       9
```

- The plot shows differences in reading score over grade (for both males and females)
- The plot shows differences in reading scores between males and females (at each grade)

USING THE EZANOVA FUNCTION

Fit the Mixed-Effects ANOVA using ezANOVA()

```r
## Load the ez library
> library(ez)

## Fit the model
> rm.aov = ezANOVA(data = mplsLong,
    dv = read,
    wid = student,
    within = .(grade),
    between = .(female),
    detailed = TRUE
    )

> rm.aov
```

Add a between-subjects factor

Since the data are repeated measures,
sphericity is assumed to be untenable, regardless of Mauchly's test. (Ignore this output!)

```
$`Sphericity Corrections`
       Effect       GGe        p[GG] p[GG]<.05       HFe        p[HF] p[HF]<.05
3        grade 0.6613116 2.262608e-05         * 0.7917665 4.628061e-06         *
4 female:grade 0.6613116 8.081902e-01           0.7917665 8.445250e-01
```

- The analysis suggests there is no sex by grade interaction ($p = 0.808$). Females and males do not have differing mean patterns in reading scores (at least in 5th–8th grade in this population).

Now we can examine the main-effect of female and the main-effect for grade.

```
$ANOVA
        Effect DFn DFd          SSn        SSd            F            p p<.05            ges
1  (Intercept)   1  12 2.491488e+06 21670.429 1.379662e+03 9.306976e-14      * 0.990854586
2       female   1  12 2.578571e+01 21670.429 1.427884e-02 9.068611e-01        0.001120057
3        grade   3  36 1.924429e+03  1325.571 1.742127e+01 3.734349e-07      * 0.077222932
4 female:grade   3  36 2.350000e+01  1325.571 2.127384e-01 8.869166e-01        0.001020874

$`Mauchly's Test for Sphericity`
        Effect        W            p p<.05
3        grade 0.205963 0.004795956      *
4 female:grade 0.205963 0.004795956      *

$`Sphericity Corrections`
        Effect       GGe        p[GG] p[GG]<.05       HFe        p[HF] p[HF]<.05
3        grade 0.6613116 2.262608e-05         * 0.7917665 4.628061e-06         *
4 female:grade 0.6613116 8.081902e-01           0.7917665 8.445250e-01
```

- The analysis suggests there is an effect of grade ($p < .001$), controlling for sex. There is *at least* one mean reading scores (in 5th–8th grade in this population) that is different from the others.

- The analysis suggests there is not an effect of female ($p = .907$), controlling for grade. There is no difference in the mean reading scores between males and females at any grade level.