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FORECASTING NEW STUDENT ENROLLMENT NUMBERS USING SIMPLE LINEAR REGRESSION

Miracle Seroan[1], Murni Sulistyaningsih[2], Cori Pitoy[3]
[1,2,3] Universitas Manado, Indonesia
21504063@unima.ac.id

ABSTRACT This study aims to forecast the number of new students at Manado State University using historical enrollment data from the past five years (2020–2024). A simple linear regression model was developed based on this data and subsequently used to predict new student admissions for the next five academic years, from 2025/2026 to 2029/2030. The results indicate that the simple linear regression method is sufficiently effective for predicting new student enrollment, despite certain limitations inherent in linear modeling. Model performance was evaluated using Mean Absolute Percentage Error (MAPE) and Mean Squared Error (MSE). At the university level, the forecasting results yielded a MAPE value of 5.7% and an MSE of 31,018.64, indicating high predictive accuracy. At the faculty level, MAPE and MSE values varied, with the Faculty of Languages and Arts (3.92% and 574), Faculty of Engineering (5.55% and 4,512.4), Faculty of Economics and Business (7.23% and 11,104.3), Faculty of Mathematics, Natural Sciences, and Earth Sciences (7.32% and 1,421.1), Faculty of Social and Legal Sciences (8.52% and 9,619.2), Faculty of Sports Science and Public Health (18.84% and 29,529.2), and Faculty of Education and Psychology (23.08% and 74,977.2). These findings suggest that simple linear regression can serve as a practical and data-driven tool to support strategic planning and decision-making in new student admissions at Manado State University.

Keywords: student enrollment forecasting, simple linear regression, higher education planning, MAPE and MSE

ABSTRAK Penelitian ini bertujuan untuk memprediksi jumlah mahasiswa baru di Universitas Negeri Manado dengan menggunakan data historis penerimaan mahasiswa selama lima tahun terakhir, yaitu periode 2020–2024. Model regresi linier sederhana dibangun berdasarkan data tersebut dan digunakan untuk memproyeksikan jumlah mahasiswa baru pada lima tahun akademik berikutnya, yaitu 2025/2026 hingga 2029/2030. Hasil analisis menunjukkan bahwa metode regresi linier sederhana cukup efektif dalam memprediksi jumlah mahasiswa baru, meskipun memiliki keterbatasan yang melekat pada model linier. Evaluasi kinerja model dilakukan menggunakan Mean Absolute Percentage Error (MAPE) dan Mean Squared Error (MSE). Pada tingkat universitas, diperoleh nilai MAPE sebesar 5,7% dan MSE sebesar 31.018,64 yang menunjukkan tingkat akurasi prediksi yang tinggi. Pada

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tingkat fakultas, nilai MAPE dan MSE bervariasi, yaitu Fakultas Bahasa dan Seni (3,92% dan 574), Fakultas Teknik (5,55% dan 4.512,4), Fakultas Ekonomi dan Bisnis (7,23% dan 11.104,3), Fakultas Matematika, Ilmu Pengetahuan Alam, dan Kebumian (7,32% dan 1.421,1), Fakultas Ilmu Sosial dan Hukum (8,52% dan 9.619,2), Fakultas Ilmu Keolahragaan dan Kesehatan Masyarakat (18,84% dan 29.529,2), serta Fakultas Ilmu Pendidikan dan Psikologi (23,08% dan 74.977,2). Temuan ini menunjukkan bahwa regresi linier sederhana dapat digunakan sebagai alat yang praktis dan berbasis data untuk mendukung perencanaan dan pengambilan keputusan terkait penerimaan mahasiswa baru di Universitas Negeri Manado.

Kata-kata kunci: peramalan mahasiswa baru, regresi linier sederhana, perencanaan pendidikan tinggi, MAPE dan MSE

INTRODUCTION

The uncertainty in the number of new students admitted each year has become a critical issue that significantly affects campus planning in higher education institutions. Fluctuations in the number of applicants and newly admitted students pose challenges in managing classroom capacity, facilities, and teaching staff allocation optimally. Amid increasing competition among universities and the evolving preferences of prospective students, higher education institutions are required to respond to these dynamics through effective and data-driven planning strategies. Recent data indicate that while the total number of universities in Indonesia has declined, competition to attract qualified students has intensified. This condition makes new student admission planning increasingly important to ensure institutional quality and long-term sustainability. Consequently, accurate prediction of new student enrollment is essential for universities to allocate resources efficiently and to anticipate changes in the higher education landscape.

In practice, the admission of new students represents one of the main annual challenges faced by higher education institutions. This process is not only closely linked to institutional sustainability but also directly influences the quality of educational services provided. However, year-to-year fluctuations in applicant numbers often make resource planning difficult. For instance, at Manado State University, the number of newly admitted students reached 2,813 in 2020, increased to 3,144 in 2021, and then gradually declined to 2,938 in 2022, 2,576 in 2023, and 2,375 in 2024. These data illustrate a significant level of uncertainty in enrollment trends. Classrooms, facilities, and teaching staff must be adequately prepared in advance to meet student needs. Without accurate forecasting, universities risk experiencing either shortages or surpluses in capacity, both of which may negatively affect educational quality. As noted by Azahra (2022), historical enrollment data can be used to identify trends and form the basis for regression models that project future student numbers.

In this context, forecasting the number of new students becomes a crucial activity in higher education management. Enrollment predictions play an important role in

determining budget planning, including revenue and expenditure projections, as well as in guiding strategic and operational decision-making. Lazăr and Lazăr (2004), in their study *Forecasting Methods of the Enrolled Students' Number*, emphasize that accurate enrollment forecasting is essential for maintaining institutional competitiveness in the education sector. Forecasting itself is defined as the process of estimating future values based on historical data and trend analysis. Despite its importance, previous studies have rarely focused on applying simple predictive models, such as linear regression, to forecast new student admissions in regional universities. This gap is particularly evident for institutions like Manado State University, where local demographic and institutional characteristics may differ from those of larger national universities.

Therefore, this study focuses on Manado State University as a case study to improve operational efficiency through enrollment forecasting. By estimating the number of new students to be admitted each year, the university can better prepare various aspects of educational services, including human resources and supporting facilities. This prediction utilizes historical data on new student admissions over the past five years, enabling a clearer depiction of enrollment trends in the North Sulawesi region. Such an approach is considered relevant for supporting efforts to improve educational quality and to maximize student potential within the university environment, as also highlighted by Ningsih, Hafel, and Septa (2024).

To achieve this objective, the simple linear regression method is employed as the primary analytical approach. Linear regression is widely used to predict enrollment numbers due to its ability to analyze the relationship between independent variables, such as academic year, and the dependent variable, namely the number of new students (Azahra, 2022; Almumtazah, Azizah, & Dian, 2021). By utilizing historical enrollment data, this method allows the development of a predictive model that is relatively simple, interpretable, and practical for institutional planning purposes. Accordingly, the purpose of this study is to apply the simple linear regression method to forecast the number of new students at Manado State University, thereby assisting higher education institutions in preparing resources more effectively and efficiently in response to enrollment uncertainty.

METHODS

Simple linear regression analysis examines the relationship between two variables, namely X and Y, in the form of a one-way relationship known as a linear functional relationship. The term *linear* indicates that the relationship between the two variables can be represented by a straight line. Meanwhile, the term *simple* means that the analysis involves only two variables, without the inclusion of additional variables (Lolombulan, 2017).

The simple linear regression equation is expressed as follows:

$$\hat{Y}_i = a + bX_i$$

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where:

$\hat{Y}$: dependent variable
X : independent variable
i : $1,2,3,\ldots,n$
n : number of observations
a : regression intercept
b : regression coefficient

The values of the intercept and regression coefficient are calculated using the following equations:

$$a = \frac{(\sum Y)(\sum X^2) - (\sum X)(\sum XY)}{n(\sum X^2) - (\sum X)^2}$$

$$b = \frac{n(\sum XY) - (\sum X)(\sum Y)}{n(\sum X^2) - (\sum X)^2}$$

This study employs a quantitative method with a case study approach conducted at Manado State University. The population consists of data on the number of new students admitted at both the university and faculty levels over the past ten years. The sample used in this study is the data on new student admissions over the most recent five-year period, from the 2020 to 2024 academic years. The data analyzed are secondary data obtained from official records and recapitulation documents of new student admissions maintained by the university and each faculty.

Data collection was conducted through documentation by gathering historical records of new student admissions from relevant university and faculty archives. All collected data were subsequently analyzed using the simple linear regression method. The analysis focused on examining the relationship between time (academic year) as the independent variable (X) and the number of new students as the dependent variable (Y). The resulting regression equation was then used to forecast the number of new students for the subsequent five academic years, from 2025 to 2029.

To evaluate the accuracy of the forecasting results, this study employed two accuracy measurement techniques: Mean Absolute Percentage Error (MAPE) and Mean Squared Error (MSE). MAPE is widely used in forecasting studies to measure the average percentage deviation between actual values and predicted values. The MAPE formula is expressed as follows:

$$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left|\frac{Y_i - \hat{Y}_i}{Y_i}\right| \times 100\%$$

where:

Y : actual data

$\hat{Y}$: forecast data

i : $1,2,3,\ldots,n$

n : number of years

The MAPE results provide an indication of the forecasting model's accuracy, with interpretative categories defined as follows: a MAPE value of less than 10% is classified as *very good*, 10–20% as *good*, 20–50% as *reasonable*, and above 50% as *inaccurate* or *failed* (Sulastri, Anwar, & Dewi, 2023).

After calculating the MAPE value, the effectiveness of the simple linear regression model in predicting new student enrollment can be evaluated. A lower MAPE value indicates that the model produces predictions that closely approximate actual data, thereby demonstrating reliability for future forecasting. Conversely, if the MAPE value exceeds 50%, it is recommended that the model be refined or that alternative forecasting methods be considered to improve prediction accuracy. Thus, the use of MAPE not only assesses model performance but also provides guidance for methodological improvement (Astuti & Sofro, 2018; Ngabidin, Sanwidi, & Arini, 2023).

Mean Squared Error (MSE) is another important metric used to evaluate the accuracy of predictive models. A lower MSE value indicates better predictive performance. MSE is calculated as the average of the squared differences between actual and predicted values, which makes it particularly sensitive to large errors and outliers (Das, Jiang, & Rao, 2004). The MSE formula is defined as follows:

$$MSE = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$$

Where,

Y : actual data

$\hat{Y}$: forecast data

i : $1,2,3,\ldots,n$

n : number of years

By using MSE, researchers can gain a clearer understanding of how well the model predicts actual outcomes. MAPE and MSE provide complementary perspectives on forecasting accuracy: MSE emphasizes larger prediction errors due to the squaring process, while MAPE presents errors in percentage terms, making it easier to interpret in practical and managerial contexts (Maulidaniar & Widodo, 2023; Sari & Winarno, 2023).

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To assess the overall accuracy of the prediction results, model evaluation was conducted using both MAPE and MSE at the university level as well as at the faculty level. This approach allows for a comprehensive assessment of the effectiveness of the simple linear regression method in predicting new student enrollment at Manado State University. All data analysis procedures were performed manually and supported by numerical data processing software to ensure the accuracy of calculations.

FINDING AND DISCUSSION

Manado State University

For the number of new student admissions registered at Manado State University, the author collected data over a period of five (5) years prior, obtained from the academic and student affairs bureau of Manado State University, starting from the year 2020 to 2024.

Table 1. Data on the Number of New Students Admitted Each Academic Year in Universitas Negeri Manado

Academic Year	SNBP	SNBT	B2P	Total
2020/2021	677	988	1.148	2.813
2021/2022	911	889	1.344	3.144
2022/2023	917	927	1.094	2.938
2023/2024	690	747	1.139	2.576
2024/2025	919	505	951	2.375
	Total			13.846

From Table 1 above, two variables will be used in the calculation process with the simple linear regression method, namely variable X (Academic Year) from 2020 to 2024 and variable Y (Number of students admitted to Manado State University during 2020-2024). Before creating the student forecasting analysis, a table consisting of the two variables X and Y is displayed, which serves as the initial stage of these variables.

Table 2. $\boldsymbol{X^2}$ and XY Calculations for Manado State University Data

Academic Year	X	Y	X^2	Y^2	X.Y
2020/2021	1	2813	1	7912969	2813
2021/2022	2	3144	4	9884736	6288
2022/2023	3	2938	9	8631844	8814
2023/2024	4	2576	16	6635776	10304

Academic Year	X	Y	X^2	Y^2	X.Y
2024/2025	5	2375	25	5640625	11875
Amount	15	13846	55	38705950	40094

Next, we will find the intercept value and the regression coefficient using equation (2) and equation (3).

$$a = \frac{(\sum Y)(\sum X^2) - (\sum X)(\sum XY)}{n(\sum X^2) - (\sum X)^2}$$

$$a = \frac{(13.846)(55) - (15)(40.094)}{5(55) - (15)^2}$$

$$a = \frac{761.530 - 601.410}{275 - 225}$$

$$a = \frac{120.026}{50}$$

$$value\ a = 3202{,}4$$

$$b = \frac{n(\sum XY) - (\sum X)(\sum Y)}{n(\sum X^2) - (\sum X)^2}$$

$$b = \frac{5(40.094) - (15)(13.846)}{5(55) - (15)^2}$$

$$b = \frac{200.470 - 207.690}{275 - 225}$$

$$b = \frac{-7.220}{50}$$

$$value\ b = -144{,}4$$

The simple linear regression model is

$$\hat{Y}_i = 3202{,}4 - 144{,}4X_i$$

Table 3. Predicted Value, Actual Value, and Value for MAPE, MSE Calculation

Academic Year	Actual Data	Forecast Data	Value of $\left\|\frac{Y_i - \hat{Y}_i}{Y_i}\right\|$	Value of $(Y_i - \hat{Y}_i)^2$
2020/2021	2.813	3.058	0,087095627	60.025
2021/2022	3.144	2.913,6	0,073282443	53.084,16
2022/2023	2.938	2.769,2	0,05745405	28.493,44
2023/2024	2.576	2.624,8	0,018944099	2.381,44
2024/2025	2.375	2.480,4	0,044378947	11.109,16
	Amount		0,281155167	155.093,2

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Using the formula as follows $MAPE = \frac{\sum_{i=1}^{n} \frac{|Y_i - \hat{Y}_i|}{\hat{Y}_i}}{n} \times 100\%$

the MAPE value is 5.7%, with very good prediction results

Using the formula as follows $MSE = \frac{1}{n}\sum_{i=1}^{n}(Y_i - \hat{Y}_i)^2$

The MSE value is 31,018.64, with a fairly good result because the value is large. With the MAPE and MSE values being relatively low, the forecasting results are very good for predicting new students in the next 5 years.

Table 4. Forecast Data Manado State University 5 Years Ahead

Academic Year	Value Forcast
2025/2026	2336
2026/2027	2191,6
2027/2028	2047,2
2028/2029	1902,8
2029/2030	1758,4

With the MAPE and MSE values being relatively low, the forecasting results are very good for predicting new students in the next 5 years.

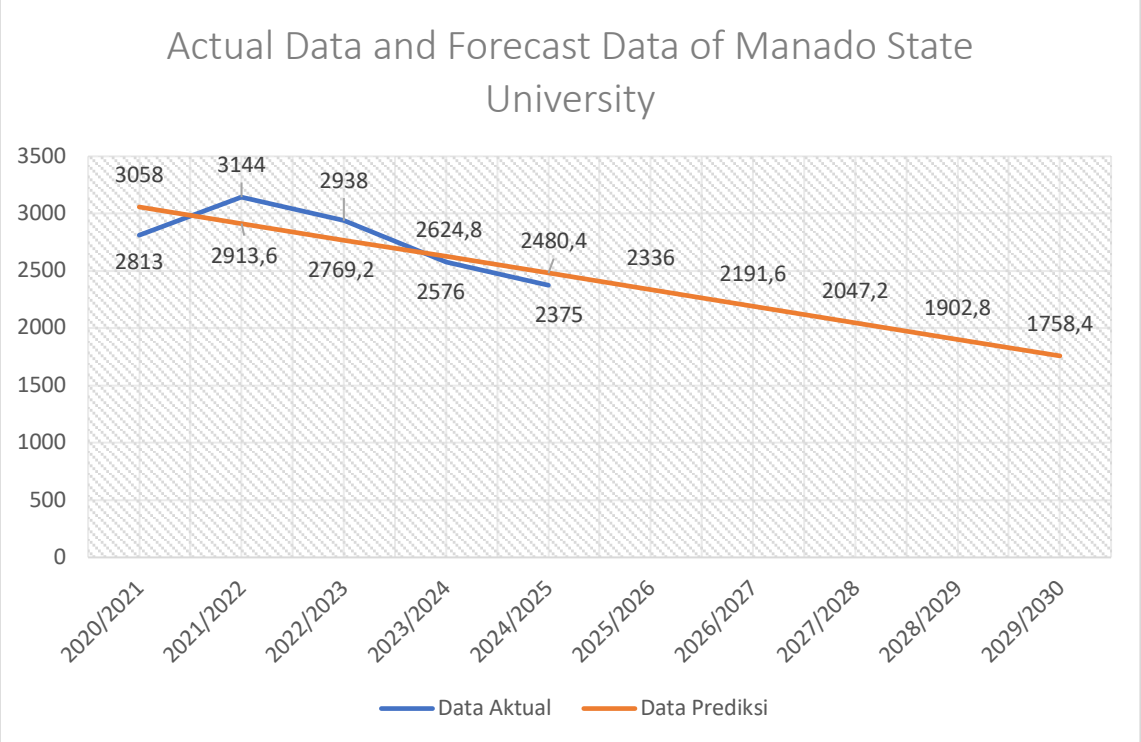

Figure 1. Actual Data dan Forecast Data of Manado State University Faculties

For further predictions, researchers will create forecasting results for each faculty, so we will try to see in the next 5 years which faculty will experience a decline in the number of students.

Table 5. New Student Data of the Faculty at Manado State University

Academic Year	Periode Academic Year (X)	Number of New Students (Y)						
		FBS	FEB	FIKKM	FIPP	FISH	FMIPAK	FT
2020/2021	1	330	525	227	543	466	241	481
2021/2022	2	279	632	293	666	537	239	498
2022/2023	3	276	499	312	723	452	153	523
2023/2024	4	231	503	255	628	335	148	476
2024/2025	5	224	432	551	322	322	116	408
Total	15	1340	2591	1638	2882	2112	897	2386

Before finding the intercept and regression coefficient values, calculations for X^2 and XY will be performed, and the results can be seen in Table 6.

Table 6. X^2 and XY calculations in the faculties

X	X^2	XY						
		FBS	FEB	FIKKM	FIPP	FISH	FMIPAK	FT
1	1	330	525	227	543	466	241	481
2	4	558	1264	586	1332	1074	478	996
3	9	828	1497	936	2169	1356	459	1569
4	16	924	2012	1020	2512	1340	592	1904
5	25	1120	2160	2755	1610	1610	580	2040
Total	55	3760	7458	5524	8166	5846	2350	6990

Next, find the intercept value and regression coefficient using equation (2) and equation (3). The calculation results can be seen in Table 7.

Table 7. Value Intercept and Regression Coefficient

Value	FBS	FEB	FIKKM	FIPP	FISH	FMIPAK	FT
a	346	612,7	144,6	720,4	569,4	281,7	527,6
b	-26	-31,5	61	-48	-49	-34,1	-16,8

Next, create a simple linear regression equation in the existing faculties.

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Table 8. Regression Equation of Each Faculty

Faculty	Regression equation
FBS	346-26X
FEB	612,7-31,5X
FIKKM	144,6+61X
FIPP	720,4-48X
FISH	569,4-49X
FMIPAK	281,7-34,1X
FT	527,6-16,8X

Next, create a simple linear regression model based on equation (1) and make predictions to determine the values of $\hat{Y}_1$ to $\hat{Y}_5$, The calculation of predicted values for the first five years can be seen in table 9.

Table 9. Forecast Data Calculation

Academic Year	Forecast Data						
	FBS	FEB	FIKKM	FIPP	FISH	FMIPAK	FT
2020/2021	320	581,2	205,6	672,4	520,4	247,6	510,8
2021/2022	294	549,7	266,6	624,4	471,4	213,5	494
2022/2023	268	518,2	327,6	576,4	422,4	179,4	477,2
2023/2024	242	486,7	388,6	528,4	373,4	145,3	460,4
2024/2025	216	455,2	449,6	480,4	324,4	111,2	443,6

Next, analyze using MAPE and MSE

Table 10. Calculation of Error Rate MAPE

Academic Year	MAPE $\frac{\lvert Y_i - \hat{Y}_i \rvert}{Y_i}$						
	FBS	FEB	FIKKM	FIPP	FISH	FMIPAK	FT
2020/2021	0,030303	0,107048	0,094273	0,238306	0,116738	0,027386	0,061954
2021/2022	0,053763	0,130222	0,090102	0,062462	0,12216	0,106695	0,008032
2022/2023	0,028986	0,038477	0,05	0,202766	0,065487	0,172549	0,087572
2023/2024	0,047619	0,032406	0,523922	0,158599	0,114627	0,018243	0,032773
2024/2025	0,035714	0,053704	0,184029	0,491925	0,007453	0,041379	0,087255
Value MAPE	3,92%	7,23%	18,84%	23,08%	8,52%	7,32%	5,55%

Table 11. Calculation of Error Rate MSE

	FBS	FEB	FIKKM	FIPP	FISH	FMIPAK	FT
Value MSE	574	11104,3	29529,2	74977,2	9619,2	1421,1	4512,4

With the obtained MAPE and MSE results, a good error rate categorized as 'very good' includes FBS, FEB, FISH, FMIPAK, and FT, while FIKKM and FIPP are categorized as 'fair', indicating that the forecasting results for FIKKM and FIPP are not as good as the other 5 faculties. FBS has the lowest MSE, thus we can conclude that this faculty has very good data, resulting in very good forecasting results. The calculations for MAPE and MSE can be seen in Table 10 and Table 11.

Based on Table 10, the MAPE values obtained for FBS, FEB, FIKKM, FIPP, FISH, FMIPAK, and FT are 3.92%, 7.23%, 18.84%, 23.08%, 8.52%, 7.32%, and 5.55%, respectively. With accuracy levels of 96.08%, 92.77%, 81.16%, 76.92%, 91.48%, 92.68%, and 94.45%.

Based on Table 11, the MSE values obtained for FBS, FEB, FIKKM, FIPP, FISH, FMIPAK, and FT are 574, 11104.3, 29529.2, 74977.2, 9619.2, 1421.1, and 4512.4 respectively. Thus, the faculty with the best MSE value is FBS with the lowest MSE value of 574.

Thus, the following results are obtained for the predictions in the academic year 2025/2026 to 2029/2030.

Table 12. 5-Year Forecast Data

Academic Year	5-Year Forecast Data						
	FBS	FEB	FIKKM	FIPP	FISH	FMIPAK	FT
2025/2026	190	423,7	510,6	432,4	275,4	77,1	426,8
2026/2027	164	392,2	571,6	384,4	226,4	43	410
2027/2028	138	360,7	632,6	336,4	177,4	8,9	393,2
2028/2029	112	329,2	693,6	288,4	128,4	-25,2	376,4
2029/2030	86	297,7	754,6	240,4	79,4	-59,3	359,6

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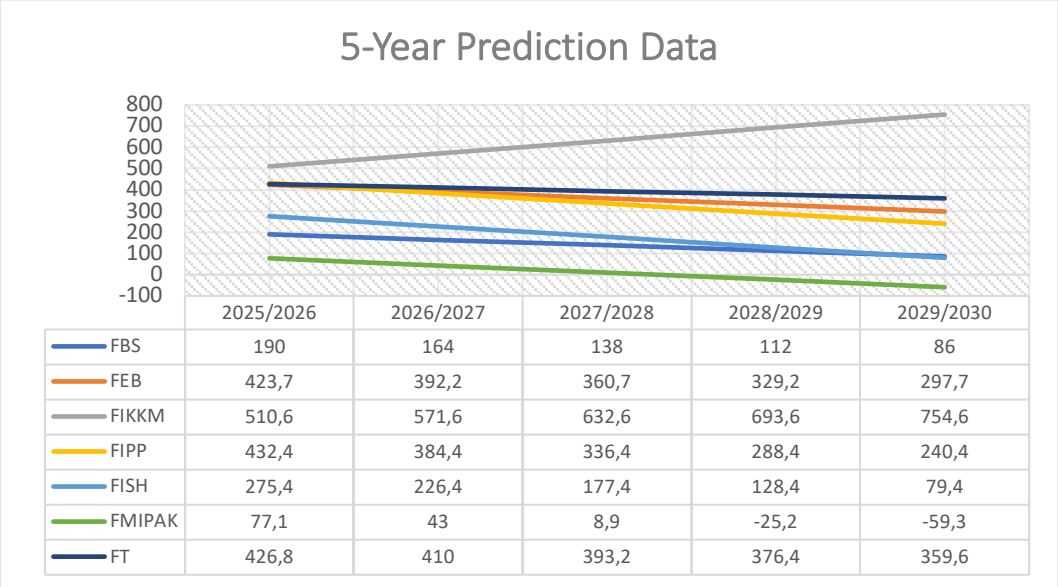

	2025/2026	2026/2027	2027/2028	2028/2029	2029/2030
FBS	190	164	138	112	86
FEB	423,7	392,2	360,7	329,2	297,7
FIKKM	510,6	571,6	632,6	693,6	754,6
FIPP	432,4	384,4	336,4	288,4	240,4
FISH	275,4	226,4	177,4	128,4	79,4
FMIPAK	77,1	43	8,9	-25,2	-59,3
FT	426,8	410	393,2	376,4	359,6

Figure 2. 5-Year Forecast Data

Considering the results obtained and referring to Figure 2, besides FIKKM, the regression model shows a downward trend, indicating that the predicted number of new students for the next five years will decrease.

CONCLUSIONS AND RECOMMENDATIONS

The regression model developed using new student enrollment data from the past five academic years (2020/2021–2024/2025) was applied to forecast new student admissions for the subsequent five academic years (2025/2026–2029/2030). Despite its inherent limitations, the simple linear regression method proved to be effective in providing an initial projection of future enrollment trends. The findings indicate a general decline in new student admissions across most faculties at Manado State University, with the exception of the Faculty of Sports Science and Public Health, which shows a projected upward trend. These results can be utilized by the university and its faculties as a strategic reference in formulating policies related to resource allocation, infrastructure planning, academic staffing, and promotional strategies aimed at increasing student enrollment. For future studies, it is recommended to apply and compare alternative forecasting methods—such as exponential smoothing, Monte Carlo simulation, Random Forest, or moving average techniques—and to incorporate more recent data alongside robust error analysis measures, including MAPE and MSE, to enhance the accuracy and reliability of enrollment predictions.

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