

The Present Behavior of Linear Increasing of Cases of Covid-19

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Abstract – We see in graphs the current approximately linear behavior of the advance in the number of confirmed cases, deaths and recovered cases by Covid-19.

Keywords – Brazil, coronavirus, Covid-19, France, Germany, Italy, pandemic, Russia, Spain, United Kingdom, US.

§ 1 – Introduction

In a previous article [1], I did an estimate on when Brazil would overtake other countries in numbers of confirmed cases and deaths in this present pandemic, the countries in the 8 first positions of ranking of the Covid-19 pandemic in May 11, 2020.

Respect to confirmed cases, the forecast has been very good even today, taking into account a small number of days. Brazil overtook Germany, France, Italy and Spain in the expected time (2, 2, 6 and 6 days, respectively), and probably tomorrow (05/19/2020) it will overtake the United Kingdom (8 days). The date $t = 0$ was 05/11/2020. The ranking of confirmed cases in that day is below (table 1) and the result next (table 2).

Ranking	Country	Confirmed Cases
1	US	1,329,799
2	Spain	224,350
3	Russia	221,344
4	United Kingdom	220,449
5	Italy	219,070
6	France	177,094
7	Germany	171,879
8	Brazil	162,699
9	Turkey	138,657
10	Iran	107,603
11	China	84,010

Table 1 – Number of confirmed cases by COVID-19 for 11 firsts classifications. Date: May 11, 2020. Time: 6:32:34 AM.

Ranking	Country	Confirmed Cases	Average Growth % in 16 days	Days for overtake	Deaths	Average Growth % in 16 days	Days for overtake
1	US	1,329,799	2.44	47	79,528	2.99	50
2	Spain	224,350	1.07	6	26,383	0.97	15
3	Russia	221,344	7.24	826	2,009	7.36	0
4	United Kingdom	220,449	2.67	8	31,930	1.93	22
5	Italy	219,070	0.79	6	30,560	1.03	18
6	France	177,094	0.80	2	26,383	1.08	16
7	Germany	171,879	0.74	2	7,569	2.09	0
8	Brazil	162,699	7.28	0	11,123	7.19	0

Table 2 – Number of days for that Brazil overtake other countries in COVID-19 pandemic.
Date $t = 0$: May 11, 2020.

These calculations did not take into account the population variation due to causes that occur routinely (births, deaths, immigrations), nor did they take into account the number of cases recovered by Covid-19, when this part of the population would be considered immune to the disease. When graphing the number of cases recovered over time, it was surprising to notice that the growth is approximately linear, as well as the number of confirmed cases and deaths in most of the countries analyzed.

In next section we will show the graphs generated with data from 04/25/2020 to 05/16/2020, a date range of 3 weeks, taken from *Wikipedia* and the Johns Hopkins University (J.H.U.) website.

§ 2 – Tables and Graphs

§ 2.1 – U.S.

Date (MM/DD/YYYY)	# of cases	# of deaths	# of recovereds
04/25/2020	933,698 (+3.9%)	47,916 (+4.0%)	99,079
04/26/2020	960,582 (+2.9%)	49,077 (+2.4%)	105,818
04/27/2020	982,668 (+2.3%)	50,314 (+2.5%)	107,045
04/28/2020	1,007,097 (+2.5%)	52,518 (+4.4%)	111,583
04/29/2020	1,033,001 (+2.6%)	55,054 (+4.8%)	115,936
04/30/2020	1,062,675 (+2.9%)	57,137 (+3.8%)	124,023
05/01/2020	1,095,682 (+3.1%)	58,931 (+3.1%)	153,947
05/02/2020	1,126,250 (+2.8%)	60,599 (+2.8%)	164,015
05/03/2020	1,151,643 (+2.3%)	61,716 (+1.8%)	175,382
05/04/2020	1,172,921 (+1.8%)	62,593 (+1.4%)	180,152
05/05/2020	1,195,173 (+1.9%)	65,028 (+3.9%)	187,180
05/06/2020	1,220,032 (+2.1%)	67,729 (+4.2%)	189,791
05/07/2020	1,247,567 (+2.2%)	69,700 (+2.9%)	189,910
05/08/2020	1,274,681 (+2.2%)	71,395 (+2.4%)	195,036
05/09/2020	1,300,243 (+2.0%)	72,950 (+2.2%)	198,993
05/10/2020	1,320,621 (+1.6%)	73,891 (+1.3%)	212,534
05/11/2020	1,338,720 (+1.3%)	74,735 (+1.1%)	216,169
05/12/2020	1,360,195 (+1.6%)	76,326 (+2.1%)	232,733
05/13/2020	1,380,755 (+1.5%)	78,041 (+2.2%)	230,287
05/14/2020	1,407,531 (+1.9%)	79,899 (+2.4%)	243,430
05/15/2020	1,432,899 (+1.8%)	81,423 (+1.9%)	246,414
05/16/2020	1,457,426 (+1.7%)	82,654 (+1.5%)	250,747

Table 3 – Confirmed cases, deaths and recovered cases in the United States of America.
Source: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_the_United_States and J.H.U.

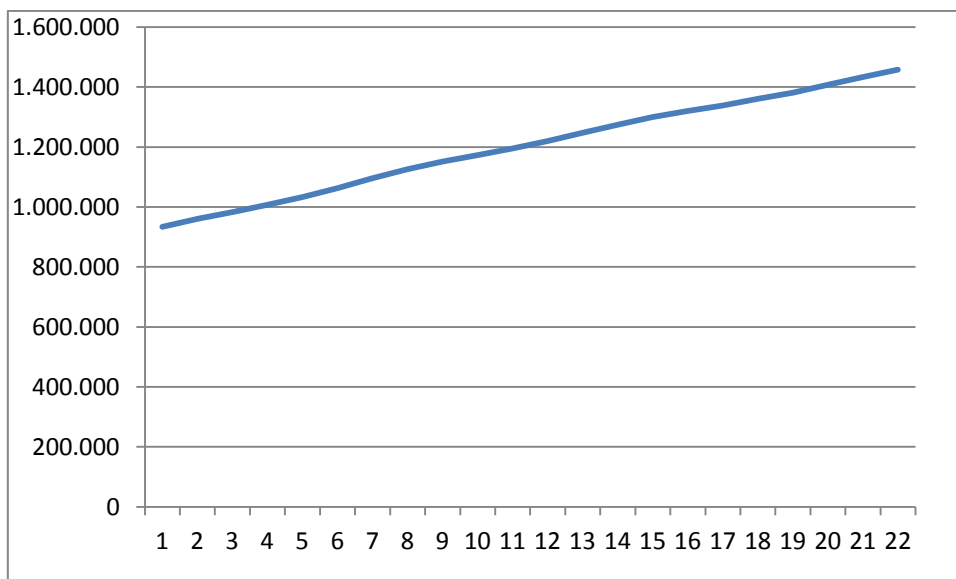


Figure 1 – Confirmed cases from 04/25/2020 to 05/16/2020 – U.S.

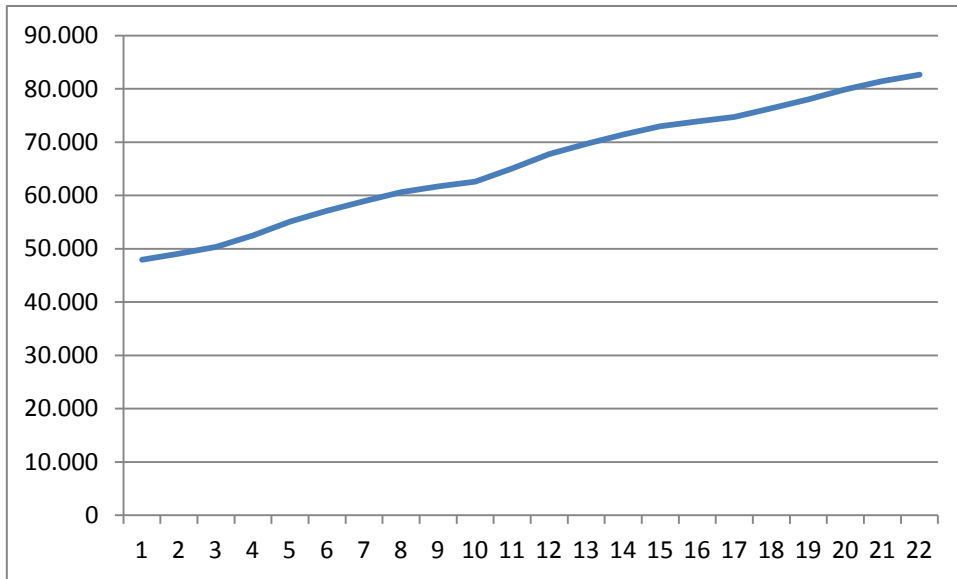


Figure 2 – Deaths by COVID-19 from 04/25/2020 to 05/16/2020 – U.S.

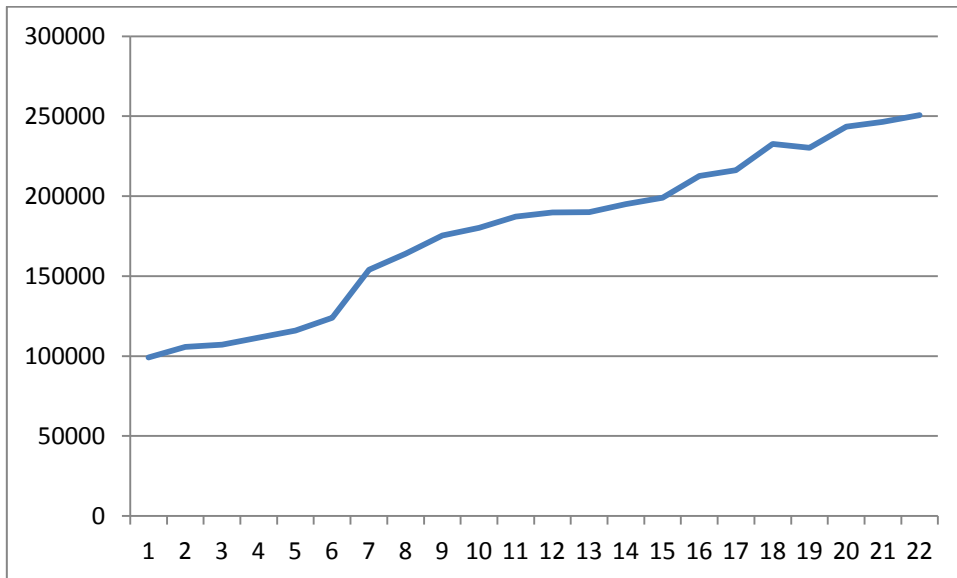


Figure 3 – Recovered cases from 04/25/2020 to 05/16/2020 – U.S.

§ 2.2 – Spain

Date (MM/DD/YYYY)	# of cases	# of deaths	# of recovereds
04/25/2020	228,610 (+1.2%)	23,190 (+1.3%)	92,355
04/26/2020	231,236 (+1.1%)	23,521 (+1.4%)	95,708
04/27/2020	234,156 (+1.3%)	23,822 (+1.3%)	117,727
04/28/2020	237,615 (+1.5%)	24,275 (+1.9%)	120,832
04/29/2020	240,743 (+1.3%)	24,543 (+1.1%)	123,903
04/30/2020	243,991 (+1.3%)	24,824 (+1.1%)	132,929
05/01/2020	246,449 (+1.0%)	25,100 (+1.1%)	112,050
05/02/2020	248,028 (+0.64%)	25,264 (+0.65%)	112,050
05/03/2020	249,120 (+0.44%)	25,428 (+0.65%)	117,248
05/04/2020	251,081 (+0.79%)	25,613 (+0.73%)	118,902
05/05/2020	254,050 (+1.2%)	25,857 (+0.95%)	121,343
05/06/2020	256,855 (+1.1%)	26,070 (+0.82%)	123,486
05/07/2020	260,117 (+1.3%)	26,299 (+0.88%)	126,002
05/08/2020	262,783 (+1.0%)	26,478 (+0.68%)	128,511
05/09/2020	264,670 (+0.72%)	26,621 (+0.54%)	131,148
05/10/2020	268,143 (+1.3%)	26,744 (+0.46%)	133,952
05/11/2020	269,520 (+0.51%)	26,920 (+0.66%)	136,166
05/12/2020	271,095 (+0.58%)	27,104 (+0.68%)	137,139
05/13/2020	272,646 (+0.58%)	27,321 (+0.8%)	138,980
05/14/2020	274,367 (+0.63%)	27,459 (+0.51%)	140,823
05/15/2020	276,505 (+0.78%)	27,563 (+0.38%)	144,783

Table 4 – Confirmed cases, deaths and recovered cases in Spain.

Source: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Spain and J.H.U.

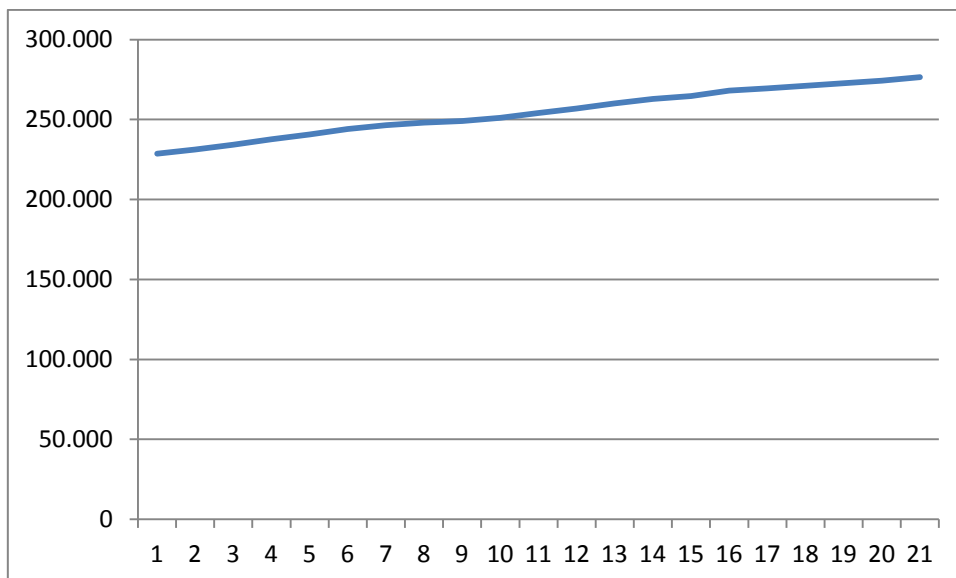


Figure 4 – Confirmed cases from 04/25/2020 to 05/15/2020 – Spain

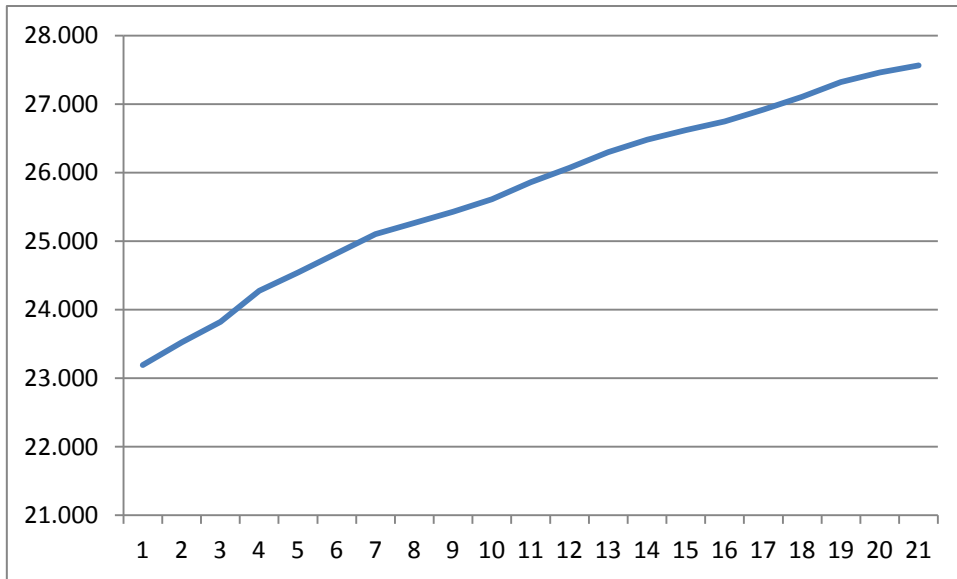


Figure 5 – Deaths by COVID-19 from 04/25/2020 to 05/15/2020 – Spain

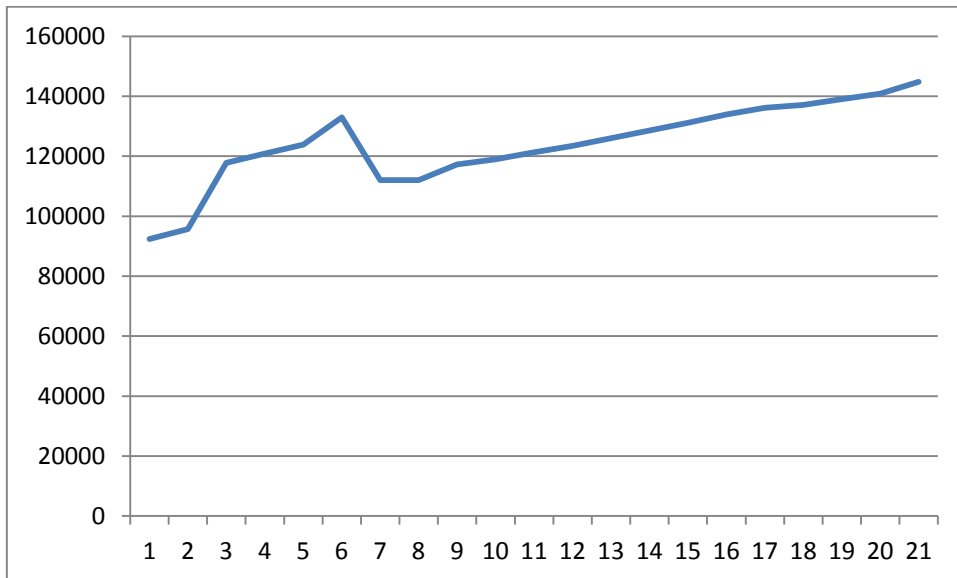


Figure 6 – Recovered cases from 04/25/2020 to 05/15/2020 – Spain

§ 2.3 – Russia

Date (MM/DD/YYYY)	# of cases	# of deaths	# of recovered
04/25/2020	74,588 (+8.7%)	681 (+11%)	5,568
04/26/2020	80,949 (+8.5%)	747 (+9.7%)	6,767
04/27/2020	87,147 (+7.7%)	794 (+6.3%)	7,346
04/28/2020	93,558 (+7.4%)	867 (+9.2%)	8,456
04/29/2020	99,399 (+6.2%)	972 (+12%)	10,286
04/30/2020	106,498 (+7.1%)	1,073 (+10%)	11,619
05/01/2020	114,431 (+7.4%)	1,165 (+8.6%)	13,220
05/02/2020	124,054 (+8.4%)	1,222 (+4.9%)	15,013
05/03/2020	134,687 (+8.6%)	1,280 (+4.7%)	16,639
05/04/2020	145,268 (+7.9%)	1,356 (+5.9%)	18,095
05/05/2020	155,370 (+7%)	1,451 (+7%)	19,865
05/06/2020	165,929 (+6.8%)	1,537 (+5.9%)	21,327
05/07/2020	177,160 (+6.8%)	1,625 (+5.7%)	23,803
05/08/2020	187,859 (+6%)	1,723 (+6%)	26,680
05/09/2020	198,676 (+5.8%)	1,827 (+6%)	31,916
05/10/2020	209,688 (+5.5%)	1,915 (+4.8%)	34,306
05/11/2020	221,344 (+5.6%)	2,009 (+4.9%)	39,801
05/12/2020	232,243 (+4.9%)	2,116 (+5.3%)	43,512
05/13/2020	242,271 (+4.3%)	2,212 (+4.5%)	48,003
05/14/2020	252,245 (+4.1%)	2,305 (+4.2%)	53,530
05/15/2020	262,843 (+4.2%)	2,418 (+4.9%)	58,226
05/16/2020	272,043 (+3.5%)	2,537 (+4.9%)	63,166

Table 5 – Confirmed cases, deaths and recovered cases in Russia.

Source: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Russia and J.H.U.

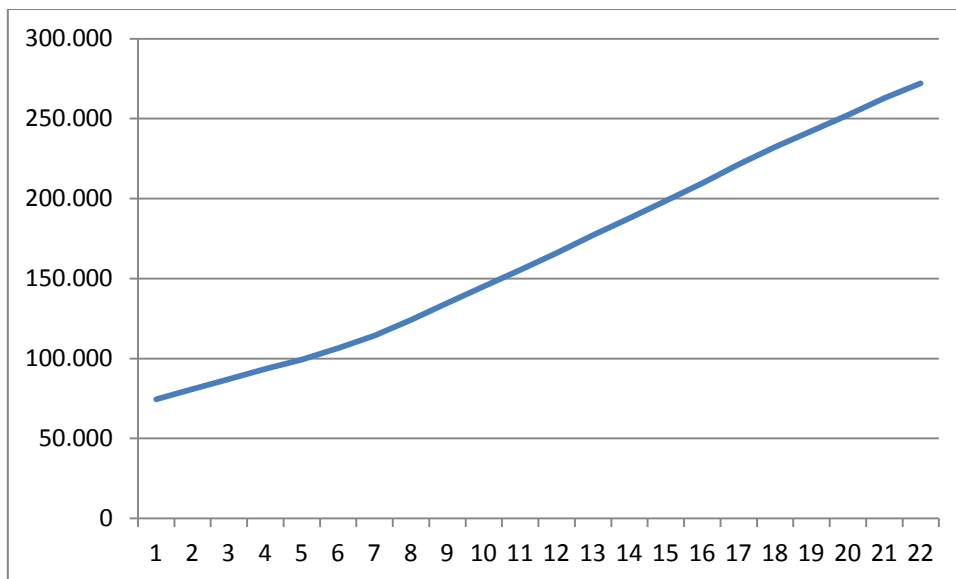


Figure 7 – Confirmed cases from 04/25/2020 to 05/16/2020 – Russia

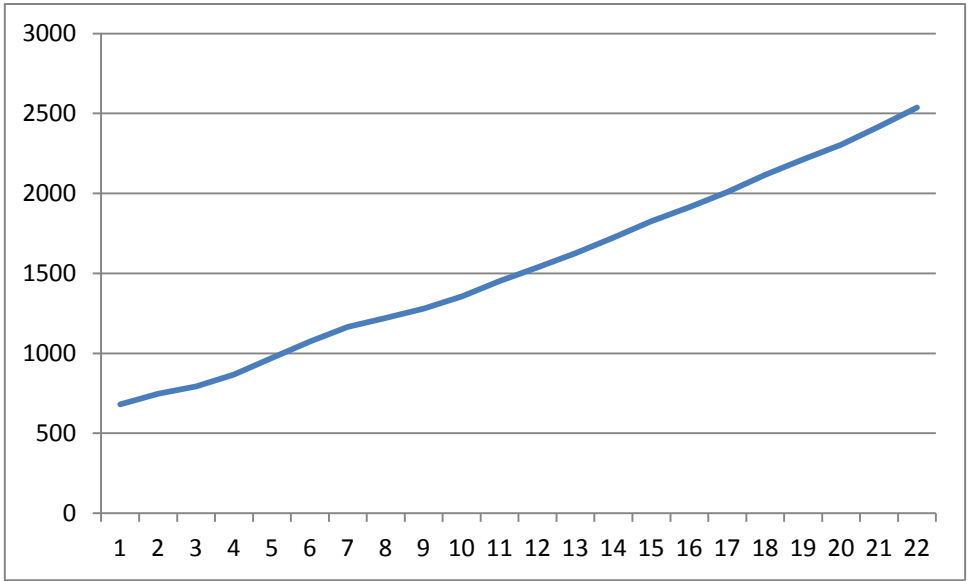


Figure 8 – Deaths by COVID-19 from 04/25/2020 to 05/16/2020 – Russia

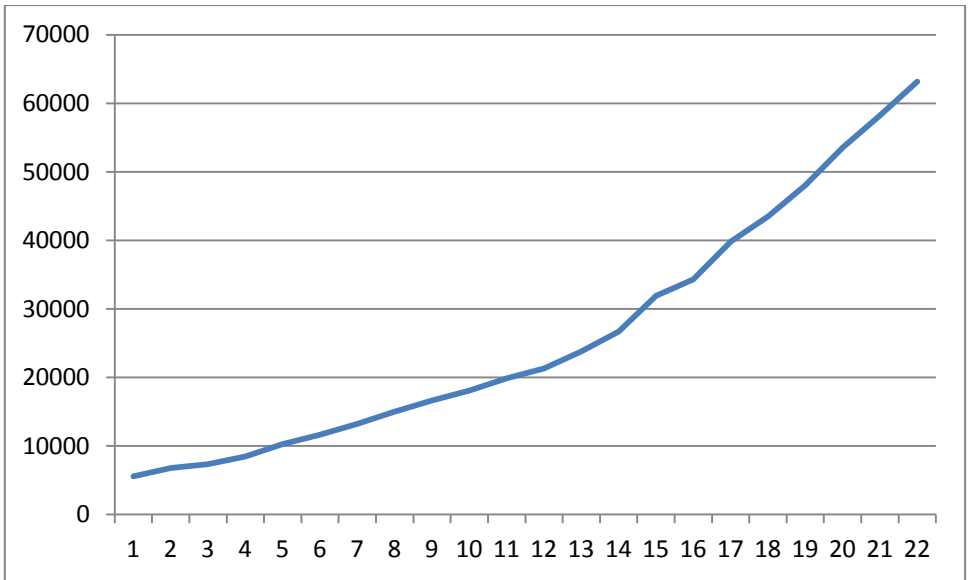


Figure 9 – Recovered cases from 04/25/2020 to 05/16/2020 – Russia

§ 2.4 – United Kingdom

Date (MM/DD/YYYY)	Cases (% rise)	Deaths (% rise)	Recovereds
04/25/2020	148,377 (3.4%)	24,055 (1.8%)	724
04/26/2020	152,840 (3.0%)	24,393 (1.4%)	774
04/27/2020	157,149 (2.8%)	25,302 (3.7%)	780
04/28/2020	161,145 (2.5%)	26,097 (3.1%)	809
04/29/2020	165,221 (2.5%)	26,771 (2.6%)	813
04/30/2020	171,253 (3.7%)	27,510 (2.8%)	857
05/01/2020	177,454 (3.6%)	28,131 (2.3%)	861
05/02/2020	182,260 (2.7%)	28,446 (1.1%)	892
05/03/2020	186,599 (2.4%)	28,734 (1.0%)	901
05/04/2020	190,584 (2.1%)	29,427 (2.4%)	902
05/05/2020	194,990 (2.3%)	30,076 (2.2%)	910
05/06/2020	201,101 (3.1%)	30,615 (1.8%)	926
05/07/2020	206,715 (2.8%)	31,241 (2.0%)	934
05/08/2020	211,364 (2.2%)	31,587 (1.1%)	970
05/09/2020	215,260 (1.8%)	31,855 (0.8%)	998
05/10/2020	219,183 (1.8%)	32,065 (0.7%)	1,002
05/11/2020	223,060 (1.8%)	32,692 (2.0%)	1,002
05/12/2020	226,463 (1.5%)	33,186 (1.5%)	1,015
05/13/2020	229,705 (1.4%)	33,614 (1.3%)	1,025
05/14/2020	233,151 (1.5%)	33,998 (1.1%)	1,032
05/15/2020	236,711 (1.5%)	34,466 (1.4%)	1,045

Table 6 – Confirmed cases, deaths and recovered cases in the United Kingdom.

Source: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_the_United_Kingdom and

J.H.U.

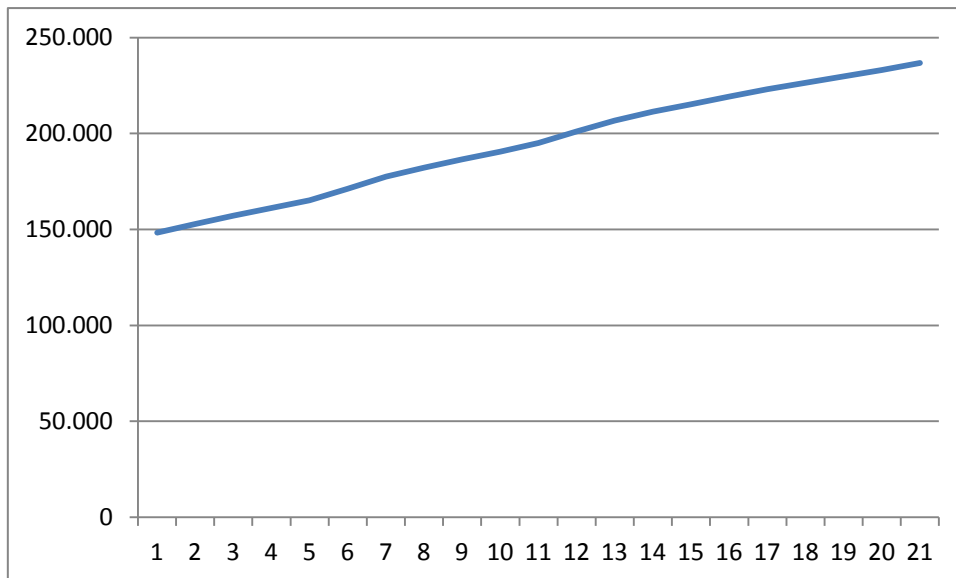


Figure 10 – Confirmed cases from 04/25/2020 to 05/15/2020 – United Kingdom

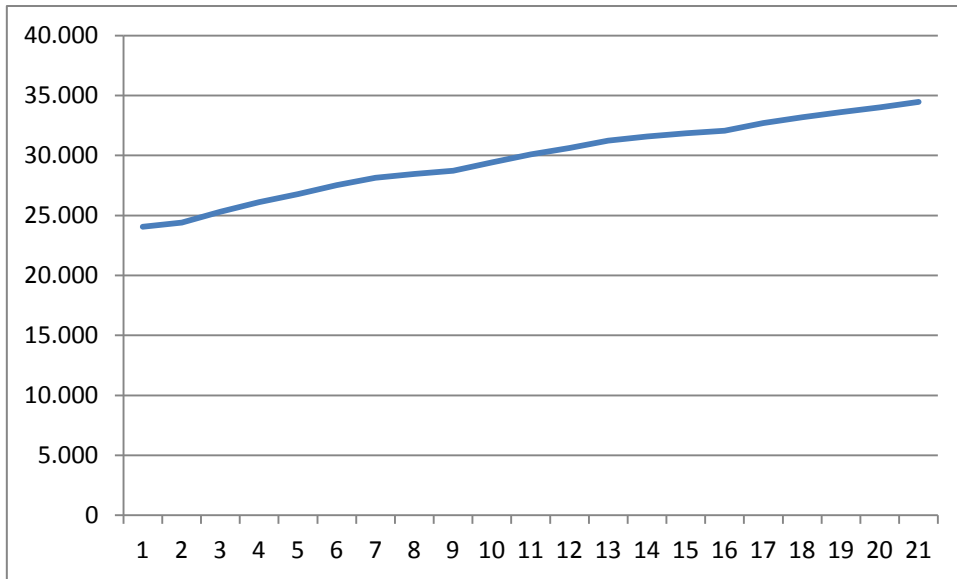


Figure 11 – Deaths by COVID-19 from 04/25/2020 to 05/15/2020 – United Kingdom

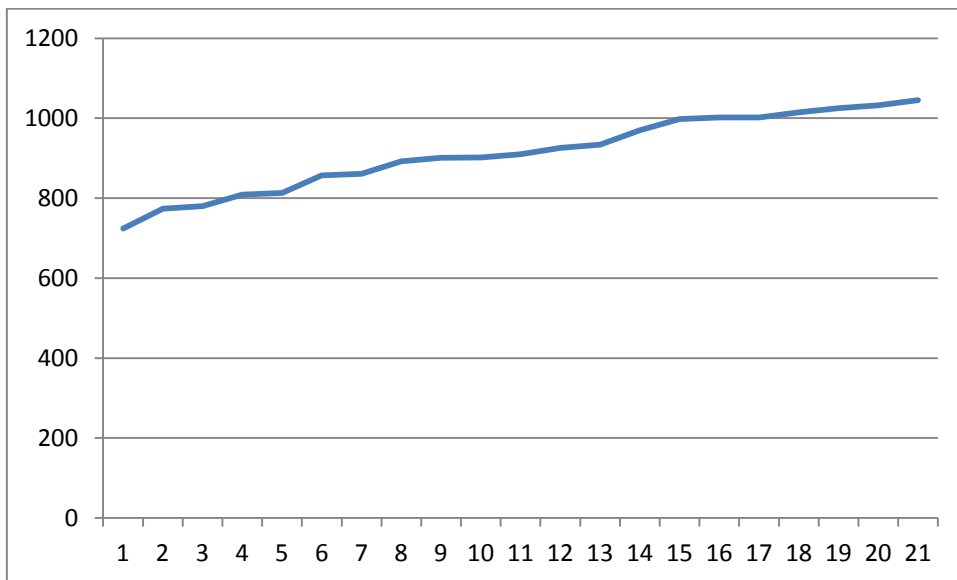


Figure 12 – Recovered cases from 04/25/2020 to 05/15/2020 – United Kingdom

§ 2.5 – Italy

Date (MM/DD/YYYY)	# of cases	# of deaths	# of recovered
04/25/2020	195,351 (+1.2%)	26,384 (+1.6%)	60,498
04/26/2020	197,675 (+1.2%)	26,644 (+1.0%)	63,120
04/27/2020	199,414 (+0.88%)	26,977 (+1.2%)	64,928
04/28/2020	201,505 (+1.0%)	27,359 (+1.4%)	66,624
04/29/2020	203,591 (+1.0%)	27,682 (+1.2%)	68,941
04/30/2020	205,463 (+0.92%)	27,967 (+1.0%)	71,252
05/01/2020	207,428 (+0.96%)	28,236 (+0.96%)	75,945
05/02/2020	209,328 (+0.92%)	28,710 (+1.7%)	79,914
05/03/2020	210,717 (+0.66%)	28,884 (+0.61%)	79,914
05/04/2020	211,938 (+0.58%)	29,079 (+0.68%)	81,654
05/05/2020	213,013 (+0.51%)	29,315 (+0.81%)	82,879
05/06/2020	214,457 (+0.68%)	29,684 (+1.3%)	85,231
05/07/2020	215,858 (+0.65%)	29,958 (+0.92%)	93,245
05/08/2020	217,185 (+0.61%)	30,201 (+0.81%)	96,276
05/09/2020	218,268 (+0.50%)	30,395 (+0.64%)	99,023
05/10/2020	219,070 (+0.37%)	30,560 (+0.54%)	103,031
05/11/2020	219,814 (+0.34%)	30,739 (+0.59%)	105,186
05/12/2020	221,216 (+0.64%)	30,911 (+0.56%)	106,587
05/13/2020	222,104 (+0.40%)	31,106 (+0.63%)	109,039
05/14/2020	223,096 (+0.45%)	31,368 (+0.84%)	112,541
05/15/2020	223,885 (+0.35%)	31,610 (+0.77%)	115,288

Table 13 – Confirmed cases, deaths and recovered cases in Italy.

Source: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Italy and J.H.U.

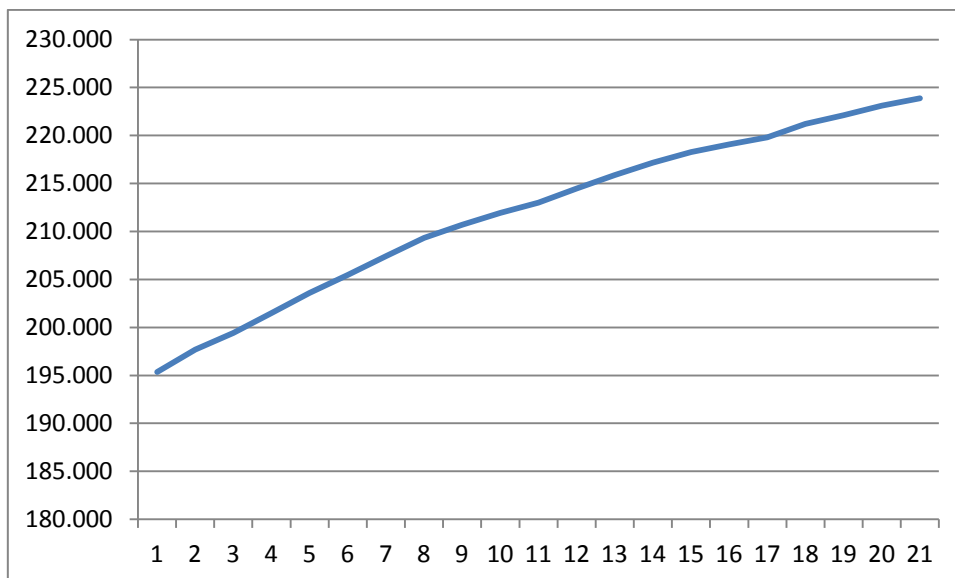


Figure 13 – Confirmed cases from 04/25/2020 to 05/15/2020 – Italy

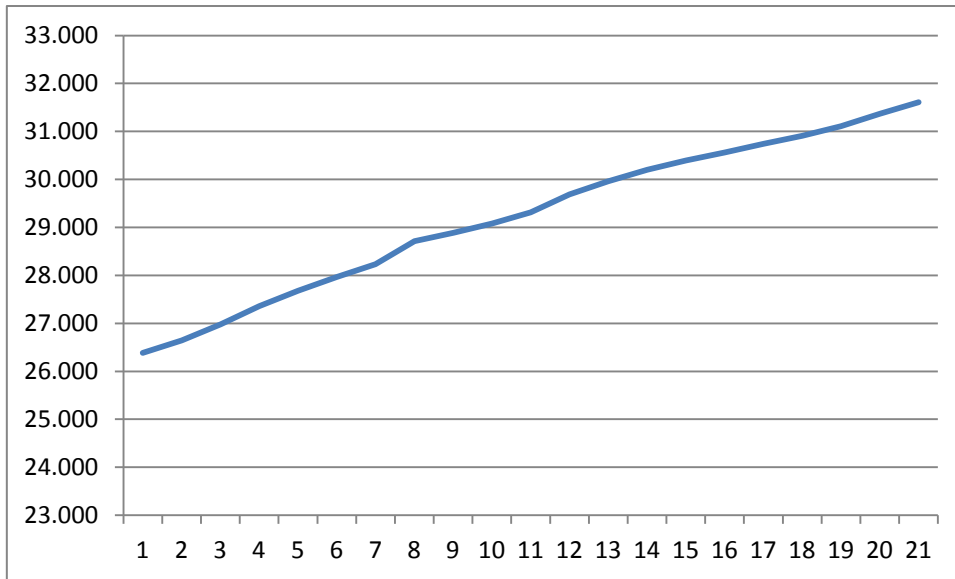


Figure 14 – Deaths by COVID-19 from 04/25/2020 to 05/15/2020 – Italy

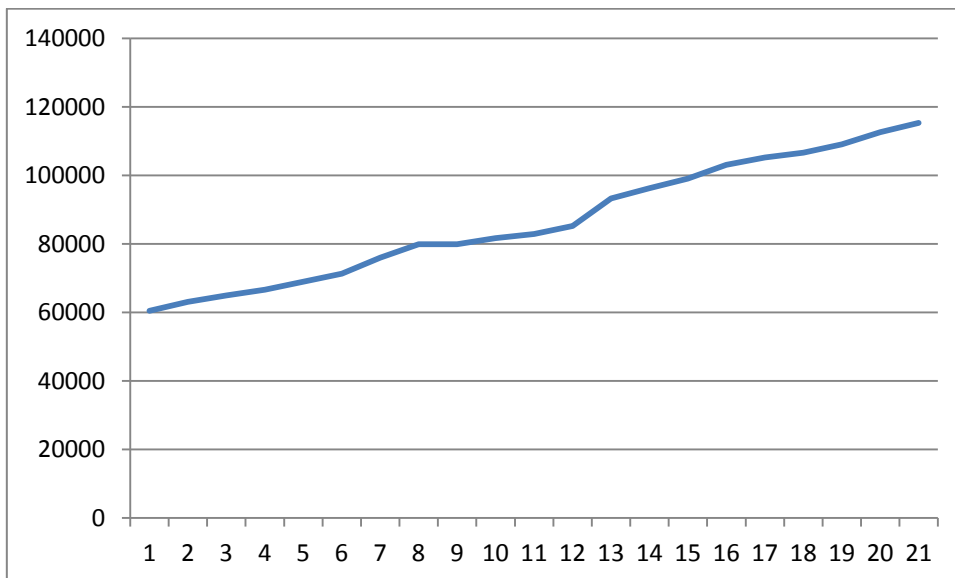


Figure 15 – Recovered cases from 04/25/2020 to 05/15/2020 – Italy

§ 2.6 – France

Date (MM/DD/YYYY)	# of cases	# of deaths	# of recovered
04/25/2020	124,114 (+1.3%)	22,614 (+1.7%)	44,271
04/26/2020	124,575 (+0.37%)	22,856 (+1.1%)	45,372
04/27/2020	125,770 (+1.0%)	23,293 (+1.9%)	45,683
04/28/2020	126,835 (+0.85%)	23,660 (+1.6%)	46,303
04/29/2020	128,442 (+1.3%)	24,087 (+1.8%)	47,775
04/30/2020	129,581 (+0.89%)	24,376 (+1.2%)	49,118
05/01/2020	130,185 (+0.47%)	24,594 (+0.89%)	50,380
05/02/2020	130,979 (+0.61%)	24,760 (+0.67%)	50,212
05/03/2020	131,287 (+0.24%)	24,895 (+0.55%)	50,663
05/04/2020	131,863 (+0.44%)	25,201 (+1.2%)	50,885
05/05/2020	132,967 (+0.84%)	25,531 (+1.3%)	51,476
05/06/2020	137,150 (+3.14%)	25,809 (+1.1%)	52,859
05/07/2020	137,779 (+0.46%)	25,987 (+0.69%)	54,081
05/08/2020	138,421 (+0.47%)	26,230 (+0.94%)	55,191
05/09/2020	138,854 (+0.31%)	26,310 (+0.30%)	55,892
05/10/2020	139,063 (+0.15%)	26,380 (+0.27%)	56,148
05/11/2020	139,519 (+0.33%)	26,643 (+1.0%)	56,327
05/12/2020	140,227 (+0.51%)	26,991 (+1.3%)	56,835
05/13/2020	140,734 (+0.36%)	27,074 (+0.31%)	57,898
05/14/2020	141,356 (+0.44%)	27,425 (+1.3%)	58,786
05/15/2020	141,919 (+0.40%)	27,529 (+0.38%)	59,719
05/16/2020	142,291 (+0.26%)	27,625 (+0.35%)	60,562

Table 8 – Confirmed cases, deaths and recovered cases in France.

Source: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_France and J.H.U.

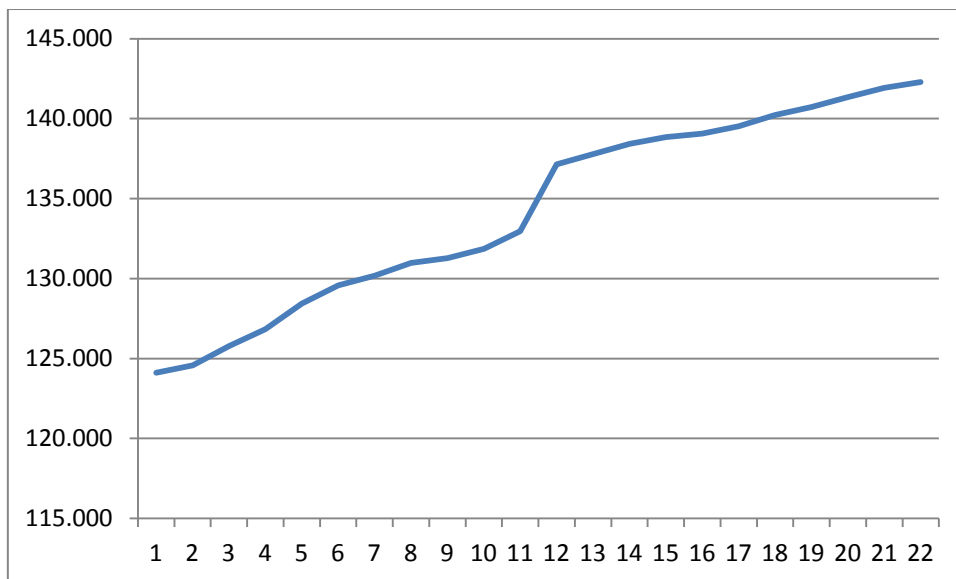


Figure 16 – Confirmed cases from 04/25/2020 to 05/16/2020 – France

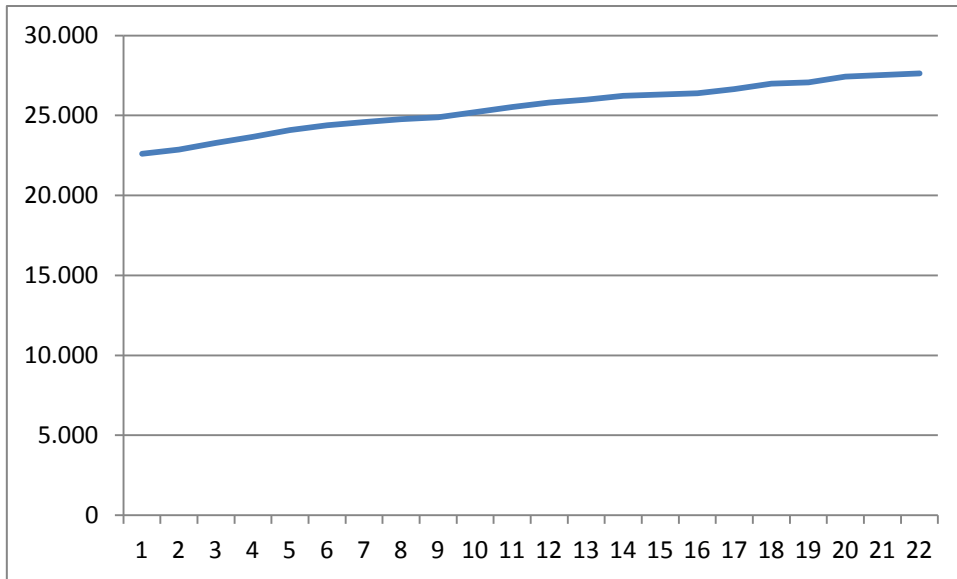


Figure 17 – Deaths by COVID-19 from 04/25/2020 to 05/16/2020 – France

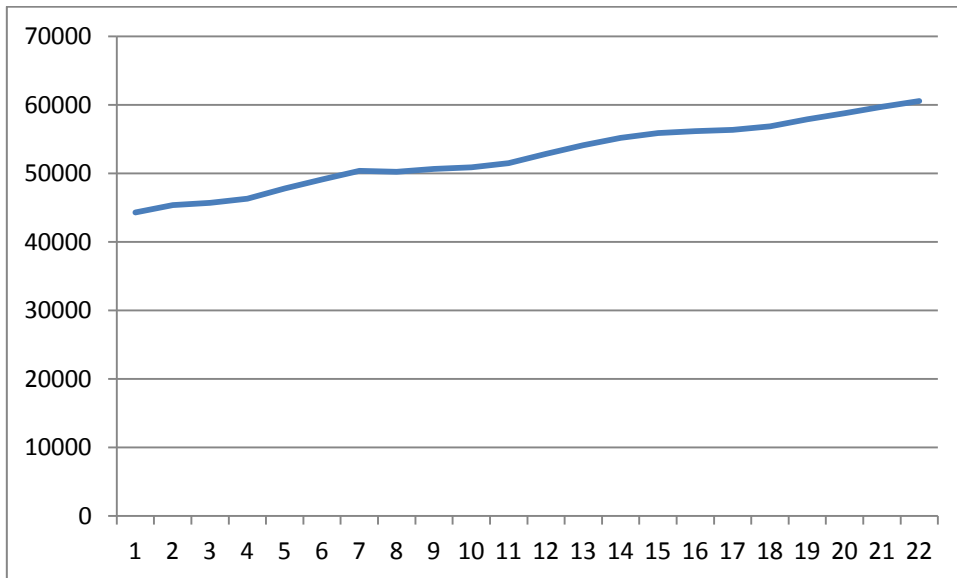


Figure 18 – Recovered cases from 04/25/2020 to 05/16/2020 – France

§ 2.7 – Germany

Date (MM/DD/YYYY)	# of cases	# of deaths	# of recovered
04/25/2020	152,438 (+1.37%)	5,500 (+3.4%)	109,800
04/26/2020	154,175 (+1.14%)	5,640 (+2.6%)	109,800
04/27/2020	155,193 (+0.66%)	5,750 (+2.0%)	114,500
04/28/2020	156,337 (+0.74%)	5,913 (+2.8%)	114,500
04/29/2020	157,641 (+0.83%)	6,115 (+3.4%)	120,400
04/30/2020	159,119 (+0.94%)	6,288 (+2.8%)	123,500
05/01/2020	160,758 (+1.03%)	6,481 (+3.1%)	126,900
05/02/2020	161,703 (+0.59%)	6,575 (+1.5%)	129,000
05/03/2020	162,496 (+0.49%)	6,649 (+1.1%)	130,600
05/04/2020	163,175 (+0.42%)	6,692 (+0.65%)	132,700
05/05/2020	163,860 (+0.42%)	6,831 (+2.1%)	135,100
05/06/2020	164,807 (+0.58%)	6,996 (+2.4%)	137,400
05/07/2020	166,091 (+0.78%)	7,119 (+1.8%)	139,900
05/08/2020	167,300 (+0.73%)	7,266 (+2.1%)	141,700
05/09/2020	168,551 (+0.75%)	7,369 (+1.4%)	143,300
05/10/2020	169,218 (+0.40%)	7,395 (+0.35%)	144,400
05/11/2020	169,575 (+0.21%)	7,417 (+0.30%)	145,600
05/12/2020	170,508 (+0.55%)	7,533 (+1.6%)	147,200
05/13/2020	171,306 (+0.47%)	7,634 (+1.3%)	148,700
05/14/2020	172,239 (+0.54%)	7,723 (+1.2%)	153,300
05/15/2020	173,152 (+0.53%)	7,824 (+1.3%)	151,547
05/16/2020	173,772 (+0.36%)	7,881 (+0.73%)	151,597

Table 9 – Confirmed cases, deaths and recovered cases in Germany.

Source: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Germany and J.H.U.

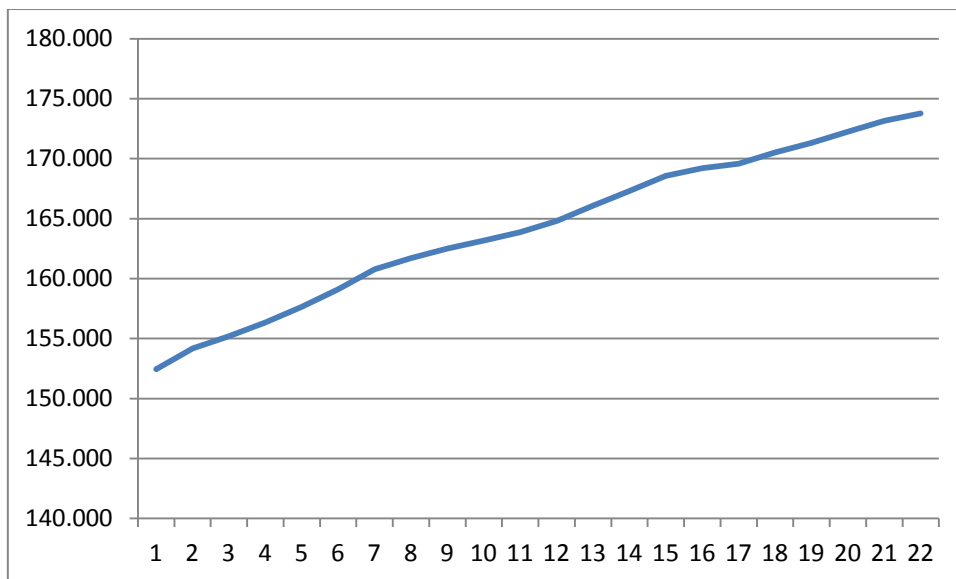


Figure 19 – Confirmed cases from 04/25/2020 to 05/16/2020 – Germany

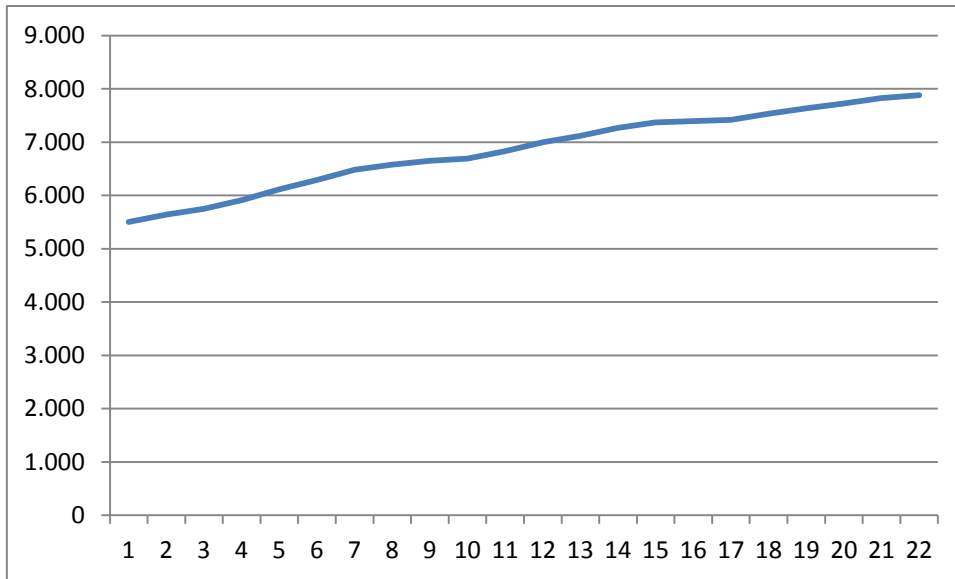


Figure 20 – Deaths by COVID-19 from 04/25/2020 to 05/16/2020 – Germany

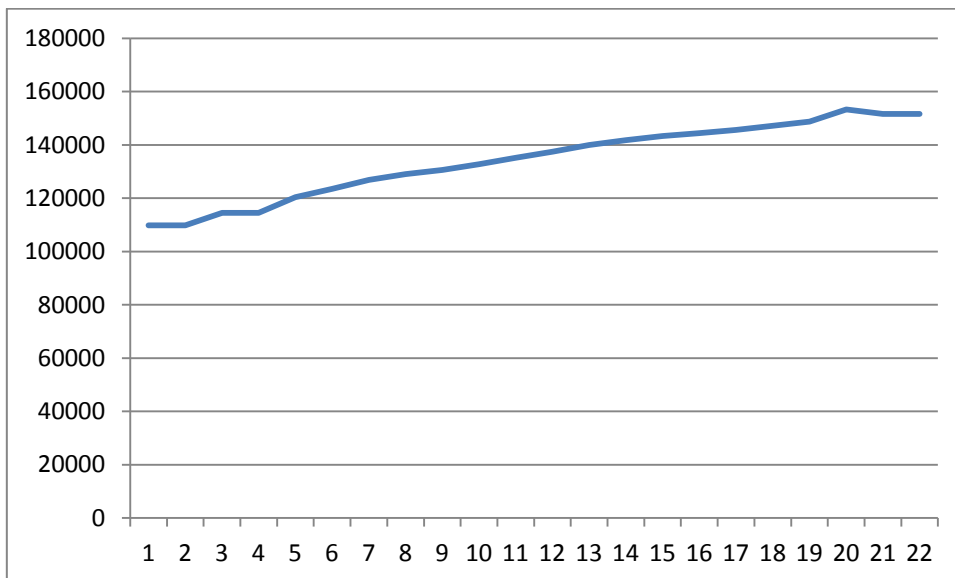


Figure 21 – Recovered cases from 04/25/2020 to 05/16/2020 – Germany

§ 2.8 – Brazil

Date (MM/DD/YYYY)	# of cases	# of deaths	# of recovered
04/25/2020	58,509 (+10.4%)	4,016 (+9.4%)	27,655
04/26/2020	61,888 (+5.8%)	4,205 (+4.7%)	29,160
04/27/2020	66,501 (+7.5%)	4,543 (+8.0%)	30,152
04/28/2020	71,886 (+8.1%)	5,017 (+10.4%)	31,142
04/29/2020	78,162 (+8.7%)	5,466 (+8.9%)	32,544
04/30/2020	85,380 (+9.2%)	5,901 (+8.0%)	34,132
05/01/2020	91,589 (+7.3%)	6,329 (+7.3%)	35,935
05/02/2020	96,559 (+5.4%)	6,750 (+6.7%)	38,039
05/03/2020	101,147 (+4.8%)	7,025 (+4.1%)	40,937
05/04/2020	107,780 (+6.6%)	7,321 (+4.2%)	42,991
05/05/2020	114,715 (+6.4%)	7,921 (+8.2%)	45,815
05/06/2020	125,218 (+9.2%)	8,536 (+7.8%)	48,221
05/07/2020	135,106 (+7.9%)	9,146 (+7.1%)	51,370
05/08/2020	145,328 (+7.6%)	9,897 (+8.2%)	55,350
05/09/2020	155,939 (+7.3%)	10,627 (+7.4%)	59,297
05/10/2020	162,699 (+4.3%)	11,123 (+4.7%)	61,685
05/11/2020	168,331 (+3.5%)	11,519 (+3.6%)	64,957
05/12/2020	178,214 (+5.9%)	12,461 (+8.2%)	67,384
05/13/2020	188,974 (+6.0%)	13,149 (+5.5%)	72,597
05/14/2020	202,918 (+7.3%)	13,993 (+6.4%)	78,424
05/15/2020	218,223 (+7.5%)	14,817 (+5.8%)	79,479

Table 10 – Confirmed cases, deaths and recovered cases in Brazil.

Source: https://en.wikipedia.org/wiki/COVID-19_pandemic_in_Brazil and J.H.U.

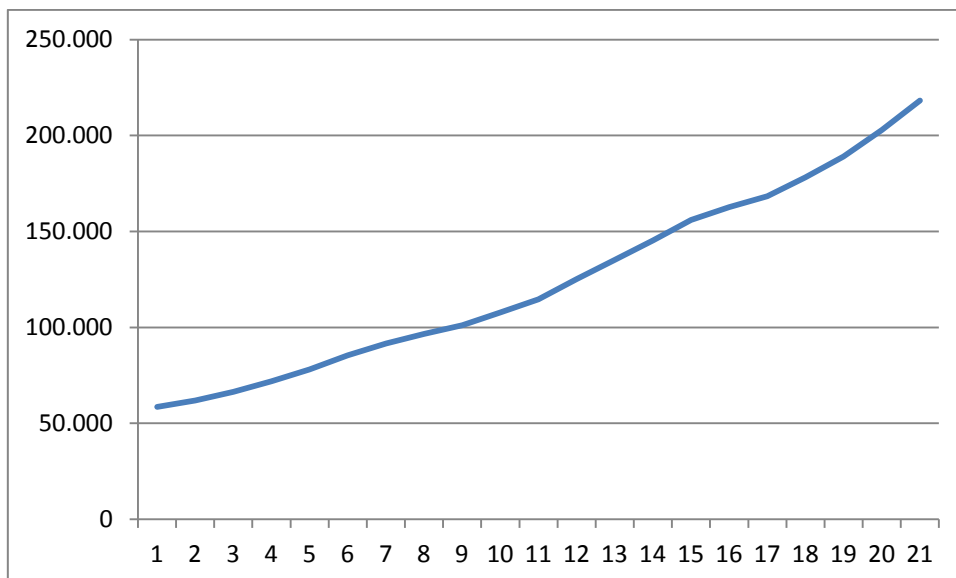


Figure 22 – Confirmed cases from 04/25/2020 to 05/15/2020 – Brazil

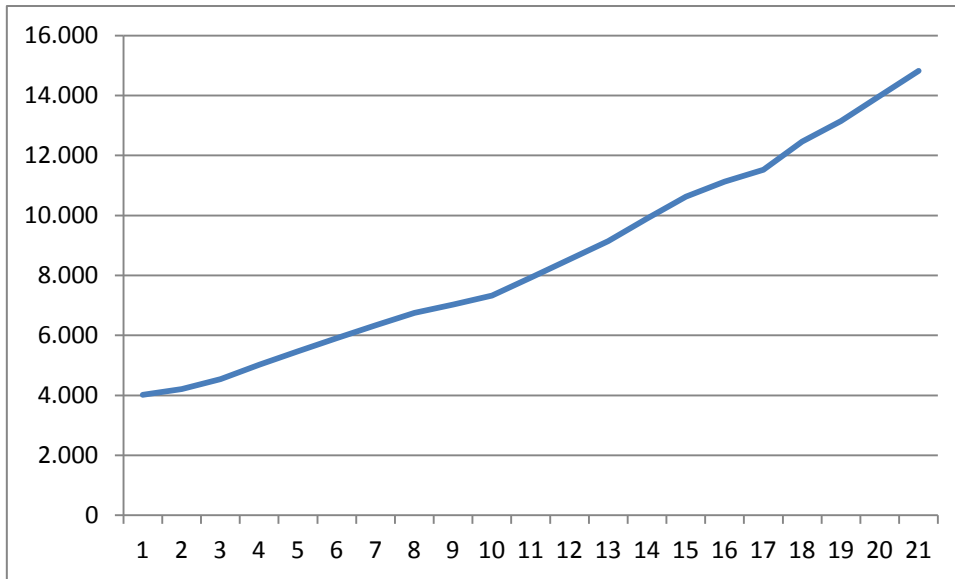


Figure 23 – Deaths by COVID-19 from 04/25/2020 to 05/15/2020 – Brazil

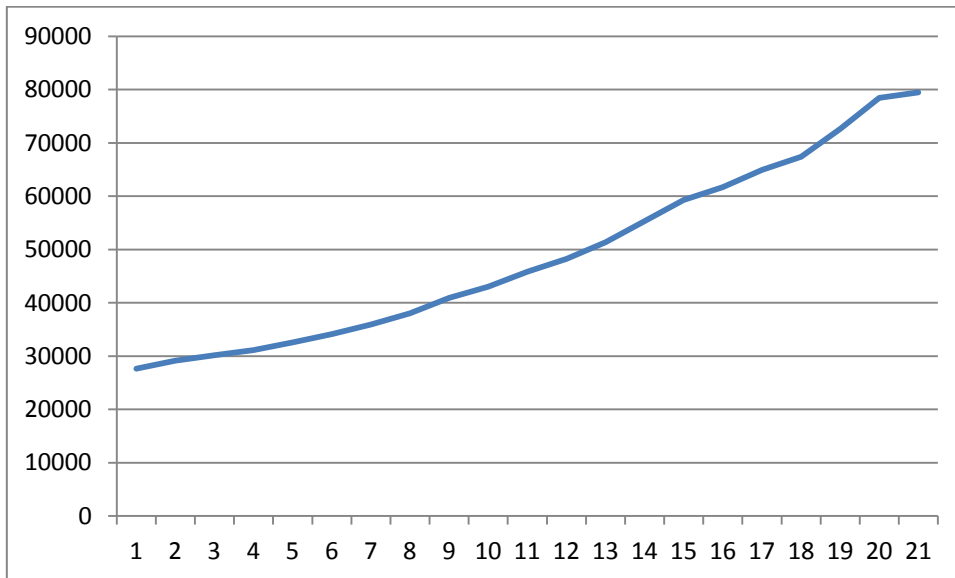


Figure 24 – Recovered cases from 04/25/2020 to 05/15/2020 – Brazil

§ 3 – Conclusion

For a long period of time, it still does not seem possible to make a more accurate forecast on the number of confirmed cases, deaths and recovered cases of Covid-19, as it is not clear whether the long-term behavior of this disease will be exponential or linear, or will follow some other function. At the beginning of the pandemic, around the beginning of 2020, there was not much doubt about the exponential trend of its

growth, but with the passage of time, with so many strong measures being adopted, a linear trend may now occur, although I cannot identify, in the countries analyzed, no clear downward trend.

Most of the graphs we display show an approximately linear predominance in their behavior, except for the number of recovered cases in Russia (table 5 and figure 9) and data from Brazil (table 10 and figures 22, 23 and 24), which are apparently exponential. The graph presented in J.H.U. from mid-March until today for confirmed cases it is clearly linear.

References:

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