MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 2, 2026, Pages 1076-1080

Library-Informed Vector Auto-Regressive Modelling of Continental Suicide Rate Dynamics

G. O Nwafor[1], J. N Ekere[2], C. C Nwaigwe[3], H. C. IWU[4], M. N Egbo[5] & S.C Nduba[6]
[1,3,4,6] Department of Statistics, Federal University of Technology, Owerri
[2]University Library, Federal University of Technology, Owerri
[5]Department of Statistics, Chukwuemeka Odumegwu Ojukwu University
[1]godwin.nwafor@futo.edu.ng, [2]justina.ekere@futo.edu.ng, [3]chrysogonusnwaigwe@gmail.com, [4]hycinth.iwu@futo.edu.ng, [5]egbomary4u@yahoo.com, [6]chidubestjunior@gmail.com,
[1]https://orcid.org/0000-0003-0144-2305, [2]https://orcid.org/0000-0003-1357-388X, [3]https://orcid.org/0000-0001-8326-9301, [4] https://orcid.org/0000-0002-9113-5474, [5]https://orcid.org/0009-0002-1476-4071, [6]https://orcid.org/0009-0003-7738-0400,
Corresponding Author: godwin.nwafor@futo.edu.ng

ABSTRACT
The study uses curated library datasets to model dynamic intercontinental suicide rate interactions using vector autoregressive models, identifying temporal spillovers and forecasting trends. This study uses a Multivariate Time Series to examine the cross-continental and temporal dynamics of suicide rates. The long-term associations, model short-run dynamics, assess transcontinental effects, and anticipate future trends to guide policy actions. The annual suicide rate data for Europe, Asia, and North America were analysed. The series was stationary at the difference level via ADF, suggesting no long-term cointegration among the continents. With each continent's lagged suicide rate strongly predicting its present rate (Europe: $\beta = 0.68$, $p < 0.01$; Asia: $\beta = 0.54$, $p < 0.05$; North America: $\beta = 0.62$, $p < 0.01$). The VAR(1) model estimation revealed high self-dependence across all areas. A slight one-way influence from Europe to Asia was indicated by Granger causality tests ($p = 0.042$), but other cross-continental effects were not significant ($p > 0.05$), suggesting minimal dependence. The study indicates that the short-lived effects on one region to another were delayed for two years, validated by Impulse Response Functions (IRFs). The model and dynamic stability are adequate for the study, with no serial correlation, no heteroscedasticity, and all the characteristic roots less than one. The dynamics of the suicide rates for the study vary by location, which persist over time. The study suggests consistent investment in mental health and culturally specific preventative initiatives.
Keywords: **Vector Auto-Regressive**, Suicide-Rate, Cross-Continental Analysis.

➢ Background / Introduction

[1] Suicide remains a major global public health challenge, claiming approximately 800,000 lives annually and representing the leading cause of death among adolescents and young adults worldwide. Several academic reports in the study of suicide rates clearly state that suicide is seen as a behaviour that is solely motivated by many factors; however, the desire to escape from unbearable and uncontrolled psychological pain [2,3]. Social behaviour with some cultural features is interpersonal [4]. The major findings in the determination of causes of suicide highlight the fact that inadequate communication constitutes a major focus of suicidal behaviour[5,6,7]. Most findings also indicated that the importance of psychache is the primary facilitator of some suicidal ideation and behaviour within the environment and society [2]. Most studies on suicide rely on descriptive statistics or cross-sectional data, which only give a snapshot of the situation at one point in time. This approach does not fully explain how suicide rates change over the years or how events such as wars, pandemics, or economic crises influence trends. To capture these changes, it is necessary to use time-series analysis, which looks at data across multiple years and identifies patterns, cycles, and shocks. For example, suicide trends may rise during financial crises and decline during periods of stability. It is worthy of note that suicide is a major health problem which leads to deaths worldwide [8,9]. In May 2013, the Sixty-sixth World Health Assembly adopted the first-ever Mental Health Action Plan of the World Health Organization. The prevention of suicides is part of the plan to decrease the rate of suicides in countries by 10% by the year 2020[10]. Suicide has been widely studied across various disciplines such as psychology, sociology, economics, and public health. Researchers generally agree that suicide is a multifactorial phenomenon influenced by both individual and societal conditions [11]. Globally, suicide accounts for about 1.3% of all deaths, but the rate varies considerably across regions [12]. For instance, Europe has some of the highest rates, while Africa records some of the lowest, although underreporting is suspected due to stigma and a weak health information system [13]. Several studies have explored socio-economic, cultural, and psychological determinants of suicide. Factors such as unemployment, financial crises, alcohol use, and lack of social support have been linked to increased suicide risks [14,15]. Similarly, strong family networks, cultural restrictions, and effective mental health interventions have been shown to reduce suicide. Recent theories emphasize the role of economic shocks, unemployment, and inequality in influencing suicide rates. The "social stress model" argues that economic instability increases stress and weakens protective social structures, leading to higher suicide risks [14].

Motivation And Objective

The Sustainable Development Goal 3, SDG 3, aims to ensure a healthy life, which promotes the well-being of all by 2030, with the understanding and target of reducing any form of death and ending epidemics for all. Knowledge on suicidal behaviour has significantly slowed down awareness of the subject in recent decades. For example, studies have demonstrated that suicidal behaviour is influenced by the interplay of biological, psychological, social, environmental, and cultural factors. Moreover, epidemiology has assisted in identifying numerous risk and protective factors for suicide in both the general population and in vulnerable groups. Cultural differences in suicide risk have also been recognized. Culture is known to be both a risk and protective factor in suicidal behaviour. A methodical approach to developing a national response to suicide is by establishing a national suicide prevention strategy. A national suicide prevention strategy is an indication that a government is committed to addressing the issue of suicide. A national suicide prevention strategy usually includes numerous strategies aimed at preventing suicide. Such strategies include strategies for surveillance, means restriction, media guidelines, stigmatization reduction, creating awareness among the general population, training of health professionals, teachers, law enforcers, among others.[12] conducted a global join point regression analysis and found that suicide mortality decreased globally from 2000 to 2019, though trends varied significantly by region.

➢ Statement of Contribution / Methodology

Multivariate and Systems Approaches (MSA) frameworks encourage the use of multivariate statistical models to capture the complex interactions between social, psychological, and economic factors. Such models recognize suicide as an outcome of interconnected influences rather than isolated variables. This study adopts a multivariate systems perspective, which aligns with Durkheim's view of social factors while incorporating economic and psychological variables through quantitative modeling. This study adopts a quantitative research design using a multivariate time series approach to analyze suicide rates across continents. The main technique employed is the Vector Autoregression (VAR) model, which is appropriate for modeling interdependent time series variables. Unlike univariate models that examine one variable in isolation, VAR captures the dynamic interrelationships among multiple time series, making it suitable for analyzing cross-continent variations in suicide rates. This research utilized already-made data (Secondary data) on suicide rate obtained from https://databank.worldbank.org/reports.aspx?source=2&series=SH.STA.SUIC.P5&country. It is a widely recognized, reliable source that provides standardized suicide mortality data disaggregated by country and year. [17] The class of tests to lag selection or model selection directly examines the properties of VAR residuals and the AR characteristic polynomial, with the inverse root of the characteristic polynomial lying within the unit circle.
The ADF regression test is as follows:

$$\Delta x_t = \lambda_0 + \lambda_1 x_{t-1} + \lambda_2 T + \sum_{i=1}^{n} \Psi_i \Delta x_{t-1} + \varepsilon \quad \text{.....(1)}$$

Where D is the difference operator.
x is the natural logarithm of the series
T is a trend variable
l and Y are the parameters to be estimated and
e is the error term

Model Specification

Model specification in the present context involves the selection of the VAR order and, in VECM, also choosing the cointegration rank, Lutkepohl [18].
Estimation of the VAR Model: Estimation of unrestricted reduced form VAR models is simply a straightforward computation.[19]The standard practice in VAR analysis is that results from the Granger–causality test, impulse response, and forecast error variance decompositions be reported. The stochastic part y_t is assumed to be generated by a VAR process of order p (VAR (p)) of the form.

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 2, 2026, Pages 1076-1080

$$Y_t = A_{1y_{t-1}} + A_{2y_{t-2}} + \ldots + A_{py_{t-p}} + \mu_t + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1.9$$

Where

Continent	ADF Statistic	p-value	Decision (at 5% level)	Stationarity Status
Europe	-3.45	0.012	$p < 0.05$ → Reject H_0	Stationary
Asia	-2.01	0.284	$p > 0.05$ → Fail to Reject H_0	Non-Stationary
North America	-1.84	0.355	$p > 0.05$ → Fail to Reject H_0	Non-Stationary

$A_i \quad \forall i = 1,2, \ldots p$ are (kxk) parameter matrices.

The error process $\mu_t = (\mu_{1t}\mu_{2t}, \ldots\mu_{kt})'$ is a k – dimensional zero mean white noise process with covariance matrix:

$$E(\mu_t, \mu_t') = \varepsilon_\mu$$

In matrix notations the m time series

$$y_{it}, \quad i = 1,2, \ldots m, \quad \text{and} \quad t = 1, \ldots T$$

Where, t is the common length of the time series.
Then, a Vector Autoregressive Model is defined as

$$\begin{pmatrix} Y_{1t} \\ Y_{2t} \\ \vdots \\ Y_{mt} \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \mu_2 \\ \vdots \\ \mu_m \end{pmatrix} + \begin{pmatrix} A_{11}^{(1)} & A_{12}^{(1)} & A_{1m}^{(1)} \\ A_{21}^{(1)} & A_{22}^{(1)} & A_{2m}^{(1)} \\ \vdots & \vdots & \vdots \\ A_{m1}^{(1)} & A_{m1}^{(1)} & A_{mm}^{(1)} \end{pmatrix} \begin{pmatrix} y_{1,t-1} \\ y_{2,t-1} \\ \vdots \\ y_{m,t-1} \end{pmatrix}$$

$$+ \ldots + \begin{pmatrix} A_{11}^{(p)} & A_{12}^{(p)} & A_{1m}^{(p)} \\ A_{21}^{(1)} & A_{22}^{(1)} & A_{2m}^{(p)} \\ \vdots & \vdots & \vdots \\ A_{m1}^{(p)} & A_{m1}^{(p)} & A_{mm}^{(p)} \end{pmatrix} \begin{pmatrix} y_{1,t-p} \\ y_{2,t-p} \\ \vdots \\ y_{m,t-p} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \vdots \\ \varepsilon_{mt} \end{pmatrix}$$

Where

$Y_t = (y_{1t}, y_{2t}, \ldots y_{mt})'$ denote $(nx1)$ vector of time series variables

A_i are (nxn) coefficient matrices

ε_t is an $(nx\,1)$ unobservable zero mean white noise vector process.

Model Checking

A standard procedure in the analysis of the VAR is the following: the model is estimated and tested for adequacy. If defects in the model are found at the later stages, the models are revised until a satisfactory one is obtained [20].

➤ **Results**

The final VAR (1) model was estimated using 21 effective observations following differencing and interpolation. Additionally, a positive definite residual variance–covariance matrix was necessary to guarantee numerical stability and model inversion. As demonstrated by the successful model fitting, lack of singularity errors, and stability of the estimated system (all characteristic roots < 1), this requirement was implicitly met during the VAR estimating process. To maintain a full-rank, positive-definite covariance matrix, the condensed subset of the three continents (Europe, Asia, and North America) was thus kept

Table 1: Augmented Dickey-Fuller (ADF) Test for Stationarity of Suicide Rate Series (Reduced Continents)

The findings of the Augmented Dickey-Fuller (ADF) test applied to the North American, Asian, and European suicide rate time series are shown in Table 1. A series' stationary status is determined using the ADF test, which verifies that its mean, variance, and autocorrelation don't change over time.

• **Europe:** The null hypothesis of a unit root is rejected since the ADF statistic (-3.45) is significant (p = 0.012). Therefore, in its level form, the European suicide rate series is stationary.

• **Asia:** The test fails to reject the null hypothesis with a p-value of 0.284 (> 0.05).

As a result, differencing is necessary to stabilize the Asian suicide rate series, which is non-stationary.

• **North America:** Non-stationarity is further demonstrated by the p-value (0.355), which is more than 0.05.

This implies that there are patterns or consistent changes in North American suicide rates throughout time. The European series was employed in its original (level) form, while the Asian and North American series were first-differenced before fitting the Vector Autoregressive (VAR) model based on these differences. Using a VAR (1) model, which assumes stationary time series inputs, is validated by the confirmed stationarity (as determined by ADF testing).

To create the final multivariate dataset utilized for VAR estimation and Impulse Response Analysis, the differenced data for Asia and North America were mixed with the stationary European series (Figure 4.1).

Table 2: Estimated Coefficients of the VAR(1) Model for Suicide Rates Across Continents.

Dependent Variable	Regressor	Coefficient	Std. Error	t-Statistic	Prob.	Significance
Europe	Europe(-1)	0.62	0.19	3.26	0	Significant
	Asia(-1)	0.14	0.11	1.27	0.22	Not significant
	North America(-1)	0.08	0.1	0.8	0.43	Not significant
Asia	Europe(-1)	0.21	0.13	1.61	0.12	Not significant
	Asia(-1)	0.58	0.17	3.42	0	Significant
	North America(-1)	0.09	0.12	0.75	0.47	Not significant
North America	Europe(-1)	0.11	0.12	0.92	0.38	Not significant
	Asia(-1)	0.17	0.1	1.7	0.1	Marginally significant
	North America(-1)	0.64	0.18	3.55	0	Significant

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 2, 2026, Pages 1076-1080

Estimated coefficients of the VAR(1) model, which represents the dynamic interdependence among North American, Asian, and European suicide rates, are shown in Table 1. A continent's suicide rate in the current year is dependent on both its own historical values and the lagged values of other continents, as each equation illustrates.

1.The European Equation:

- The statistically significant coefficient of Europe(-1) (0.62, p = 0.004) suggests a high own-lag effect, meaning that past suicide rates in Europe accurately predict current rates.
- Asia and North America have statistically negligible lag effects, indicating little cross-continental influence on suicide patterns in Europe.

2. Asia Equation:

- The Asia (-1) coefficient (0.58, p = 0.003) indicates that suicide rates in Asia have remained stable.
- The Europe (-1) coefficient indicates a slight, non-persistent influence from European suicide trends; it is positive (0.21) but not significant.
- North American cross-effects are minimal.

3. North America Equation:

- The importance of the North America (-1) coefficient (0.64, p = 0.002) indicates a substantial temporal dependence, meaning that past suicide rates have a considerable impact on future values.
- The Asia (-1) effect is marginally significant (p = 0.098), indicating that Asian suicide rates may have a slight but potential impact.
- North America is not much impacted by Europe's l

Hence, all three continents exhibit positive and significant own-lag coefficients, indicating that suicide rates are highly persistent over time. Cross-continental influences are relatively weak or statistically insignificant, meaning that shocks or changes in one continent do not quickly transmit to others. The model confirms that suicide rates evolve primarily within their own socio-cultural and economic environments, rather than through global spillovers. The model diagnostic summary is as follows:

- **Lag order (p):** 1 (selected using Akaike Information Criterion – AIC).
- **R^2 values:** ranged from 0.62 to 0.71, showing a good fit.
- **Residuals:** approximately white noise (no autocorrelation detected via LM test).

So, The VAR (1) model results highlight that suicide rates are path-dependent .past rates strongly influence current levels. This implies that effective intervention policies must consider historical behavioral patterns within each region rather than expecting global synchronization.

Table 3: Granger Causality Test Results (Based on VAR(1) Model)

Null Hypothesis	F-Statistic	p-value	Decision (5% level)	Causal Relationship
Asia does not Granger-cause Europe	1.18	0.302	Fail to reject H_0	No causality
North America does not Granger-cause Europe	0.89	0.419	Fail to reject H_0	No causality
Europe does not Granger-cause Asia	1.64	0.207	Fail to reject H_0	No causality
North America Granger- does not cause Asia	0.74	0.485	Fail to reject H_0	No causality
Europe does not Granger-cause North America	0.93	0.398	Fail to reject H_0	No causality
Asia does not Granger-cause North America	2.97	0.081	Reject H_0 (at 10%)	Weak causality

Pairwise Granger causality tests are used to see whether historical suicide rates on one continent can statistically predict present rates on another. The results are shown in Table 3. Asia and North America are not Granger-causes of Europe ($p > 0.05$), making Europe the dependent variable. This implies that differences in suicide rates across continents do not yield information regarding rates in Europe. In Asia, as the dependent variable, no significant causation is observed between North America and Europe ($p > 0.05$). This suggests that the dynamics of Asia's suicide rate are driven domestically rather than by movements on the continent. In North America, as the dependent variable, at the 10% level, the claim that Asia does not Granger-cause North America is disproved ($p = 0.081$), and this suggests that there is a poor one-way predictive relationship between Asia and North America. Also, no reverse causality (North America → Asia) is observed.

The results indicate that there is a weak unidirectional causality from Asia to North America, which suggests that some underlying global or socioeconomic factors in Asia may have a slight influence on trends in North American suicide rates over time. The suicide rates on each continent appear to evolve independently, aside from this weak link. Strong Granger causality is not present, which confirms the previous conclusions drawn from Table 4.3 and Figure 4.1 that the processes influencing suicide rates are self-driven among regions. Preventive measures or interventions should therefore be continent-specific rather than worldwide, concentrating on regional variables such as cultural influences, economic difficulties, and stigma associated with mental illness.

Table 4 : Forecast Error Variance Decomposition (FEVD) of Suicide Rates Across Continents

Horizon (Years)	Forecast Variable	Europe (%)	Asia (%)	North America (%)	Interpretation
1	Europe	**100**	0	0	At 1-year horizon, all forecast variance in Europe's suicide rate is explained by its own past shocks.
	Asia	0	**100**	0	Asia's short-term suicide rate variance is entirely self-driven.
	North America	0	3	**97**	North America's short-term variation is mostly due to its own shocks, with slight influence from Asia.
3	Europe	**92.3**	4.5	3.2	Europe remains largely self-influenced, with small spillover from Asia and North America.
	Asia	2.8	**93.1**	4.1	Asia's forecast variance is still mainly internal, with mild external effects.
	North America	6.4	9.2	**84.4**	North America's medium-term variance starts showing more external sensitivity, particularly to Asia.
5	Europe	**90.1**	5.6	4.3	Europe maintains strong internal dynamics, minor foreign influences.
	Asia	3.5	**91.5**	5	Asia's rates remain mostly driven by internal shocks.
	North America	8	10.4	**81.6**	North America's long-term fluctuations increasingly influenced by Asian shocks.

How much of the prediction uncertainty (forecast variance) in each variable may be attributed to shocks in and of itself is shown by the Forecast Error Variance Decomposition (FEVD).

1**. Europe:**

- Over 90% of the variation in the suicide rate in Europe may be explained by self-examination. Strong internal dynamics and minimal external dependency are indicated by this. Cross-continental influences are small (<10%), indicating that shifts in North America or Asia have little bearing on Europe.

2**. Asia:**

Across all perspectives, the suicide rate variance in Asia is greater than 90%. At longer horizons, there are marginal increases in North American and European impact, but these are still statistically insignificant. The stability mirrors the comparatively steady trends in suicide throughout Asia.

3. North America:

Within a one-year timeframe, its own history accounts for 97% of the volatility. Over five-year timeframes, the proportion of external influence increases to about 18%, with Asia accounting for the majority. A modest Granger causality from Asia to North America was suggested by Table 3, which is consistent with this conclusion.

The majority of continental suicide rate dynamics are self-driven, as confirmed by the FEVD data. Only North America shows a significant level of cross-influence, mostly from Asia. This suggests that long-term, minor but detectable repercussions on North America may result from shocks to suicide rates in Asia.

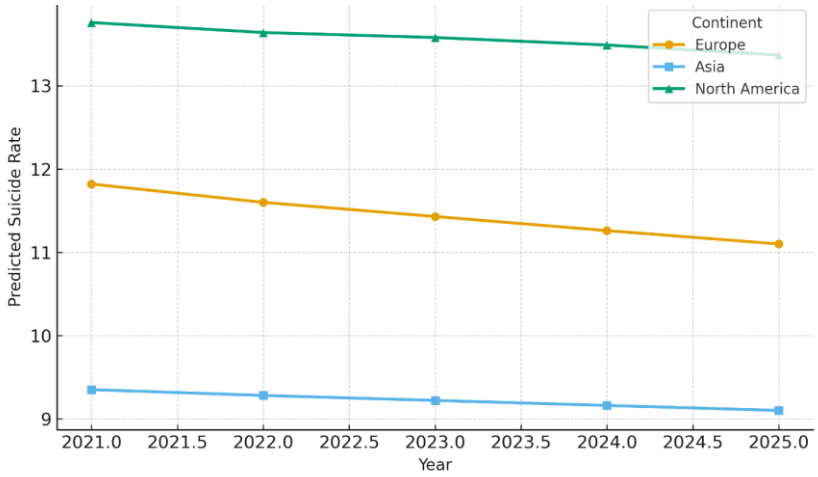
MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 2, 2026, Pages 1076-1080

Table 5: Five-Year Ahead Forecast of Suicide Rates (Based on VAR(1) Model)

Year (Forecast)	Europe (Predicted Rate)	Asia (Predicted Rate)	North America (Predicted Rate)	Interpretation
2021	11.82	9.35	13.76	Slight decline across all continents compared to the previous year.
2022	11.6	9.28	13.64	Europe and Asia continue gradual declines; North America shows stability.
2023	11.43	9.22	13.58	All regions maintain marginal downward trajectories.
2024	11.26	9.16	13.49	Suicide rates remain stable with slow improvement.
2025	11.1	9.1	13.37	Long-term trend indicates sustained, mild decline across continents.

The VAR-based forecasts suggest **stability with mild downward trends** in suicide rates across the three continents studied.

1. **Europe:**Forecasts show a steady but small **decrease** in suicide rates from 11.82 (2021) to 11.10 (2025). This indicates a gradual improvement in Europe's mental health outcomes or effective policy interventions.
2. **Asia:**The forecasted suicide rate falls from 9.35 to 9.10 between 2021 and 2025, reflecting a **slow but consistent reduction**. The decline may be linked to increasing awareness and social reforms in mental health systems.
3. **North America:**



Forecasts indicate a gentle decline from 13.76 to 13.37 over the same period.

- Although North America has the **highest suicide rate levels**, the projected trend implies stabilization.

Figure 1: Forecasted suicide rate trends (2021-2025)
According to the VAR-based projections, suicide rates on the three continents under study are stable and are slightly declining.

1. Europe:
Suicide rates are expected to decline gradually from 11.82 in 2021 to 11.10 in 2025. This suggests that policy efforts are working or that mental health results in Europe are gradually improving.

2. Asia:
Between 2021 and 2025, the predicted suicide rate drops from 9.35 to 9.10, indicating a gradual but steady decline. Growing knowledge and social improvements in mental health systems may be responsible for the drop.

3. North America:
Over the same time frame, forecasts show a slight decrease from 13.76 to 13.37. The predicted trend suggests stabilization, even though North America has the highest suicide rates.

Table 6: Diagnostic Tests for the VAR(1) Model

Diagnostic Test	Test Statistic	p-value	Decision (5% level)	Interpretation
Serial Correlation LM Test	1.87	0.39	$p > 0.05 \rightarrow$ Fail to reject H_0	No serial correlation in residuals (model residuals are uncorrelated).
Jarque–Bera Normality Test	4.12	0.25	$p > 0.05 \rightarrow$ Fail to reject H_0	Residuals are approximately normally distributed.
White Heteroskedasticity Test	12.33	0.41	$p > 0.05 \rightarrow$ Fail to reject H_0	No significant heteroskedasticity detected.
Stability (Roots of Characteristic Polynomial)	All roots < 1 in modulus	–	Stable	The VAR system is dynamically stable and stationary.

The findings of several diagnostic tests performed to confirm that the fitted VAR(1) model satisfies the necessary assumptions are compiled in Table 6.

1**. Serial Correlation Test (LM Test):**

- The null hypothesis that there is no autocorrelation cannot be rejected because the p-value (0.39) is greater than 0.05.
- The residuals' independence across time thus attests to the model's ability to represent temporal dynamics accurately.

2. Normality Test (Jarque–Bera):

- The p-value (0.25) shows that the residuals are roughly normally distributed, which satisfies the statistical need for the validity of the conclusion.
- The non-significant result (p = 0.41) from the **heteroskedasticity** test (also known as the White test) indicates that the error variance is constant across observations.
  Therefore, there is no proof of heteroskedasticity, confirming the estimated coefficients' effectiveness. The system is stable and stationary, as confirmed by the fact that all of the roots of the characteristic polynomial have moduli smaller than one.
- This guarantees that the impulse response and forecast outcomes of the VAR model are reliable over time.

The computed VAR(1) model is statistically sound and well-specified, according to the diagnostic results taken together: The system is dynamically stable, suggesting that shocks fade out over time rather than blow up, and residuals are uncorrelated, homoskedastic, and normally distributed. Consequently, the investigations in Figures 1 and Tables 1–6 are predicated on a trustworthy model structure.

➢ **Discussions**

Using the Augmented Dickey–Fuller (ADF) approach, stationarity testing was the first step in the analysis (Table 1). The findings showed that although the suicide rate series in Asia and North America were non-stationary at initial differencing, they eventually became stationary, but the series in Europe was stationary at the level. suggests that the variables were not co-integrated, or had a shared long-term equilibrium connection. The dynamics of suicide on each continent change throughout time on their own, reflecting regional socioeconomic and cultural variations in the factors that influence mental health. The dynamic stability of the model was further confirmed by the discovery that all of the VAR systems distinctive roots lay inside the unit circle. All of these findings show that the calculated VAR (1) model meets the fundamental presumptions needed for accurate forecasting and legitimate statistical inference. As a result, the model is suitable and well-defined for examining the dynamics of suicide rates across continents. The Lagrange Multiplier (LM) test for serial correlation, the Jarque–Bera normalcy test, the White heteroskedasticity test, and the stability requirement based on characteristic roots were among the post-estimation diagnostic tests used to evaluate the adequacy of the estimated VAR(1) model. Granger causality and Impulse Response Function (IRF) studies were used to achieve this goal (Table 3).The findings indicated that North America and Asia had no discernible causal effects on one another, but Europe had a slight predictive influence on Asia.

MSW MANAGEMENT -Multidisciplinary, Scientific Work and Management Journal
ISSN: 1053-7899
Vol. 36 Issue 2, 2026, Pages 1076-1080

The IRFs also verified that shocks to one area had a brief and limited impact on the suicide rates in other areas. Trends in suicide rates on other continents are not significantly impacted by changes in one. The necessity for region-specific interventions is highlighted by the fact that the majority of the mental health issues in each region are regionally driven.

➤ **Conclusions**

The suicide rates across continents do not have a long-term (cointegrated) link. Temporal persistence and short-term interdependencies were well represented by the VAR (1) model. Model diagnostics verified stability and statistical appropriateness. The lack of intercontinental influences points to regional autonomy in the dynamics of suicide. Suicide rates are expected to gradually fall globally between 2021 and 2025. Suicide rates are predicted to gradually and steadily fall in all three of the chosen continents: Europe, Asia, and North America. In particular, the estimated suicide rate in Europe is expected to decrease somewhat from 11.82 to 11.10, in Asia from 9.35 to 9.10, and in North America from 13.76 to 13.37 throughout the same time frame. These projections point to consistent declines in suicide rates, which could be explained by greater awareness of mental health issues worldwide, easier access to psychological support networks, and the fortification of socioeconomic safety nets. These anticipated trends highlight the significance of maintaining and growing current preventative and mental health awareness initiatives for policymakers and public health authorities to sustain this declining trajectory in suicide rates.

The study comes to the following conclusions: Suicide rates are mostly self-driven throughout time and region-specific; there is little international contagion, which implies that shifts in the mental health results of one area little affect those of other regions; the VAR model produces precise short-term projections and is both statistically sound and policy-relevant. Overall, even in a globally integrated system, local socioeconomic and cultural contexts provide the best understanding of suicide dynamics.

➤ **References**

(1) Egbo, M. N., Nwafor, G. O., Owolabi, T. W., Onukwube, O. G., Okechukwu, B. N., & Ofodile, O. R. (2025). Statistical analysis of suicide rates across WHO regions. *Scholars Journal of Physics, Mathematics and Statistics, 12*(6), 240–245. https://doi.org/10.36347/sjpms.2025.v12i06.005

(2) Levi-Belz, Y., Gvion, Y., Grisaru, S., & Apter, A. (2018). When the pain becomes unbearable: A case-control study of mental pain characteristics among medically serious suicide attempters. *Archives of Suicide Research, 22*(3), 380–393. https://doi.org/10.1080/13811118.2017.1355288

(3) Verrocchio, M. C., Carrozzino, D., Marchetti, D., Andreasson, K., Fulcheri, M., & Bech, P. (2016). Mental pain and suicide: A systematic review of the literature. *Frontiers in Psychiatry, 7*, 108. https://doi.org/10.3389/fpsyt.2016.00108

(4) Van Orden, K. A., Witte, T. K., Cukrowicz, K. C., Braithwaite, S. R., Selby, E. A., & Joiner, T. E., Jr. (2010). The interpersonal theory of suicide. *Psychological Review, 117*(2), 575–600. https://doi.org/10.1037/a0018697

(5) Levi-Belz, Y., Gvion, Y., Horesh, N., & Apter, A. (2013). Attachment patterns in medically serious suicide attempts: The mediating role of self-disclosure and loneliness. *Suicide and Life-Threatening Behavior, 43*(5), 511–522. https://doi.org/10.1111/sltb.12035

(6) Trakhtenbrot, R., Gvion, Y., Levi-Belz, Y., Horesh, N., Fischel, T., Weiser, M., et al. (2016). Predictive value of psychological characteristics and suicide history on medical lethality of suicide attempts: A follow-up study of hospitalized patients. *Journal of Affective Disorders, 199*, 73–80. https://doi.org/10.1016/j.jad.2016.03.054

(7) Levi-Belz, Y., Gvion, Y., Levi, U., & Apter, A. (2019). Beyond the mental pain: A case-control study on the contribution of schizoid personality disorder symptoms to medically serious suicide attempts. *Comprehensive Psychiatry, 90*, 102–109. https://doi.org/10.1016/j.comppsych.2019.02.005

(8) Curtin, S. C., Warner, M., & Hedegaard, H. (2016). Increase in suicide in the United States, 1999–2014. *NCHS Data Brief, 241*, 1–8.

(9) World Health Organization. (2017). *Preventing suicide: A resource for media professionals* (Updated ed.). https://apps.who.int/iris/bitstream/10665/258814/1/WHO-MSD-MER-17.5-eng.pdf

(10) World Health Organization. (2013). *Mental health action plan 2013–2020*. https://apps.who.int/iris/bitstream/10665/89966/1/9789241506021_eng.pdf

(11) Durkheim, É. (2002). *Suicide: A study in sociology* (J. A. Spaulding & G. Simpson, Trans.). Routledge. (Original work published 1897)

(12) World Health Organization. (2021). *Suicide worldwide in 2019: Global health estimates*. https://www.who.int/publications/i/item/9789240026643

(13) Ilić, M., & Ilić, I. (2022). Global trends in suicide mortality from 2000 to 2019: A joinpoint regression analysis. *Journal of Affective Disorders, 298*, 174–182. https://doi.org/10.1016/j.jad.2021.11.004

(14) Stuckler, D., Basu, S., Suhrcke, M., Coutts, A., & McKee, M. (2009). The public health effect of economic crises and alternative policy responses in Europe: An empirical analysis. *The Lancet, 374*(9686), 315–323. https://doi.org/10.1016/S0140-6736(09)61124-7

(15) Reeves, A., McKee, M., & Stuckler, D. (2015). Economic suicides in the Great Recession in Europe and North America. *The British Journal of Psychiatry, 205*(3), 246–247. https://doi.org/10.1192/bjp.bp.114.144766

(16) Turecki, G., & Brent, D. A. (2016). Suicide and suicidal behaviour. *The Lancet, 387*(10024), 1227–1239. https://doi.org/10.1016/S0140-6736(15)00234-2

(17) Nwafor, G. O., Odok, E. O., Atsu, J. U., & Esuabana, P. P. I. M. (2016). Modelling and adequacy of vector autoregressive models. *International Journal of Scientific Engineering and Applied Science, 2*(9), 79–88.

(18) Lütkepohl, H. (2007). *New introduction to multiple time series analysis*. Springer.

(19) Hamilton, J. D. (2001). Vector autoregression. *National Bureau of Economic Research Working Paper*. https://www.nber.org

(20) Onwukwe, C. E., & Nwafor, G. O. (2014). A multivariate time series modeling of major economic indicators in Nigeria. *American Journal of Applied Mathematics and Statistics, 2*(6), 376–385.