

Psychology 2020 Introduction to Psychological Methods

Unit 6 Analyzing Research Results

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Measurement Scales (Review)

- Nominal (name)
- Ordinal (rank order)
- Interval (equal intervals, no zero)
- Ratio (equal intervals, zero)

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Name the Measurement Scale

- a. A book critic rates books according to the quality of writing. She assigns 4 checks for excellent, 3 for good, 2 for fair, and 1 for poor.
- b. Researchers have identified 2 styles of attachment and classify individuals as *secure* or *avoidant*.
- c. Organizing pets from "least work" to "most work".
- d. A measure of an individual's assertiveness on a scale of 10-50.

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Name the Measurement Scale

- a. Getting a count of the number of coffee makers that were made in Europe, Japan and the USA (totals for each group).
- b. The score you receive on the Beck Depression scale (1-18 is not depressed, above 18 is depressed).
- c. Deciding if a painting style is modern, classic, or impressionistic.
- d. Measuring how long it takes someone to run a mile.

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Analyzing Research Results

- Comparing group percentages.
- Correlating scores on two variables from individuals.
- Comparing group data.

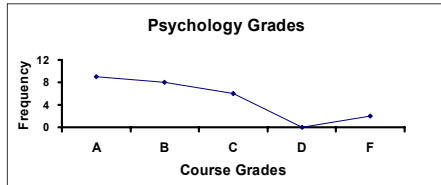
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Frequency Distributions

- Data are displayed in terms of the frequency of each score in a sample.
 - Frequency distributions are often displayed in graphic form.
 - Frequency Polygon (line graph).
 - Bar Graph (columns)
 - Pie Charts (circle representing relative percentages)

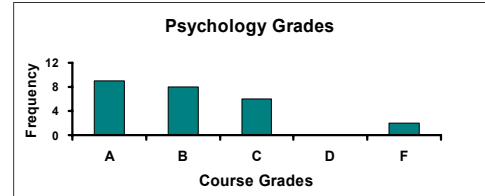
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Frequency Polygon



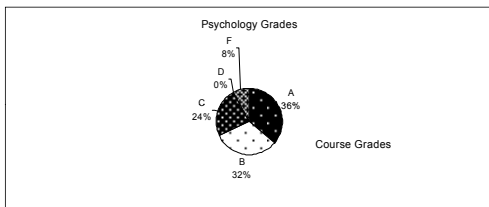
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Bar Graph



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Pie Chart



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Descriptive Statistics

- Descriptive statistics quantitatively summarize a data set.
- Two numbers are usually reported
 - A measure of central tendency
 - A measure variability

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Measures of Central Tendency

- Mean
 - Total divided by the number of scores
- Median
 - Middle score after scores have been arranged in numerical order from highest to lowest
- Mode
 - Most frequently occurring score

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Practice Calculations

- Data set values: 10, 13, 6, 23, 18, 25, 54, 54
- Mean =
 - $10+13+6+23+18+25+54+54=203$
 - $203/8=25.38$
- Median =
 - 6, 10, 13, **18, 23**, 25, 54, 54
 - $(18+23)/2=20.5$
- Mode =
 - 54

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Measures of Variability

- Variance or s^2
 - The average squared deviation of scores from the mean
- Standard Deviation or s
 - The square root of the variance which gives you the average deviation of scores from the mean
- Range
 - The difference between the highest and lowest scores in a group.

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Practice Calculations

- Data set values: 10, 13, 6, 23, 18, 25, 54, 54
- Range =
 - $54-6=48$

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Correlation Coefficients

- Statistics that describe the strength of the relation between two or more variables.
 - Pearson Product-Moment Correlation Coefficient (r)
 - Linear relationships between interval or ratio data.
 - Higher the number the stronger the correlation
 - + or - before the number indicates a positive or negative correlation.
 - Squaring the r value yields the percentage of shared variance accounted for by the measured variables
 - [See the correlation](#)

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Effect Size

- Measures the strength of an independent variable manipulation.
- Effect size correlations
 - .10 to .20 small effect
 - .30 medium effects
 - .40 and above are considered strong effects

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Statistical Significance

- If the difference between group scores is largely due to the IV manipulation and not chance we say they are "significant".
- Statistics allow us to determine how significant they are compared to what we would expect by chance alone.
- Statistically significant means that we have analyzed our data with an inferential statistic and found differences that would be expected by chance less than 5% of the time if the experiment were repeated several times.

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Regression Equations

- These are used to predict a person's score on one variable when we know their score on another variable.
 - Predictor variable is the known score
 - Criterion variable is the score to be predicted
- Multiple Correlations make predictions of the value of the criterion variable using more than one predictor variable.

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Partial Correlations

- The correlation of two variables with the effects of a third variable statistically removed.
- This method helps the researcher understand more clearly how the relationship between two variables is influenced by other variables.

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Structural Models

- These methods give more information than simple correlation or partial correlation methods.
- They indicate "paths of effect" of proposed causal sequences and the effect strength of each variable in the sequence.

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Practice Activity

- Arrange these correlation coefficients from weakest correlation to strongest correlation:

.45, .21, -.56, .02, -.98, .76, -.87, .13

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Two Hypotheses

- Null Hypothesis
 - The observed difference is due to random error.
- Research Hypothesis
 - The observed difference is due to the manipulation of the independent variable.

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The Logic of the Null Hypothesis

- The goal of an experiment is to show the null hypothesis is false.
- The research hypothesis is never "proven" but only supported.
- Results are always discussed in terms of the probability that the observed differences could have been produced by random error.

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Interpreting Research Results

- What is the probability that the difference in group means is due to chance variability?
 - Inferential statistics help us calculate and compare variability caused by the IV manipulation with chance variability.
 - This allows us to generalize our results from our sample to our populations.
 - Examples of inferential statistics are t-tests and analyses of variance (F-tests)

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T-Tests

- T-tests compare the difference between the two group means to the variability found in each group (within-group variability).

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{s_1^2}{N_1} + \frac{s_2^2}{N_2}}}$$

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T-Tests

- The T formula yields a value that must be compared to the critical value related to the significance (or alpha) level of interest (either .05 or .01)
- If the T value is greater than the critical value it is assumed that the group differences did not occur by chance but was probably caused by the independent variable manipulation.

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T- Tests

- Degrees of freedom (df) are the number scores that can vary about the mean once it is known.
 - For the T-Test the df is the number of total participants minus 2 (the number of groups).
- Most computer programs give you a p value instead of a T that must be converted.
 - p is the probability that the between group differences were caused by chance.
 - To be statistically significant p must be less than .05 ($p < .05$)

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T-Tests

- Two-Tailed T-Tests are used when you don't include a direction of difference in your hypothesis.
 - *Men's average incomes will differ from women's in heavy industry.*
- One-Tailed T-Tests are used when you do include a direction of difference in your hypothesis.
 - *Men will have higher average incomes than women in heavy industry.*

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F-Tests

- F-Tests (also known as Analysis of Variance or ANOVA) are used instead of T-Tests when more than two groups are used in an experiment or an independent variable has more than two levels.
- F-Tests calculate the difference between "systematic variance" (how much the group means differ from the grand mean) and error variance (how much the individual scores in each group differ from their group mean)
- The larger the F ratio the more likely the results are statistically significant.

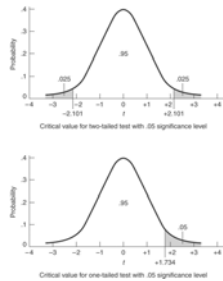
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Statistical Concepts

- *Statistical Significance* means that there was a very low probability (5% or less) that our experimental results were due to change variation.
- *Level of Significance (Alpha level)*
 - If we did the experiment 100 times and got the same results 95 out of 100 times we would be 95% confident that the results were real and not due to chance. This means 5% of the time there was error.
 - Our Alpha Level would be .05 in this example

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Two-tailed and One-tailed T-tests with a .05 Alpha level ($p=.05$)



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Statistical Concepts

- The goal of statistical tests is to help you decide if your experimental results are true.
- The alpha level you choose indicates how confident you are that your results are true.
- Large sample sizes provide better estimates of true population values.
- The larger your effect size (i.e. difference between groups) the more likely it is that your results were not produced by chance variation.

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Statistical Concepts

- Type I and Type II errors
 - If we reject the Null Hypothesis when in fact it is true we are making a *Type I* error
 - If we accept the Null Hypothesis when in fact it is false we are making a *Type II* error
- What are Type I and Type II errors in terms of the Research Hypothesis???
- As we change the Alpha levels we change the probability of making Type I and Type II errors.

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When Type I errors are more serious.

		True state	
		Null is true (innocent)	Null is false (guilty)
Decision	Reject null (find guilty)	Type I error	Correct decision
	Accept null (find innocent)	Correct decision	Type II error

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When a Type II errors are more serious.

		True state	
		Null is true (no operation needed)	Null is false (operation is needed)
Decision	Reject null (operate on patient)	Type I error	Correct decision
	Accept null (don't operate)	Correct decision	Type II error

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Statistical Concepts

- Nonsignificant results could occur because
 - A true relationship between the variables does not really exist
 - A true relationship exists but the experimental procedures could not detect it
 - Because the Alpha level was set too low
 - Because the sample size was too small
 - The relationship is weak so the effect size is too small

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Significance Tests

- One chooses a significance test based on the following:
 - the way the data were collected (nominal, ordinal, interval, ratio)
 - the number of groups
 - the number of independent variables
- You should be able to match the significance tests listed on pages 269-269 with the appropriate measurement scale, number of groups and independent variables.