1 Contents

Premise: In this course. students will be assigned a real research project from another discipline and consult the researchers in the application and interpretation of statistics. Students will lead meetings with their clients, decide on methods for data description and inferential statistics to be applied, clean the data, execute the analyses, and present the results to their clients in a final report. Organization:

- One and a half month of lectures, group discussion, and assignments to prepare for role as consultant

- Remaining time work on project, weekly seminar meetings for presenting progress and successes, receiving guidance, learning new statistical methods (as required by the projects), discussing issues related to consulting and statistics in general. Additional, meetings with clients and instructor. A small number of extra assignments to practice writing statistical reports.

1.1 Introduction

1. consultant versus collaborator

2. roles of statistical consultant (first ideas)

3. skills of an effective consultant/collaborator
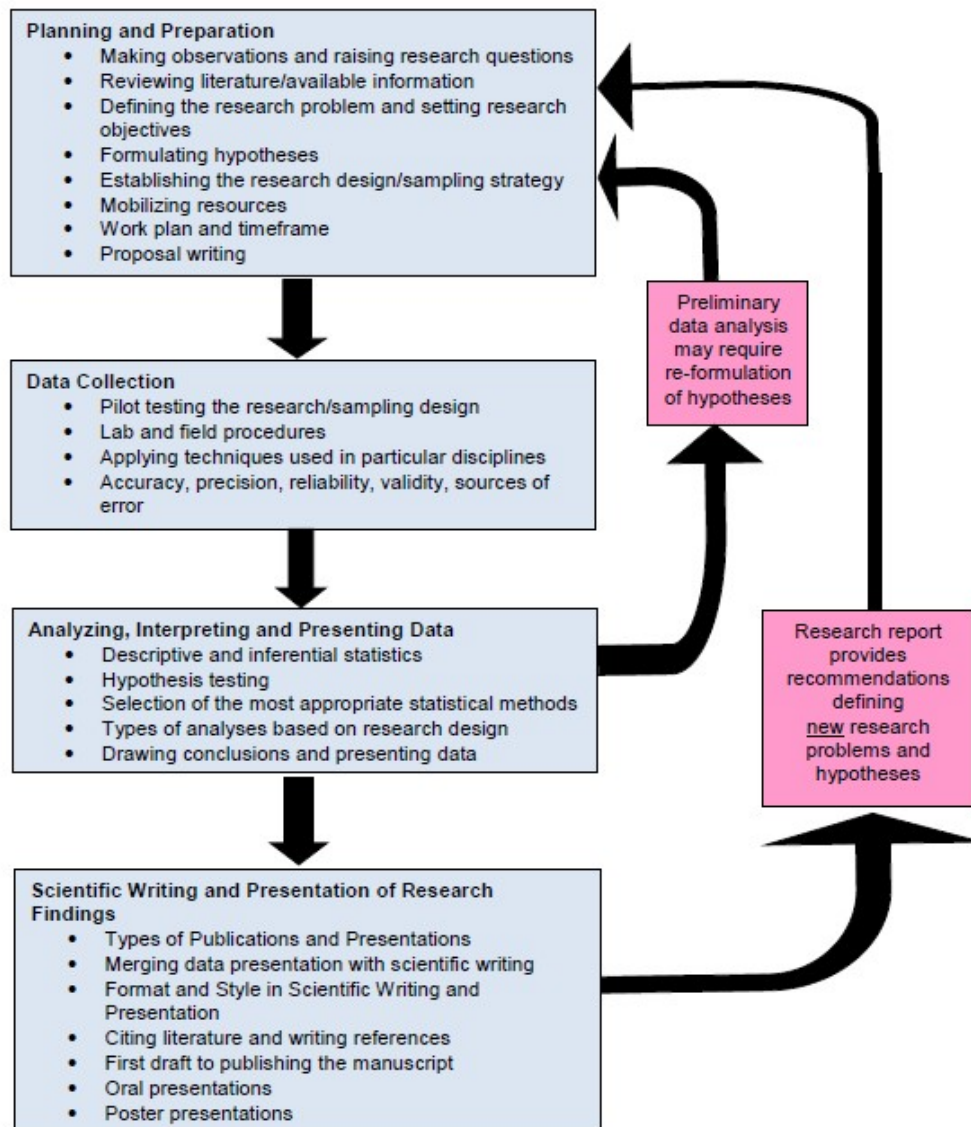
4. role of communication

1.2 Scientific Method

The discussion of the scientific method provides the basis for understanding the roles of statisticians in science. It will illustrate why it is vital for researchers to work with statisticians from the onset of a project until its completion.

1.2.1 The four stages and their Interactions

1. Planning and Preparation

2. Data Collection

3. Analyzing, Interpreting, and Presenting Data

4. Scientific Writing and Presentation of Research Findings

Flow Chart of the Scientific Process

Planning and Preparation
- Making observations and raising research questions
- Reviewing literature/available information
- Defining the research problem and setting research objectives
- Formulating hypotheses
- Establishing the research design/sampling strategy
- Mobilizing resources
- Work plan and timeframe
- Proposal writing

Data Collection
- Pilot testing the research/sampling design
- Lab and field procedures
- Applying techniques used in particular disciplines
- Accuracy, precision, reliability, validity, sources of error

Analyzing, Interpreting and Presenting Data
- Descriptive and inferential statistics
- Hypothesis testing
- Selection of the most appropriate statistical methods
- Types of analyses based on research design
- Drawing conclusions and presenting data

Scientific Writing and Presentation of Research Findings
- Types of Publications and Presentations
- Merging data presentation with scientific writing
- Format and Style in Scientific Writing and Presentation
- Citing literature and writing references
- First draft to publishing the manuscript
- Oral presentations
- Poster presentations

Preliminary data analysis may require re-formulation of hypotheses

Research report provides recommendations defining new research problems and hypotheses

1.3 Role of Statistical Consultant

Before assuming the role of a statistician in a scientific project, it is crucial to understand our responsibilities and the support we can and should provide.
Discussion topics:

1. At which stages of the scientific process should the statistician be involved?

2. What is the role of the statistician at the different stages?

3. What can go wrong if a statistician is not consulted at the different stages?

4. What are the challenges for the statistician at the different stages? (communication must be mentioned at every stage)

1.4 Ethics

People's behaviors should always be based on proper ethical guidelines. The ethical consideration relevant to scientists in general and statistical consultants/collaborators, in particular, will be discussed.

1. ethical conduct of a scientist in general

2. ethical conduct of a statistician in particular

Relevant resources:

1. Complete TCPS 2: Core Website

2. Ethics Guidelines from the American Statistical Association (ASA) and the Statistical Society of Canada (SSC):

   ASA: Ethical Guidelines for statistical practice

   SSC: Code of ethical statistical practice

1.5 Communication

Communicating professionally requires a different style than in casual settings. We will establish guidelines for written (email) and oral (meetings) settings.
A statistical consultant/collaborator must be an effective communicator. This is especially challenging in this context since the clients and statisticians are experts in different fields and must establish a communication mode allowing them to solve problems effectively. The first meeting between the collaborators is crucial for establishing a strong basis for future work.
After all analyses are completed, the statistical consultant will communicate the methods applied and the results to their clients in an extensive report. They will have to write reports that use formal statistical language and explain the interpretation and limitations of the findings. Learning the proper style for reporting statistical results in tables, figures, and texts is fundamental to improving statistical writing skills.

1. emails

2. leading a consultation meeting

   - 1st meeting
   - last meeting

3. checking in with clients

4. presenting statistical results (APA style)

5. writing a report

6. weekly presentation for peers

1.6 Topics from Statistics

Of course, the fundamental requirement for becoming a successful collaborator is statistical knowledge and the willingness to learn about new topics and skills.

This course will introduce only new topics as the projects require them. E.g. in previous years, we introduced survival analysis and Structural Equation Models.

This section proposes some topics worth reviewing, like the P-value misconceptions leading to the "statistics crisis". There is also an emphasis on data description, which is sometimes neglected in favour of methods in inferential statistics but is crucial for understanding and learning from data.

1. data description (resources) – get inspired

   - Hans Rosling Video
   - Intro to ggplot
   - ggplot websites

2. P-values (statistics crisis)

3. "The Key"

4. measuring effect size

5. interaction

6. mediation analysis

1.7 Statistical Computing

In addition to knowing about statistical methods and their interpretation, the statistical consultant must be able to apply these to data using different software packages. Students learning statistical consulting should already have extensive experience in at least two packages, one of which is usually R.

This section emphasizes the importance of creating code that reproduces the results presented in the final report and some skills that students might not have had the opportunity to apply before.

1. Data Cleaning/Preparation

   - R library tidyverse

2. Reproducibility of statistical analyses

   - R: Rmarkdown
   - SPSS: Syntax files
   - Do not use Excel, steps can not be automatically repeated

1.8   Additional Technical Topics Starting with the Fundamentals

Depending on previous knowledge, reviewing fundamental concepts from statistics and presenting some methods students have not seen in previous courses can be valuable. Find some suggested topics below.

1. experimental design

2. data science

3. power analysis, and principles for choosing a sample size

4. assumptions/interpretation of non-significant results

5. multiple comparisons

6. factor analysis

7. survival analysis

8. time series analysis

9. repeated measure analysis

10. mediation analysis

11. Structural Equation Modelling