Covid-19 Modelling Results, as at 17 April 2020

<u>**CANADA**</u>
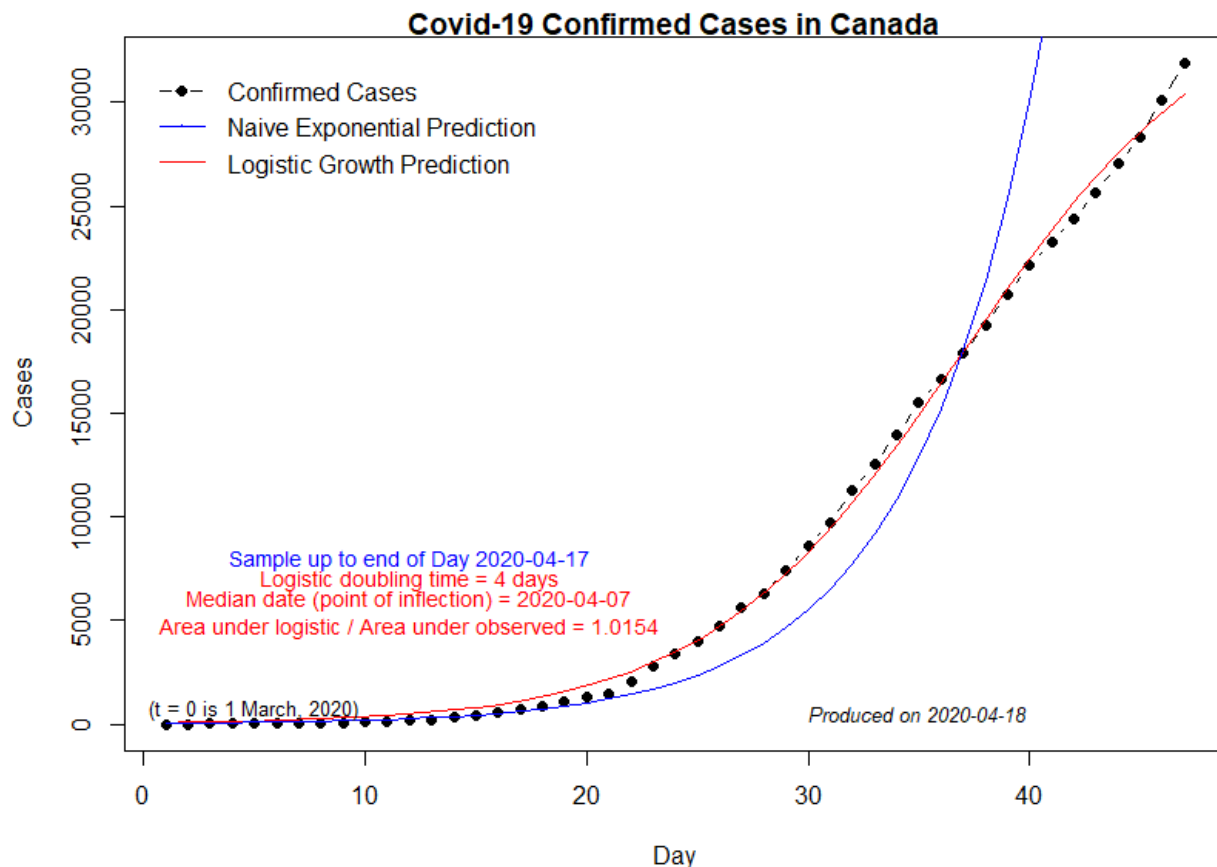
1. Total Confirmed Cases

My R code for Covid-19 modelling is at

https://raw.githubusercontent.com/DaveGiles1949/r-code/master/Canadian_Covid-19_Cases.R

The code will automatically download the latest data from my github account.

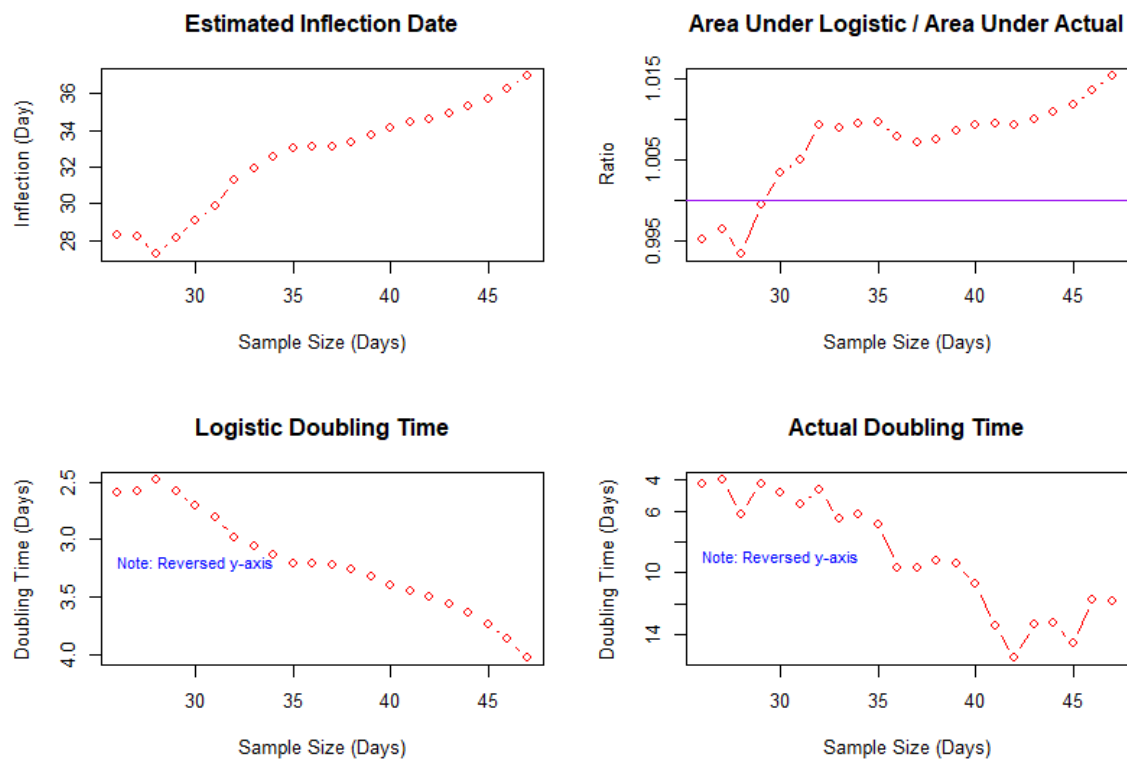The chart below shows results based on *data from 2 March to 17 April inclusive*.

The Logistic model produces an "S-shaped" growth curve. One *disadvantage* is that this S-shape is symmetric about its point of inflection.

It's also interesting to see how the results change over time as more data become available.

This is summarized in the next set of charts, which are based on successive samples, each starting on 2 March, ending after 26, 27, ..., 47 days. The last sample is the full sample used to get the chart above.

The second chart indicates the on-going "good fit" of the Logistic model to the observed data. A ratio value greater than 1.0 indicates that the model is over-predicting the actual data over the full sample range. A value of 1.0 would be "ideal", in a loose overall sense.

Estimated Inflection Date

Area Under Logistic / Area Under Actual

Logistic Doubling Time

Actual Doubling Time

The following plot shows the projections for total confirmed cases of Covid-19 based on the latest version of the Logistic model. The projections go to 7 days beyond the end of the latest sample.
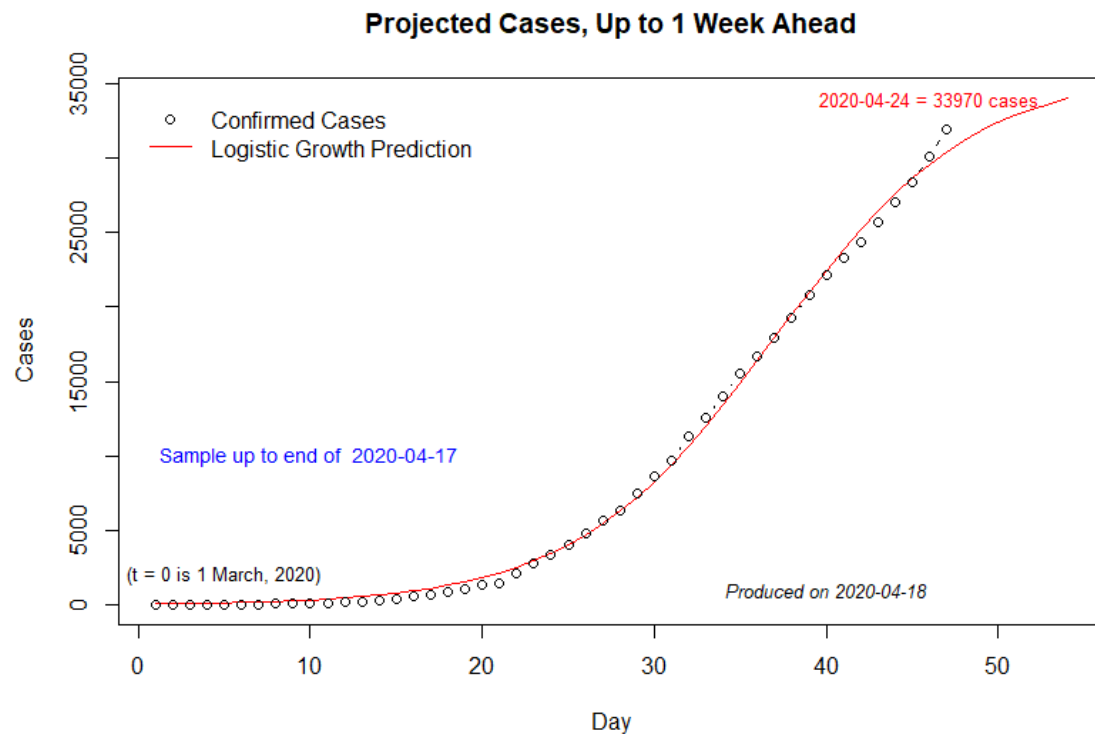

Projected Cases, Up to 1 Week Ahead

2020-04-24 = 33970 cases

○ Confirmed Cases
— Logistic Growth Prediction

Sample up to end of 2020-04-17

(t = 0 is 1 March, 2020)

Produced on 2020-04-18

Table 1: Projected Covid-19 Cases in Canada

(Projections are in Blue; Actual Values are in Brackets)

Sample end (projection made): 08 April

09 Apr	10 Apr	11 Apr	12 Apr	13 Apr	14 Apr	15 Apr
20162	21096	21916	22627	23236	23753	24188
[20765]	[22148]	[23318]	[24383]	[25680]	[27063]	[28379]

Sample end (projection made): 09 April

10 Apr	11 Apr	12 Apr	13 Apr	14 Apr	15 Apr	16 Apr
21445	22339	23122	23798	24377	24868	25282
[22148]	[23318]	[24383]	[25680]	[27063]	[28379]	[30106]

Sample end (projection made): 10 April

11 Apr	12 Apr	13 Apr	14 Apr	15 Apr	16 Apr	17 Apr
22724	23582	24331	24977	25531	26000	26396
[23318]	[24383]	[25680]	[27063]	[28379]	[30106]	[31927]

Sample end (projection made): 11 April

12 Apr	13 Apr	14 Apr	15 Apr	16 Apr	17 Apr	18 Apr
23883	24687	25385	25987	26500	26936	27303
[24383]	[25680]	[27063]	[28379]	[30106]	[31927]	

Sample end (projection made): 12 April

13 Apr	14 Apr	15 Apr	16 Apr	17 Apr	18 Apr	19 Apr
24919	25656	26293	26840	27306	27700	28032
[25680]	[27063]	[28379]	[30106]	[31927]		

Sample end (projection made): 13 April

14 Apr	15 Apr	16 Apr	17 Apr	18 Apr	19 Apr	20 Apr
25991	26679	27272	27781	28214	28581	28890
[27063]	[28379]	[30106]	[31927]			

Sample end (projection made): 14 April

15 Apr	16 Apr	17 Apr	18 Apr	19 Apr	20 Apr	21 Apr
27127	27783	28349	28835	29250	29602	29899
[28379]	[30106]	[31927]				

Sample end (projection made): 15 April

16 Apr	17 Apr	18 Apr	19 Apr	20 Apr	21 Apr	22 Apr
28281 [30106]	28912 [31927]	29458	29927	30329	30670	30960

Sample end (projection made): 16 April

17 Apr	18 Apr	19 Apr	20 Apr	21 Apr	22 Apr	22 Apr
29615 [31927]	30247	30797	31272	31680	32030	32328

Sample end (projection made): 17 April

| 18 Apr	19 Apr	20 Apr	21 Apr	22 Apr	22 Apr	23 Apr
31119	31774	32347	32845	33277	33650	33970

2. Total Number of Deaths

My R code for Covid-19 modelling is at

https://raw.githubusercontent.com/DaveGiles1949/r-code/master/Canadian_Covid-19_Deaths.R

The code will automatically download the latest data from my github account.

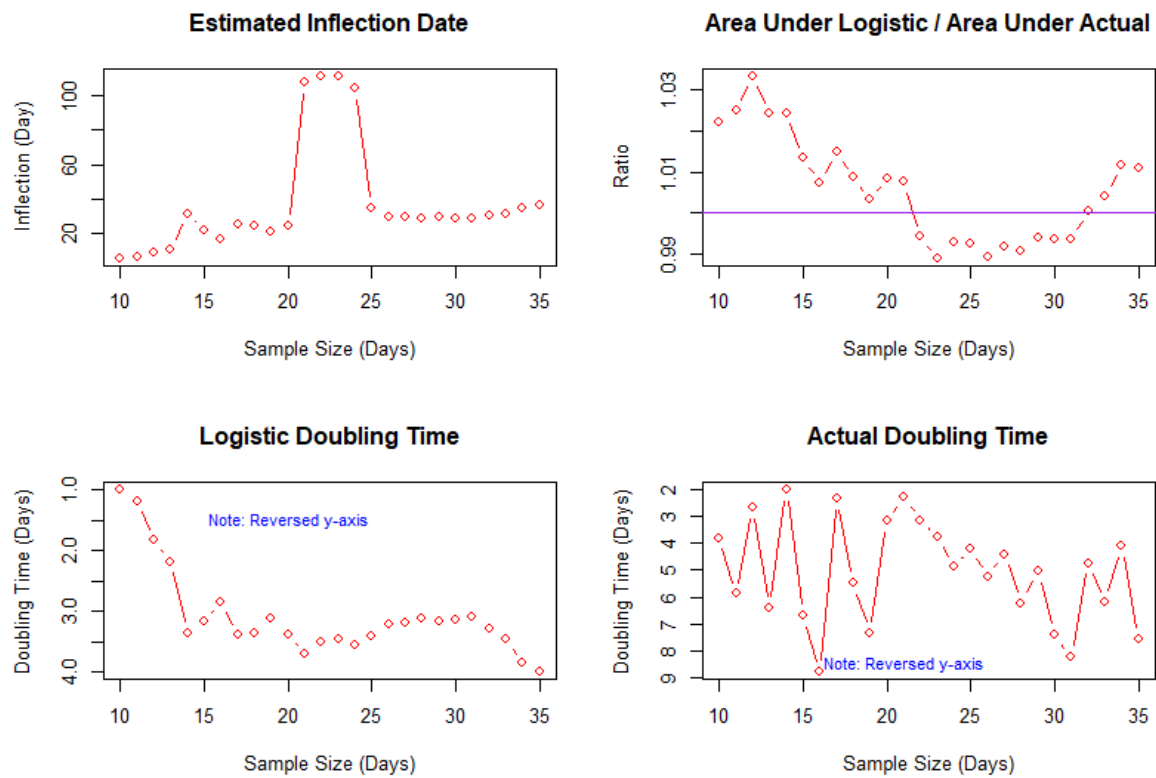The chart below shows results based on *data from 14 March to 17 April inclusive*.

The Logistic model produces an "S-shaped" growth curve. One *disadvantage* is that this S-shape is symmetric about its point of inflection.
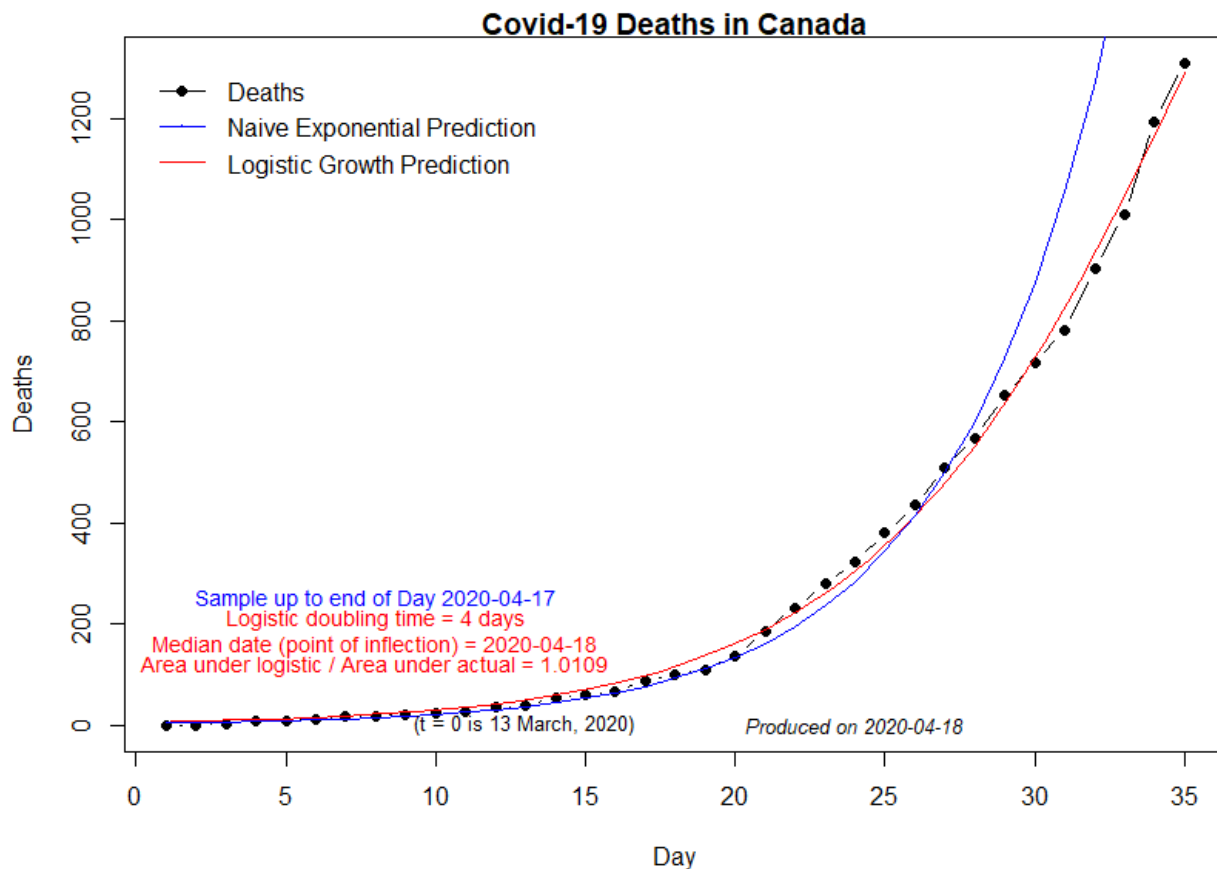
It's also interesting to see how the results change over time as more data become available.

This is summarized in the next set of charts, which are based on successive samples, each starting on 14 March, ending after 10, 11, …., 35 days. The last sample is the full sample used to get the chart above.

The second chart indicates the on-going "good fit" of the Logistic model to the observed data. A ratio value greater than 1.0 indicates that the model is over-predicting the actual data over the full sample range. A value of 1.0 would be "ideal", in a loose overall sense.

Estimated Inflection Date

Area Under Logistic / Area Under Actual

Logistic Doubling Time

Actual Doubling Time

The following plot shows the projections for total confirmed cases of Covid-19 based on the latest version of the Logistic model. The projections go to 7 days beyond the end of the latest sample.
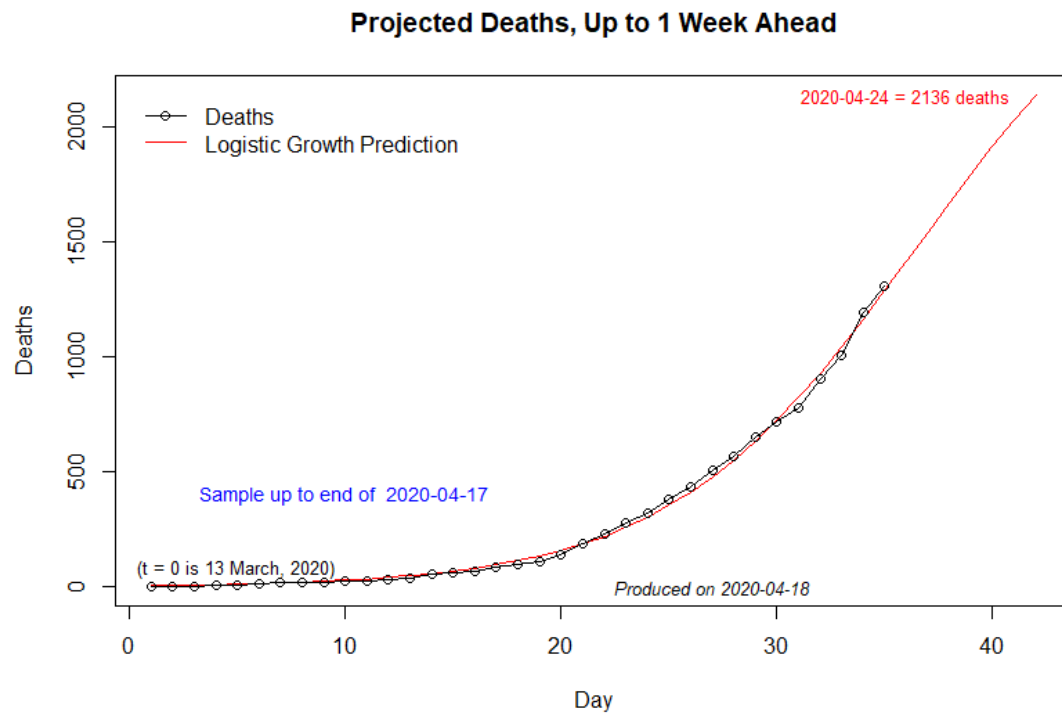
Projected Deaths, Up to 1 Week Ahead

Table 2: Projected Covid-19 Deaths in Canada

(Projections are in Red; Actual Values are in Brackets)

Sample end (projection made): 08 April

09 Apr	10 Apr	11 Apr	12 Apr	13 Apr	14 Apr	15 Apr
510	585	663	744	824	902	977
[509]	[569]	[653]	[717]	[780]	[903]	[1010]

Sample end (projection made): 09 April

10 Apr	11 Apr	12 Apr	13 Apr	14 Apr	15 Apr	16 Apr
582	659	737	815	890	962	1029
[569]	[653]	[717]	[780]	[903]	[1010]	[1195]

Sample end (projection made): 10 April

11 Apr	12 Apr	13 Apr	14 Apr	15 Apr	16 Apr	17 Apr
643	713	781	846	906	961	1010
[653]	[717]	[780]	[903]	[1010]	[1195]	[1310]

Sample end (projection made): 11 April

12 Apr	13 Apr	14 Apr	15 Apr	16 Apr	17 Apr	18 Apr
723	795	865	930	991	1045	1093
[717]	[780]	[903]	[1010]	[1195]	[1310]	

Sample end (projection made): 12 April

13 Apr	14 Apr	15 Apr	16 Apr	17 Apr	18 Apr	19 Apr
789	856	919	976	1027	1073	1112
[780]	[903]	[1010]	[1195]	[1310]		

Sample end (projection made): 13 April

14 Apr	15 Apr	16 Apr	17 Apr	18 Apr	19 Apr	20 Apr
847	907	961	1010	1052	1088	1119
[903]	[1010]	[1195]	[1310]			

Sample end (projection made): 14 April

15 Apr	16 Apr	17 Apr	18 Apr	19 Apr	20 Apr	21 Apr
953	1021	1085	1142	1193	1238	1276
[1010]	[1310]					

Sample end (projection made): 15 April

16 Apr	17 Apr	18 Apr	19 Apr	20 Apr	21 Apr	22 Apr
1068	1147	1220	1287	1348	1403	1451
[1195]	[1310]					

Sample end (projection made): 16 April

17 Apr	18 Apr	19 Apr	20 Apr	21 Apr	22 Apr	22 Apr
1257	1369	1479	1585	1687	1782	1871
[1310]						

Sample end (projection made): 1 April

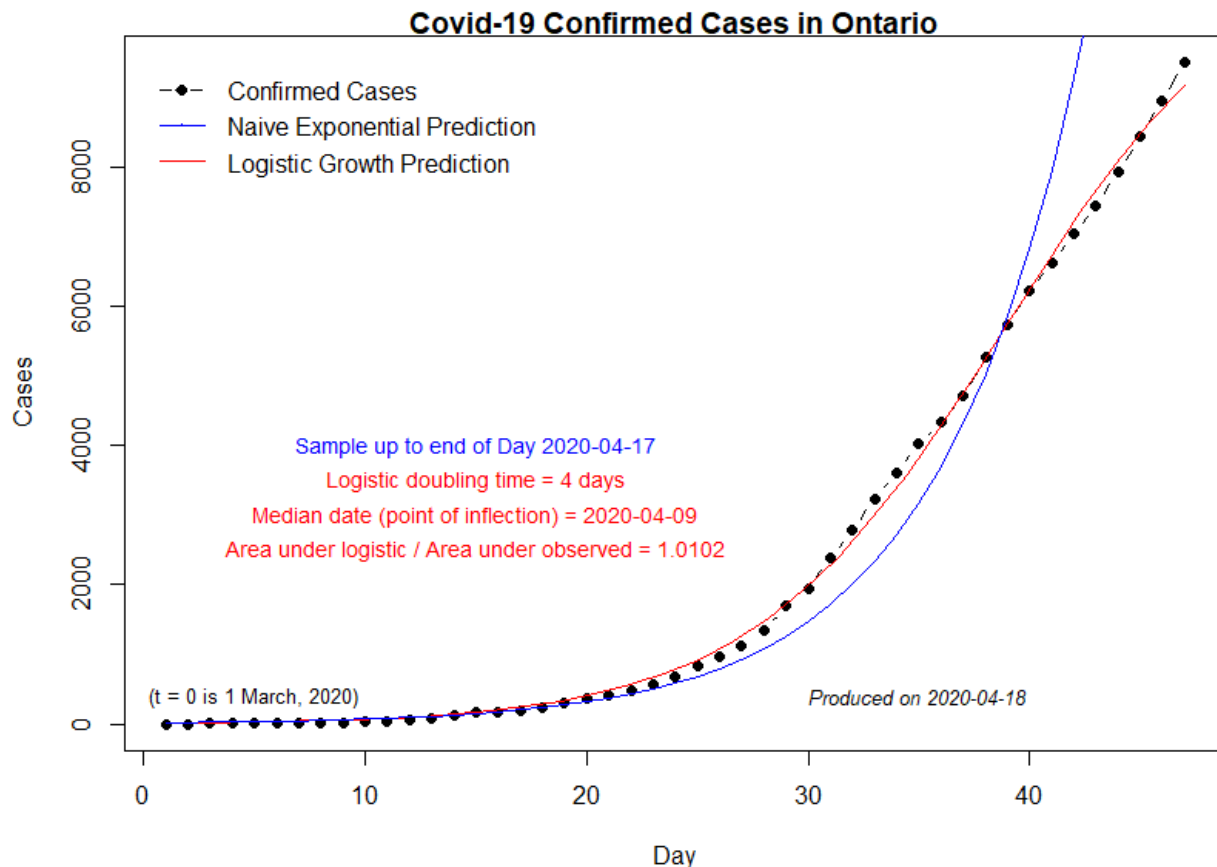| 18 Apr	19 Apr	20 Apr	21 Apr	22 Apr	22 Apr	23 Apr
1416	1544	1671	1796	1915	2029	2136

1. Total Confirmed Cases

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The code will automatically download the latest data from my github account.

The chart below shows results based on *data from 2 March to 76 April inclusive*.

The Logistic model produces an "S-shaped" growth curve. One *disadvantage* is that this S-shape is symmetric about its point of inflection.
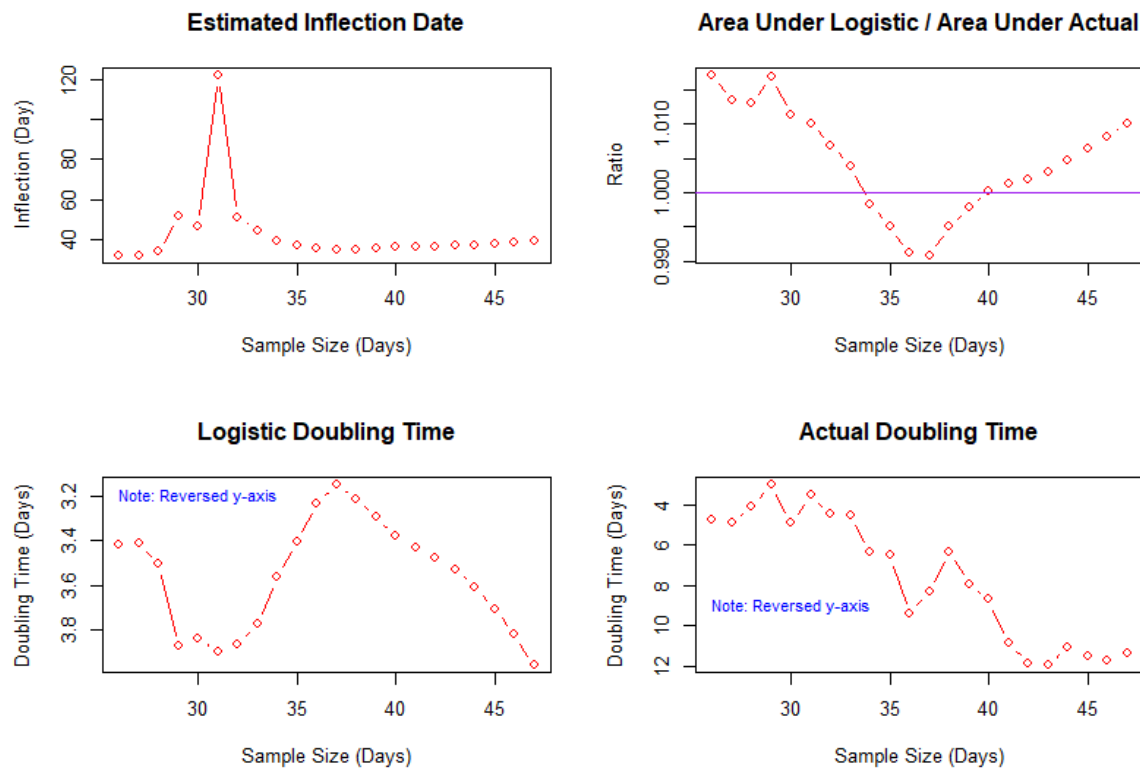

It's also interesting to see how the results change over time as more data become available.

This is summarized in the next set of charts, which are based on successive samples, each starting on 2 March, ending after 26, 27, …., 47 days. The last sample is the full sample used to get the chart above.

 The second chart indicates the on-going "good fit" of the Logistic model to the observed data. A ratio value greater than 1.0 indicates that the model is over-predicting the actual data over the full sample range. A value of 1.0 would be "ideal", in a loose overall sense.

Both the observed and estimated "doubling times" for new cases have improved substantially. (Note the reverse axis on the last two charts, and the fact that a longer doubling time is better than a short one.)

Estimated Inflection Date

Area Under Logistic / Area Under Actual

Logistic Doubling Time

Note: Reversed y-axis

Actual Doubling Time

Note: Reversed y-axis

The following plot shows the projections for total confirmed cases of Covid-19 based on the latest version of the Logistic model. The projections go to 7 days beyond the end of the latest sample.
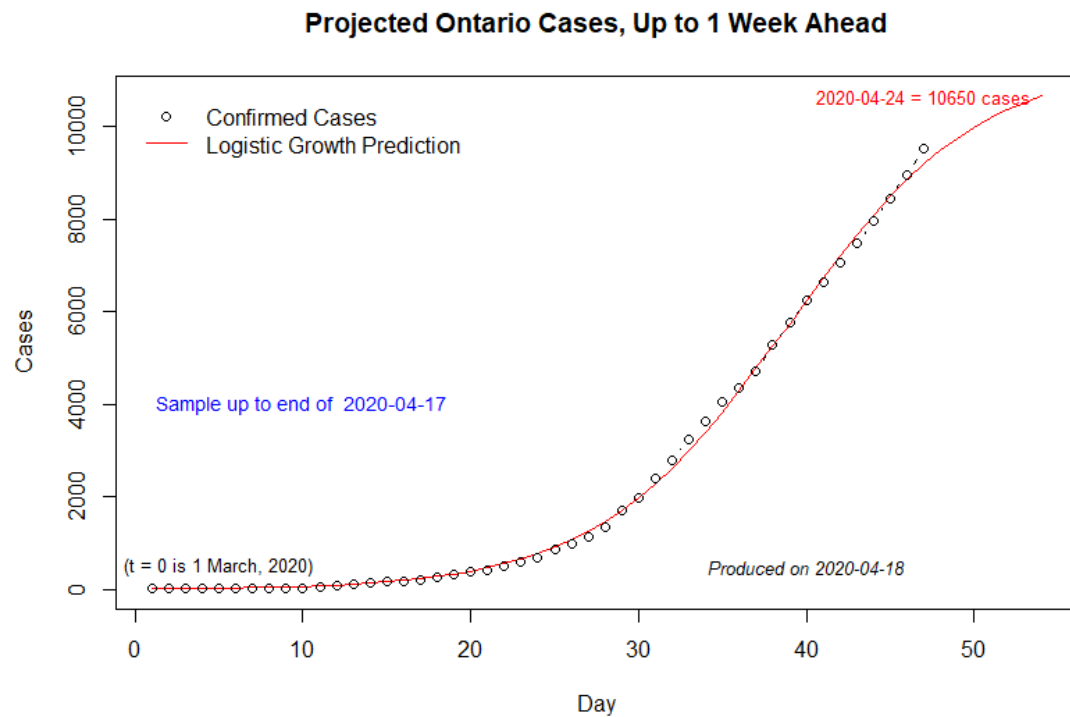
Projected Ontario Cases, Up to 1 Week Ahead

- ○ Confirmed Cases
- — Logistic Growth Prediction

2020-04-24 = 10650 cases

Sample up to end of 2020-04-17

(t = 0 is 1 March, 2020)

Produced on 2020-04-18

Table 3: Projected Covid-19 Cases in Ontario

(Projections are in Blue; Actual Values are in Brackets)

Sample end (projection made): 08 April

09 Apr	10 Apr	11 Apr	12 Apr	13 Apr	14 Apr	15 Apr
5575	5913	6217	6485	6719	6920	7091
[5759]	[6237]	[6648]	[7049]	[7470]	[7953]	[8447]

Sample end (projection made): 09 April

10 Apr	11 Apr	12 Apr	13 Apr	14 Apr	15 Apr	16 Apr
6033	6369	6670	6935	7167	7366	7535
[6237]	[6648]	[7049]	[7470]	[7953]	[8447]	[8961]

Sample end (projection made): 10 April

11 Apr	12 Apr	13 Apr	14 Apr	15 Apr	16 Apr	17 Apr
6497	6830	7128	7390	7619	7815	7983
[6648]	[7049]	[7470]	[7953]	[8447]	[8961]	[9525]

Sample end (projection made): 11 April

12 Apr	13 Apr	14 Apr	15 Apr	16 Apr	17 Apr	18 Apr
6916	7234	7516	7763	7978	8163	8320
[7049]	[7470]	[7953]	[8447]	[8961]	[9525]	

Sample end (projection made): 12 April

13 Apr	14 Apr	15 Apr	16 Apr	17 Apr	18 Apr	19 Apr
7303	7599	7861	8089	8286	8455	8599
[7470]	[7953]	[8447]	[8961]	[9525]		

Sample end (projection made): 13 April

14 Apr	15 Apr	16 Apr	17 Apr	18 Apr	19 Apr	20 Apr
7682	7960	8203	8415	8597	8753	8885
[7953]	[8447]	[8961]	[9525]			

Sample end (projection made): 14 April

15 Apr	16 Apr	17 Apr	18 Apr	19 Apr	20 Apr	21 Apr
8091	8357	8591	8794	8969	9119	9246
[8447]	[8961]	[9525]				

Sample end (projection made): 15 April

16 Apr	17 Apr	18 Apr	19 Apr	20 Apr	21 Apr	21 Apr
8523 [8961]	8784 [9525]	9014	9213	9385	9533	9659

Sample end (projection made): 16 April

17 Apr	18 Apr	19 Apr	20 Apr	21 Apr	21 Apr	22 Apr
8981 [9525]	9241	9470	9669	9842	9992	10120

Sample end (projection made): 17 April

| 18 Apr	19 Apr	20 Apr	21 Apr	21 Apr	22 Apr	23 Apr
9479	9743	9977	10182	10361	10516	10650

2. Total Number of Deaths

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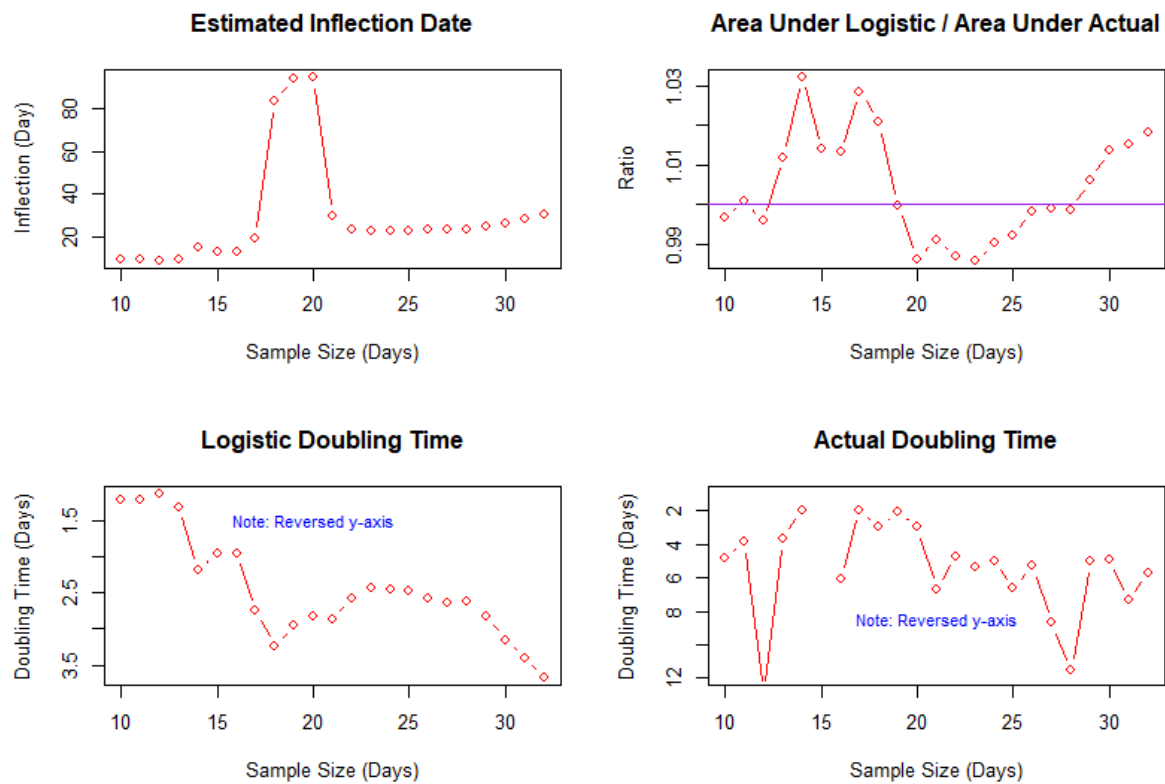The chart below shows results based on *data from 17 March to 17 April inclusive*.

The Logistic model produces an "S-shaped" growth curve. One *disadvantage* is that this S-shape is symmetric about its point of inflection.
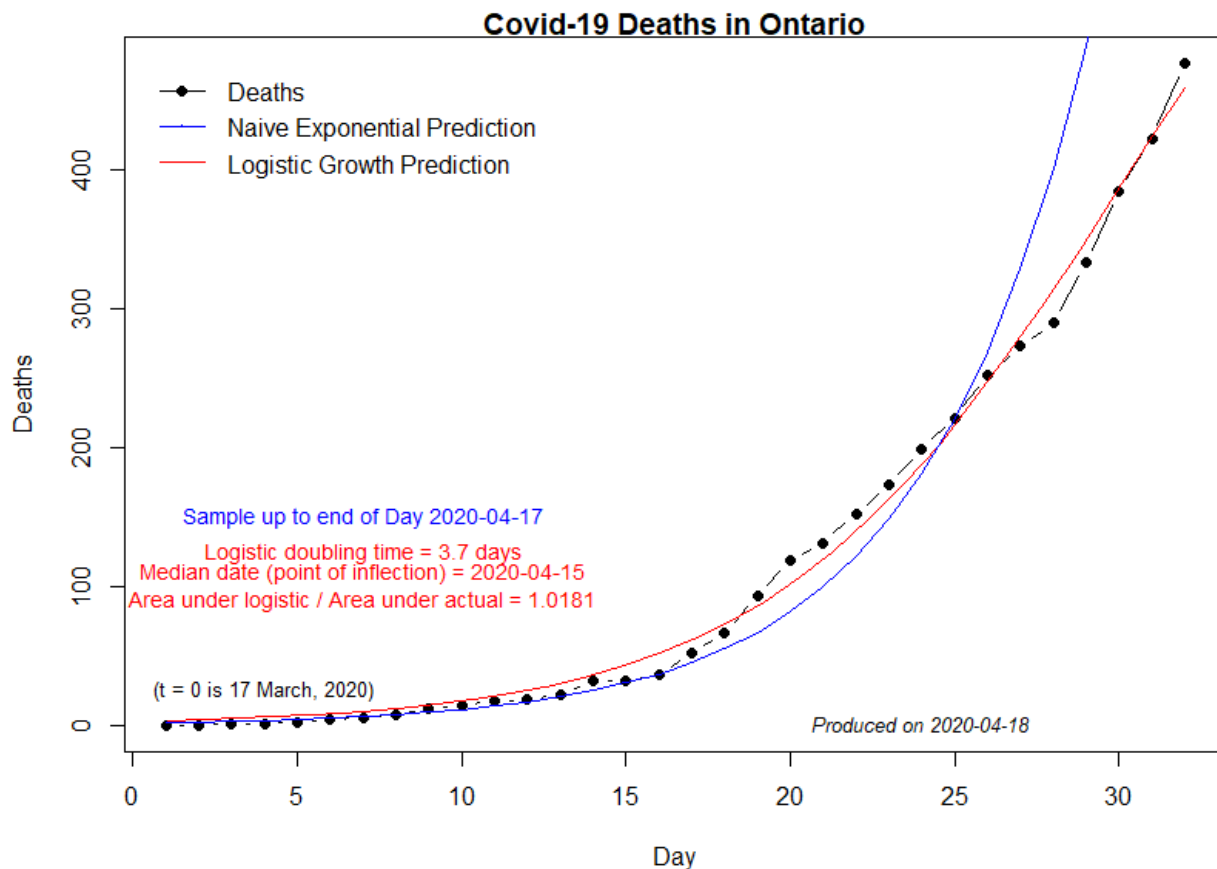
It's also interesting to see how the results change over time as more data become available.

This is summarized in the next set of charts, which are based on successive samples, each starting on 17 March, ending after 10, 11, …., 32 days. The last sample is the full sample used to get the chart above.

The second chart indicates the on-going "good fit" of the Logistic model to the observed data. A ratio value greater than 1.0 indicates that the model is over-predicting the actual data over the full sample range. A value of 1.0 would be "ideal", in a loose overall sense.

Estimated Inflection Date

Area Under Logistic / Area Under Actual

Logistic Doubling Time

Actual Doubling Time

The following plot shows the projections for total confirmed cases of Covid-19 based on the latest version of the Logistic model. The projections go to 7 days beyond the end of the latest sample.
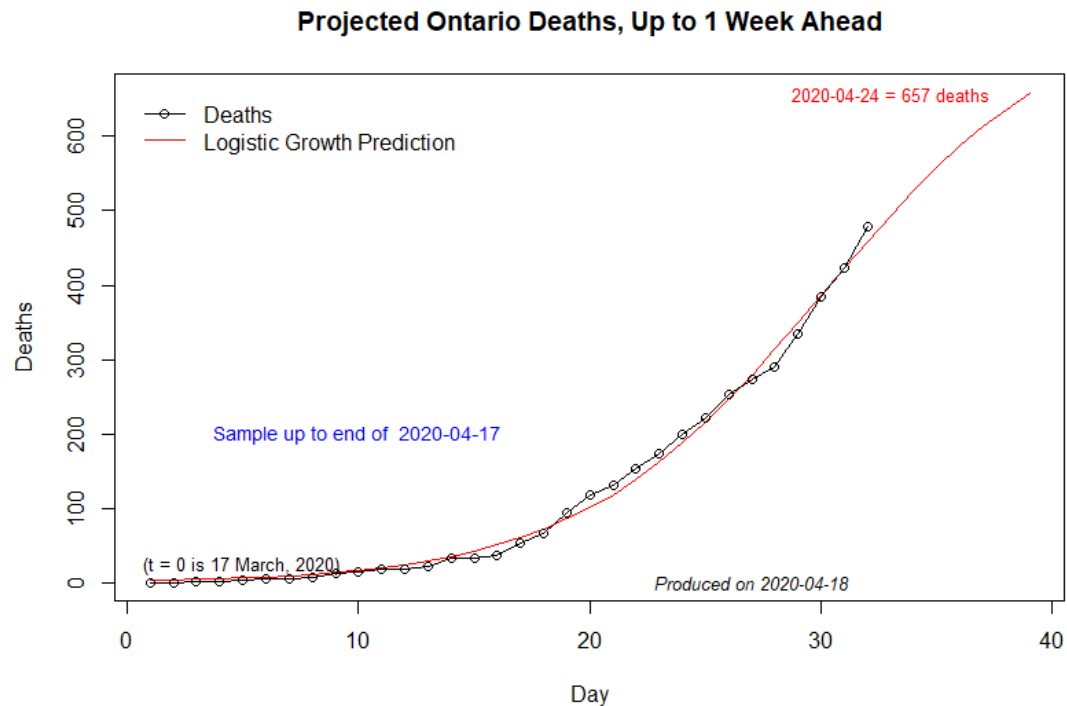

Projected Ontario Deaths, Up to 1 Week Ahead

Table 4: Projected Covid-19 Deaths in Canada

(Projections are in Red; Actual Values are in Brackets)

Sample end (projection made): 08 April

09 Apr	10 Apr	11 Apr	12 Apr	13 Apr	14 Apr	15 Apr
198	219	238	254	268	280	289
[200]	[222]	[253]	[274]	[291]	[334]	[385]

Sample end (projection made): 09 April

10 Apr	11 Apr	12 Apr	13 Apr	14 Apr	15 Apr	16 Apr
220	240	257	271	283	293	301
[222]	[253]	[274]	[291]	[334]	[385]	[423]

Sample end (projection made): 10 April

11 Apr	12 Apr	13 Apr	14 Apr	15 Apr	16 Apr	17 Apr
240	258	273	285	296	304	310
[253]	[274]	[291]	[334]	[385]	[423]	[478]

Sample end (projection made): 11 April

12 Apr	13 Apr	14 Apr	15 Apr	16 Apr	17 Apr	18 Apr
268	287	303	316	327	336	343
[274]	[291]	[334]	[385]	[423]		

Sample end (projection made): 12 April

13 Apr	14 Apr	15 Apr	16 Apr	17 Apr	18 Apr	19 Apr
291	308	322	334	344	352	358
[291]	[334]	[385]	[423]	[478]		

Sample end (projection made): 13 April

14 Apr	15 Apr	16 Apr	17 Apr	18 Apr	19 Apr	20 Apr
307	321	333	343	351	357	362
[334]	[385]	[423]	[478]			

Sample end (projection made): 14 April

15 Apr	16 Apr	17 Apr	18 Apr	19 Apr	20 Apr	21 Apr
340	356	369	381	390	398	404
[385]	[423]	[478]				

Sample end (projection made): 15 April

16 Apr	17 Apr	18 Apr	19 Apr	20 Apr	21 Apr	21 Apr
388 [423]	410 [478]	429	446	461	473	483

Sample end (projection made): 16 April

17 Apr	18 Apr	19 Apr	20 Apr	21 Apr	21 Apr	22 Apr
436 [478]	462	486	507	526	543	557

Sample end (projection made): 17 April

18 Apr	19 Apr	20 Apr	21 Apr	21 Apr	22 Apr	23 Apr
494	527	558	587	613	636	657