

Practical stats tips for surviving 4th year

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UNE Fourth Year Intensive 2022

**DON'T
PANIC**

Can't I wait till I get the data?

- No!!! It's much better if you understand what you're doing BEFORE you even collect any data
- Then you can design a good study that will produce results you can interpret easily
- There are some things you may not have learned (or have forgotten) in undergrad that will be helpful to know now
- You should be able to write your Methods and Analysis sections before you even see the data (and ideally, preregister the project).

Preregistration

The banner features the OSF REGISTRIES logo at the top left, followed by a large search bar with the placeholder "Search registrations...". Below the search bar, a message states "287,086 searchable registrations as of February 5, 2019". To the right of the search bar is a "Search" button. The background is a dark blue gradient with faint white geometric patterns.

Browse Registrations [See more](#)

[See more](#)

2016, Deutchman, The Role of Framing Effects, the Dark Triad, and Empathy in Predicting Behavior in a One-shot Prisoner's Dilemma

Paul Michael Deutchman, Jess Sullivan

Pragmatic adaptation: testing whether inference judgments are susceptible to bias over the course of an experiment

Stephen Politzer-Ahles, Edward Matthew Husband

Does Practicing Cognitive Reappraisal Enhance Impulse Inhibition during Subsequent Risk Taking?

Joao F Guassi Moreira, Emilia Ninova, Jennifer A Silvers

Local predictors of variation in plant phenology

Margaret Kosmala

Promoting School Belongingness and Academic Performance: A Multisite Effectiveness Trial of a Scalable Student Mindset Intervention

[25.0-IM-S25STAT-A.zip](#) ... [25.0-IM-S25STAT-A.zip](#) ... [25.0-IM-S25STAT-A.zip](#) ... [25.0-IM-S25STAT-A.zip](#) ... [python-3.7.2-macos.pkg](#) ... [25.0-IM-S25STATC.dmg](#) ... [25.0-IM-S25STATC.dmg](#) ...

<http://help.osf.io/m/registrations/l/524205-register-your-project>

Guide to Preregistration and Registered Reports

Useful paper here

Henderson, E. L. (2022, January 25). A guide to preregistration and Registered Reports. <https://doi.org/10.31222/osf.io/x7aqr>

Abstract: When you preregister (or create a pre-analysis plan) you specify your research plan and publicly register it in advance of undertaking your study. The preregistration is a time-stamped, read-only plan. When this plan is extended and undergoes formal peer review at a journal ahead of the research, it is called a Registered Report. This preprint explains why and how to write a preregistration or Registered Report, along with information on the types of work this applies to, whether preregistration and Registered Reports “work”, and a list of resources and templates.

Tools

| Program | Advantages | Disadvantages |
|------------------|--|--|
| SPSS | Powerful, reasonably simple to use, you already know it | Expensive, too much output, need to run analysis again if you get it wrong, terrible graphs. |
| jamovi | FREE, very simple to use, intuitive, makes nice graphs, powerful, lots of help online | May not have some of the more complex analyses you need, your supervisor may need persuading |
| JASP | FREE, also simple to use, fantastic for Bayesian analyses, also does SEM and machine learning! | Not quite as good for non-parametric tests and traditional stats, graphs not as pretty |
| R/RStudio | FREE, extremely powerful, makes AMAZING plots, best for replicability | Steep learning curve, sometimes not super easy to interpret output, need to Google a lot. |

If statistics programs/languages were cars...



Credit - Darren L. Dahly from [Twitter](#)

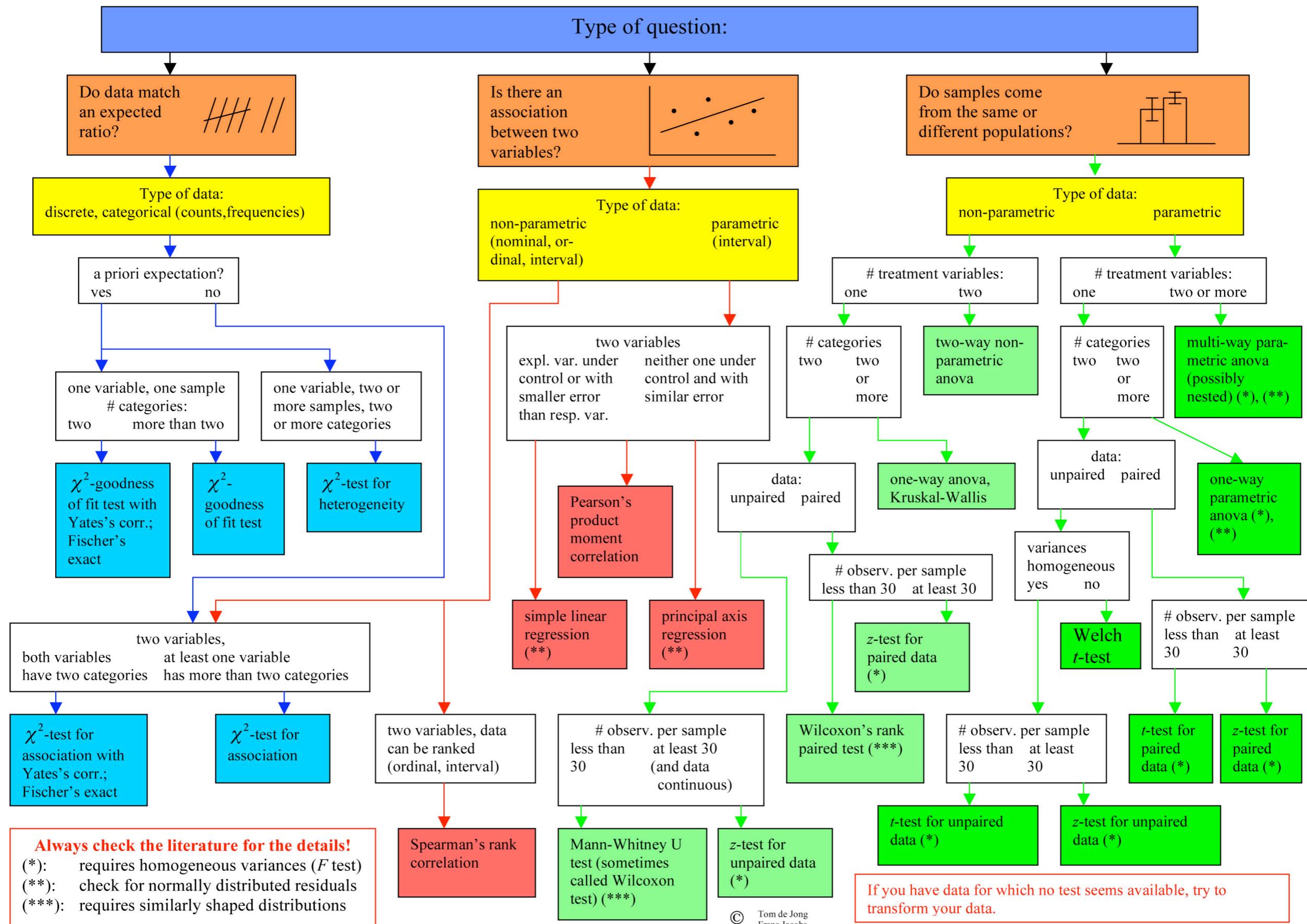


updated....



What statistic to use?

- Questions to start with: What is your dependent variable? What is/are your independent variable/s?
- Is your design between-subjects or within-subjects?
- Is your DV interval/ratio (continuous) or categorical?
- Are your IVs interval/ratio (continuous) or categorical, or both?
- Are your assumptions [likely to be] met?



Neat tool in jamovi - Statkat - helps you decide!

2018_2019_FTT_data

Data Analyses

Coloration T-Tests ANOVA Regression Frequencies Factor Base R PPDA Flexplot EstimationStats Statkat ufs Linear Models TOSTER MAJOR jpower me

| Respons... | Gender | Age | FT_comp... | FT_score... | FT_sc... |
|---------------|--------|-----|------------|-------------|----------|
| R_2D1atGW... | 2 | 22 | mac | 48.4 | |
| R_1H6k0nB... | 2 | 28 | win | 70.4 | |
| R_3emJSw3... | 1 | 41 | win | 63.6 | |
| R_1oBwoTD... | 1 | 43 | ios | 69.8 | |
| R_20ZEmw5... | 1 | 51 | win | 66.8 | |
| R_2rCPDvw... | 1 | 46 | win | 54.6 | |
| R_3nkkJGg2... | 1 | 44 | mac | 63.0 | |
| R_1PS1m0F... | 2 | 38 | mac | 76.4 | |
| R_z2RAbkW... | 1 | 40 | win | 70.2 | |
| R_3oYMZA5... | 1 | 41 | win | 58.6 | |
| R_USeC98 | 4 | 25 | win | 52.4 | |

Single Variable
Relationships, Prediction, and Group Comparisons
Repeated Measurements

Data types for tests

| | Parametric | Non-parametric |
|------------------------|---------------------------|---------------------------------------|
| Assumed distribution | <u>Normal</u> | Any |
| Assumed variance | <u>Homogeneous</u> | Any |
| Typical data | <u>Ratio or Interval</u> | <u>Ordinal or Nominal</u> |
| Data set relationships | <u>Independent</u> | Any |
| Usual central measure | <u>Mean</u> | <u>Median</u> |
| Benefits | Can draw more conclusions | Simplicity; less affected by outliers |

Tests

| | Parametric | Non-parametric |
|----------------------------------|--|---------------------------------------|
| Choosing | <u>Choosing a parametric test</u> | <u>Choosing a non-parametric test</u> |
| Correlation test | <u>Pearson</u> | <u>Spearman</u> |
| Independent measures, 2 groups | <u>Independent-samples t-test</u> | <u>Mann-Whitney test</u> |
| Independent measures, > 2 groups | <u>One-way, independent-measures ANOVA</u> | <u>Kruskall-Wallis test</u> |
| Repeated measures, 2 conditions | <u>Paired-samples t-test</u> | <u>Wilcoxon signed-ranks test</u> |
| Repeated measures, >2 conditions | <u>One-way, repeated-measures ANOVA</u> | <u>Friedman test</u> |

Some examples

- Are people better at recognising upright faces compared to upside-down ones?
 - Extension: is this different for faces compared to objects?
- Do people who recall their dreams more often perform better on a short-term memory task?
 - Extension: Is this relationship affected by poor sleep?
- Did more men than women drop out of your experiment?

Expectation vs. reality

The dataset you're used to



Exercise_3_t-test_data.sav

Your 4th year dataset



Qualtrics_data_22_8_2022.sav

Get a preview of your data!

Qualtrics can generate random test responses!

The screenshot shows the Qualtrics interface for a survey titled "DASS21". The top navigation bar includes "Survey" (which is selected), "Actions", "Distributions", "Data & Analysis", and "Reports". Below the navigation is a toolbar with "Look & Feel", "Survey Flow", "Survey Options", and a "Tools" dropdown. The "Tools" dropdown menu is open, showing options like "Auto-Number Questions...", "Reset Recode Values...", "Collaborate", "Review" (which is selected and highlighted in blue), "Triggers", "Salesforce", "Quotas...", "Manage Reusable Choices...", "Scoring...", "Translate Survey...", "Versions", and "Import/Export". A sub-menu for "Review" is also open, listing "Search and Replace...", "Strip Formatting...", "Generate Test Responses..." (which is selected and highlighted in blue), "Check Survey Accessibility...", "Analyse Survey...", and "Turn off ExpertReview...". The main content area displays a survey page for "The DASS21". The page includes instructions: "Please read each statement and choose the one that best describes how you have felt applied to you over the past week. There are no right or wrong answers, just think about how you have been feeling on any statement." Below the instructions is a table with two rows of statements and five response options ("Not at all", "A little", "Good", "Applied to me very much, or most of the time", and "Extremely"). The first row contains the statement "I found it hard to wind down." and the second row contains "I was aware of dryness of my mouth.". The response options are represented by radio buttons.

You can use this to see what your data would look like & set up analyses

Data integrity tips

- ALWAYS save your data in a non-proprietary format (.csv is best).
- Avoid saving multiple versions if possible. Do save a raw version and a minimally processed version (e.g. deleting non-completers), but after that try to use filters rather than deleting participants.
- BACK UP!!!
- Keep a copy of your syntax for making scales etc. (if using SPSS). This will save you a lot of work. (Can also save a template in jamovi, or save the R code.) I'll show you how in a minute.
- Really good preprint [here](#) about principles of data management

Data carpentry

(Sometimes known as data cleaning)

- You'll have participants who haven't completed your surveys/experiments
- You'll have participants who don't meet inclusion criteria
- You might have people who did the survey twice
- Sometimes you need to compile 2 datasets (e.g. at two timepoints).
HANDY HINT - do NOT let participants generate their own random code.
Have Qualtrics do it for you.
- You'll need to compute scales and subscales (e.g. DASS Depression, Anxiety, Stress) - may need to reverse-score items first
- You might want to check outliers (if real and not data error, think CAREFULLY before excluding them).

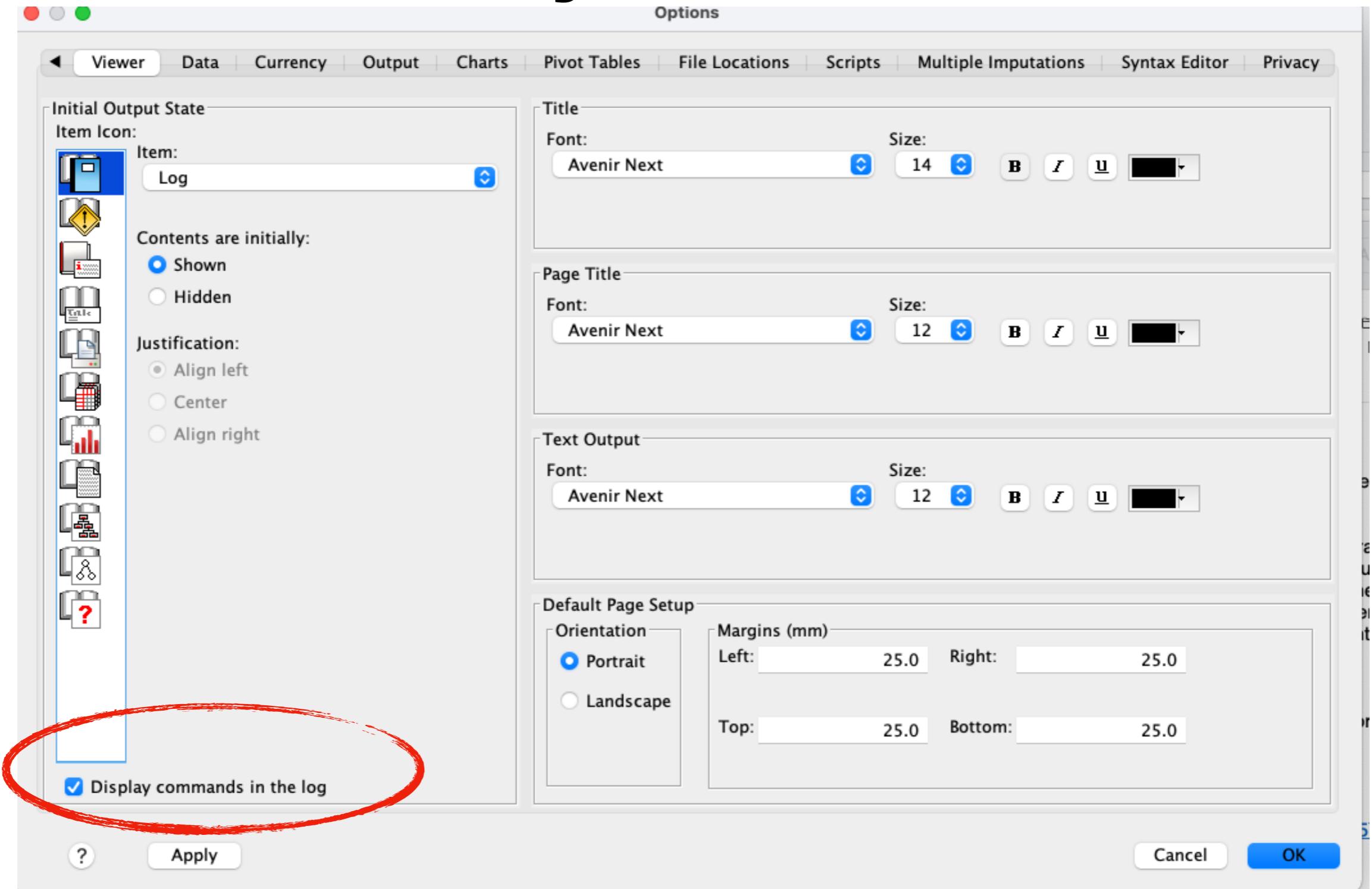
Tools for data cleaning

- Excel (not recommended for complex data)
- SPSS has some tools (Data > Validation)
- Can do filtering in jamovi
- Open Refine: <http://openrefine.org/>
- Excellent free online book (pdf) [here](#)
- Good paper [here](#)

Creating scales

- Most survey-type studies will consist of established scales with published reliability figures and scoring systems
- Make sure you ALWAYS check reliability in your own sample as well
- You'll need to sum or average items to create your scale and/or subscale (also, only use validated cutoff scores)
- Sometimes you need to re-score items (e.g. reverse scaled, scored in a different way by Qualtrics)
- DEMO

Get SPSS to show you the syntax!



Checking scale reliability (SPSS)

The screenshot shows the IBM SPSS Statistics Data Editor interface. The menu bar at the top includes Data, Transform, Analyze, Graphs, Utilities, Extensions, Window, and Help. The Analyze menu is currently open, displaying various statistical analysis options. The "Scale" option is highlighted with a blue selection bar. Below the menu, the "Reliability Analysis..." option is also highlighted with a blue selection bar. The main workspace shows a data table with 23 rows and several columns of variables. The bottom of the screen displays the status bar with "IBM SPSS Statistics Processor is ready" and "Unicode:ON".

Checking scale reliability (SPSS)

The screenshot shows the SPSS Reliability Analysis dialog box and its Statistics sub-dialog box.

Main Dialog: Reliability Analysis

- Items:** A list of items selected for analysis, including DASS_3_R, DASS_5_R, DASS_10_R, DASS_13_R, DASS_16_R, DASS_17_R, and DASS_21_R. DASS_21_R is highlighted with a blue selection bar.
- Model:** Set to "Alpha".
- Scale label:** Empty field.
- Buttons:** OK, Cancel, Statistics...

A red circle highlights the "Statistics..." button.

Sub-DIALOG: Reliability Analysis: Statistics

- Descriptives for:**
 - Item
 - Scale
 - Scale if item deleted
- Inter-Item:**
 - Correlations
 - Covariances
- Summaries:**
 - Means
 - Variances
 - Covariances
 - Correlations
- ANOVA Table:**
 - None
 - F test
 - Friedman chi-square
 - Cochran chi-square
- Other Options:**
 - Hotelling's T-square
 - Tukey's test of additivity
- Model:** Two-Way Mixed
- Type:** Consistency
- Confidence interval:** 95 %
- Test value:** 0
- Buttons:** ? (Question mark), Cancel, Continue

Reliability Statistics Output

| Cronbach's Alpha | | |
|------------------|---------|------------|
| Cronbach's Alpha | d Items | N of Items |
| .930 | .931 | 7 |

Checking scale reliability (JAMOVI)

The screenshot shows the JAMOVI software interface. The top navigation bar has 'Data' and 'Analyses' tabs. Under 'Analyses', there are several icons: Exploration, T-Tests, ANOVA, Regression, Frequencies, Factor, Base R, and Survival. A sub-menu for 'Scale Analysis' is open, showing options: Reliability Analysis (selected), Data Reduction, Principal Component Analysis, Exploratory Factor Analysis, and Confirmatory Factor Analysis.

The main window displays a 'Reliability Analysis' dialog box. On the left, under 'Items', there is a list of variables: DASS_7_R, DASS_8_R, DASS_9_R, DASS_11_R, DASS_12_R, DASS_14_R, DASS_15_R, DASS_18_R, DASS_19_R. An arrow button points from this list to the 'Scale Statistics' section. In the 'Scale Statistics' section, 'Cronbach's α ' is checked. In the 'Item Statistics' section, there are several unchecked options: Cronbach's α (if item is dropped), McDonald's ω (if item is dropped), Mean, Standard deviation, and Item-rest correlation.

A red circle highlights the 'Normal Scaled Items' and 'Reverse Scaled Items' sections at the bottom of the dialog box. These sections contain lists of items: Normal Scaled Items include DASS_3_R, DASS_5_R, DASS_10_R, DASS_13_R, DASS_16_R, DASS_17_R, DASS_21_R; Reverse Scaled Items include DASS_11_R, DASS_12_R, DASS_14_R, DASS_15_R, DASS_18_R, DASS_19_R.

On the right side of the interface, there is a sidebar titled 'Reliability Analysis' which shows 'Scale Reliability Statistics' with 'Cronbach's α ' listed as 0.93.

Checking scale reliability

QualtricsData_with_all_ExpVars_ScaleScores_FINAL

Data Analyses

Exploration T-Tests ANOVA Regression Frequencies Factor Base R Survival Statkat Linear Models TOSTER MAJOR jpower blandr medmod Walrus

Reliability Analysis →

Items →

DASS_7_R
DASS_8_R
DASS_9_R
DASS_11_R
DASS_12_R
DASS_14_R
DASS_15_R
DASS_18_R
DASS_19_R

DASS_3_R
DASS_5_R
DASS_10_R
DASS_13_R
DASS_16_R
DASS_17_R
DASS_21_R

Scale Statistics

Cronbach's α
 McDonald's ω
 Mean
 Standard deviation

Item Statistics

Cronbach's α (if item is dropped)
 McDonald's ω (if item is dropped)
 Mean
 Standard deviation
 Item-rest correlation

Additional Options

Correlation heatmap

Reverse Scaled Items

Scale Reliability Statistics

| | mean | sd | Cronbach's α | McDonald's ω |
|-------|------|------|---------------------|---------------------|
| scale | 0.73 | 0.75 | 0.93 | 0.93 |

Item Reliability Statistics

| | mean | sd | item-rest correlation | Cronbach's α | McDonald's ω |
|-----------|------|------|-----------------------|---------------------|---------------------|
| DASS_3_R | 0.67 | 0.80 | 0.79 | 0.92 | 0.92 |
| DASS_5_R | 1.20 | 0.95 | 0.65 | 0.93 | 0.93 |
| DASS_10_R | 0.67 | 0.91 | 0.84 | 0.91 | 0.91 |
| DASS_13_R | 0.83 | 0.94 | 0.80 | 0.92 | 0.92 |
| DASS_16_R | 0.66 | 0.84 | 0.79 | 0.92 | 0.92 |
| DASS_17_R | 0.61 | 0.93 | 0.81 | 0.92 | 0.92 |
| DASS_21_R | 0.48 | 0.86 | 0.76 | 0.92 | 0.92 |

Correlation Heatmap

| | DASS_3_R | DASS_5_R | DASS_10_R | DASS_13_R | DASS_16_R | DASS_17_R | DASS_21_R |
|-----------|----------|----------|-----------|-----------|-----------|-----------|-----------|
| DASS_3_R | 1 | 0.56 | 0.72 | 0.71 | 0.72 | 0.68 | 0.62 |
| DASS_5_R | 0.56 | 1 | 0.54 | 0.59 | 0.61 | 0.54 | 0.51 |
| DASS_10_R | 0.72 | 0.54 | 1 | 0.73 | 0.73 | 0.76 | 0.74 |
| DASS_13_R | 0.71 | 0.59 | 0.73 | 1 | 0.65 | 0.73 | 0.65 |
| DASS_16_R | 0.72 | 0.61 | 0.73 | 0.65 | 1 | 0.66 | 0.62 |
| DASS_17_R | 0.68 | 0.54 | 0.76 | 0.73 | 0.66 | 1 | 0.73 |
| DASS_21_R | 0.62 | 0.51 | 0.74 | 0.65 | 0.62 | 0.73 | 1 |

Qualtrics tip to avoid re-scoring

The DASS₂₁ Scale

Recode Values

Recode Values Variable Naming Question Export Tags

I found it hard to wind down.

I was aware of dryness of my mouth.

I couldn't seem to experience any positive feeling at all.

I experienced breathing difficulty (eg, excessively rapid breathing, breathlessness in the absence of physical exertion).

I found it difficult to work up the initiative to do things.

I tended to over-react to situations.

I experienced trembling (eg, in the hands).

I felt that I was using a lot of nervous energy.

I was worried about situations in which I might panic and make a fool of myself.

I felt that I had nothing to look forward to.

0 Did not apply to me at all

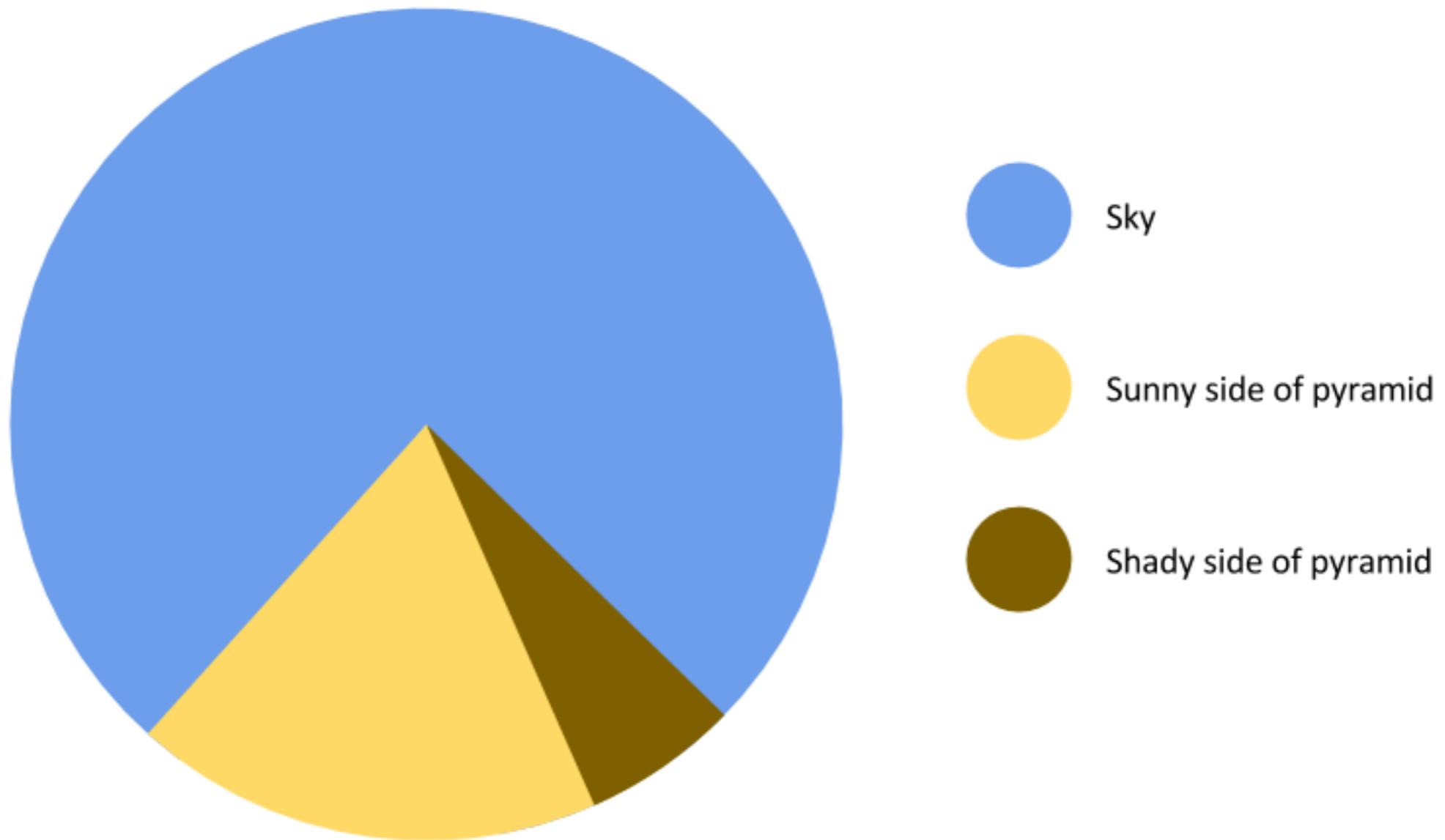
1 Applied to me to some degree, or some of the time

2 Applied to me to a considerable degree, or a good part of time

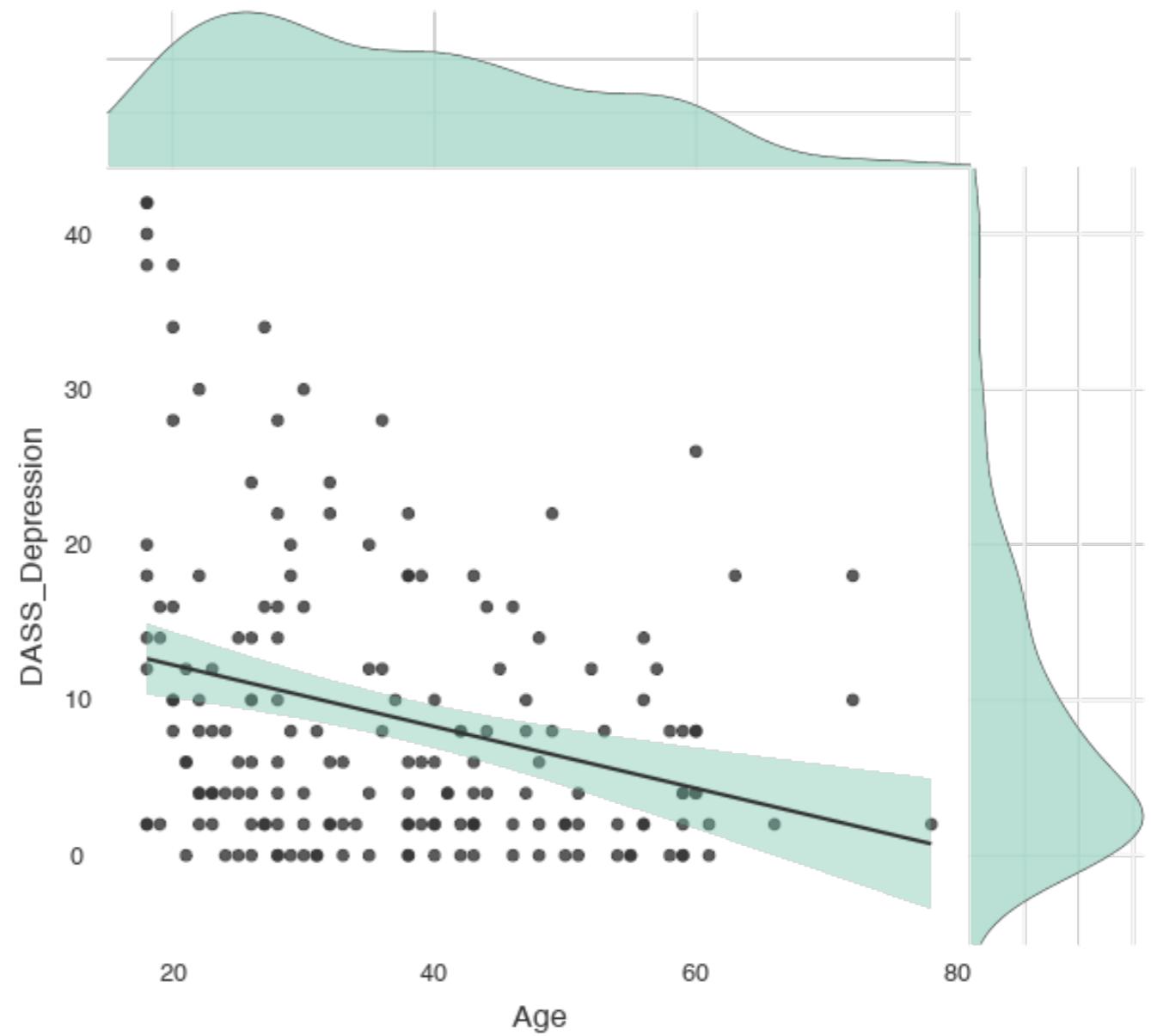
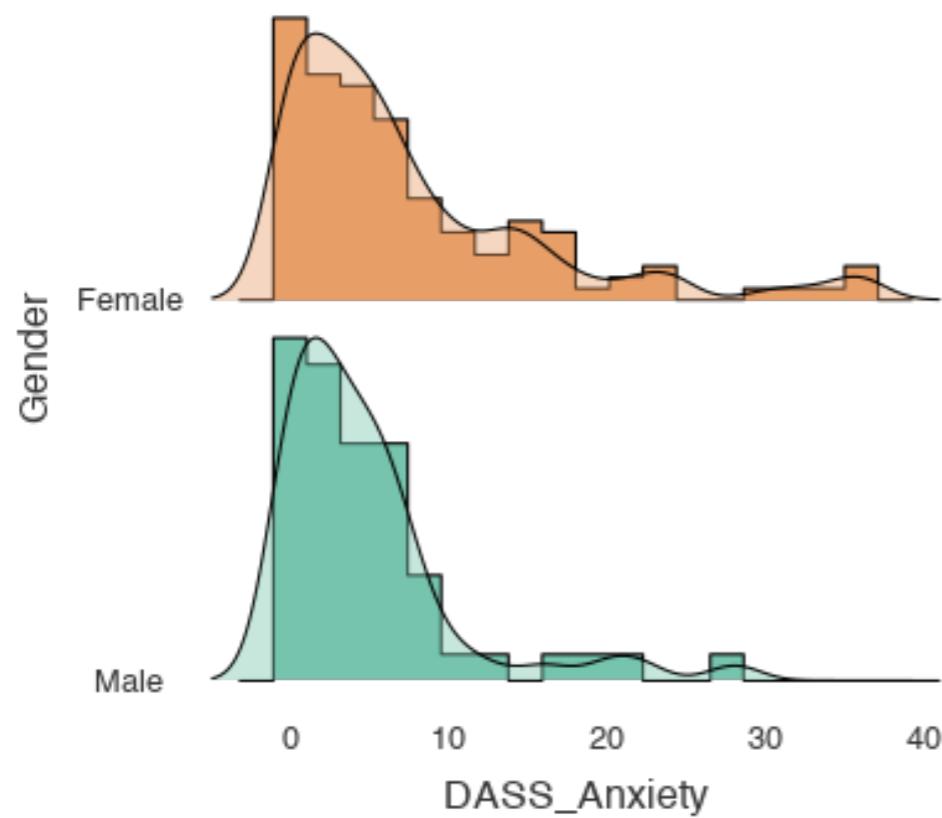
3 Applied to me very much, or most of the time

ANSWER INSTRUCTIONS...

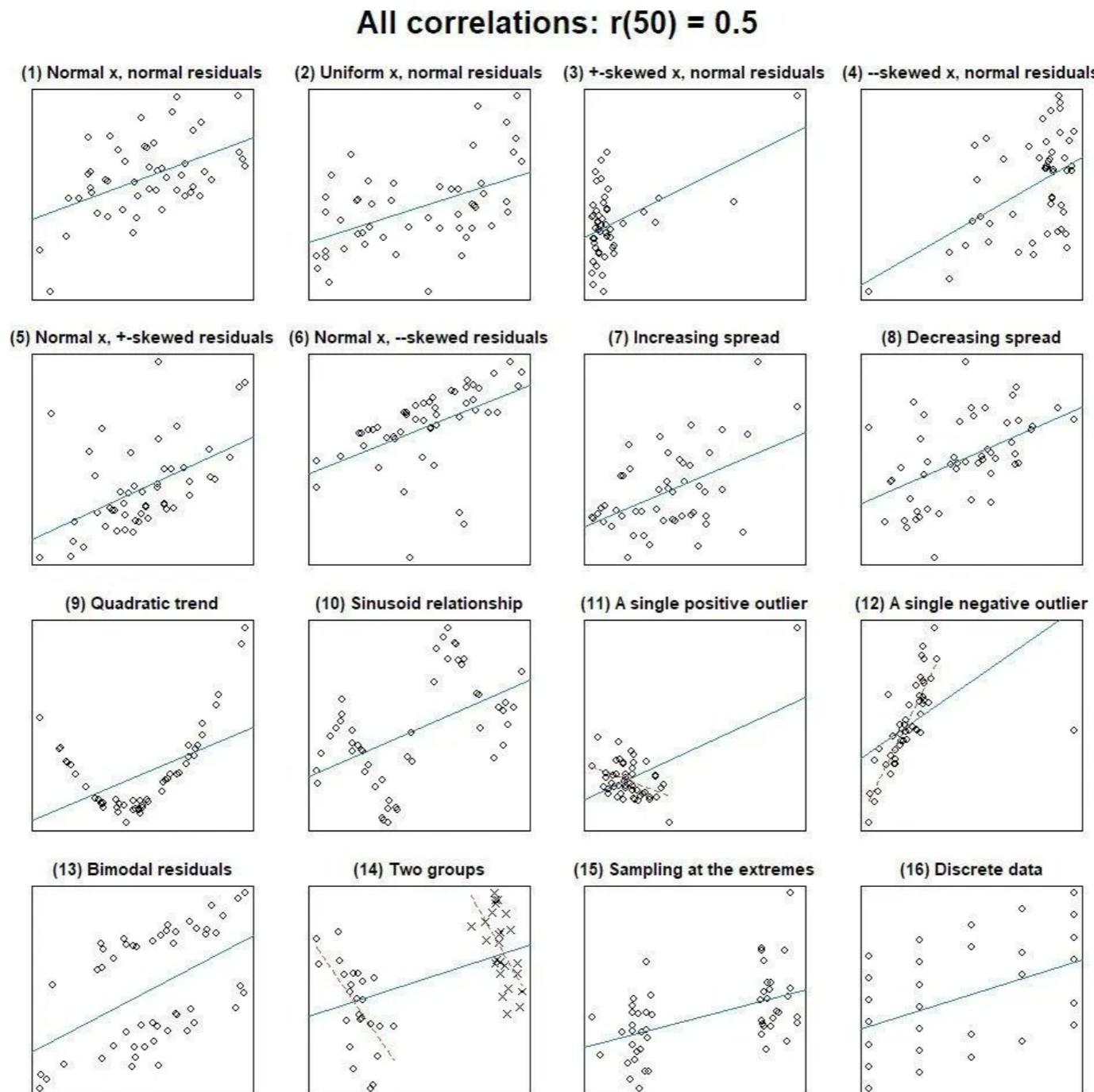
Visualise your data!!



Visualise your data!!



Correlation example



Code available [here](#)

Reporting results

- Try to report as much detail as possible (means/mean difference, SD, test stat, df, p-value, effect size and 95% confidence interval)
- APA format!!! Make sure you do it right!
- Tables are good for stats (but format them properly!)
- You can make SPSS produce APA style tables!!
- Good graphs can make all the difference in your thesis (but DON'T cut & paste straight from SPSS)

Bend SPSS to your will

Before

Frequencies

[DataSet1] /Users/dapthorp/ownClc

Statistics

What do you identify as? – Selected Choice

| N | Valid | 481 |
|----------------|---------|------|
| | Missing | 3 |
| Mean | | 1.31 |
| Median | | 1.00 |
| Std. Deviation | | .489 |
| Range | | 2 |
| Minimum | | 1 |
| Maximum | | 3 |

After

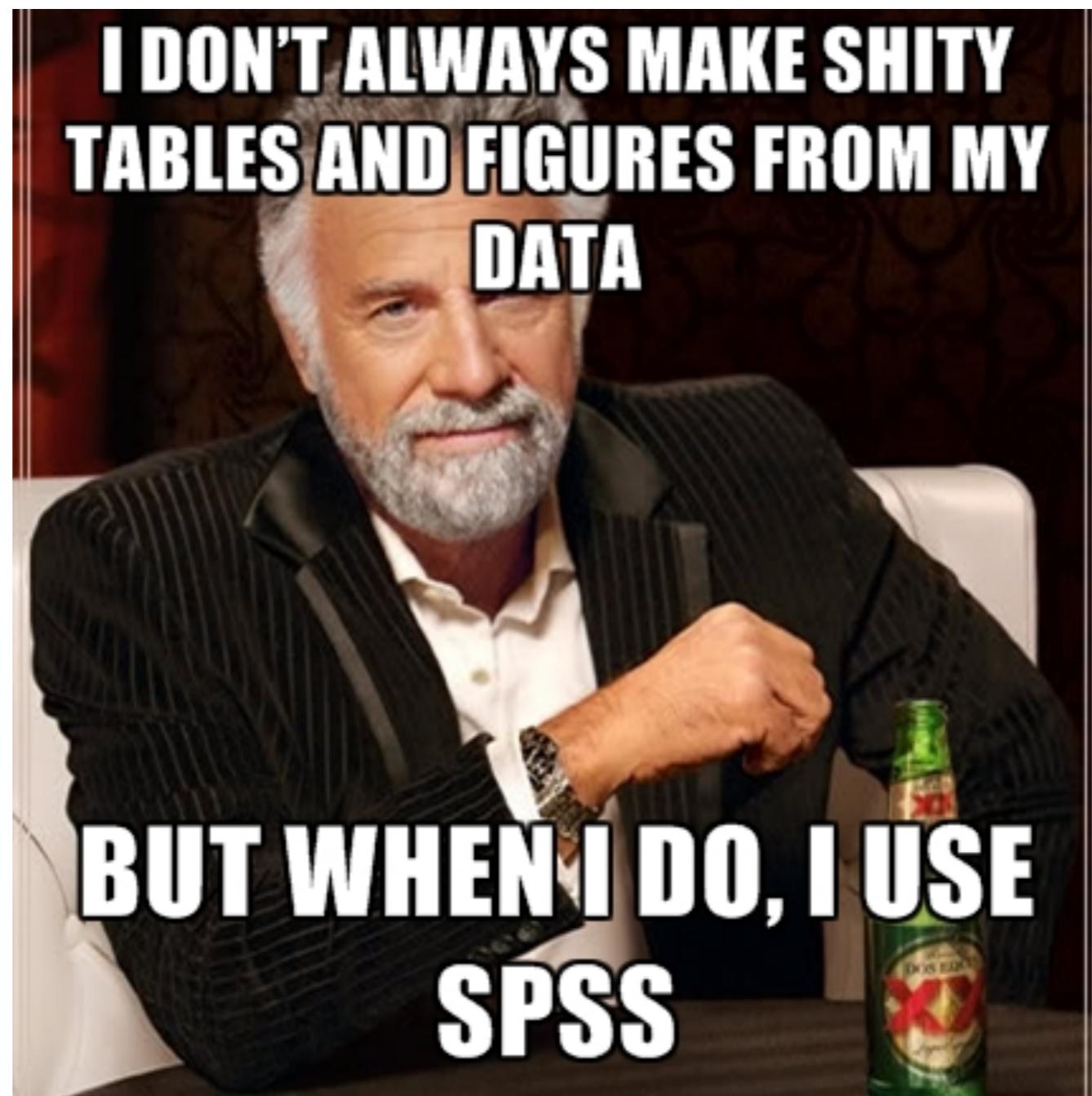
→ Frequencies

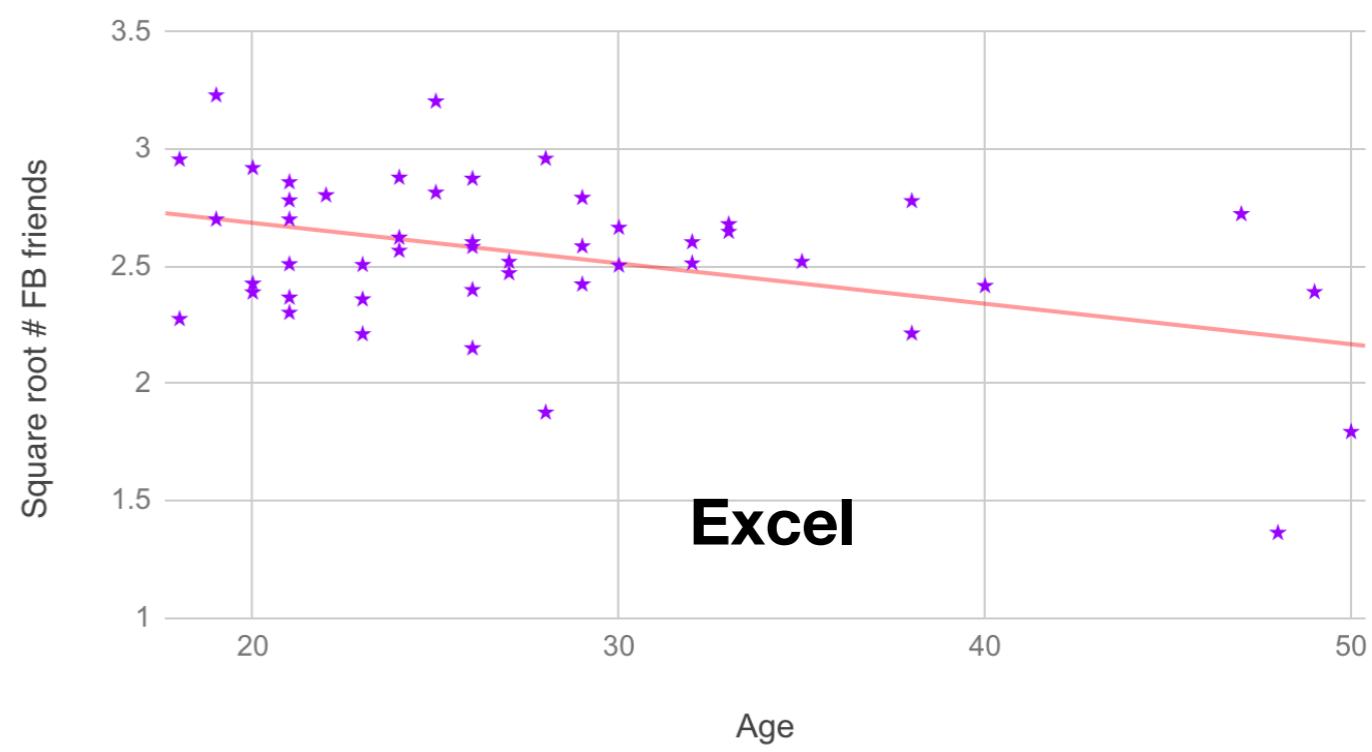
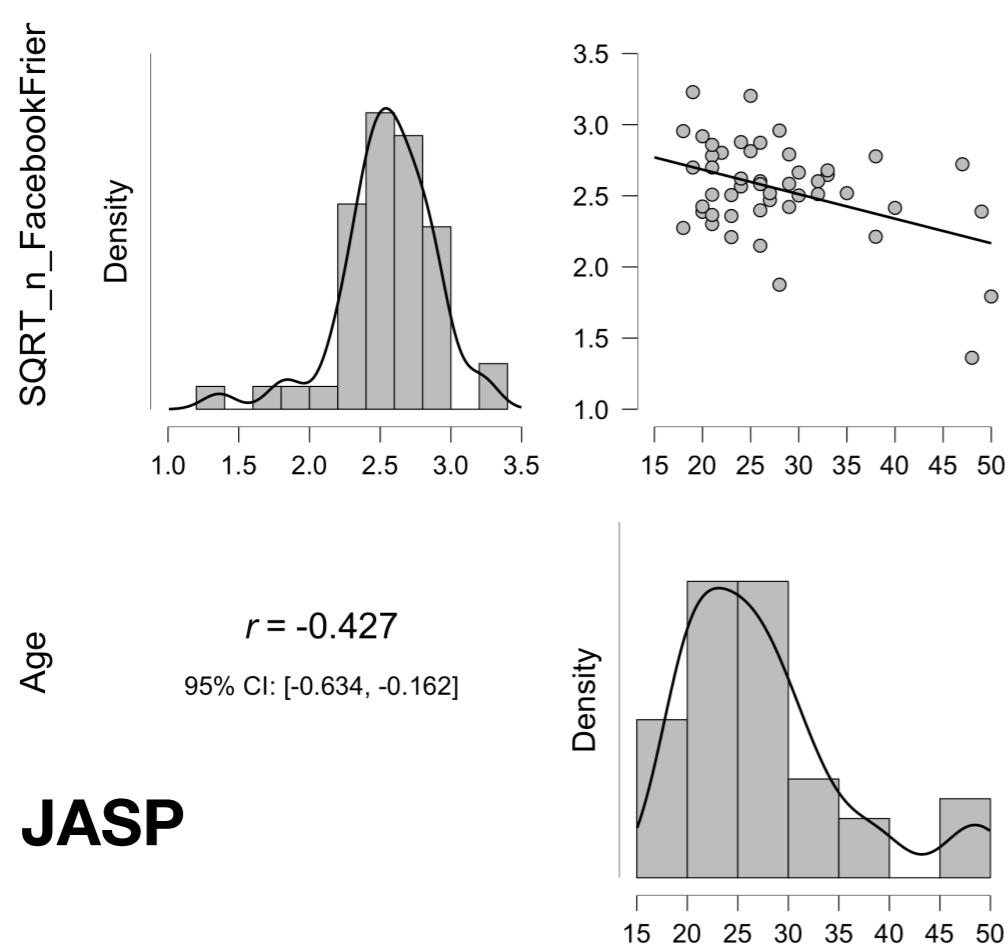
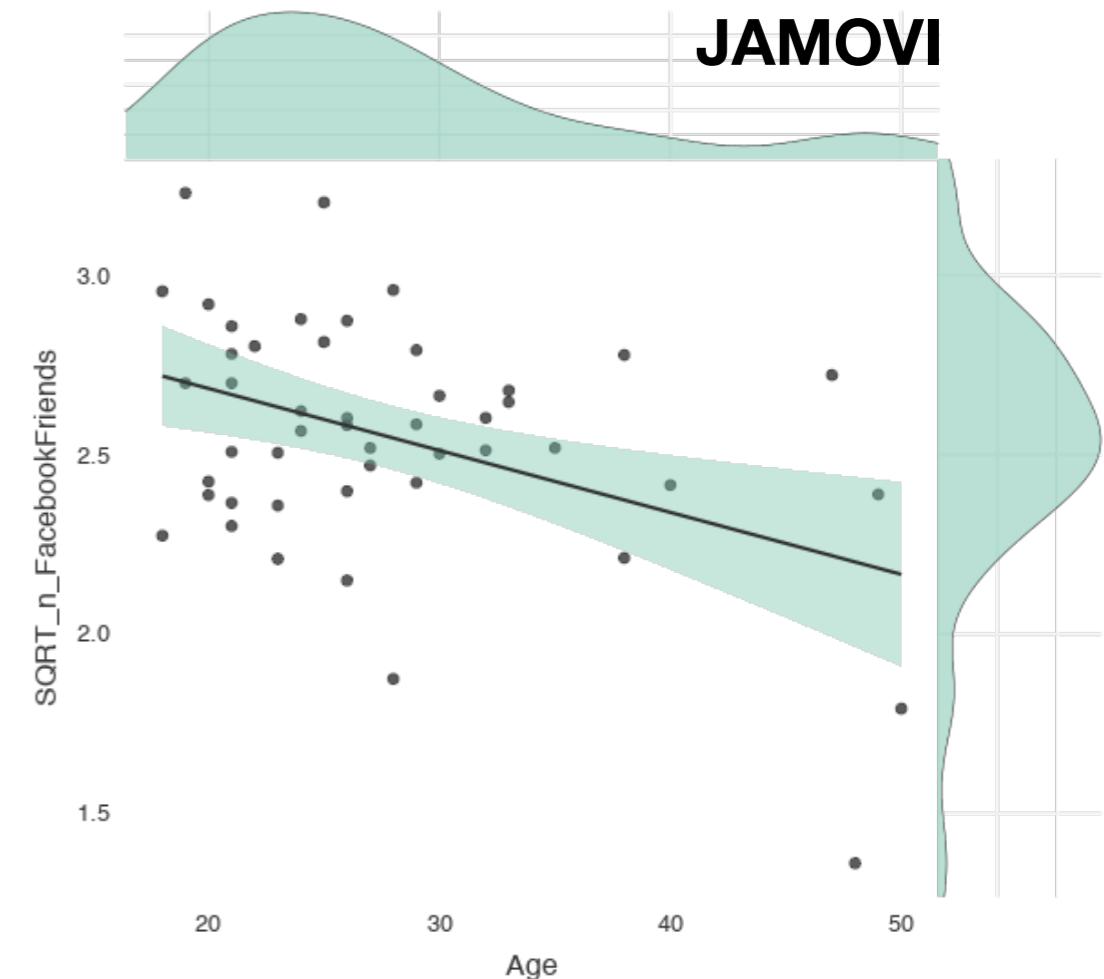
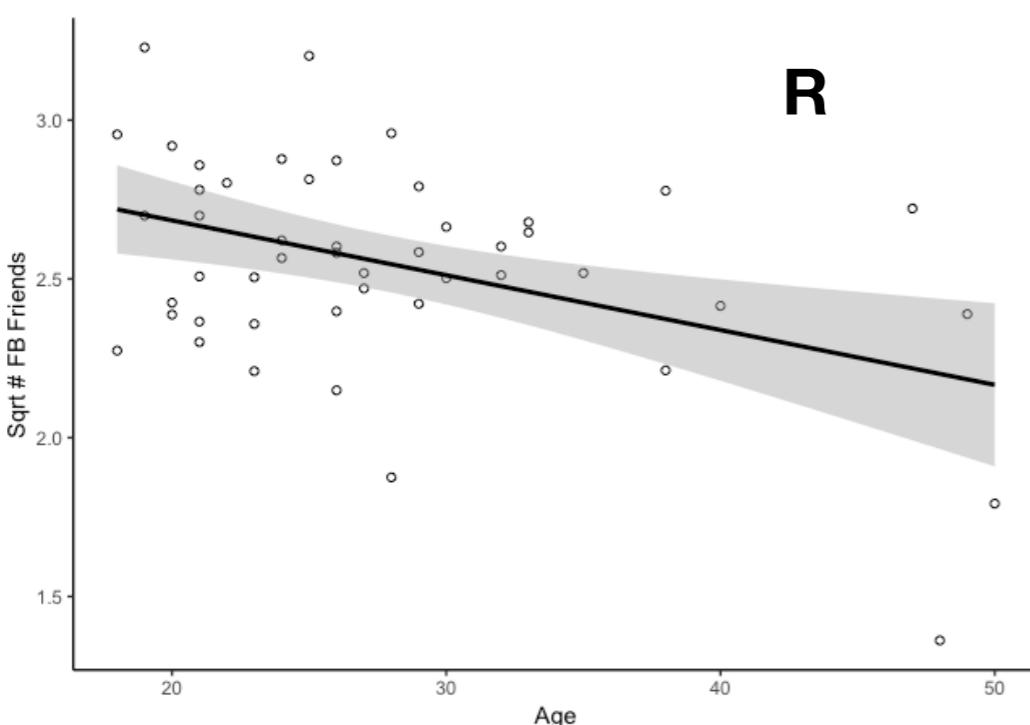
Statistics

What do you identify as? - Selected Choice

| N | Valid | 481 |
|--------|---------|------|
| | Missing | 3 |
| Mean | | 1.31 |
| Median | | 1.00 |
| Mode | | 1 |

Make nice graphs!





What to do when assumptions aren't met

- Non-parametric tests (Mann-Whitney U, Spearman's Rank Correlations, Friedman ANOVA)
- Transform data? (log, square root, inverse - ONLY for interval/ratio variables)
- Poisson regression, ordinal logistic regression, negative binomial regression (all available in SPSS under the Generalized Linear Model menu, or in jamovi's GLM add-on)
- Bootstrapping is another possibility (although debatable) - available in SPSS

Surprising/controversial things

- Dichotomising or grouping variables can reduce statistical power considerably (e.g. low/med/high instead of summed scores)
- Using metric models (e.g. ANOVA, regression) for ordinal data (e.g. Likert scales) can seriously distort your results (see [this article](#) - blog post digest [here](#)).
- Moderation is mathematically exactly the same thing as interaction in regression
- Mediation using correlational designs has been heavily criticised (see [here](#), for instance).

Learning resources

- Fantastic FREE book about learning statistics with jamovi
- Online FREE course with video tutorials (datalab)
- Rosetta (covers many analyses in jamovi and SPSS)
- For SPSS - YouTube is great!
- Statistics of DOOM YouTube Channel (thanks Bernie!)

Questions?

