Reporting Your Research Results

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Abstract

You just obtained a grant to research an interesting idea. But how can you conduct the research so that you can quantitatively assess the results of your research? The objective of this presentation is to learn how to state specific research objectives that facilitate the identification of dependent and independent variables. We also discuss the development of the operational definition of a variable to enable its quantification. Furthermore we discuss ideas of how to reduce the error of measurement to ensure the exact and precise quantification of a variable. Then we proceed to present basic ideas of experimental design, types of experiments and different strategies to collect data, so that the objectives of the research can be quantitatively assessed. Finally, we present suggestions to analyze, summarize and display the data collected, using simple summary statistics and easy-to-understand graphical display and tables.

In summary, at the end of this presentation you will have a set of guidelines to assist you in planning your research, executing your plan, and analyzing and presenting the results of your investigation. This approach will enable you to quantitatively demonstrate whether or not your proposed ideas are correct and provide guidelines for further investigations.

Research Scholars Program (RSP)

USDA HSI Grant:

Implementation of RSP to expand and improve the M.S. in Research Statistics at UIW.

Objectives:

1. Recruit qualified underrepresented low-income students

2. Graduate research statisticians

Define Specific Goals

SMART Goals

S – **Specific**: **Clear and unambiguous**

M – **Measurable**: **Quantify and assess progress**

A – **Attainable**: **Realistic and challenging**

R – **Relevant**: **Important to achieve objectives**

T – **Time bound**: **Start and end, fixed duration**

Define Specific Goals

Objectives

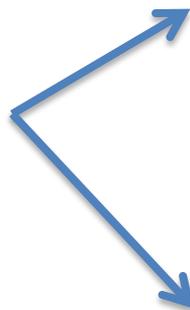Recruit qualified underrepresented or low-income students
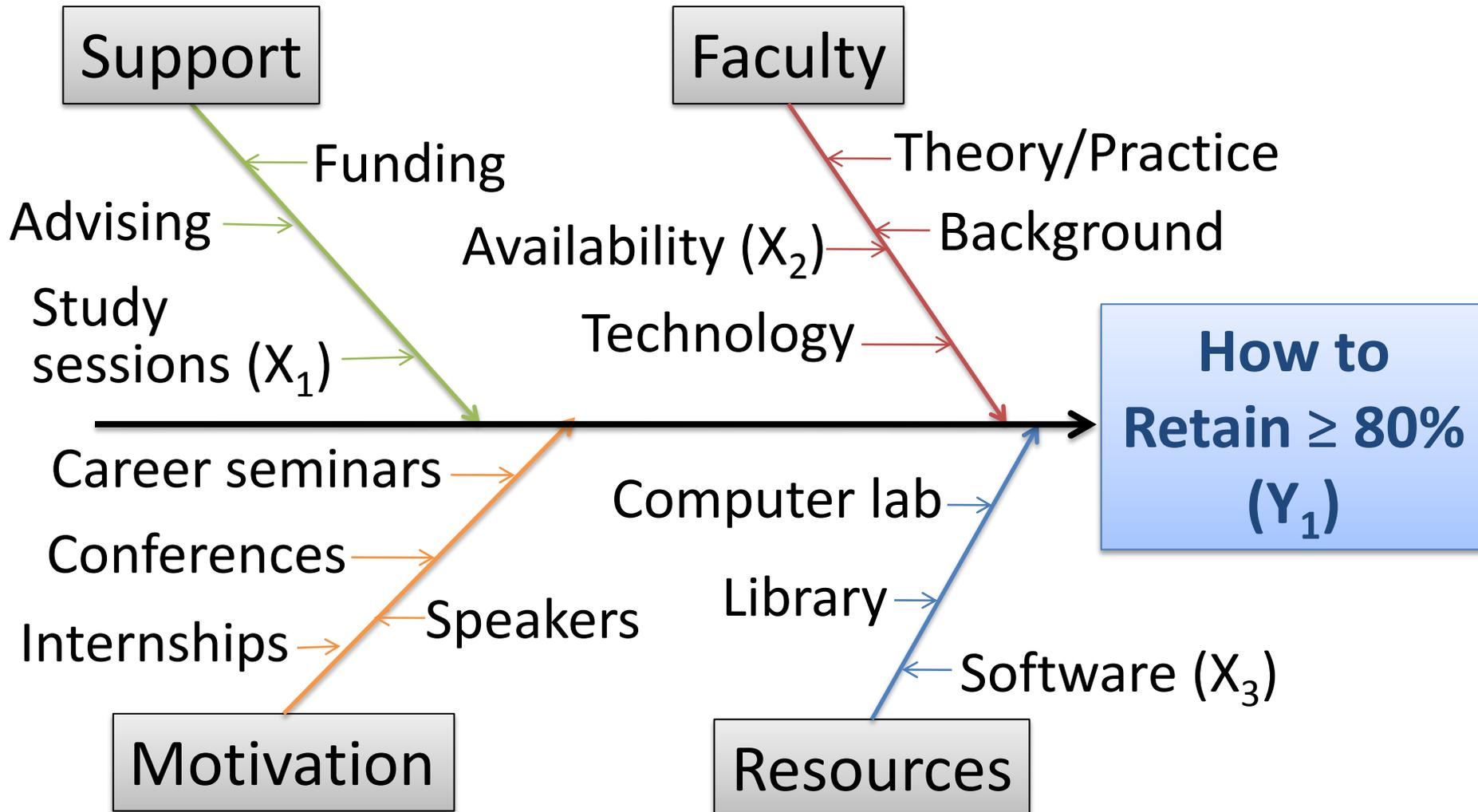
Graduate research statisticians

Goals

Recruitment ≥ 11 RSP students by registration dateline for Spring 2009

Retain ≥ 80% of admitted RSP students through Graduation (Spring 2011)

Place ≥ 60% of RSP students in internships before Spring 2011

# Dependent and Independent Variables

Support
- Funding
- Advising
- Study sessions (X_1)

Faculty
- Theory/Practice
- Background

Availability (X_2)
Technology

How to Retain $\geq 80\%$ (Y_1)

Career seminars
Conferences
Internships
Speakers

Motivation

Computer lab
Library
Software (X_3)

Resources

Operational Definition

- Identifies a specific observable event and describes how to measure it.

Operational Definition → Valid

Operational Definition → Reliable
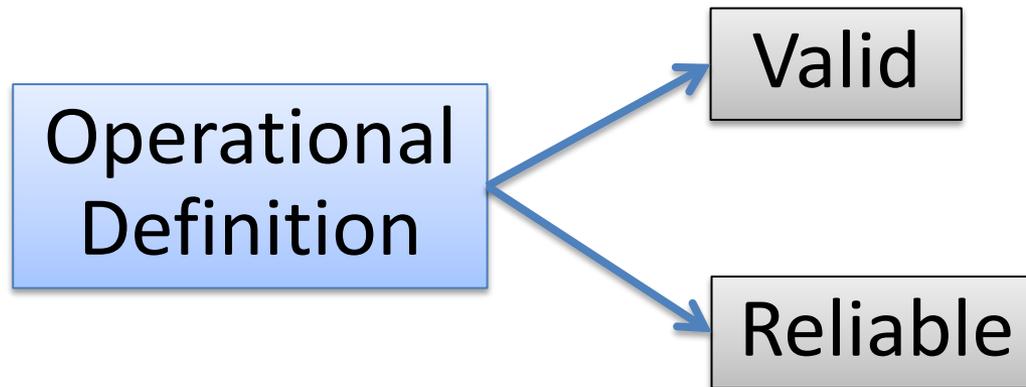
- Develop operational definitions for every X and Y variables.

Operational Definition

Y_1 - Retain ≥ 80% through graduation

At least 9 of the 11 RSP funded students admitted in the Spring 2009 semester will

- complete 18 credit-hours core coursework and 18 credit-hours of approved electives,

- maintain at least a B grade average,

- complete a capstone project, and

- be awarded a M.S. in applied statistics degree by the end of the spring 2011 semester.

Measurement Error

- The method to assess the characteristic of interest (X or Y) must produce the true value reproducibly and repeatedly.

- A complete operational definition may be sufficient to guarantee accuracy and precision.

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Measurement          Accurate
Method
                     Precise ──→ Repeatable
                             ──→ Reproducible
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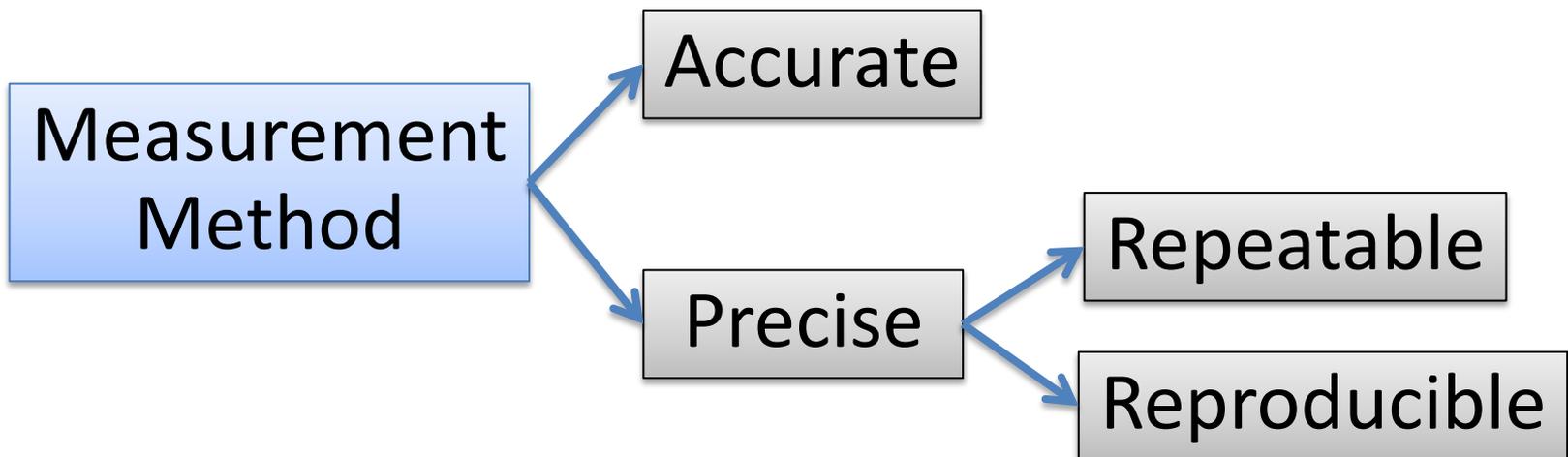
Experimentation

- Establish a quantitative relationship between dependent and independent variables.

$$Y = f(X)$$

- Design experiments to:
  - Account for the effect of nuisance variables (**Blocking**)
  - Protect against effect of unobserved nuisance variables (**Randomization**)
  - Increment precision of estimation (**Replication**)

Experimentation

Variables assumed to affect student retention:

- Study sessions (X_1):
  - X_1 = Faculty led vs.
  - X_1 = Student led

- Faculty availability for consultation (X_2):
  - X_2 = 4 hours/week vs.
  - X_2 = 2 hours/week

- Software (X_3):
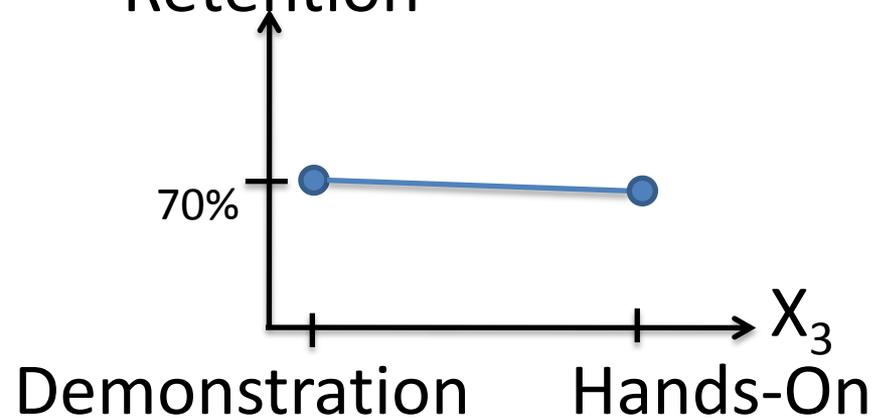 - X_3 = Demonstration vs.
  - X_3 = Hands-On

Analysis of Results

- Exploratory analysis
  - Graphs (Box plots, scatter plots, main effect and interaction plots, etc)
  - Tables
  - Summary statistics
- Statistical analysis:
  - Continuous Y (Regression, ANOVA, ANCOVA)
  - Discrete Y (logistic, Poisson regression, etc.)
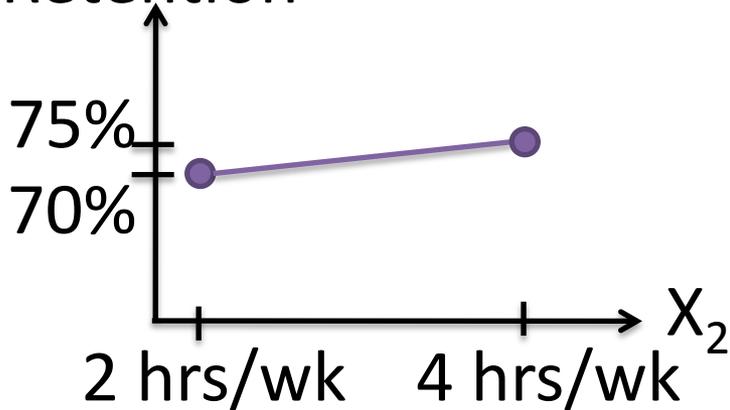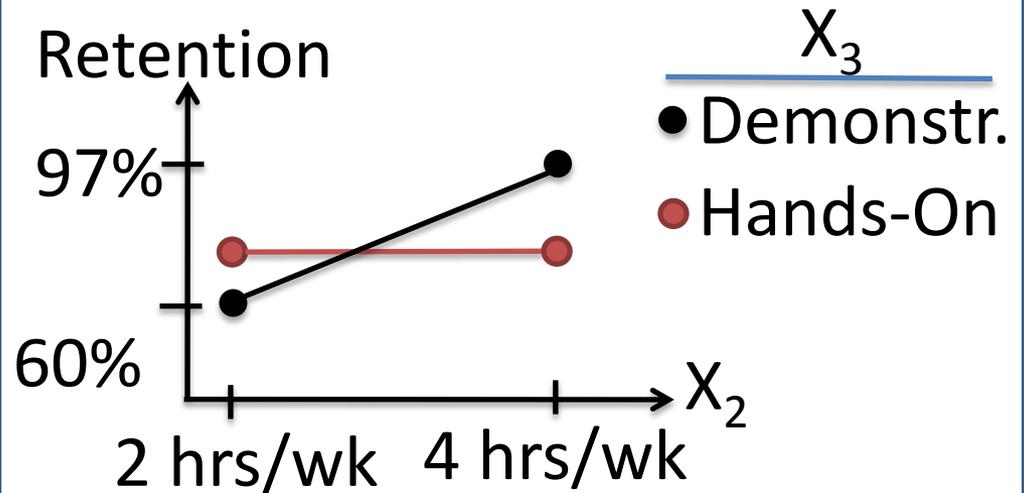 - Etc.

Analysis of Results
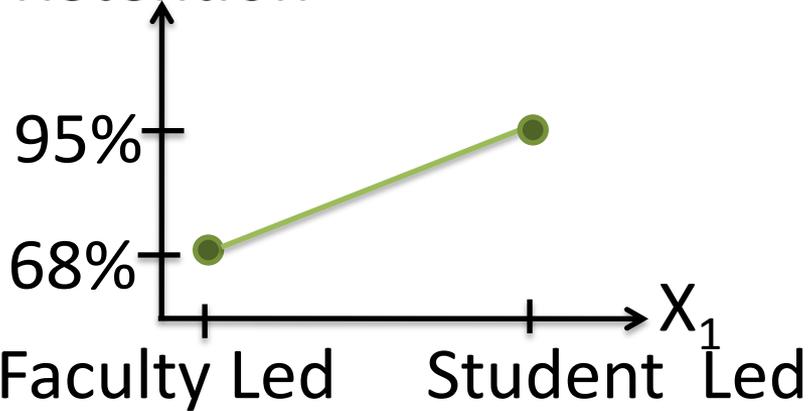
Conclusion

- A method has been outlined to
  - define goals quantitatively,
  - identify dependent and independent variables,
  - establish their relationship,
  - determine if goals were met,
  - identify improvements.

- The 11 students have completed 5 of 7 semesters in the program (100% retention).

- Two Ph.D. statisticians added to our faculty.