

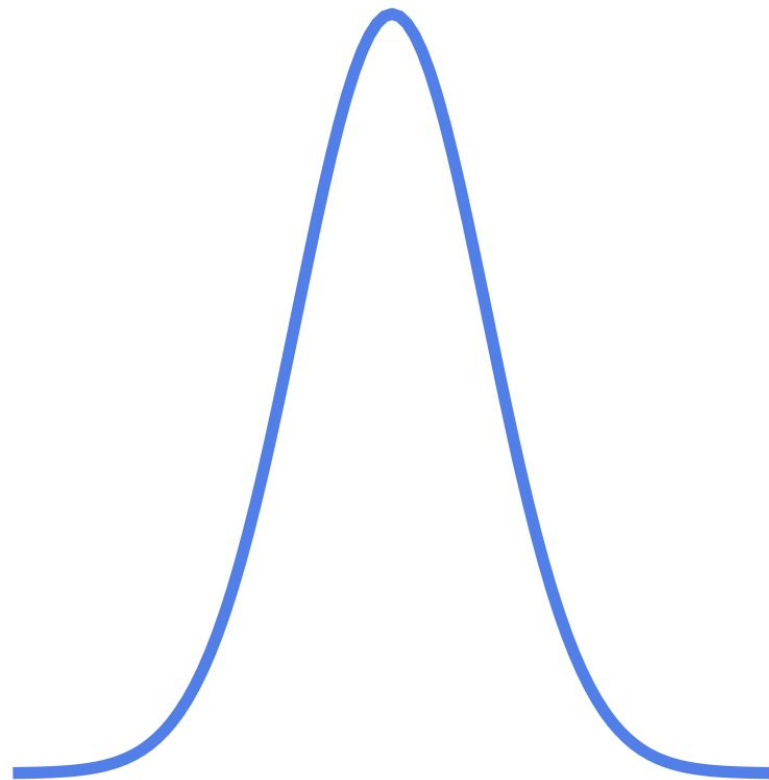
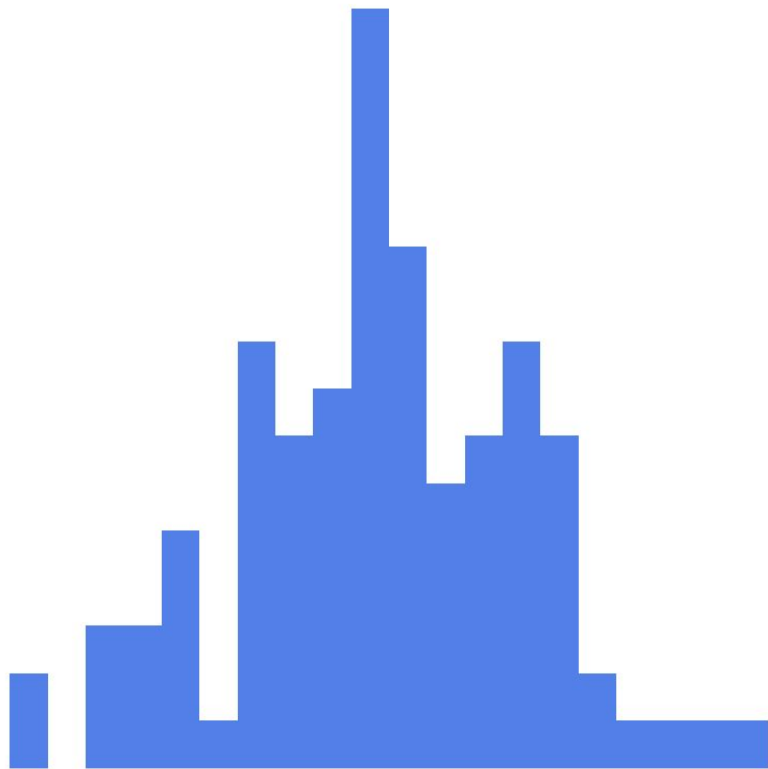
# Week 1 Lecture 2:

## Random variables and distribution functions

*EDS 222: Statistics for Environmental Data Science*



# Two distributions



# Today's agenda

- Parameters, PMFs, and PDFs
- Families of random variables
- Simulating data



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# How many heads?

If I flip a coin 10 times, how many heads would I expect?

Would seeing 10 tails mean the coin is unfair?

# Say hello to binomial

Binomial variables describe:

Examples of applications:

# Say hello to binomial

# Binomial PMF



# How many ~~jellybeans~~ Hi-chew in the jar?



Photo: The Wizard's Shop

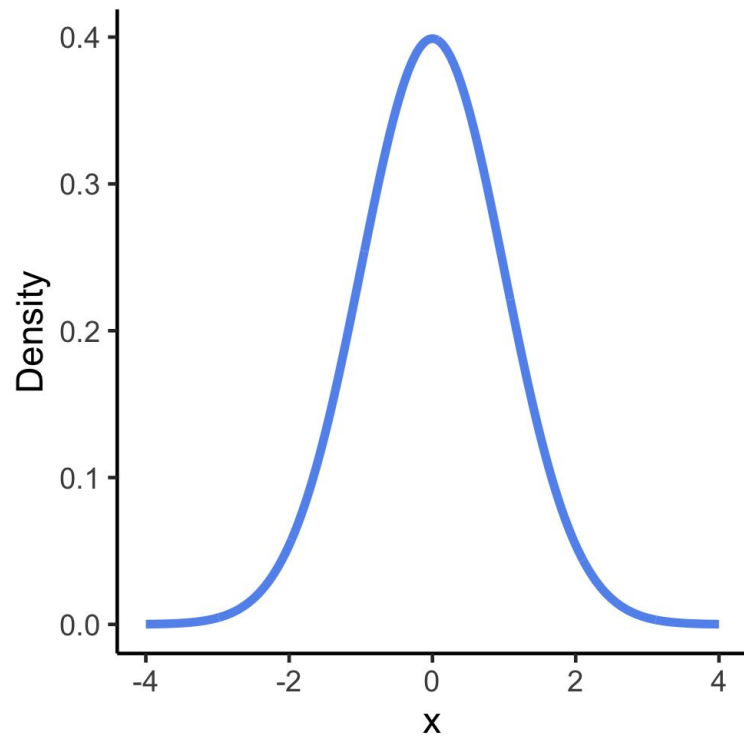
How many ~~jellybeans~~ Hi-chew in the jar?

# Say hello to normal

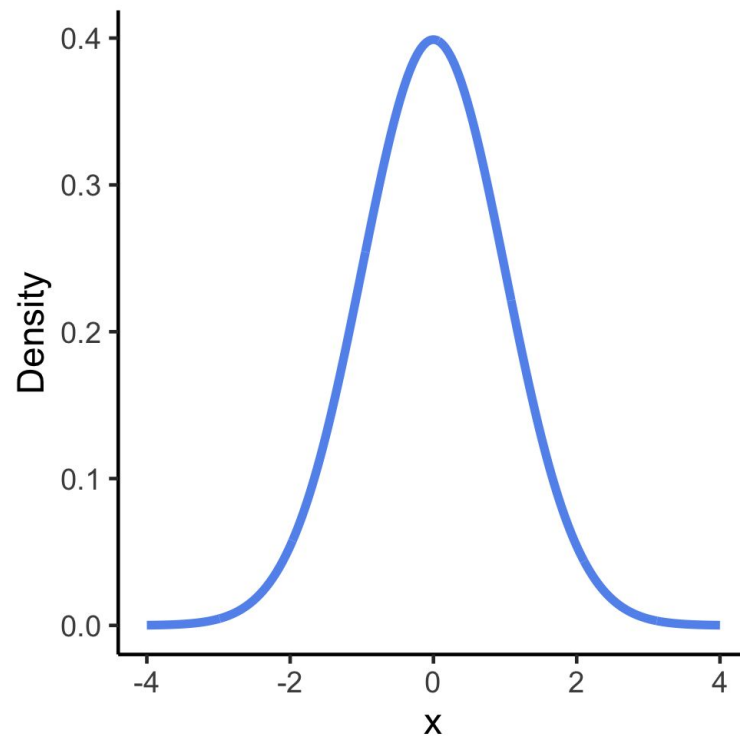
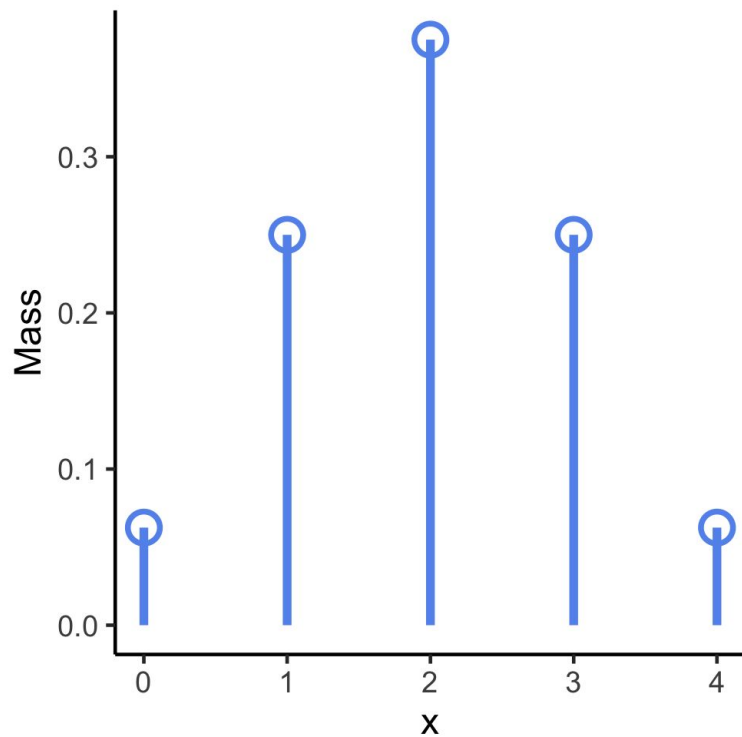
Normal variables describe:

Examples of applications:

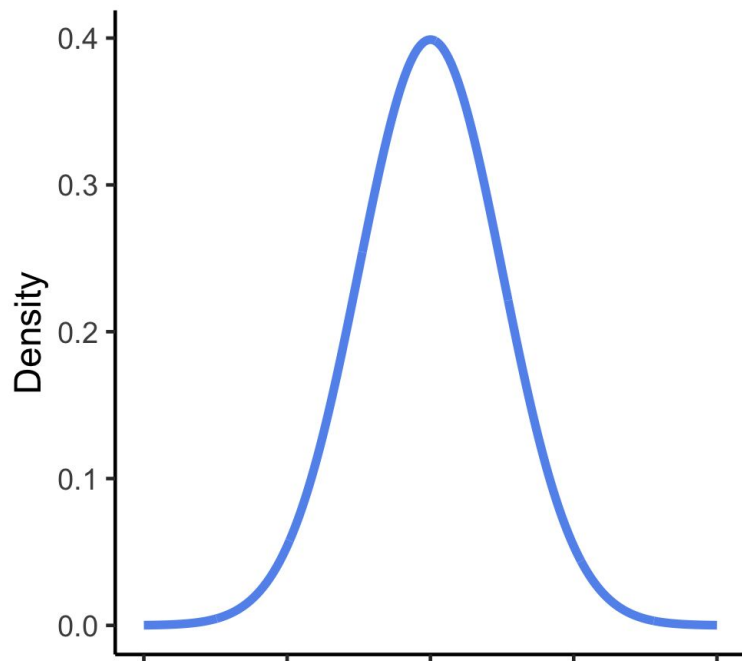
# Normal PDF



# Binomial PMF vs normal PDF



# Probability with jellybean PDF



# Parameters, PMF, PDF recap

# Random variables and populations



# How to plot PMFs and PDFs

# Today's agenda

- Parameters, PMFs, and PDFs
- **Families of random variables**
- Simulating data



# Families of random variables

- Form groups of four
- Each group member learns a puzzle piece individually
- Assemble the jigsaw!



# Poisson distribution [dpois()]

## Poisson variables describe:

The number of events in a fixed window

## The notation is:

Poisson( $\lambda$ )

How does the parameter control the shape of the distribution?

## Examples of applications:

- Number of invasive plants observed along a transect
- Number of hurricanes in the month of November
- Number of homes with solar panels installed on a block

# Geometric distribution [dgeom()]

## Geometric variables describe:

The number of trials before a success

## The parameter is:

$\text{Geometric}(p)$

How does the parameter control the shape of the distribution?

## Examples of applications:

- Number of weeks until a drought ends
- Number of water samples tested before a toxic chemical found

# Gamma distribution [dgamma()]

## Gamma variables describe:

Positive continuous variables, such as durations and concentrations

## The parameter is:

$\text{Gamma}(\alpha, \lambda)$  [shape, rate]

How do the parameters control the shape of the distribution?

## Examples of applications:

- Time until wildfire containment
- Concentration of mercury in a fish
- Heights of floods

# Beta distribution [dbeta()]

## Beta variables describe:

Continuous variables between 0 and 1, such as proportions

## The parameter is:

$\text{Beta}(\alpha, \beta)$

How do the parameters control the shape of the distribution?

## Examples of applications:

- Fraction of algal cover on a coral reef
- Proportion of livestock infected with parasites

# Families of random variables

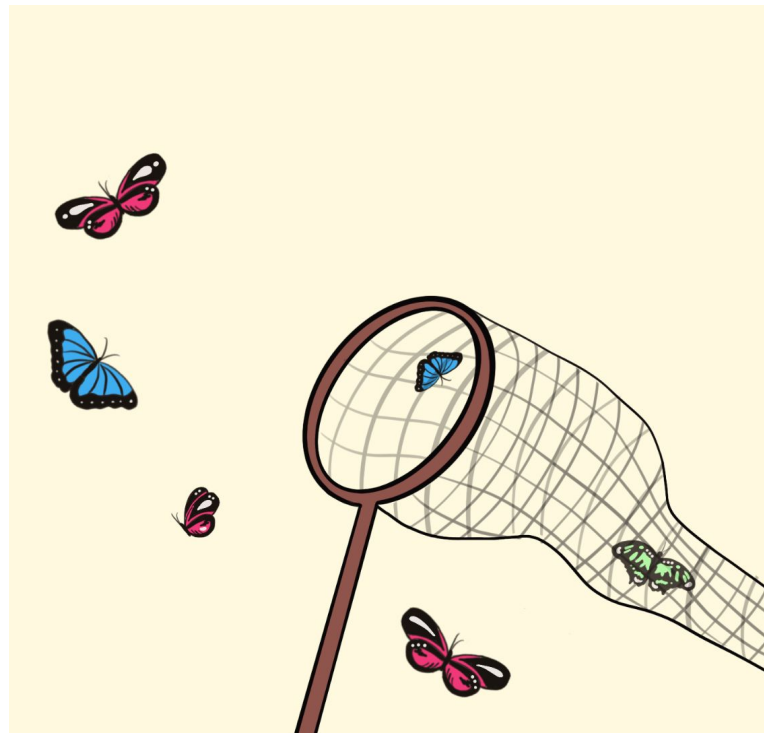
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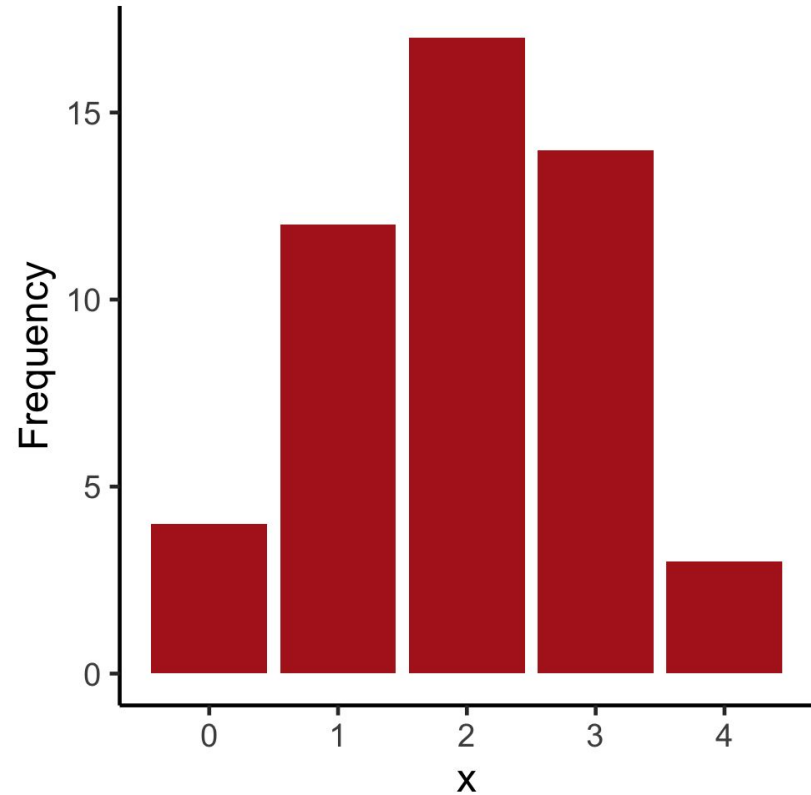
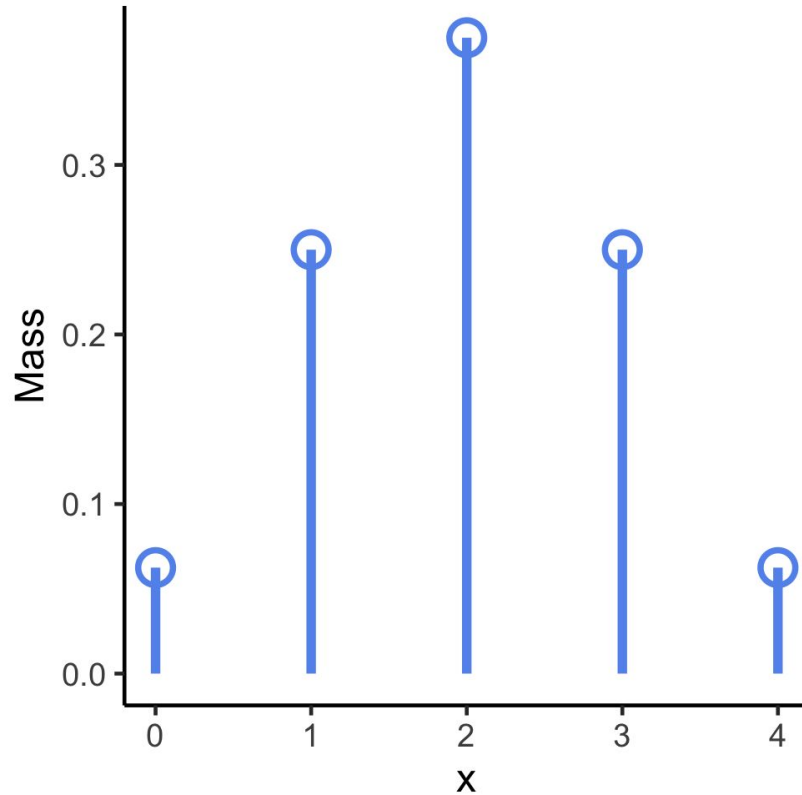


# Today's agenda

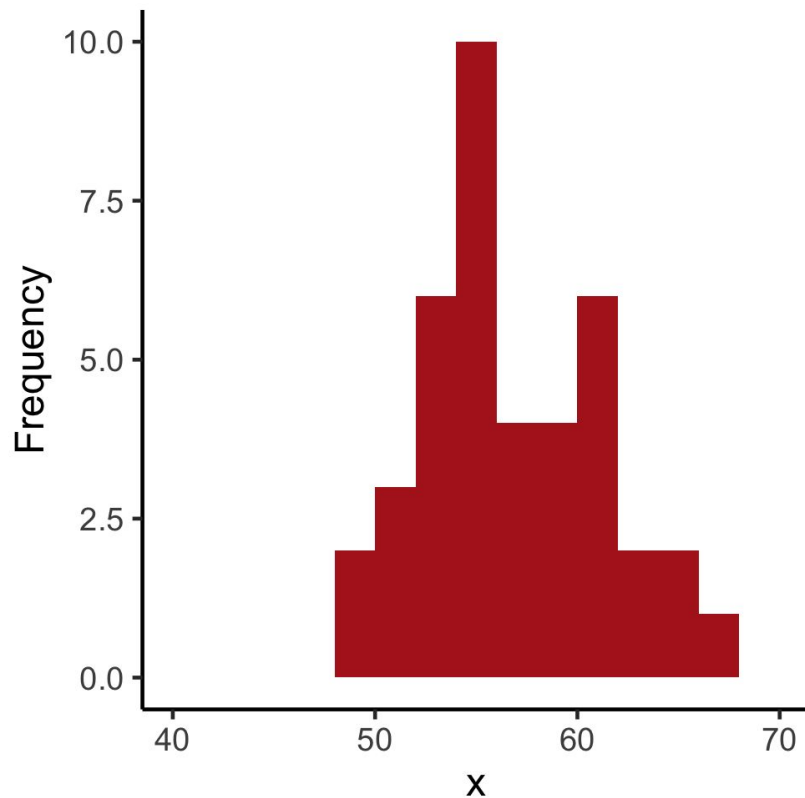
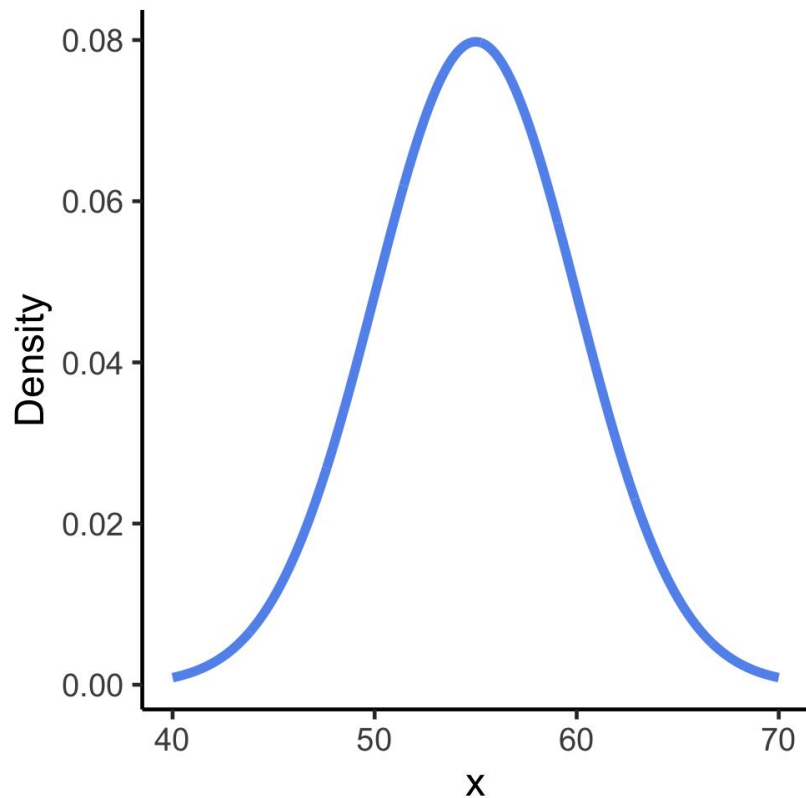
- Parameters, PMFs, and PDFs
- Families of random variables
- **Simulating data**



# d\_\_\_\_\_() and r\_\_\_\_\_() functions



# d\_\_\_\_() and r\_\_\_\_() functions



# Recap

Parameters, PMFs,  
and PDFs

Families of random  
variables

Simulating data