Methods and Research Design

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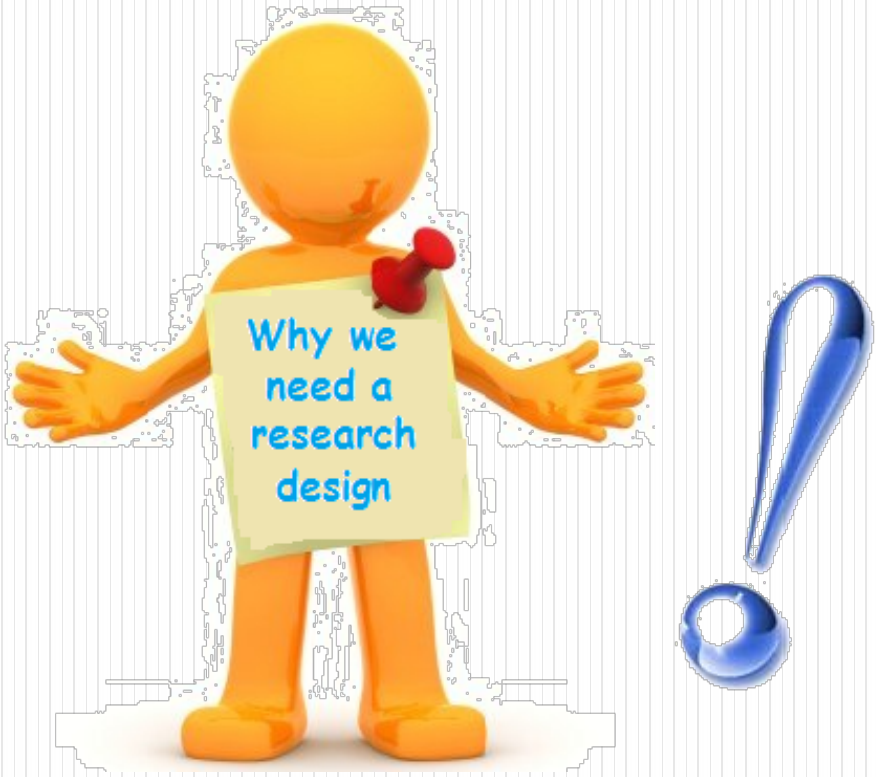
Introduction

- Earliest recorded use of the term “Research” was in 1577.
- Derived from the French "*recerche*", which means

"to go about seeking or searching"


Why we need a research design

Continue...

- Searching for:
  - knowledge or as any systematic investigation
- In order to:
  - find an answer
  - establish novel facts
  - solve new or existing problems
  - prove new ideas
  - develop new theories
- **Scientific Research:** using scientific methods.

Your research will take you on a journey to find out:

So enjoy the journey and be enthusiastic

Research has a route map

- What makes us want to start a journey?
  - Research question
- How do we know which direction to move in?
  - Hypothesis
- What exactly is the first step?
  - Research design
- What do we do when the road gets too tough?
  - Modify design
- What happen if we do nothing and ignore?
  - Failure

Research Plan

Portray

- What you intend to do
  - Specific Aims
- Why it is important
  - Background and Significance
- What has been done so far
  - Preliminary Studies
- How you are going to do it
  - Research Design and Methods

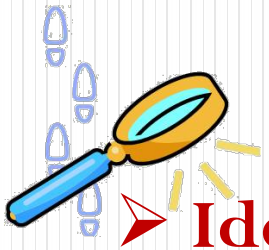
Factors to be considered

- Proper designing
- Common sense
- Clear thinking

- Is necessary for the management of the entire research endeavor.

Research Design

- A master plan that specifies the methods and procedures for collecting and analyzing needed information.



Research Process

- Identify and Define Research Problem

Theory

Hypotheses

Research Design

Data collection

Data analysis

Findings

Three Purposes of Research

- Exploration
  - Generally not sufficient for dissertation project.
- Description
  - What is going on.
- Explanation
  - Why is it going on.

Research Design

Exploratory Research

- Secondary Data
- Experience Surveys
- Pilot Studies
- Case Studies

Descriptive Research

- Secondary Data
- Survey
- Observation

Causal Research

- Experiment

Comparison of Research Designs

	Exploratory	Descriptive	Causal
Purpose	ID problems, gain insights	Describe things	Determine cause-and-effect relationships
Assumed background knowledge	Minimal	Considerable	Considerable
Degree of structure	Very little	High	High
Flexibility	High	Some	Little
Sample	Non-representative	Representative	Representative
Research environment	Relaxed	Formal	Highly controlled
Cost	Low	Medium	High
Findings	Preliminary	Conclusive	Conclusive

Research Design: Exploratory Research

- Exploratory research is most commonly unstructured, "informal" research that is undertaken to gain background information about the general nature of the research problem.

- Exploratory research is usually conducted when the researcher does not know much about the problem and needs additional information or desires new or more recent information.

Continue...

- Exploratory research is used in a number of situations:
  - To gain background information
  - To define terms
  - To clarify problems and hypotheses
  - To establish research priorities

Example…. Case Study

The case: Morning Rush Hour:

1. Identify the problem in the case.
2. Identify the cause of the problem.
3. Work on solution.
4. Implementation plan.
5. Backup plan.

Research Design: Descriptive Research

- Descriptive research is undertaken to provide answers to questions of who, what, where, when, and how – but not **why.**

- e.g. H1N1 in a population?

  Prevalence in different cities?

  What causes H1N1?

  How many people vaccinated?

Example…. Survey

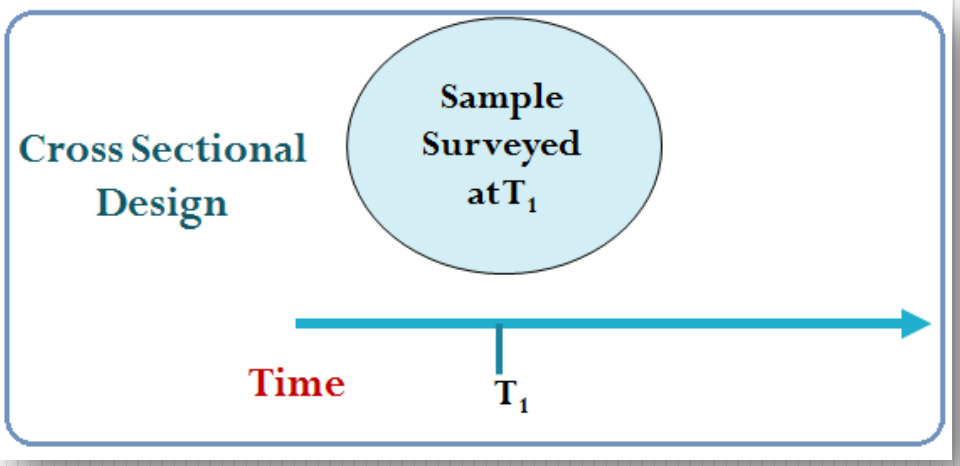
A method of Quantitative research

- Using questionnaires, Delphi method, interviews, normative.

- e.g. Statistical survey, a method for collecting quantitative information about items in a population.

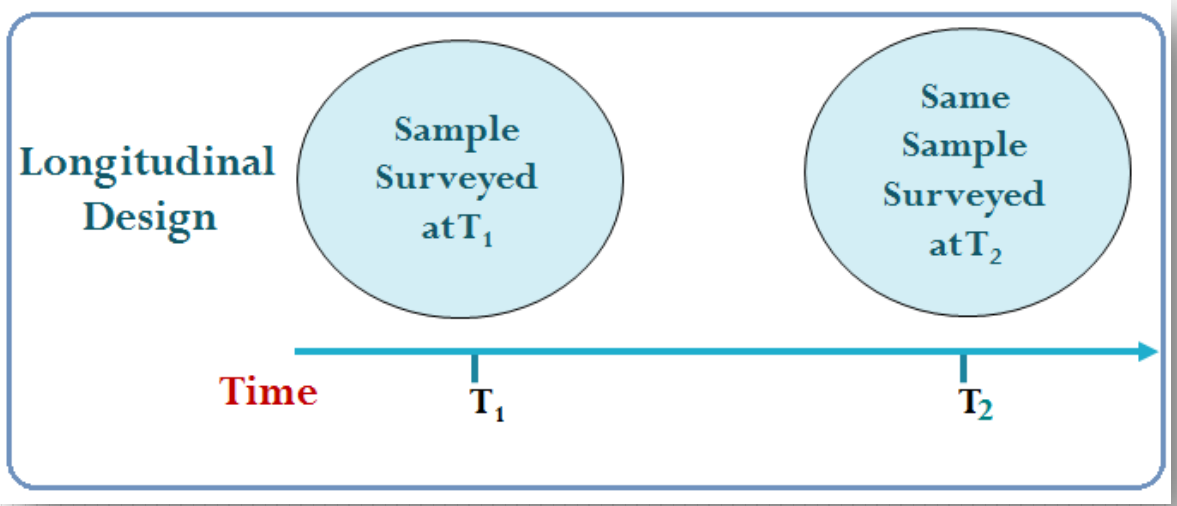
Cross-sectional Studies

- Cross-sectional studies measure units from a sample of the population at only one point in time.
- Sample surveys are cross-sectional studies whose samples are drawn in such a way as to be representative of a specific population.



Longitudinal Studies

- Longitudinal studies repeatedly draw sample units of a population over time.
- One method is to draw different units from the same sampling frame.
- A second method is to use a "panel" where the same people are asked to respond periodically.



Cross-Sectional vs. Longitudinal Designs

	Cross-Sectional	Longitudinal
Detecting change	Worse	Better
Amount of data collected	Worse	Better
Accuracy	Worse	Better
Representativeness	Better	Worse
Response bias	Better	Worse

Causal Research

- Causal Research explores the effect of one thing on another and more specifically, the effect of one variable on another.
- Causal relationships are typically determined by the use of experiments, but other methods are also used.

Experiments

An experiment is defined as manipulating (changing values/situations) one or more independent variables to see how the dependent variable(s) is/are affected, while also controlling the affects of additional extraneous variables.

- ✓ Independent variables: those over which the researcher has control and wishes to manipulate.
- ✓ Dependent variables: those over which the researcher has little to no direct control, but has a strong interest in testing.

For example:

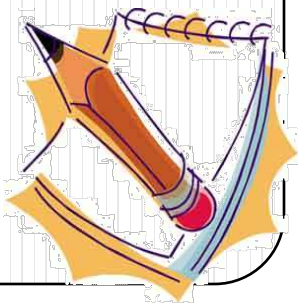
- If a scientist conducts an experiment to test the theory that a vitamin could extend a person's life-expectancy, then the independent variable is the amount of vitamin that is given to the subjects within the experiment.
This is **controlled** by the experimenting scientist.

- The dependent variable, or the variable being affected by the independent variable in this case, is life span.

other examples of dependent and independent variables in science:

- A scientist studies the impact of a drug on cancer. The independent variable is the administration of the drug. The dependent variable is the impact the drug has on cancer.

- A scientist studies how many days people can eat soup until they get sick. The independent variable is the number of days of consuming soup. The dependent variable is the onset of illness.



Types of Experiments

- **Two broad classes:**
  - **Laboratory experiments:** those in which the independent variable is manipulated and measures of the dependent variable are taken in a contrived, artificial setting for the purpose of controlling the many possible extraneous variables that may affect the dependent variable.
  - **Field experiments:** those in which the independent variables are manipulated and measurements of the dependent variable are made on test units in their natural setting

Comparison

- Comparison is used to determine and quantify relationships between two or more variables by observing different groups that either by choice or circumstance are exposed to different treatments.

- Examples: in the 1950s investigations initiated to study the relationship between cigarette smoking and lung cancer in which scientists compared individuals who were smoking with non-smokers and correlated smoking with various health problems including lung cancer.

Getting Started

Main Points That You Must Get Across

- Research design, if carried out successfully, will accomplish Specific Aims.
- Methods are feasible and well developed.
- Approach is original.
- Data will be analyzed correctly.
- Enough subjects/specimens will be tested to lead to conclusive results.
- Limitations are of minor concern only.
- Study can be accomplished in requested time.

- Describe overall approach that will be used to achieve aims.
- Consider using flowchart or table.

Rationale

Reiteration of Research Question

Design, Approach

For Each Specific Aim

Anticipated Results, Interpretation

Detailed Methods

Difficulties, Limitations, Alternative approaches

Rationale

- Directly and succinctly reiterate why you are doing this Specific Aim

Design/Approach

Briefly describe:

- Design of study
- Choice of specimens
- Choice of interventions/independent factors and outcome assessments

Novel methods

- Emphasize what is new about your methods.
- Point out advantages to using your proposed techniques over other approaches.

Measurements

Describe techniques and equipment for measuring all variables

- Use illustrations.
- Demonstrate that measurements will be accurate, precise, sensitive and specific.

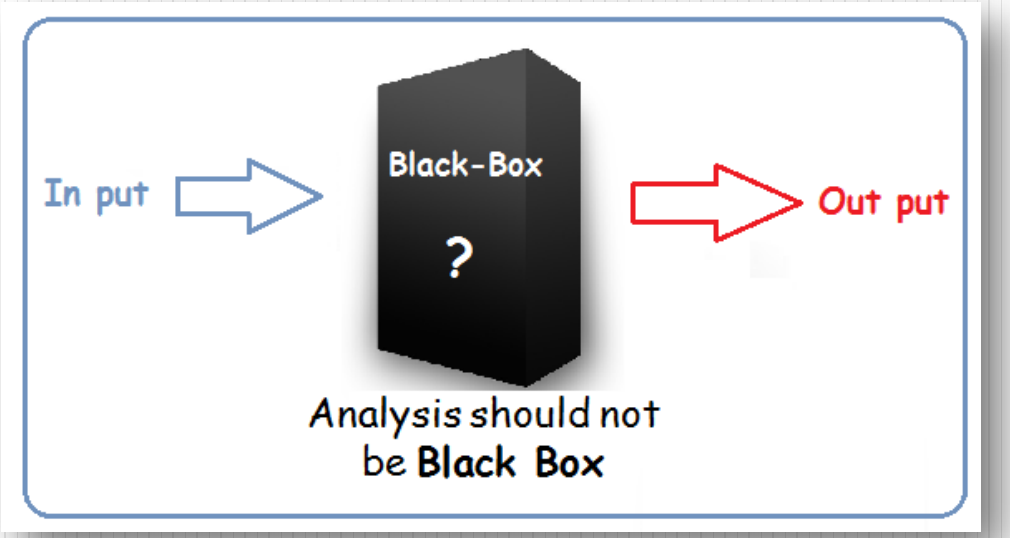
Data analysis

If using analytic statistics, specify

- Statistical parameters and tests
- Assumptions of tests
- Reference if statistical approach is not well known

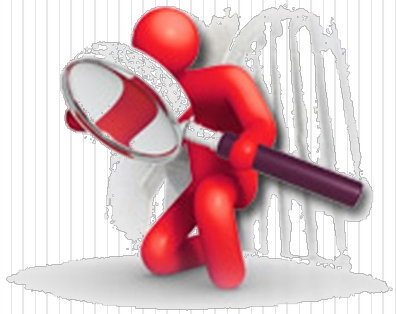
Power analysis

- Remember that you need to determine
  - How many specimens are needed to have a certain probability of detecting an effect?
  - Goal is to demonstrate that enough data will be collected to support analysis.
  - Straightforward procedure.



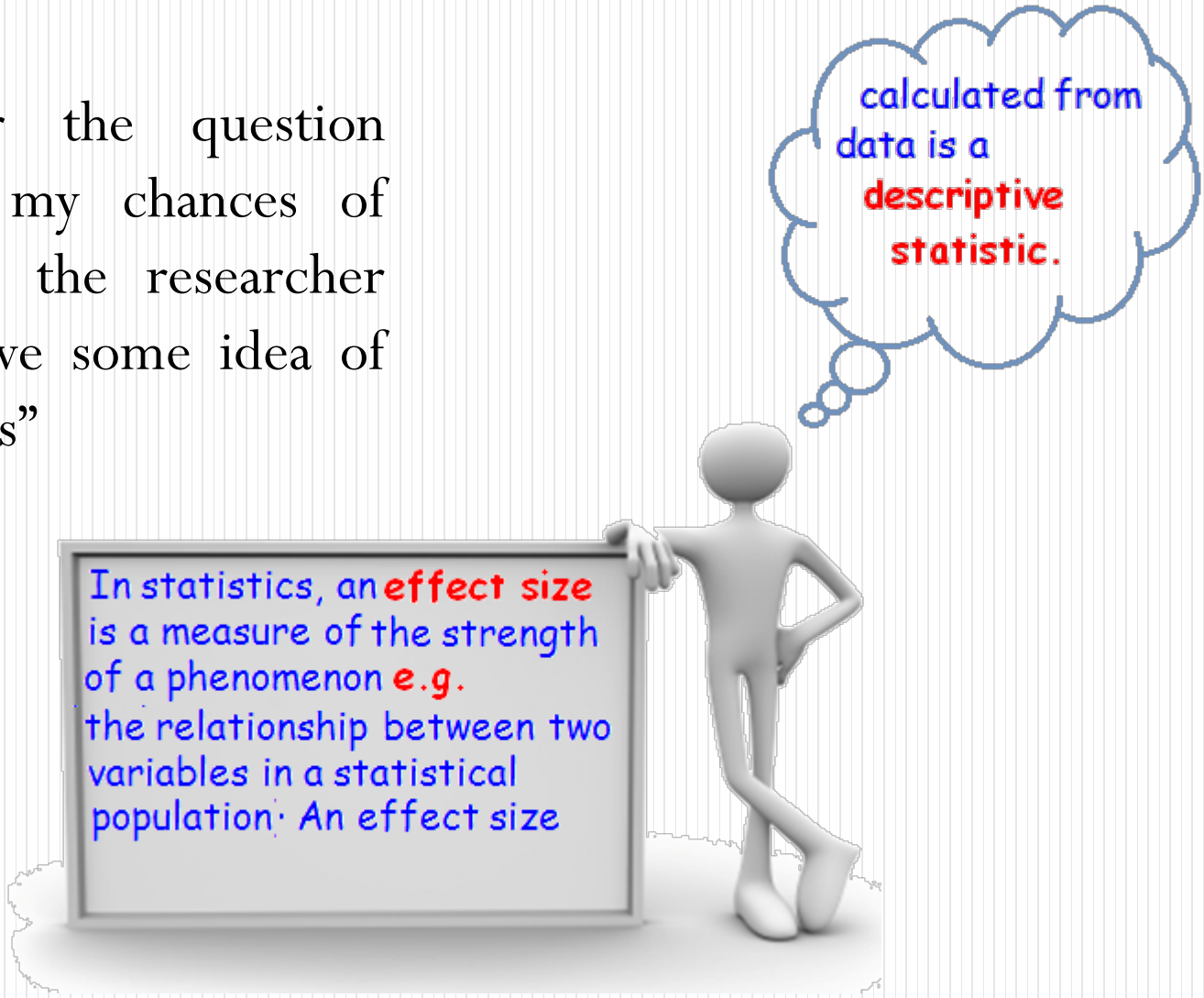
Number of Specimens in Research Plan

- State assumptions and methods used for power analysis
- Specify primary outcome variable.
- Specify factor(s) or independent variable(s) of interest.
- State proposed statistical test or interval estimation.
  - Examples
  - Analysis of variance
  - Linear regression
- Note that each test has specific formula for power/number of specimens.



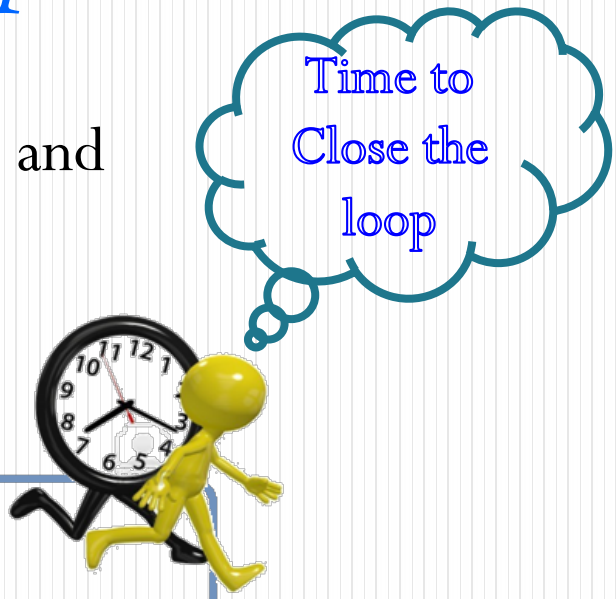
Effect Size

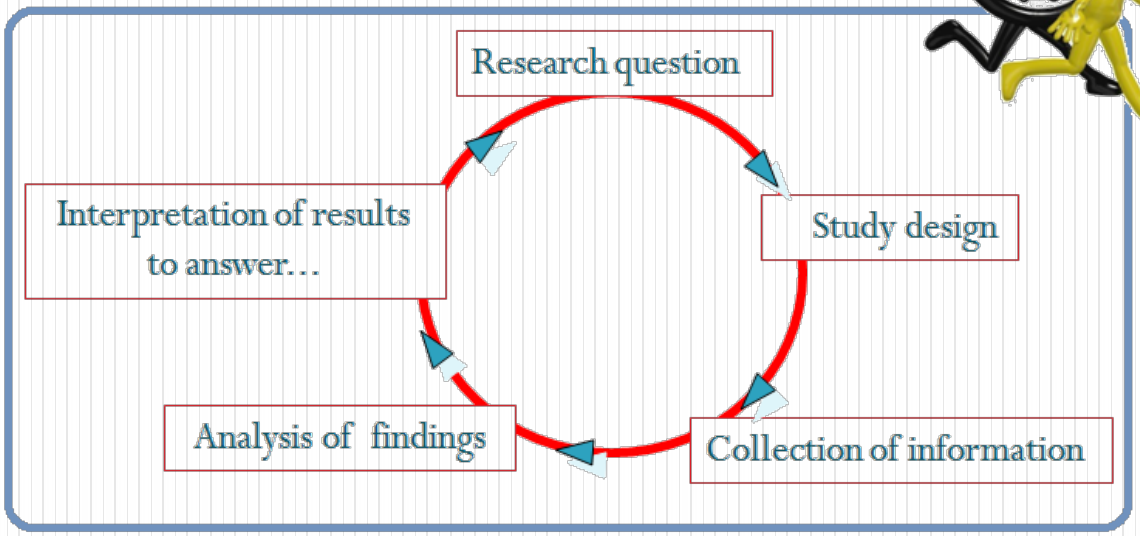
"…to answer the question 'What are my chances of finding it?', the researcher needs to have some idea of how big 'it' is"



Expected Results and Interpretation

✓ Remember to discuss expected results and interpretation of analysis.





TimeTable

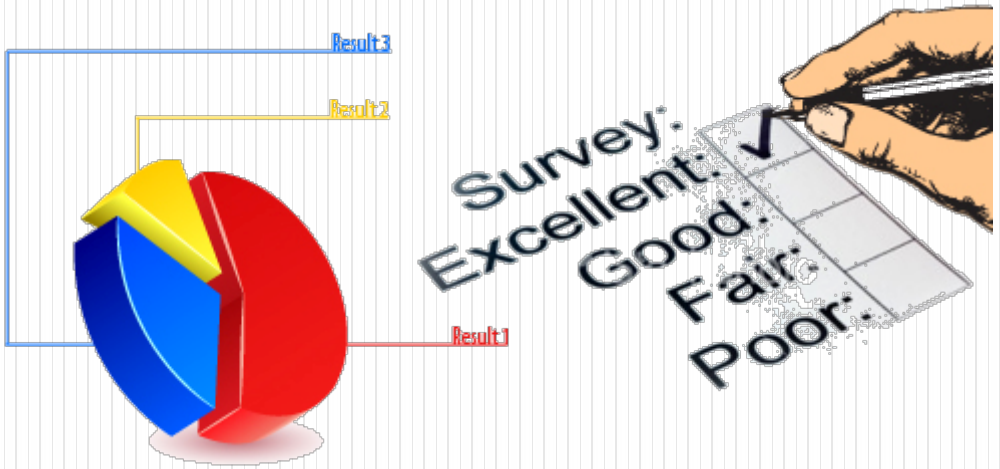
Include timeline or timetable at end of *Research Design and Methods*

- Give enough detail for evaluation
- Make it reasonable

	YEAR 1	YEAR 2	YEAR 3
Aim 1			
Part A			
Part B			
Aim 2			
Part A			
Part B			

Ending

- Close *Research Design and Methods* with overall statement about significance of study.
- Be enthusiastic.



Avoid

- Overly ambitious research plans
- Contingent Specific Aims
- Complex, emerging techniques without establishing familiarity or including expert
- Too little detail on data analysis
- Under-powered studies

Summary:

Successful Research Design and Methods

- Bright idea
- Well developed and clearly described methods
- Appropriate data analysis
- Large enough sample size
- Plenty of time to do the work
- Only minor limitations
- Clear pathway
- Strong conclusions

Good research results require a careful design of the research methodology and considerable evaluation efforts


Thank you