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ANALYSIS OF CRITICAL THINKING SKILLS IN DECISION MAKING WITH R PROJECT IN MATHEMATICAL STATISTICS COURSE

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ABSTRACT: This study aims to analyze how the use of R Project Software in mathematical statistics courses can contribute to improving students' critical thinking skills, especially in the context of data-based decision making. Indicators of critical thinking in decision making with R Project: 1) interpretation (can write what is known and asked in the question clearly or identify the problem correctly); 2) analysis (can write what must be done in solving the problem); 3) inference (can draw conclusions from what is asked logically and visualize the results); 4) evaluation (can write down the solution to the problem and build a model to evaluate alternatives); and 5) explanation (can provide reasons for the conclusions drawn). The research method uses a descriptive quantitative approach. This research has a population of 80 students with a sample size of 40 students using non-probability sampling with the purposive sampling technique. By using a significance level of 5% and a df value of nk = 40 - 2 = 38, the t_{table} value is 1.686. The t_{count} value of 3.383 exceeds the t_{table} value of 1.686, indicating that the null hypothesis is rejected at a 95% confidence level. And, keep the abstract concise by stating only the conclusion of the statistical test (significant positive effect). Thus, R Project can be recommended as a natural analysis tool for learning mathematical statistics.

Keywords: Critical Thinking, Decision Making, Mathematical Statistics, Quantitative Study, R Project Software.

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INTRODUCTION

Mathematical statistics is a course that provides the basics of statistical theory used to analyze data and make decisions based on available information (Watt-Douglas & George, 2021). In a world increasingly filled with data, the ability to analyze data critically is a very important skill, both in academic and work contexts. Therefore, in teaching mathematical statistics courses, developing critical thinking skills is one of the main goals that must be achieved (Paroqi et al., 2020).

Critical thinking refers to a person's ability to analyze, evaluate, and draw conclusions based on information objectively and rationally (Rahmawati & Harun, 2019; Siskayanti et al., 2022). In the context of mathematical statistics, critical thinking means that students are not only able to apply statistical formulas

or procedures, but are also able to consider various factors that can influence the results of the analysis, and make the right decisions based on existing data and evidence (Pasaribu et al., 2025). However, to develop effective critical thinking skills, students need to be equipped with tools to help them process data, interpret analysis results, and make decisions based on that data. One effective tool to assist students in this process is statistical software, and one of the most popular and widely used software programs in statistics education is R Project (Pratiwi, 2024).

The R Project is a powerful open-source software for statistical analysis and data visualization. R offers a wide range of features that allow users to perform various types of statistical analysis, from descriptive analysis and hypothesis testing to more complex statistical models (Malmia et al., 2019). The use of R in mathematical statistics courses provides students with the opportunity to apply statistical theory directly to real-world data and gain a deeper understanding of the statistical concepts taught (Sariyatun et al., 2024).

By using R Project, students not only learn to calculate and analyze data, but are also encouraged to think critically about how the data was obtained, what the implications of the analysis results are, and what decisions should be made based on the available information. Therefore, this study aims to analyze how the use of R Project Software in mathematical statistics courses can contribute to improving students' critical thinking skills, especially in the context of data-based decision making.

This study explore how the use of R Project can help students interpret the results of statistical analysis, assess the validity of data, and make appropriate decisions based on the results of the analysis (Işıklar & Öztürk, 2022). With a better understanding of how to use R for data analysis, it is hoped that students will be more skilled in critical thinking and making decisions based on strong evidence and objective analysis.

Indicators of critical thinking with decision making with R Project: 1) interpretation (can write what is known and asked in the question clearly or identify the problem correctly); 2) analysis (can write what must be done in solving the problem); 3) inference (can draw conclusions from what is asked logically and visualize the results); 4) evaluation (can write down the solution to the problem and build a model to evaluate alternatives); and 5) explanation (can provide reasons for the conclusions drawn) (Swart, 2017). Through this research, it is hoped that a clearer understanding can be obtained regarding the relationship between critical thinking skills and the use of R Project in mathematical statistics courses and how this technological tool can improve the quality of teaching and learning in the field of statistics (Chen, 2023). Thus, this research is expected to provide a significant contribution in the development of better learning methods in mathematical statistics courses, especially in improving students' critical thinking skills in data-based decision making (Hidayati et al., 2020).

The state of the art in this research is an analysis of previous research but own draft method which in line with study currently (Djamilah et al., 2023). By reviewing the state of the art in research, we can see the extent of the differences each each research (Bellaera et al., 2021). There are several studies related to critical thinking skills in making decisions with the help of R Project Software,

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that is: 1) Jiang & Liu (2017) in their research examined the use of technology in statistics learning, including tools such as R, MATLAB, and Python, which had a significant impact on students' analytical skills; 2) A study by Grolemund & Wickham (2017) examined the effectiveness of using R Project in learning statistics and data analysis; and 3) research conducted by Zhao et al. (2018) exploring the use of statistical software in statistics learning in higher education.

METHOD

In this study, the researcher used a descriptive quantitative approach (Sitepu et al., 2024). This method is used to research certain populations and samples, data collection using research instruments, quantitative or statistical data analysis with the aim of testing the established hypothesis (Padilah et al., 2025). This study has a population of 80 students with a sample size of 40 students using non-probability sampling with purposive sampling techniques (Indriyani et al., 2019).

The subjects of this study were 40 students enrolled in the mathematical statistics course at the Mathematics Education Study Program at HKBP Nommensen University in the even semester of the 2024/2025 academic year. Independent variable (X): Use of R Project Software in learning mathematical statistics (Muhibbin et al., 2021). Dependent variable (Y): Critical thinking skills, measured using a critical thinking scale designed by Paul and Elder (Prasetyo & Kristin, 2020). Using statistical techniques to analyze quantitative data (Purwandari & Yusro, 2018). Descriptive and inferential analysis to assess changes in critical thinking skills and data-based decision making (Harjilah et al., 2019).

RESULTS AND DISCUSSION

A linearity test was conducted to determine whether the independent and dependent variables have a linear relationship. The relationship between the independent variable and the dependent variable is said to be linear if the value significance > 0,05 (Setiabudhi et al., 2025).

Table 1. Linearity Test Table for Variables Using R Project Software in Mathematical Statistics Learning and Students' Critical Thinking Skills.

Variables	Sig.	Information	Conclusion
Using R Project Software in Mathematical Statistics Learning with Students' Critical Thinking Skills.	0.652	Sig. > 0.05	Linear

Based on the results of the linearity test, it can be seen that the use of R Project Software in learning mathematical statistics has an impact on students' critical thinking skills. there is connection which linear with results significance 0.667 > 0.05 (Suarmanayasa, 2021).

Test Normality Data

The requirements that must be met before conducting a regression analysis are data normality, or a normal distribution for the dependent variable. The first

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assumption test is a normality test. If the data distribution is not normal, the analysis cannot proceed because it does not meet the requirements for data normality (Ardiwinata & Ismuniar, 2021).

Table 2. Test Normality Data.

One-Sample Kolmogorov-Smirnov Test		
		Critical Thinking Ability
N		40
Normal Parameters[a.b]	Mean	107.80
	Std. Deviation	8.692
Most Extreme Differences	Absolute	.180
	Positive	.069
	Negative	-.180
Kolmogorov-Smirnov Z		1.138
Asymp. Sig. (2-tailed)		.150

a. Test distribution is normal.
b. Calculated from data.

Kolmogorov-Smirnov Asymp. Sig. Regression equation of reading interest Asymp. Sig. (2-tailed) 0.150 significance is above 0.05. This means that the residual the equation under study is normally distributed, because the normality assumption test has been met, so the statistical technique of equation regression can be used. Furthermore, the residual normality test is also illustrated with a normal PP Plot (Ben-Zvi et al., 2017).

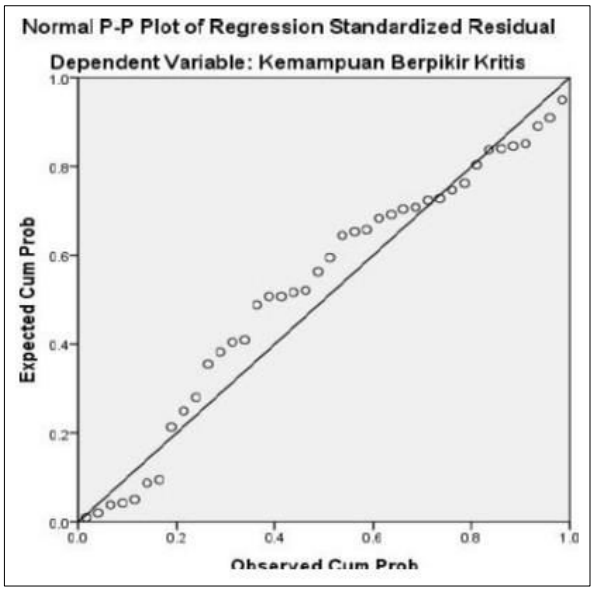

Figure 1. Test Normality Data.

It is known that the residuals in the regression model are spread around the diagonal line and follow the direction of the diagonal line, so that the regression model meets the assumption of normality (Heriyanto & Panggabean, 2025). The residuals are normally distributed, so that the data analysis quantitative regression analysis can be continued because it meets the requirements of this test (Midway & White, 2025).

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Test Analysis Regression Simple

After meeting the data normality requirements, a regression analysis was conducted between the use of R Project Software in mathematical statistics learning and students' critical thinking skills. The analysis technique used was simple linear regression analysis (Salkind & Frey, 2021).

Table 3. Test Analysis Regression Simple.

Constant	Unstandardized Coefficient	R	R^2	Adj R Square	F_{count}	Sig.
48.089	0.545	0.504	0.254	0.2 2 9	8.73 8	0.01

Based on the results of the analysis above, the regression model of the influence of the use of R Project Software in learning mathematical statistics on critical thinking skills is $\hat{Y} = 48.089 + 0.545X$. This means that each additional variable of software usage R Project in learning mathematical statistics, then the participant's value is the critical thinking ability variable increased by 0.545, the regression coefficient is positive, so it can be said that the direction of the influence of the variable of using R Project Software in learning mathematical statistics on critical thinking skills is positive (Benjamin et al., 2018).

Test Partial (Test t)

After the model testing is carried out, the next step will be to test the significance of the use of R Project Software in learning mathematical statistics on students' critical thinking abilities (Evendi et al., 2022).

Table 4. Test Partial (Test t).

t_{count}	t_{table}
3.3383	1.686

From the results of the analysis above, it can be seen that the t_{table} value obtained for the variable of using R Project Software in learning mathematical statistics is 3.383. To get a conclusion whether to accept or reject H0, the t_{table} value to be used must first be determined (Mutakinati et al., 2018). By using a significance level of 5% and a df value of nk = 40 - 2 = 38, the t_{table} value obtained is 1.686. If compared to with mark t_{count} which obtained as big as 3,383. Therefore, the t value obtained is still greater than the t_{table} value, so H0 is rejected. Thus, at a 95% confidence level, it can be concluded that there is a positive and significant influence of the use of R Project Software in learning mathematical statistics on students' critical thinking skills (Suputra et al., 2023). To find out the average score of students' critical thinking skills, it is presented in the following Table 5.

Table 5. Average Scores of Students' Critical Thinking Skills.

Critical Thinking Indicators	Average (%)	Elementary School
Interpretation (can write down what is known and asked in the question clearly or identify the problem correctly).	82.4	8.1
Analysis (can write down what to do to solve a problem).	79.8	9.4
Inference (can draw conclusions from what is asked	75.3	10.2

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Critical Thinking Indicators	Average (%)	Elementary School
logically and visualize the results).		
Evaluation (can write down solutions to problem solving).	80.1	7.8
Explanation (can provide reasons for the conclusions drawn).	84.6	6.9
Total	81.6	–

The results of this study show that the inference indicator (can draw conclusions from what is asked logically) and visualizing results are the main weak aspects of students, while evaluation (being able to write down solutions to problems) is the strongest aspect (Wulandari et al., 2024). The criteria for students' critical thinking ability levels are listed in Table 6.

Table 6. Criteria Category Ability Critical Thinking.

Interval	Category Ability
80 < Score < 100	Very Good
60 < Score ≤ 80	Good
40 < Score ≤ 60	Enough
20 < Score ≤ 40	Not Enough
0 < Score ≤ 20	Very Not Enough

From the research results shows the average score of students' critical thinking abilities. The results are in the very good category. The results of the study indicate a positive and significant influence of the use of R Project Software in learning mathematical statistics on students' critical thinking skills. The analysis results indicate that (Kania et al., 2023) using R Project helps students: 1) conduct data exploration independently; 2) understand statistical concepts in more depth; and 3) develop evidence-based critical thinking skills (evidence-based decision making). These results are consistent with recent research (Gunadi, 2025; Wanda, 2024) which shows that interactive statistical tools improve higher-order thinking skills. Thus, R Project can be recommended as an analytical tool for learning mathematical statistics.

CONCLUSION

This study demonstrates that integrating R Project Software into mathematical statistics courses has a positive and significant impact on students' critical thinking skills. Statistical analysis confirmed that the software enhances students' abilities to analyze data, draw logical inferences, evaluate solutions, and provide reasoned explanations. Among the critical thinking indicators, students excelled in evaluation but showed relative weakness in inference, suggesting a need for additional support in drawing logical conclusions from data. Overall, students' critical thinking scores fall into the very good category, highlighting the effectiveness of R Project in promoting higher-order thinking and data-based decision making. Thus, R Project Software is recommended as an effective tool for teaching mathematical statistics, with future instruction aimed at reinforcing weaker skills, particularly inference, to further enhance students' critical thinking abilities.

RECOMMENDATION

For future researchers, it is recommended to test the effectiveness of R in other data analysis-based courses to determine the consistency of its impact on student learning. It is also necessary to develop learning models or strategies specifically designed to improve inference indicators, so that students are able not only to process data but also to draw accurate and logical conclusions. Future research could also use a broader research design involving a larger sample or implementing a different experimental approach to achieve a stronger and more comprehensive level of generalizability.

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