Stats 401 Lab 1

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Welcome!

- GSI: Naomi Giertych
- Email: ngierty@umich.edu
- Please use Piazza for general class questions
- My Office Hours: Thursdays 9-11am in 2165 USB
- Additional GSI Office Hours: Mondays 4:30-5:30pm, Tuesdays 11:30am-2:30pm in 2165 USB

Lab Objectives

- Develop statistical computation skills (R) and mathematical skills
- Provide examples and exercises to help prepare you for homework, quiz, and exam questions

Lab Expectations and Requirements

- (Printed) Homework is due at the start of class
- If you need to make up a lab: Please email me and make-up GSI in advance
- To be respectful of the labs after us, I will not answer questions immediately following lab. Please post on Piazza or come to office hours.

What will lab look like?

The main goal of the course is to introduce you to the linear regression model and its theoretical underpinnings with examples and exercises on real datasets. To help achieve this goal, lab is the space to practice the theory and the application of the linear model.

- Lab will consist of the following:

1. Brief review of what was covered in lecture the previous week
2. A worked example (this may be combined with 1 if reasonable)
3. An in lab exercise
4. Lab ticket to complete and hand in

- If time permits, I'm willing to guide you in homework. However, I will not directly provide answers.

Questions?

About You!

- Raise your hand if you've programmed in any language before
- Raise your hand if you've opened R Studio before this class
- Raise your hand if you know what a vector is

Introduction to Matrices

- Motivating factors:
- Convenient way to store information including data
- Ability to solve complex problems efficiently
- What is a matrix?

$$\mathbb{L} = \begin{bmatrix} l_{11} & l_{12} & \dots & l_{1p} \\ l_{21} & l_{22} & \ddots & l_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ l_{n1} & l_{n2} & \dots & l_{np} \end{bmatrix}$$

Examples

$$\mathbb{A} = \begin{bmatrix} 1 & 3 & -2 \\ 1 & -1 & 2 \end{bmatrix}$$

What is the dimension of $\mathbb{A}$?

Examining the elements of $\mathbb{A}$:

$$A_{12} = 3$$

$$A_{23} = 2$$

A single row or column of a matrix is a vector.

- First column of $\mathbb{A}$. $\begin{bmatrix} 1 \\ 1 \end{bmatrix}$
- First row of $\mathbb{A}$. $\begin{bmatrix} 1 & 3 & -2 \end{bmatrix}$

Working with a Dataset

We have a dataset of 120 random freshman students. We may be interested in determining whether a student's GPA at the end of their freshman year can be predicted from the ACT test score.

```
# Reading in a dataset
gpa = read.table("CH01PR19.txt", header = T)

# Check that the dataset has loaded correctly
head(gpa)
```

```
##     GPA ACT
## 1 3.897  21
## 2 3.885  14
## 3 3.778  28
## 4 2.540  22
## 5 3.028  21
## 6 3.865  31
```

In Lab Activity Part 1

- Use summary() to get the summary statistics from the GPA data.
- What are the GPAs and ACT scores of the 2nd and 106th students? Do you find these surprising?
- Create a matrix using

```
A = matrix(c(3,-2,-1,4,1,2),nrow=2); A
```

Change the number of entries and the number of rows of the matrix. Report your results.

In Lab Activity Part 2

- Has everyone been able to install R and R Studio successfully?
- Navigating Swirl

```
# Install Swirl
  install.packages('swirl')

# Call packages

  library(swirl)

# Use Swirl
  swirl()

# Navigate to Lesson 2
# Try a couple of commands
# Exit swirl; this will save progress
  bye()
```

Lab Ticket

Label the indices in this 64×5 matrix.

$$\mathbb{B} = \begin{bmatrix} 2 & 4 & \dots & 6 \\ 1 & -1 & \dots & 8 \\ \vdots & \vdots & \ddots & \vdots \\ -1 & 3 & \dots & 5 \end{bmatrix}$$

Read in the plastic hardness dataset from the 'Lab Materials' section of the website. Time is measured in hours.

- Use length() to determine how many observations there are.
- (Optional) Challenge Question: View the dataset and determine which rows are associated with molds that were in the oven for 24 hours. Use a sequence of indices to extract the vector of these observations. (Hint: Use Lesson 1 in Swirl for help.)

Next Time: Basic matrix computation

- Addition
- Scalar multiplication
- Transpose
- Matrix multiplication
- Inverse
- Solving linear equations