

Intermediate R Programming

POS6933: Computational Social Science

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Overview

- Random Number Generation in R
- Loops and Iteration
- Visualizing Data and Relationships Using `ggplot::()`

Coin Flips

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What about 100 times?

What about 1000 times?

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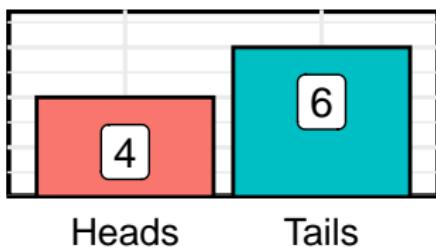
What about 100 times?

What about 1000 times?

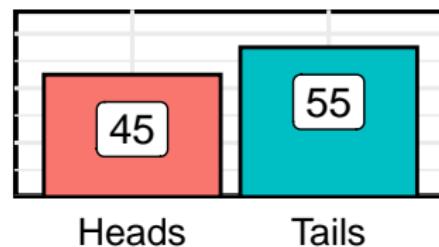
What about 10000 times?

Coin Flips (Cont.)

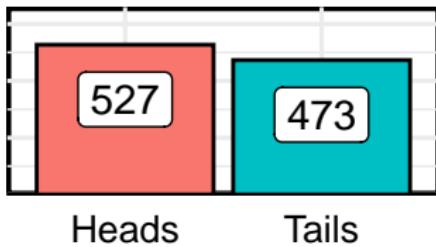
10 Flips



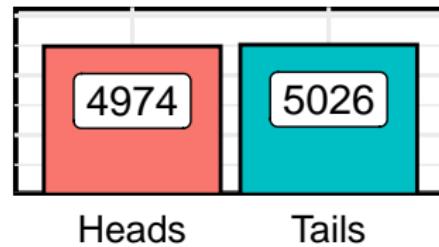
100 Flips



1k Flips



10k Flips



Coin Flips (Cont.)

- We can use `sample()` to randomly select elements from a vector
- In this case, a coin flip where $p(\text{heads}) = p(\text{tails}) = 0.5$

```
sides <- c("Heads", "Tails") # Flip Options
single_flip <- sample(sides, size = 1) # Single Draw
print(single_flip)
```

```
[1] "Heads"
```

6-Sided Die

- We can use the same approach to “roll” a six-sided die.

```
sides <- c(1:6) # 1, 2, 3, 4, 5, 6
single_roll <- sample(sides, size = 1) # Single Roll
message("Result of Single Roll: ", single_roll)
```

Result of Single Roll: 1

Poker Hands

- We can even use it to do more complex operations like simulate a random draw from 5-card Poker

```
cards <- as.character(c(2:10, "J", "Q", "K", "A"))
# All Card Values
suits <- c("Hearts", "Diamonds", "Spades", "Clubs")
# Suits

deck <- expand.grid(value = cards, suit = suits) |>
  mutate(card = paste(value, "of", suit)) |>
  pull(card) # Create a Full Deck

random_draw <- sample(deck, size = 5, replace = F)
# Random 5-Card Draw w/out Replacement
```

Poker Hands (Cont.)

Hand:

9 of Clubs

Q of Clubs

6 of Clubs

2 of Diamonds

6 of Hearts

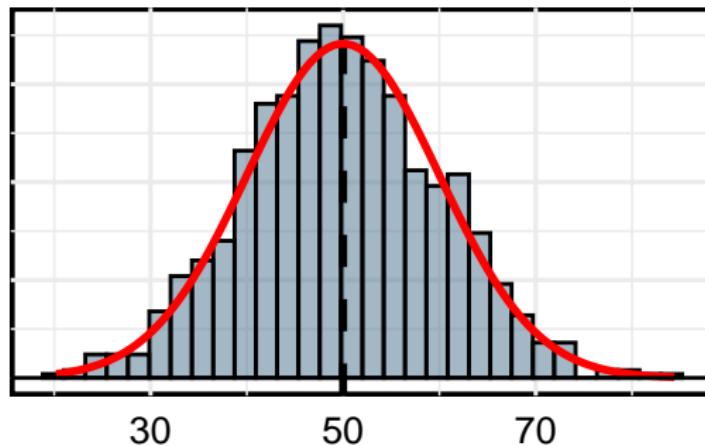
Generating Distributions

- What if we wanted to move beyond random selection where each draw or iteration exists with equal probability or within a uniform distribution?
- R is very flexible and capable of illustrating sampling distributions against expected outcomes

Generating Distributions (Standard Normal)

- Let's start with 1000 samples from a standard normal distribution where $\mu = 50$ and $\sigma = 10$

```
normal <- rnorm(1000, mean = 50, sd = 10)
```

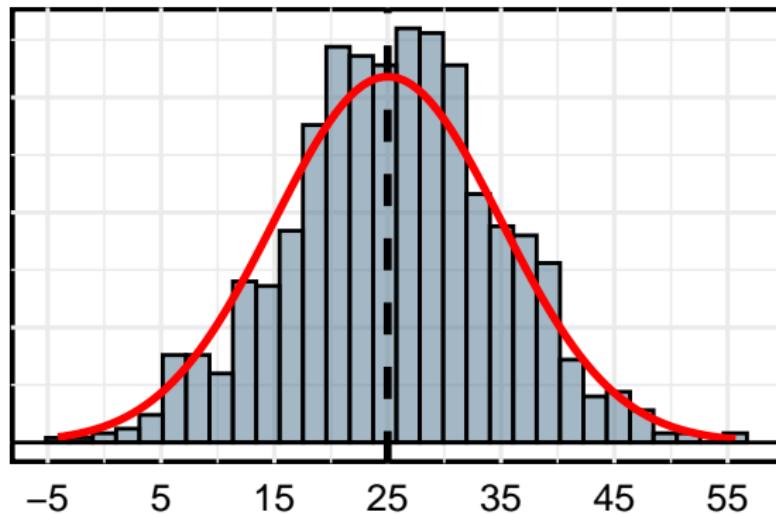


Generating Distributions (Standard Normal)

- **Your Turn:** Generate 1000 draws from a standard normal distribution where $\mu = 25$ and $\sigma = 10$.

Generating Distributions (Standard Normal – Ex)

```
normal <- rnorm(1000, mean = 25, sd = 10)
```

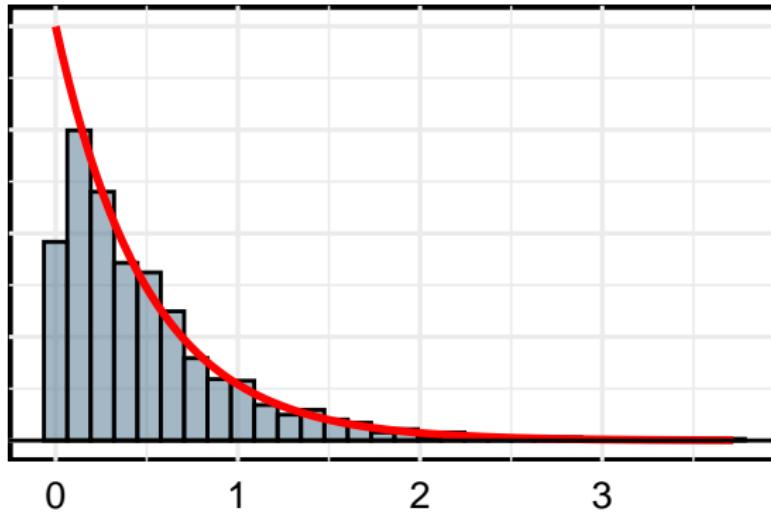


Generating Distributions (Exponential – Ex)

- **Your Turn:** Generate 1000 draws from an exponential distribution where `rate = 2`

Generating Distributions (Exponential – Ex)

```
exp <- rexp(1000, rate = 2)
```



Loops (Basics)

- Functions concern

Games of Chance: Blackjack

What are the basic rules of Blackjack?



Rules of Blackjack:

- Objective: Beat the dealer by getting closer to 21 without going over
- Card values:
 - Number Cards = Face Value
 - Face Cards = 10 (Aces = 1 or 11)
- Dealer Rules: Dealer reveals cards after players act and must hit until *at least* 17
- Gameplay:
 - Go Over 21 = **BUST** (Loss)
 - Tie w/ Dealer = Push (No Win/Loss)
 - Standard Win = **1:1** (Win Bet x2)
 - Blackjack (Ace + 10-Value Card = **3:2**)

Blackjack Exercise

Write an R routine to play a round of Blackjack. I will be the Dealer

- *Hint:* Sample from all 52 cards without replacement...

Blackjack Exercise (Cont.)

- ① What if we play with a four-deck shoe?
- ② What if I wanted to repeat this process 1,000 times?

Hint: Use a loop!

Blackjack Exercise (Cont.)

- ① Assume I begin with \$1000 every day and bet \$100 each game (though I'll only play 10 hands...). Over 100 days, approximately how much money am I left with? *Note:* If I run out of money on a given day, I'm done – also, each day restarts with \$1000 but previous day's leftover sum is added to aggregate winnings.
- ② What if I start with \$1000 but don't replace the money every day... How much will I have after 10 days? 50 days?
- ③ Take some time then play around with `blackjack_simulation.R`

Roulette Exercise