The Role of Statistics in Research

RALITSA TODOROVA
PSY250

We will cover…

- Scales
- Measures of central tendency
- Measures of dispersion
- Correlation
- T-test and ANOVA

- We have data – we want to organize it and make sense of it
- To be able to say something about the social world

- Pew Research Center election data
- NY Times states shift

Scales of Measurement

Nominal Scale

- Classify data into categories = numbers, labels

- Order is arbitrary and unimportant
- No magnitude given to the numbers; numbers themselves don't carry any information

- Gender
- Seasons
- Basketball jersey numbers

Ordinal Scale

- The order matters
- Distance between categories doesn't matter

- Grades
- Rank-ordered data
  - Attractiveness
  - A statement is being made about the amount of the characteristic being measured (one person is more attractive than two others) but the intervals need not be equivalent (they are not increasing in attractiveness in the same 'amounts')

Interval Scale

- Equal units of measurement throughout the scale
- Provides information about the order and the relative quantity of a characteristic being measures
- *No true zero value – zero means something*
- Temperature

- Likert scales – controversy – ordinal or interval?
- Satisfaction:

1	2	3	4	5	6	7
completely unsatisfied						completely satisfied

Ratio Scale

- Information about order, equal increments, has a true zero
- Having true zero allows ratios to be formed

- Age
  - **A person who is 1 is younger than a person who is 2**
  - **Each year is the same amount of time**
  - **A person who is 20 is half as old as someone who is 40**

What scale of measurement are these?

- Military titles: Lieutenant, captain, major
- The rated sweetness of a can of soda
- Responding to a yes or no question
- Height measured in inches
- Gender
- Weight measured as light, medium, heavy

- Nominal? Ordinal? Interval? Ratio?

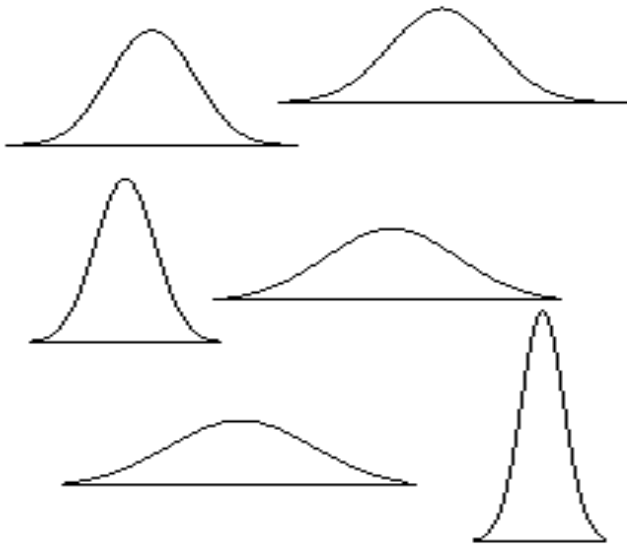
- So we have all these scales – is everything measureable?

Ways to describe our data

Measures of Central Tendency

- Provides info about the middle of a distribution, not about the spread

- Averages: mean, median, mode



Mode

- The most common score in a frequency distribution
- Represents most typical score

Person	Score
1	64
2	74
3	82
4	84
5	85
6	85
7	87
8	92
9	96

Median

- Middle most score in a distribution (ordered)

Person	Score
1	64
2	74
3	82
4	84
5	85
6	85
7	87
8	92
9	96

Mean

- Average
- $= \frac{\text{sum of scores}}{\text{\# of scores}}$
- Advantage: uses all info in distribution
- Disadvantage: sensitive to outliers

Person	Score
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Summary

Measure of central tendency	Property of measurement	Examples
Mode	Nominal	Eye color; party affiliation
Median	Ordinal	Rank in class; birth order
Mean	Interval & Ratio	Age; height

Measures of Dispersion

- Degree to which scores are clustered or spread out (how close they are to the mean)
- Important especially when groups are being compared
- Range, standard deviation, variance

Range

- Difference between the highest and lowest score
- = highest – lowest + 1
- (+1 includes both highest and lowest number so you don't lose a value)

Person	Score
1	64
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Standard Deviation & Variance

- Standard deviation: The average distance that the scores in a set of data fall from the mean (p. 87)
- The SD will depend on how much the scores vary
- Variance: standard deviation squared
- These measures are used primarily with interval or ratio data because they use the mean
  - **Why not use with nominal data for example?**

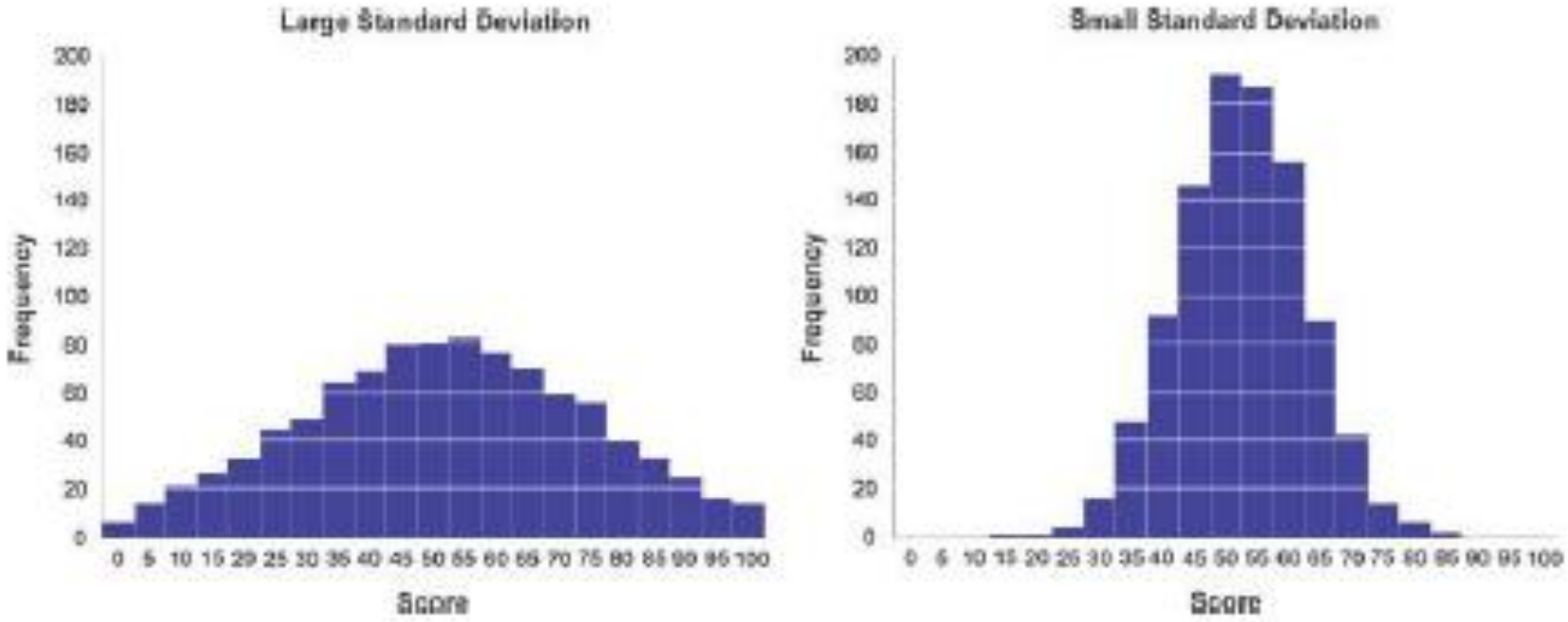
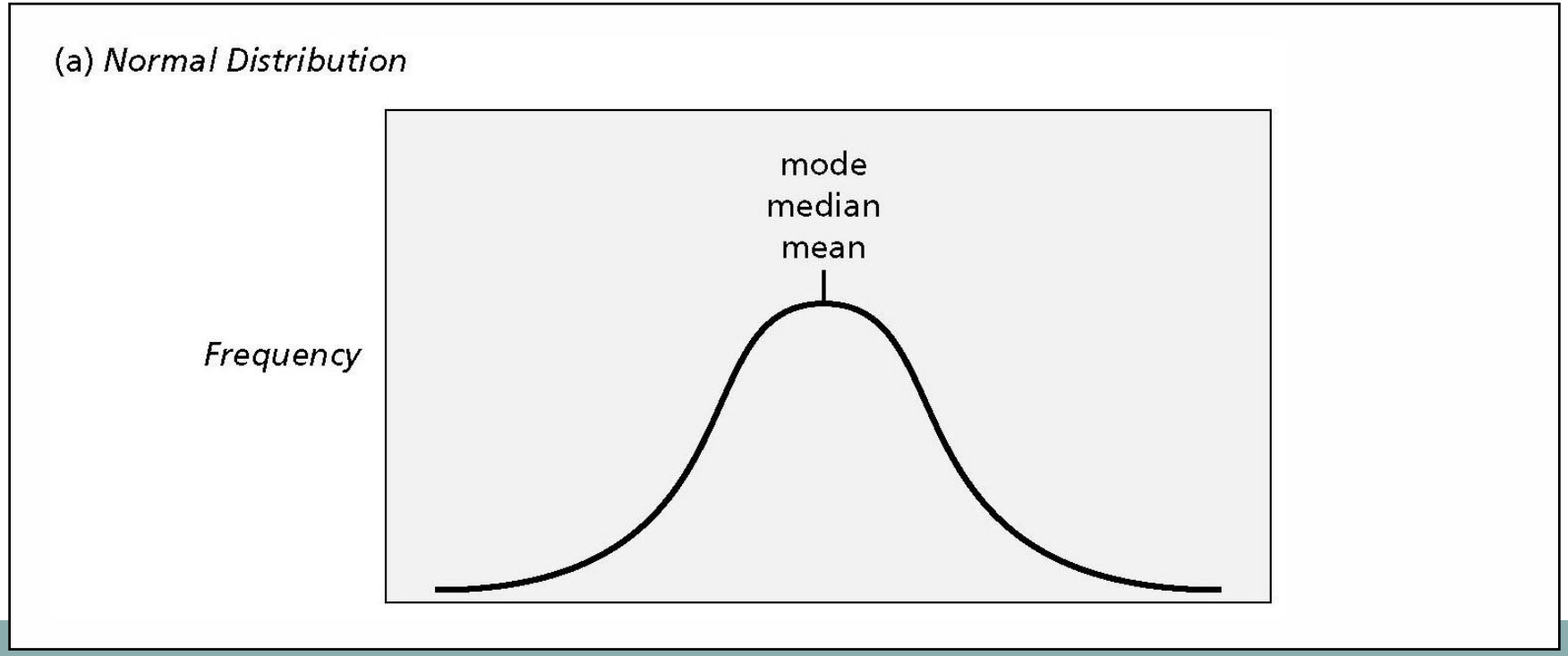


FIGURE 2.6 Two distributions with the same mean, but large and small standard deviations

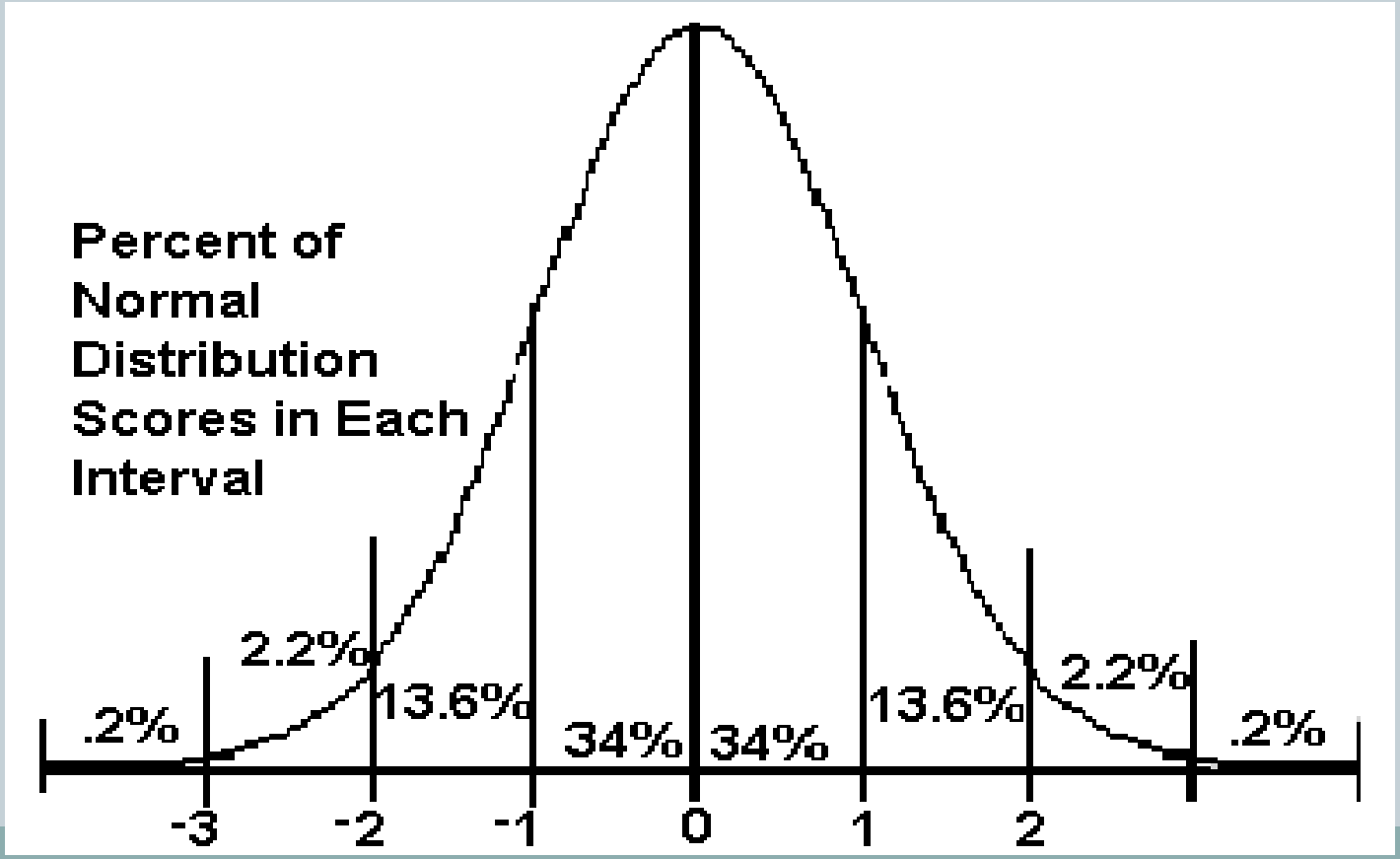
Normal Distribution

- Bell-shaped, Symmetrical
- Observations are mostly clustered around the center, with fewer at the "tails"



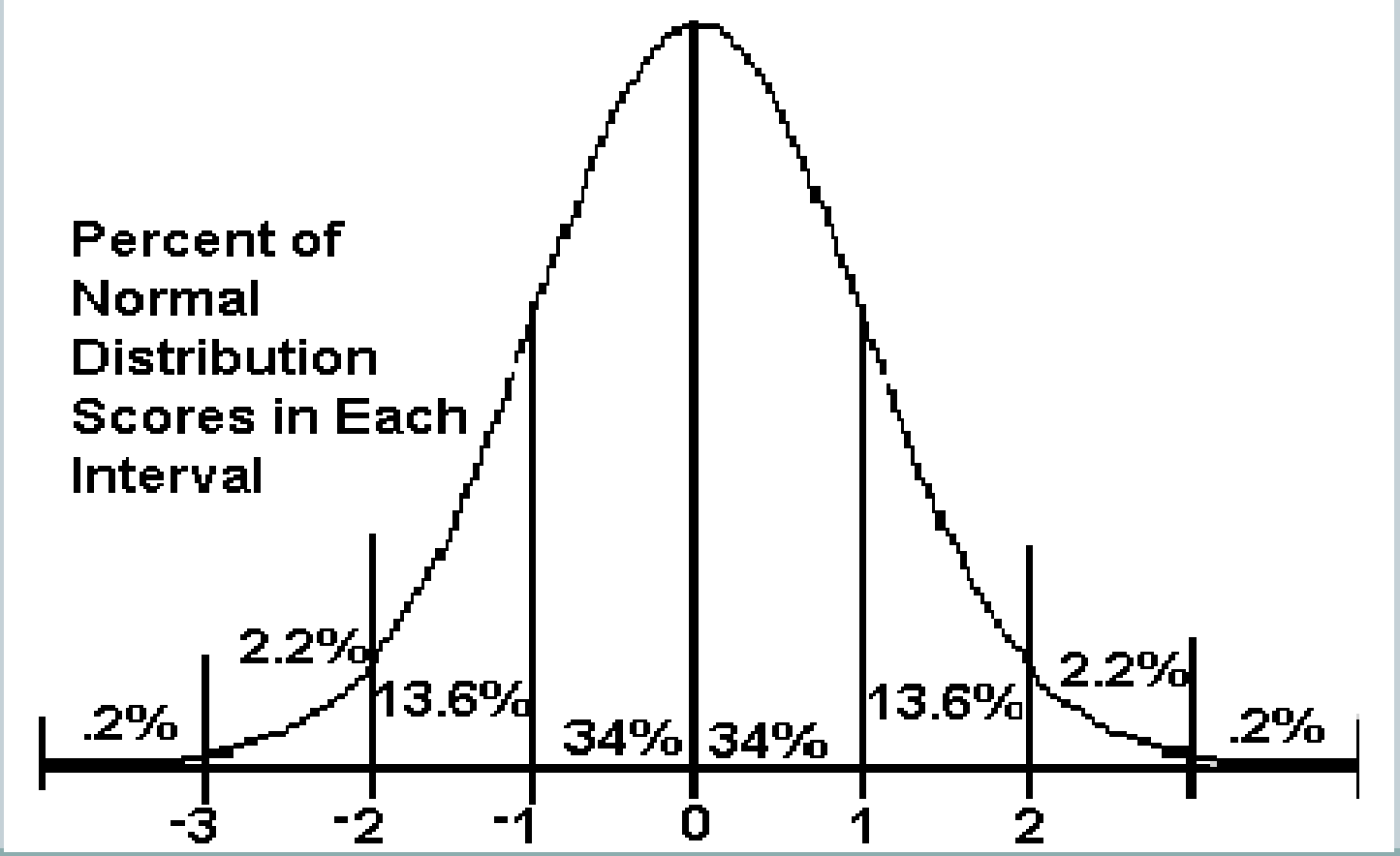
Normal Distribution

1 SD is about 34% of area beneath curve toward each tail, so 68% of scores fall within 1 SD



Normal Distribution

95.2% of scores fall within 2 SD



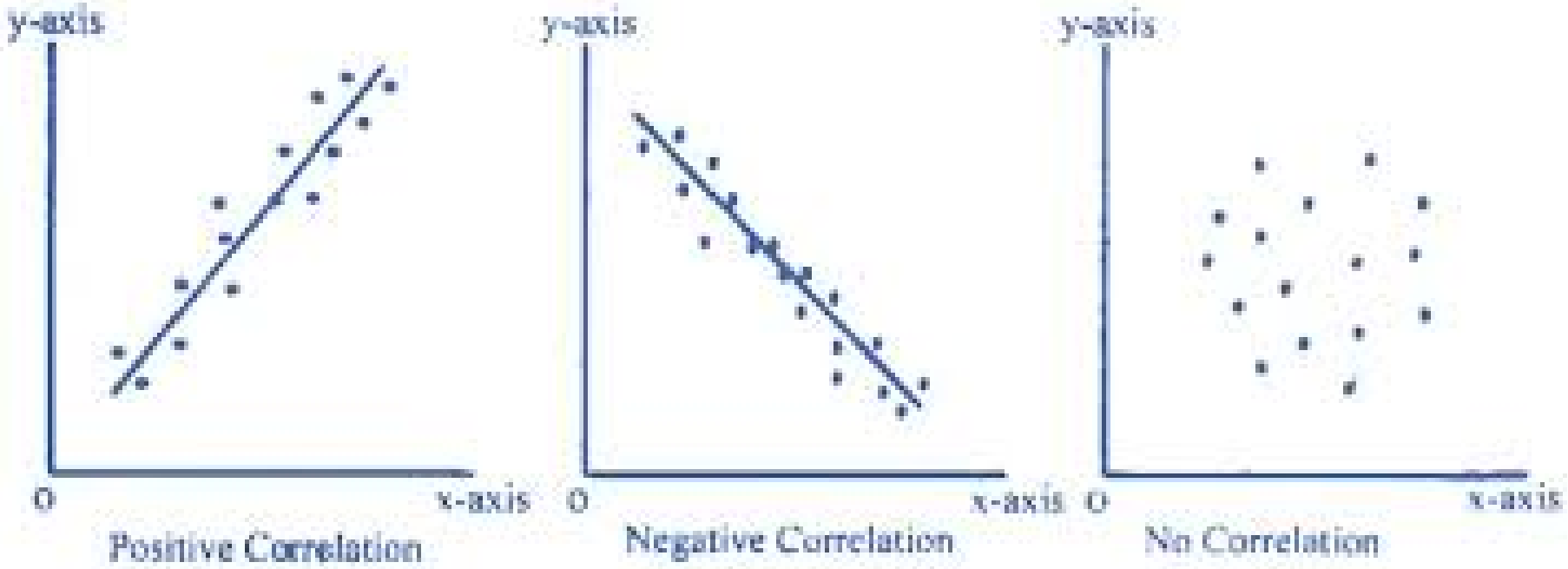
Ways to measure relationships

- Correlations
  - Regressions
- T-tests
- ANOVA

Correlation Coefficient

- How much two variables are related to one another
- Strength = 0 – 1.00 where 1 is a perfect correlation
- Direction = positive or negative
- -0.89 = +0.89
- What could our squirrel research question be if we wanted to calculate a correlation?

Positive, Negative, & No Correlation



Comparing groups

- Whether the difference between two groups (control and experimental) is large enough and consistent enough to suggest that the *populations* represented by those samples would show the same effect (p. 91)

- Differences *within* each group
- Differences *between* groups

Error Variance

- This is any difference in the scores that is not due only to the variable that is being tested, but also to other possible factors
- Ratio of the differences among the scores *between* groups (*IV*) to the differences among the scores *within* the groups (*error variance*)
- Can be measured with SD
- Ex.: placebo vs. drug treatment (headaches)
  - **Factors such as motivation or sensitivity can create within group differences**

Comparing Groups

- Using means to compare groups
- Uses same concept of between and within group differences
  - **Whether the means of groups differ significantly from one another**

Comparing Groups

- T-Test: used to compare 2 groups
  - **Quant SAT scores of students in a calculus class compared to students in an English class**
  - **Squirrels**

- Analysis of Variance (ANOVA): used to compare 3 or more groups
  - **Quant SAT scores of students in a calculus class, English class, and physics class**