

Assessment in Special Education: A Practical Approach

5th Edition

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Special Education

A PRACTICAL APPROACH

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Chapter 3 Basic Statistical Concepts

Overview of Chapter Three

- After reading this chapter, you should be able to understand (and in some cases be able to calculate) the following: Scales of measurement
- Measures of central tendency (mean, median, and mode)
- Frequency distribution
- Range
- Variance
- Standard deviation
- Normal curve
- Skewed distributions
- Correlations

Scales of Measurement

- In a **nominal scale of measurement**, nominal data are categorical data. They are created by assigning observations into various independent categories and then counting the frequency of occurrence within each of the categories
- **Ordinal scales of measurement** involve the rank order system. It is a scale in which scores indicate only relative amounts or rank order

Scales of Measurement

- An **interval scale of measurement** is one in which equal differences in scores represent equal differences in amount of the property measure
- A **ratio scale of measurement** has all the properties of an interval scale with the additional property of zero indicating a total absence of the quality being measured. A score of zero means zero but with an arbitrary zero point.

Measures of Central Tendency

- Most students have learned the **measures of central tendency** many times in their academic lives. So, for many of you, this may be a review. There are three ways to describe central tendency in a set of scores. These are mean, median, and mode.
- The measures of central tendency can be very important to know because they organize and describe data to see how the data fall together or cluster. Central tendency shows how scores are distributed around a numerical representation of the average score

Mean

- The **mean** is the mathematical average of the distribution of scores. Statistically, the mean is represented by the symbol M . The way to calculate the mean score is simply to add up the scores in the distribution and divide by the number of units.
- *The mean is greatly affected by extreme scores.* For example, suppose four students take an exam and receive scores of 90, 95, 100, and 7 percent. The mean of the distribution is 73 percent. Notice though that three students did extremely well, but the one student who got a 7 percent took the mean from an A average to a C average.

Mean

- **Calculation of the Mean**
- Add up the scores (this is also referred to as summing or summation): $8 + 10 + 8 + 14 + 40 = 80$
- Count the number of units in the distribution. Here, there are five of them (8, 10, 8, 14, and 40 = 5 numbers in total).
- Take the total score in Step 1 and divide by the number of units calculated in Step 2: $80/5 = 16$
- The mean is 16 (or you can write it as $M = 16$).

Median

- Another way to measure central tendency is to order the scores relative to where they fall in a distribution. The **median** is the middle score in a distribution. It is the point at which half the scores fall above and half the scores fall below
- *The median is less affected by extreme scores than is the mean.* For example, suppose four students take an exam and receive scores of 90, 95, 100, and 7 percent. Although the mean of the distribution is 73 percent, the median is 92.5 percent, a much better indication of how the four students did overall.

Median

- **Calculation of the Median**
- Rank order the data from least to greatest. What you do is simply list the scores from the smallest number to the largest: 8, 8, 10, 14, 40.
- Now cross off the low score (8), then the high score (40). Repeat this step until there is only one number left. In our example you would next cross off the 8, then the 14. This leaves 10 as the middle number. The median is 10.

Median

- Now, suppose the distribution of scores had an even number of units. For example: 8, 10, 12, 8, 14, and 40. Calculate the median. In this example, first rank order the data: 8, 8, 10, 12, 14, 40. After crossing out the high and low numbers, you are left with 10 and 12.
- To find the median, simply take the average of the two numbers left. This would make 11 the median score: $10 + 12 = 22 / 2 = 11$

Mode

- The **mode** is the most frequently occurring score in a distribution. For example: In the distribution 8, 10, 8, 14, and 40, what is the mode? The answer is 8. The number 8 occurs twice, whereas all other numbers occur only once.
- What is the mode in the following distribution: 8, 10, 8, 10, 14, and 40? Here, the scores 8 and 10 occur twice; therefore, we have two modes: 8 and 10. When you have two modes in a distribution, it is referred to as a **bimodal distribution**.

Mode

- If you have three or more modes in your distribution, it is referred to as a **multimodal distribution**. For example, what is the mode of this distribution: 8, 10, 8, 10, 14, 14, and 40? Because 8, 10, and 14 are the most frequently occurring numbers (three of them), it is a multimodal distribution.

Frequency Distribution

- In order to see data more clearly (and often the way to find the mode) in a distribution, it can be extremely helpful to set up a frequency distribution. A **frequency distribution** expresses how often a score occurs in a set of data.
- A frequency distribution sets up a much easier way to look at the data. To set up a frequency distribution simply make three columns: Column 1—Test Score, Column 2—Tally, Column 3—Frequency. Under each column fill in the appropriate information.
- When setting up a frequency distribution, always rank order the data from the smallest to the largest number or the largest to the smallest.

Range

- The **range** of a distribution is the difference between the high score and the low score in the distribution (range = high score - low score).
- The range is very simple to determine, yet there is a serious problem with just giving the range of scores. Think about it: The range tells you nothing about the scores in between the high and low scores. And, if there is *one extreme score*, it *can greatly affect the range*. Suppose the distribution was 8, 9, 8, 9, 8, and 1,000. The range would be 992 ($1,000 - 8 = 992$). Yet, only one score is even close to 992, the 1,000.

Variance

- When looking at scores within a distribution, it is often very helpful to know how the scores are spread out. In order to get a better idea of the spread of scores within a distribution, it is necessary to calculate the variance.
- The **variance** is a statistical concept that tells you the spread of scores within a distribution. The variance is an extremely important concept to understand because it is necessary in the calculation of the standard deviation and the analysis of data in the normal curve

Standard Deviation

- In almost all cases, we determine the variance in order to calculate the standard deviation. The standard deviation is the spread of scores around the mean. It is an extremely important statistical concept to understand when doing assessment in special education (see normal curve explanation).
- The standard deviation is calculated by taking the square root of the variance. The steps for calculating standard deviation are the exact same steps for calculating the variance except that there is one extra step. After finding the variance, take the square root. This is the **standard deviation**.

Normal Curve

- A **normal distribution** is an arrangement of a data set in which most values cluster in the middle of the range and the rest taper off symmetrically toward either extreme.
- A graphical representation of a normal distribution is sometimes called a **normal curve**.
- The **normal curve** (also referred to as the *bell curve*) tells us many important facts about test scores and the population.
- The beauty of the normal curve is that it never changes.
- As students, this is great for you because once you memorize it, it will never change on you

Normal Curve

- Do you know what the requirements are for most gifted programs regarding minimum IQ scores (that have a mean of 100 and SD of 15)? By looking at the normal curve you may have figured it out—the minimum is normally an IQ of 130 for entrance. Why? Gifted programs will take only students who are 2 SD or more above the mean. In a sense, they want only those whose IQs are better than 97.5 percent of the population.

Normal Curve

- How about an intellectual disability? On the Wechsler Scales, the classification of intellectual disability is determined if a child receives an IQ score below 70. Why 70? This score was not just randomly chosen. What we are saying is that in order to be classified with an intellectual disability, a student is usually 2 or more SD below the mean. In a sense, the child's IQ is only as high as 2.5 percent (or even lower) of the normal population (or, in other words, 97.5 percent or more of the population has a higher IQ than this child).

Skewed Distributions

- As you may have noticed, the normal curve is *symmetrical*. This means that the left side of the bell is exactly the same shape as the right side. However, the normal curve may not always occur when you have only a small number of test scores in your distribution. When the population of a sample is not large, there may be a tendency for the scores to be **skewed**.

Skewed Distributions

- A **skewed distribution** is one in which the majority of scores fall at either the high end or the low end rather than the middle of a distribution
- A distribution can be either positively skewed or negatively skewed
- In a **positively skewed distribution**, more of the scores fall below the mean. In a **negatively skewed distribution**, more of the scores fall above the mean.

Correlations

- **Correlations** tell us the relationship between two variables. There are three types of correlations: positive, negative, and zero
- When describing the relationship between any two variables, you determine the **correlation coefficient**. Statistically, this is represented by the letter r . Now, the general rules for correlations are as follows:
- Correlations range from +1.00 to -1.00.
- The closer you get to +1.00 or -1.00, the stronger the relationship.
- The closer you get to zero, the weaker the relationship.
- is the weakest correlation—no relationship between the variables.

Correlations

Positive correlation: Variables are said to be positively correlated when a high score on one is accompanied by a high score on the other (direct relationship). Conversely, low scores on one variable are associated with low scores on the other.

Negative correlation: Variables are said to be negatively correlated when a high score on one is accompanied by a low score on the other (an inverse relationship). Conversely, low scores on one variable are associated with high scores on the other.

Zero correlation: Here, there is *no relationship between the variables*.

Conclusion

- Descriptive statistics play a very important role in the assessment process. The fact is, without statistics there would be no way to collect truly objective data to be interpreted. Statistics give us the opportunity to compare children to the norms in many different ways. Understanding statistics is a vital part of being an effective special educator.

Conclusion

- Numerous results will be presented to you on a daily basis. Without the proper understanding or interpretation of data, you will not be able to critically evaluate and properly diagnose a child with a disability. Therefore, being able to look at data and make sense of it are fundamental professional responsibilities of special educators.