Z-scores

- Sometimes being able to compare scores from different distributions is important.
- Z-scores measure distance of a score from the mean in units of standard deviation.
- Scores below the mean have negative z-scores, and those above have positive z-scores.
- FOR EXAMPLE: Test: Mean = 80 & SD = 8

  Phineas got a 72%: z-score of -1

  Ferb got a 84%: z-score of +0.5

Direction of a Z-score

- The sign of any Z-score indicates the direction of a score: whether that observation fell above the mean (the positive direction) or below the mean (the negative direction)
  - If a raw score is below the mean, the z-score will be negative, and vice versa

Comparing variables with very different observed units of measure

- Example of comparing an SAT score to an ACT score
  - Mary's ACT score is 26. Jason's SAT score is 900. Who did better?
  - The mean SAT score is 1000 with a standard deviation of 100 SAT points. The mean ACT score is 22 with a standard deviation of 2 ACT points.

Let's find the z-scores

$$Z = \frac{\text{Score-mean}}{\text{SD}}$$

Jason: $$Z_x = \frac{900-1000}{100} = -1$$

Mary: $$Z_x = \frac{26-22}{2} = +2$$

- From these findings, we gather that Jason's score is 1 standard deviation below the mean SAT score and Mary's score is 2 standard deviations above the mean ACT score.
- Therefore, Mary's score is relatively better.

Interpreting the graph

- For any normally distributed variable:
  - 50% of the scores fall above the mean and 50% fall below.
  - Approximately 68% of the scores fall within plus and minus 1 Z-score from the mean.
  - Approximately 95% of the scores fall within plus and minus 2 Z-scores from the mean.
  - 99.7% of the scores fall within plus and minus 3 Z-scores from the mean.

Z – Score Conclusions

- Z-score is defined as the number of standard deviations from the mean.
- Z-score is useful in comparing variables with very different observed units of measure.

  (Like measures of central tendency and variation – z-scores can *describe.)*

- HOWEVER -

- Z-scores allow for precise ***predictions*** to be made of how many of a population's scores fall within a score range in a normal distribution.

  (So they are also inferential, because they can infer what might happen in the future.)

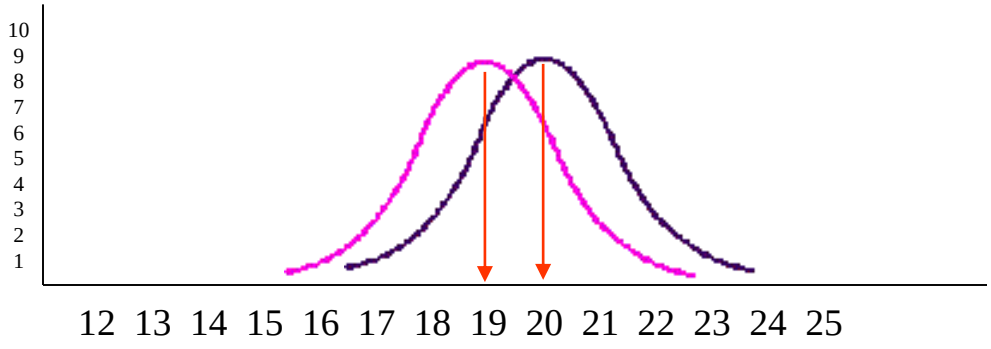
Types of statistics

- Descriptive statistics are used to *reveal patterns* through the analysis of numeric data.
  - Measures of Central tendency
  - Measures of variation
  - Z-scores

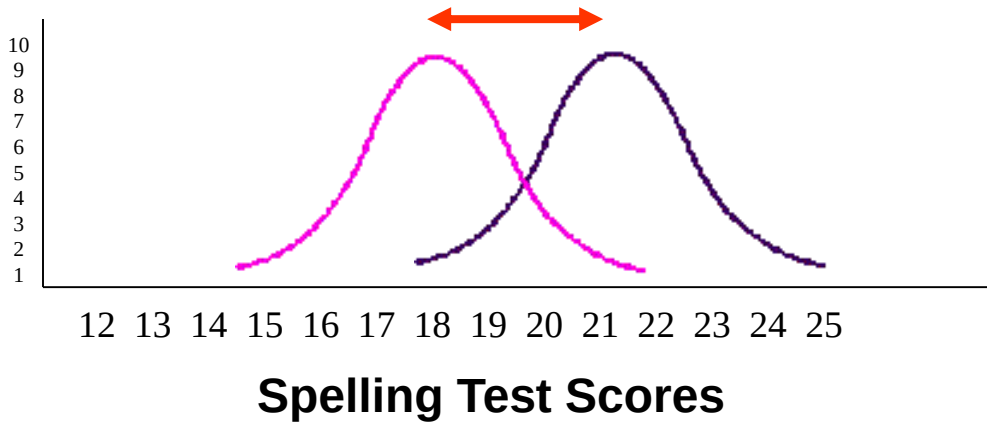
- Inferential statistics are used to *draw conclusions and make predictions* based on the analysis of numeric data.
  - Z-scores
  - t-tests
    - These types of stats help us determine if ***chance*** played a role in our findings.

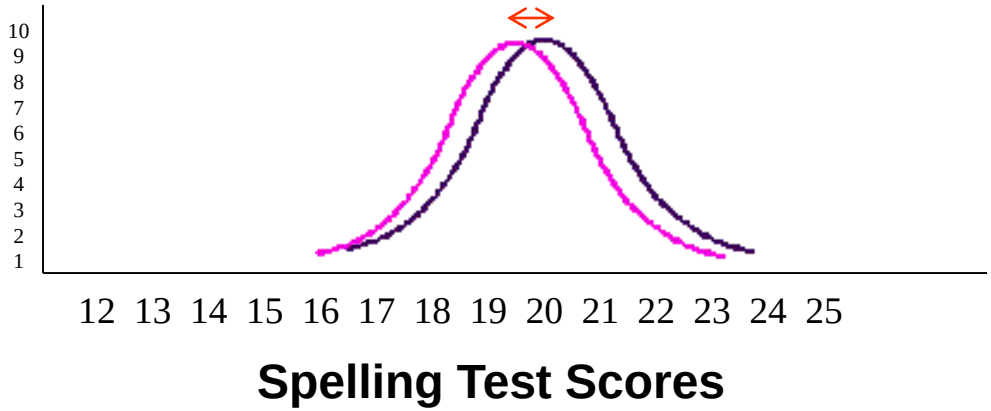
Drawing conclusions – did our experiment work?

- Suppose we conducted a study to compare two strategies for teaching spelling.
- Group A had a mean score of 19. The range of scores was 16 to 22, and the standard deviation was 1.5.
- Group B had a mean score of 20. The range of scores was 17 to 23, and the standard deviation was 1.5.
- How confident can we be that the difference we found between the means of Group A and Group B occurred because of differences in our reading strategies, rather than by chance?



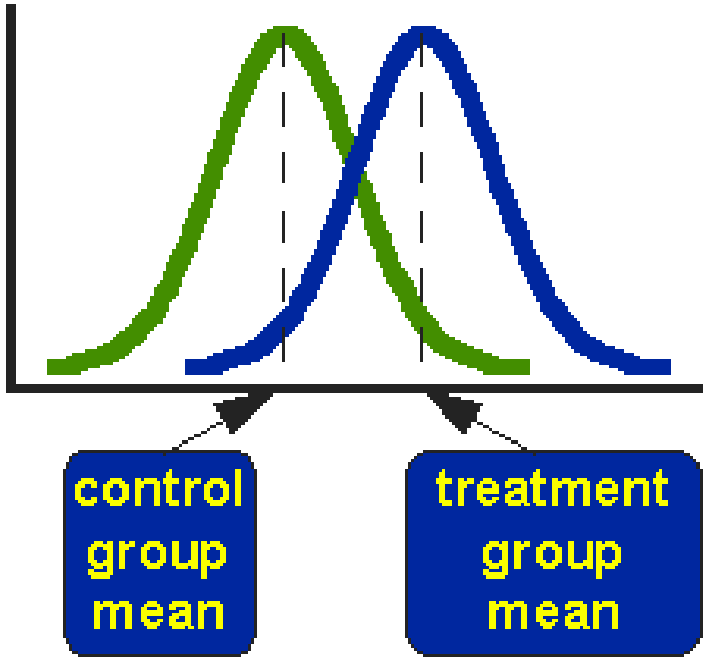
All other factors being equal, large differences between means are less likely to occur by chance than small differences.

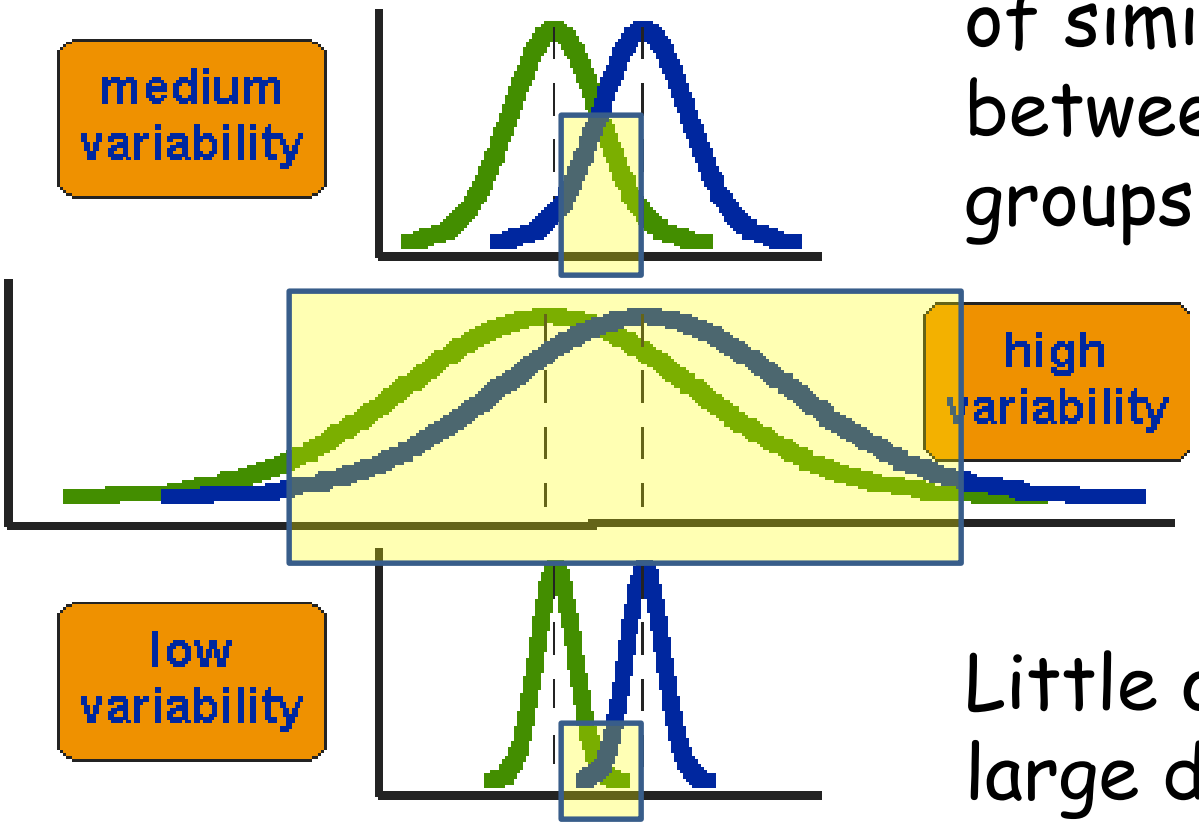




t-test

- ***In summary:***
- Determine whether the means of two groups are *statistically* different from each other by comparing the means.
- This analysis is appropriate whenever you want to compare the means of two groups.





Large overlap, a lot of similarity between the two groups.

Little overlap, large differences between groups.

T-Tests are a good way to determine whether a finding is statistically significant because they compare the means of the experimental and control groups.

Inferential Statistics

When is a Difference Significant?

p-values

Statistically Significant: a result is called **statistically significant** if it is unlikely to have occurred by chance.

"Magic number" is $p \leq .05$

This means you are 95% sure the results did not occur by chance.

- The purpose is to discover whether the finding can be applied to the larger population from which the sample was collected.

Making Inferences

When is an Observed Difference Reliable?

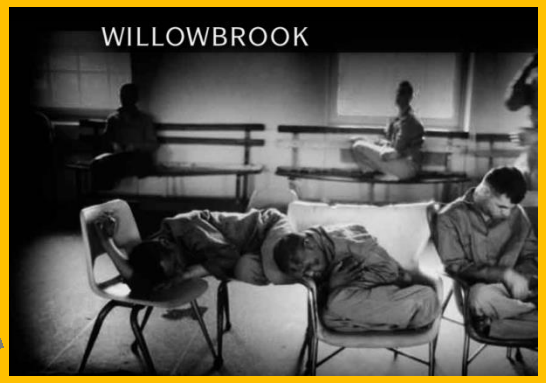
1. **Large, representative samples** are better than biased samples.
2. Observations with **low variability** are more reliable than those with high variability.
3. **Many cases** that support your data **are** better than fewer cases.

POINT TO REMEMBER: Don't be overly impressed by a few anecdotes. Generalizations based on a few unrepresentative cases are unreliable.

Ethics in research

How do ethical issues inform and restrain research practices?

How are humans and animals protected during research?



The Need for Ethical Principles

- Psychologists must ask and answer questions such as:
  - Are we putting our participants at risk?
  - Is our experimental treatment harmful?
  - Is the information we will gather from our experiment worth the potential risk and harm to participants that is involved?

Standards governing social science research

- at the department level
  - Human Subjects Committees

- at the university level:
  - ***Institutional Review Boards (IRBs)***
  - **The purpose of an IRB is to review research and to ensure the rights and welfare of human subjects involved in research are adequately protected.**

- professional associations
  - American Psychological Association's (APA) "Ethical Guidelines"
  - "Code of Ethics" of the American Speech Hearing and Language Association

Voluntary informed consent

- Before conducting any research using human participants, a participant's voluntary informed consent must first be obtained:
  - **Voluntary**: the subject willingly agrees to participate in the study, and is free to withdraw at any time without penalty
  - **Informed:** the subject is aware of any risks (physical or psychological) associated with participating
  - **Consent:** the subject's consent is unambiguous, e.g., a signed permission form

    (no such thing as "implied consent")
- Exceptions to the consent requirements
  - Low-risk anonymous survey
  - Observations gathered in public place
  - Information in the public domain
- Minors cannot give consent, and parental consent is required.

No harm to the participants

- minimizing psychological risks
  - Example: avoid simulations that accentuate racist, sexist, or homophobic attitudes
- minimizing physical risks
  - Example: Avoid infecting people with diseases, avoid shocking people.
- showing concern for the welfare of participants
  - Example: Wendell Johnson's "Monster Study"

Privacy concerns

- Anonymity: no one including the experimenter can match the data to specific individuals
- Confidentiality: the experimenter may know the participants' identities but takes steps to protect participant's privacy. (Don't release names, SS#'s, results, etc.)

Debriefing

- ***Dehoaxing***:
  - undoing the cover story and revealing the true purpose of the investigation
- ***Desensitizing***:
  - addressing any lingering psychological or emotional concerns associated with participating in the investigation
  - Explaining the benefits of participation to subjects
  - Thanking subjects and providing for future contact if necessary

Deception and the use of cover stories

- Intentional deception beyond the purpose of the study should be avoided.
- The following structures should be adhered to for the use of deception in experimental research:
  - As a last resort: When there is no other feasible way to obtain the desired information
    - example: studies on student cheating
  - When the benefits substantially outweigh the risks
    - example: controlled double-blind studies on drug efficacy
  - When subjects are given the ***option to withdraw at any time, without penalty***
  - When any physical or psychological harm is temporary
  - When subjects are debriefed and the research procedures are made available for public review

Treating participants with respect and dignity

- the "subjects" versus "participants" controversy.
- avoid "isms" in research; sexism, racism, ethnocentrism, ageism, etc.
- Ethical concerns involved when withholding treatment from control groups

Ethics are a set of guidelines that should be followed by psychologists carrying out research They are provided by the American Psychological Association (APA) which oversees the work of psychologists

Ethics are not simply a question of right or wrong.

Ethics
In Psychology

① Informed consent
Participants should give informed consent, they should be aware of the true nature of the study. In studies involving children, informed parental consent should be obtained. Payment should never be used to induce risk taking behaviour.

② Deception
Intentional deception over the purpose of the investigation should be avoided when possible. There must be strong medical or scientific justification for any deception.

③ Debriefing
Participants should be fully debriefed. Their experiences should be discussed to assess any negative effects. Debriefing should be in the form of active intervention before leaving the research facility.

④ Protection from harm
Participants should be protected from emotional and physical harm. They should be asked about any factors which may create risk; i.e. medical conditions – any risk should be no more than could be expected in the course of daily lifestyle.

⑤ Confidentiality
The source of all information should remain confidential. Participants should be informed as early as possible if confidentiality cannot be guaranteed.

⑥ Right to withdraw
Participants should be aware of their right to withdraw from the investigation at any time. This may be done retrospectively by revoking permission for their data to be used.

⑦ Giving advice
Psychological advice must only be given if the psychologist is qualified in the area that the advice is requested in.