Overall Mark for summaries on Moodle is misleading

- Moodle shows an “Overall Mark” for your paper summaries, which is the average of the two summaries you will submit.
- The second unsubmitted summary gets assigned the default mark of 0% so your overall mark is \((\text{first mark} + 0\%) / 2 = \text{first mark} / 2\)
- Once your second summary is marked the overall mark will be correct, and this will go into Portico.
- Results are unconfirmed and provisional and are subject to change by the Board of Examiners and UCL Education Committee.
Counterfactual reasoning to establish causality

• Statistics gives us correlations, which are not the same as causation

• Causation can be shown by re-winding time and changing one thing
  • Hypothesis: not studying causes poor grades
  • Wind back time, start studying, do grades improve?

• Good experiments approximate re-winding time in order to show causality
A Good Experiment

• **Reminder**: Experiments manipulate the topic under study
  • Different from observational study

• Provides sufficient data to support or refute the hypothesis – i.e. experiment is **valid**
A Good Experiment

• Only tests one variable
  • If more than one variable, which one affected result?
• Is unbiased – researcher does not let their opinions influence the experiment
• Is repeated – not a ‘one-off’
• Attempts to remove all external factors which may influence experiment
  • e.g. lab environment, time of day, equipment, etc.
  • Really difficult to achieve with human subjects
Variables

• Something in an experiment which can vary, or be deliberately changed by the experimenter
  • e.g. temperature of gas, height a ball dropped from, length of password in characters

• Sometimes researcher not aware of all variables influencing an experiment
  • e.g. Trying to measure affect of keyboard design on typing speed, but perhaps temperature of room influences participants’ typing speed.
Types of Variables

- **Independent variable** (sometimes called factor)
  - Manipulated by the researcher – e.g. password length
  - Experiment must only change one variable
- **Dependent variable**
  - Hypothesized to change if independent variable changes
    - Effect is observed and measured - data collected
    - State how dependent variable measured and units
- **Controlled variable**
  - Variable not allowed to change
Independent & Dependent Variables

• Charles’s Law – simply put
  • As temperature increases – volume of gas expands
  • As temperature decreases – volume of gas decreases

• Design the experiment
  • What could be the independent variable?
  • What could be the dependent variable?
  • What could be a controlled variable?
Control Group

- Some studies have a control group
  - Different from a controlled variable
- What happens if independent variable is not changed?
  - Not all experiments have control groups
  - Common in drug trials – use of placebos
- Could you have a control group with an information security experiment?
Within Subjects/Paired Design

• Each participant has one treatment and two measurements
  • One sample group of participants
    • e.g. time to complete a task before and after training
• Advantages
  • Few subjects – can be quicker
  • Removes risk of introducing confounding variables
• Disadvantages
  • Participants may drop out
    • Need to remove them from data set
  • Participants may suffer from fatigue and practice effects
Between Subjects/Independent Design

- Two or more groups of participants have same treatment and measured once
  - e.g. measure of privacy concern between old and young
    - Look for statistically significant difference between means of groups
- Advantages
  - Less risk of participants dropping out
  - Participants unlikely to suffer fatigue and practice effects
- Disadvantages
  - Higher risk of introducing confounding variables
  - More participants needed – takes more time
Sampling Bias

• Statistical term
• Important in surveys and user trials
• Sample population not representative of total population
  • Members of total population less likely to be included in sample
  • Non-random sample - all individuals not equally likely to be selected
Sampling Bias

- **Examples**
  - People at a local painting club used to determine views concerning funding of the arts in the UK – (qualitative)
  - Average male height in UK determined by measuring people in local basketball team – (quantitative)

- **Aim to minimise bias**
  - Papers likely to be criticised if there is obvious sampling bias

- Undermines ability to generalise to total population
- Also impacts between subjects/independent experiment design
WEIRD

• Experiments typically performed on:
  • Western
  • Educated
  • Industrialized
  • Rich
  • Democratic countries
• Around 12% of the population
Which line is longer? (Müller-Lyer illusion)
The weirdest people in the world? Henrich et al. (2010)
Selection Bias

• Selection bias leads to sampling bias
  • Terms often used interchangeably (incorrectly)
  • Sampling bias is a sub-type of selection bias

• Other types of selection bias:
  • Terminate trial when result achieved
  • Discounting drop outs
Selection and Sampling Bias

- **Selection Bias**
  - Asking your friends to take part in your study

- **Sampling Bias**
  - Sample not representative of total UK/world population

- In Method section of paper
  - Provide description of selection process and any limitations
  - Provided description of sample collected and any limitations
Structured Sampling

- May want to deliberately manage sampling
- Deliberately select participants based on criteria
- Example:
  - Focus groups to discuss television viewing habits
  - Objective of selection process is to get a good coverage of ages and regions in the UK
Quantitative Research

• Historical roots in positivism
  • Goal is to find laws that explain the real world
  • Identify causal links between things
  • Knowledge is only obtained through experience and observation
• Facts are separated from values
• Science is based on quantitative data obtained through rigorous processes
Quantitative Research

- Types of variables
  - Categorical variables
    - Binary (e.g. yes/no)
    - Nominal (e.g. males, females)
    - Ordinal (e.g. strongly/somewhat agree/disagree)
  - Continuous variables
    - Interval (e.g. temperature in degrees Fahrenheit)
    - Ratio (e.g. natural zero point e.g. degrees Kelvin)
Quantitative Research

• Measurement error
  • Discrepancy between real value of a variable and measurement obtained
  • Instruments can be calibrated to reduce measurement error
  • Self-reported measures can also have measurement error because participants may have a reason to lie
Quantitative Research

• Validity
  • Whether an instrument measures what it is supposed to measure
    • e.g. Can we use password length to measure password complexity?
• Content validity
  • Whether the questions in a questionnaire cover the full range of a construct
• Reliability
  • Whether a measure produces the same results under the same conditions
Quantitative Research

• Correlational Research
  • Observe what happens in the world without interfering
  • Measure two or more variables at one point in time
    • e.g. Measure complexity of passwords used by employees in one organisation and which ones write them down
  • Minimises researcher bias
  • Contributes to external validity (ecological validity)
• Note: Correlation does not imply causality!
Questionnaires

• “Feel the pulse” of a specific population about a topic
• Collect small amount of data from large sample
• Aim to get sample representative of population

• Advantages
  • Efficient
  • Statistical significance
  • Simplicity
  • Transparency
  • Credible results

• Disadvantages
  • Require high technical proficiency to design
  • Only measure attitudes, not behaviour
    • e.g. self-selection bias of more private individuals!
Experimental Research

- Manipulate one variable to see effect on another variable (remember independent/dependent variables)
  - e.g. create passwords with different complexities and assign them to different participants. Take note of which ones resort to writing them down
- Cause and effect (David Hume)
  - Events must occur close together in time
  - Cause must precede the effect
  - Effect never occurs without the cause
- Confounding variables may cause both events:
  - Cause never occurs without the effect
Experiments

• Between-groups design
  • Manipulate the independent variable with different participants
  • Each group of participants is tested under different experimental conditions
  • Differences between people (e.g. IQ) can lead to unsystematic variation in results
Experiments

• Within-subjects design
  • Manipulate the independent variable with same participants
  • Every participants goes through all the experimental conditions
  • Can introduce learning and boredom/fatigue effects
Laboratory experiments

• Advantages:
  • Control over environment
  • Replicable
  • Allows the determination of cause and effect
  • Statistical significance
  • Capture behaviour, not just attitudes

• Disadvantages
  • Artificiality
  • Researcher bias
  • Demand bias (participants guess what the experiment is about)
Qualitative Research

• Associated with **constructivism**
  • Reality is a social construction
  • Capture multiple perspectives of same phenomenon
  • Context in which data was collected is very important
  • Relationship between researcher and object/subject of research is taken into account
Qualitative Research

• Qualitative data has no variables per se
  • But, you can generate some:
    • e.g. Counting instances of a code / theme
    • e.g. Correlation between code and age group
Interviews

- Conducted with less people than questionnaires
- Can be structured, semi-structured, or unstructured

**Advantages**
- Flexible
- Rich interactions
- Generate secondary level data such as body language or tone of voice

**Disadvantages:**
- Standardisation is hard
- Less reliability
- Researcher bias
- Time consuming
- Only measure attitudes
Focus groups

- Group interviews between 4–12 participants
- Group can be homogeneous or heterogeneous

Advantages
- Participants interact with each other
- Efficient
- Extreme views are kept in check by the group
- Enjoyable to participants

Disadvantages
- Difficult to manage
- Dominating personalities
- Small sample sizes make it difficult to generalise results
- Group dynamic bias
Asch conformity experiment
(Solomon Asch, 1951)
Diary methods

- Participants record their own experiences
- Capture data in natural contexts
- Substitute for observation

Advantages
- Report of experience close in time to actual experience
- Data generated by participant

Disadvantages
- Require lots of training and briefing of participants
- Time consuming for participants
- Participants may want to please researcher (bias)