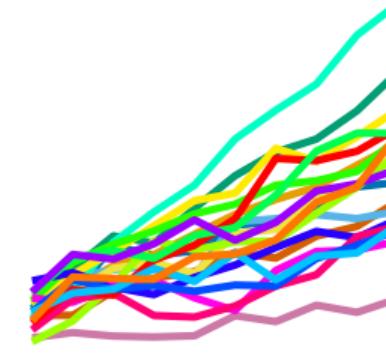
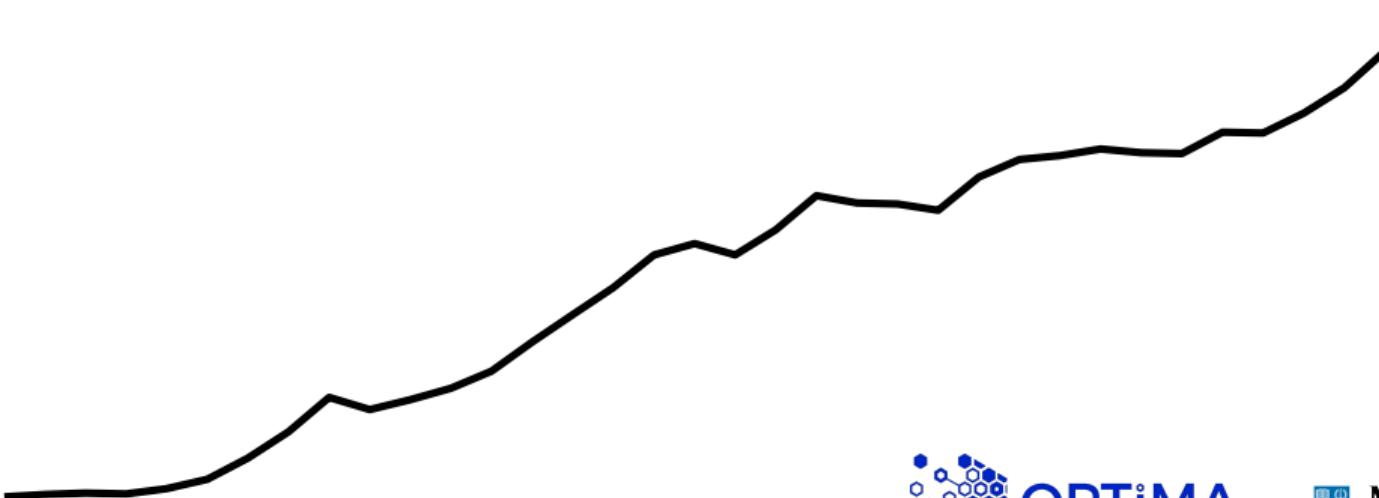


# Statistical forecasting

Rob J Hyndman



OPTiMA



MONASH University

# Outline

- 1 Random futures
- 2 Forecasting peak electricity demand
- 3 Forecasting COVID19 cases
- 4 Future ideas

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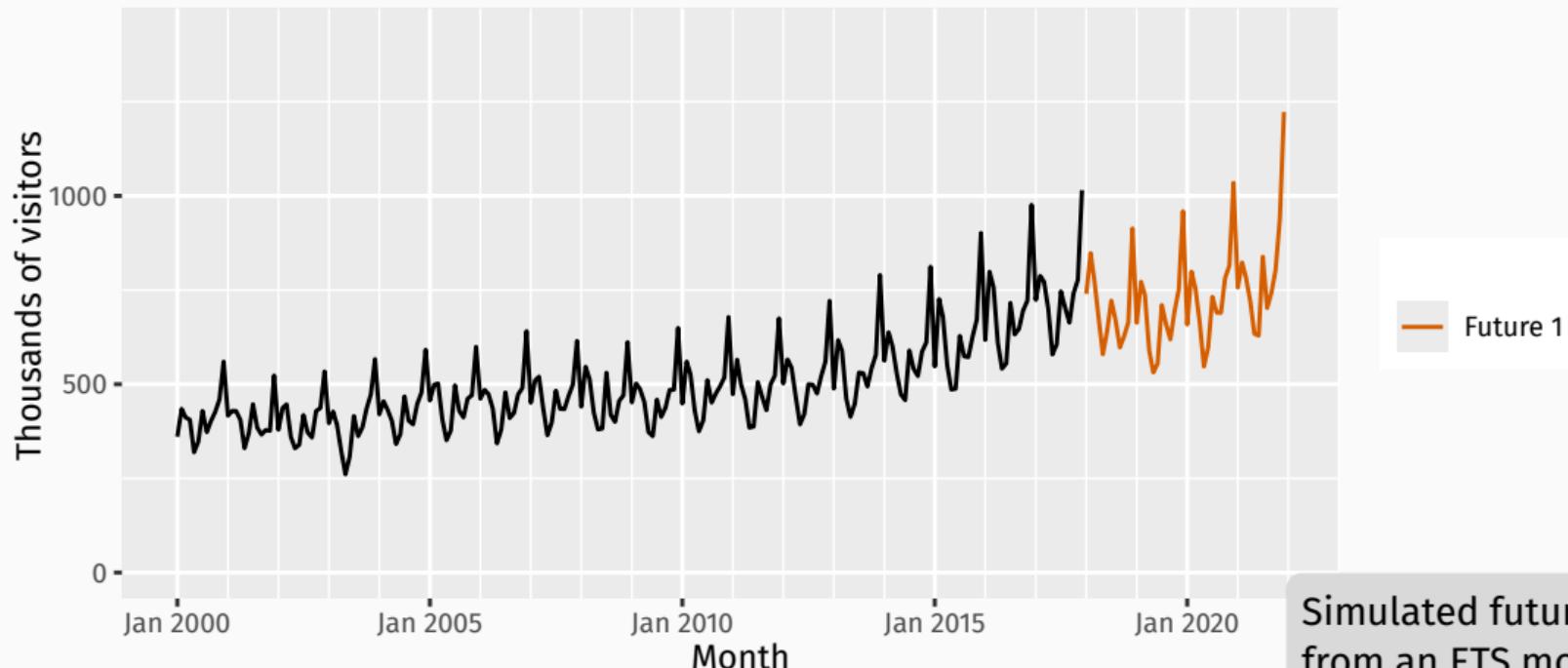
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A forecast is an estimate of the probability distribution of a variable to be observed in the future.

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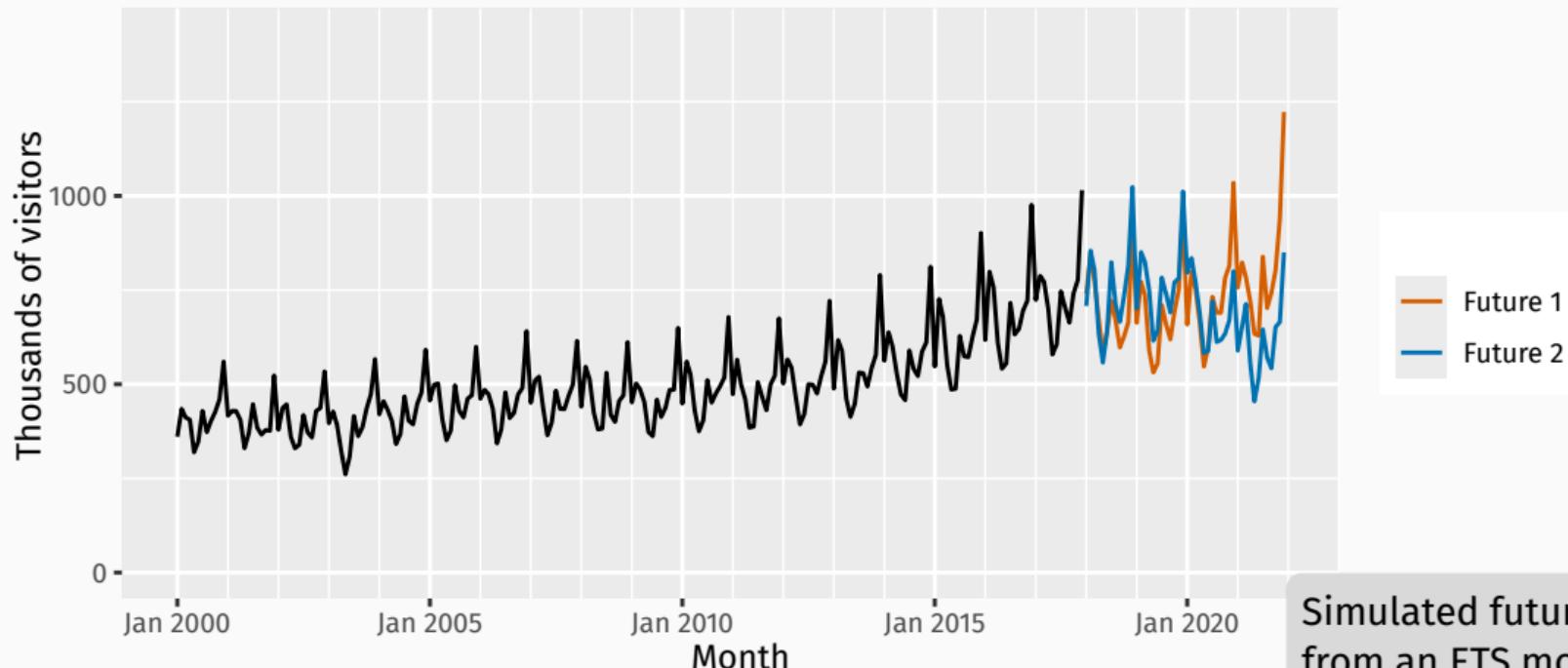
Total short-term visitors to Australia



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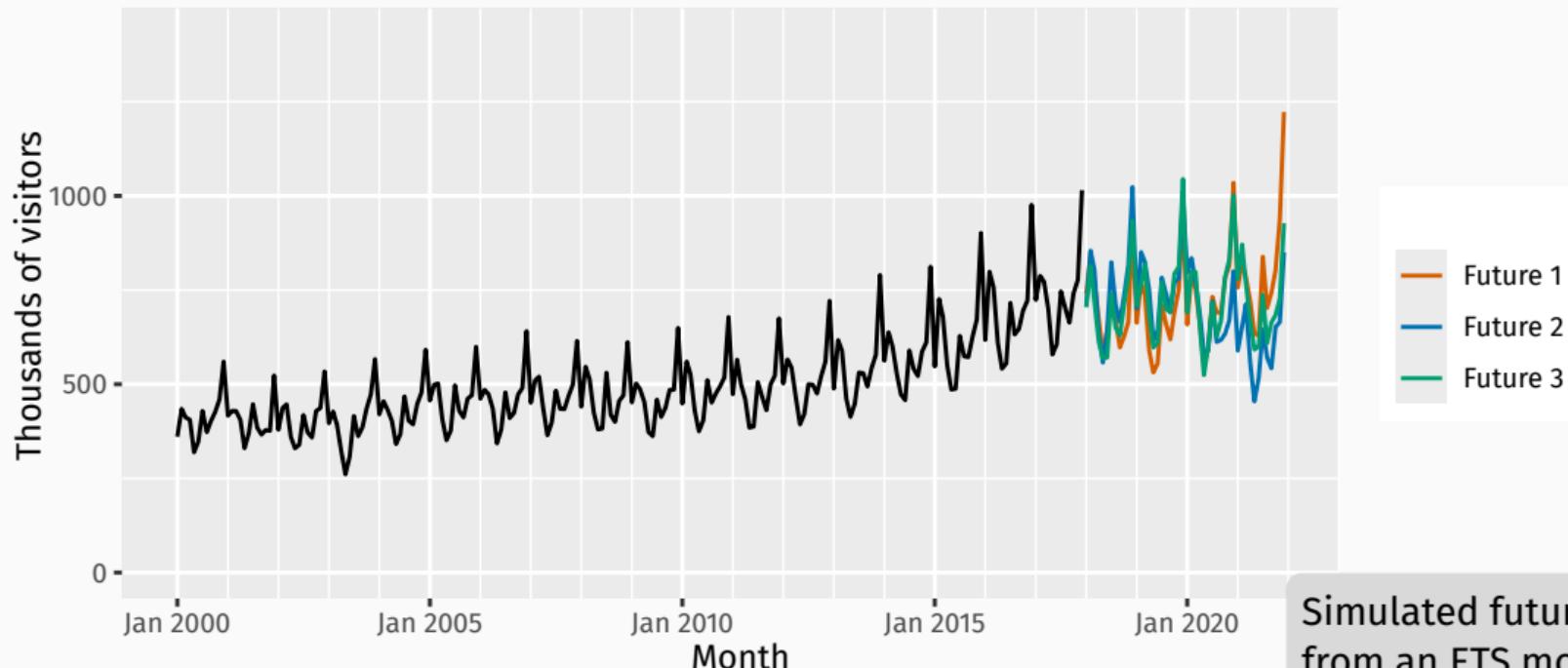
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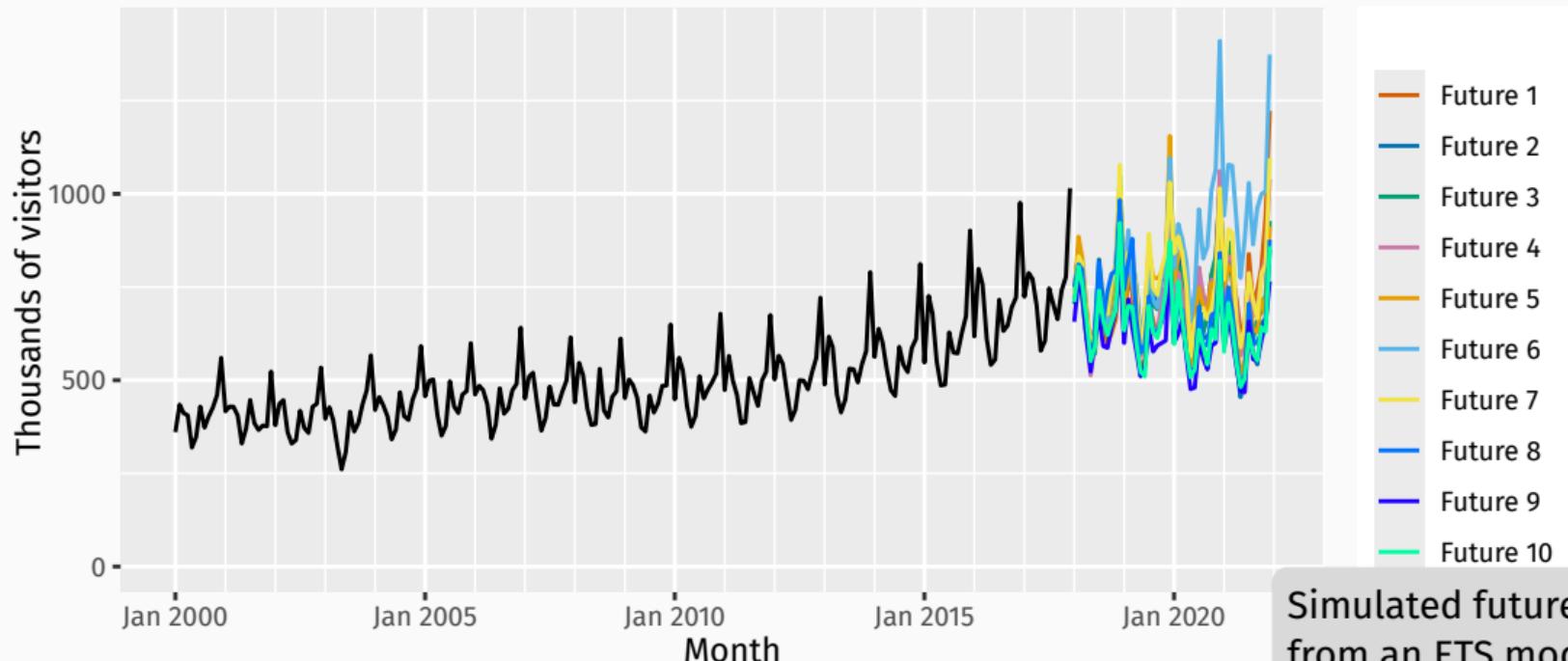
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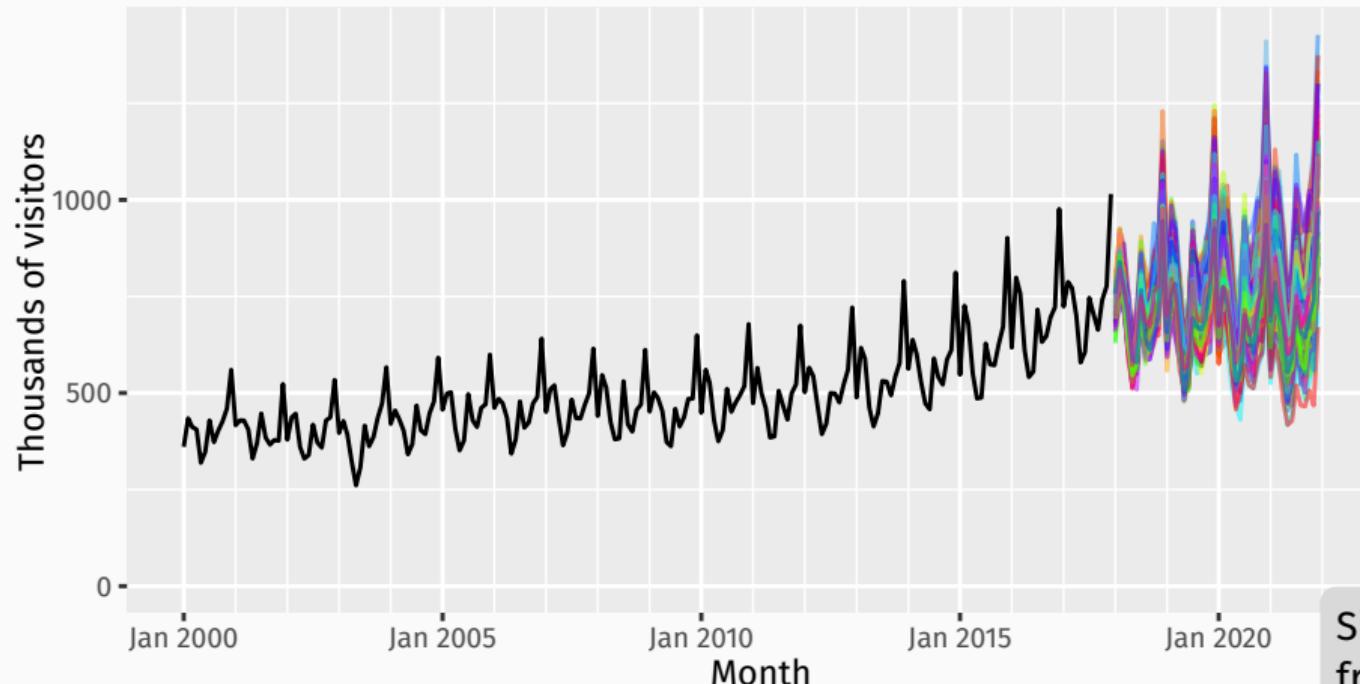
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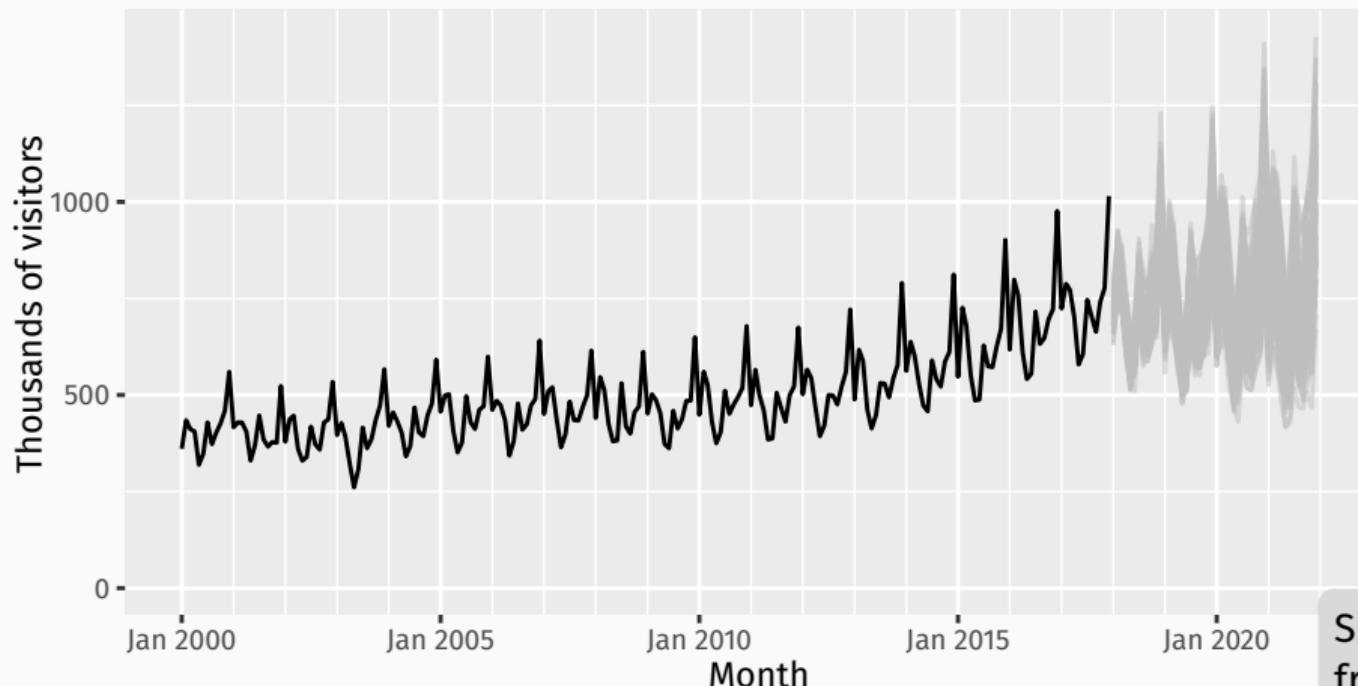


Simulated futures  
from an ETS model

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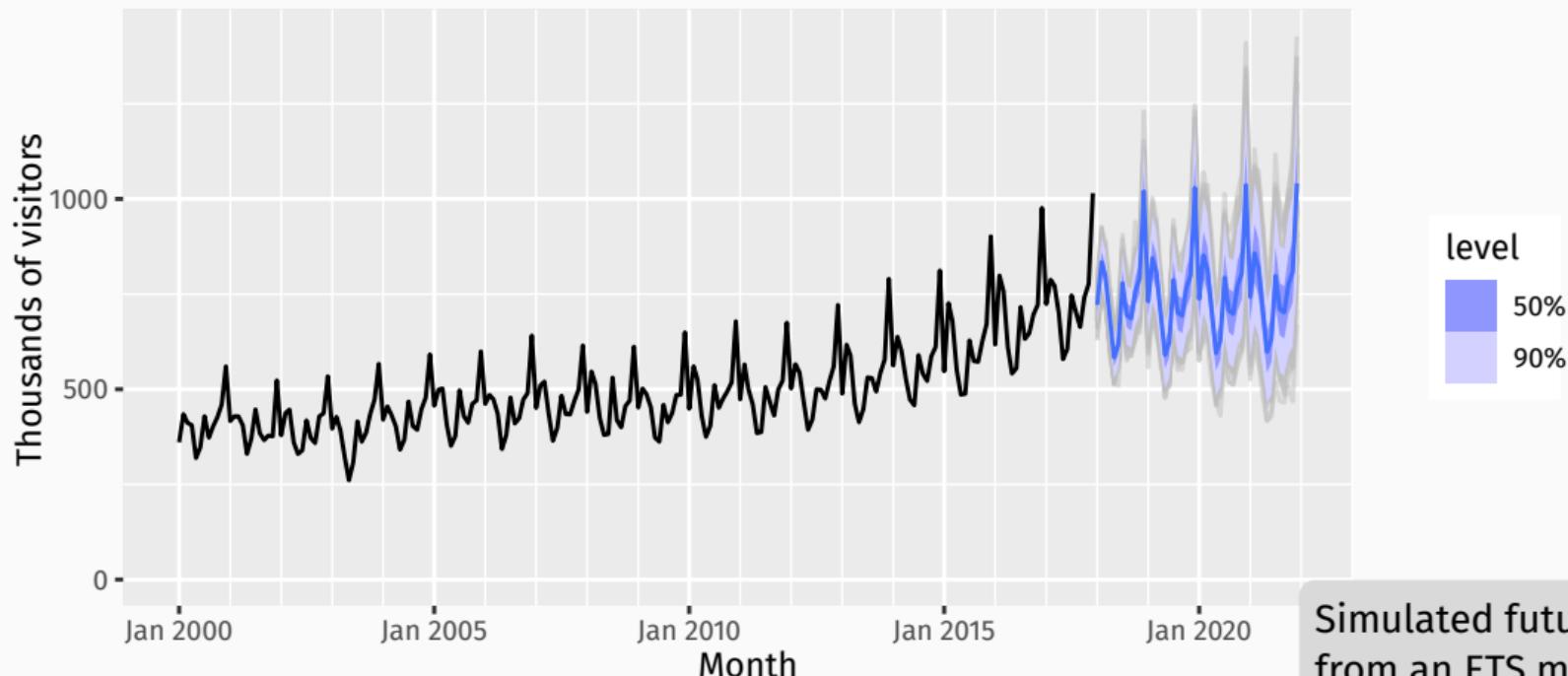


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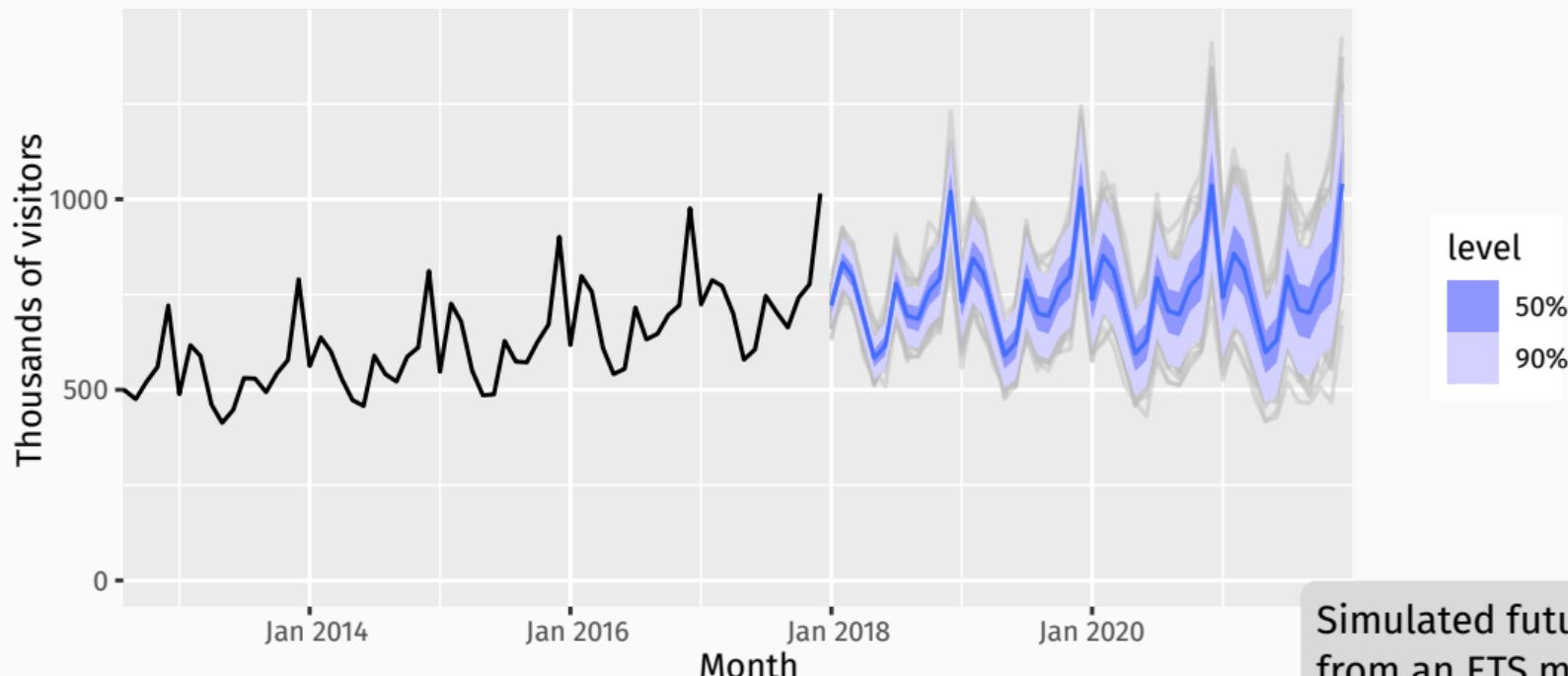
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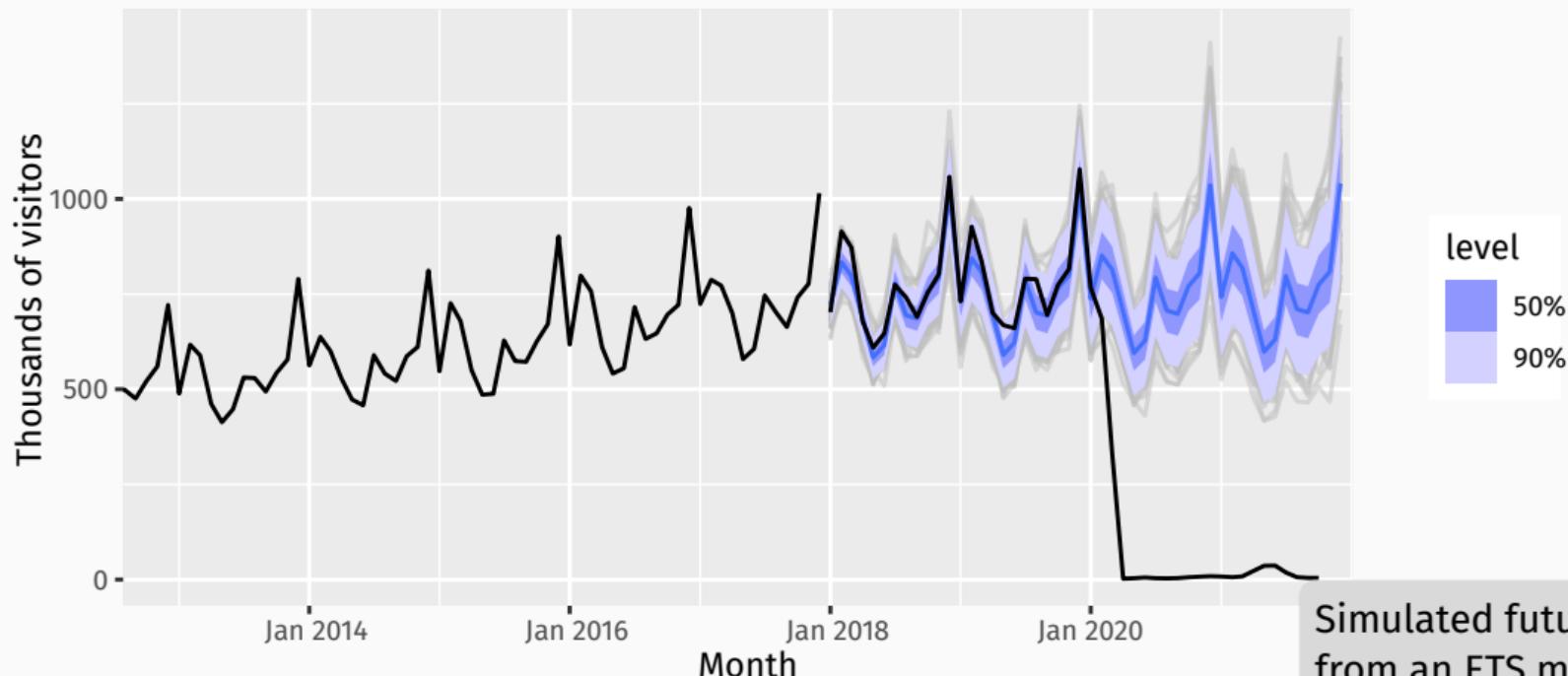
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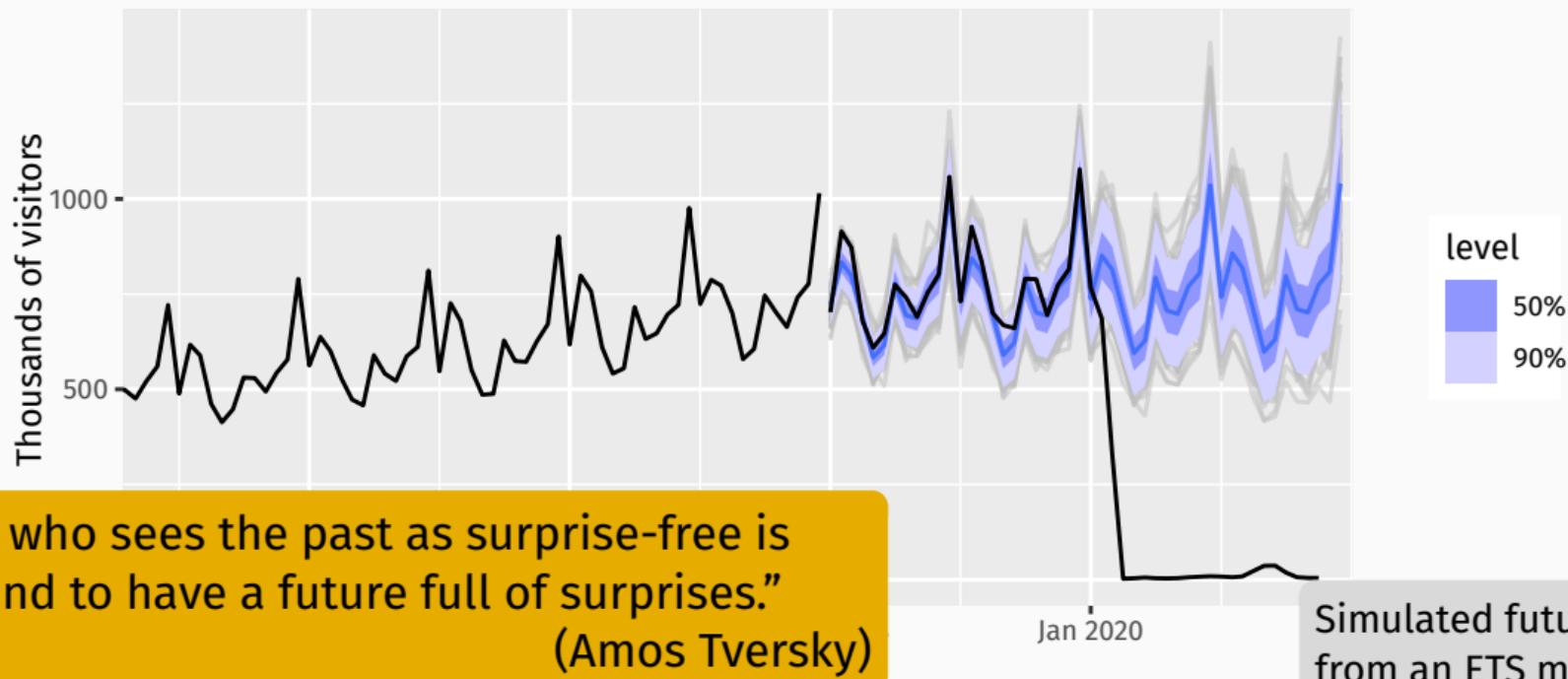
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1 Random futures

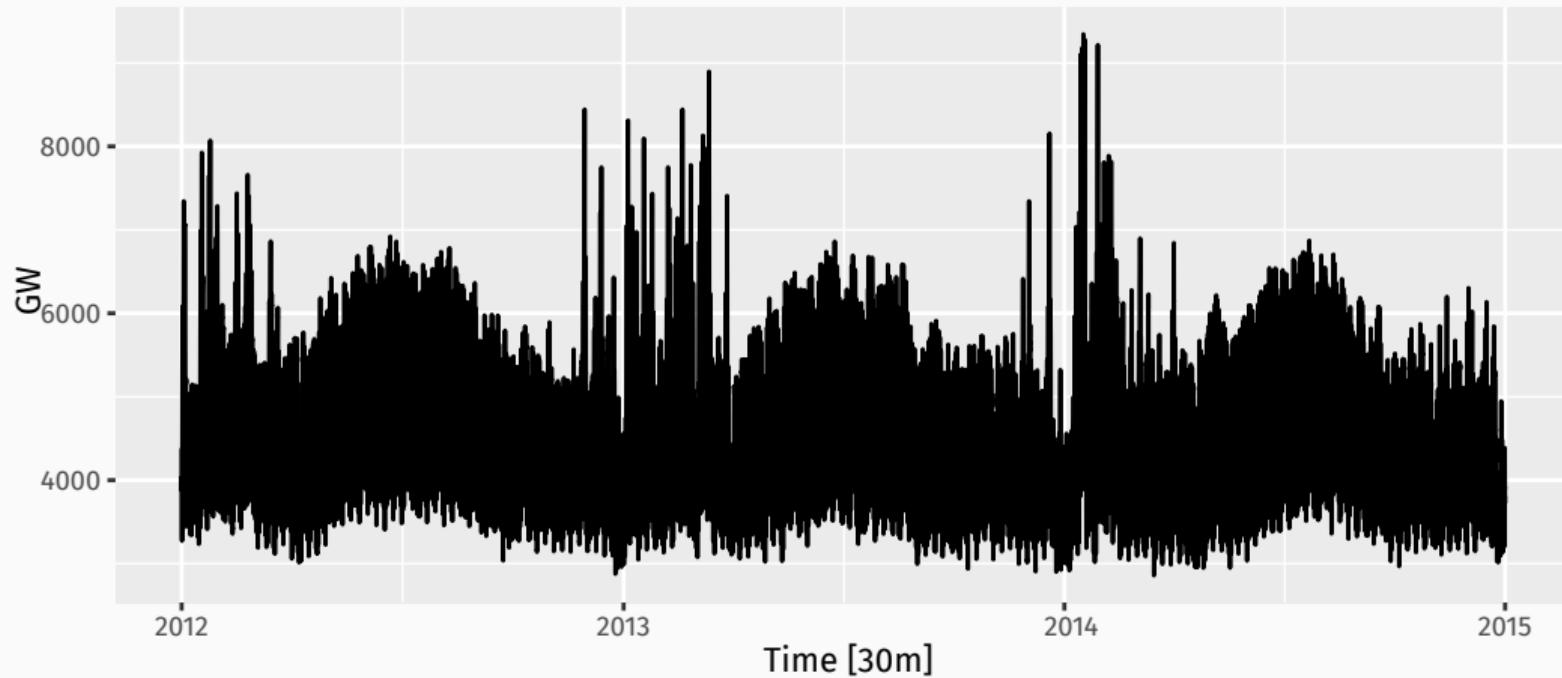
2 Forecasting peak electricity demand

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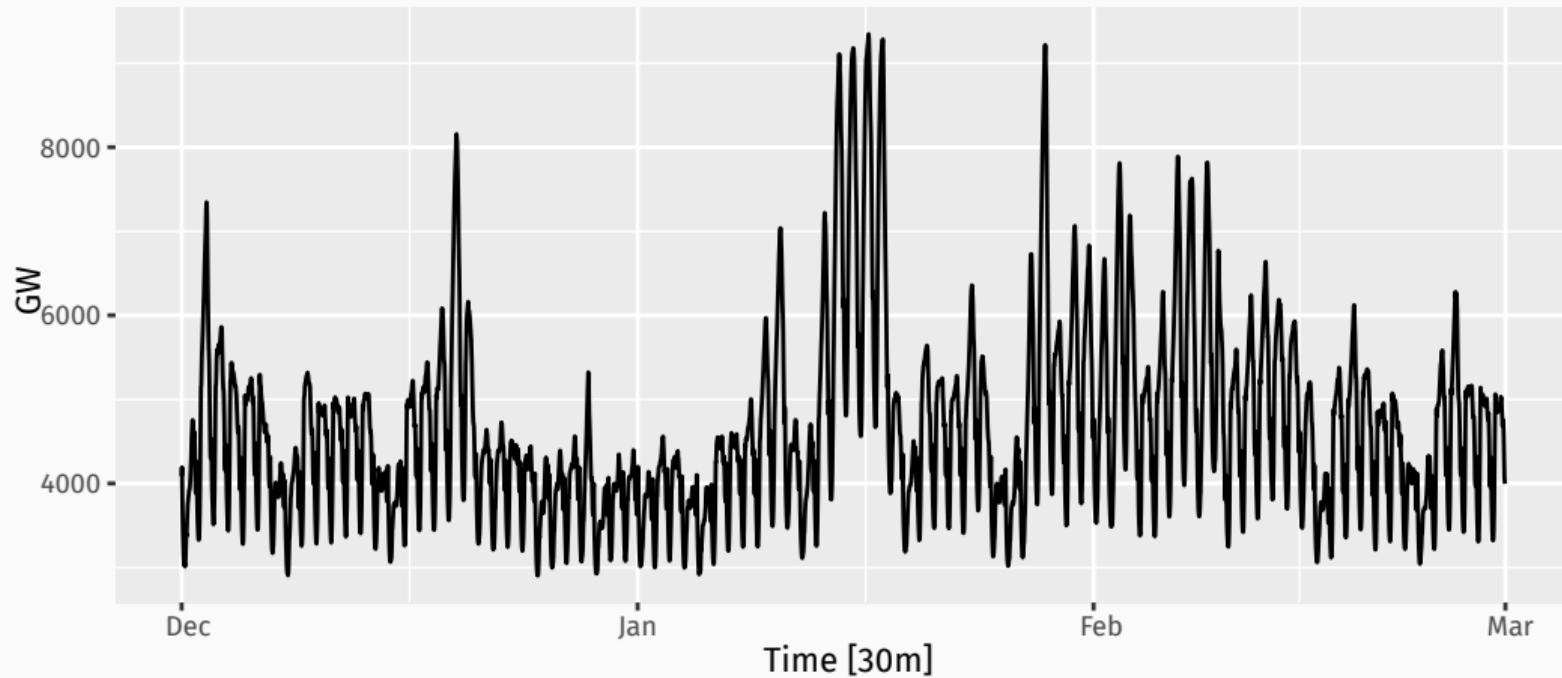
# Forecasting peak electricity demand

VIC statewide demand



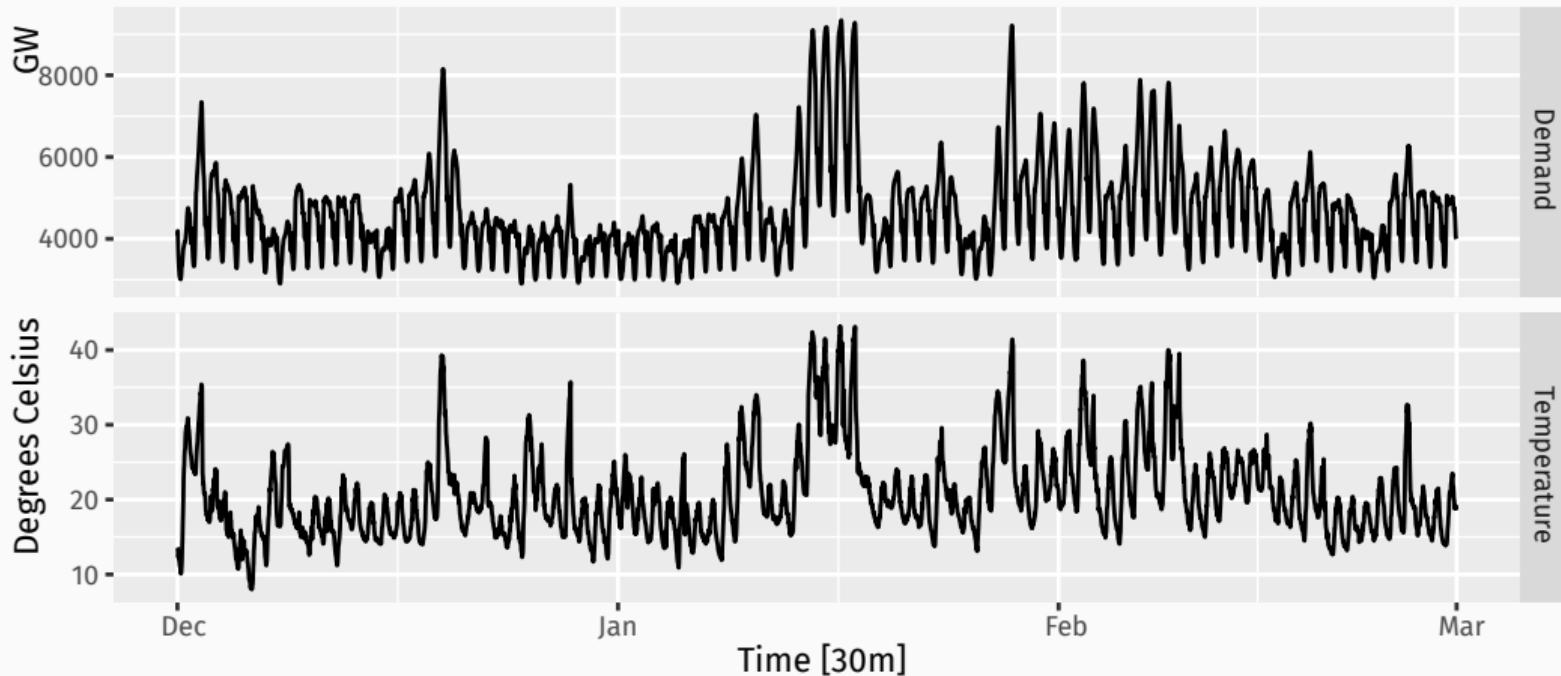
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VIC statewide demand: Summer 2013/14

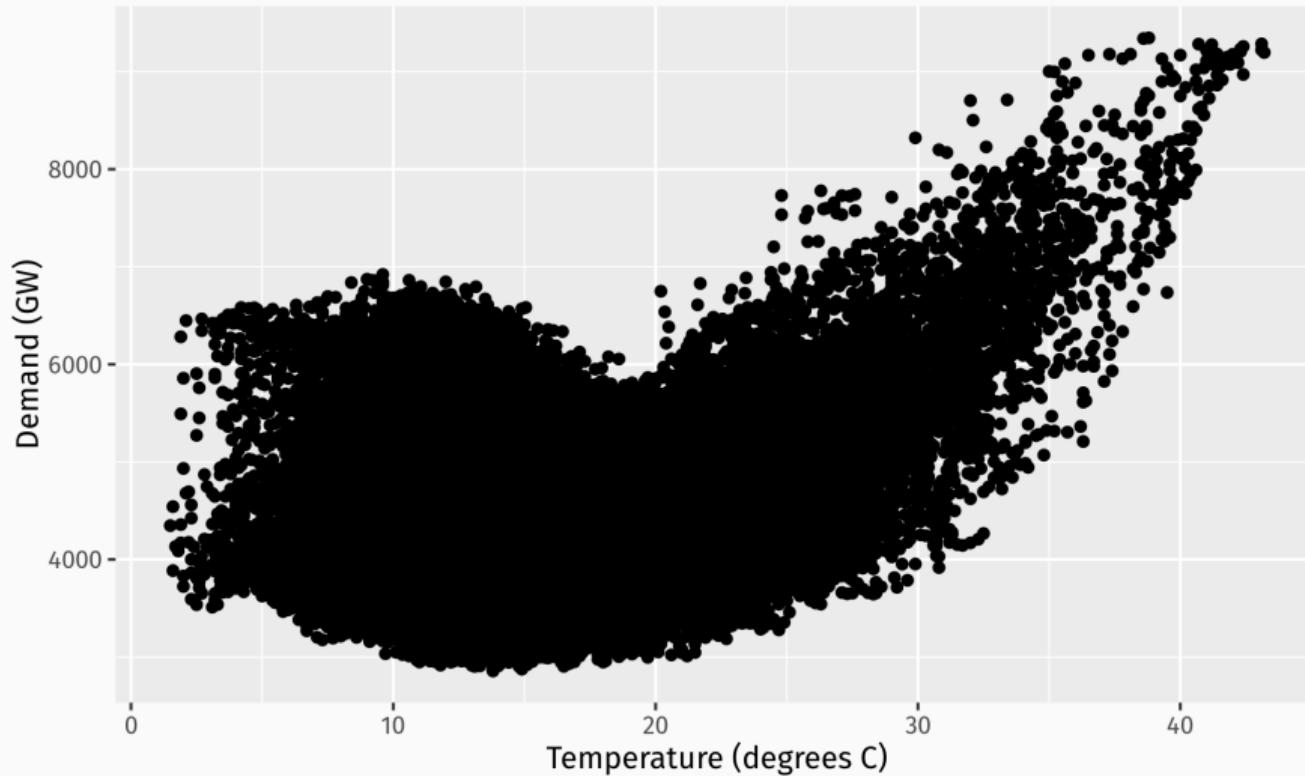


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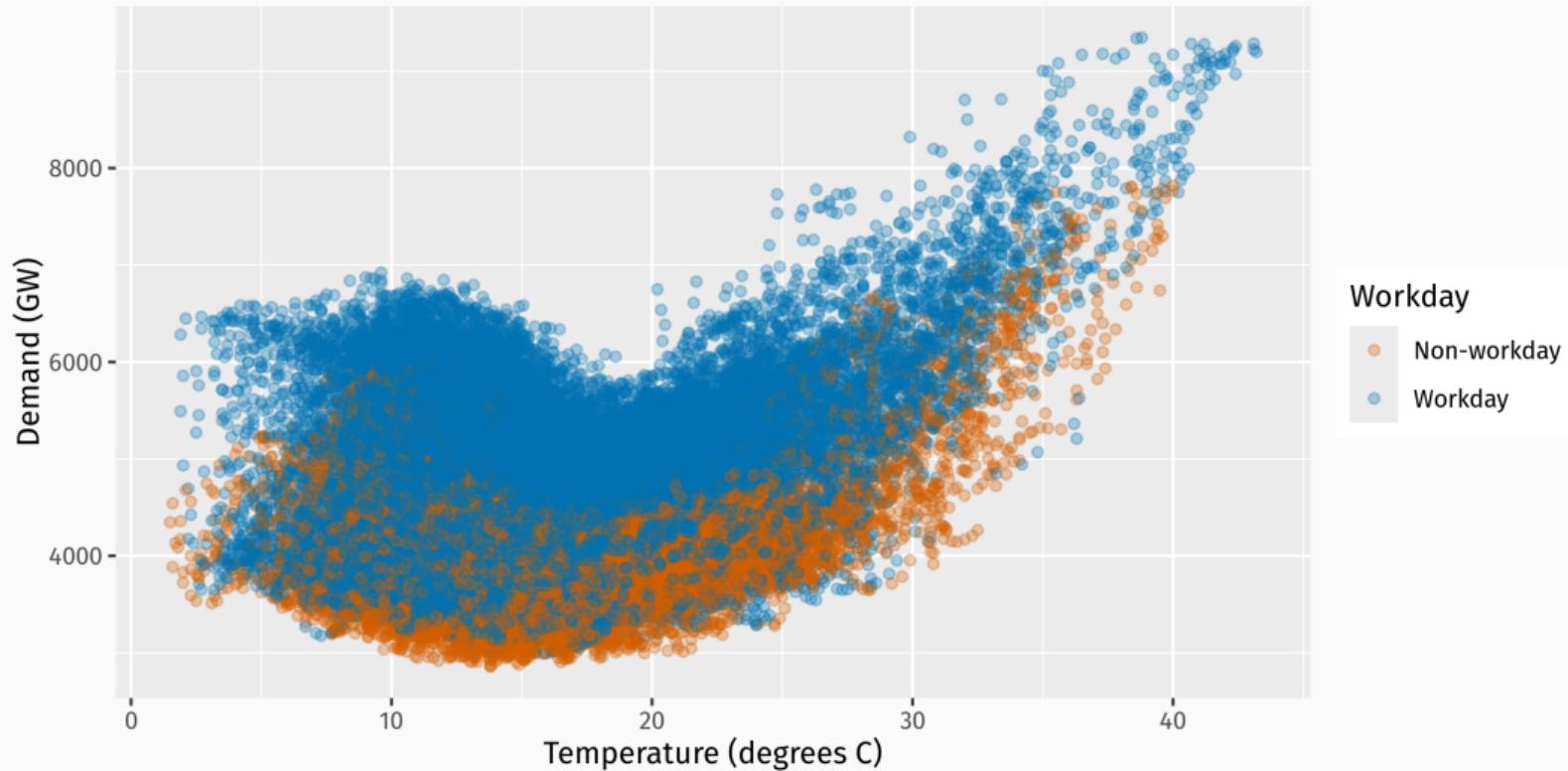
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# Forecasting peak electricity demand



# Forecasting peak electricity demand



# Forecasting peak electricity demand

# Forecasting peak electricity demand

## Predictors

- calendar effects: time of day, day of week, time of year, holidays, etc.
- prevailing and recent weather conditions
- climate change
- demand response incentives
- changing technology
- economic and demographic changes

We build a nonparametric stochastic model of demand as a function of these predictors.

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# Forecasting COVID19 cases

The **Australian Health Protection Principal Committee** is the key decision-making committee for national health emergencies. It comprises all state and territory Chief Health Officers and is chaired by the Australian Chief Medical Officer.

## COVID-19 forecasting group

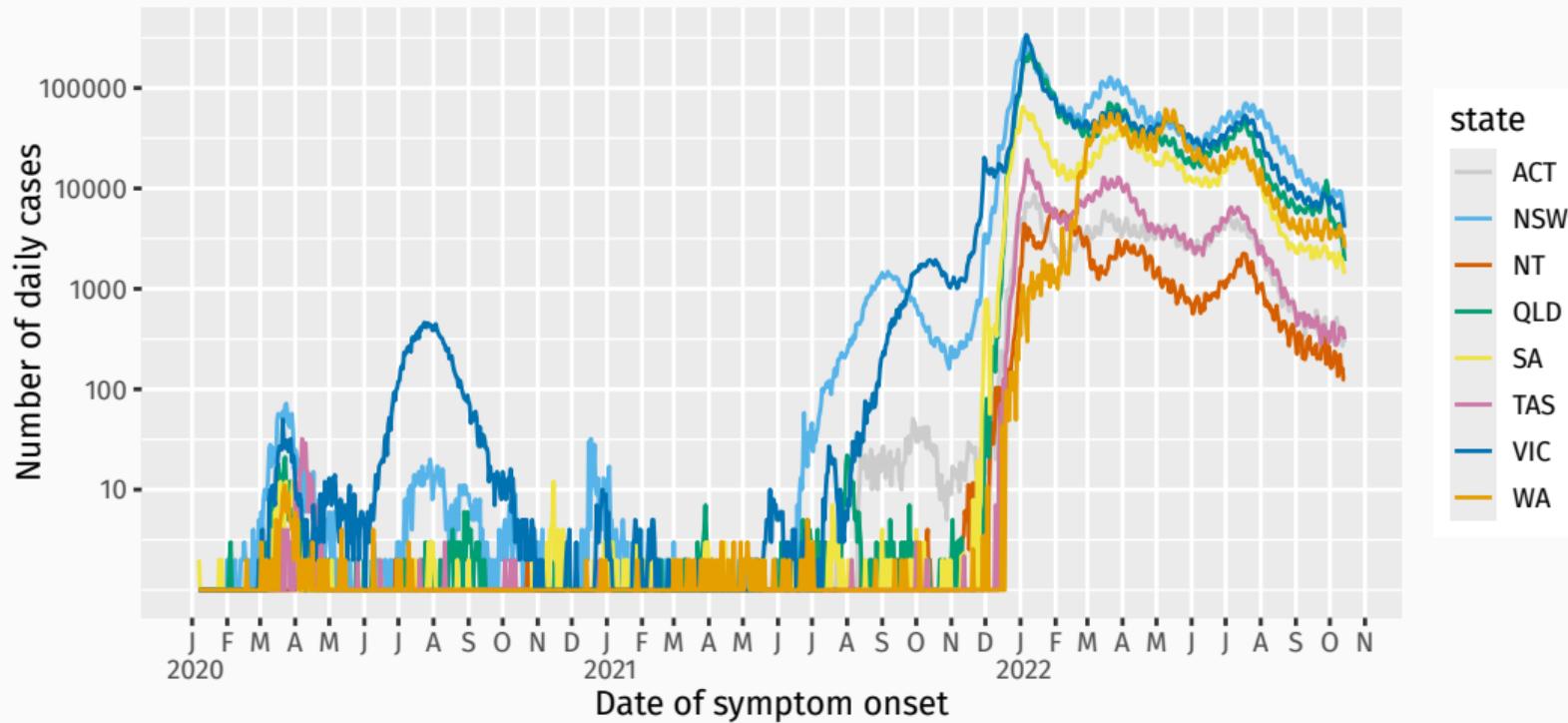
- Peter Dawson
- Nick Golding
- Rob J Hyndman
- Dennis Liu
- Michael Lydeamore
- James M McCaw
- Jodie McVernon
- Pablo Montero-Manso
- Robert Moss
- Mitchell O'Hara-Wild
- David J Price
- Joshua V Ross
- Gerry Ryan
- Freya M Shearer
- Tobin South
- Nicholas Tierney
- Ruarai Tobin

# Forecasting COVID19 cases

## Data sources

- Case-level data of all positive COVID-19 tests: onset and detection times.
- Daily population mobility data from Google, Apple & Facebook
- Weekly non-household contact surveys
- Weekly behavioural surveys
- Daily case numbers from many countries and regions via the Johns Hopkins COVID-19 repository

# Forecasting COVID19 cases



# Forecasting COVID19 cases

## Model 1: SEIIR (Uni Melbourne/Doherty Institute)

- Stochastic compartmental model with time-varying effective reproduction number.

## Model 2: Generative model (Uni Adelaide)

- Simulation with three types of infectious individuals: imported, asymptomatic, symptomatic

## Model 3: Global AR model (Monash)

- Single model fitted to all Johns Hopkins data from countries and regions with sufficient data.
- Series with obvious anomalies removed.

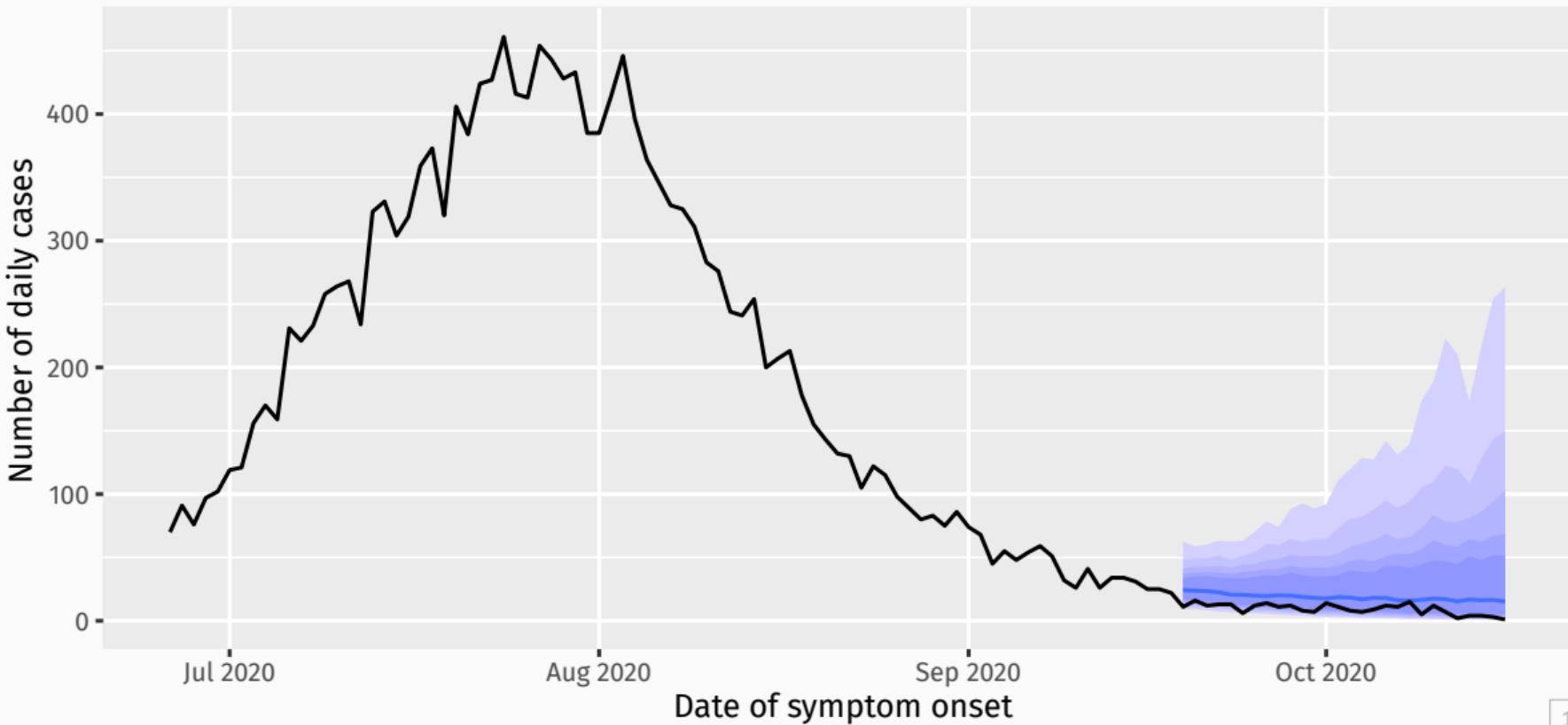
# Forecasting COVID19 cases

## Forecasting ensemble

- Forecasts obtained from a equally-weighted mixture distribution of the component forecasts.
- Also known as “linear pooling”
- Works best when individual models are over-confident and use different data sources.

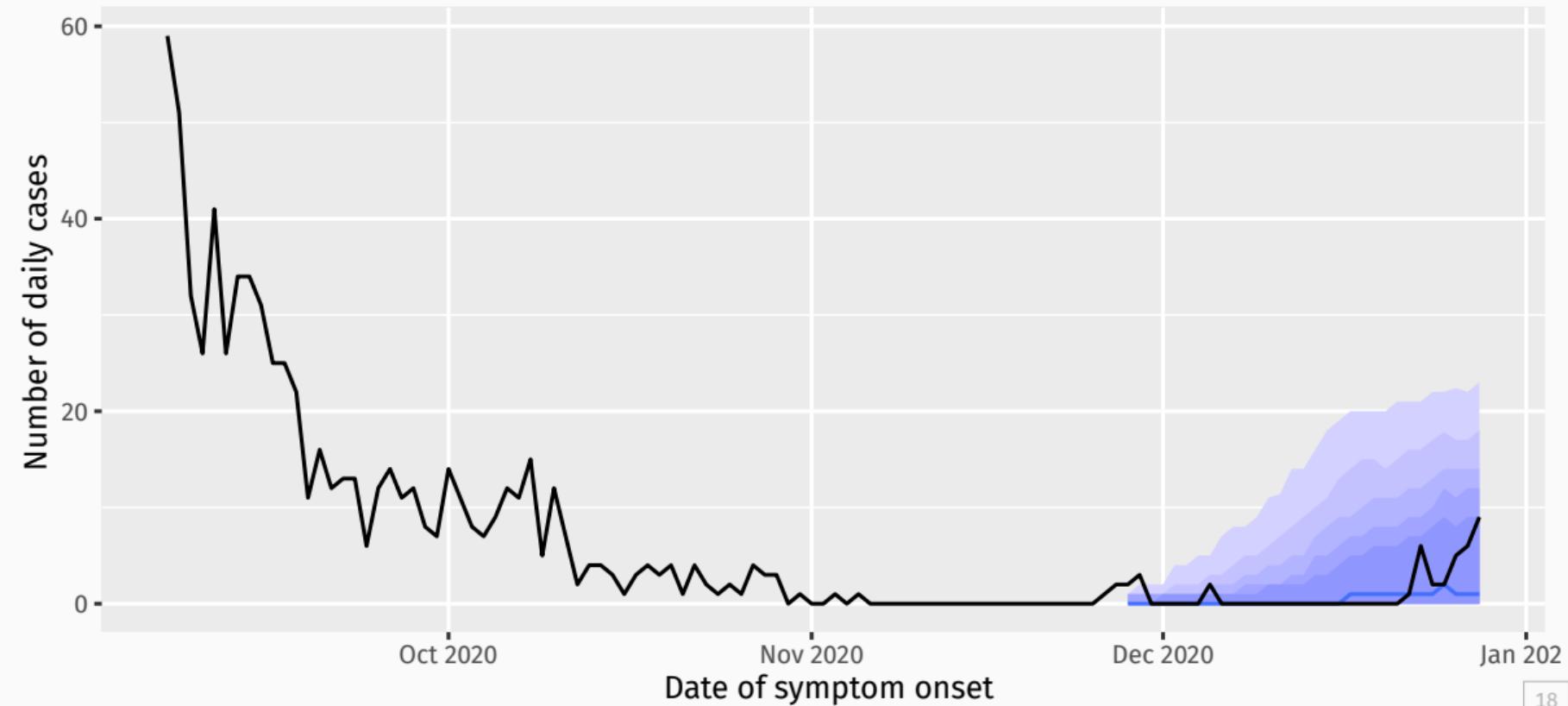
# Forecasting COVID19 cases

Ensemble forecasts: Victoria



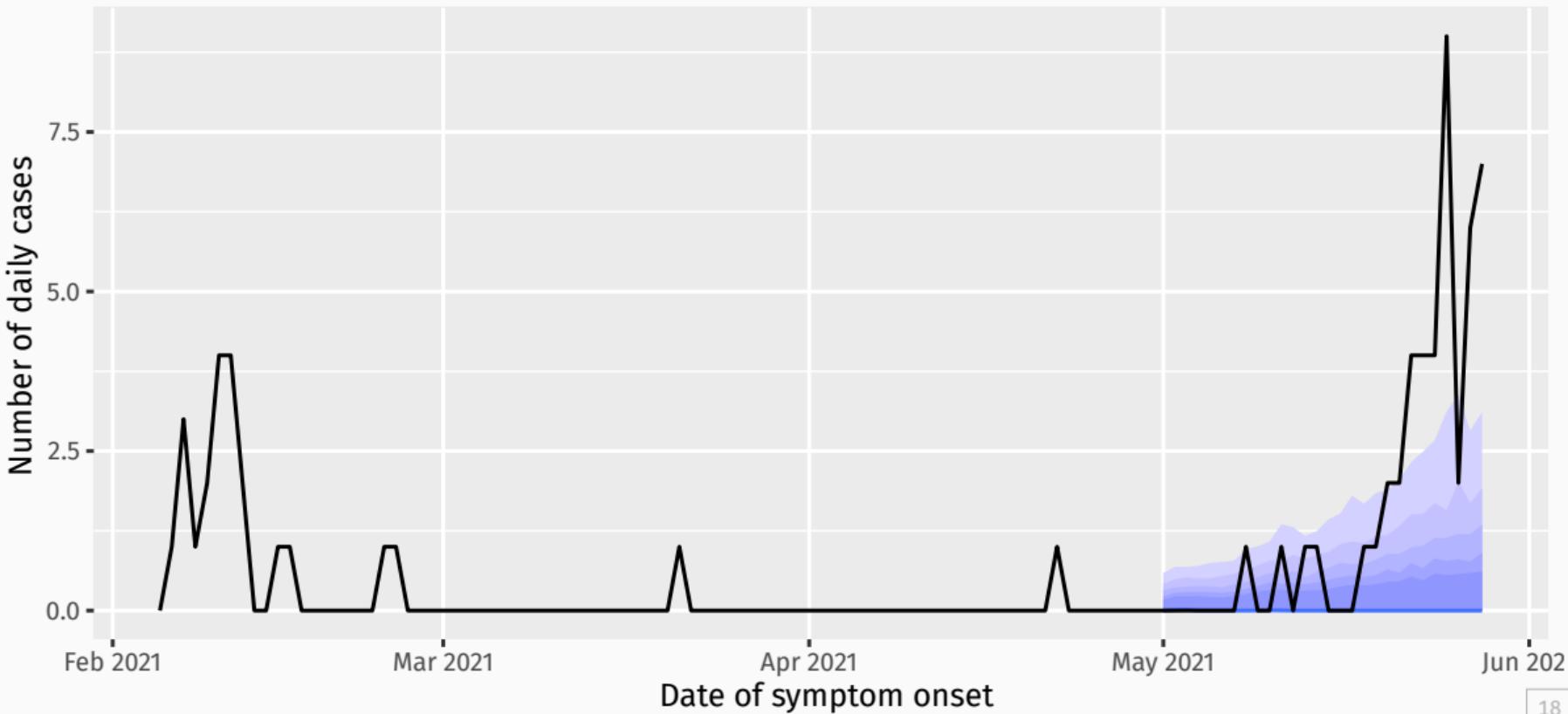
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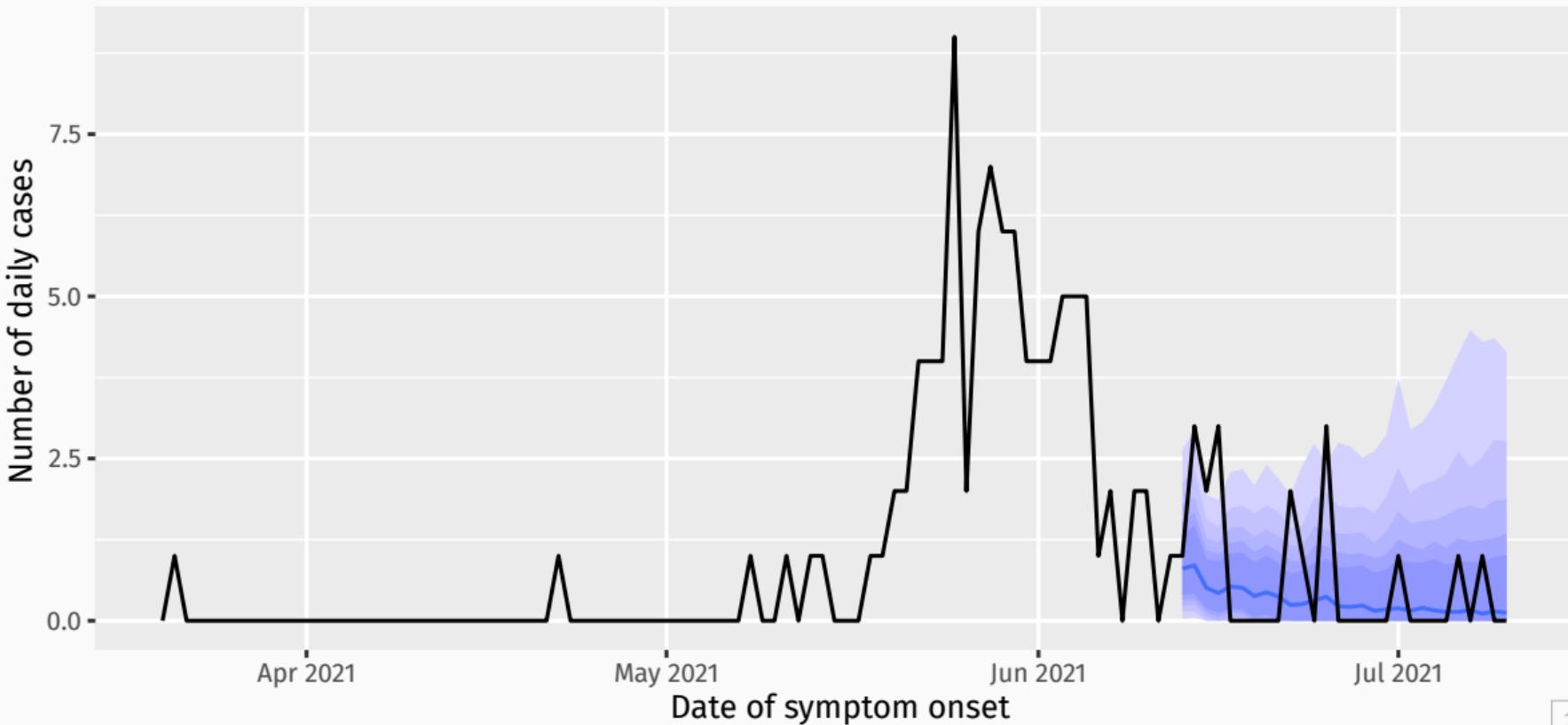
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# Forecasting COVID19 cases

Ensemble forecasts: Victoria



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# Current research interests

- Forecasting thousands of related series simultaneously:
  - ▶ sales forecasts for individual products in a retail store
  - ▶ electricity demand for small regions in a country
- Calibrating forecasting uncertainty using past forecast errors
- Probabilistic identification of anomalies
  - ▶ when the outcome is highly unlikely given the probabilistic forecast
  - ▶ combination of extreme value theory and probability scoring methods

## Statistical forecasting works best when ...

- there is substantial historical data
- the evolution of the underlying environment is stable
- the aim is to produce short-term forecasts
- there are no feedback loops (forecasts affecting outcomes)

## FUTURE ideas

- Compare statistical forecasts with alternative methods to identify the horizon at which statistical methods are no longer competitive.
- Use alternative approaches to help identify the forecast distributions.

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