Types of Studies

Roman Kern <rkern@tugraz.at>

706.015 - Introduction to Scientific Working

Types of Studies

What kind of study design exist?

Roman Kern <rkern@tugraz.at>, Institute of Interactive Systems and Data Science, Graz University of Technology

706.015 - Introduction to Scientific Working

Main Types

- The type of study to conduct depends on the research question

- And the research methodology, theory driven vs. exploratory

- Research design is the discipline of how to conduct scientific studies

Types of Studies

Main Types

- Interventional study
    - Able to find causations

- Observational study
    - Correlations
    - New insights

Roman Kern <rkern@tugraz.at>, Institute of Interactive Systems and Data Science, Graz University of Technology

706.015 - Introduction to Scientific Working

Controlled Experiment

- A precondition for conducting an experiment is a clear hypothesis (derived from theories)

- *Independent variables* are manipulated to measure their effect

- ... on one or more *dependent variables*

- Each combination of values of the independent variables is a treatment

- E.g., applying a method or not (= two groups from a single independent variable)

- We want to measure the effect of a treatment

- I.e., the cause-effect relationships

Roman Kern <rkern@tugraz.at>, Institute of Interactive Systems and Data Science, Graz University of Technology

706.015 - Introduction to Scientific Working

Controlled Experiment

- Subjects should be drawn from a well-defined population

- ... with the idea that if it holds for the selected subject,

- ... it also holds for the whole population

Note

Students are not always a representative sample

Controlled Experiment

- Variables other than the chosen independent variables

- ... must not be allowed to affect the experiment

- Between subjects design

  - Split subjects according to variable
  - E.g., smokers vs. non-smokers
  - Assign randomly to treatment groups

- Within subjects design

  - Each subject uses all treatments
  - Downside: learning effect

Controlled Experiment

Pros

- As variables are designed in the beginning, the chance of "spurious corrections" is reduced

Cons

- If critical variables are ignored, the results will not scale to the population

- I.e., will not generalise to the real-world

Controlled Experiment

Quasi-Experiments

- If a true experiment is not possible

    - Results need to be interpreted carefully

- Subject cannot be randomly assigned to the groups

- The effect can only be measured at discrete time stamps

Case Study

Definition
An empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident

- Exploratory case studies
    - Initial investigations of some phenomena to derive new hypotheses
- Confirmatory case studies
    - Test existing theories
    - Or refute them

Case Study

- Prerequisite of case study is a research question

- *Study proposition* states precisely what the study is intended to show (the case)

- Collecting the data

  - Interviews
  - Questionnaires
  - Observations

- Sampling

  - Purposive sampling (instead of random sampling)
  - ... pick the samples one can learn the most
  - *Units of analysis* might be companies, employees, ...

Roman Kern <rkern@tugraz.at>, Institute of Interactive Systems and Data Science, Graz University of Technology

706.015 - Introduction to Scientific Working

Case Study

Example #1

- Theory predicts that companies with many Linux users are more innovative

- The case study will observe Linux and non-Linux companies

- ... and their innovation characteristics of their employees

Example #2

- Theory predicts that the writing style depends on the platform

- The case study will observe the writing style on different platforms

- ... including all distractions of the typical environment (e.g. writing a tweet on a phone)

Case Study

Pros

- Case studies needed, if the context plays an important role

- ... and cannot be modelled in the controlled experiment

- Case studies needed, if the effect take a long time

Cons

- More room for interpretation and more bias

Survey Research

- Identify characteristics via a large sample of the population

- Typically questionnaires

- More recently, crowd sourcing

Survey Research

- Selection of units of analysis is crucial

  - Does not need to be people

- Random sampling might introduce bias in certain populations

- ... stratification might be needed

Survey Research

- Cross-sectional survey
    - Single snapshot at a given time
- Case-controlled design
    - Collect multiple variables
    - Study correlations between variables across population
- Cohort study
    - Changes over time in a sub-population (group)
    - Form of longitudinal studies (in contrast to cross-sectional studies)

Prospective studies are studies running over a long period of time

Survey Research

Pros

- Generalisation of results

- Novel insights

Cons

- Sample bias (see missing value types)

- Limited insights (in comparison with case study)

- Only finds correlations

Survey Research

1. Avoid leading questions

2. Avoid questions that invite the social desirability bias

3. Avoid double-barreled questions

4. Avoid long questions

5. Avoid negations

6. Avoid irrelevant questions

7. Avoid poorly worded response options

8. Avoid big words

9. Avoid ambiguous words & phrases

https://www.slideshare.net/rsmehta/3-types-of-research-study

Roman Kern <rkern@tugraz.at>, Institute of Interactive Systems and Data Science, Graz University of Technology
706.015 - Introduction to Scientific Working

Ethnographies

- Study a community via observations and interviews (exploratory)

- E.g. how are certain phrases being used

- Participant observation is the special case where the observer becomes part of the community

- Instead of (dis)proving hypothesis, local theories are generated

- Challenge: data collection and interpretation

Action Research

- Attempt to solve a real-world problem while simultaneously studying the experience of solving the problem

- Problem owner works together with the researcher

- Data collection via interviews, questionnaires, focus groups

Comparison

- **Mixed-method research**
  - Combine multiple approaches
  - Using quantitative and qualitative data collection methods

- **Sequential explanatory strategy**
  - Use qualitative results to assist in explaining and interpreting the findings of a quantitative study

- **Concurrent triangulation strategy**
  - Use multiple methods at the same time
  - Compare results

Roman Kern <rkern@tugraz.at>, Institute of Interactive Systems and Data Science, Graz University of Technology

706.015 - Introduction to Scientific Working

Types of Studies

Practical advise & remarks

- Plan experiments early on

- Test the experiments with friendly users

- In industrial setting A/B testing is widespread

- Learn about design of experiments and design space exploration

Types of Study

Literature

- Yin, R. K. Case Study Research: Design and Methods. Sage. 2002.

- Kitchenham, B., Pickard, L., and Pfleeger, S.L. (1995). Case studies for method and tool evaluation. IEEE Software 12 (4) 52-62.

Roman Kern <rkern@tugraz.at>, Institute of Interactive Systems and Data Science, Graz University of Technology
706.015 - Introduction to Scientific Working

Thank You

For your attention!

Roman Kern <rkern@tugraz.at>, Institute of Interactive Systems and Data Science, Graz University of Technology

706.015 - Introduction to Scientific Working