

# Applied Statistics for the Behavioral Sciences

## Chapter 3 Central Tendency



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## Chapter 3 Outline

- Measures of Central Tendency
  - mean
  - median
  - mode
- Finding central tendency from simple frequency distributions
- When to use each
- Weighted mean

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## Measures of central tendency

- mean
- median
- mode

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## Mean



- a statistic calculated from a sample
- corresponding population parameter is  $\mu$
- population parameter, we know the exact value with certainty
- statistic uncertainty is involved
- $\bar{X}$  is the best estimator of  $\mu$

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## Summation notation



- $\Sigma$  uppercase Greek sigma
- tells us to add up an entire group of numbers
- $\Sigma X$  means add up all the Xs
- Formula for the mean
  - where:
  - $\bar{X}$  = the mean
  - $\Sigma X$  = add up all the X values
  - N = number of scores

$$\bar{X} = \frac{\Sigma X}{N}$$

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## Characteristics of the mean



- sum of differences between mean and each score in a distribution will always equal 0
- difference scores are called deviations from the mean
- stated mathematically:  $\Sigma(X - \bar{X}) = 0$
- sum of squared deviations of the mean from each score represents a minimum
- no value can be used to make the sum of squares any smaller than using the mean
- So:  $\Sigma(X - \bar{X})^2$  represents a minimum

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## Median



- point at exact middle of the set of scores.
- list all scores in order, then locate the point in the center of the sample.
- if 499 scores in list, score #250 would be median if 500, the avg. of 250 and 251 would be the median
- odd number of scores, Median will be score in location  $(N+1)/2$
- even number of scores, Median will be average of scores  $N/2, ((N/2)+1)$
- even number of scores, the median may not be a score that actually exists in the distribution.

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## Median (cont.)



- a point in the distribution, not necessarily a value observed
- simplest interpretation it is the score or value where half are higher and half lower
- also the 50<sup>th</sup> percentile of a set of scores

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## Mode



- simply the most frequently occurring value in a set of scores
- when giving a modal value should also give an idea of how often it occurred
- can be more than one mode

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## Mean from frequency distribution



- Multiply each score by its frequency
- Add all of these scores up
- Divide by the total number of scores

- $\mu$  or  $\bar{X} = \frac{\sum fX}{N}$

- where:  $f$  = frequency of  $X$   
 $X$  = value of  $X$   
 $N$  = number of scores

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## Median/mode from frequency distribution



- Median
  - example
- Mode
  - Just pick out the score with the highest  $f$ .

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## Which should I be using?



- scale of measurement dictates measure of central tendency
- mean with interval/ratio level data, not ordinal/nominal.
- median with ordinal or higher, not nominal.
- mode with any level

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## Skewness



- If the distribution is normal (i.e., bell-shaped), the mean, median and mode are all about equal
- positive skew:  $\text{Mean} > \text{Median} > \text{Mode}$
- negative skew:  $\text{Mean} < \text{Median} < \text{Mode}$

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## Means of sets of means



- if means are based on the same number of cases can just average them
- if from different numbers of observations have to weight each according to number of cases it is based on

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