Art of Stat
Mobile Apps for Intro Stats

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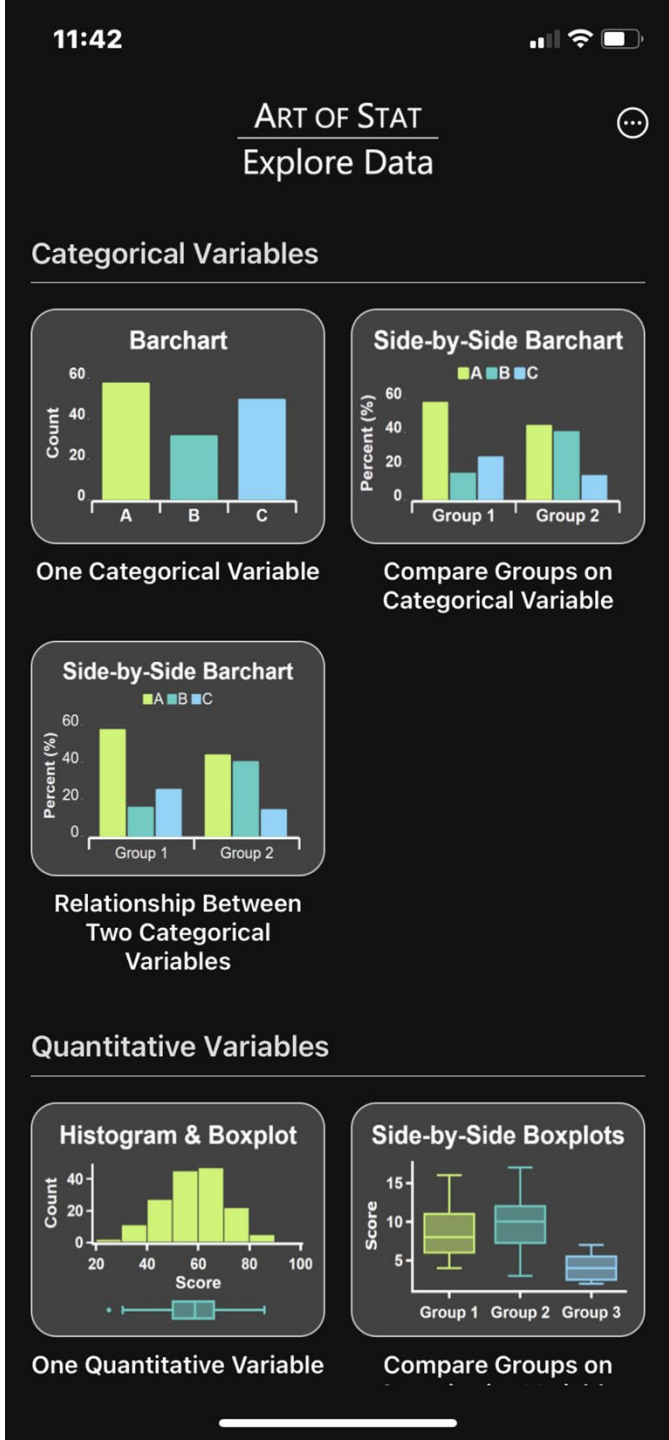
Prof. of Statistics

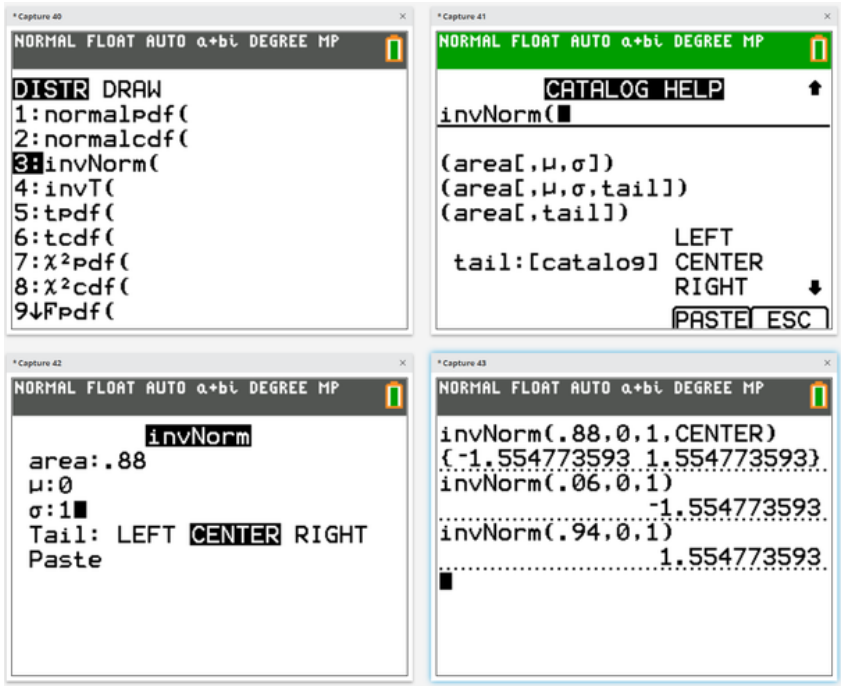
Williams College



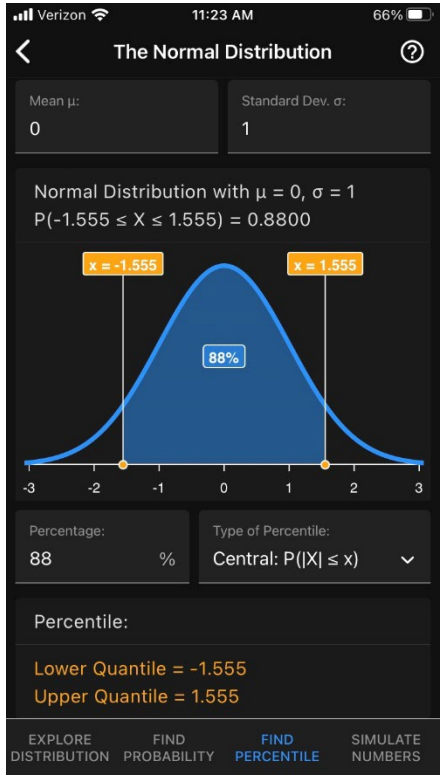
Overview

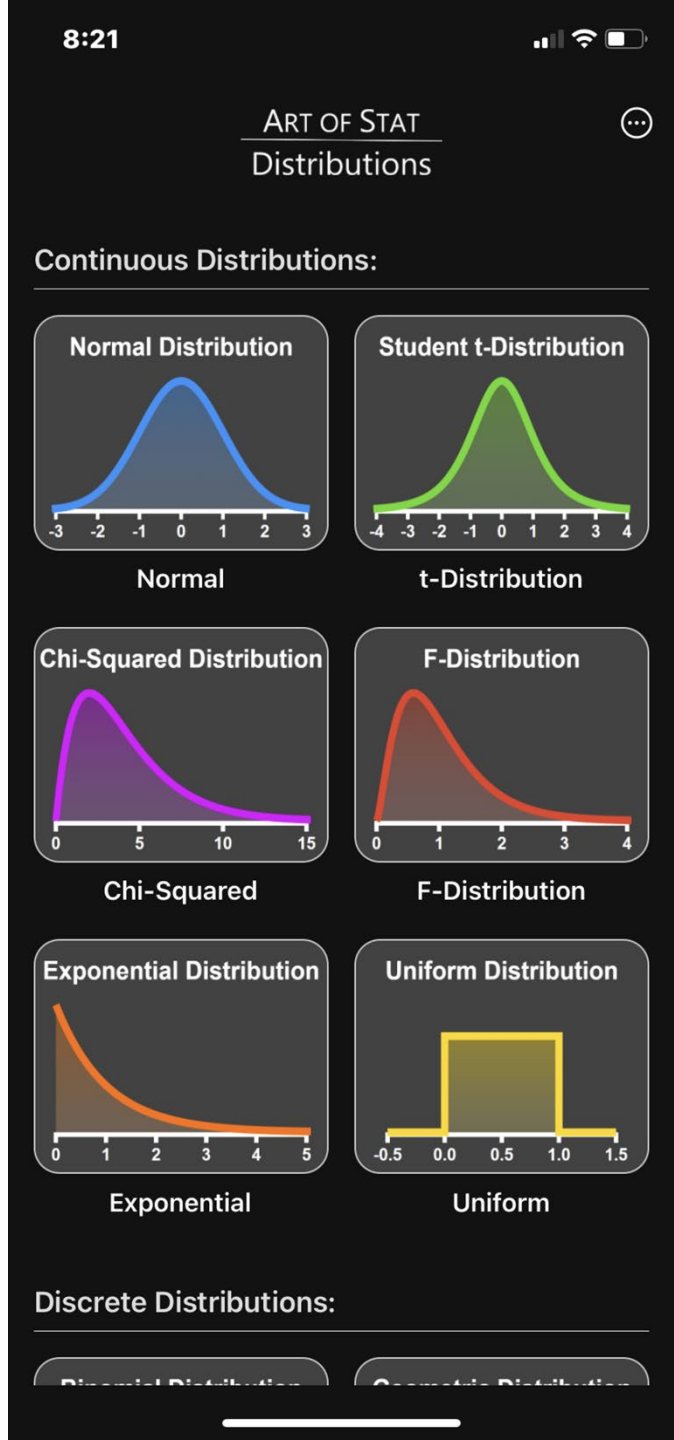
Conference Theme: “Preparing the Modern Student”

The modern student deserves a modern calculator!



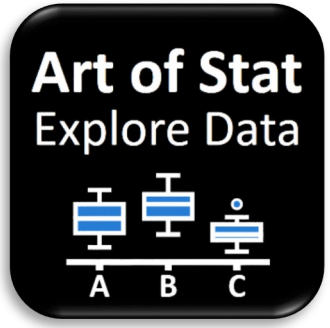
vs.

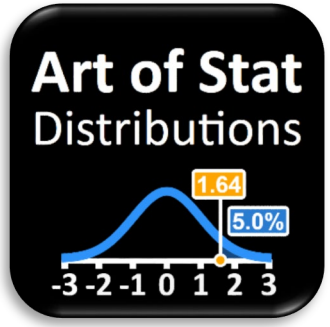


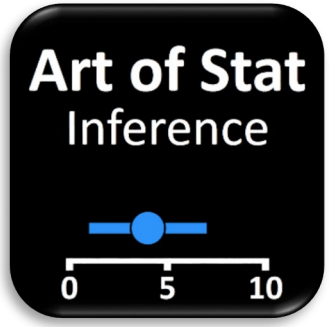


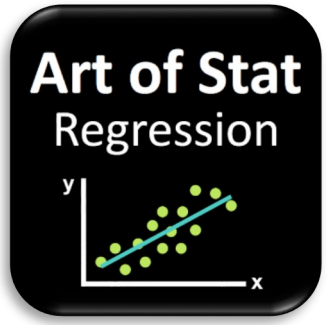
Overview

- Apps span four major themes:





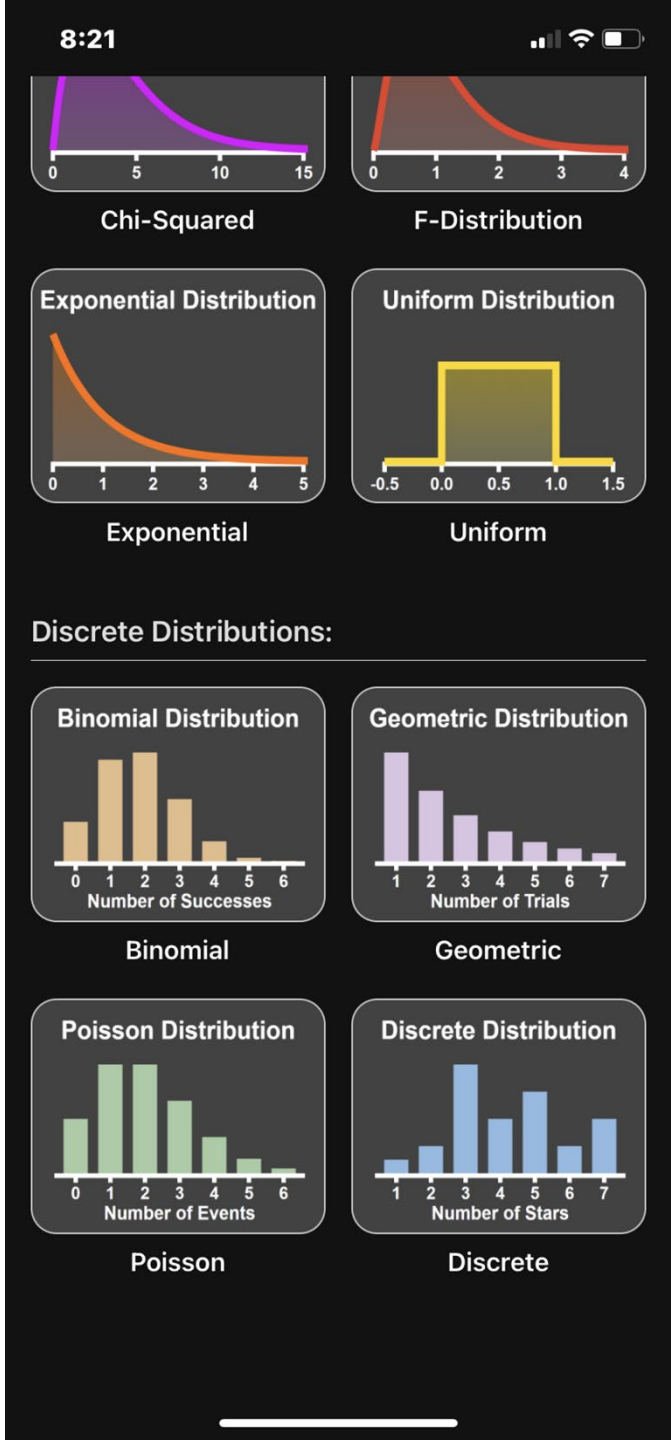




- Available for iOS and Android (search for “Art of Stat”)

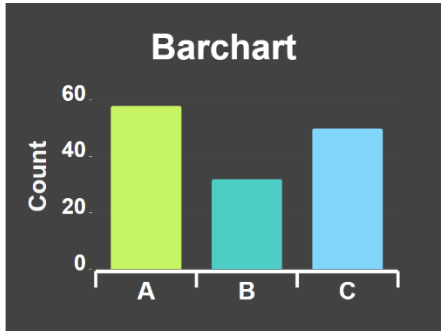
Download on the App Store

GET IT ON Google Play

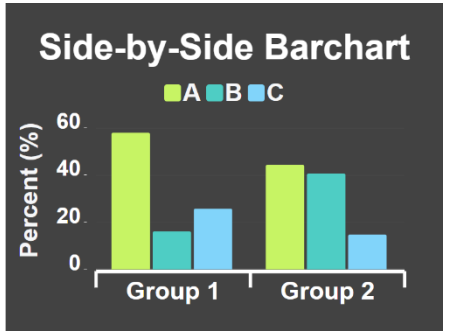


Overview: Explore Data

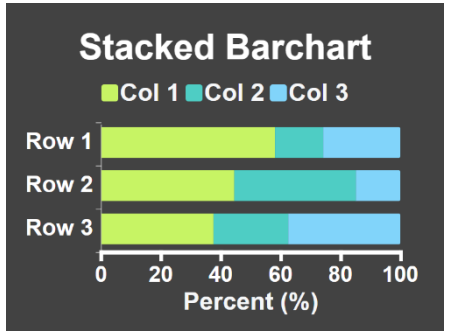
- Explore Categorical Variables



Distribution of One Variable

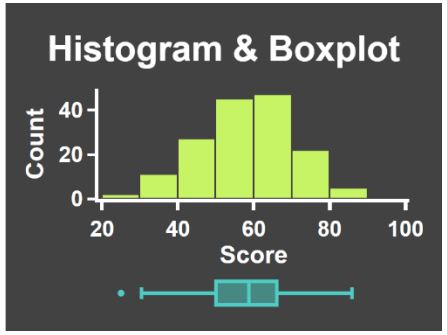


Comparing Groups

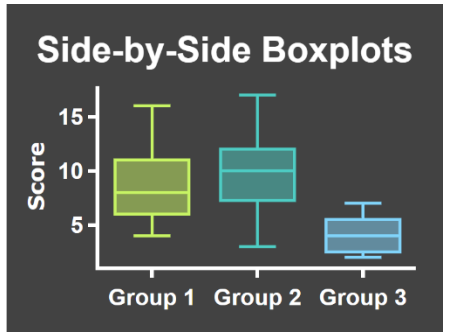


Relationship Btw. Two Variables

- Explore Quantitative Variables

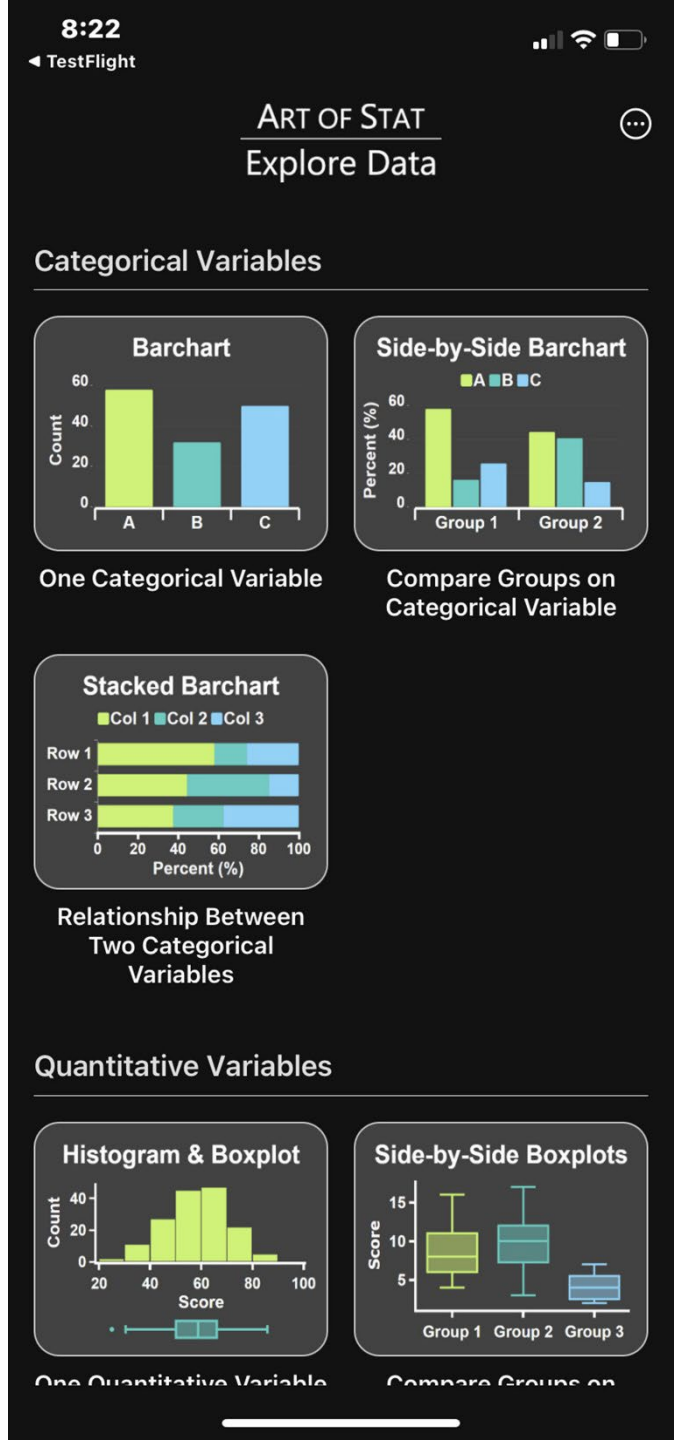


Distribution of One Variable



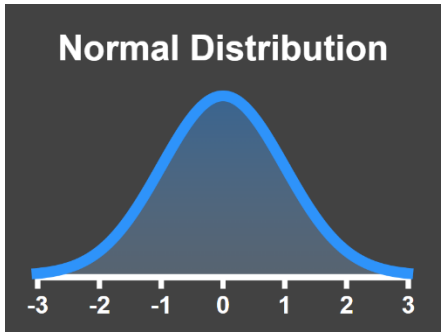
Comparing Groups

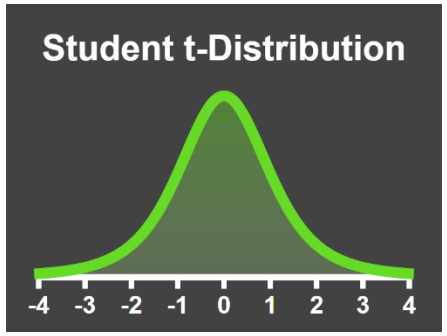
Relationship Btw. Two Variables

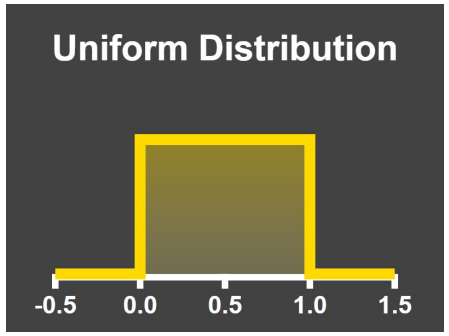


Overview: Distributions

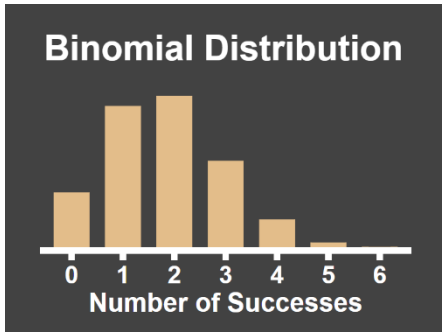
- Continuous Distributions

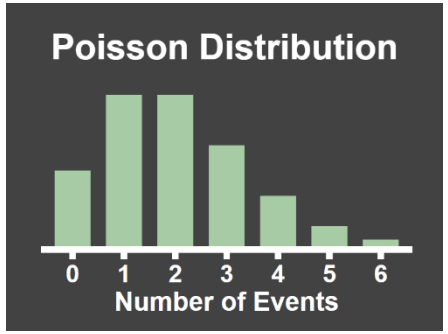


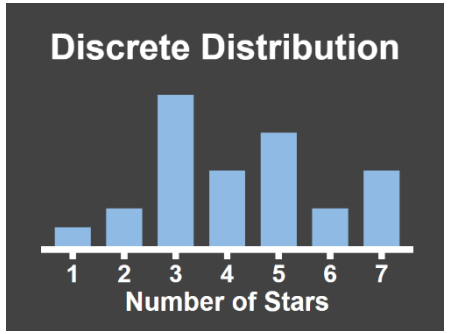


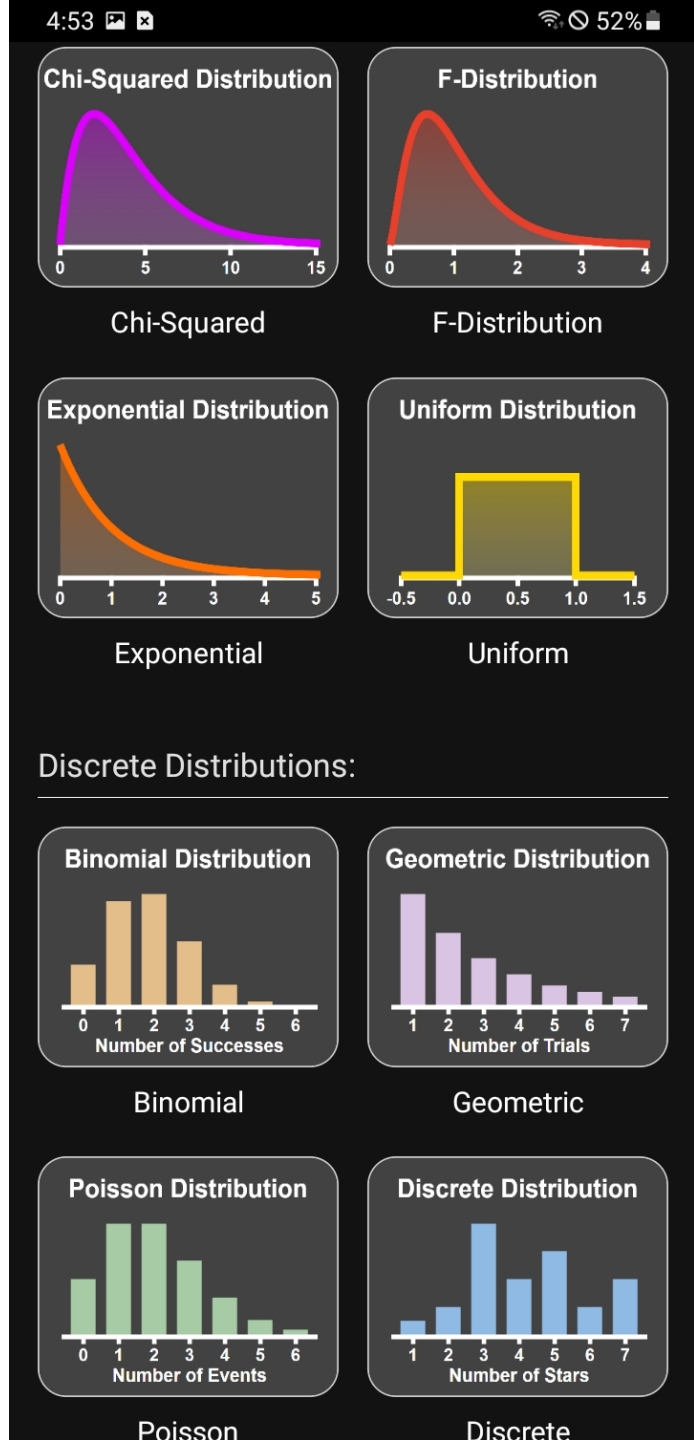


- Discrete Distributions



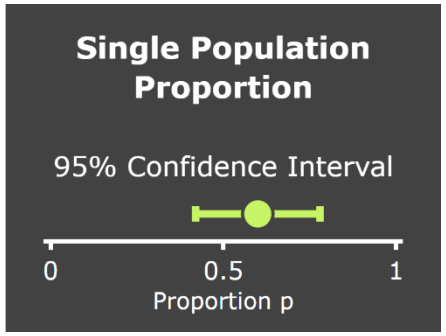


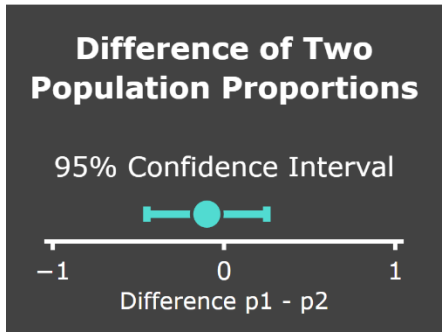


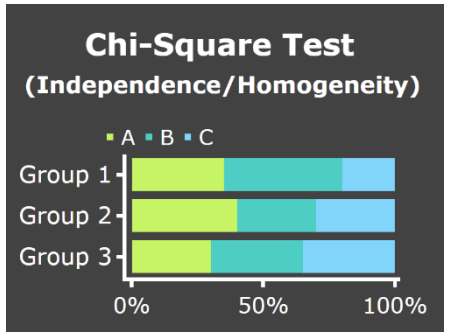


Overview: Inference

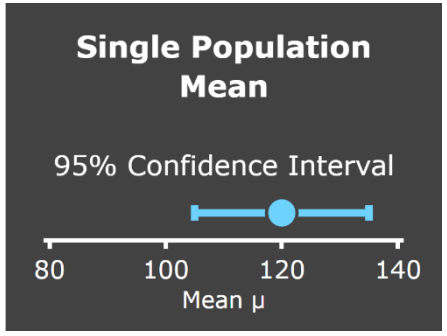
- For Population Proportions

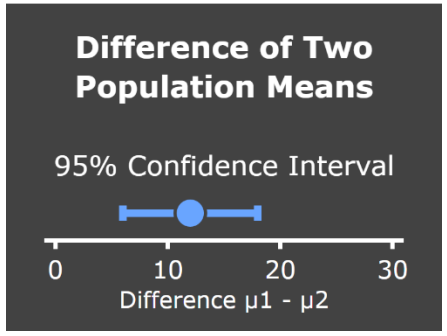


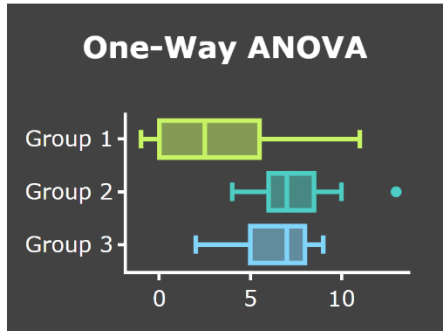


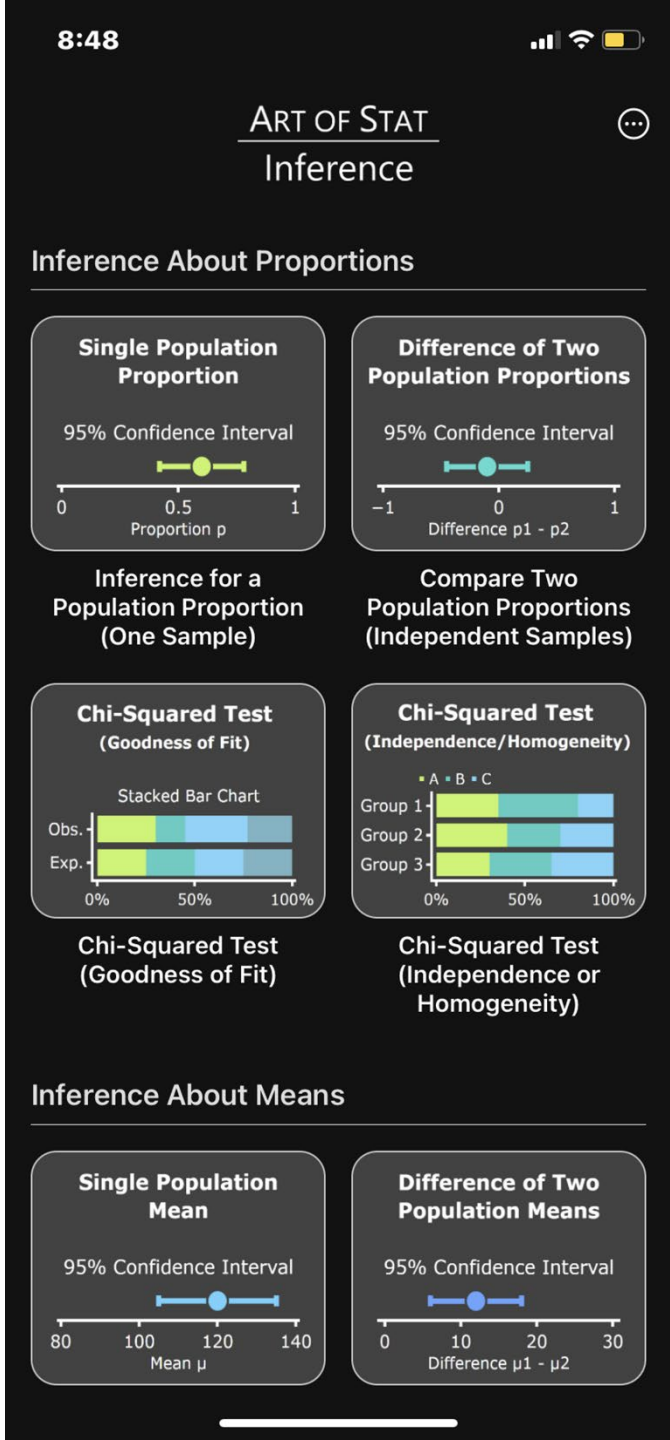


- For Population Means

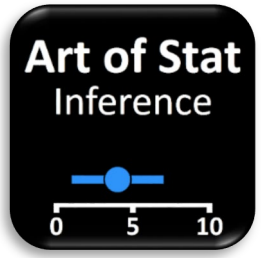




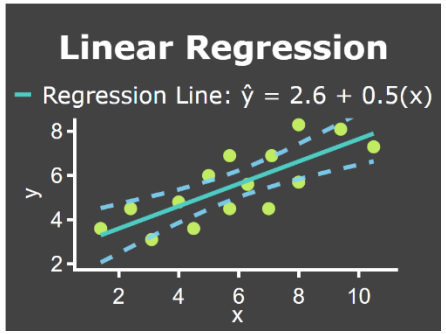




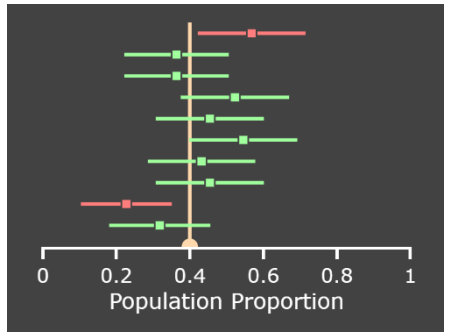
Overview: Inference

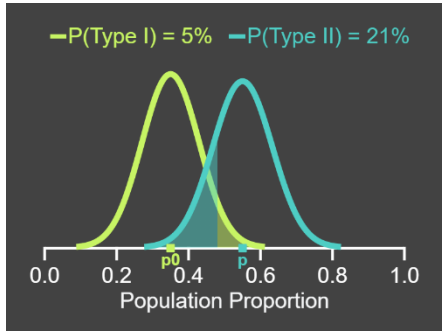


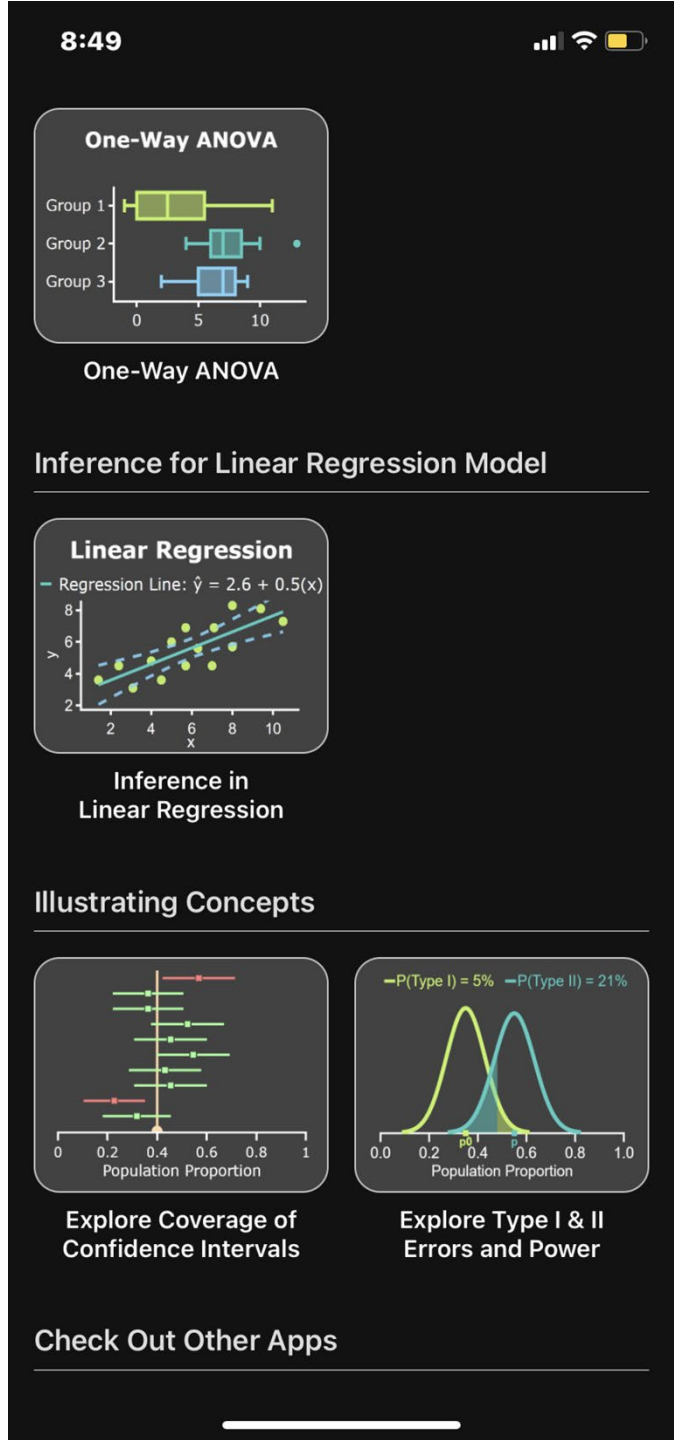
- Inference in Linear Regression



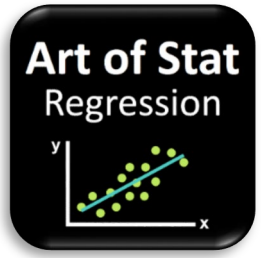
- Illustrating Concepts: Coverage and Errors & Power



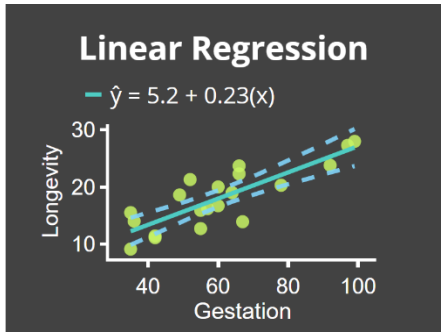


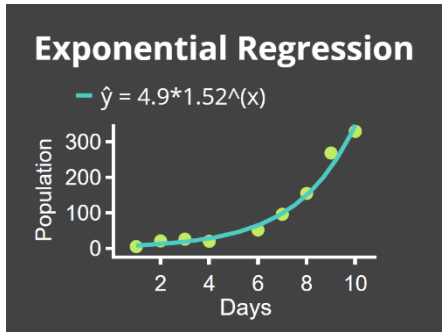


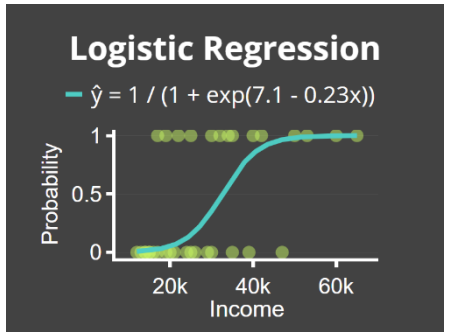
Overview: Regression



- Simple Regression







- Multiple Regression (coming fall ‘22)
  - Multiple Linear Regression
  - Multiple Logistic Regression

Let’s try it with proportion inference

Elon Musk @elonmusk · May 13
Twitter deal temporarily on hold pending details supporting calculation that spam/fake accounts do indeed represent less than 5% of users

To find out, my team will do a random sample of 100 followers of @twitter.

I invite others to repeat the same process and see what they discover …

Pranay Pathole @PPathole · May 13
Replying to @elonmusk and @Twitter
Elon, can you elaborate a bit on the "process"? So that we as Twitter can help you in finding out the real percentage of scam/spam/bot accounts

Elon Musk @elonmusk · May 13
Any sensible random sampling process is fine. If many people independently get similar results for % of fake/spam/duplicate accounts, that will be telling.

I picked 100 as the sample size number, because that is what Twitter uses to calculate <5% fake/spam/duplicate.

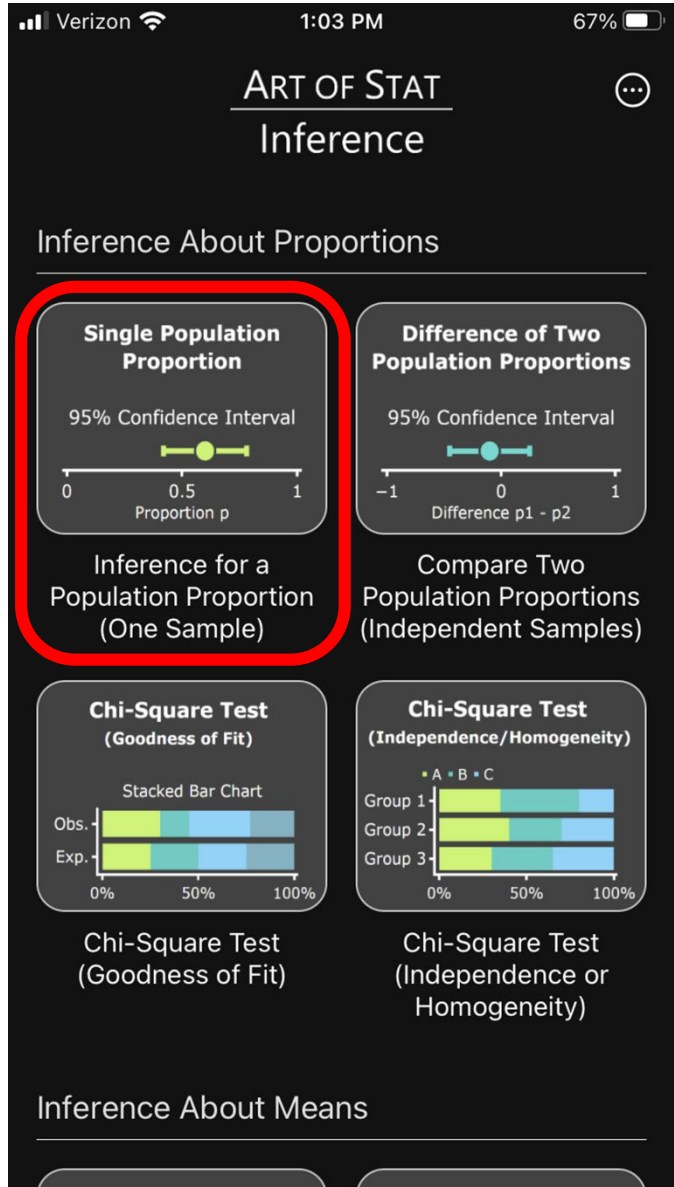
Tesla Owners Silicon… @teslaowne… · May 13
Replying to @elonmusk and @Twitter
How are defining random ? How will you select them

Elon Musk @elonmusk · May 13
Ignore first 1000 followers, then pick every 10th. I’m open to better ideas.

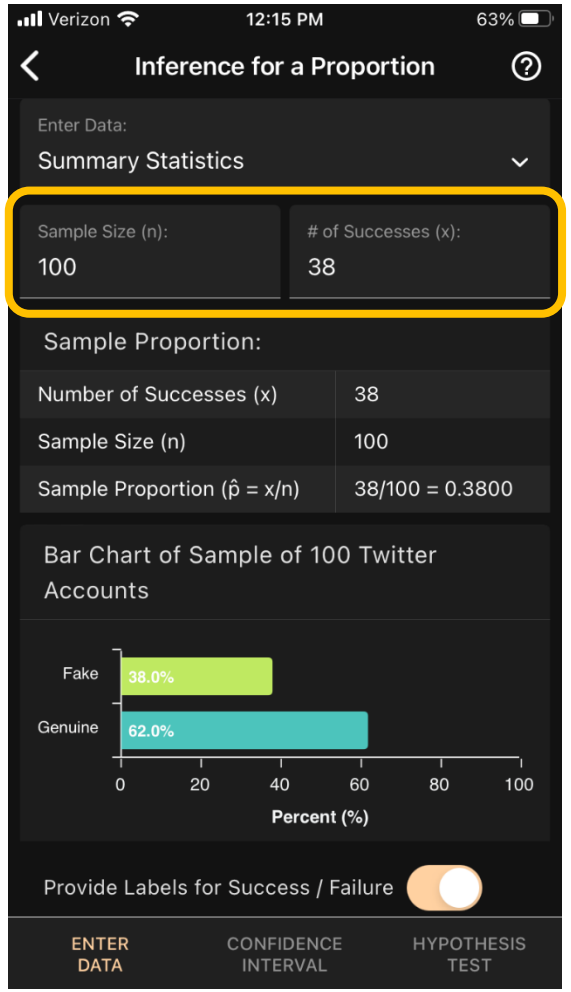
Coffee Table Tesla (☕ … @coffeet… · May 13
Replying to @elonmusk and @Twitter
Why followers of that account, specifically? Why not yours?

Elon Musk @elonmusk · May 13
Pick any account with a lot of followers

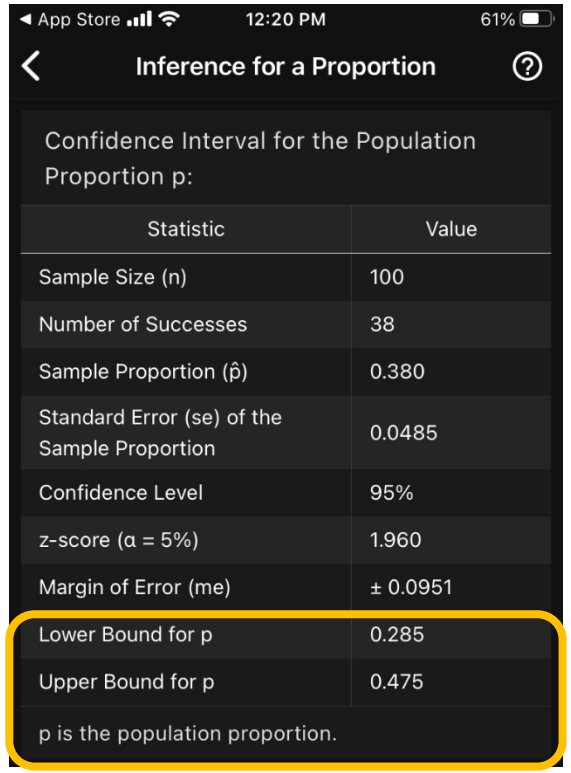
@realworldNeo · May 14
Replying to @elonmusk and @Twitter
I did @nytimes and it had 38 out of 100



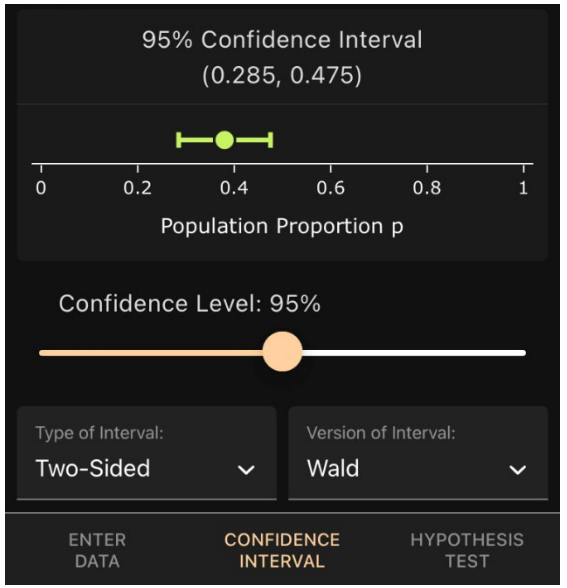
Let’s try it with proportion inference



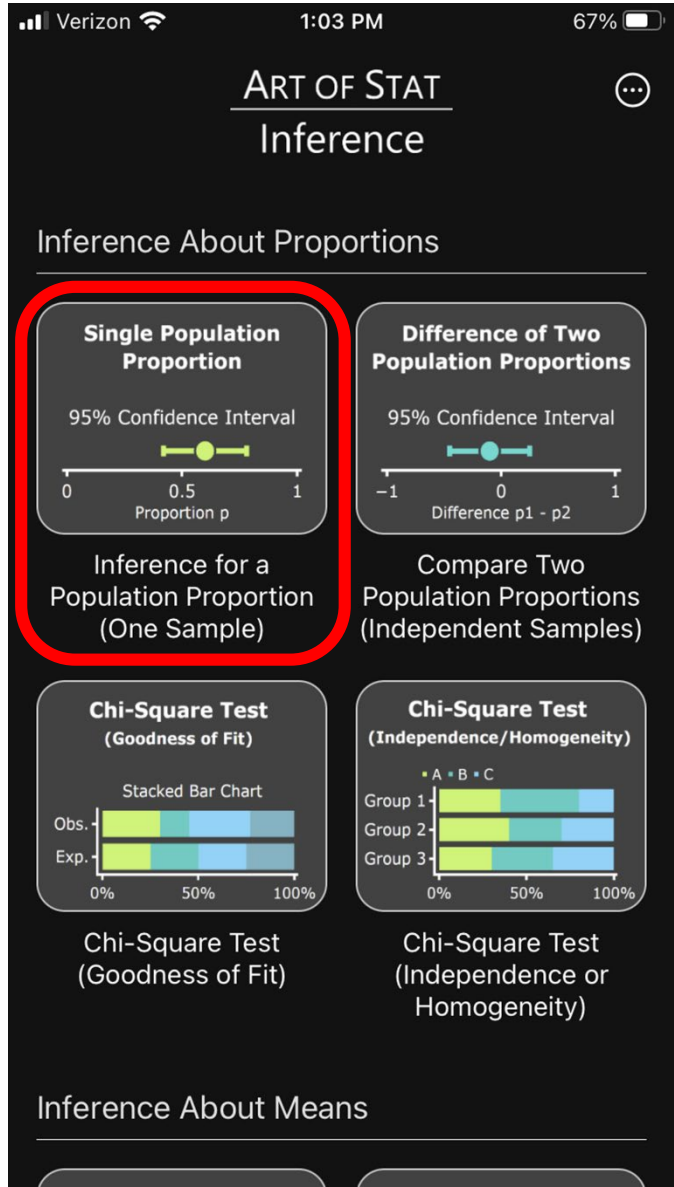
Enter Data on First Tab



Go to Second Tab “Confidence Interval” and obtain lower and upper bounds (plus intermediate statistics such as ME)



Get a graphical representation of the interval, plus options such as choosing the confidence level



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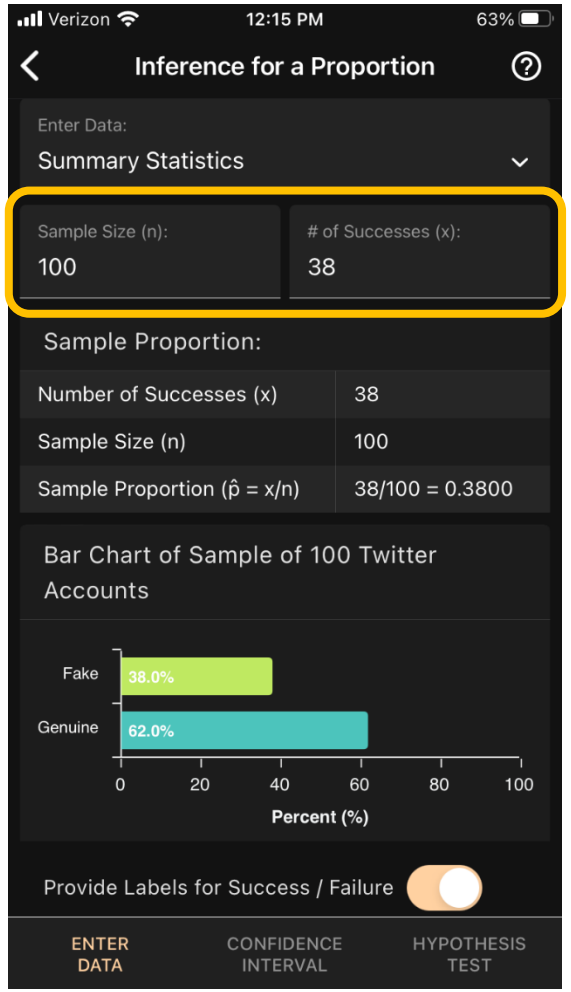

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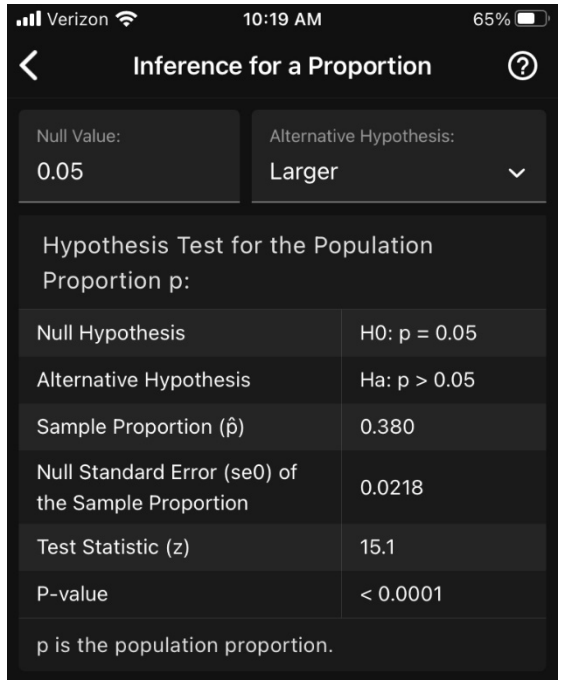
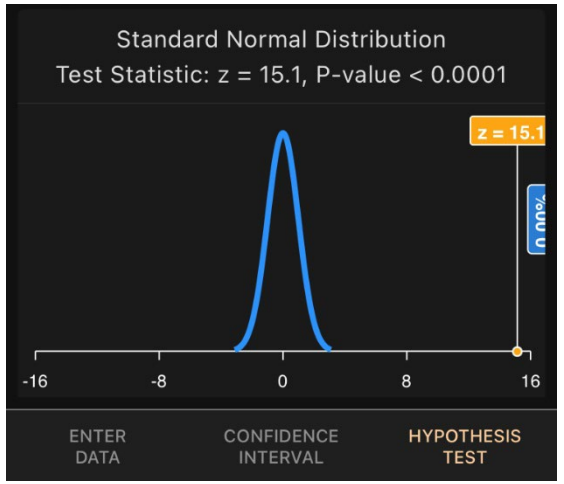
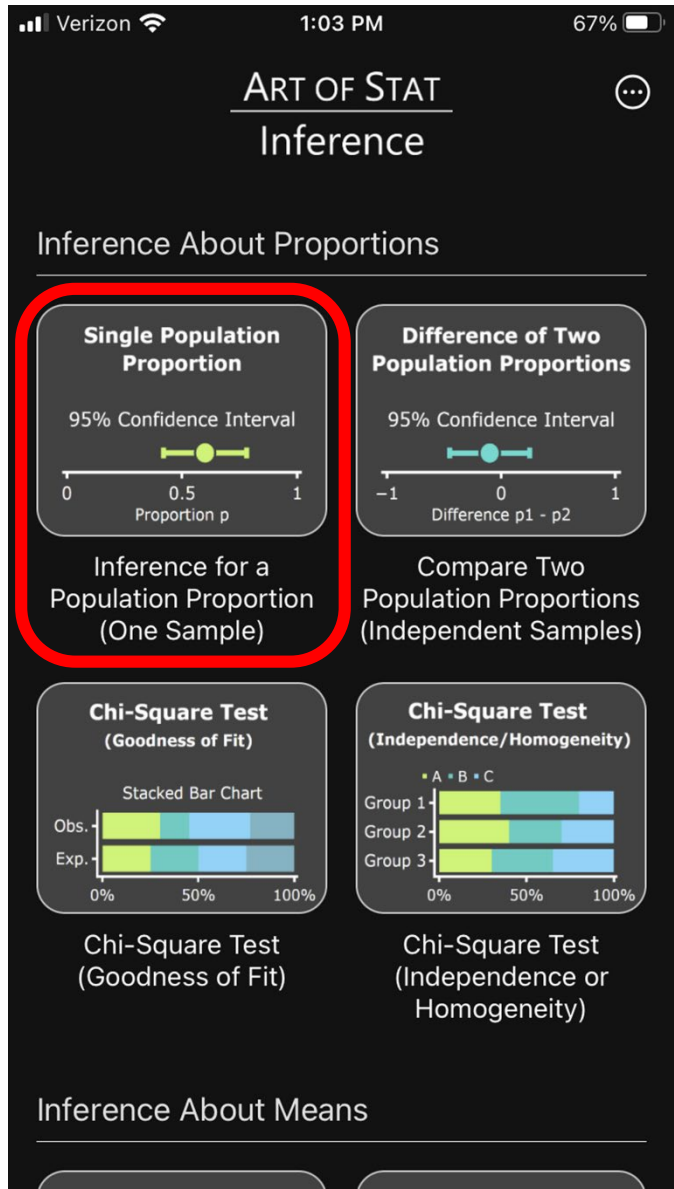


Go to Third Tab “Hypothesis Test”, provide null value and type of hypothesis, and obtain P-value and intermediate steps.

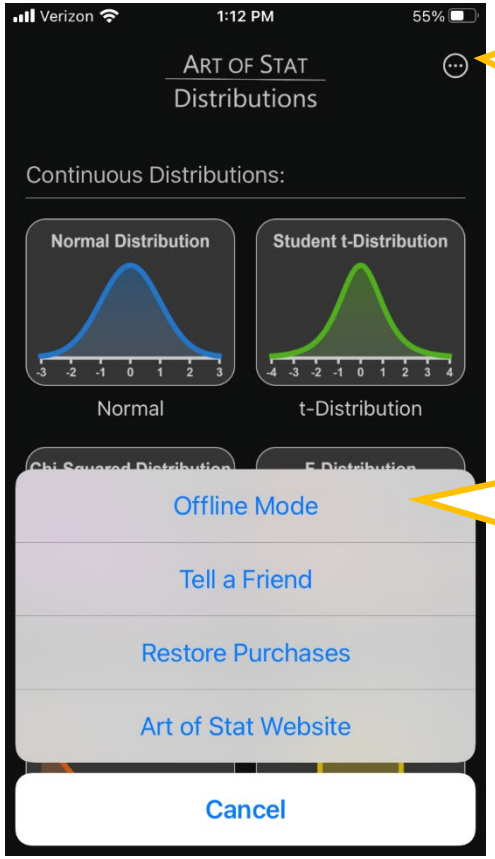


Get a graphical representation of the distribution of the test statistic under the null, and the P-value.



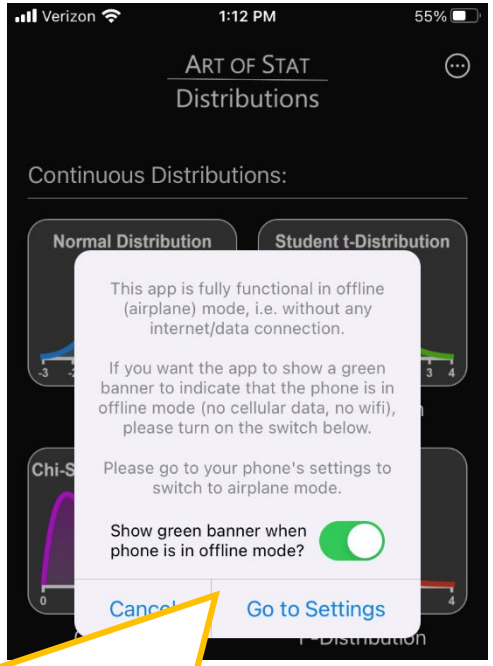
Teaching with the Apps

- The apps work in offline mode:



On initial page of an app, tab the three dots in the upper right corner

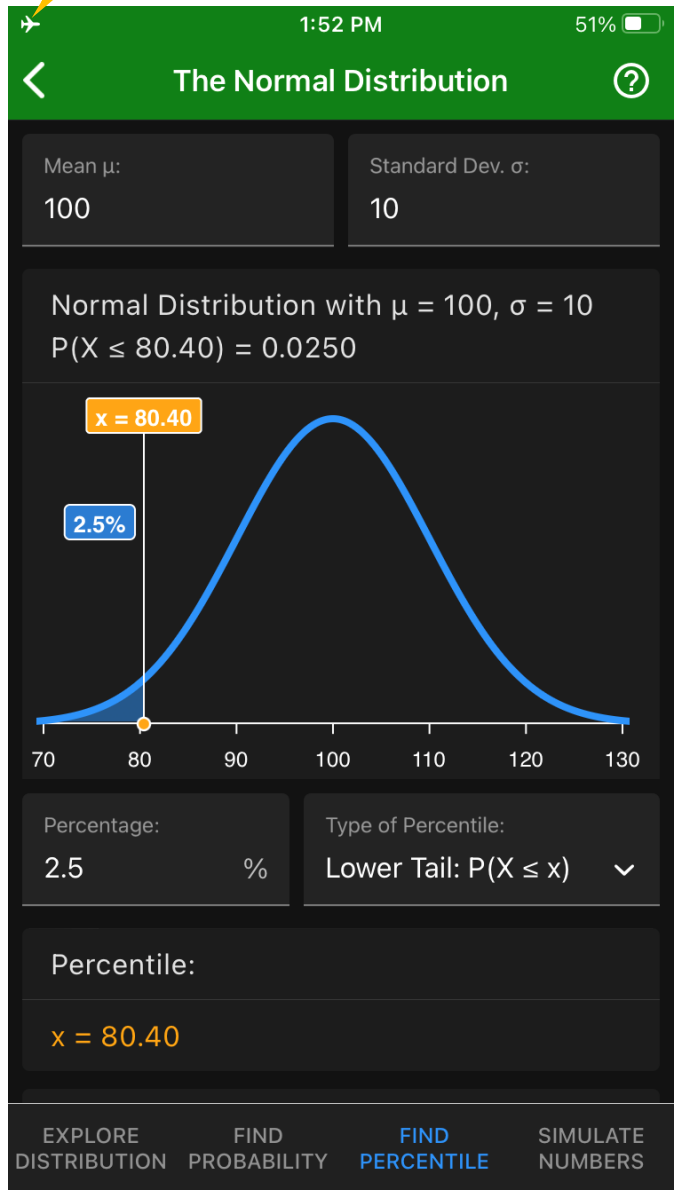
Select "Offline Mode" from menu



Decide if you want to display green banner if phone is in offline mode (for exams?)

Then, go to settings to turn on Airplane Mode

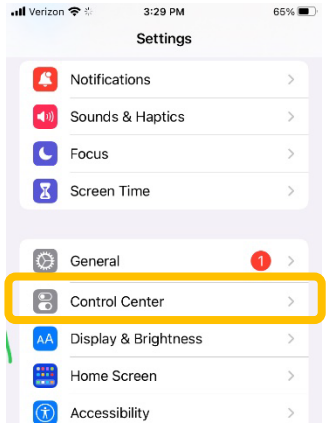
Green Banner when in Airplane Mode

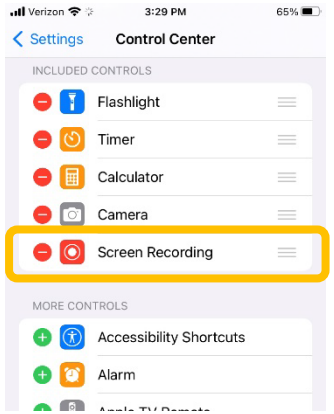


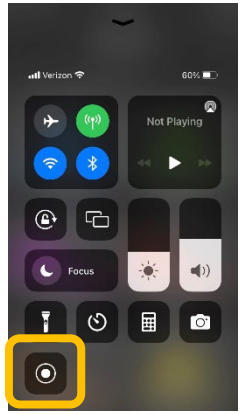
Teaching with the Apps

This is a video. Click on it to start it!

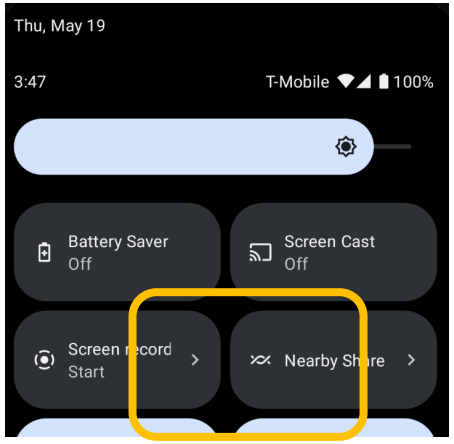
- Take screenshots
- Share with students/teachers or entire class, or post to social media.
- Create (narrated) videos through screen capture:







1. On iOS, go to *Settings*, then *Control Center*
2. Activate *Screen Recording*
3. To start screen recording, swipe up from the bottom

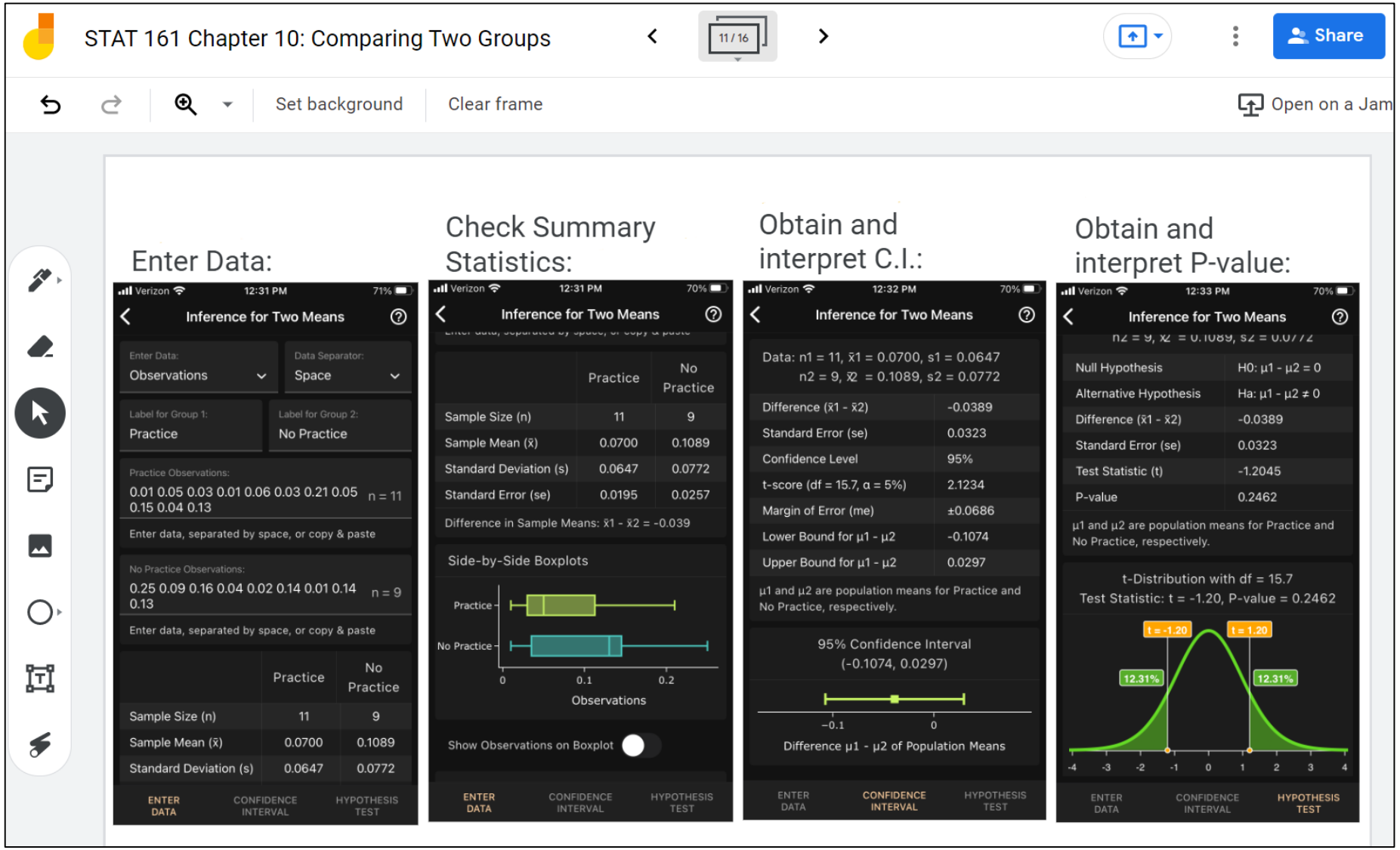


On Android, swipe down from the top twice to see if your phone supports Screen Cast

Teaching with the Apps

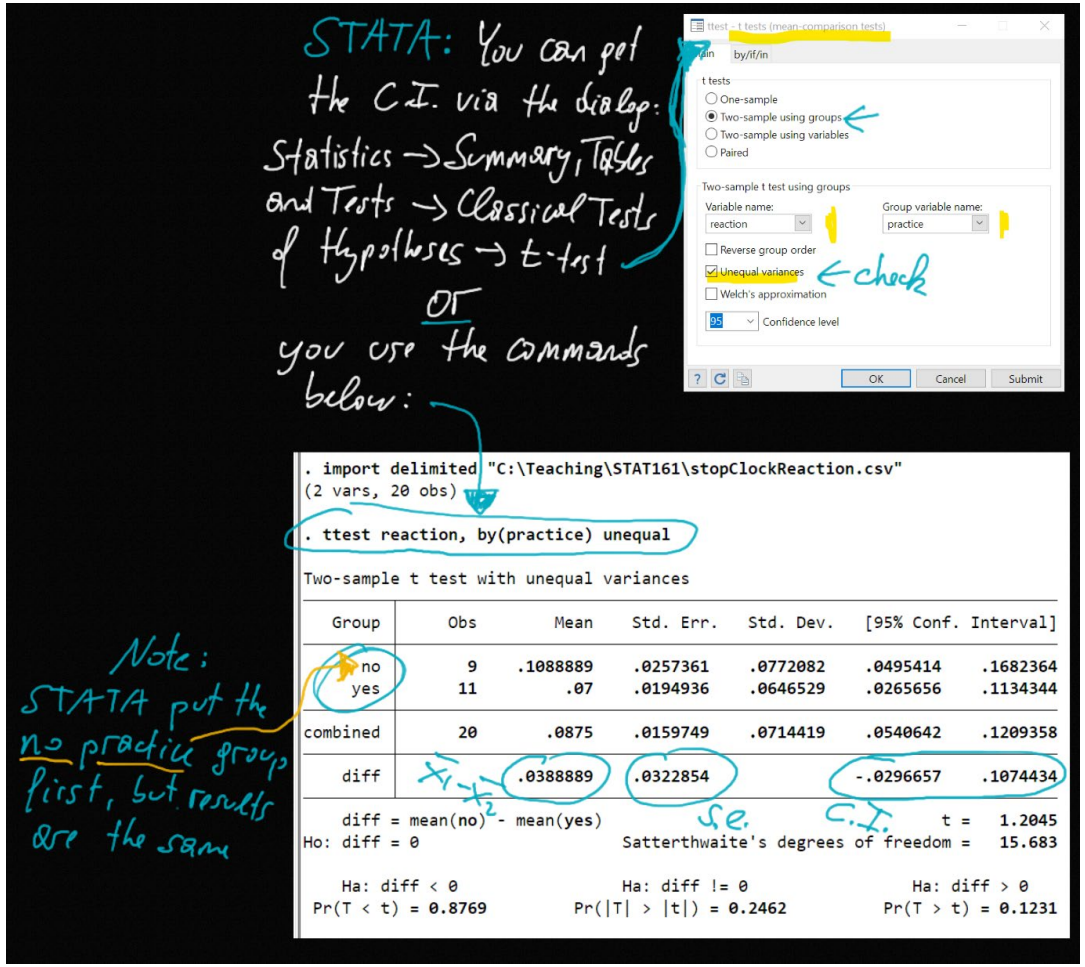
Include screenshots in documents.

Here is a copy of my Jam-board that I share with students after class.



Teaching with the Apps

- I show output of other software (here STATA) only after having talked about the app:

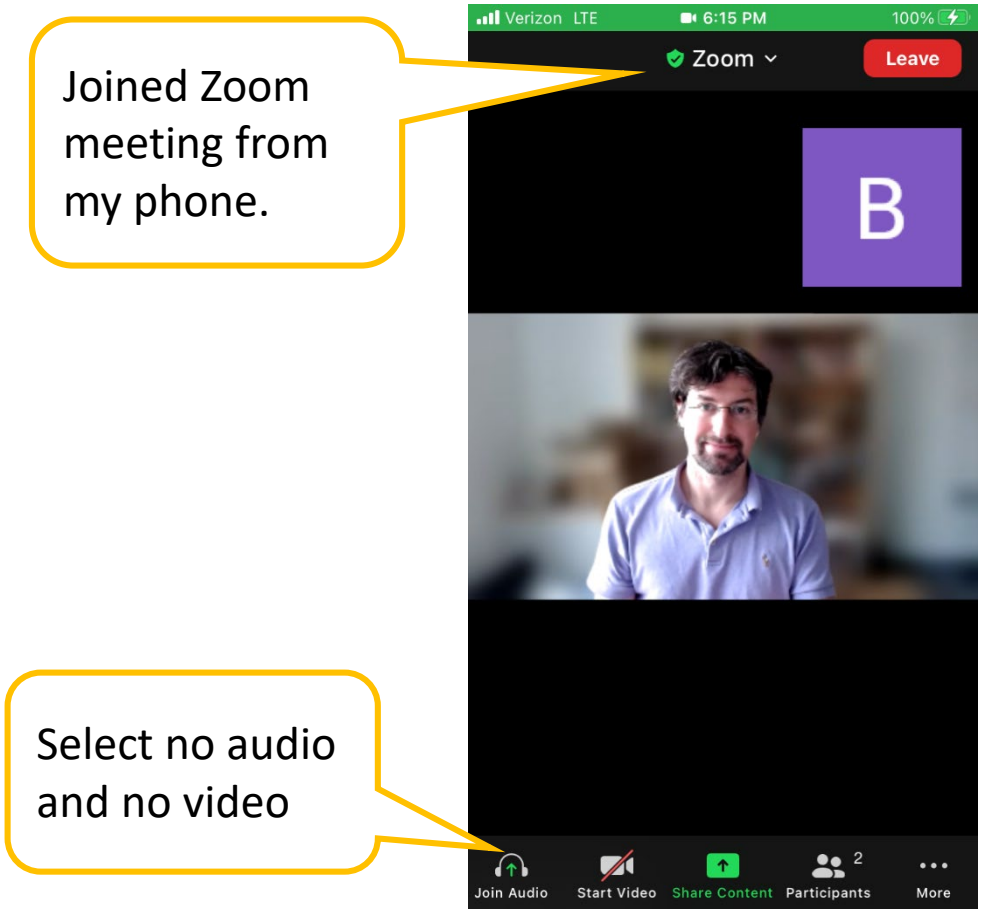


Output from commercial software such as Minitab, STATA, SPSS, JMP, but also from R is easier to understand and process once students have seen the app.

Teaching with the Apps

- Projecting the app on screen (either in class or remotely)

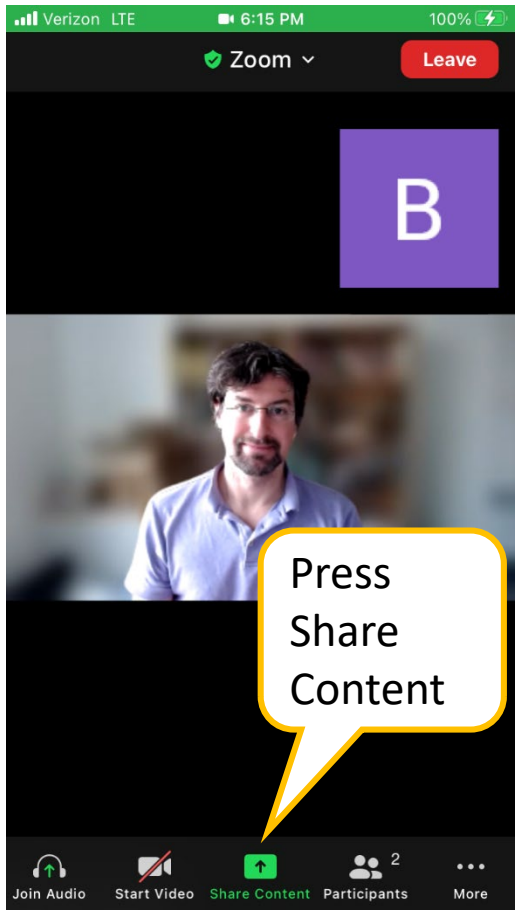
1. Start a Zoom call from your computer
2. Join the Zoom call on your phone (with no audio and no video)
3. On computer, “admit” phone and make it a “Co-Host”

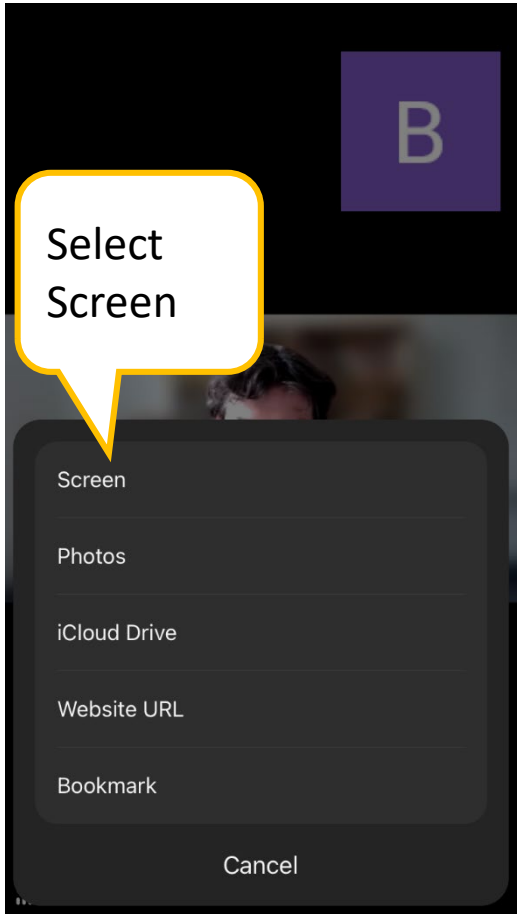


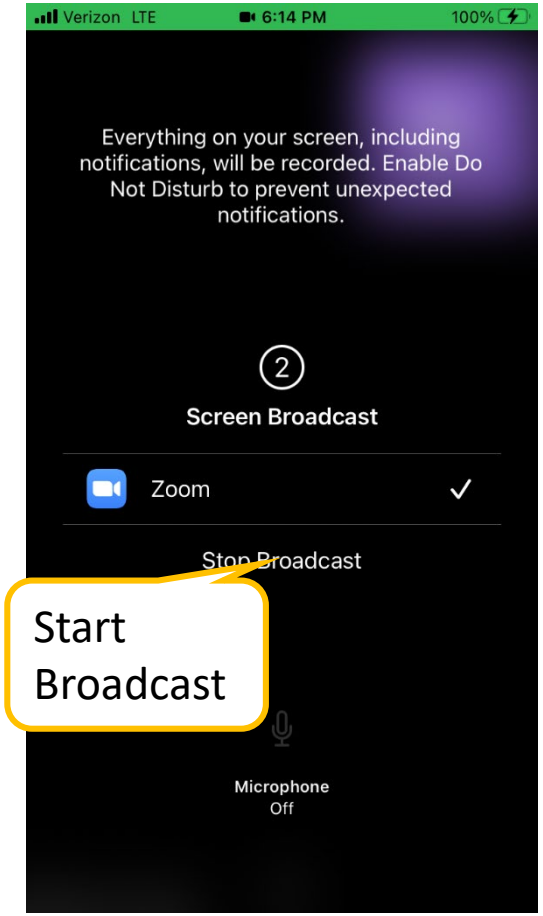
Teaching with the Apps

- Projecting the app on screen (either in class or remotely)

4. Press Share Content on your Phone
5. Select “Screen”
6. Go to the app to start broadcasting it





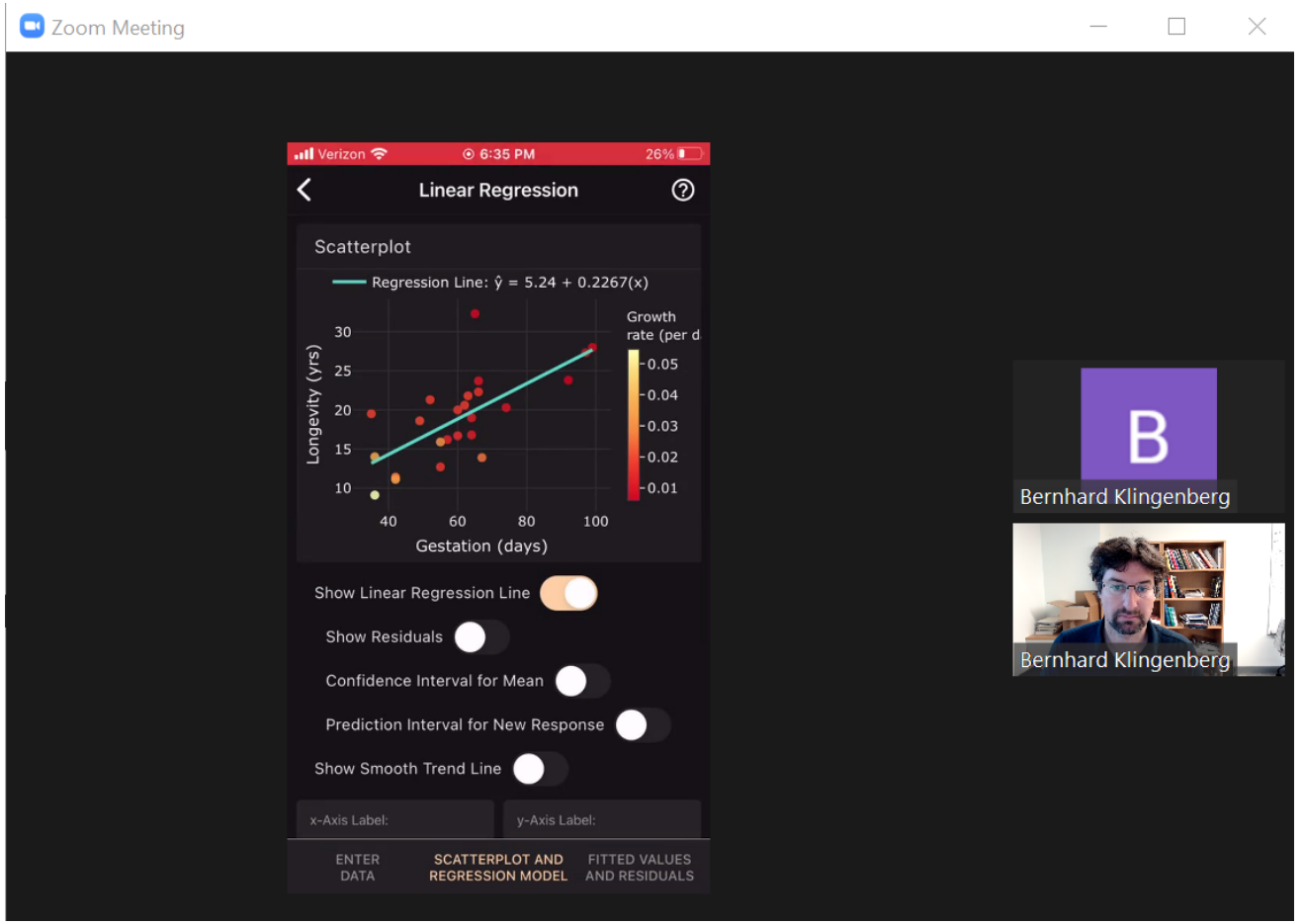


Teaching with the Apps

- Projecting the app on screen (either in class or remotely)

7. On your phone, go to the content you want to share (e.g., the Art of Stat App) Select “Screen”

8. Present on your phone



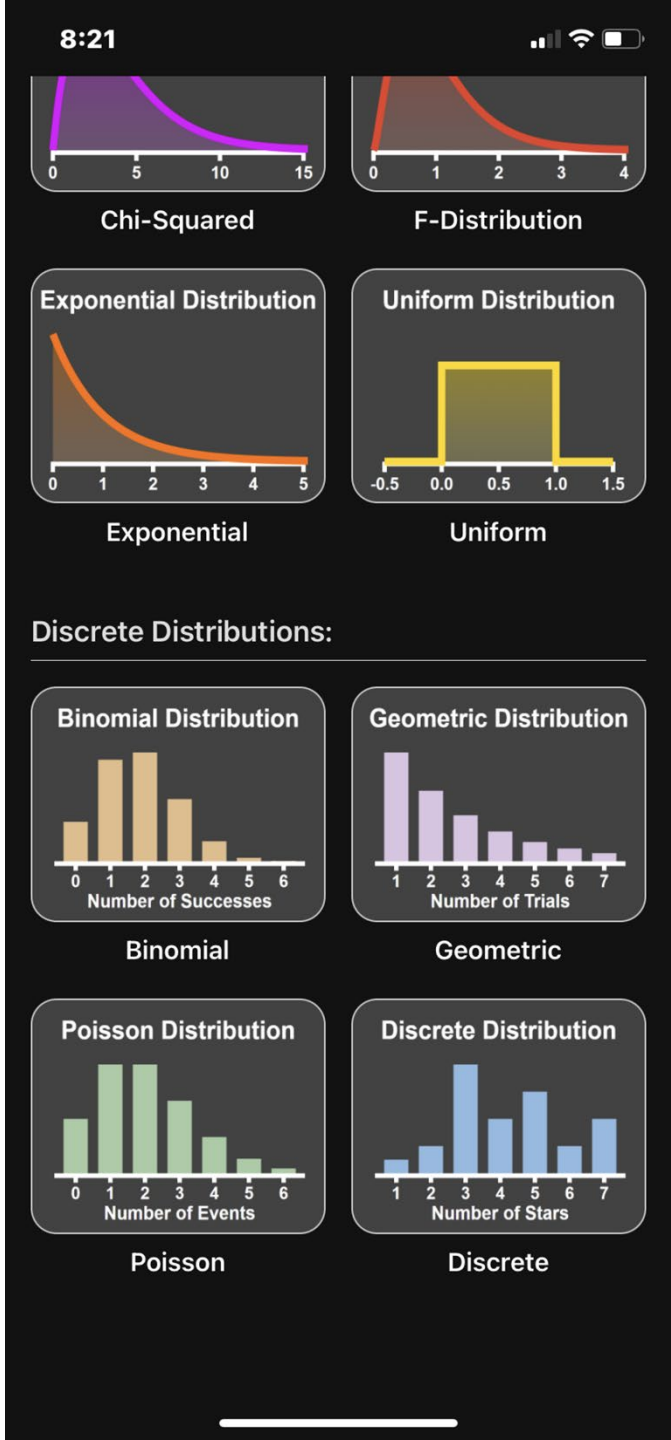
This is a video demoing the Linear Regression app and multivariate thinking.

Click on it to start it!

Teaching with the Apps

- Students might get carried away a bit:

This is a video. Click on it to start it!

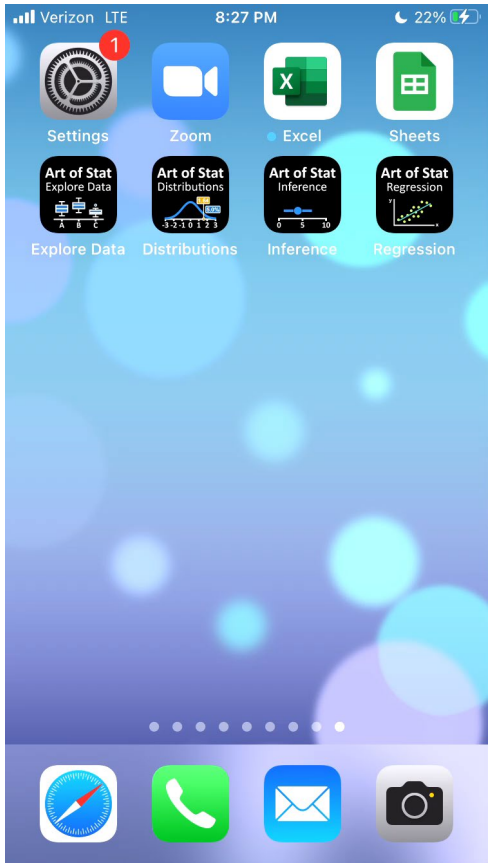


James Zinn ‘22

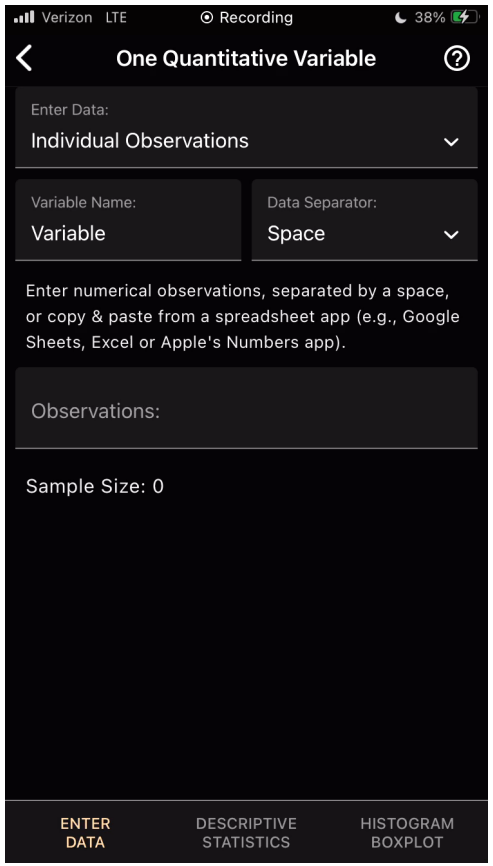
Teaching with the Apps

These are short videos to show how to upload data into the app. Click each on to play.

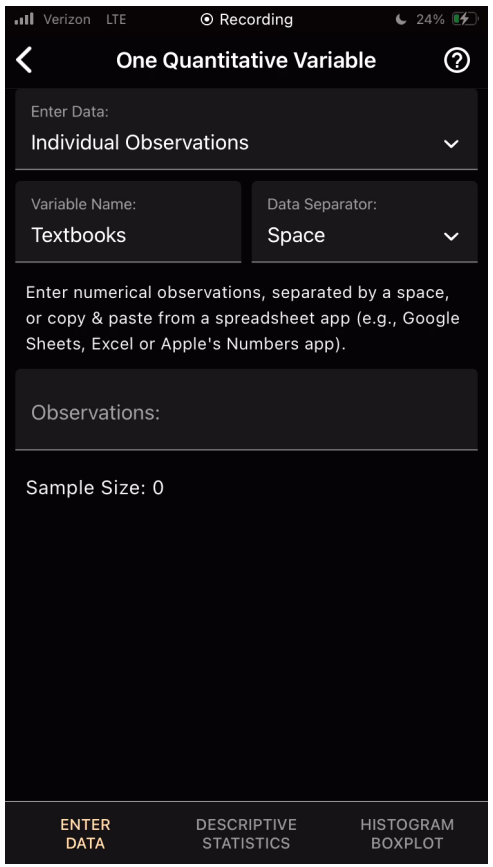
- Data Entry



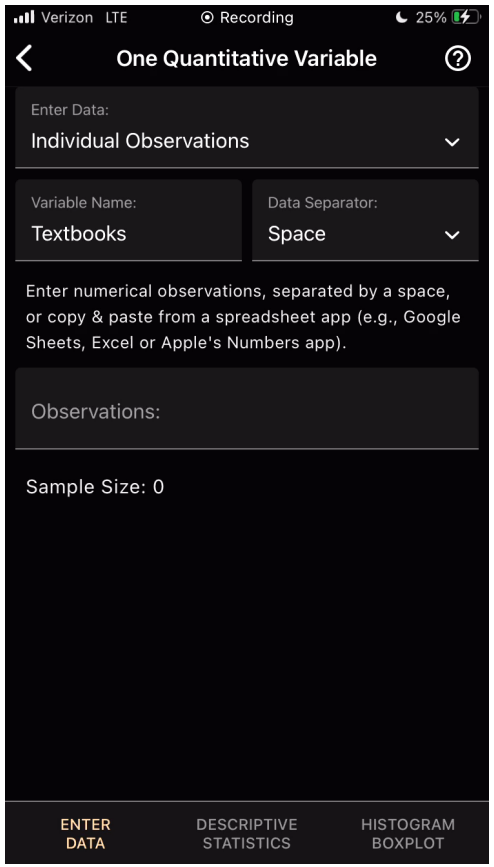
Type in data



Copy & Paste



Upload CSV File

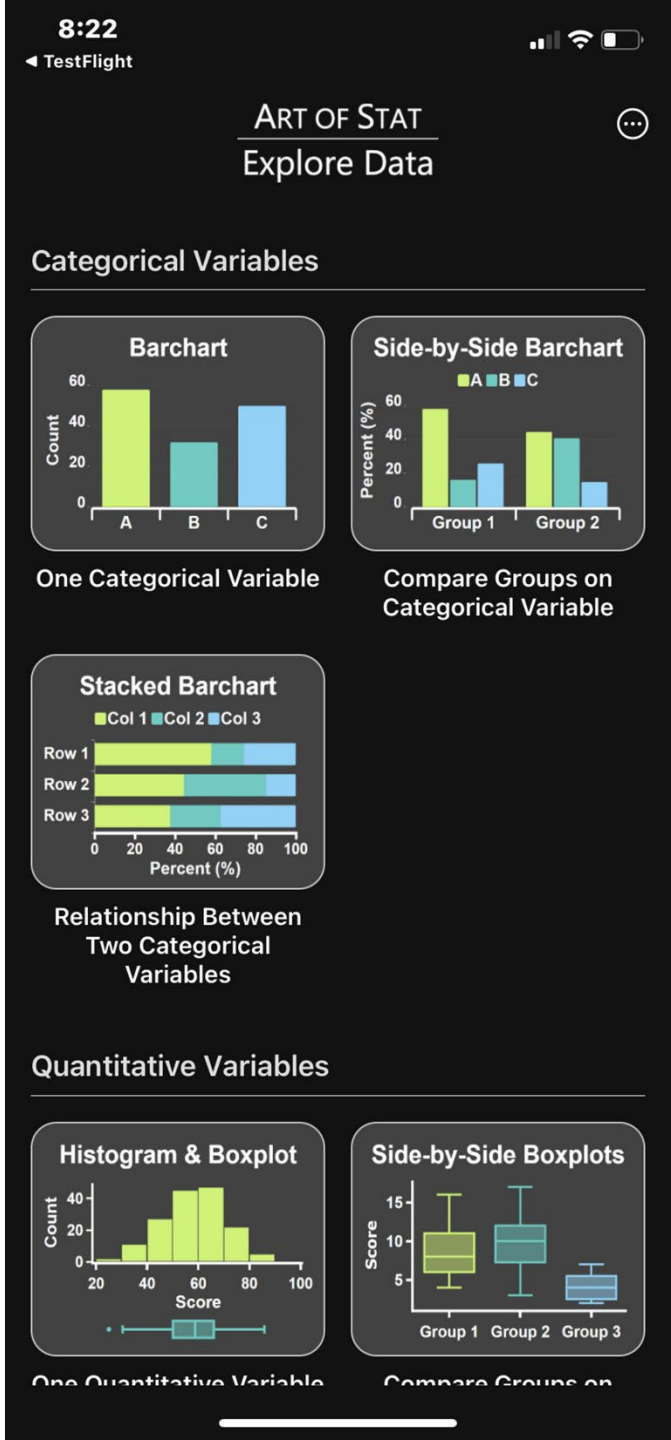


Sample Dataset

Explore Data

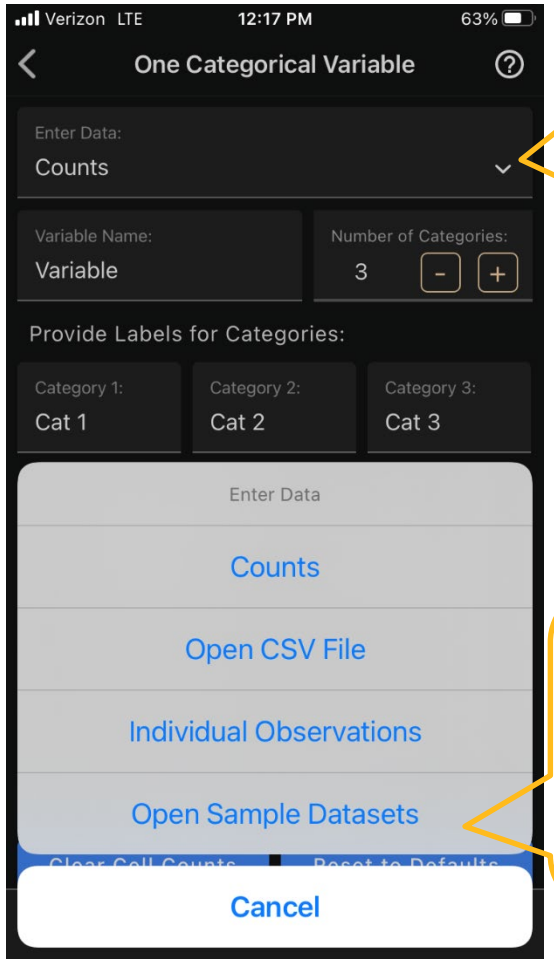
- Pre-implemented Dataset: Online Lending
  - Data on 200 randomly sampled loans made through a website

Loan	Loan Amount	Duration	Interest Rate	Grade	Home	Income	FICO Score
1	35000	36	13.6	C	rent	160000	710
2	12000	60	16.1	C	mortgage	65000	675
3	15000	36	11.8	B	rent	34000	690
4	3025	36	15.1	C	mortgage	150000	740
5	9000	36	14.5	C	own	70000	705
6	20000	36	6.5	A	mortgage	100000	785
7	12500	60	7.8	A	rent	41600	700
8	5000	36	18.9	D	mortgage	44000	685
9	21000	60	16	C	mortgage	80000	685
10	35000	36	14.5	C	mortgage	90000	745



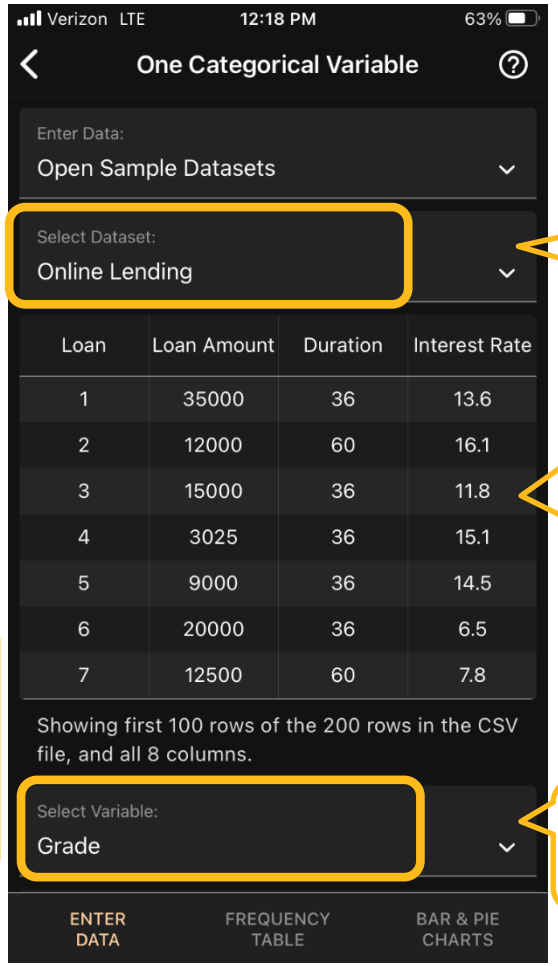
Explore Data

- Analyze the variable “Grade of the Loan”



Press the dropdown for “Enter Data”

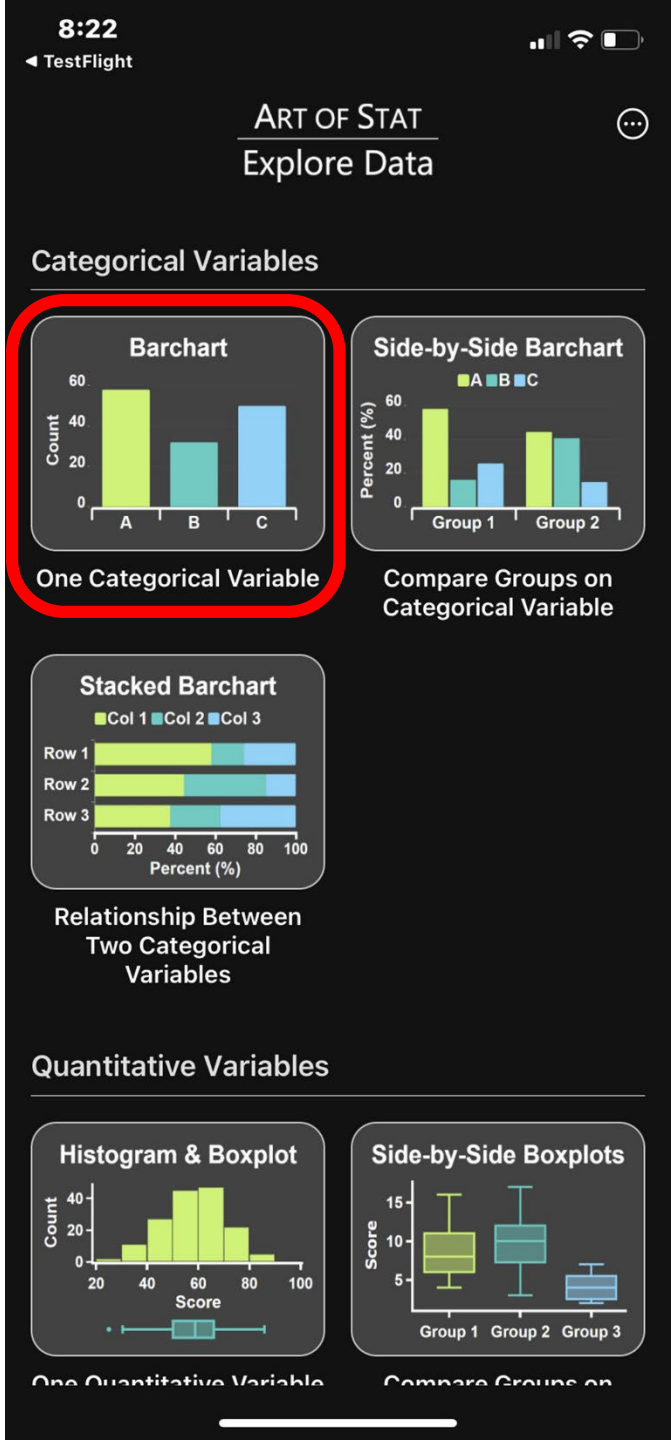
Select Open Sample Datasets, then Online Lending



Selected “Online Lending”

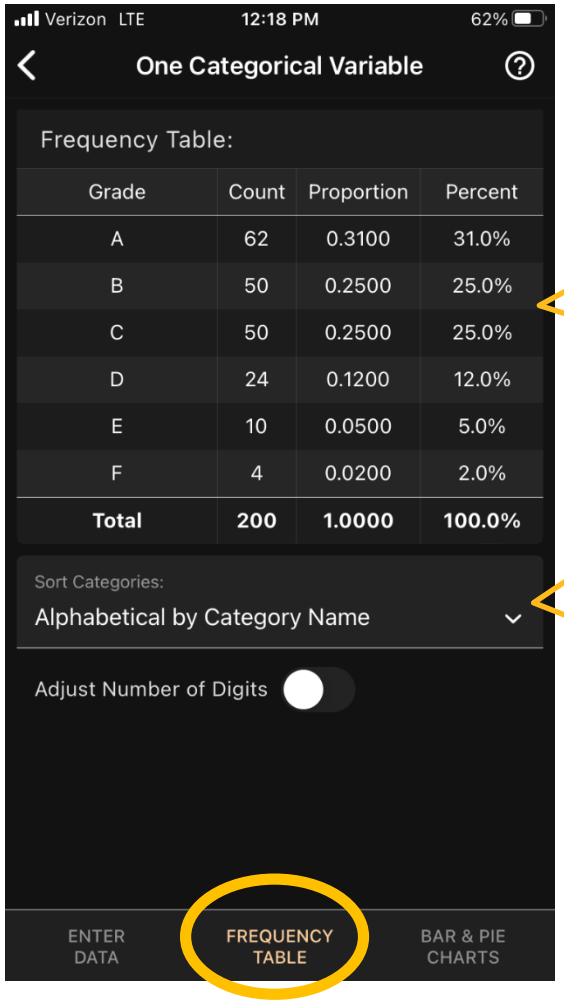
Online Lending Dataset is displayed

Select “Grade” as the Variable



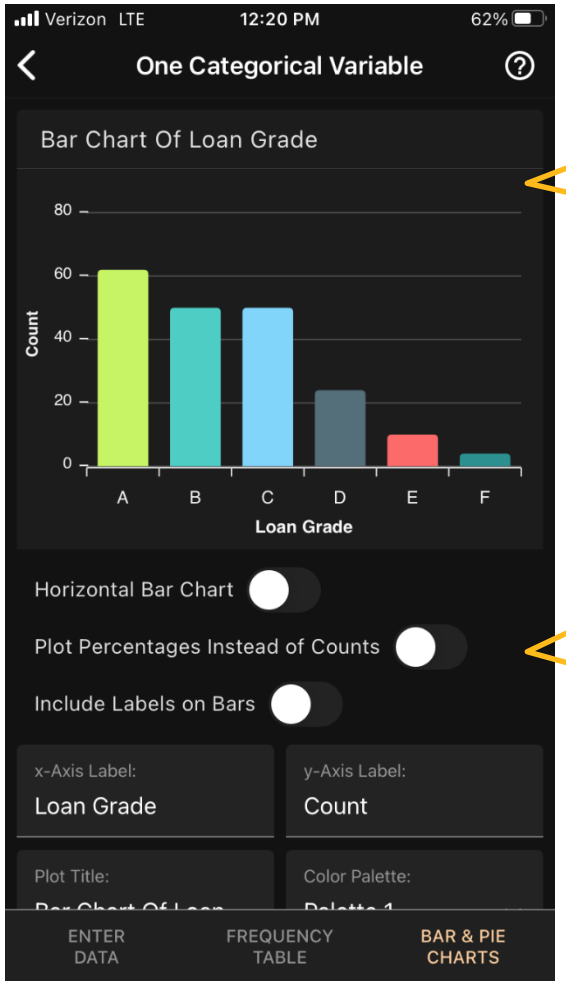
Explore Data

- Analyze the variable “Grade of the Loan”



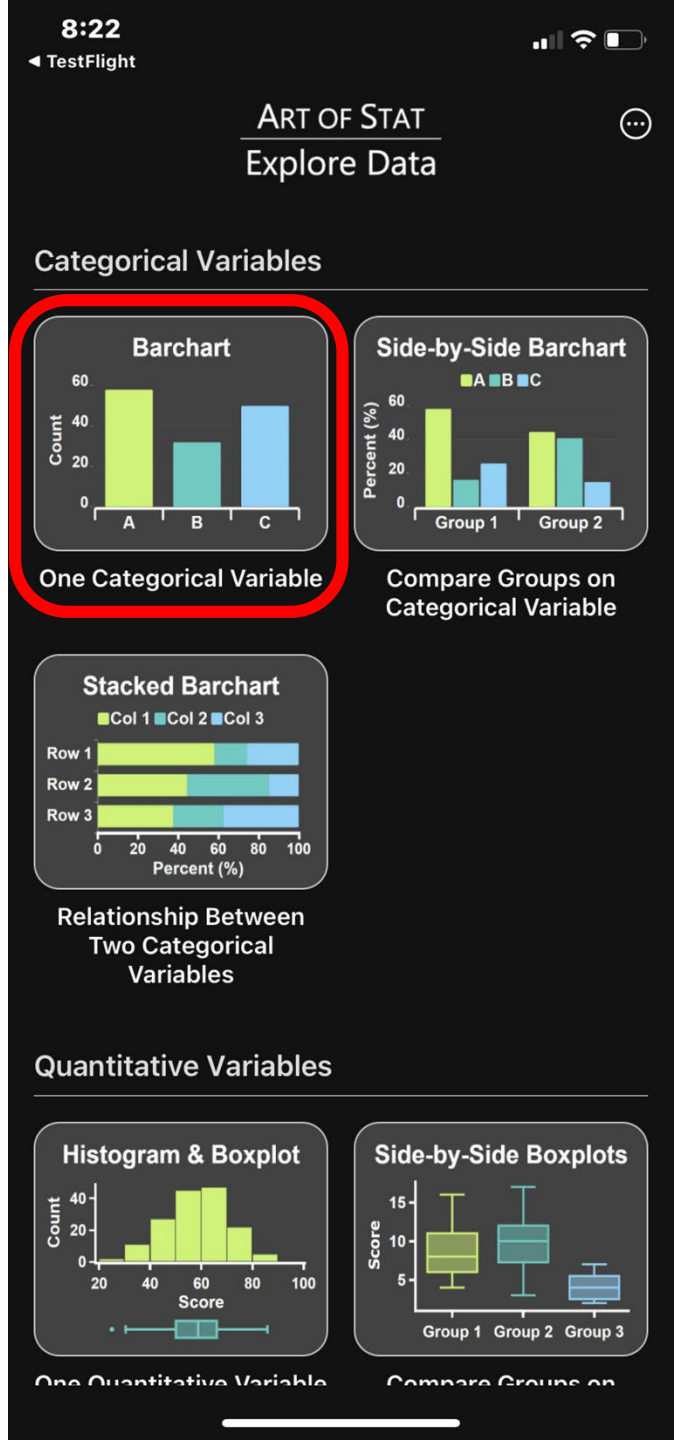
Frequency Table

Sort Grade Labels Alpha-betically



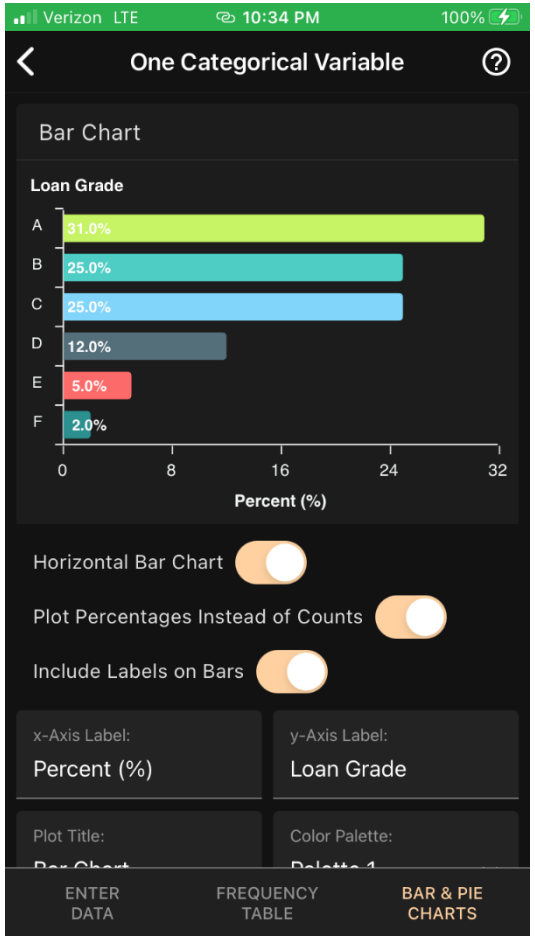
Bar Chart

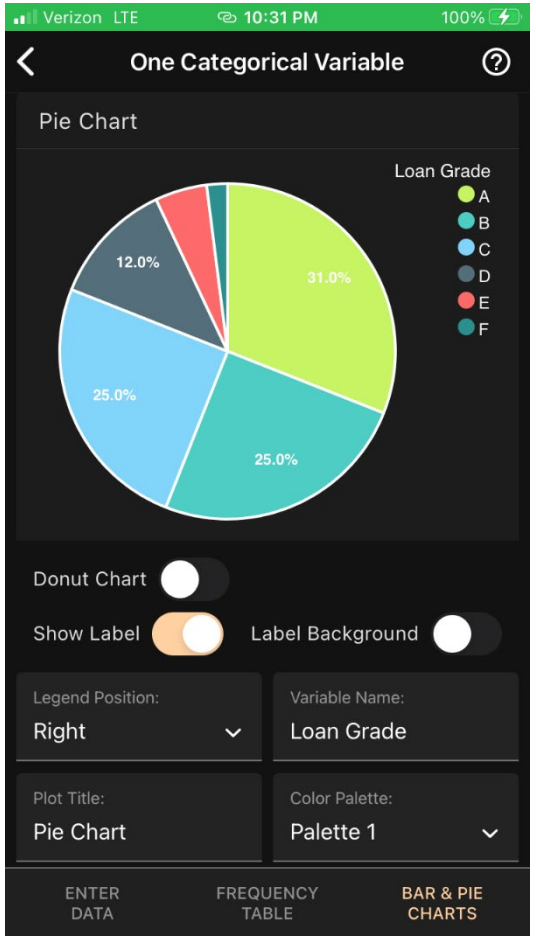
Various Options

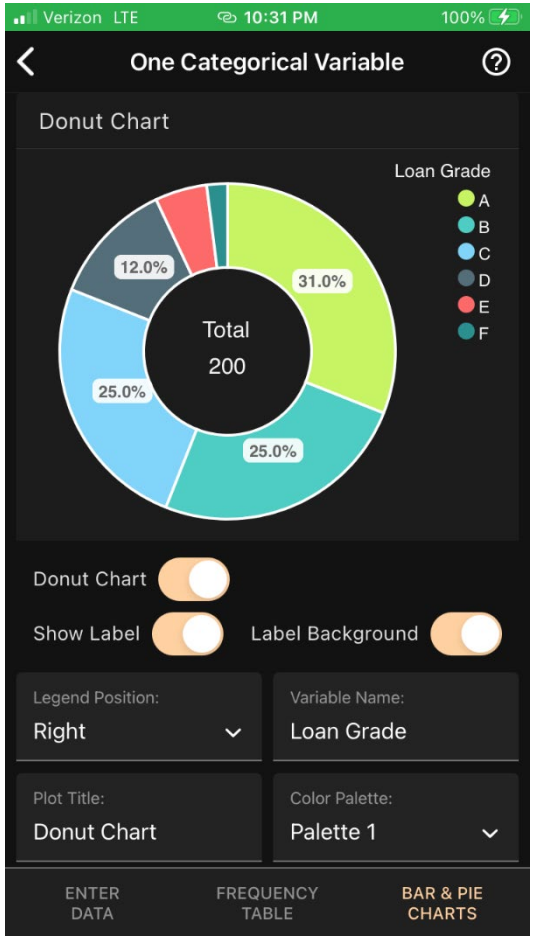


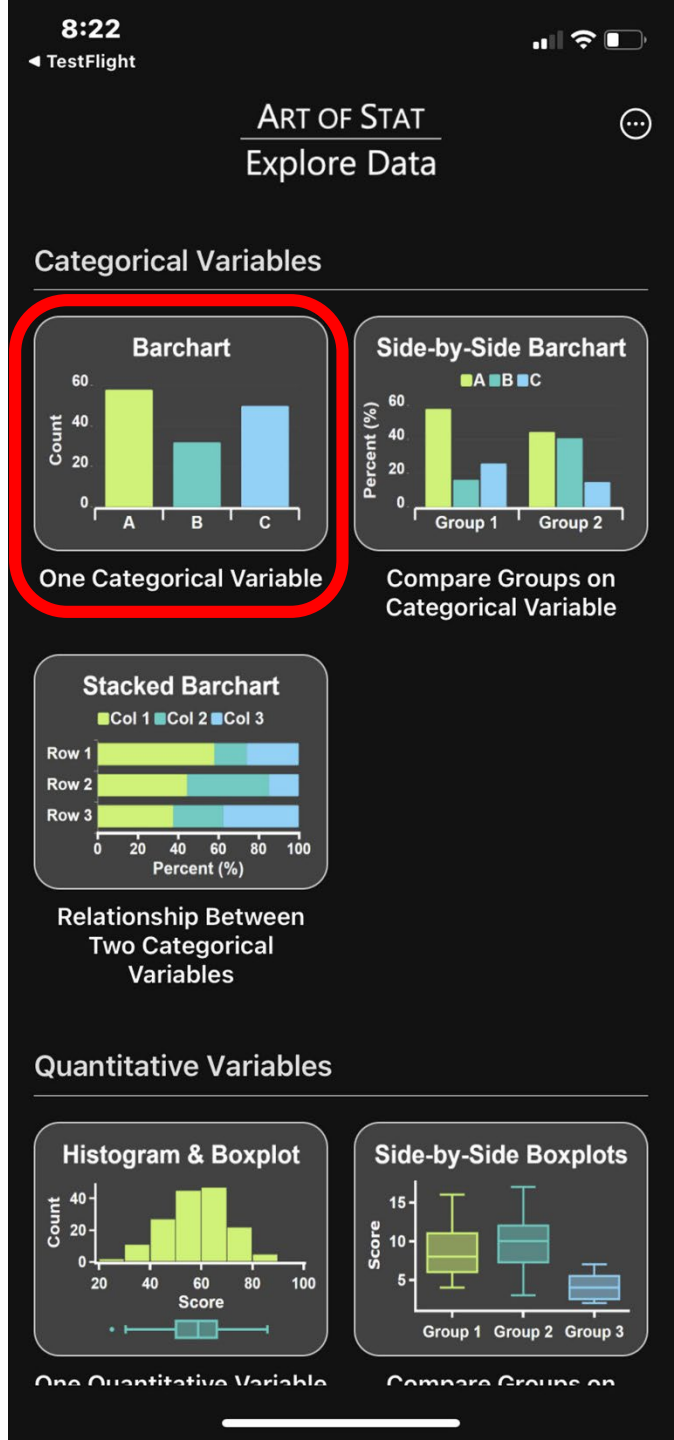
Explore Data

- Other Options:





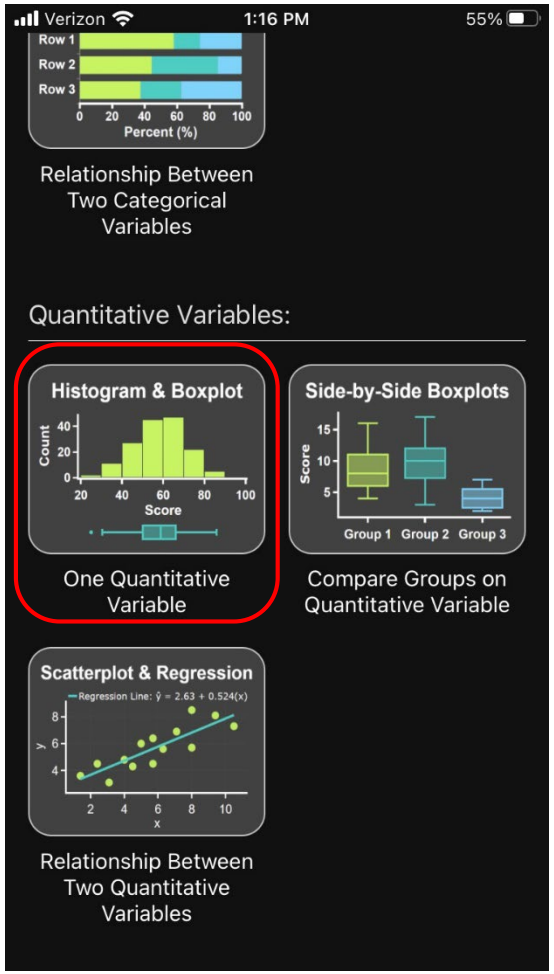


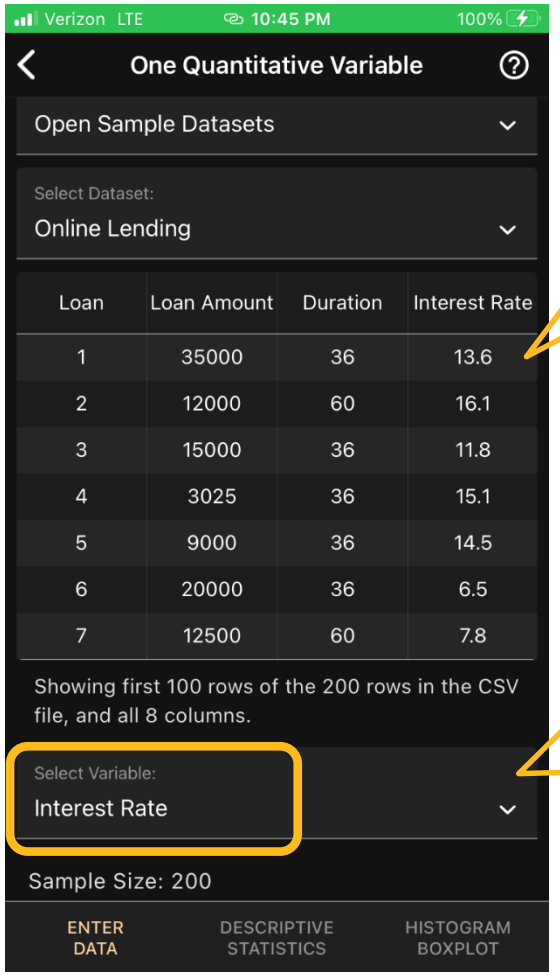


Explore Data

- Now, analyze the variable “Interest Rate”

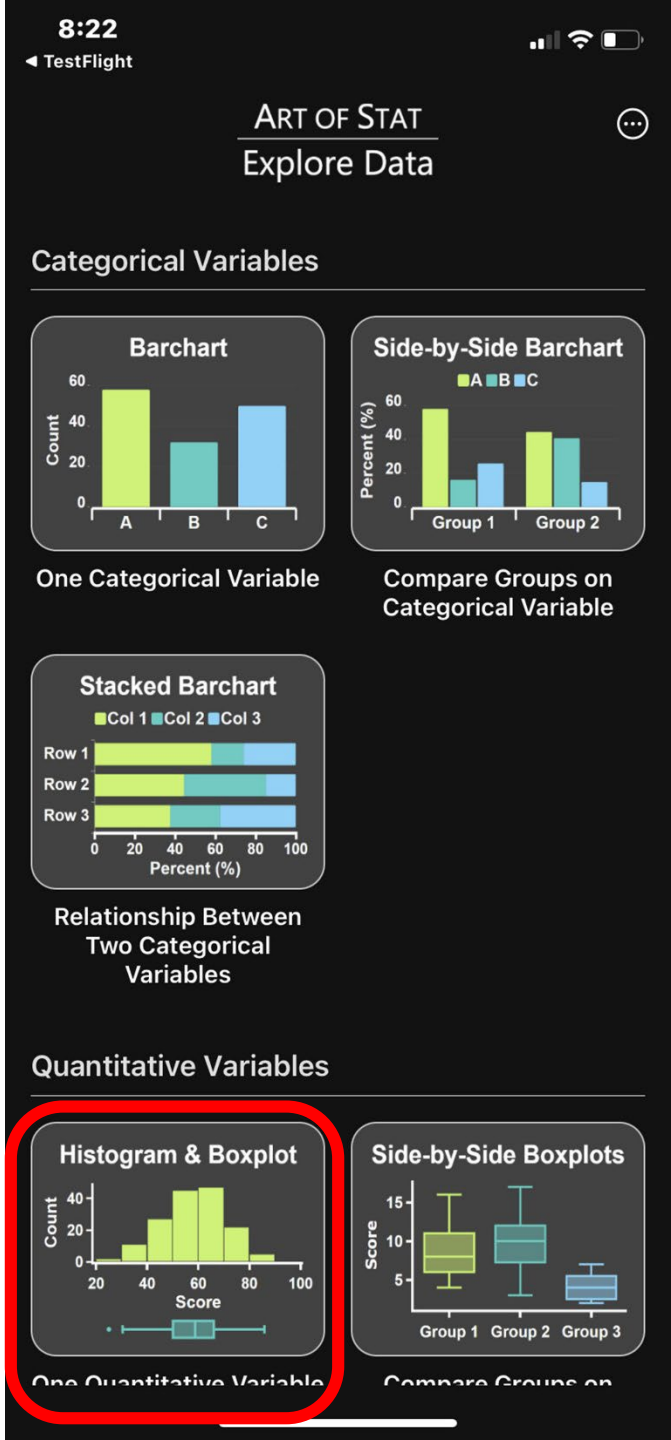
Interest Rate
13.6
16.1
11.8
15.1
14.5
6.5
7.8
18.9
16
14.5





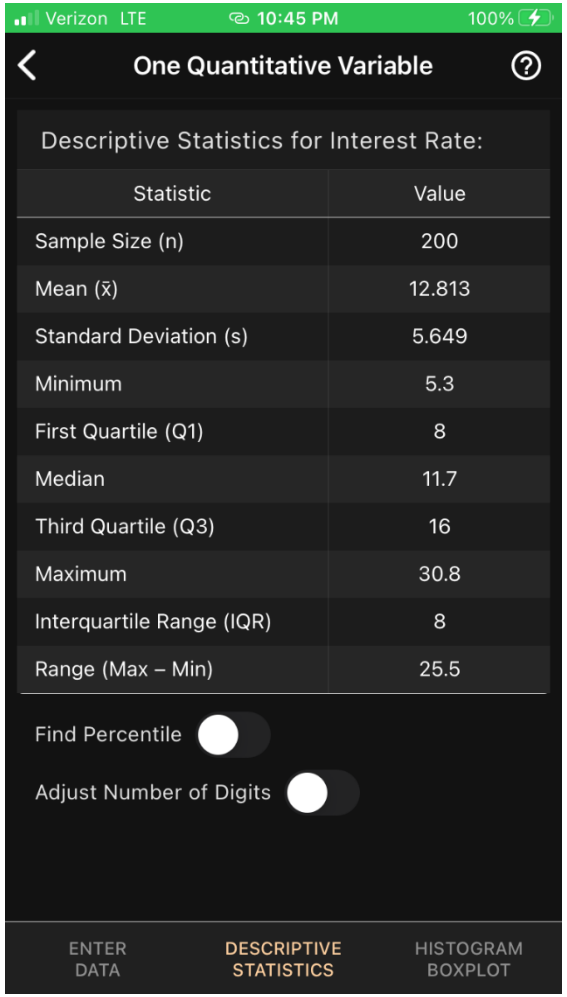
Interest Rate data

Select Interest Rate

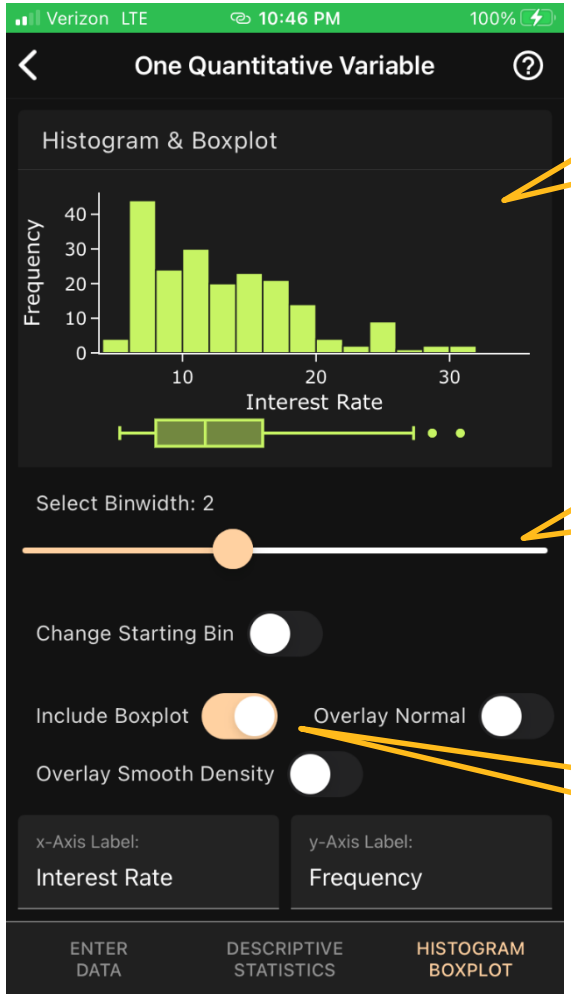


Explore Data

- Quantitative Variable Analysis:



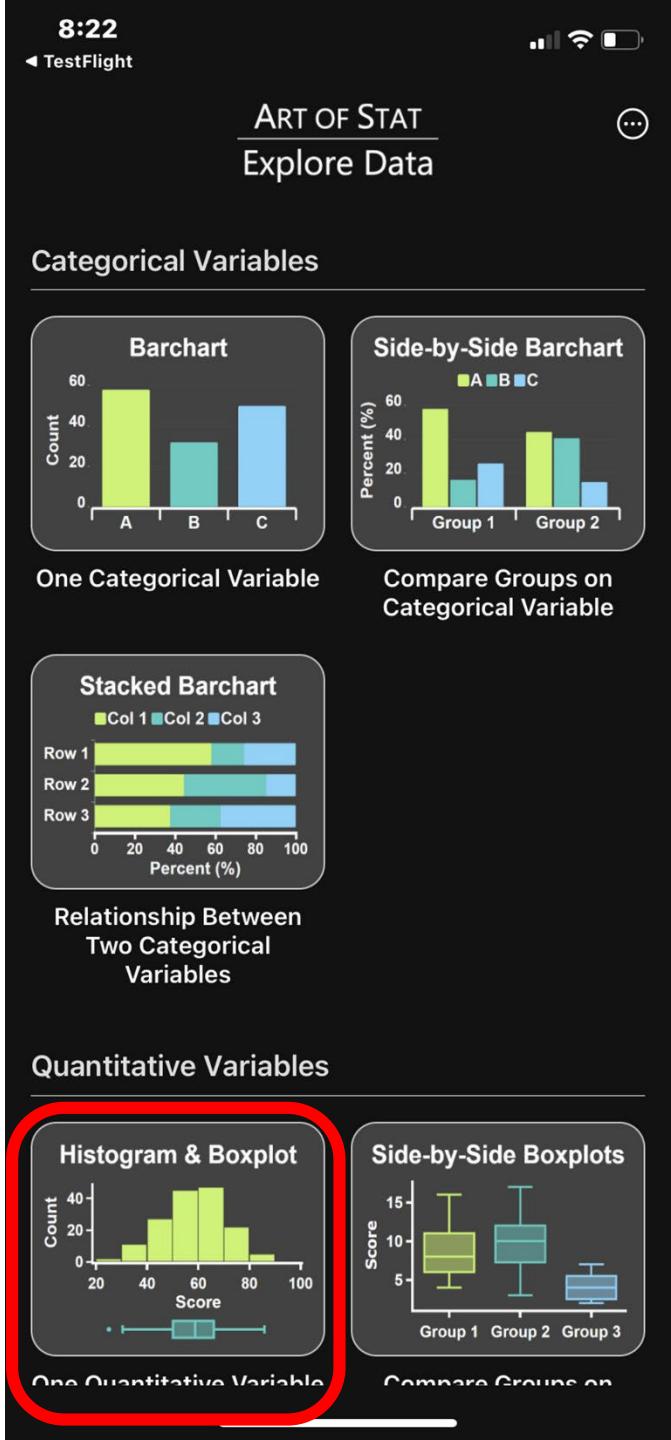
Descriptive Statistics



Histogram of Interest Rate

Vary bin size interactively with slider

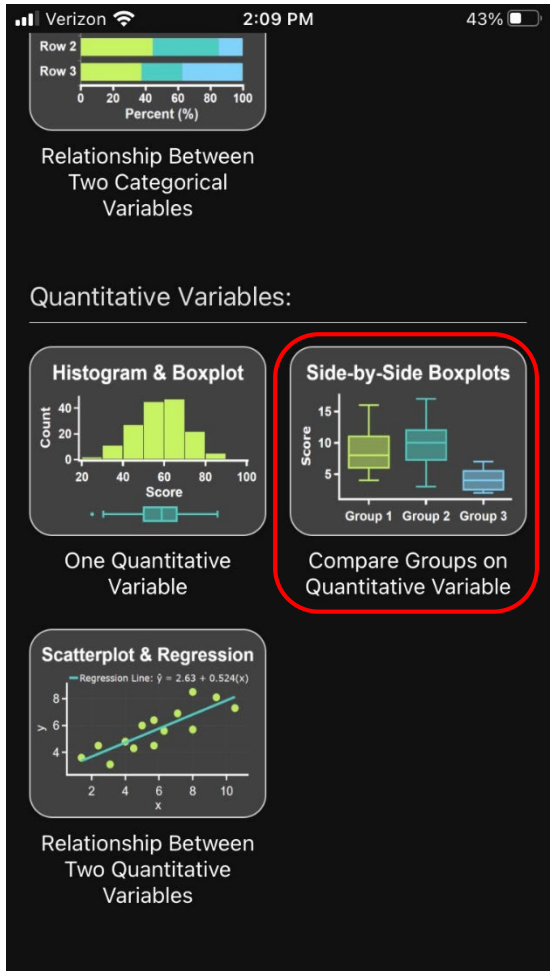
Include Boxplot

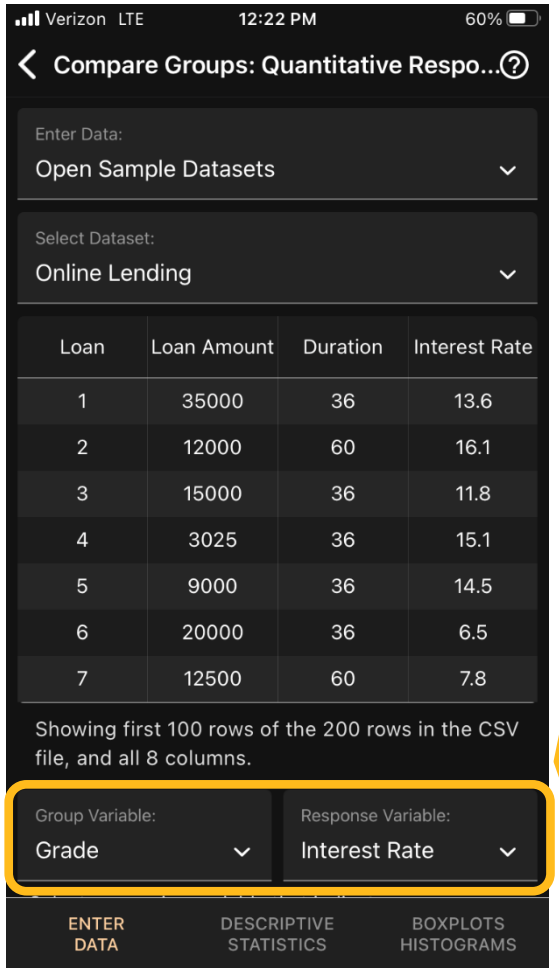


Explore Data

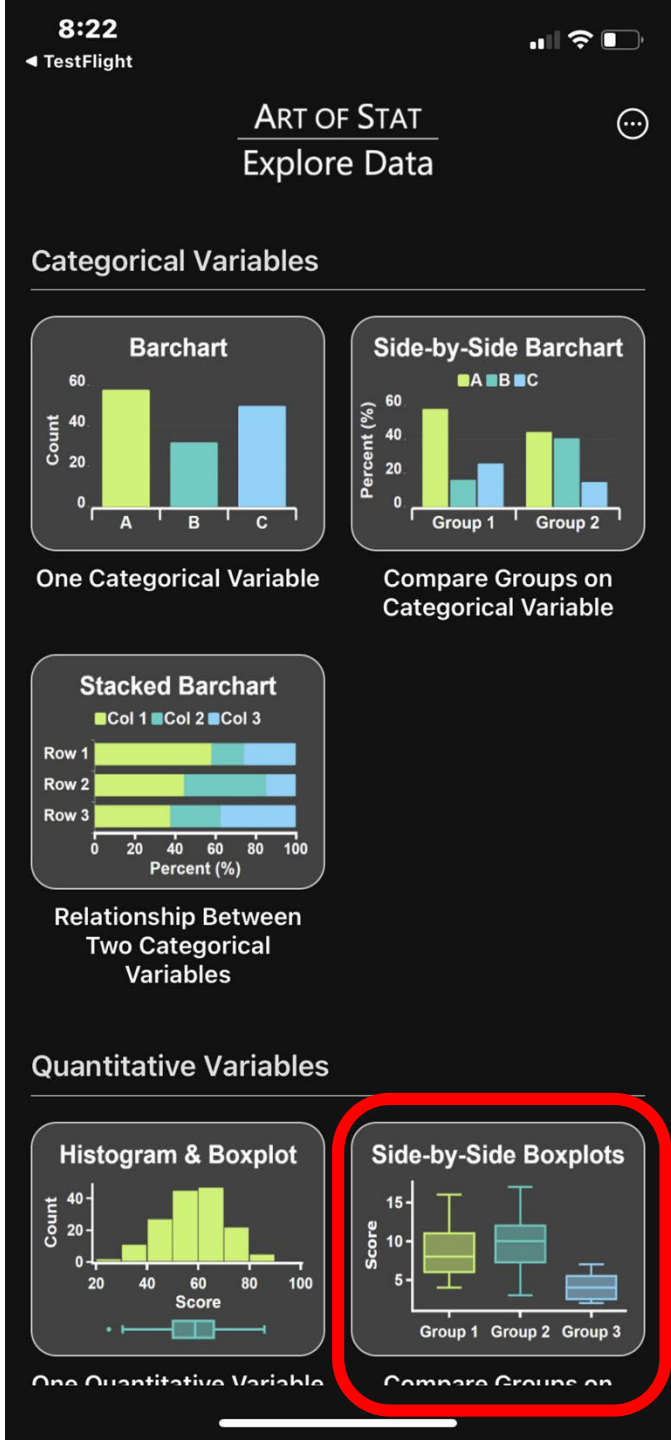
- Finally: Compare Groups on Quantitative Variable

Interest Rate	Grade
13.6	C
16.1	C
11.8	B
15.1	C
14.5	C
6.5	A
7.8	A
18.9	D
16	C
14.5	C



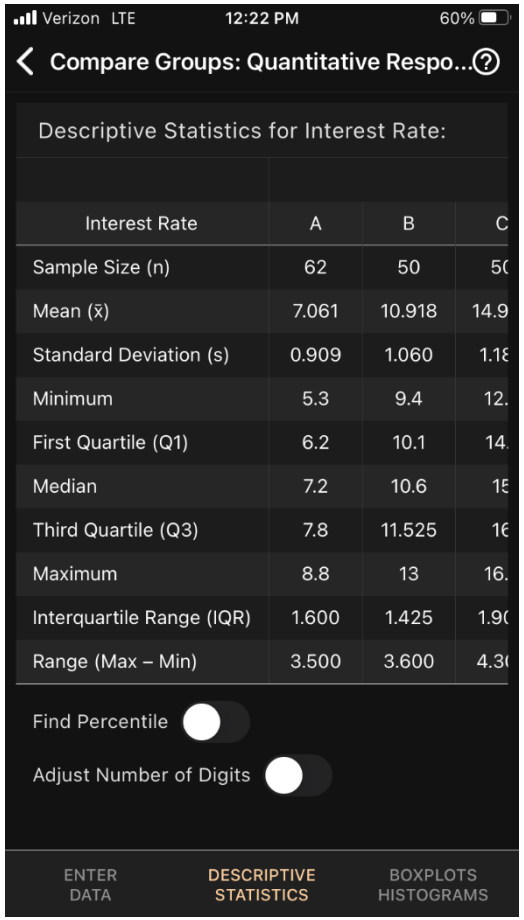


Select Grade as the Grouping Variable, and Interest Rate as the Response Variable

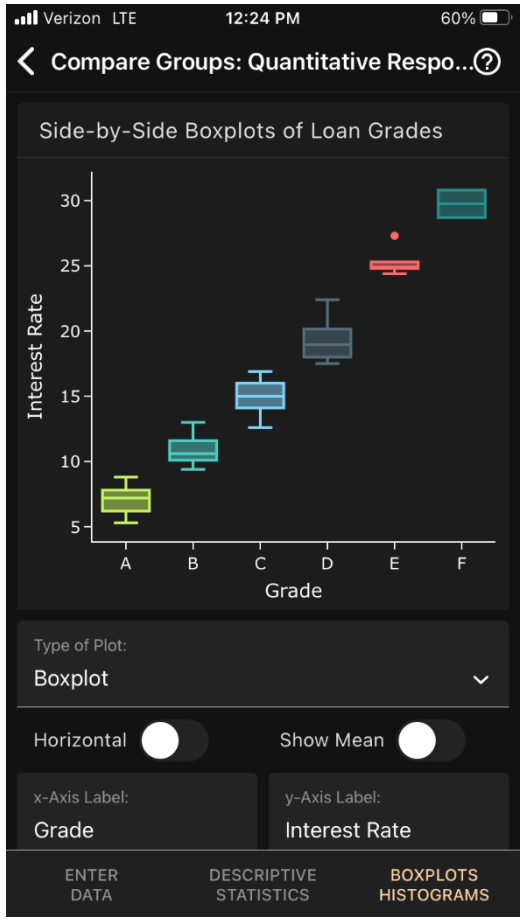


Explore Data

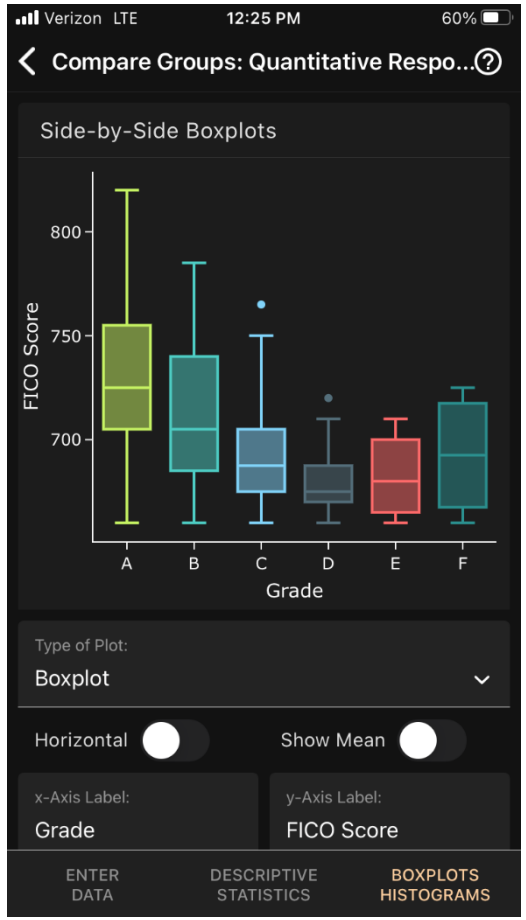
- Finally: Compare Groups on Quantitative Variable



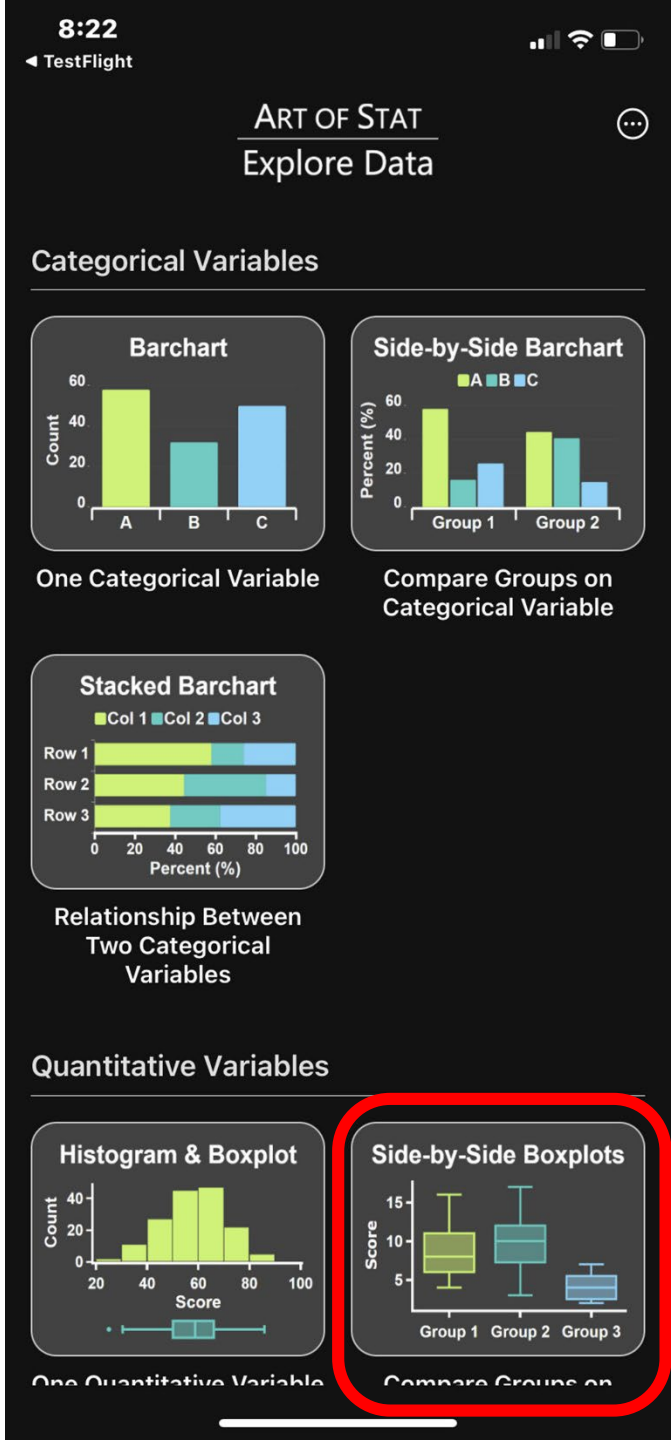
Descriptive Statistics



Side-By-Side Boxplots

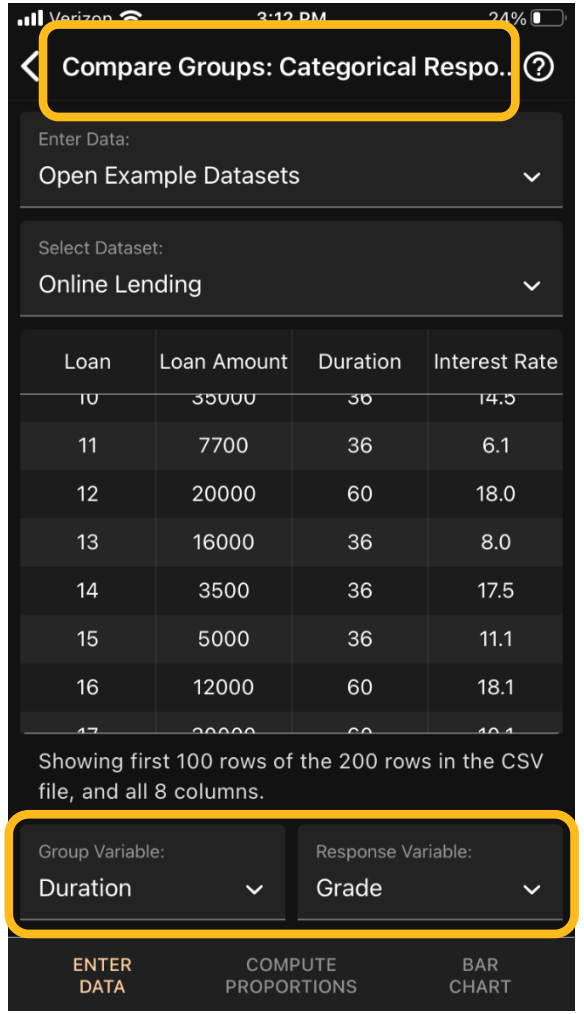


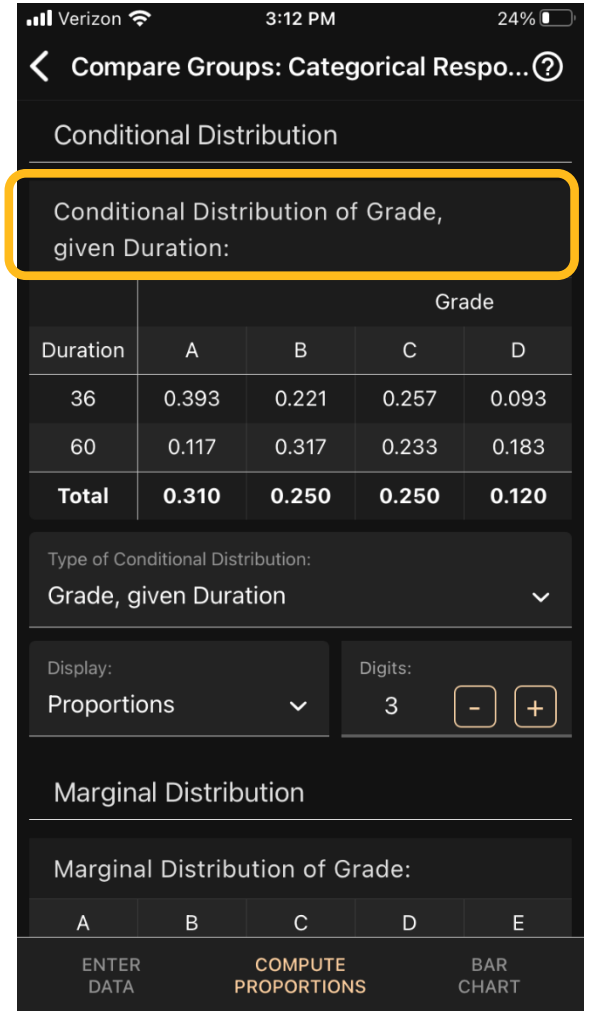
With FICO Score

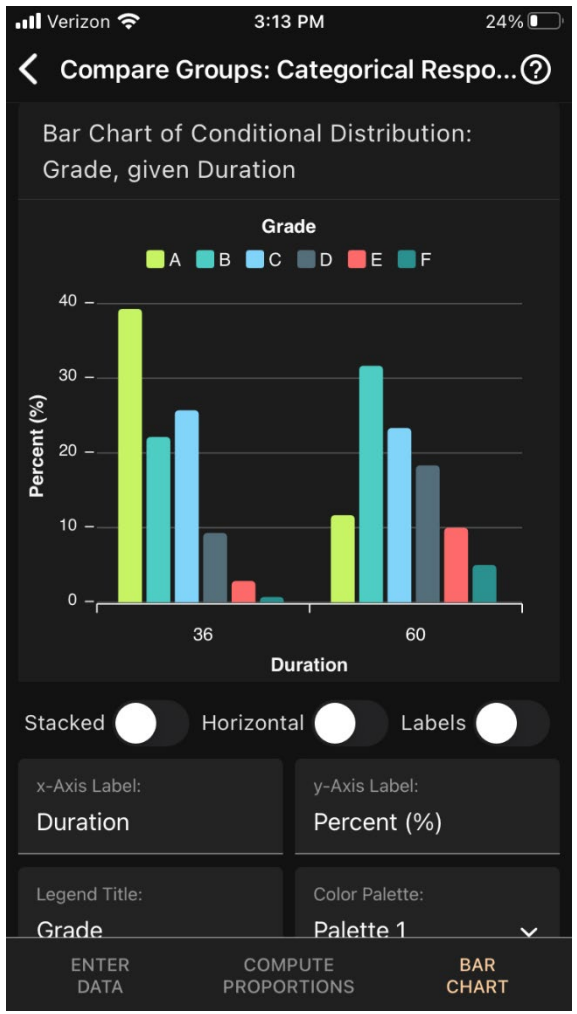


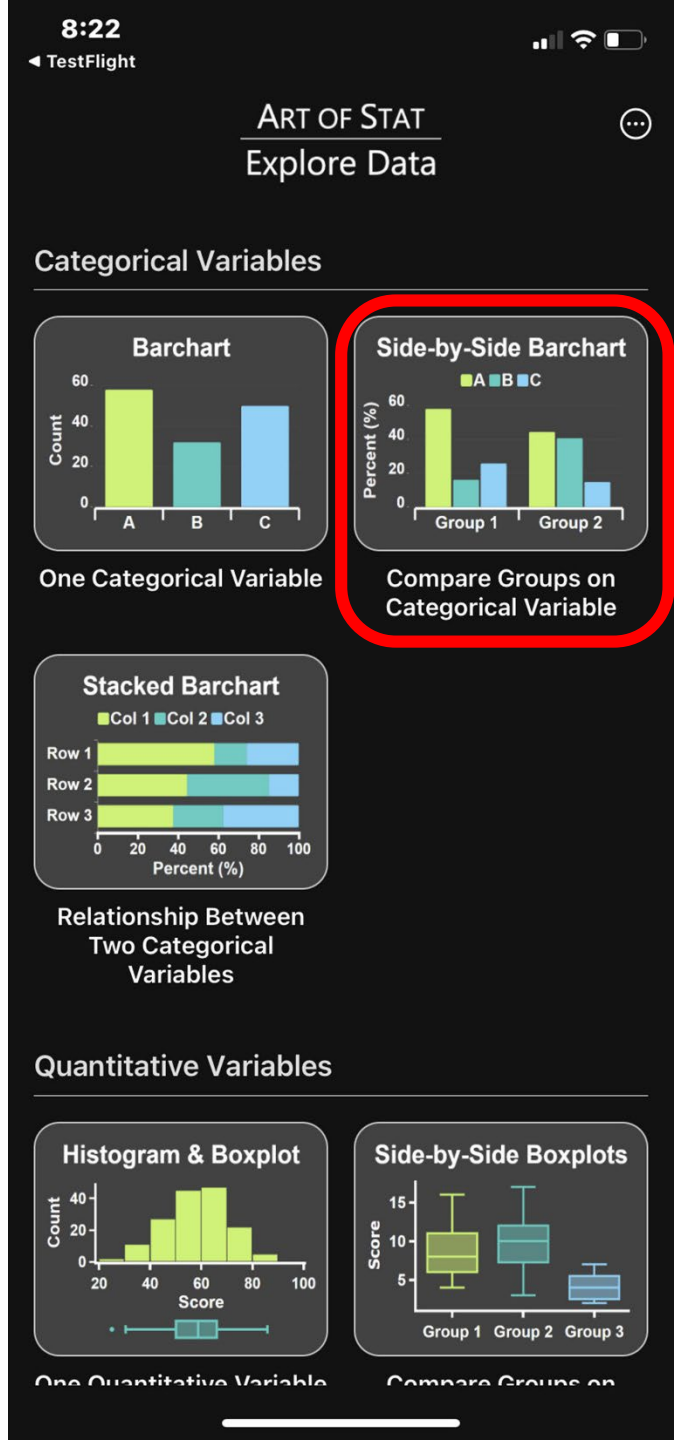
Explore Data & Inference

- Apps handle Contingency Tables





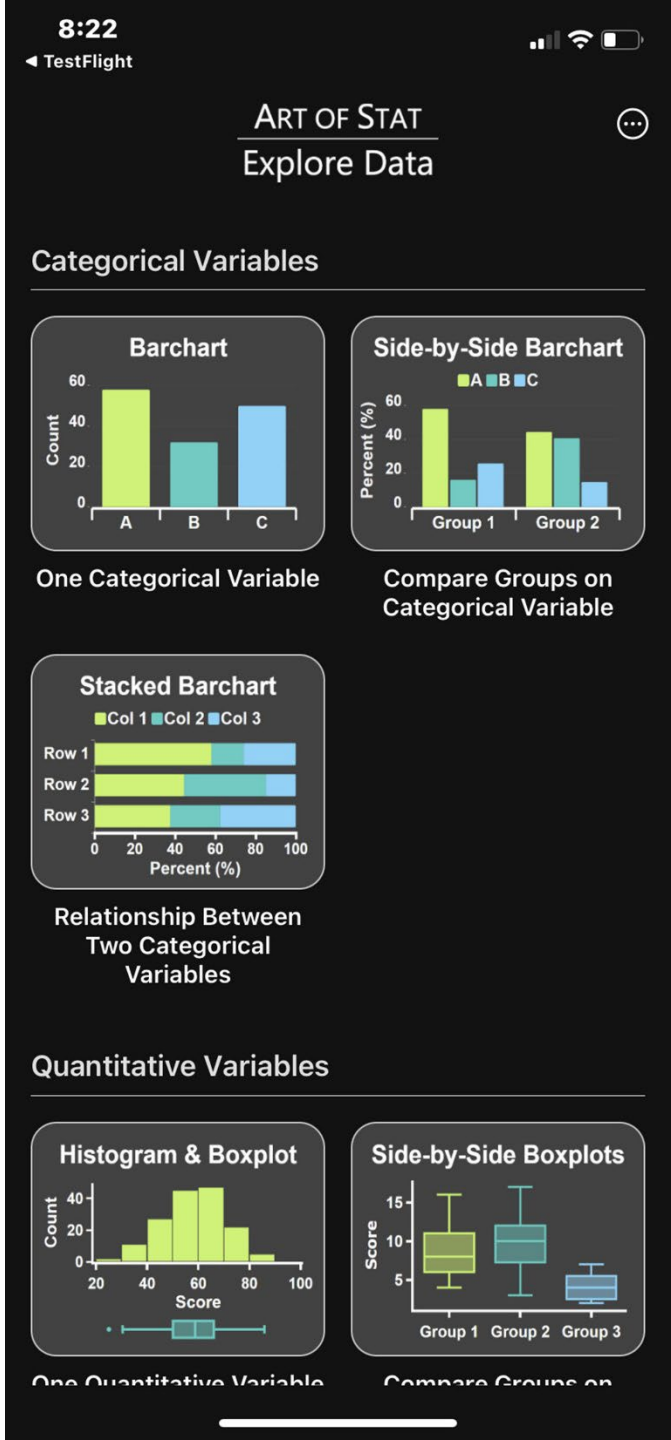




Your turn!

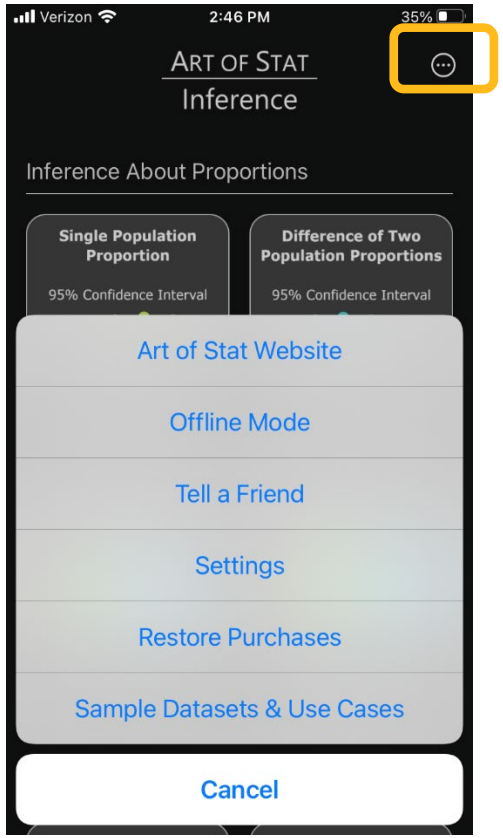
- A couple of prompts:
  - The online lending website records home ownership of loan applicants. Explore the distribution of **Home Ownership**.
  - You can either get a 36 months or a 60 months loan. Which one is more popular? Explore the distribution of **Loan Duration**.
  - Investigate the relationship btw. **Loan Duration** and **Grade**. Do 60 months loans tend to have lower grades? *
  - The online lending website records the FICO score of loan applicants. Explore the distribution of **FICO scores**.*
  - How do **FICO scores** compare across **Home Ownership**? *

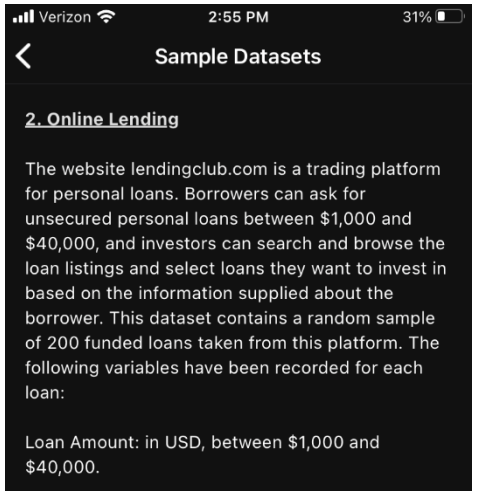
* Requires unlocking



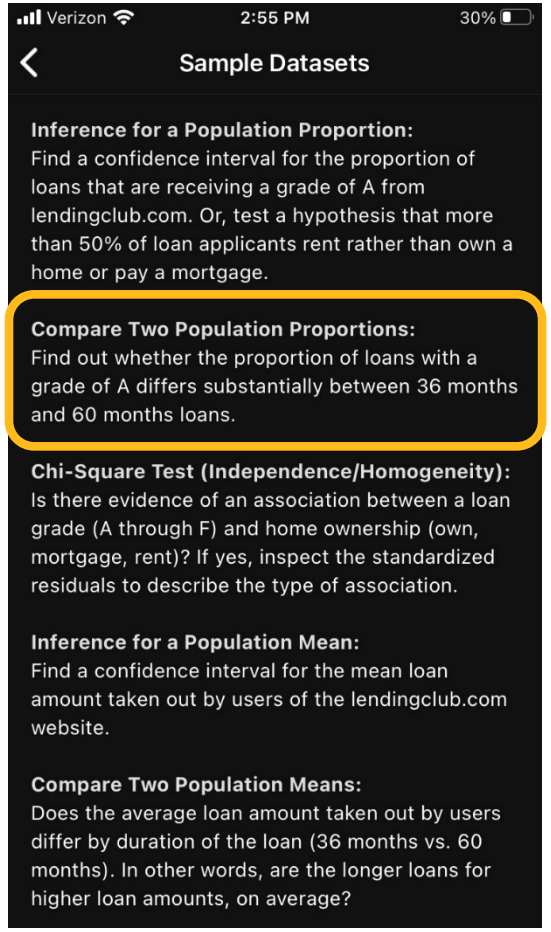
Your turn!

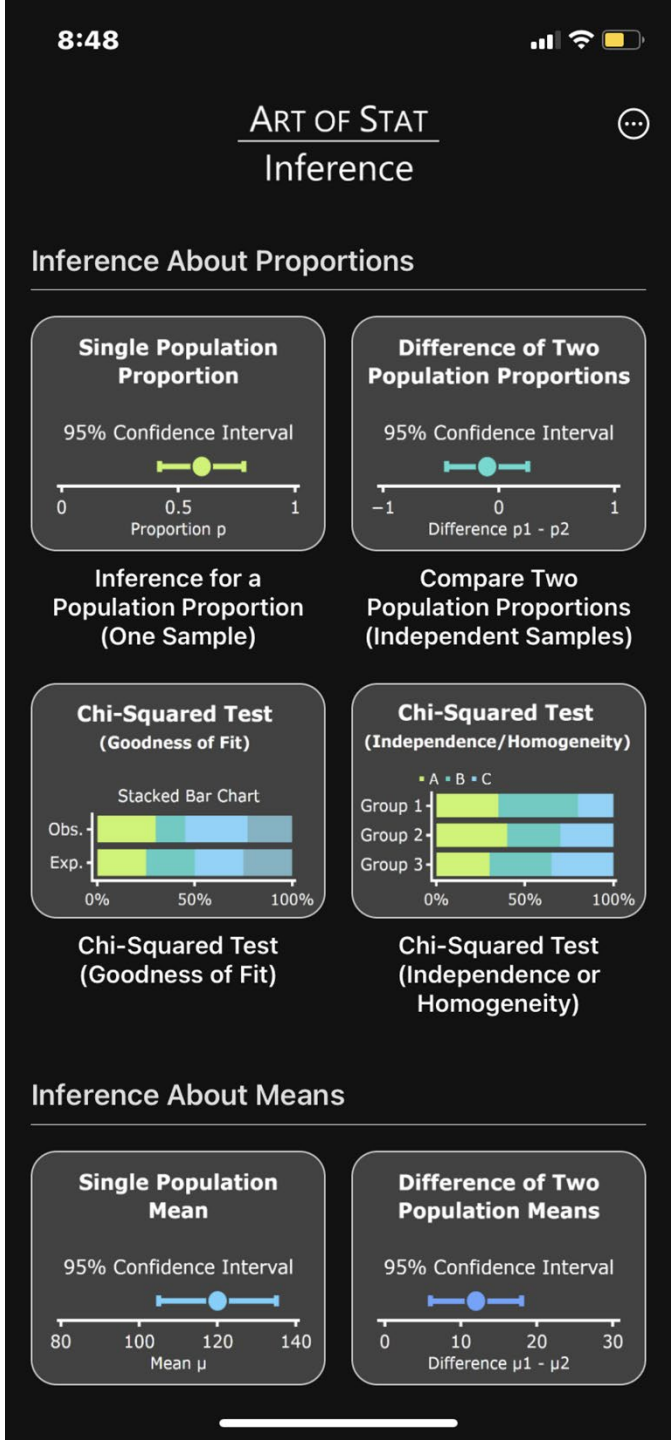
- The Online Lending dataset is also available as a Sample Dataset in the Inference app.





Access its descriptions and prompts for inference by going to *Sample Datasets & Use Cases.* (Press the three dots in the top right on the landing page.)





Concluding Remarks

Technology is crucial for how students and teachers interact with the material in a course:

- Concepts come to life when …

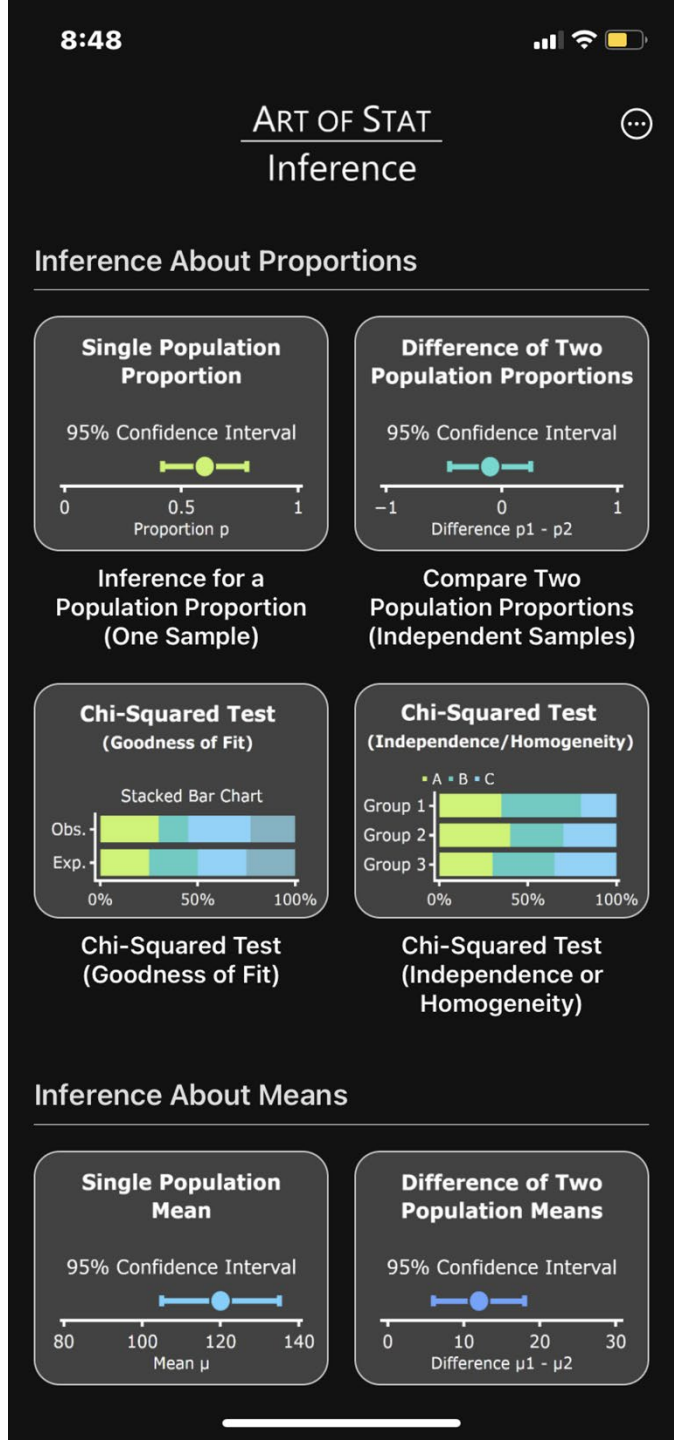
  … you can “see” and interact with them.

- Concepts and ideas become memorable when …

  … you can associate an activity with them.

- Concepts and procedures stay relevant when …

  … you can use them on your own data.



Concluding Remarks

The Art of Stat Mobile Apps provide

- A whole ecosystem of apps for (almost) the entire intro stats curriculum.
- Supports students in creating and sharing content, and telling the story.

Thank you and I'm happy to answer any questions!