“Analysis of nCov-2019 Data on 2/10/2020” by Michael Levitt, Stanford University,

Date	Day	Cases Confirmed			Number Deaths			Death Rate (%)			Ratio Hubei/ Others	Fraction Change Cases Confirmed			Fraction Change Number Deaths		
		Total	Hubei	Others	Total	Hubei	Others	Total	Hubei	Others		Total	Hubei	Others	Total	Hubei	Others
1/22/2020	54	555	444	111	0	0	0	0.00%	0.00%	0.00%	0.0						
1/23/2020	55	653	444	209	18	17	1	2.76%	3.83%	0.48%	8.0	1.177	1.000	1.883	-	-	-
1/24/2020	56	941	549	392	26	24	2	2.76%	4.37%	0.51%	8.6	1.441	1.236	1.876	1.444	1.412	2.000
1/25/2020	57	2019	1052	967	56	52	4	2.77%	4.94%	0.41%	11.9	2.146	1.916	2.467	2.154	2.167	2.000
1/26/2020	58	2794	1423	1371	80	76	4	2.86%	5.34%	0.29%	18.3	1.384	1.353	1.418	1.429	1.462	1.000
1/27/2020	59	4473	2714	1759	107	100	7	2.39%	3.68%	0.40%	9.3	1.601	1.907	1.283	1.338	1.316	1.750
1/28/2020	60	6047	3554	2493	132	125	7	2.18%	3.52%	0.28%	12.5	1.352	1.310	1.417	1.234	1.250	1.000
1/29/2020	61	7783	4586	3197	170	162	8	2.18%	3.53%	0.25%	14.1	1.287	1.290	1.282	1.288	1.296	1.143
1/30/2020	62	9776	5806	3970	213	204	9	2.18%	3.51%	0.23%	15.5	1.256	1.266	1.242	1.253	1.259	1.125
1/31/2020	63	11374	7153	4221	259	249	10	2.28%	3.48%	0.24%	14.7	1.163	1.232	1.063	1.216	1.221	1.111
2/1/2020	64	14562	9074	5488	305	294	11	2.09%	3.24%	0.20%	16.2	1.280	1.269	1.300	1.178	1.181	1.100
2/2/2020	65	17373	11177	6196	362	350	12	2.08%	3.13%	0.19%	16.2	1.193	1.232	1.129	1.187	1.190	1.091
2/3/2020	66	20679	13522	7157	427	414	13	2.06%	3.06%	0.18%	16.9	1.190	1.210	1.155	1.180	1.183	1.083
2/4/2020	67	23906	16678	7228	492	479	13	2.06%	2.87%	0.18%	16.0	1.156	1.233	1.010	1.152	1.157	1.000
2/5/2020	68	28344	19665	8679	565	549	16	1.99%	2.79%	0.18%	15.1	1.186	1.179	1.201	1.148	1.146	1.231
2/6/2020	69	30818	22112	8706	634	618	16	2.06%	2.79%	0.18%	15.2	1.087	1.124	1.003	1.122	1.126	1.000
2/7/2020	70	34662	24953	9709	724	699	25	2.09%	2.80%	0.26%	10.9	1.125	1.128	1.115	1.142	1.131	1.563
2/8/2020	71	37278	27100	10178	813	780	33	2.18%	2.88%	0.32%	8.9	1.075	1.086	1.048	1.123	1.116	1.320
2/9/2020	72	40171	29631	10540	908	871	37	2.26%	2.94%	0.35%	8.4	1.078	1.093	1.036	1.117	1.117	1.121

Table 1. Showing data for New Coronavirus 2019 (nCoV) from 22 January to 10 February 2020. The raw data of Number of Cases and Deaths is taken from https://www.kaggle.com/sudalairajkumar/novel-corona-virus-2019-dataset/data#, from https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6, https://bnonews.com/index.php/2020/02/the-latest-coronavirus-cases/ and https://jobtube.cn/wv/?from=groupmessage&isappinstalled=0. We separate data into Hubei and Others or non-Hubei as most deaths are in a 90 km x 35 km area centered on Wuhan in Hubei (**Fig. 2**). The Death Rate is the Number Deaths divided by the Number Cases Confirmed, and Ratio Hubei/Others is the ratio of the Death Rate for Hubei to the Death Rate for non-Hubei. The Fraction Change for all raw data is Value_Today divided by Value_Yesterday.

Plots of this data against time are shown in **Fig. 1**. Panel (A) shows expected exponential increase in Number of Cases. Panel (B) confirms that almost all the deaths are in Hubei (96%). Panel (C) shows that the Hubei death rate has decreased from 3.5% on 1-Jan to 2.9% today (9-Feb.). While the Death Rate is high in Hubei at 2.9%, the non-Hubei rate is 9 times lower at 0.35 %, which is comparable to that of influenza. Panel (D) shows that the Fractional Change in Total Cases (Cases_Today / Cases_Yesterday) is increasing more and more slowly for Hubei, non-Hubei & Total. Panel (E), shows that on 28-Jan the Fractional Change in Total Deaths (Deaths_Today / Deaths_Yesterday) was 1.3 (30% more deaths per day) but by today this ratio is 1.09 (9% more deaths per day). Specifically, the overall ratio of deaths today to deaths yesterday has decreased steadily since 1/25/2020. This together with the data on Number of Cases in (D) suggests that the rate of increase in the number of deaths and cases will continue to slow down over the next week. An extrapolation based on the sigmoid function (see **Fig. 3**) suggests that the number of deaths should not exceed 2000 and that it will reach 95% of this limiting value by 16-Feb-2020.

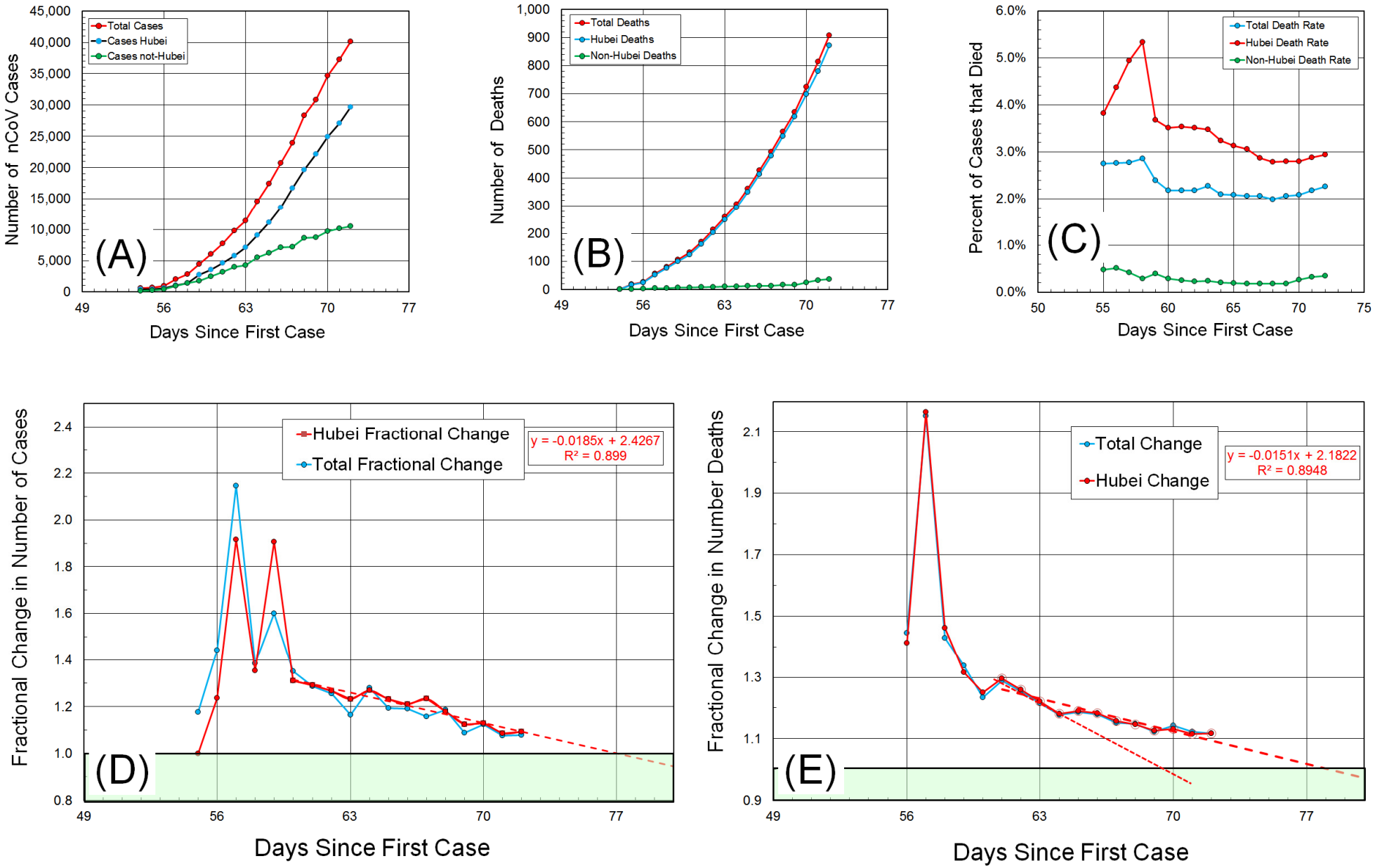

Figure. 1. Variation of nCov-2019 data against time in days since 29 Nov 2019 (guessed date of the first case). Table 1 data is plotted from 22 January to 5 February 2020. In Panels (D) (E) linear trend-lines are added using data for the last 12 days from 1/29/2020. For both Cases and Deaths, the Fraction Change for both Hubei and the world, the fit to a straight line is excellent (correlation coefficient or sqrt(R^2)> 0.94). This linear extrapolation suggests the Fractional Change in Number of Cases and Deaths will decrease to near 1.0 within a week, after which time, numbers of deaths will grow slowly. We also show in panel (E) a red short-dashed of the straight-line the fit to the four data points for 31-Dec to 02-Feb; this trend was used in the first draft of this analysis dated 2/3/20 and gave rise to the expectation that the growth of deaths would slow soon.

			6-Feb				5-Feb				4-Feb				3-Feb				2-Feb				1-Feb				31-Jan		
Province or City in Hubei	Population	Deaths / million pop	Cases	Deaths	Death Rate	Death Change	Cases	Deaths	Death Rate	Death Change	Cases	Deaths	Death Rate	Death Change	Cases	Deaths	Death Rate	Death Change	Cases	Deaths	Death Rate	Death Change	Cases	Deaths	Death Rate	Death Change	Cases	Deaths	Death Rate
Hubei	58,500,000	10.6	22,112	618	2.79%	1.13	19,665	549	2.79%	1.15	16,678	479	2.87%	1.16	13,522	414	3.06%	1.18	11,177	350	3.13%	1.19	9,074	294	3.24%	1.18	7,153	249	3.48%
Wuhan	11,080,000	43.1	11,618	478	4.11%	1.15	10,117	414	4.09%	1.14	8,351	362	4.33%	1.16	6,384	313	4.90%	1.18	5,142	265	5.15%	1.18	4,109	224	5.45%	1.17	3,215	192	5.97%
Ezhou	1,050,000	17.1	471	18	3.82%	1.00	423	18	4.26%	1.00	382	18	4.71%	1.00	332	18	5.42%	1.20	306	15	4.90%	1.15	278	13	4.68%	1.44	227	9	3.96%
Jingmen	3,023,000	5.6	553	17	3.07%	1.00	508	17	3.35%	1.06	422	16	3.79%	1.14	400	14	3.50%	1.27	345	11	3.19%	1.57	329	7	2.13%	1.40	251	5	1.99%
Tianmen	1,731,000	5.8	163	10	6.13%	1.00	138	10	7.25%	1.00	128	10	7.81%	1.00	117	10	8.55%	1.00	115	10	8.70%	1.43	99	7	7.07%	1.00	82	7	8.54%
Huanggang	7,403,000	4.3	1,897	32	1.69%	1.10	1,807	29	1.60%	1.16	1,645	25	1.52%	1.32	1,422	19	1.34%	1.12	1,246	17	1.36%	1.13	1,002	15	1.50%	1.07	726	14	1.93%
Xiaogan	4,900,000	5.1	2,141	25	1.17%	1.00	1,886	25	1.33%	1.39	1,462	18	1.23%	1.06	1,120	17	1.52%	1.21	918	14	1.53%	1.00	749	14	1.87%	1.17	628	12	1.91%
Jingzhou	3,692,000	2.7	885	10	1.13%	1.00	801	10	1.25%	1.11	713	9	1.26%	1.29	613	7	1.14%	1.17	499	6	1.20%	1.50	333	4	1.20%	1.00	287	4	1.39%
Suizhou	2,500,000	3.6	915	9	0.98%	1.00	834	9	1.08%	1.13	706	8	1.13%	1.33	641	6	0.94%	1.20	458	5	1.09%	1.67	384	3	0.78%	3.00	304	1	0.33%
Xiantao	1,175,000	4.3	307	5	1.63%	1.00	265	5	1.89%	1.25	225	4	1.78%	1.33	188	3	1.60%	1.00	169	3	1.78%	1.00	140	3	2.14%	3.00	97	1	1.03%
Qianjiang	1,000,000	1.0	74	1	1.35%	1.00	64	1	1.56%	1.00	54	1	1.85%	1.00	44	1	2.27%	1.00	35	1	2.86%	1.00	35	1	2.86%	0.00	27	1	3.70%
Yichang	4,060,000	1.7	610	7	1.15%	1.17	563	6	1.07%	1.50	496	4	0.81%	1.33	452	3	0.66%	3.00	392	1	0.26%	1.00	353	1	0.28%	1.00	276	1	0.36%
Huangshi	2,450,000	0.8	635	2	0.31%	1.00	566	2	0.35%	1.00	509	2	0.39%	1.00	405	2	0.49%	1.00	334	2	0.60%	1.00	252	2	0.79%	1.00	209	2	0.96%
Xiangyang	900,000	3.3	838	3	0.36%	1.00	787	2	0.25%	1.00	735	2	0.27%	1.00	632	1	0.16%	1.00	548	0	0.00%	1.00	441	0	0.00%	1.00	347	0	0.00%
Enshi	750,000	0.0	157	0	0.00%	1.00	144	0	0.00%	1.00	138	0	0.00%	1.00	123	0	0.00%	1.00	111	0	0.00%	1.00	105	0	0.00%	1.00	87	0	0.00%
Shennongjia	76,000	0.0	10	0	0.00%	1.00	19	0	0.00%	1.00	10	0	0.00%	1.00	10	0	0.00%	1.00	7	0	0.00%	1.00	7	0	0.00%	1.00	7	0	0.00%
Shiyan	3,340,000	0.0	395	0	0.00%	1.00	353	0	0.00%	1.00	318	0	0.00%	1.00	291	0	0.00%	1.00	256	0	0.00%	1.00	212	0	0.00%	1.00	177	0	0.00%
Xianning	2,800,000	0.4	443	1	0.23%	1.00	399	1	0.25%	1.00	384	0	0.00%	1.00	348	0	0.00%	1.00	296	0	0.00%	1.00	246	0	0.00%	1.00	206	0	0.00%

Table. 2. Number of Cases, Number of Deaths, Death Rates and Fractional Changes in Deaths shown for 17 Hubei cities from 31 Jan to 6 Feb.

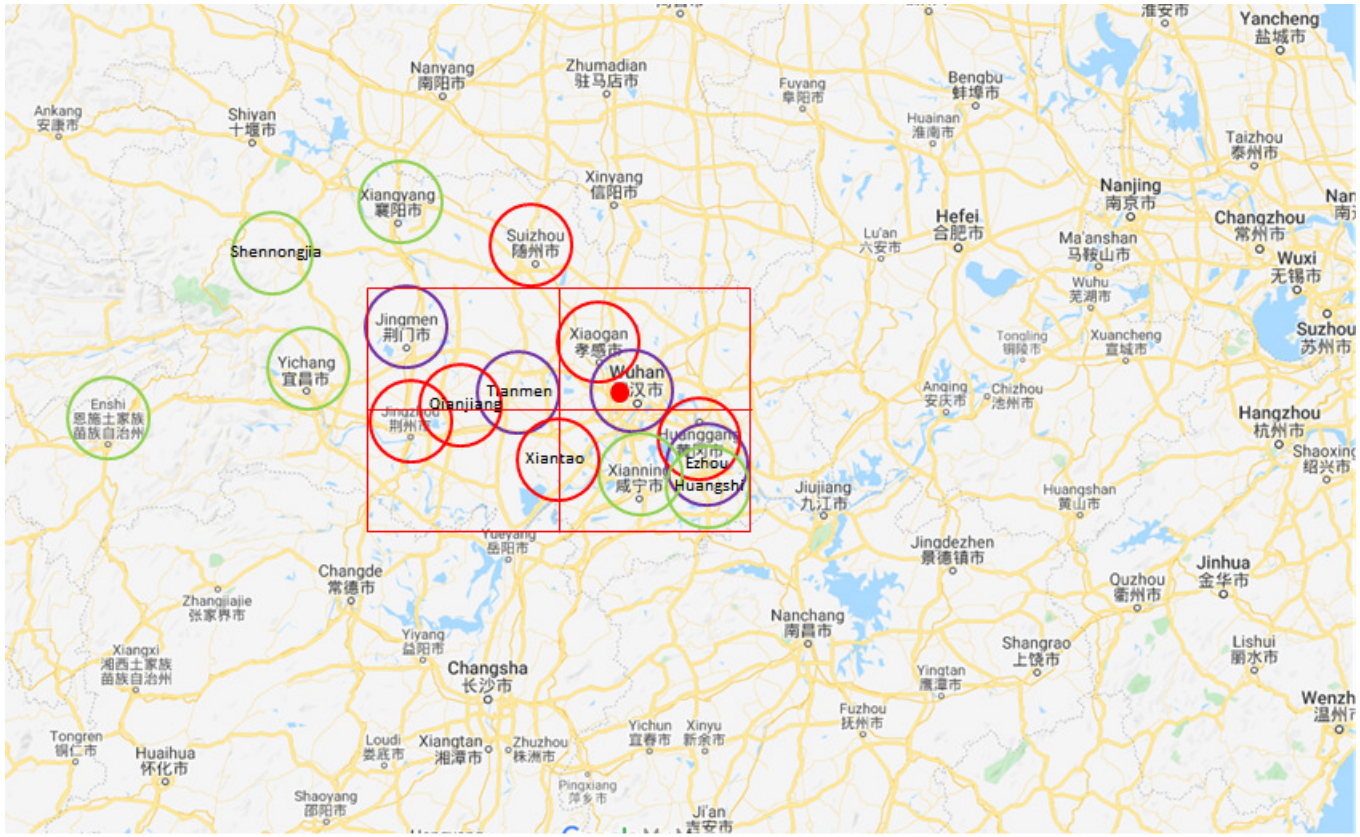

Figure. 2. Map of Hubei circling in purple cities with a death rate > 3%, in red cities with a death rate > 1% and in green other cities for which there is data. Most deaths are localized to a 90km x 35km area centered near Tianmen and high death rates occur in four cities: Wuhan, Ezhou, Jingmen and Tianmen (Table 2). Other cities in the same area have low death rates, comparable to those elsewhere in China and the rest of the world data (data 1/4/2020 from jobtube.cn). The red dot marks the Wuhan South China Seafood Market thought to be the source of this coronavirus.

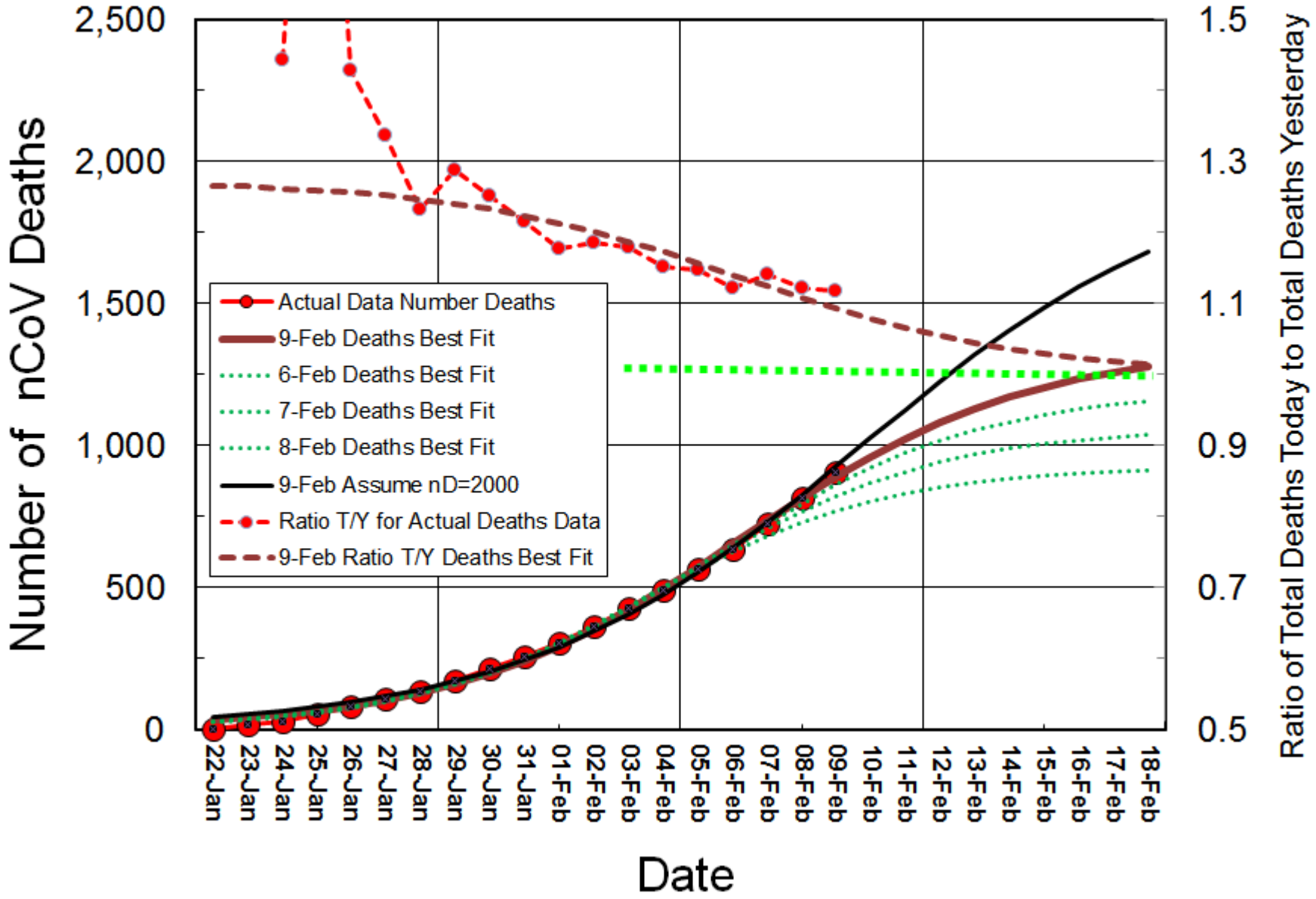

Figure. 3. Fit of the sigmoid function f(x) = 1/(1-exp(-x)) to the actual Total Number of Deaths from the coronavirus nCoV-2019 since 22 Jan 2020. The best fit (brown line) is obtained using Excel to optimize the parameters A, B & C in f(x) = A/(1-exp(-x+B)/C) so that the 18 actual Number of Deaths values to 9-Feb (red solid line) are well fit by the sigmoid function. Particularly impressive is that the Ratio of Deaths Today to Yesterday (T/Y) from the actual data (red dashed line on secondary axis) is well fit by the calculated Ratio (brown green line on secondary axis), which decreases in a linear fashion as assumed in **Fig. 2 (E**). The fit for the 16, 17 or 18 values to 06-Feb, 07-Feb or 08-Feb (green dashed line) are also shown to indicate how sensitive the extrapolation is to new data values. The situation is still very fluid and values the that are released in the next few days will be crucial. We now expect the total death rate to plateau below the black line that assumes 2000 total Number of Deaths.

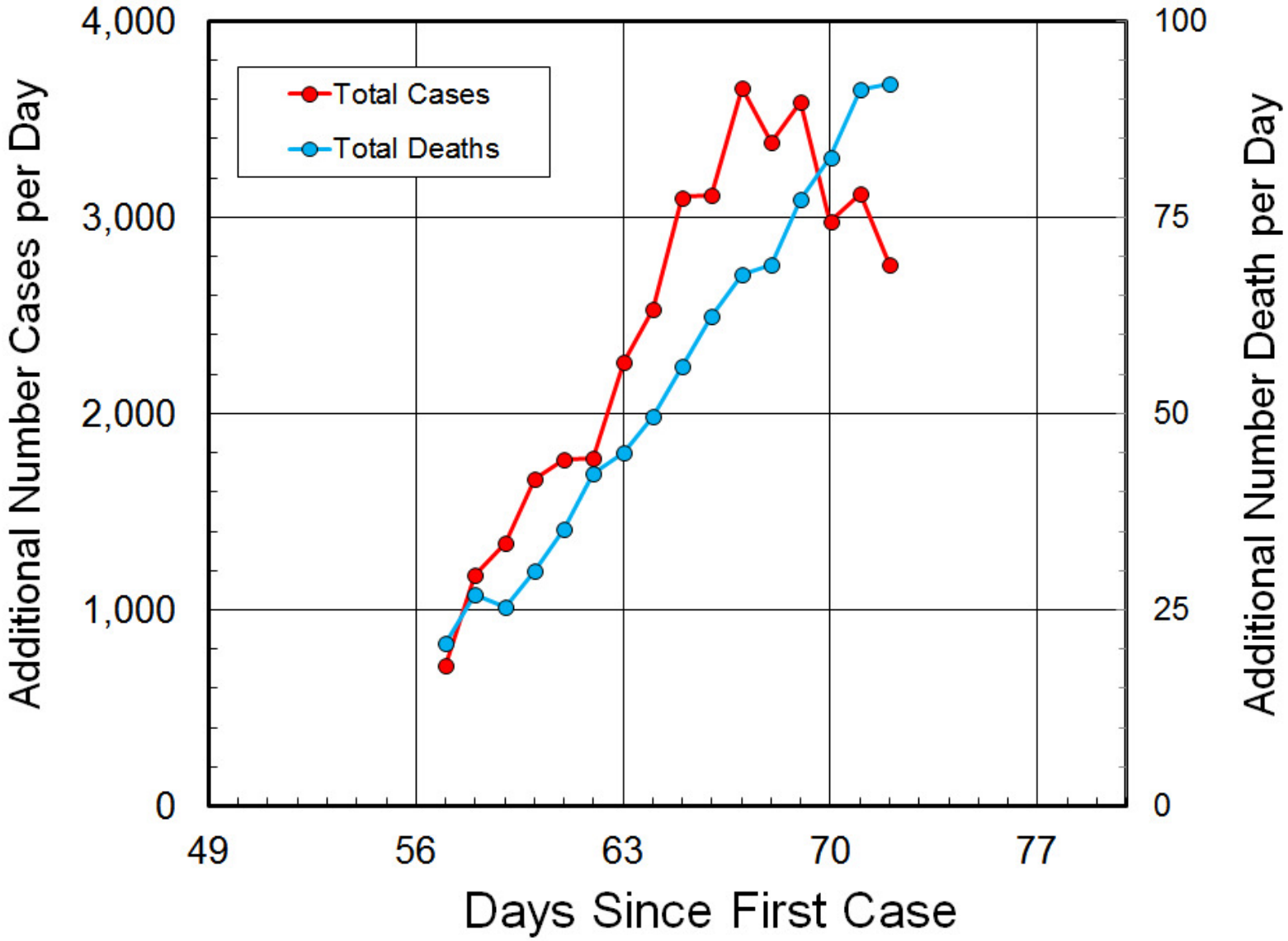

Figure. 4. Showing how the Additional Number of Cases per Day peaked on Day 68 (5-Feb), whereas the Additional Number of Deaths per Day may have peaked today (Day 72) or has yet to peak. For sigmoid growth like that shown in Fig. 3, the additional number reaches a maximum midway through the curve. If this holds here, then the total Number of Cases should reach about 50,000. Interesting too is that the growth curves for deaths is shifted by at least 5 days from that of cases. This means that death occurs on average 5 after being counted as a confirmed case. The data is plotted for total Cases and Total Deaths averaged over a three days window so that, for example, the value given on day 68 is the average of the values on days 67, 68 & 69. This smoothing reduces the noise in the data.