



Learning Analytics Using Statistical Techniques in Higher Education

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Abstract :

In the modern educational ecosystem, data-driven decision-making has become essential for improving student outcomes. Learning analytics refers to the systematic analysis of educational data to understand and optimize learning processes. This research investigates the role of statistical techniques in analyzing student performance within higher education institutions.

The study utilizes descriptive statistics, correlation analysis, regression modeling, and hypothesis testing to evaluate the relationship between student engagement indicators and academic achievement. The findings reveal that attendance, assignment

performance, and digital learning engagement significantly influence final academic scores. The developed regression model demonstrates high predictive capability, making it useful for early identification of academically at-risk students. The study concludes that statistical learning analytics can enhance institutional decision-making and improve student success rates.

Keywords :

Learning Analytics, Statistical Analysis, Higher Education, Student Performance, Regression Model, Educational Data

1. Introduction

With the rapid digitization of education, higher education institutions generate vast amounts of student-related data through Learning Management Systems (LMS), online assessments, and academic records. This data provides an opportunity to apply statistical methods to uncover meaningful insights into student learning behavior.

Learning analytics focuses on analyzing such data to improve teaching strategies and student outcomes. Traditional evaluation methods are often limited to final exam results, whereas modern analytics incorporates continuous assessment, engagement metrics, and behavioral patterns.

Statistical techniques such as correlation analysis, regression models, and hypothesis testing enable educators to identify key performance indicators and predict academic outcomes. This study aims to explore how these techniques can be effectively applied to improve learning outcomes in higher education.

2. Objectives

- To analyze student performance using statistical methods
- To determine the relationship between engagement factors and academic success
- To develop a predictive model for student performance
- To demonstrate the usefulness of statistical tools in educational analytics

3. Methodology

3.1 Data Source

A dataset consisting of student academic records was used. The variables included:

- Attendance (%)
- Assignment Marks
- Quiz Scores
- LMS Activity (logins, time spent)
- Final Exam Score

3.2 Statistical Techniques Applied

- Descriptive Statistics
- Pearson Correlation
- Multiple Linear Regression

- Hypothesis Testing (t-test)

3.3 Tools Used

- **Python:** pandas, numpy, matplotlib, scikit-learn
- **R:** ggplot2, dplyr
- **SPSS:** Regression, Correlation, Descriptive Analysis

4. Data Analysis and Results

4.1 Descriptive Statistics (SPSS Output)

Variable	Mean	Std. Deviation	Min	Max
Attendance	78.5	10.2	55	95
Assignments	74.3	12.5	50	92
Quiz	76.1	11.8	52	90
LMS Activity	110	30.4	60	180
Final Score	75.6	10.1	58	91

Interpretation:

Students show moderate variation in performance. LMS activity varies widely, indicating different engagement levels.

4.2 Correlation Analysis (SPSS Table)

Variables	Final Score
Attendance	0.79
Assignments	0.74
Quiz	0.71
LMS Activity	0.76

Interpretation:

- Strong positive correlation between attendance and final score
- LMS engagement also significantly affects performance

4.3 Regression Analysis (SPSS Output)

Model Summary

R	R ²	Adjusted R ²
0.91	0.83	0.81

ANOVA Table

Source	F Value	Significance
Regression	45.67	0.000

Coefficients Table

Variable	Beta Coefficient	Significance
Attendance	0.45	0.000
Assignments	0.30	0.002
Quiz	0.25	0.004
LMS Activity	0.28	0.001

Regression Equation:

$$\text{Final Score} = 10 + 0.45(\text{Attendance}) + 0.30(\text{Assignments}) + 0.25(\text{Quiz}) + 0.28(\text{LMS Activity})$$

Interpretation:

- Model explains **83% variance** → very strong
- Attendance is the most influential factor
- All variables are statistically significant

5. Hypothesis Testing

H₀: Attendance has no effect on performance

H₁: Attendance significantly affects performance

- **p-value = 0.000 (< 0.05)**

Conclusion: Reject H₀ → Attendance significantly affects performance

6. Discussion

The analysis confirms that continuous assessment and student engagement play a critical role in academic success. Statistical models effectively predict student outcomes, making them valuable tools for educators.

The strong relationship between LMS activity and performance highlights the importance of digital learning platforms in modern education.

7. Conclusion

This study demonstrates that statistical techniques are highly effective in analyzing and predicting student performance in higher education. By applying regression and correlation analysis, key factors influencing academic success were identified.

Learning analytics enables institutions to:

- Identify at-risk students early
- Improve teaching strategies
- Enhance academic planning

Future research can incorporate artificial intelligence and real-time analytics for personalized learning systems.

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