e-ISBN : 978-629-98755-2-9

SIG : e-Learning@CS
https://appspenang.uitm.edu.my/sigcs/
Publication Date : 18 – Sep - 2024

THE IMPORTANCE OF MINITAB SOFTWARE IN THE SUBJECT OF STATISTICS (STA408) AMONG ENGINEERING STUDENTS

*Wan Nur Shaziayani[1], Sharifah Sarimah [2], Fuziatul Norsyiha [3] and Mawardi Omar [4]
**shaziayani@uitm.edu.my[1], sh.sarimah@uitm.edu.my[2], fuziatul@uitm.edu.my[3], mawardi@uitm.edu.my[4]*

[1,2,3,4]Jabatan Sains Komputer & Matematik (JSKM),
Universiti Teknologi MARA Cawangan Pulau Pinang, Malaysia

**Corresponding author*

ABSTRACT

Engineering students often find statistical analysis, including data collection, methodology, and preparation, to be challenging aspects of their academic projects. This study explains the importance of integrating Minitab software into the STA408 Statistics course for student performance and comprehension. This study also aimed to describe how Minitab's user-friendly interface and advanced analytical capabilities enhance the learning experience by providing practical, hands-on opportunities to engage with complex statistical concepts. Students using Minitab can understand and apply statistical methods such as correlation, regression, hypothesis testing, and confidence intervals. Additionally, the software fosters self-regulated learning and prepares students for data-driven decision-making in professional settings. The value of incorporating advanced statistical software into educational programmes is to improve learning outcomes and equip students with essential analytical skills.

Keywords: Statistics, Minitab Software, Engineering Education

Introduction

Science Improving a country's human resource base is mostly dependent on scientific and technological advancements. One approach to human resource management involves enhancing the quality of education (Suharti et al., 2020). One of the courses that is crucial to a well-rounded education is statistics. According to Oldknow et al. (2010), lecturers should make sure that their undergraduate students have enough chances to learn and grow in class. So that students can relate to and utilise any technology for any topic, it is the responsibility of all lecturers, not just those teaching computers.

Students must possess the basic ability to analyse data through the use of real-world problems in statistical learning. Students should learn this skill to enhance their creative problem-solving abilities during the learning process. As outlined by Mairing (2020), Statistics courses encompass the comprehensive processes of data collection, representation, summarization, analysis, and drawing conclusions. These procedures involve intricate computations utilizing various formulas, which become more complex with larger datasets, diverse types of analyses, and additional variables under study.

When considering the use of software as an educational tool, it is crucial to assess the necessity of using the programme. The development of Minitab software-based statistical teaching materials is designed to cater to the needs and advancements of technology (De Muth, 2019). The creation of

statistical teaching materials using Minitab software is anticipated to foster a favourable environment for students to engage in self-regulated learning. Effective self-regulated learning significantly influences students' attitudes following the completion of the recovery period. The researcher formulated the problem statement as follows: "How can statistical teaching materials be designed using Minitab software to facilitate self-regulated learning among engineering students?" Therefore, the aim of this study is to describe the effect of using Minitab with teaching teams on the undergraduates' achievements in the Statistics course (STA408).

Statistical Analysis Using MINITAB

STA408 is a statistics course specifically designed for students in the fields of science and engineering. This course familiarises students with fundamental and advanced techniques of data analysis. The focus will be on utilising descriptive and inferential statistics, which encompass measures of central tendency, measures of dispersion, correlation, regression, hypothesis testing, and analysis of variance. Students will have the capacity to analyse and understand the computer-generated results produced by the statistical software MINITAB.

In the STA408 course, engineering students are introduced to the versatile capabilities of Minitab software for statistical analysis. One of the fundamental topics covered is correlation, where students utilise Minitab to calculate and interpret the strength and direction of relationships between variables. By inputting their data and selecting appropriate statistical tests within Minitab, students gain practical insights into how correlation coefficients are computed and how to interpret their significance in real-world applications.

In STA408, students also utilize Minitab to construct confidence intervals for both population mean and variance. Minitab simplifies the calculation process by allowing students to input sample data and specify the desired confidence level. For estimating population mean, students use Minitab to compute confidence intervals based on sample statistics such as mean, standard deviation, and sample size. Similarly, for variance, students apply Minitab to calculate confidence intervals using sample variance and sample size. This hands-on approach not only reinforces the concept of confidence intervals but also enhances students' ability to interpret and communicate statistical results effectively in engineering and scientific contexts.

Hypothesis testing is a critical component of statistical analysis covered in STA408, facilitated by the robust capabilities of Minitab software. Students learn to formulate and test hypotheses regarding one population mean, two population means, one population variance or standard deviation, and two population variances or standard deviations. Through Minitab, students can conduct t-tests and as well as chi-square tests for comparing categorical data proportions. This practical application of hypothesis testing using Minitab allows students to not only understand the theoretical foundations of statistical

inference but also gain proficiency in executing and interpreting tests to make informed decisions based on data-driven insights.

Regression analysis is another crucial area where Minitab plays a pivotal role in STA408. Students learn to perform both linear and logistic regressions using the software, enabling them to model and predict relationships between variables. Through interactive sessions with Minitab, students not only observe how regression equations are formulated but also grasp the underlying statistical principles and assumptions that govern regression analysis.

Analysis of variance (ANOVA) represent advanced statistical techniques covered in STA408, supported by Minitab's robust analytical tools. Students learn to formulate hypotheses, select appropriate test procedures in Minitab, and interpret results to draw meaningful conclusions. Beyond simply executing tests, students deepen their understanding of statistical inference by exploring the formulas and statistical assumptions underpinning hypothesis tests and ANOVA, thereby enhancing their analytical and critical thinking skills.

In STA408, students engage with Minitab not only as a learning tool but also as an integral part of their assessment strategy, encompassing both individual tests and collaborative group assignments. Individual assessments often involve students applying Minitab to conduct statistical tests, such as hypothesis testing or regression analysis, on given datasets. Through these assessments, students demonstrate their proficiency in using Minitab to analyze data, interpret results, and draw valid conclusions based on statistical principles.

Moreover, group assignments in STA408 provide students with opportunities to leverage Minitab's collaborative features for more complex statistical analyses. Groups may be tasked with designing experiments, collecting data, and using Minitab to perform comprehensive analyses that involve multiple variables or experimental conditions. This collaborative approach not only fosters teamwork and communication skills but also reinforces students' understanding of statistical concepts as they apply Minitab to solve real-world problems collectively.

By incorporating Minitab into both individual assessments and group assignments, STA408 ensures that students not only gain theoretical knowledge but also develop practical skills in statistical analysis using industry-standard software (Allen, 2019). This approach equips engineering students with the competencies necessary to excel in data-driven decision-making and research within their academic and professional careers (Ghavifekr & Rosdy, 2015).

Exploring Minitab's Interface for Statistical Analysis

When launching Minitab, users are typically presented with a visual representation resembling Figure 1. The interface is divided into several key sections: the menu bar at the top provides access to various functions and statistical tools; the session window displays commands and results, facilitating user

interaction and output review; and the worksheet area is where data is inputted and managed, allowing for efficient organization and analysis. This intuitive layout enables users to easily navigate and utilize Minitab's powerful statistical capabilities, streamlining the process of data analysis and hypothesis testing.

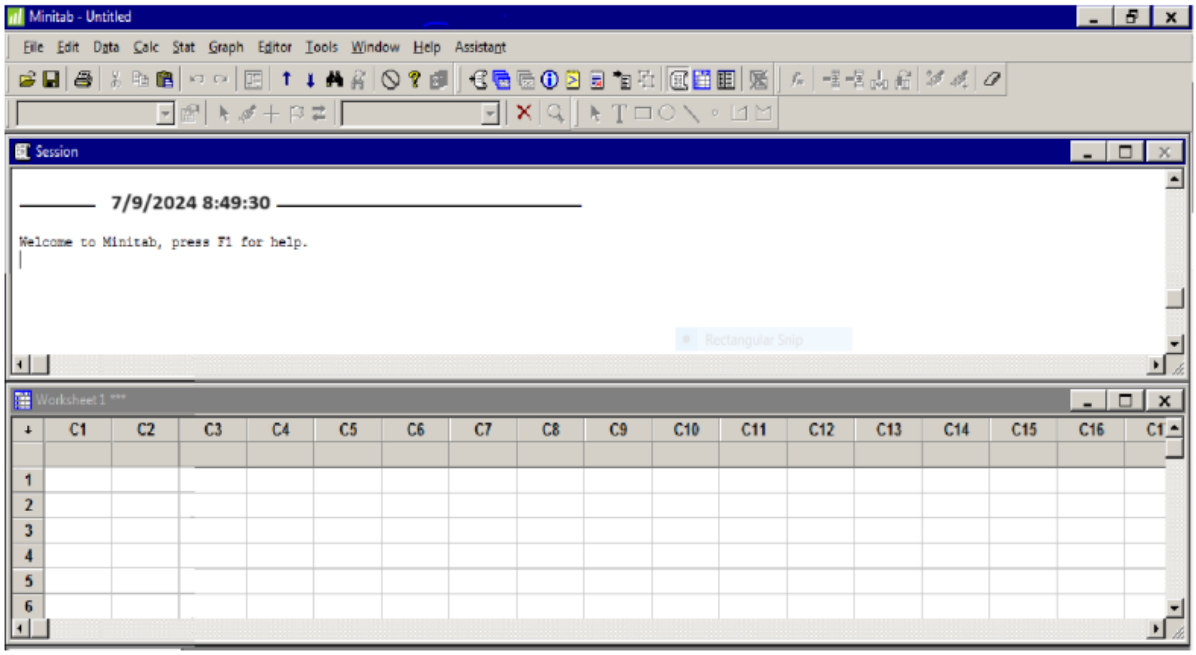

Figure 1: Minitab-Integrated Session and Worksheet Windows

Figure 2 illustrates the steps in Minitab to compute and interpret the confidence interval for one population mean. Users navigate to the 'Stat' menu, select 'Basic Statistics,' and then '1-Sample t...' to input data and specify the desired confidence level. The output window displays the computed confidence interval, providing insights into population parameter estimation using Minitab's statistical tools.

Figure 3 illustrates the steps in Minitab to conduct hypothesis testing for one population mean. Users navigate to the 'Stat' menu, select 'Basic Statistics,' and then '1-Sample t...' to input data and specify the hypothesized mean. In the dialog box, users can check the 'Perform hypothesis test' box and enter the hypothesized mean value. The output window displays the test results, including the sample mean, standard deviation, standard error of the mean, confidence interval, t-value, and p-value. This process enables users to determine if there is a significant difference between the sample mean and the hypothesized mean, providing insights into population parameter testing using Minitab's statistical tools.

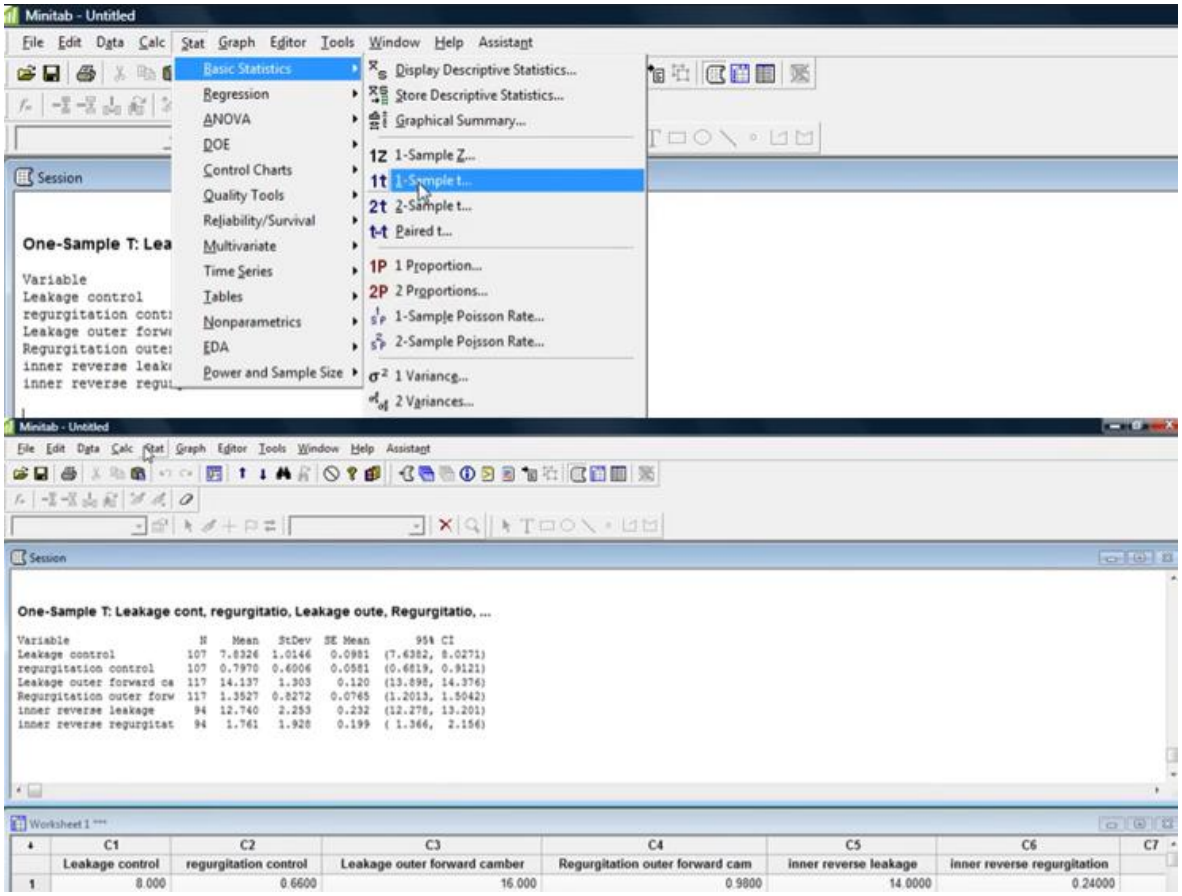

Figure 2: Locating Confidence Interval for One Population Mean in Minitab

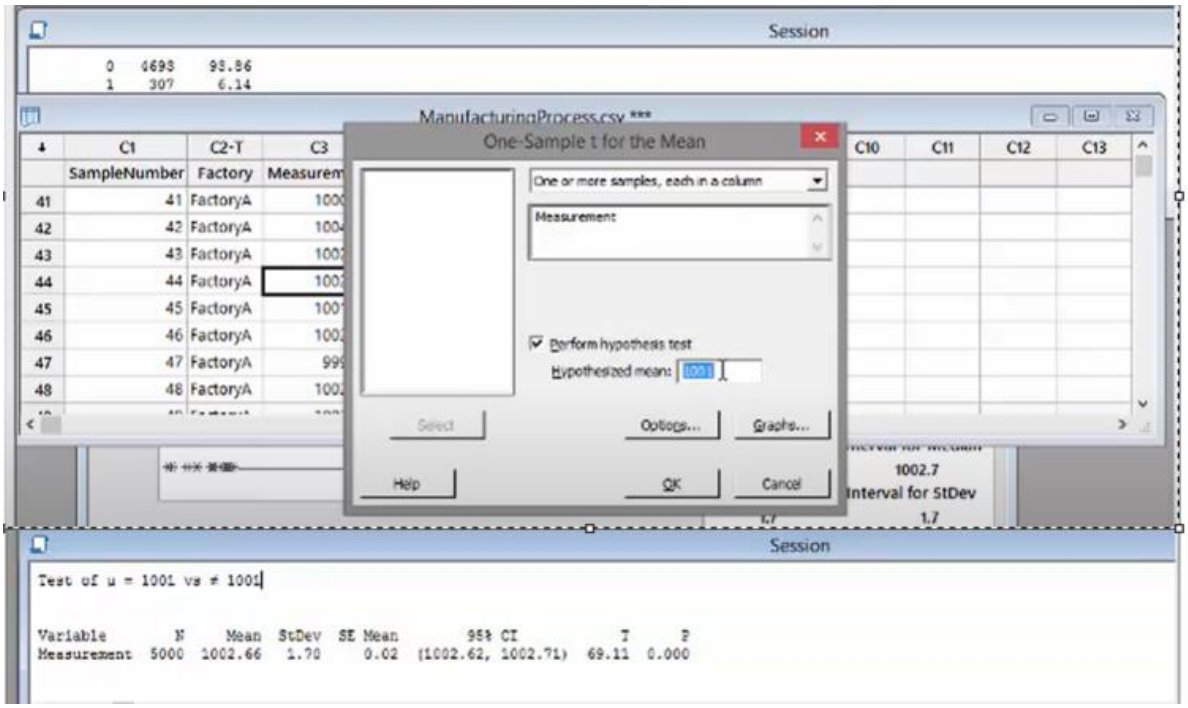

Figure 3: Locating Hypothesis Testing for One Population Mean in Minitab

Figures 4 and 5 illustrate performing correlation and regression analysis using Minitab. In Figure 3, users navigate to the 'Stat' menu, select 'Basic Statistics,' and then 'Correlation...' to input the variables for which they want to compute the correlation coefficient. The output window displays the correlation matrix, providing insights into the strength and direction of the linear relationship between the variables. In Figure 4, users navigate to the 'Stat' menu, select 'Regression,' and then 'Regression...' to specify the dependent and independent variables. The output window presents the regression equation, coefficients, and various diagnostic statistics, offering a comprehensive understanding of the predictive relationship between the variables.

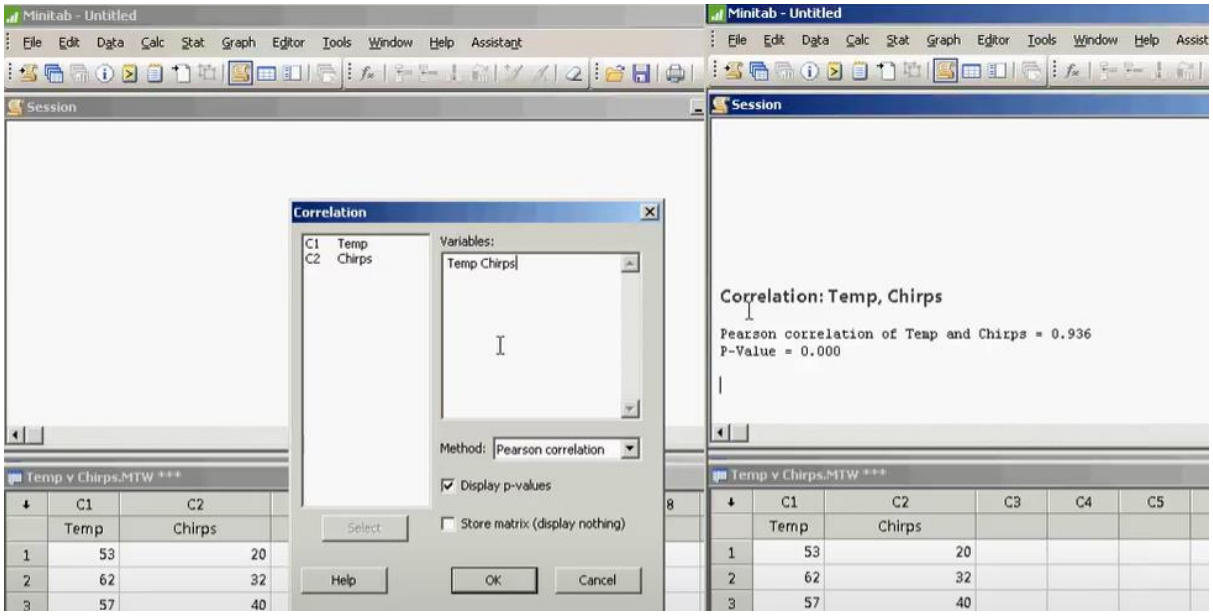

Figure 4: Locating Correlation in Minitab

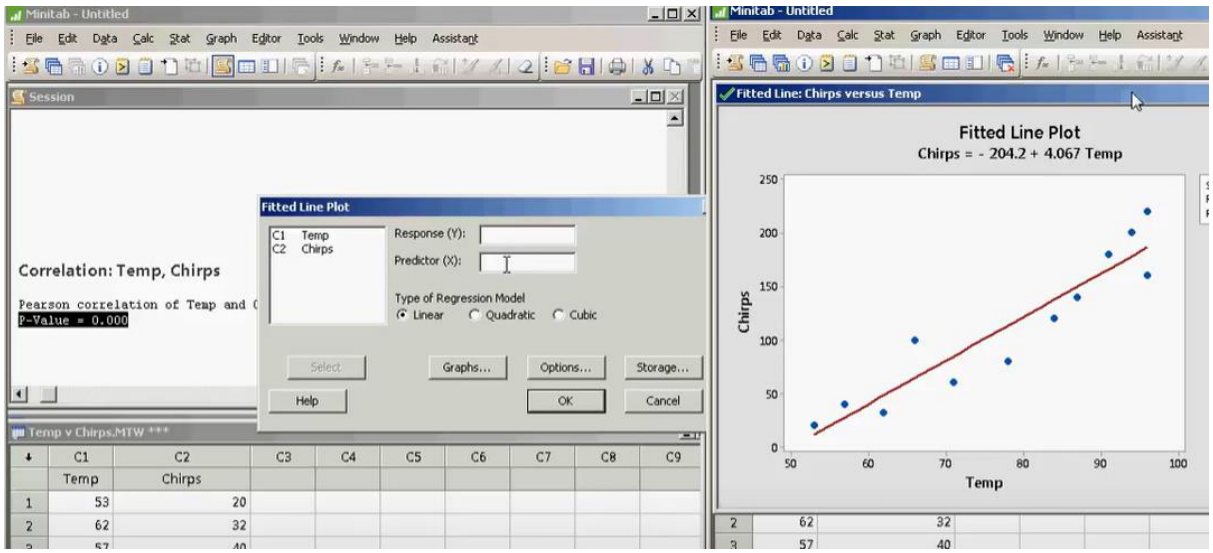

Figure 5: Locating Regression in Minitab

Conclusion

The integration of Minitab software into the Statistics course (STA408) for engineering students has demonstrated significant benefits in enhancing their learning experiences and outcomes. Minitab's user-friendly interface and robust analytical capabilities enable students to engage with complex statistical concepts through practical, hands-on application. By navigating through various statistical analyses such as correlation, regression, hypothesis testing, and confidence intervals, students not only grasp theoretical foundations but also develop essential skills in data analysis and interpretation. This study underscores the importance of incorporating advanced software tools like Minitab in educational curricula to foster self-regulated learning, improve analytical proficiency, and prepare students for data-driven decision-making in their future careers. As engineering education continues to evolve, the use of Minitab in teaching statistics will undoubtedly play a crucial role in shaping competent and confident professionals in the field.

References:

Allen, T. T. (2019). *Software overview and methods review: Minitab. In Introduction to Engineering Statistics and Lean Six Sigma*. Springer, London 575-600.

De Muth, J. E. (2019). *Practical Statistics for Pharmaceutical Analysis: With Minitab Applications.* Springer Nature, 40.

Ghavifekr, S., & Rosdy, W. A. (2015). *Teaching and learning with technology: Effectiveness of ICT integration in schools. International Journal of Research in Education and Science*, 1(2), 175-192.

Mairing, J. P. (2020). *The Effect of Advance Statistics Learning Integrated Minitab and Excel with Teaching Teams.* International Journal of Instruction, 13(2), 139-150.

Oldknow, A., Taylor, R., & Tetlow, L. (2010). Teaching mathematics using ICT. *New York, NY: Continuum International Publishing Group.*

Suharti, Sulasteri, S., Sari, N. N., Sriyanti, A., & Baharuddin (2020). *The Development of Teaching Materials for Subjects of Numerical Method Assisted by MATLAB Software in Mathematics Education Department Students*. *Journal of Physics: Conference* Series-1539.