Multiple regressions and interactions

April 4, 2018

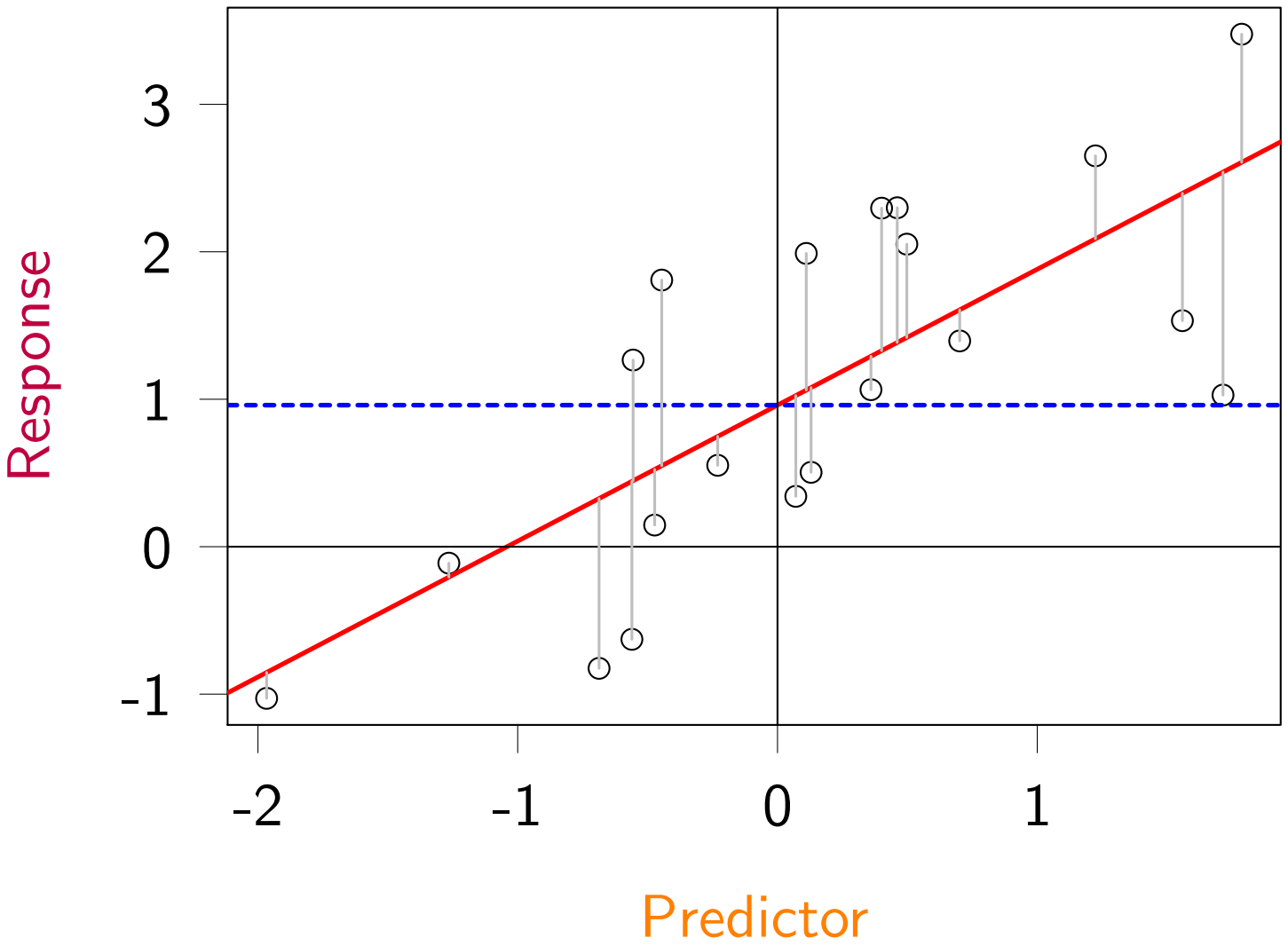
1 Linear model, reminder

2 Multiple regression

3 Interaction

A simple linear model

Response = **Intercept** + **Slope** × **Predictor** + **Error**



A simple linear model

$$\textbf{Response} = \textbf{Intercept} + \textbf{Slope1} \times \textbf{Predictor1} + \textbf{Slope2} \times \textbf{Predictor2} + \textbf{Error}$$

In R:

```
lm(response ~ 1 + predictor1 + predictor2, data=data)
```

1 Linear model, reminder

2 Multiple regression

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Sequential regression

```
     1

[1] 1
```

1 Linear model, reminder

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Warnings

Vocabulary warning!

- **correlation**: linear association between two variables *"how well does x explain y ?"*

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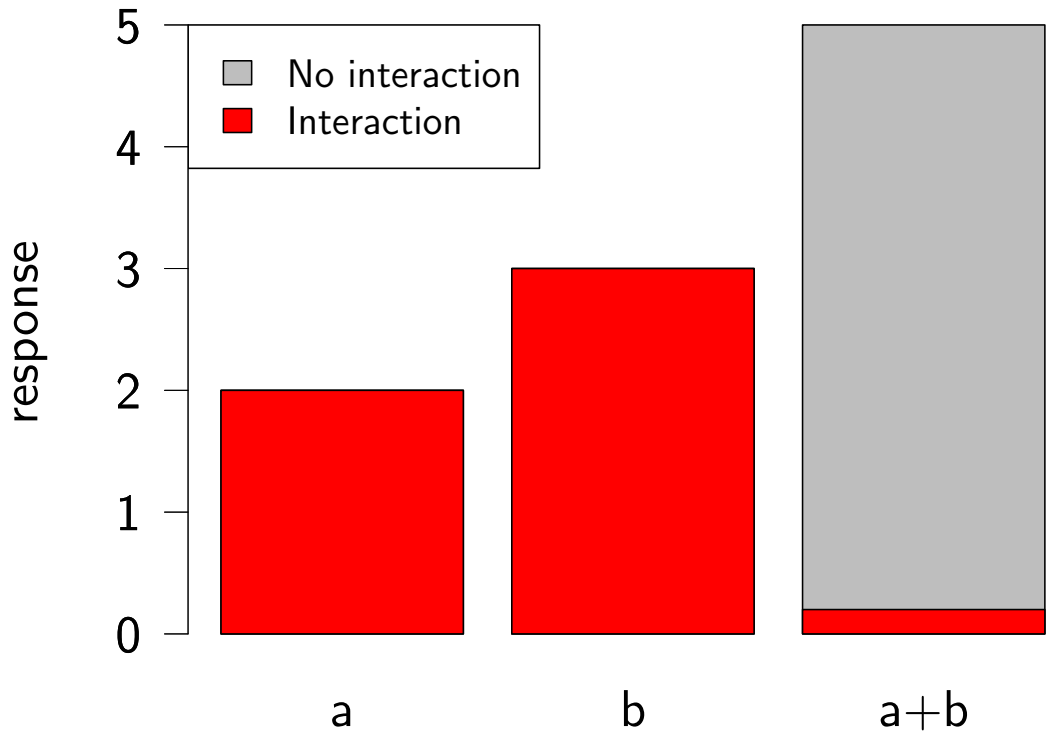

Fitting an interaction

```
lm(y ~ 1 + x1 * x2)
lm(y ~ 1 + x1 + x2 + x1:x2)
```

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```
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```

```
summary(lm(y~ 1 + x1*x2))
```

```
Call:
lm(formula = y ~ 1 + x1 * x2)

Residuals:
    Min      1Q  Median      3Q     Max
-1.8719 -0.6777 -0.1086  0.5897  2.3166

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.14098    0.09578  11.913  < 2e-16 ***
x1          -0.49281    0.10834  -4.549 1.58e-05 ***
x2           0.53434    0.09881   5.408 4.67e-07 ***
x1:x2        0.35911    0.11449   3.137  0.00227 **
---
```

Fitting an interaction

Why the multiplication sign?

Fitting an interaction

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```
x1Xx2 <- x1*x2
```

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x1Xx2 <- x1*x2
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```
summary(lm(y~ 1 + x1 + x2 + x1Xx2))


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---
```

Warnings

Modeling warning!

- ~~DO NOT COMPARE P-VALUES OF TWO MODELS TO TEST FOR AN INTERACTION~~

Exercise

1. Load the data masssex.csv
2. Fit a simple regression explaining movement by mass for each sex separately. Is the relationship different between sexes?
3. Fit the multiple regression explaining movement by mass, sex, and mass:sex, using the full dataset. Is the relationship different between sexes?
4. Try to understand the discreapancy by plotting the data

Warnings

1.

```
masssex <- read.csv(file="masssex.csv")
```

Warnings

1.

```
masssex <- read.csv(file="masssex.csv")
```

2.

```
summary(lm(movement ~ mass, data=masssex[masssex$sex==0,]))
summary(lm(movement ~ mass, data=masssex[masssex$sex==1,]))
```

Warnings

1.

```
masssex <- read.csv(file="masssex.csv")
```

2.

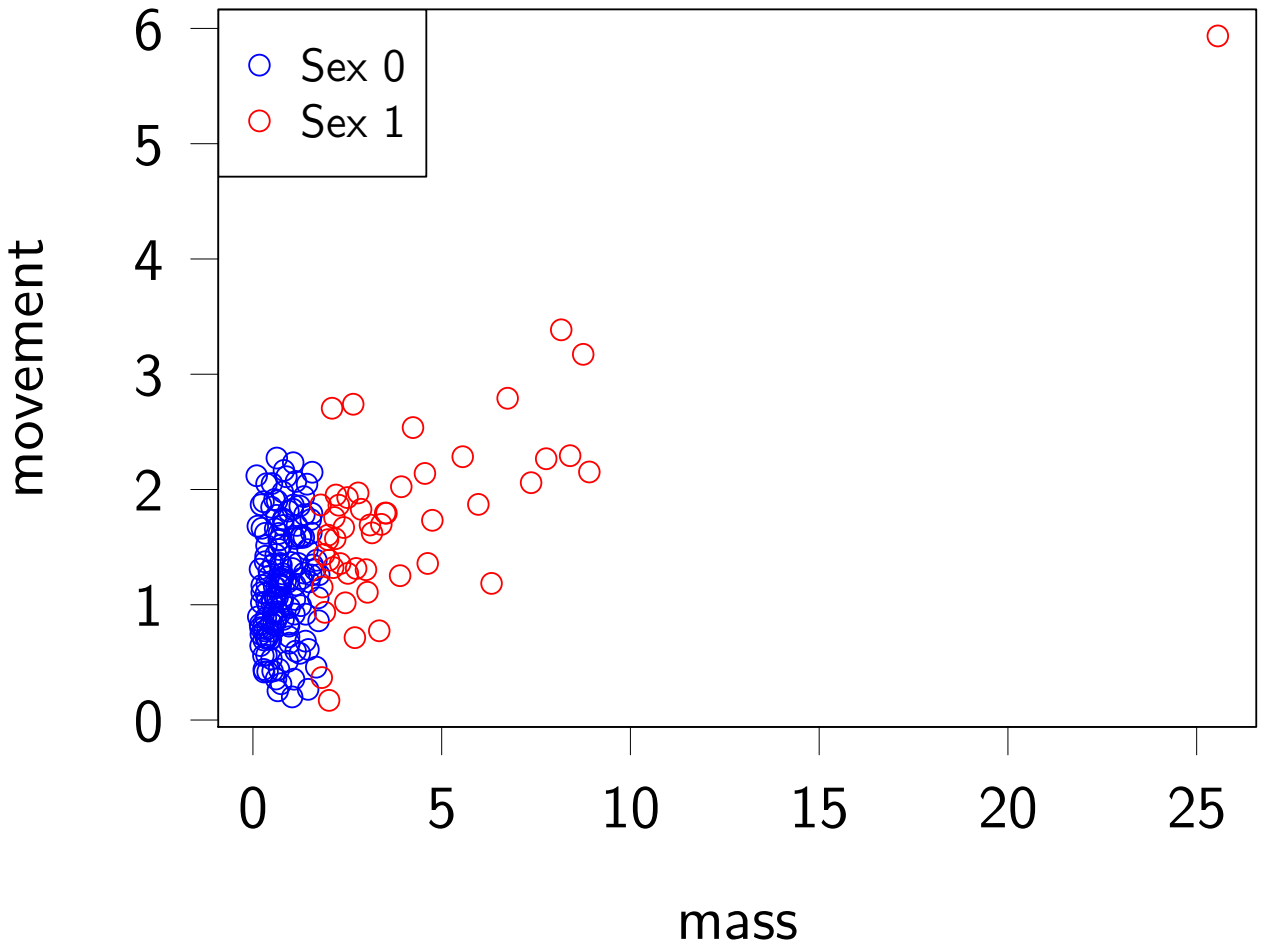
```
summary(lm(movement ~ mass, data=masssex[masssex$sex==0,]))
summary(lm(movement ~ mass, data=masssex[masssex$sex==1,]))
```

3.

```
summary(lm(movement ~ mass*sex, data=masssex))
```

Warnings

4.



Prediction

Exercise

1. Load plantsize.csv and plot the data
2. Fit an additive model explaining plant size by x and y coordinates

```
plantsize <- read.csv("plantsize.csv")
m0 <- lm(plantsize ~ x_location + y_location, data=plantsize)
```

Prediction

Exercise

1. Load plantsize.csv and plot the data
2. Fit an additive model explaining plant size by x and y coordinates
3. Create a prediction for plant size as a function of x for two values of y

```
plantsize <- read.csv("plantsize.csv")
m0 <- lm(plantsize ~ x_location + y_location, data=plantsize)
```

Prediction

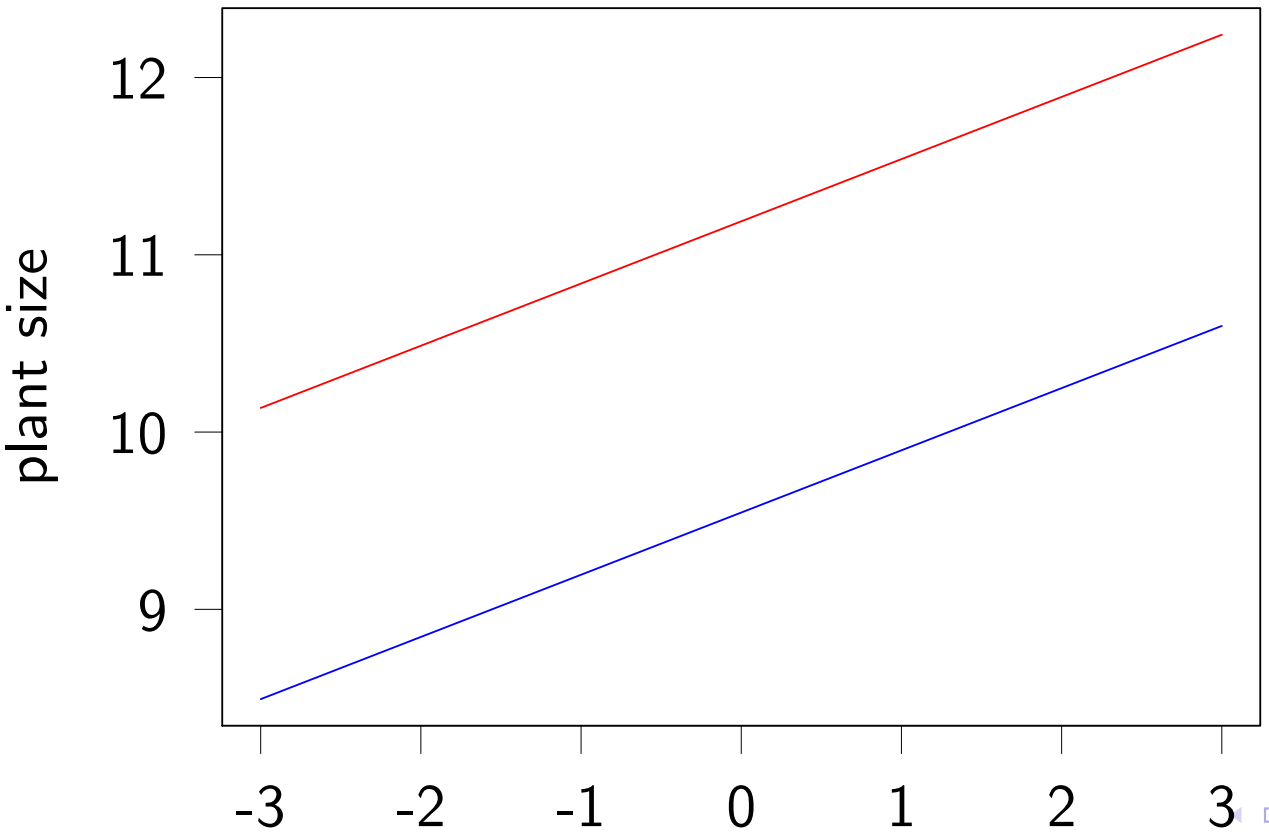
3.1. Predict

```
newdata <- data.frame(x_location = rep(seq(-3,3, length.out = 100),2),
                      y_location = c(rep(-3, 100), rep(4,100)))
newdata$prediction <- predict(m0, newdata = newdata)
```

Prediction

3.2 Visualize

```
setPar()
plot(newdata$x_location[newdata$y_location==-3], newdata$prediction[newda
     xlab="x location", ylab="plant size", type="l", ylim = range(newdata
lines(newdata$x_location[newdata$y_location==4], newdata$prediction[newda
```

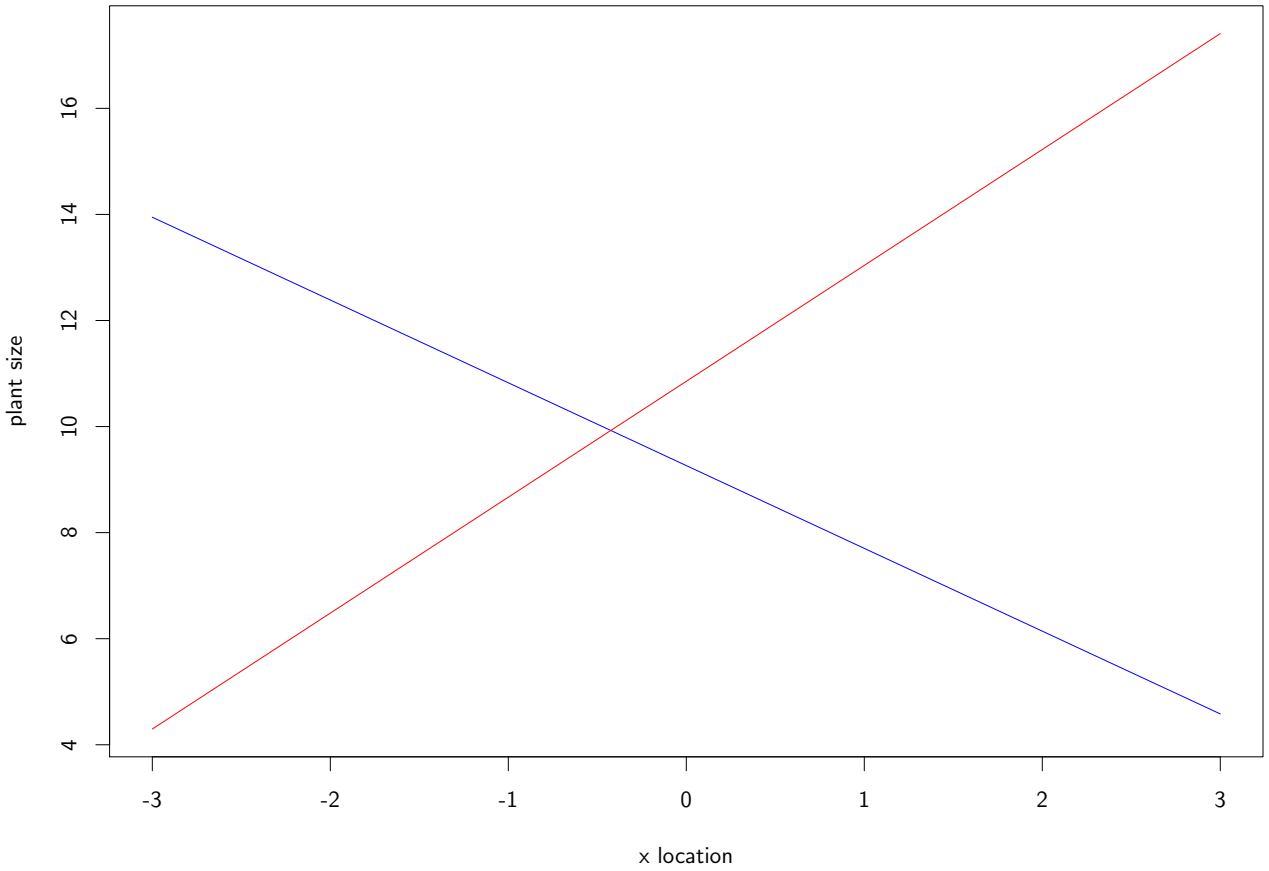


Prediction with interaction

Exercise

1. Load plantsize.csv and plot the data
2. Fit an additive model explaining plant size by x and y coordinates
3. Create a prediction for plant size as a function of x for two values of y and plot it
4. Fit an interaction between x and y coordinates
5. Create a new prediction with interaction, and plot it

Prediction with interaction



Next times

- April 20th Kevin on ggplot
- May 4th Nina on Structural Equation Modeling
- then, mixed models and GLM
- **Other requests?**