

Covid-19 –In Jammu and Kashmir (UT) a study through Weibull and related models

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ABSTRACT

Coronavirus(covid-19) pandemic is changing the world. As of August 08, 2020, according to world health organization, there are around 19,187,943 confirmed cases along with 716075 deaths from 212 countries and territories and 2 international conveyances. SARS-CoV-2 is a new disease and we are still learning its distribution and spread control. Respirational virus infection can occur through contact (direct or indirect), droplet spray (short range transmission), aerosol (long range transmission). In the Union Territory of Jammu and Kashmir(India) the virus is also spreading and researchers are busy finding its vaccine and cure. Mathematical models are utilized and probability distribution function(pdf)conceives a better idea of virus spread. Here we utilized Weibull and its associated distributions and came up with a better understanding of its spread in turn will help its control and management.

KEYWORDS: Covid-19(SARS-CoV-2), Mathematical models, Probability distribution function, J&K

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I. INTRODUCTION:

Coronavirus(COVID-19) is infecting the masses across the world, the new corona virus disease (SARS-CoV-2) is regularly identified on almost every day. As of August 08, 2020, according to world health organization, there are around 19187943 confirmed cases along with 716075 deaths from 212 countries and territories. The first case of COVID-19 in India was reported on 30th January 2020 originating from China. In the Union territory of J & K the very first 2 cases were reported on 04th March in Jammu. Till date nearly 2153010 confirmed cases with 43,379 deaths have been reported in India so far and in the Union Territory of Jammu and Kashmir 24390 confirmed cases besides 459 deaths out of this novel disease. An outbreak of this type of corona virus is novel and is named as COVID-19(SARS-CoV-2). The first case of coronavirus that specialists had never seen before in humans had begun to spread among the population of Wuhan city in the province of Hubei in China in December 2019. Since then it is spreading like anything to all over the world. "COVID-19 is a new disease and we are on a learning curve about it. In general, respiratory virus infection can occur through contact (direct or indirect), droplet spray from mouth and nose (short range transmission), aerosol (long range transmission). Any person infected by the SARS-CoV-2 virus does not show symptoms immediately. The SARS-CoV-2 virus has an incubation period of 14 days. If 10 patients are infected in one day, each one would show symptoms at a different time within the incubation period. Most of the patients show symptoms on the 4th, 5th, 6th, and 7th. The maximum possible studies regarding it is being undertaken across the globe and the only remedy in vogue till now to prevent its spread is physical distancing and lock down.

The spread of the infection can be studied through models that can be validated on real life data. An infected patient may show symptoms any time from day one to the end of the incubation period. The median infected people may start showing symptoms by the 3rd day to 8th day.

Probability distribution function and mathematical models have been used for COVID-19 cases. Researchers are working to study the trend and various approaches are being used. Villalobos and Mario (2020) use a generalized logistic equation and the Gompertz equation for fitting COVID-19 data from China. Jia et al. (2020) use Gompertz, Bertalan y, and Logistic equations for modeling the growth of COVID-19. Auto Regressive Moving Average (ARMA) models of time series has been tried by Deb et al. (2020) on COVID-19. Based on the SIRD model Fanelli and Piazza (2020) used the four categories viz. Susceptible (S), Infected (I), Recovered (R), and the Dead (D) and any person who is infected fall in one of the categories there by forecasted cases in China, Italy, and France.

Fitting of Weibull, Gaussian(Norm), and Gamma distributions

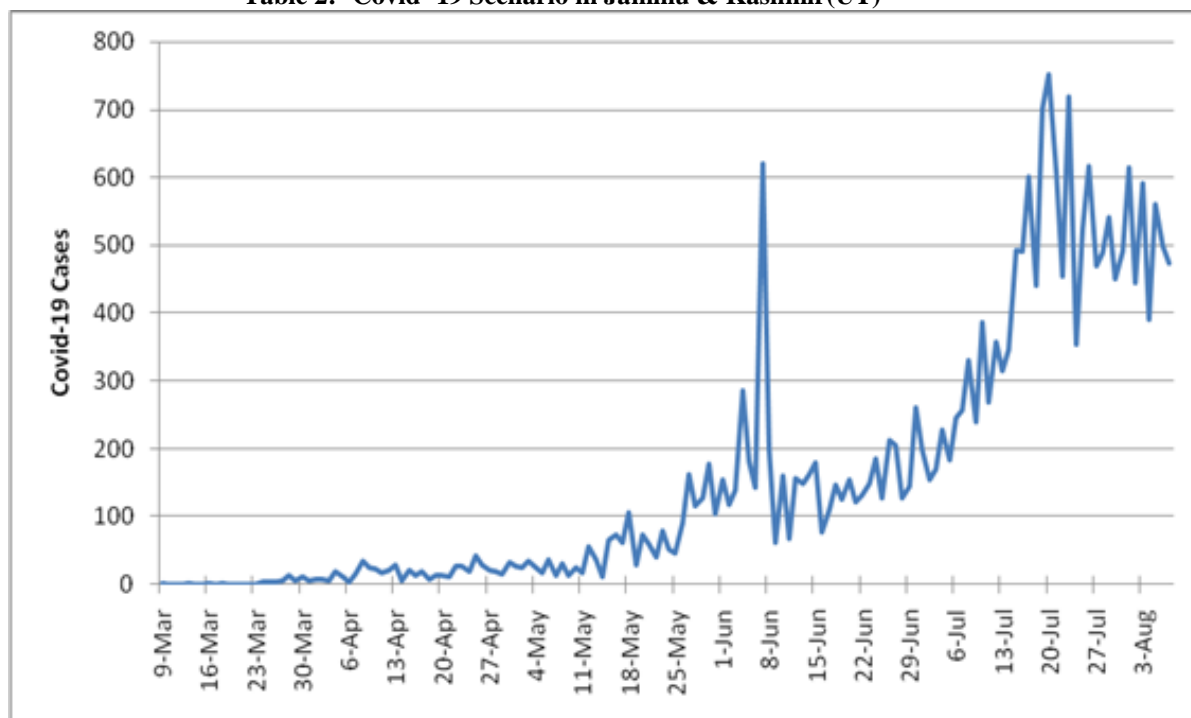
Three most widely used distributions have been utilized i.e Weibull, Gamma, and Gaussian. The data pertains to weekly number of COVID-19 cases of Union Territory of Jammu and Kashmir from 3rd March to 8th

August 2020. Magnitude of each distribution is kept similar so that any distribution does not have the advantage of having greater magnitude than others. The probability density functions for each distribution are given below. The best PDF, CDF, P-P Plot and Q-Q Plot was chosen. The best among them was observed and later further analysis was carried out.

Table1:-Description of various probability distribution functions.

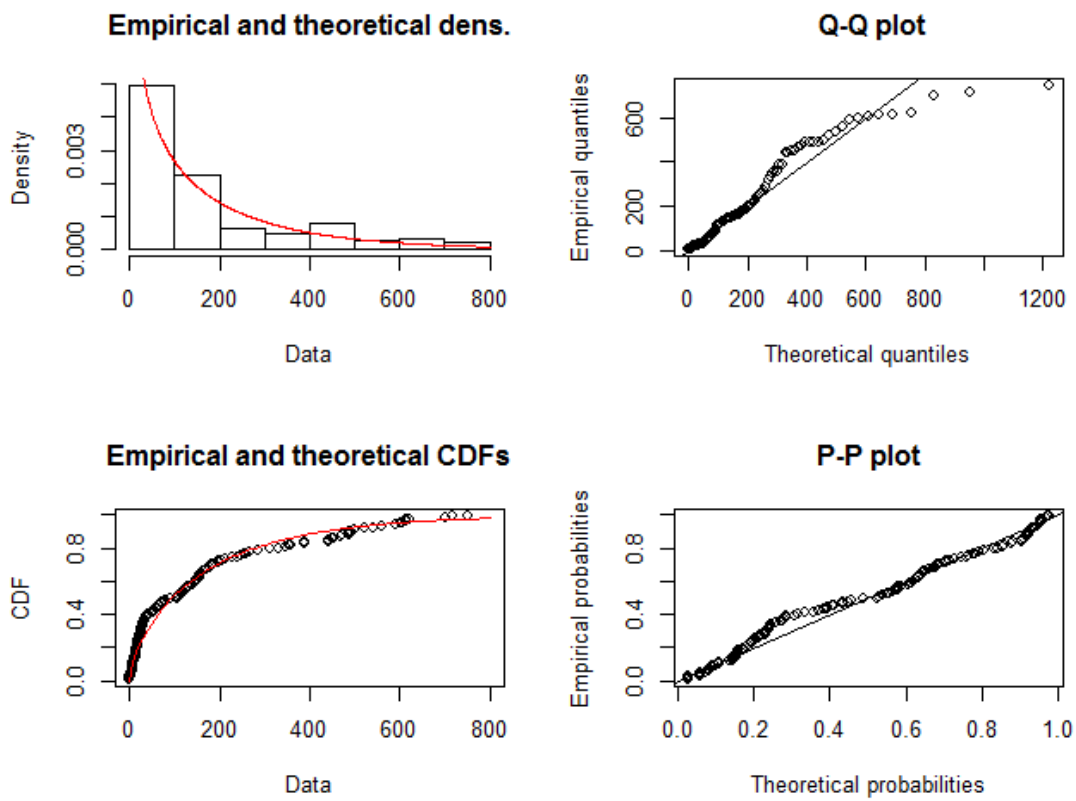
Distribution	Probability density function f(x)	Range	Parameters
Weibull(2P)	$\frac{\alpha}{\beta} \left(\frac{x}{\beta}\right)^{\alpha-1} \cdot \exp\left[-\left(\frac{x}{\beta}\right)^\alpha\right]$	$-\infty < x < \infty$	$\alpha = \text{shape}(\alpha > 0)$ $\beta = \text{scale}(\beta > 0)$
Gaussian	$\frac{1}{\sigma\sqrt{2\pi}} \exp\left[-\frac{1}{2}\left(\frac{x-\mu}{\sigma}\right)^2\right]$	$-\infty < x < \infty$	$\mu = \text{mean}$ $\sigma =$ $(\sigma > 0)$
Gamma(2P)	$\frac{(x)^{\alpha-1}}{\beta^\alpha \Gamma(\alpha)} \exp\left(-\frac{x}{\beta}\right)$	$-\infty < x < \infty$	$\alpha = \text{shape}(\alpha > 0)$ $\beta = \text{Scale}(\beta > 0)$ $\Gamma = \text{Gamma function}$

Table 2:- Covid -19 Scenario in Jammu & Kashmir(UT)



**Fitting of the distribution ' Gamma ' by maximum likelihood
Parameters :-**

	Estimate	Std. Error
Shape	0.659419187	0.063621646
Rate	0.003886182	0.000498828
Loglikelihood:	-855.2894	
AIC: 1714.579	BIC: 1720.476	

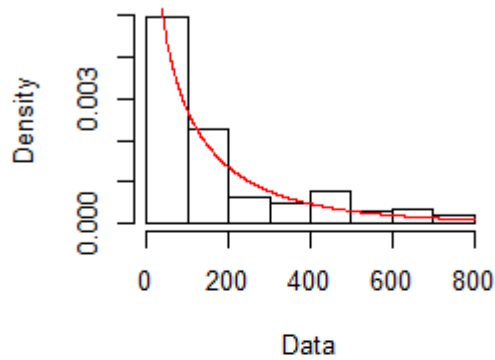


Fitting of the distribution ' Weibull ' by maximum likelihood

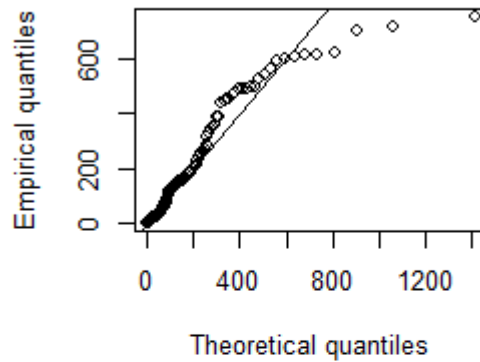
Parameters :

	Estimate	Std. Error	
Shape	0.7586224	0.05101127	
Scale	144.6975596	16.93761314	
Loglikelihood:	-855.3535		
	AIC: 1714.707		BIC: 1720.605

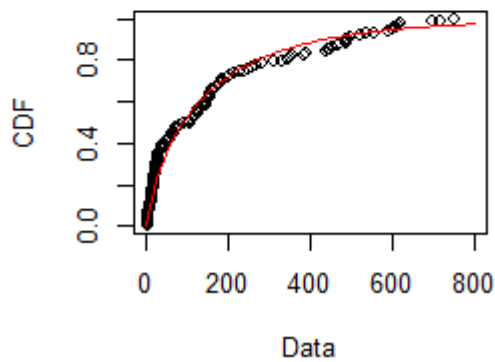
Empirical and theoretical dens.



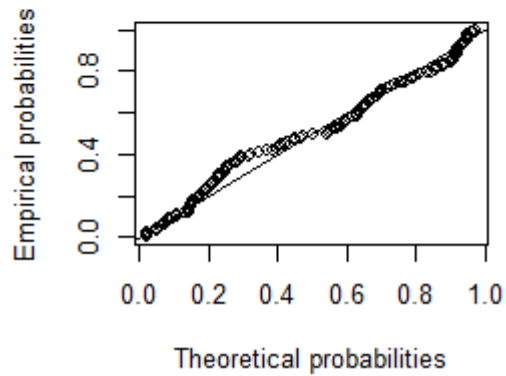
Q-Q plot



Empirical and theoretical CDFs



P-P plot



Fitting of the distribution ' Norm ' by maximum likelihood

Parameters :

	Estimate	Std. Error
Mean	169.6950	16.32519
Sd	193.8509	11.54368
Loglikelihood:	-942.7299	
AIC:	1889.46	BIC: 1895.357

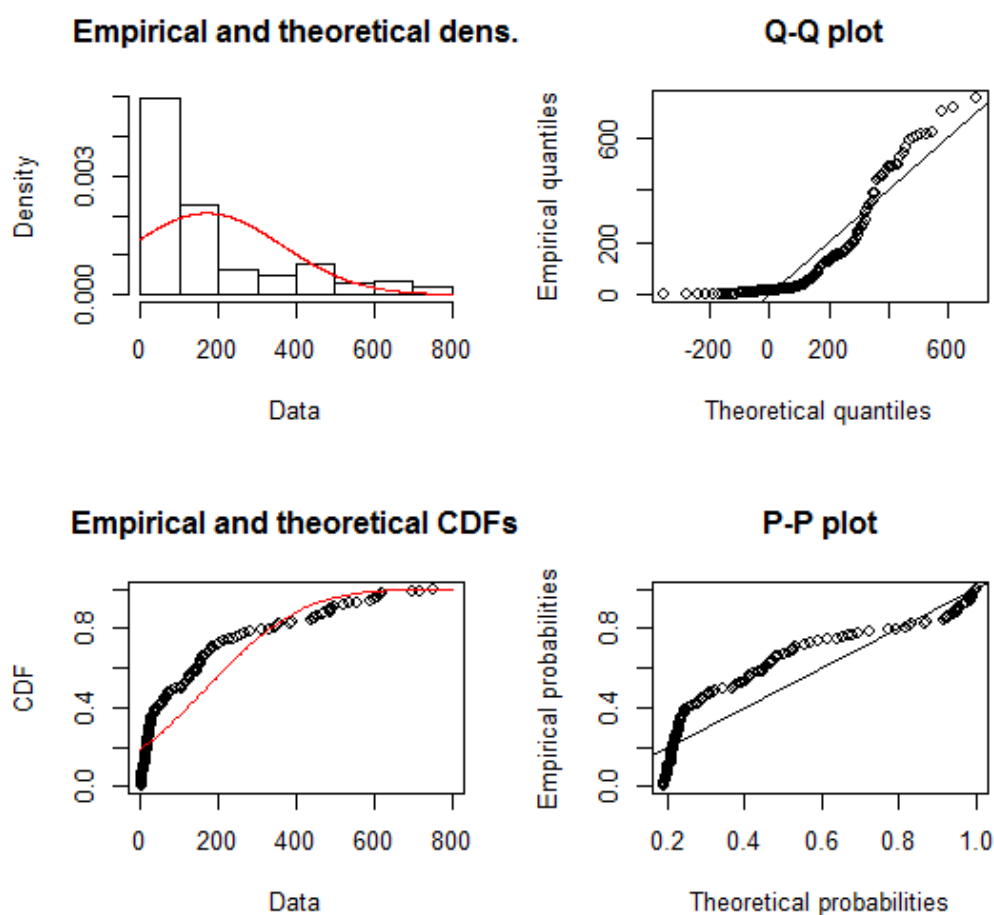
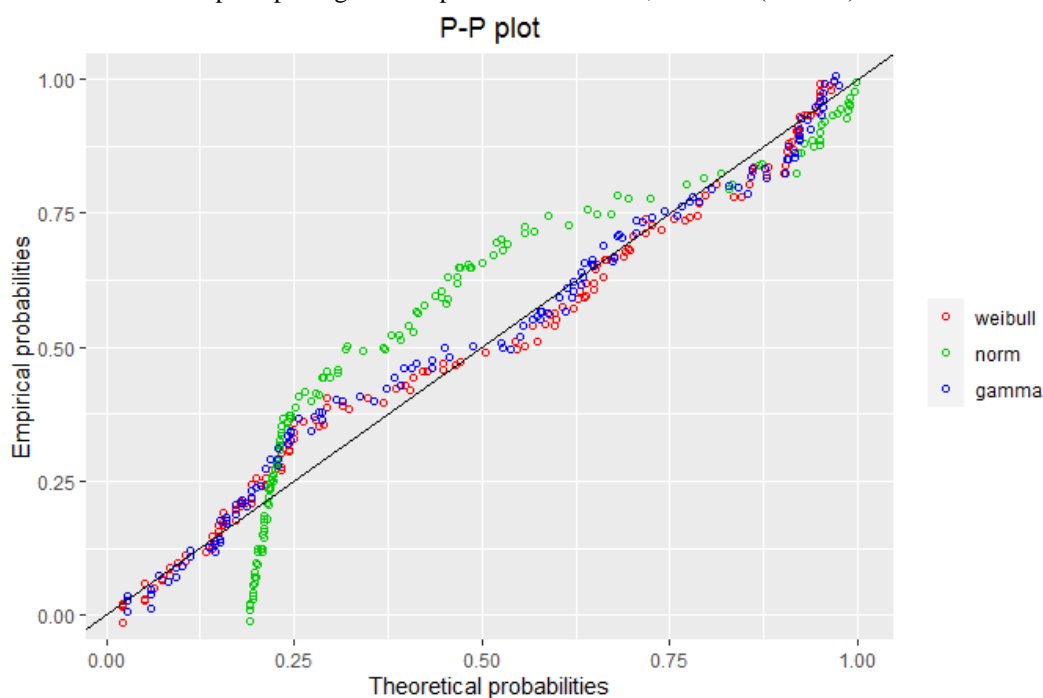
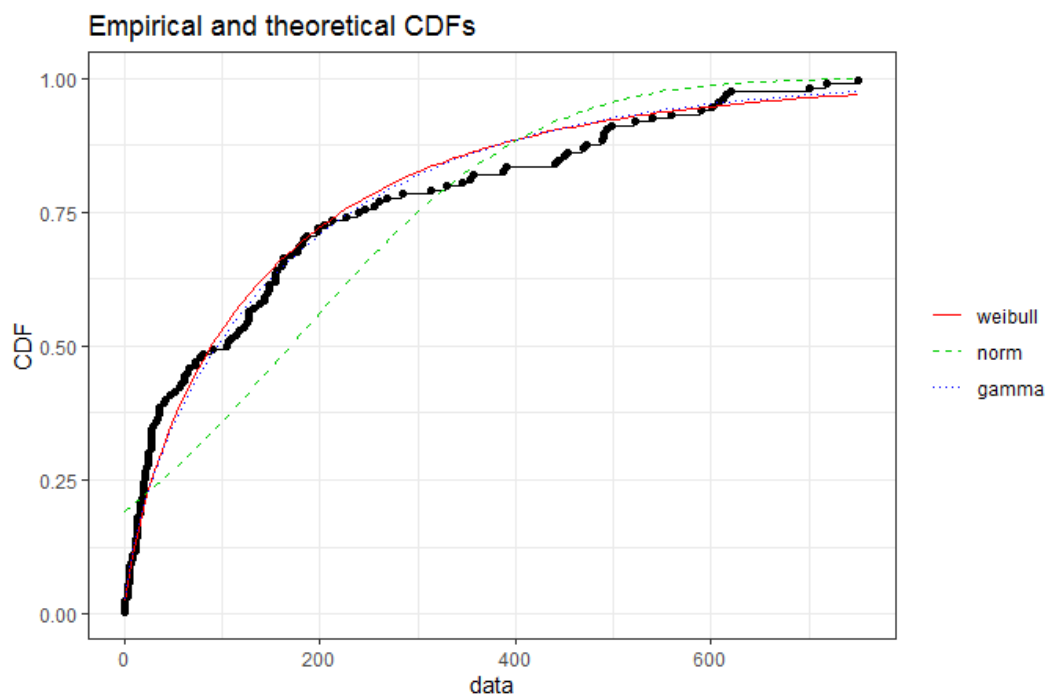


Table 3:- Graph depicting the comparison of Weibull, Gaussian(Normal) and Gamma





II. RECOMMENDATIONS

Throughout world a speedy process is on to find out the vaccine which could be the possible cure for the novel Corona virus-Covid 19. The following are the main recommendations to tackle the Spread of virus.

- i. Maintaining personal hygiene which includes washing and sanitizing hands with soaps and running water, avoid touching things unnecessarily and not to spit in public places.
- ii. Persons suffering from Common Cold, fever & influenza like illness should consult doctors immediately duly covering their nose and mouth with mask
- iii. Covering of nose and mouth with tissue paper when coughing and sneezing and later on immediately washing with running water and soap.
- iv. Some body in close contact with person suspected with Corona virus or have just returned from foreign countries or place inflicted with virus, needs immediate home isolation
- v. Avoiding of crowded atmosphere is highly recommended.
- vi. Avoid meeting people having cough fever and avoid touching body parts such as eyes, nose or mouth with untidy hands
- vii. Personal Protection Equipment (PPE) kits are must for person dealing with the patients
- viii. Avoid unnecessarily travel and as far as possible confine to homes and isolated places.

III. CONCLUSION

The paper concludes that there is a dire need to work on statistical models to study the spread of COVID-19 pandemic State wise and country wise. For the present data set pertaining to J & K (UT) the Gamma and Weibull gave better fit to the data set. The Akaike information criterion(AIC) and Bayesian information criterion are less in Gamma and Weibull as compared to Gaussian. The type of PDF are from Gamma and Weibull. One can take up the different data sets and watch various probability models to work out the spread of the disease.

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