Statistics for Social Research I

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September 22, 2024

Professor

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Answer the following questions in an essay format, with 1-2 fully developed paragraphs for each

question. Include citations/references from your Developmental Reading log.

1. Describe the purpose of the following descriptive statistics in social science research:

a. Sample Size (n)

b. Mean, Median, and Mode

c. Standard Deviation

d. Minimum and Maximum

e. Variance

2. Why are these descriptive statistics only relevant for dependent (continuous) variables at

the ordinal, interval, or ratio levels of measurement? Why would they not apply to

independent (categorical) variables at the nominal level of measurement? You will

examine the histograms and box and whisker plots in Core 4.

3. Navigate to OGS’s Practical Statistics for Social Research (PSSR) tool. Click on

“Example Datasets” and load the “Independent t-Test: Ethical Decision-Making” dataset.

4. Scroll to “Step Two: Run Descriptives and Assumptions” and click “Descriptives”.

5. Copy and paste the output contents into your assignment document.

6. What do the descriptive statistics tell you about the variables in the dataset? What do

they tell you about each sample?

7. Repeat Steps 5-8 for the “Dependent t-Tests: Achievement Scores” dataset.

# Question 1

## Sample Size

In descriptive statistics the sample size (n) refers to the number of independent units from which data is collected such as people being observed or responding to an instrument. Sampling refers to the purposeful selecting of “…a subset of a population” (Frost, 2020, p. 161) A population refers to all the individual units or people in a group that share a set of attributes that the researcher defines. (p.145) Given that populations may be large, and it is difficult to survey an entire population, using a representative sample is far easier to handle in research. (Terrell, 2021, p. 24) Measures from a randomly selected sample of sufficient size should be similar to the population. (p. 24) In sampling researchers must be careful to focus on randomization as if choices are based on preference or even convenience, the data can be skewed and reflect biases, even unintentional ones, leading to conclusions that do not reflect the larger population from which the sample was drawn. (Frost, p. 161) Random samples are essential to inferential statistics. (p. 161)

The results from a sample will always be a bit different, “…always at least a little bit wrong” from the population. (p. 152) “Your data are not 100% representative of the population because they are not the entire population!” (p. 152) When comparing two or more sample groups it is possible that differences are due to chance or the fact that an included data point reflects an outlier not typical of the larger population. This is referred to as sampling error. (Terrell, p. 26) “Sampling error is the difference between the sample statistic and the population value. Inferential statistics incorporate estimates of this error into the statistical results.” (Frost, p. 143) This is why sample size matters. “…larger sample sizes help you avoid unusual samples…” (p. 153) The smaller the sample the larger the margin of error. (p. 156) In research, “…precision is a function of both the variability in the population and the size of the sample.” (p. 157)

## Mean, Median, Mode

Mean, median and mode are measures of central tendency. “A measure of central tendency is a summary statistic that represents the center point or typical value of a dataset. The measures indicate where most values in a distribution fall. In other words, it’s the central location of a distribution.” (Frost, p. 69)

The mean is the mathematical average of the data points. (p. 72) This calculation includes all values in that data set and the addition or subtraction of any value changes the mean. (p. 72) The mean is most useful for understanding where most of the data is clustered around when there is symmetric distribution and continuous data. (p. 73) In skewed distributions the mean may fall outside the central area of data. Outliers can have a substantial impact on the value of the mean. (p. 73) Graphing one’s data can assist in evaluating the effectiveness of the mean for communicating central tendency. (p. 73)

“The median is the middle value.” (p. 73) It is the variable value that divides the data set in half with half the data points above this value and half below. (Ngetich, 2024, p. 18) To find the median one simply arranges the data values from highest to lowest and find the one point that has the same number of values above it as below it. (Frost, p. 73) The median can be extremely helpful in finding central tendency for skewed data as outliers have a smaller effect on the median than the mean. (p. 76)

The mode is the quantitative variable that occurs most often within the dataset. (Ngetich, p. 16) Or in other words, “…the value that occurs most frequently…” (Frost, p. 76) With continuous data, it is quite possible that one may not have two or more values that are exactly equal since there is an infinite number of values between any two values. (p. 79) The mode can still be calculated for continuous data by “…locating the maximum value on a probability distribution plot.” (p. 80) The mode can be useful for understanding central tendencies when dealing with categorical data as it identifies the most frequent category. It can be useful when dealing with datasets that have multiple peaks in value as the mode can clarify the most frequent values within these groups. It may also be helpful with skewed data and discrete data which is heavily concentrated around certain values being more descriptive than mean or median. (Frost, p, 81; Terrell, p. 51; Ngetich, pp 17-19)

Variability is a descriptive statistic that “…represents the amount of dispersion in a dataset.” In other words, it indicates how spread out the data is from the central distribution or how tightly clustered it is around the central distribution. (Frost, p., 81) A lower dispersion of the data indicates the values cluster tightly around the central distribution whereas a higher dispersion indicates more data points fall further away. (Frost, p. 140) All data includes variability. (p. 83) Understanding “…variability helps you grasp the likelihood of unusual events.” (p. 83) For example two fast food places may have the same average delivery time, but one may exhibit narrow variability and more consistency in delivery time whereas another may have much more variability with very short and very long delivery times. (pp. 83-85)

## Standard deviation

Standard deviation is the typical difference or deviation of each data point from the mean. A smaller value indicates that the dataset is grouped closely around the mean. A larger value would indicate that the values are more spread out, that is have more variance. The value of the standard deviation reflects the distance between datapoints. (p. 92) Because the standard deviation uses the same unit of measurement as the data, interpretation of variability is easier to see and interpret than with variance where the figures can be much higher than the units in the dataset. (p.92) Standard deviation is the best way to understand variability if the data is normally distributed and not heavily skewed. (p. 93)

## Maximum – Minimum

Range is a measure of variability that indicates the highest and lowest value in the dataset. (p. 85) It is simply the “…highest observed value and the lowest observed value within a data group.” (Ngetich, p. 19) The range is most useful in small data sets where standard deviation is not as clear about variability. But range has limited use because it only considers the highest and lowest value. (p. 19; Frost p. 93) Range is highly “…susceptible to outliers. If one of those numbers is unusually high or low, it affects the entire range even if it is atypical.” (Frost, p. 86) As sample sizes are increased there is more opportunity to obtain such an extreme value. (p. 86) Thus with larger sample sizes, the standard deviation is a better measure of variability. When comparing the variability between groups, the range is only useful if the sample sizes are similar. (p. 86)

## Variance

Variance as a measure of variability is like the standard deviation in that also measures how far individual datapoints are from the mean. As in standard deviation, a higher value indicates more variability. “Variance is the average squared difference of the values from the mean.” Because these values are higher than the unit of measurement applied to the data, interpretation is not as apparent. However, this may be useful when comparing two or more data sets where the standard deviation is similar in helping to determine which has more variability. (p. 86, 92)

# Question 2

Discrete data is a “…a count of the presence of a characteristic, result, item, or activity…that cannot be divided into smaller increments.” (Frost, p. 19) While you can quantify and interpret such counts by displaying counts or percentages, applying something like a measure of central tendency may not make sense. (p. 25) For instance you might count how many of an item is a particular color, but it does not make sense to try to average red, blue, or orange.

Continuous data can take on any numeric value and the scale of the values can be divided into smaller increments with an infinite number of possible values between any two values. (p. 19) Unlike nominal values which do not have a logical ranking or order among the categories, continuous data does indicate order. (Ngetich, p. 16) Ordinal data may have a limited number of discrete values like nominal or categorical data, but ordinal values do indicate some sort of order or rank. The differences between the values may not be consistent thus limiting the understanding of what the differences might mean, but ordinal data still indicates measurable difference thus making measurements such as central tendency and variability useful for interpretation. (Frost, p. 29-30) When data is in the interval scale, where the distance between two points communicates meaning and the distance between two points is equivalent, descriptive statistics become much more precise and helpful for interpretation. (p. 19) Ratio data is similar in that the distance between two points is equivalent and meaningful but also the data includes a true zero point or absence of the attribute whereas interval data does not indicate such an absence. (p. 20)

Thus, nominal data has no true numerical order even though it may present data than can be counted and represented by frequency such as percentages. But there is no true numeric order or difference between red and green thus it is meaningless to try to average red and green or to talk about the variability between red and green (unless one is look at the actual measurable frequency of the color through the lens of physics). Nominal data represent categories without inherent order or numerical meaning. (Ngetich, p. 16)

# Questions 3 – 5

**Descriptive Statistics**

**Religious Participants Descriptives**

**Table 1**

|  |  |
| --- | --- |
| Measure | Value |
| n | 16.00 |
| Mean (x̄) | 9.1625 |
| Median | 9.4650 |
| Mode | 8.5600 |
| Standard Deviation | 3.6577 |
| Max | 15.4900 |
| Min | 3.5700 |
| Variance | 13.3785 |

**Non-Religious Participants Descriptives**

**Table 2**

|  |  |
| --- | --- |
| Measure | Value |
| n | 20.00 |
| Mean (x̄) | 4.3630 |
| Median | 3.1300 |
| Mode | 0.9100 |
| Standard Deviation | 3.7669 |
| Max | 15.7800 |
| Min | 0.9100 |
| Variance | 14.1899 |

**Attribution**

Statistical procedures were conducted using [PSSR (Practical Statistics for Social Research)](https://stats.ogs.edu/), statistical analysis software developed by Joshua D. Reichard for [Omega Graduate School](https://ogs.edu/) based on the [jStat](https://jstat.github.io/) library.

**Reference**

Reichard, J. (2024). *Practical Statistics for Social Research (PSSR)*. Omega Graduate School. <https://stats.ogs.edu/>

# Question 6

The study compares two groups for ethical decision making, those identified as religious and non-religious. Examining the religious group, we find that 16 individuals were included in the sample. The range of is from a low of 3.57 to a high of 15.49 which suggests at least some degree of inconsistence or variability among the participants. The standard deviation of 3.65 and variance of 13.38 suggests to me a moderate difference in how the religious participants exhibited ethical behavior with some more so and some less so. Comparing the median of 9.465 with the mean of 9.1625 suggests the data might be skewed with some lower score pulling the average down. The mode (8.560) being lower than the mean suggests scores might be concentrated lower than the mean but not overwhelmingly so since the median is higher than the mode. The difference is not so great as to suggest the mean does not reflect a decent performance in ethical decision making in the group.

For the non-religious group, we find the sample included 4 more participants than the non-religious group. This group exhibits an even higher degree of variability, with scores ranging from a low of .910 to a high of 15.78. The standard deviation is a bit higher at 3.7669 indicating that the variability in ethical decision making was similar but slightly larger for the non-religious group. When comparing the mean (4.3630), the median (3.130) we see the data may be skewed to the right with some participants scoring high enough to pull up the mean. Looking at the mode in conjunction with the lower mean and median suggests that many participants scored extremely low on the decision-making scale with the minimum of 0.91 indicating that at least one participant scored extremely low on the decision-making scale.

Comparing the two groups we see that non-religious participants tended to score lower in ethical decision making than religious participants reflected by the lower man of 4.36 compared to 9.16. There was also bit more variability in the non-religious participants suggesting the non-religious group was less uniform in their ethical decision making, but not significantly so as the values for variability are close. However, comparison of the medians, mode, and means suggest that for the non-religious groups, the scores tended to cluster on the lower end of performance whereas for the religious groups the tendency toward lower performance was much less. In general, two things stand out. First, non-religious participants tended to perform worse than religious participants related to ethical decision making. Second, there was less consistency in ethical decision making by non-religious participants compared to religious participants.

# Question 7

**Descriptive Statistics**

**Fall Descriptives**

**Table 1**

|  |  |
| --- | --- |
| Measure | Value |
| n | 25.00 |
| Mean (x̄) | 65.9188 |
| Median | 70.2400 |
| Mode | 71.2300 |
| Standard Deviation | 11.8968 |
| Max | 81.0400 |
| Min | 45.2400 |
| Variance | 141.5347 |

**Spring Descriptives**

**Table 2**

|  |  |
| --- | --- |
| Measure | Value |
| n | 25.00 |
| Mean (x̄) | 76.4172 |
| Median | 76.3500 |
| Mode | 78.0900 |
| Standard Deviation | 12.6898 |
| Max | 98.9600 |
| Min | 57.6200 |
| Variance | 161.0313 |

**Attribution**

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**Reference**

Reichard, J. (2024). *Practical Statistics for Social Research (PSSR)*. Omega Graduate School. <https://stats.ogs.edu/>

The study compares the academic performance of a group of students between the fall and the spring. The sample size (n=25) indicates that most probably the same exact students were observed between the two terms. Taking a look at the fall term we find a mean score of 65.92 which indicates in general the class was not performing up to standards. However, when we examine the mean considering the median (70.24) and the mode (71.23) which is higher than the mean, the evidence suggest that a few exceptionally low scores was pulling down the class average with more students performing better than mean might indicate. The range indicates that the highest score was an 81.04 which on a scale of 0-100 is not an overly high performance even among the best students in the class. The minimum score of 45.24 being far below the mean suggests that indeed low scores are pulling down the class average with a few students among the 25 performing very poorly academically. The standard deviation of 11.8968 and variance of 144.53 suggest some variability among the student’s academic performance but not extremely so. Most of the students are clustered around the mean but there are a few performing better and a few much worse.

Looking at the spring term the first measure that stands out is the significant increase in the mean of 76.42 compared to the previous fall of 65.92. This suggests a potential intervention or change that has improved overall student performance. Noticeable also is that the median (76.35) and the mode (78.09) are much closer to the mean than in the previous fall suggesting less extreme performance from one student to the other. In the fall a few exceptionally low scores were pulling the average down while most students were actually performing better than the average. In the spring the data is more symmetrical suggesting extreme values were not driving the value of the mean. This supports improvement in academic performance especially among lower performing students. However, the standard deviation is higher at 12.69 compared to 11.90 which indicates more variability in the spring than the fall suggesting that some students benefited more than others. This observation is further supported by the range with a significant jump of improvement to the high of 98.96 though even the lowest performing student(s) performed better in the fall moving from a low of 45.24 to 57.62, still far below adequate performance but better.

The data suggests three conclusions. First, overall academic performance improved from the fall to the spring somewhat significantly. Second, in the fall exceptionally low scores on the part of some students was pulling down the average whereas performance was more consistent in the spring across the students. However, third, we see a wider range of performance in the spring than in the fall indicating some students benefited more while still an increase in performance is supported for all the students. In general, this group of students improved in their academic performance from fall to the spring.

WORKS CITED

Frost, J. (2020). *Introduction to statistics: An intuitive guide for analyzing data and unlocking discoveries*. Statistics by Jim Publishing.

Ngetich, A. (2024). *Introduction to statistics*. Toronto Academic Press. <https://ereader.perlego.com/1/book/4501051/1>

Terrell, S. R. (2012). *Statistics translated: A step-by-step guide to analyzing and interpreting data*. Guilford Press.