Suggestions for Readers of Research Using Statistics

Overall Suggestions:

1. Look for sources of uncertainty.
2. Keep these quotes in mind:

> "Some experts think peer review validates published research. For those of us who have been editors, associate editors, reviewers, or the targets of peer review, this argument may ring hollow. Even for careful readers of journal articles, the argument may seem a little farfetched."
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> David A. Freedman, Chance 2008, v. 21 No. 1, p. 61

> *"... scientists understand that peer review per se provides only a minimal assurance of quality, and that the public conception of peer review as a stamp of authentication is far from the truth.*
>
> Charles G. Jennings, Quality and Value: The true purpose of peer review?, Peer-To-Peer, Nature.com 2006

Specific Suggestions:

- Do *not* just read the abstract.
  - Abstracts sometimes focus on conclusions that are more speculative than the data warrant.
- Identify the exact research question(s) the researchers are asking
  - Decide if these are the questions that you are interested in, or if they have only a superficial interest to what is of interest to you (For example, a question might be phrased the same as what you are interested in, but is studied in a different population than you are interested in.)
- Identify the measures the researchers are using.
  - Carefully read their definitions – names may be deceiving or subject to different interpretations (e.g., "unemployment rate")
  - Think about whether the measures used really measure what you are interested in. For example, if you are interested in the effect of a medication on the incidence of hip fractures, is this the endpoint that the researchers have studied, or have they just studied a proxy such as bone density?
  - Remember that some studies have "primary endpoints" and "secondary endpoints." If the paper just reports on secondary endpoints, try to find the results for the primary endpoints as well, to get a more complete understanding of findings.
  - If subjects were asked questions, try to find the exact questions asked and check them over for possible ambiguity or other problems in wording. If the authors of the study are not willing to reveal the questions, be especially cautious in making interpretations.

    - Be cautious in drawing conclusions involving more than one study (e.g., comparing two medications for osteoporosis) – *if the measures are not the same, comparisons of results may not be valid*.
- Determine the type of study: observational or experimental; exploratory of confirmatory
    - This will influence the strength of the conclusions that can be drawn; generally speaking, experimental studies give stronger evidence than observational studies, and confirmatory studies (if well done) give stronger evidence than exploratory studies.
    - Some studies may involve both confirmatory and exploratory aspects. Sometimes these are reported in separate publications, so try to find all publications based on the study, to get a more complete view of the results.
- Pay attention to how the sample(s) was/were chosen.
    - Think about any circumstances that might make the sample biased.
        - Remember that results from a biased sample are unreliable, although sometimes they might give some information about a smaller population than intended.
    - Remember that voluntary response samples are usually biased.
    - Be cautious in interpreting the results of a survey.
- Have the researchers explained why the statistical procedures they have used are appropriate for the data they are analyzing?
    - In particular, have they given good reasons why the model assumptions fit the context well enough?
    - If not, their results should be given less credibility than if the model has been shown to fit the context well.
- If there are multiple inferences using the same data, have the authors taken that into account appropriately in deciding significance or confidence levels?
    - If the study resulted in more than one publication, did the authors adjust for multiple inference taking all of the inferences in all of the publications into account?
- If hypothesis tests are used, are confidence intervals also given?
    - Confidence intervals can give an idea of the range of uncertainty due to sampling variability.
    - But remember that there might also be other sources of uncertainty not captured by confidence intervals (e.g., bias, lack of fit of model assumptions, measurement uncertainty.)
- Have claims been limited to the population from which the data were actually gathered?
- Have the authors taken practical significance as well as statistical significance into account in drawing conclusions?
- Is the power of statistical tests large enough to warrant claims of no difference?
- If you are reading a report on a clinical trial, keep the following two points in mind:
    - A recent study (Wieseler et al, 2013, Completeness of Reporting of Patient-Relevant Clinical Trial Outcomes: Comparison of Unpublished

Clinical Study Reports with Publicly Available Data, *PLoS Med 10(10),* http://www.plosmedicine.org/article/info%3Adoi%2F10.1371%2Fjournal.pmed.1001526) found that unpublished clinical study reports "provided complete information on a considerably higher proportion of outcomes (86%) than the combined publicly available sources (39%)."

  - Another study (Pablos-Mendez et al, JAMA 279(3), 21 January 1998, http://mres.gmu.edu/pmwiki/uploads/Main/RunInTrialsRCT) points out how "run-in" periods to select or exclude certain patients from clinical trials can result in findings that, although they may have validity for the populations studied,

- Do not let a single study convince you of anything!
- If you are reading a meta-analysis, check whether and how well the authors have taken the file-drawer problem into account.
  - Also bear in mind that methods for combining results from several studies themselves depend on model assumptions. Check out what these model assumptions are and whether or not they are reasonable assumptions for the meta-analysis in question.
- See Chapter 9 of Good and Hardin (2012) for more suggestions and details.
- See van Belle (2008, Chapter 7) for items specific to Evidence Based Medicine

Further References:

Good, P. I. and Hardin, J. W, (2012). *Common Errors in Statistics (And How to Avoid Them)*, Wiley

van Belle, Gerald (2008). Statistical Rules of Thumb, 2nd ed., Wiley