Module 2: Central tendency, shape, and difference in means

MSIR 525

Monday, September 23, 2019

Recap of Module 1 (check list from syllabus; see pages 1-2)

- We learned about the NHST framework
- We developed an understanding of *p*-values and how they can be used to inform evidence-based management decisions
- We compared different types of error that can threaten our inferences and conclusions
  - We also learned how one can attempt to avoid these errors and disclosures that must be given if a study is underpowered
- We contrasted three different research designs (e.g. observational) and two different data collection approaches (e.g., longitudinal)
- We learned about different data sources and data types
- We summarized several types of validity and phenomena that may threaten them

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- 10/7/2019
  - In-class exercise for credit (i.e., a hackathon)
  - Applying what we learned in M2 to ascertain whether or not a meaningful group difference exists

Agenda for Module 2

- Let’s get started! ☺

Summarizing Data

- Frequency distribution

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Table 2. Frequency Distribution

Rating	Stress	WLB	Job satisfaction	Pay satisfaction
10	0	0	0	3
9	0	0	0	0
8	0	2	1	0
7	3	0	3	2
6	2	0	0	2
5	2	1	0	0
4	0	1	2	0
3	0	0	1	0
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1	0	0	0	0
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Count	7	7	7	7

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CAN BE VISUALIZED IN A BARPLOT

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CAN BE VISUALIZED IN A BARPLOT

CAN BE USED TO SUMMARIZE ALL TYPES OF DATA (SEE MODULE 1)

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$$\text{Relative frequency} = \frac{frequency\ of\ response}{total\ number\ of\ responses}$$

$$= \frac{3}{7} = 43\%$$

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Table 3. Frequency Distributions for Stress

Rating	Frequency	Relative frequency	Cumulative frequency	Cumulative percentage
10	0	0 (0%)	7	1.0 (100%)
9	0	0 (0%)	7	1.0 (100%)
8	0	0 (0%)	7	1.0 (100%)
7	3	.43 (43%)	7	1.0 (100%)
6	2	29 (29%)	4	.58 (58%)
5	2	.29 (29%)	2	.29 (29%)
4	0	0 (0%)	0	0 (0%)
3	0	0 (0%)	0	0 (0%)
2	0	0 (0%)	0	0 (0%)
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$$\text{Average job satisfaction rating} = \frac{7+7+7+8+3+4+4}{7} = 5.71$$

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Summarizing Data

4 out 7 =“high” scores

4/7 = .57 (57%)

3 out 7 =“low” scores

3/7 = .43 (43%)

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  - Represents a simple statistical model of the center of the distribution of scores.
  - A hypothetical estimate of the “typical” score

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- Mean, median, mode
  - Represents the middle score of a set of ordered observations
  - When there is an even number of observations the median is the average of the two scores that fall either side of what would be the middle value

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Calculate column median (mid-point of distribution)

Median job satisfaction rating = 7

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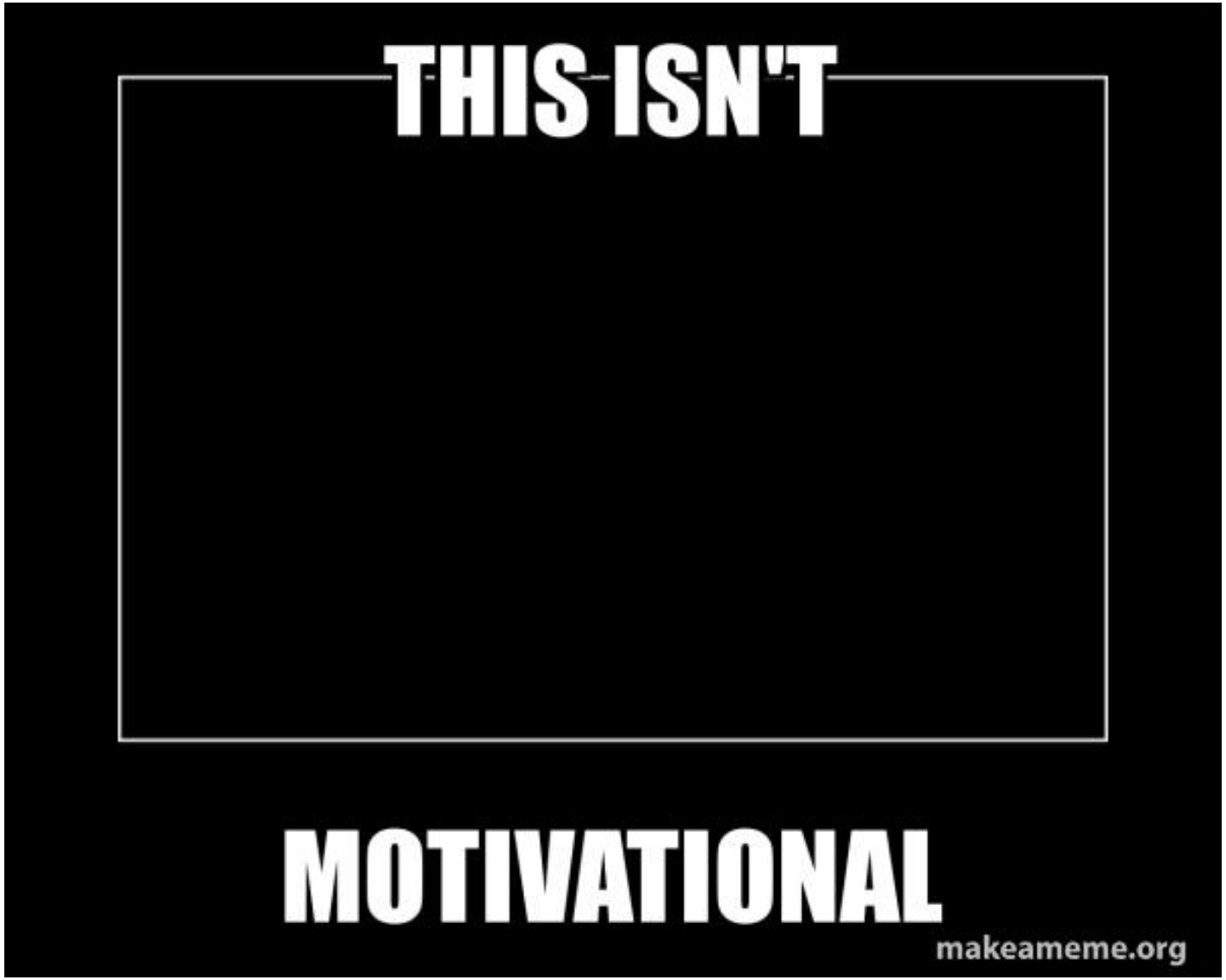
Calculate column mode

Modal job satisfaction rating = 7


WE'RE MASTERS STUDENTS...
WHY TF ARE WE TALKING ABOUT MEAN, MEDIAN, AND MODE
imgflip.com


Because mean,
median, and
mode are important
CHANGE MY MIND
imgflip.com


THIS ISN'T
MOTIVATIONAL
makeameme.org


ME WAITING ON THE POINT TO BE MADE
makeameme.org

The point is…

- Although we know about these measures of central tendency, we may not be using them to their full potential

- Many of the descriptive statistics that we aware of (e.g., mean) are meaningless if they are not reported in tandem with other important information

- What other important information should accompany the mean…

Variance

- Standard deviation
  - SD is an estimate of the average variability (spread) of a set of observations around the mean
  - Importantly, SD is expressed in the same units of measurement as the raw scores
  - It is the square root of the variance (sqrt[sum of squares/number of values])

Variance

- Range
  - The range of scores is the value of the smallest score subtracted from the highest score

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Range = $Highest\ score\ -lowest\ score$

= 8 – 3

= 5

Shape

- Skewness
- Kurtosis

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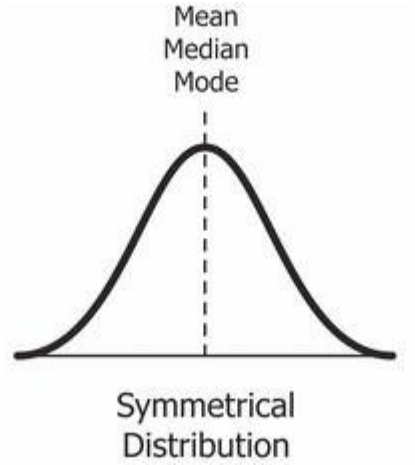

Symmetrical distributions have a skew of 0

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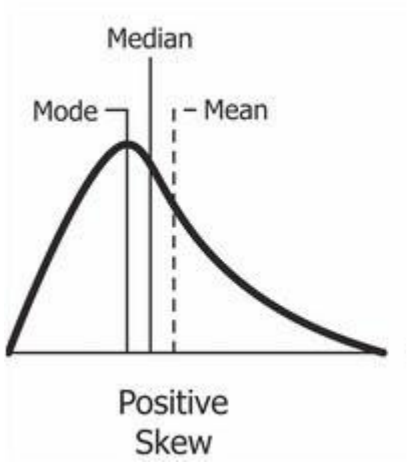

Symmetrical distributions have a skew of 0

When the frequent scores are clustered at the lower end of the distribution and the tail points to the higher (more positive) scores, the value of skew is positive

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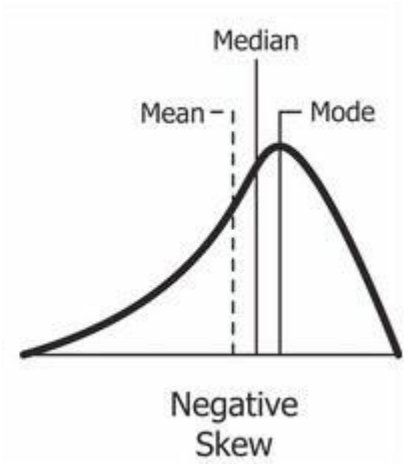

Symmetrical distributions have a skew of 0

When the frequent scores are clustered at the lower end of the distribution and the tail points to the higher (more positive) scores, the value of skew is positive

When the frequent scores are clustered at the higher end of the distribution and the tail points to the lower (more negative) scores, the value of skew is negative

Shape

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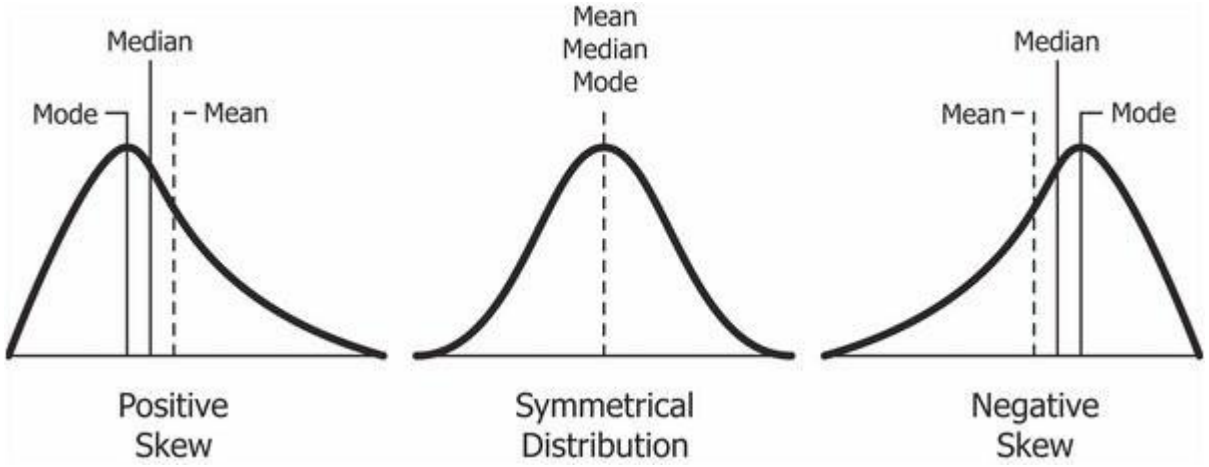
- Kurtosis



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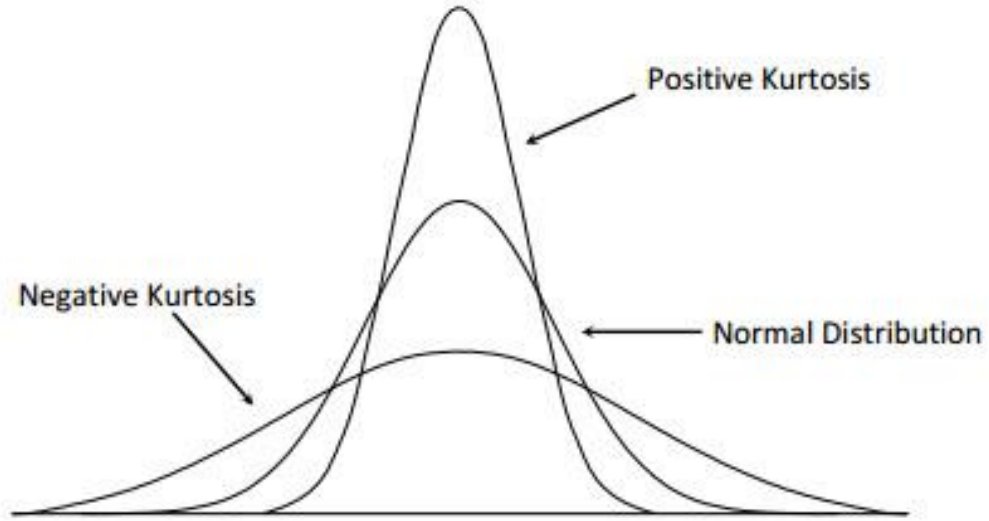
Shape

- Skewness

- Kurtosis → a measure of the degree



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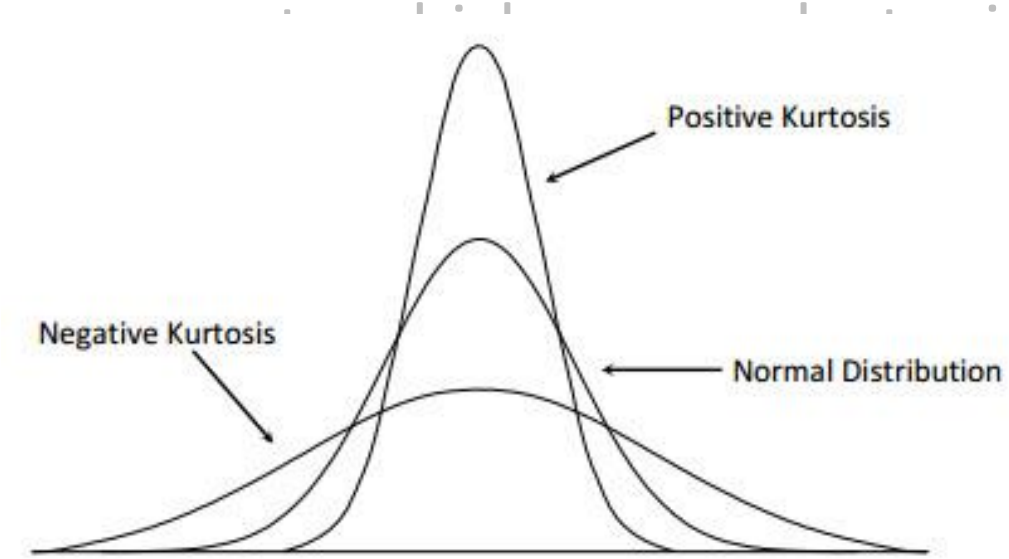

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Kurtosis < 3 → Platykurtic
(the distribution produces fewer and less extreme values [e.g., outliers] than does the normal distribution)

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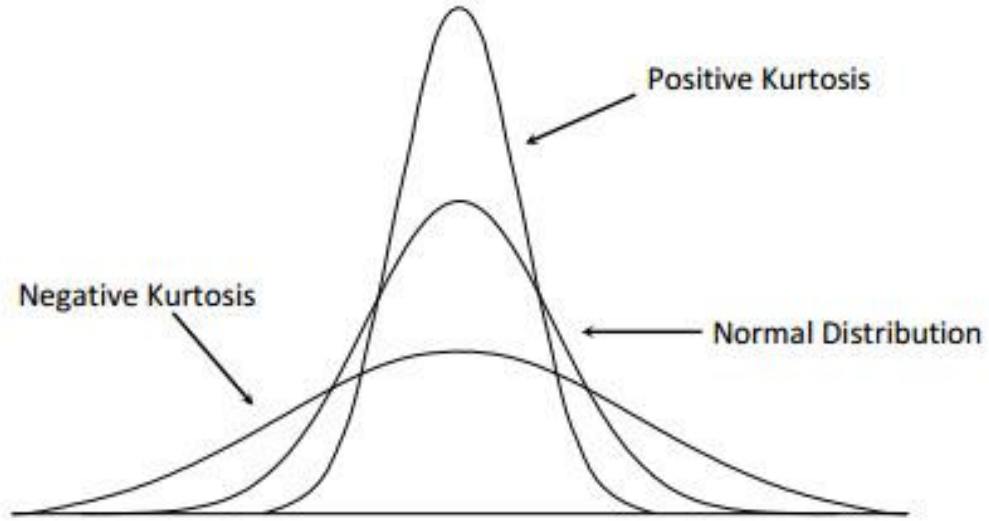
- Kurtosis → a measure of the degree



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(the distribution produces fewer and less extreme values [e.g., outliers] than does the normal distribution)

Kurtosis > 3 → Leptokurtic
(this distribution produces more extreme values [e.g., outliers] than the normal distribution)

Threats to descriptive statistics

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- Outliers
- Range restriction

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1. Missing Completely at Random (MCAR)

2. Missing at Random (MAR)

3. Missing Not at Random (MNAR; this type of missingness cannot be ignored)

See https://www.theanalysisfactor.com/missing-data-mechanism/ for an explanation of each type of missing data.

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  - The mean is not informative without reporting the corresponding SD
  - The raw frequency is not informative without reporting the corresponding relative frequency
  - Etc.

- Descriptive statistics are the gateway to more sophisticated, in-depth analyses
  - Imagine that you observe low levels of job satisfaction among female employees. The next question that might need to be addressed is, "*Why* are females experiencing low levels of job satisfaction?"

Comparing means

- *t*-test
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  - A t-test is a type of inferential statistic used to determine if there is a significant difference between the means of two groups, which may be related in certain features.

  - Essentially, a t-test allows us to compare the average values of the two data sets and determine if they came from the same population.

Comparing means

- *t*-test
  - Remember Module 1 and NHST? What does the null hypothesis propose for a *t*-test?

Null hypothesis:

A statistical test of the hypothesis that suggests that there is no difference between specified populations (or no relation between constructs) and that any observed difference is due to sampling or experimenter error.

$r = 0$

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  - Remember Module 1 and NHST? What does the null hypothesis propose for a *t*-test?

Null hypothesis:

A statistical test of the hypothesis that suggests that there is no difference between specified populations (or no relation between constructs) and that any observed difference is due to sampling or experimenter error.

***r* = 0**

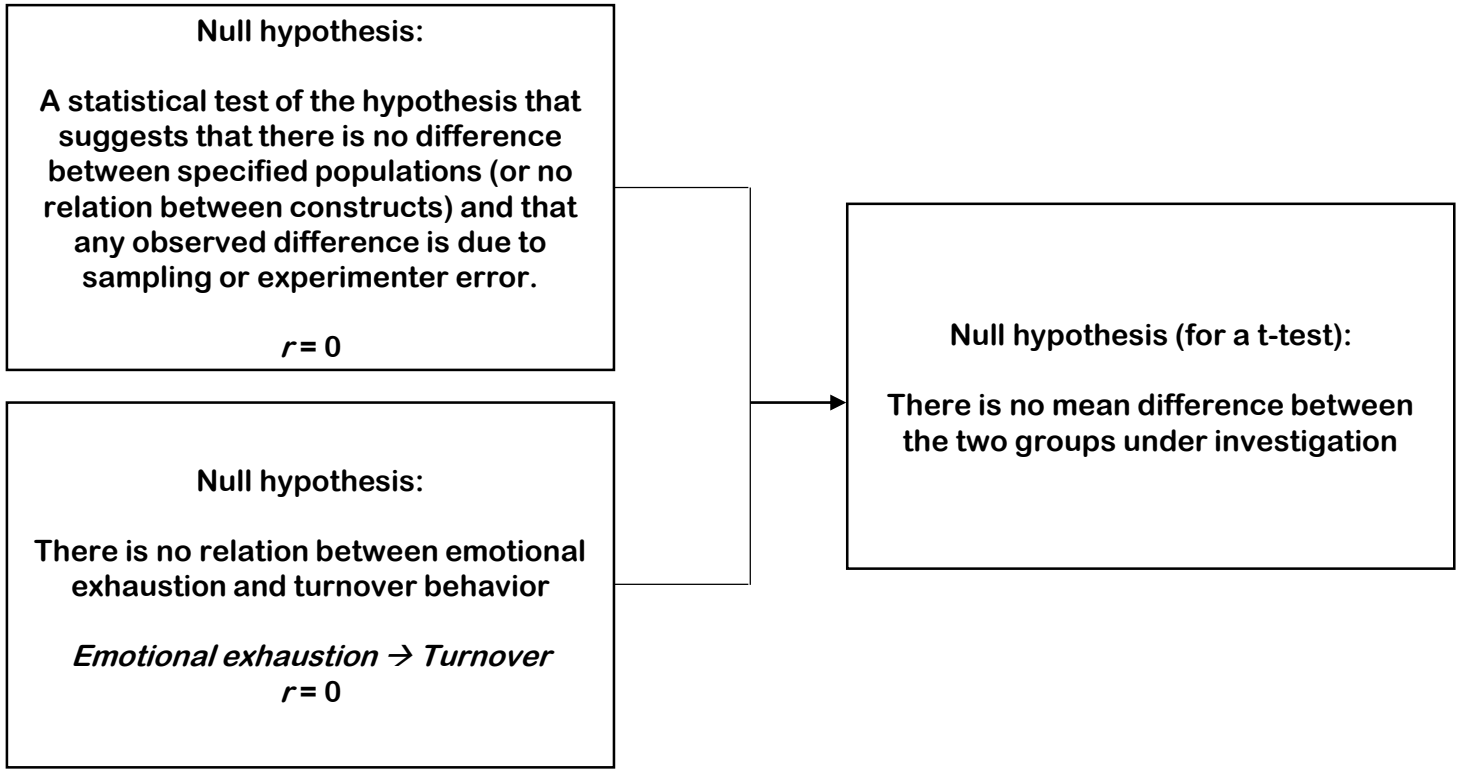
Null hypothesis:

There is no relation between emotional exhaustion and turnover behavior

Emotional exhaustion → Turnover
***r* = 0**

Comparing means

- *t*-test
  - Remember Module 1 and NHST? What does the null hypothesis propose for a *t*-test?



Comparing means

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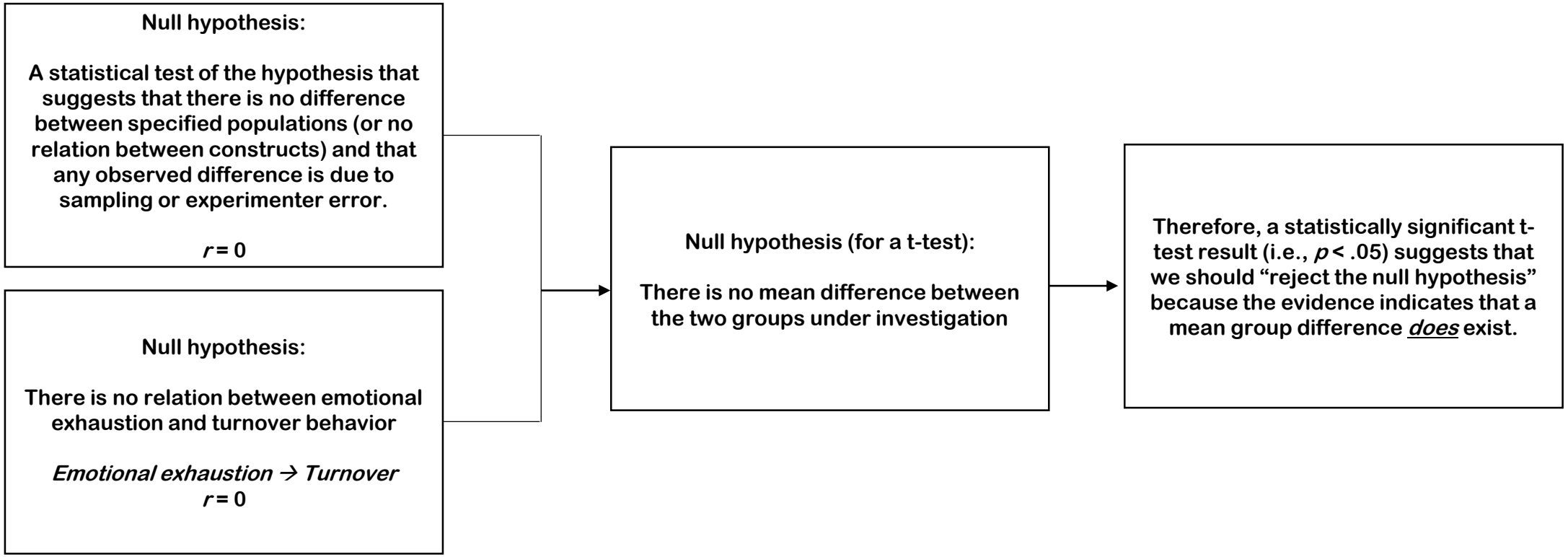

Comparing means

- ANOVA
  - A t-test is a type of inferential statistic used to determine if there is a significant difference between the means of two or more groups, which may be related in certain features.