



LIMITATIONS INVOLVED IN A TWO-SAMPLE INDEPENDENT T-TEST

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Abstract-

While looking at obscure populace means for two groups on a specific variable, at times it is difficult to investigate the data and it brings about the error of information. There are a few limitations to utilizing a two-sample independent t-test. In this article, these limitations have been examined.

Introduction-

The two-sample t-test, otherwise called the independent sample t-test, is a strategy used to test whether the obscure populace mean for two groups on a specific variable are equivalent or not (Kim, 2015). It is additionally known to break down assuming there is any distinction between the mean scores of two groups on a specific variable is significant or not (Chiang, 2015). A two-sample t-test is equivalent to we use to investigate the outcomes from the A/B test (Xu, et al., 2017). The independent t-test is utilized when the information values are independent; randomly chosen from two normally distributed populations and the two independent groups have equal variance. In the event that the variance isn't equivalent, it is called to be utilizing an alternate test of the standard deviation (Moore, Notz, & Flinger, 2013). In some cases the researchers have multiple groups to compare and they use to compare them individually with break down information for example group A v/s group B, Group A v/s Group C, and Group B v/s Group C. Yet, it's anything but a decent practice for utilizing t-test. The researchers, experiencing the same thing, should use Analysis of Variance (ANOVA), Tukey-Kramer test (TKT), Analysis of Means (ANOM) to compare group means to the overall mean or they can utilize Dunnett's test to compare each group mean to a control mean (Lee & Lee, 2018). There are a few assumptions of the t-test which incorporate-

Assumptions of t-test-

1. **The scale of measurement-** The assumption for a t-test is that the scale of measurement applied to the information collected follows a continuous or ordinal scale, such as the scores for an aptitude test. (Boateng, Neilands, Frongillo, Melgar-Quiñonez, & Young, 2018)
2. **Independence-** Data in each group ought to be randomly and independently sampled from the populace. (Kim, 2015)
3. **Random Sampling-** The information is gathered from a representative, randomly chosen portion of the entire populace. (Banerjee & Chaudhury, 2010)
4. **Normal distribution-** The information gathered from the sample should be normally distributed and can be seen on NPC. (Ghasemi & Zahediasl, 2012)
5. **Equal variance-** The two populaces ought to have the same variance. This can be adjusted through. (Kim, 2015)
6. **No outliers-** There ought to be no outliers in the information collected from the independent samples. (Kwak & Kim, 2017)

The above presumptions are applied in practically all parametric factual methods. These suppositions are obeyed by each researcher who is utilizing an independent t-test as they are valid or as sure to occur without evidence. As these suppositions are called to be followed, these are likewise called limits of independent t-test as under-

Limitations of t-Test-

1. **Limitations concerning the scale of measurement-** Scales of measurement are the way variables are characterized and ordered (Mishra, Pandey, Singh, & Gupta, 2018). There are four common scales of measurement in social research. For example nominal, ordinal, interval, and ratio. Each scale of measurement has properties that decide how to dissect the information appropriately (Mishra, Pandey, Singh, & Gupta, 2018). In the t-test, numerous impediments are concerning the measurement tool. The measurement ought to be based on certain properties as-
 - **Identity-** Any measurement through a tool must have an identity. It refers to each value having a unique meaning. In the t-test, the mean scores of collected data are analyzed. It is very hard to identify the uniqueness of the scores of every subject from which the data were collected. If few of them score the highest marks, then the whole group seems to have good scores based on mean scores. (Dahiru, 2008)
 - **Magnitude-** The magnitude in measurement implies that values are in an arranged relationship to each other, so there is a specific order to the variables. However, in the t-test, the values are not really in an arranged structure. (Kaliyadan & Kulkarni, 2019)
 - **Equal Interval-** In any good measurement, the informative elements or the data-points along the scale ought to be equivalent. This is called equivalent spans between the relevant informative elements. For this situation, the information point first and second will have similar interval as the information point

third and fourth have. Be that as it may, it isn't seen when we utilize the t-test. In the t-test as referenced above, we utilize mean scores and dissect something very similar to decipher. We can't analyze each data point and they may fundamentally vary from the previous or next element or the average value of the whole group. (Banerjee & Chaudhury, 2010)

- **Minimum value zero-** In every measurement, the scale ought to begin from nothing or 'zero', however in t-test, generally Likert type scales are utilized and in these scales, the minimum value isn't zero. Subsequently, appropriate and precise estimation of the qualities is absurd. (Ghasemi & Zahediasl, 2012)
2. **Limitations concerning the independence of data-** A major supposition in the t-test are that the information ought to be independent and sampled randomly. A random sample is a grouping of independent, identically distributed (IID) random variables. The term random sample is omnipresent in numerical insights while the truncation IID is similarly as common basic probability, and accordingly this part can be considered to be a scaffold between the two subjects. In educational, psychological, and social research, the researchers typically select the sample according to their convenience (Kwak & Kim, 2017). The sample seems to be random, but actually, it is taken from a selected group of subjects. The data collected in this manner is not actually from a randomly selected sample and this sample does not truly represent every part of the population. (Lee & Lee, 2018)
 3. **Limitations concerning the random sampling-** When any researcher uses t-test as the inferential statistics to analyze and interpret information, he/she has to collect data from random sampling techniques. Normally simple random sampling methods are used to determine the sample for the research. This is one of the methods researchers use to choose a sample from a larger population (Dahiru, 2008). This method is also used to generalize the population. The major advantage of the random sampling is that it includes the simplicity and lack of bias but there is a big difficulty in selecting the sample randomly as it is hard to access a complete list of a larger population, time, costs, and that bias can still occur under certain circumstances. In a t-test, it is hard to remain unbiased and also have access to every subject selected through a random method. It is also hard to maintain costs and time to gather information in stipulated time. (Chiang, 2015)
 4. **Limitations concerning the normal distribution-** in social, educational, and psychological research, when the researchers use a t-test, they have to confirm if the data is normally distributed or not (Banerjee & Chaudhury, 2010). For this, they either use skewness and kurtosis or build a normal distribution curve to confirm. For any researcher, it is compulsory to confirm that the data is normally distributed. Otherwise; he/she shall have to collect the data again and again unless and until the data gets normally distributed. One disadvantage of the normal distribution is that the normal distribution starts at negative infinity. This can result in negative values in some of the results. (Boateng, Neilands, Frongillo, Melgar-Quiñonez, & Young, 2018)

- 5. Limitations concerning the equal variance-** The independent t-test require equal variance among data. To test a null hypothesis, the variance of information should be equal if we are using an independent t-test (Ghasemi & Zahediasl, 2012). This is an assumption that The t-test is used to test a null hypothesis that the variance is equal across the groups. But, a p-value less than 0.05 indicates a violation of this assumption (Mishra, Pandey, Singh, & Gupta, 2018). If a violator occurs, conducting the non-parametric equivalent of the analysis is likely more appropriate.
- 6. Limitations concerning the no-outliers-** In any data set, outliers increase the error variance and reduce the power of statistical tests. They can cause bias or influence estimates. They can also impact the basic assumption of the t-test as well as other statistical methods. Outliers arise because of changes in system behavior, fraudulent behavior, human error, instrument error, or simply natural deviations in a certain population (Banerjee & Chaudhury, 2010). A sample may have been contaminated with elements from outside the population being examined. In social, psychological, and educational research, the researchers are not much experienced and trained to do research. They tend to fulfill the need of having a degree after their masters and to satisfy their goal of career only. When they use a t-test, they are normally biased or do not know how to remove outliers. This causes having wrong data-set and also improper analysis and incomplete interpretation of the information. (Kim, 2015)

Discussion-

The two-sample independent t-test is normally used in social, psychological, and educational research to compare the mean scores of two groups that have equal variance. In this test, the results of the tests may be different if we do not remove errors that normally occur in data gathering. These errors occur when we do not know the limitations of using the t-test. These limitations help the researcher not be biased and be cautious while selecting the data gathering tool, selecting the sample, and using the collected data. The researcher must select the sample from an entire population that is well defined. The sample should be randomly selected and after collecting the data, the researcher should see if the data fits in NPC or not. If not, the data should be collected again. All outliers must be removed or minimized before analyzing for interpretation.

References-

- Banerjee, A., & Chaudhury, S. (2010). Statistics without tears: Populations and samples. *Indian Psychiatry Journal*, 19(1), 60-65. doi:10.4103/0972-6748.77642
- Boateng, G. O., Neilands, T. B., Frongillo, E. A., Melgar-Quinonez, H. R., & Young, S. L. (2018). Best Practices for Developing and Validating Scales for Health, Social, and Behavioral Research: A Primer. *Frontiers in Public Health*, 6(149), 149. doi:10.3389/fpubh.2018.00149
- Chiang, I.-C. A. (2015). Chapter 13: Inferential Statistics: Understanding Null Hypothesis Testing. In P. C. Price, R. Jhangiani, & I.-C. A. Chiang, *Research Methods in Psychology* (2nd Canadian Edition ed.,

- pp. 32-59). New York: opentextbc. Retrieved March 28, 2022, from <https://opentextbc.ca/researchmethods/chapter/understanding-null-hypothesis-testing/>
- Dahiru, T. (2008). P – Value, A True Test of Statistical Significance? A Cautionary Note. *Annals of Ibadan Postgraduate Medicine*, 6(1), 21-26. Retrieved April 02, 2022, from <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4111019/>
- Ghasemi, A., & Zahediasl, S. (2012). Normality Tests for Statistical Analysis: A Guide for Non-Statisticians. *International Journal of Endocrinology and Metabolism*, 10(2), 486-489. doi:10.5812/ijem.3505
- Kaliyadan, F., & Kulkarni, V. (2019). Types of Variables, Descriptive Statistics, and Sample Size. *Indian Dermatology Online Journal*, 10(1), 82-86. doi:10.4103/idoj.IDOJ_468_18
- Kim, T. K. (2015). T test as a parametric statistics. *Korean Journal of Anesthesiology*, 68(6), 540-546. doi:10.4097/kjae.2015.68.6.540
- Kwak, S. K., & Kim, J. H. (2017). Statistical data preparation: management of missing values and outliers. (407-411, Ed.) *Korean Journal of Anesthesiol*, 70(4). doi:10.4097/kjae.2017.70.4.407
- Lee, S., & Lee, D. K. (2018). What is the proper way to apply the multiple comparison test? *Korean Journal of Anesthesiol*, 71(5), 353-360. doi:10.4097/kja.d.18.00242
- Mishra, P., Pandey, C. M., Singh, U., & Gupta, A. (2018). Scales of Measurement and Presentation of Statistical Data. *Annals of Cardiac Anaesthesia*, 21(4), 419-422. doi:10.4103/aca.ACA_131_18
- Moore, D. S., Notz, W. I., & Flinger, M. A. (2013). *Two-Sample Problems* (6 ed.). New York: W. H. Freeman and Company. Retrieved March 18, 2022, from westga: https://www.westga.edu/academics/research/vrc/assets/docs/TwoSampleProblems_LectureNotes.pdf
- Xu, M., Fralick, D., Zheng, J. Z., Wang, B., Tu, X. M., & Feng, C. (2017). The Differences and Similarities Between Two-Sample T-Test and Paired T-Test. *Shanghai Arch Psychiatry*, 29(3), 184-188. doi:10.11919/j.issn.1002-0829.217070