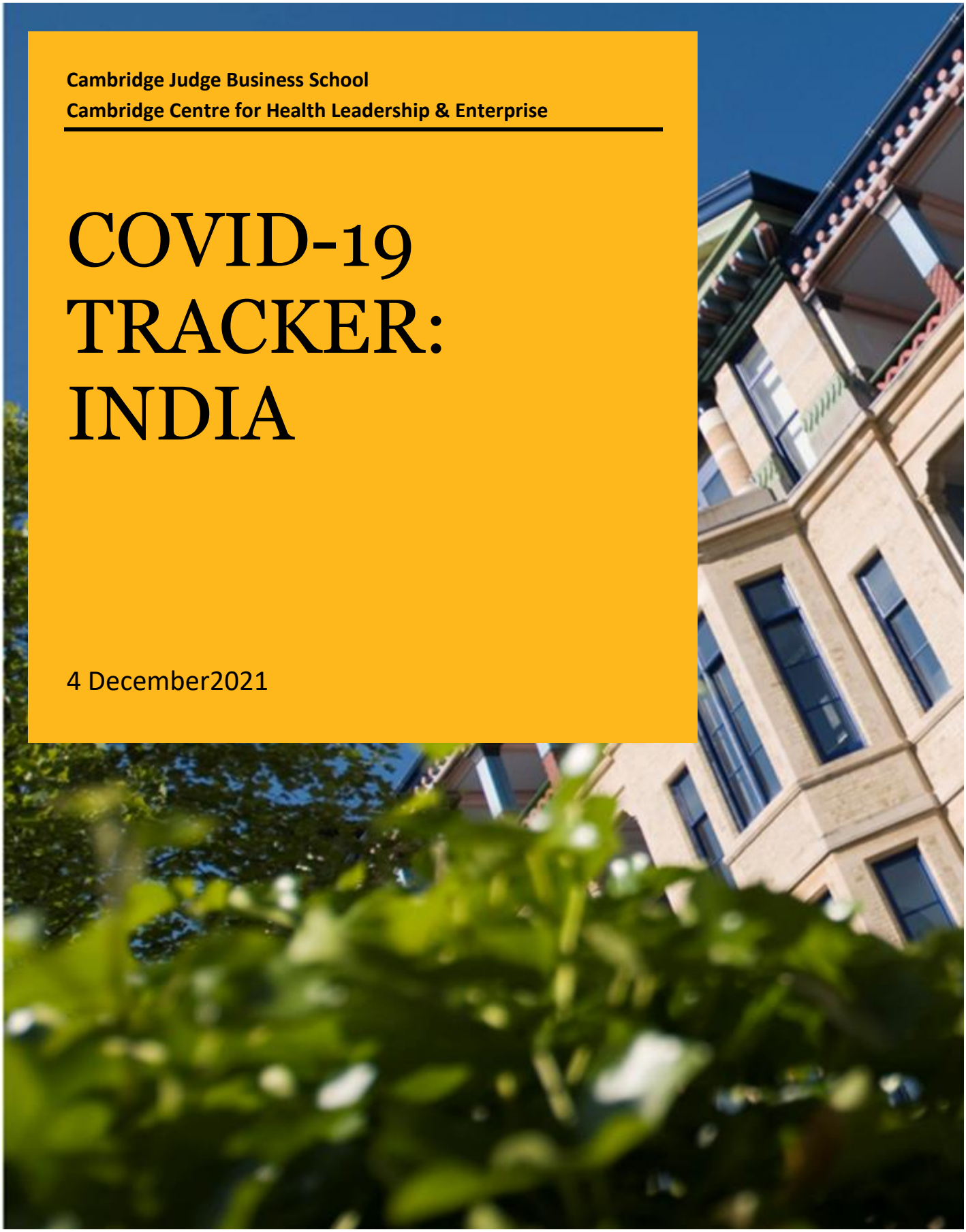
Cambridge Judge Business School
Cambridge Centre for Health Leadership & Enterprise

COVID-19 TRACKER: INDIA

4 December2021



Centre for Health Leadership & Enterprise
UNIVERSITY OF CAMBRIDGE Judge Business School
HSTP Health Systems Transformation Platform
National Institute of Economic and Social Research

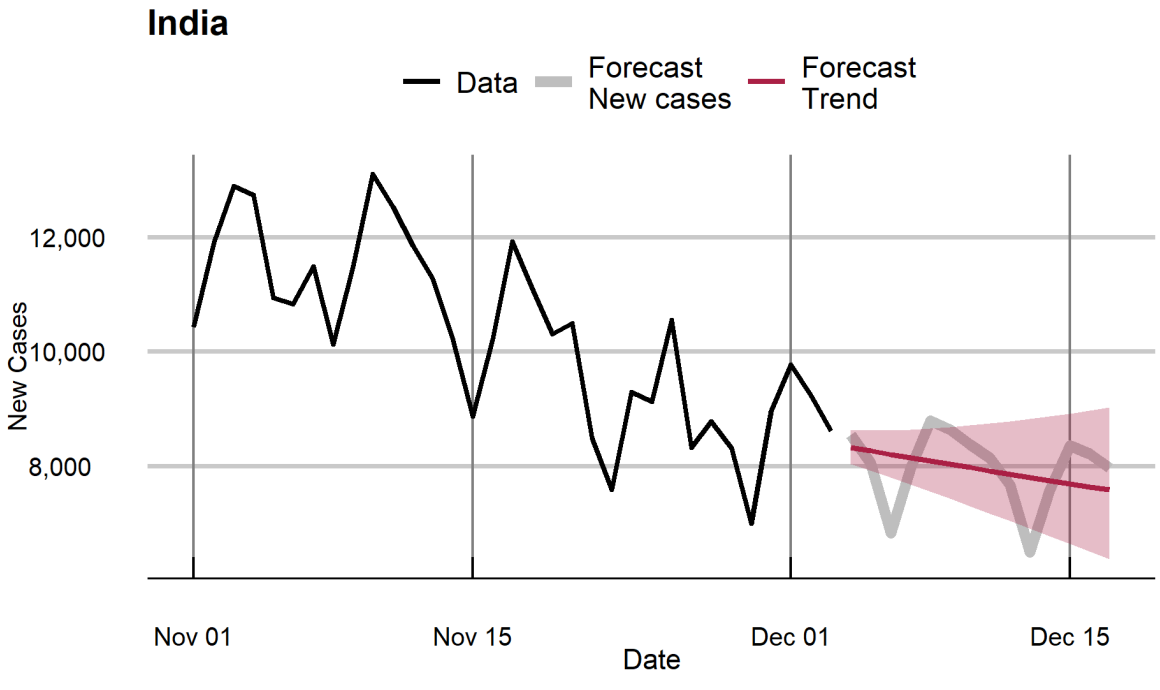
Delhi, Goa, Gujarat, Sikkim and Tripura are the states currently seeing flare ups, with filtered daily growth rates of new COVID-19 cases exceeding 5%.

Karnataka and Telangana have relatively high infection incidences with daily cases continuing to grow.

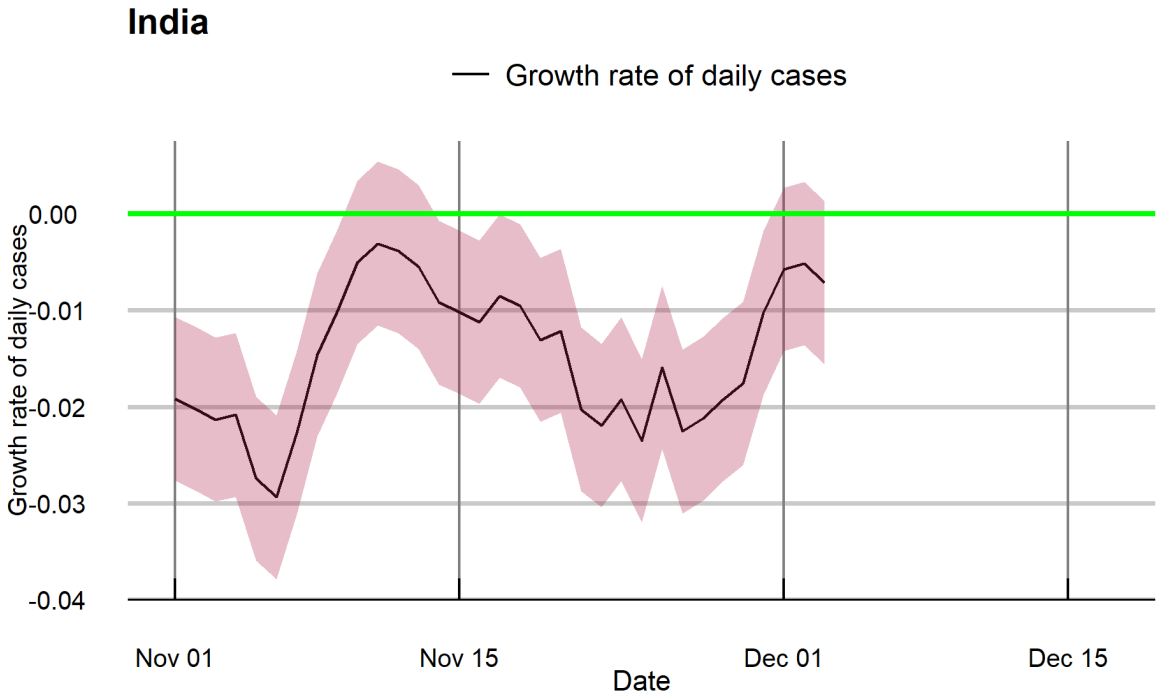
India as a whole remains on a declining trend. The trend value of new cases is likely to be about 7,500 per day in two week's time, by 17 December.

Daily Covid-19 cases in India: Forecast

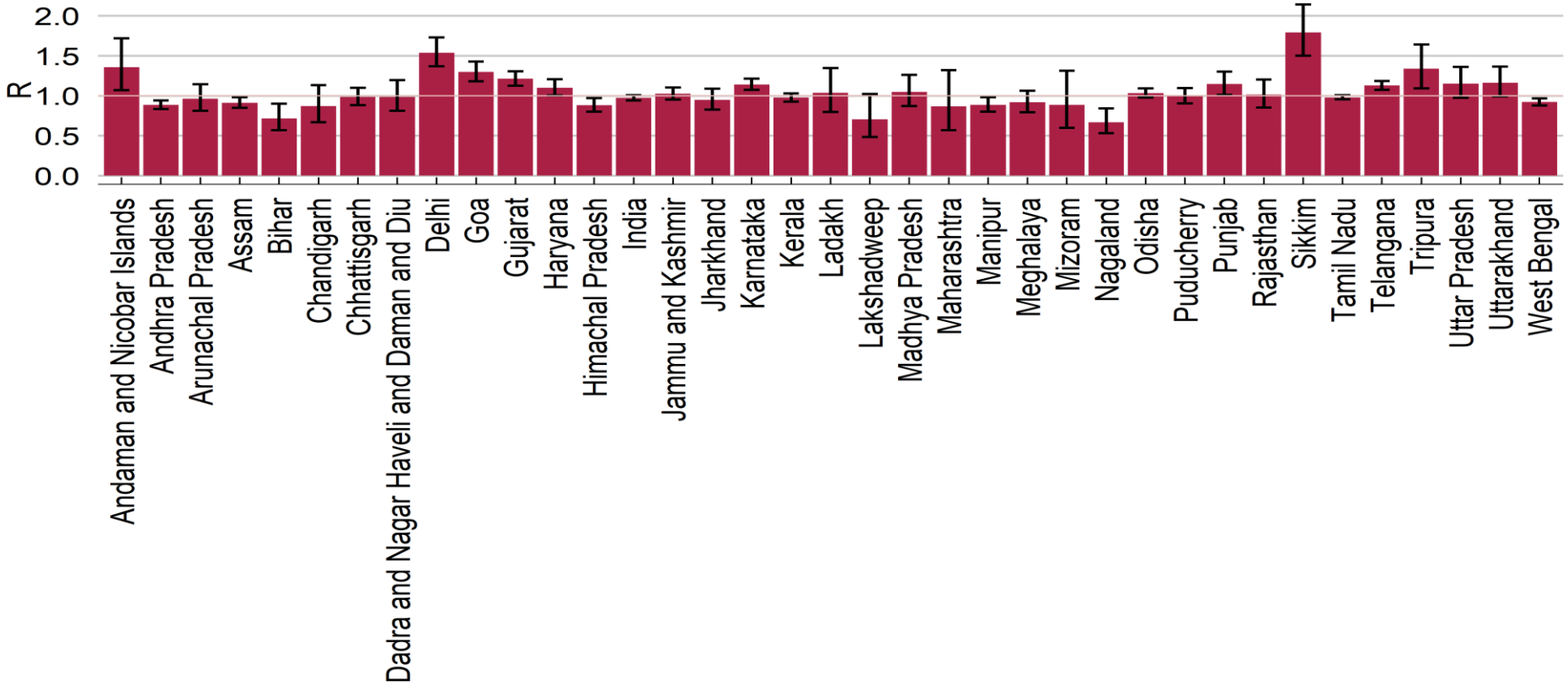
Forecasts of daily new cases for the period 4 December to 17 December 2021, based on data till 3 December 2021. The trend value of new COVID-19 cases is likely be about 7,500 per day by 17 December.



The filtered growth rate of daily new cases was -0.007 (-0.7 %) as on 3 December 2021.



R_t: 3 December 2021



Bar chart shows point estimates of R and the ± 1 standard deviation confidence intervals

Note: Due to small numbers, estimates are not reliable for: Andaman and Nicobar Islands, Arunachal Pradesh, Bihar, Chandigarh, Chhattisgarh, Dadra and Nagar Haveli and Daman and Diu, Haryana, Jharkhand, Ladakh, Lakshadweep, Madhya Pradesh, Manipur, Meghalaya, Nagaland, Rajasthan, Tripura, Uttar Pradesh and Uttarakhand. *Unusually daily case numbers reported for Delhi and Sikkim on 2nd and 3rd December respectively call for investigation and explanation.*

Filtered daily growth rates of daily cases for States and Union territories currently seeing flare ups

Filtered daily growth rate over 5% as on 3 December 2021

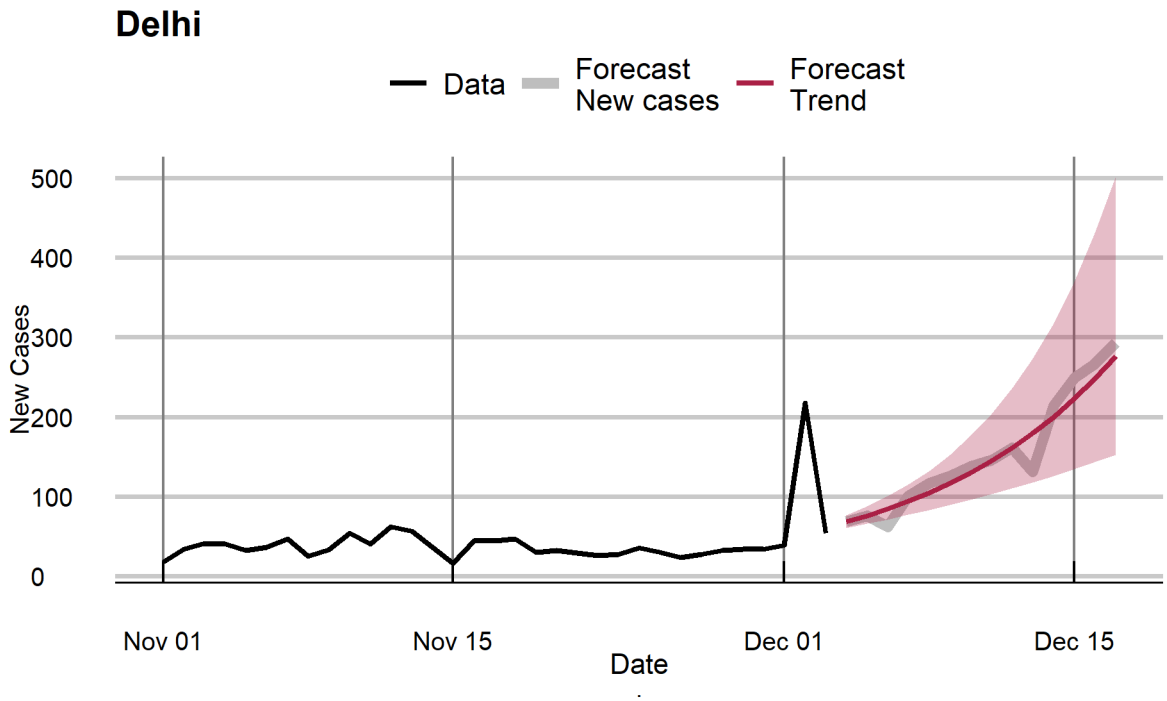
Date	Delhi	Goa	Gujarat	Sikkim	Tripura
20/11/2021	-2.5%	0.6%	3.4%	7.7%	-3.0%
21/11/2021	-3.2%	-1.1%	0.0%	6.6%	-10.2%
22/11/2021	-2.3%	-1.8%	-1.5%	2.6%	-6.1%
23/11/2021	-3.7%	-0.3%	-0.8%	-1.3%	0.8%
24/11/2021	-3.1%	-1.1%	-1.6%	-7.7%	4.2%
25/11/2021	-3.0%	0.9%	-1.9%	-0.1%	-3.7%
26/11/2021	-4.5%	2.7%	-2.5%	0.0%	0.5%
27/11/2021	-3.9%	4.7%	-2.7%	-3.4%	4.3%
28/11/2021	-2.3%	4.5%	-2.5%	3.1%	2.0%
29/11/2021	1.2%	3.9%	-2.0%	5.7%	-2.5%
30/11/2021	1.2%	3.7%	0.3%	4.7%	1.4%
01/12/2021	1.7%	6.6%	2.4%	3.9%	5.9%
02/12/2021	12.4%	7.5%	4.2%	5.3%	8.9%
03/12/2021	10.8%	6.5%	4.8%	14.6%	7.3%

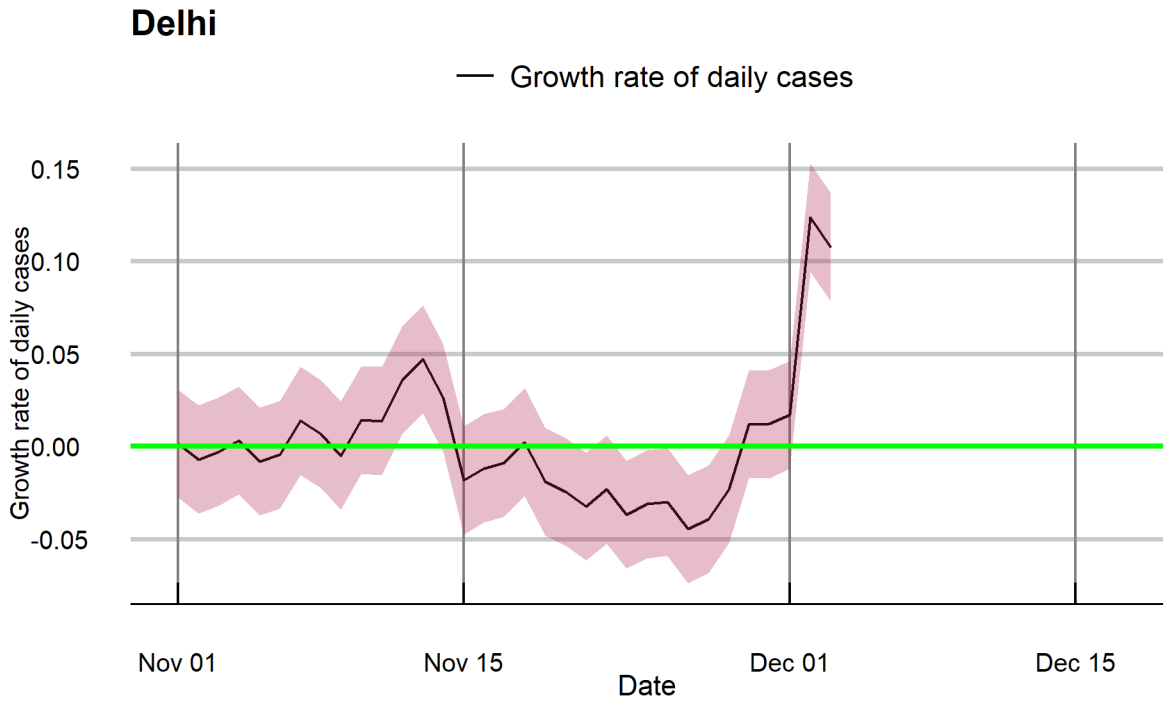
Forecasts of daily cases for States and Union territories currently seeing flare ups

4 December to 17 December 2021

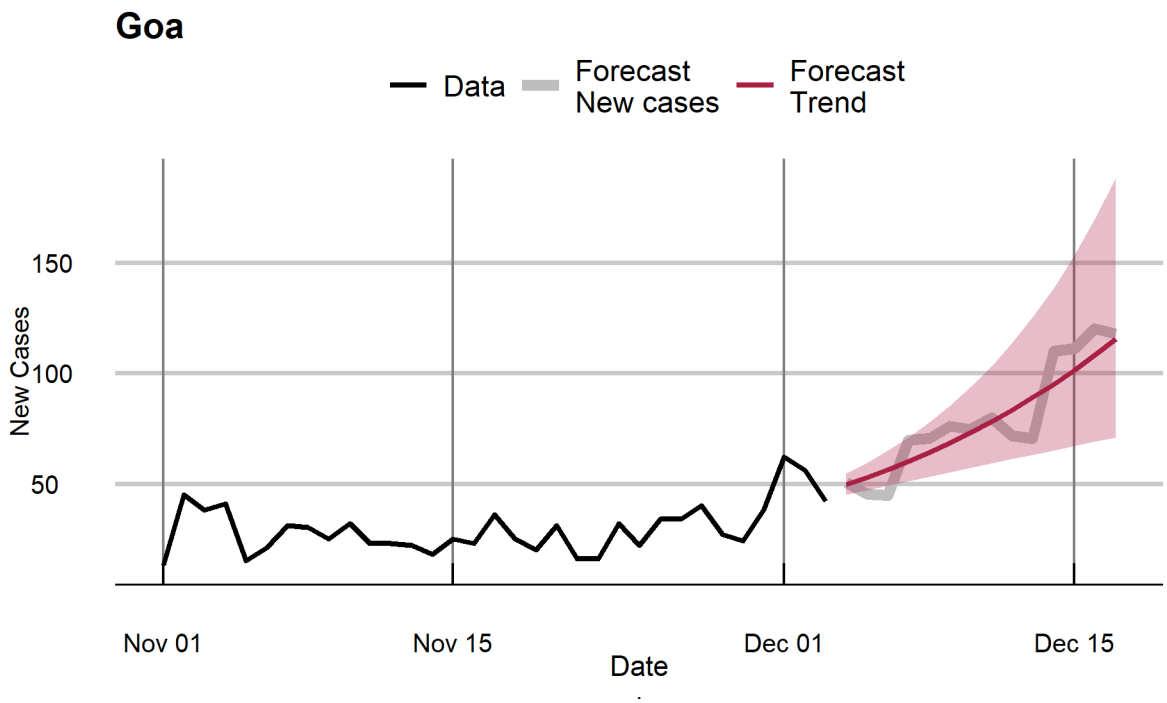
Date	Delhi: Forecast of new cases	Delhi: Forecast trend	Goa: Forecast of new cases	Goa: Forecast trend	Gujarat: Forecast of new cases	Gujarat: Forecast trend	Sikkim: Forecast of new cases	Sikkim: Forecast trend	Tripura: Forecast of new cases	Tripura: Forecast trend
04/12/2021	68	**68**	51	**49**	45	**43**	21	**21**	13	**12**
05/12/2021	76	**76**	45	**53**	42	**45**	26	**24**	7	**12**
06/12/2021	62	**84**	45	**56**	44	**48**	11	**28**	16	**13**
07/12/2021	101	**94**	70	**60**	50	**50**	35	**32**	19	**14**
08/12/2021	117	**105**	70	**64**	54	**53**	43	**37**	16	**16**
09/12/2021	125	**117**	76	**69**	58	**55**	51	**43**	17	**17**
10/12/2021	138	**130**	75	**73**	59	**58**	76	**50**	18	**18**
11/12/2021	145	**145**	80	**78**	63	**61**	58	**58**	22	**19**
12/12/2021	161	**161**	72	**83**	59	**64**	71	**67**	12	**21**
13/12/2021	131	**179**	70	**89**	62	**67**	31	**77**	27	**22**
14/12/2021	214	**200**	110	**95**	71	**70**	97	**90**	32	**24**
15/12/2021	249	**223**	111	**101**	76	**74**	120	**104**	26	**26**
16/12/2021	267	**248**	120	**108**	82	**77**	144	**121**	28	**28**
17/12/2021	293	**276**	118	**115**	82	**81**	215	**140**	30	**30**

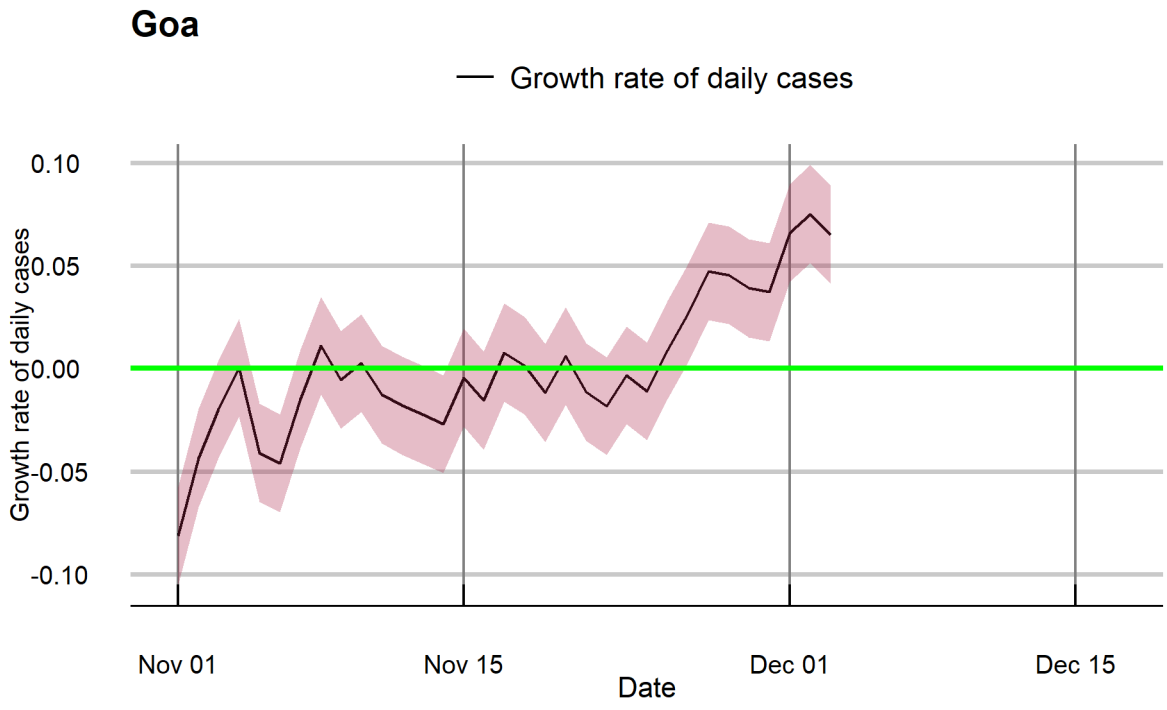
New cases forecasts (4 to 17 December) **and filtered daily growth rates** (up to 3 December) **for States and Union territories currently of concern**

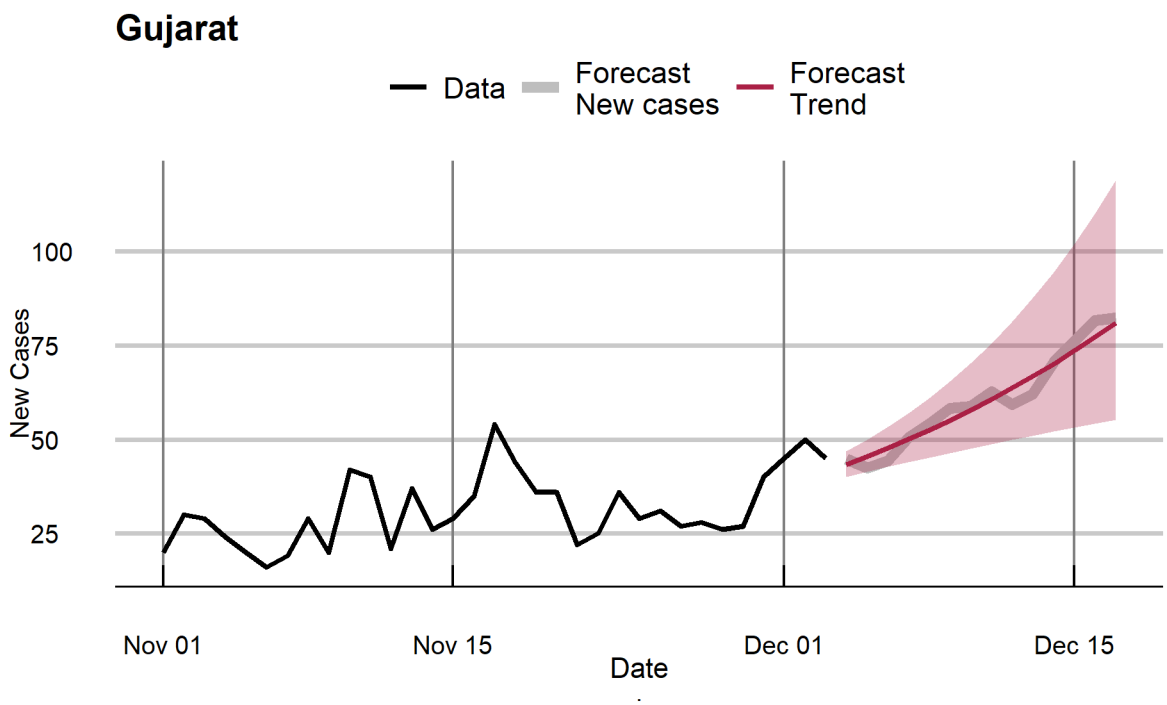


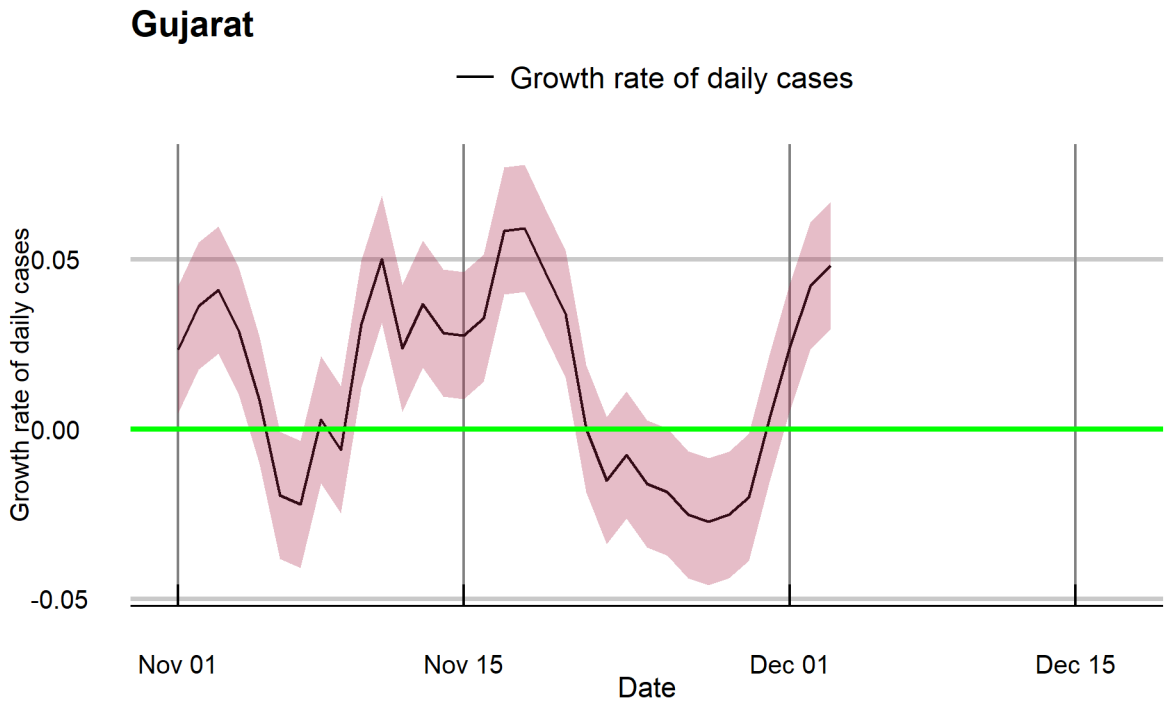


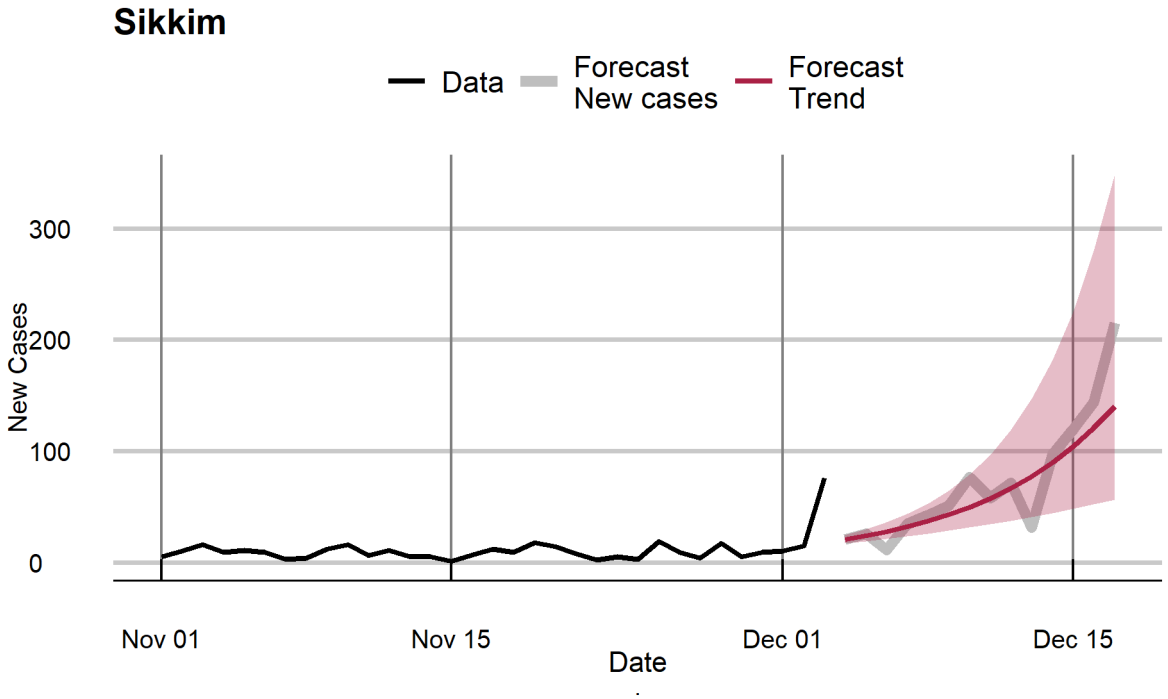
Note: The value reported for the number of new cases on 2 December (217) is an outlier that calls for investigation and explanation.

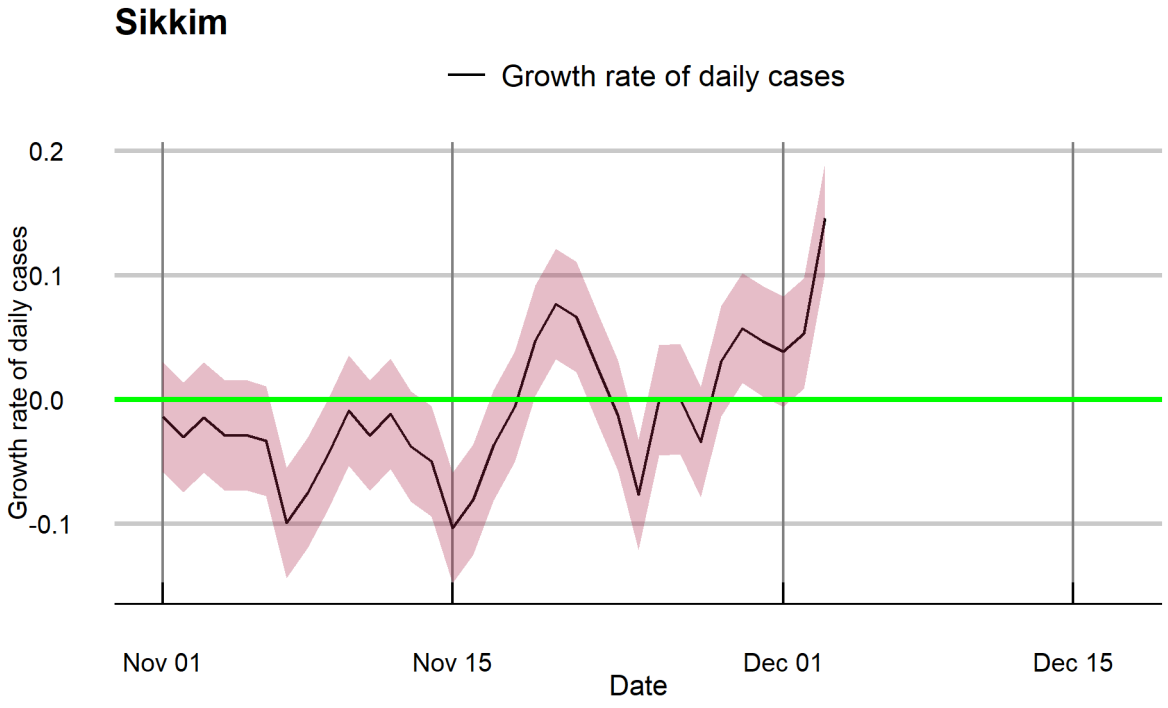

Goa
Data
Forecast
New cases
Forecast
Trend
150
100
50
New Cases
Nov 01
Nov 15
Dec 01
Dec 15
Date


Goa
Growth rate of daily cases
0.10
0.05
0.00
-0.05
-0.10
Growth rate of daily cases
Nov 01
Nov 15
Dec 01
Dec 15
Date

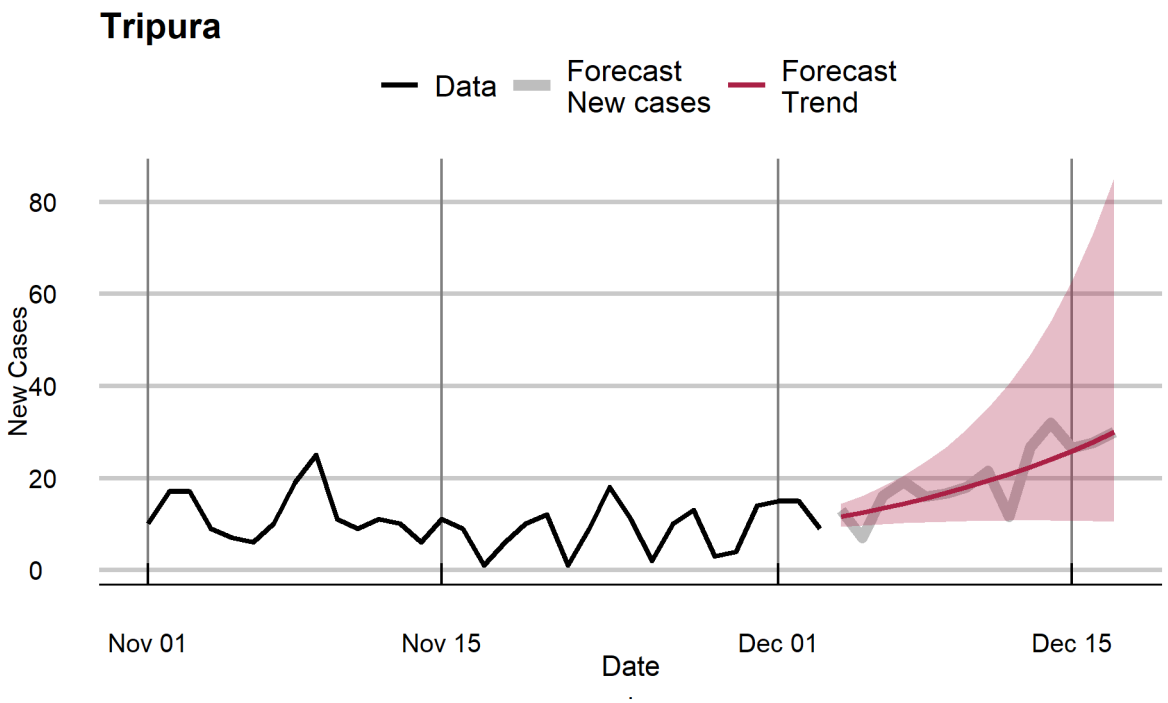

Gujarat
Data
Forecast
New cases
Forecast
Trend
100
75
50
25
New Cases
Nov 01
Nov 15
Dec 01
Dec 15
Date

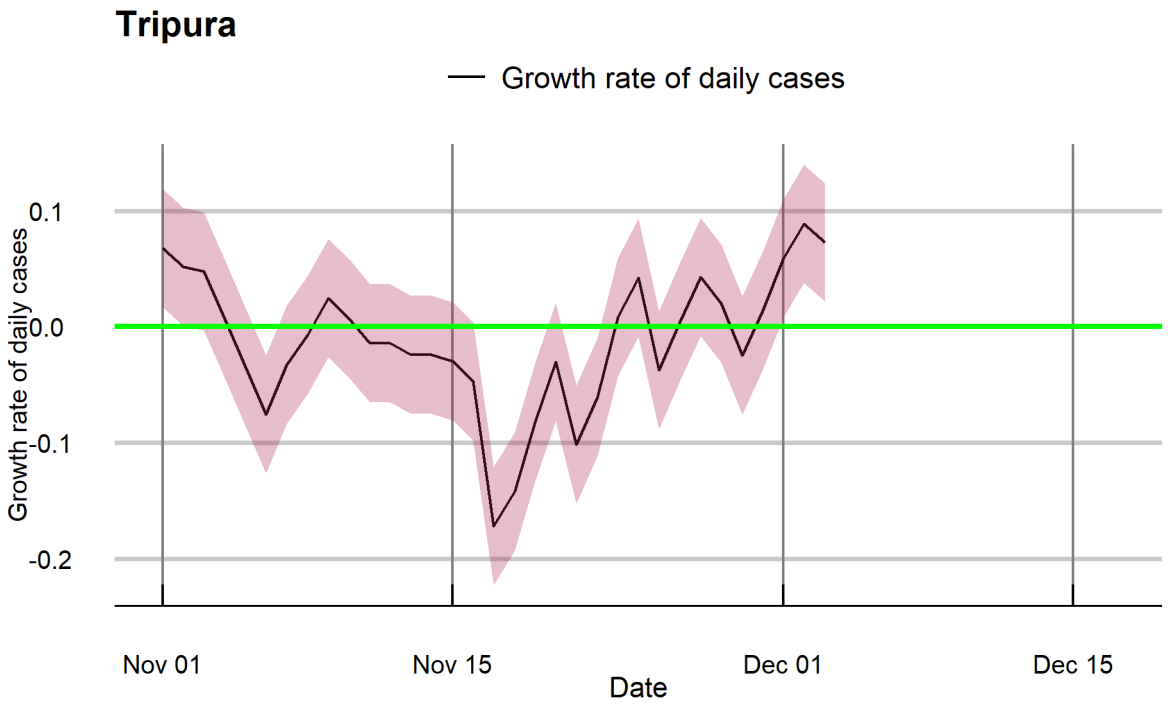

Gujarat
Growth rate of daily cases
0.05
0.00
-0.05
Growth rate of daily cases
Nov 01
Nov 15
Dec 01
Dec 15
Date



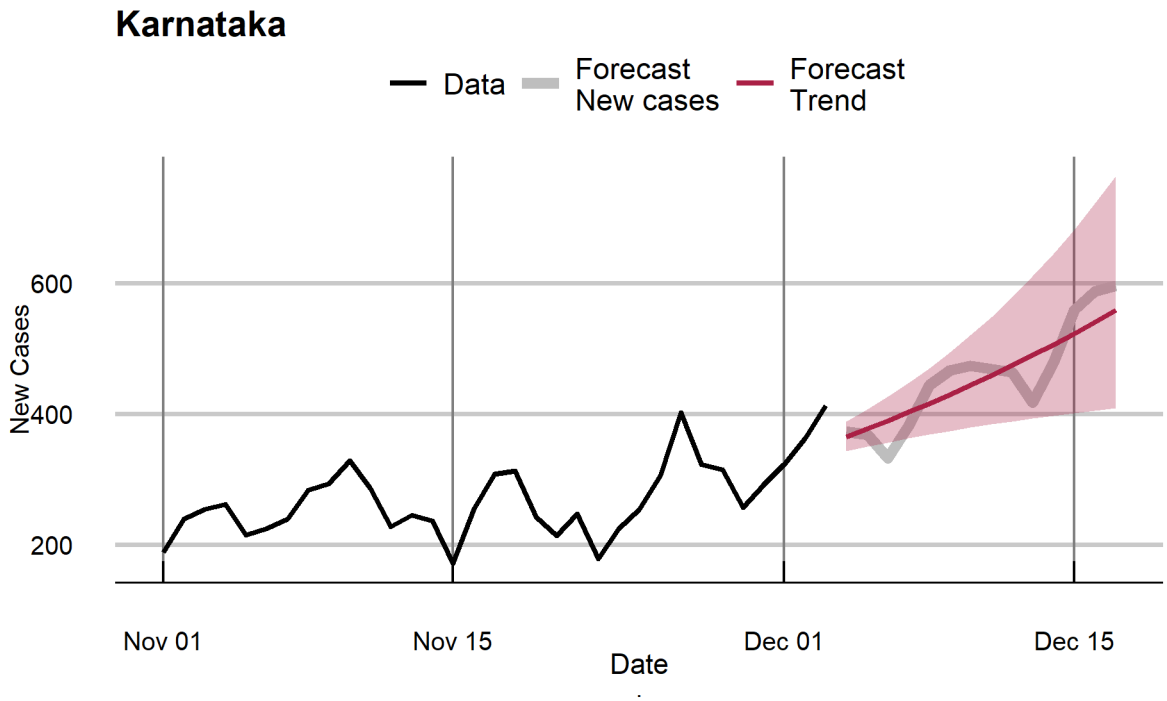


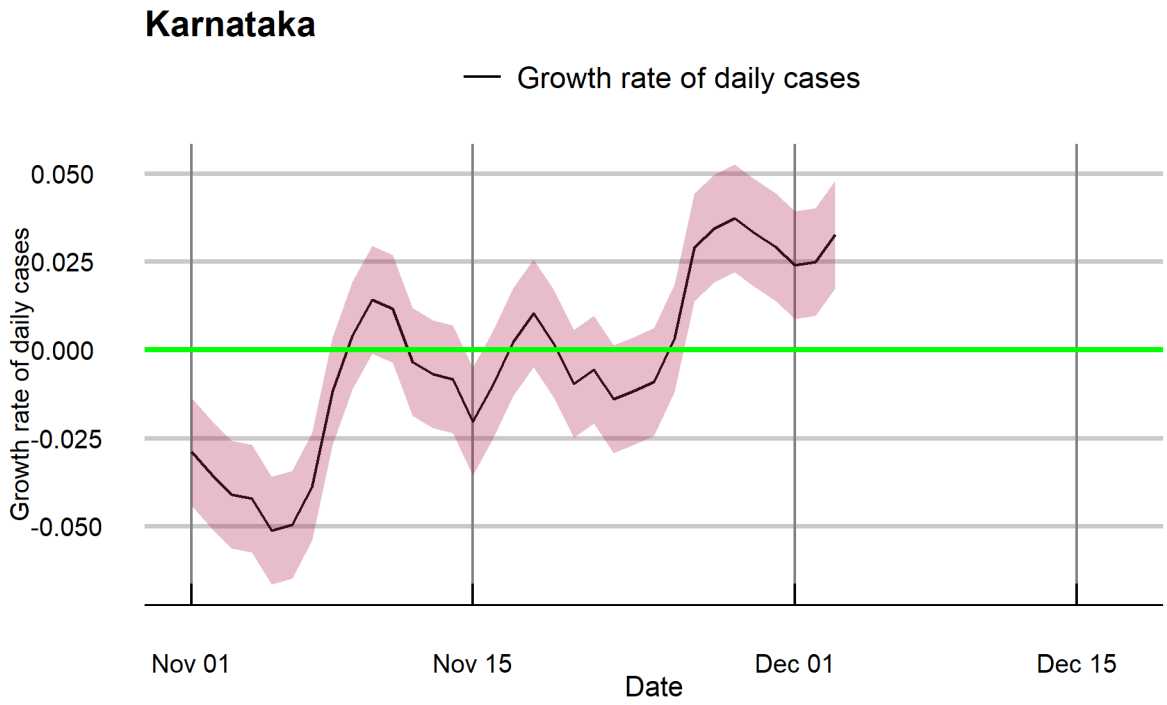
Note: The value reported for the number of new cases on 3 December (76) is an outlier that calls for investigation and explanation.

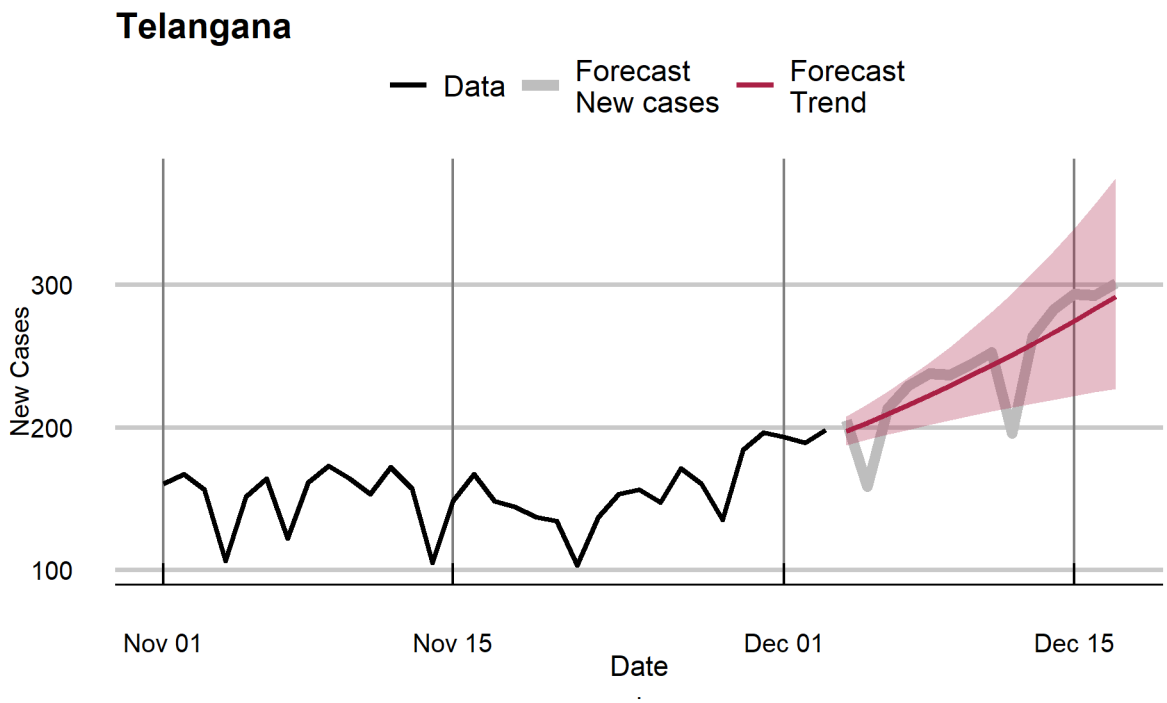

Tripura
Data
Forecast
New cases
Forecast
Trend
80
60
40
20
0
New Cases
Nov 01
Nov 15
Dec 01
Dec 15
Date

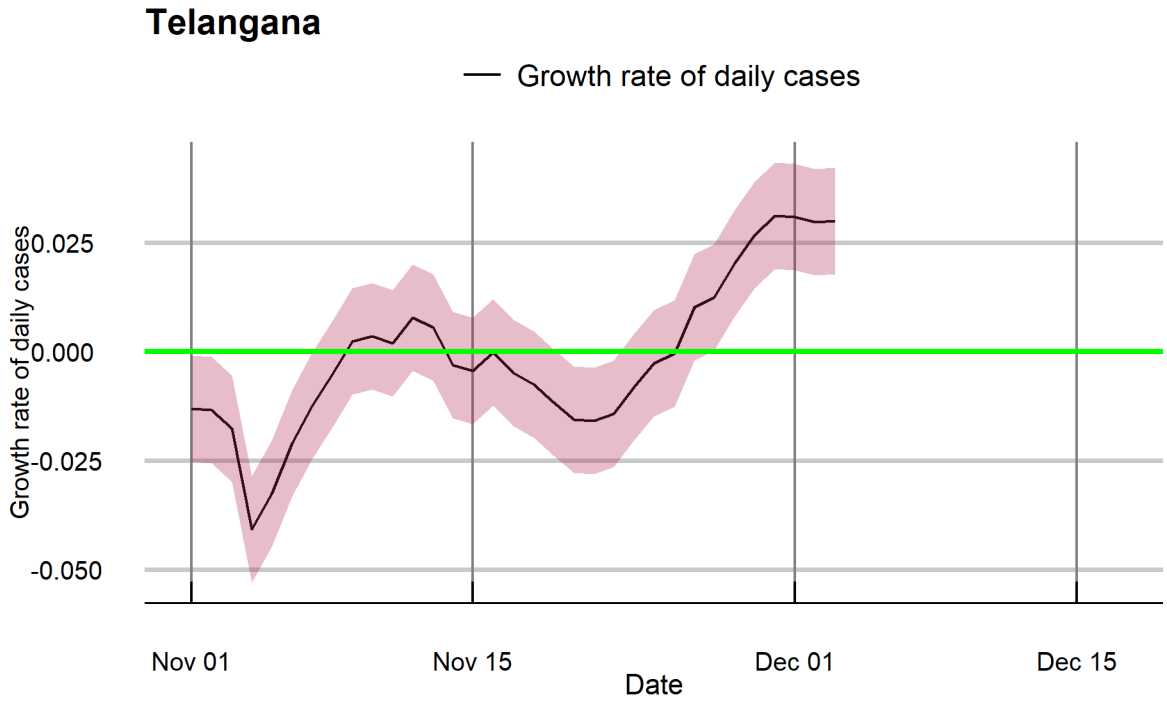

Tripura
Growth rate of daily cases
0.1
0.0
-0.1
-0.2
Growth rate of daily cases
Nov 01
Nov 15
Dec 01
Dec 15
Date

New cases forecasts (4 December to 17 December) **and filtered daily growth rates** (up to 3 December) **for States with relatively high infection incidence and positive but less extreme growth rates**






Telangana
Data
Forecast
New cases
Forecast
Trend
New Cases
300
200
100
Nov 01
Nov 15
Dec 01
Dec 15
Date


Telangana
Growth rate of daily cases
Growth rate of daily cases
0.025
0.000
-0.025
-0.050
Nov 01
Nov 15
Dec 01
Dec 15
Date

Notes

This tracker was developed by researchers at Cambridge Judge Business School and National Institute of Economic and Social Research, working with Health Systems Transformation Platform in India, as part of a pandemic monitoring series devoted to India and its states and union territories. It provides short term forecasts of the trajectory of the pandemic, identifying states and union territories that are at risk of increases in infection incidence.

Data: COVID-19 confirmed cases and deaths data are sourced from Johns Hopkins University (JHU), Center for Systems Science and Engineering (CSSE).

New cases: forecasts. Forecasts above are based on a structural time series model that uses all the data in estimation but adapts to the trend emerging in the most recent period.

The method is described in: Harvey, A. and P. Kattuman (2020). Time series models based on growth curves with applications to forecasting coronavirus. *Harvard Data Science Review*, Special issue 1 - COVID -19. https://hdsr.mitpress.mit.edu/pub/ozgjx0yn/release/2 , and Harvey, A., P. Kattuman, and C. Thamotheram (2021). Tracking the mutant: forecasting and nowcasting COVID-19 in the UK in 2021. *National Institute Economic Review*. 256, 110-126. doi:10.1017/nie.2021.12.

New cases: growth rate. The filtered trends presented for daily growth rates of cases are estimated using the Kalman filter, applied to the observed series. The method filters out day of the week effects and random noise to reveal the underlying signal. Unlike methods such as the moving average, this method adapts the trend to changes in real time and characterises underlying patterns of surges or attenuations that are hidden in the volatile series. The method is described in the papers listed above.

***R*:** The *R*-estimates are based on the nowcast of the growth rate; the estimation approach is described in Harvey, A. and P. Kattuman (2021). A farewell to R: Time series models for tracking and forecasting epidemics. Journal of the Royal Society Interface, 18, 20210179, https://royalsocietypublishing.org/doi/10.1098/rsif.2021.0179.The confidence interval is based on one standard deviation, with coverage of 68%.

Note: The accuracy of forecasts rely on the quality of the published data. Further, changes in government pandemic policies and in transmission relevant social behaviour may lead realised numbers to deviate from forecasts.

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