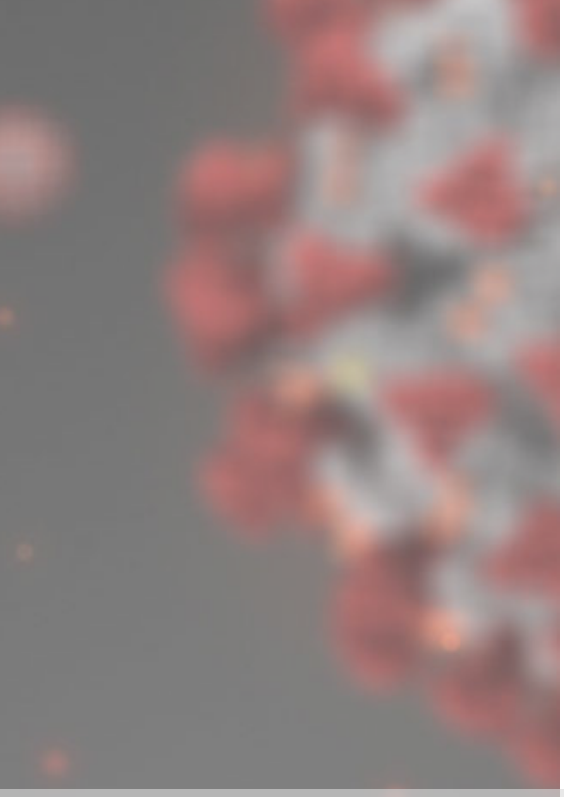

Outbreaks of coronavirus COVID-19

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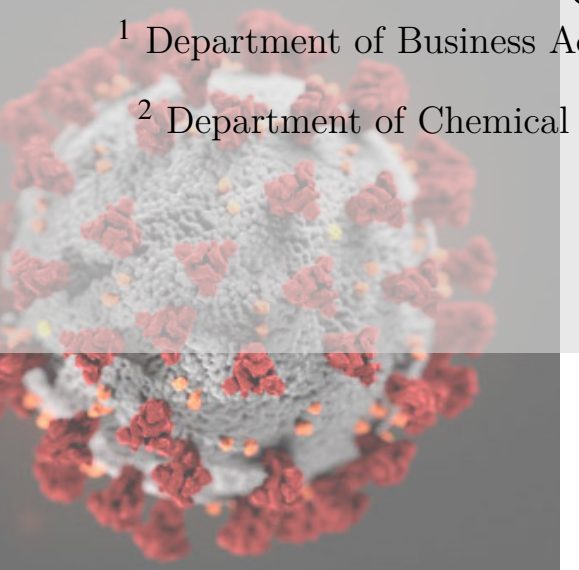
April 13, 2020



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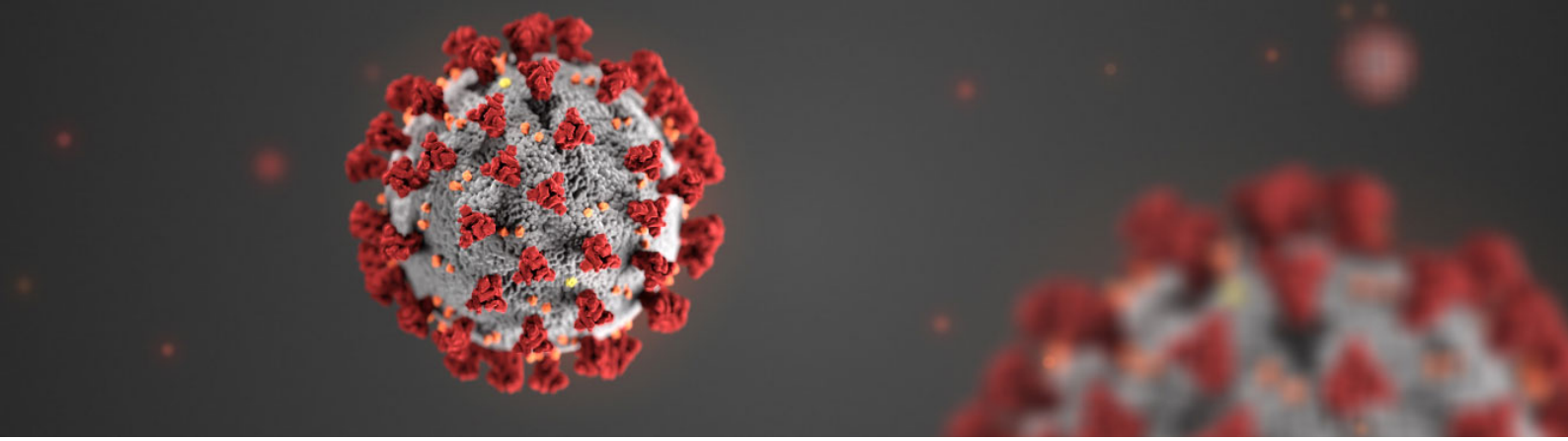
7^{th} Edition (April 13, 2020).

Contents



1. Introduction

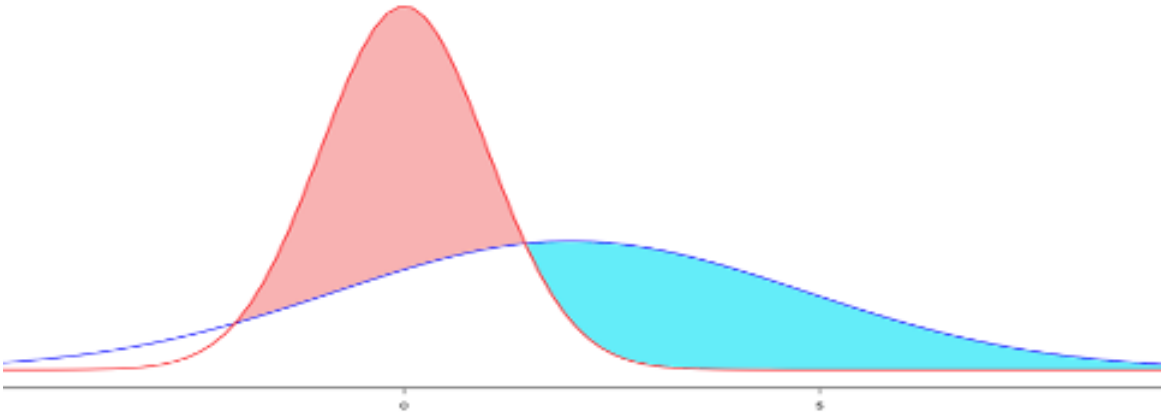
The number of coronavirus cases per day is a time series[1]. Time series analysis comprises methods for analyzing time series data in order to extract meaningful statistics and other characteristics of the data. Time series forecasting is the use of a model to predict future values based on previously observed values. Since many forecasting methodologies are value-oriented, it is essential to focus on point-oriented methods in order to forecast not the future value of the time series, but the future time that its optima will occur, [1, 10, 11, 12].These methodologies are based on non-linear optimization techniques. Specifically, in this kind of techniques, time series is treated as an objective function subject to the factors affecting its future values. Thus, these point-oriented techniques are very accurate in predicting the time when the future extreme will occur.

This work uses the point-oriented technique provided by Lisgara, Karolidis & Androulakis, [11], in order to predict the period of time at which the COVID-19 outbreaks peak. Then, for this period provided by the point-oriented technique, value-oriented methods are applied in order to approximate the number of cases that will occur until the predicted period[2]. In this work were used data recorded until April 13^{th}, [5].

Let's focus on the time series defined by the number of cases of coronavirus per day. This series initially follows an exponentially increasing course, then this growth rate gradually slows down and the number of coronavirus cases peaked (takes its maximum value). Then the number of cases follows an exponential declining course and eventually the number of cases becomes zero. This ascending-peaked-descending path of the multitude virus outbreaks is defined as a period of the phenomenon. If this cycle is plotted on a graph where the x-axis is time, it looks like a bell (red and blue curves below).

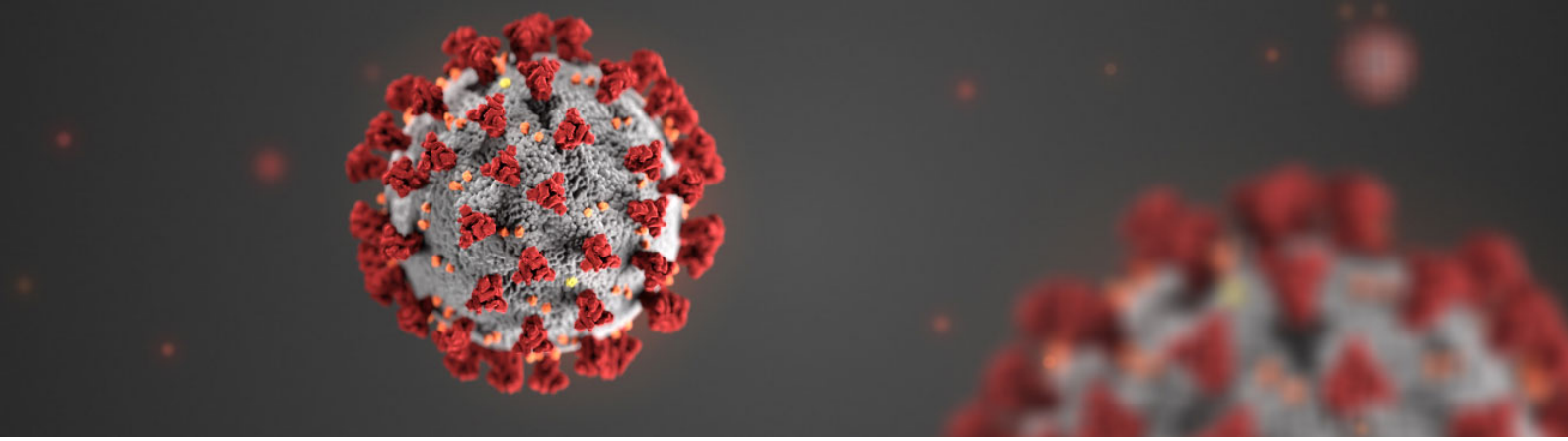
[1] A time series is a series of data points indexed (or listed or graphed) in time order. Most commonly, a time series is a sequence taken at successive equally spaced points in time

[2] For quantitative estimation of cases an exponential or an ARIMA (Autoregressive Integrated Moving Average) prediction model can be applied, [2, 6, 7, 14]. Note that these numerical predictions become unreliable as we move away from the time of calculation.



The control of the peak time is important to ensure that the healthcare system does not exceed its capacity. Let's assume that the number of cases that are about to occur is constant. Only the range of the period changes. Note that when extending the period (see blue and red curves in the figure above), this results in a lower maximum value (blue curve). Therefore, fewer cases are occurring per day and consequently less serious incidents per day. Also note that this reduction in the maximum number of cases will result in the delay of disease's peak. Therefore, the people who were in the red area will spread to the blue area, so, they will get sick, but this will happen over a longer period of time. Thus: (a) scientists are given more time to find the drug for the disease, and (b) there is a prolongation of the phenomenon towards the end of the spring, as the weather gets warmer, and then there is hope that the spread of the virus will slow.

I An overview



2. Global cases

All graphs were based on the number of new cases per day until April 13^{th}.

2.1 The confirmed and death graphs

In these two graphs:

- Confirmed graph refers to the number of cases reported each day. Graphs are made for regions/countries that have more than 500 cases in total.
- Deaths graph refers to the number of deaths reported each day. Graphs are made for regions/countries that have more than 500 deaths in total.
- Labels above each dot indicate the number per day. Red font denotes the days where the curvature is like u and blue when is inverted u.
- If a cyan area appears between two dates in the graph, it refers to a period of Phase 1 measures[1], [9, 15, 16, 17].
- The yellow area between two dates in the graph renders the period of mild mitigation measures and that would be Phase 2[2].
- Finally, the pink area between two dates in the graph shows the critical period of draconian measures, and that would be Phase 3[3].

2.2 Estimation for future maximum

For the approximation of the interval that the maximum is expected to appear, is employed the alogrithm provided by Lisgara, Karolidis & Androulakis, [11].

The procedure is approximate; so as the phenomenon evolutes and the time series acquires more data, the approximated interval may slightly move and narrow.

For instance, on day zero of the constrictive measures imposition the only known points are the past ones, that actually correspond to a period without measures. As the phenomenon evolutes and the restrictive measures work, the approximation of the day that the maximum will appear is expected to move some days later and affecting the forecast.

[1] closed schools and universities.

[2] some business closure, gathering restrictions, travel restrictions (i.e. reduced flights, public transport and route restrictions),voluntary home quarantine, partial lockdown, etc.

[3] the extreme mitigation step known as "suppression" or "lockdown"; ban on all non essential transport and movement across the country, closed physical retail businesses except for those providing essential services, like grocery and food stores,and pharmacies.

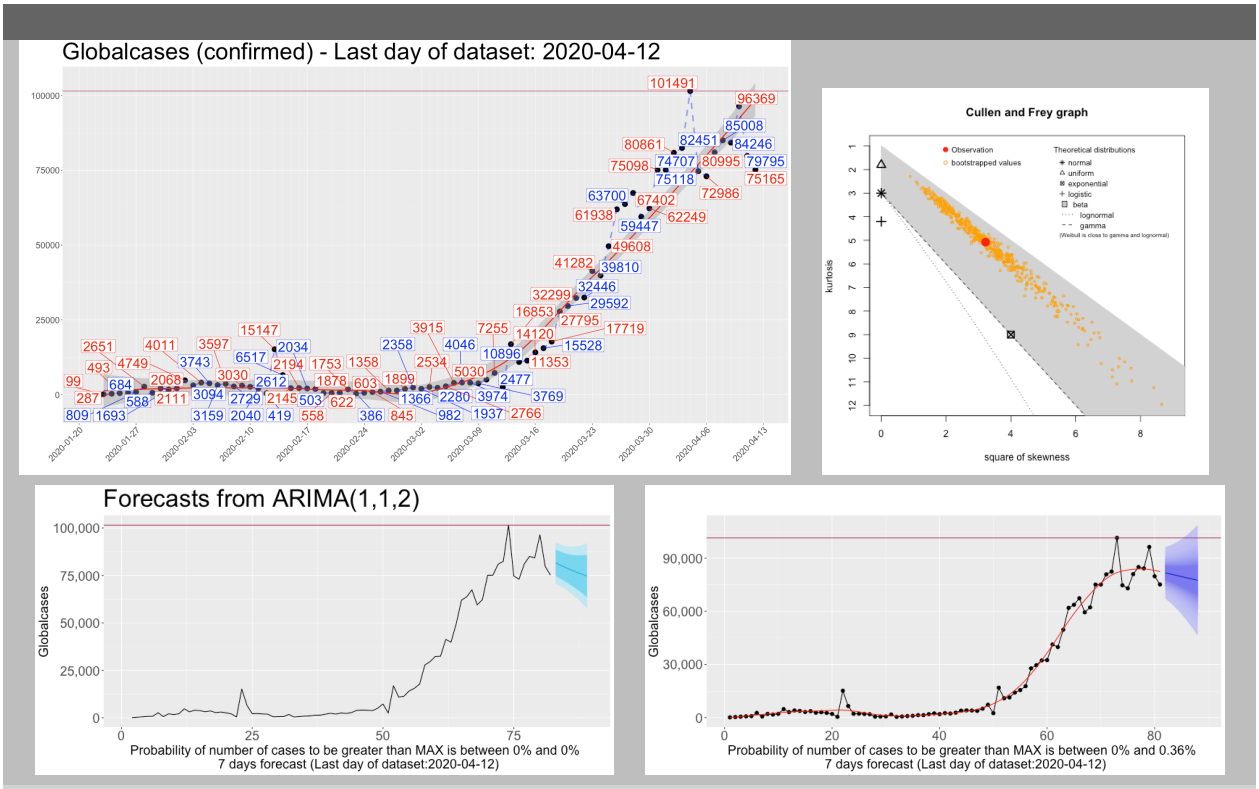
2.3 Estimation of the number of cases

For the estimation of the number of cases two algorithms were applied:

1. ARIMA, and
2. Cubic splines, [8].

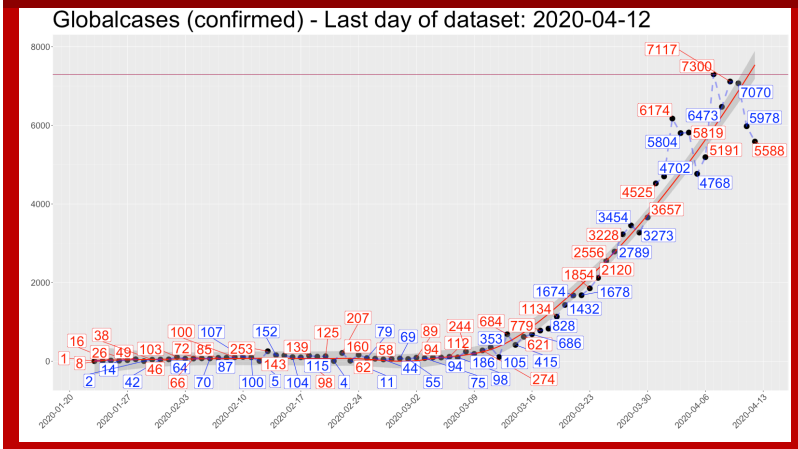
These algorithms were applied to predict the number of cases over the next 7 days. In addition, the ARIMA method was used to calculate the total number of cases throughout the period (including the number of cases until yesterday).

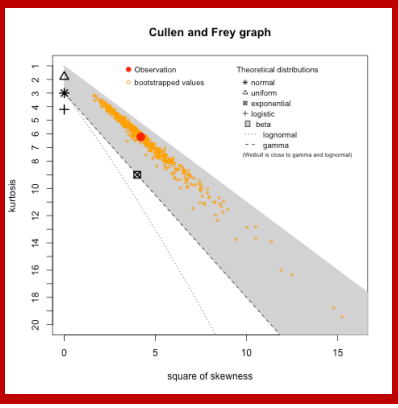
The focus is on the number of cases per day [4], [13, 14]:

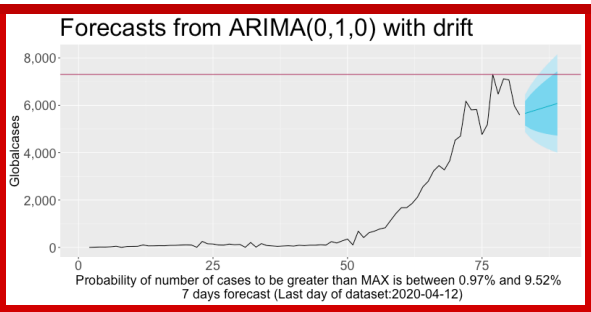


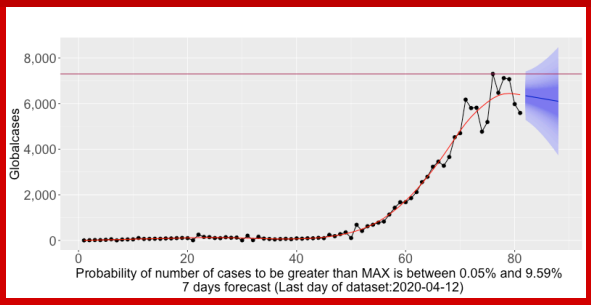
Estimation for future maximum after period around the maximum
Estimation of number of cases: ARIMA [2 394 816, 3 044 087]

[4] The Cullen & Frey [3, 4] was used for the provision of the visual estimation of the coronavirus cases evolution. When the phenomenon is at the beginning the red dot lies bellow and to the right of the graph (near to the symbol ⊗ at the bottom right of the figure indicating the exponential distribution) but when it declines then it moves up to the left of the graph (near to the * indicates the normal distribution).



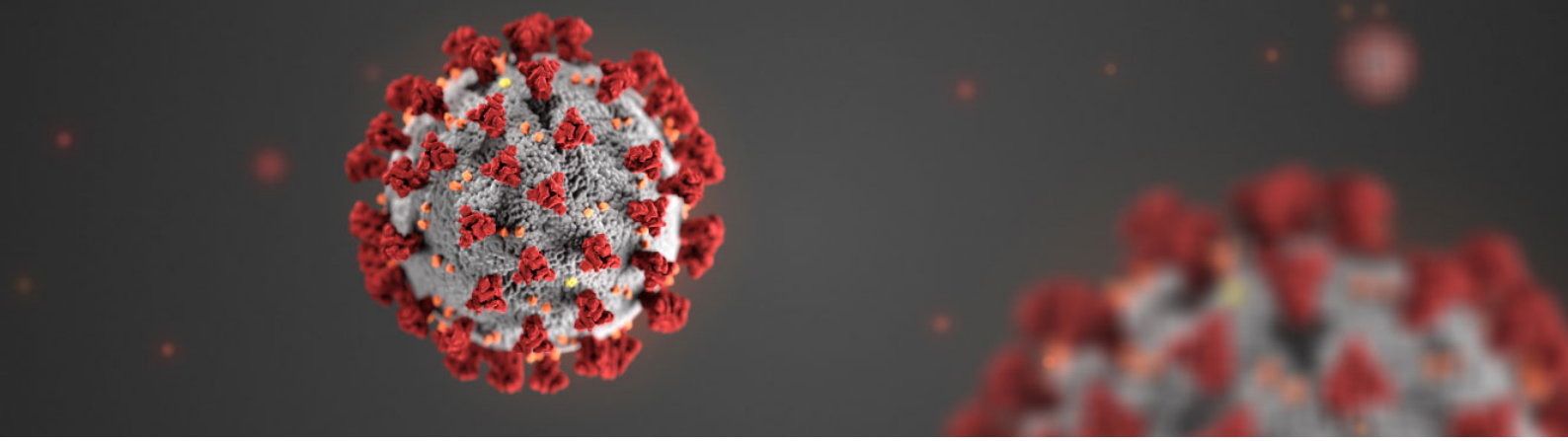






Estimation for future maximum after 28 - 37 days (05-09 - 05-18)

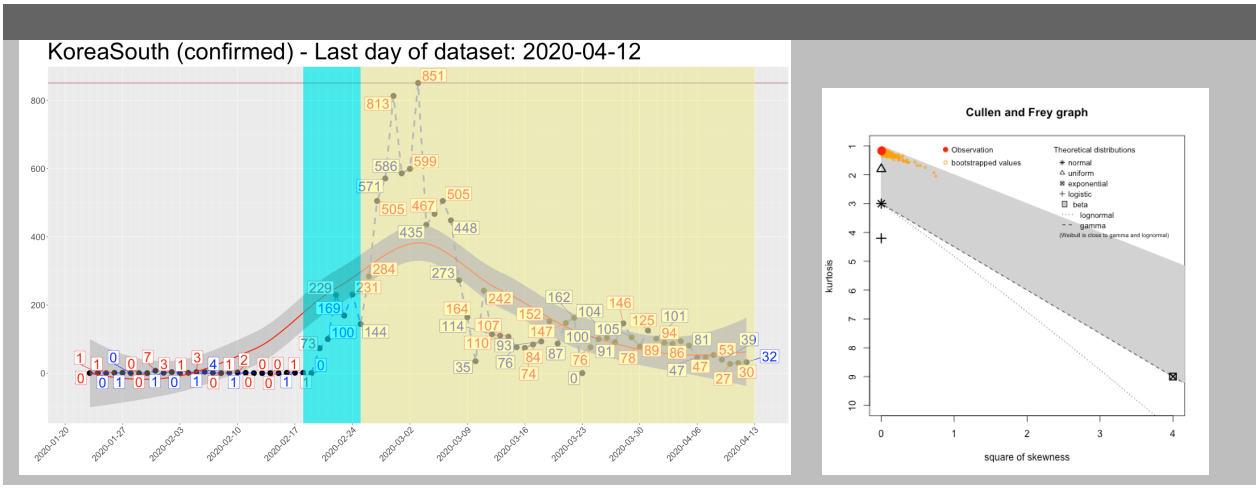
Estimation of number of cases: ARIMA [451 273, 967 486]



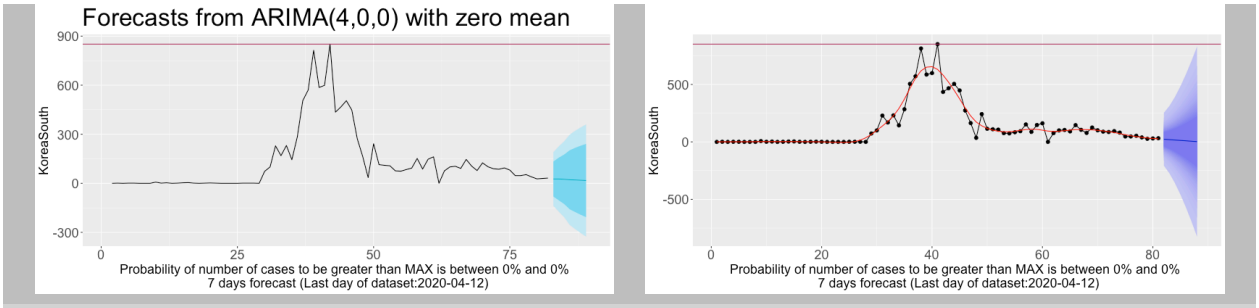
3. The phenomenon is declined

3.1 South Korea

Let's see what the case of South Korea, where a first cycle of the phenomenon has been observed, shows.



4 weeks period



Estimation for future maximum after

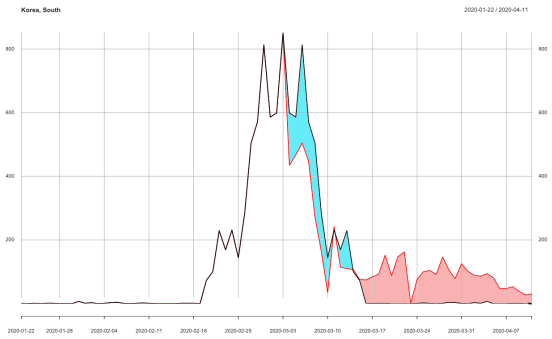
Estimation of number of cases: ARIMA

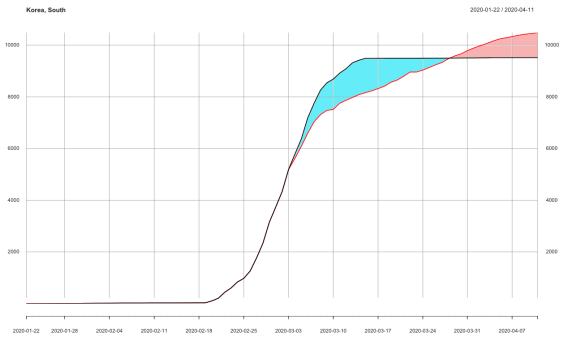
1. The uptrend started on February 19th and peaked on February 29th the first (813 cases) and on March 3^{rd} the second (851 cases). Therefore, this growth course lasted 11 to 14 days.
2. The descending direction begins on March 4^{th} and continues until March 15^{th}, therefore it lasted about 12 days.

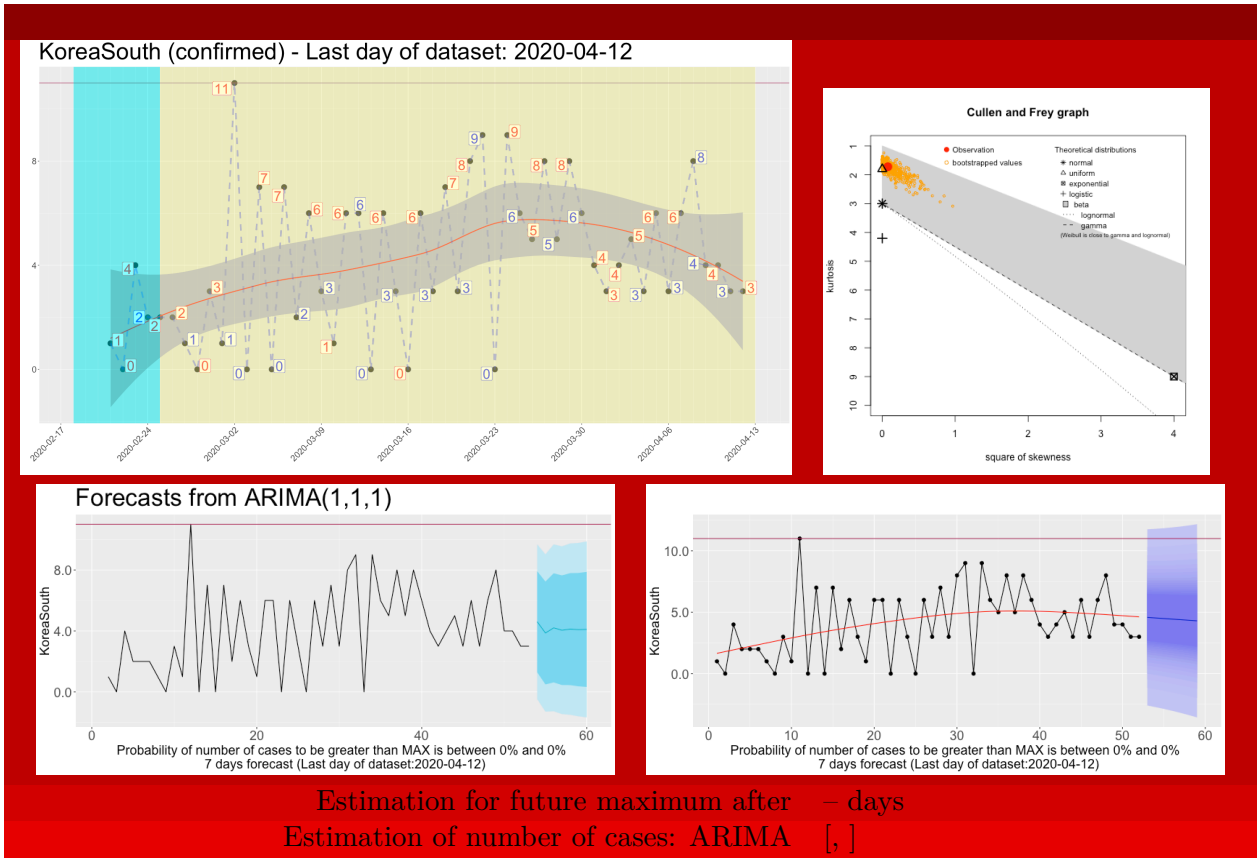
Remark 3.1 — South Korea. There has been a slight increase in the last seven days, which is alarming as this may indicate that a new outbreak is starting. ■

The chart below shows the actual course of events (red line) and the corresponding theoretical course of the de-escalation of the number of cases (black line) for (a) the number of cases per day (left chart) and (b) cumulative (right chart).

We observe asymmetry. Initially, the real-time curve is lower and after a long period of time exceeds the theoretical curve.



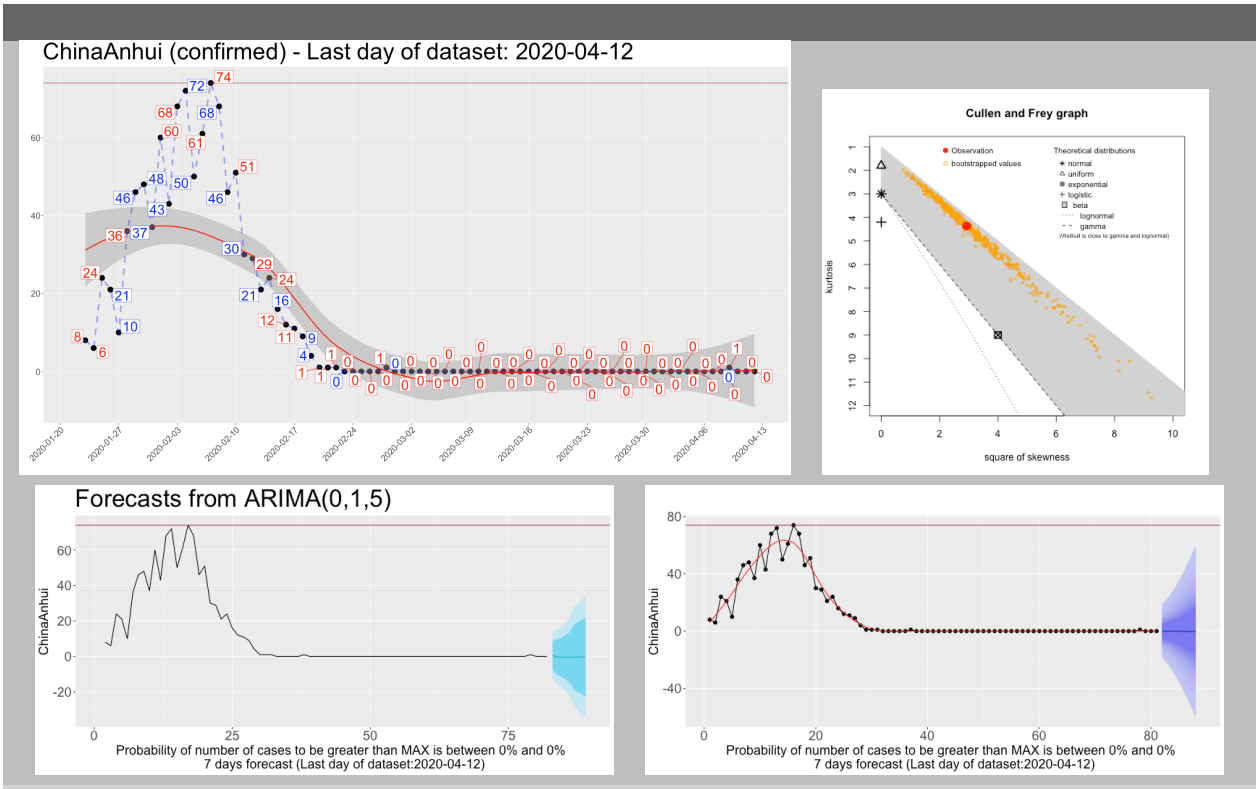




Remark 3.2 — Curve of the number of deaths. Notice that the death-rate curve is still rising, while the incidence-rate curve has diminished. ■

3.2 China

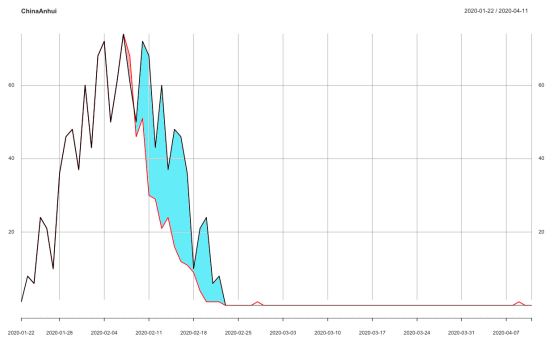
3.2.1 China Anhui

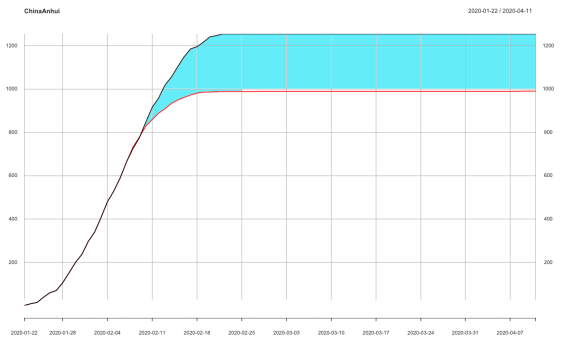


Period: 4 weeks

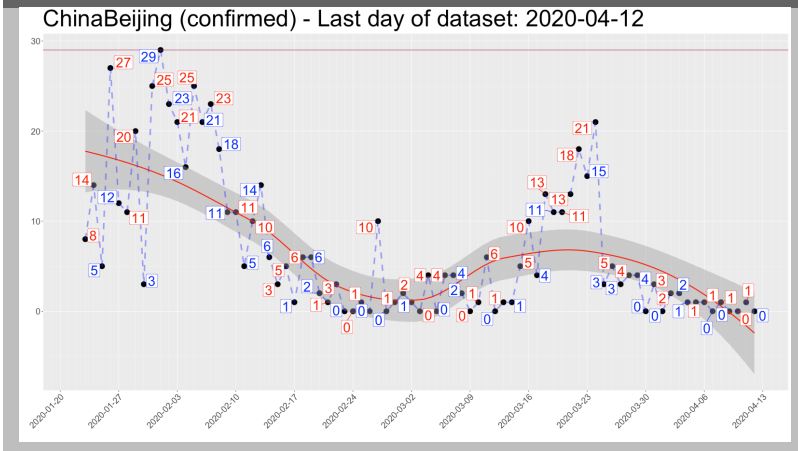
Estimation of number of cases: ARIMA -

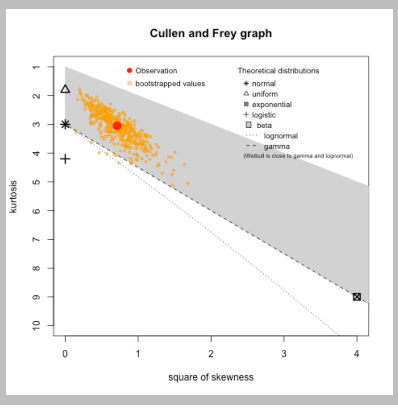
It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are relatively less.

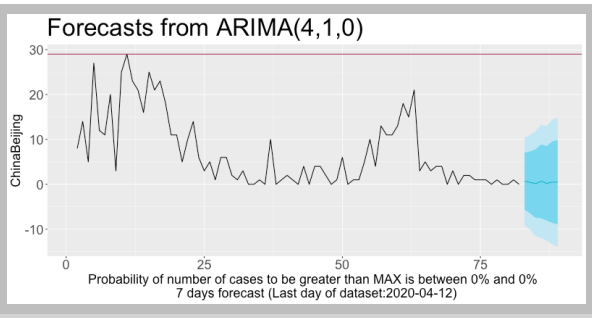


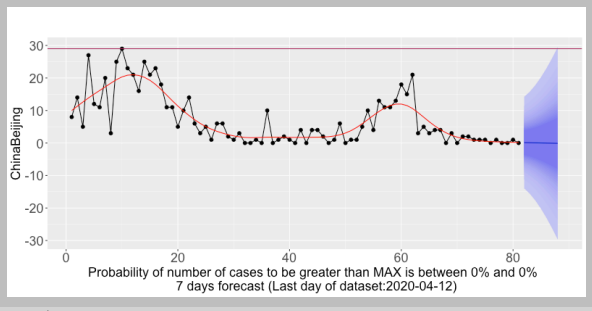


3.2.2 China Beijing









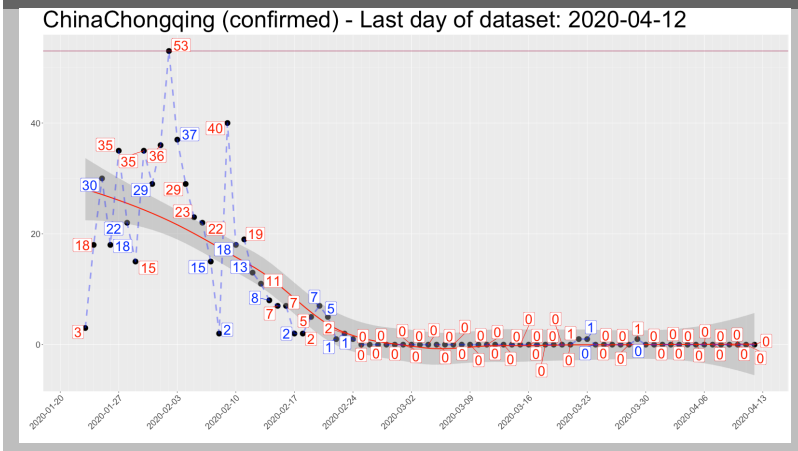
1^{st} Period: 4 weeks

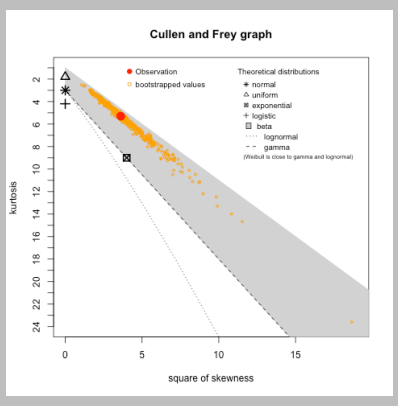
Estimation for future maximum (2nd period) after:

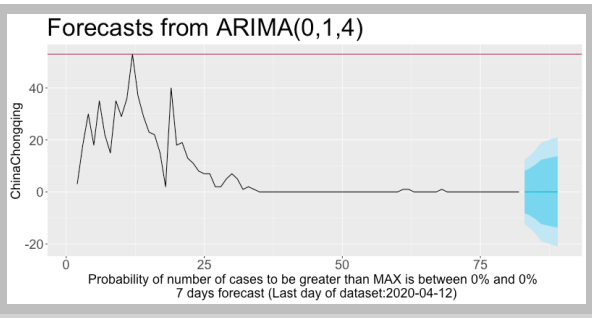
Estimation of number of cases: ARIMA

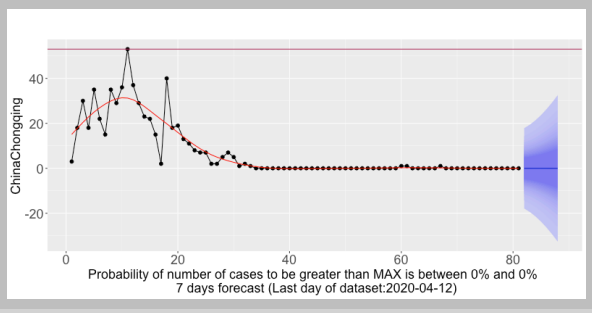
The virus'second cycle is less severe that the first; in both duration and instensity-number of cases.

3.2.3 China Chongqing







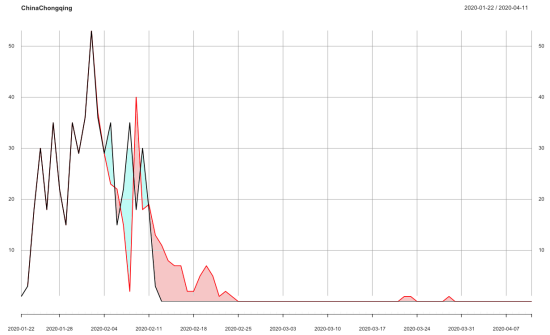


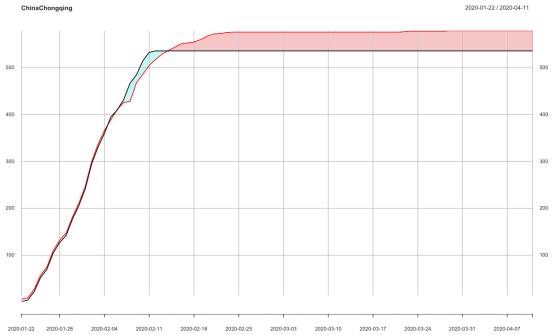
Period: 5 weeks (probably)

Estimation of number of cases: ARIMA -

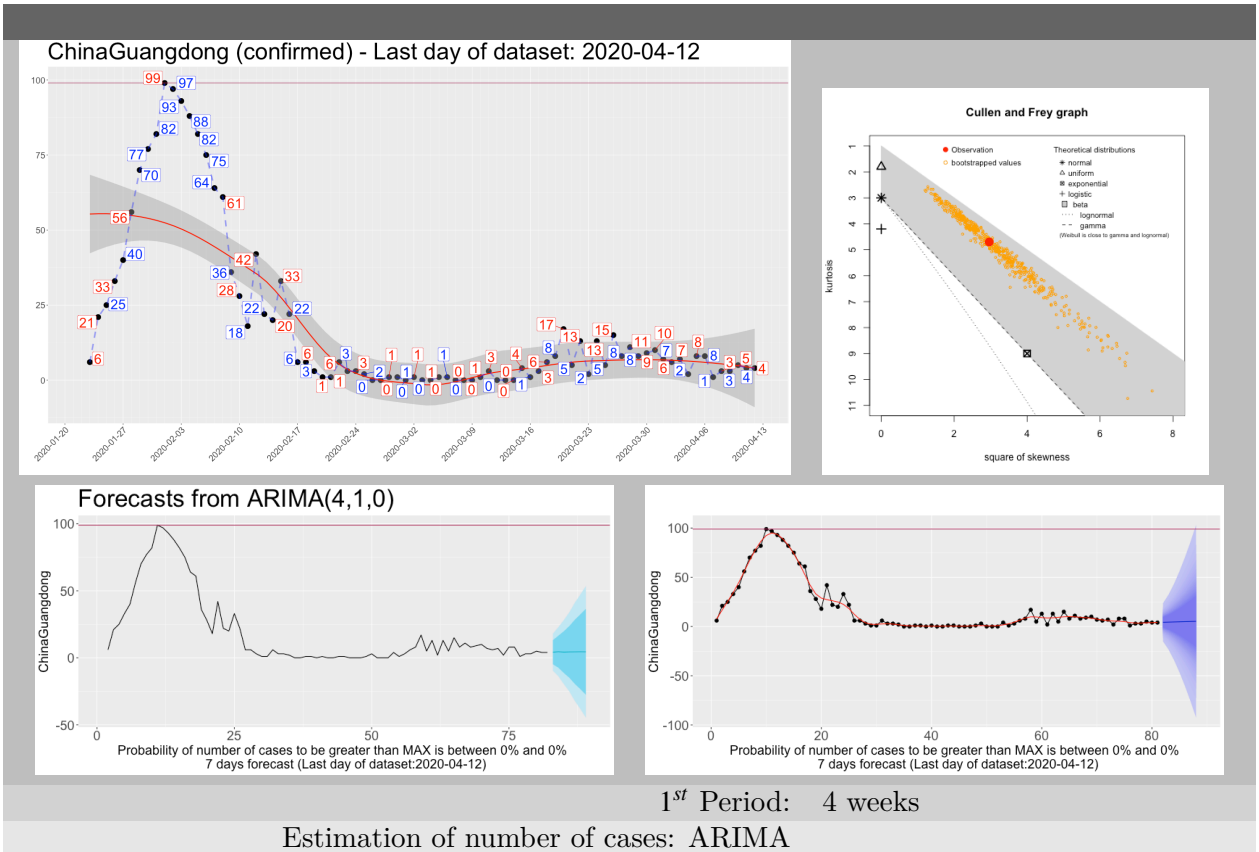
It is observed that de-escalation is not symmetric to the escalation rate. At the beginning the

de-scalation rate is faster and it slows down when reaches the end. The cases during the de-escalation period are relatively more.





3.2.4 China Guangdong

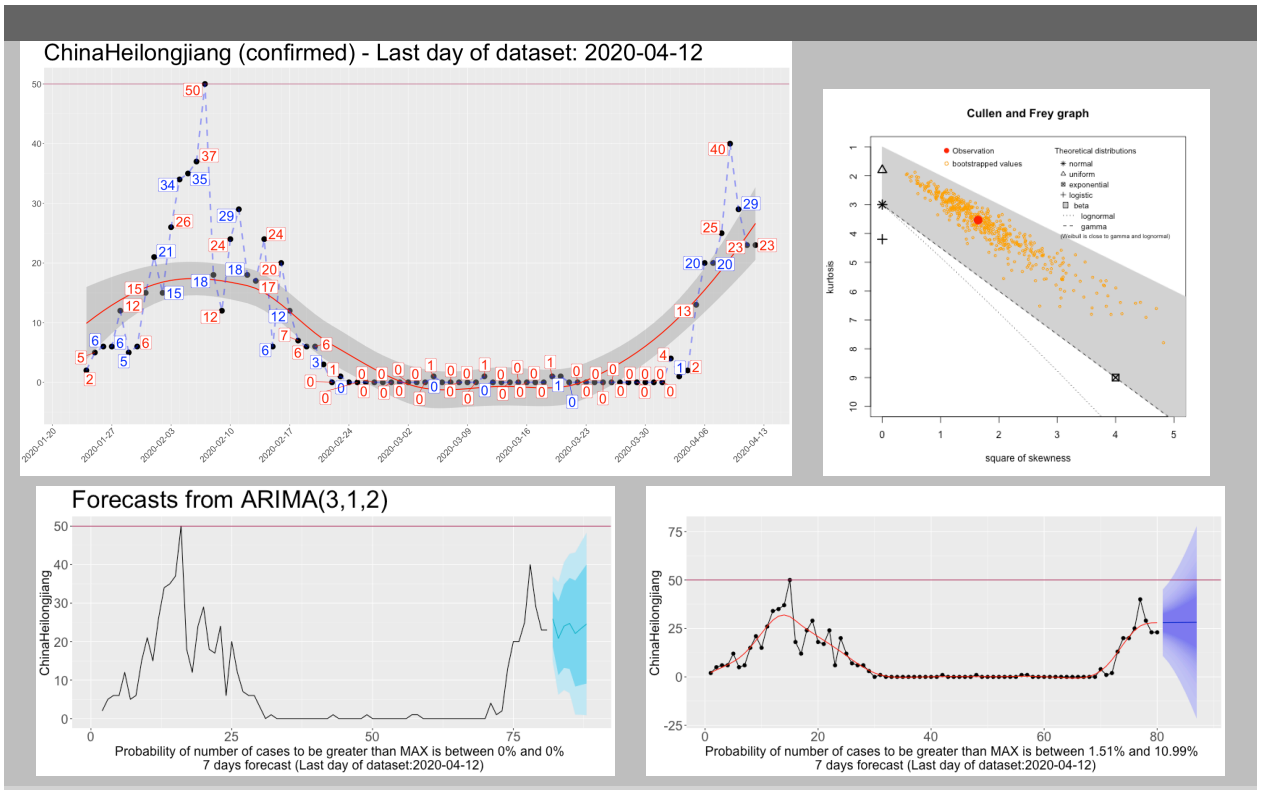


1^{st} Period: 4 weeks

Estimation of number of cases: ARIMA

The virus'second cycle is less severe that the first; in both duration and instensity-number of cases.

3.2.5 China Heilongjiang

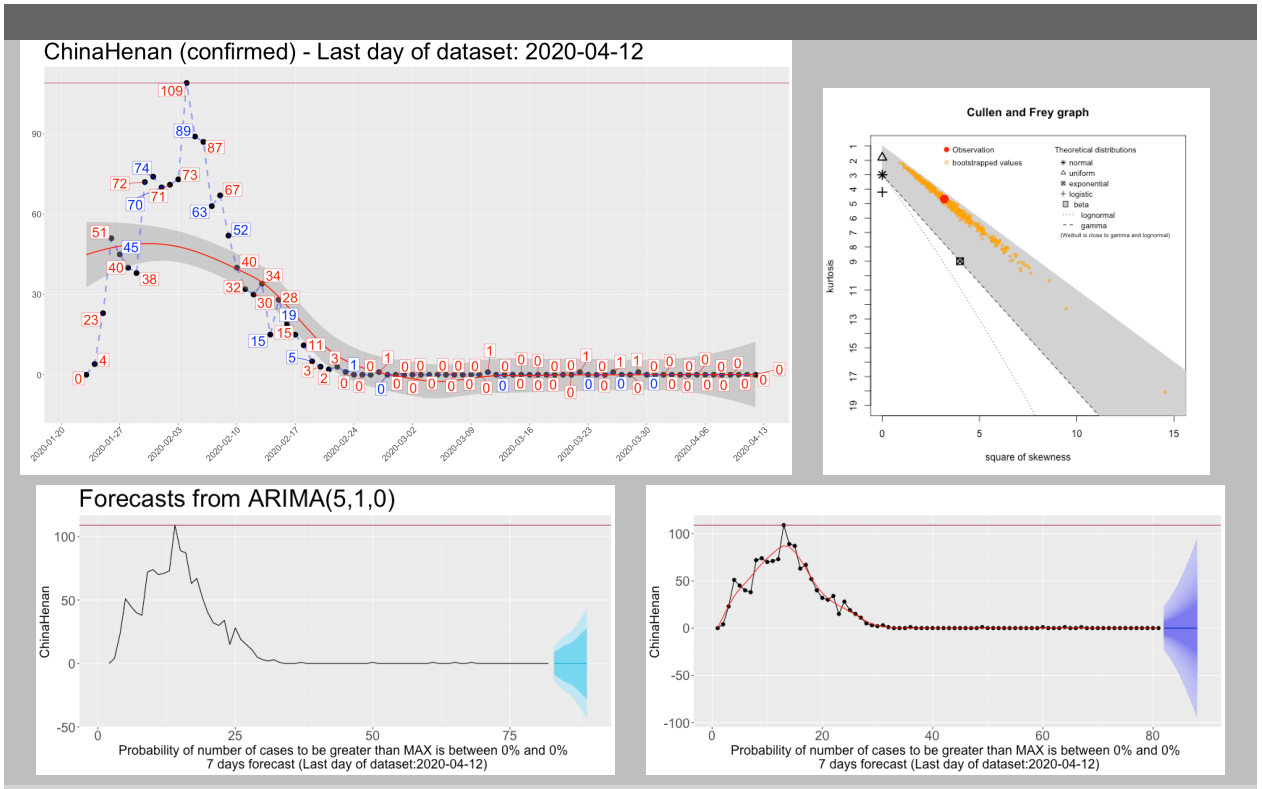


Period 3 weeks

Estimation of number of cases: ARIMA

The virus'second cycle is less severe that the first; in both duration and instensity-number of cases.

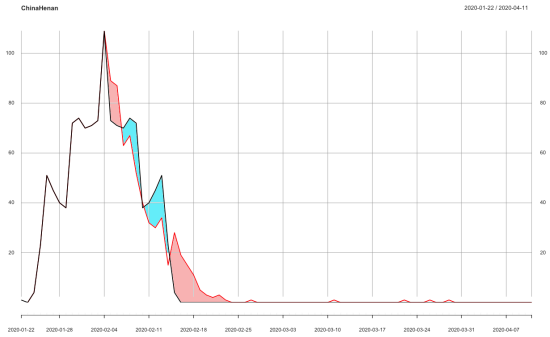
3.2.6 China Henan

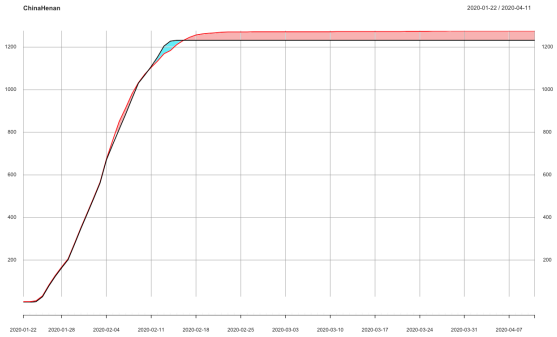


Period: 4 weeks (probably)

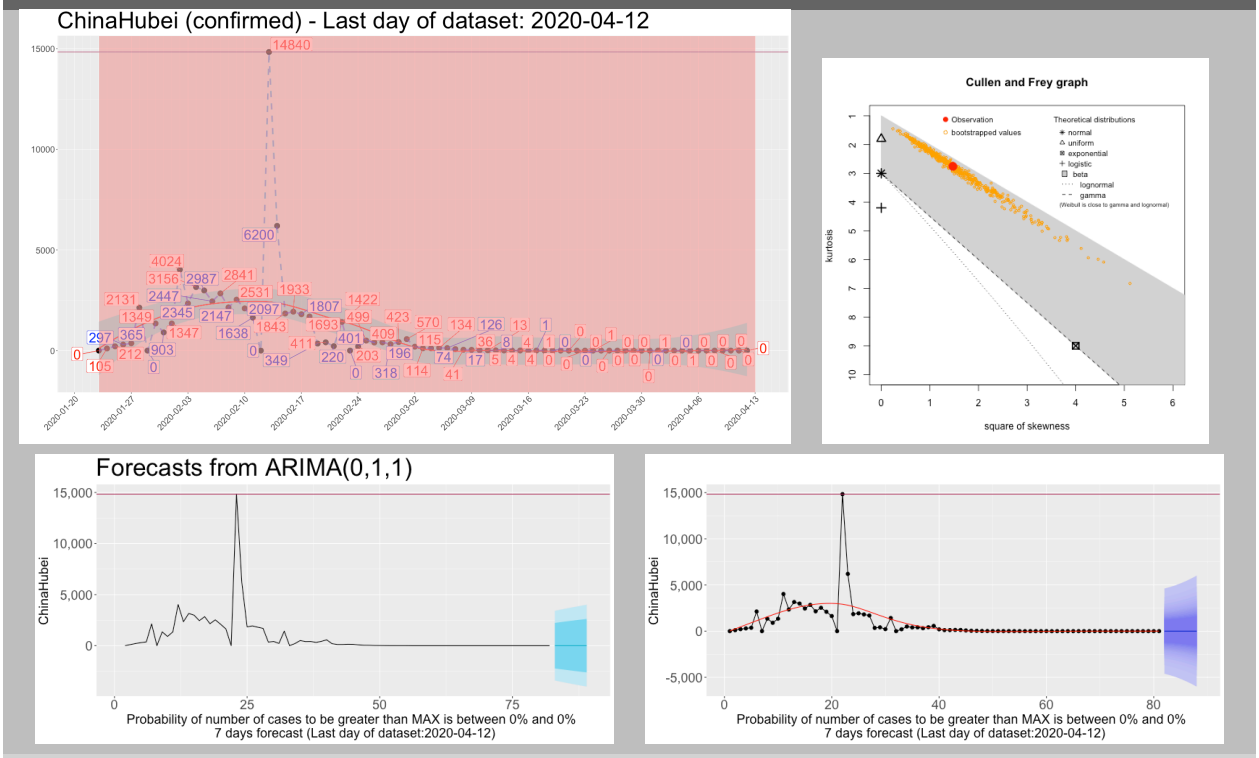
Estimation of number of cases: ARIMA -

It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are relatively more.



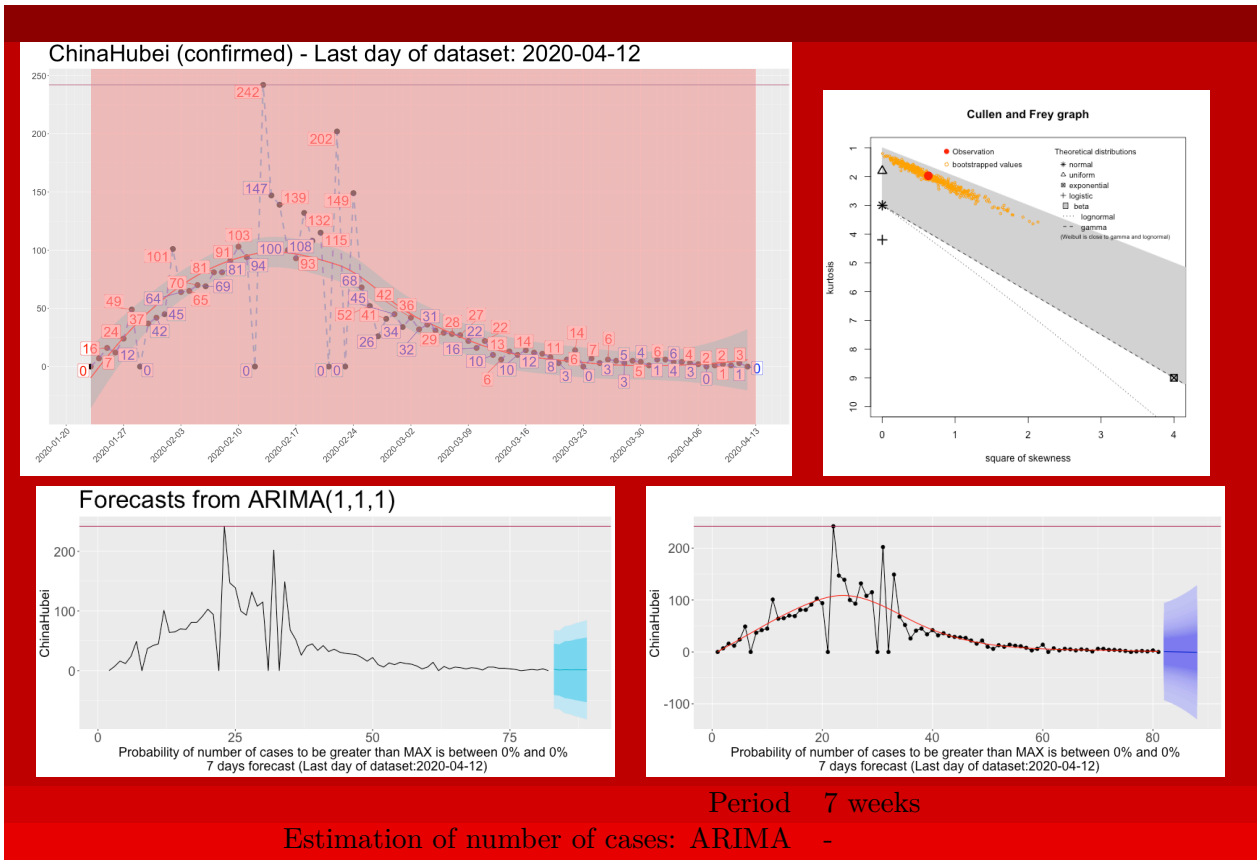


3.2.7 China Hubei



Period: 4 weeks

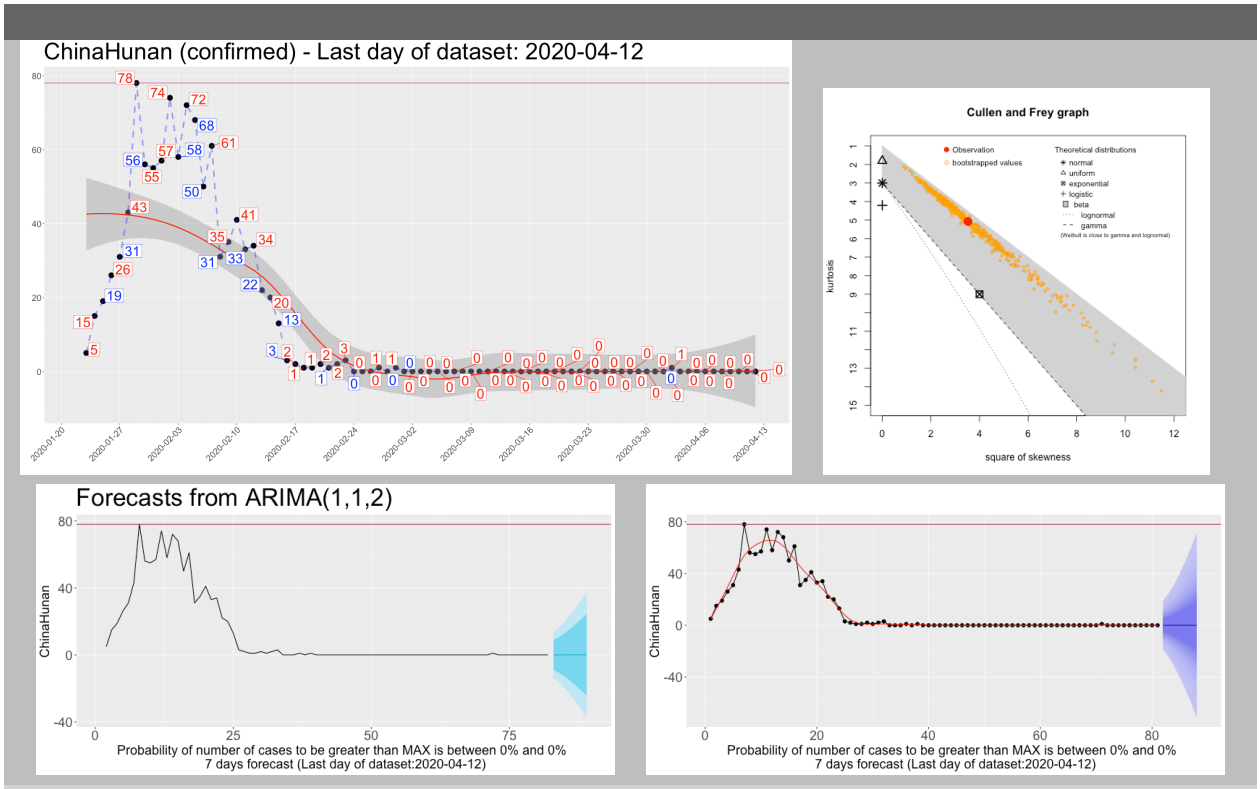
Estimation of number of cases: ARIMA -



Apparently it is the only area that a full cycle, in both number of confirmed cases and number of deaths, is complete. It is observed that the ”death period” is almost double than the ”confirmed cases” period.

Remark 3.3 Therefore, although the COVID-19 confirmed cases phenomenon tends to de-escalate, the COVID-19 deaths phenomenon is increasing almost until the number of confirmed cases eliminates. ■

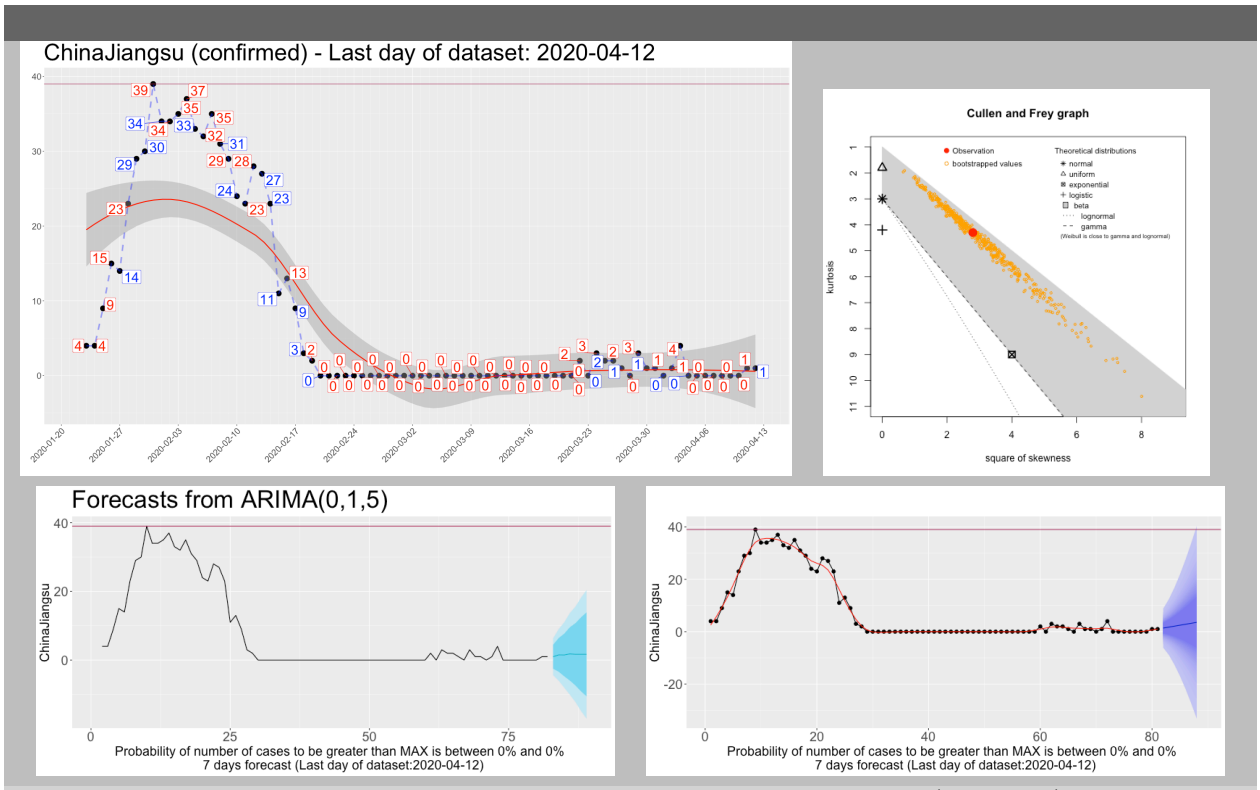
3.2.8 China Hunan



Period: 4 weeks

Estimation of number of cases: ARIMA -

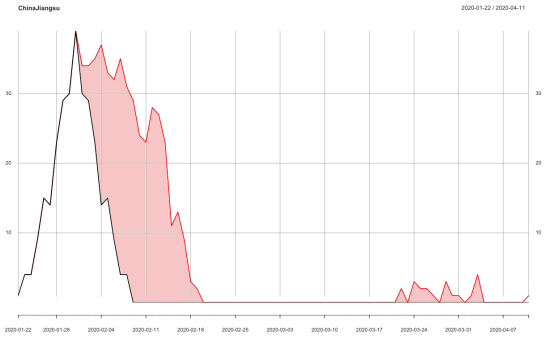
3.2.9 China Jiangsu

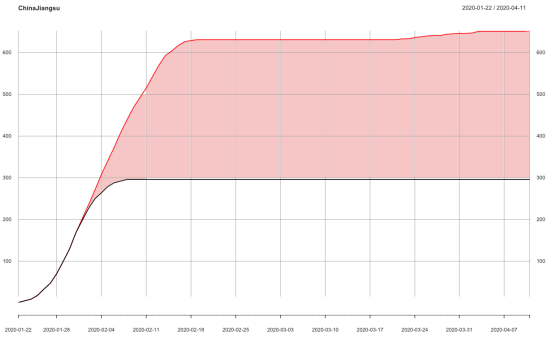


Period: 5 weeks (probably)

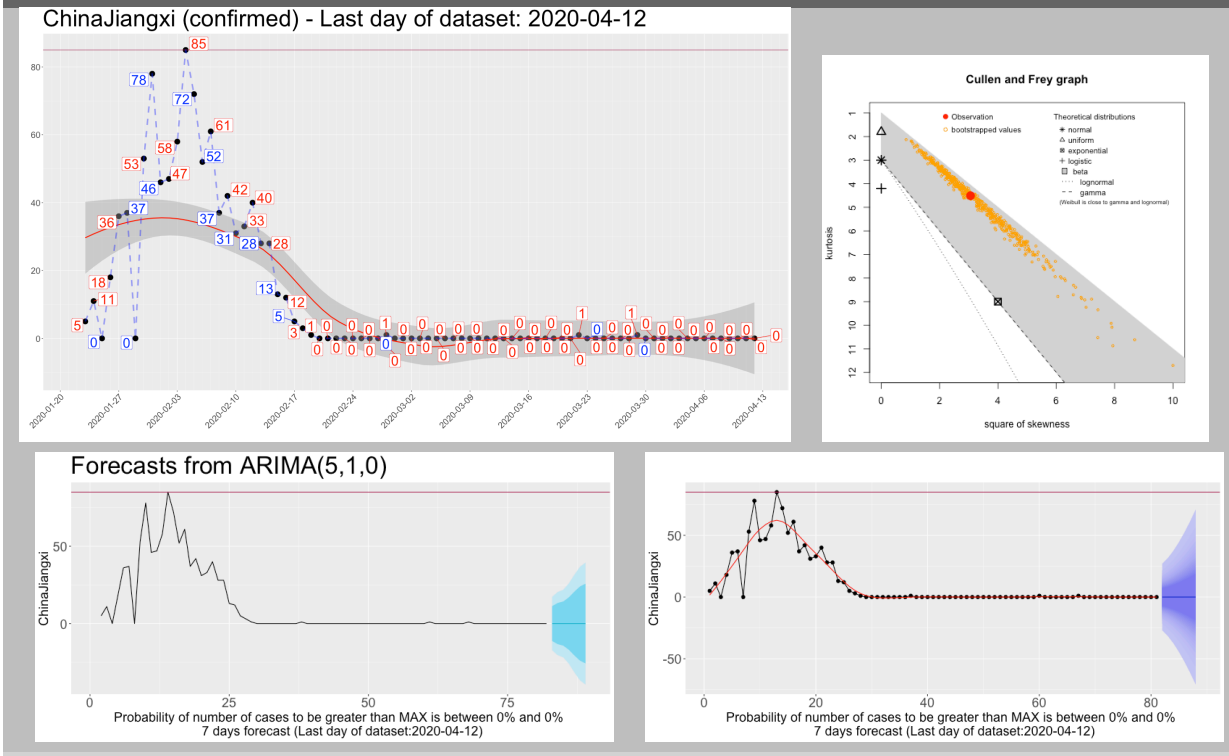
Estimation of number of cases: ARIMA -

It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are relatively more.





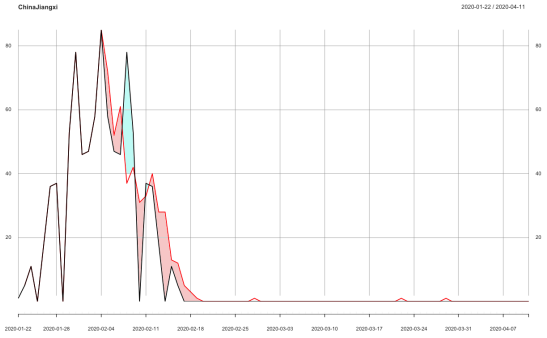
3.2.10 China Jiangxi

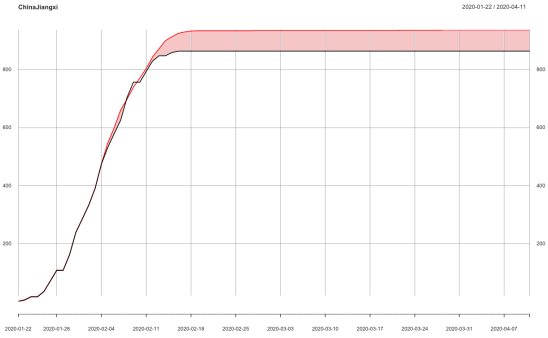


Period: 4 weeks

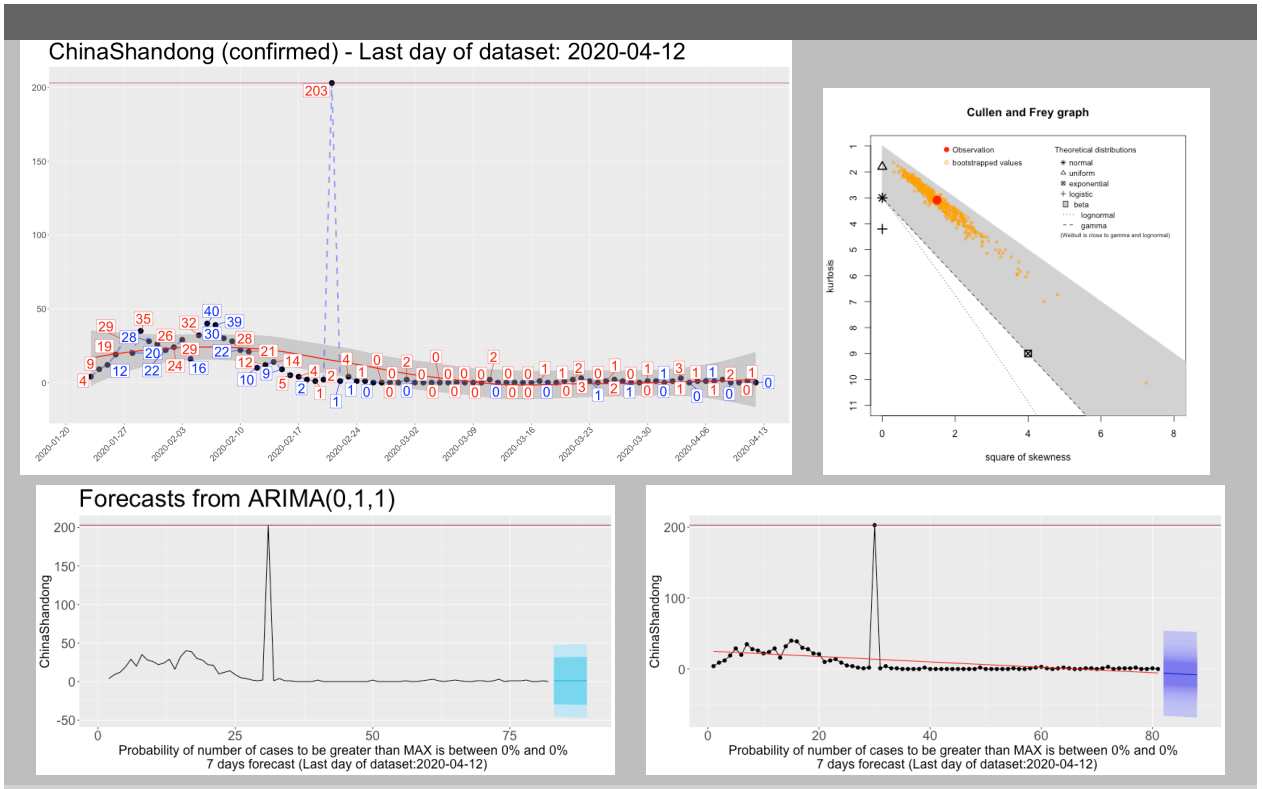
Estimation of number of cases: ARIMA -

It is observed that de-escalation is not symmetric to the escalation rate. At the beginning the de-scalation rate is faster and it slows down when reaches the end. The cases during the de-escalation period are relatively more.





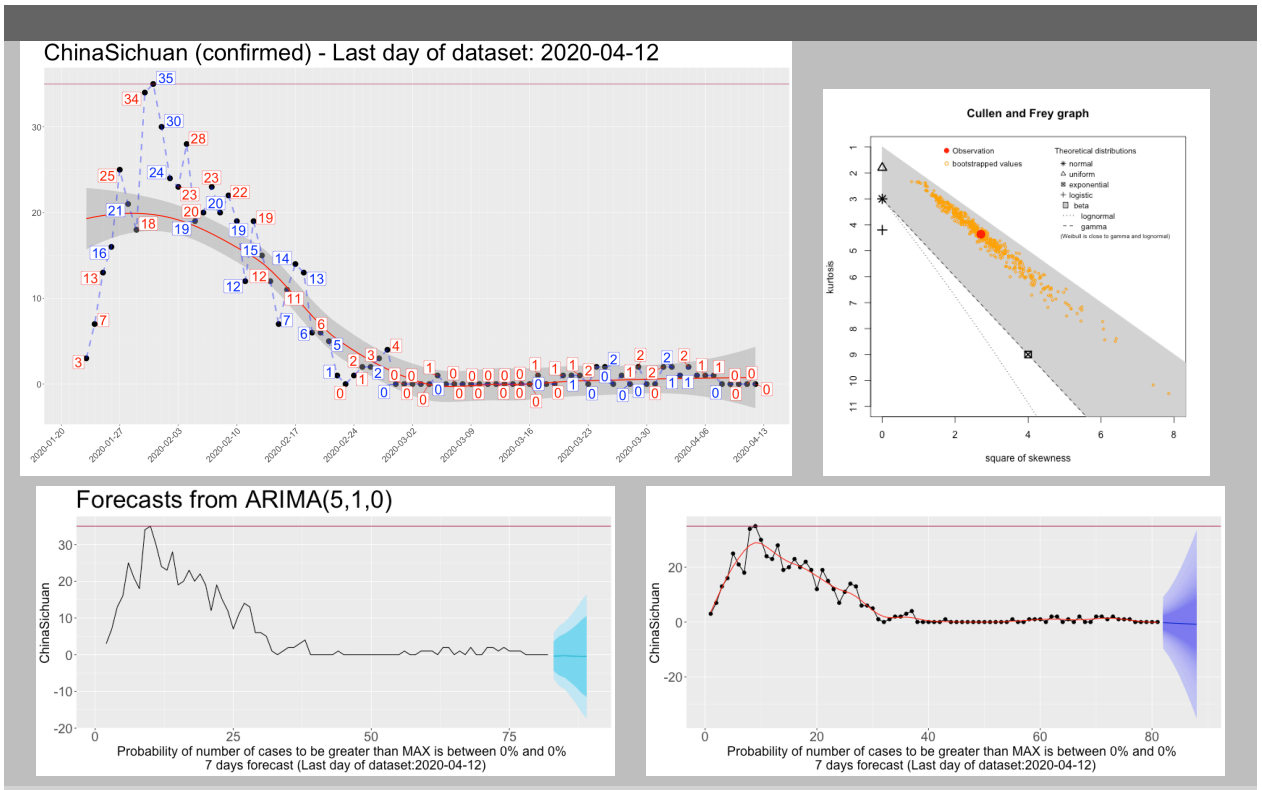
3.2.11 China Shandong



Period: 4 weeks

Estimation of number of cases: ARIMA -

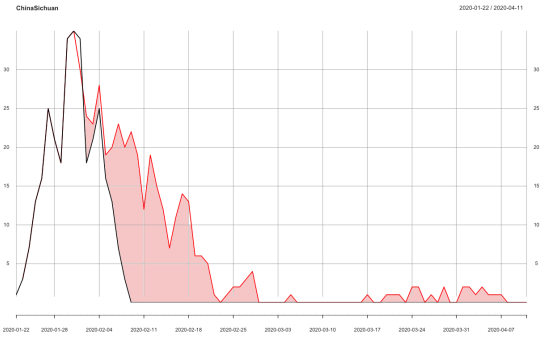
3.2.12 China Sichuan

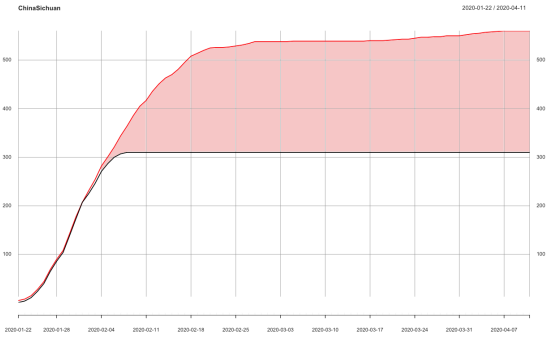


Period: 4 weeks

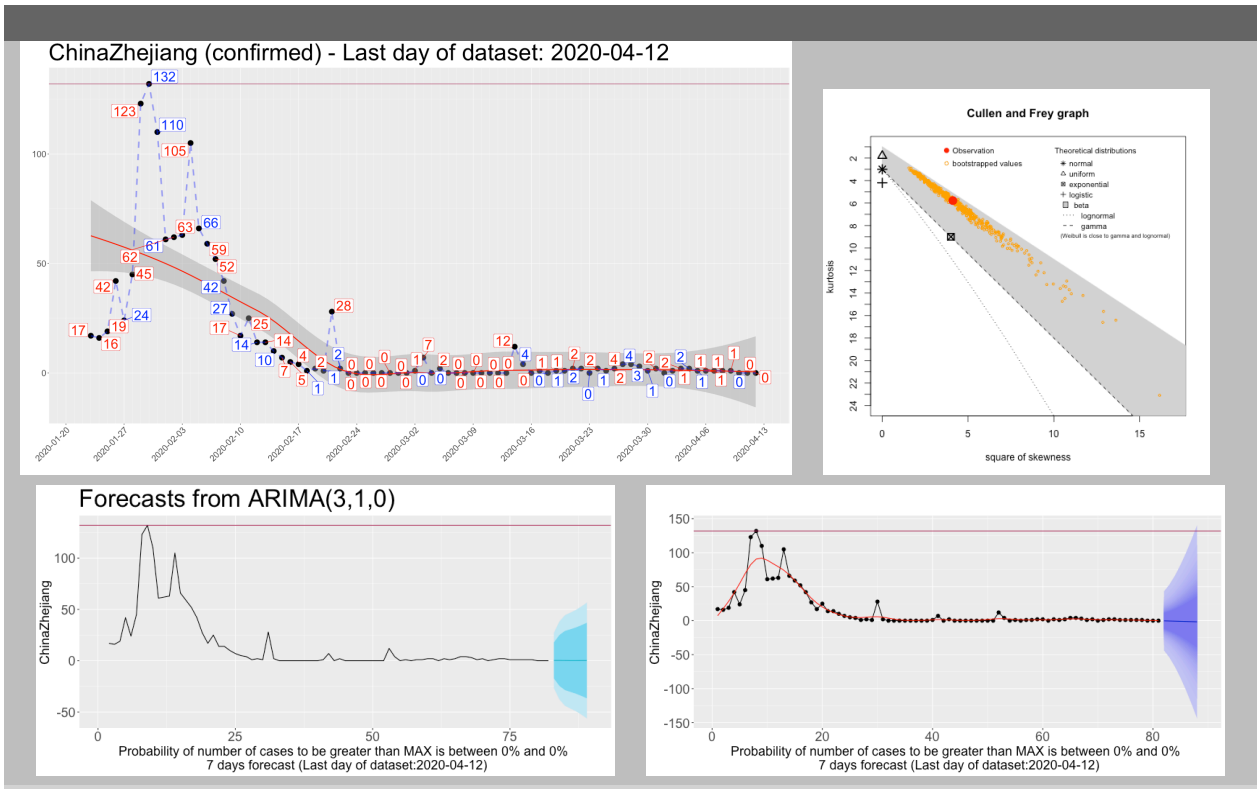
Estimation of number of cases: ARIMA -

It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are relatively more.





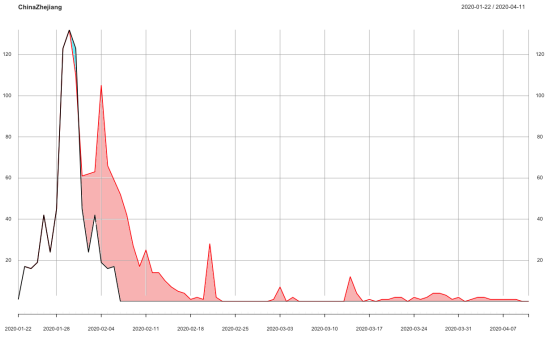
3.2.13 China Zhejiang

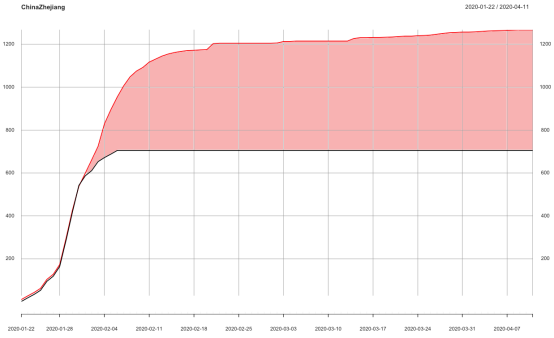


Period: 4 weeks (probably)

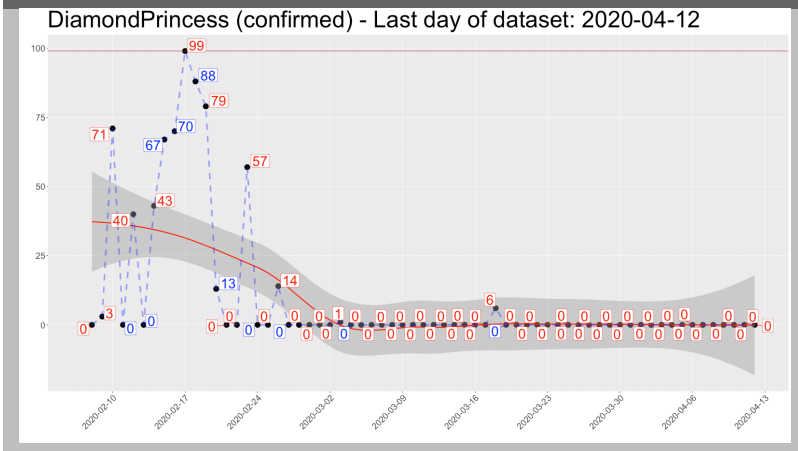
Estimation of number of cases: ARIMA -

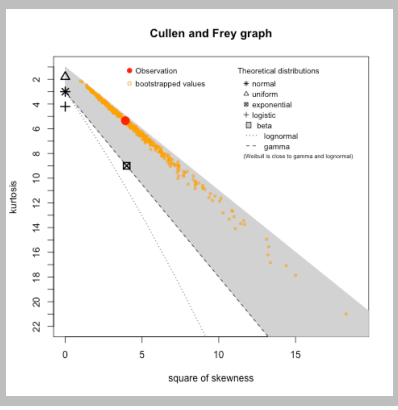
It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are more.

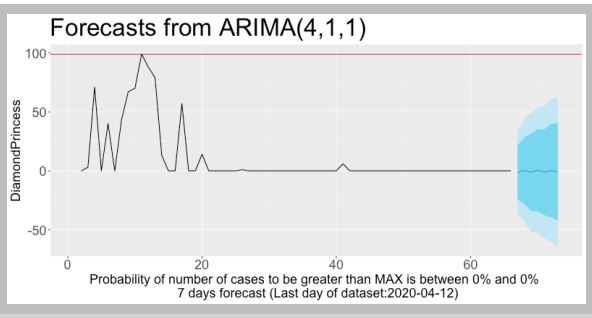


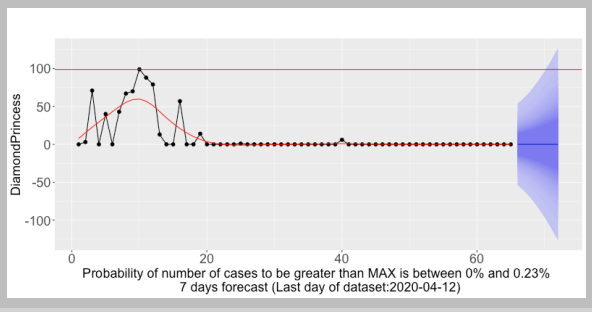


3.3 Cruise Ship Diamond Princess





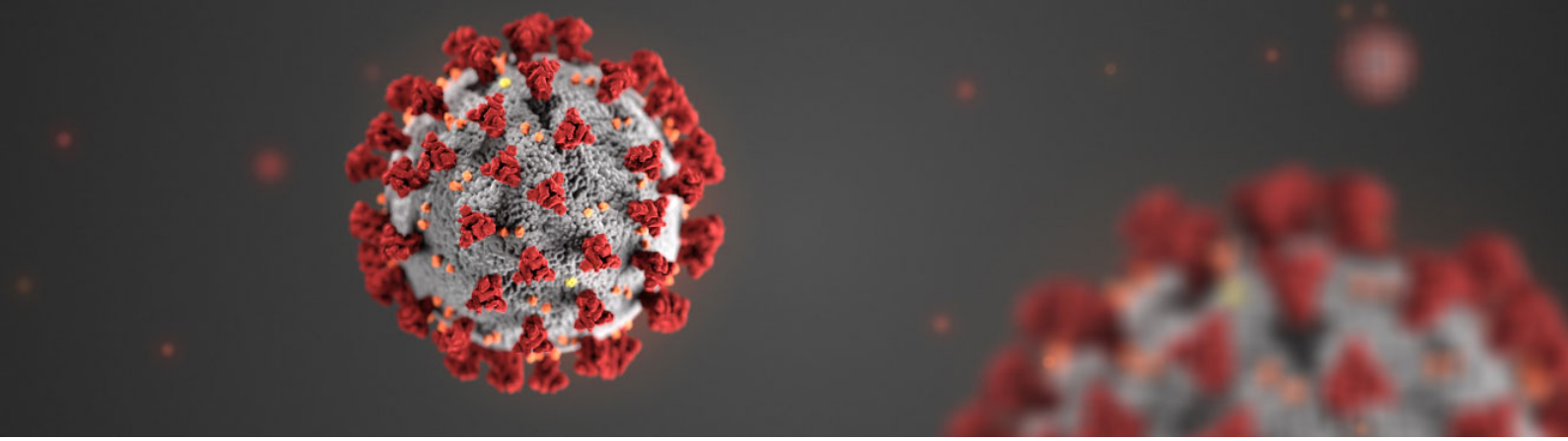




	Period:	3 weeks
Estimation of number of cases:	ARIMA	-

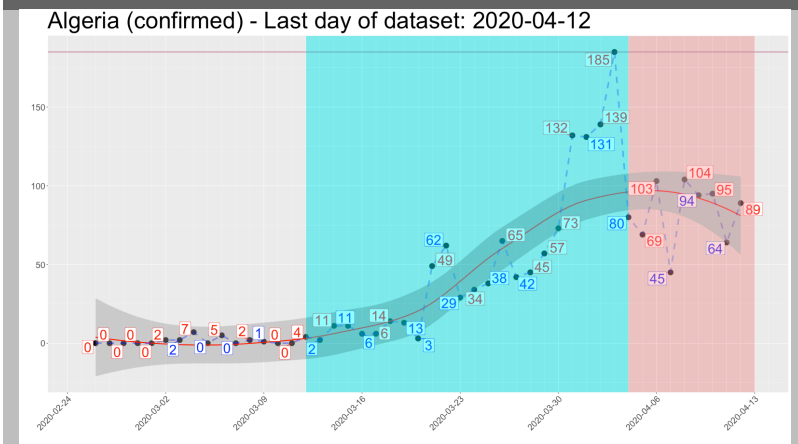
II

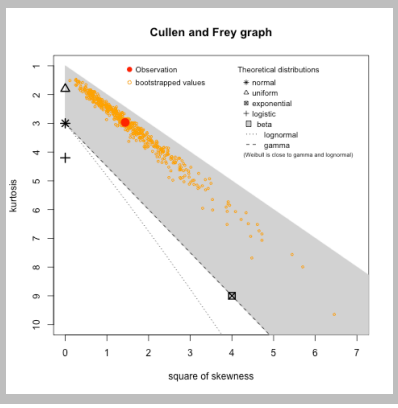
Africa

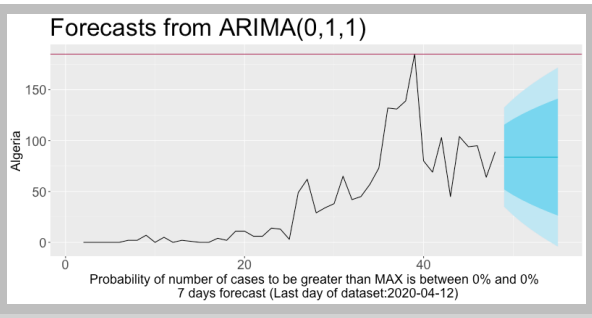


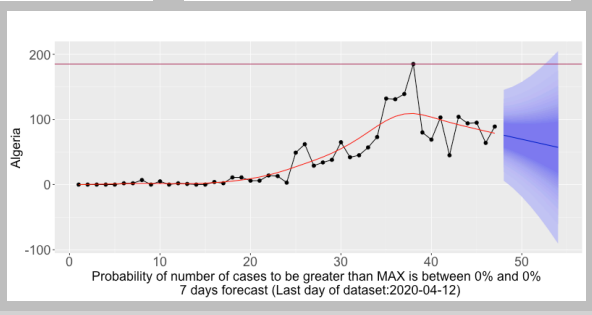
4. Africa

4.1 Algeria



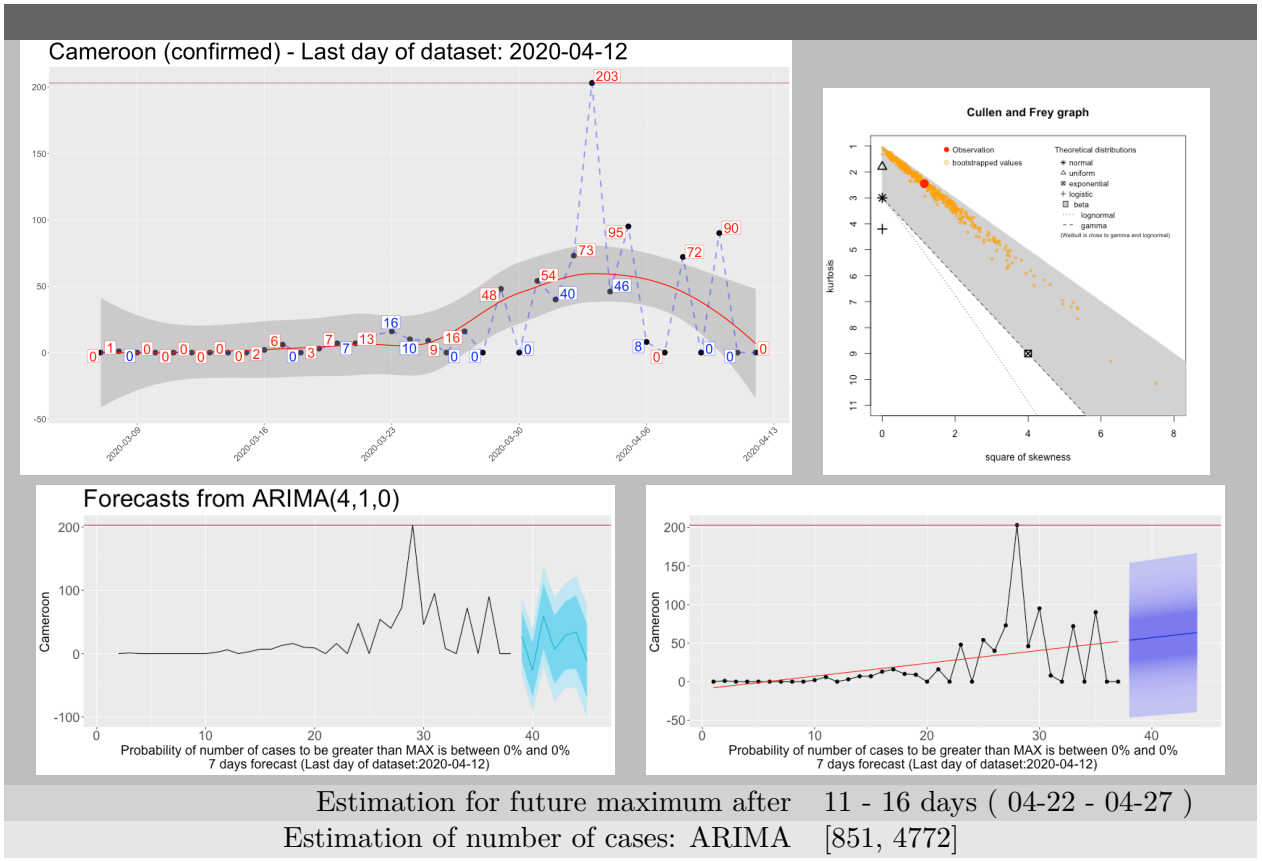






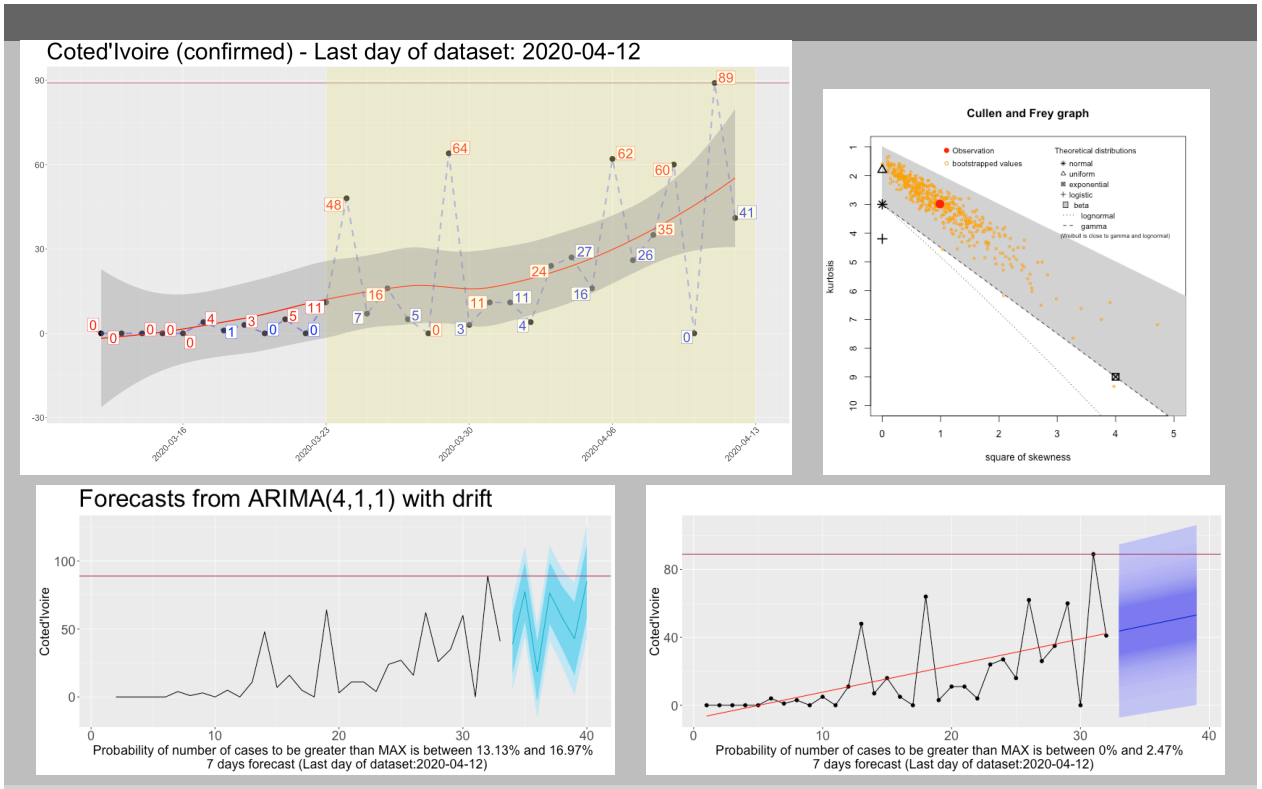
Maximum reached	2020-04-03
Estimation of number of cases: ARIMA	[1825, 2996]

4.2 Cameroon



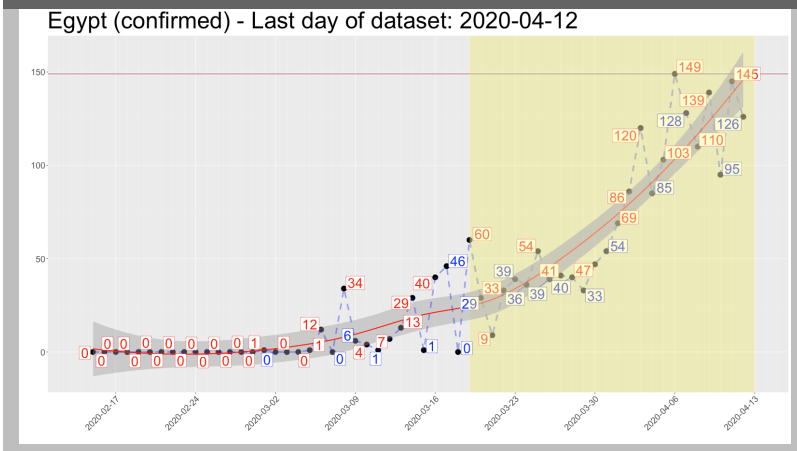
Estimation for future maximum after	11 - 16 days (04-22 - 04-27)
Estimation of number of cases: ARIMA	[851, 4772]

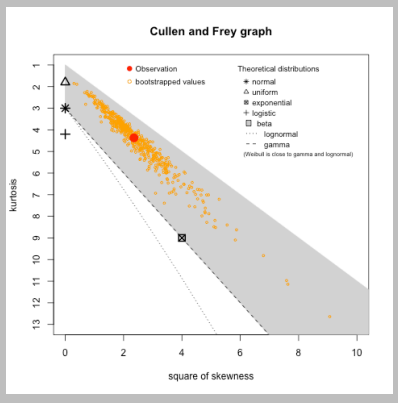
4.3 Cote d' Ivoire

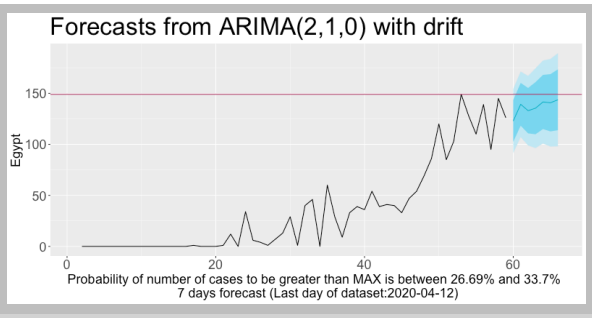


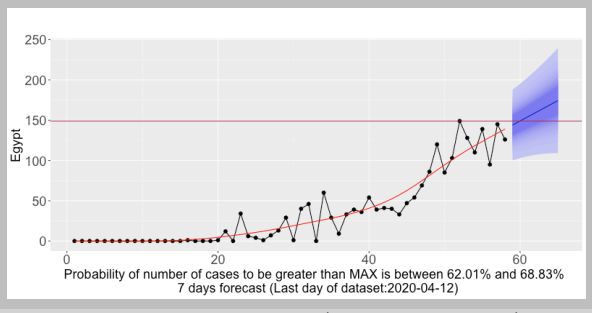
Estimation for future maximum after	14 - 20 days (04-25 - 05-01)
Estimation of number of cases: ARIMA	[1282, 4645]

4.4 Egypt



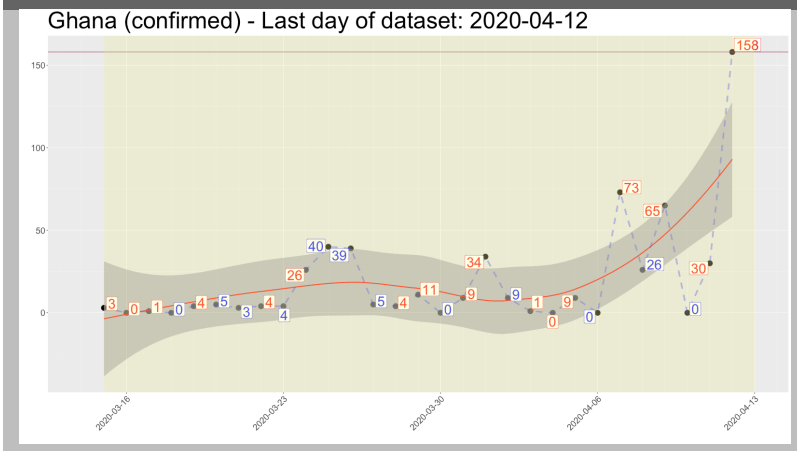


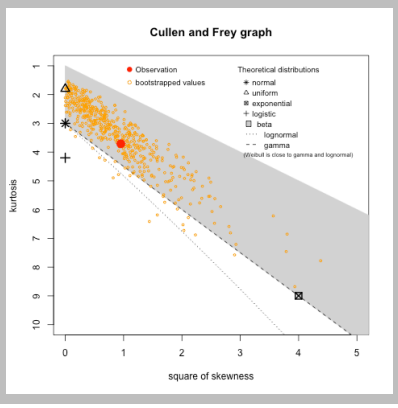


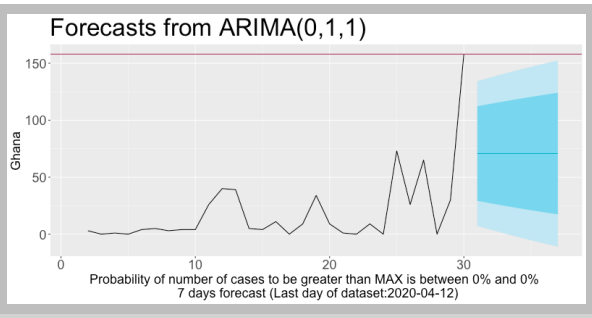


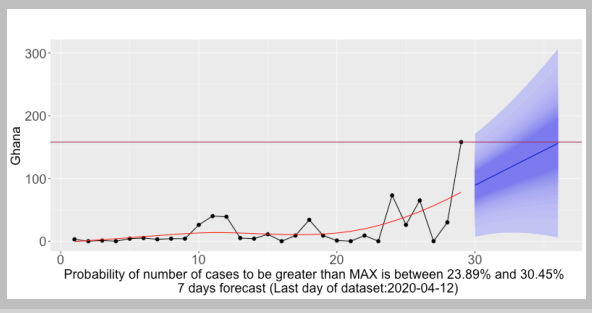
Estimation for future maximum after	2 - 7 days (04-13 - 04-18)
Estimation of number of cases: ARIMA	[4266, 6186]

4.5 Ghana



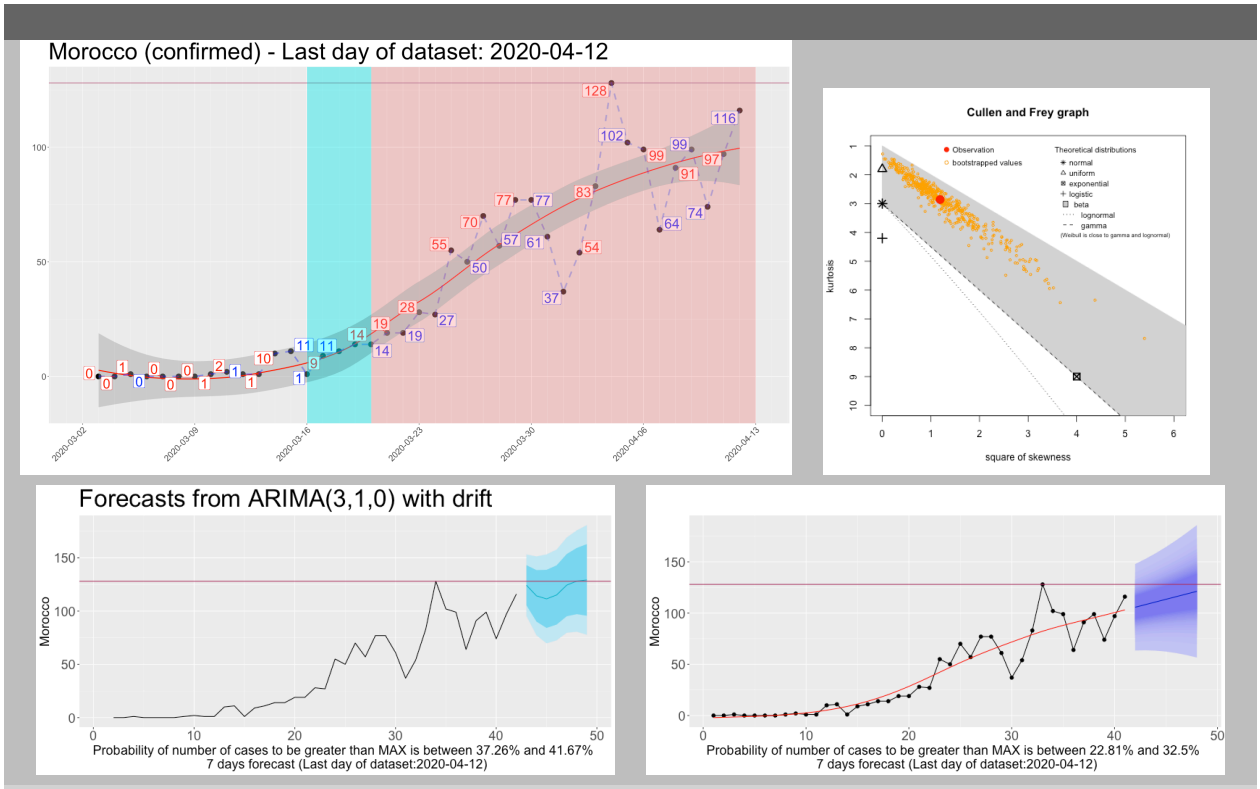






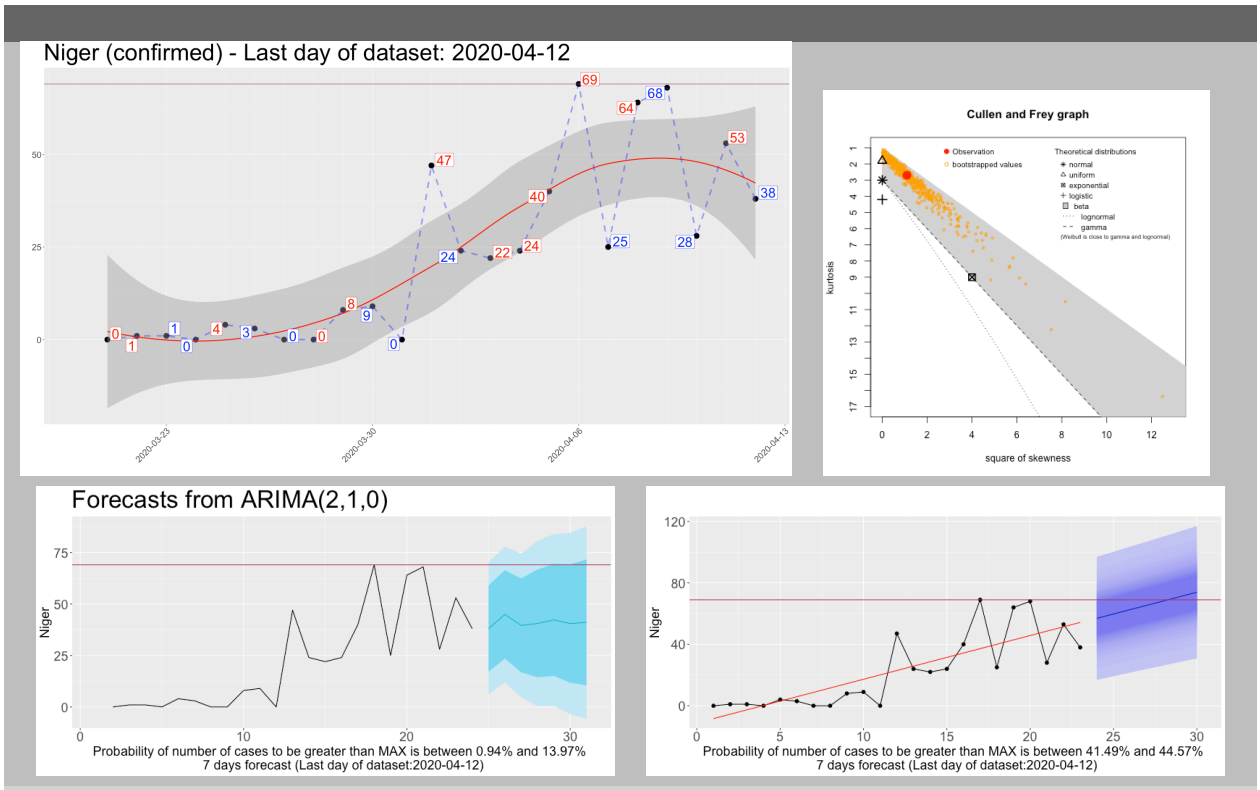
Estimation for future maximum after	5 - 10 days (04-17 - 04-22)
Estimation of number of cases: ARIMA	[1350, 3615]

4.6 Morocco



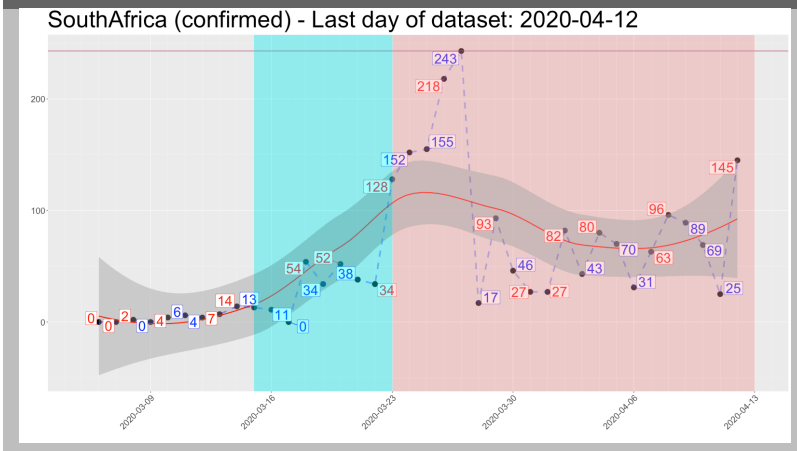
Estimation for future maximum after 2 - 6 days (04-13 - 04-17)
Estimation of number of cases: ARIMA [3352, 4629]

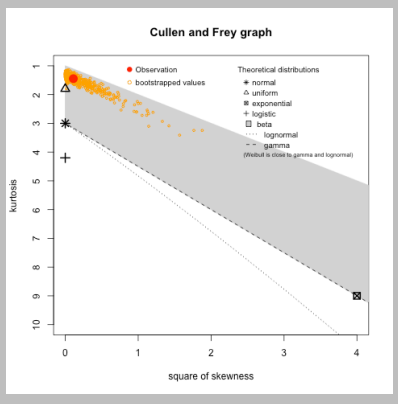
4.7 Niger

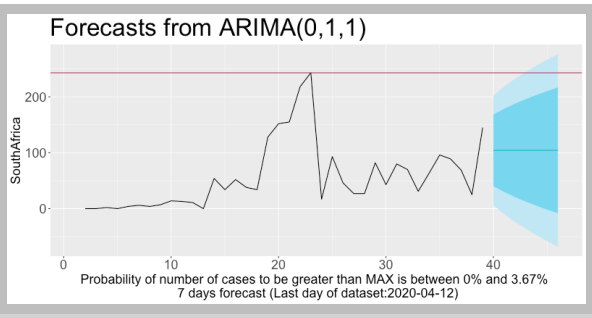


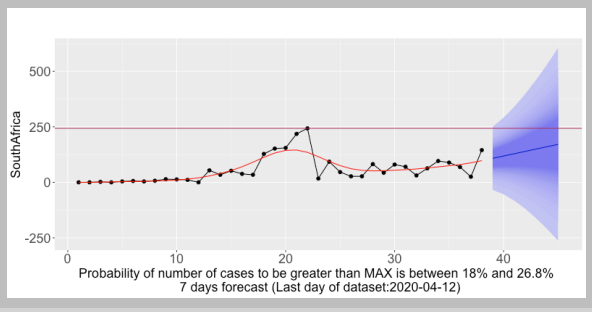
Estimation for future maximum after 4 - 9 days (04-16 - 04-21)
Estimation of number of cases: ARIMA [1183, 2340]

4.8 South Africa



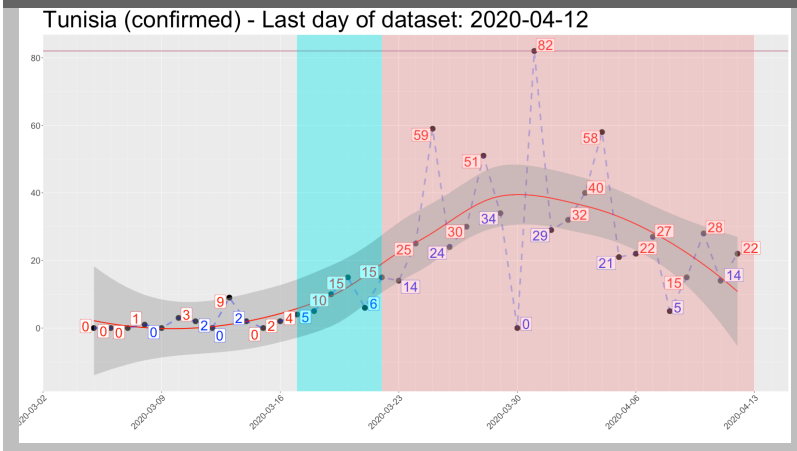


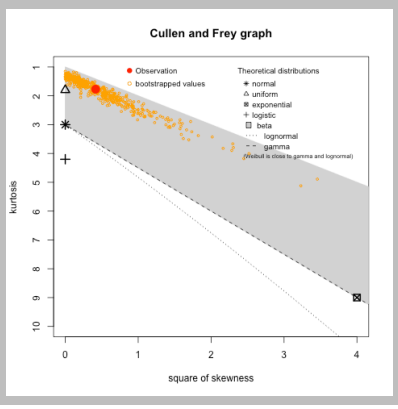


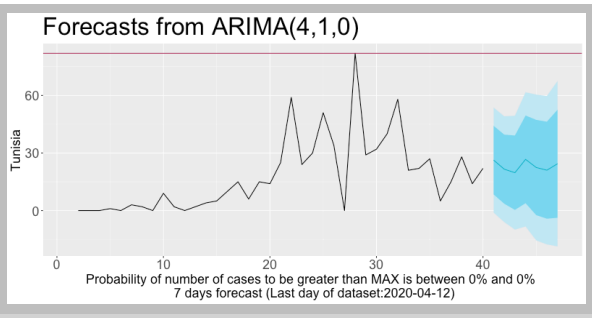


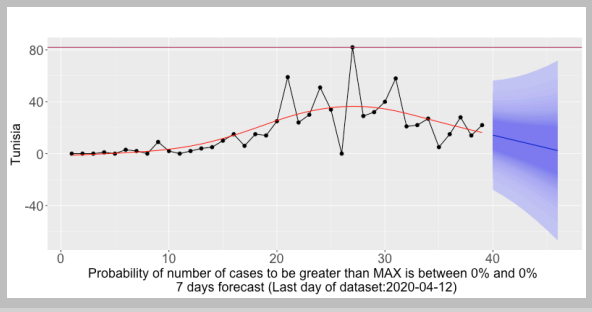
Maximum reached	2020-03-27
Estimation of number of cases: ARIMA	[2028, 3198]

4.9 Tunisia



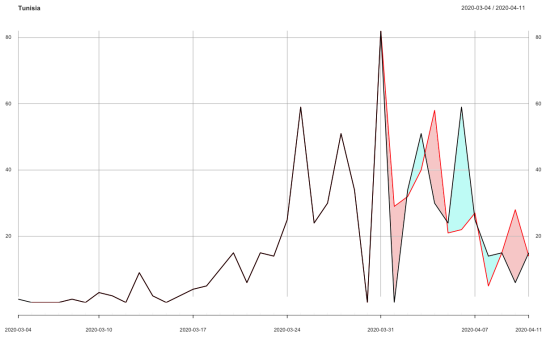


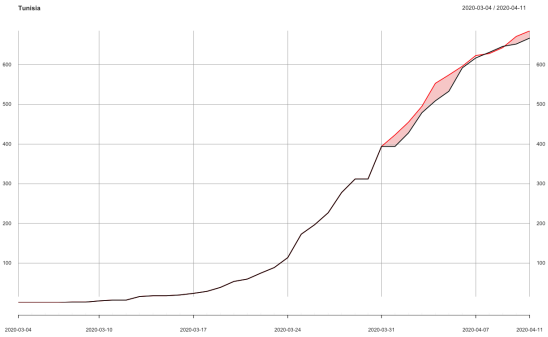




Maximum reached	2020-03-31
Estimation of number of cases: ARIMA	[685, 1079]

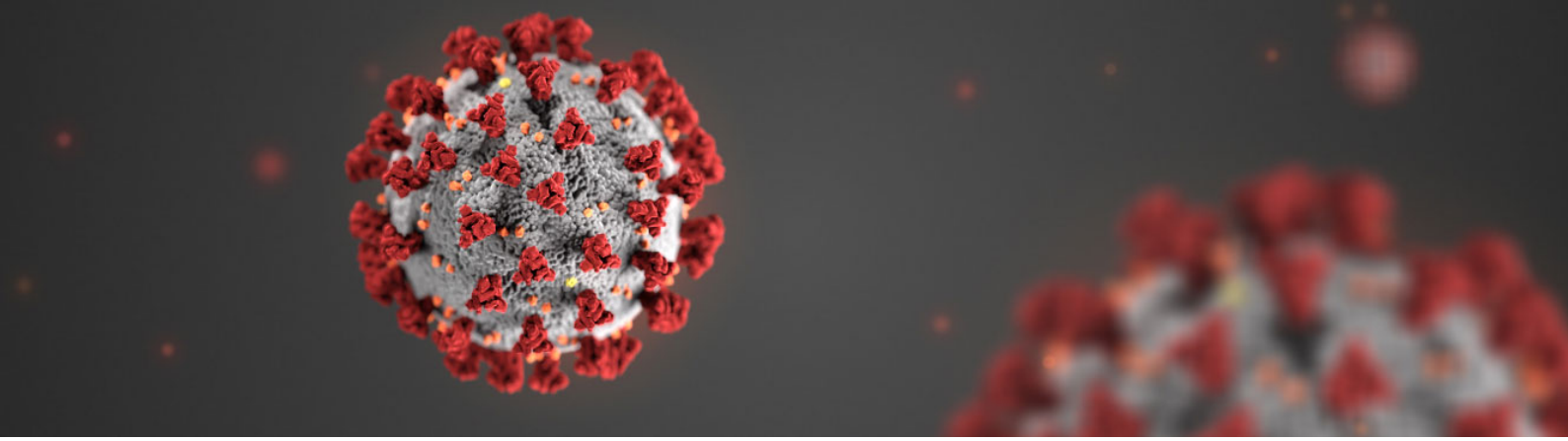
It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are relatively more.


Tunisia
2020-03-04 / 2020-04-11
80
60
40
20
2020-03-04
2020-03-10
2020-03-17
2020-03-24
2020-03-31
2020-04-07
2020-04-11


Tunisia
2020-03-04 / 2020-04-11
600
500
400
300
200
100
2020-03-04
2020-03-10
2020-03-17
2020-03-24
2020-03-31
2020-04-07
2020-04-11

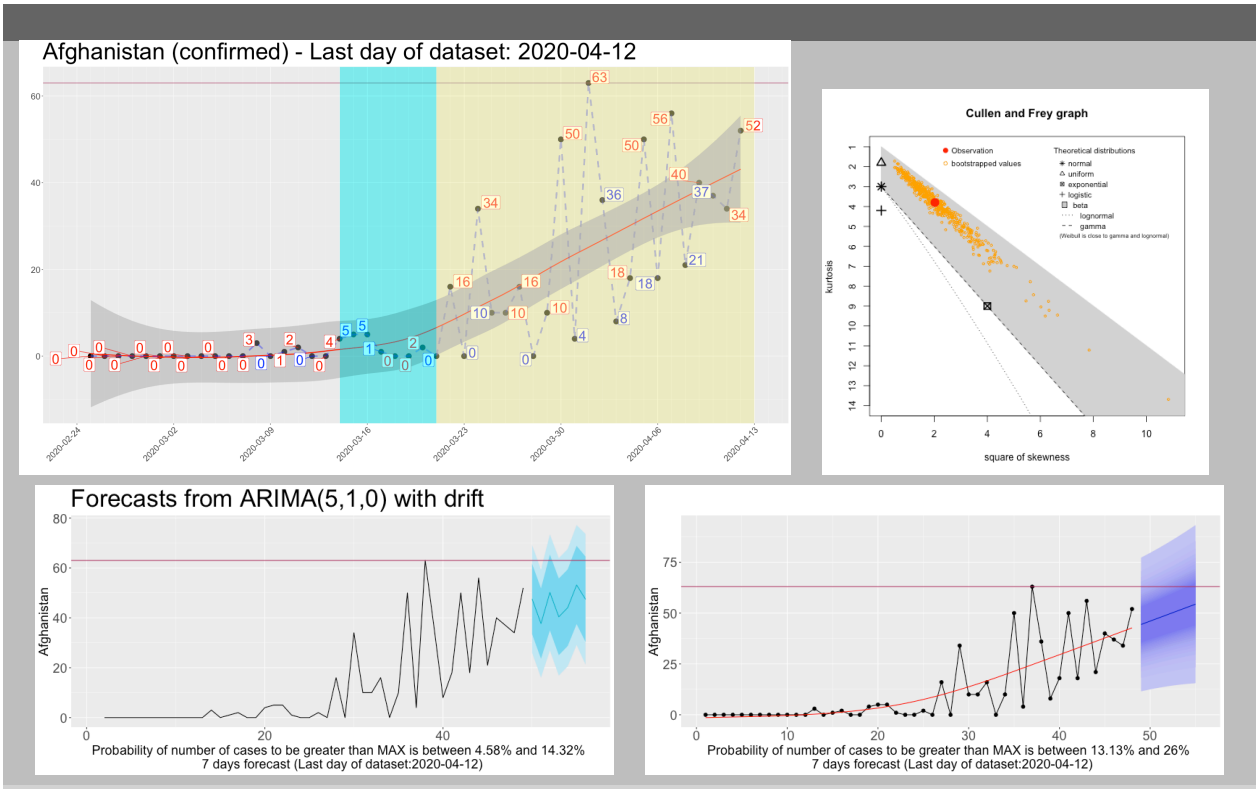
III

Asia



5. Asia

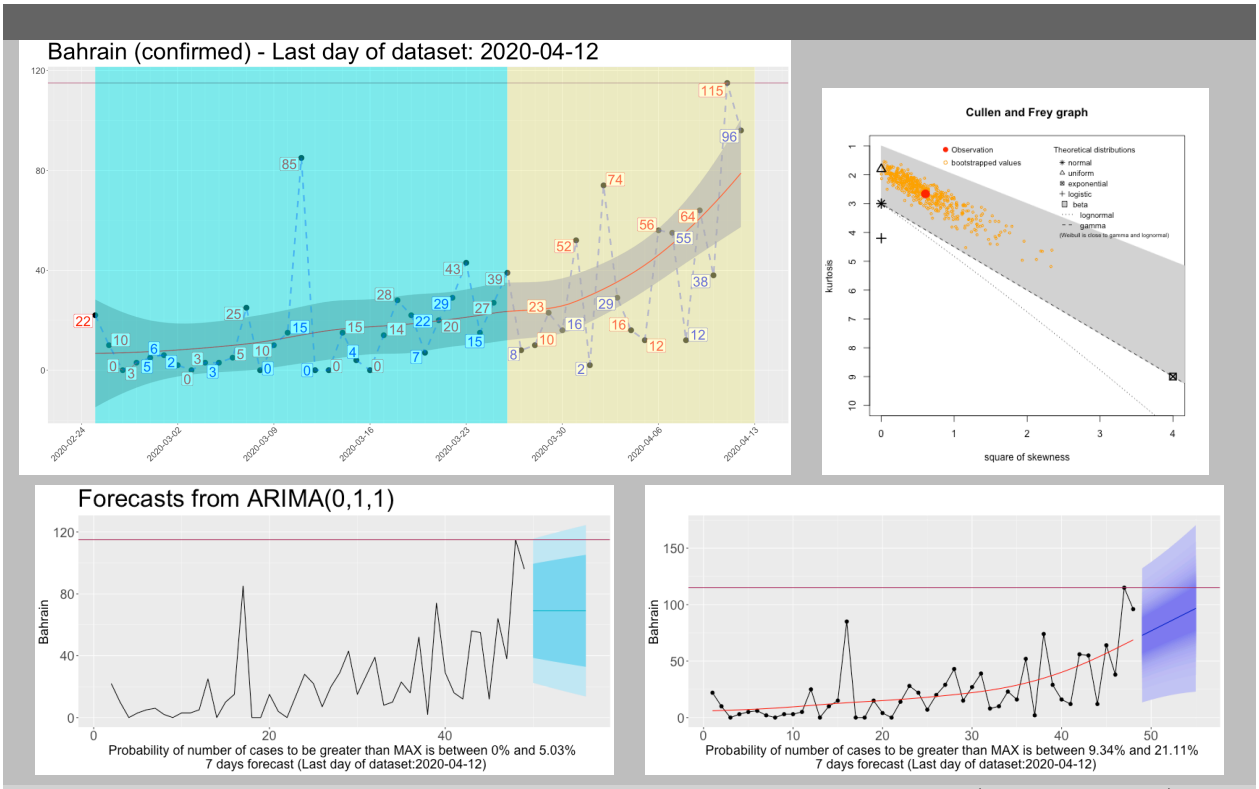
5.1 Afghanistan



Estimation for future maximum after 5 - 11 days (04-16 - 04-22)

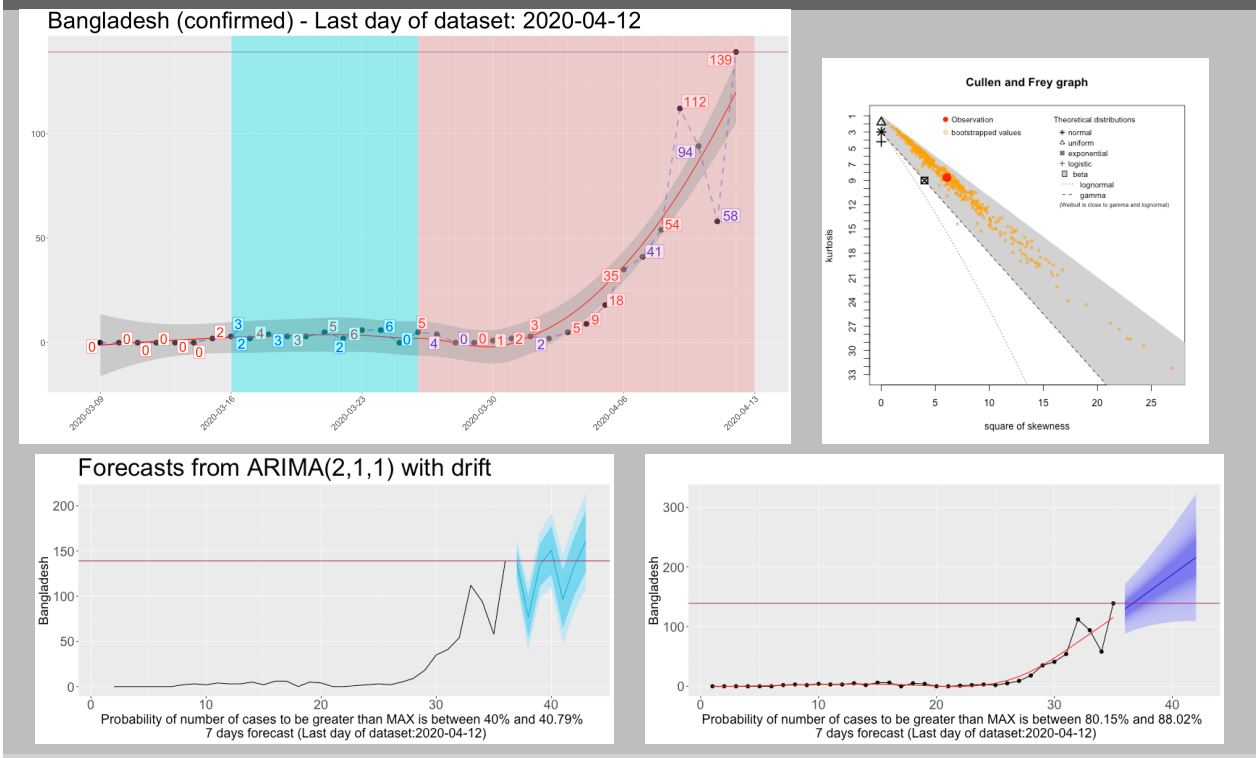
Estimation of number of cases: ARIMA [1323, 2208]

5.2 Bahrain



Estimation for future maximum after	9 - 13 days (04-20 - 04-24)
Estimation of number of cases: ARIMA	[2521, 4180]

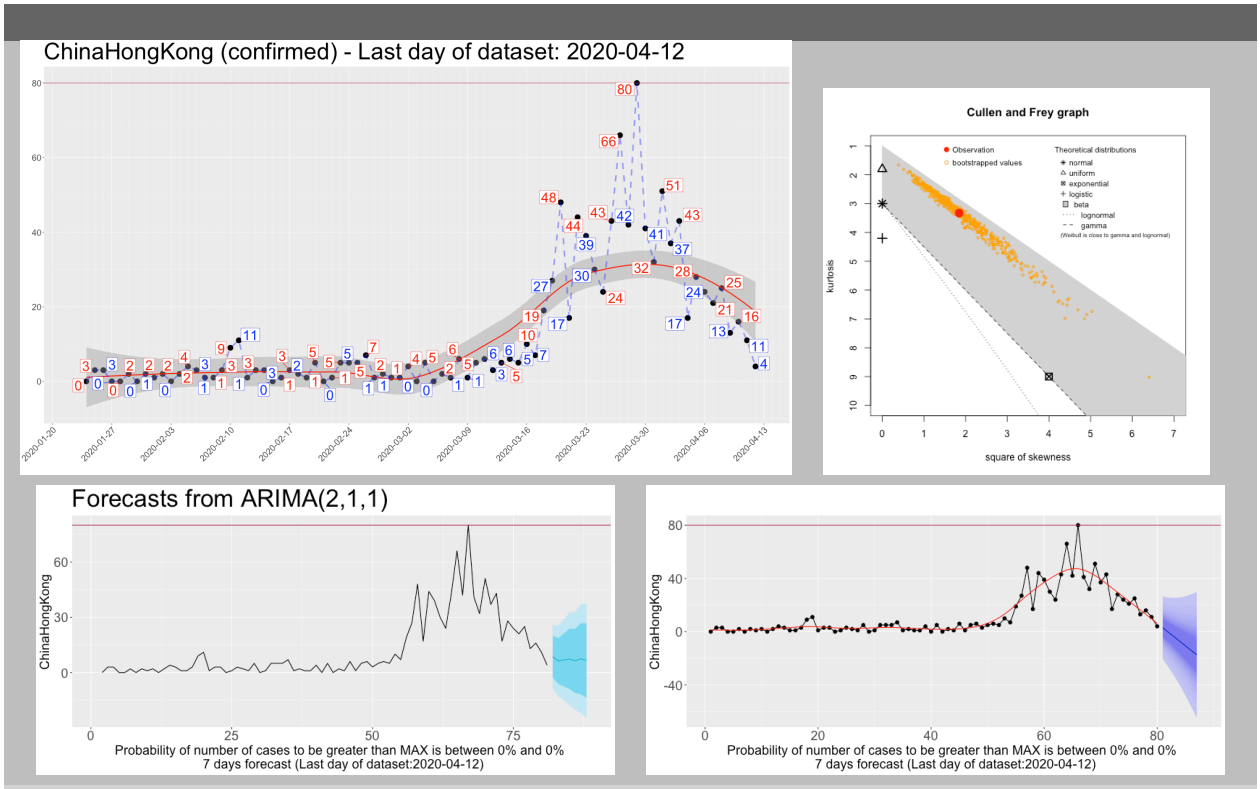
5.3 Bangladesh



Estimation for future maximum after	16 - 21 days (04-28 - 05-03)
Estimation of number of cases: ARIMA	[3329, 8149]

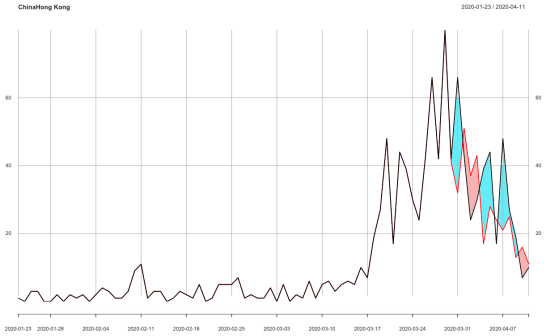
5.4 China

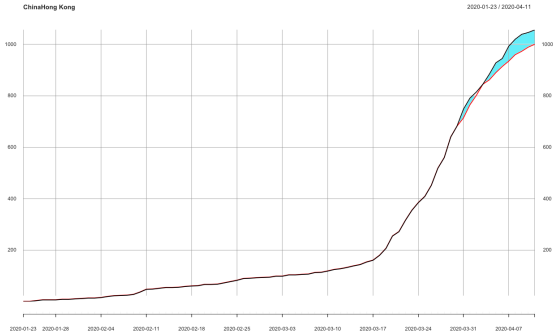
5.4.1 China Hong Kong



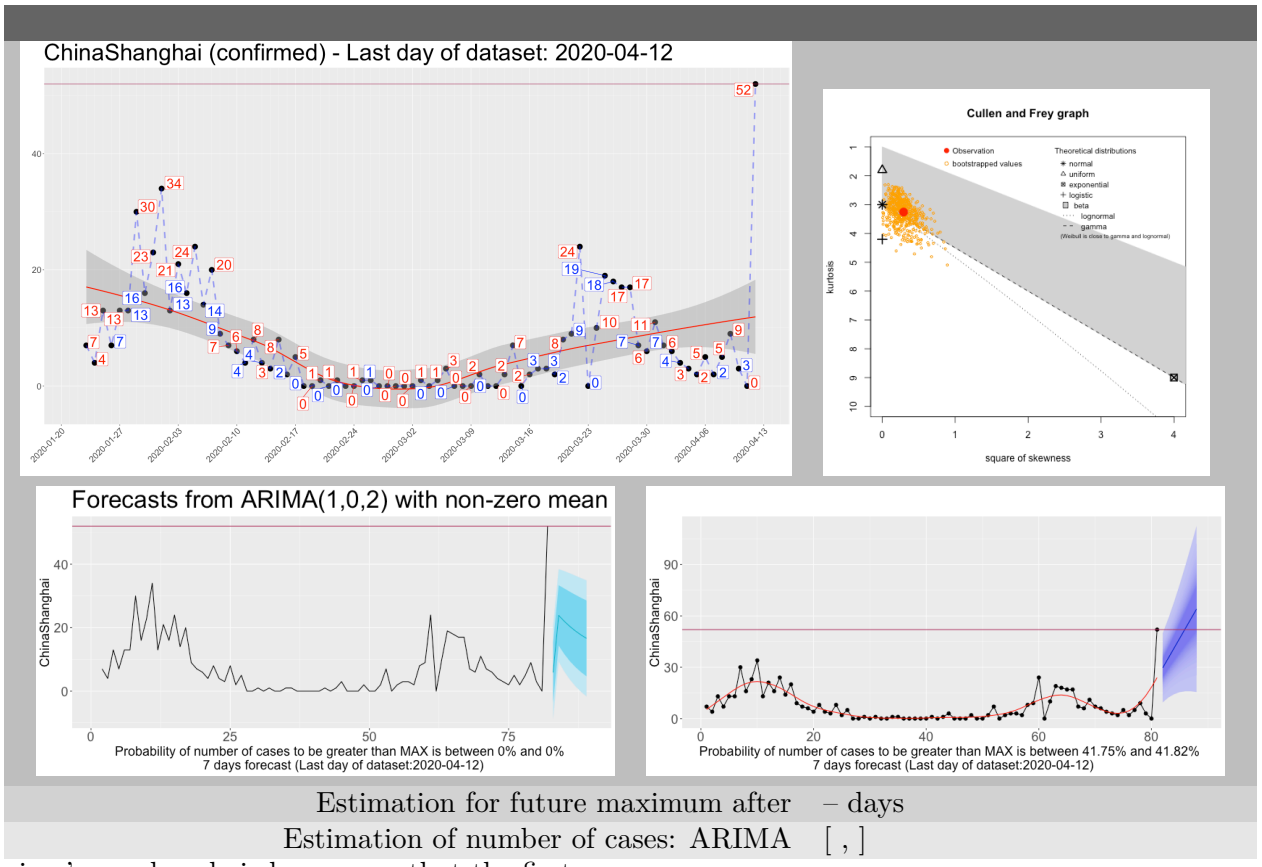
Maximum reached (probably)	2020-03-29
Estimation of number of cases: ARIMA	[890, 1531]

It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are relatively less.





5.4.2 ChinaShanghai 2nd period

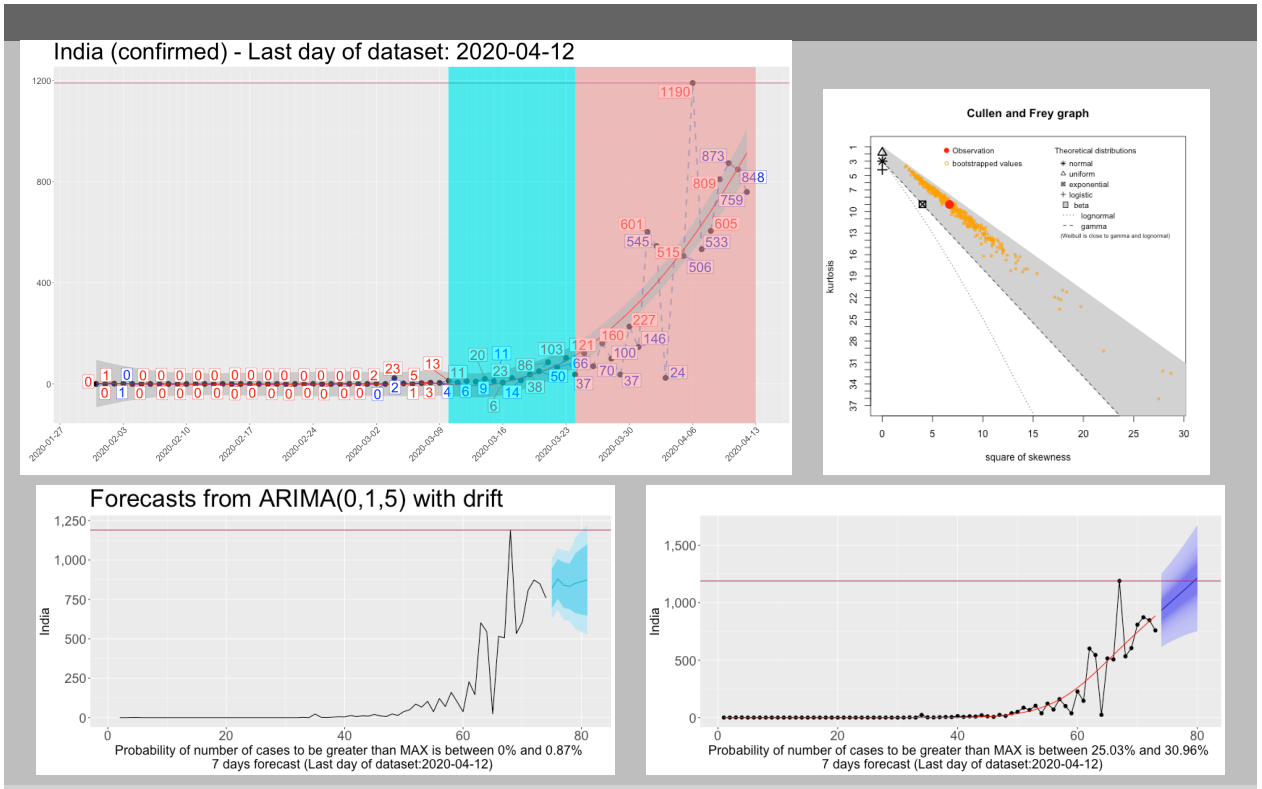


Estimation for future maximum after – days

Estimation of number of cases: ARIMA [,]

The virus'second cycle is less severe that the first one.

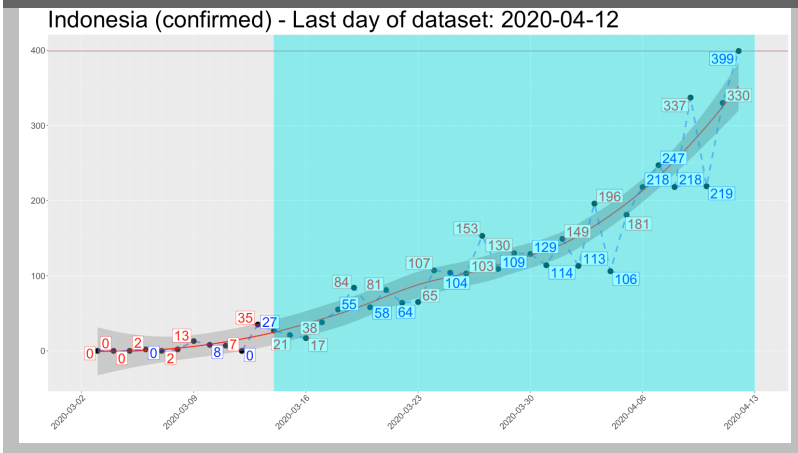
5.5 India

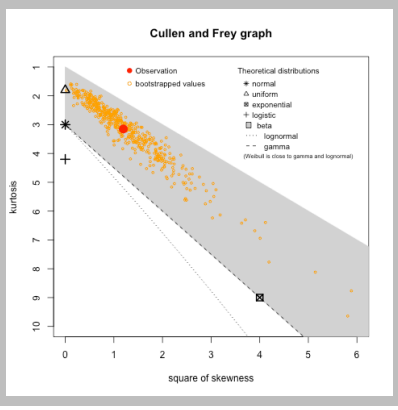


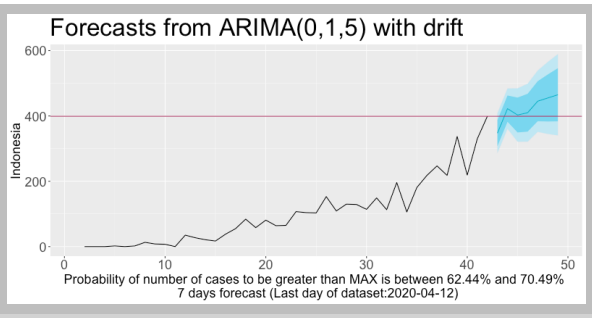
Estimation for future maximum after 4 - 9 days (04-15 - 04-20)

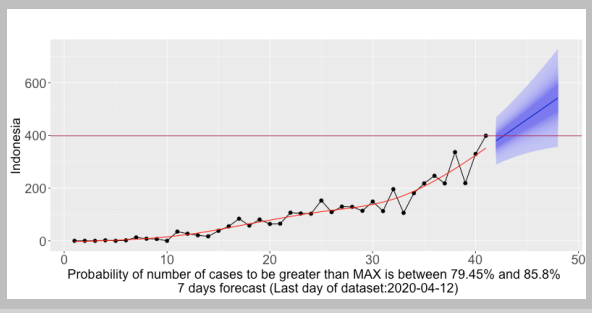
Estimation of number of cases: ARIMA [21050, 33773]

5.6 Indonesia



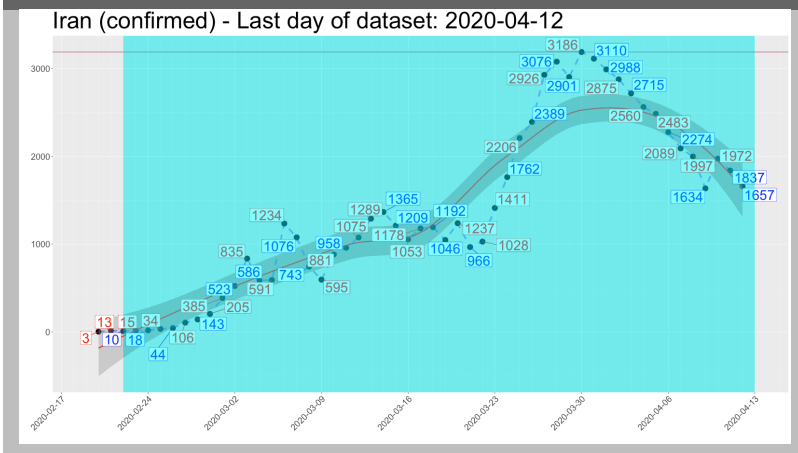


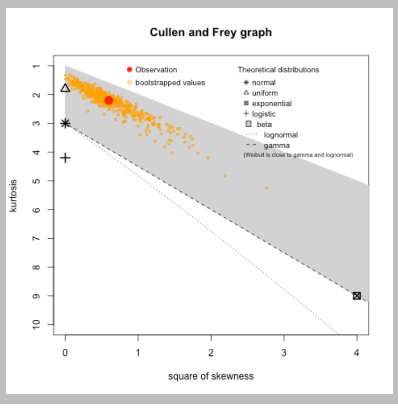


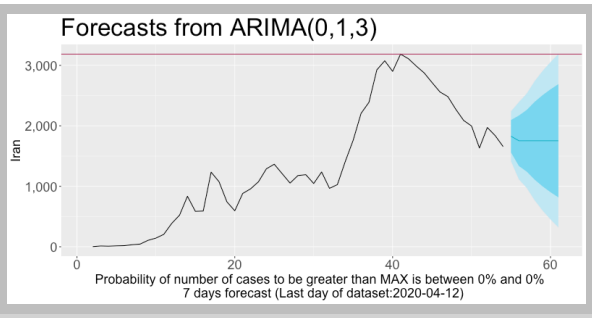


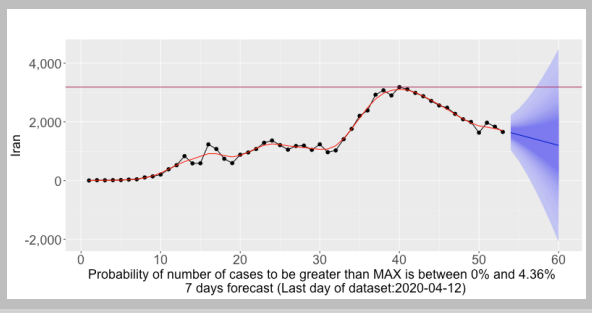
Estimation for future maximum after	6 - 10 days (04-17 - 04-21)
Estimation of number of cases: ARIMA	[10295, 14765]

5.7 Iran

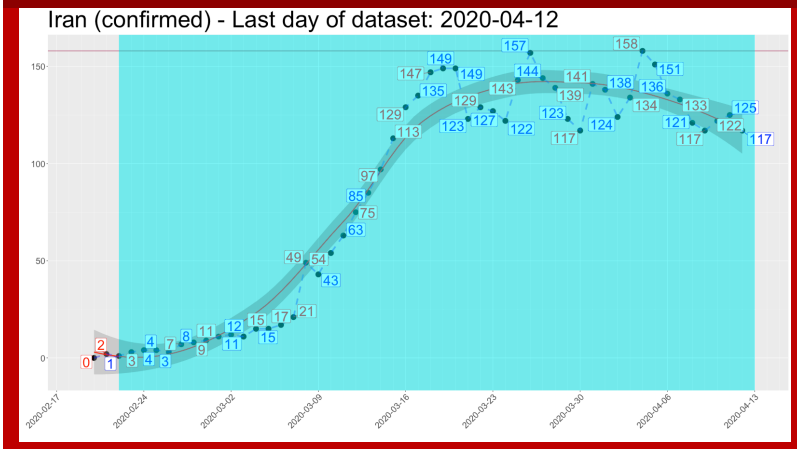


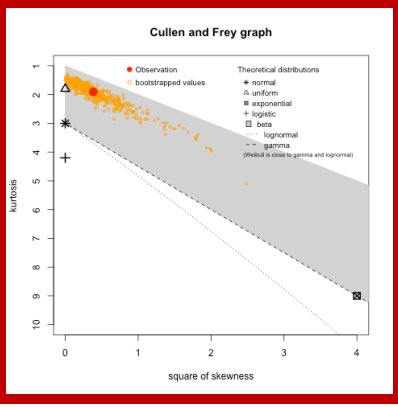


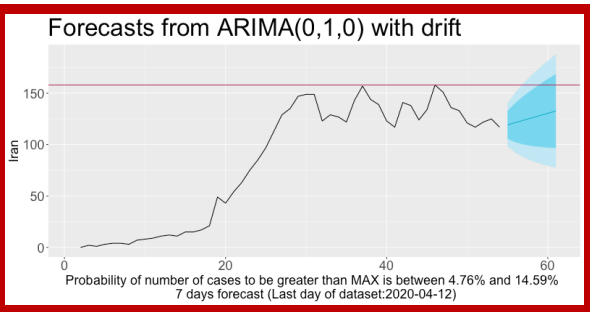


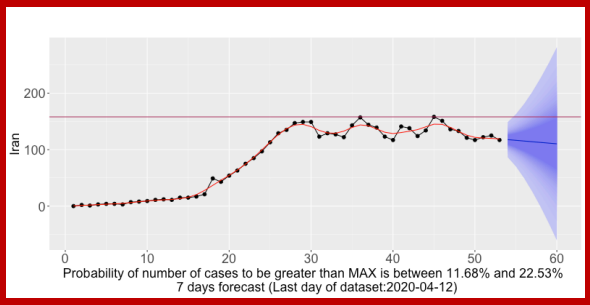


Maximum reached	2020-03-30
Estimation of number of cases: ARIMA	[70 029, 114 634]



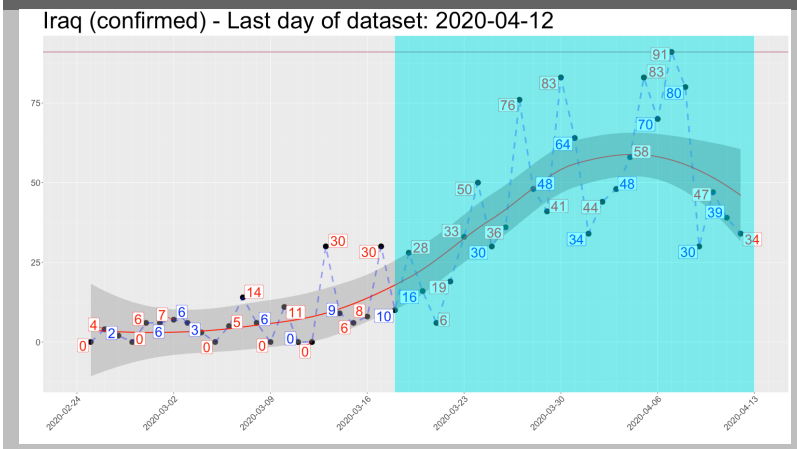


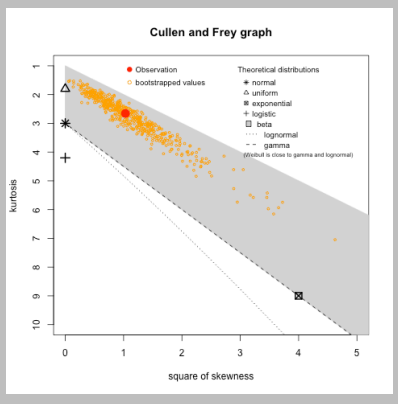


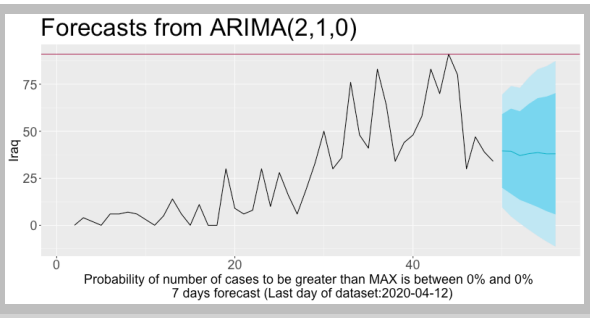


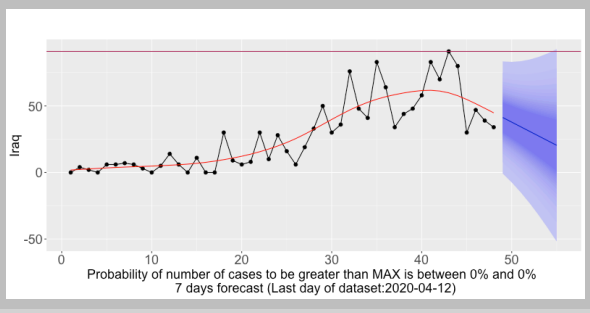
Estimation for future maximum after period around the maximum
Estimation of number of cases: ARIMA [4357, 7809]

5.8 Iraq



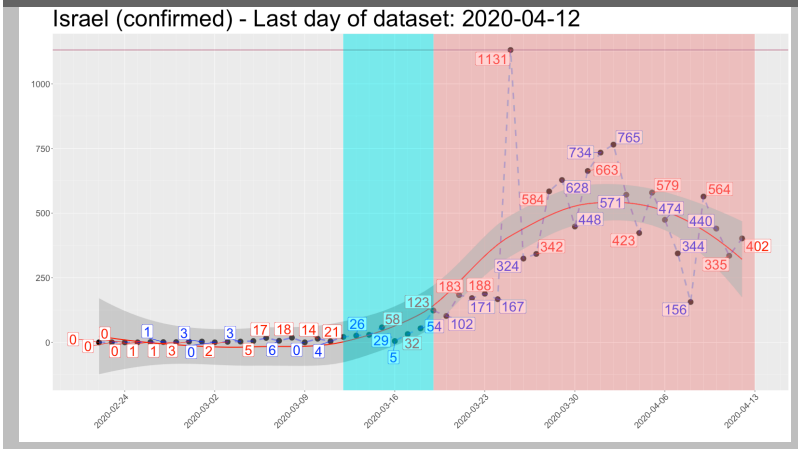


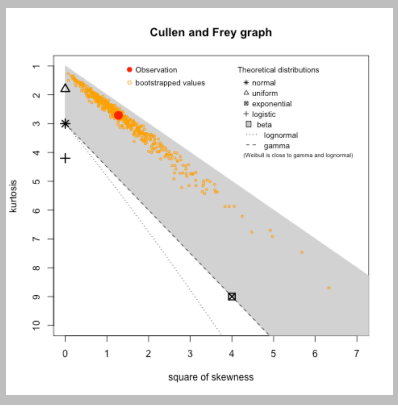


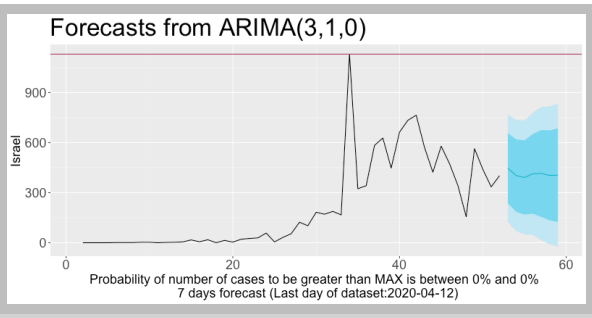


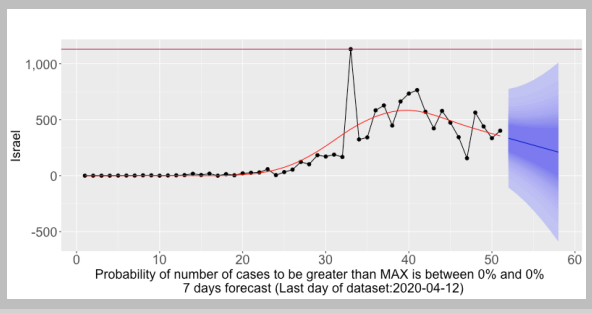
Estimation for future maximum after period around the maximum
Estimation of number of cases: ARIMA [1318, 2440]

5.9 Israel





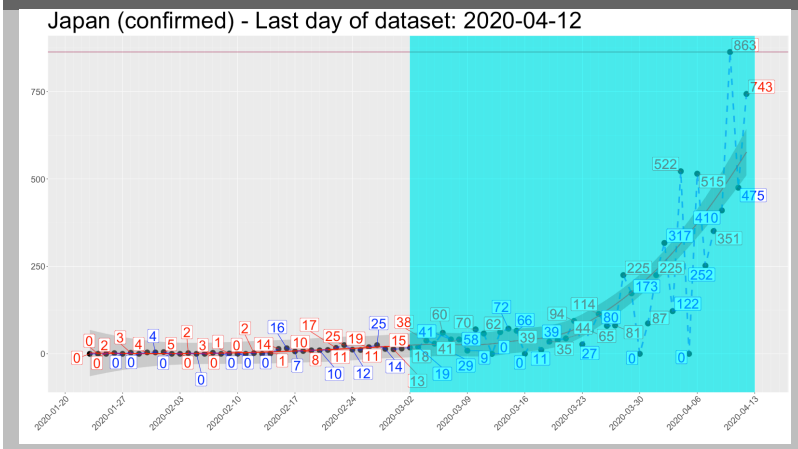


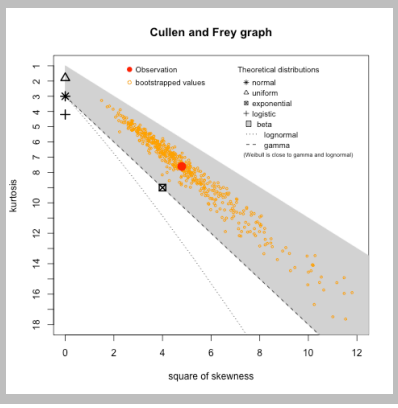


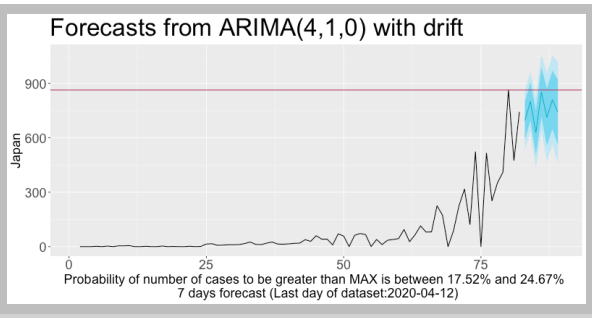
Maximum reached	2020-04-05
Estimation of number of cases: ARIMA	[10743, 19173]

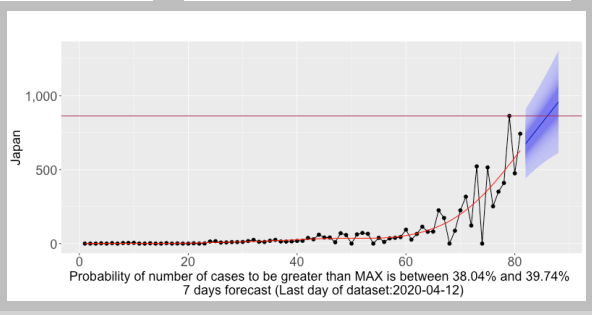
In Israel, Phase 1 measures were imposed on March 14^{th} and Phase 3 measures on March 19^{th}. A slight hold back on the exponential growth rate of the confirmed cases is observed.

5.10 Japan





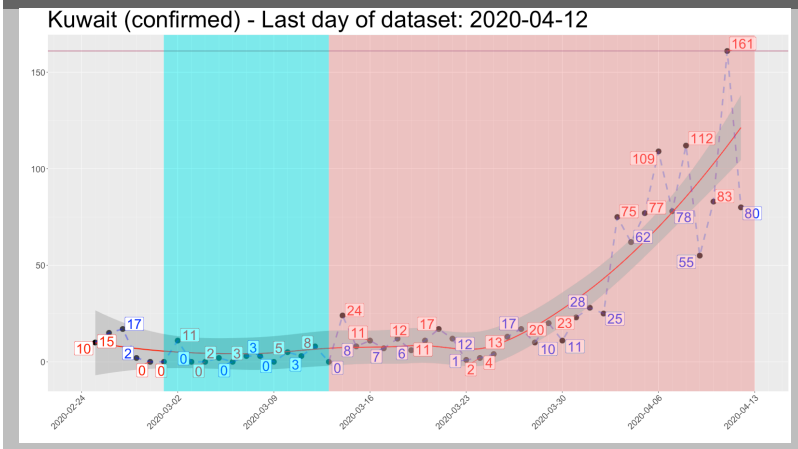


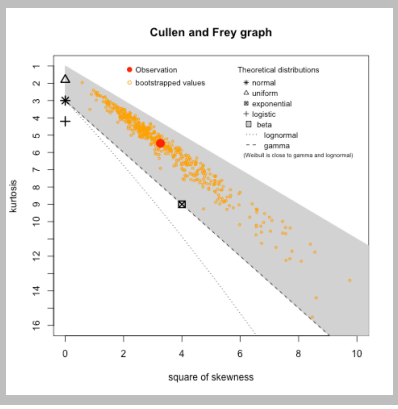


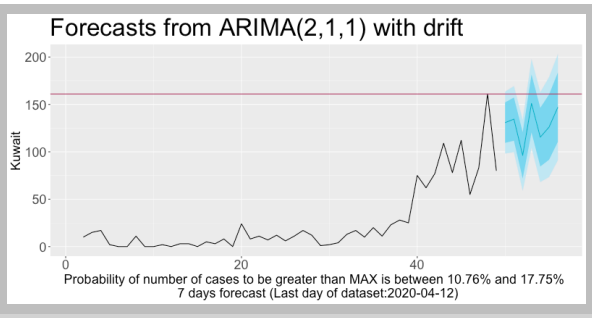
Estimation for future maximum after	3 - 8 days (04-14 - 04-19)
Estimation of number of cases: ARIMA	[15795, 27103]

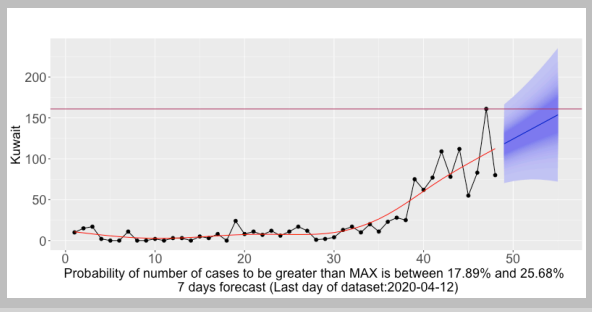
In Japan, Phase 1 measures were imposed on March 2^{nd}. For a comparatively long period of 4 weeks, the COVID-19 confirmed cases trend has increased only moderately.

5.11 Kuwait



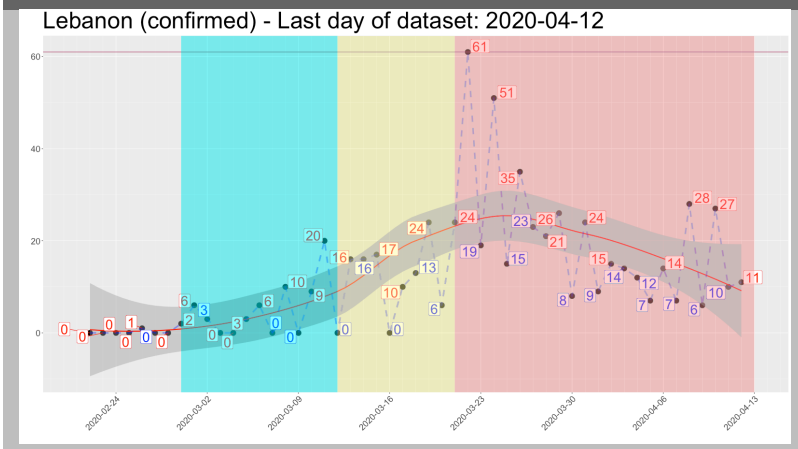


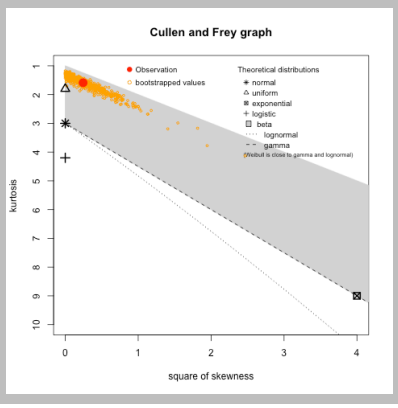


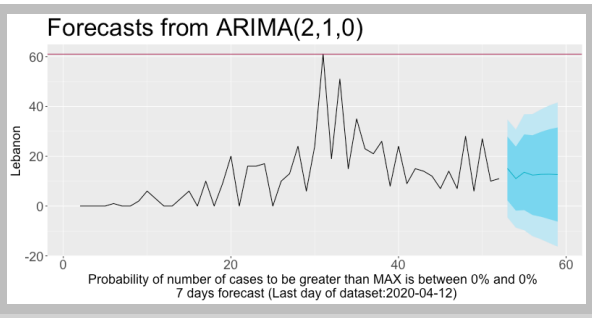


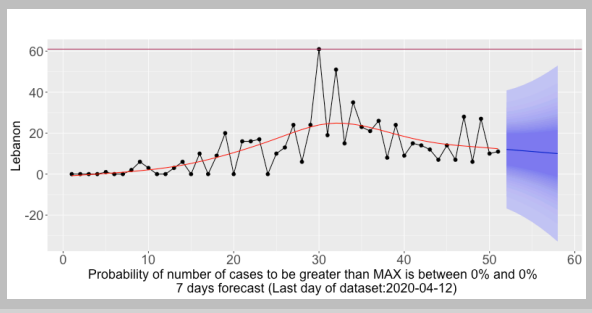
Estimation for future maximum after	2 - 7 days (04-13 - 04-18)
Estimation of number of cases:	[2608, 4380]

5.12 Lebanon



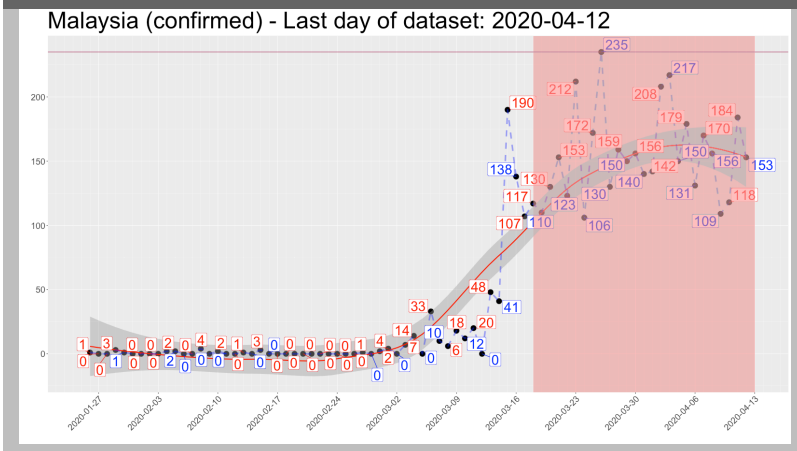


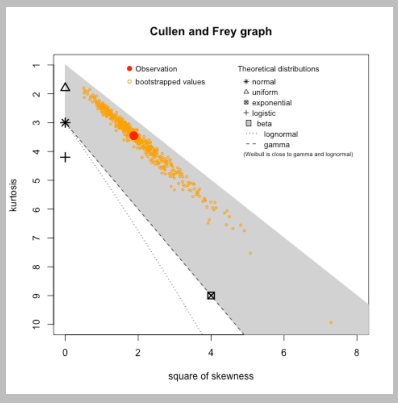


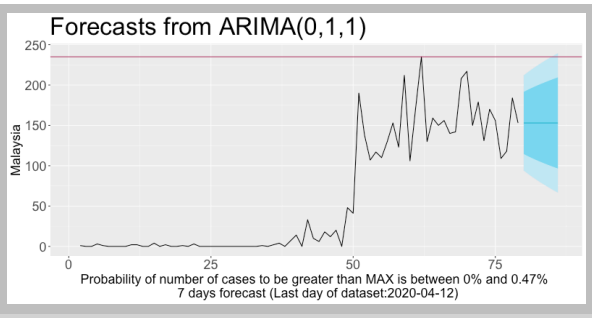


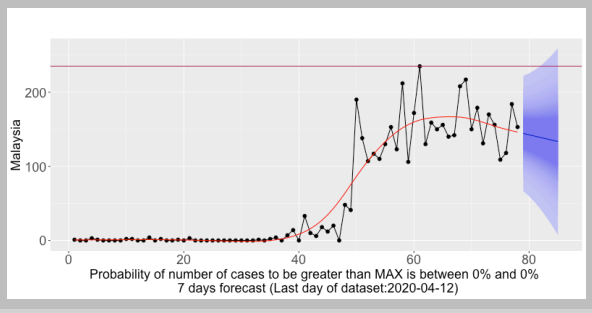
Maximum reached	2020-03-22
Estimation of number of cases:	[619, 867]

5.13 Malaysia



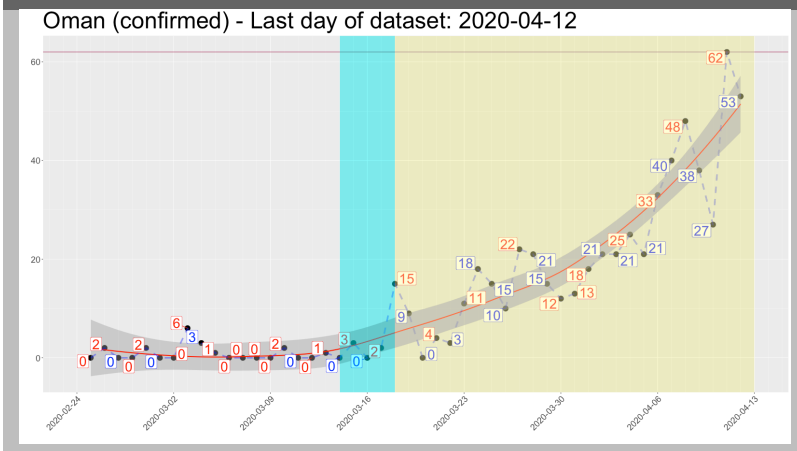


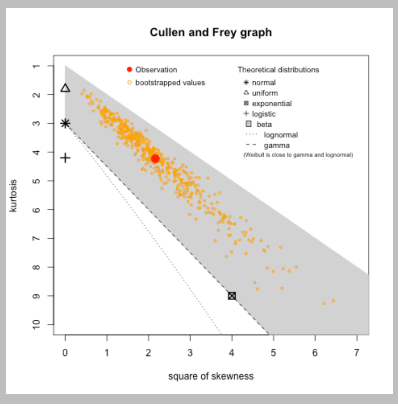


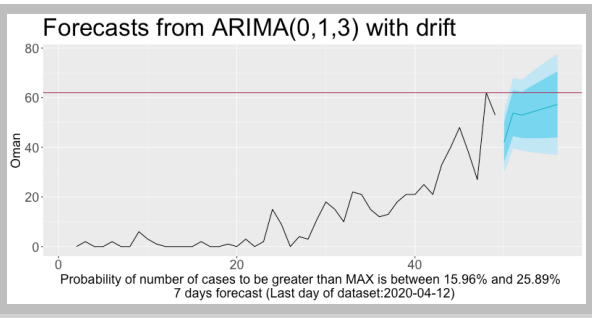


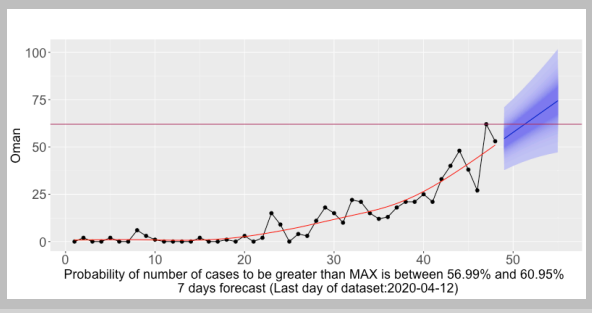
Maximum reached	2020-04-03
Estimation of number of cases: ARIMA	[4530, 7863]

5.14 Oman



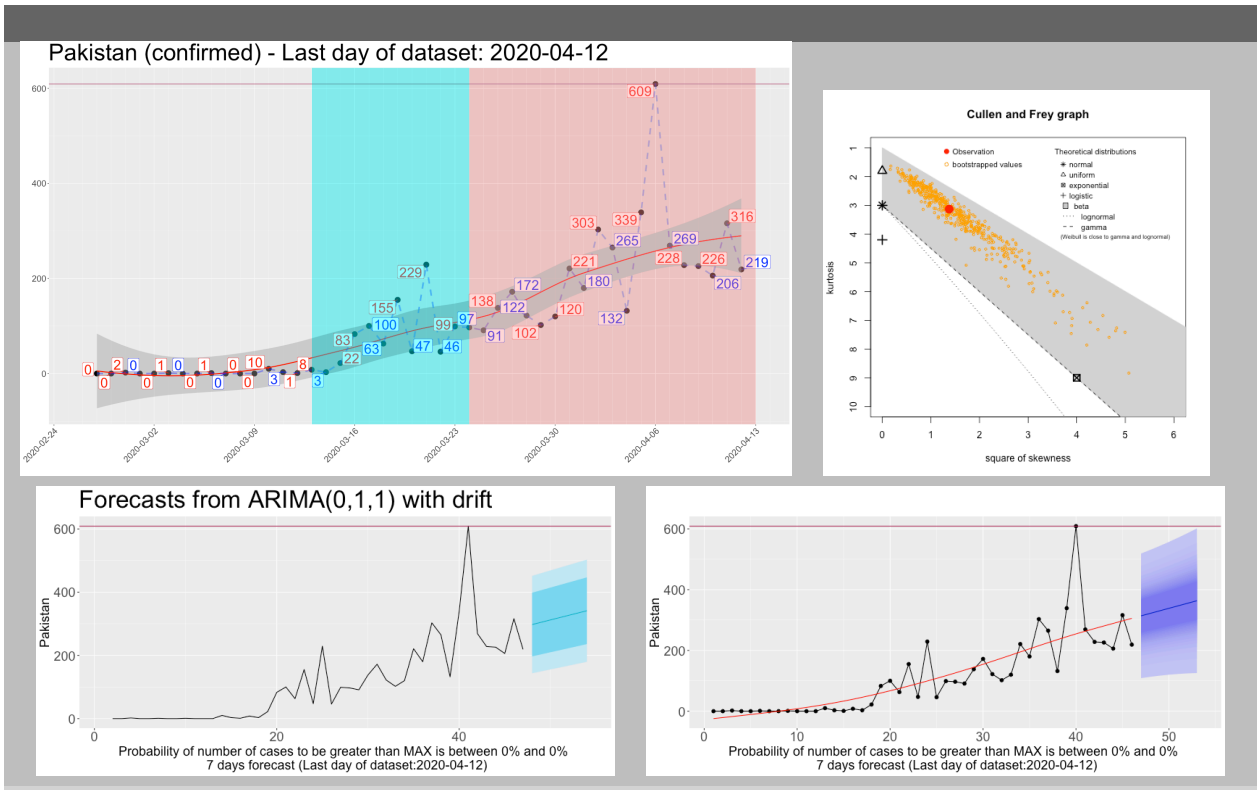






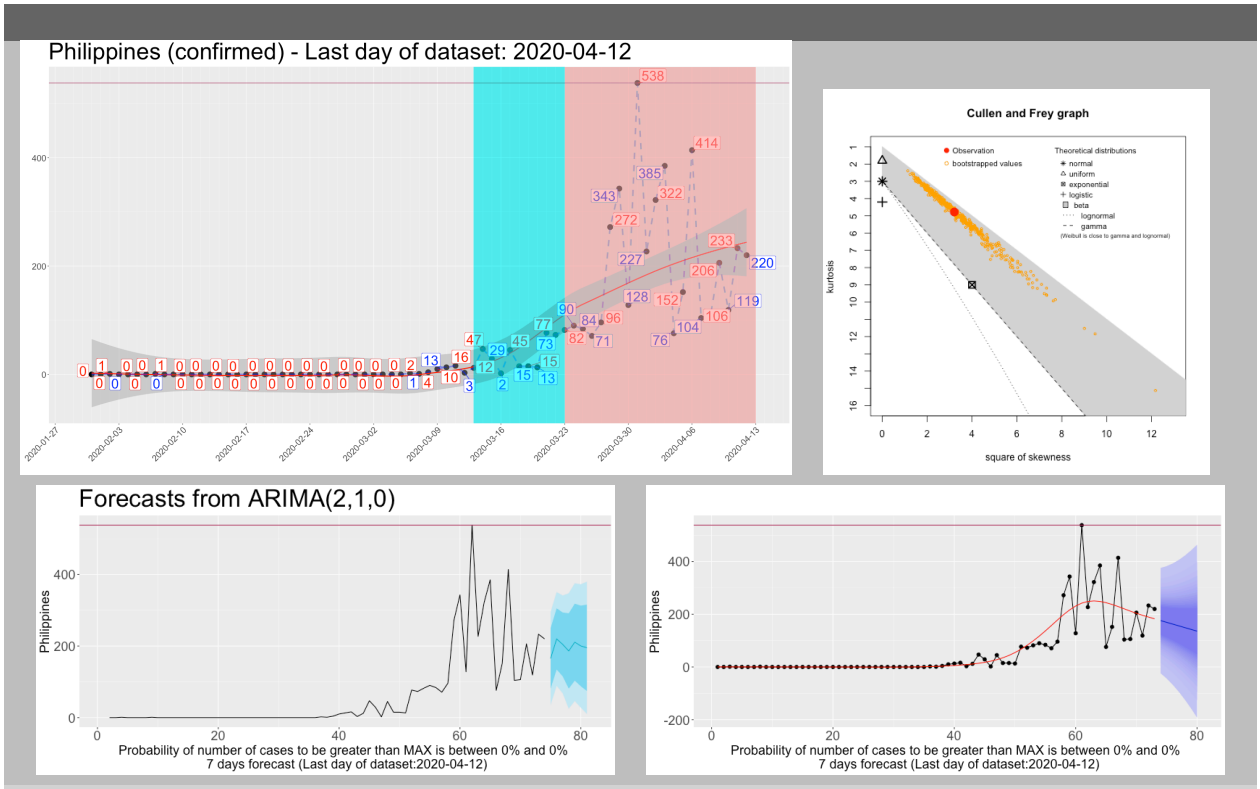
Estimation for future maximum after	7 - 13 days (04-18 - 04-24)
Estimation of number of cases: ARIMA	[1606, 2920]

5.15 Pakistan



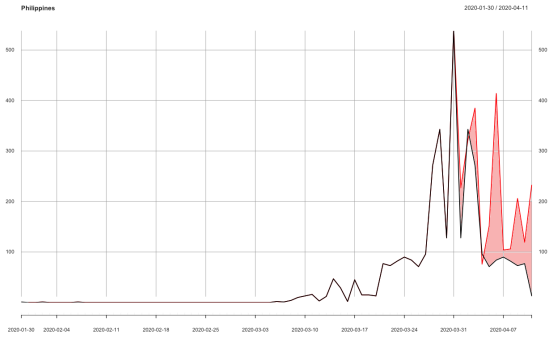
Estimation for future maximum after	3 - 8 days (04-14 - 04-19)
Estimation of number of cases: ARIMA	[10889, 16548]

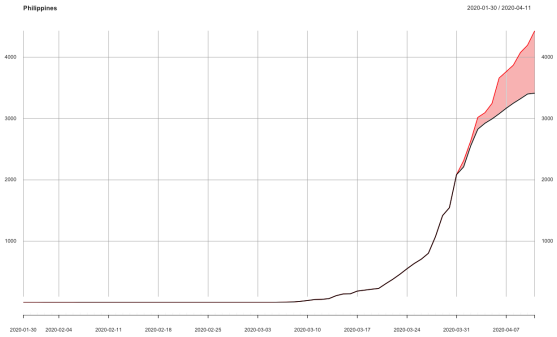
5.16 Philippines



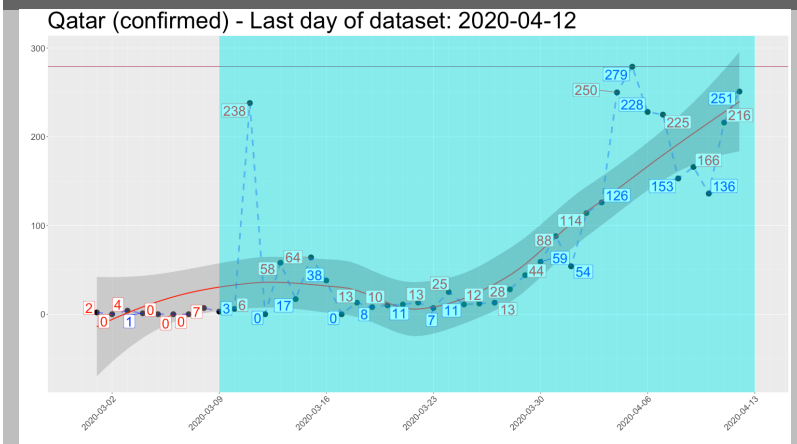
Maximum reached	2020 - 03 - 31
Estimation of number of cases: ARIMA	[4428, 6512]

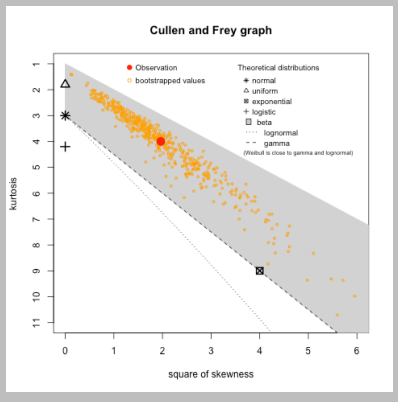
It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are relatively more.

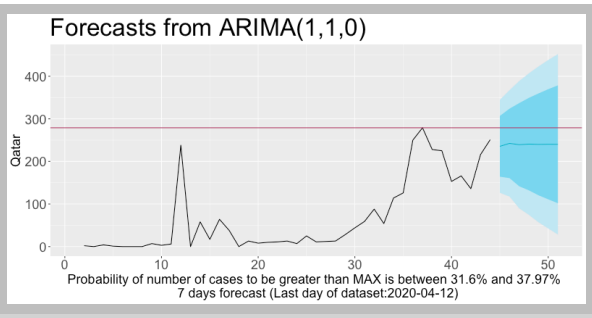


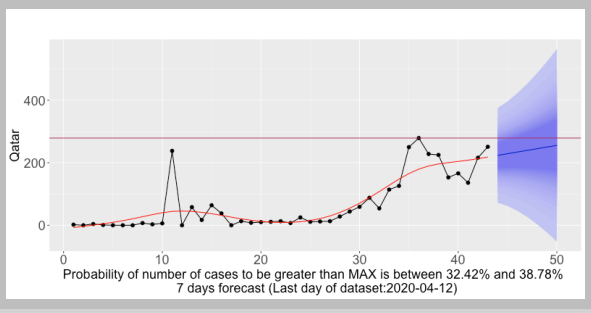


5.17 Qatar



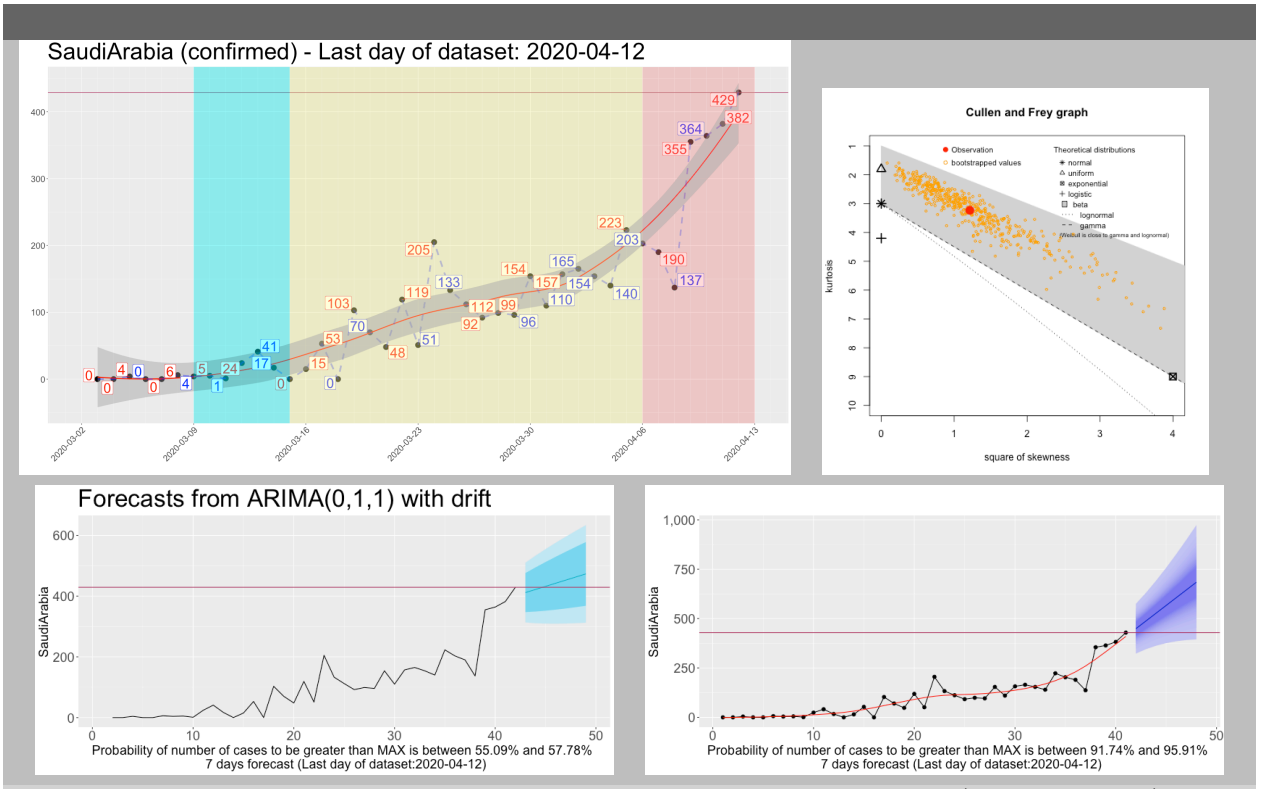






Estimation for future maximum after	4 - 7 days (04-15 - 04-18)
Estimation of number of cases: ARIMA	[6071, 9942]

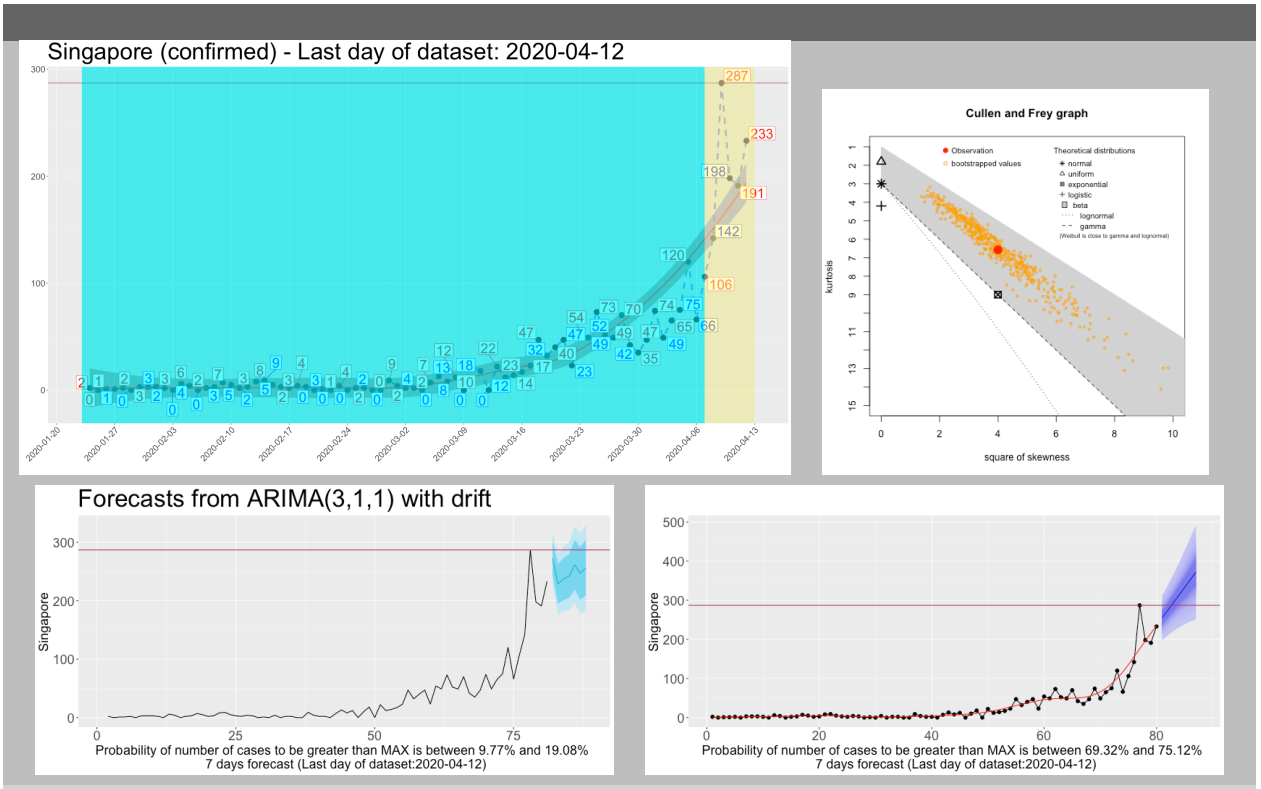
5.18 Saudi Arabia



Estimation for future maximum after 3 - 9 days (04-14 - 04-20)

Estimation of number of cases: ARIMA [9710, 17406]

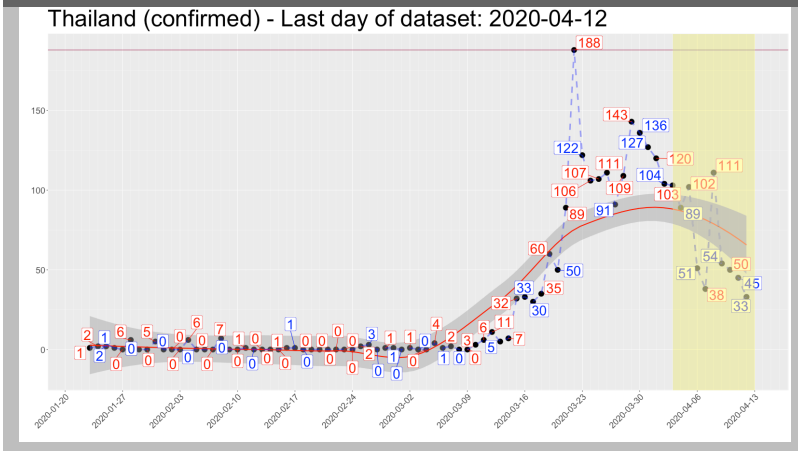
5.19 Singapore

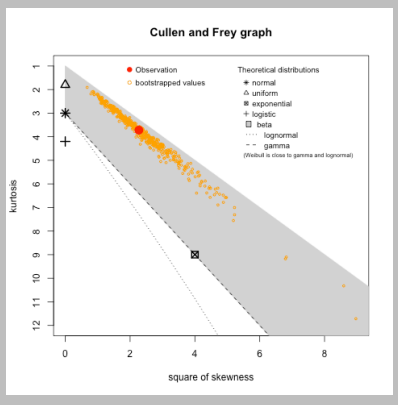


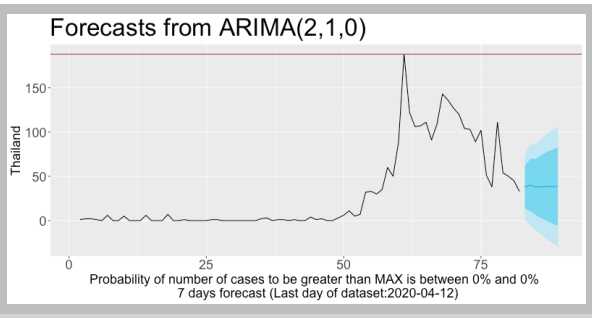
Estimation for future maximum after 3 - 8 days (04-14 - 04-19)

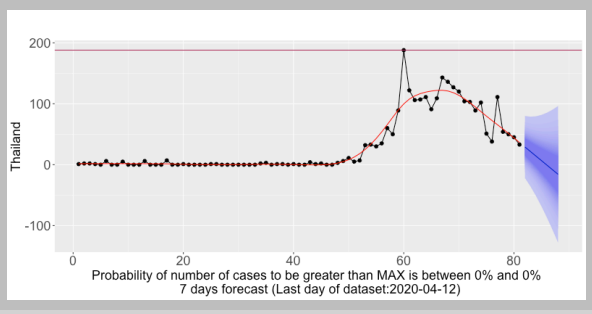
Estimation of number of cases: ARIMA [5336, 8210]

5.20 Thailand



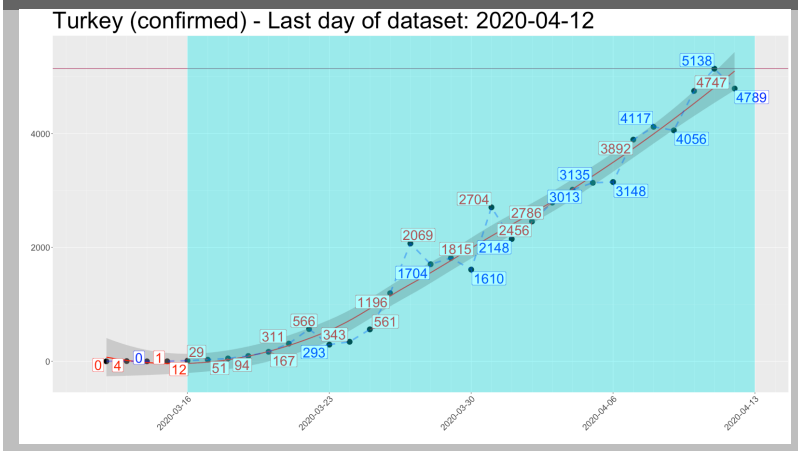


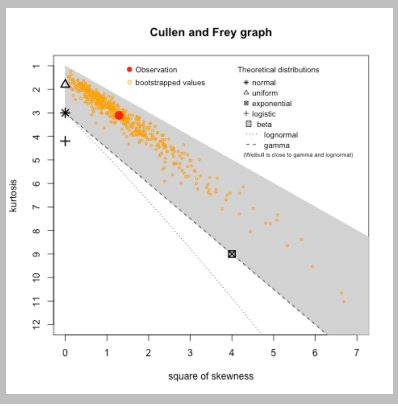


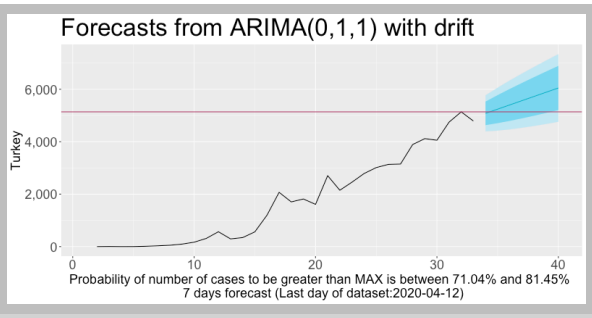


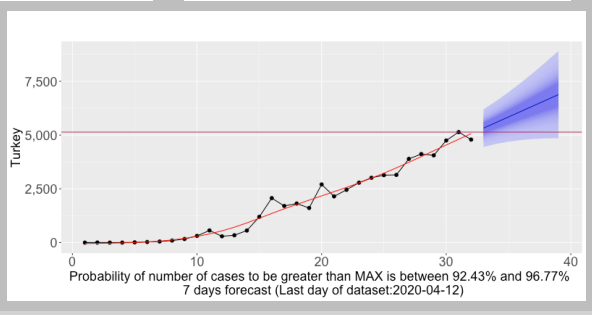
Maximum reached	2020-03-30
Estimation of number of cases: ARIMA	[2518, 1524]

5.21 Turkey

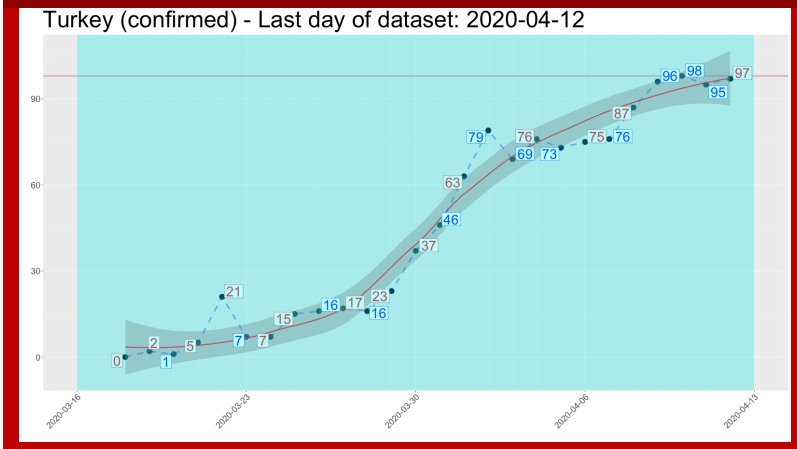


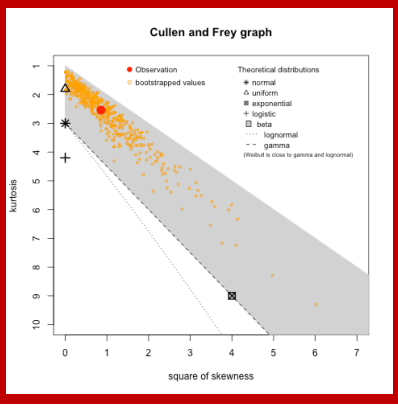


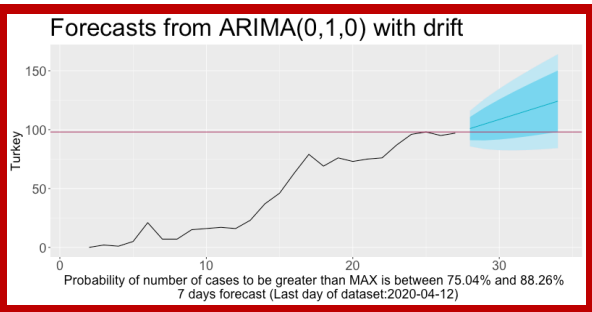


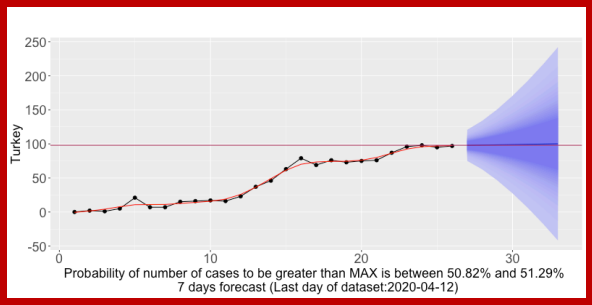


Estimation for future maximum after	7 - 11 days (04-18 - 04-22)
Estimation of number of cases: ARIMA	[158 132, 251 845]



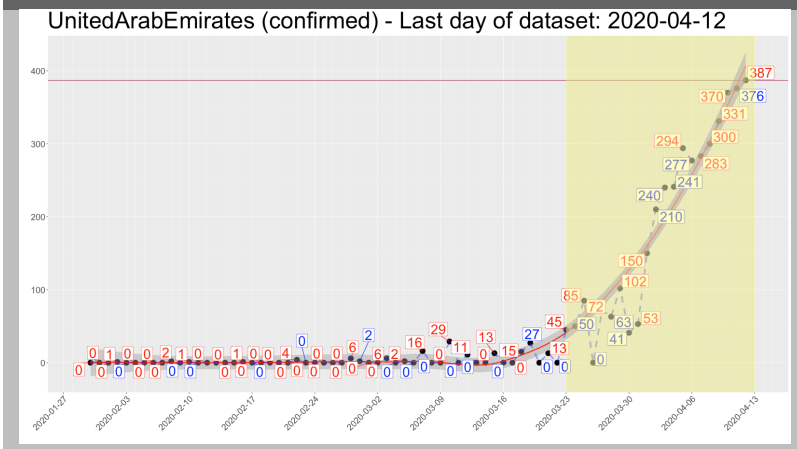


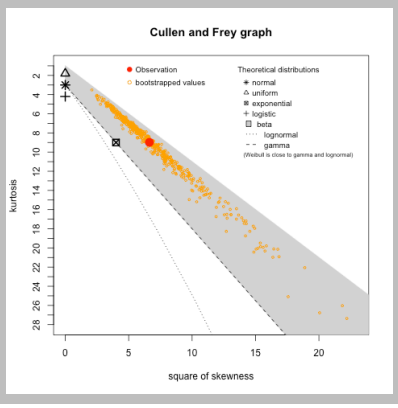


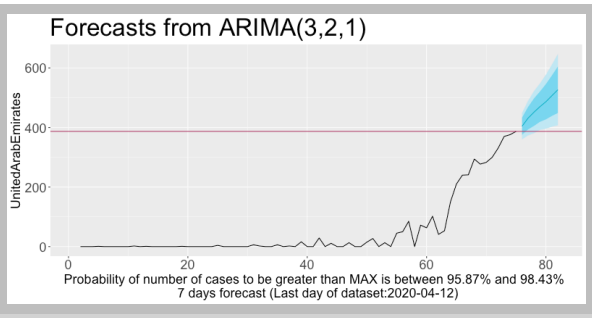


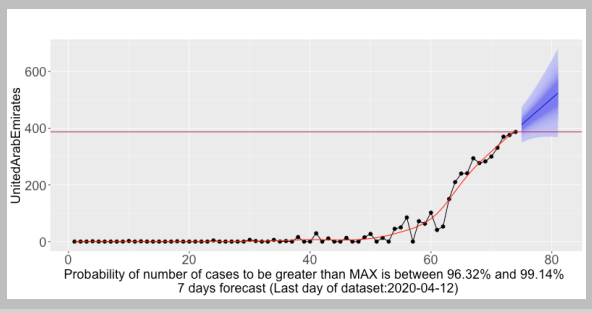
Estimation for future maximum after 14 - 22 days (04-25 - 05-03)
Estimation of number of cases: ARIMA [3784, 8467]

5.22 United Arab Emirates



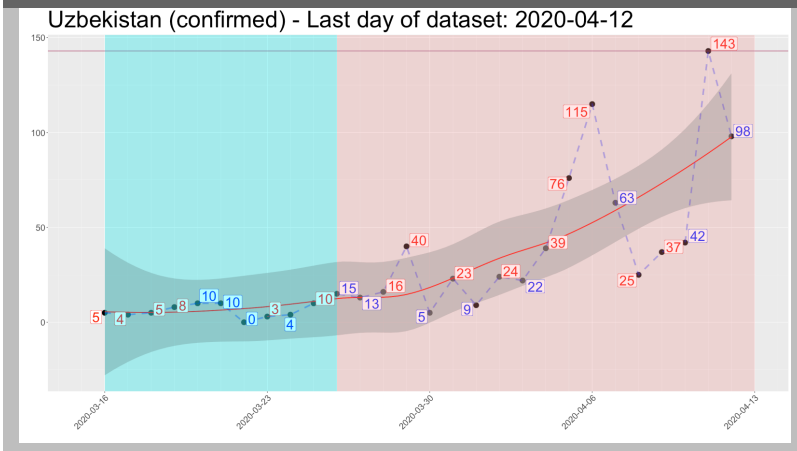


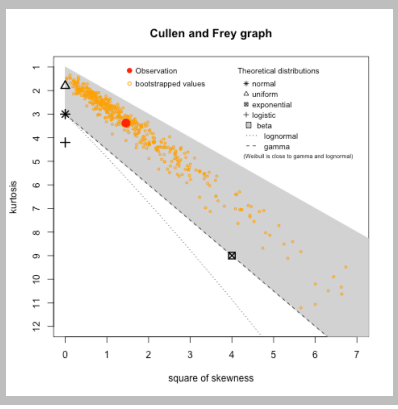


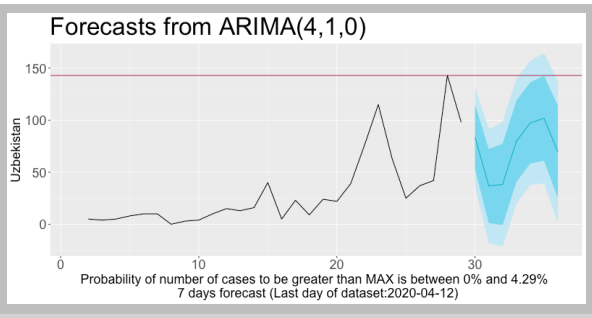


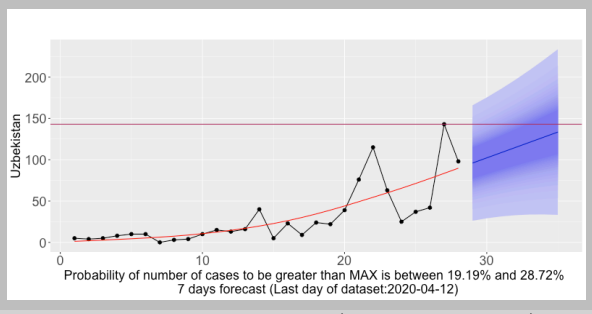
Estimation for future maximum after 9 - 15 days (04-20 - 04-26)
Estimation of number of cases: ARIMA [14622, 26264]

5.23 Uzbekistan



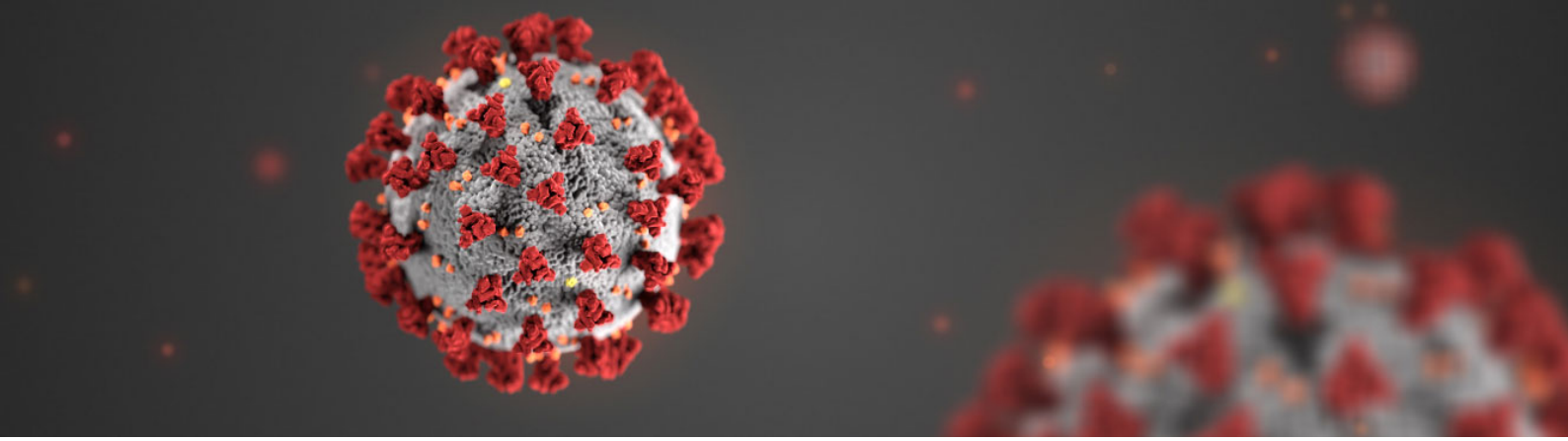






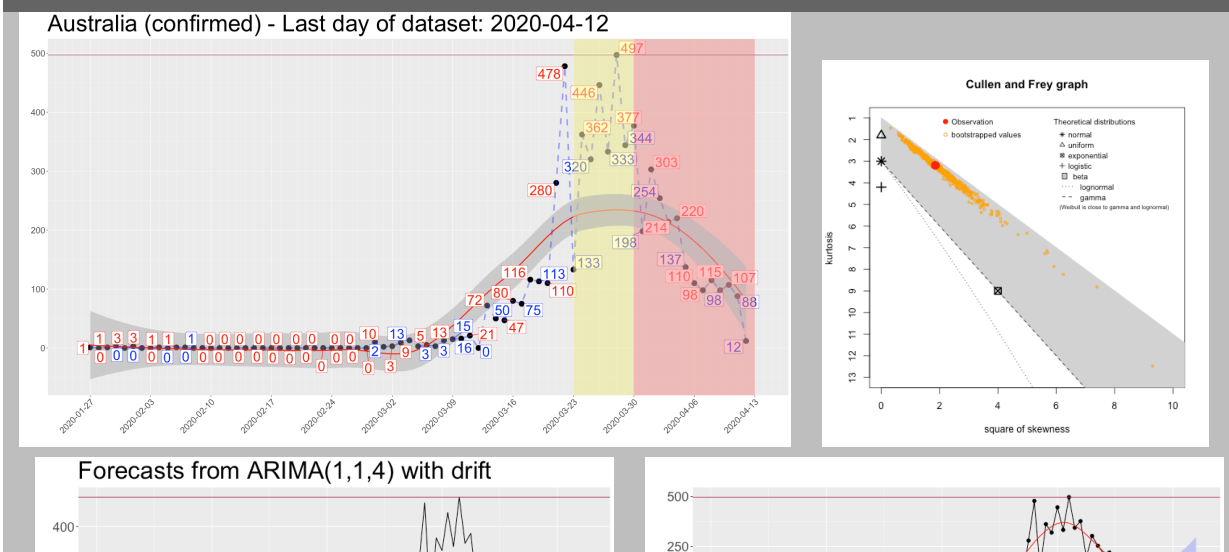
Estimation for future maximum after	9 - 15 days (04-20 - 04-26)
Estimation of number of cases: ARIMA	[2252, 9695]

IV Australia



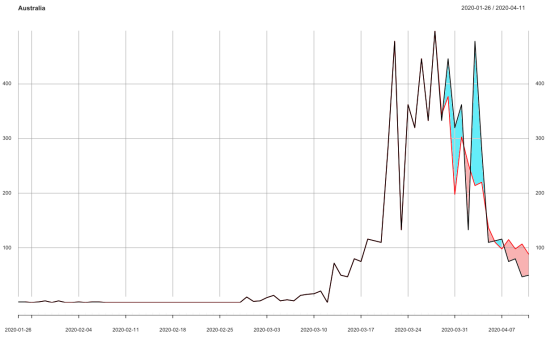
6. Australia

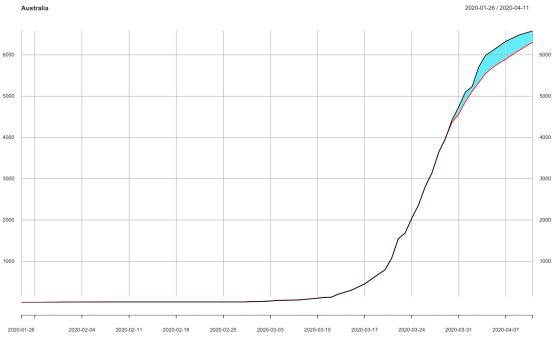
6.1 Australia



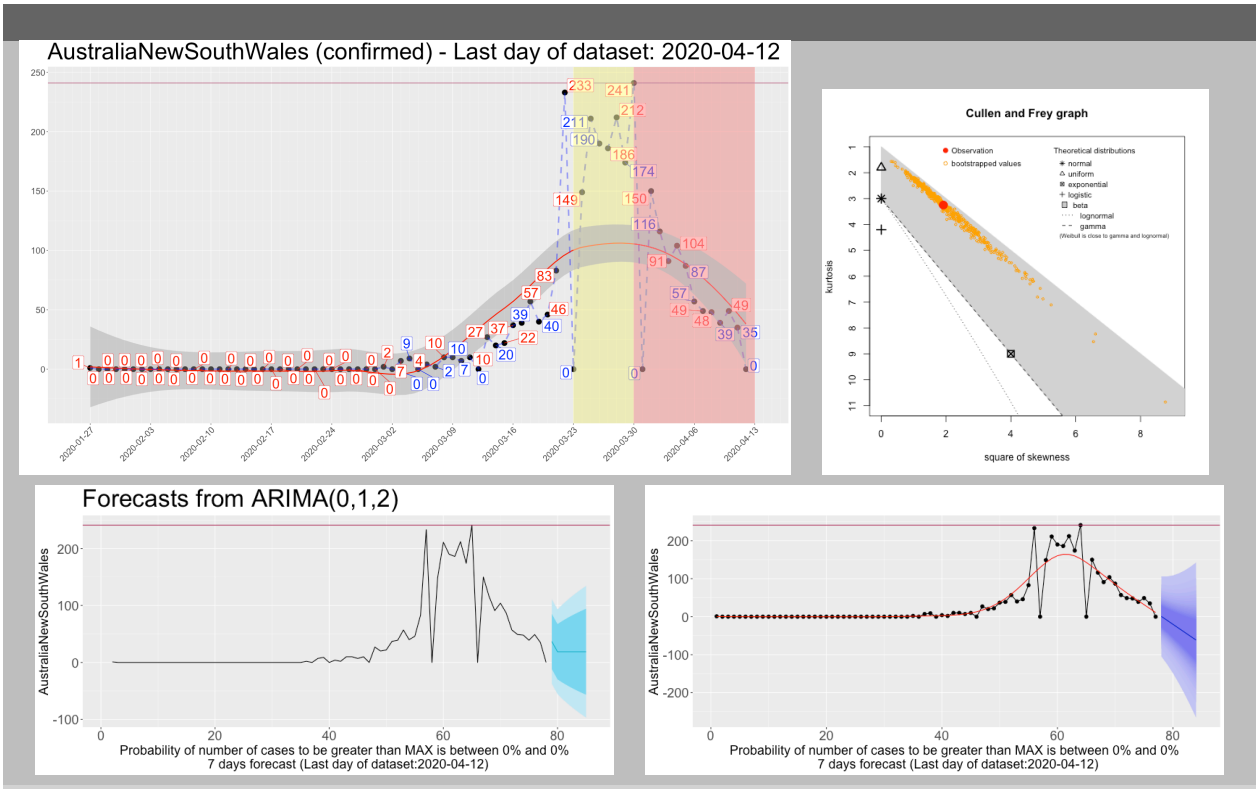
Maximum reached	2020-03-28
Estimation of number of cases: ARIMA	[6303, 9943]

It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are relatively less.



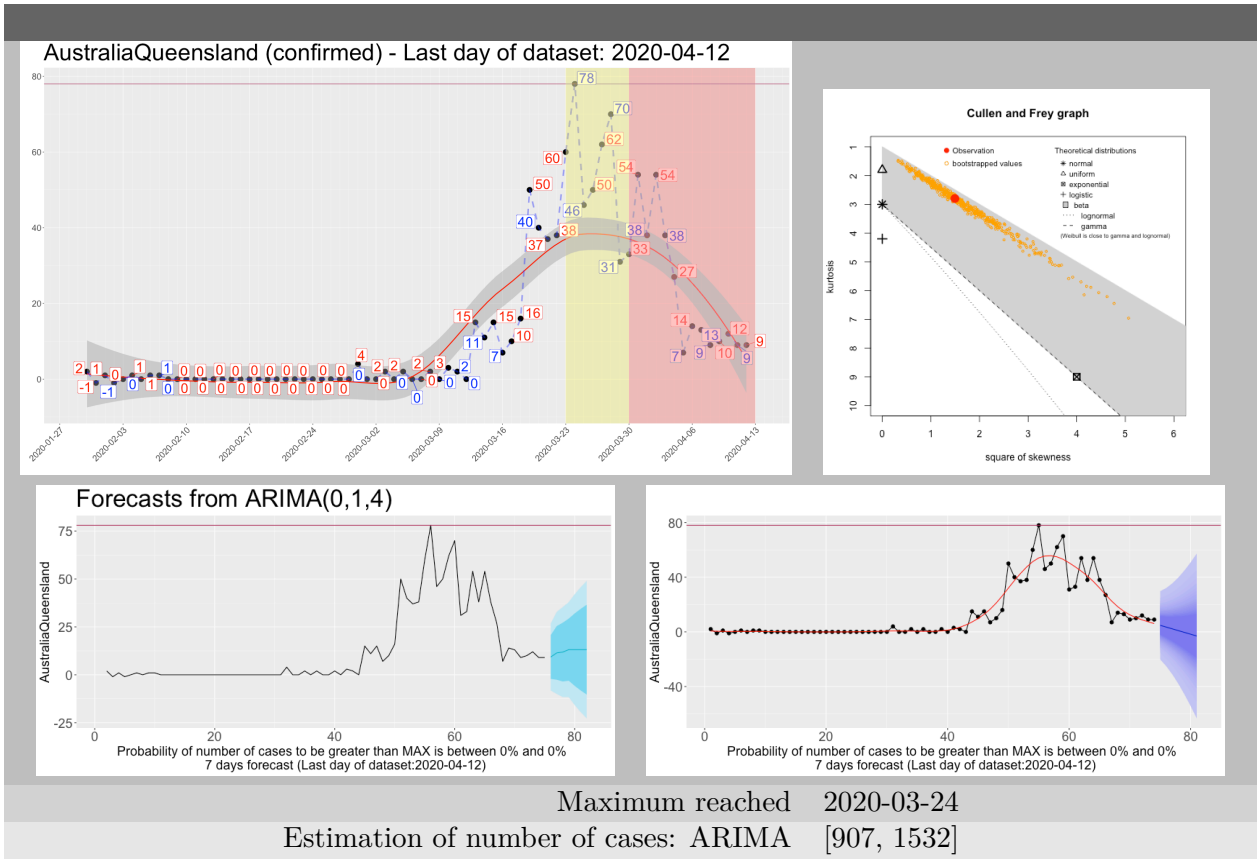


6.1.1 Australia New South Wales



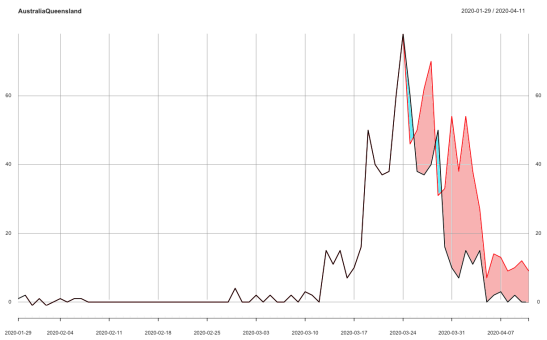
Maximum reached (probably)	2020-03-30
Estimation of number of cases: ARIMA	[2857, 4889]

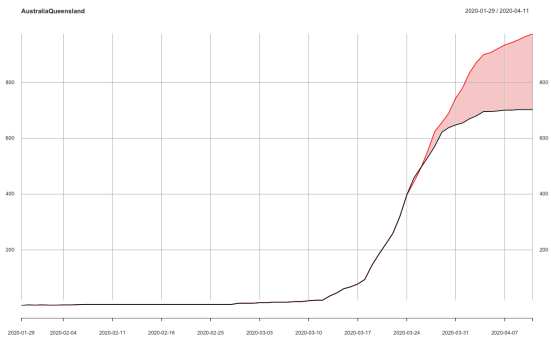
6.1.2 Australia Queensland



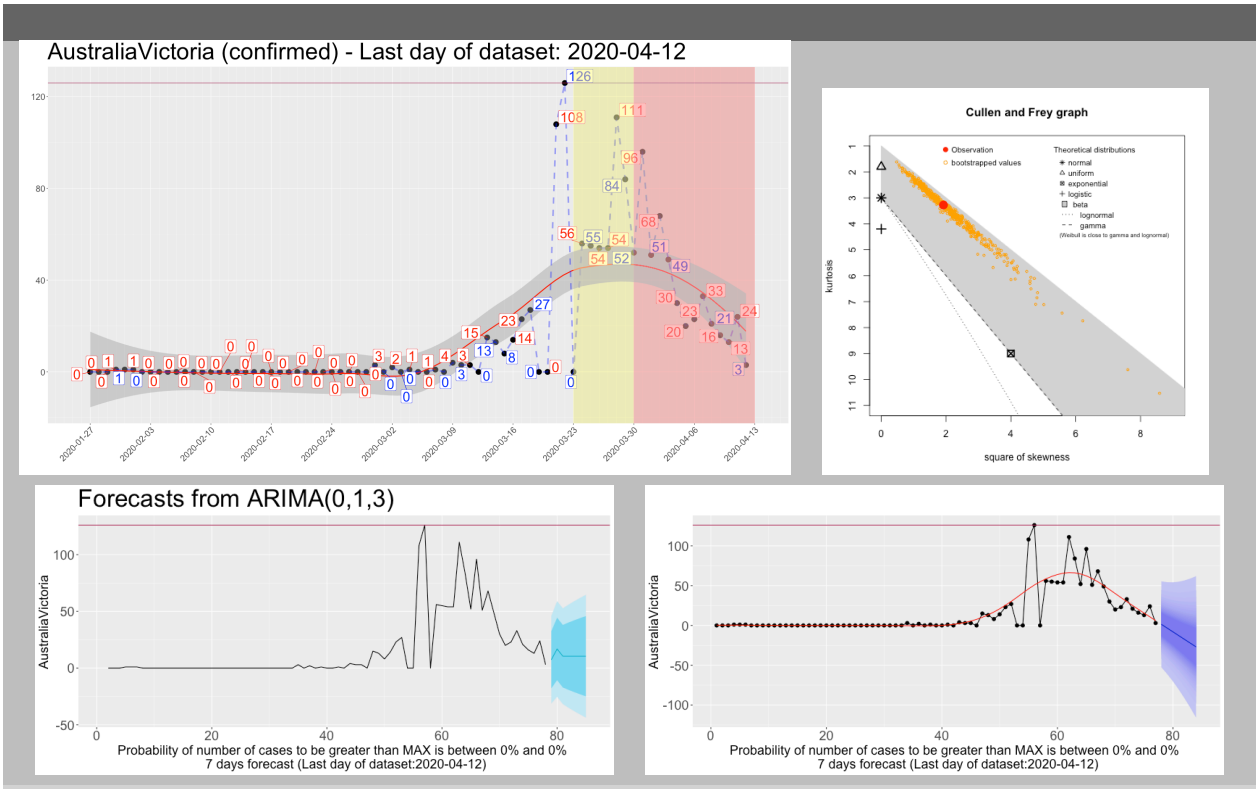
Maximum reached	2020-03-24
Estimation of number of cases: ARIMA	[907, 1532]

It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are relatively more.



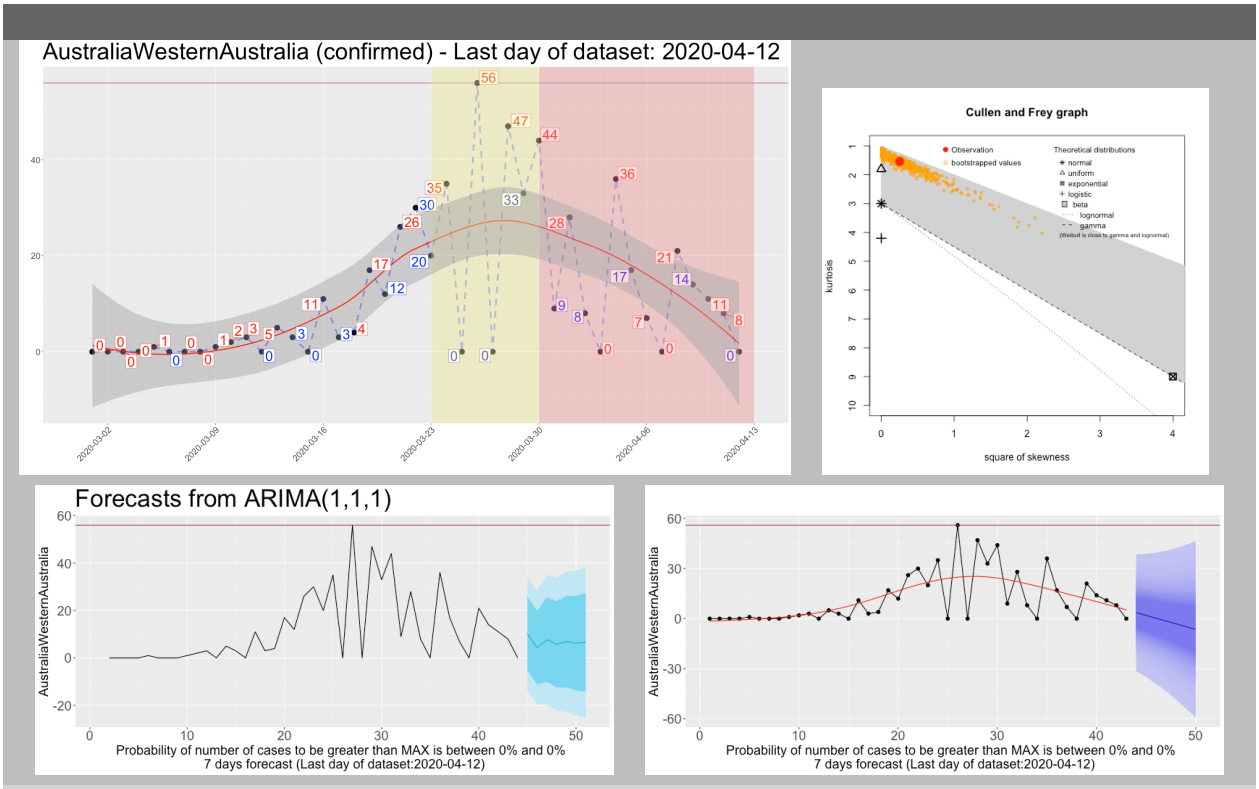


6.1.3 Australia Victoria



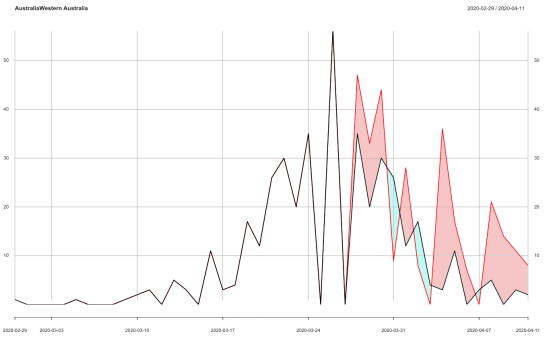
Maximum reached	2020-03-22
Estimation of number of cases: ARIMA	[1265, 1620]

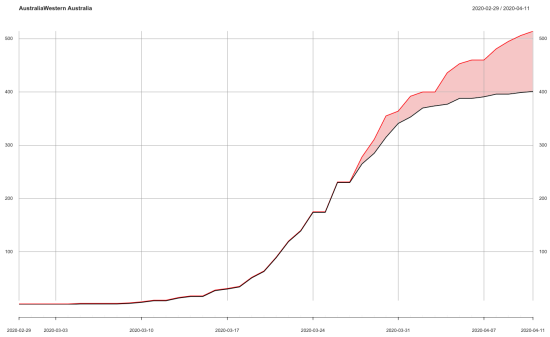
6.1.4 Australia Western Australia



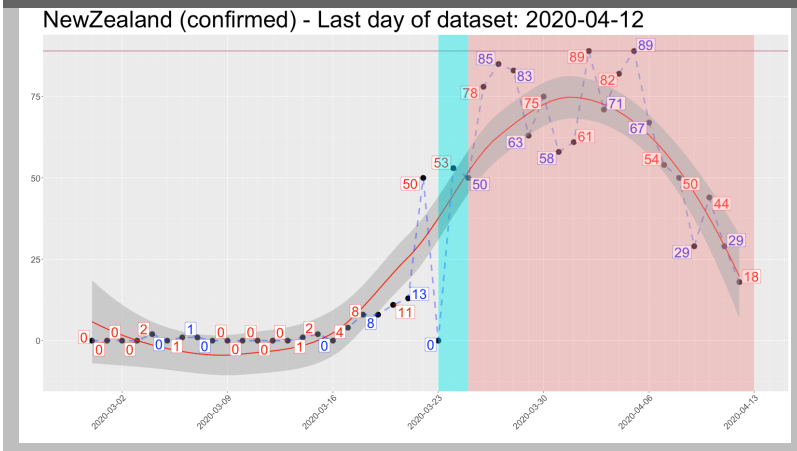
Maximum reached	2020-03-26
Estimation of number of cases: ARIMA	[514, 745]

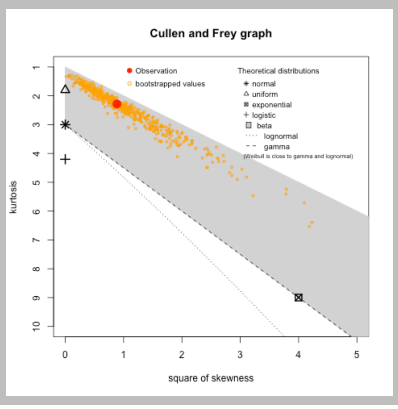
It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are relatively more.

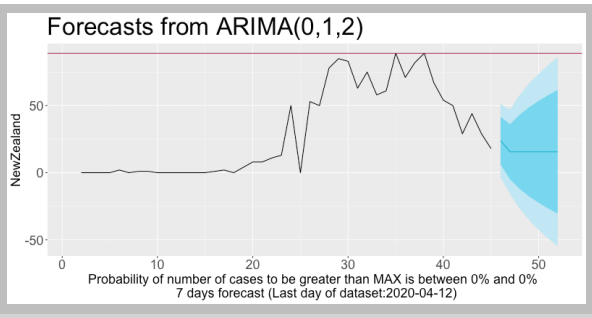


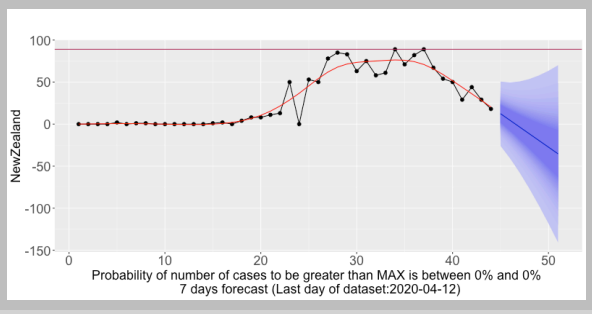


6.2 New Zealand





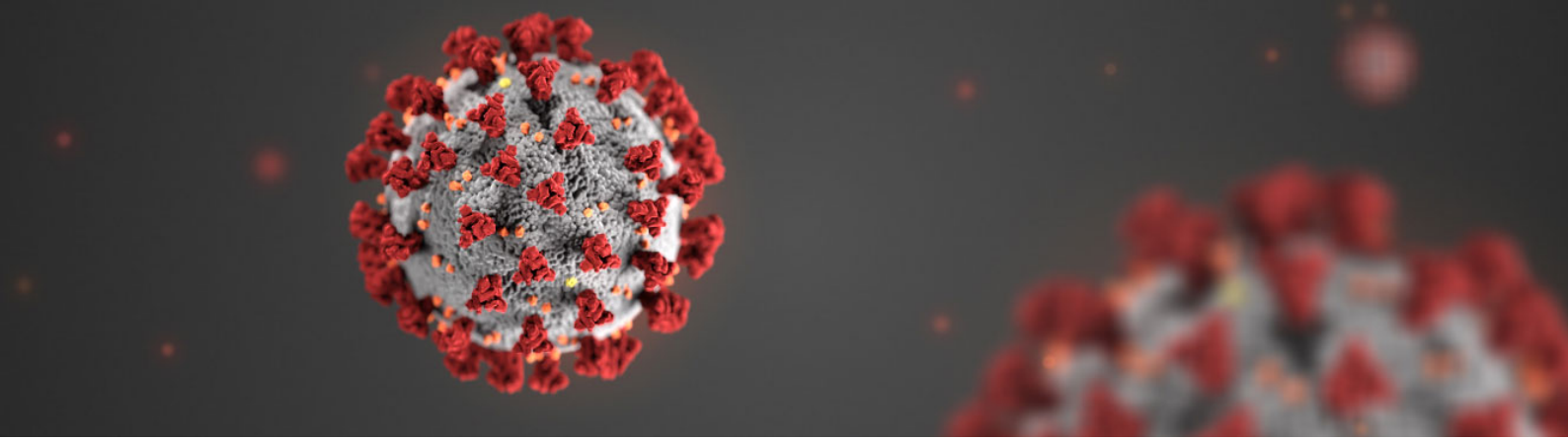




Maximum reached	2020-04-05
Estimation of number of cases: ARIMA	[1312, 2351]

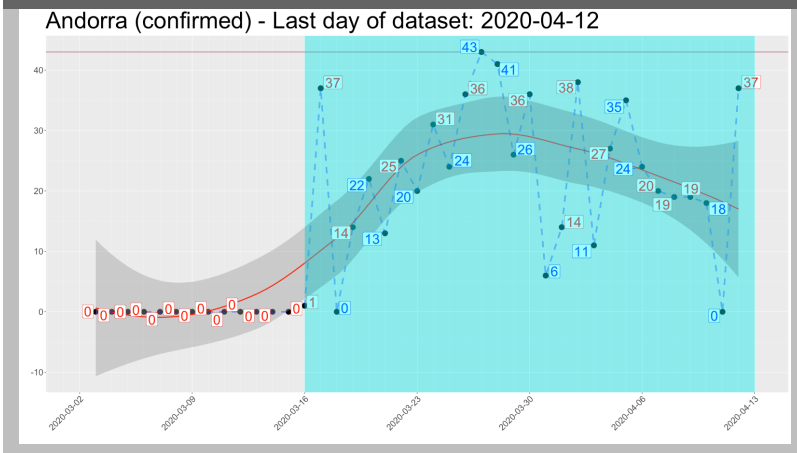
V

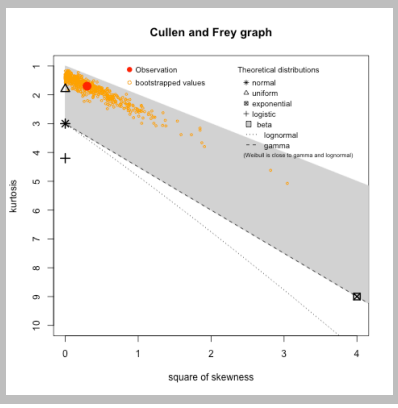
Europe

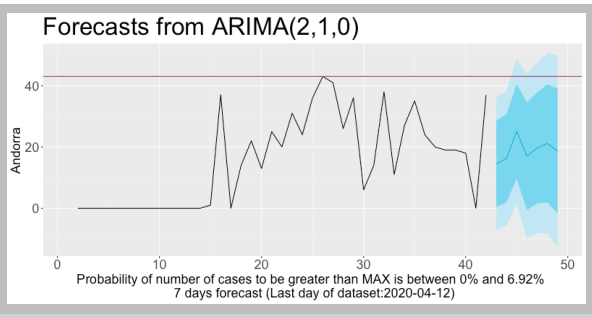


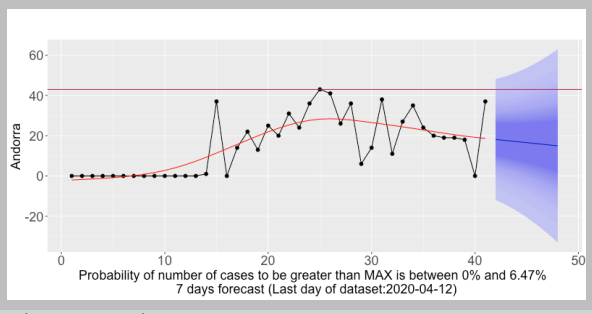
7. Europe

7.1 Andorra



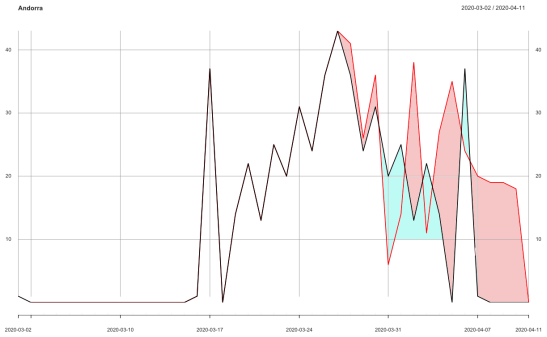


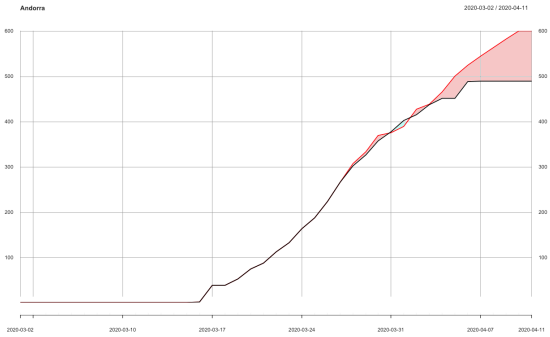




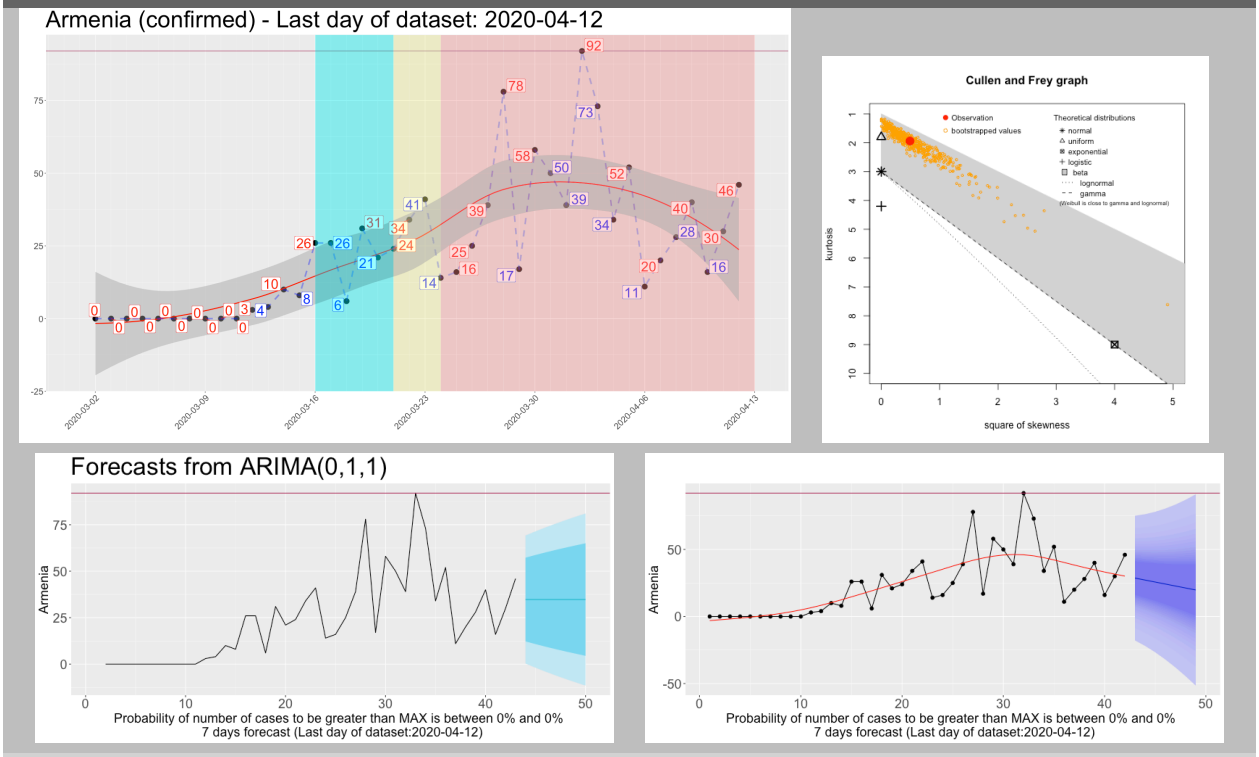
Maximum reached (probably)	2020-03-27
Estimation of number of cases: ARIMA	[501, 768]

It is observed that de-escalation is not symmetric to the escalation rate. At the beginning the de-scalation rate is faster and it slows down while reaches the end. The cases during the de-escalation period are relatively more.



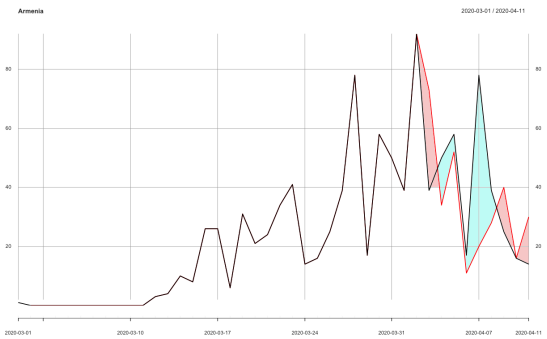


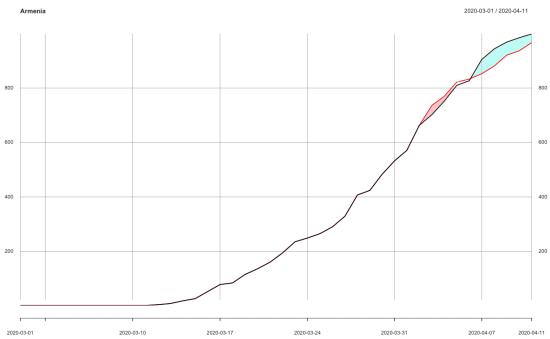
7.2 Armenia



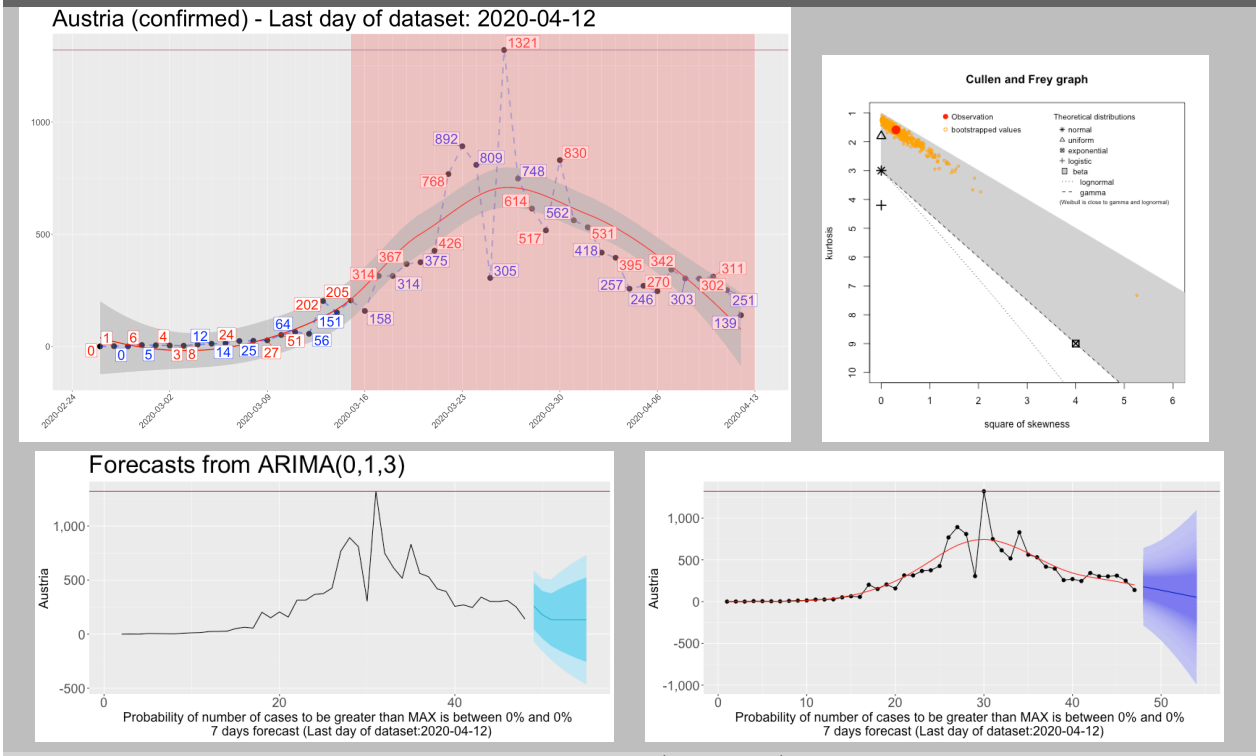
Maximum reached	2020-04-02
Estimation of number of cases: ARIMA	[967, 1630]

It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are relatively less





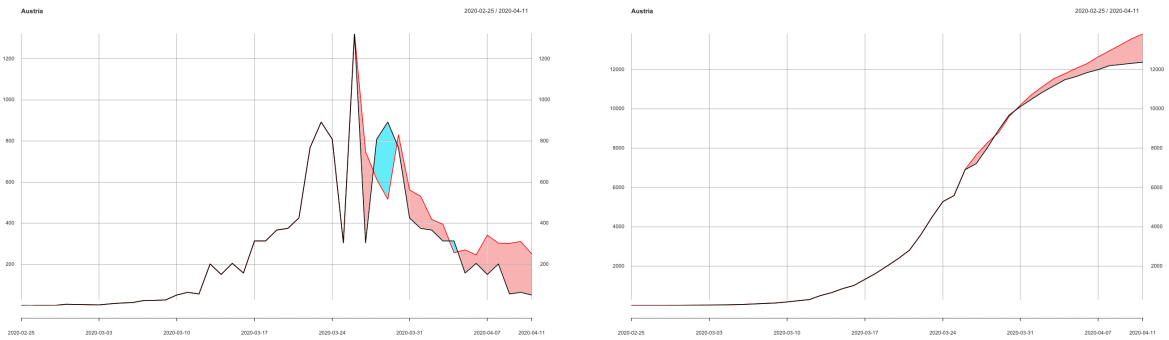
7.3 Austria



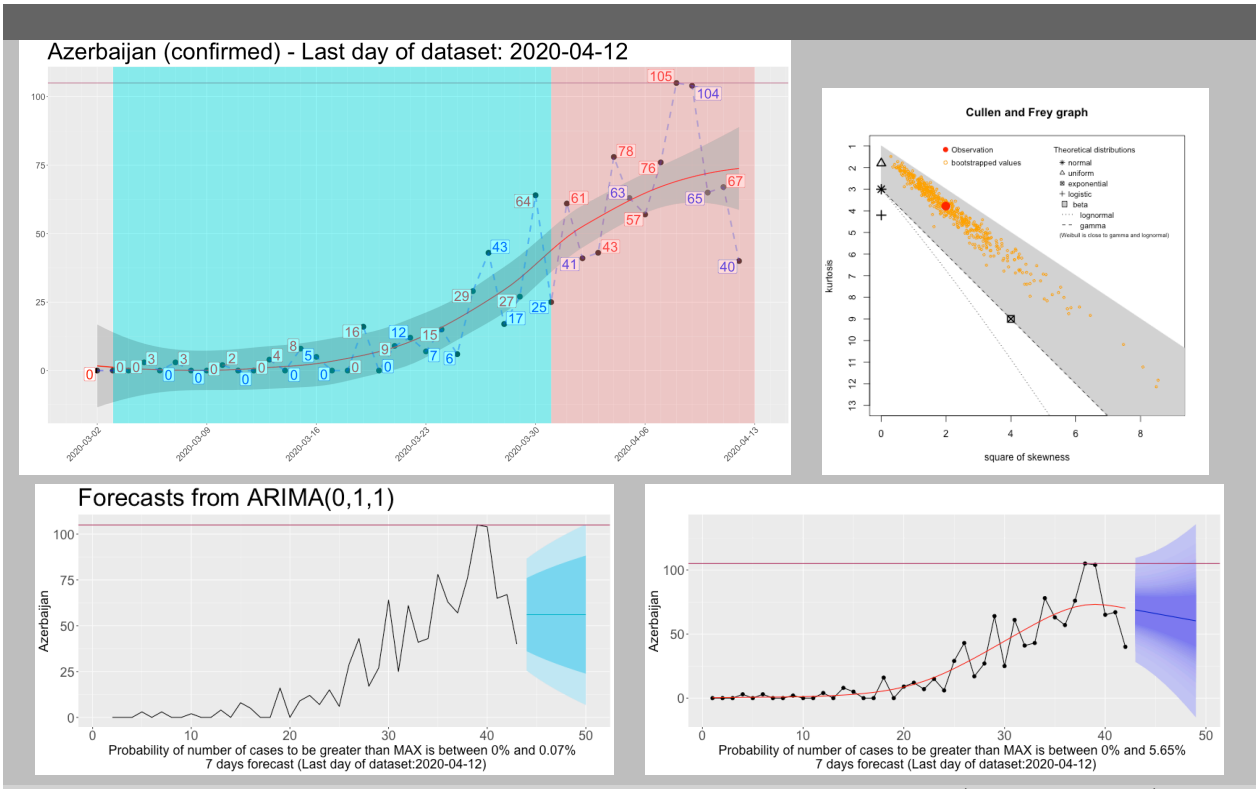
Maximum reached (probably)	2020-03-30
Estimation of number of cases: ARIMA	[13806, 23424]

In Austria the imposition of Phase 3 measures on March 3rd did not change the dynamics of the exponential growth rate the cases follow.

It is observed that de-escalation is not symmetric to the escalation rate. At the beginning the de-scalation rate is faster and it slows down while reaches the end. The cases during the de-escalation period are relatively more.

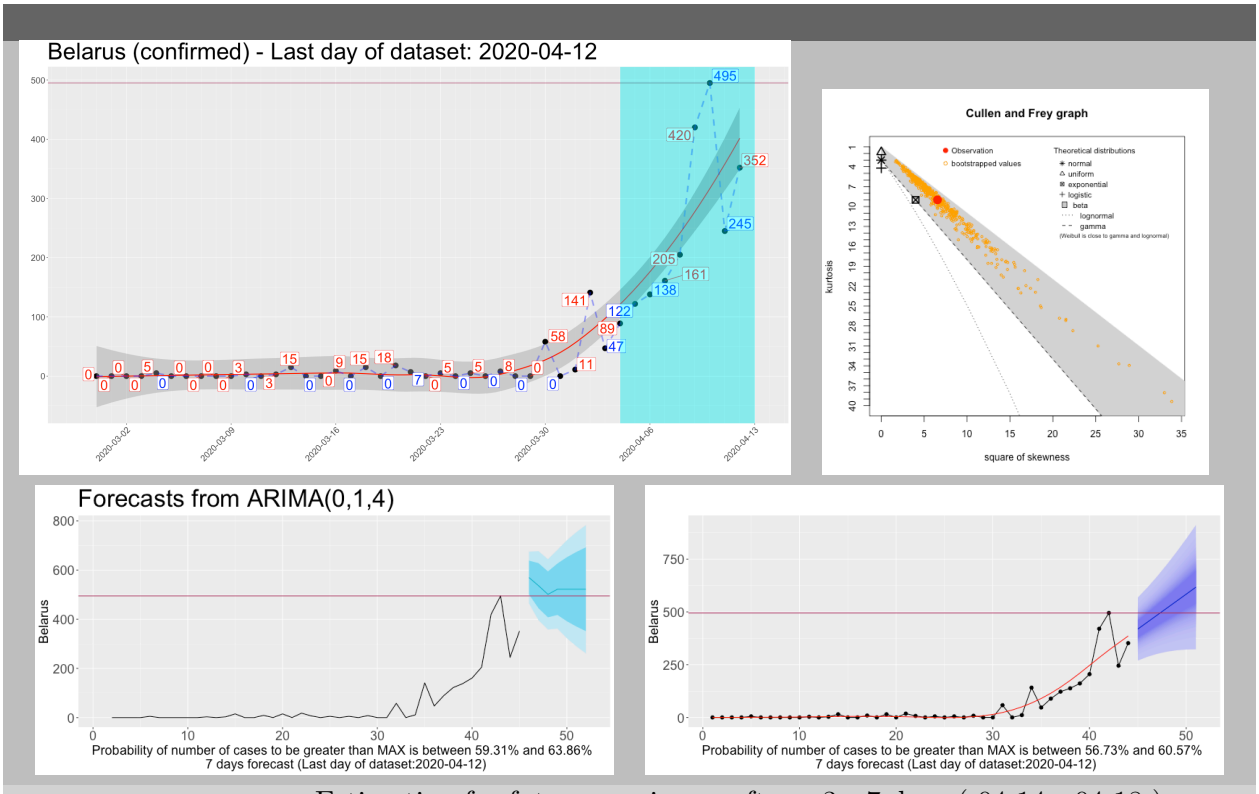


7.4 Azerbaijan



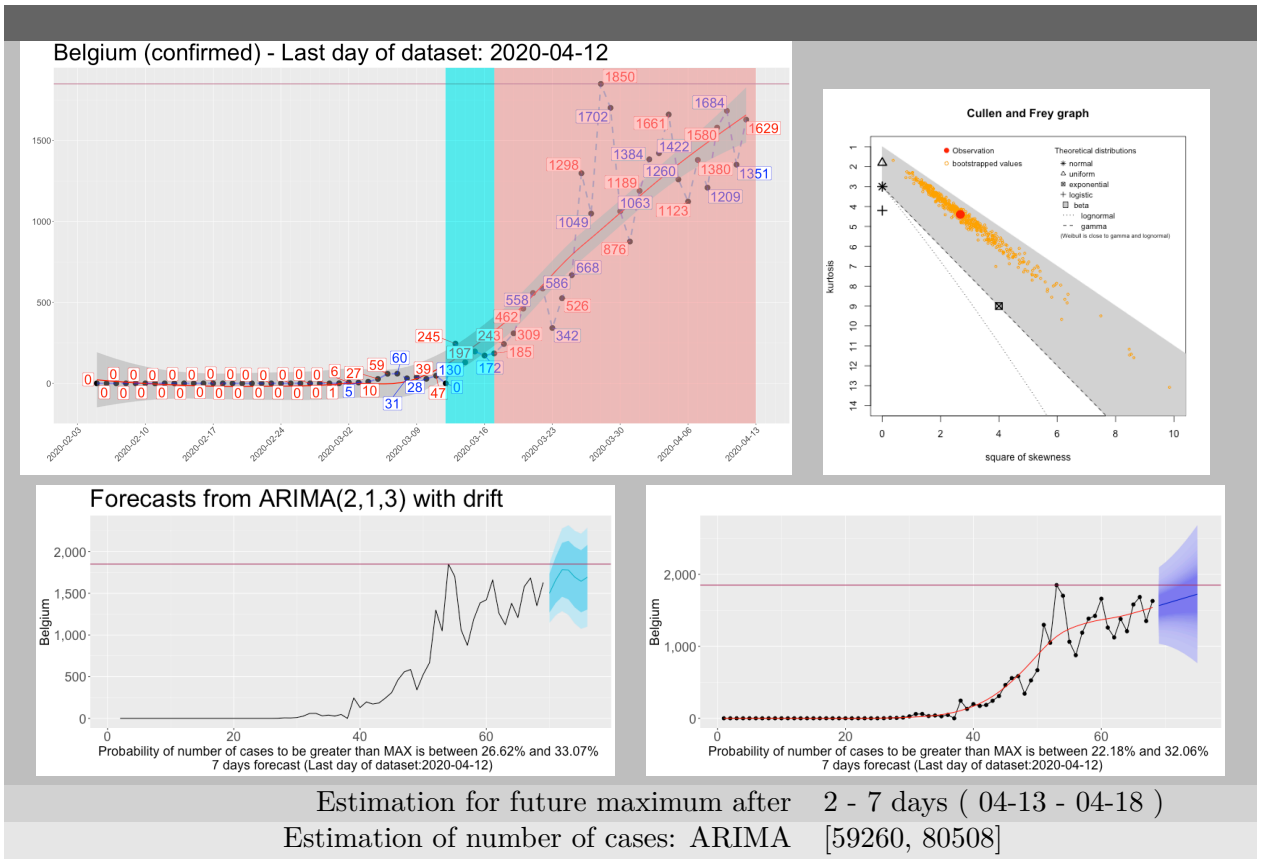
Estimation for future maximum after	5 - 9 days (04-16 - 04-20)
Estimation of number of cases: ARIMA	[2617, 4008]

7.5 Belarus



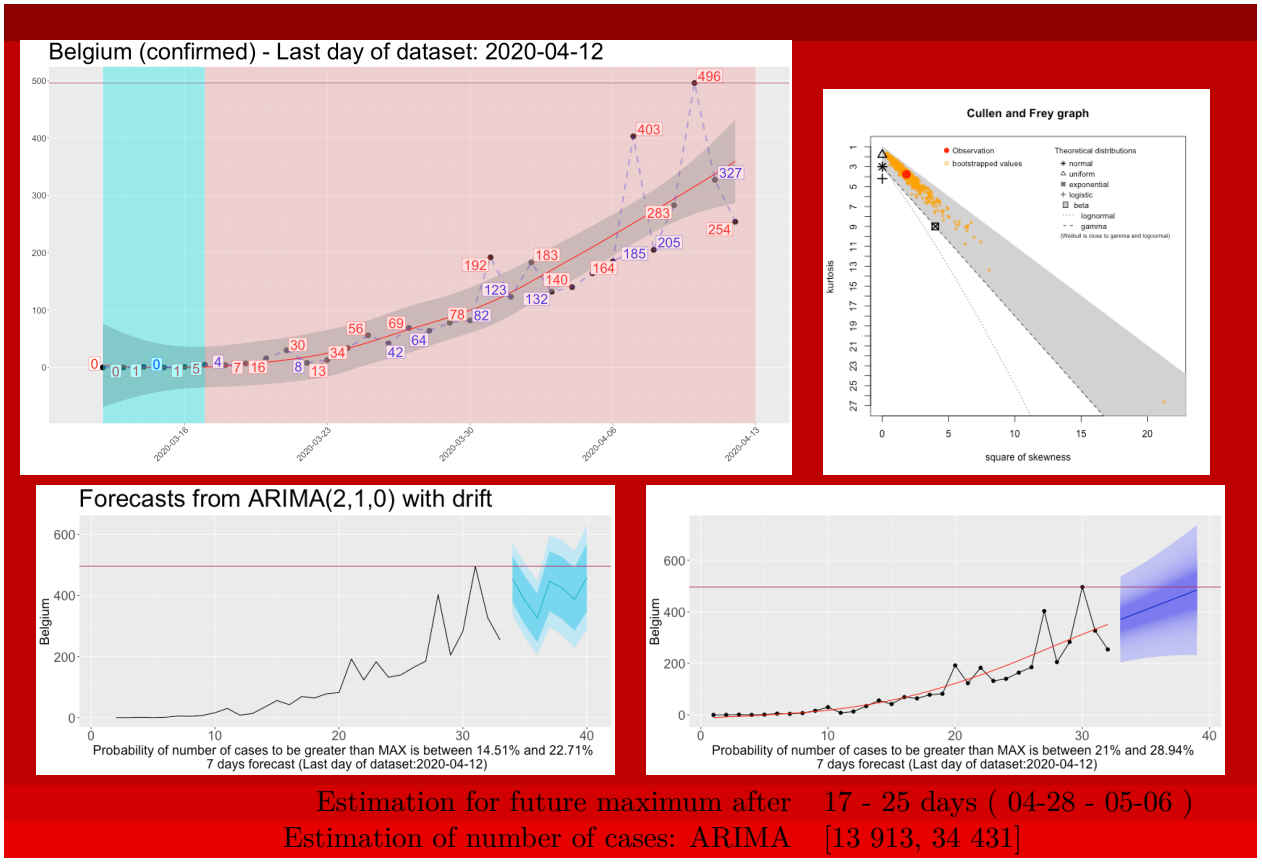
Estimation for future maximum after	3 - 7 days (04-14 - 04-18)
Estimation of number of cases:	[5056, 9990]

7.6 Belgium



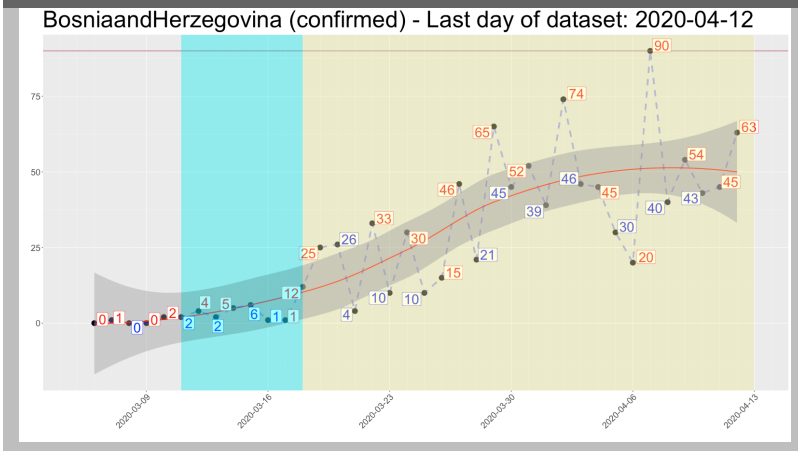
Estimation for future maximum after 2 - 7 days (04-13 - 04-18)
Estimation of number of cases: ARIMA [59260, 80508]

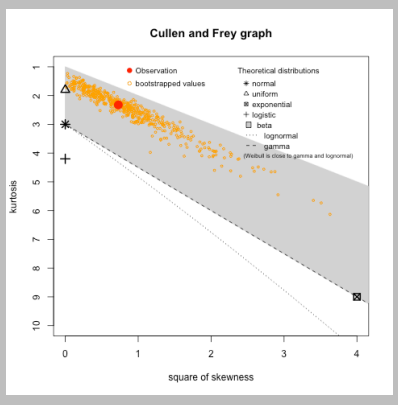
In Belgium the imposition of Phase 2 measures on March 18^{th} did change the dynamics of the exponential growth rate of the confirmed cases for two days, March 23^{rd} and 24^{th}.

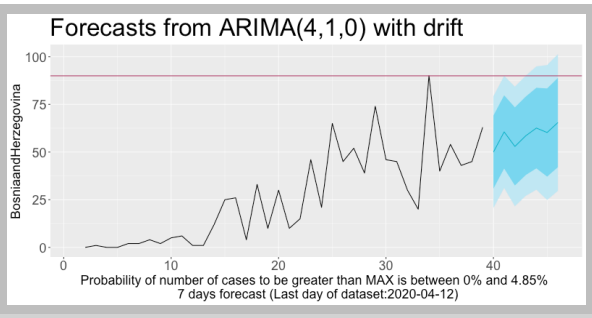


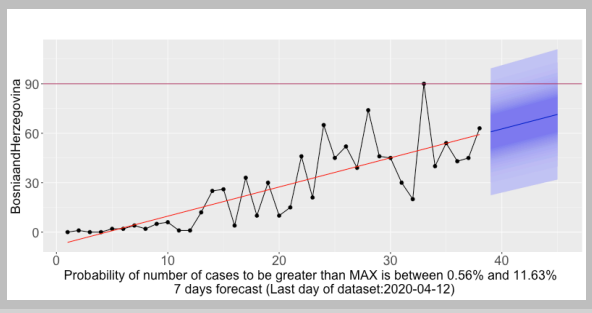
Estimation for future maximum after 17 - 25 days (04-28 - 05-06)
Estimation of number of cases: ARIMA [13 913, 34 431]

7.7 Bosnia and Herzegovina



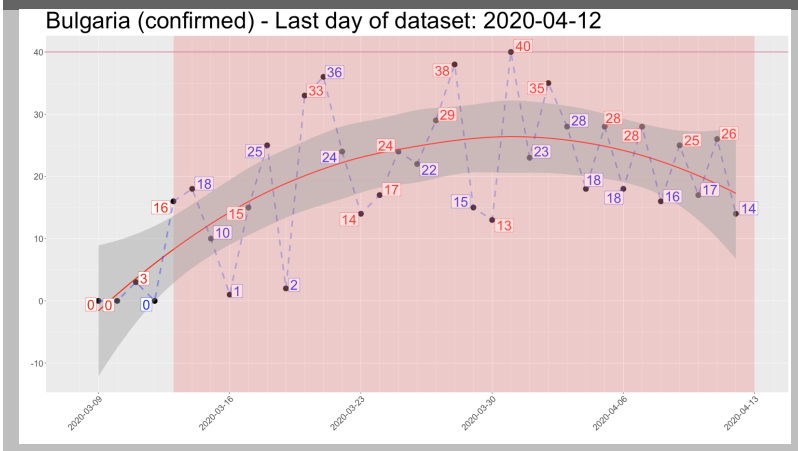


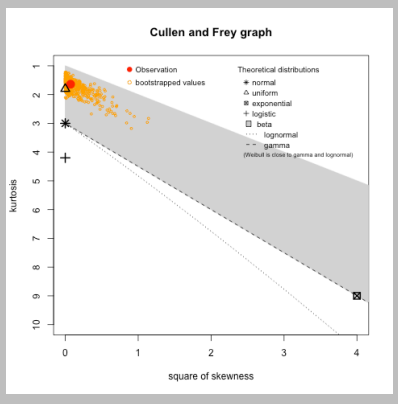


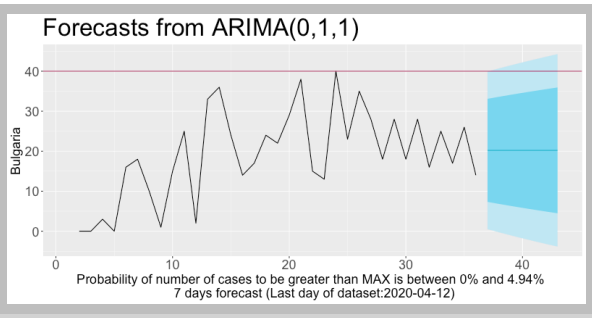


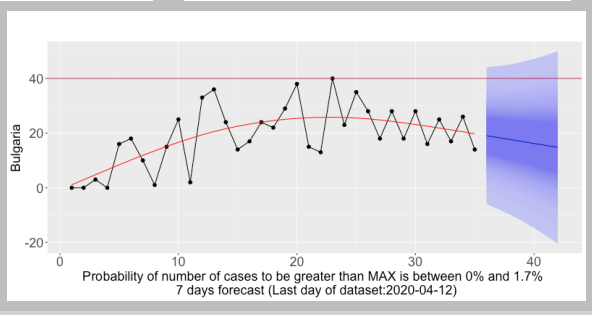
Estimation for future maximum after	period around the maximum
Estimation of number of cases: ARIMA	[1923, 2887]

7.8 Bulgaria



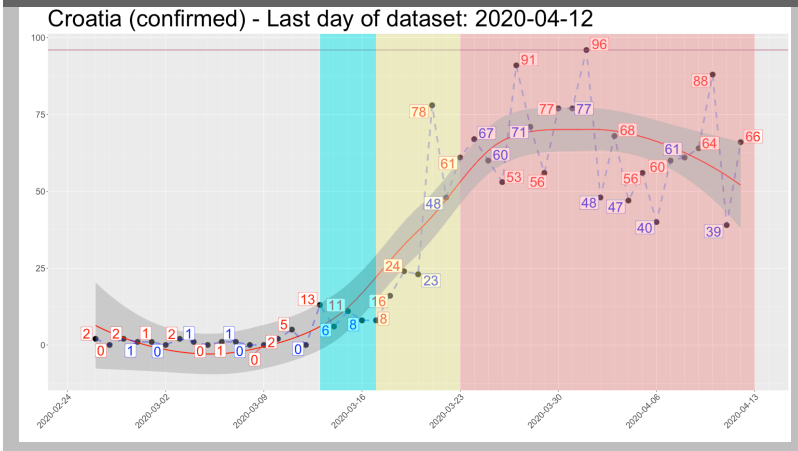


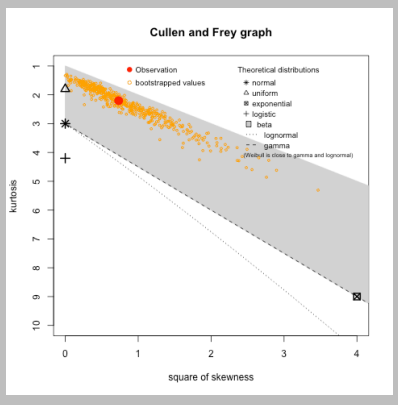


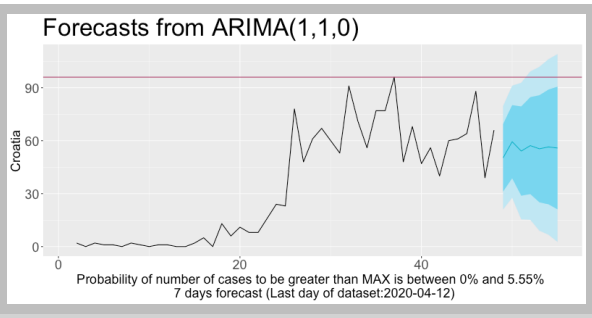


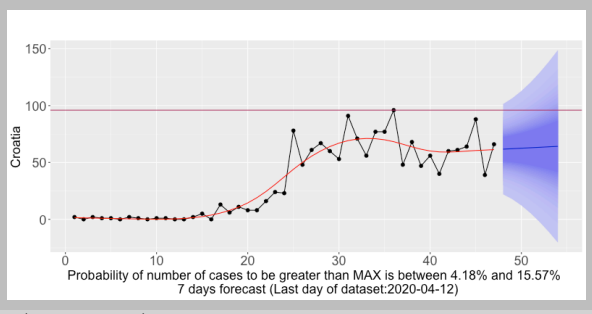
Maximum reached	2020-03-31
Estimation of number of cases: ARIMA	[661, 1060]

7.9 Croatia



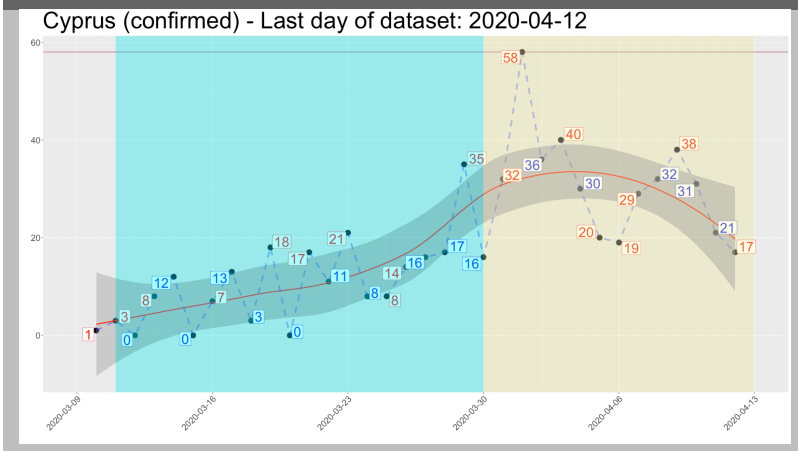


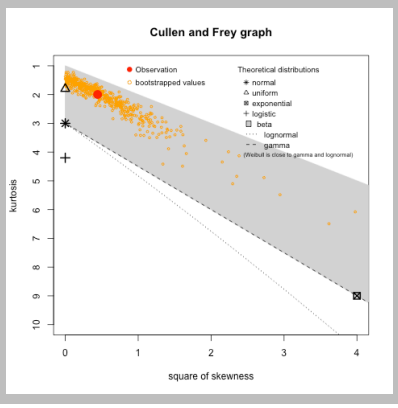


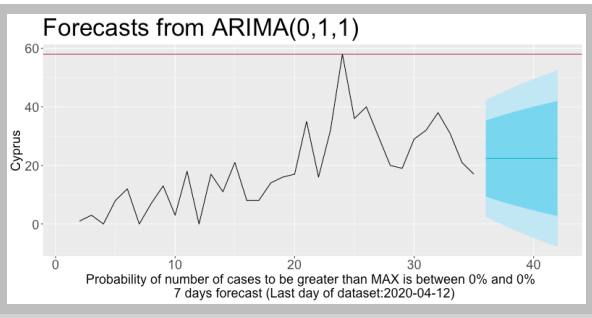


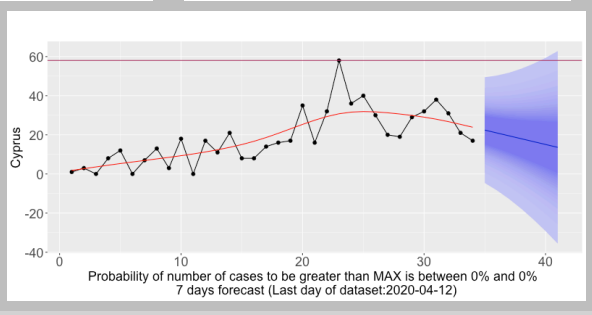
Mmaximum reached (probably)	2020-04-01
Estimation of number of cases: ARIMA	[1534, 2497]

7.10 Cyprus



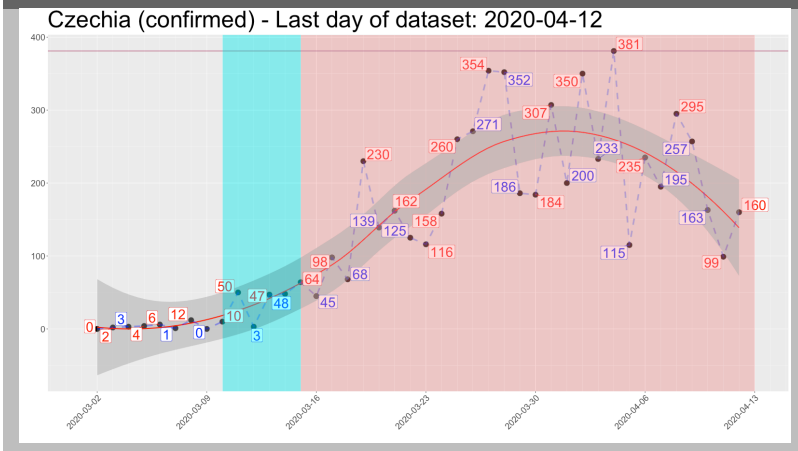


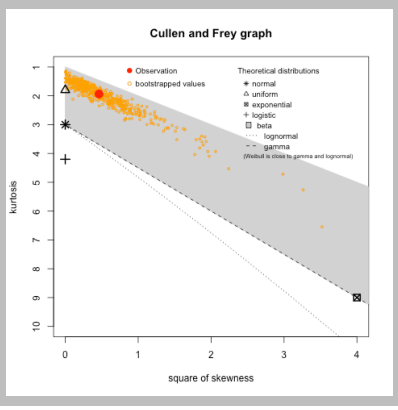


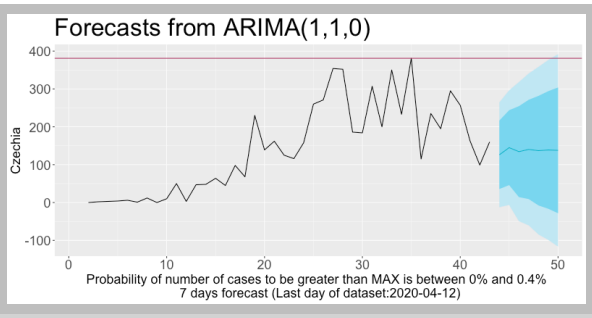


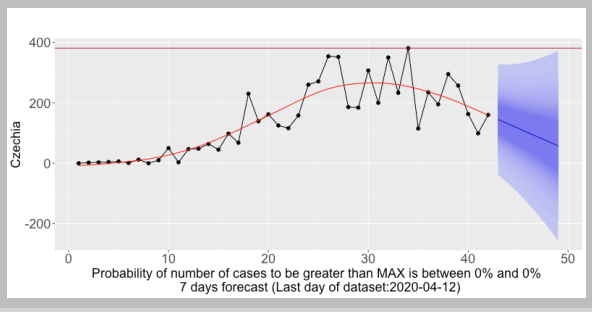
Maximum reached (probably)	2020-04-01
Estimation of number of cases: ARIMA	[616, 936]

7.11 Czechia





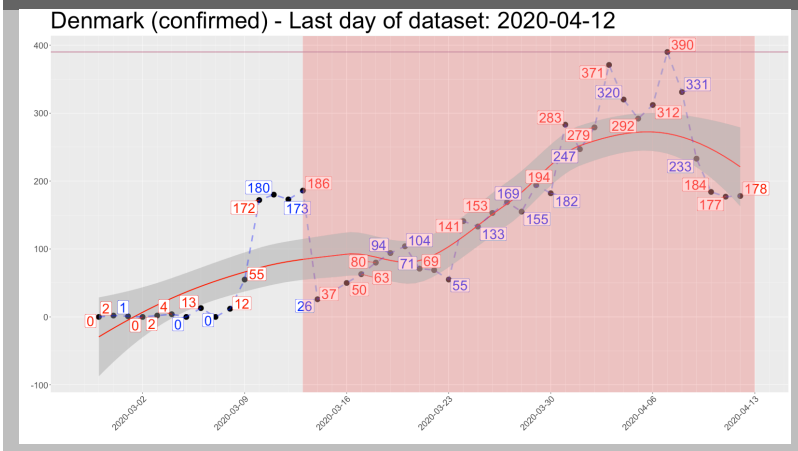


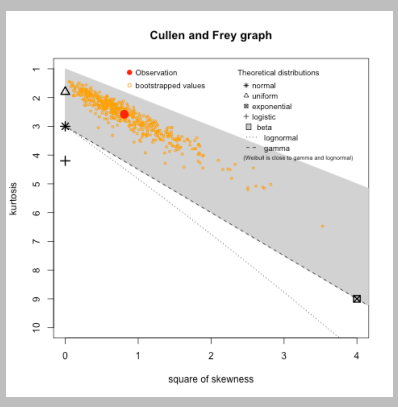


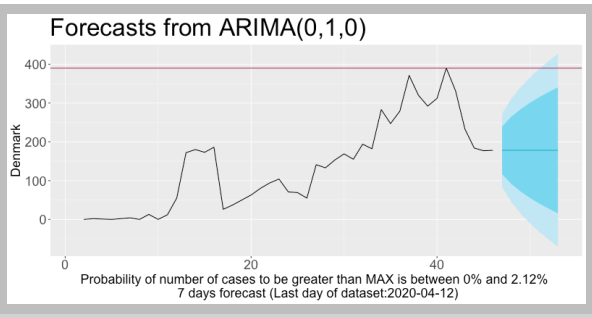
Maximum reached	2020-04-04 days
Estimation of number of cases: ARIMA	[5831, 10303]

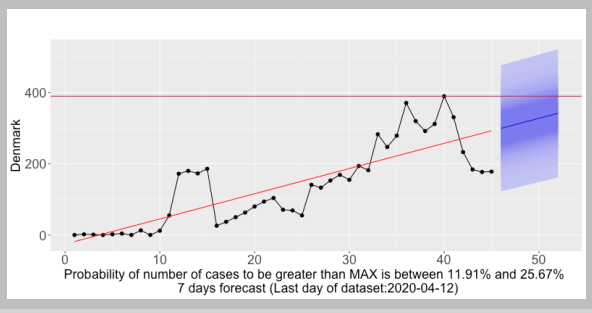
In the Czech Republic the imposition of Phase 3 measures on March 15^{th} did change the dynamics of the exponential growth rate of the confirmed cases for three days, from March the 21^{st} until the 23^{rd}.

7.12 Denmark



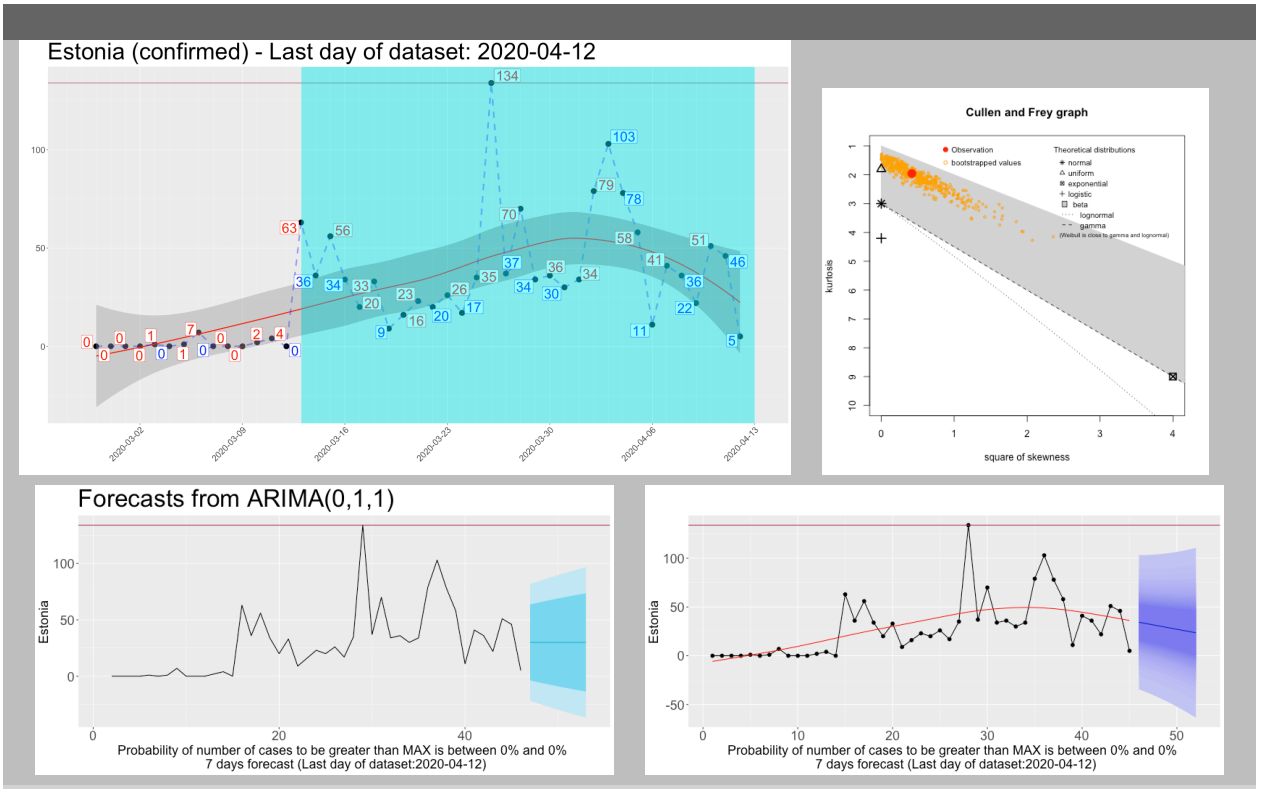






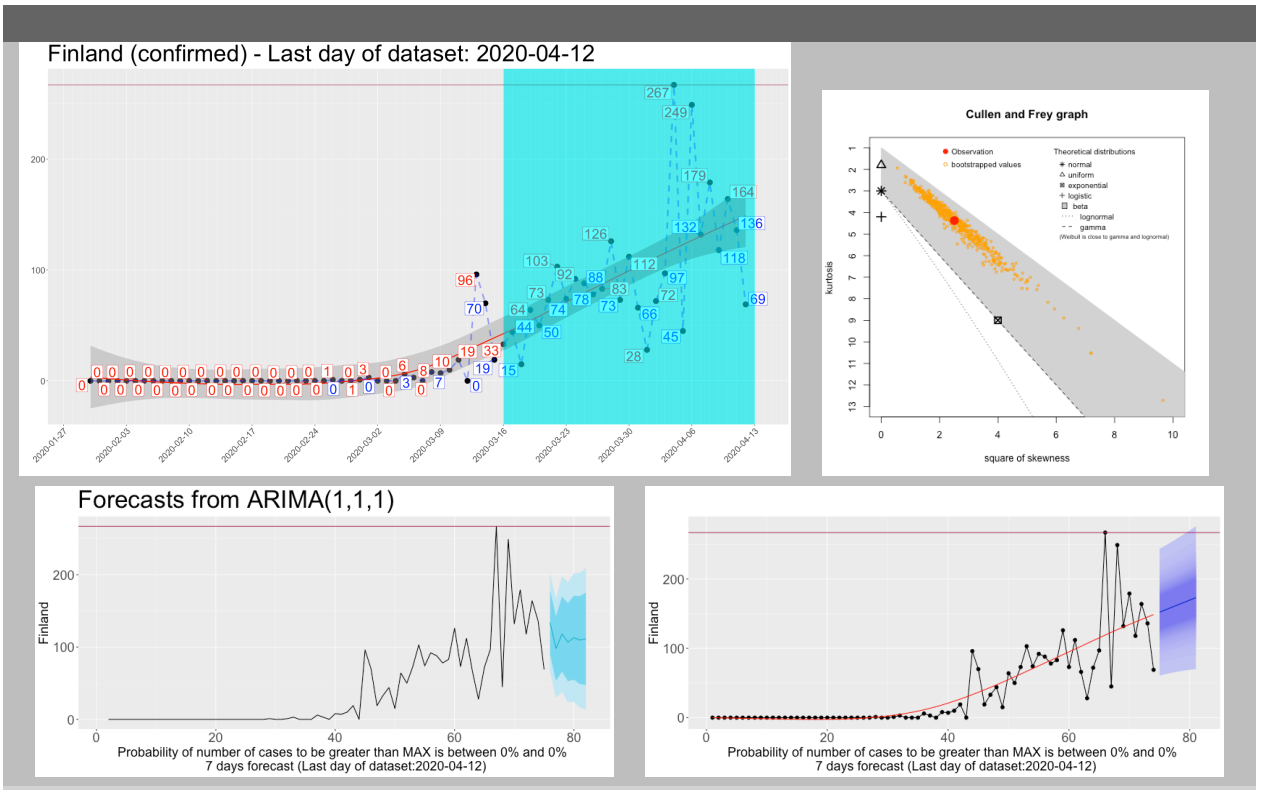
Maximum reached	2020-04-07
Estimation of number of cases: ARIMA	[5996, 11067]

7.13 Estonia



Maximum reached (probably)	2020-04-03
Estimation of number of cases: ARIMA	[1304, 2265]

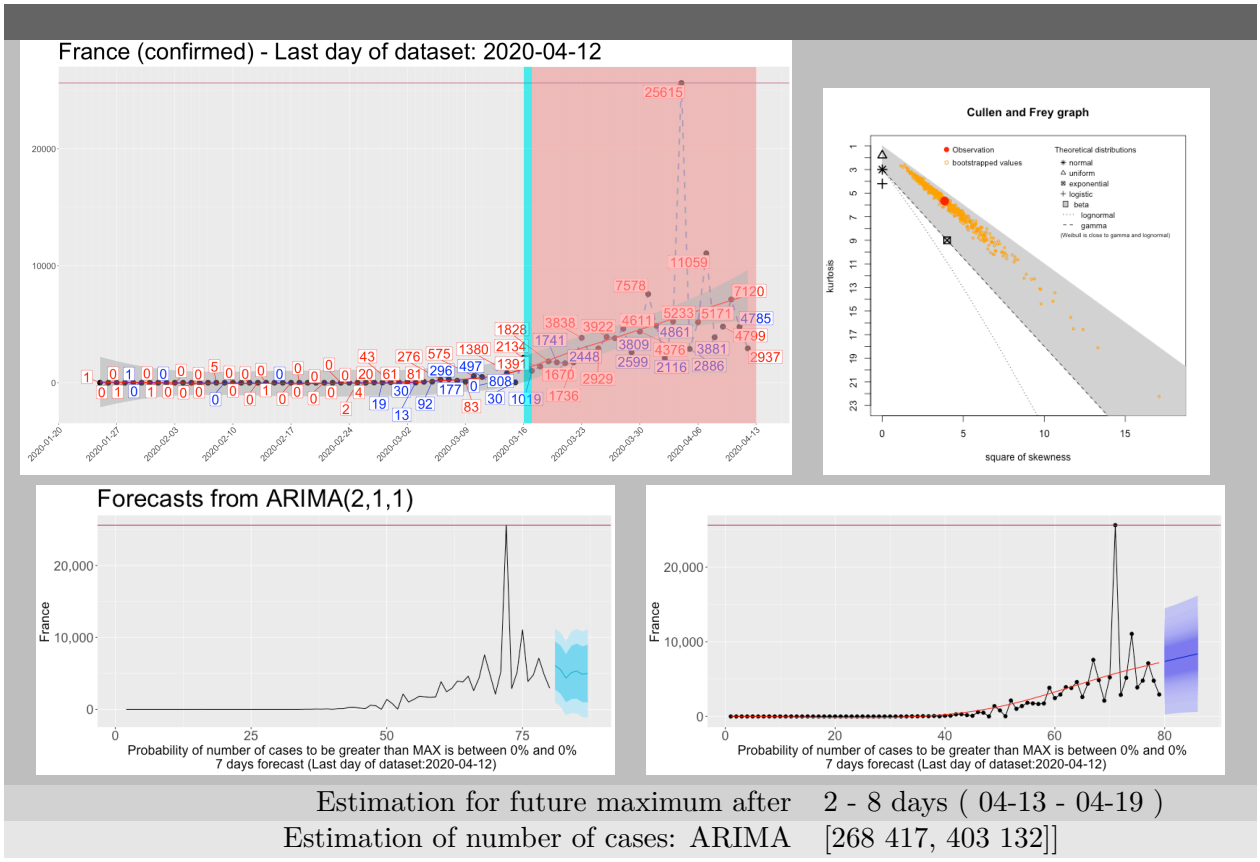
7.14 Finland



Estimation for future maximum after	3 - 7 days (04-14 - 04-18)
Estimation of number of cases: ARIMA	[6402, 8651]

In Finland only Phase 1 measures were imposed.

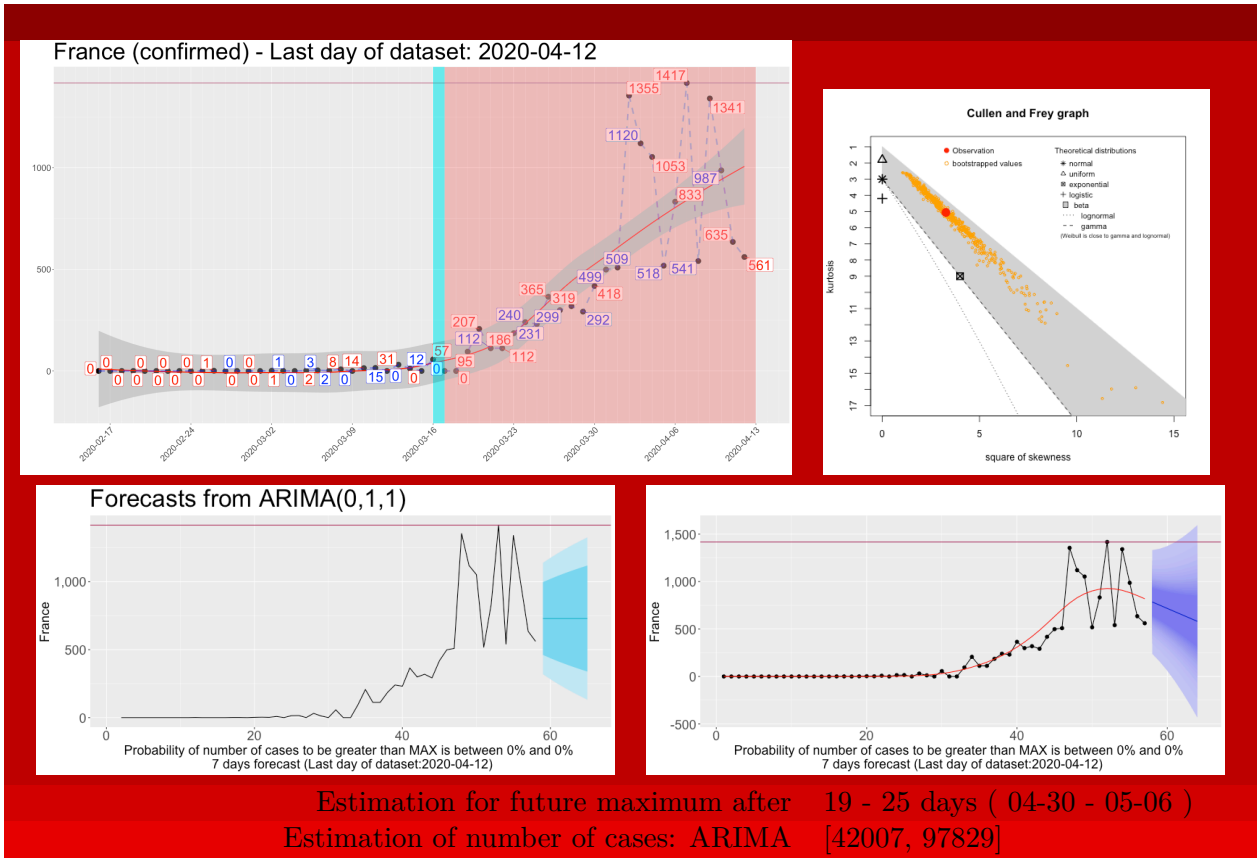
7.15 France



Estimation for future maximum after 2 - 8 days (04-13 - 04-19)
Estimation of number of cases: ARIMA [268 417, 403 132]]

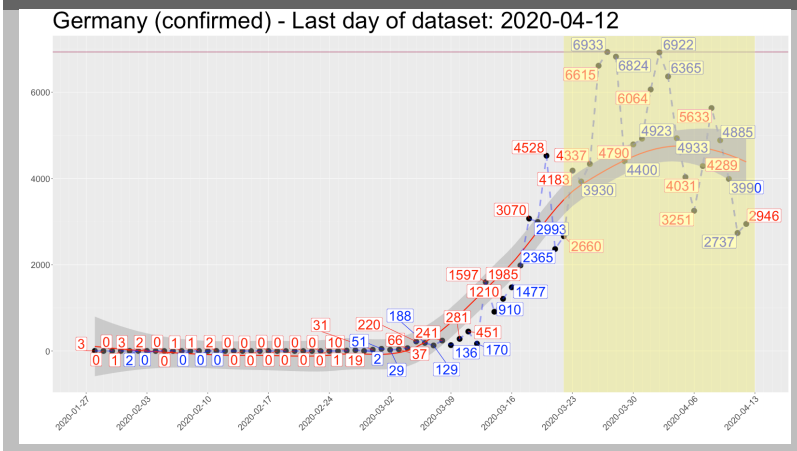
In France, Phase 3 measures were imposed on March 17^{th}. However, the dynamics of the exponential growth rate of the confirmed cases changed for two days, March 21^{st} and 22^{nd}.

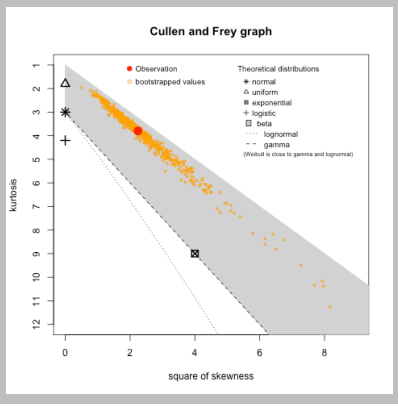
In France, the large number of cases announced on April 4 affects the forecast and makes it unstable.

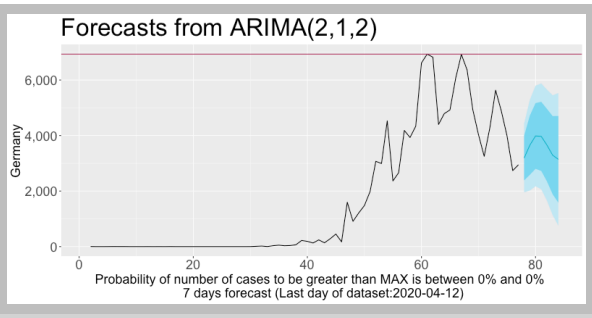


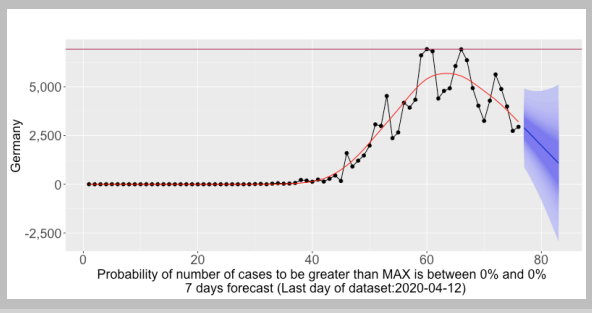
Estimation for future maximum after 19 - 25 days (04-30 - 05-06)
Estimation of number of cases: ARIMA [42007, 97829]

7.16 Germany



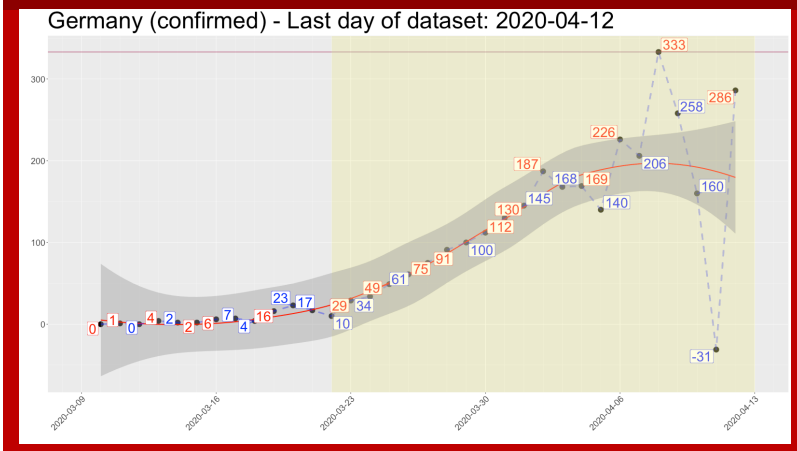


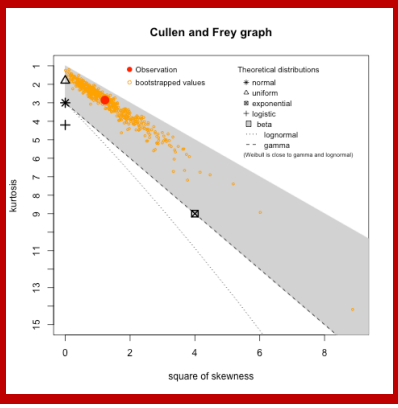


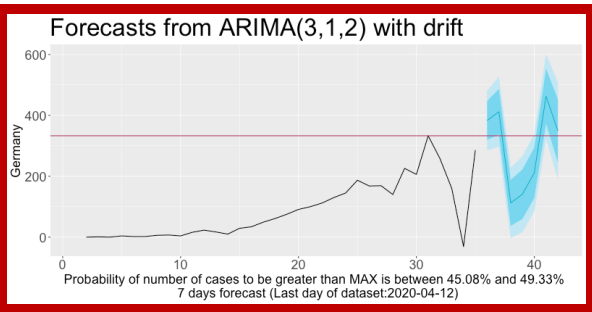


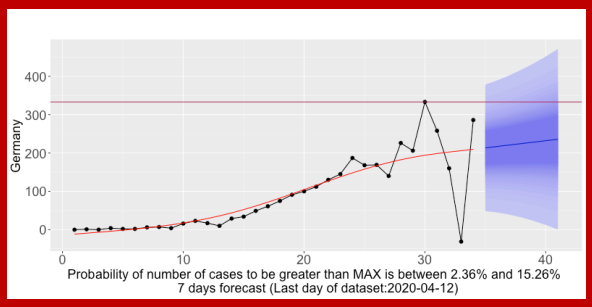
Maximum reached 2020-04-02

Estimation of number of cases: ARIMA [124 908, 209 702]





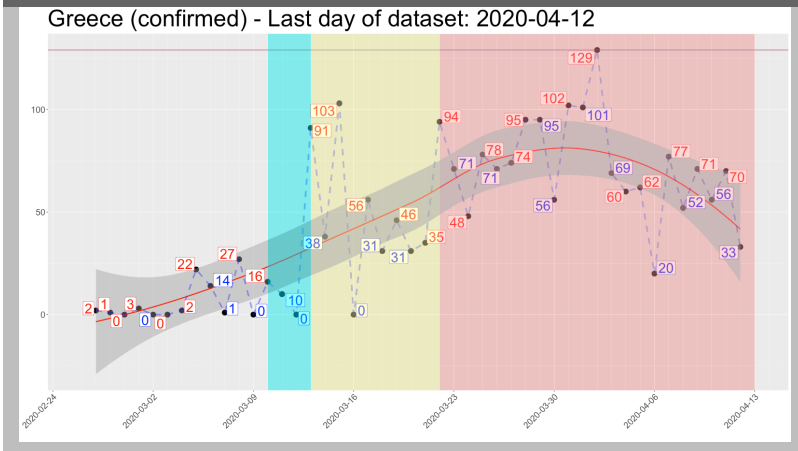


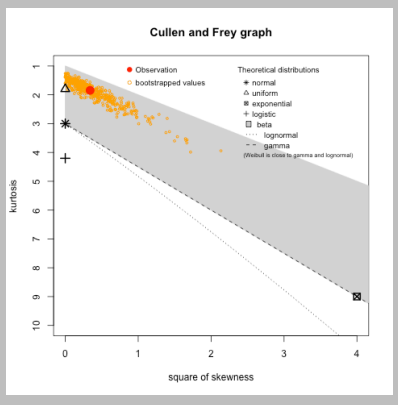


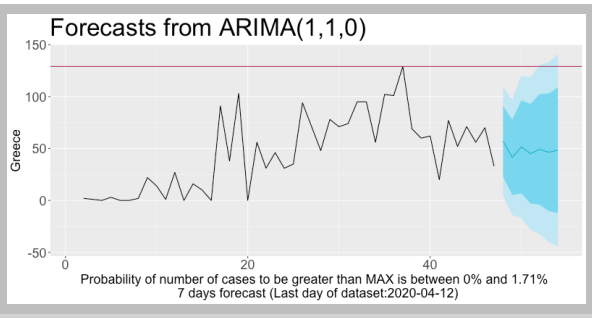
Estimation for future maximum after 6 - 10 days (04-18 - 04-22)

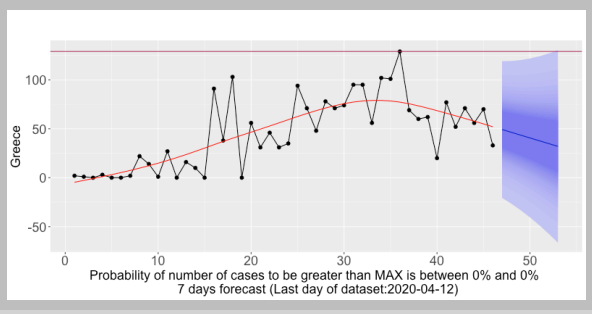
Estimation of number of cases: ARIMA [6985, 12045]

7.17 Greece



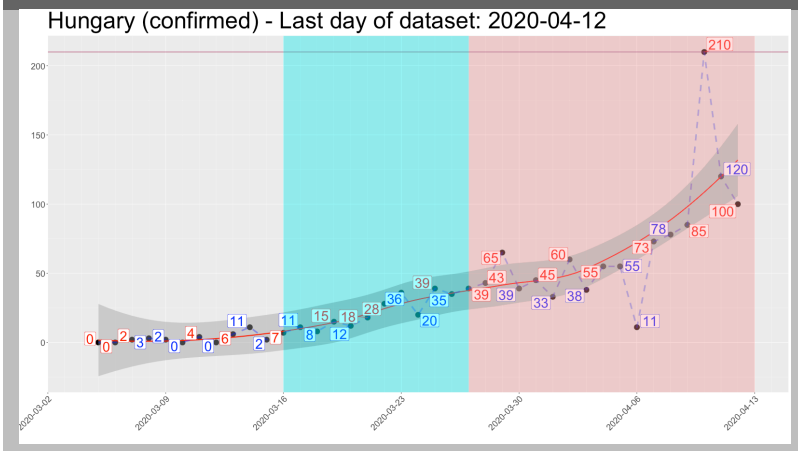


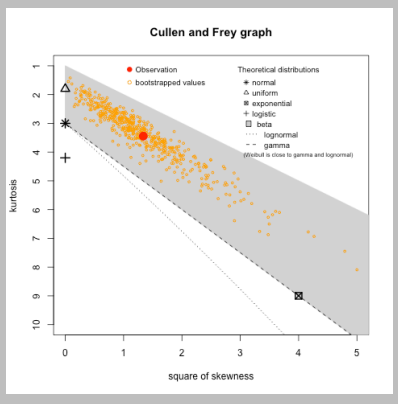


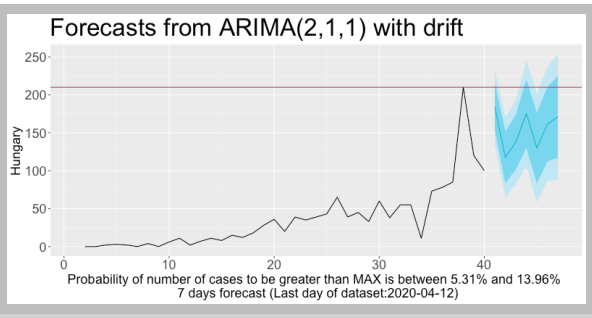


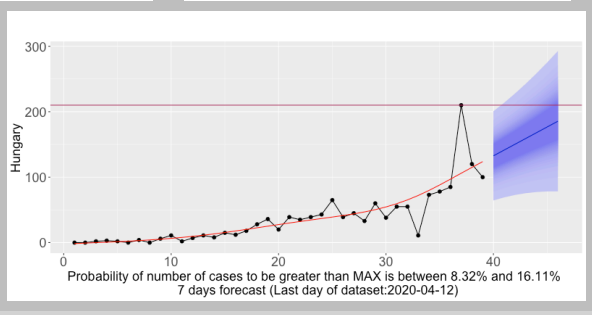
Maximum reached (probably)	2020-04-02
Estimation of number of cases: ARIMA	[2081, 3625]

7.18 Hungary



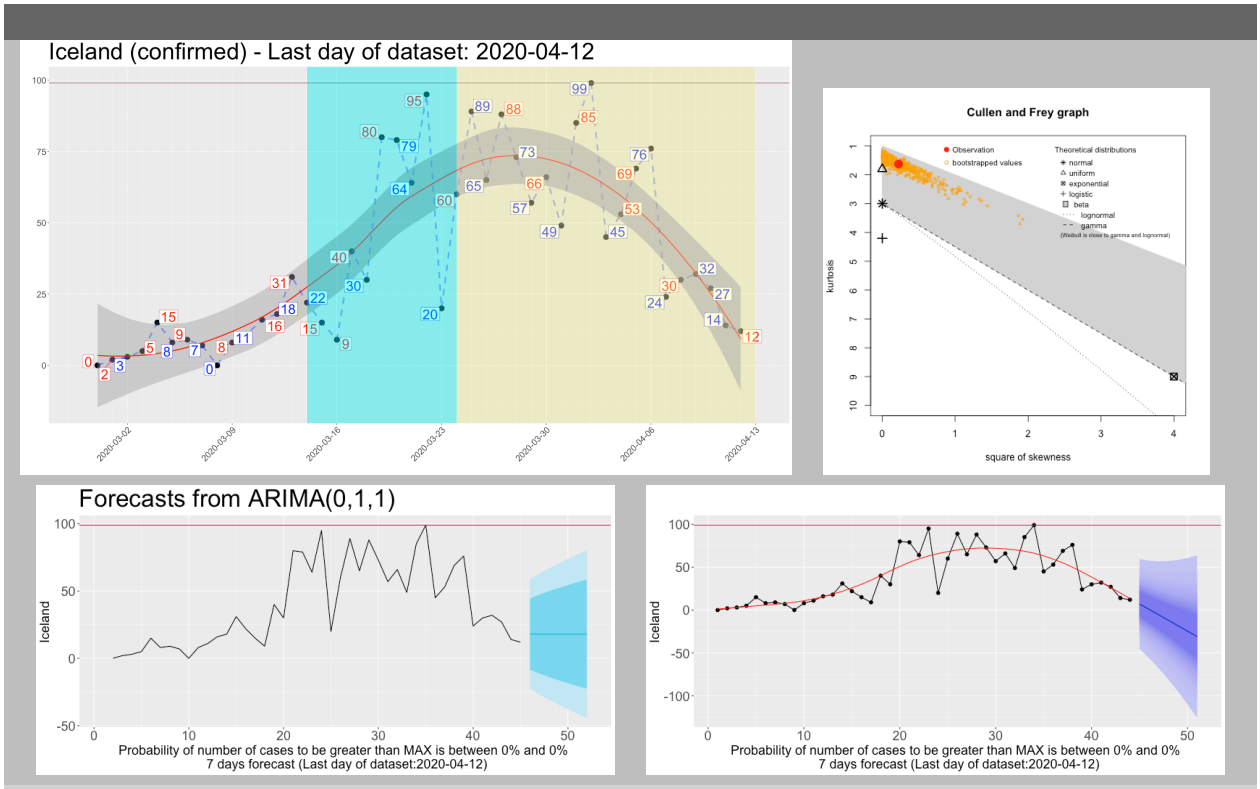






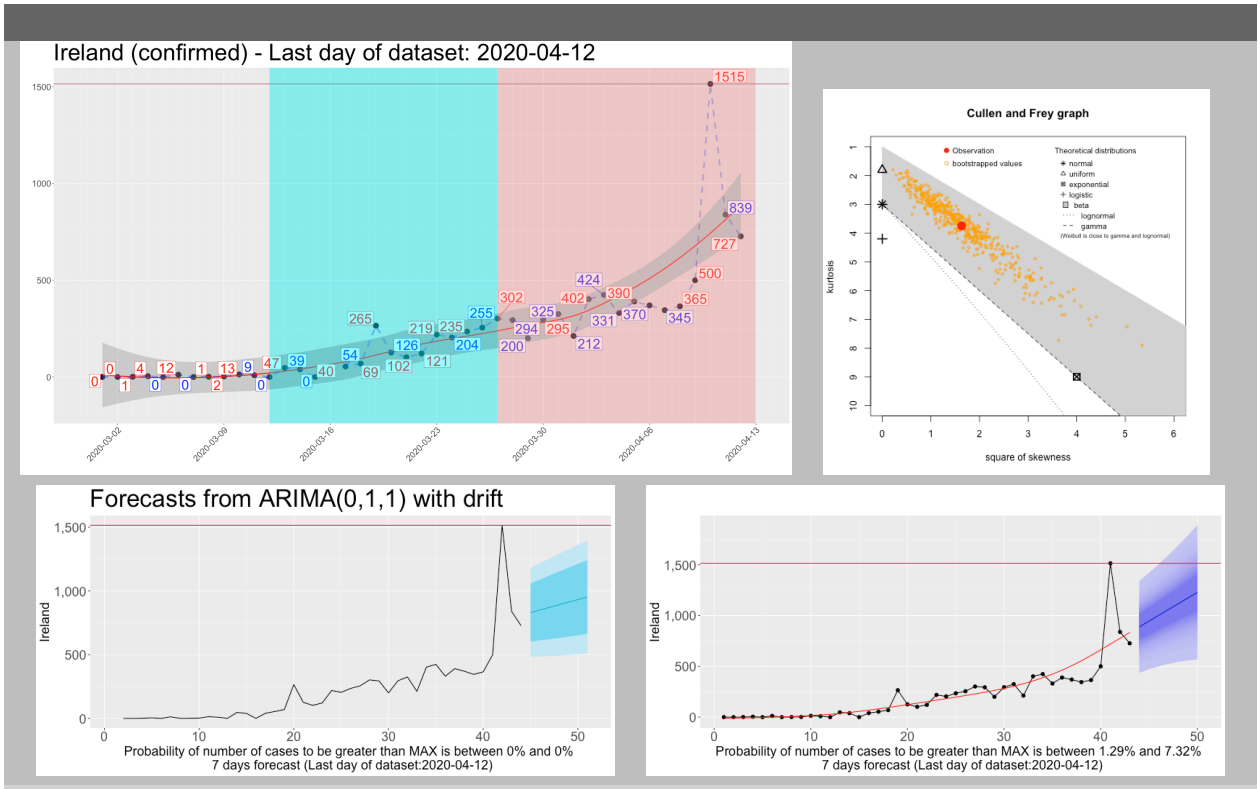
Estimation for future maximum after	4 - 10 days (04-15 - 04-21)
Estimation of number of cases: ARIMA	[3466, 7040]

7.19 Iceland



Maximum reached	2020-04-02
Estimation of number of cases: ARIMA	[1689, 3008]

7.20 Ireland

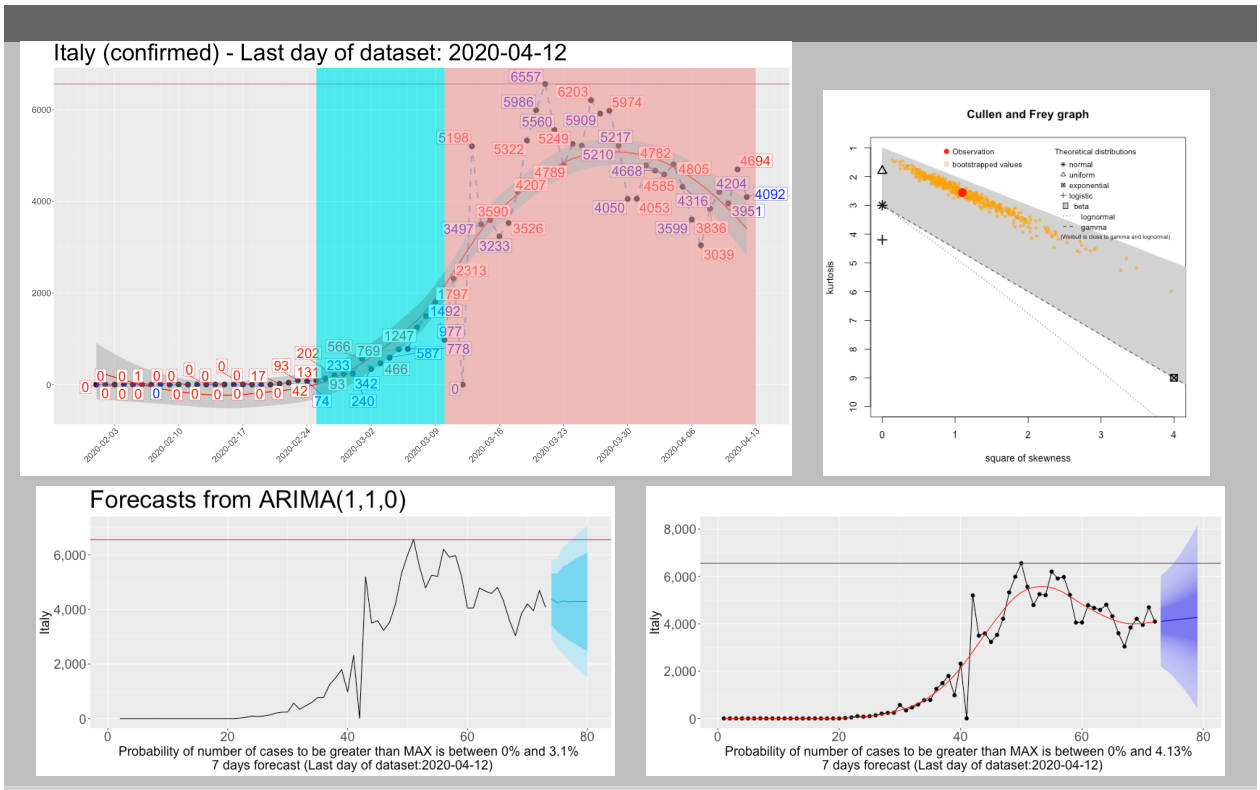


Estimation for future maximum after	5 - 8 days (04-16 - 04-19)
Estimation of number of cases: ARIMA	[23517, 38591]

In Ireland the Phase 1 measures were imposed on March 12^{th} and seem to have slightly hold back the growth rate of the confirmed cases. Also, the imposition of Phase 3 measures on March 23^{rd} may result to shift peak point by some days; the data to be collected during the next 3-4 days will

contribute to a safer forecast.

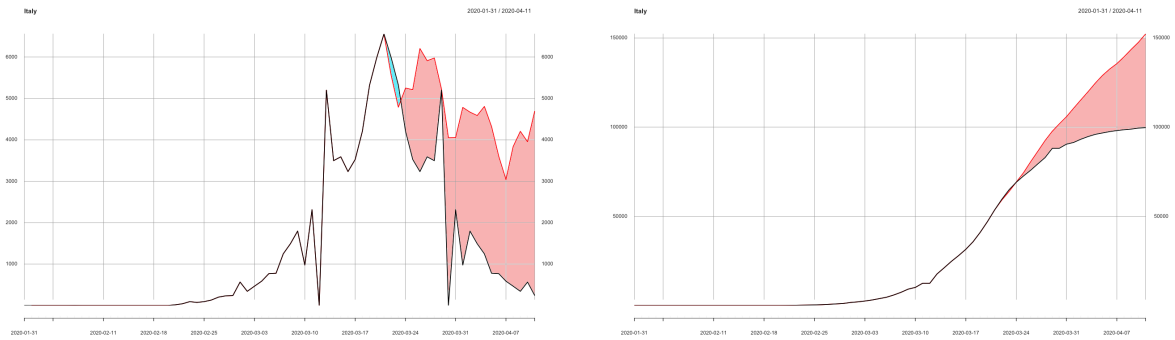
7.21 Italy

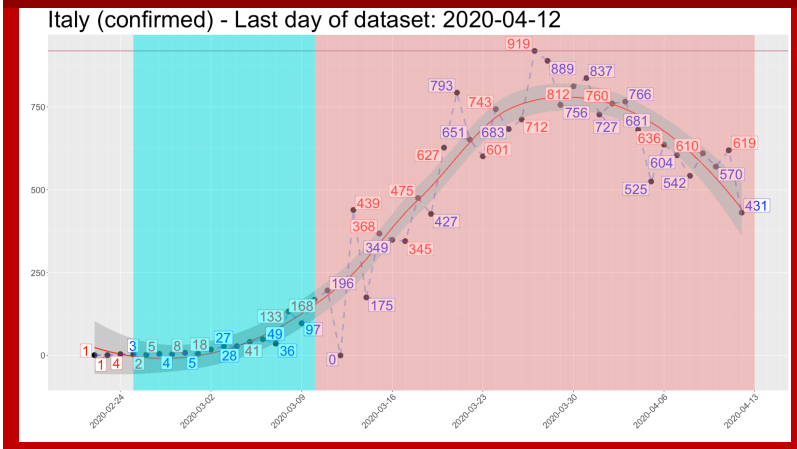


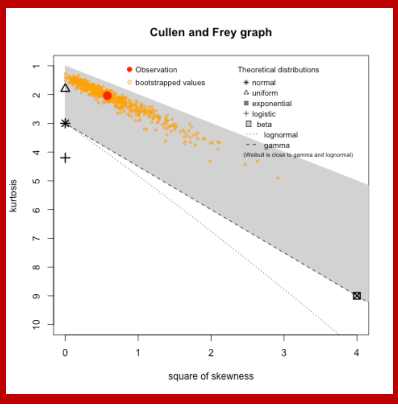
Maximum reached	2020 - 03 - 26
Estimation of number of cases: ARIMA	[152 271, 232 860]

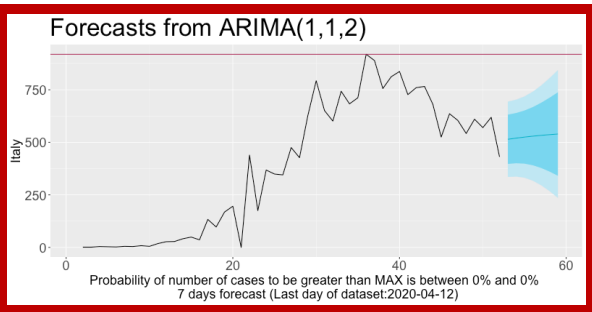
In Italy it is observed (a) that number of the COVID-19 confirmed cases per day is is reducing, and (b) the curvature tends to change. This is an indication that the exponential growth has suspended, and the phenomenon is at its peak or close to it.

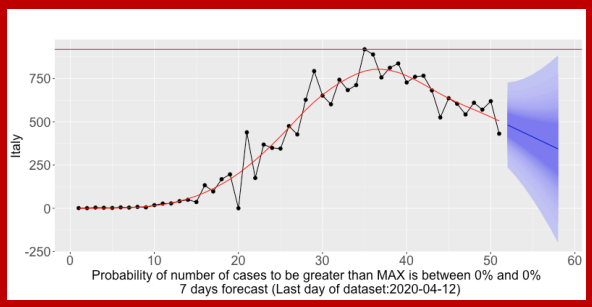
It is observed that de-escalation is not symmetric to the escalation rate, while, the cases during the de-escalation period are much more.





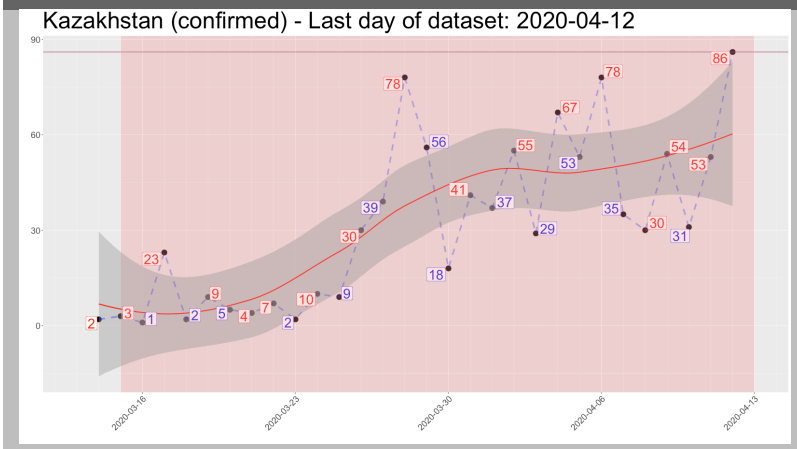


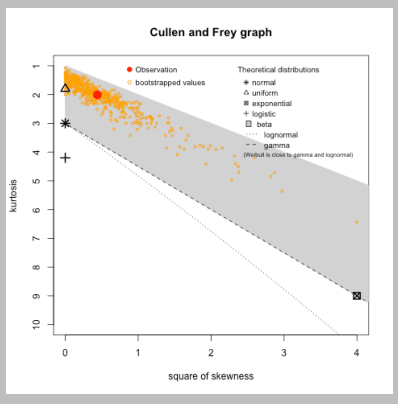


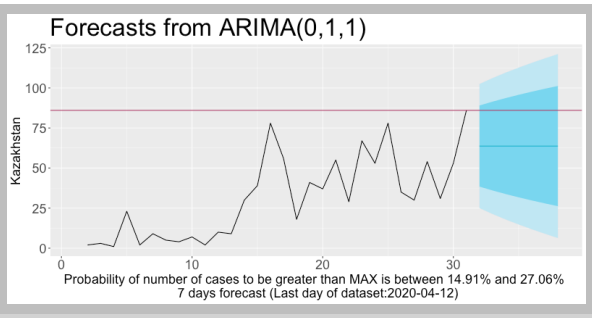


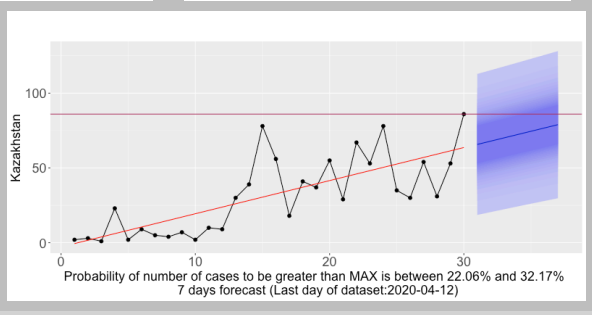
Maximum reached (probably) 2020-03-27
Estimation of number of cases: ARIMA [19 468, 28 602]

7.22 Kazakhstan



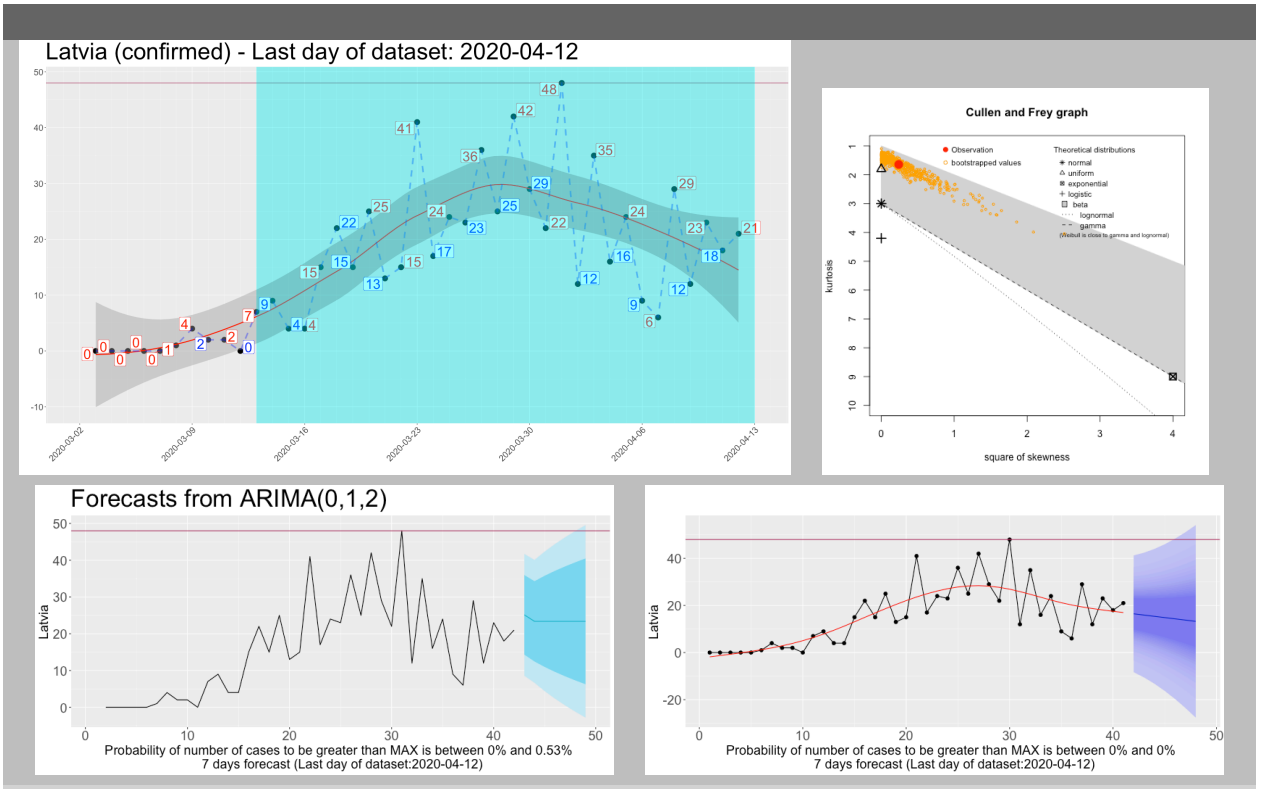






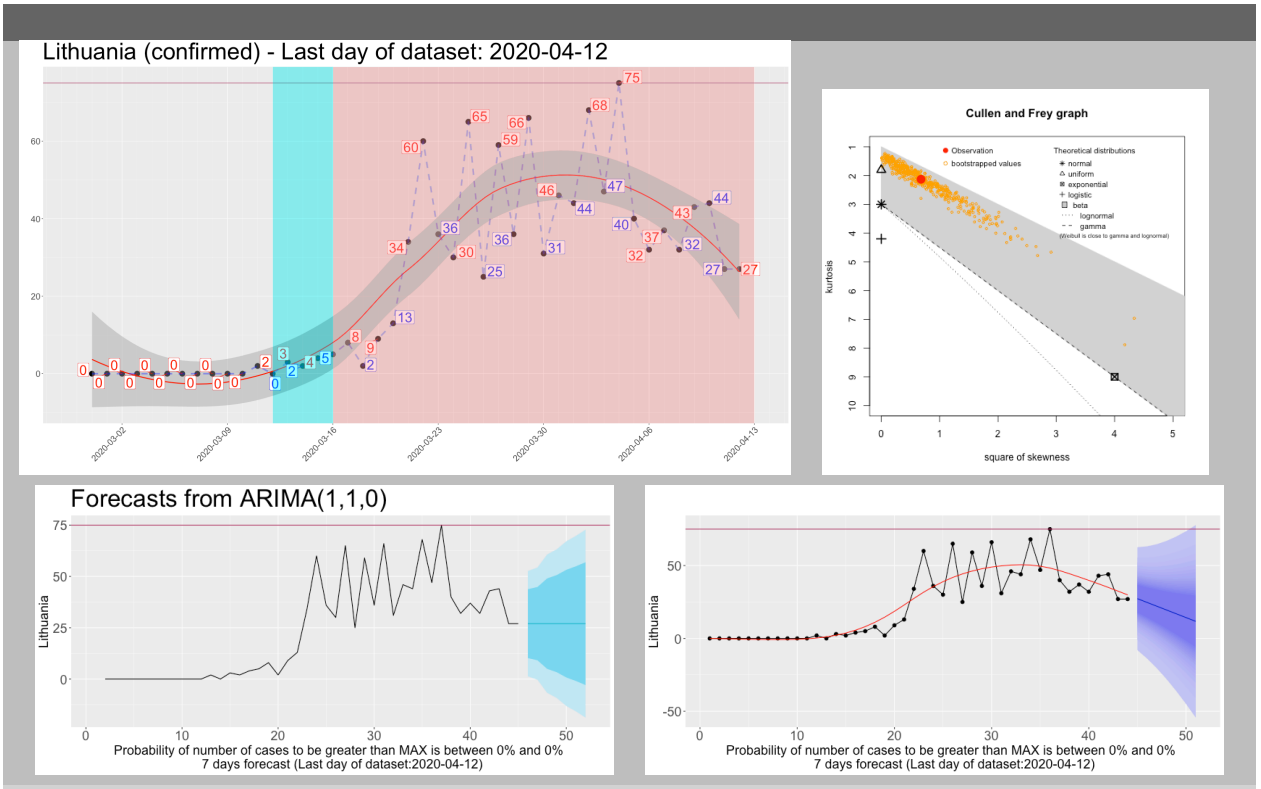
Estimation for future maximum after 2 - 11 days (04-14 - 04-23)
Estimation of number of cases: ARIMA [2021, 4210]

7.23 Latvia



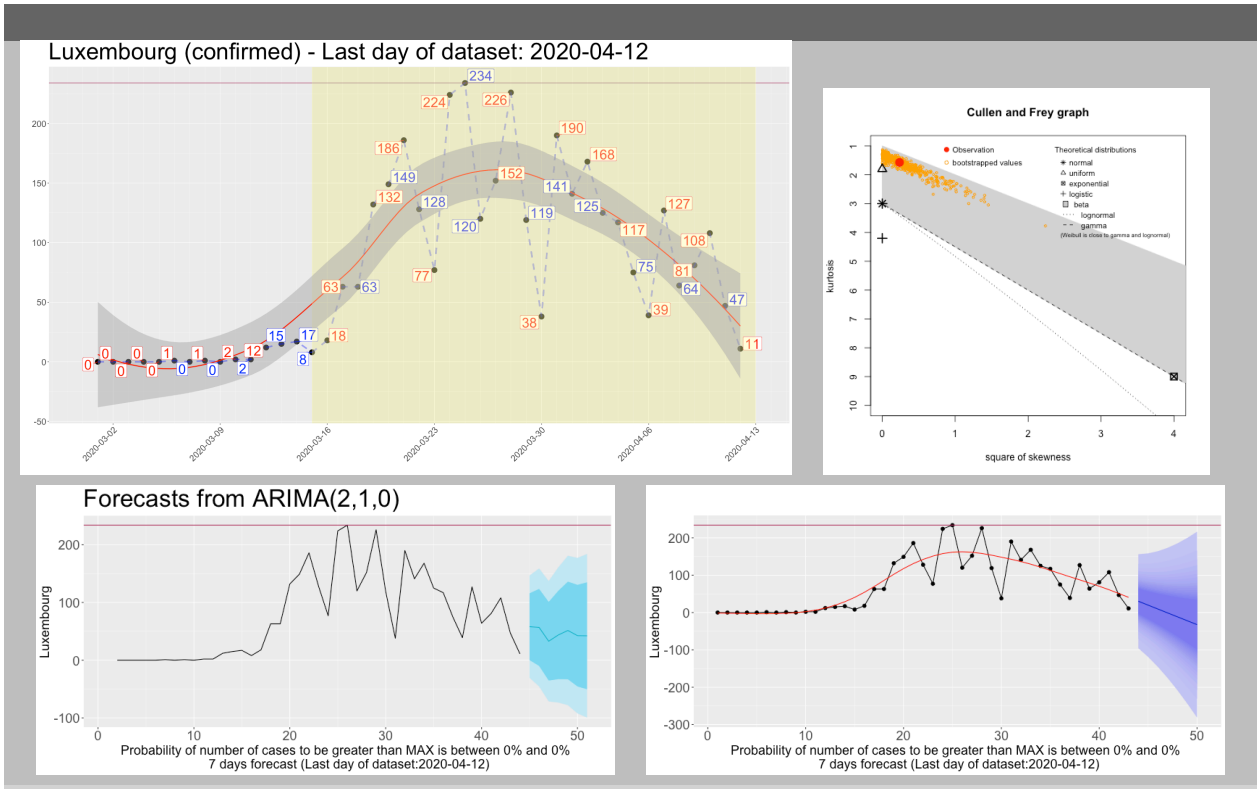
Maximum reached	2020-04-01
Estimation of number of cases:	[892, 1018]

7.24 Lithuania



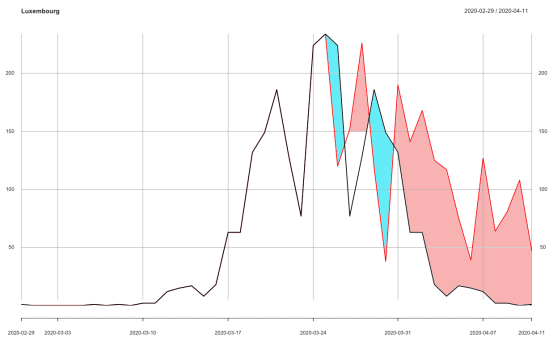
Maximum reached	2020-04-04
Estimation of number of cases: ARIMA	[1026, 1797]

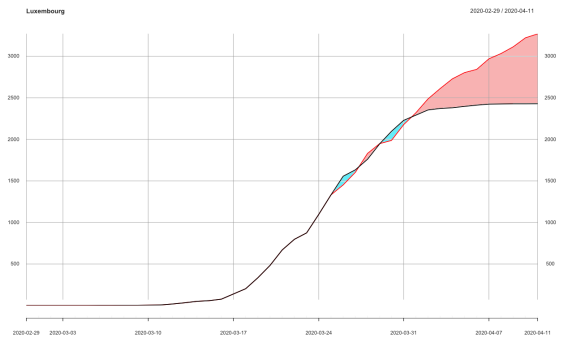
7.25 Luxembourg



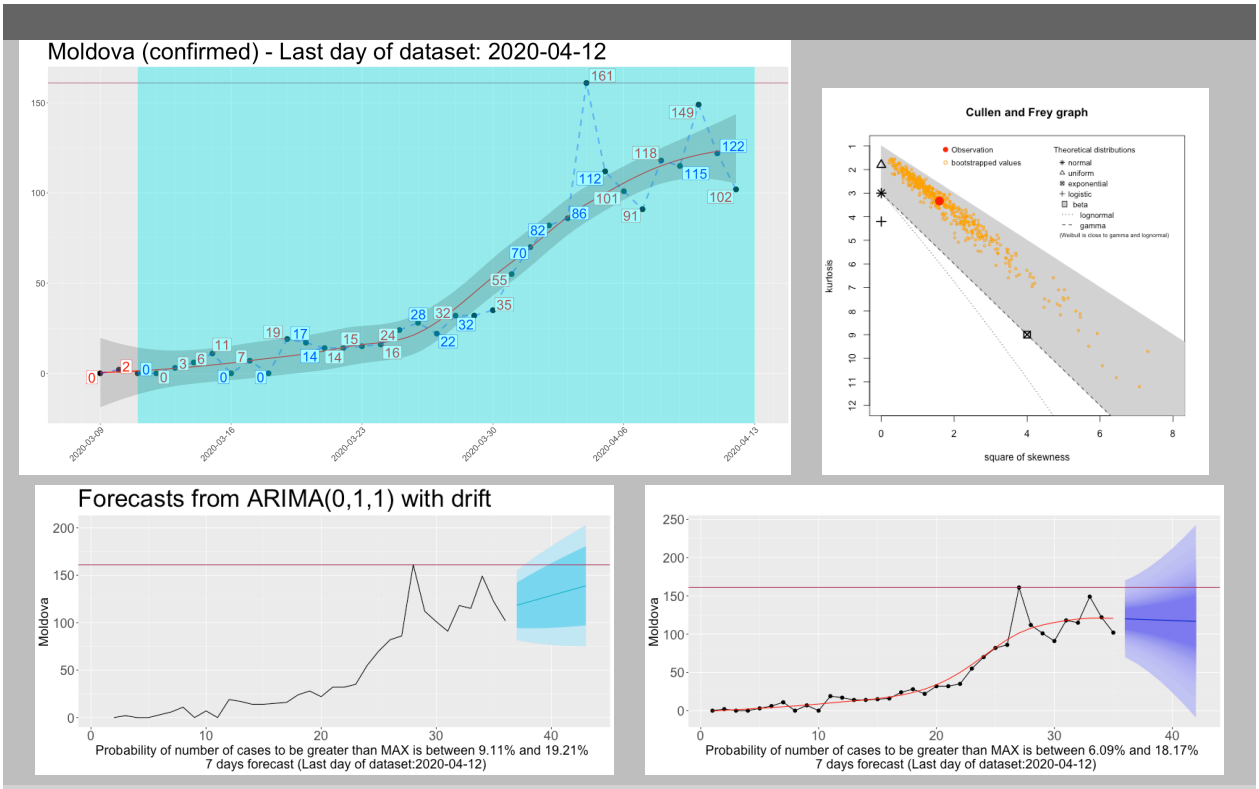
Maximum reached	2020-03-31
Estimation of number of cases: ARIMA	[3270, 5448]

It is observed that de-escalation is not symmetric to the escalation rate; the cases during the de-escalation period are relatively more.



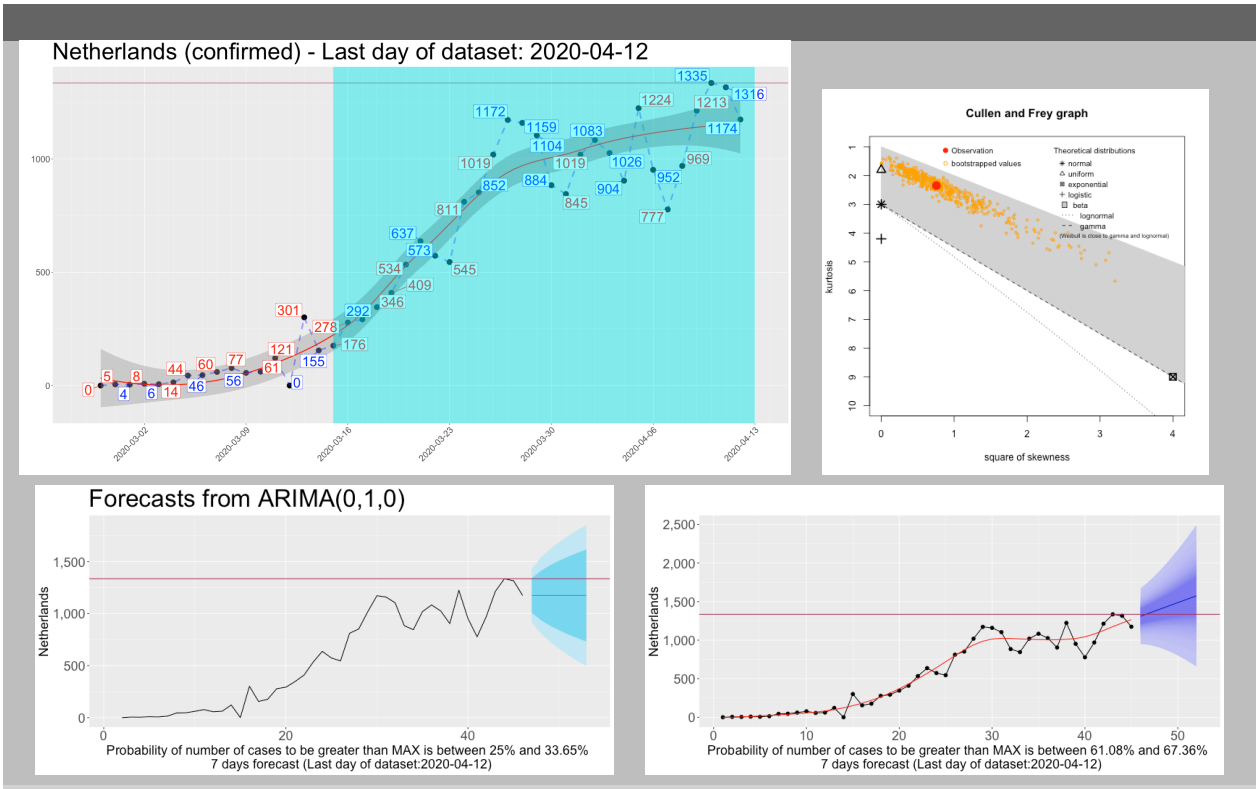


7.26 Moldova

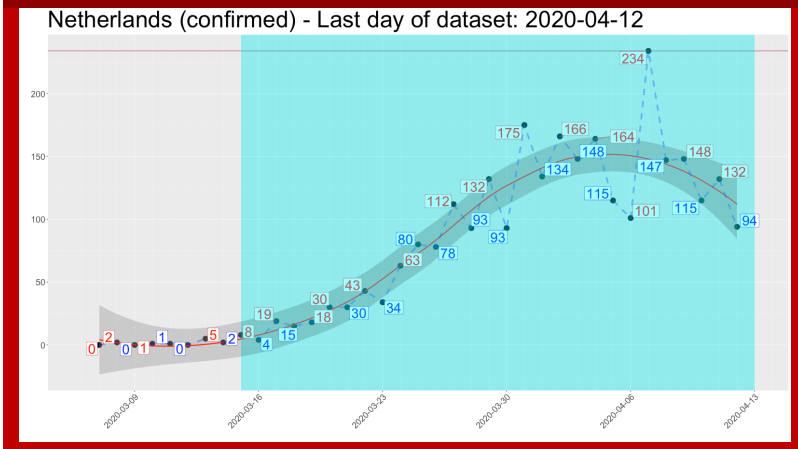


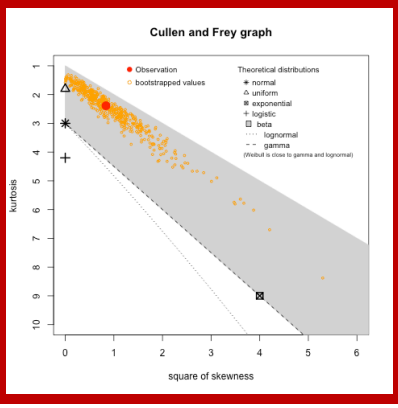
Estimation for future maximum after 2 - 6 days (04-13 - 04-17)
Estimation of number of cases: ARIMA [3493, 5227]

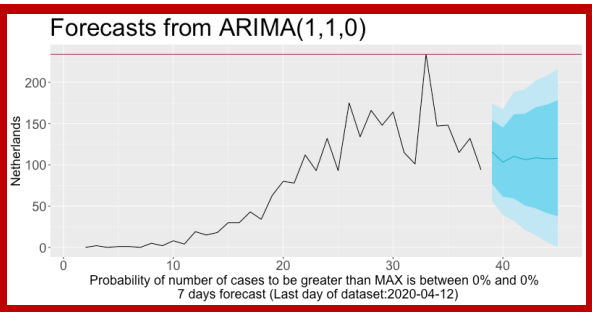
7.27 Netherlands

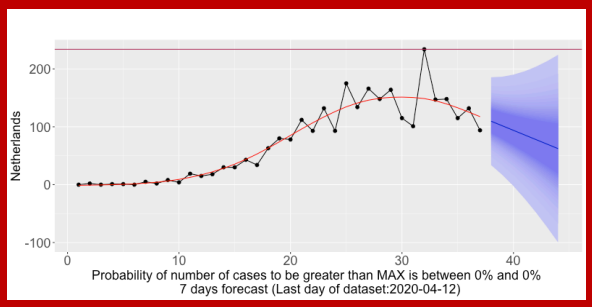


Estimation for future maximum after 1 - 7 days (04-12 - 04-18)
Estimation of number of cases: ARIMA [50948, 73290]



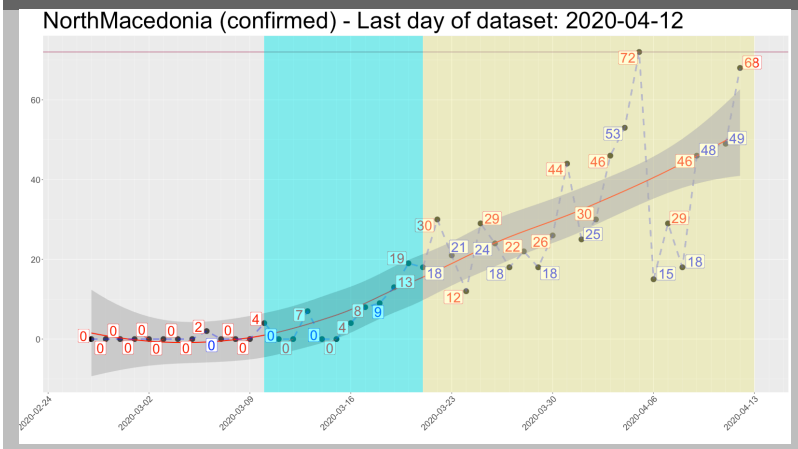


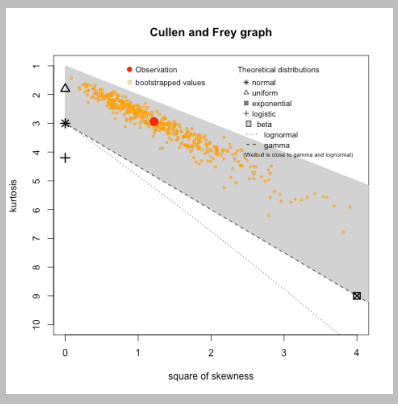


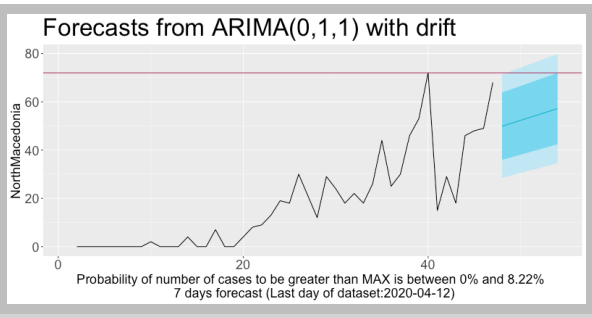


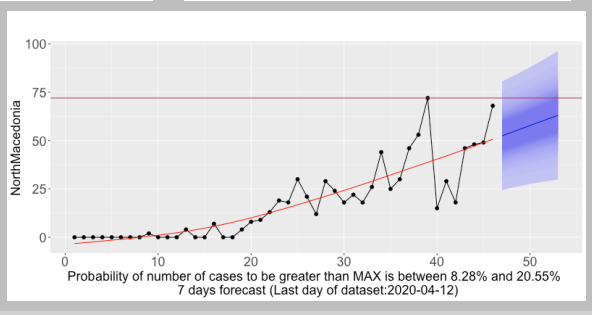
Estimation for future maximum after 14 - 20 days (04-25 - 05-01)
Estimation of number of cases: ARIMA [6961, 14441]]

7.28 North Macedonia



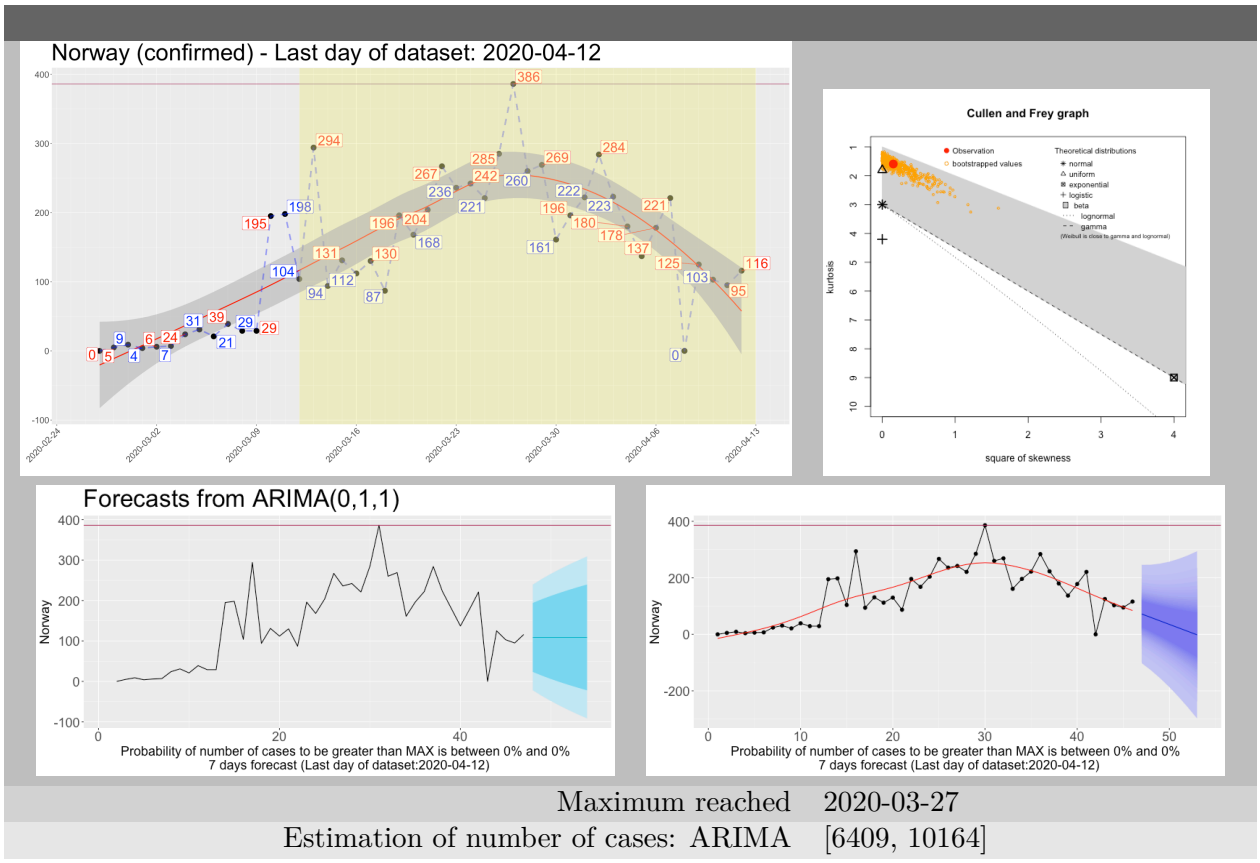






Estimation for future maximum after 1 - 6 days (04-12 - 04-17)
Estimation of number of cases: ARIMA [1554, 2186]

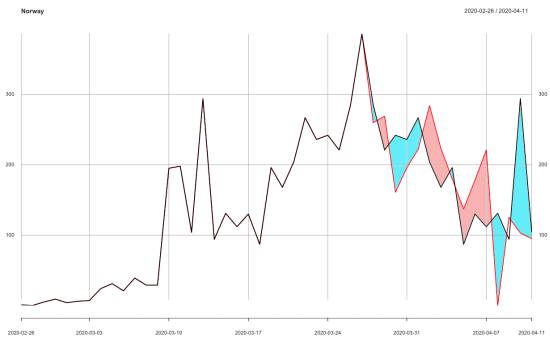
7.29 Norway

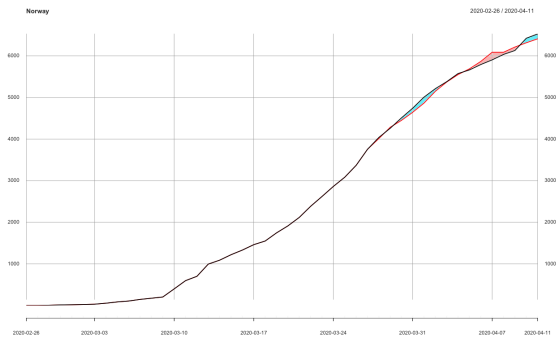


Maximum reached	2020-03-27
Estimation of number of cases: ARIMA	[6409, 10164]

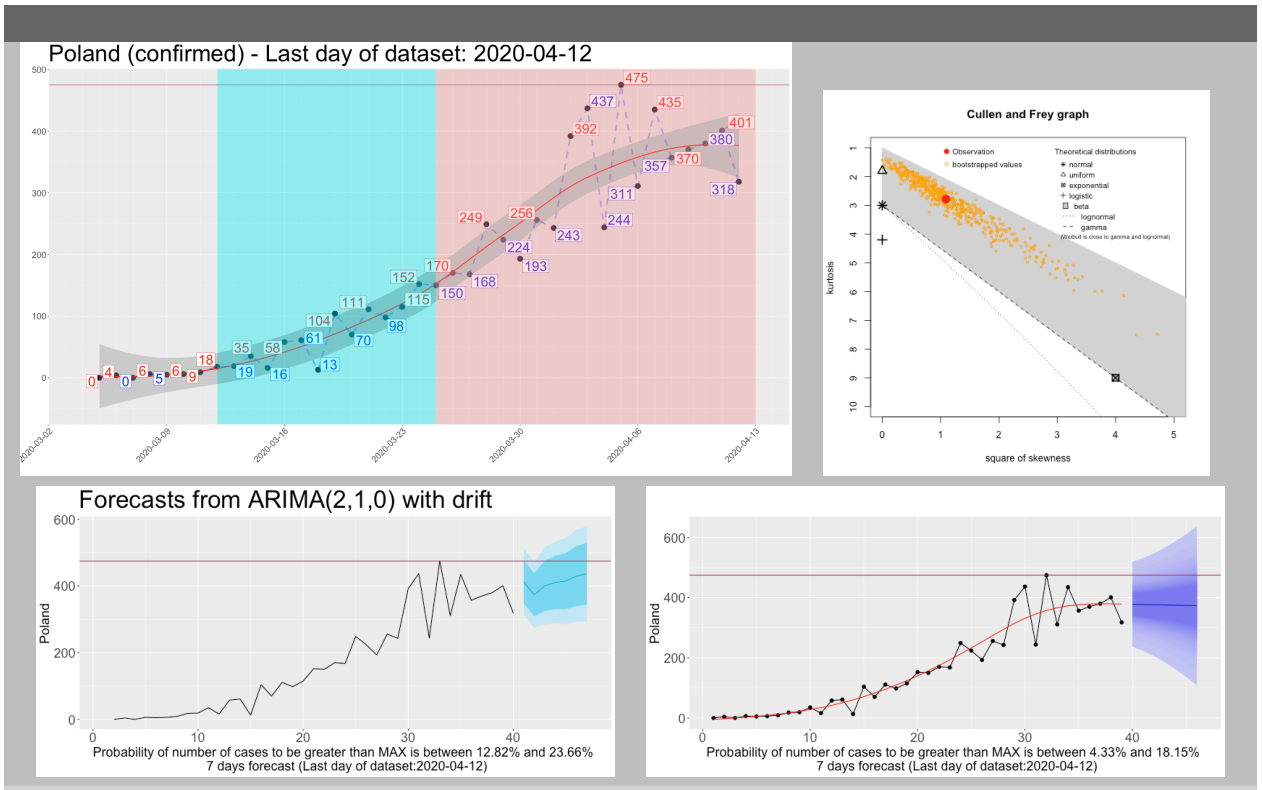
In Norway, only Phase 1 measures were imposed and there are some indications that the phenomenon is close to its peak.

It is observed that de-escalation rate is almost symmetric to the escalation one.





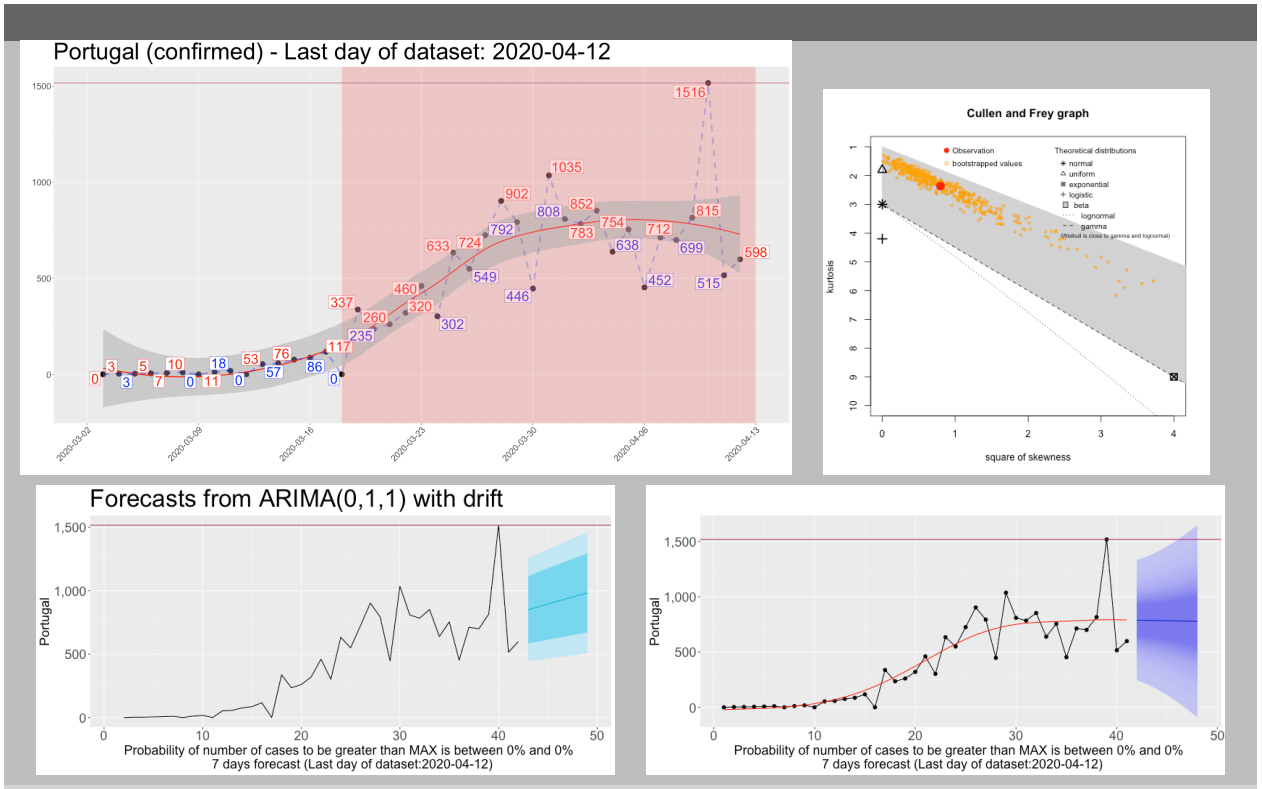
7.30 Poland



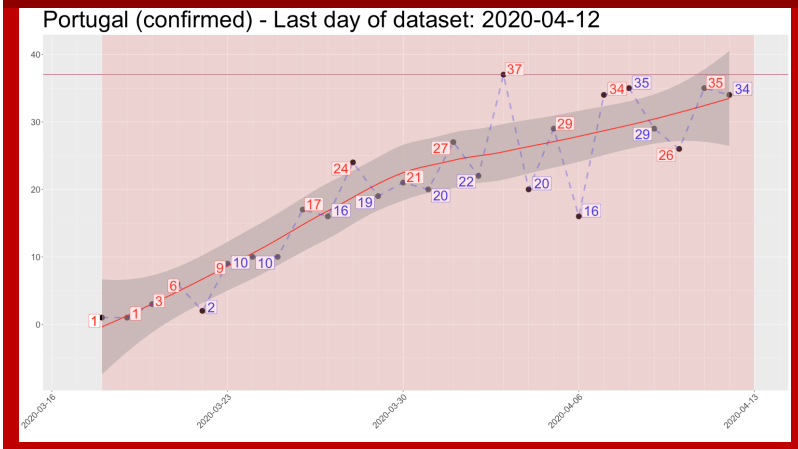
Estimation for future maximum after	period around the maximum
Estimation of number of cases: ARIMA	[13259, 20691]

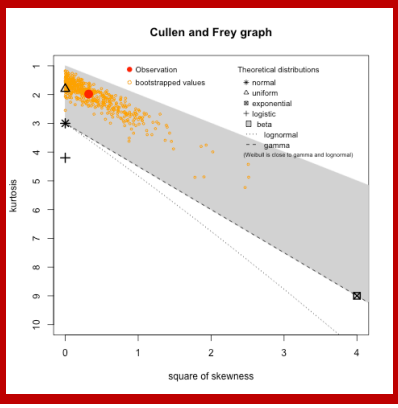
In Portugal, the large number of cases announced on April 10 affects the forecast and makes it unstable.

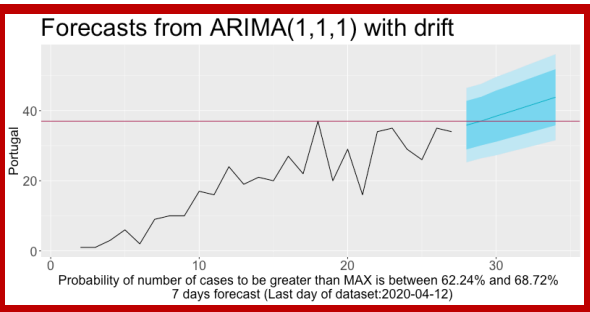
7.31 Portugal

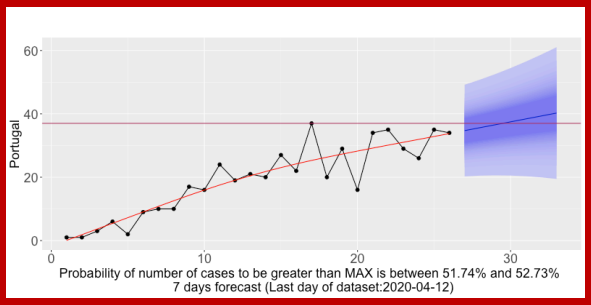


Estimation for future maximum after	4 - 6 days (04-15 - 04-17)
Estimation of number of cases: ARIMA	[37490, 47686]



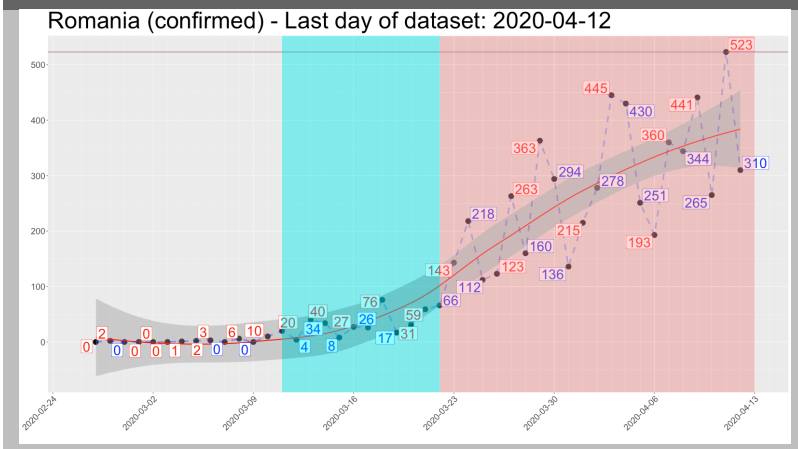


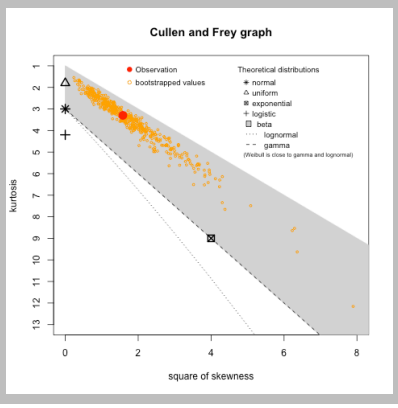


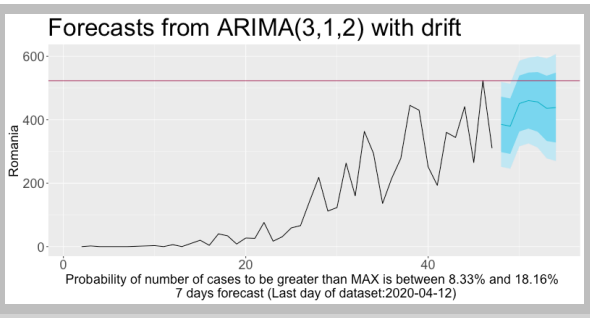


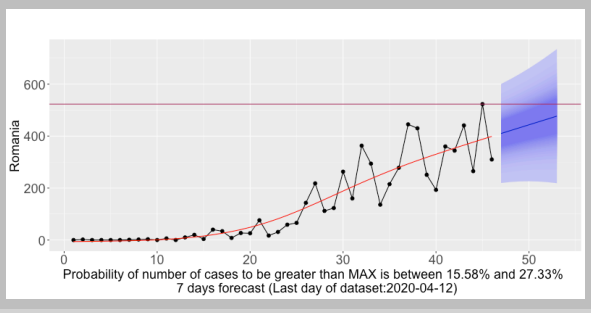
Estimation for future maximum after 15 - 21 days (04-27 - 05-03)
Estimation of number of cases: ARIMA [1504, 3319]

7.32 Romania



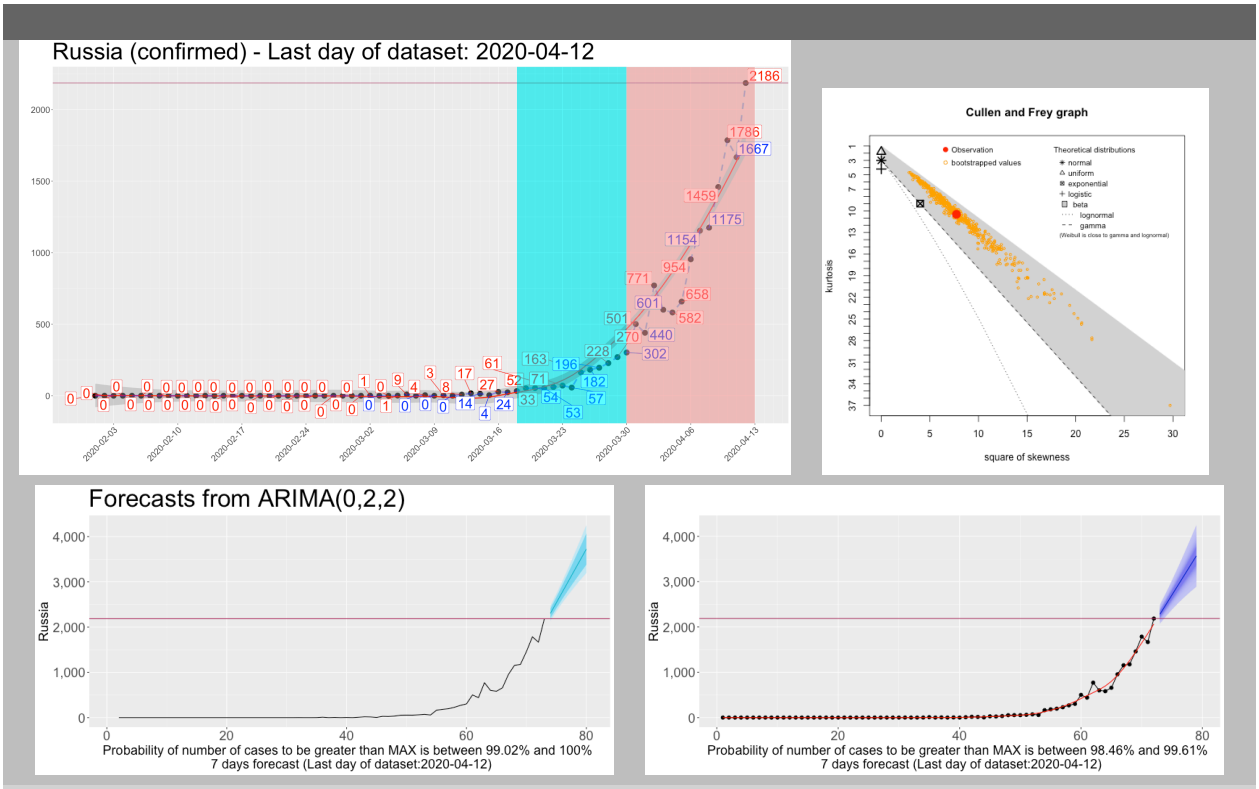






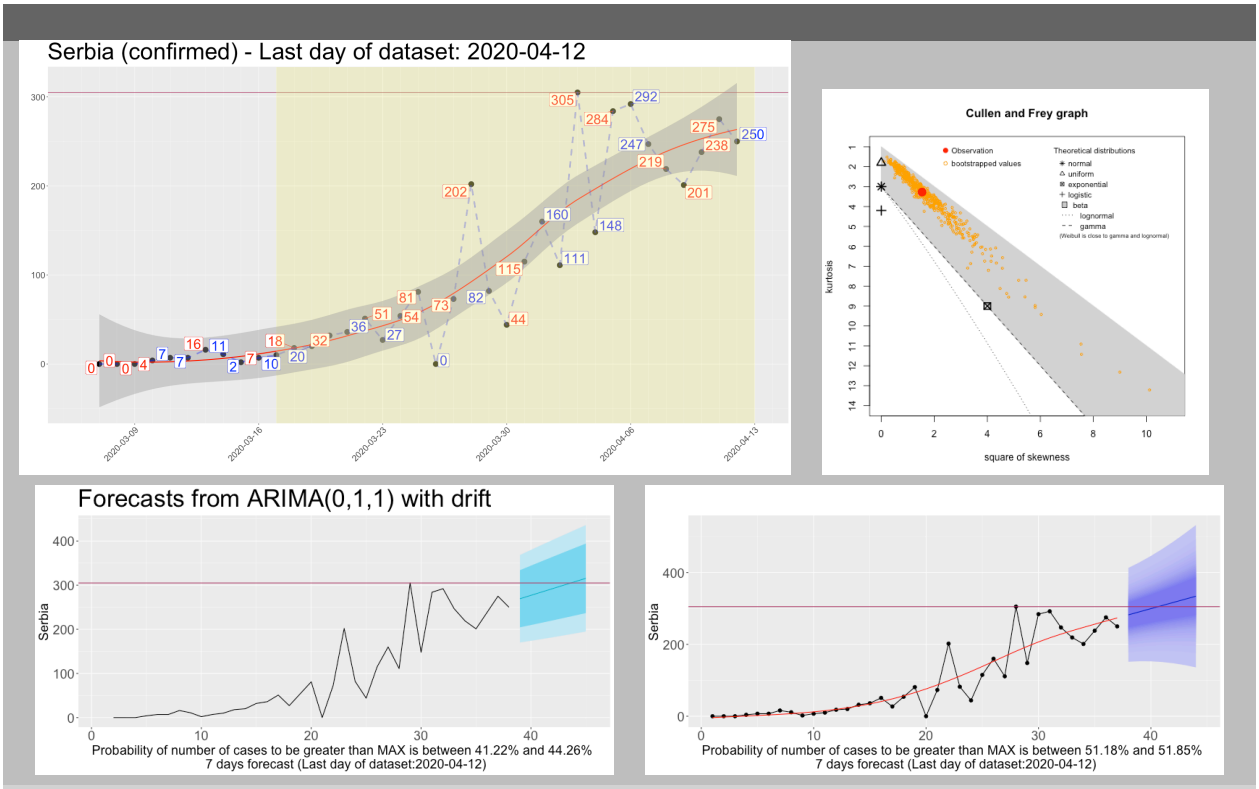
Estimation for future maximum after 3 - 8 days (04-14 - 04-19)
Estimation of number of cases: ARIMA [13703, 20264]

7.33 Russia



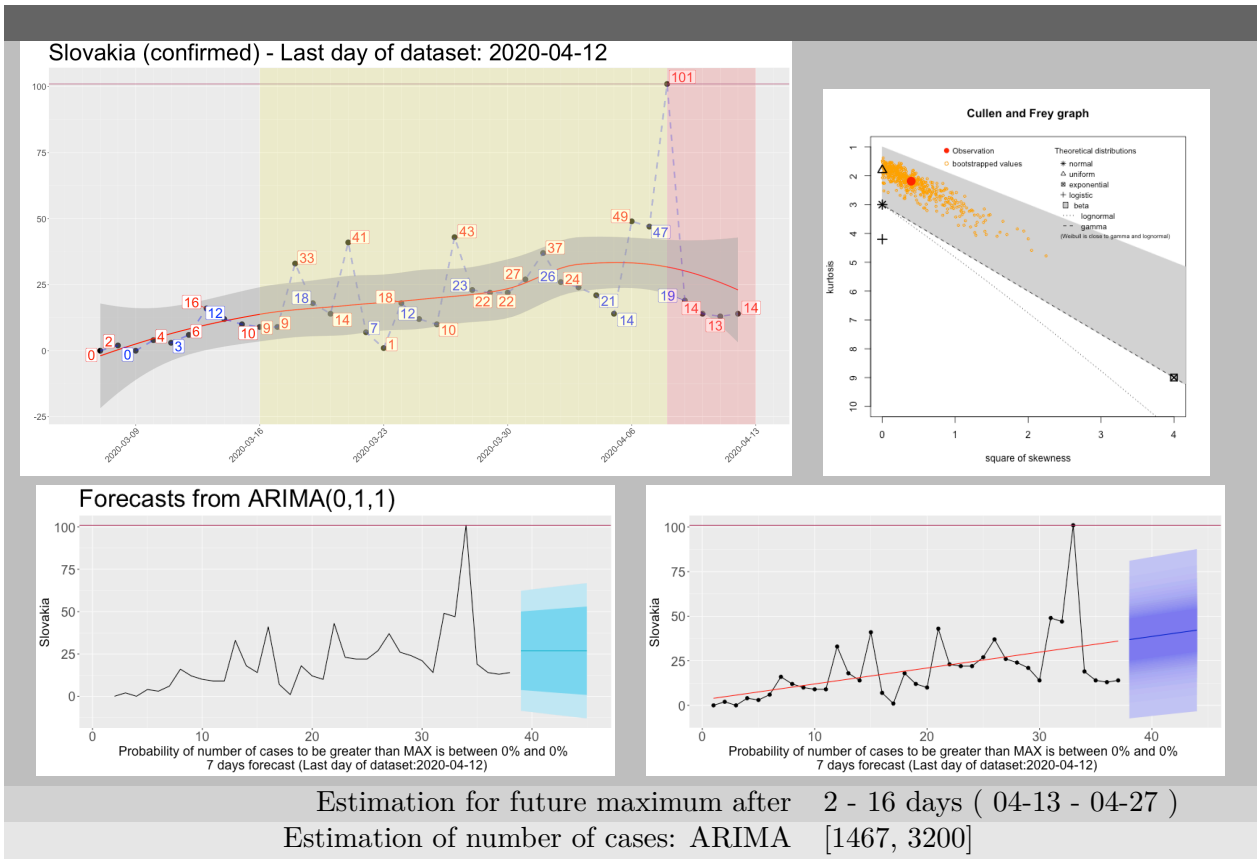
Estimation for future maximum after 4 - 10 days (04-15 - 04-21)
Estimation of number of cases: ARIMA [41484, 81380]

7.34 Serbia



Estimation for future maximum after 2 - 7 days (04-13 - 04-18)
Estimation of number of cases: ARIMA [7382, 11665]

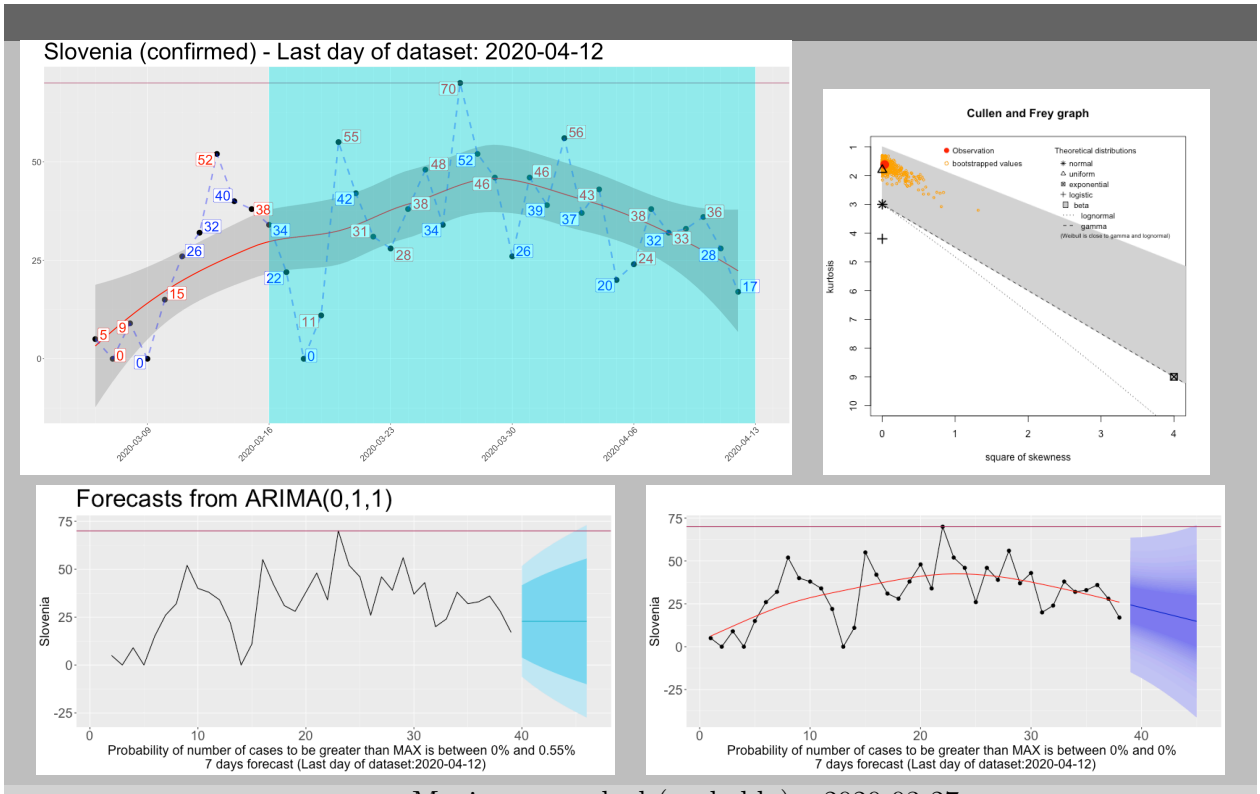
7.35 Slovakia



Estimation for future maximum after	2 - 16 days (04-13 - 04-27)
Estimation of number of cases: ARIMA	[1467, 3200]

In Slovakia, the large number of cases announced on April 8 affects the forecast and makes it unstable.

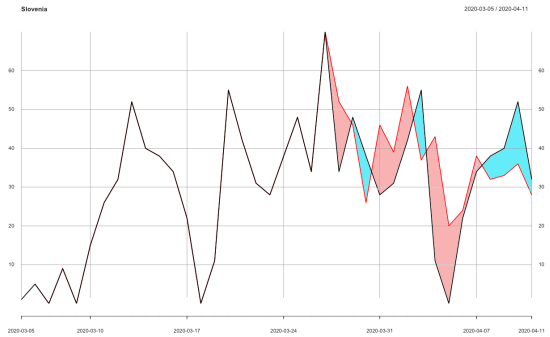
7.36 Slovenia

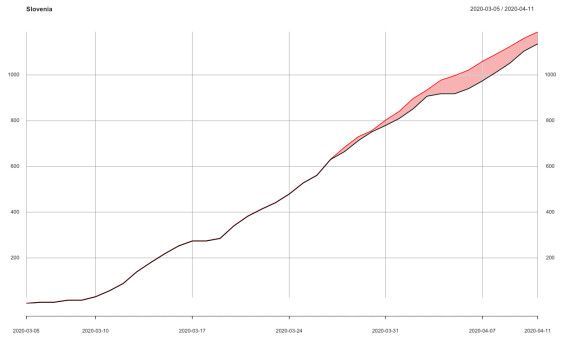


Maximum reached (probably)	2020-03-27
Estimation of number of cases: ARIMA	[1188, 1820]

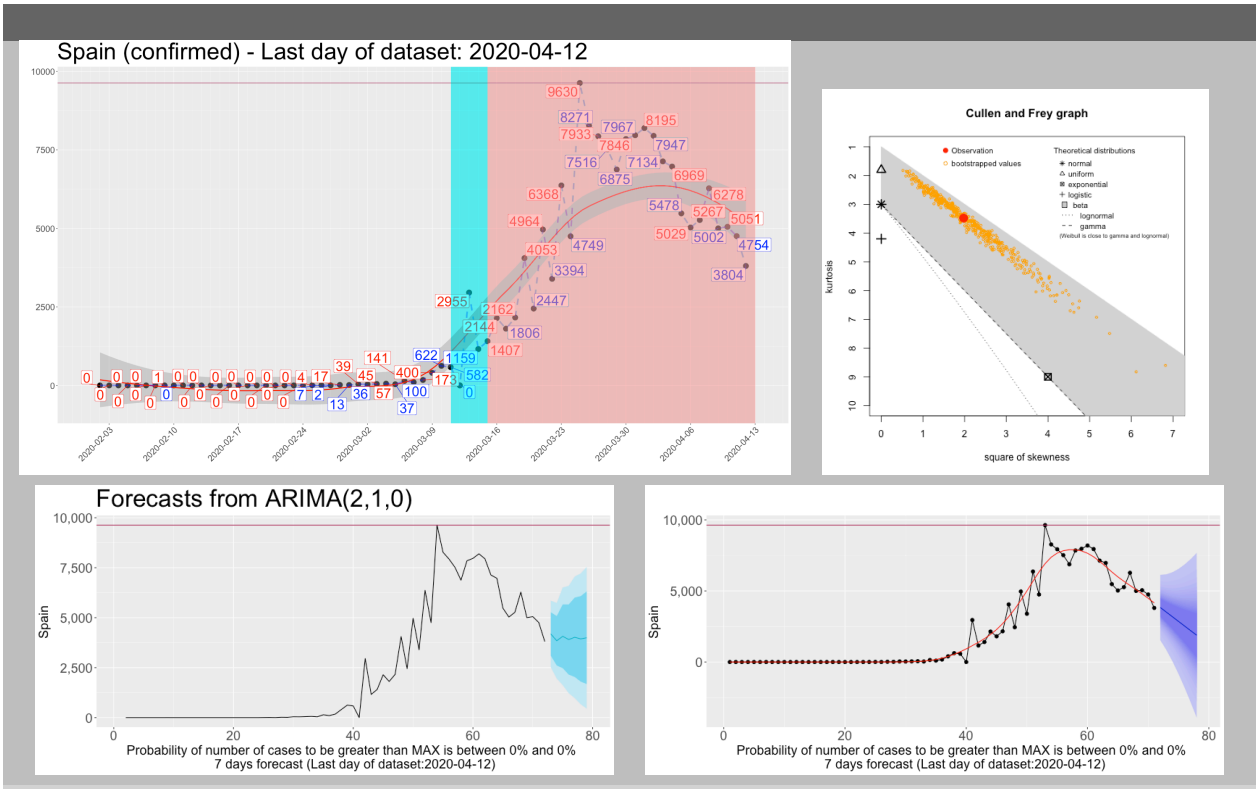
It is observed that de-escalation is not symmetric to the escalation rate; the cases during the

de-escalation period are relatively more.





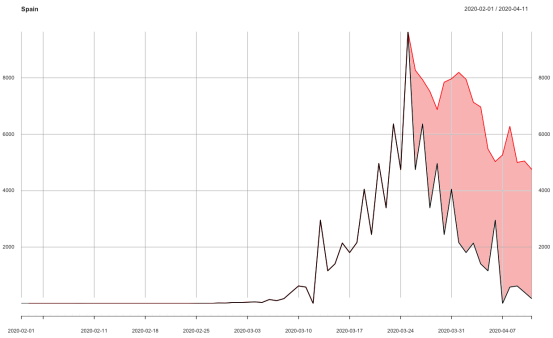
7.37 Spain

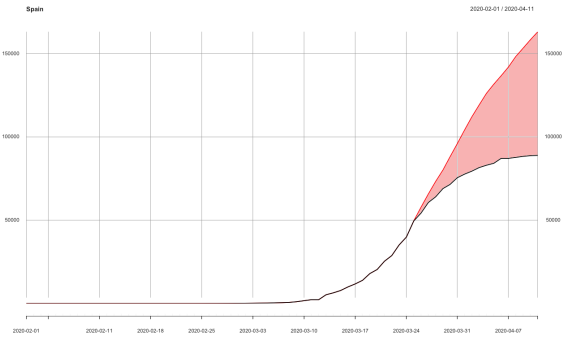


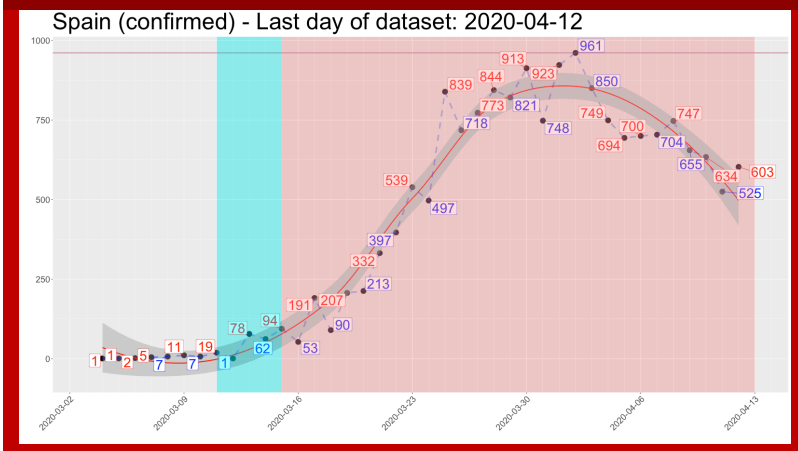
Maximum reached	2020 - 03 - 25
Estimation of number of cases: ARIMA	[163 027, 212 542]

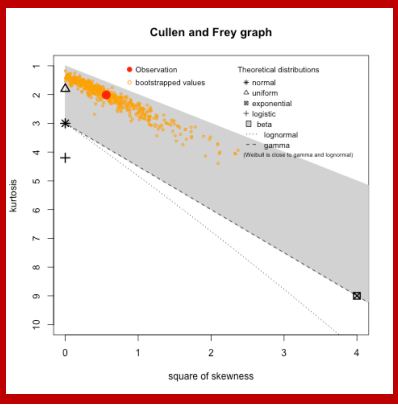
In Spain is observed that for a 5-day period the COVID-19 confirmed cases were reducing, while during the three later days the trend seems to form a u-curve. In many areas that the curve trend changed that change occurred 5-6 days days after the restriction measures, that is equal to the COVID-19 mean incubation period.

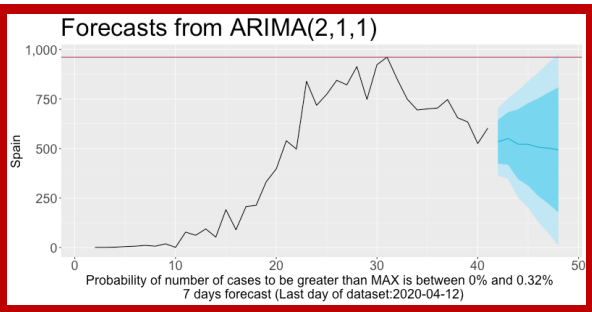
It is observed that de-escalation rate is not symmetric to the escalation one; the cases during the de-escalation period are much more.

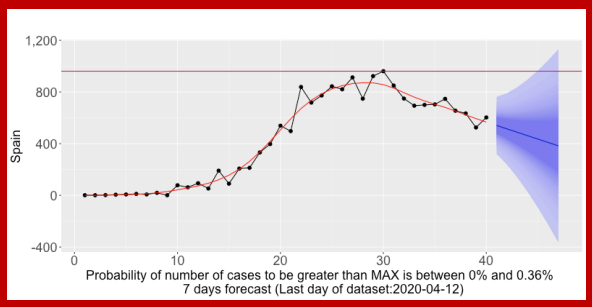








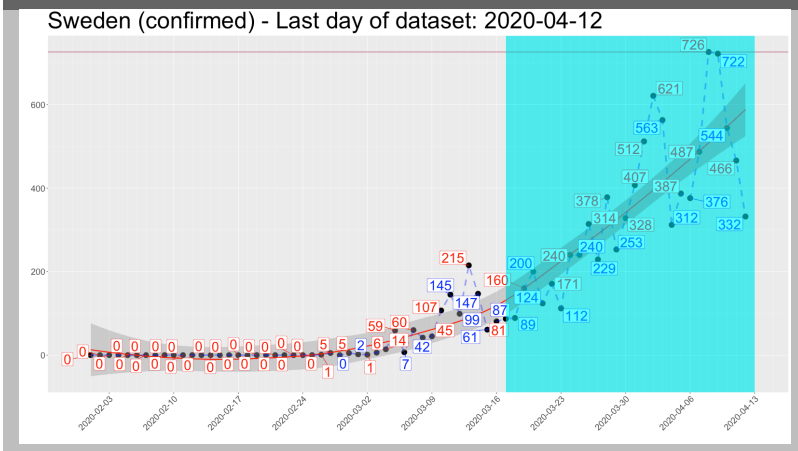


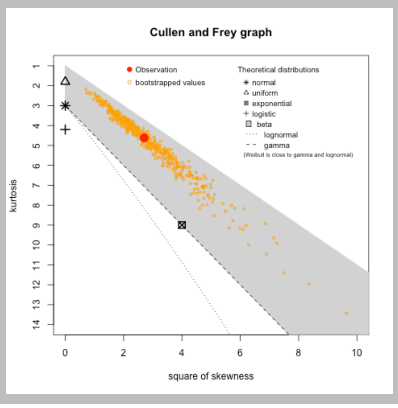


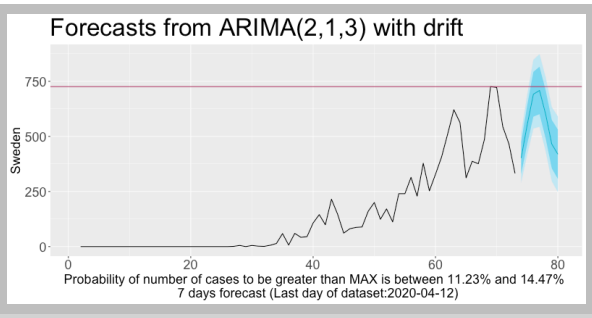
Maximum reached 2020-04-02

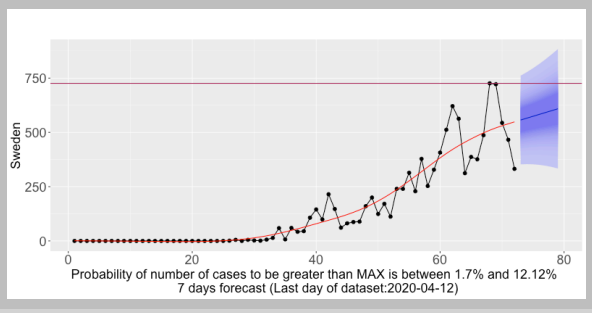
Estimation of number of cases: ARIMA [16 606, 26 954]

7.38 Sweden



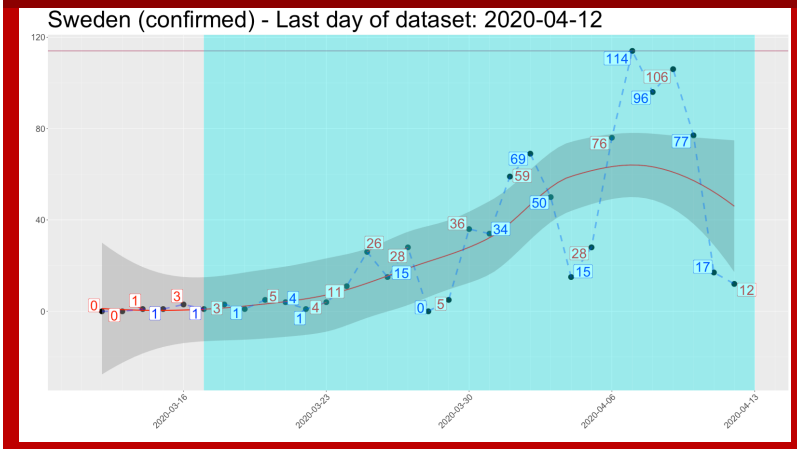


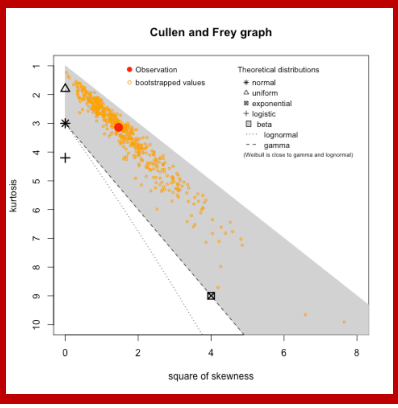


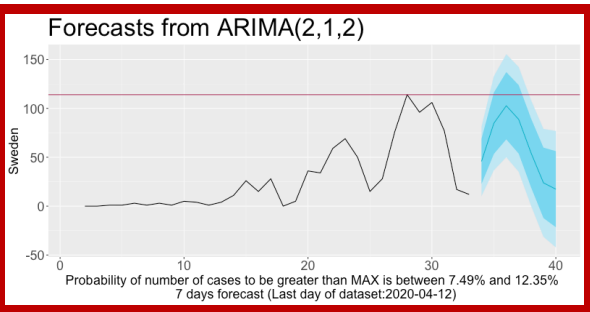


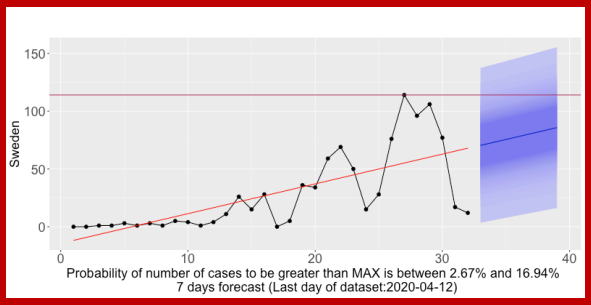
Estimation for future maximum after 4 - 8 days (04-15 - 04-19)

Estimation of number of cases: ARIMA [23081, 30000]



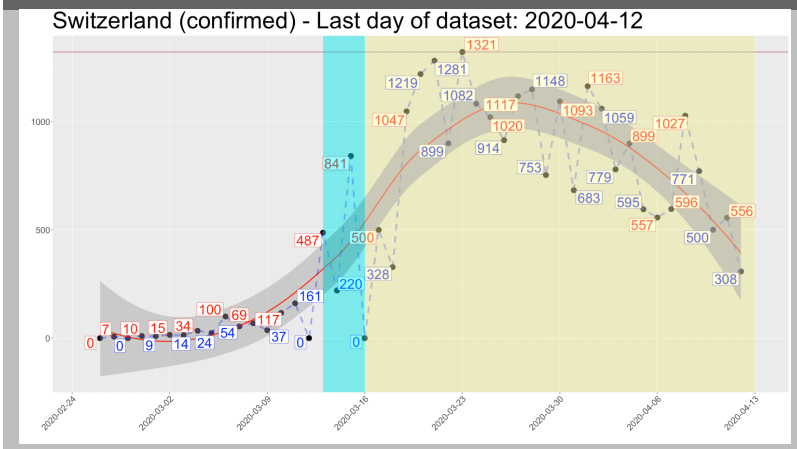


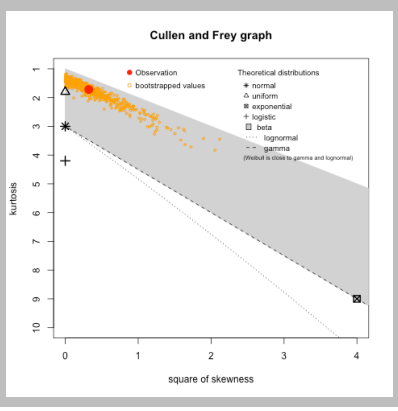


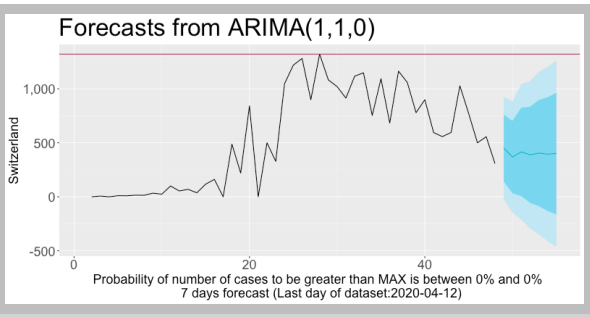


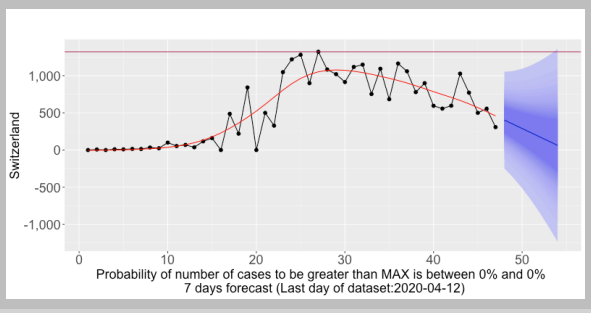
Estimation for future maximum after 9 - 18 days (04-20 - 04-29)
Estimation of number of cases: ARIMA [1774, 6729]

7.39 Switzerland

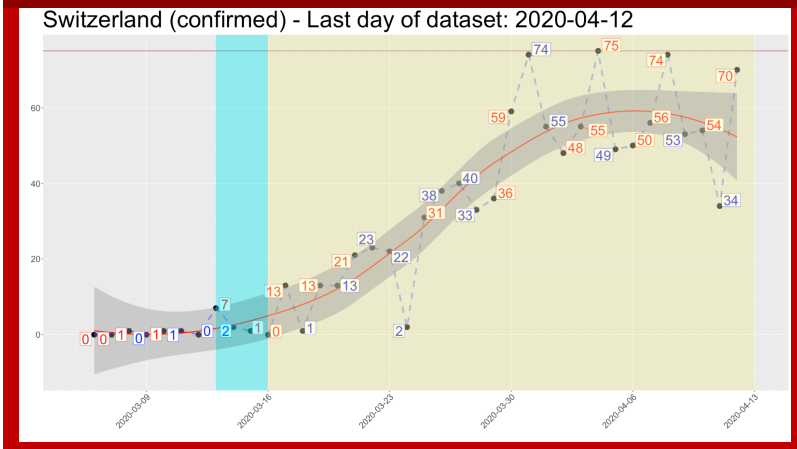


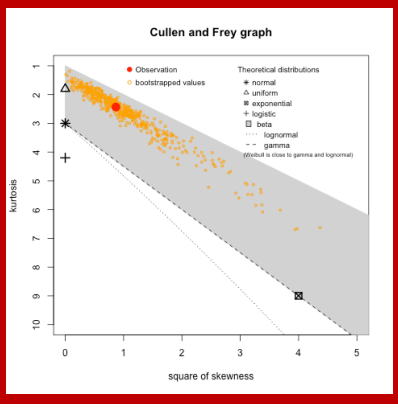


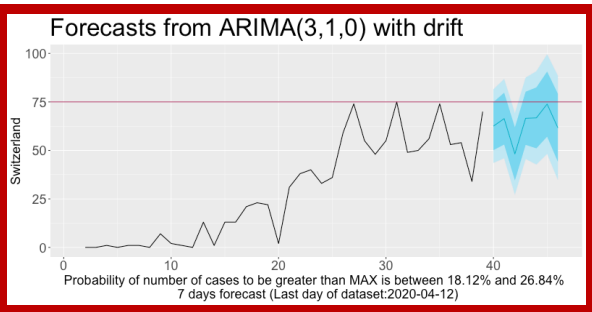


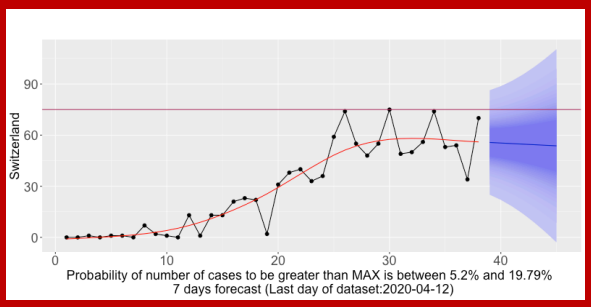


Maximum reached 2020-03-23
Estimation of number of cases: ARIMA [25107, 33902]



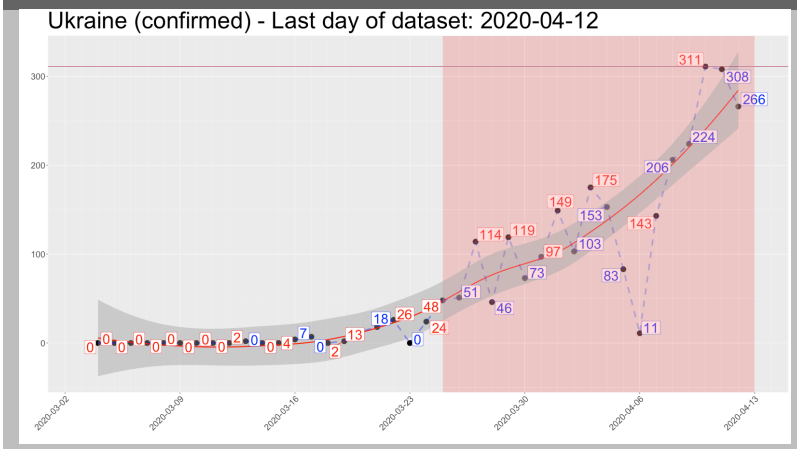


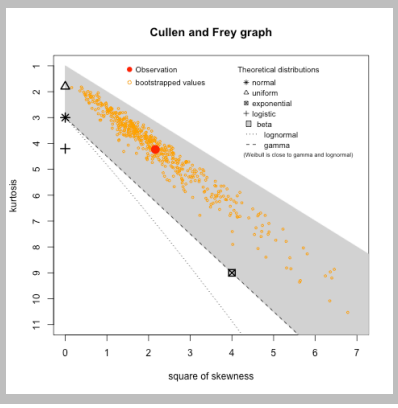


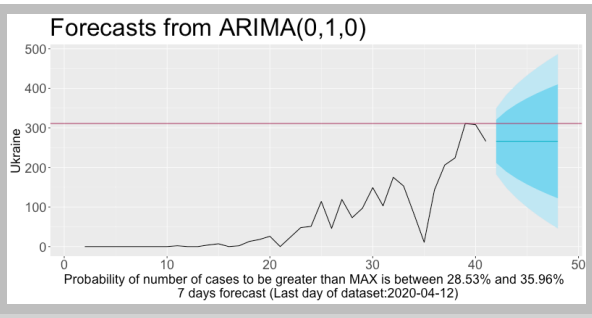


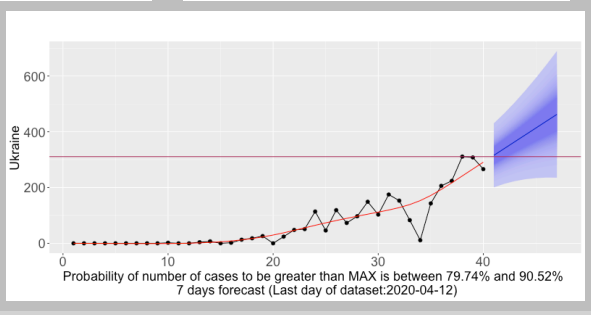
Maximum reached (probably 2020-04-04
Estimation of number of cases: ARIMA [1036, 1702]

7.40 Ukraine



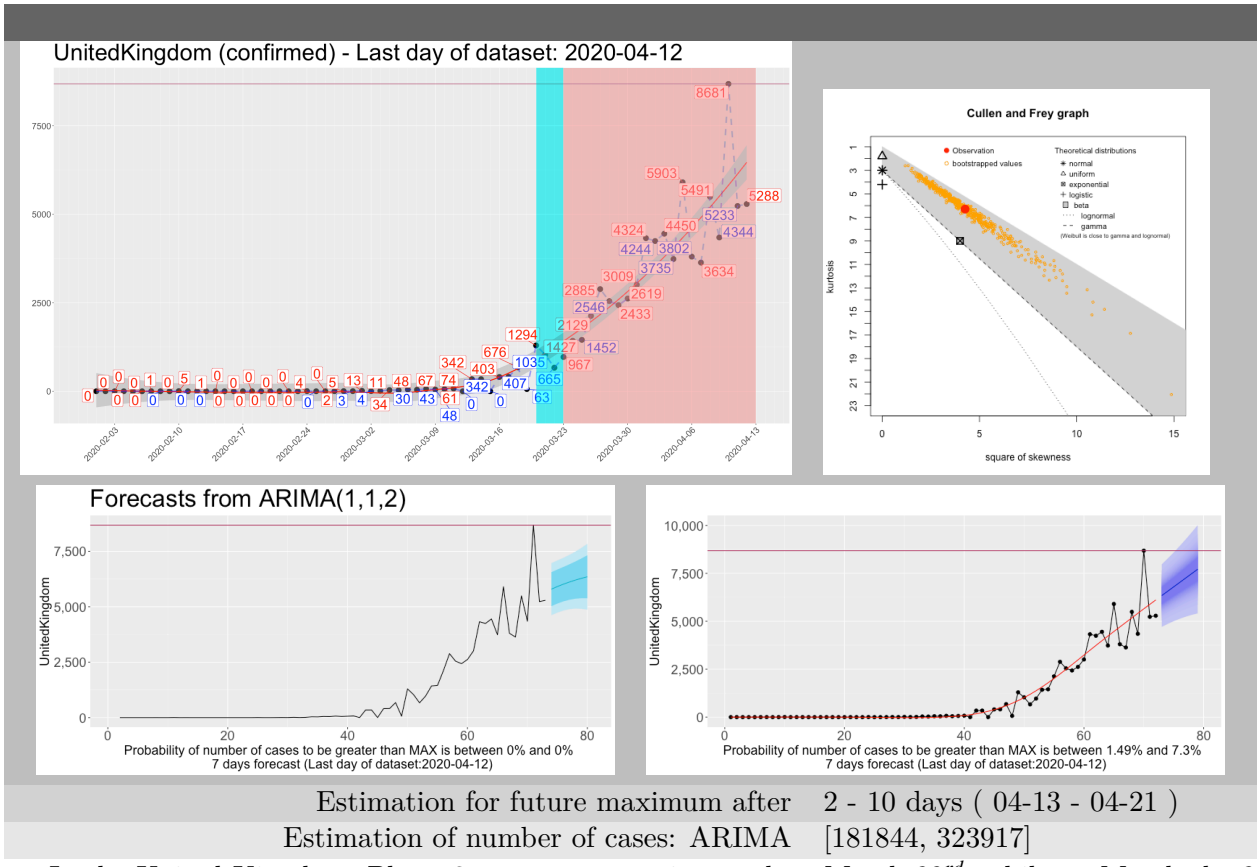






Estimation for future maximum after 4 - 9 days (04-15 - 04-20)
Estimation of number of cases: ARIMA [6574, 13378]

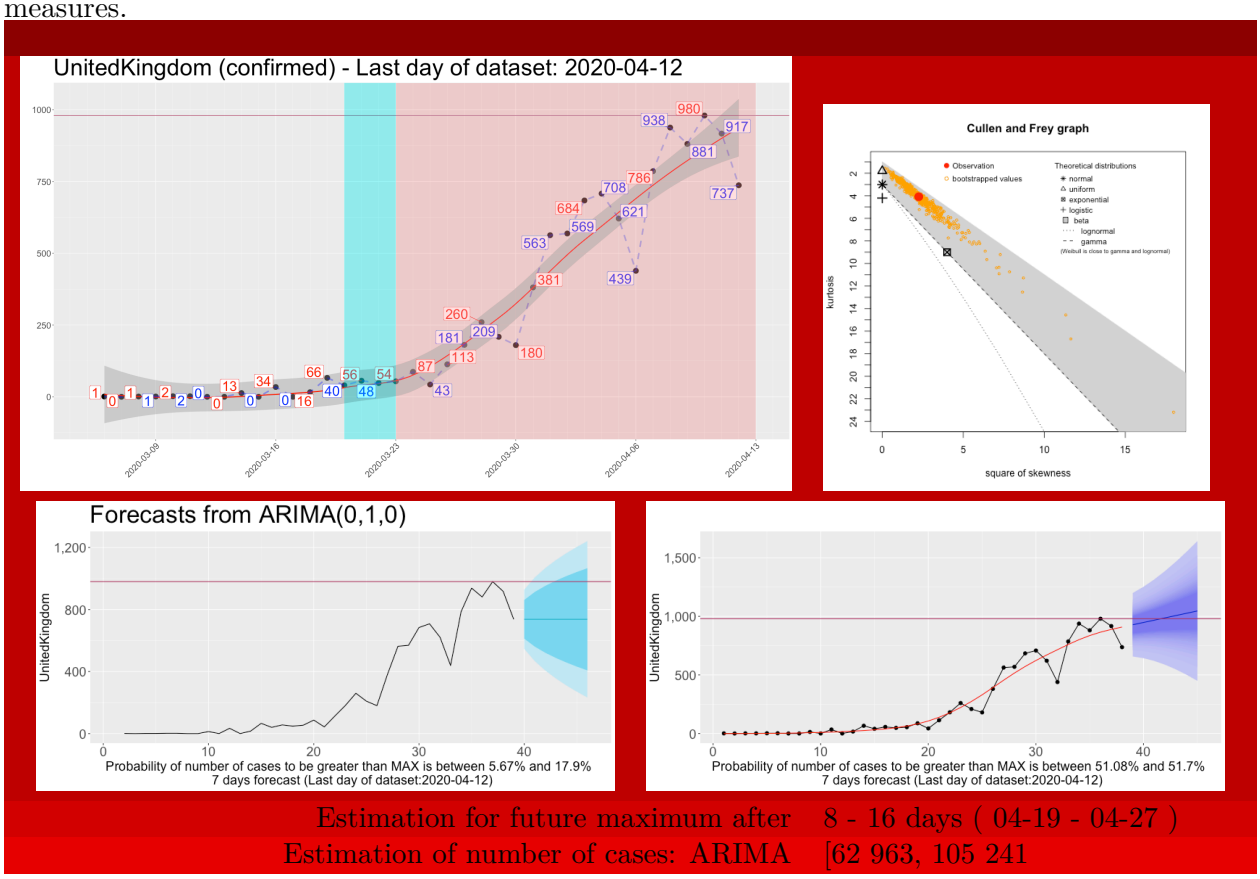
7.41 United Kingdom



Estimation for future maximum after 2 - 10 days (04-13 - 04-21)

Estimation of number of cases: ARIMA [181844, 323917]

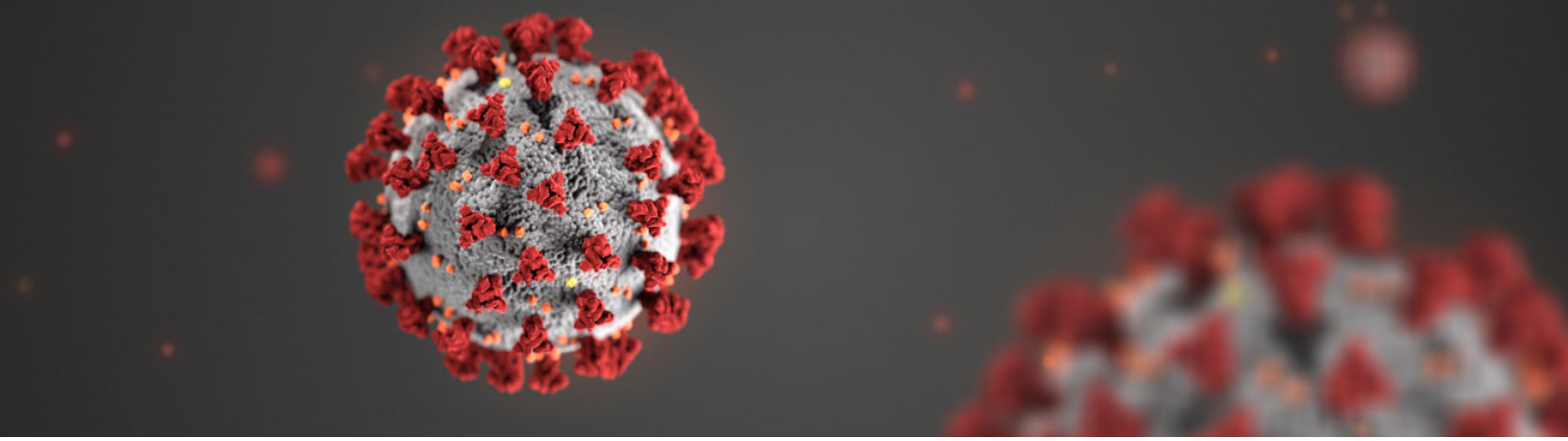
In the United Kingdom, Phase 3 measures were imposed on March 23rd, while on March the 29th the first sign of decline on the number of COVID-19 confirmed cases appeared, as a result of these measures.



Estimation for future maximum after 8 - 16 days (04-19 - 04-27)

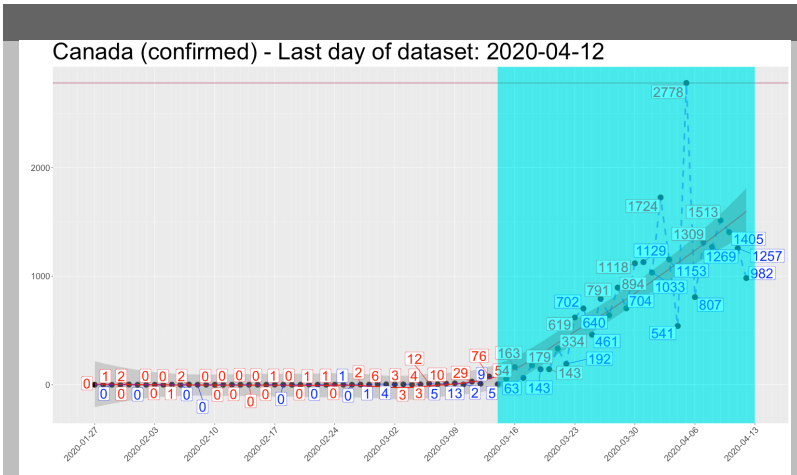
Estimation of number of cases: ARIMA [62 963, 105 241

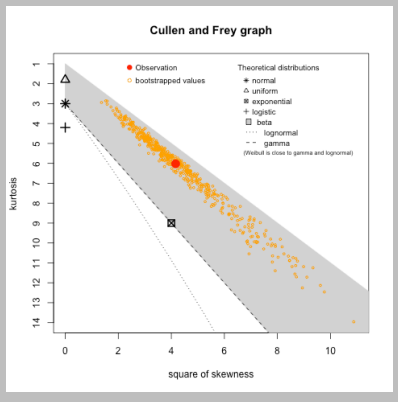
VI North America

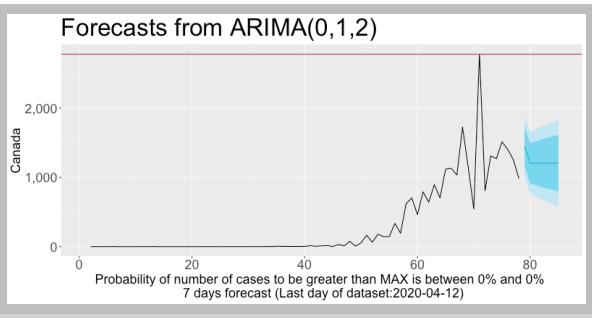


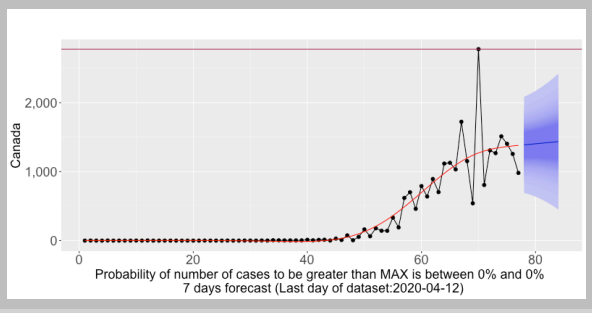
8. North America

8.1 Canada

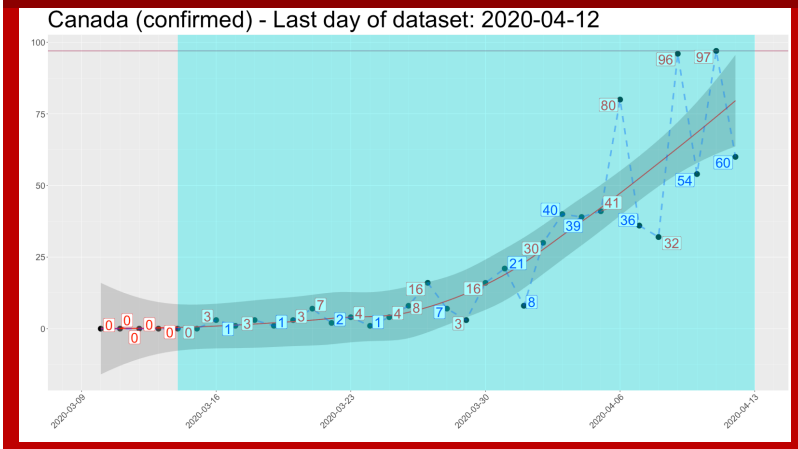


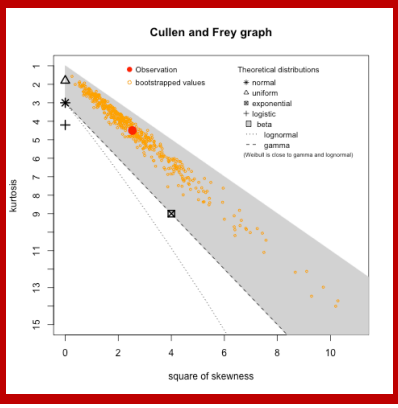


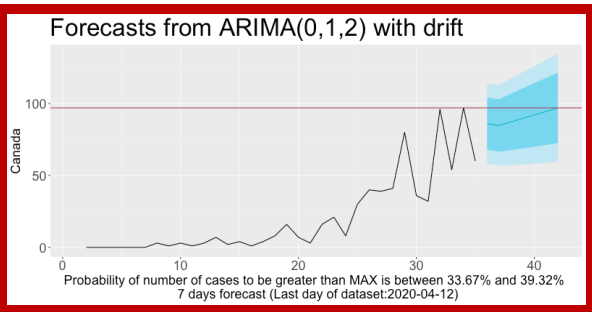


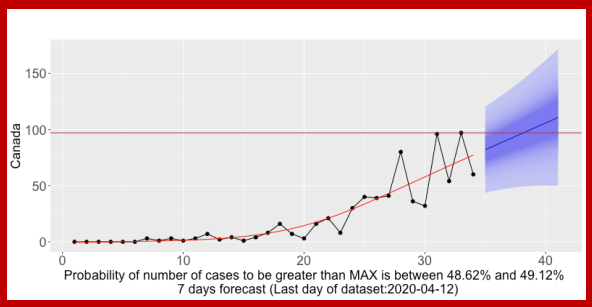


Estimation for future maximum after	7 – 12 days
Estimation of number of cases: ARIMA	[42974, 73723]



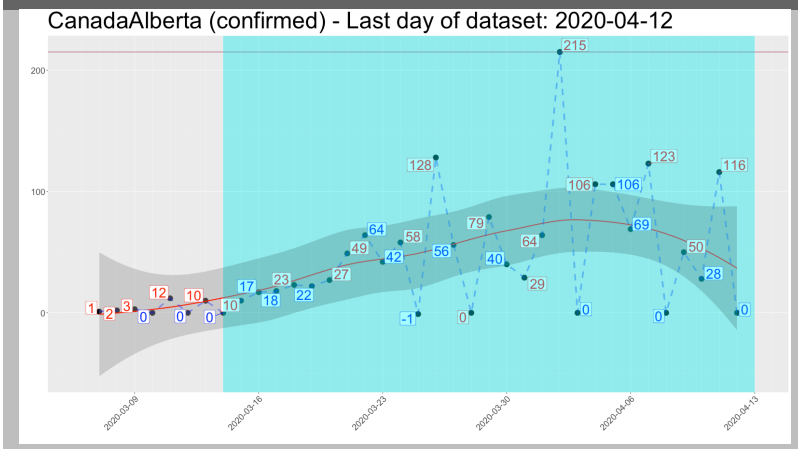


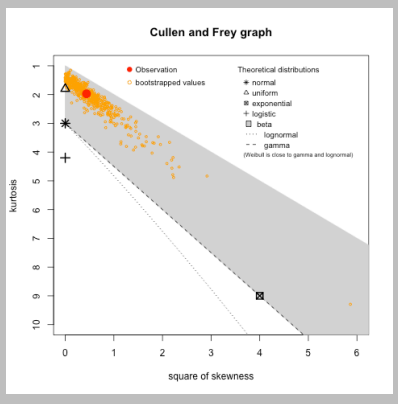


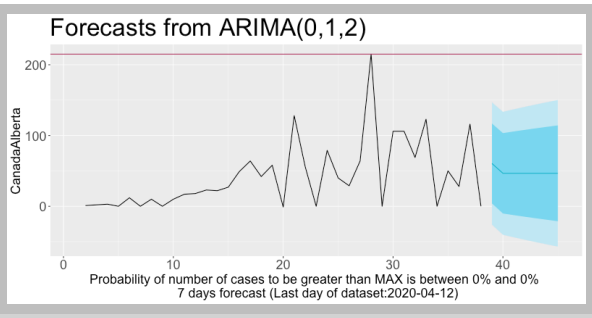


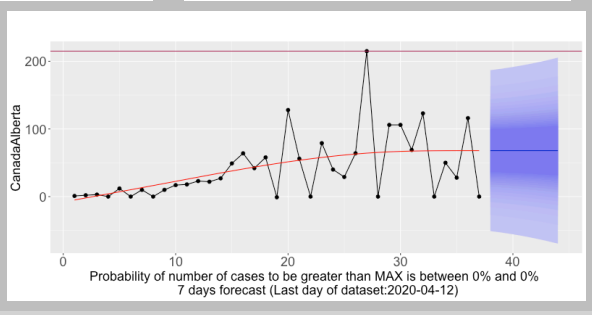
Estimation for future maximum after 19 - 28 days (04-30 - 05-09)
Estimation of number of cases: ARIMA [2998, 11047]

8.1.1 Canada Alberta



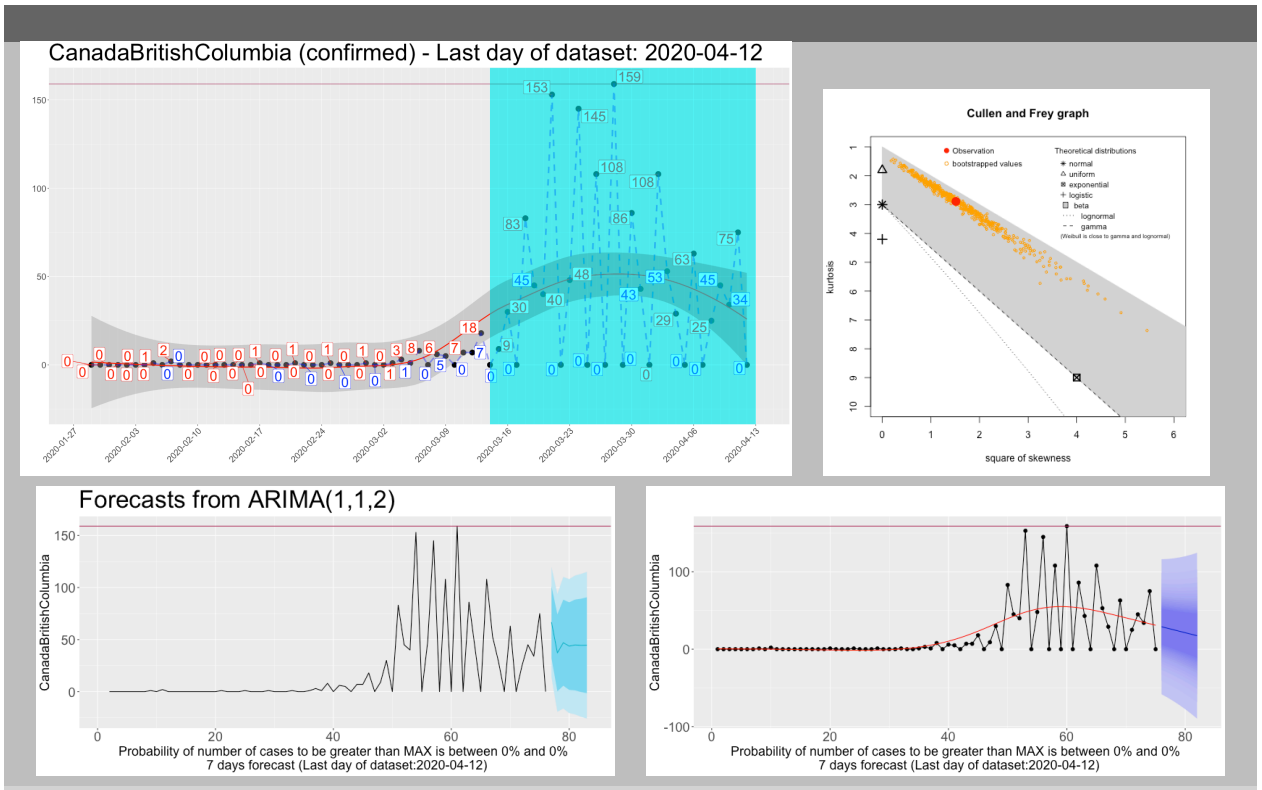






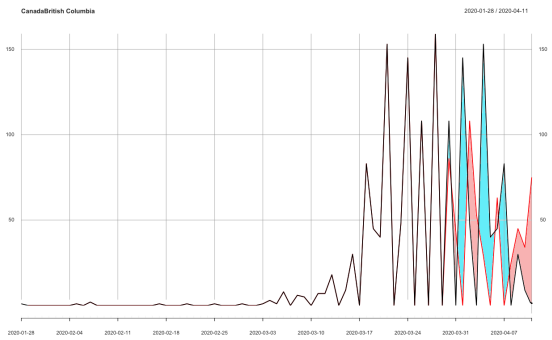
Estimation for future maximum after 3 - 10 days (04-14 - 04-21)
Estimation of number of cases: ARIMA [3164, 5361]

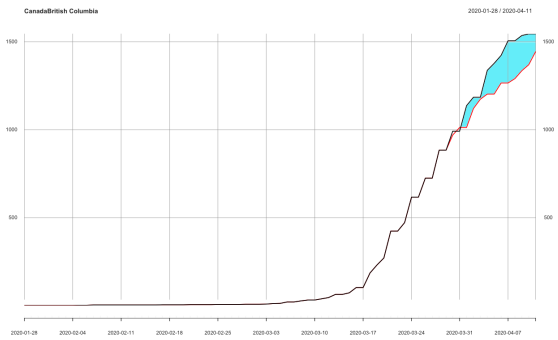
8.1.2 Canada British Columbia



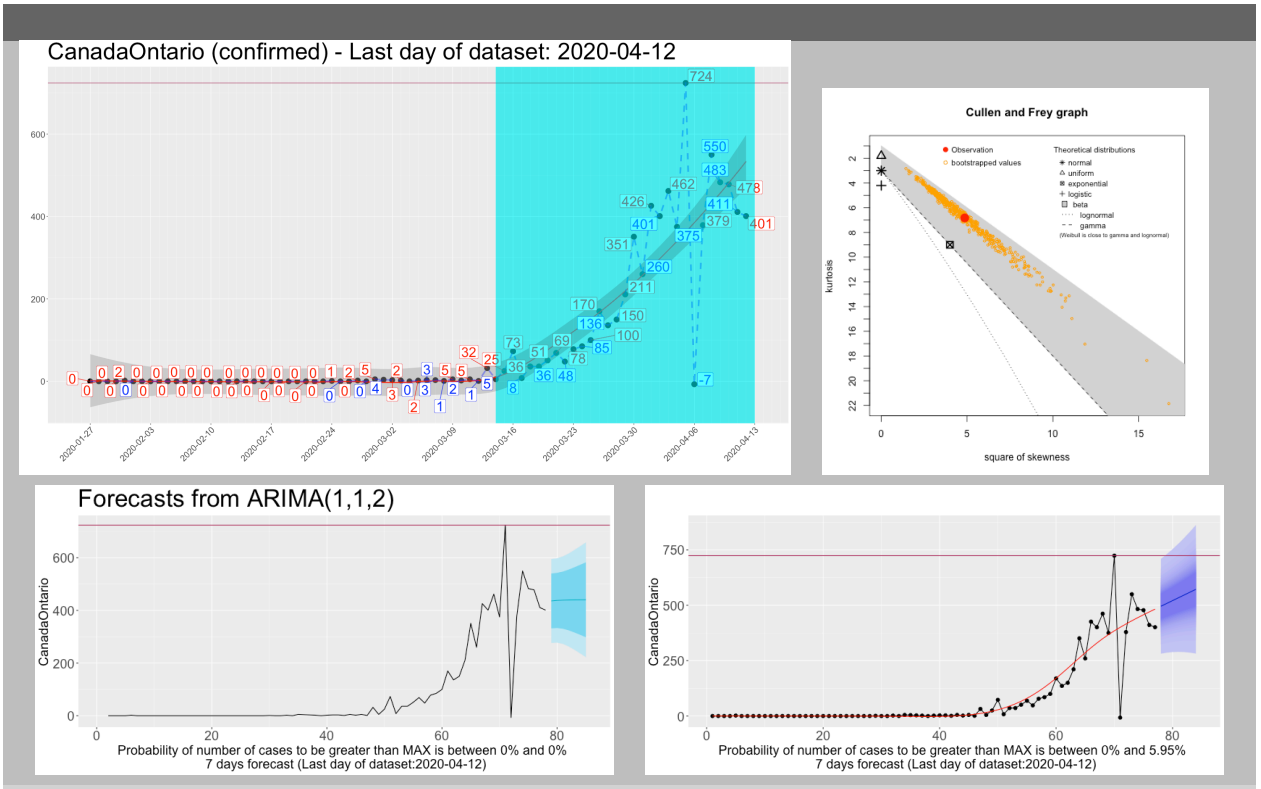
Maximum reached	2020-03-28
Estimation of number of cases: ARIMA	[1445, 2329]

It is observed that de-escalation is not symmetric to the escalation rate, while the cases during the de-escalation period are less.



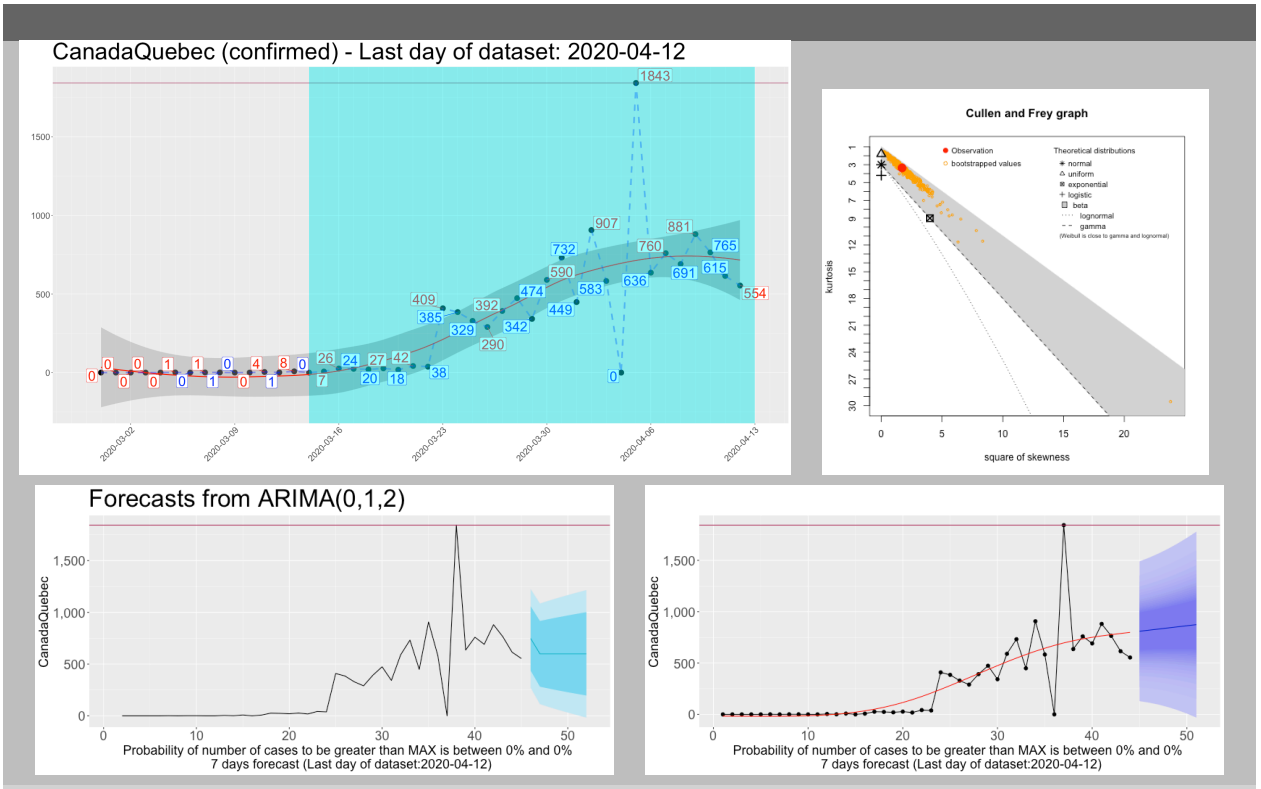


8.1.3 Canada Ontario



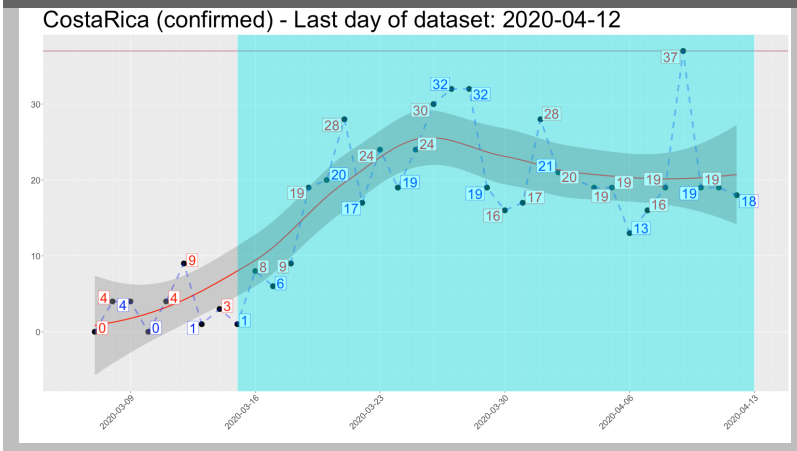
Estimation for future maximum after	3 - 7 days (04-14 - 04-18)
Estimation of number of cases: ARIMA	[15470, 21636]

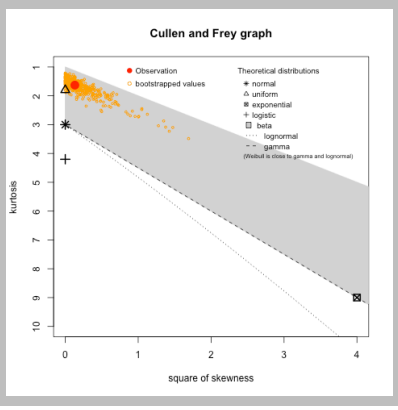
8.1.4 Canada Quebec

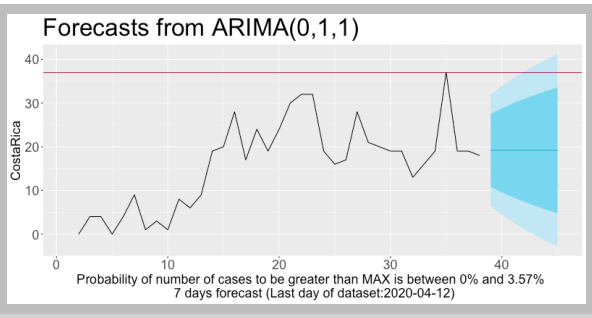


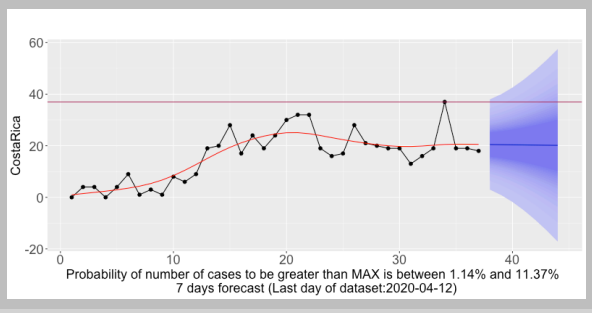
Estimation for future maximum after	5 - 8 days (04-16 - 04-19)
Estimation of number of cases: ARIMA	[29195, 40880]

8.2 Costa Rica



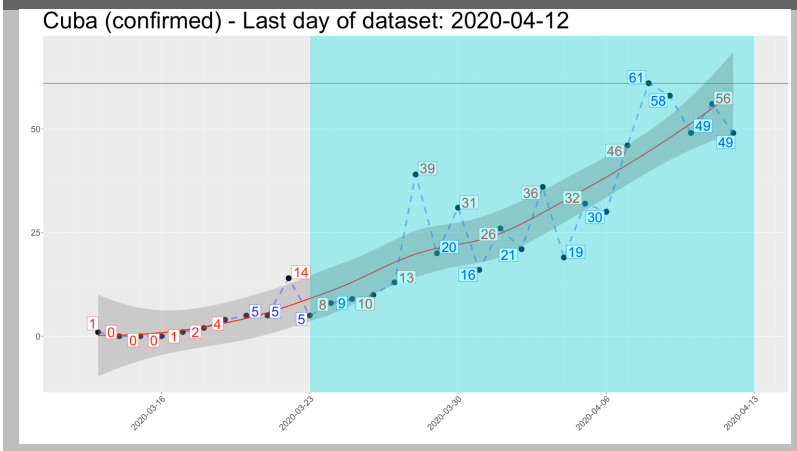


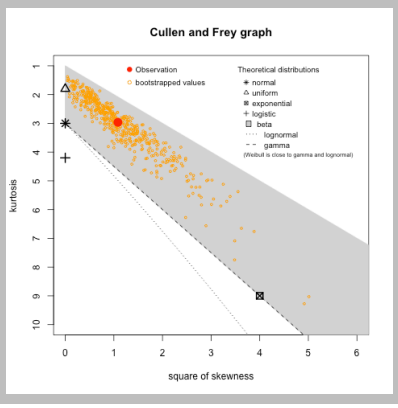


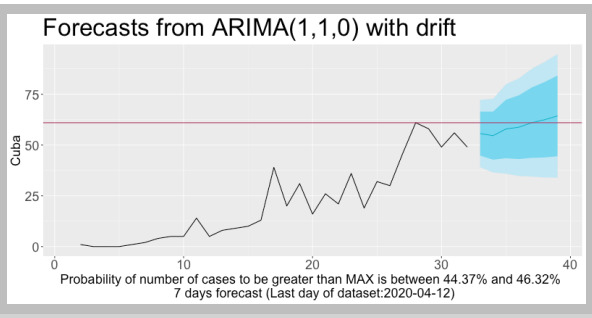


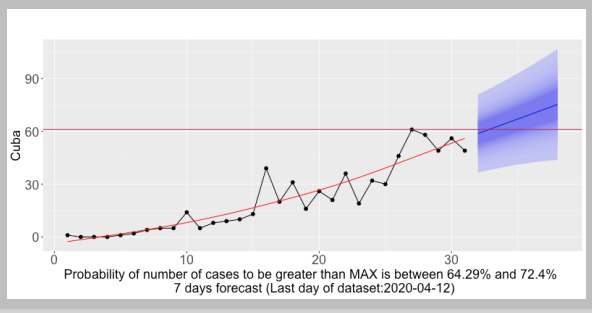
Estimation for future maximum after	2 - 9 days (04-13 - 04-20)
Estimation of number of cases: ARIMA	[1189, 1805]

8.3 Cuba



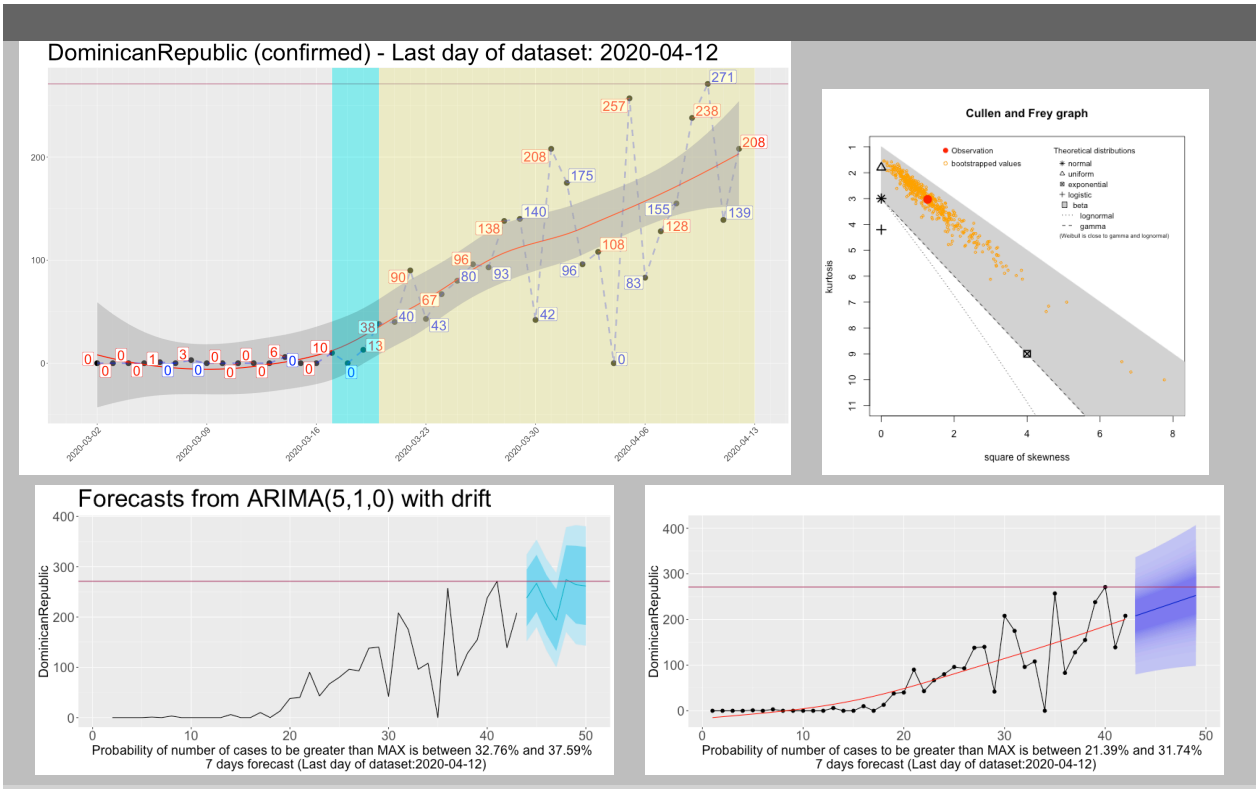






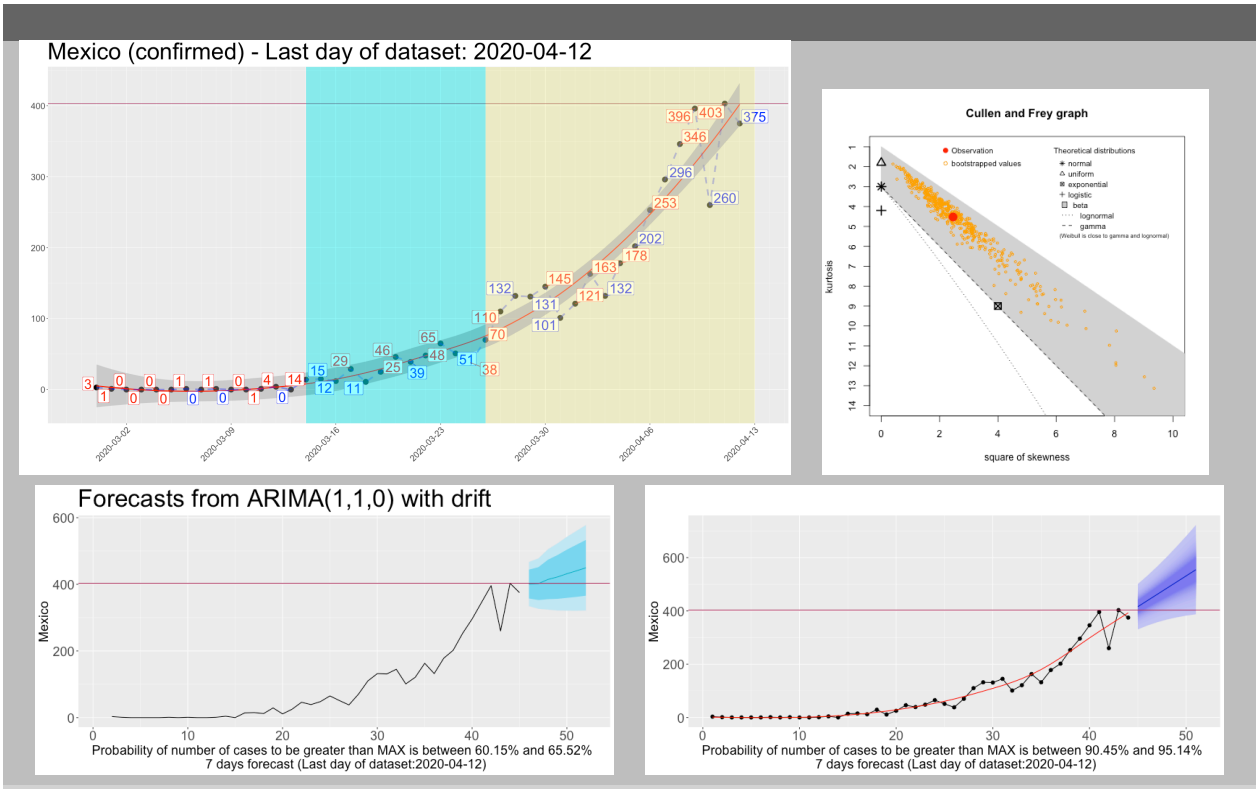
Estimation for future maximum after	7 - 13 days (04-18 - 04-24)
Estimation of number of cases: ARIMA	[1644, 3491]

8.4 Dominican Republic



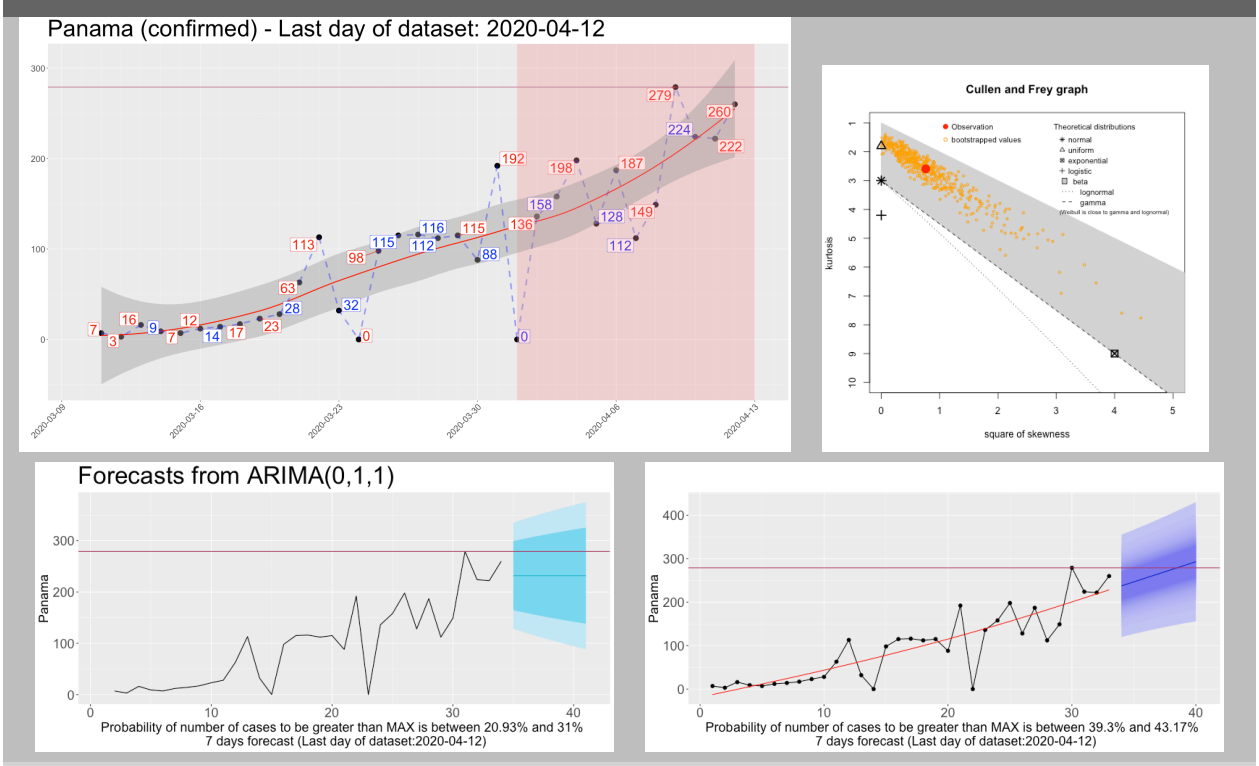
Estimation for future maximum after	2 - 8 days (04-13 - 04-19)
Estimation of number of cases: ARIMA	[6221, 10937]

8.5 Mexico



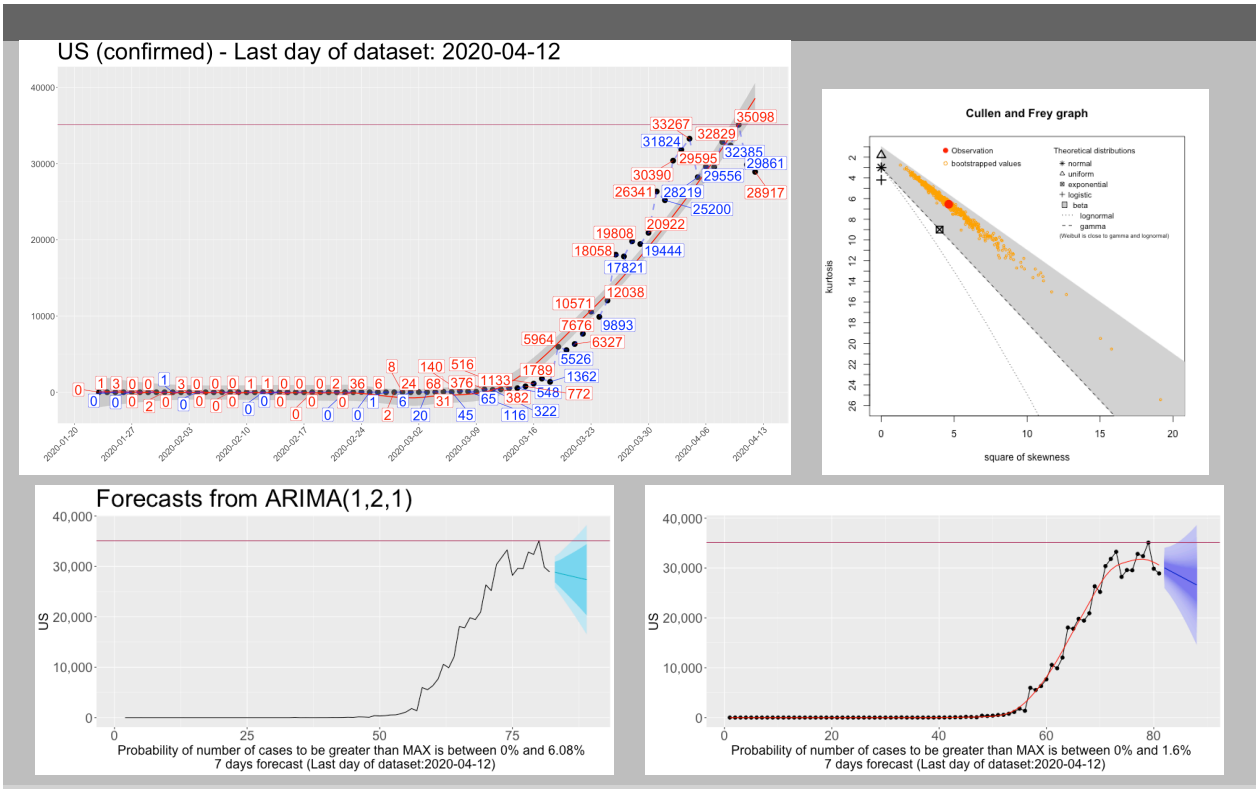
Estimation for future maximum after	5 - 9 days (04-16 - 04-20)
Estimation of number of cases: ARIMA	[9955, 15530]

8.6 Panama

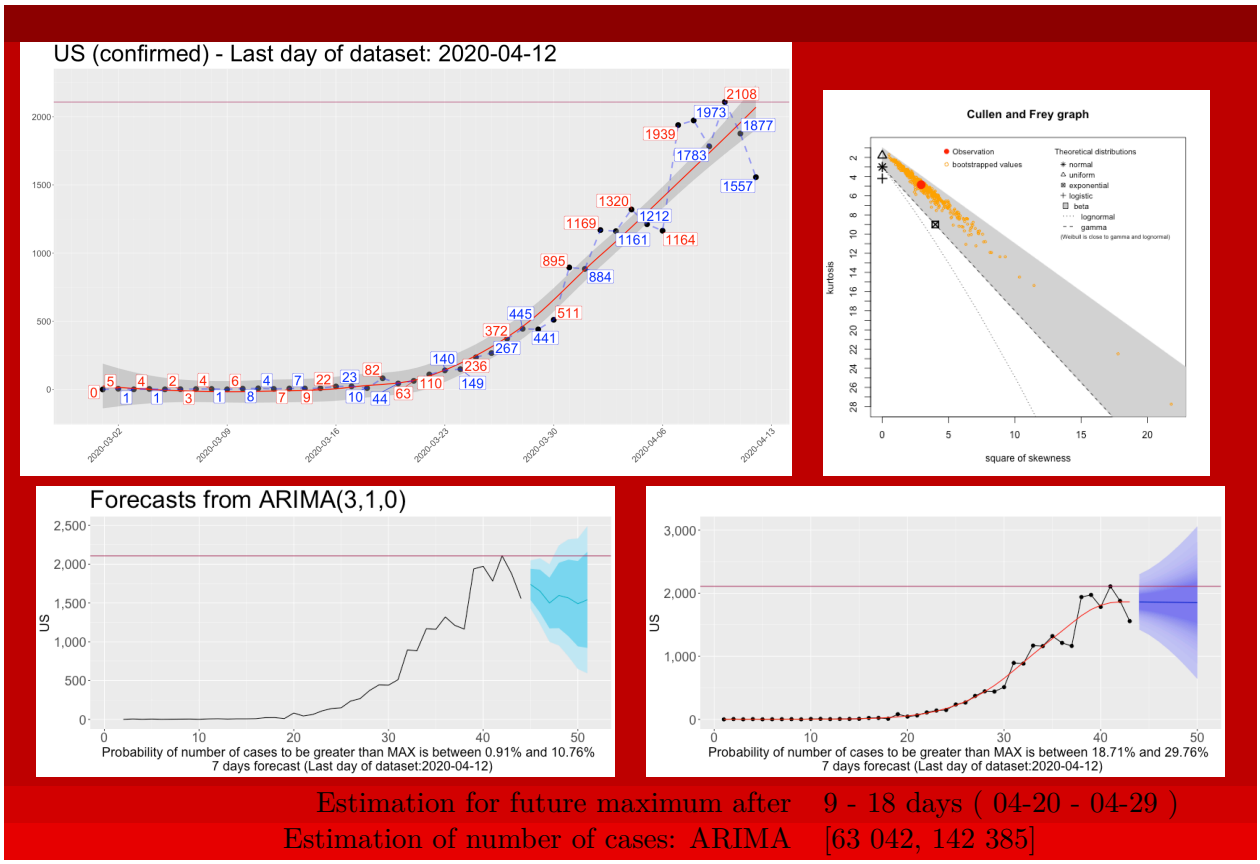


Estimation for future maximum after	5 - 9 days (04-16 - 04-20)
Estimation of number of cases: ARIMA	[7221, 11426]

8.7 US

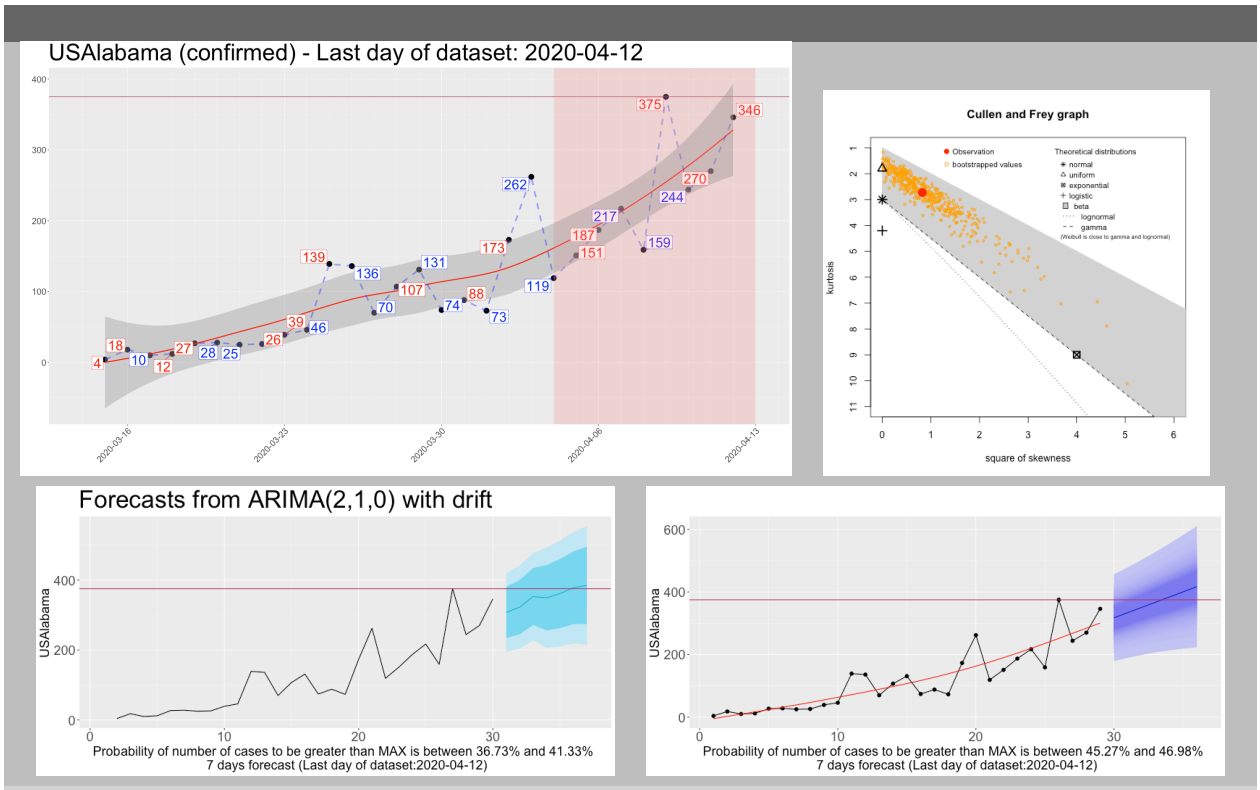


Estimation for future maximum after	1 - 7 days (04-12 - 04-18)
Estimation of number of cases: ARIMA	[1 111 426, 1 574 852]



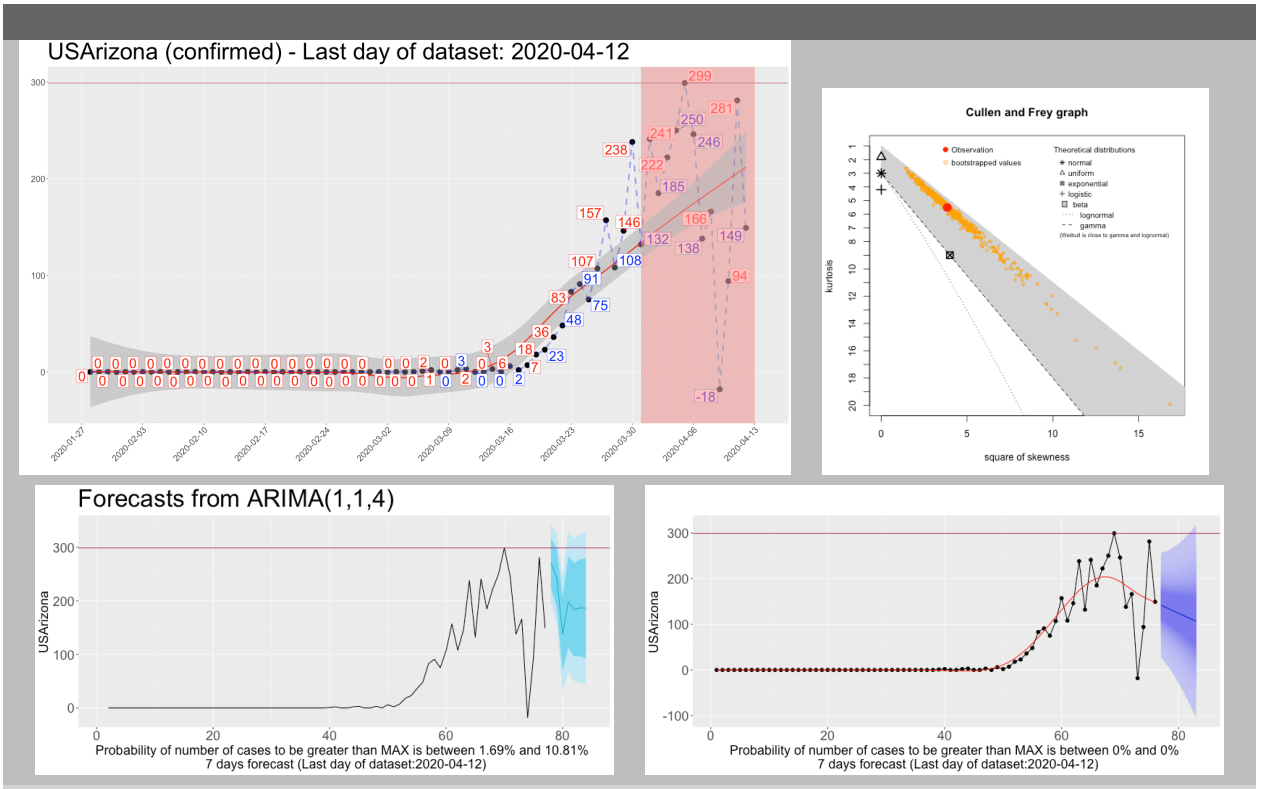
Estimation for future maximum after 9 - 18 days (04-20 - 04-29)
Estimation of number of cases: ARIMA [63 042, 142 385]

8.7.1 US Alabama



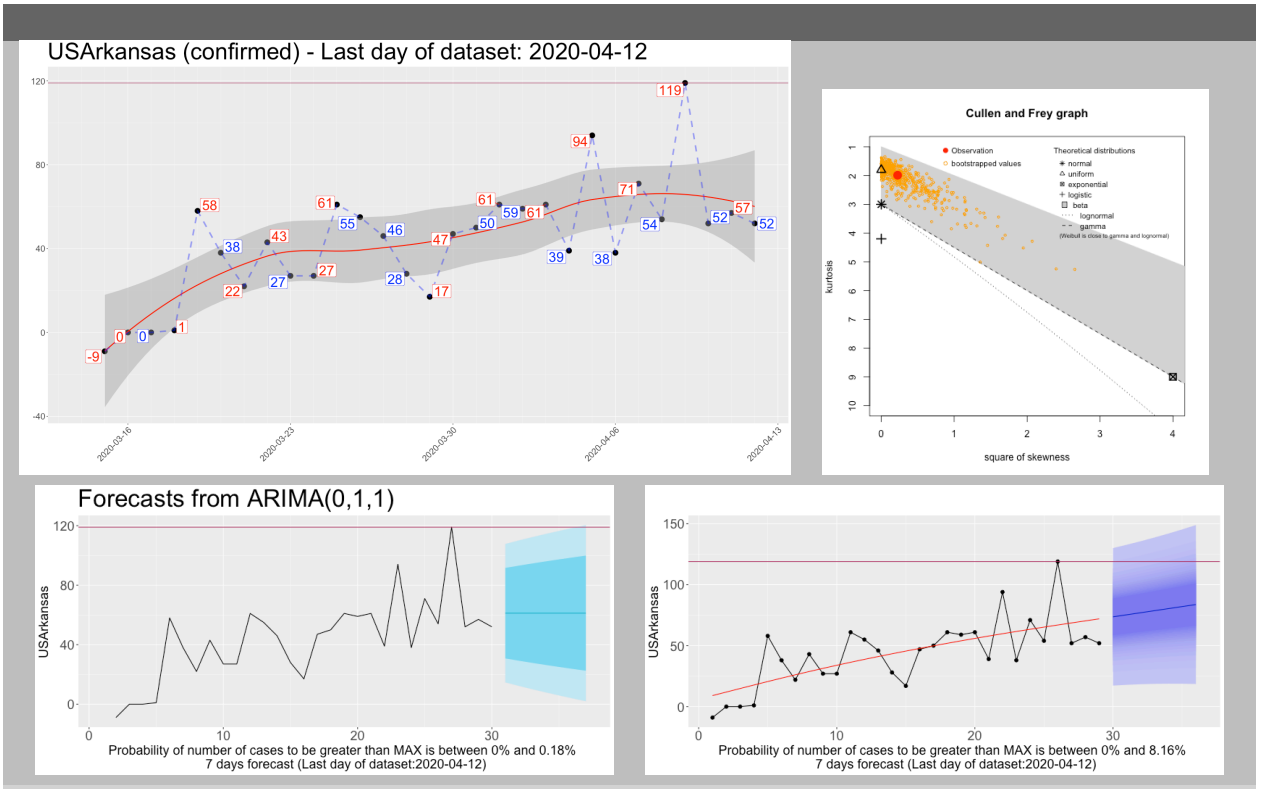
Estimation for future maximum after 6 - 12 days (04-18 - 04-24)
Estimation of number of cases: ARIMA [9381, 17769]

8.7.2 US Arizona



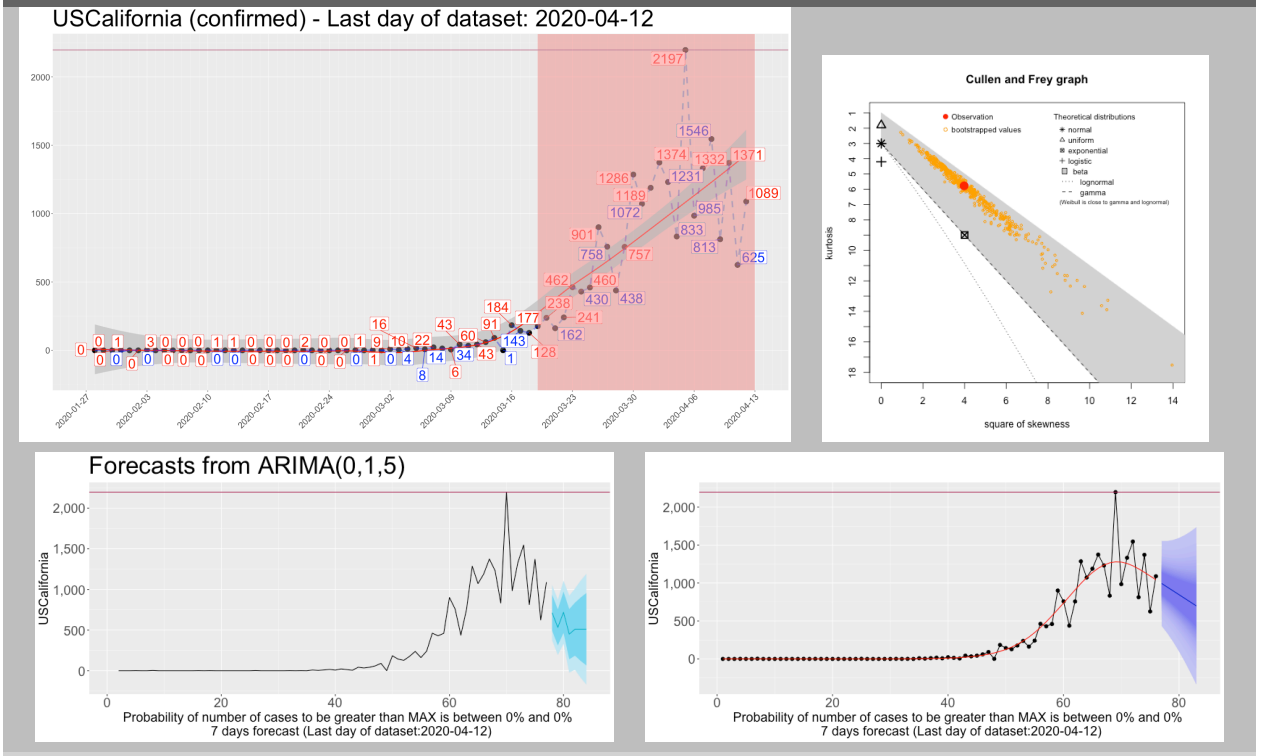
Estimation for future maximum after	3 - 9 days (04-15 - 04-21)
Estimation of number of cases: ARIMA	[7937, 12374]

8.7.3 US Arkansas



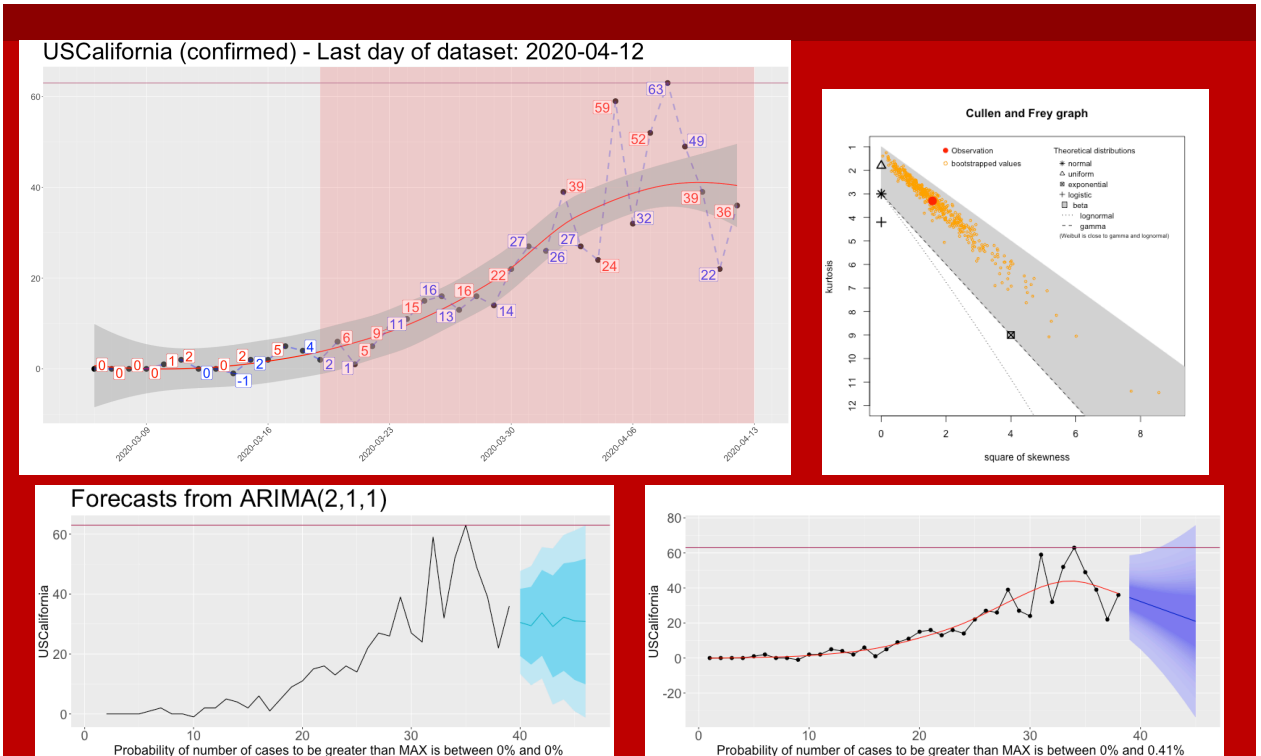
Estimation for future maximum after	4 - 6 days (04-16 - 04-18)
Estimation of number of cases: ARIMA	[2766, 3724]

8.7.4 US California



Maximum reached 2020-04-05

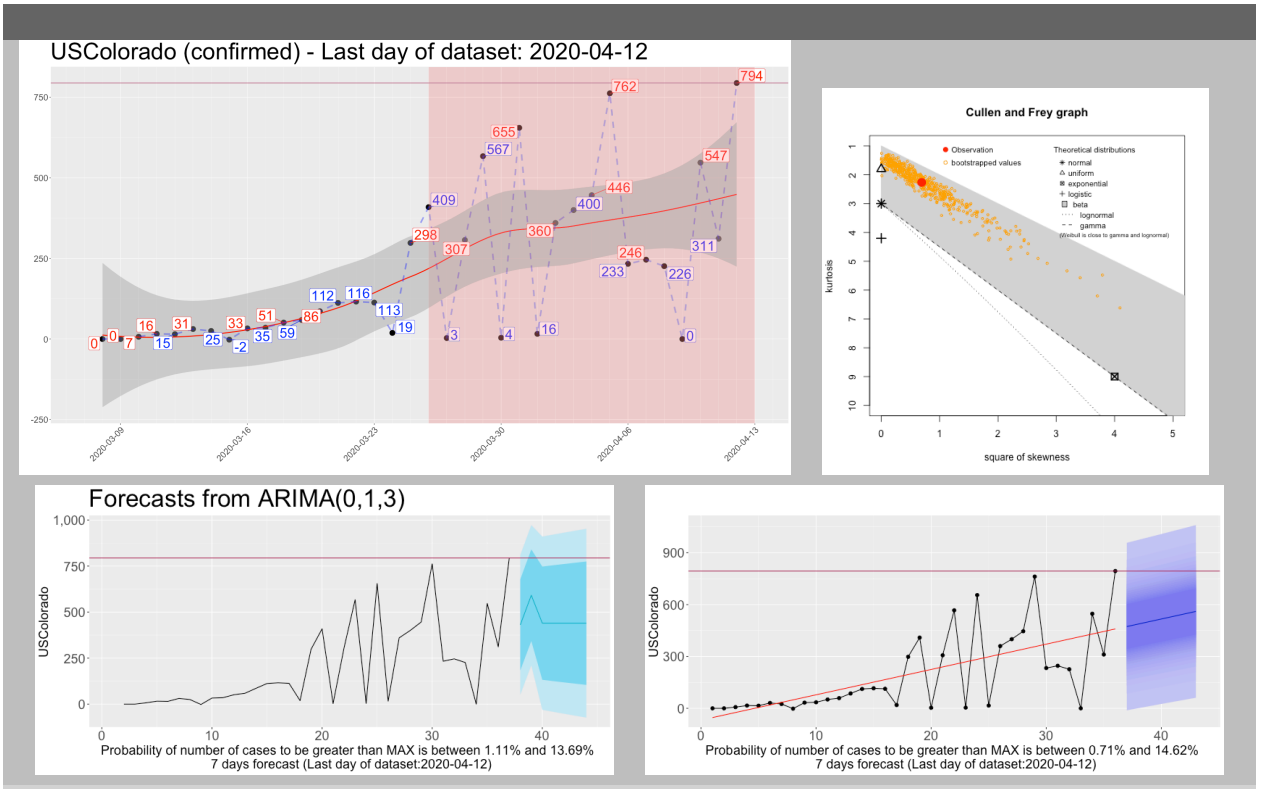
Estimation of number of cases: ARIMA [22795, 37829]



Maximum reached (probably) 2020-04-08

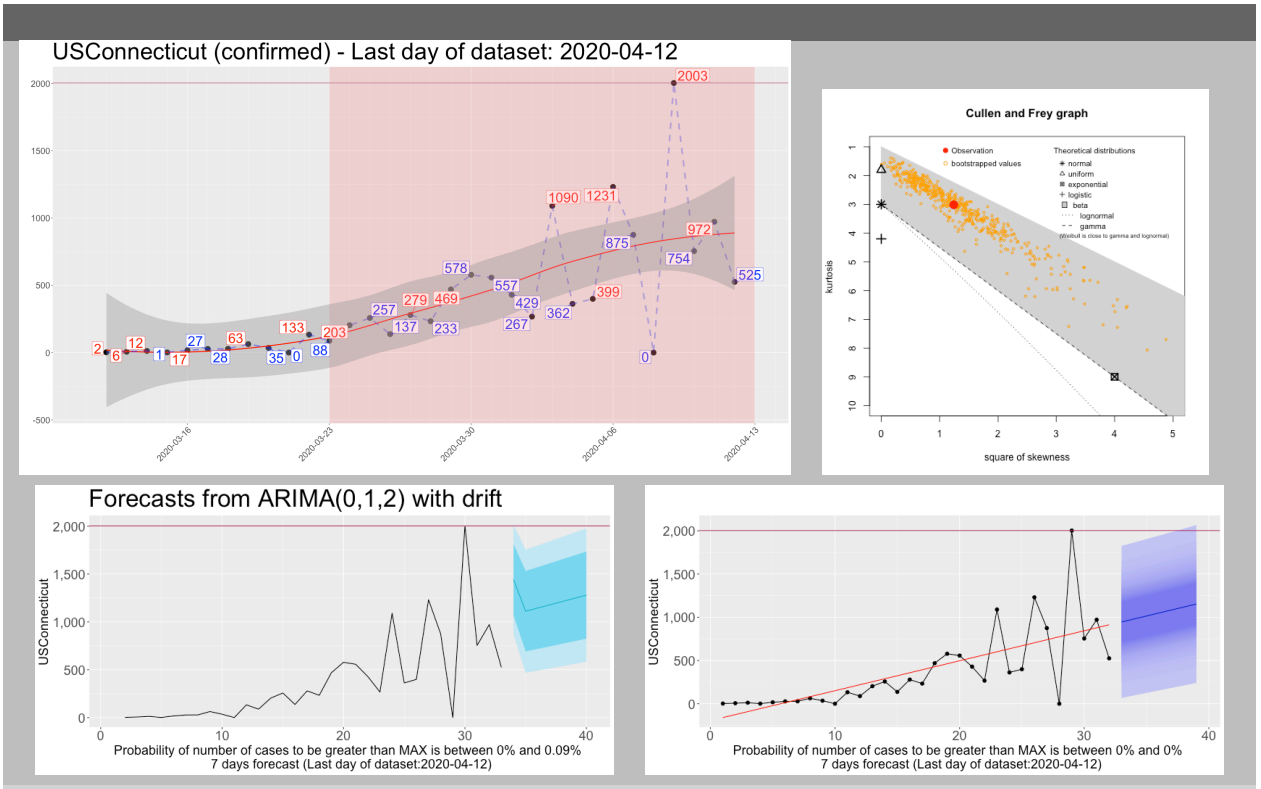
Estimation of number of cases: ARIMA [641, 1136]

8.7.5 US Colorado

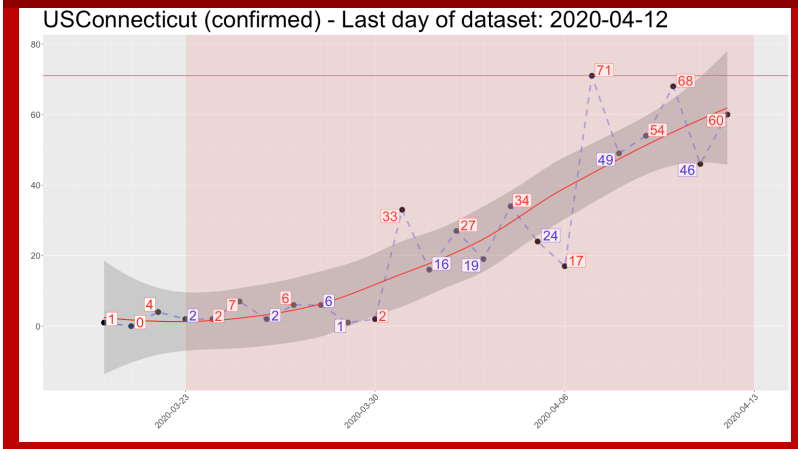


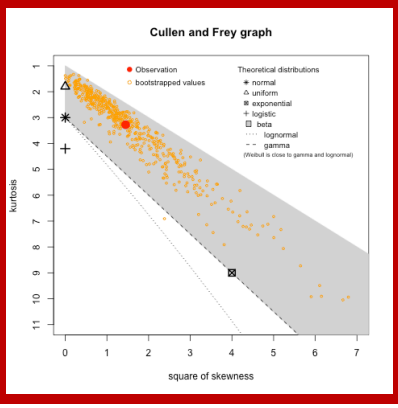
Estimation for future maximum after	period around the maximum
Estimation of number of cases: ARIMA	[14717, 23776]

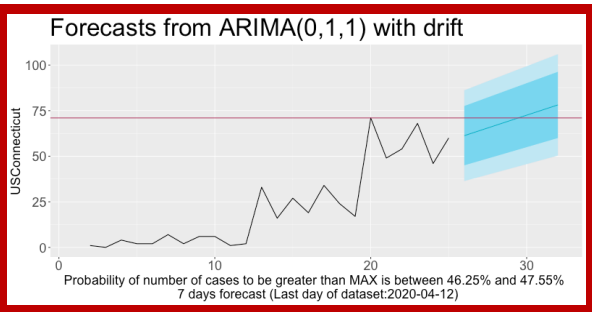
8.7.6 US Connecticut

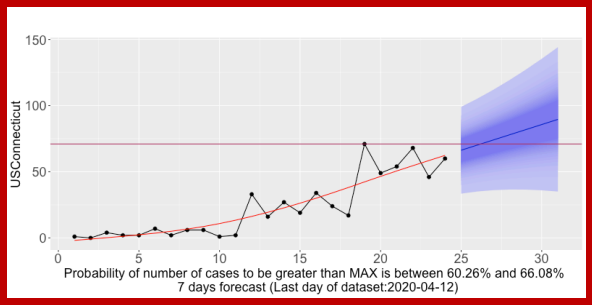


Maximum reached	2020-04-09
Estimation of number of cases: ARIMA	[12035, 21819]



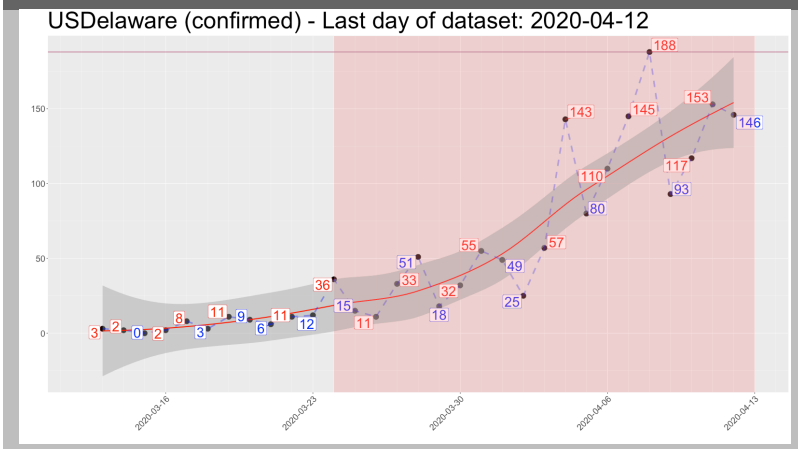


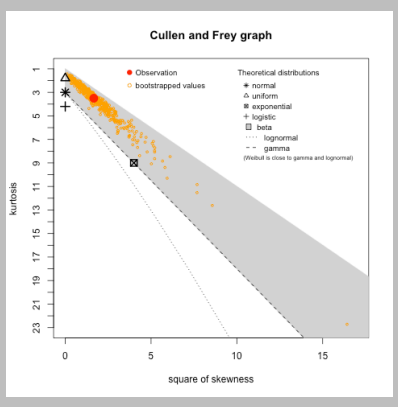


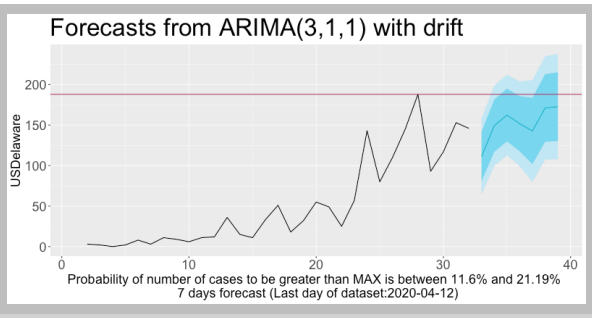


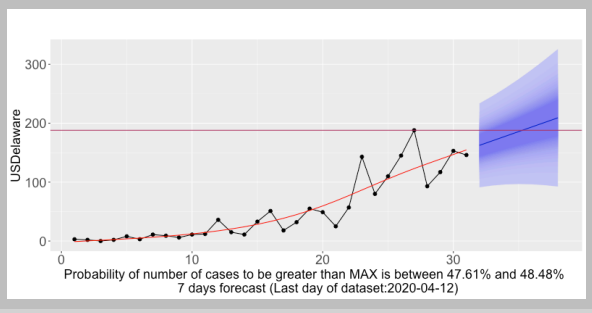
Estimation for future maximum after 5 - 10 days (04-17 - 04-22)
Estimation of number of cases: ARIMA [1408, 2860]

8.7.7 US Delaware



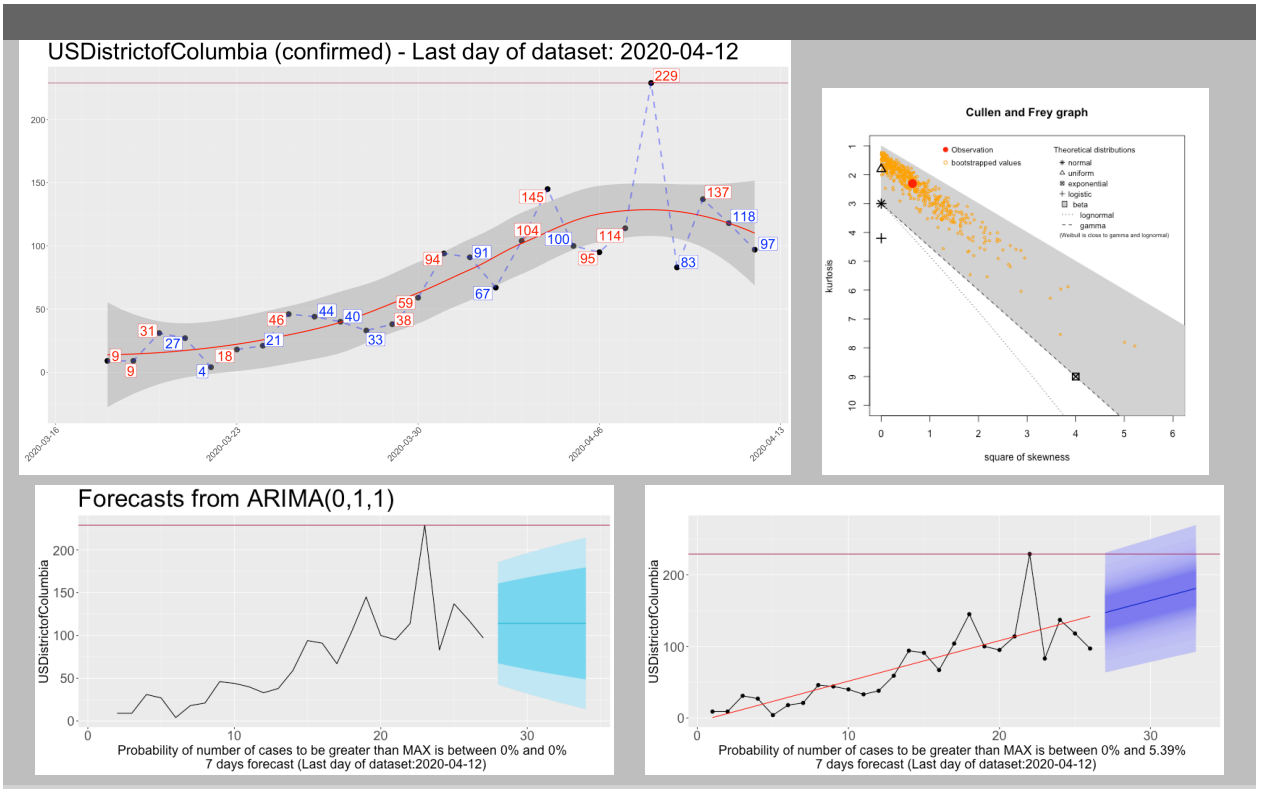






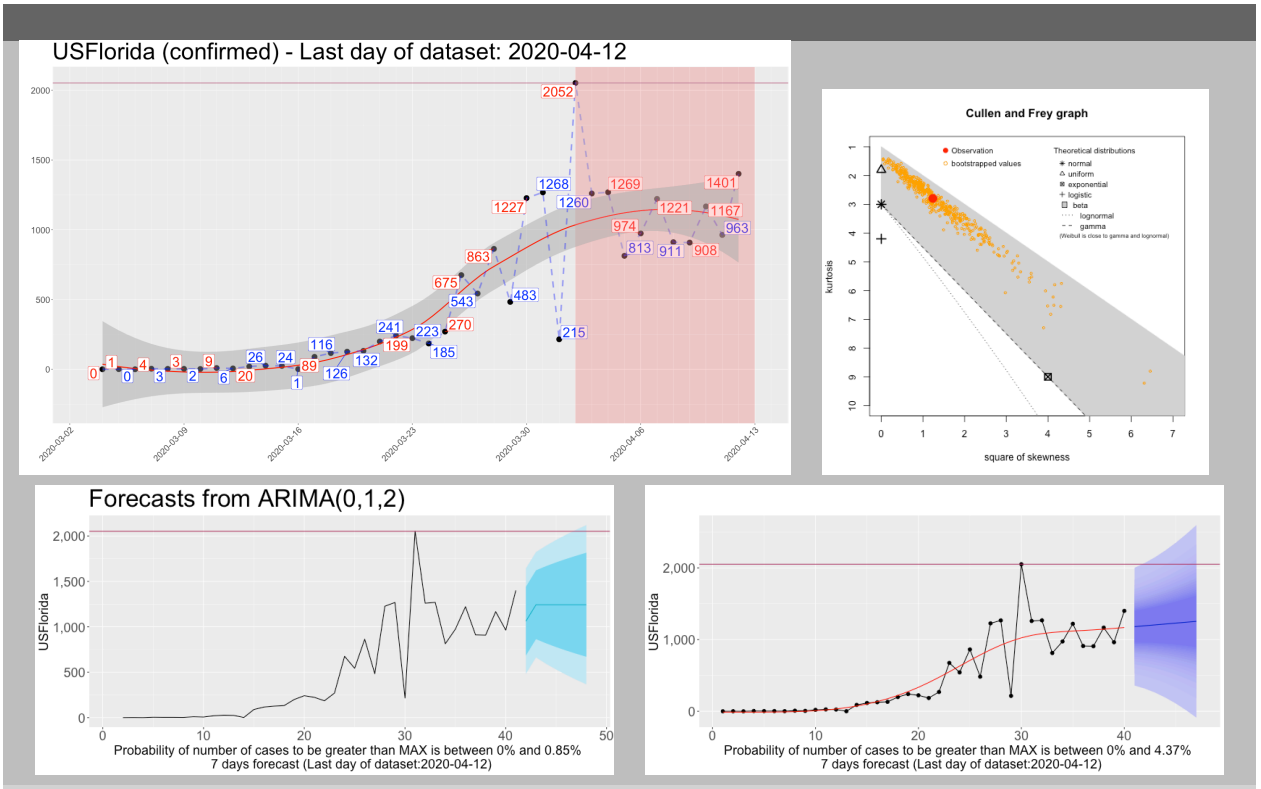
Estimation for future maximum after 3 - 9 days (04-15 - 04-21)
Estimation of number of cases: ARIMA [3756, 6429]

8.7.8 US District of Columbia



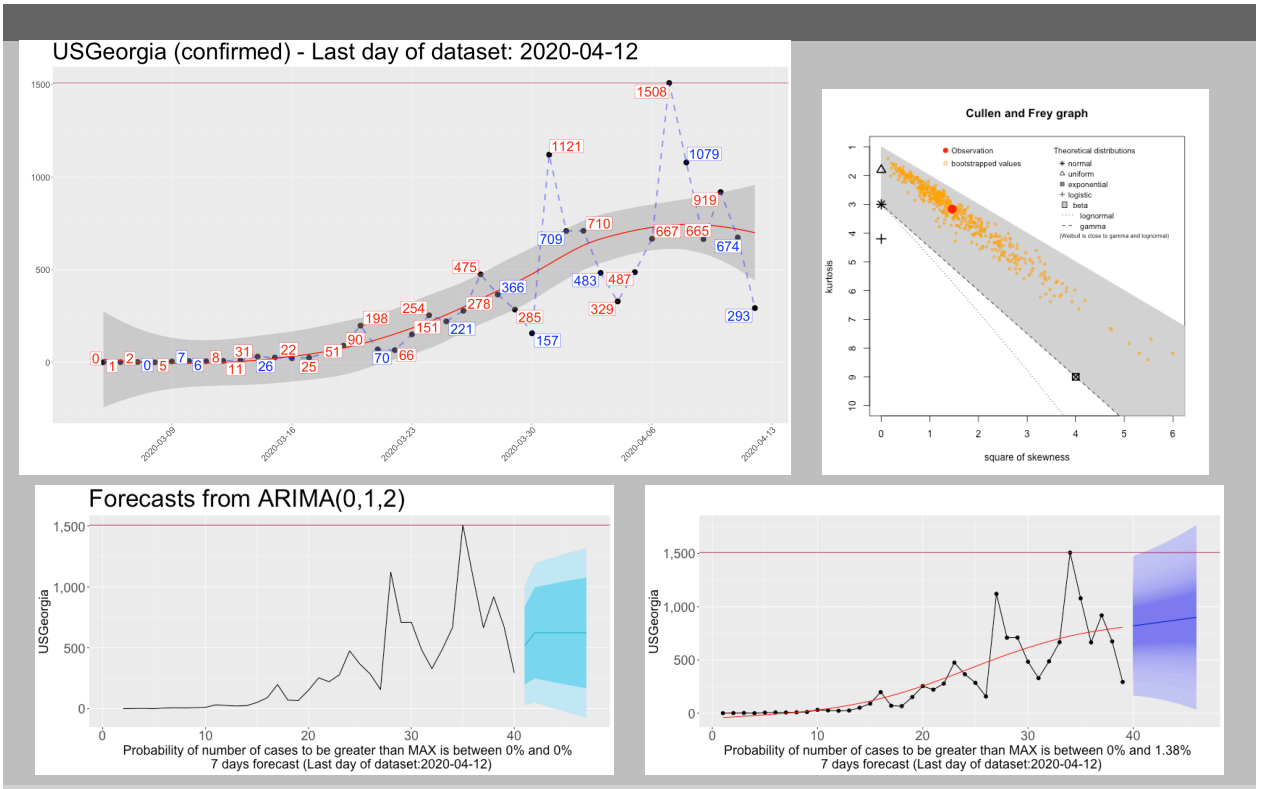
Estimation for future maximum after	3 - 7 days (04-15 - 04-19)
Estimation of number of cases: ARIMA	[4079, 6234]

8.7.9 US Florida



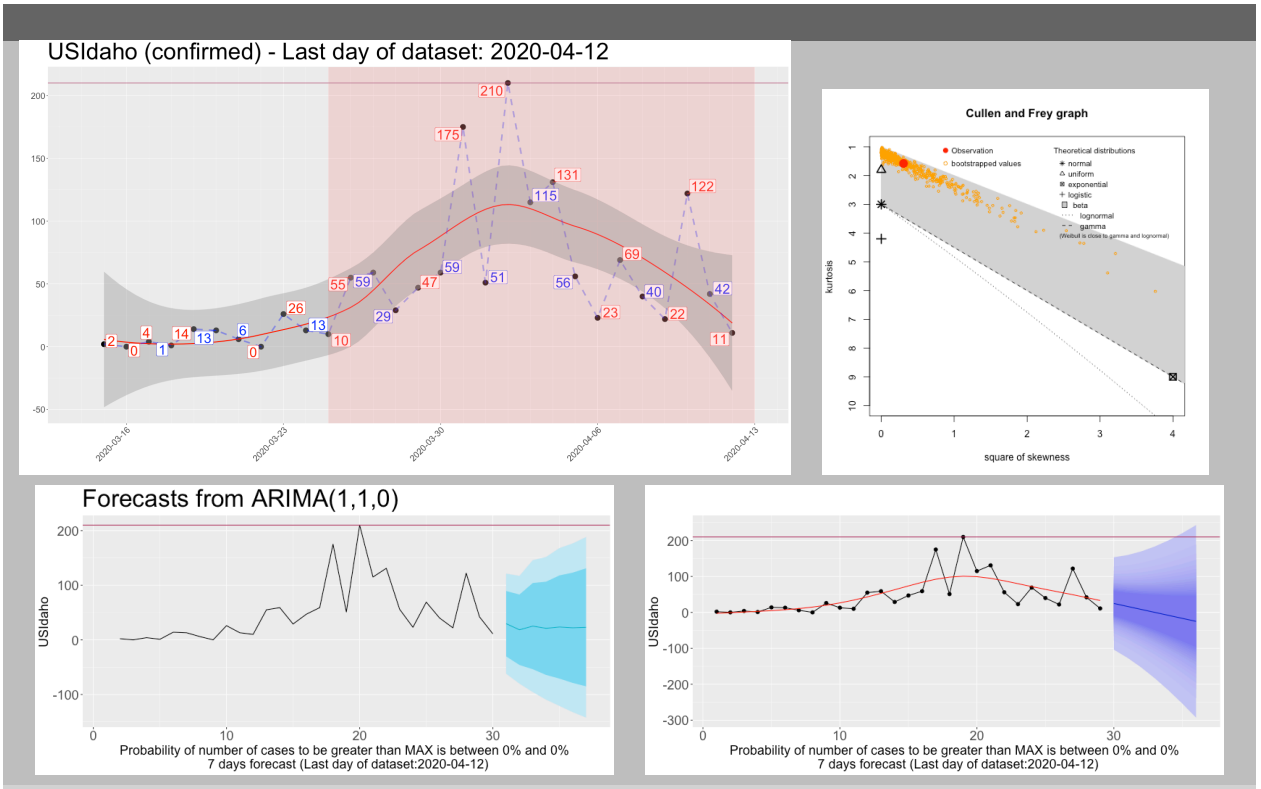
Estimation for future maximum after	2 - 9 days (04-14 - 04-21)
Estimation of number of cases: ARIMA	[42761, 71736]

8.7.10 US Georgia



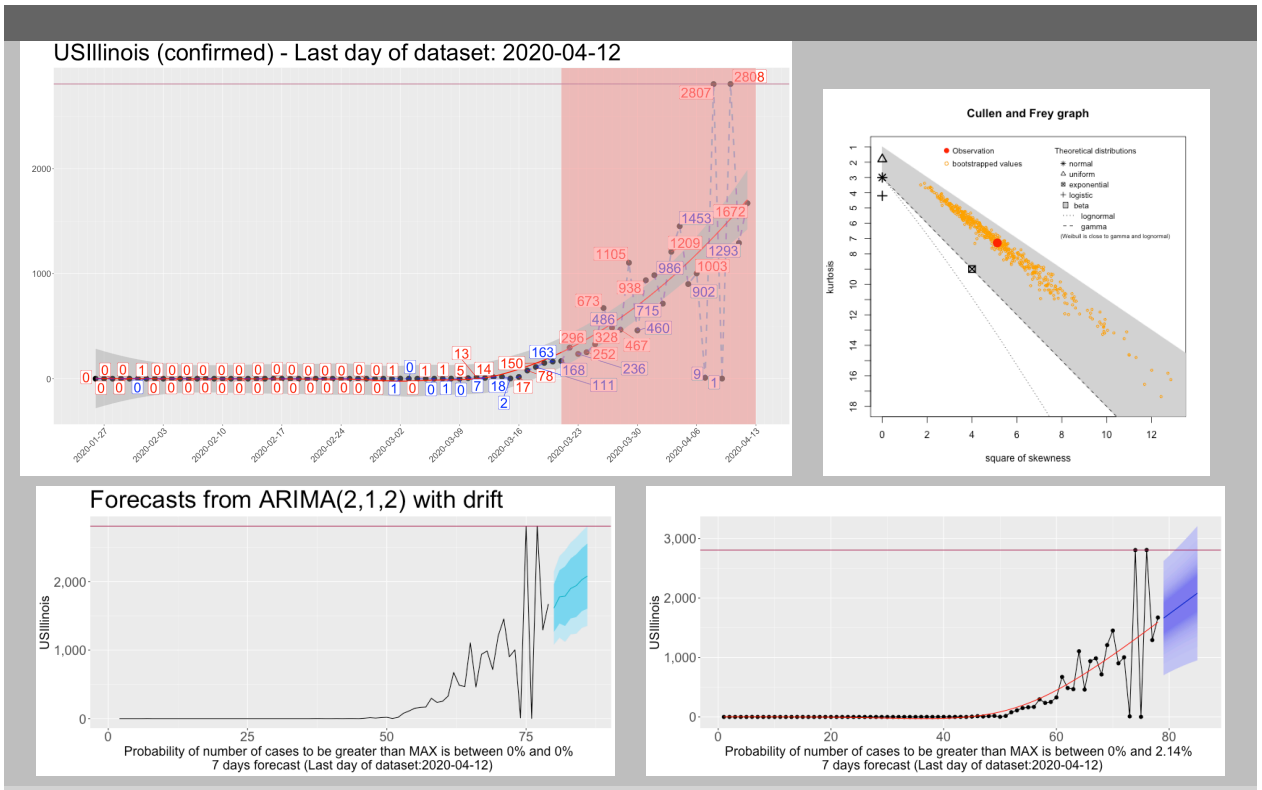
Maximum reached (probably)	2020-04-07
Estimation of number of cases: ARIMA	[12452, 21274]

8.7.11 US Idaho

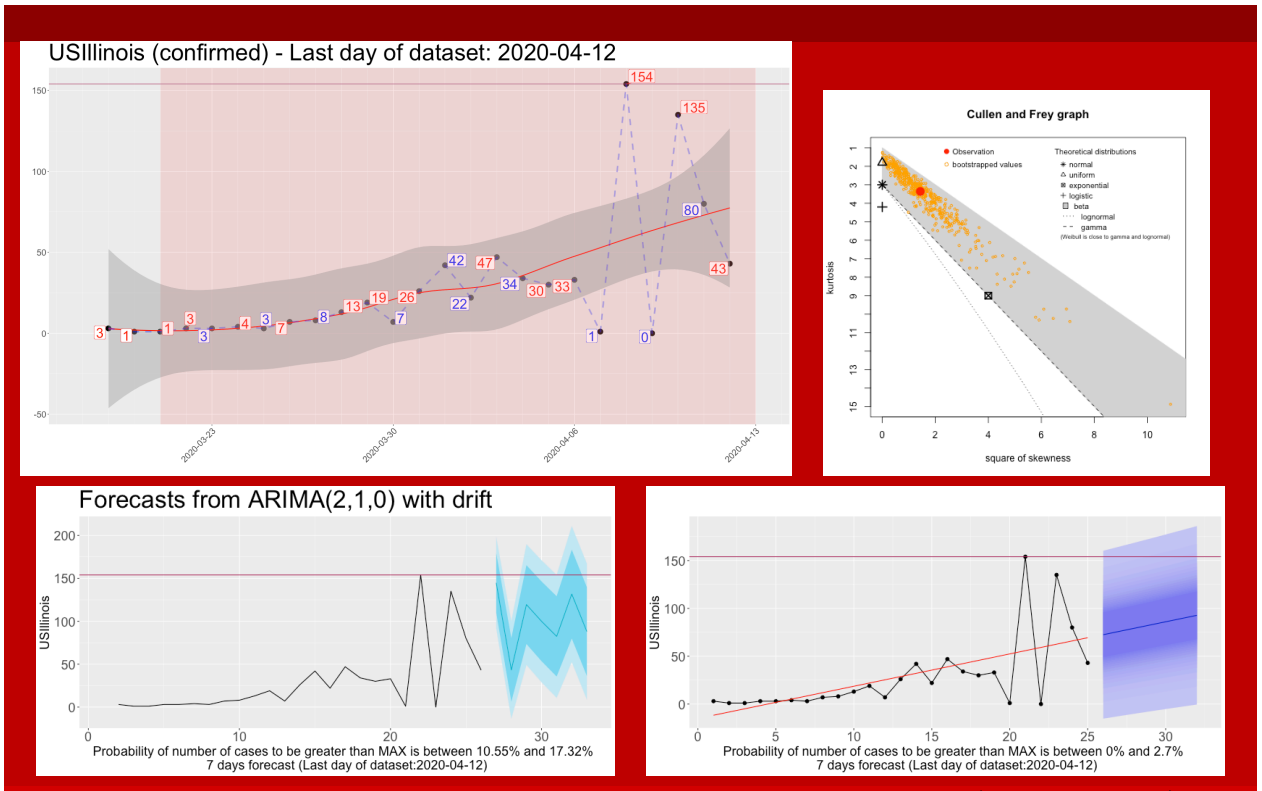


Maximum reached (probably)	2020-04-02
Estimation of number of cases: ARIMA	[1407, 2181]

8.7.12 US Illinois

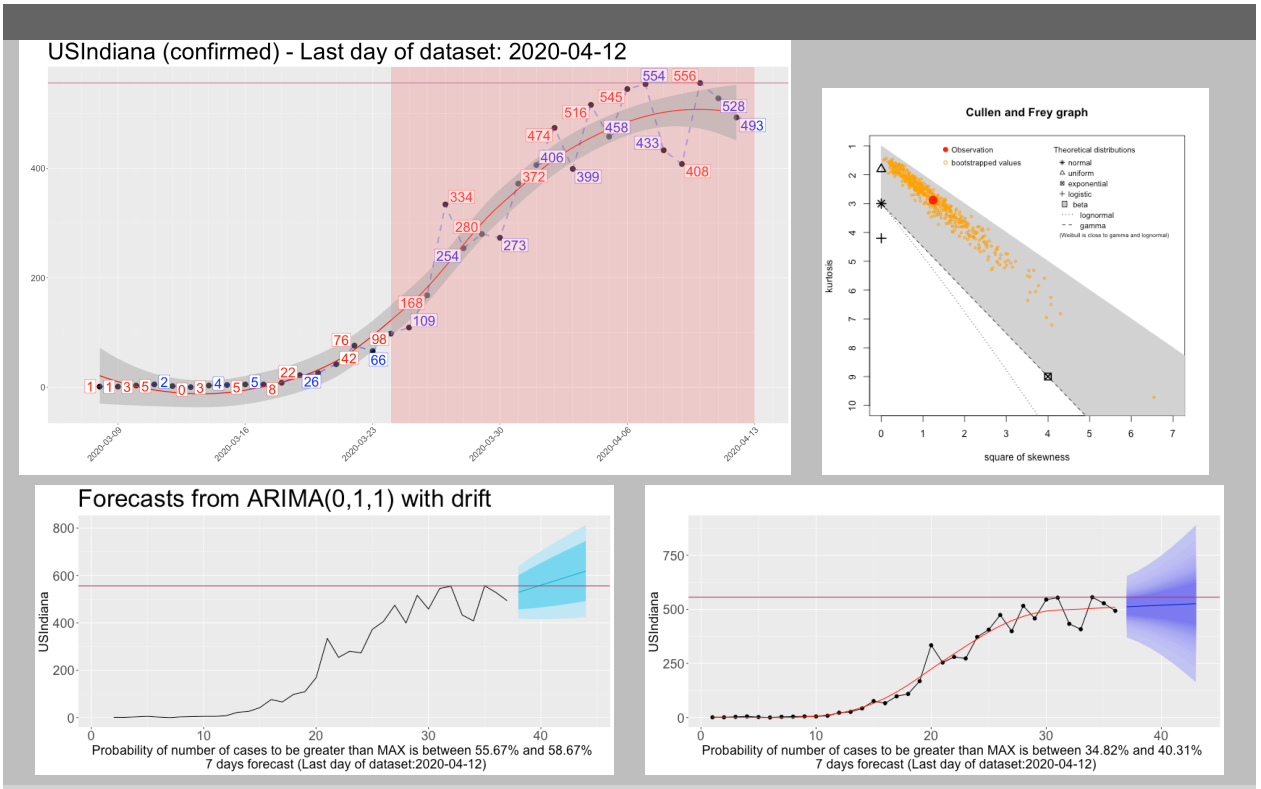


Estimation for future maximum after 3 - 9 days (04-15 - 04-21)
Estimation of number of cases: ARIMA [50536, 84109]



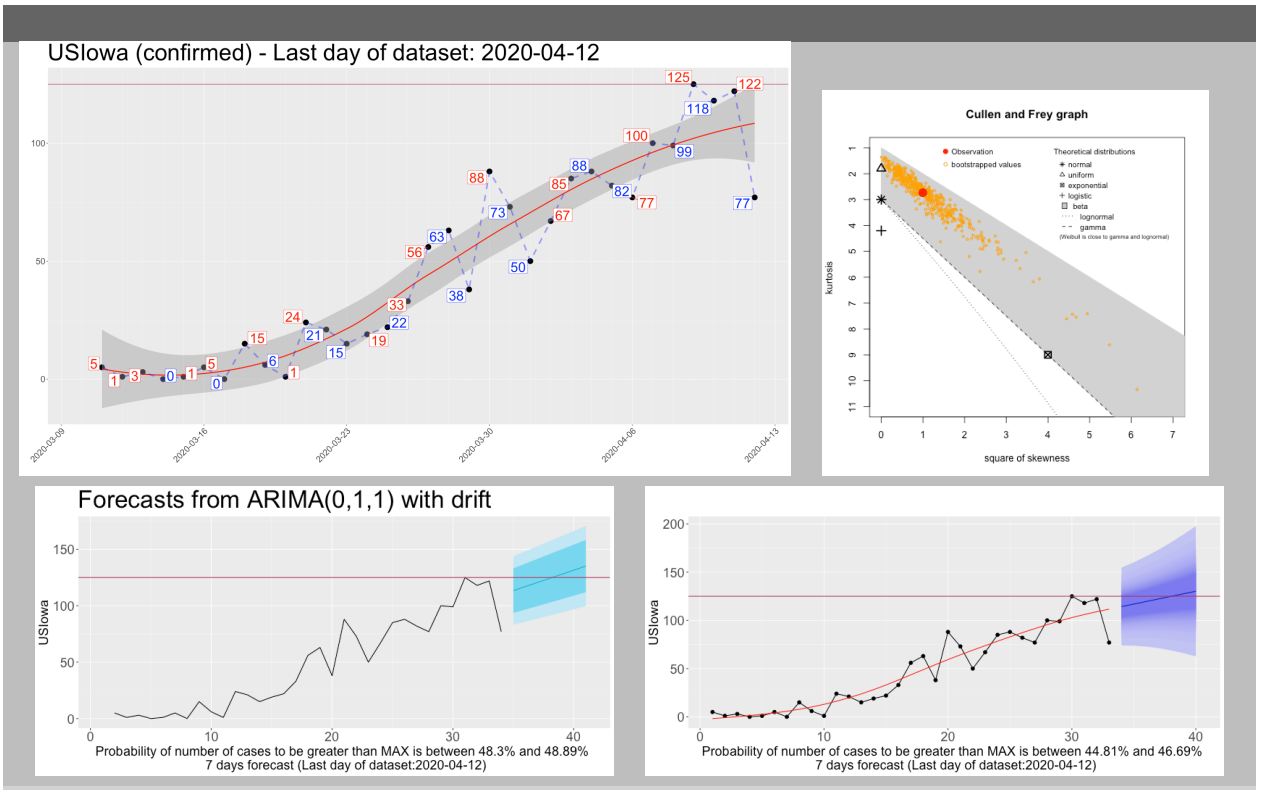
Estimation for future maximum after 8 - 12 days (04-20 - 04-24)
Estimation of number of cases: ARIMA [2115, 4483]

8.7.13 US Indiana



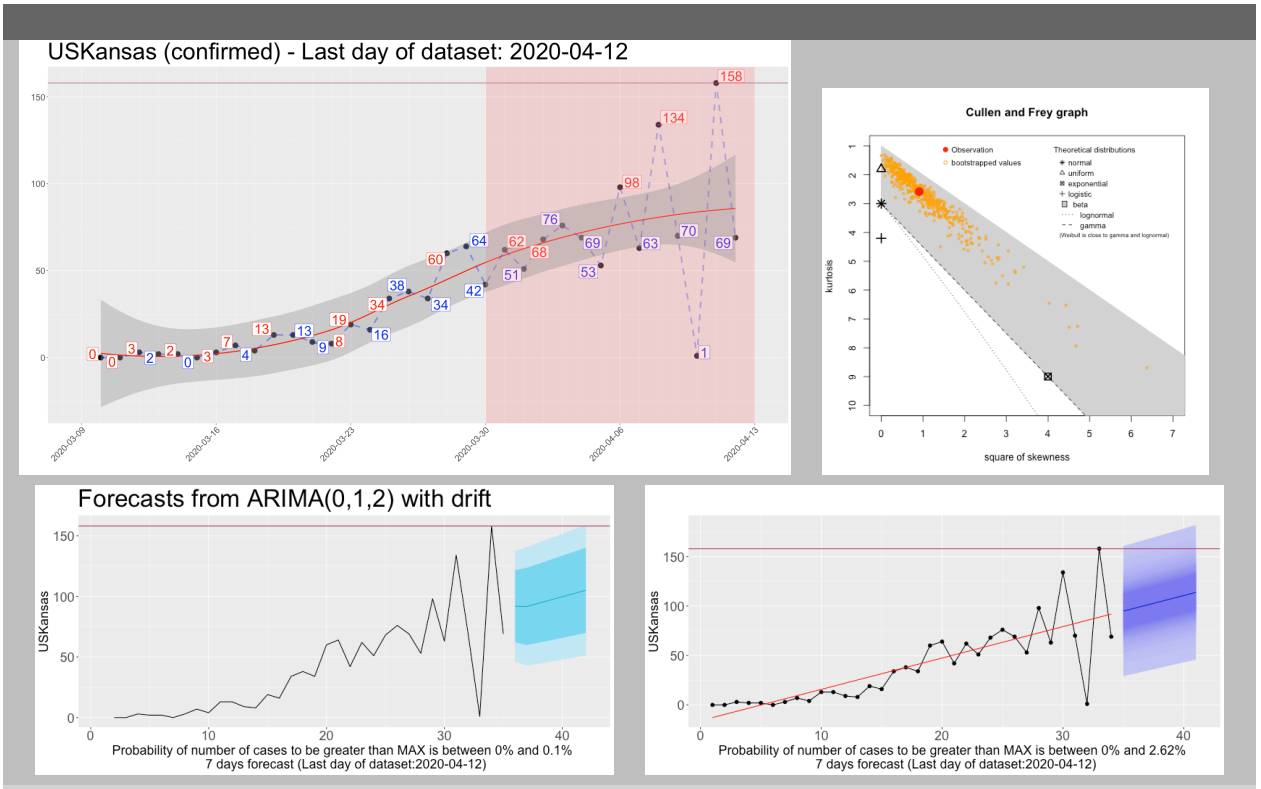
Estimation for future maximum after	1 - 6 days (04-13 - 04-18)
Estimation of number of cases: ARIMA	[16607, 24017]

8.7.14 US Iowa



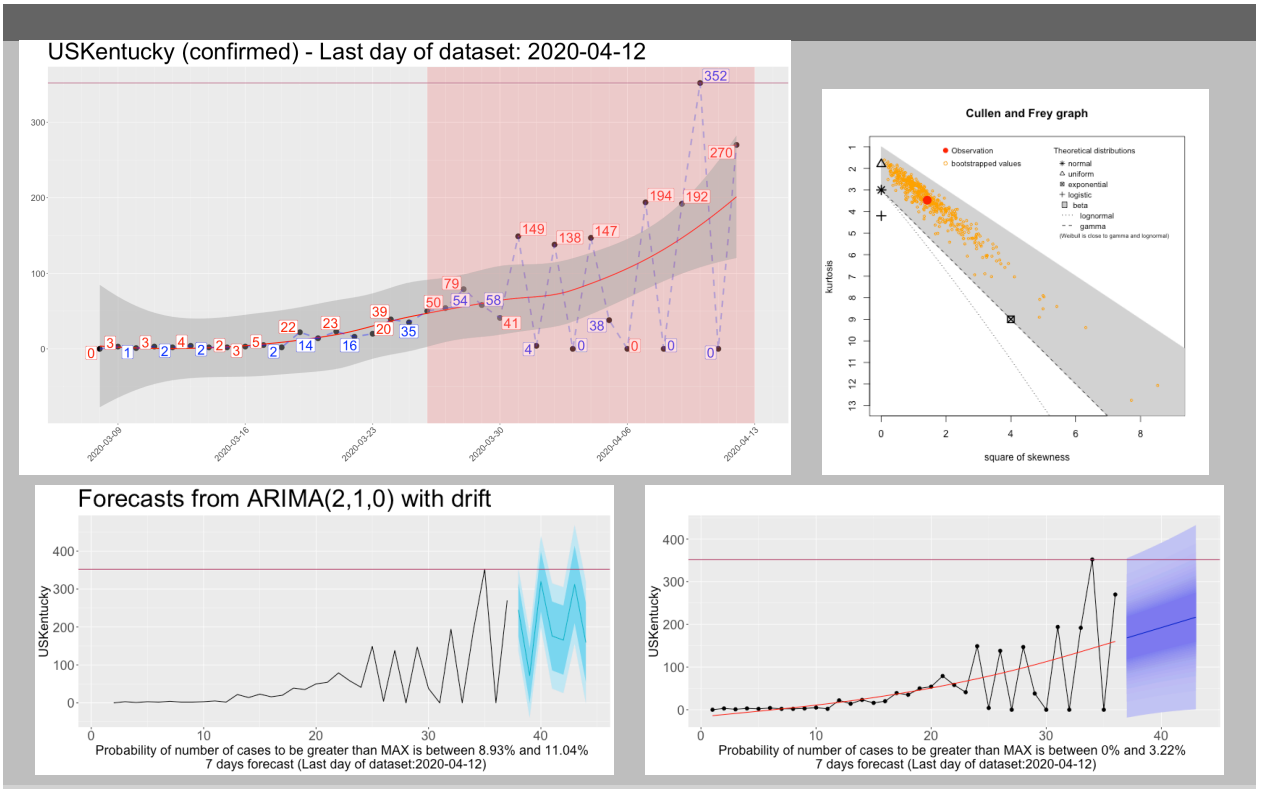
Estimation for future maximum after	2 - 7 days (04-14 - 04-19)
Estimation of number of cases: ARIMA	[3421, 5019]

8.7.15 US Kansas



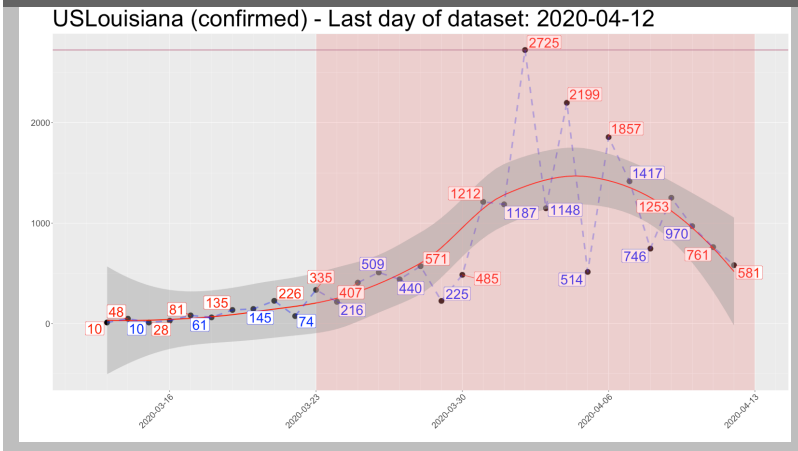
Estimation for future maximum after	2 - 8 days (04-14 - 04-20)
Estimation of number of cases: ARIMA	[2883, 4488]

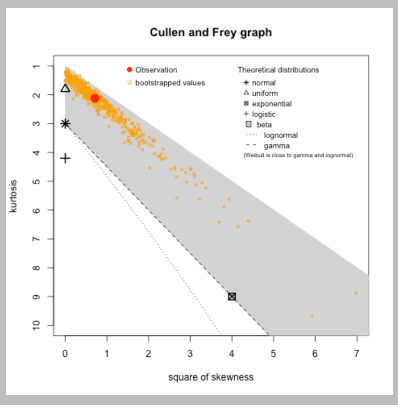
8.7.16 US Kentucky

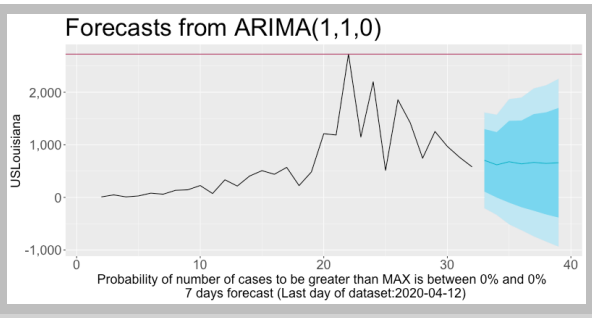


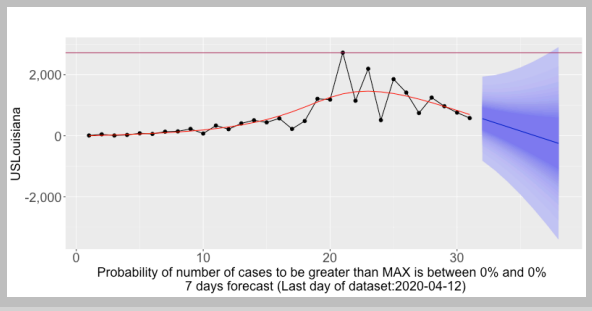
Estimation for future maximum after	4 - 13 days (04-16 - 04-25)
Estimation of number of cases: ARIMA	[4796, 11003]

8.7.17 US Louisiana



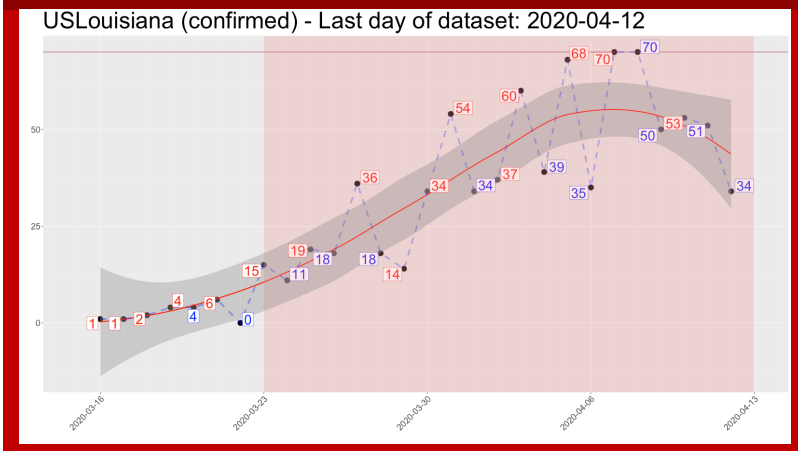


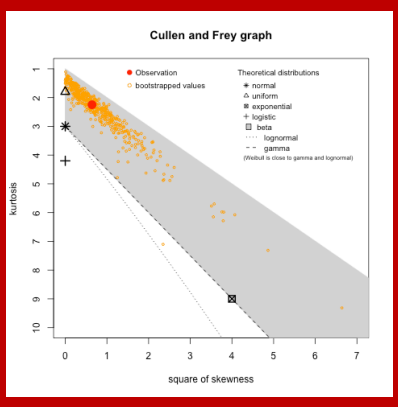


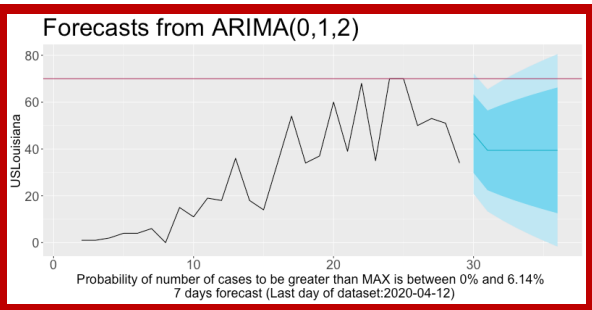


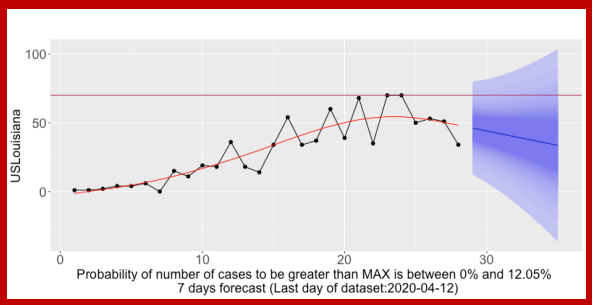
Maximum reached 2020-04-04

Estimation of number of cases: ARIMA [20595, 33091]





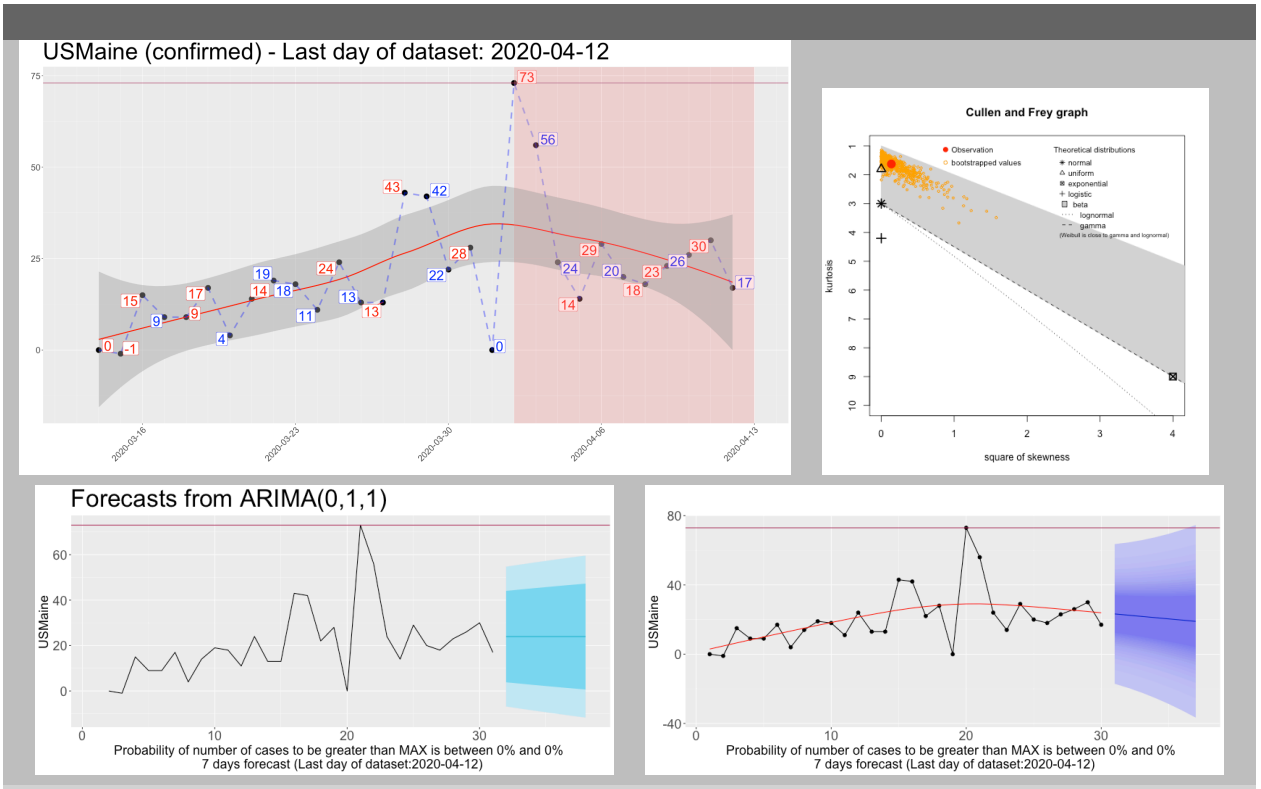




Maximum reached 2020-04-08

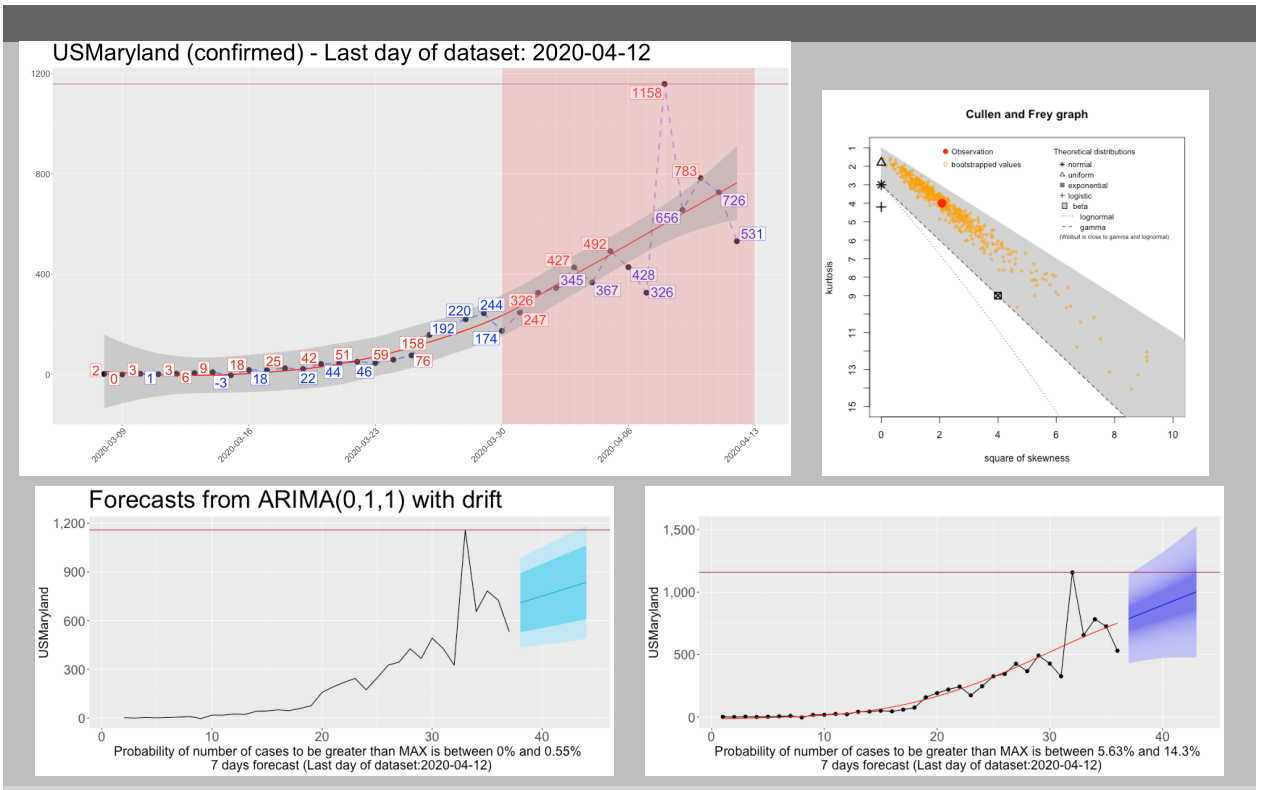
Estimation of number of cases: ARIMA [840, 1492]

8.7.18 US Maine



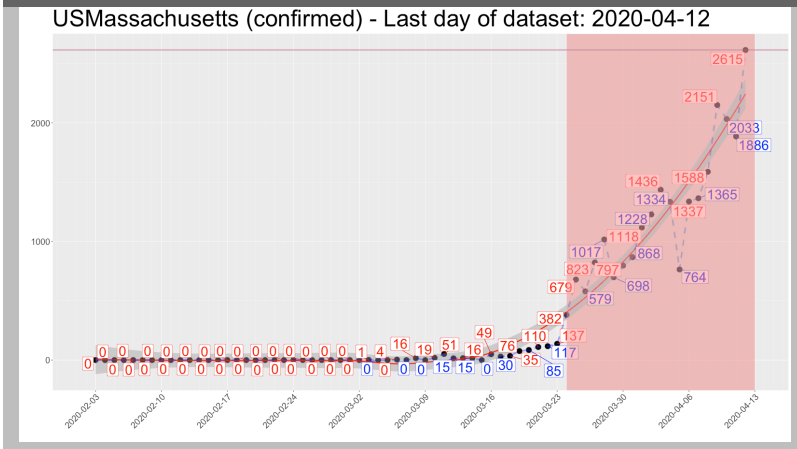
Estimation for future maximum after	period around the maximum
Estimation of number of cases: ARIMA	[633, 1006]

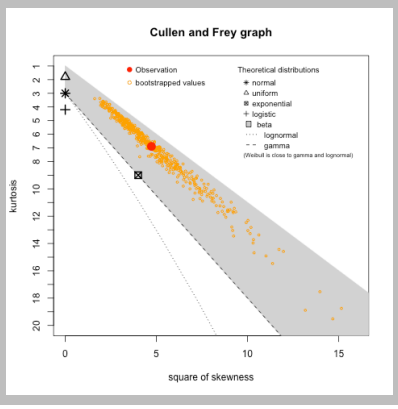
8.7.19 US Maryland

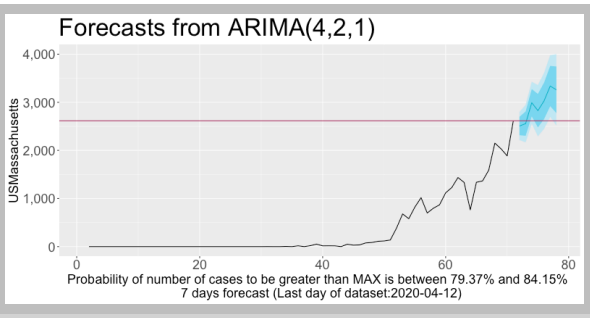


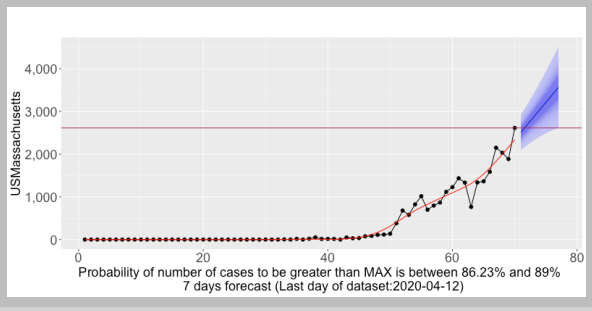
Estimation for future maximum after	4 - 6 days (04-16 - 04-18
Estimation of number of cases: ARIMA	[19663, 27325]

8.7.20 US Massachusetts

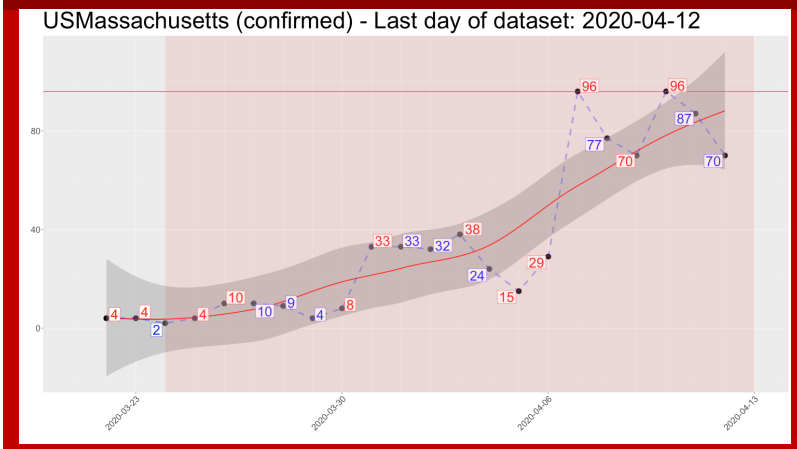


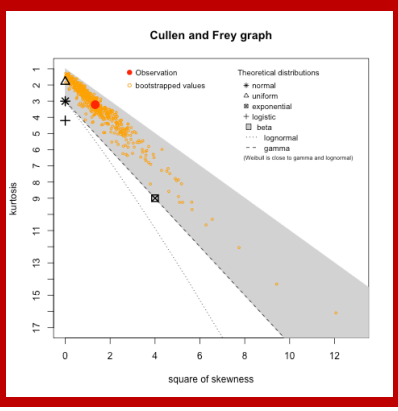


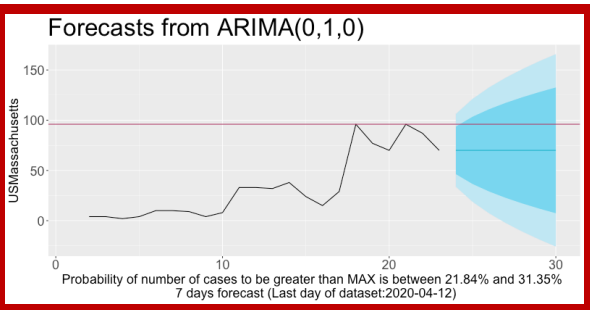


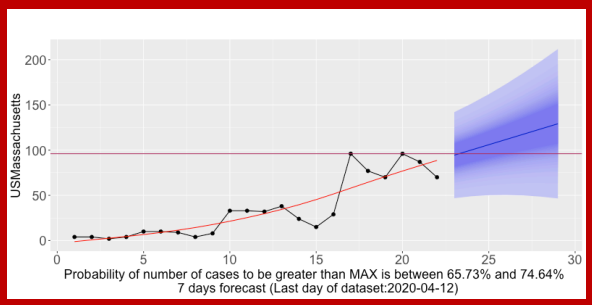


Estimation for future maximum after 9 - 13 days (04-21 - 04-25)
Estimation of number of cases: ARIMA [86 642, 139 252]



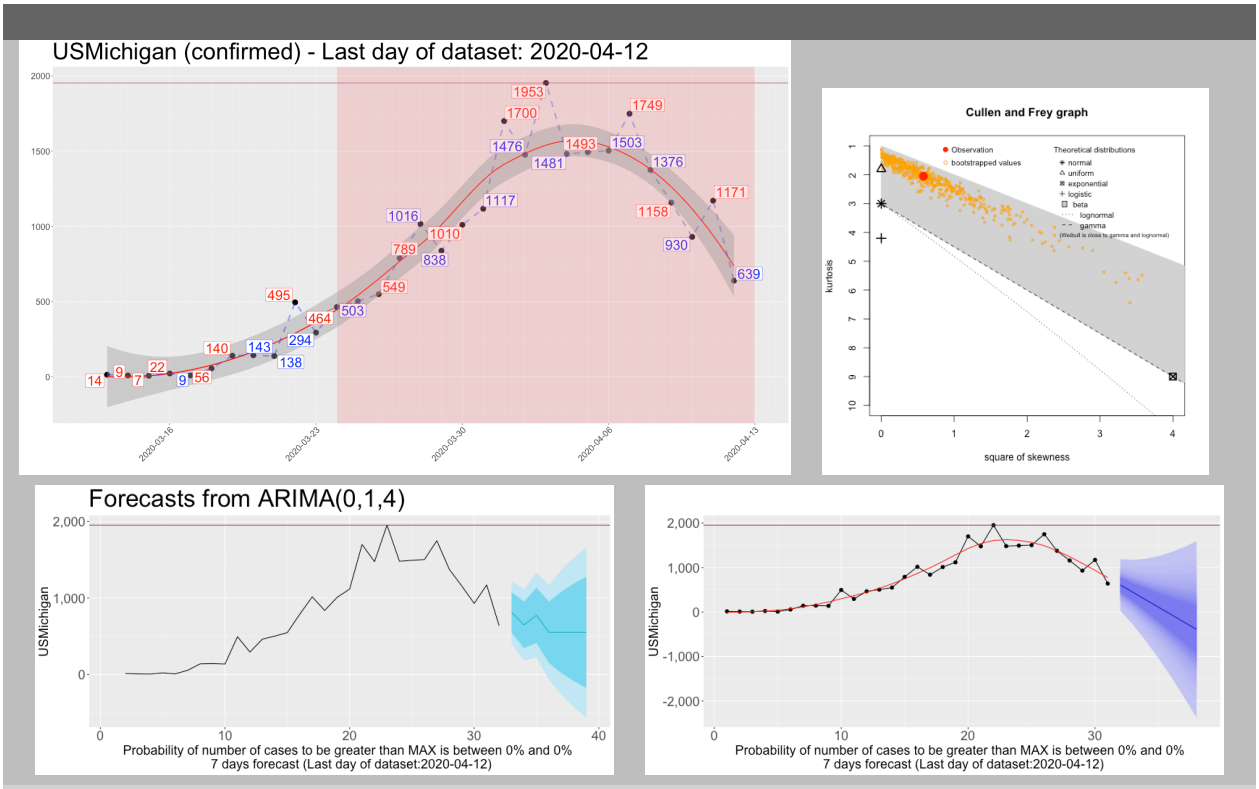






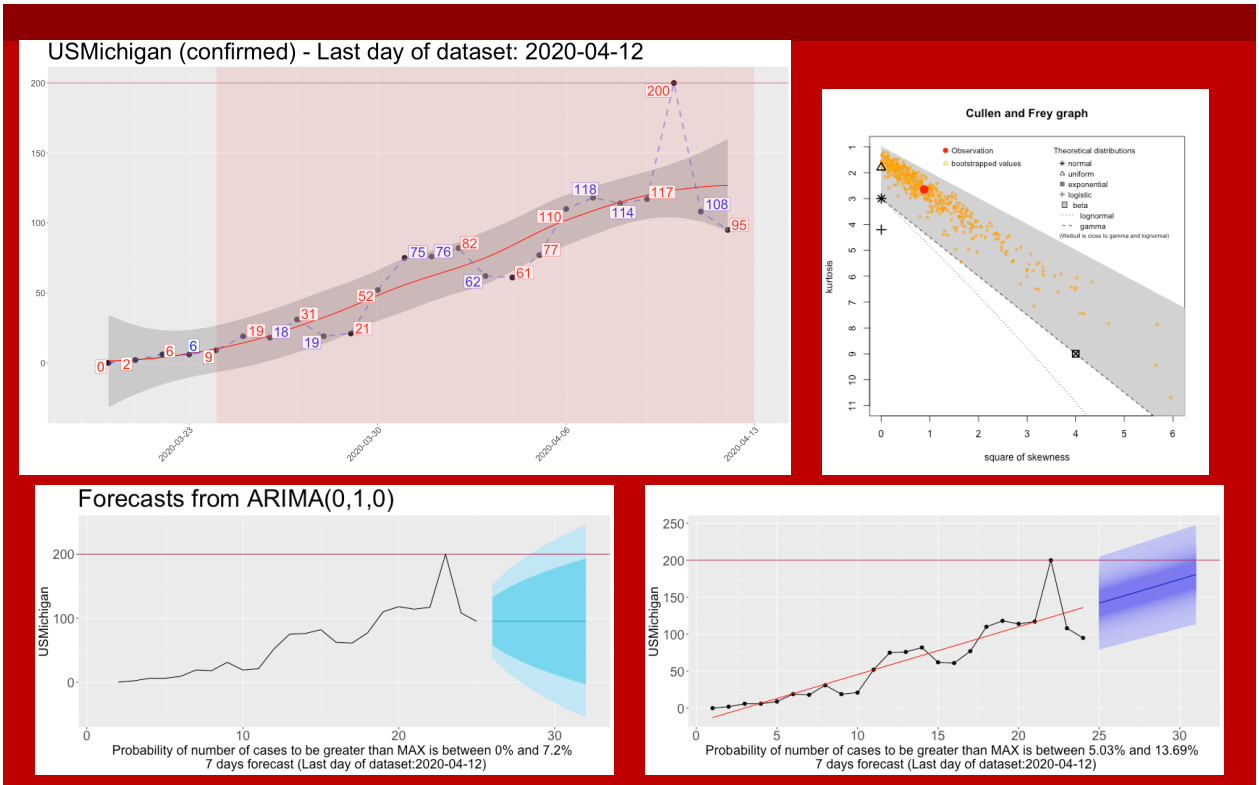
Estimation for future maximum after 12 - 20 days (04-24 - 05-02)
Estimation of number of cases: ARIMA [1346, 8191]

8.7.21 US Michigan



Maximum reached 2020-04-03

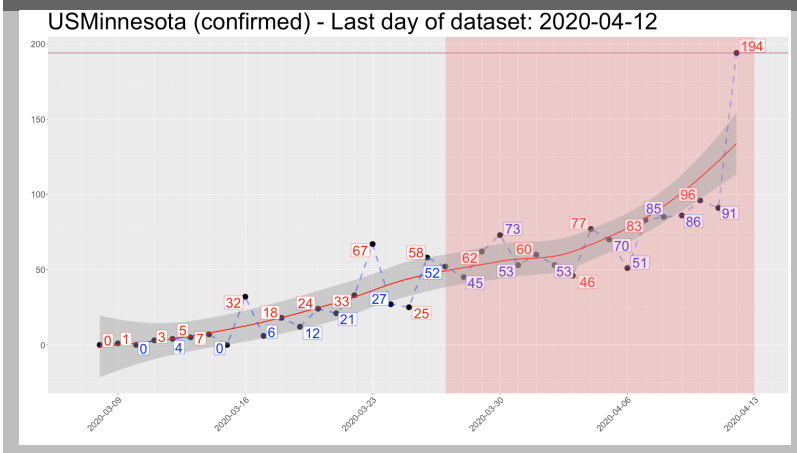
Estimation of number of cases: ARIMA [24244, 36988]

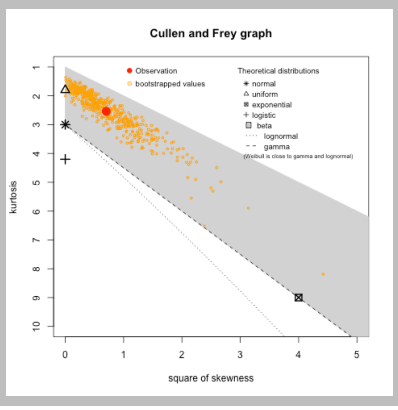


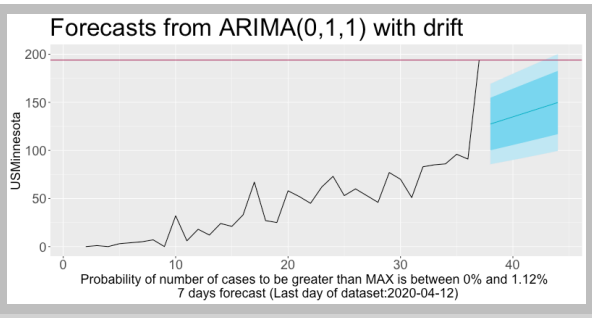
Estimation for future maximum after period around the maximum

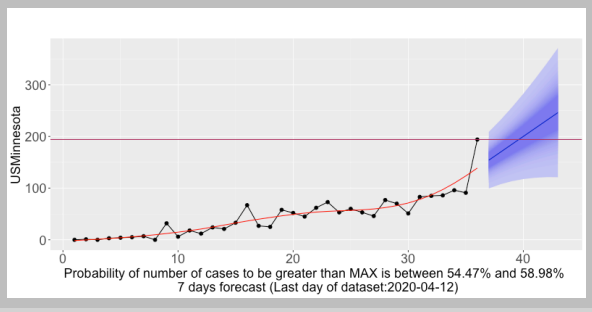
Estimation of number of cases: ARIMA [3034, 7088]

8.7.22 US Minnesota



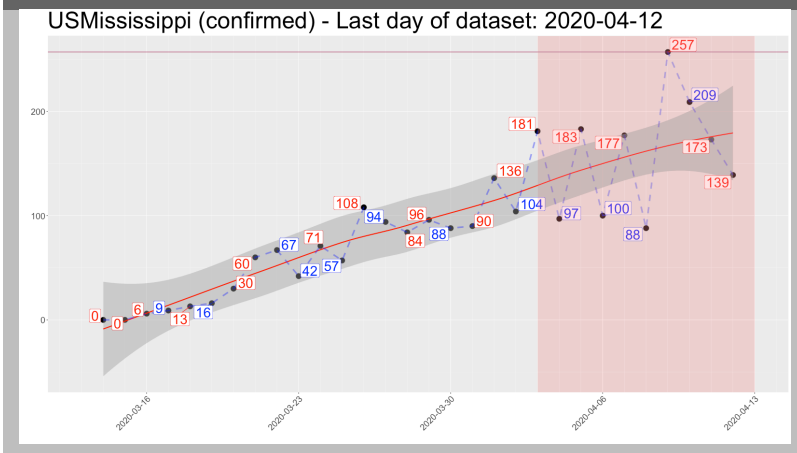


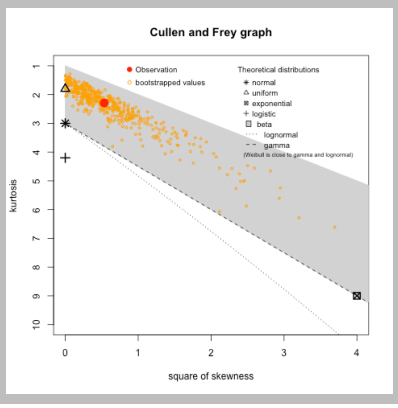


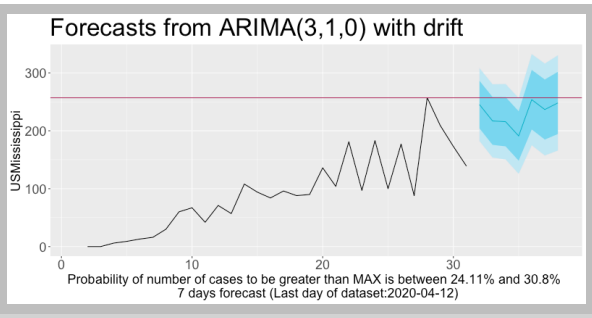


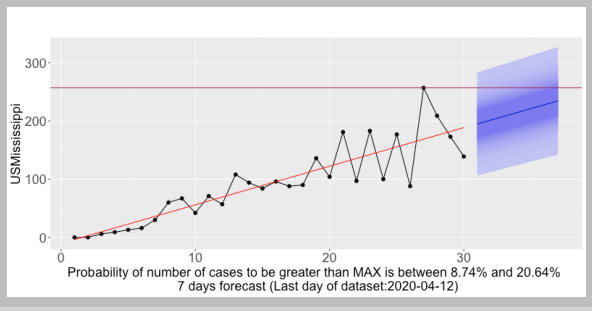
Estimation for future maximum after	4 - 10 days (04-16 - 04-22)
Estimation of number of cases: ARIMA	[4083, 7338]

8.7.23 US Mississippi



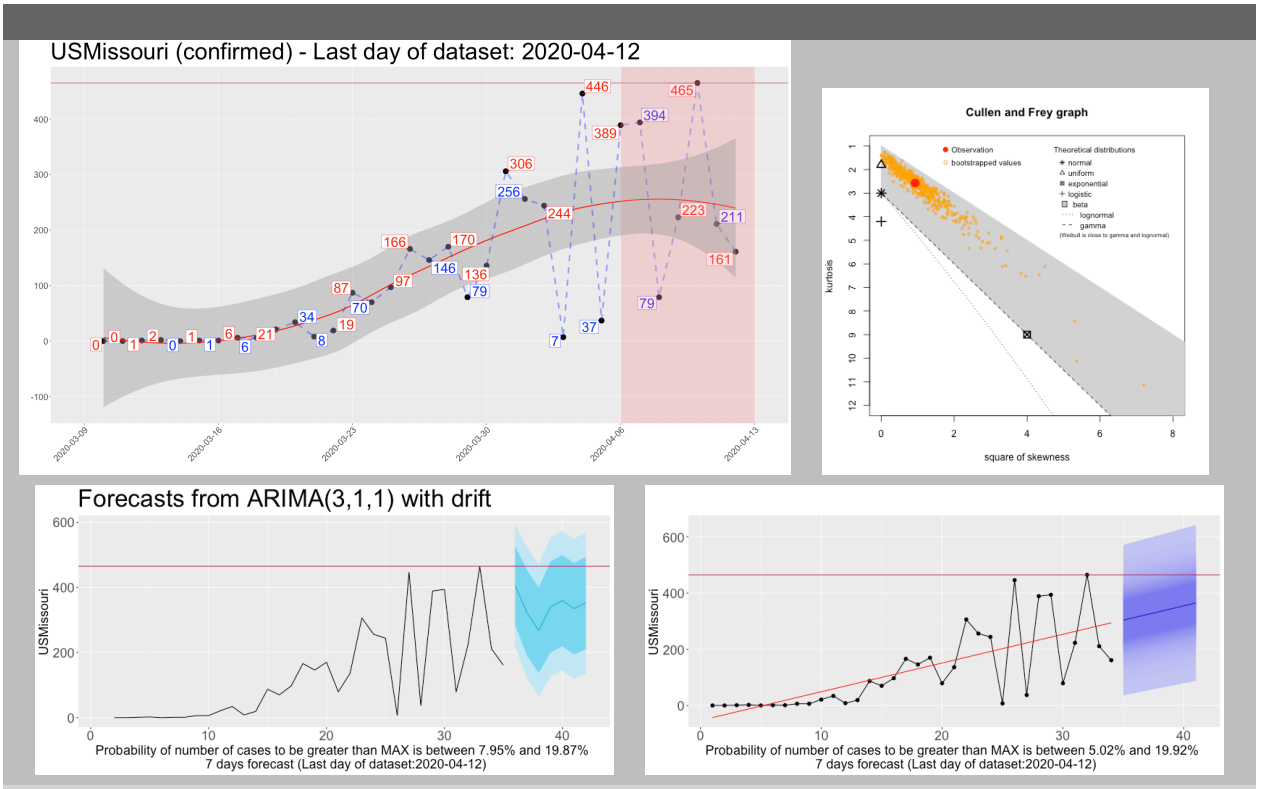






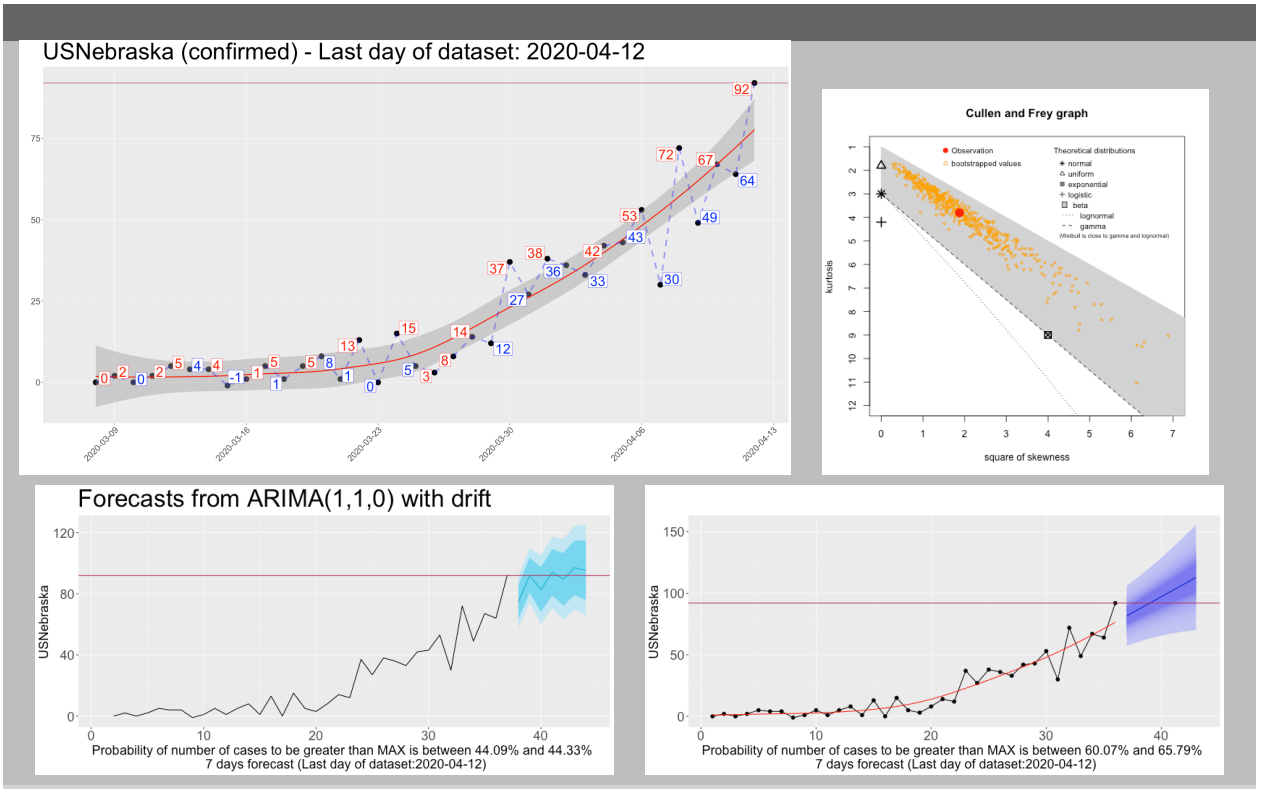
Estimation for future maximum after	4 - 11 days (04-16 - 04-23)
Estimation of number of cases: ARIMA	[6256, 10990]

8.7.24 US Missouri



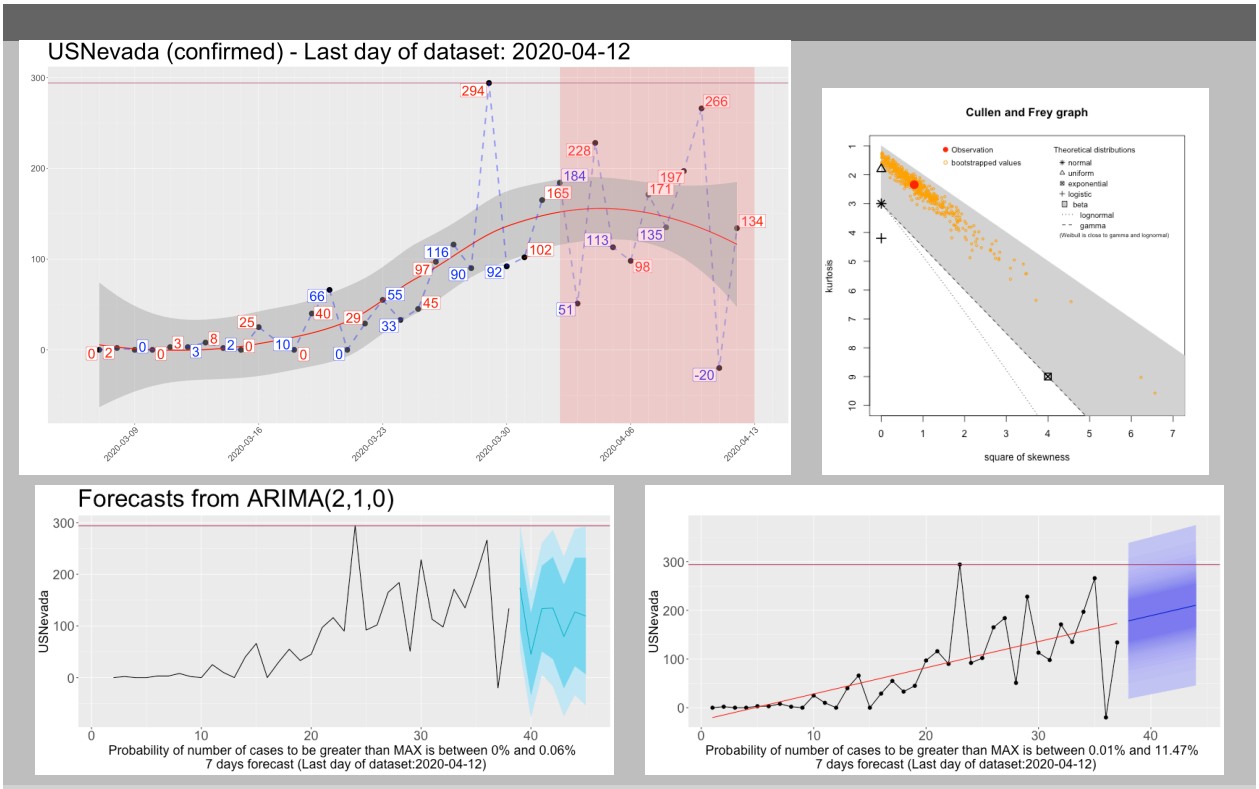
Estimation for future maximum after 3 - 9 days (04-15 - 04-21)
Estimation of number of cases: ARIMA [9538, 15858]

8.7.25 USNebraska



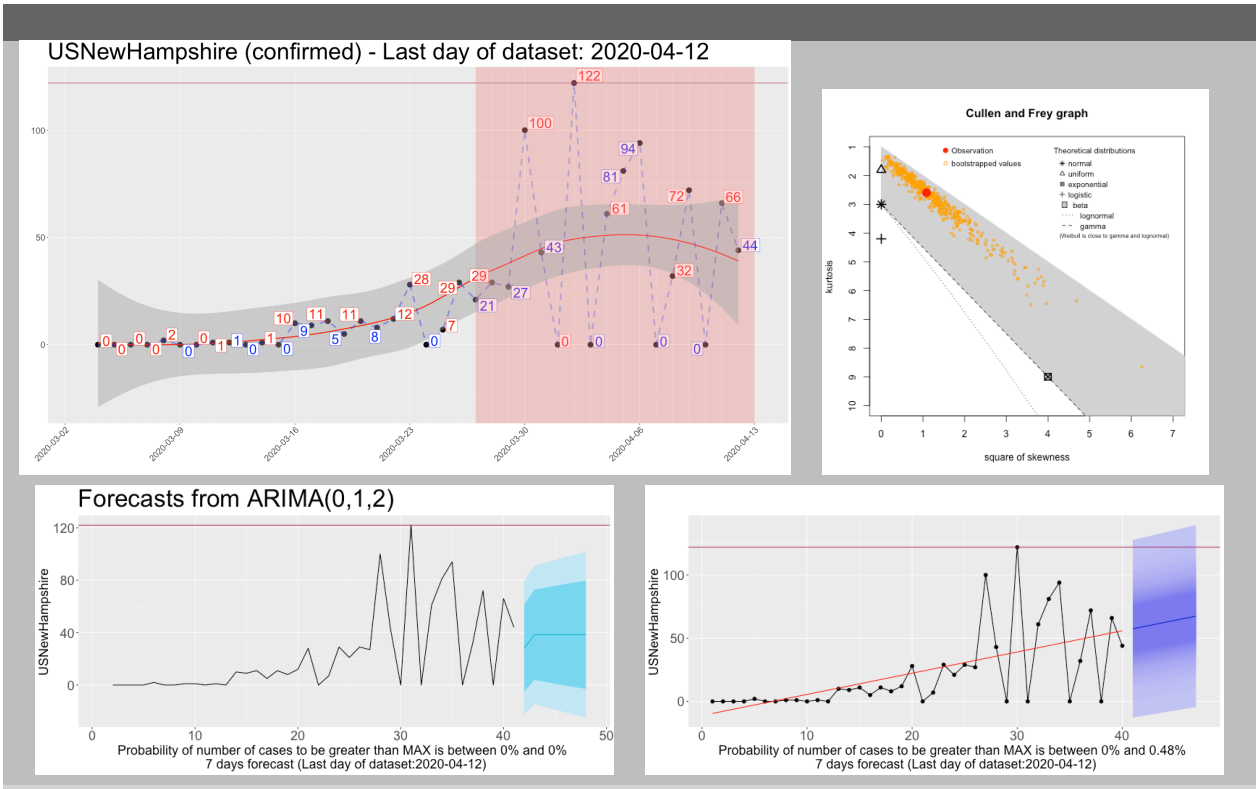
Estimation for future maximum after 6 - 13 days (04-18 - 04-25)
Estimation of number of cases: ARIMA [2352, 4890]

8.7.26 US Nevada



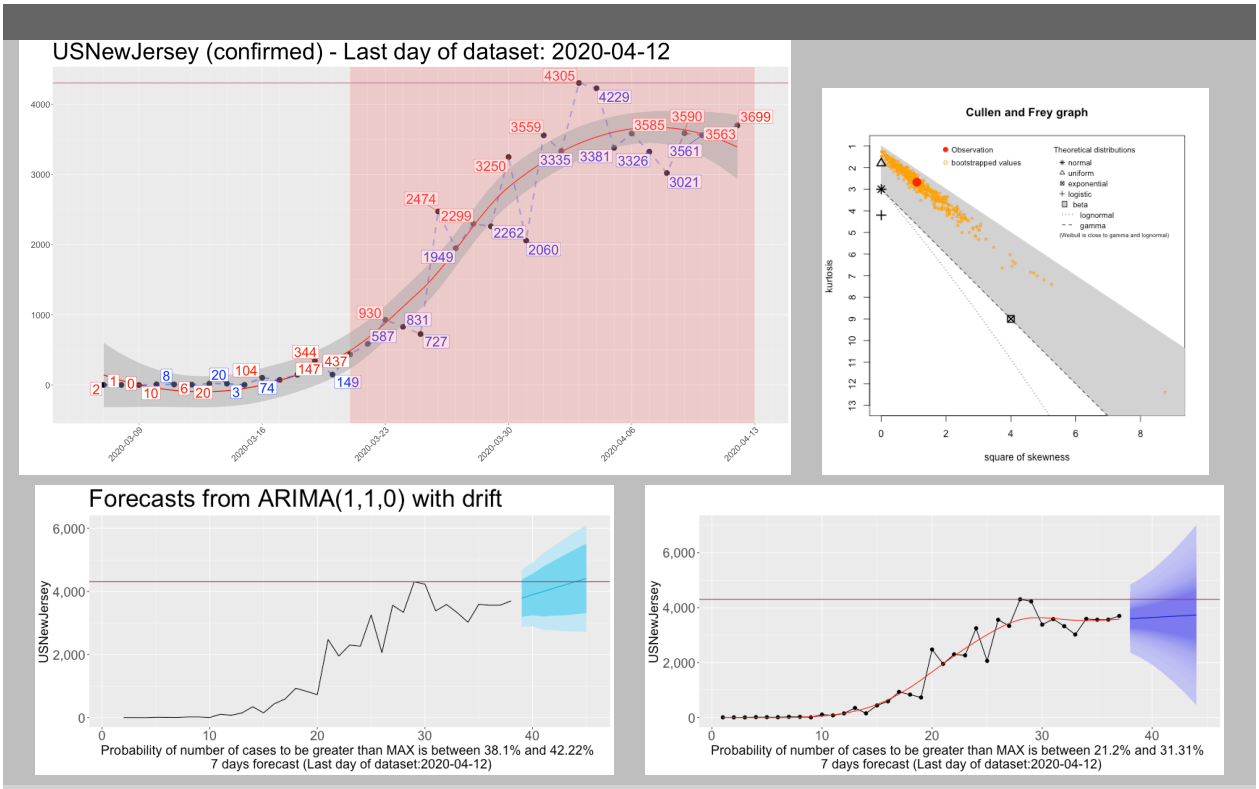
Estimation for future maximum after 5 - 11 days (04-17 - 04-23)
Estimation of number of cases: ARIMA [5898, 10616]

8.7.27 US New Hampshire

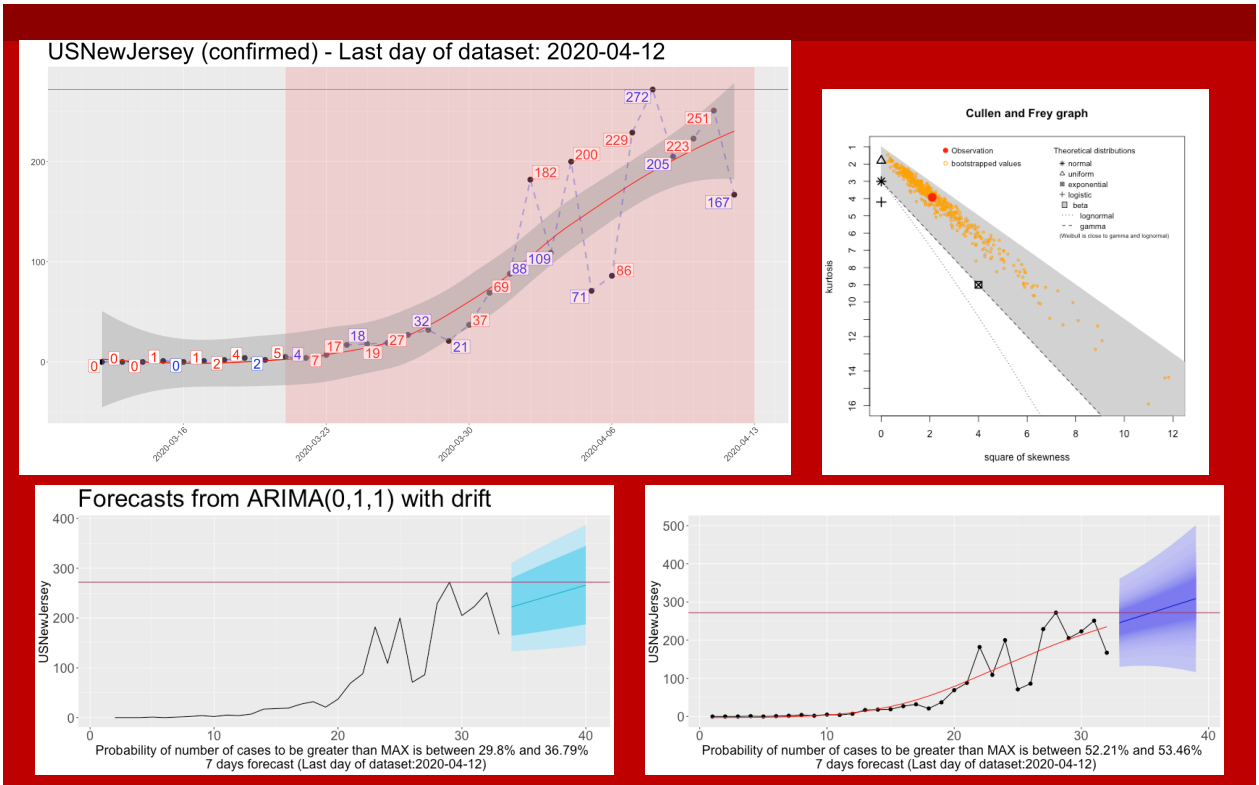


Estimation for future maximum after 6 - 13 days (04-18 - 04-25)
Estimation of number of cases: ARIMA [1962, 3768]

8.7.28 US New Jersey

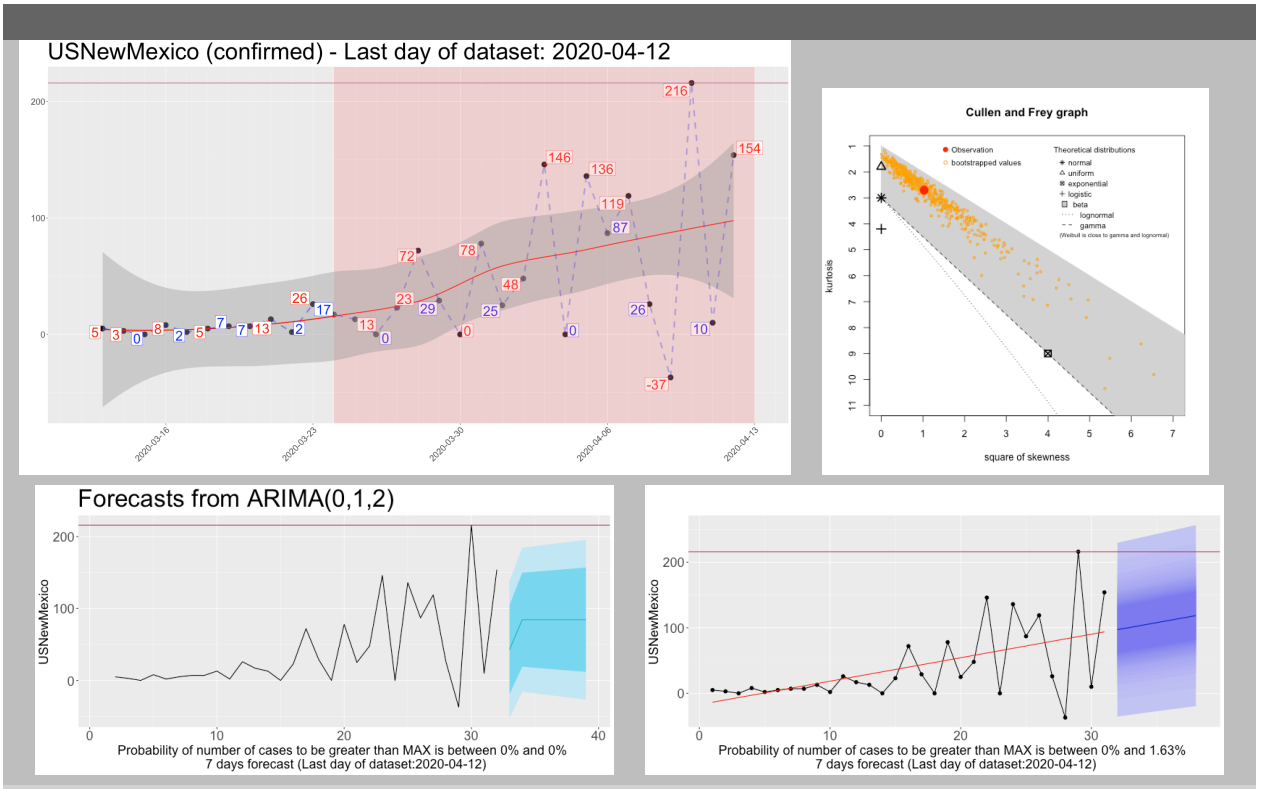


Estimation for future maximum after period around the maximum
Estimation of number of cases: ARIMA [129 077, 160 720]



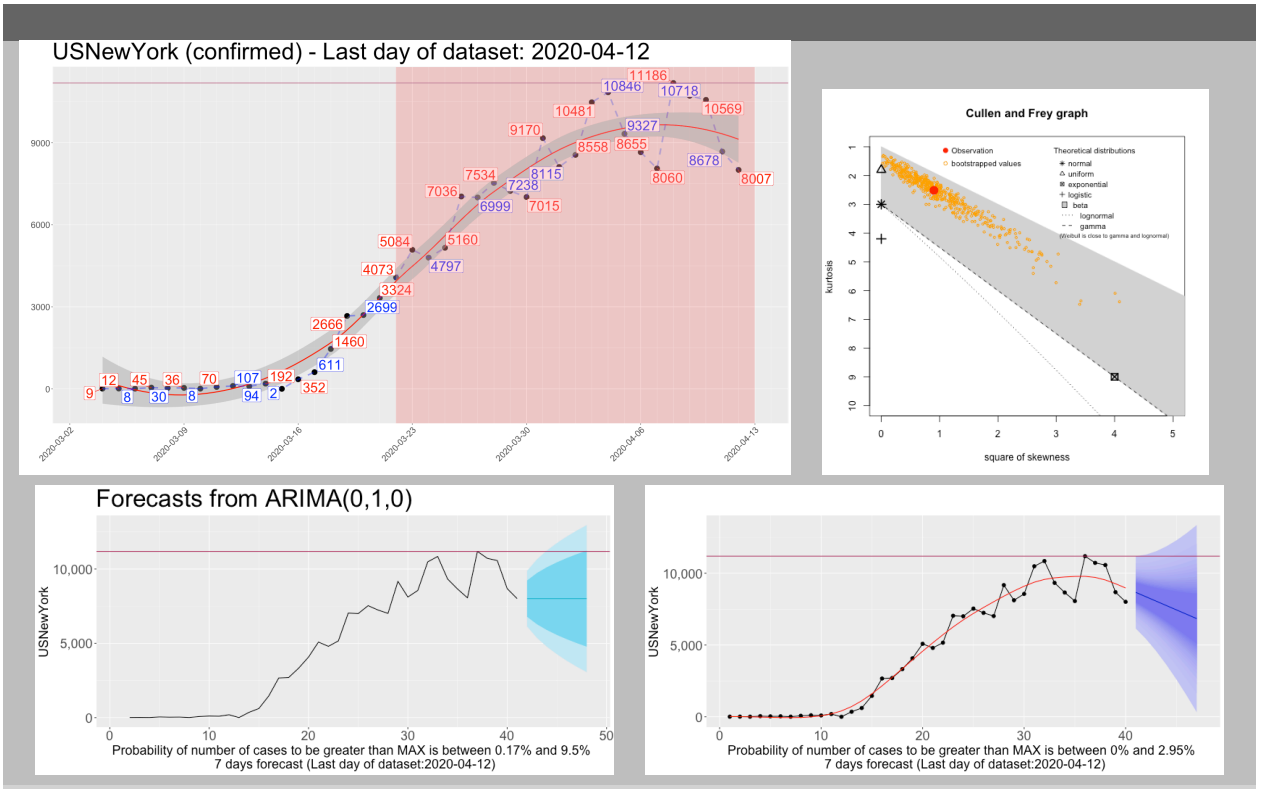
Estimation for future maximum after 6 - 10 days (04-18 - 04-22)
Estimation of number of cases: ARIMA [5895, 10922]

8.7.29 US New Mexico

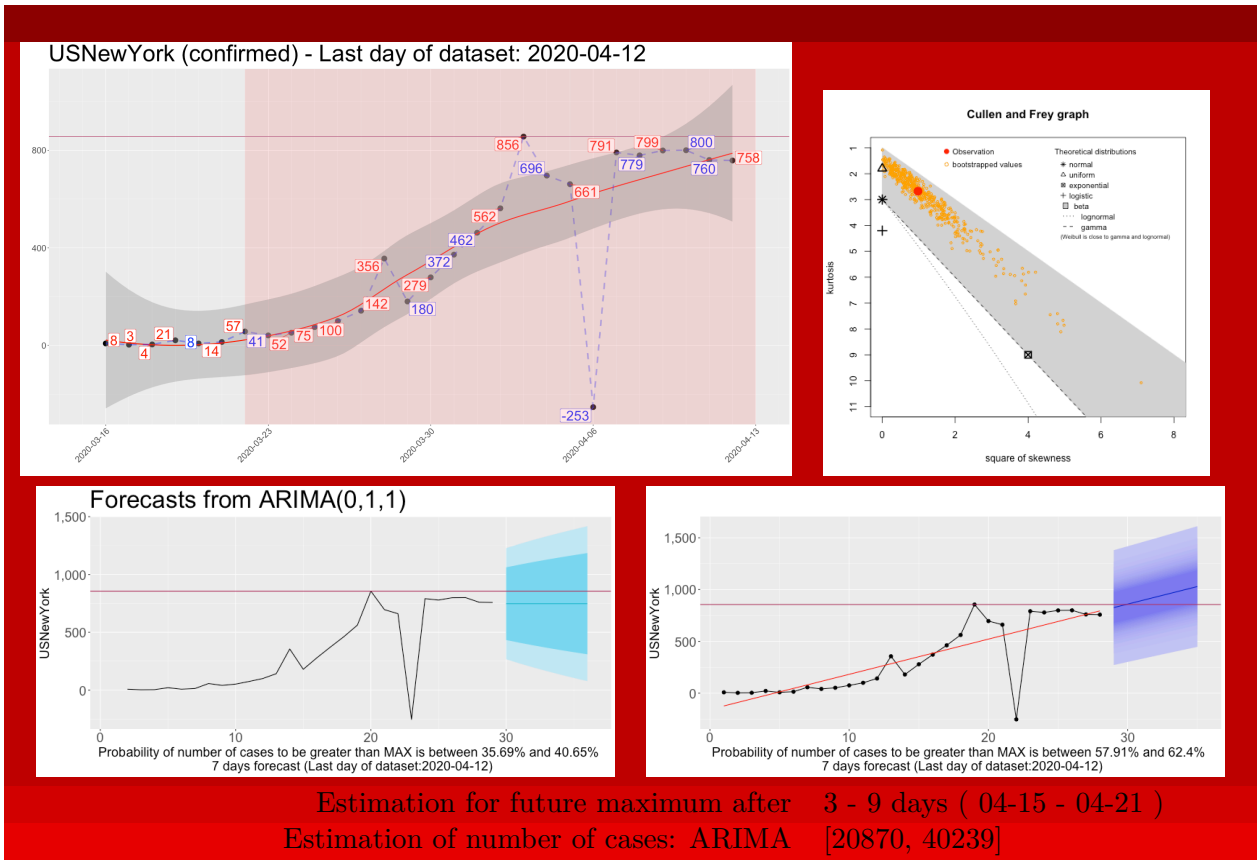


Estimation for future maximum after	2 - 9 days (04-14 - 04-21)
Estimation of number of cases: ARIMA	[2518, 4778]

8.7.30 US New York

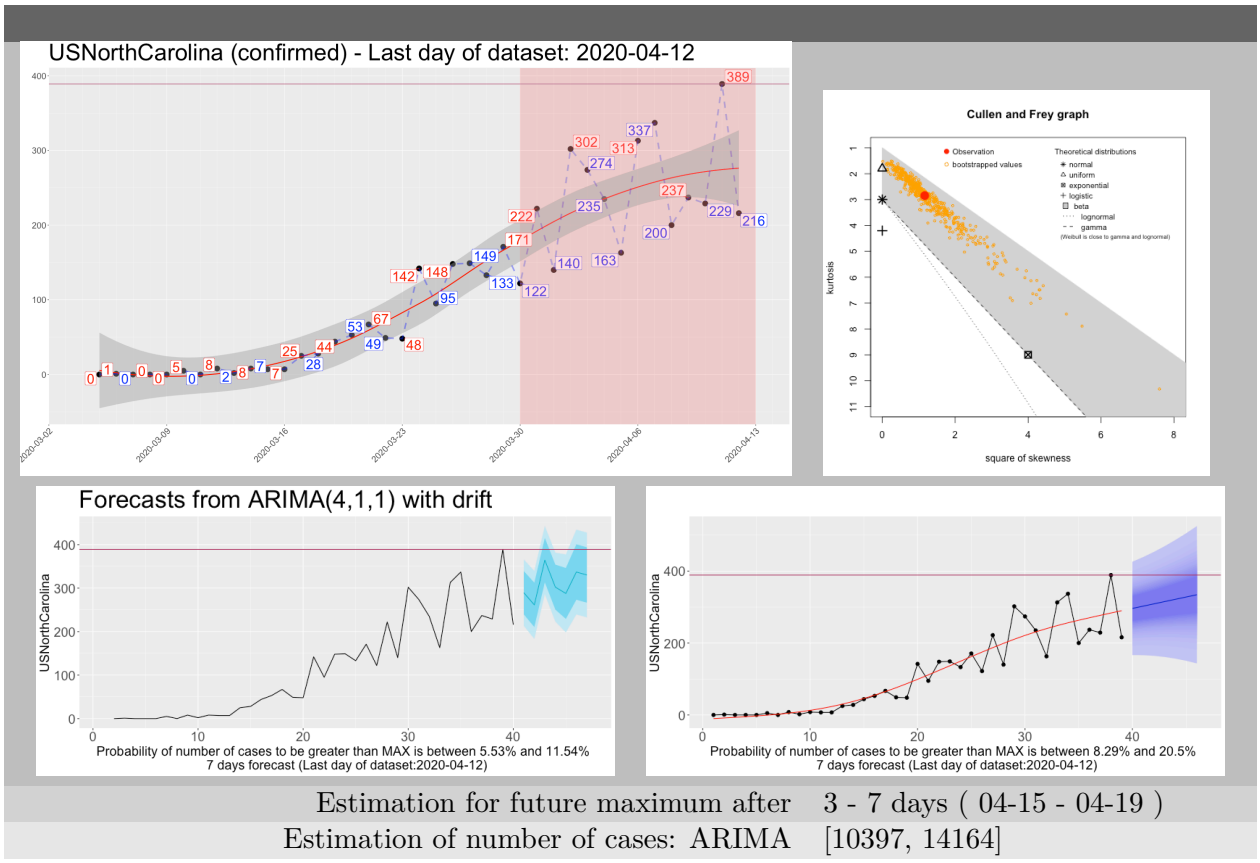


Maximum reached	2020-04-08
Estimation of number of cases: ARIMA	[189 033, 340 094



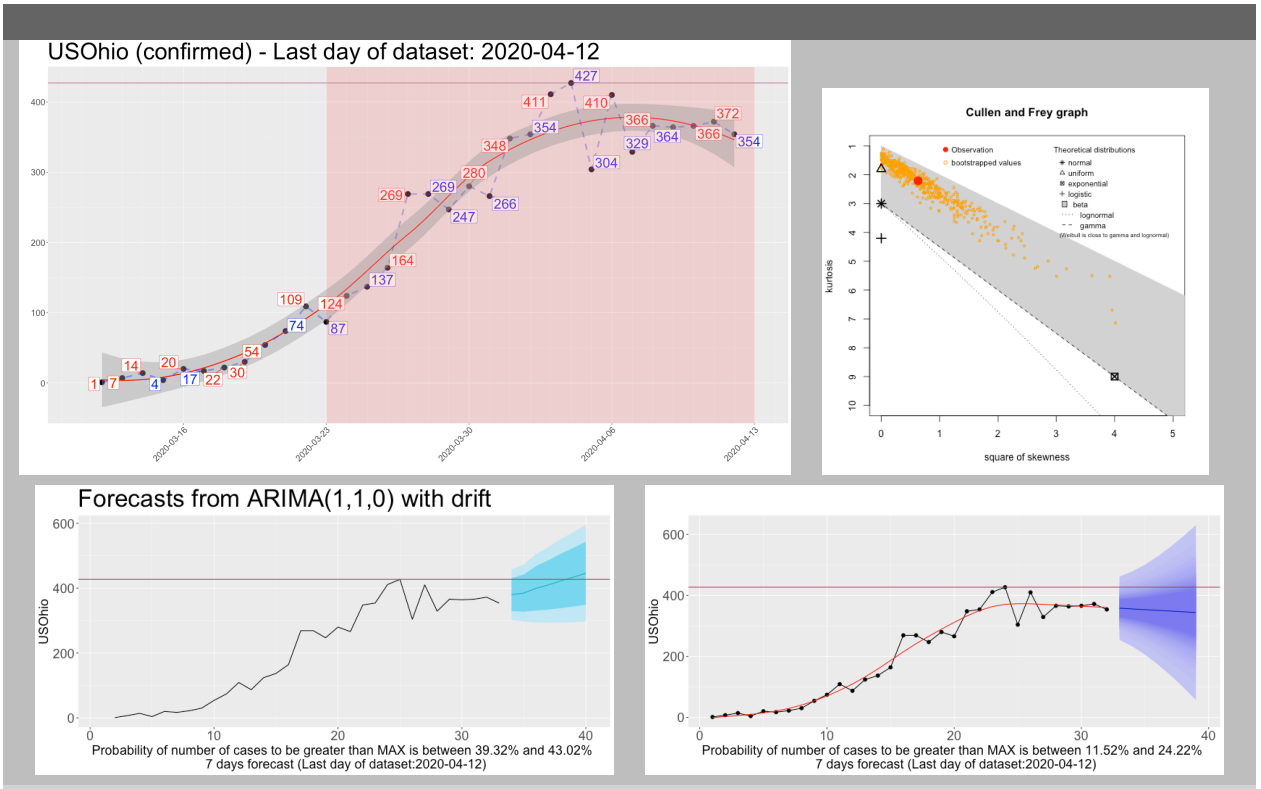
Estimation for future maximum after 3 - 9 days (04-15 - 04-21)
Estimation of number of cases: ARIMA [20870, 40239]

8.7.31 US North Carolina



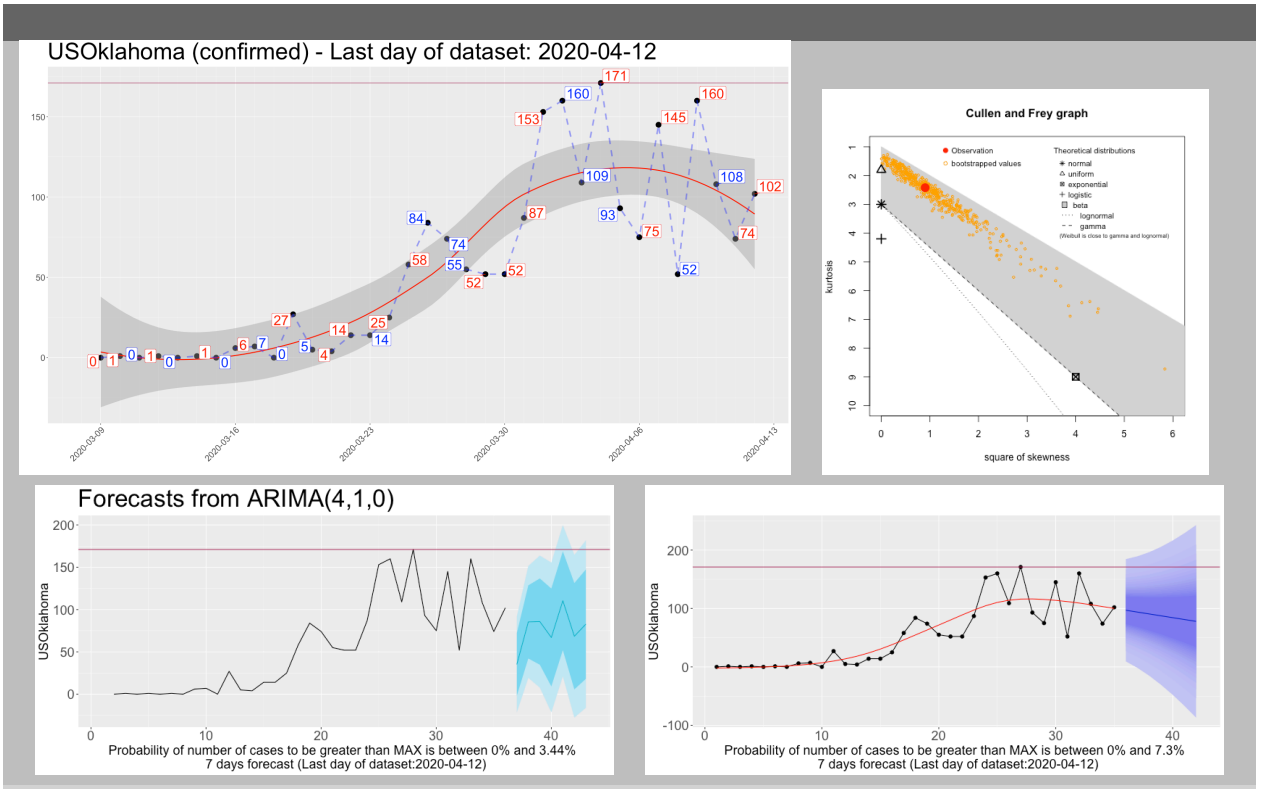
Estimation for future maximum after 3 - 7 days (04-15 - 04-19)
Estimation of number of cases: ARIMA [10397, 14164]

8.7.32 US Ohio



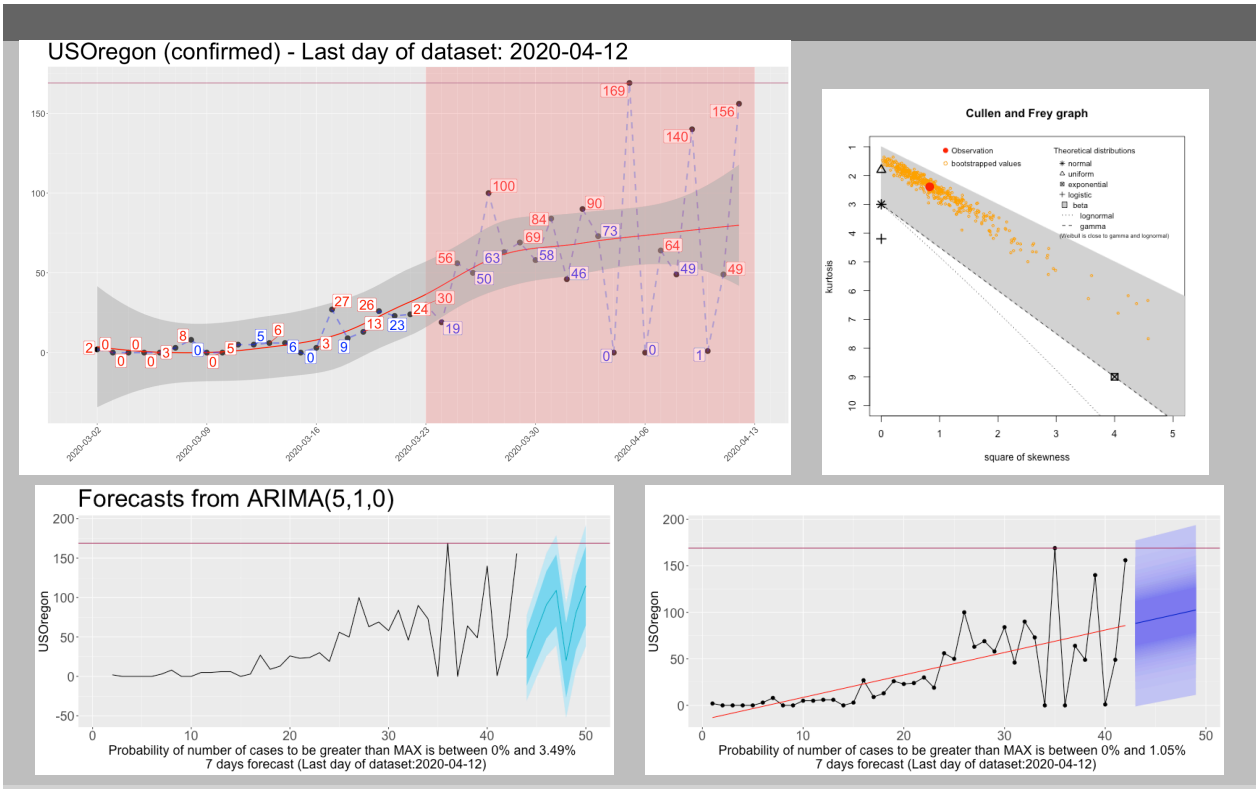
Estimation for future maximum after	period around the maximum
Estimation of number of cases: ARIMA	[13763, 18747]

8.7.33 US Oklahoma



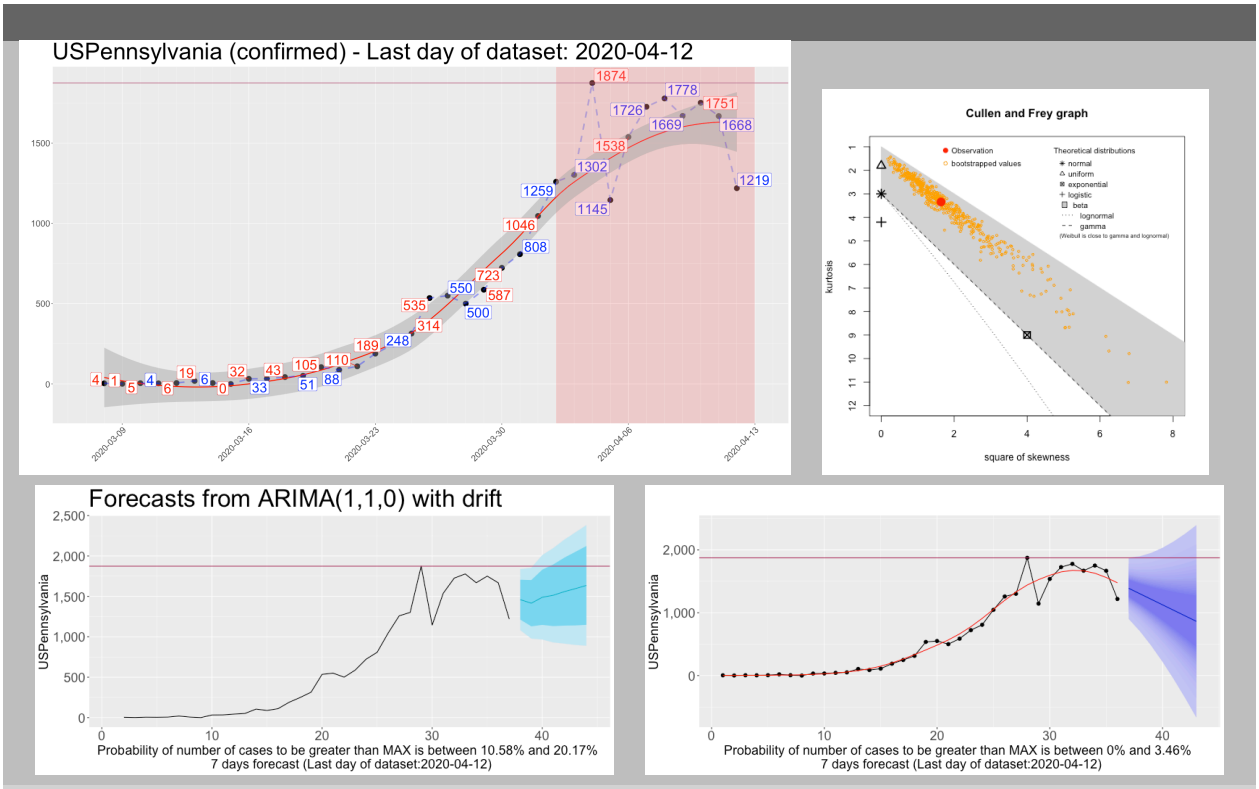
Estimation for future maximum after	period around the maximum
Estimation of number of cases: ARIMA	[3967, 6240]

8.7.34 US Oregon

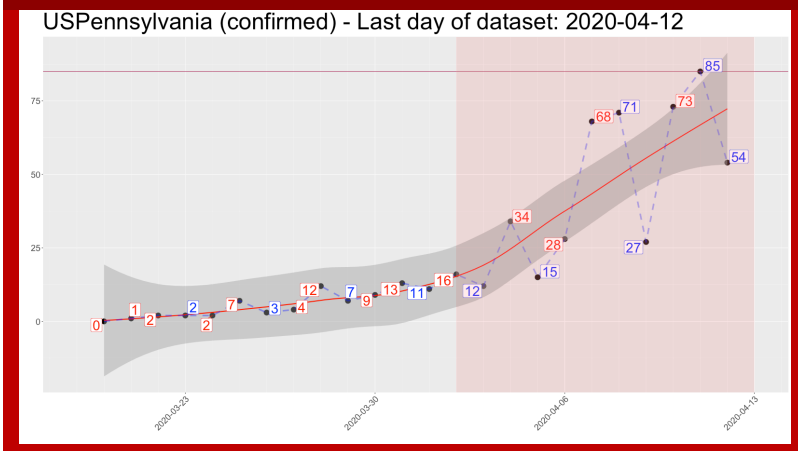


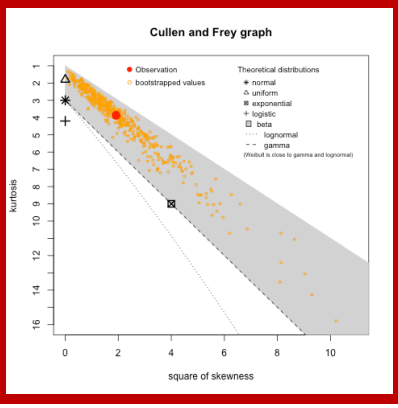
Estimation for future maximum after	2 - 6 days (04-14 - 04-18)
Estimation of number of cases: ARIMA	[3090, 4205]

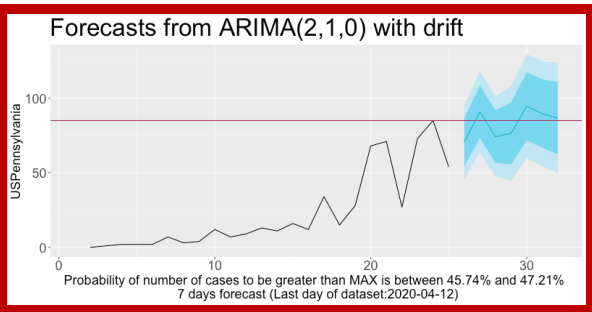
8.7.35 US Pennsylvania

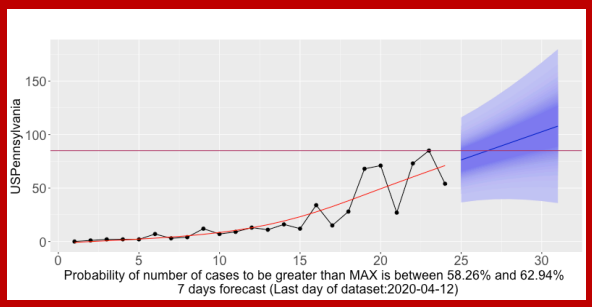


Estimation for future maximum after	period around the maximum
Estimation of number of cases: ARIMA	[22938, 33382]



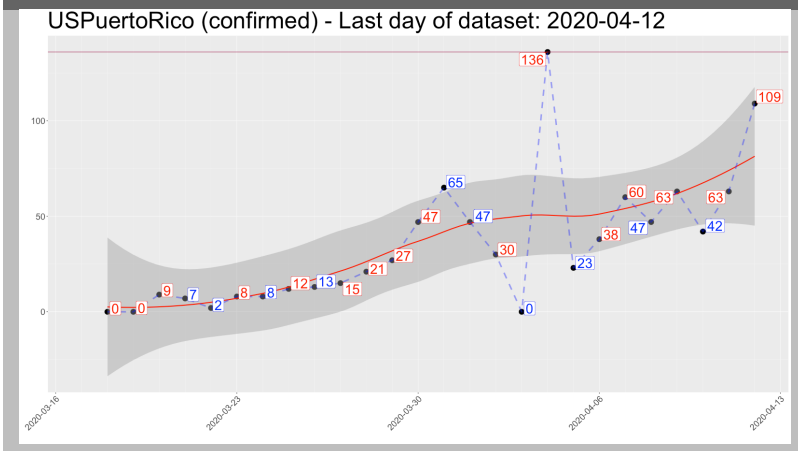


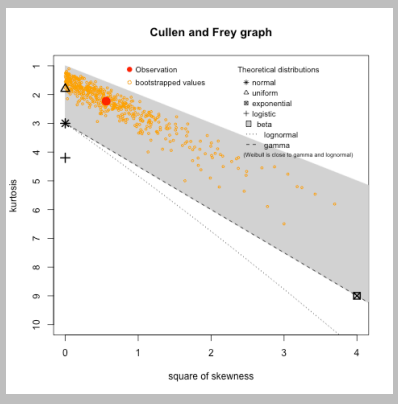


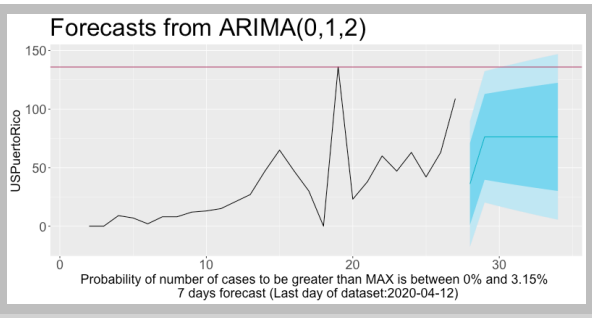


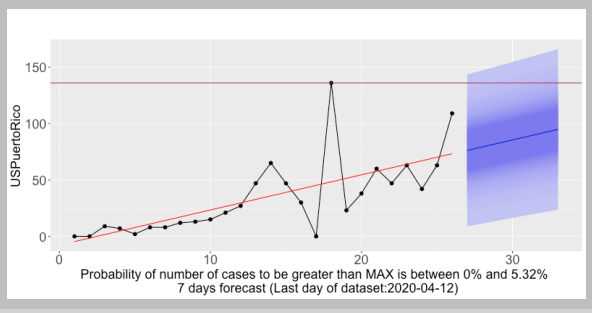
Estimation for future maximum after 4 - 9 days (04-16 - 04-21)
Estimation of number of cases: ARIMA [1454, 2830]

8.7.36 US Puerto Rico



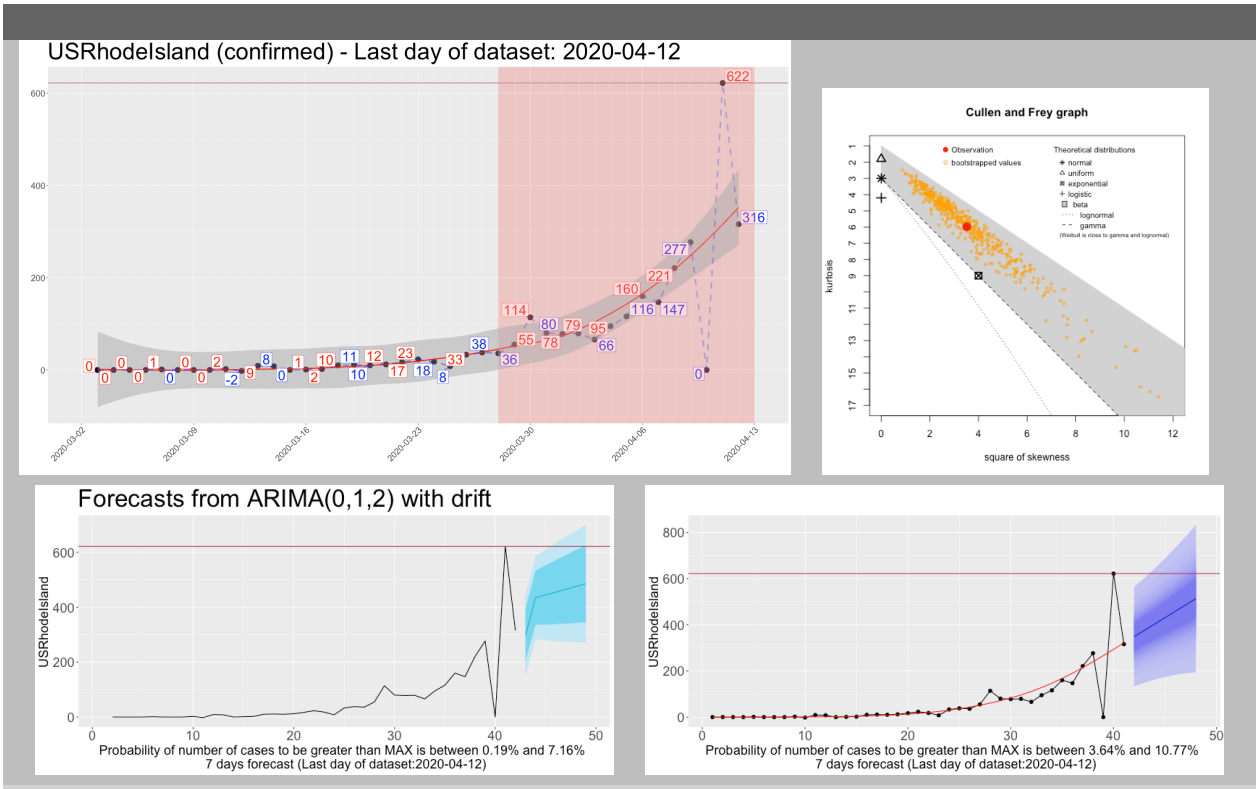






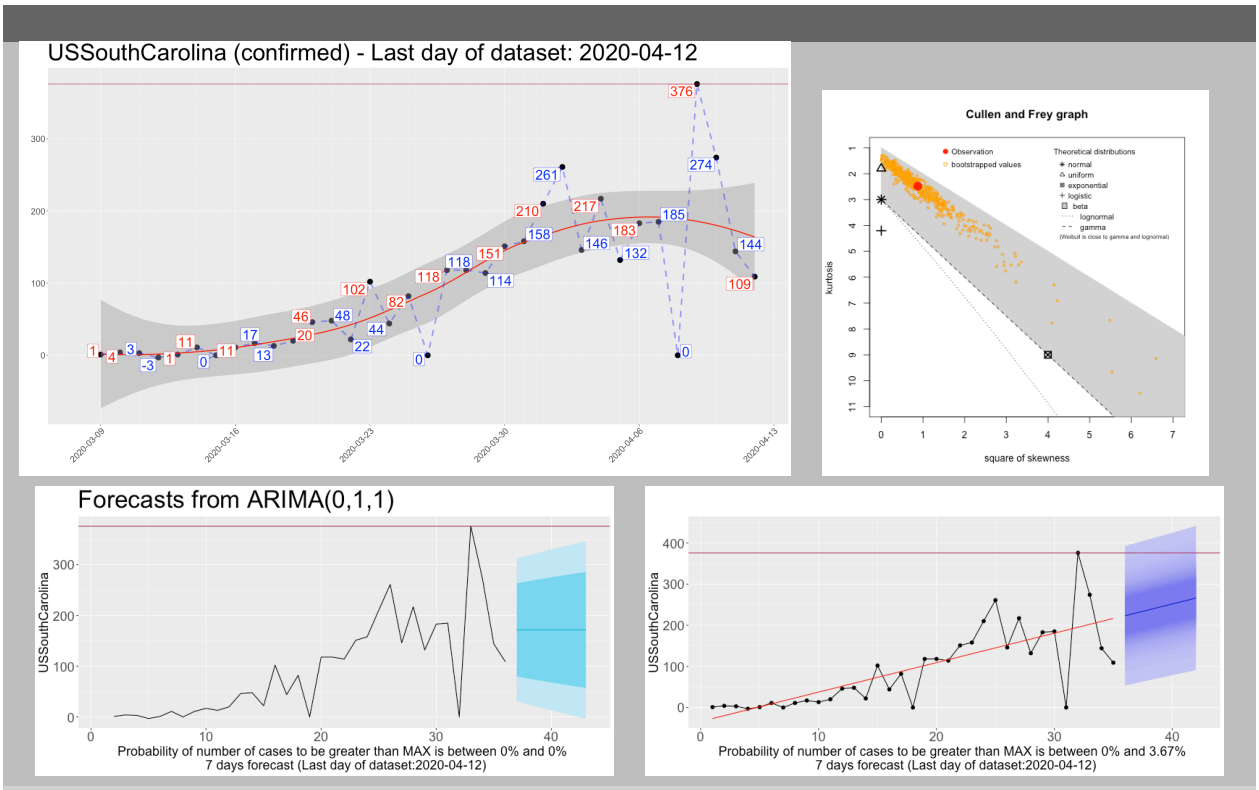
Estimation for future maximum after 3 - 11 days (04-15 - 04-23)
Estimation of number of cases: ARIMA [2000, 4254]

8.7.37 US Rhode Island



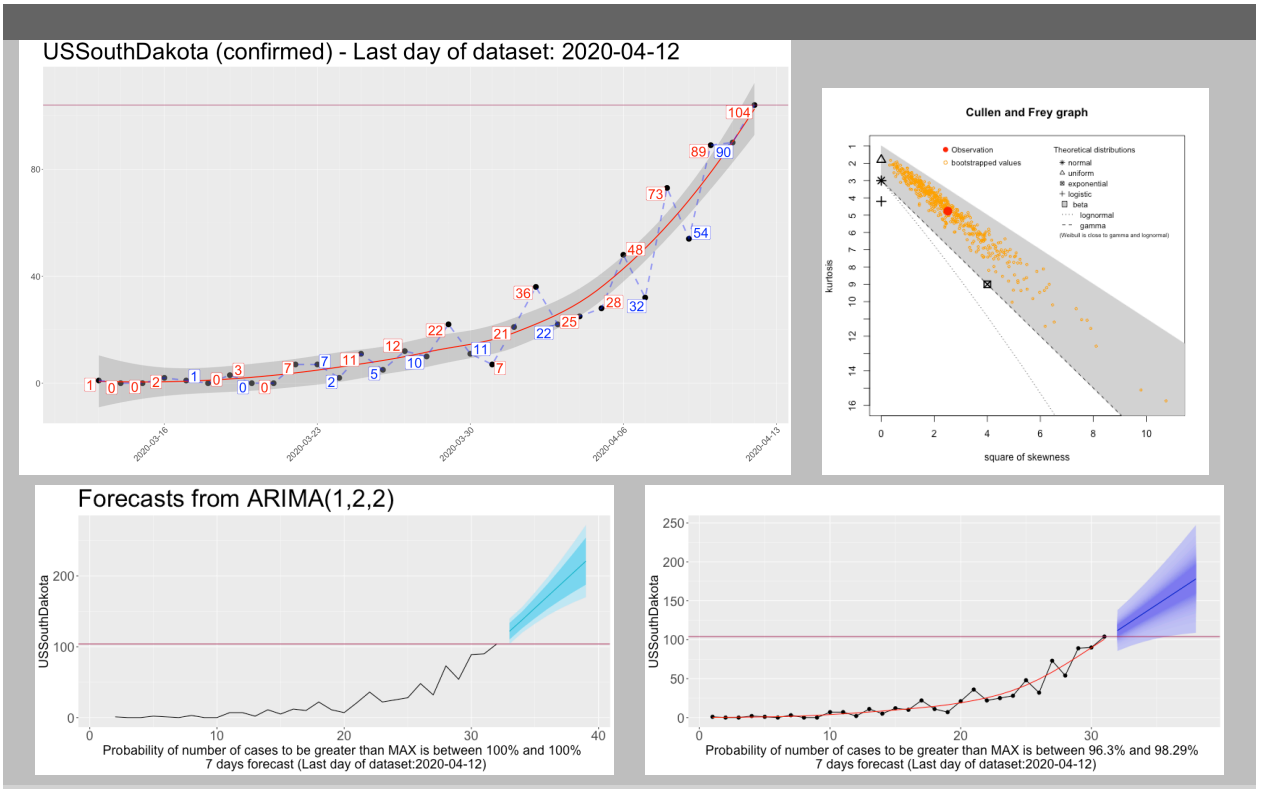
Estimation for future maximum after 3 - 9 days (04-15 - 04-21)
Estimation of number of cases: ARIMA [7057, 14950]

8.7.38 US South Carolina



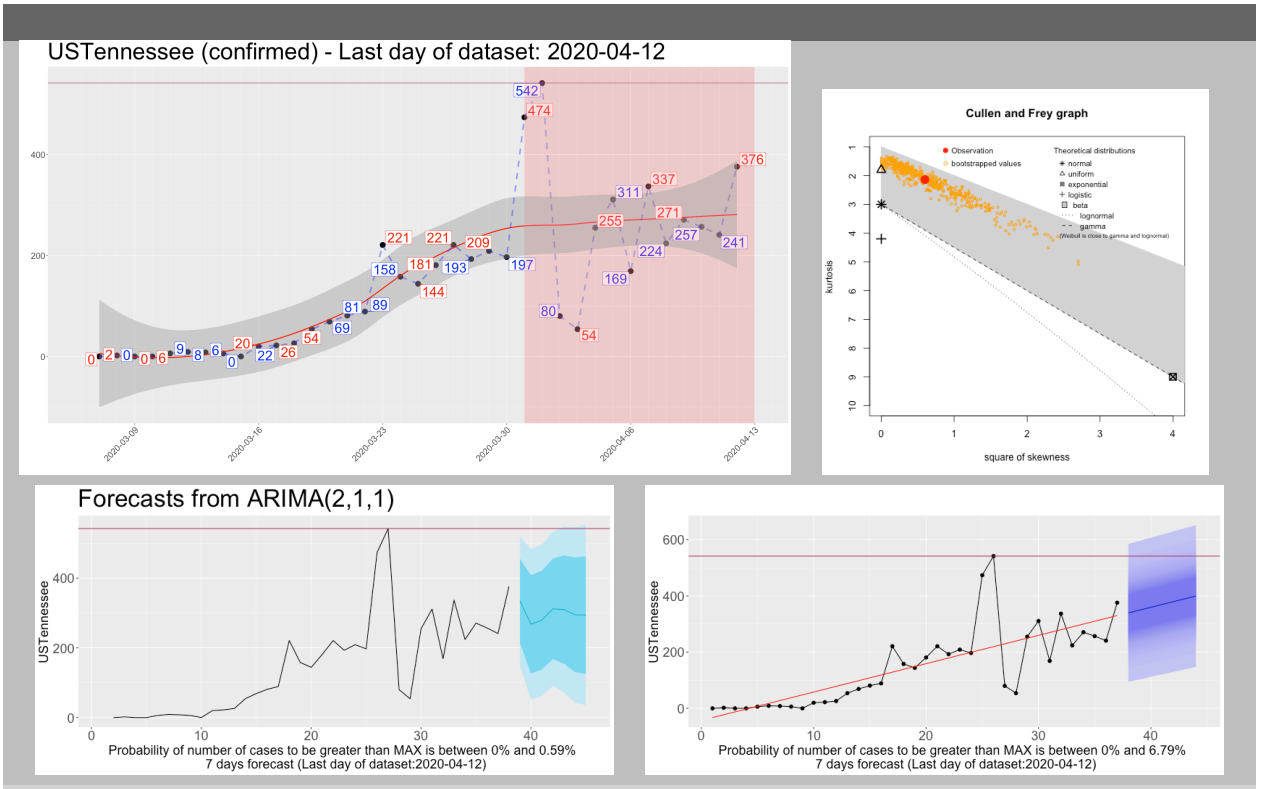
Estimation for future maximum after 4 - 9 days (04-16 - 04-21)
Estimation of number of cases: ARIMA [7174, 11701]

8.7.39 US South Dakota



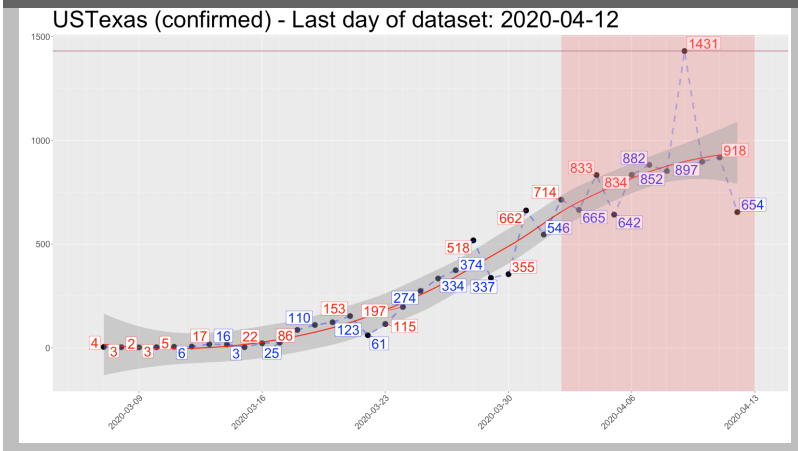
Estimation for future maximum after	6 - 15 days (04-18 - 04-27)
Estimation of number of cases: ARIMA	[2584, 7692]

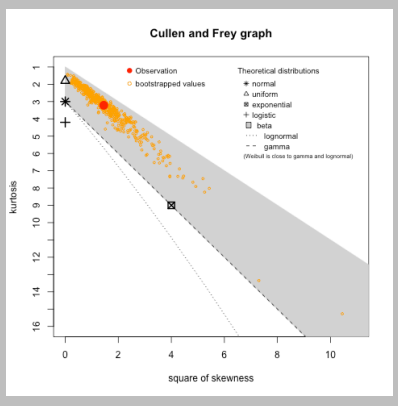
8.7.40 US Tennessee

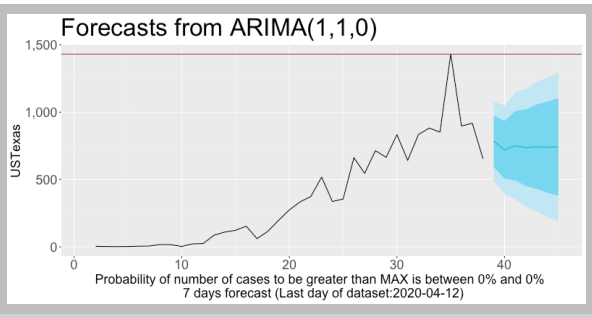


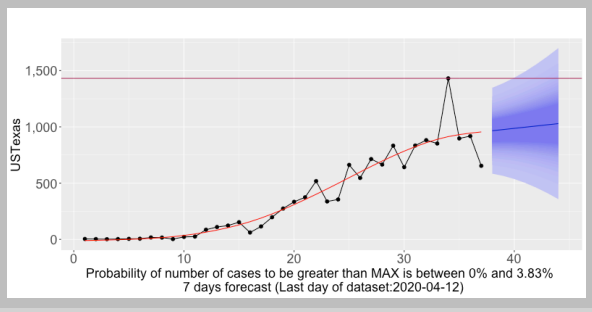
Estimation for future maximum after	period around the maximum
Estimation of number of cases: ARIMA	[11317, 26626]

8.7.41 US Texas



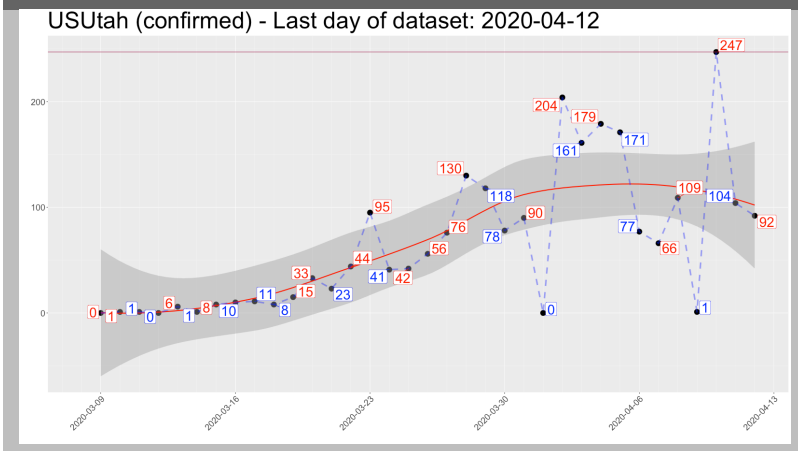


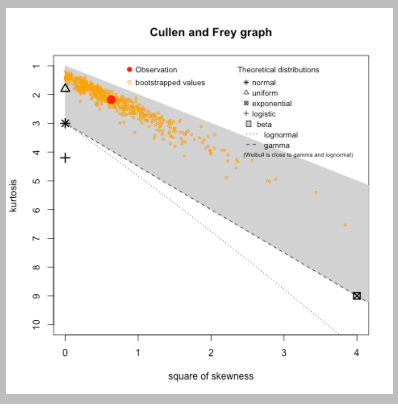


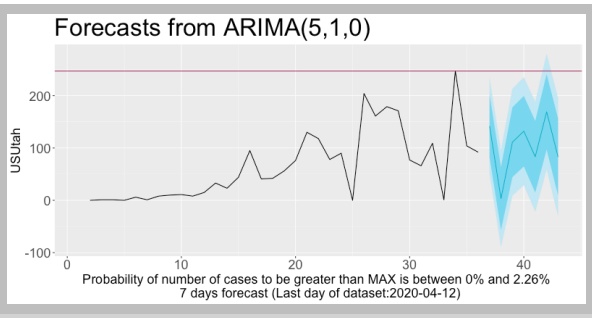


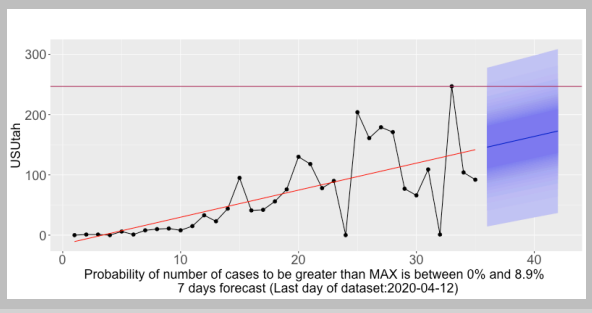
Estimation for future maximum after	3 - 7 days (04-15 - 04-19)
Estimation of number of cases: ARIMA	[30170, 42740]

8.7.42 US Utah



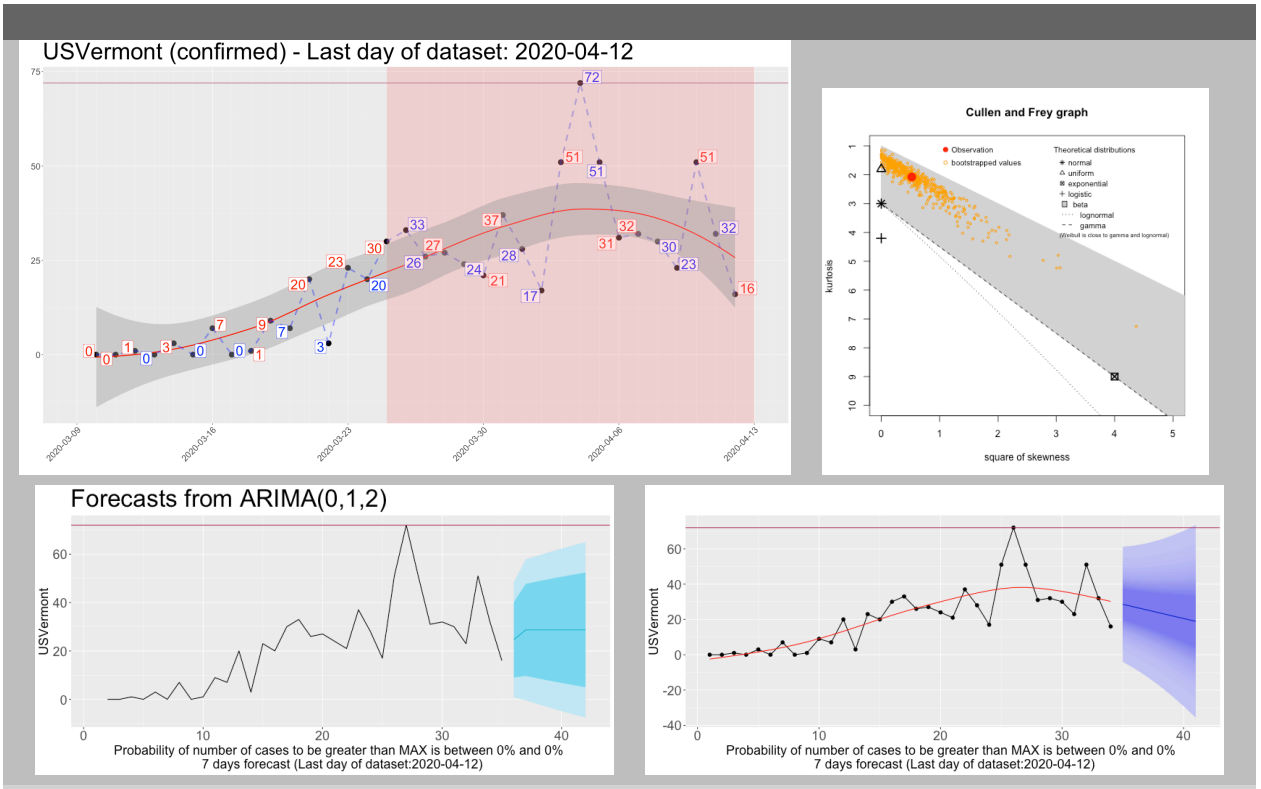






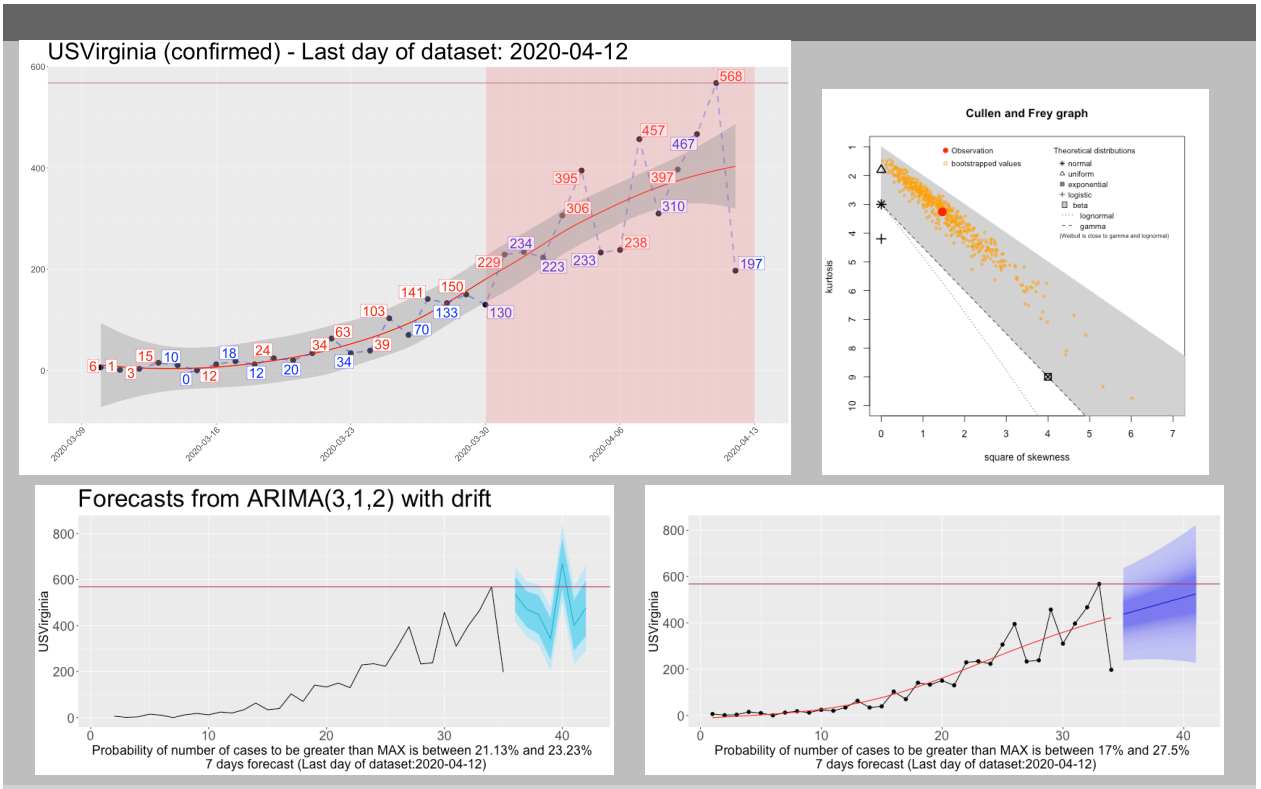
Estimation for future maximum after	5 - 13 days (04-17 - 04-25)
Estimation of number of cases: ARIMA	[4955, 8888]

8.7.43 US Vermont



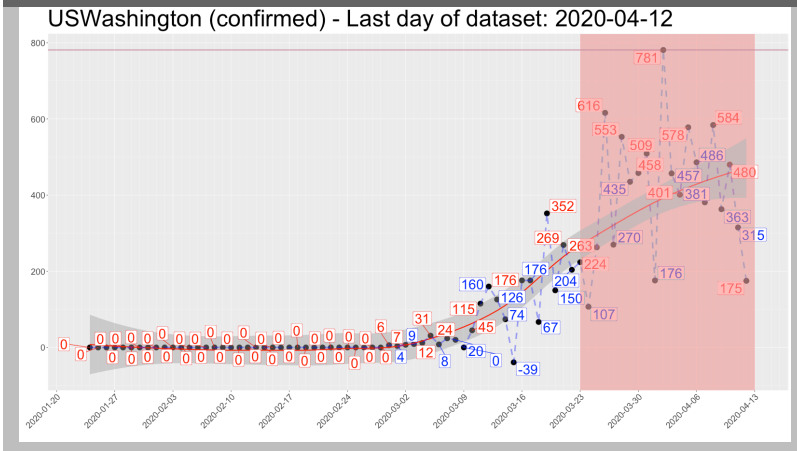
Maximum reached	2020-04-04
Estimation of number of cases: ARIMA	[727, 1188]

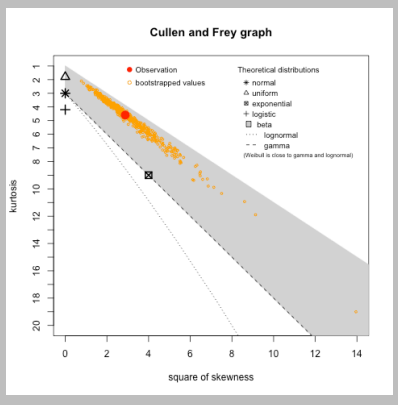
8.7.44 US Virginia

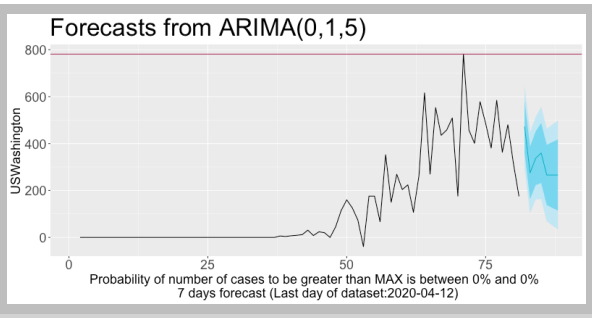


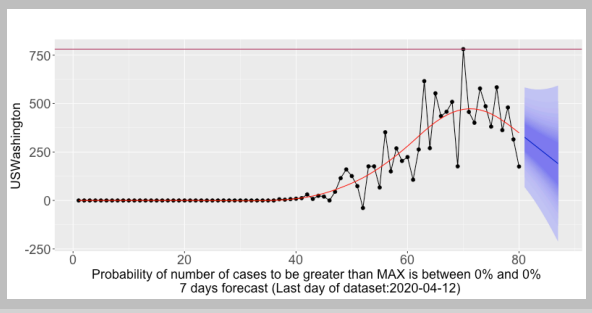
Estimation for future maximum after	5 - 12 days (04-17 - 04-24)
Estimation of number of cases: ARIMA	[13222, 24082]

8.7.45 US Washington



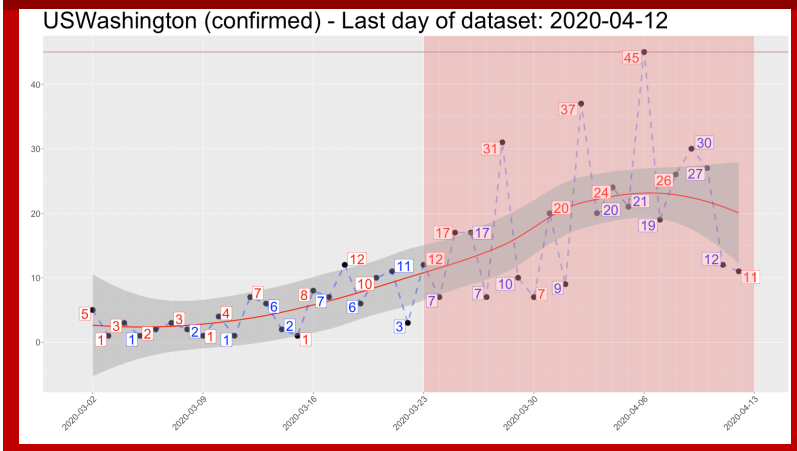


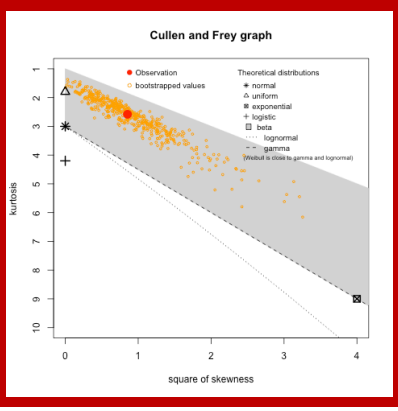


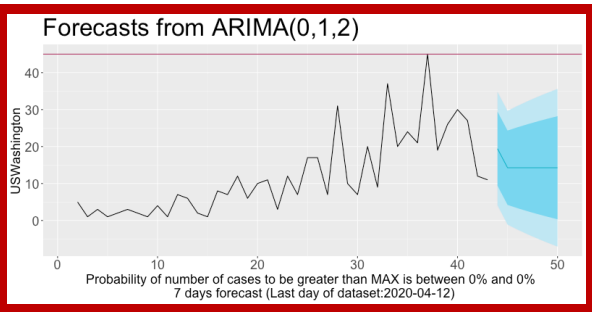


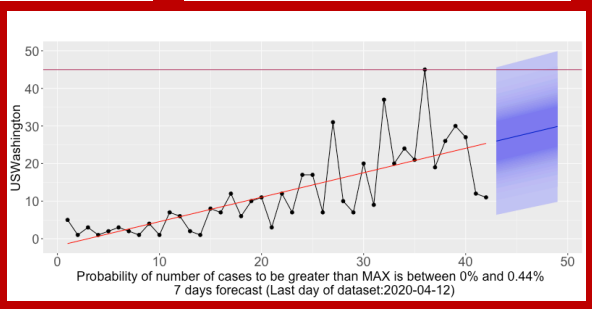
Maximum reached 2020-04-02

Estimation of number of cases: ARIMA [10609, 16998]





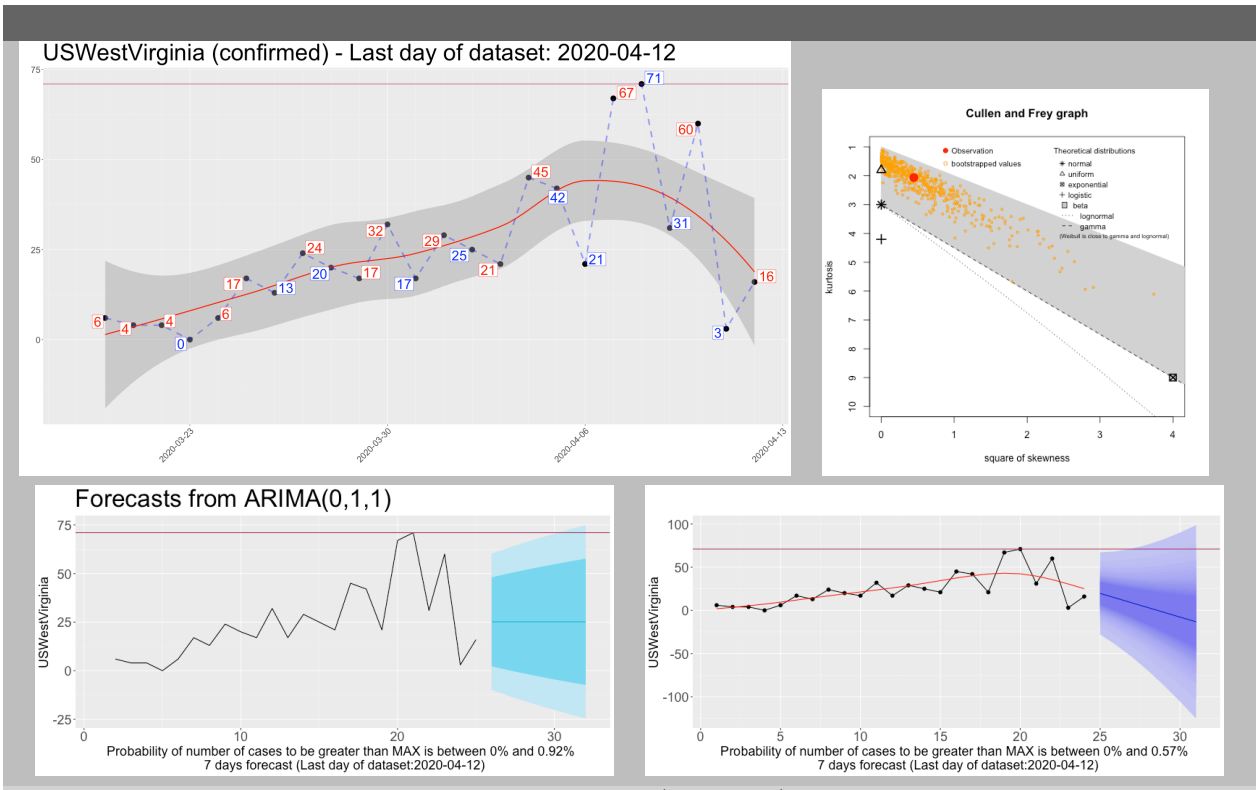




Estimation for future maximum after 3 - 7 days (04-15 - 04-19)

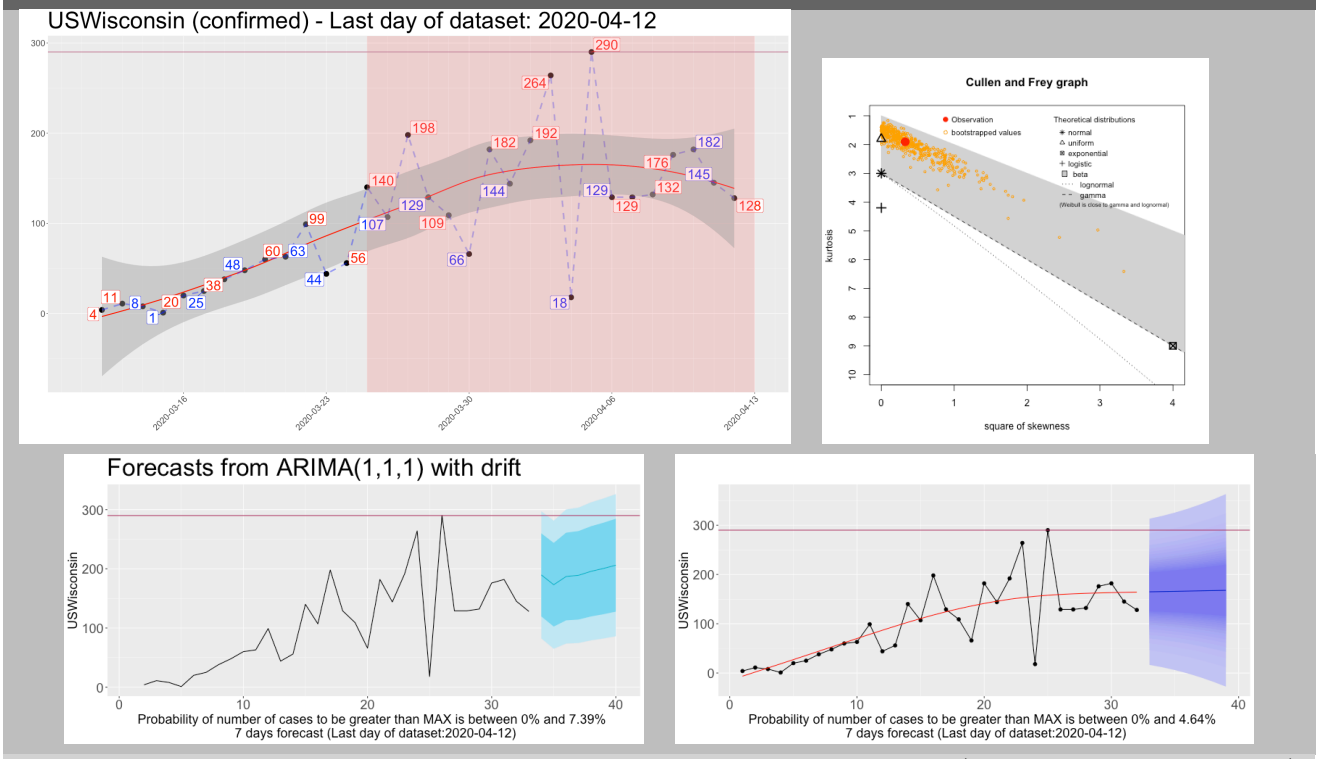
Estimation of number of cases: ARIMA [1043, 1397]

8.7.46 US West Virginia



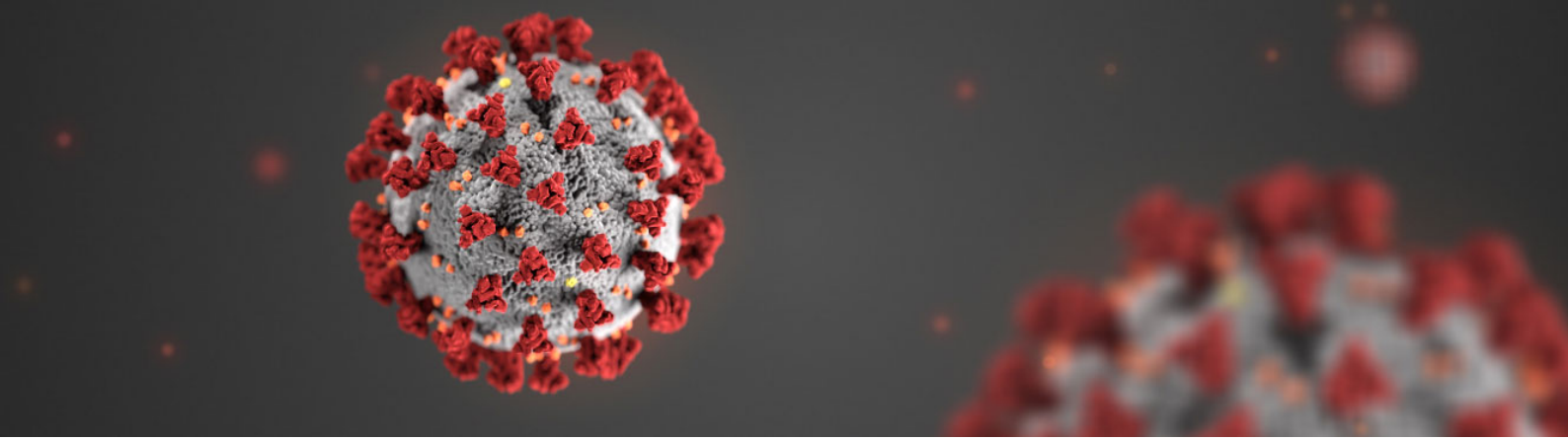
Maximum reached (probably)	2020-04-08
Estimation of number of cases: ARIMA	[593, 1076]

8.7.47 US Wisconsin



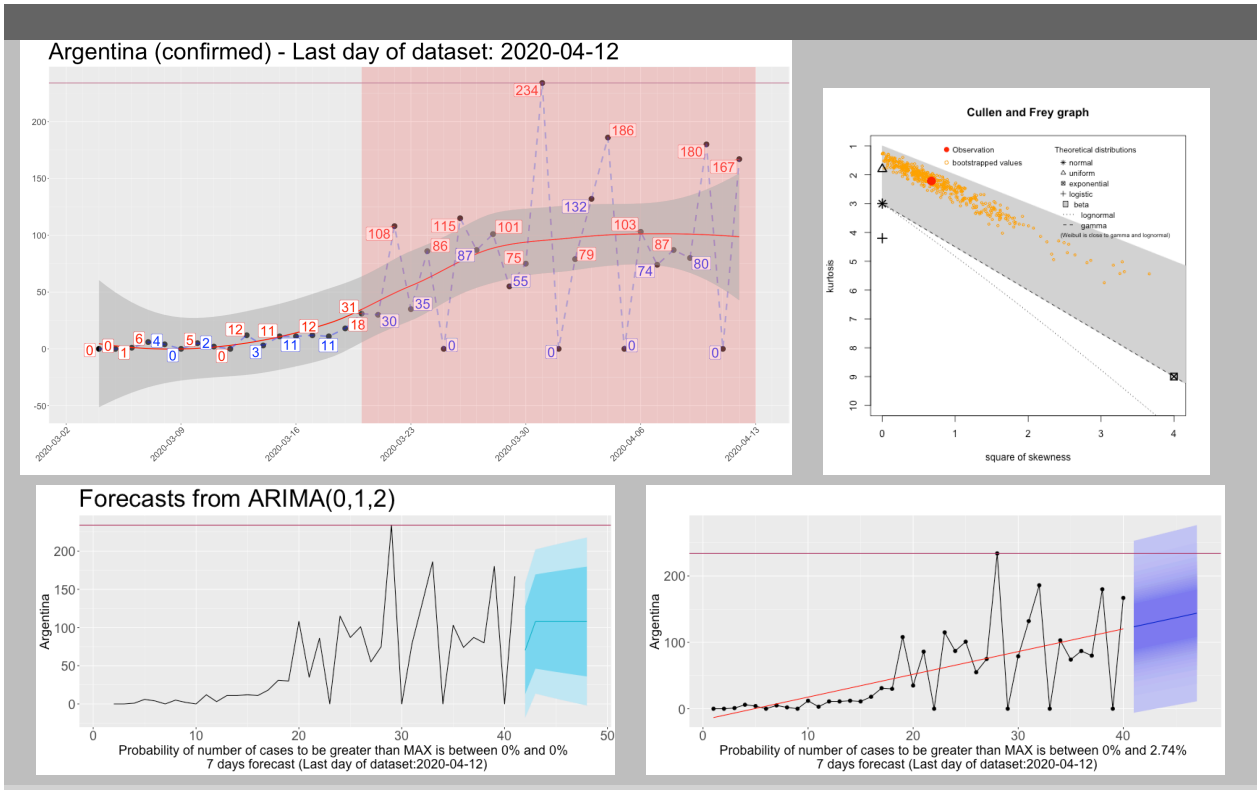
Estimation for future maximum after	2 - 6 days (2020-04-14 - 2020-04-18)
Estimation of number of cases: ARIMA	[6990, 9379]

VII South America



9. South America

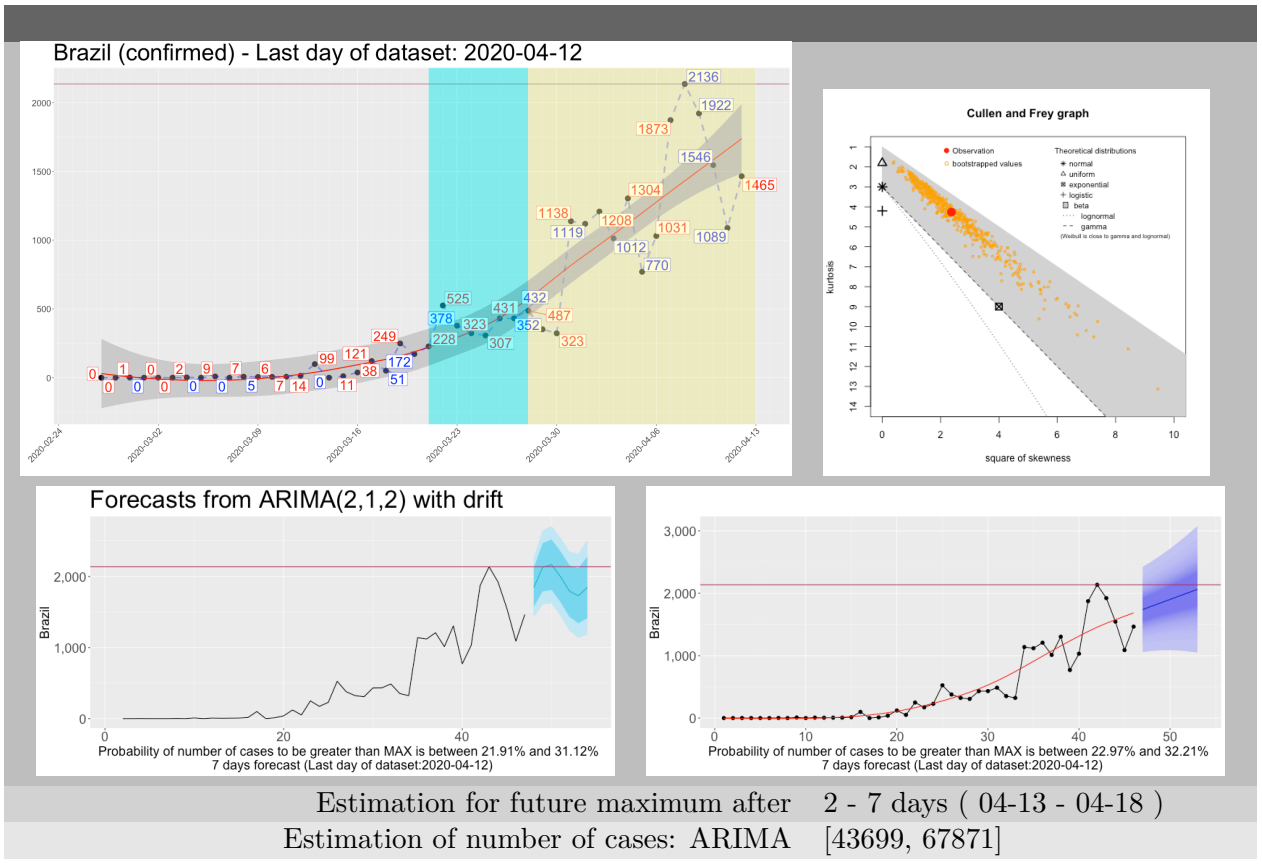
9.1 Argentina



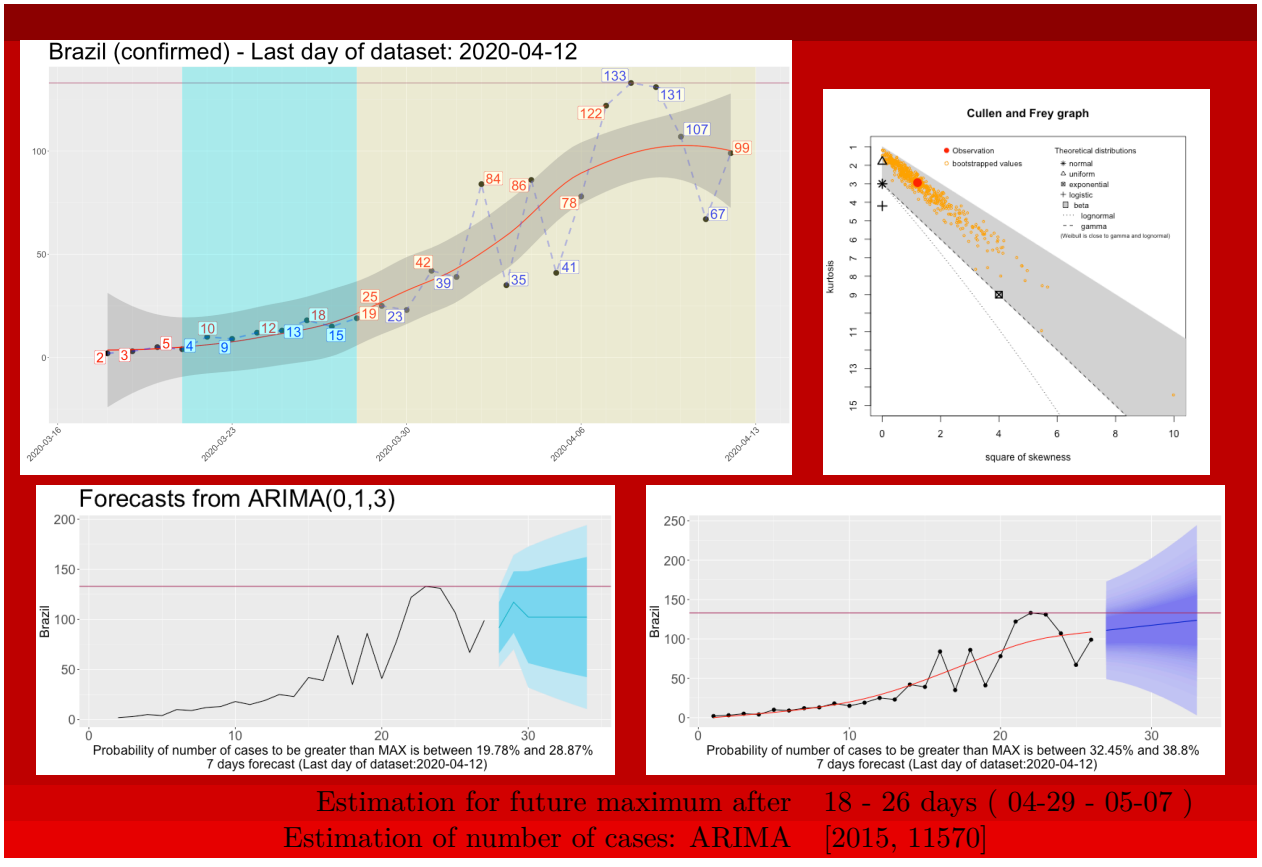
Estimation for future maximum after period around the maximum
Estimation of number of cases: ARIMA [1975, 3029]

In Argentina the imposition of Phase 3 measures on March 20^{th} did not change the dynamics of the exponential growth rate the cases follow.

9.2 Brazil

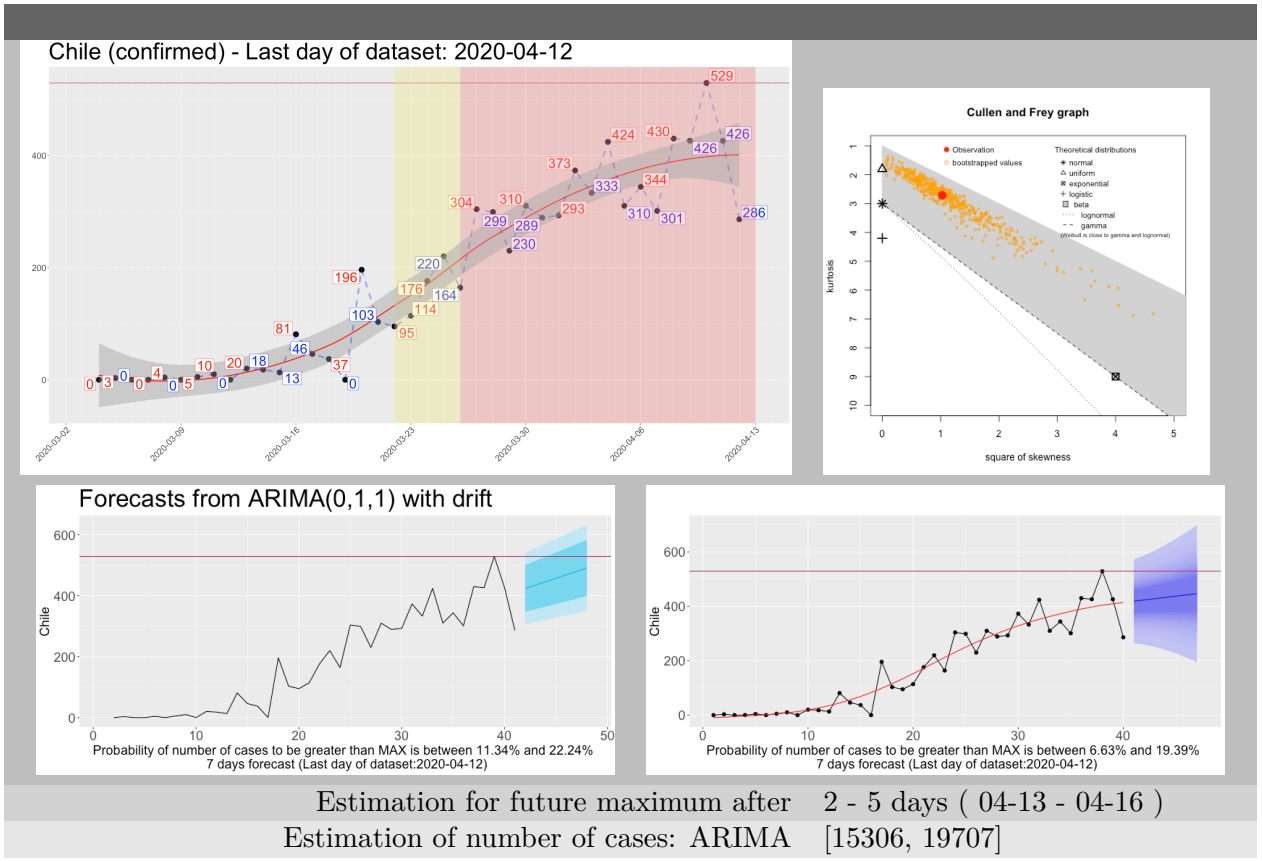


Estimation for future maximum after 2 - 7 days (04-13 - 04-18)
Estimation of number of cases: ARIMA [43699, 67871]



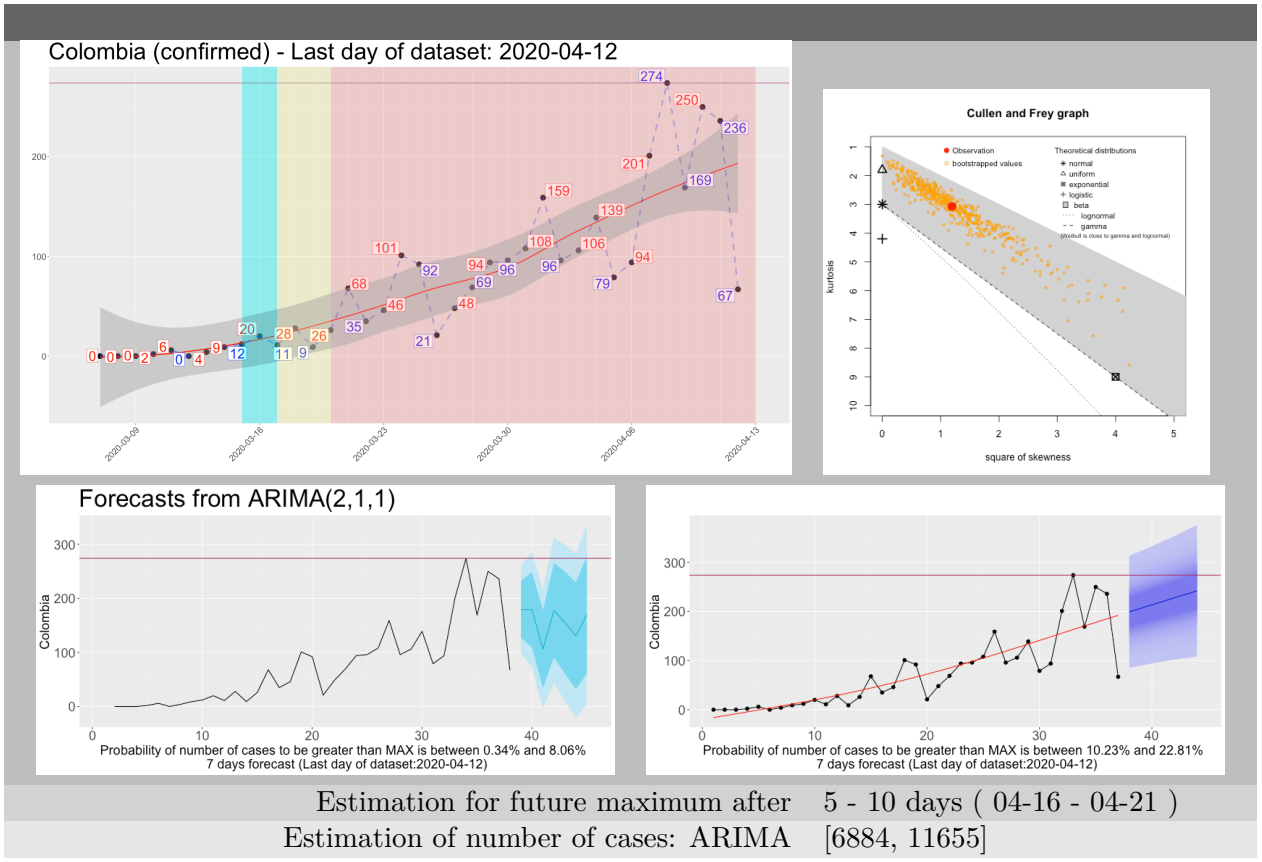
Estimation for future maximum after 18 - 26 days (04-29 - 05-07)
Estimation of number of cases: ARIMA [2015, 11570]

9.3 Chile



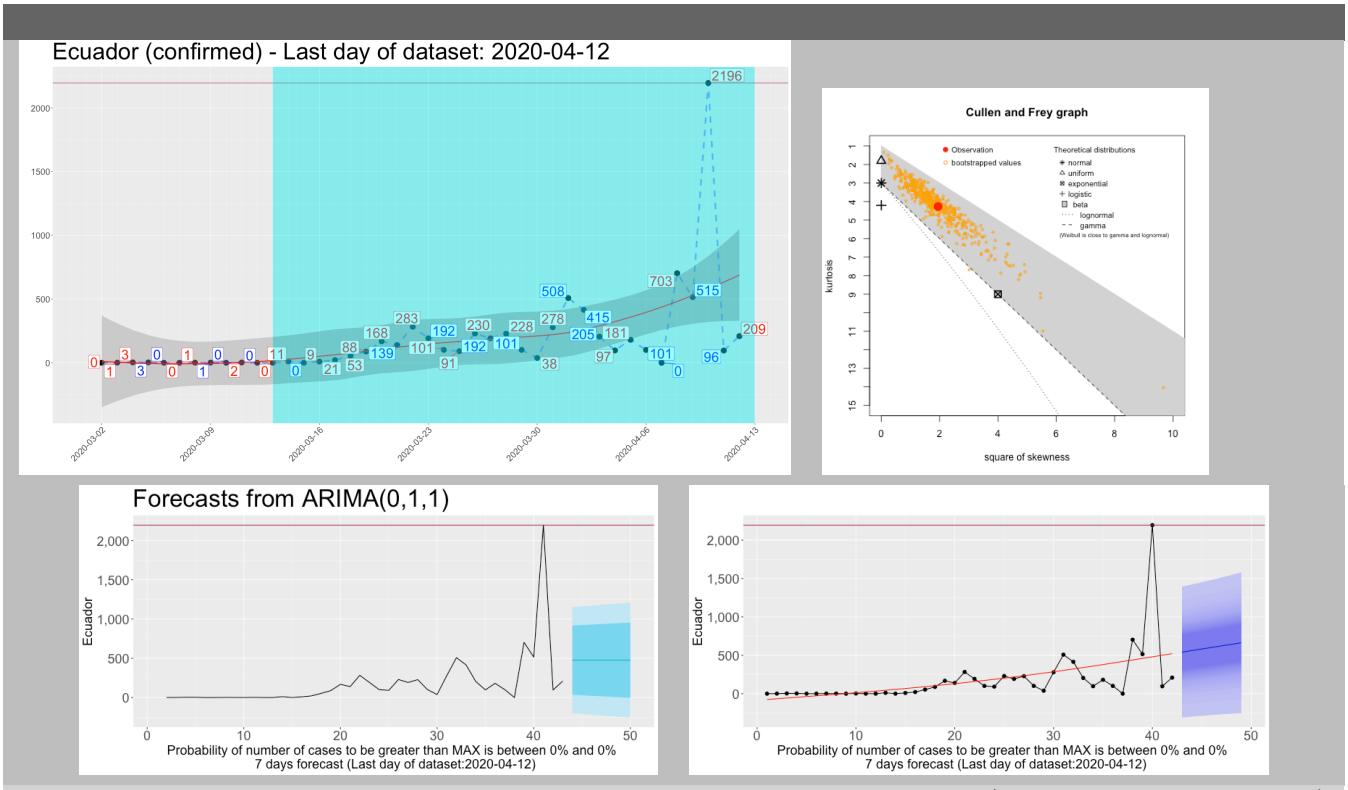
Estimation for future maximum after 2 - 5 days (04-13 - 04-16)
Estimation of number of cases: ARIMA [15306, 19707]

9.4 Colombia



Estimation for future maximum after 5 - 10 days (04-16 - 04-21)
Estimation of number of cases: ARIMA [6884, 11655]

9.5 Ecuador

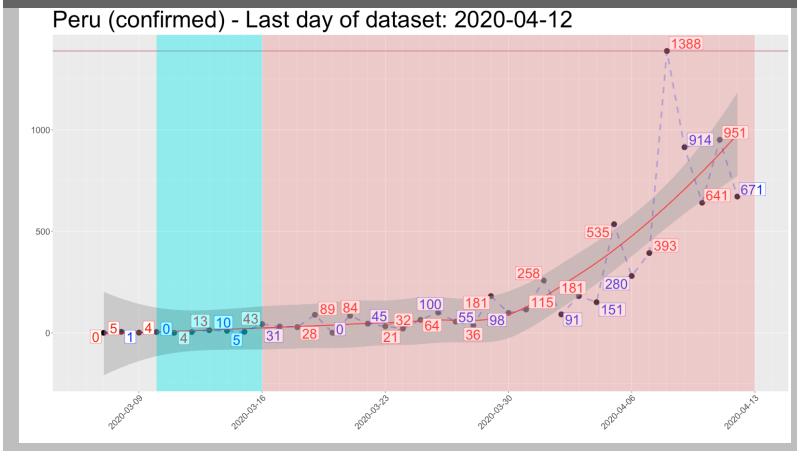


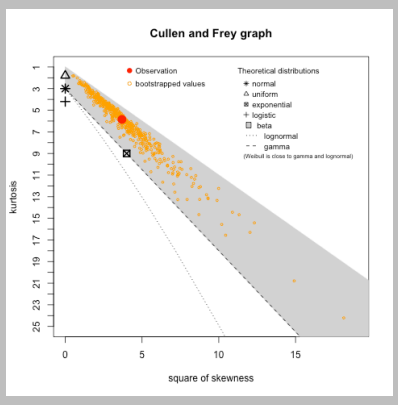
Estimation for future maximum after 11 - 17 days (2020-04-22 - 2020-04-28)
Estimation of number of cases: ARIMA [17679, 49799]

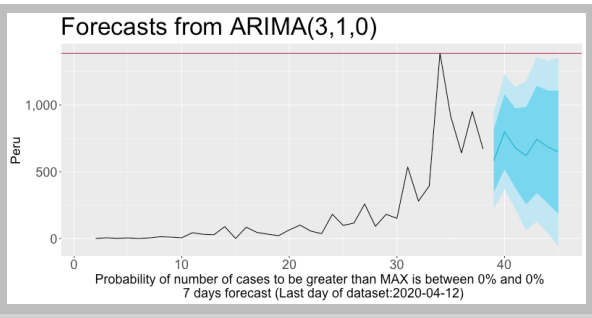
In Ecuador, although only Phase 1 measures were imposed, the exponential growth rate is not large.

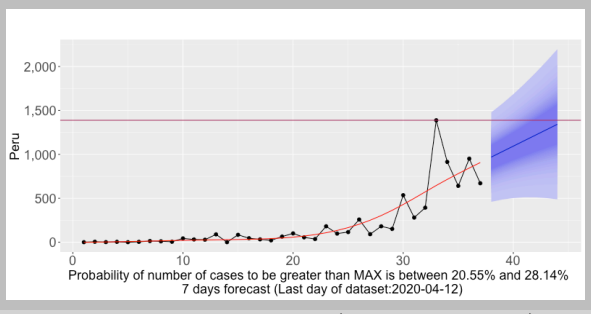
In Ecuador, the extremely large number of cases announced on April 10 affects the forecast and makes it unstable.

9.6 Peru





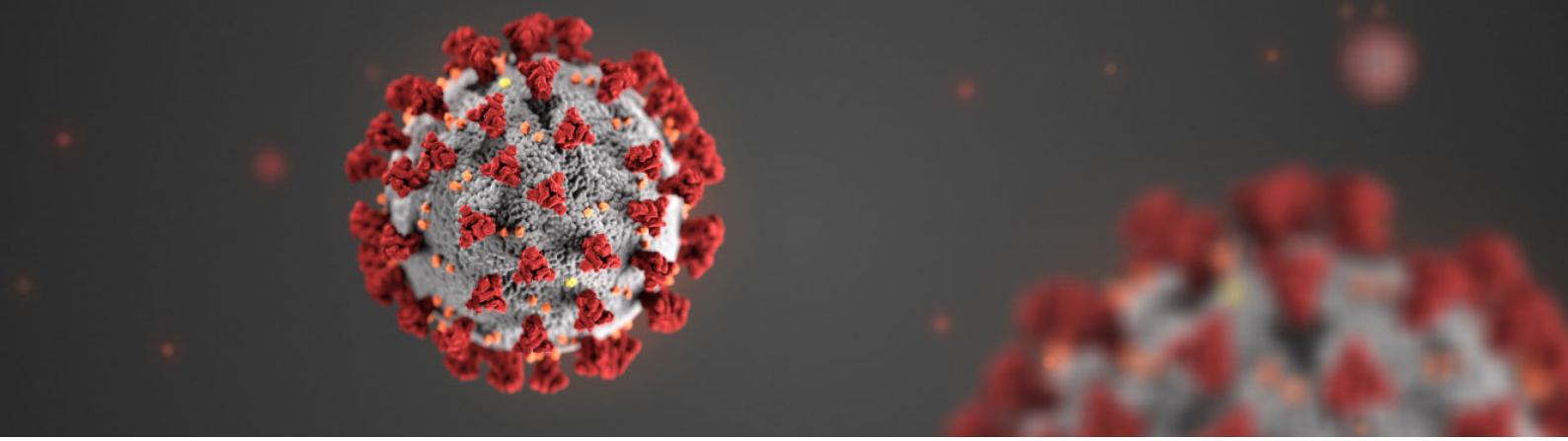




Estimation for future maximum after 4 - 10 days (04-15 - 04-21)

Estimation of number of cases: ARIMA [18178, 39178]

VIII Conclusion and Further Research



10. Conclusion

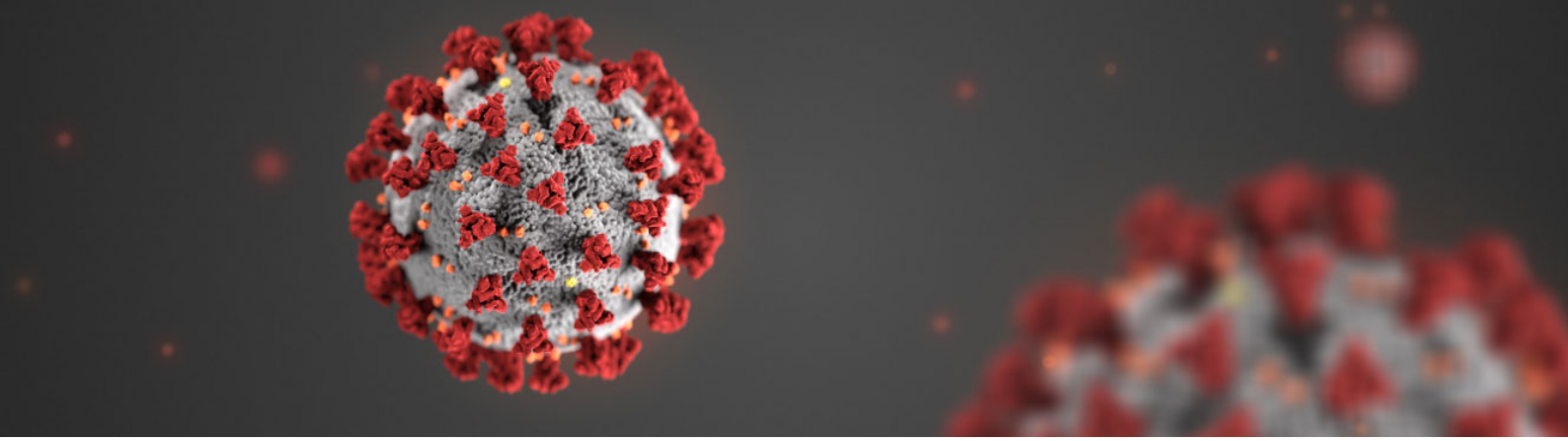
The basic conclusions are:

1. The case of the regions/countries where the decline has occurred, do not reject the theoretical expectation that the time of escalation and decline is approximately the same.
2. In regions/countries where the phenomenon has completed a cycle, the cycle duration was approximately 4 weeks.
3. In the regions/countries where the cycle of the phenomenon is ongoing its duration looks like it has been extended.
4. It is observed that the "death period" is almost double (7 weeks) than the "confirmed cases" period (4 weeks).
5. It seems that in the southern hemisphere (e.g. Australia and South Africa) the incidence of the virus decreases. The period in the southern hemisphere is 3-4 weeks.
6. Apparently the virus seems to appear to areas close to the equator, located in central Africa and the upper part of South America.
7. The de-escalation period is characterised by positive skewness when comparing to the escalation period, especially in the areas that have imposed strict measures.

Further research:

- in some areas, despite the imposition of mitigation measures, their impact was not expressed as a trend change on the COVID-19 confirmed cases curve
- however, in some areas the mitigation measures did affect the COVID-19 confirmed cases curve. In these cases what should be further approximated is the measures' impact in terms of time shifting of the expected peak, and the qualitative reduction of maximum infected cases, as well.

How realistic is the above? Unfortunately, the "no free lunch theorem" leaves little room for generalization. Each case is unique, each problem has its own optimal solution, so we have to adapt better to it.



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