

Applied Statistical Analysis

EDUC 6050

Week 8

Finding clarity using data

Today

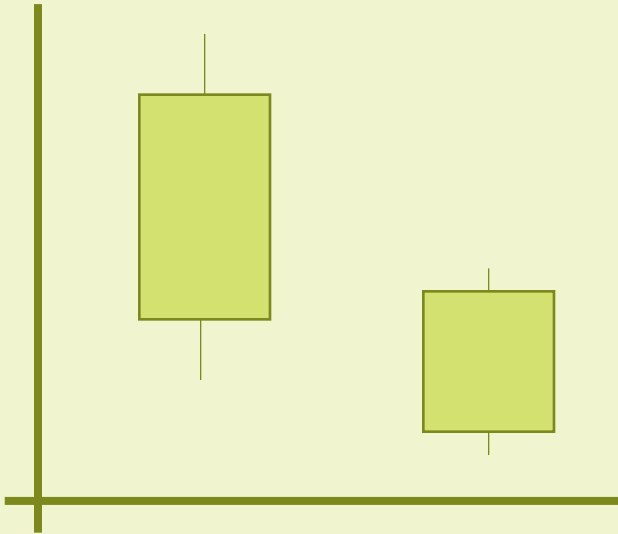
1. Relationships! 
2. Correlation and Intro to Regression
3. Chapter 13 in Book

Comparing Means

Is one group different than the other(s)?

- Z-tests
- T-tests
- ANOVA

We compare the means and use the variability to decide if the difference is significant

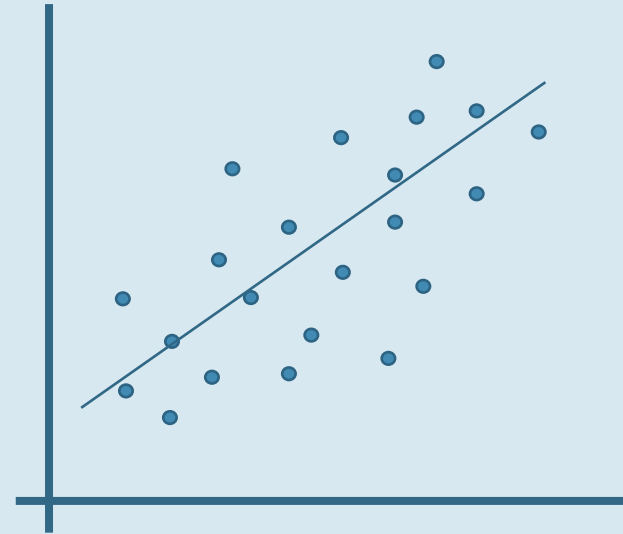


Assessing Relationships

Is there a relationship between the two variables?

- Correlation
- Regression

We look at how much the variables “move together”



Correlation

- It is a **whole class of methods**
- Generally used with **observational** designs
- Has similar assumptions to t-test
- Is a measure of effect size
- Very related (and **based on**) **z-scores**
- Tells us **direction** and **strength** of a relationship between *two* variables

Correlation and Z-Scores

- Z-score is a univariate statistic (only uses info from ONE variable)
- Correlation is essentially the z-score between TWO variables

$$r = \frac{\sum Z_x Z_y}{N - 1}$$

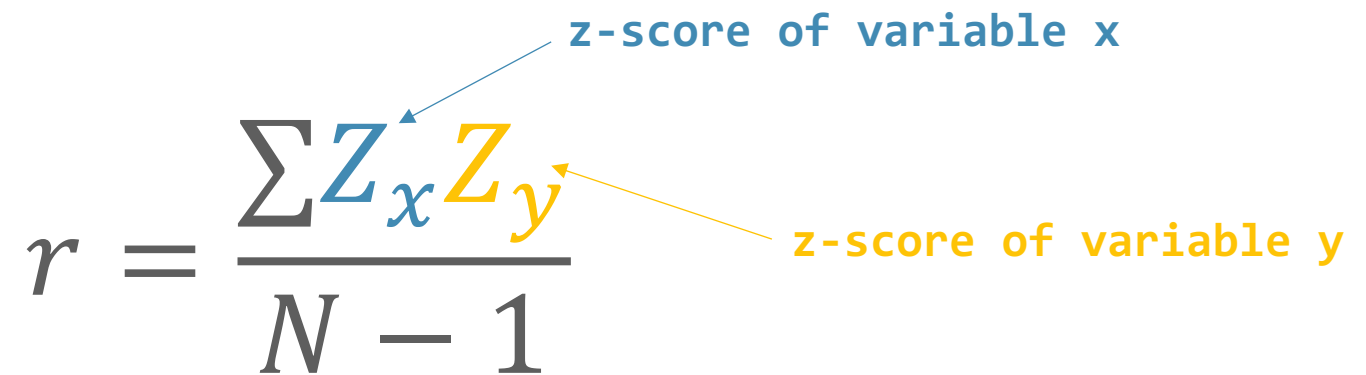
Correlation and Z-Scores

- Z-score is a univariate statistic (only uses info from ONE variable)
- Correlation is essentially the z-score between TWO variables

$$r = \frac{\sum Z_x Z_y}{N - 1}$$

z-score of variable x

z-score of variable y



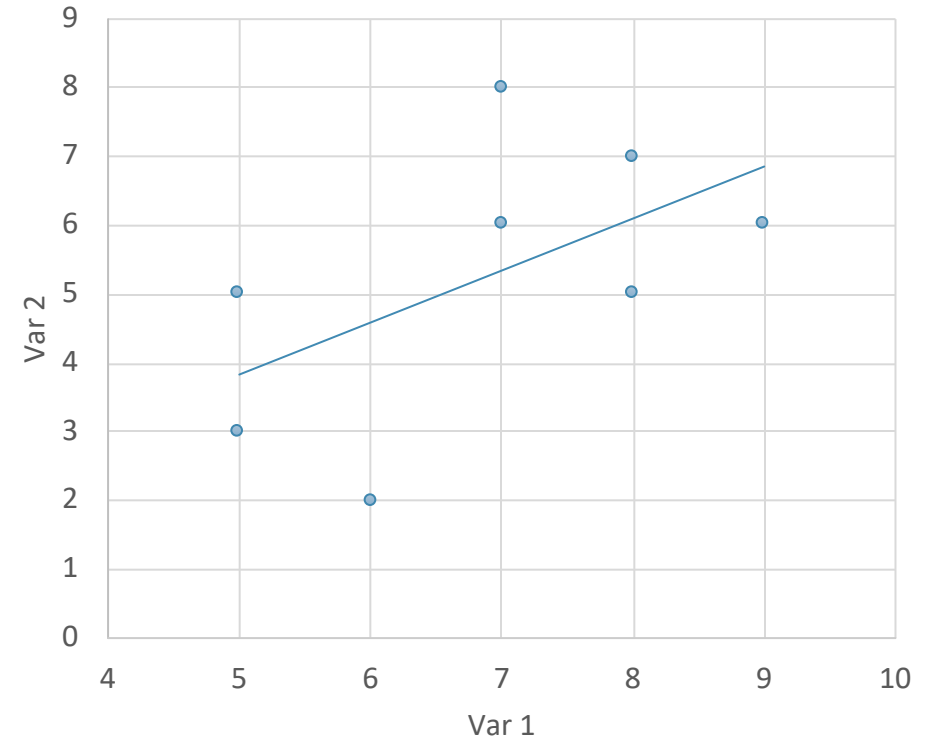
General Requirements

1. Two or more continuous variables,
2. Not necessarily directional (one causes the other)

ID	Var 1	Var 2
1	8	7
2	6	2
3	9	6
4	7	6
5	7	8
6	8	5
7	5	3
8	5	5

General Requirements

1. Two or more continuous variables,
2. Not necessarily directional (one causes the other)
3. Linear Relationship (or at least ordinal)



Hypothesis Testing with Correlation

The same 6 step approach!

1. Examine Variables to Assess Statistical Assumptions
2. State the Null and Research Hypotheses (symbolically and verbally)
3. Define Critical Regions
4. Compute the Test Statistic
5. Compute an Effect Size and Describe it
6. Interpreting the results

1 Examine Variables to Assess Statistical Assumptions

Basic Assumptions

1. Independence of data
2. Appropriate measurement of variables for the analysis
3. Normality of distributions
4. Homoscedastic

1

Examine Variables to Assess Statistical Assumptions

Basic Assumptions

1. Independence of data

2. Appropriateness for the analysis

3. Normality

4. Homoscedasticity



Individuals are independent of each other (one person's scores does not affect another's)

1

Examine Variables to Assess Statistical Assumptions

Basic Assumptions

1. Independence of data
- 2. Appropriate measurement of variables for the analysis**
3. Normality of distributions
4. Homogeneity of data




Here we need interval/ratio variables

1

Examine Variables to Assess Statistical Assumptions

Basic Assumptions

1. Independence
 2. Appropriateness for the analysis
 3. Normality of distributions
 4. Homoscedastic
- 
- Multivariate normality (the two variables are jointly normal)

1

Examine Variables to Assess Statistical Assumptions


Basic Assumptions

1. Independence of data

2. Appropriateness for the test

3. Normality

4. Homoscedastic



Variance around the line should be roughly equal across the whole line

1 Examine Variables to Assess Statistical Assumptions

Examining the Basic Assumptions

1. **Independence:** random sample
2. **Appropriate measurement:** know what your variables are
3. **Normality:** Histograms, **Q-Q**, skew and kurtosis
4. **Homoscedastic:** Scatterplots

2

State the Null and Research Hypotheses (symbolically and verbally)

Hypothesis Type	Symbolic	Verbal	Difference between means created by:
Research Hypothesis	$\rho \neq 0$	There is a relationship between the variables	True relationship
Null Hypothesis	$\rho = 0$	There is no <i>real</i> relationship between the variables.	Random chance (sampling error)

3 Define Critical Regions

How much evidence is enough to believe the null is not true?

generally based on an $\alpha = .05$

Compute the Test Statistic

Click on
"Correlation Matrix"

4

Compute the Test Statistic

The screenshot displays a statistical software interface with a top menu bar containing 'Data' and 'Analyses'. Below the menu is a toolbar with icons for Exploration, T-Tests, ANOVA, Regression, Frequencies, and Factor. The main window is titled 'Correlation Matrix' and features a variable selection area on the left with a 'Group' button and a list of variables including 'Pretest' and 'Posttest'. Below this are sections for 'Correlation Coefficients' (Pearson, Spearman, Kendall's tau-b), 'Additional Options' (Report Significance, Flag significant correlations, Confidence intervals), 'Hypothesis' (Correlated, Correlated positively, Correlated negatively), and 'Plot' (Correlation matrix, Densities for variables, Statistics). An orange arrow points from a text box to the variable selection area. The right side of the interface shows the 'Results' section, which includes a 'Correlation Matrix' table and a 'Plot' area. The table shows Pearson's r and p-values for Pretest and Posttest. The plot area displays density curves for Pretest and Posttest, a scatter plot with a regression line, and a correlation coefficient of 0.0862.

Correlation Matrix

		Pretest	Posttest
Pretest	Pearson's r	—	0.086
	p-value	—	0.718
Posttest	Pearson's r	—	—
	p-value	—	—

Plot

Pretest

Posttest

Corr: 0.0862

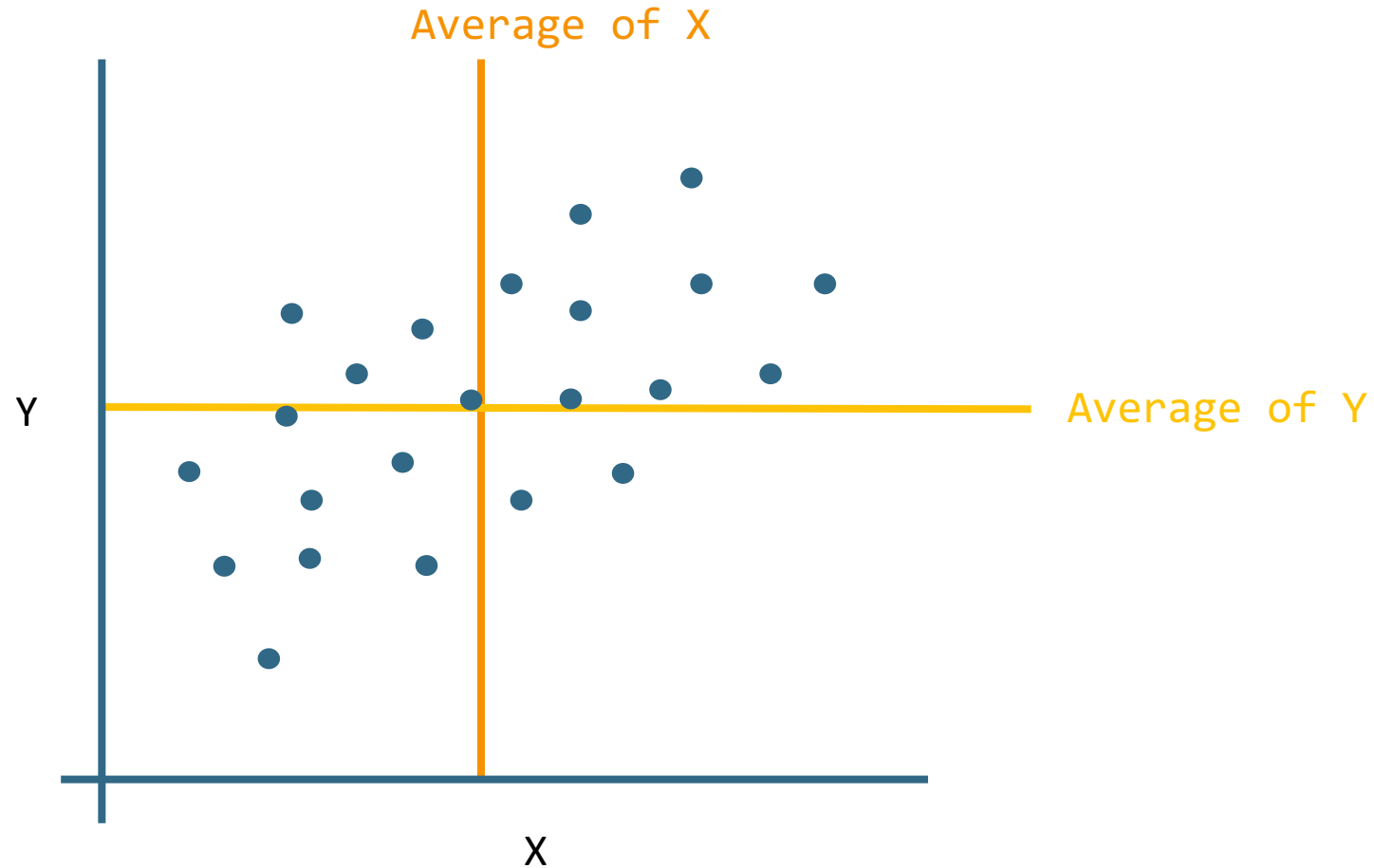
Pretest

Posttest

Bring variables to be correlated over here

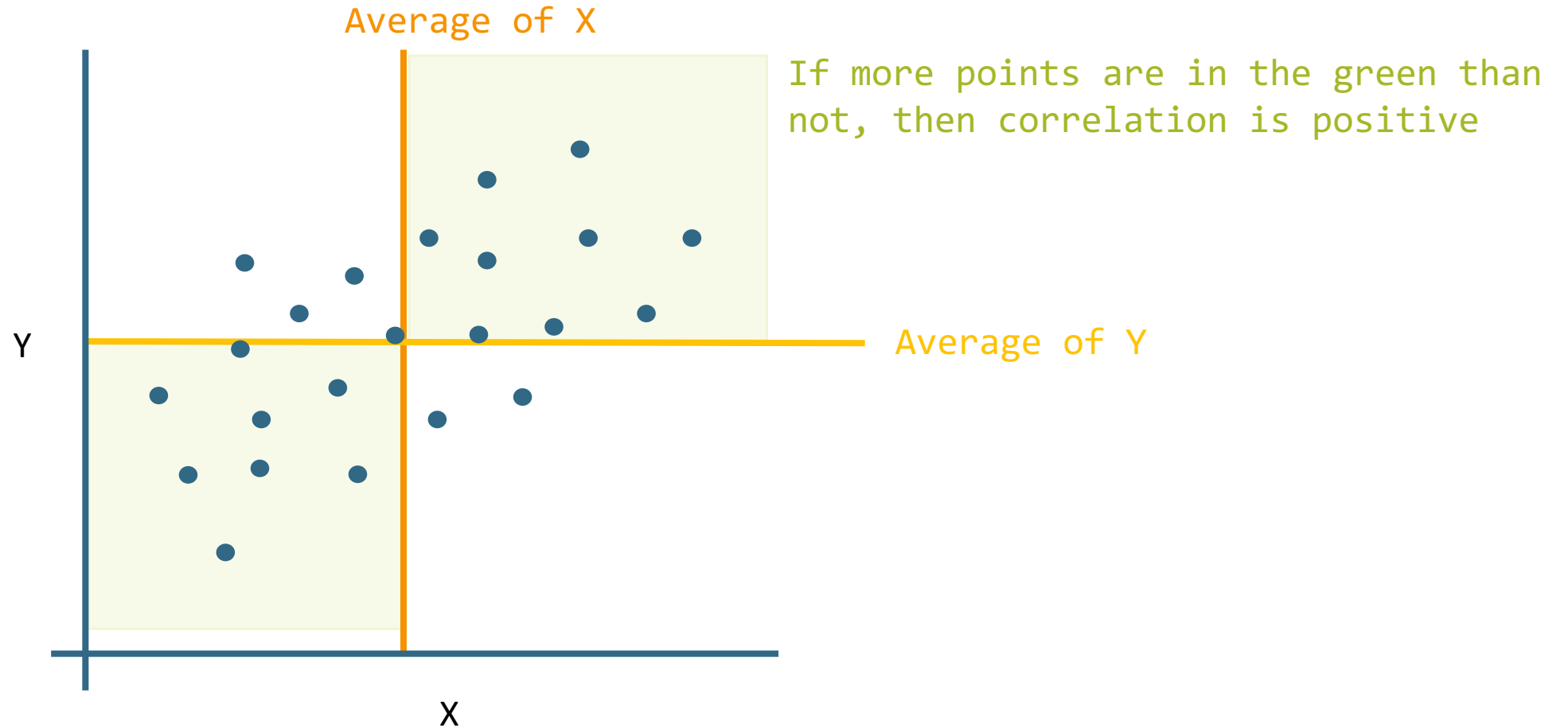
4

Compute the Test Statistic



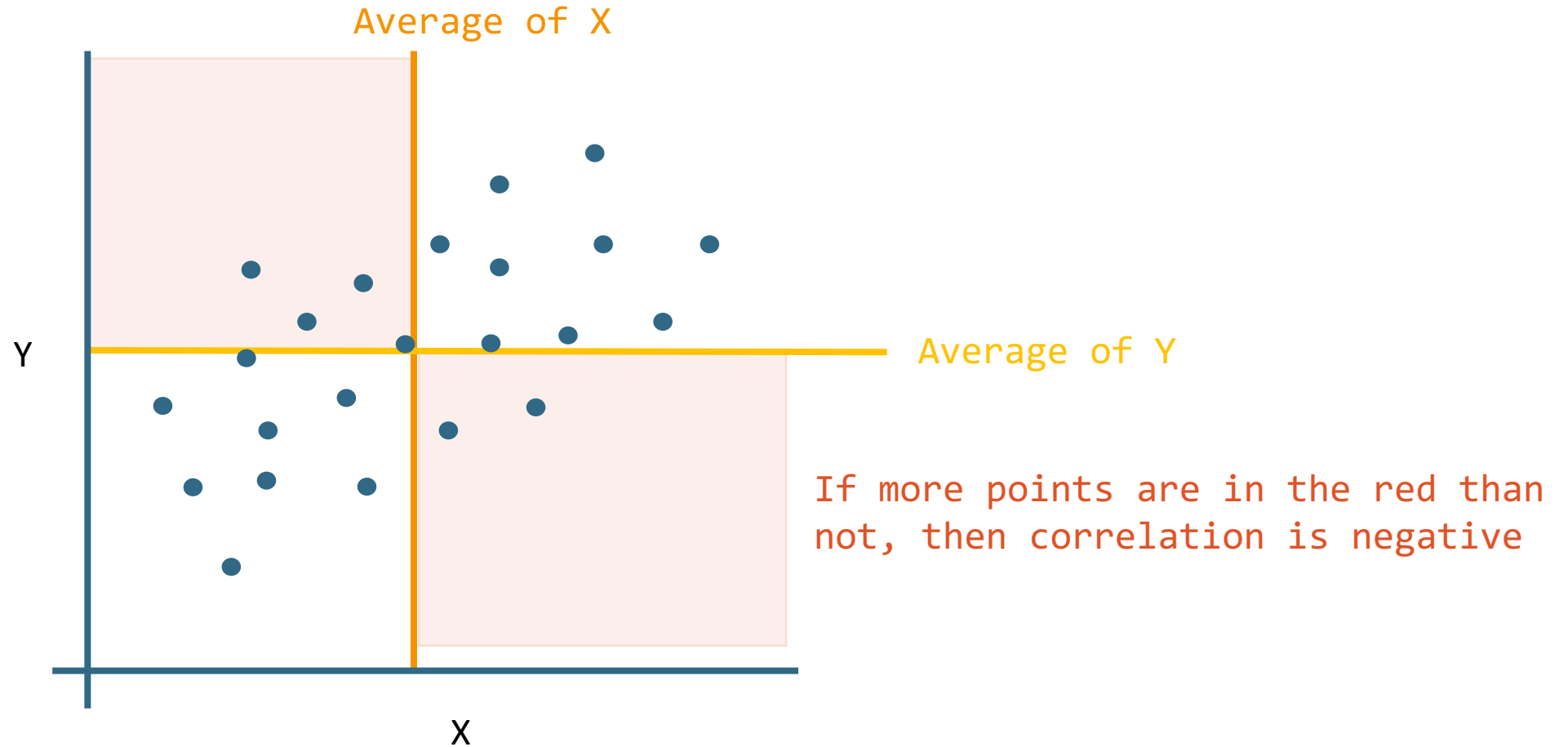
4

Compute the Test Statistic



4

Compute the Test Statistic



5

Compute an Effect Size and Describe it

One of the main effect sizes for correlation is r^2

$$r^2 = (r)^2$$

r^2	Estimated Size of the Effect
Close to .01	Small
Close to .09	Moderate
Close to .25	Large

6 Interpreting the results

Put your results into words

Use the example around **page 529** as a template

Let's use Jamovi

Correlation

Intro to Regression

Intro to Regression

The **foundation** of almost everything we do in statistics



```
graph TD; A[The foundation of almost everything we do in statistics] -- red arrow --> B[Comparing group means]; A -- yellow arrow --> C[Assess relationships]; A -- orange arrow --> D[Compare means AND assess relationships at the same time];
```

Comparing group means

Assess relationships

Compare means AND assess relationships at the same time

Can handle many types of outcome and predictor data types
Results are interpretable

Two Main Types of Regression

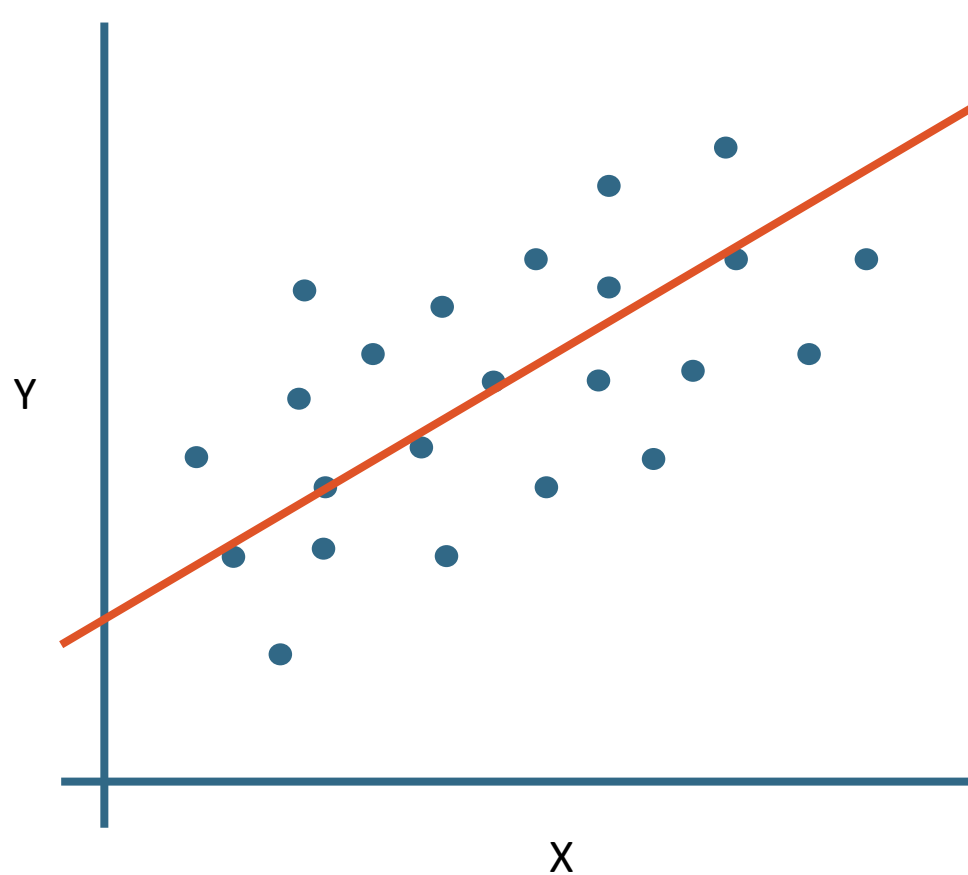
Simple

- Only one predictor in the model
- When variables are standardized, gives same results as correlation
- When using a grouping variable, same results as t-test or ANOVA

Multiple

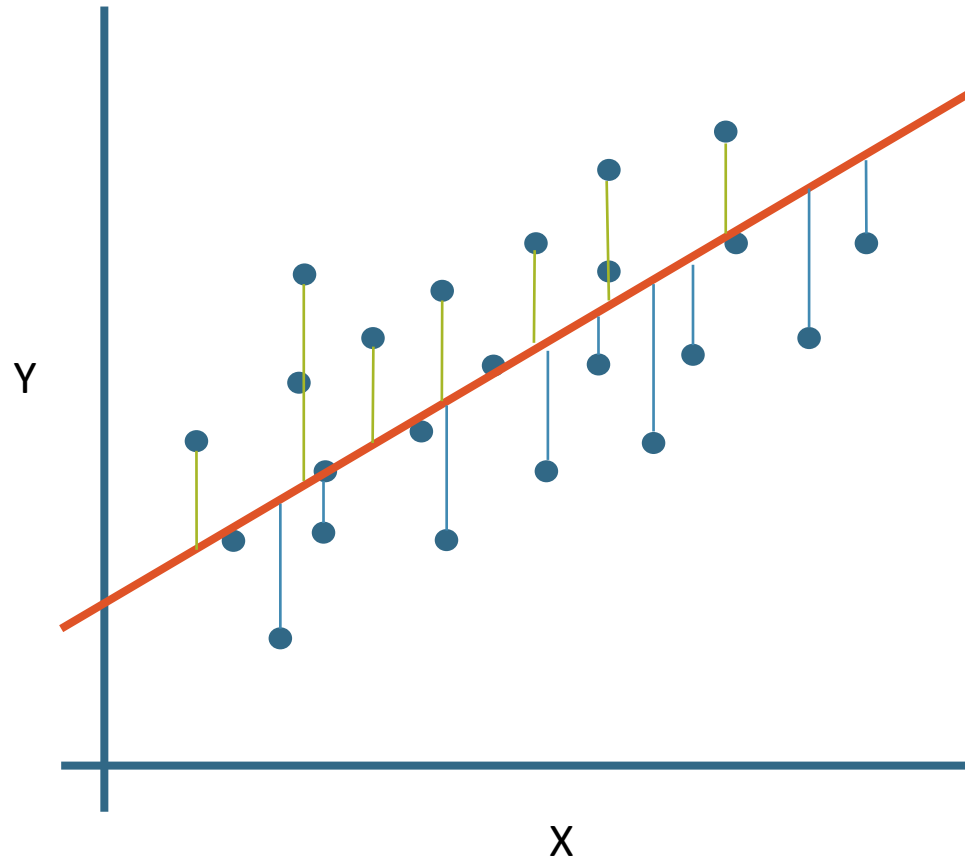
- More than one variable in the model
- When variables are standardized, gives “partial” correlation
- Predictors can be any combination of categorical and continuous

Logic of Regression



We are trying to
find the best
fitting line

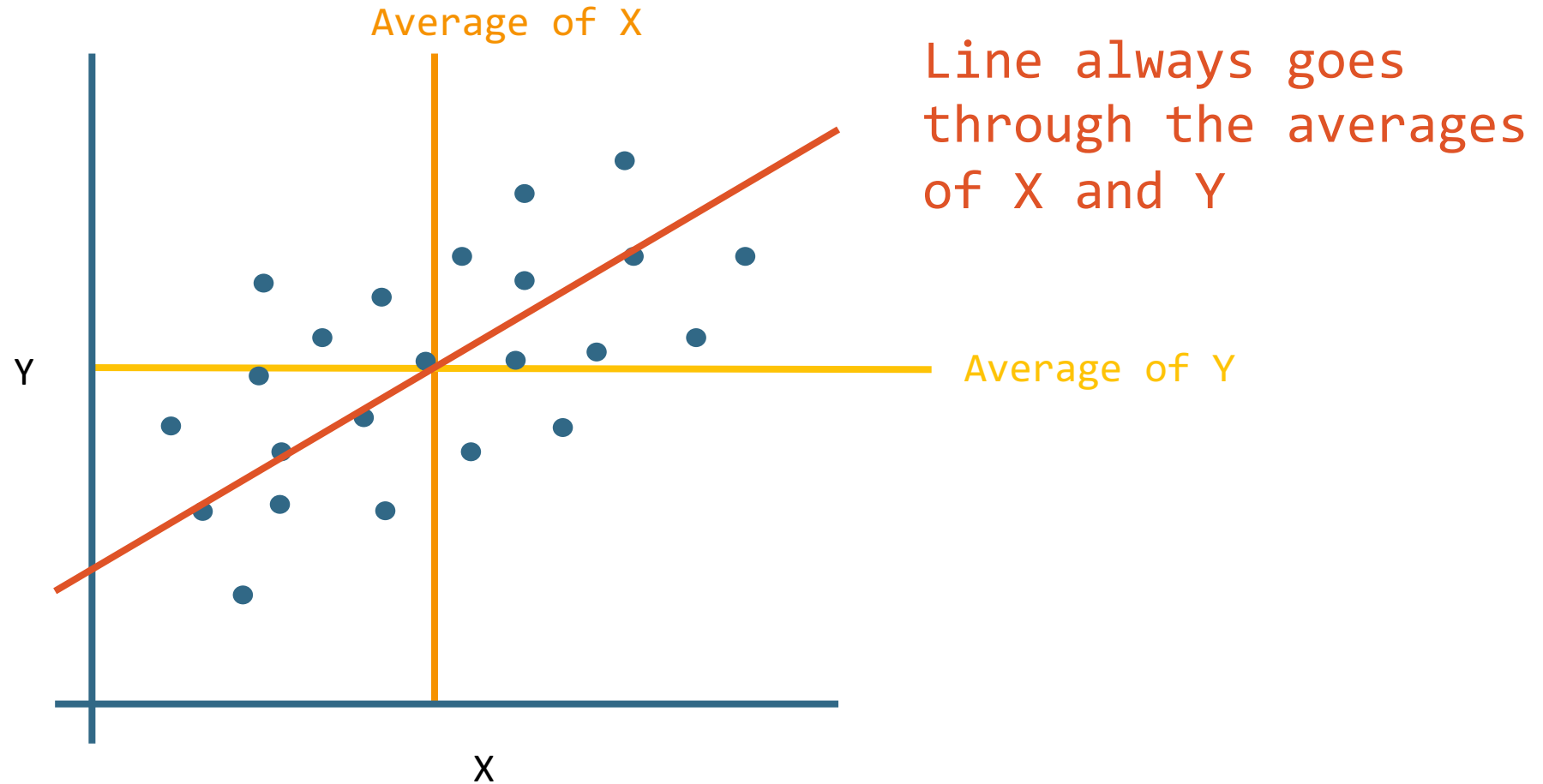
Logic of Regression



We are trying to find the best fitting line

We do this by minimizing the difference between the points and the line (called the residuals)

Logic of Regression



Questions?

Please post them to the
discussion board before
class starts

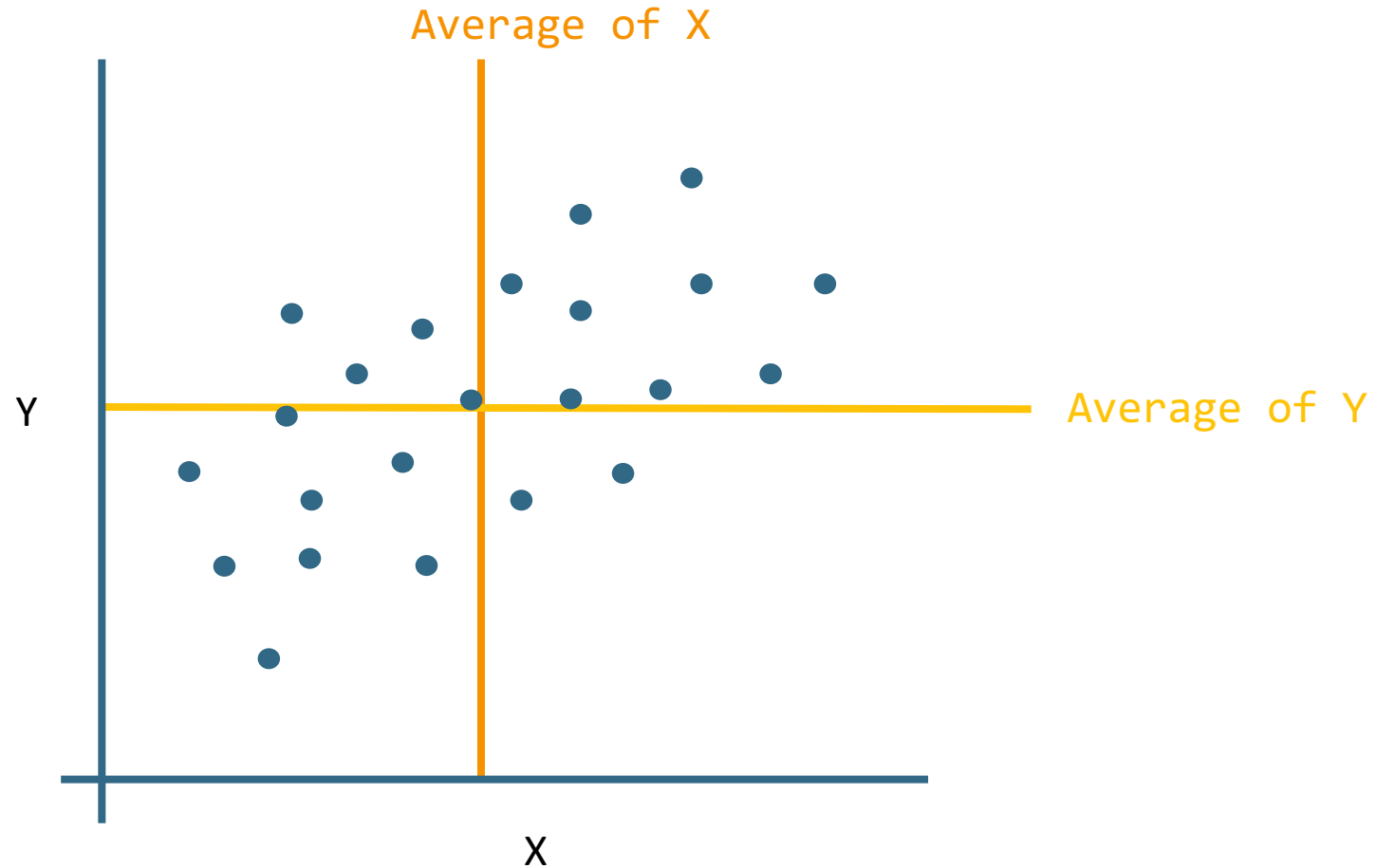
End of Pre-Recorded Lecture Slides

In-class discussion slides

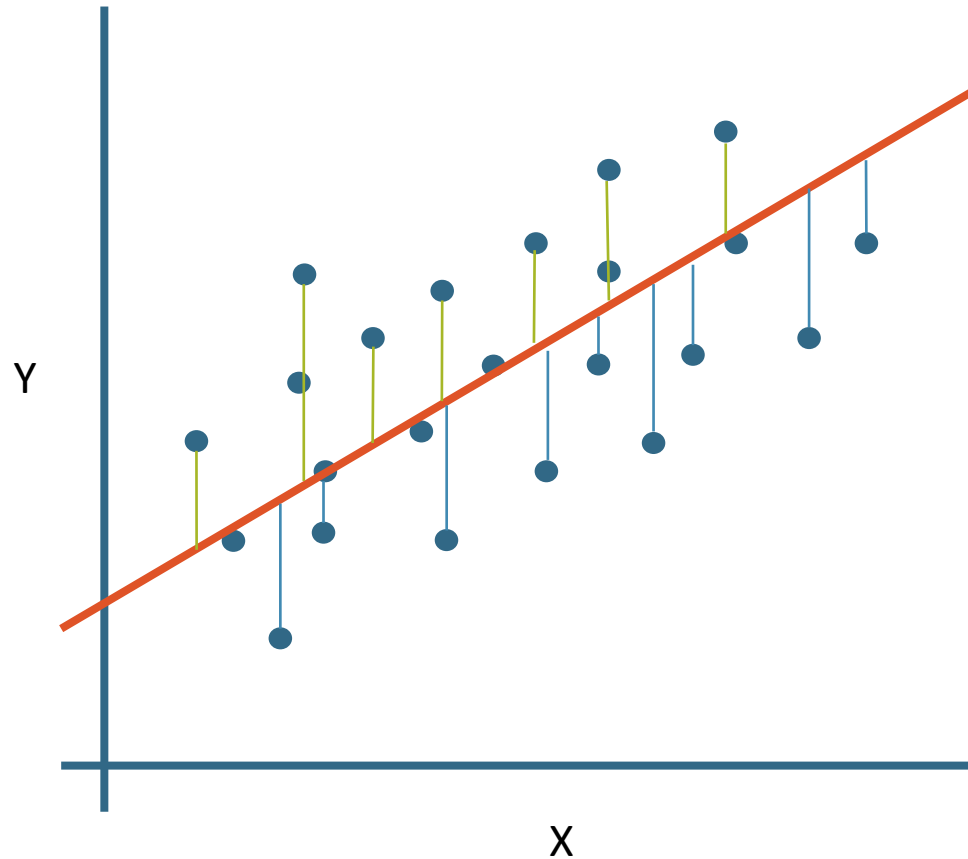


<https://www.youtube.com/watch?v=sxYrzzy3cq8>

How Correlation Works



How Regression Works



We are trying to find the best fitting line

We do this by minimizing the difference between the points and the line (called the residuals)

Application

Example Using
The Office/Parks and Rec Data Set

Hypothesis Test with
Correlation