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Pattern of day wise death rate due to Covid-19 in India using Chi-Square test

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Abstract:

The Pandemic disease Covid-19 is infectious disease caused by the most newly discovered Virus.The Covid-19 discovered in China causing global alarm, in December 2019. On 31st January2020 India confirmed the Covid-19 case. Afterword's the number of confirmed cases were increased day by day. Recent data that is upto 12th April 2020 India has confirmed 9240 cases and 331 deaths according to 'Worldometer'. As there is no Vaccination invented, so number of deaths are increasing. In this article we study the distribution pattern of number of deaths due to Covid-19 in India using Chi-Square test of goodness of fit, and to see that the number of death in India are not uniformly distributed over the days. It is a very powerful test for testing significance of discrepancy between theory and experiment was given by Prof. Karl Pearson in 1900 and is known as "Chi-square test of goodness of fit" We study the data of number of deaths from 12th March 2020 to 12th April 2020.

Key words : Ms-Excel, Chi-square test of goodness of fit, Line chart, Bar chart.

Introduction:

"India is at a crucial juncture in its fight against COVID-19. The country has responded with urgency and determination as reflected in the Prime Minister's bold and decisive leadership.The government has also aggressively stepped up the response measures - find, isolate, test, treat and trace. WHO is supporting the government's endeavor to further strengthen and intensify surveillance and build capacity of the health system. Because of that we have less number of infected cases compare to other countries.

In this method we collected the data of from 12th March 2020 to 12th April 2020.Since the article is related to pattern of number of deaths and the first death occur in India on 12th March 2020 we have taken data from starting date and studying it for one month. Using this test we can assume some pattern of deaths and testing it.

Methodology:

In this paper we are trying to find out whether the number of deaths occurring daywise is uniformly distributed or not by setting the null and alternative hypothesis. Chi-Square goodness of fit test is a non-parametric test that is used to find out how the observed value of a given phenomenon is significantly different from the expected value. In Chi-Square goodness of fit test, the term goodness of fit is used to compare the observed sample distribution with the expected probability distribution. Chi-Square goodness of fit test determines how well theoretical distribution fits the empirical distribution.

Procedure for Chi-Square Goodness of Fit Test:

- Set up the hypothesis for Chi-Square goodness of fit test:
  A. **Null hypothesis:** In Chi-Square goodness of fit test, the null hypothesis assumes that there is no significant difference between the observed and the expected value.
  B. **Alternative hypothesis:** In Chi-Square goodness of fit test, the alternative hypothesis assumes that there is a significant difference between the observed and the expected value.
- Compute the value of Chi-Square goodness of fit test using the following formula:

$$\chi^2 = \left[\frac{(O-E)^2}{E}\right]$$ Where, χ^2 = Chi-Square goodness of fit test

O= observed value
E= expected value

In this case our hypothesis will be,
H_0: The number of deaths due to Covid-19 is Uniformly distributed over [1,30]
Vs
H_1: The number of deaths due to Covid-19 is not Uniformly distributed over [1,30]

Observation table:

Date	Day	No. of deaths (O_i)	e_i	O_i^2	O_i^2/e_i
3/12/2020	1	1	10.34375	1	0.096676737
3/13/2020	2	1	10.34375	1	0.096676737
3/14/2020	3	0	10.34375	0	0
3/15/2020	4	0	10.34375	0	0
3/16/2020	5	0	10.34375	0	0
3/17/2020	6	1	10.34375	1	0.096676737
3/18/2020	7	0	10.34375	0	0
3/19/2020	8	1	10.34375	1	0.096676737
3/20/2020	9	1	10.34375	1	0.096676737
3/21/2020	10	0	10.34375	0	0
3/22/2020	11	2	10.34375	4	0.386706949
3/23/2020	12	3	10.34375	9	0.870090634
3/24/2020	13	0	10.34375	0	0
3/25/2020	14	2	10.34375	4	0.386706949
3/26/2020	15	8	10.34375	64	6.187311178
3/27/2020	16	0	10.34375	0	0
3/28/2020	17	4	10.34375	16	1.546827795
3/29/2020	18	3	10.34375	9	0.870090634
3/30/2020	19	5	10.34375	25	2.416918429
3/31/2020	20	3	10.34375	9	0.870090634
4/1/2020	21	23	10.34375	529	51.14199396
4/2/2020	22	14	10.34375	196	18.94864048

4/3/2020	23	14	10.34375	196	18.94864048
4/4/2020	24	13	10.34375	169	16.33836858
4/5/2020	25	19	10.34375	361	34.90030211
4/6/2020	26	18	10.34375	324	31.32326284
4/7/2020	27	24	10.34375	576	55.6858006
4/8/2020	28	18	10.34375	324	31.32326284
4/9/2020	29	49	10.34375	2401	232.1208459
4/10/2020	30	22	10.34375	484	46.79154079
4/11/2020	31	39	10.34375	1521	147.0453172
4/12/2020	32	43	10.34375	1849	178.755287
				Total	**877.3413897**

Applying the Chi-square test of goodness of fit to above data:

Under H_0, the test Statistic is

$$\chi^2 = \left[\frac{(O-E)^2}{E}\right]$$

= **546.3413897**

[Calculated value]

$\chi^2_{k-p-1} = \chi^2_{32-0-1}$ = 32-1=31,

Where , k is number of observations and p is number of parameters

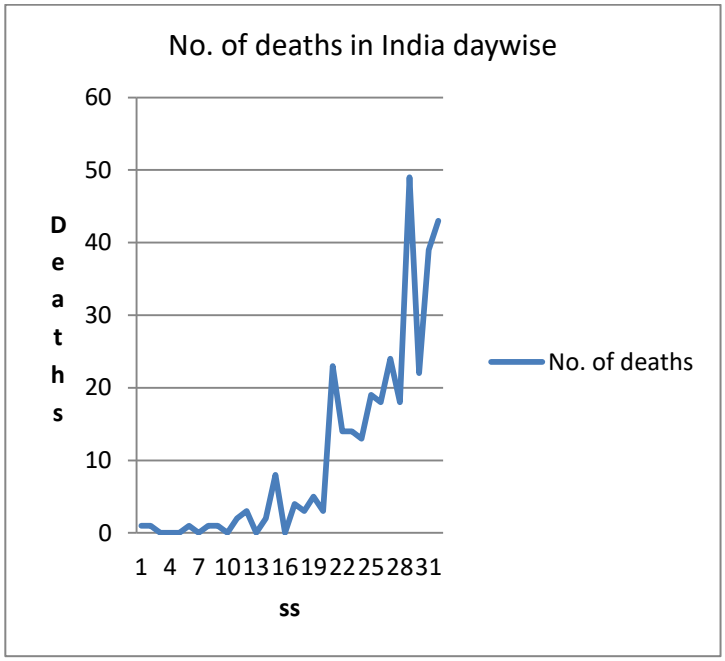
tabulated value at 5% level of significance $\chi^2_{32,0.05} = 46.19$

Since , Calculated value **greater than** Tabulated value , it is highly significant and we **reject the null hypothesis.** Thus we conclude that the number of deaths due to Covid-19 in are not uniformly distributed.

Graphical Representation:

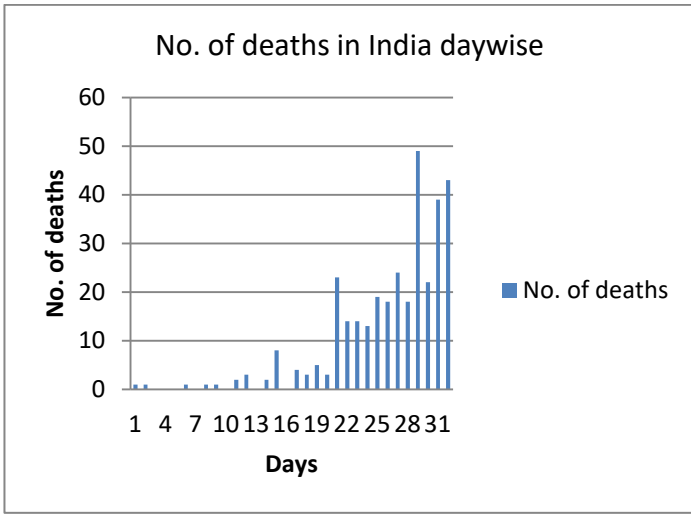
To represent the pattern of death rate due to Covid-19 in India we use line chart as well as Bar chart.

- **Line Chart :**



Above chart represents pattern of deaths rate.

- **Bar Chart :**



Conclusion :

By calculation we can conclude that the number of deaths are not equally frequently occur daywise. It is not uniformly distributed over [1,30].

Graphically we can also say that number of deaths **are not same**(equal) over the days.

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