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Statistical Analysis of Suicidal Death in India During 2021

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Abstract:
A social and public health response in addition to mental health response is crucial to prevent suicide behavior in India. Yearly statistics show a concerning increasing pattern of suicidal deaths in India. The current report reviews the data from the series accidental death and suicide in India published by India's National Crime Records Bureau (NCRB) reporting official suicide rates based on police reports.

Keywords: Suicide, rate of Suicide/Percentage of share

Introduction:
A suicide is an act of killing oneself. The Government of India classifies a death as suicide if it meets the following three criteria:

- It is an unnatural death,
- The intent to die originated within the person,
- There is a reason for the person to end his or her life. There as on may have been specified in a suicide note or unspecified.

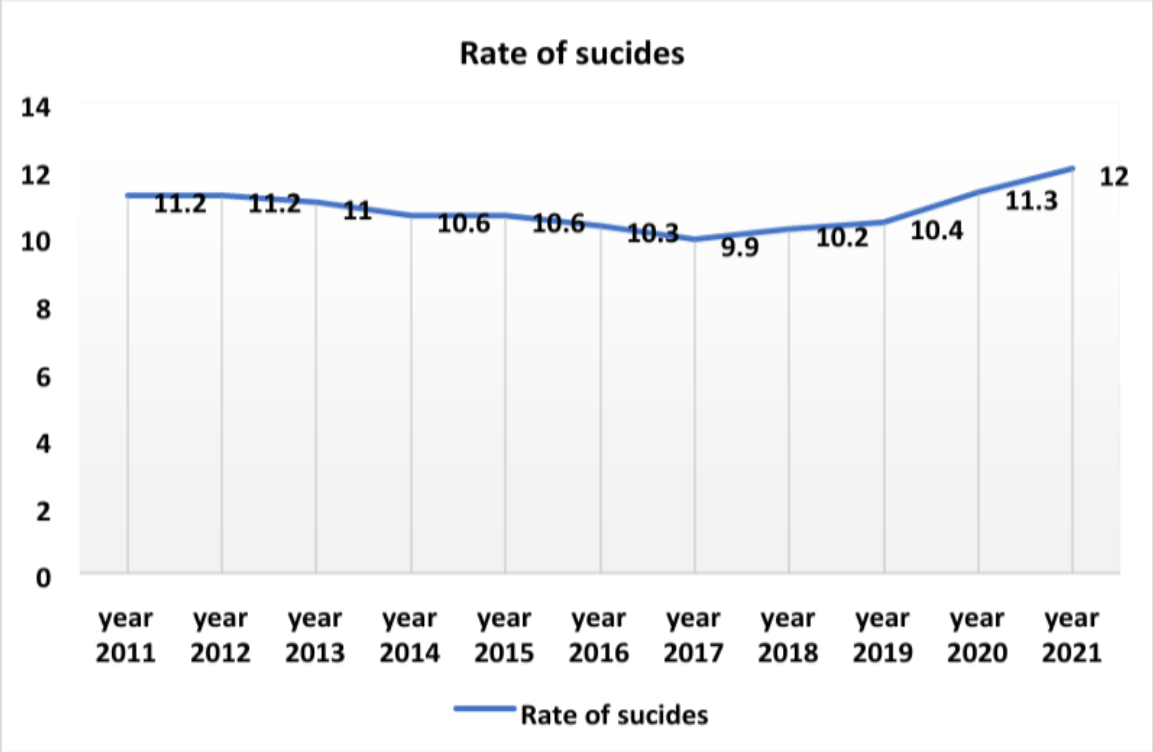
Each suicide is a personal tragedy that prematurely takes the life of an individual and has a continuing ripple effect, dramatically affecting the lives of families, friends and communities. 1,64,033 Indians committed suicide in 2021 according to the NCRB reports. The year 2021 recorded as the highest suicide rate (of 12 suicides per 1 lakh population) since the beginning of this century. But experts say a lot of suicides would have gone unreported and that the numbers and suicide rates could have gone up in 2022 as well. According to The World Health Organization, in India, suicide is an emerging and serious public health issue. The burden of deaths by suicide in 2021 has increased in India by 7.2 per cent from 2020. Majority of suicides were reported in Maharashtra (22,207) followed by 18,925 suicides in Tamil Nadu, 14,965 suicides in Madhya Pradesh,13,500 suicides in West Bengal and 13,056 suicides in Karnataka accounting for 13.5%, 11.5%, 9.1%, 8.2% and 8.0% of total suicides respectively. These 5 States together accounted for 50.4% of the total suicides reported in the country. The remaining 49.6% suicides were reported in the remaining 23 States and 8 UTs. Uttar Pradesh, the most populous State (16.9% share of country population) has reported comparatively lower percentage share of suicidal deaths, accounting for only 3.6% of the total Suicides reported in the country. There are many causes to attempt Suicide like family problems, failure in examination, Marriage related issue (Divorce), Professional /career problem, illness, Poverty, Property dispute, etc. To understand suicide patterns we need to understand the reason for suicides in India which are Family problems, Illness, Drug / alcoholic addiction, Marriage related issues, Love affairs, Bankruptcy, Poverty, etc.

Research Methodology:

- **Data collection:** The data used for project is secondary data. The current report reviews the data from the series accidental death and suicide in India published by India's National Crime Records Bureau (NCRB) reporting official suicide rates based on police reports. We collected the data from National Crime Record Bureau (NCRB), India, the nodal agency for collecting the data on suicide incidences across India. National Crime Record Bureau (NCRB) functions under the Ministry of Home Affairs, Government of India and it publishes time series data on accidental deaths and suicides on annual basis from the year 1969 onwards for this study, we have collected data on suicide for a period of 11 years (2011-2021) and for year 2021 from NCRB annual reports on Accidental Deaths and Suicides in India (ADSI), freely available at https://ncrb.gov.in/en/adsi-reports-of-previous-years

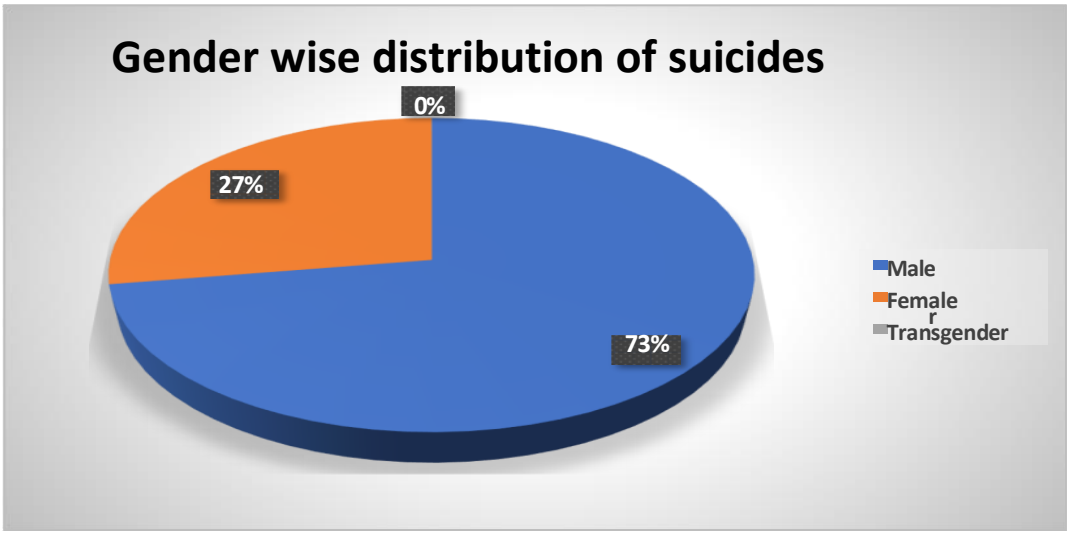
- **Statistical Analysis**: Statistical Analysis of the data was executed by using graphical methods like pie chart, column chart, bar diagram, Histogram in Microsoft Excel.

1. **Rate of suicides during 2011 to 2021 :**



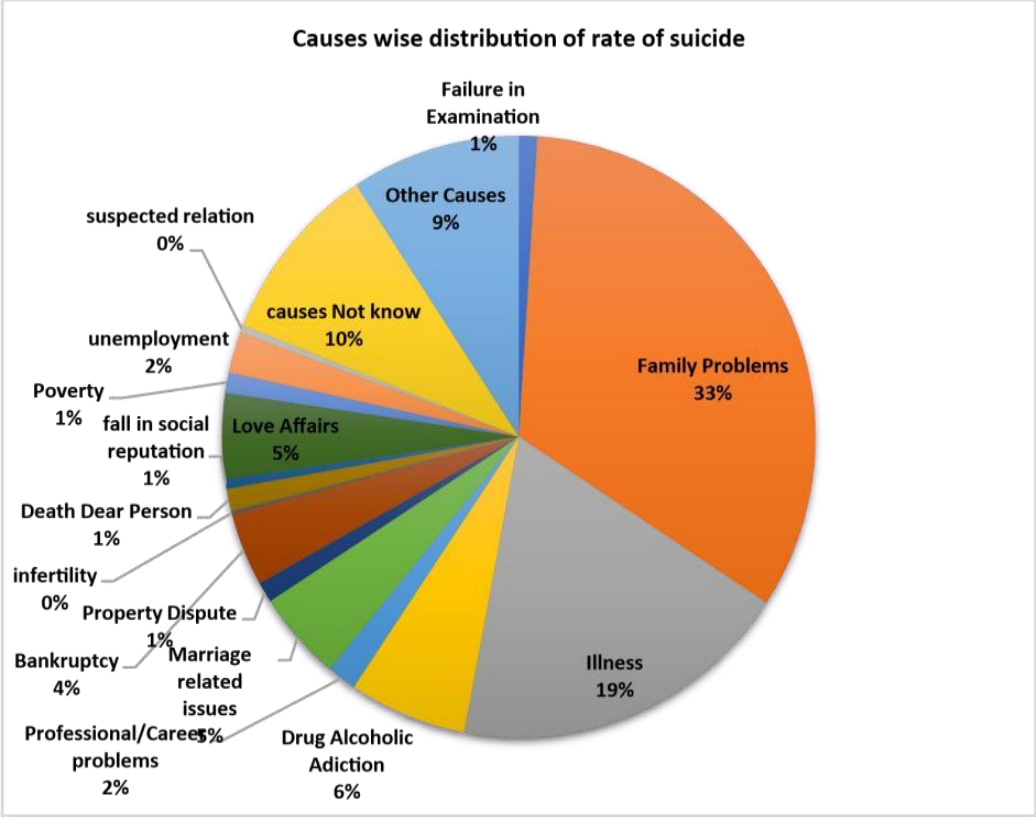
Finding from Analysis: According to analysis the year 2021 has the highest suicides rate of 12% in India since 2011.

2. **Gender wise distribution of suicides:**



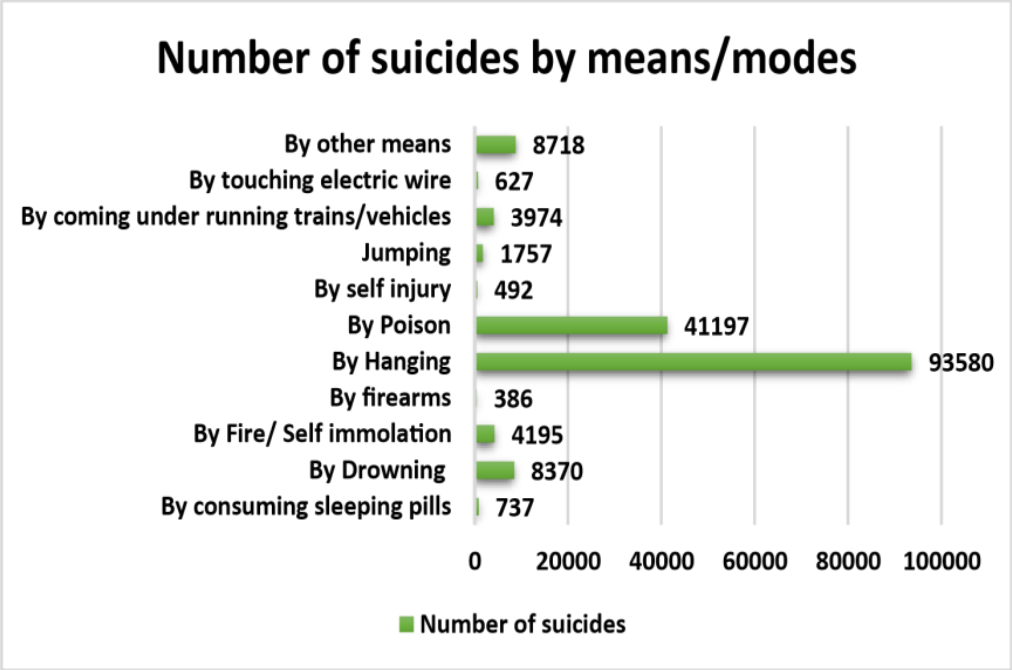
Finding: Out of total 73% Male committed suicides in India during2021.

3. **Causes wise distribution of suicides:**



Finding from Analysis: Family problems are the highest reason for suicides in India. Out of total 33.2% people committed suicides in 2021.

4. Distribution of suicides by means /modes



Finding from Analysis: Hanging (93580), consuming Poison (41197), Drowning (8370) are the prominent mean/mode of committing suicides.

Chi square test of independence: Analysis of chi square test was executed in the Microsoft Excel .The chi-square test of independence also known as the chi-square test of association which is used to determine the association between the categorical variables. It is considered as a non-parametric test. It is mostly used to test statistical independence.

Hypothesis: H_0 : In the population, the two categorical variables are independent.

Vs. H_1 : In the population, the two categorical variables are dependent.

Test Statistic: $\chi^2 = \frac{\Sigma(Oi - Ei)^2}{Ei}$

Where Oi is the observed value and Ei is the expected value.

Interpretation: For a Chi-square test, a p-value that is less than or equal to the specified significance level indicates sufficient evidence to conclude that the observed value is not the same as the expected value. Here, we can conclude that a relationship exists between the given categorical variables.

Chi-square Test:

Hypothesis

H_0: Attributes A and B are independent Vs H1: Attributes A and B are dependent

Sr. No.	Attributes	P- value	Decision	Conclusion
1	A:Economicalstatus B:Gender wise distribution of suicide	0.0000	0.0000 <0.05 Hence, we reject H0	Economical status and Gender wise distribution suicide are dependent
2	A: Marital status B:Gender wise distribution of suicide	0.0000	0.0000 <0.05 Hence, we reject H0	Marital status and gender wise distribution suicide are dependent
3	A: Educational status B: Gender wise distribution of suicide	0.0001	0.0001 <0.05 Hence, we reject H0	Educational status and gender wise distribution suicide are dependent
4	A:Professional status B: Gender wise distribution of suicide	0.0000	0.0000 <0.05 Hence, we reject H0	Professional status and Gender wise distribution of suicide are dependent

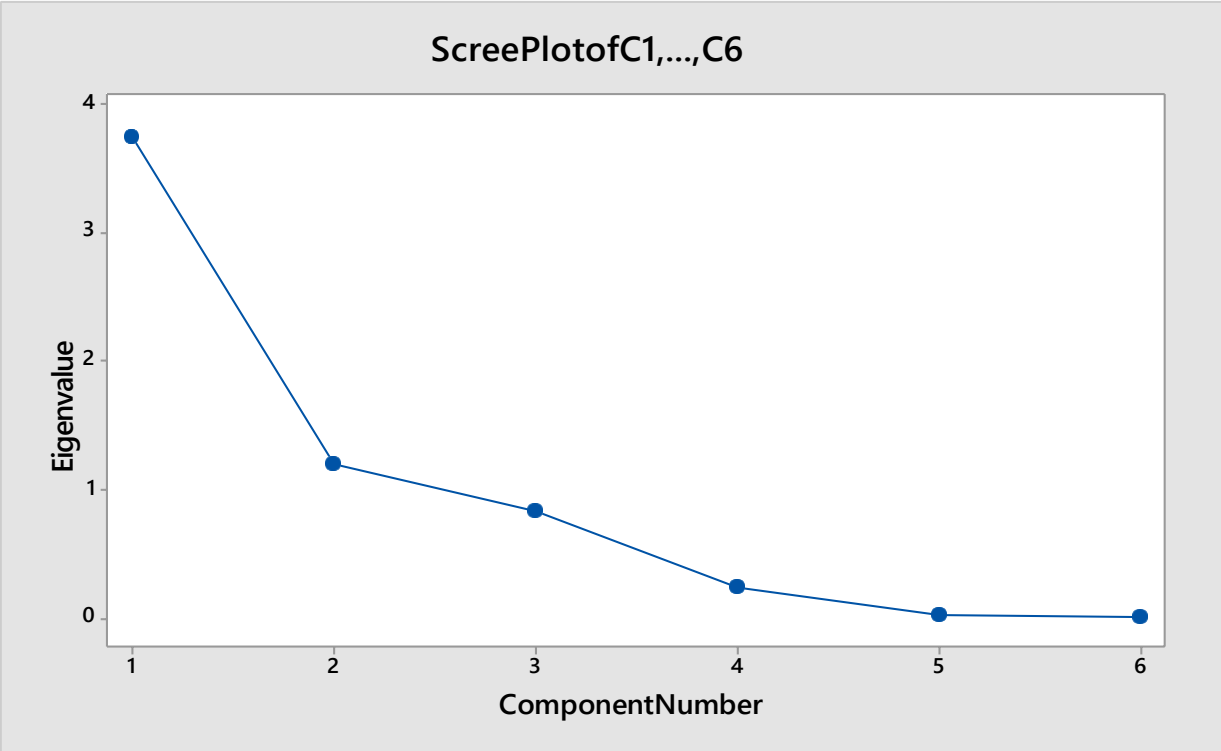
Principal component analysis: Statistical analysis of principal Component Analysis was executed by using R software version 4.0.1 and Minitab. Principal component analysis, or PCA, is a dimensionality reduction method that is often used to reduce the dimensionality of large data sets, by transforming a large set of variables into a smaller one that still contains most of the information in the large set. In multivariate statistics, a scree plot is a line plot of the eigen values of factors or principal components in an analysis. The scree plot is used to determine the number of factors to retain in exploratory principal components to keep in a principal component analysis (PCA). A scree plot always displays the eigen values in a downward curve, ordering the eigen values from largest to smallest. According to the scree test, the “elbow” of the graph where the eigen values seem to level off is found and factors or components to the left of this point should be retained as significant.

Principal Component Analysis: C1,C2, C3,C4,C5, C6

Eigen analysis of the Correlation Matrix

Eigenvalue	3.7360	1.1898	0.8215	0.2402	0.0125	0.0000
Proportion	0.623	0.198	0.137	0.040	0.002	0.000
Cumulative	0.623	0.821	0.958	0.998	1.000	1.000

Variable	PC1	PC2	PC3	PC4	PC5	PC6
C1	0.475	0.178	0.339	-0.275	-0.732	-0.128
C2	0.304	0.048	-0.885	-0.184	-0.081	-0.286
C3	0.507	-0.081	-0.018	-0.350	0.306	0.721
C4	-0.267	-0.737	0.048	-0.596	-0.081	-0.149
C5	0.331	-0.640	-0.067	0.642	-0.231	0.104
C6	0.493	-0.088	0.309	-0.016	0.55	1-0.591



ScreePlot

Interpretation: This scree plot shows that the eigenvalues start to form a straight line after the second principal component. Therefore, the remaining principal components account for a very small proportion of the variability (close to zero) and are probably unimportant. Family problems and illness Accounts 82.1% variation in the data. Family problems and illness are main causes for suicidal rate in India.
For first two principal components the equations are

$Y_1=0.475X_1+0.304X_2+0.507X_3-0.267X_4+0.331X_5+0.493X_6$

$Y_2= 0.178\ X_1+ 0.048X_2-0.081\ X_3- 0.737X_4- 0.640\ X_5- 0.088\ X_6$

Forecasting rate of suicide using ARIMA model

	year	rate
1	2011	11.2
2	2012	11.2
3	2013	11.0
4	2014	10.6
5	2015	10.6

6 2016 10.3
7 2017 9.9
8 2018 10.2
9 2019 10.4
10 2020 11.3
11 2021 12.0

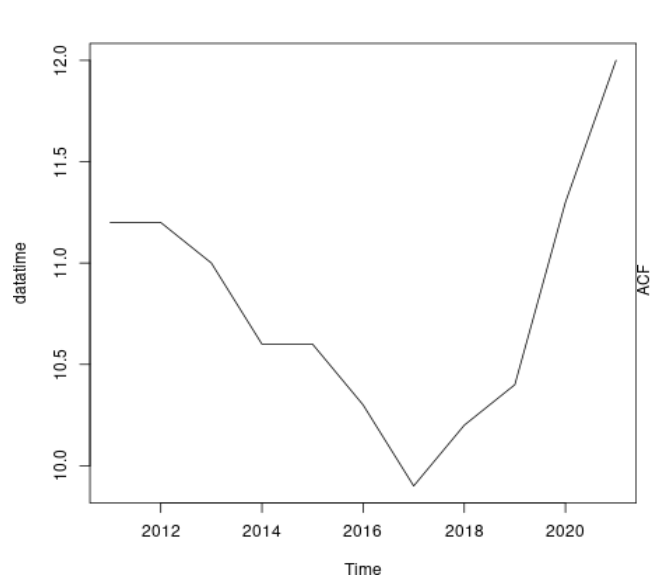
Augmented Dickey-Fuller Test

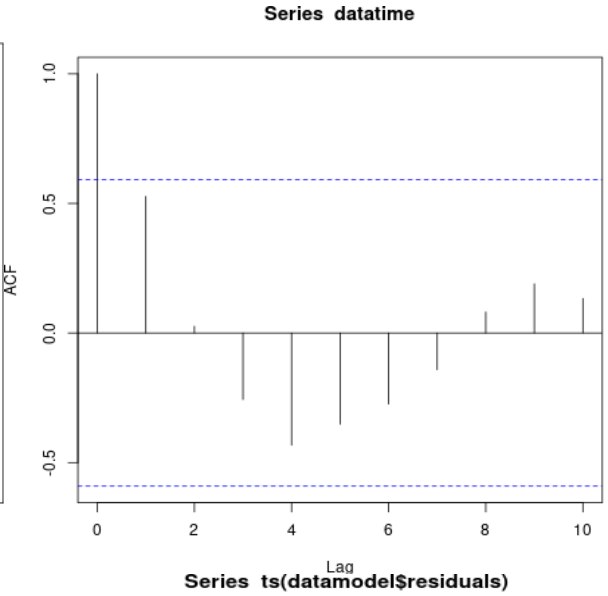
Data: datatime
Dickey-Fuller = 0.27675, Lag order = 2, p-value = 0.99
Alternative hypothesis: stationary
In adf.test(datatime) : p-value greater than printed p-value
ARIMA(2,0,2) with non-zero mean : Inf
ARIMA(0,0,0) with non-zero mean : 23.25845
ARIMA(1,0,0) with non-zero mean : 18.46923
ARIMA(0,0,1) with non-zero mean : Inf
ARIMA(0,0,0) with zero mean : 85.57994
ARIMA(2,0,0) with non-zero mean : 14.4225
ARIMA(3,0,0) with non-zero mean : Inf
ARIMA(2,0,1) with non-zero mean : Inf
ARIMA(1,0,1) with non-zero mean : Inf
ARIMA(3,0,1) with non-zero mean : Inf
ARIMA(2,0,0) with zero mean : Inf
Best model: ARIMA(2,0,0) with non-zero mean
Series: datatime
ARIMA (2,0,0) with non-zero mean
Coefficients:

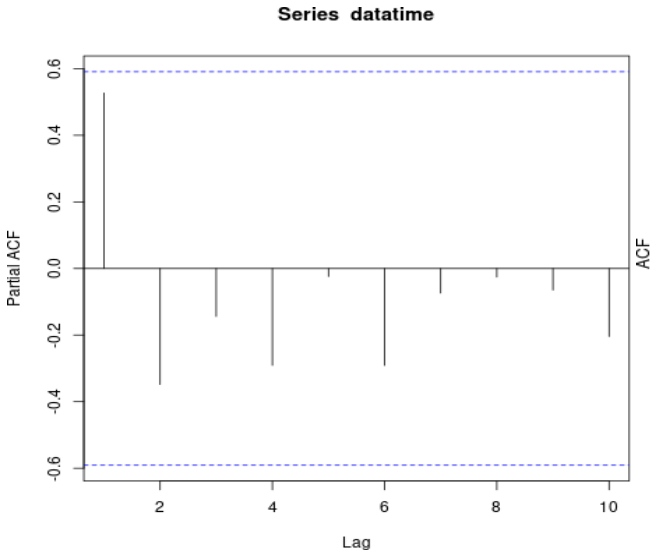
	ar1	ar2	mean
	1.3261	-0.7250	10.8651
s.e.	0.2308	0.2135	0.2685

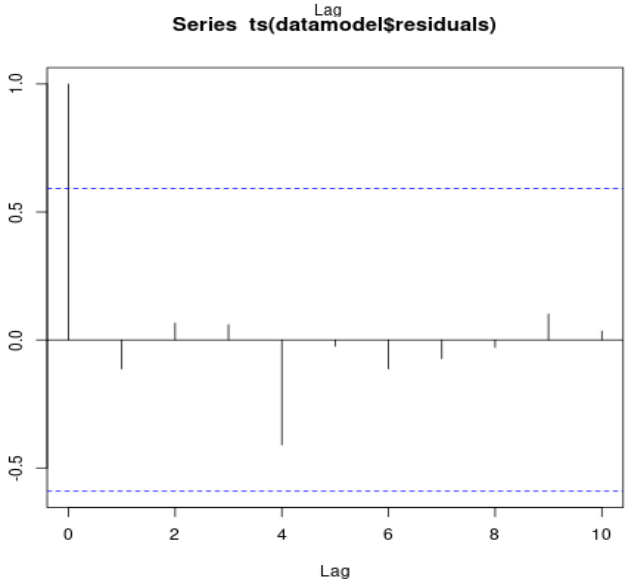
sigma^2 estimated as 0.1162: log likelihood= -3.21
AIC=14.42 AICc=21.09 BIC=16.01

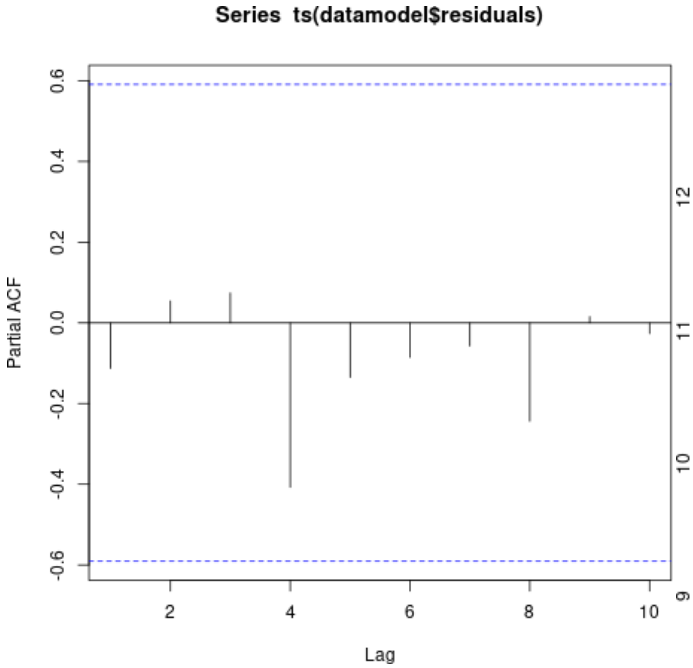
Point	Forecast	Lo95	Hi95
2022	12.05480	11.386673	12.72292
2023	11.61999	10.510312	12.72967
2024	11.00367	9.696666	12.31067
2025	10.50158	9.166286	11.83688
2026	10.28258	8.940167	11.62499

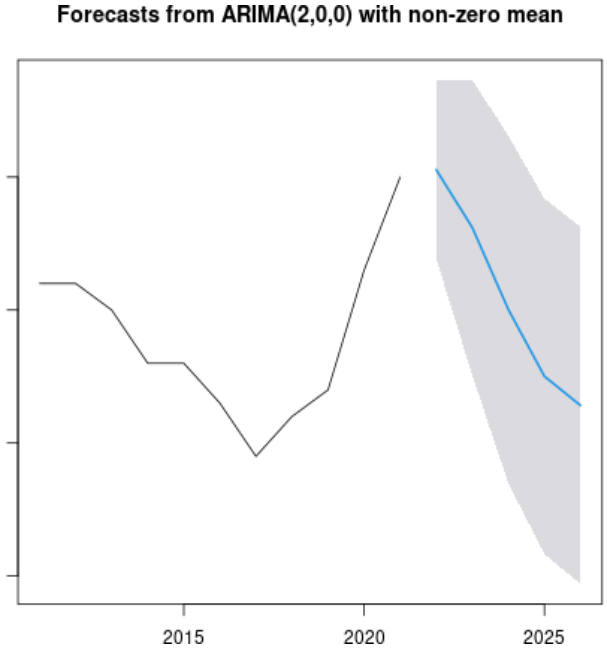

datatime
Time
2012
2014
2016
2018
2020
10.0
10.5
11.0
11.5
12.0


Series datatime
ACF
Lag
-0.5
0.0
0.5
1.0
0
2
4
6
8
10


Series datatime
Partial ACF
Lag
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
2
4
6
8
10


Series ts(datamodel$residuals)
ACF
Lag
-0.5
0.0
0.5
1.0
0
2
4
6
8
10


Series ts(datamodel$residuals)
Partial ACF
Lag
-0.6
-0.4
-0.2
0.0
0.2
0.4
0.6
2
4
6
8
10


Forecasts from ARIMA(2,0,0) with non-zero mean
9
10
11
12
2015
2020
2025

Finding from Analysis: The rate of suicide decreases for next some years by using Forecasting of ARIMA model. According to NCRB data the rates of suicide for year 2022 is 12.4 and by forecasting using ARIMA model the rate of suicide for year 2022 is 12.1 with confidence interval (11.4, 12.7) which is approximately near about NCRB rate. The NCRB rate of suicide 12.4 is in between confidence interval of forecasting hence the ARIMA (2,0,0) model is good fit for our data.

Conclusion:

- The rate of suicides is increases year by year.
- The rate of suicide 12% in 2021 is recorded as highest suicide rate in India.
- Male count for commuting suicides is more than female or transgender.
- A family problem is the main reason for commuting suicide.
- The age group (18 – below 30 years) and (30 – below 45 years) are prominent age group for commuting suicides in India.
- Hanging is the most prominent means/modes for suicide.
- The people whose economic condition is bad committed suicide than other people.
- Economic status, marital status and professional status and education status depends on gender wise distribution of suicides.
- By forecasting rate of suicide using ARIMA model, the rate of suicide for year 2022 is
- 12.1 with 95% confidence interval is (11.4, 12.7).

Prevention:

The current high rates of suicide in India highlight an urgent need for a coordinated national suicide prevention plan that will raise awareness and help make suicide prevention a national priority. A comprehensive approach across country at community, regional and national levels including all the stakeholders such as departments of health and education, social welfare, police and the judiciary is required. One of the observations was a high demand for prevention efforts, but lack of resources and scarcity of available program in populous countries like India. These factors play a more salient role as risk and protective factors for suicide than they do in Europe or the USA.

Suicide Prevention:

- Reducing social isolation.
- Preventing social is integration.
- Treating mental disorders.
- Regulating the sale of pesticides and ropes.
- Promoting psychological motivational sessions and meditation and yoga.

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