Statistics & Methodology: Do's & Don'ts

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Do's and Don'ts

Consultants are in a prime position to observe common issues for researchers with statistics and methodology.

In current document the aim is to briefly highlight those issues and suggest how to deal with them.

This draft, based on shared experience in statistical consulting, highlights some issues and remains work in progress. Please share your suggestions for modifications and additions with ICDS (wilfried.cools@vub.be).

p-values and statistical effects

The primary product of a research inquiry is one or more measures of effect size, not p values, says Cohen in 1990.

significance

Do not mistake a low p-value (significant result) with an important result.

p-Values -> probability that there is -no- effect (difference, relation, ...)

- NOT size of effect -> strongly influenced by sample size
- NOT importance of effect -> always interpret the estimate
- conditional on assumptions of the statistical test (often not met fully)

x% confidence interval -> x% probability effect within given range

definition: stargazing = naively focusing only on what effects are significant

non-significance and equality

Absence of proof is not proof of absence.

insignificant -> assumption -no- effect in line with evidence, BUT many other effects also in line with evidence

Note: to show equality requires test of equivalence (with margin of error)

interpretation and prediction

Understand the system or simply use it to make good predictions.

- understand the underlying system and its parts -> p-Values and confidence intervals
- correct prediction can be aimed for without such understanding -> no p-values, use cross-validation

effect sizes

Do not interpret p-values as effect sizes.

- a small p-value is not a big effect
- a p-value of .06 is not 'almost' a significant effect, or trending towards a significant effect (with alpha .05)

Errors

Poor statistics often result in wrong inferences.

Ways to show you do not know what you are doing:

- test equality of predictor values over groups (group similarity with chi2 tests)
- multicollinearity, especially when using adapted scores
- test correlations between series of observations that have to correlate (eg., two raters)
- using paired t-tests for matched data (blocking is not sufficient)
- use the omnibus F-test to infer upon specific group differences (contrasts are important)
- use cronbach alpha to prove items measure a uni-dimensional latent variable

Inefficiencies

Poor practices often result in throwing away information.

If efficiency is a concern, which is typically the case with observations that require resources, it is good practice to carefully avoid the loss of information.

Ways that information is lost:

- use cut-off values for a continuous variable where not necessary, cut-off values can always be introduced afterward
- perform many simple tests using very simple models that can easily be combined into one model
- analyzing summaries of data instead of the actual data
- performing analysis on subsets of equivalent data

Naiveties

Do not believe everything they tell you.

Ways you can be naive.

- focus on p-values in non-experimental research
- think your statistics shows causality
  - implies the exclusion of all confounding variables (requires experimental control)
  - implies a (possibly short) time-lag for the effects to take place (longitudinal)
- simply assuming that questionnaires are validated because they say so
  - does it measure what it is supposed to

    - and do you use it like you are supposed to
- use of power analysis after the data is analysed

Data Issues

Also your computer needs to understand your data correctly.

Ways data issues compromise your research:

- errors (this happens more than you think, so double check your data)
- ambiguous data (eg., empty cells meaning 'missing' or 'empty')
- multiple pieces of information within a cell (eg., cells that list all treatments performed)
- data mixed with results and whatever (keep a raw datafile separate and made anonymous)