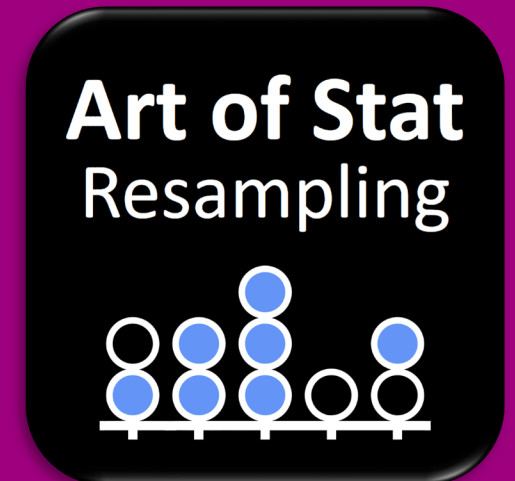
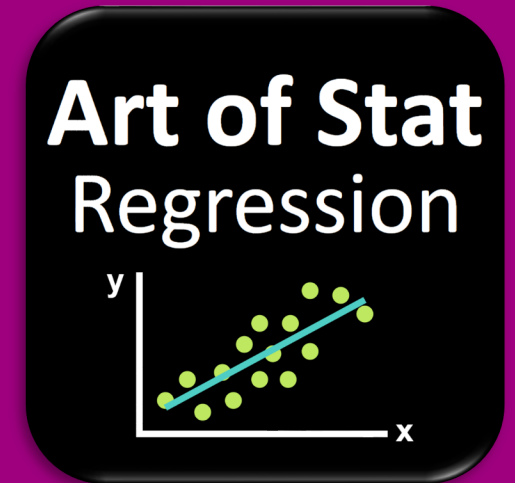
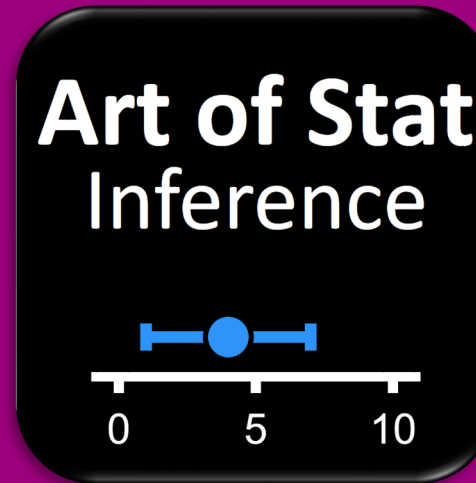
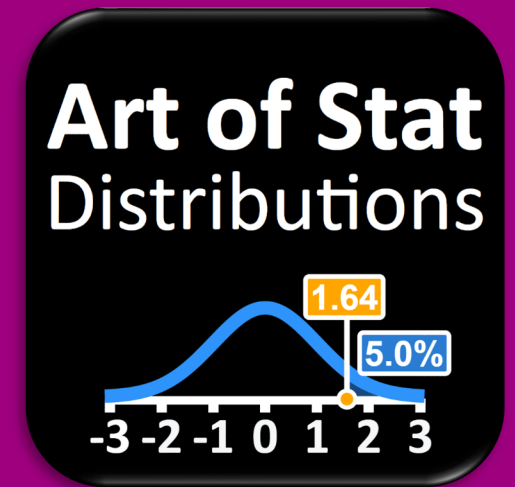
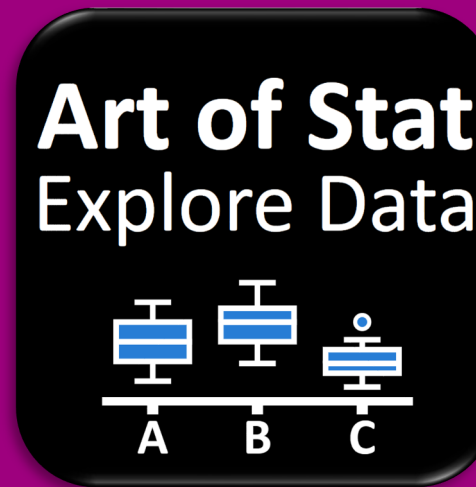
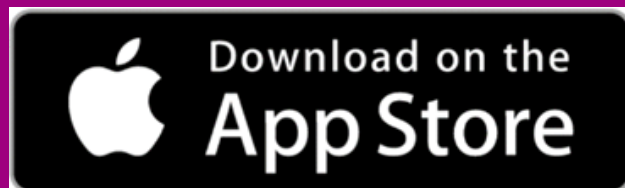
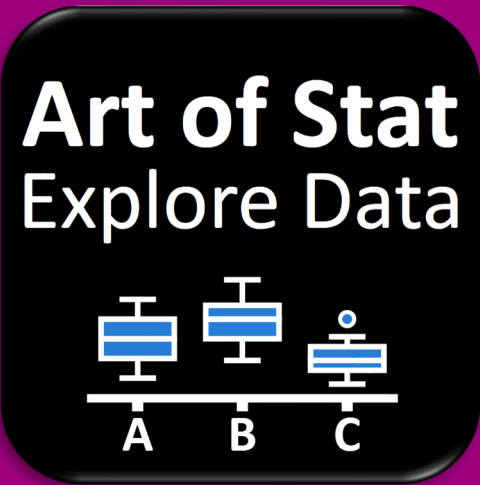


1) The Six Art of Stat Mobile Apps

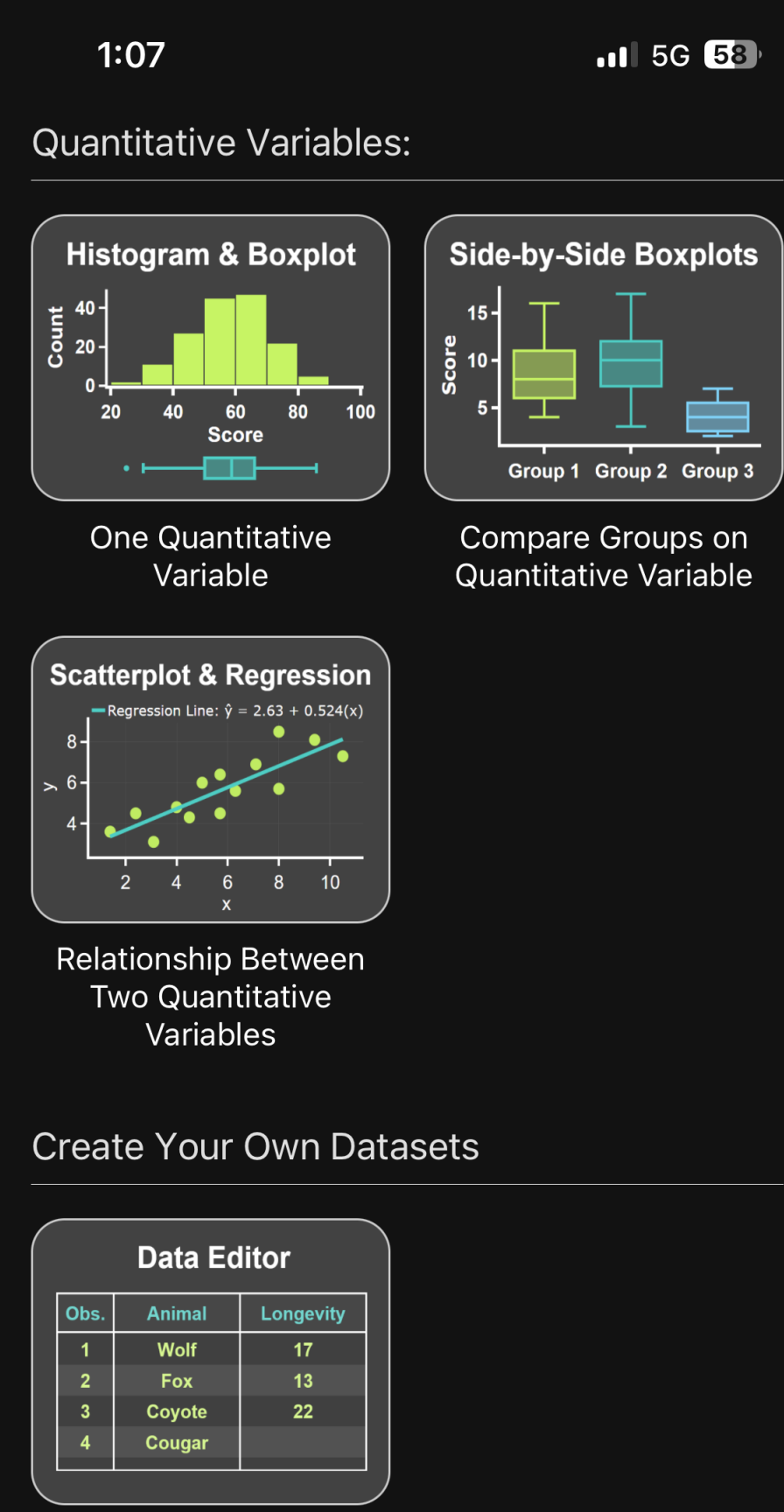
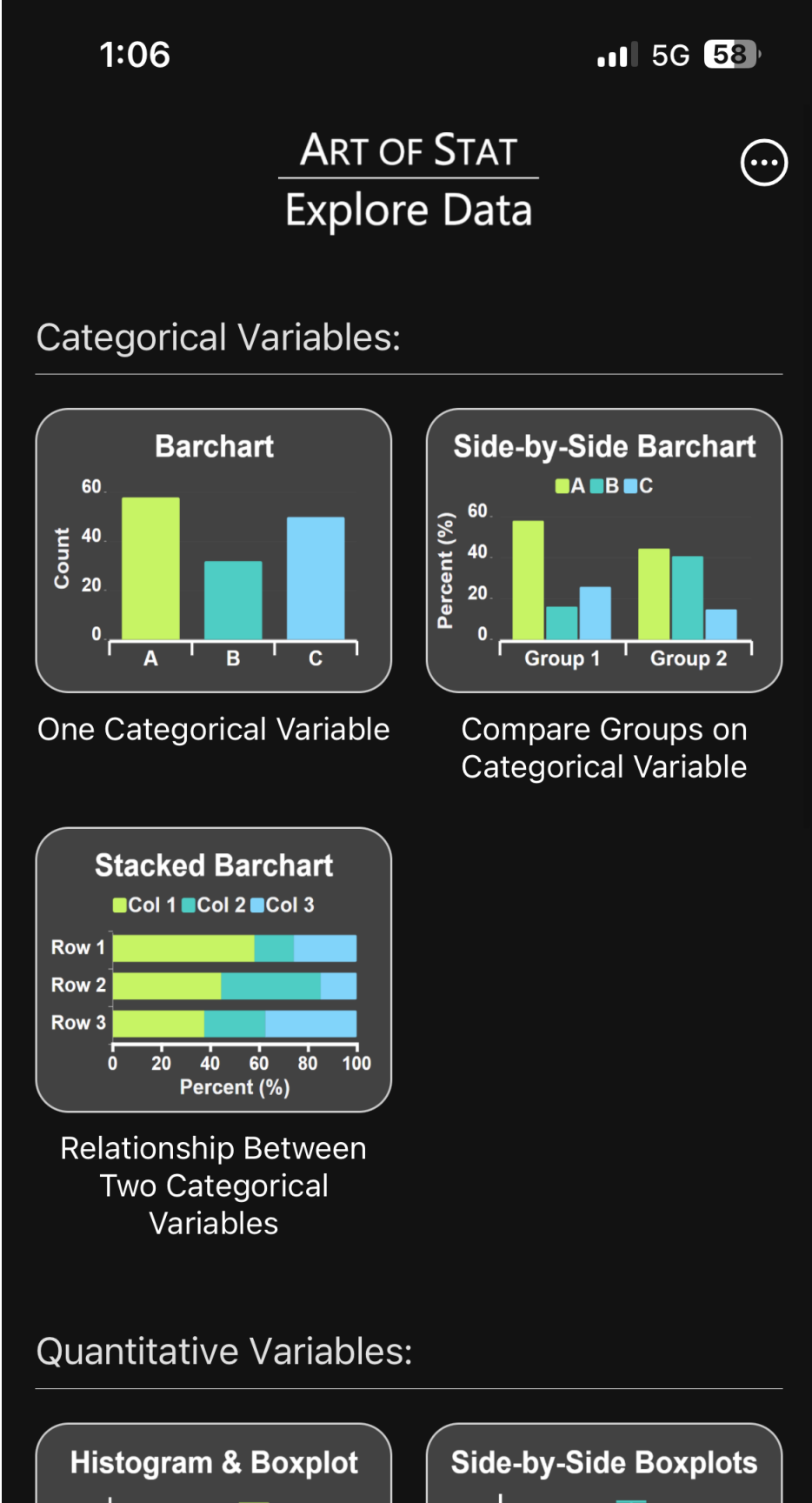
- Explore Data
- Inference
- Concepts
- Distributions
- Regression
- Resampling



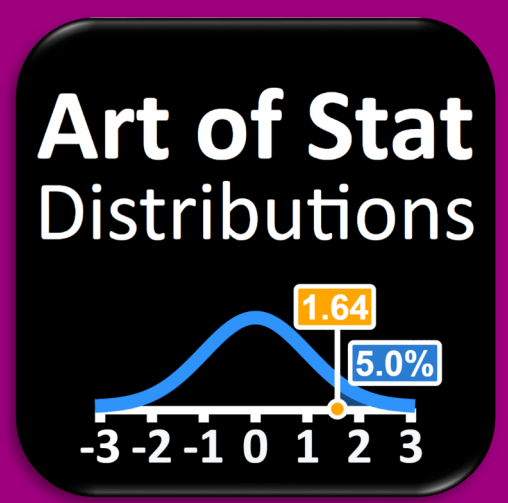
Art of Stat: Explore Data



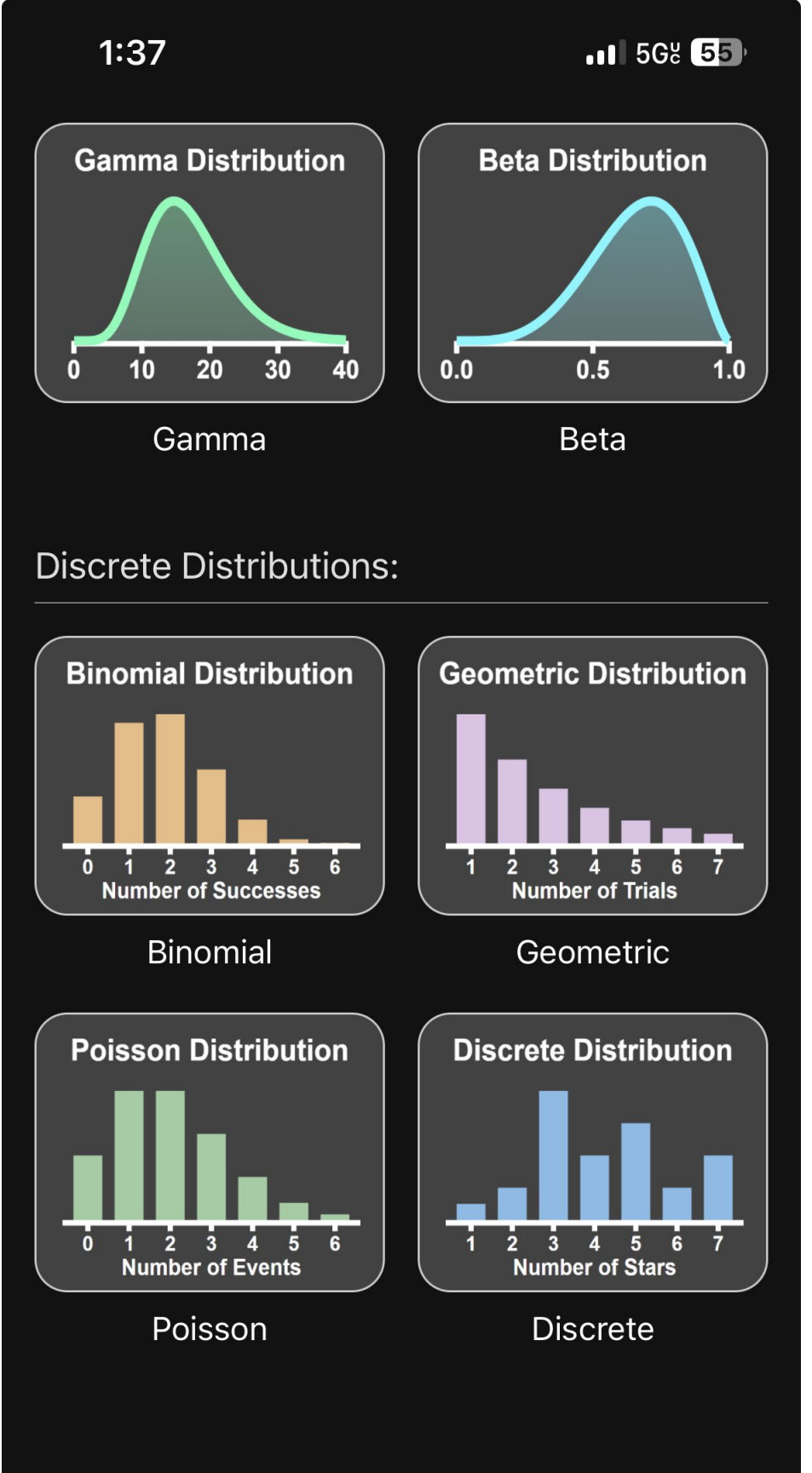
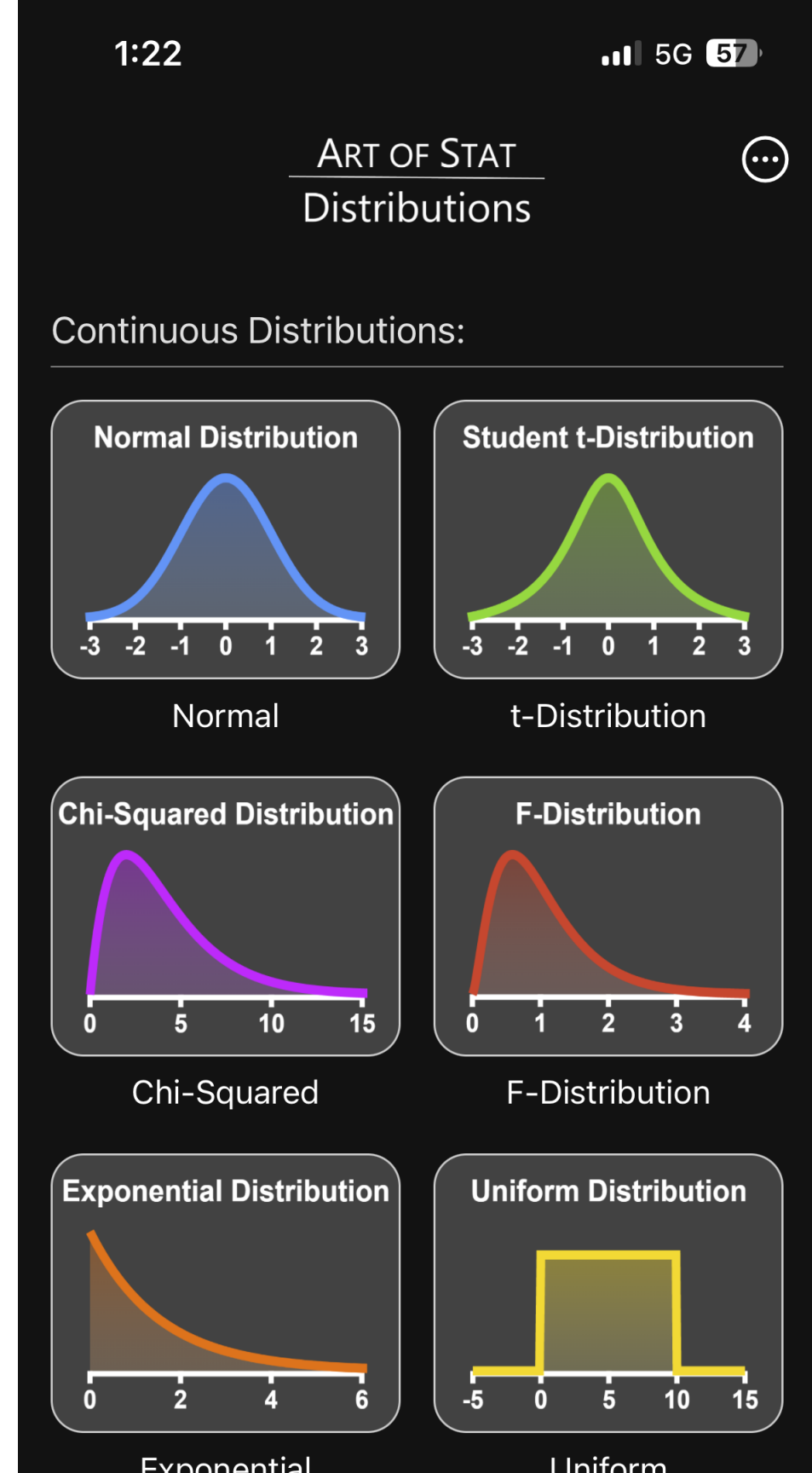
Descriptive Statistics &
Plots for Categorical and
Quantitative Variables



Art of Stat: Distribution



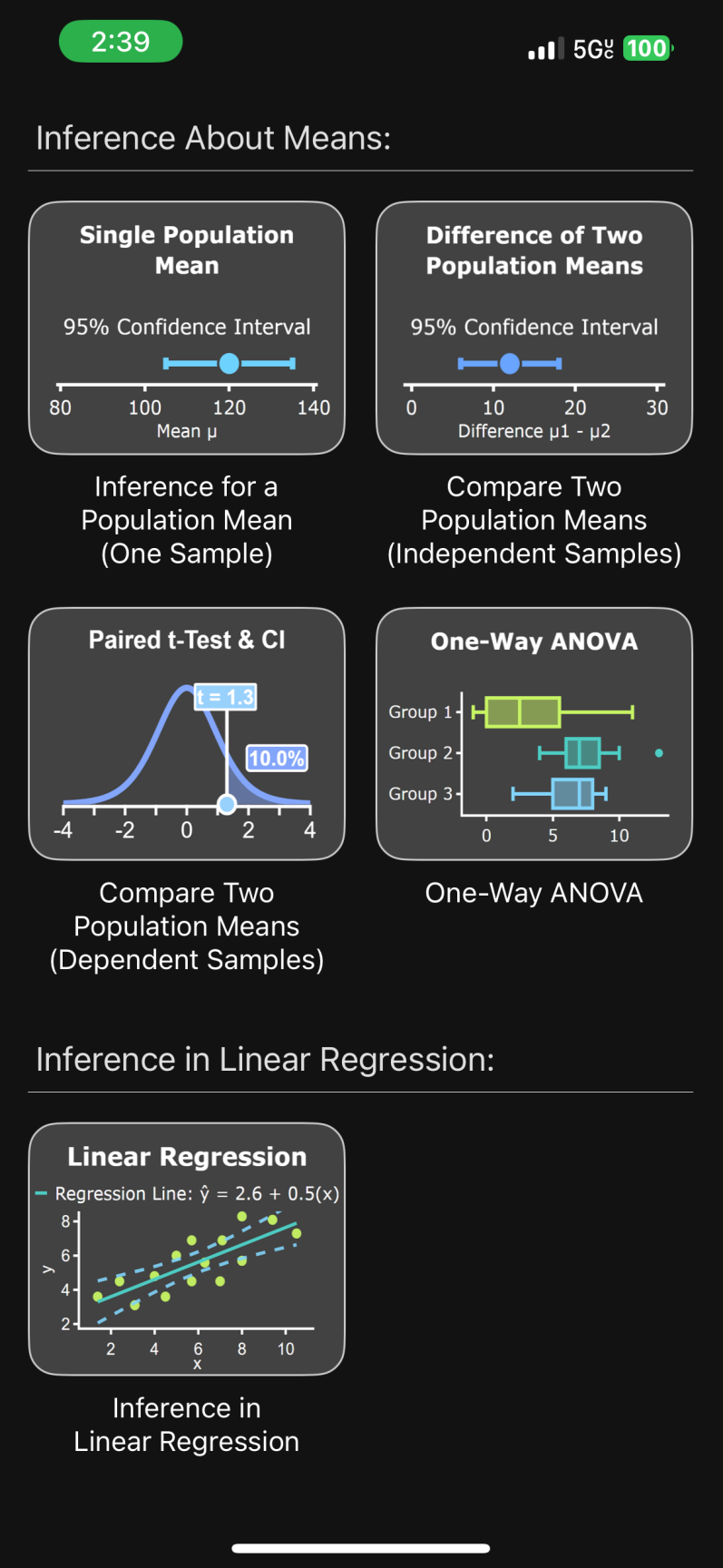
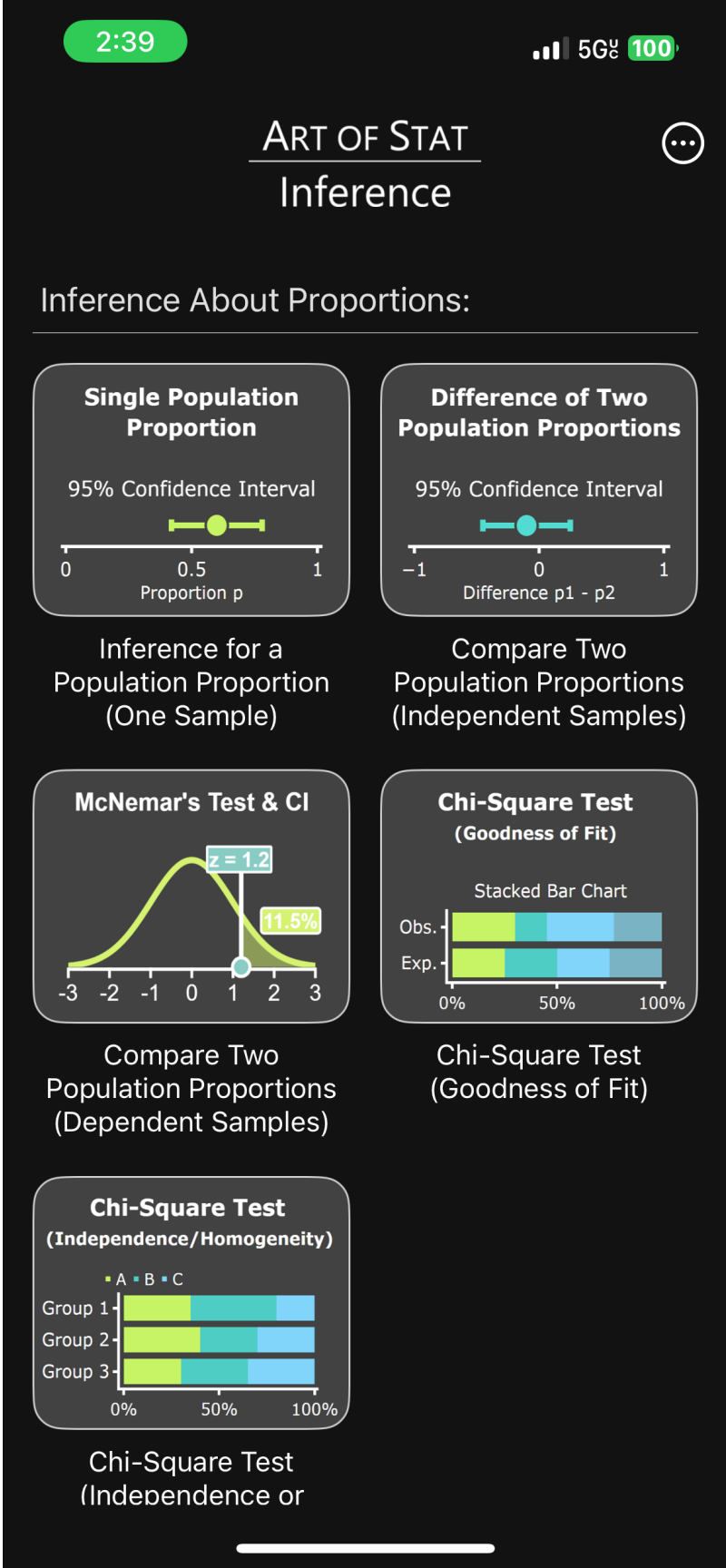
Explore & Visualize
Discrete and
Continuous Probability
Distributions



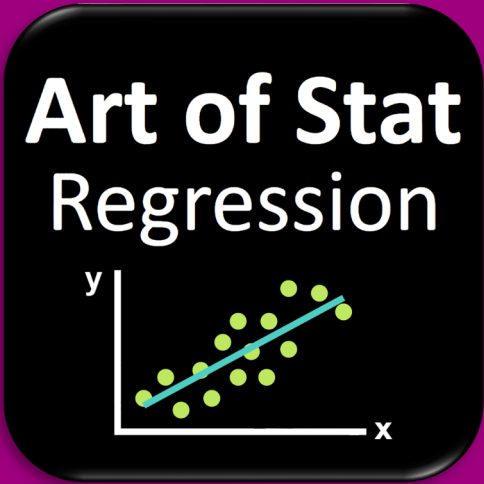
Art of Stat: Inference



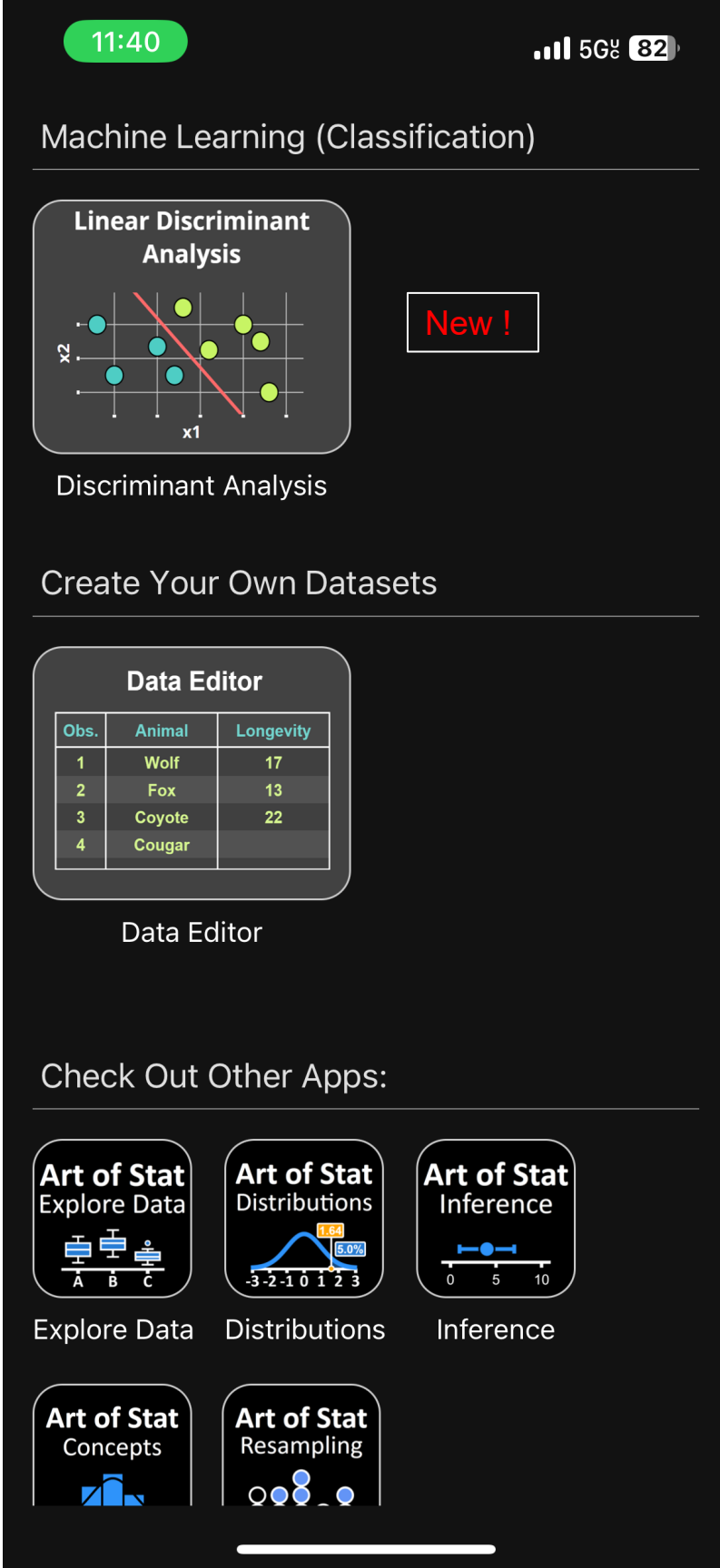
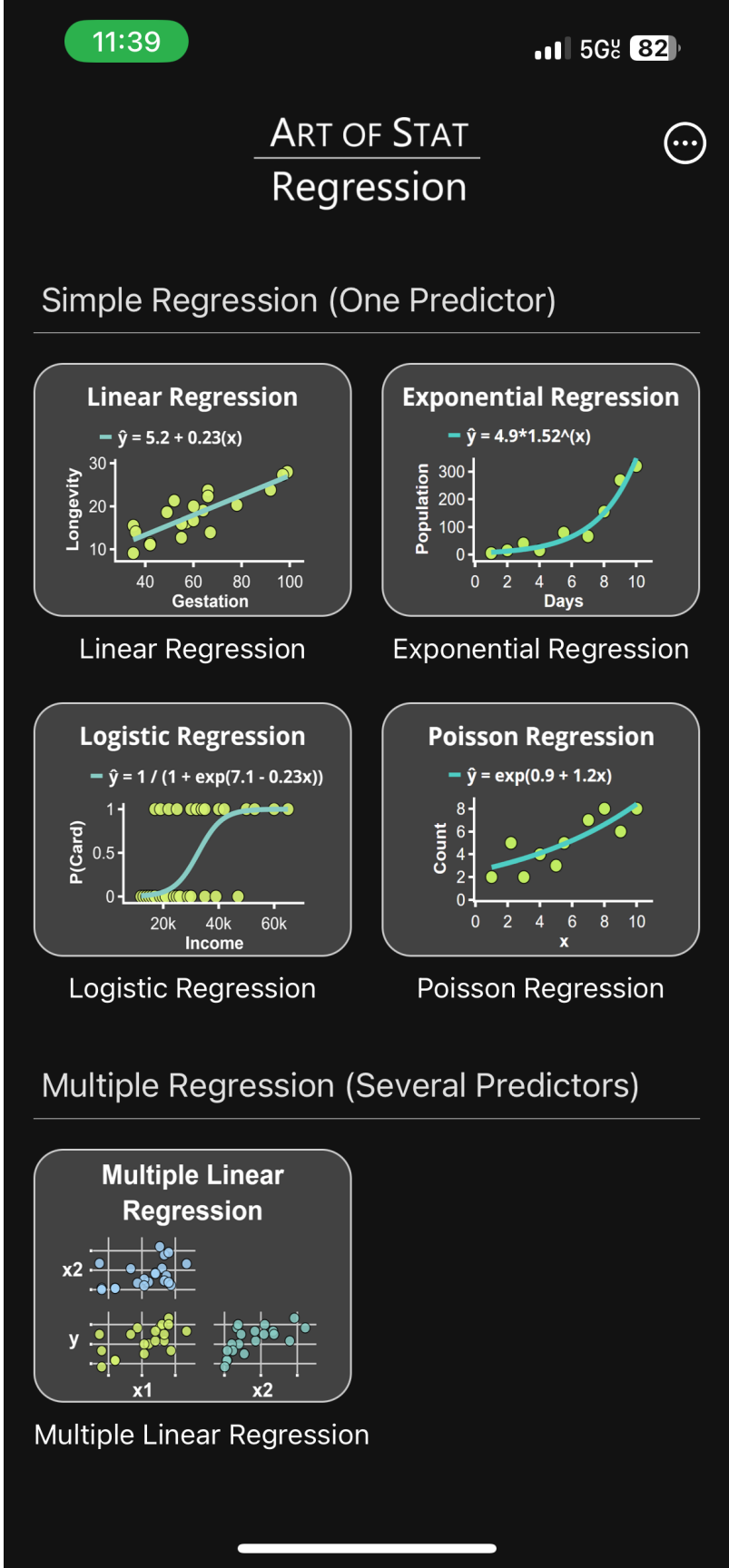
Confidence Intervals &
Hypothesis Tests



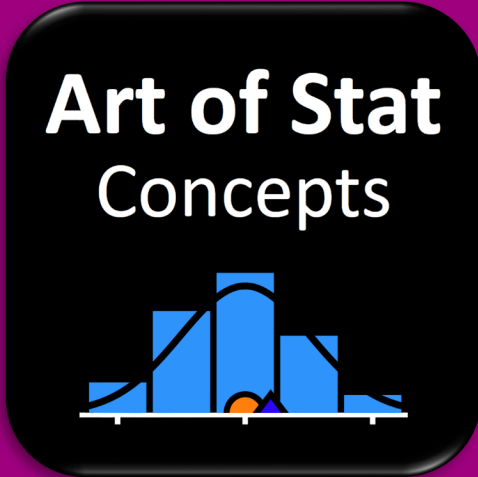
Art of Stat: Regression



Simple Linear and
Logistic Regression &
Multiple Linear
Regression



Art of Stat: Concepts



Central Limit Theorem,
Correlation, Regression,
Coverage & Power

2:51

5G

50

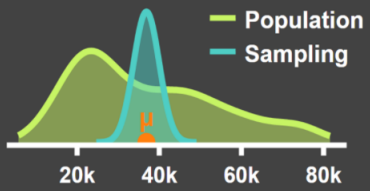
ART OF STAT

Concepts

...

Central Limit Theorem

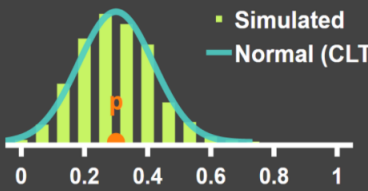
Distribution of the Sample Mean \bar{x}



Population
Sampling

CLT for Means

Distribution of the Sample Proportion \hat{p}

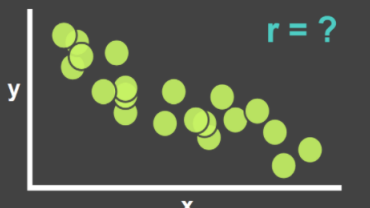


Simulated
Normal (CLT)

CLT for Proportions

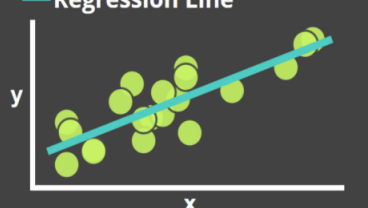
Correlation and Regression

Guess Correlation



Explore Correlation


Explore Regression



Explore Regression


Coverage, Errors and Power

Explore Coverage



Explore Coverage of Confidence Intervals

Errors and Power



Explore Type I & II Errors and Power


2:52

5G

50

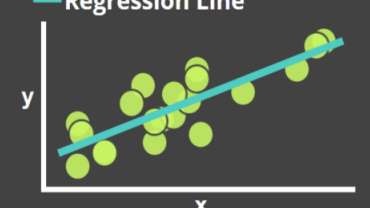
Correlation and Regression

Guess Correlation



Explore Correlation


Explore Regression



Explore Regression

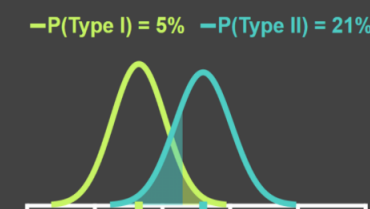
Coverage, Errors and Power

Explore Coverage



Explore Coverage of Confidence Intervals

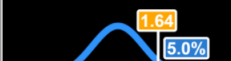
Errors and Power




Explore Type I & II Errors and Power

Check Out Other Apps:


Art of Stat Distributions



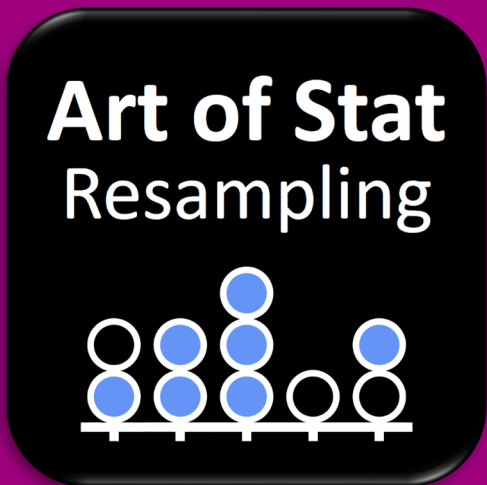
Art of Stat Explore Data



Art of Stat Inference



Art of Stat: Resampling



Bootstrap Confidence
Intervals & Permutation
Tests

11:47 5G 80

ART OF STAT
Resampling

...

Bootstrap Confidence Intervals:

**Population Mean,
Median, Std. Dev.**

Mean, Median,
Std. Deviation

**Population
Proportion, Odds**

Proportion & Odds

Correlation & Slope

Correlation & Slope

**Difference Between
Two Means or Medians**

Differences in Means
or Medians

Permutation Tests:

**Permutation Test
Mean & Median**

**Permutation Test
Two Means or Medians**

11:47 5G 80

Permutation Tests:

**Permutation Test
Mean & Median**

Permutation Test
for the Mean or Median

**Permutation Test
Two Means or Medians**

Permutation Test
Comparing Two Groups

**Permutation Chi-Square
Test of Independence**

Permutation Chi-Square
Test of Independence

New !

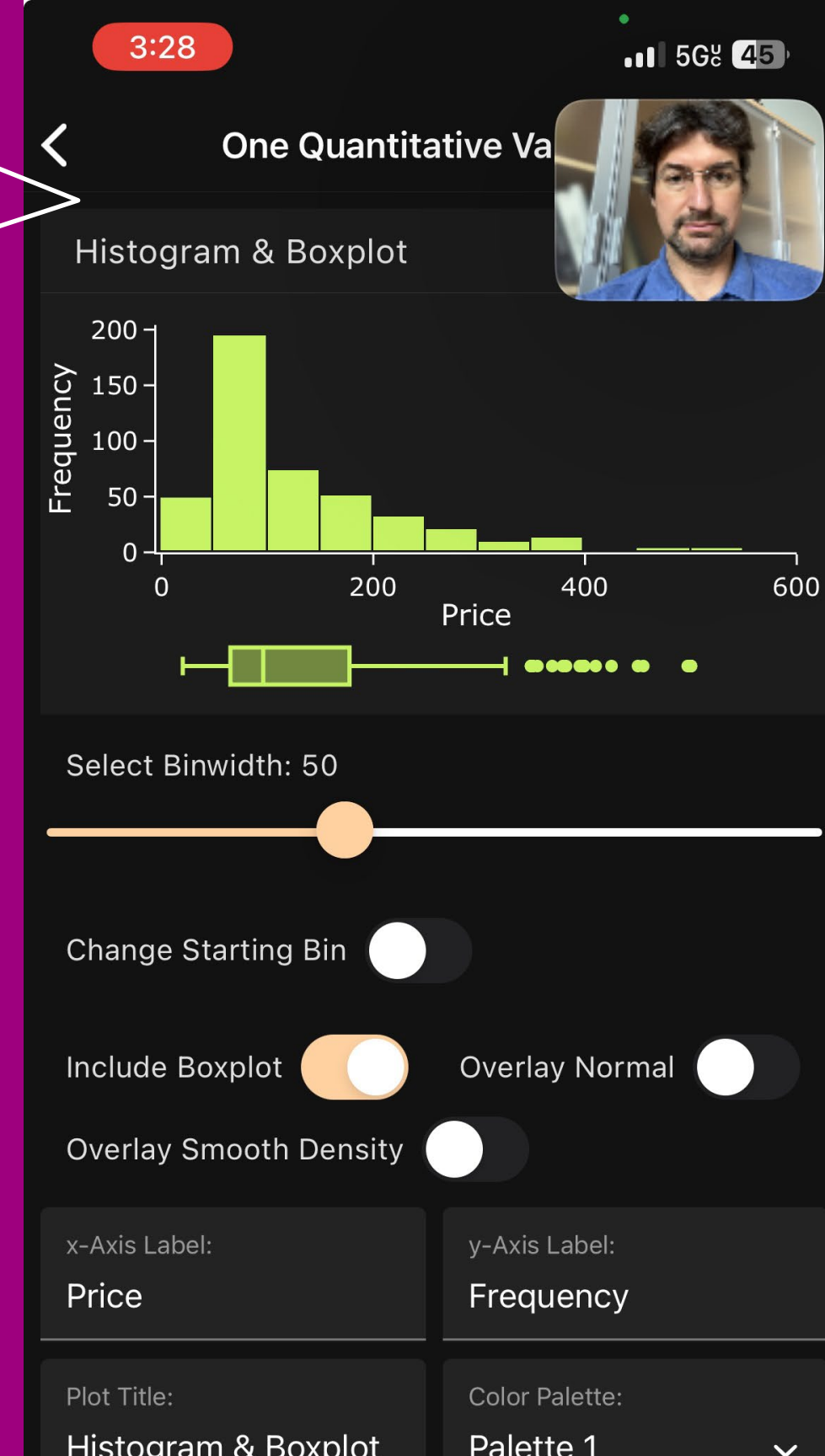
Create Or Edit Your Own Datasets

Data Editor		
Obs.	Animal	Longevity
1	Wolf	17
2	Fox	13
3	Coyote	22
4	Cougar	

2) Technology

- Connect Cell Phone to Screen
- Share: Screen Shots
- Record: Short Videos
- Connect: Join Zoom Call
- Upload Your Data (.CSV)
- Cost: \$2.99 per app (one-time)

Me in a Zoom call
sharing my screen
with the class



Technology: Connect to Screen

Connect Device to a
Screen/Projector via an
HDMI Adapter

- Connect to a Projector or Screen via HDMI

For older iPhone models



For Android Phones,
most tablets, iPads, etc.

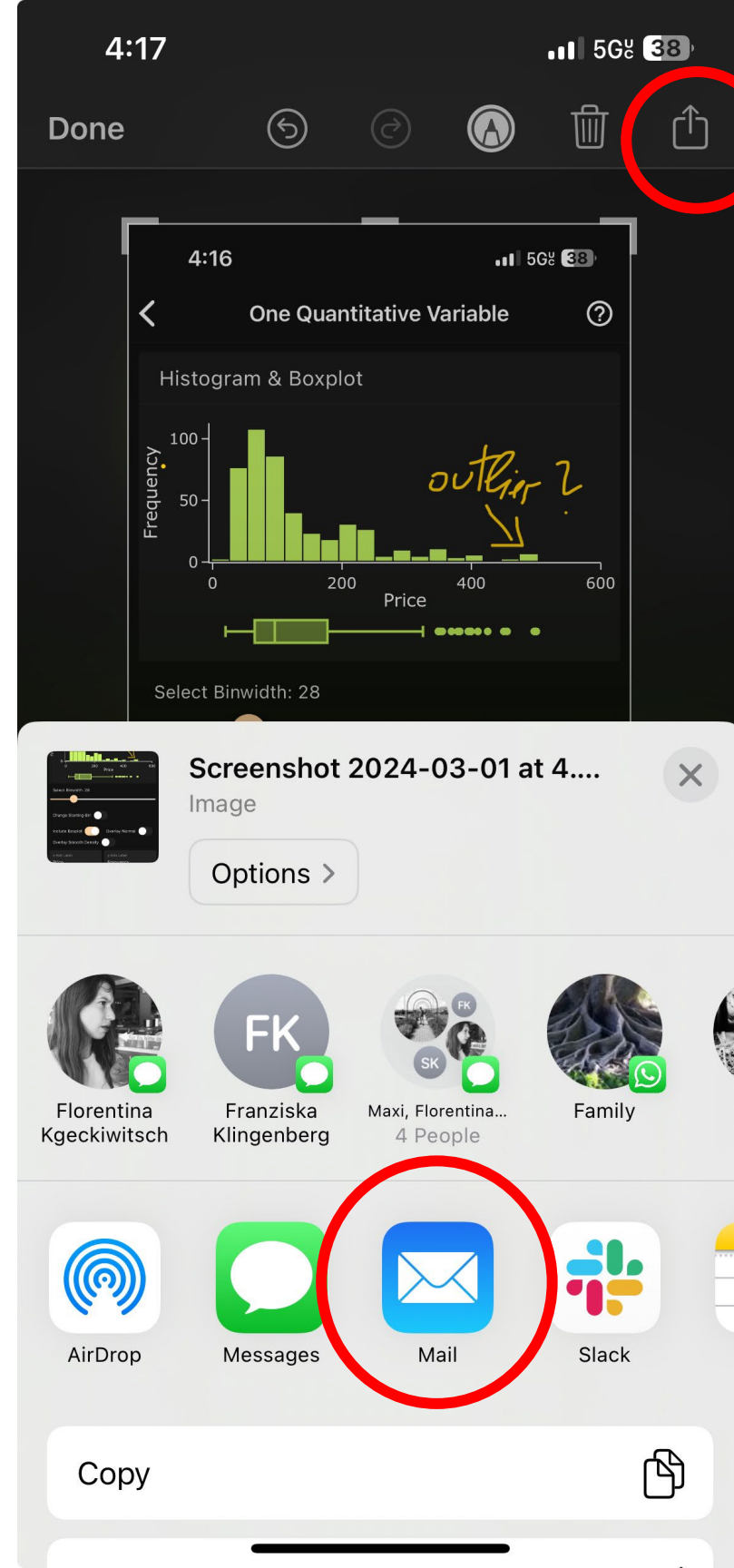


- Another Option: Screen Casting
or Mirroring to another screen



Technology: Screen Shots & Sharing

Connect Device to a
Screen/Projector via an
HDMI Adapter



- For both iOS and Android, easy to take screen shot
- Annotate screenshots
- Share via text message, email, Social Media, etc.

Technology: Screen Shots & Sharing

Upload screenshots
and annotate

Annotated screenshots from my Stat 101 class

Stat 101: CLT and Confidence Intervals

8 / 9

Share

You can do all computations with the Art of Stat: Inference app:

For one proportion, select this:

Enter the data:

ART OF STAT Inference

Inference About Proportions:

Single Population Proportion

95% Confidence Interval

0 0.5 Proportion p 1

Inference for a Population Proportion (One Sample)

Chi-Square Test (Goodness of Fit)

Stacked Bar Chart

Obs. Exp.

0% 50% 100%

Chi-Square Test (Goodness of Fit)

Chi-Square Test (Independence or Homogeneity)

Chi-Square Test (Independence or Homogeneity)

Inference About Means:

Single Population Mean

95% Confidence Interval

Difference of Two Population Means

95% Confidence Interval

Inference for a Proportion

Enter Data:

Summary Statistics

Sample Size (n): 16

of Successes (x): 5

Sample Proportion:

Number of Successes (x) 5

Sample Size (n) 16

Sample Proportion ($\hat{p} = x/n$) $5/16 = 0.3125$

Bar Chart

Yes, Too Old

No, Not Too Old

Percent (%)

Provide Labels for Success / Failure

Label for Success: Yes, Too Old

Label for Failure: No, Not Too Old

Modify Plot Title

Show Percentages on Bars

ENTER DATA CONFIDENCE INTERVAL HYPOTHESIS TEST

Confidence Interval for the Population Proportion p:

Statistic	Value
Sample Size (n)	16
Number of Successes	5
Sample Proportion (\hat{p})	0.313
Standard Error (se) of the Sample Proportion	0.116
Confidence Level	95%
z-score ($\alpha = 5\%$)	1.960
Margin of Error (me)	± 0.227
Lower Bound for p	0.0854
Upper Bound for p	0.540

p is the population proportion.

95% Confidence Interval (0.0854, 0.540)

0 0.2 0.4 0.6 0.8 1

Population Proportion p

Confidence Level: 95%

ENTER DATA CONFIDENCE INTERVAL HYPOTHESIS TEST

Read off everything from here

graphical representation

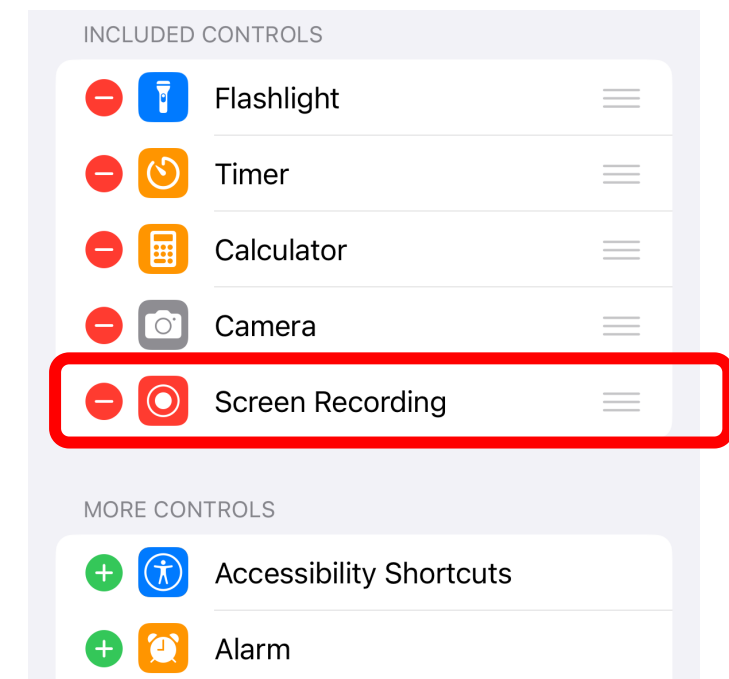
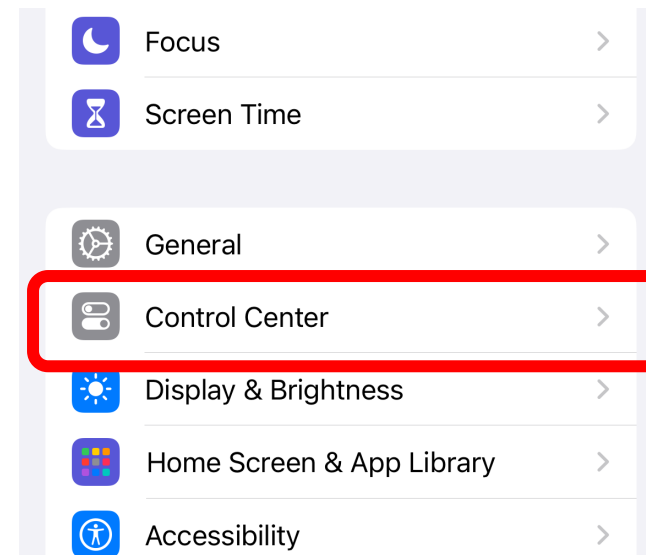
second tab

I changed the labels

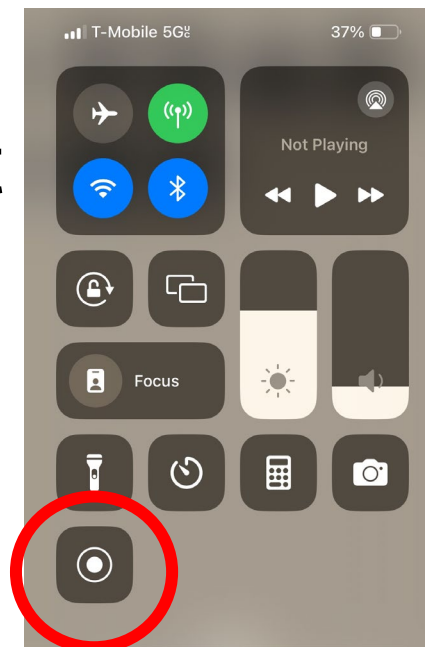
Technology: Screen Casting

Record your Screen to
Produce a Short Video
of a Concept or Analysis

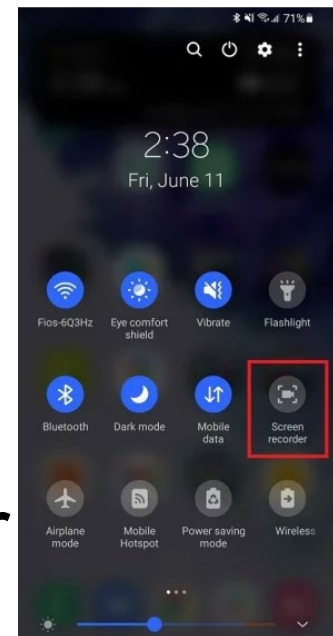
Settings > Control Center > Customize Controls



Swipe
down, start
recording



On Android,
swipe down from
the top once or
twice, to reveal
Screen Recorder

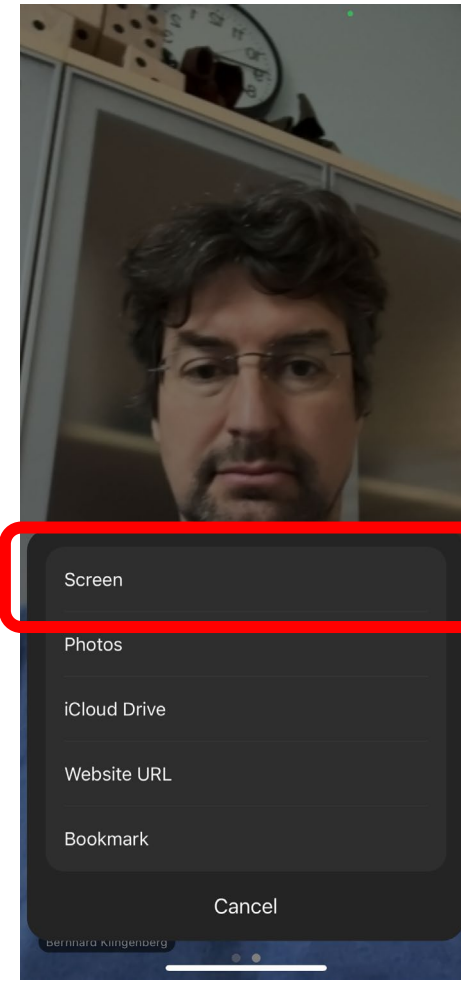


Technology: Zoom Calls

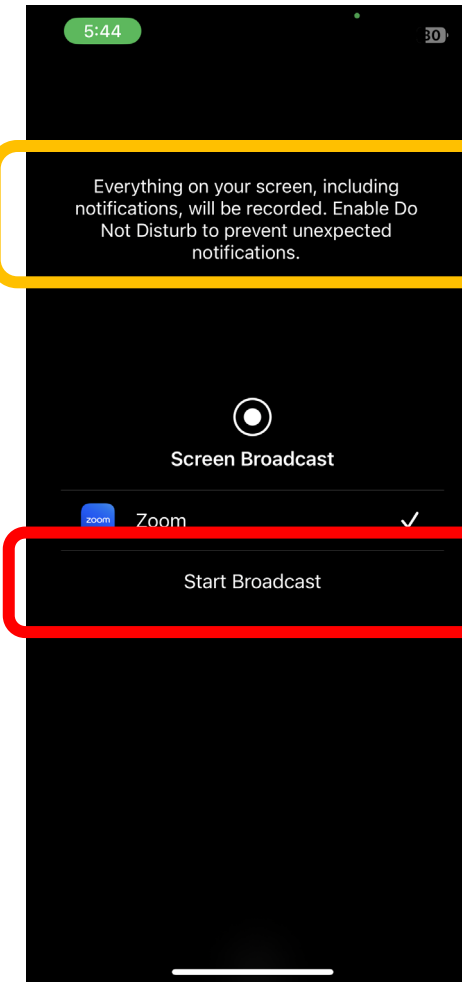
Start (or Join) a Zoom Call and Share your Screen to Teach Statistics



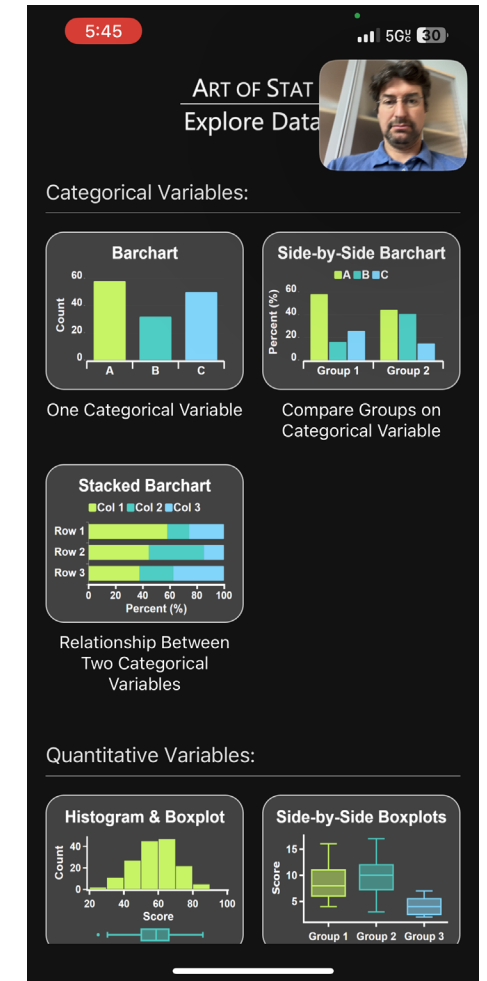
In the Zoom call, select "Share"



Select "Screen"



Enable *Do Not Disturb* on your phone and start broadcasting



Teach with the apps

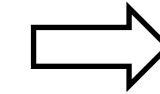
Technology: Upload Data

In every app, you can not only type in your own data, but also upload a CSV file and select columns from it

1) Create a dataset

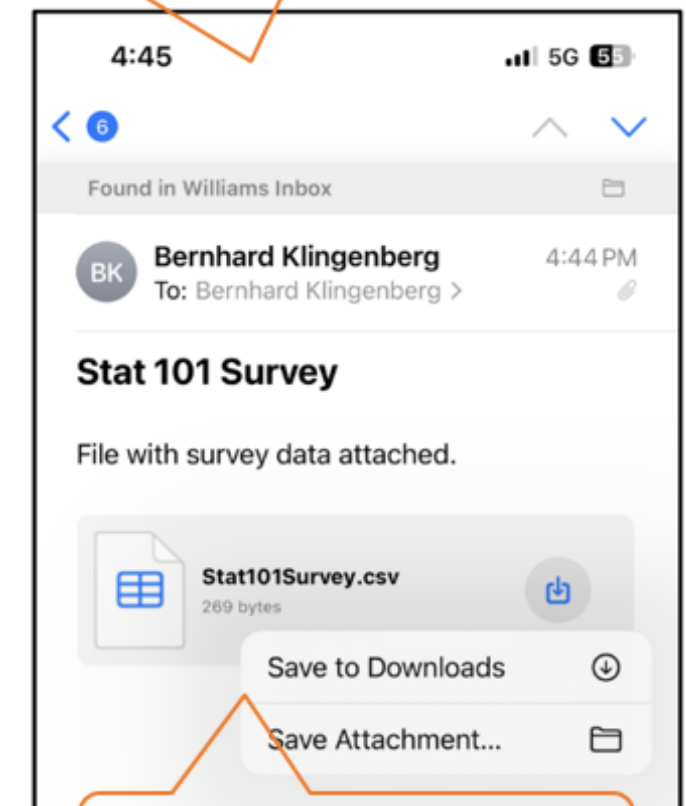
	A	B	C
1	Frosh	Preference	Cost
2	No	milk	0
3	No	dark	200
4	No	milk	0
5	Yes	white	500
6	No	dark	400
7	Yes	dark	80
8	No	milk	130

File: Stat101Survey.csv



2a) Email it to yourself and then long-press to save it on your device

Email Client on phone



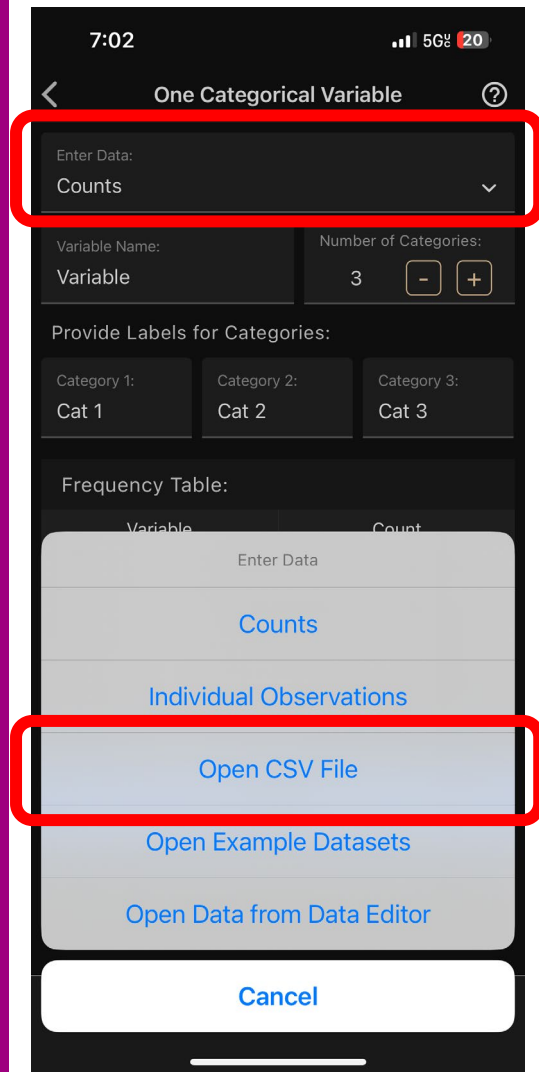
Save on your phone

2b) Alternatively, put it on iCloud or Google Drive so you can access it from your phone/tablet

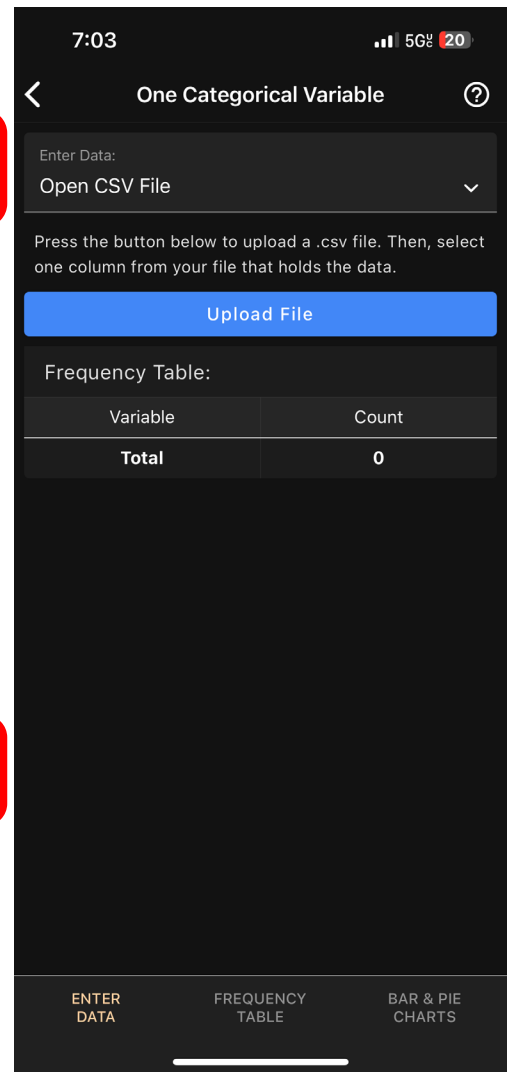
Technology: Upload Data

In every app, you can upload a CSV file and select columns from it.

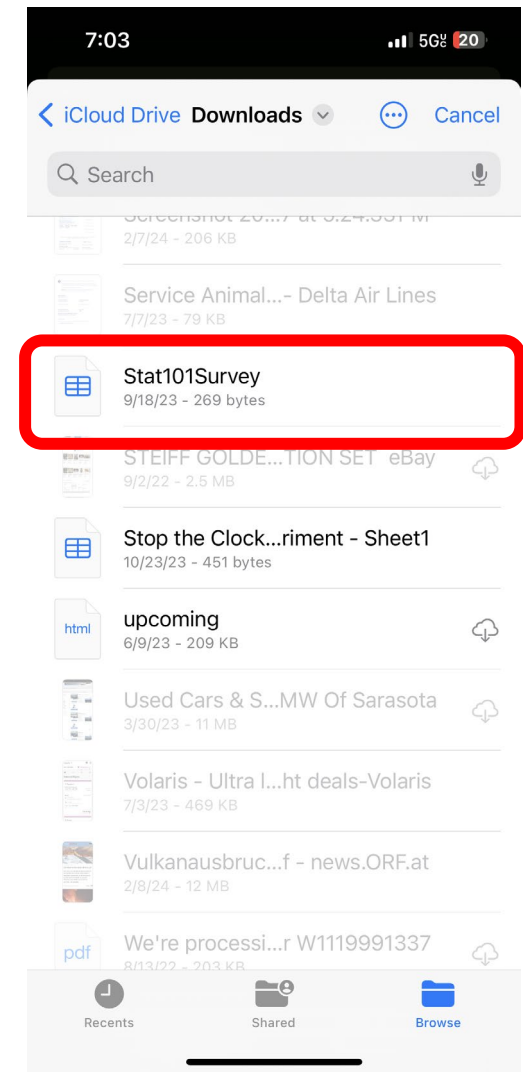
Alternatively, you can create or edit datasets with the Data Editor.



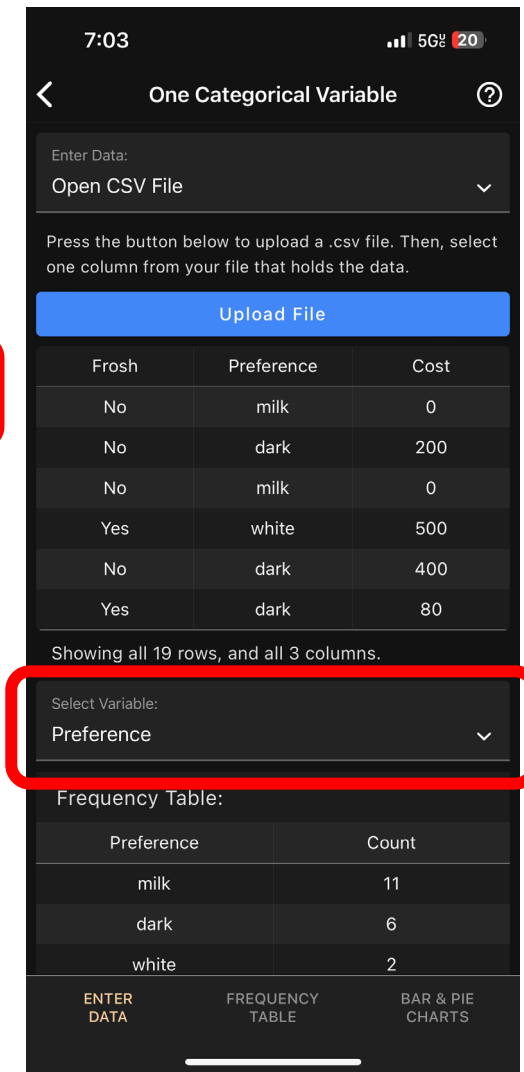
In any app, under *Enter Data*, select *Upload CSV File*



Press *Upload File* button



Navigate to folder and select file. File loads and is displayed

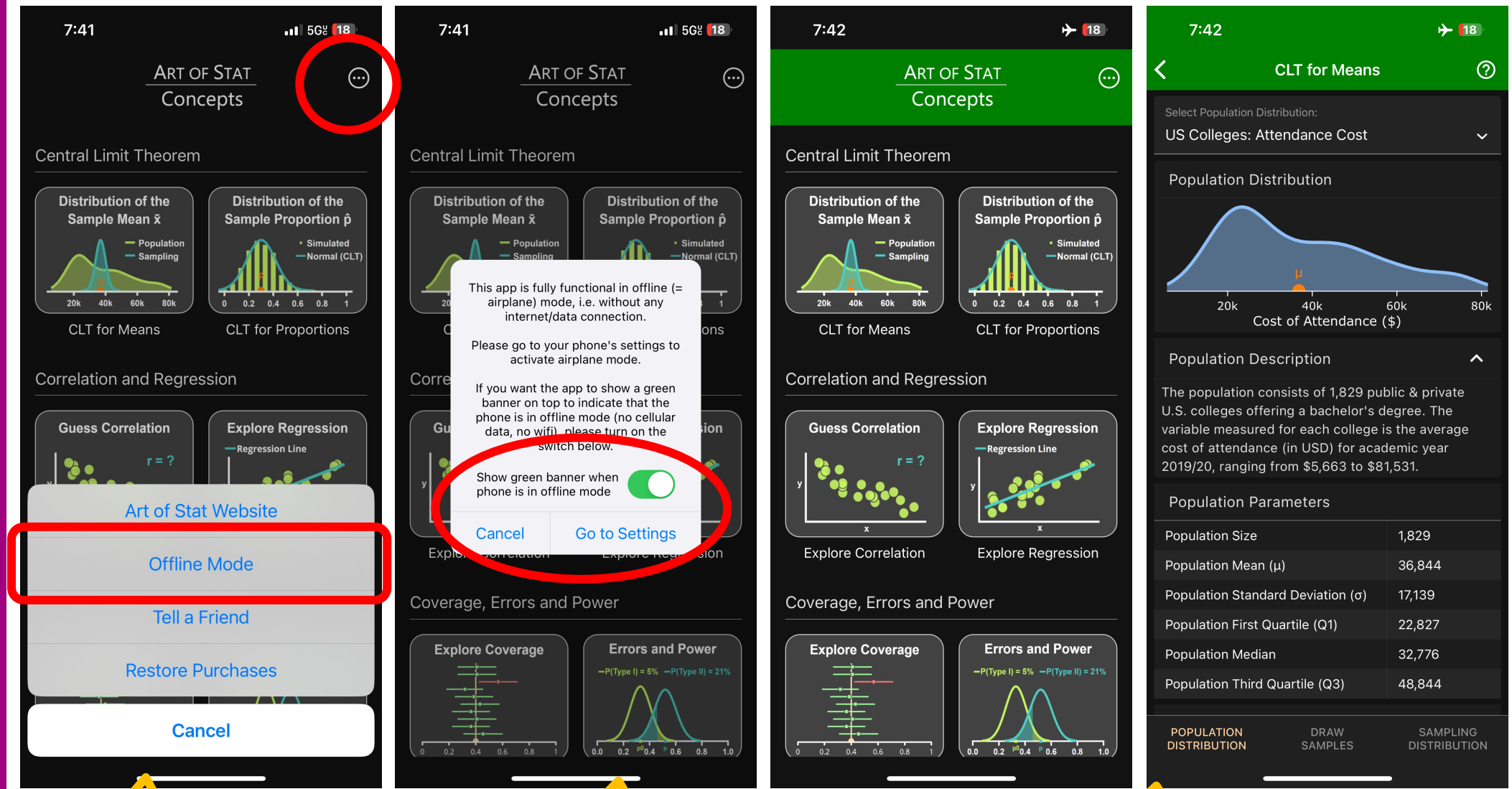


Select variable from file

Technology: Airplane Mode

All apps work in
Airplane Mode.

No wifi or cellular
connection necessary.



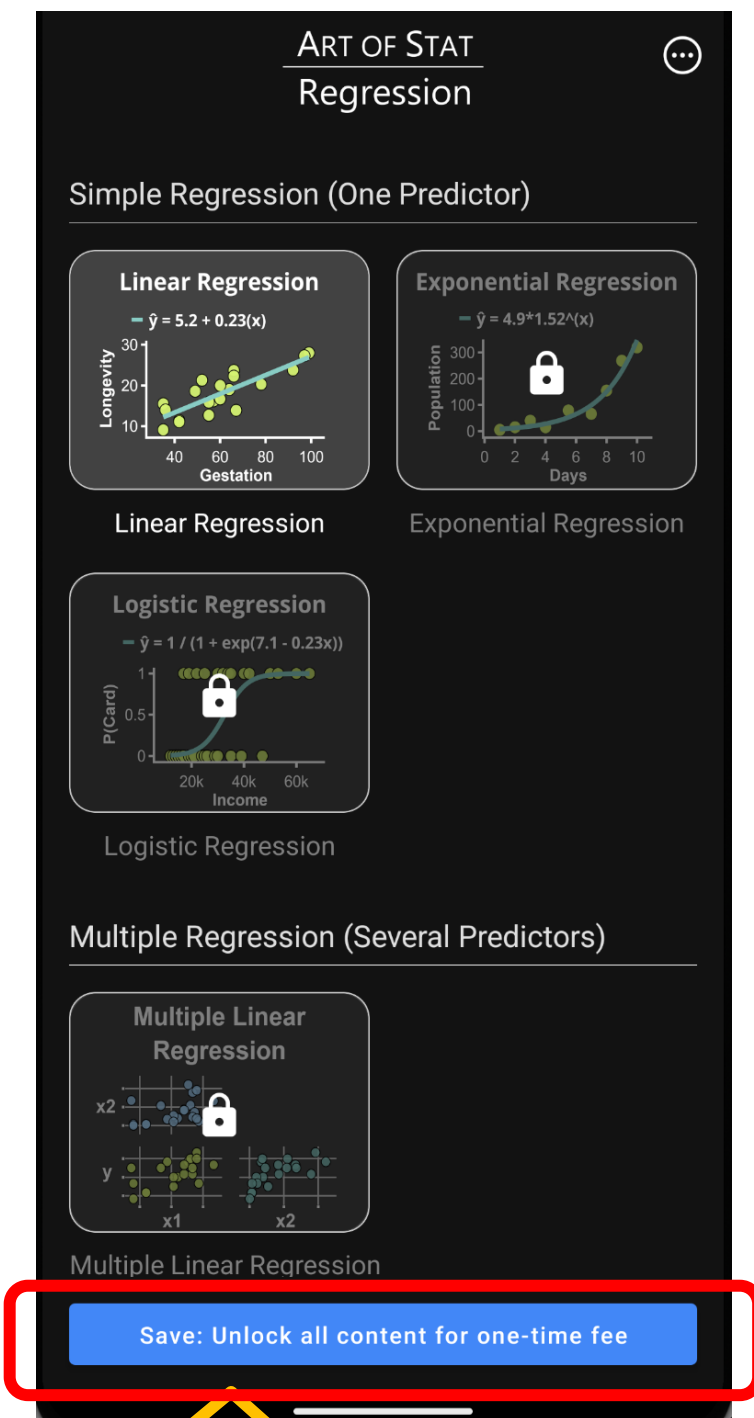
In any app, tab on the three dots in the upper right corner and select *Offline Mode*

Toggle switch for showing green banner, then go to Settings and enable airplane mode.

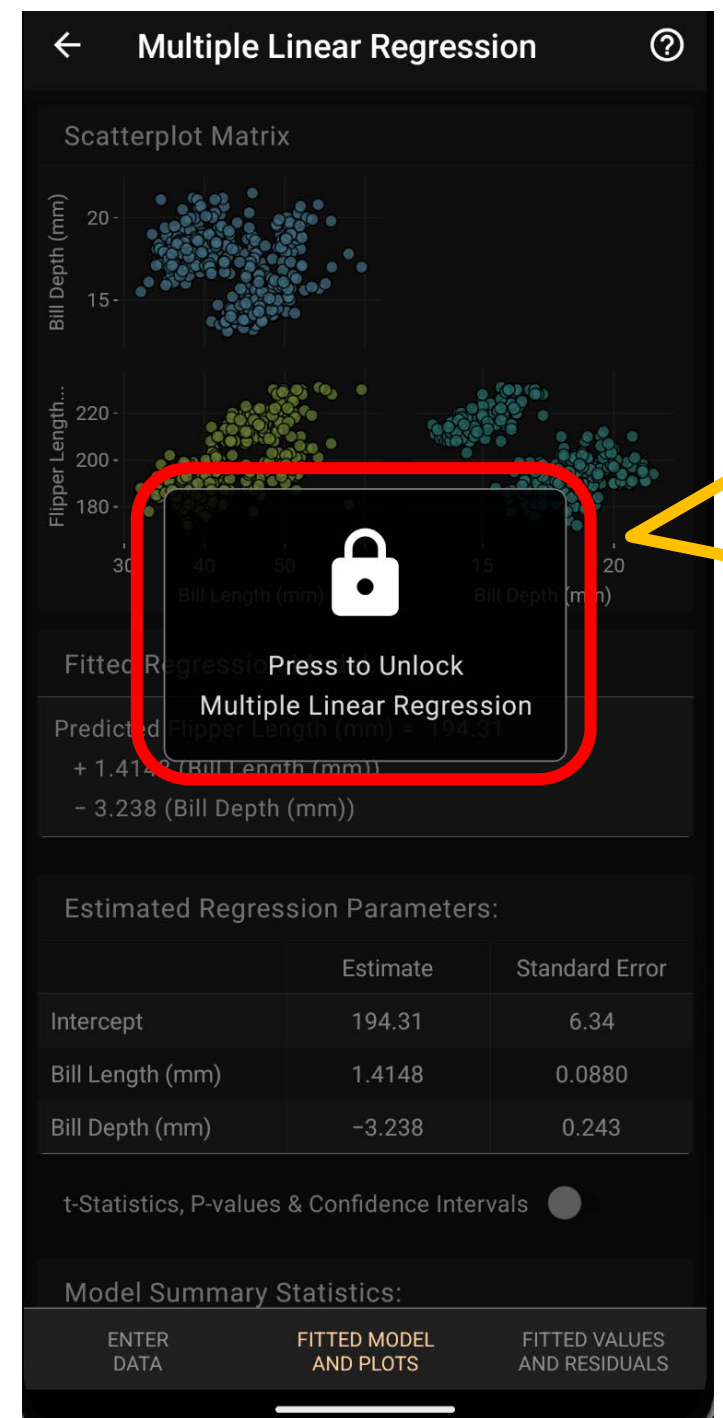
Every screen now shows green banner on top to indicate no internet/data connection

Technology: Price

- Some limited free content to try out things
- In each app, you can unlock all features for a one-time fee of \$2.99.
- Individual modules are \$0.99
- No subscriptions



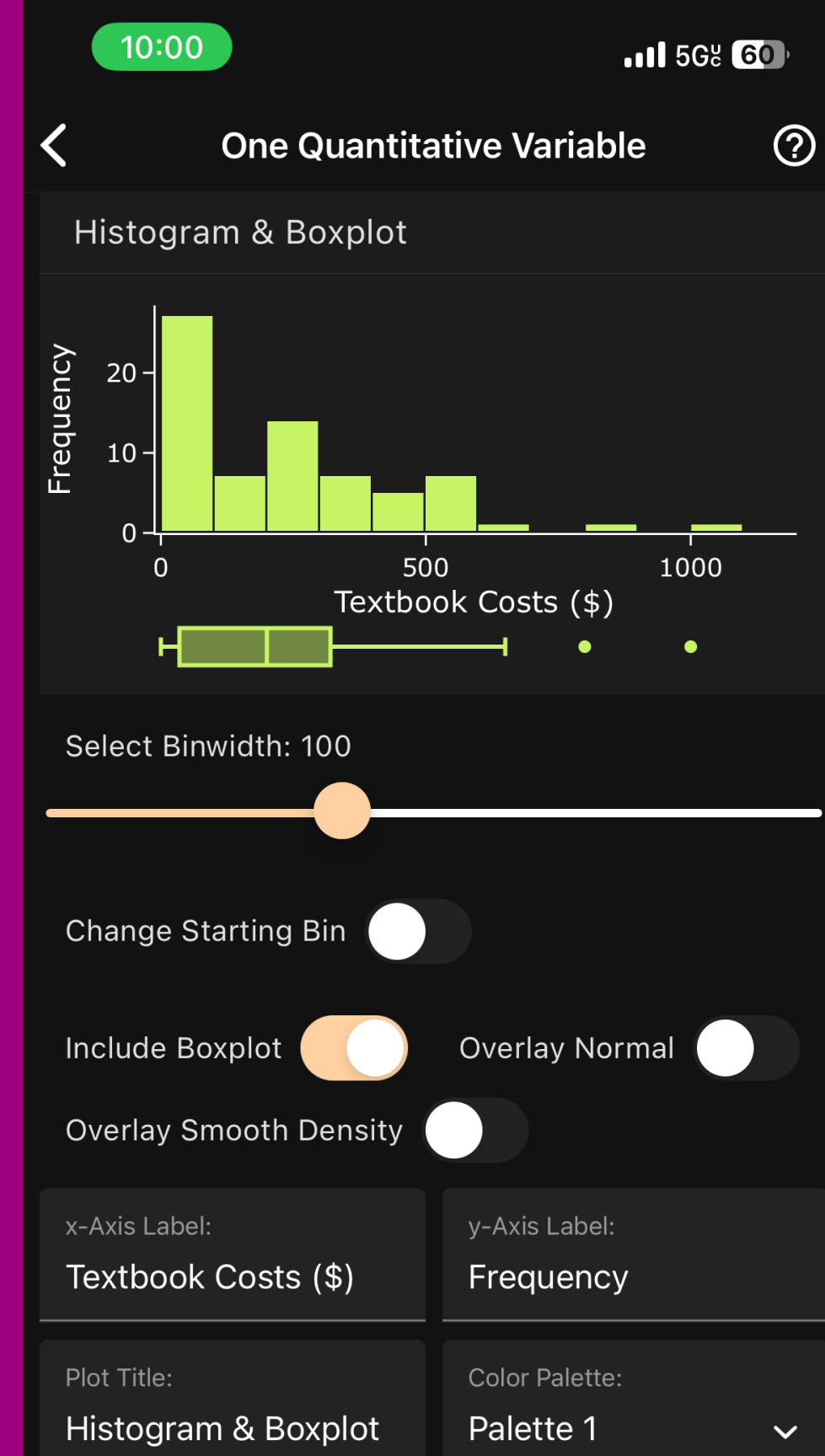
Unlock all features for a one time fee of \$2.99



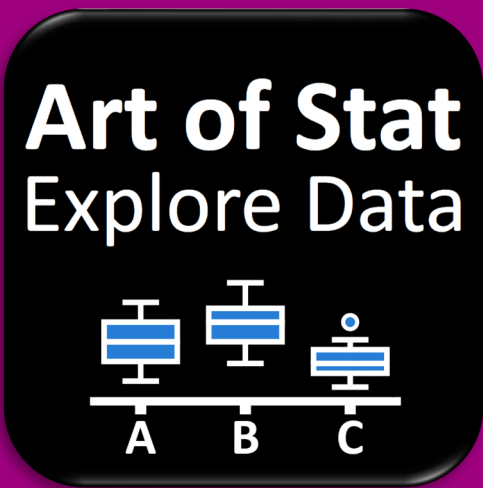
Unlock an individual module for \$0.99

3) Case Studies

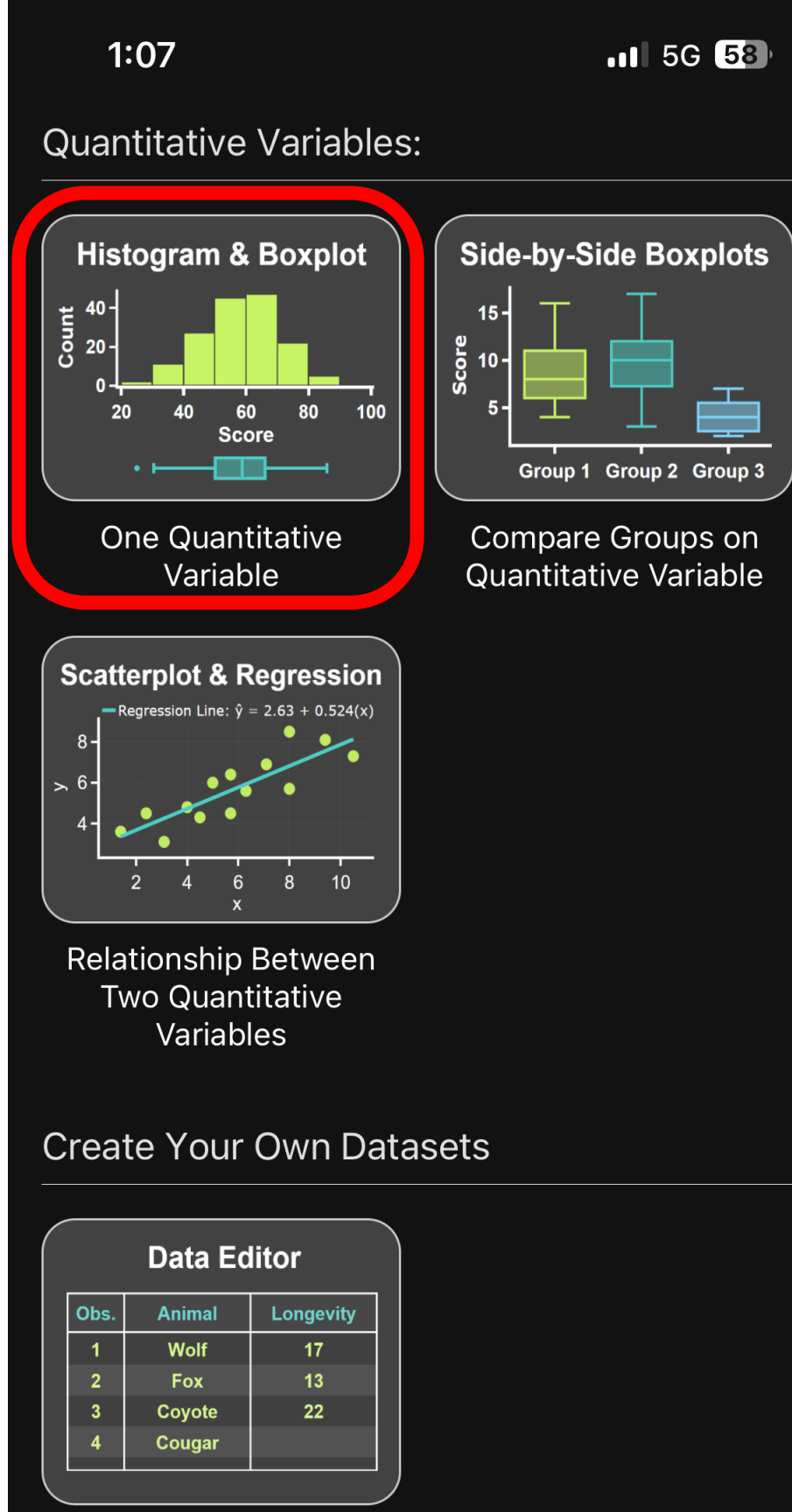
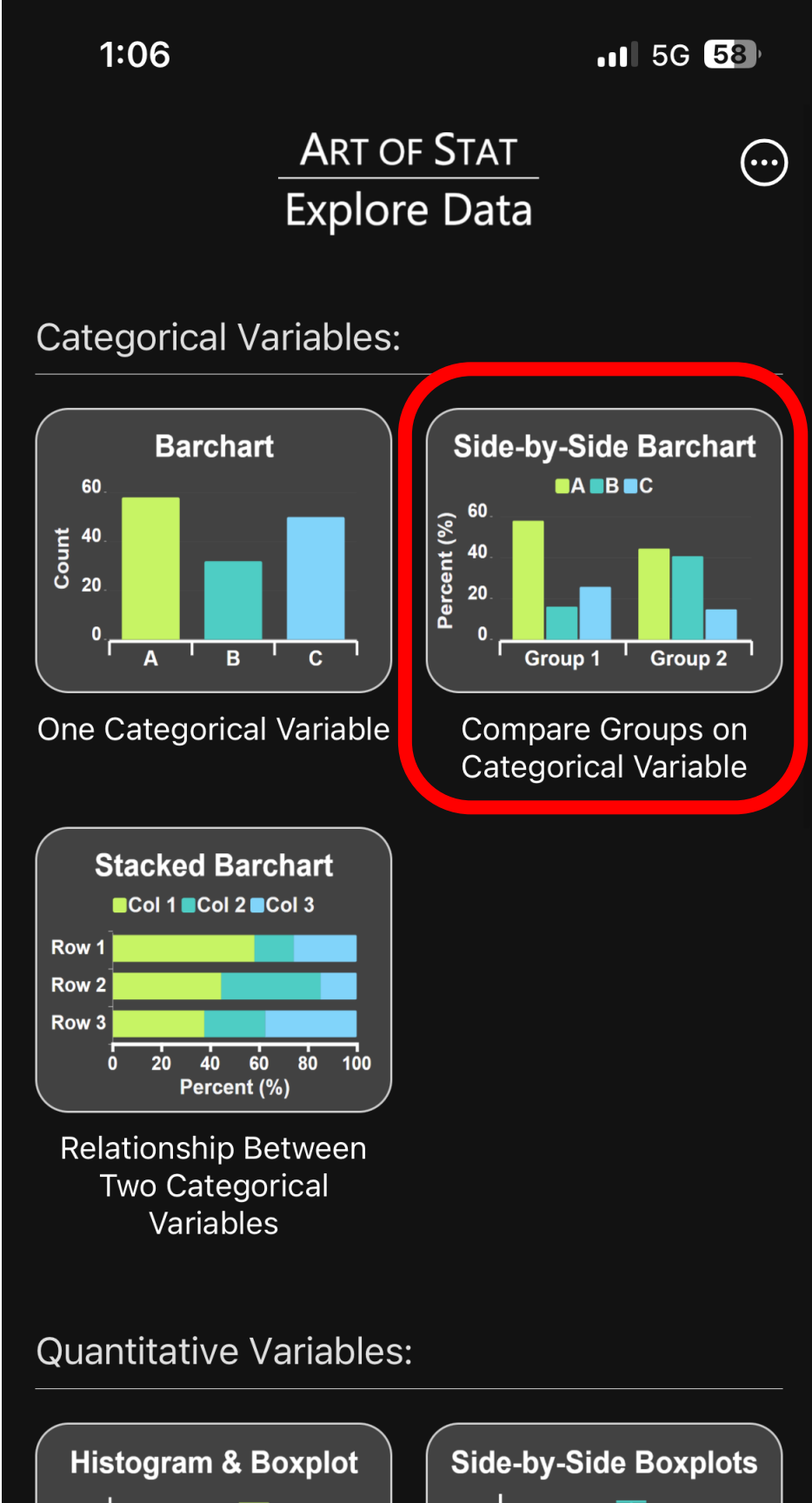
- Art of Stat: *Explore Data* app
 - One Quantitative Variable
 - Two Categorical Variables
- Art of Stat: *Distributions* app
 - Normal Distribution
 - Binomial Distribution
- Art of Stat: *Concepts* app
 - Central Limit Theorem



Art of Stat: Explore Data

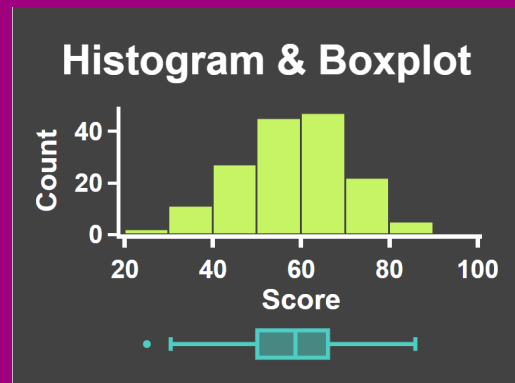


Descriptive Statistics &
Plots for Categorical and
Quantitative Variables

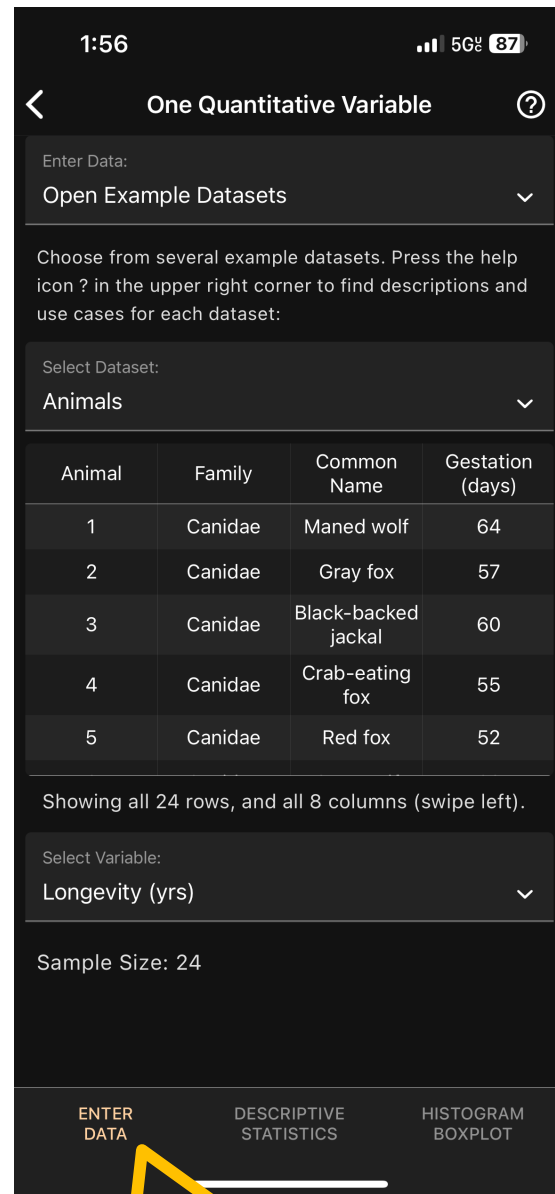


Art of Stat: Explore Data

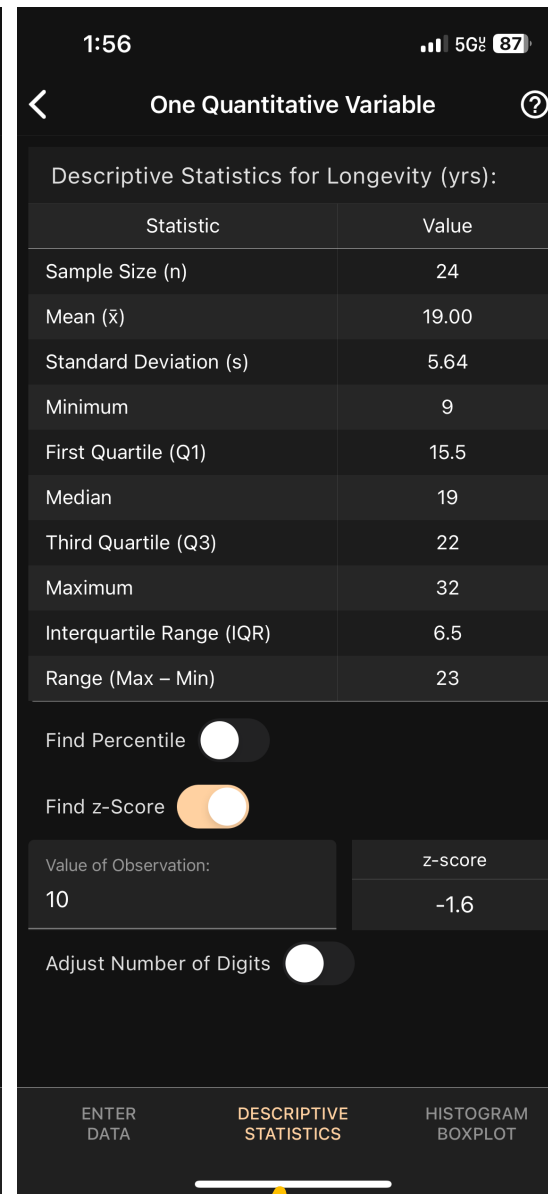
One Quantitative Variable



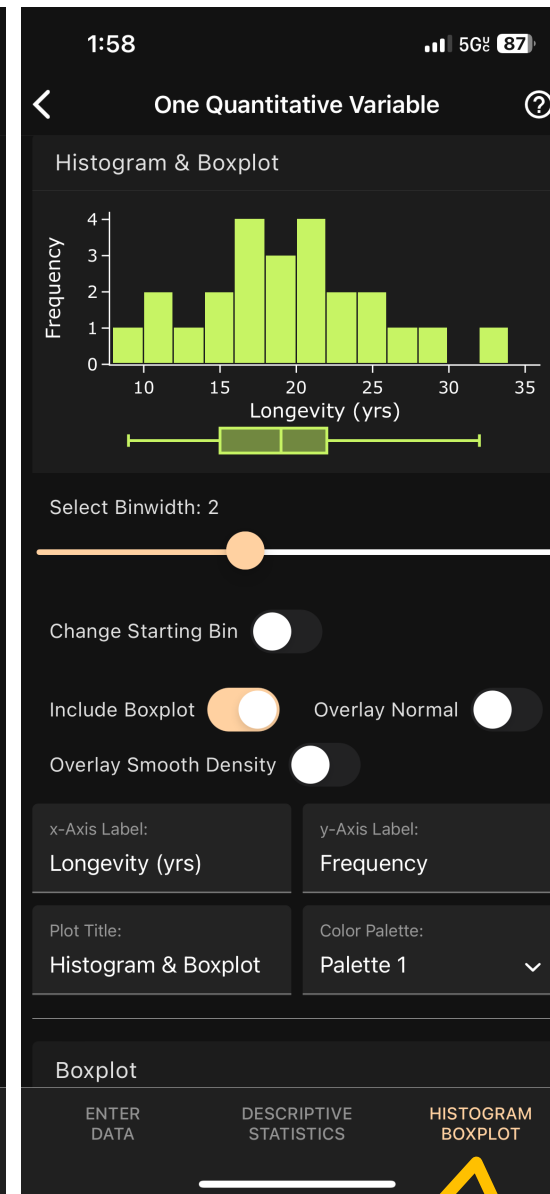
- Screens:
- Enter Data
 - Descriptive Statistics
 - Histogram, Boxplot



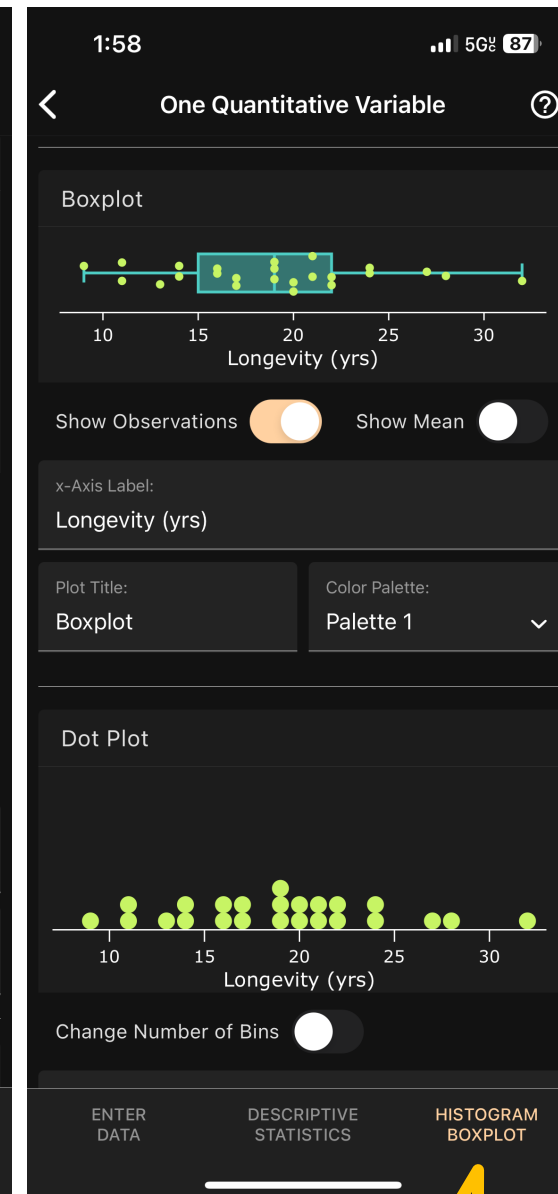
Enter data manually or copy and paste from somewhere else. You can also upload a CSV file, or use one of several example datasets.



Study descriptive statistics, and find percentiles.



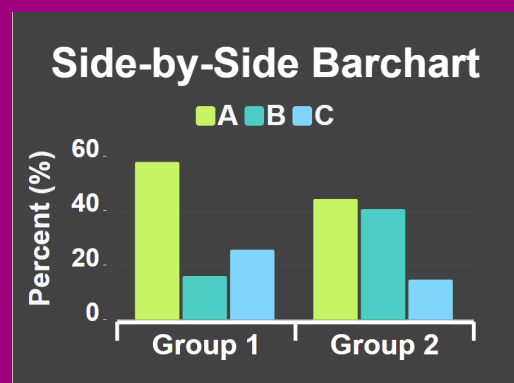
Obtain histogram, vary the bin-size or starting bin, include boxplot, overlay normal or smooth density.



Interact with boxplot, obtain dotplot.

Art of Stat: Explore Data

Two Categorical Variables



Screens:

- Enter Data
- Descriptive Statistics
- Histogram, Boxplot

2:24 5G% 86

< Compare Groups: Categorical Response ?

Enter Data:
Open Example Datasets

Choose from several example datasets. Press the help icon ? in the upper right corner to find descriptions and use cases for each dataset:

Select Dataset:
Online Lending

Grade	Home	Income	FICO Score
C	rent	160000	710
C	mortgage	65000	675
B	rent	34000	690
C	mortgage	150000	740
C	own	70000	705
A	mortgage	100000	785

Showing first 100 rows of the 200 rows, and all 8 columns (swipe left).

Group Variable:
Duration

Response Variable:
Grade

Select one variable that indicates group membership, and select a response variable that holds the observations.

ENTER DATA COMPUTE PROPORTIONS BAR CHART

Datasets about online lending. Can sort categories of variable (not shown, used to sort loan grade categories)

2:24 5G% 86

< Compare Groups: Categorical Response ?

Joint Distribution

Contingency Table (Counts):

	Grade			
Duration	A	B	C	D
36	55	31	36	13
60	7	19	14	11
Total	62	50	50	24

Display:
Counts

Digits:
0 - +

Conditional Distribution

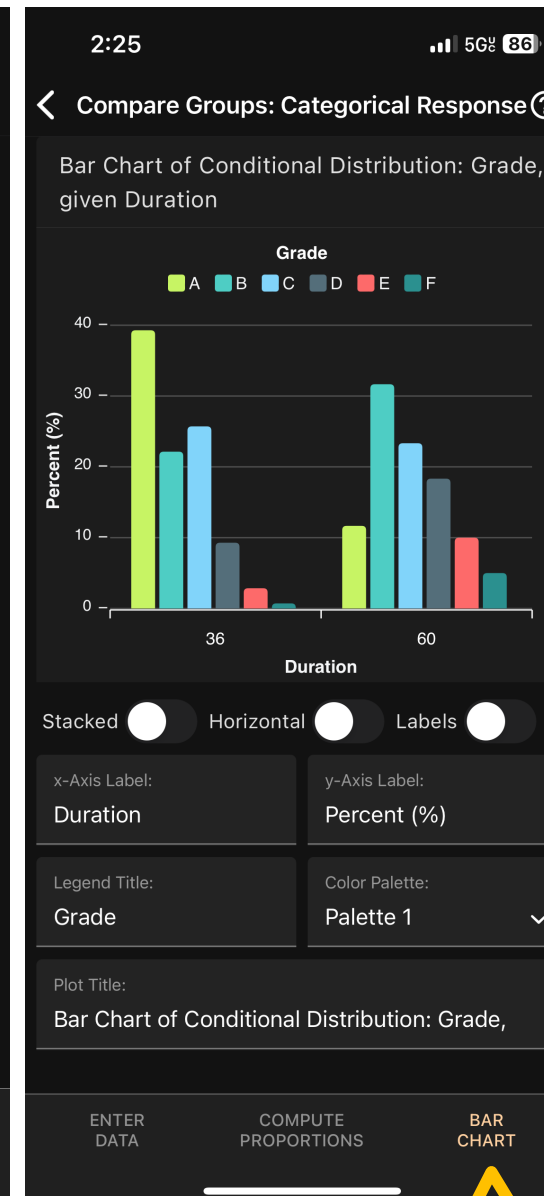
Conditional Distribution of Grade, given Duration:

	Grade			
Duration	A	B	C	D
36	0.393	0.221	0.257	0.093
60	0.117	0.317	0.233	0.183
Total	0.310	0.250	0.250	0.120

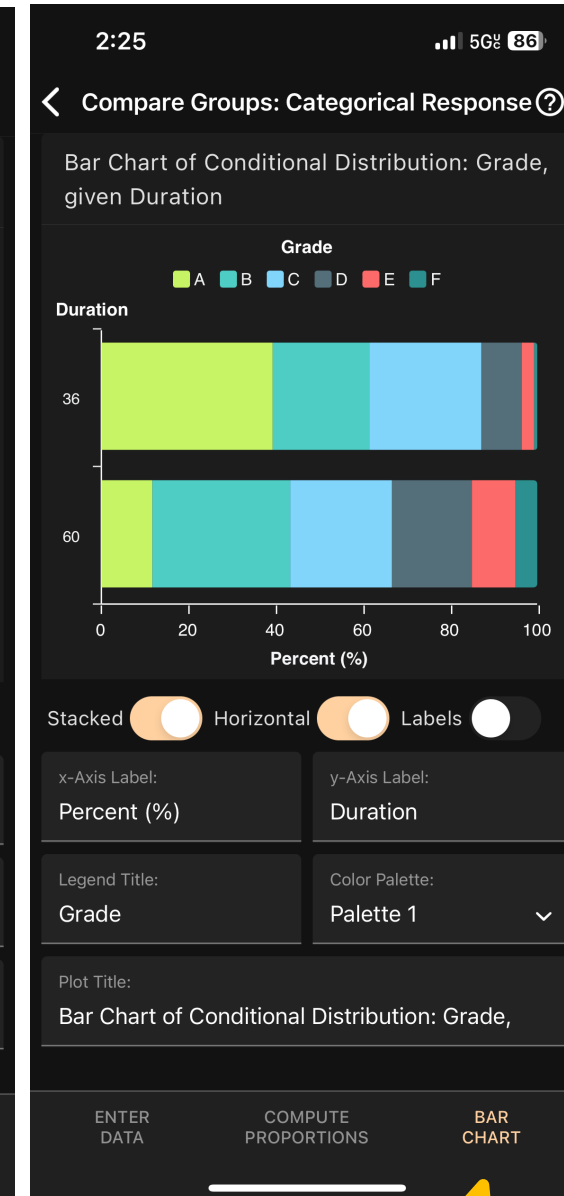
Type of Conditional Distribution:
Grade, given Duration

ENTER DATA COMPUTE PROPORTIONS BAR CHART

Obtain contingency table, joint, conditional and marginal distributions. (Row or column percentages.)

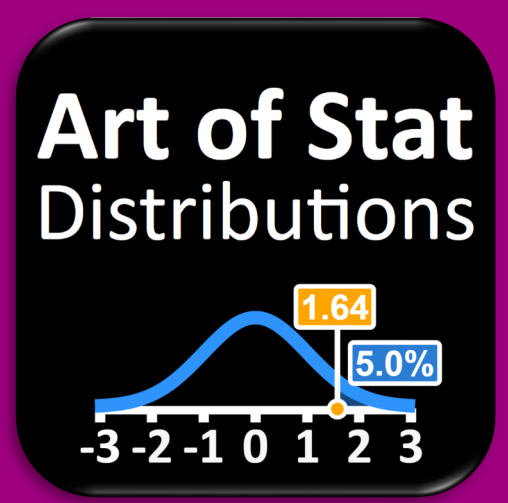


Side-by-Side bar charts

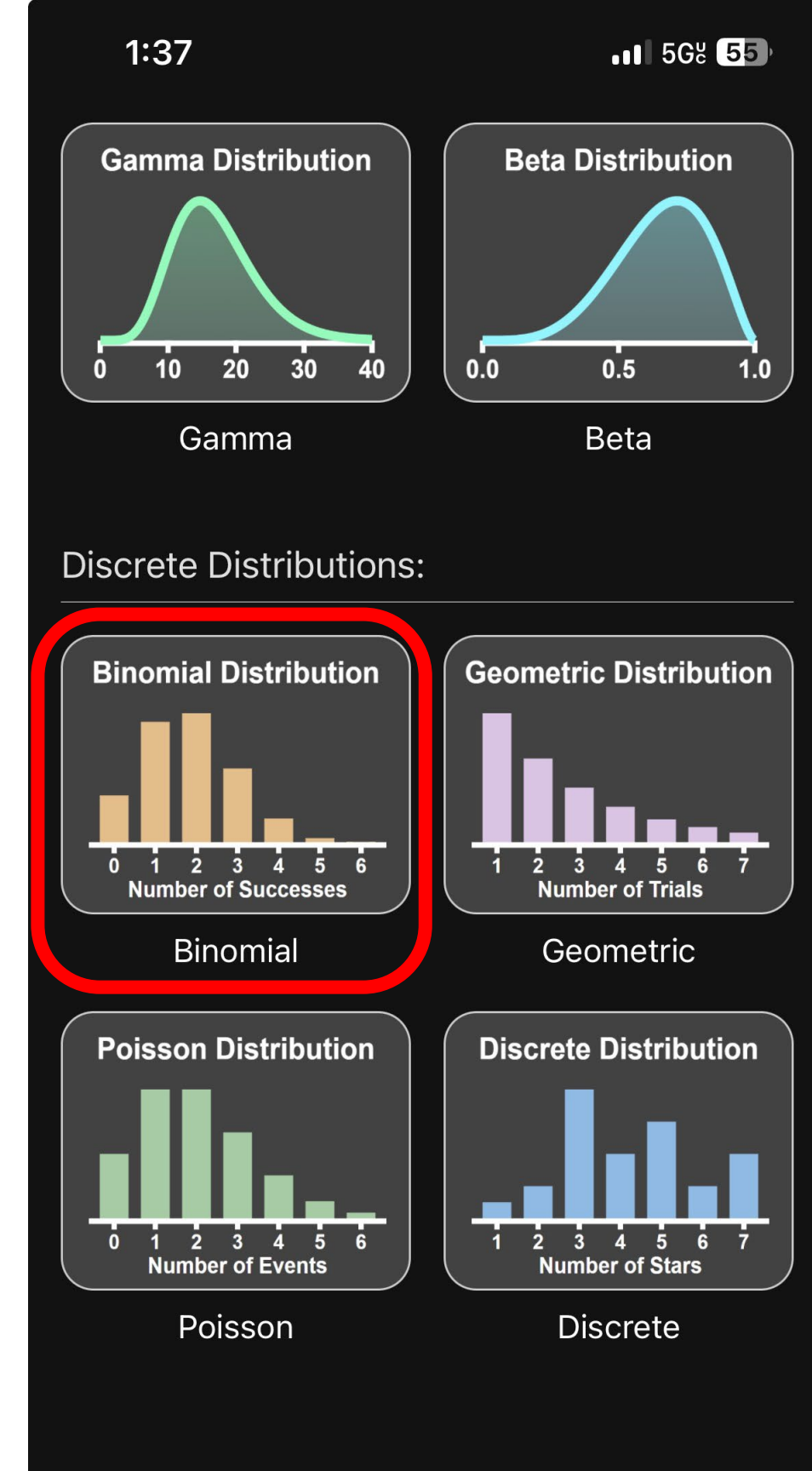
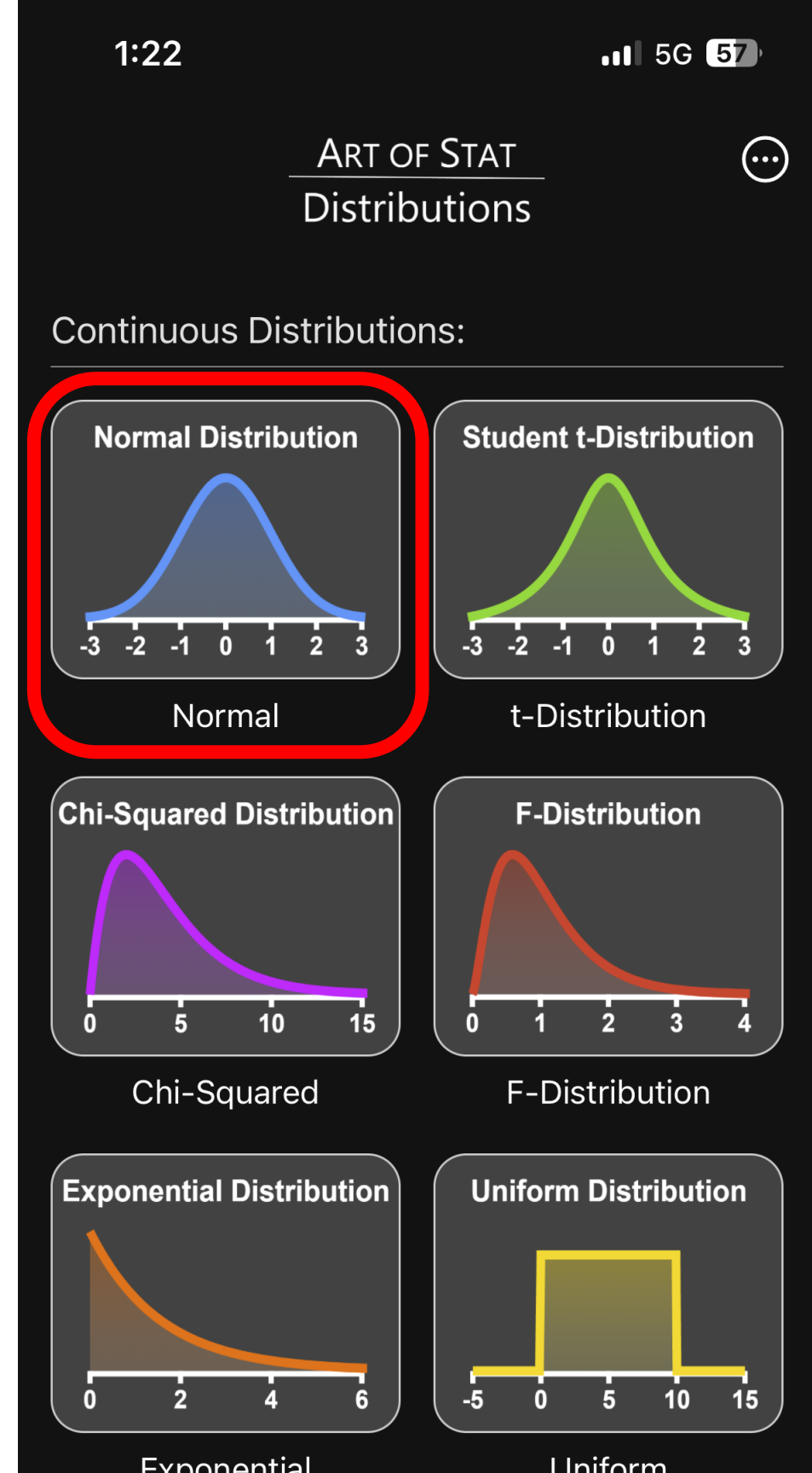


Stacked bar charts

Art of Stat: Distribution

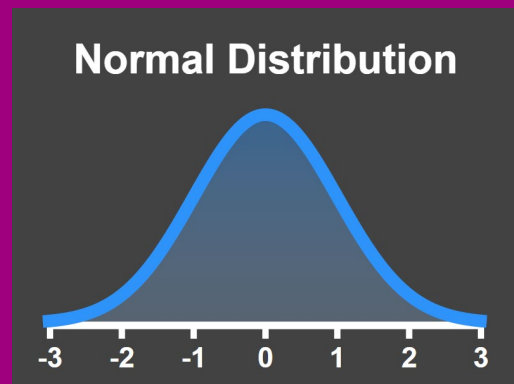


Explore & Visualize
Discrete and
Continuous Probability
Distributions



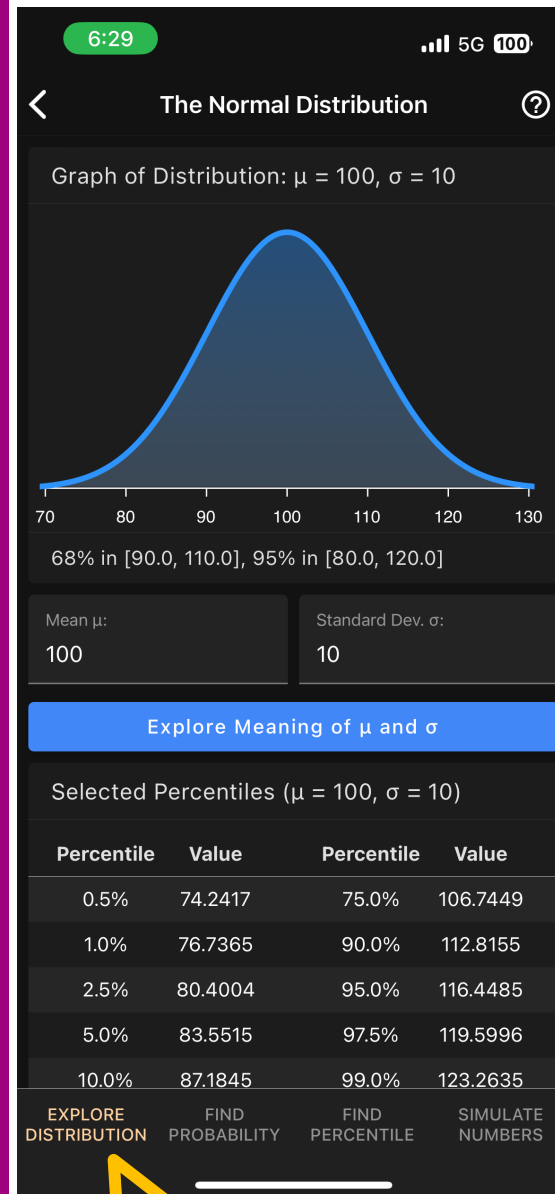
Art of Stat: Distributions

Normal Distribution

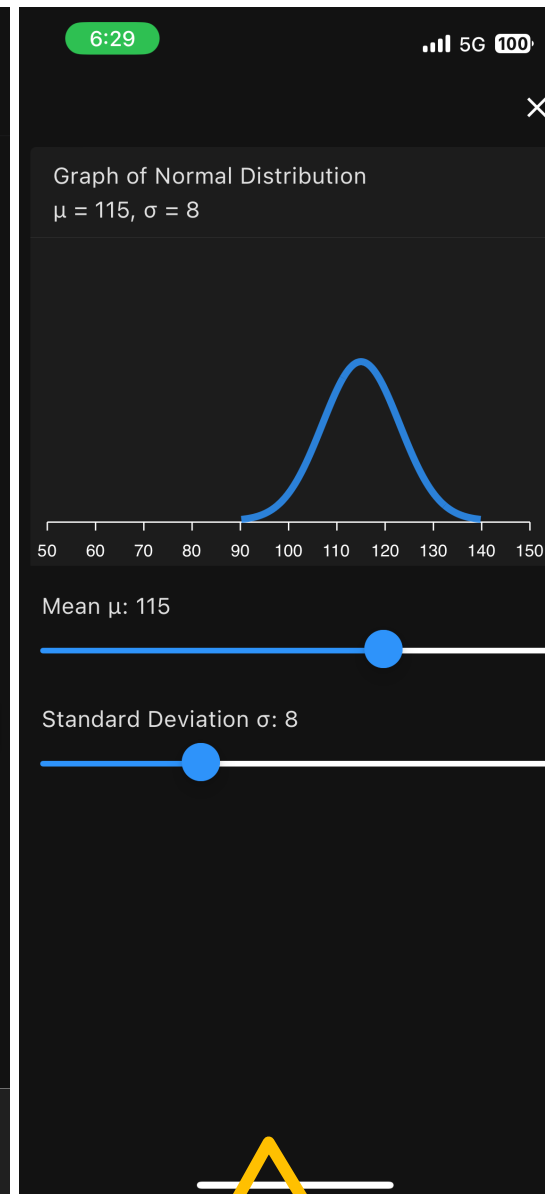


Screens:

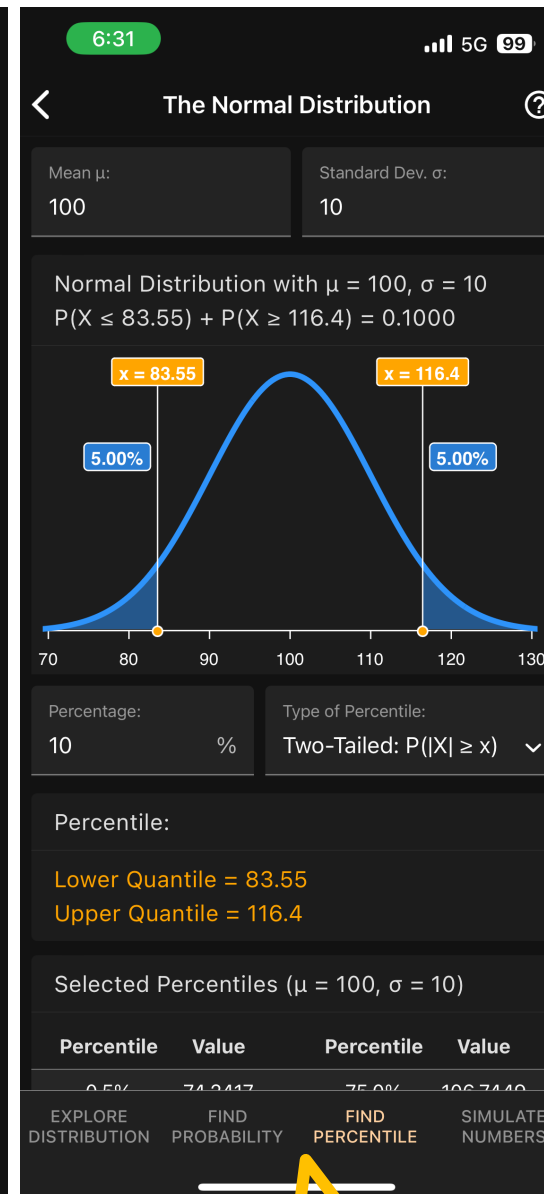
- Explore Distribution
- Find Probability
- Find Percentiles
- Histogram, Boxplot



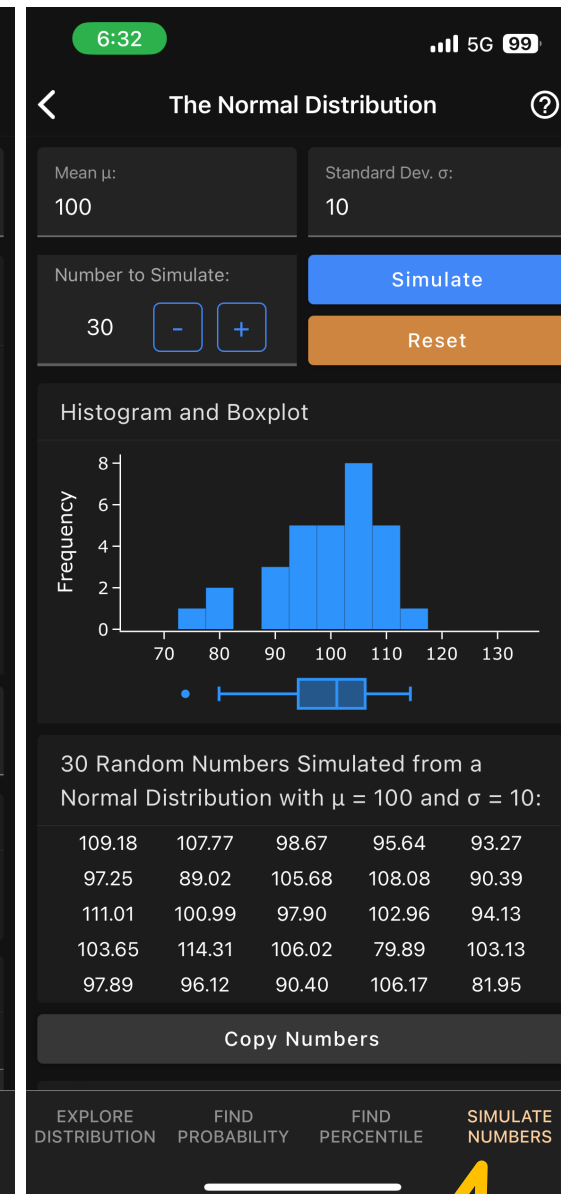
Enter values for the mean and standard deviation, and get an overview of all the essentials



To understand the meaning of “mu” and “sigma”, use sliders to see that these describe location and variability



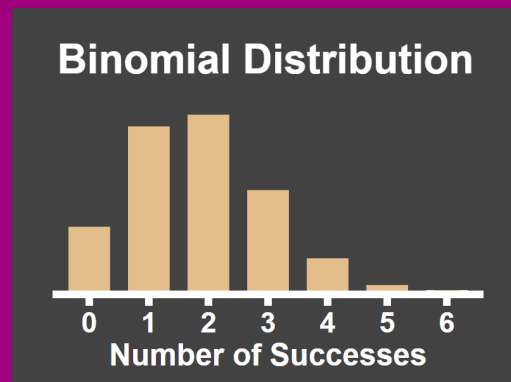
You can find probabilities and percentiles, and confirm them visually



Simulate from a normal distribution

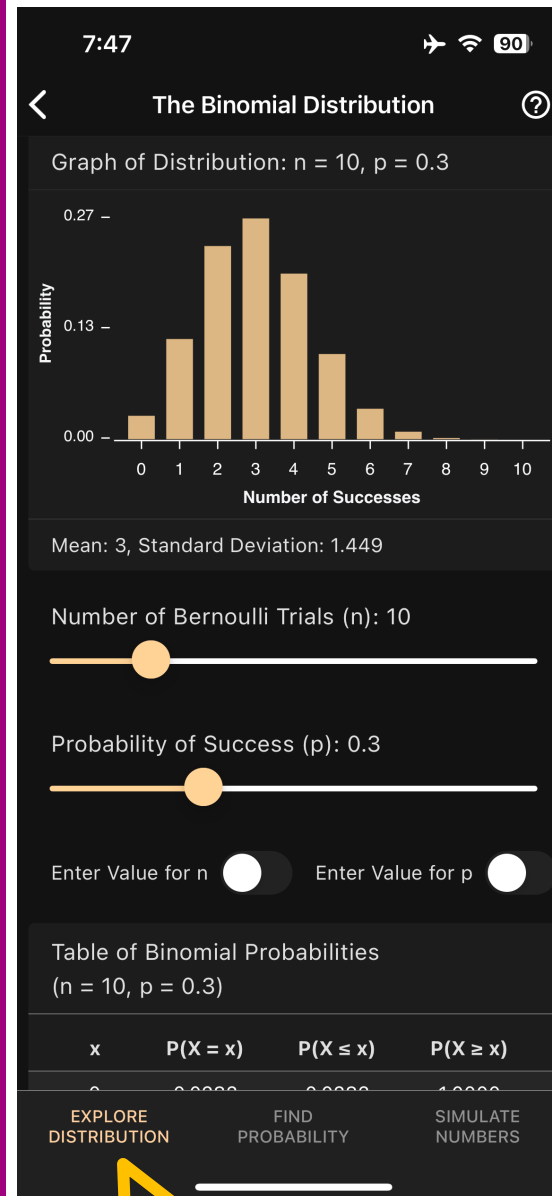
Art of Stat: Distributions

Binomial Distribution

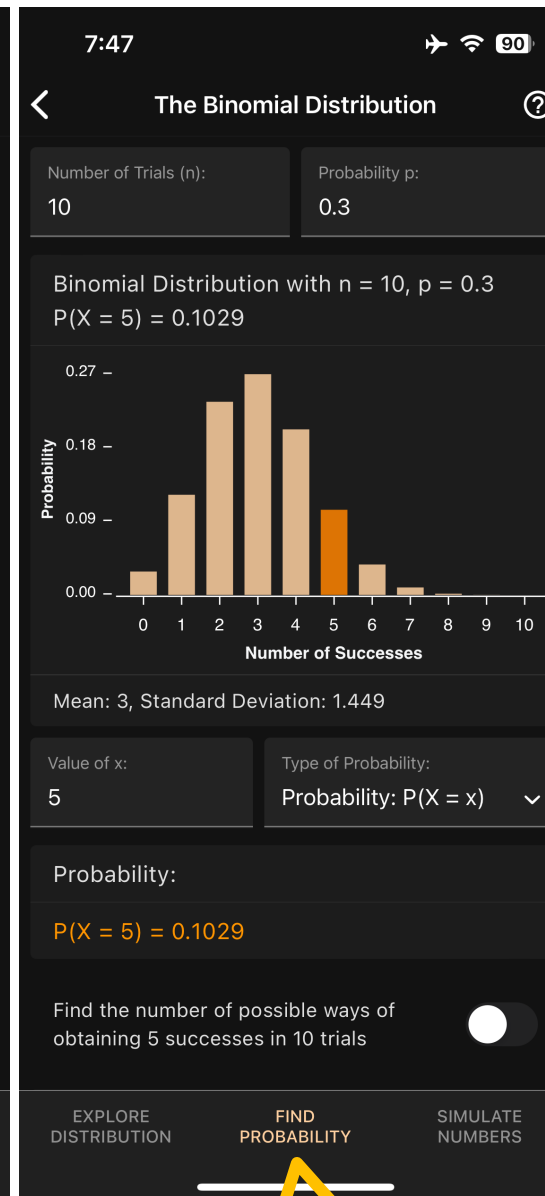


Screens:

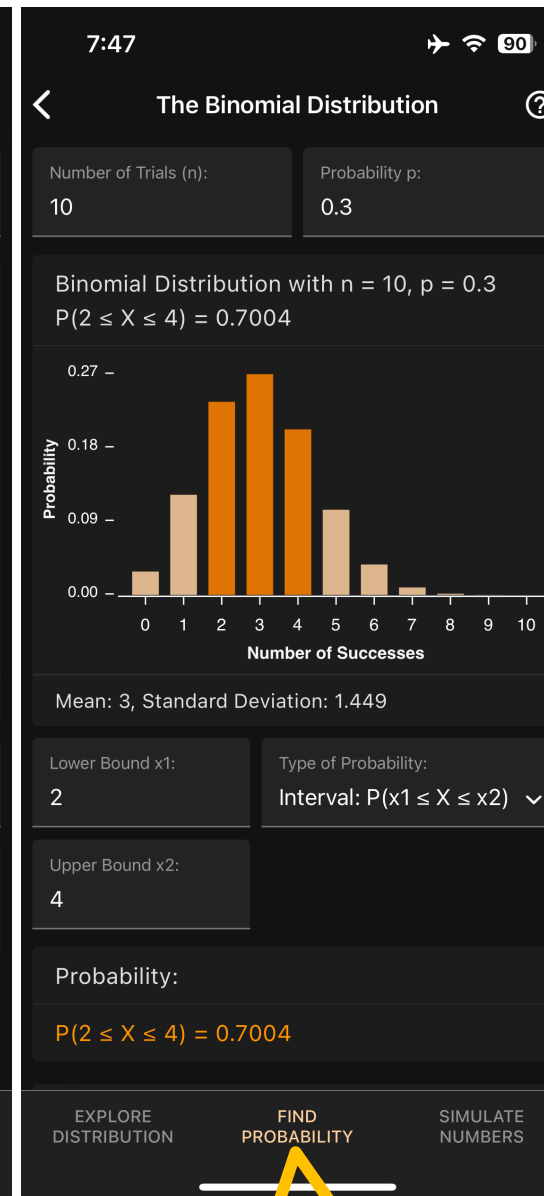
- Explore Distribution
- Find Probability
- Simulate Numbers



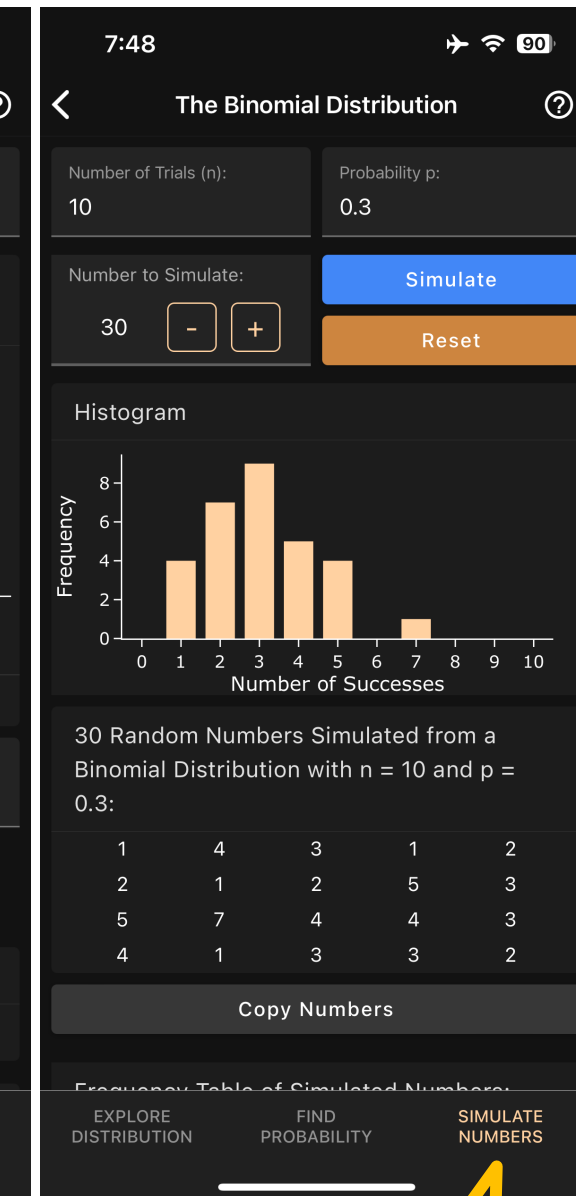
Visualize the binomial distribution, see how it changes with p, get the probability table for any value of n and p.



Easily find and visualize binomial probabilities...



... of any type, individual, lower tail, upper tail or interval.

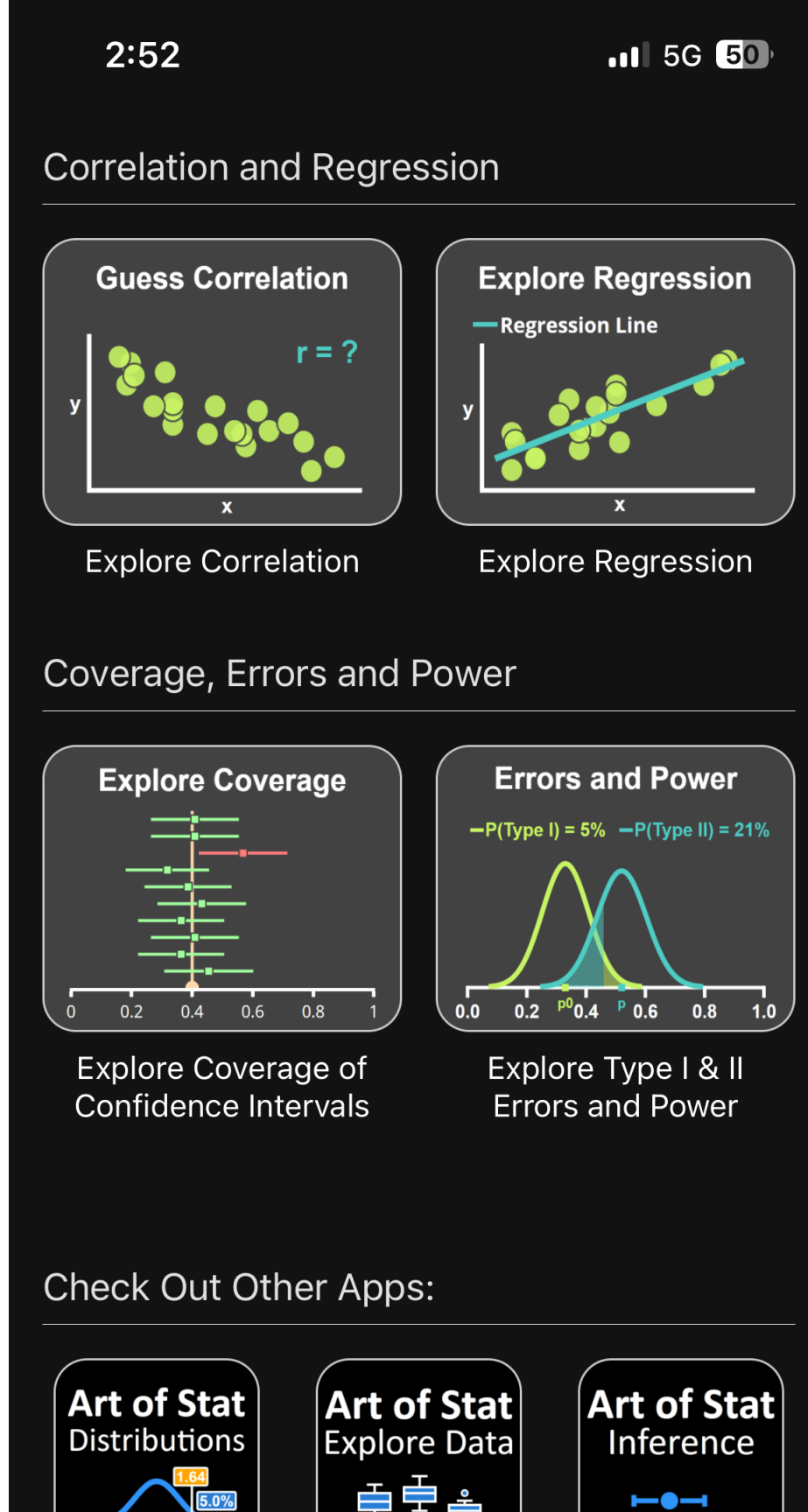
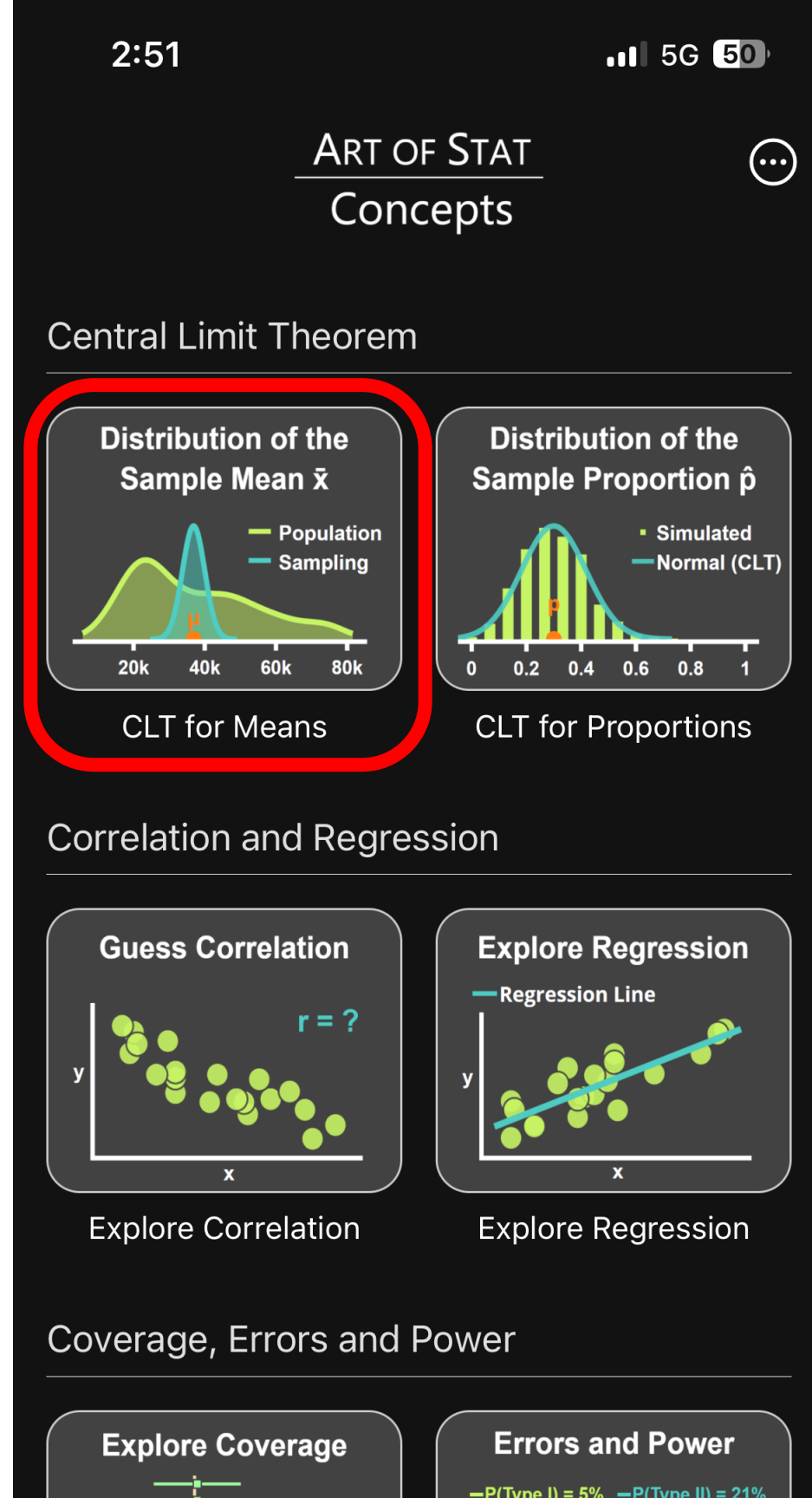


Simulate from a binomial distribution

Art of Stat: Concepts

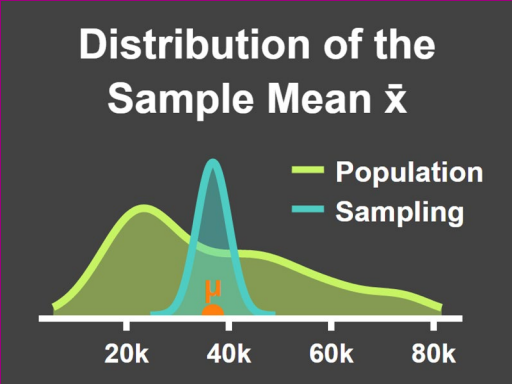


Central Limit Theorem,
Correlation, Regression,
Coverage & Power



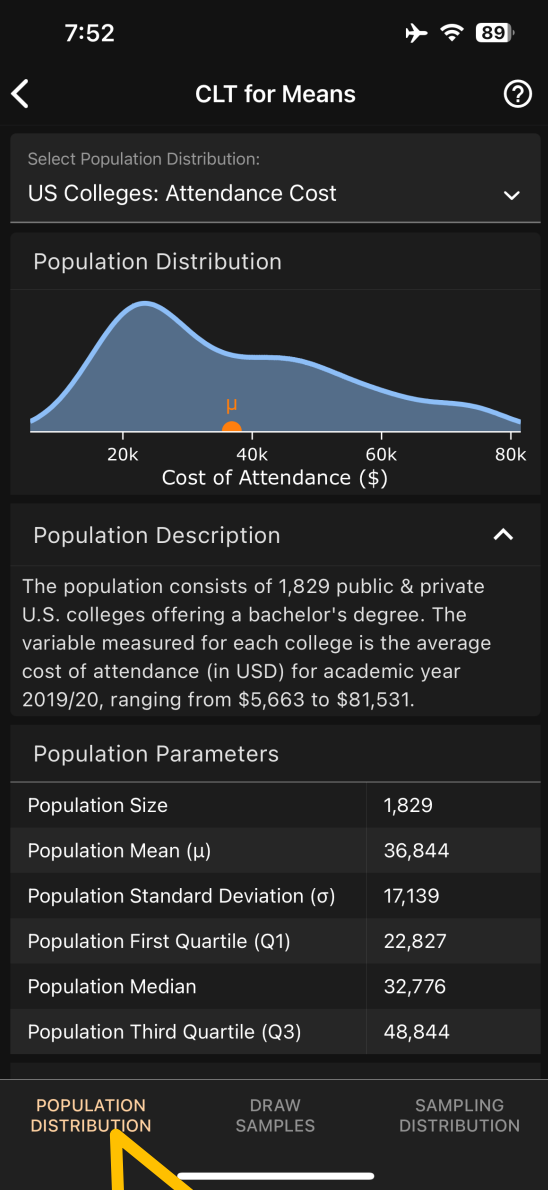
Art of Stat: Concepts

Central Limit Theorem for Means

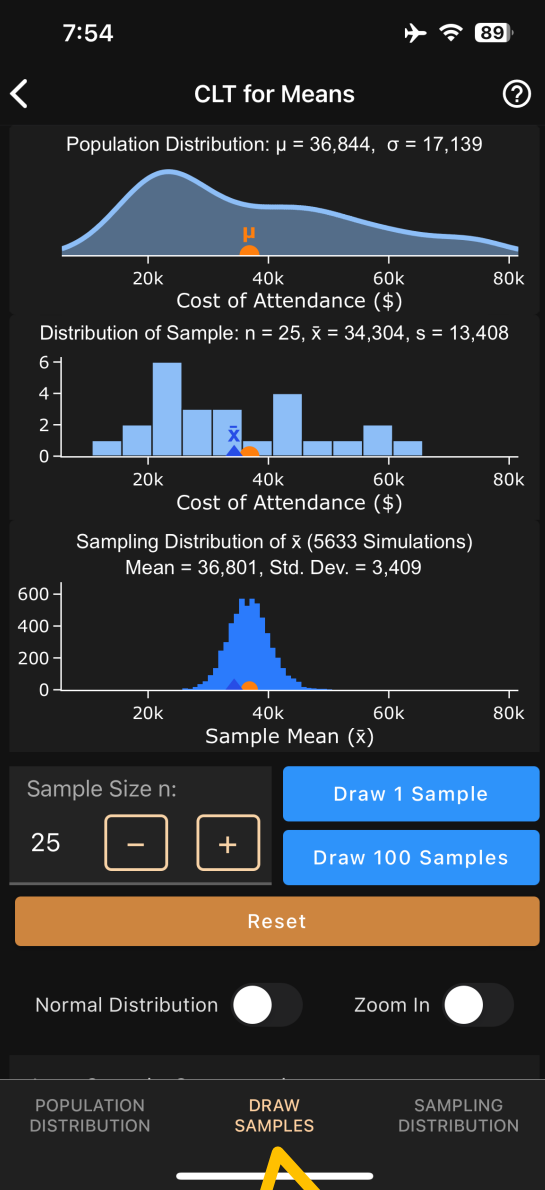


Screens:

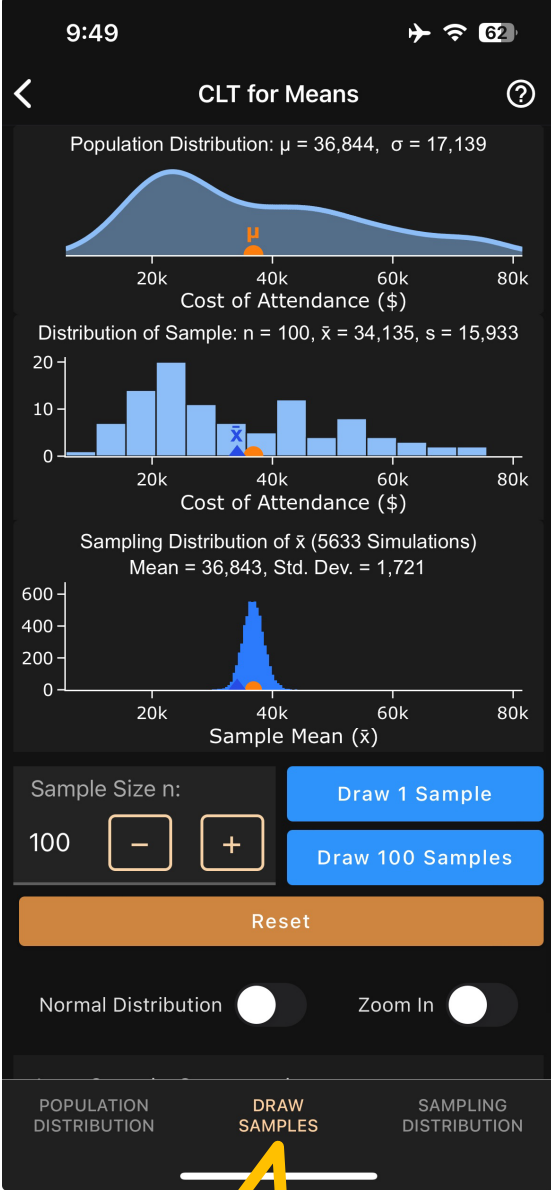
- Population Distribution
- Draw Samples
- Sampling Distribution



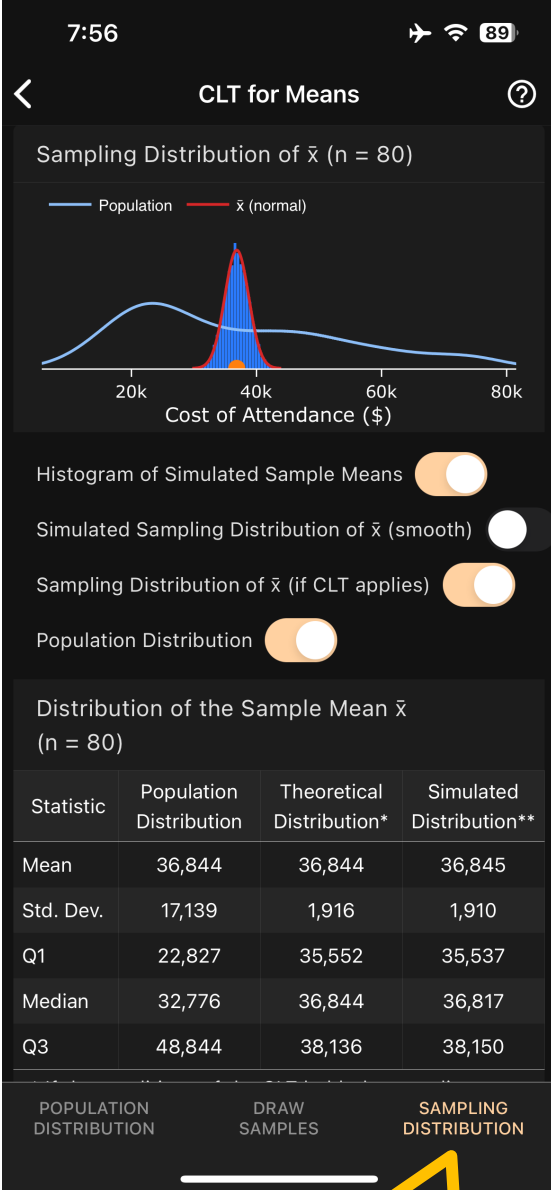
Look at a real population distribution, and its parameters (population mean, standard deviation). Several examples available.



Draw samples of a given size from this population distribution, and keep track of the sample means



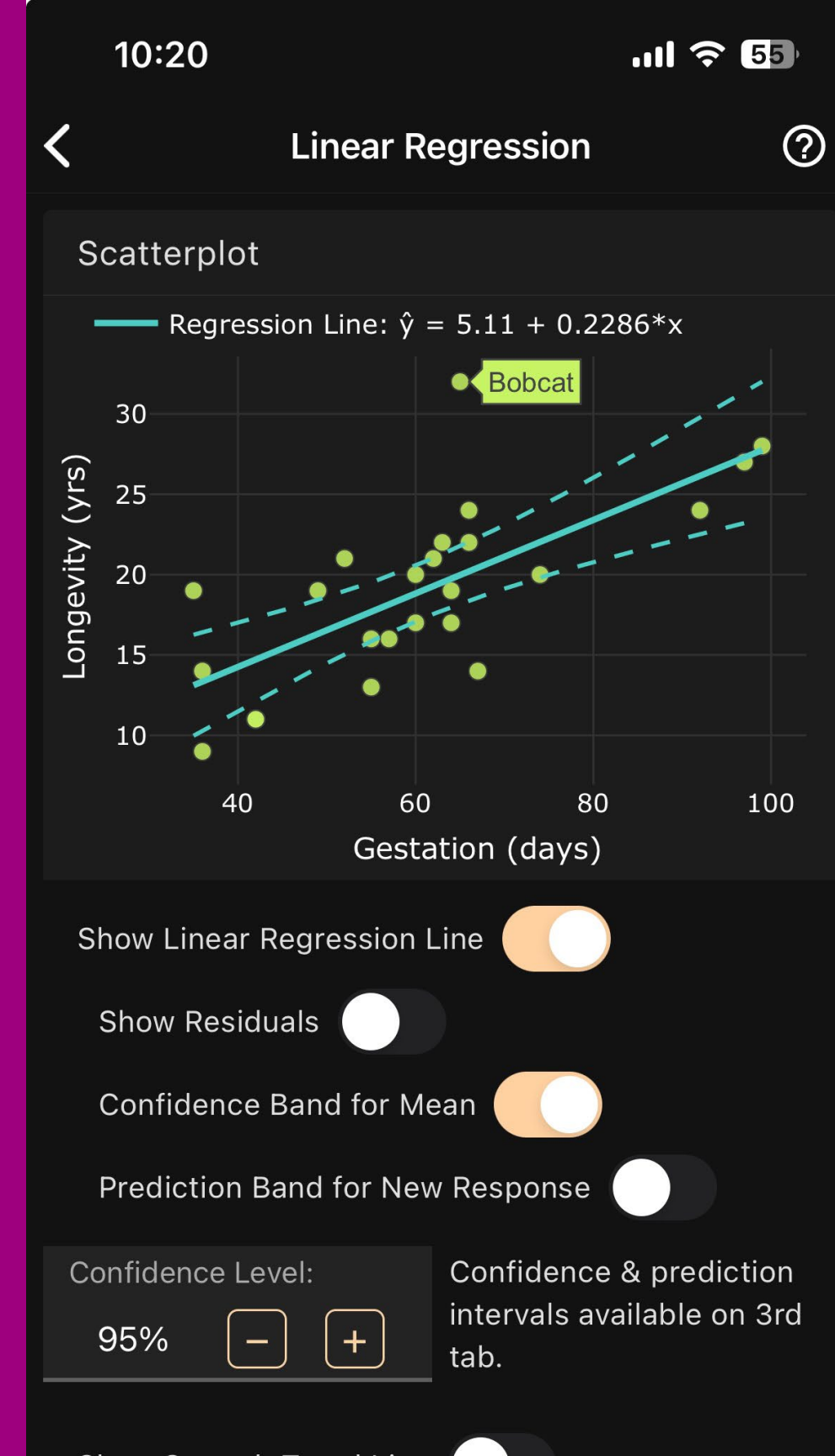
See what happens as the sample size increases



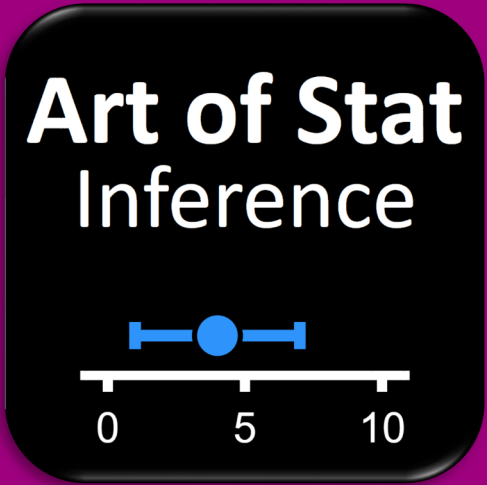
Show (simulated) sampling distribution, compare to population distribution

3) Case Studies (cont.)

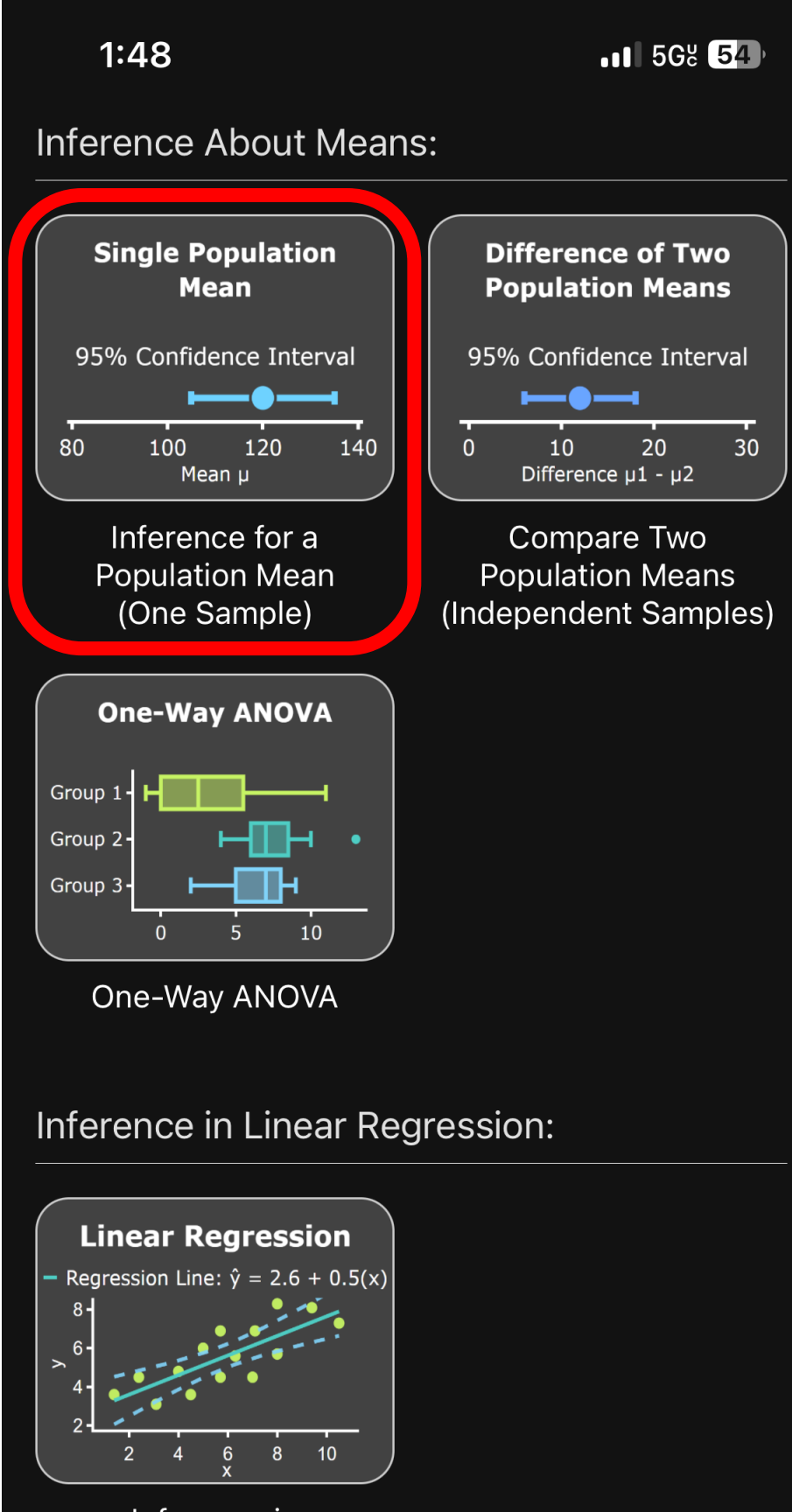
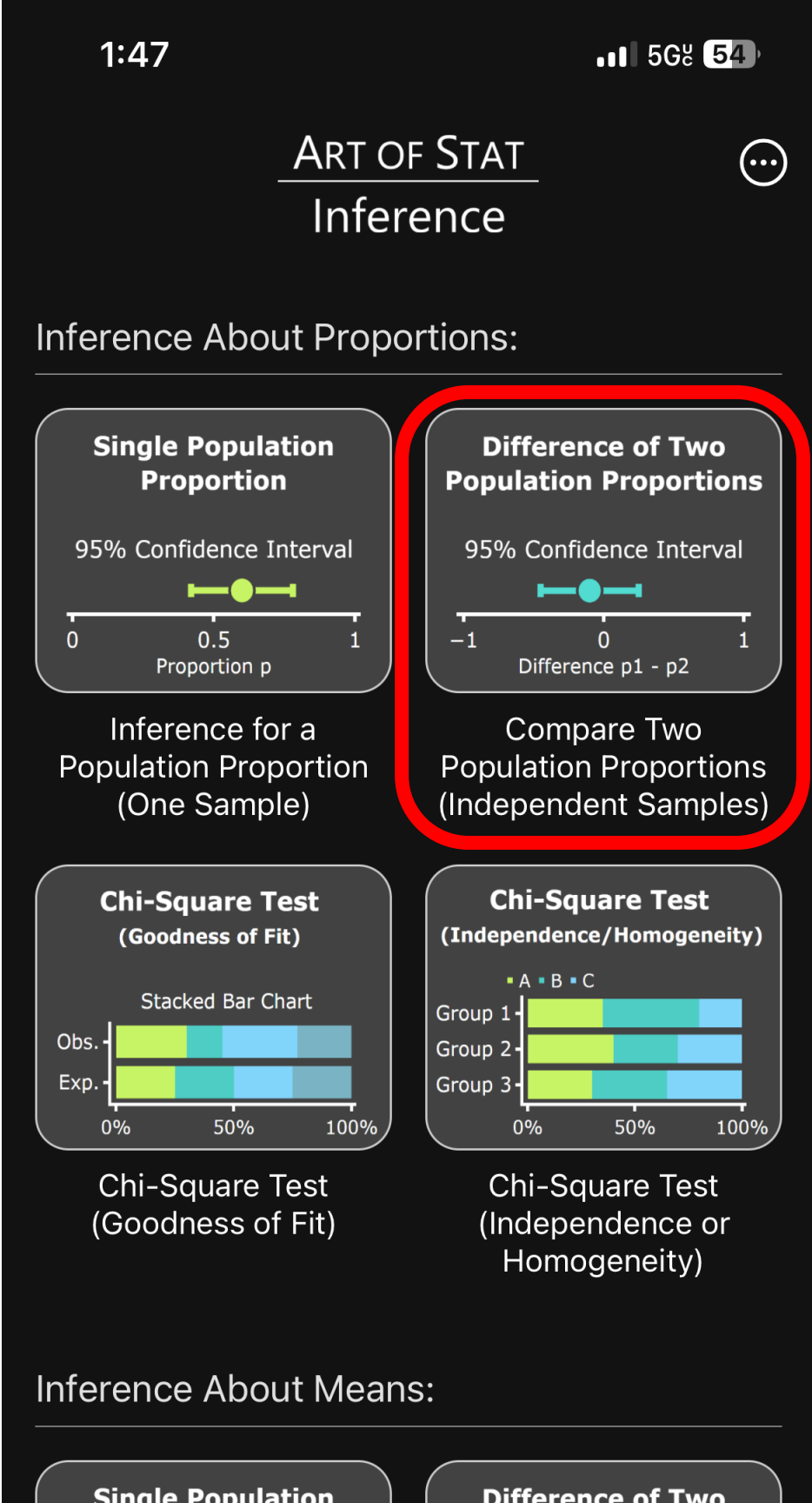
- Art of Stat: *Inference* app
 - Inference for a Population Mean
 - Inference Comparing Two Population Proportions
- Art of Stat: *Regression* app
 - Linear Regression



Art of Stat: Inference

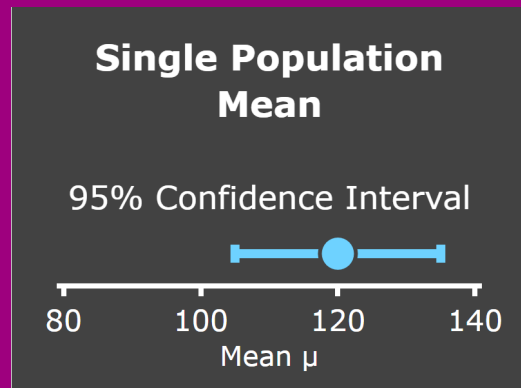


Confidence Intervals &
Hypothesis Tests



Art of Stat: Inference

Inference for a Population Mean



- Screens:
- Enter Data
 - Confidence Interval
 - Hypothesis Testing

10:35

Inference for a Mean

Enter Data:
Open Sample Datasets

Select Dataset:
Online Lending

Loan	Loan Amount	Duration	Interest Rate
1	35000	36	13.6
2	12000	60	16.1
3	15000	36	11.8
4	3025	36	15.1
5	9000	36	14.5
6	20000	36	6.5
7	12500	60	7.8

Showing all 200 rows, and all 8 columns (swipe left).

Select Variable:
Loan Amount

Enter Population Standard Deviation

Note: Only switch on if you know the population standard deviation σ and want to use it for inference.

Descriptive Statistics for Loan Amount:

ENTER DATA CONFIDENCE INTERVAL HYPOTHESIS TEST

Type in or copy & paste data, load CSV file, or use example dataset

8:09

Inference for a Mean

Descriptive Statistics for Loan Amount:

Statistic	Value
Sample Size (n)	200
Sample Mean (\bar{x})	16604
Sample Standard Deviation (s)	9802
Minimum	1000
First Quartile (Q1)	10000
Median	15000
Third Quartile (Q3)	21437.5
Maximum	40000
Interquartile Range (IQR)	11437.5
Range (Max - Min)	39000

Adjust Number of Digits

Histogram

A histogram showing the frequency distribution of loan amounts. The x-axis is labeled 'Loan Amount' and ranges from 0 to 40k. The y-axis is labeled 'Frequency' and ranges from 0 to 40. The bars are light blue.

ENTER DATA CONFIDENCE INTERVAL HYPOTHESIS TEST

Immediately get descriptive statistics and graphs to check assumptions

8:10

Inference for a Mean

Confidence Interval for the Population Mean μ :

Statistic	Value
Sample Size (n)	200
Sample Mean (\bar{x})	16604
Sample Standard Deviation (s)	9802
Standard Error (se) of the Sample Mean (s/\sqrt{n})	693
Confidence Level	95%
t-score (df = 199, α = 5%)	1.972
Margin of Error (me)	± 1367
Lower Bound for μ	15237
Upper Bound for μ	17971

μ is the population mean of Loan Amount.

95% Confidence Interval (15237, 17971)

A horizontal number line with a central point at 16604. A blue line segment with vertical end caps extends from 15237 to 17971, representing the 95% confidence interval.

Confidence Level: 95%

ENTER DATA CONFIDENCE INTERVAL HYPOTHESIS TEST

Obtain confidence interval for mean, including all intermediate steps. Change slider for confidence coefficient.

8:11

Inference for a Mean

Null Value: 15000

Alternative Hypothesis: Two-Sided

Hypothesis Test for the Population Mean μ :

Null Hypothesis	$H_0: \mu = 15000$
Alternative Hypothesis	$H_a: \mu \neq 15000$
Sample Mean (\bar{x})	16604
Sample Standard Deviation (s)	9802
Standard Error (se) of the Sample Mean (s/\sqrt{n})	693
Test Statistic (t, df = 199)	2.31
P-value	0.0217

μ is the population mean of Loan Amount.

t-Distribution with df = 199
Test Statistic: t = 2.31, P-value = 0.0217

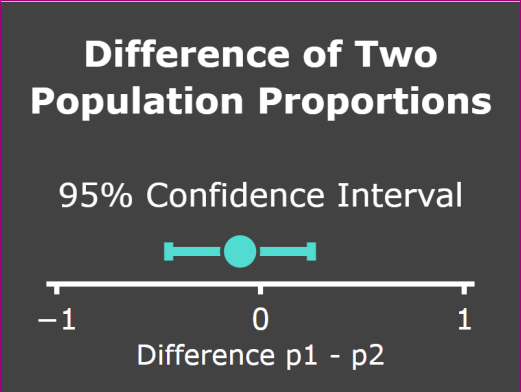
A t-distribution curve with a peak at 0. The x-axis ranges from -4 to 4. Two vertical lines are drawn at t = -2.31 and t = 2.31. The area under the curve to the right of t = 2.31 is shaded green and labeled 1.08%.

ENTER DATA CONFIDENCE INTERVAL HYPOTHESIS TEST

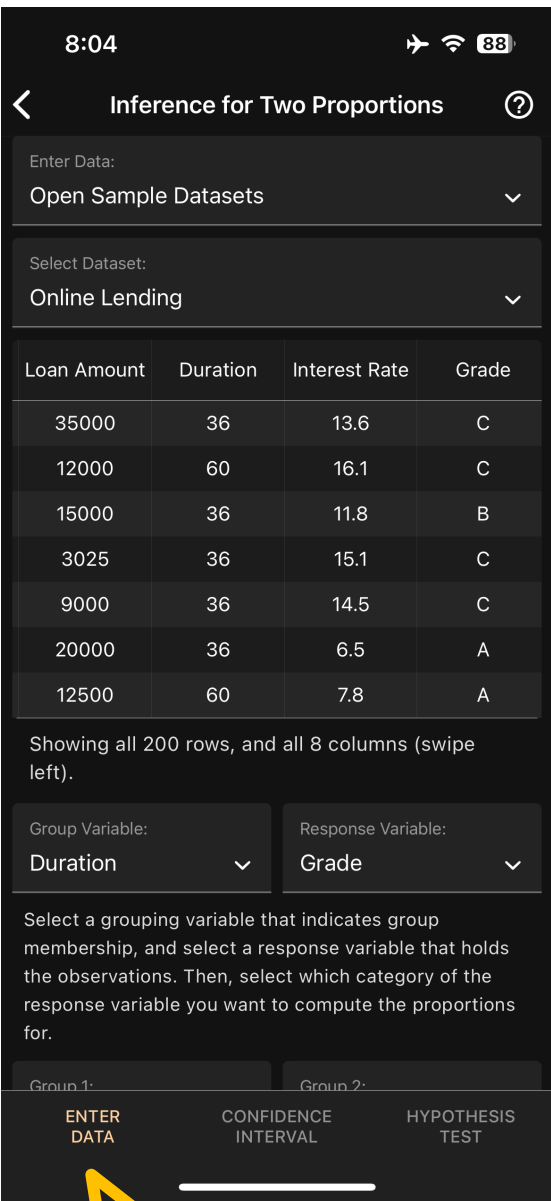
Carry out t-test, and obtain all intermediate steps leading to P-value. Visualize P-value on t-distribution.

Art of Stat: Inference

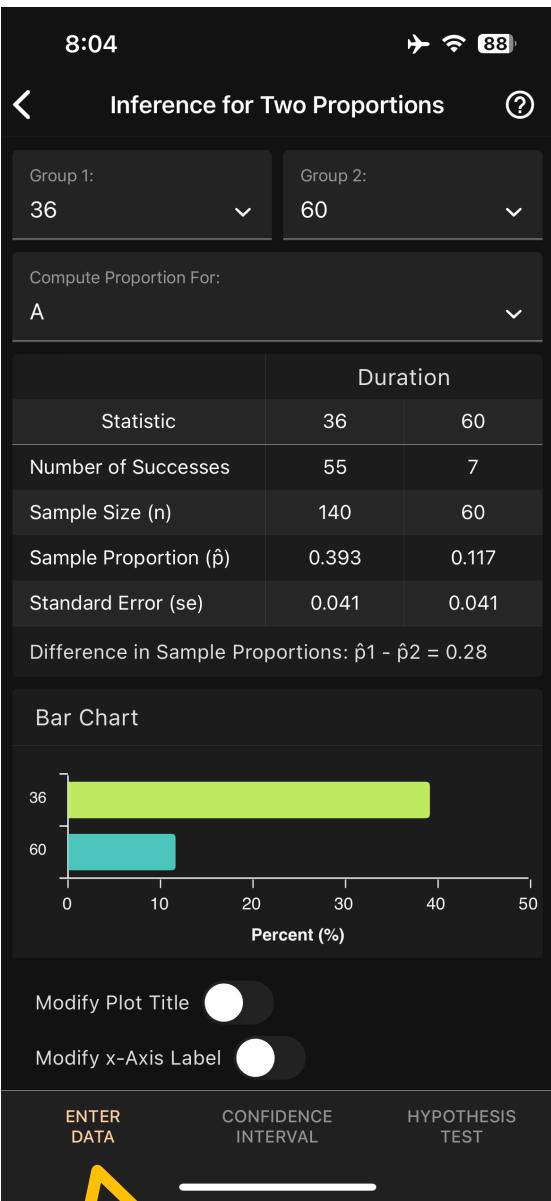
Inference for a Population Mean



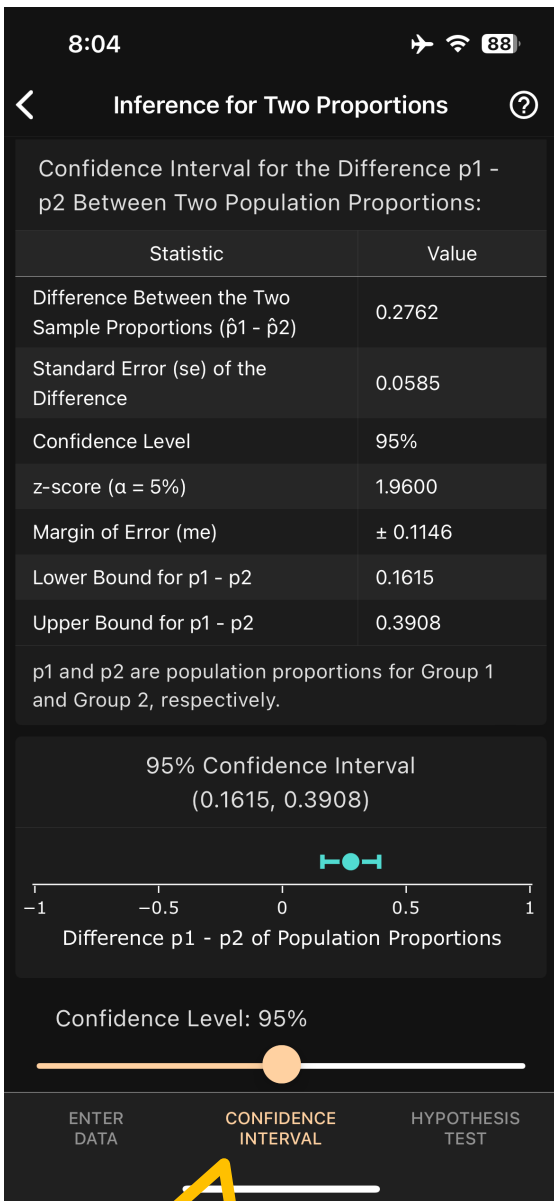
- Screens:
- Enter Data
 - Confidence Interval
 - Hypothesis Testing



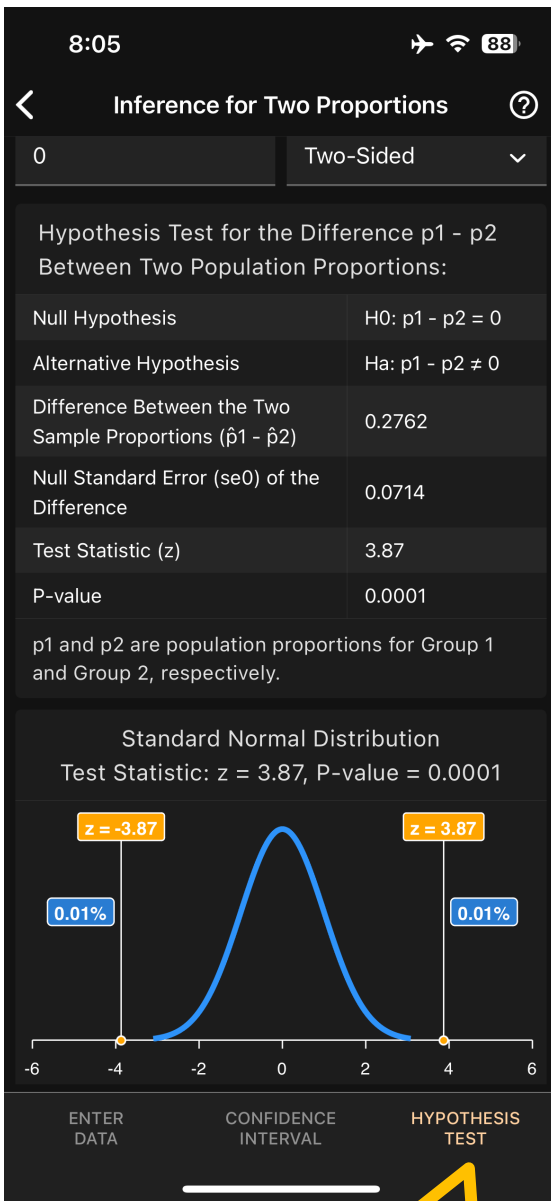
Type in number of successes and trials (not shown), or load CSV file, or use example dataset



Immediately get sample proportions in each group and bar graph to describe data

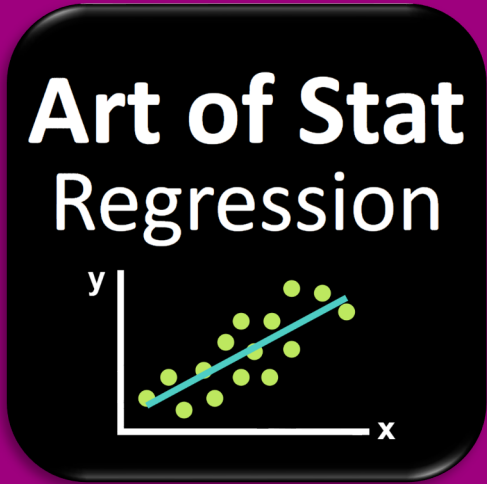


Obtain confidence interval for difference of proportions, including intermediate steps.

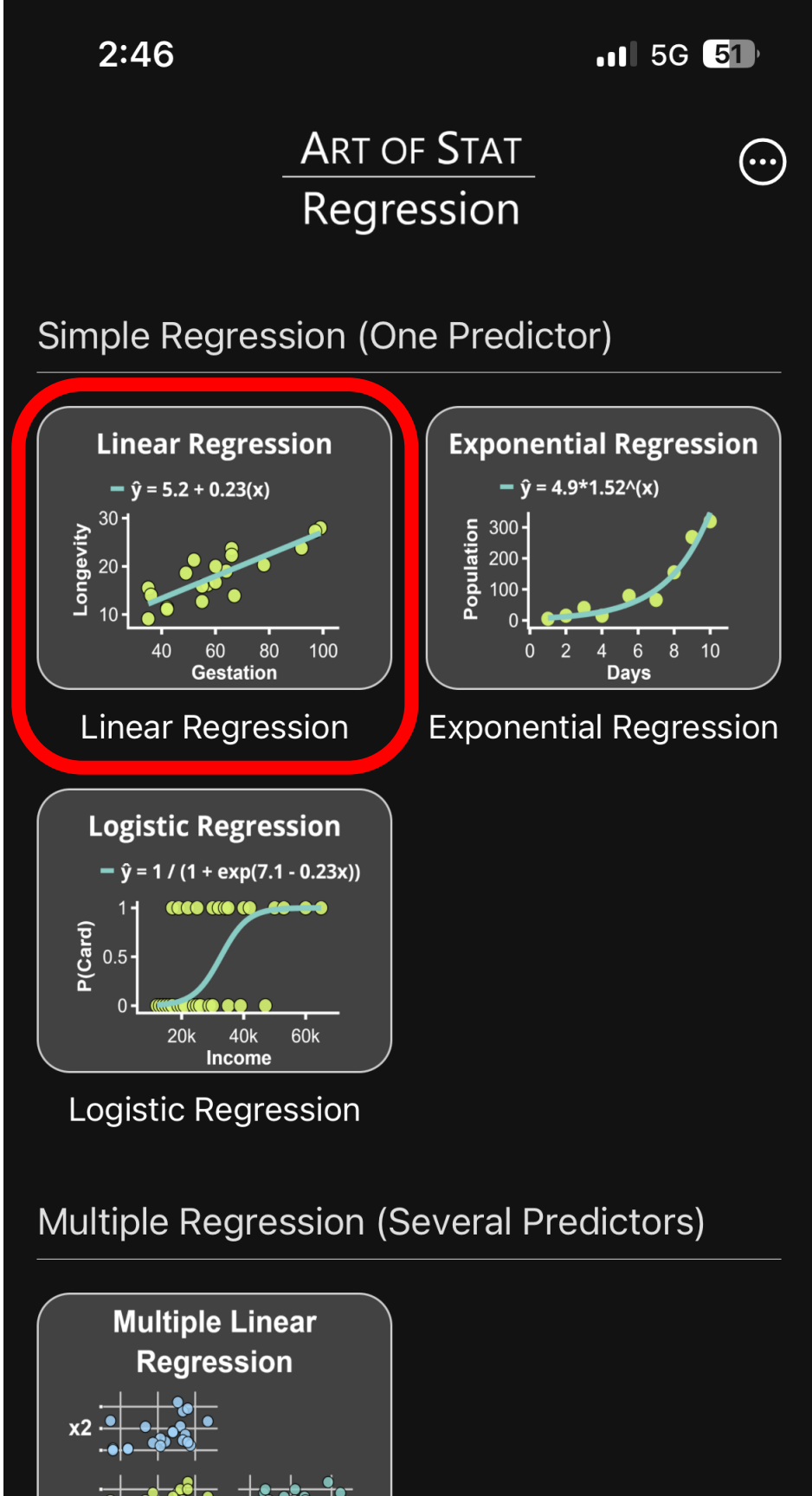


Carry out hypothesis test. Visualize P-value on normal distribution graph.

Art of Stat: Regression

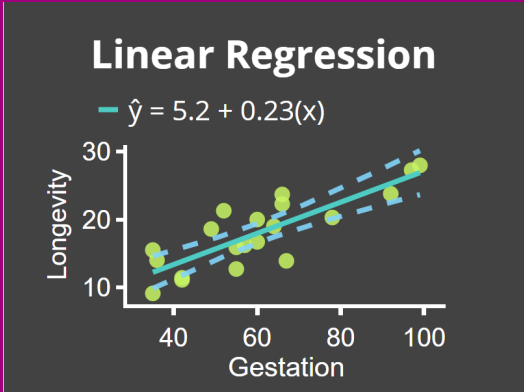


Simple Linear and
Logistic Regression &
Multiple Linear
Regression



Art of Stat: Regression

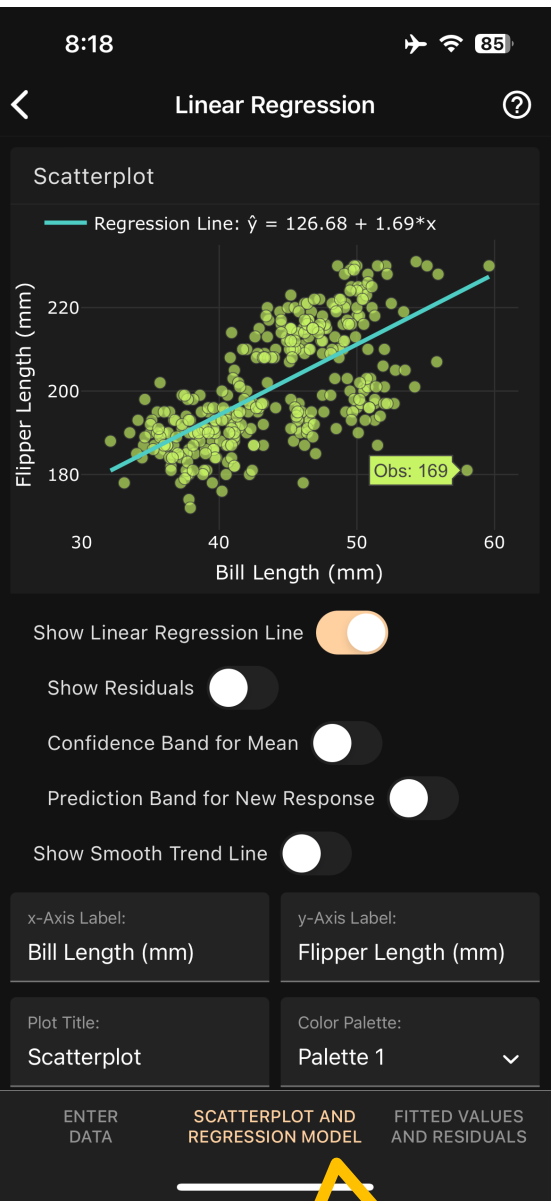
Linear Regression



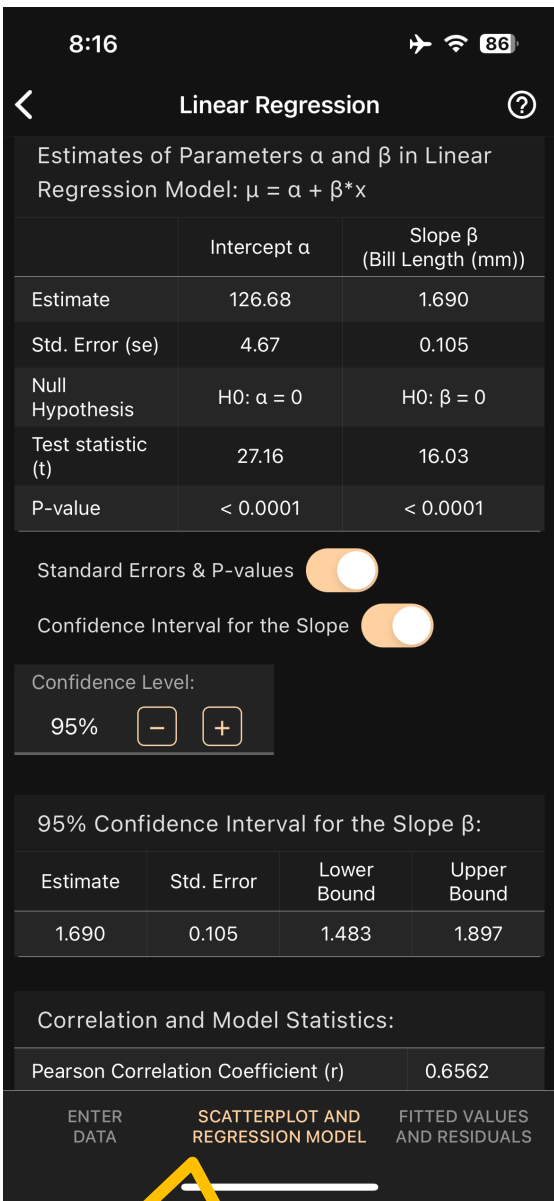
- Screens:
- Enter Data
 - Scatterplot & Model
 - Fitted Values, Residuals



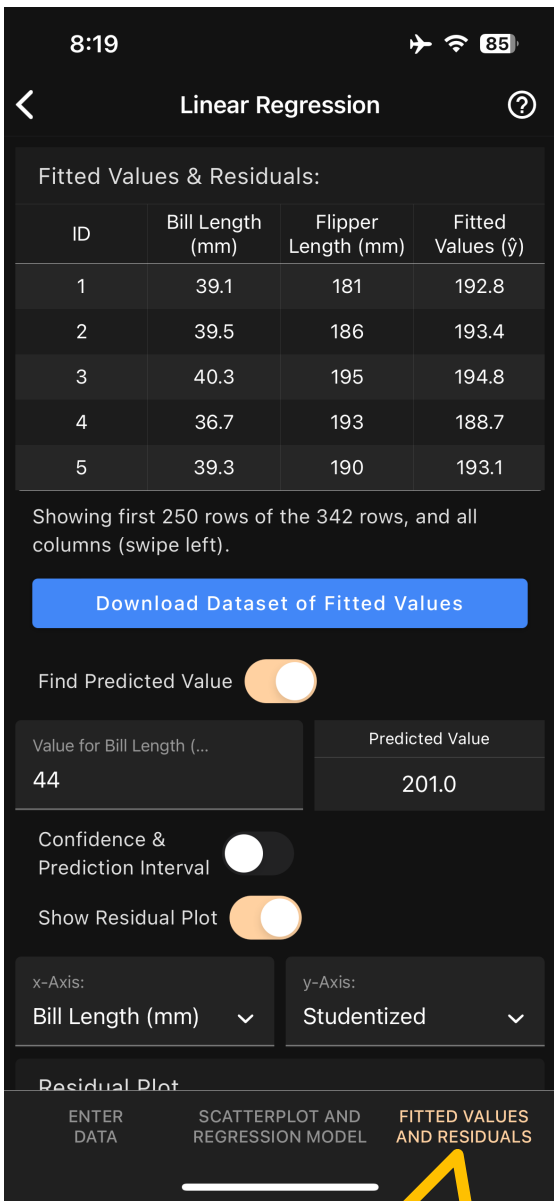
Type in or copy & paste data, load CSV file, or use example dataset.



Obtain scatterplot and superimpose linear regression line. Identify observations.



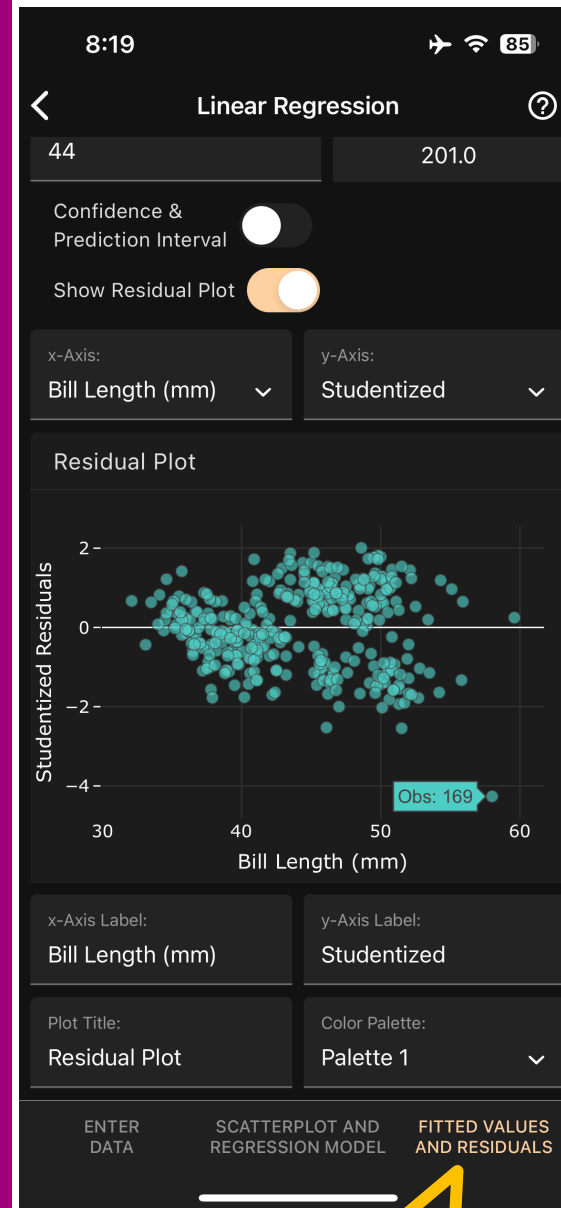
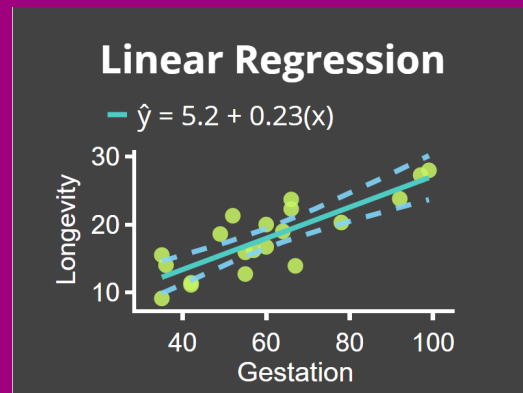
Get estimates of intercept and slope, their standard errors, and P-values. Get R^2 .



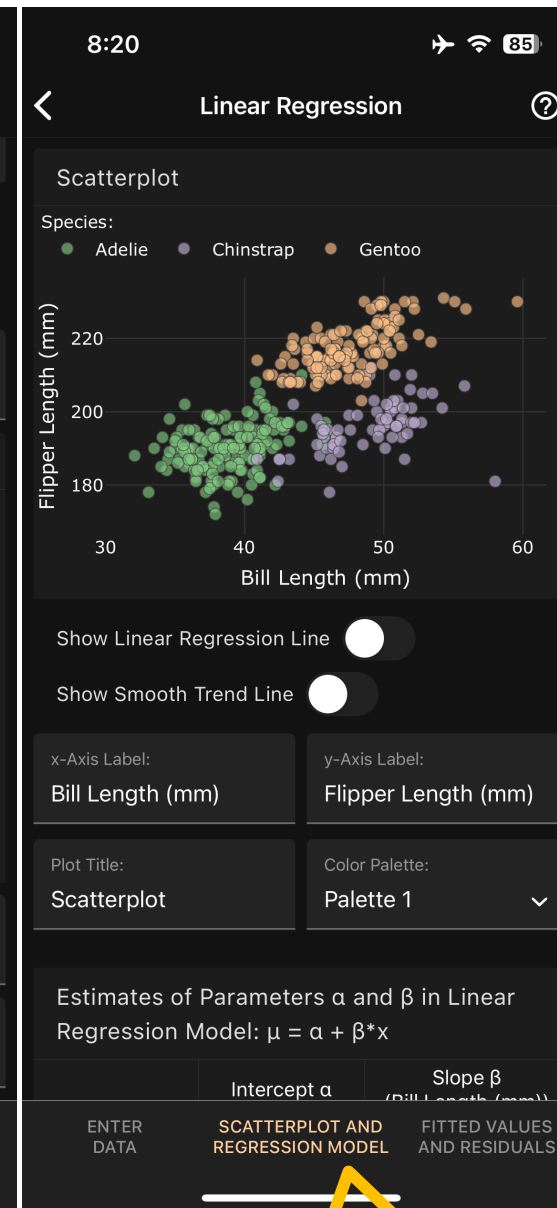
Obtain fitted values, and make predictions for new x values.

Art of Stat: Regression

Linear Regression



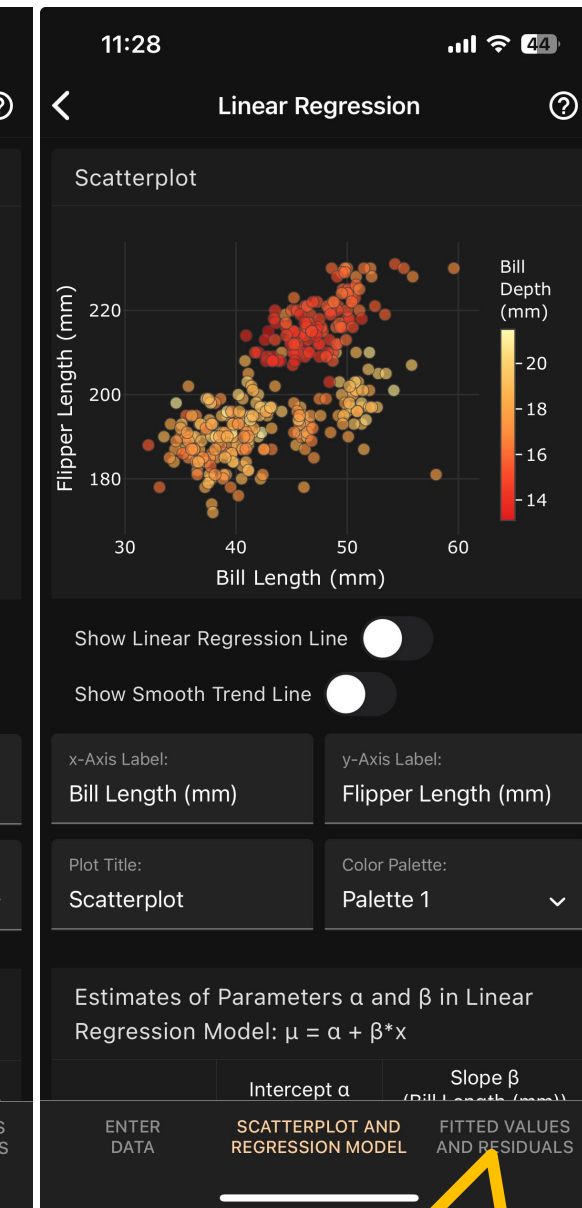
Obtain residual plot, using standardized residuals.



Use a third variable to color the dots (selected in Enter Data screen) to reveal group structures.



Tab on legend to look at only one group.



Can also color dots according to a third continuous variable