Mathematical modeling and prediction of COVID-19 cases, hospitalisation (including intensive care and ventilation units) and deaths in the German states

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Summary

Aims

- The aim of this project is to develop a mechanistic mathematical model to predict COVID-19 infections including hospital bed occupancy, intensive care units (ICU), ventilation and death rates in the individual German federal states and to estimate non-pharmaceutical interventions (NPI, e.g. school closure) over time.
- The model will be used to predict the further course of infections (including hospital occupancy, ICU, ventilation, death rates) and to simulate various possible scenarios.
- The model and the predictions will be adjusted with new data at regular intervals (every one to two weeks). New predictions for all federal states are made available as PDF reports. The website www.covid-simulator.com serves as an online platform for the transmission of information and for the provision of an online simulator.

Results

- A modified infection model (Susceptible - Exposed - Infectious - Recovered - Death; SEIRD) has been developed and adapted to the respective situation of each federal state. The model shows an excellent descriptive characteristic of COVID-19 case numbers, occupancy of inpatient beds, intensive care beds (ventilated and non-ventilated), deaths and recoveries in all 16 German federal states.
- The influence of non-pharmaceutical interventions on R(t) was investigated:
  - At the beginning of the infection occurrence the R(t) value in Germany was 2.78.
  - School closure, lockdown (on 23.03.2020) and a subsequent lockdown (on 01.04.2020) have a significant effect ($p<0.001$) on the reduction of R(t). Due to the close alignment of NPIs, it cannot be ruled out that the effects of other NPIs are overlapped. The reproduction number R(t) decreases from the initial value of $R(t) = 2.78$ to $R(t) = 0.636$ on a national average on 01.04.2020.
  - In April, even slighter but statistically significant ($p<0.001$) changes of R(t) occurred. On 25.04.2020, 5 days after reopening of shops (20.04.2020), state specific R(t) changes were observed.
  - In May (on 06.05.2020), two days after school reopening on 04.05.2020, there was a small increase of R(t) by 13% on average to 0.716.
  - In June (on 05.06.2020) there was a further increase of R(t) value by approx. 51% from 0.716 to 1.08 on a national average with subsequent reduction of R(t) on 17.06.2020 by about 21% from 1.08 to 0.857.
  - In July (on 12.07.2020) a new increase of R(t) by approx. 55% from 0.857 to 1.33 on average can be observed.
  - In August, a reduction of R(t) on 09.08.2020 by about 21% from 1.33 to 1.05 on a national average followed by a further reduction of R(t) on 19.08.2020 by approx. 10% from 1.05 to 0.946 on average can be observed.

  - In September there was a new increase of R(t) on 06.09.2020 by approx. 32% from 0.946 to 1.25 on average.
  - In October further increases of R(t) took place: on 03.10.2020 by approx. 22% from 1.25 to 1.52 and on 11.10.2020 by 2% from 1.52 to 1.55 on average. Followed by a subsequent reduction of R(t) on 27.10.2020 by about 31% from 1.55 to 1.07 on average.
  - Following the relaxation of NPIs nationwide, a general increase in infections has been observed. The R(t) changes in June seem to depict emergence of the local "corona hotspots" in some federal states (e.g. North Rhine-Westphalia, Berlin, Brandenburg, Saxony-Anhalt) followed by containment of this local outbreaks. In the time period from July to August, the rising case numbers of positively tested individuals among incoming travellers also play an increasingly important role. In September, a renewed increase in the number of cases with the state-specific R(t) value above 1.0 was observed. In October, the continuing trend towards a further increase in case numbers can be observed. Smaller outbreaks in various districts contributed to the rising number of cases. After nationwide tightening of the corona rules, a reduction of R(t) mid-October can be observed.
  - The current R(t) values are estimated at 1.07 on a national average and lie above 1.0 for 12 of 16 federal states.

- Changes in hospitalization and inpatient mortality over time.
  - The hospitalization rate estimated by the model changes over time. At the beginning of the pandemic, it averaged around 20% and has dropped to an average of 3% over the course of the pandemic. Since mid-September, the hospitalization rate has more than doubled to 6.5%.
  - The hospitalization rate is strongly correlated with the age structure of infected COVID-19 population. Particularly the proportion of patients over 60 years of age determines the hospitalization rate. This percentage has decreased from over 35% initially to less than 10% in the meantime. Since the beginning of September, the proportion of patients over 60 years of age has been steadily increasing again.
  - With an increased number of infections among elderly patients, a rising hospitalization rate can be expected, even if the number of new infections remains the same.
  - Inpatient mortality rates (normal ward, ICU ventilated and non-ventilated) also change significantly over time. Mortality rates first decrease by about 50% during the pandemic and then increase, similar to the hospitalization rate, by about 22% in mid-September. This can also be attributed to the change in the age structure of the infected patients. Also here, an increased in hospital mortality can also be expected if a higher number of elderly patients continue to become infected.

- Prediction of lockdown scenarios.
  - Scenarios for the lockdown from 11.11.2020 were created, assuming that the reproduction number R(t) remains the same or changes to 1.1, 0.8 or 0.6.

  - In the lockdown of the first wave a reproduction number of 0.6 was reached. A decrease to values between 0.8 and 0.6 seems possible if social distancing and good hygiene concepts are followed and contacts are strongly restricted.
  - The hospital occupancy situation in the individual German states varies greatly and the maximum intensive care bed capacity is unclear.
  - In some federal states, the current occupancy rate in hospitals already exceeds the maximum values of the first wave, in others these values have not yet been reached.
  - Thus, the simulation results are correspondingly different. In some federal states, even if the lockdown succeeds, a borderline hospitals load or overrun can be expected, while in other states sufficient capacity should be available.
  - If the reproduction number R(t) increases again or does not drop below 1, then the capacity limit will be exceeded in all federal states in the next 4 to 8 weeks.
  - Even if the lockdown is successful, the maximum occupancy in intensive care units will not be reached until 3 to 6 weeks (depending on the extent of the effects) after the lockdown.

- The German public health institute (Robert Koch Institute, RKI) publishes regular updates on the current reproduction numbers in Germany. The method of calculating the R-values of the RKI differs significantly from our model approach. The RKI only considers new infections in the last 7 days, whereas our model considers the complete data set (extent and also other data, such as hospitalizations, deaths, and recoveries). Due to the short time period of the RKI data considered, their R-value is more susceptible to changes and fluctuations in reporting and also sensitive in the range of small numbers of new infections. The R-value of the RKI therefore fluctuates more over time compared to the R(t) value calculated by our model. Nonetheless, a lagre agreement can be found comparing the R-values calculated by the RKI and our calculated R(t) values.

Contents

1 Overview

1.1 Background

Infections of humans with the SARS coronavirus-2 (the resulting disease is known as "COVID-19") are increasing rapidly in Germany and the world. This results in rising hospitalisation rates and also an increased occupancy of intensive care beds (ICU) as well as the use of ventilation capacities. In the course of the pandemic, various non-pharmaceutical interventions (NPI) were introduced (e.g. school closure) in order to delay the spread of the pandemic and not to exceed the stress limits of the health care system. Unfortunately, predicting the further course of infection, the workload of the health care system and the influence of NPIs on the course of the disease is a difficult task. This can only be achieved by mathematical modeling and simulation.

1.2 Objectives

- The aim of this project is to develop a mechanistic mathematical model to predict COVID-19 infections including hospital bed occupancy, intensive care units (ICU), ventilation and death rates in the individual German states and to estimate NPIs (e.g. school closure) over time.
- The model will be used to predict the further course of infections (including hospital occupancy, ICU, ventilation, death rates) and to simulate various possible scenarios.
- The model and the predictions will be adjusted with new data at regular intervals (every one to two weeks). New predictions for all federal states are made available as PDF reports. The website www.covid-simulator.com serves as an online platform for the transmission of information and for the provision of an online simulator.

1.3 Target group

- The model is intended to help authorities, politicians and the health care system to better estimate the course of the current SARS coronavirus-2 pandemic in the short and medium term and to plan capacities. Furthermore, the influence of NPIs (e.g. lockdown) can be estimated to justify either their introduction or their lifting.
- On the other hand, the model presented can be used to illustrate the influence of interventions on the course of infection numbers to the population and thereby encouraging people to abide the NPIs.

1.4 Methods

- The following data sources serve as a basis:
  - Database of the German public health institute (Robert Koch Institute, RKI)
  - Database Berliner Morgenpost

  - MetaKIS: Documentation of anonymized billing data from more than 250 hospitals throughout Germany
  - Information from the ministries of health
  - Results of literature search on intervention measures in the federal states
  - DIVI Intensive Care Register

- The modeling is done using the Non-Linear Mixed Effects (NLME) approach and is performed in the software NONMEM® (Version 7.4.3)
- Statistical analysis, graphical display and report generation were performed with R® (version 3.6.3) and R-Studio® (version 1.2.5033)
- An approved ethics application of the ethics committee of the medical association of the Saarland has been submitted
- A detailed description of the model structure and the parameterization will be available in the forthcoming publication

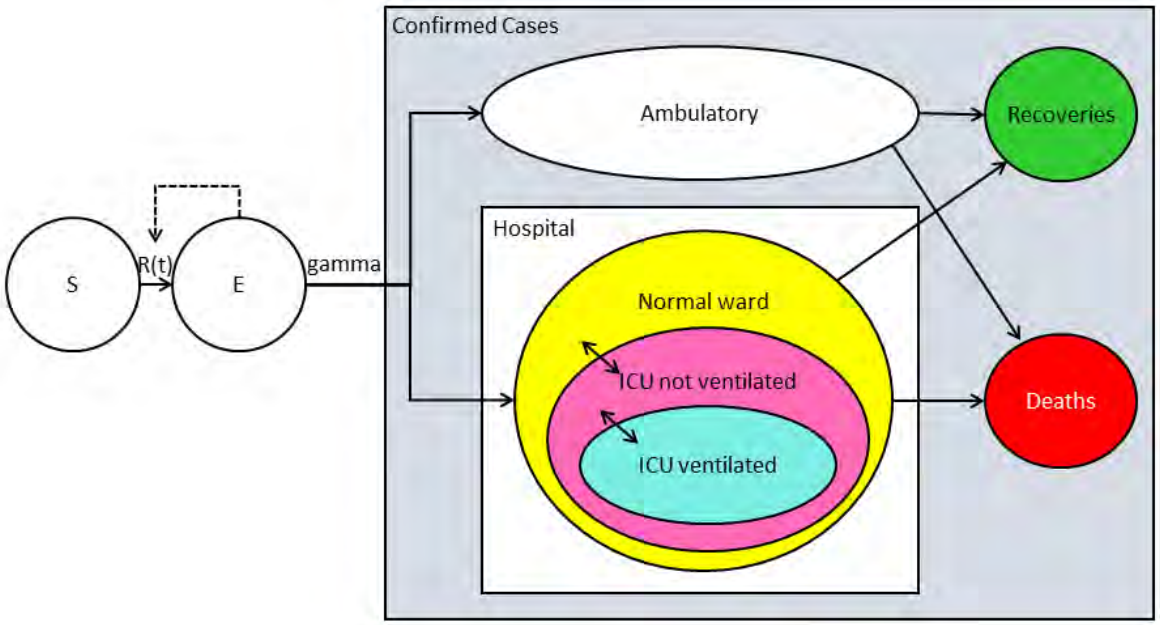
1.5 Model structure

The developed model is based on a classical SEIR model, which in mathematical epidemiology describes the spread of infections within a population. In this classical model, an individual can pass through four disease-relevant stages: *Stage S:* People who can be infected, *Stage E:* People who are infected, can be infectious, but are not yet identified as infected, *Stage I:* Infected people, *Stage R:* Cured people.

The more advanced SEIR/D model describes more complex relationships. In addition to the stages S, E and R, a distinction is made for infected people between *stage C:* Infected people who remain outpatients, *stage KH:* Infected in hospital, *stage ICU:* Infected in intensive care unit and *stage ICU ventilated:* Infected people requiring mechanical ventilation. In addition, the model was extended to include *stage D:* Infected people who have died.

People from *stage E* infect people from *stage S*. The factor *R0 or R(t) (basic reproduction number)* indicates how many people from stage S are infected on average by a single person from stage E. Infected people in stage E are only identified as infected after a certain time (*gamma*) and thus reach stage C (C: Cases = confirmed cases). Infected persons (C) can either be recovered on an outpatient basis (R) or admitted to hospital as inpatients (KH). Inpatients in all categories of hospitalisation (Normal ward, ICU and ICU ventilated) can either recover or die with ward specific rates.

The model structure with the different stages and their transitions is shown in Fig.1. The given data (duration of hospitalization, percentage of patients, ventilation, etc.) are taken from hospital data of more than 8000 German COVID-19 patients from more than 250 hospitals, which were derived anonymously from the MetaKIS system.



	Distribution [%]		Ratio [%]	Duration [days]	ICU [% Duration]	Ventilation [% Duration]
Normal ward	80.1	recovered	84.5	12	-	-
		deceased	15.5	8.8	-	-
ICU not ventilated	5.0	recovered	79.6	19	34	-
		deceased	20.4	13	57	-
ICU ventilated	14.9	recovered	48.6	35	75	49
		deceased	51.4	13	88	76

Figure 1: SEIR/D Model - Model structure

1.6 Model results

1.6.1 Description of the data

Using the SEIR/D model developed in Section 1.5, the numbers of SARS-CoV-2 infections, hospital bed occupancy (acute and cumulative hospital beds), ICU occupancy (non-ventilated and ventialted, acute and cumulative), recovery and deaths can be described in the Federal Republic of Germany and separately for each federal state.

Fig. 2 shows the model description of the case numbers (line) and the reported case numbers (dots) for each federal state over time for infection numbers (blue), recovery numbers (green), deaths (red), occupied hospital beds acute (pink) and cumulative (purple), occupied ICU beds acute (yellow) and cumulative (orange), and number of ventilated ICU patients (cyan).

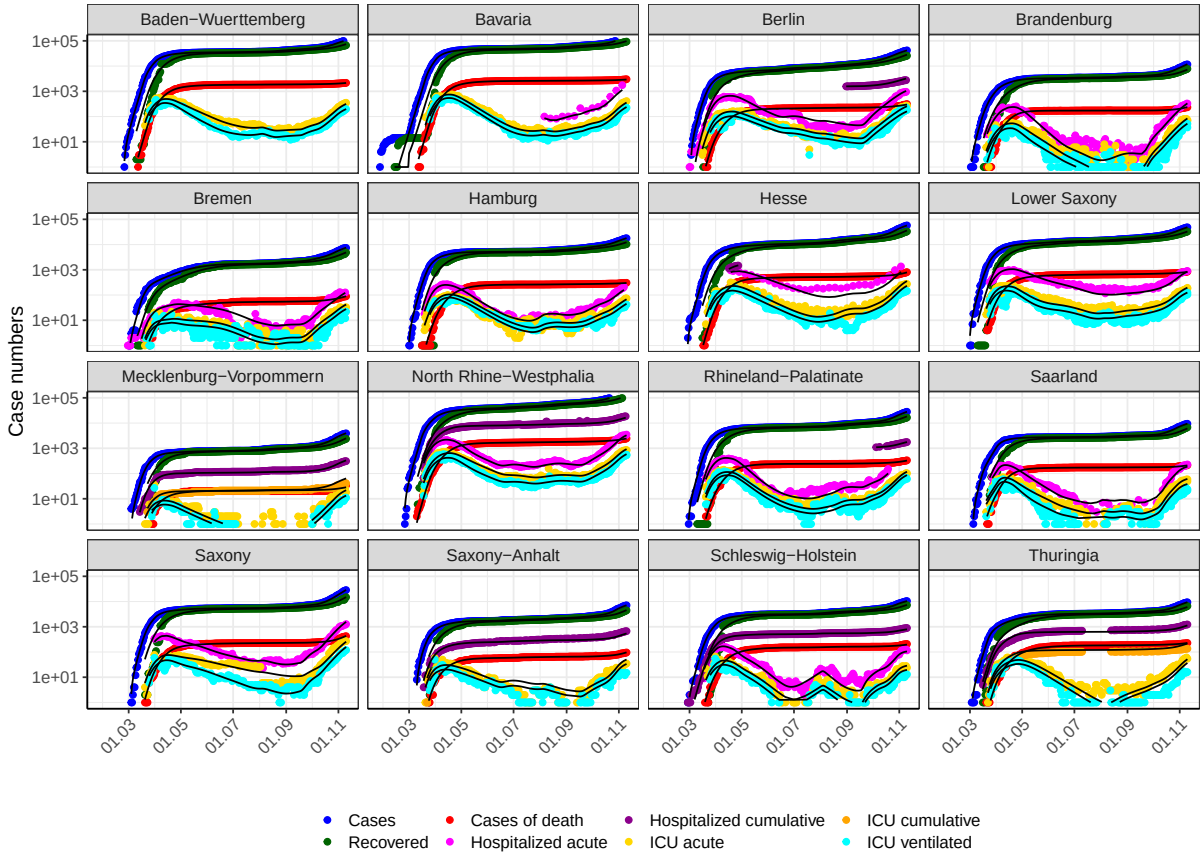


Figure 2: Germany by federal states - model description of case numbers.
Points: Reported case numbers - Lines: Model description

Fig. 3 and 4 show the model description of the infection numbers (line) and the reported infection numbers (points) for each state over time in linear (3) and semi-logarithmic (4) representation.

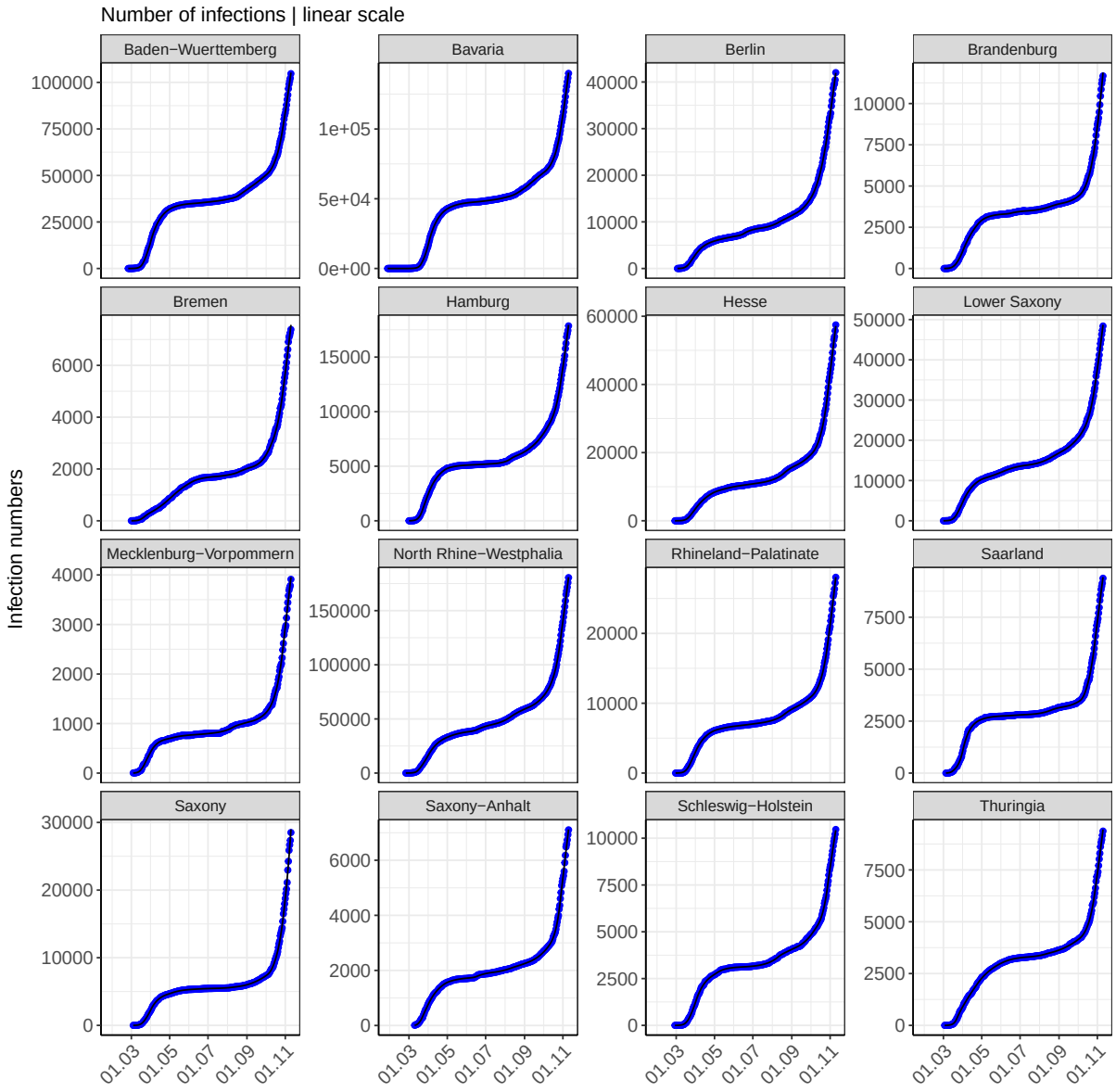


Figure 3: Germany by federal states - model description of the infection cases.
Points: Reported cases of infection - Lines: Model description

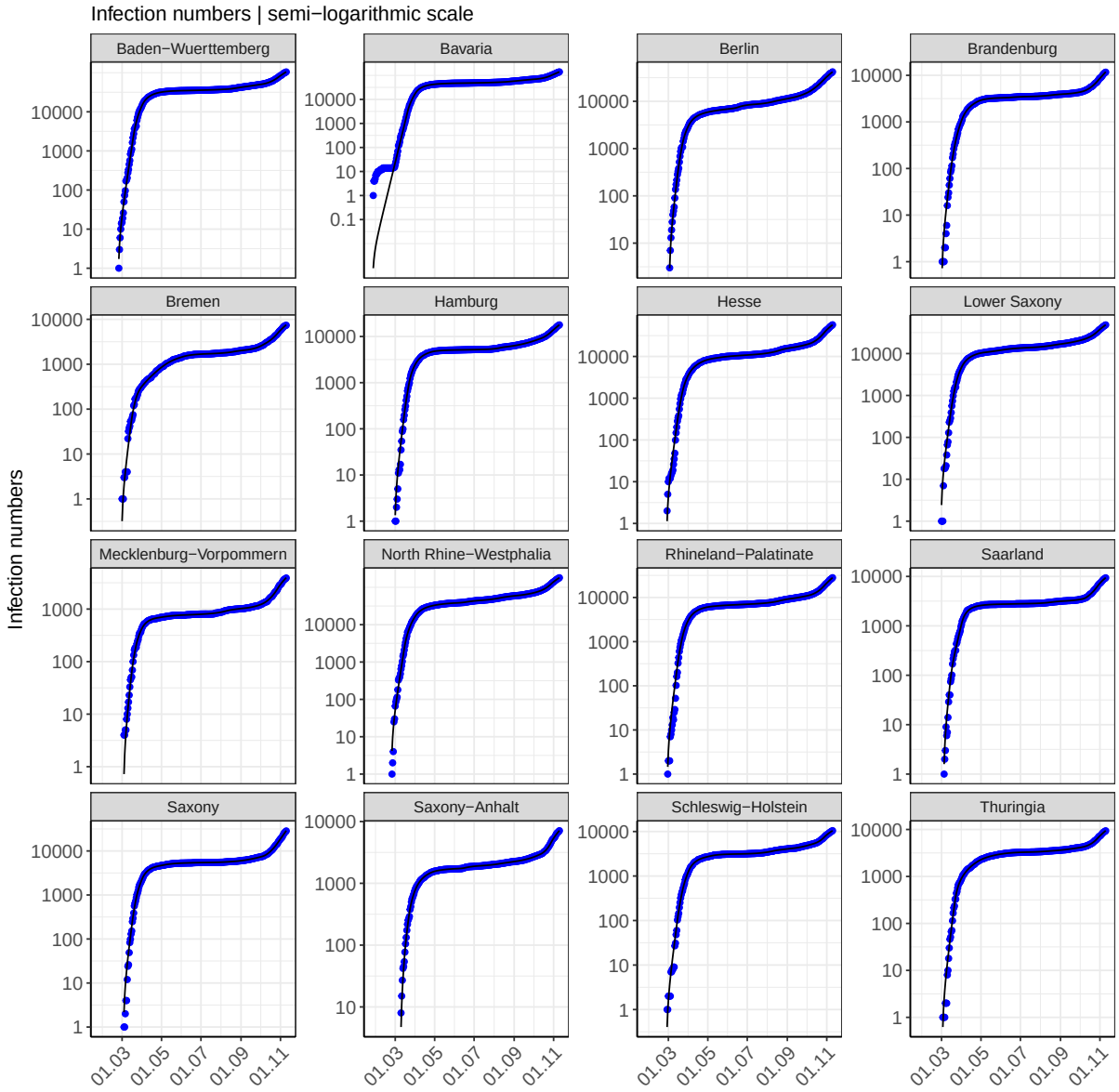


Figure 4: Germany by federal states - model description of infection cases.
Points: Reported cases of infection - Lines: Model description

Fig. 5 shows the model description of the occupied hospital beds, ICU beds, and ventilated ICU patients (line) and the reported occupancy of the hospital and ICU beds and ventilated patients (dots) for each federal state over time. The occupancy of the hospital and ICU beds is shown acutely and/or cumulatively.

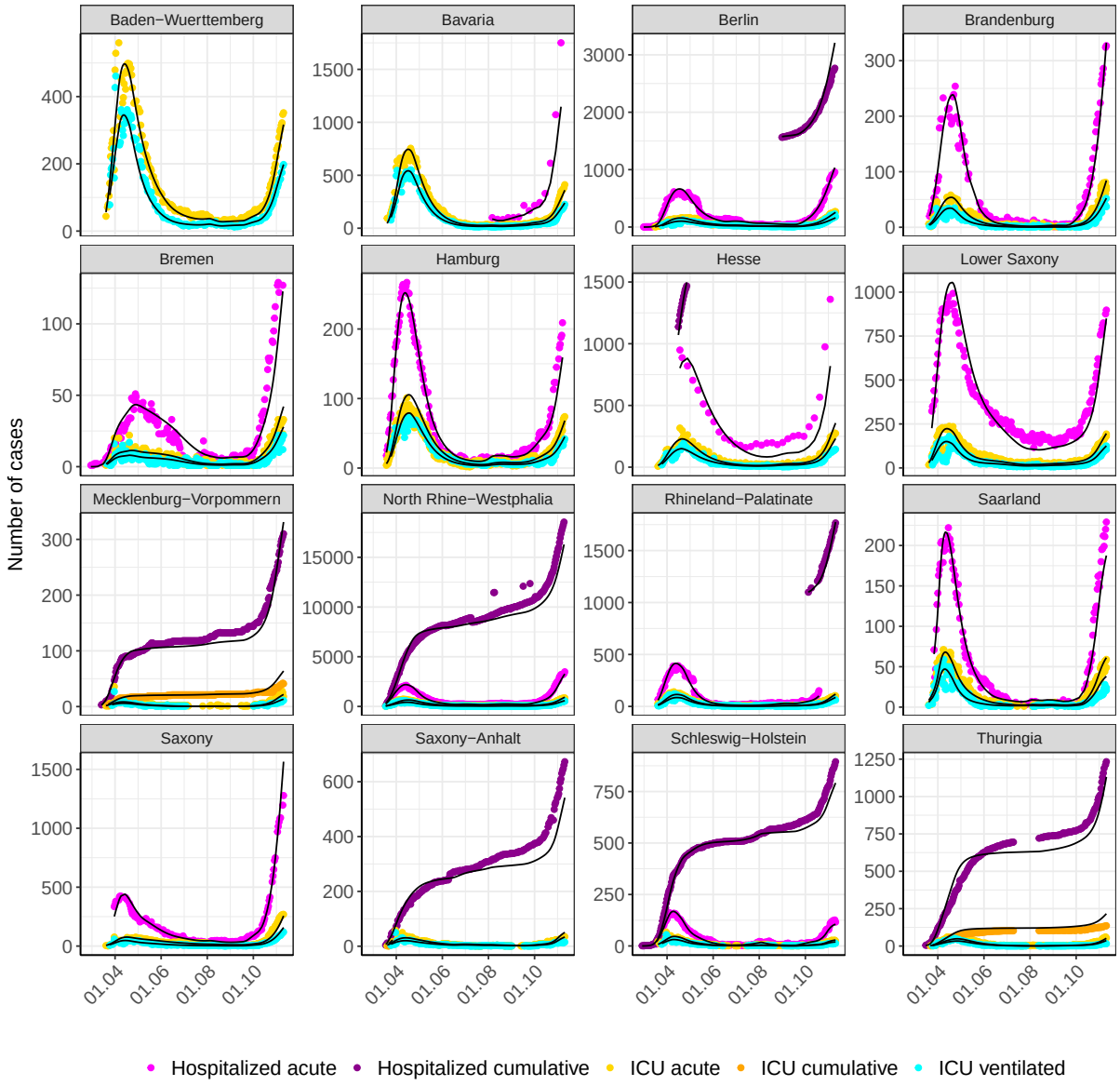


Figure 5: Germany by federal states - model description of the hospital and ICU occupancy. Points: Reported occupancy - Lines: Model description

Fig. 6 shows the model description of the patients recovered from COVID-19 (line) as well as the reported cases of recovered patients (points) for each federal state over time.

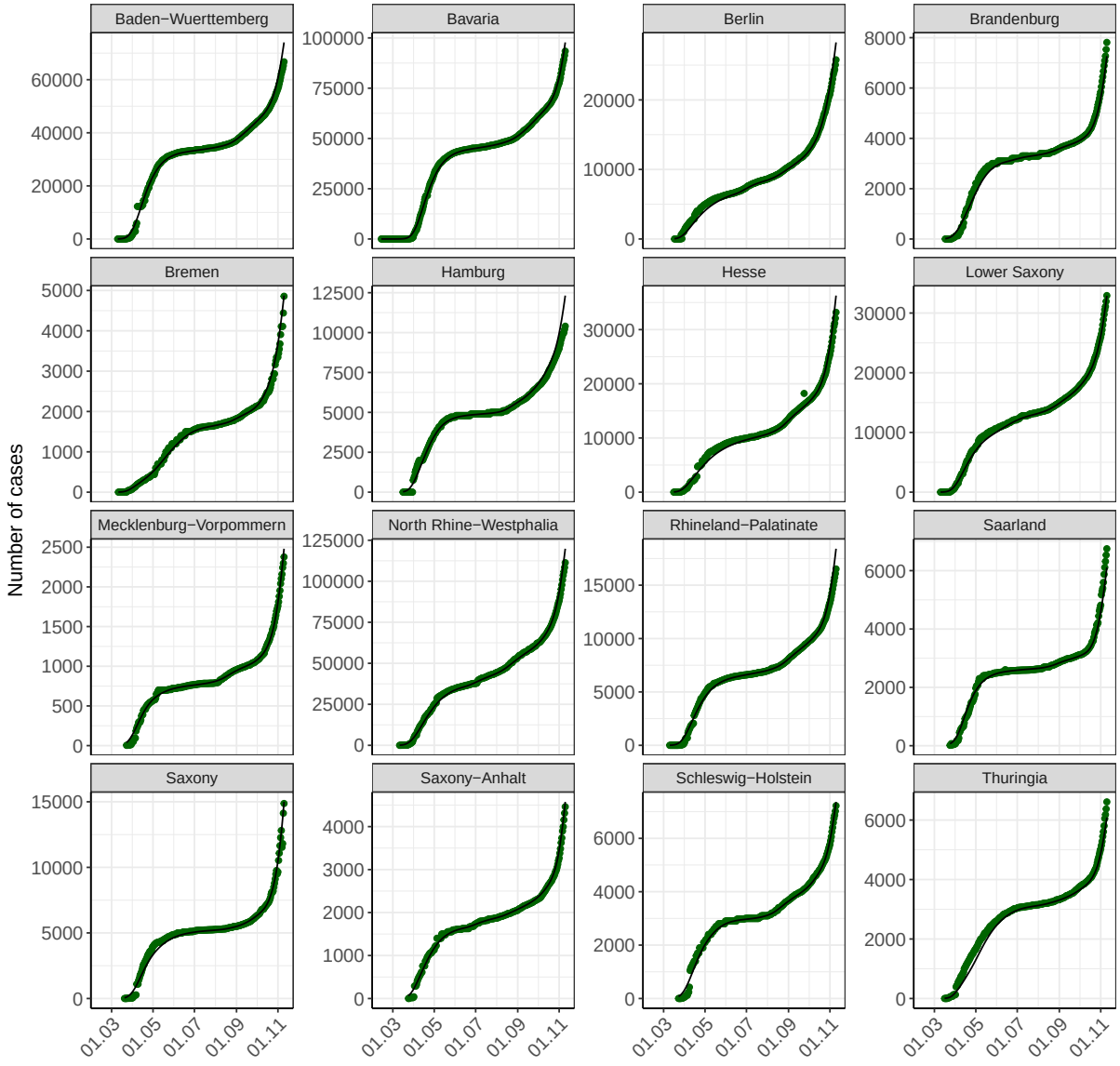


Figure 6: Germany by federal states - model description of patients recovered from COVID-19.
Points: Reported numbers - Lines: Model description

Fig. 7 shows the model description of the patients who died with COVID-19 (line) and the reported death numbers (points) for each state over time.

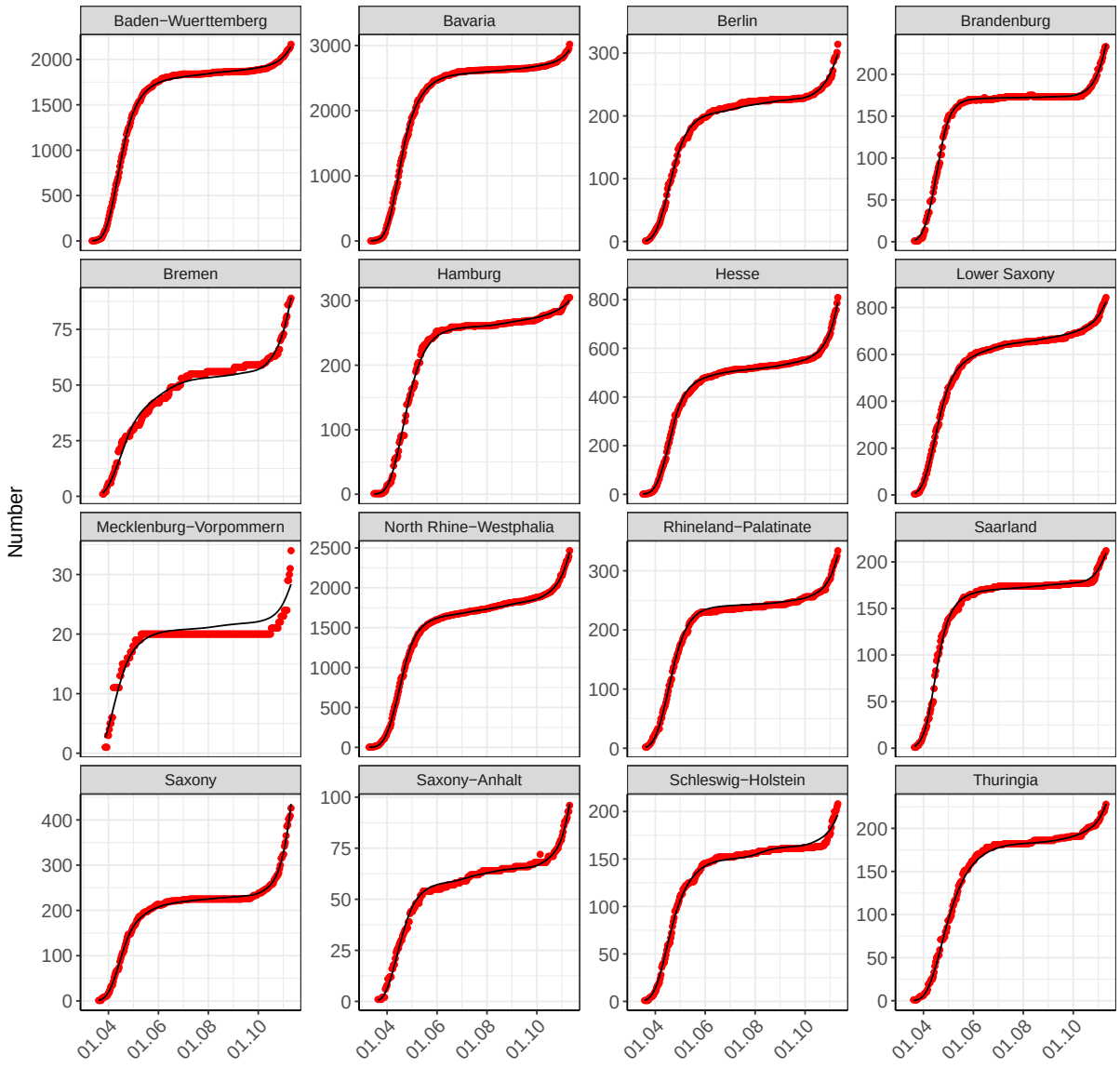


Figure 7: Germany by federal states - model description of deaths.
Points: Reported deaths - Lines: Model description

Fig. 8 shows a goodness-of-fit (GOF) plot, the graphical representation of the goodness-of-fit of the model. The values calculated by the model are plotted against the raw data. If the pairs of values were 100% identical, all data points would be located on the line of identity. The points are distributed evenly around the identity line. This reflects the good descriptive performance of the model.

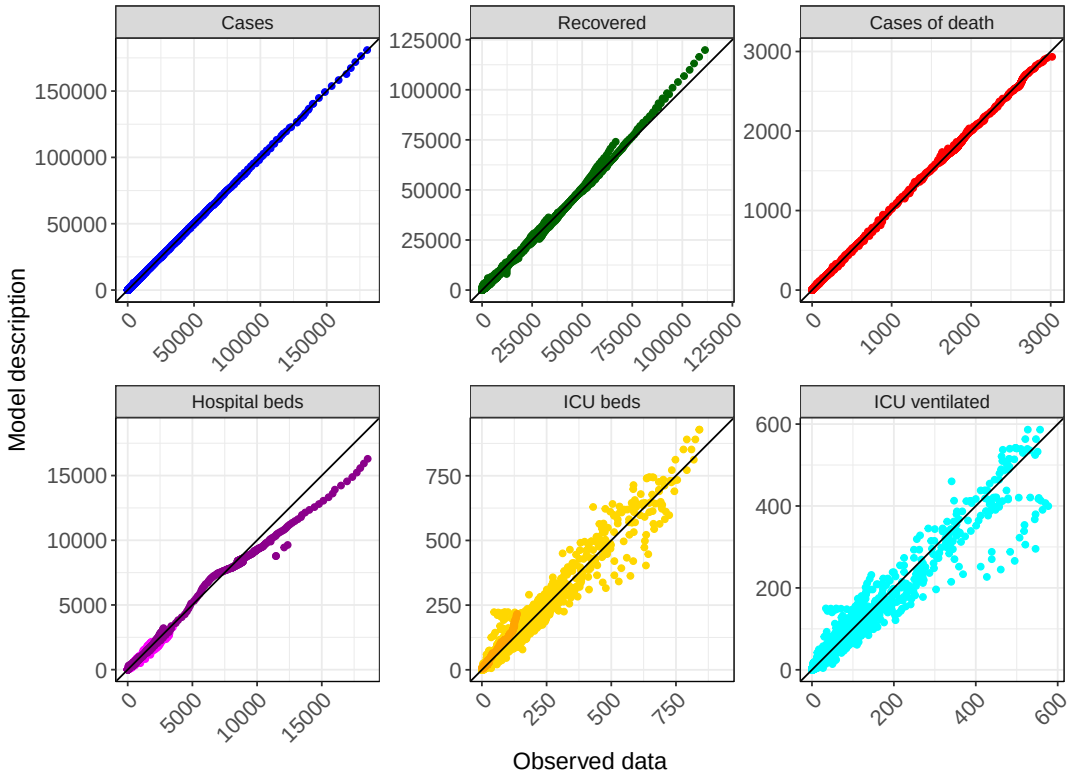


Figure 8: Germany - Goodness-of-fit plot: reported data vs. model description

1.6.2 Influence of non-pharmaceutical interventions (NPI) and other structural changes

The influences of NPIs and other events were systematically investigated and incorporated into the model. Investigations of influencing factors on R(t) revealed the following statistically significant effects: school closure, lockdown, a "2nd stage" of the lockdown since 01.04.2020 and changes on 25.04.2020, 06.05.2020, 05.06.2020, 17.06.2020, 12.07.2020, 09.08.2020, 19.08.2020, 06.09.2020, 03.10.2020, 11.10.2020 and 27.10.2020. The effects vary slightly in each federal state (see Tab. 1, Fig. 9 and 10), while the exact causes are not clear. It can be assumed that the geographical situation of the federal states ("rural" states vs. "urban" states, border region, mentality) as well as local policies play a role. Two days after the school reopening on 04.05.2020, the R(t) value increased by approx. 13% to 0.716 on a national average. In general, the safety measures taken appear to have been effective in keeping R(t) at a stable level below 1, with the exception of the federal states with known "corona hotspots". Since the beginning of the easing of the NPIs and especially during the vacation season (high incidence among incoming travellers) a new increase of the R(t) value has been observed. In addition, smaller local outbreaks are increasingly contributing to the rising case numbers. In October, the continuing trend towards a further increase in case numbers can be observed. After nationwide tightening of the corona rules, a reduction of R(t) can be seen in the second half of October.

The factors influencing R(t) are listed in detail below:

- School closures: Reduction of R(t) on average by approx. 31% from 2.78 to 1.92 (p-value < 0.001).
- Lockdown (on 23.03.2020): Reduction of R(t) on average by approx. 43% from 1.92 to 1.1 (p-value < 0.001).
- "2nd stage" of the lockdown (on 01.04.2020): Reduction R(t) on average by approx. 42% from 1.1 to 0.636 (p-value < 0.001).
- From 06.05.2020: Increase of R(t) by 13% to 0.716 (p-value < 0.001).
- From 05.06.2020: Increase of R(t) by 51% from 0.716 to 1.08 (p-value < 0.001).
- From 17.06.2020: Reduction of R(t) by 21% from 1.08 to 0.857 (p-value < 0.001).
- From 12.07.2020: Increase of R(t) by 55% from 0.857 to 1.33 (p-value < 0.001).
- From 09.08.2020: Reduction of R(t) by 21% from 1.33 to 1.05 (p-value < 0.001).
- From 19.08.2020: Reduction of R(t) by 10% from 1.05 to 0.946 (p-value < 0.001).
- From 06.09.2020: Increase of R(t) by 32% from 0.946 to 1.25 (p-value < 0.001).
- From 03.10.2020: Increase of R(t) by 22% from 1.25 to 1.52 (p-value < 0.001).
- From 11.10.2020: Increase of R(t) by 2% from 1.52 to 1.55 (p-value < 0.001).
- From 27.10.2020: Reduction of R(t) by 31% from 1.55 to 1.07 (p-value < 0.001).

Table 1 lists the R(t) values after the introduction of the individual NPIs for each federal state. The values for Germany may differ slightly in this table due to different calculation methods.

Table 1: R(t) value before and after the NPIs

Federal State	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
Baden-Wuerttemberg	2.78	1.75	1.30	0.59	0.55	0.60	1.16	1.06	1.20	1.70	1.00	1.06	1.68	1.51	1.10
Bavaria	2.78	2.79	1.51	0.57	0.56	0.67	0.94	1.13	1.19	1.45	1.15	0.99	1.59	1.59	1.18
Berlin	2.78	1.99	1.01	0.62	0.78	0.90	1.79	0.58	1.33	0.94	1.03	1.33	1.48	1.35	1.05
Brandenburg	2.78	1.91	1.38	0.78	0.44	0.53	1.80	0.64	1.35	1.15	0.81	1.38	1.77	1.51	1.26
Bremen	2.78	1.46	0.70	1.13	1.05	0.88	0.55	0.67	1.27	1.48	0.83	1.50	1.23	1.48	1.09
Hamburg	2.78	2.14	0.93	0.64	0.29	0.60	1.07	1.07	1.58	0.63	1.21	1.22	1.13	1.54	1.14
Hesse	2.78	2.09	1.09	0.77	0.60	0.85	0.85	1.04	1.30	1.40	0.75	1.23	1.67	1.55	0.98
Mecklenburg-Vorpommern	2.78	1.68	0.92	0.43	1.01	0.72	1.01	1.17	1.35	0.57	0.93	1.41	1.60	1.55	1.00
Lower Saxony	2.78	2.06	1.17	0.66	0.49	1.07	0.82	0.75	1.31	1.17	1.00	1.22	1.38	1.52	1.12
North Rhine-Westphalia	2.78	1.37	1.14	0.65	0.76	0.76	1.77	0.80	1.28	0.82	0.91	1.31	1.38	1.57	1.02
Rhineland-Palatinate	2.78	1.90	1.07	0.62	0.50	0.80	1.02	1.04	1.28	1.42	0.81	1.18	1.65	1.57	1.10
Saarland	2.78	1.52	1.83	0.41	0.52	0.59	1.29	0.91	1.42	1.27	0.68	1.35	2.22	1.52	0.96
Saxony	2.78	1.93	1.26	0.51	0.96	0.63	0.88	0.78	1.41	1.12	1.33	1.20	1.93	1.55	1.35
Saxony-Anhalt	2.78	2.00	0.94	0.69	0.47	0.69	2.01	0.66	1.26	0.87	1.10	1.27	1.24	1.77	0.96
Schleswig-Holstein	2.78	1.94	1.29	0.59	0.92	0.50	0.82	1.35	1.37	0.64	0.97	1.30	1.08	1.67	0.90
Thuringia	2.78	2.51	0.80	0.93	0.78	0.81	0.68	0.66	1.32	0.95	1.20	1.15	1.66	1.62	1.07
Germany	2.78	2.19	1.29	0.62	0.64	0.76	1.33	0.88	1.27	1.17	1.00	1.18	1.55	1.54	1.09

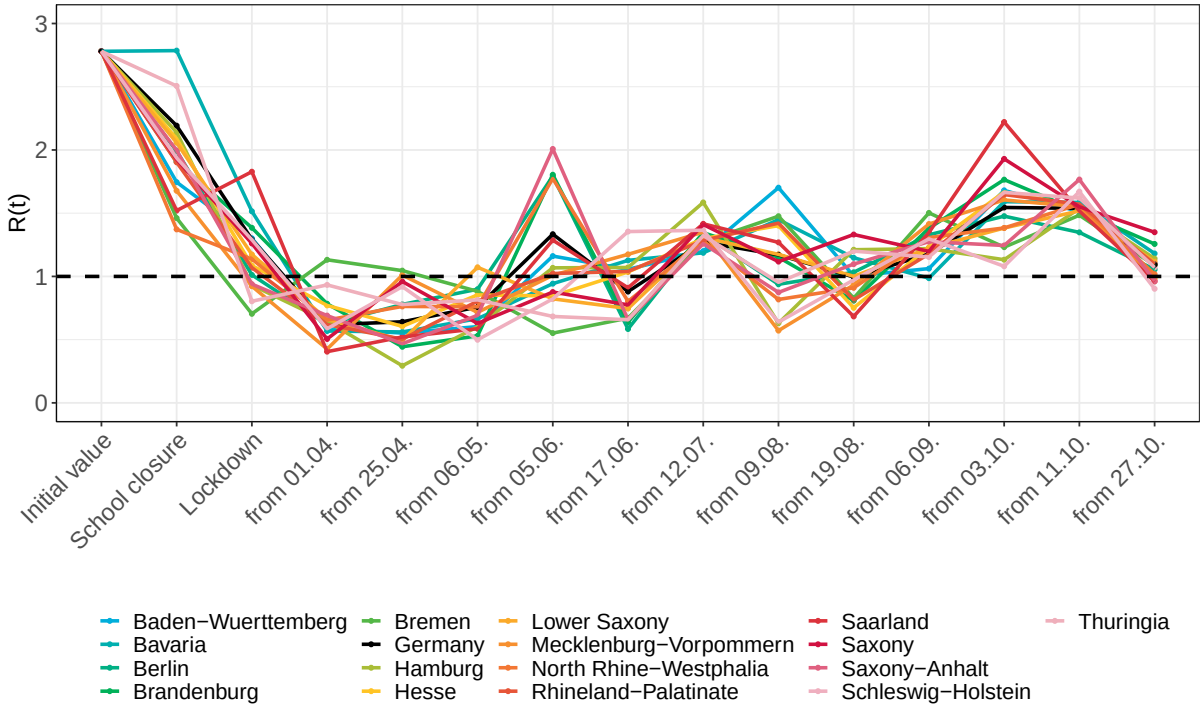


Figure 9: R(t) distribution before and after NPIs

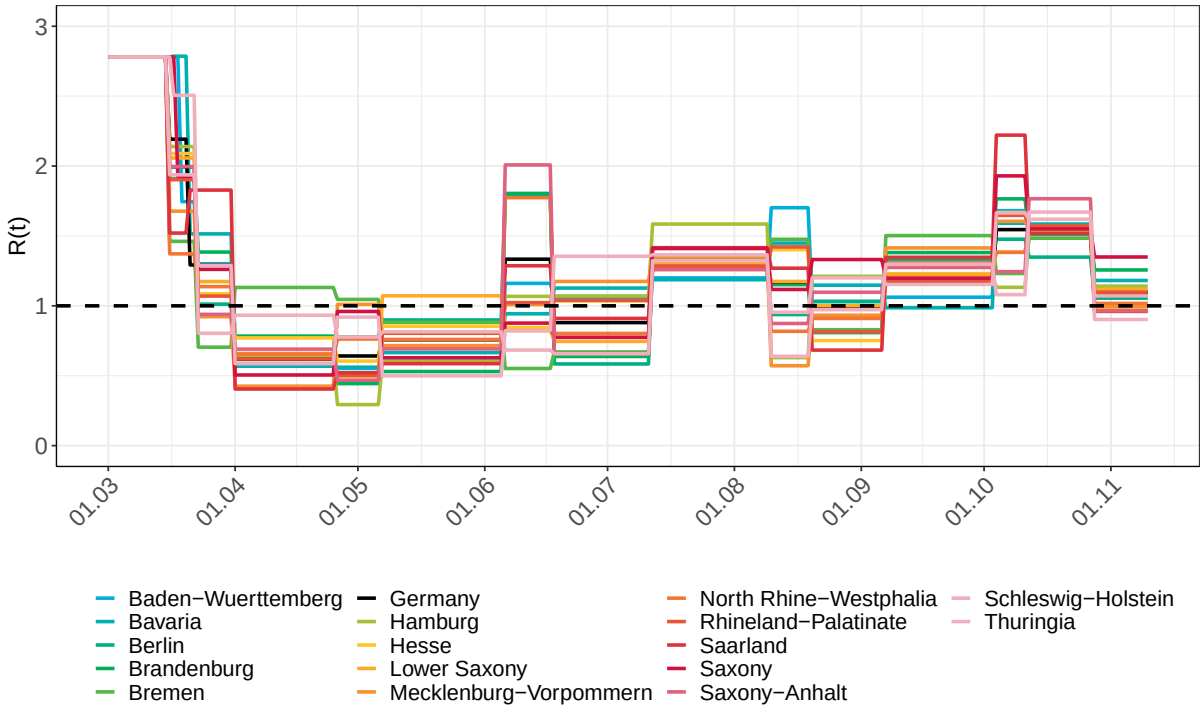


Figure 10: R(t) over time

The Robert Koch Institute (RKI) provides regular updates on the current reproduction number (R) for Germany. The modeling approach for estimating the R(t) presented here and the RKI's method for calculating the R-value differ considerably. The RKI only considers the new infections of the past seven days. Therefore, their R-value is more sensitive to the changes in reporting as well as to the small case numbers and fluctuates more strongly. Our modeling approach on the other hand considers the complete data set (infection numbers since the beginning of the pandemic, as well as other data, such as hospitalizations, deaths, and recoveries). Nevertheless, we can observe a strong agreement between the R(t) model estimates for Germany presented here (red line = Germany, grey lines = federal states) and the 7-day R-value (black line) reported by the RKI over time (Fig.11). The black dots represent the point estimator of the reproductive number (R) reported by RKI.

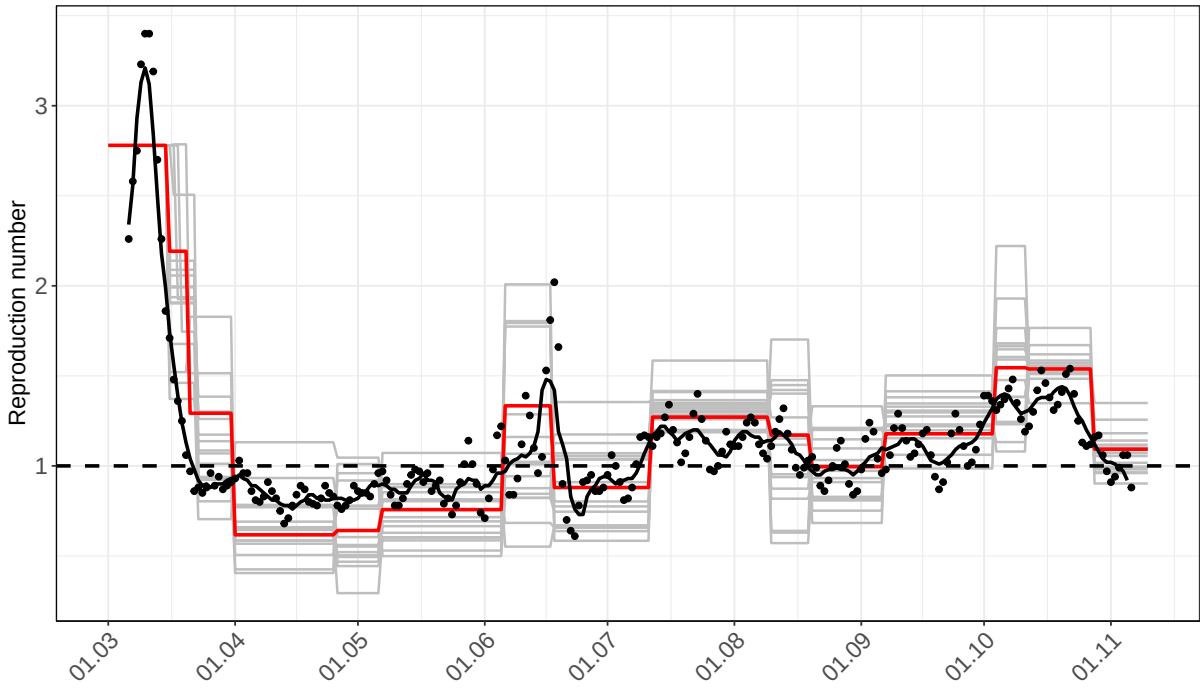


Figure 11: Comparison of R(t) model estimates (red line: Germany, grey lines: federal states) and R-values reported by the RKI (black line: 7-day R-values, black dots: point estimator of the reproduction number R) over time.

1.6.3 Changes in hospitalization and inpatient mortality over time

The hospitalization rate estimated by the model changes over time (Fig.12). At the beginning of the pandemic, it averaged around 20% and has dropped to an average of 3% over the course of the pandemic. Since mid-September, the hospitalization rate has more than doubled to 6.5%.

The hospitalization rate is strongly correlated with the age structure of the poputation infected with SARS-CoV-2. Particularly the proportion of patients over 60 years of age determines the hospitalization rate. This percentage has decreased from over 35% initially to less than 10% in the meantime (Fig.13). Since the beginning of September, the proportion of patients over 60 years of age has been steadily increasing again.

With an increased number of infections among elderly patients, a rising hospitalization rate can be expected, even if the number of new infections remains the same.

Inpatient mortality rates (normal ward, ICU ventilated and non-ventilated) change significantly over time, similar to the hospitalization rate (Fig.12). Mortality rates first decrease by about 50% during the pandemic and then increase by about 22% in mid-September. This can also be attributed to the change in the age structure of the infected patients. Also here, an increased in hospital mortality can also be expected if a higher number of elderly patients continue to become infected.

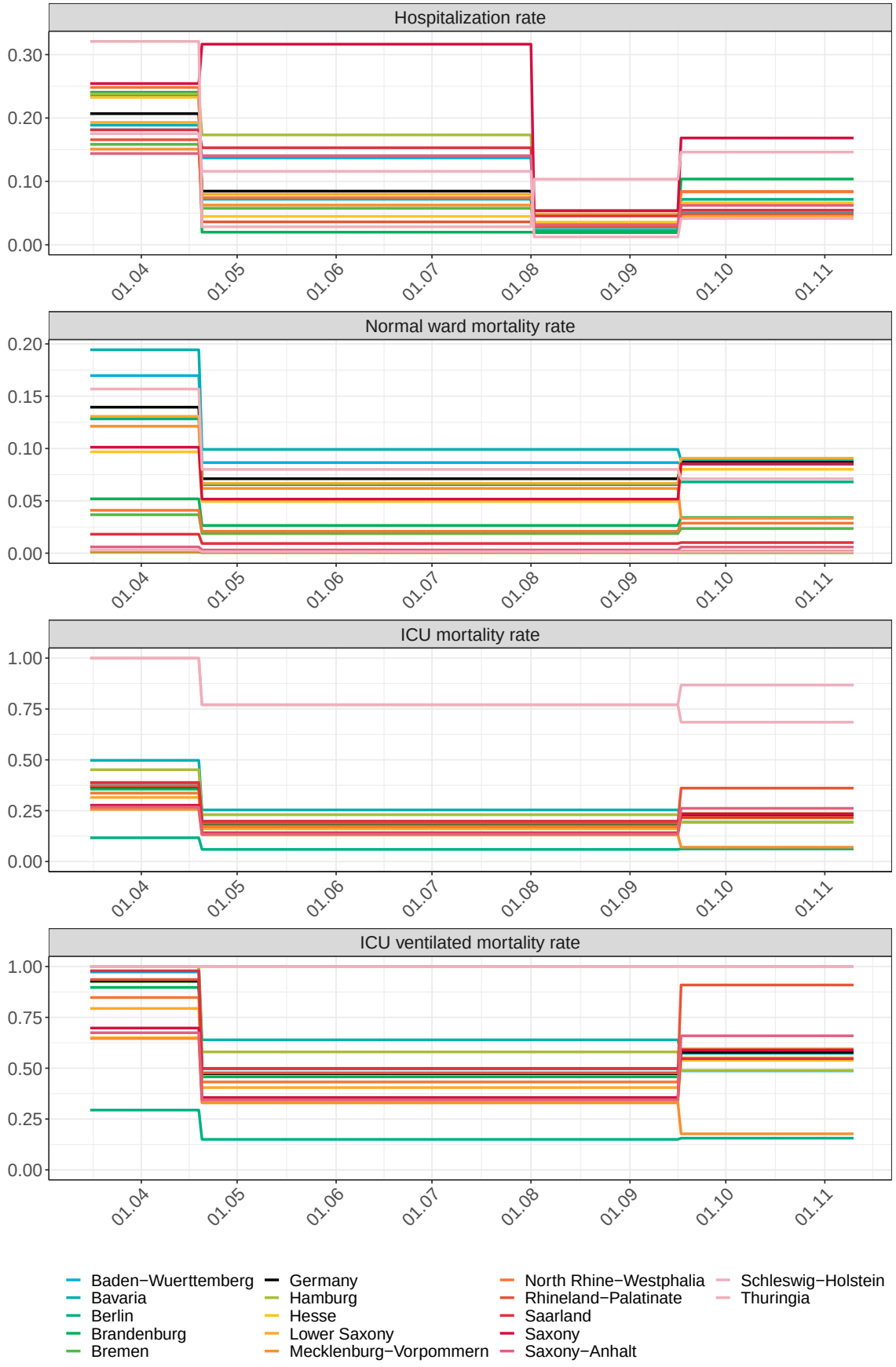


Figure 12: Hospitalization and mortality rates over time

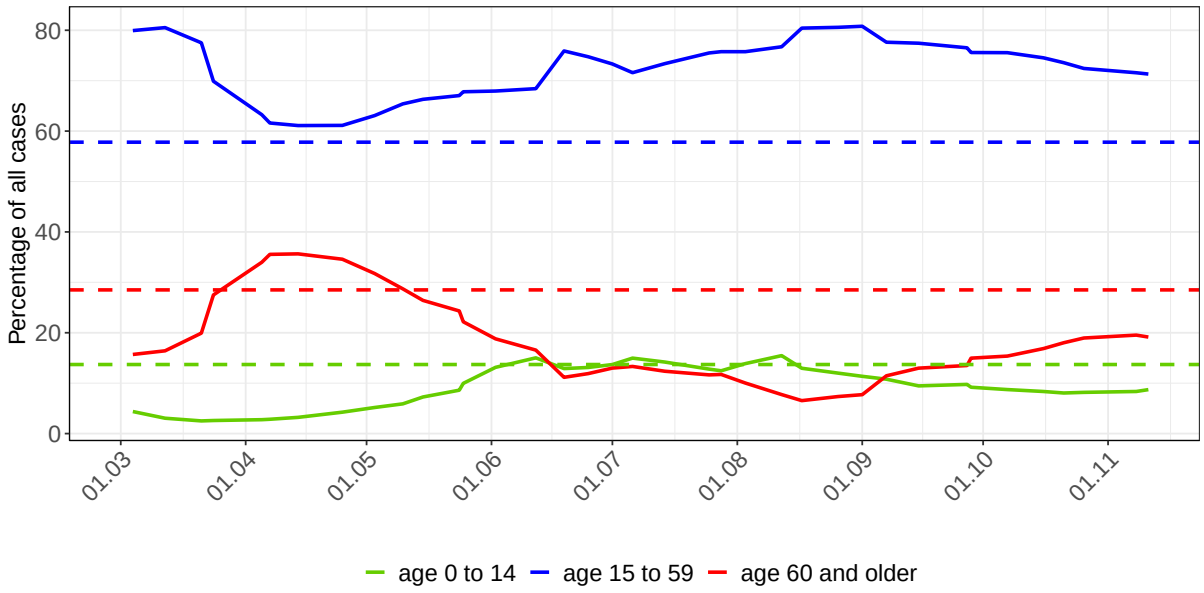


Figure 13: Age distribution of COVID-19 cases over time in Germany. Solid line: proportion of cases per age group summarized per week. Dotted line: proportion of the age group in the total population.

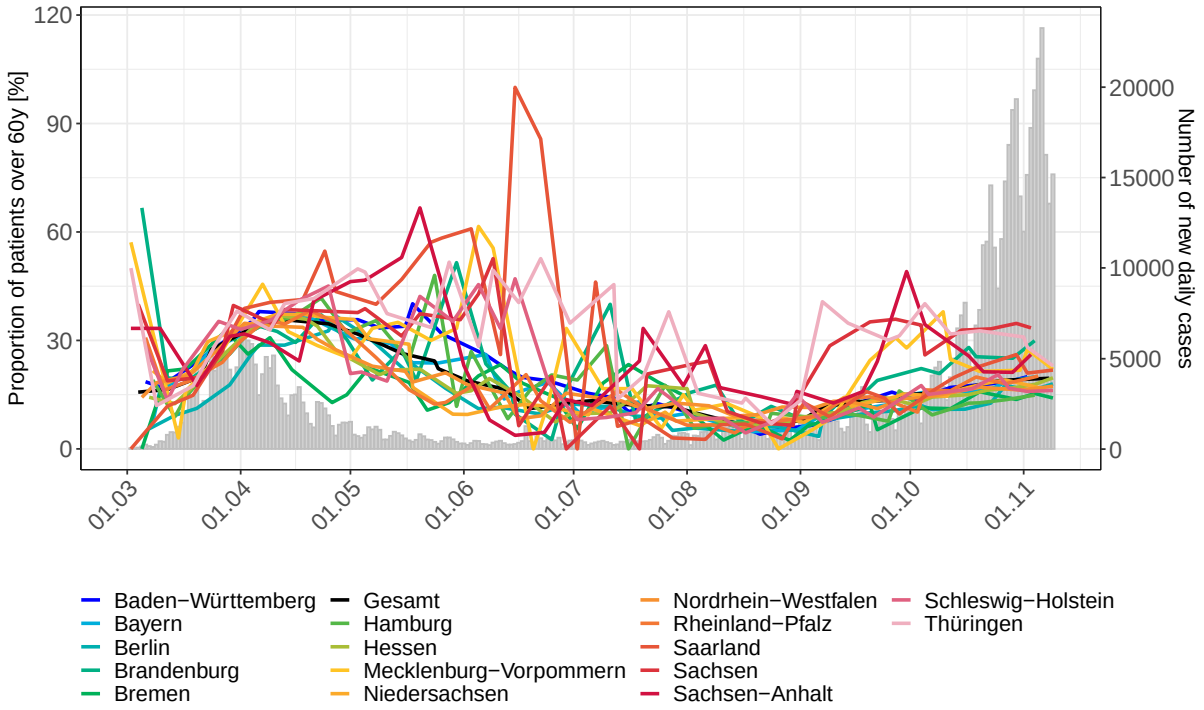


Figure 14: Proportion of patients over 60 years of age over time in the federal states and Germany

1.6.4 Change of R(t) over time for country- and citycounties

Fig. 15 and 16 show R(t) values estimated by the model on the country- and citycounties level.

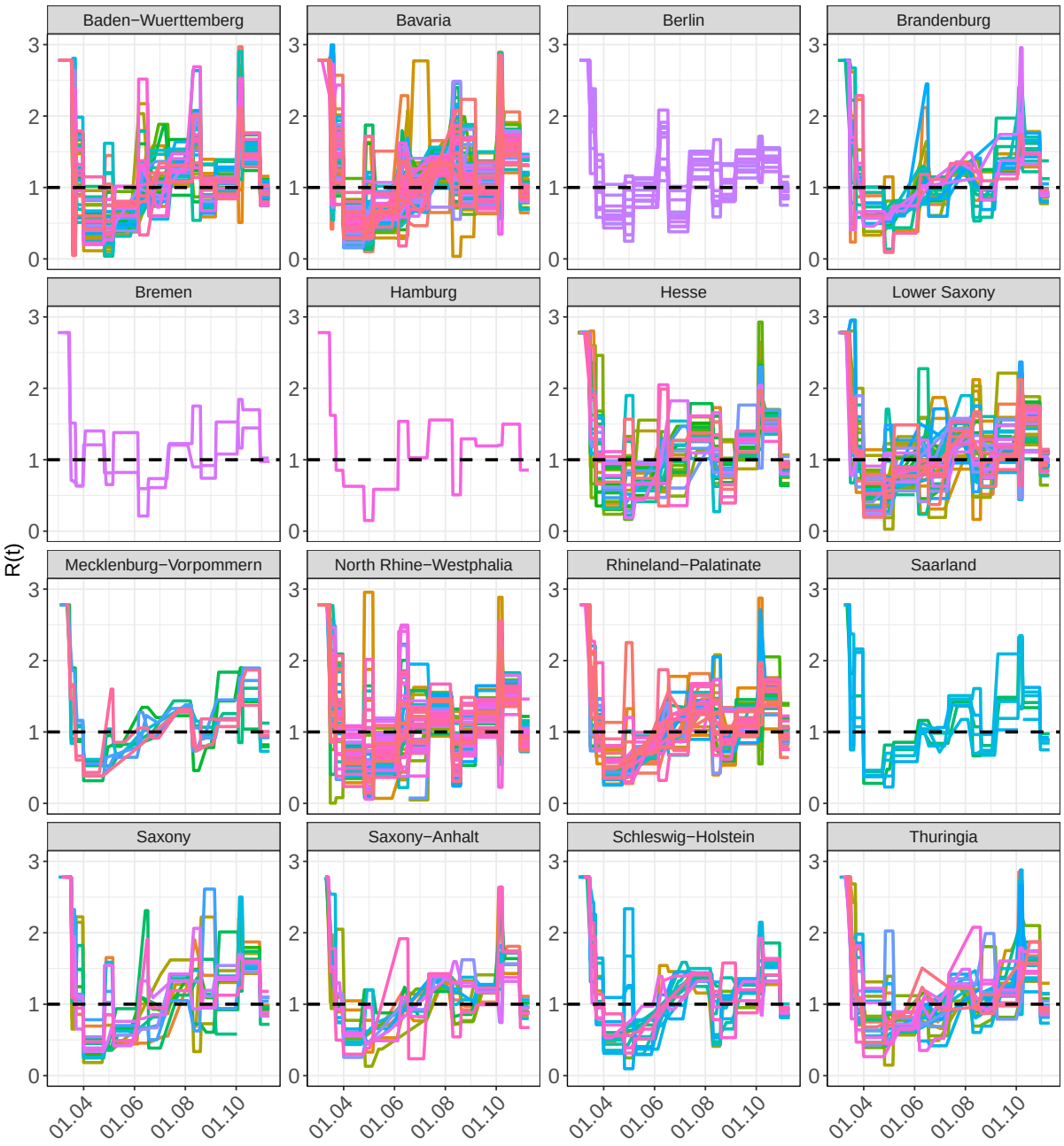


Figure 15: Veränderung von R(t) über die Zeit für Land- und Stadtkreise

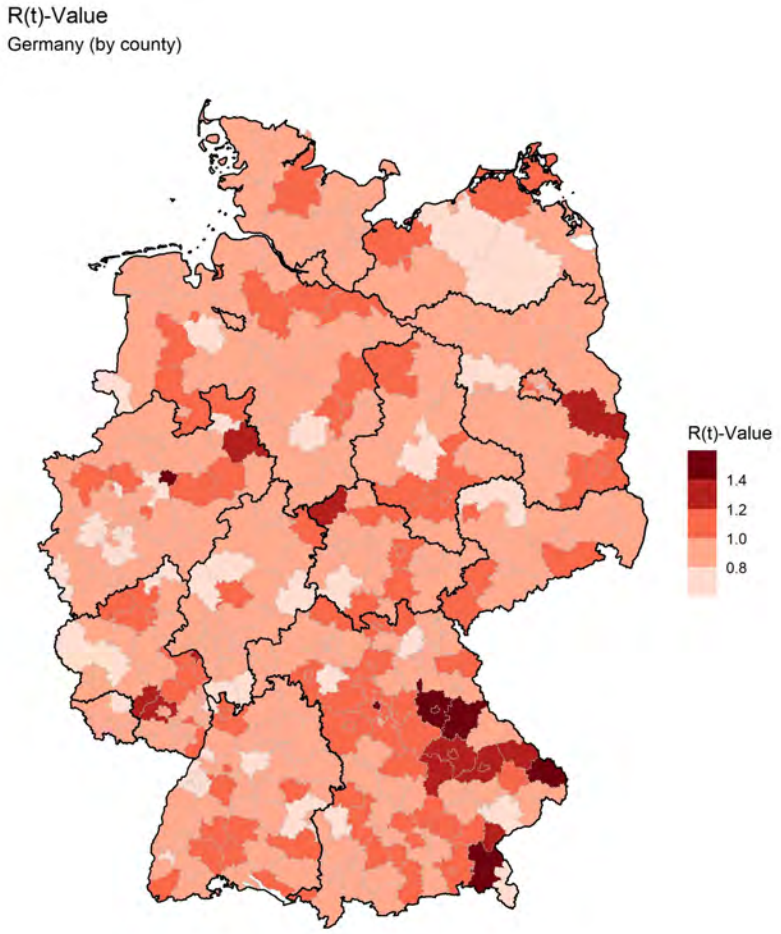


Figure 16: R(t) Werte auf Land- und Stadtkreis Ebene

2 Baden-Wuerttemberg

2.1 Model description

Fig. 17 depicts the results of the modeling (lines) compared to the observed data (points) for Baden-Wuerttemberg on a linear (A) and semi-logarithmic (B) scale.

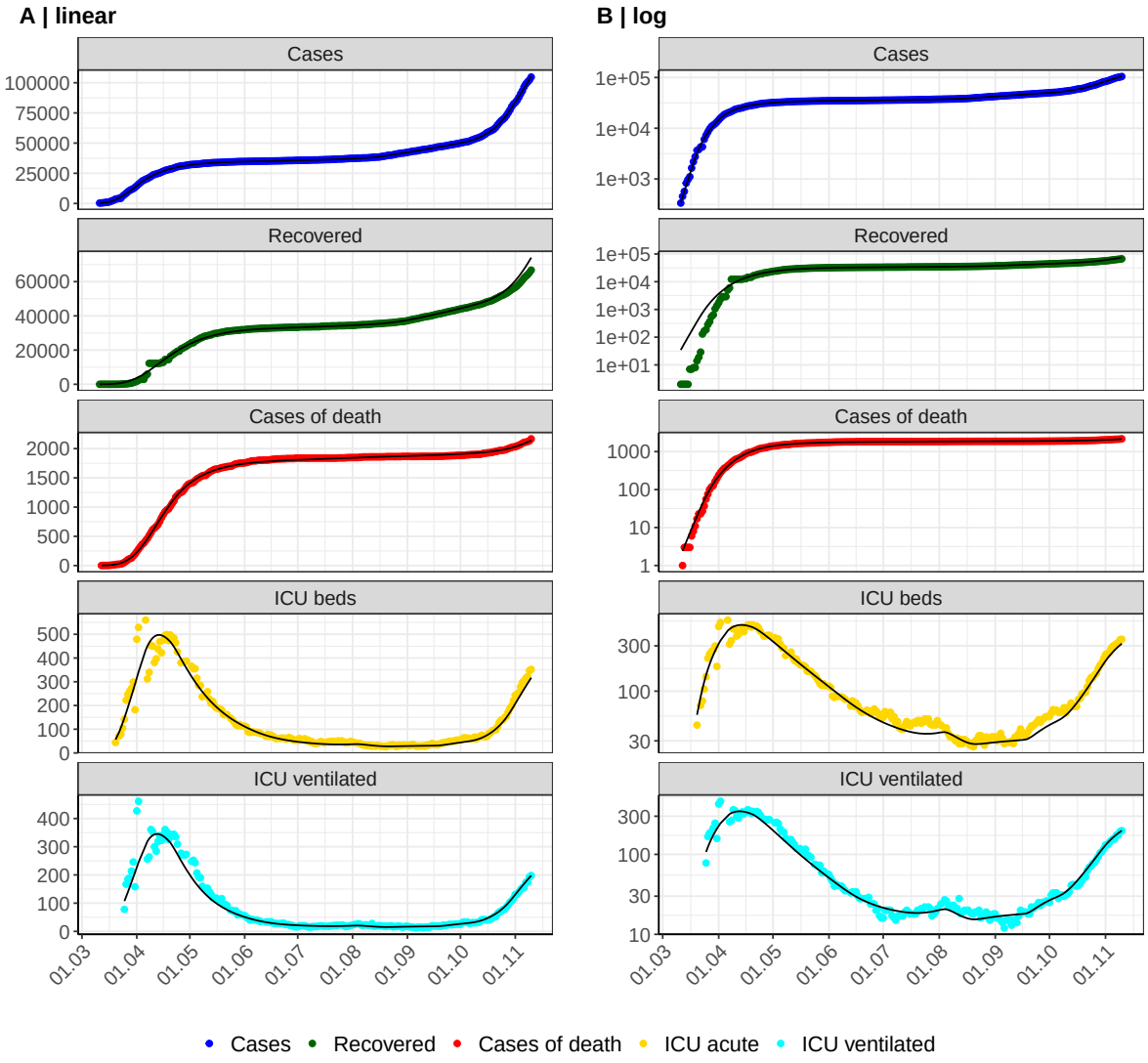


Figure 17: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Baden-Wuerttemberg. Points: reported data; lines: model description.

Fig. 18 shows the goodness-of-fit for Baden-Wuerttemberg. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

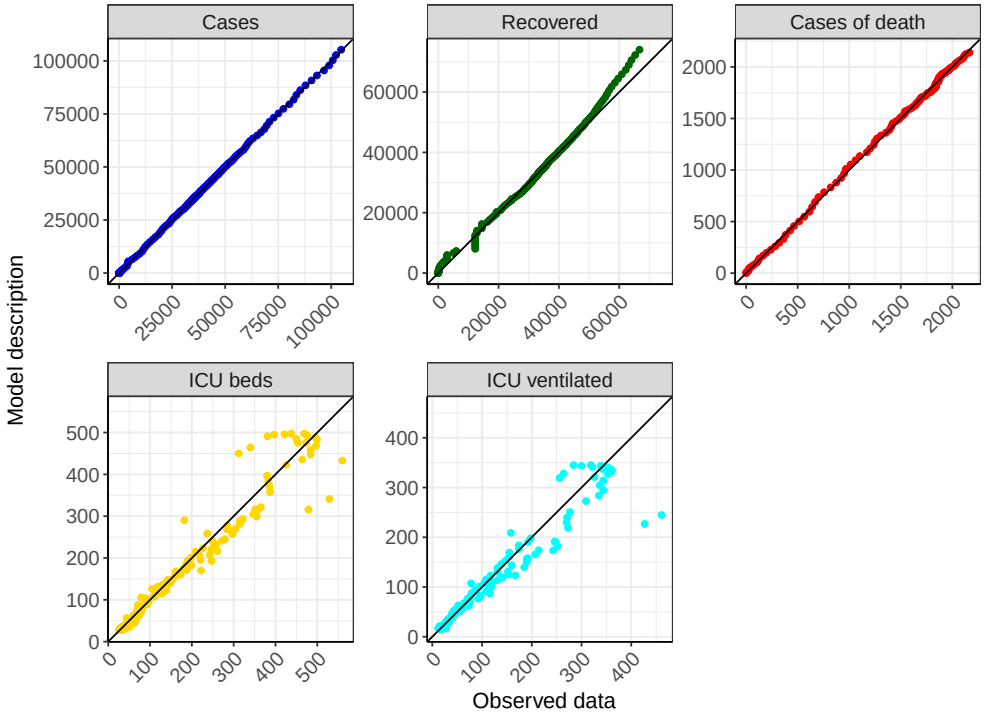


Figure 18: Goodness-of-fit plots for Baden-Wuerttemberg. Lines: lines of identity.

Fig. 19 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Baden-Wuerttemberg (red line) in comparison with the other federal states (grey lines).

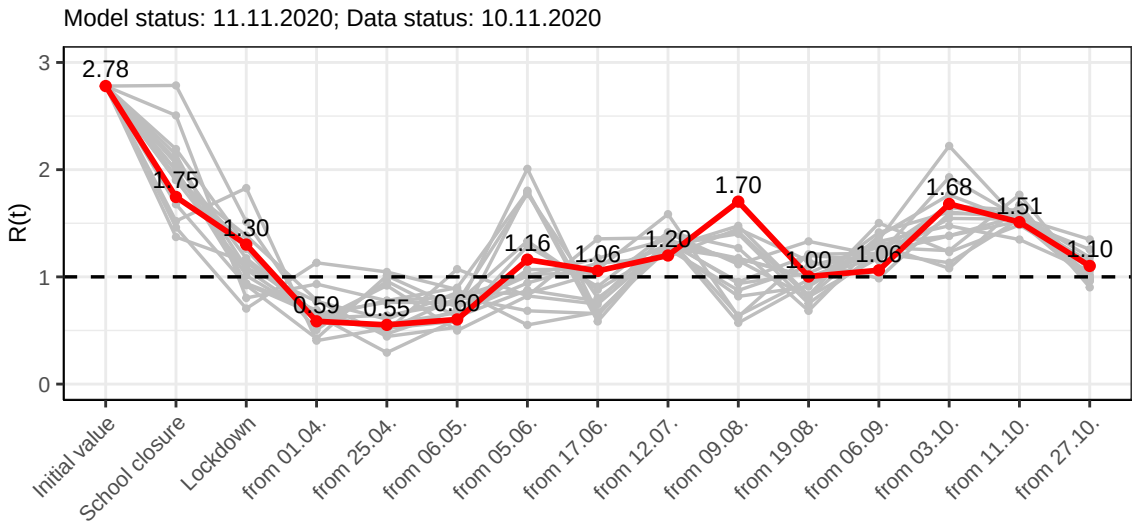


Figure 19: R(t) values before and after the NPIs for Baden-Wuerttemberg

Fig. 20 shows the R(t) estimated value for Baden-Wuerttemberg (red line) over time in comparison with the other federal states (grey lines).

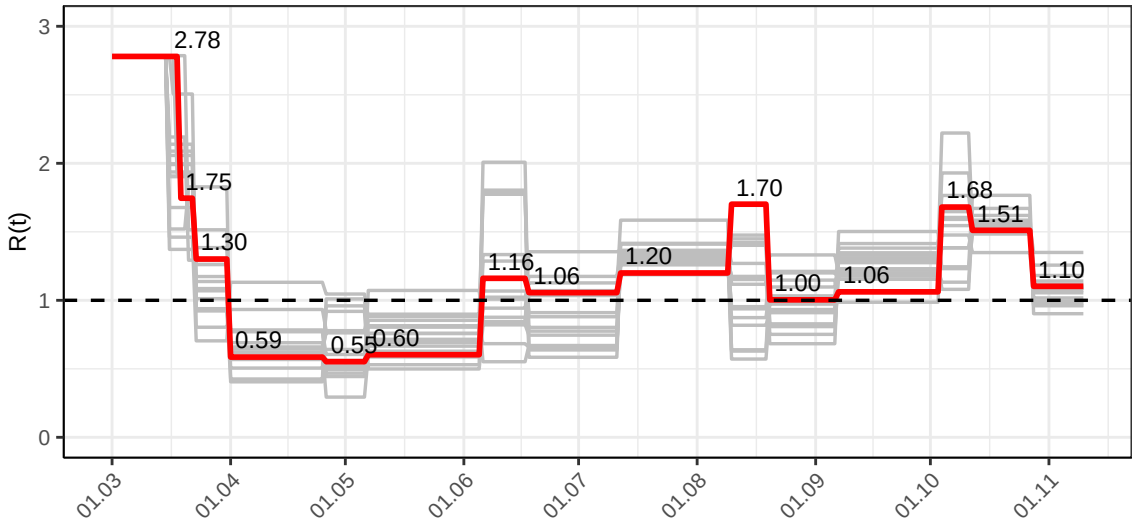


Figure 20: R(t) values over time for Baden-Wuerttemberg

Fig. 21 shows the changes in hospitalization and death rates for Baden-Wuerttemberg (red line) over time compared to the other states (grey lines).

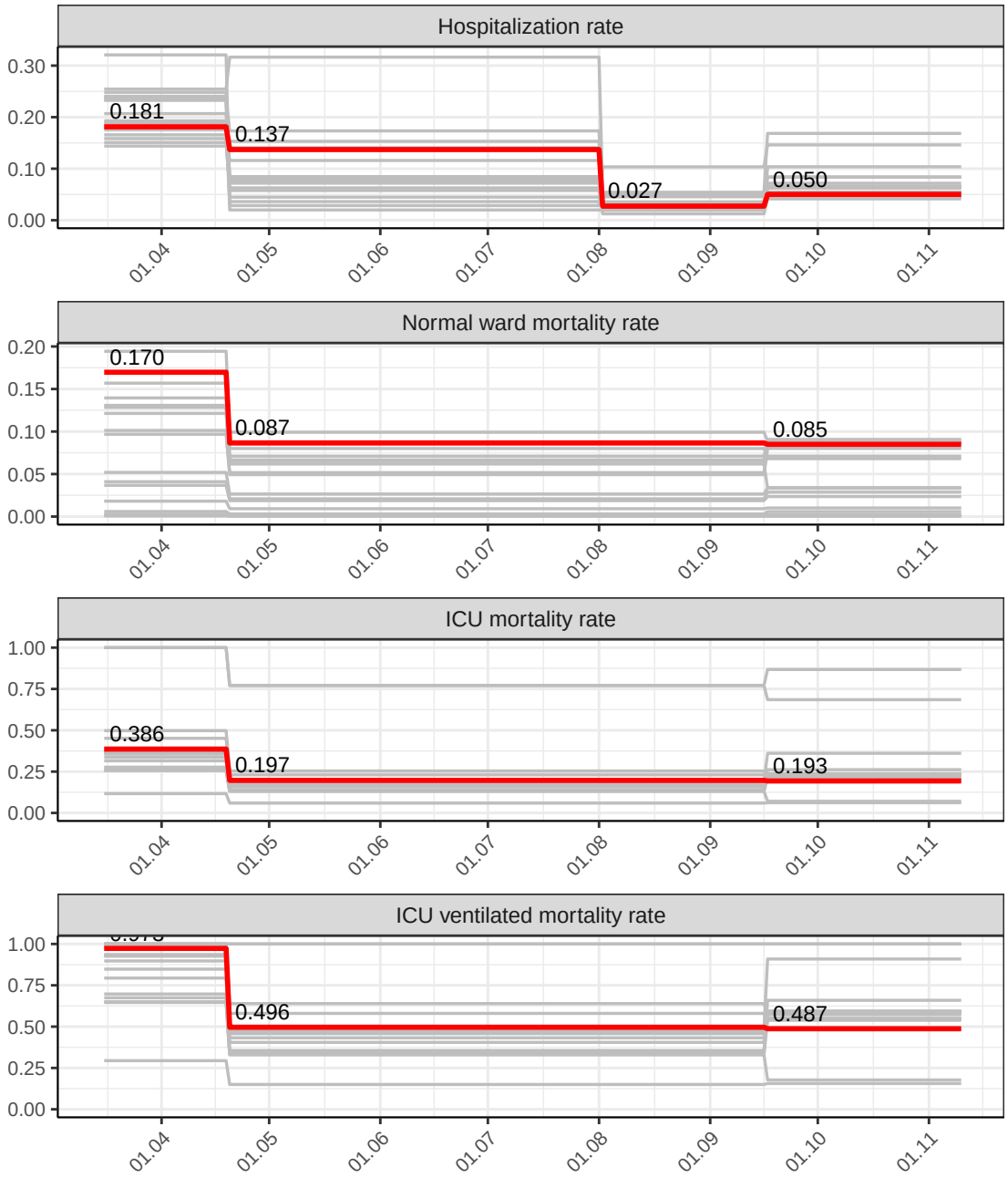


Figure 21: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Baden-Wuerttemberg

2.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1.1) and assuming various scenarios from 11.11.2020

Fig.22 and 23 represent the model prediction for the next 8 weeks for Baden-Wuerttemberg on a linear (22) and a semi-logarithmic (23) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

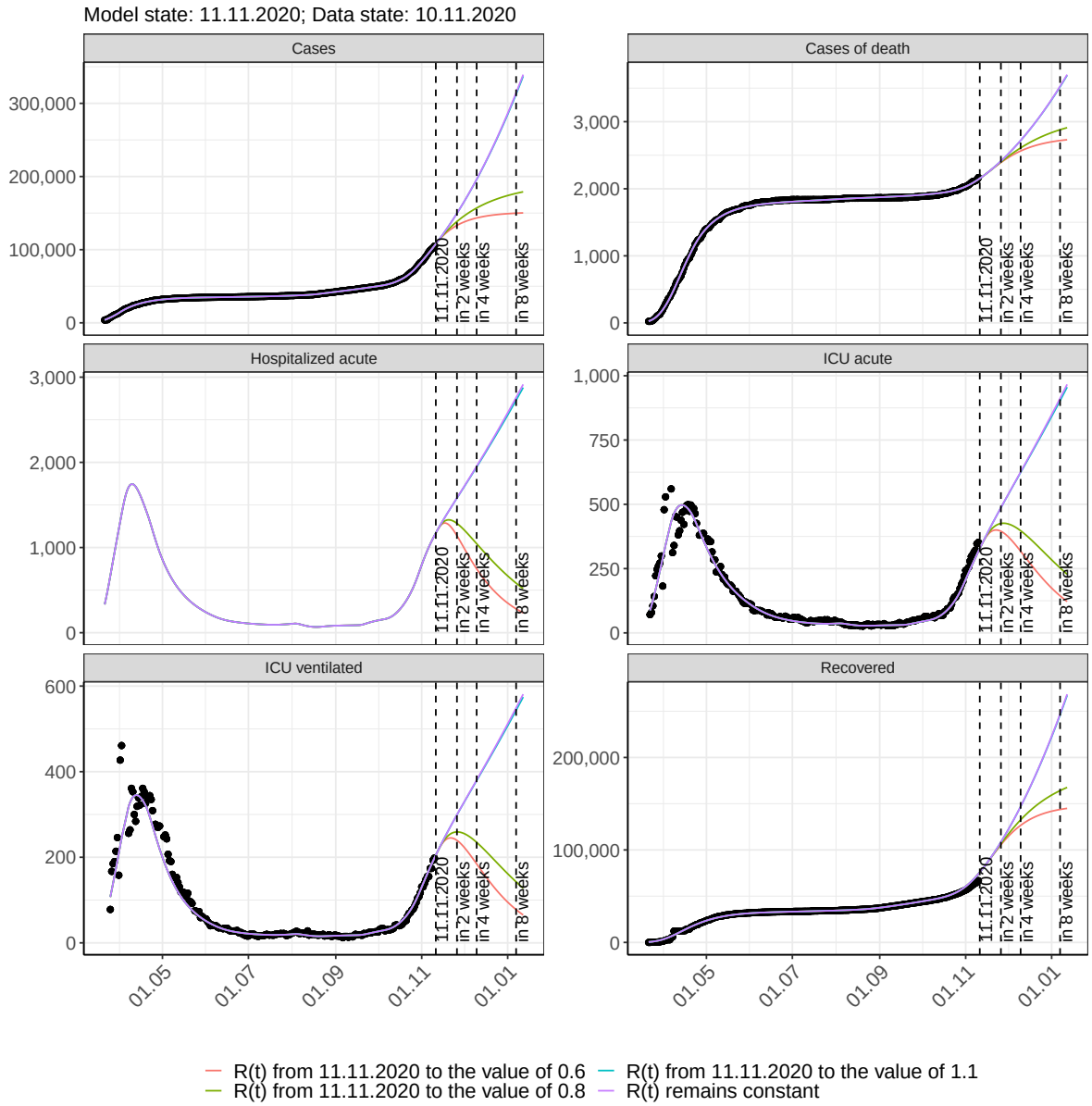


Figure 22: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Baden-Wuerttemberg assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

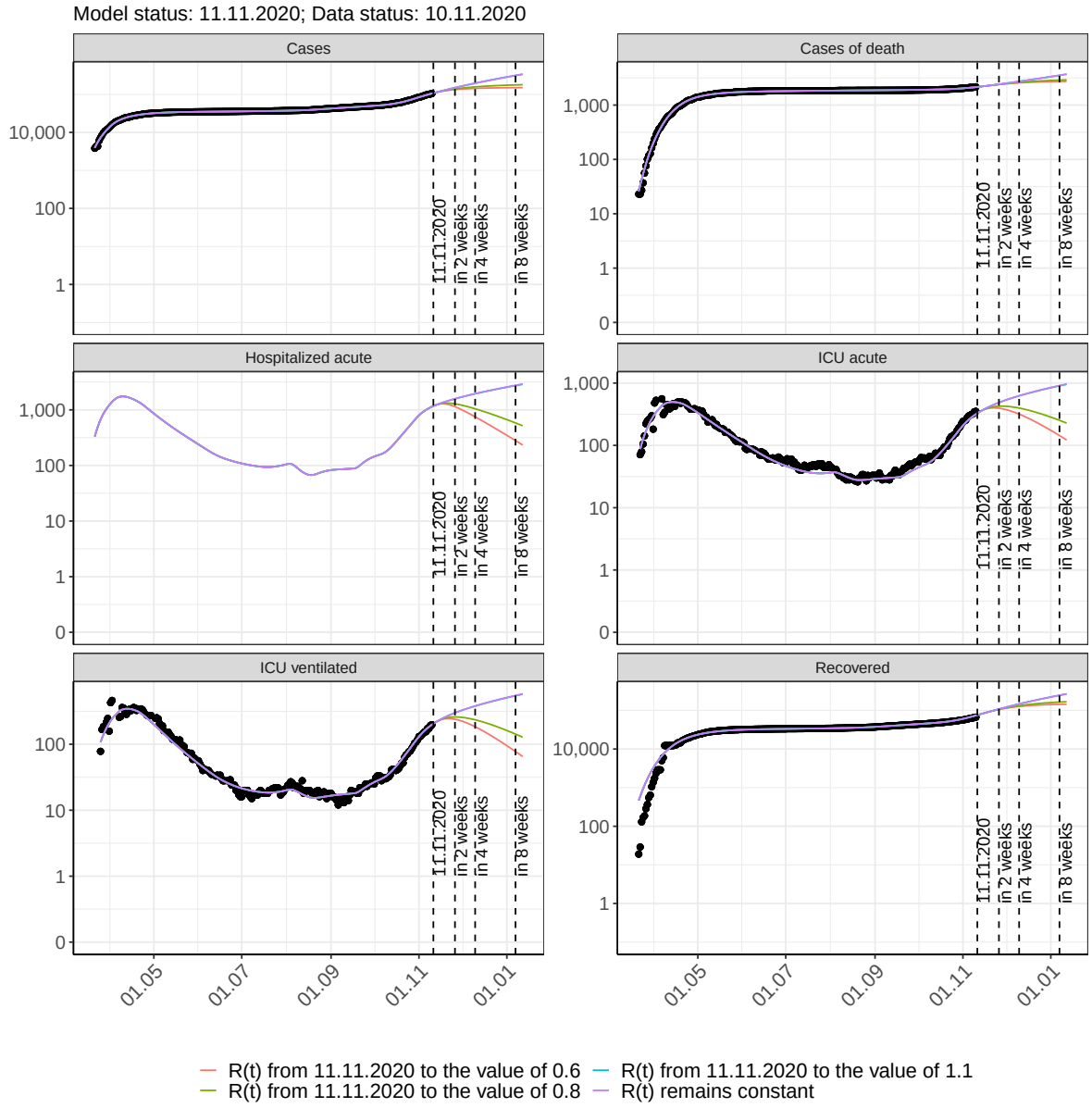


Figure 23: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Baden-Wuerttemberg assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 24 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

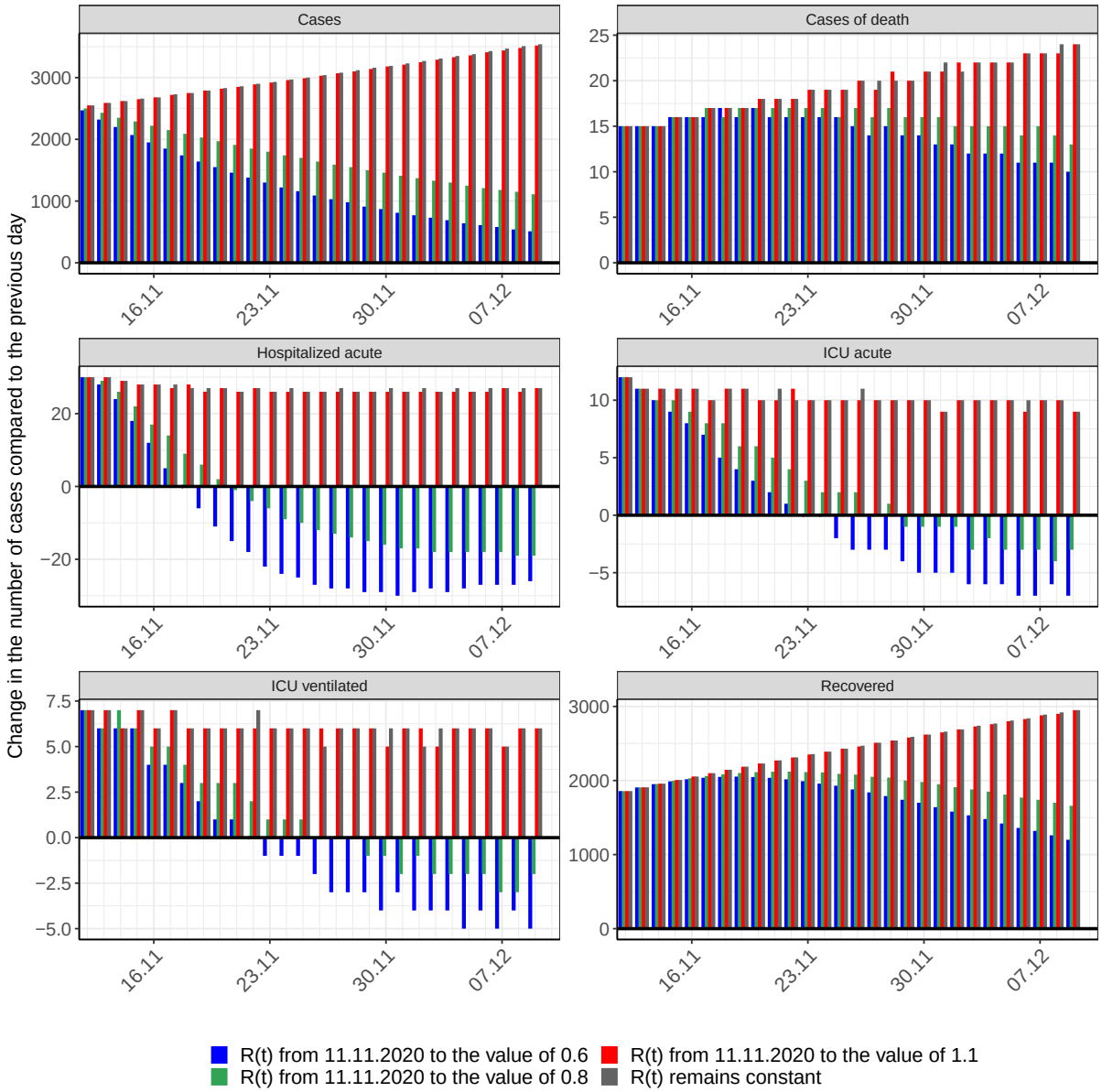


Figure 24: Simulation of daily new cases for the next 4 weeks - Baden-Wuerttemberg

2.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Baden-Wuerttemberg over time.

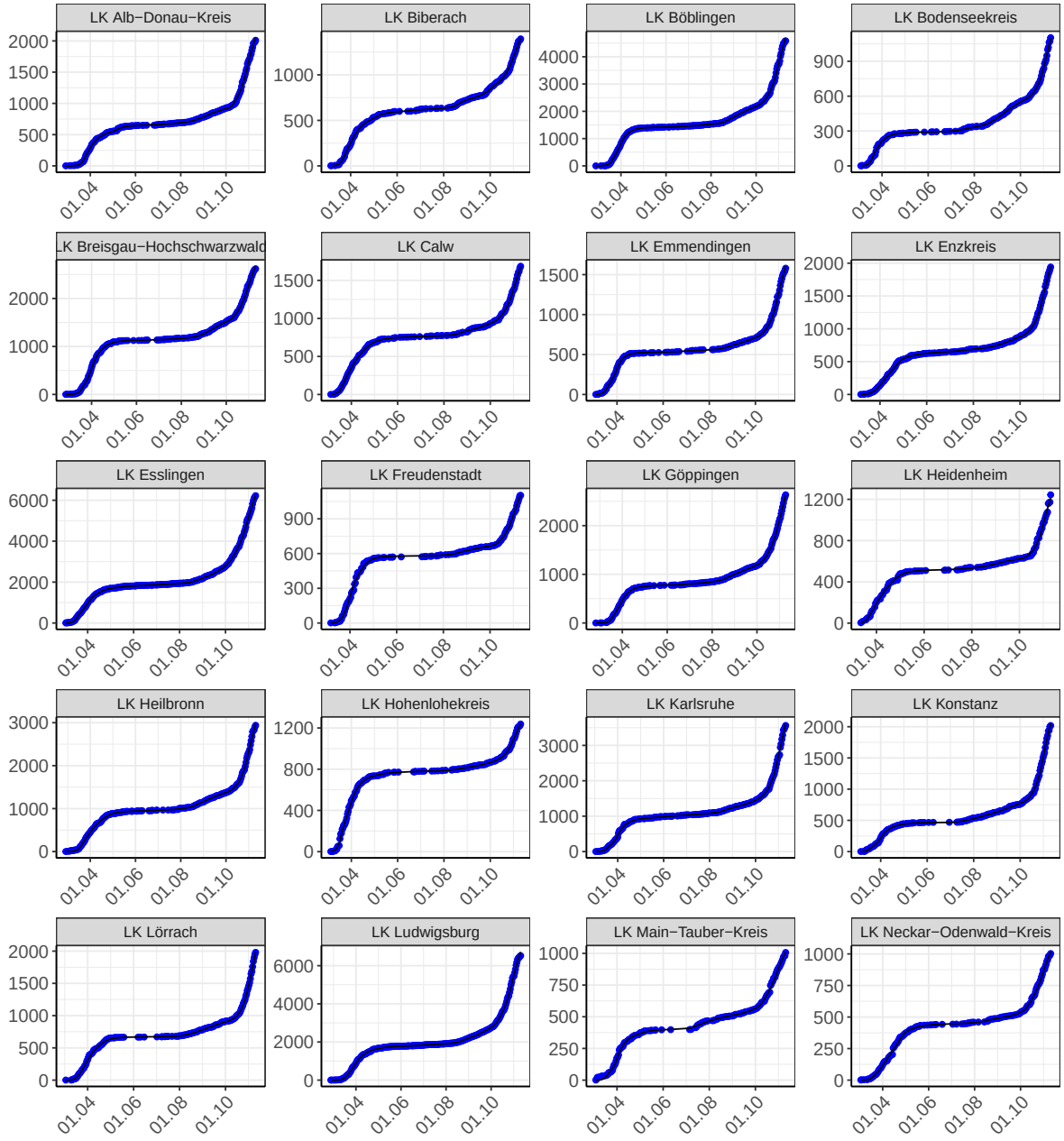


Figure 25: Model description of the reported case numbers in country- and citycounties in Baden-Wuerttemberg. Points: reported data; lines: model description.

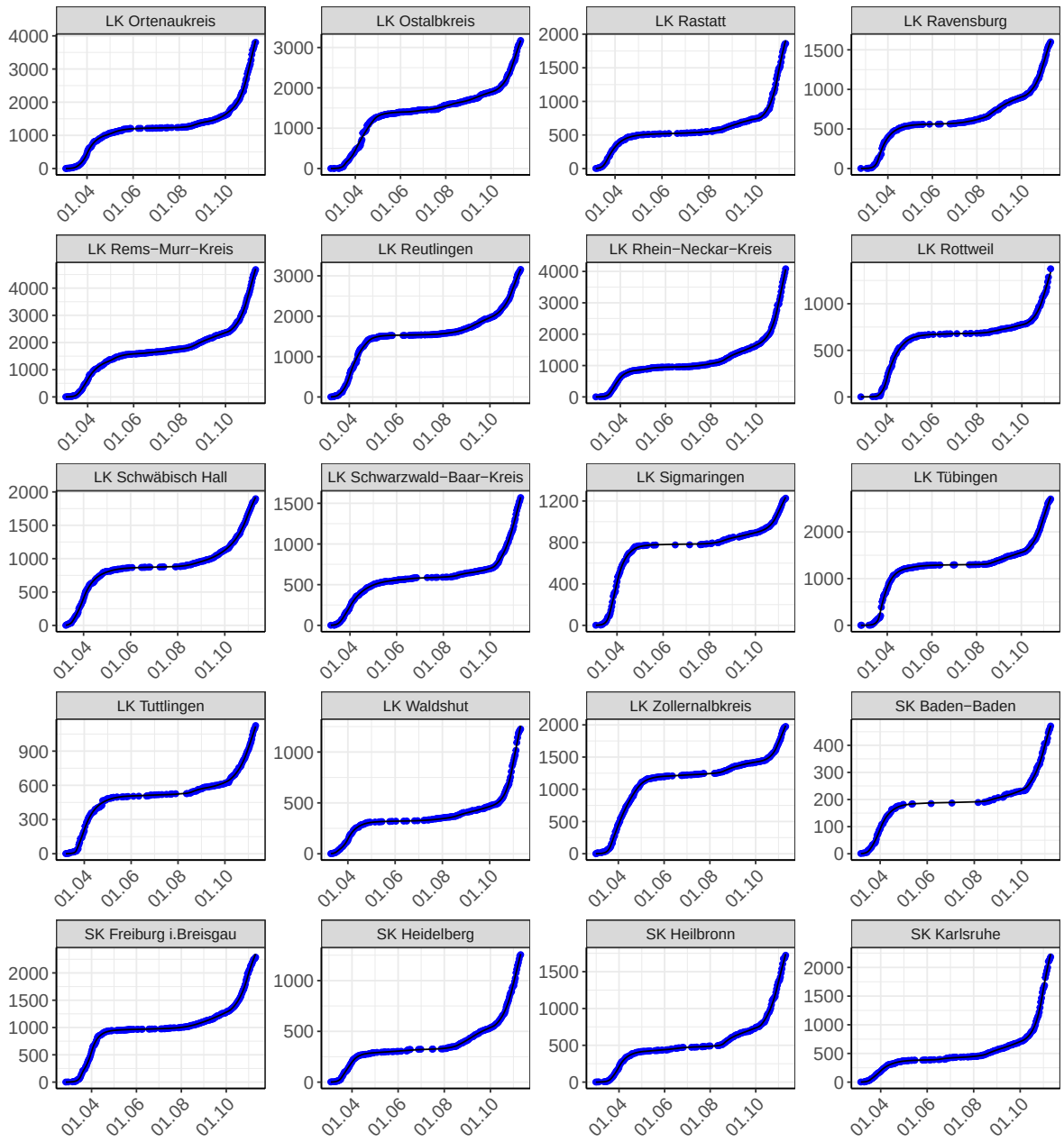


Figure 26: Model description of the reported case numbers in country- and citycounties in Baden-Wuerttemberg. Points: reported data; lines: model description.

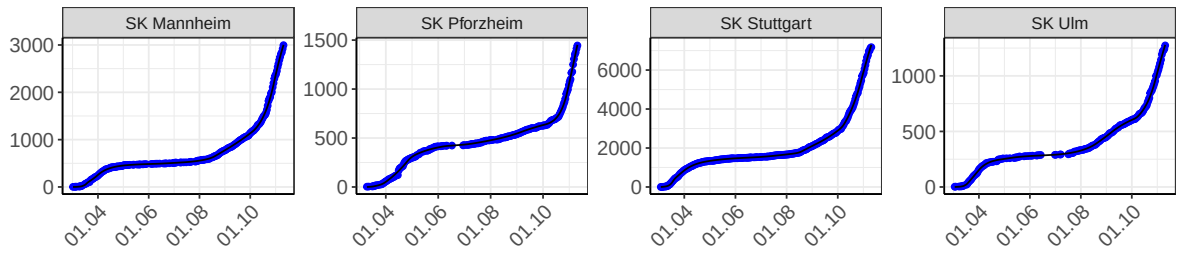


Figure 27: Model description of the reported case numbers in country- and citycounties in Baden-Wuerttemberg. Points: reported data; lines: model description.

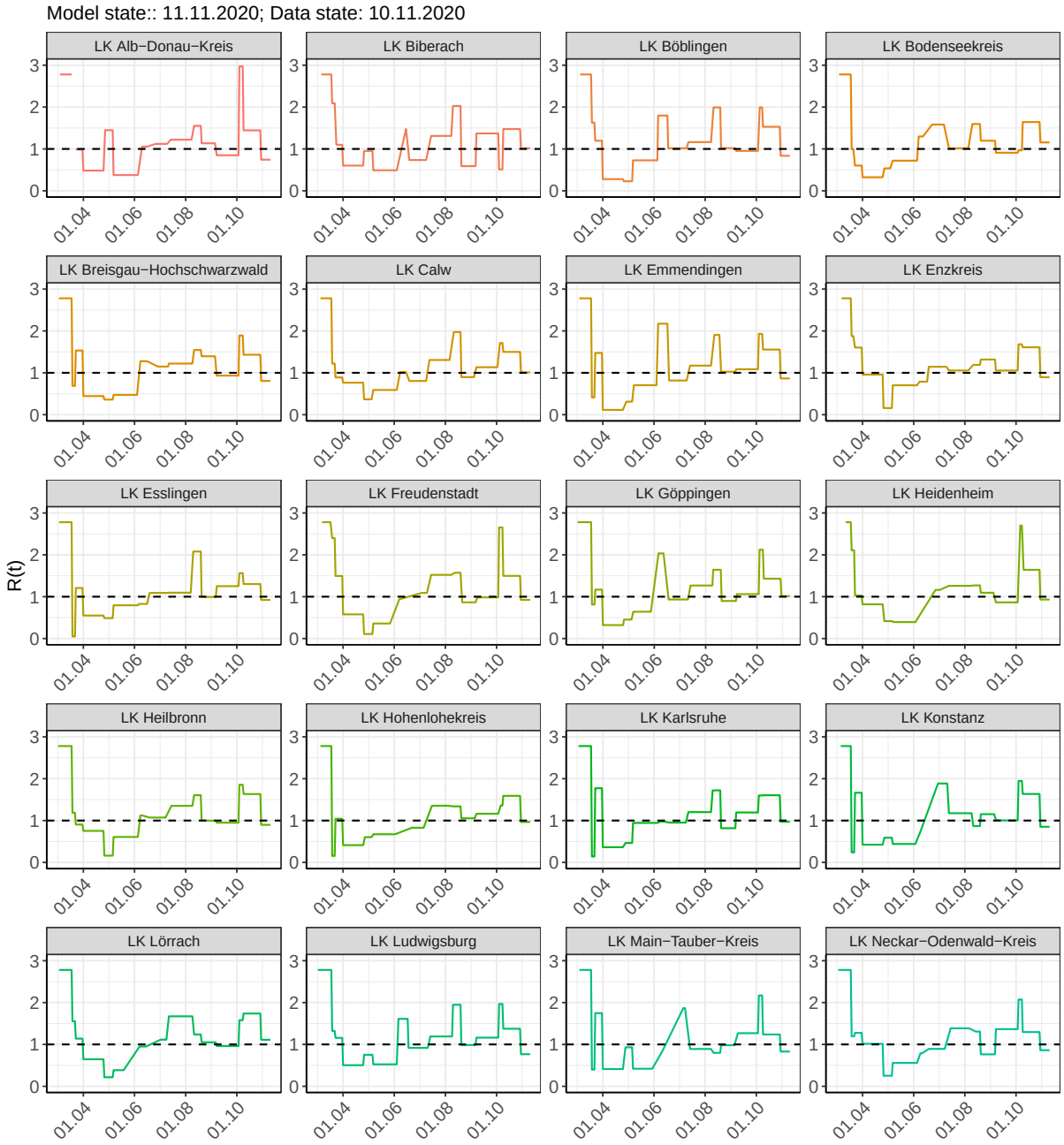


Figure 28: R(t) values over time for country- and citycounties in Baden-Wuerttemberg

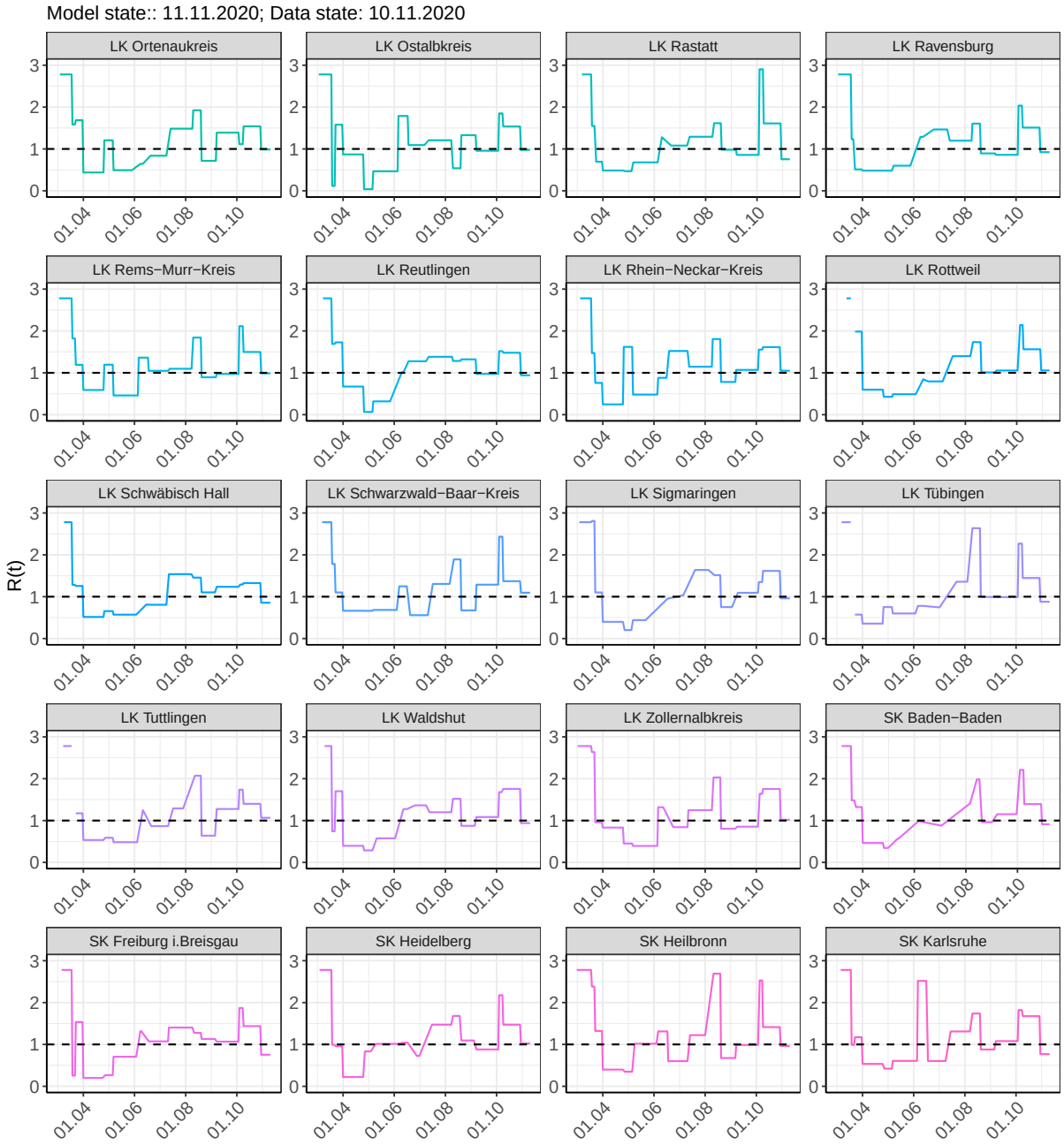


Figure 29: R(t) values over time for country- and citycounties in Baden-Wuerttemberg

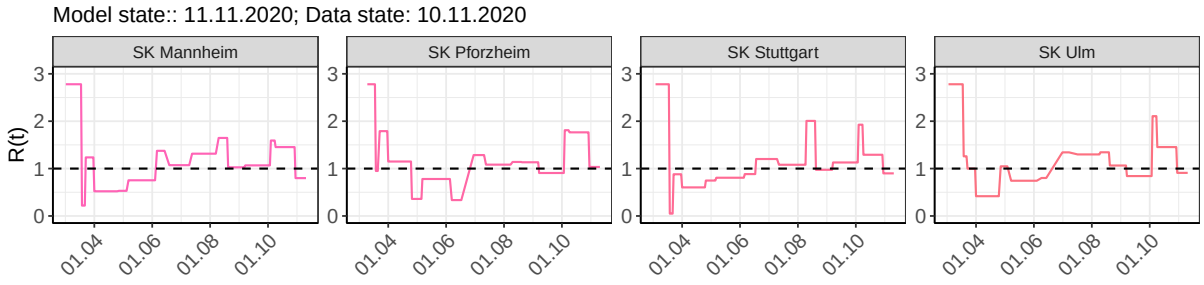


Figure 30: R(t) values over time for country- and citycounties in Baden-Wuerttemberg

Table 2: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Alb-Donau-Kreis	2.78	3.15	0.99	0.48	1.45	0.38	1.05	1.12	1.22	1.55	1.13	0.85	2.97	1.44	0.74
LK Biberach	2.78	2.09	1.10	0.60	0.95	0.49	1.48	0.74	1.31	2.03	0.59	1.37	0.51	1.48	1.02
LK Böblingen	2.78	1.63	1.20	0.28	0.23	0.73	1.80	1.02	1.16	1.99	1.02	0.95	1.99	1.53	0.84
LK Bodenseekreis	2.78	1.00	0.60	0.32	0.54	0.72	1.30	1.58	1.02	1.60	1.20	0.91	0.97	1.64	1.16
LK Breisgau-Hochschwarzwald	2.78	0.69	1.53	0.44	0.36	0.47	1.28	1.15	1.22	1.55	1.40	0.93	1.89	1.43	0.81
LK Calw	2.78	1.22	0.89	0.76	0.37	0.59	1.02	0.81	1.31	1.97	0.90	1.13	1.71	1.50	1.01
LK Emmendingen	2.78	0.41	1.47	0.11	0.31	0.70	2.17	0.82	1.17	1.91	1.03	1.08	1.93	1.56	0.87
LK Enzkreis	2.78	1.88	1.60	0.96	0.16	0.70	0.79	1.15	1.06	1.19	1.32	1.05	1.68	1.61	0.89
LK Esslingen	2.78	0.05	1.21	0.55	0.49	0.79	0.83	1.09	1.10	2.08	0.99	1.25	1.56	1.30	0.92
LK Freudenstadt	2.78	2.40	1.50	0.58	0.11	0.36	0.94	1.09	1.52	1.57	0.87	0.98	2.66	1.50	0.92
LK Göppingen	2.78	0.81	1.17	0.32	0.45	0.64	2.03	0.93	1.27	1.64	0.90	1.06	2.12	1.43	1.01
LK Heidenheim	2.78	2.11	1.03	0.82	0.42	0.39	1.02	1.16	1.26	1.27	1.09	0.86	2.70	1.64	0.93
LK Heilbronn	2.78	1.19	0.90	0.75	0.16	0.61	1.12	1.07	1.35	1.61	1.00	0.95	1.85	1.63	0.90

Table 2: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Hohenlohekreis	2.78	0.16	1.04	0.41	0.60	0.67	0.93	0.83	1.35	1.34	1.05	1.16	1.36	1.59	0.97
LK Karlsruhe	2.78	0.14	1.77	0.36	0.46	0.94	0.98	0.95	1.20	1.72	0.82	1.19	1.60	1.60	0.97
LK Konstanz	2.78	0.24	1.66	0.42	0.59	0.44	0.74	1.88	1.18	0.87	1.15	1.00	1.95	1.63	0.85
LK Lörrach	2.78	1.55	1.14	0.65	0.22	0.38	0.95	1.11	1.67	1.24	1.05	0.96	1.58	1.74	1.11
LK Ludwigsburg	2.78	1.32	1.16	0.50	0.75	0.52	1.61	0.92	1.19	1.95	0.99	1.16	1.97	1.37	0.77
LK Main-Tauber-Kreis	2.78	0.40	1.75	0.41	0.93	0.42	0.84	1.87	0.89	0.80	0.98	1.27	2.17	1.24	0.83
LK Neckar-Odenwald-Kreis	2.78	1.19	1.28	1.01	0.25	0.56	0.79	0.89	1.39	1.31	0.76	1.36	2.07	1.30	0.86
LK Ortenaukreis	2.78	1.58	1.69	0.44	1.21	0.49	0.64	0.84	1.48	1.92	0.72	1.39	1.11	1.54	0.99
LK Ostalbkreis	2.78	0.12	1.58	0.87	0.04	0.47	1.79	1.09	1.21	0.54	1.33	0.96	1.85	1.54	0.98
LK Rastatt	2.78	1.55	0.70	0.48	0.47	0.68	1.28	1.08	1.29	1.62	0.98	0.86	2.90	1.61	0.75
LK Ravensburg	2.78	1.23	0.51	0.48	0.48	0.60	1.29	1.47	1.20	1.61	0.89	0.86	2.04	1.51	0.92
LK Rems-Murr-Kreis	2.78	1.82	1.19	0.59	1.19	0.46	1.36	1.05	1.10	1.84	0.89	0.97	2.11	1.50	0.99

Table 2: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Reutlingen	2.78	1.69	1.73	0.67	0.06	0.32	1.01	1.28	1.38	1.28	1.32	0.98	1.52	1.48	0.94
LK Rhein-Neckar-Kreis	2.78	1.47	0.76	0.25	1.62	0.48	0.88	1.52	1.15	1.81	0.78	1.07	1.55	1.61	1.05
LK Rottweil	2.78	5.12	1.98	0.60	0.43	0.49	0.85	0.79	1.40	1.73	1.01	1.05	2.14	1.56	1.06
LK Schwäbisch Hall	2.78	1.28	1.26	0.52	0.66	0.57	0.81	0.81	1.54	1.46	1.10	1.24	1.29	1.33	0.86
LK Schwarzwald-Baar-Kreis	2.78	1.78	1.10	0.66	0.66	0.68	1.25	0.56	1.30	1.89	0.67	1.29	2.43	1.37	1.09
LK Sigmaringen	2.78	2.81	1.10	0.40	0.20	0.44	0.95	1.04	1.64	1.51	0.75	1.09	1.35	1.62	0.96
LK Tübingen	2.78	3.31	0.57	0.36	0.75	0.60	0.78	0.75	1.36	2.64	0.99	0.99	2.27	1.45	0.88
LK Tuttlingen	2.78	4.72	1.17	0.54	0.59	0.48	1.25	0.87	1.29	2.07	0.64	1.28	1.74	1.40	1.06
LK Waldshut	2.78	0.74	1.70	0.40	0.29	0.57	1.27	1.36	1.20	1.52	0.87	1.08	1.68	1.76	0.94
LK Zollernalbkreis	2.78	2.64	0.96	0.83	0.45	0.39	1.32	0.84	1.25	2.03	0.81	0.85	1.64	1.75	1.02
SK Baden-Baden	2.78	1.48	1.32	0.46	0.35	0.56	0.99	0.88	1.41	1.98	0.96	1.15	2.21	1.39	0.91

Table 2: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
SK Freiburg i.Breisgau	2.78	0.25	1.53	0.20	0.27	0.71	1.32	1.07	1.40	1.28	1.13	1.07	1.87	1.44	0.75
SK Heidelberg	2.78	0.99	0.96	0.22	0.83	1.01	1.04	0.72	1.47	1.68	1.09	0.88	2.18	1.47	1.02
SK Heilbronn	2.78	2.38	1.32	0.40	0.35	1.02	1.31	0.60	1.22	2.69	0.68	0.99	2.53	1.41	0.96
SK Karlsruhe	2.78	0.99	1.17	0.54	0.42	0.61	2.52	0.60	1.31	1.74	0.88	1.08	1.82	1.68	0.77
SK Mannheim	2.78	0.22	1.24	0.52	0.53	0.75	1.37	1.07	1.31	1.65	1.03	1.07	1.59	1.45	0.80
SK Pforzheim	2.78	0.95	1.79	1.15	0.36	0.78	0.34	1.29	1.08	1.14	1.13	0.91	1.81	1.76	1.03
SK Stuttgart	2.78	0.05	0.88	0.60	0.75	0.81	0.88	1.20	1.08	2.01	0.97	1.13	1.93	1.29	0.90
SK Ulm	2.78	1.26	1.00	0.42	1.05	0.74	0.80	1.34	1.30	1.34	1.06	0.84	2.11	1.45	0.91

3 Bavaria

3.1 Model description

Fig. 31 depicts the results of the modeling (lines) compared to the observed data (points) for Bavaria on a linear (A) and semi-logarithmic (B) scale.

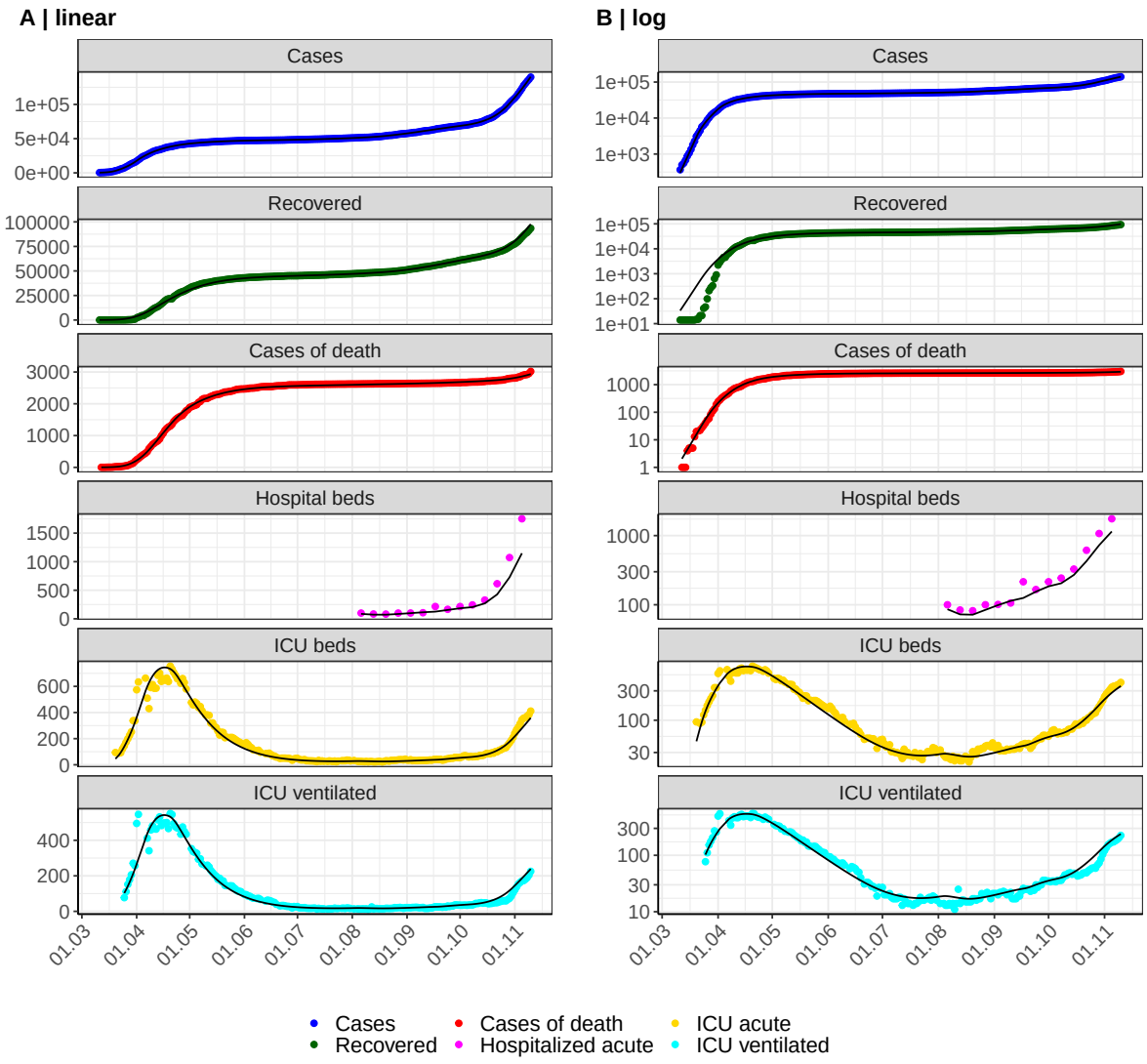


Figure 31: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Bavaria. Points: reported data; lines: model description.

Fig. 32 shows the goodness-of-fit for Bavaria. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

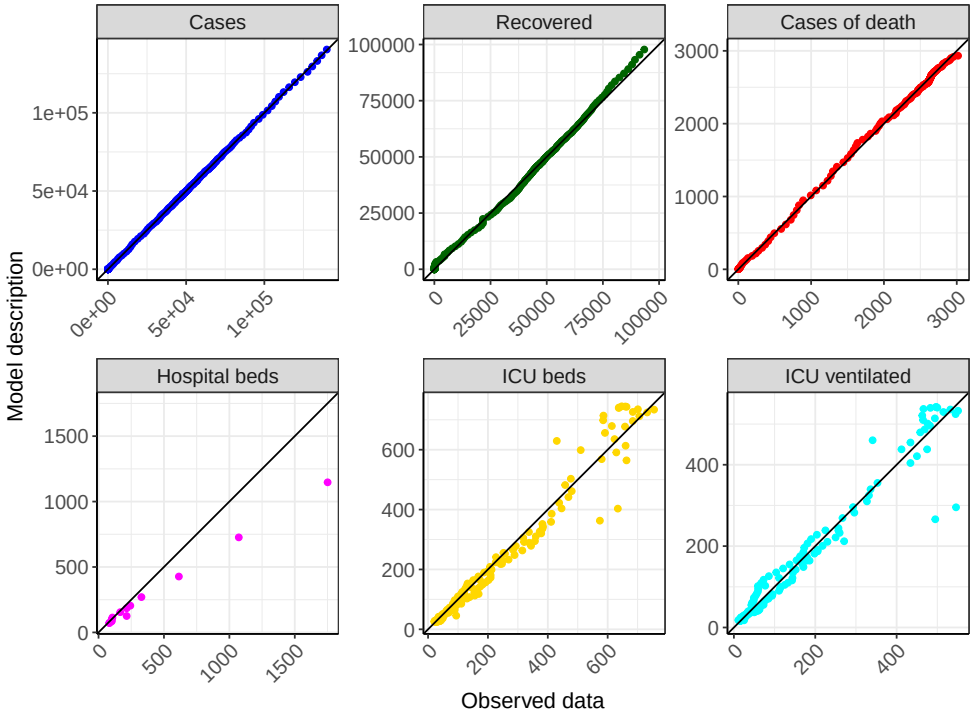


Figure 32: Goodness-of-fit plots for Bavaria. Lines: lines of identity.

Fig. 33 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Bavaria (red line) in comparison with the other federal states (grey lines).

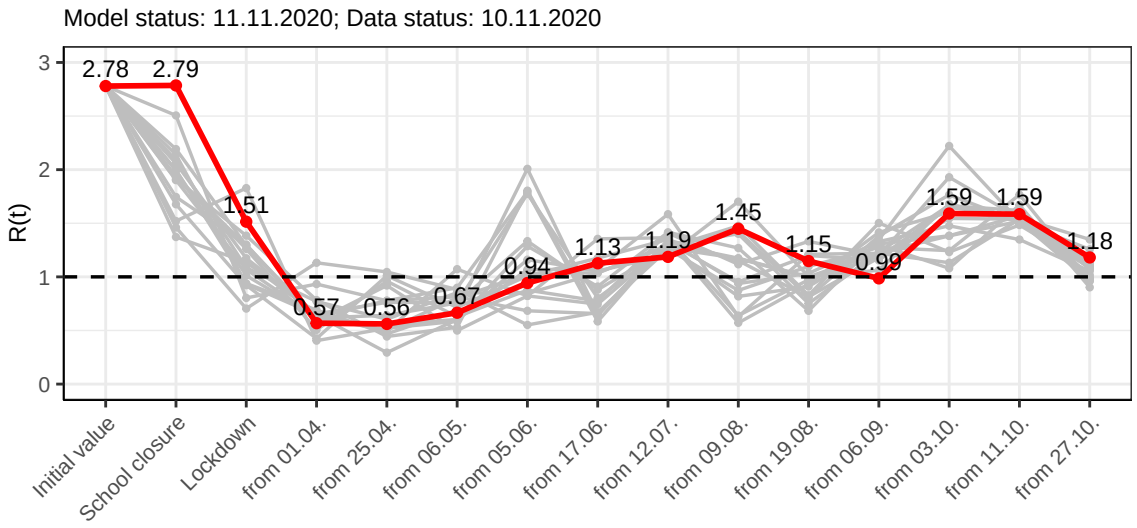


Figure 33: R(t) values before and after the NPIs for Bavaria

Fig. 34 shows the R(t) estimated value for Bavaria (red line) over time in comparison with the other federal states (grey lines).

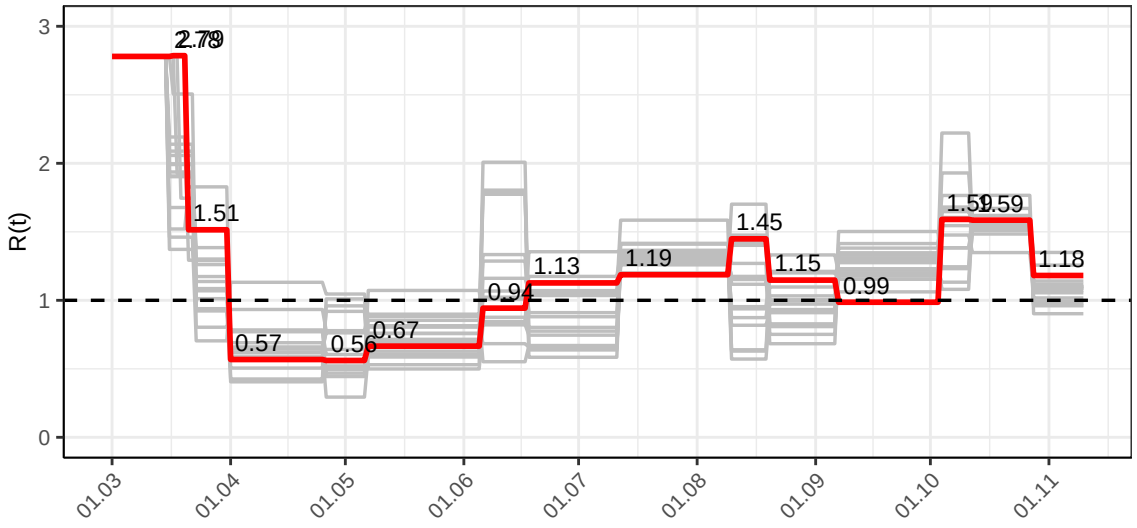


Figure 34: R(t) values over time for Bavaria

Fig. 35 shows the changes in hospitalization and death rates for Bavaria (red line) over time compared to the other states (grey lines).

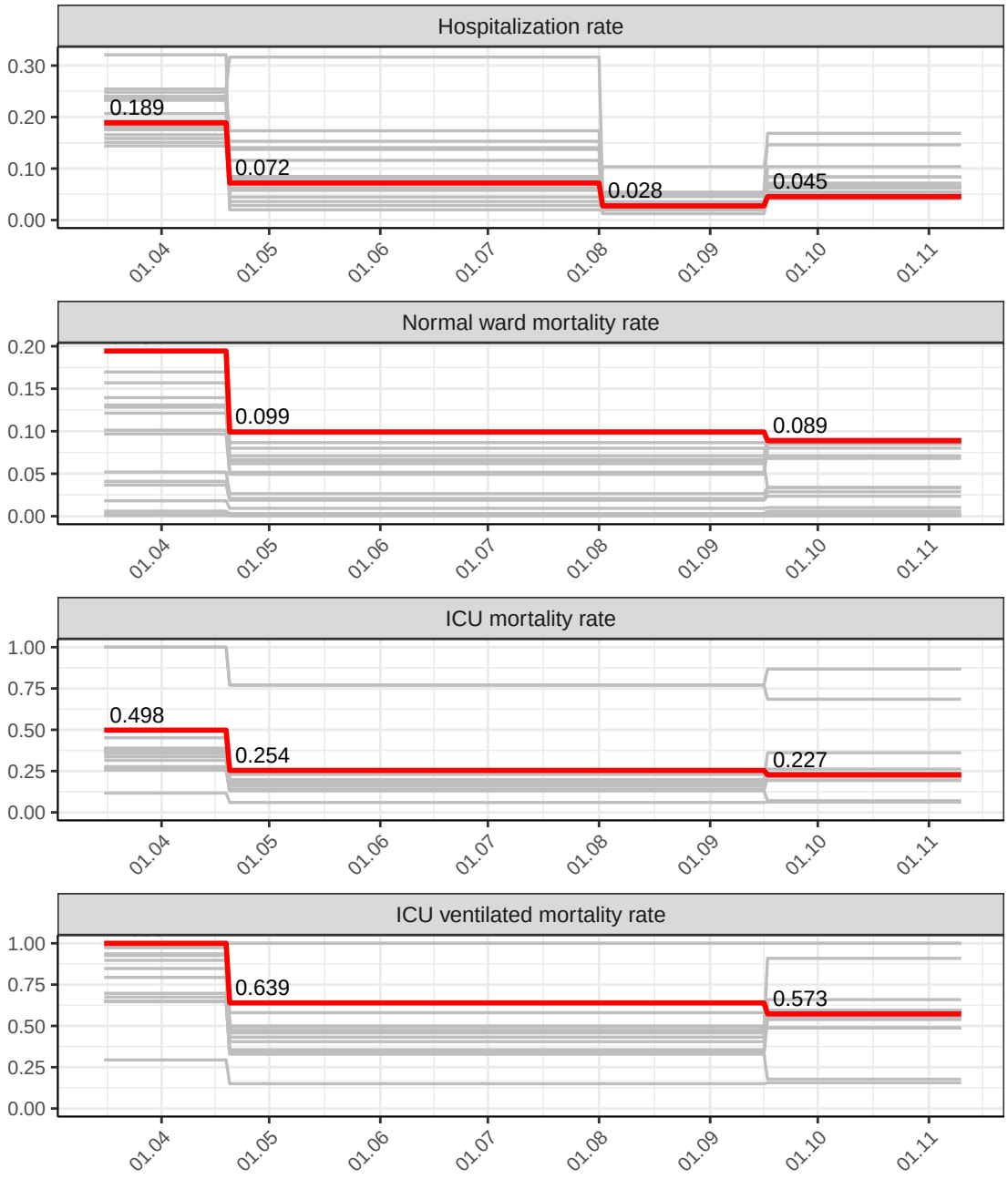


Figure 35: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Bavaria

3.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1.18) and assuming various scenarios from 11.11.2020

Fig.36 and 37 represent the model prediction for the next 8 weeks for Bavaria on a linear (36) and a semi-logarithmic (37) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

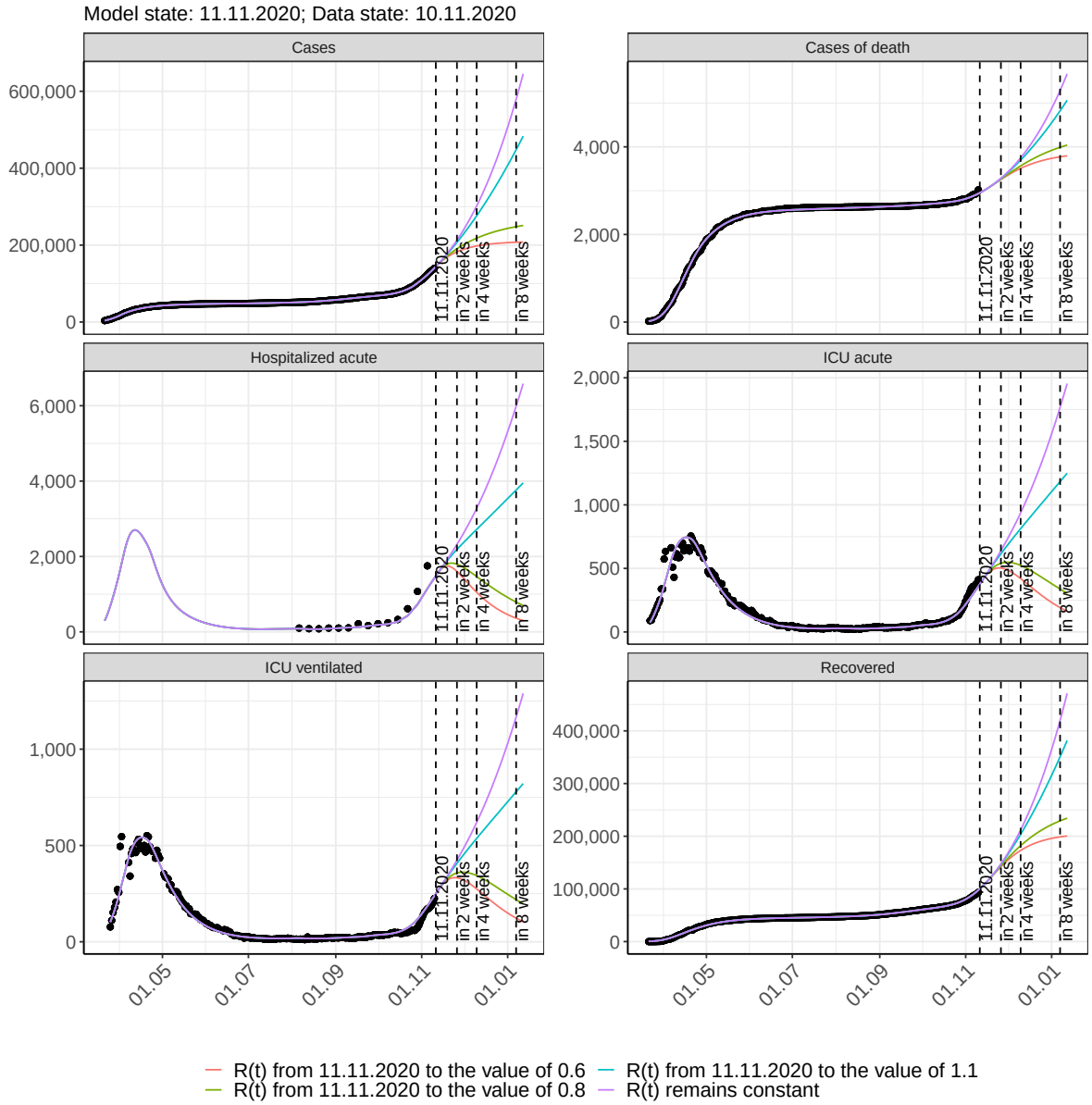


Figure 36: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Bavaria assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

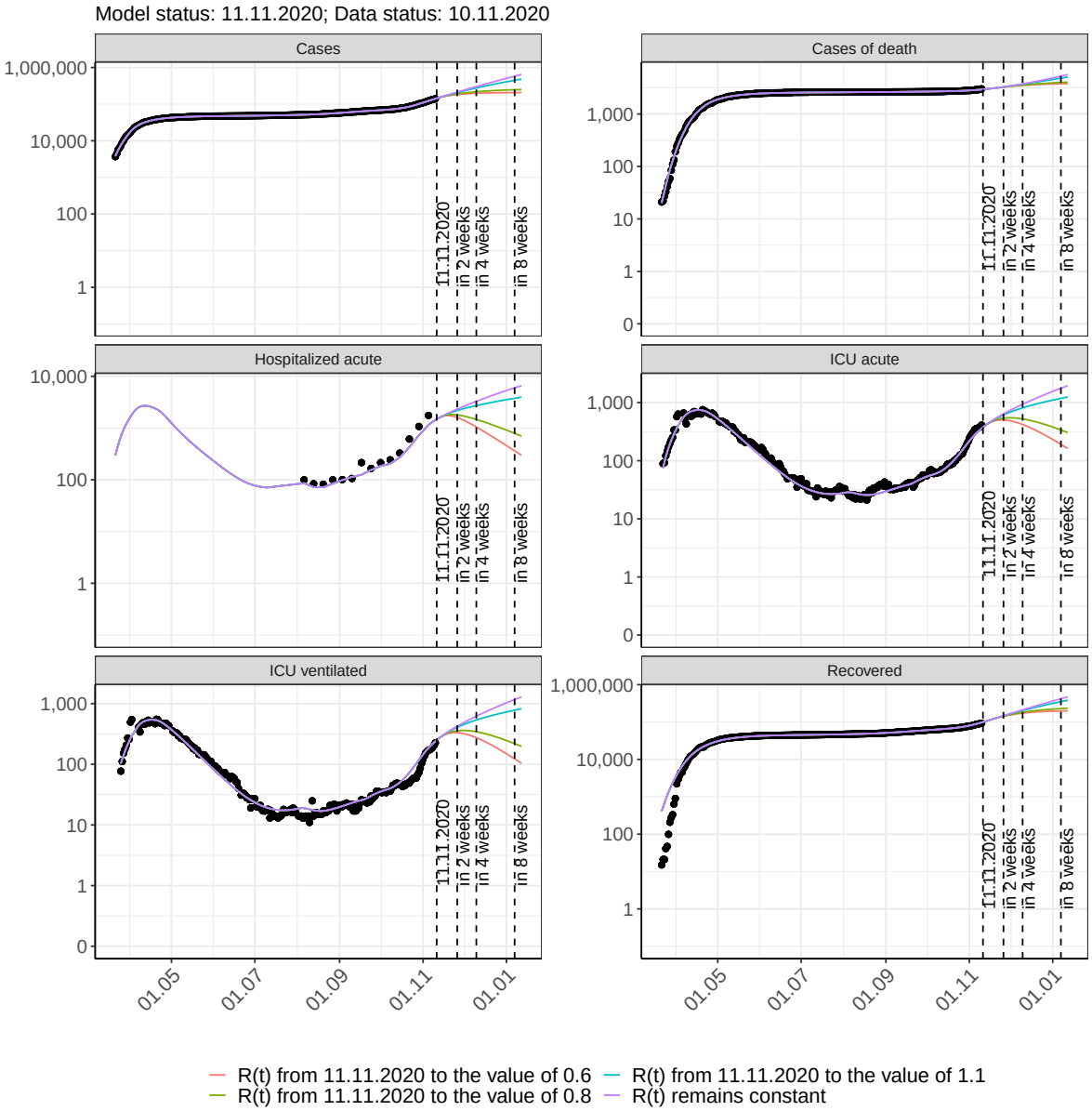


Figure 37: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Bavaria assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 38 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

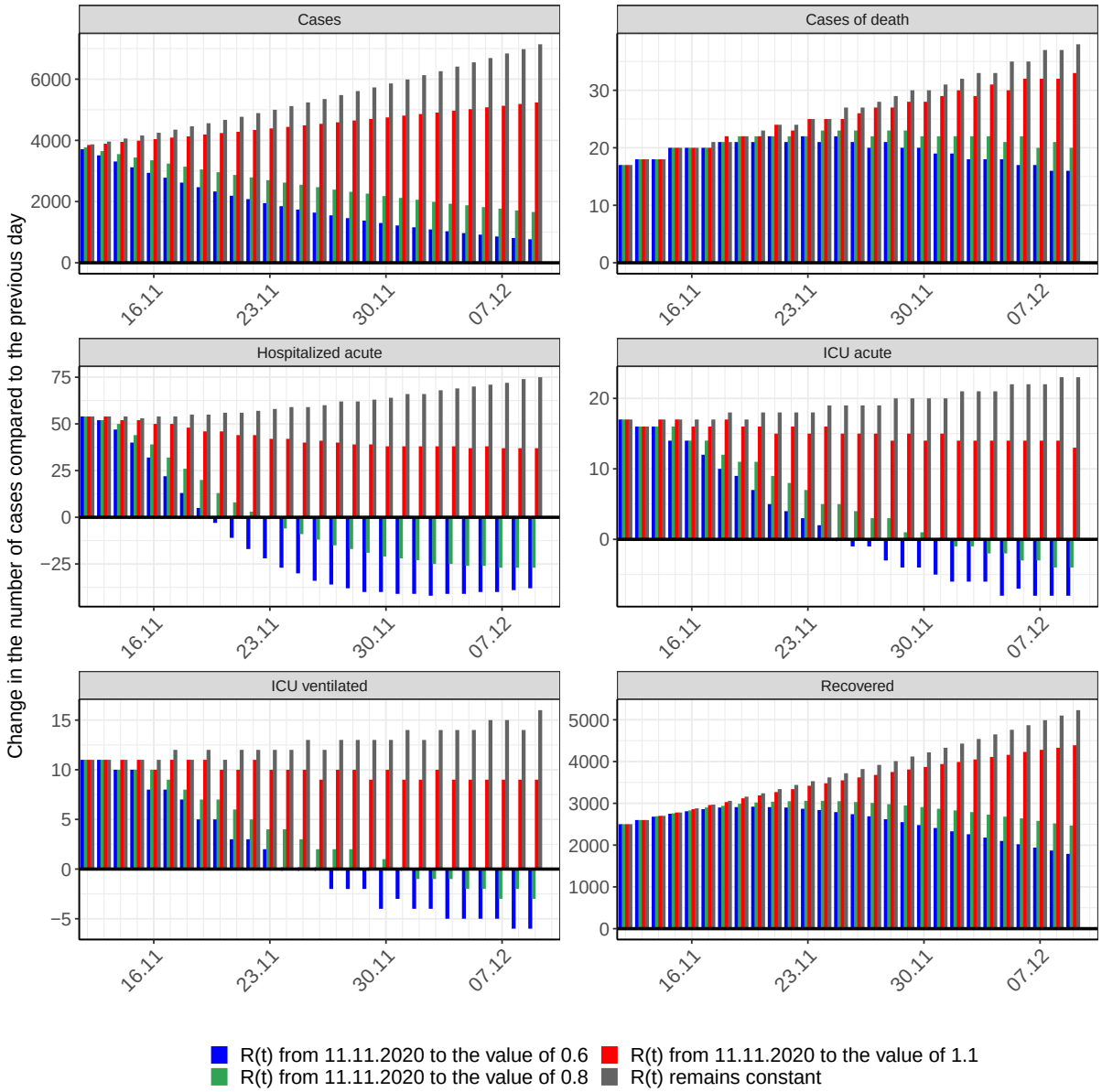


Figure 38: Simulation of daily new cases for the next 4 weeks - Bavaria

3.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Bavaria over time.

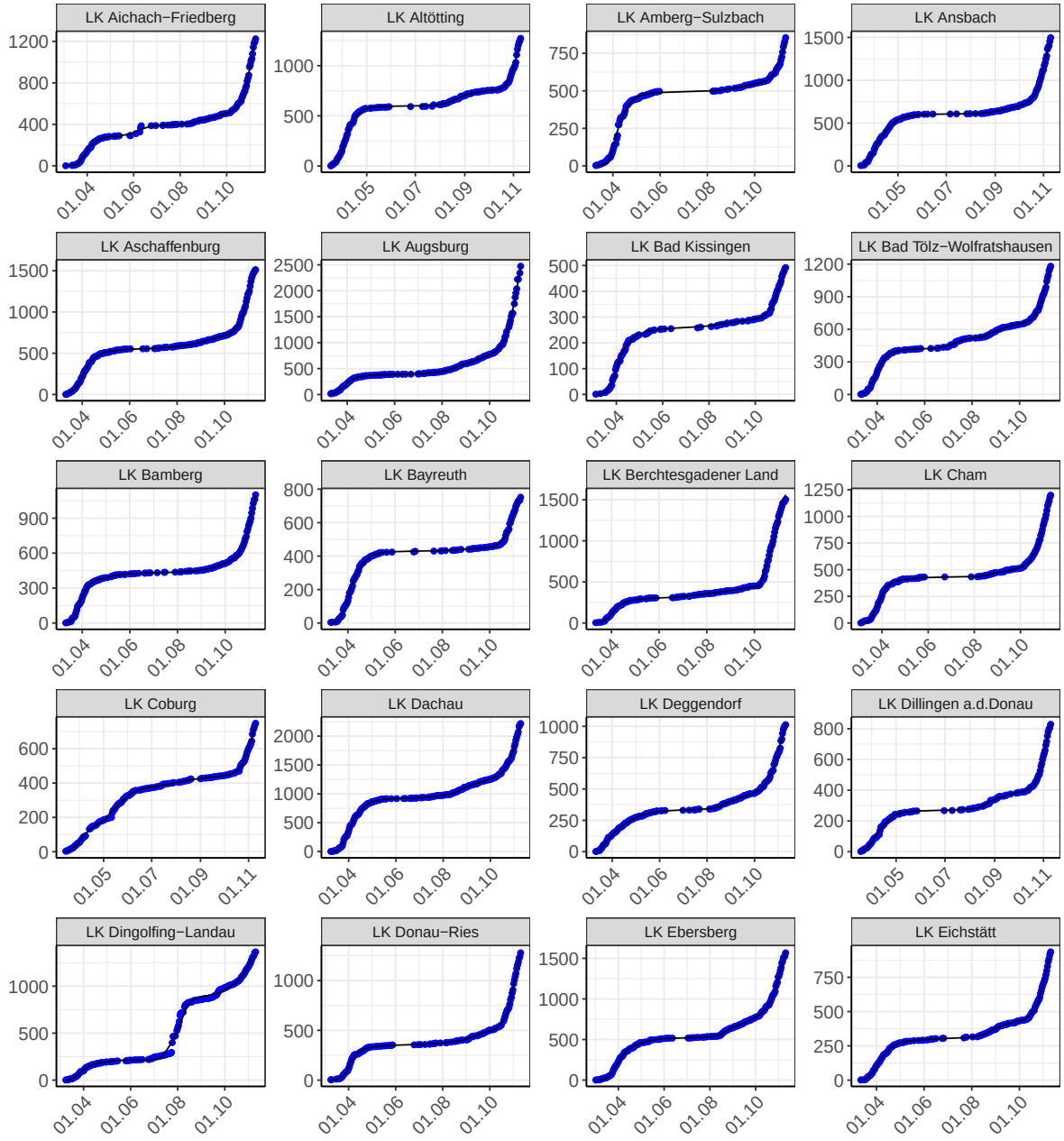


Figure 39: Model description of the reported case numbers in country- and citycounties in Bavaria. Points: reported data; lines: model description.

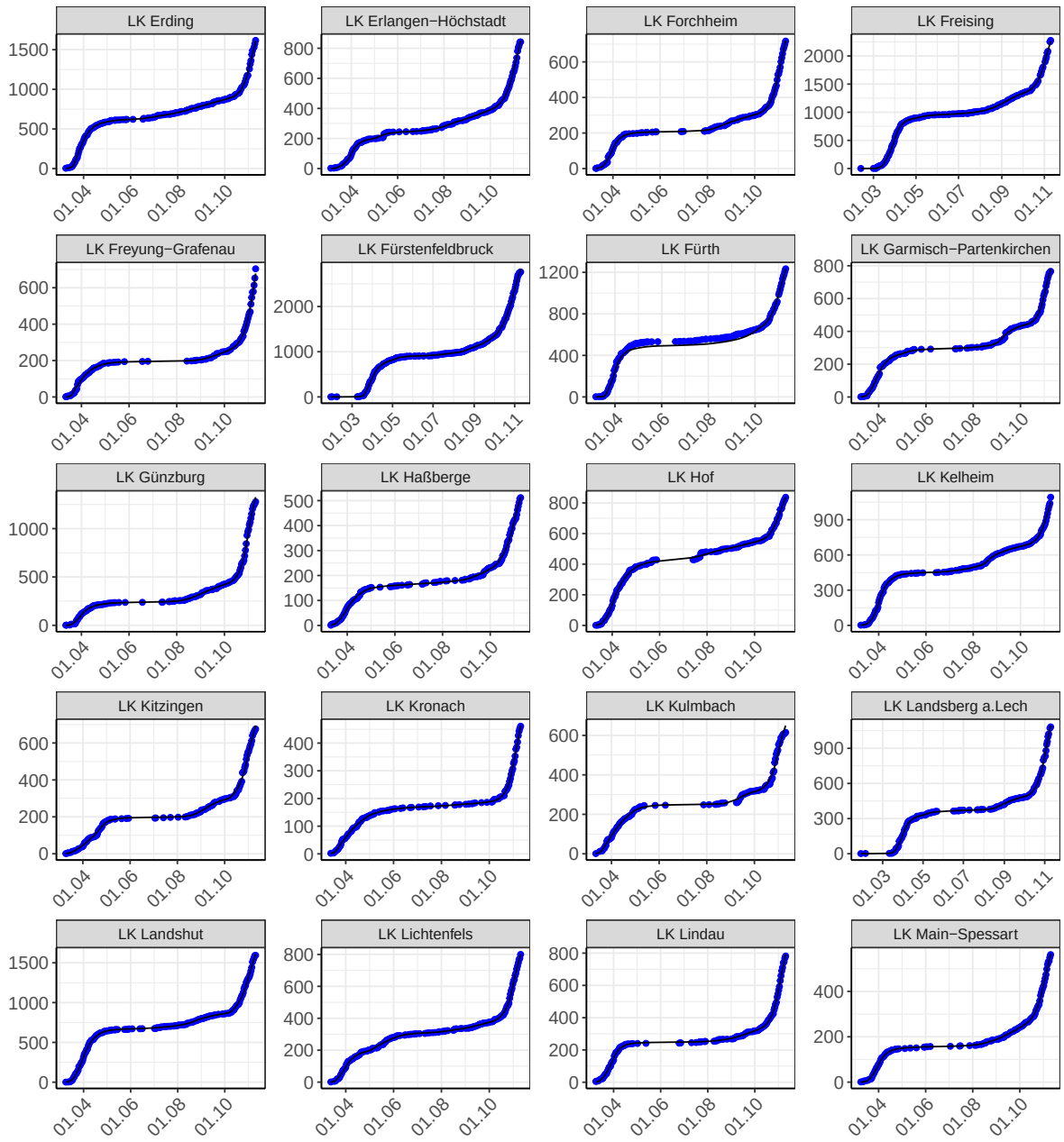


Figure 40: Model description of the reported case numbers in country- and citycounties in Bavaria. Points: reported data; lines: model description.

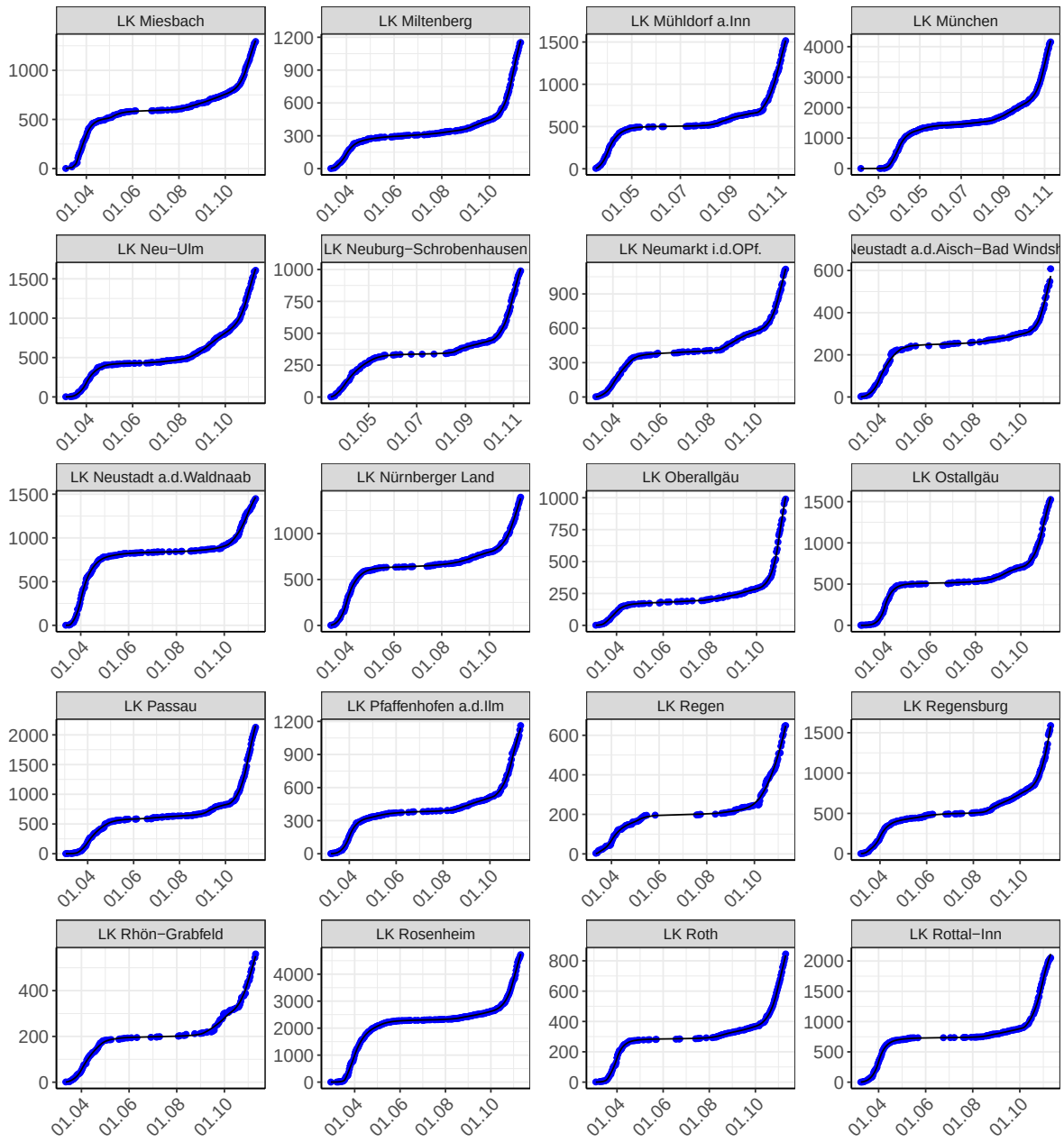


Figure 41: Model description of the reported case numbers in country- and citycounties in Bavaria. Points: reported data; lines: model description.

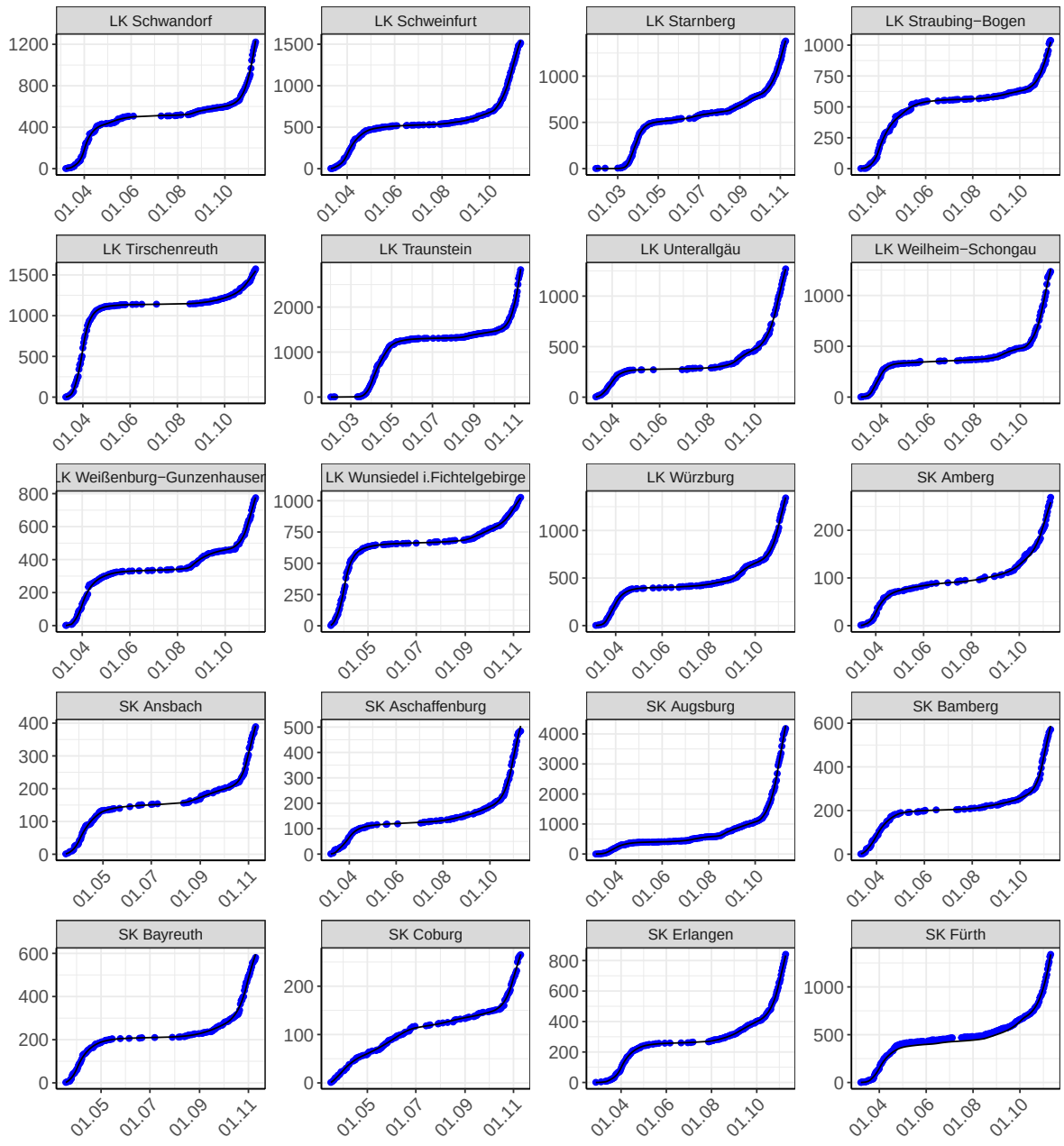


Figure 42: Model description of the reported case numbers in country- and citycounties in Bavaria. Points: reported data; lines: model description.

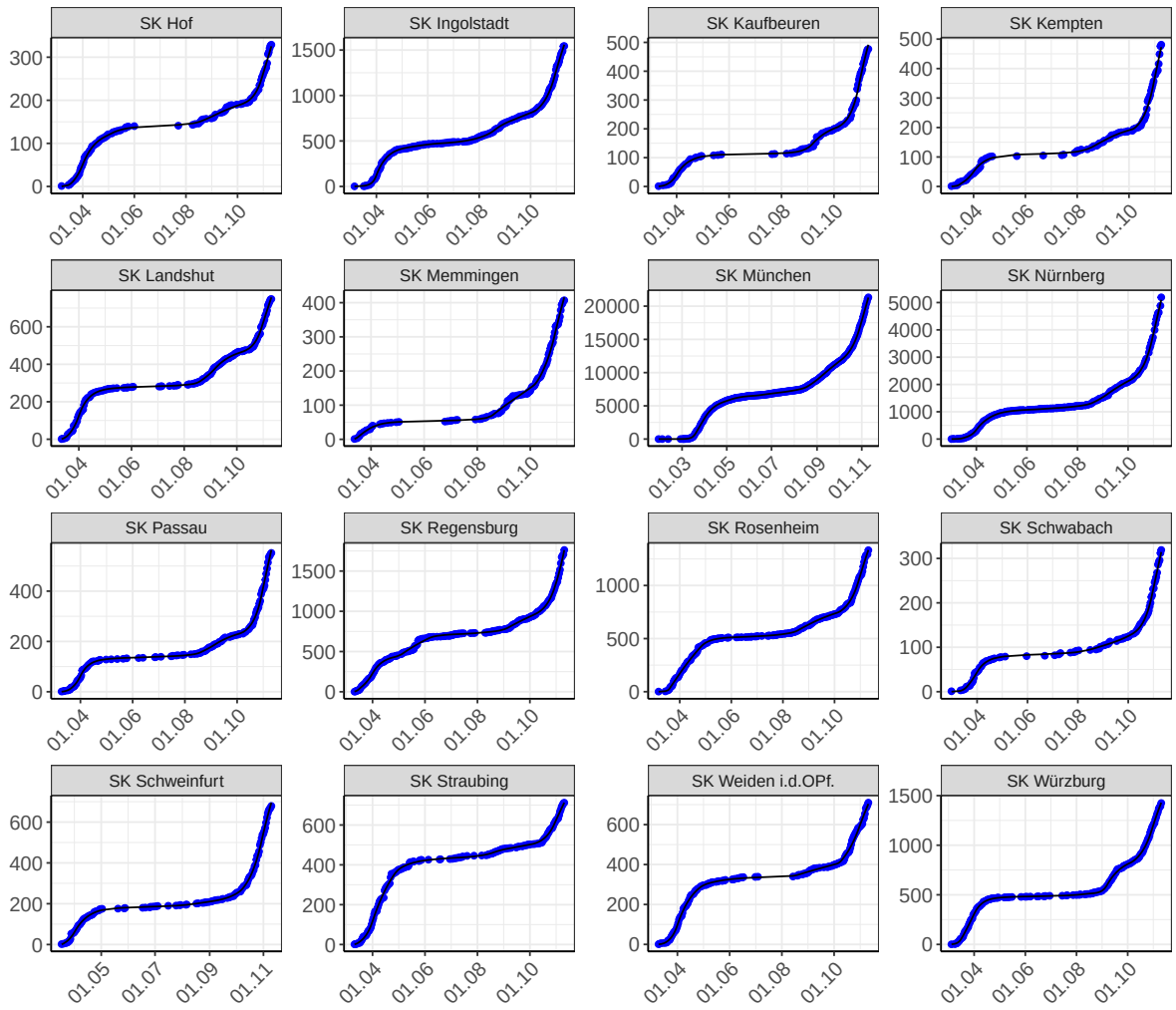


Figure 43: Model description of the reported case numbers in country- and citycounties in Bavaria. Points: reported data; lines: model description.

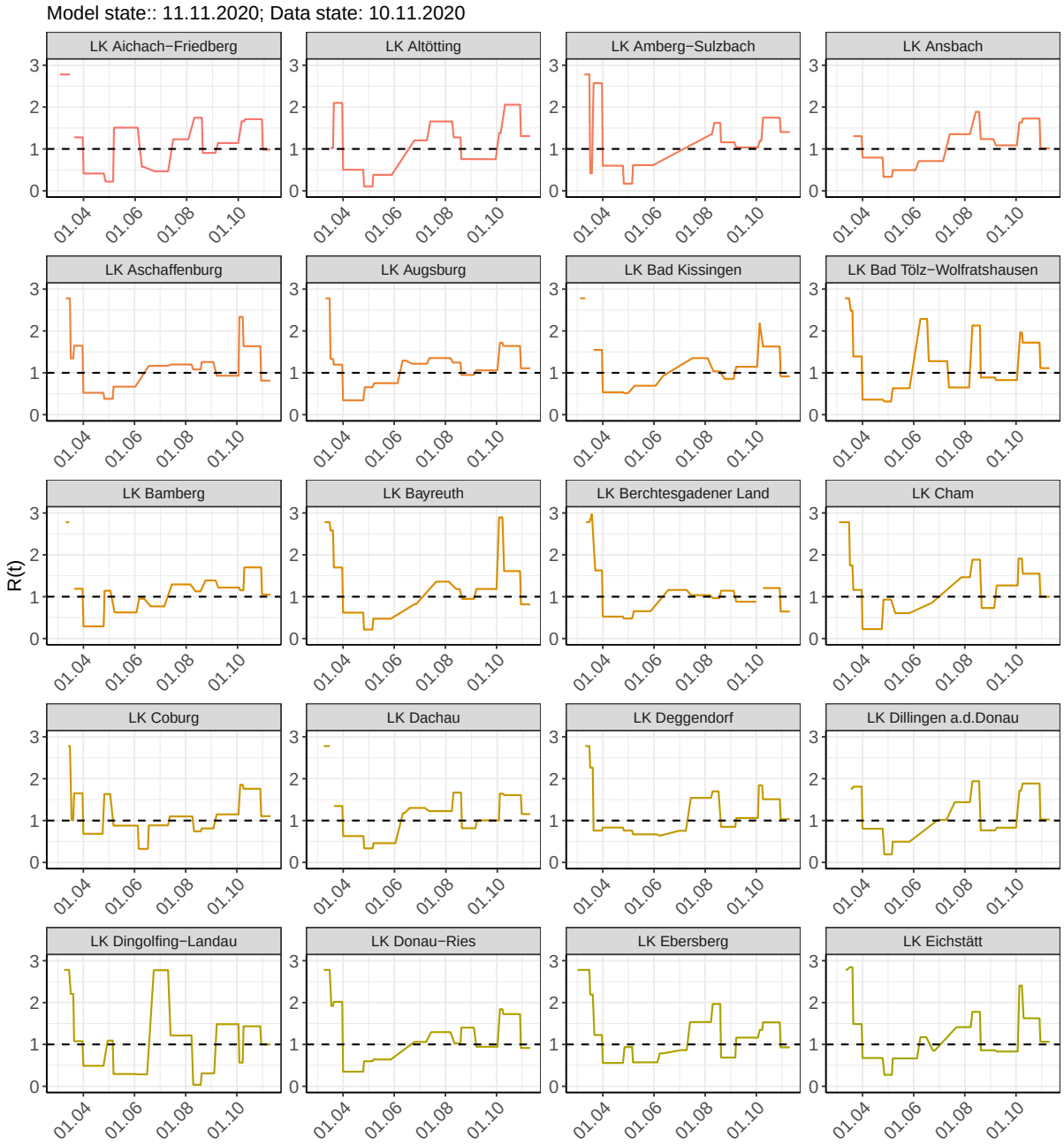


Figure 44: R(t) values over time for country- and citycounties in Bavaria

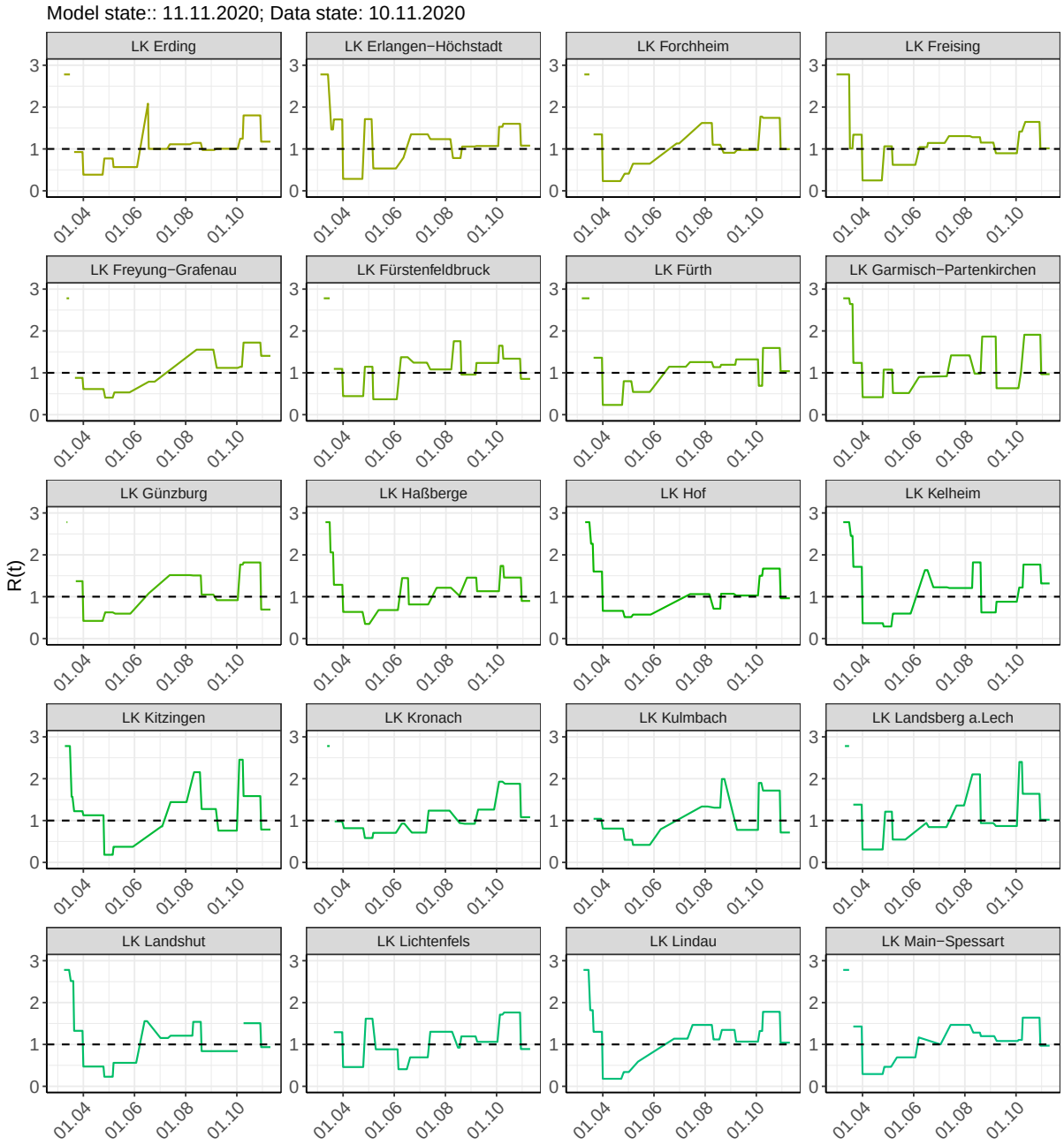


Figure 45: R(t) values over time for country- and citycounties in Bavaria

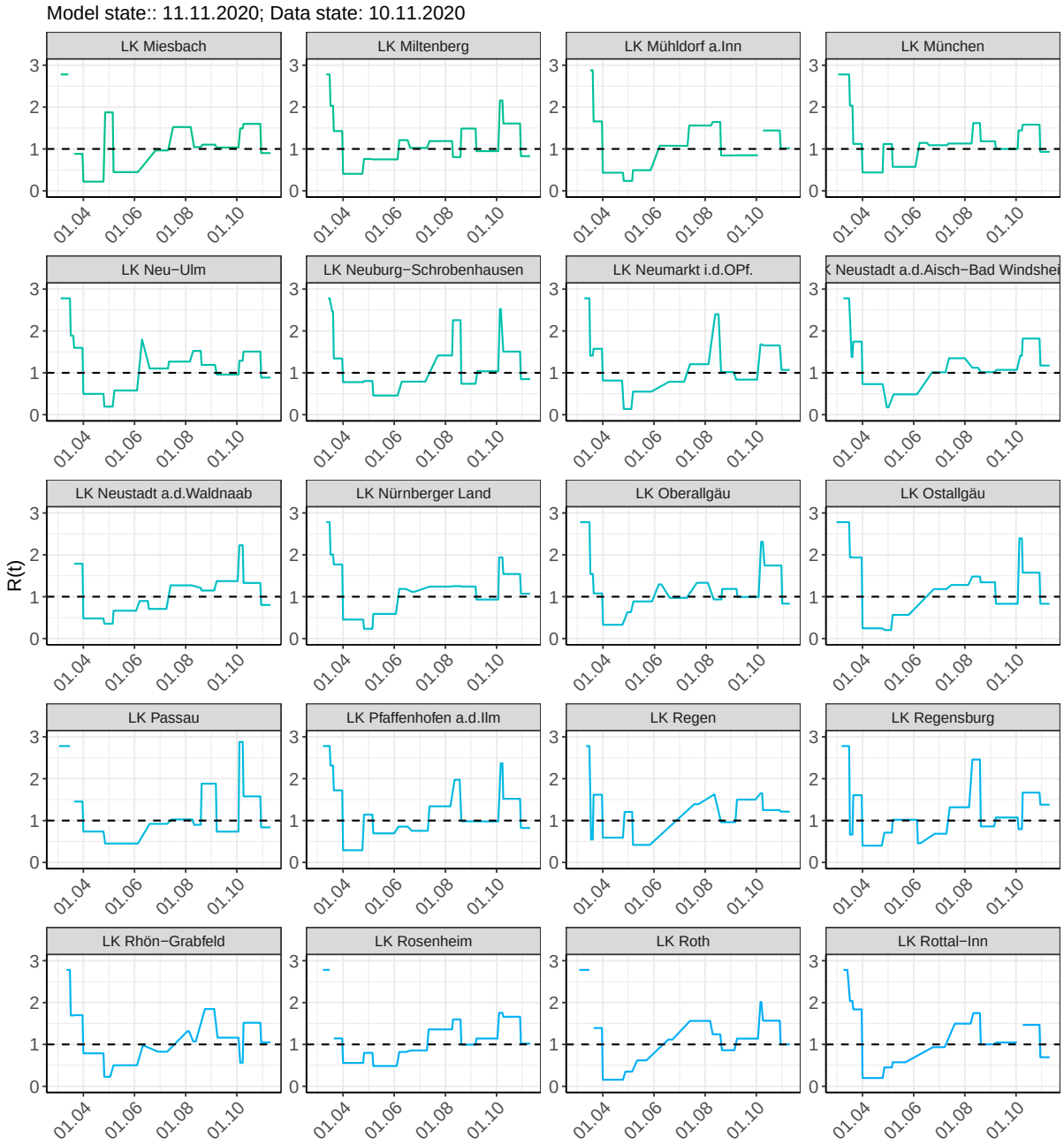


Figure 46: R(t) values over time for country- and citycounties in Bavaria

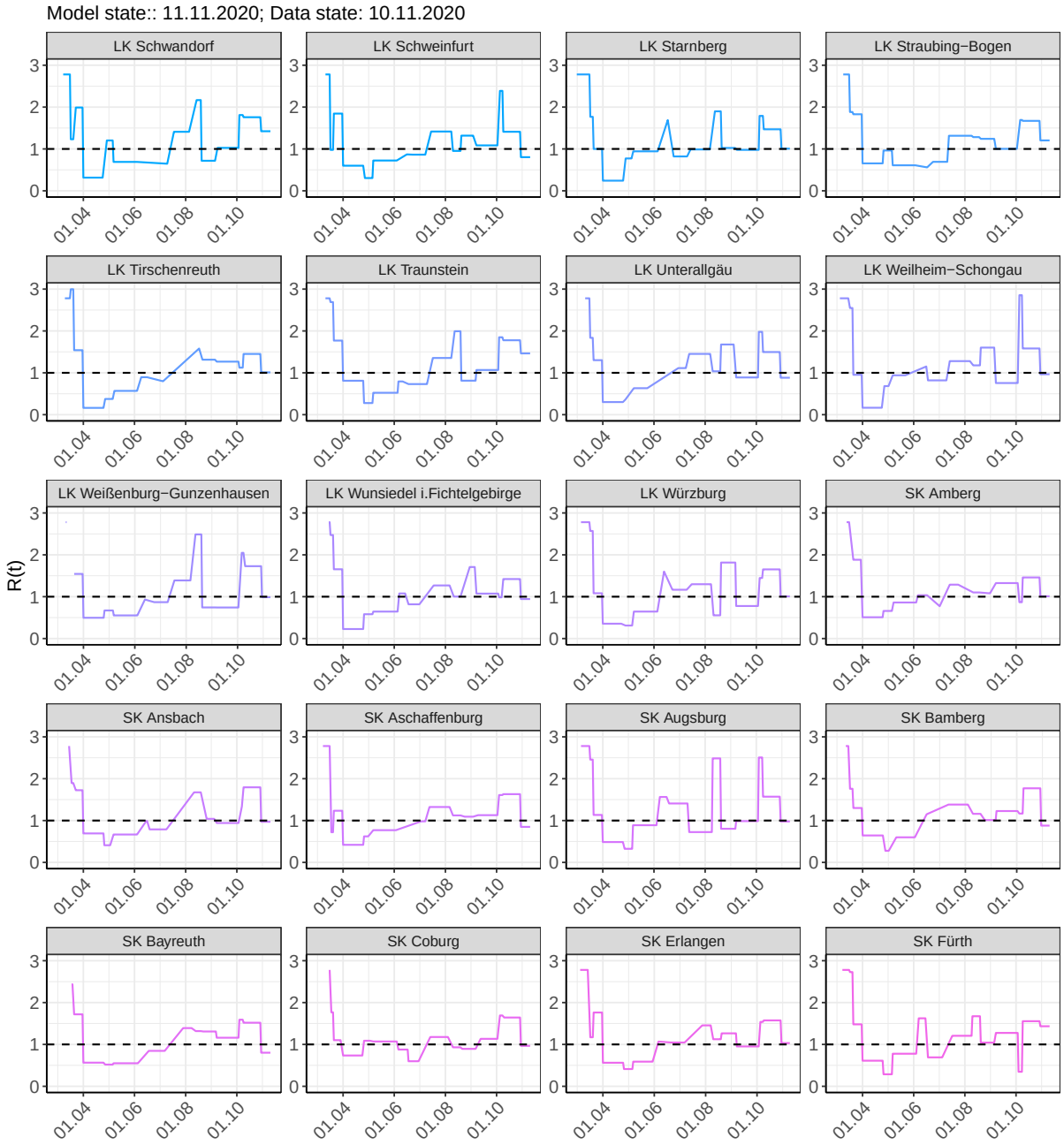


Figure 47: R(t) values over time for country- and citycounties in Bavaria

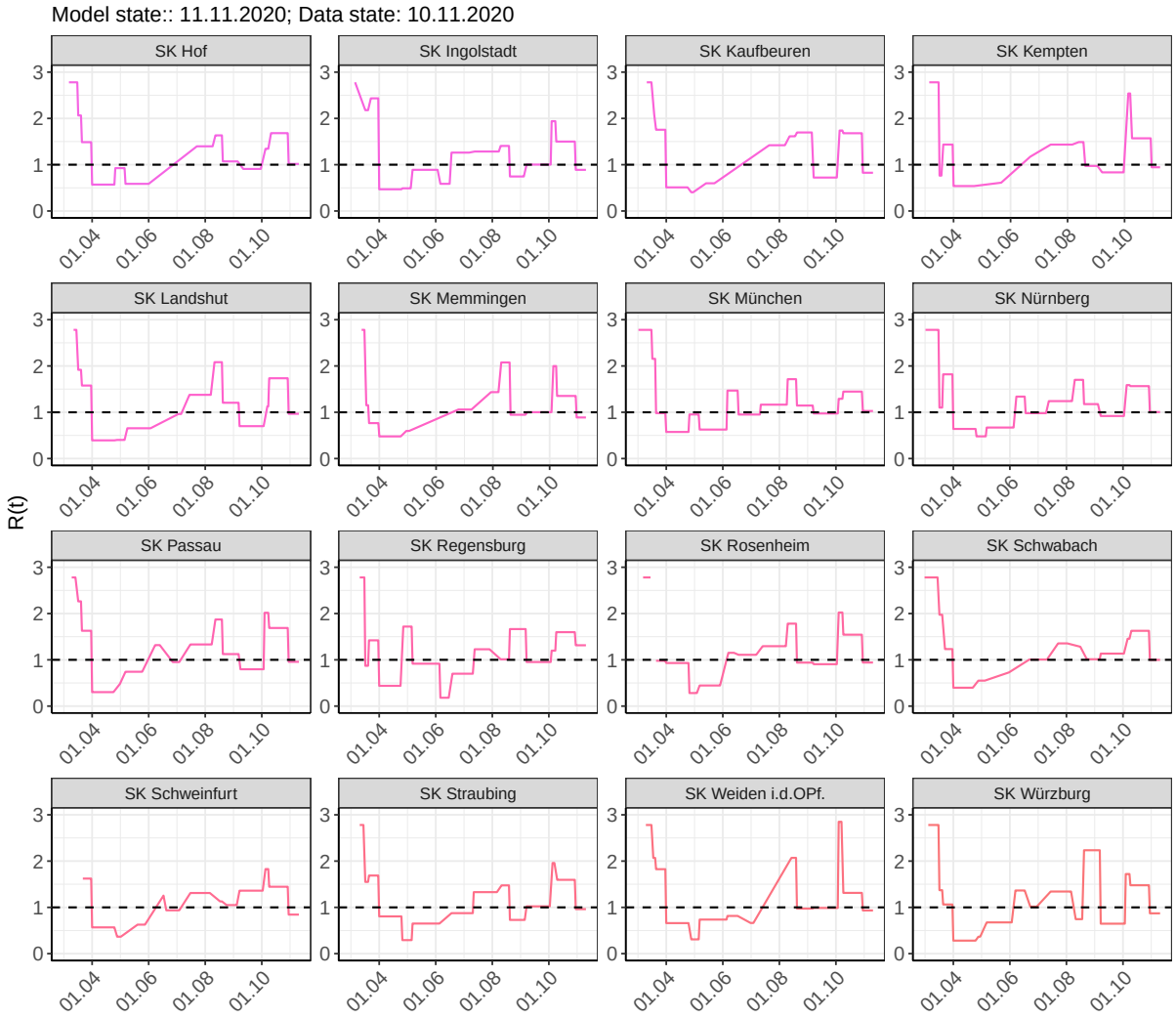


Figure 48: R(t) values over time for country- and citycounties in Bavaria

Table 3: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Aichach-Friedberg	2.78	3.42	1.28	0.41	0.22	1.51	0.57	0.47	1.23	1.75	0.90	1.14	1.66	1.71	0.98
LK Altötting	2.78	1.03	2.10	0.50	0.10	0.38	1.02	1.20	1.66	1.28	0.76	0.75	1.38	2.06	1.31
LK Amberg-Sulzbach	2.78	0.42	2.57	0.60	0.17	0.61	0.73	0.71	1.35	1.62	1.16	1.04	1.19	1.75	1.40
LK Ansbach	2.78	4.52	1.30	0.79	0.33	0.49	0.71	0.71	1.35	1.89	1.24	1.09	1.63	1.73	1.01
LK Aschaffenburg	2.78	1.34	1.65	0.52	0.38	0.67	0.94	1.17	1.20	1.08	1.26	0.93	2.33	1.64	0.81
LK Augsburg	2.78	1.33	1.19	0.34	0.66	0.75	1.29	1.22	1.35	1.24	0.95	1.06	1.72	1.64	1.11
LK Bad Kissingen	2.78	3.05	1.55	0.54	0.51	0.69	0.93	0.82	1.35	1.03	0.85	1.14	2.18	1.63	0.91
LK Bad Tölz-Wolfratshausen	2.78	2.48	1.39	0.36	0.32	0.63	2.29	1.28	0.65	2.13	0.89	0.83	1.97	1.72	1.11
LK Bamberg	2.78	3.25	1.19	0.29	1.14	0.62	0.95	0.77	1.29	1.13	1.39	1.22	1.15	1.70	1.05
LK Bayreuth	2.78	2.58	1.70	0.62	0.21	0.47	0.89	0.82	1.36	1.18	0.95	1.18	2.90	1.61	0.82
LK Berchtesgadener Land	2.78	2.97	1.63	0.52	0.48	0.65	1.58	1.16	1.04	0.96	1.14	0.88	4.95	1.21	0.65
LK Cham	2.78	1.75	1.16	0.23	0.93	0.61	0.91	0.86	1.47	1.88	0.73	1.27	1.91	1.55	1.00
LK Coburg	2.78	1.01	1.65	0.68	1.63	0.88	0.32	0.89	1.10	0.74	0.81	1.15	1.85	1.76	1.11

Table 3: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Dachau	2.78	3.59	1.35	0.63	0.34	0.46	1.18	1.30	1.23	1.67	0.82	1.00	1.64	1.61	1.16
LK Deggendorf	2.78	2.26	0.76	0.83	0.76	0.67	0.64	0.76	1.54	1.70	0.85	1.06	1.84	1.51	1.03
LK Dillingen a.d.Donau	2.78	1.76	1.81	0.80	0.19	0.50	1.01	1.02	1.44	1.94	0.76	0.83	1.72	1.89	1.03
LK Dingolfing-Landau	2.78	2.21	1.08	0.49	1.09	0.29	0.29	2.77	1.21	0.04	0.31	1.48	0.57	1.43	1.00
LK Donau-Ries	2.78	1.92	2.02	0.35	0.60	0.64	1.12	1.06	1.29	1.03	1.40	0.94	1.84	1.72	0.91
LK Ebersberg	2.78	2.19	1.22	0.56	0.94	0.57	0.79	0.86	1.53	1.97	0.69	1.16	1.34	1.53	0.93
LK Eichstätt	2.78	2.84	1.49	0.68	0.27	0.67	1.17	0.85	1.41	1.78	0.86	0.83	2.41	1.62	1.06
LK Erding	2.78	3.84	0.93	0.39	0.77	0.57	2.08	1.00	1.11	1.14	0.97	1.00	1.24	1.80	1.17
LK Erlangen-Höchstadt	2.78	1.47	1.70	0.28	1.71	0.53	0.79	1.35	1.23	0.78	1.06	1.07	1.53	1.60	1.08
LK Forchheim	2.78	3.17	1.35	0.23	0.41	0.65	1.16	1.13	1.62	1.10	0.91	0.97	1.77	1.74	1.00
LK Freising	2.78	1.01	1.34	0.25	1.06	0.62	1.04	1.14	1.31	1.28	1.15	0.90	1.42	1.65	1.01
LK Freyung-Grafenau	2.78	4.65	0.88	0.61	0.41	0.53	0.88	0.79	1.36	1.55	1.55	1.12	1.14	1.72	1.40

Table 3: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Fürstenfeldbruck	2.78	4.19	1.09	0.44	1.15	0.37	1.37	1.24	1.08	1.75	0.96	1.24	1.65	1.34	0.85
LK Fürth	2.78	5.58	1.36	0.23	0.80	0.54	1.11	1.15	1.26	1.14	1.19	1.32	0.69	1.59	1.04
LK Garmisch-Partenkirchen	2.78	2.64	1.24	0.42	1.08	0.52	0.90	0.92	1.42	0.98	1.87	0.63	1.01	1.91	0.97
LK Günzburg	2.78	4.83	1.37	0.42	0.63	0.59	1.07	1.08	1.52	1.51	1.05	0.92	1.77	1.82	0.69
LK Haßberge	2.78	2.06	1.28	0.64	0.35	0.68	1.44	0.81	1.21	1.02	1.46	1.13	1.74	1.46	0.90
LK Hof	2.78	2.27	1.60	0.66	0.51	0.57	0.76	1.48	1.06	0.71	1.07	1.03	1.50	1.67	0.96
LK Kelheim	2.78	2.45	1.71	0.37	0.29	0.60	1.64	1.22	1.21	1.82	0.62	0.88	1.22	1.77	1.32
LK Kitzingen	2.78	1.57	1.22	1.13	0.18	0.37	0.85	0.86	1.44	2.16	1.28	0.76	2.45	1.58	0.79
LK Kronach	2.78	3.00	0.98	0.82	0.58	0.71	0.93	0.71	1.24	0.94	0.92	1.26	1.93	1.88	1.08
LK Kulmbach	2.78	3.14	1.04	0.81	0.54	0.42	0.79	0.74	1.34	1.31	1.99	0.78	1.90	1.72	0.71
LK Landsberg a.Lech	2.78	3.21	1.38	0.31	1.21	0.55	0.94	0.84	1.36	2.10	0.94	0.87	2.40	1.64	1.02
LK Landshut	2.78	2.51	1.33	0.47	0.23	0.56	1.56	1.15	1.21	1.54	0.84	0.84	3.14	1.51	0.94
LK Lichtenfels	2.78	4.42	1.29	0.46	1.62	0.88	0.41	0.69	1.30	0.92	1.19	1.06	1.71	1.76	0.89
LK Lindau	2.78	1.82	1.30	0.18	0.34	0.59	1.13	1.14	1.47	1.12	1.35	1.07	1.32	1.78	1.04

Table 3: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Main-Spessart	2.78	3.54	1.43	0.29	0.47	0.69	1.17	1.00	1.47	1.28	1.20	1.08	1.11	1.64	0.97
LK Miesbach	2.78	3.11	0.88	0.22	1.87	0.45	0.80	0.96	1.52	1.04	1.10	1.03	1.49	1.60	0.90
LK Miltenberg	2.78	2.03	1.43	0.41	0.76	0.75	1.21	1.02	1.19	0.81	1.49	0.95	2.16	1.61	0.83
LK Mühldorf a.Inn	2.78	2.88	1.66	0.43	0.24	0.49	1.08	1.07	1.56	1.64	0.84	0.85	3.43	1.44	1.01
LK München	2.78	2.03	1.12	0.44	1.12	0.57	1.14	1.09	1.13	1.62	1.18	1.00	1.44	1.58	0.93
LK Neu-Ulm	2.78	1.89	1.60	0.50	0.19	0.58	1.80	1.10	1.27	1.52	1.19	0.96	1.29	1.51	0.89
LK Neuburg-Schrobenhausen	2.78	2.46	1.34	0.78	0.80	0.46	0.79	0.79	1.42	2.26	0.74	1.04	2.53	1.51	0.85
LK Neumarkt i.d.OPf.	2.78	1.41	1.57	0.82	0.14	0.55	1.48	0.79	1.21	2.40	1.02	0.84	1.68	1.65	1.07
LK Neustadt a.d.Aisch-Bad Windsheim	2.78	1.38	1.75	0.73	0.18	0.49	1.10	1.01	1.35	1.12	1.02	1.07	1.41	1.82	1.17

Table 3: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Neustadt a.d.Waldnaab	2.78	7.52	1.79	0.48	0.35	0.67	0.90	0.71	1.27	1.21	1.15	1.37	2.23	1.33	0.80
LK Nürnberger Land	2.78	2.01	1.77	0.45	0.23	0.59	1.19	1.12	1.24	1.25	1.24	0.93	1.94	1.54	1.07
LK Oberallgäu	2.78	1.54	1.08	0.33	0.63	0.89	1.29	0.97	1.33	0.93	1.19	0.99	2.31	1.74	0.83
LK Ostallgäu	2.78	1.94	1.94	0.24	0.20	0.57	1.39	1.18	1.28	1.48	1.34	0.83	2.39	1.57	0.83
LK Passau	2.78	3.17	1.45	0.74	0.45	0.45	1.80	0.92	1.03	0.90	1.88	0.74	2.88	1.58	0.84
LK Pfaffenhofen a.d.Ilm	2.78	2.32	1.72	0.29	1.14	0.69	0.86	0.75	1.34	1.98	0.98	0.98	2.37	1.52	0.82
LK Regen	2.78	0.55	1.62	0.59	1.21	0.42	0.77	0.77	1.39	1.63	0.96	1.50	1.65	1.25	1.21
LK Regensburg	2.78	0.66	1.61	0.40	0.71	1.02	0.46	0.68	1.32	2.46	0.86	1.07	0.79	1.67	1.38
LK Rhön-Grabfeld	2.78	1.69	1.70	0.79	0.23	0.50	0.98	0.83	1.31	1.07	1.85	1.16	0.56	1.52	1.05
LK Rosenheim	2.78	4.37	1.14	0.56	0.80	0.48	0.82	0.86	1.36	1.60	1.00	1.14	1.76	1.66	1.02
LK Roth	2.78	3.21	1.39	0.16	0.35	0.62	1.17	1.12	1.56	1.24	0.86	1.14	2.01	1.57	1.00
LK Rottal-Inn	2.78	2.04	1.84	0.20	0.45	0.57	0.97	0.93	1.50	1.75	1.00	1.05	3.02	1.47	0.69

Table 3: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Schwandorf	2.78	1.23	1.99	0.31	1.20	0.69	0.52	0.65	1.41	2.17	0.72	1.03	1.81	1.76	1.42
LK Schweinfurt	2.78	0.98	1.84	0.60	0.30	0.72	0.87	0.86	1.42	0.95	1.32	1.08	2.39	1.41	0.80
LK Starnberg	2.78	1.77	1.00	0.24	0.77	0.94	1.69	0.82	0.99	1.90	1.02	0.98	1.79	1.47	1.01
LK Straubing-Bogen	2.78	1.88	1.83	0.66	0.96	0.61	0.56	0.69	1.32	1.28	1.24	1.00	1.69	1.67	1.20
LK Tirschenreuth	2.78	3.00	1.54	0.16	0.38	0.57	0.89	0.80	1.36	1.58	1.31	1.27	1.12	1.45	1.01
LK Traunstein	2.78	2.69	1.77	0.81	0.28	0.52	0.79	0.73	1.35	1.99	0.81	1.07	1.85	1.78	1.46
LK Unterallgäu	2.78	1.84	1.30	0.30	0.36	0.63	1.19	1.11	1.45	1.04	1.68	0.89	1.98	1.50	0.88
LK Weilheim-Schongau	2.78	2.55	0.95	0.17	0.68	0.94	1.15	0.82	1.28	1.18	1.60	0.76	2.86	1.58	0.97
LK Weißenburg-Gunzenhausen	2.78	3.39	1.54	0.50	0.67	0.55	0.93	0.87	1.39	2.49	0.74	0.74	2.05	1.73	0.99
LK Wunsiedel i.Fichtelgebirge	2.78	2.47	1.66	0.23	0.58	0.64	1.08	0.82	1.27	1.00	1.71	1.07	0.98	1.42	0.94

Table 3: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Würzburg	2.78	2.57	1.08	0.35	0.31	0.64	1.60	1.17	1.30	0.55	1.82	0.78	1.45	1.65	1.01
SK Amberg	2.78	1.92	1.88	0.51	0.66	0.86	1.03	0.77	1.29	1.10	1.08	1.32	0.87	1.46	1.01
SK Ansbach	2.78	1.90	1.72	0.69	0.41	0.67	0.99	0.79	1.36	1.67	1.04	0.94	1.34	1.79	0.97
SK Aschaffenburg	2.78	0.72	1.23	0.42	0.62	0.77	1.29	0.98	1.32	1.12	1.09	1.13	1.61	1.63	0.85
SK Augsburg	2.78	2.46	1.13	0.49	0.33	0.89	1.56	1.41	0.72	2.49	0.80	0.99	2.51	1.57	0.98
SK Bamberg	2.78	1.76	1.30	0.64	0.28	0.60	1.15	0.94	1.38	1.16	1.01	1.23	1.17	1.77	0.88
SK Bayreuth	2.78	2.44	1.72	0.56	0.52	0.55	0.95	0.85	1.39	1.32	1.31	1.16	1.59	1.52	0.80
SK Coburg	2.78	1.77	1.10	0.74	1.09	1.07	0.88	0.60	1.18	0.93	0.89	1.13	1.69	1.64	0.97
SK Erlangen	2.78	1.17	1.76	0.56	0.41	0.59	1.07	1.05	1.46	1.12	1.26	0.95	1.54	1.57	1.03
SK Fürth	2.78	2.73	1.48	0.61	0.29	0.78	1.62	0.69	1.21	1.67	1.04	1.27	0.35	1.55	1.43
SK Hof	2.78	2.06	1.49	0.57	0.93	0.59	0.88	0.81	1.40	1.63	1.07	0.91	1.34	1.68	1.02
SK Ingolstadt	2.78	2.18	2.43	0.47	0.49	0.89	0.59	1.26	1.28	1.41	0.75	1.00	1.94	1.50	0.89
SK Kaufbeuren	2.78	2.08	1.76	0.51	0.40	0.60	1.01	0.90	1.42	1.61	1.70	0.72	1.74	1.68	0.83
SK Kempten	2.78	0.76	1.44	0.54	0.36	0.61	1.17	1.17	1.43	1.49	0.97	0.83	2.54	1.57	0.94
SK Landshut	2.78	1.92	1.58	0.39	0.40	0.65	1.13	0.96	1.38	2.08	1.21	0.70	1.13	1.73	0.97
SK Memmingen	2.78	1.15	0.77	0.48	0.60	0.75	1.27	1.06	1.43	2.08	0.95	1.00	2.00	1.35	0.89

Table 3: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
SK München	2.78	2.15	0.98	0.57	0.95	0.63	1.47	0.95	1.16	1.72	1.14	0.97	1.29	1.45	1.03
SK Nürnberg	2.78	1.10	1.82	0.64	0.48	0.67	1.34	0.98	1.24	1.70	1.18	0.92	1.59	1.56	1.00
SK Passau	2.78	2.26	1.63	0.30	0.48	0.74	1.32	0.95	1.33	1.87	1.12	0.80	2.02	1.69	0.96
SK Regensburg	2.78	0.87	1.42	0.44	1.72	0.92	0.18	0.70	1.23	1.01	1.66	0.95	1.20	1.60	1.31
SK Rosenheim	2.78	4.01	0.98	0.93	0.28	0.45	1.15	1.11	1.29	1.78	0.94	0.91	2.02	1.54	0.94
SK Schwabach	2.78	1.97	1.23	0.40	0.55	0.73	1.25	1.01	1.35	1.28	1.01	1.13	1.46	1.63	1.00
SK Schweinfurt	2.78	3.65	1.62	0.57	0.37	0.63	1.25	0.94	1.31	1.13	1.05	1.36	1.83	1.45	0.84
SK Straubing	2.78	1.55	1.69	0.81	0.29	0.65	0.84	0.88	1.33	1.48	0.73	1.02	1.96	1.60	0.96
SK Weiden i.d.OPf.	2.78	2.07	1.82	0.66	0.31	0.74	0.82	0.66	1.31	2.07	0.97	0.99	2.85	1.31	0.93
SK Würzburg	2.78	1.37	1.06	0.28	0.37	0.68	1.37	1.02	1.34	0.75	2.23	0.65	1.72	1.48	0.87

4 Berlin

4.1 Model description

Fig. 49 depicts the results of the modeling (lines) compared to the observed data (points) for Berlin on a linear (A) and semi-logarithmic (B) scale.

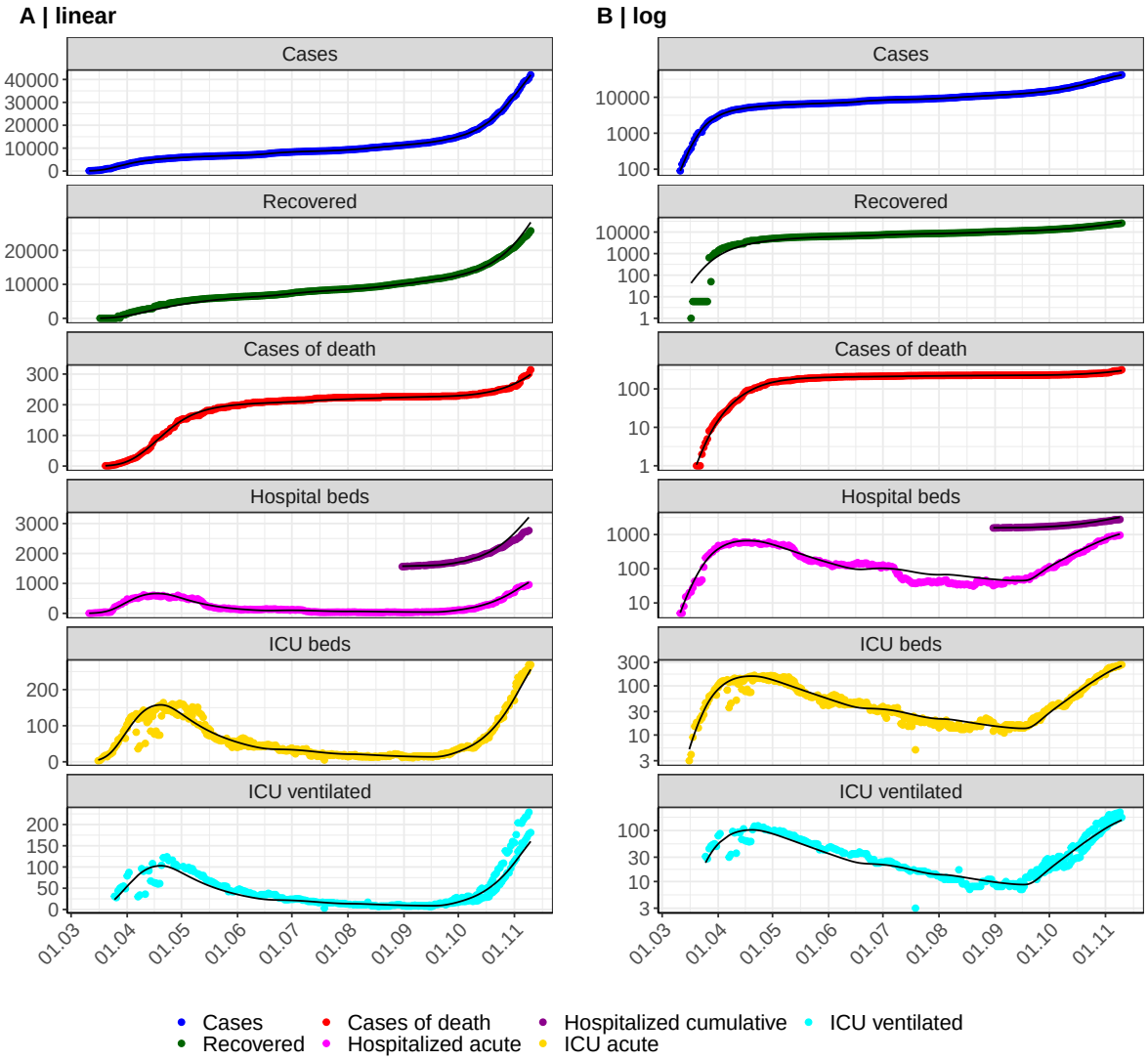


Figure 49: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Berlin. Points: reported data; lines: model description.

Fig. 50 shows the goodness-of-fit for Berlin. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

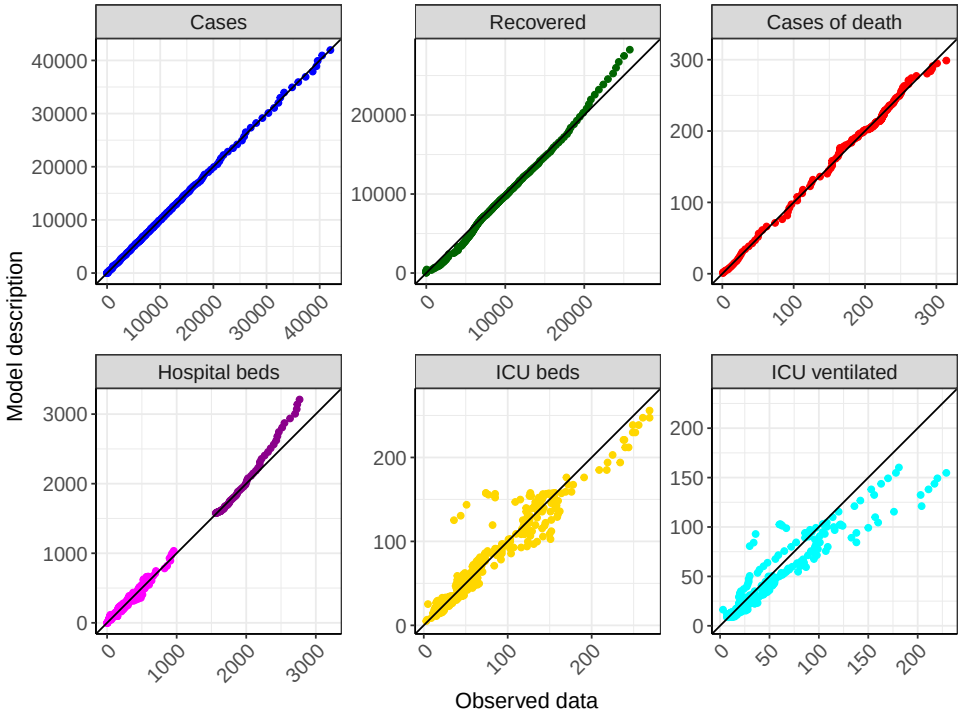


Figure 50: Goodness-of-fit plots for Berlin. Lines: lines of identity.

Fig. 51 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Berlin (red line) in comparison with the other federal states (grey lines).

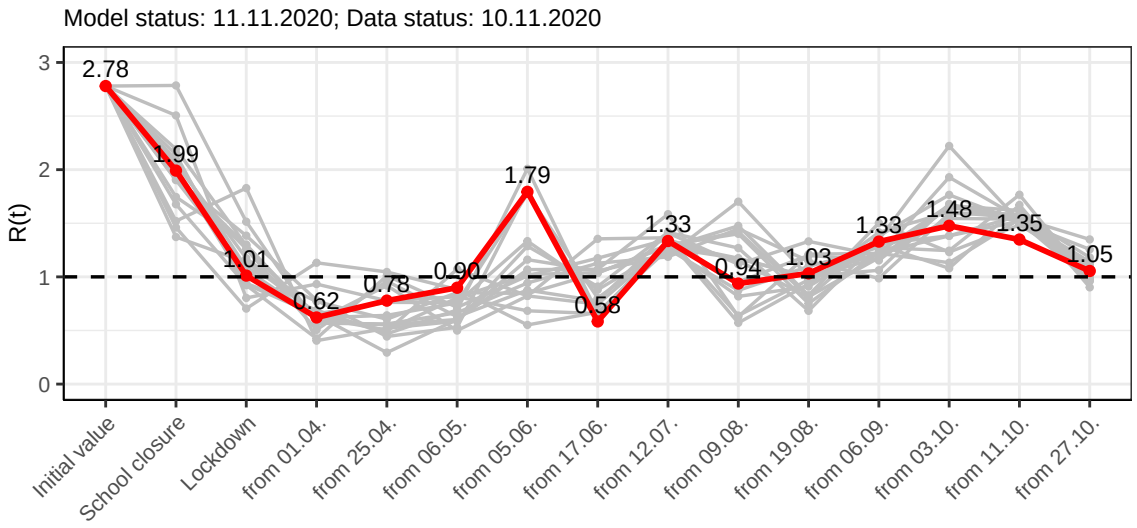


Figure 51: R(t) values before and after the NPIs for Berlin

Fig. 52 shows the R(t) estimated value for Berlin (red line) over time in comparison with the other federal states (grey lines).

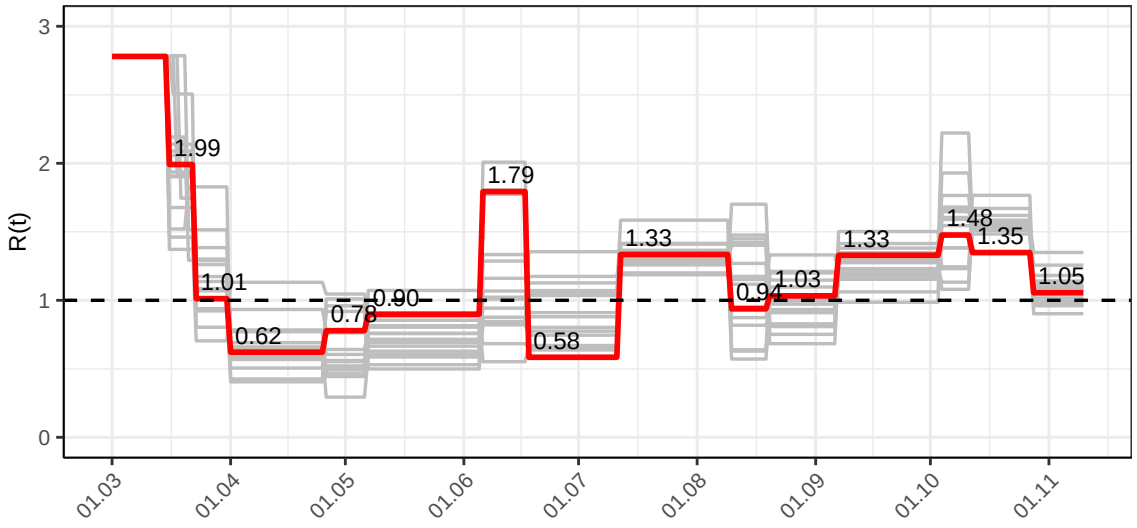


Figure 52: R(t) values over time for Berlin

Fig. 53 shows the changes in hospitalization and death rates for Berlin (red line) over time compared to the other states (grey lines).

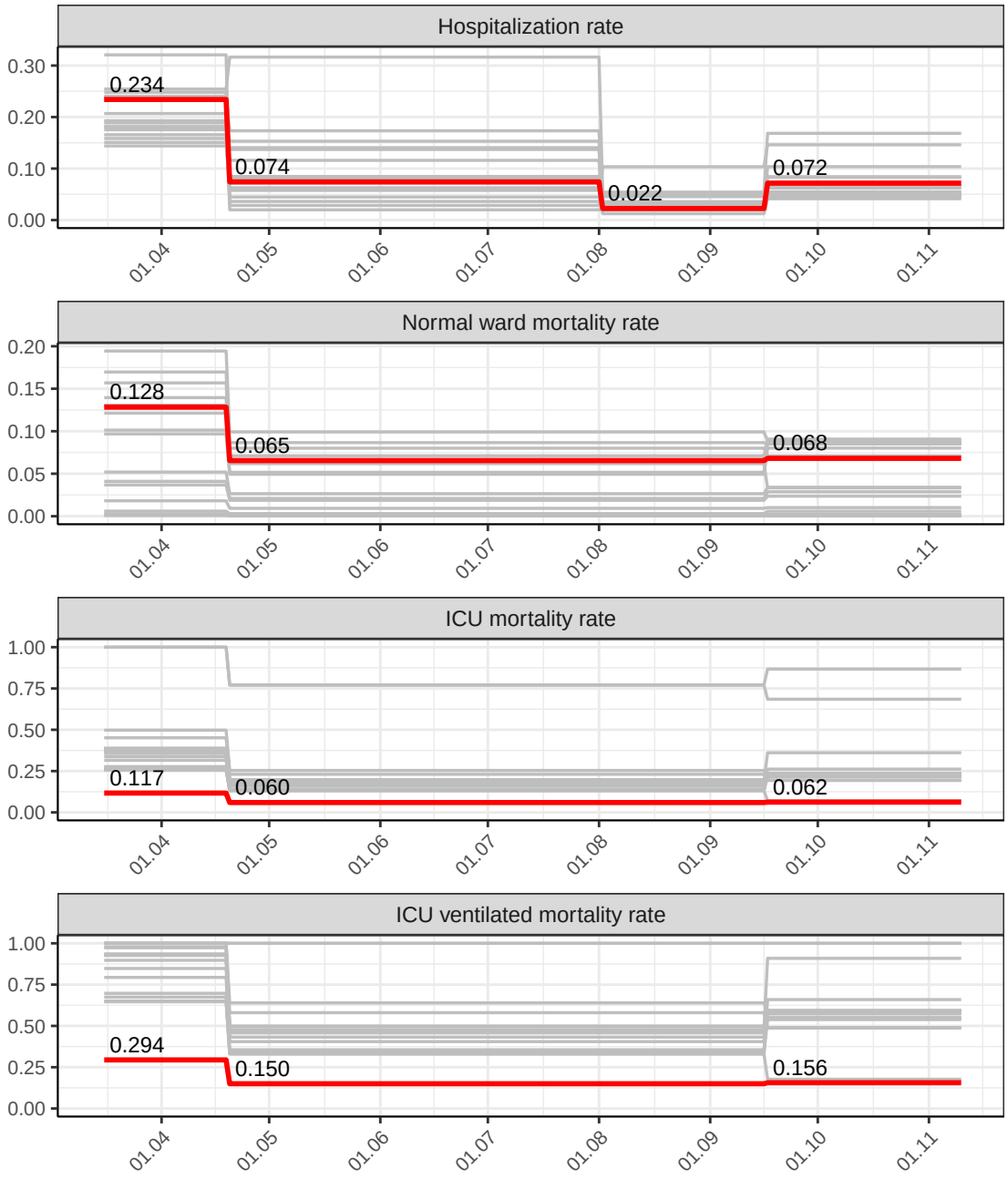


Figure 53: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Berlin

4.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1.05) and assuming various scenarios from 11.11.2020

Fig.54 and 55 represent the model prediction for the next 8 weeks for Berlin on a linear (54) and a semi-logarithmic (55) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

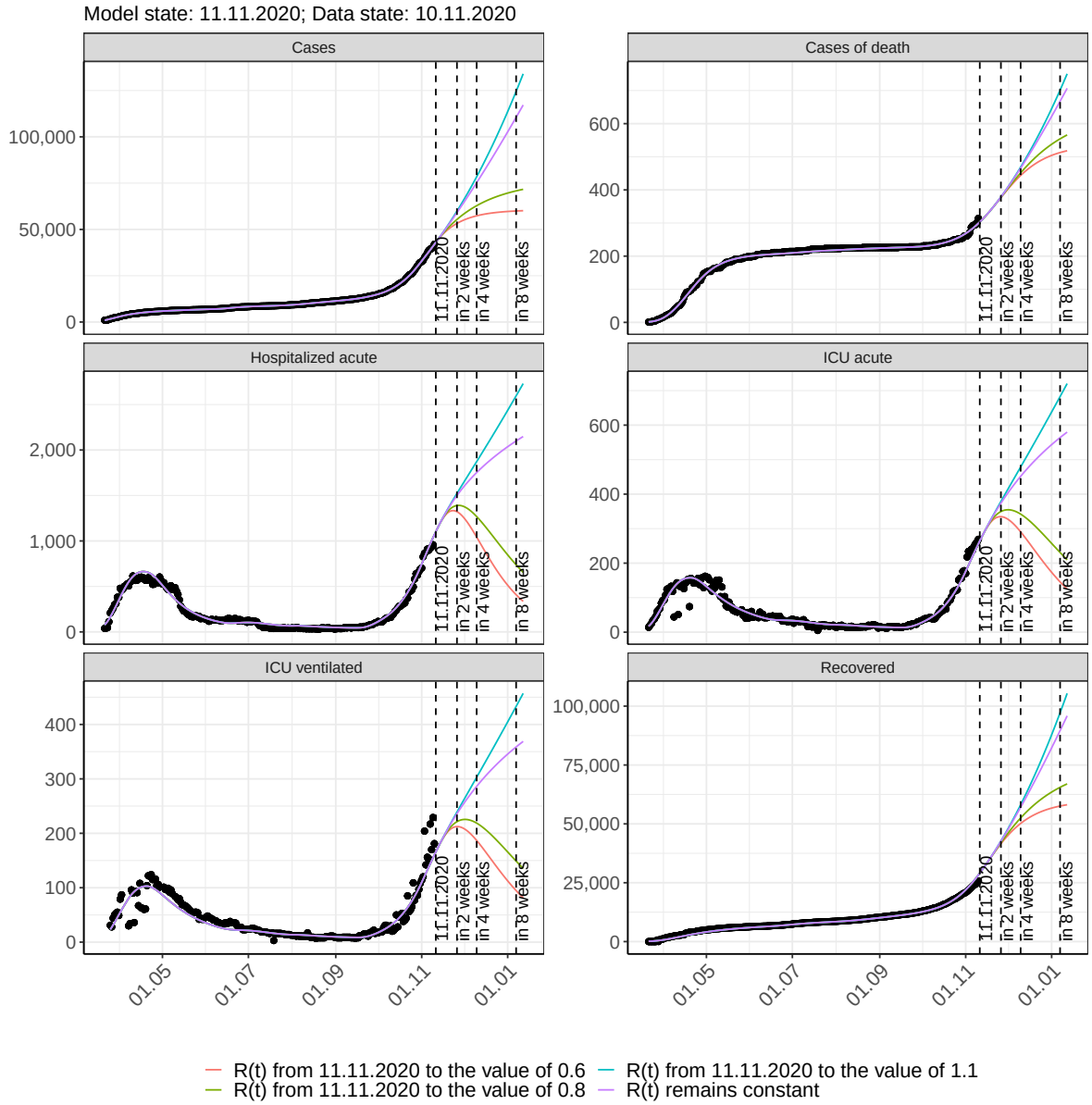


Figure 54: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Berlin assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

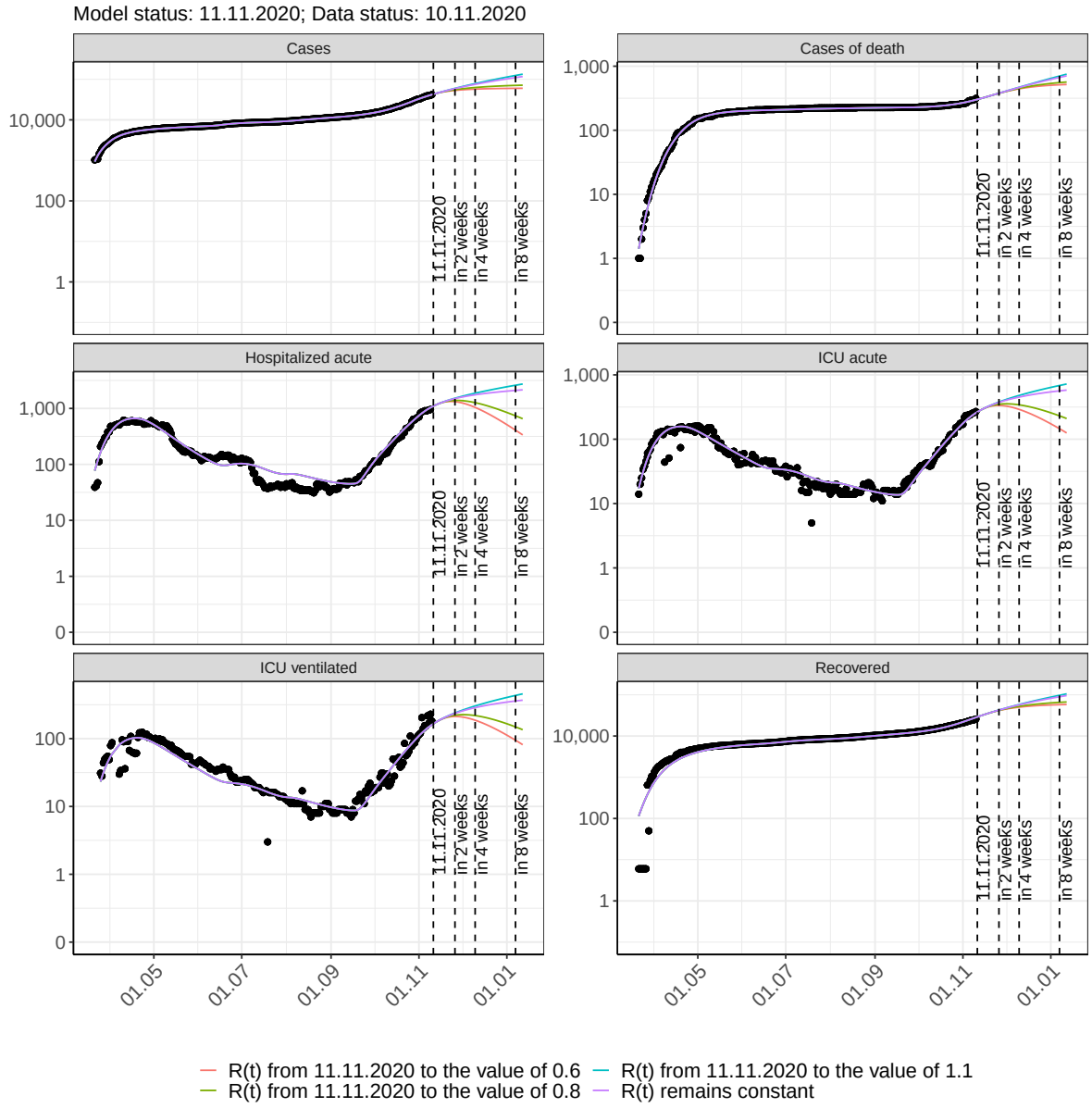


Figure 55: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Berlin assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 56 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

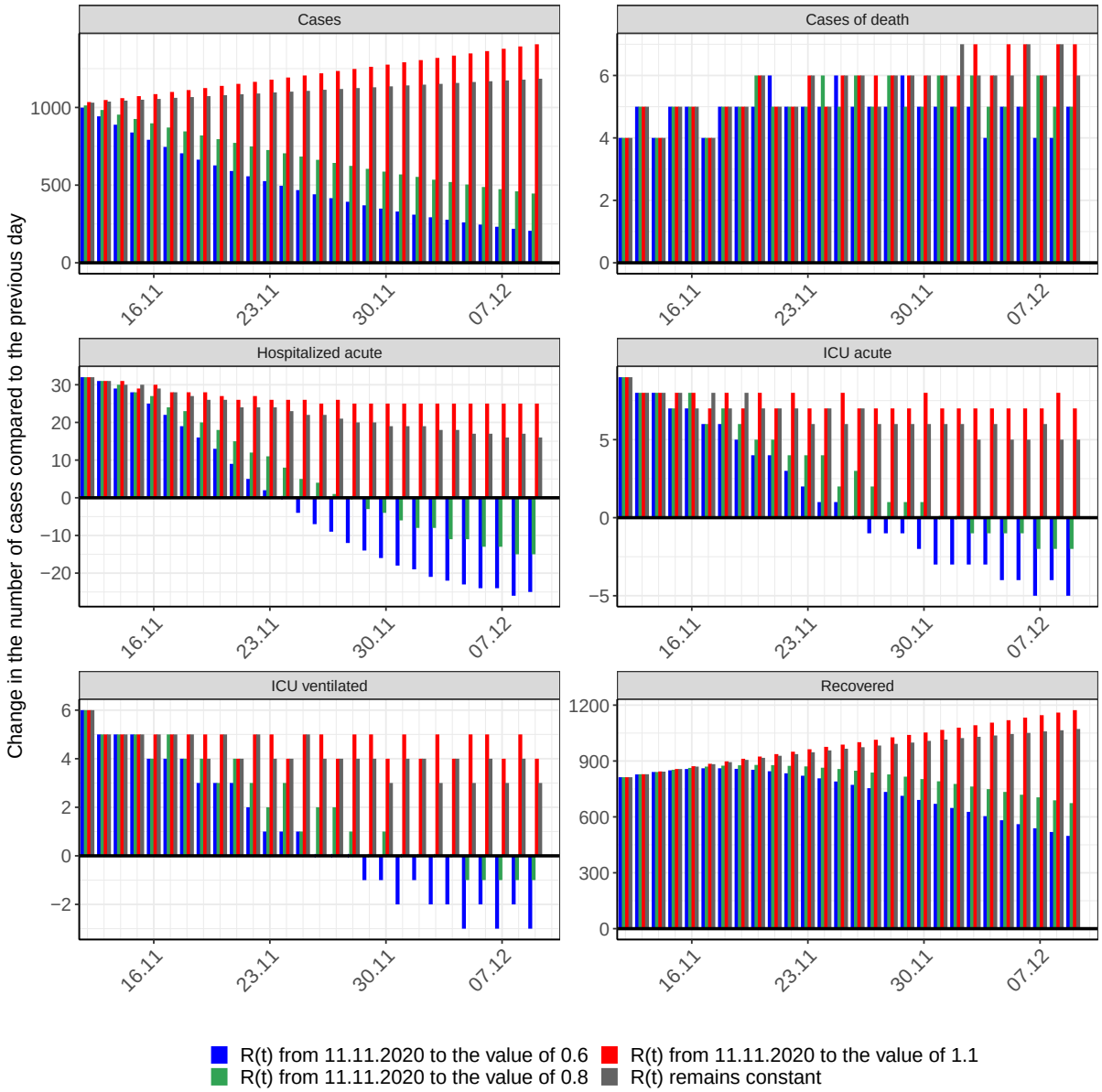


Figure 56: Simulation of daily new cases for the next 4 weeks - Berlin

4.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Berlin over time.

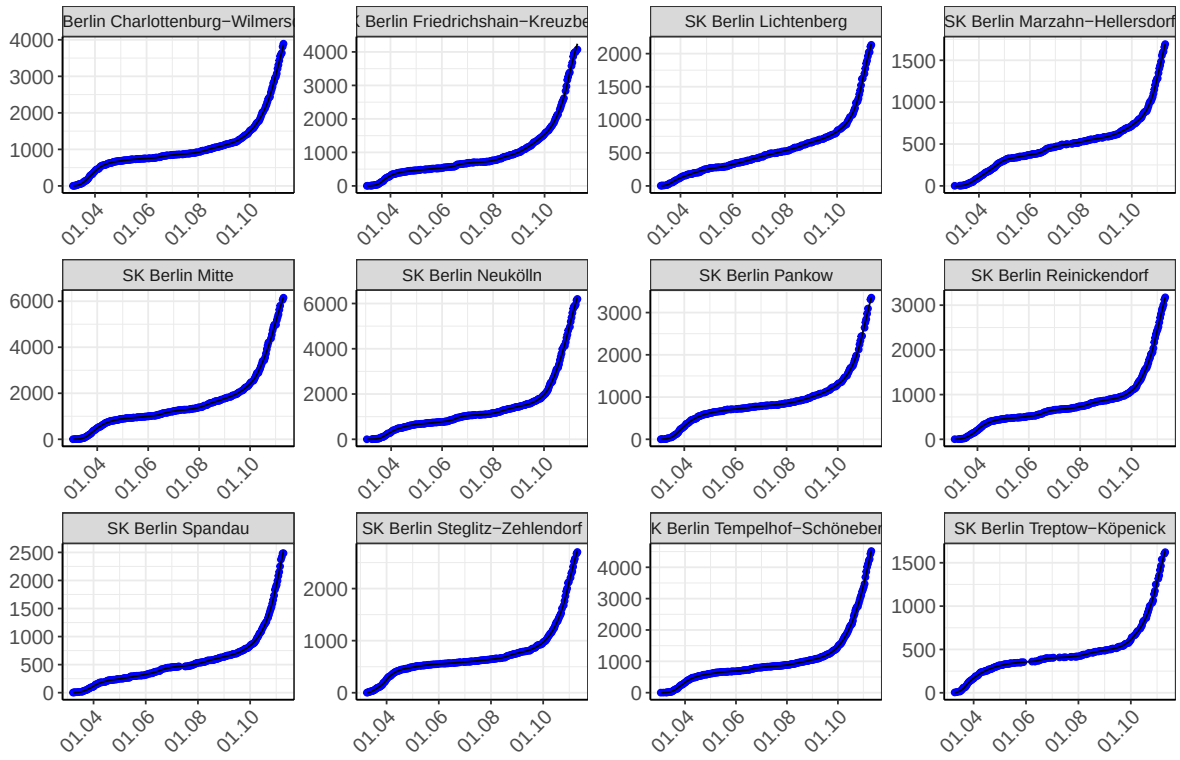


Figure 57: Model description of the reported case numbers in country- and citycounties in Berlin. Points: reported data; lines: model description.

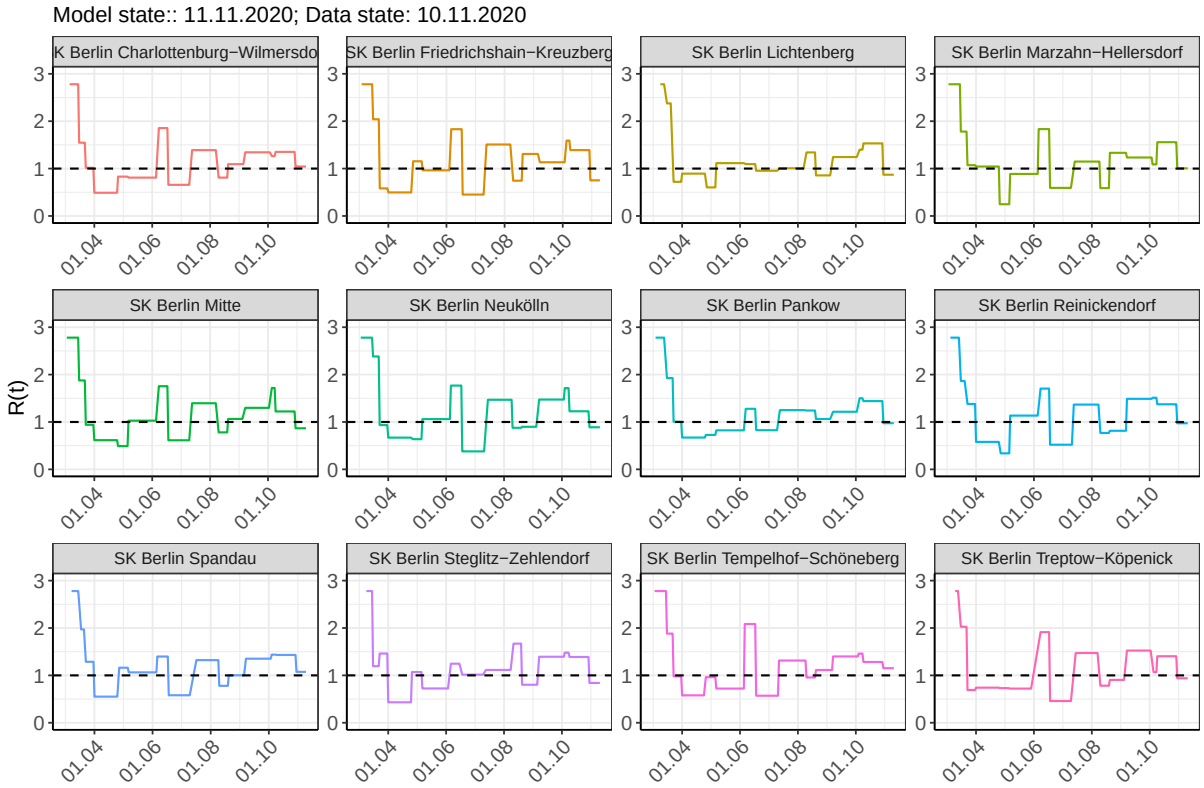


Figure 58: R(t) values over time for country- and citycounties in Berlin

Table 4: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
SK Berlin Charlottenburg-Wilmersdorf	2.78	1.55	1.02	0.49	0.83	0.81	1.85	0.66	1.39	0.81	1.09	1.34	1.26	1.35	1.04
SK Berlin Friedrichshain-Kreuzberg	2.78	2.04	0.58	0.50	1.15	0.96	1.83	0.45	1.51	0.74	1.31	1.13	1.59	1.39	0.75
SK Berlin Lichtenberg	2.78	2.38	0.72	0.89	0.60	1.11	1.09	0.95	1.01	1.34	0.86	1.24	1.40	1.53	0.87
SK Berlin Marzahn-Hellersdorf	2.78	1.78	1.07	1.04	0.25	0.89	1.83	0.59	1.15	0.59	1.33	1.23	1.09	1.56	1.00
SK Berlin Mitte	2.78	1.88	0.94	0.62	0.49	1.03	1.75	0.61	1.40	0.78	1.06	1.30	1.72	1.22	0.87
SK Berlin Neukölln	2.78	2.38	0.93	0.67	0.64	1.06	1.77	0.38	1.47	0.88	0.90	1.47	1.71	1.23	0.89
SK Berlin Pankow	2.78	1.93	1.00	0.67	0.73	0.82	1.28	0.83	1.25	1.24	1.06	1.22	1.50	1.44	0.97
SK Berlin Reinick-endorf	2.78	1.86	1.38	0.58	0.34	1.13	1.70	0.52	1.37	0.77	0.81	1.49	1.51	1.37	0.97
SK Berlin Spandau	2.78	1.97	1.29	0.55	1.16	1.06	1.40	0.58	1.32	0.78	1.00	1.35	1.44	1.43	1.07
SK Berlin Steglitz-Zehlendorf	2.78	1.19	1.46	0.43	1.07	0.72	1.25	1.02	1.11	1.67	0.80	1.39	1.48	1.39	0.84

Table 4: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
SK Berlin Tempelhof-Schöneberg	2.78	1.88	0.98	0.58	0.96	0.72	2.08	0.57	1.31	0.96	1.11	1.40	1.46	1.28	1.15
SK Berlin Treptow-Köpenick	2.78	2.03	0.69	0.74	0.73	0.72	1.91	0.46	1.47	0.78	0.90	1.52	1.07	1.40	0.94

5 Brandenburg

5.1 Model description

Fig. 59 depicts the results of the modeling (lines) compared to the observed data (points) for Brandenburg on a linear (A) and semi-logarithmic (B) scale.

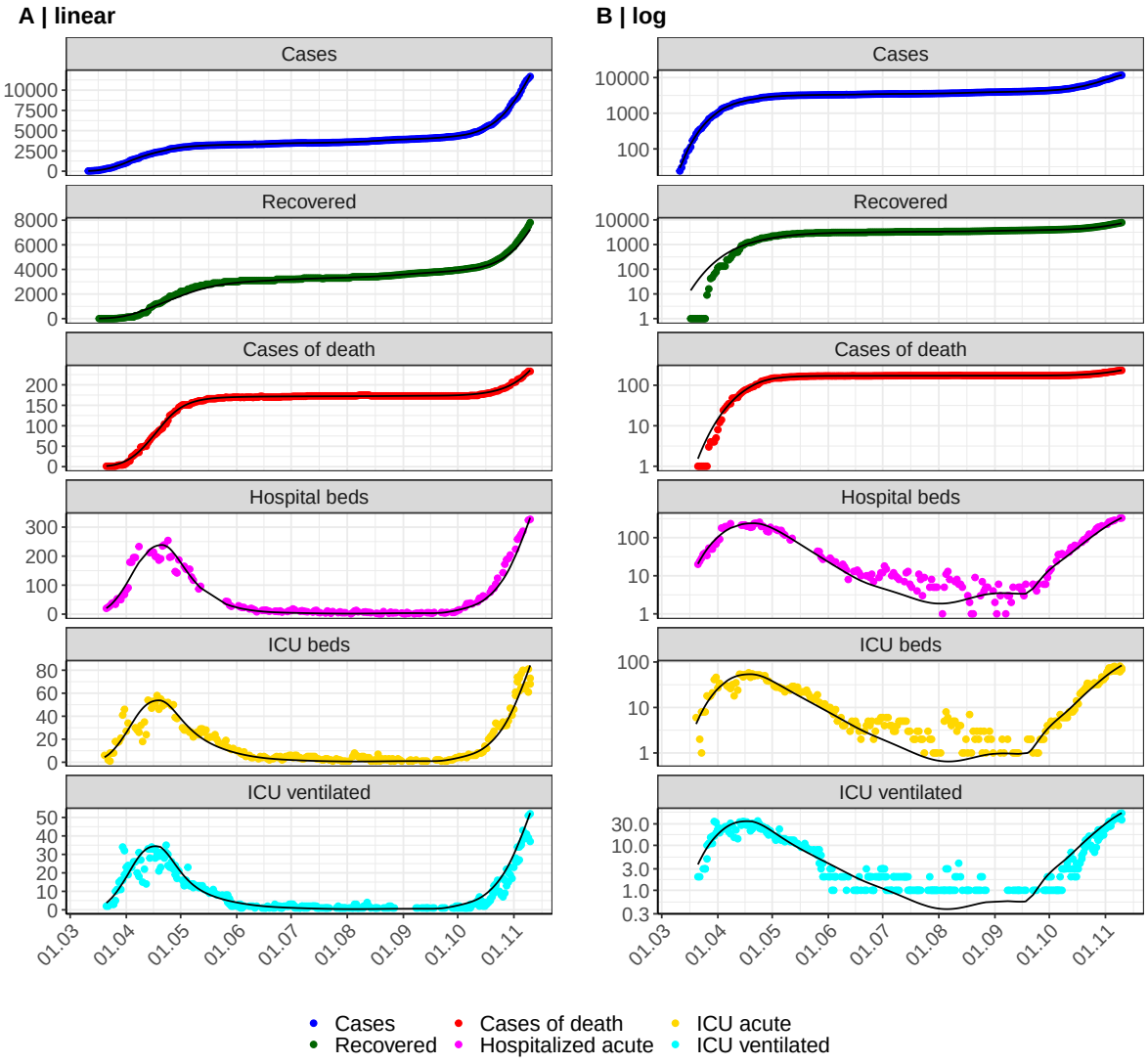


Figure 59: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Brandenburg. Points: reported data; lines: model description.

Fig. 60 shows the goodness-of-fit for Brandenburg. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

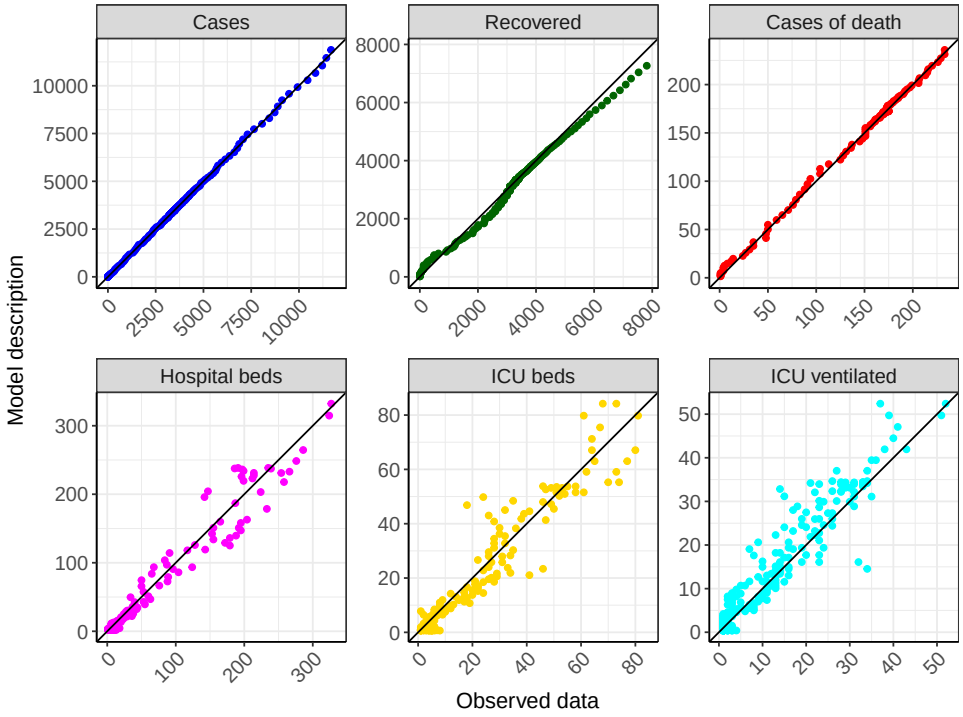


Figure 60: Goodness-of-fit plots for Brandenburg. Lines: lines of identity.

Fig. 61 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Brandenburg (red line) in comparison with the other federal states (grey lines).

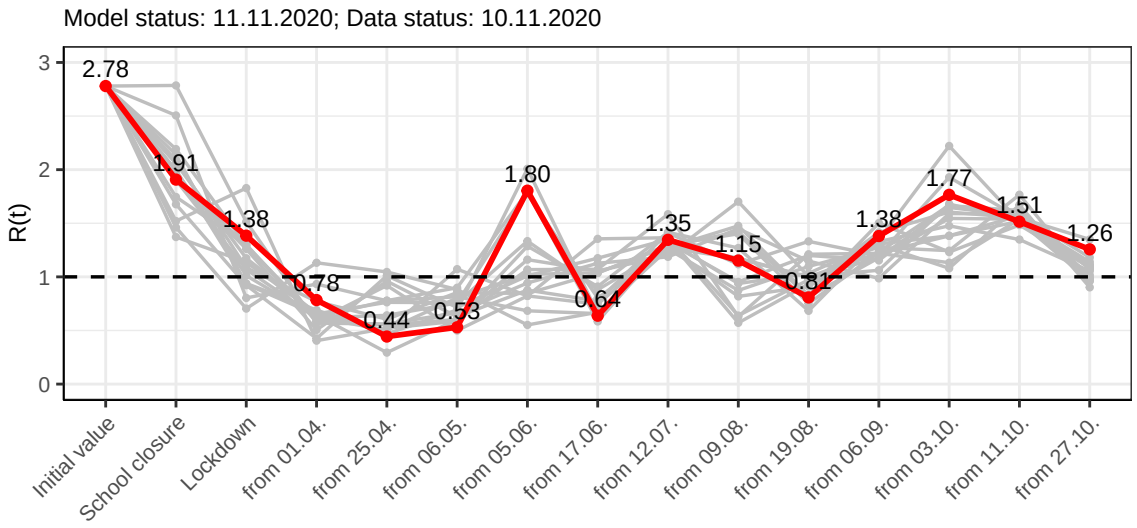


Figure 61: R(t) values before and after the NPIs for Brandenburg

Fig. 62 shows the R(t) estimated value for Brandenburg (red line) over time in comparison with the other federal states (grey lines).

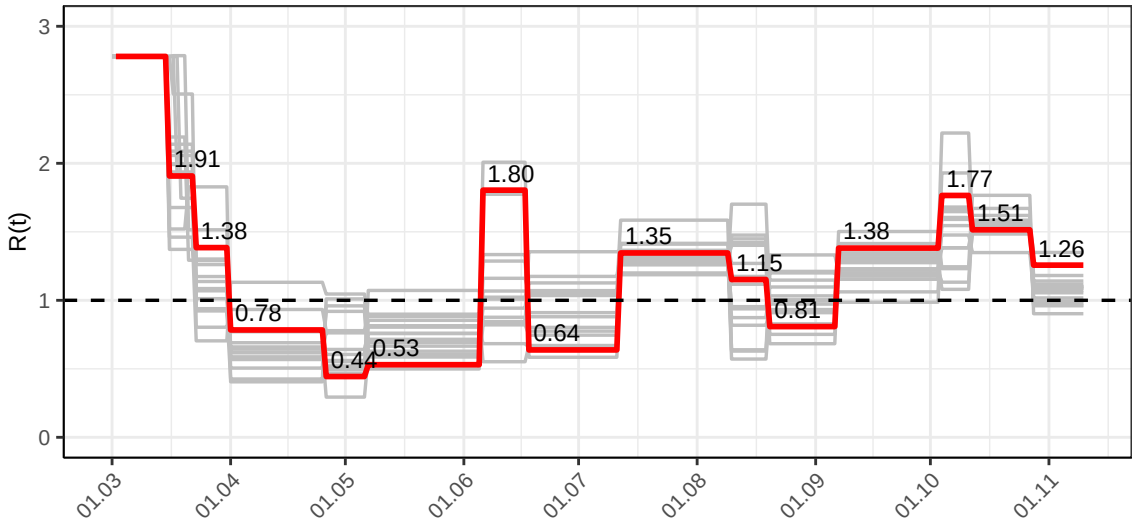


Figure 62: R(t) values over time for Brandenburg

Fig. 63 shows the changes in hospitalization and death rates for Brandenburg (red line) over time compared to the other states (grey lines).

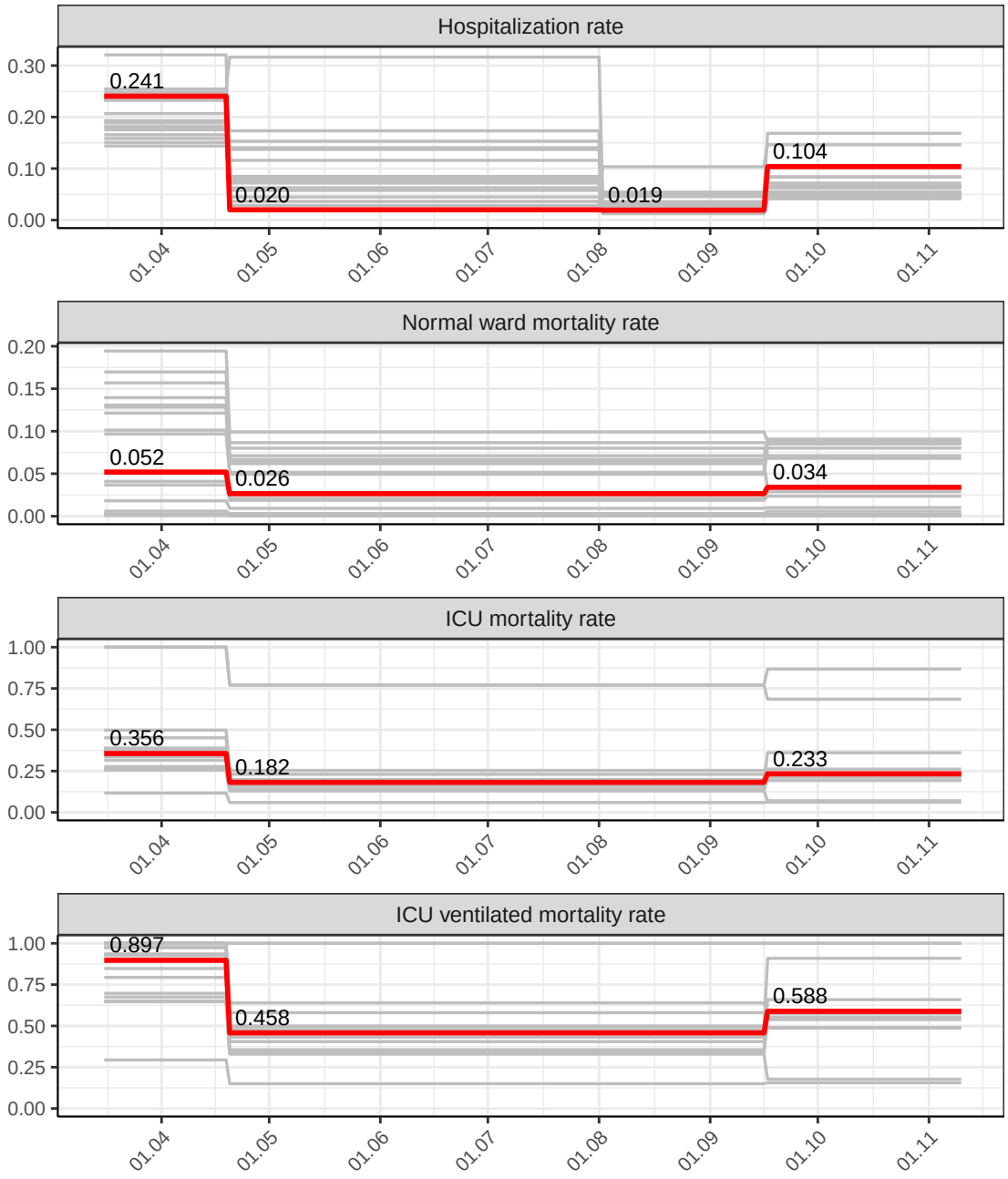


Figure 63: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Brandenburg

5.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1.26) and assuming various scenarios from 11.11.2020

Fig.64 and 65 represent the model prediction for the next 8 weeks for Brandenburg on a linear (64) and a semi-logarithmic (65) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

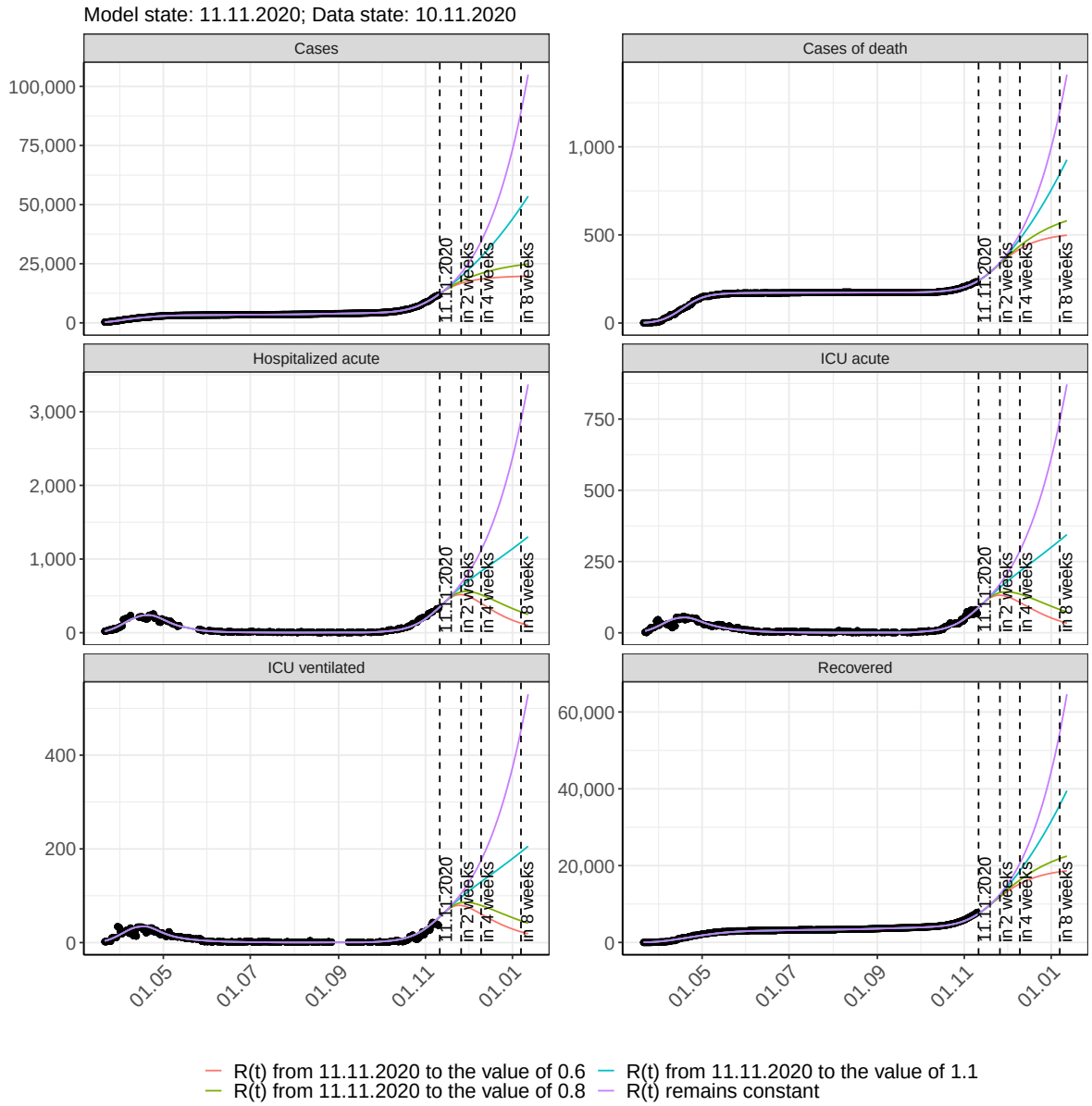


Figure 64: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Brandenburg assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

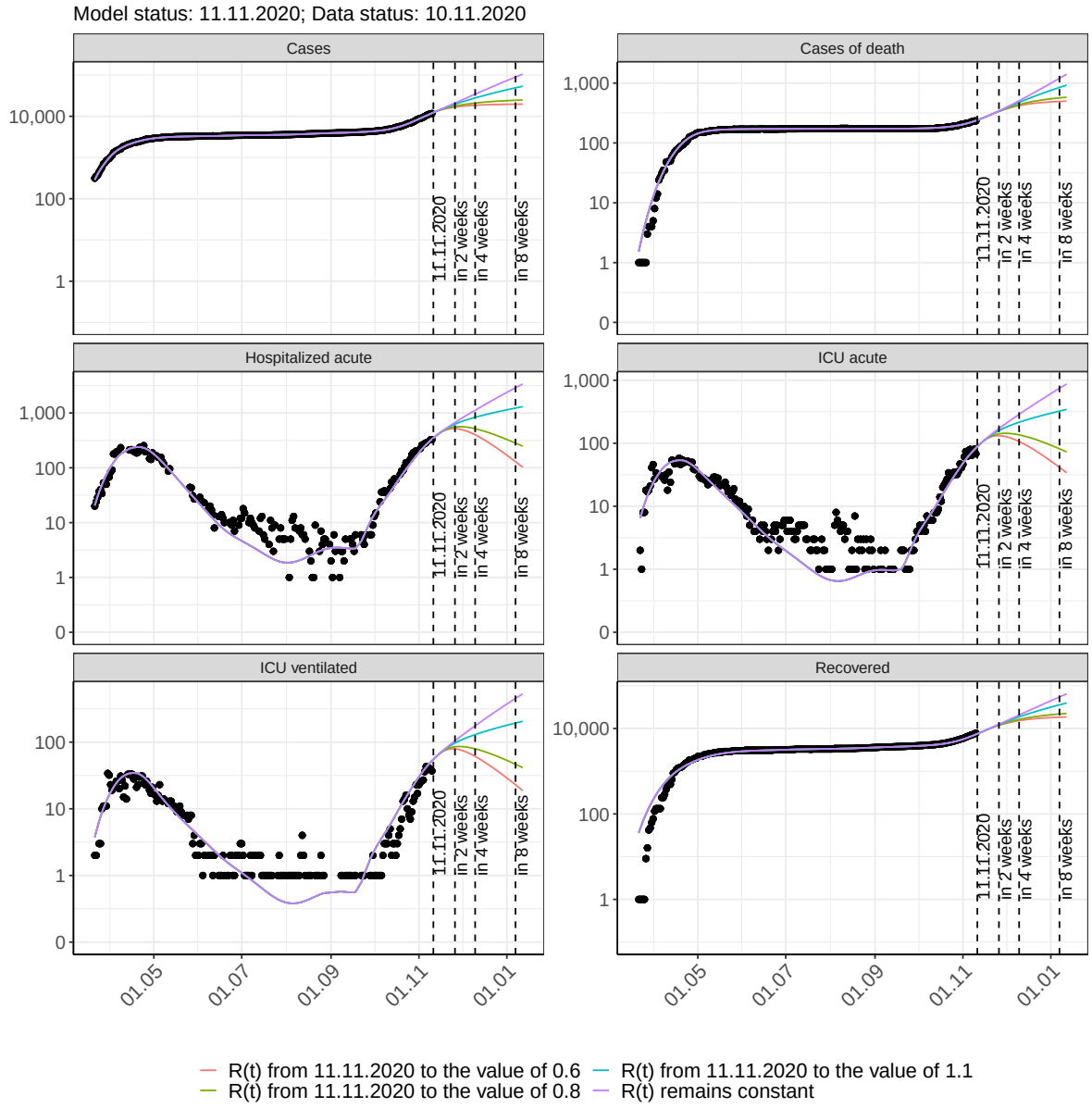


Figure 65: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Brandenburg assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 66 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

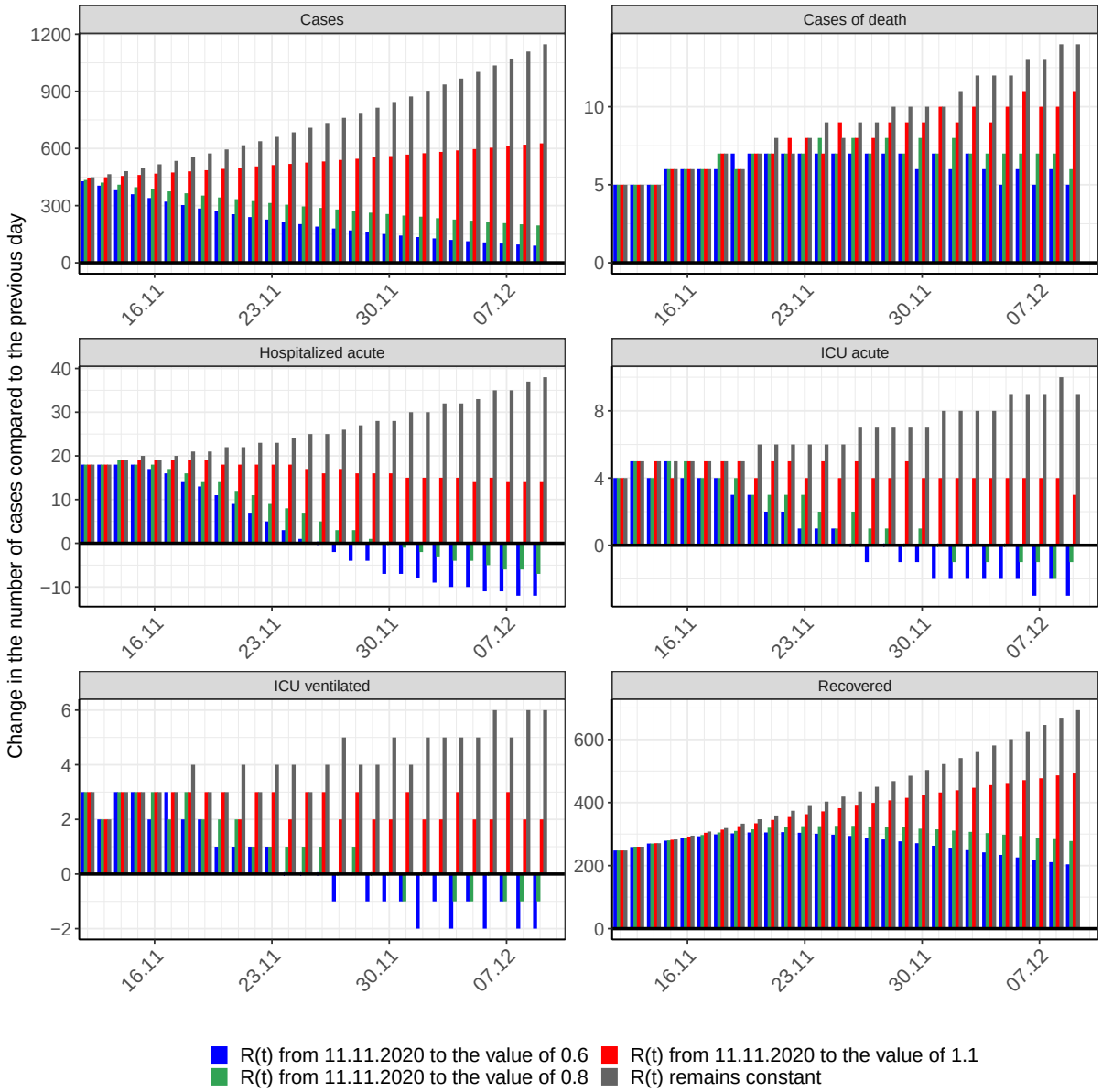


Figure 66: Simulation of daily new cases for the next 4 weeks - Brandenburg

5.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Brandenburg over time.

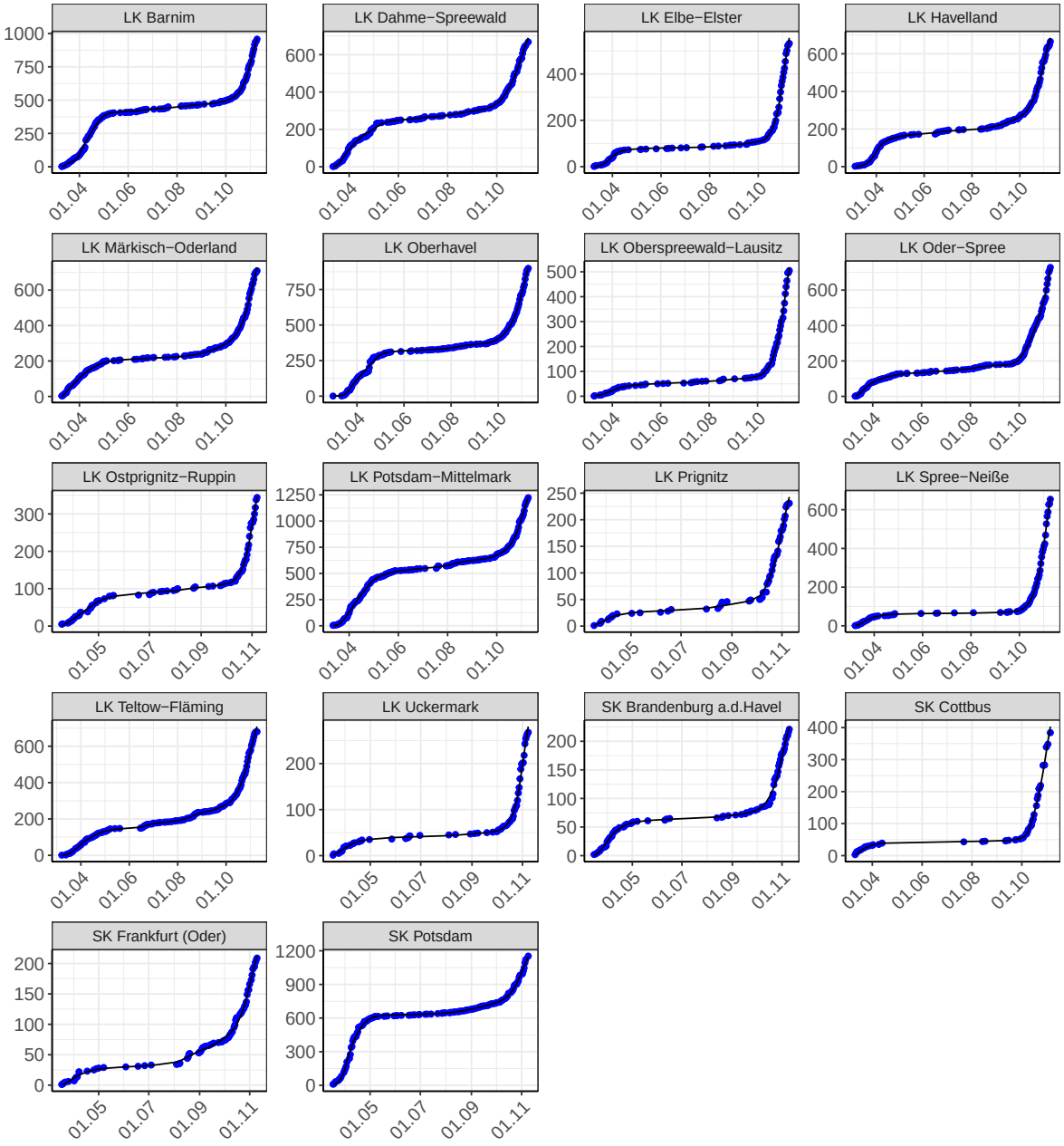


Figure 67: Model description of the reported case numbers in country- and citycounties in Brandenburg. Points: reported data; lines: model description.

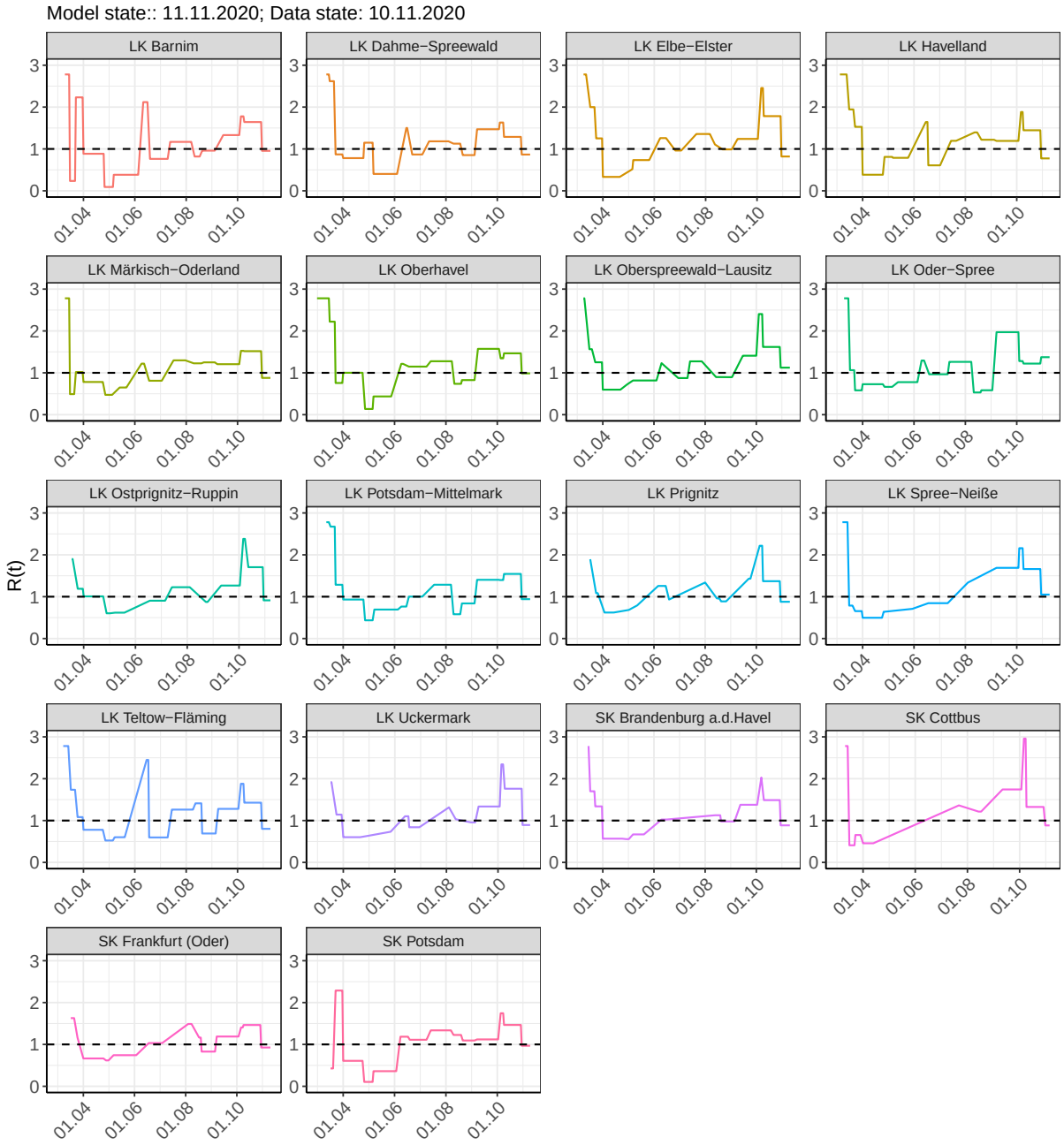


Figure 68: R(t) values over time for country- and citycounties in Brandenburg

Table 5: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Barnim	2.78	0.24	2.23	0.88	0.09	0.38	2.12	0.76	1.17	0.82	0.96	1.33	1.78	1.64	0.95
LK Dahme-Spreewald	2.78	2.62	0.87	0.78	1.15	0.40	1.50	0.87	1.18	1.13	0.85	1.47	1.63	1.29	0.87
LK Elbe-Elster	2.78	2.00	1.25	0.33	0.52	0.73	1.26	0.96	1.36	1.11	0.99	1.24	2.46	1.78	0.82
LK Havelland	2.78	1.94	1.53	0.38	0.81	0.79	1.64	0.61	1.19	1.40	1.22	1.19	1.88	1.45	0.77
LK Märkisch-Oderland	2.78	0.49	1.02	0.78	0.47	0.65	1.22	0.81	1.30	1.23	1.25	1.21	1.52	1.52	0.88
LK Oberhavel	2.78	2.22	0.76	1.00	0.14	0.44	1.21	1.15	1.28	0.74	0.83	1.57	1.35	1.47	0.99
LK Oberspreewald-Lausitz	2.78	1.56	1.25	0.60	0.72	0.82	1.23	0.87	1.27	0.90	0.90	1.41	2.40	1.62	1.12
LK Oder-Spree	2.78	1.06	0.58	0.73	0.66	0.78	1.29	0.97	1.26	0.53	0.58	1.97	1.28	1.22	1.37
LK Ostprignitz-Ruppin	2.78	1.90	1.19	1.01	0.60	0.62	1.08	0.90	1.23	0.84	0.87	1.27	2.38	1.70	0.91
LK Potsdam-Mittelmark	2.78	2.67	1.28	0.93	0.44	0.69	0.76	1.00	1.29	0.58	0.84	1.40	1.40	1.54	0.94
LK Prignitz	2.78	1.89	1.08	0.62	0.68	0.79	1.26	0.93	1.34	0.96	0.89	1.43	2.22	1.37	0.88

Table 5: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Spree-Neiße	2.78	0.79	0.66	0.50	0.64	0.71	1.06	0.84	1.34	1.14	1.03	1.69	2.16	1.66	1.05
LK Teltow-Fläming	2.78	1.74	1.08	0.78	0.52	0.60	2.45	0.60	1.26	1.41	0.69	1.28	1.88	1.43	0.80
LK Uckermark	2.78	1.92	1.14	0.60	0.63	0.73	1.10	0.84	1.32	1.03	0.96	1.34	2.34	1.76	0.89
SK Brandenburg a.d.Havel	2.78	1.70	1.34	0.57	0.56	0.67	1.02	0.84	1.34	1.13	0.98	1.38	2.03	1.49	0.89
SK Cottbus	2.78	0.41	0.66	0.46	0.56	0.68	1.07	0.88	1.36	1.21	1.05	1.74	2.96	1.32	0.88
SK Frankfurt (Oder)	2.78	1.63	1.16	0.66	0.62	0.74	1.24	1.03	1.49	1.16	0.83	1.19	1.40	1.46	0.93
SK Potsdam	2.78	0.43	2.29	0.61	0.10	0.36	1.18	1.11	1.34	1.23	1.09	1.12	1.74	1.47	0.97

6 Bremen

6.1 Model description

Fig. 69 depicts the results of the modeling (lines) compared to the observed data (points) for Bremen on a linear (A) and semi-logarithmic (B) scale.

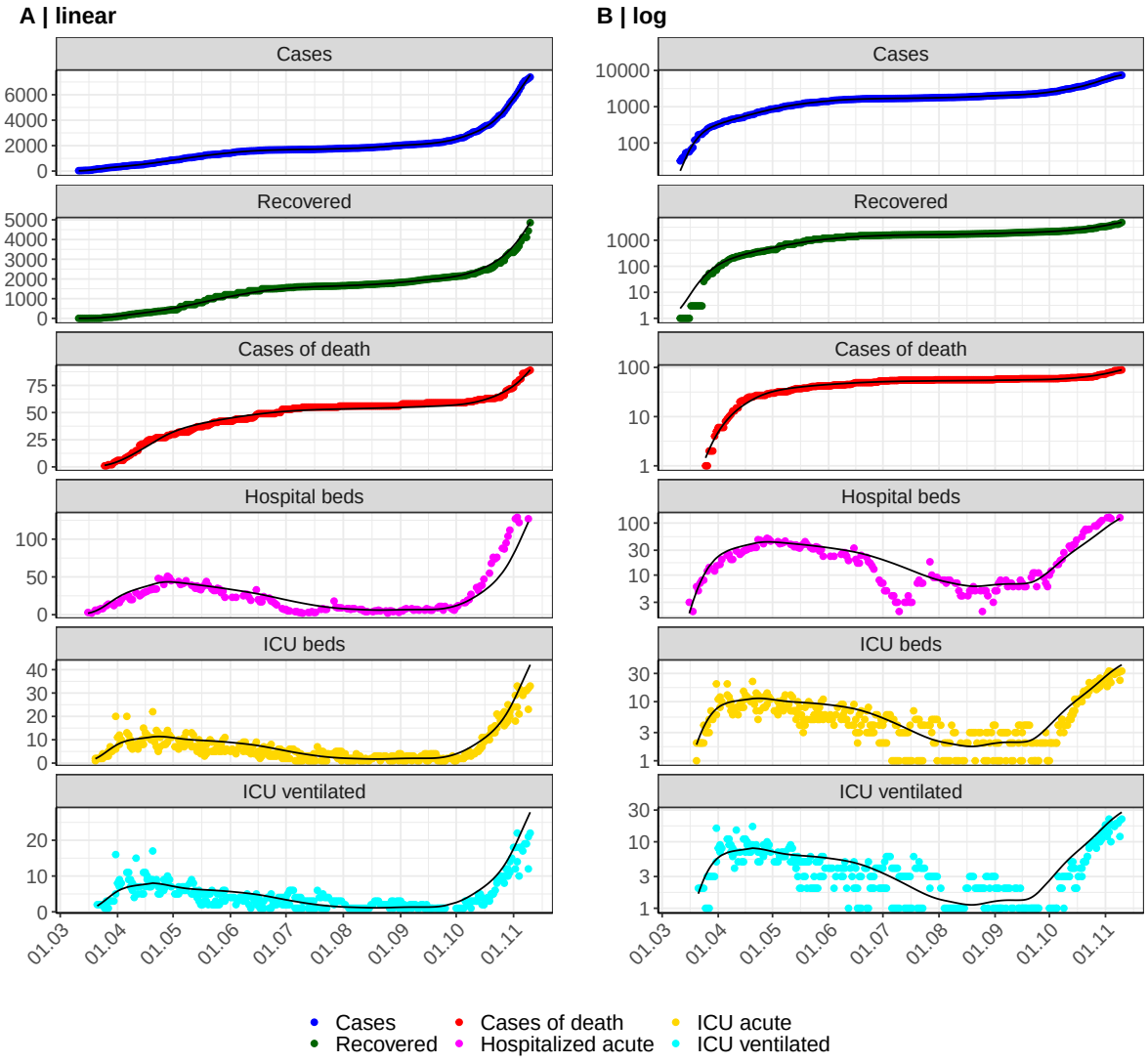


Figure 69: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Bremen. Points: reported data; lines: model description.

Fig. 70 shows the goodness-of-fit for Bremen. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

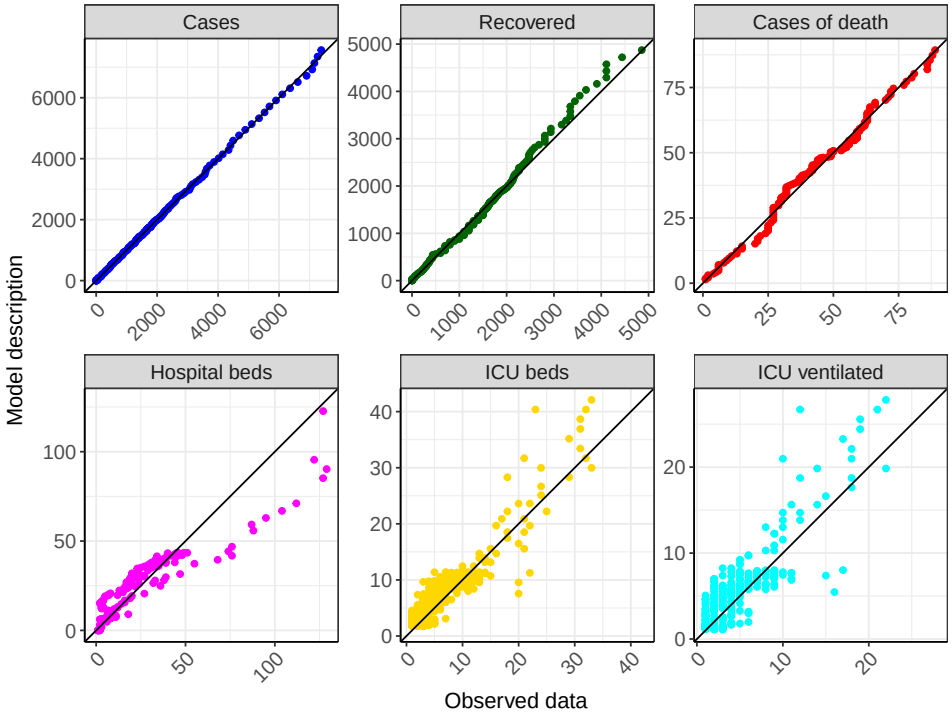


Figure 70: Goodness-of-fit plots for Bremen. Lines: lines of identity.

Fig. 71 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Bremen (red line) in comparison with the other federal states (grey lines).

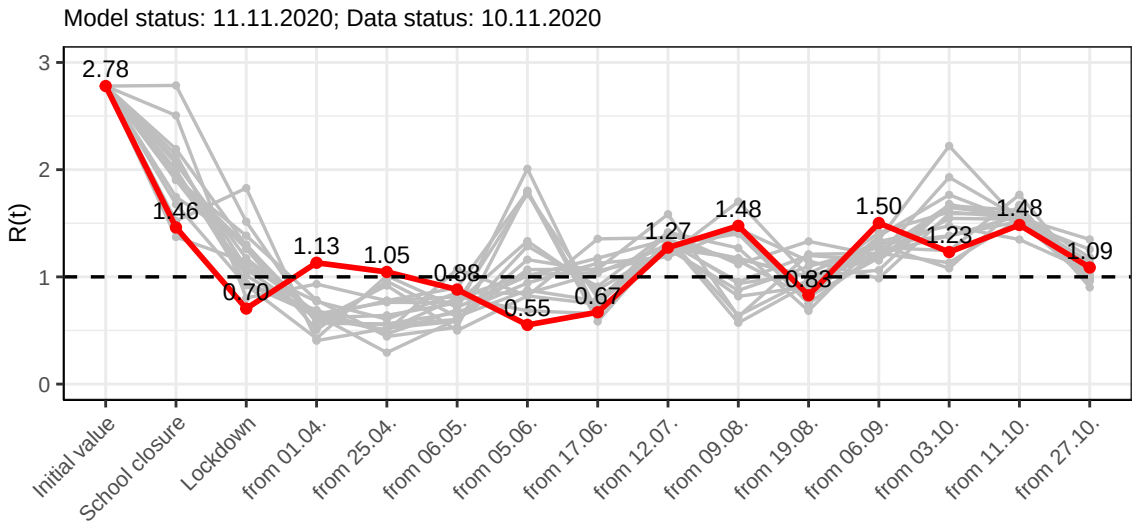


Figure 71: R(t) values before and after the NPIs for Bremen

Fig. 72 shows the R(t) estimated value for Bremen (red line) over time in comparison with the other federal states (grey lines).

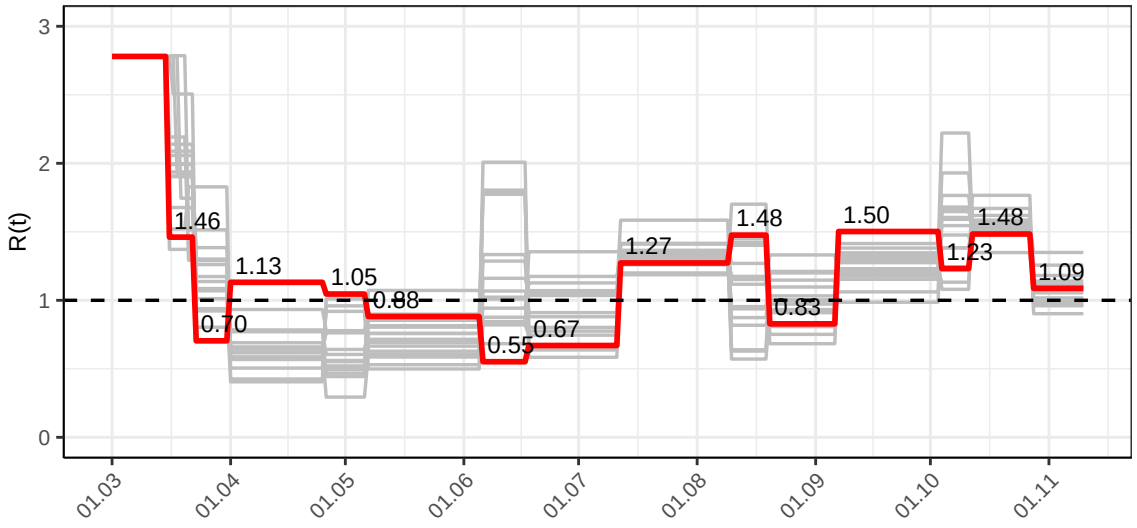


Figure 72: R(t) values over time for Bremen

Fig. 73 shows the changes in hospitalization and death rates for Bremen (red line) over time compared to the other states (grey lines).

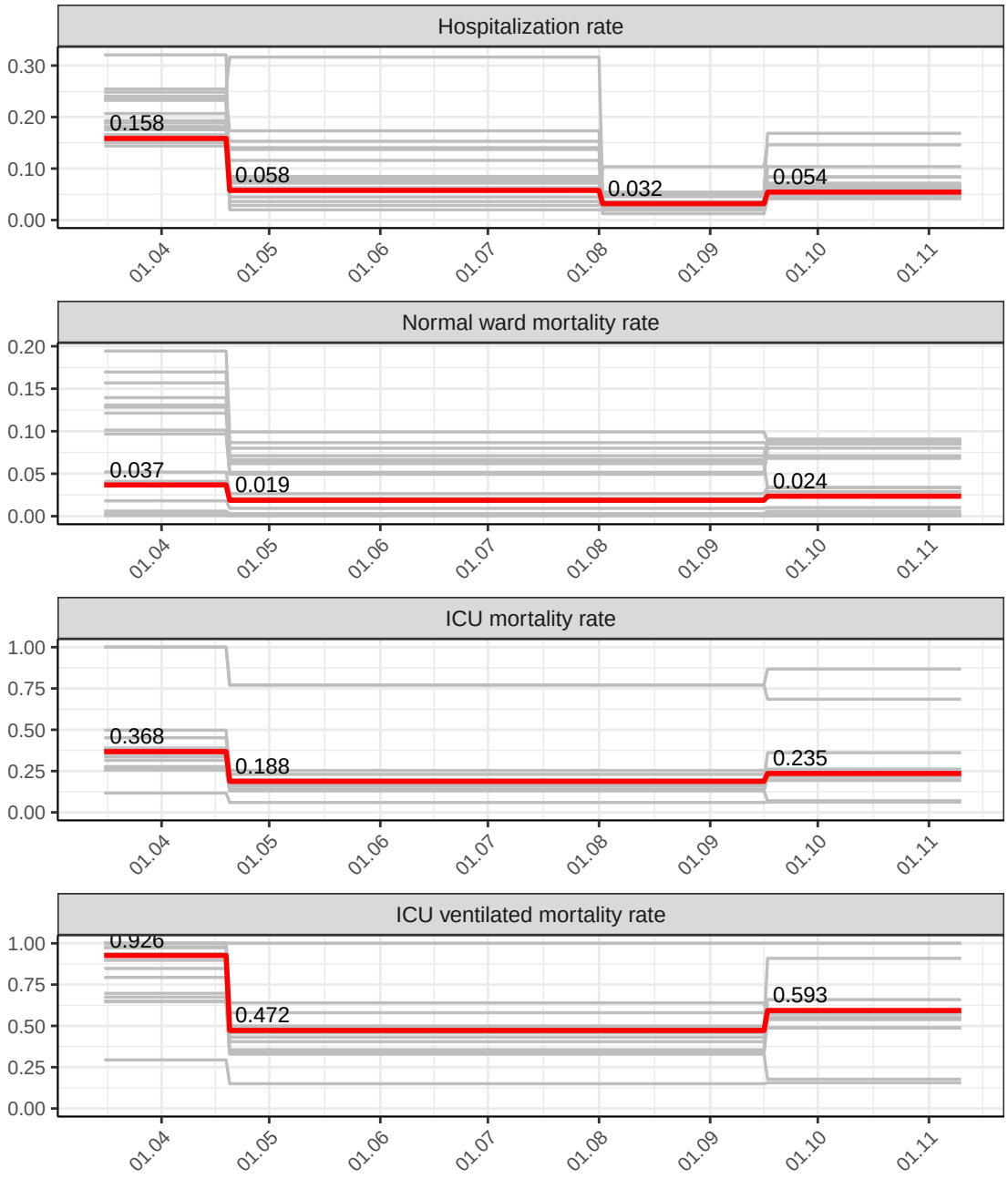


Figure 73: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Bremen

6.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1.09) and assuming various scenarios from 11.11.2020

Fig.74 and 75 represent the model prediction for the next 8 weeks for Bremen on a linear (74) and a semi-logarithmic (75) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

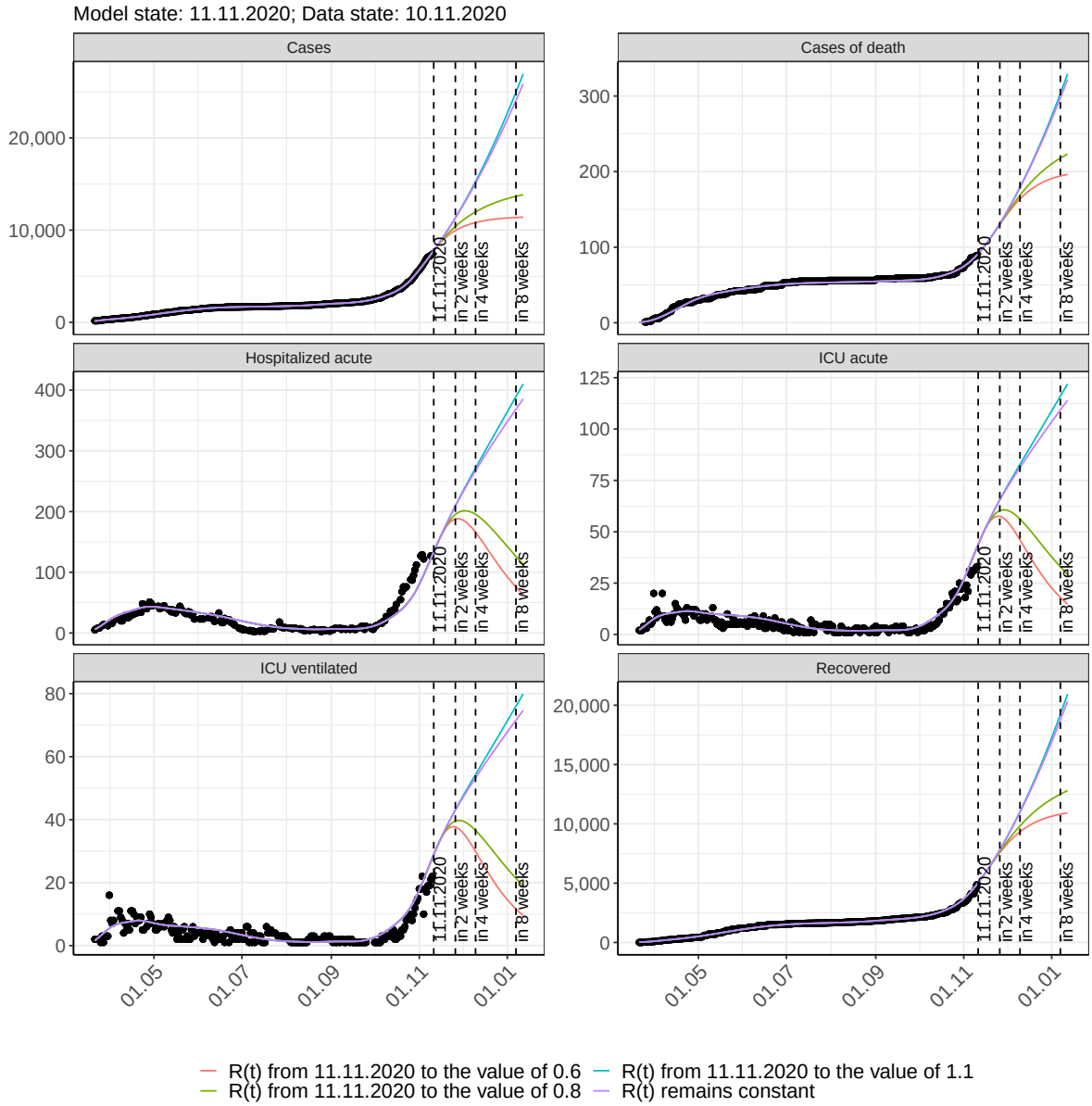


Figure 74: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Bremen assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

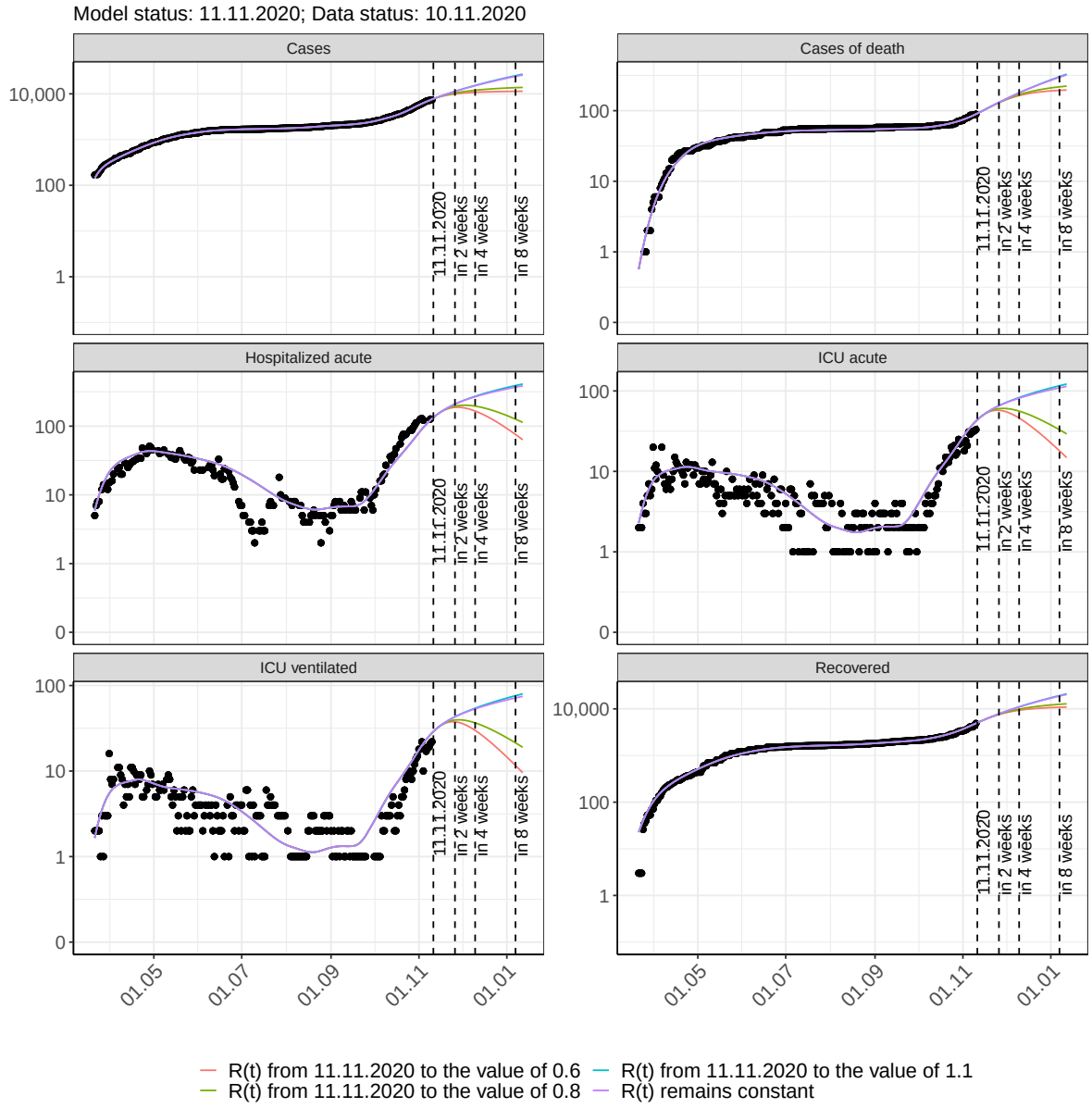


Figure 75: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Bremen assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 76 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

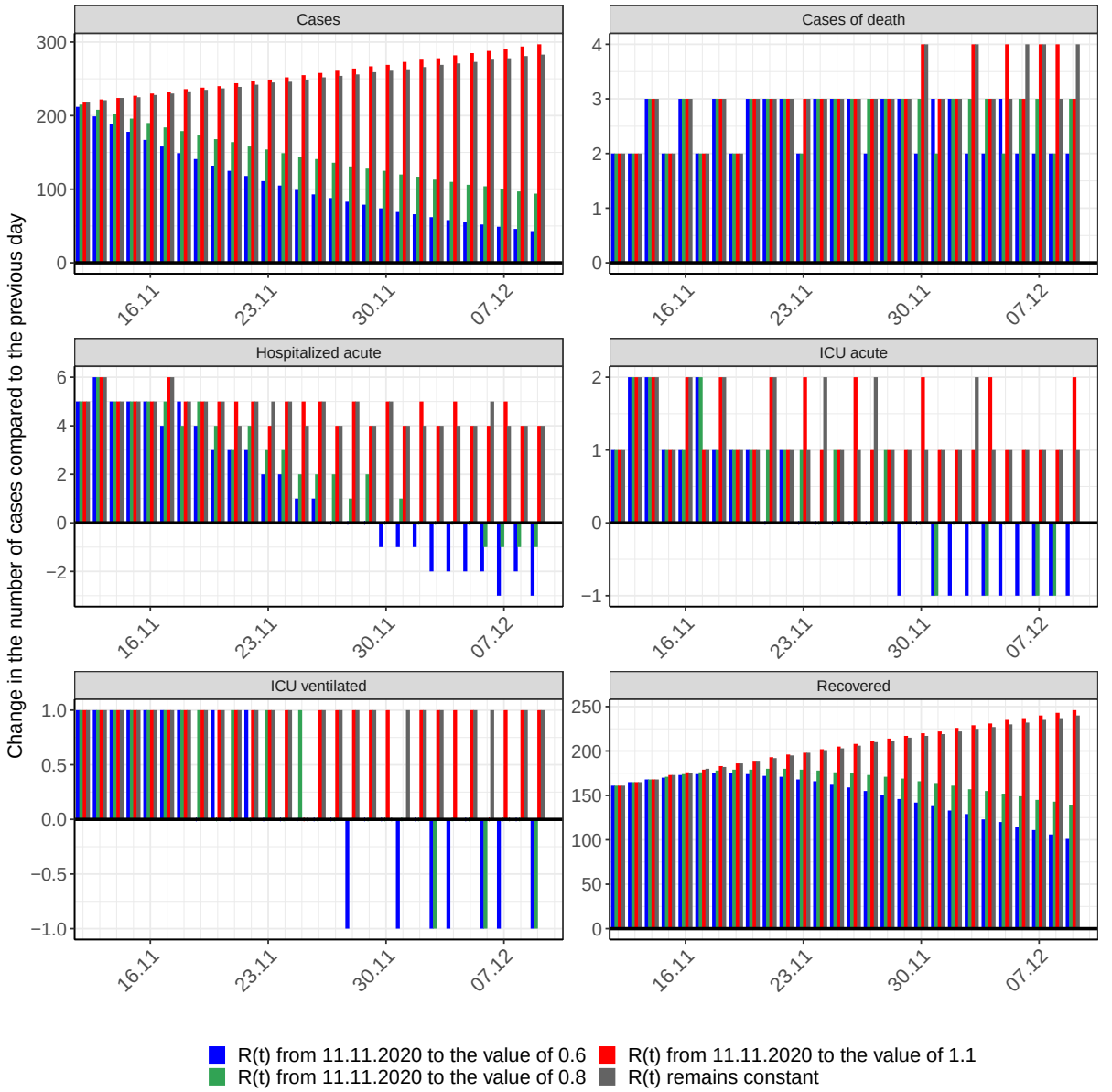


Figure 76: Simulation of daily new cases for the next 4 weeks - Bremen

6.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Bremen over time.

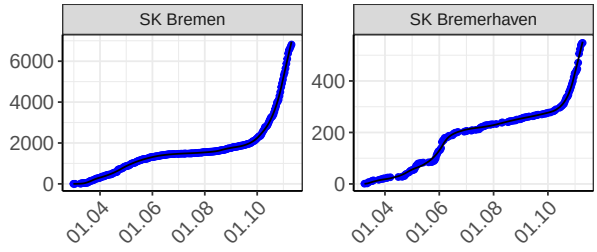


Figure 77: Model description of the reported case numbers in country- and citycounties in Bremen. Points: reported data; lines: model description.

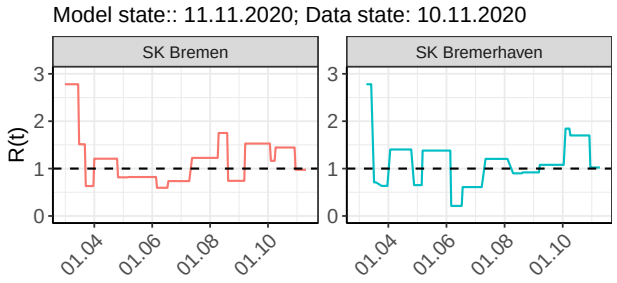


Figure 78: R(t) values over time for country- and citycounties in Bremen

Table 6: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
SK Bremen	2.78	1.51	0.63	1.21	0.82	0.82	0.59	0.74	1.23	1.75	0.74	1.53	1.16	1.45	0.98
SK Bremerhaven	2.78	0.71	0.63	1.40	0.65	1.38	0.21	0.61	1.20	0.90	0.92	1.08	1.84	1.70	1.02

7 Hamburg

7.1 Model description

Fig. 79 depicts the results of the modeling (lines) compared to the observed data (points) for Hamburg on a linear (A) and semi-logarithmic (B) scale.

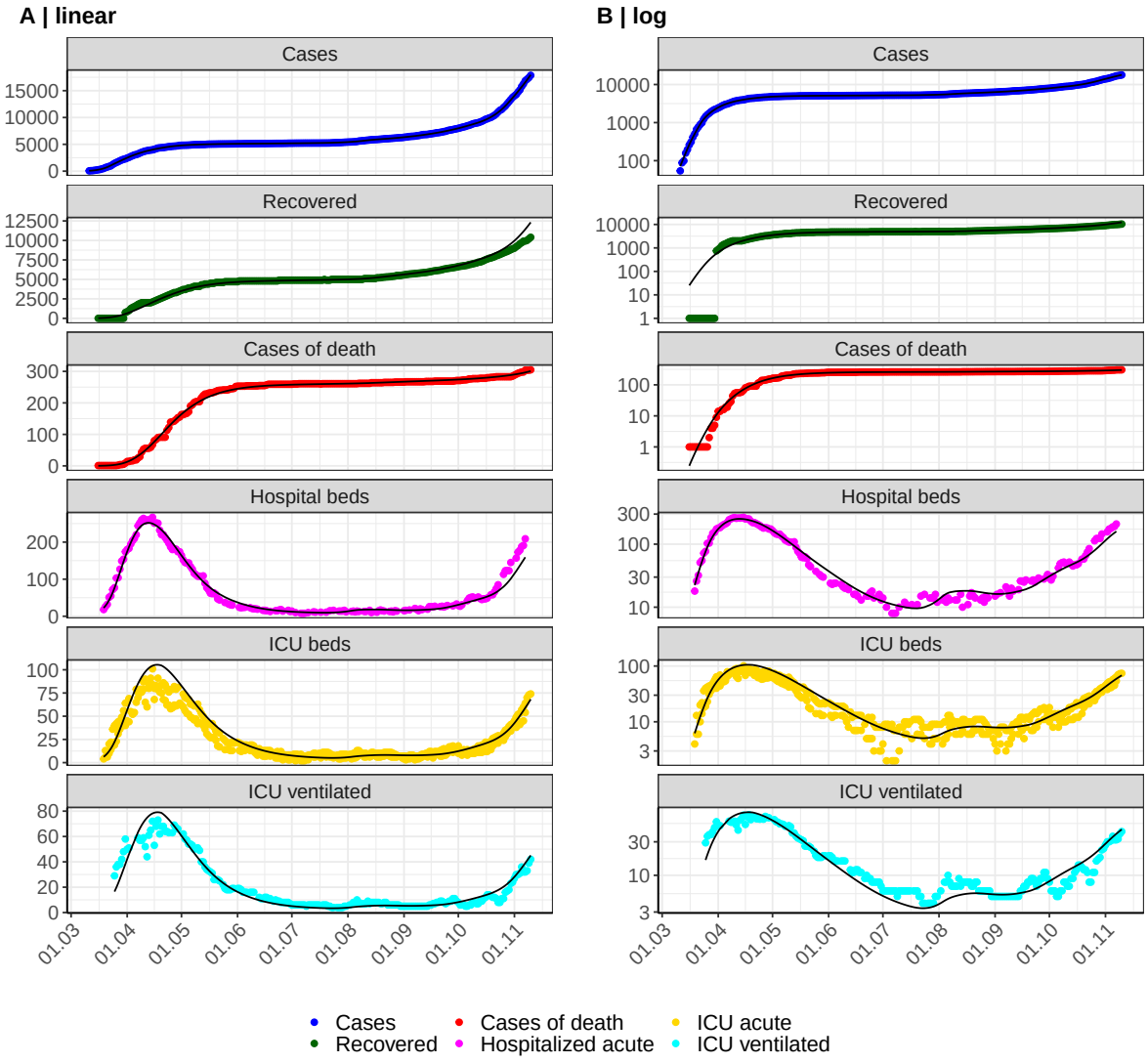


Figure 79: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Hamburg. Points: reported data; lines: model description.

Fig. 80 shows the goodness-of-fit for Hamburg. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

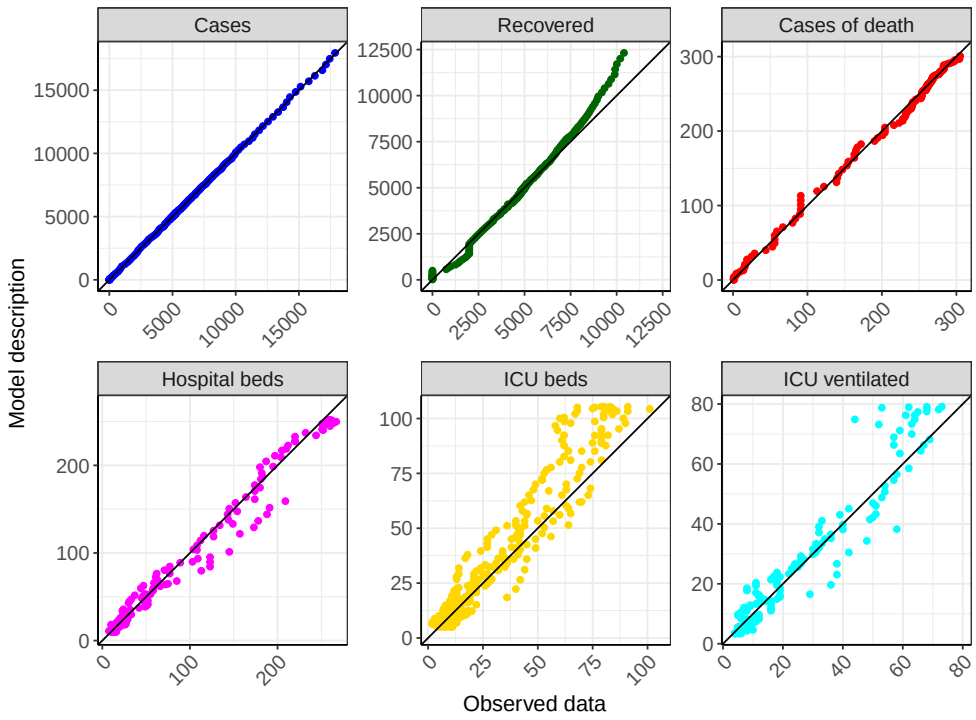


Figure 80: Goodness-of-fit plots for Hamburg. Lines: lines of identity.

Fig. 81 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Hamburg (red line) in comparison with the other federal states (grey lines).

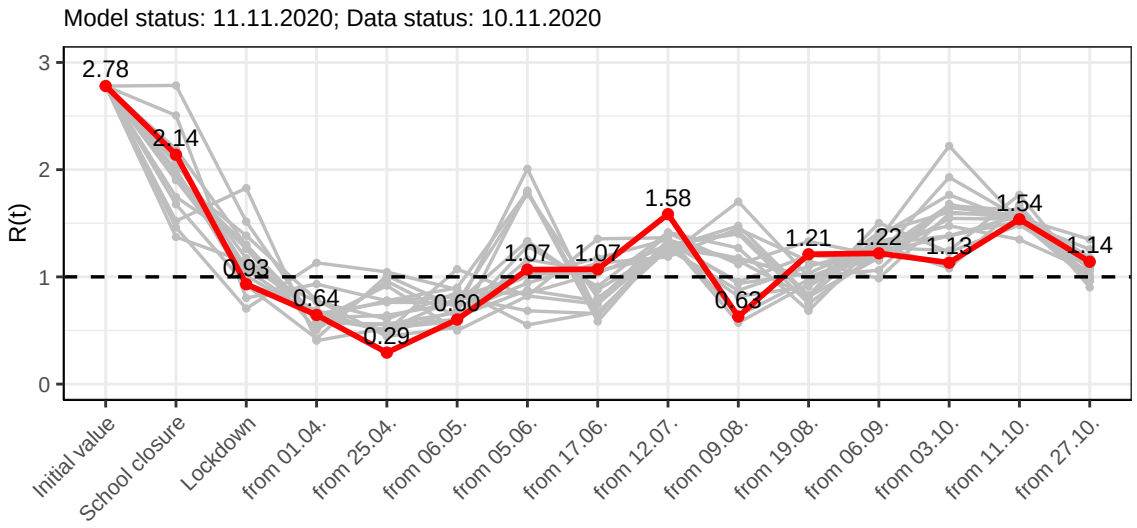


Figure 81: R(t) values before and after the NPIs for Hamburg

Fig. 82 shows the R(t) estimated value for Hamburg (red line) over time in comparison with the other federal states (grey lines).

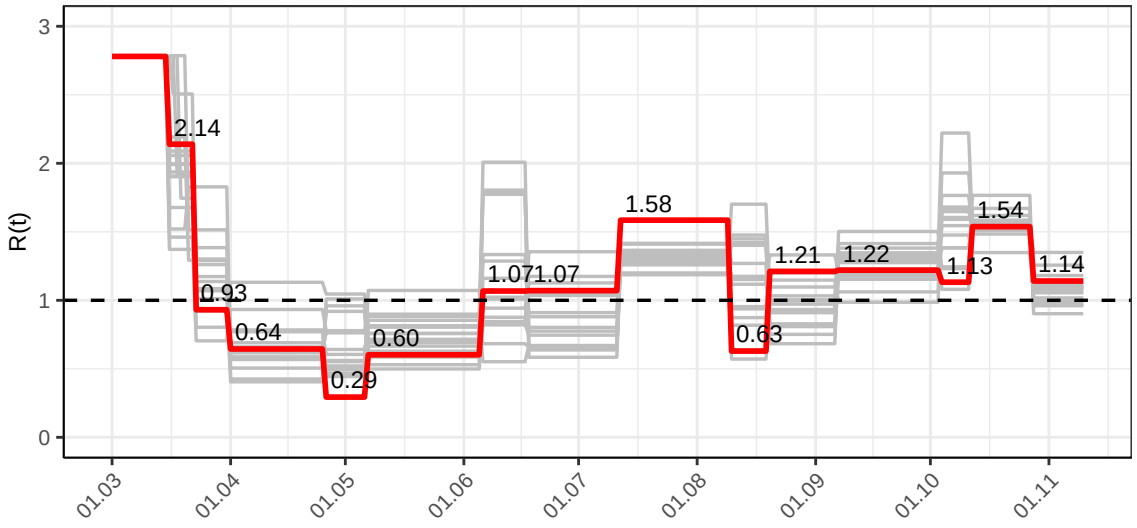


Figure 82: R(t) values over time for Hamburg

Fig. 83 shows the changes in hospitalization and death rates for Hamburg (red line) over time compared to the other states (grey lines).

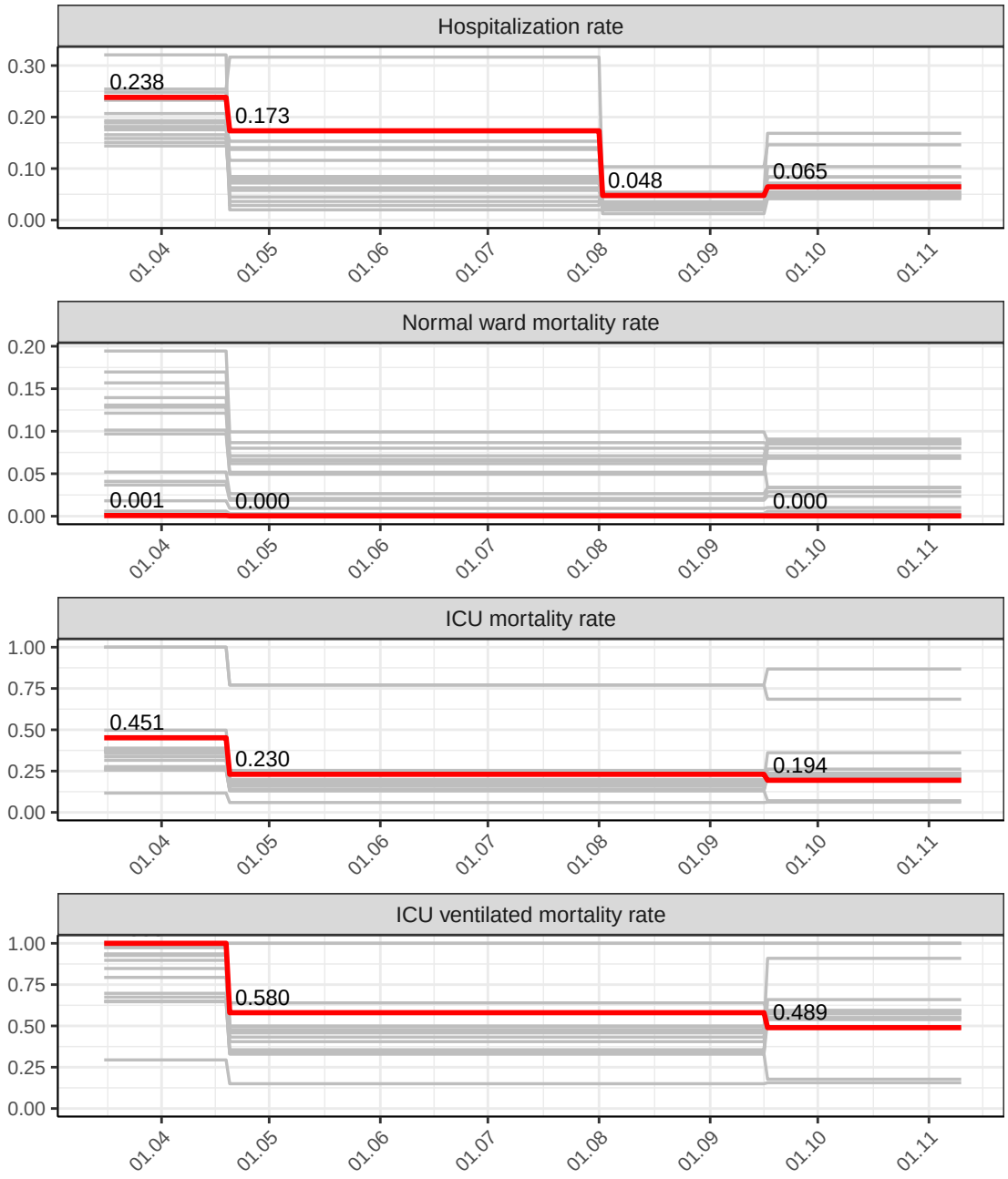


Figure 83: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Hamburg

7.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1.14) and assuming various scenarios from 11.11.2020

Fig.84 and 85 represent the model prediction for the next 8 weeks for Hamburg on a linear (84) and a semi-logarithmic (85) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

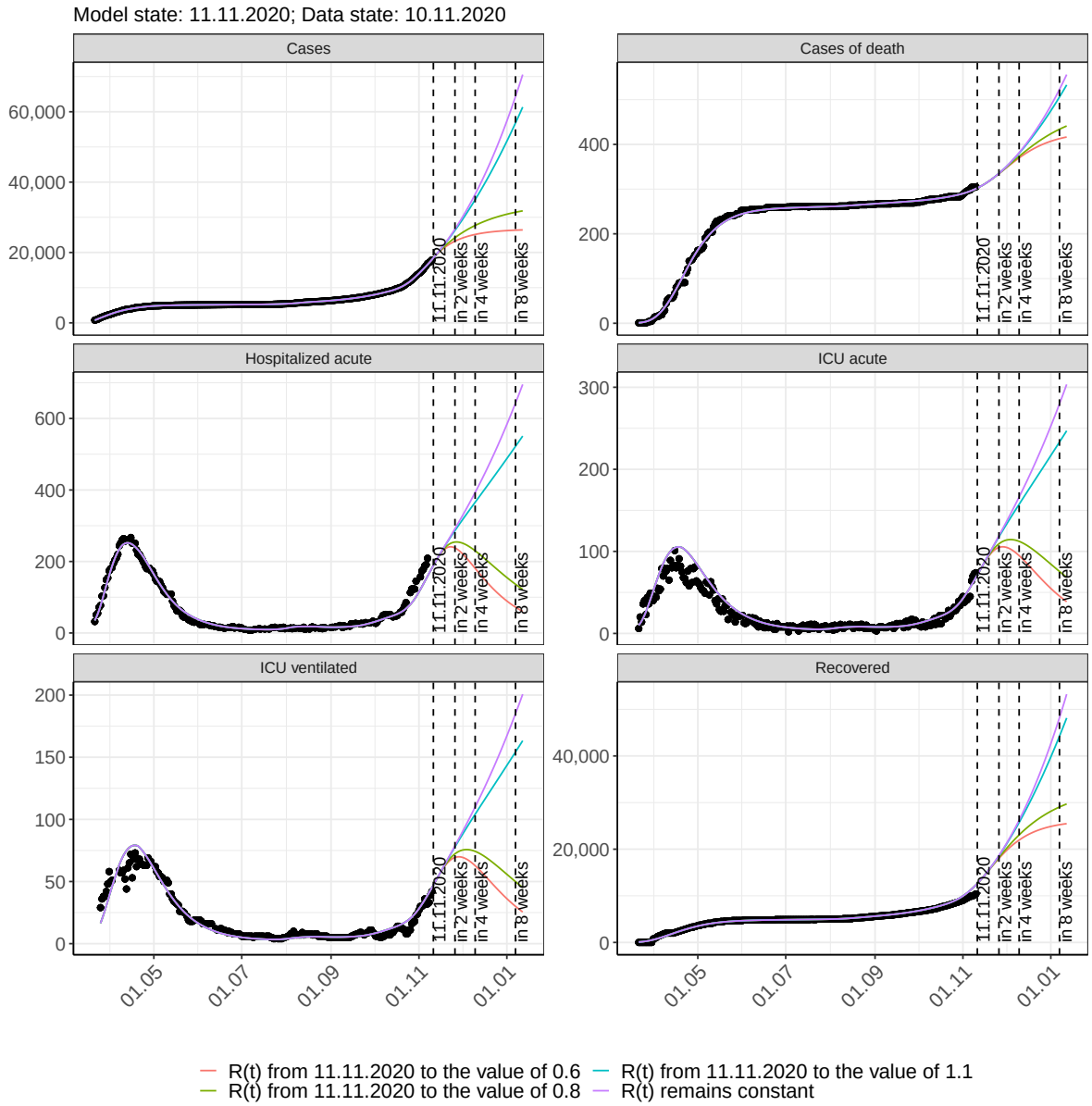


Figure 84: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Hamburg assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

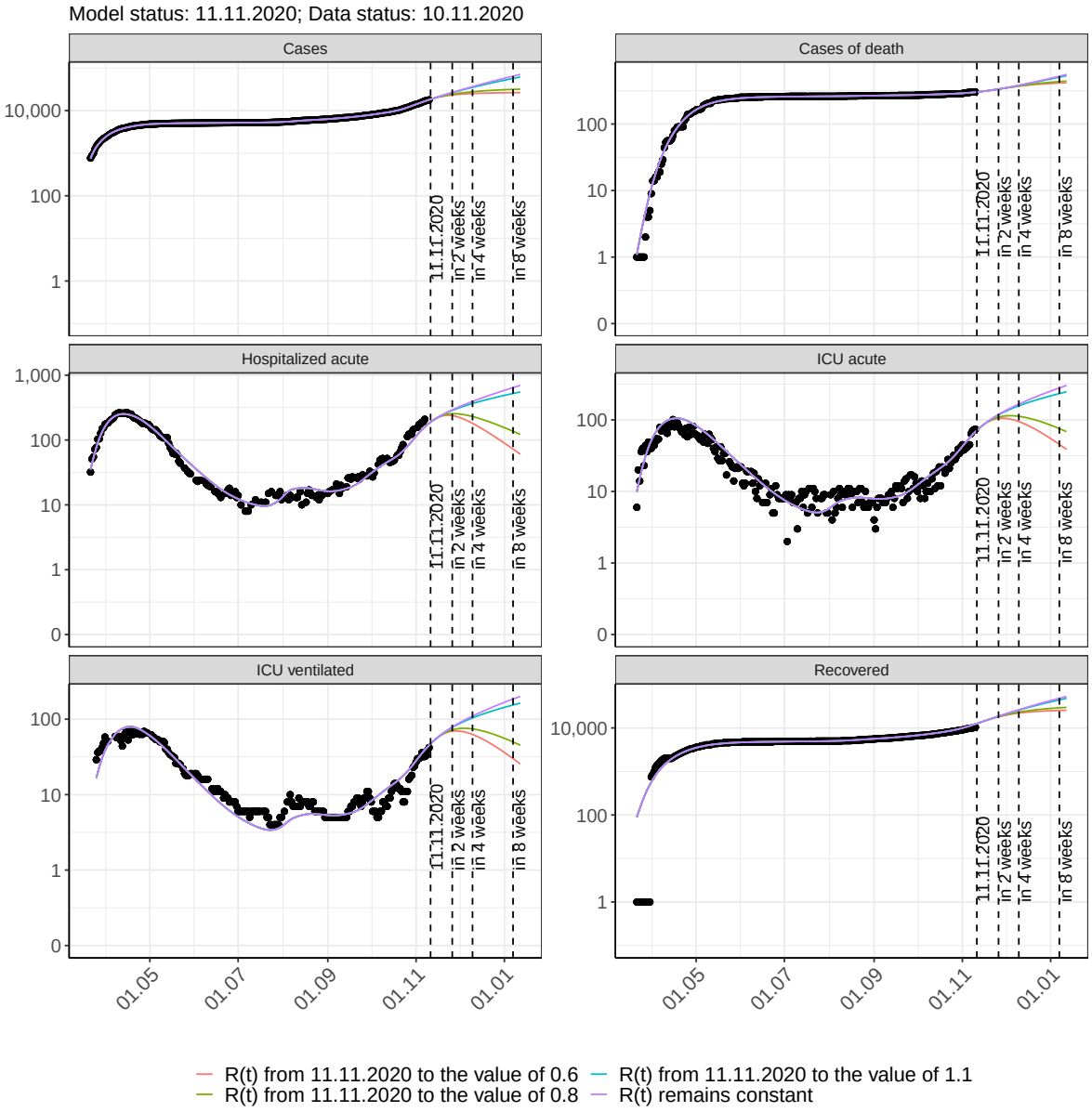


Figure 85: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Hamburg assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 86 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

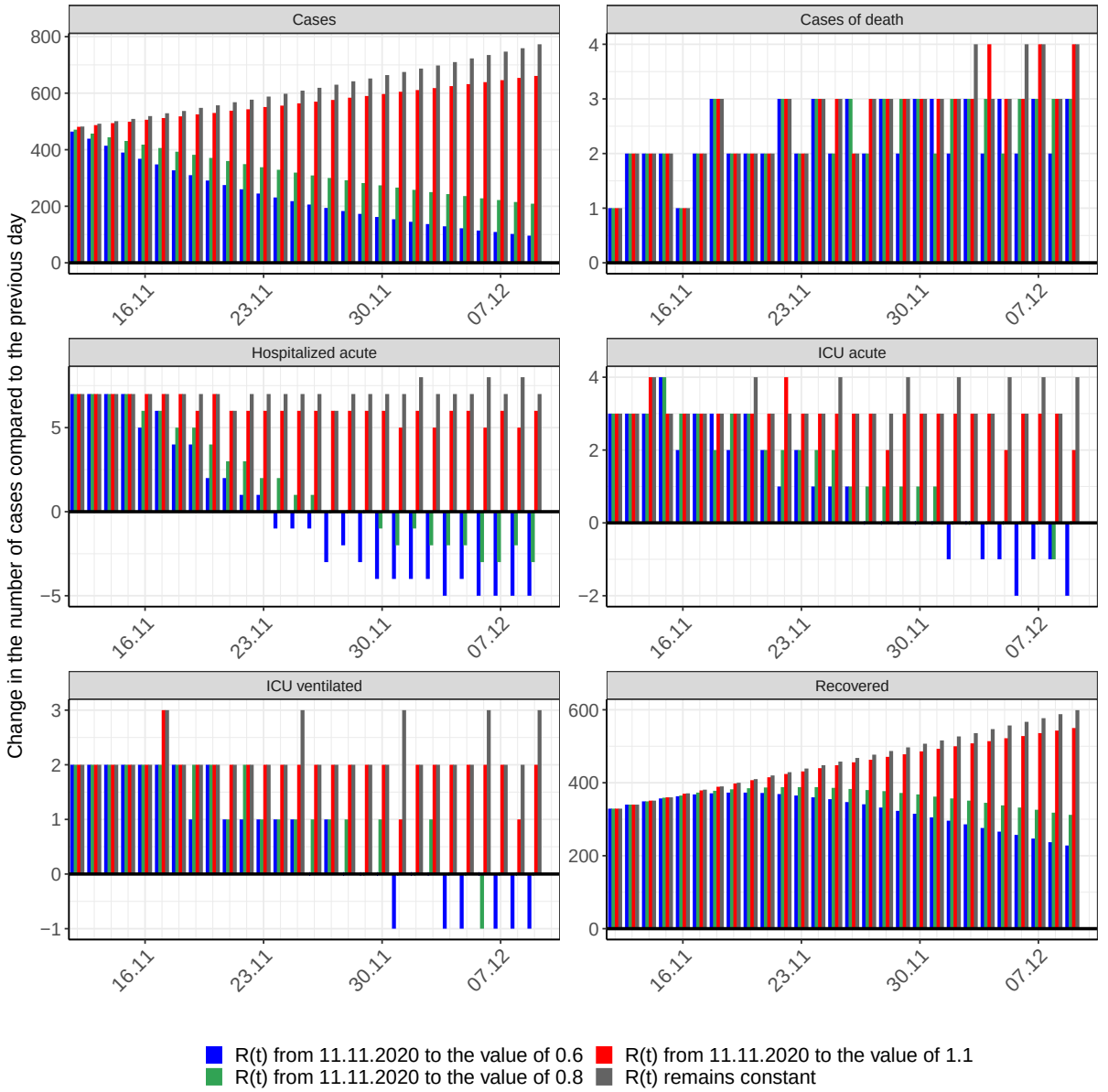


Figure 86: Simulation of daily new cases for the next 4 weeks - Hamburg

7.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Hamburg over time.

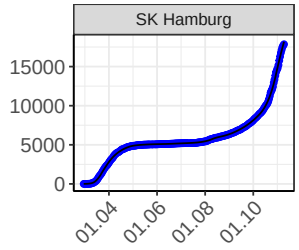


Figure 87: Model description of the reported case numbers in country- and citycounties in Hamburg. Points: reported data; lines: model description.

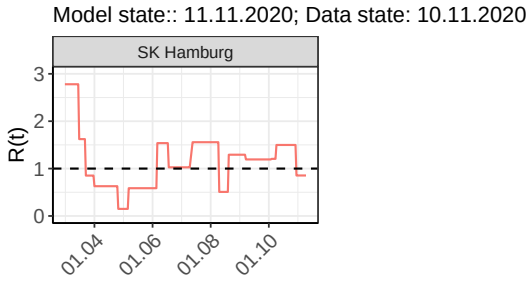


Figure 88: R(t) values over time for country- and citycounties in Hamburg

Table 7: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
SK Hamburg	2.78	1.62	0.85	0.63	0.15	0.59	1.54	1.03	1.56	0.51	1.29	1.19	1.21	1.5	0.85

8 Hesse

8.1 Model description

Fig. 89 depicts the results of the modeling (lines) compared to the observed data (points) for Hesse on a linear (A) and semi-logarithmic (B) scale.

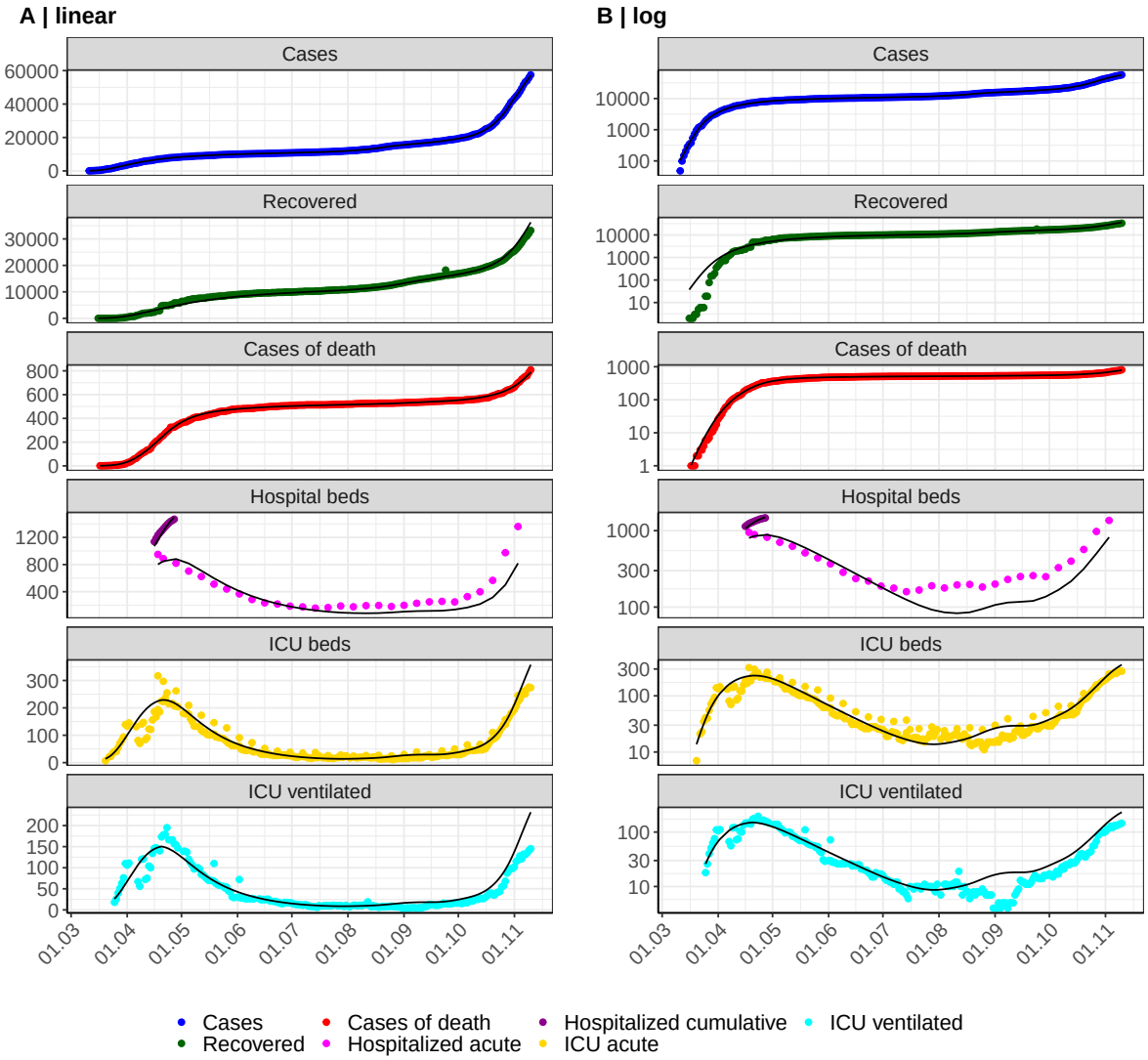


Figure 89: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Hesse. Points: reported data; lines: model description.

Fig. 90 shows the goodness-of-fit for Hesse. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

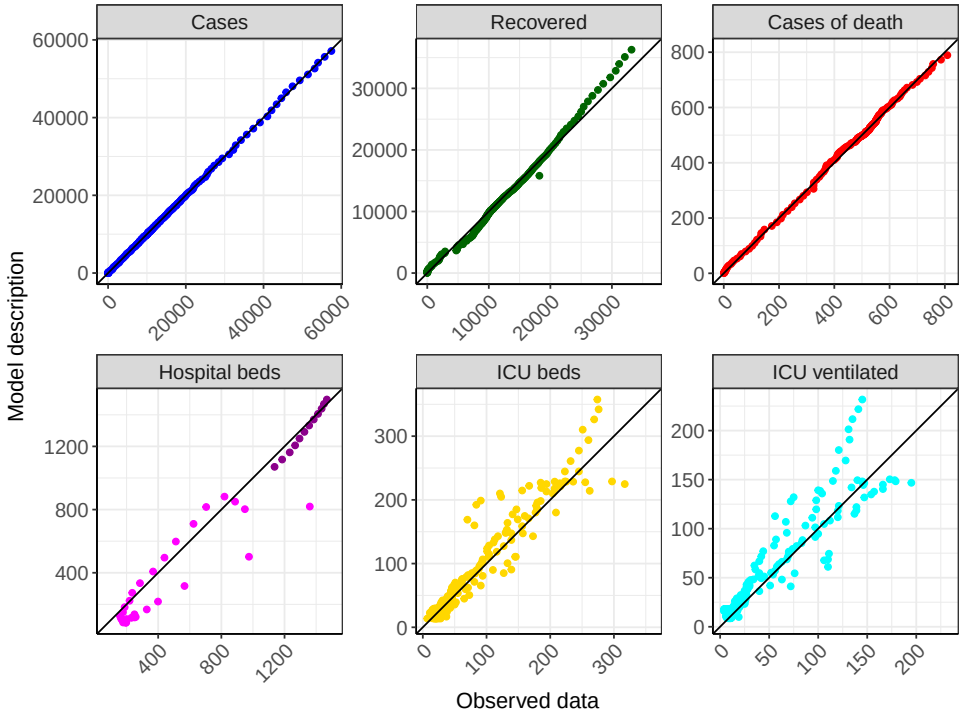


Figure 90: Goodness-of-fit plots for Hesse. Lines: lines of identity.

Fig. 91 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Hesse (red line) in comparison with the other federal states (grey lines).

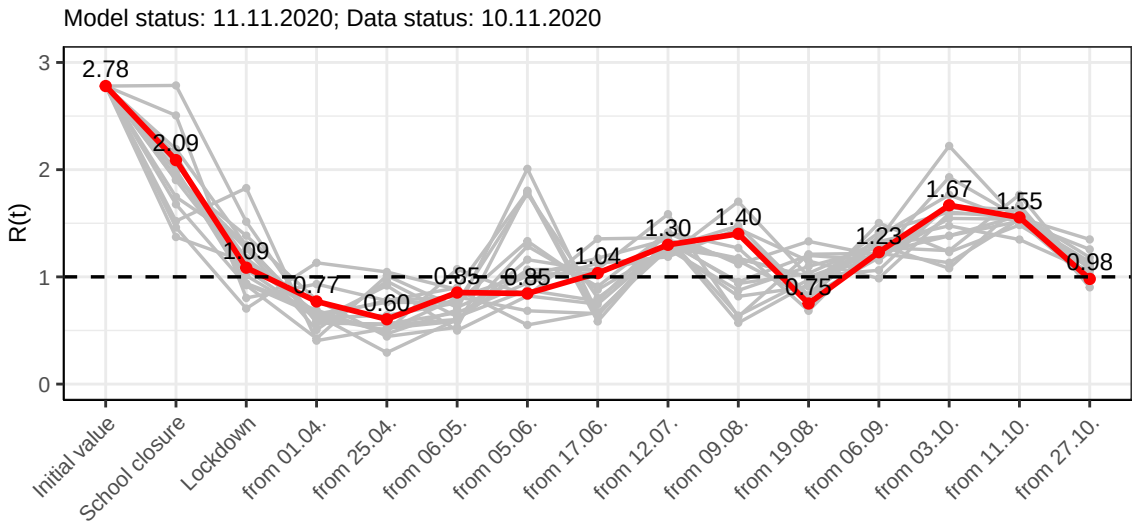


Figure 91: R(t) values before and after the NPIs for Hesse

Fig. 92 shows the R(t) estimated value for Hesse (red line) over time in comparison with the other federal states (grey lines).

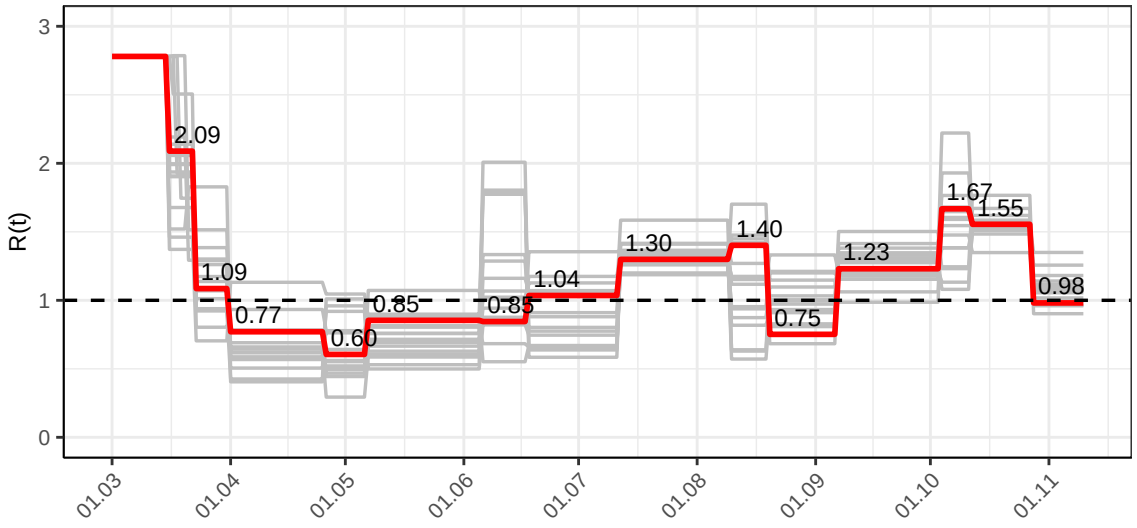


Figure 92: R(t) values over time for Hesse

Fig. 93 shows the changes in hospitalization and death rates for Hesse (red line) over time compared to the other states (grey lines).

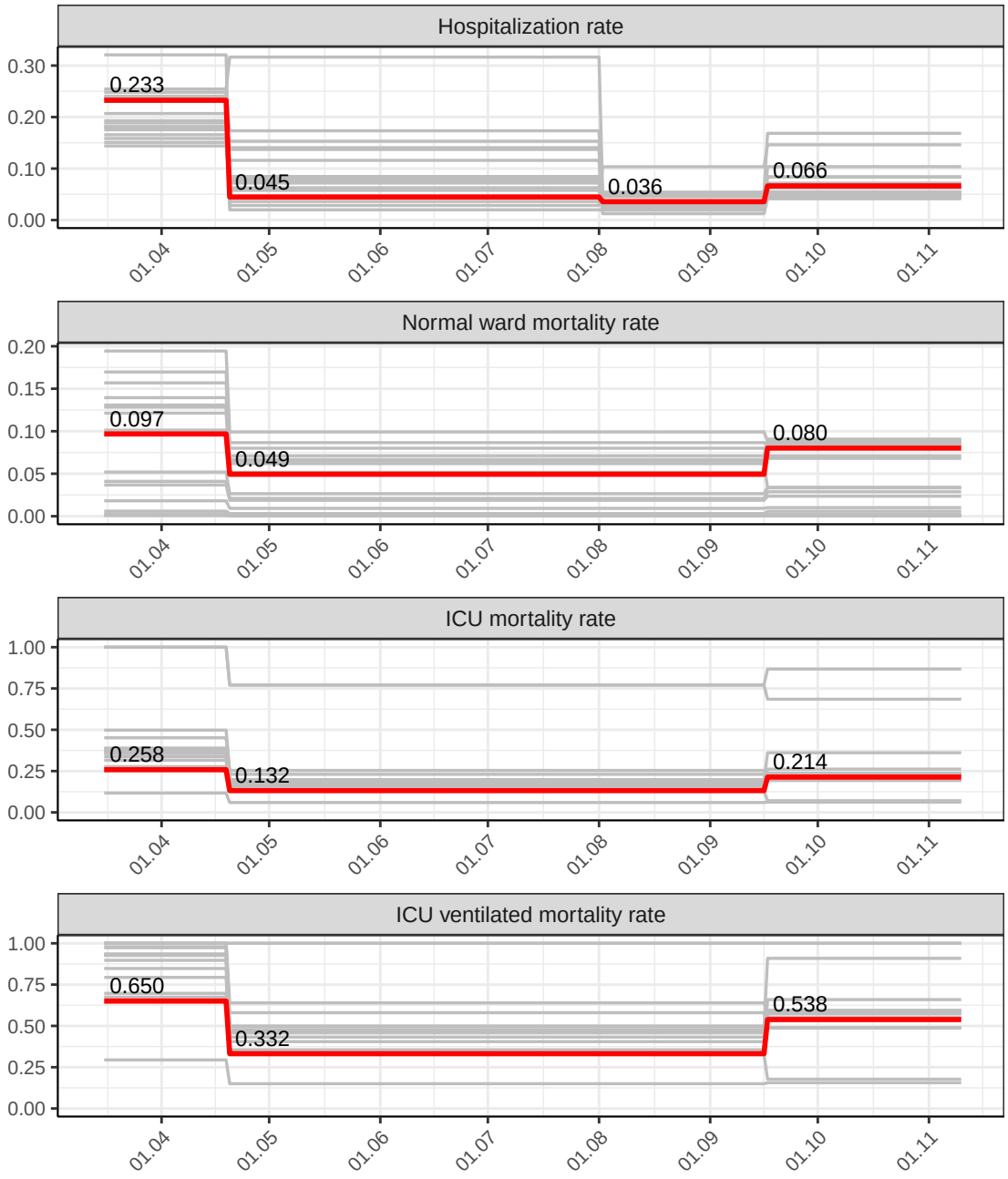


Figure 93: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Hesse

8.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 0.98) and assuming various scenarios from 11.11.2020

Fig.94 and 95 represent the model prediction for the next 8 weeks for Hesse on a linear (94) and a semi-logarithmic (95) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

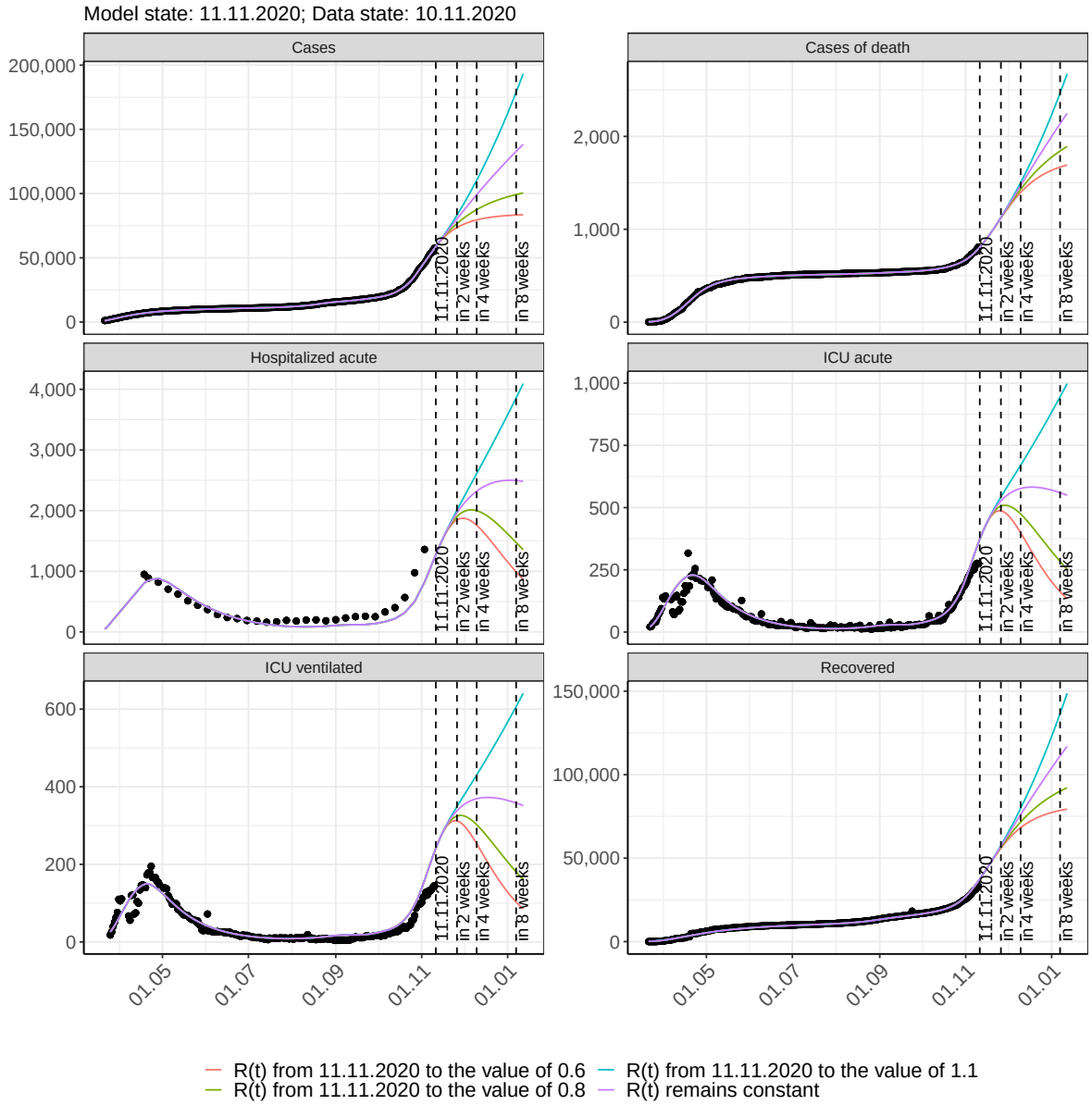


Figure 94: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Hesse assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

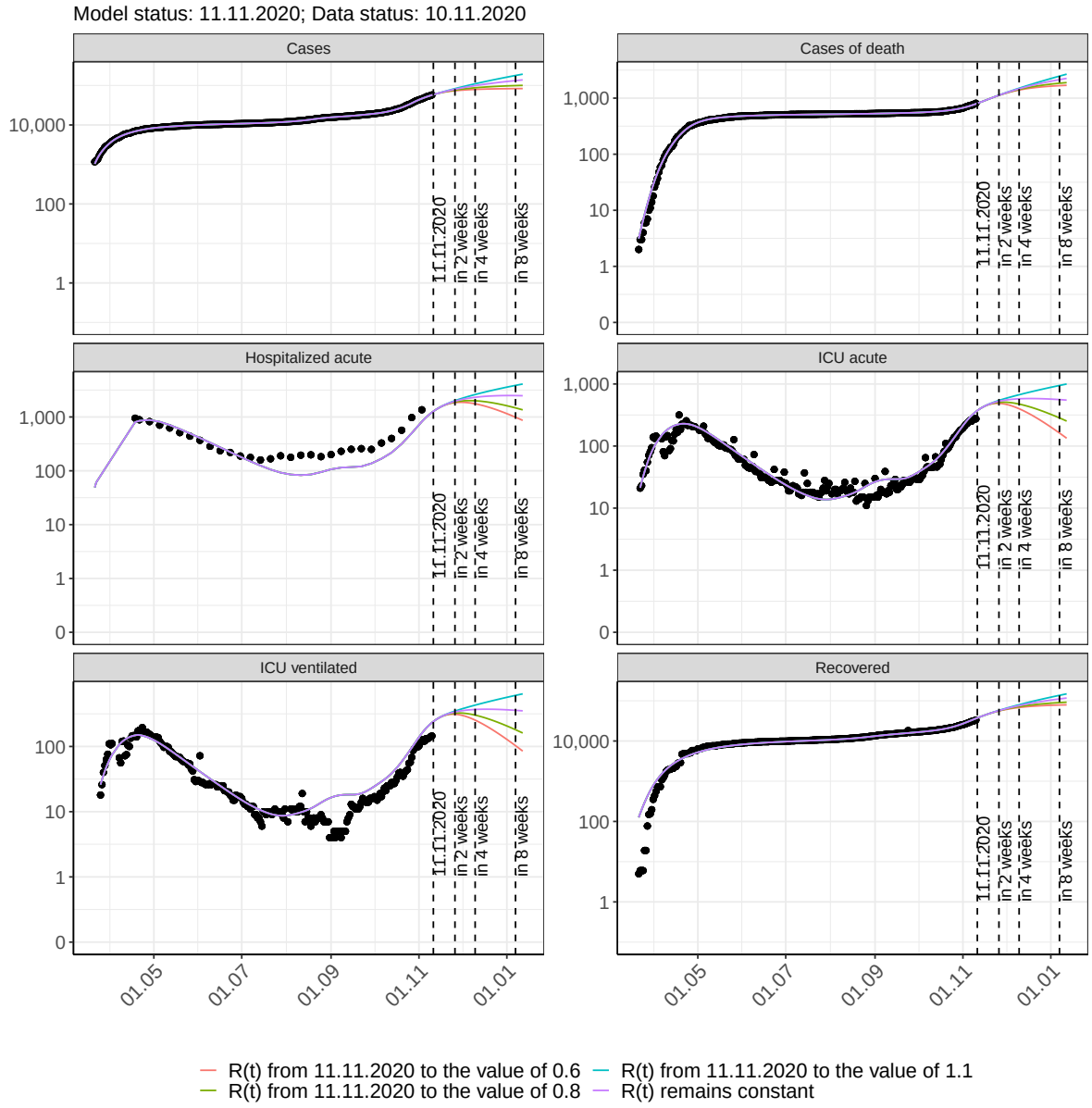


Figure 95: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Hesse assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 96 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

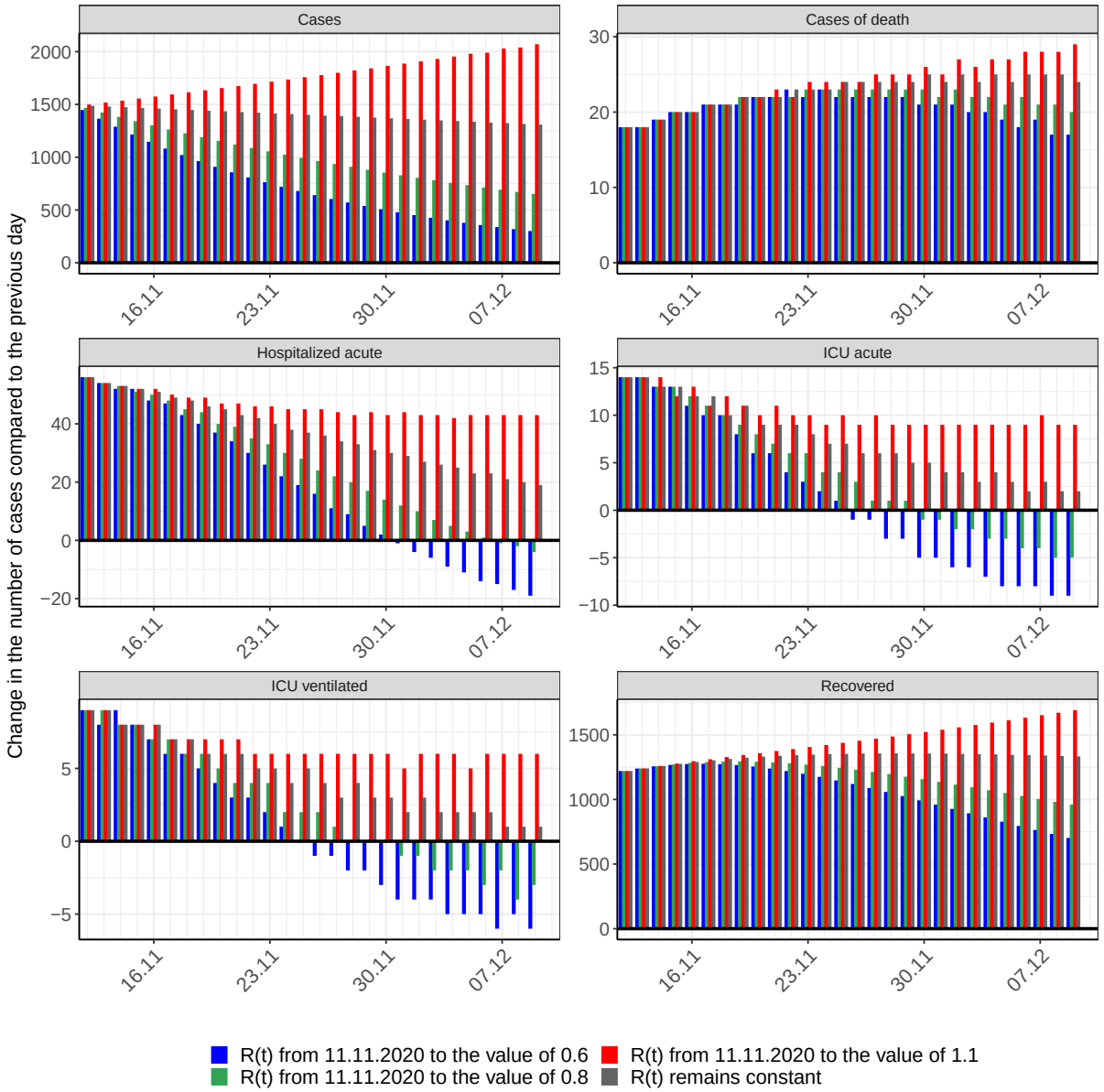


Figure 96: Simulation of daily new cases for the next 4 weeks - Hesse

8.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Hesse over time.

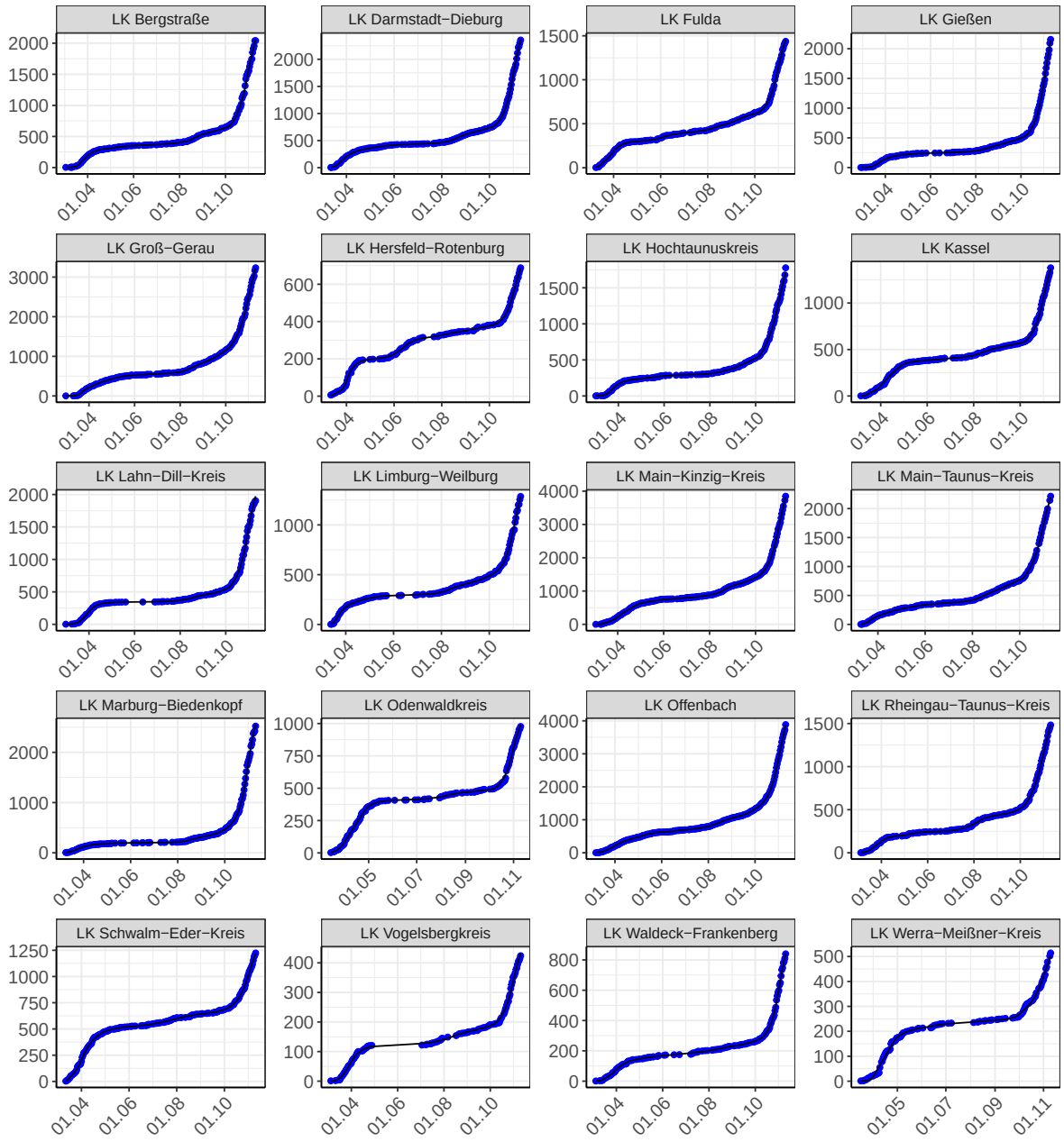


Figure 97: Model description of the reported case numbers in country- and citycounties in Hesse. Points: reported data; lines: model description.

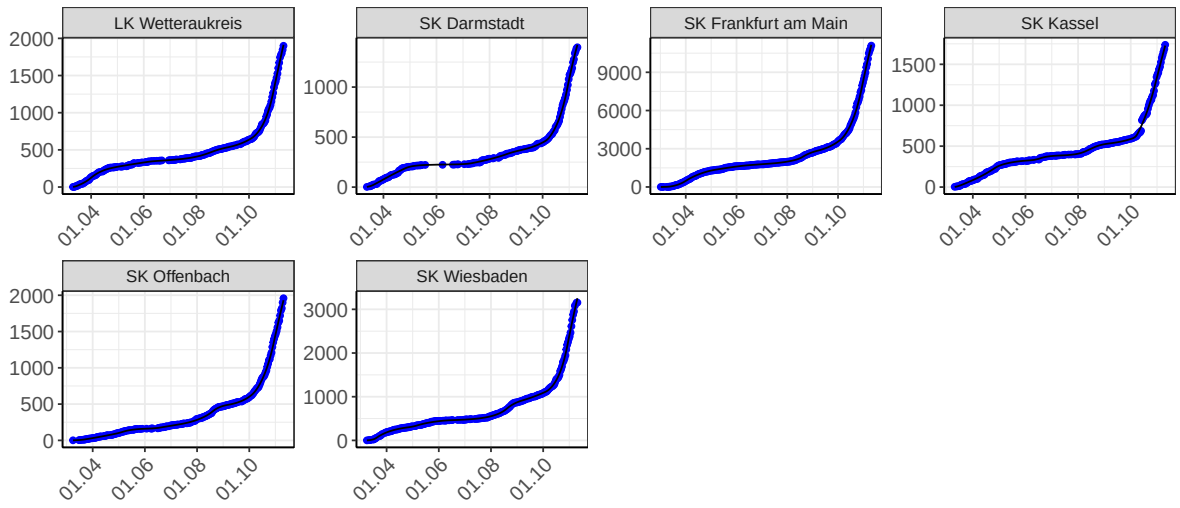


Figure 98: Model description of the reported case numbers in country- and citycounties in Hesse. Points: reported data; lines: model description.

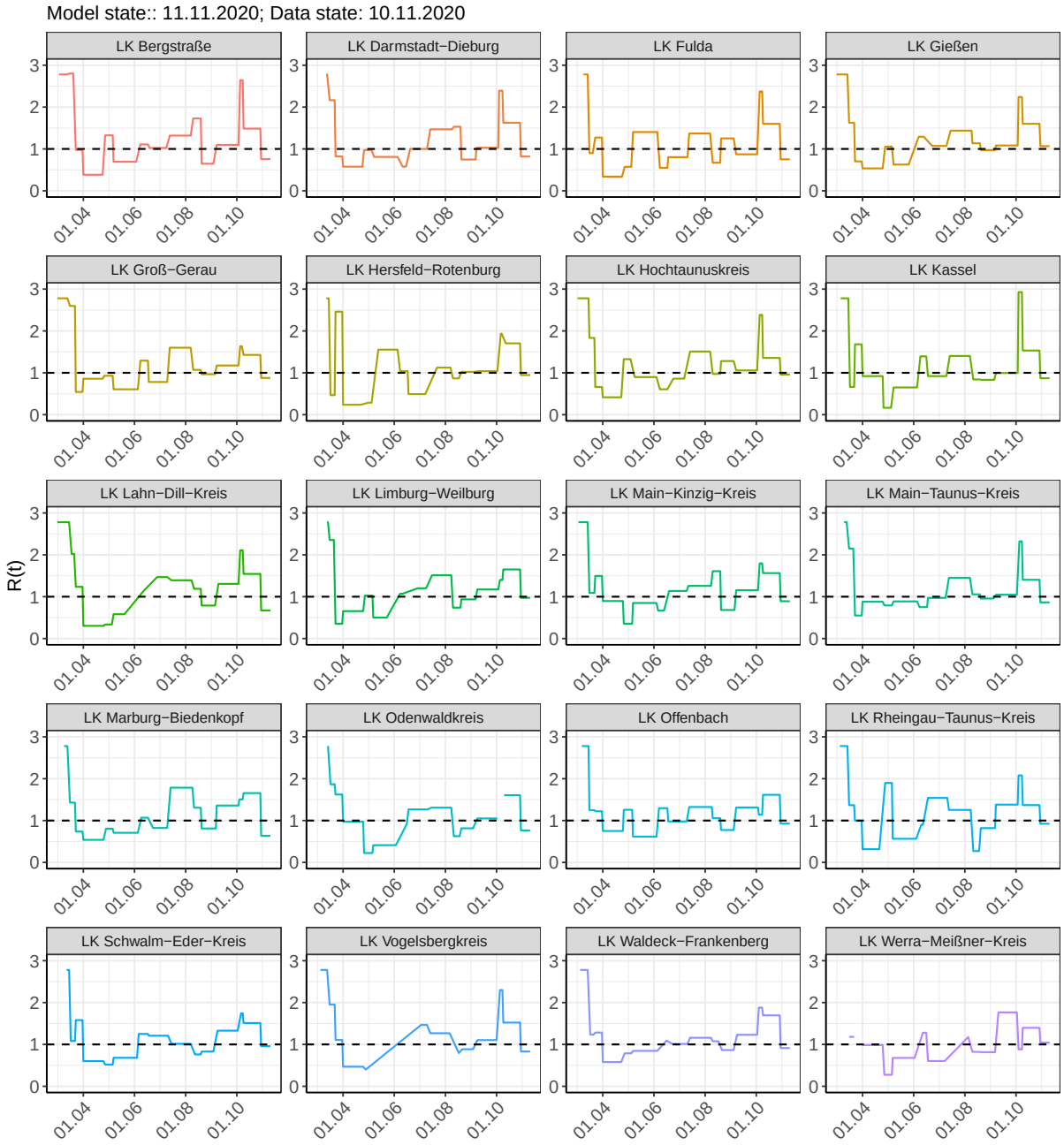


Figure 99: R(t) values over time for country- and citycounties in Hesse

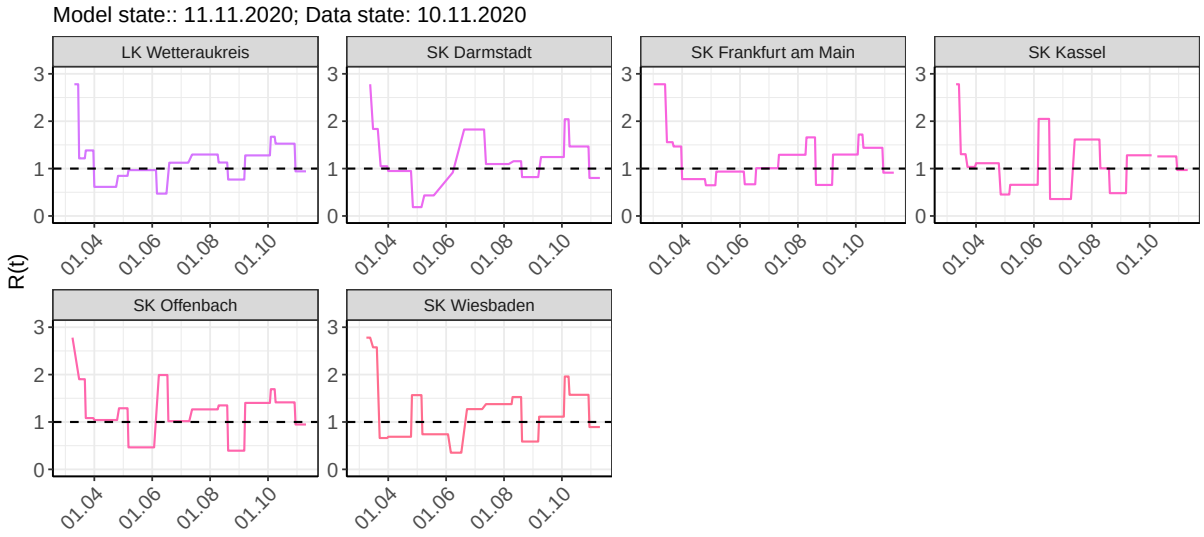


Figure 100: R(t) values over time for country- and citycounties in Hesse

Table 8: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Bergstraße	2.78	2.80	0.98	0.38	1.32	0.69	1.11	1.02	1.32	1.73	0.65	1.10	2.64	1.49	0.76
LK Darmstadt-Dieburg	2.78	2.16	0.82	0.58	0.97	0.81	0.58	1.00	1.47	1.53	0.75	1.03	2.39	1.63	0.82
LK Fulda	2.78	0.90	1.27	0.34	0.57	1.40	0.55	0.80	1.37	0.67	1.25	0.87	2.37	1.60	0.75
LK Gießen	2.78	1.63	0.70	0.54	1.06	0.63	1.29	1.07	1.44	1.14	0.97	1.08	2.24	1.60	1.07
LK Groß-Gerau	2.78	2.60	0.54	0.86	0.93	0.61	1.29	0.78	1.60	1.07	0.97	1.18	1.63	1.43	0.88
LK Hersfeld-Rotenburg	2.78	0.47	2.46	0.24	0.29	1.55	1.04	0.49	1.12	0.87	1.02	1.04	1.94	1.70	0.95
LK Hochtaunuskreis	2.78	1.83	0.66	0.42	1.33	0.90	0.61	0.86	1.51	0.97	1.28	1.06	2.38	1.36	0.96
LK Kassel	2.78	0.66	1.68	0.92	0.16	0.65	1.39	0.92	1.40	0.84	0.83	1.00	2.93	1.53	0.87
LK Lahn-Dill-Kreis	2.78	2.02	1.24	0.30	0.34	0.58	1.14	1.47	1.39	1.19	0.79	1.31	2.11	1.54	0.67
LK Limburg-Weilburg	2.78	2.36	0.35	0.66	1.03	0.50	1.07	1.20	1.51	0.74	0.94	1.17	1.40	1.65	0.97
LK Main-Kinzig-Kreis	2.78	1.09	1.50	0.90	0.36	0.85	0.67	1.14	1.26	1.61	0.68	1.16	1.80	1.56	0.89
LK Main-Taunus-Kreis	2.78	2.15	0.55	0.88	0.79	0.89	0.75	0.97	1.45	1.06	0.96	1.05	2.32	1.40	0.86

Table 8: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Marburg-Biedenkopf	2.78	1.43	0.74	0.54	0.81	0.71	1.07	0.82	1.79	1.31	0.81	1.36	1.51	1.66	0.64
LK Odenwaldkreis	2.78	1.87	1.62	0.97	0.22	0.41	0.92	1.27	1.31	0.63	0.82	1.05	3.27	1.61	0.76
LK Offenbach	2.78	1.25	1.22	0.75	1.26	0.62	1.30	0.98	1.32	1.06	0.77	1.31	1.14	1.62	0.93
LK Rheingau-Taunus-Kreis	2.78	1.37	0.99	0.32	1.90	0.56	0.90	1.54	1.25	0.27	0.82	1.38	2.08	1.37	0.92
LK Schwalm-Eder-Kreis	2.78	1.08	1.58	0.60	0.52	0.68	1.25	1.21	1.02	0.76	0.83	1.33	1.75	1.51	0.96
LK Vogelsbergkreis	2.78	1.95	1.11	0.47	0.40	0.62	1.16	1.47	1.27	0.79	0.89	1.10	2.30	1.52	0.83
LK Waldeck-Frankenberg	2.78	1.23	1.28	0.58	0.79	0.85	1.09	1.01	1.16	1.07	0.87	1.23	1.88	1.69	0.91
LK Werra-Meißner-Kreis	2.78	1.18	3.03	0.99	0.27	0.68	1.28	0.60	1.18	0.82	0.82	1.77	0.88	1.40	1.04
LK Wetteraukreis	2.78	1.22	1.38	0.61	0.85	0.97	0.47	1.12	1.30	1.13	0.77	1.28	1.67	1.53	0.94

Table 8: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
SK Darmstadt	2.78	1.84	1.05	0.95	0.19	0.43	0.92	1.82	1.10	1.16	0.82	1.24	2.04	1.47	0.80
SK Frankfurt am Main	2.78	1.56	1.47	0.78	0.65	0.94	0.67	1.01	1.29	1.66	0.65	1.30	1.72	1.44	0.91
SK Kassel	2.78	1.30	1.04	1.11	0.45	0.66	2.05	0.36	1.61	1.01	0.48	1.28	3.10	1.26	0.97
SK Offenbach	2.78	1.90	1.08	1.04	1.29	0.46	1.99	1.02	1.27	1.35	0.39	1.40	1.69	1.41	0.95
SK Wiesbaden	2.78	2.58	0.66	0.69	1.57	0.74	0.35	1.27	1.38	1.53	0.59	1.11	1.96	1.57	0.89

9 Mecklenburg-Vorpommern

9.1 Model description

Fig. 101 depicts the results of the modeling (lines) compared to the observed data (points) for Mecklenburg-Vorpommern on a linear (A) and semi-logarithmic (B) scale.

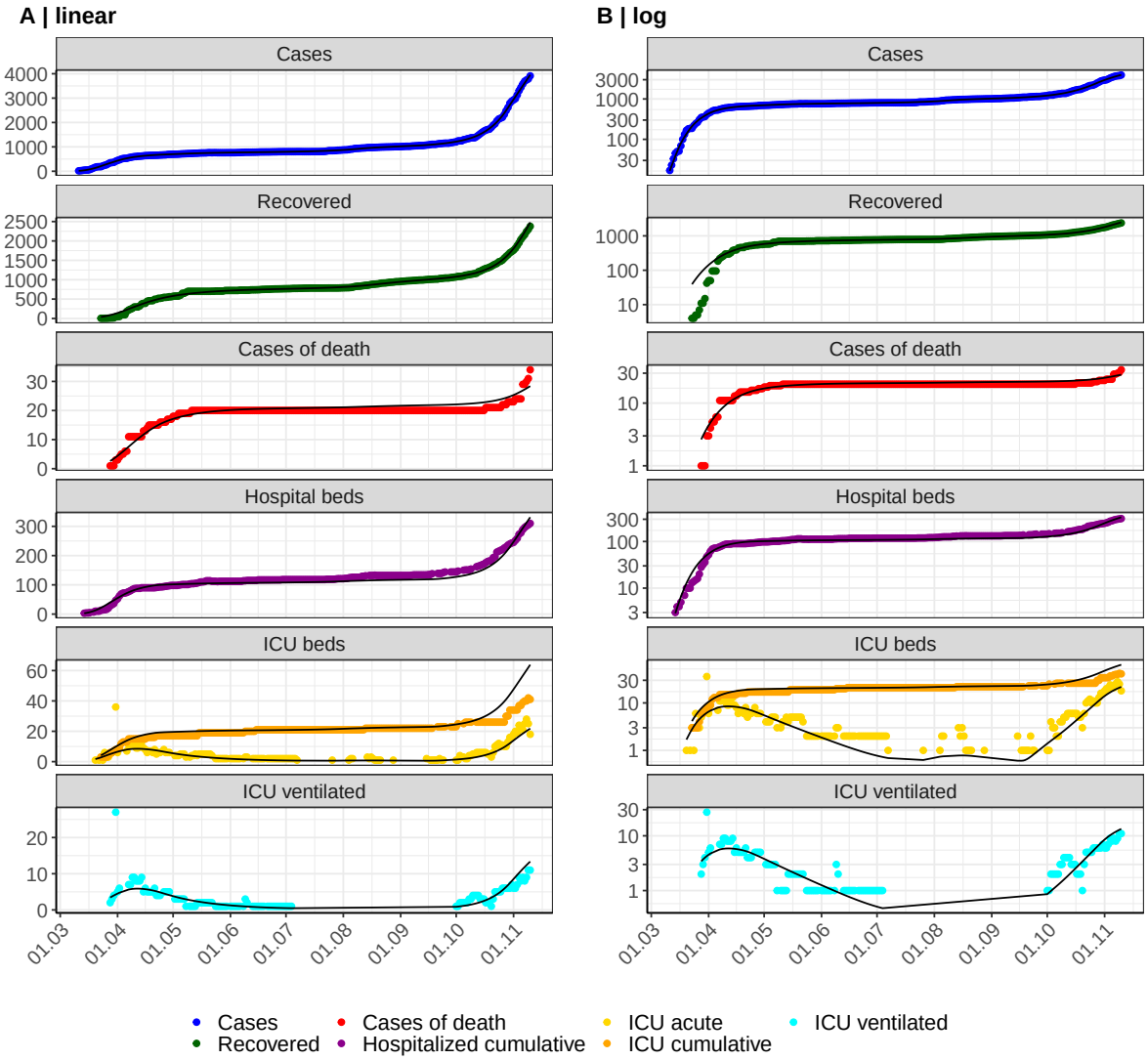


Figure 101: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Mecklenburg-Vorpommern. Points: reported data; lines: model description.

Fig. 102 shows the goodness-of-fit for Mecklenburg-Vorpommern. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

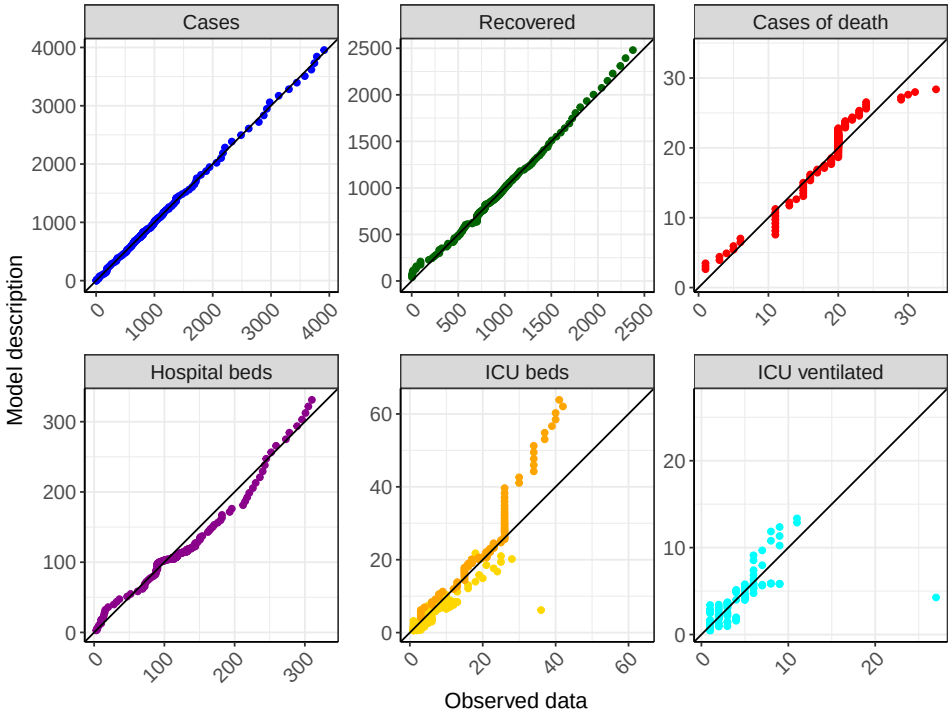


Figure 102: Goodness-of-fit plots for Mecklenburg-Vorpommern. Lines: lines of identity.

Fig. 103 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Mecklenburg-Vorpommern (red line) in comparison with the other federal states (grey lines).

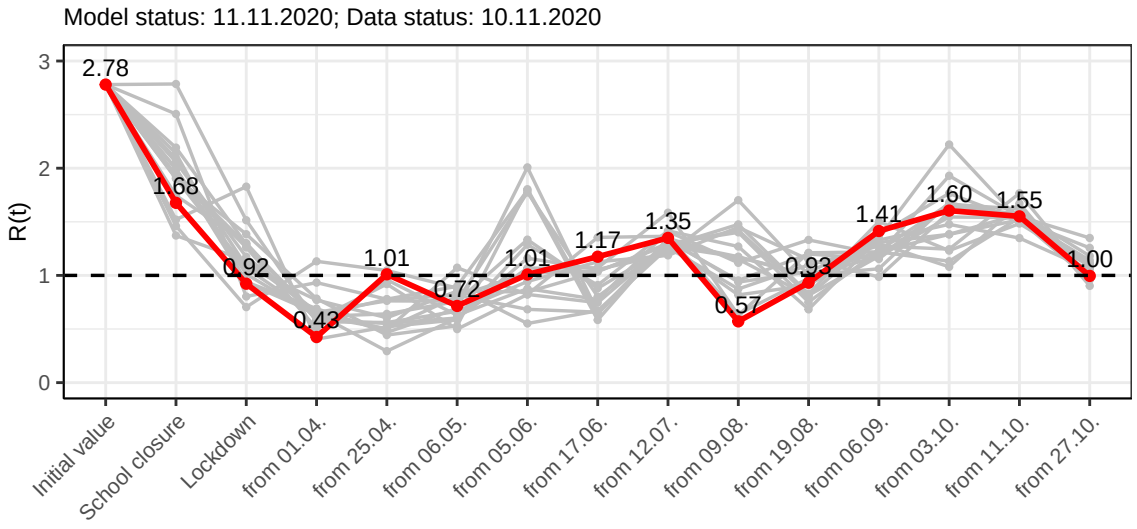


Figure 103: R(t) values before and after the NPIs for Mecklenburg-Vorpommern

Fig. 104 shows the R(t) estimated value for Mecklenburg-Vorpommern (red line) over time in comparison with the other federal states (grey lines).

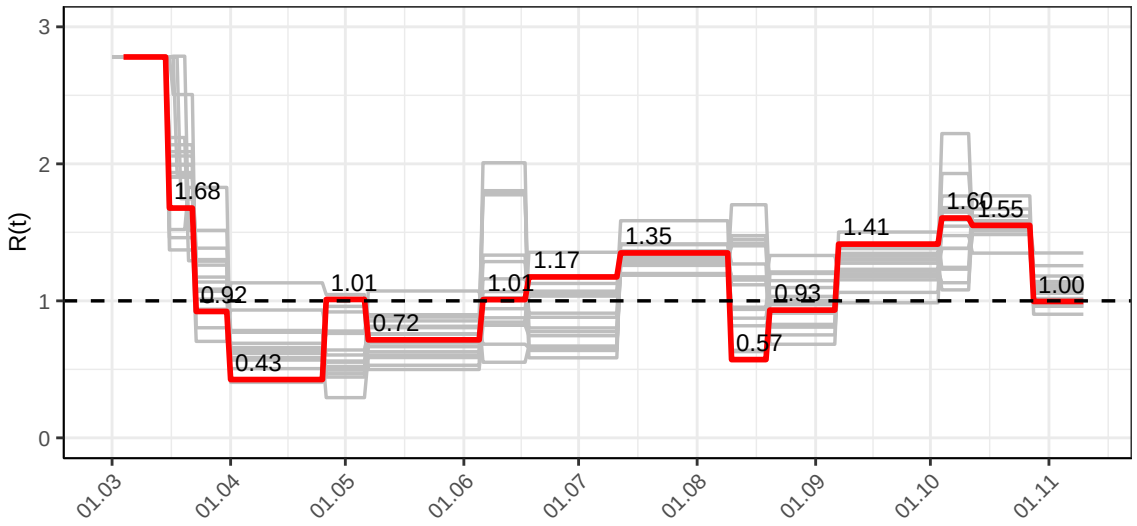


Figure 104: R(t) values over time for Mecklenburg-Vorpommern

Fig. 105 shows the changes in hospitalization and death rates for Mecklenburg-Vorpommern (red line) over time compared to the other states (grey lines).

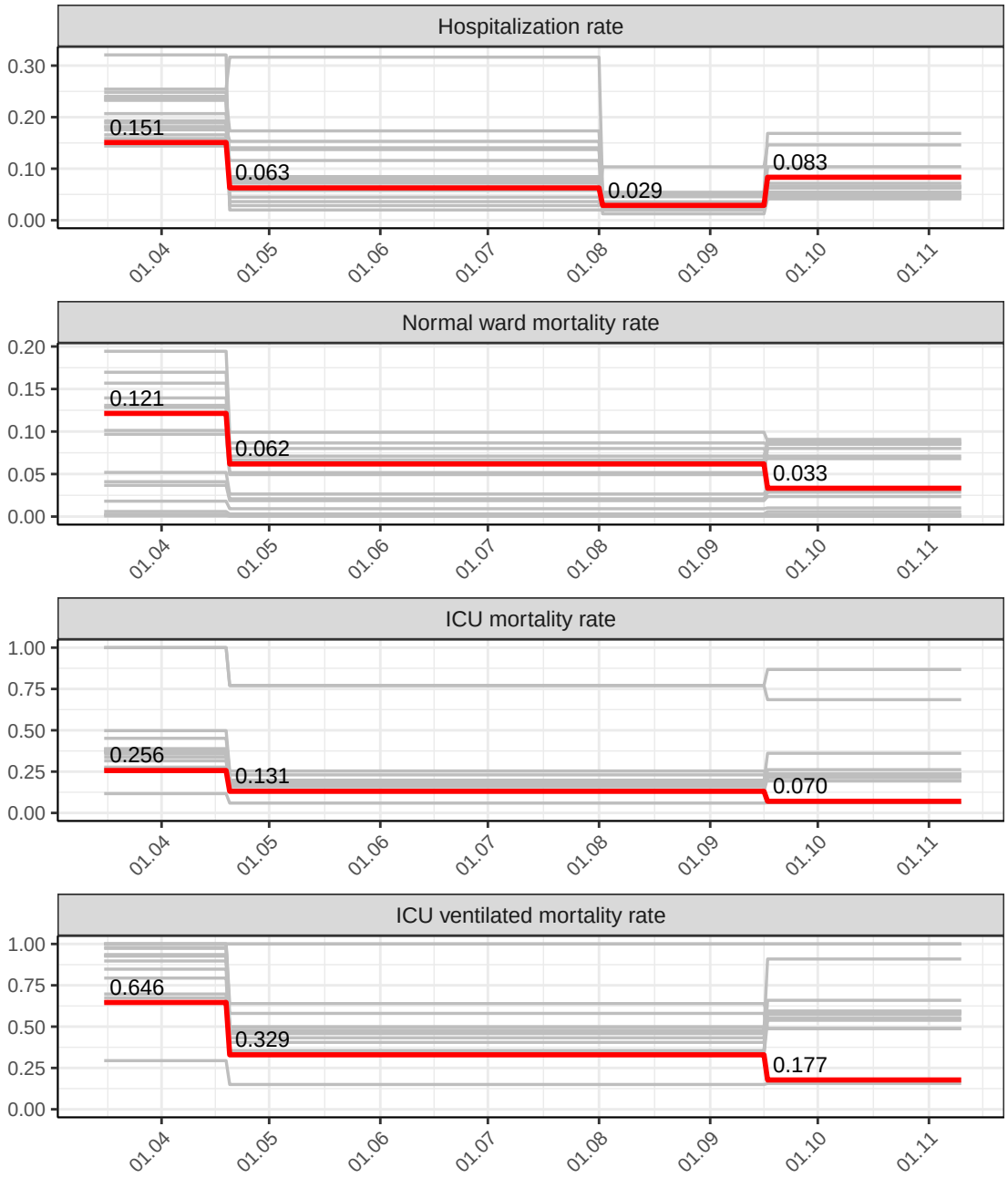


Figure 105: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Mecklenburg-Vorpommern

9.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1) and assuming various scenarios from 11.11.2020

Fig.106 and 107 represent the model prediction for the next 8 weeks for Mecklenburg-Vorpommern on a linear (106) and a semi-logarithmic (107) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

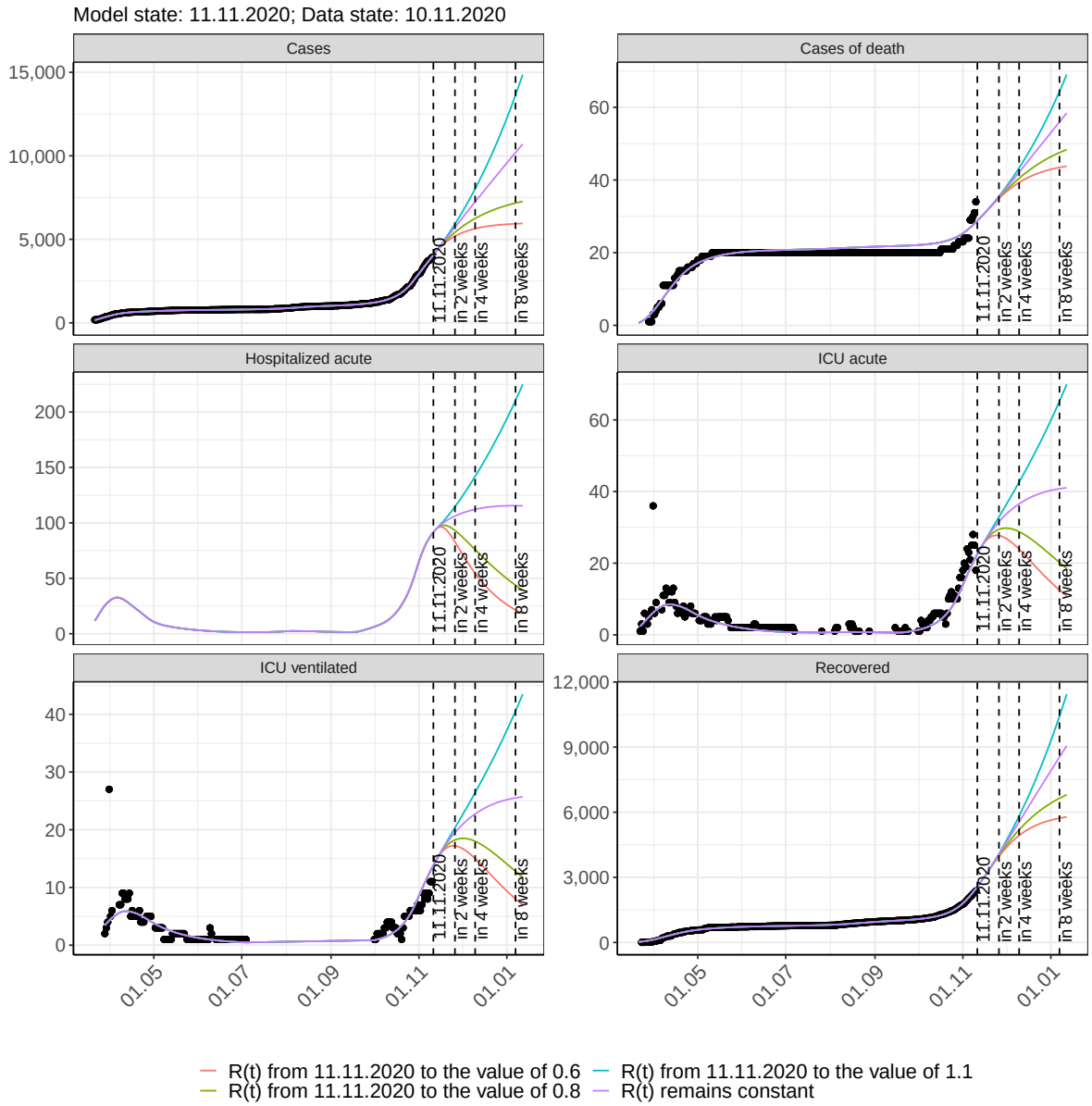


Figure 106: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Mecklenburg-Vorpommern assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

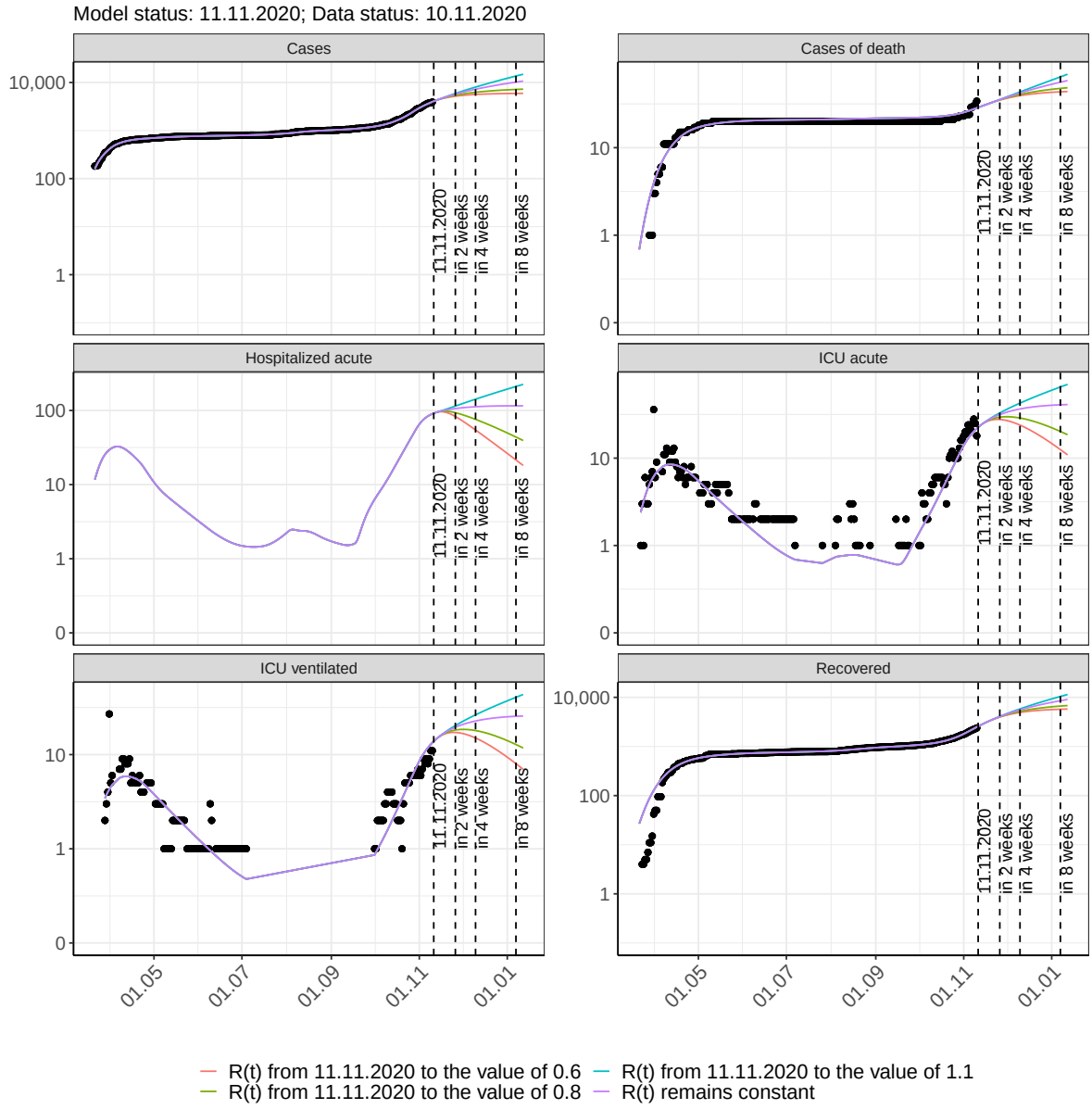


Figure 107: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Mecklenburg-Vorpommern assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 108 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

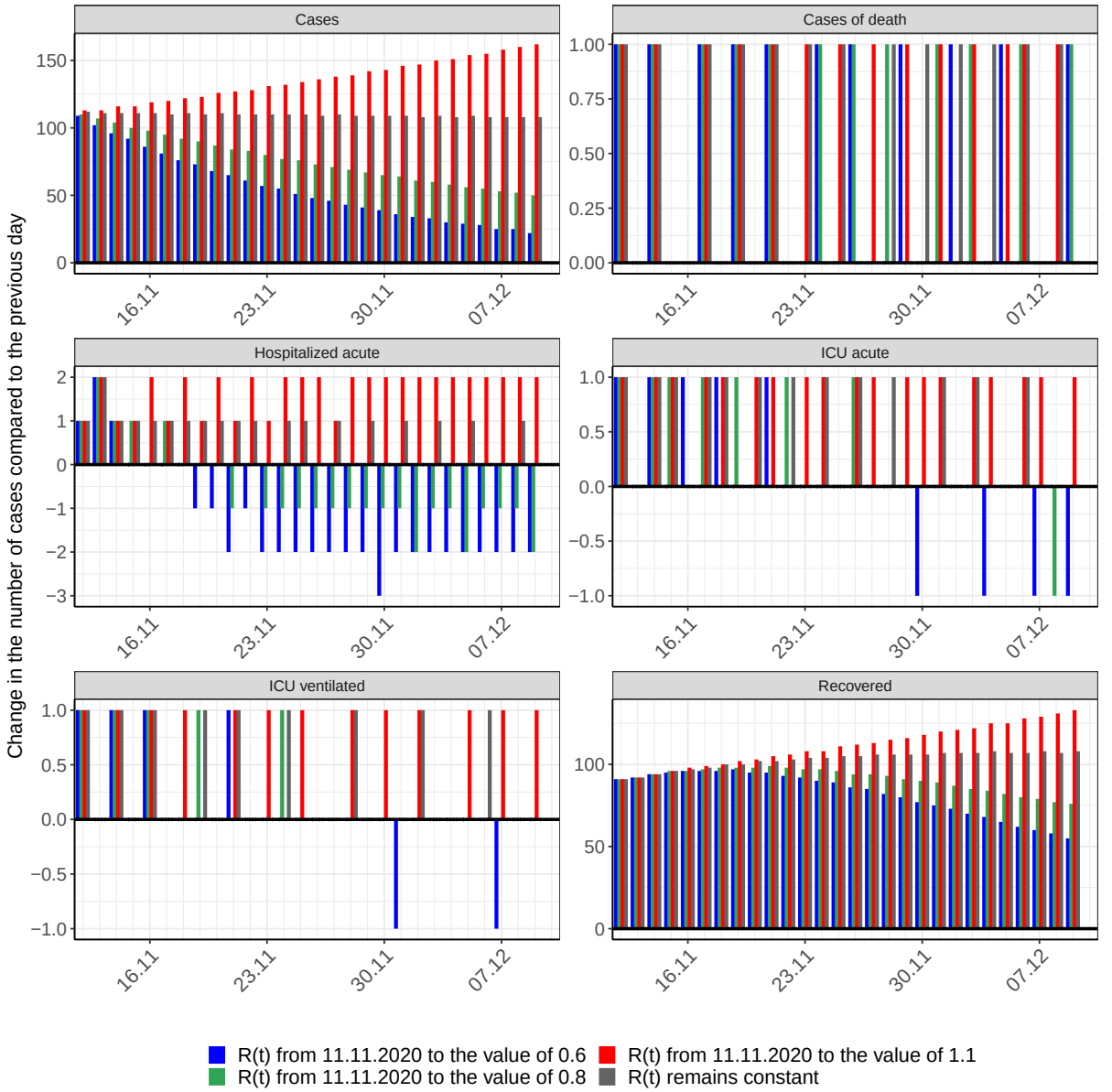


Figure 108: Simulation of daily new cases for the next 4 weeks - Mecklenburg-Vorpommern

9.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Mecklenburg-Vorpommern over time.

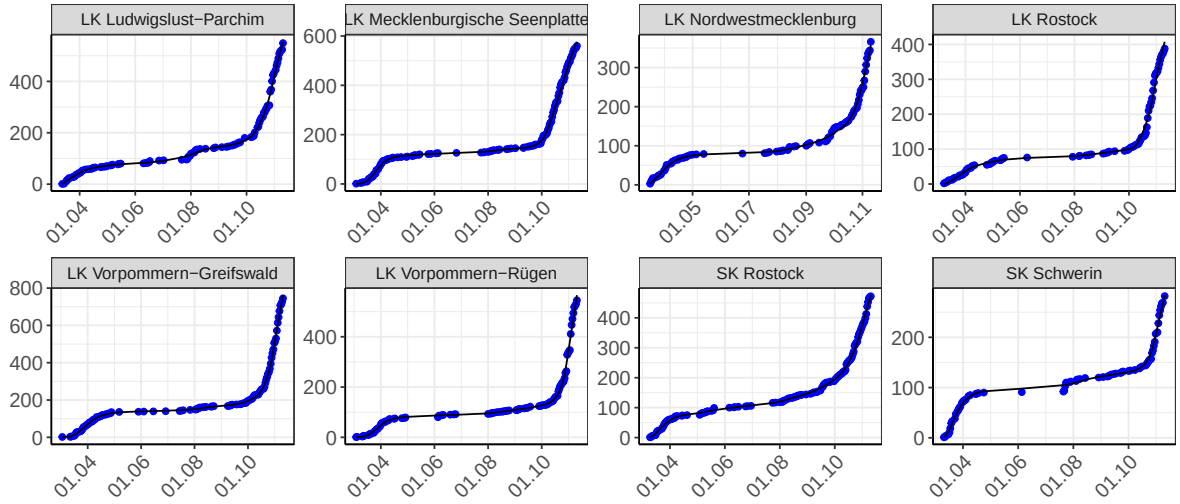


Figure 109: Model description of the reported case numbers in country- and citycounties in Mecklenburg-Vorpommern. Points: reported data; lines: model description.

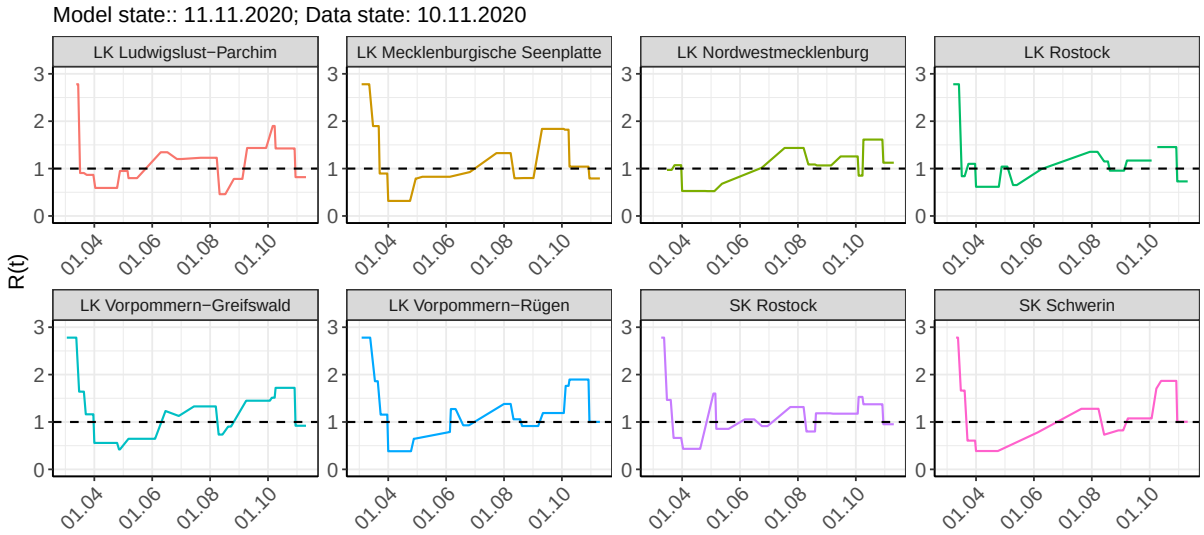


Figure 110: R(t) values over time for country- and citycounties in Mecklenburg-Vorpommern

Table 9: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Ludwigslust-Parchim	2.78	0.91	0.87	0.59	0.95	0.80	1.34	1.20	1.23	0.46	0.78	1.43	1.90	1.43	0.82
LK Mecklenburgische Seenplatte	2.78	1.90	0.90	0.32	0.79	0.83	1.17	0.93	1.33	0.80	0.80	1.84	1.82	1.04	0.79
LK Nordwestmecklenburg	2.78	0.97	1.07	0.53	0.52	0.68	1.16	1.02	1.44	1.09	1.07	1.26	0.85	1.61	1.12
LK Rostock	2.78	0.84	1.10	0.62	1.04	0.65	0.99	0.84	1.35	1.15	0.96	1.17	3.37	1.45	0.73
LK Vorpommern-Greifswald	2.78	1.64	1.16	0.56	0.42	0.65	1.23	1.13	1.33	0.73	0.90	1.45	1.51	1.72	0.92
LK Vorpommern-Rügen	2.78	1.86	1.16	0.38	0.65	0.79	1.27	0.93	1.38	1.06	0.91	1.19	1.76	1.90	1.00
SK Rostock	2.78	1.47	0.66	0.43	1.60	0.85	1.05	0.91	1.32	0.80	1.18	1.18	1.53	1.37	0.95
SK Schwerin	2.78	1.66	0.61	0.39	0.59	0.78	1.46	1.14	1.28	0.73	0.82	1.08	1.70	1.87	1.00

10 Lower Saxony

10.1 Model description

Fig. 111 depicts the results of the modeling (lines) compared to the observed data (points) for Lower Saxony on a linear (A) and semi-logarithmic (B) scale.

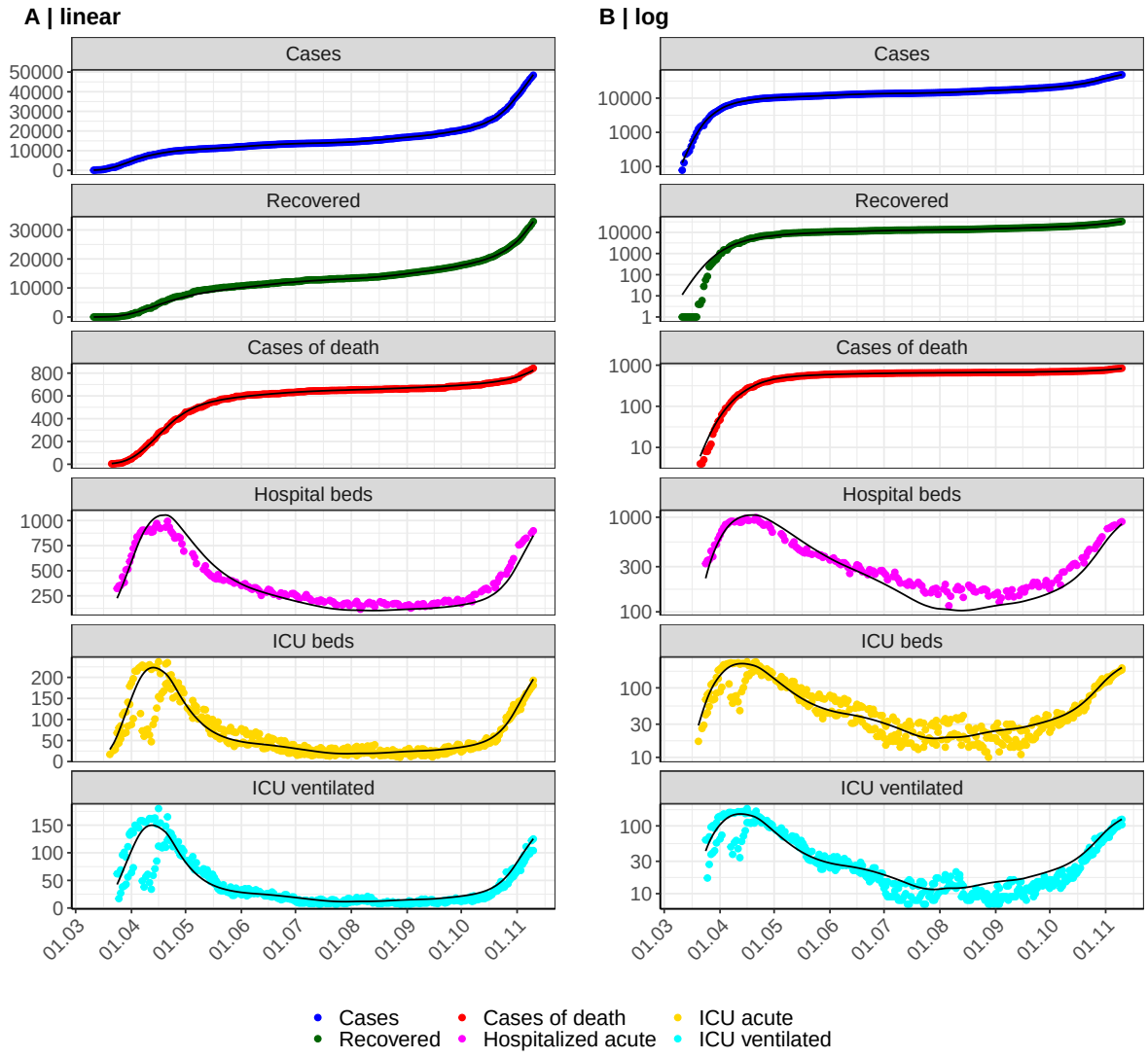


Figure 111: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Lower Saxony. Points: reported data; lines: model description.

Fig. 112 shows the goodness-of-fit for Lower Saxony. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

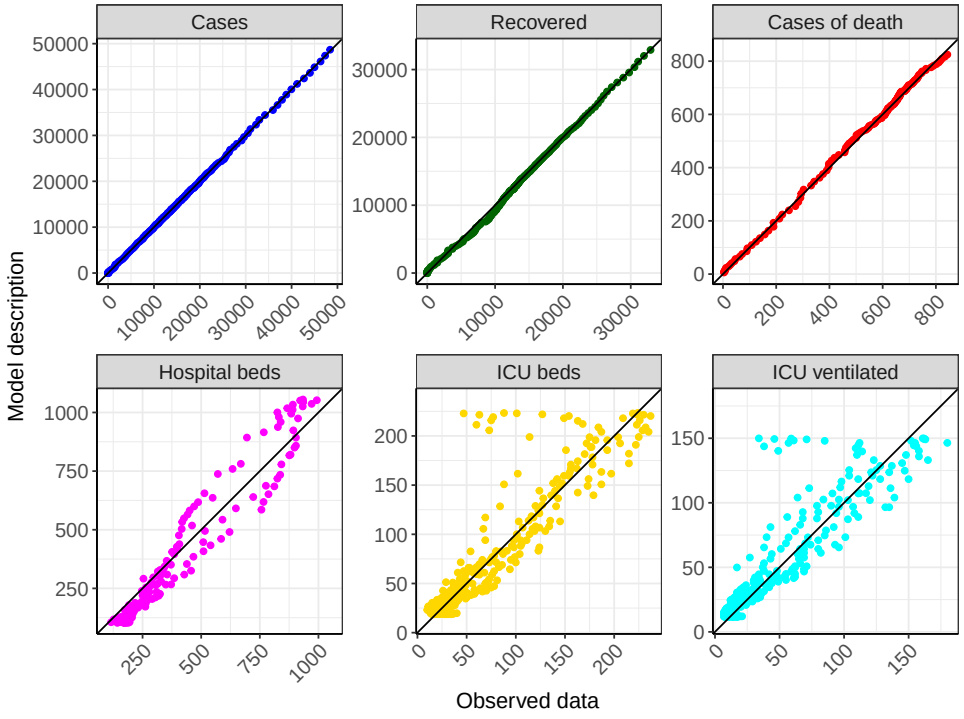


Figure 112: Goodness-of-fit plots for Lower Saxony. Lines: lines of identity.

Fig. 113 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Lower Saxony (red line) in comparison with the other federal states (grey lines).

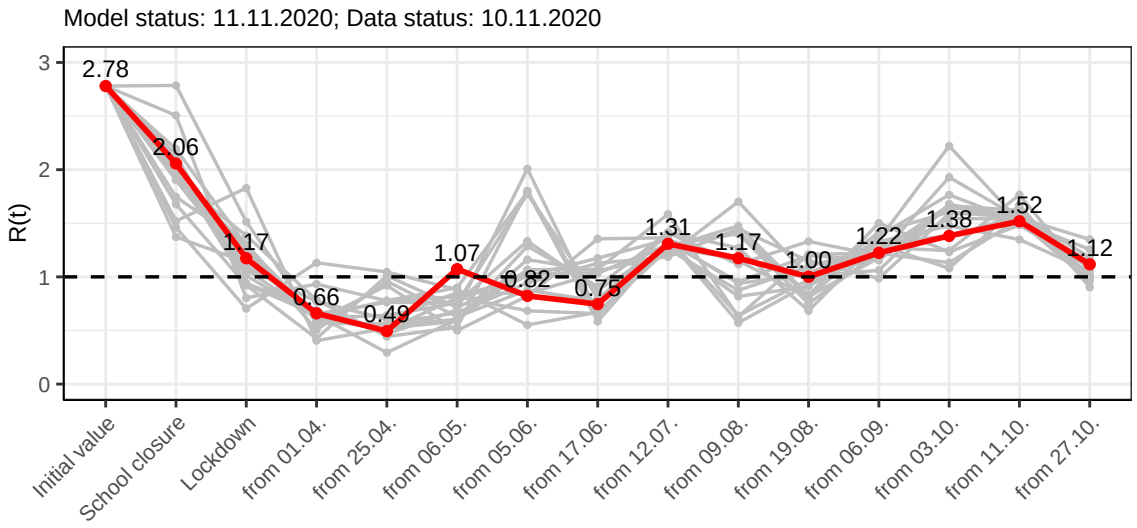


Figure 113: R(t) values before and after the NPIs for Lower Saxony

Fig. 114 shows the R(t) estimated value for Lower Saxony (red line) over time in comparison with the other federal states (grey lines).

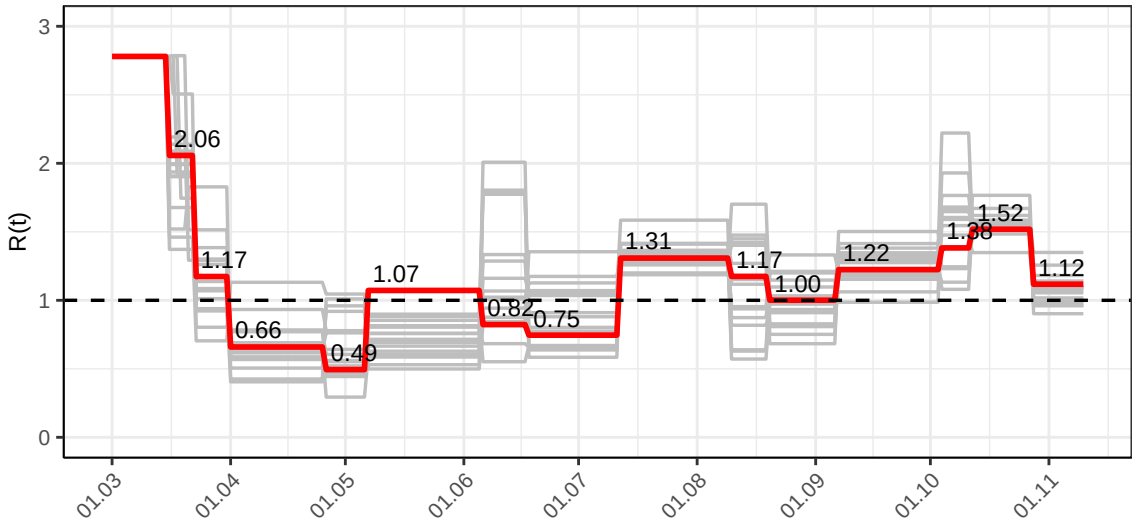


Figure 114: R(t) values over time for Lower Saxony

Fig. 115 shows the changes in hospitalization and death rates for Lower Saxony (red line) over time compared to the other states (grey lines).

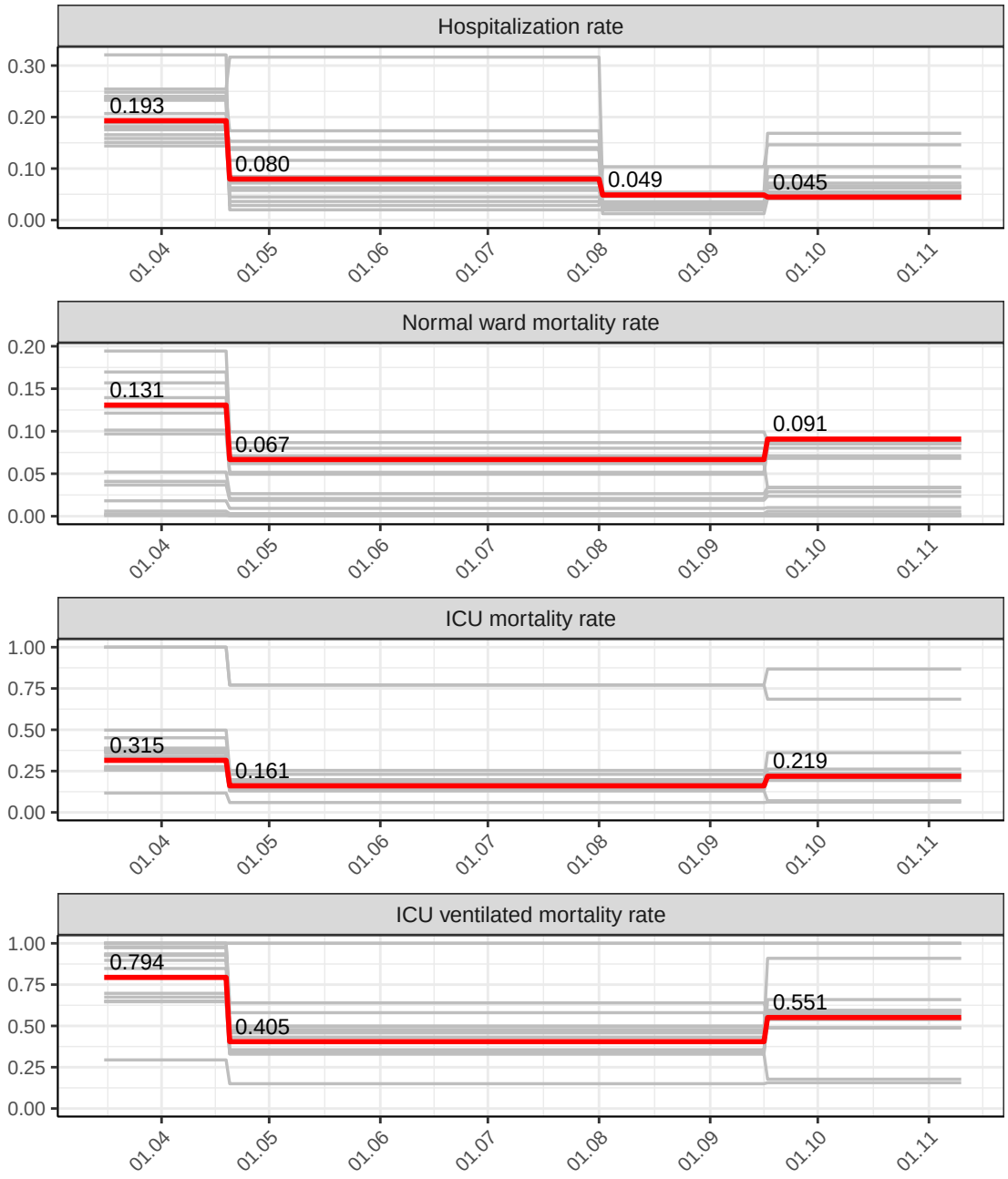


Figure 115: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Lower Saxony

10.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1.12) and assuming various scenarios from 11.11.2020

Fig.116 and 117 represent the model prediction for the next 8 weeks for Lower Saxony on a linear (116) and a semi-logarithmic (117) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

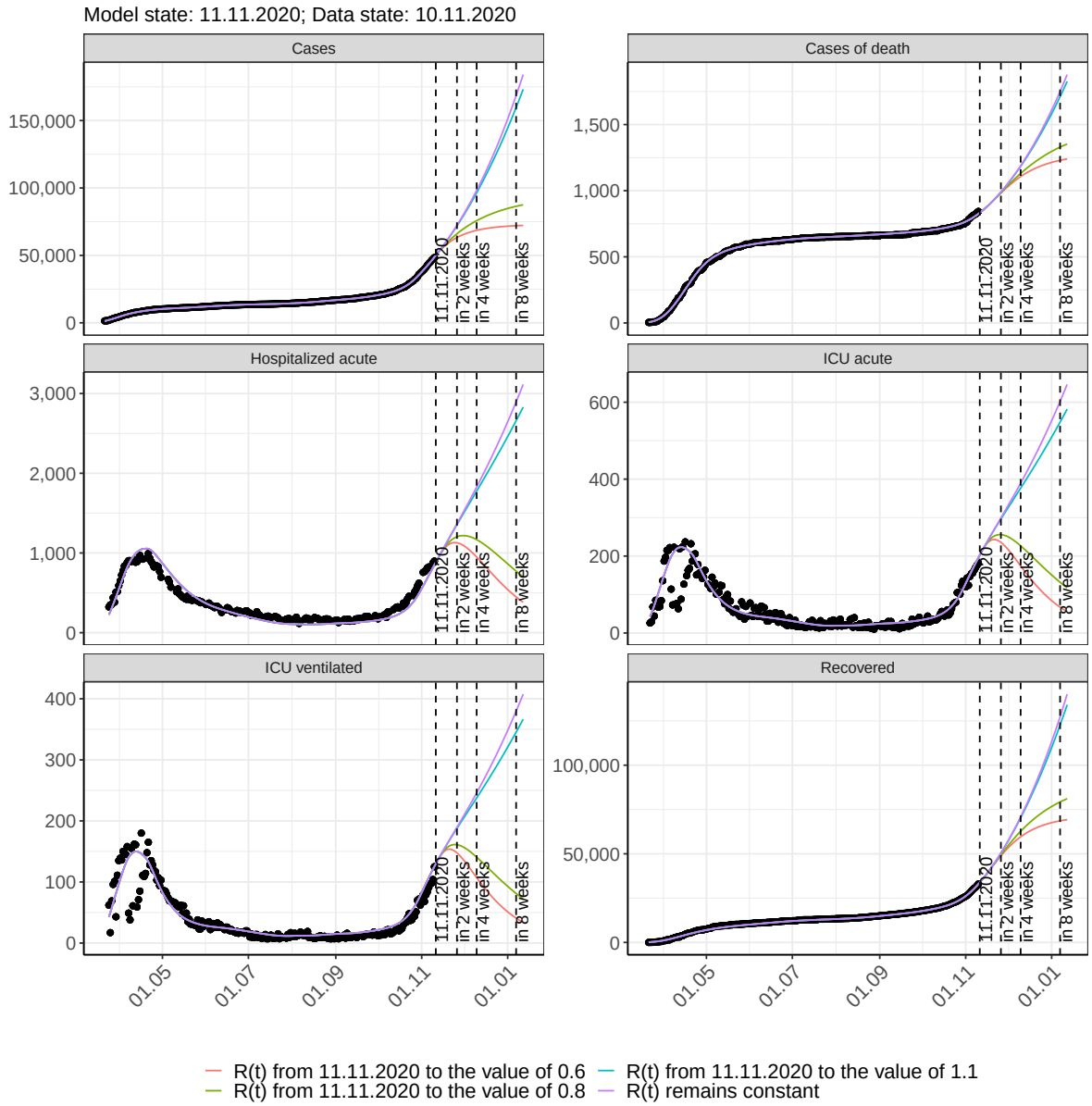


Figure 116: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Lower Saxony assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

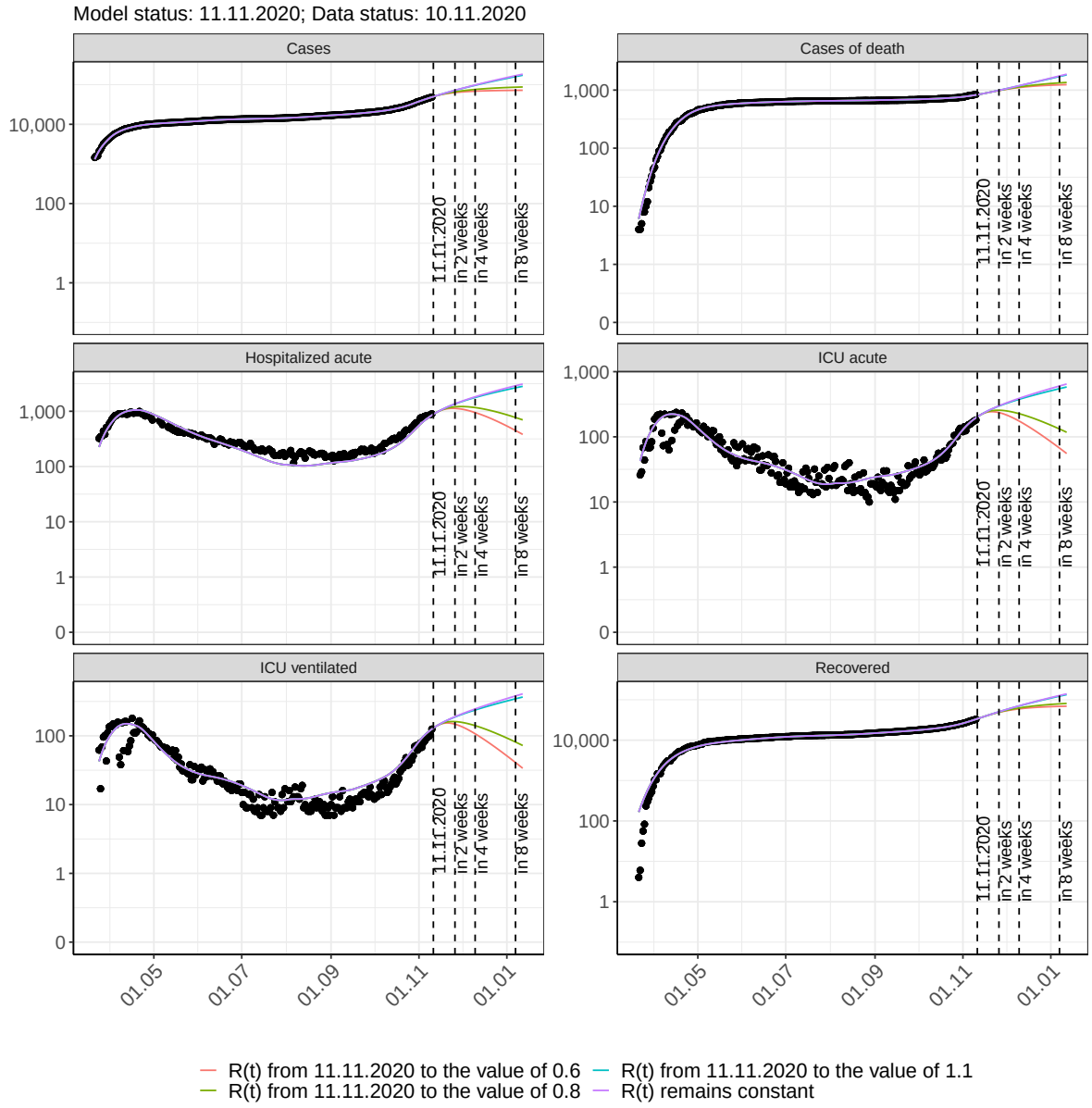


Figure 117: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Lower Saxony assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 118 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

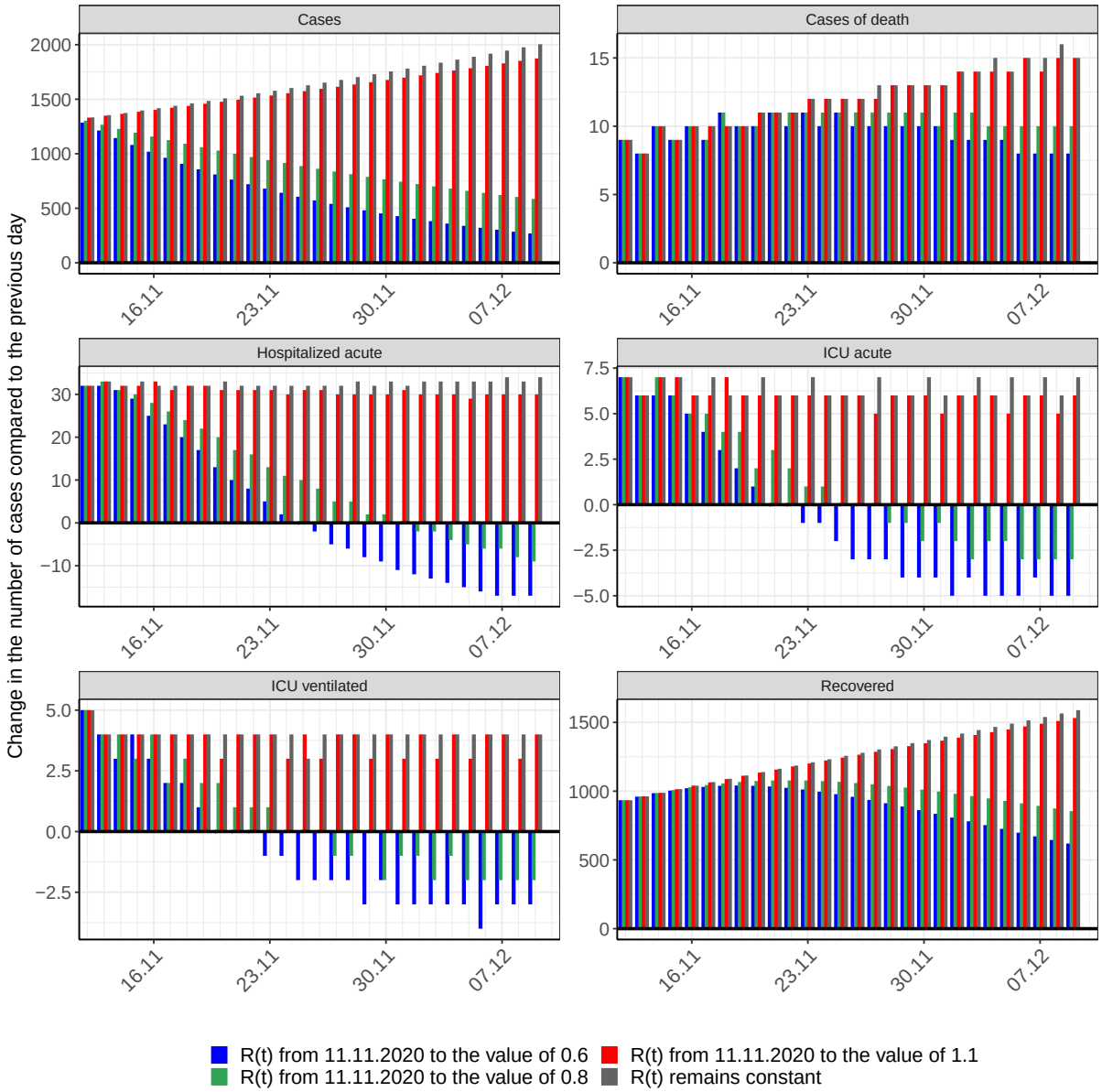


Figure 118: Simulation of daily new cases for the next 4 weeks - Lower Saxony

10.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Lower Saxony over time.

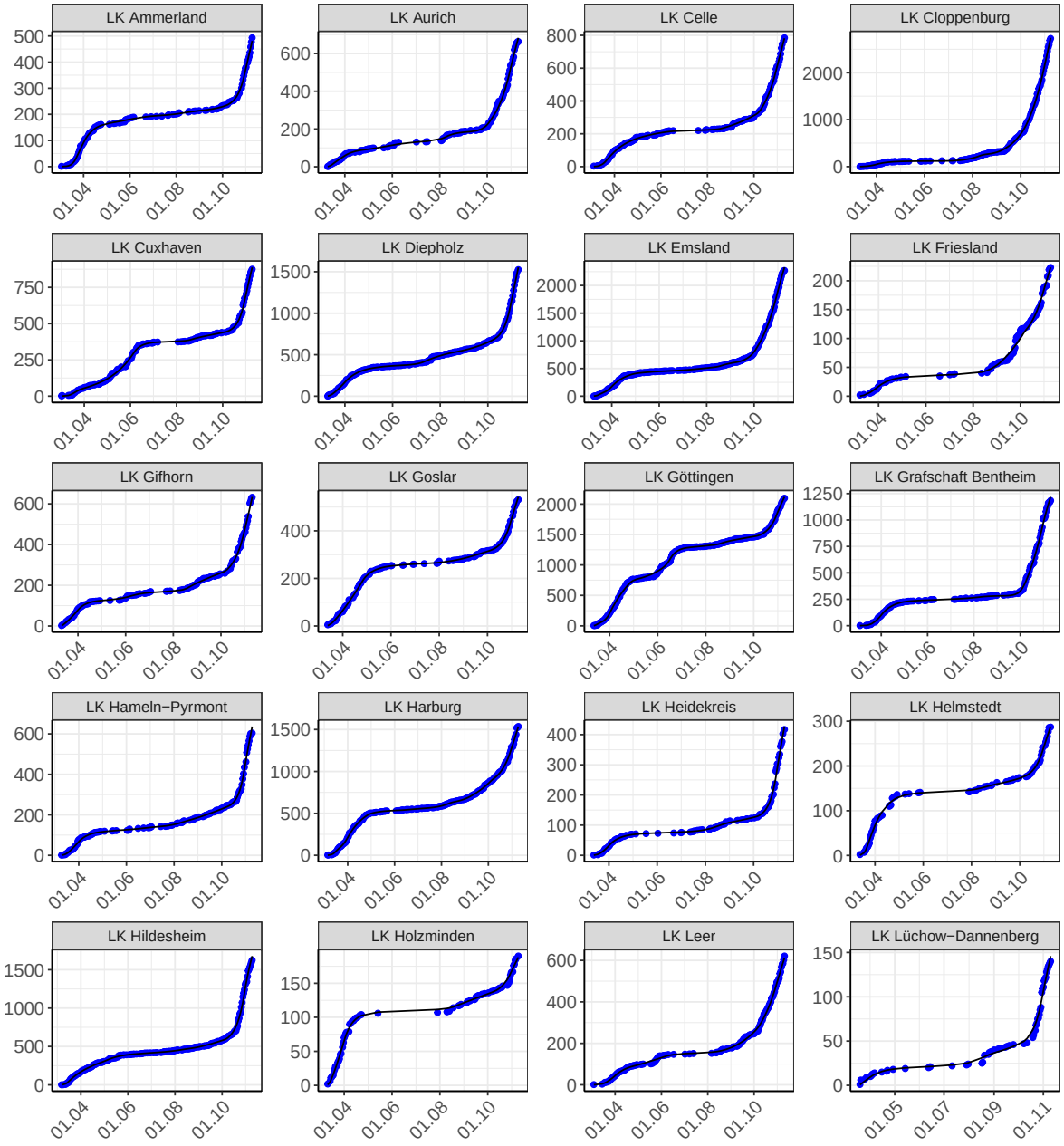


Figure 119: Model description of the reported case numbers in country- and citycounties in Lower Saxony. Points: reported data; lines: model description.

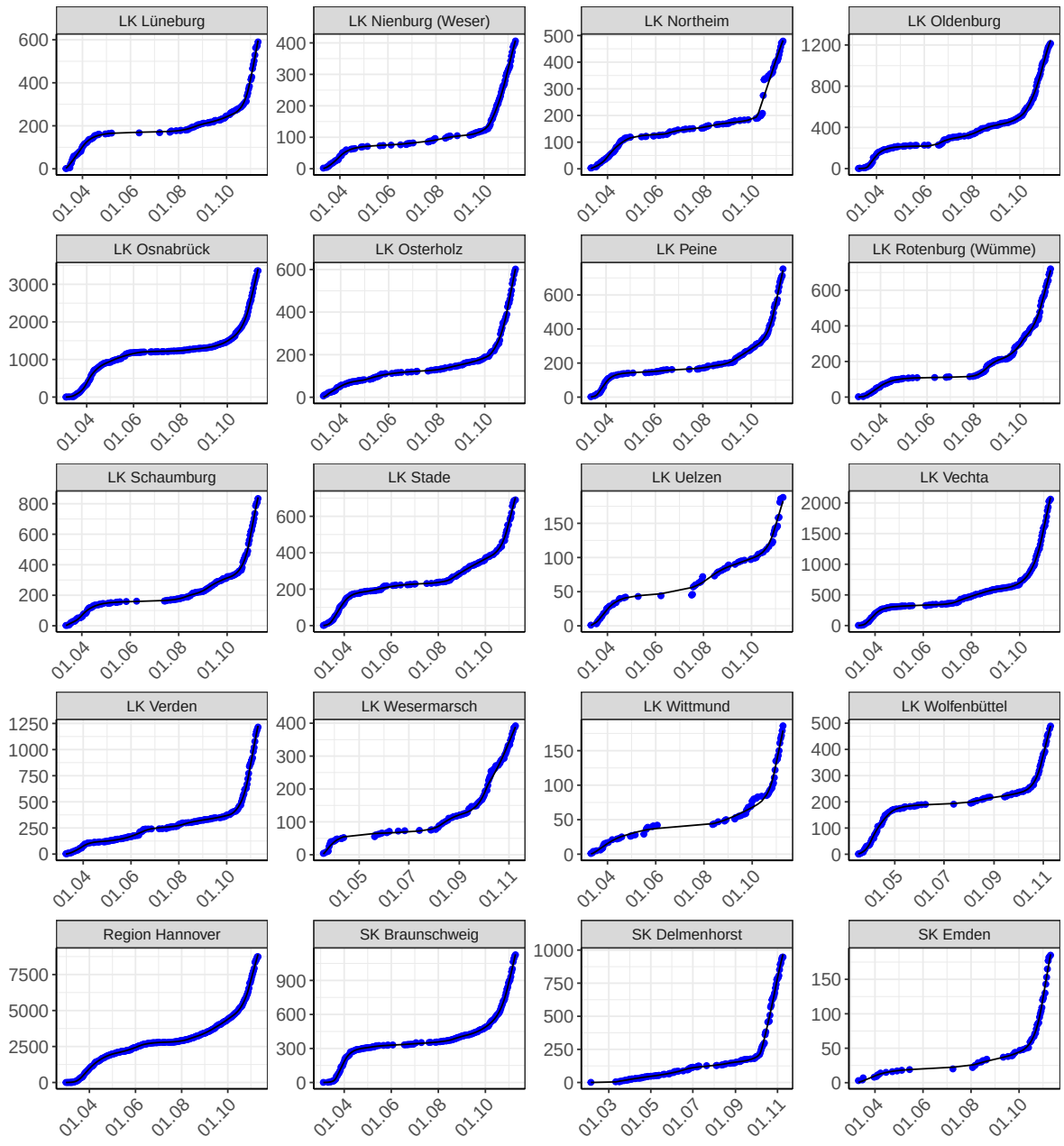


Figure 120: Model description of the reported case numbers in country- and citycounties in Lower Saxony. Points: reported data; lines: model description.

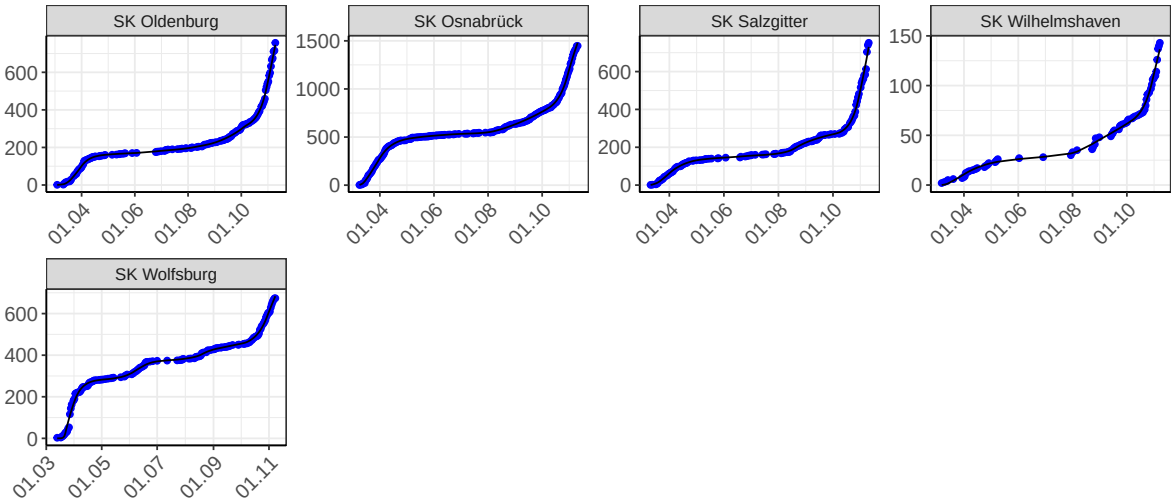


Figure 121: Model description of the reported case numbers in country- and citycounties in Lower Saxony. Points: reported data; lines: model description.

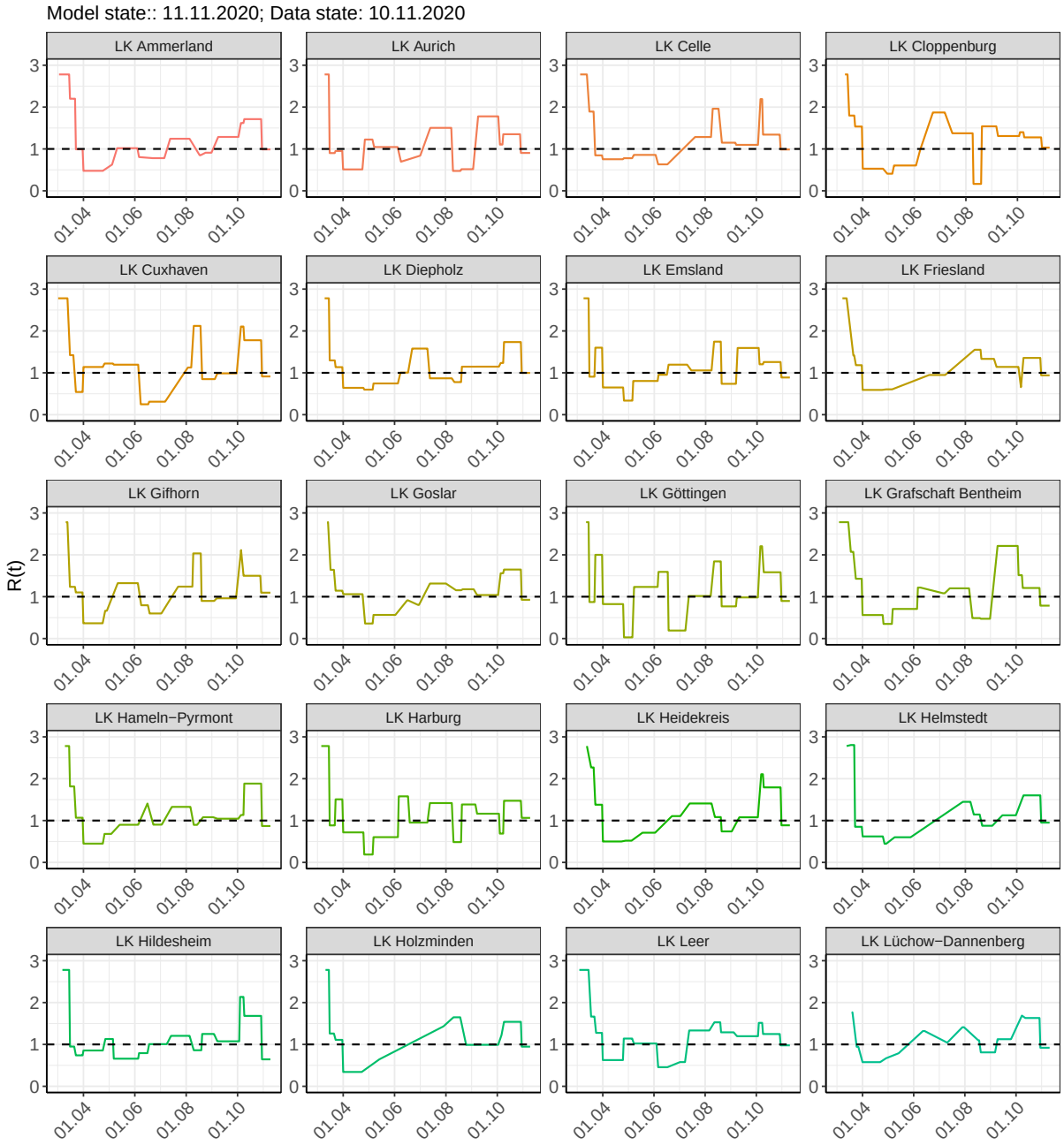


Figure 122: R(t) values over time for country- and citycounties in Lower Saxony

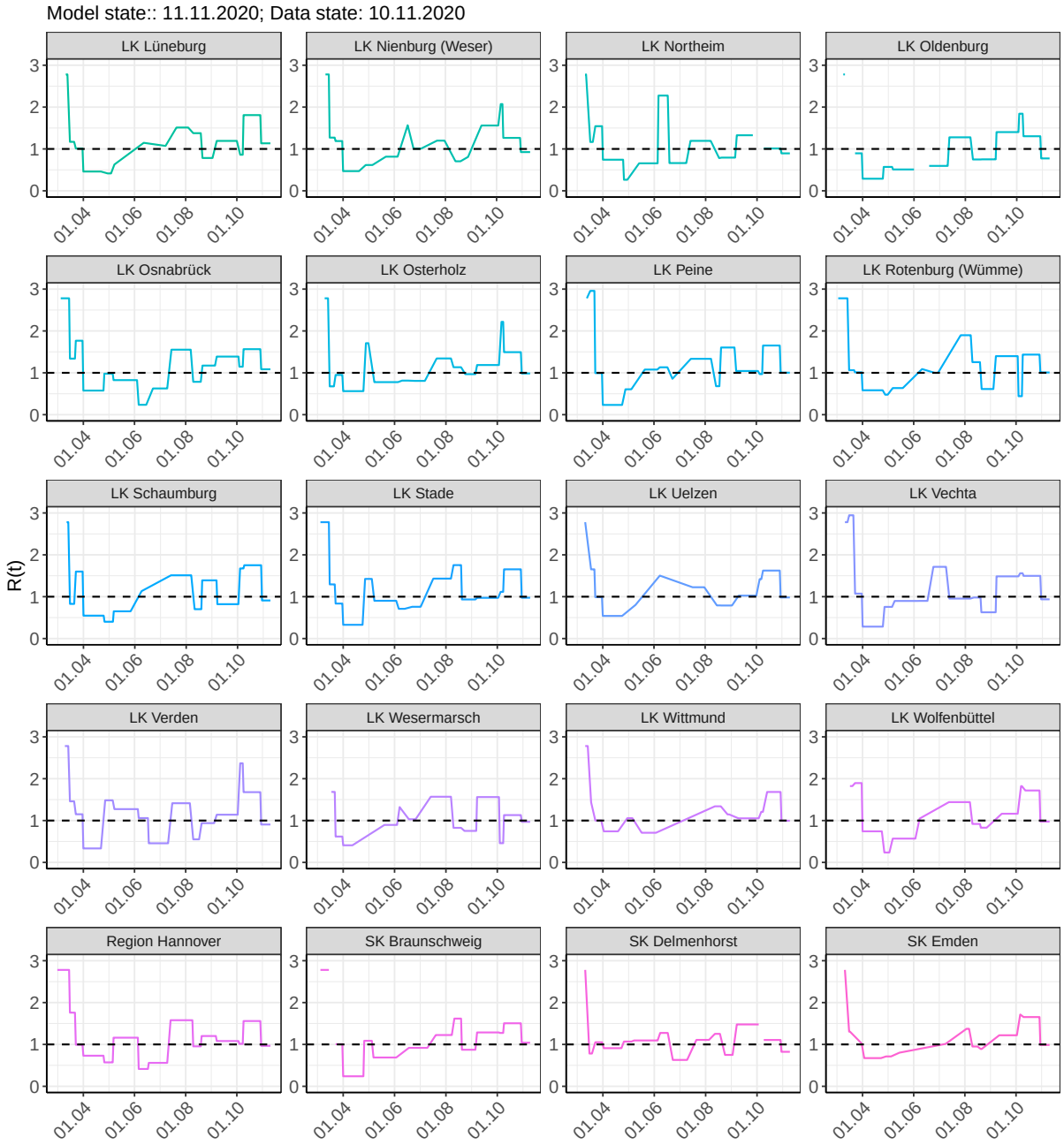


Figure 123: R(t) values over time for country- and citycounties in Lower Saxony

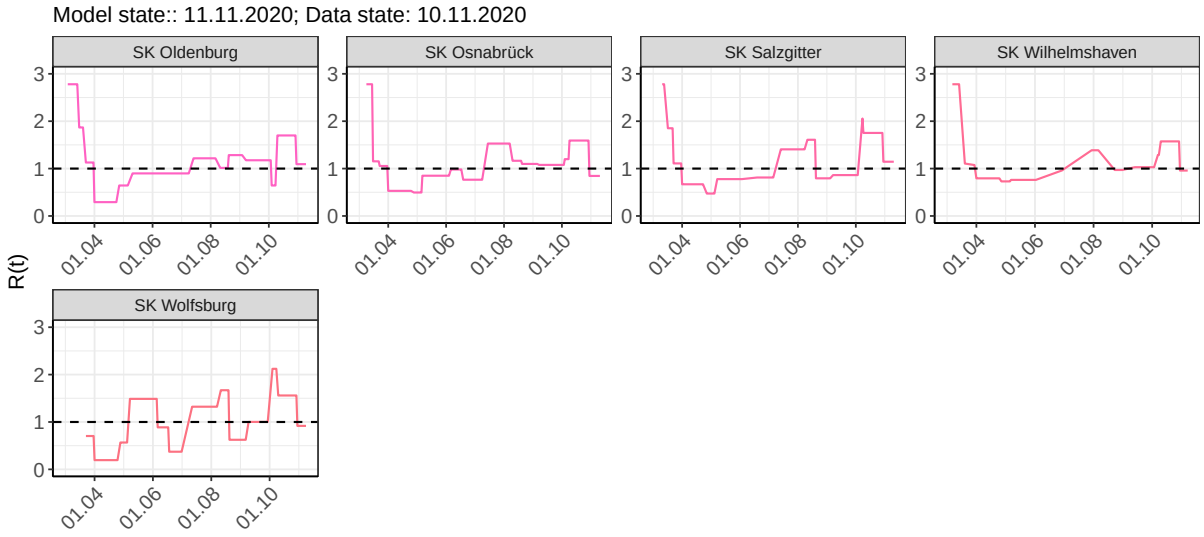


Figure 124: R(t) values over time for country- and citycounties in Lower Saxony

Table 10: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Ammerland	2.78	2.20	0.99	0.48	0.63	1.02	0.81	0.78	1.24	0.85	0.91	1.29	1.62	1.71	0.99
LK Aurich	2.78	0.90	0.95	0.51	1.23	1.05	0.69	0.84	1.50	0.47	0.52	1.78	1.10	1.35	0.90
LK Celle	2.78	1.89	0.85	0.75	0.78	0.86	0.63	0.62	1.28	1.96	1.15	1.10	2.19	1.34	0.99
LK Cloppenburg	2.78	1.80	1.54	0.53	0.41	0.60	0.98	1.87	1.37	0.16	1.54	1.31	1.40	1.28	1.03
LK Cuxhaven	2.78	1.42	0.54	1.14	1.22	1.19	0.25	0.31	1.13	2.12	0.85	0.99	2.11	1.78	0.91
LK Diepholz	2.78	1.30	1.14	0.64	0.60	0.75	1.00	1.58	0.87	0.78	1.15	1.15	1.24	1.73	1.00
LK Emsland	2.78	0.91	1.60	0.65	0.34	0.80	0.95	1.20	1.06	1.74	0.74	1.59	1.20	1.26	0.89
LK Friesland	2.78	1.42	1.18	0.59	0.60	0.73	1.17	0.95	1.41	1.55	1.33	1.14	0.66	1.36	0.94
LK Gifhorn	2.78	1.23	1.10	0.36	0.66	1.32	0.80	0.60	1.24	2.03	0.90	0.96	2.11	1.50	1.10
LK Goslar	2.78	1.64	1.14	1.06	0.36	0.56	0.91	0.80	1.31	1.15	1.18	1.04	1.56	1.65	0.93
LK Göttingen	2.78	0.87	2.00	0.82	0.03	1.23	1.59	0.19	1.02	1.84	0.77	0.98	2.21	1.58	0.90
LK Grafschaft Bentheim	2.78	2.07	1.43	0.56	0.35	0.71	1.22	1.08	1.20	0.49	0.47	2.21	1.51	1.21	0.79
LK Hameln-Pyrmont	2.78	1.82	1.07	0.45	0.68	0.90	1.41	0.90	1.33	0.90	1.08	1.04	1.13	1.88	0.87
LK Harburg	2.78	0.88	1.51	0.72	0.19	0.60	1.58	0.95	1.42	0.49	1.38	1.16	0.69	1.47	1.06
LK Heidekreis	2.78	2.27	1.38	0.50	0.52	0.71	1.28	1.11	1.41	1.08	0.74	1.08	2.11	1.79	0.89

Table 10: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Helmstedt	2.78	2.80	0.85	0.62	0.45	0.60	1.02	0.92	1.45	1.14	0.88	1.13	1.60	1.60	0.95
LK Hildesheim	2.78	0.95	0.74	0.86	1.13	0.66	0.79	1.01	1.21	0.86	1.25	1.07	2.14	1.68	0.64
LK Holzminden	2.78	1.26	1.11	0.34	0.46	0.64	1.07	0.93	1.43	1.65	0.99	0.99	1.22	1.54	0.95
LK Leer	2.78	1.67	1.28	0.63	1.14	1.02	0.46	0.58	1.33	1.53	1.29	1.20	1.52	1.25	0.98
LK Lüchow-Dannenberg	2.78	1.77	0.94	0.58	0.67	0.79	1.32	1.04	1.41	1.10	0.81	1.13	1.69	1.63	0.92
LK Lüneburg	2.78	1.17	1.01	0.46	0.41	0.63	1.15	1.07	1.51	1.38	0.78	1.19	0.86	1.81	1.13
LK Nienburg (Weser)	2.78	1.27	1.19	0.47	0.62	0.82	1.57	1.01	1.20	0.71	0.81	1.56	2.07	1.26	0.92
LK Northeim	2.78	1.17	1.54	0.74	0.26	0.66	2.27	0.66	1.19	0.78	0.79	1.33	3.74	1.01	0.89
LK Oldenburg	2.78	3.63	0.90	0.29	0.57	0.51	3.86	0.60	1.28	0.75	0.75	1.40	1.84	1.30	0.77
LK Osnabrück	2.78	1.34	1.77	0.58	0.98	0.83	0.24	0.63	1.55	0.78	1.17	1.39	1.15	1.56	1.09
LK Osterholz	2.78	0.68	0.95	0.56	1.71	0.78	0.81	0.81	1.34	1.13	0.97	1.19	2.22	1.49	0.98
LK Peine	2.78	2.96	0.99	0.23	0.61	1.08	1.13	0.86	1.33	0.68	1.60	1.04	0.97	1.65	1.00

Table 10: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Rotenburg (Wümme)	2.78	1.06	1.01	0.58	0.48	0.64	1.09	1.00	1.90	1.25	0.61	1.40	0.44	1.44	1.01
LK Schaumburg	2.78	0.83	1.60	0.55	0.40	0.65	1.13	1.18	1.51	0.70	1.39	0.82	1.67	1.75	0.91
LK Stade	2.78	1.29	0.84	0.33	1.42	0.90	0.71	0.76	1.43	1.75	0.93	0.97	1.12	1.65	0.98
LK Uelzen	2.78	1.65	0.99	0.54	0.63	0.80	1.50	1.25	1.23	0.79	0.79	1.03	1.42	1.62	0.98
LK Vechta	2.78	2.95	1.07	0.28	0.76	0.90	0.90	1.71	0.95	0.98	0.63	1.49	1.56	1.50	0.94
LK Verden	2.78	1.46	1.15	0.33	1.48	1.27	1.06	0.46	1.41	0.55	0.94	1.14	2.37	1.68	0.91
LK Weser-marsch	2.78	1.68	0.62	0.41	0.66	0.90	1.32	1.03	1.57	0.83	0.75	1.56	0.46	1.13	0.97
LK Wittmund	2.78	1.44	1.00	0.74	1.06	0.71	0.96	0.83	1.36	1.34	1.15	1.05	1.21	1.68	1.00
LK Wolfen-büttel	2.78	1.82	1.90	0.74	0.24	0.57	1.05	0.95	1.44	0.92	0.83	1.16	1.82	1.72	0.98
Region Hannover	2.78	1.76	0.99	0.73	0.57	1.16	0.41	0.56	1.58	0.95	1.20	1.08	1.01	1.56	0.97
SK Braun-schweig	2.78	3.11	1.01	0.24	1.09	0.69	1.40	0.92	1.22	1.62	0.87	1.29	1.27	1.51	1.04
SK Delmenhorst	2.78	0.78	1.05	0.91	1.07	1.09	1.27	0.63	1.11	1.25	0.75	1.48	3.23	1.11	0.82
SK Emden	2.78	1.31	1.02	0.67	0.71	0.80	1.31	1.01	1.37	0.95	0.89	1.22	1.72	1.65	0.99
SK Oldenburg	2.78	1.87	1.13	0.29	0.64	0.90	1.60	0.90	1.22	1.01	1.28	1.18	0.64	1.70	1.09

Table 10: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
SK Osnabrück	2.78	1.15	1.05	0.53	0.49	0.85	0.98	0.77	1.53	1.16	1.10	1.08	1.20	1.59	0.84
SK Salzgitter	2.78	1.85	1.11	0.67	0.47	0.78	1.43	0.81	1.41	1.61	0.79	0.86	2.06	1.75	1.15
SK Wilhelmshaven	2.78	1.11	1.08	0.79	0.73	0.76	1.20	0.96	1.39	1.25	0.97	1.03	1.29	1.57	0.96
SK Wolfsburg	2.78	6.23	0.70	0.19	0.57	1.49	0.89	0.37	1.32	1.67	0.62	1.00	2.12	1.56	0.92

11 North Rhine-Westphalia

11.1 Model description

Fig. 125 depicts the results of the modeling (lines) compared to the observed data (points) for North Rhine-Westphalia on a linear (A) and semi-logarithmic (B) scale.

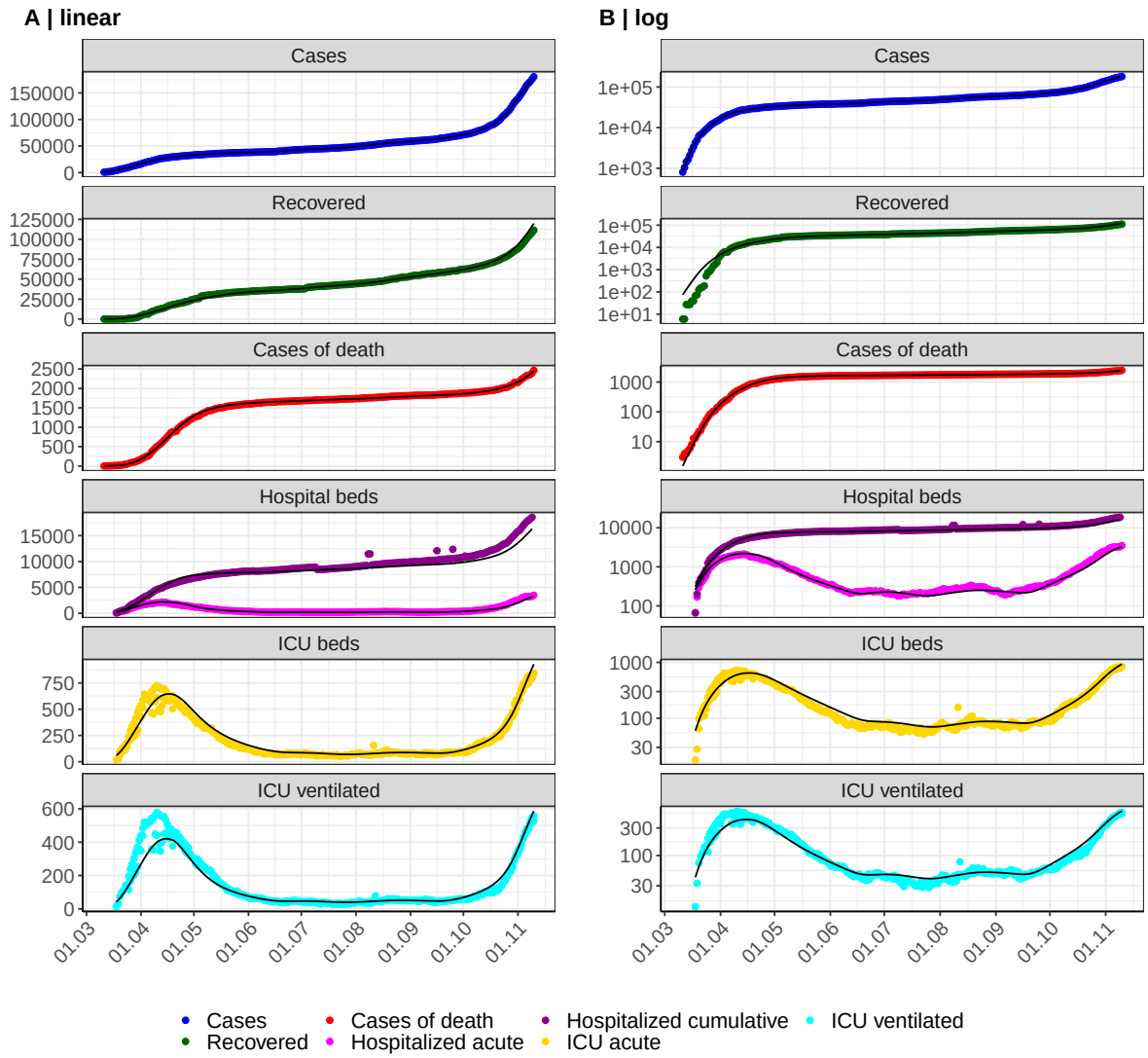


Figure 125: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in North Rhine-Westphalia. Points: reported data; lines: model description.

Fig. 126 shows the goodness-of-fit for North Rhine-Westphalia. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

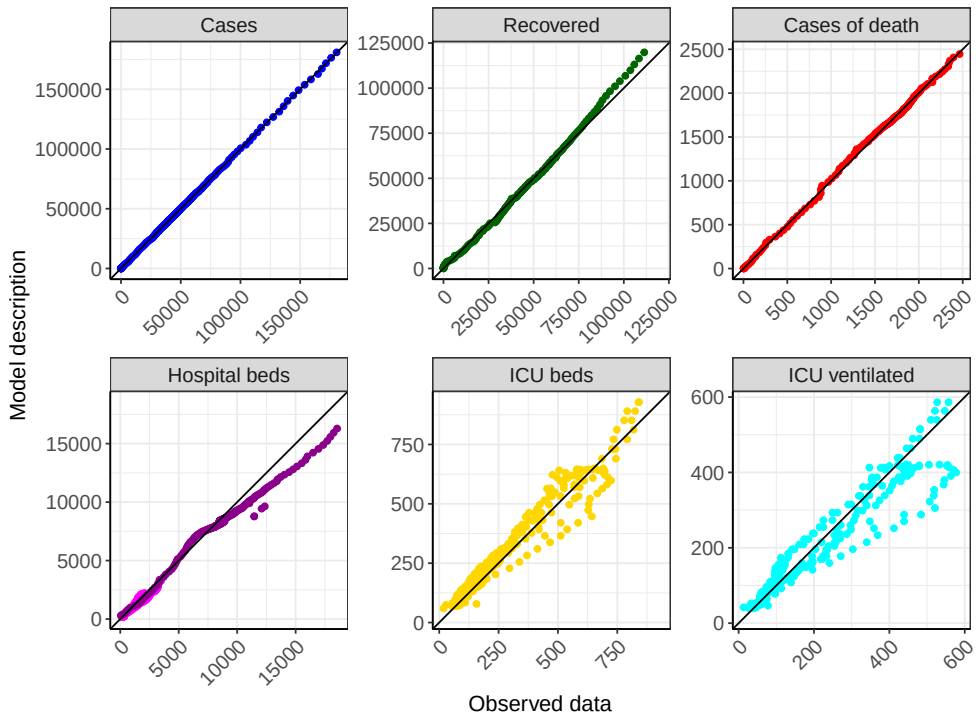


Figure 126: Goodness-of-fit plots for North Rhine-Westphalia. Lines: lines of identity.

Fig. 127 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for North Rhine-Westphalia (red line) in comparison with the other federal states (grey lines).

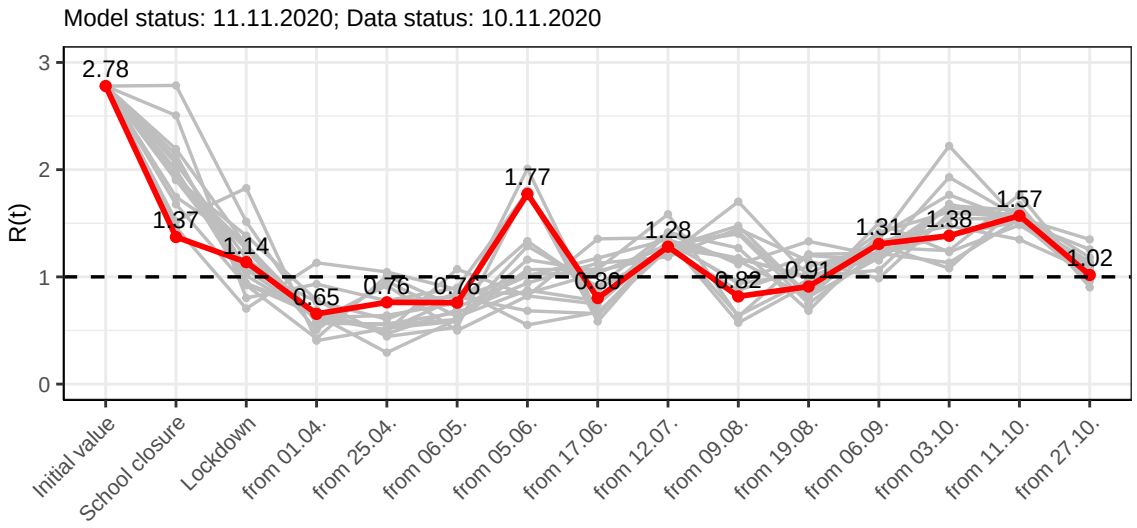


Figure 127: R(t) values before and after the NPIs for North Rhine-Westphalia

Fig. 128 shows the R(t) estimated value for North Rhine-Westphalia (red line) over time in comparison with the other federal states (grey lines).

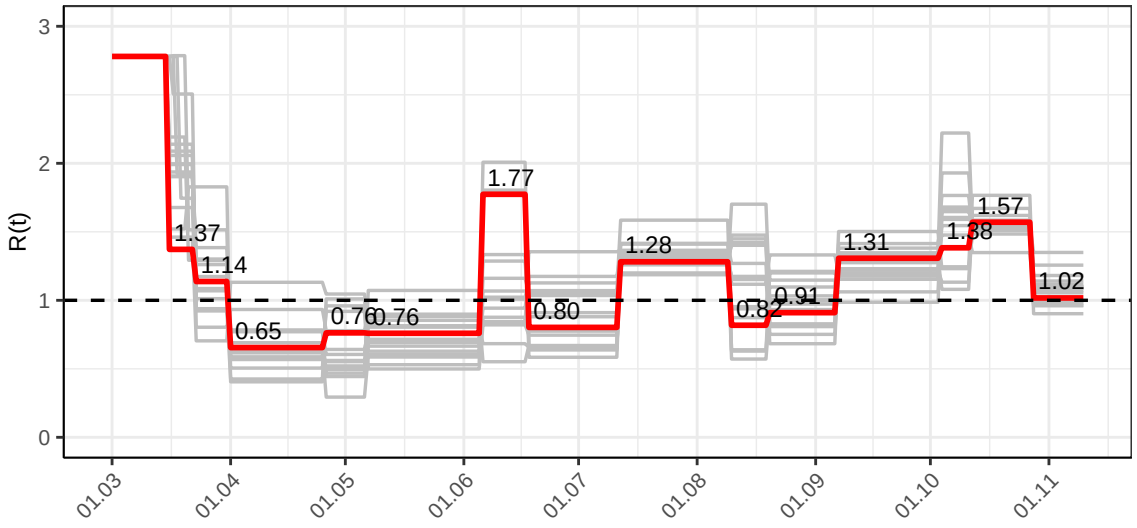


Figure 128: R(t) values over time for North Rhine-Westphalia

Fig. 129 shows the changes in hospitalization and death rates for North Rhine-Westphalia (red line) over time compared to the other states (grey lines).

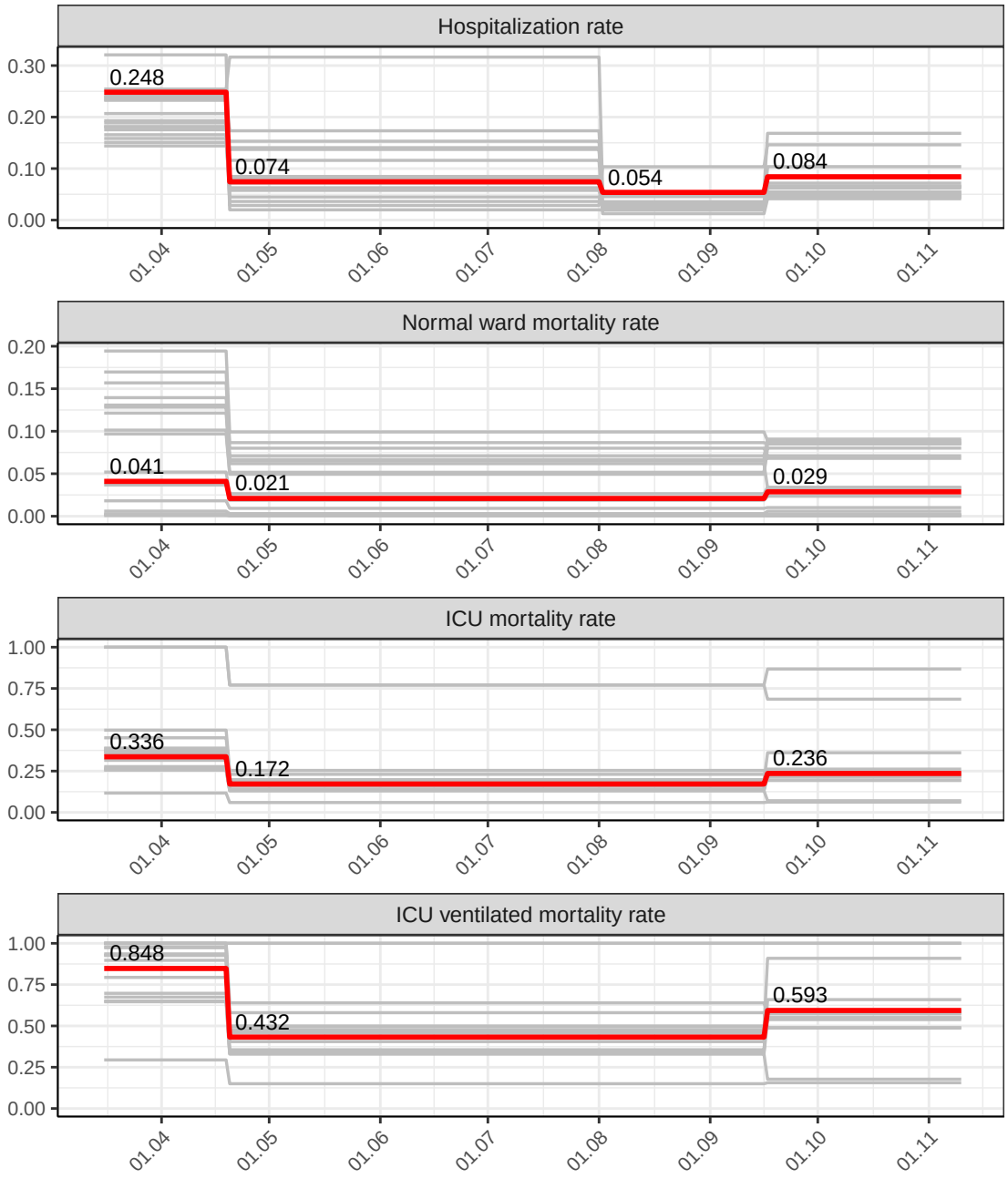


Figure 129: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for North Rhine-Westphalia

11.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1.02) and assuming various scenarios from 11.11.2020

Fig.130 and 131 represent the model prediction for the next 8 weeks for North Rhine-Westphalia on a linear (130) and a semi-logarithmic (131) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

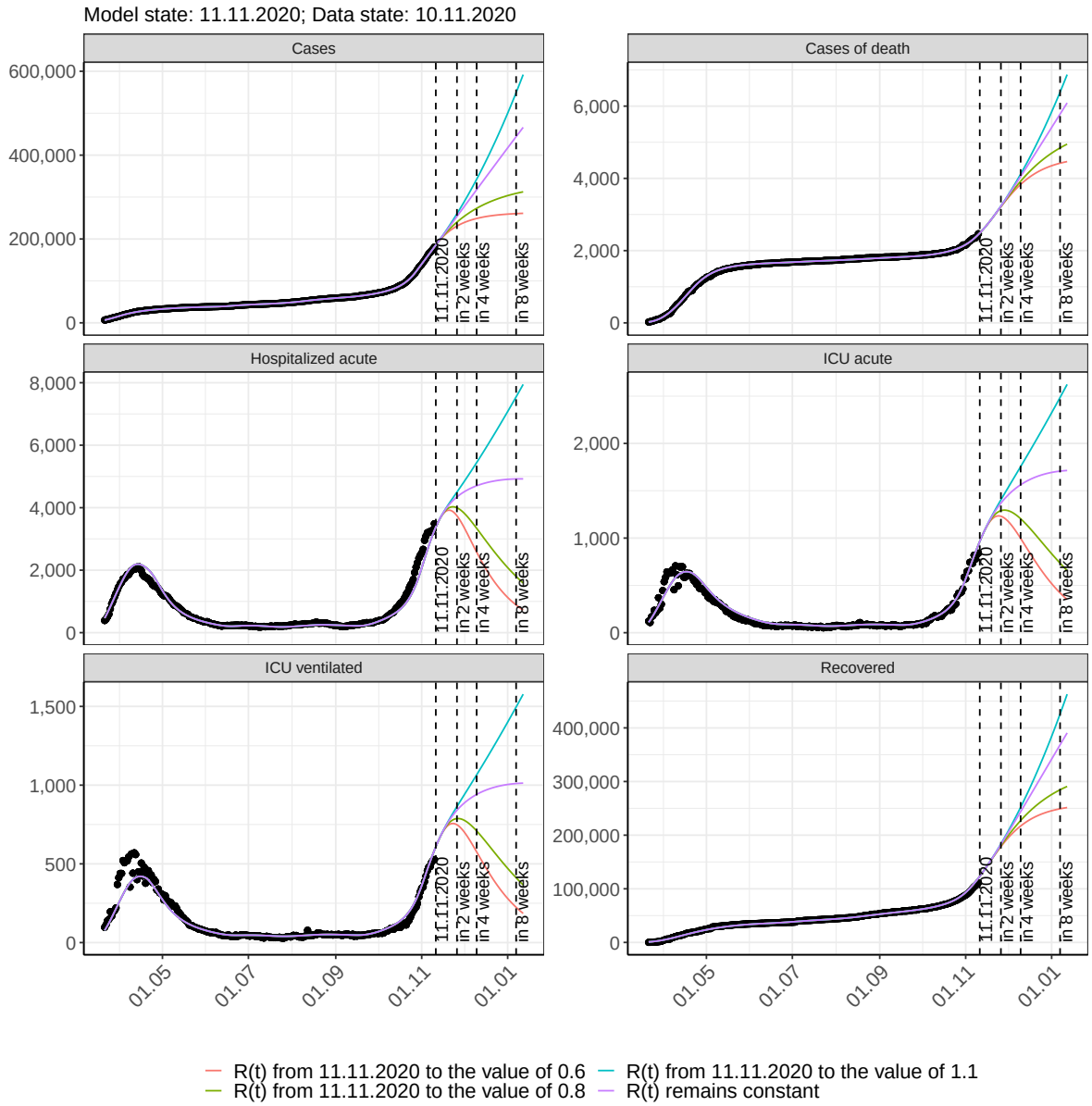


Figure 130: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for North Rhine-Westphalia assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

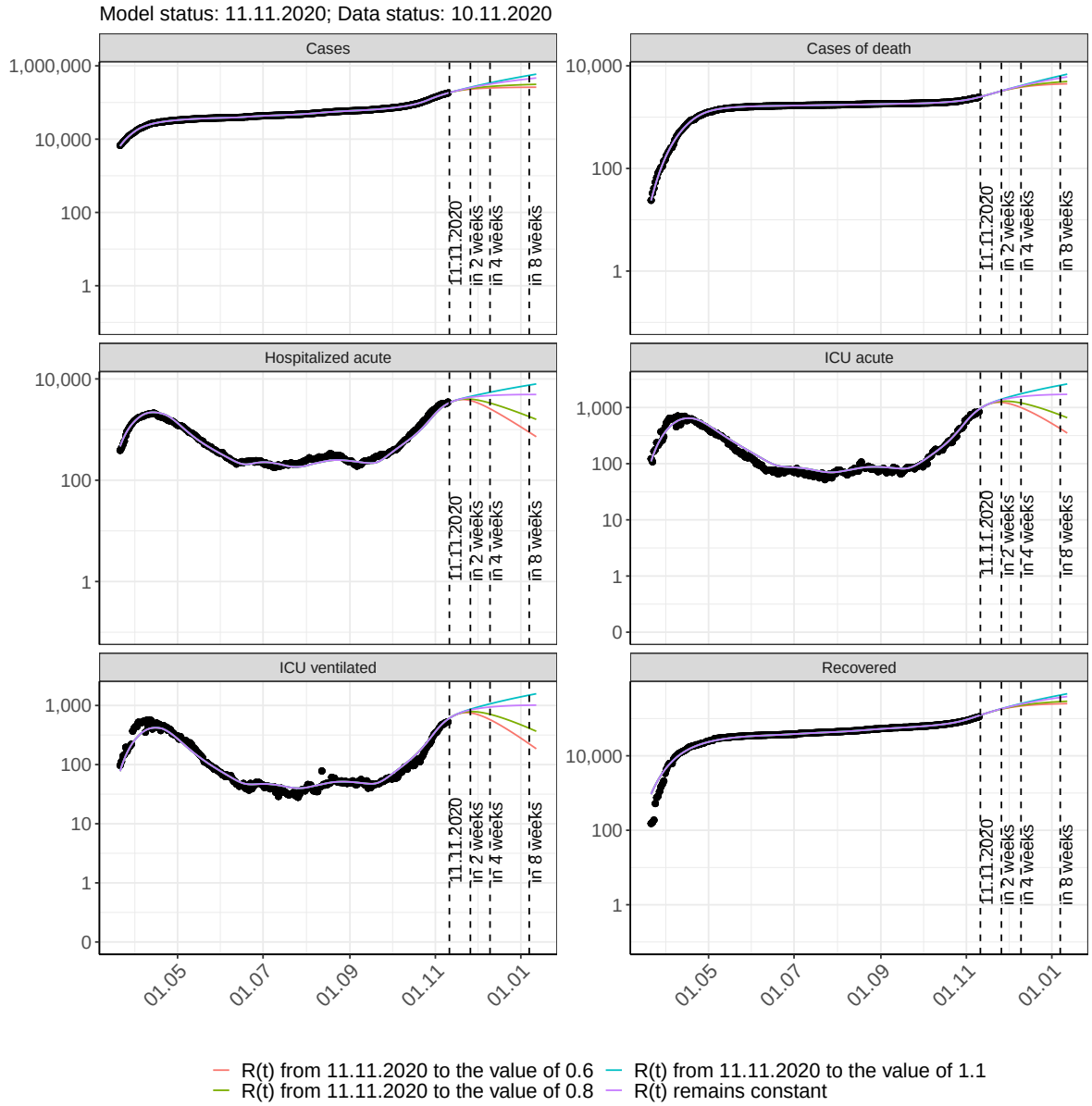


Figure 131: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for North Rhine-Westphalia assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 132 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

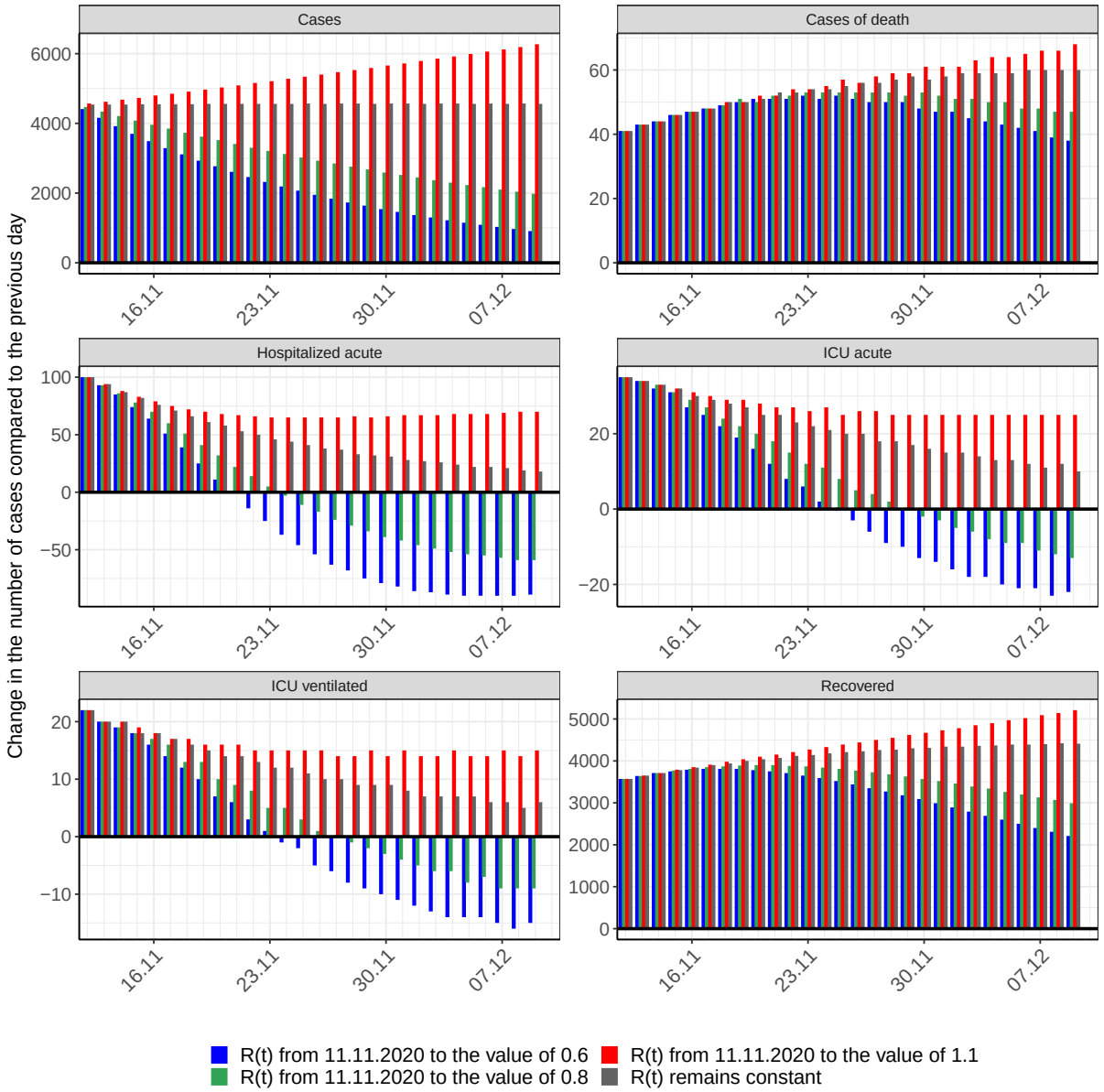


Figure 132: Simulation of daily new cases for the next 4 weeks - North Rhine-Westphalia

11.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in North Rhine-Westphalia over time.

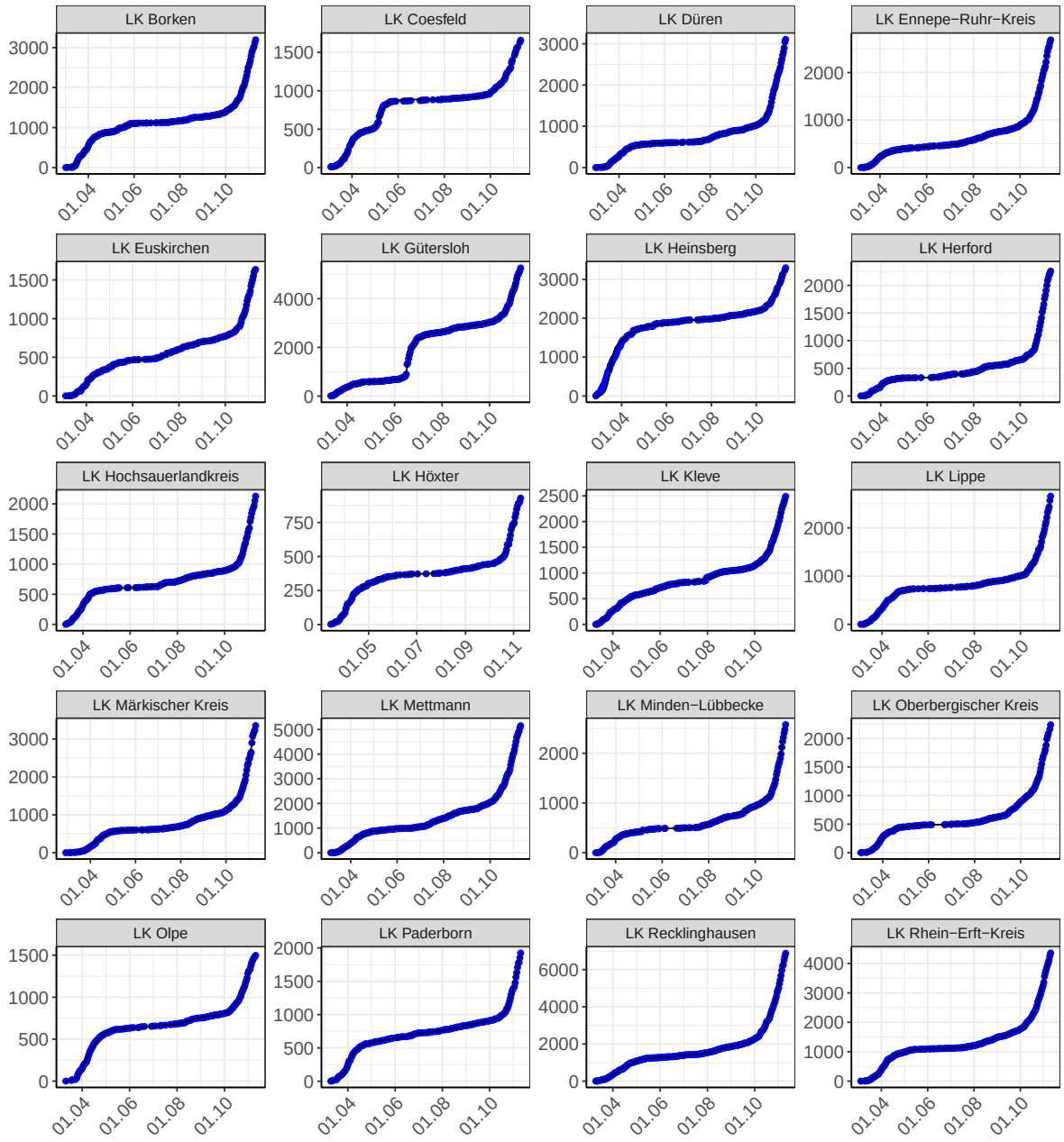


Figure 133: Model description of the reported case numbers in country- and citycounties in North Rhine-Westphalia. Points: reported data; lines: model description.

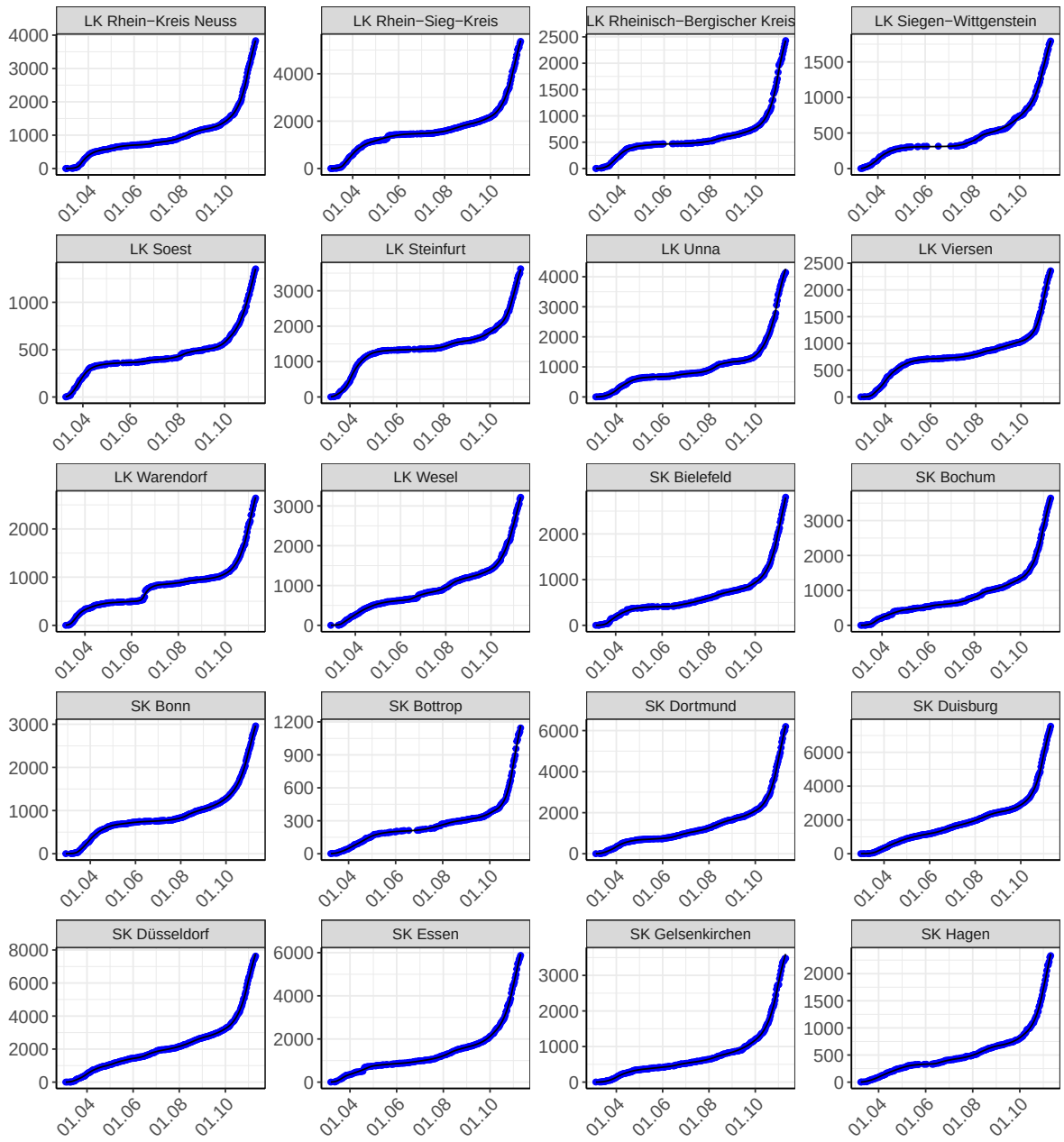


Figure 134: Model description of the reported case numbers in country- and citycounties in North Rhine-Westphalia. Points: reported data; lines: model description.

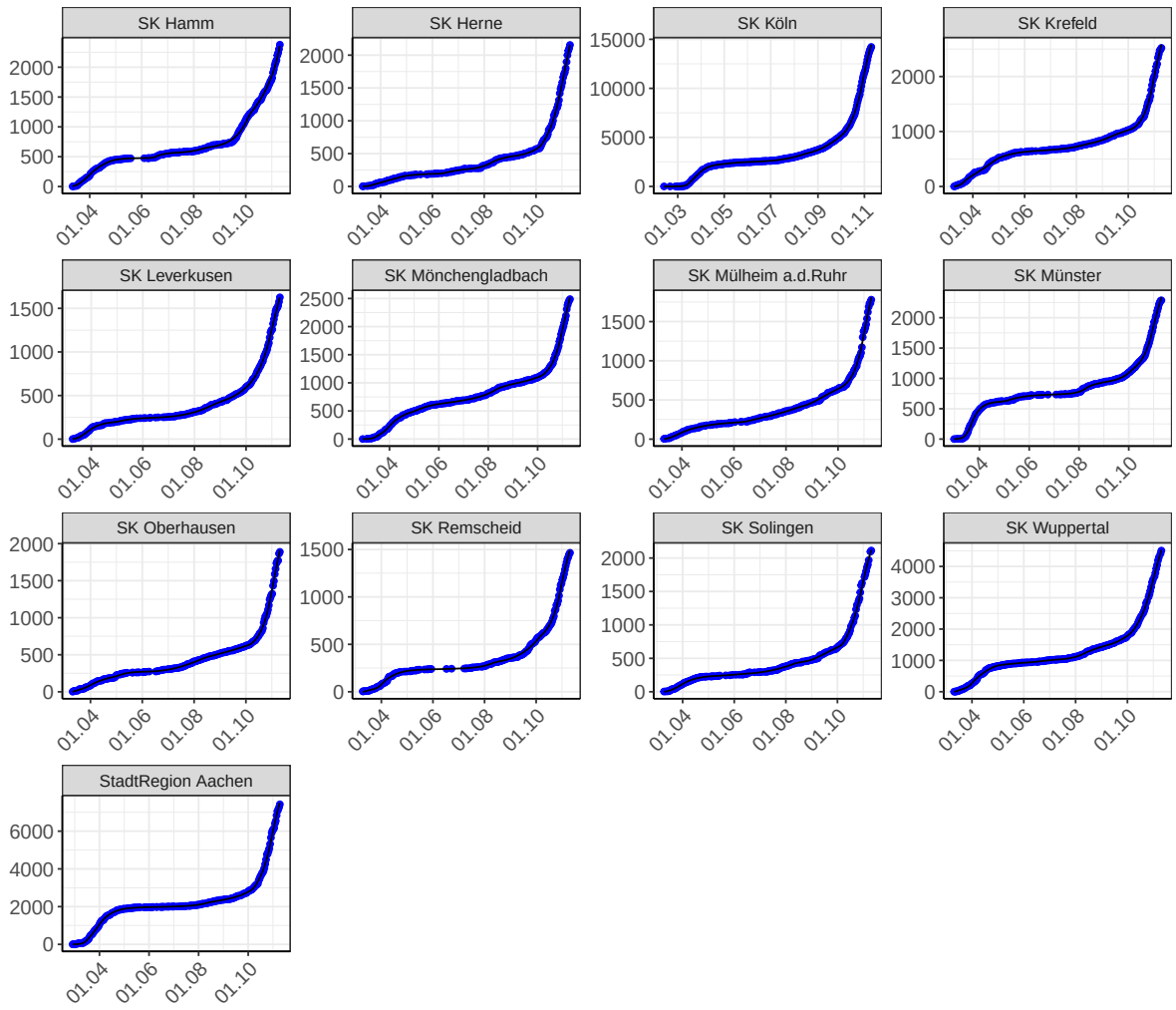


Figure 135: Model description of the reported case numbers in country- and citycounties in North Rhine-Westphalia. Points: reported data; lines: model description.

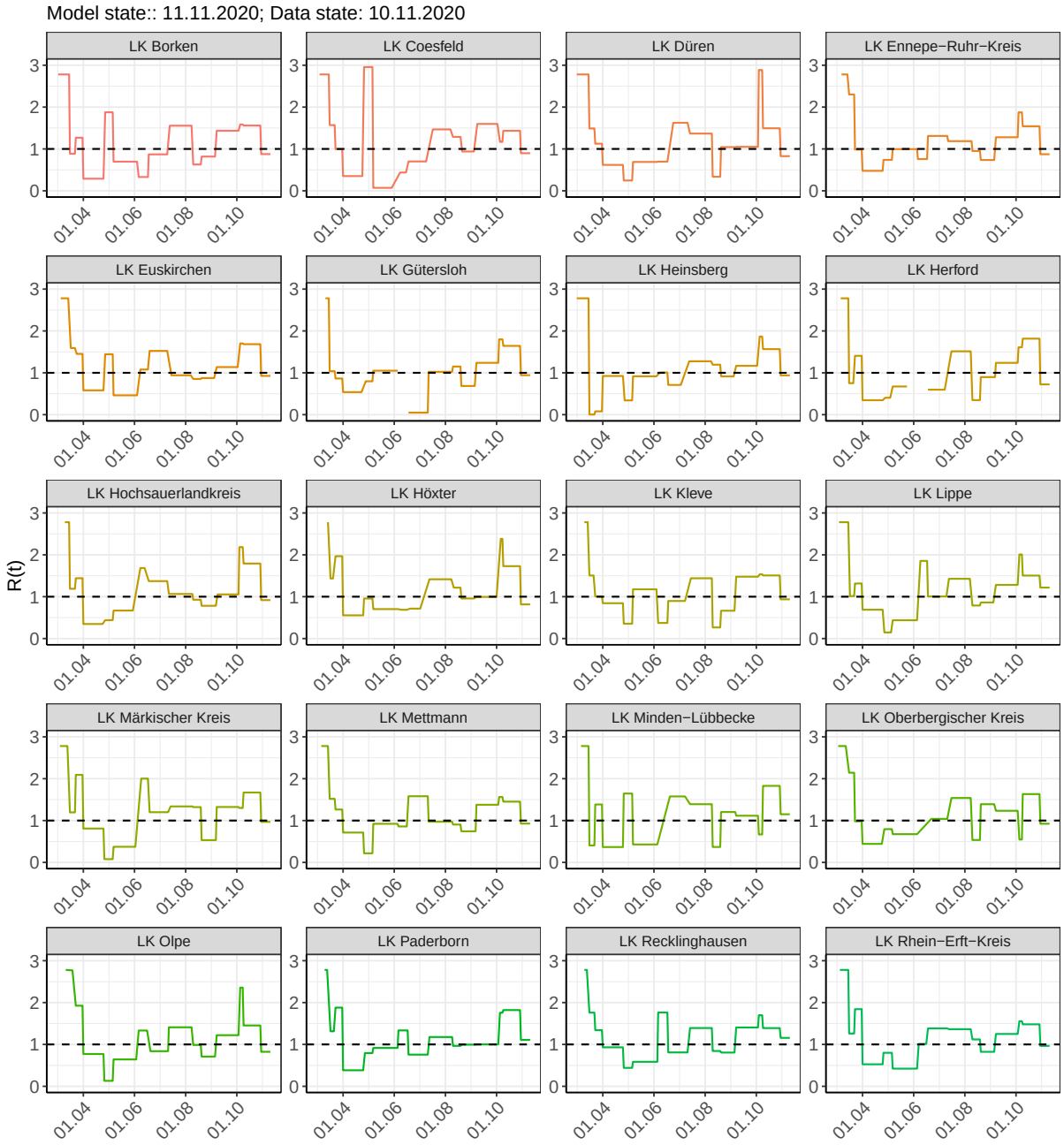


Figure 136: R(t) values over time for country- and citycounties in North Rhine-Westphalia

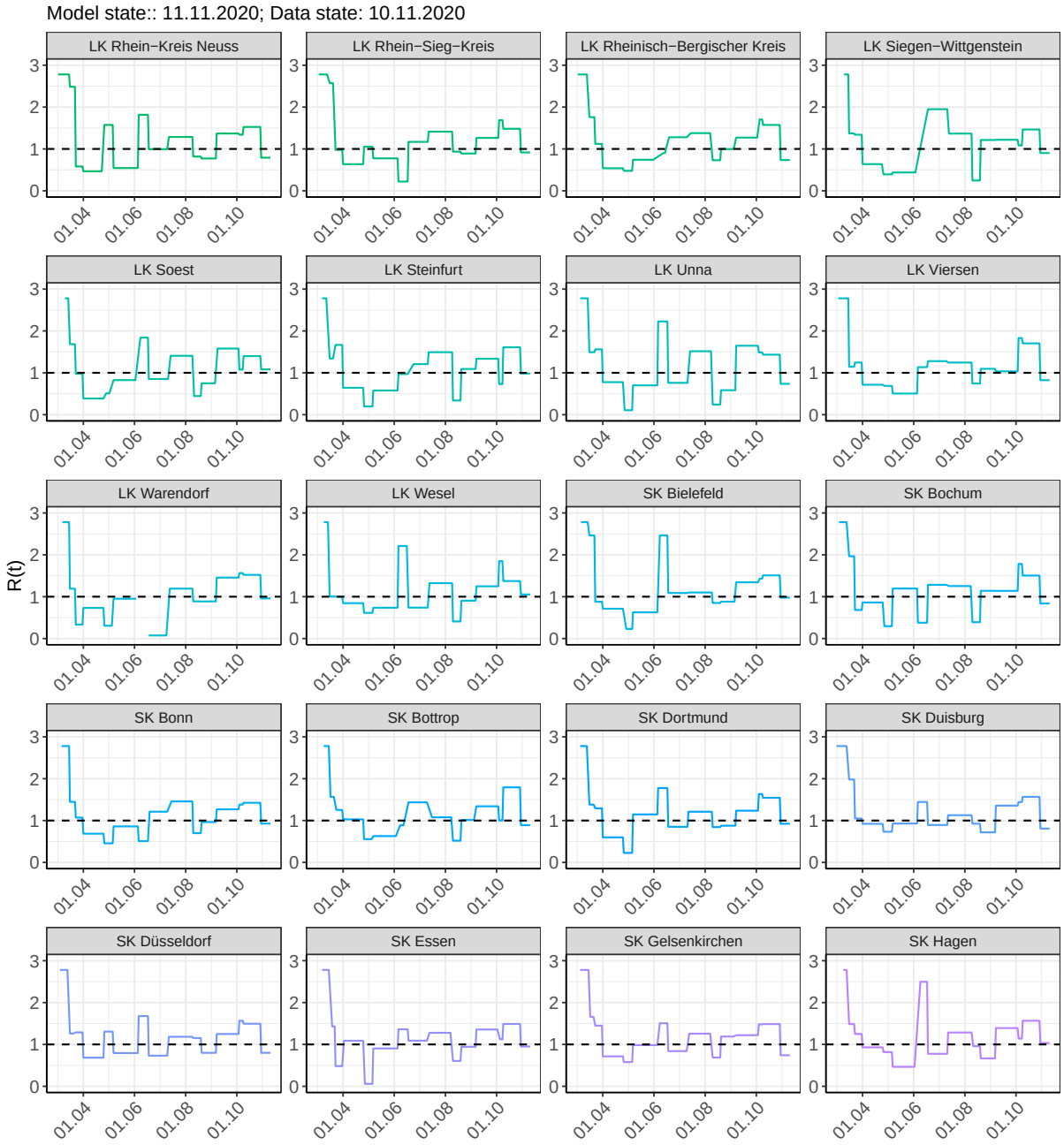


Figure 137: R(t) values over time for country- and citycounties in North Rhine-Westphalia

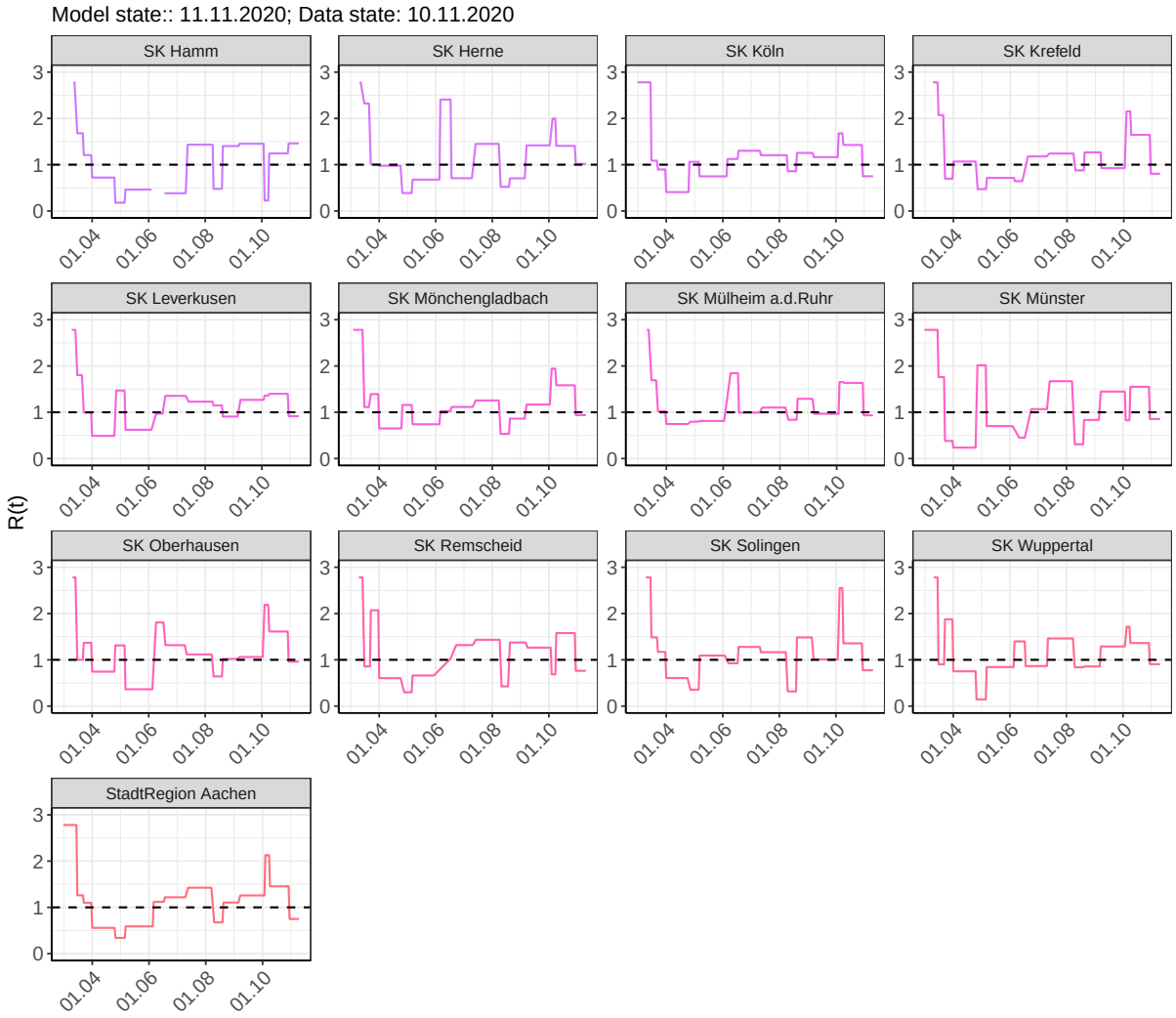


Figure 138: R(t) values over time for country- and citycounties in North Rhine-Westphalia

Table 11: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Borken	2.78	0.89	1.27	0.29	1.88	0.70	0.33	0.87	1.56	0.63	0.82	1.43	1.58	1.56	0.88
LK Coesfeld	2.78	1.57	1.00	0.35	2.96	0.07	0.44	0.70	1.47	1.29	0.94	1.60	1.17	1.43	0.90
LK Düren	2.78	1.49	1.13	0.62	0.25	0.69	0.70	1.63	1.37	0.34	1.04	1.05	2.89	1.49	0.83
LK Ennepe-Ruhr-Kreis	2.78	2.30	0.99	0.48	0.74	1.00	0.76	1.31	1.19	0.95	0.74	1.28	1.88	1.54	0.87
LK Euskirchen	2.78	1.59	1.45	0.58	1.44	0.46	1.08	1.52	0.94	0.85	0.87	1.14	1.70	1.68	0.93
LK Gütersloh	2.78	1.04	0.86	0.54	0.80	1.05	3.53	0.05	1.02	1.15	0.69	1.24	1.80	1.64	0.94
LK Heinsberg	2.78	0.00	0.08	0.92	0.34	0.92	1.01	0.71	1.28	1.19	0.91	1.17	1.87	1.57	0.94
LK Herford	2.78	0.75	1.41	0.35	0.40	0.67	3.02	0.60	1.51	0.35	0.90	1.24	1.61	1.82	0.72
LK Hochsauerlandkreis	2.78	1.19	1.44	0.35	0.44	0.67	1.69	1.37	1.06	0.93	0.78	1.05	2.18	1.79	0.92
LK Höxter	2.78	1.44	1.97	0.55	0.96	0.70	0.69	0.71	1.42	1.22	0.96	0.99	2.38	1.73	0.82
LK Kleve	2.78	1.51	1.00	0.84	0.35	1.18	0.37	0.90	1.44	0.27	0.66	1.48	1.53	1.51	0.94
LK Lippe	2.78	1.01	1.32	0.69	0.15	0.44	1.86	1.00	1.43	0.79	0.86	1.28	2.01	1.50	1.22
LK Märkischer Kreis	2.78	1.20	2.09	0.81	0.08	0.37	2.00	1.20	1.34	1.32	0.53	1.32	1.30	1.67	0.97
LK Mettmann	2.78	1.52	1.26	0.71	0.22	0.92	0.86	1.58	0.97	0.90	0.74	1.38	1.56	1.45	0.93
LK Minden-Lübbecke	2.78	0.41	1.38	0.37	1.65	0.43	0.69	1.58	1.39	0.37	1.20	1.12	0.67	1.83	1.15

Table 11: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Oberbergischer Kreis	2.78	2.14	0.98	0.44	0.79	0.67	1.01	1.04	1.54	0.54	1.39	1.23	0.55	1.63	0.92
LK Olpe	2.78	2.77	1.92	0.77	0.13	0.64	1.33	0.84	1.41	0.99	0.71	1.22	2.36	1.45	0.82
LK Paderborn	2.78	1.31	1.88	0.38	0.79	0.92	1.33	0.76	1.18	0.97	0.99	1.00	1.76	1.82	1.11
LK Recklinghausen	2.78	1.76	1.34	0.93	0.44	0.58	1.76	0.81	1.39	0.84	0.81	1.41	1.70	1.39	1.16
LK Rhein-Erft-Kreis	2.78	1.26	1.84	0.53	0.80	0.42	1.01	1.38	1.36	1.12	0.82	1.25	1.55	1.48	0.97
LK Rhein-Kreis Neuss	2.78	2.48	0.58	0.47	1.57	0.54	1.82	0.99	1.29	0.82	0.77	1.37	1.34	1.53	0.79
LK Rhein-Sieg-Kreis	2.78	2.57	0.98	0.64	1.05	0.77	0.22	1.17	1.41	0.94	0.89	1.26	1.69	1.48	0.92
LK Rheinisch-Bergischer Kreis	2.78	1.76	1.12	0.54	0.48	0.74	0.90	1.28	1.38	0.73	1.00	1.27	1.71	1.57	0.73
LK Siegen-Wittgenstein	2.78	1.37	1.34	0.64	0.39	0.44	0.71	1.95	1.37	0.25	1.21	1.22	1.08	1.46	0.90
LK Soest	2.78	1.68	0.98	0.39	0.51	0.83	1.84	0.85	1.41	0.44	0.75	1.58	1.08	1.40	1.08
LK Steinfurt	2.78	1.34	1.67	0.64	0.20	0.58	0.97	1.21	1.49	0.34	1.09	1.34	0.73	1.61	0.98
LK Unna	2.78	1.49	1.56	0.78	0.11	0.70	2.23	0.76	1.52	0.24	0.58	1.65	1.49	1.43	0.74
LK Viersen	2.78	1.15	1.24	0.72	0.69	0.51	1.14	1.28	1.25	0.74	1.10	1.03	1.83	1.70	0.82

Table 11: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Warendorf	2.78	1.19	0.33	0.73	0.31	0.95	3.23	0.07	1.19	0.89	0.89	1.46	1.56	1.52	0.96
LK Wesel	2.78	1.00	1.00	0.85	0.61	0.74	2.21	0.74	1.32	0.41	0.90	1.25	1.85	1.37	1.05
SK Bielefeld	2.78	2.46	0.88	0.71	0.23	0.63	2.46	1.09	1.10	0.85	0.88	1.34	1.43	1.51	0.98
SK Bochum	2.78	1.97	0.68	0.86	0.30	1.20	0.38	1.28	1.25	0.39	1.14	1.14	1.78	1.50	0.84
SK Bonn	2.78	1.45	1.07	0.69	0.46	0.86	0.51	1.21	1.46	0.70	0.96	1.27	1.38	1.43	0.93
SK Bottrop	2.78	1.57	1.25	1.03	0.55	0.63	0.89	1.44	1.08	0.52	1.01	1.34	1.00	1.79	0.89
SK Dortmund	2.78	1.38	1.29	0.60	0.23	1.15	1.78	0.85	1.21	0.84	0.88	1.24	1.63	1.55	0.92
SK Duisburg	2.78	1.98	1.05	0.92	0.73	0.93	1.44	0.89	1.13	0.92	0.72	1.36	1.44	1.57	0.81
SK Düsseldorf	2.78	1.26	1.29	0.68	1.31	0.79	1.68	0.73	1.18	1.15	0.80	1.25	1.57	1.50	0.80
SK Essen	2.78	1.43	0.48	1.09	0.06	0.90	1.36	1.09	1.28	0.61	0.94	1.36	1.12	1.49	0.95
SK Gelsenkirchen	2.78	1.66	1.45	0.72	0.58	0.98	1.51	0.84	1.26	0.69	1.19	1.22	1.48	1.49	0.74
SK Hagen	2.78	1.49	1.25	0.93	0.82	0.47	2.50	0.78	1.28	0.96	0.67	1.39	1.14	1.57	1.03
SK Hamm	2.78	1.68	1.21	0.72	0.18	0.46	3.31	0.38	1.43	0.48	1.40	1.45	0.23	1.24	1.46
SK Herne	2.78	2.32	1.01	0.98	0.39	0.68	2.41	0.71	1.45	0.52	0.71	1.42	2.00	1.41	1.02
SK Köln	2.78	1.09	0.90	0.41	1.06	0.75	1.12	1.30	1.20	0.86	1.25	1.16	1.68	1.43	0.75
SK Krefeld	2.78	2.07	0.70	1.07	0.47	0.72	0.64	1.18	1.24	0.88	1.27	0.93	2.15	1.64	0.80
SK Leverkusen	2.78	1.80	0.99	0.49	1.47	0.62	0.97	1.35	1.23	1.15	0.91	1.27	1.36	1.40	0.92

Table 11: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
SK Mönchengladbach	2.78	1.11	1.39	0.65	1.16	0.74	1.02	1.11	1.25	0.53	0.86	1.17	1.94	1.58	0.94
SK Mülheim a.d.Ruhr	2.78	1.69	1.02	0.74	0.80	0.81	1.84	0.99	1.10	0.84	1.29	0.97	1.65	1.63	0.93
SK Münster	2.78	1.76	0.38	0.24	2.02	0.70	0.45	1.07	1.67	0.31	0.83	1.45	0.83	1.55	0.85
SK Oberhausen	2.78	1.00	1.37	0.74	1.31	0.36	1.81	1.32	1.12	0.64	1.02	1.06	2.19	1.61	0.96
SK Remscheid	2.78	0.86	2.07	0.60	0.30	0.66	1.03	1.32	1.43	0.43	1.37	1.26	0.69	1.58	0.76
SK Solingen	2.78	1.49	1.17	0.61	0.35	1.09	0.93	1.28	1.16	0.32	1.48	1.01	2.55	1.36	0.77
SK Wuppertal	2.78	0.90	1.88	0.75	0.14	0.84	1.40	0.86	1.46	0.84	0.86	1.29	1.72	1.36	0.91
StadtRegion Aachen	2.78	1.26	1.10	0.56	0.34	0.59	1.12	1.22	1.43	0.68	1.11	1.26	2.13	1.45	0.75

12 Rhineland-Palatinate

12.1 Model description

Fig. 139 depicts the results of the modeling (lines) compared to the observed data (points) for Rhineland-Palatinate on a linear (A) and semi-logarithmic (B) scale.

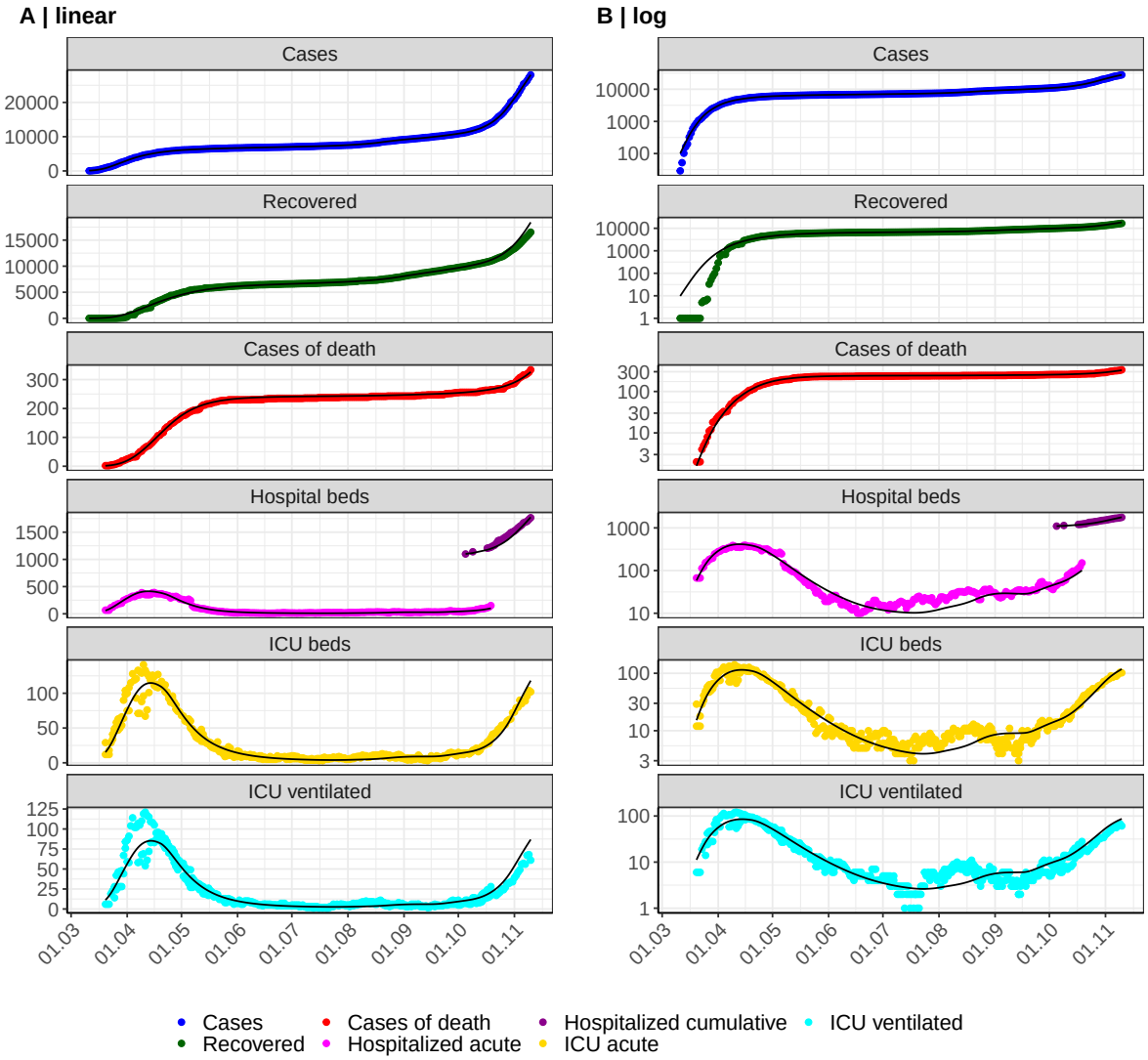


Figure 139: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Rhineland-Palatinate. Points: reported data; lines: model description.

Fig. 140 shows the goodness-of-fit for Rhineland-Palatinate. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

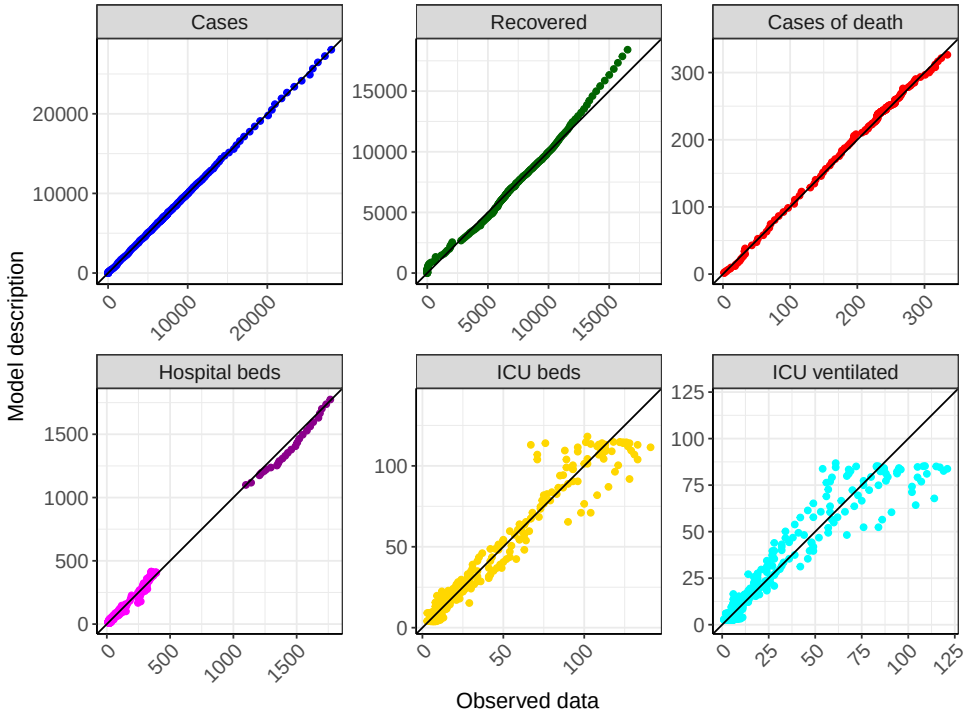


Figure 140: Goodness-of-fit plots for Rhineland-Palatinate. Lines: lines of identity.

Fig. 141 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Rhineland-Palatinate (red line) in comparison with the other federal states (grey lines).

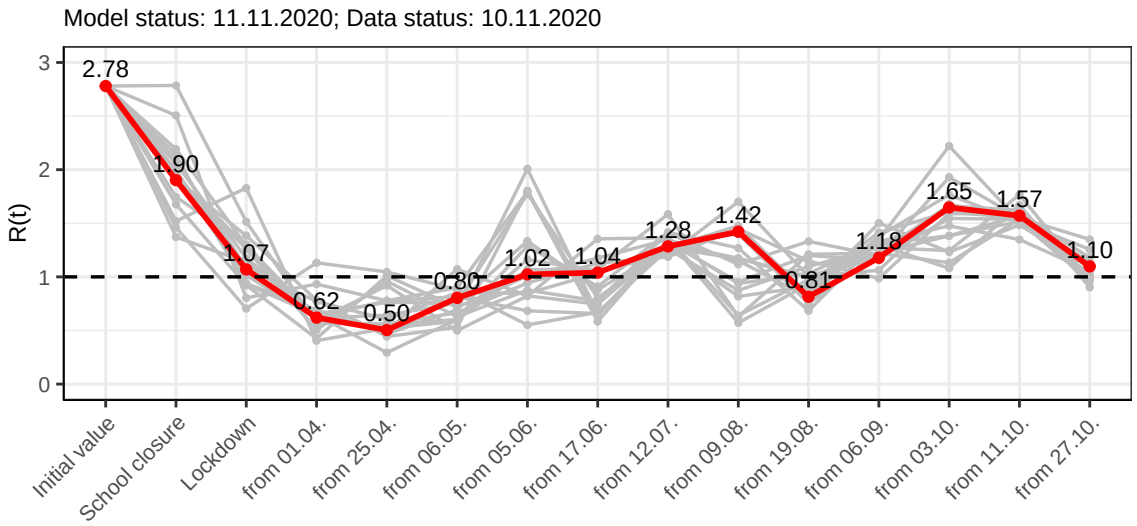


Figure 141: R(t) values before and after the NPIs for Rhineland-Palatinate

Fig. 142 shows the R(t) estimated value for Rhineland-Palatinate (red line) over time in comparison with the other federal states (grey lines).

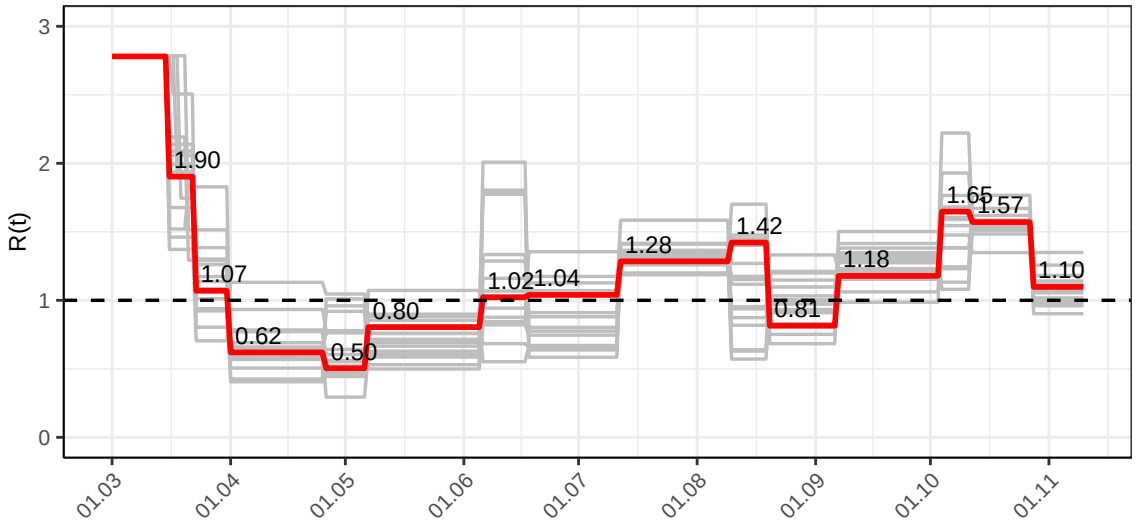


Figure 142: R(t) values over time for Rhineland-Palatinate

Fig. 143 shows the changes in hospitalization and death rates for Rhineland-Palatinate (red line) over time compared to the other states (grey lines).

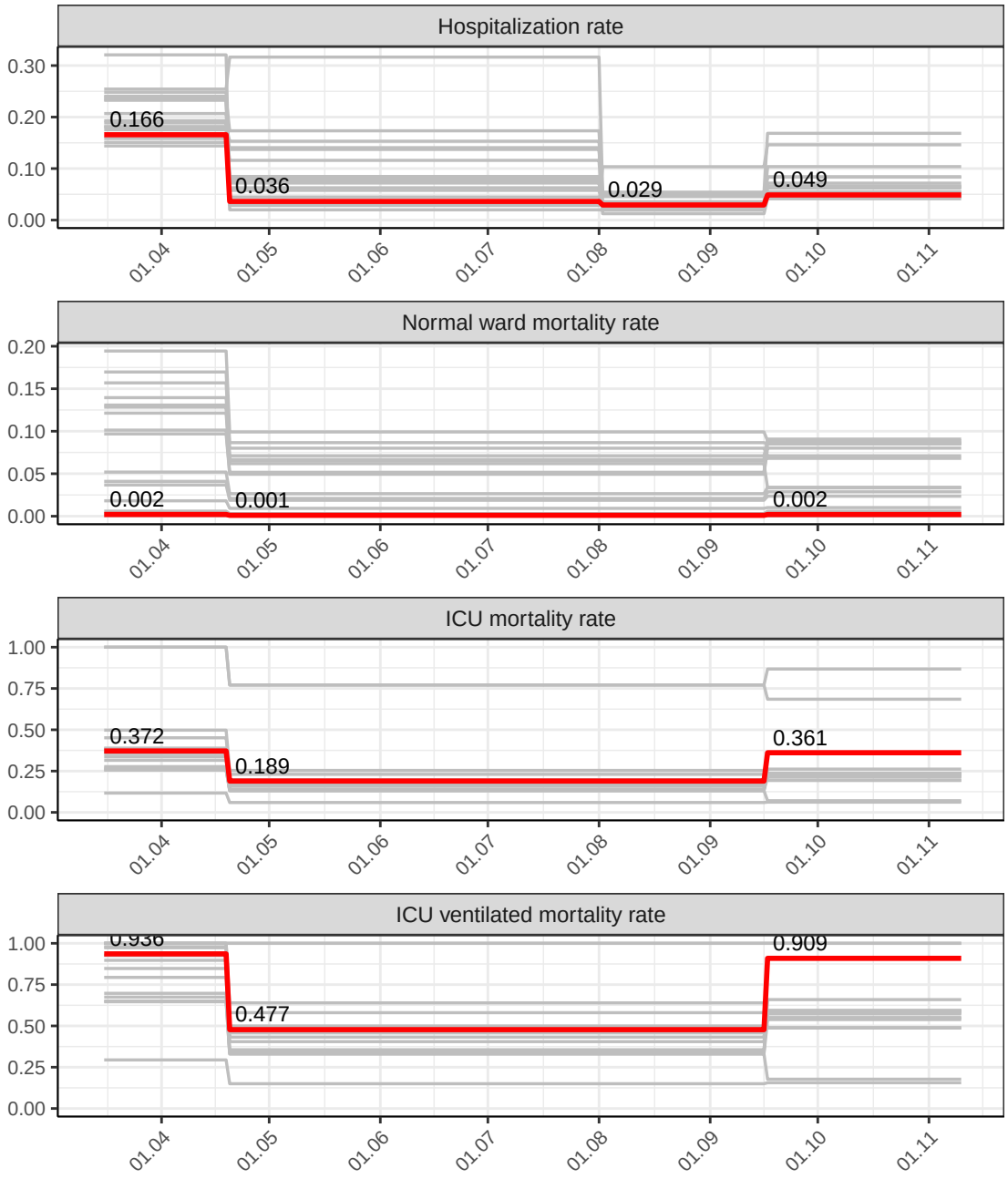


Figure 143: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Rhineland-Palatinate

12.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1.1) and assuming various scenarios from 11.11.2020

Fig.144 and 145 represent the model prediction for the next 8 weeks for Rhineland-Palatinate on a linear (144) and a semi-logarithmic (145) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

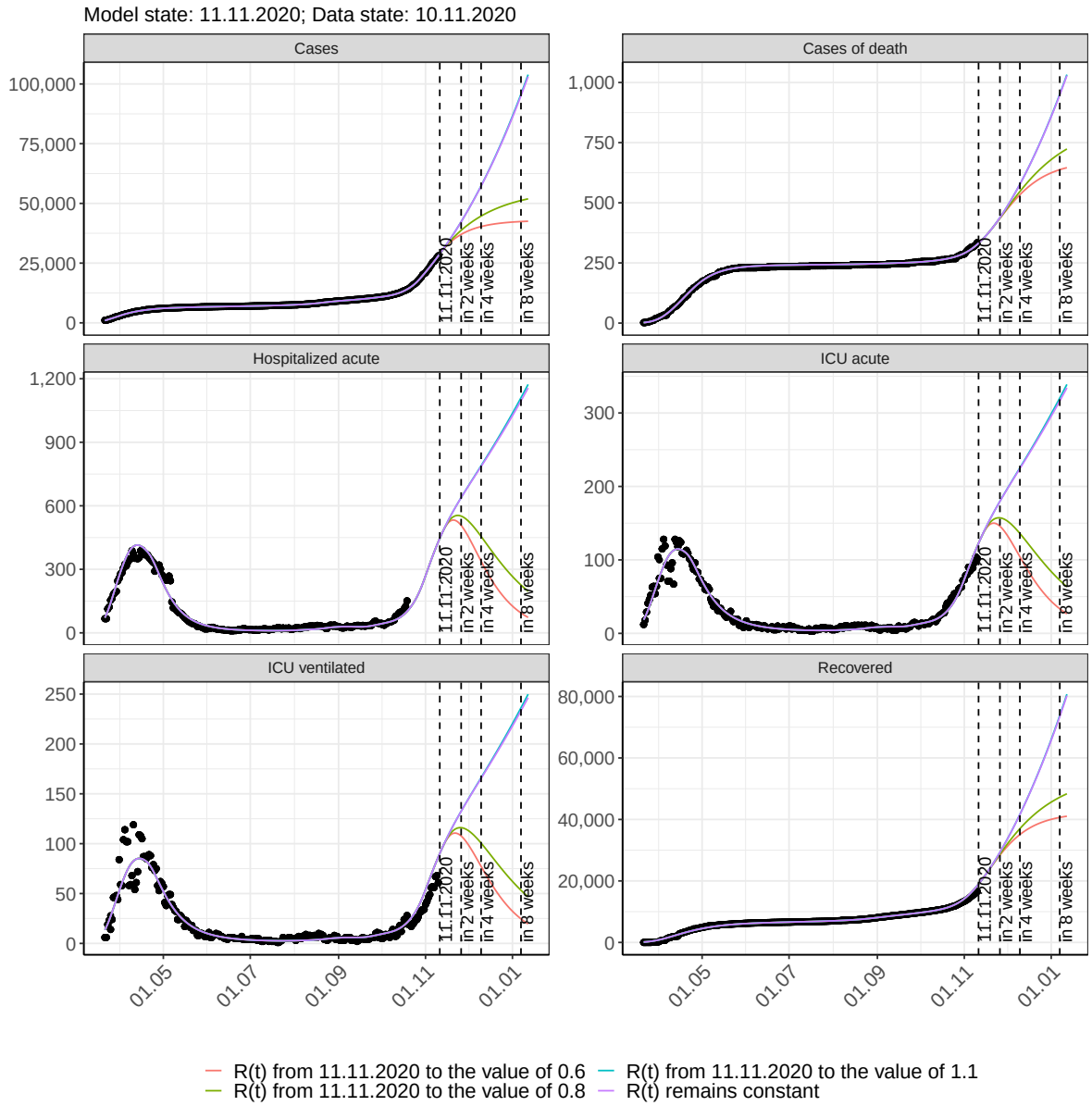


Figure 144: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Rhineland-Palatinate assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

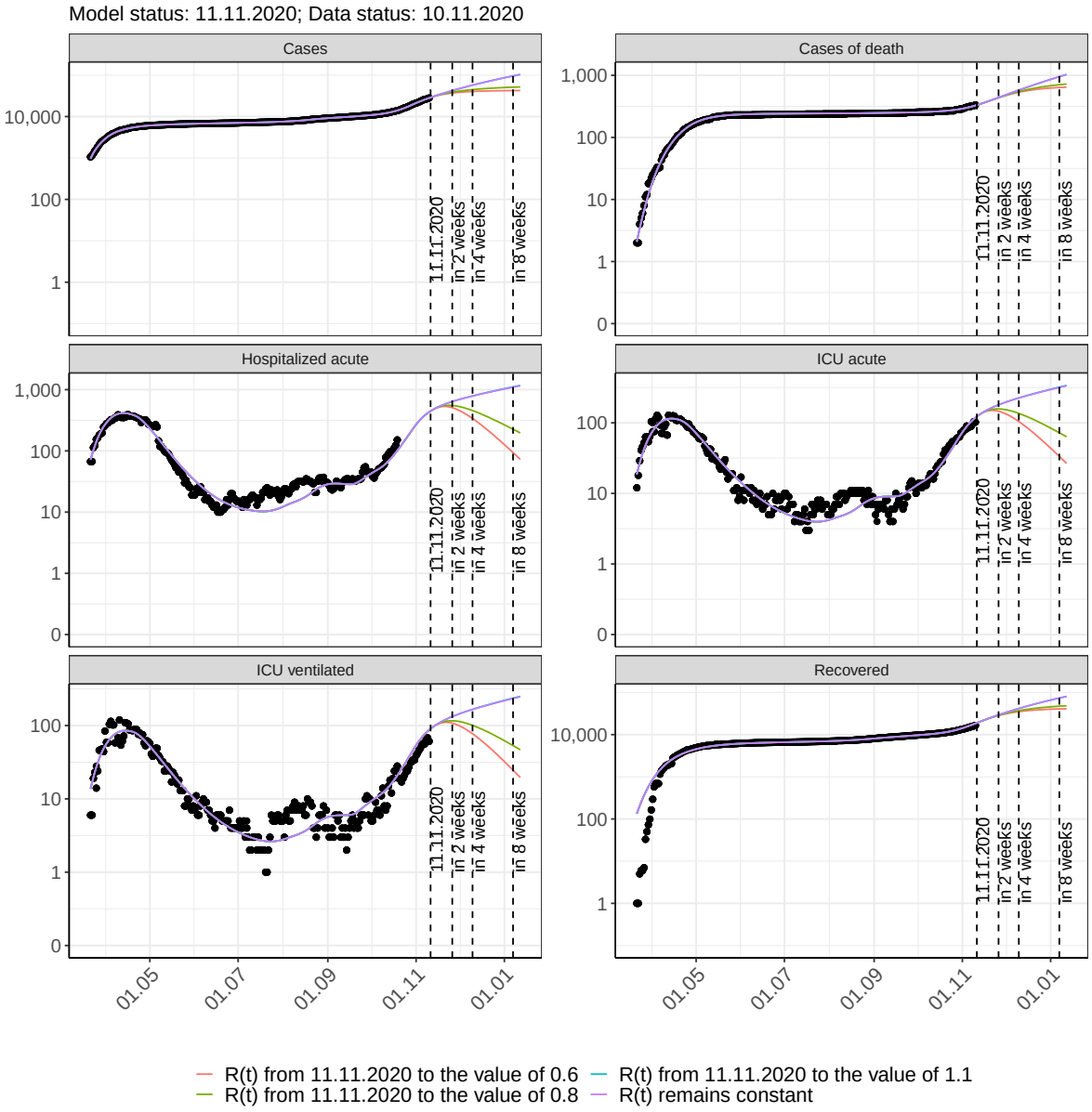


Figure 145: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Rhineland-Palatinate assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 146 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

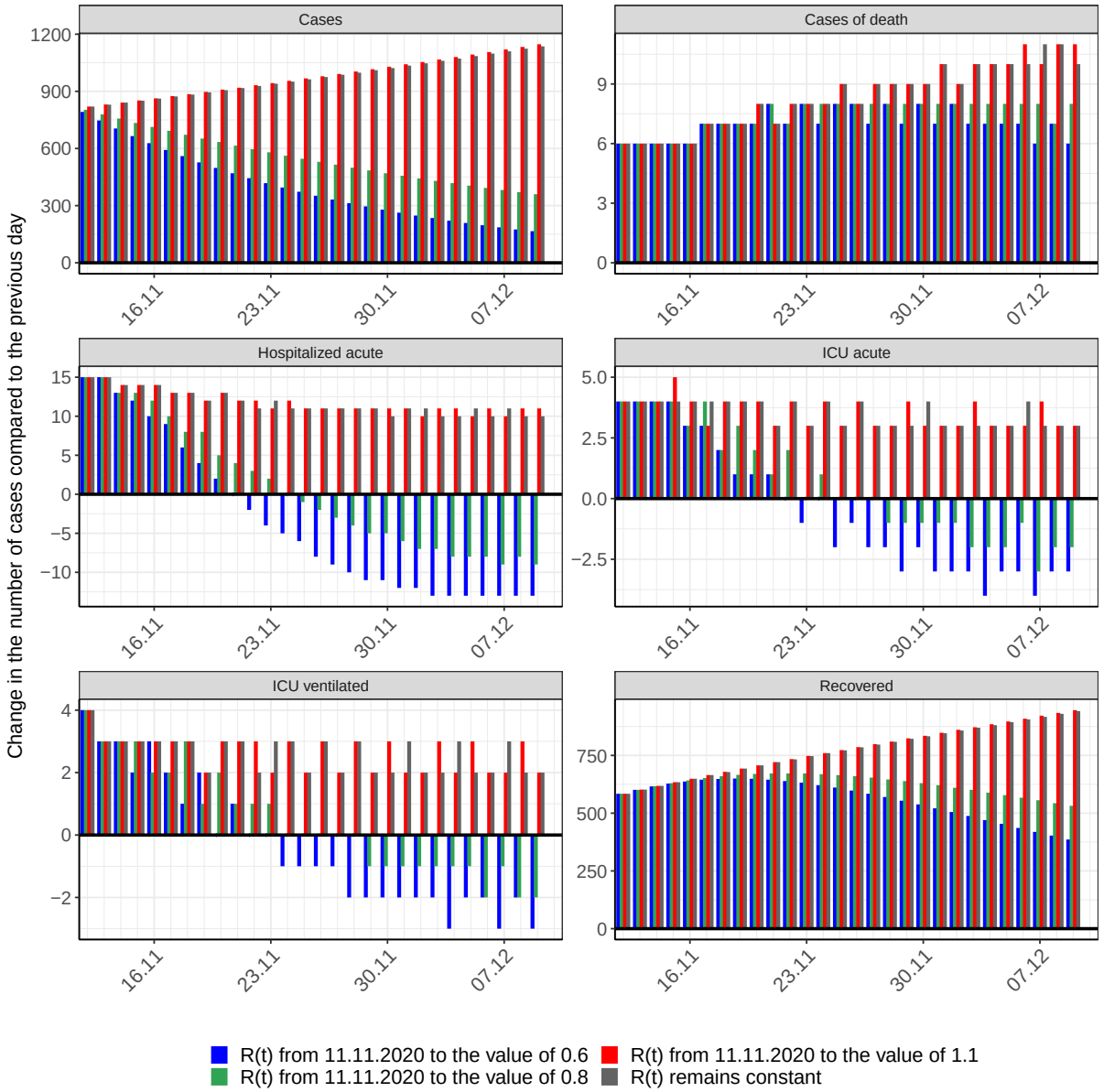


Figure 146: Simulation of daily new cases for the next 4 weeks - Rhineland-Palatinate

12.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Rhineland-Palatinate over time.

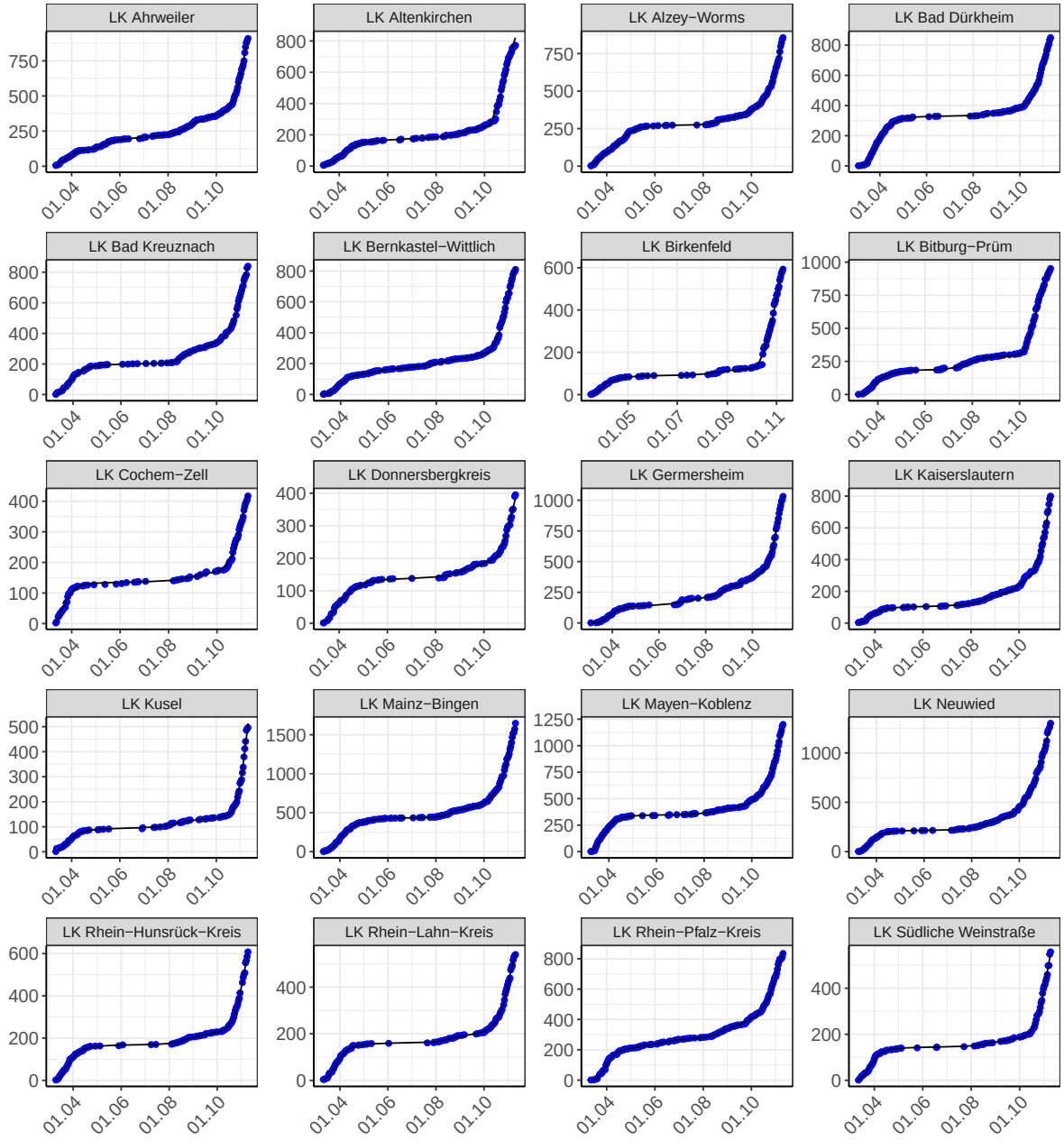


Figure 147: Model description of the reported case numbers in country- and citycounties in Rhineland-Palatinate. Points: reported data; lines: model description.

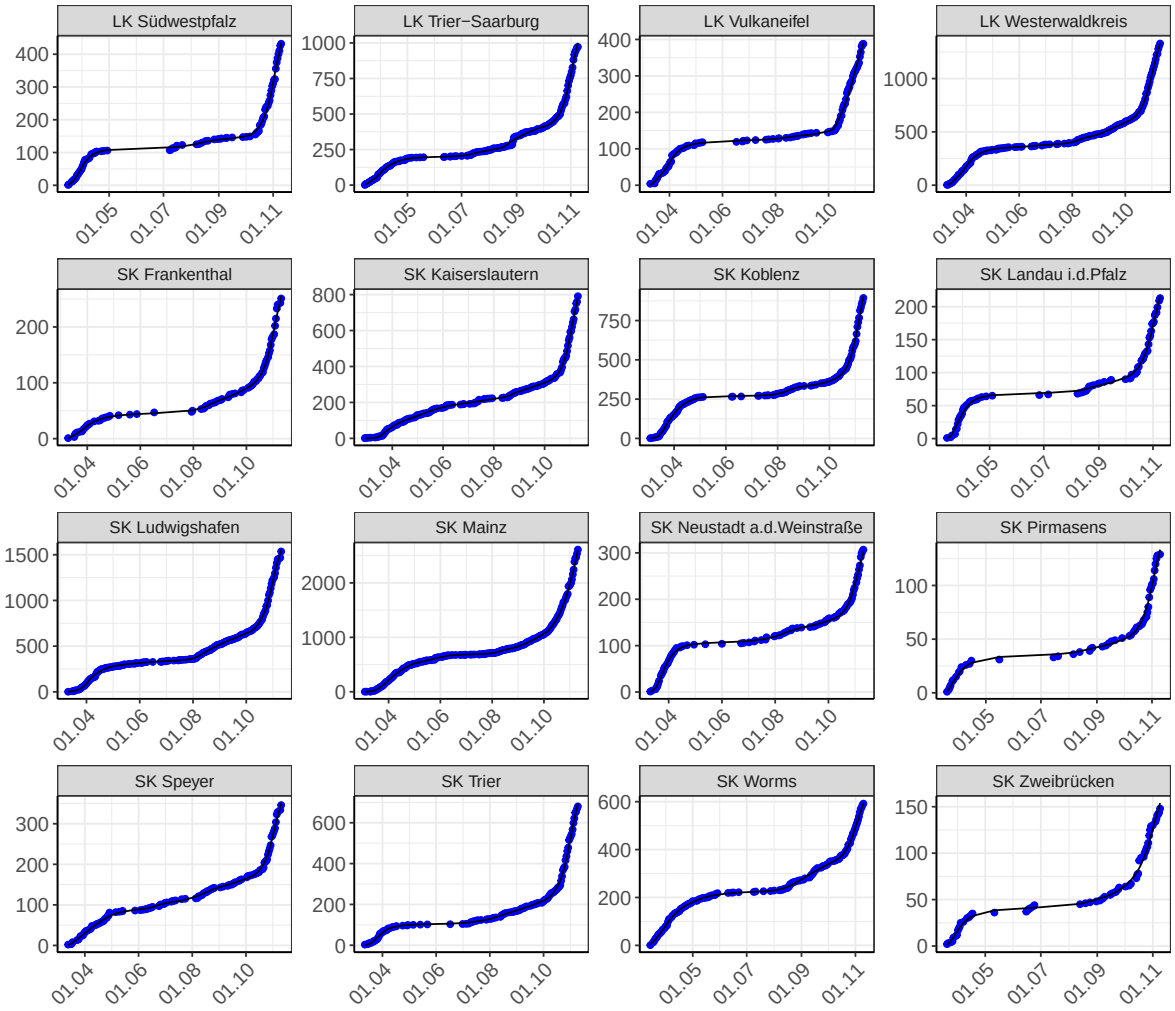


Figure 148: Model description of the reported case numbers in country- and citycounties in Rhineland-Palatinate. Points: reported data; lines: model description.

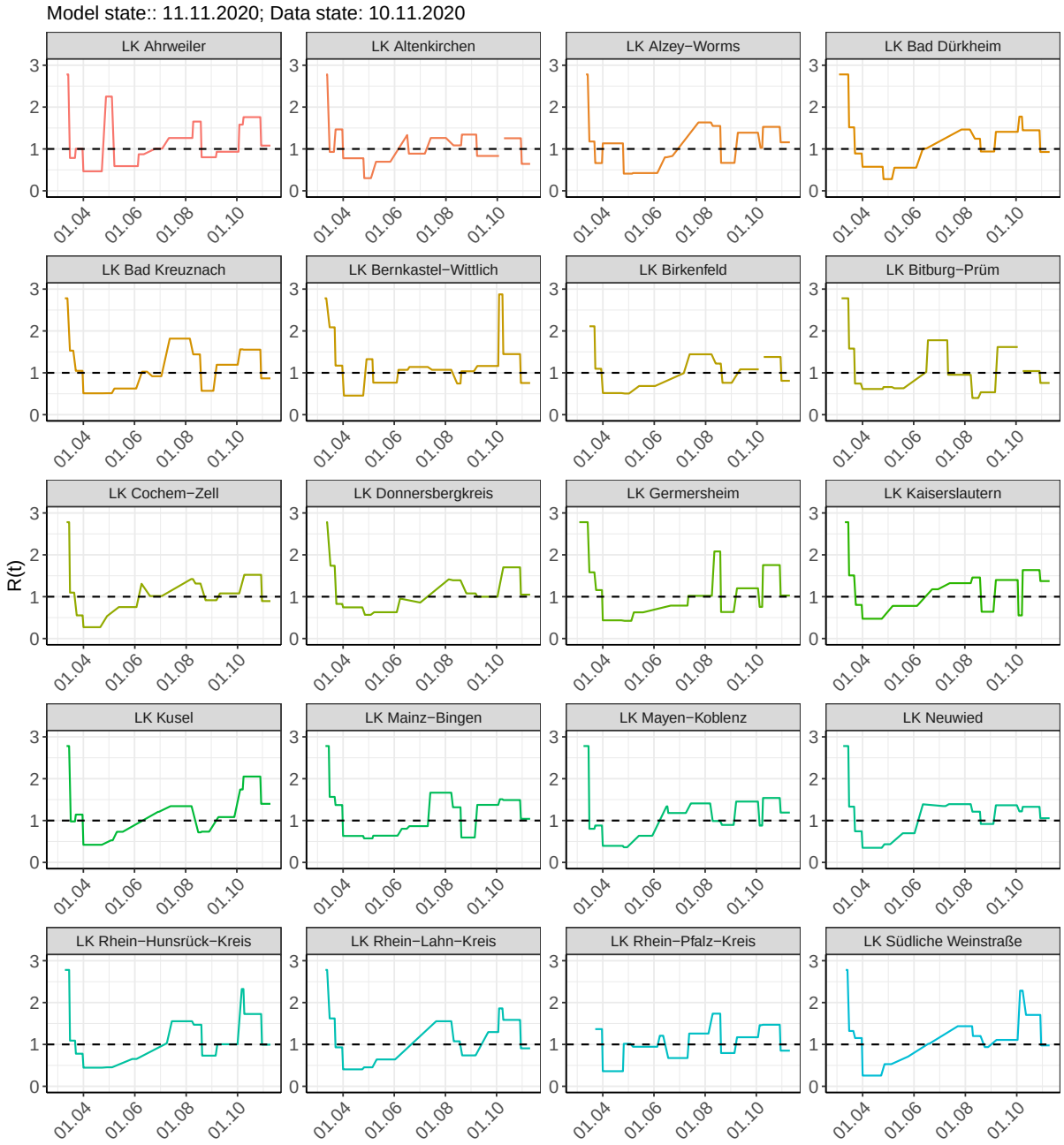


Figure 149: R(t) values over time for country- and citycounties in Rhineland-Palatinate

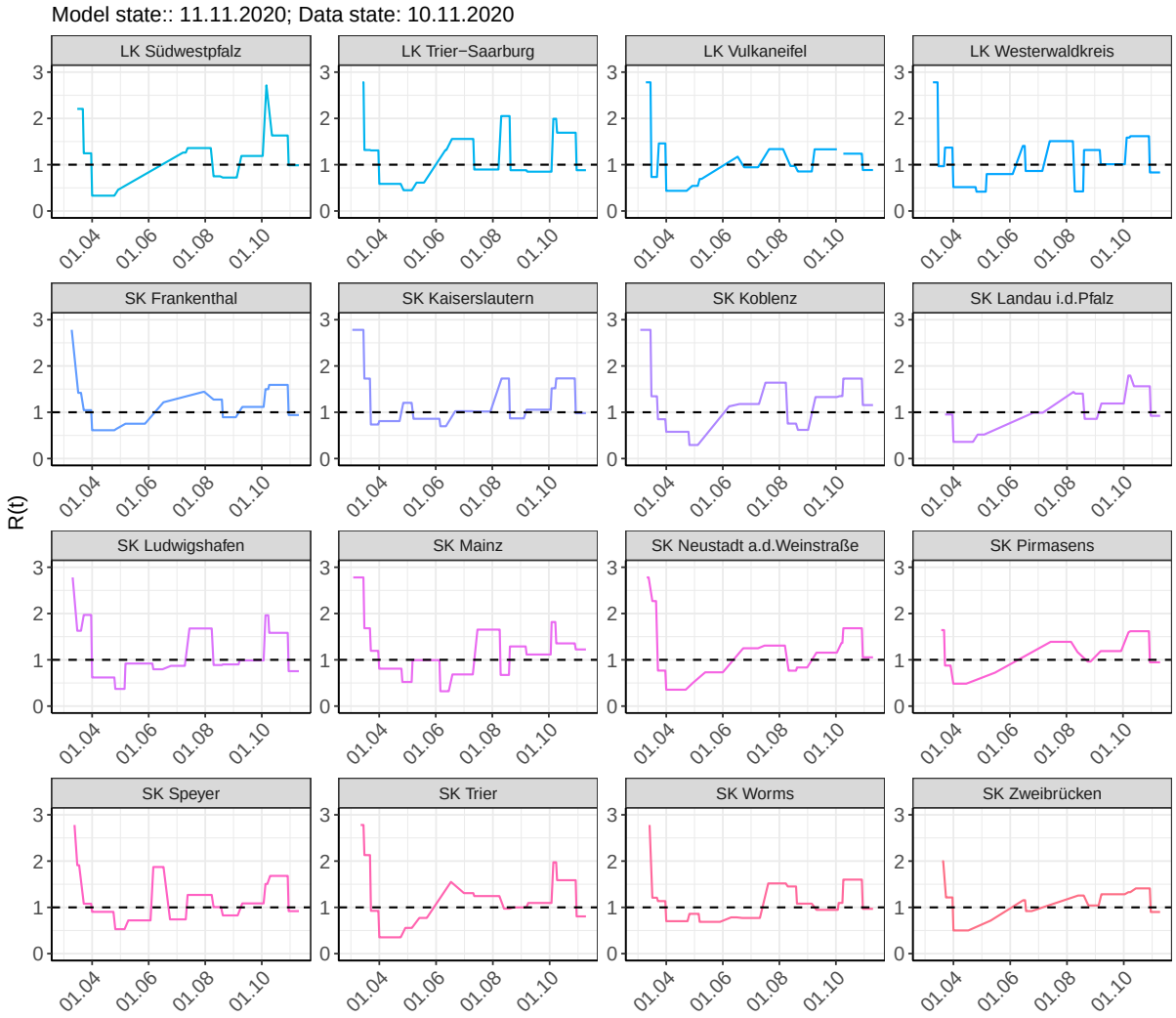


Figure 150: R(t) values over time for country- and citycounties in Rhineland-Palatinate

Table 12: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Ahrweiler	2.78	0.78	1.01	0.47	2.25	0.59	0.87	1.01	1.26	1.65	0.80	0.93	1.58	1.76	1.08
LK Altenkirchen	2.78	0.93	1.47	0.78	0.30	0.69	1.33	0.89	1.26	1.08	1.34	0.83	4.12	1.26	0.64
LK Alzey-Worms	2.78	1.18	0.66	1.13	0.41	0.42	0.80	0.83	1.63	1.55	0.67	1.39	1.03	1.53	1.16
LK Bad Dürkheim	2.78	1.52	0.89	0.57	0.28	0.55	1.01	0.92	1.46	1.24	0.94	1.41	1.77	1.45	0.93
LK Bad Kreuznach	2.78	1.53	1.05	0.51	0.51	0.62	1.03	0.92	1.82	1.44	0.57	1.19	1.56	1.55	0.87
LK Bernkastel-Wittlich	2.78	2.09	1.17	0.46	1.33	0.76	1.07	1.14	1.07	0.74	1.04	1.16	2.88	1.45	0.76
LK Birkenfeld	2.78	2.11	1.10	0.52	0.51	0.68	1.14	0.99	1.44	1.22	0.76	1.08	4.24	1.38	0.81
LK Bitburg-Prüm	2.78	1.58	0.74	0.61	0.66	0.63	1.02	1.78	0.95	0.40	0.54	1.62	3.50	1.04	0.76
LK Cochem-Zell	2.78	1.10	0.55	0.27	0.54	0.75	1.31	1.01	1.42	1.31	0.92	1.08	2.73	1.52	0.89
LK Donnersbergkreis	2.78	1.74	0.83	0.74	0.57	0.63	0.95	0.86	1.41	1.39	1.08	1.00	1.42	1.70	1.05
LK Germersheim	2.78	1.58	1.16	0.44	0.42	0.63	3.19	0.79	1.02	2.08	0.63	1.20	0.76	1.76	1.03

Table 12: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Kaiserslautern	2.78	1.51	0.80	0.47	0.54	0.78	1.48	1.18	1.32	1.46	0.64	1.40	0.55	1.64	1.37
LK Kusel	2.78	0.98	1.14	0.42	0.53	0.73	1.32	1.21	1.34	0.72	0.73	1.08	1.74	2.05	1.40
LK Mainz-Bingen	2.78	1.57	1.37	0.63	0.57	0.64	0.80	0.87	1.67	1.32	0.60	1.37	1.51	1.49	1.04
LK Mayen-Koblenz	2.78	0.80	0.88	0.40	0.36	0.64	1.34	1.18	1.41	0.99	0.90	1.45	0.88	1.54	1.19
LK Neuwied	2.78	1.33	0.74	0.35	0.43	0.70	1.39	1.35	1.39	1.21	0.92	1.37	1.22	1.33	1.06
LK Rhein-Hunsrück-Kreis	2.78	1.09	0.78	0.44	0.45	0.65	1.14	1.03	1.55	1.47	0.73	1.00	2.32	1.73	0.99
LK Rhein-Lahn-Kreis	2.78	1.62	0.93	0.40	0.45	0.64	1.13	1.04	1.55	1.07	0.74	1.30	1.86	1.59	0.91
LK Rhein-Pfalz-Kreis	2.78	3.40	1.37	0.36	1.02	0.94	1.21	0.68	1.26	1.74	0.79	1.17	1.46	1.47	0.85
LK Südliche Weinstraße	2.78	1.32	1.15	0.26	0.53	0.71	1.21	1.02	1.44	1.20	0.94	1.11	2.29	1.70	0.98
LK Südwestpfalz	2.78	2.21	1.25	0.33	0.46	0.66	1.21	1.26	1.36	0.75	0.72	1.19	2.72	1.63	0.99
LK Trier-Saarburg	2.78	1.32	1.31	0.59	0.45	0.61	1.32	1.56	0.90	2.05	0.88	0.85	1.99	1.69	0.88
LK Vulkaneifel	2.78	0.73	1.46	0.44	0.54	0.69	1.17	0.94	1.34	0.97	0.85	1.33	3.16	1.24	0.89
LK Westerwaldkreis	2.78	0.97	1.37	0.52	0.42	0.80	1.41	0.86	1.51	0.42	1.32	1.01	1.59	1.62	0.83

Table 12: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
SK Frankenthal	2.78	1.42	1.04	0.61	0.64	0.75	1.22	1.00	1.44	1.27	0.89	1.12	1.50	1.59	0.94
SK Kaiserslautern	2.78	1.73	0.74	0.81	1.20	0.86	0.70	1.02	1.02	1.73	0.87	1.06	1.52	1.73	0.98
SK Koblenz	2.78	1.35	0.85	0.58	0.29	0.54	1.13	1.18	1.64	0.76	0.62	1.33	1.35	1.73	1.16
SK Landau i.d.Pfalz	2.78	3.19	0.95	0.36	0.52	0.69	1.15	0.99	1.44	1.40	0.86	1.19	1.79	1.56	0.92
SK Ludwigshafen	2.78	1.63	1.97	0.62	0.37	0.92	0.80	0.87	1.68	0.89	0.90	0.99	1.96	1.58	0.75
SK Mainz	2.78	1.68	1.19	0.81	0.52	0.99	0.32	0.68	1.65	0.67	1.29	1.11	1.82	1.36	1.22
SK Neustadt a.d.Weinstraße	2.78	2.27	0.77	0.35	0.51	0.73	1.41	1.25	1.31	0.77	0.83	1.15	1.36	1.68	1.05
SK Pirmasens	2.78	1.64	0.88	0.48	0.58	0.72	1.17	0.95	1.39	1.17	0.96	1.19	1.60	1.62	0.95
SK Speyer	2.78	1.91	1.08	0.90	0.53	0.72	1.87	0.74	1.27	1.01	0.83	1.09	1.51	1.68	0.92
SK Trier	2.78	2.13	0.93	0.35	0.56	0.77	1.55	1.31	1.24	0.97	1.00	1.10	1.97	1.59	0.80
SK Worms	2.78	1.21	1.14	0.70	0.86	0.69	0.78	0.77	1.52	1.45	1.08	0.95	1.10	1.60	0.97
SK Zweibrücken	2.78	2.00	1.21	0.50	0.57	0.71	1.16	0.92	1.38	1.26	1.04	1.28	1.33	1.41	0.90

13 Saarland

13.1 Model description

Fig. 151 depicts the results of the modeling (lines) compared to the observed data (points) for Saarland on a linear (A) and semi-logarithmic (B) scale.

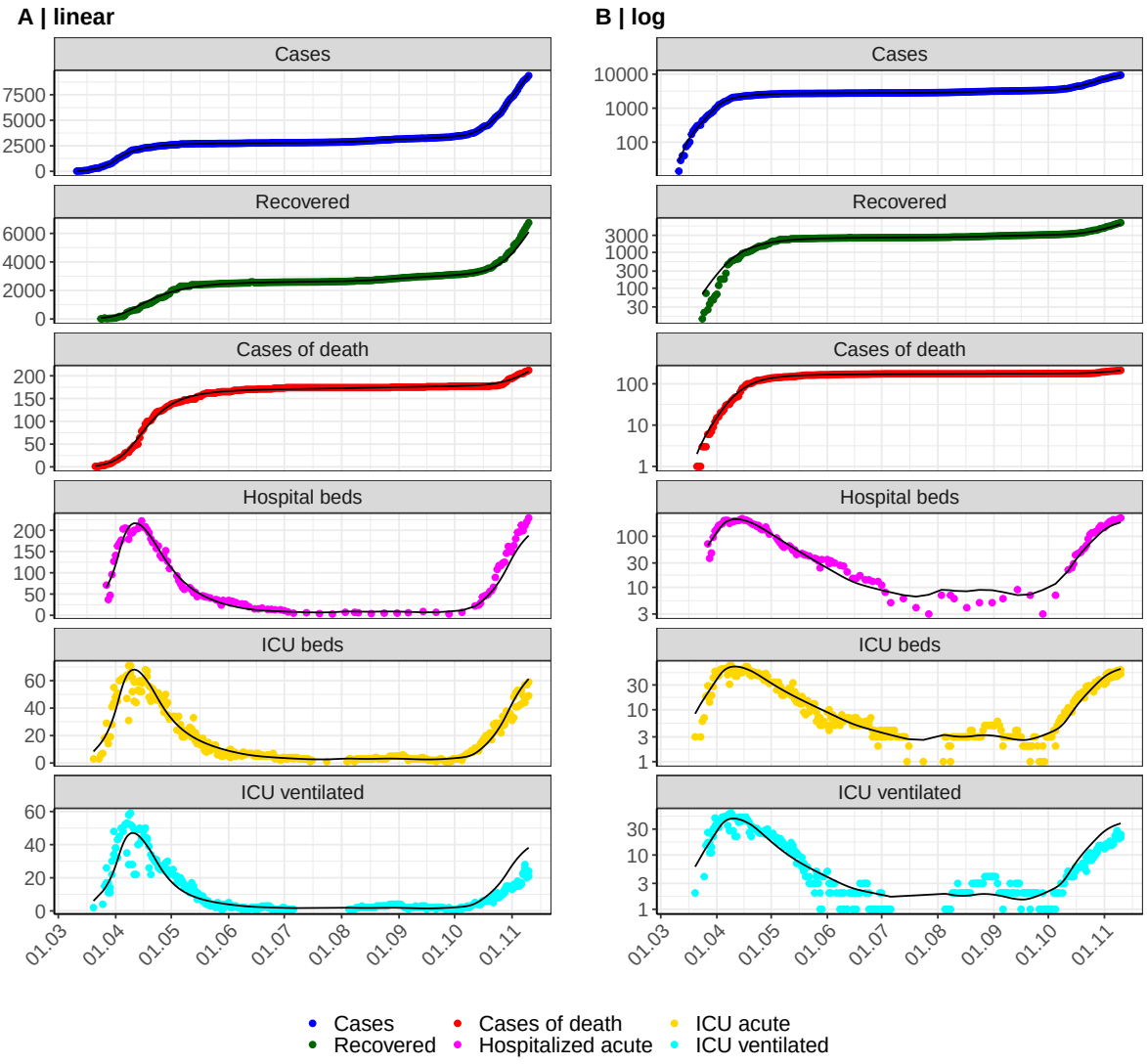


Figure 151: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Saarland. Points: reported data; lines: model description.

Fig. 152 shows the goodness-of-fit for Saarland. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

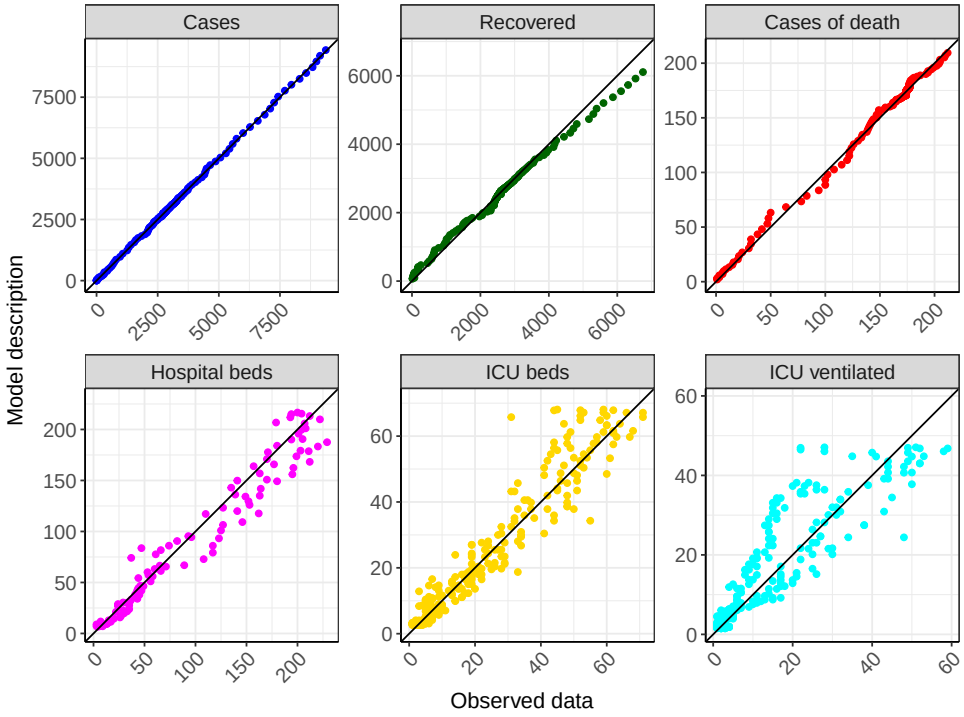


Figure 152: Goodness-of-fit plots for Saarland. Lines: lines of identity.

Fig. 153 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Saarland (red line) in comparison with the other federal states (grey lines).

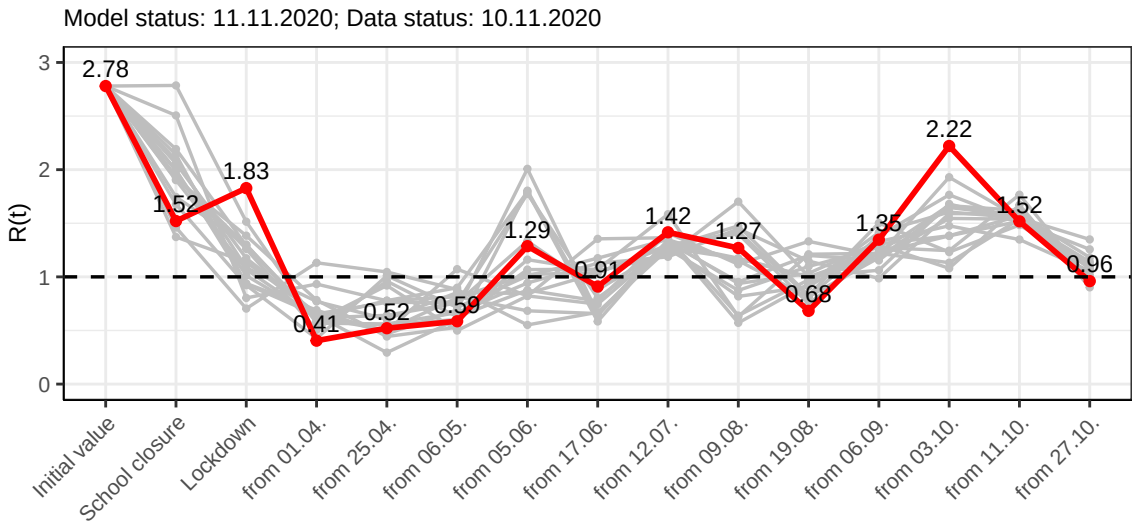


Figure 153: R(t) values before and after the NPIs for Saarland

Fig. 154 shows the R(t) estimated value for Saarland (red line) over time in comparison with the other federal states (grey lines).

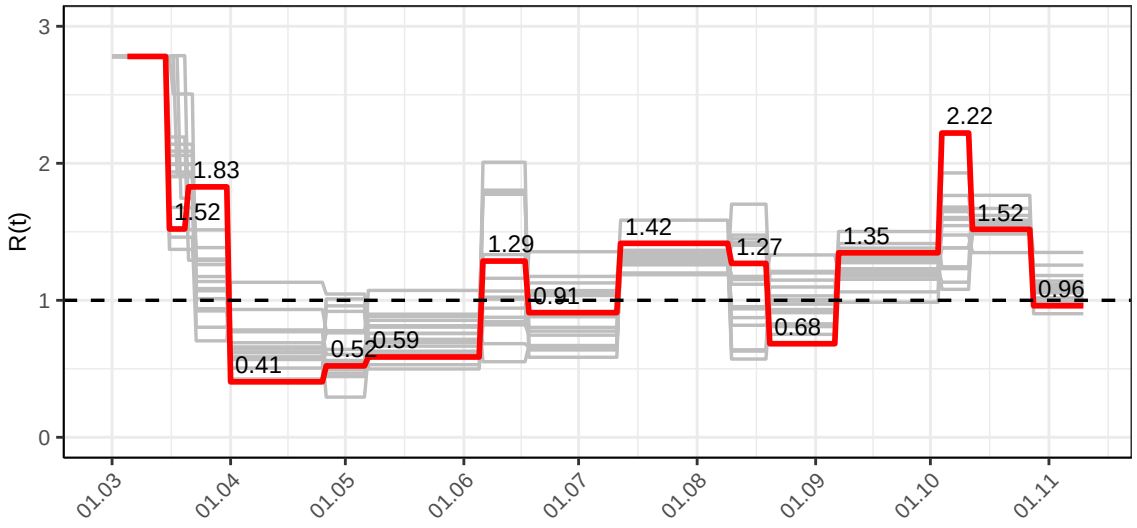


Figure 154: R(t) values over time for Saarland

Fig. 155 shows the changes in hospitalization and death rates for Saarland (red line) over time compared to the other states (grey lines).

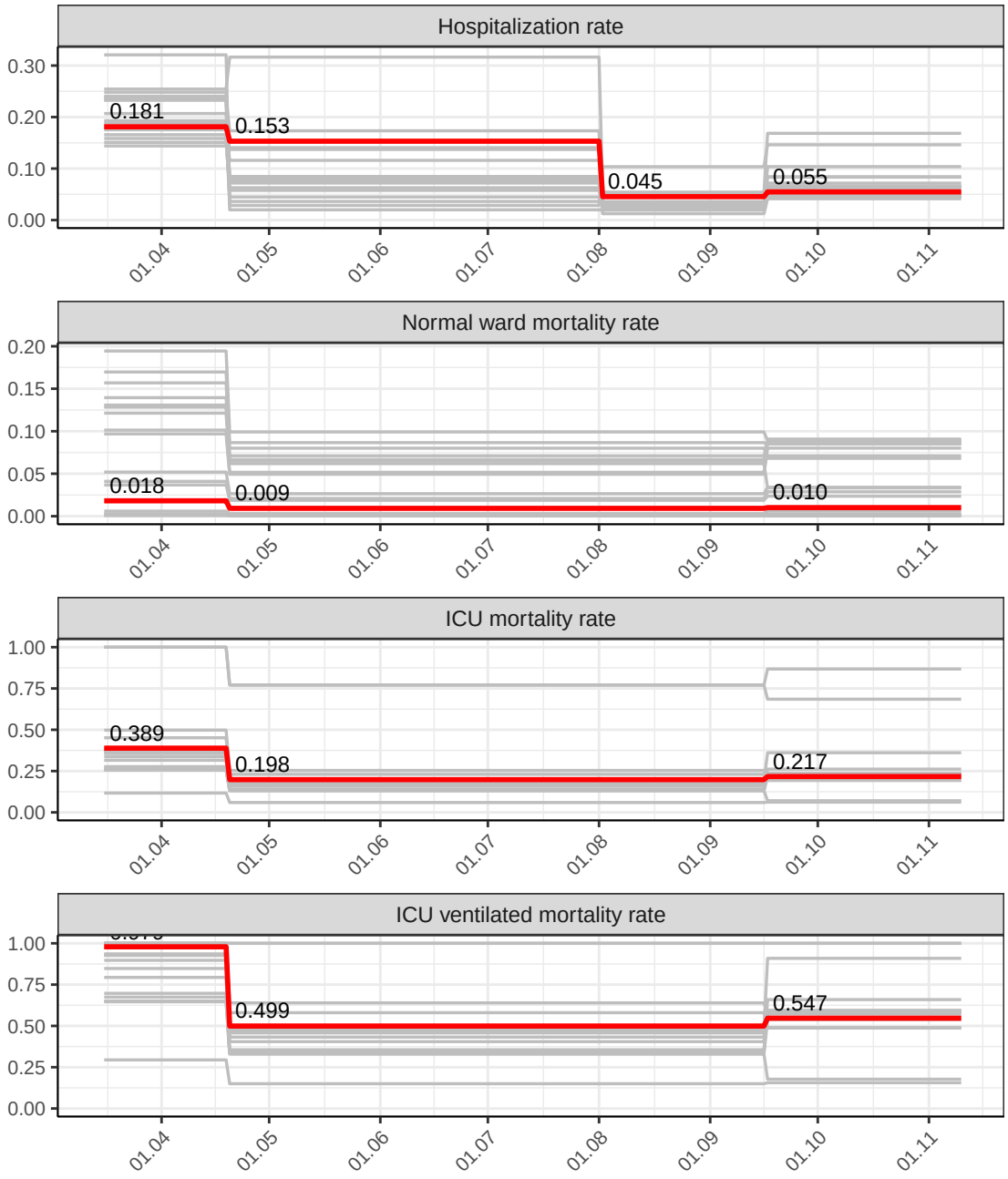


Figure 155: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Saarland

13.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 0.96) and assuming various scenarios from 11.11.2020

Fig.156 and 157 represent the model prediction for the next 8 weeks for Saarland on a linear (156) and a semi-logarithmic (157) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

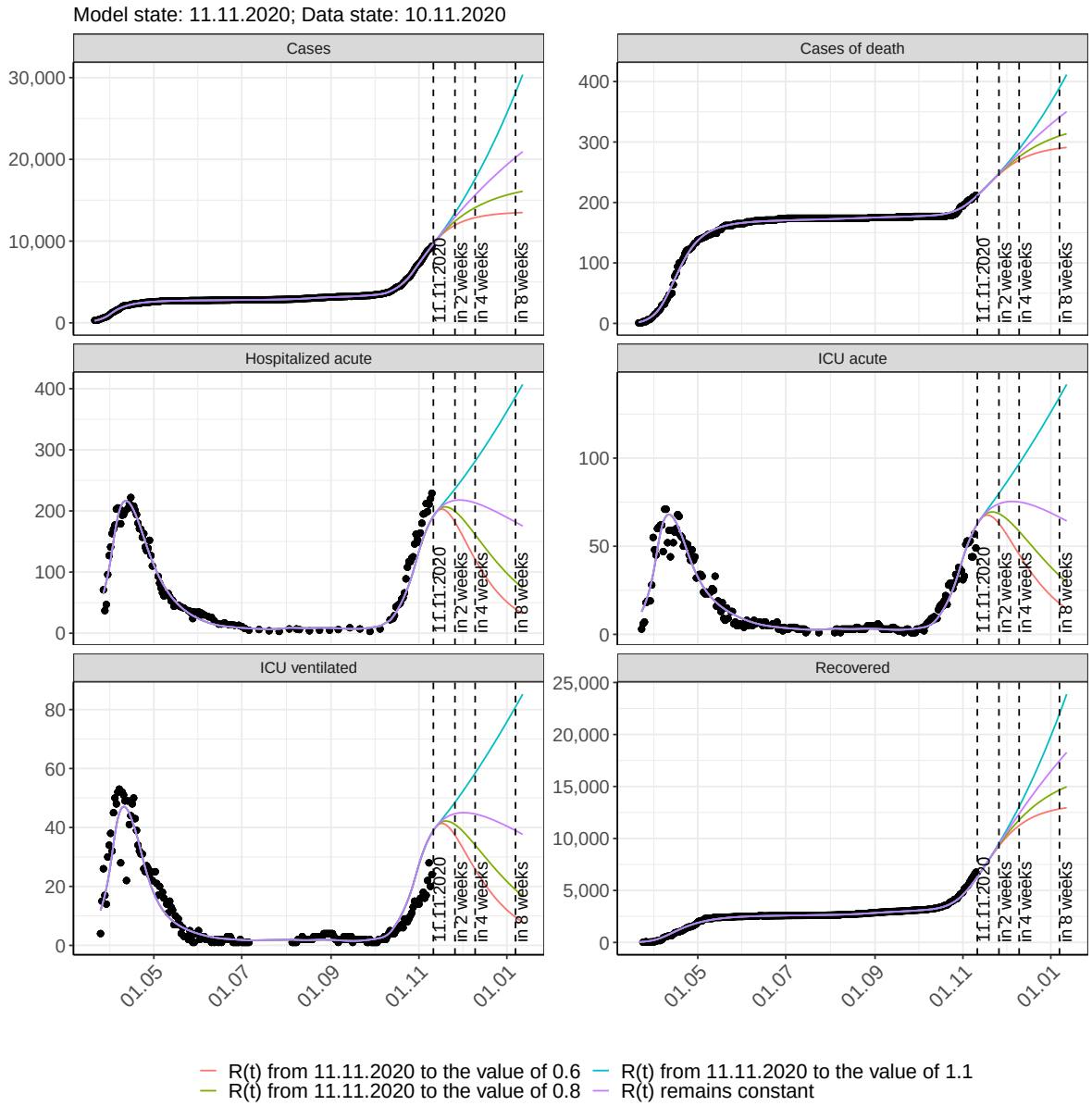


Figure 156: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Saarland assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

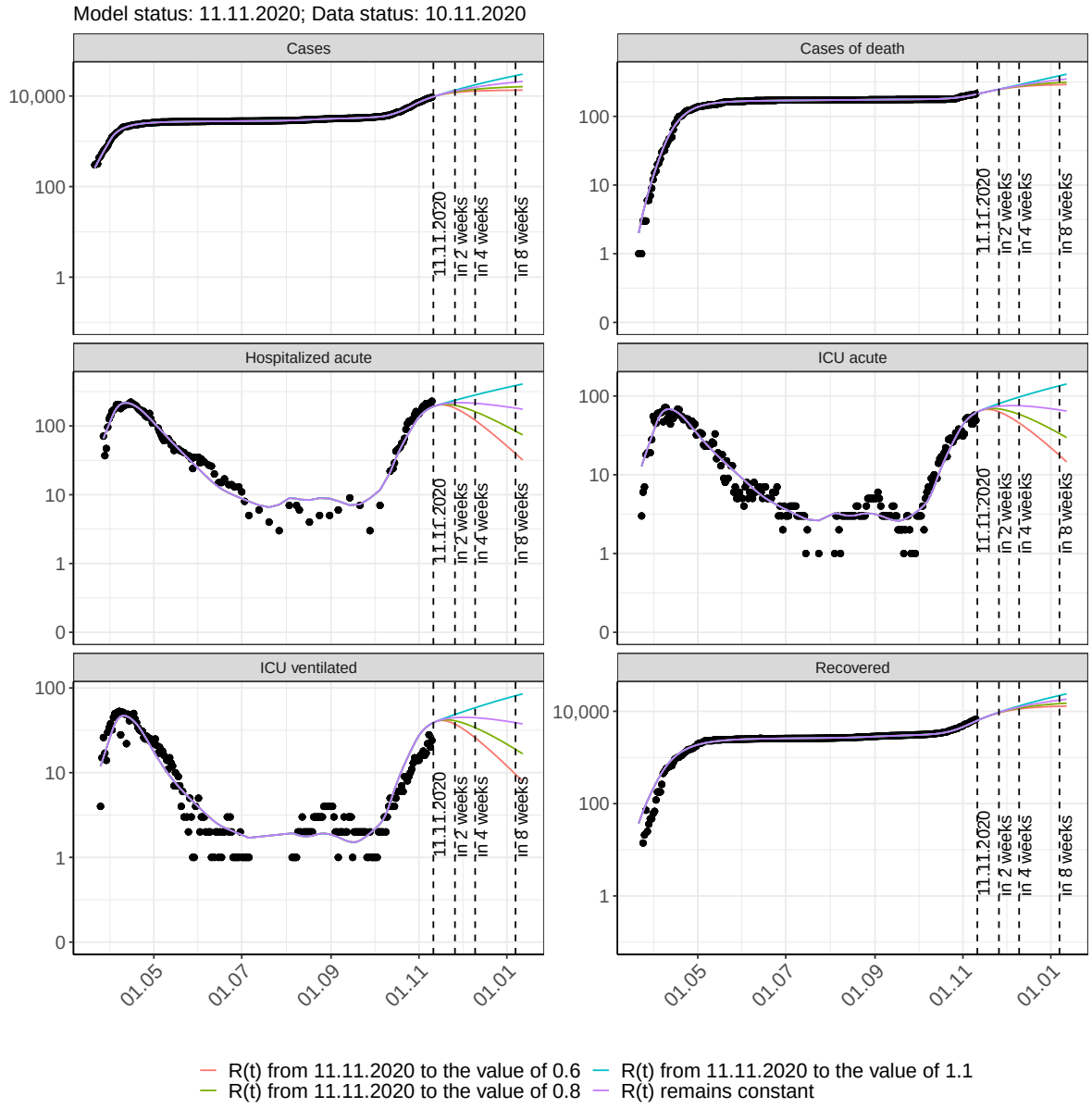


Figure 157: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Saarland assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 158 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

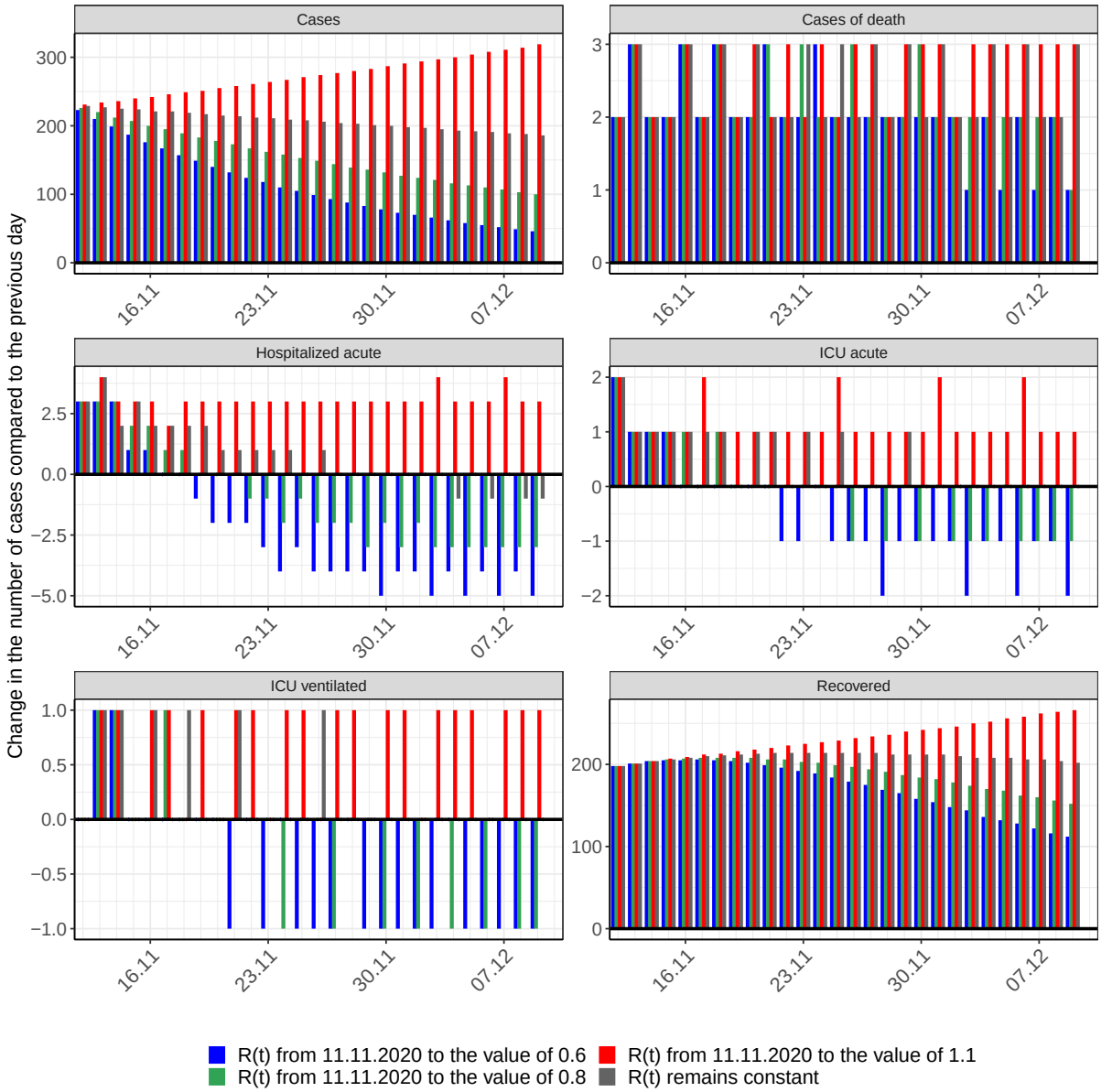


Figure 158: Simulation of daily new cases for the next 4 weeks - Saarland

13.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Saarland over time.

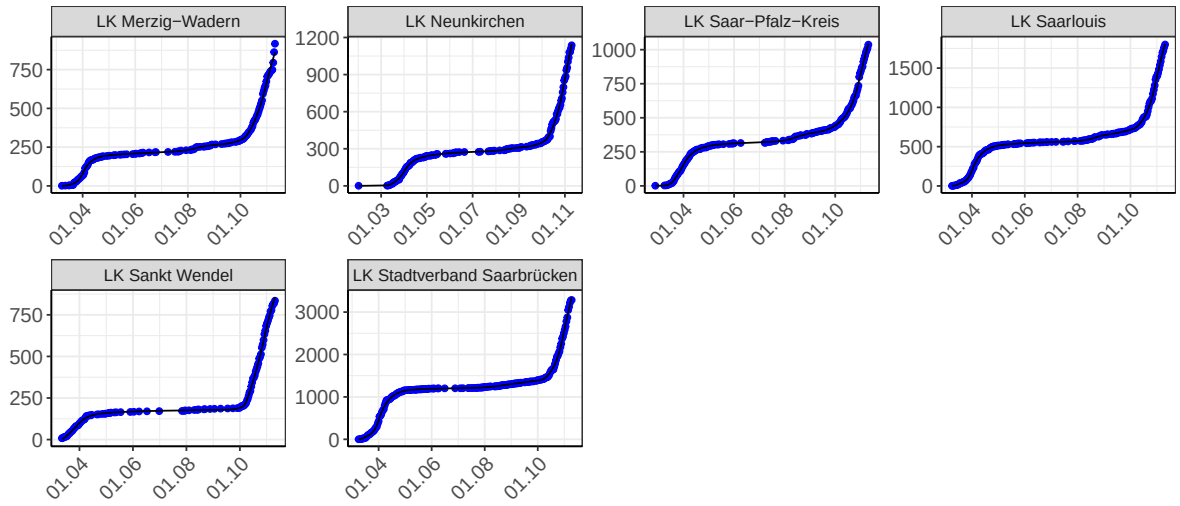


Figure 159: Model description of the reported case numbers in country- and citycounties in Saarland. Points: reported data; lines: model description.

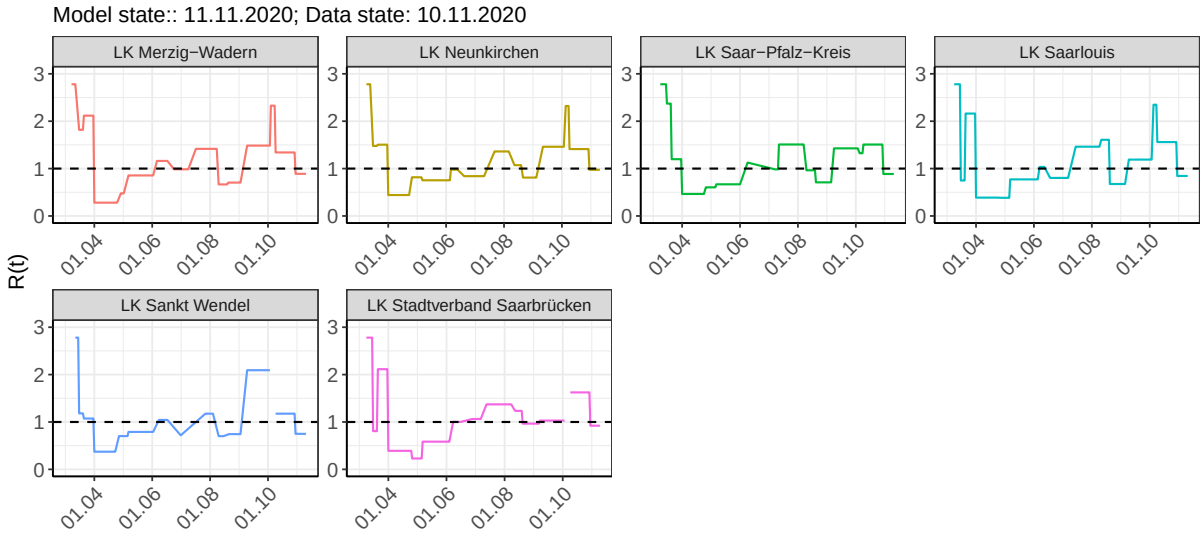


Figure 160: R(t) values over time for country- and citycounties in Saarland

Table 13: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Merzig-Wadern	2.78	1.82	2.12	0.28	0.48	0.86	1.16	0.98	1.42	0.67	0.70	1.49	2.33	1.34	0.89
LK Neunkirchen	2.78	1.48	1.50	0.44	0.82	0.75	0.98	0.84	1.36	1.07	0.81	1.46	2.32	1.41	0.97
LK Saar-Pfalz-Kreis	2.78	2.37	1.20	0.46	0.60	0.67	1.13	0.98	1.51	0.96	0.71	1.43	1.32	1.51	0.89
LK Saarlouis	2.78	0.75	2.16	0.39	0.38	0.77	1.03	0.80	1.46	1.61	0.67	1.19	2.35	1.56	0.84
LK Sankt Wendel	2.78	1.18	1.07	0.37	0.70	0.79	1.04	0.72	1.18	0.70	0.74	2.09	3.08	1.18	0.75
LK Stadtverband Saarbrücken	2.78	0.81	2.11	0.39	0.23	0.58	1.00	1.06	1.37	1.23	0.96	1.03	3.11	1.62	0.92

14 Saxony

14.1 Model description

Fig. 161 depicts the results of the modeling (lines) compared to the observed data (points) for Saxony on a linear (A) and semi-logarithmic (B) scale.

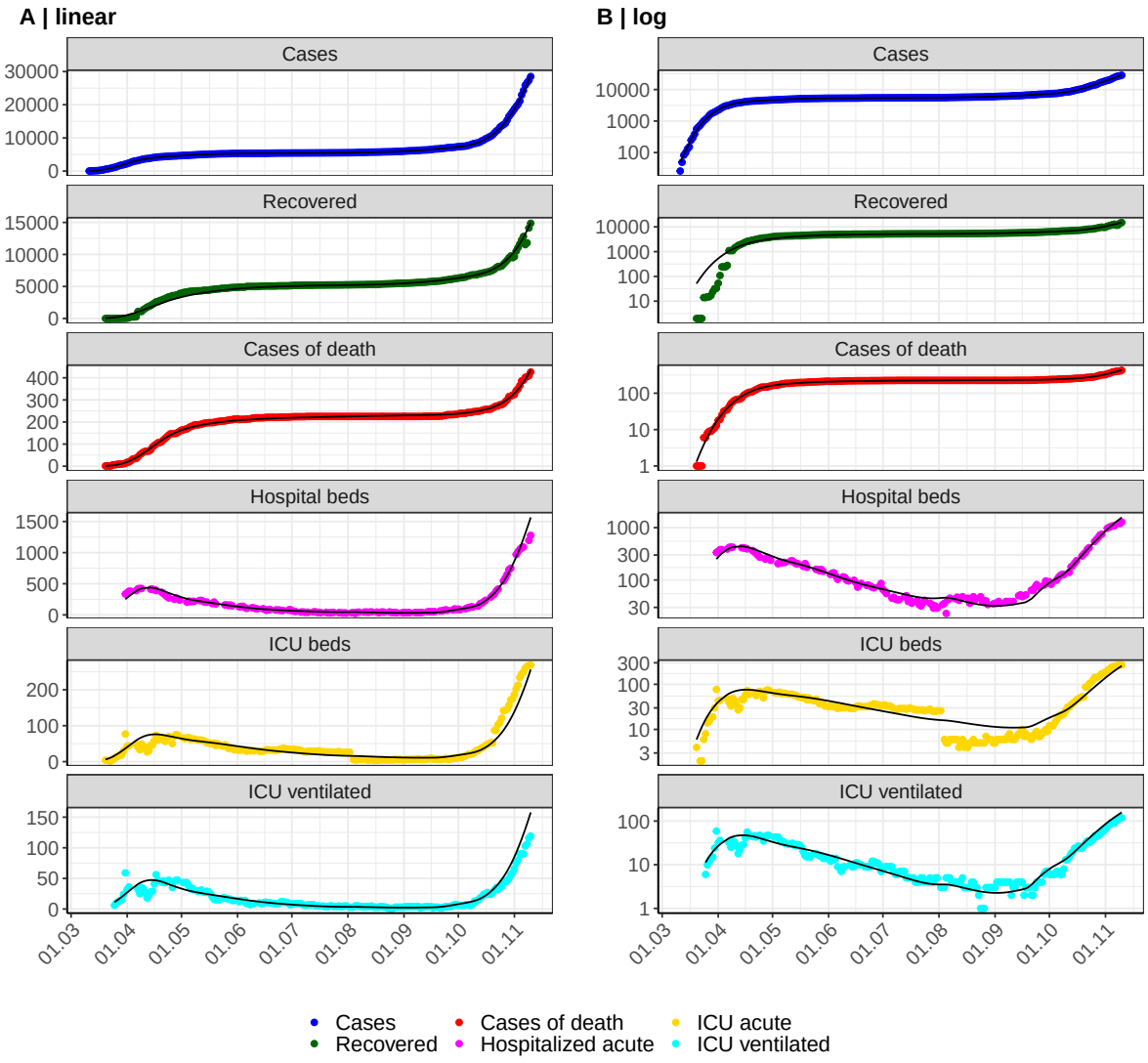


Figure 161: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Saxony. Points: reported data; lines: model description.

Fig. 162 shows the goodness-of-fit for Saxony. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

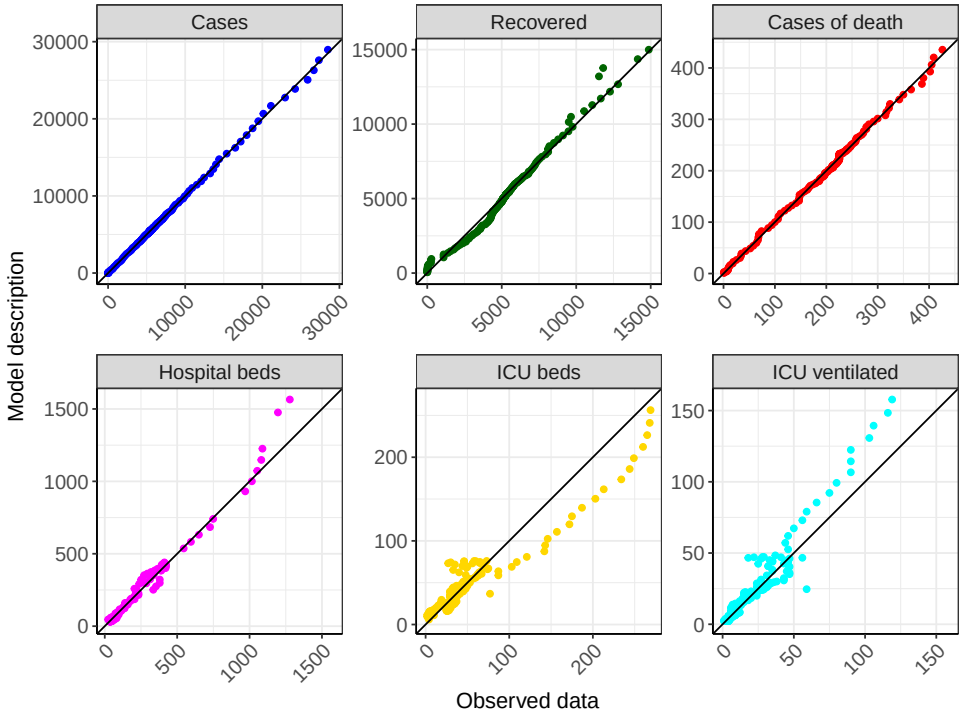


Figure 162: Goodness-of-fit plots for Saxony. Lines: lines of identity.

Fig. 163 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Saxony (red line) in comparison with the other federal states (grey lines).

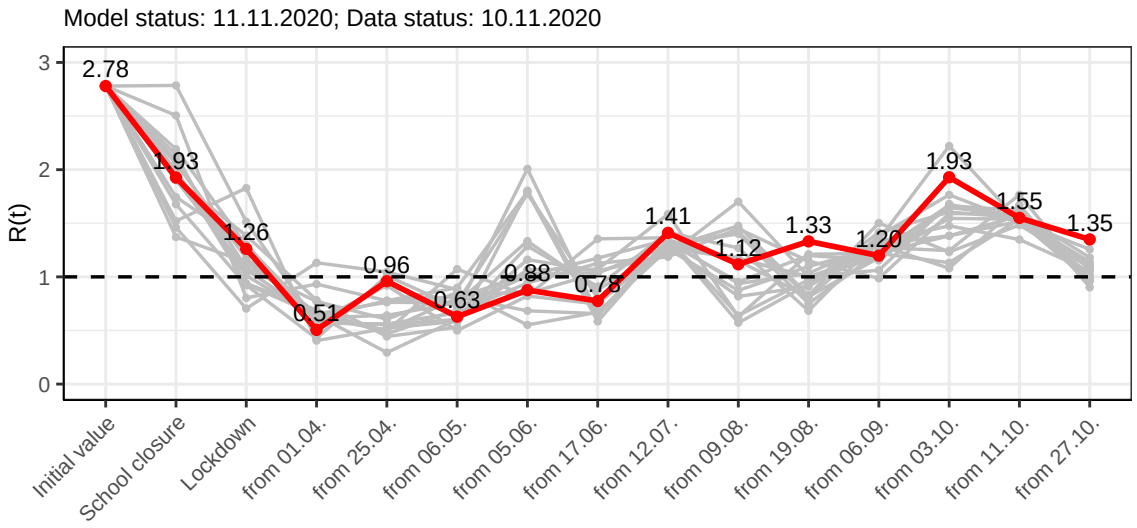


Figure 163: R(t) values before and after the NPIs for Saxony

Fig. 164 shows the R(t) estimated value for Saxony (red line) over time in comparison with the other federal states (grey lines).

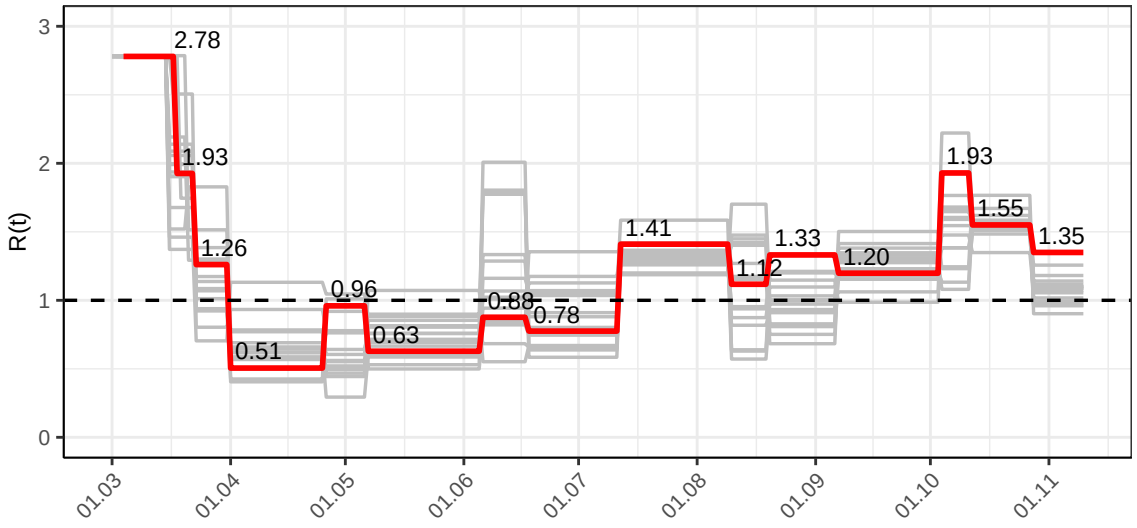


Figure 164: R(t) values over time for Saxony

Fig. 165 shows the changes in hospitalization and death rates for Saxony (red line) over time compared to the other states (grey lines).

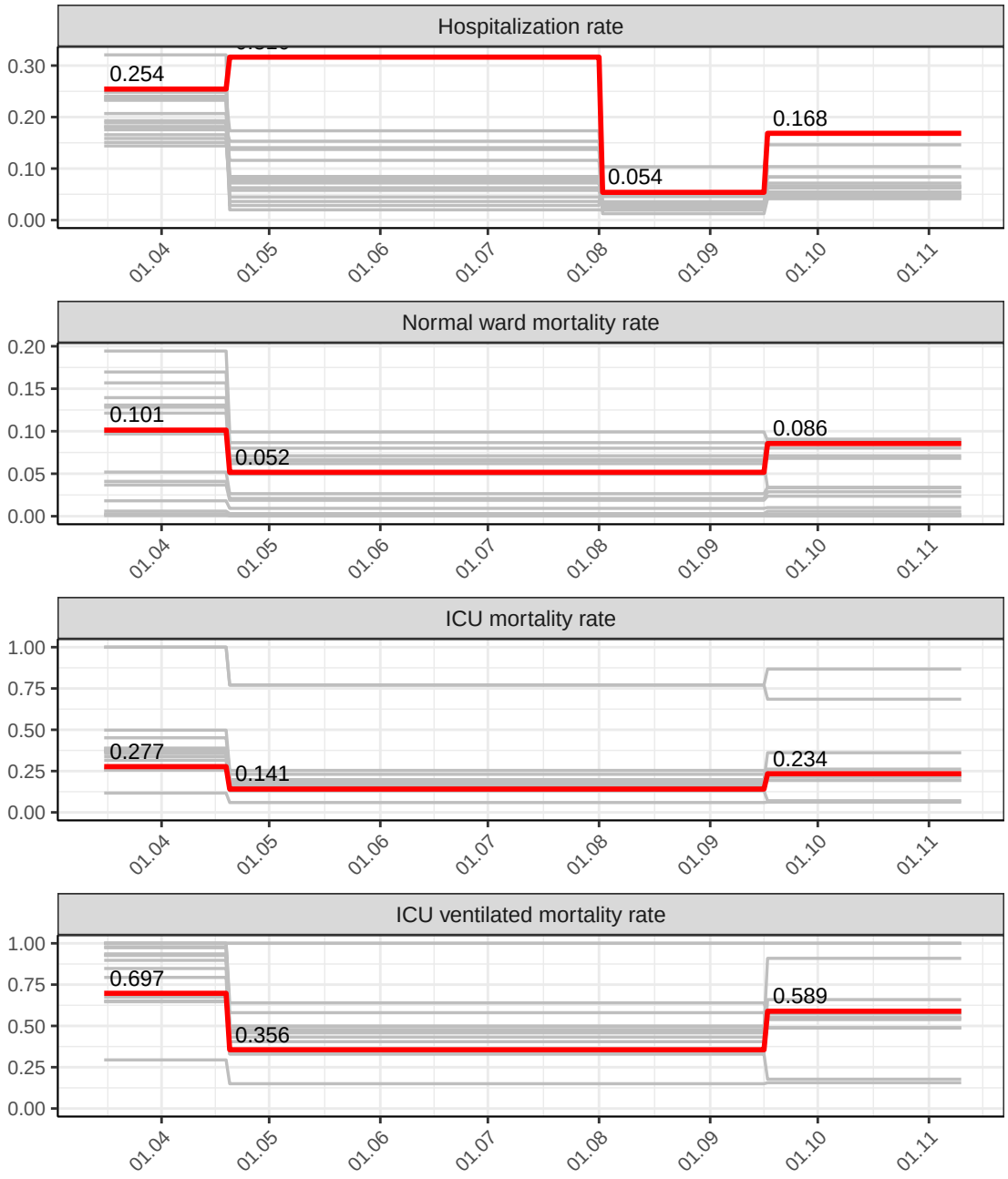


Figure 165: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Saxony

14.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1.35) and assuming various scenarios from 11.11.2020

Fig.166 and 167 represent the model prediction for the next 8 weeks for Saxony on a linear (166) and a semi-logarithmic (167) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

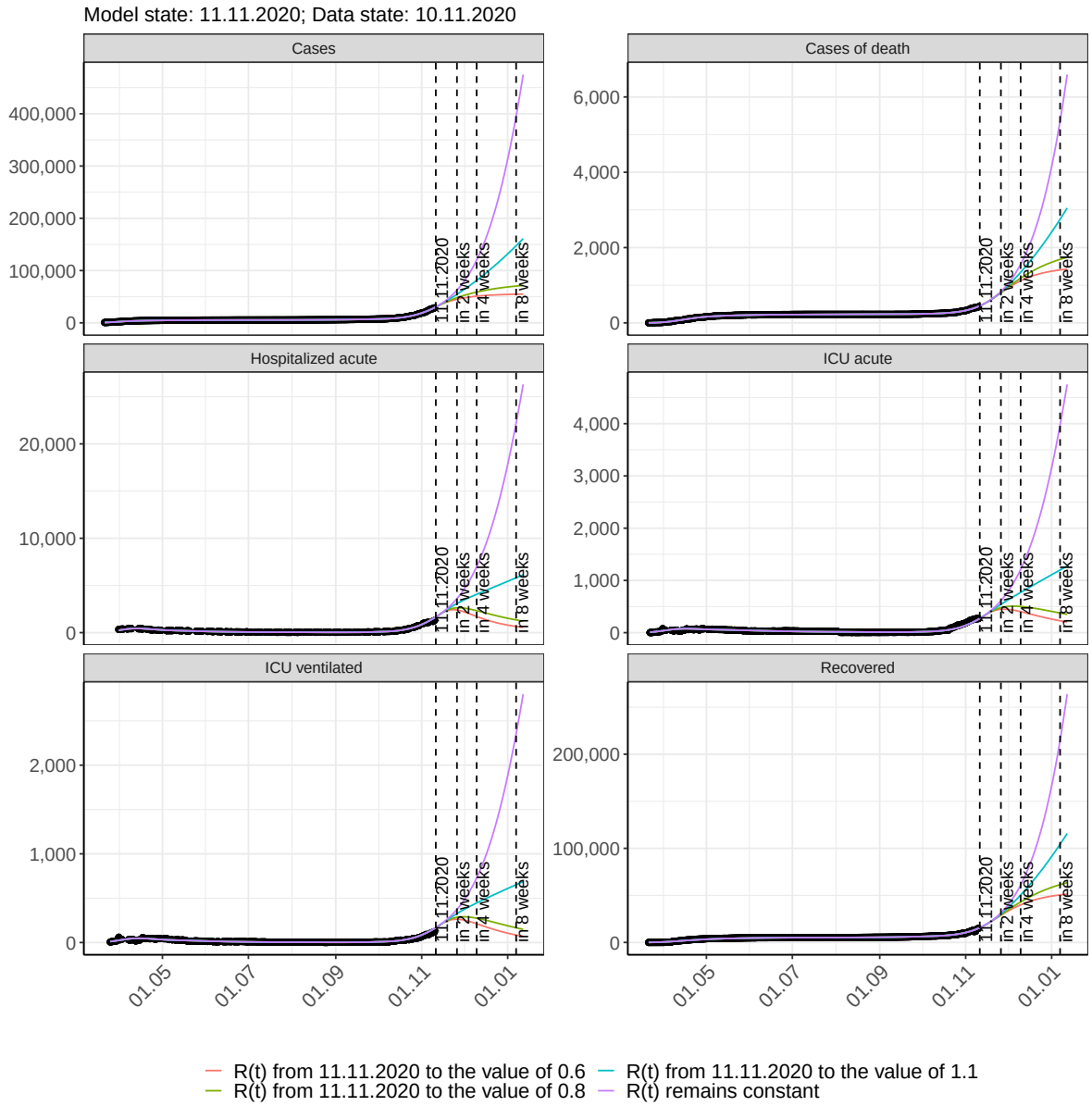


Figure 166: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Saxony assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

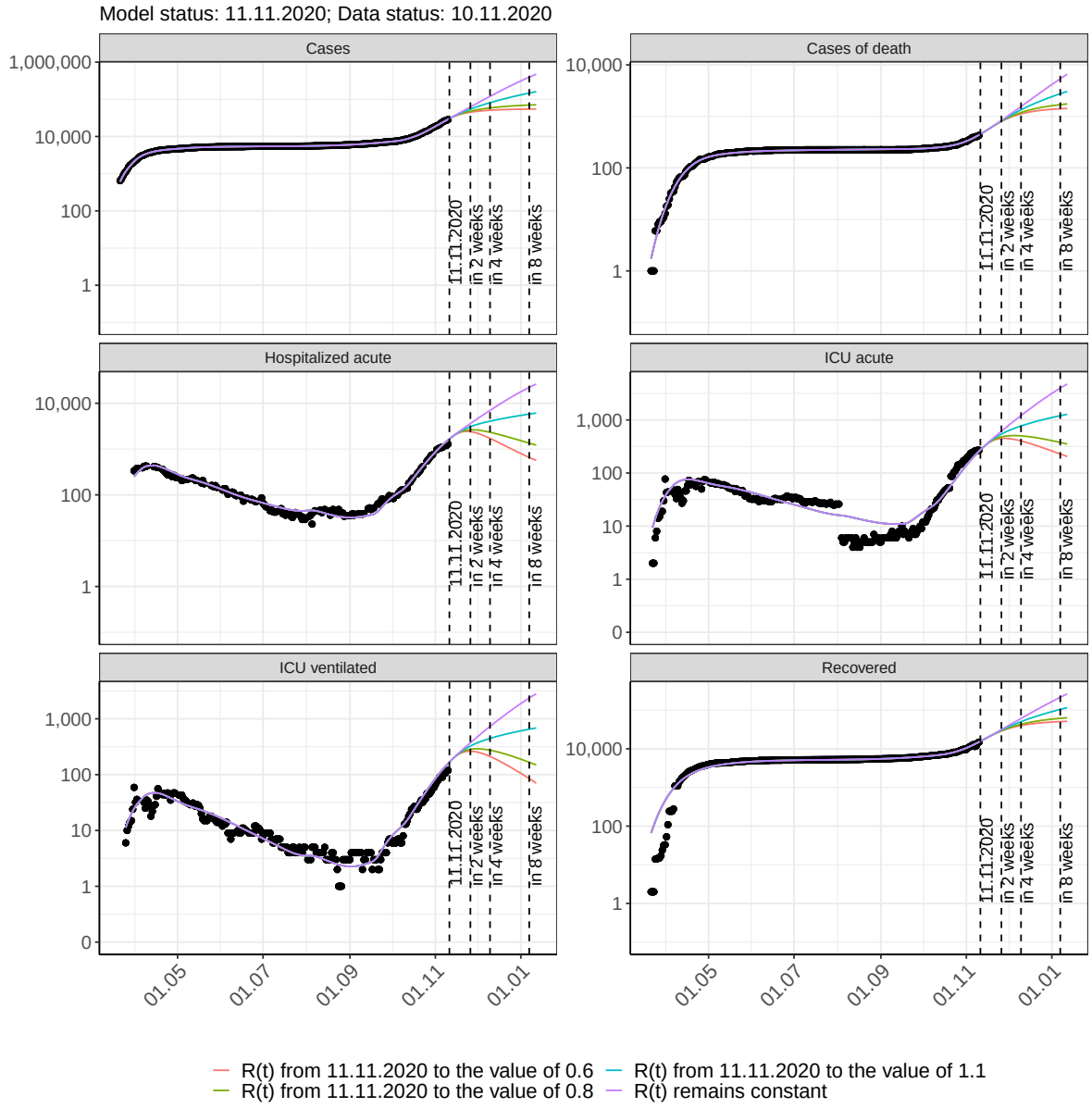


Figure 167: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Saxony assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 168 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

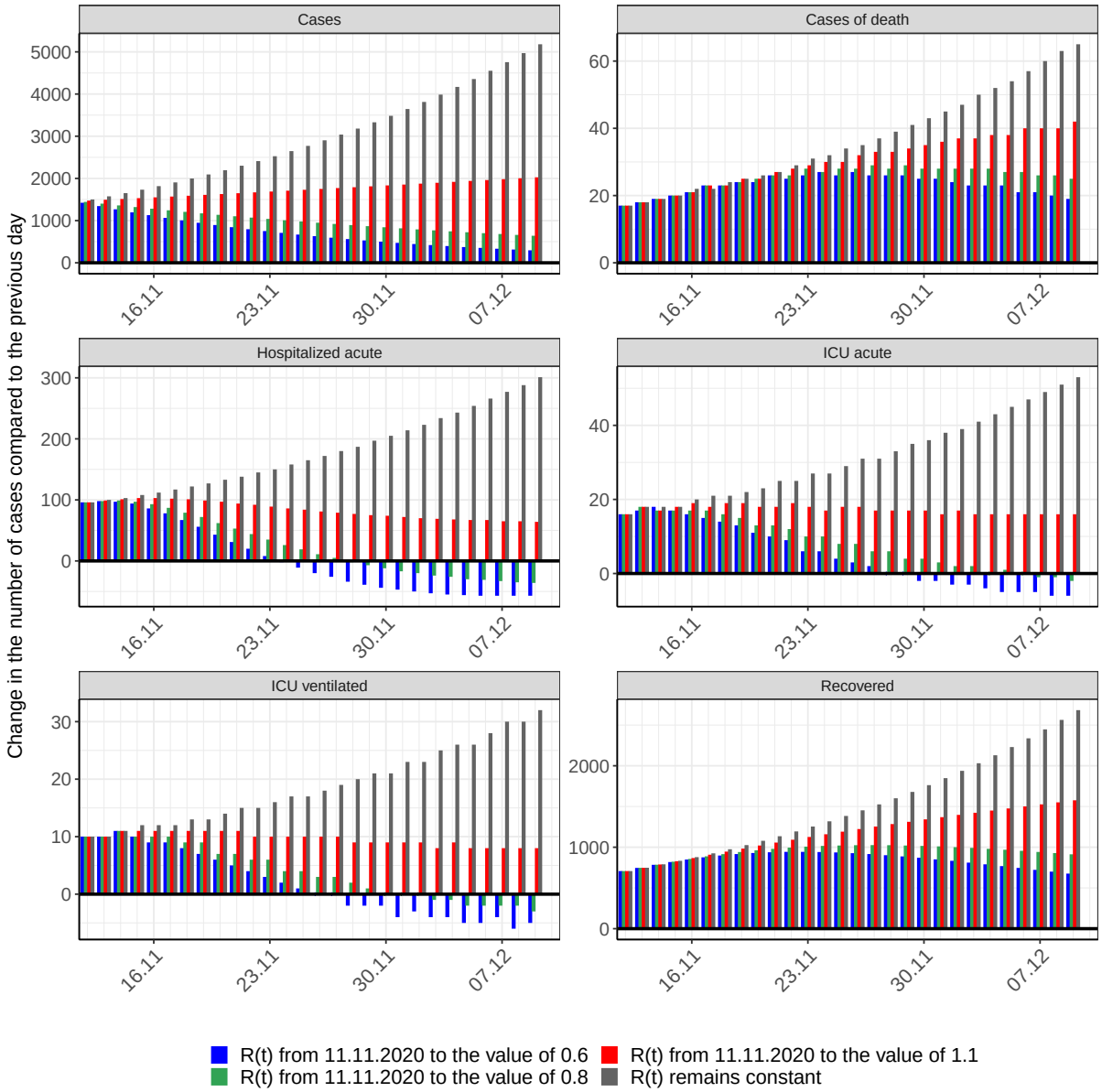


Figure 168: Simulation of daily new cases for the next 4 weeks - Saxony

14.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Saxony over time.

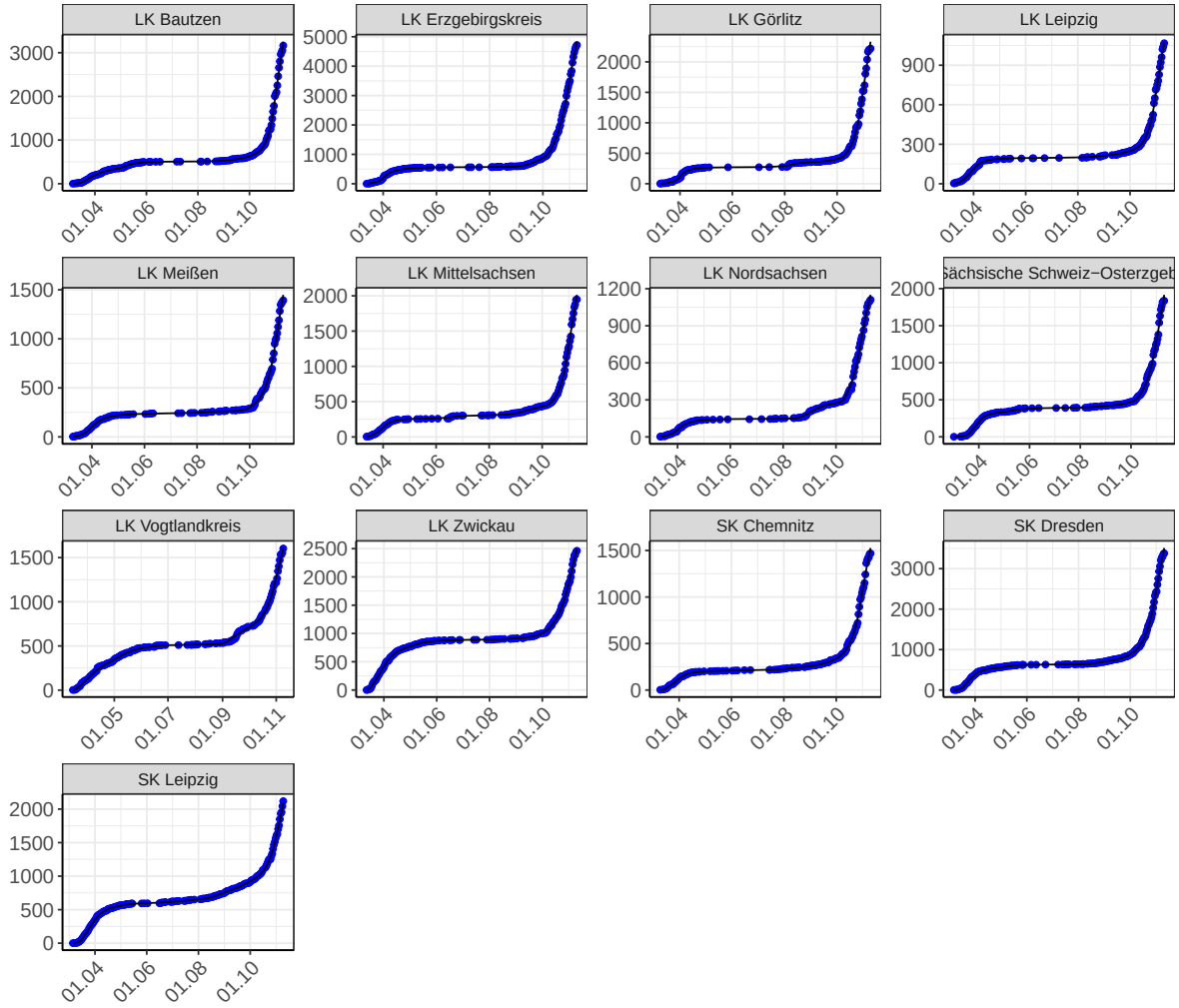


Figure 169: Model description of the reported case numbers in country- and citycounties in Saxony. Points: reported data; lines: model description.

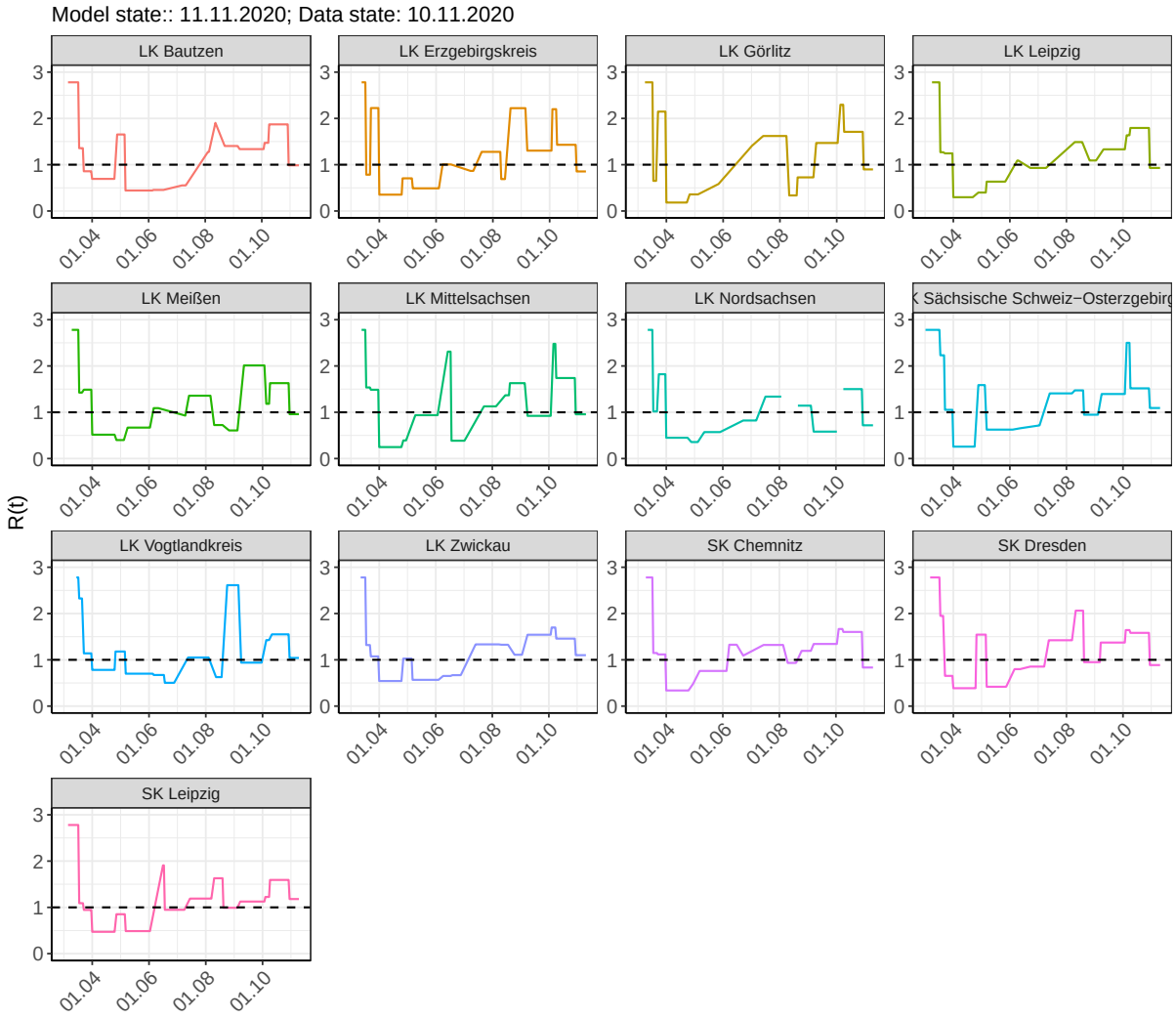


Figure 170: R(t) values over time for country- and citycounties in Saxony

Table 14: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Bautzen	2.78	1.36	0.86	0.69	1.65	0.44	0.46	0.55	1.28	1.90	1.40	1.34	1.47	1.87	0.99
LK Erzgebirgskreis	2.78	0.78	2.22	0.35	0.71	0.49	1.01	0.87	1.28	0.69	2.22	1.30	2.20	1.43	0.85
LK Görlitz	2.78	0.65	2.15	0.18	0.36	0.58	1.11	1.41	1.62	0.34	0.73	1.47	2.30	1.71	0.90
LK Leipzig	2.78	1.27	1.25	0.30	0.40	0.63	1.09	0.93	1.42	1.49	1.09	1.33	1.64	1.79	0.93
LK Meißen	2.78	1.42	1.49	0.52	0.40	0.67	1.09	0.93	1.36	0.72	0.61	2.01	1.18	1.63	0.96
LK Mittelsachsen	2.78	1.54	1.49	0.25	0.39	0.94	2.31	0.39	1.13	1.37	1.63	0.92	2.48	1.74	0.96
LK Nordsachsen	2.78	1.02	1.82	0.45	0.36	0.57	0.96	0.82	1.34	3.29	1.14	0.58	4.08	1.50	0.72
LK Sächsische Schweiz-Osterzgebirge	2.78	2.23	1.05	0.26	1.59	0.62	0.65	0.72	1.41	1.47	0.95	1.39	2.50	1.52	1.09
LK Vogtlandkreis	2.78	2.33	1.14	0.78	1.18	0.70	0.67	0.50	1.05	0.63	2.61	0.94	1.43	1.55	1.04
LK Zwickau	2.78	1.32	1.07	0.54	1.03	0.57	0.65	0.67	1.33	1.33	1.11	1.54	1.70	1.46	1.10
SK Chemnitz	2.78	1.15	1.12	0.34	0.48	0.76	1.33	1.09	1.32	0.93	1.19	1.34	1.67	1.60	0.83
SK Dresden	2.78	1.95	0.65	0.39	1.54	0.42	0.80	0.85	1.42	2.06	0.95	1.37	1.64	1.58	0.89
SK Leipzig	2.78	1.09	0.94	0.47	0.85	0.49	1.91	0.95	1.19	1.63	0.99	1.13	1.23	1.59	1.18

15 Saxony-Anhalt

15.1 Model description

Fig. 171 depicts the results of the modeling (lines) compared to the observed data (points) for Saxony-Anhalt on a linear (A) and semi-logarithmic (B) scale.

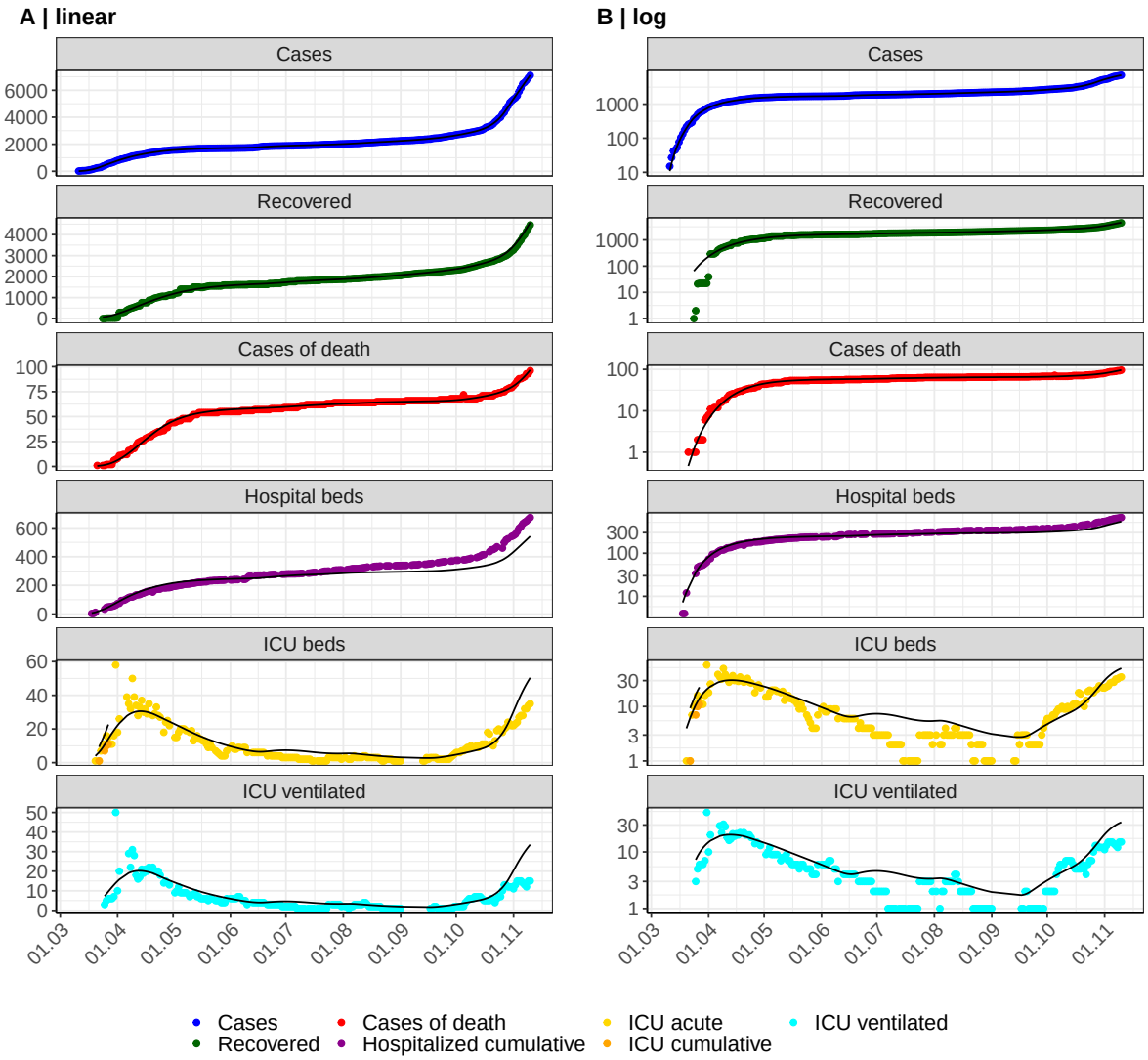


Figure 171: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Saxony-Anhalt. Points: reported data; lines: model description.

Fig. 172 shows the goodness-of-fit for Saxony-Anhalt. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

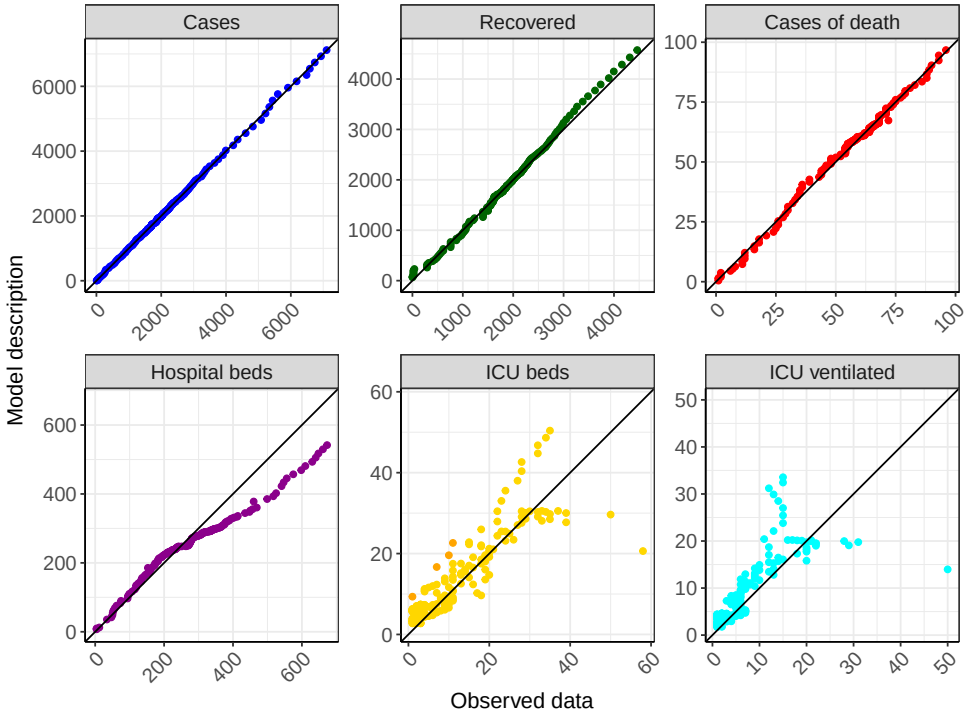


Figure 172: Goodness-of-fit plots for Saxony-Anhalt. Lines: lines of identity.

Fig. 173 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Saxony-Anhalt (red line) in comparison with the other federal states (grey lines).

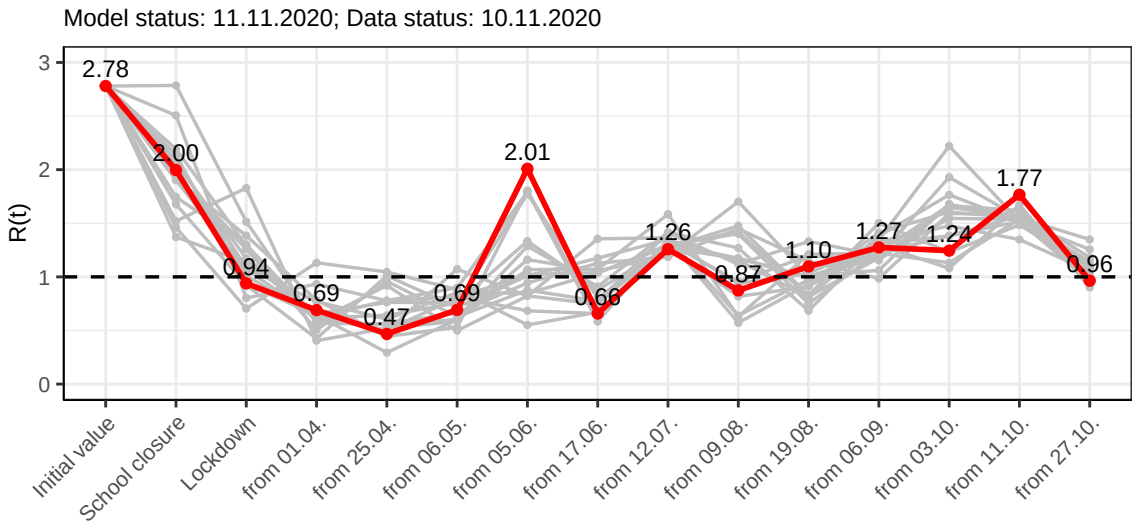


Figure 173: R(t) values before and after the NPIs for Saxony-Anhalt

Fig. 174 shows the R(t) estimated value for Saxony-Anhalt (red line) over time in comparison with the other federal states (grey lines).

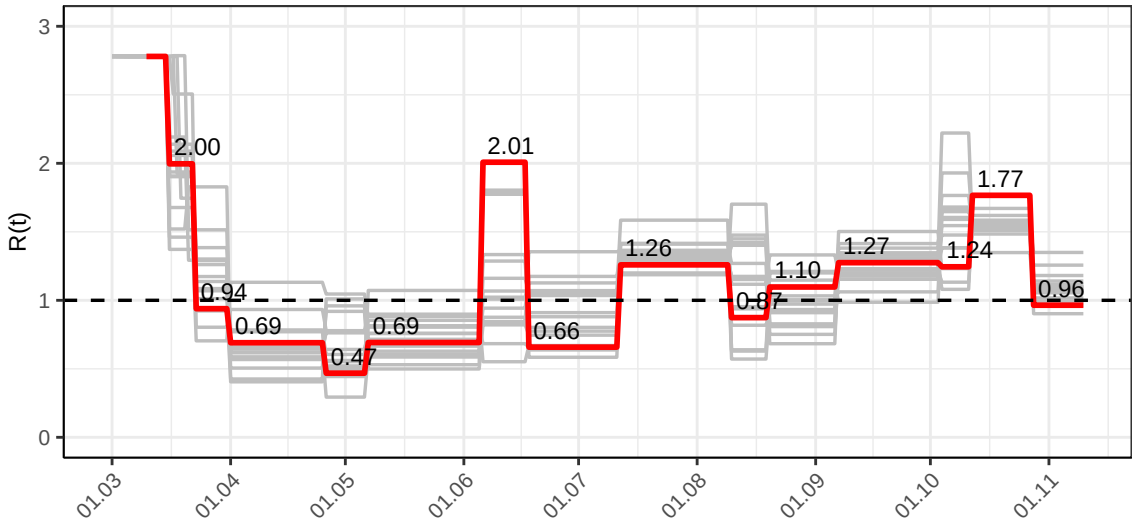


Figure 174: R(t) values over time for Saxony-Anhalt

Fig. 175 shows the changes in hospitalization and death rates for Saxony-Anhalt (red line) over time compared to the other states (grey lines).

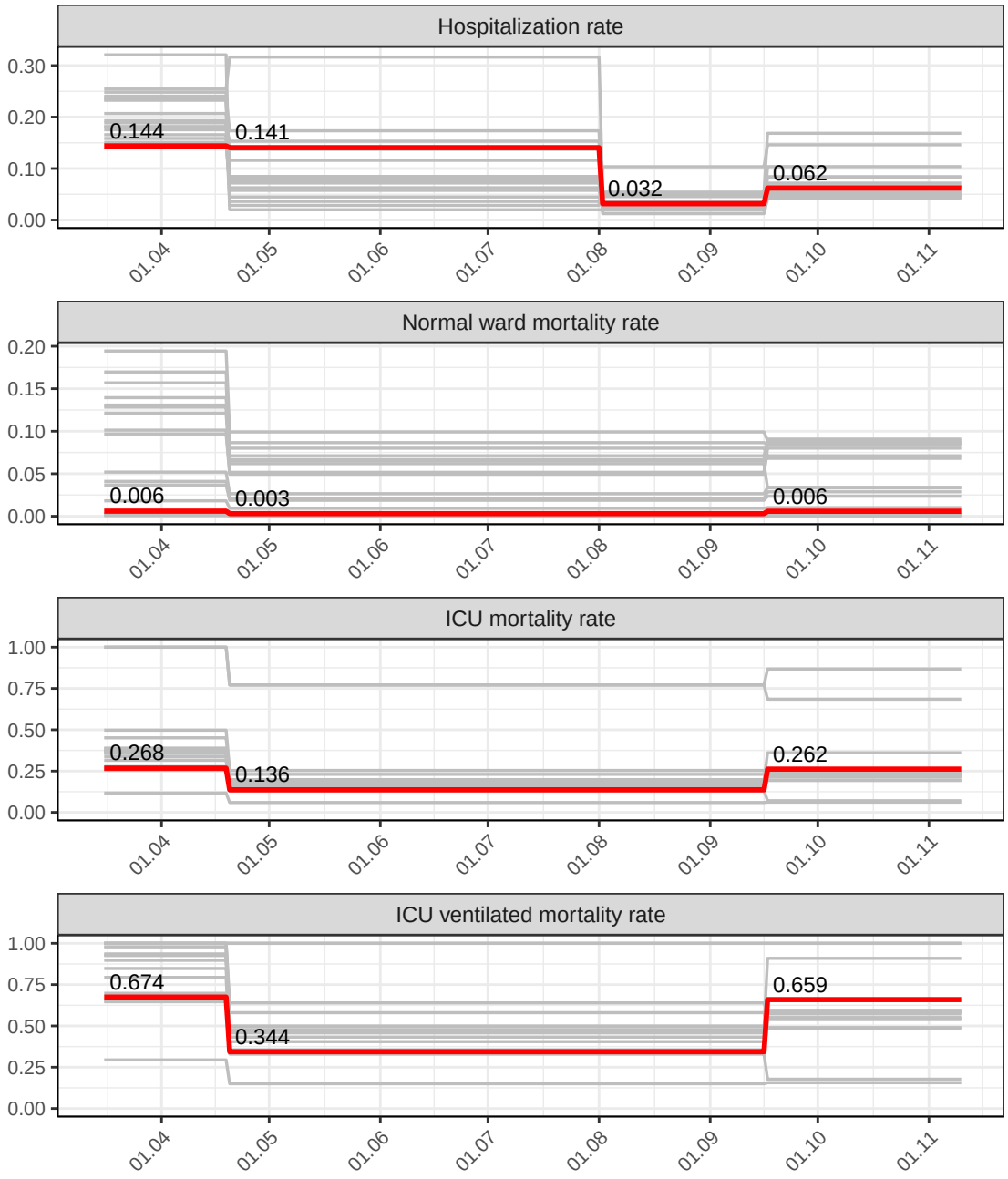


Figure 175: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Saxony-Anhalt

15.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 0.96) and assuming various scenarios from 11.11.2020

Fig.176 and 177 represent the model prediction for the next 8 weeks for Saxony-Anhalt on a linear (176) and a semi-logarithmic (177) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

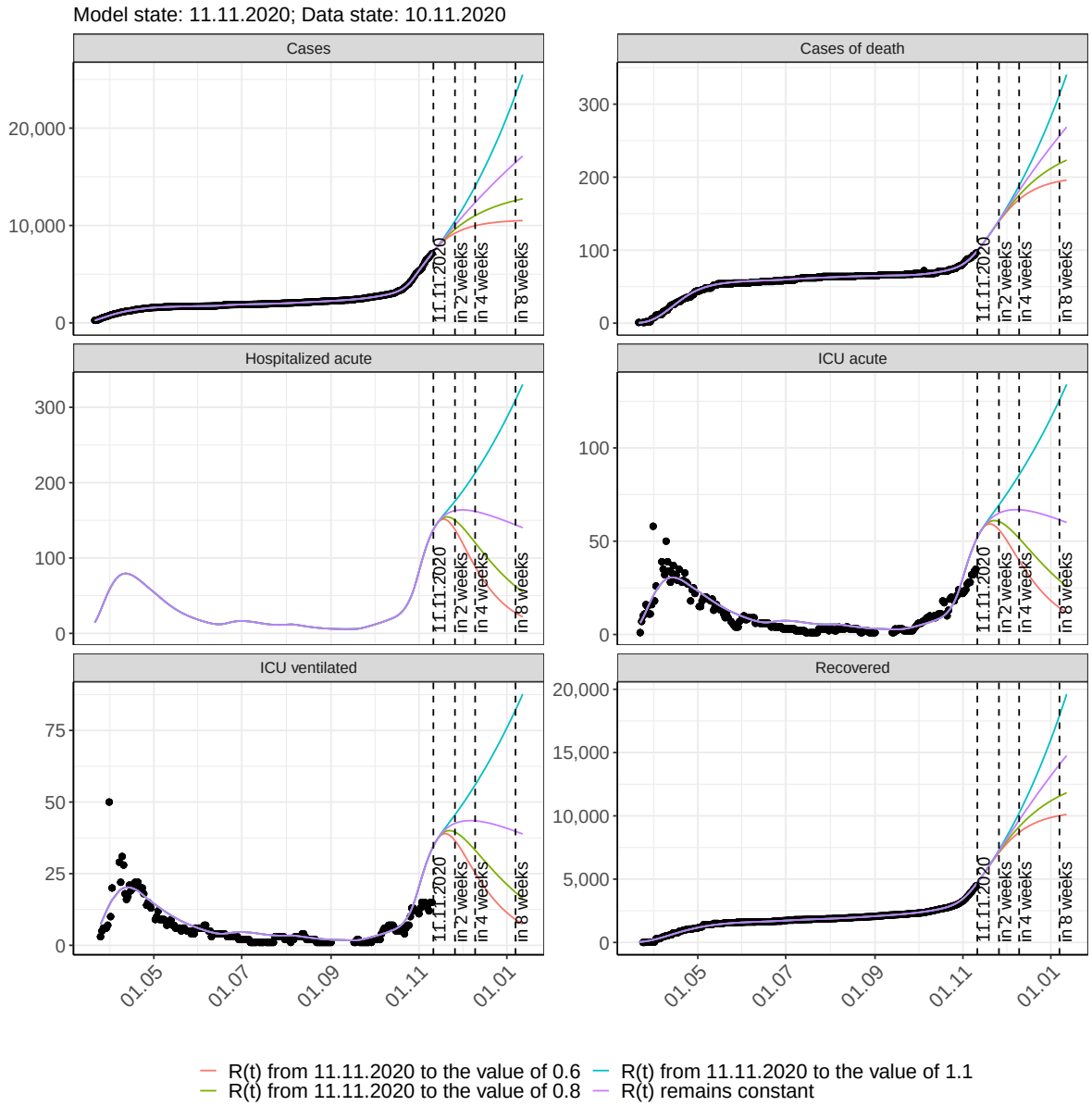


Figure 176: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Saxony-Anhalt assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

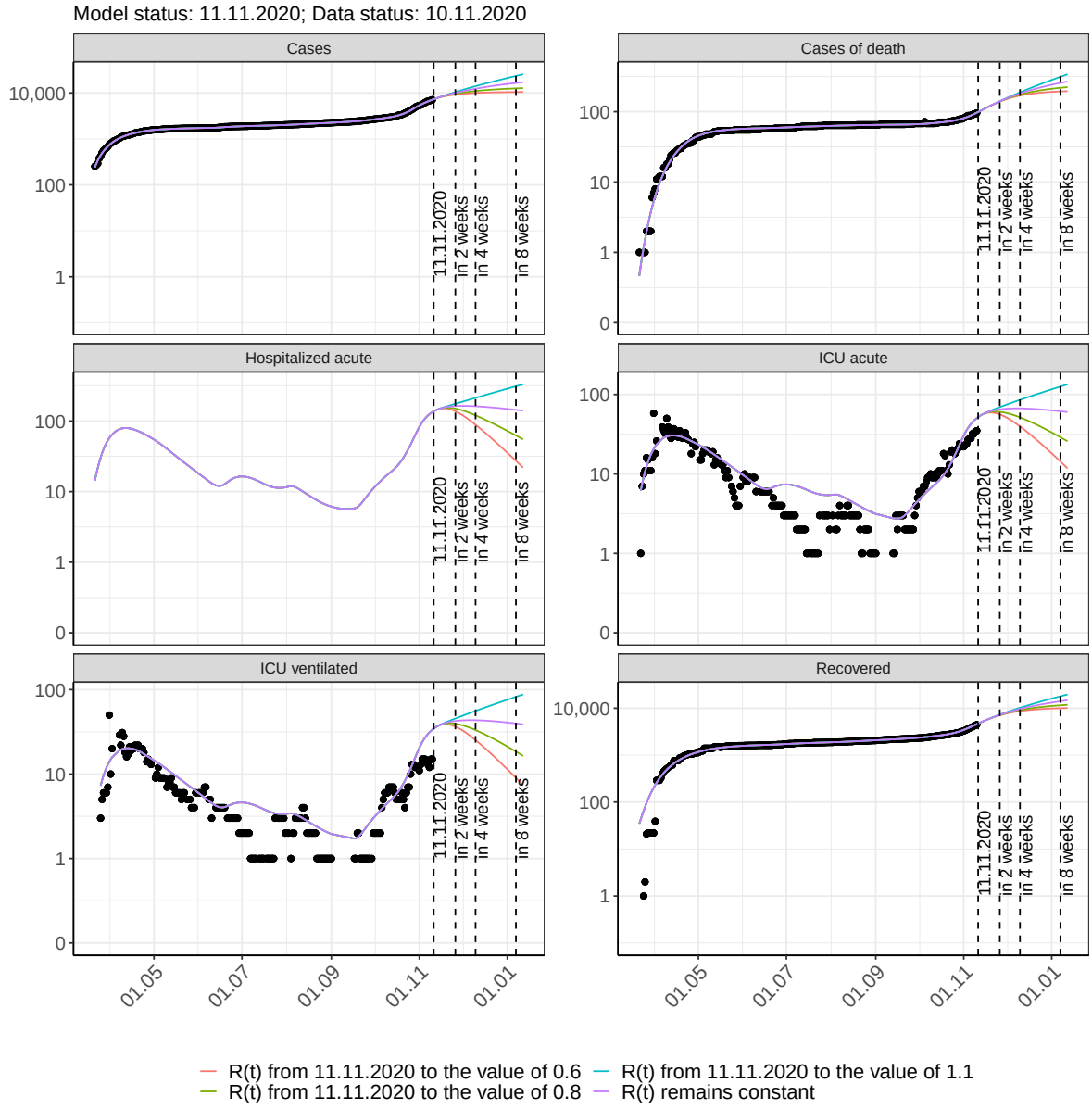


Figure 177: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Saxony-Anhalt assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 178 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

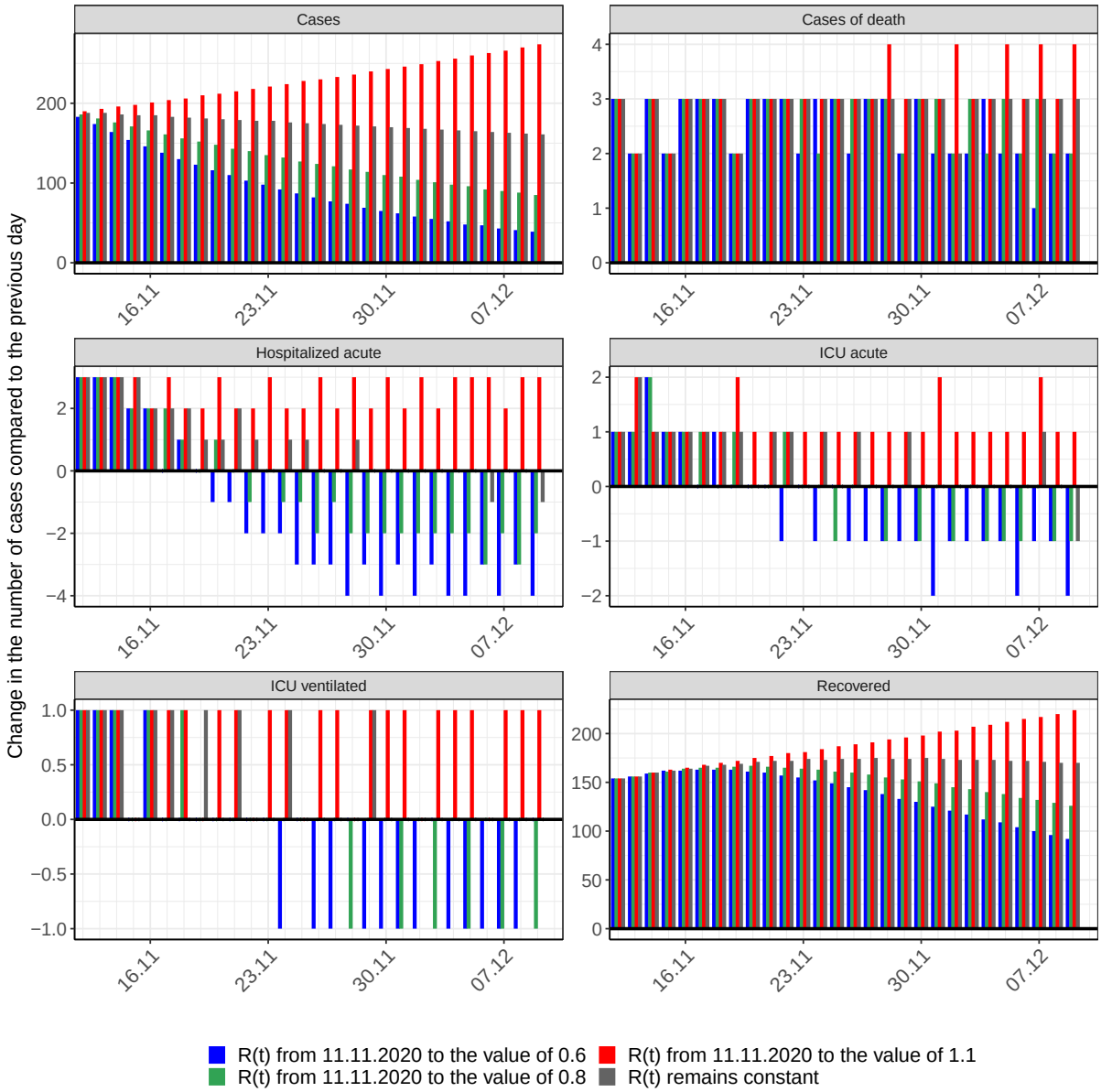


Figure 178: Simulation of daily new cases for the next 4 weeks - Saxony-Anhalt

15.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Saxony-Anhalt over time.

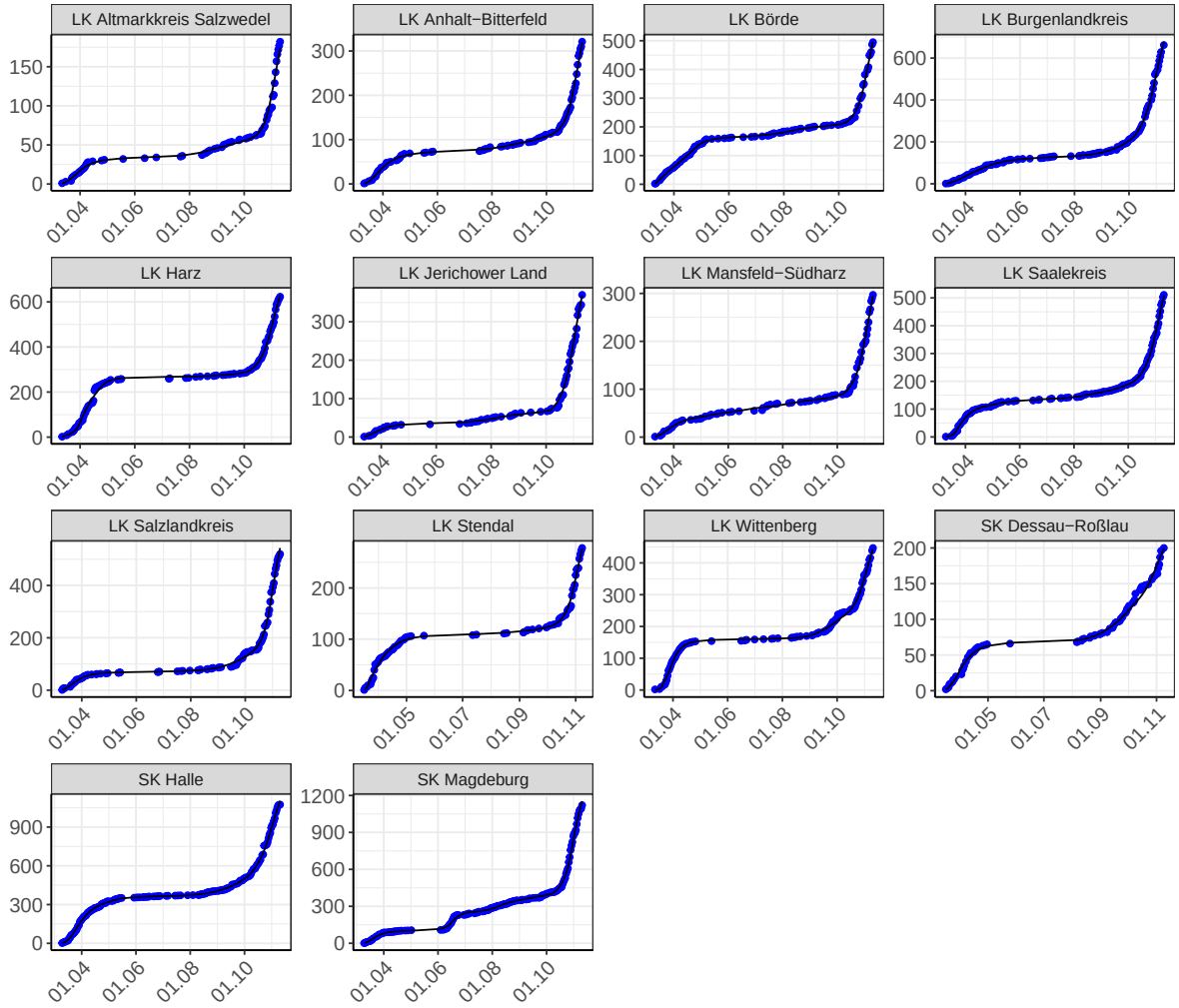


Figure 179: Model description of the reported case numbers in country- and citycounties in Saxony-Anhalt. Points: reported data; lines: model description.

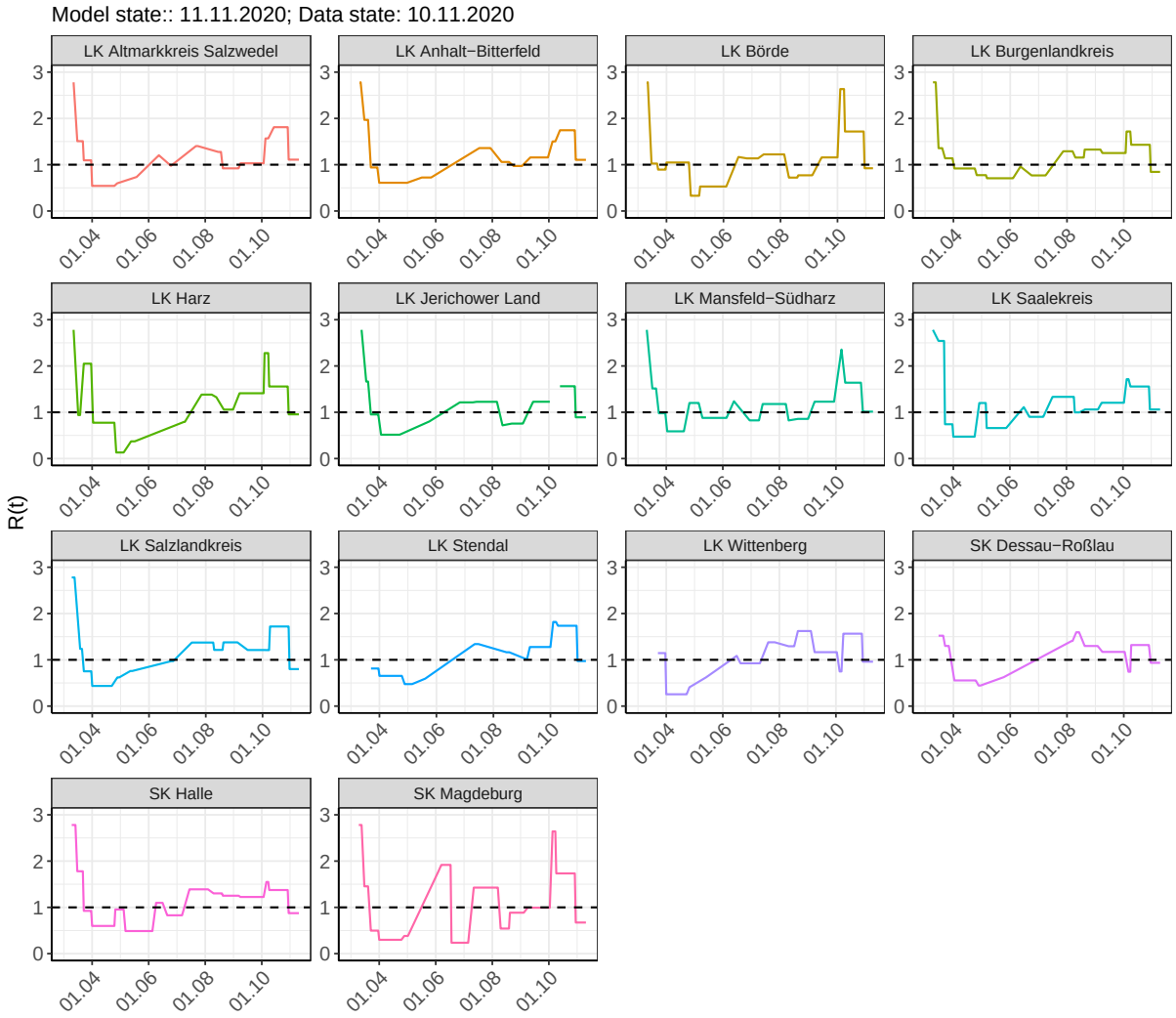


Figure 180: R(t) values over time for country- and citycounties in Saxony-Anhalt

Table 15: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lockdown	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Altmarkkreis Salzwedel	2.78	1.51	1.09	0.54	0.60	0.73	1.20	0.98	1.40	1.28	0.92	1.03	1.57	1.81	1.11
LK Anhalt-Bitterfeld	2.78	1.97	0.94	0.61	0.61	0.72	1.16	0.95	1.36	1.06	0.97	1.16	1.50	1.74	1.11
LK Börde	2.78	1.02	0.89	1.05	0.33	0.53	1.17	1.14	1.22	0.72	0.77	1.16	2.63	1.72	0.92
LK Burgenlandkreis	2.78	1.36	1.14	0.92	0.77	0.71	0.96	0.77	1.29	1.15	1.33	1.25	1.72	1.43	0.84
LK Harz	2.78	0.94	2.05	0.77	0.13	0.37	0.80	0.79	1.38	1.32	1.06	1.41	2.28	1.56	0.96
LK Jerichower Land	2.78	1.66	0.95	0.51	0.63	0.80	1.47	1.21	1.23	0.72	0.75	1.23	3.21	1.56	0.89
LK Mansfeld-Südharz	2.78	1.51	0.98	0.59	1.20	0.88	1.24	0.82	1.18	0.82	0.86	1.23	2.36	1.64	1.01
LK Saalekreis	2.78	2.54	0.74	0.47	1.20	0.66	1.11	0.90	1.33	1.00	1.06	1.21	1.71	1.56	1.06
LK Salzlandkreis	2.78	1.24	0.75	0.44	0.62	0.76	1.23	0.97	1.37	1.21	1.38	1.21	1.21	1.72	0.80
LK Stendal	2.78	3.33	0.81	0.65	0.48	0.59	0.95	0.82	1.34	1.16	1.02	1.28	1.82	1.74	0.97
LK Wittenberg	2.78	4.05	1.15	0.26	0.41	0.62	1.09	0.93	1.38	1.29	1.62	1.17	0.75	1.56	0.96
SK Dessau-Roßlau	2.78	1.52	1.30	0.55	0.44	0.62	1.03	0.89	1.41	1.60	1.30	1.17	0.74	1.32	0.94
SK Halle	2.78	1.78	0.92	0.60	0.96	0.49	1.10	0.83	1.39	1.30	1.25	1.22	1.55	1.38	0.88

Table 15: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
SK Magdeburg	2.78	1.45	0.50	0.30	0.38	1.78	1.92	0.24	1.43	0.54	0.89	0.99	2.64	1.73	0.67

16 Schleswig-Holstein

16.1 Model description

Fig. 181 depicts the results of the modeling (lines) compared to the observed data (points) for Schleswig-Holstein on a linear (A) and semi-logarithmic (B) scale.

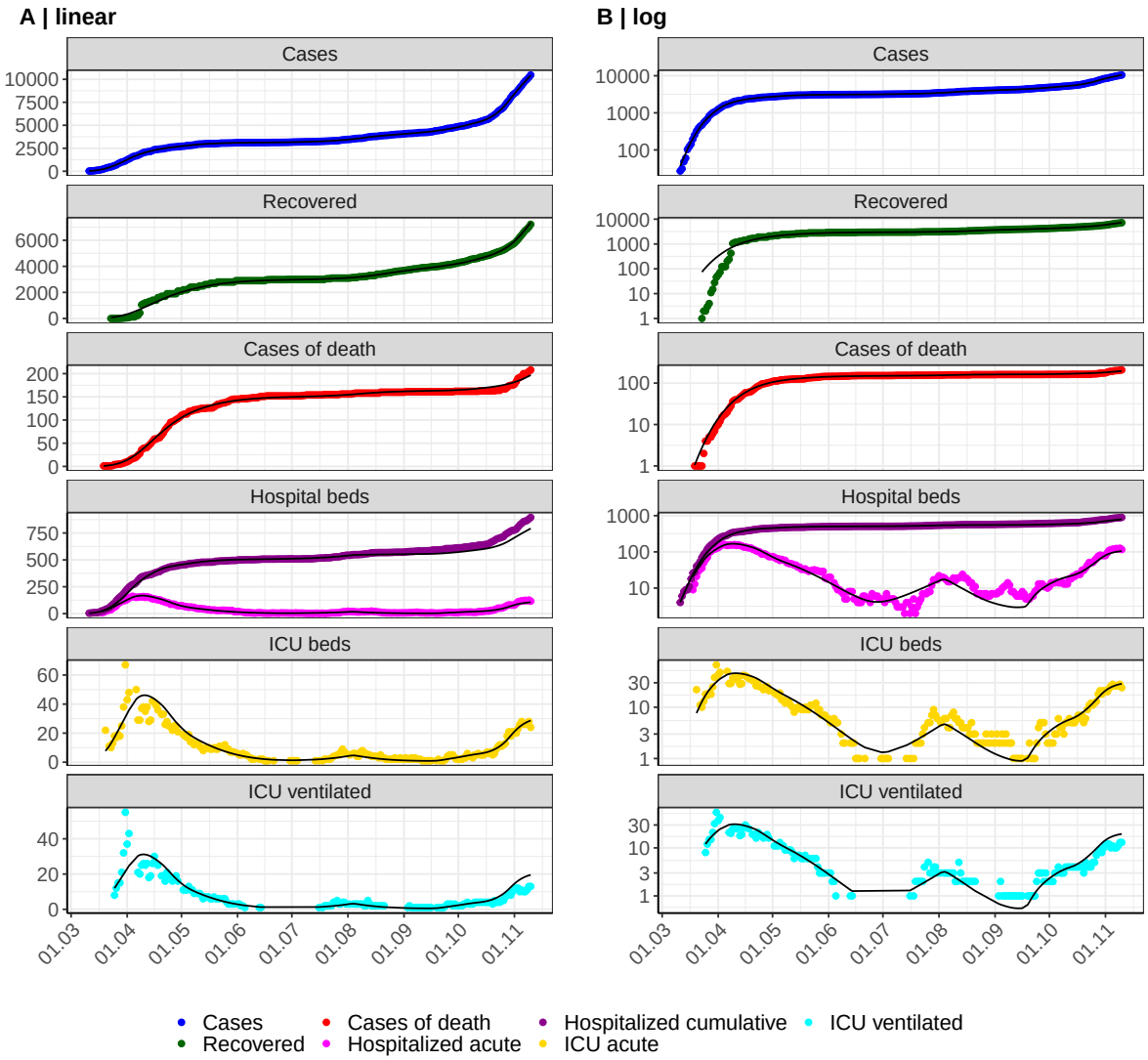


Figure 181: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Schleswig-Holstein. Points: reported data; lines: model description.

Fig. 182 shows the goodness-of-fit for Schleswig-Holstein. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

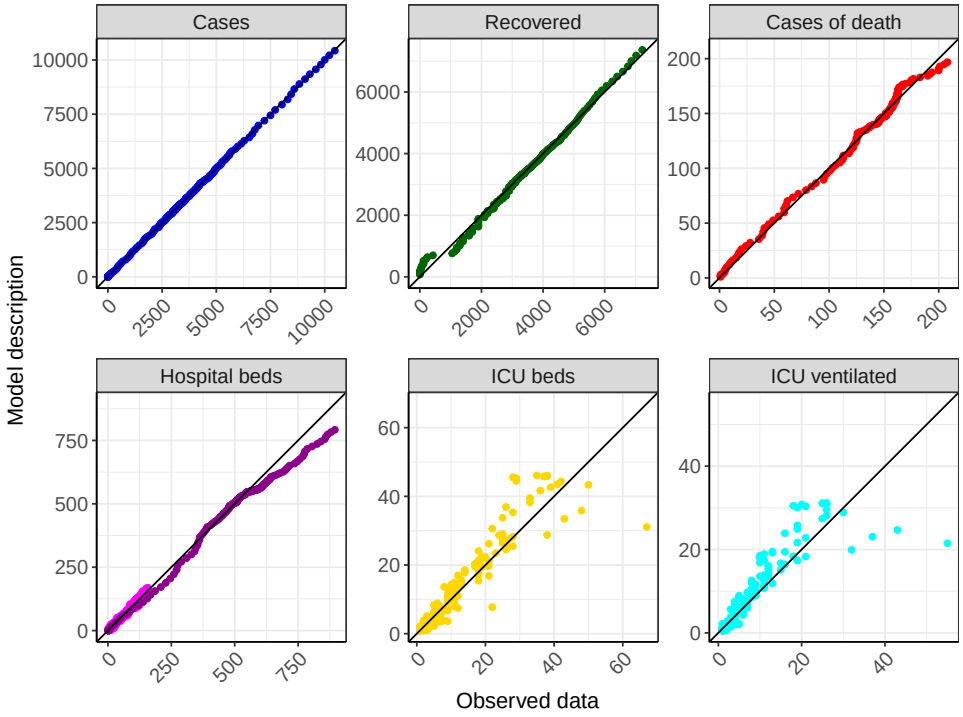


Figure 182: Goodness-of-fit plots for Schleswig-Holstein. Lines: lines of identity.

Fig. 183 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Schleswig-Holstein (red line) in comparison with the other federal states (grey lines).

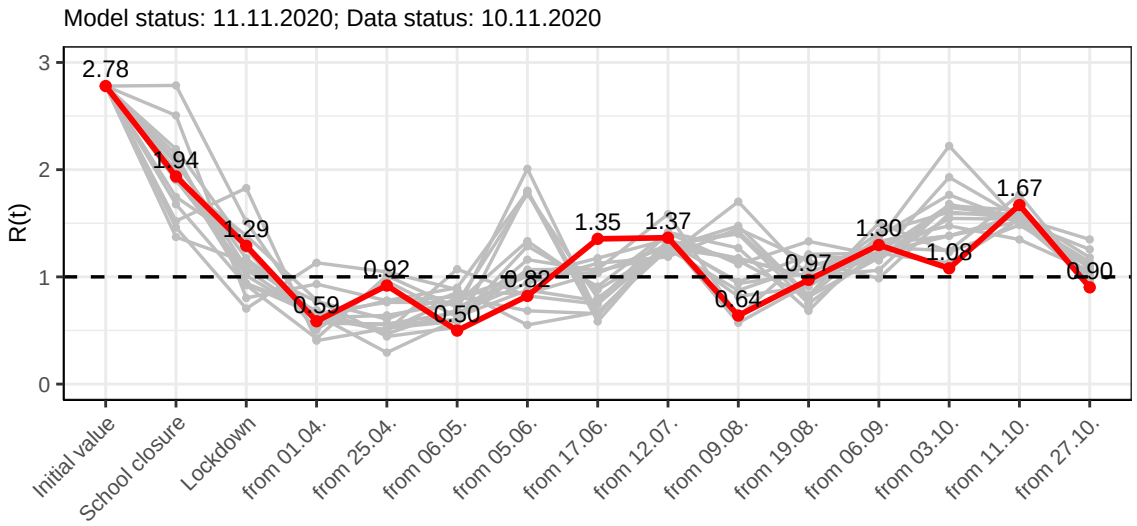


Figure 183: R(t) values before and after the NPIs for Schleswig-Holstein

Fig. 184 shows the R(t) estimated value for Schleswig-Holstein (red line) over time in comparison with the other federal states (grey lines).

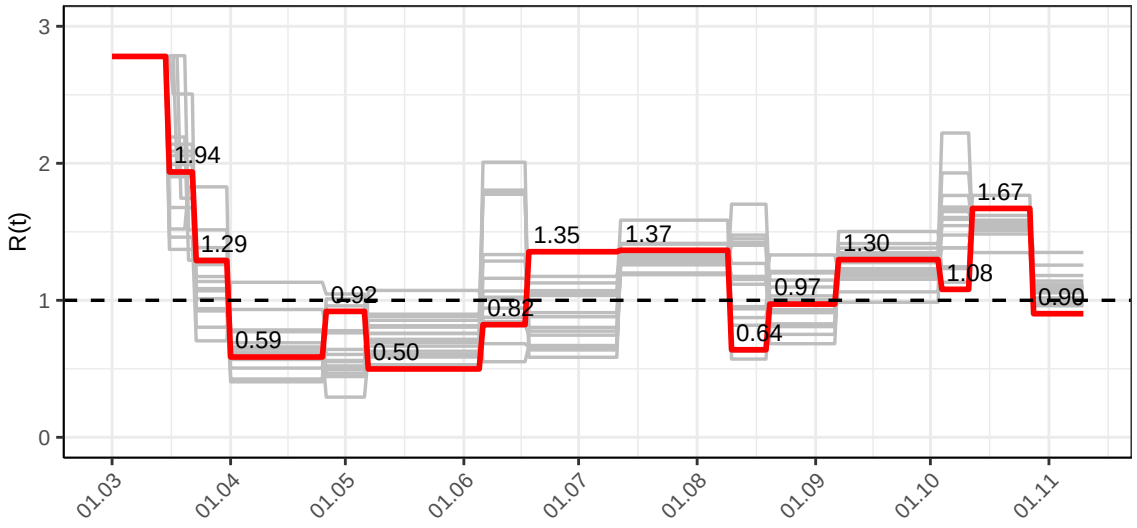


Figure 184: R(t) values over time for Schleswig-Holstein

Fig. 185 shows the changes in hospitalization and death rates for Schleswig-Holstein (red line) over time compared to the other states (grey lines).

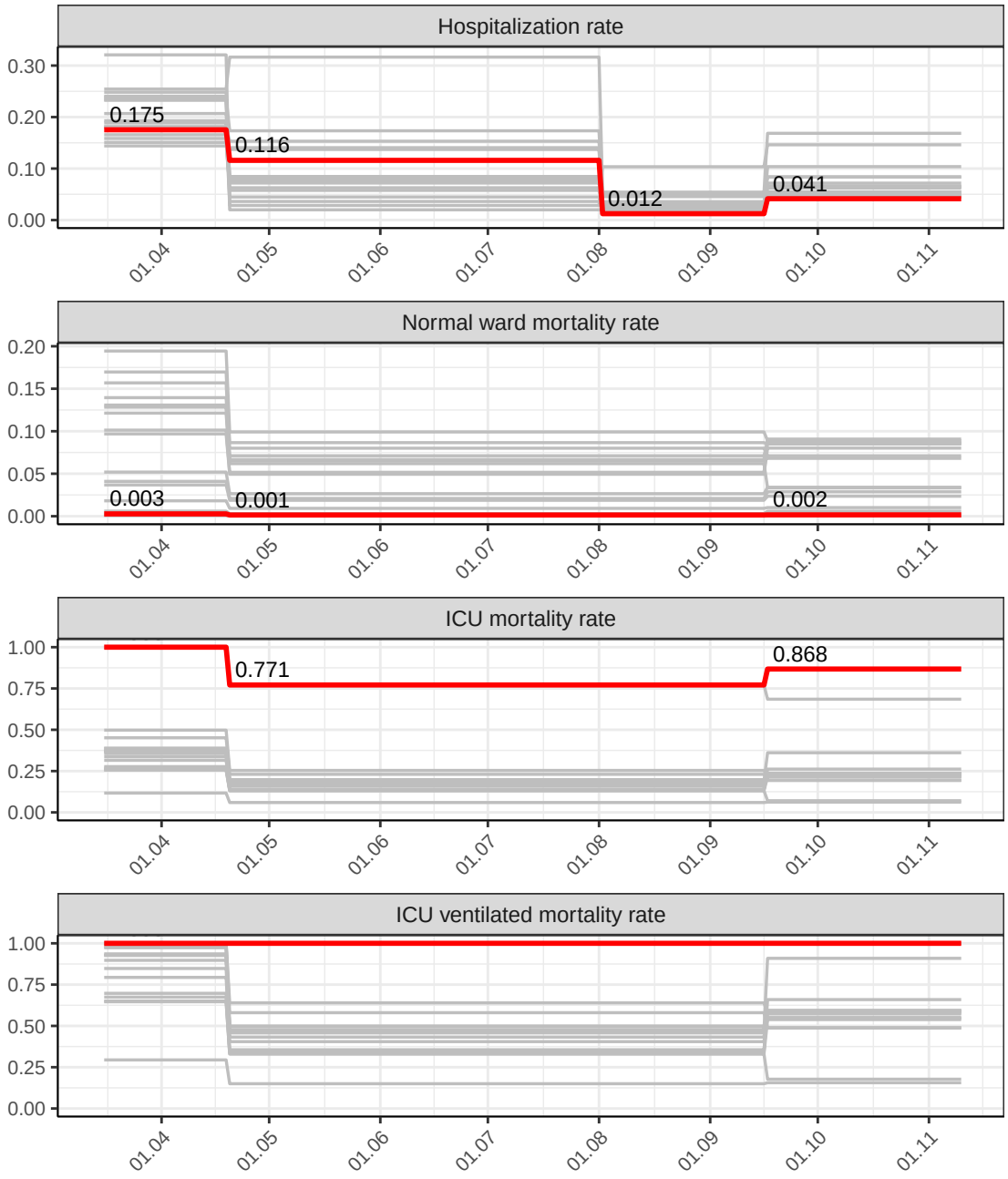


Figure 185: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Schleswig-Holstein

16.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 0.9) and assuming various scenarios from 11.11.2020

Fig.186 and 187 represent the model prediction for the next 8 weeks for Schleswig-Holstein on a linear (186) and a semi-logarithmic (187) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

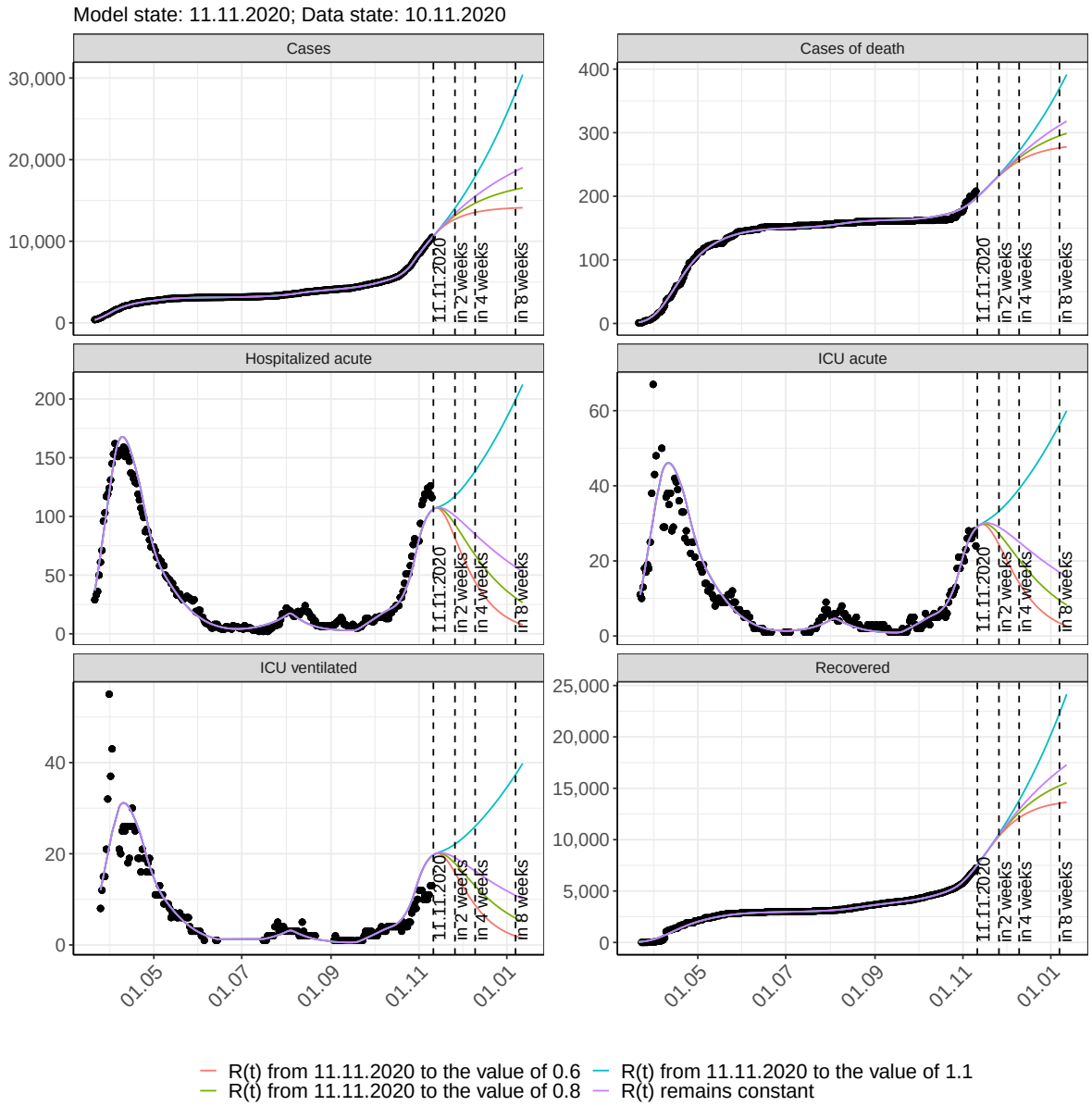


Figure 186: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Schleswig-Holstein assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

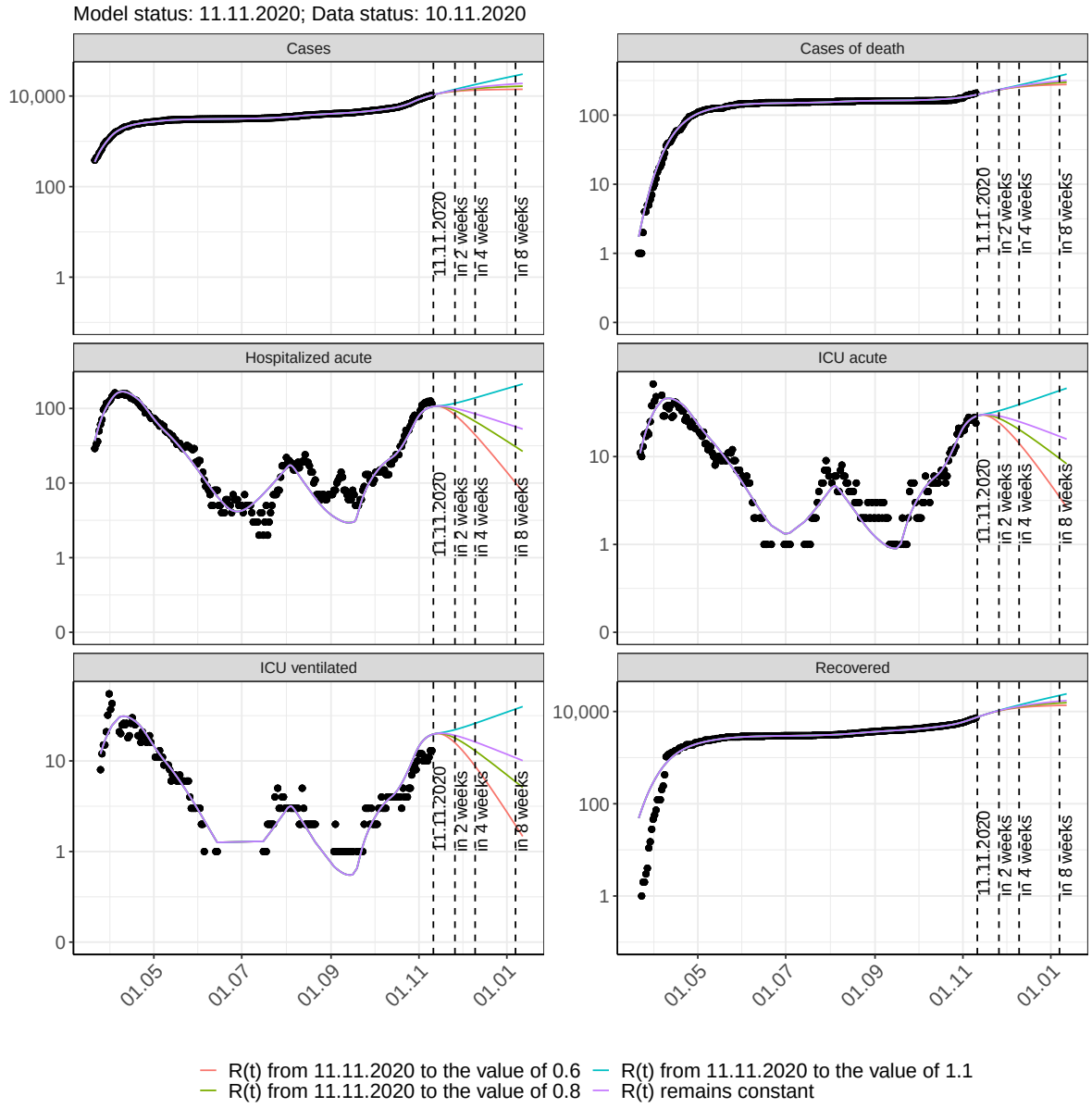


Figure 187: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Schleswig-Holstein assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 188 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

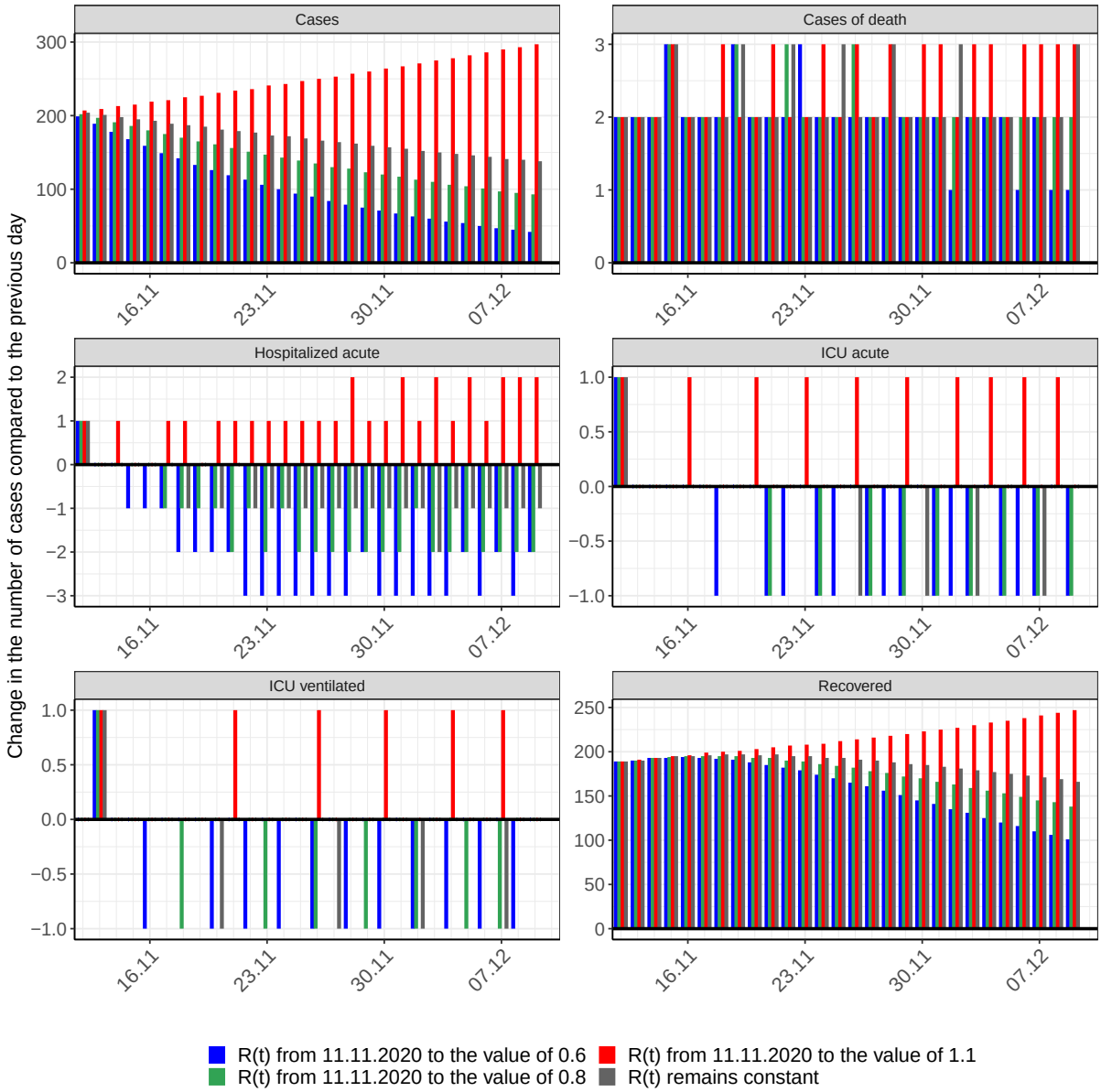


Figure 188: Simulation of daily new cases for the next 4 weeks - Schleswig-Holstein

16.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Schleswig-Holstein over time.

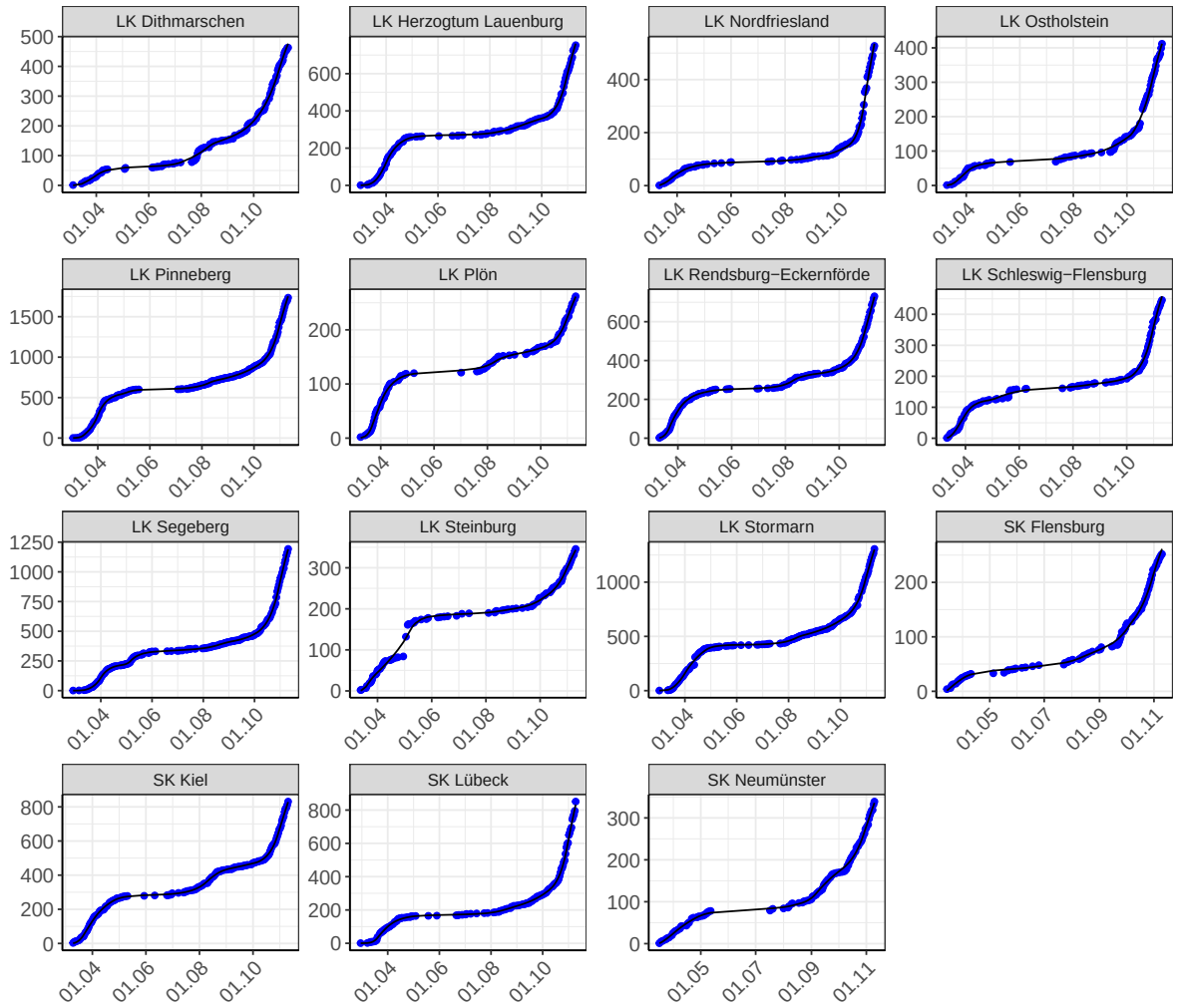


Figure 189: Model description of the reported case numbers in country- and citycounties in Schleswig-Holstein. Points: reported data; lines: model description.

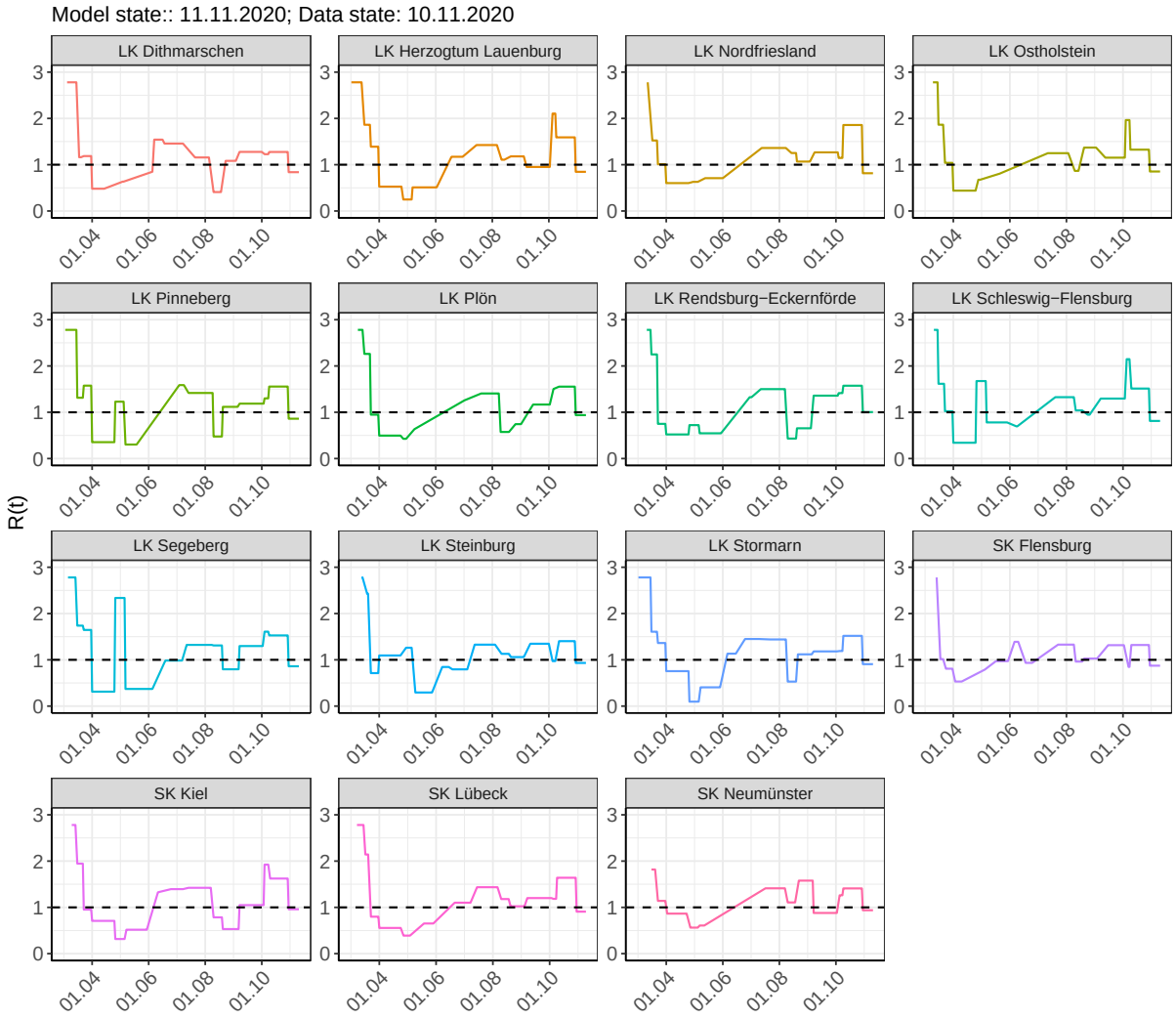


Figure 190: R(t) values over time for country- and citycounties in Schleswig-Holstein

Table 16: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Dithmarschen	2.78	1.16	1.19	0.48	0.63	0.85	1.54	1.46	1.16	0.41	1.08	1.28	1.23	1.28	0.84
LK Herzogtum Lauenburg	2.78	1.86	1.39	0.53	0.25	0.51	1.10	1.17	1.42	1.11	1.18	0.95	2.10	1.59	0.85
LK Nordfriesland	2.78	1.52	1.01	0.60	0.63	0.71	1.08	0.89	1.36	1.25	1.07	1.27	1.15	1.86	0.82
LK Ostholstein	2.78	1.86	1.04	0.44	0.68	0.81	1.35	1.05	1.25	0.87	1.37	1.15	1.96	1.33	0.85
LK Pinneberg	2.78	1.31	1.58	0.35	1.23	0.30	0.70	1.59	1.42	0.48	1.12	1.19	1.30	1.56	0.86
LK Plön	2.78	2.26	0.95	0.50	0.43	0.63	1.17	1.26	1.41	0.57	0.74	1.17	1.50	1.55	0.94
LK Rendsburg-Eckernförde	2.78	2.25	0.75	0.52	0.72	0.55	0.98	1.33	1.50	0.43	0.65	1.36	1.41	1.57	1.00
LK Schleswig-Flensburg	2.78	1.62	1.02	0.34	1.67	0.78	0.70	0.70	1.33	1.04	0.95	1.30	2.15	1.51	0.81
LK Segeberg	2.78	1.74	1.65	0.31	2.34	0.37	0.89	0.98	1.32	1.31	0.80	1.30	1.61	1.53	0.86
LK Steinburg	2.78	2.43	0.71	1.09	1.26	0.29	0.85	0.79	1.33	1.13	1.06	1.35	0.97	1.40	0.93
LK Stormarn	2.78	1.61	1.36	0.76	0.10	0.41	1.13	1.45	1.44	0.53	1.12	1.18	1.19	1.52	0.91
SK Flensburg	2.78	1.02	0.81	0.53	0.79	0.97	1.39	0.93	1.33	0.96	1.03	1.32	0.85	1.32	0.87

Table 16: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
SK Kiel	2.78	1.95	0.95	0.71	0.32	0.52	1.33	1.39	1.42	0.78	0.53	1.05	1.92	1.62	0.96
SK Lübeck	2.78	2.14	0.80	0.56	0.39	0.65	1.31	1.10	1.44	1.18	1.02	1.20	1.18	1.64	0.91
SK Neumünster	2.78	1.82	1.14	0.86	0.56	0.61	1.04	0.94	1.41	1.11	1.58	0.88	1.26	1.41	0.94

17 Thuringia

17.1 Model description

Fig. 191 depicts the results of the modeling (lines) compared to the observed data (points) for Thuringia on a linear (A) and semi-logarithmic (B) scale.

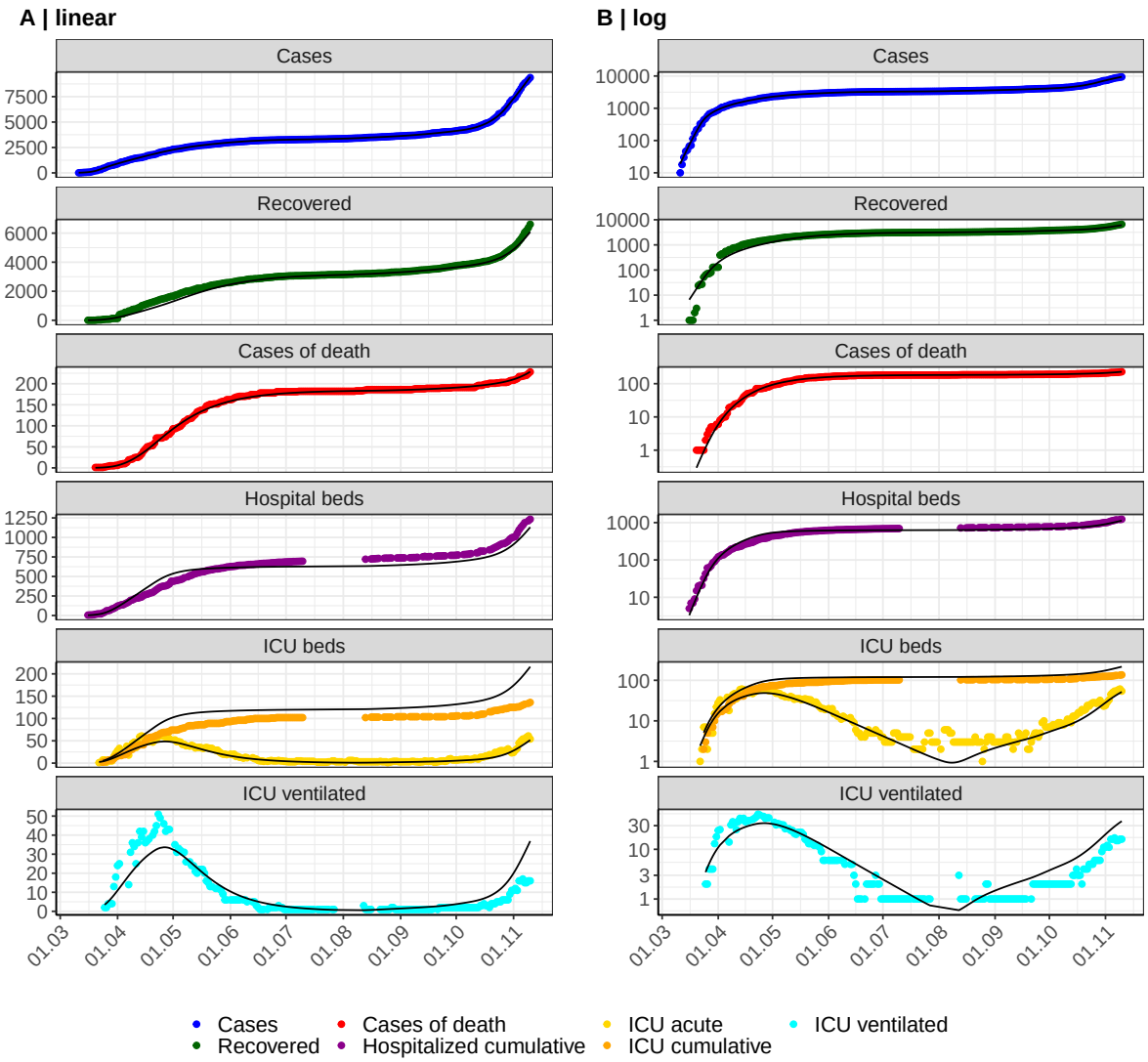


Figure 191: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Thuringia. Points: reported data; lines: model description.

Fig. 192 shows the goodness-of-fit for Thuringia. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

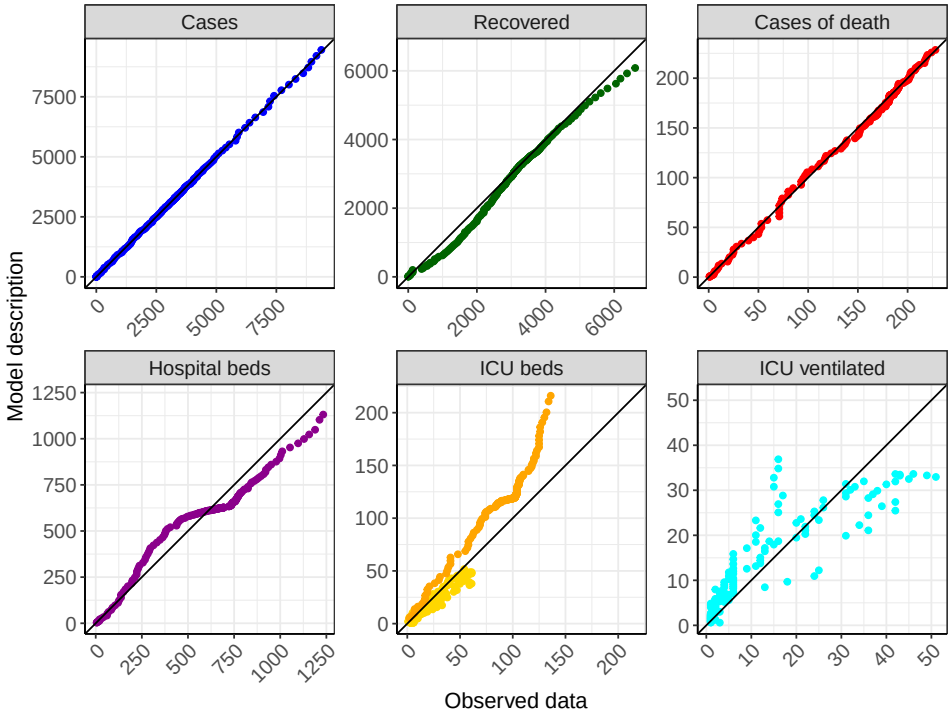


Figure 192: Goodness-of-fit plots for Thuringia. Lines: lines of identity.

Fig. 193 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Thuringia (red line) in comparison with the other federal states (grey lines).

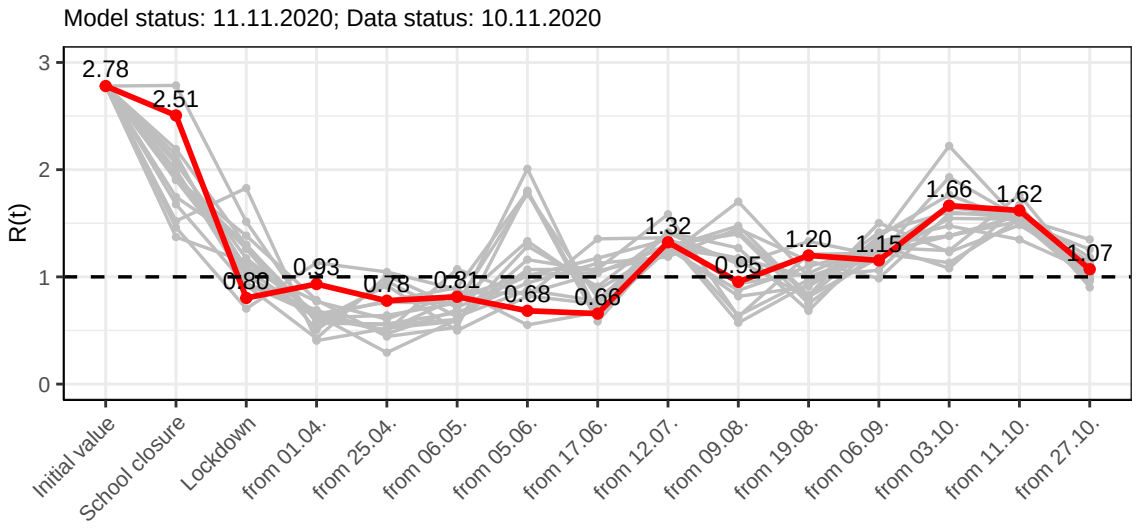


Figure 193: R(t) values before and after the NPIs for Thuringia

Fig. 194 shows the R(t) estimated value for Thuringia (red line) over time in comparison with the other federal states (grey lines).

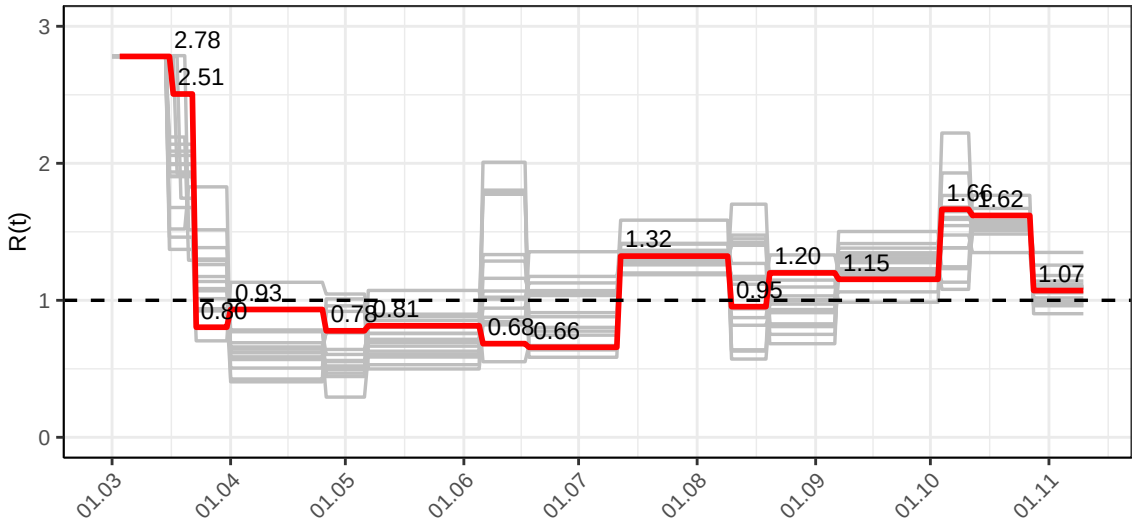


Figure 194: R(t) values over time for Thuringia

Fig. 195 shows the changes in hospitalization and death rates for Thuringia (red line) over time compared to the other states (grey lines).

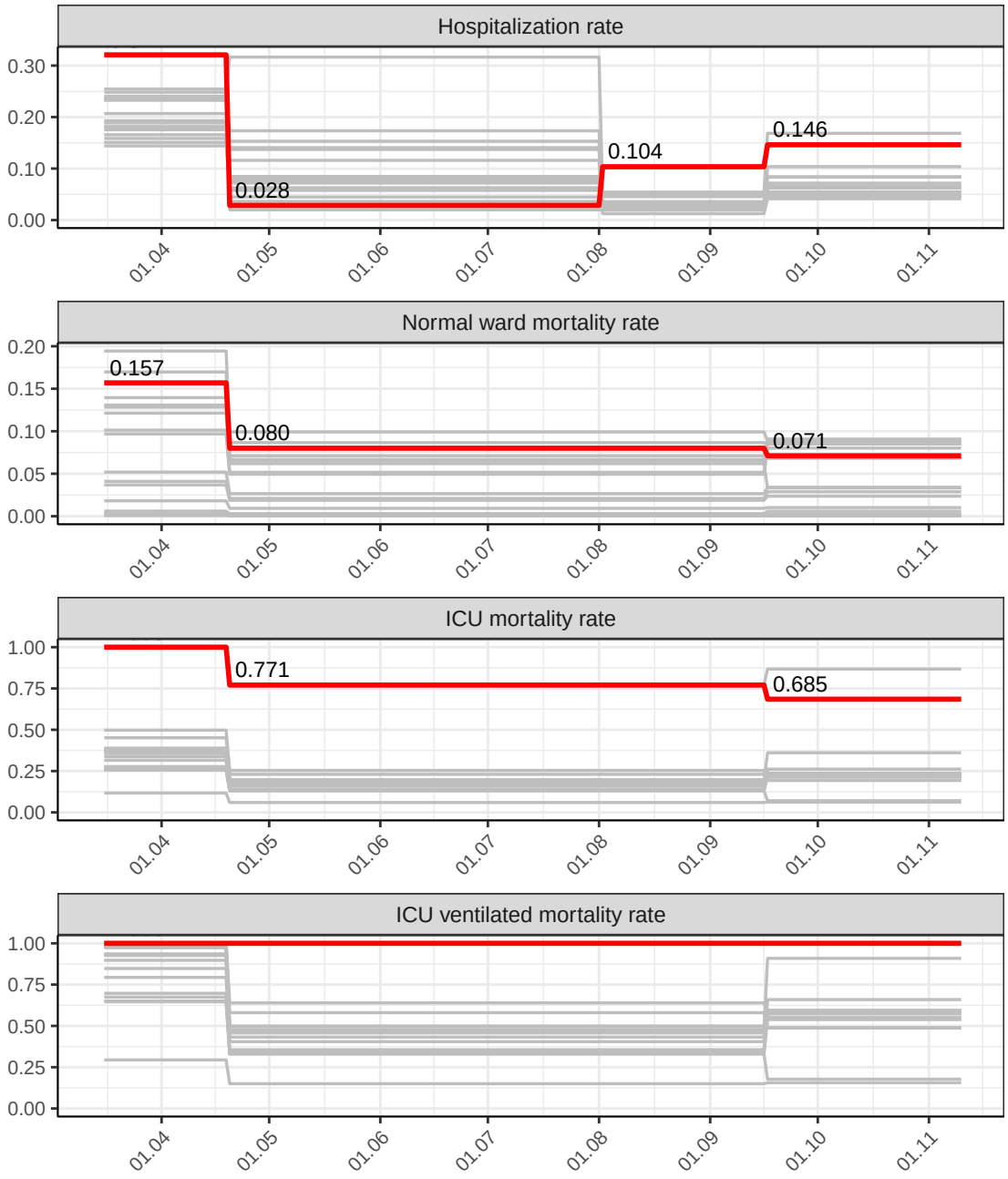


Figure 195: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Thuringia

17.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1.07) and assuming various scenarios from 11.11.2020

Fig.196 and 197 represent the model prediction for the next 8 weeks for Thuringia on a linear (196) and a semi-logarithmic (197) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

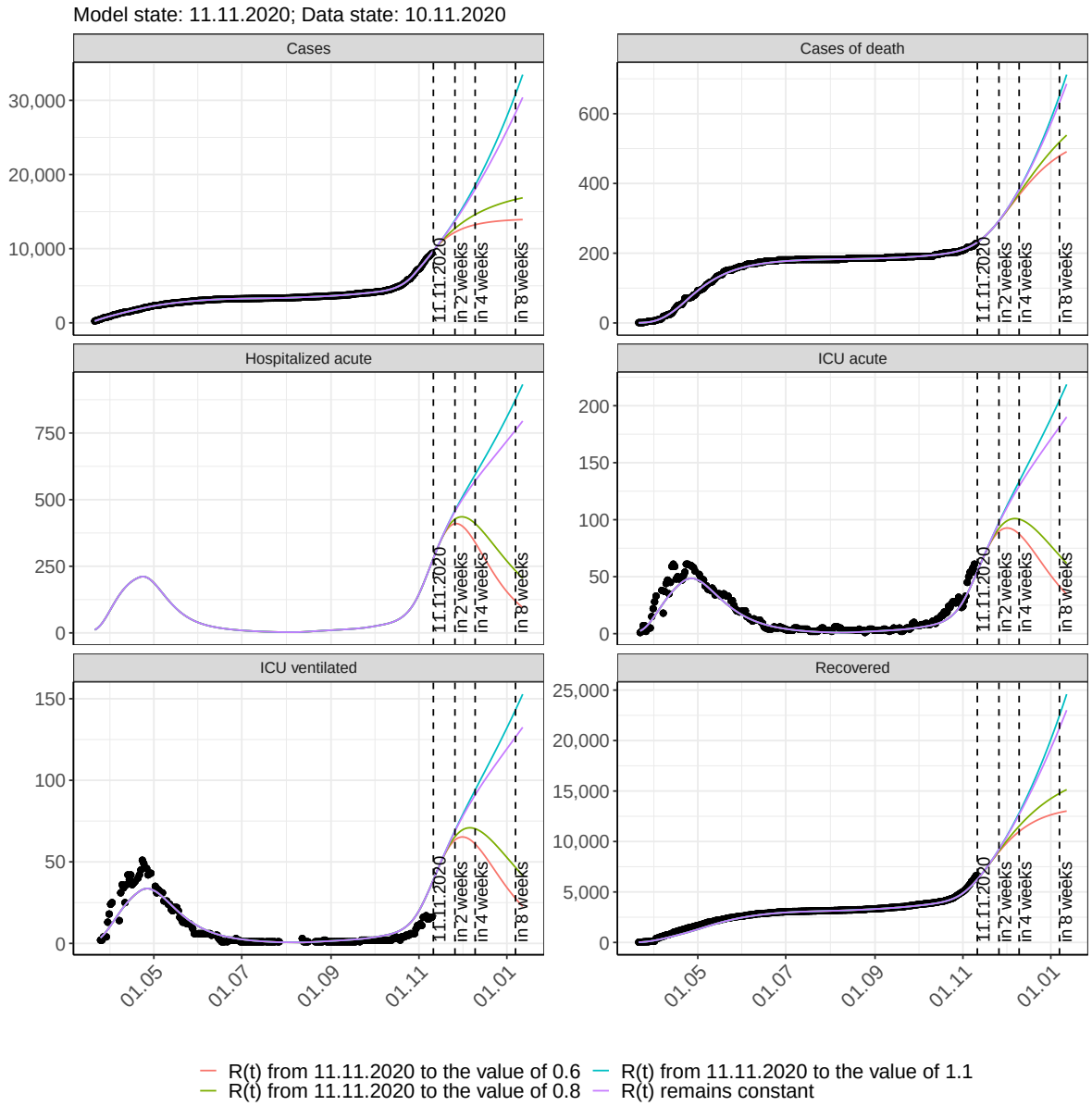


Figure 196: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Thuringia assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

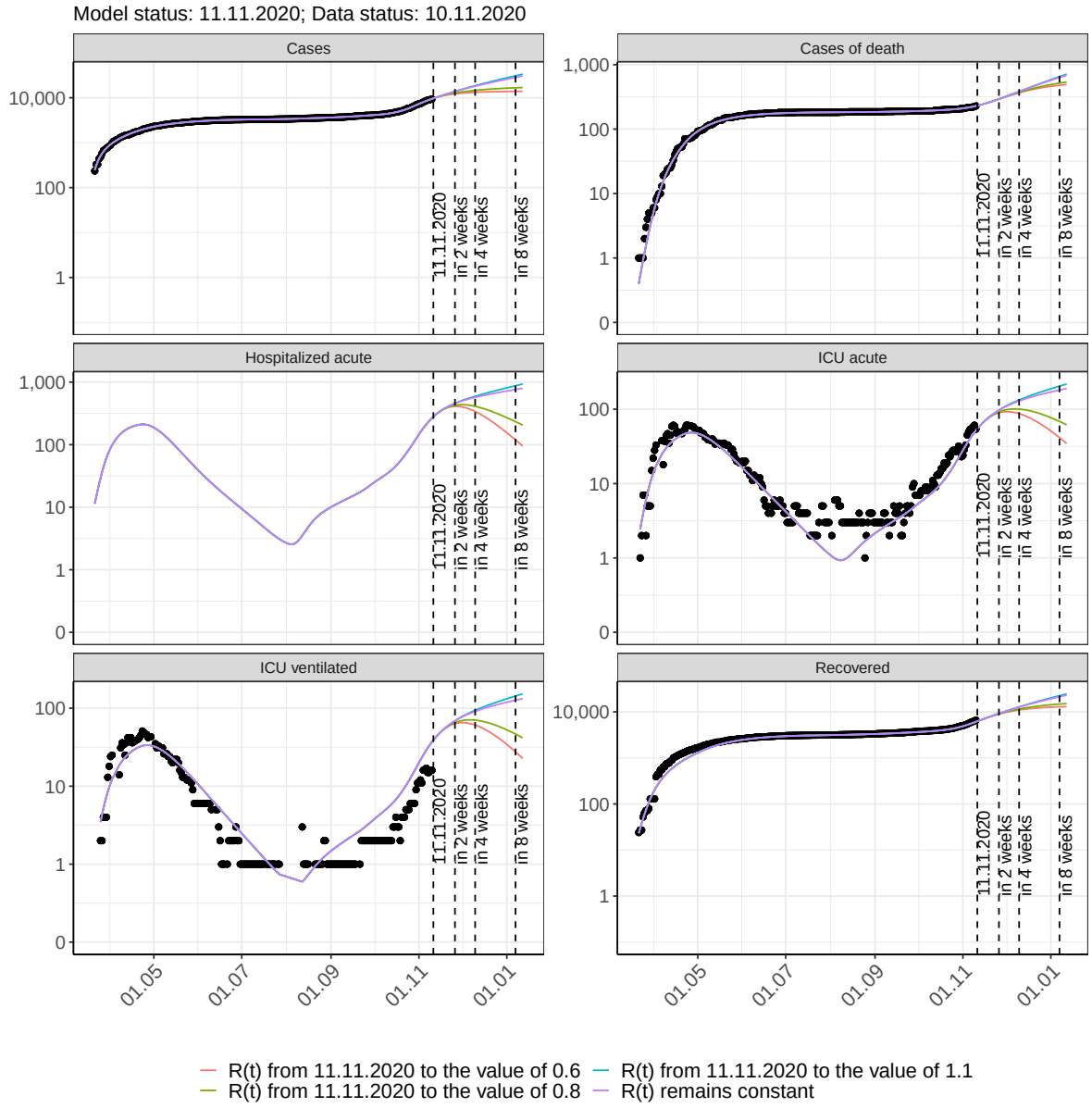


Figure 197: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Thuringia assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from 11.11.2020

Fig. 198 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

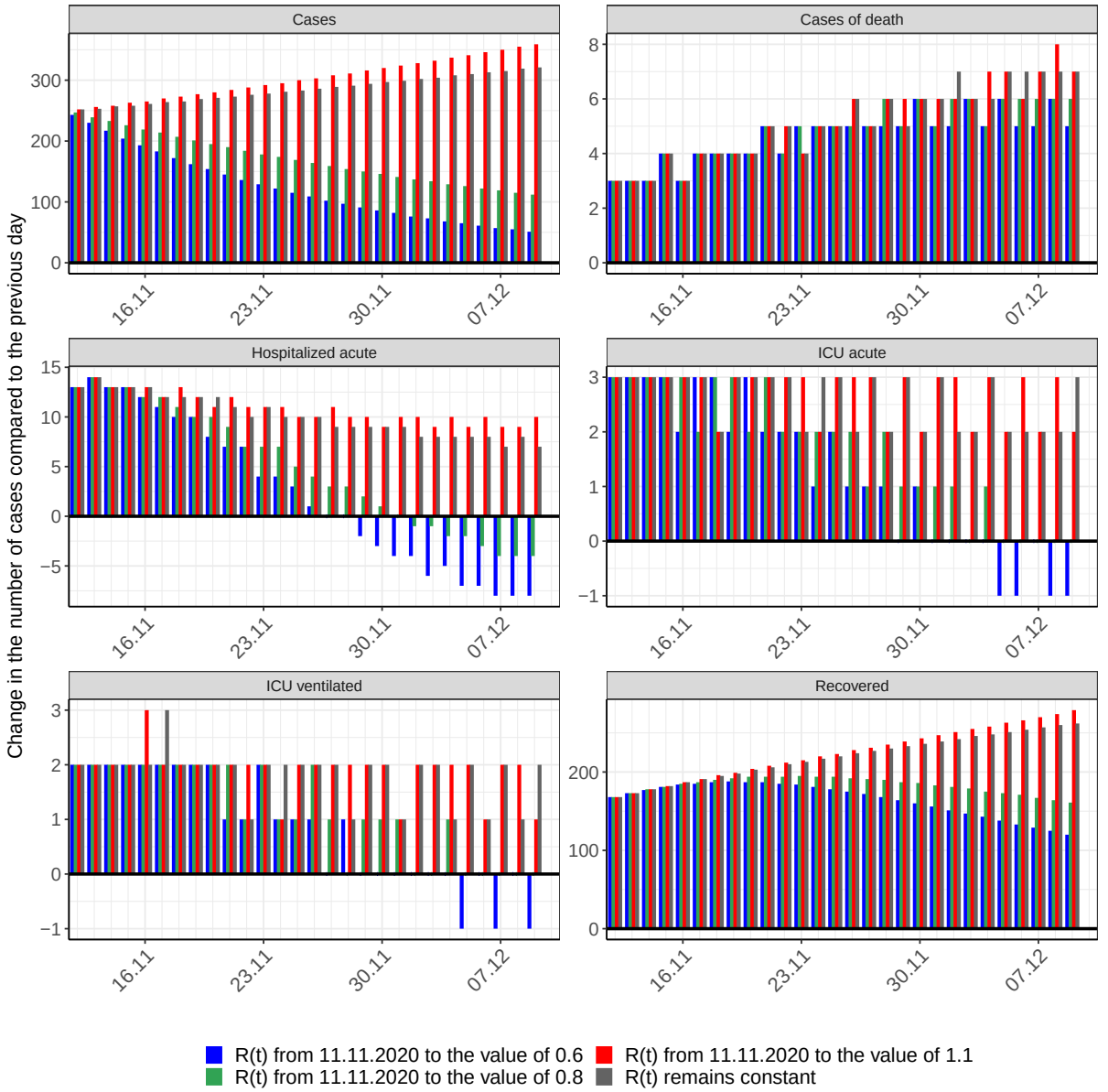


Figure 198: Simulation of daily new cases for the next 4 weeks - Thuringia

17.3 Country- and citycounties

The figures and tables in this chapter present the results of the modeling for country- and citycounties in Thuringia over time.

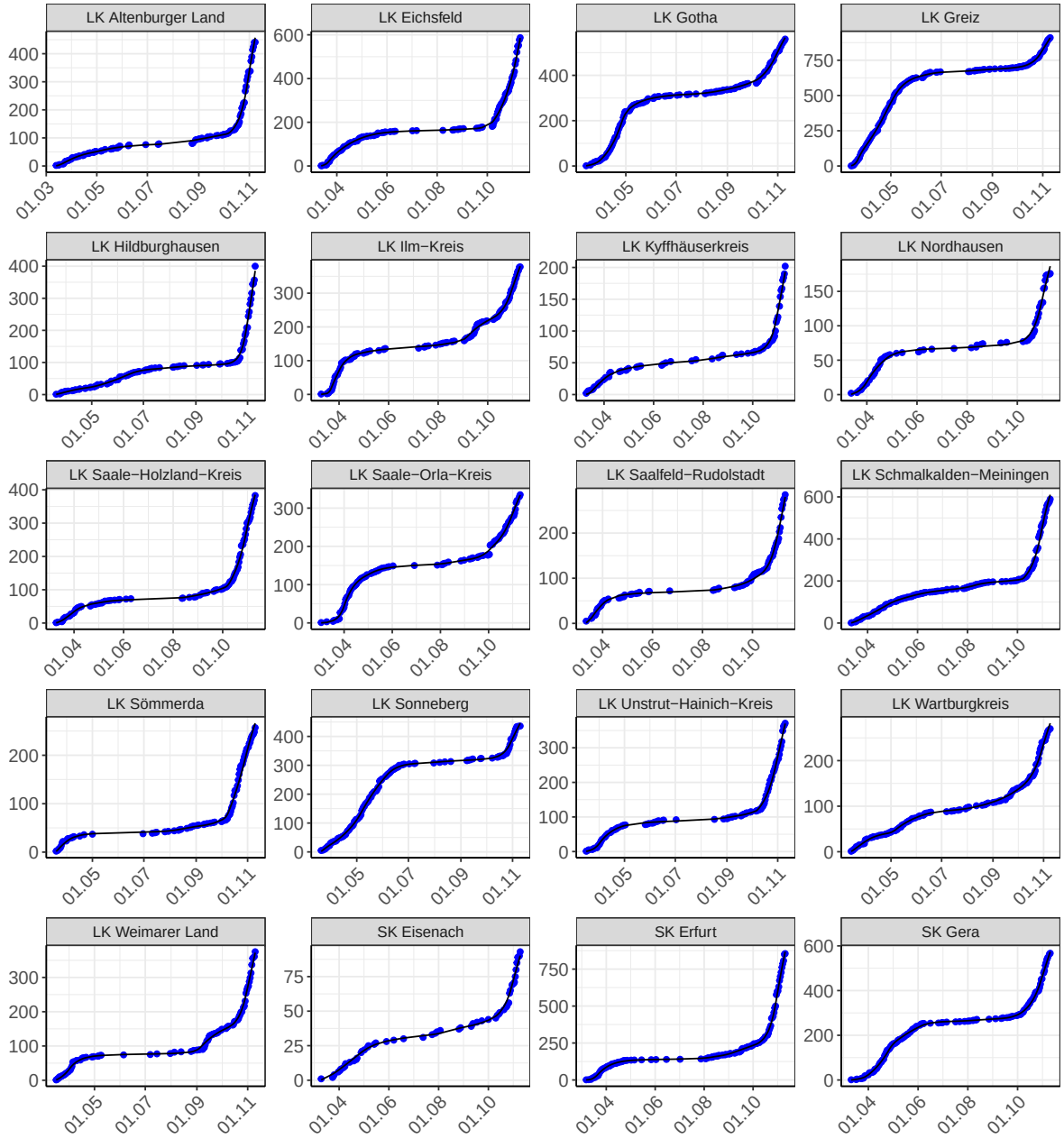


Figure 199: Model description of the reported case numbers in country- and citycounties in Thuringia. Points: reported data; lines: model description.

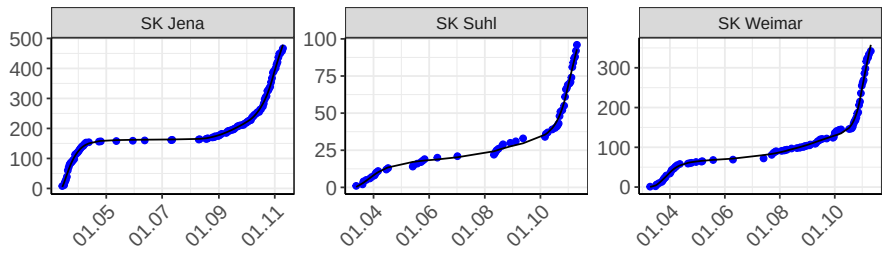


Figure 200: Model description of the reported case numbers in country- and citycounties in Thuringia. Points: reported data; lines: model description.

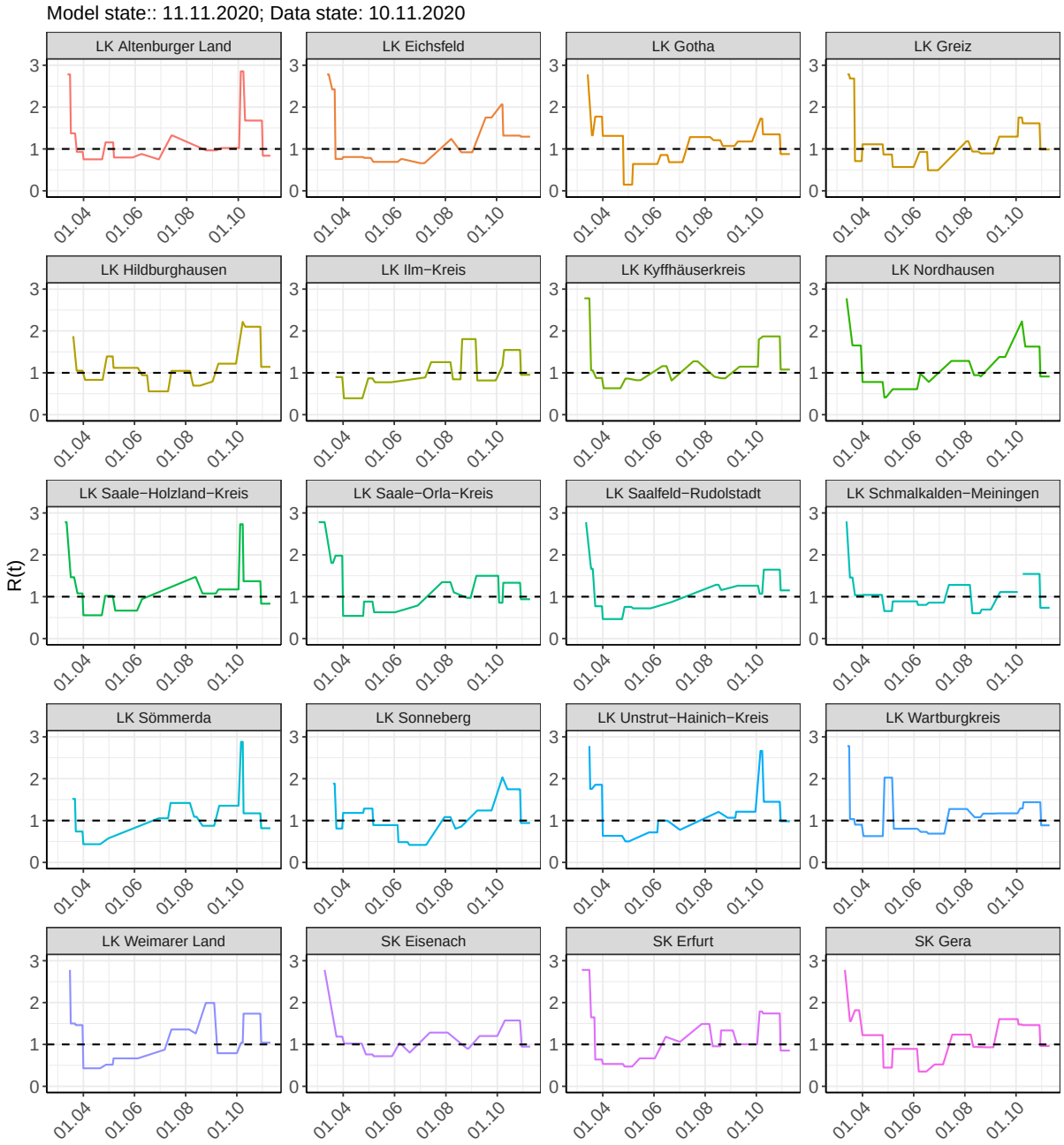


Figure 201: R(t) values over time for country- and citycounties in Thuringia

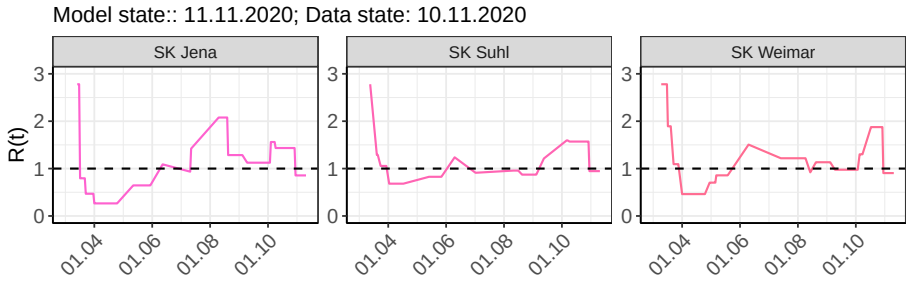


Figure 202: R(t) values over time for country- and citycounties in Thuringia

Table 17: R(t) changes for country- and citycounties

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Altenburger Land	2.78	1.37	0.93	0.75	1.16	0.80	0.88	0.75	1.32	1.33	0.97	1.02	2.85	1.68	0.84
LK Eichsfeld	2.78	2.42	0.76	0.81	0.79	0.69	0.76	0.66	1.24	0.95	0.92	1.75	2.06	1.32	1.29
LK Gotha	2.78	1.33	1.77	1.31	0.15	0.64	0.86	0.68	1.28	1.21	1.07	1.18	1.72	1.35	0.88
LK Greiz	2.78	2.68	0.71	1.11	0.87	0.57	0.93	0.49	1.19	0.94	0.89	1.29	1.75	1.61	0.99
LK Hildburghausen	2.78	1.88	1.05	0.83	1.39	1.12	0.94	0.56	1.05	0.69	0.79	1.22	2.22	2.10	1.14
LK Ilm-Kreis	2.78	3.41	0.90	0.39	0.87	0.77	1.13	0.89	1.25	0.84	1.81	0.82	1.16	1.55	0.95
LK Kyffhäuserkreis	2.78	1.06	0.88	0.63	0.86	0.82	1.16	0.82	1.27	0.91	0.87	1.15	1.79	1.87	1.08
LK Nordhausen	2.78	1.66	1.65	0.78	0.41	0.61	0.98	0.78	1.28	0.94	0.91	1.38	2.23	1.63	0.91
LK Saale-Holzland-Kreis	2.78	1.46	1.08	0.56	1.02	0.67	0.94	0.83	1.37	1.47	1.08	1.17	2.73	1.37	0.83
LK Saale-Orla-Kreis	2.78	1.81	1.98	0.54	0.88	0.63	0.87	0.79	1.35	1.10	0.97	1.50	0.86	1.33	0.94
LK Saalfeld-Rudolstadt	2.78	1.67	0.77	0.47	0.76	0.72	1.07	0.87	1.37	1.28	1.16	1.26	1.07	1.65	1.15
LK Schmalkalden-Meiningen	2.78	1.46	1.03	1.04	0.66	0.89	0.80	0.86	1.28	0.60	0.69	1.11	3.74	1.54	0.74

Table 17: R(t) changes for country- and citycounties *(continued)*

Landkreis	Initial value	School closure	Lock-down	from 01.04.	from 25.04.	from 06.05.	from 05.06.	from 17.06.	from 12.07.	from 09.08.	from 19.08.	from 06.09.	from 03.10.	from 11.10.	from 27.10.
LK Sömmerda	2.78	1.52	0.74	0.44	0.58	0.73	1.24	1.05	1.42	1.09	0.88	1.35	2.88	1.17	0.82
LK Sonneberg	2.78	1.88	0.81	1.18	1.29	0.89	0.48	0.42	1.08	0.81	0.86	1.24	2.03	1.75	0.94
LK Unstrut-Hainich-Kreis	2.78	1.76	1.86	0.64	0.50	0.72	1.00	0.78	1.32	1.21	1.07	1.21	2.66	1.45	0.98
LK Wartburgkreis	2.78	1.04	0.90	0.63	2.03	0.80	0.73	0.69	1.28	1.08	1.17	1.17	1.29	1.44	0.89
LK Weimarer Land	2.78	1.50	1.46	0.43	0.52	0.67	1.06	0.87	1.36	1.26	1.99	0.79	1.04	1.74	1.04
SK Eisenach	2.78	1.92	1.19	1.02	0.76	0.72	1.04	0.80	1.28	0.95	0.90	1.20	1.56	1.57	0.95
SK Erfurt	2.78	1.65	0.64	0.53	0.47	0.67	1.18	1.06	1.49	0.96	1.33	1.00	1.79	1.74	0.85
SK Gera	2.78	1.55	1.82	1.22	0.45	0.89	0.35	0.52	1.23	0.94	0.93	1.60	1.48	1.46	0.96
SK Jena	2.78	0.80	0.47	0.27	0.45	0.65	1.09	0.93	1.42	2.08	1.29	1.12	1.56	1.43	0.86
SK Suhl	2.78	1.29	1.06	0.68	0.75	0.83	1.24	0.91	1.33	0.96	0.87	1.21	1.59	1.57	0.95
SK Weimar	2.78	1.89	1.09	0.46	0.70	0.86	1.51	0.99	1.22	0.92	1.13	0.98	1.30	1.88	0.91

18 Germany

18.1 Model description

Fig. 203 depicts the results of the modeling (lines) compared to the observed data (points) for Germany on a linear (A) and semi-logarithmic (B) scale.

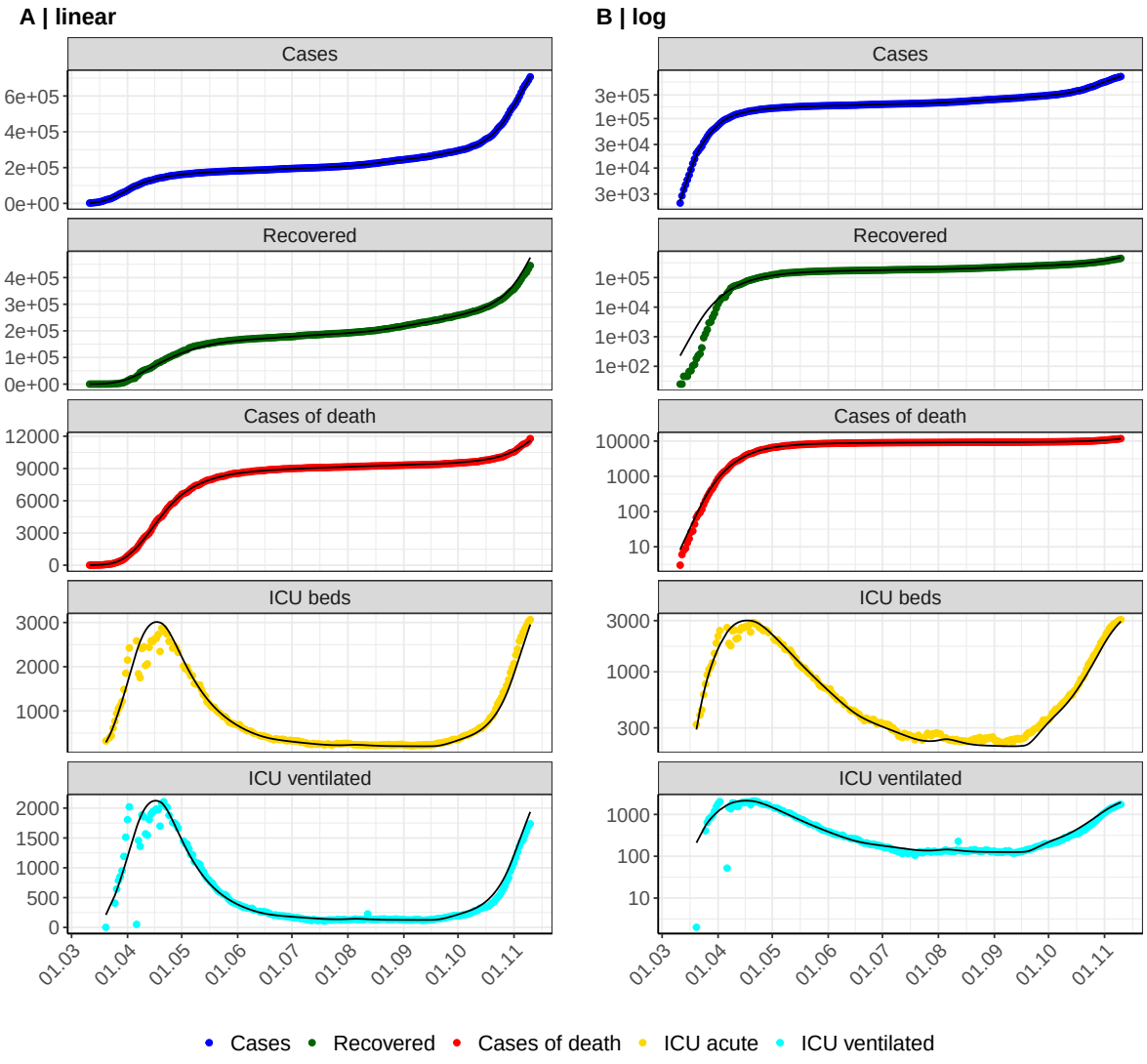


Figure 203: Model description of the reported case numbers, occupancy of hospital beds, recovery and deaths in Germany. Points: reported data; lines: model description.

Fig. 204 shows the goodness-of-fit for Germany. The values calculated by the model are plotted against the observed data. If the model fit is good, the points scatter randomly along the lines of identity.

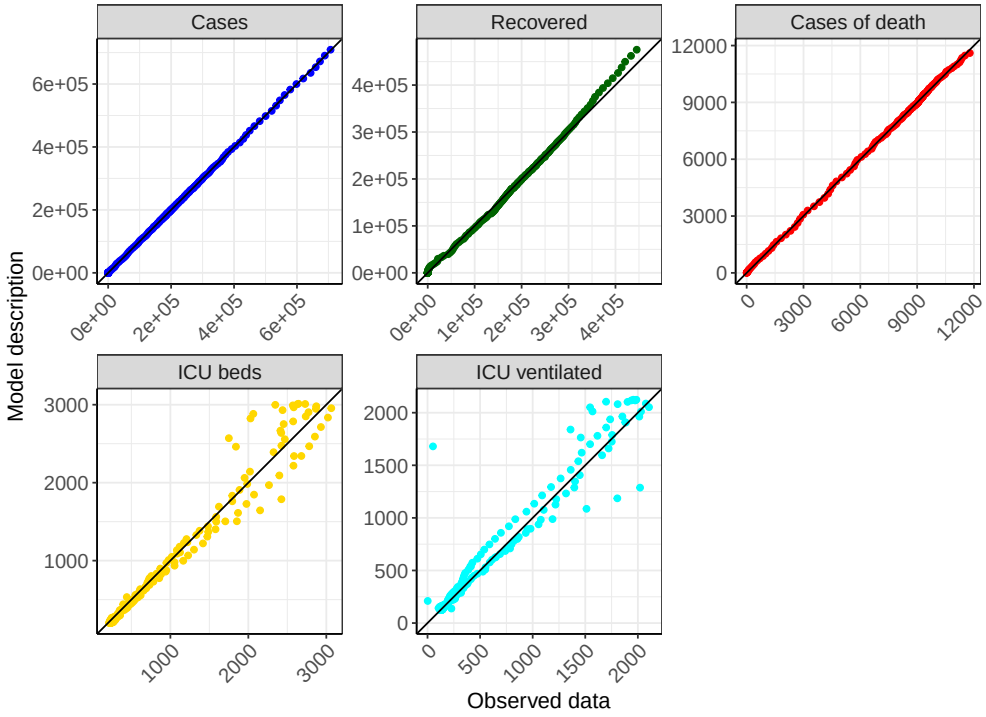


Figure 204: Goodness-of-fit plots for Germany. Lines: lines of identity.

Fig. 205 shows the influence of non-pharmaceutical interventions (NPI) on R(t) for Germany (red line) in comparison with the other federal states (grey lines).

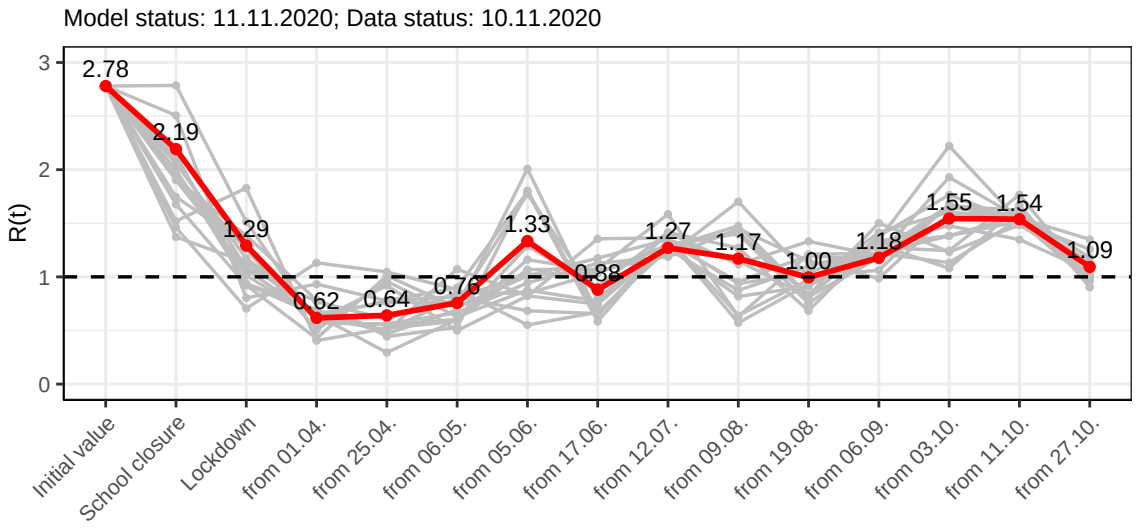


Figure 205: R(t) values before and after the NPIs for Germany

Fig. 206 shows the R(t) estimated value for Germany (red line) over time in comparison with the other federal states (grey lines).

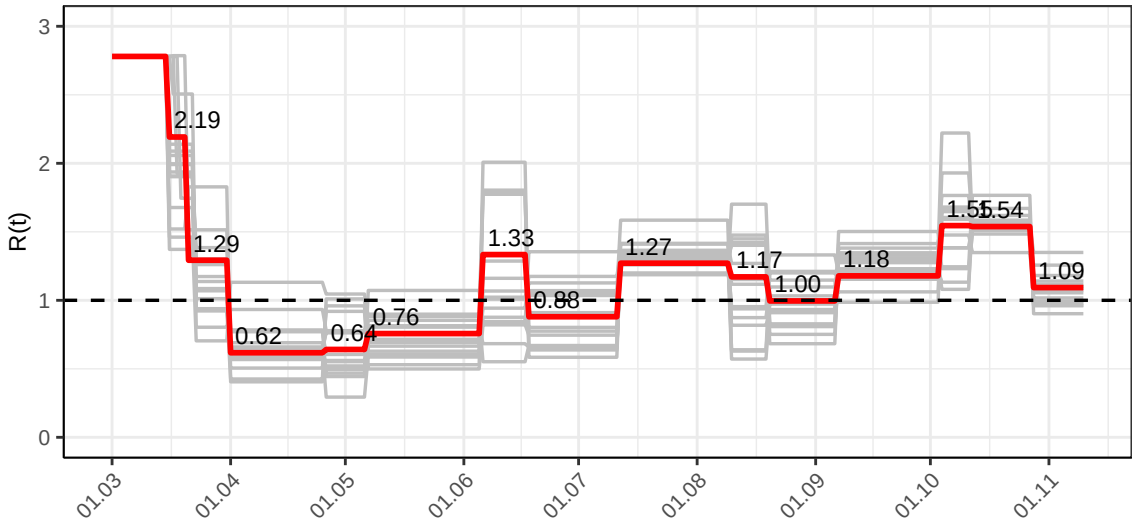


Figure 206: R(t) values over time for Germany

Fig. 207 shows the changes in hospitalization and death rates for Germany (red line) over time compared to the other states (grey lines).

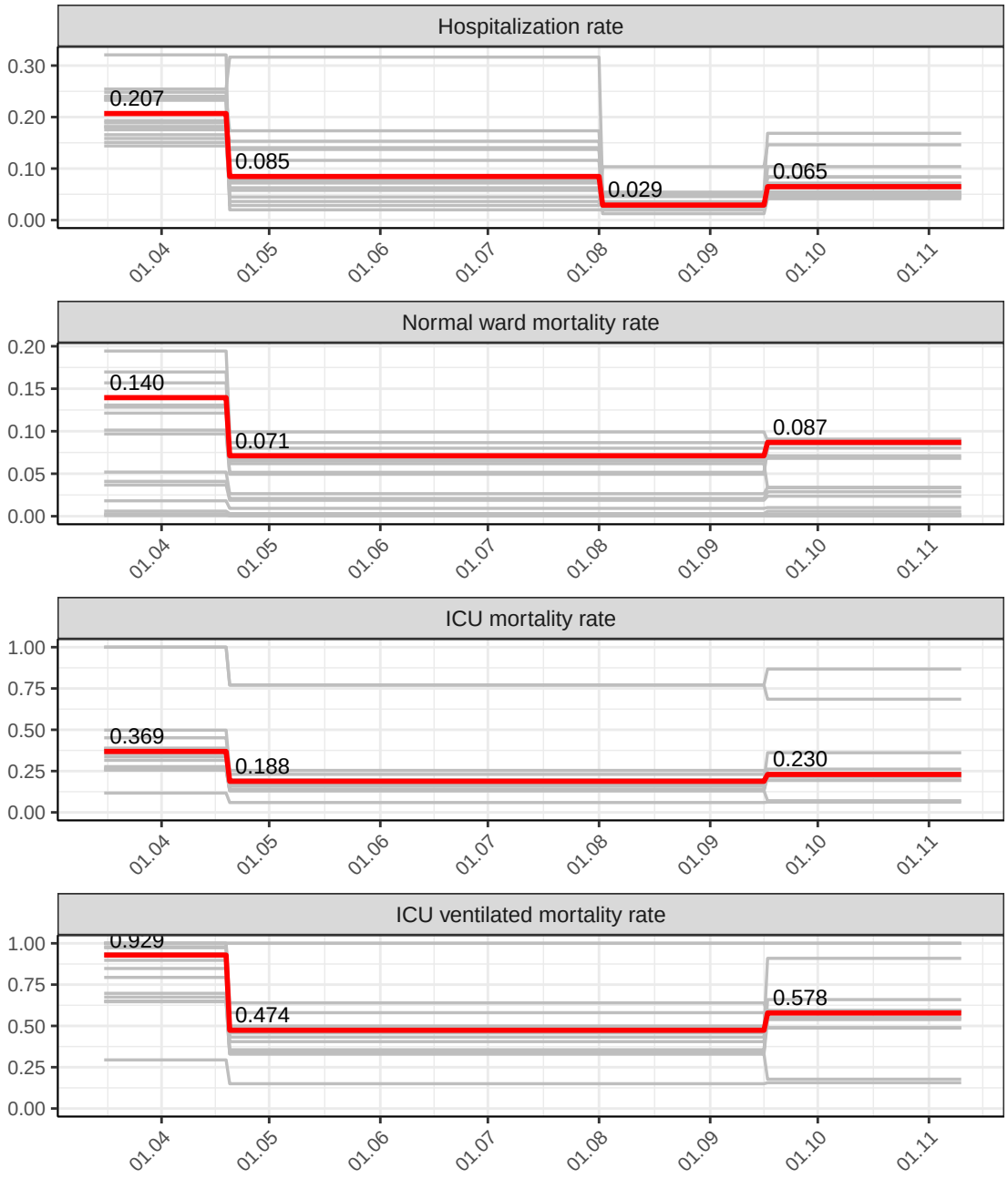


Figure 207: Hospitalization rate and death rates (normal ward, ICU and ICU ventilated) over time for Germany

18.2 Model predictions

Prediction for the next 8 weeks assuming that R(t) estimate will not change (R(t) = 1.09) and assuming various scenarios from the 11.11.2020

Fig.208 and 209 represent the model prediction for the next 8 weeks for Germany on a linear (208) and a semi-logarithmic (209) scale. In this simulation different scenarios of the possible course from the 11.11.2020 were tested.

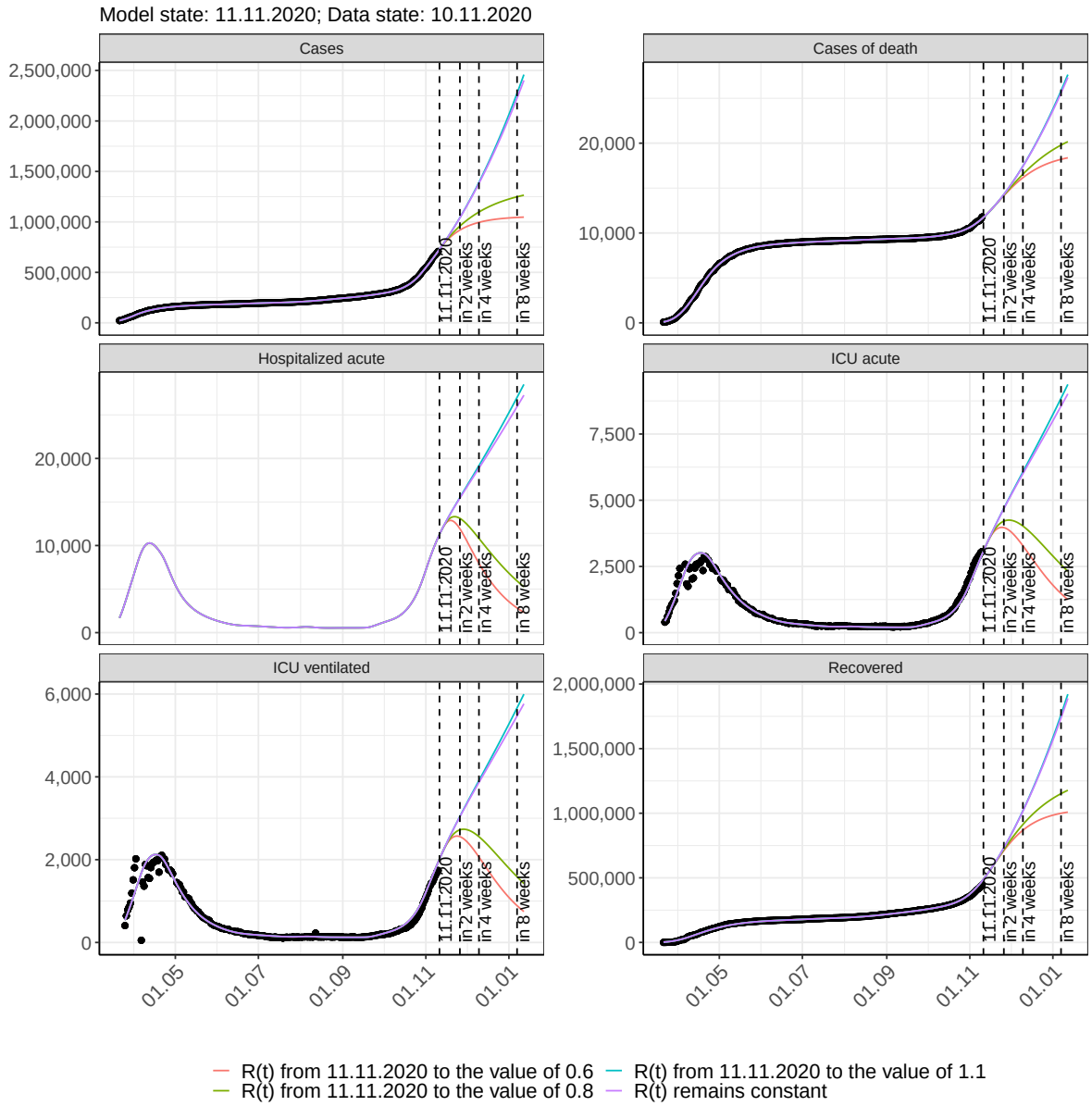


Figure 208: Linear representation of model predictions (case numbers, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Germany assuming various scenarios from the 11.11.2020. Points: reported case numbers; lines: model prediction.

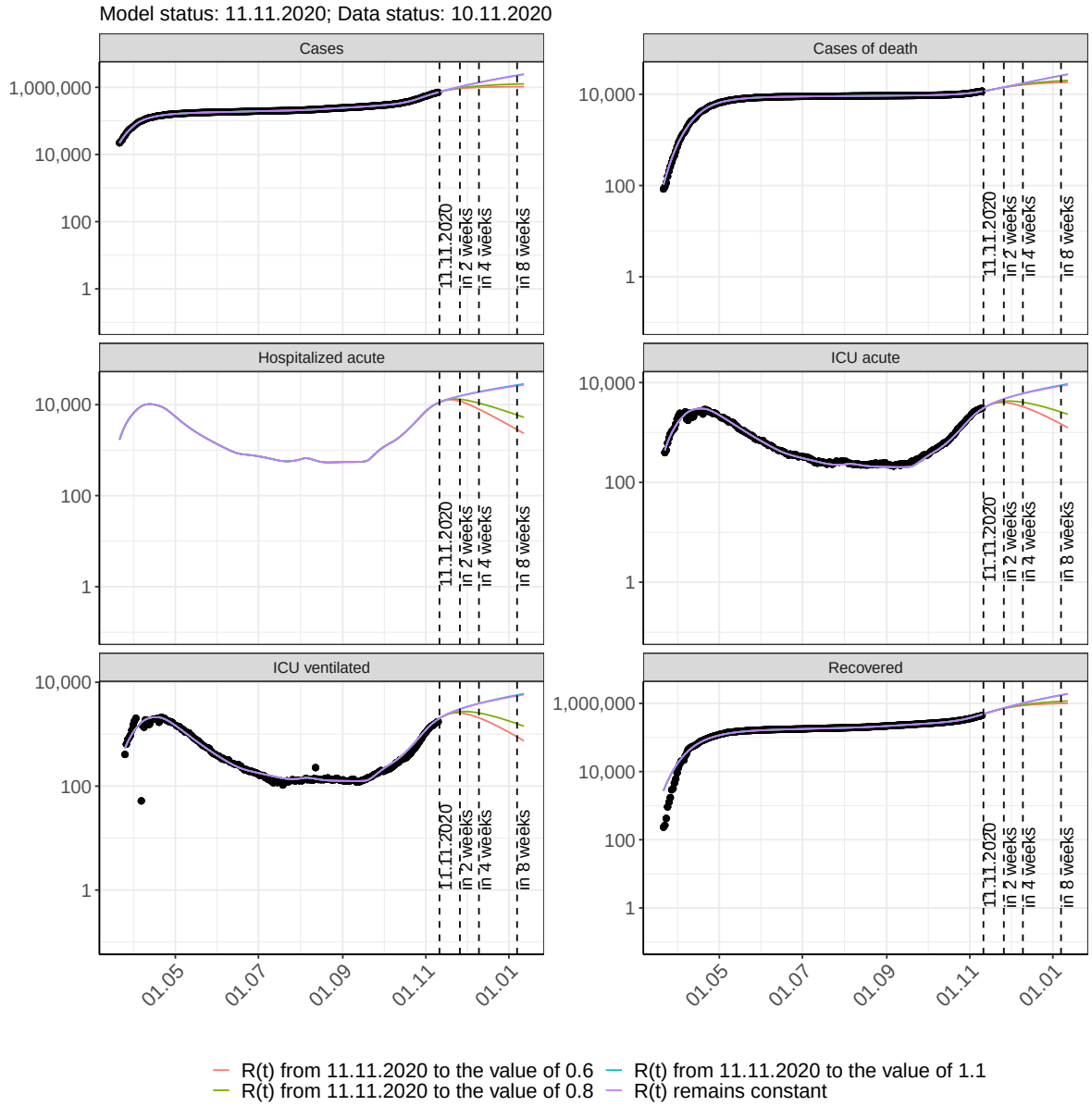


Figure 209: Semi-logarithmic depiction of the model prediction (cases, recovered, ICU ventilated, ICU beds, hospital beds, deaths) for Germany assuming various scenarios after 11.11.2020. Points: reported case numbers; lines: model predictions.

Prediction for the next 4 weeks under the assumption of different scenarios from the 11.11.2020

Fig. 210 shows the absolute changes in case numbers compared to the previous day for the next 4 weeks for different R(t) values. If no bars are shown on the plot it means that the number of cases has not changed compared to the previous day.

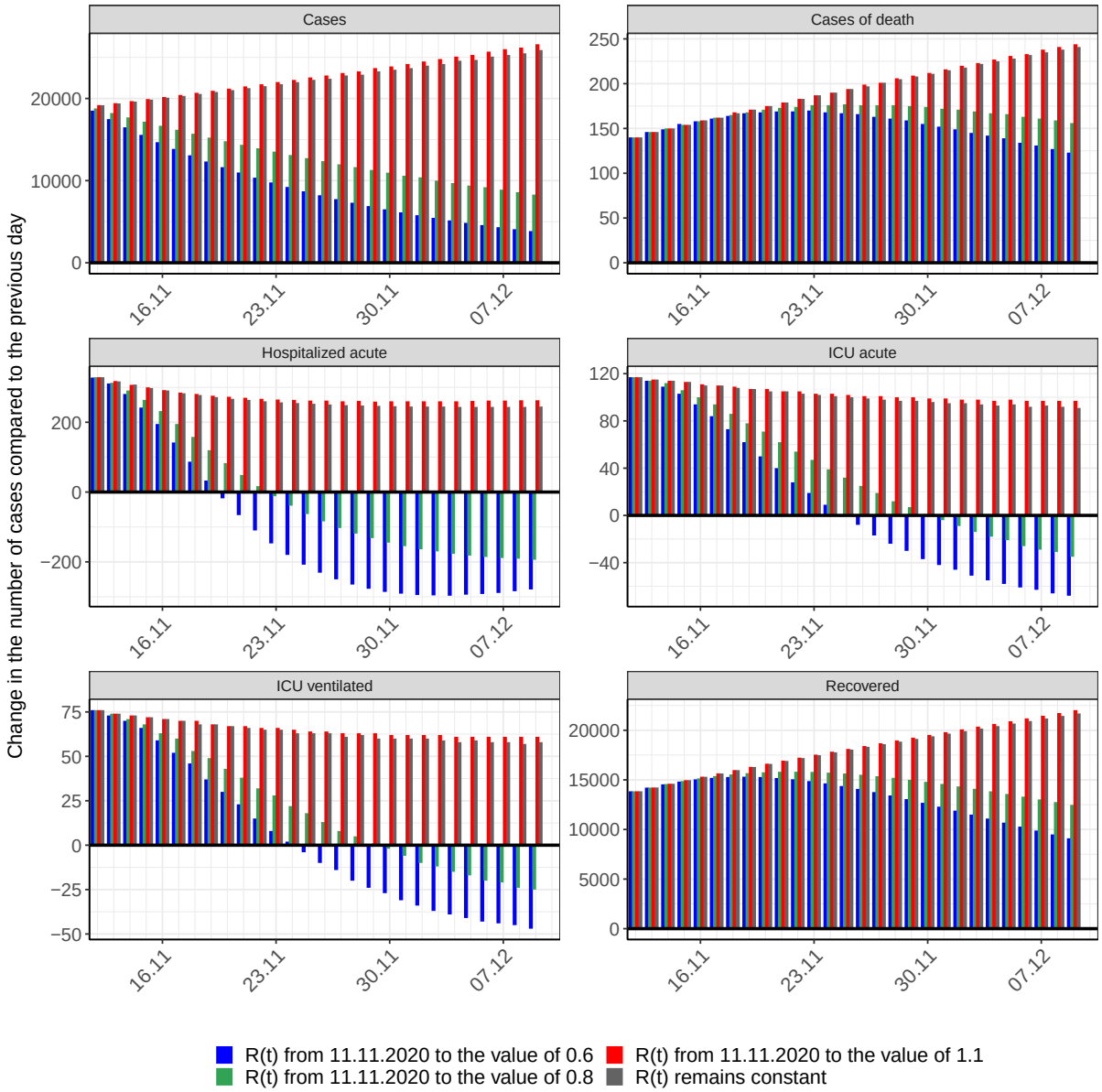


Figure 210: Simulation of daily new cases for the next 4 weeks - Germany

19 Changes in the document

Compared to the last report of **04.11.2020**, the database has been expanded and the model parameters have been estimated with new data up to **10.11.2020**. A further effect on R(t) on 27.10 was estimated (p-value < 0.001). A further effect on hospital mortality rates was estimated (p-value < 0.001).