

Research Planning Through a Statistician's Eyes

Society of the Water Institute Graduate Students

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When does statistics begin?

- ▶ Researchers often seek for help from a statistician during the analysis process.
- ▶ Reliable statistics results depend on quality data.
- ▶ Statistics begin at the beginning of any research study.

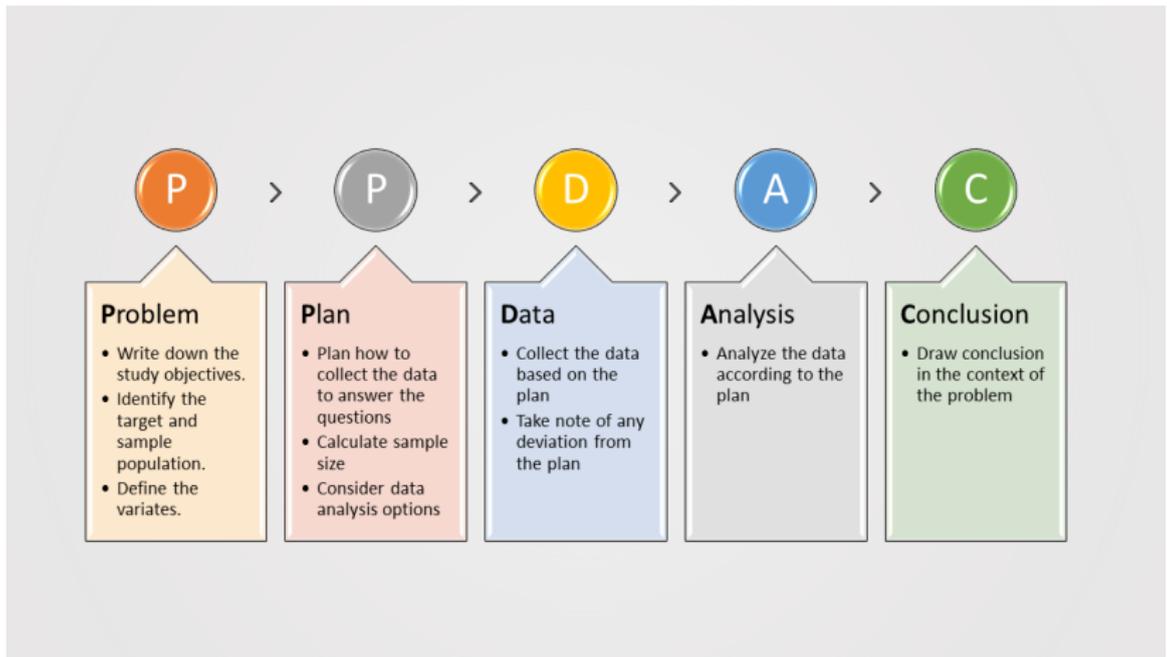


Figure 1: A general guide to research

1. Problem

The elements of the Problem address questions starting with “What?”

- ▶ What conclusions are we trying to draw?
- ▶ What group of subjects (people/thing) do we want the conclusion to apply?
- ▶ What characteristics/features/variables can we define?
- ▶ What is (are) the question(s) we are trying to answer?
- ▶ What statistical model can be used?

2. Plan

- ▶ The purpose of the planning stage is decide what subjects we will examine. These subjects made up the sample.
- ▶ We decide on the data that we can and will collect, and the steps to collect these information.
- ▶ A common question at this stage is, “how many samples do I need?”
 - ▶ A sample size calculator such as GPower is often recommended. However, the main restriction is generally time and resources.
- ▶ The plan depends on the questions posed in the Problem step.

A checklist

At the end of the planning stage, we would have figured out:

- ▶ the study population,
- ▶ the sampling protocol,
- ▶ the features/characteristics to be measured, and
- ▶ the quality of the measurement systems that are intended for use.

3. Data

- ▶ The Data step is to collect the data according to the Plan.
- ▶ Any deviation from the Plan should be noted.
- ▶ Long term studies require careful management
- ▶ The data must be stored in a way that facilitates the upcoming analysis.

4. Analysis



Review the hypotheses

Review the research questions

Consider sub-questions



Process the raw data

Select a suitable statistics software

Convert the data into an acceptable format



Explore the data

Descriptive summaries

Data visualization



Analyze the data

Inferential analysis

Prediction



Report the results

Interpret the results in the context of the study

Figure 2: An overview of the analysis process

Generally speaking

The MIDI steps of data analysis

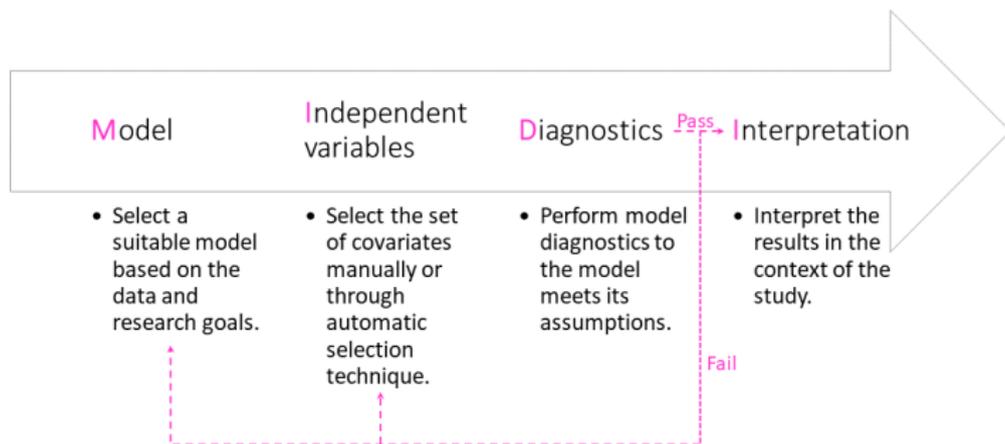


Figure 3: Recommended steps to data analysis

5. Conclusion

- ▶ The Conclusion step is to answer the questions posed in the Problem.
- ▶ An attempt should be made to quantify or discuss potential limitations and errors from the study.

Our advice

Start early.

"All models are wrong, but some are useful." — George Box

11. Next steps

Every model has its strengths and limitations. When in doubt, get help. The SCSRU offers free 1-1 consultation to all UWaterloo researchers.

The SCSRU organize various workshops on a regular basis to improve quality of research and data literacy among the UWaterloo community. We also provide 1-1 free consultation to all researchers on campus. More information are available on our website.

Thank you!

The Statistical Consulting and Survey Research Unit (SCSRU) is the unit through which the Department of Statistics and Actuarial Science provides statistical advice to those working on research problems.