STATS 250 Lab 06

Simulation

Nick Seewald
nseewald@umich.edu

Week of 10/05/2020

Reminders

Your tasks for the week running Friday 10/2 - Friday 10/9:

Task	Due Date	Submission
M-Write 1 Final Revision	Wednesday 10/7	Canvas
Homework 5	Friday 10/9 8AM ET	course.work
Lab 5	Friday 10/9 8AM ET	Canvas

Stop by office hours! You can attend anyone's -- not just mine!

M-Write office hours schedule on Canvas (see MWrite Info on home page)

Homework 4 Comments

- Statistics is not a branch of math. It is a *mathematical science*.
    - In statistics, it's important that we tie our conclusions back to data.

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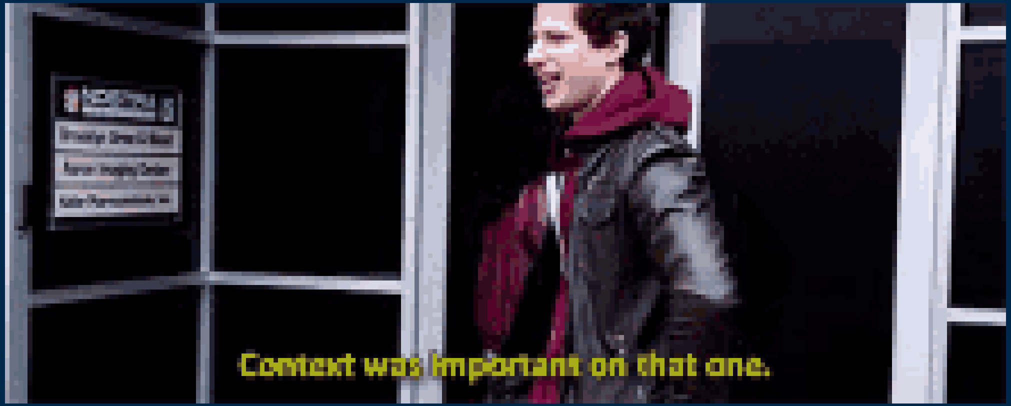
  - In statistics, it's important that we tie our conclusions back to data.
- context context context context context
- *ALWAYS* put your answer back into the context of the problem.
  - What does R^2 mean in *this* situation?
  - Why is regression useful to address *this* question?



Learning Objectives

Statistical Learning Objectives

1. Explore sample-to-sample variation
2. Investigate probability using long-run proportions

R Learning Objectives

1. Learn about reproducible randomness by "setting seeds"
2. Functions within functions: `table(sample())`
3. Line plots in R

Weekly Advice

- Randomness is **random**: your mileage may vary when you run code inside chunks.
- Check your HTML file before submitting it! You'll notice formatting issues you can easily fix (often by adding blank lines to your Rmd file).

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  Please try to follow along with this video. **It will help.**

Vectors (again)

A *character* vector is a vector where the elements are "strings" of text.

```
x <- c("hi", "this is", "a character vector.", "Are you impressed?")
x
```

```
[1] "hi"                  "this is"             "a character vector."
[4] "Are you impressed?"
```

Again, note the use of the `c()` function.

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Again, note the use of the `c()` function.

rep()

What's easier to code?

```r
pets <- c("cat", "cat", "cat", "cat")
pets
```

```
[1] "cat" "cat" "cat" "cat"
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rep()

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[1] "cat" "cat" "cat" "cat"
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```
cats <- rep("cat", 4)
cats
```

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[1] "cat" "cat" "cat" "cat"
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```

```
[1] "cat" "cat" "cat" "cat"
```

`rep(`what you want to repeat`,` number of times to repeat it`)`

rep()

What's easier to code?

```
pets <- c("cat", "cat", "cat", "cat", "dog", "dog", "dog", "dog", "dog")
pets
```

```
[1] "cat" "cat" "cat" "cat" "dog" "dog" "dog" "dog" "dog"
```

```
pets2 <- c(rep("cat", 4), rep("dog", 5))
pets2
```

```
[1] "cat" "cat" "cat" "cat" "dog" "dog" "dog" "dog" "dog"
```

Functions in Functions

Arguments to functions can be functions! This is called **nesting**.

```r
table(
  c(
    rep("heads", 5000),
    rep("tails", 5000)
  )
)
```

```
heads tails 
 5000  5000 
```

Functions in Functions

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table(
  c(
    rep("heads", 5000),
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  )
)
```

```
heads tails 
 5000  5000 
```

WATCH OUT FOR PARENTHESES

Remember `sample()`?

We used `sample()` to simulate rolling a die using the vector `1:6`.

We can also give `sample()` a character vector to sample from!

```r
coin <- c('heads', 'tails')
sample(coin, size = 30, replace = TRUE)
```

```
 [1] "heads" "heads" "heads" "heads" "tails" "heads" "tails" "tails" "tails"
[10] "heads" "heads" "tails" "tails" "tails" "tails" "heads" "heads" "heads"
[19] "heads" "heads" "tails" "tails" "heads" "heads" "heads" "tails" "tails"
[28] "tails" "tails" "tails"
```

The `prob` argument to `sample()`

We can simulate a *biased* coin using the `prob` argument.

- `prob` takes a vector of "probability weights", one per element of the vector to sample from
- `prob` applies the weights *in order*

```r
coin <- c('heads', 'tails')
sample(coin, size = 30, replace = TRUE, prob = c(0.3, 0.7))
```

```
 [1] "heads" "tails" "tails" "tails" "heads" "tails" "tails" "tails" "tails"
[10] "tails" "heads" "tails" "tails" "tails" "heads" "heads" "tails" "tails"
[19] "tails" "tails" "tails" "tails" "heads" "heads" "tails" "tails" "tails"
[28] "tails" "tails" "tails"
```

Pseudo-random numbers

- Humans are very bad at generating random numbers.
- Computers only **seem** better.
- Computers produce *pseudo-random* numbers: if you know the "seed", you know the entire sequence of "random" numbers.

123
666
777
222
345
420
333
999
888
456
111
369
313
444
678
789
734
321
654

set.seed()

- We can tell R to use a particular "seed" with `set.seed()`.
- Setting the seed makes your randomness **reproducible**: you will now get the same answers (in your knitted document) as your peers, provided you use the same code.

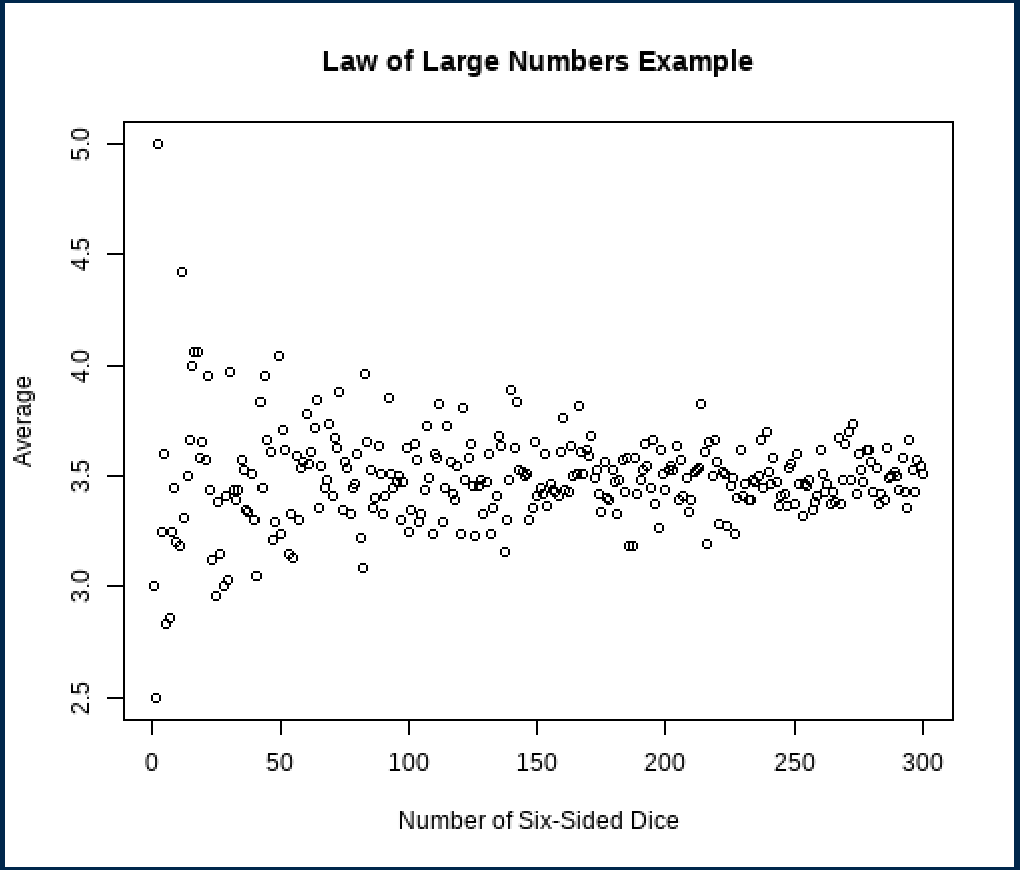
```
set.seed(8362)
sample(1:5000, size = 3)
```

```
[1]  258 1834 2371
```

Line Graphs

Remember this?

```r
sixSidedDieRoll <- function(n) {
  mean(sample(1:6, size = n, replace = T))
}
plot(sapply(1:300, sixSidedDieRoll),
     main = "Law of Large Numbers Example",
     xlab = "Number of Six-Sided Dice",
     ylab = "Average")
```

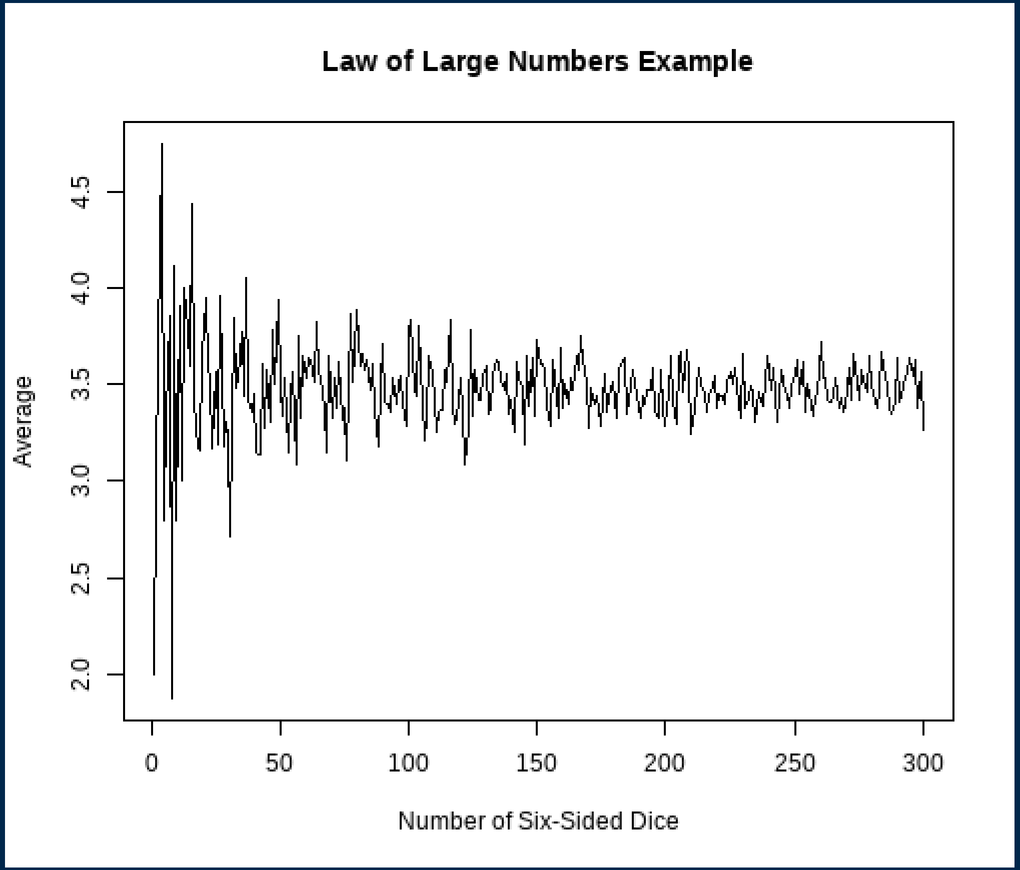


Line Graphs 📈

We can make a line graph with the `type` argument to `plot()`:

```r
plot(sapply(1:300, sixSidedDieRoll),
     main = "Law of Large Numbers Example",
     xlab = "Number of Six-Sided Dice",
     ylab = "Average",
     type = "l")
```

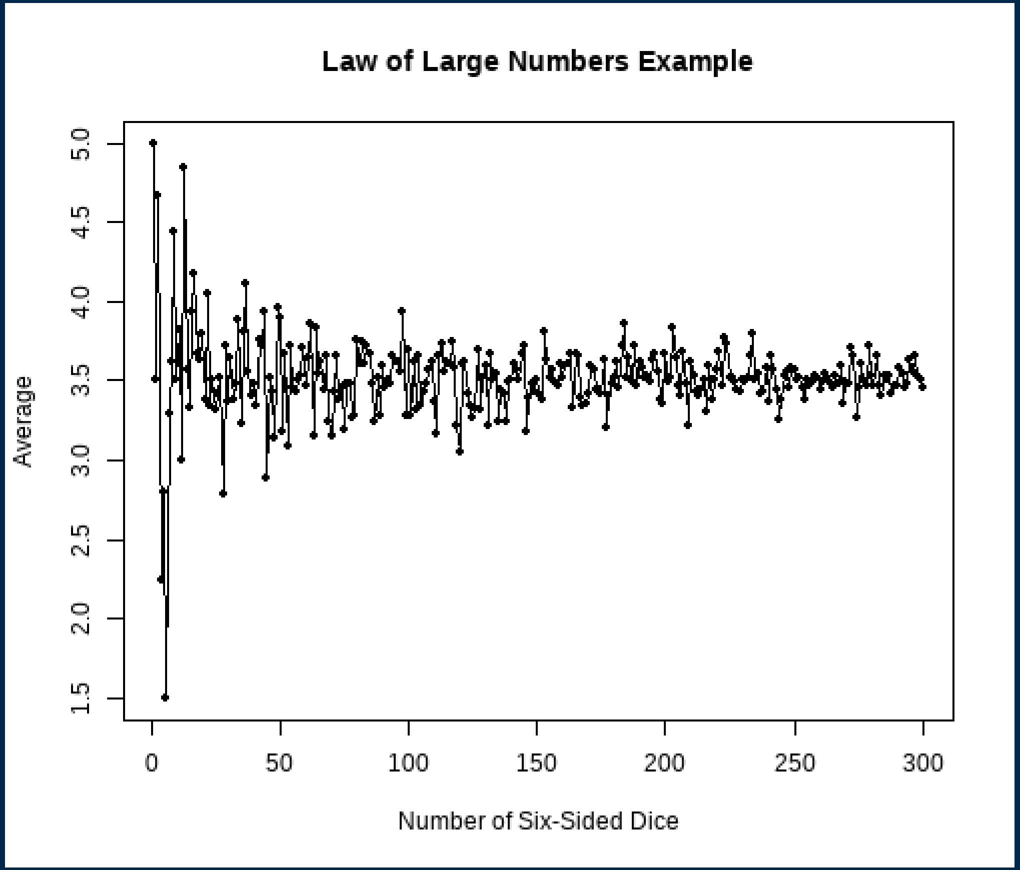
Use `type = l` for a `l`ine graph (that's a **lowercase L**)



Line Graphs

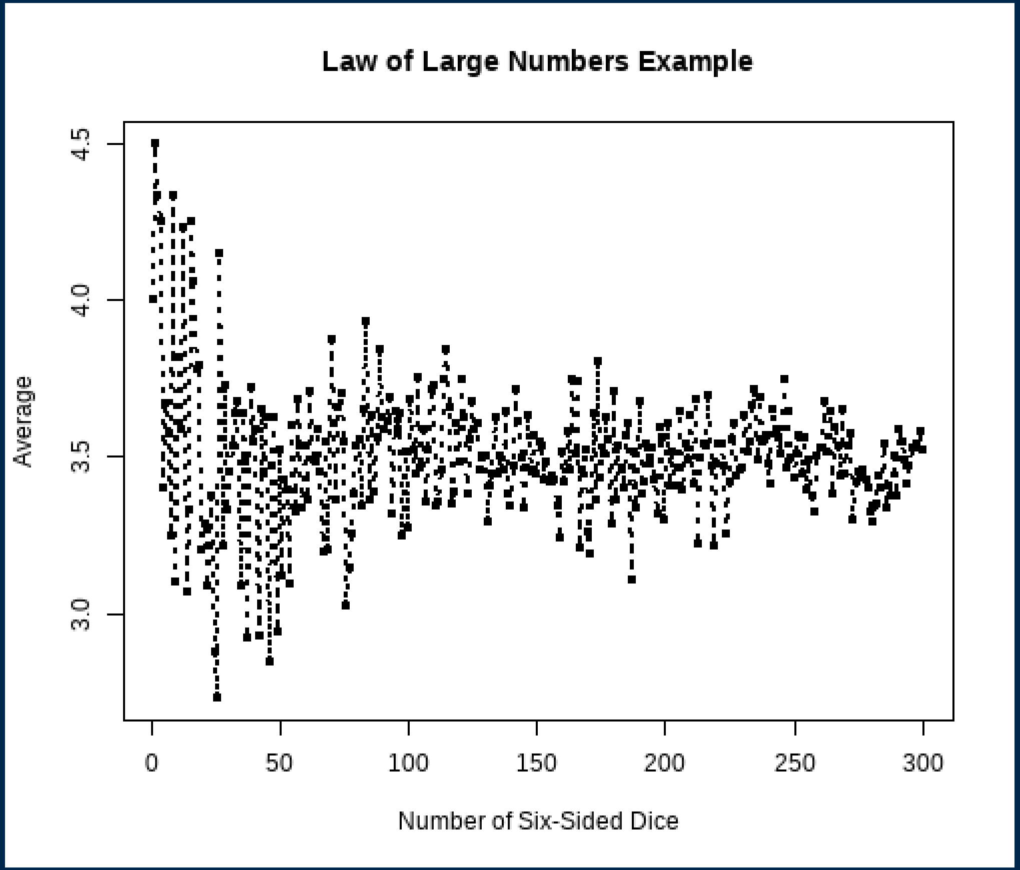
```
plot(sapply(1:300, sixSidedDieRoll),
     main = "Law of Large Numbers Example",
     xlab = "Number of Six-Sided Dice",
     ylab = "Average",
     type = "o",
     pch = 20)
```

Use `type = o` to draw lines between points (and `pch` is back!)



Line Graphs

```
plot(sapply(1:300, sixSidedDieRoll),
     main = "Law of Large Numbers Example",
     xlab = "Number of Six-Sided Dice",
     ylab = "Average",
     type = "o",
     pch = 20,
     lty = "dotted",
     lwd = 2)
```



- Use `lty` to specify **l**ine **ty**pe: (0=blank, 1=solid (default), 2=dashed, 3=dotted, 4=dotdash, 5=longdash, 6=twodash)
- Use `lwd` to specify **l**ine **w**i**d**th (default is 1)

Lab Project ⌨

Your tasks

- Complete the "Try It!" and "Dive Deeper" portions of the lab assignment by copy/pasting and modifying appropriate code from earlier in the document.

How to get help

- Use the "labs" section of Piazza to ask questions and work with your peers.
- If you use Piazza, please note that in the "Collaborators" list at the top of the discussion section.
- If you're really stuck, email your lab instructor!

I'M ROOTING FOR YOU