STAT3494W: Undergraduate Seminar
STAT5095: Investigation of Special Topics

Note 3: Statistical Research Projects

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Getting Started

Writing a Research Proposal

Getting Started

Full Cycle of a Statistical Research Project

Like any research project, a statistical research project starts with an interesting idea, and goes through a full cycle of

- ▶ brainstorming,
- ▶ planning with the right design/methods,
- ▶ investigating with the simulation studies/data analyses,
- ▶ fixing and iterating as necessary, and
- ▶ summarizing through writing/revision.

1. Find a topic of interest.

The topic should interest you, and be something which you already know at least somewhat and/or can find out more.

The topic should also be something that is within your capacity restricted by your skill sets and time.

Check the literature to see what works are available on it or related topics.

In short, the topic should be reasonably interesting and doable.

You can get ideas for research by

- attending seminars;
- reading journals, books, magazines, and newspapers;
- consulting;
- collaboration.

You can get ideas for your statistical paper by checking out

- live data science competitions at Kaggle and other places.
- open data websites (e.g., NYC Open Data, Connecticut Open Data.)
- ASA data challenge expo.
- statistics journals and magazines! *The American Statistician* and *Signifance Magazine* are usually student-friendly.

2. Initial planning.

After you have identified a topic, you need to narrow down on the specific research questions that you want to answer, what data will be needed/used, and what methods are appropriate.

- ▶ Form a hypothesis and design a study.
- ▶ Collect data and/or find some existing data.
- ▶ Decide on appropriate statistical methods.
- ▶ Make a tentative outline to guide writing.

3. Statistical investigation.

- ▶ Perform data analysis.
- ▶ Summarize substantive findings.
- ▶ Investigate the performance of any newly proposed methods via simulations.
- ▶ Iterate between planning and investigation as needed.

4. Write, Revise and Proofread.

Revising and writing are two separate processes.

Tips when starting to write:

- ▶ Start with an outline for each section which includes major headings, sub-headings and paragraphs covering different points.
- ▶ When starting, the goal is to get the main points and ideas captured in a document, so at this time, it does not matter if sentences are incomplete or if the grammar is incorrect.

Tips for revising and proofreading:

- ▶ Are the statistical statements correct?
- ▶ Are the data displays informative?
- ▶ Are the conclusions based on sound evidence?
- ▶ Are the style and tone appropriate for the venue?
- ▶ Is the problem clearly stated?
- ▶ Check organization — reorganize paragraphs and add transitions where necessary.
- ▶ Work on sentences and grammar — check spelling, punctuation, word choice, tense, etc.
- ▶ Make sure all researched information is documented (reproducibility).
- ▶ Rework introduction and conclusion.
- ▶ Read out loud to check for flow.
- ▶ Find a friend to review.

Writing a Research Proposal

Writing a Research Proposal

A research proposal is piece of writing that details exactly what you plan to do in a research project.

The following components are expected in your proposal. Use the `proposal.tex` template (under Templates.zip on course website) to get you started.

- ▶ Introduction: Introducing the topic and why you have chosen this topic (3–5 lines). Mention briefly the current related research and cite relevant works.
- ▶ Specific aims: Formulate a research question or hypothesis in the chosen topic. Describe briefly why you select such a question or hypothesis and its importance in the field (cite sources).
- ▶ Data description: Describe your data set (for instance: sampling scheme, number of observations, number of variables, variables of interest, nature of the variables) and the source of your data set if it is not collected by yourself.

- ▶ Research design and methods: Describe briefly (5-7 lines) your plan of action. If you choose to apply any specific statistical methods, please mention and cite them. Please be consistent here with your research hypothesis. Write a line regarding how the methods would help in investigating the research hypothesis.
- ▶ Discussion: What do you expect to find and why do you feel so? Any ways your work can corroborate or challenge existing results or assumptions? What are the potential impacts of your work? What if the results of your investigation are not what you expected?
- ▶ Conclusion: Wrap it up by briefly summarizing your research proposal and reinforcing your research's stated purpose.