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Trend Analysis of Early Marriage Cases in South Sulawesi Using VAR for Stunting Solution

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Abstract

This study uses a Vector Autoregressive (VAR) model to forecast early marriage cases across 23 regions in South Sulawesi. Monthly data from January 2017 to September 2024 were obtained from the provincial agency responsible for women's empowerment and child protection and the Makassar Religious High Court. The analysis included stationarity testing, lag selection using the Akaike Information Criterion (AIC), parameter estimation, and evaluation using Mean Absolute Error (MAE). Among the candidate lags reported, VAR(2) was selected because it had the lowest AIC value, −69.241. Regional MAE values ranged from 0.666 to 4.650 cases. Forecasts for October 2024 to September 2025 showed differing regional patterns. Sengkang increased from 12 to 23 cases, Pangkajene from 2 to 7, and Pare-Pare from 4 to 6, whereas Barru and Masamba declined to 6 cases each. Makale and Selayar remained stable at 2 cases per month. These forecasts provide a basis for identifying regional priorities for early marriage prevention. Their relevance to stunting prevention is discussed in the context of maternal and child health; stunting itself was not included as a modeled variable.

Keywords: Vector autoregression, time series, early marriage
MSC2020: 62M10, 62M20

Abstrak

Penelitian ini menggunakan model Vector Autoregressive (VAR) untuk meramalkan jumlah kasus pernikahan dini di 23 wilayah di Sulawesi Selatan. Data bulanan periode Januari 2017 hingga September 2024 diperoleh dari dinas provinsi yang menangani pemberdayaan perempuan dan perlindungan anak serta Pengadilan Tinggi Agama Makassar. Analisis mencakup pengujian stasioneritas, pemilihan lag menggunakan Akaike Information Criterion (AIC), estimasi parameter, dan evaluasi menggunakan Mean Absolute Error (MAE). Di antara kandidat lag yang dilaporkan, VAR(2) dipilih karena memiliki nilai AIC terendah, yaitu −69,241. Nilai MAE antarwilayah berkisar antara 0,666 dan 4,650 kasus. Hasil peramalan untuk Oktober 2024 hingga September 2025 menunjukkan pola yang berbeda antarwilayah. Sengkang meningkat dari 12 menjadi 23 kasus, Pangkajene dari 2 menjadi 7 kasus, dan Pare-Pare dari 4 menjadi 6 kasus, sedangkan Barru dan Masamba menurun hingga masing-masing 6 kasus. Makale dan Selayar tetap stabil pada 2 kasus per bulan. Hasil peramalan ini dapat menjadi dasar untuk mengidentifikasi wilayah prioritas dalam upaya pencegahan pernikahan dini dan menyusun kebijakan yang sesuai dengan pola kasus setempat. Relevansinya terhadap pencegahan stunting dibahas dalam konteks kesehatan ibu dan anak; stunting tidak dimasukkan sebagai variabel yang dimodelkan dalam penelitian ini.

Kata kunci: Vektor autoregresi, deret waktu, pernikahan dini
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Introduction

Time series analysis examines historical observations collected at regular intervals to describe temporal patterns and generate forecasts. Univariate methods focus on a single series, whereas multivariate methods allow several series and their dynamic relationships to be modeled jointly [1]. In this study, the Vector Autoregressive (VAR) model is used to forecast early marriage cases across regions in South Sulawesi.

VAR extends the autoregressive model to a vector of variables, with each variable expressed in terms of lagged observations in the system. Its regression-based formulation facilitates estimation and simultaneous forecasting. Previous applications include exchange rates and trade [2], air pollution [3], and stock prices [4]. The VARX extension has also been used to forecast interbank interest rates [5]. These studies provide methodological context for applying multivariate time series models to regional case counts.

Recent research continues to develop the broader vector autoregressive framework. Düker et al. review VARMA models and their uses in forecasting and Granger causality analysis [6]. Chavleishvili and Manganelli examine quantile VAR forecasting [7], and Demetrescu and Salish investigate the effects of unmodeled changes in mean and volatility [8]. These developments emphasize the importance of a clearly specified model and careful interpretation of forecasts. The present study retains the conventional VAR framework to describe regional early marriage patterns.

Early marriage is a social phenomenon with implications for community welfare. Previous Indonesian studies have examined its determinants in rural areas [9] and its legal context [10]. According to the provincial agency cited in the original data compilation, South Sulawesi recorded an early marriage rate of 9.23% in 2023. The Makassar Religious High Court annual data reported 402 cases in Sidrap, 158 in Soppeng, 74 in Barru, and 70 in Enrekang.

Early marriage has been discussed in relation to maternal and child health, including stunting [11], [12]. Reported stunting prevalence among children under five in South Sulawesi was 27.2% in 2022 [13]. Other Indonesian studies address early marriage and stunting in local communities and prevention programs [14], [15]. More recently, Hidayah et al. reported associations between parental child marriage, children’s nutritional status, and food security [16]. However, Rosyida et al. found no significant independent relationship between early marriage and stunting in their Mataram sample [17]. This variation supports a cautious interpretation of the relationship.

This study aims to model and forecast early marriage cases across 23 regions in South Sulawesi using VAR and to discuss the implications for prevention priorities. Its focus is the regional pattern of early marriage forecasts. The connection to stunting is discussed as a policy context rather than as a relationship estimated directly by the VAR model.

Methods

Data and Variables

This quantitative study uses monthly early marriage case counts for 23 regions in South Sulawesi, covering January 2017 to September 2024. The data were sourced from Dinas Pemberdayaan, Perlindungan Perempuan dan Anak, Pengendalian Penduduk, dan Keluarga Berencana (DP3AP2KB) Sulawesi Selatan and Pengadilan Tinggi Agama Makassar. The variable of interest is the number of early marriage cases in each region.

The monthly observation interval provides a common time scale for describing changes in the regional series. Each regional count refers to the same type of outcome, namely the number of early marriage cases, while the geographical labels distinguish the series included in the analysis. Maintaining this distinction is important when reading the regional equations and forecast tables together. The historical observation period and the forecast period also serve different purposes: the former provides the recorded series used in modeling, whereas the latter contains the projected values reported as the study's forecasting results.

Vector Autoregressive Model

The VAR model combines autoregressive equations in vector form. A VAR model of order p is expressed as follows [1]:

$$\boldsymbol{Y_t} = \boldsymbol{\alpha} + \emptyset_1 \boldsymbol{Y_{t-1}} + \emptyset_2 \boldsymbol{Y_{t-2}} + \ldots\ldots + \emptyset_p \boldsymbol{Y_{t-p}} + \boldsymbol{\varepsilon_t} \quad (1)$$

Here, Y_t denotes the vector of regional observations at time t, α is the intercept vector, ϕ_i is the coefficient matrix for lag i, and ε_t is the error vector. VAR(2) uses observations from the two preceding time periods. The regional equations are presented in the order used in the data tables.

In this notation, a lag represents the distance between an observation and an earlier observation in the monthly sequence. Thus, the two preceding periods in VAR(2) refer to the preceding two months. The vector representation summarizes the model structure, while the regional equations express the corresponding relationships for individual series. Reading these two forms together helps connect the general model specification with the district and city results. The coefficients describe the lagged relationships represented in the fitted model [1].

Analysis Procedure

1. Describe the monthly early marriage data for January 2017–September 2024.
2. Apply the Augmented Dickey-Fuller (ADF) unit-root test. A p-value below 0.05 is taken as evidence against the unit-root null hypothesis.
3. Examine candidate lags and select the model using the minimum AIC.
4. Use Granger causality analysis to examine predictive relationships between regional series.
5. Estimate the VAR parameters and evaluate errors using MAE.
6. Produce regional forecasts for October 2024-September 2025.

Forecast Error Measure

MAE summarizes the average absolute difference between observed and predicted values. Forecast evaluation is also used in applications of moving-average and exponential-smoothing methods [18], [19]. The MAE measure used in this study is:

$$\boldsymbol{MAE} = \sum_{\boldsymbol{i=1}}^{\boldsymbol{n}} \frac{|\boldsymbol{y_i} - \widehat{\boldsymbol{y}}_i|}{\boldsymbol{n}} \quad (2)$$

Here, y_i is the observed value, $\hat{y}_i$ is the predicted value, and n is the number of observations used to calculate the error.

Results and Discussion

Testing for Stationarity in Averages Using the Augmented Dickey-Fuller (ADF) Test

The first step in analyzing data with Vector Autoregression is to check the data for stationarity using the Augmented Dickey-Fuller test. Data is considered stationary if the p-value is less than 0.05. The results of the stationarity test are:

Table 1. Results of the Augmented Dickey-Fuller (ADF) Test

District	P-Value	Description	District	P-Value	Description
Makassar	0.044	Stationary	Enrekang	0.447	Non-stationary
Sengkang	0.309	Non-stationary	Sidrap	0.620	Non-stationary
Watampone	0.01	stationary	Makale	0.021	stationary
Pangkajene	0.239	Non-stationary	Maros	0.363	Non-stationary
Jeneponto	0.018	stationary	Watangsoppeng	0.734	Non-stationary
Takalar	0.01	stationary	Bulukumba	0.353	Non-stationary
Barru	0.192	Non-stationary	Palopo	0.01	stationary
Sungguminasa	0.01	stationary	Selayar	0.016	stationary
Bantaeng	0.01	stationary	Masamba	0.01	stationary
Sinjai	0.347	Non-stationary	Belopa	0.472	Non-stationary
Pare-Pare	0.525	Non-stationary	Malili	0.908	Non-stationary
Pinrang	0.767	Non-stationary			

Table 1 shows that several districts and cities are non-stationary, as the p-value is greater than 0.05. Therefore, differencing is required to make the data stationary.

Optimum Lag Testing

Table 2. Optimal Lag Determined by the Minimum AIC Value

Lag	AIC	HQ	SC
1	-66.579	-60.435	-51.349
2	-69.241	-57.208	-39.415

Table 2 shows that lag 2 has the lowest AIC value (−69.241), and VAR(2) is therefore retained under the AIC criterion used in this study. HQ and SC are lower at lag 1, so the criteria do not give a unanimous selection.

The interpretation of Table 2 therefore depends on the selection criterion stated in the analysis. Under AIC, the comparison favors the second lag among the two alternatives presented. The different rankings under HQ and SC do not change the reported AIC-based decision, but they make the basis of that decision explicit. Accordingly, the subsequent regional equations and forecasts are discussed consistently as results of the selected VAR(2) specification.

Parameter Estimation Testing

The simplified equation model derived from the VAR(2) parameter estimation based on the Regency or City is:

1. Makassar
   Y_1=4,169+0,075$Y_{16(t-1)}$-0,268$Y_{16(t-2)}$
   Multiple R-Squared: 0,6899

2. Sengkang
   Y_2=6,776+0,913$Y_{2(t-1)}$-0,231$Y_{2(t-1)}$-1,525$Y_{5(t-1)}$-0,188$Y_{5(t-1)}$+1,647$Y_{11(t-1)}$-2,734$Y_{11(t-2)}$
   Multiple R-Squared: 0,9002

3. Watampone
   Y_3=4,563-0,097$Y_{11(t-1)}$-1,243$Y_{11(t-2)}$-5,921$Y_{20(t-1)}$ 6,258$Y_{20(t-2)}$+0,023$Y_{21(t-1)}$+1,013$Y_{21(t-2)}$
   Multiple R-Squared: 0,7694

4. Pangkajene
   Y_4=0,028+0,841$Y_{11(t-1)}$-0,256$Y_{11(t-2)}$-0,438$Y_{19(t-1)}$-0,912$Y_{19(t-2)}$
   Multiple R-Squared: 0,8071

5. Jeneponto
   Y_5=-0,863+0,261$Y_{4(t-1)}$+0,278$Y_{4(t-2)}$-0,173$Y_{19(t-1)}$-0,761$Y_{19(t-2)}$
   Multiple R-Squared: 0,7935

6. Takalar
   Y_6=0,163+0,252$Y_{6(t-1)}$-0,442$Y_{6(t-2)}$-0,029$Y_{7(t-1)}$+0,079$Y_{7(t-2)}$+0,088$Y_{11(t-1)}$+$Y_{19(t-1)}$-0,031$Y_{13(t-1)}$-0,128$Y_{13(t-2)}$+0,052$Y_{16(t-1)}$-0,084$Y_{16(t-2)}$+0,100$Y_{21(t-1)}$-0,109$Y_{21(t-2)}$
   Multiple R-Squared: 0,7653

7. Barru
   Y_7=1,358+0,429$Y_{11(t-1)}$-0,402$Y_{11(t-2)}$-0,026$Y_{16(t-1)}$-0,230$Y_{16(t-2)}$
   Multiple R-Squared: 0,6598

8. Sungguminasa
   Y_8=2,523+1,231$Y_{1(t-1)}$-0,302$Y_{1(t-2)}$+0,577$Y_{7(t-1)}$-0,188$Y_{7(t-2)}$+0,261$Y_{8(t-1)}$+0,595$Y_{8(t-2)}$
   Multiple R-Squared: 0,6819

9. Bantaeng
   Y_9=0,776+0,177$Y_{1(t-1)}$-0,233$Y_{1(t-2)}$+0,056$Y_{11(t-1)}$-0,244$Y_{11(t-2)}$
   Multiple R-Squared: 0,5674

10. Sinjai
Y_{10}=5,969+0,345$Y_{2(t-1)}$-0,107$Y_{2(t-2)}$-0,012$Y_{3(t-1)}$-
0,407$Y_{3(t-2)}$+0,485$Y_{4(t-1)}$+0,334$Y_{4(t-2)}$+0,022$Y_{21(t-1)}$+0,947$Y_{21(t-2)}$+1,752$Y_{22(t-1)}$-
0,001$Y_{22(t-2)}$
Multiple R-Squared: 0,8536

11. Pare-Pare
Y_{11}=0,615-0,110$Y_{10(t-1)}$+0,144$Y_{10(t-2)}$-0,526$Y_{15(t-1)}$+0,484$Y_{15(t-2)}$
Multiple R-Squared: 0,7819

12. Pinrang
Y_{12}=1,244+0,494$Y_{2(t-1)}$-0,104$Y_{2(t-2)}$+0,249$Y_{4(t-1)}$+1,520$Y_{4(t-2)}$+0,850$Y_{7(t-1)}$-
0,485$Y_{7(t-2)}$+0,305$Y_{11(t-1)}$-1,378$Y_{11(t-2)}$-0,446$Y_{16(t-1)}$0,576$Y_{16(t-2)}$+0,225$Y_{17(t-1)}$-
0,323$Y_{17(t-2)}$+0,226$Y_{19(t-1)}$+1,337$Y_{19(t-2)}$-1,544$Y_{22(t-2)}$ +0,417$Y_{22(t-1)}$
Multiple R-Squared: 0,9149

13. Enrekang
Y_{13}=4,161+0,145$Y_{4(t-1)}$+0,463$Y_{4(t-2)}$+-0,466$Y_{16(t-1)}$-0,259$Y_{16(t-2)}$
Multiple R-Squared: 0,6887

14. Sidrap
Y_{14}=1,313+0,600$Y_{2(t-1)}$-0,169$Y_{2(t-2)}$+1,859$Y_{9(t-1)}$-0,305$Y_{9(t-2)}$+1,477$Y_{11(t-1)}$-
1,714$Y_{12(t-2)}$
Multiple R-Squared: 0,8384

15. Makale
Y_{15}=0,847+-0,081$Y_{2(t-1)}$-0,006$Y_{2(t-2)}$+-0,016$Y_{4(t-1)}$-0,131$Y_{4(t-2)}$+0,255$Y_{6(t-1)}$-
0,580$Y_{6(t-2)}$+0,185$Y_{10(t-1)}$ −0,110$Y_{10(t-2)}$+0,200$Y_{11(t-1)}$+0,073$Y_{11(t-2)}$+0,099$Y_{12(t-1)}$+
0,046$Y_{12(t-2)}$-0,087$Y_{13(t-2)}$-0,178$Y_{13(t-1)}$
Multiple R-Squared: 0,752

16. Maros
Y_{16}=0,470+0,243$Y_{2(t-1)}$-0,169$Y_{2(t-2)}$+0,315$Y_{4(t-1)}$-0,446$Y_{4(t-2)}$+0,459$Y_{7(t-1)}$-
0,027$Y_{7(t-2)}$+0,495$Y_{11(t-1)}$-1,136$Y_{11(t-2)}$+1,881$Y_{15(t-1)}$-0,247$Y_{15(t-2)}$+0,209$Y_{23(t-1)}$+
0,788$Y_{23(t-2)}$
Multiple R-Squared: 0,8792

17. Soppeng
Y_{7}=1,435+0,043$Y_{4(t-1)}$-0,912$Y_{4(t-2)}$+0,922$Y_{7(t-1)}$-0,427$Y_{7(t-2)}$
Multiple R-Squared: 0,774

18. Bulukumba
Y_{18}=2,572+0,830$Y_{6(t-1)}$+1,588$Y_{6(t-2)}$-0,256$Y_{10(t-1)}$-0,061$Y_{10(t-2)}$+0,217$Y_{17(t-1)}$-
0,143$Y_{17(t-2)}$
Multiple R-Squared: 0.8505

19. Palopo
Y_{19}=1,426-0,108$Y_{2(t-1)}$-0,036$Y_{2(t-2)}$-0,098$Y_{13(t-1)}$-0,260$Y_{13(t-2)}$-
0,281$Y_{18(t-1)}$+0,047$Y_{18(t-2)}$
Multiple R-Squared: 0.7215

20. Selayar
Y_{20}=0,482+0,025$Y_{3(t-1)}$-0,001$Y_{3(t-2)}$+0,002$Y_{4(t-1)}$-0,064$Y_{4(t-2)}$+0,039$Y_{10(t-1)}$-
0,028$Y_{10(t-2)}$-0,035$Y_{18(t-1)}$-0,071$Y_{18(t-2)}$
Multiple R-Squared: 0.6804

21. Masamba
Y_{21}=0,371+0,448$Y_{7(t-1)}$-0,174$Y_{7(t-2)}$+0,200$Y_{8(t-1)}$-0,001$Y_{8(t-2)}$-0,267$Y_{13(t-1)}$-
0,240$Y_{13(t-2)}$-0,129$Y_{17(t-1)}$-0,152$Y_{17(t-2)}$+0,321$Y_{18(t-1)}$-0,121$Y_{18(t-2)}$
Multiple R-Squared: 0.8254

22. Belopa
Y_{22}=0,182+0,114$Y_{2(t-1)}$-0,097$Y_{2(t-2)}$+0,133$Y_{3(t-1)}$-0,032$Y_{3(t-2)}$+0,295$Y_{11(t-1)}$-
0,123$Y_{11(t-2)}$-0,215$Y_{16(t-1)}$-0,104$Y_{16(t-2)}$+0,0
Multiple R-Squared: 0.7886

23. Malili
Y_{23}=1,448+0,191$Y_{2(t-1)}$-0,083$Y_{2(t-2)}$-0,007$Y_{4(t-1)}$-0,456$Y_{7(t-2)}$
Multiple R-Squared: 0.7652

The VAR(2) model was utilized to analyze the number of early marriage cases in various districts and cities in South Sulawesi. This model predicts the number of early marriage cases based on previous time series data, and the Multiple R-Squared value indicates how effectively the model explains the variation in the data. In most areas, such as Pinrang and Sengkang, the high R-Squared values (above 0.9) suggest that the VAR(2) model effectively captures trends in early marriage. However, in some regions, such as Bantaeng and Barru, the lower R-Squared values indicate that the model is less effective in explaining the variations in early marriage data.

Forecast Accuracy

Table 3. Results of Mean Absolute Error (MAE) Values

District	MAE	District	MAE
Makassar	0.916	Enrekang	4.603
Sengkang	3.099	Sidenreng	4.650
Watampone	1.538	Makale	0.833
Pangkajene	0.730	Maros	0.666
Jeneponto	1.166	Soppeng	2.514
Takalar	0.999	Bulukumba	1.919
Bantaeng	4.090	Palopo	1.135
Barru	1.595	Selayar	0.999
Sungguminasa	1.234	Masamba	1.521
Sinjai	2.865	Belopa	0.916
Pare-pare	3.833	Malili	1.500
Pinrang	2.623		

Table 3 reports the regional MAE values. The smallest reported MAE is 0.666 for Maros, and the largest is 4.650 for Sidenreng. These values describe absolute errors in case counts and should be interpreted in relation to the scale of each regional series.

Because MAE is expressed in the same unit as the observations, the values in Table 3 can be read directly as average absolute discrepancies in the number of cases. Taking the absolute value prevents positive and negative errors from cancelling each other when the average is calculated. The measure consequently summarizes error magnitude without indicating whether predictions tend to be above or below the observed counts. This interpretation complements the reported regional values and helps distinguish forecast error from the direction of the projected trend.

For this reason, Table 3 is best read together with the regional forecast discussion. An increasing or decreasing forecast describes the projected movement of the series, while MAE describes the size of the reported prediction discrepancies. Neither description substitutes for the other. Presenting both allows the reader to retain the direction of the projected regional pattern and the reported error magnitude as distinct pieces of information, without assigning a common accuracy category to all regions.

Regional Forecasts

Based on the estimation results obtained during the process of forecasting early marriage cases in South Sulawesi for the year from October 2024 to September 2025, the predicted outcomes by Regency/City are as follows:

Table 4. Predicted Number of Early Marriage Cases in South Sulawesi

No.	Region	Oct 2024	Nov 2024	Dec 2024	Jan 2025	Feb 2025	Mar 2025	Apr 2025	May 2025	Jun 2025	Jul 2025	Aug 2025	Sep 2025
1	Makassar	4	6	4	5	5	4	5	5	5	5	5	4
2	Sengkang	12	9	10	12	13	14	15	17	18	20	22	23
3	Watampone	5	6	4	7	6	7	6	6	7	7	7	7
4	Pangkajene	2	3	2	2	3	3	3	5	5	5	6	7
5	Jeneponto	1	1	1	1	1	1	1	4	4	4	4	4
6	Takalar	1	2	1	2	2	2	2	2	2	2	2	2
7	Barru	16	5	7	7	6	5	5	5	5	5	5	6
8	Sungguminasa	2	2	3	3	3	3	3	4	5	5	5	5
9	Bantaeng	3	2	3	3	3	3	3	3	3	3	3	3
10	Sinjai	10	6	5	7	6	5	6	7	6	7	8	8
11	Pare-Pare	4	4	4	4	5	4	4	4	5	5	6	6
12	Pinrang	8	4	3	5	6	6	8	8	9	11	11	12
13	Enrekang	3	3	3	7	4	5	5	5	6	6	6	6
14	Sidrap	42	16	18	21	19	16	19	18	19	21	21	22
15	Makale	2	2	2	2	2	2	2	2	2	2	2	2
16	Maros	3	3	2	3	3	4	4	5	5	6	6	6
17	Watangsoppeng	12	12	7	12	8	8	9	10	10	11	11	12
18	Bulukumba	5	7	5	9	8	7	8	8	8	8	8	8
19	Palopo	4	3	4	5	3	3	4	4	3	4	3	3
20	Selayar	2	2	2	2	2	2	2	2	2	2	2	2
21	Masamba	12	7	5	6	6	5	5	5	5	6	6	6
22	Belopa	3	3	4	4	2	2	2	2	2	2	2	2
23	Malili	4	5	3	5	3	3	3	3	4	4	4	4

According to Table 4, the prediction analysis for early marriage cases in South Sulawesi covers a one-year period from October 2024 to September 2025. The analysis reveals forecasts for 23 regions

in the region. The data indicates that some areas are expected to see an increase in early marriages, while others may experience a decrease or remain stable.

Notably, Sengkang is projected to see a rise in cases, increasing from 12 to 23. Pangkajene is also expected to increase, going from 2 to 7 cases. Pare-Pare will likely see an uptick from 4 to 6 cases, and Pinrang may rise from 8 to 12 cases. Additionally, although Watangsoppeng and Sidrap initially show a decline, they are expected to experience an increase in early marriage cases in subsequent months. Barru and Masamba are categorized as regions with a downward trend in case numbers. In Barru, the number of cases decreased from 16 to 6, while in Masamba, it fell from 12 to 6. Several other regions displayed stable patterns, showing little or no significant changes over the prediction period. For instance, Makale maintained a steady count of 2 cases per month, as did Selayar, which also had no change from 2 cases. Areas like Jeneponto and Takalar experienced slight increases but eventually stabilized. Meanwhile, Belopa and Malili had small fluctuations, lacking any clear upward or downward trend.

Overall, Sengkang and Pangkajene saw the most significant increases, while Barru and Masamba exhibited a downward trend in early marriage cases. Other regions, such as Makale and Selayar, remained stable throughout the prediction period.

The monthly sequence in Table 4 also provides context for interpreting the beginning and end of each forecast trajectory. For Sengkang, the initial decline is followed by increases over the later months, whereas Pangkajene reaches higher values toward the end of the horizon after remaining relatively low in the earlier months. Barru and Masamba show lower endpoint values, although their intermediate forecasts fluctuate. These sequences explain why a general trend description should be read alongside the individual monthly entries. A stable endpoint alone does not necessarily imply that every intervening month has the same forecast count.

Implications for Prevention

The forecasts identify different regional patterns relevant to early marriage prevention. Sengkang increases from 12 to 23 cases over the forecast horizon, whereas Sidrap starts at 42 and ends at 22 cases, despite recovering after its initial decline. Watangsoppeng returns to its initial value of 12 cases. These patterns support region-specific planning rather than a uniform interpretation of increasing cases across all areas.

The distinction between the level of a forecast and its direction of change is useful for interpreting these regional priorities. A region can end below its initial forecast while still having a higher projected count than another region with an increasing trajectory. Sidrap illustrates this distinction in the reported table. Similarly, the constant forecasts for Makale and Selayar describe stability at the displayed level, rather than the absence of early marriage cases. Considering both the projected count and its progression over the forecast horizon gives a clearer reading of the patterns already identified in the analysis.

Early marriage can negatively impact both maternal and child health, so it is important for local governments and all stakeholders to closely address this issue. Early marriage affects the lives of young couples and is also linked to maternal and child health challenges, particularly in relation to stunting caused by malnutrition [11], [12].

Young women are often not fully prepared to conceive and give birth, which heightens the risk of health complications such as premature birth and low birth weight (LBW). Additionally, children born to mothers who marry early are more likely to experience long-term health issues, primarily due to inadequate access to nutritious food and medical care [16].

Early marriage is often linked to a lack of education and poor economic conditions for families. Many young mothers who marry early tend to leave school prematurely, which hinders their access to proper healthcare and nutrition. Economic factors play a crucial role as well; families that marry young are typically in worse financial situations. As a result of their limited resources, they struggle to provide adequate nutrition for pregnant women and their children. This leads to issues such as malnutrition and stunting in young children [9], [16].

Reducing the number of early marriages is relevant to broader stunting-prevention efforts in South Sulawesi and to promote maternal and child health. Lowering the incidence of early marriages can also decrease the risk of pregnancies at inappropriate ages, allowing young mothers more time to complete their education and better prepare their children for the future.

It is essential to implement a comprehensive and integrated strategy to address both stunting and early marriage. This strategy should include improved education on reproductive health for adolescents, economic empowerment for women in areas with high rates of early marriage, and enhanced access to quality health services, particularly for pregnant women and children, to promote proper nutritional development [15], [16].

A more assertive government is necessary to combat early marriage. Addressing early marriage and stunting can be more effective through the implementation of stronger policies in education, health, and law enforcement, along with active participation from communities and local governments. By improving the quality of life for mothers and children, these actions will also positively impact the long-term socio-economic development of South Sulawesi, creating a healthier and more educated generation that is prepared to tackle future challenges.

The forecasts concern early marriage counts, not stunting prevalence. Their relevance to stunting should therefore be interpreted alongside external evidence, including the differing findings reported by Hidayah et al. [16] and Rosyida et al. [17]. No reduction in stunting is estimated by the present model.

Within this scope, the contribution of the forecast tables is to organize information about regional early marriage patterns for discussion of prevention priorities. The maternal and child health literature supplies the context for that discussion, while the VAR results supply the projected case counts. Keeping these roles explicit allows the policy implications to be linked to the reported findings without treating a forecast of early marriage as a direct estimate of a health outcome. The proposed regional focus therefore follows the differences in the existing forecasts and the prevention considerations discussed above.

Conclusion

The study selected VAR(2) using the lowest AIC among the reported candidate lags and presented 23 regional equations for forecasting early marriage cases in South Sulawesi. Forecasts for October 2024–September 2025 show increasing endpoint counts in Sengkang, Pangkajene, Pare-Pare, and Pinrang, declines in Barru and Masamba, and stable counts in Makale and Selayar. Sidrap recovers after an initial decline but ends below its first forecast value, while Watangsoppeng returns to its initial value. These patterns can inform regional early marriage prevention priorities, including education, economic empowerment, and access to health services. Their connection to stunting prevention remains a policy implication supported by related literature, since stunting is not included in the estimated model.

References

[1] W. Enders, Applied Econometric Time Series. University of Alabama (United States of America): Waley, 2008.

[2] D. R. Febrianti, M. A. Tiro, and S. Sudarmin, "Metode Vektor Autoregresssive (VAR) Dalam Menganalisis Pengaruh Kurs Mata Uang Terhadap Ekspor Dan Impor Di Indonesia," Jurnal Statistik, vol. 2, no. 1, 2021.

[3] A. P. Desyina and M. Julliana, "Pemodelan Pencemaran Udara Menggunakan Metode Vektor Autoregressive (VAR) Di Provinsi Riau," Jurnal Sains Teknologi Dan Industri, vol. 13, no. 2, 2016.

[4] D. A. Maruddanidah and D. Safitri, "Vektor Autoregressive (VAR) Untuk Meramalkan Harga Saham PT. Indofood Sukses Makmur Indonesia Tbk.," Jurnal Matematika, vol. 11, no. 1, 2008.

[5] K. Nurfadilah and I. Kasse, "Peramalan Tingkat Suku Bunga Pasar Uang Antar Bank (PUAB) Dengan Vector Autoregressive Exogenous (VARX)," Jurnal MSA (Matematika Dan Statistika Serta Aplikasinya), vol. 6, no. 1, 2018.

[6] M.-C. Düker, D. S. Matteson, R. S. Tsay, and I. Wilms, "Vector AutoRegressive Moving Average Models: A Review," WIREs Computational Statistics, vol. 17, no. 1, Art. no. e70009, 2025, doi: 10.1002/wics.70009.

[7] S. Chavleishvili and S. Manganelli, "Forecasting and stress testing with quantile vector autoregression," Journal of Applied Econometrics, vol. 39, no. 1, pp. 66–85, 2024, doi: 10.1002/jae.3009.

[8] M. Demetrescu and N. Salish, "(Structural) VAR models with ignored changes in mean and volatility," International Journal of Forecasting, vol. 40, no. 2, pp. 840–854, 2024, doi: 10.1016/j.ijforecast.2023.06.002.

[9] A. B. Boro and I. S. Oktora, "Pemodelan Determinan Pernikahan Dini Di Daerah Pedesaan Dengan Pendekatan Regresi Logistik Biner," Indonesia Journal Of Applied Statistics, vol. 4, no. 2, 2021.

[10] Y. S. Almahisa and A. Agustian, "Pernikahan Dini Dalam Perspektif Undang-Undang Perkawinan Dan Kompulasi Hukum Islam," Jurnal Rechten: Reset Hukum Dan Hak Asasi Manusia, vol. 3, no. 1, 2021.

[11] M. Stefani and N. A. Hanifah, "Hubungan Pernikahan Dini Dengan Angka Kejadian Stunting Pada Balita Di Kelurahan Mekarsari," Jurnal Gizi Ilmiah (JGI), vol. 9, no. 3, 2022.

[12] C. Permatasari, "Pernikahan Usia Dini Dan Risiko Terhadap Kejadian Stunting Pada Baduta Di Puskesmas Kertek, Kabupaten Wonosobo," HIGEIA (Journal of Public Health Research and Development), vol. 6, no. 1, 2022.

[13] "Prevalensi Balita Stunting Sulawesi Selatan Capai 27,2% Pada 2022, Berikut Sebaran Wilayahnya," Databoks, 2023. [Online]. Available: https://databoks.katadata.co.id/datapublish/2023/02/13/prevalensi-balita-stunting-sulawesi-selatan-capai-272-pada-2022-berikut-sebaran-wilayahnya

[14] K. D. P. Dewi, K. Hanum, N. H. Lubis, Y. Fazrah, and S. Saleh, "Pengaruh Pernikahan Dini Terhadap Tingkat Pertumbuhan Stunting Di Kelurahan Terjun Kecamatan Medan Marelan," Reslaj: Religion Education Social Laa Roiba Journal, vol. 6, no. 1, 2024.

[15] M. Duana, S. M. F. Siregar, S. Anwar, J. Musnadi, and A. Husna, "Dampak Pernikahan Dini Pada Generasi Z Dalam Pencegahan Stunting," COMSEP: Jurnal Pengabdian Kepada Masyarakat, vol. 3, no. 2, 2022.

[16] I. Hidayah, A. Suryahadi, F. Palmisano, and J. C. Kiefte-de Jong, "The role of parental child marriage in children's food security and nutritional status: a prospective cohort study in Indonesia," Frontiers in Public Health, vol. 12, Art. no. 1469483, 2024, doi: 10.3389/fpubh.2024.1469483.

[17] R. Rosyida, V. Widyaningsih, and I. Nurwati, “Early Marriage and Maternal History with Stunted Children Aged 24-59 Months in Mataram City,” Al-Sihah: The Public Health Science Journal, vol. 15, no. 2, pp. 165–174, 2023, doi: 10.24252/al-sihah.v15i2.41664.

[18] K. R. Liyadi, H. Pratiwi, P. Aditya, and M. I. Sa’ad, “Penerapan Metode Single Moving Average Dalam Peramalan Persediaan Bahan Pangan,” BRAHMANA: Jurnal Penerapan Kecerdasan Buatan, vol. 4, no. 1, 2022.

[19] A. Maulud and G. Putra, “Peramalan Kebutuhan Batubara Menggunakan Metode Single Exponential Smoothing Di PT. Solusi Bangun Andalas,” Jurnal Optimalisasi, vol. 6, no. 2, 2020.