Statistics for Social Research II

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Assignment #1 – Core Essential Elements Answer the following questions in short answer format and be prepared to discuss them with your classmates in the virtual residency or the discussion forum. 1. What is the purpose of assumptions tests and what do they tell us about a given sample of data? 2. How are histograms and box-whisker plots helpful when evaluating a sample against a normal distribution? 3. How does normality help inform whether we can use parametric (generalizable to the target population) vs nonparametric procedures (applicable only to the sample)? 4. Determine when to use a t-test and Pearson’s r or their nonparametric equivalents to test hypotheses 5. Navitage to OGS’s Practical Statistics for Social Research (PSSR) tool. Click on “Example Datasets” and load the “Dependent t-Test: Achievement Scores” dataset. Click on “Descriptives” and then on “Assumptions”. What do the histograms and box and whisker plots tell you about the normality of the samples? Now, click on “Tools and Options” and then “Generate Normal Distributions”. Re-run the “Descriptives” and “Assumptions”. How are the normal distributions different from the original samples?

1. What is the purpose of assumptions tests and what do they tell us about a given sample of data?

Assumption tests are statistical procedures used to verify whether a given sample of data meets the assumptions required for specific statistical analyses or models to produce valid results. Many statistical methods rely on certain assumptions about the data, such as normality, skewness and kurtosis, independence, or linearity. Violating assumptions would result in the statistical process rendering inaccurate results and leading to inaccuracies in interpretation. Not meeting these assumptions would indicate that non-parametric methods would need to be used. (Lani, 2025)

2. How are histograms and box-whisker plots helpful when evaluating a sample against a normal distribution?

Histograms and box-whisker plots are graphical tools that provide valuable insights into the characteristics of a sample, particularly when evaluating its alignment with a normal distribution. It can be helpful for visual assessment to graph the data before even looking at individual numbers providing a visual image for evaluating normal distribution where relying only on summary statistics would be difficult. The histogram reveals whether the sample resembles the bell shape of normal distribution and if the data is symmetrical or skewed. It can also make outliers clearly standout and show the kurtosis of the data (if it has peaks or is flat) compared to the bell curve. (Frost, 2019, pp. 31-43) A box-whisker plot breaks the data into quarters and summarizes the data’s distribution using five key metrics: minimum, first quartile, median, third quartile, and maximum. These can be especially useful when comparing groups to examine the shape of the distribution and visually assess symmetry and skewness as well showing the spread of the data and showing outliers outside the whiskers. (pp. 45-49)

3. How does normality help inform whether we can use parametric (generalizable to the target population) vs nonparametric procedures (applicable only to the sample)?

Parametric procedures assume that the data follows a normal distribution allowing for statistical tools to evaluate the data and produce interpretations that can be generalized from the sample to the larger population. When the data is not normally distributed, nonparametric procedures are used which also facilitates interpretation of the data, but only pertaining the particular sample. If normality is met, parametric tests allow for for greater precision, power, and generalizability to the population. When normality is not met nonparametric tests are a viable alternative, especially for small sample sizes, skewed distributions, or ordinal data. (Rockinson-Szapkiw, 2013)

4. Determine when to use a t-test and Pearson’s r or their nonparametric equivalents to test hypotheses

To determine if a t-test or Pearson’s r should be used to test a hypothesis, or a nonparametric equivalent, one must look at the type of data collected to answer the specific research question looking to see if certain assumptions are met by the data. A t-test focuses on differences between the groups. A t-test compares the means between two groups but can only be utilized if the data is continuous and normally distributed. If these assumptions are not met then the nonparametric equivalent would be used. (Ngetich, 2024, pp. 81-86, Terrell 2012, pp. 208-209) If the research question is focused not on difference but establishing a link between variables, then the Pearson’s r is used as it examines correlation indication the strength of a positive or negative correlation or the absence of a correlation. (Ngetich, p 85) If the researcher is comparing groups the t-test or nonparametric equivalent is utilized. If the researcher is looking to see if a relationship between variables exists, then Pearson’s r or nonparametric equivalent is utilized.

5. Navigate to OGS’s Practical Statistics for Social Research (PSSR) tool. Click on “Example Datasets” and load the “Dependent t-Test: Achievement Scores” dataset. Click on “Descriptives” and then on “Assumptions”. What do the histograms and box and whisker plots tell you about the normality of the samples? Now, click on “Tools and Options” and then “Generate Normal Distributions”. Re-run the “Descriptives” and “Assumptions”. How are the normal distributions different from the original samples?

In the examples provided the box and whisker plots for both samples lack a median line making it difficult to determine normality from the graphic. The whiskers in sample one indicate that the score outliers were equally distributed from main group of scores. In sample two there is a noticeable reduction in the size of the box with a much more elongated whisker to the right indicating that for some students and improvement in scores from the fall to the spring. The assumption tests reveal that the students in the fall were for the most part consistent compared to one another in their performance with outliers trending toward lower performance. The first sample has a KS Statistic score of 0.1549 which is somewhat close to zero indicating a degree of normality. However, the histogram with longer tales in the lower scores would suggest a shift to the lower spectrum. This is supported by the applications analysis of kurtosis with lighter tails indication most student scores in the fall were clustered, but the data is skewed to the left which indicates tendencies toward lower performance. In the spring the lighter tail indicates the scores remained clustered, but the distribution now shifts to the right indicating some students experienced strong increased performance. However, the data in the spring is more balanced on the histogram suggesting no significant deviation from normality. This is supported by the KS Statstic of 0.13 (close to 0) and SW Statistic 0.9752 (close to 1) suggesting the data in the spring followed a normal distribution. (Reichard, 2024)

Generating normal distributions with the tool, sample one shows the scores are clustered around the new mean with the whiskers showing outliers a bit more extreme to the lower end but not significantly more distant from the mean the higher outliers. The box and whisker for the second sample indicates stronger outliers to the right still supporting that some students experienced significant improvement. For sample 1, tests for skewness and kurtosis demonstrate a stronger normality but remain skewed more to the lower end of performance than the higher. The Spring data also demonstrated stronger normality with the KS and SW statistic from the previous example but continues to skew to the right following the suggestion from the box and whisker that some students demonstrated significant improvement.

Examining the raw data between fall and spring and the subsequent modification generating normal distribution suggests more consistency in performance with the spring data than with the fall data.

One question I am left with is since the fall data is somewhat skewed whereas the spring data is more normalized, would on stick with non-parametric testing since we are comparing two groups over time or would we use non-parametric testing for the first sample and parametric tests for the second sample?

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.

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