

Chapter 4 - Measures of Variability

Intro:

- measures of variability are alternatives to measures of central tendency (mean, median, mode)
 - Using measures of variability allows us to see differences between respondents.
- Measures of variability describe diversity or variability in the distribution
 - Shows variation & diversity within the answers we received.
- Measures of variability:
 - 1- **Index of qualitative variation (IQV)** - Measure of variability for nominal variables. Index can range from 0.00 (if all the cases in the distribution are in the same category, meaning no variation) to 1.00 (if all the cases in the distribution are distributed evenly across the categories, meaning max variation).
 - 2- **Range** - Highest score - lowest score. Can be misleading indicator of variation as it's based on 2 values.
 - 3- **Interquartile range (IQR)** - Measure of variation for ordinal variables. IQR uses the middle scores of the distribution, those at the 50% mark. IQR is based on middle scores, so we don't face the problem of misrepresentation of the distribution as we do w/the range.
 - 4- **Standard Deviation** - Square root of the variance. Measures variability in interval-ratio variables.
 - 5- **Variance** - Average of the squared deviations from the mean of the distribution. Measures how spread out a distribution is. Measures variability in interval-ratio variables.
- For nominal vars:
 - **only** use Index of qualitative variation (IQV)
- For ordinal vars:
 - 3/5 can be used: Index of qualitative variation (IQV), Interquartile range (IQR), and range can be calculated but Interquartile range (IQR) provides more info about the var
- For interval-ratio vars:
 - You can use all 5 (Index of qualitative variation (IQV), Interquartile range (IQR), variance, standard deviation), and range Though, the standard deviation & variance provide the most info.

Index of Qualitative Variation (IQV)

IQV Definition:

- The index of qualitative variation is a measure of variability for nominal variables based on the ratio of the total actual number of differences in the distribution to the max number of possible differences within the same distribution.
- The index of IQV can vary from 0.00 to 1.00
 - If all the cases in the distribution are in 1 category, there is no variation (or diversity) & the IQV is 0.00.
 - If all the cases in the distribution are distributed evenly across the categories, there is a max variation (or diversity) & the IQV is 1.00.
 - Basically, the closer to zero the IQV is, the less diverse/variation there is.

Calculating IQV:

$$IQV = \frac{K(100^2 - \sum Pct^2)}{100^2(K-1)}$$

K = the number of categories

$\sum Pct^2$ = the sum of all squared percentages in the distribution

- Square each percent first, then add them all up.
- **NOTE:** If the scores are represented as frequencies, you use this equation:

$$■ IQV = \frac{K(n^2 - \sum f^2)}{n^2 (K-1)}$$

→

→ N = total number of cases

→ K = number of categories

- To express the final IQV score as a percentage rather than a proportion, multiply it by 100

The Range

Definition:

- The range is a measure of variation for interval-ratio variables, it's the difference between the highest (max) and the lowest (min) scores in the distribution
- *Range = Highest Score - Lowest Score*

The Interquartile Range (IQR)

IQR Definition:

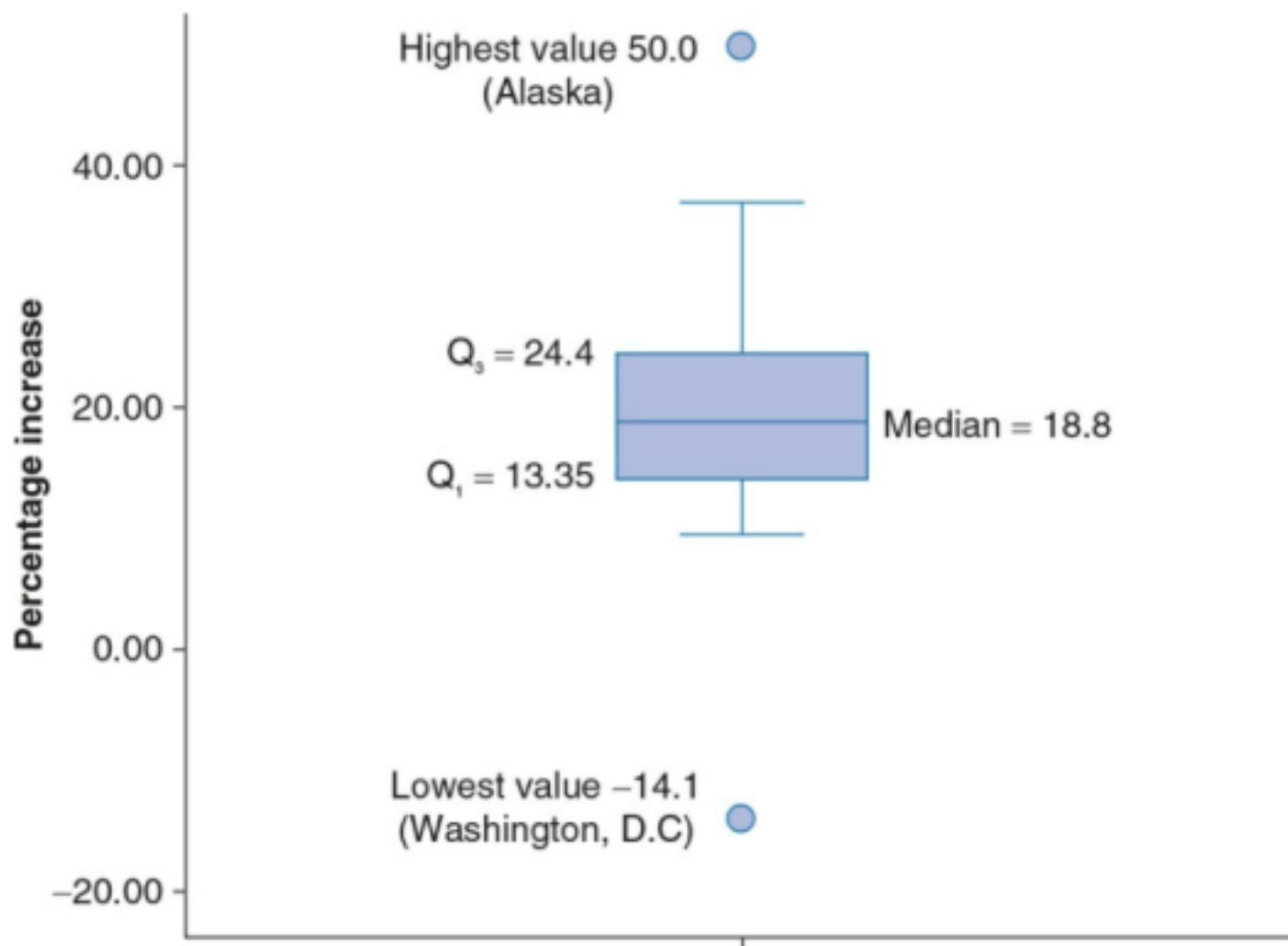
- The IQR is the width of the middle 50% of the distribution. It's the difference between the lower and upper quartiles (Q1 & Q3). IQR can be calculated for interval-ratio & ordinal data.
- $IQR = Q3 - Q1$

Calculating IQR:

1. Order the scores in the distribution from highest to lowest or vice versa.
2. Identify the 1st quartile, Q1 or the 25th percentile by multiplying the total number of cases (N) by 0.25.
 - $(N)(0.25)$
 - If you get a decimal, you take the average of the 2 numbers the percentile falls into in terms of the category
3. Identify the 3rd quartile, Q3 or the 75th percentile by multiplying the total number of cases (N) by 0.75.
 - If you get a decimal, take the average of the 2 numbers the percentile falls into in terms of the category.
4. Once you find the quartile values, line the values up least to greatest and find the value that the quartile equals
 - **EX:** If the 25th quartile is at 25.5, find the values at 25 and take the average of them. That is your Q1 value you will subtract from Q3 later. Do the same for the 3rd quartile.
6. $IQR = Q3 - Q1$ to finally find the IQR

The Box Plot:

- A box plot can visually present the range, the IQR, the median, the lowest (min) score, and the highest (max) score.



Variance & Standard Deviation

Variance Definition:

- The variance is a measure of variation for interval-ratio variables. It's the average of the squared deviations from the mean

Standard Deviation Definition:

- The standard deviation is a measure of variation for interval-ratio & ordinal variables. It's the square root of the variance.

Calculating The Variance:

$$s_Y^2 = \frac{\sum (Y - \bar{Y})^2}{N - 1}$$

- 1) Calculate the mean.
- 2) Subtract the mean from each score to find the deviation. *Deviation = Score - Mean.*
- 3) Square each deviation.
- 4) Add all the squared deviations.
- 5) Divide the sum by N-1 (total cases - 1).
- 6) The answer is the variance.

Calculating Standard Deviation:

- Simply **square** the variance
- Easier to interpret since the variance is expressed in squared percentages.
- Standard deviation tells you how much deviation from the mean to expect for a distribution.