

## RACHEL'S STUDY GUIDE

### HYPOTHESIS TESTING

#### I. Quick Review of What We've Learned...

A. **Hypothesis** - states a relationship or difference between independent and dependent variables so that they can be tested.

1. What makes a good hypothesis?

- a. Testable
- b. Compatible with **current** knowledge
- c. Logically consistent (e.g., a hypothesis cannot contradict itself and actually be a hypothesis)
- d. It's simple

2. Types of hypotheses

a. One-tailed:

- i A hypothesis that predicts the specific nature of the relationship or difference

b. Two-tailed

- i Hypothesis that predicts that a significant difference or relationship exists but does not indicate the specific nature of that difference (which group would have a higher score) or relationship (positive or negative).
- ii Several scholars suggest that you should be conservative and use a two-tailed hypothesis.

B. **Research questions (RQ)** - an explicit question that researchers ask about variables of interest (if you do not have the literature to form a clear argument for a hypothesis, use a RQ).

1. Directional

- a. Asks whether there is either a specific significant difference between two or more variables or a positive or negative relationship between two or more variables.
  - i **EX:** "Do males drink significantly more than females in social situations?"

2. Nondirectional

- a. Asks whether there is a difference or relationship between two or more variables.
  - i **EX:** "Is there a difference between consumption of alcohol by females and males during social events?"

C. **Alternative Hypothesis (H1)**

1. Defined - prediction that there is **a relationship or a difference** that has not occurred by chance or random error.
  - a. Researchers never test an actual alternative hypothesis (or the one listed in a research article as H1).
  - b. **Instead, researchers always test the null hypothesis.**

- c. We cannot prove a hypothesis, but we can prove that a null hypothesis is false.
- 2. Example - H1: There is a **negative relationship** between communication apprehension (CA) and an individual's belief that all students should take public speaking in college.
- D. Null Hypothesis (H0)
  - 1. Defined - hypothesis that predicts **that groups will not vary on a dependent variable** or that there **is not a relationship** between two variables.
  - 2. Example - H0: There is **no relationship** between communication apprehension and an individual's belief that all students should take public speaking in college.
- E. **Hypothesis testing** - process a researcher goes through using inferential **statistics** to determine **whether to reject or accept the null hypothesis**.
  - 1. example: Hypothesis Testing Case Study
    - a. Determine whether televangelists positively or negatively influenced nonreligious individuals' perceptions of religion.
    - b. Used a phone bank that randomly called a large number of potential participants in a major city.
    - c. Next, they mailed a series of scales and asked the participants to fill out and return them in the self-addressed stamped envelope.
    - d. Each participant rated the televangelist's religion two different times - Time 1 (T1; first survey packet) and Time 2 (T2; second survey packet).
    - e. H1: There is a **difference** between people who view a televangelist and people who do not and their perceptions of a televangelist's religion.
    - f. H0: There **is no difference** between people who view a televangelist and people who do not and their perceptions of a televangelist's religion.
- F. From Random Samples to a Whole Population
  - 1. Sampling
    - a. Sampling error
      - i Degree to which a sample probably differs with respect to a specific variable from a population.
      - ii Must be taken into account when attempting to determine whether a statistical difference or relationship exists.
    - b. **95% confidence interval**
      - i For something to be considered statistically significant, an interval of numbers should be accurate at least 95% of the time.
      - ii Means that **95%** of all sample means will fall between two standard deviations away from the mean or  $\pm 2SD$ .
    - c. Confidence levels across research fields - most research from medical to physical and social sciences uses the 95% confidence interval when testing for significance.

## 2. Testing for Significance

- a. Significance testing - the process to **determine if chance causes** a difference or relationship between two or more variables.
  - i Take the percentile number (95) and subtract it from 1 ( $1 - 0.95 = 0.05$ )
  - ii The probability level is also sometimes called a p value, or probability value ( $\alpha$ ).
  - iii  $p = .05$

## II. STEPS IN DATA ANALYSIS.....

## III. Step 1: Set the probability level

- A. Researchers prefer to be at least 95% confident.
- B. The level of **probability** you establish for your study will determine whether a difference exists.

## IV. Step 2: Identify and conduct the statistical test

## A. Rachel's Cheat Chart (C3)

Independent Variable	Dependent Variable	Statistical Test
categorical IV	~~~~~	one-variable chi-square
categorical IV	categorical DV	two-variable chi-square
categorical IV	continuous DV	t-test
categorical IV w/ 3+ categories	continuous DV	one-way anova
2+ categorical IVs	continuous DV	factorial anova
continuous IV	continuous DV	pearson product moment correlation

B. **One-variable chi-square**= categorical IV

1. When there is **only one categorical IV**, it must be a One-variable chi square!
2. When only one categorical variable rides high, it must be One-variable chi! Most common with descriptive research questions.
3. ex. RQ: What type of digital TV streaming service do people most commonly use at home?
  - a. IV= digital TV streaming services used at home
  - b. DV= none (descriptive research question)
4. ex. RQ: What social media sites are most popular among students?
  - a. IV= social media sites popular among students
  - b. DV= none (descriptive research question)
5. ex. RQ: What type of shoes do people wear to class?
  - a. IV= type of shoes worn to class
  - b. DV= none (descriptive research question)
6. ex. RQ: What color Starburst appears most often in a 2oz. pack?
  - a. IV= color Starburst most often in 2oz. pack
  - b. DV= none (descriptive research question)

7. ex. RQ: What issues do customers most commonly report having with the company website?
  - a. IV= issues customers report w/ company website
  - b. DV= none (descriptive research question)
8. ex. RQ: What topics are trending today on Twitter?
  - a. IV= topics trending on Twitter today
  - b. DV= none (descriptive research question)

C. **Two-variable chi-square**= categorical IV & categorical DV

1. When **the IV and DV are both categorical**, it must be a Two-variable chi square! Usually best w/ research questions.
2. ex. RQ: Will basketball and football players differ in their preference to drink PowerAid or Gatorade?

	B	F
P	24	16
G	6	10

- a. IV= sport played (basketball, football)
  - b. DV= preferred sport drink (PowerAid, Gatorade)
3. ex. RQ: Does one's personality type (introvert, extrovert) influence their preferred choice of delivery (contactless, meet-at-door)?
  - a. IV= personality type (introvert, extrovert)
  - b. DV= delivery choice (contactless, meet-at-door)
4. ex. RQ: Will QVC and HSN viewers differ in their preference to order merchandise online or via telephone?
  - a. IV= shopping network (QVC, HSN)
  - b. DV= order method (online, telephone)
5. ex. RQ: Will liberal and conservative voters differ in their preference to vote by mail or in-person?
  - a. IV= voter orientation (liberal, conservative)
  - b. DV= voting method (mail, in-person)
6. ex. RQ: Will those who read news online or in print differ in political affiliation (republican, democrat, independent, green, libertarian, other)?
  - a. IV= modality of news read (online, print)
  - b. DV= political affiliation (republican, democrat, independent, green, libertarian, other)

7. ex. RQ: Do men and women differ in their political affiliation (democrat, republican, independent, libertarian, green, other)?
    - a. IV= sex (male, female)
    - b. DV= political affiliation (democrat, republican, independent, libertarian, green, other)
  8. ex. RQ: Will students who study together and students who study on their own differ in their grades (A, B, C, D, F)?
    - a. IV= study method (with others, without others)
    - b. DV= grades (A, B, C, D, F)
- D. **t-Test**= categorical IV & continuous DV
1. When *the IV has 2 categories and DV is continuous*, it must be a *t*-test!
  2. ex. H: Those with a high exposure to television news will be less satisfied with their life than those with low exposure to television news.
    - a. IV= exposure to television news (high, low)
    - b. DV= level of life satisfaction
  3. ex. RQ: Will republicans or democrats be more likely to vote in a general election?
    - a. IV= political affiliation (republican, democrat)
    - b. DV= likelihood to vote in a general election
  4. ex. H: Investigation Discovery viewers will be more likely to concentrate on the program they are watching than Lifetime viewers.
    - a. IV= network watched (Investigation Discovery, Lifetime)
    - b. DV= level of concentration on program
  5. ex. H: Low carb dieters will be less hungry after a meal than low fat dieters.
    - a. IV= type of diet (low carb, low fat)
    - b. DV= level of hunger after meal
  6. ex. H: Will low fat dieters suffer more health problems than low carb dieters?
    - a. IV= type of diet (low carb, low fat)
    - b. DV= amount of health problems
  7. ex. H: Those who watch marine life swim in an aquarium will report less anxiety than those who watch volcanoes erupting.
    - a. IV= content watched (marine life, volcanoes erupting)
    - b. DV= level of anxiety
  8. ex. RQ: Will QVC shoppers spend more money on Black Friday than HSN shoppers?
    - a. IV= shopping channel (QVC, HSN)
    - b. DV= amount of money spent on Black Friday
  9. ex. RQ: Will Lifetime Christmas movies feature more sinister characters than Hallmark Christmas movies?
    - a. IV= Christmas movie network (Lifetime, Hallmark)
    - b. DV= amount of sinister characters featured
- E. **One-way ANOVA**= categorical IV w/ 3+ categories & continuous DV
1. When *the IV has 3 or more categories and DV is continuous*, it must be a One-way ANOVA!

2. ex. H: Disney+ viewers will report less anxiety than Netflix or Hulu viewers.
  - a. IV= Streaming service viewed (Disney+, Netflix, Hulu)
  - b. DV= level of anxiety
3. ex. H: Children who are exposed to mildly violent cartoons will exhibit more verbally aggressive behavior than children who are exposed to cartoons with extreme violence or no violence.
  - a. IV= Child cartoon violence exposure (mild, extreme, none)
  - b. DV= amount of verbal aggressive behavior
4. ex. RQ: Will those who select chicken, fish, beef, or vegetarian dinner options on their wedding invitation card vary in their likelihood to dance?
  - a. IV= Wedding invitation dinner option selected (chicken, fish, beef, vegetarian)
  - b. DV= likelihood to dance
5. ex. RQ: Will the color of paper a job candidate submits their resume on (white, off, gray, pink, blue) impact the employer's view of the applicants credibility?
  - a. IV= resume color of paper (white, off, gray, pink, blue)
  - b. DV= employer perceived level of applicant credibility
6. ex. H: e-Society majors are savvier than history or math majors.
  - a. IV= major (e-Society, history, math)
  - b. DV= level of savvy
7. ex. H: Birds are more likely to attack people than cats or dogs.
  - a. IV= animal (birds, cats, dogs)
  - b. DV= likelihood to attack people
8. ex. H: Instagram users will report greater life satisfaction than Facebook, Tumblr, or Twitter users.
  - a. IV= social media network used (Instagram, Facebook, Tumblr, Twitter)
  - b. DV= level of life satisfaction
9. ex. RQ: Do those with active identity theft protection software feel more comfortable making online purchases than those with inactive, expired, or out-of-date protection software?
  - a. IV= identity theft protection software status (active, inactive, expired, out-of-date)
  - b. DV= level of comfort making online purchases
10. ex. RQ: Will Disneyland goers spend more money than California Adventure or Walt Disney World visitors?
  - a. IV= amusement park visited (Disneyland, California Adventure, Walt Disney World)
  - b. DV= amount of money spent

**F. Factorial ANOVA= 2+ categorical IVs & continuous DV**

1. When there are **2 or more categorical IVs and DV is continuous**, it must be a Factorial ANOVA.

2. ex. H: While cardio workouts will burn more calories than strength training at the gym, strength training will burn more calories when done at home.
  - a. IV1= workout type (cardio, strength training)
  - b. IV2= workout location (gym, home)
  - c. DV= amount of calories burnt
3. ex. RQ: Will those who visit Disneyland or California Adventure with kids spend more money than those who visit without kids?
  - a. IV1= amusement park visited (Disneyland, California Adventure)
  - b. IV2= company (with kids, without kids)
  - c. DV= amount of money spent
4. ex. RQ: Will one's dining method (takeout, fast food, delivery, restaurant, homemade) **and** food preference (Italian, Chinese, Mexican, Indian, Lebanese, Japanese) impact their likelihood to eat dessert?
  - a. IV1= dining method (takeout, fast food, delivery, restaurant, homemade)
  - b. IV2= food preference (Italian, Chinese, Mexican, Indian, Lebanese, Japanese)
  - c. DV= likelihood to eat dessert
5. ex. H: At home, school, or work, those who read physical textbooks will retain more information than those who read e-textbooks.
  - a. IV1= reading location (home, school, work)
  - b. IV2= textbook modality (physical, electronic)
  - c. DV= amount of information retained
6. ex. RQ: Will one's preferred television news network (FOX, CNN, MSNBC, CNBC, ABC, CBS, NBC, PBS, NEWSMAX, OANN) **and** their political orientation (democrat, republican, libertarian, green, independent) affect their likelihood to vote in a runoff election?
  - a. IV1= television news network preferred (FOX, CNN, MSNBC, CNBC, ABC, CBS, NBC, PBS, NEWSMAX, OANN)
  - b. IV2= political orientation (democrat, republican, libertarian, green, independent)
  - c. DV= likelihood to vote in a runoff election
7. ex. RQ: Will one's style of coffee (strong, regular, decaf), milk choice (fat free, low fat, whole, almond, coconut), **and** whipped cream preference (whip on, whip off) influence their likelihood to arrive to work happy?
  - a. IV1= coffee style (strong, regular, decaf)
  - b. IV2= milk choice (fat free, low fat, whole, almond, coconut)
  - c. IV3= whipped cream preference (with, without)
  - d. DV= likelihood to arrive to work happy
8. ex. RQ: Will one's drink choice (vodka, whisky, tequila, rum, gin, brandy) **and** serving preference (up, neat, on rocks) influence their likelihood to dance?
  - a. IV1= drink choice (vodka, whisky, tequila, rum, gin, brandy)
  - b. IV2= serving style (up, neat, on rocks)
  - c. DV= likelihood to dance

9. ex. RQ: Will one's meat temperature preference (rare, medium rare, medium, medium well, well) **and** side dish choice (fries, macaroni and cheese, asparagus, green beans, mashed potatoes) impact the speed in which their meal is delivered?
  - a. IV1= meat temperature preference (rare, medium rare, medium, medium well, well)
  - b. IV2= side dish (fries, macaroni and cheese, asparagus, green beans, mashed potatoes)
  - c. DV= amount of meal delivery time

**G. Pearson Product Moment Correlation= continuous IV & continuous DV**

1. Assesses **relationship** between \*continuous\* variables
2. ex. H: One's likelihood to engage in risky behavior and their likelihood to follow amusement park ride safety protocols are negatively **related**.
  - a. IV= likelihood to engage in risky behavior
  - b. DV= likelihood to follow amusement park ride safety protocols
3. ex. H: Student enthusiasm and instructor enthusiasm are positively **related**.
  - a. IV= degree of student enthusiasm
  - b. DV= degree of instructor enthusiasm
4. ex. H: Frequency to make credit card payments on time and future interest rates are negatively **related**.
  - a. IV= amount of credit card payments made on time
  - b. DV= future interest rate
5. ex. H: The extent to which a viewer is mentally engaged during a television show and their likelihood to purchase a product advertised during the program will be positively **related**.
  - a. IV= level of mental engagement during television show
  - b. DV= likelihood to purchase product advertised
6. ex. H: Amount of Court TV watching and bar exam scores will be positively **related**.
  - a. IV= amount of Court TV watched
  - b. DV= bar exam score
7. ex. H: There will be a positive **relationship** between Disney+ viewing and one's tendency to be kind to others.
  - a. IV= amount of Disney+ watched
  - b. DV= likelihood to be kind to others
8. ex. H: There will be a **relationship** between a user's likelihood to skip YouTube ads and their likelihood to purchase products advertised during videos.
  - a. IV= likelihood to skip YouTube ads
  - b. DV= likelihood to purchase products advertised during videos
9. ex. H: There will be a **relationship** between the amount of daily e-mail messages one receives and their perceived level of digital communication competence.
  - a. IV= amount of e-mail received daily
  - b. DV= perceived level of digital communication competence



10. ex. RQ: Is there a positive **relationship** between the amount of drinks one consumes at a party and the amount of lottery tickets they purchase?
  - a. IV= amount of drinks consumed at party
  - b. DV= amount of lottery tickets purchased

#### V. Step 3: Compare calculated and critical values

A. Calculated value - the answer one achieves through arithmetic.

B. Critical value

1. Value of the random variable at the boundary for **accepting or rejecting the null hypothesis**.
2. Critical value is the value that a calculated value must be **greater** than in order to **achieve statistical significance** at a calculated confidence level.
  - a. **+/-1.96 critical t-value for a 1-tailed test**
  - b.  $t = 4.33, p < .05$ , significant
  - c.  $t = -1.44, p > .05$ , not significant
  - d.  $t = -3.66, p < .05$ , significant
- C. If the calculated value is larger than the critical value, then the test is statistically significant at that probability level.

#### VI. Assessing Results and Limitations

##### A. Power

1. Degree to which a researcher is certain he or she can reject a false null hypothesis.
2. If a study has power, researchers can detect even small differences.
3. One-tailed vs. two-tailed hypotheses

##### B. Effect Sizes

1. Defined -strength of a relationship or the magnitude of difference occurring between two variables or the degree to which a null hypothesis is false.
2. Large vs. small effects

##### C. Understanding Error ( $\alpha$ and $\beta$ Errors)

1. The confidence interval
  - a.  $H_0$  is true, and you accept  $H_0$
  - b. How many times out of 100 that your results will say there is no effect (difference or relationship) and there really is no effect.
  - c. **Significant vs. nonsignificant p values**
2. **Power** -
  - a.  $H_0$  is false, and you reject  $H_0$
  - b. Number of times out of 100 when there is an effect; we'll say there is one.
3. Type I Error
  - a.  $H_0$  is true, but you reject  $H_0$
  - b. **We found there is a relationship between surface acting and server tip average, meaning we reject the null hypothesis.**
  - c. Number of times out of 100 when there is no effect; we'll say there is one.
4. Type II Error
  - a.  $H_0$  is false, but you accept  $H_0$

- b. Number of times out of 100 when there is an effect; we'll say there is none.