Omega Analysis

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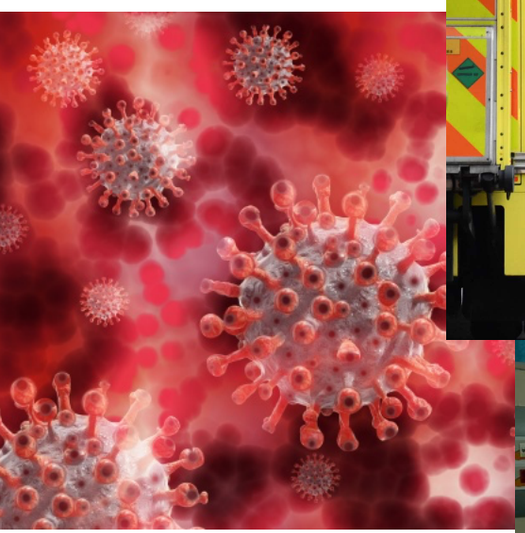
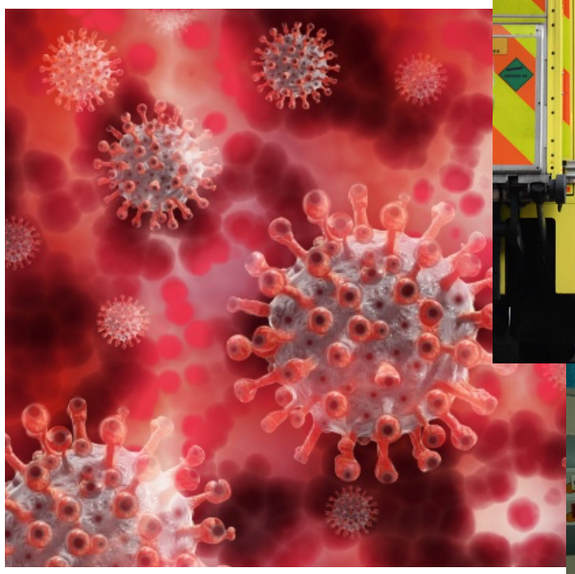
Technology that helps you look into the future…



Predicting the Course of Covid-19 Outbreaks



Accurate predictions enable contingency planning

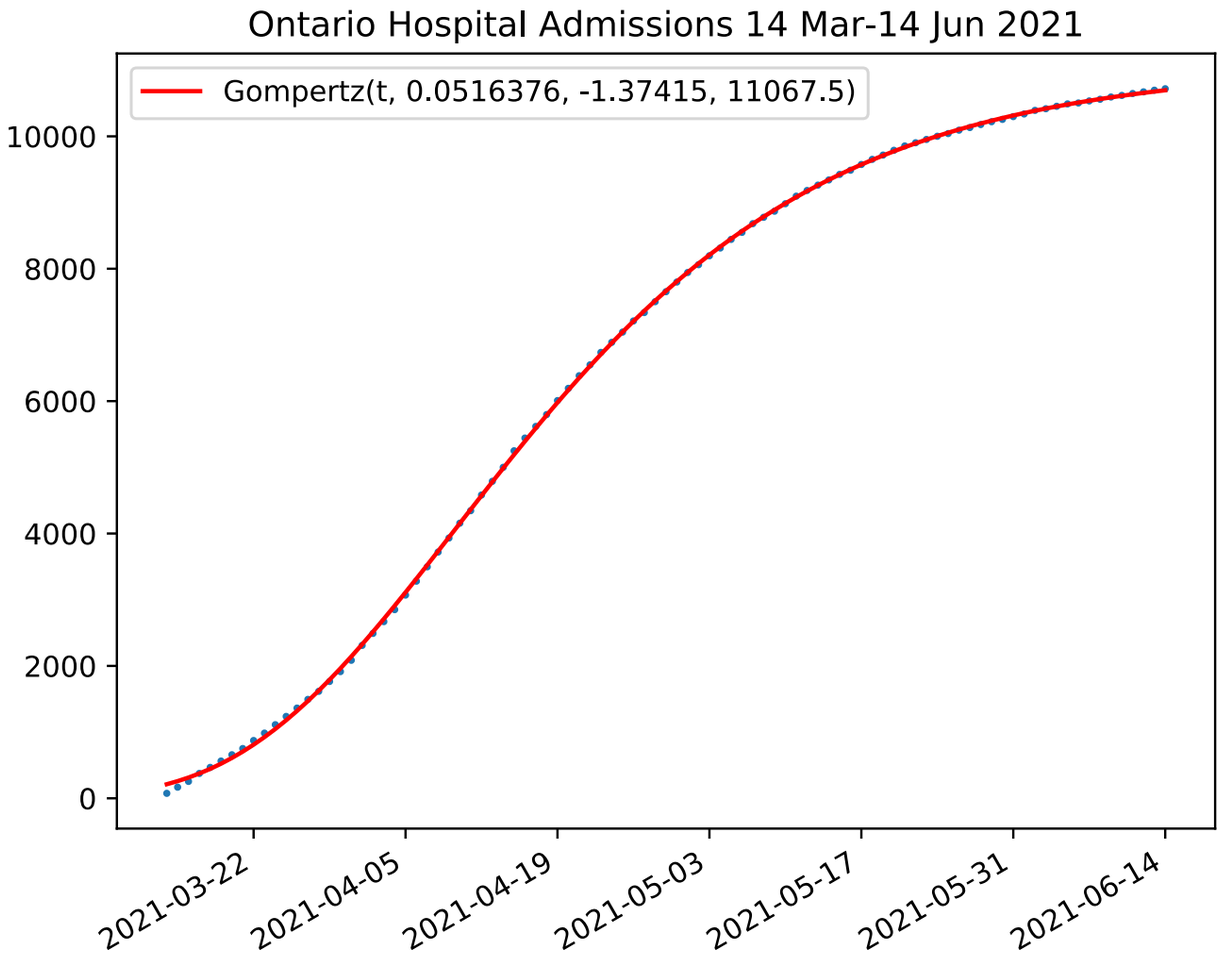
We have developed a model that accurately predicts the course of outbreaks (and the attendant demands on healthcare resources).

For the first time since March 2020, our model provides a means to navigate successive waves of Covid-19 with reliable projections for the short to medium term future.

All Covid-19 events: cases, hospitalisations, ICU admissions and deaths can be forecast accurately, first for a few days into the future and then for weeks at a time with increasing precision as outbreaks progress.

The Model and its predictions

We have shown that Covid-19 outbreaks follow a cycle of growth along a particular curve, called a Gompertz Function, alternating with linear growth.



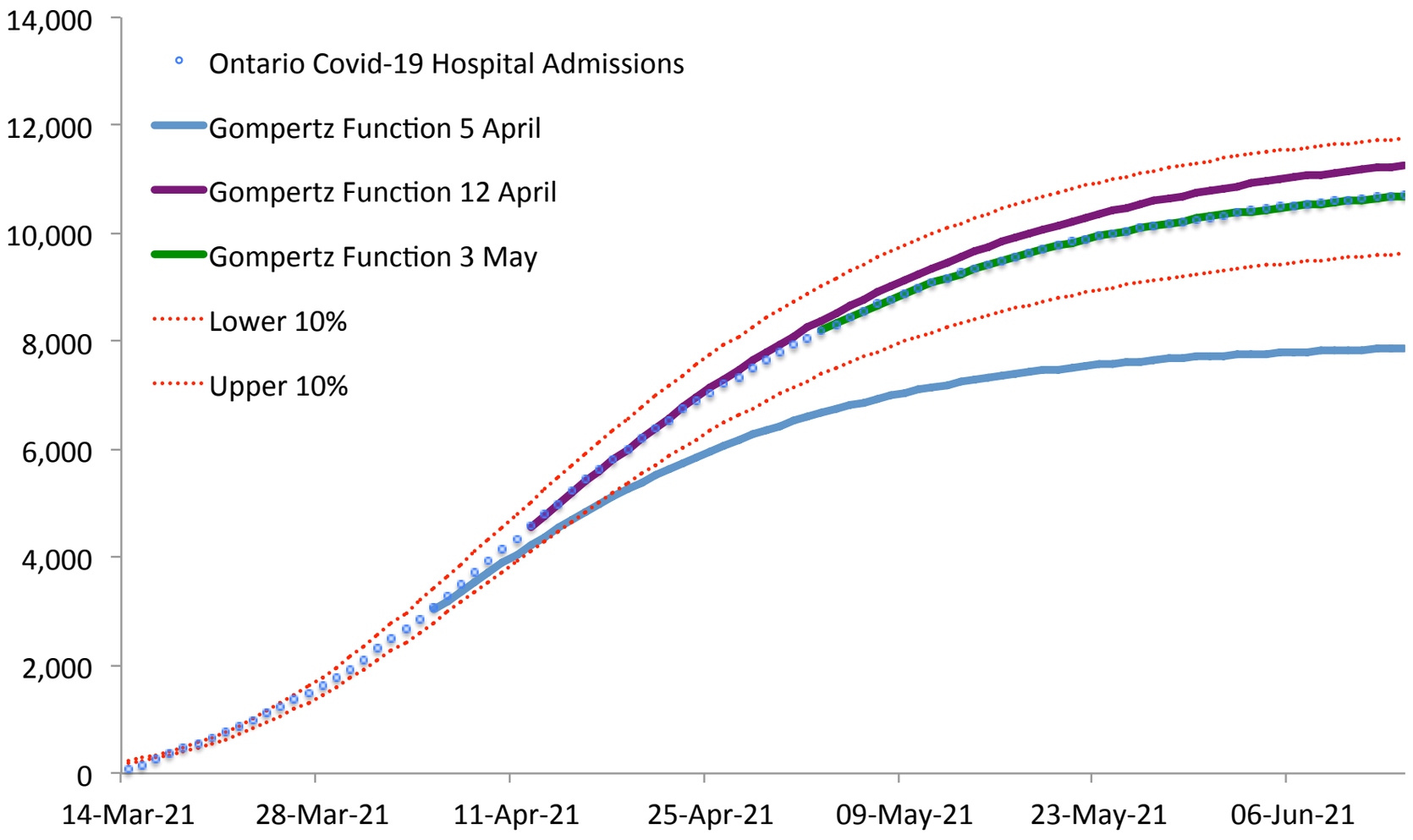
For example, Covid-19 hospital admissions in Ontario from 14 March to 14 June 2021 were almost perfectly matched by a Gompertz Function.

As this outbreak progressed, the Gompertz Function that best fit the data converged to the one shown here, slowly at first and then rapidly.

Accurate predictions made directly from data

It took a few weeks for this process to converge.

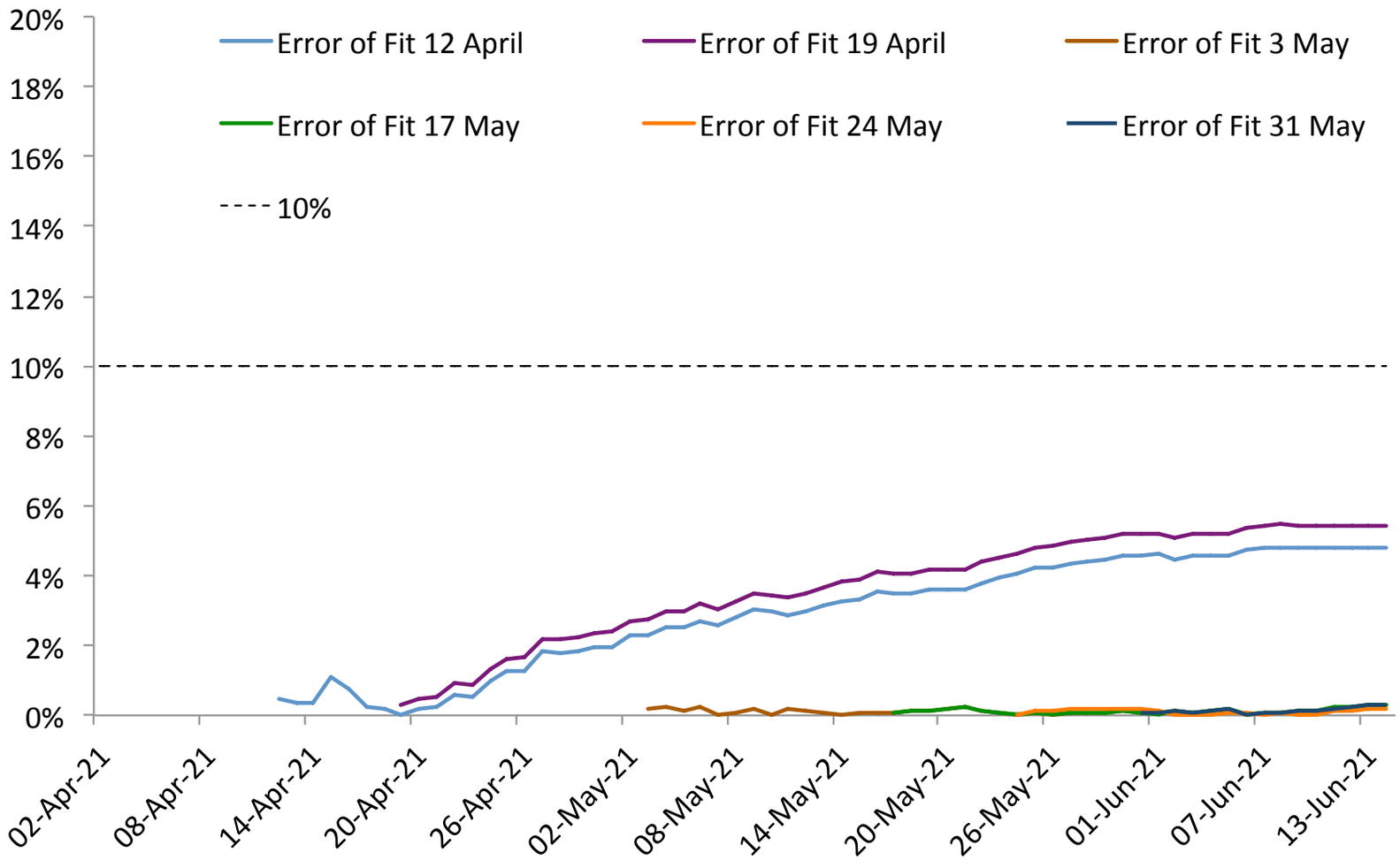
By 12 April 2021, all of the weekly Gompertz Function fits had prediction errors of less than 6% until 14 June—when the next linear growth phase began.



Successive Gompertz Function fits shown with a +/- 10% error band around the final fit.

Errors in predictions are very small

Here are the absolute values of the errors in the predictions as percentages of the predictions.



Magnitude of prediction errors as percentages of the predictions.

The Full Cycle

In the linear growth phases, simple linear extrapolation gives very good predictions of the future.

In the Gompertz Function phases, after an initial period where uncertainty is significant, the model's predictions remain accurate for extended periods.

This reduces the prediction problem to:

1) Identifying the switch from linear to Gompertz Function growth

2) Providing bounds on growth over the period (approximately 3 weeks) before the Gompertz Function's predictive power develops.

3) Identifying the end of the outbreak and return to linear growth

Advanced statistics reduce uncertainty during the initial Gompertz Function phase

Example: Hospital admissions in England with the emergence of the Omicron variant.

In November 2021, Covid-19 hospital admissions in England were growing linearly.

We detected a transition from the linear phase on 5 December 2021.

From the sample of daily admissions from 15 November to 5 December 2021 we used a form of Extreme Value analysis* to calculate bounds for growth of hospital admissions in the initial phase of the Omicron outbreak.

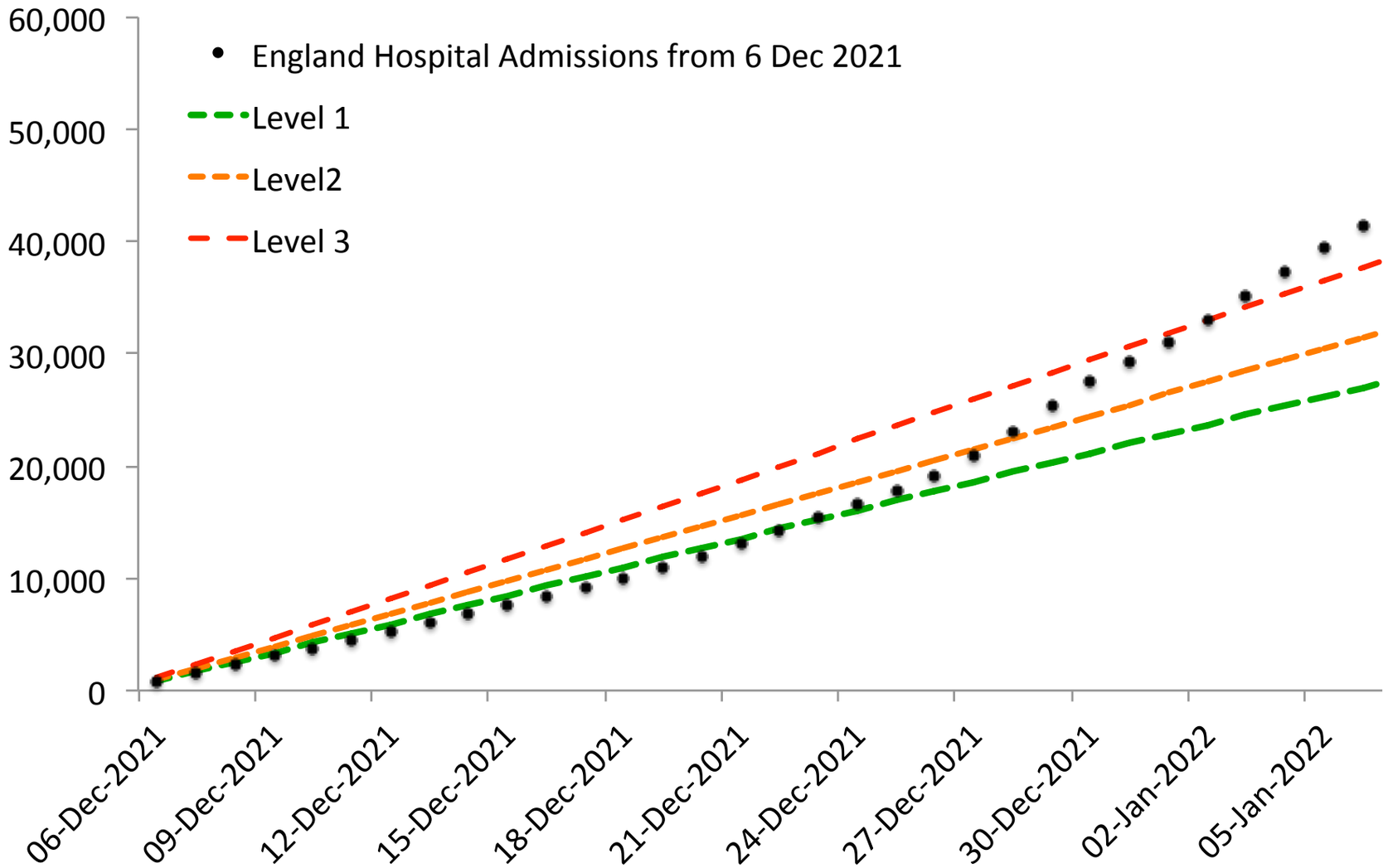
*Extreme Value analysis models the (unobserved) tail of the sample distribution of daily admissions to predict 3 Levels that depend only on the sample.

Level 1 is the average daily admissions conditional on exceeding the sample maximum.
Level 2 is the average daily admissions conditional on exceeding Level 1.
Level 3 is the average daily admissions conditional on exceeding Level 3.

We have observed in previous outbreaks that cumulative admissions are contained between linear growth at Level 1 admissions per day and linear growth at Level 3 admissions per day until the Gompertz Function achieves a high level of predictive power.

Accurate bounds on growth in hospitalisations

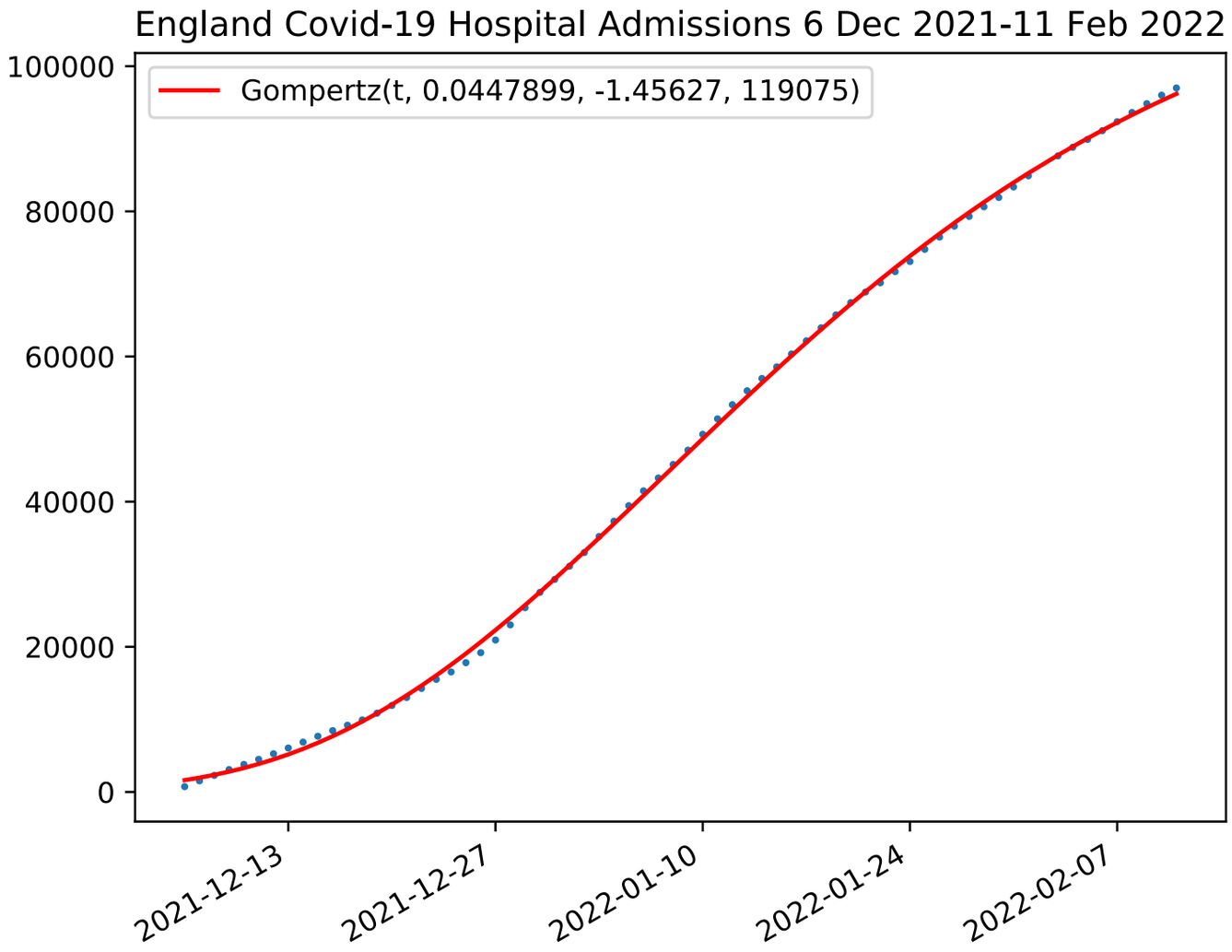
From 29 December 2021, the prediction errors of the Gompertz Function fits to hospital admissions data have been under 9%.



As expected, cumulative admissions remained within the linear growth bounds until the Gompertz Function fits achieved a high level of predictive power.

Accurate predictions from Gompertz Function fits

From 29 December 2021, the prediction errors of the Gompertz Function fits to hospital admissions data have been under 9%.



The Omicron outbreak in England has progressed to the endemic phase.

Cumulative Hospital admissions started growing linearly on 8 February 2020.

Admissions should now be monitored for the next transition to Gompertz Function growth.

The Gompertz Function fit on 11 Feb 2022 is shows that Omicron evolved as expected..

Advanced statistics reduce uncertainty during the initial Gompertz Function phase for Omicron

Example: Hospital admissions in Ontario with the emergence of the Omicron variant.

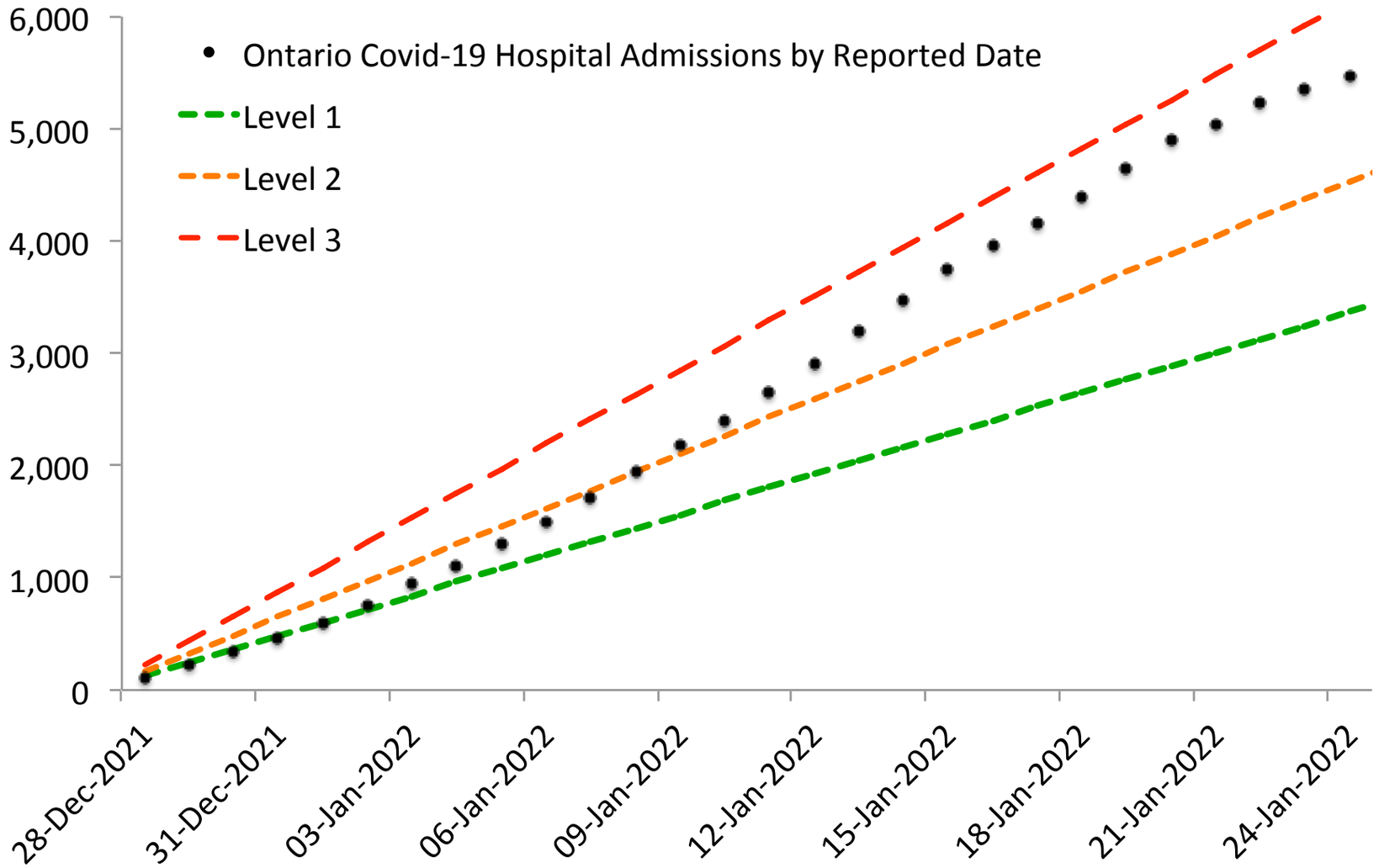
In November and December 2021, Covid-19 hospital admissions in Ontario were growing linearly.

We detected a transition from the linear phase on 27 December 2021.

From the sample of daily admissions from 7 to 27 December 2021 we used the same statistical analysis described for England to calculate bounds for growth of hospital admissions in the initial phase of the Omicron outbreak.

Accurate bounds on growth in hospitalisations

From 17 January 2021, the prediction errors of the Gompertz Function fits to hospital admissions data have been under 12% and from 18 January under 6%.



As expected, cumulative admissions remained within the linear growth bounds until the Gompertz Function fits achieved a high level of predictive power.

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About Ana Cascon and William F. Shadwick

Ana Cascon and William F. Shadwick have decades of experience in industry and academia.*

Omega Analysis' prize winning technology is based on their fundamental mathematical discoveries in probability and statistics.

Both Cascon and Shadwick are currently on an extended visit to IMPA, Brazil's national mathematics research institute in Rio de Janeiro.

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* https://www.omegaanalysis.com/about-us