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The Constant K and the Gaussian Temporal Evolution for COVID-19

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Abstract: We present the Gaussian temporal evolution of Corona Virus, the temporal average constant $K_{temporal\ average\ constant} = K_t$. The K_t and its standard deviation come from the analysis of 52 experimental Gaussian distribution -histogram-. We have analyzed all histograms from 185 countries presented in the reference (Johns Hopkins, 2020), and, we found 52 countries have a definite trend towards an experimental Gaussian profile. As a result, we found Kt = $K_{52\ countries}$ = (35 ± 5) days - average & standard deviation-. We also calculate using an experimental Gaussian got in reference (Johns Hopkins, 2020), the temporal evolution for the world, the constant K_{world}. We found $K_{world} = K_w$ = (47 ± ½) days. Finally, up to this date, 20 April/2020, we have only 52 of 185 countries presenting the trends towards an experimental Gaussian profile (Johns Hopkins, 2020). The main conclusion from this short communication is that the standard deviation found -K_t = (35 ± 5) days-, is very low, which is very good. Therefore, we may conclude the maximum spread of the Corona contamination will occur in a maximum of up to 40 days from the first registered contamination and, in the worst scenario, up to 30 days. Regarding the Brazil peak of contamination, on 10 March/2020, we carried out A PREVISION, and, in that time, we have affirmed by reasoning, the peak in Brazil would be around 10-15 April/2020. Up to this date, there is a confirmation of this prevision (Johns Hopkins, 2020). For our next prevision, the decrease from contamination must trend to zero among 30-40 days after the peak contamination. These are the most critical situation faced because the real zero takes a while to get to null and, if no personal safety such as social reclusion is adopted, the contamination starts all over. Finally, we have observed the K_w has a shifting in the function of the time and, our finding explains this.

Keywords: Gaussian Constant K, COVID-19, Temporal Evolution for Constant K, Prevision, Trends, Countries, JHU/CRC

Introduction

This short paper presents the Gaussian temporal evolution from COVID-19, the temporal average constant $\mathbf{K_{temporal\ average\ constant} = K_t}$

The $\mathbf{K_t}$ and its standard deviation come from the analysis of 52 experimental Gaussian distribution -histogram-. The studies started on April 13, 2020, and concluded on April 20, 2020, with a full review from all histograms from 185 countries presented in the reference (Johns Hopkins, 2020). We found 52 countries with a definite trend towards an experimental Gaussian profile -histogram (Johns Hopkins, 2020). The calculation of **K** for each of the 52 countries followed the methodology presented in Figure 1, for Gaussian frequency distribution. Table 1 presents the spreadsheet with all information about each country. The main finding is $\mathbf{K_t}$ = $K_{52\ countries}$ = (35 ± 5) days, showing the average value and respective standard deviation for those 52 countries.

By using the same methodology presented in Figure 1, we also calculated the World temporal evolution constant -$\mathbf{K_{world}}$-. The reference (Johns Hopkins, 2020) makes available the World experimental Gaussian -a histogram-, from where we figured out the K_{world} = (47 ± ½) days (the "± ½ day" corresponds the half of the column width at the world histogram (Johns Hopkins, 2020). For both calculations of the average $K_{52\ countries}$ and K_{world}, we suppressed the data from several countries because their histogram does not follow and experimental Gaussian profile -histogram (Johns Hopkins, 2020). Finally, up to this date, April 20, 2020, when Table 1 was constructed, we found out -according to our experimental expertise-, only 52 of 185 countries present the trends towards an experimental Gaussian profile -histogram (Johns Hopkins, 2020).

The main conclusion from this short paper is that the <u>standard deviation found</u> -see Table 1, $K_t = K_{52\ countries}$ = (35 ± 5) days-, is very low -which is also very good- and this result agrees with the K_{world} = (47 ± ½) days. Therefore, for this analysis, we may conclude -for any Gaussian distribution regarding the Corona Virus contamination-, the maximum spread of the contamination will occur up to, at least, 40 days from the first registered contamination and, in the worst scenario, up to 30 days from the first registered contamination.

By last, regarding the Brazil peak of contamination, we must share that near March 10, 2020, we carried out a prevision -inference-, regarding the peak of contamination in Brazil. In that time, we have affirmed -to our fellows-, by reasoning, and in no formal communication, the peak of COVID-19 contamination in Brazil would be around 10-15 April/2020. That prevision is confirmed according to the Brazilian histogram presented for April 20, 2020 (Johns Hopkins, 2020). These previsions were -by inference- carried out by analyzing by several weeks before and up to March 10, 2020, the growing behavior of the contamination for South Korea, China, Italy, and Brazil. This paper proves our preliminary -inference- analyses were entirely right. According to Table 1, the day of minimum point of contamination for Brazil is 9 March 2020, which implies, according to the finding of $\mathbf{K_t}$ of a peak among 9 April 2020 to 19 April 2020 [$\mathbf{K_t}$ = $K_{52\ countries}$ = (35 ± 5) days].

Table 1 shows the 52 unique values for K, collected in the following days: 13 (28 unique values of K), 19 (16 unique values of K), and 20 (8 unique values of K) April 2020.

Experimental Calculations of $K_{52\ countries}$ and K_{world}

(Data Source: reference (Johns Hopkins, 2020)

We carried out an extensive analysis from all 185 counties histograms presented in (Johns Hopkins, 2020), and we found 52 countries with a definite trend towards an experimental Gaussian profile -histogram, similar to that theoretical curve of Gauss presented in Figure 1-. For each of the 52 countries, we have calculated the **K** value, the temporal distance AB from the minimum point of contamination (A: MINIMUM) to the peak contamination (B: MAXIMUM), Figure 1.

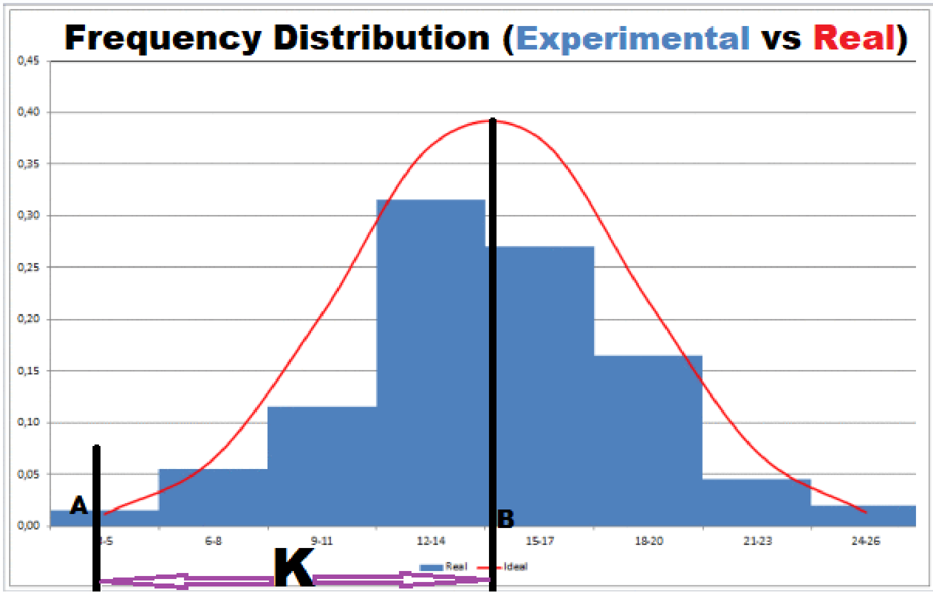

Figure 1. K_{AB} = K is the Constant Temporal Distance -Unique- for a Given Country.
-Source: Authors-

By using an Excel spreadsheet, we have calculated the average value from those 52 values of **K** -unique value for each country-. Table 1 presents the values found for the **K**, and the average value $\mathbf{K_t}$ as well the respective standard deviation: K_t = $K_{52\ countries}$ = (35 ± 5) days.

Table 1 presents the values of each unique K calculated according to Figure 1. The K values presented in Table 1 come from an experimental Gaussian profile, got from reference (Johns Hopkins, 2020). These K's were used to calculate the $\mathbf{K_t}$ -the Average Value of the K's- and the Standard Deviation. We inserted in Table 1 the contamination Peak Value, i.e., the maximum rate of contamination in the peak of the histogram with a Gaussian approach, according to the data collected in (Johns Hopkins, 2020).

Table 1. The Values of Each Unique K

A	B	C	D	E	F	G	H	I	J	K	L	M	N
Index	K	Country	Analysis Day	Start Day	Peak Day	Peak Value	Index	K	Country	Analysis Day	Start Day	Peak Day	Peak Value
1	26	Turkey	13/04/20	16/03/2C	11/04/20	92	27	36	Portugal	19/04/20	02/03/20	06/04/20	5100
2	27	Luxembourg	13/04/20	29/02/2C	27/03/20	1300	28	36	Italy	13/04/20	20/02/20	27/03/20	8700
3	27	Tunisia	13/04/20	04/03/20	31/03/20	105	29	36	Greece	19/04/20	26/02/20	02/04/20	129
4	27	Australia	19/04/20	01/03/20	28/03/20	105	30	36	Colombia	19/04/20	06/03/20	11/04/20	497
5	27	Cyprus	19/04/20	09/03/20	05/04/20	400	31	37	Germany	13/04/20	25/02/20	02/04/20	3000
6	28	Iceland	13/04/20	28/02/20	27/03/20	400	32	37	Hungary	13/04/20	04/03/20	10/04/20	500
7	30	Austria	13/04/20	25/02/20	26/03/20	267	33	37	Ireland	19/04/20	09/03/20	15/04/20	274
8	30	Lebanon	13/04/20	21/02/20	22/03/20	6900	34	38	Indonesia	20/04/20	08/03/20	14/04/20	50
9	30	Norway	13/04/20	26/02/20	27/03/20	210	35	38	Denmark	13/04/20	27/02/20	05/04/20	188
10	30	Switzerland	13/04/20	25/02/20	26/03/20	100	36	38	Iraq	13/04/20	24/02/20	02/04/20	1500
11	30	Thailand	13/04/20	25/02/20	26/03/20	3200	37	38	Egypt	19/04/20	11/03/20	18/04/20	1100
12	30	Uzbekistan	20/04/20	15/03/20	14/04/20	90	38	38	Poland	19/04/20	04/03/20	11/04/20	734
13	32	Czechia	13/04/20	29/02/20	31/03/20	6600	39	38	Romania	19/04/20	04/03/20	11/04/20	48
14	31	Malta	13/04/20	07/03/20	07/04/20	10000	40	38	Brazil	20/04/20	09/03/20	16/04/20	260
15	31	Latvia	19/04/20	02/03/20	02/04/20	851	41	38	US	20/04/20	02/03/20	09/04/20	2300
16	32	Armenia	13/04/20	01/03/20	02/04/20	61	42	38	Morocco	20/04/20	10/03/20	17/04/20	475
17	32	Peru	19/04/20	12/03/20	13/04/20	80	43	39	Azerbaijan	13/04/20	01/03/20	09/04/20	1000
18	33	Bosnia and Herzegovina	13/04/20	05/03/20	07/04/20	250	44	39	Finland	13/04/20	26/02/20	05/04/20	523
19	33	New Zealand	13/04/20	28/02/20	01/04/20	52	45	39	France	20/04/20	04/03/20	12/04/20	3100
20	33	Israel	19/04/20	29/02/20	02/04/20	386	46	40	Iran	13/04/20	19/02/20	30/03/20	33700
21	33	Moldova	20/04/20	08/03/20	10/04/20	90	47	41	North Macedonia	20/04/20	06/03/20	16/04/20	26800
22	34	Lithuania	13/04/20	28/02/20	02/04/20	726	48	42	South Korea	13/04/20	21/01/20	03/03/20	380
23	34	Taiwan	13/04/20	16/02/20	21/03/20	1400	49	42	Sweden	13/04/20	26/02/20	08/04/20	149
24	34	Canada	19/04/20	07/03/20	10/04/20	30	50	42	Chile	19/04/20	02/03/20	13/04/20	281
25	35	Spain	13/04/20	25/02/20	31/03/20	150	51	43	India	19/04/20	07/03/20	19/04/20	90
26	35	Panama	19/04/20	10/03/20	14/04/20	82	52	44	United Kingdom	13/04/20	26/02/20	10/04/20	155

K VALUES:		
	Average	34.90
	Standard Deviation	4.70

Table 1 has the same values already presented in reference (Balloni & Winter, 2020). In the previous table, in reference (Balloni & Winter, 2020), the data format follows the criterium of the day of data collection, 13/April/20, 19/April/20, and 20/April/20. In this paper, Table 1, the data were formatted from the lower value of K (26) to the higher K (44) and an extra column inserted, the Peak Value of Contamination. The reason for this insertion of the increasing value of K and the corresponding peak contamination will be more precise next.

The Range of K_t Distribution and the Profile for the World Contamination Distribution

Figure 2 presents the range for the Kt distribution.

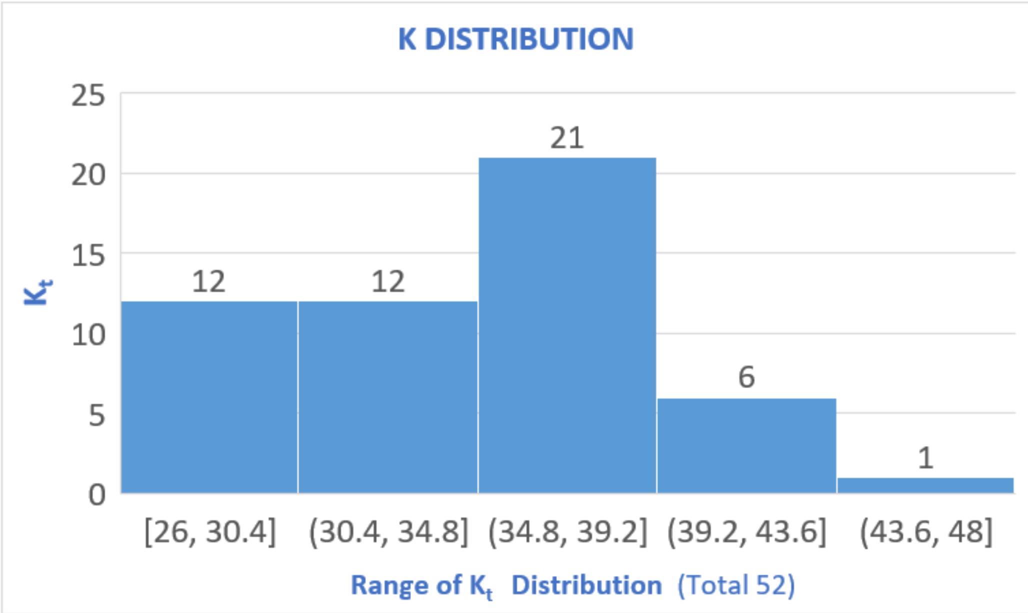

Figure 2. The 2 Values of K -unique Value for Each Country-,23.1% are among [26.0 – 30.4] days; 23.1% are among [30.4 – 34.8] days; 40.4% are among [34.8 – 39.2] days; 11.5% are among [39.2 – 43.6] days and, 1.9% are among [43.6 – 48].

Figure 2 shows about 50% from the K measured from the histograms with Gaussian trend (Johns Hopkins, 2020), are centered around the 37 days. Figure 3 presents the distribution profile for the values of K (linear), and it offers a different perspective regarding the 40.4% K distribution shown in Figure 2.

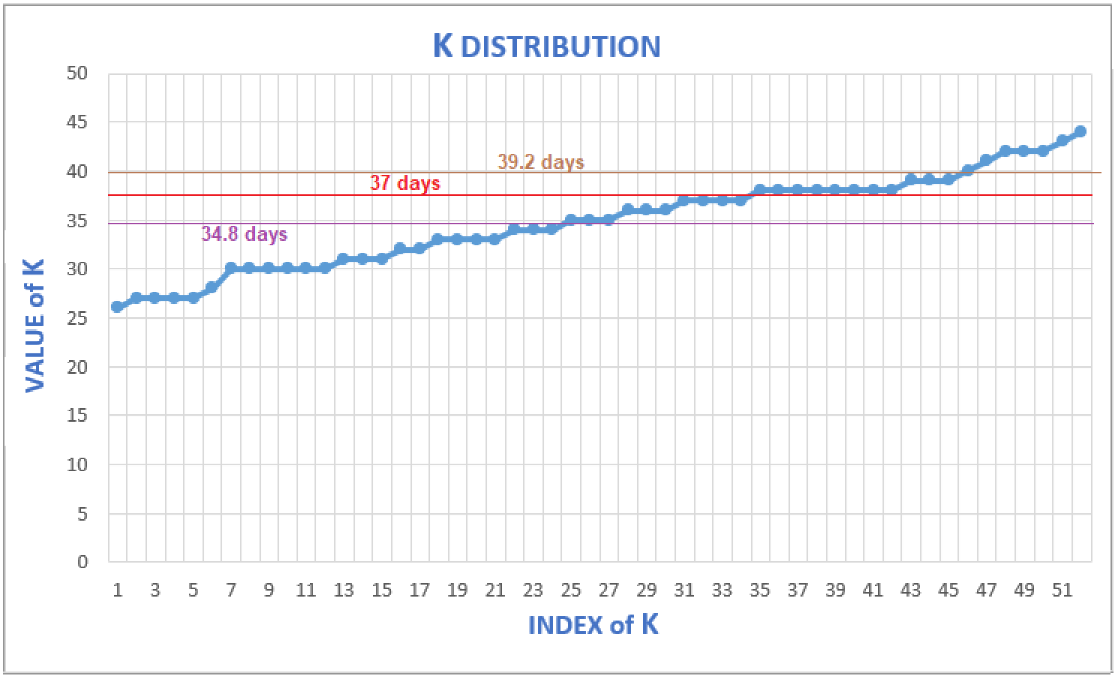

Figure 3. Linear Distribution Profile for the Values of K & Relation to Figure 2

Finally, Figure 4 presents the Temporal Average Constant K -informed in Table 1-, versus the Peak Contamination -also in Table 1.

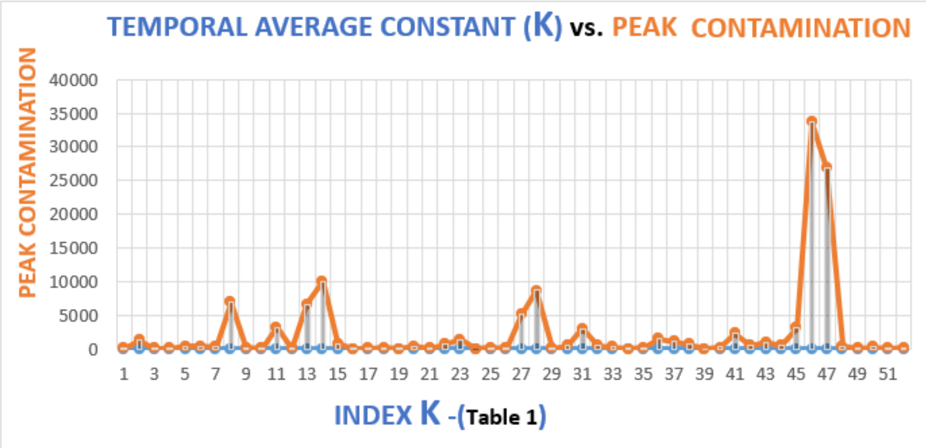

Figure 4. Temporal Average Constant K versus the Peak Contamination -see Table 1

In Figure 4, the values of K -index K in blue-, may not be detected. However, Figure 3 gives a clear vision regarding the profile from the K distribution. In Figure 4, the orange curve is the Peak Contamination -see table 1-, in the function of the INDEX -index 1, K=26; index 52, K=44).

When analyzing the histogram from the World, presented in (Johns Hopkins, 2020), it is clear it has a trend of a Gaussian profile, with a clear MAXIMUM and, also, a very WIDE -broad- distribution. Figure 3 shows the reason for this broad distribution. For each value of the Peak Contamination from Figure 3, we find in the original experimental histogram (Johns Hopkins, 2020), a curve with a Gaussian trend. This Gaussian curve presents a MINIMUM and a MAXIMUM point of contamination, and, in most of the graphics, each country's curve DOES not show a very WIDE/broad distribution. Since the World contamination curve is a whole -total amount-, the sum from individuals' curves -SUM of all curves from all the 185 countries and NOT only our 52 countries presented in Table 1-, then, it explained the wide distribution observed for the world contamination profile, (Johns Hopkins, 2020).

As a direct result of the reasoning presented above, it is understandable the reason the World temporal evolution constant -$\mathbf{K}_{\mathbf{world}}$- is larger than the individuals K:

$\mathbf{K}_{\mathbf{t}} = K_{52\ countries} = (35 \pm 5)$ days <<<>>>- $K_{world} = (47 \pm ½)$ days

Regarding Our Next Prevision

We may affirm for those countries following up an experimental Gaussian profile, the DECREASE from CONTAMINATION should trend -have the tendency- **TO ZERO** AMONG minimum of 30 to a maximum of 40 DAYS AFTER THE PEAK CONTAMINATION. These assumptions are directly CORRELATED with the public policy adopted by each country regarding the rule for the quarantine. For those countries following these minimum requirements, the model proposed in this paper works perfectly well. Furthermore, regarding the trends cited in the last paragraph, it is essential to make it clear we are facing the most critical in regarding THE ZERO contamination. This ZERO -real zero contamination- takes a while to get to null and, if no proper care -personal safety such as socializing- is adopted, the contamination starts spreading all over again.

As an example -which supports the above concern-, the graphic presented for South Korea -see daily cases at reference (Johns Hopkins, 2020), and other similar situations for other countries- clarifies the issue. By applying our $\mathbf{K}_{\mathbf{t}} = (35 \pm 5)$ days to the South Korea day of Maximum contamination, i.e., 3 March 2020, we find the following points of Minimum contamination **[**86 (3 April), 25 (13 April)**]**. However, even after the minimum value (25 contaminations), registered on 13 April 2020, when we should expect for the following days a definitive trend to null -real zero-; this real zero does not occur and, instead, we have the following new contaminations a day after the prevision of the minimum -for the day 13 April 2020-. The graphic from South Korea (Johns Hopkins, 2020) shows these news contaminations, which presents the following numbers 27, 27, 22, 22, 18, 8, and 13 -where 13 is the number of contaminated as registered on April 20, 2020 (Johns Hopkins, 2020).

Conclusion

We presented a simple and straightforward method applied to a histogram with a Gaussian tendency for calculating the spread of COVID-19 contamination, the constant K. The average value $\mathbf{K_t}$ and its standard deviations [$\mathbf{K_t}$ = (35 ± 5) days] offer a reasonable methodology to easily detect what is ongoing with the temporal spread of COVID-19. From this paper, we conclude the maximum range of the contamination will occur up to, at least, 40 days from the first registered contamination and, in the worst scenario, up to 30 days from the first registered contamination. Regarding the Brazil peak of contamination, near March 10, 2020, we predicted -inference-, the peak would be around 10-15 April/2020. We have this confirmation (Johns Hopkins, 2020).

Table 1 shows the day of minimum point of contamination for Brazil is March 9, 2020, which implies, according to the finding of $\mathbf{K_t}$ of a peak among April 9, 2020, to April 19, 2020 [$\mathbf{K_t}$ = $K_{52\ countries}$ = (35 ± 5) days]. **Our Next Prevision.** Similarly, **w**e may affirm for those countries following up an experimental Gaussian profile, the decrease from contamination should trend -have the tendency- **to zero** among a minimum of 30 to a maximum of 40 days after the peak contamination. **About the trends cited in the last paragraph, it is essential to make it clear we are facing the most critical in regarding THE ZERO contamination. This ZERO -real zero contamination- takes a while to get to null and, if no proper care -personal safety such as socializing- is adopted, the contamination starts spreading all over again.** See in this paper the explanation for the country South Korea, which is summarized: by applying our $\mathbf{K_t}$ = (35 ± 5) days to the South Korea day of Maximum contamination, i.e., March 3, 2020, and, we find the following amount for the Minimum contamination 86 on April 3/2020, and 25 on April 13/2020.

About the minimum amount of 25 contaminations for South Korea, registered on April 13, 2020, when we should expect for the following days a definitive trend to null -real zero-; this real zero does not occur and, instead, we have news contaminations a day after the prevision of the minimum -for the day April 13 2020-. On April 20, 2020, when we concluded this paper, the graphic from South Korea (Johns Hopkins, 2020) presented the following amount for the news contaminations 27 (observed on April 14, 2020), 27, 22, 22, 18, 8, and **13 (**observed on April 20, 2020), (Johns Hopkins, 2020). This situation -applying $\mathbf{K_t}$ = (35 ± 5) days to the maximum point of contamination-, could be generalized for any country presenting a histogram with Gaussian distribution and, of course, adopting as a continuum -not asymptotic- behavior towards the minimization of the contamination spread.

We also presented in the final of the section "*The Range of K_t Distribution and the Profile for the World Contamination Distribution.*", the reasons the world temporal evolution constant -$\mathbf{K_{world}}$- is larger than the individuals K. For each K_t, *m*ost of each graphics country's curve DOES not show a very WIDE/broad distribution. The World contamination curve is a whole -total amount-, the sum from individuals' curves -SUM of all curves from all the 185 countries and NOT only our 52 countries presented in Table 1-, therefore, and the wide distribution observed for the world contamination profile is clarified (see Figure 3 and explanations for more information regarding the wide of the world contamination distribution).

Finally, it is a must to present a clarification. Up to April 20, 2020, when we conclude data collection presented in Table 1, the 52 countries present their histograms as a very reasonable experimental Gaussian profile distribution. However, in the previous days, when we were writing this report, political trends around the world have generated distortions -*misleading but not with bad faith and, yes, lack of scientific knowledge*- in the human being's behavior. These political concerns about orders and counterorders aiming to withdraw socializing restrictions are published in the media. A direct and expected consequence from the publication of these orders and counterorder may be an increase in the socializing among human beings and, as a consequence, an artificial -inflated- expansion of the virus contamination rate, with profound impact in the natural experimental Gaussian distribution!

The point is, this biased breach in the restriction of socializing -STOP & GO human behavior-, for sure may generate distortion in the experimental Gaussian profile curve found up to this date -April 20, 2020, Table 1-, and, the natural trend for the virus spreading is lost. Therefore, we expect to observe this breach in the next days -after April 20, 2020-, in those countries which do not follow a strict Public Policy planning in regarding virus mass contamination. In the following subsection, we are proposing simple guidelines actions for constructing a Public Policy regarding virus mass contamination.

Final Considerations

The paper presents a straightforward method applied to a histogram with a Gaussian tendency for calculating the spread of COVID-19 contamination, the constant K -a reasonable methodology to easily detect what is ongoing with the temporal spread of the virus-. The proposal of the model is clear; however, its success depends on each country's Public Policy. A reasonable guideline for any Public Policy aiming at the decreasing of the impact of a PANDEMIC issue should consider the following principles in the written description (Federal Constitution, 2019): "legality, impersonality, morality, publicity, and efficiency." A real Public Policy should comply with these 5 Principles (Federal Constitution, 2019) or, if not, this paper could be considered as a misleading one because humans beings are stupid and do not abide by the sense of social welfare. Human being stupidity is a factor that no public policy can solve and, social welfare means citizens with health. In today's world, health includes education, technology development, economic growth, etc., all together. Therefore, the healthy of any citizens implies an explicit interdependence of the technical and social aspects englobing this citizen. We call this interdependency as a socio-technical system (Mussi, Balloni, Faraco, Cordioli, Pereira, & Dutra, 2014). Any public policy drafting towards the PANDEMIC issue must comply with the concept of a socio-technical system!

Furthermore, various studies (Winter, de Franco Rosa, Bonacin and Jino, 2019) consider technology as one of the most dynamic parts of the environment and more susceptible to failure. However, people & human behavior are as vulnerable as technology. Therefore, any government or private strategy for drafting a Public Policy towards the PANDEMIC issue depends exclusively on human beings in both design and execution.

By last, we have heard the orders and counter orders to withdraw socializing restrictions due to pure lack of knowledge -science is knowledge- and as a consequence, occurs a socializing increase among human beings which, brings an expansion of the contamination rate -new waves of COVID-X-. The withdraw of socializing restrictions may, in the mid & long term, guide us to the failure of the model proposed in this paper.

However, some countries have Public in full compliance and, they may achieve the result -GAUSSIAN CONTAMINATION TRENDING TO ZERO-, as explained in this paper. See South Korea, section "Regarding our next Prevision."

Recommendations

All over the years, we have had several issues regarding virus contamination. The suggestions are to apply the methodology explained in this short paper to observe if the same trends -previsions carried out in this paper- are valid for those previous virus issues in the world.

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Note

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