

Analysis of the Padang City's Labor Force with Least Square Method

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Abstract: The labor force is an important indicator in the labor sector that reflects the number of working age people participating in economic activities, so its changes from year to year need to be analyzed quantitatively to support regional development planning. Padang City as the center of economic activity in West Sumatra Province shows relatively stable labor force development but still fluctuates, so a forecasting method is needed that is able to provide an accurate picture of the development of the labor force in the coming period. This study aims to forecast the number of Padang City workforce in 2026 using the Least Square method based on historical data for the 2017–2025 period. The Least Square method is used because it is able to form the best linear trend line with the principle of minimizing the number of squares of the error between the actual data and the value of the forecast result. The accuracy level of the forecast results was evaluated using Mean Absolute Percentage Error (MAPE). The results of the study show that the number of Padang City workforce in 2026 is projected to reach around 509,359 people with a MAPE value of 1.91%, which indicates that the Least Square method has an excellent level of forecasting accuracy and is suitable for use as a basis for data-based employment policy planning.

Keywords: economic activity, forecasting, MAPE, the labor force

1. Introduction

The labor force is one of the important indicators in the field of employment that describes the number of people who are ready to work and contribute to economic activities. The labor force consists of the working and unemployed population, so the change in the number of labor force every year greatly affects the dynamics of the labor market in an area (Lumi et al., 2021). Therefore, the availability of accurate information on the workforce is very necessary, especially for local governments in formulating development policies and strategies to improve welfare.

The city of Padang as the capital of West Sumatra Province has economic activities that grow from year to year. The growth of the service, trade, and education sectors makes Padang City a center of economic activity that is able to absorb a large number of workers. However, labor force data from year to year still show fluctuations, both in terms of the number of employed population and the number of unemployed (Tindaon et al., 2011). These fluctuations need attention because they can

affect the open unemployment rate, labor market stability, and the sustainability of regional development.

Changes in the number of uncertain labor force can make it difficult for local governments to determine strategic steps, such as the provision of jobs, the implementation of skills training, and the allocation of budgets in the employment sector (Unawekly *et al.*, 2024). Inaccuracies in predicting the development of the labor force have the potential to cause the policies taken not to run optimally, for example, the occurrence of an excess supply of labor without being balanced by the availability of adequate employment, or conversely, labor shortages in certain sectors. Therefore, a forecasting method is needed that is able to estimate the number of labor force in the coming period more accurately and systematically.

Forecasting is a quantitative analysis technique used to predict future values by utilizing historical data. One of the commonly used forecasting methods for *time series data* is the Least Square method. The Least Square method forms a linear equation to obtain the best trend line with the principle of minimizing the number of squares of the error between the actual data and the value of the forecast result (Ridwan *et al.*, 2020)(Shidiq *et al.*, 2022). This method is widely used because the calculation is relatively simple, easy to interpret, and effective in describing the long-term trends of a data (Hariri, 2016).

Several previous studies have shown that the Least Square method is able to provide fairly good forecasting results in various areas, such as forecasting sales, revenue, and market demand, with a relatively small error rate (Syamsudin, 2024). In addition, the Least Square approach is also widely used in economic and employment analysis to look at the trend of labor growth in a linear manner. However, the application of the Least Square method in forecasting the regional workforce is still relatively limited, especially for the Padang City area.

Based on this background, this study aims to apply the Least Square method in forecasting the number of Padang City's workforce in 2026 based on historical data for the 2017–2025 period. In addition, this study also evaluates the accuracy level of forecasting results using the Mean Absolute Percentage Error (MAPE) indicator as a measure of forecasting error commonly used in forecasting research [10]. The results of this study are expected to provide an overview of the development of the labor force in the coming period and become a consideration for local governments in the preparation of more precise and data-based labor policies.

2. Methods

2.1 Data Collection

The data used in this study is secondary data obtained from the official publication of the Central Statistics Agency (BPS) of Padang City, especially the Padang City Manpower Statistics and a

summary of employment indicators from the results of the National Labor Force Survey (Sakernas). The data taken is the number of Padang City labor force for the 2017-2025 period.

The system development method used in this study is a prototype model. This model was chosen because it is suitable for research that requires a gradual process, repeated evaluation, and refinement of mathematical models and data visualization. The stages in the prototype method are as follows:

- a. Identification and Data Collection : At this stage, the researcher identifies the research needs, determines the necessary variables, and collects related documents from the BPS. In addition, the researcher also studied the flow of employment data presentation so that the forecasting model was able to adjust the data format used officially.
- b. System Planning : The system planning stage is done to plan the flow of the forecasting process in a structured manner. At this stage, a calculation model of the Least Square method is designed with linear equations $Y = a + bX$. The design also includes the preparation of data tables, calculation flows, and the presentation of forecast results in the form of trend tables and graphs.
- a. Modeling : The implementation stage is the stage of applying the design results into the form of a calculation system. The implementation process is carried out using Microsoft Excel software as a data processing tool. Historical data is entered into the system, then the calculation of the constant value and trend coefficient is carried out.*ab*
- b. The testing stage is carried out to ensure that the developed forecasting system has run in accordance with the research objectives.

2.2 Least Square Method

The Least Square method is one of the quantitative forecasting methods used to analyze time series data with the aim of determining trends or trends in data based on historical data. The basic principle of this method is to find a trend line equation that best matches the observation data, namely by minimizing the number of squares of the difference between the actual value and the forecast value (Oktavia et al., 2023).

The Least Square method is generally used for data that has a linear trend pattern, where changes in the data over time tend to increase or decrease relatively constantly. Therefore, this method is widely applied in the fields of economics, business, and development planning to forecast sales, income, demand, and other socioeconomic variables. Mathematically, the equations for the least square method are as follows:

$$Y = a + bX \quad (1)$$

where:

- Y = the value of the forecast result,
- a = the trend constant or value at the moment $X = 0$

- b = the slope coefficient that shows the magnitude of the trend change
- X = a time variable that is expressed in the form of a specific period or time code.

The values of constants a and b coefficients are determined based on historical data using the equation:

$$a = \frac{\sum Y}{n} \quad b = \frac{\sum XY}{\sum X^2}$$

by n being the amount of observation data. In its application, the value X is usually determined in such a way that the amount X is worth zero. with the aim of simplifying parameter calculations and improving the stability of the forecasting model.

2.3 Mean Absolute Percentage Error (MAPE)

Mean Absolute Percentage Error (MAPE) is one of the evaluation measures commonly used to assess the accuracy of forecast results. MAPE calculates the average absolute error in the form of a percentage by comparing the difference between the actual value and the value of the forecast result to the actual value. The use of MAPE is widely applied in forecasting research because it is easy to understand and interpret, and is able to provide a quantitative picture of the error rate of the forecasting model used.

Mathematically, the MAPE calculation is formulated as follows:

$$MAPE = \frac{1}{n} \sum_{t=1}^n \left| \frac{Y_t - \hat{Y}_t}{Y_t} \right| \times 100\% \quad (2)$$

where :

Y_t = actual value in the second period t

\hat{Y}_t = the value of forecasting results in the second period t

n = amount of observation data

In the application of the Least Square method, the MAPE's value is used to assess the extent to which the resulting trend line is able to represent historical data patterns. Smaller MAPE values indicate higher forecasting accuracy, and MAPE below 10% is categorized as having excellent accuracy [12]. Several studies have stated that MAPE is effectively used as an indicator of the feasibility of forecasting models on time series data, especially economic and social data that have relatively stable patterns of change, such as employment data (Swanjaya & Pamungkas, 2021)(Adha et al., 2025).

The number of the Padang City's labor force based on the publication of the BPS Sakernas has experienced quite dynamic development in recent years. Based on available data, the labor force of Padang City in 2017 was recorded at 422,196 people, increasing to 493,647 people in 2024, and increasing again in 2025. It shows a growth trend even though every year there is a variation in the working population and the number of unemployed. Data on the labor force of Padang City can be seen in Table 1 below.

Table 1. Number of Padang City's Labor Force

Year	Number of Workforce
2017	422.196
2018	435.998
2019	436.811
2020	476.663
2021	480.324
2022	480.376
2023	478.779
2024	486.638
2025	493.647*

*The 2025 labor force figure in the publication is shown as a value equal to the total employed population + unemployment in the infographic (445,778 + 47,869).

In general, there is a trend of increasing the labor force from 2017 to 2025, although the increase is not very large. This increase is in line with the increase in the working population, such as an increase of 7,207 people from 2024 to 2025. With a pattern like this, the least square method is used to forecast a period ahead.

In this study, the calculation was carried out using the Least Square method, which determines the value of parameter a and b that produces the smallest total square error. From the calculation, we get $a = 465.805$ and $b = 8710,88$. So,

$$Y = 465.805 + 8710,88x.$$

The results of the forecast can be seen in Table 2.

Table 2. The Labor Force Forecasting Results

Year	Actual Data	Forecasting Result
2017	422.916	432.561
2018	435.998	440.372
2019	436.811	448.183
2020	476.663	455.994
2021	480.376	463.805
2022	480.376	471.616
2023	478.779	479.427
2024	486.638	491.938
2025	493.687	500.648
2026	-	509.359

From Table 2, it can be seen that the value of the forecast results follows the trend of increasing the number of labor force from year to year. The Least Square model produces an estimated workforce in 2026 of around 509,359 people.

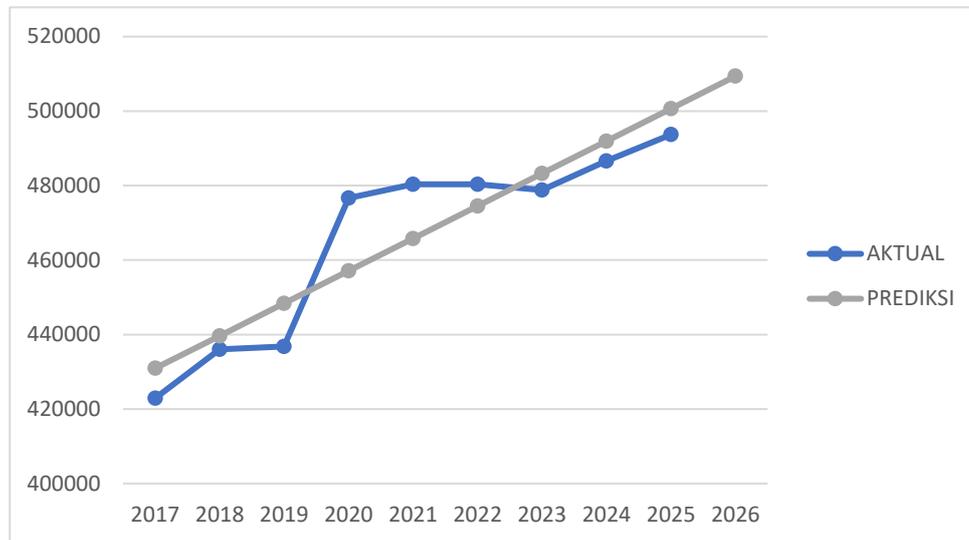


Figure 1. Comparison of Actual and Prediction Graph

The graph shows that the forecasting results of the Least Square method follow the trend of increasing actual data with a relatively small difference, so this method is quite appropriate to be used for forecasting the labor force of Padang City.

To measure the accuracy of the Least Square forecasting model that has been prepared, a test was carried out using the Mean Absolute Percentage Error (MAPE) method. MAPE is the average of the absolute difference between actual data and predicted data, expressed in the form of a percentage. The smaller the MAPE value, the higher the accuracy of the model.

Based on the calculation of MAPE for the period 2017–2025, the total Average Percentage Error was obtained of 17.18%, so that the MAPE value was 1.91%. MAPE values that are below 10% indicate that the forecasting model has a very high level of accuracy [16]. Thus, the estimate for 2026 of 509,359 people can be considered quite reliable as a basis for employment planning.

3. Conclusion

The Least Square method can be applied to forecast the number of Padang City's labor force because historical data shows a relatively stable pattern of change and has a tendency to trend linear. Based on the results of forecasting using the Least Square method, the number of Padang City's workforce in 2026 is projected to reach around 509,359 people, which shows an increase compared to previous years. The accuracy level of the forecasting model assessed using MAPE resulted in a value of 1.91%, so the difference between the actual value and the value of the forecast result was relatively small and the model could be categorized as very accurate. The MAPE value

is below 10% indicates that the Least Square method has a very good level of accuracy, so that the forecasting results obtained can be used as a reliable basis in planning and making employment policies in Padang City.

References

- Adha, Febriyan Idil, et al. Forecasting Penjualan Bahan Bangunan Menggunakan Metode Least Square Berbasis Website Menggunakan Framework Codeigniter. *Journal of Informatics Management and Information Technology*, 2025, 5.2: 104-111.
- Anjolie, R., Setiawan, A., & Pratama, R. Analisis akurasi peramalan menggunakan Mean Absolute Percentage Error (MAPE) pada data time series. *Jurnal Informatika dan Sistem Informasi*, 10(1), 45–52.
- BPS, "Statistik ketenagakerjaan Kota Padang dalam infografis 2025 (Vol. 1).", BPS Kota Padang. [Online]. Available: <https://padangkota.bps.go.id/>.
- F. R. Hariri. Metode Least Square Untuk Prediksi Penjualan Sari Kedelai Rosi, *Jurnal SIMETRIS*, 2016, vol. 07, No.02, Nov.
- Kurniawati, Eriska Fitri; Sari, Ita Indah. Peramalan Produksi Padi Menggunakan Metode Least Square di Desa Leranwetan Kecamatan Palang Kabupaten Tuban. *MathVision: Jurnal Matematika*, 2020, 2.1: 23-28.
- Lumi, Angela NM; Walewangjo, Een N.; Lapijan, Agnes LCP. Analisis pengaruh jumlah angkatan kerja dan indeks pembangunan manusia terhadap tingkat pengangguran di Kota-Kota Provinsi Sulawesi Utara. *Jurnal EMBA: Jurnal Riset Ekonomi, Manajemen, Bisnis dan Akuntansi*, 2021, 9.3.
- Musdalifa, A., Ramadhan, F., & Nurhayati, S. (2021). Perbandingan metode peramalan berdasarkan nilai Mean Absolute Percentage Error (MAPE) pada data runtun waktu. *Jurnal Ilmiah Teknik Informatika*, 6(1), 15–22.
- Oktavia, Aulia; Nita, Sri; Putra, Roni Tri. Prediksi Penjualan Tabung Gas LPG 5, 5 kg di PT. Parafin Energi Mandiri dengan Menggunakan Metode Least Square. *Jurnal Ilmiah Matematika dan Terapan*, 2023, 20.1: 31-37.
- Oktavia, Aulia., Wahyu, Sri., Resmi, Fitroh. Analisis Single Exponential Smoothing Dan Double Exponential Smoothing Dalam Peramalan Jumlah Pelanggan Listrik Di Pt. PLN ULP Padang. *MAP Journal: Mathematics and Applications*.
- Ridwan, M., Fitriani, E., & Sari, D. P. Penerapan metode least square dalam peramalan data runtun waktu. *Jurnal Sistem Informasi dan Teknologi*, 2020, 4(2), 45–52.
- Shidiq, Brillian Ghulam Ash; Furqon, Muhammad Tanzil; Muflikhah, Lailil. Prediksi Harga Beras menggunakan Metode Least Square. *Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer*, 2022, 6.3: 1149-1154.
- Swanjaya, I. G. N., & Pamungkas, A. R. (2021). Analisis tingkat kesalahan peramalan menggunakan Mean Absolute Percentage Error (MAPE). *Jurnal Sistem Informasi dan Komputasi*, 5(2), 101–108.
- Syamsudin, M. (2024). Penyerapan tenaga kerja: Pendekatan panel least square (PLS) di Pulau Jawa–Bali tahun 2012–2022. *Diponegoro Journal of Economics*, 13(1), 61–71.

- Tindaon, Ostinasia; Edy Yusuf, Edy Yusuf. *Analisis Penyerapan Tenaga Kerja Sektoral di Jawa Tengah (Pendekatan Demometrik)*. 2011. PhD Thesis. Universitas Diponegoro.
- Unawekly, A. J., Soselisa, A. L., Ririhena, C. Y., Tamera, E. C. V., Salosso, G. N., & Hasiyati, W. O. N. Implementasi metode least square untuk peramalan penjualan pada Bigshoots Boba. *Jurnal Teknologi dan Pengabdian kepada Masyarakat*, 2024, 1(2), 291–296.
- Yudaruddin, Rizky. Forecasting untuk kegiatan ekonomi dan bisnis. *Samarinda: RV Pustaka Horizon*, 2019.