

# Distance as a signal

Nutcha Wattanachit, Johannes Bracher, Evan Ray, Nick Reich

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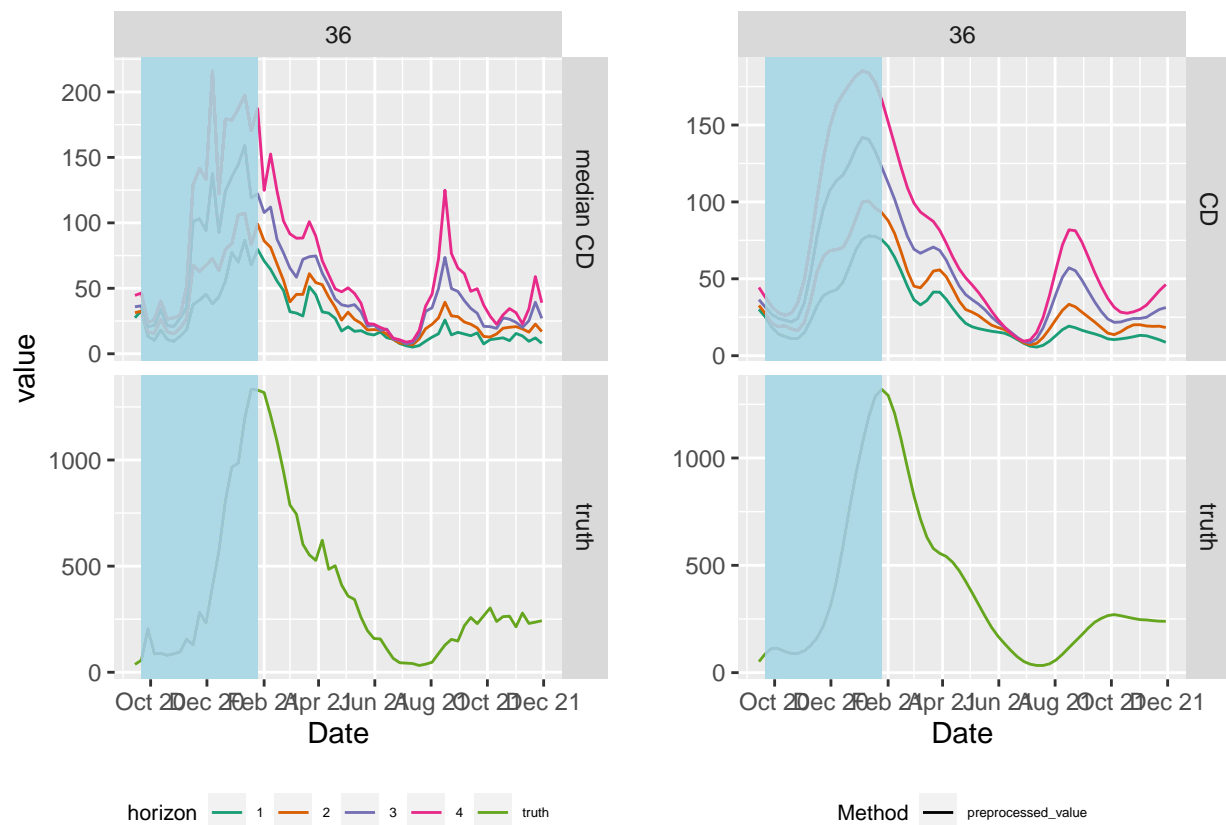
## Cross-correlations

### Forecast inclusion criteria

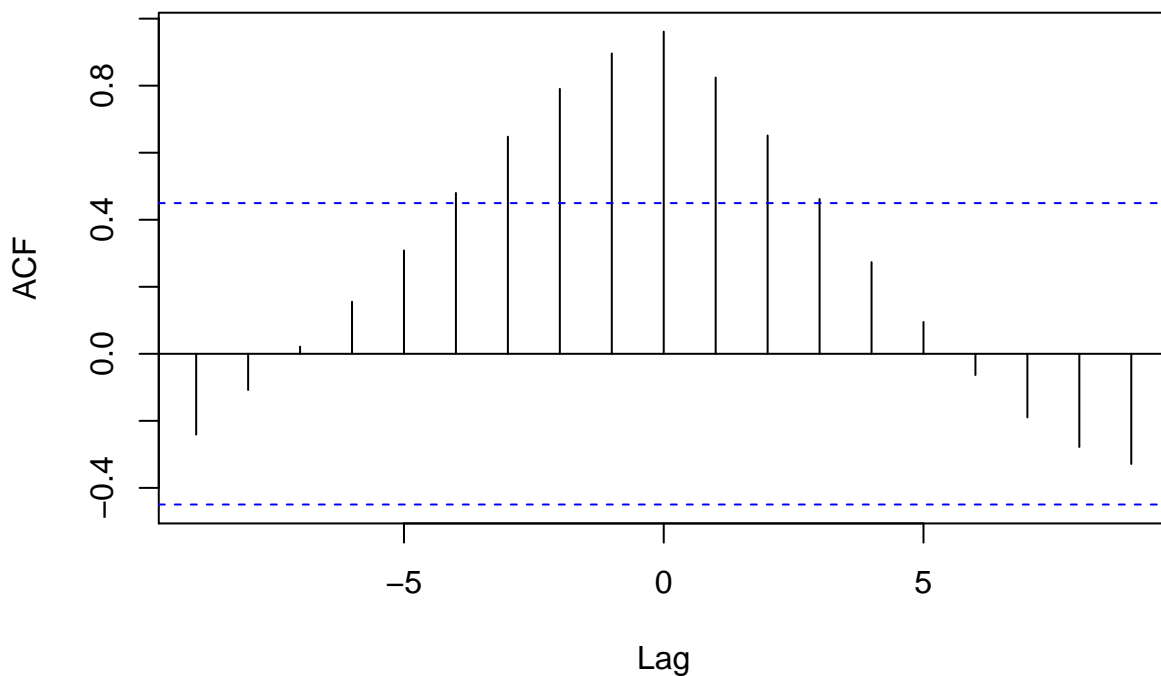
- Targets: 1-4 wk ahead inc death
- Target End Dates: Jan-Dec 2021 with all 4 horizons.
- Model: all models submitted on a particular date
- Probability levels: All
- Locations: 28 locations that had a “wave” (large or small) in 2021 - except US. Locations that are excluded had either no distinct peak in 2021 or severe data irregularity.

Using raw values means the sign (which should be positive) is not as important as the lag.

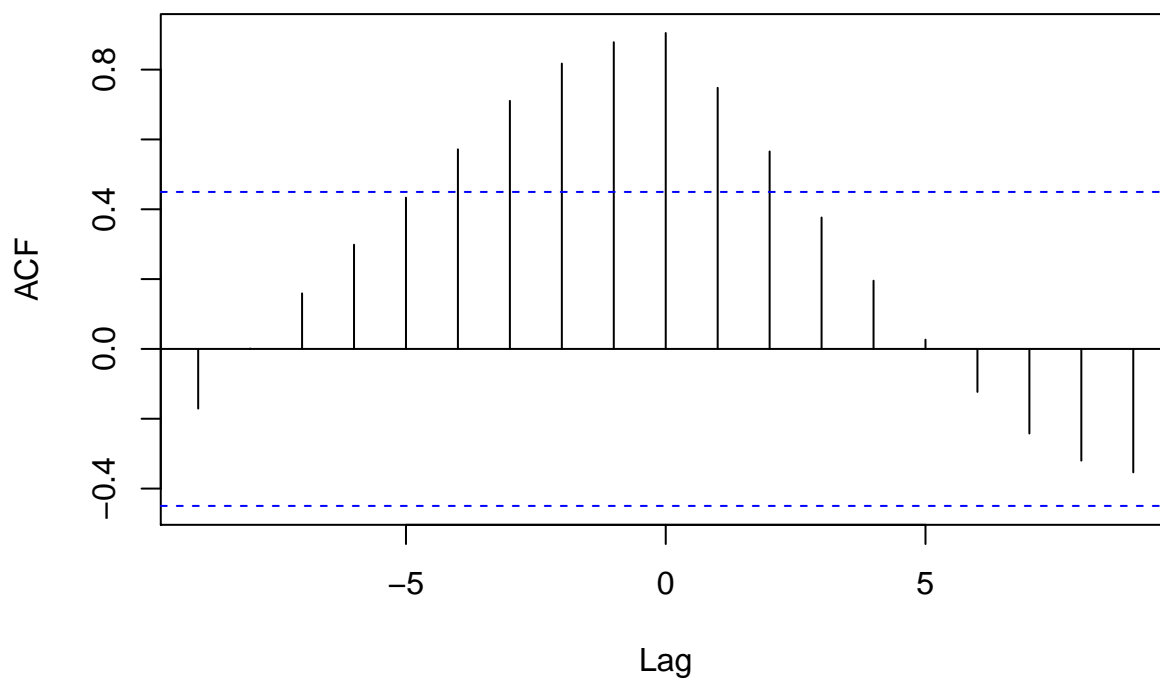
Plots of inc deaths, median CDs, smoothed inc deaths, smoothed median CDs, and CCF - date 1



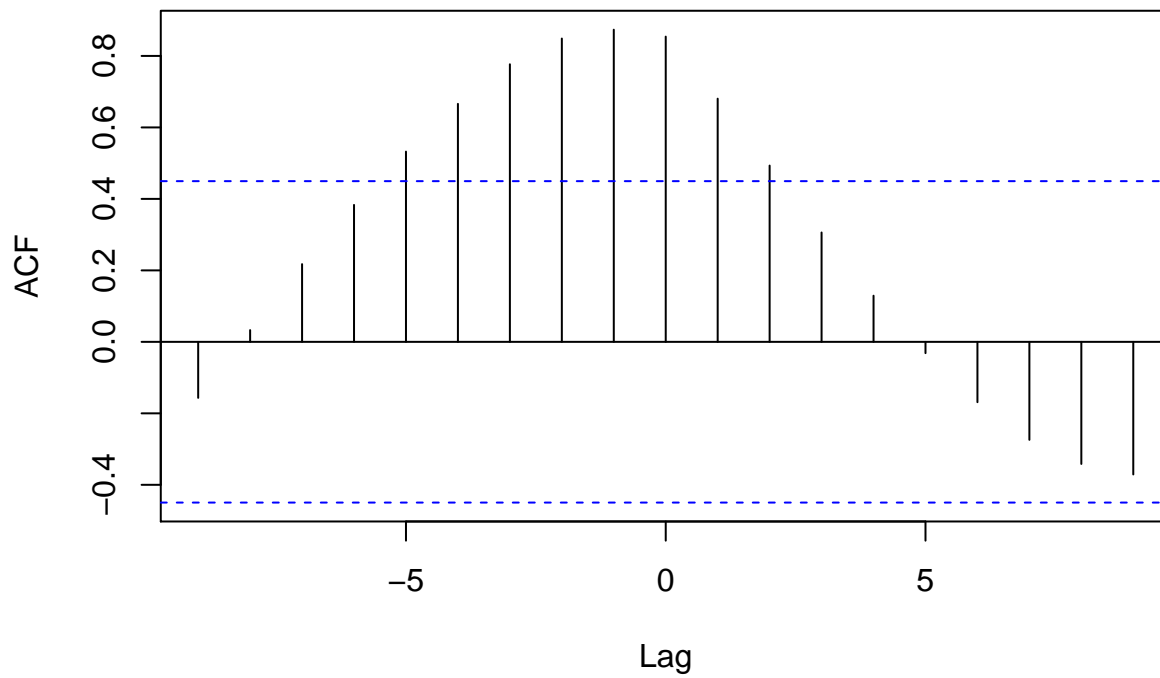
1 wk ahead - 36



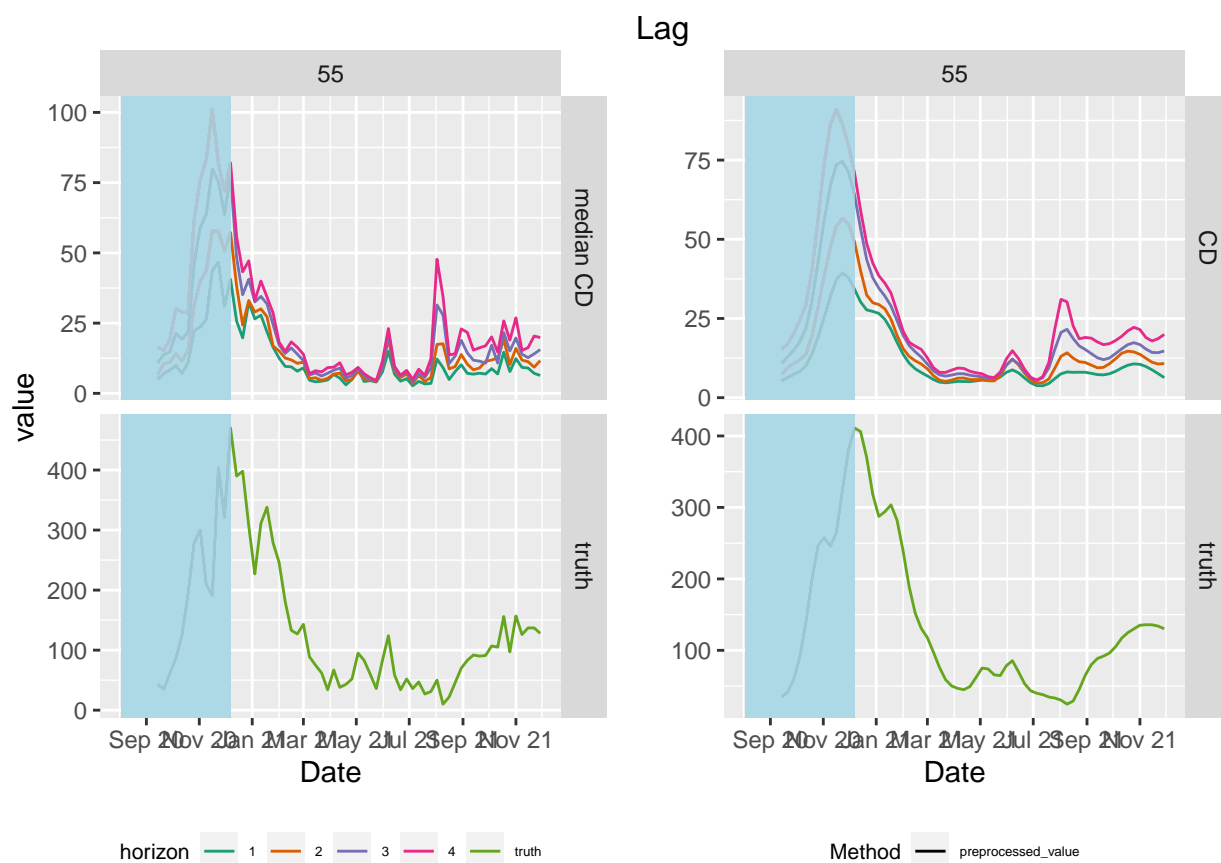
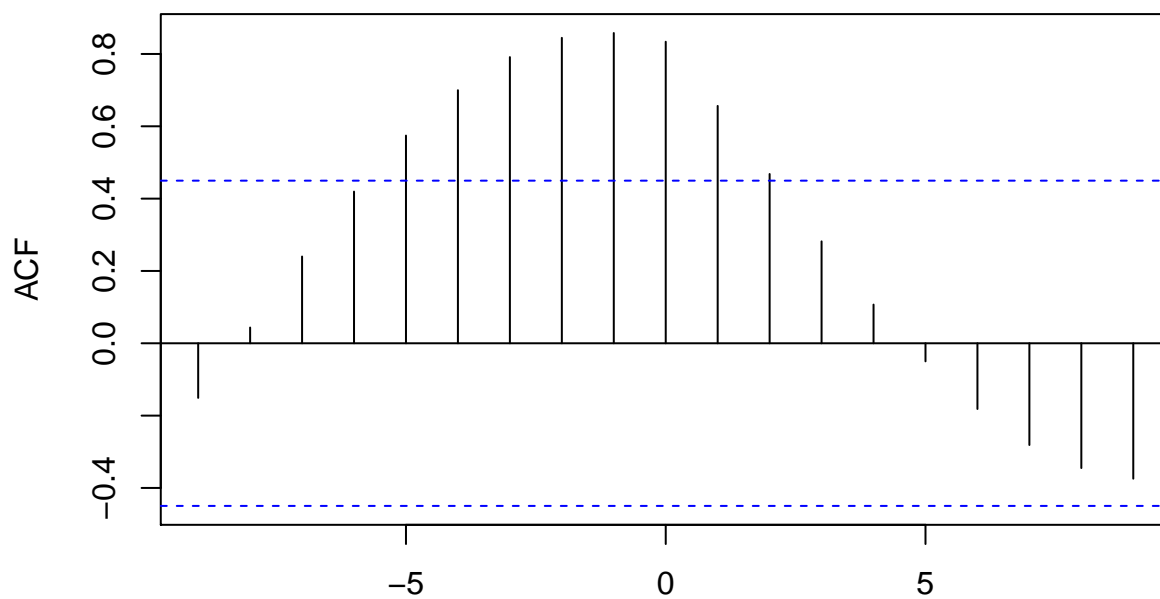
**2 wk ahead – 36**



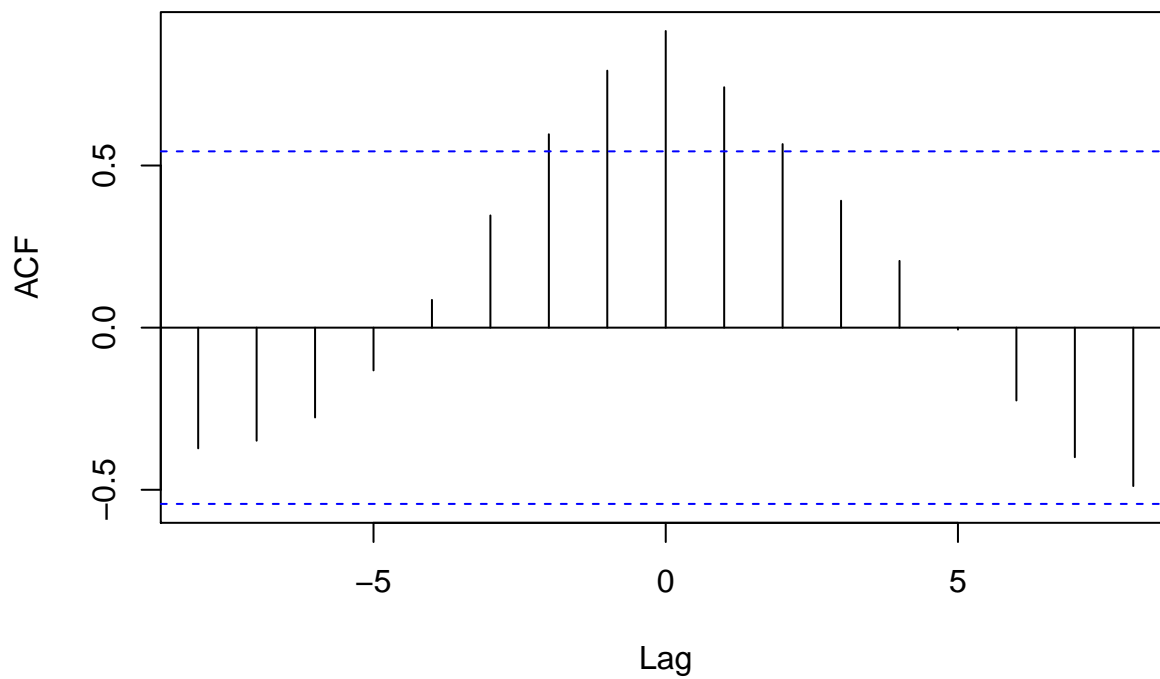
**3 wk ahead – 36**



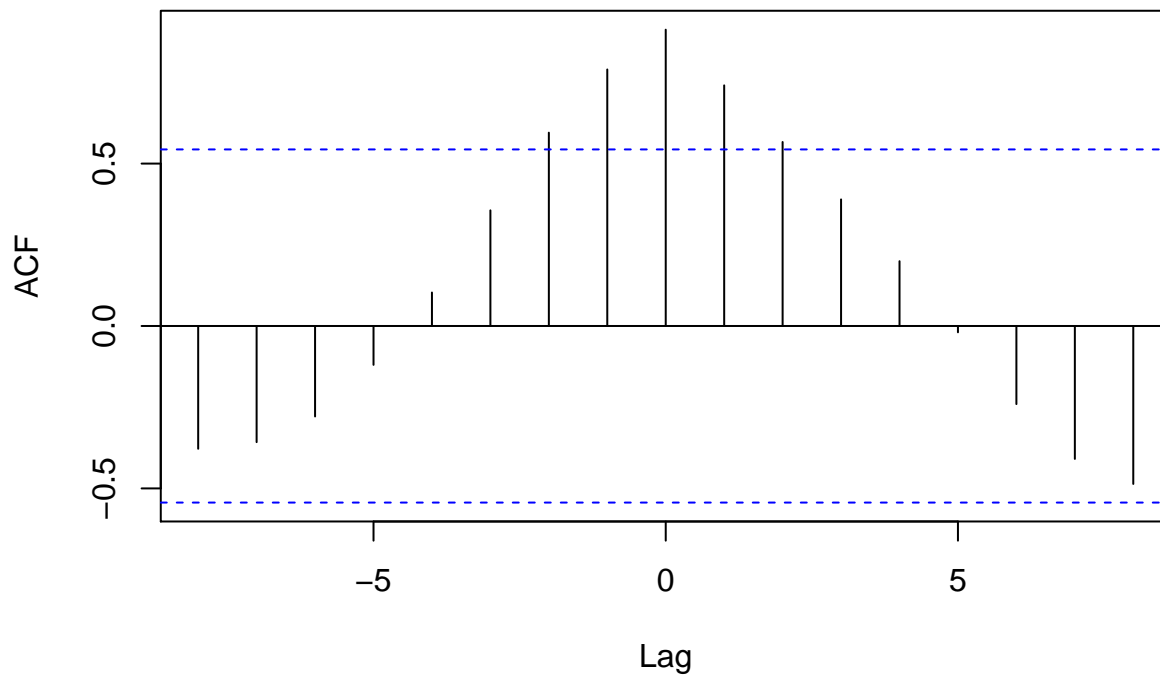
## 4 wk ahead – 36



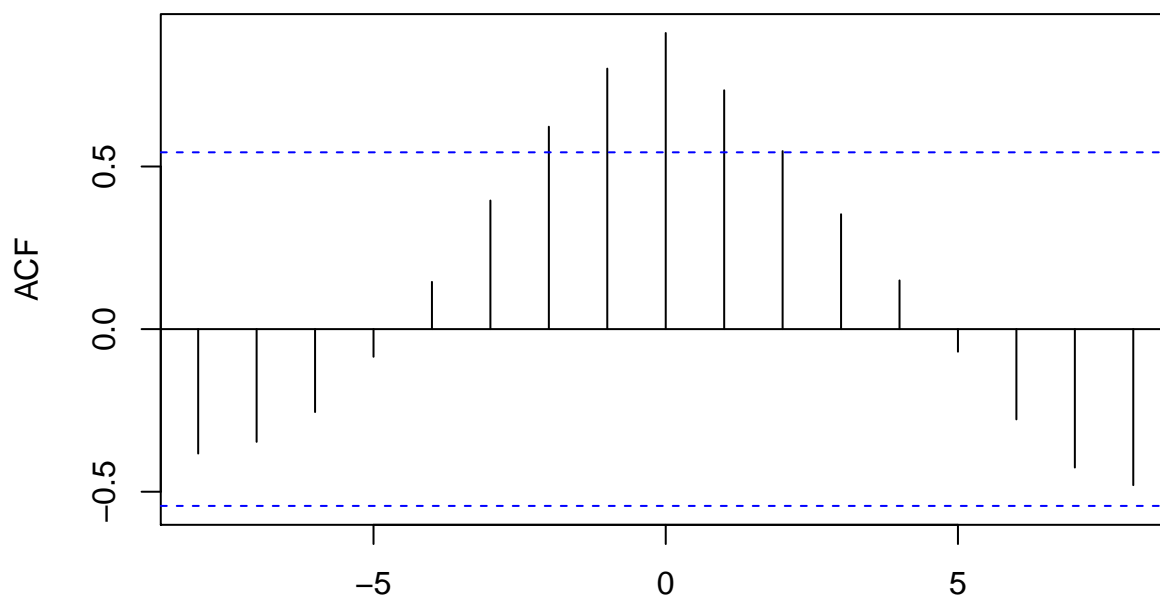
**1 wk ahead – 55**



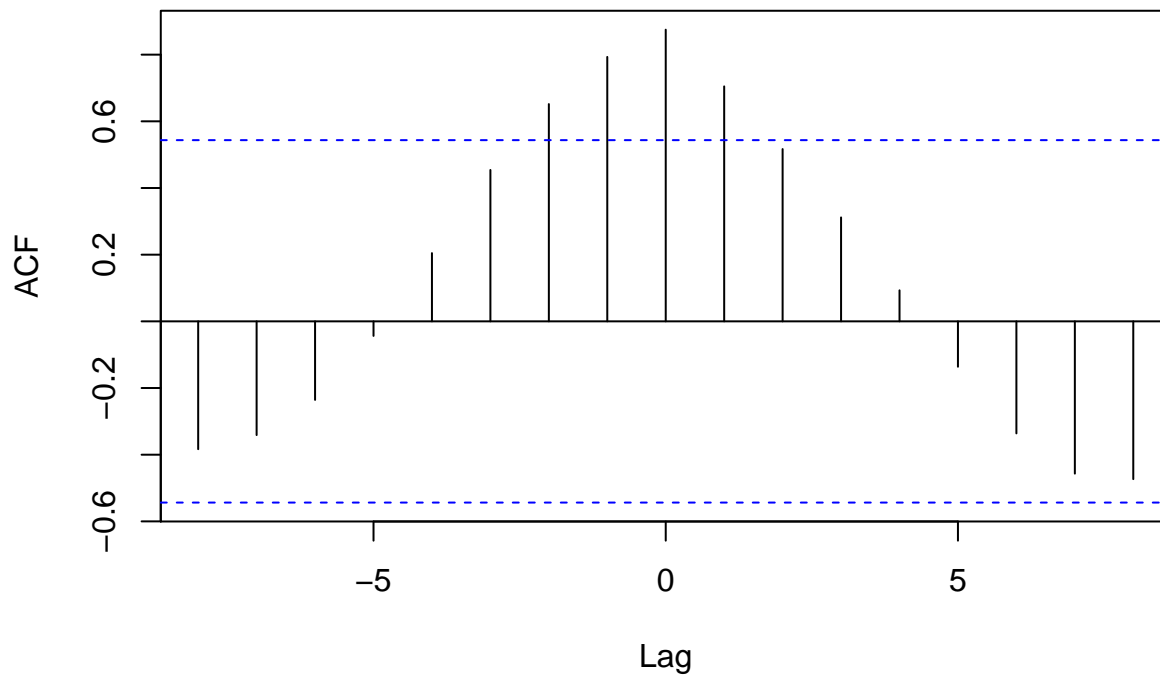
**2 wk ahead – 55**

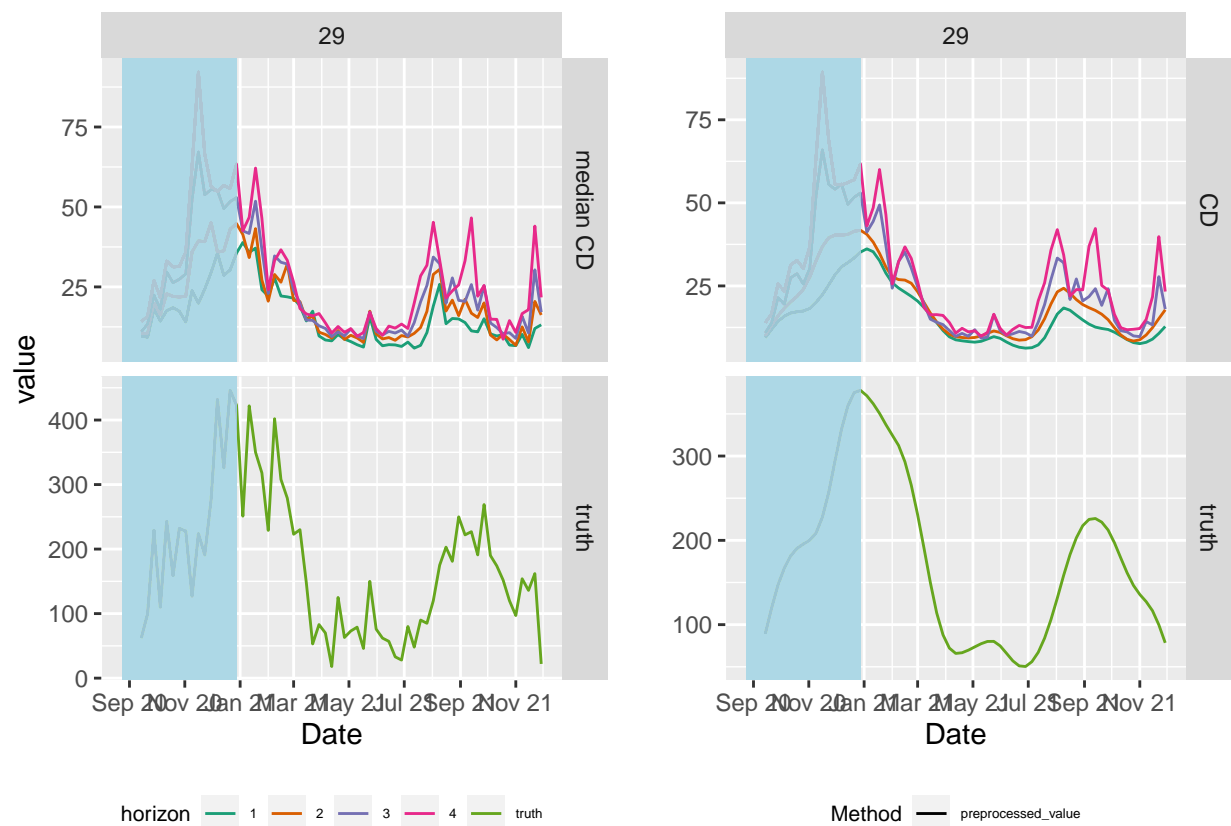


**3 wk ahead – 55**

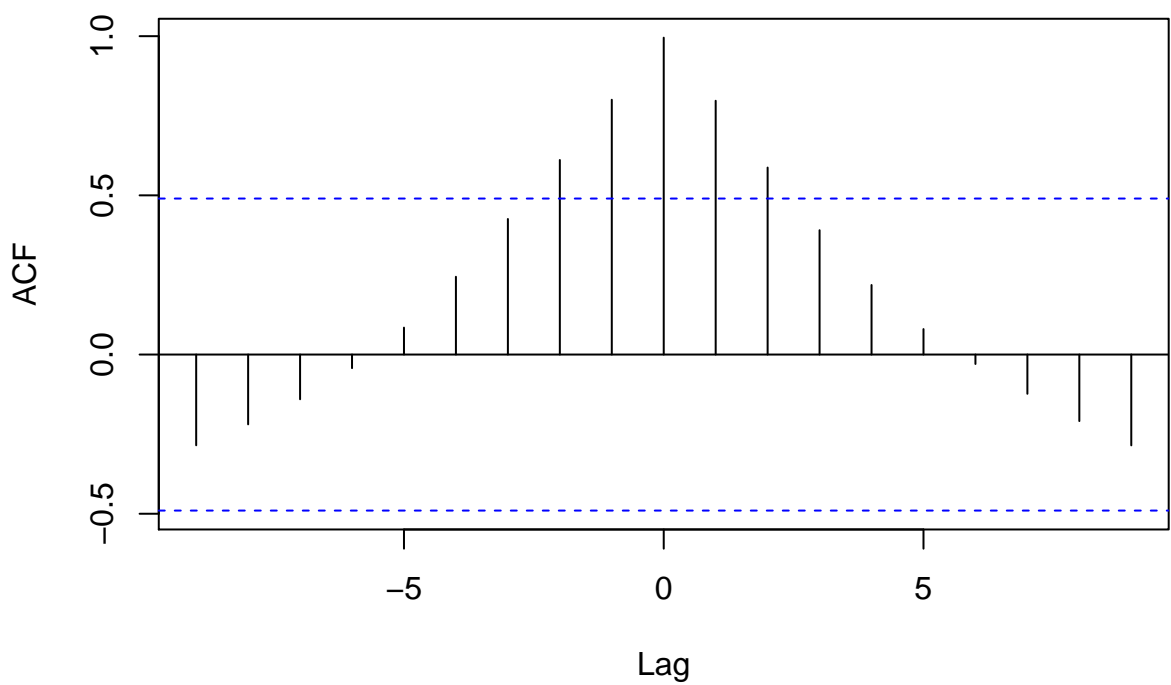


**4 wk ahead – 55**

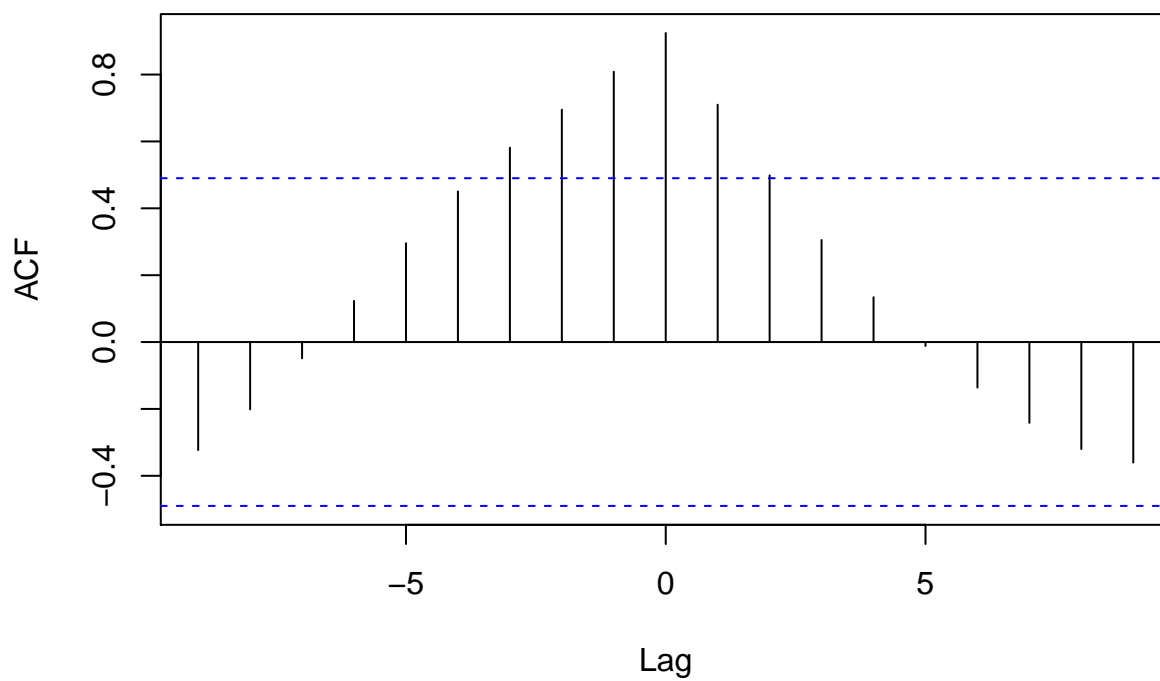




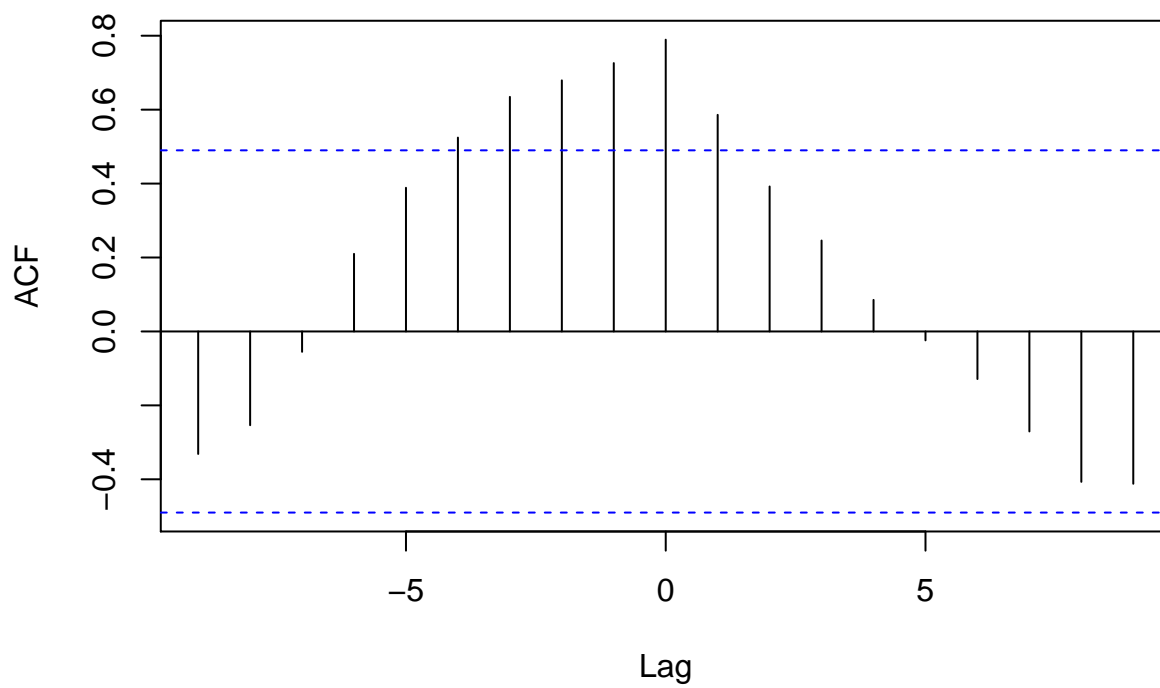
**1 wk ahead – 29**



**2 wk ahead – 29**

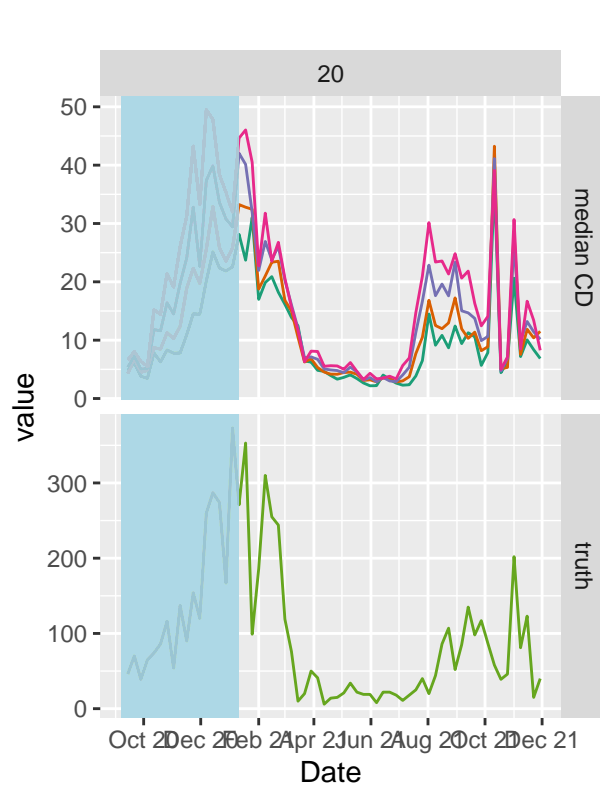
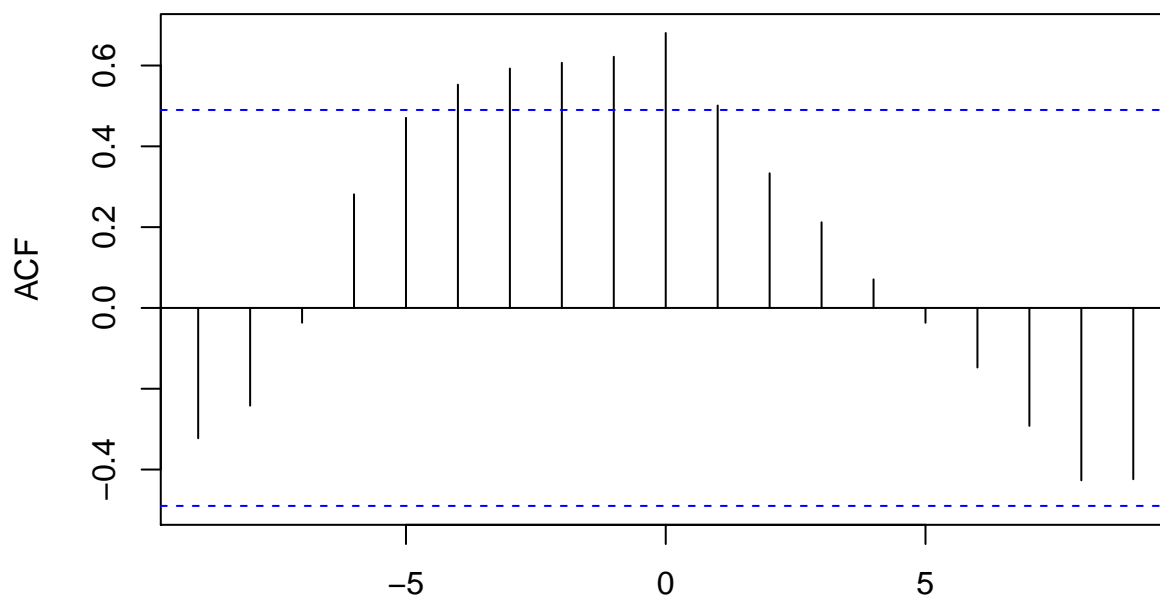


**3 wk ahead – 29**

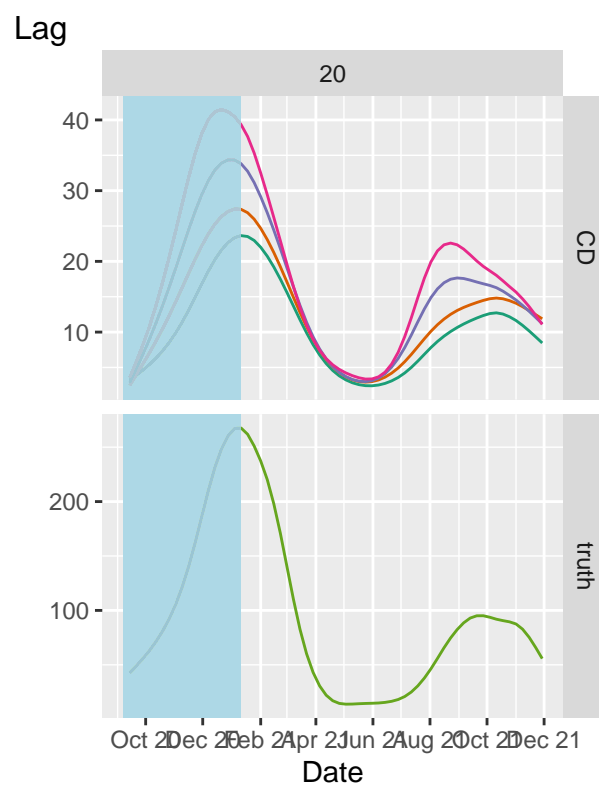




## 4 wk ahead – 29

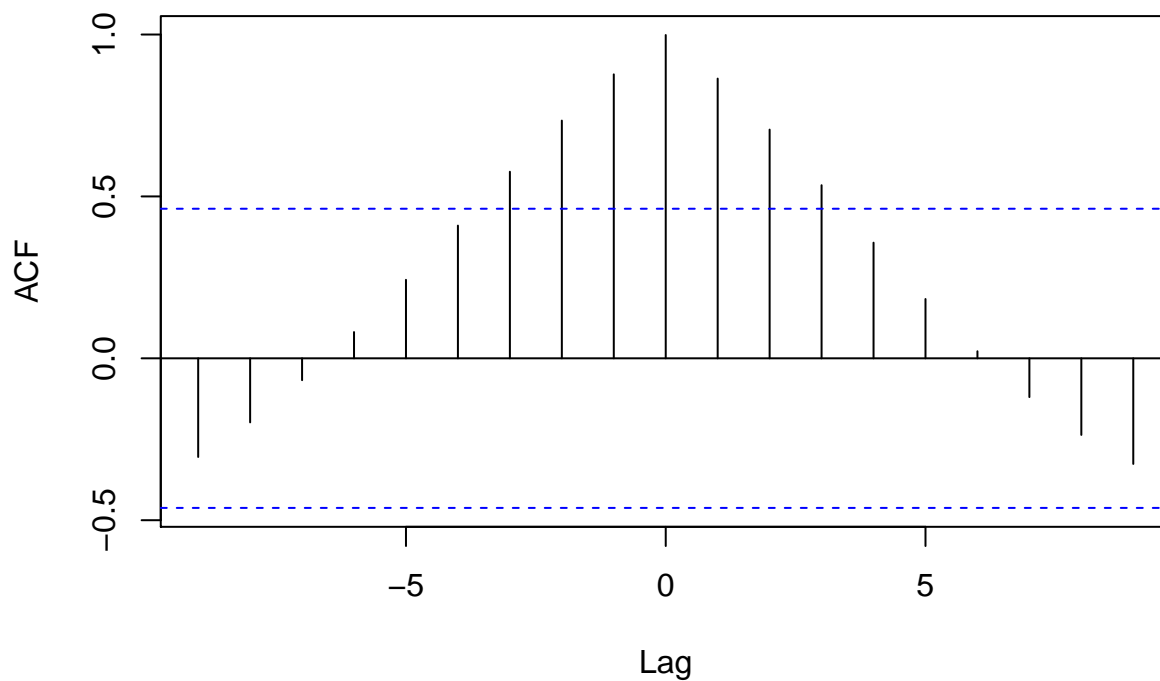


horizon 1 2 3 4 truth

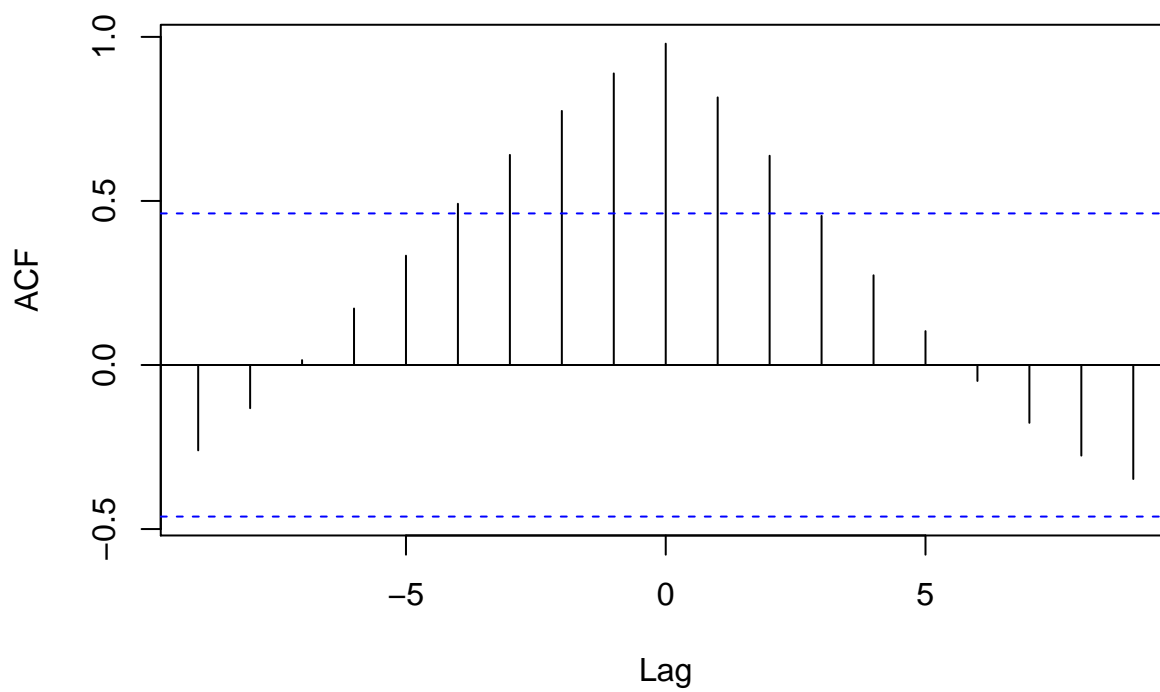


Method preprocessed\_value

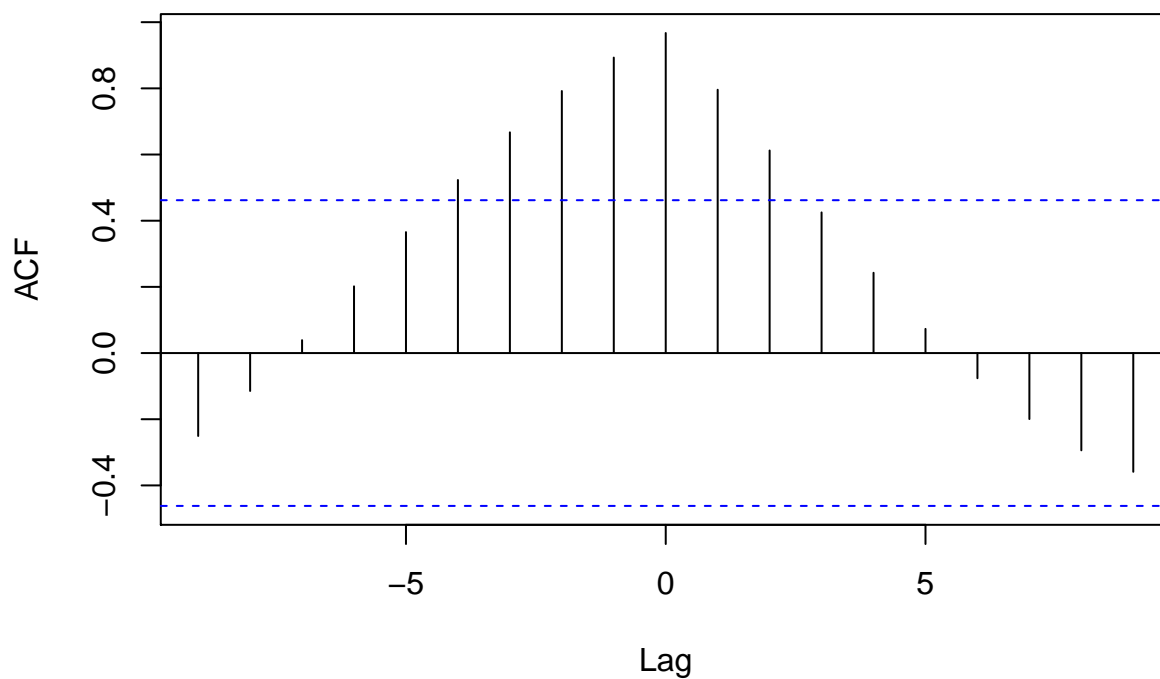
**1 wk ahead – 20**



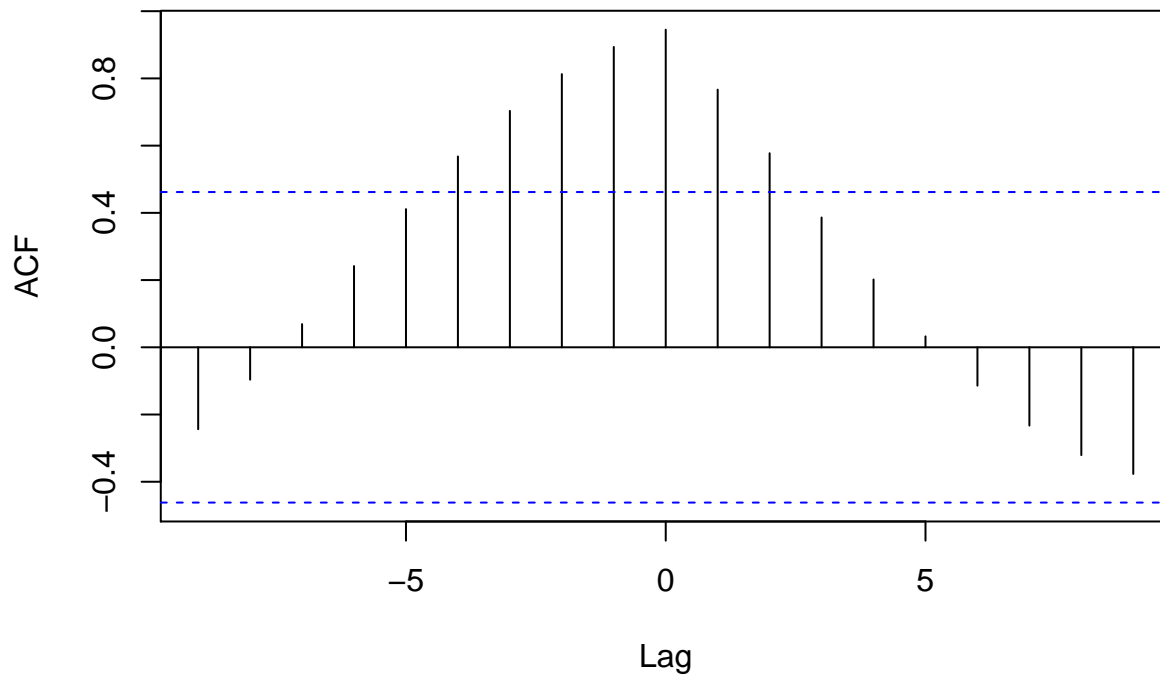
**2 wk ahead – 20**

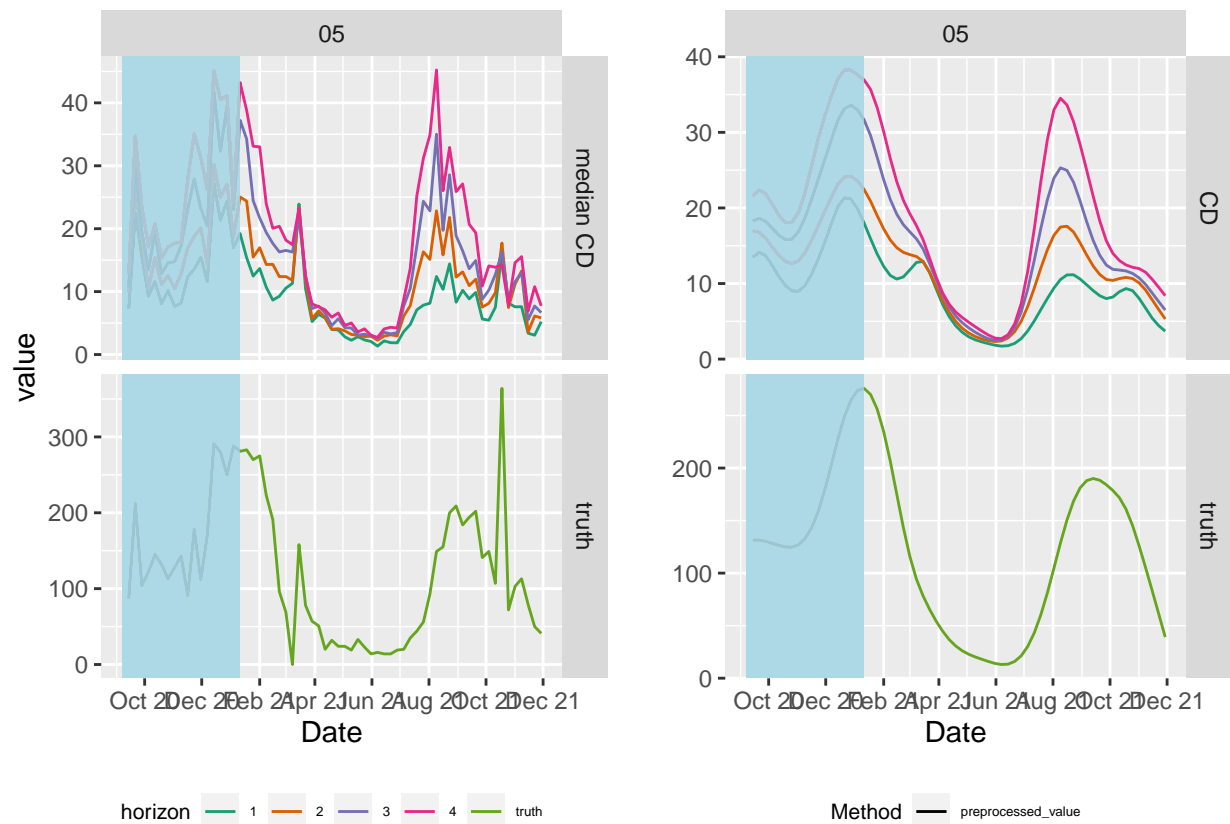


**3 wk ahead – 20**

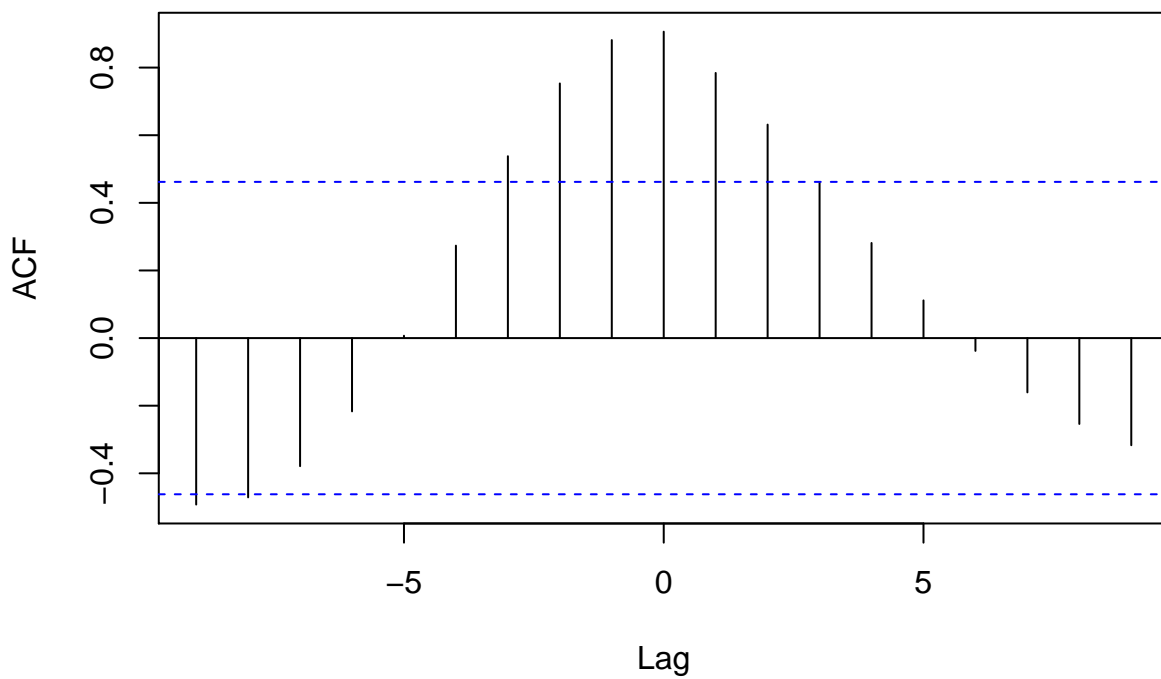


**4 wk ahead – 20**

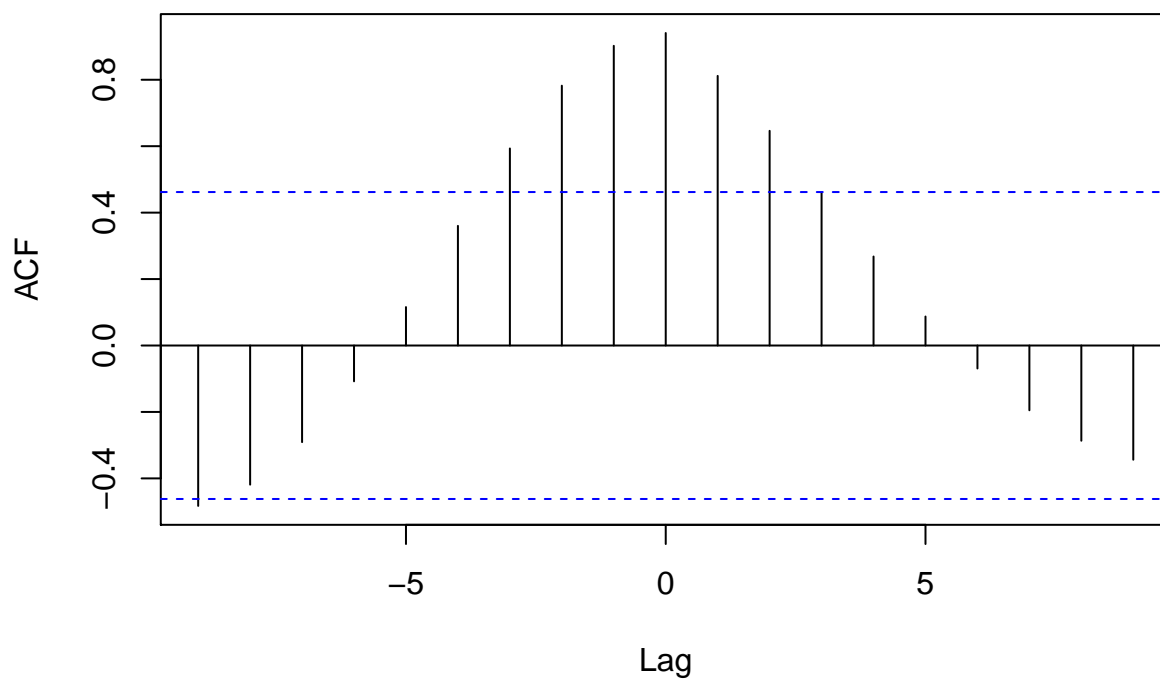




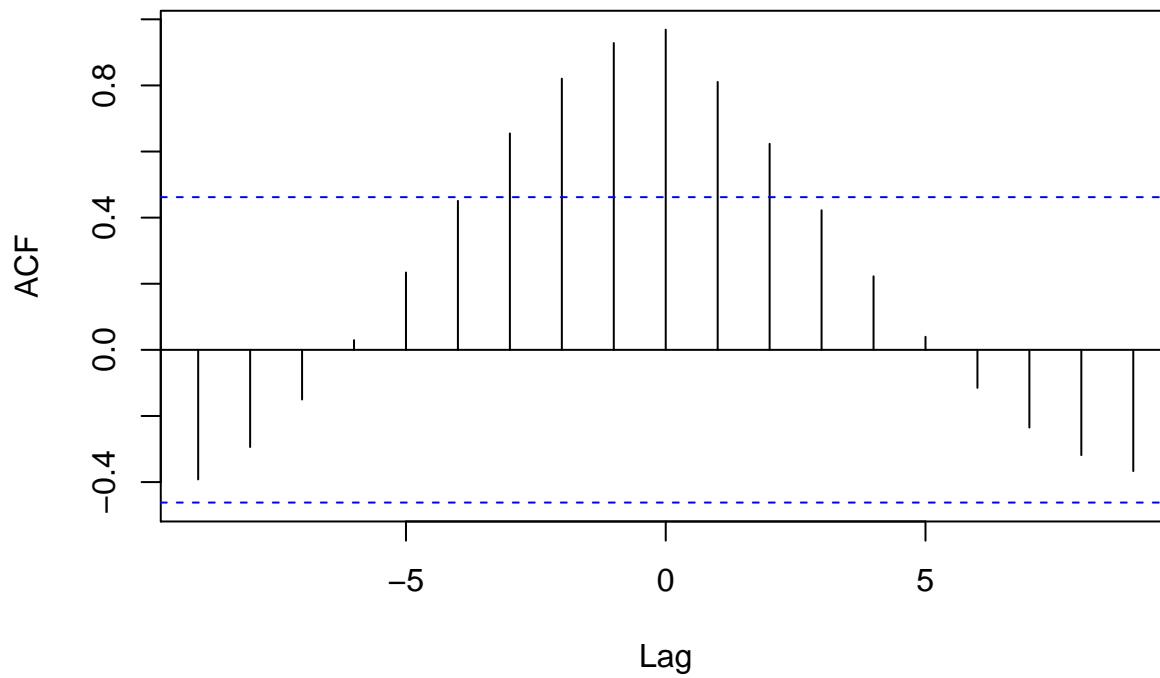
### 1 wk ahead – 05



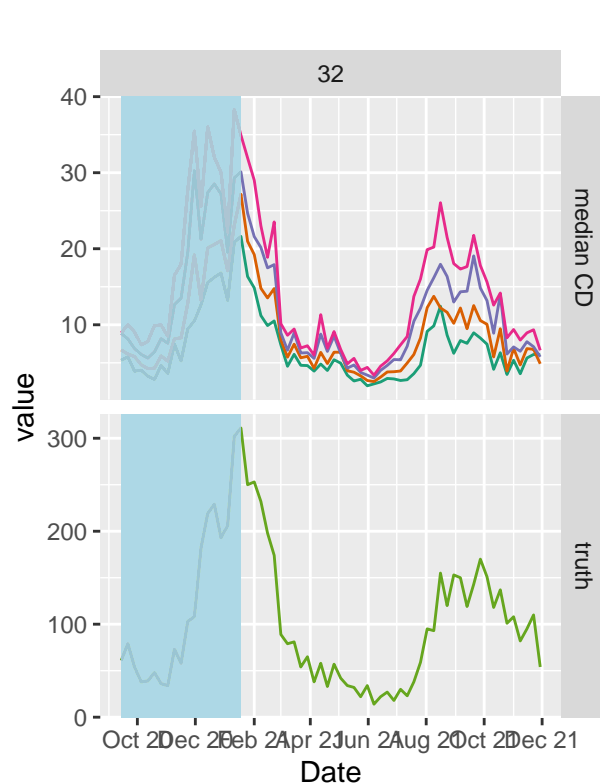
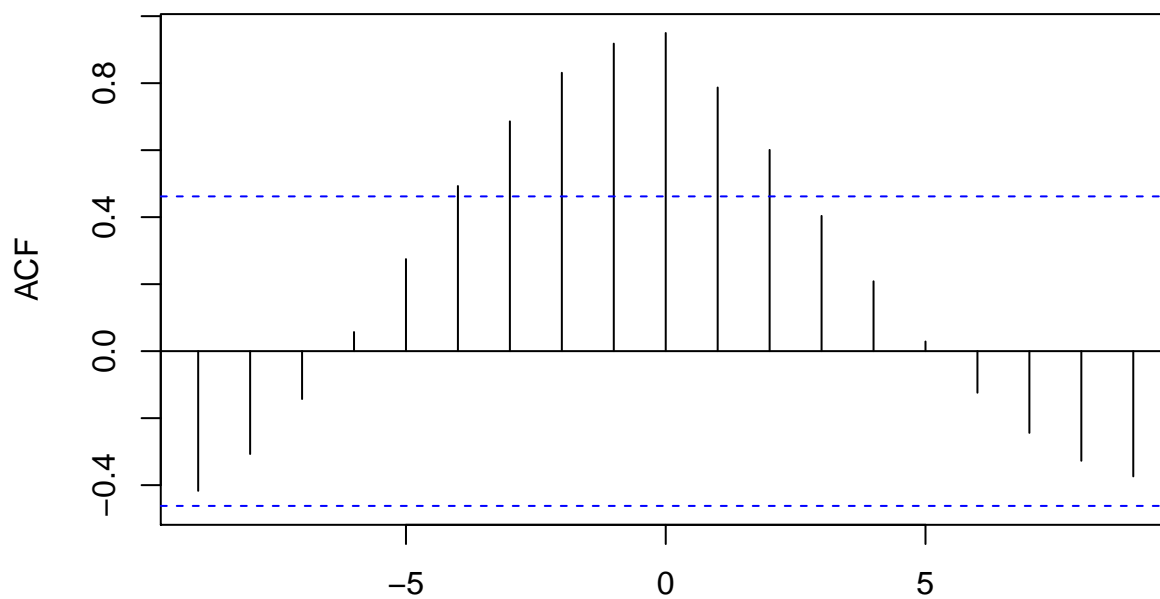
**2 wk ahead – 05**



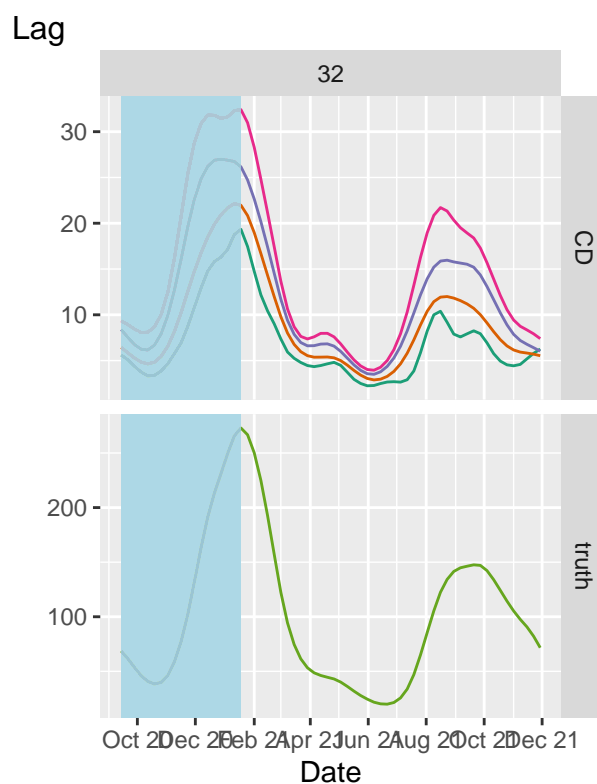
**3 wk ahead – 05**



## 4 wk ahead – 05

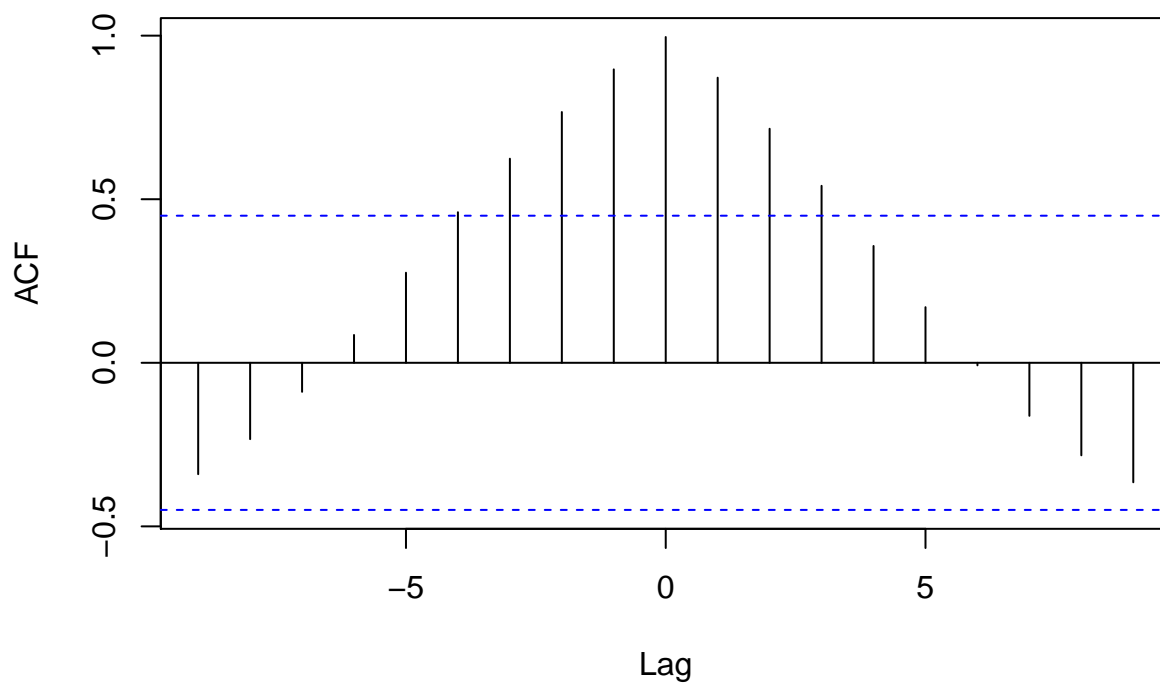


horizon 1 2 3 4 truth

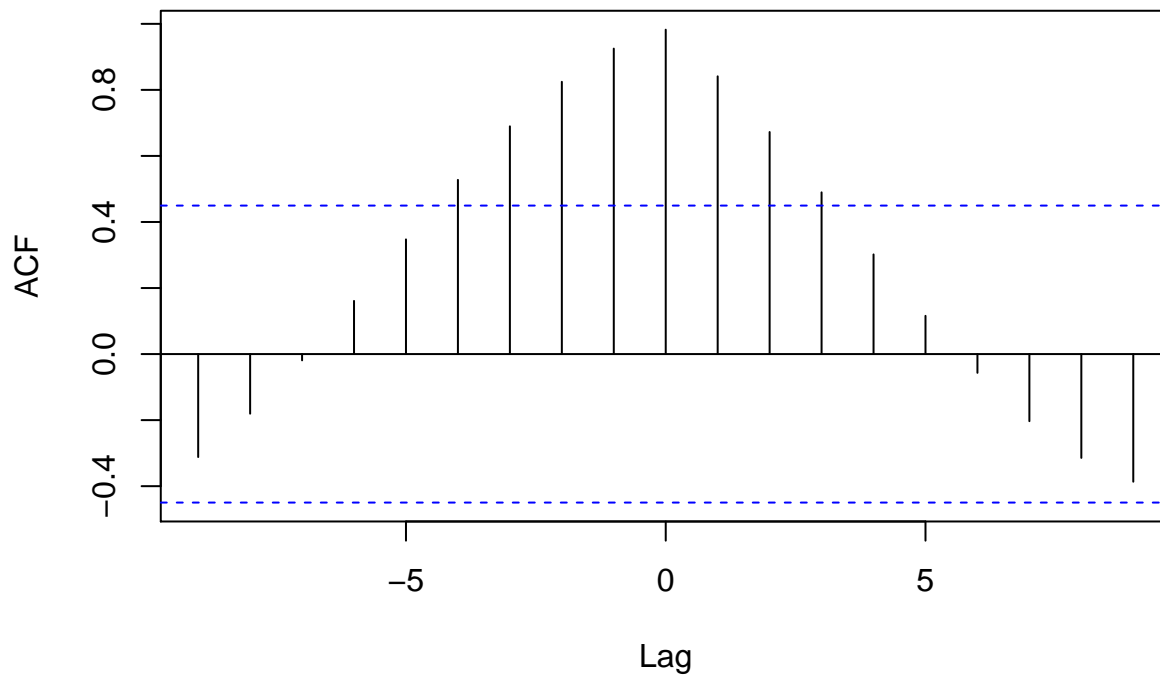


Method preprocessed\_value

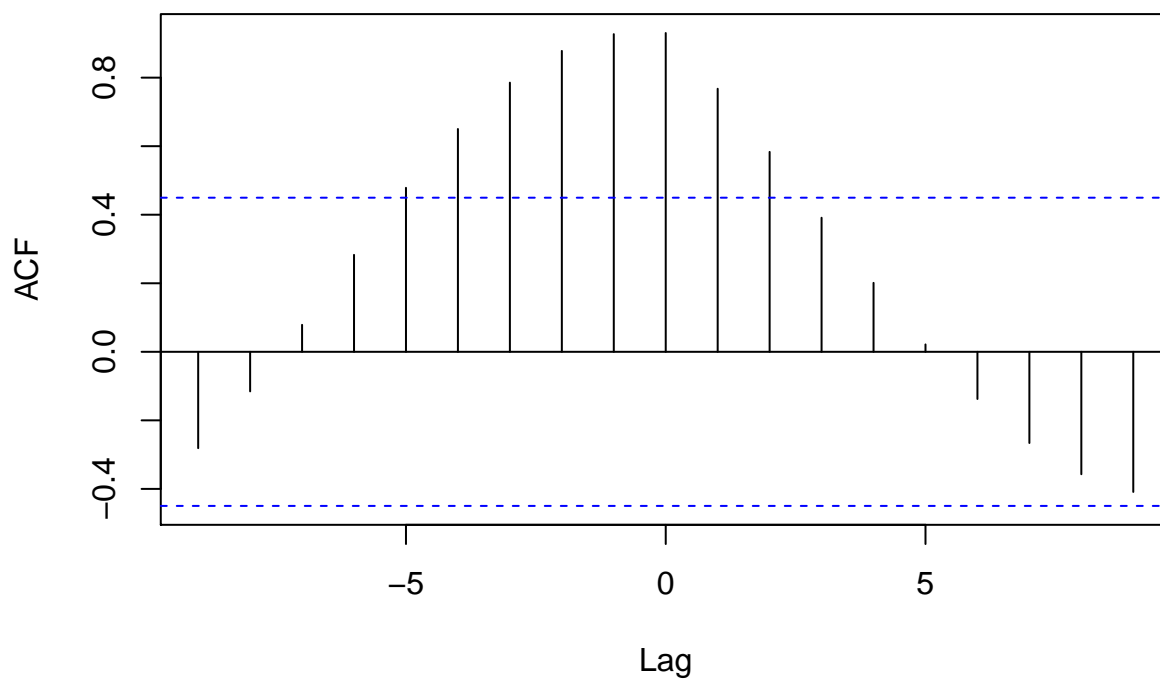
**1 wk ahead – 32**



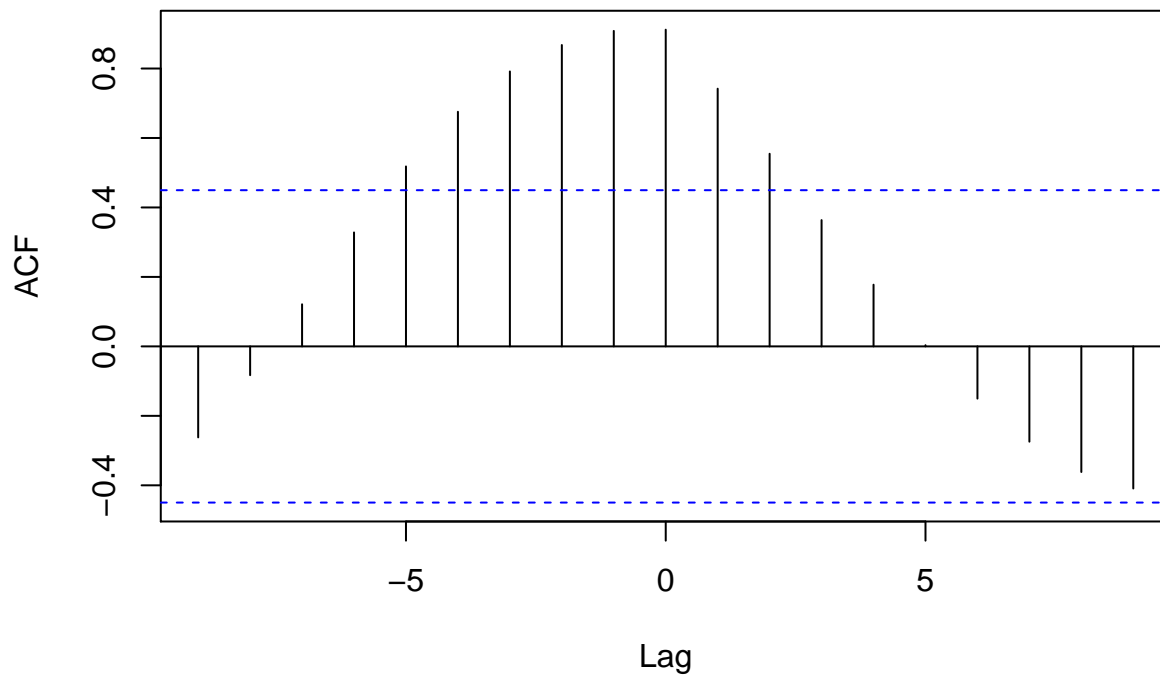
**2 wk ahead – 32**



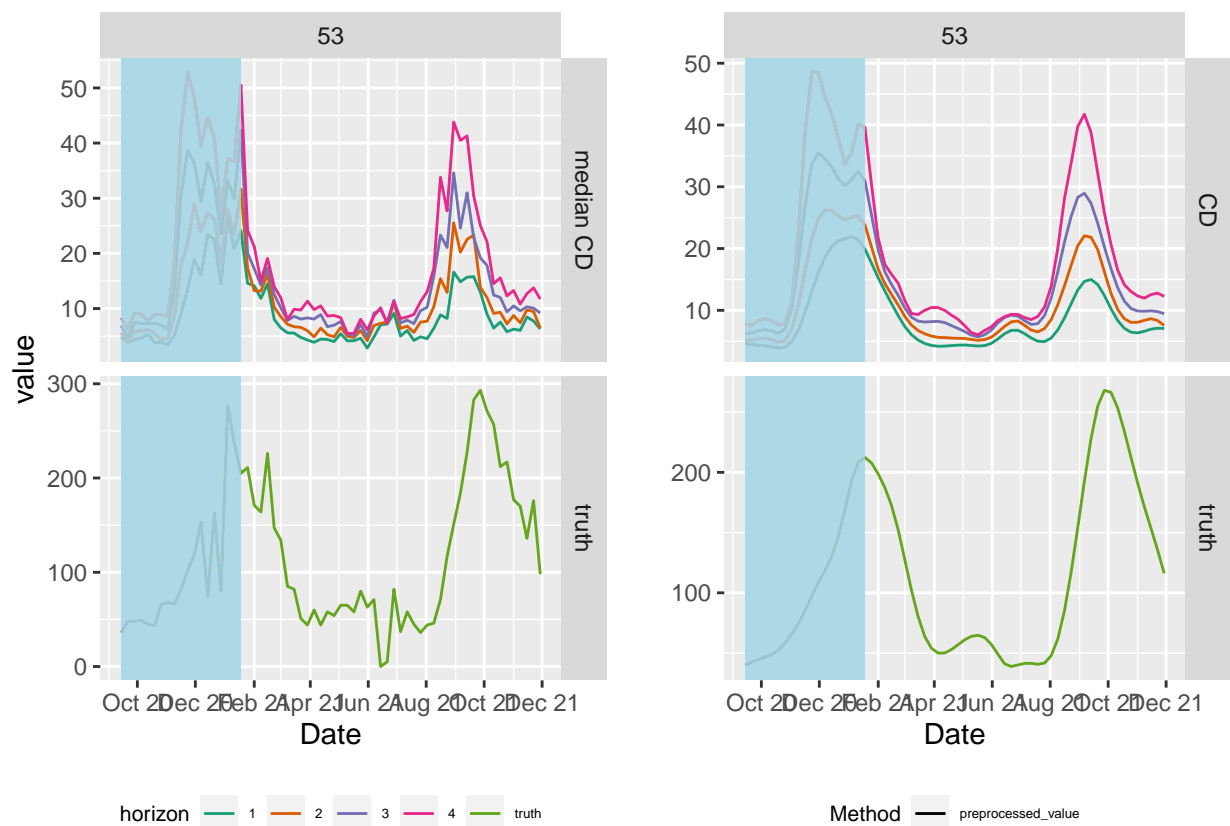
**3 wk ahead – 32**



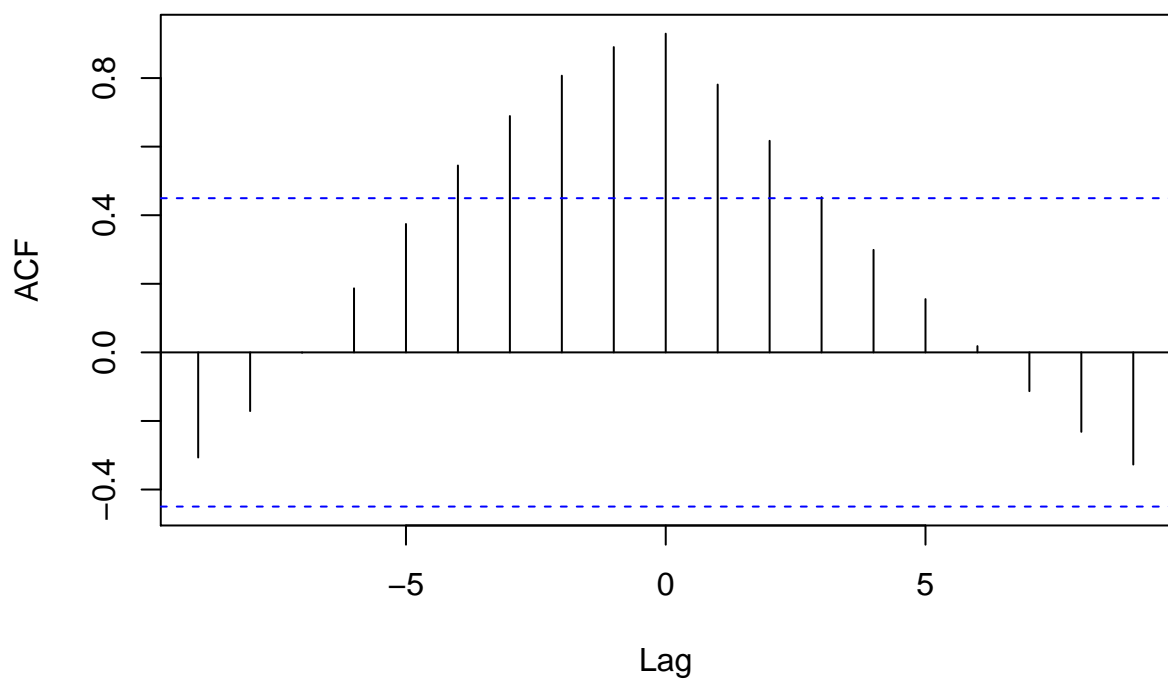
**4 wk ahead – 32**



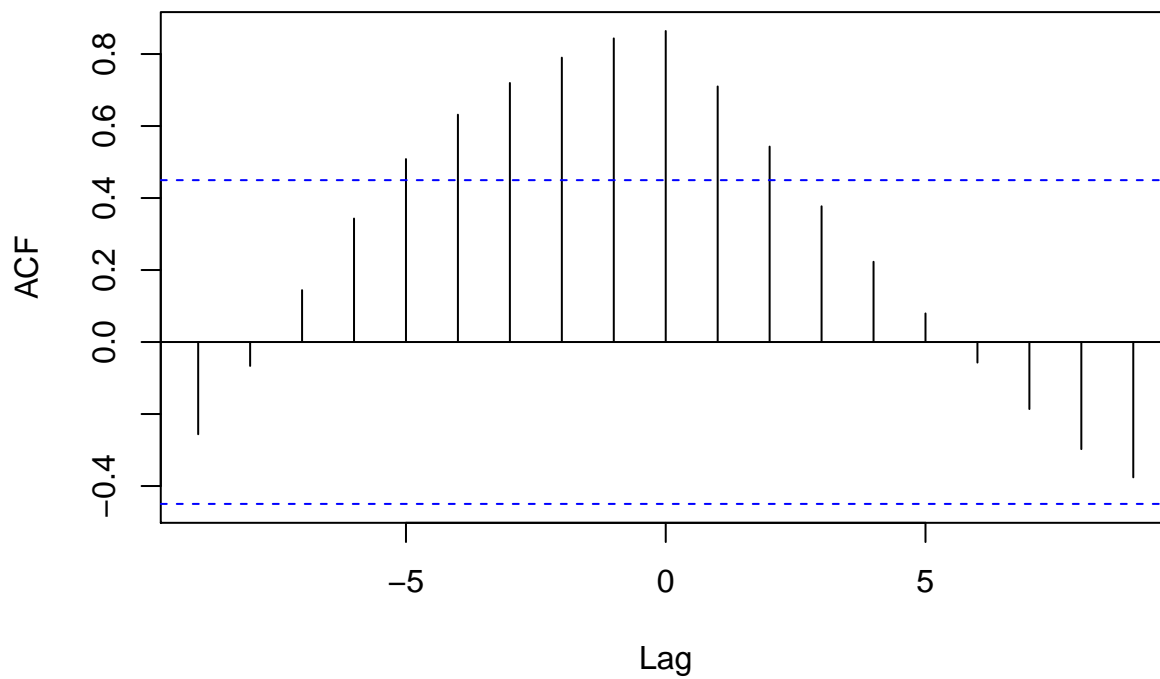




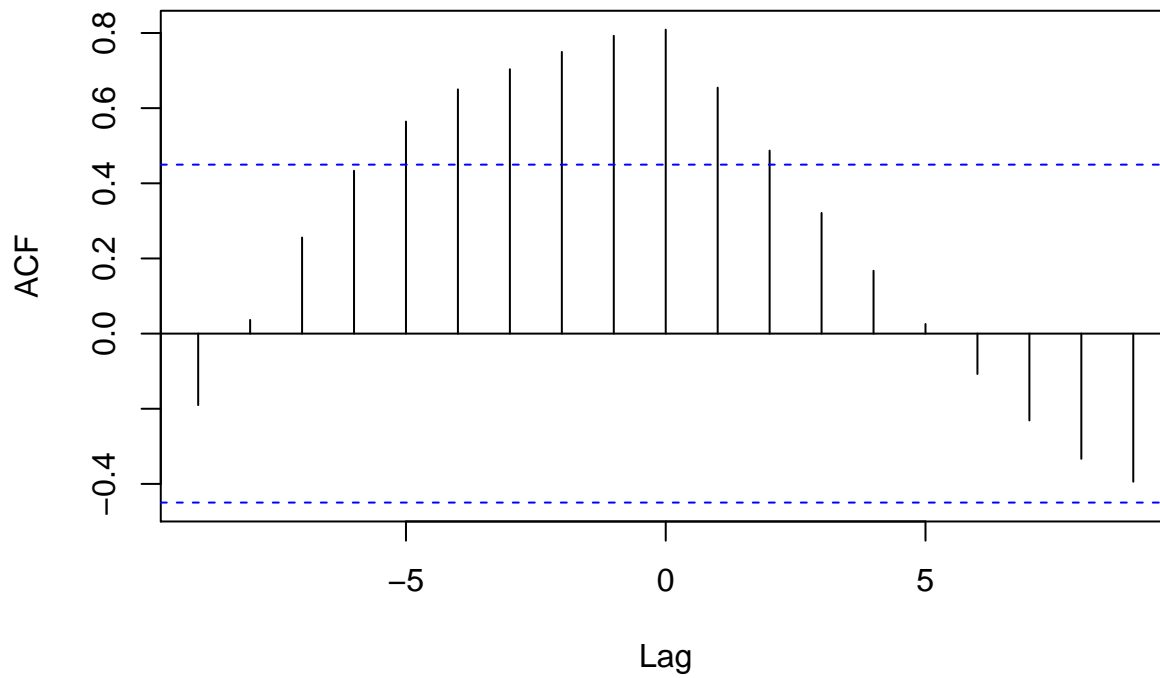
**1 wk ahead – 53**



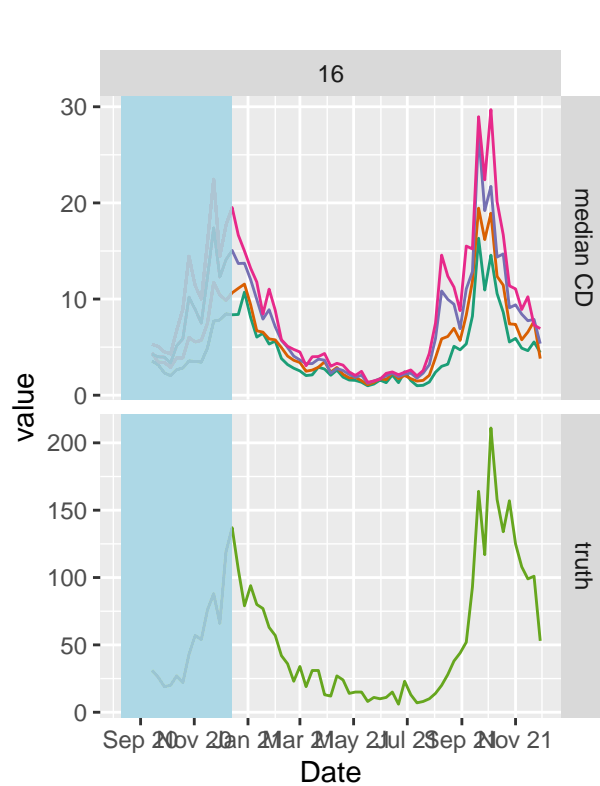
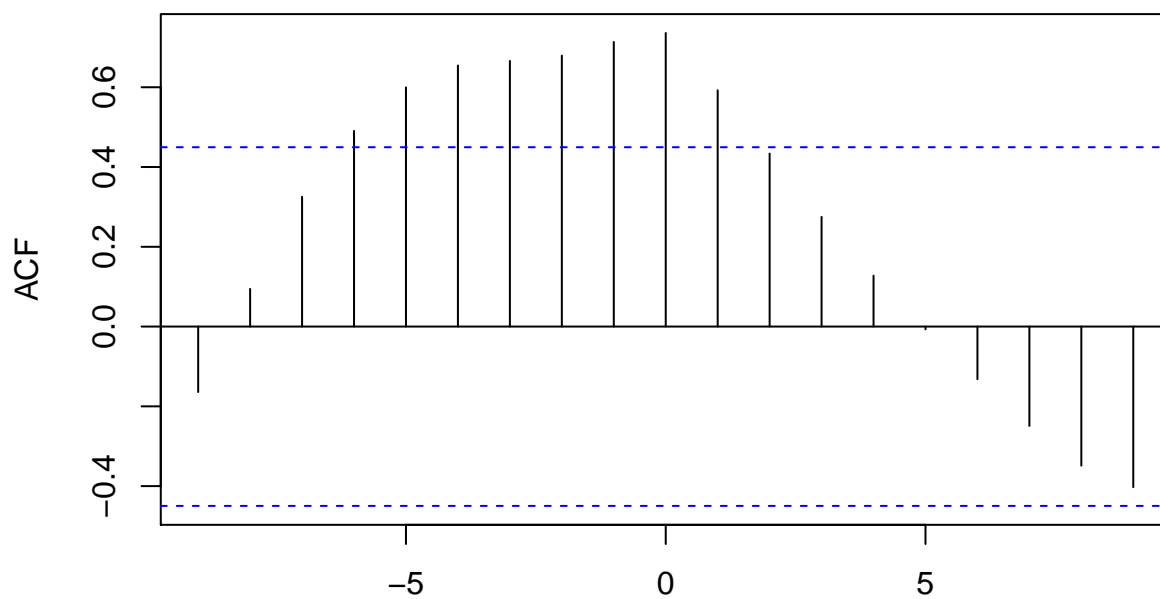
**2 wk ahead – 53**



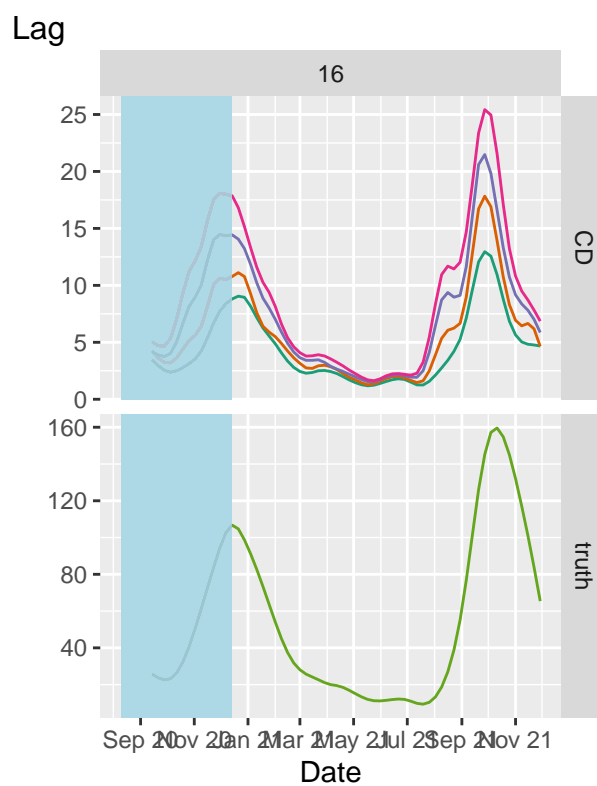
**3 wk ahead – 53**



## 4 wk ahead – 53

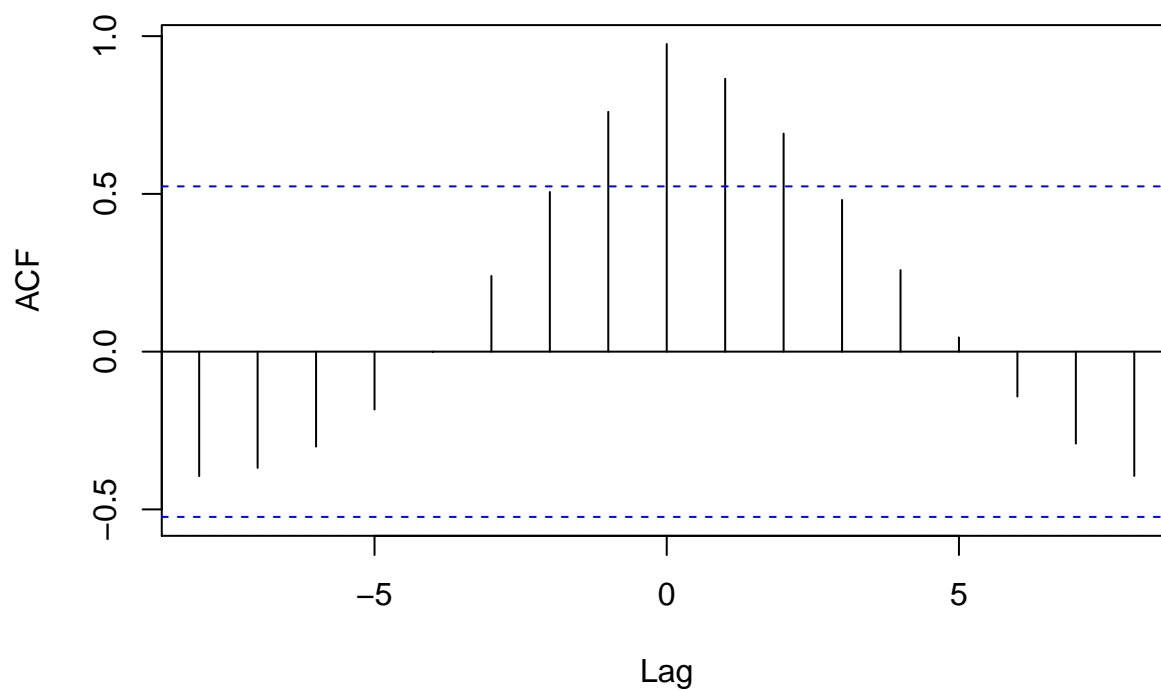


horizon 1 2 3 4 truth

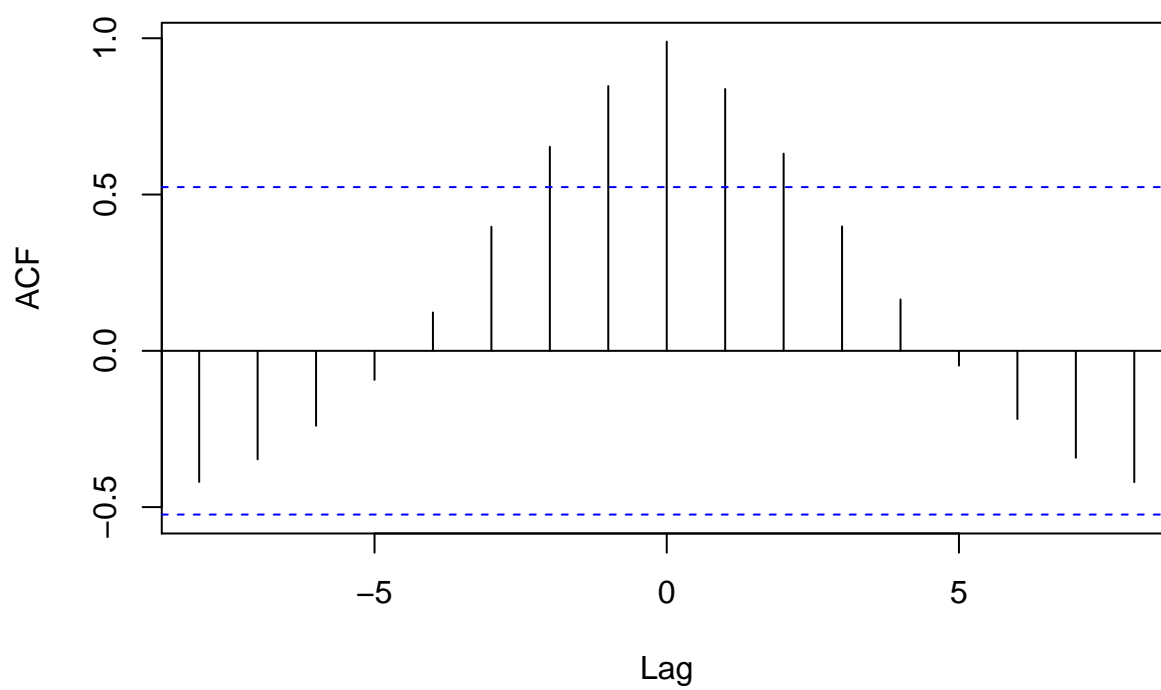


Method preprocessed\_value

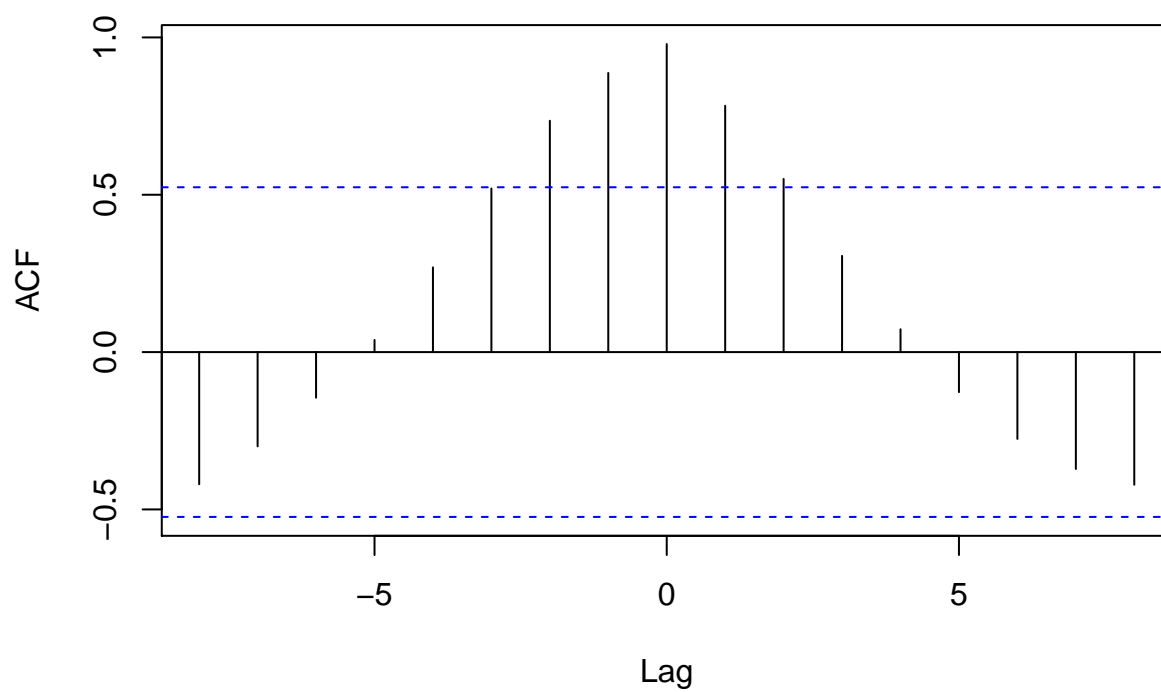
**1 wk ahead – 16**



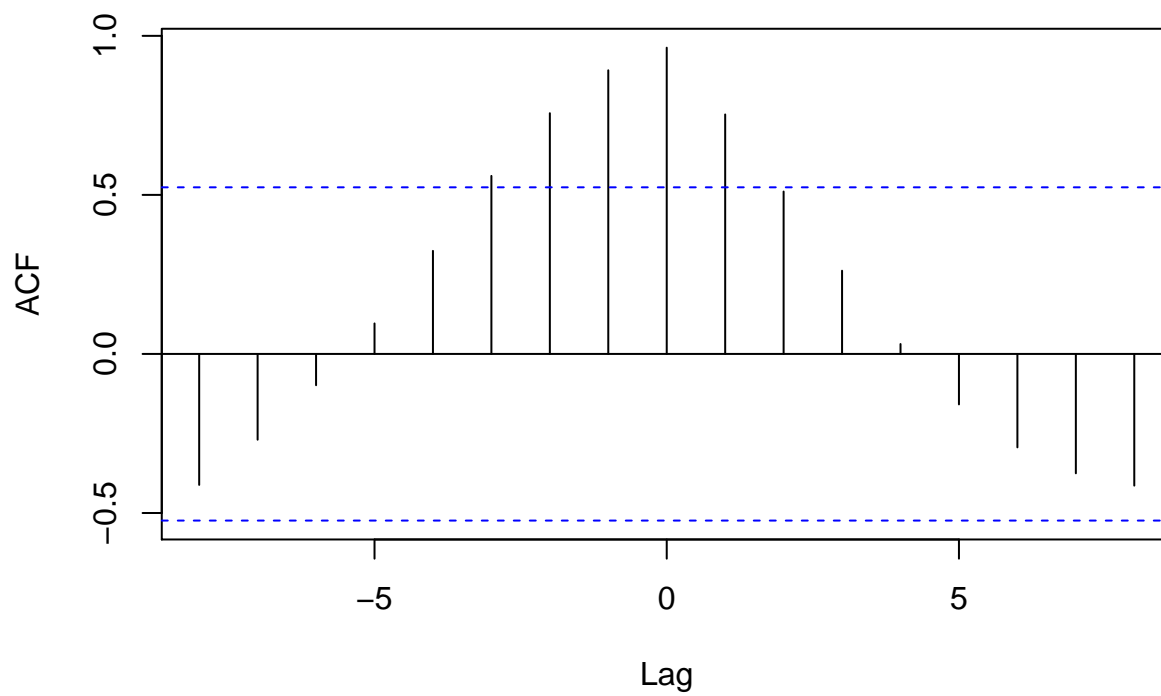
**2 wk ahead – 16**

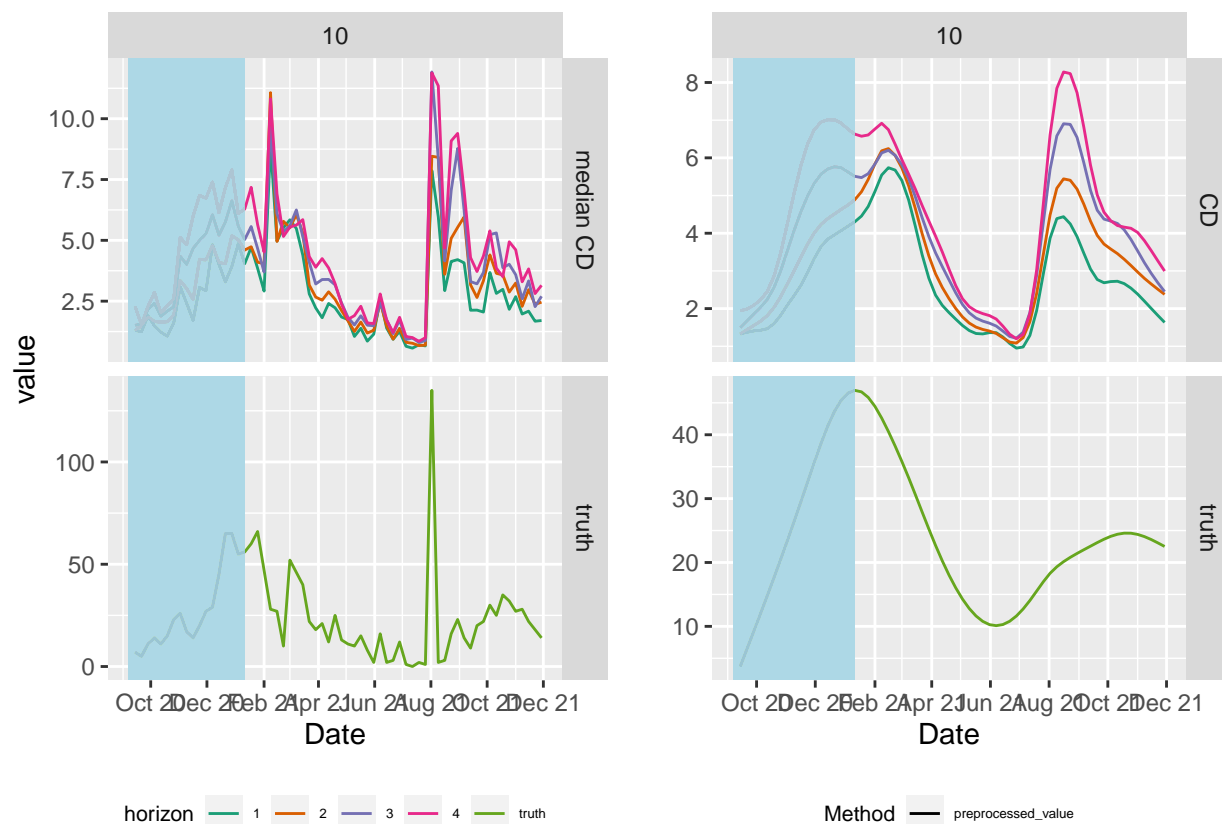


**3 wk ahead – 16**

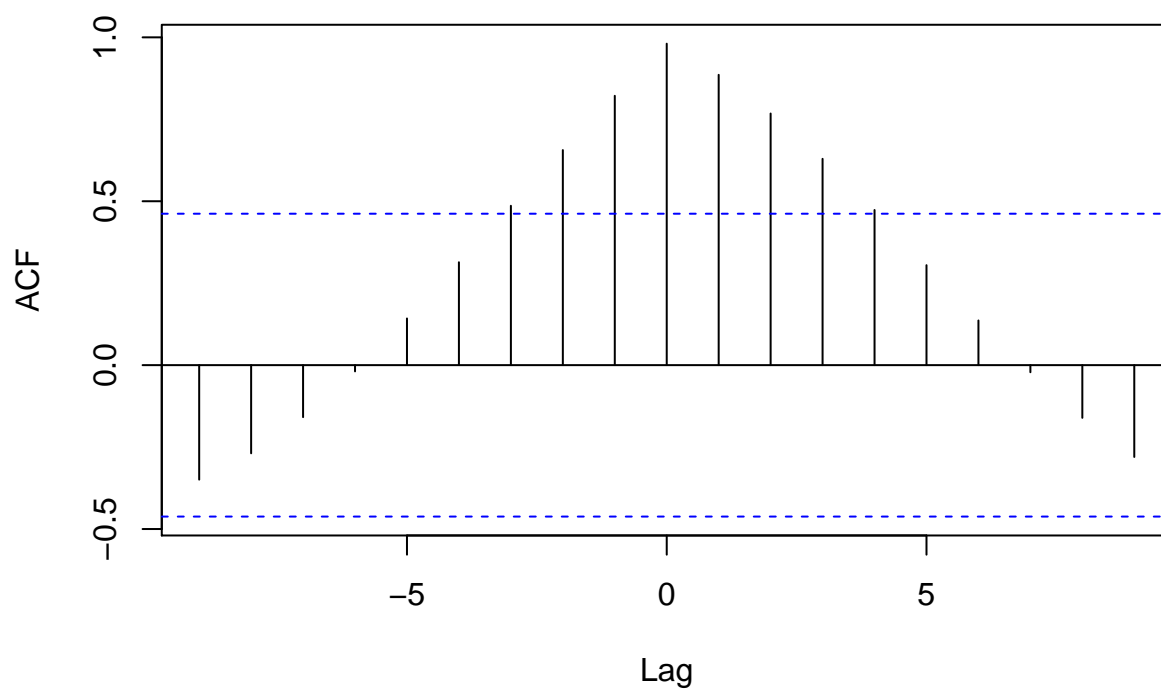


**4 wk ahead – 16**

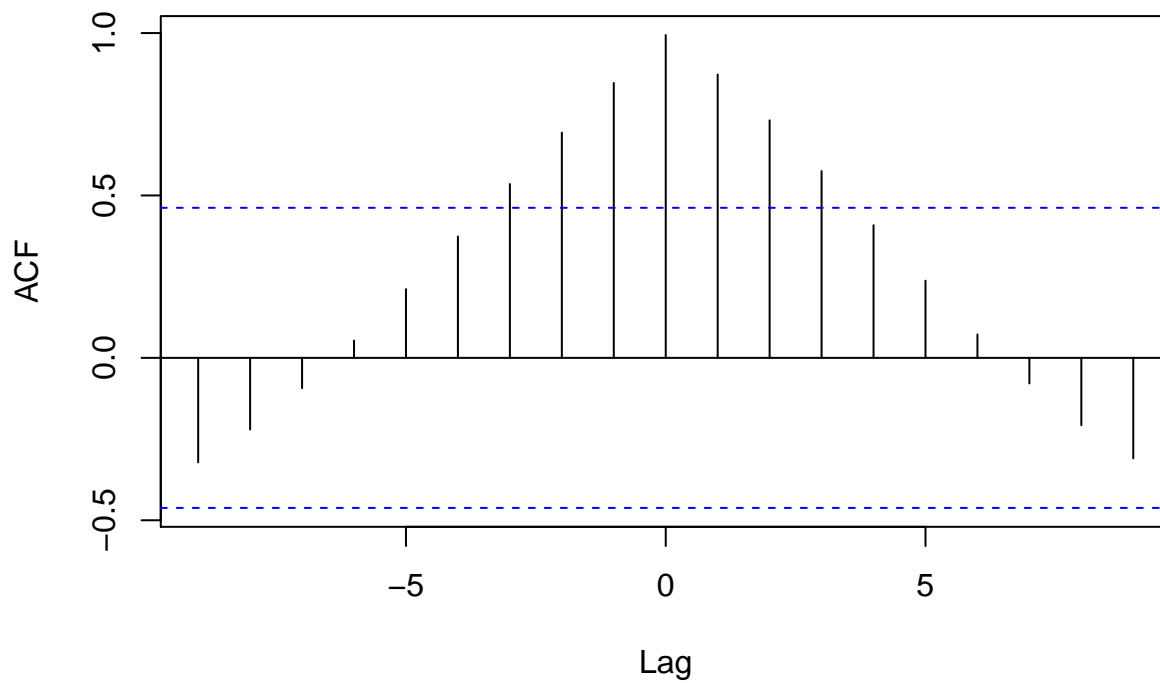




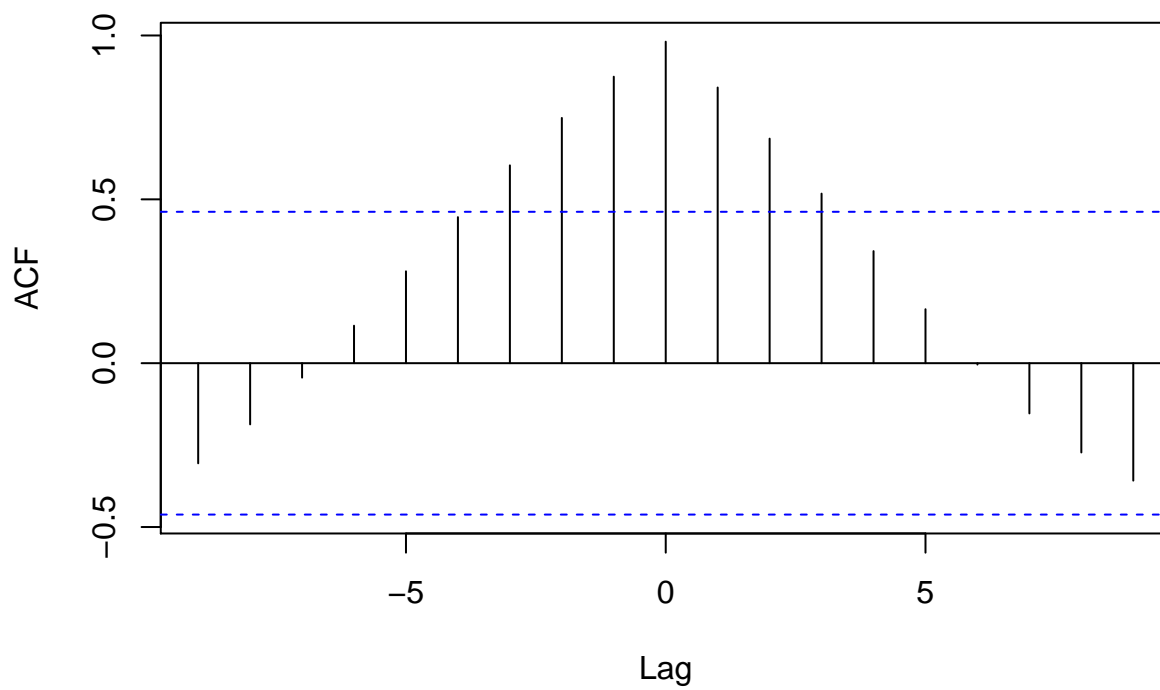
**1 wk ahead – 10**



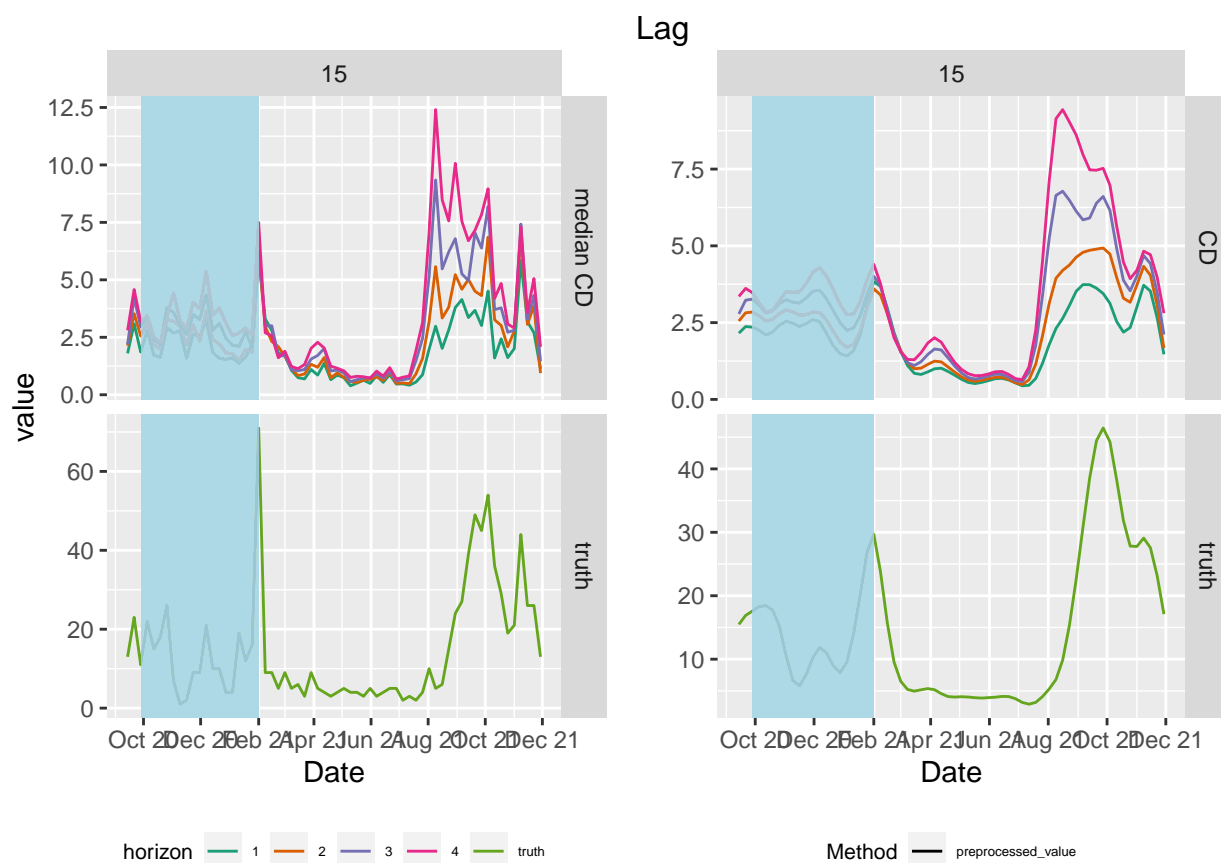
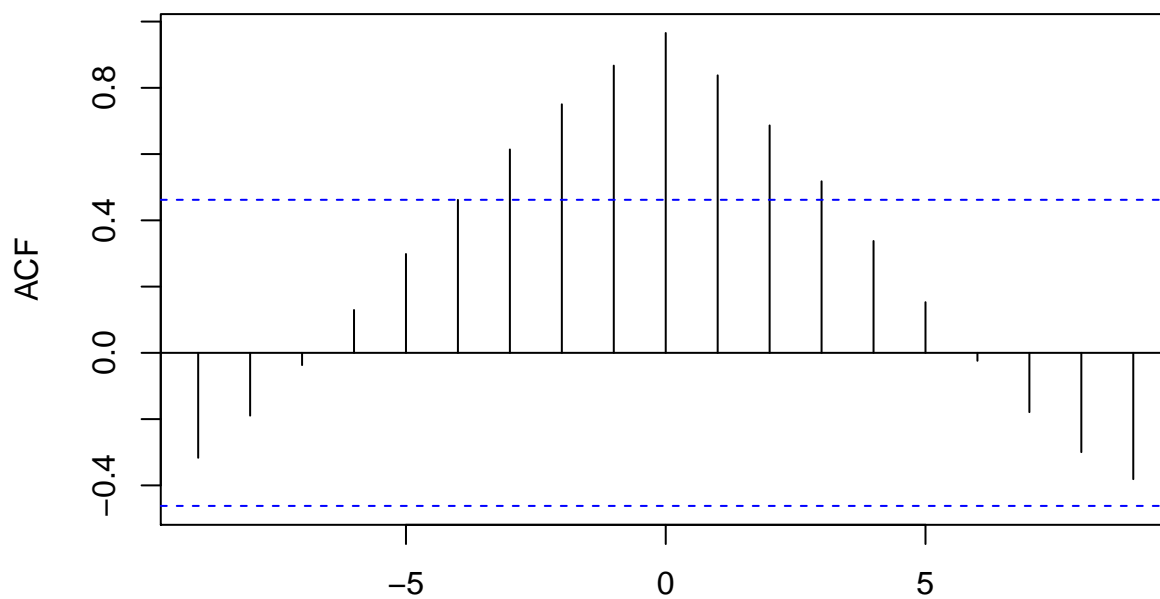
**2 wk ahead – 10**



**3 wk ahead – 10**

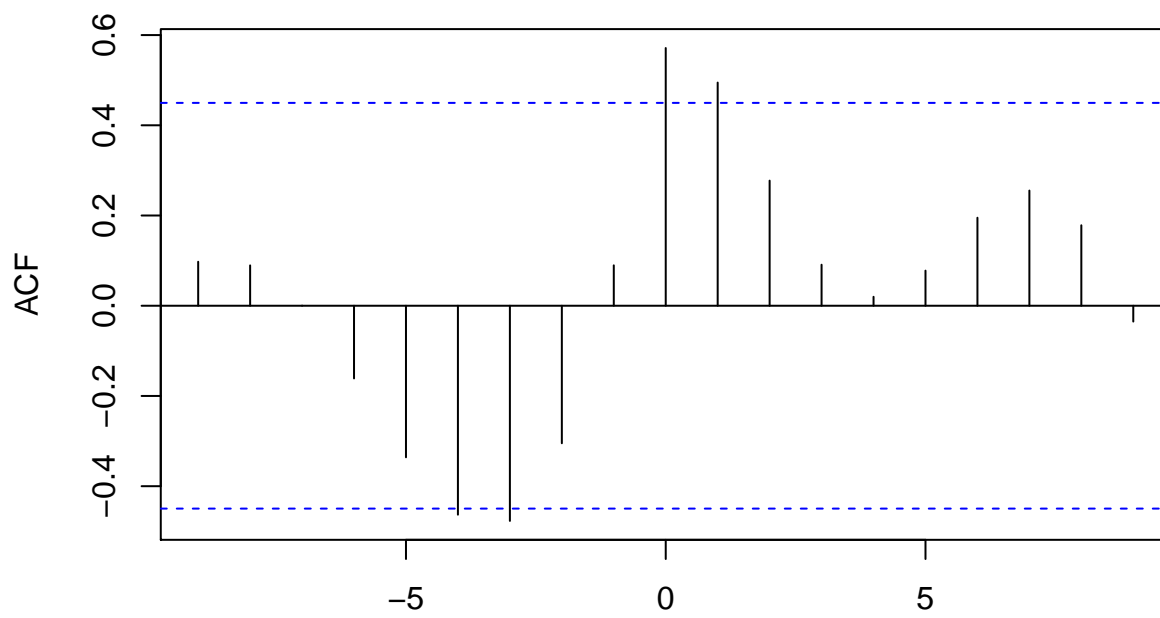


## 4 wk ahead – 10

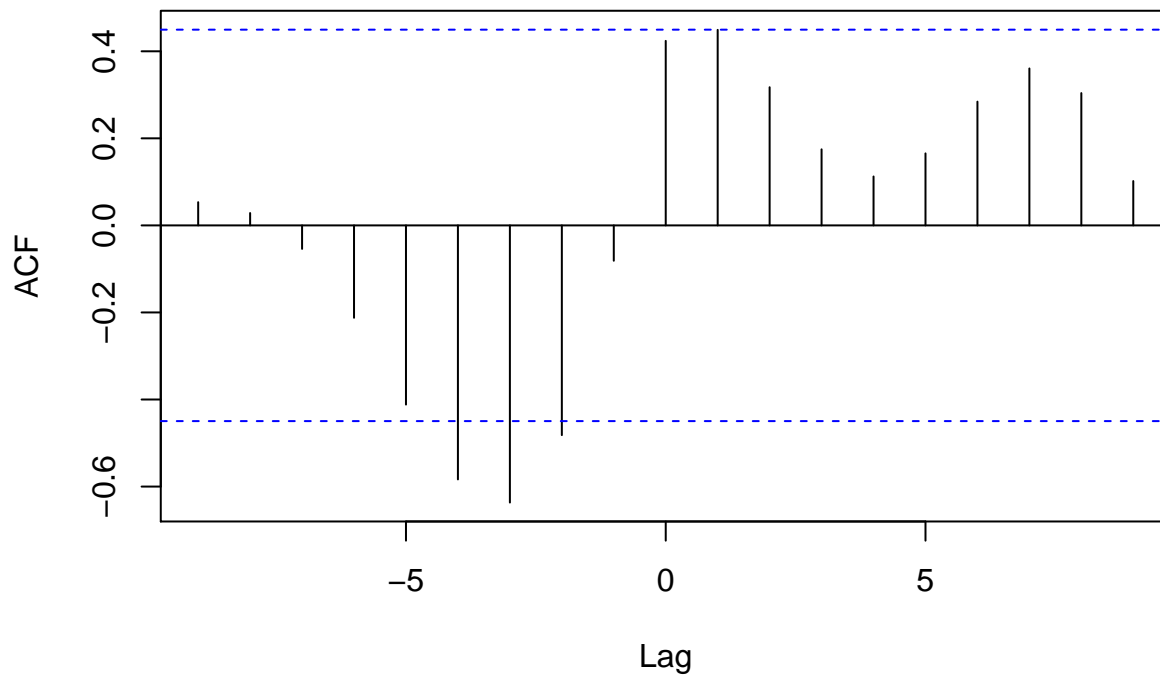




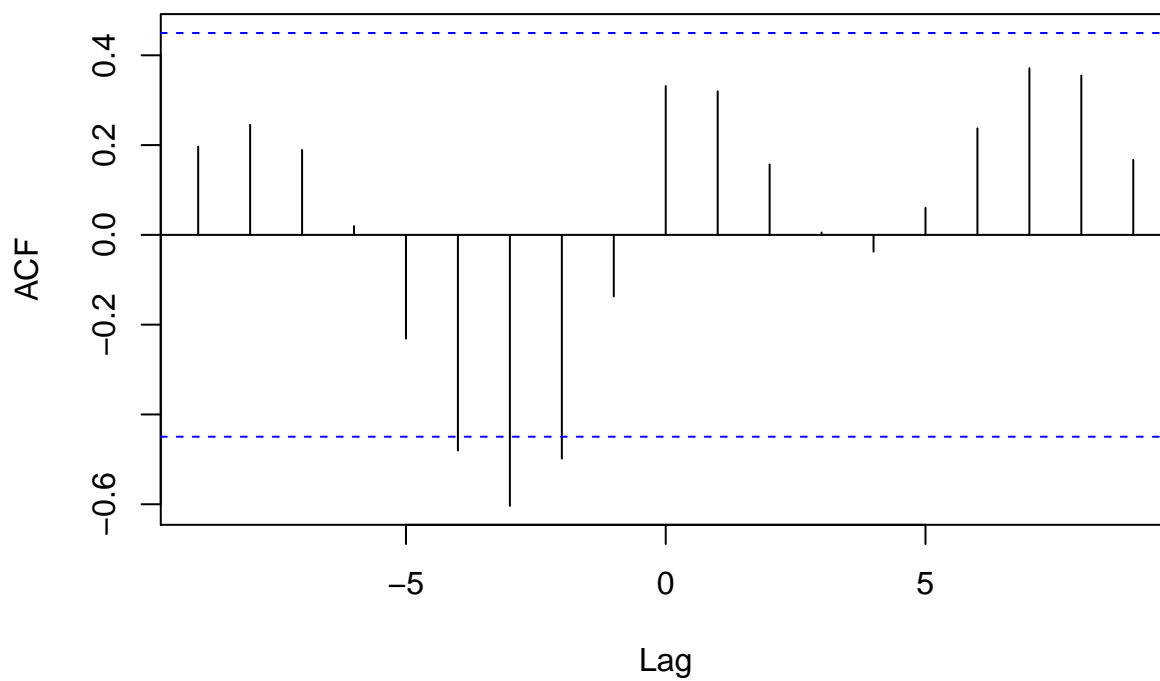
**1 wk ahead – 15**



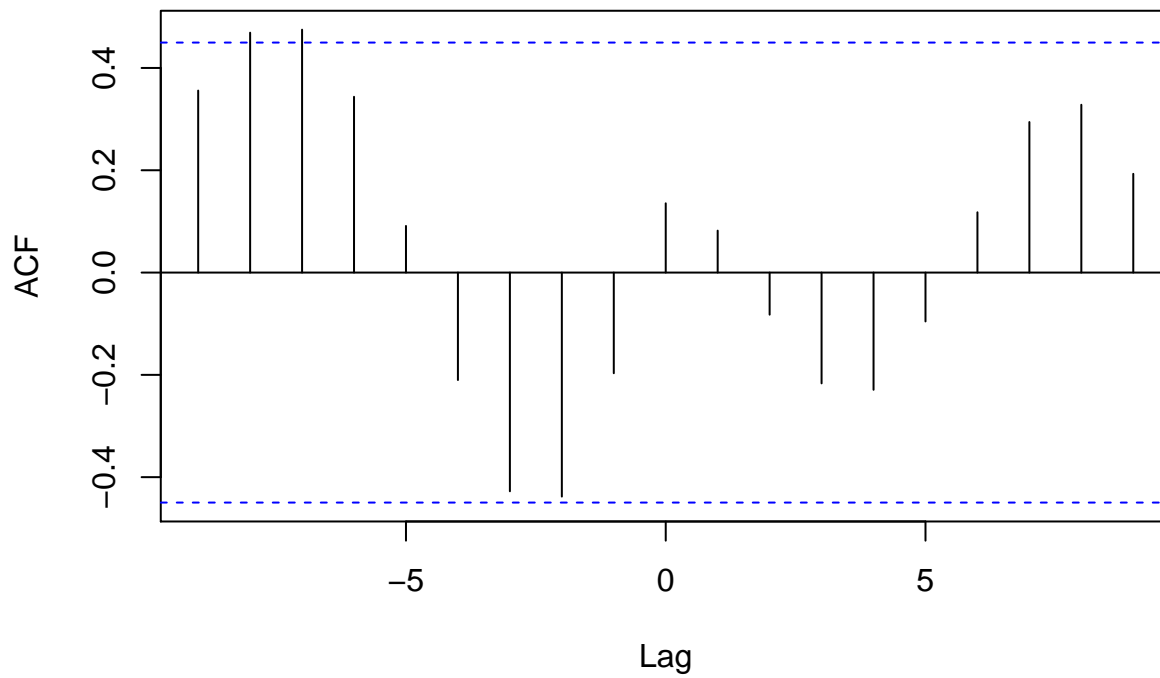
**2 wk ahead – 15**

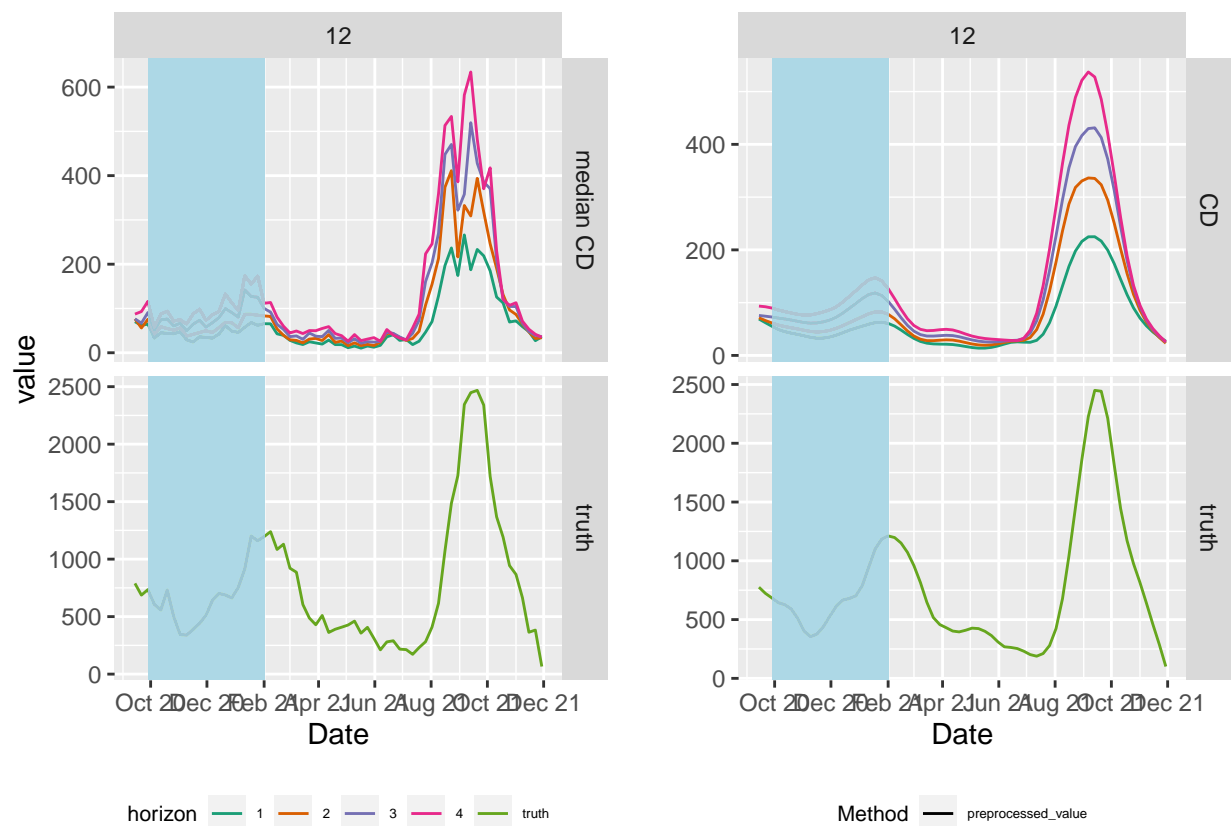


### 3 wk ahead – 15

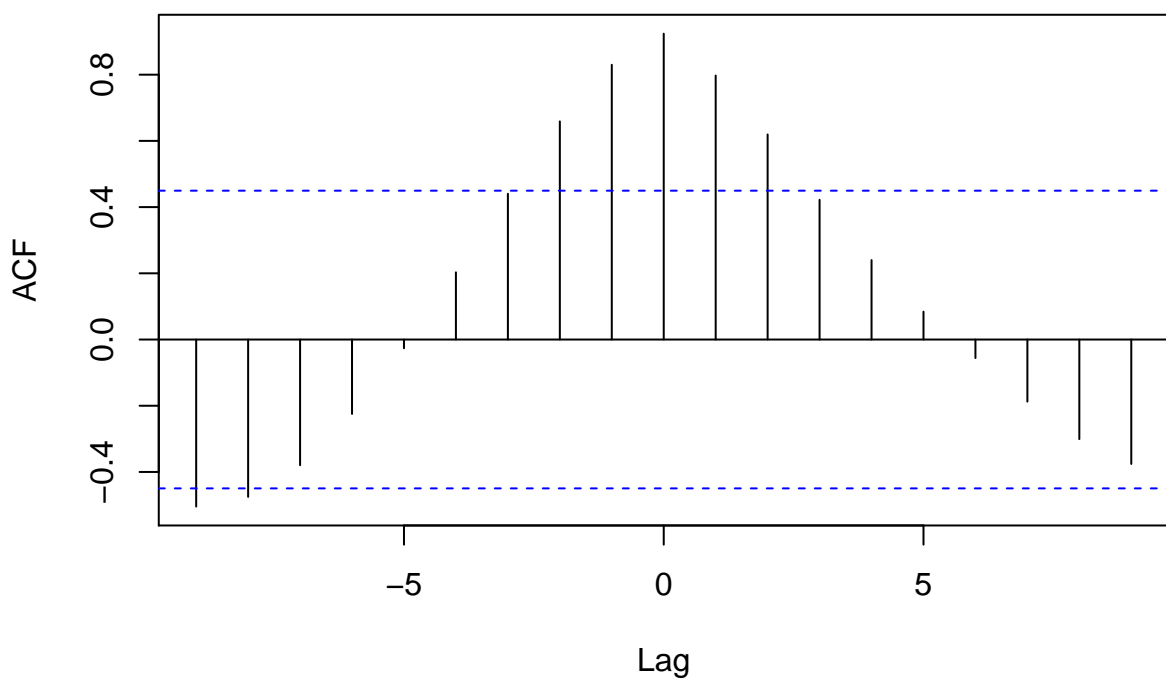


### 4 wk ahead – 15

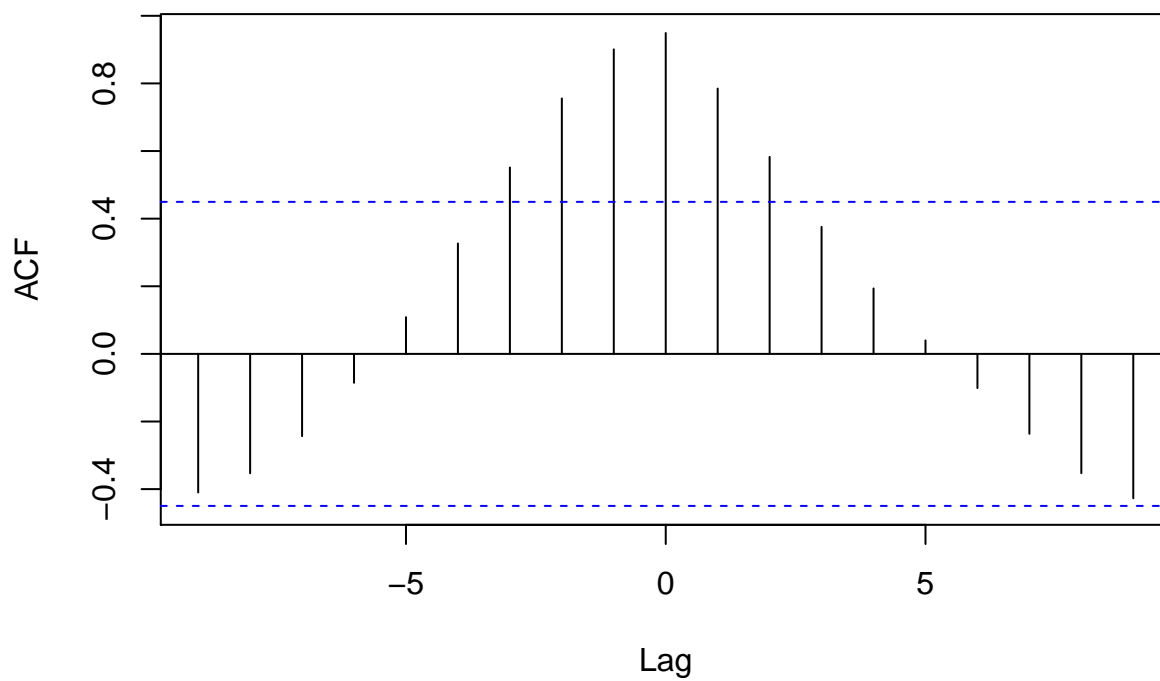




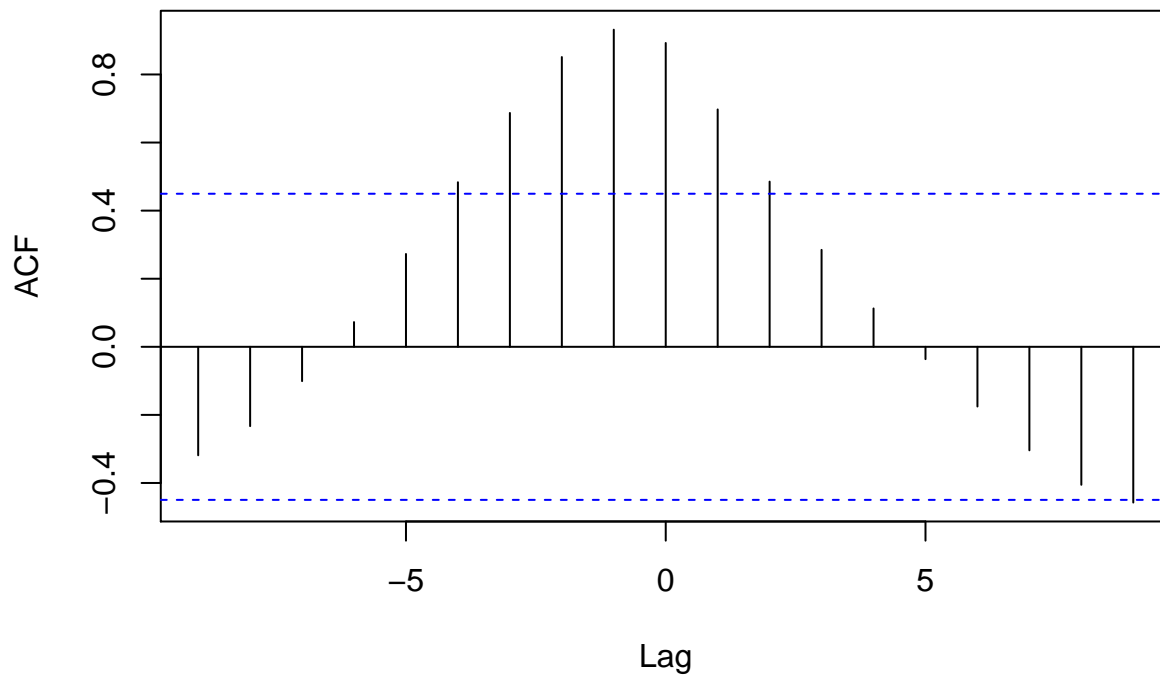
**1 wk ahead – 12**



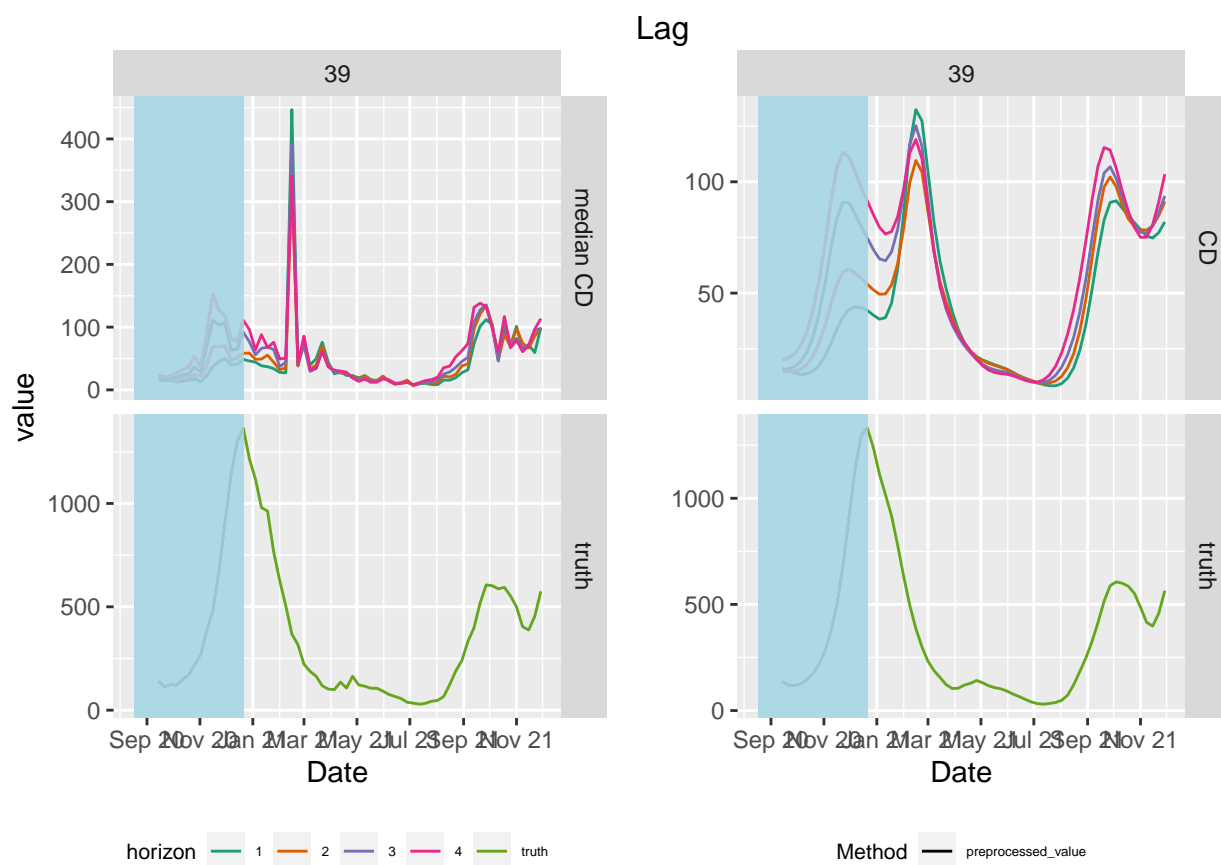
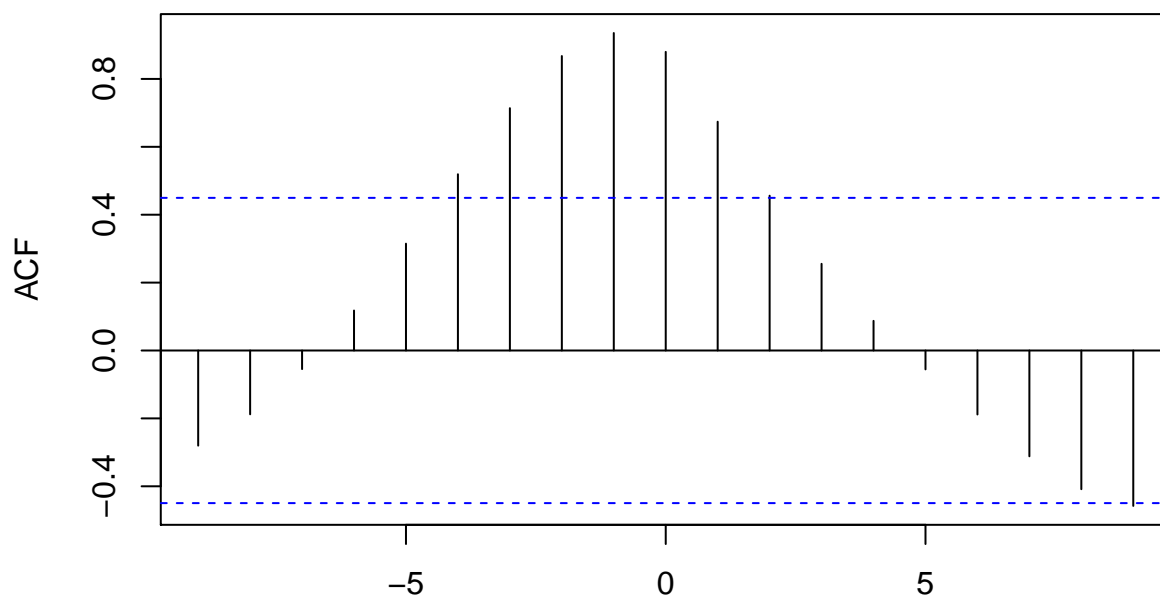
**2 wk ahead – 12**



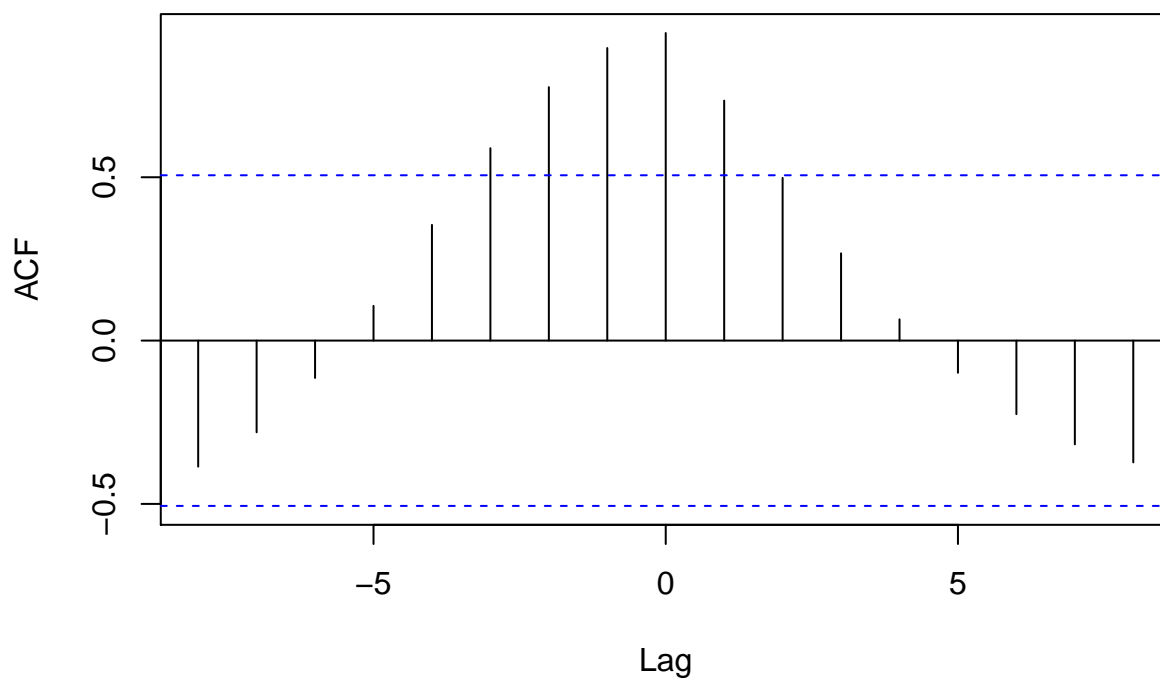
**3 wk ahead – 12**



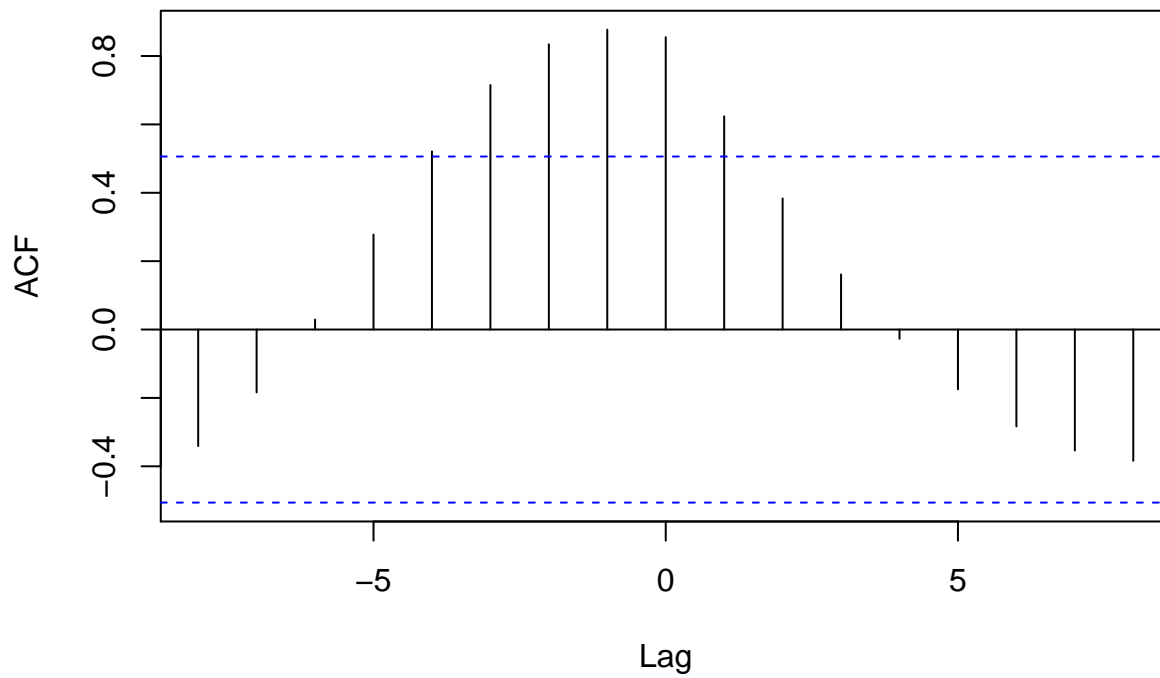
## 4 wk ahead – 12



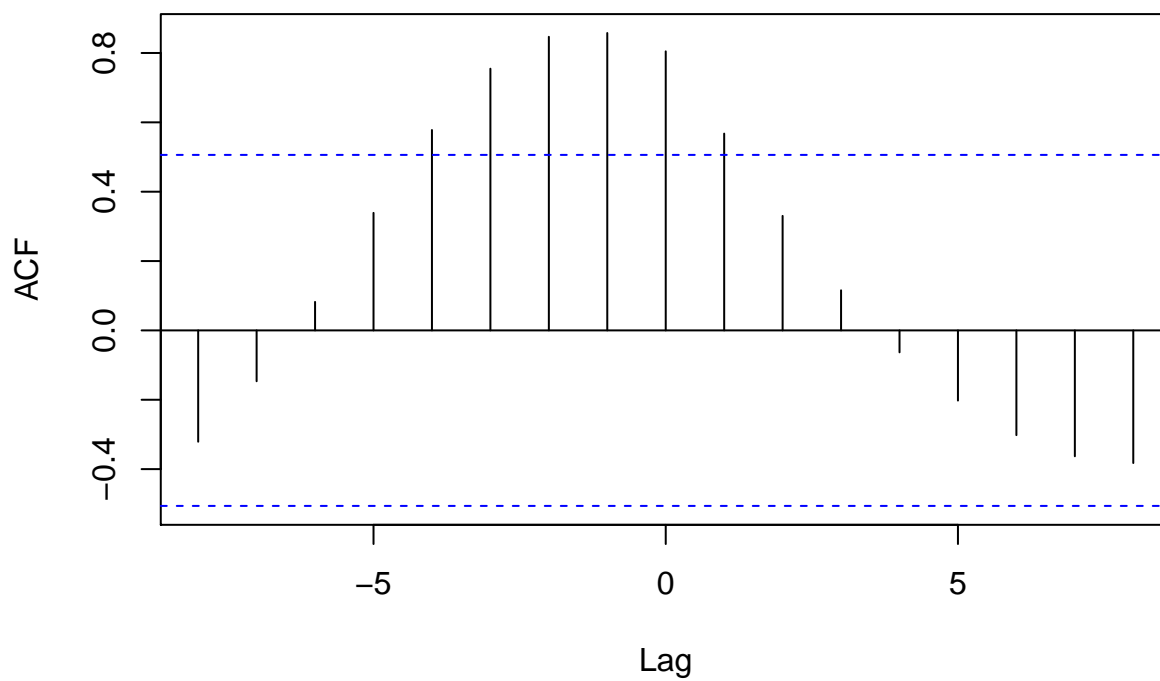
**1 wk ahead – 39**



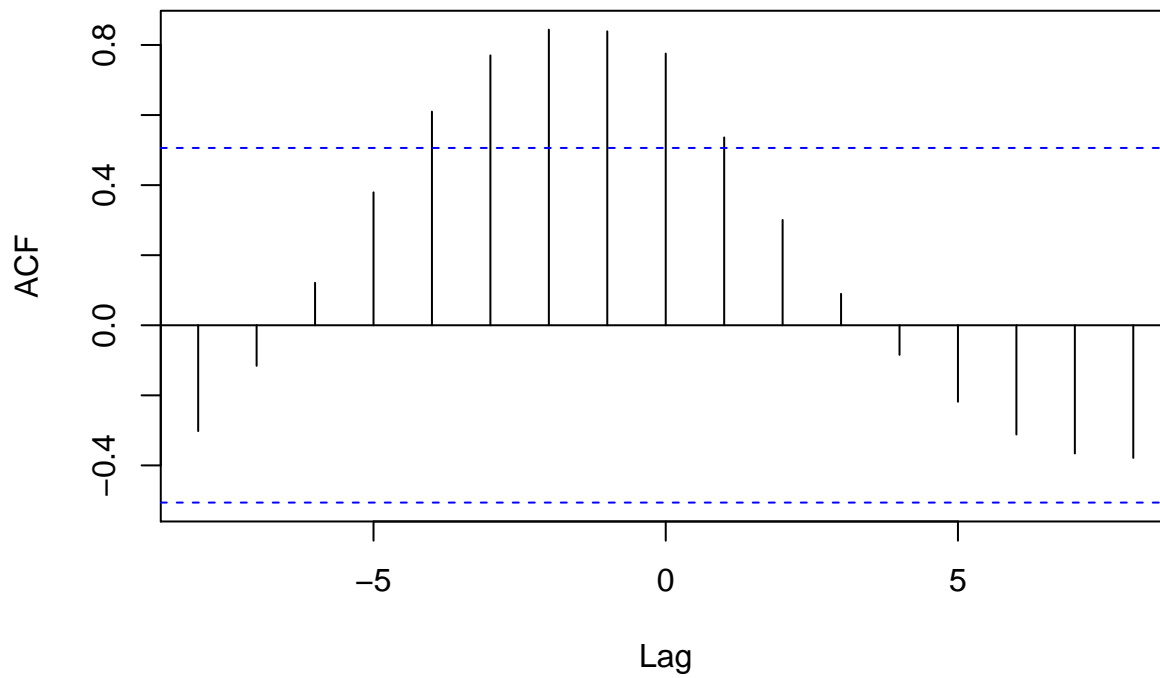
**2 wk ahead – 39**

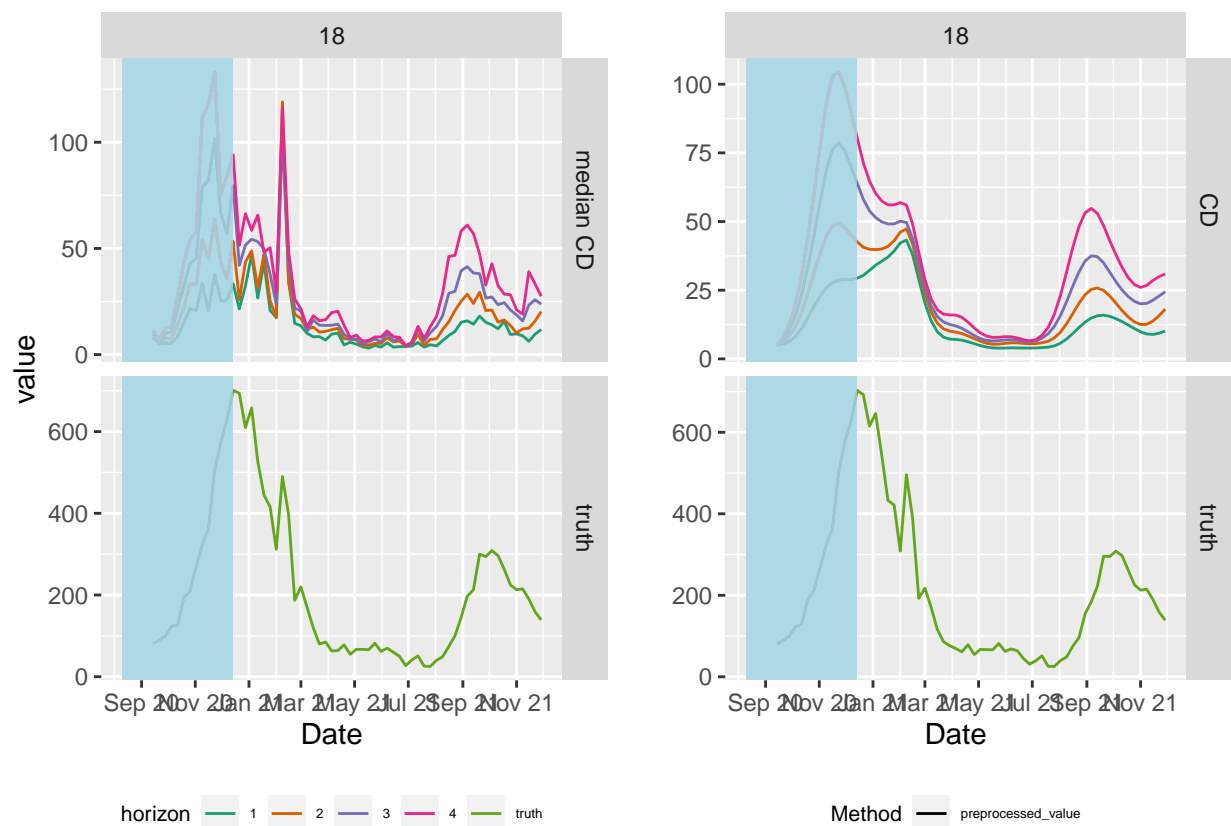


### 3 wk ahead – 39

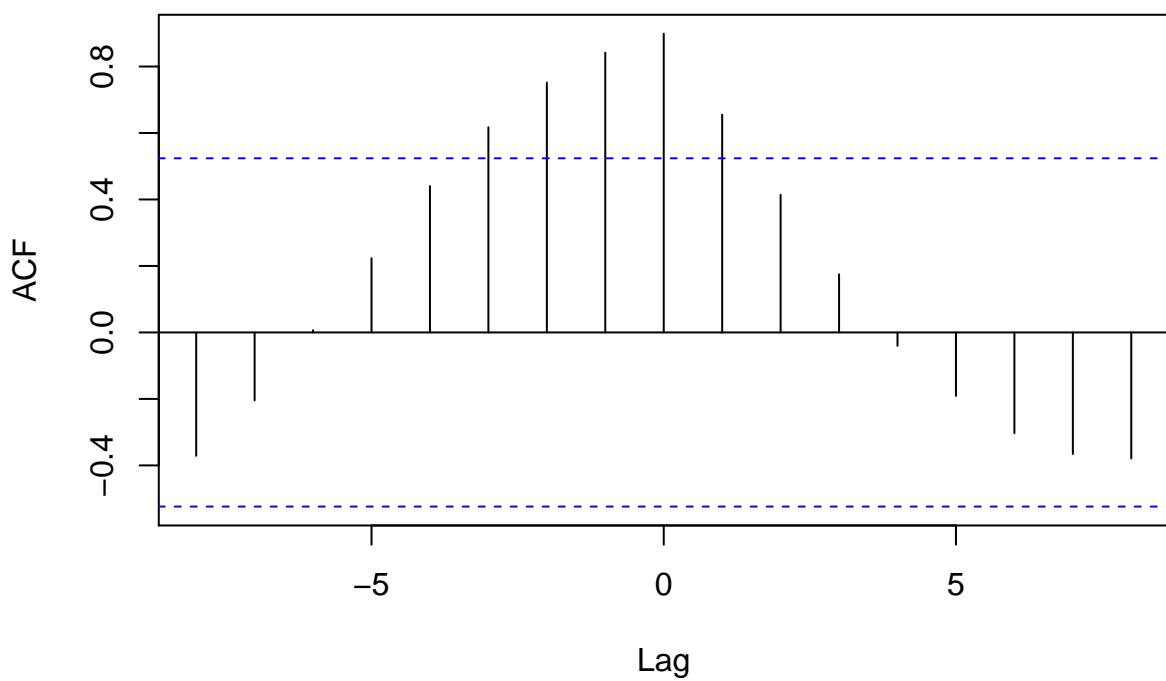


### 4 wk ahead – 39



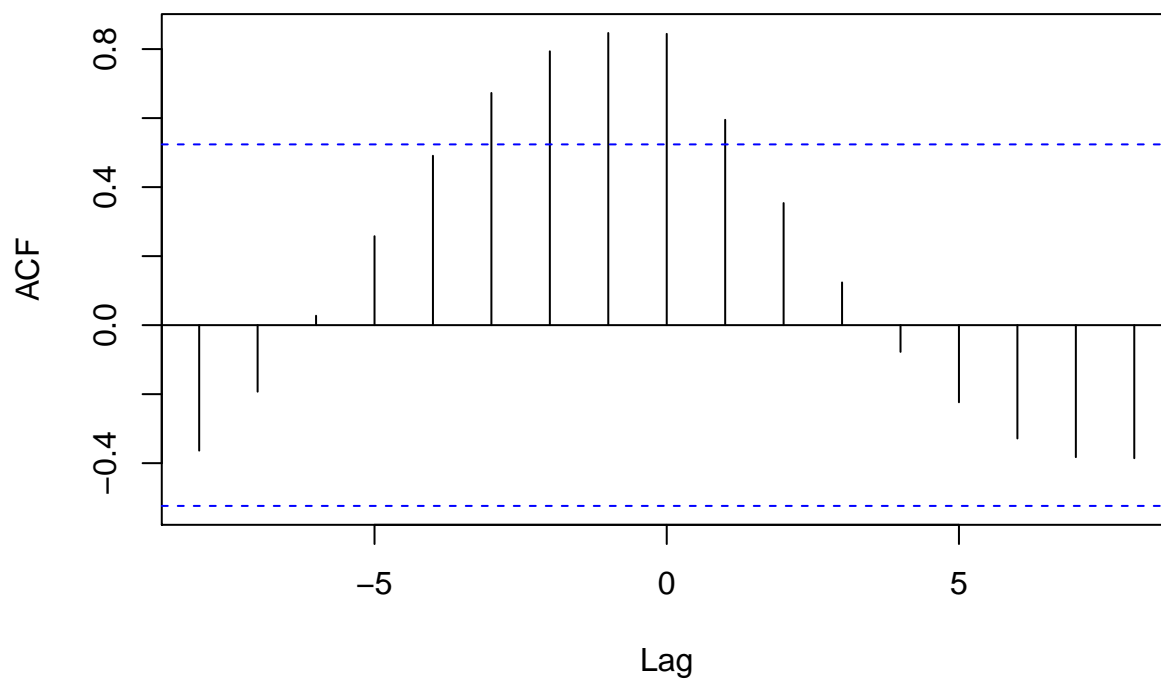


1 wk ahead – 18

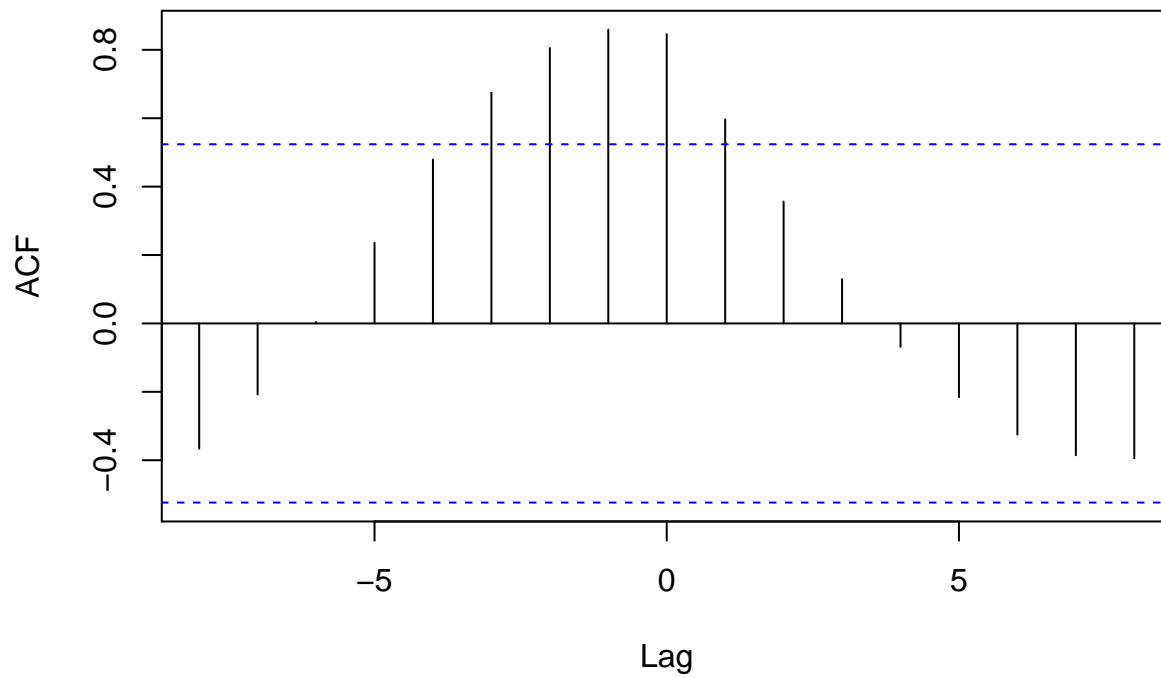




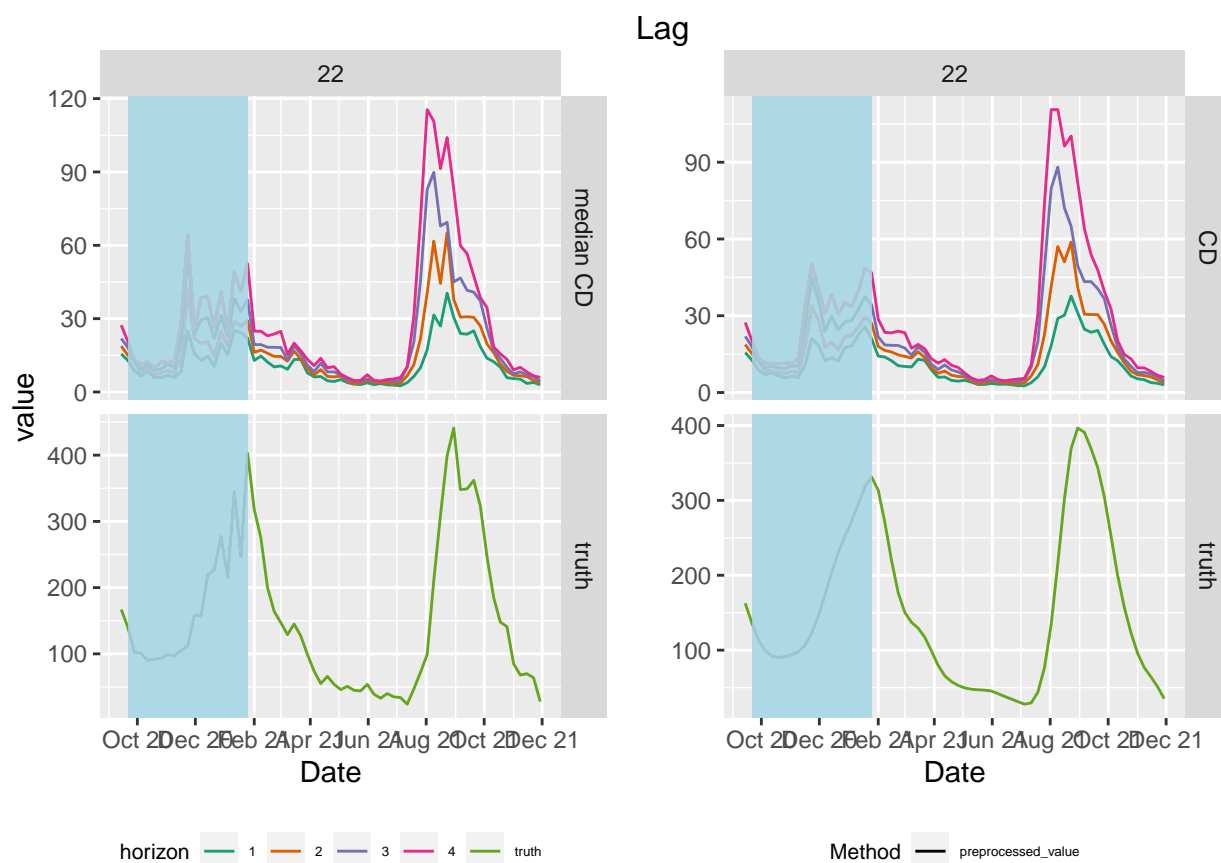
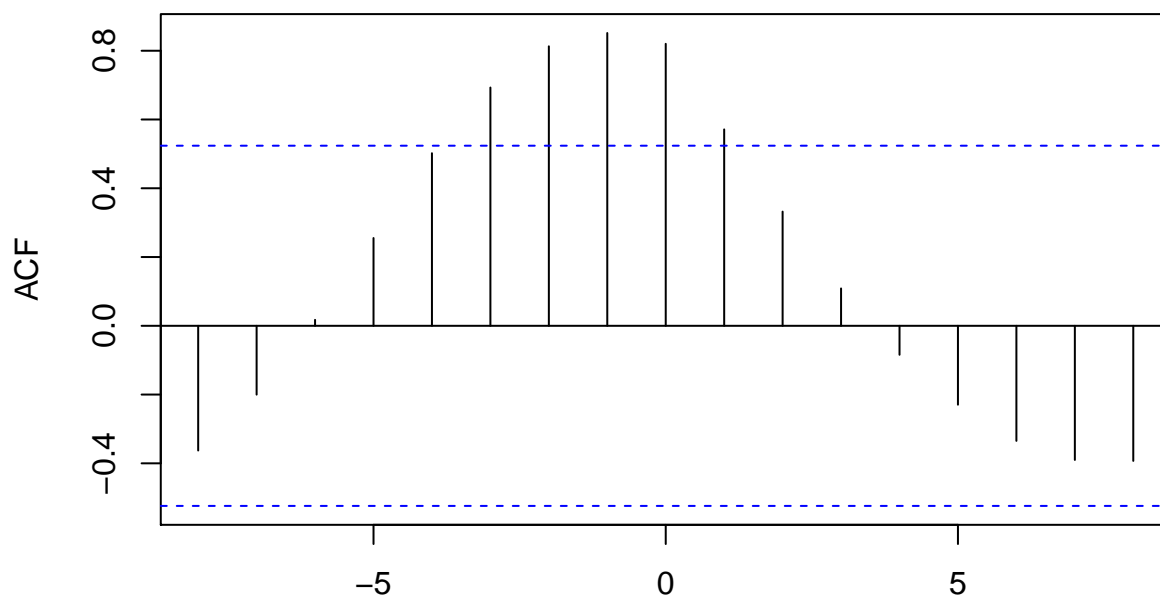
**2 wk ahead – 18**



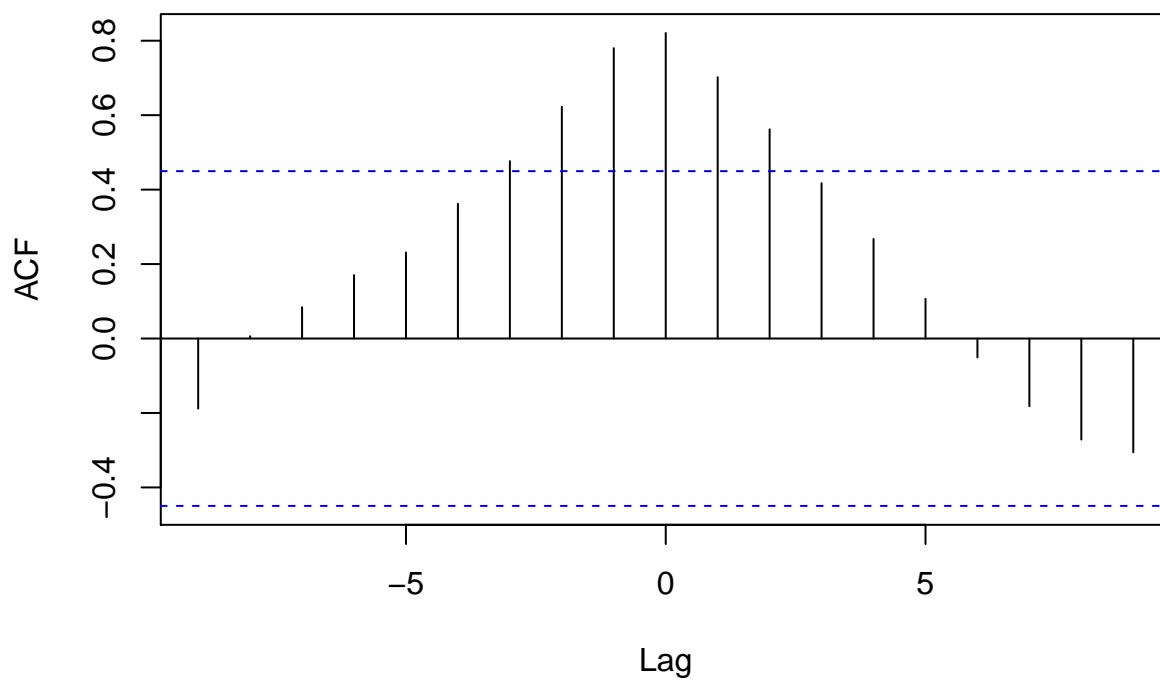
**3 wk ahead – 18**



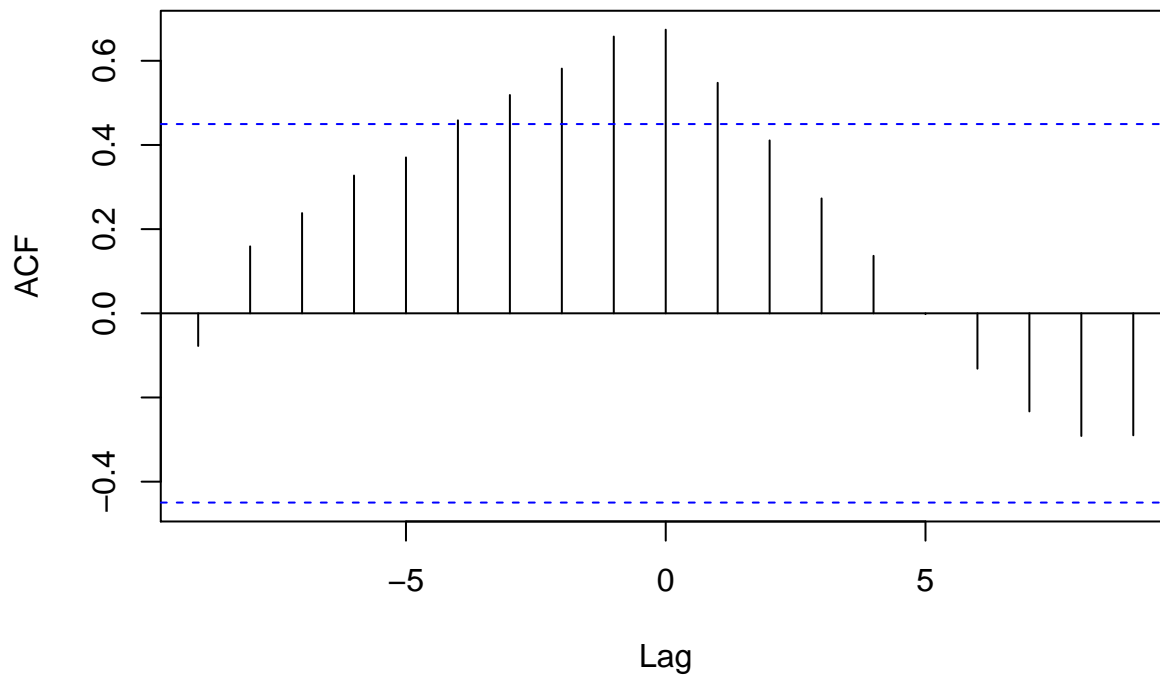
## 4 wk ahead – 18



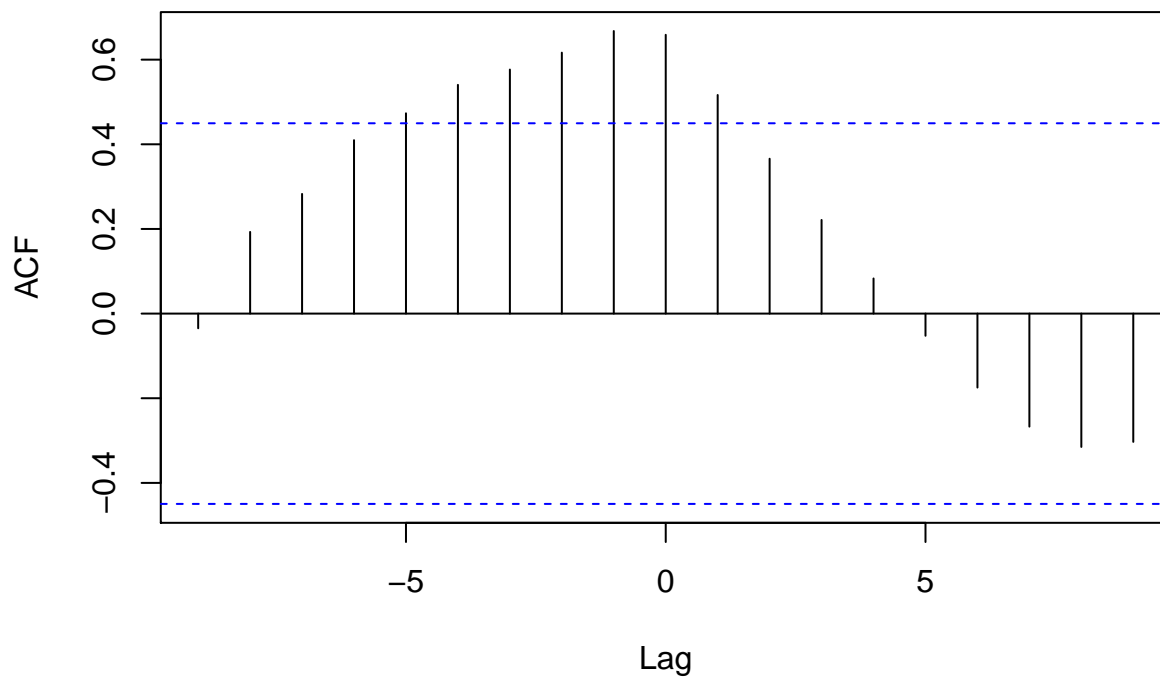
**1 wk ahead – 22**



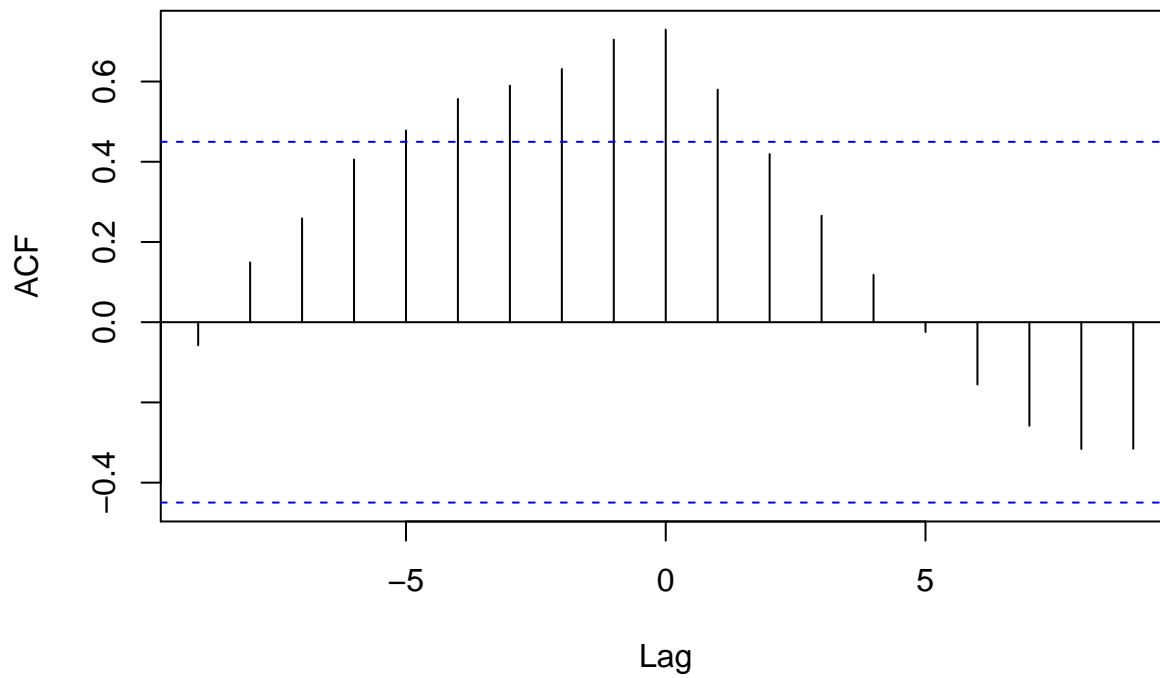
**2 wk ahead – 22**

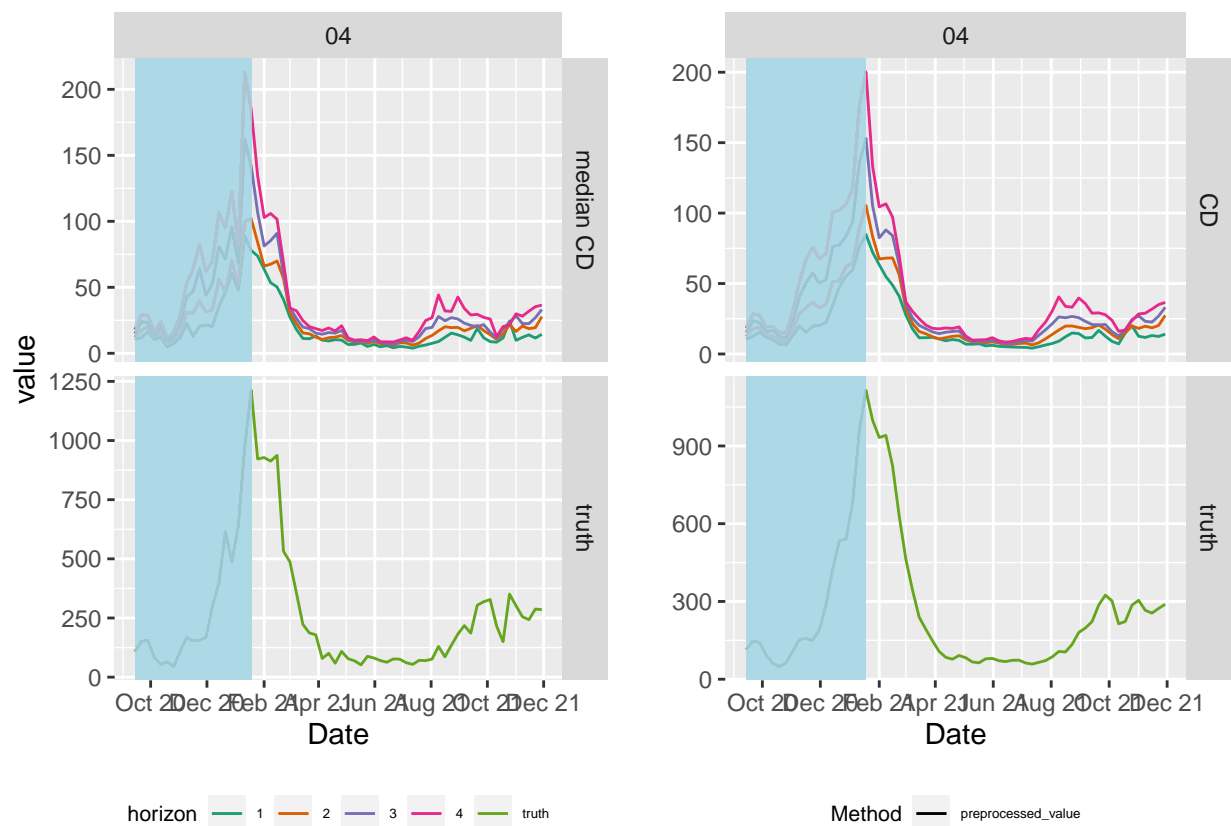


**3 wk ahead – 22**

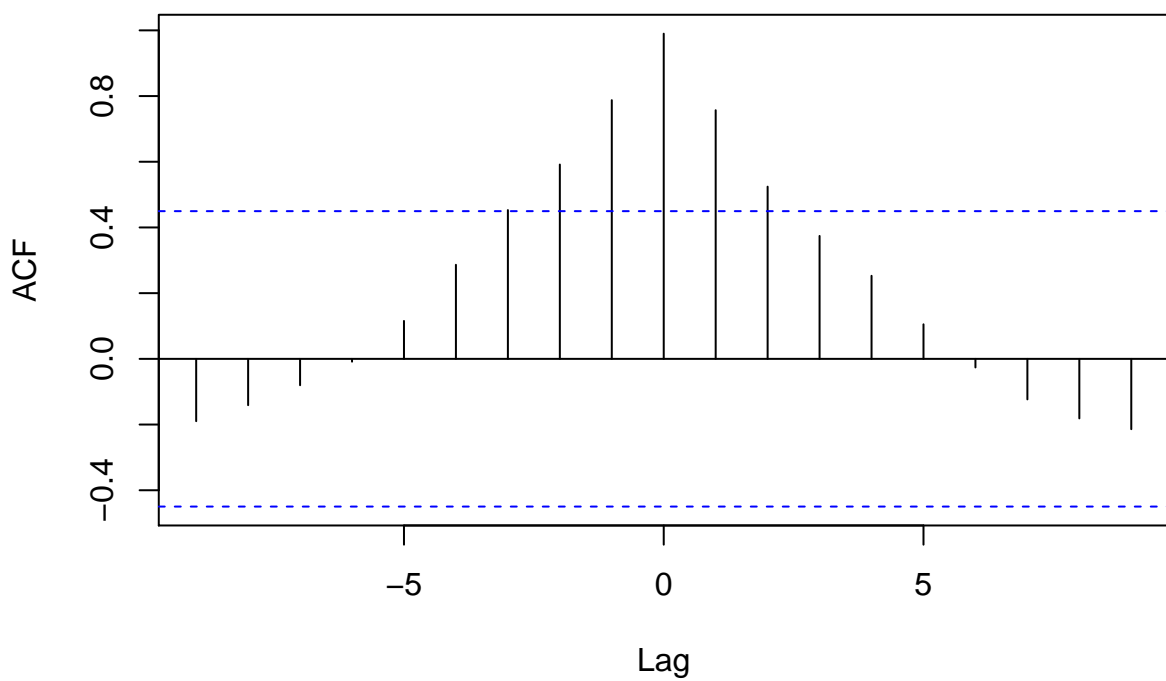


**4 wk ahead – 22**

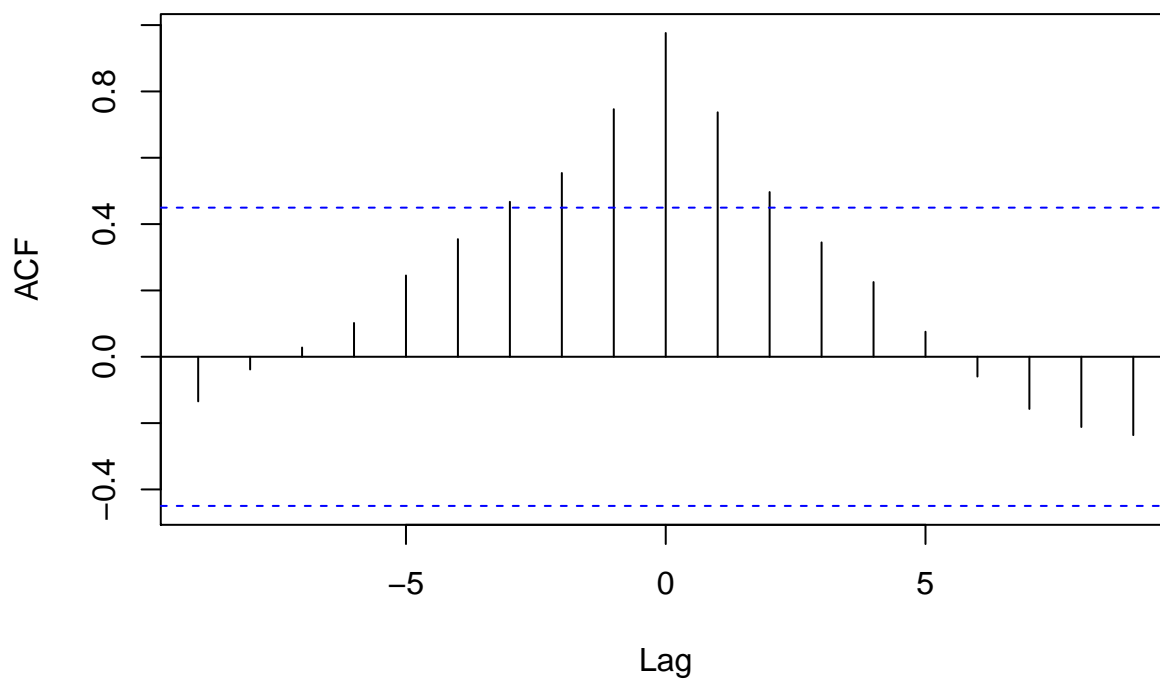




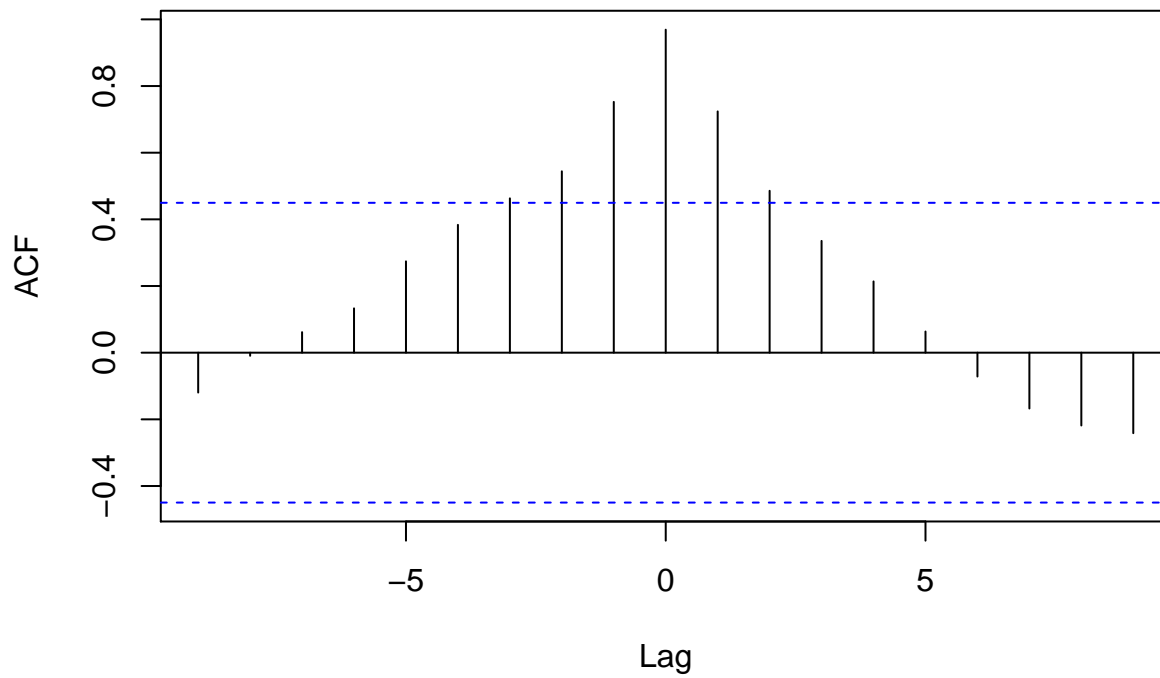
**1 wk ahead – 04**



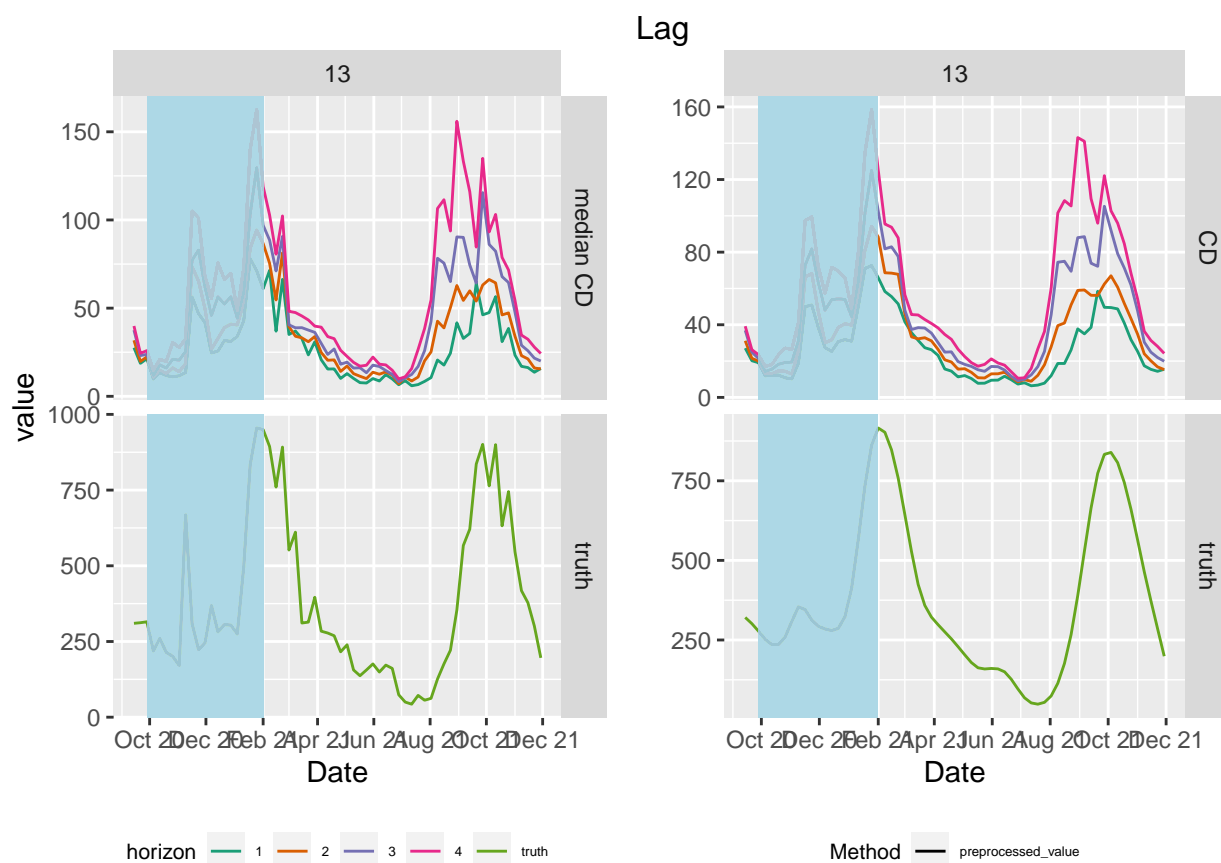
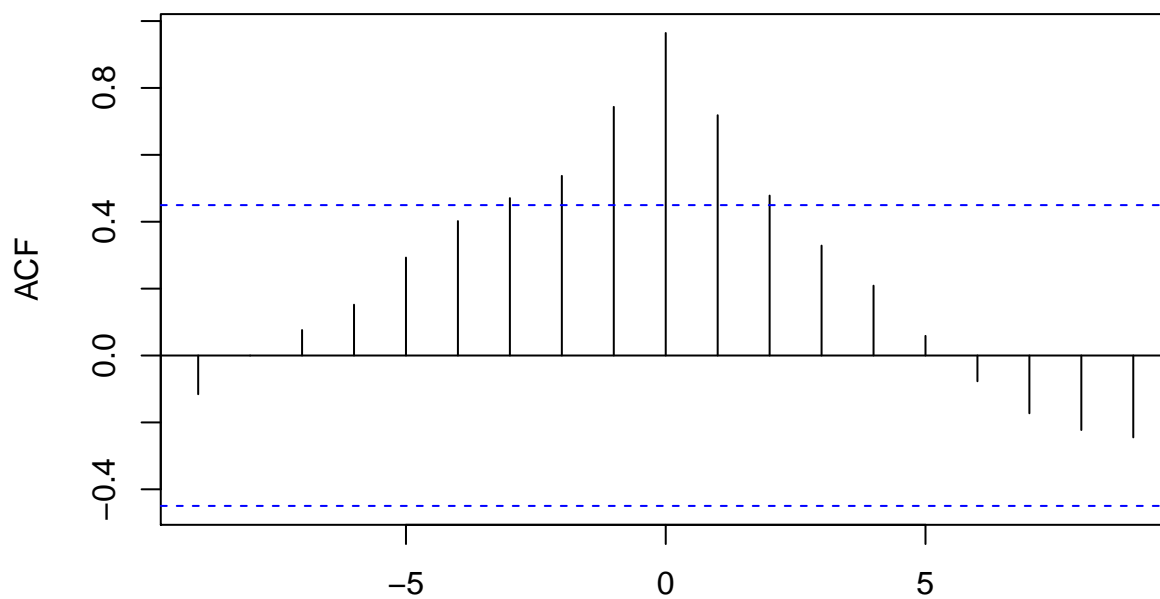
**2 wk ahead – 04**



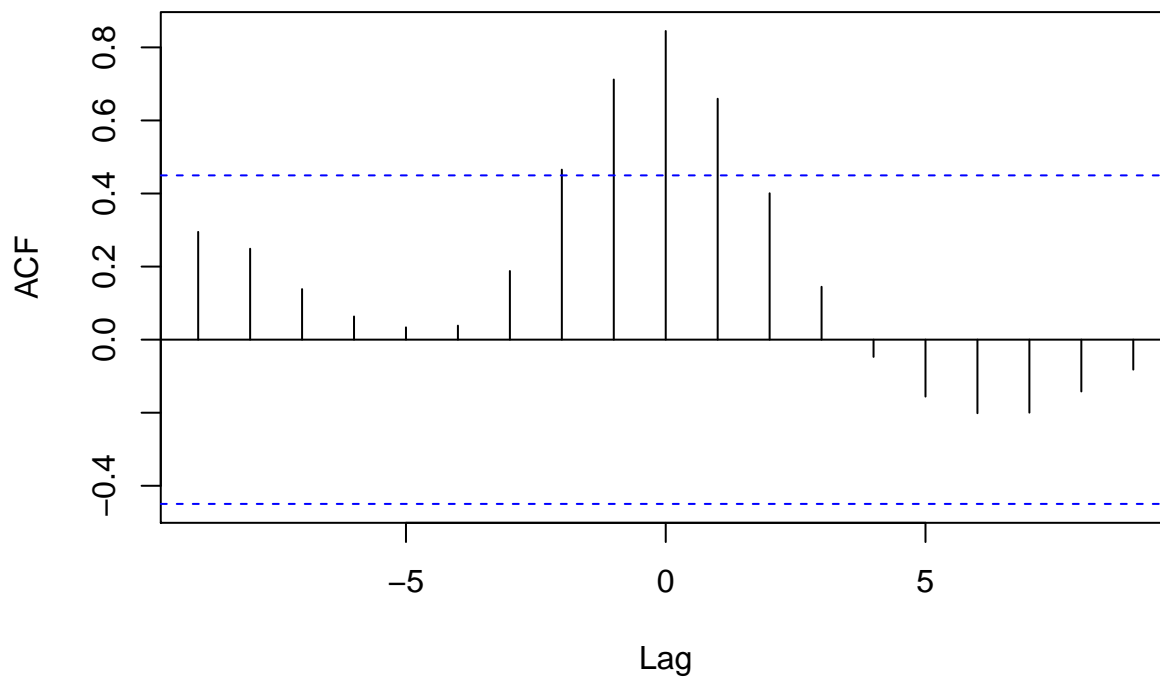
**3 wk ahead – 04**



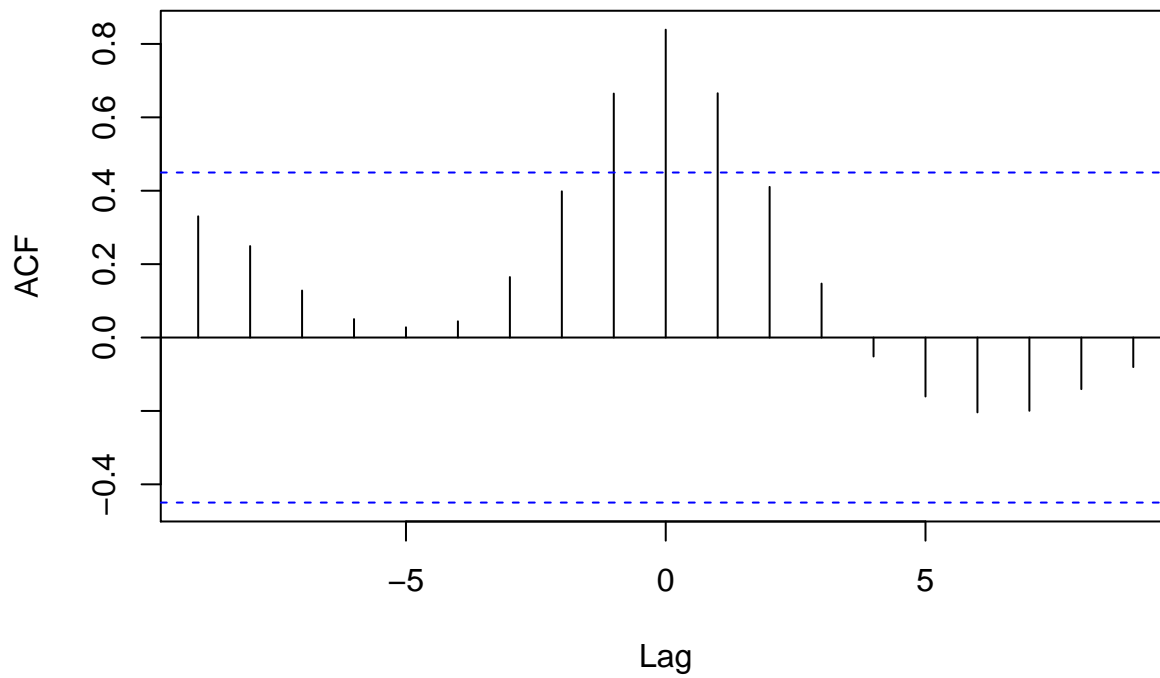
## 4 wk ahead – 04



**1 wk ahead – 13**

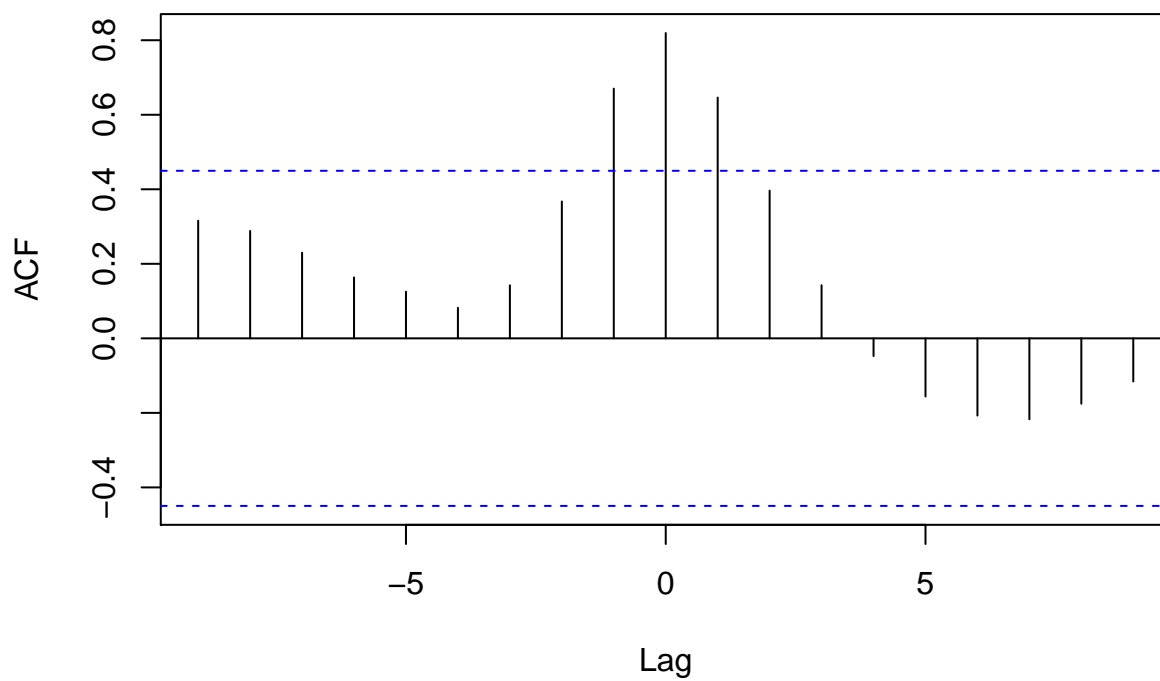


**2 wk ahead – 13**

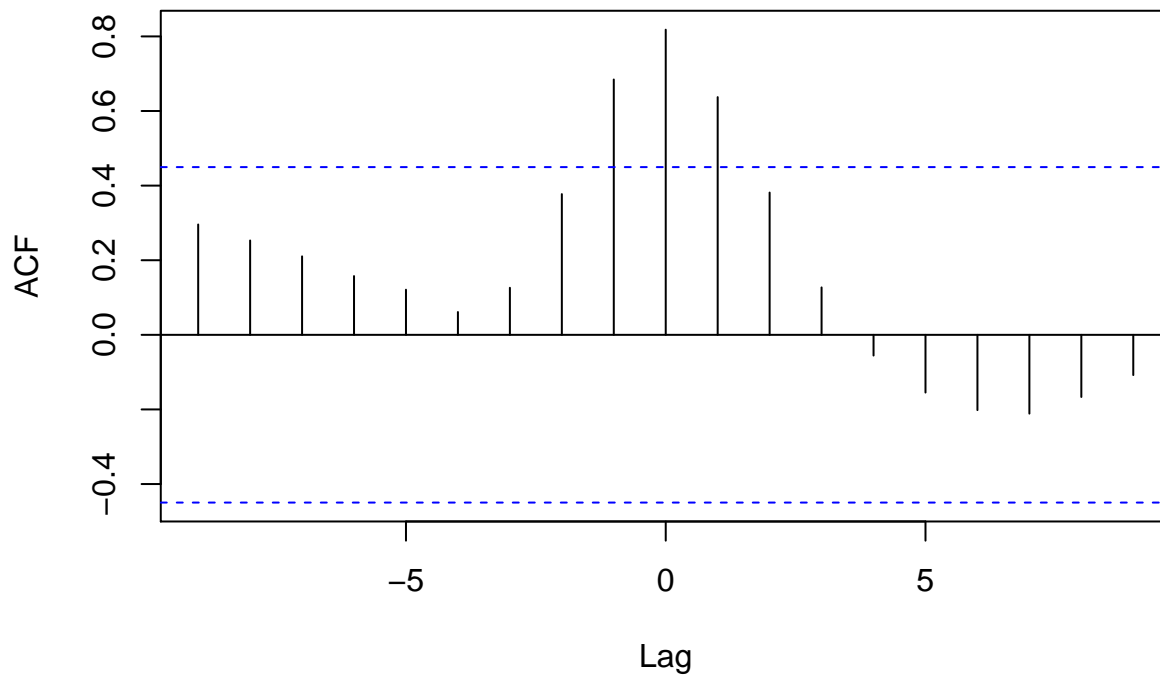


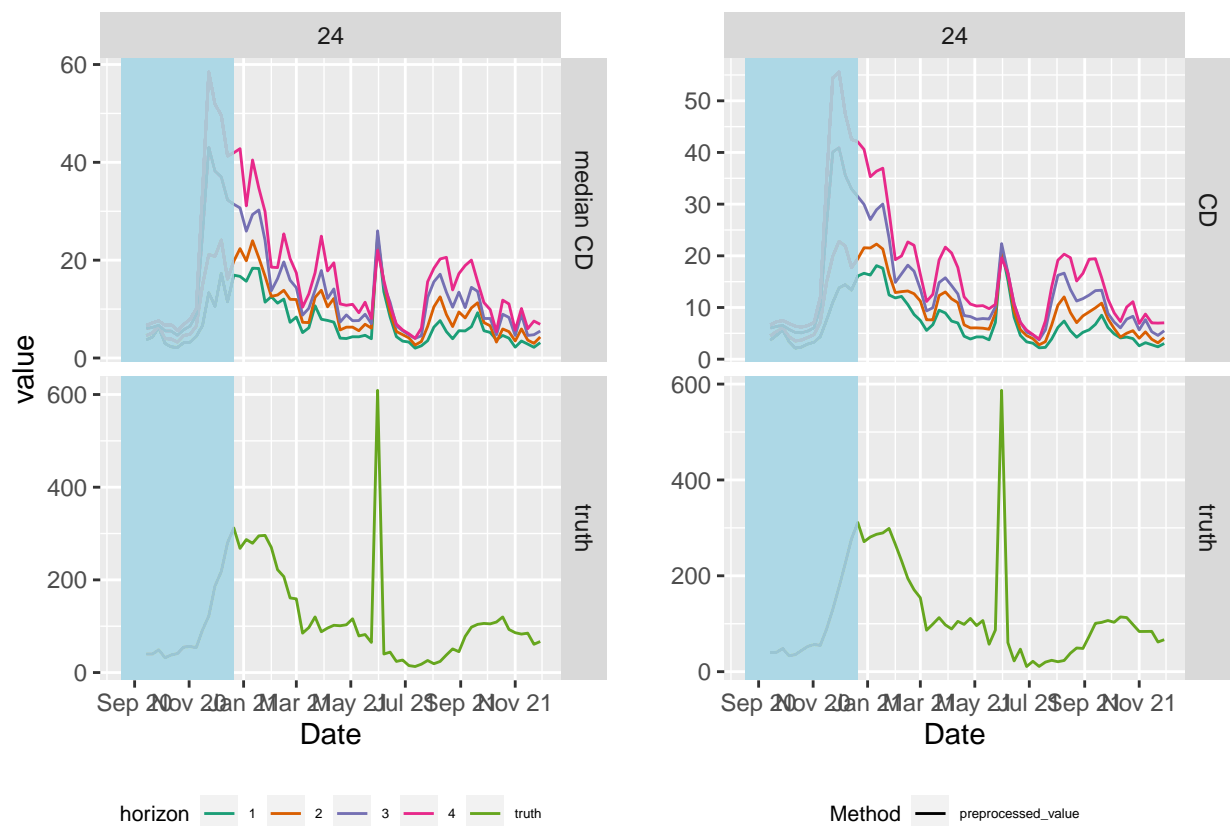


### 3 wk ahead – 13

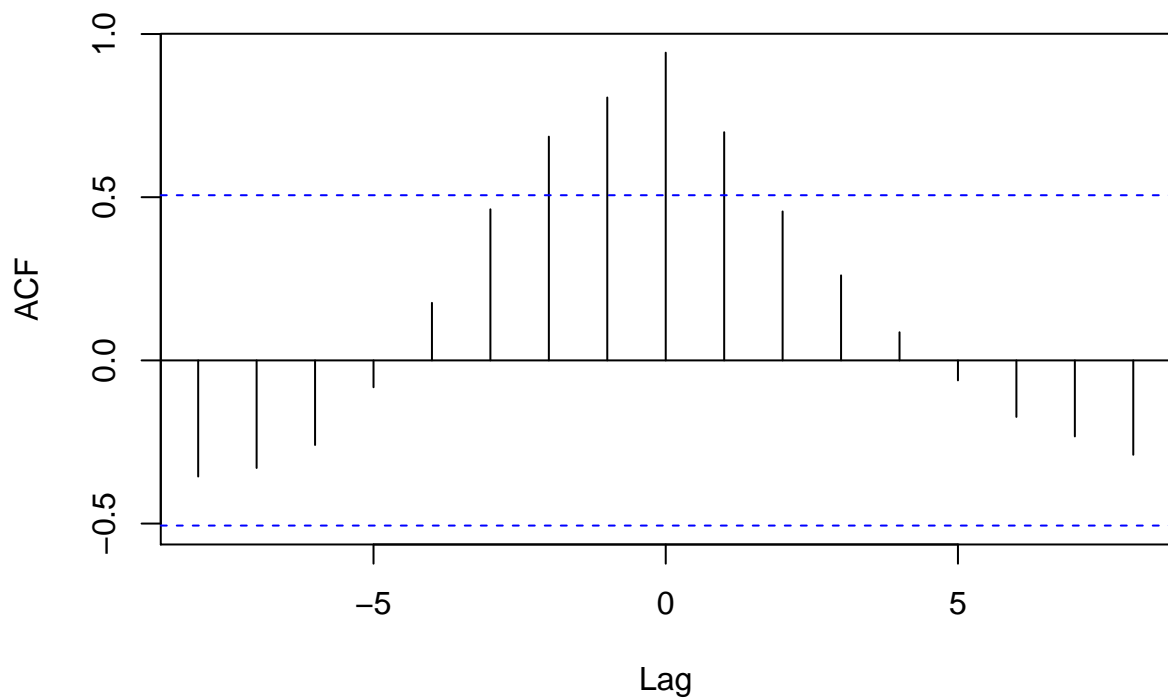


### 4 wk ahead – 13

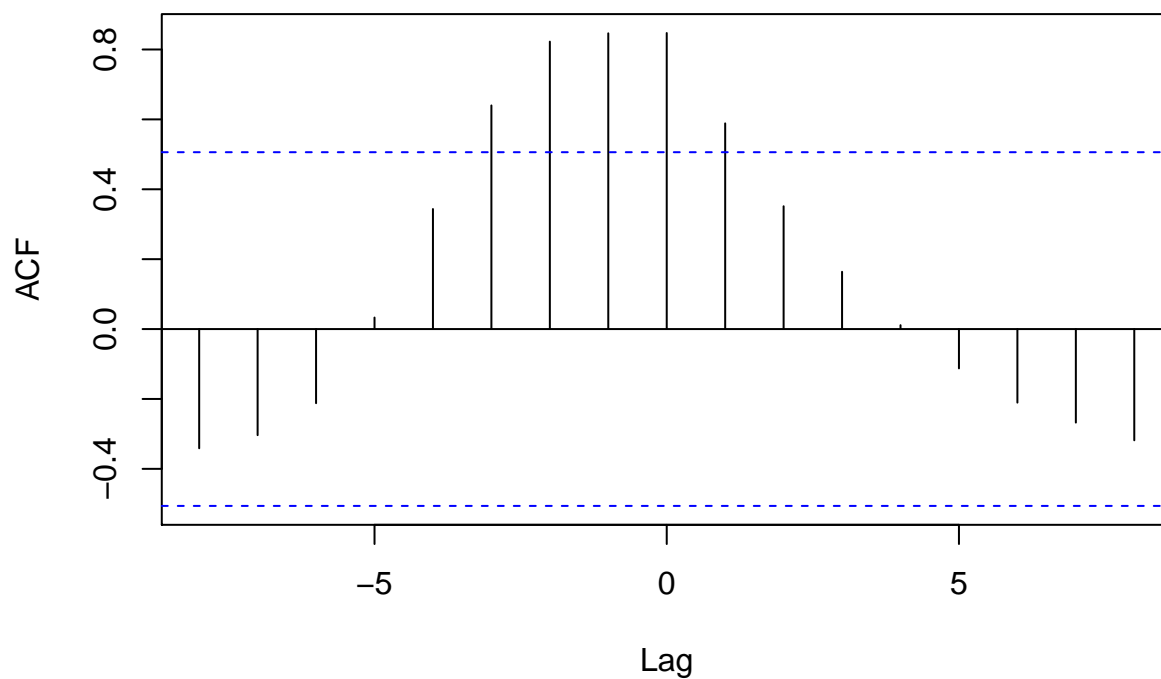




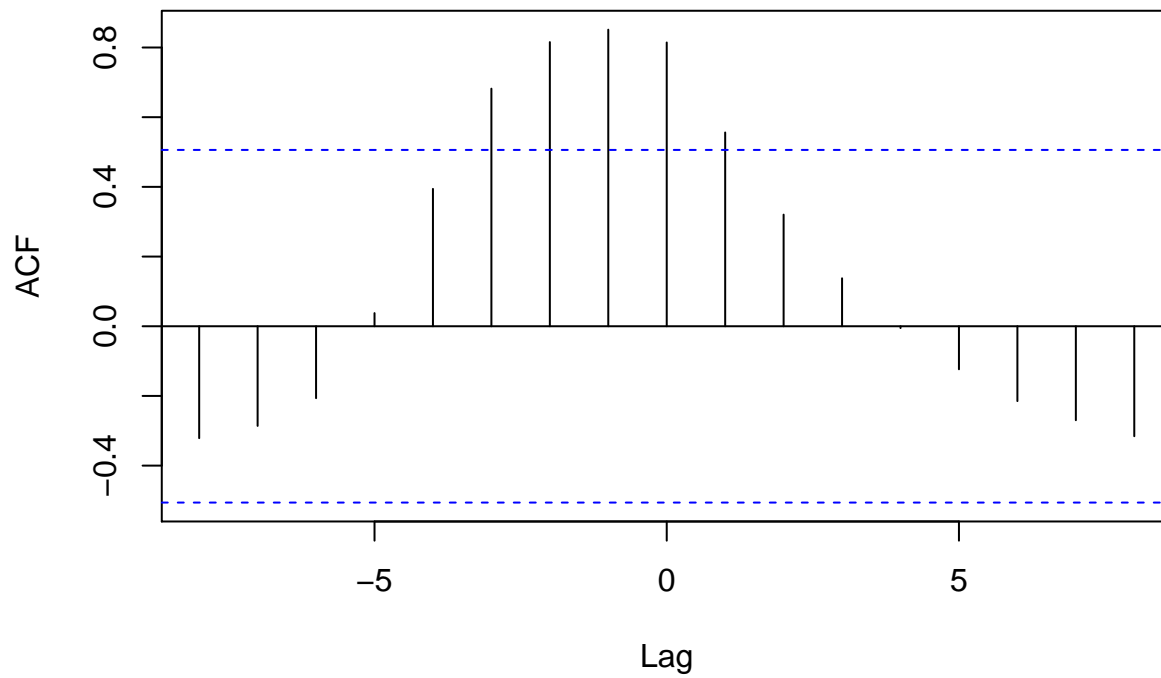
**1 wk ahead – 24**



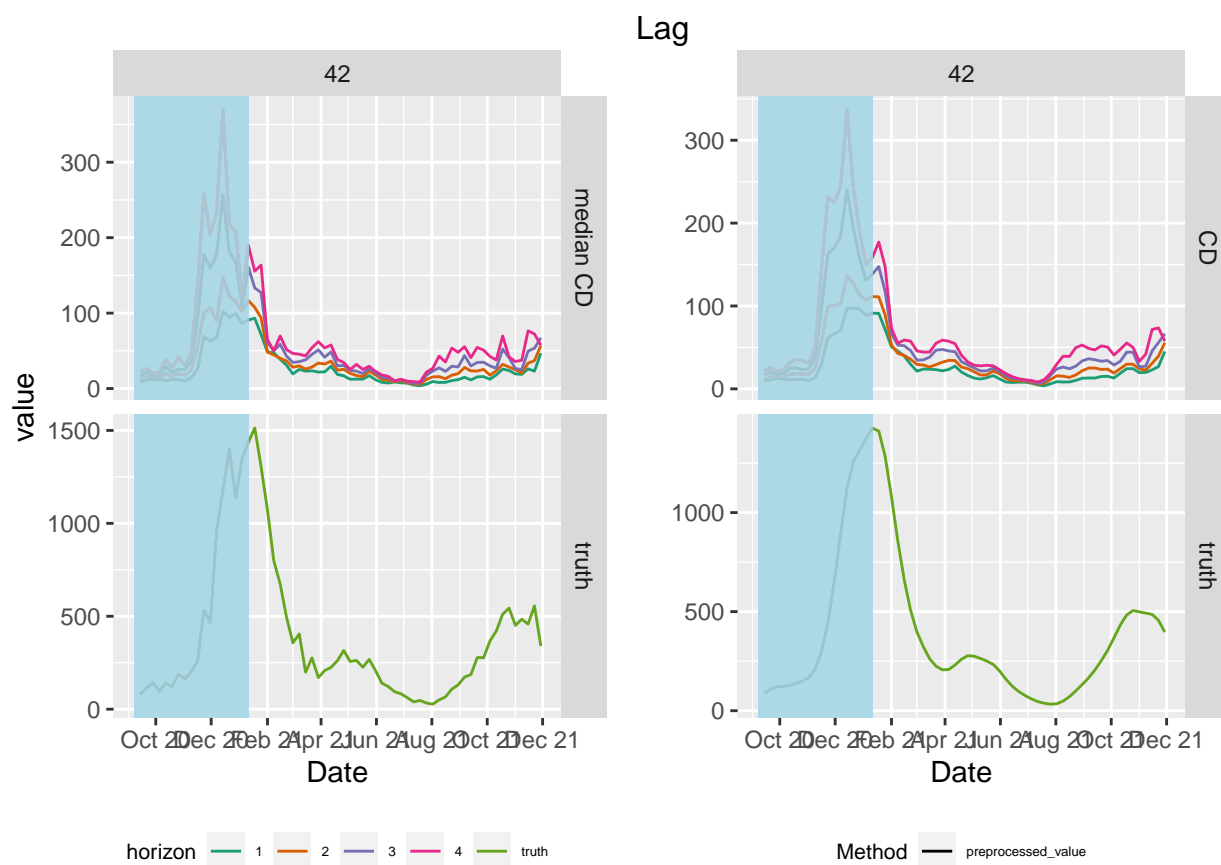
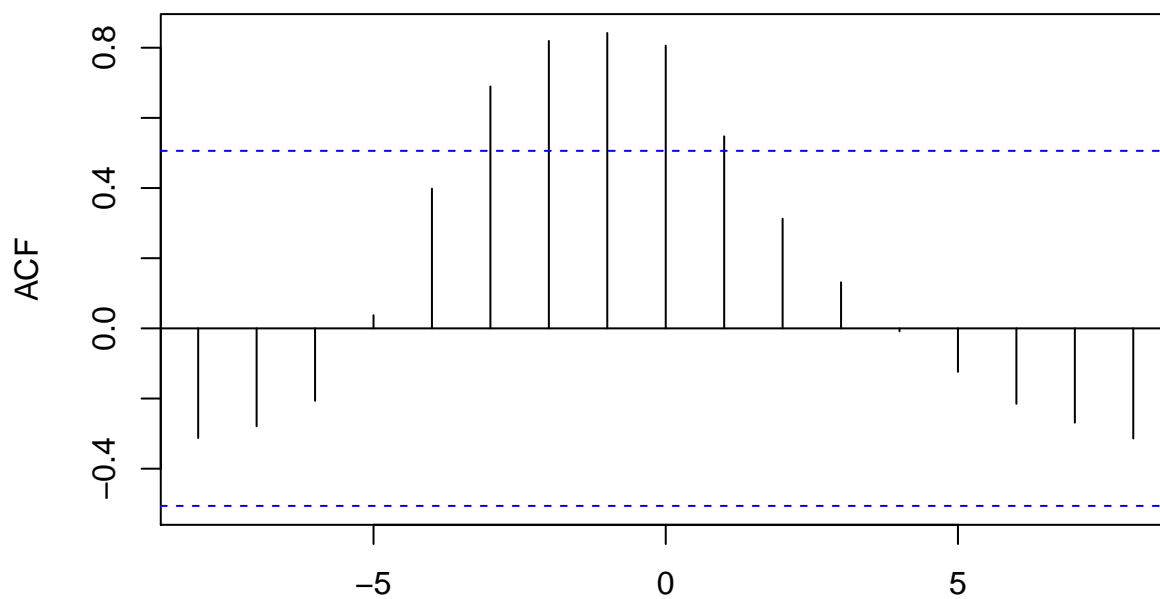
**2 wk ahead – 24**



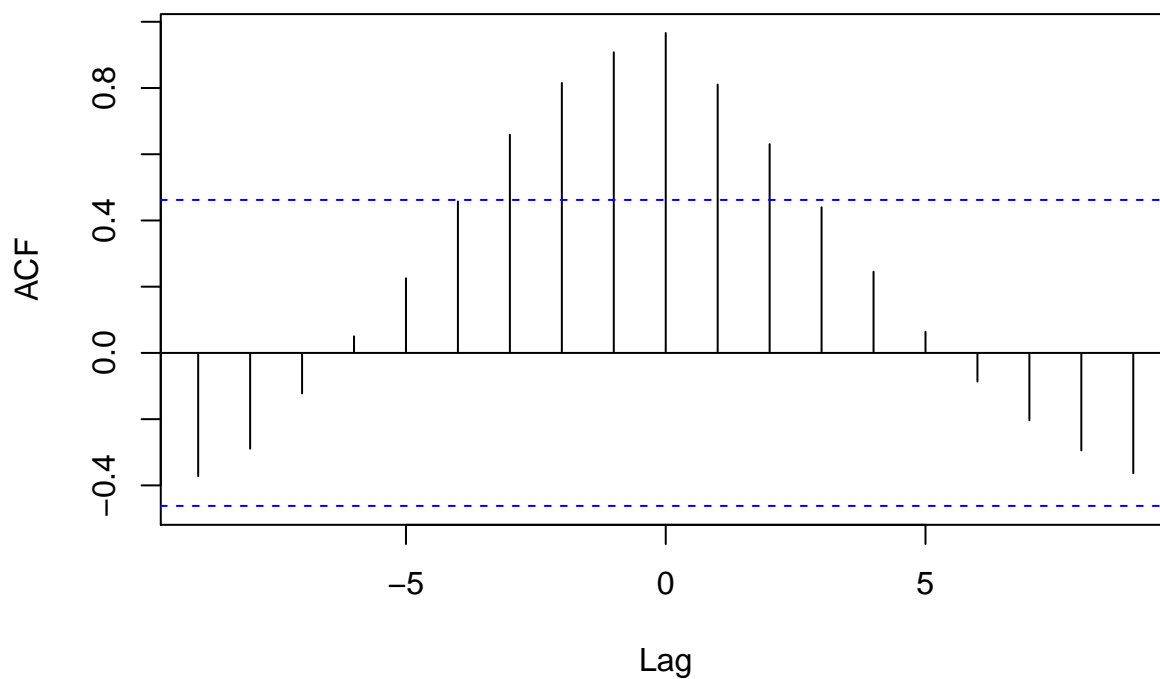
**3 wk ahead – 24**



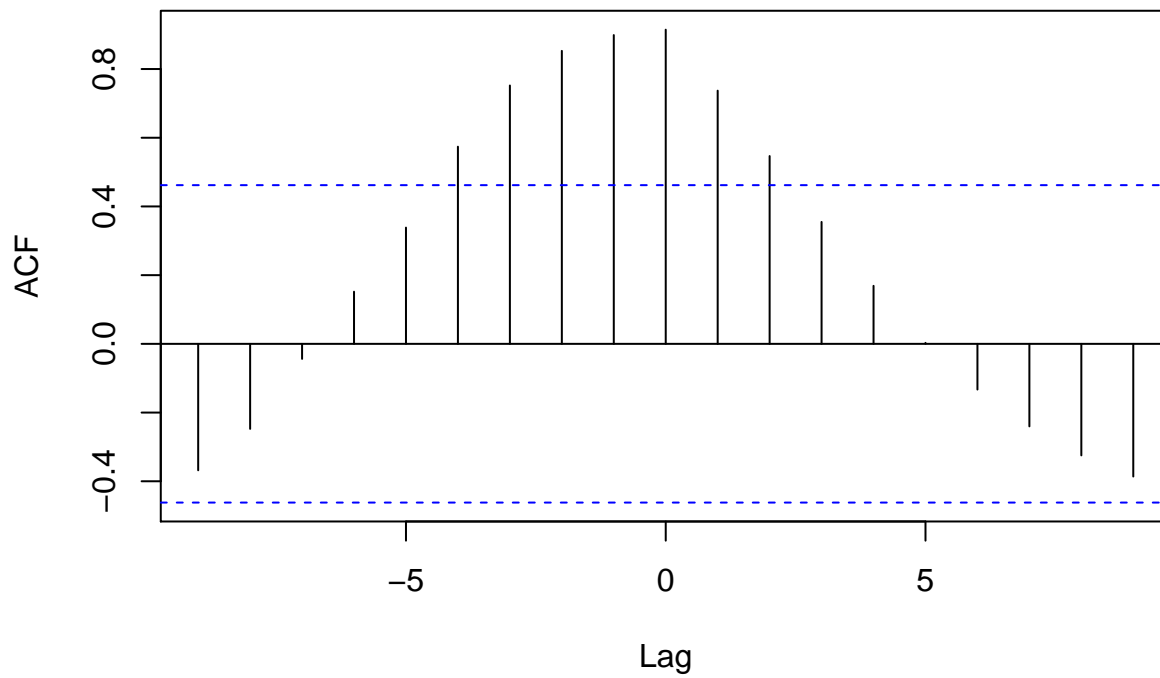
## 4 wk ahead – 24



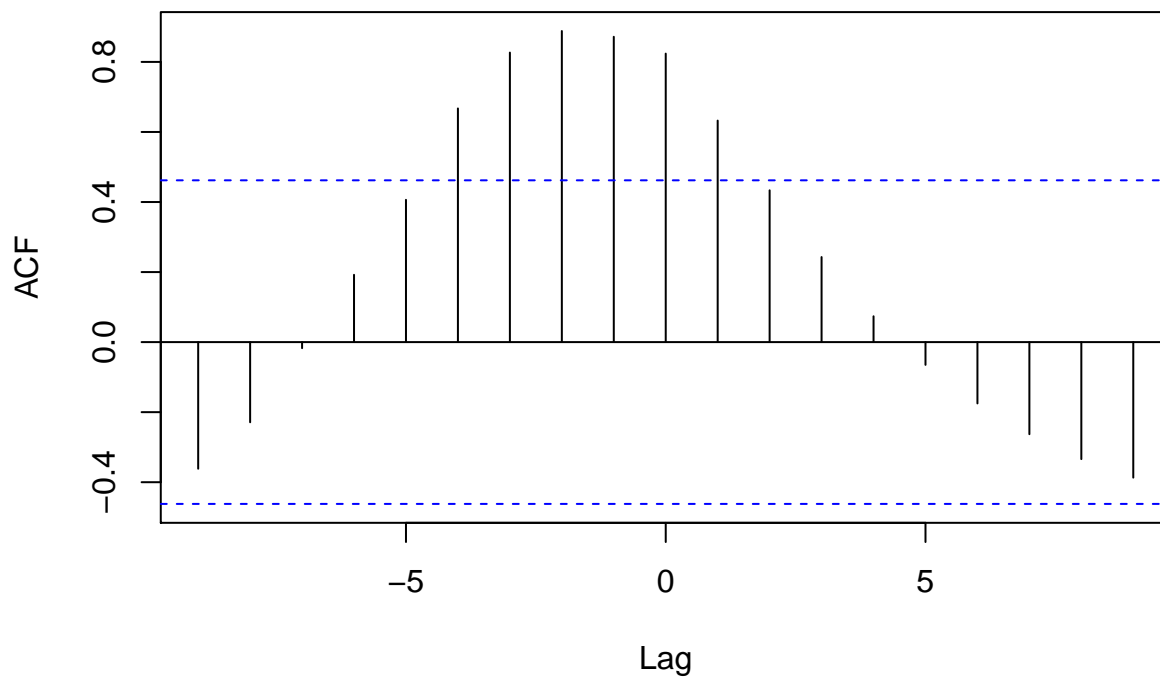
**1 wk ahead – 42**



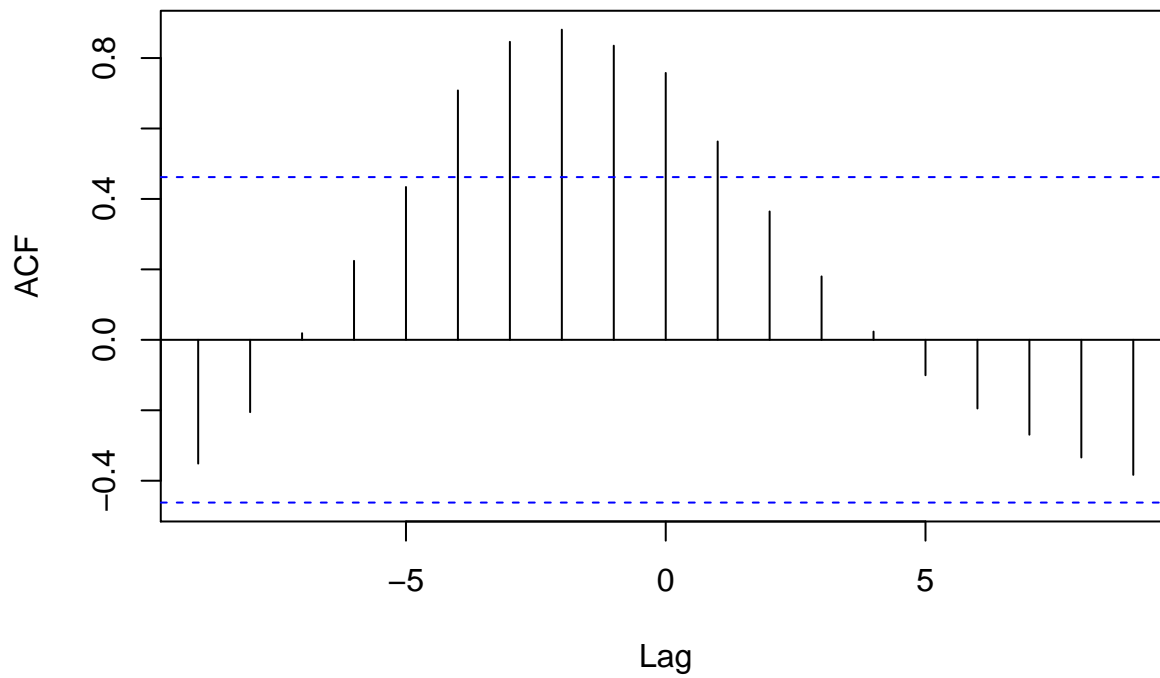
**2 wk ahead – 42**

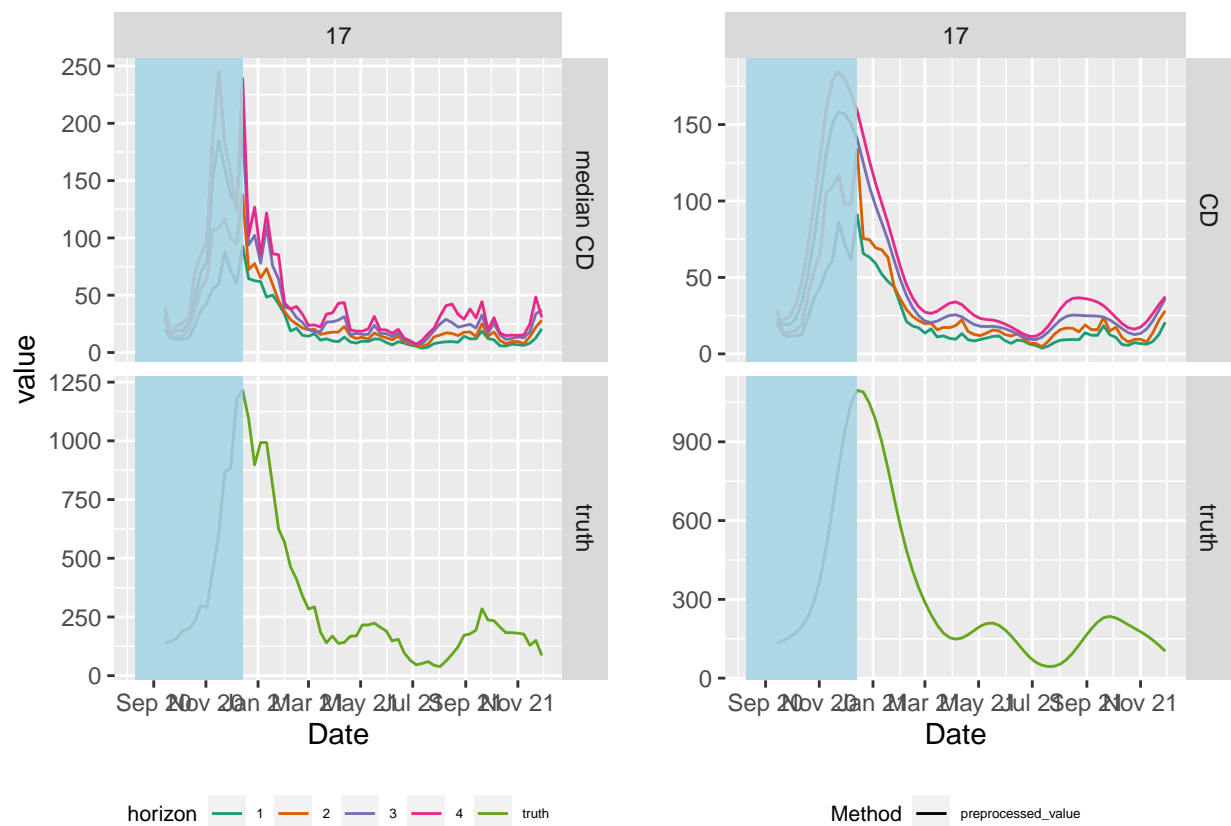


**3 wk ahead – 42**

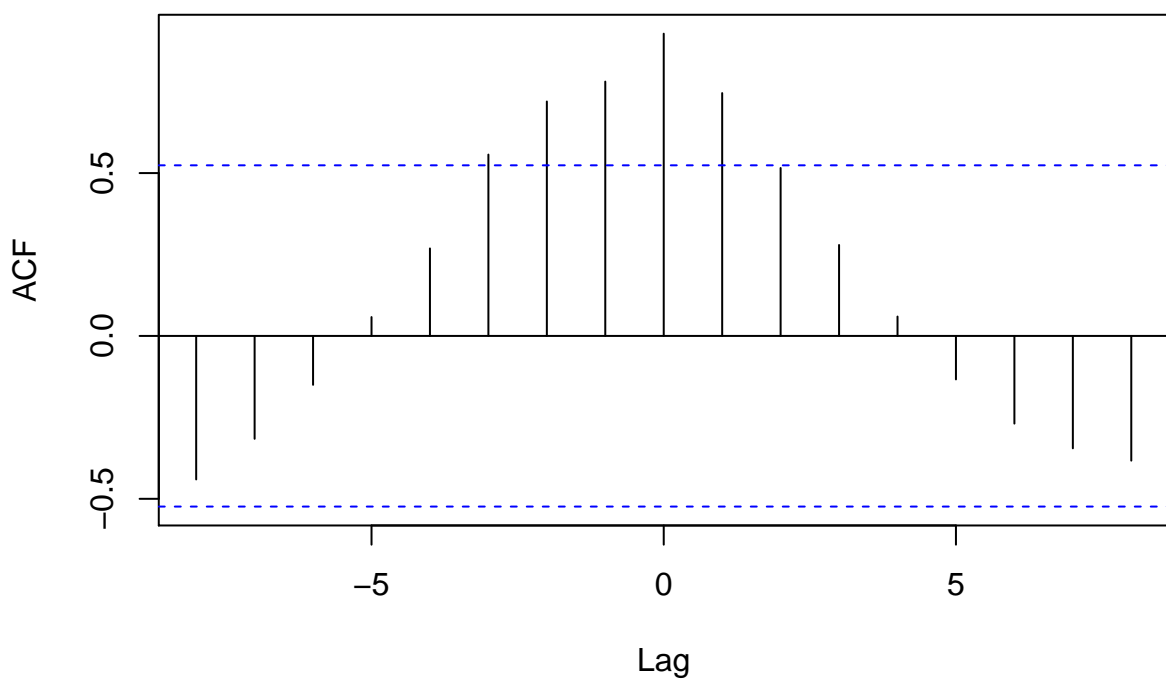


**4 wk ahead – 42**

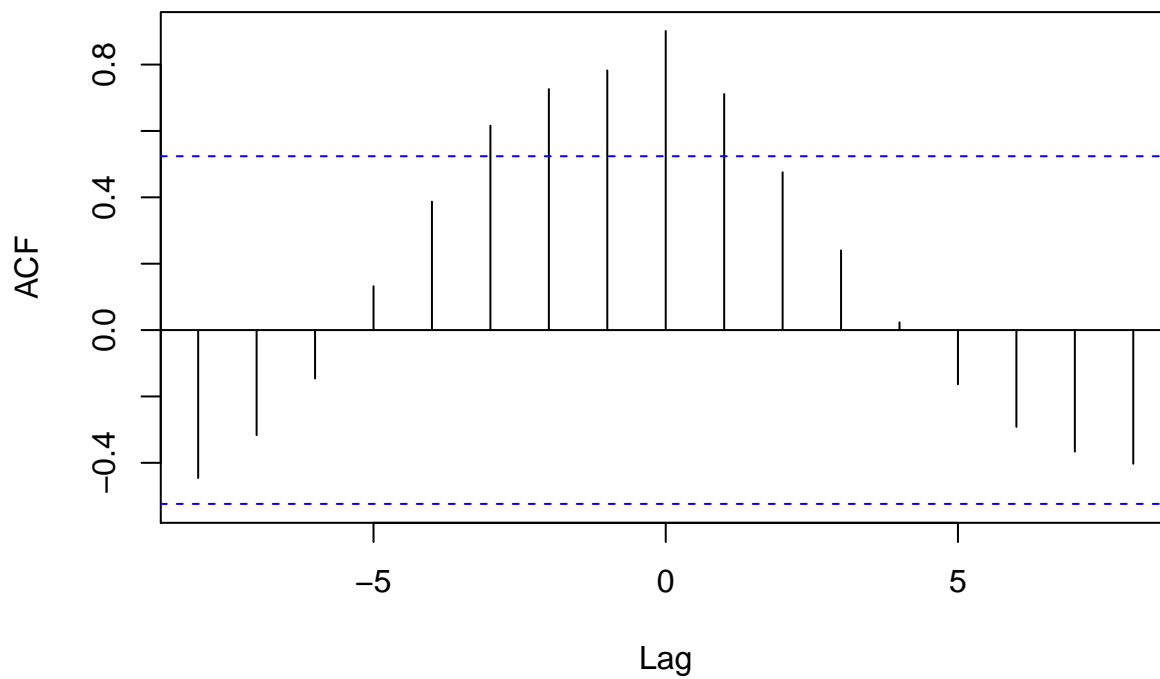




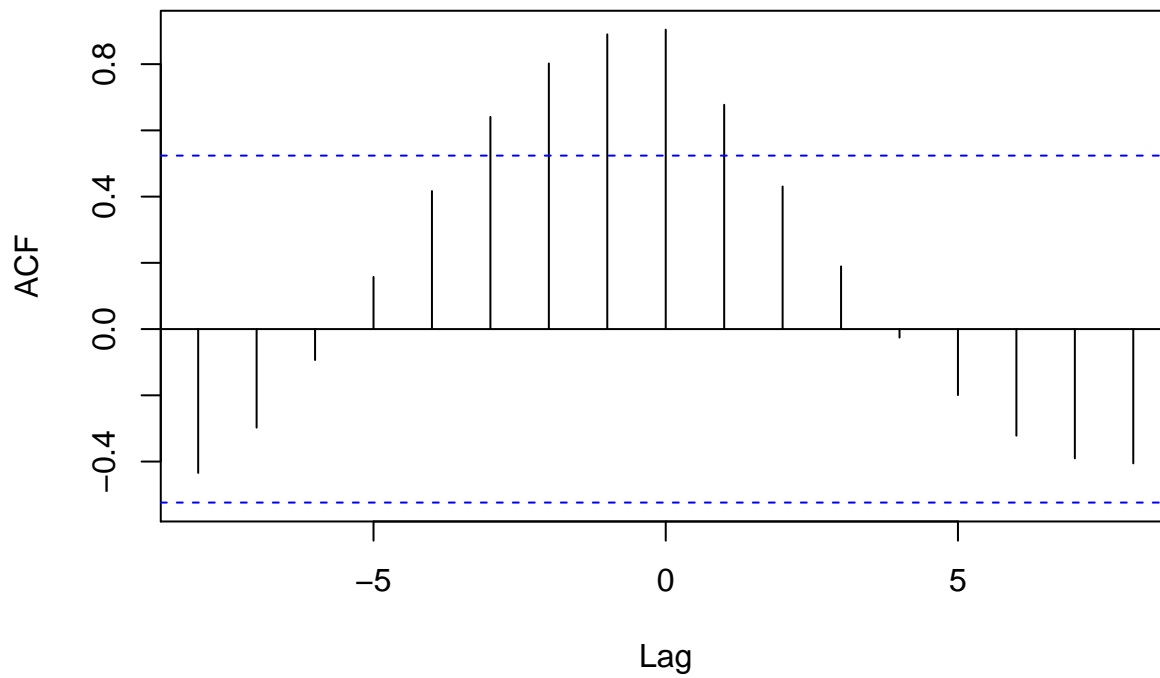
**1 wk ahead – 17**



**2 wk ahead – 17**

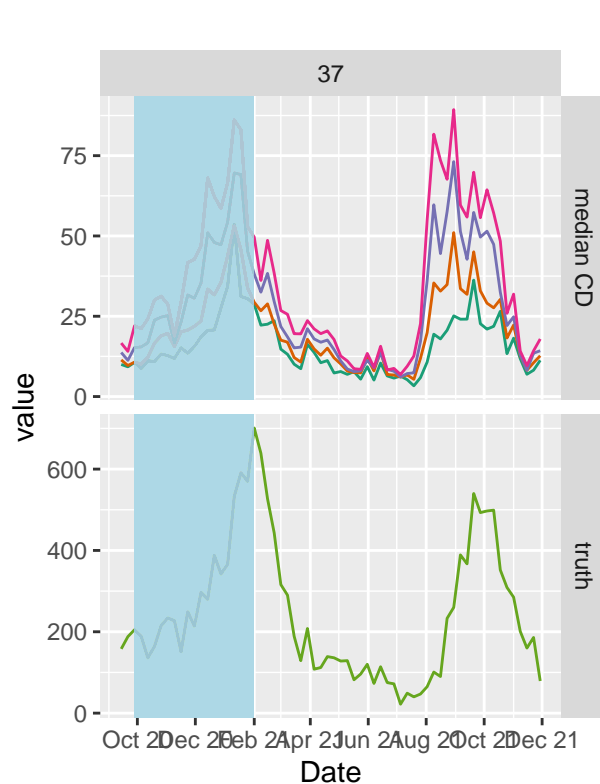
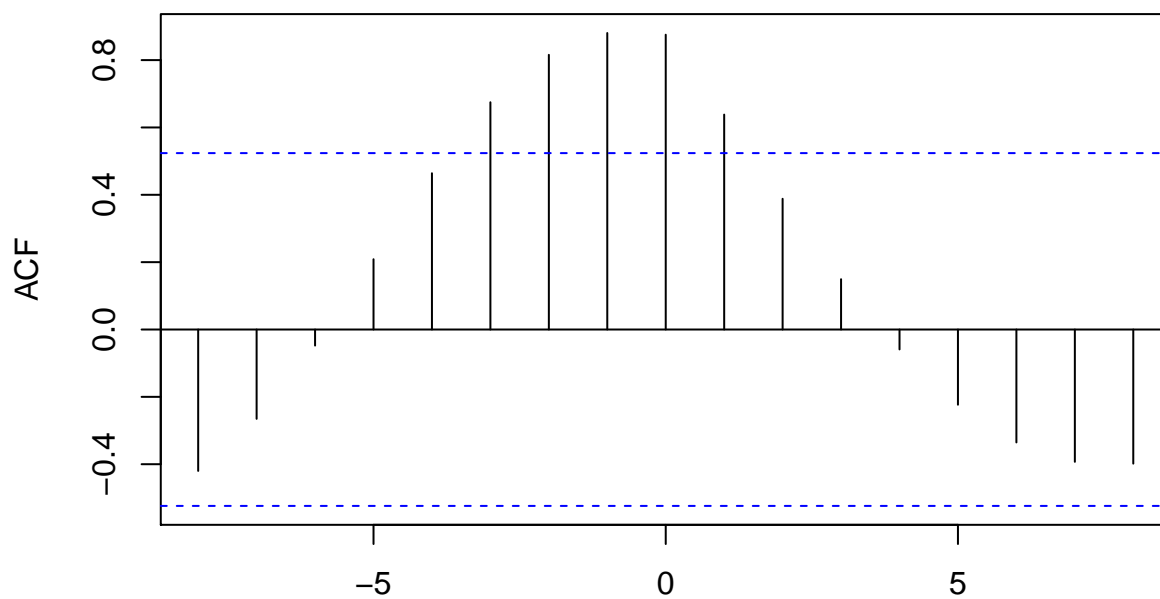


**3 wk ahead – 17**

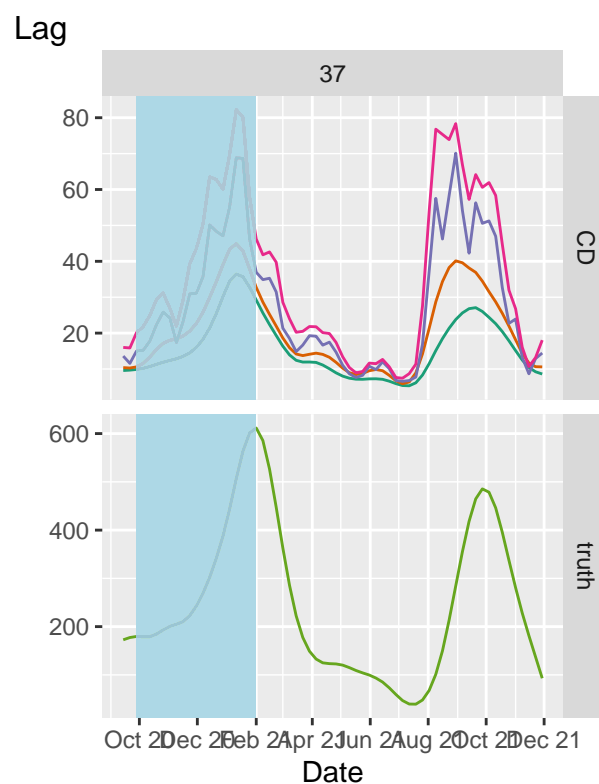




## 4 wk ahead – 17

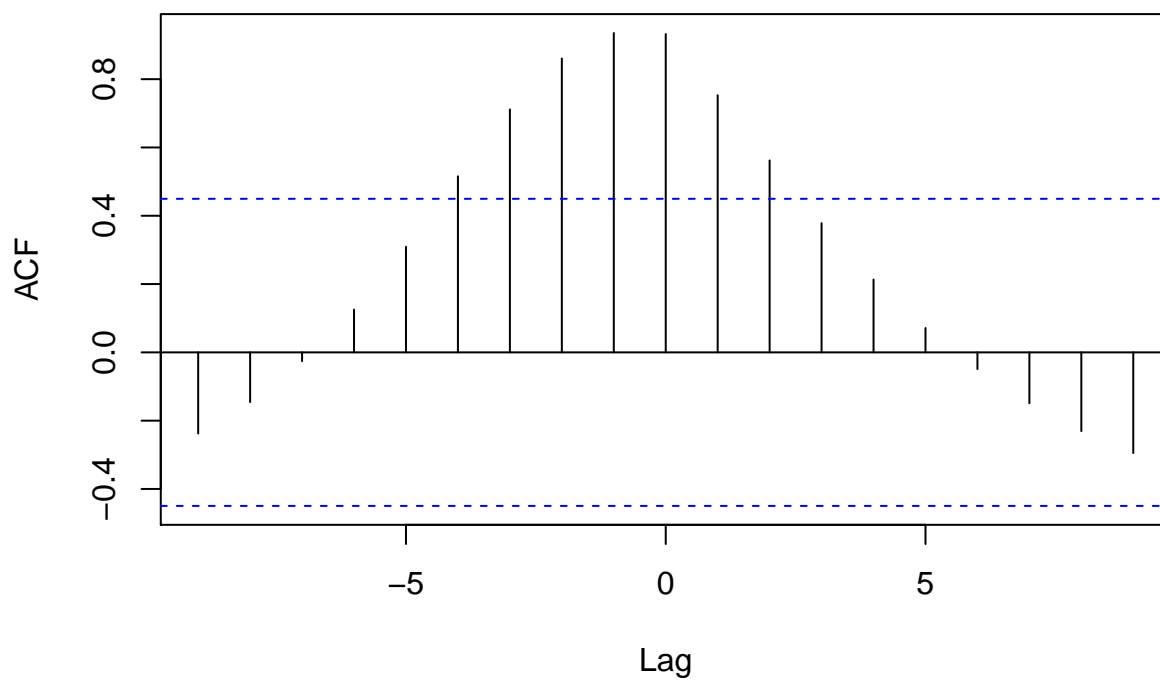


horizon 1 2 3 4 truth

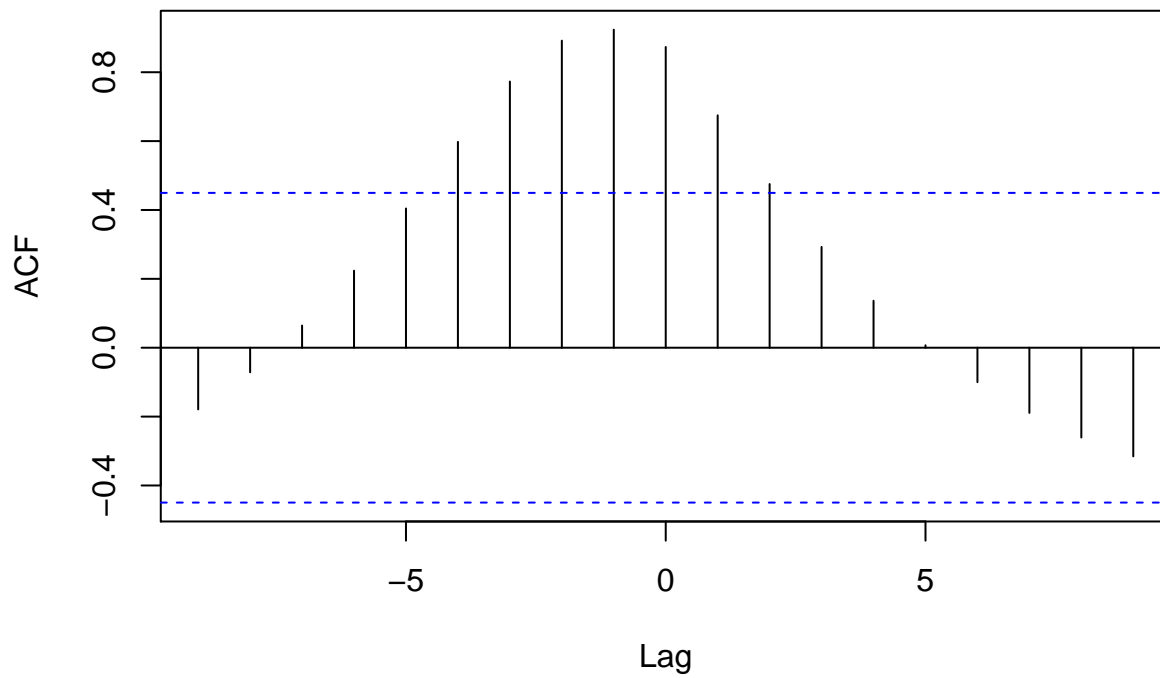


Method preprocessed\_value

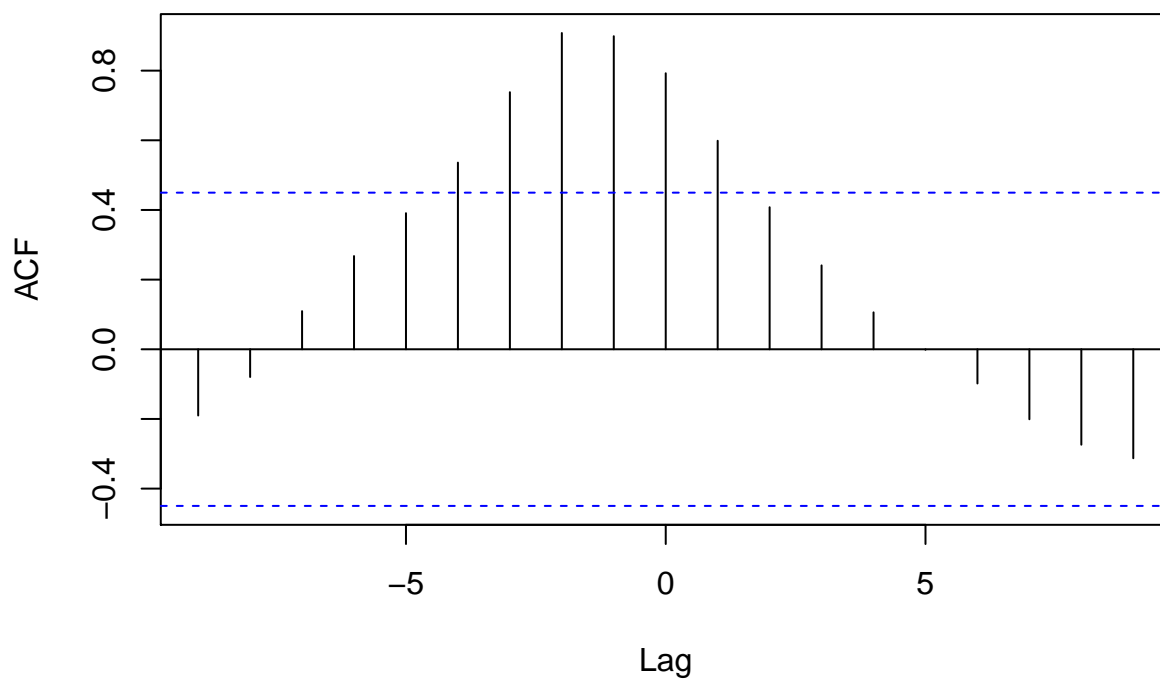
**1 wk ahead – 37**



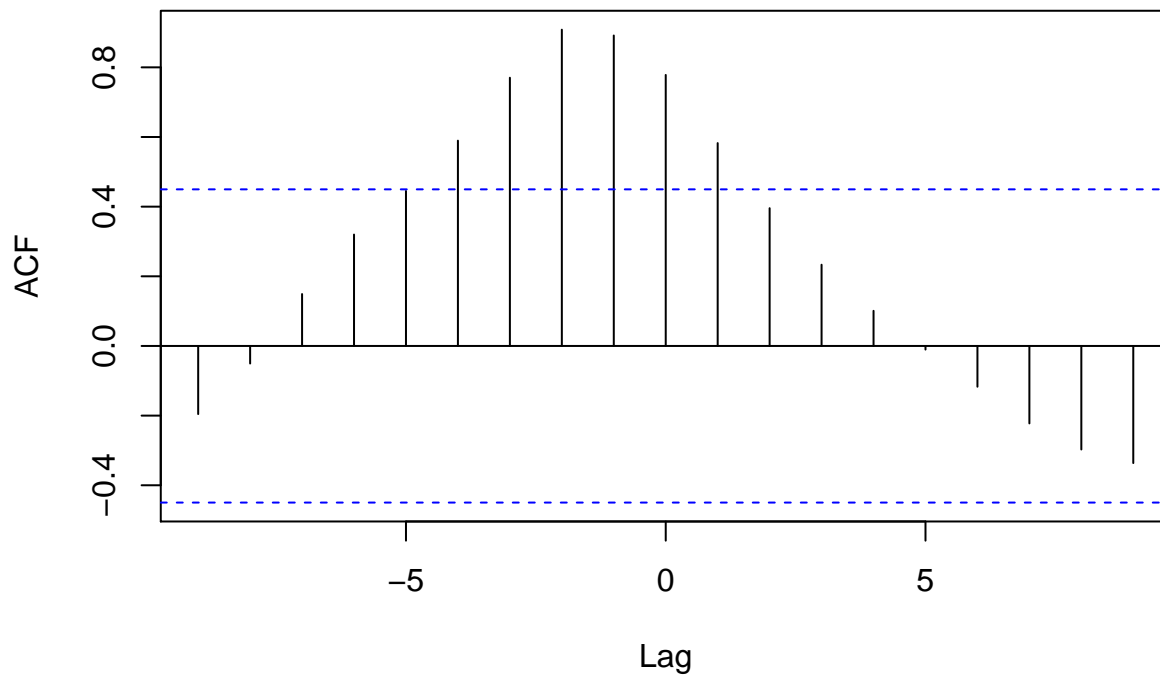
**2 wk ahead – 37**

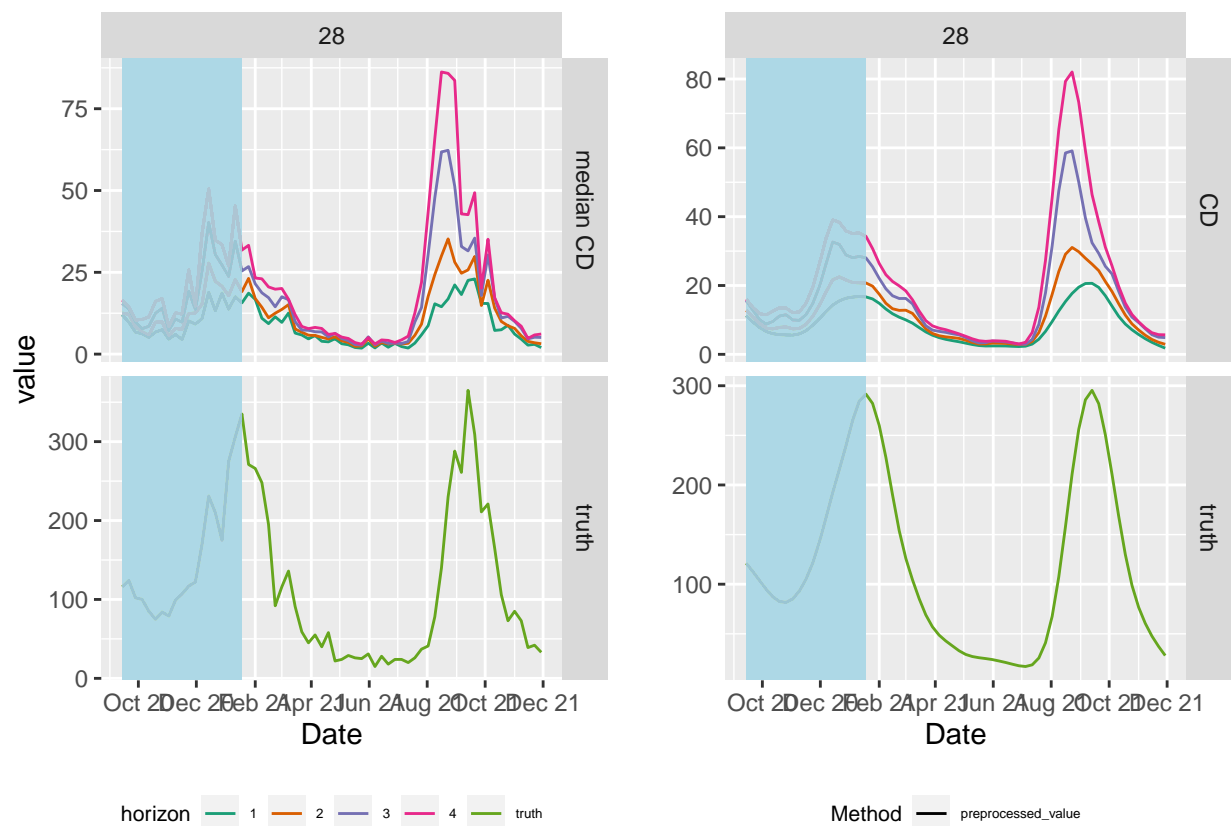


**3 wk ahead – 37**

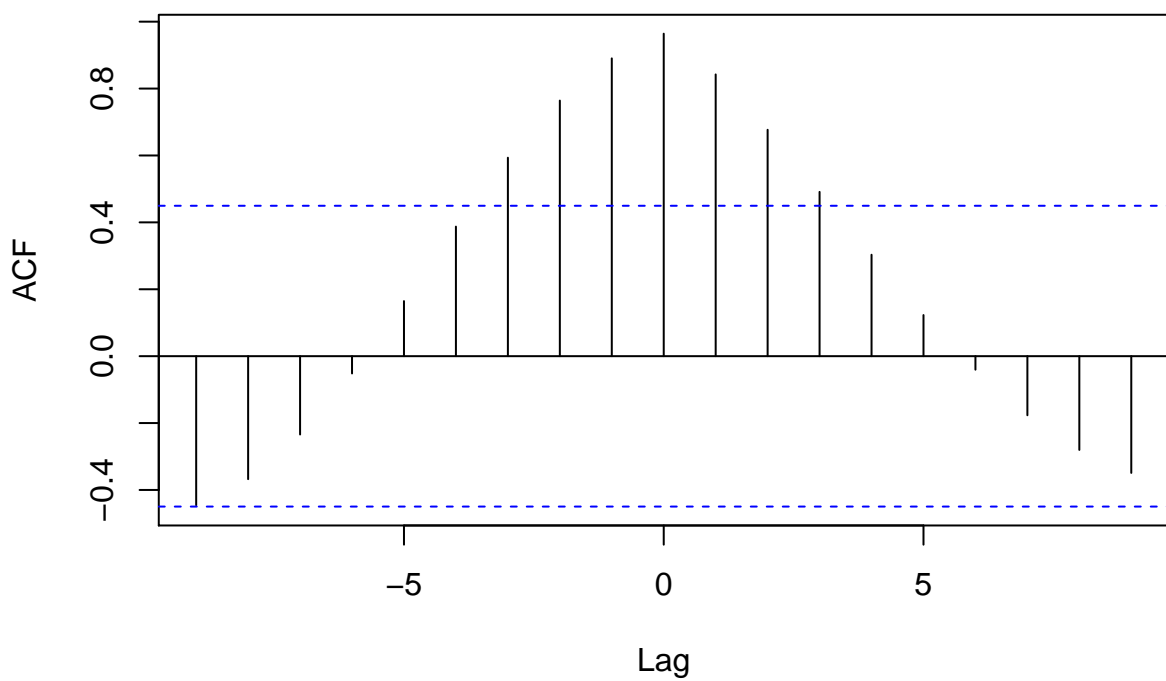


**4 wk ahead – 37**

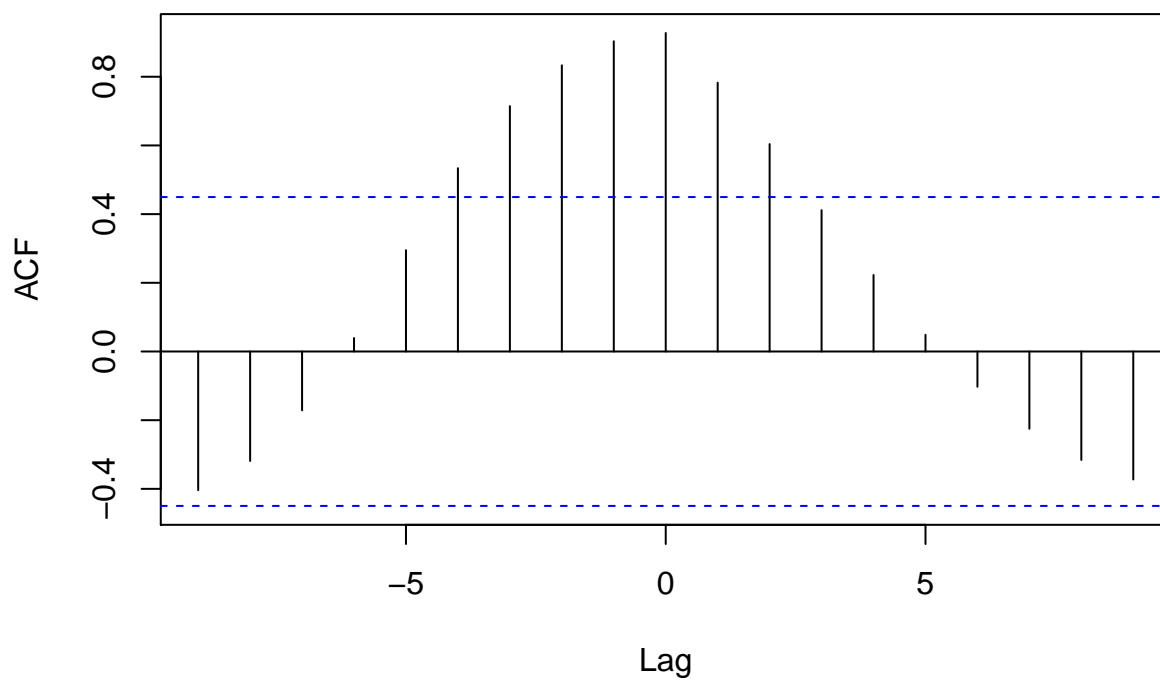




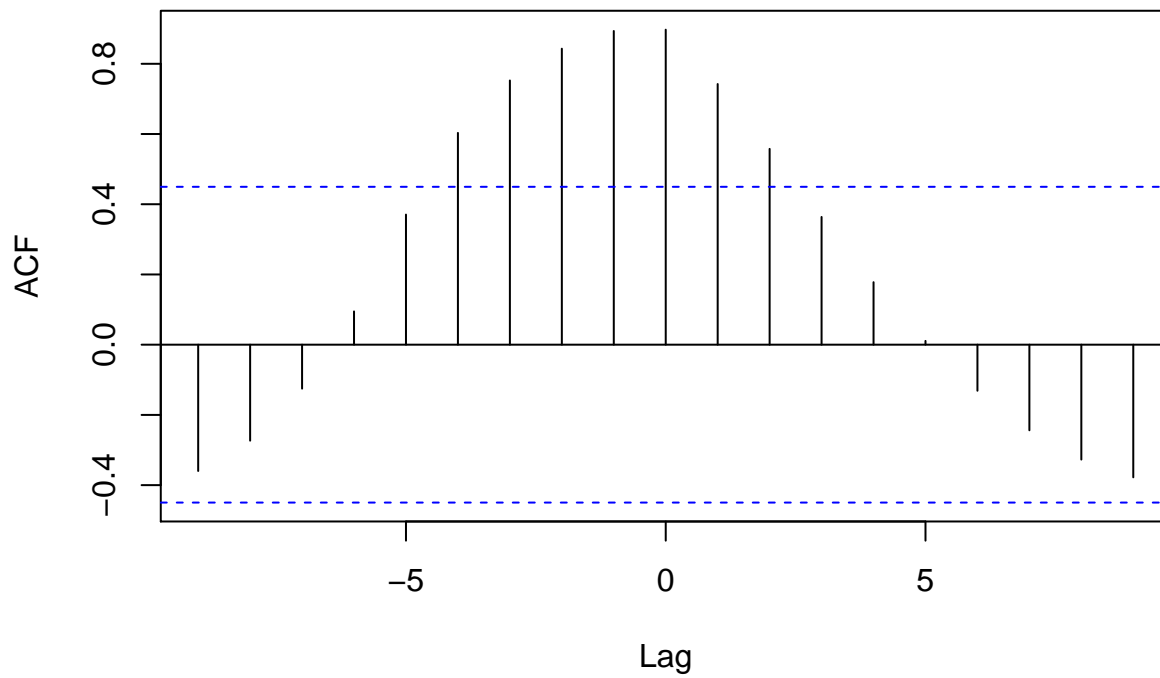
### 1 wk ahead – 28



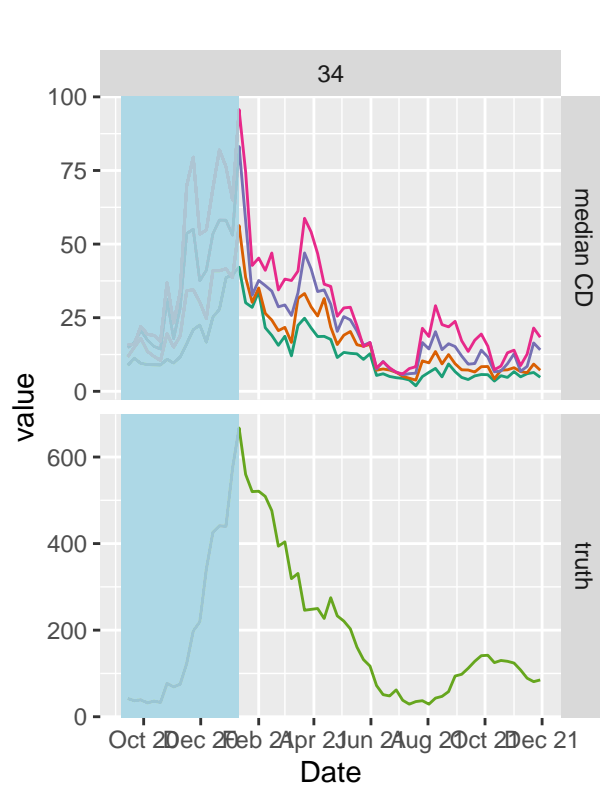
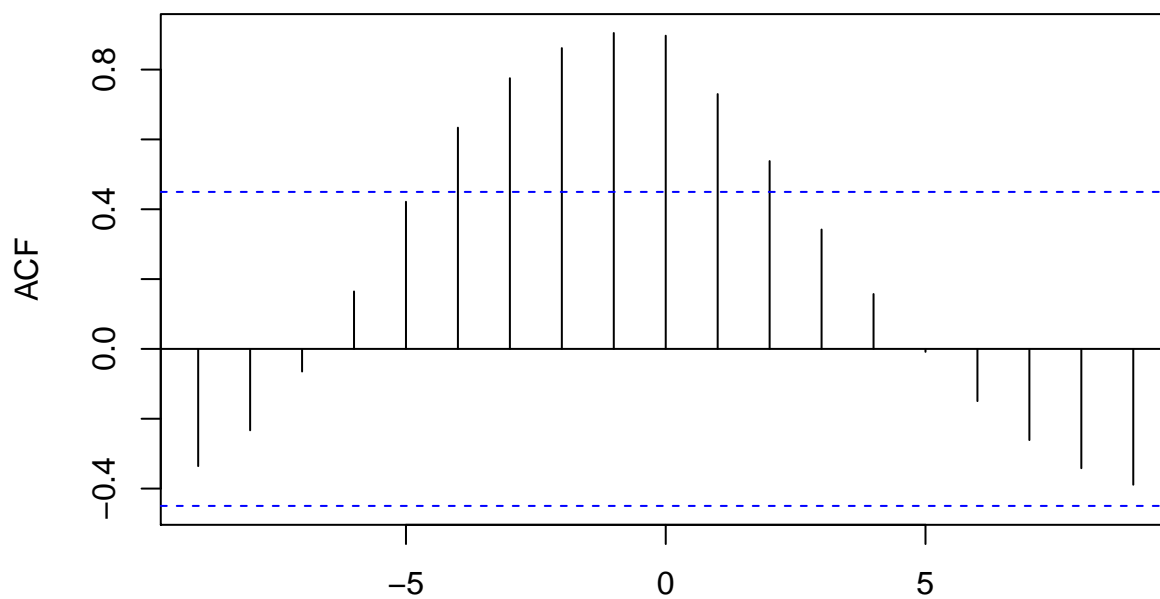
**2 wk ahead – 28**



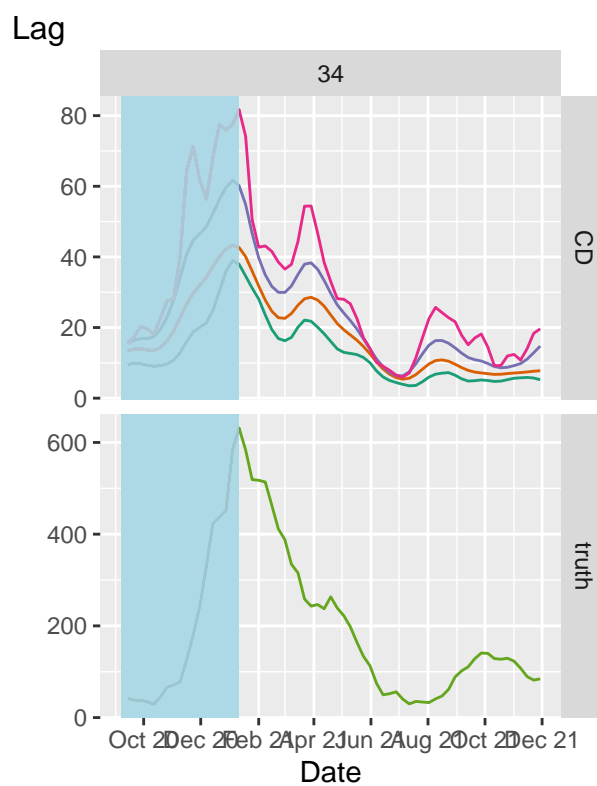
**3 wk ahead – 28**



## 4 wk ahead – 28

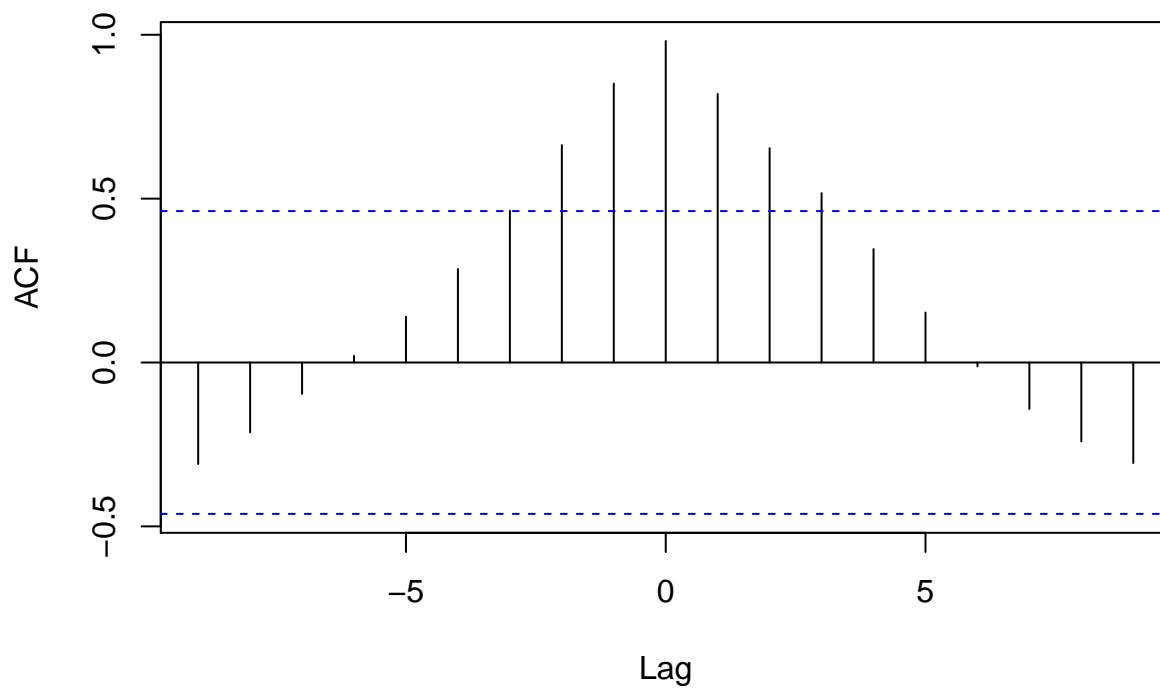


horizon 1 2 3 4 truth

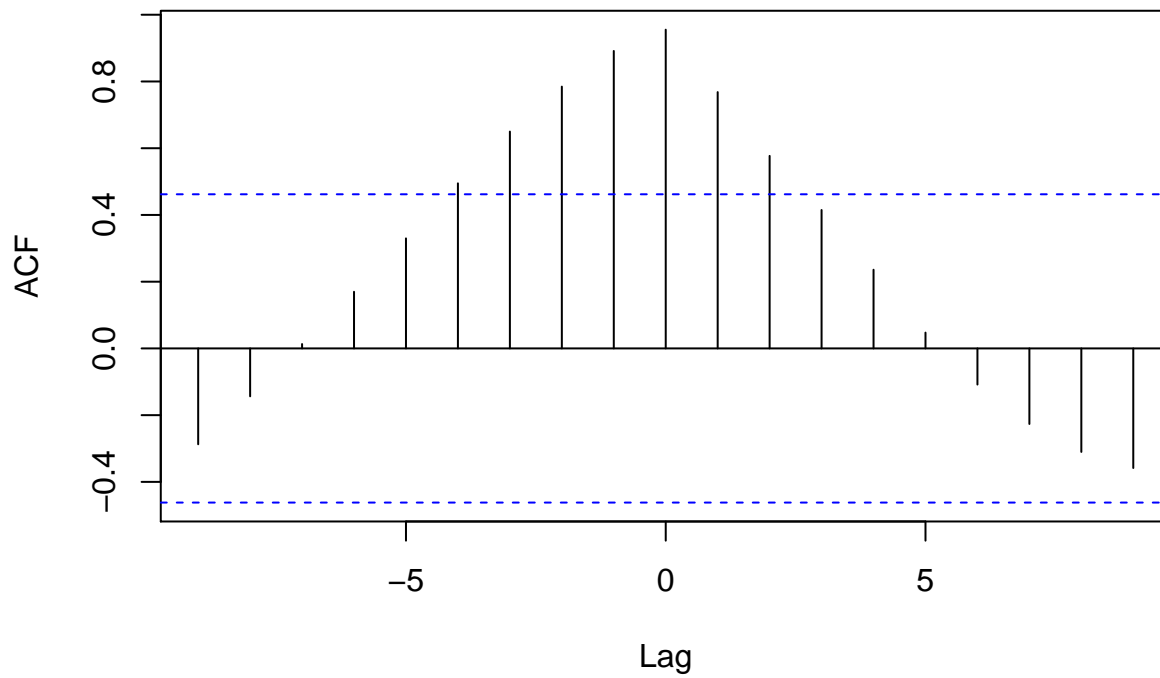


Method preprocessed\_value

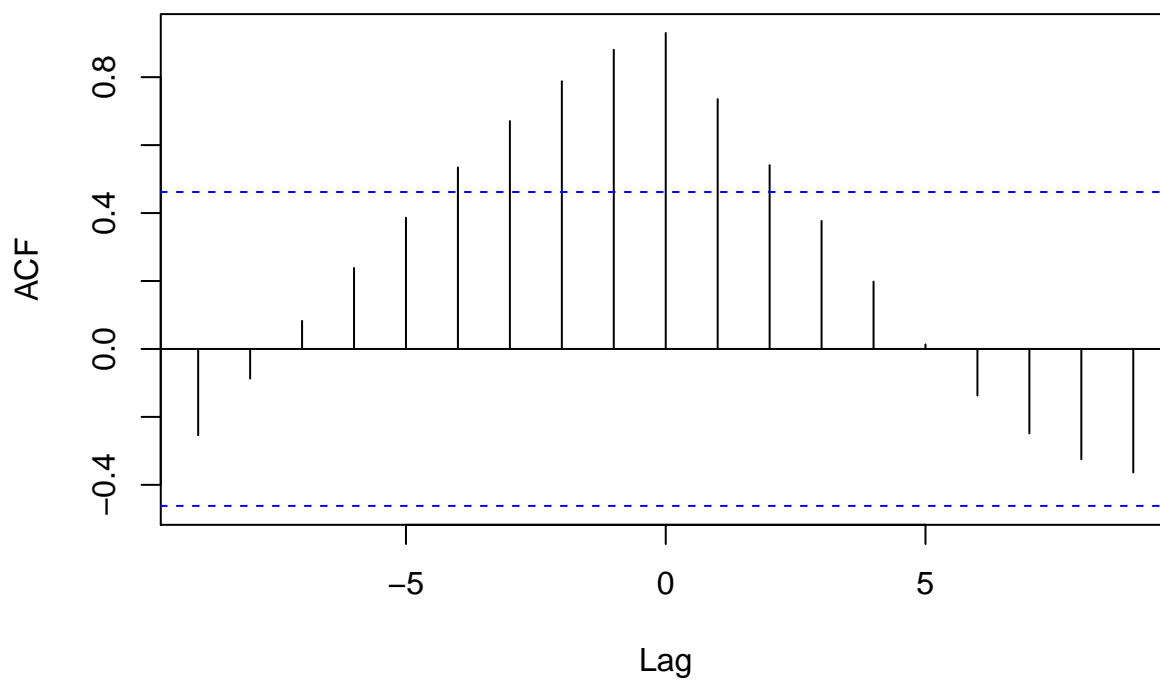
**1 wk ahead – 34**



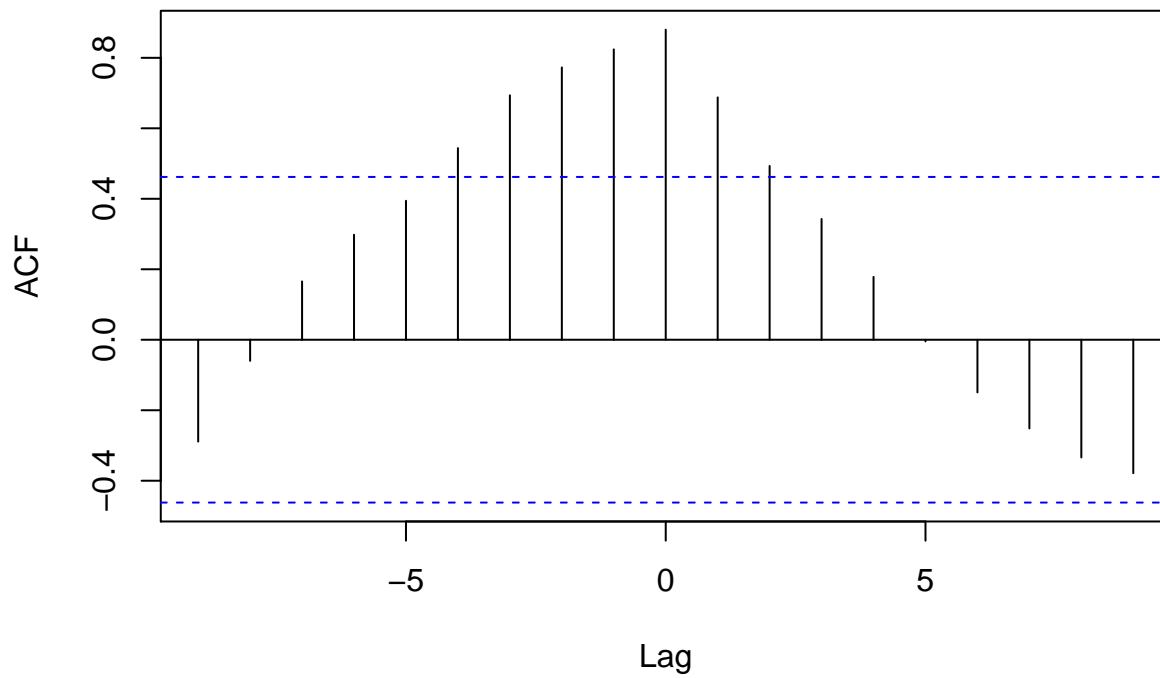
**2 wk ahead – 34**



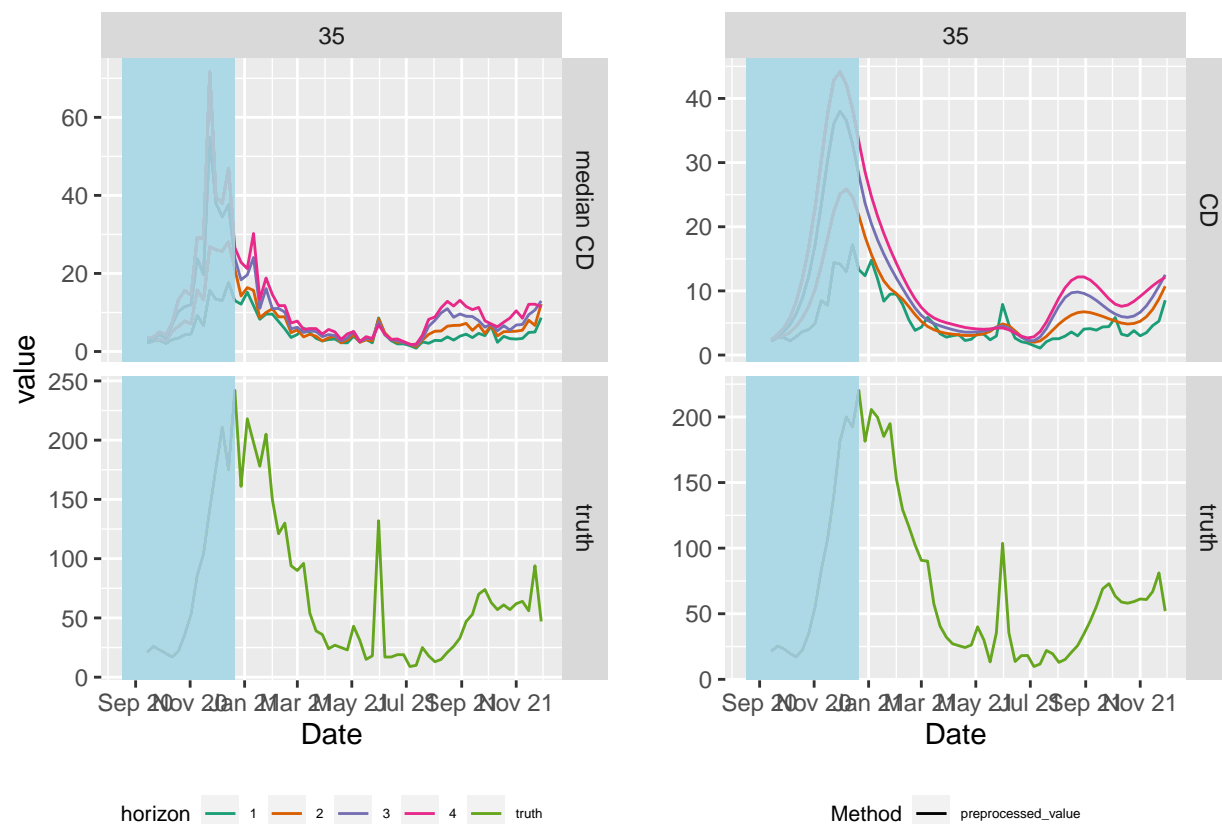
**3 wk ahead – 34**



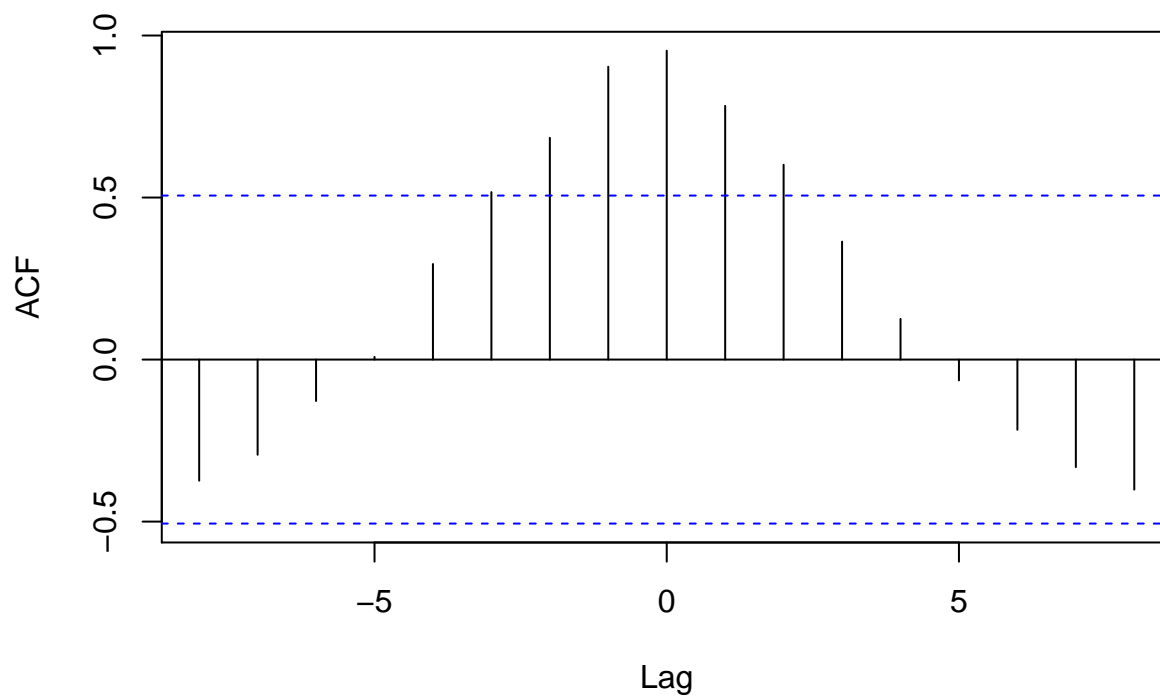
**4 wk ahead – 34**



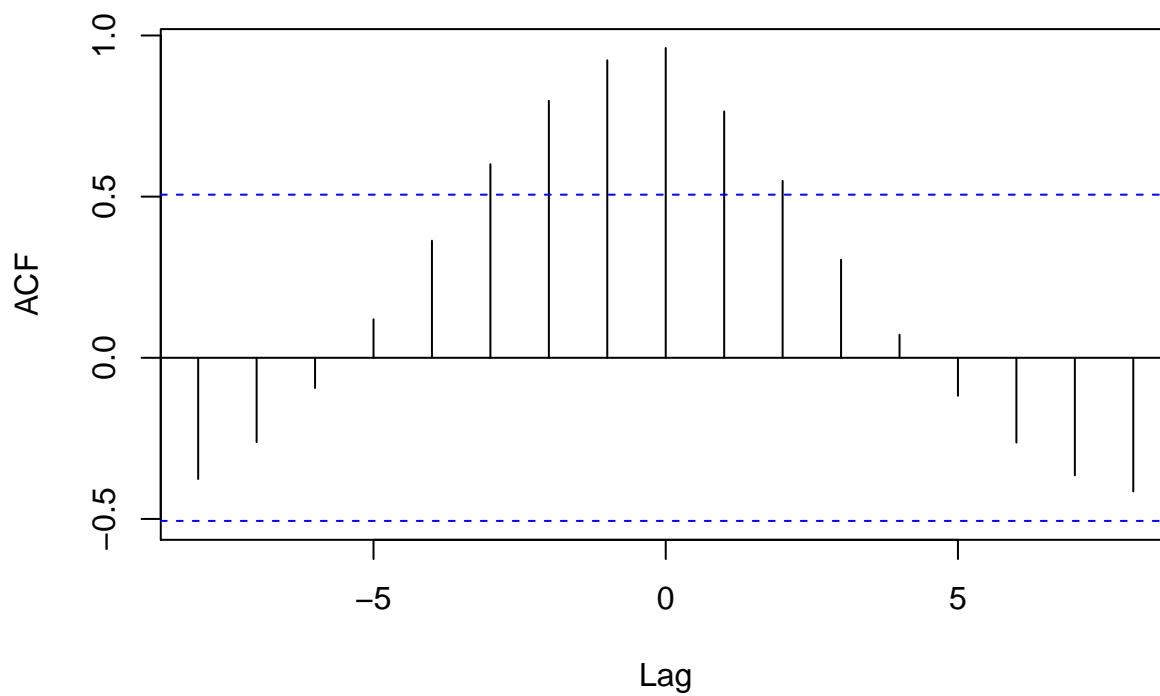




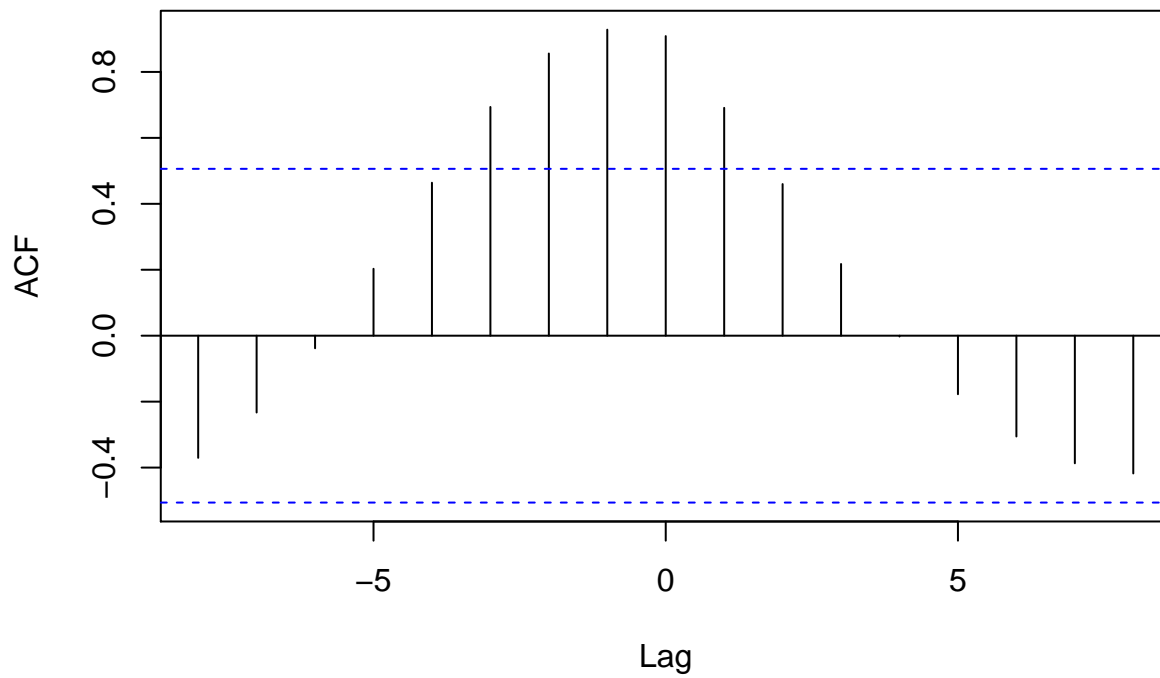
**1 wk ahead – 35**



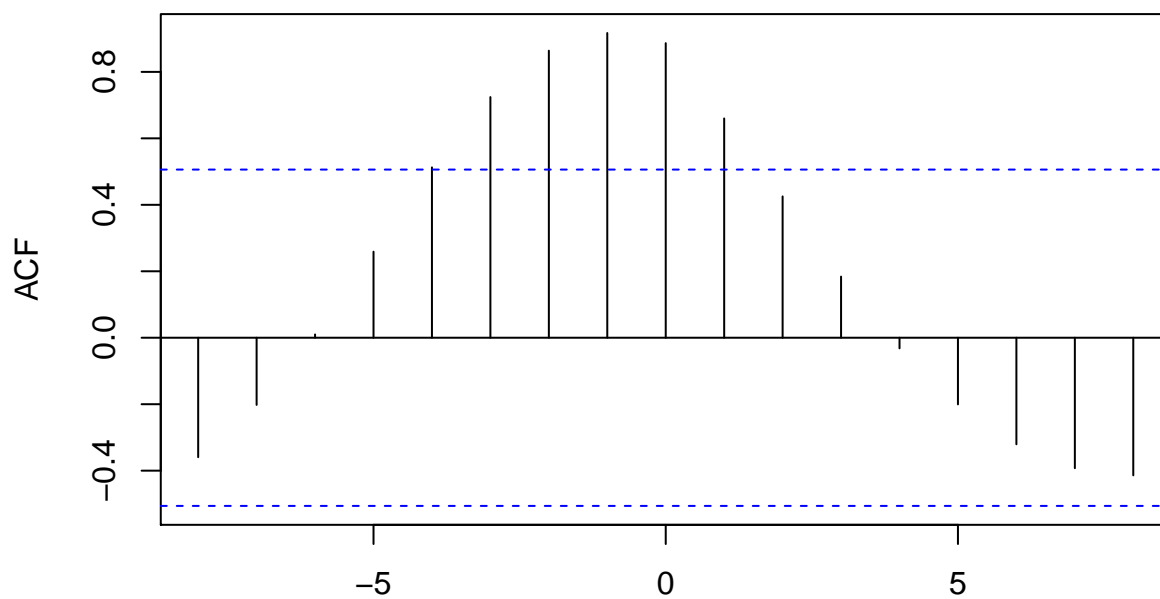
**2 wk ahead – 35**



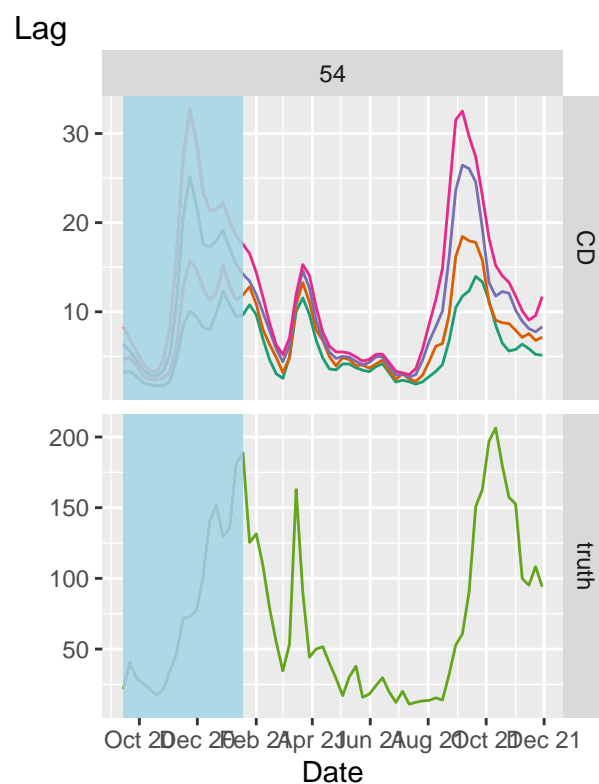
**3 wk ahead – 35**



## 4 wk ahead – 35

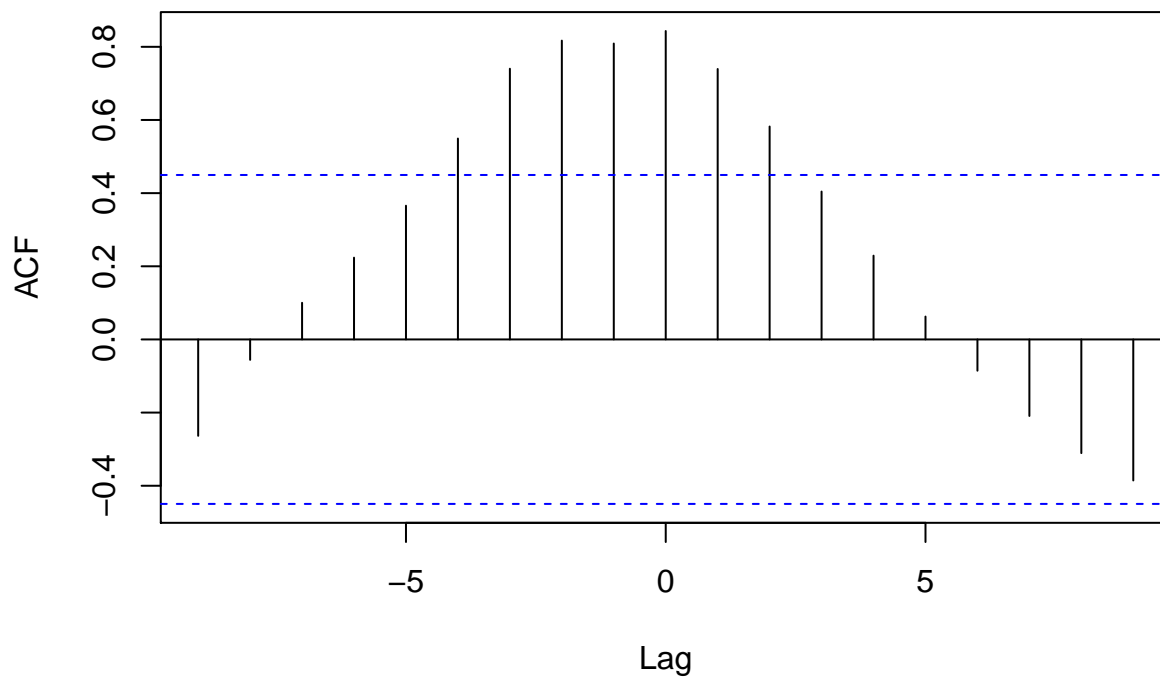


horizon 1 2 3 4 truth

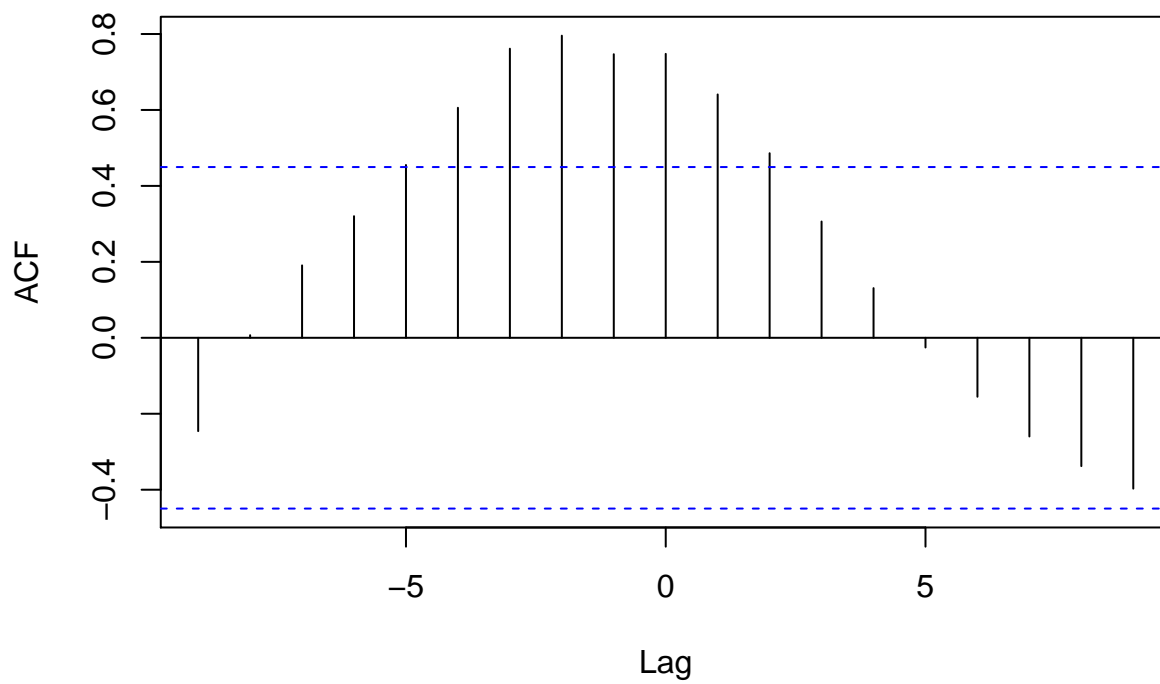


Method preprocessed\_value

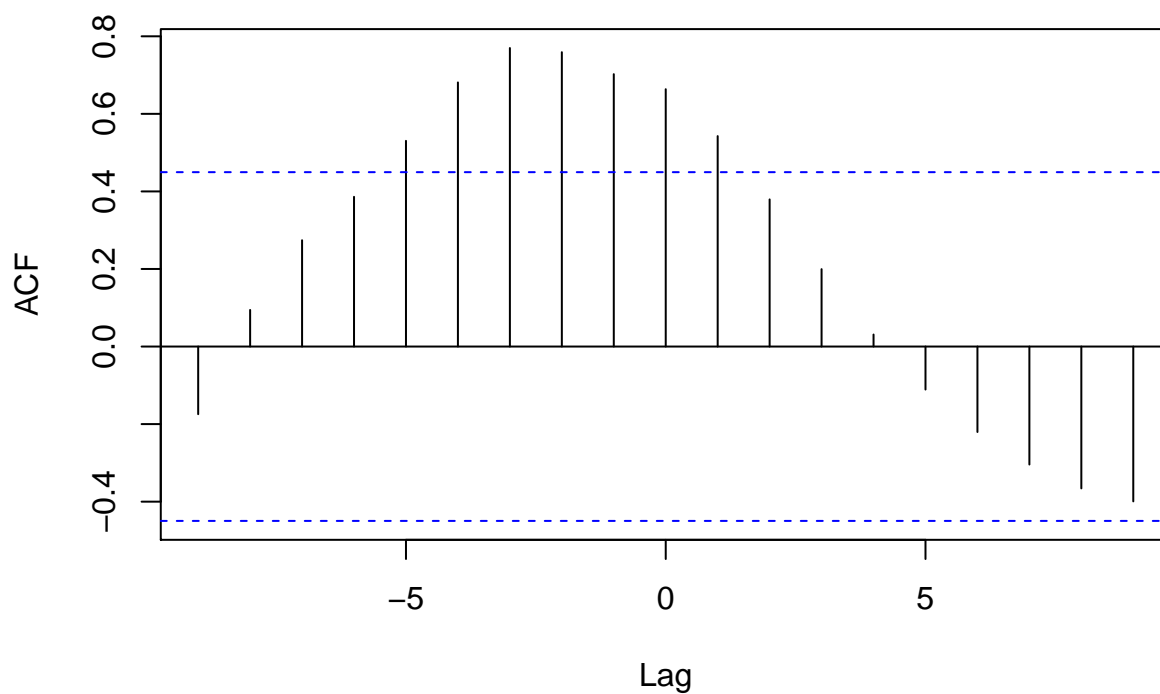
**1 wk ahead – 54**



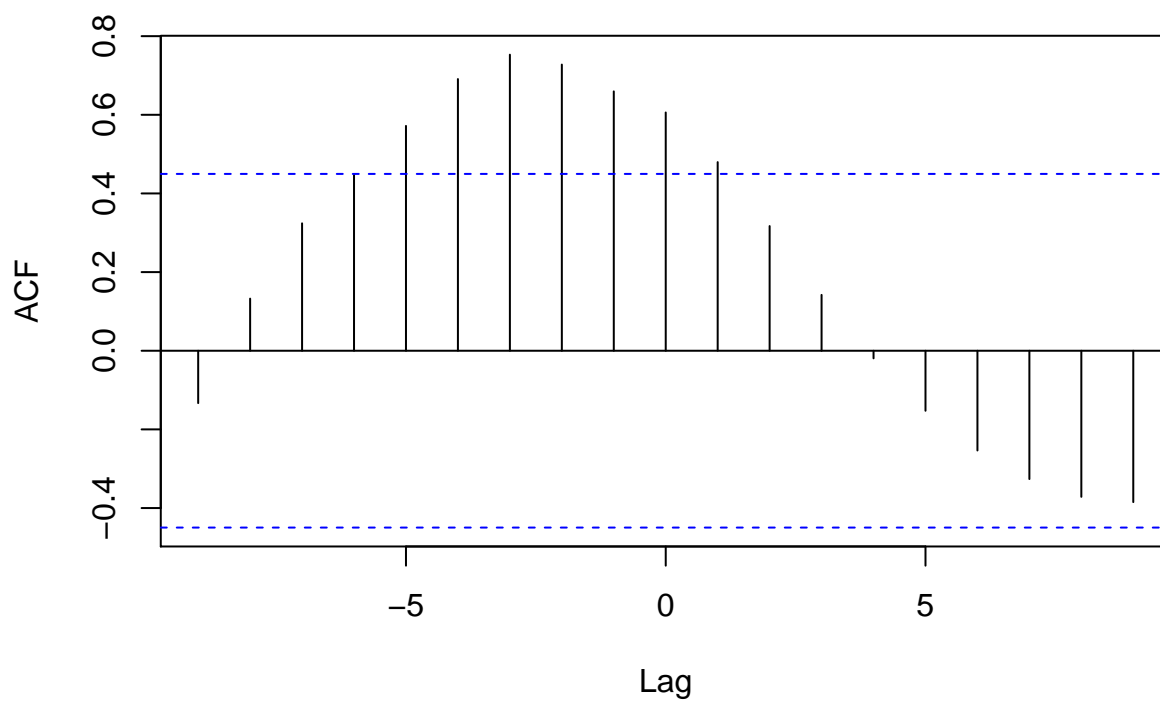
**2 wk ahead – 54**

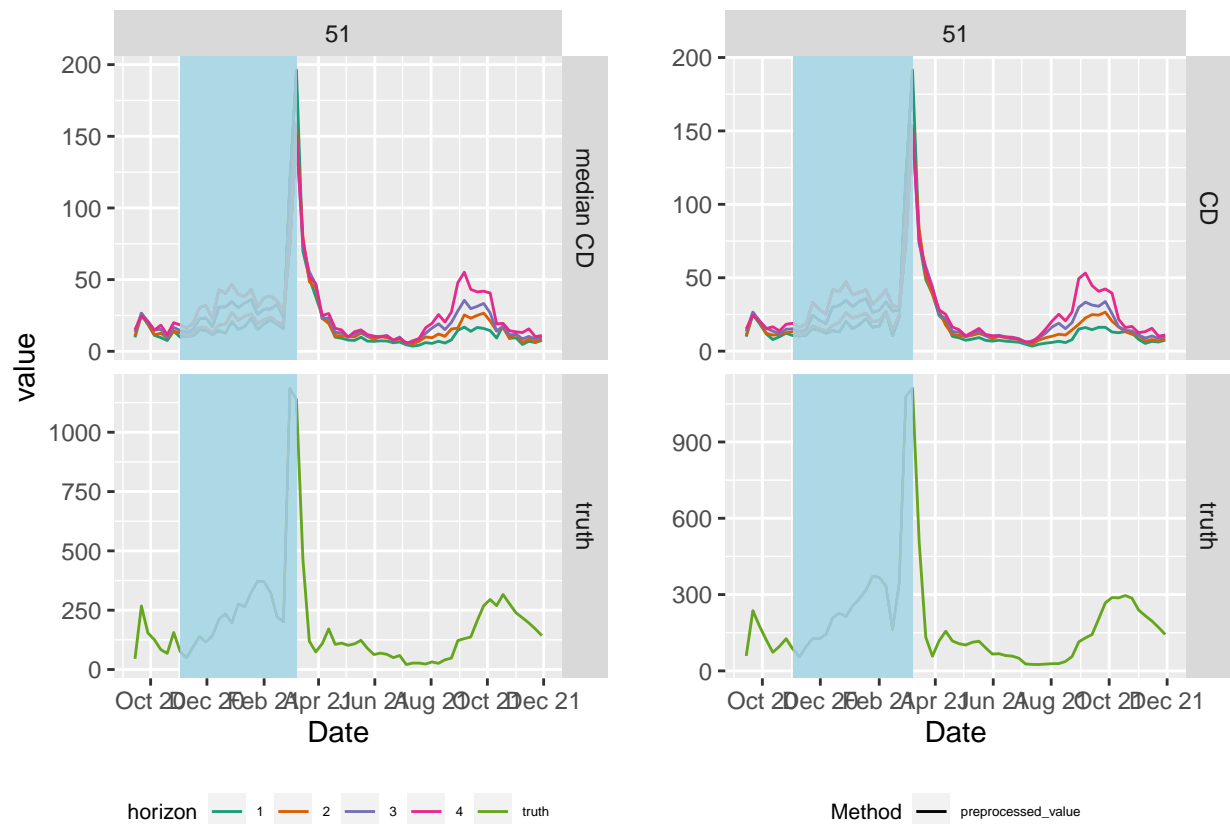


**3 wk ahead – 54**

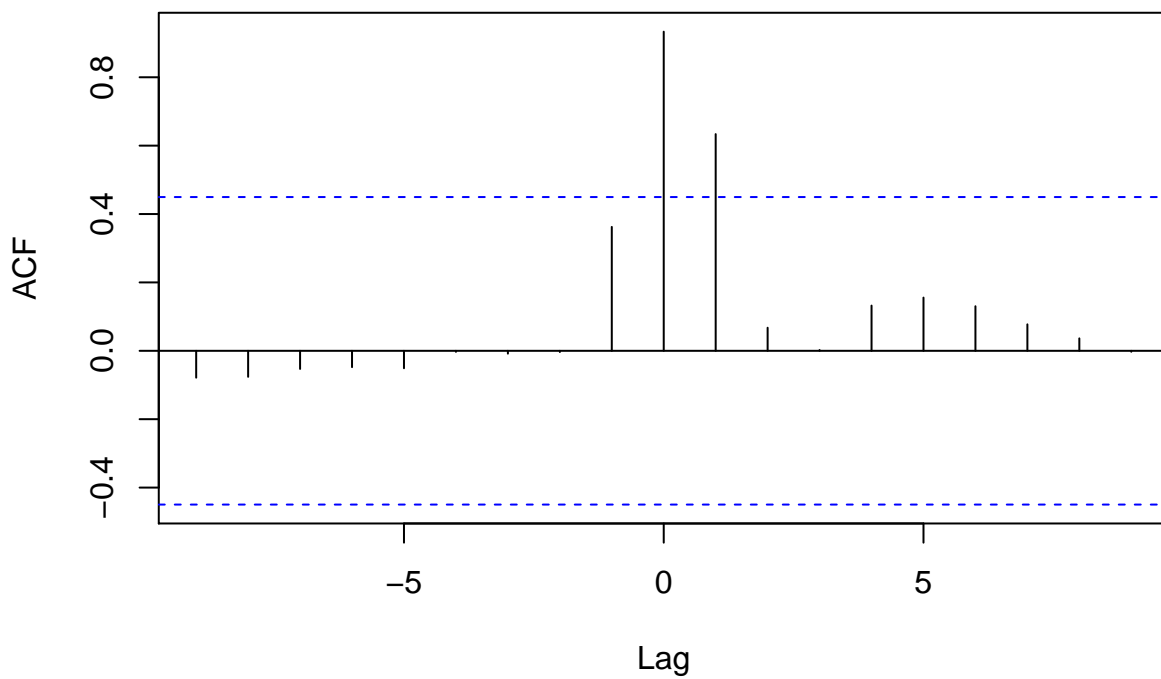


**4 wk ahead – 54**

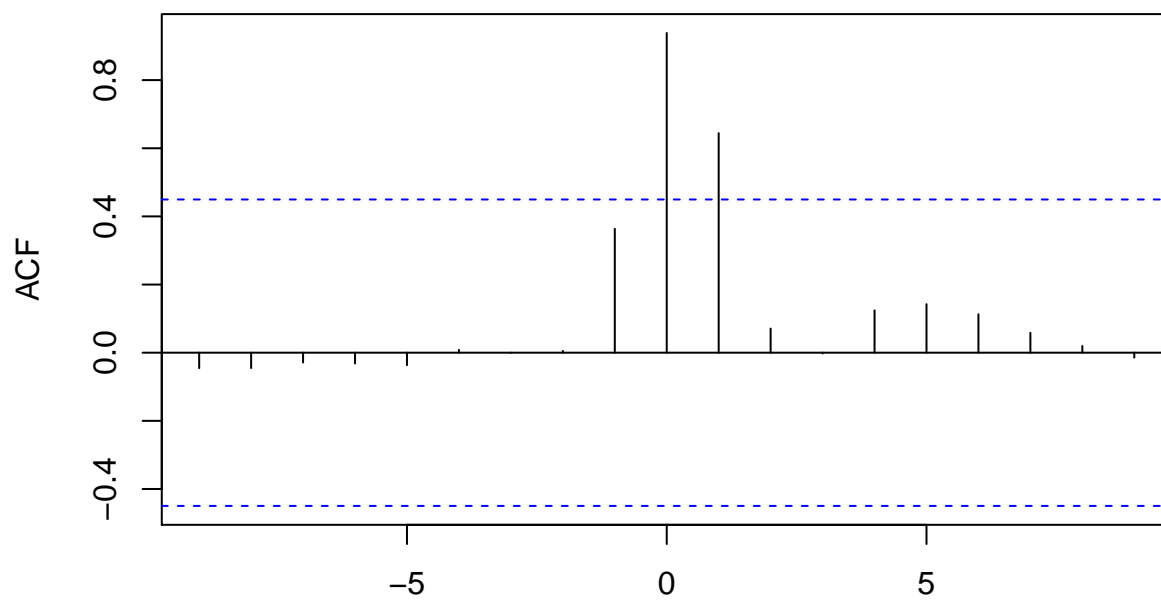




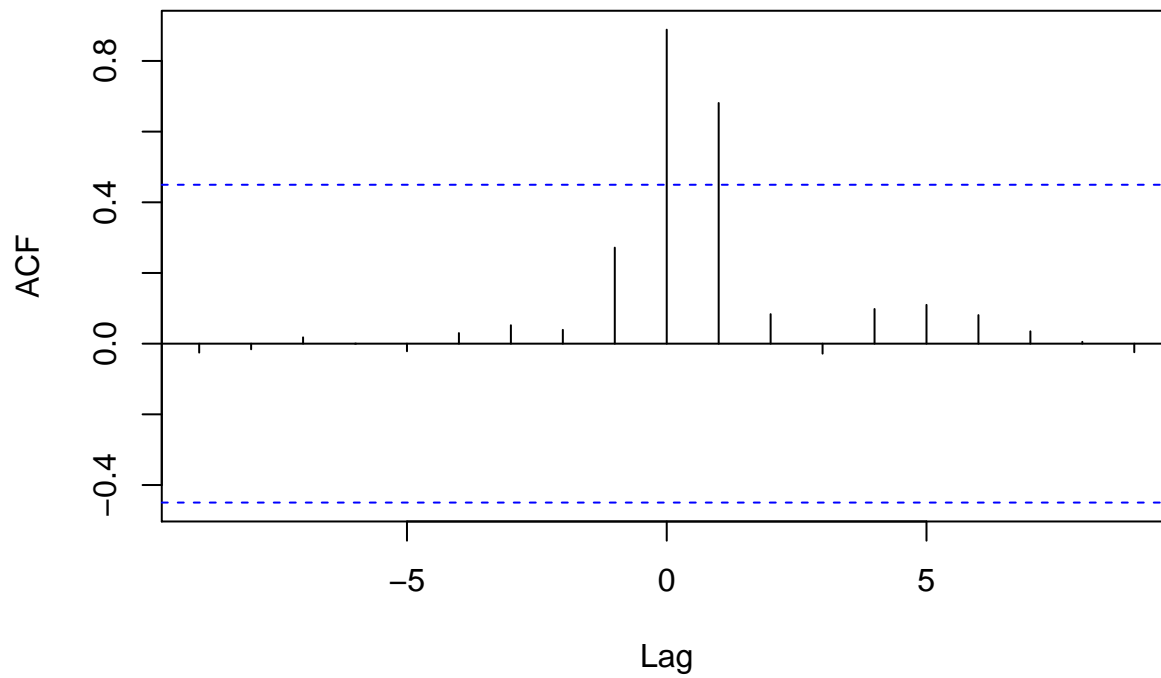
**1 wk ahead - 51**



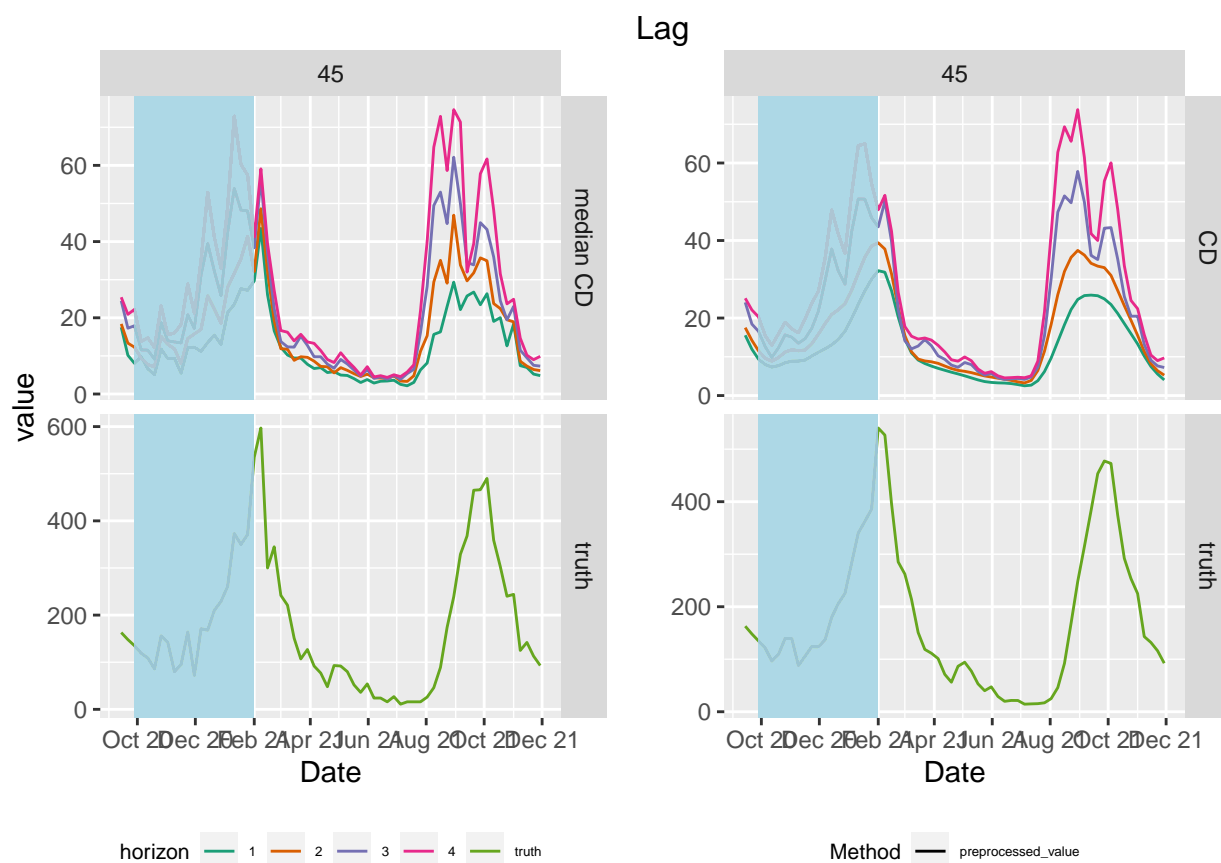
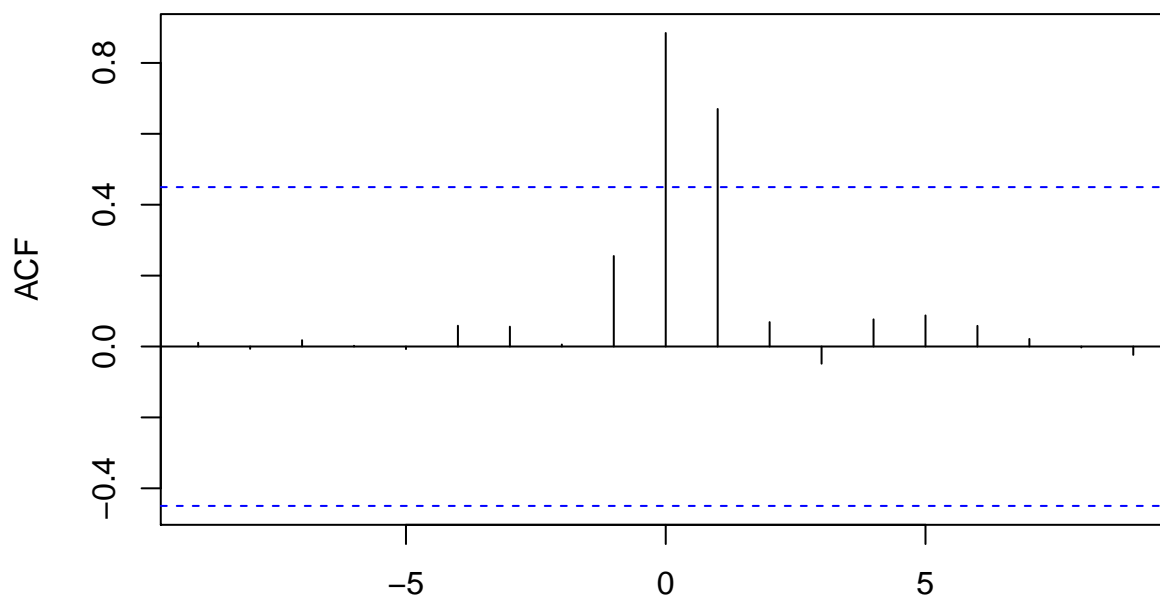
**2 wk ahead – 51**



**3 wk ahead – 51**

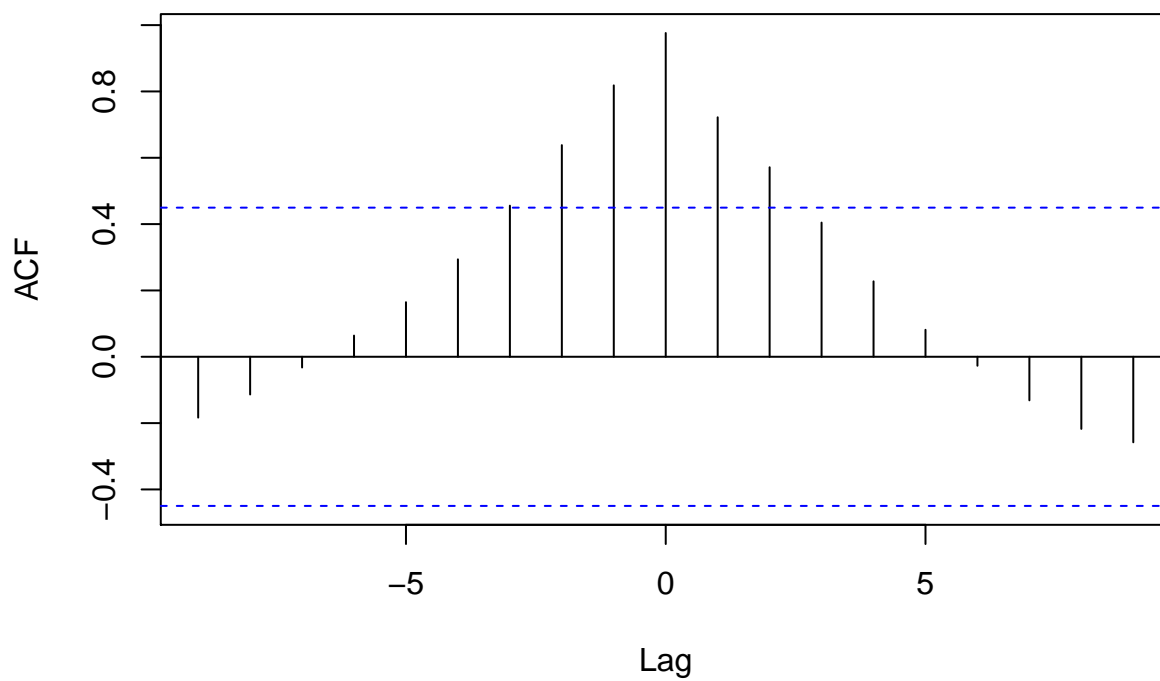


## 4 wk ahead – 51

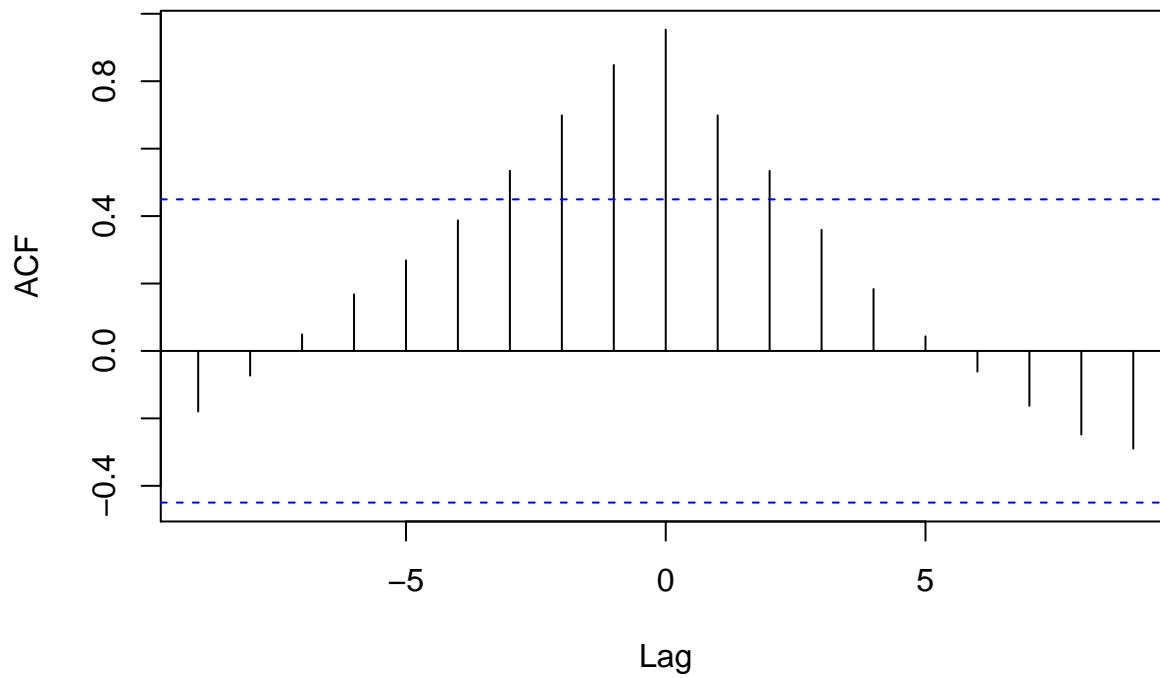




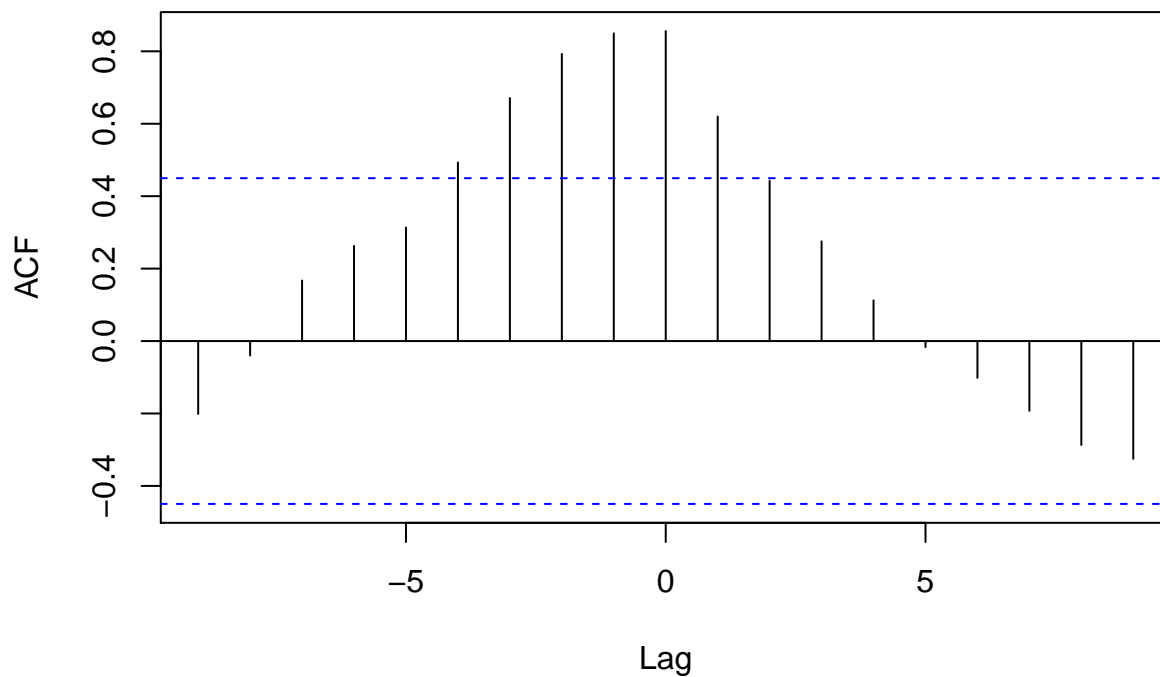
**1 wk ahead – 45**



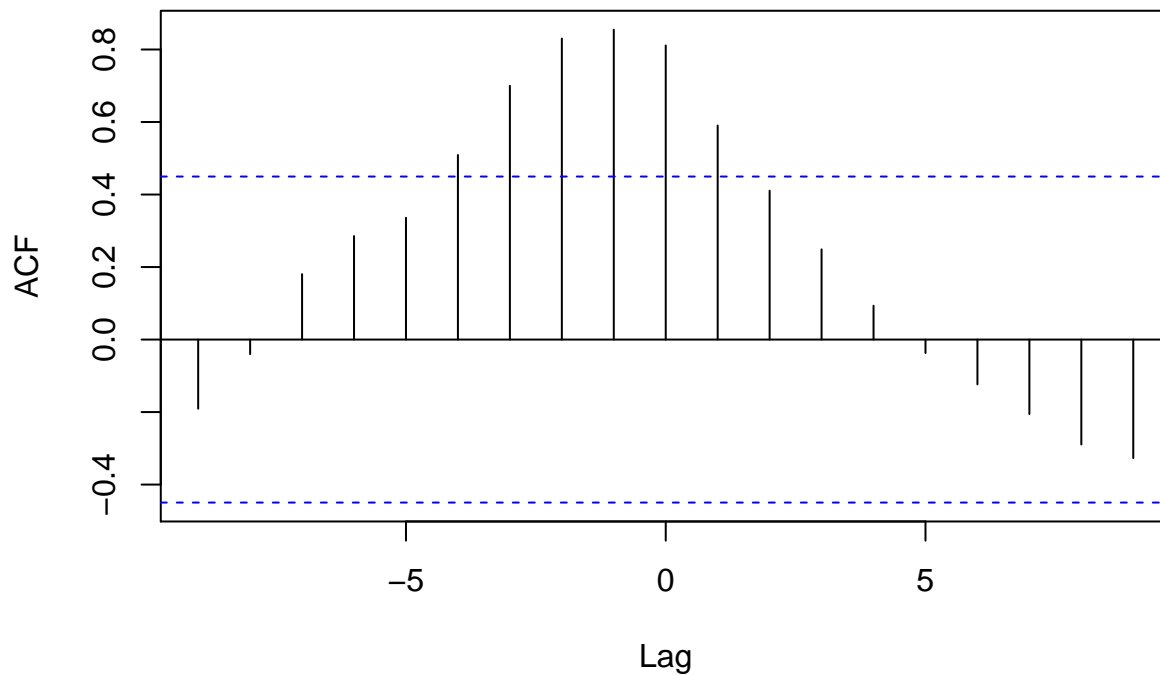
**2 wk ahead – 45**

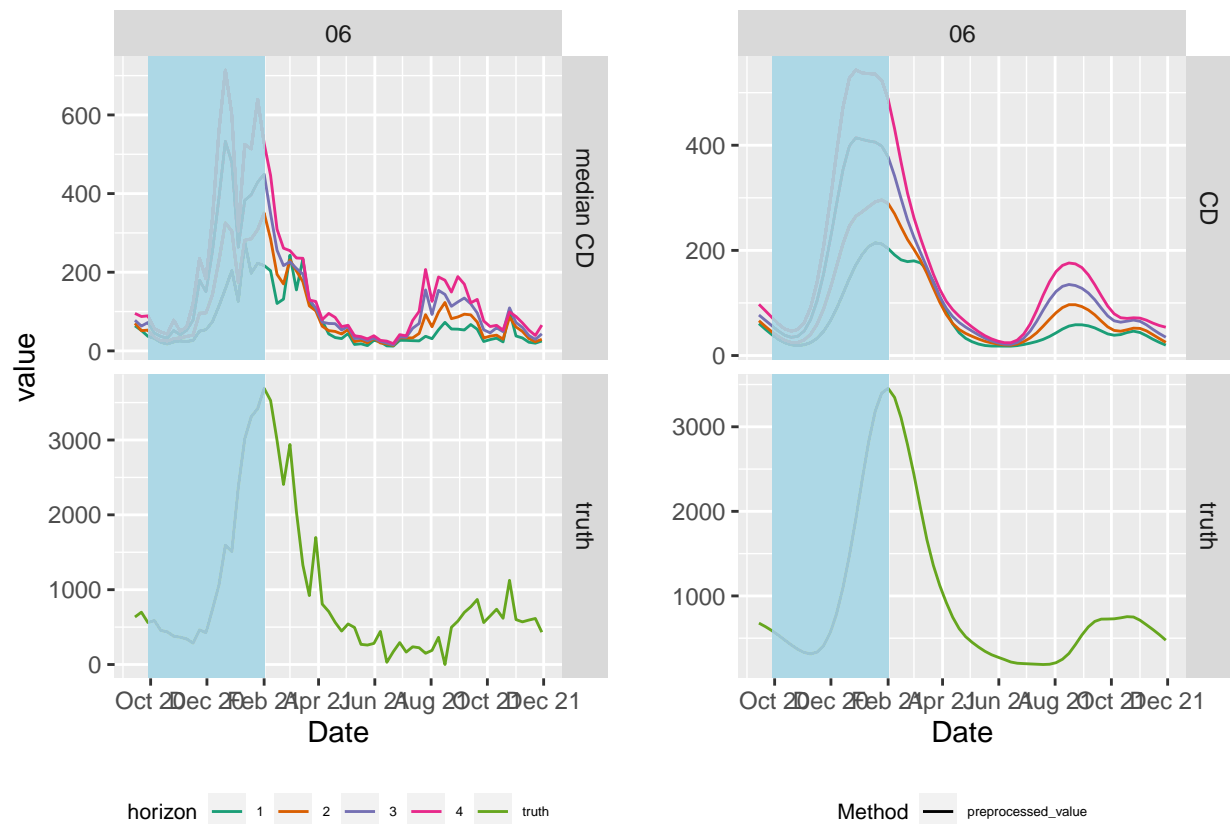


**3 wk ahead – 45**

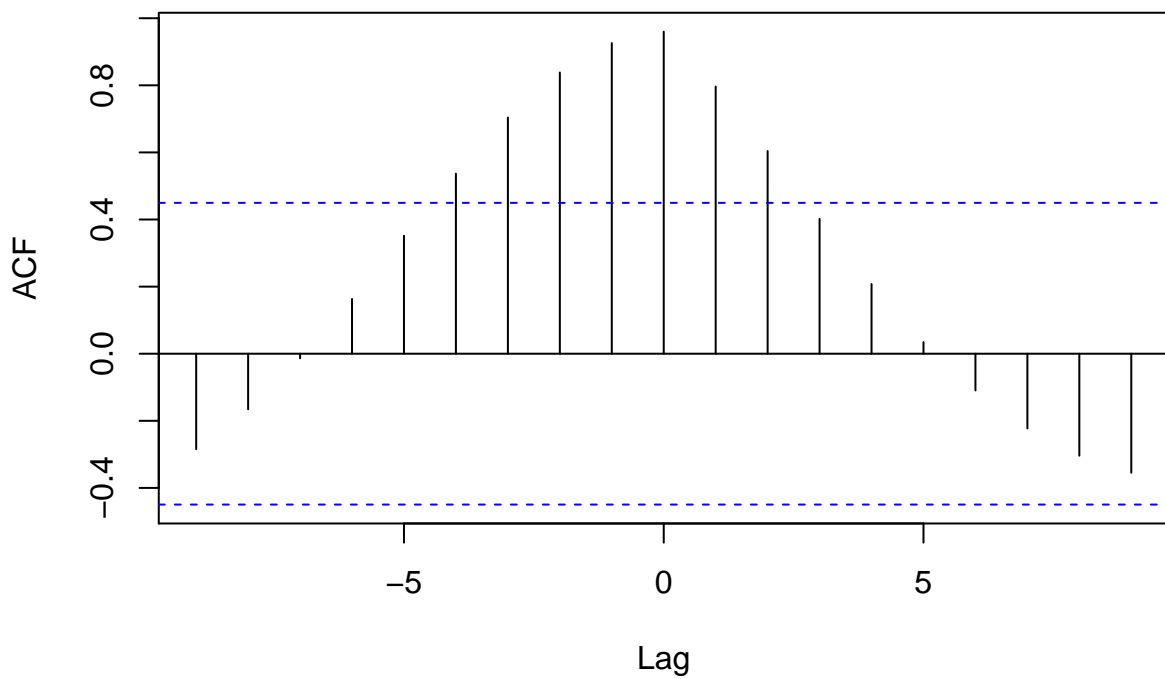


**4 wk ahead – 45**

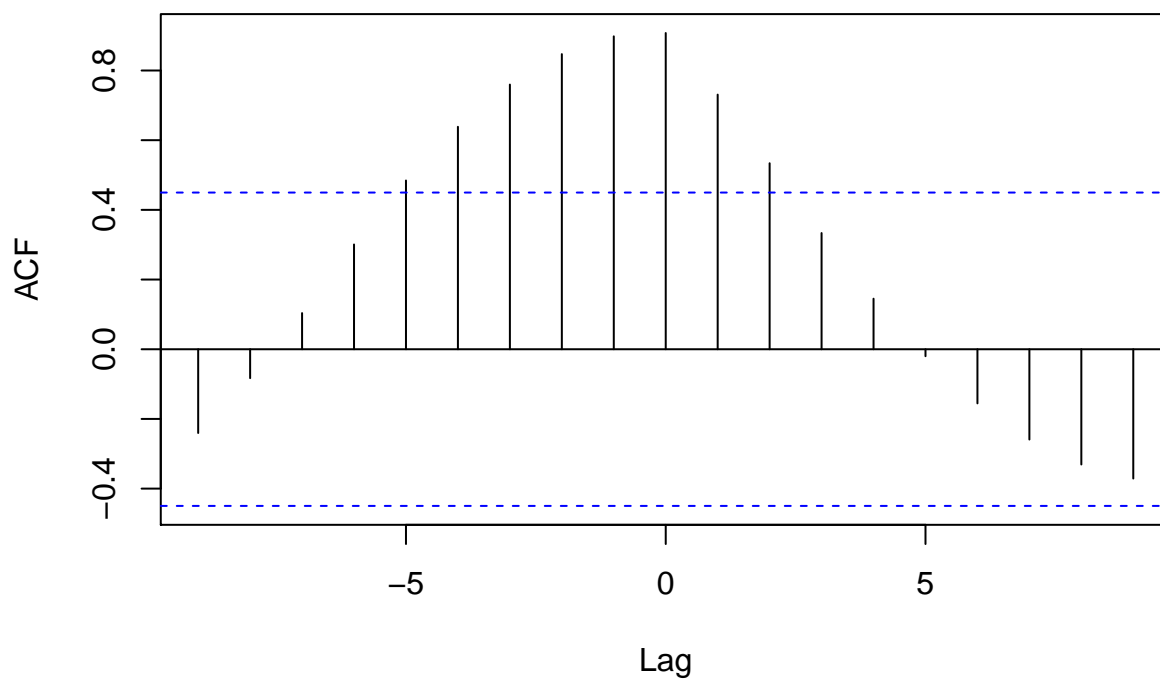




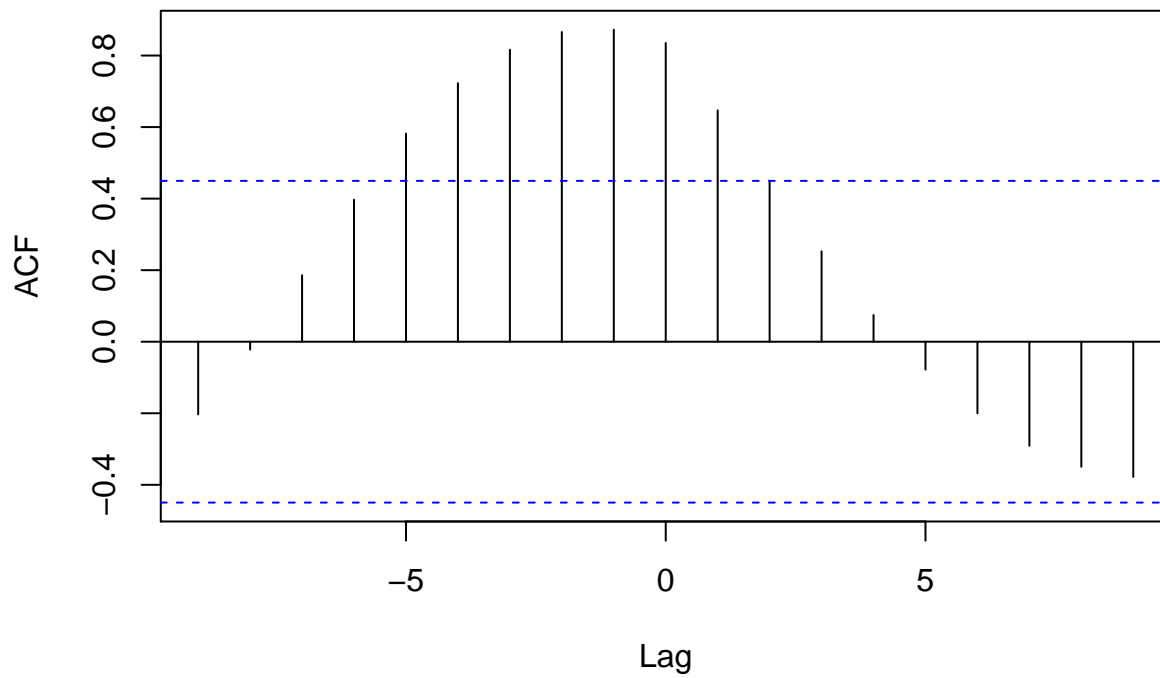
1 wk ahead – 06



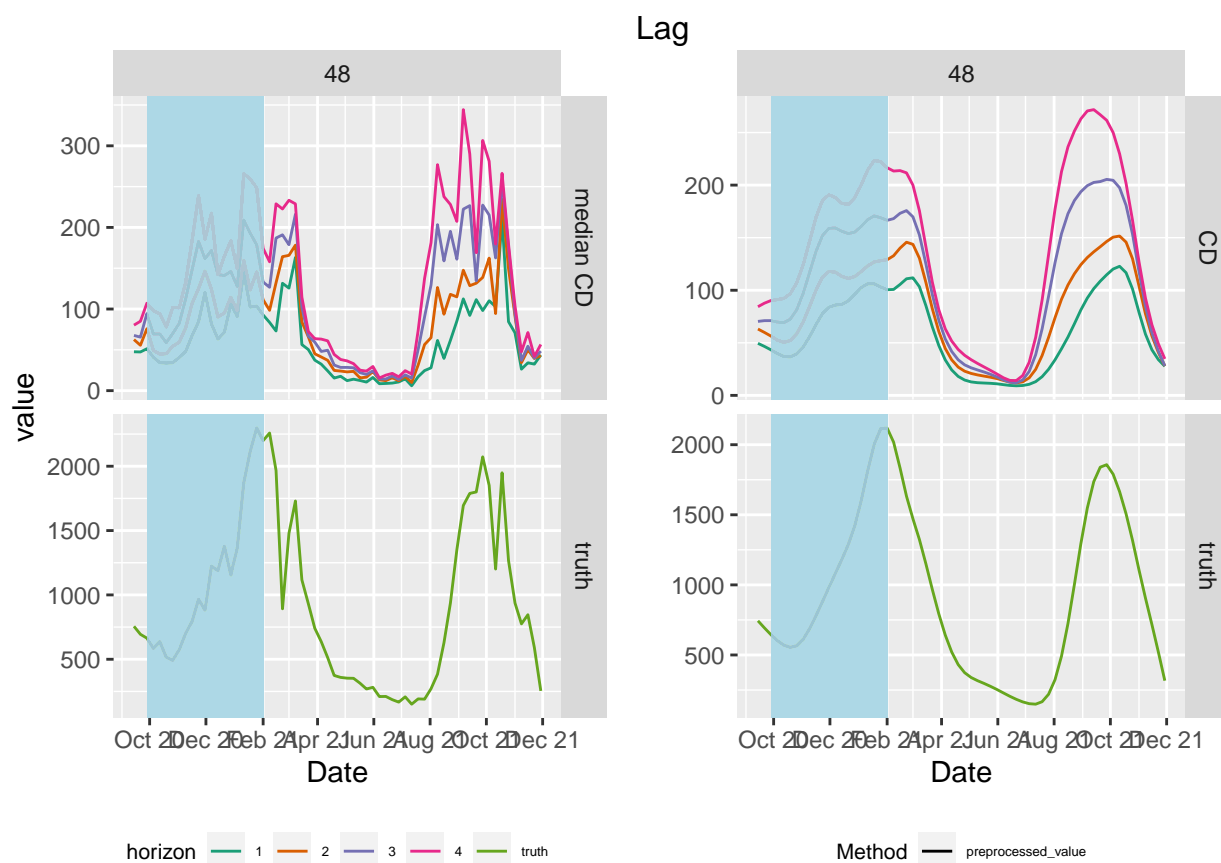
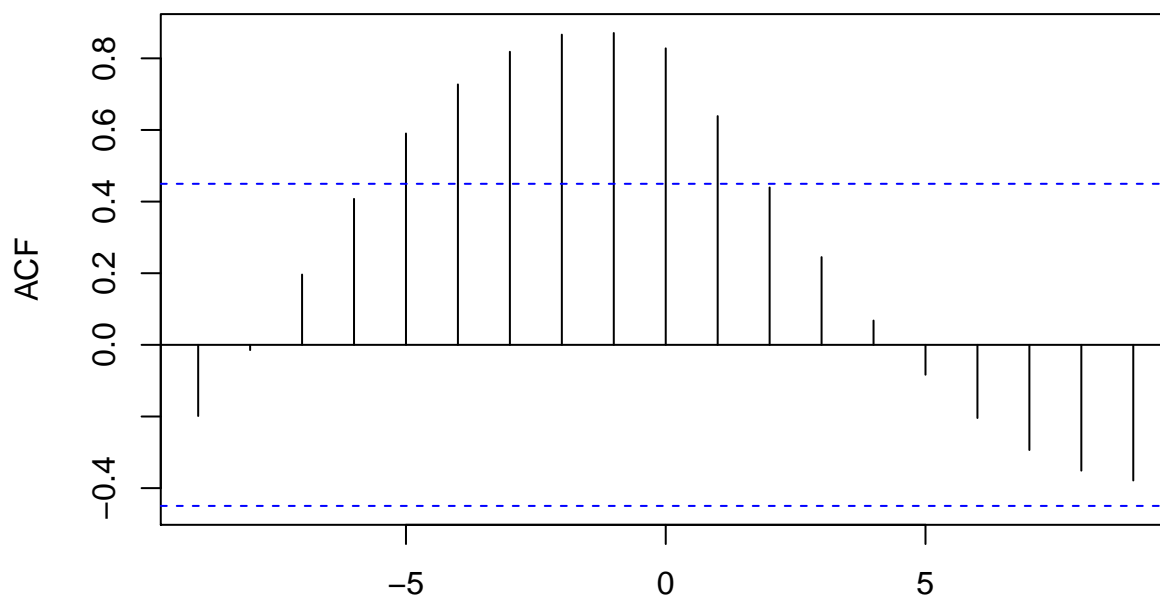
**2 wk ahead – 06**



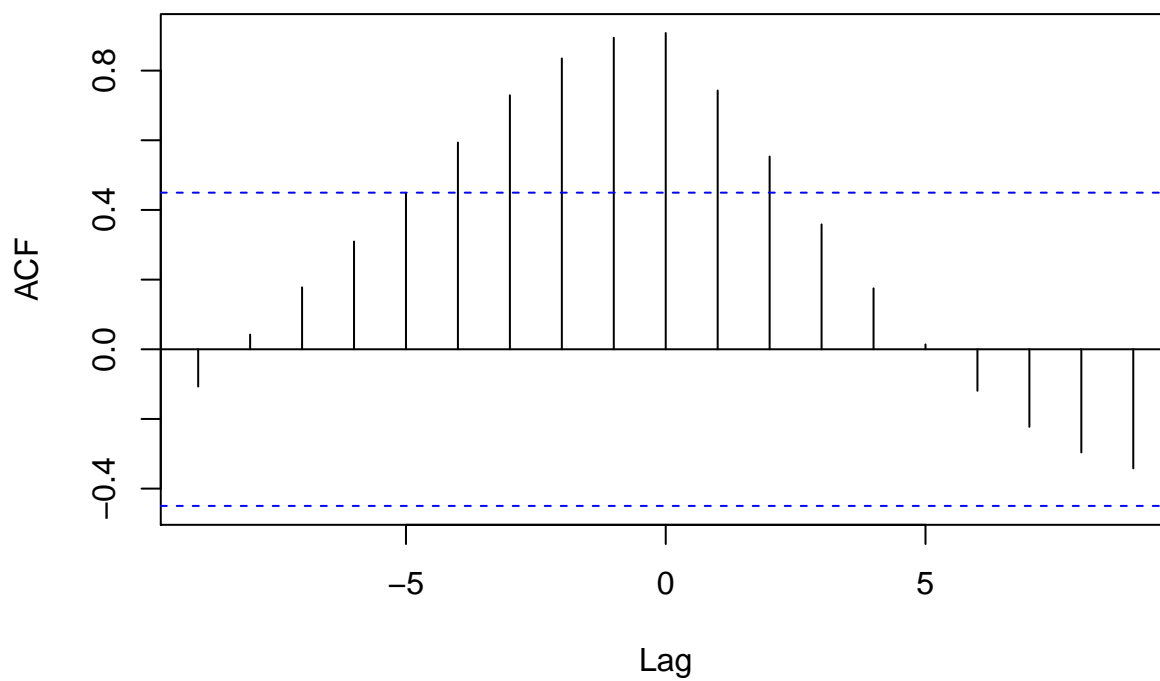
**3 wk ahead – 06**



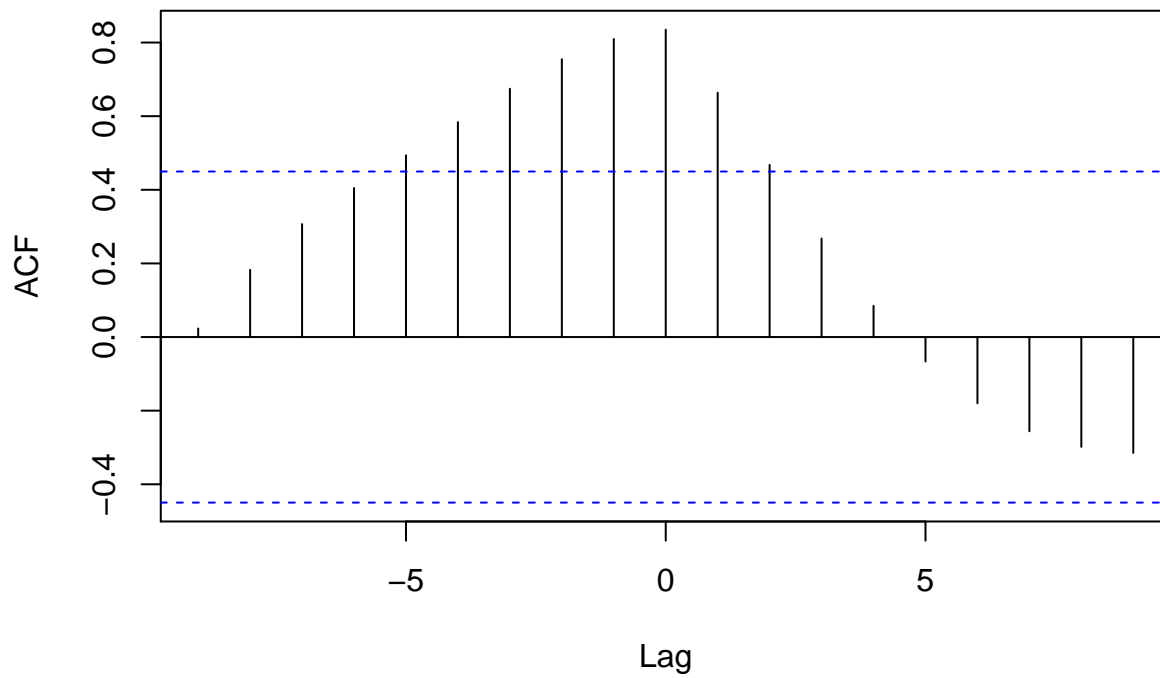
## 4 wk ahead – 06



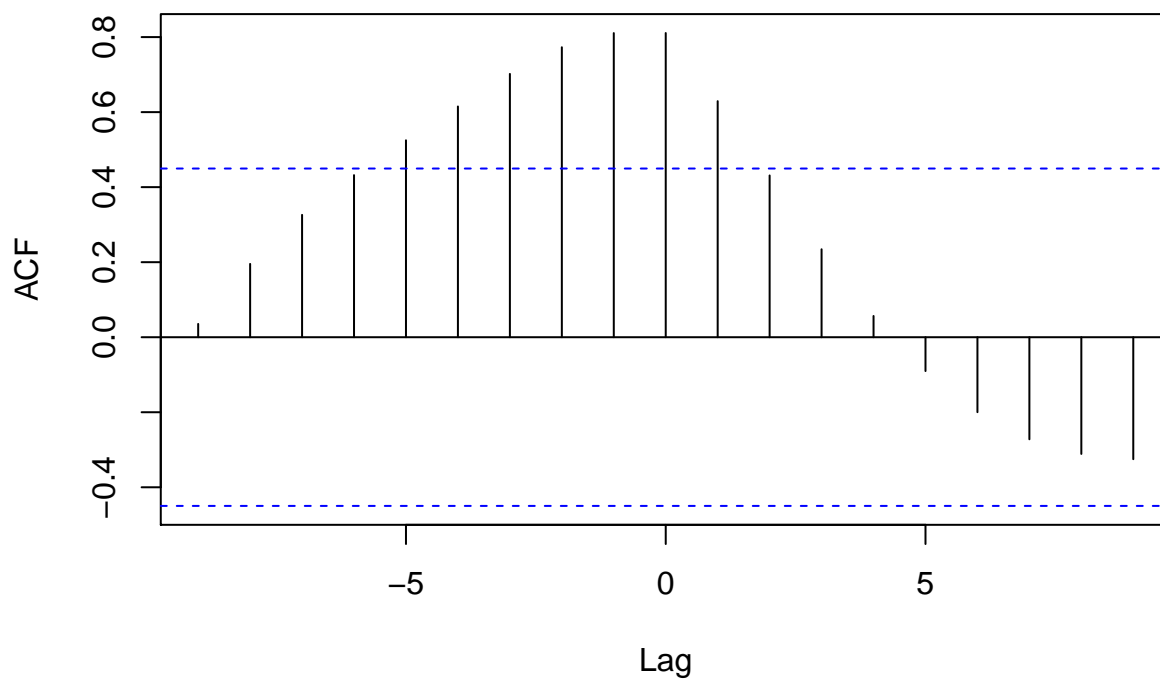
**1 wk ahead – 48**



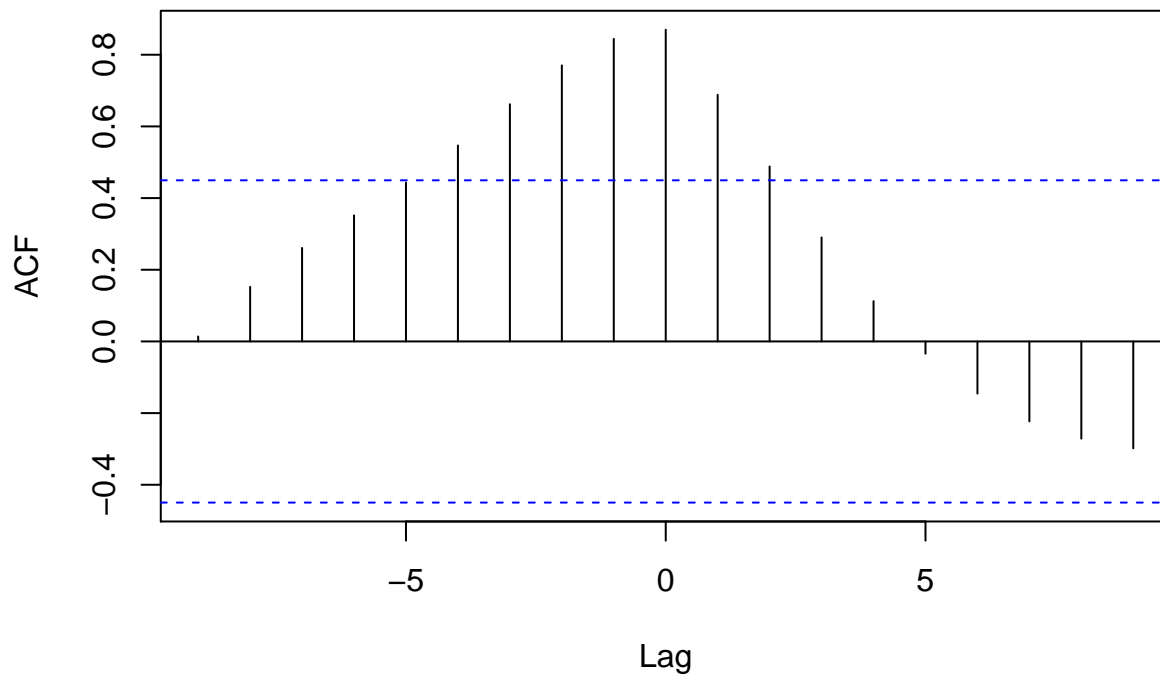
**2 wk ahead – 48**

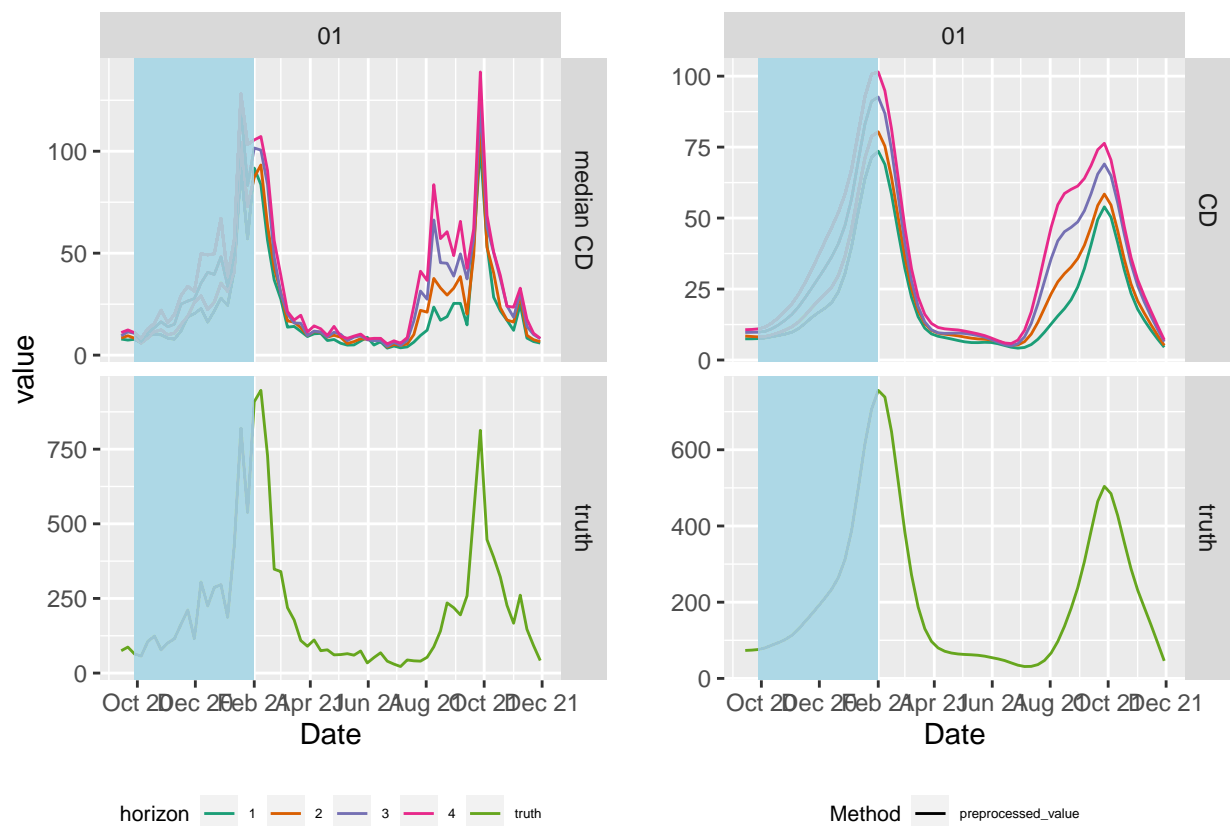


**3 wk ahead – 48**

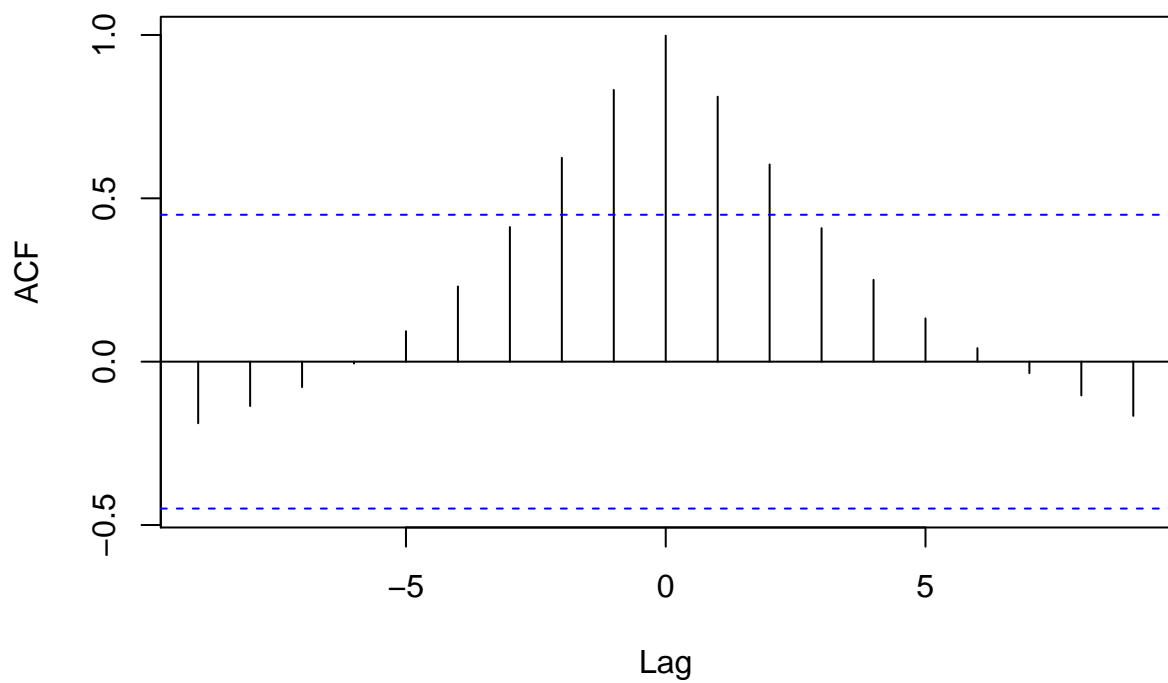


**4 wk ahead – 48**



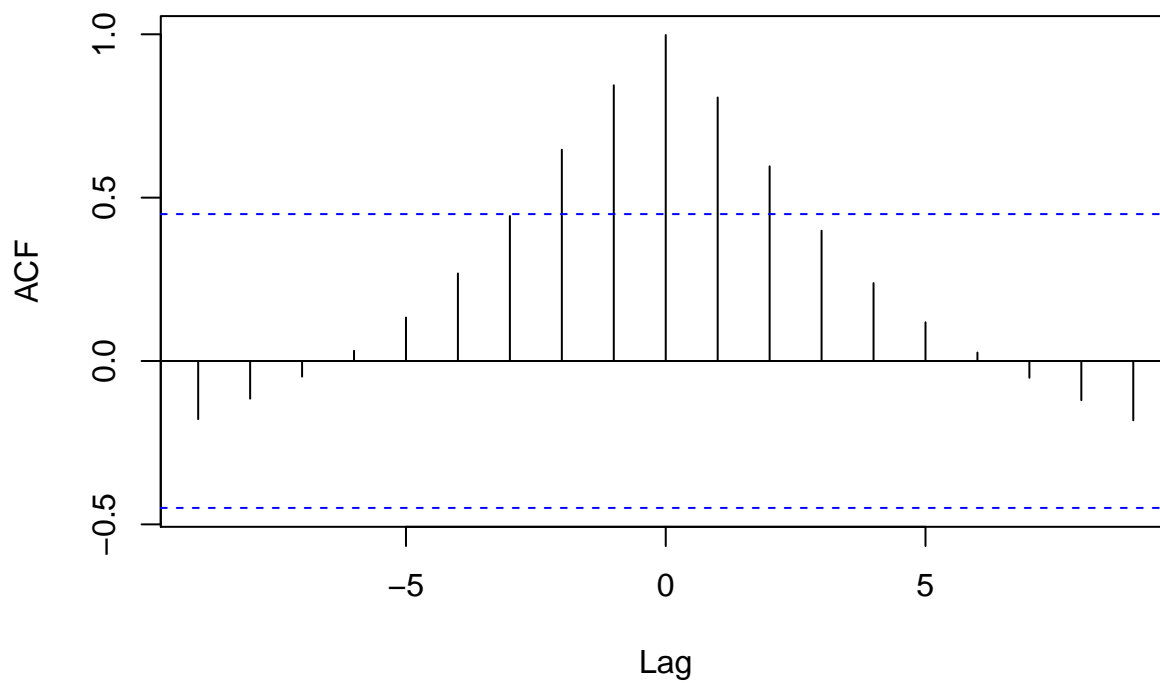


**1 wk ahead – 01**

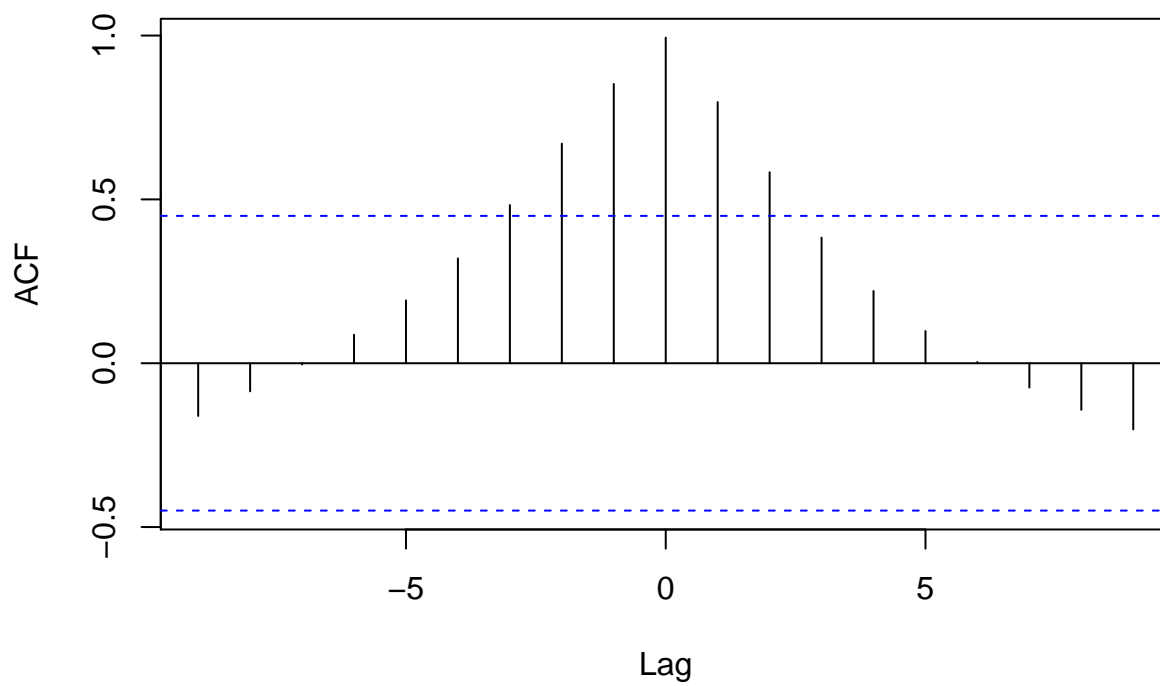




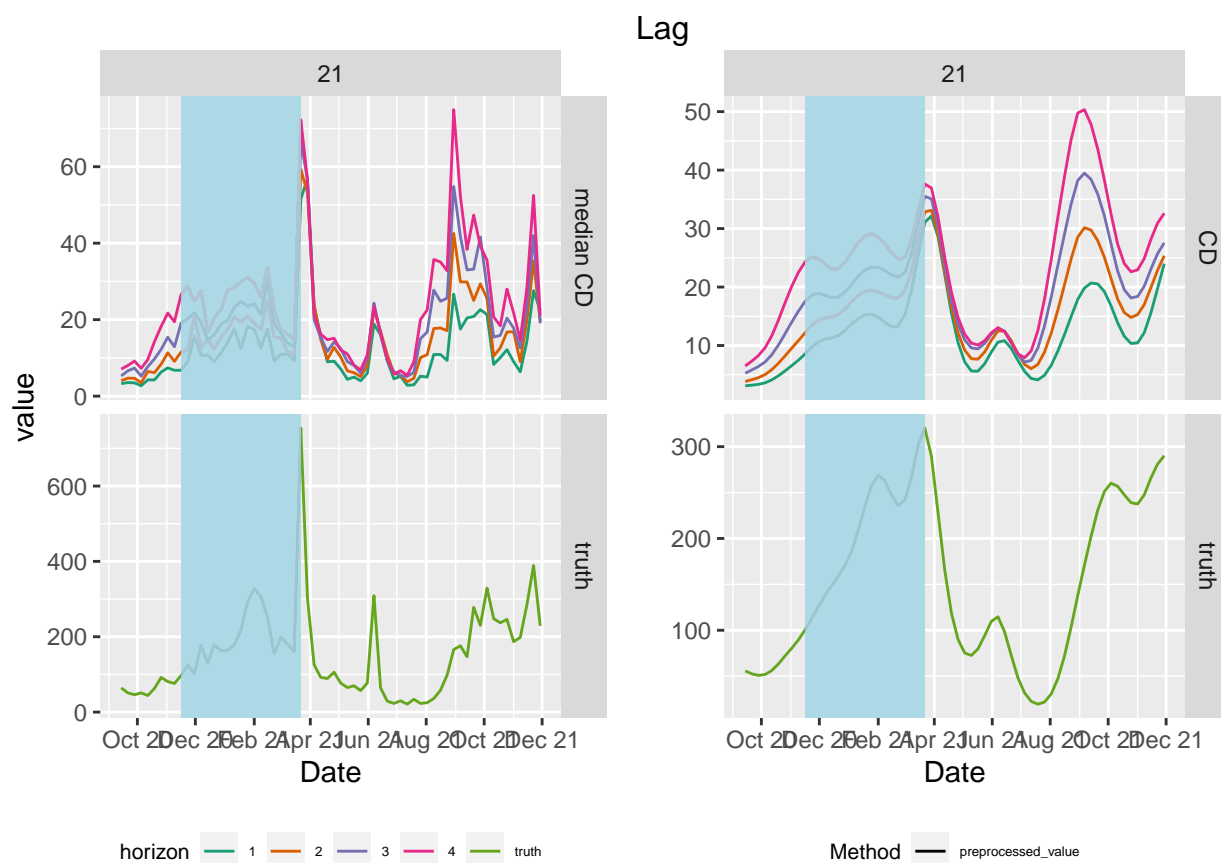
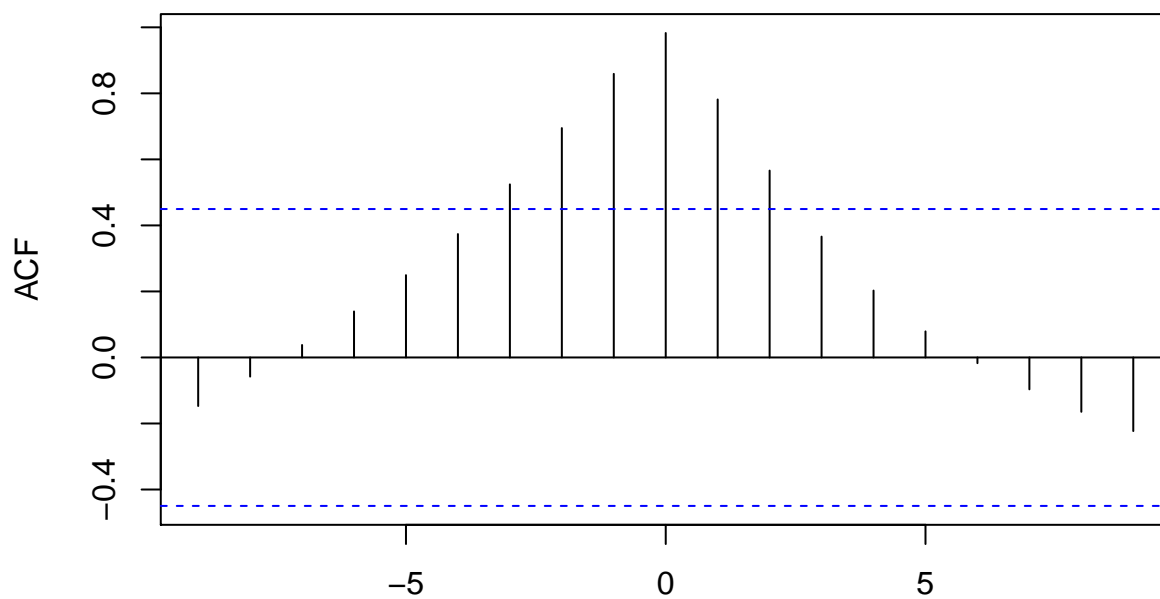
**2 wk ahead – 01**



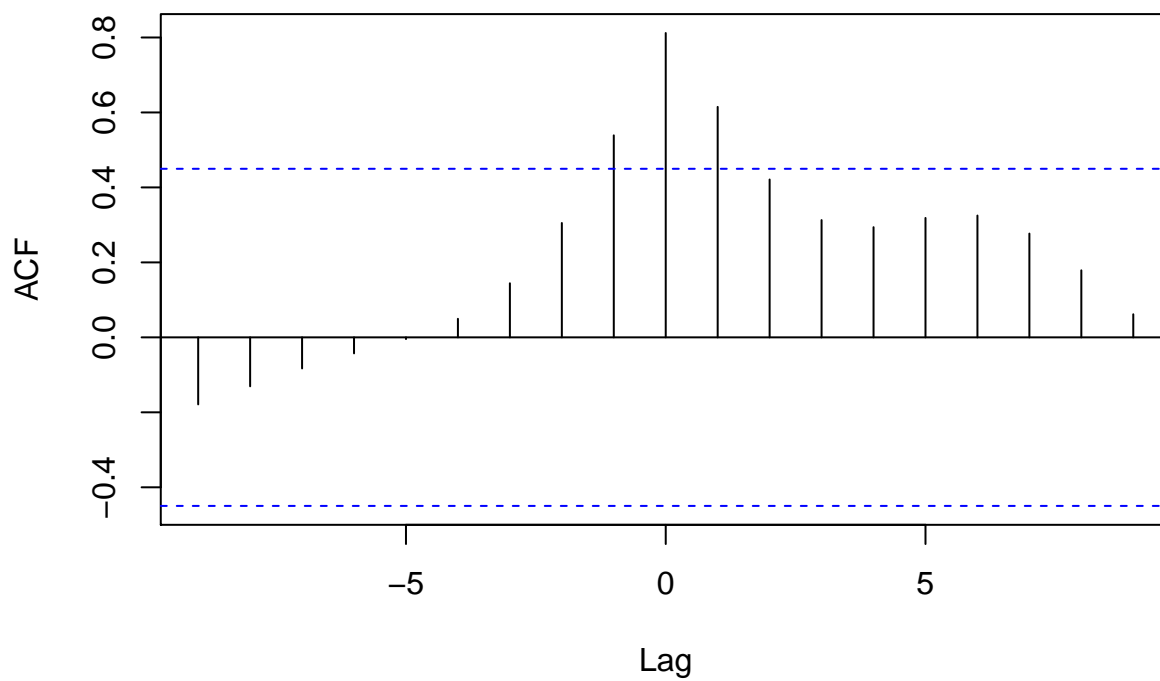
**3 wk ahead – 01**



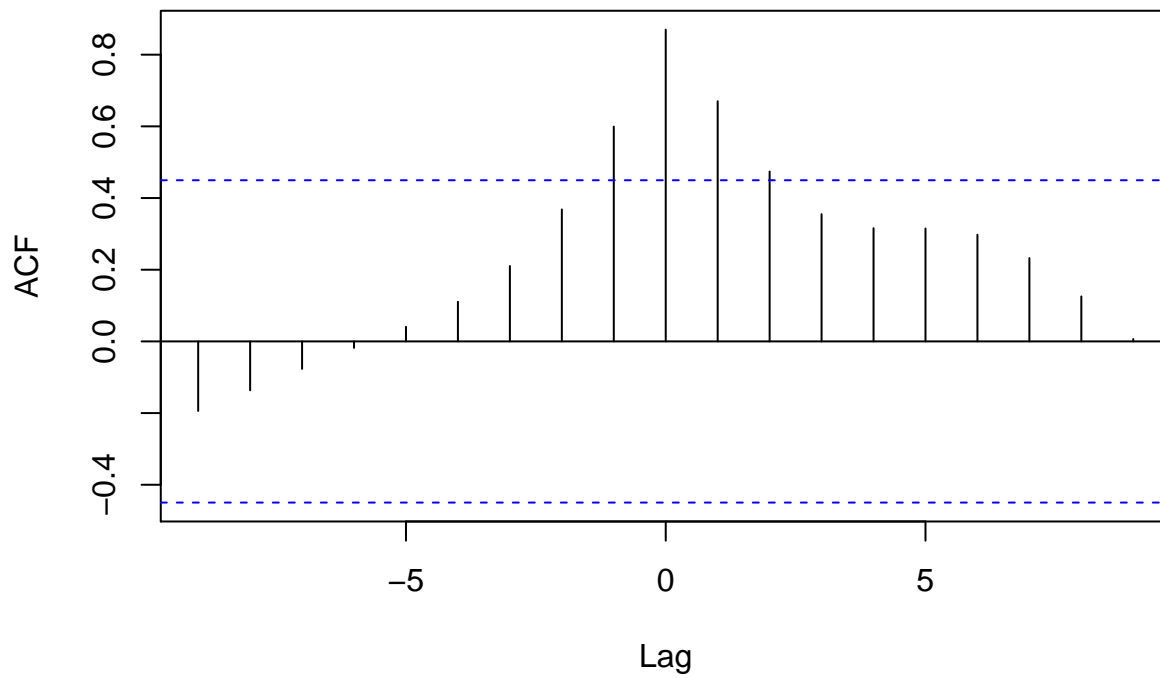
## 4 wk ahead – 01



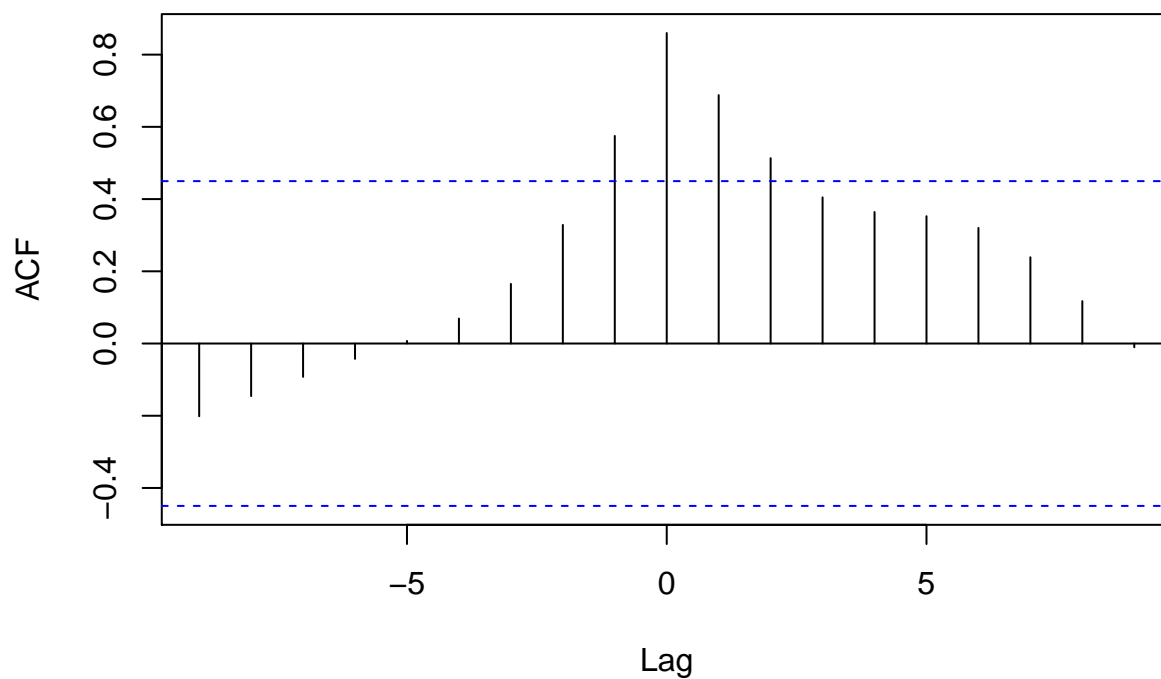
**1 wk ahead – 21**



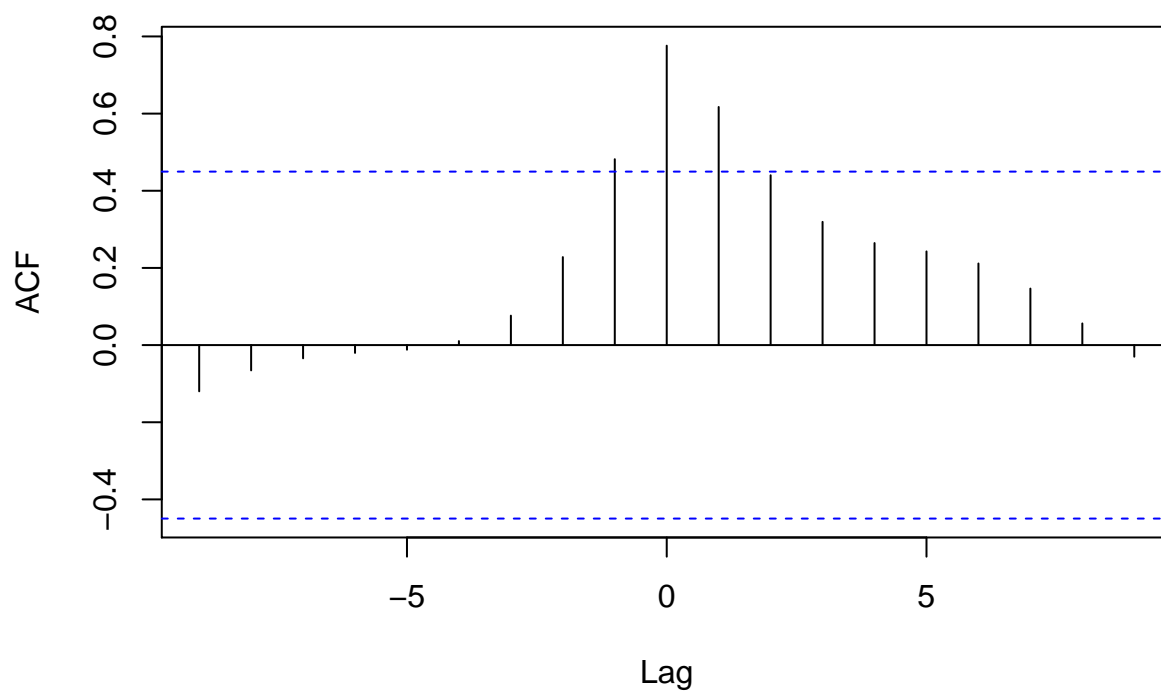
**2 wk ahead – 21**

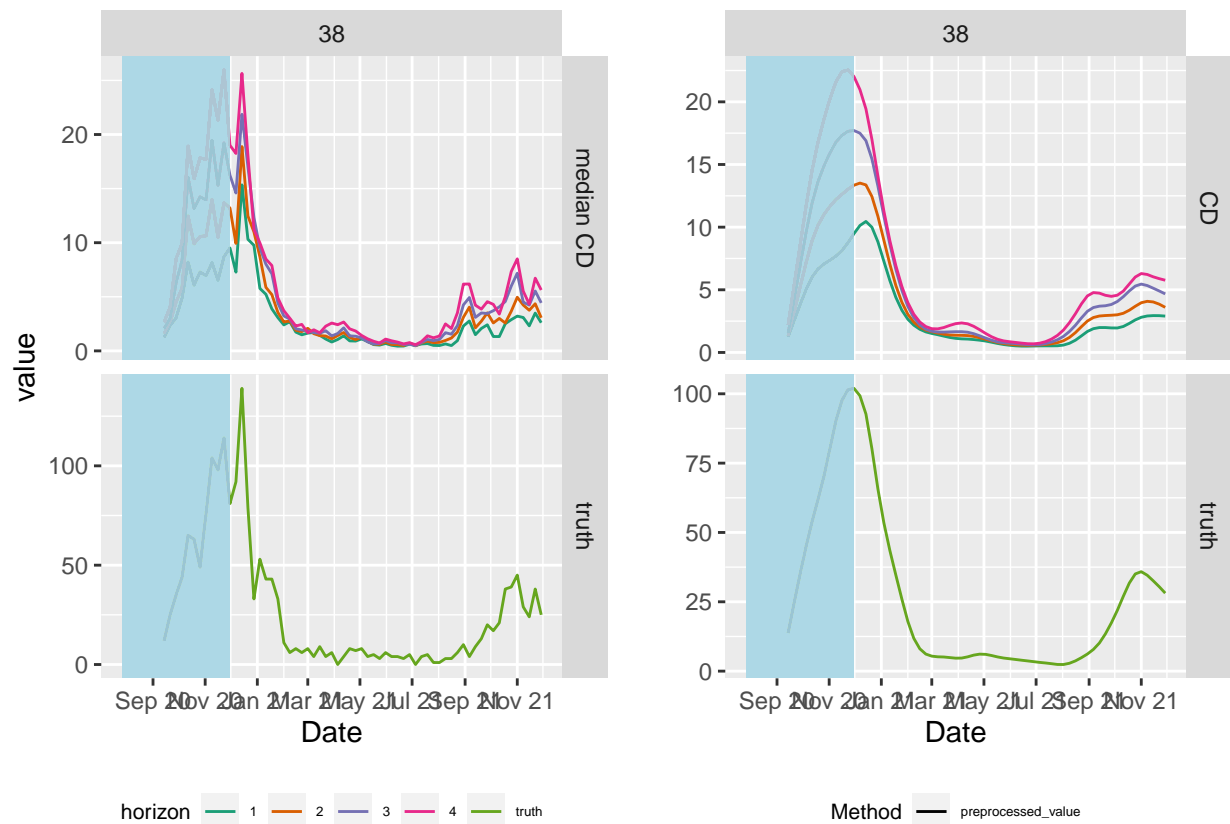


**3 wk ahead – 21**

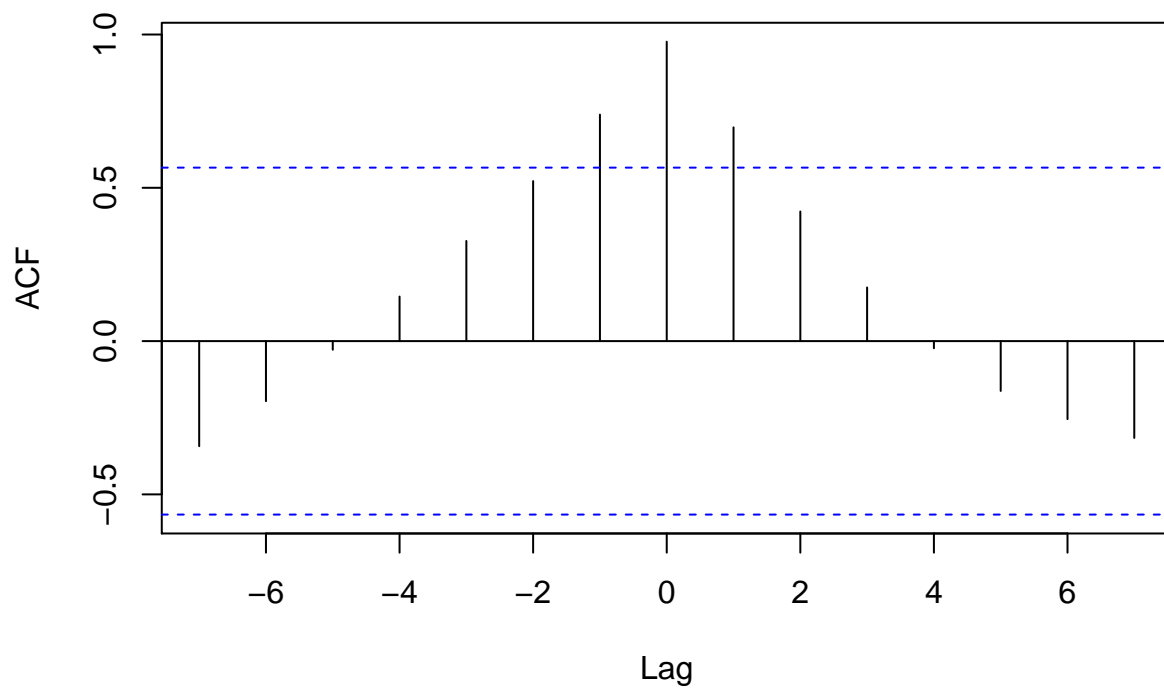


**4 wk ahead – 21**

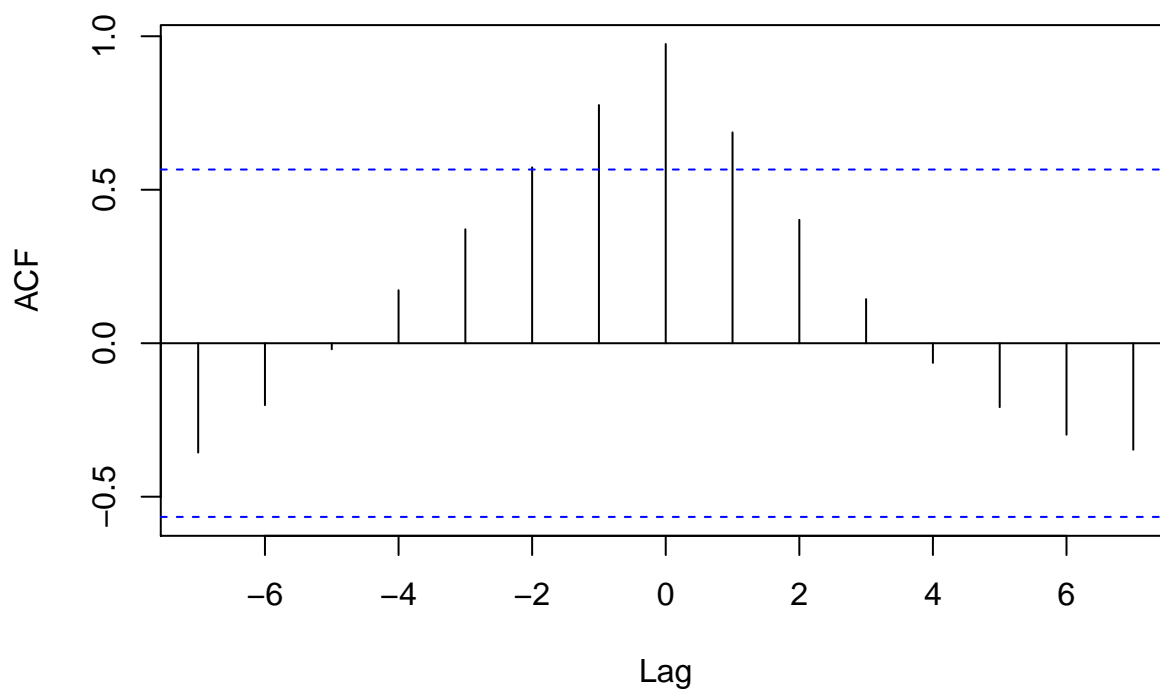




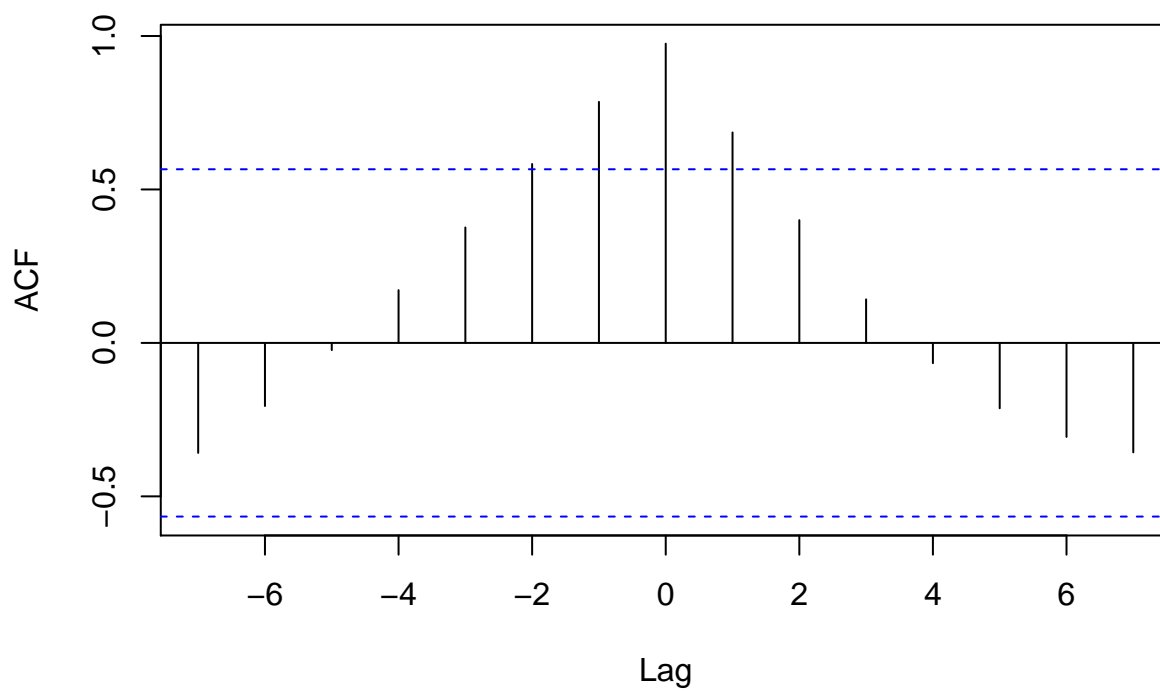
### 1 wk ahead – 38



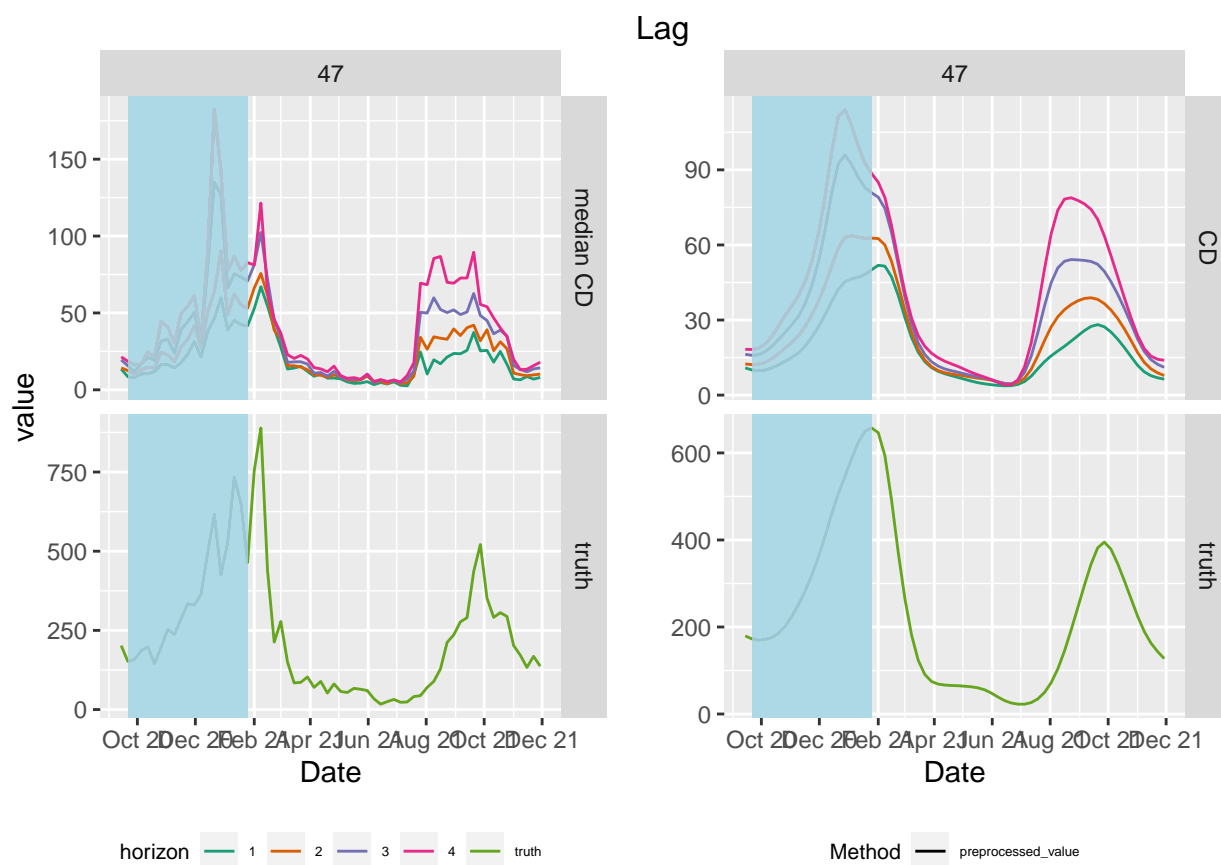
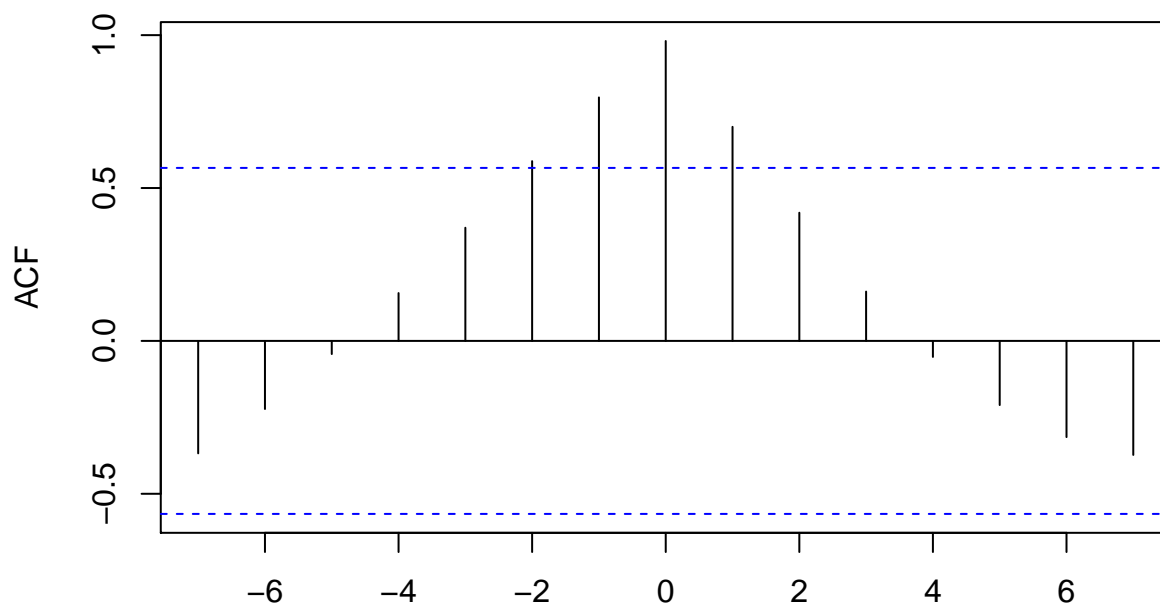
**2 wk ahead – 38**



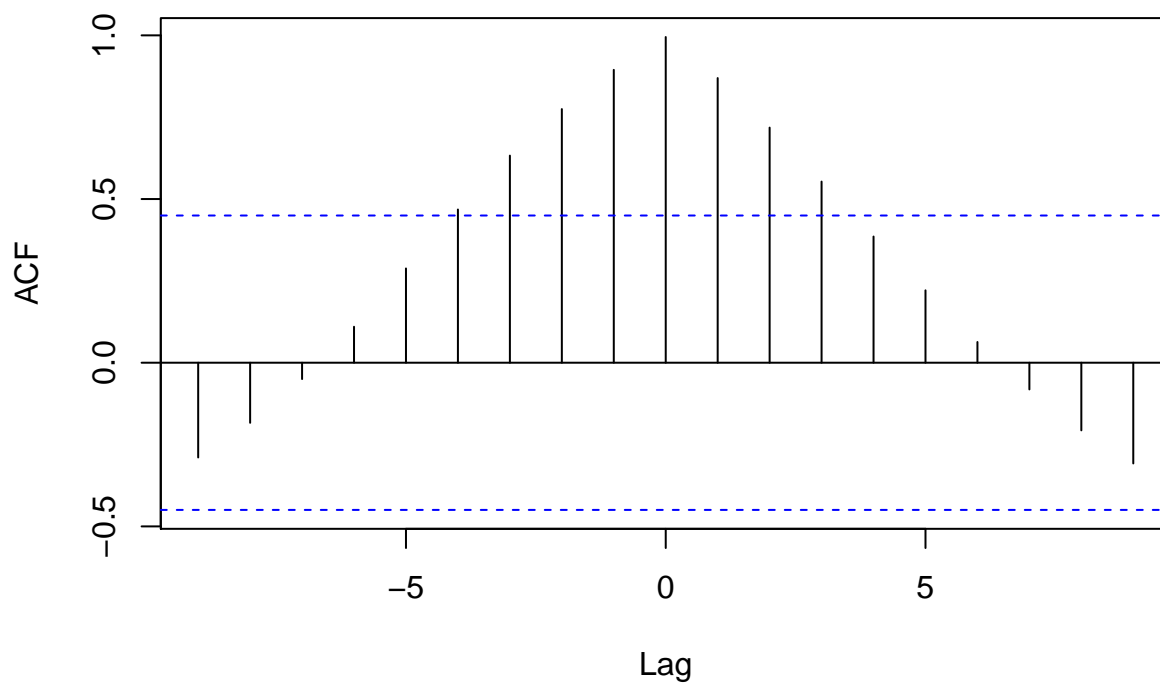
**3 wk ahead – 38**



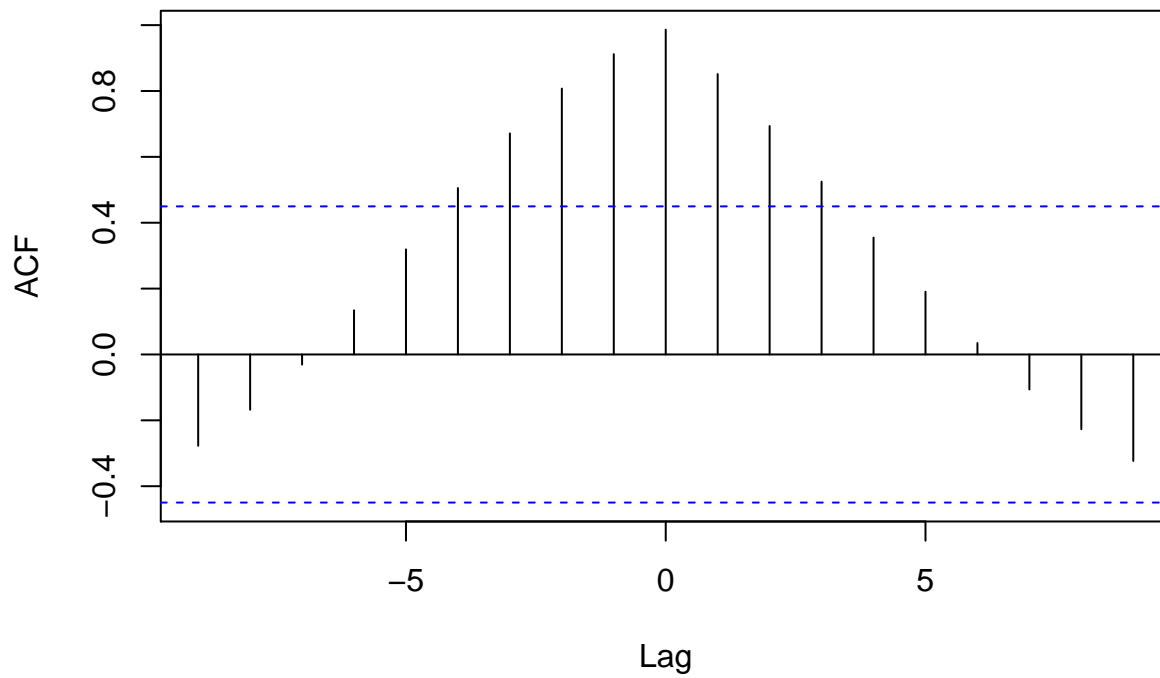
## 4 wk ahead – 38



**1 wk ahead – 47**

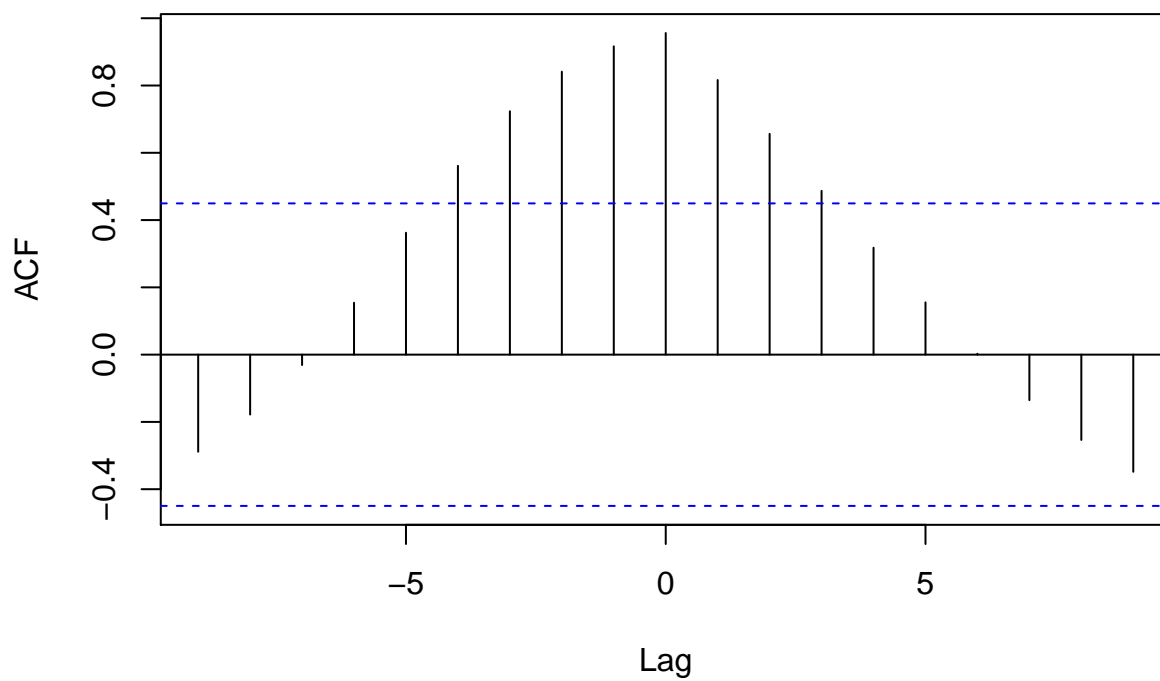


**2 wk ahead – 47**

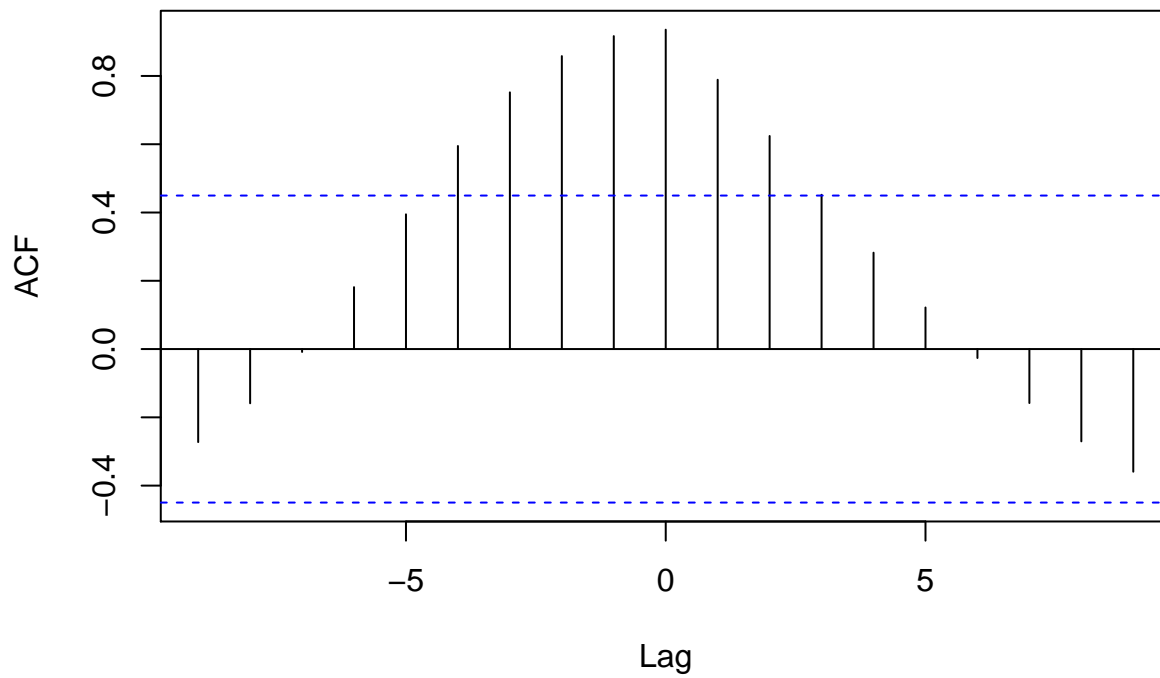




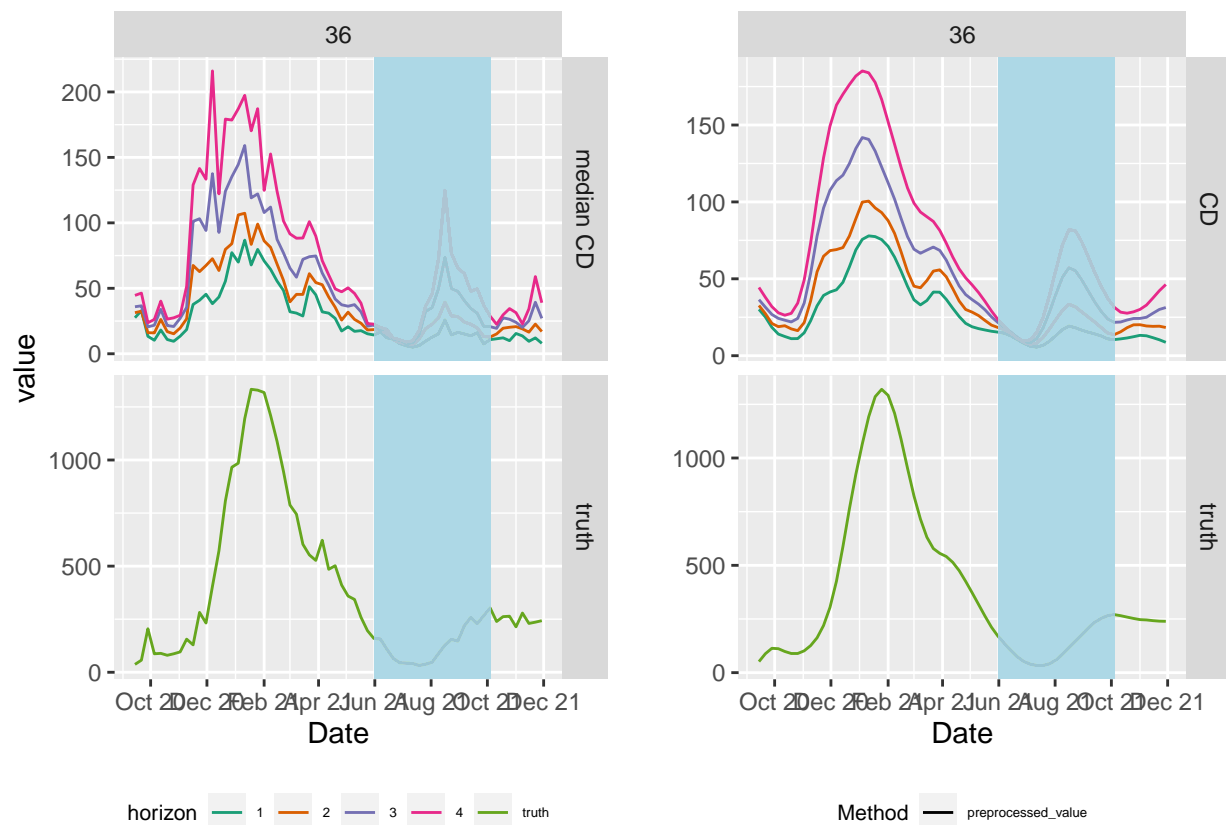
**3 wk ahead – 47**



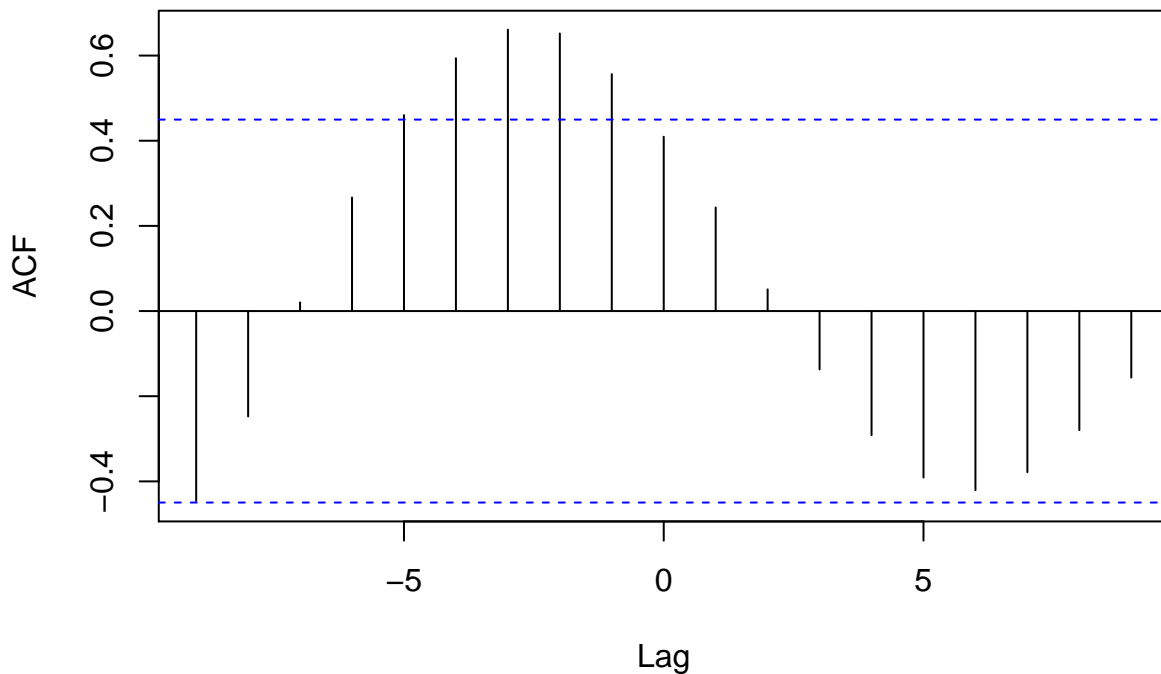
**4 wk ahead – 47**



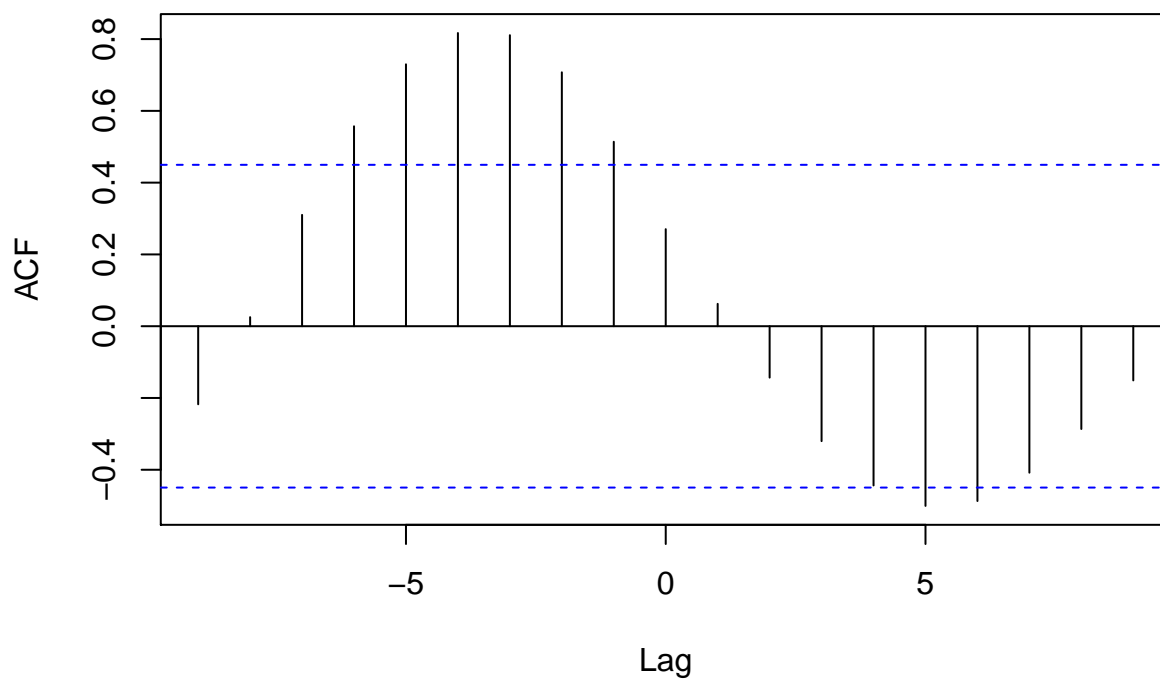
Plots of inc deaths, median CDs, smoothed inc deaths, smoothed median CDs, and CCF - date 2



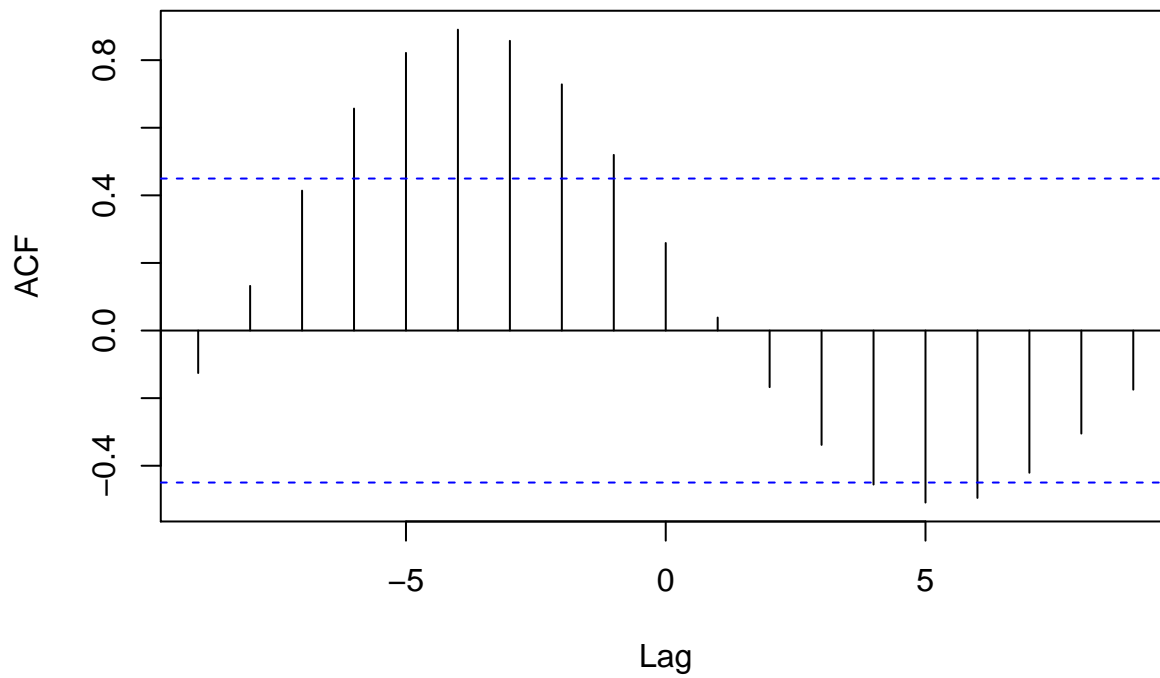
1 wk ahead - 36



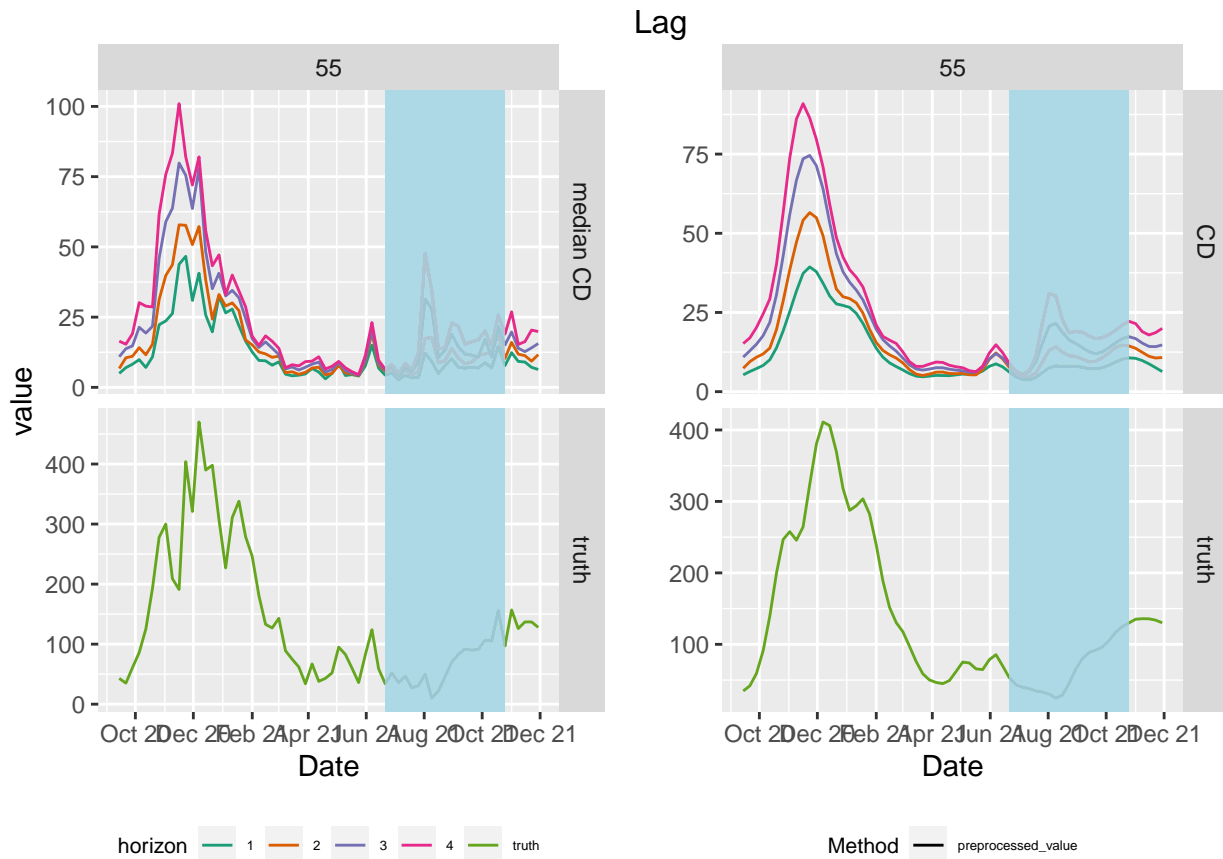
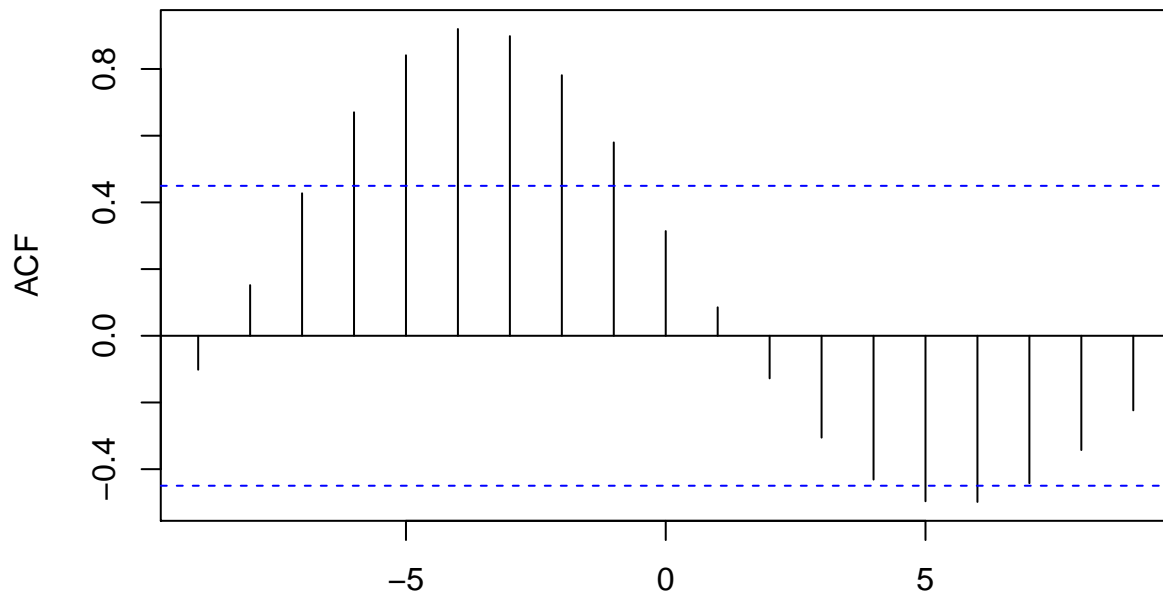
**2 wk ahead – 36**



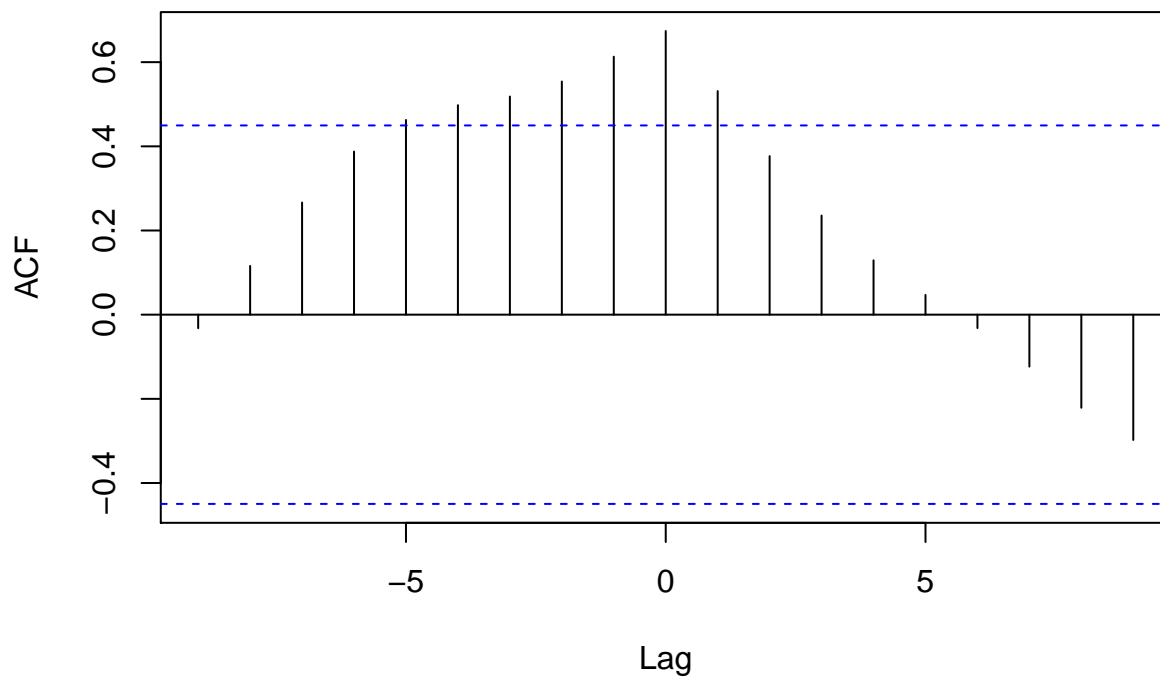
**3 wk ahead – 36**



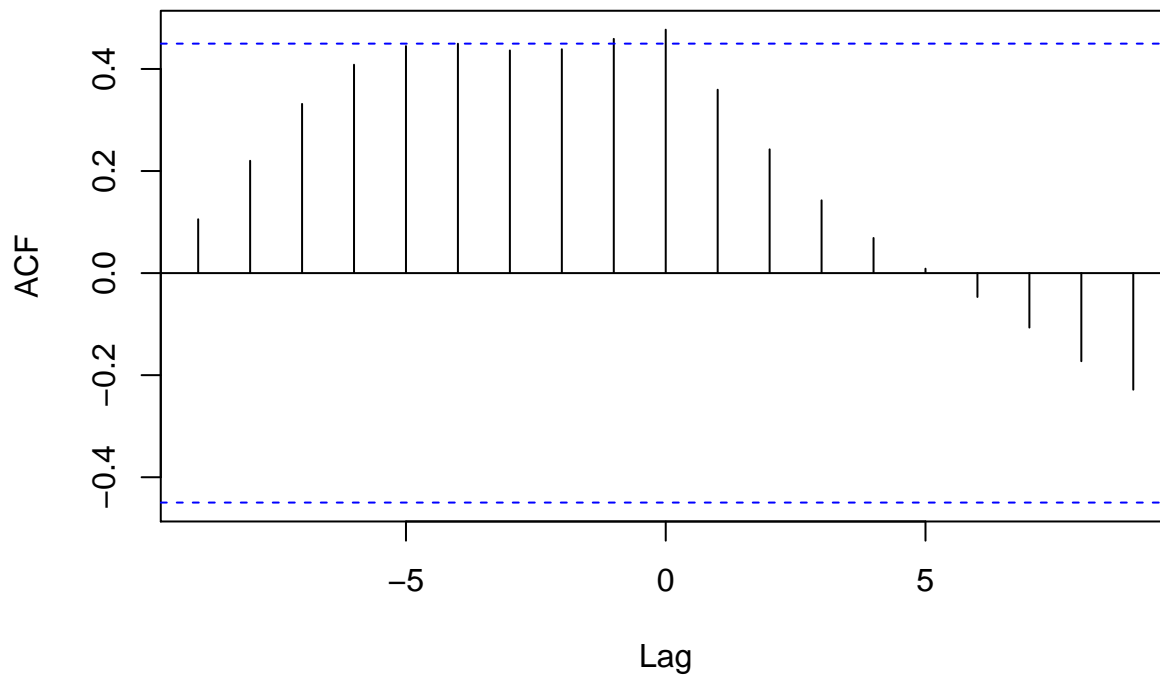
## 4 wk ahead – 36



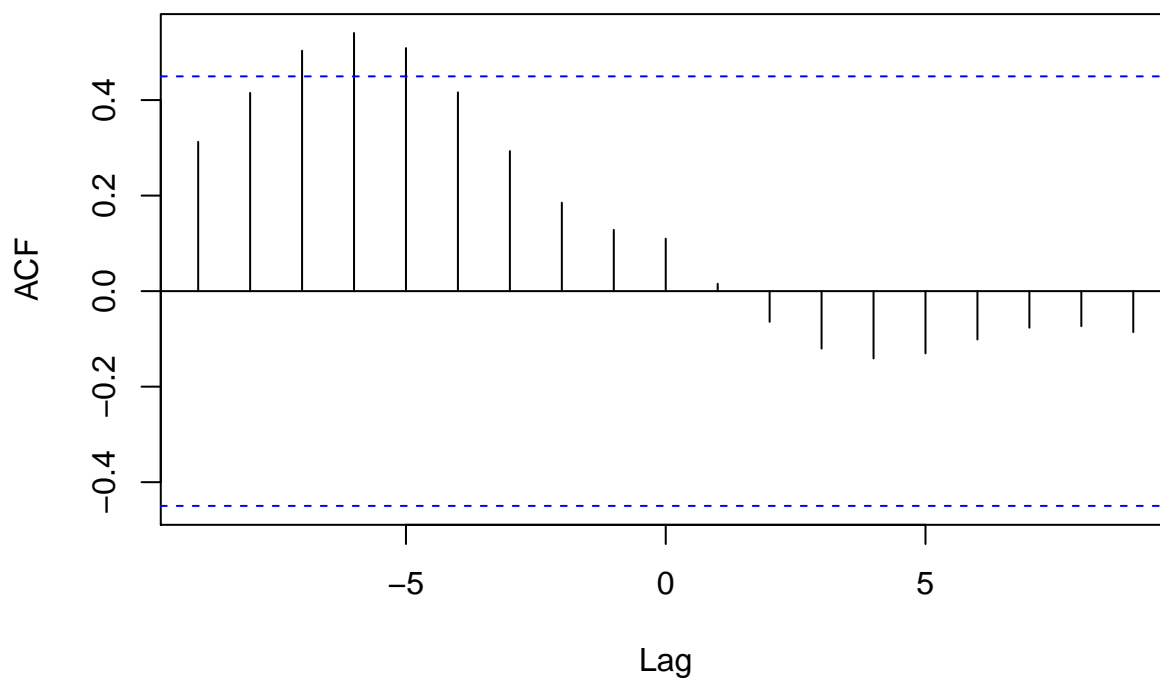
**1 wk ahead – 55**



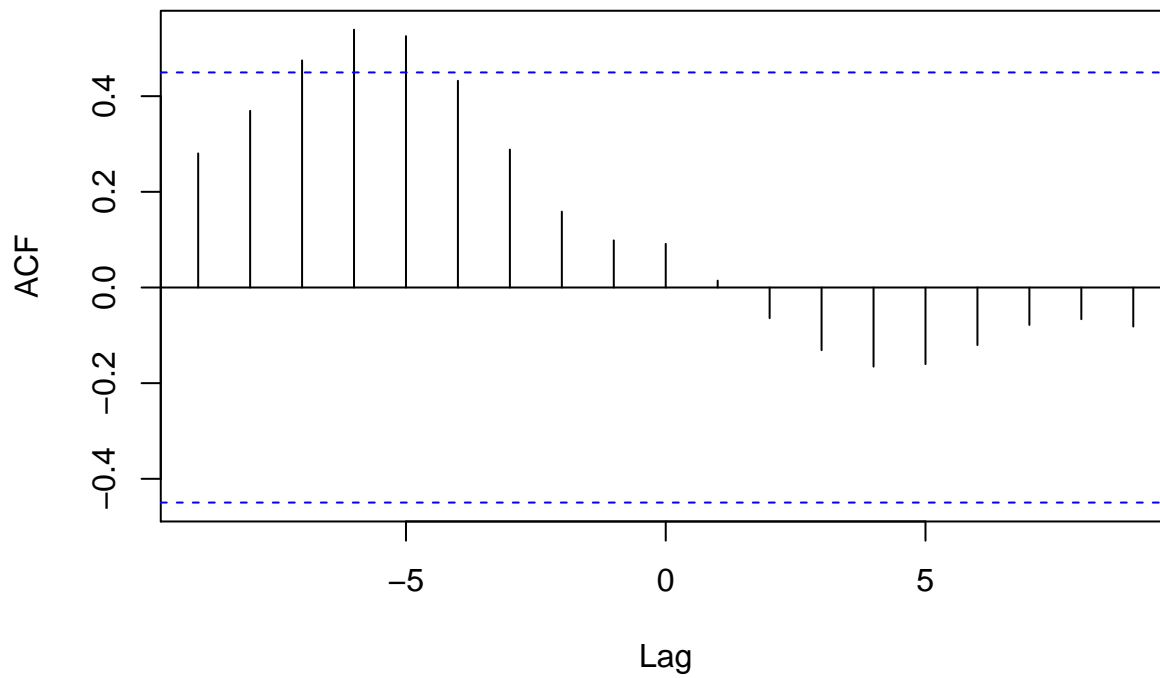
**2 wk ahead – 55**



**3 wk ahead – 55**

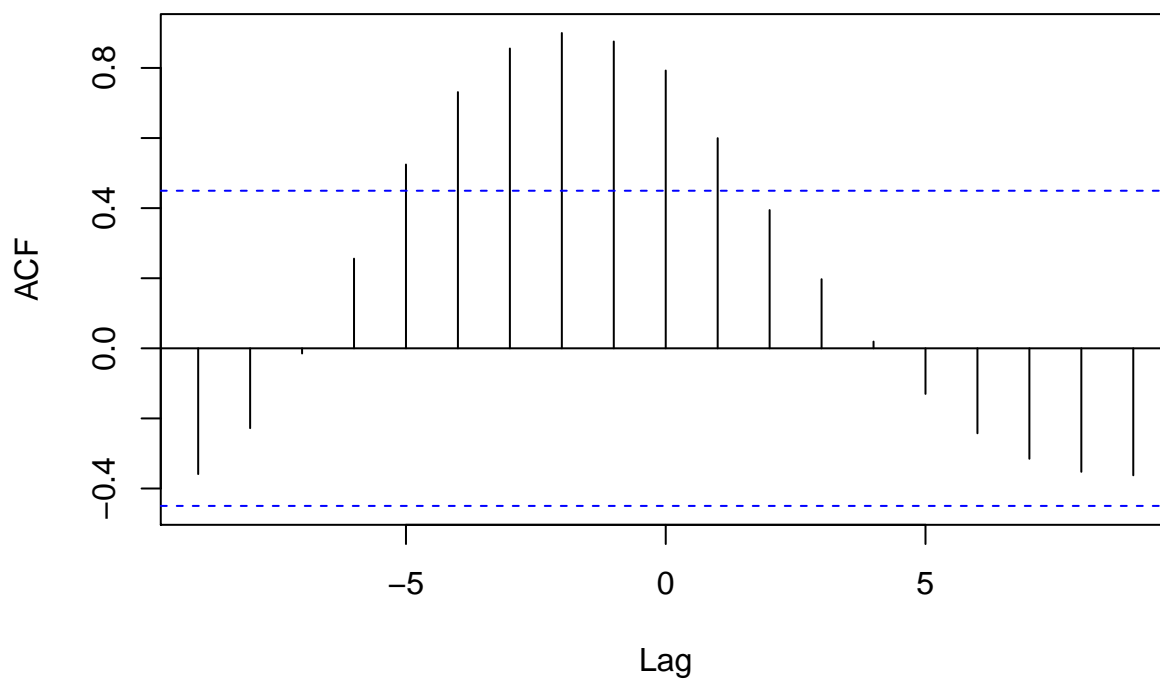


**4 wk ahead – 55**

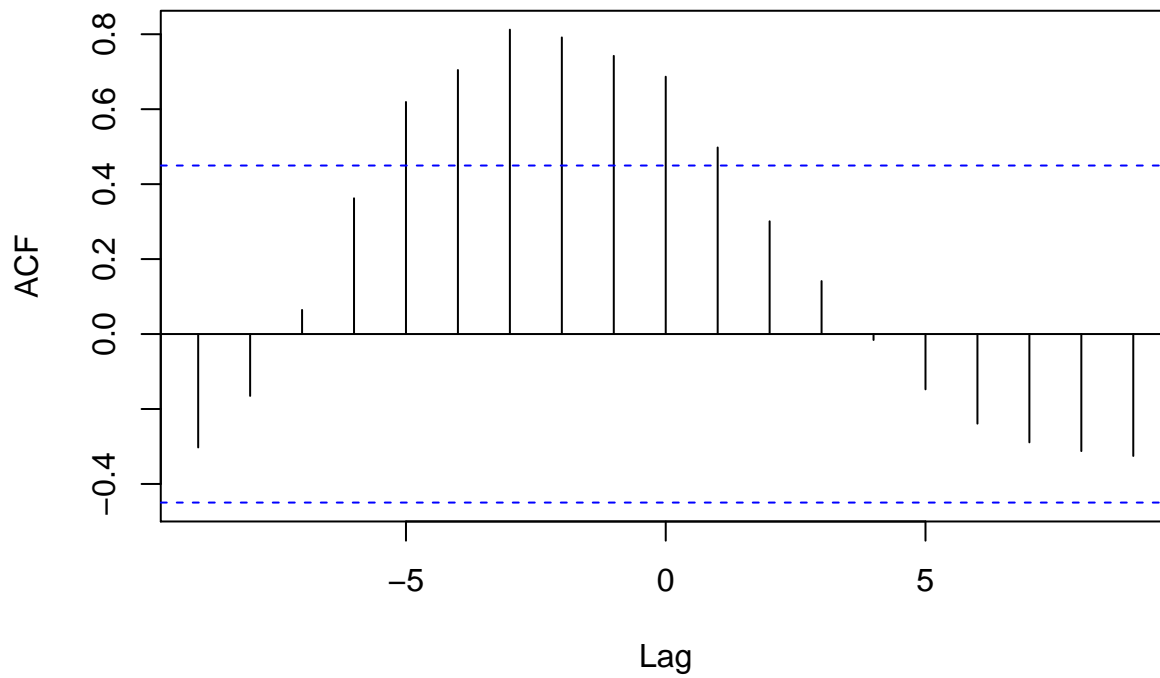




**2 wk ahead – 29**

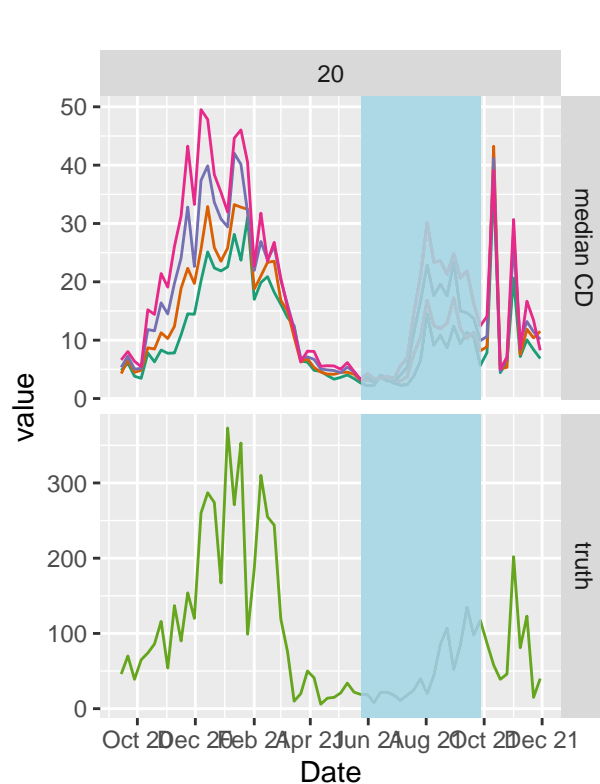
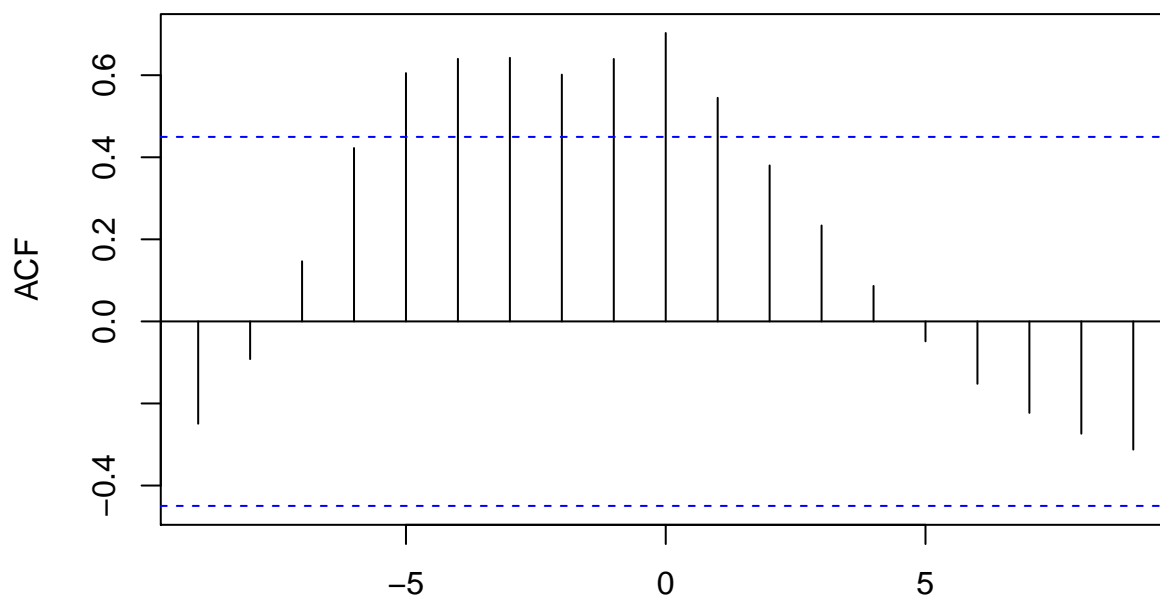


**3 wk ahead – 29**

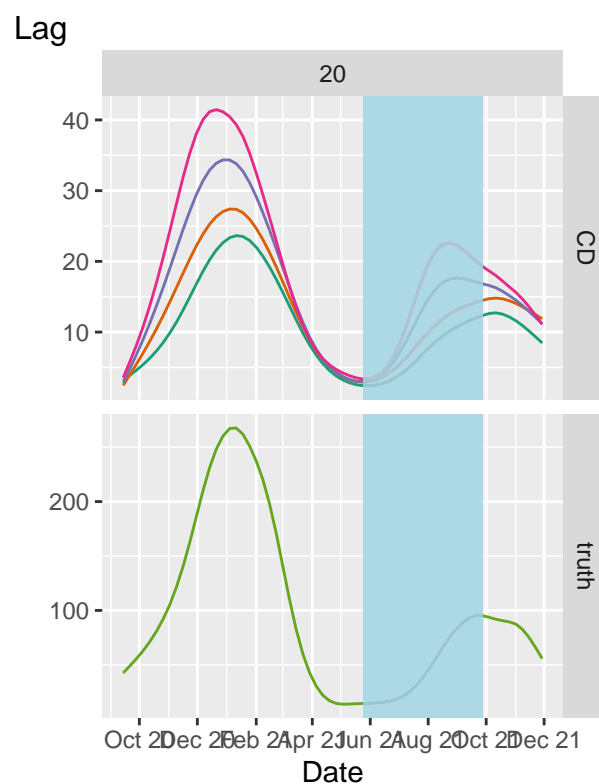




## 4 wk ahead – 29

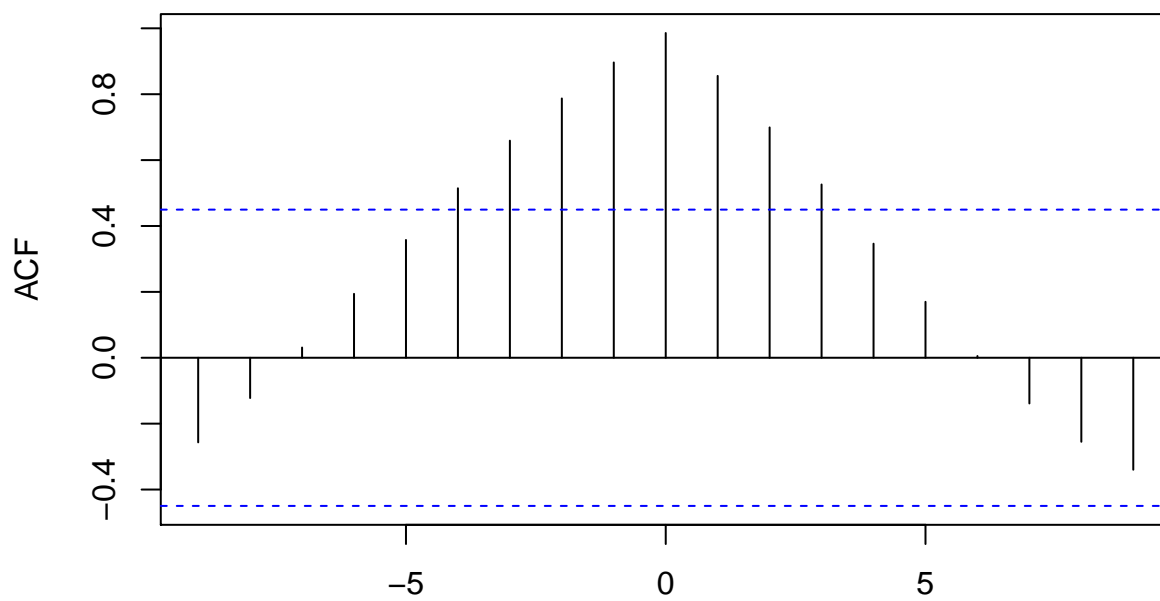


horizon 1 2 3 4 truth

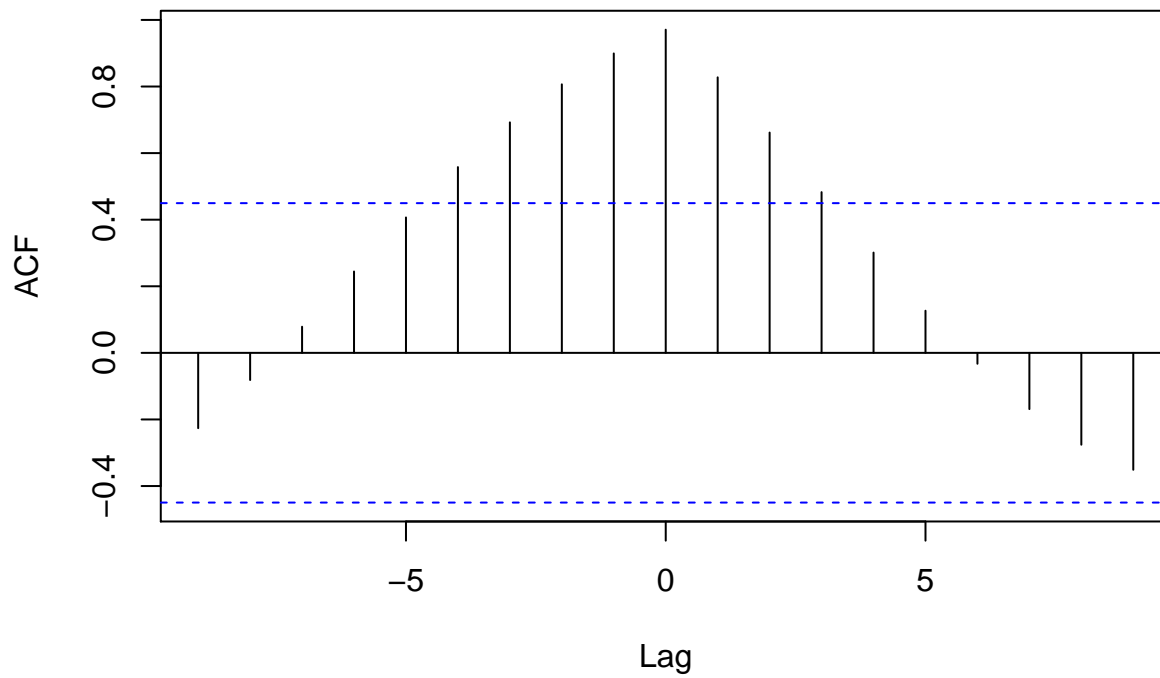


Method preprocessed\_value

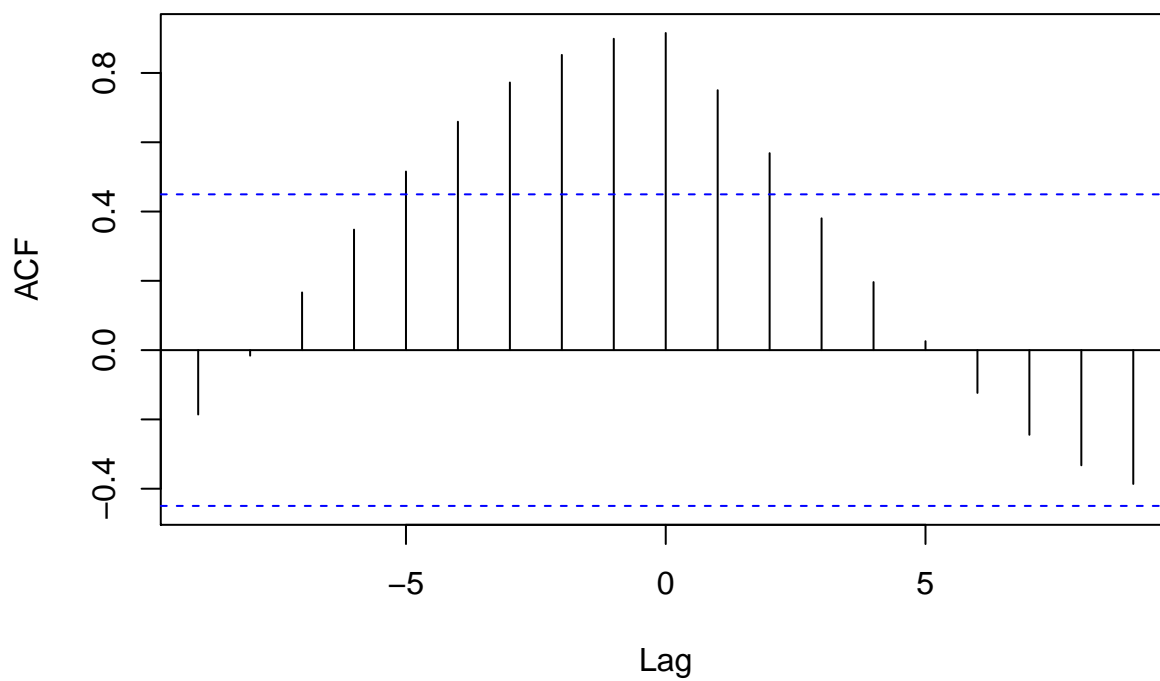
**1 wk ahead – 20**



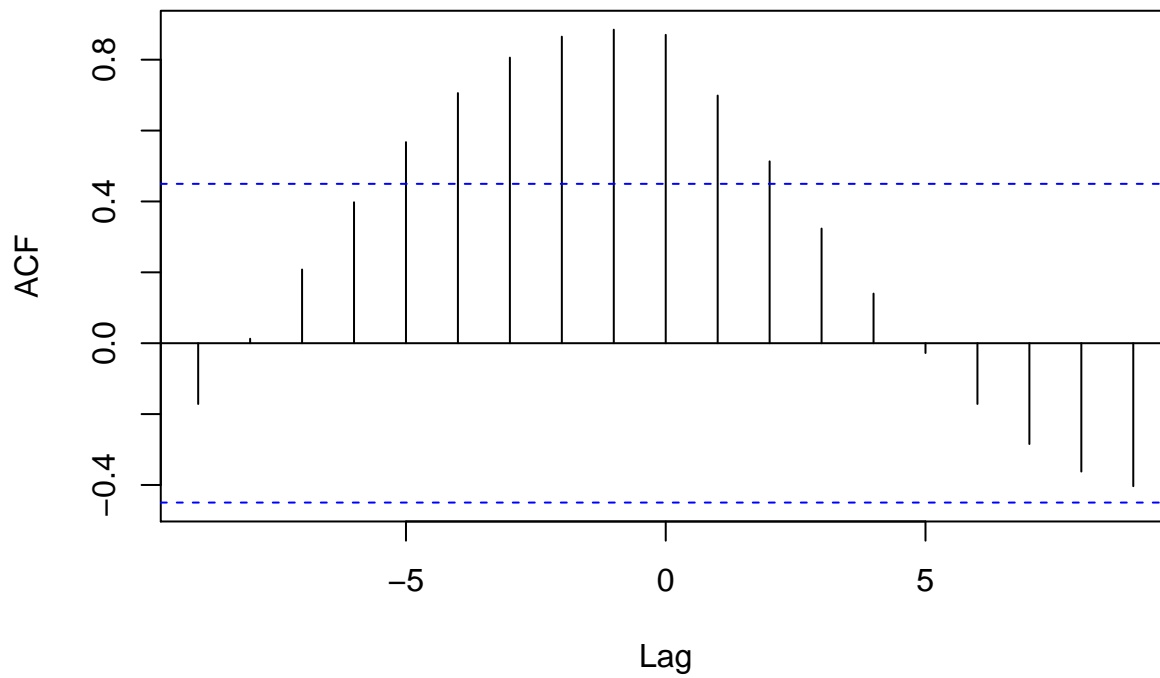
**2 wk ahead – 20**

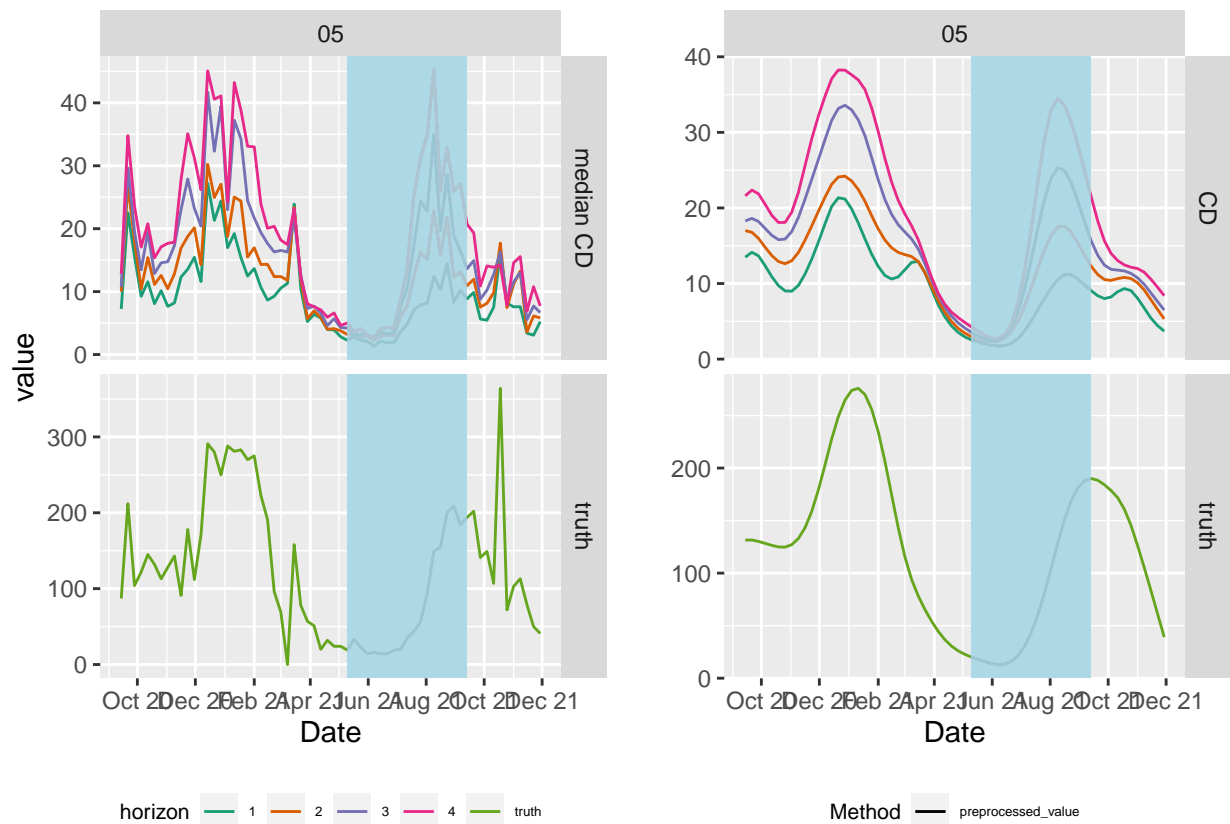


**3 wk ahead – 20**

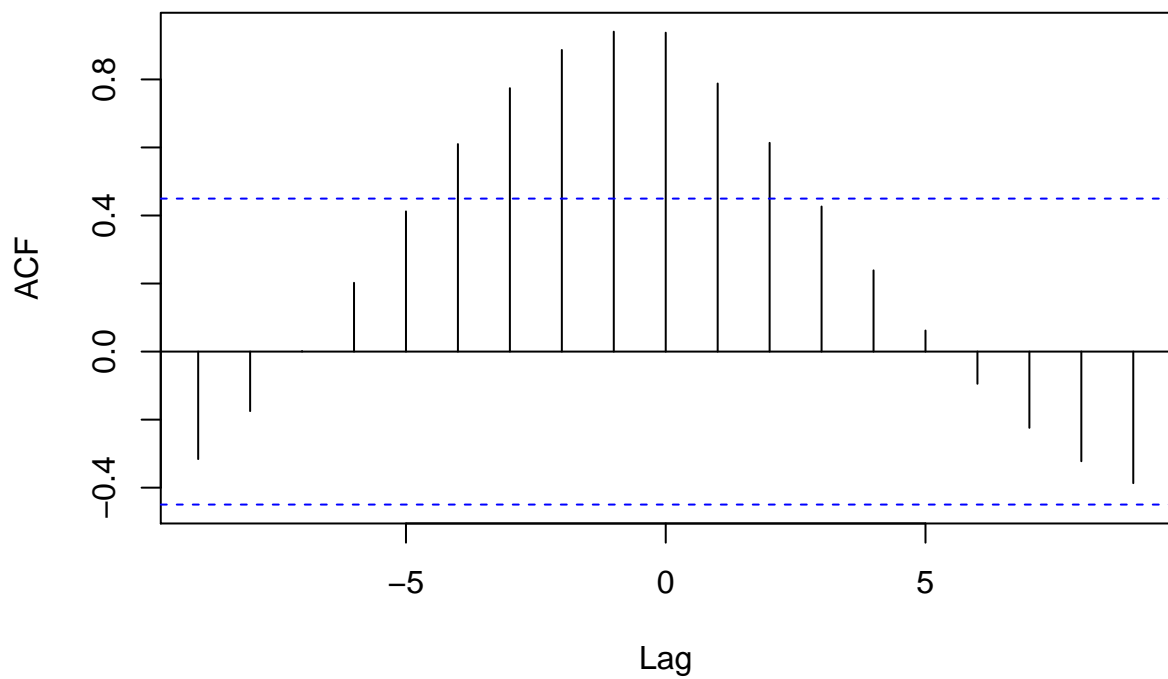


**4 wk ahead – 20**

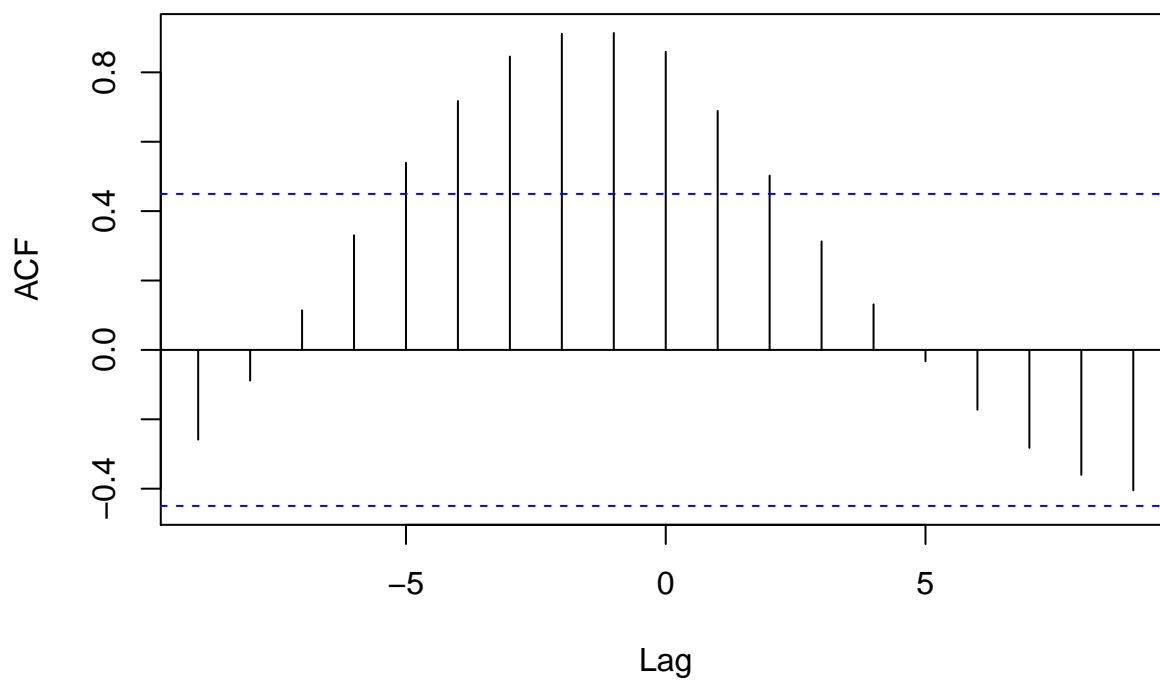




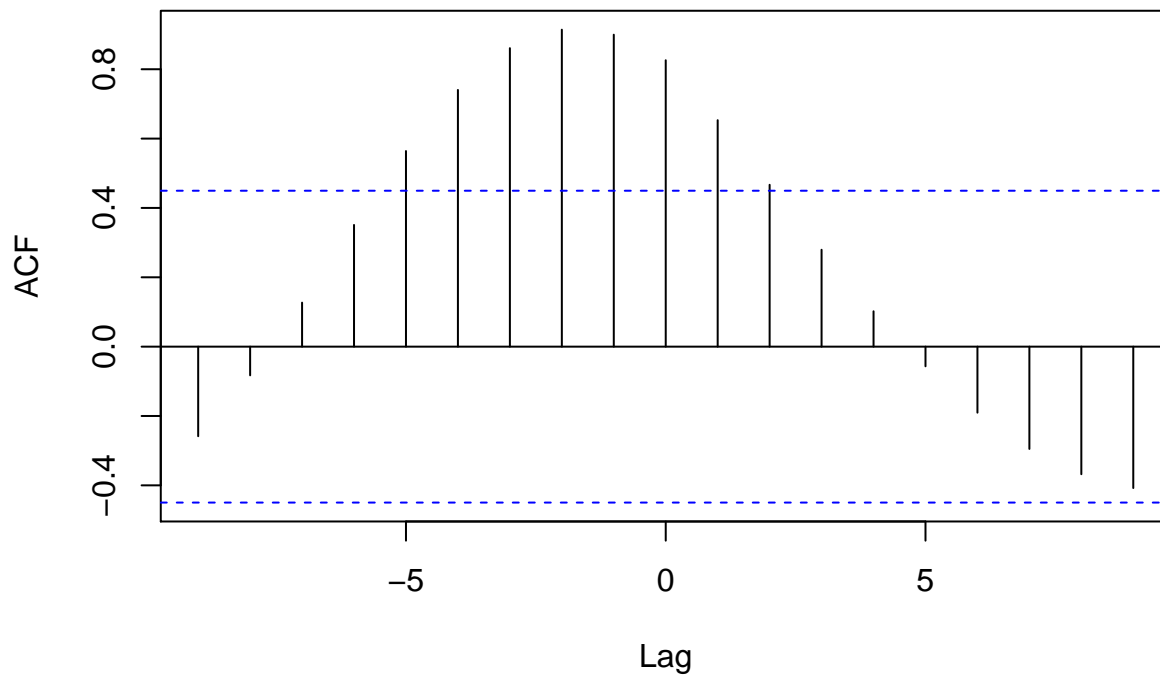
**1 wk ahead – 05**



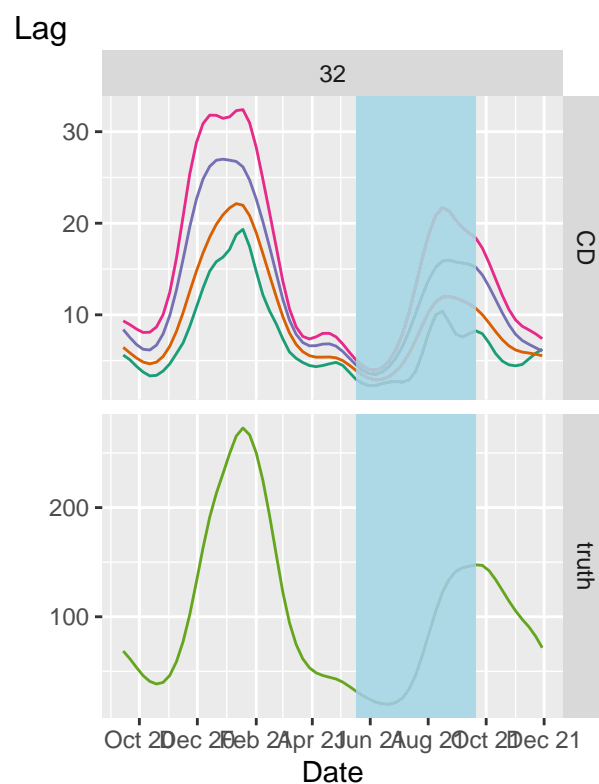
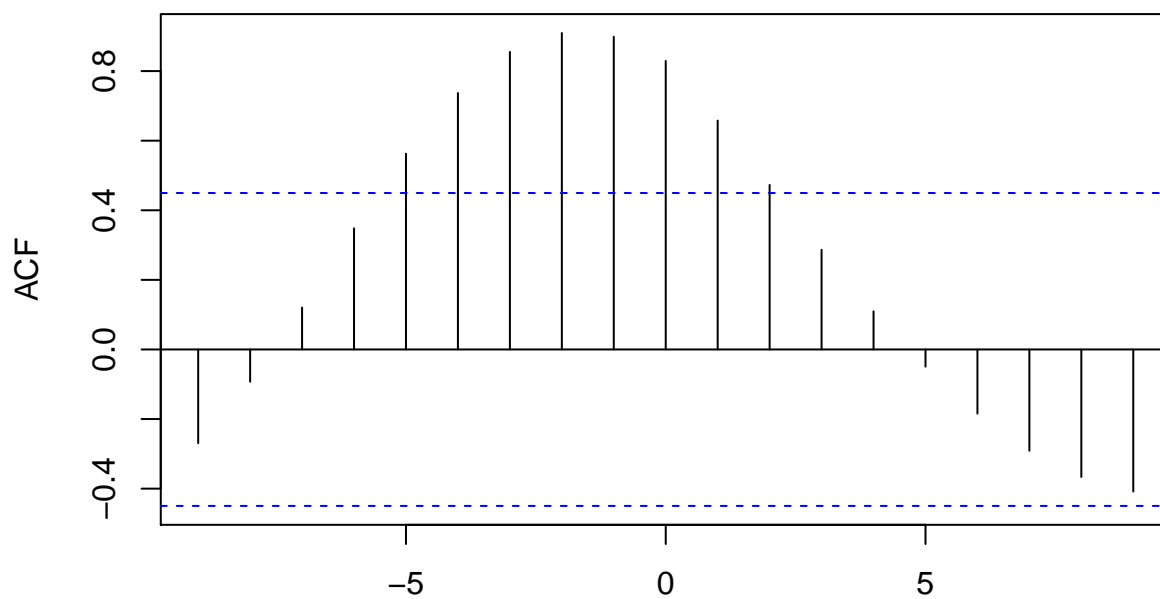
**2 wk ahead – 05**



**3 wk ahead – 05**



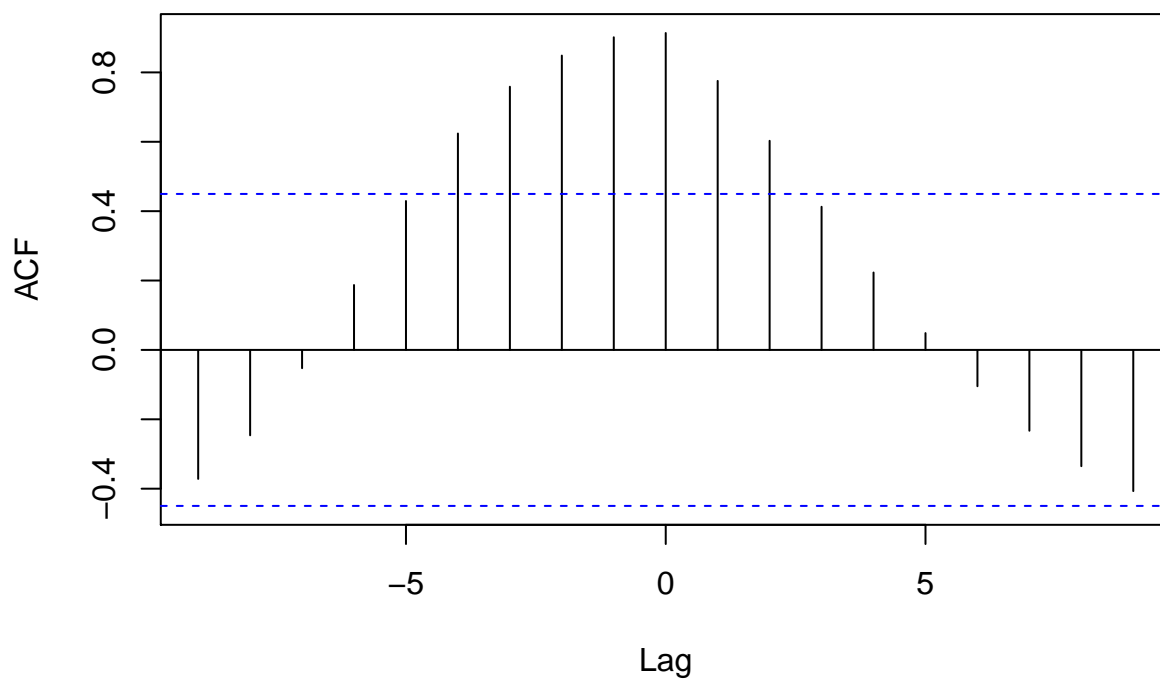
## 4 wk ahead – 05



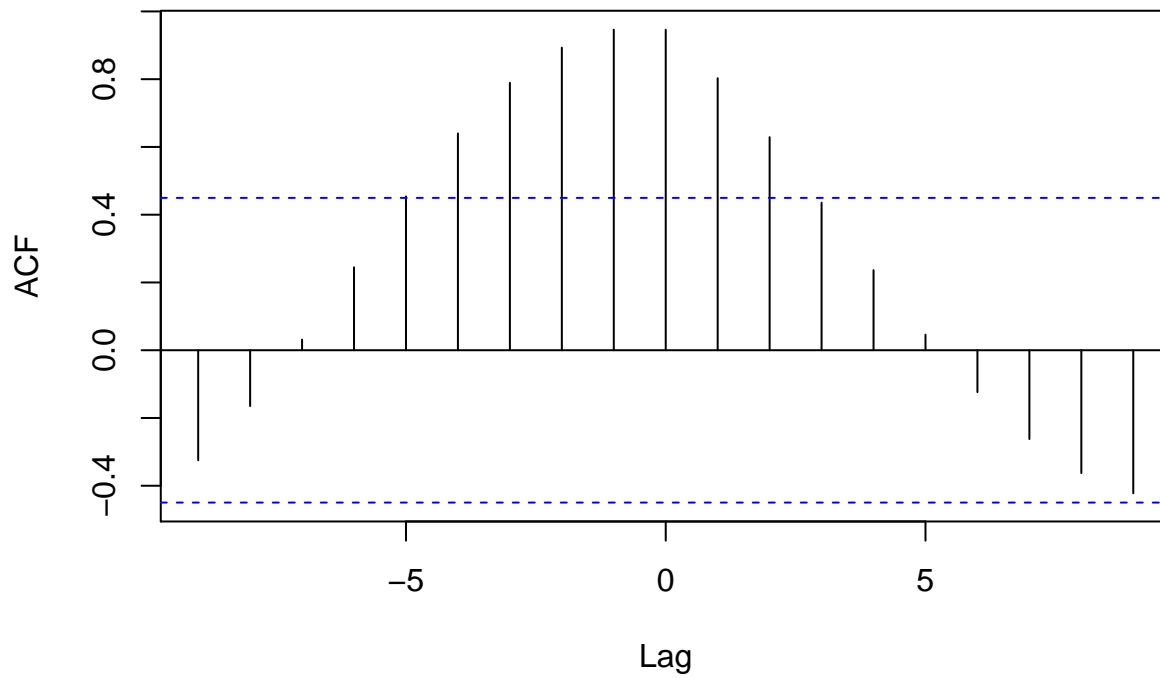
horizon 1 2 3 4 truth

Method preprocessed\_value

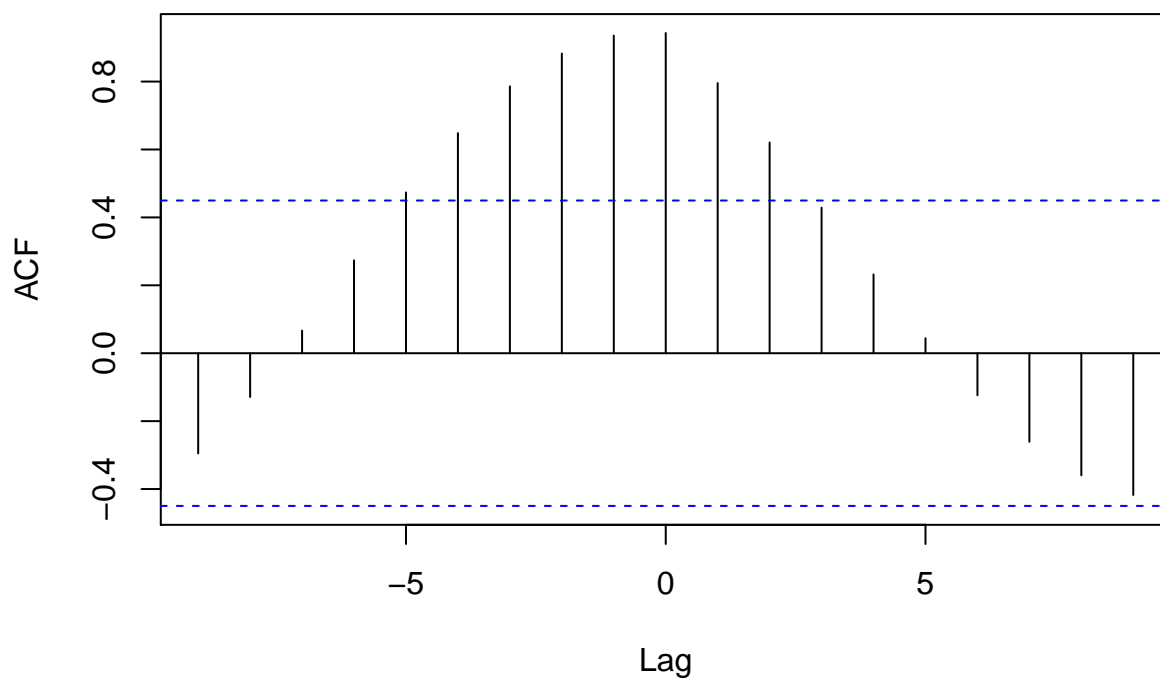
**1 wk ahead – 32**



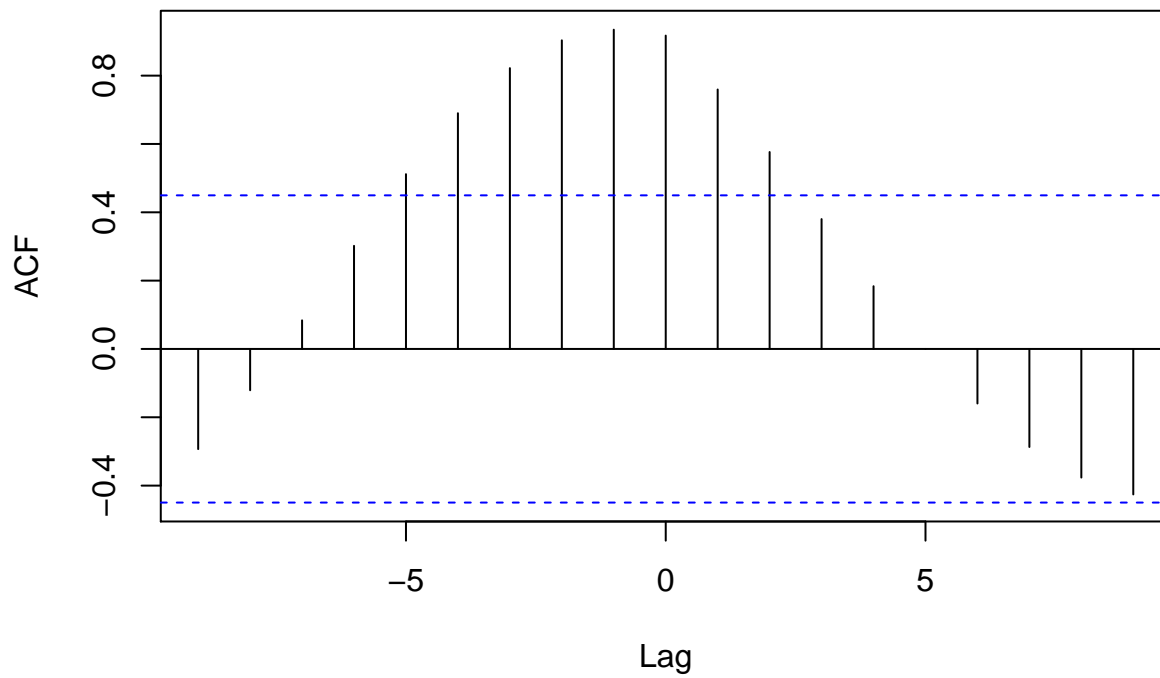
**2 wk ahead – 32**



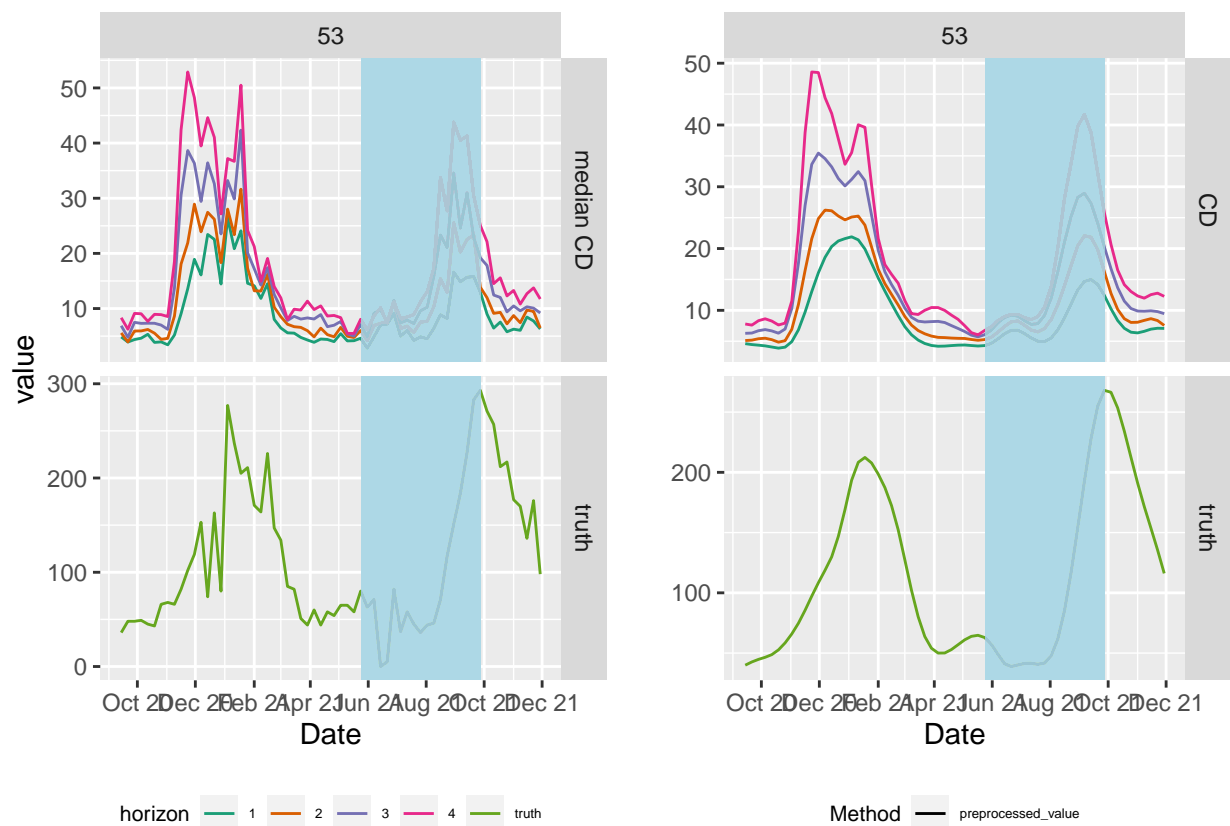
**3 wk ahead – 32**



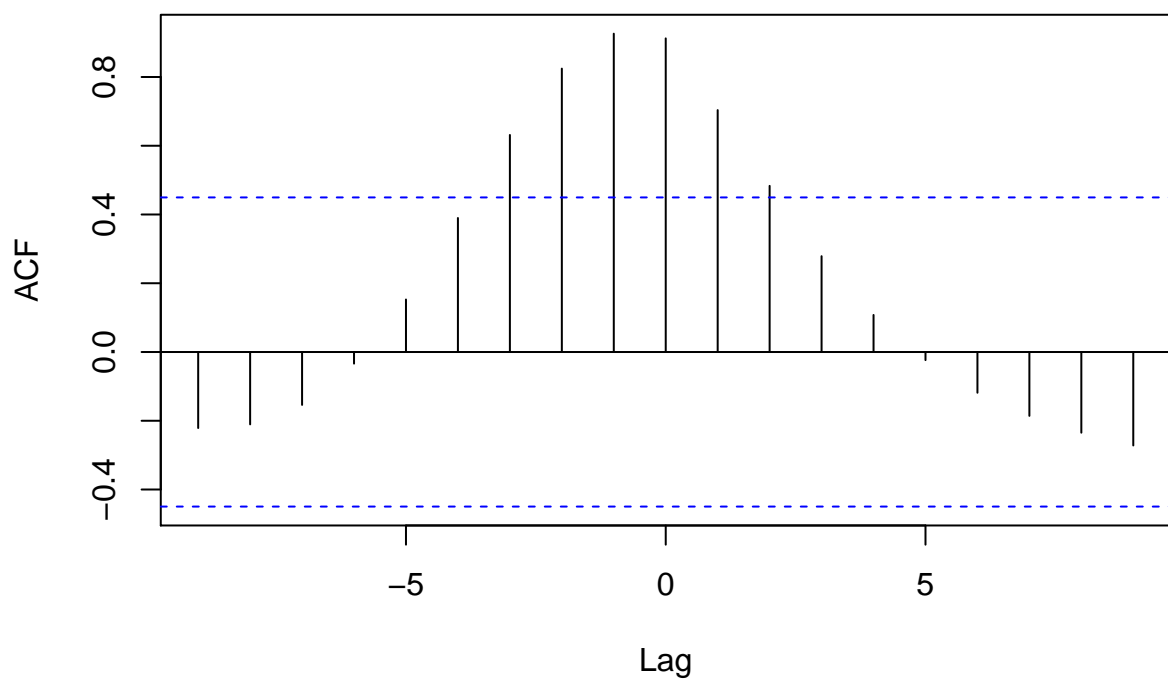
**4 wk ahead – 32**



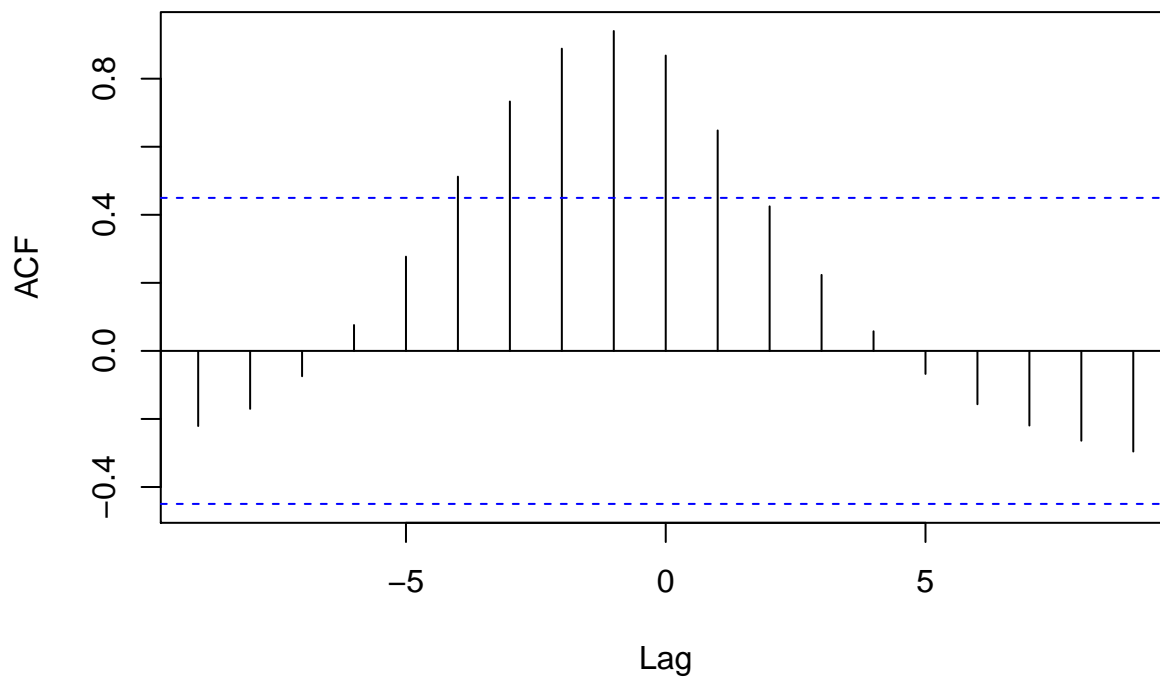




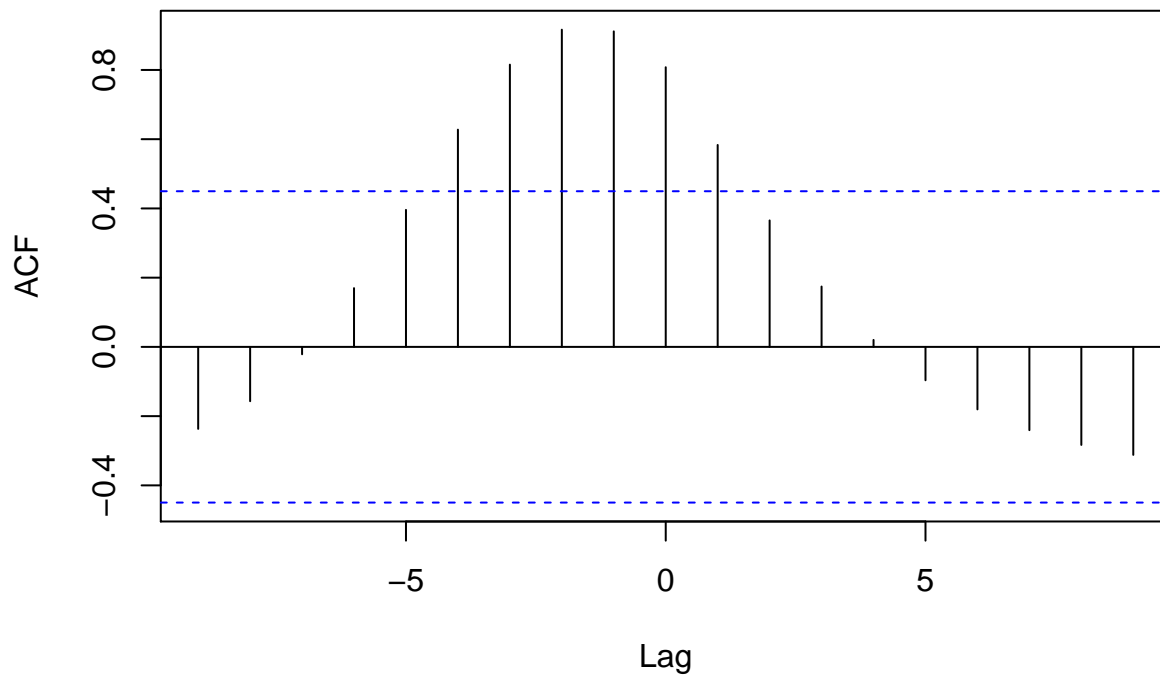
**1 wk ahead – 53**



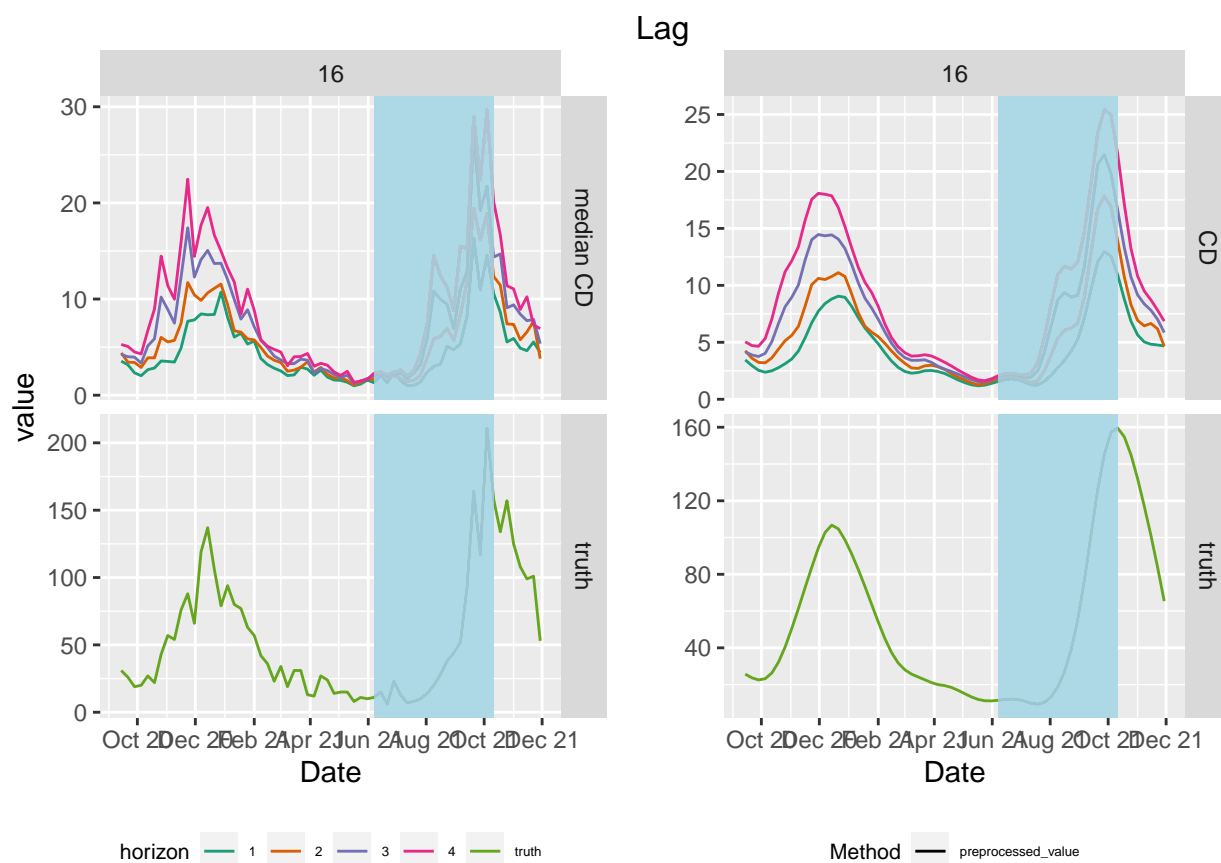
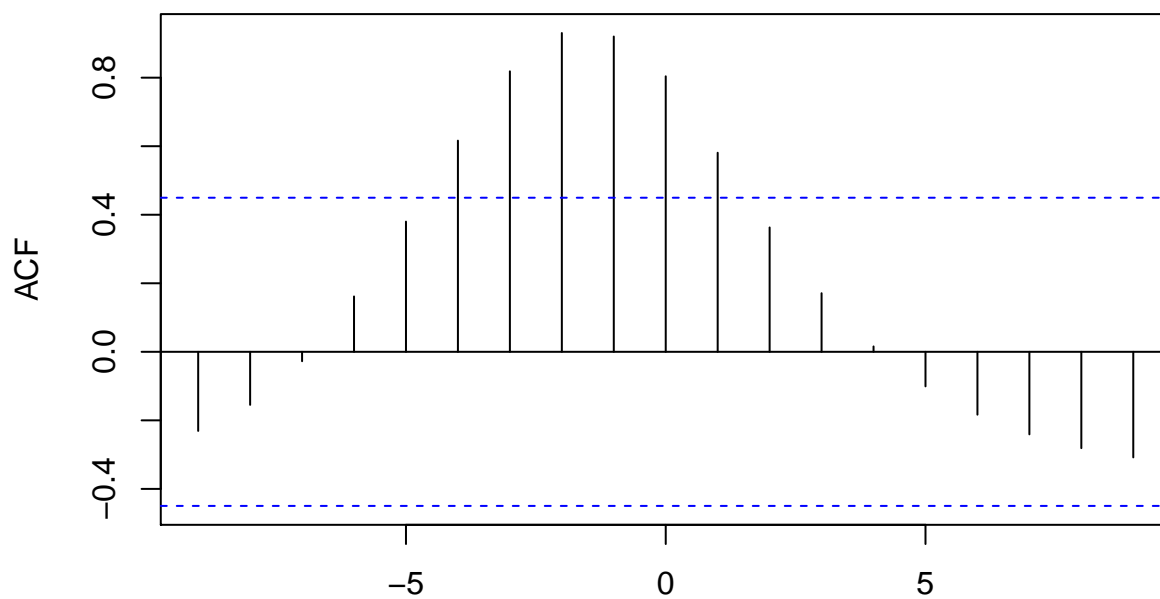
**2 wk ahead – 53**



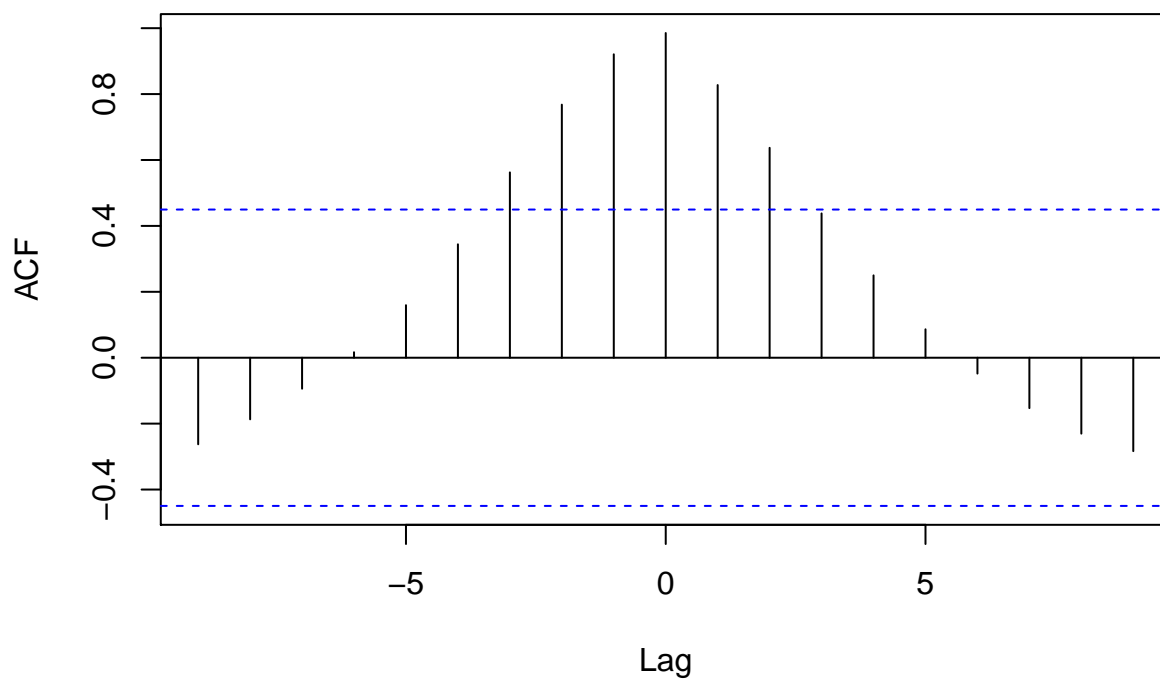
**3 wk ahead – 53**



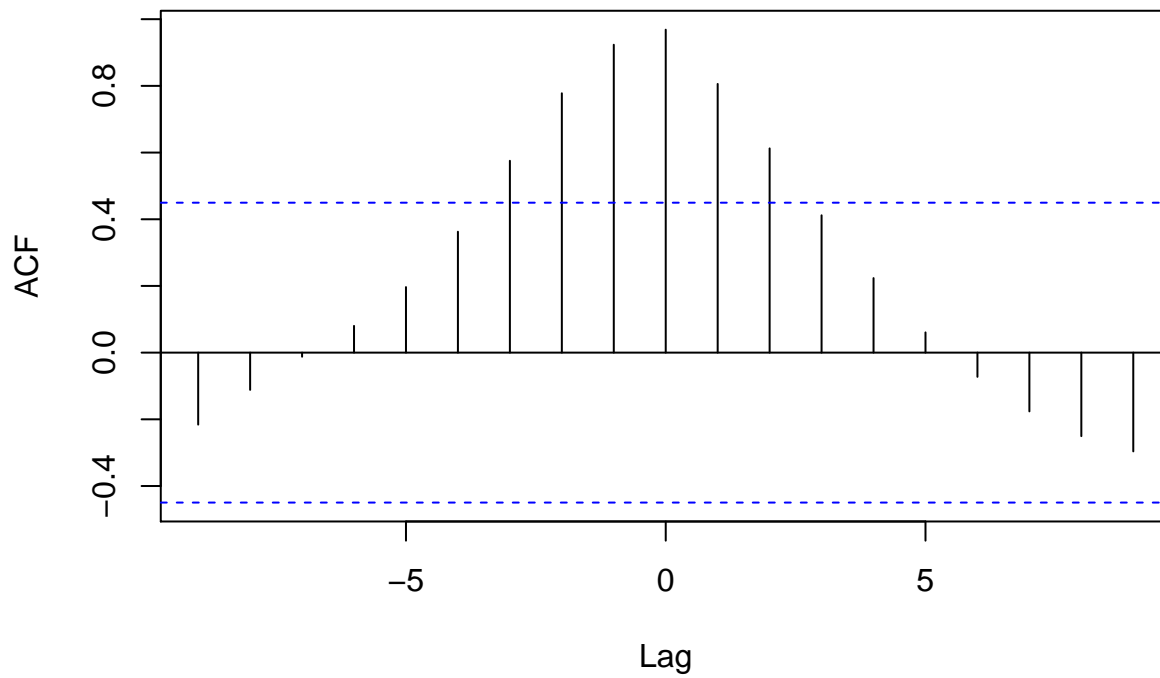
## 4 wk ahead – 53



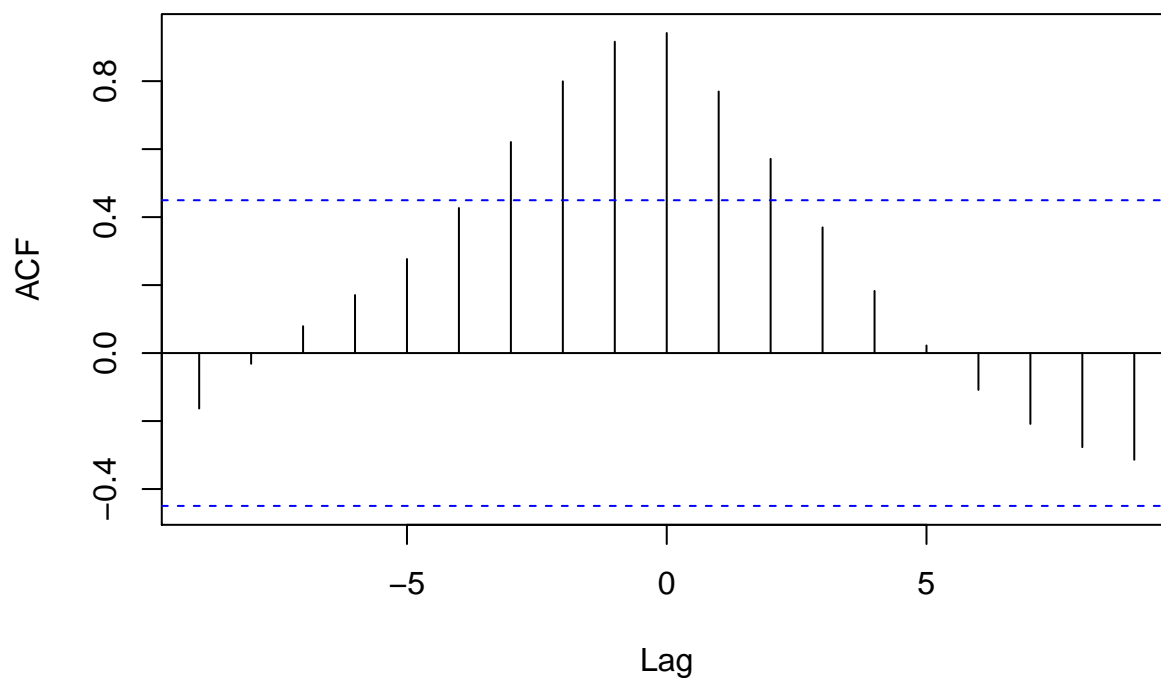
**1 wk ahead – 16**



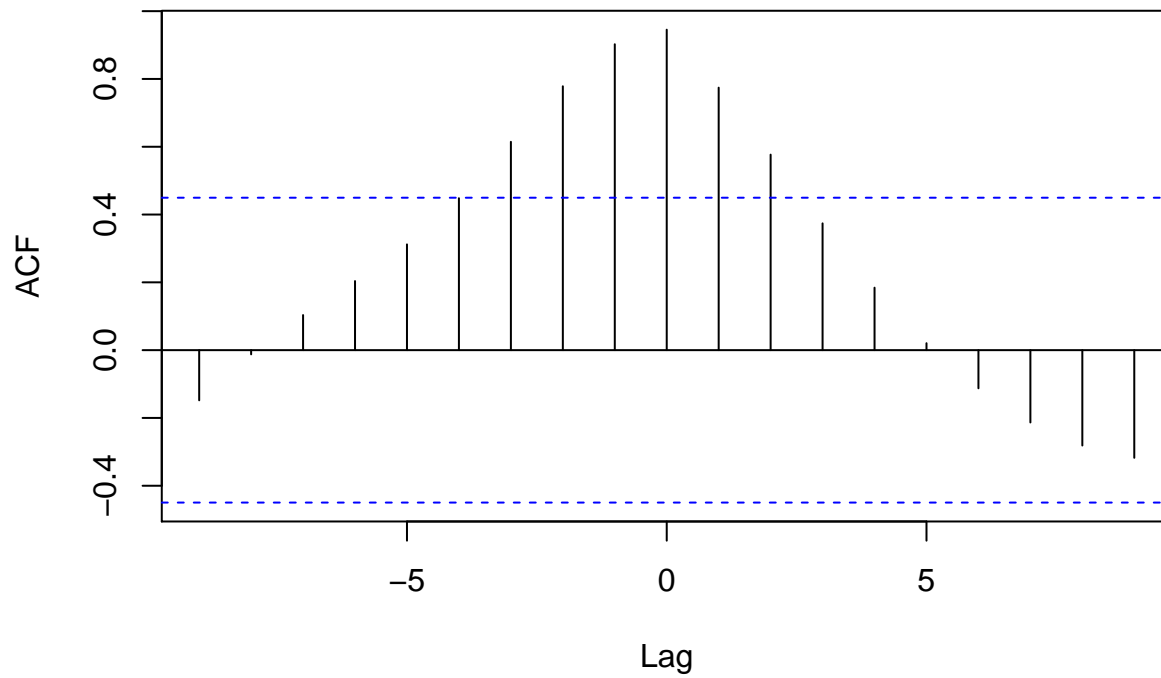
**2 wk ahead – 16**

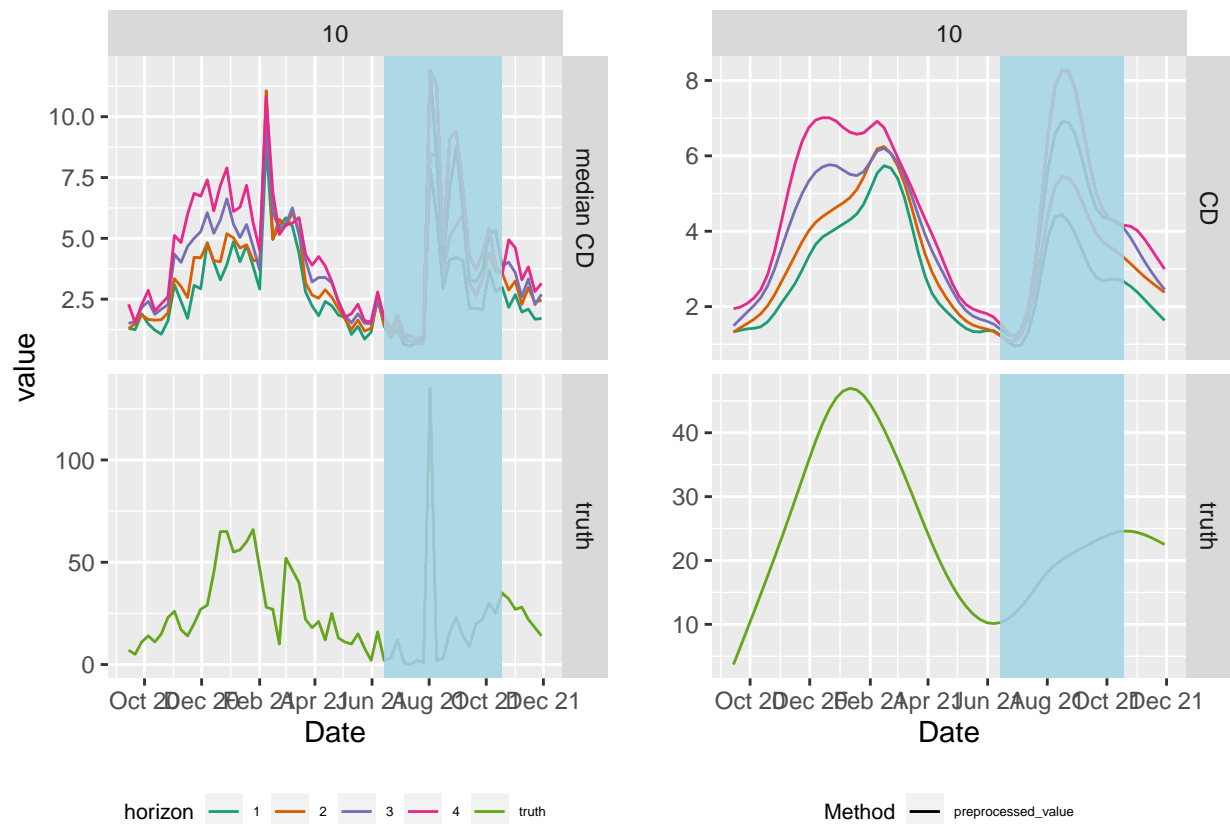


**3 wk ahead – 16**

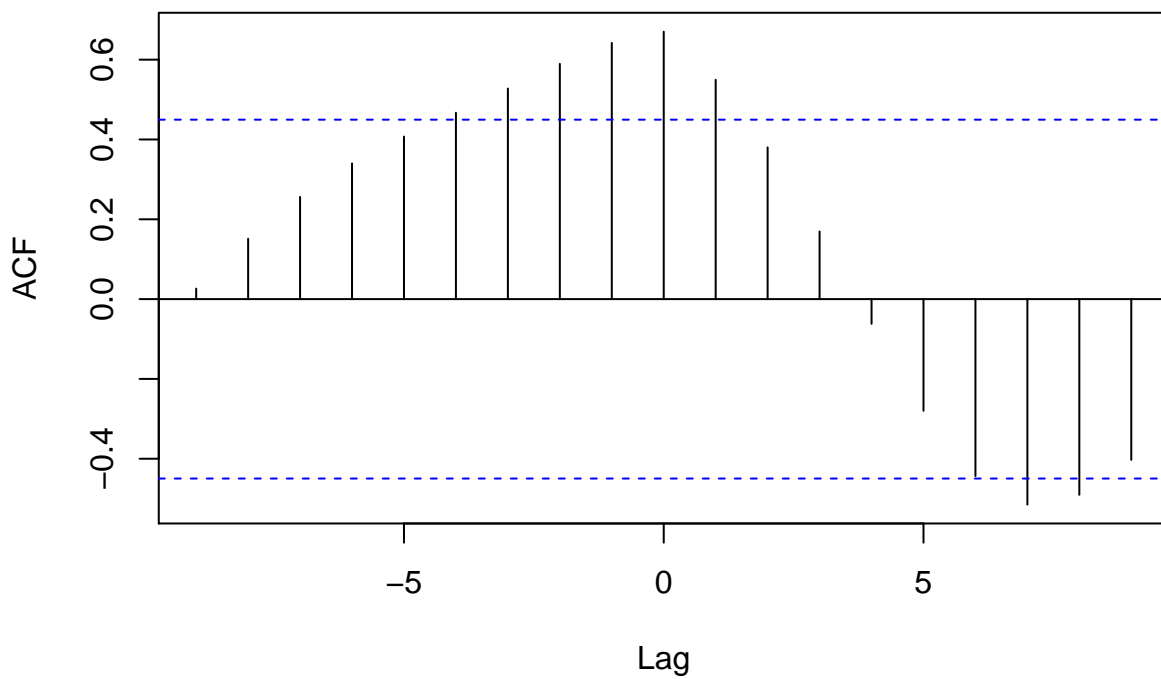


**4 wk ahead – 16**

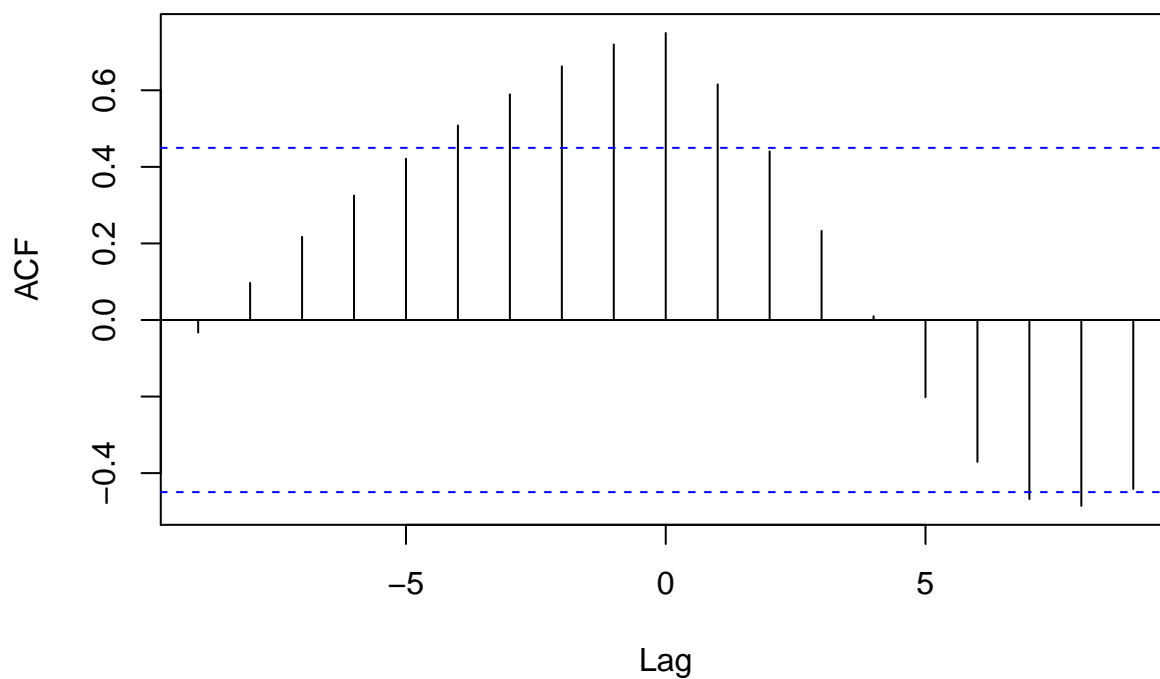




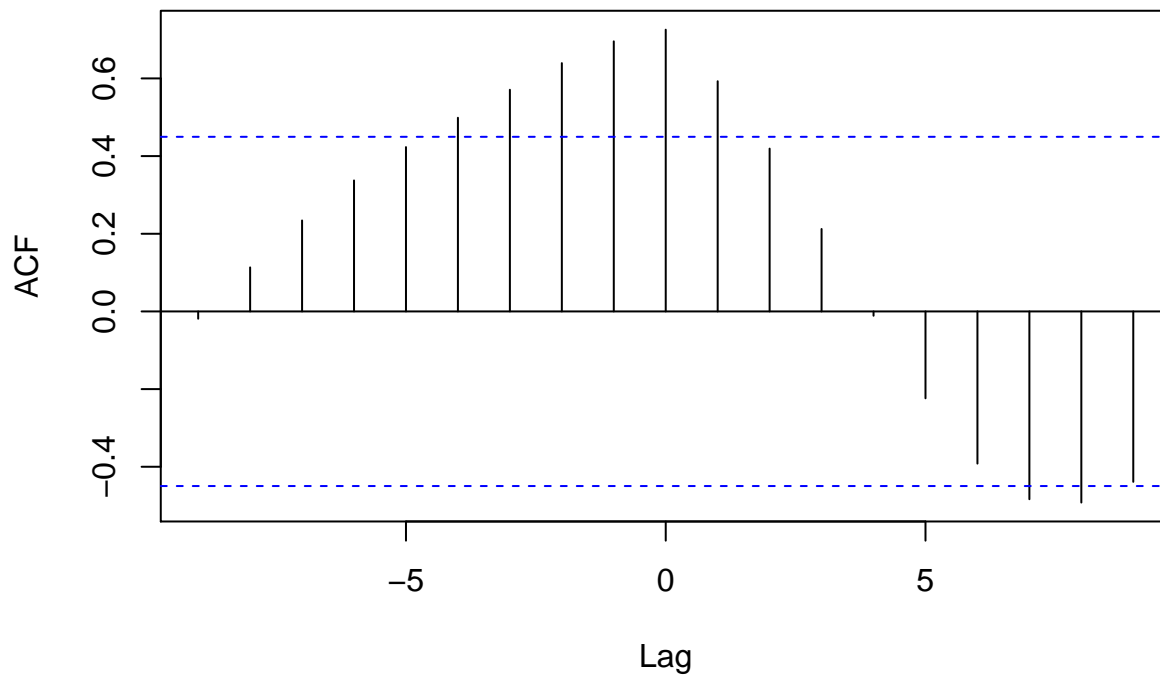
**1 wk ahead – 10**



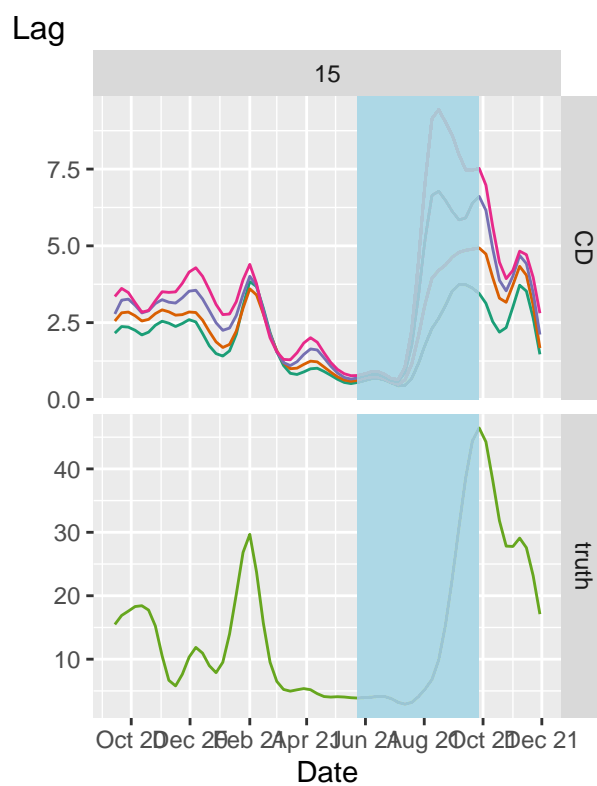
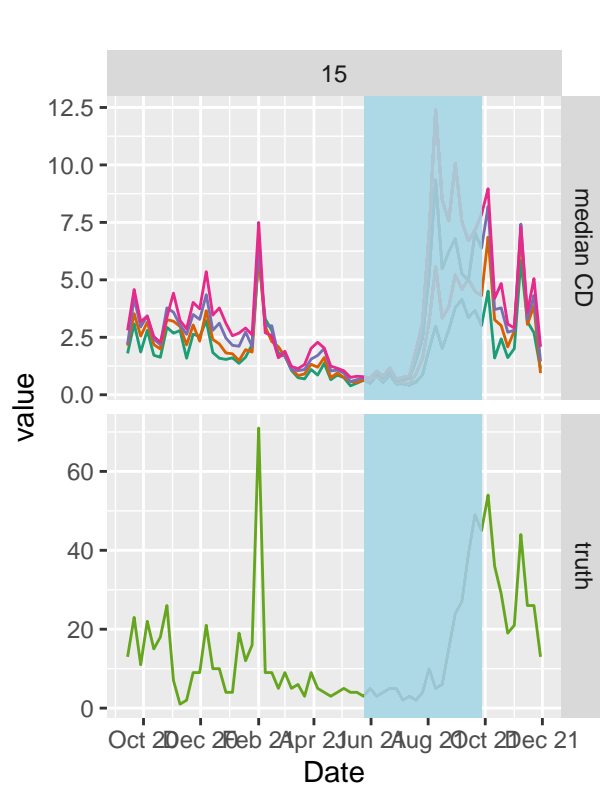
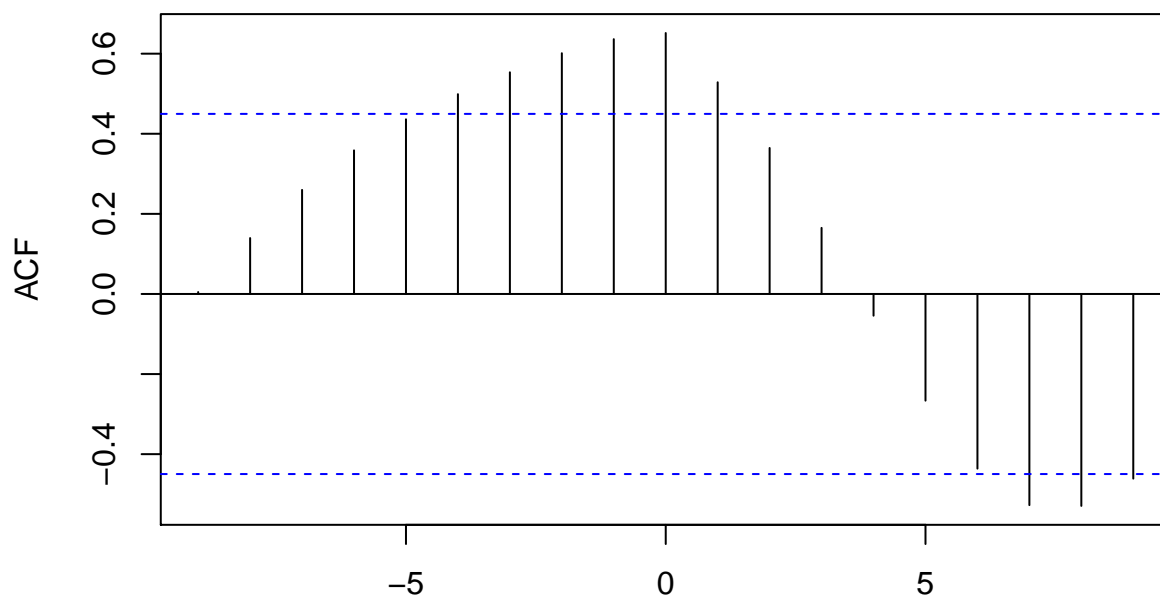
**2 wk ahead – 10**



**3 wk ahead – 10**

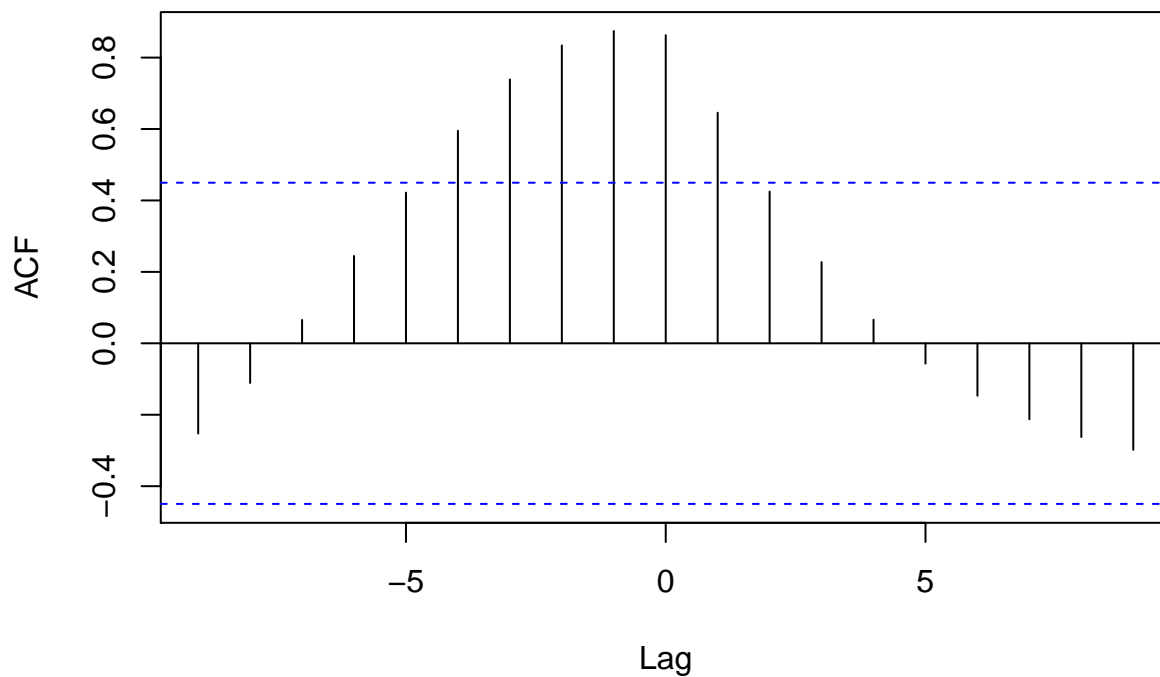


## 4 wk ahead – 10

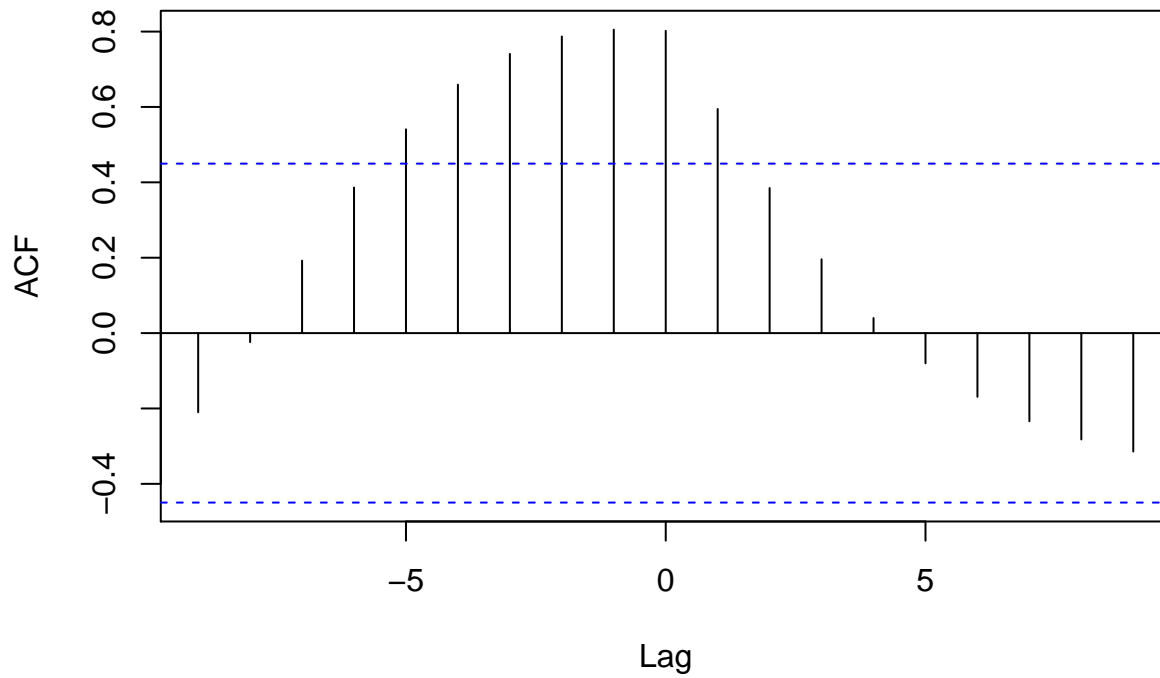




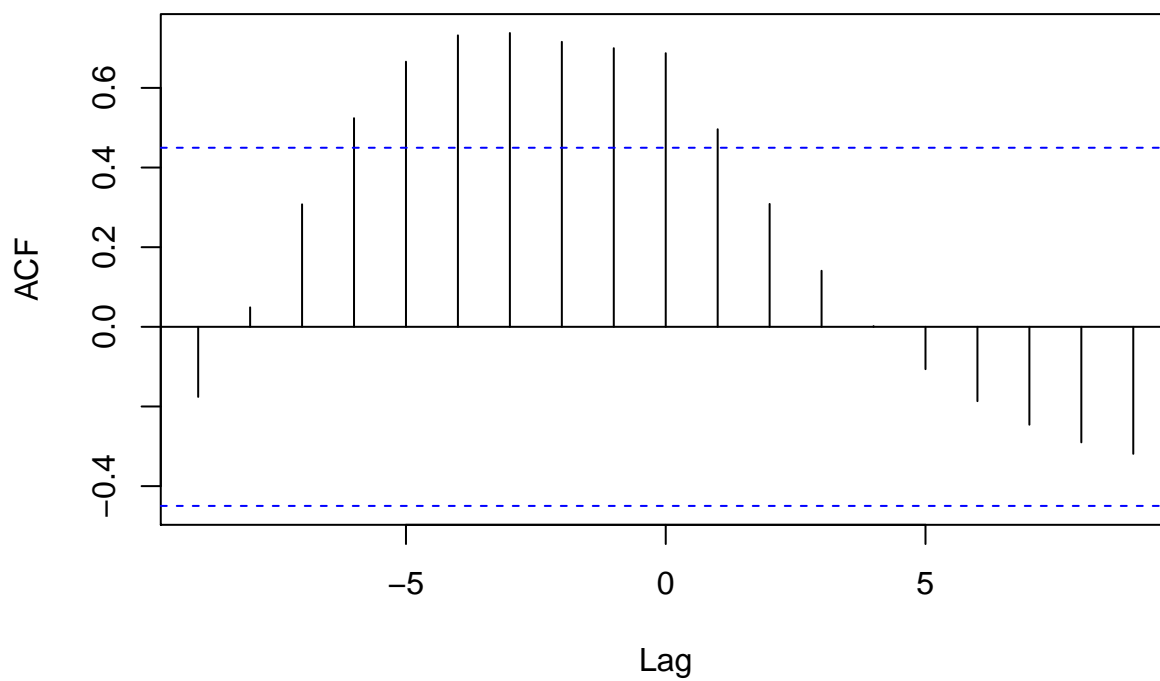
**1 wk ahead – 15**



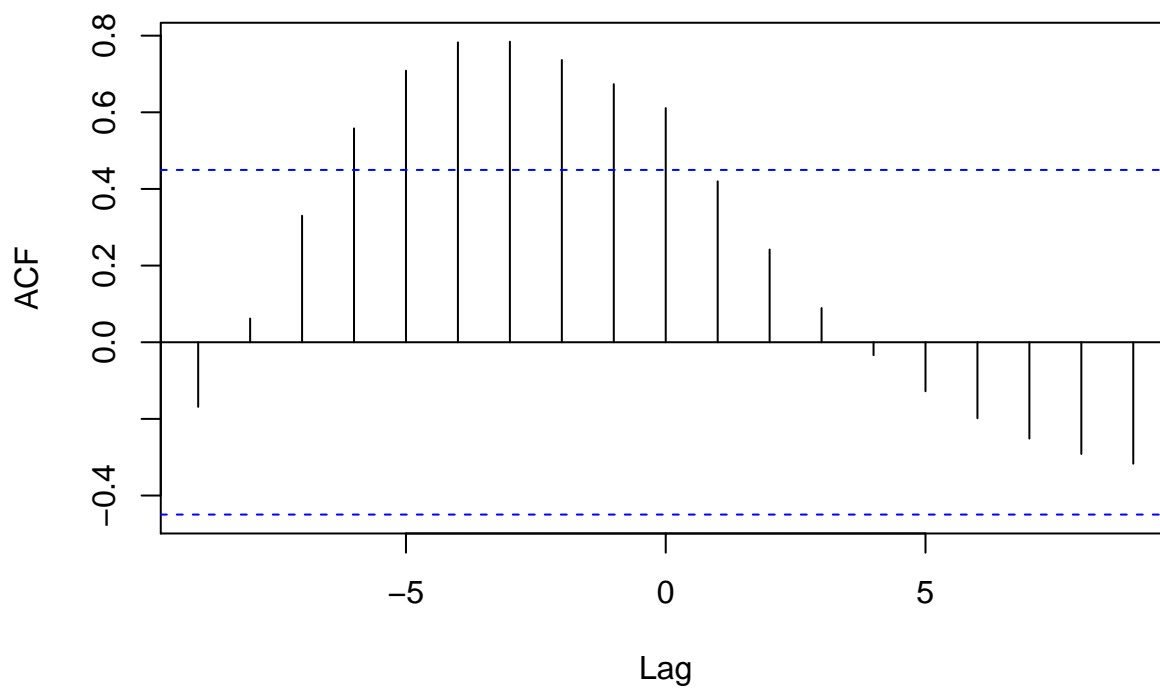
**2 wk ahead – 15**

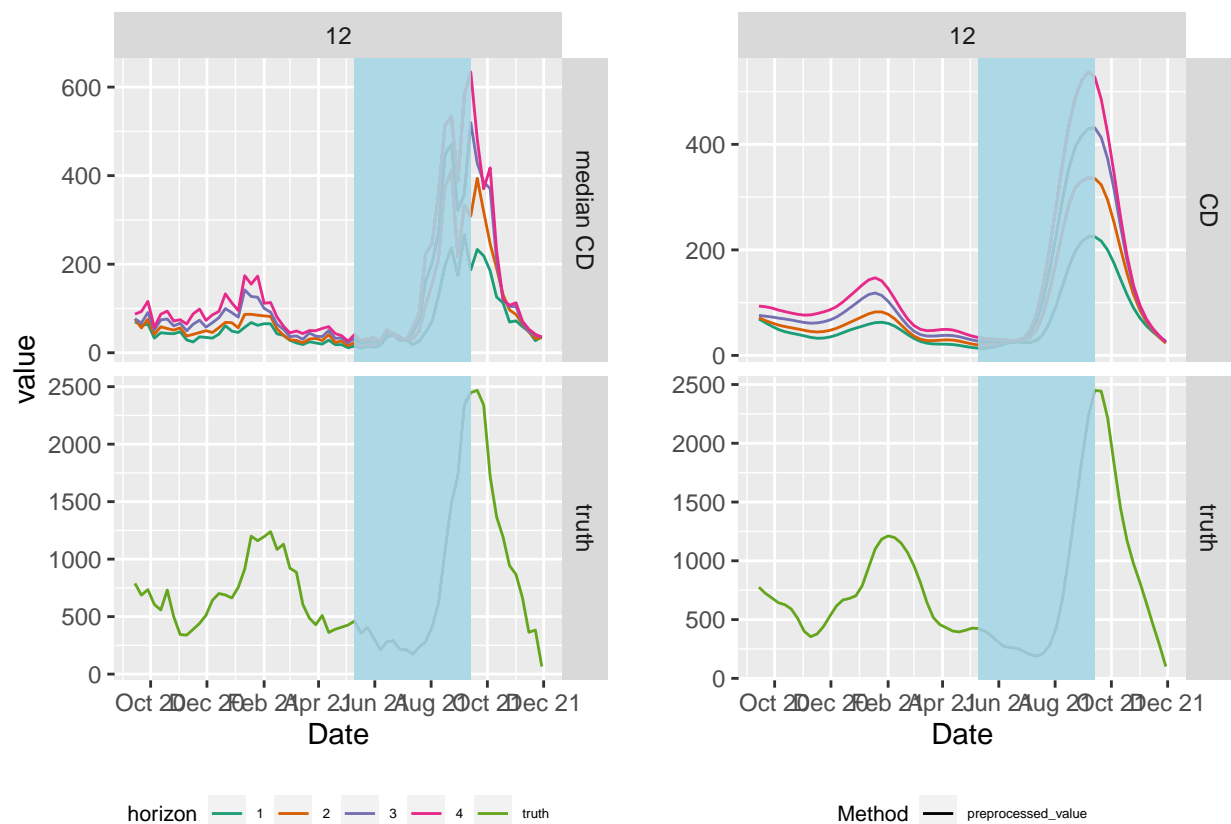


**3 wk ahead – 15**

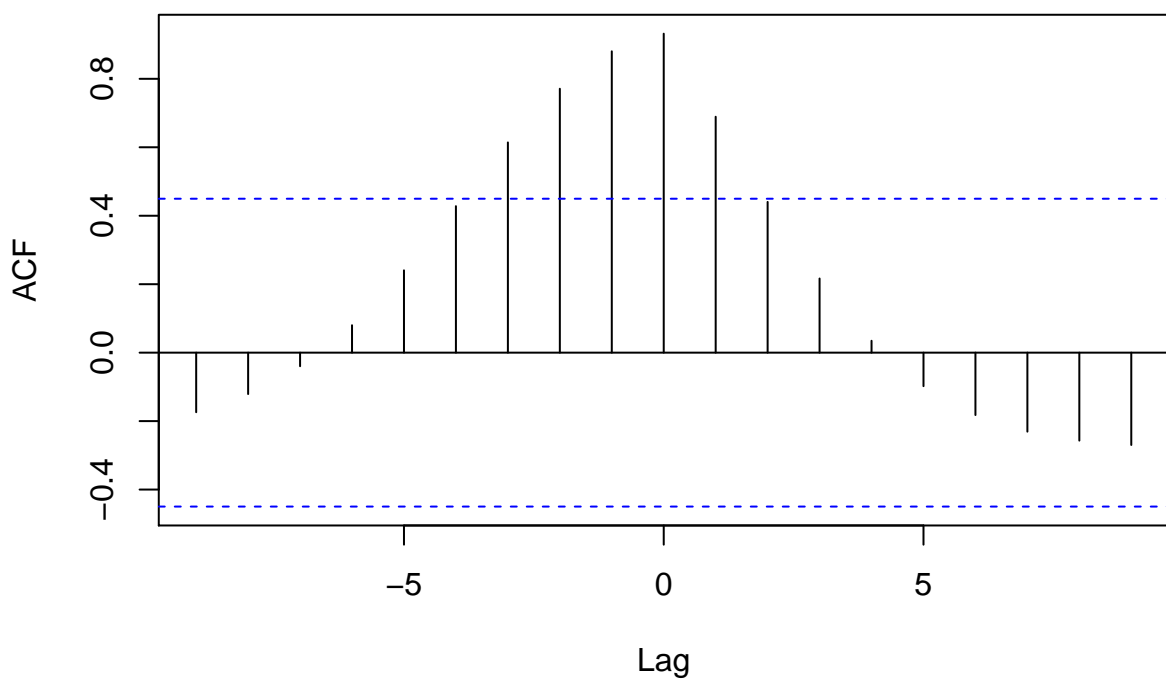


**4 wk ahead – 15**

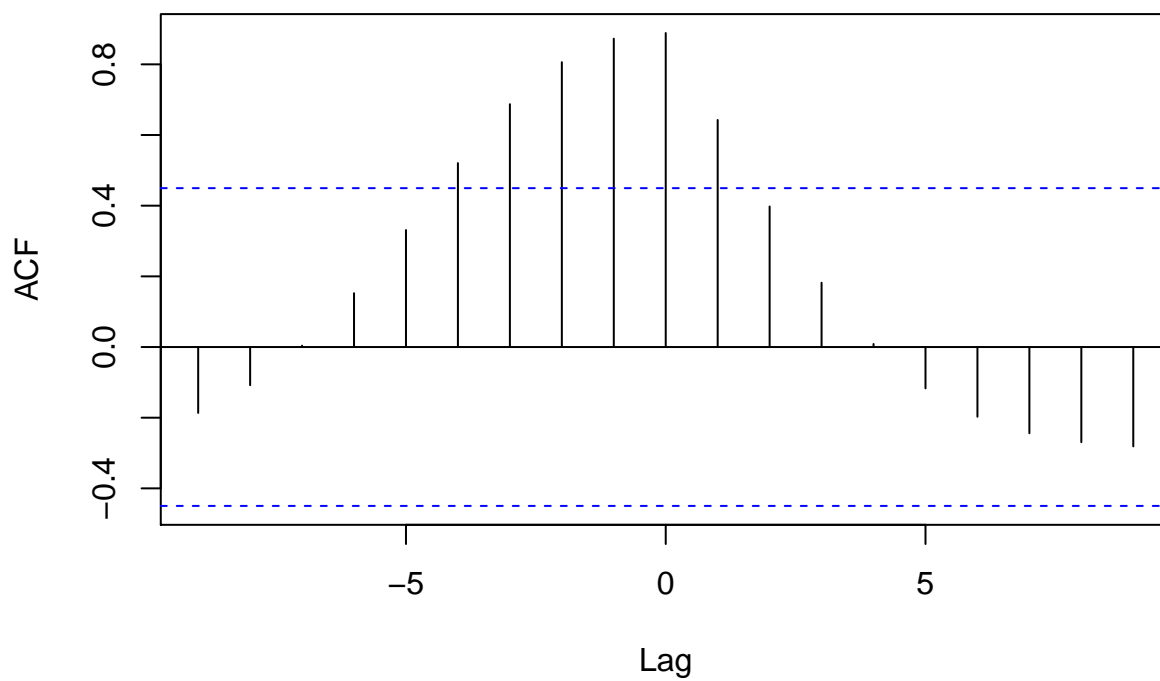




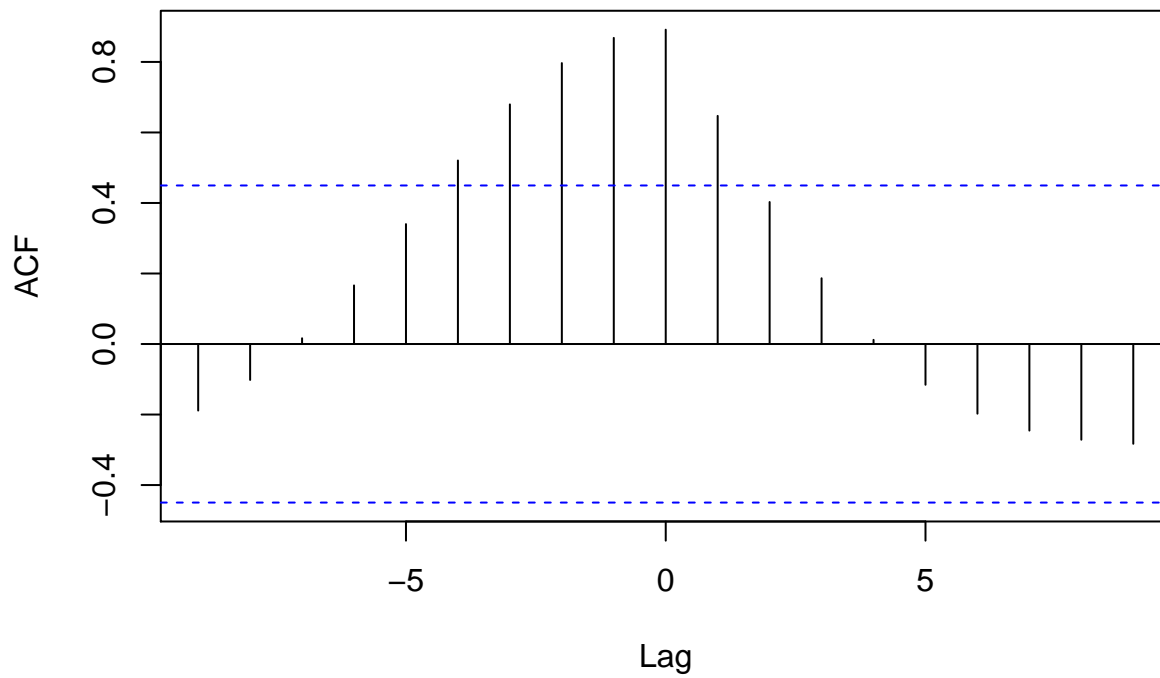
**1 wk ahead – 12**



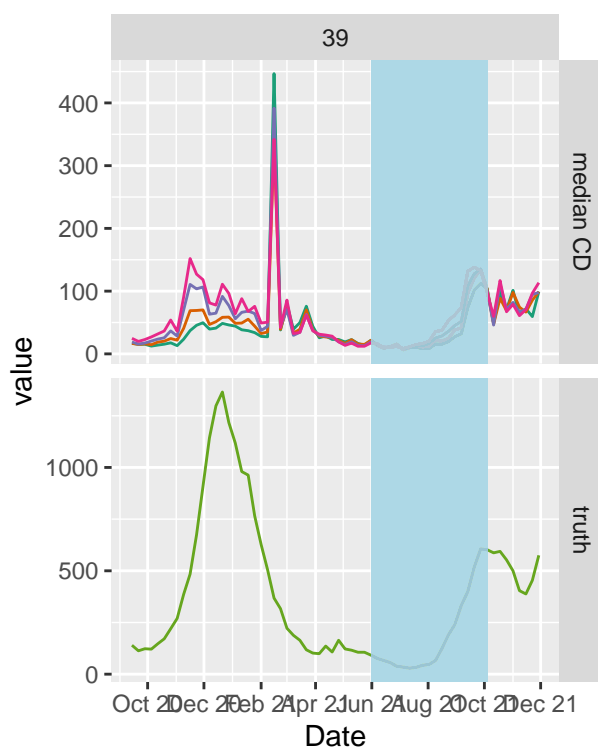
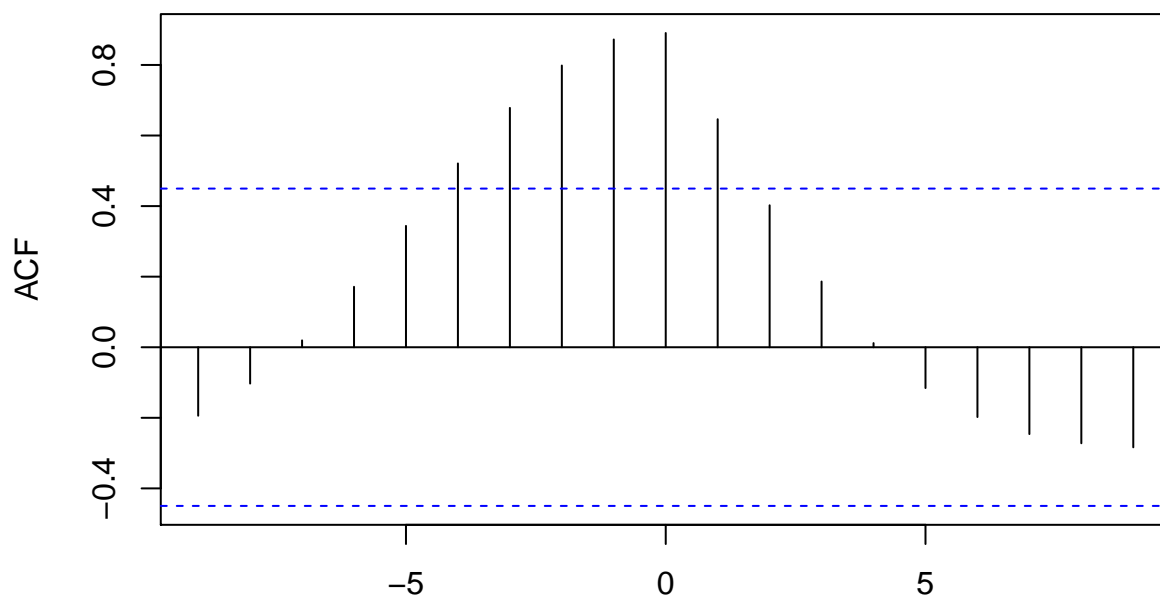
**2 wk ahead – 12**



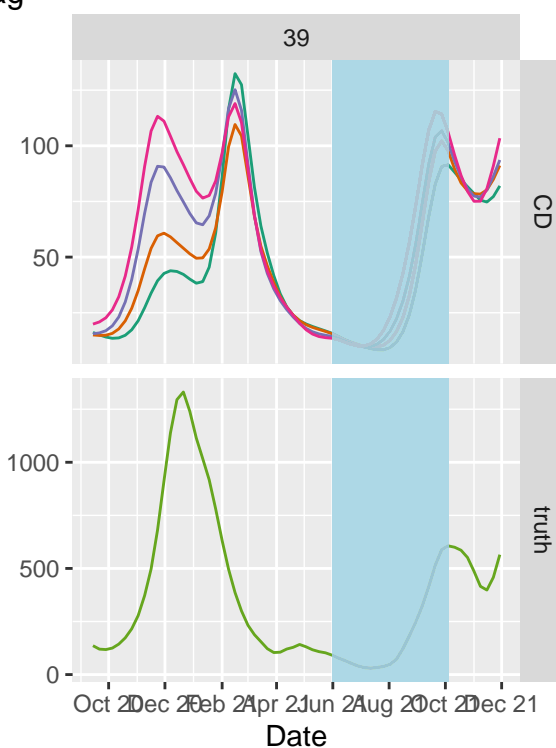
**3 wk ahead – 12**



## 4 wk ahead – 12

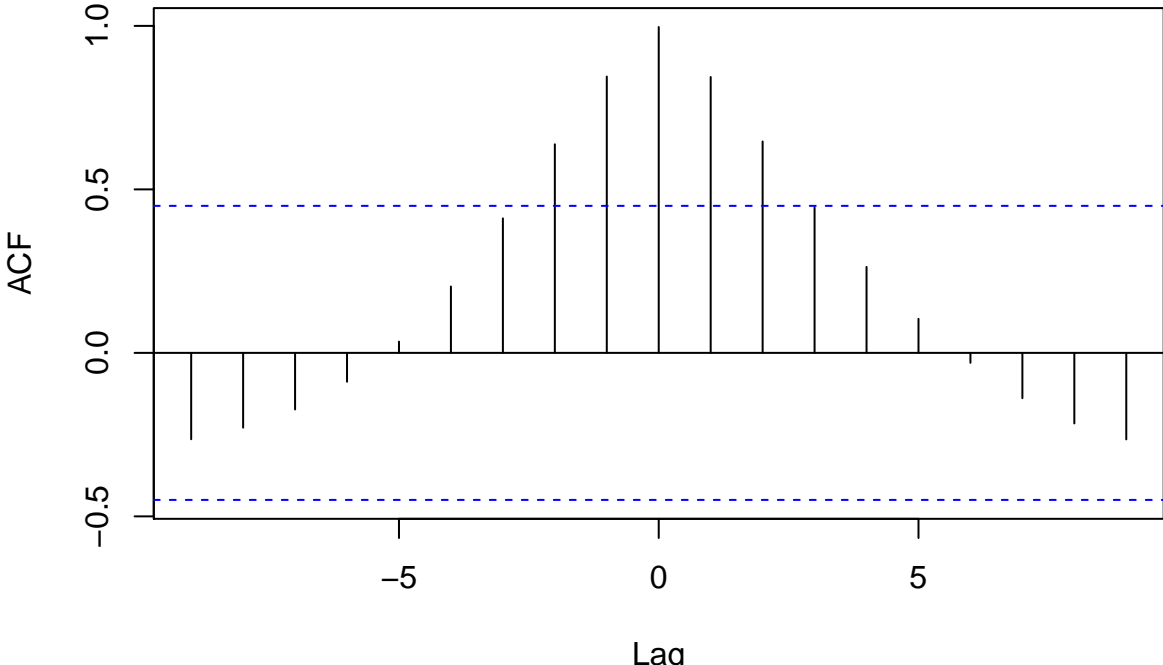


horizon 1 2 3 4 truth

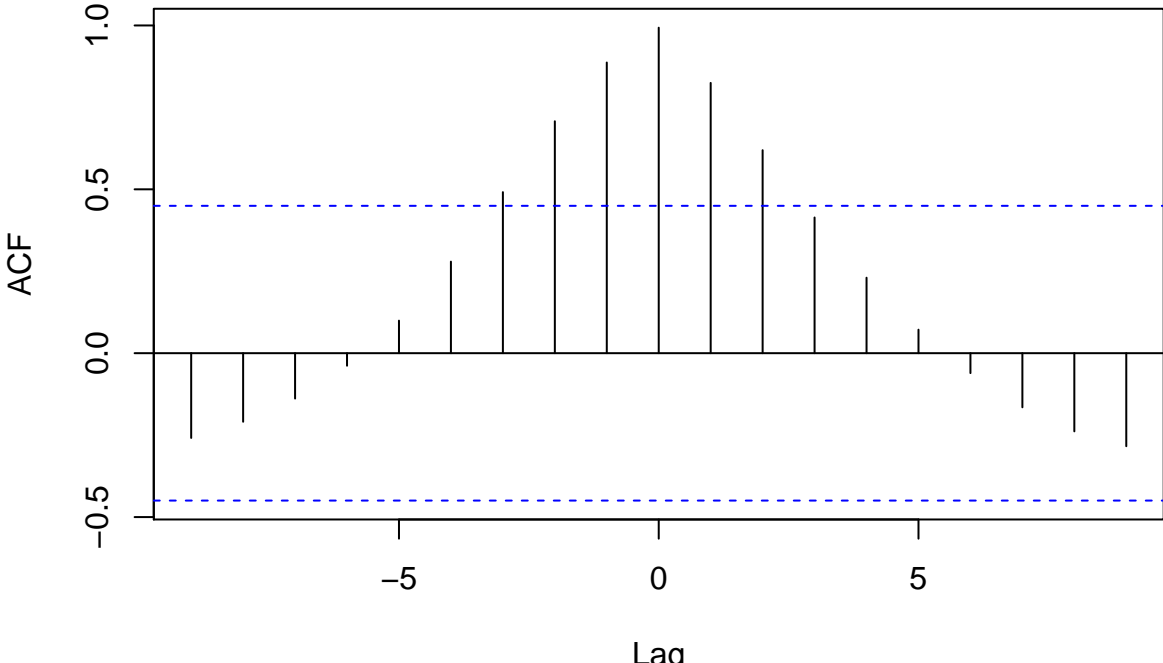


Method preprocessed\_value

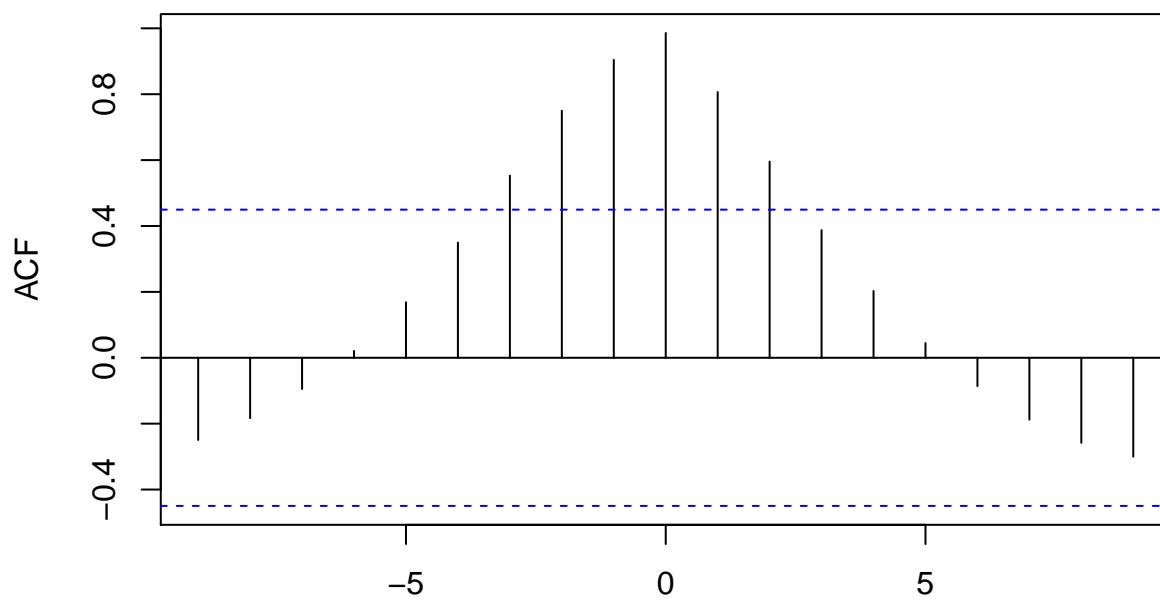
## 1 wk ahead – 39



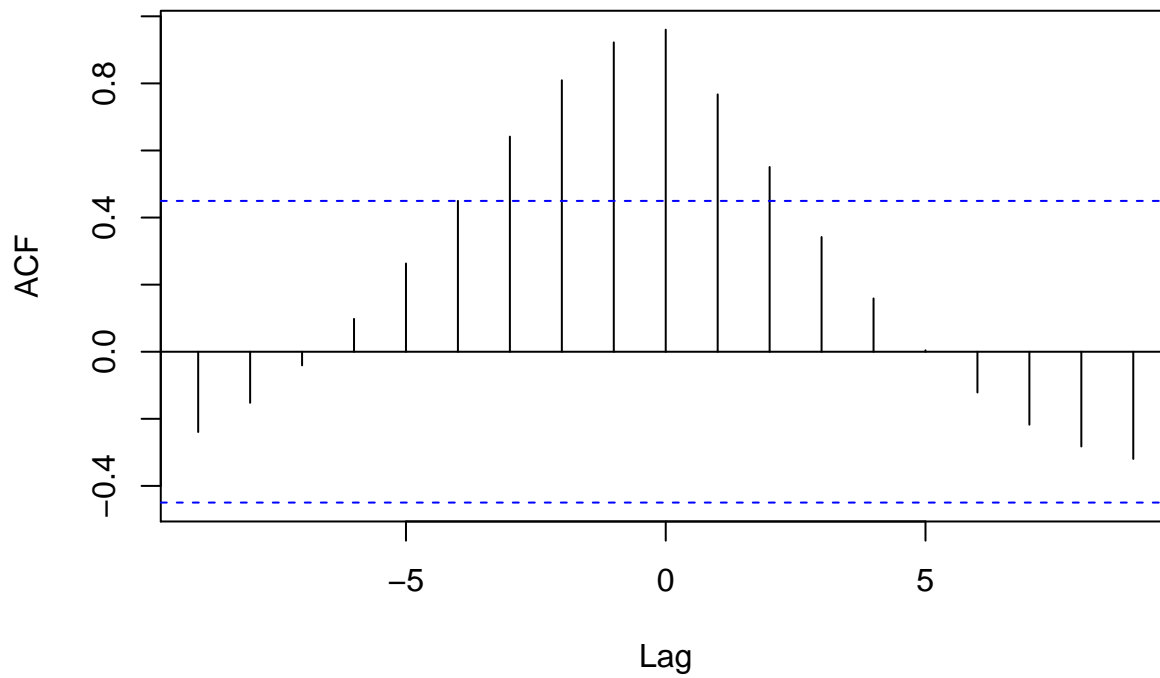
**2 wk ahead – 39**

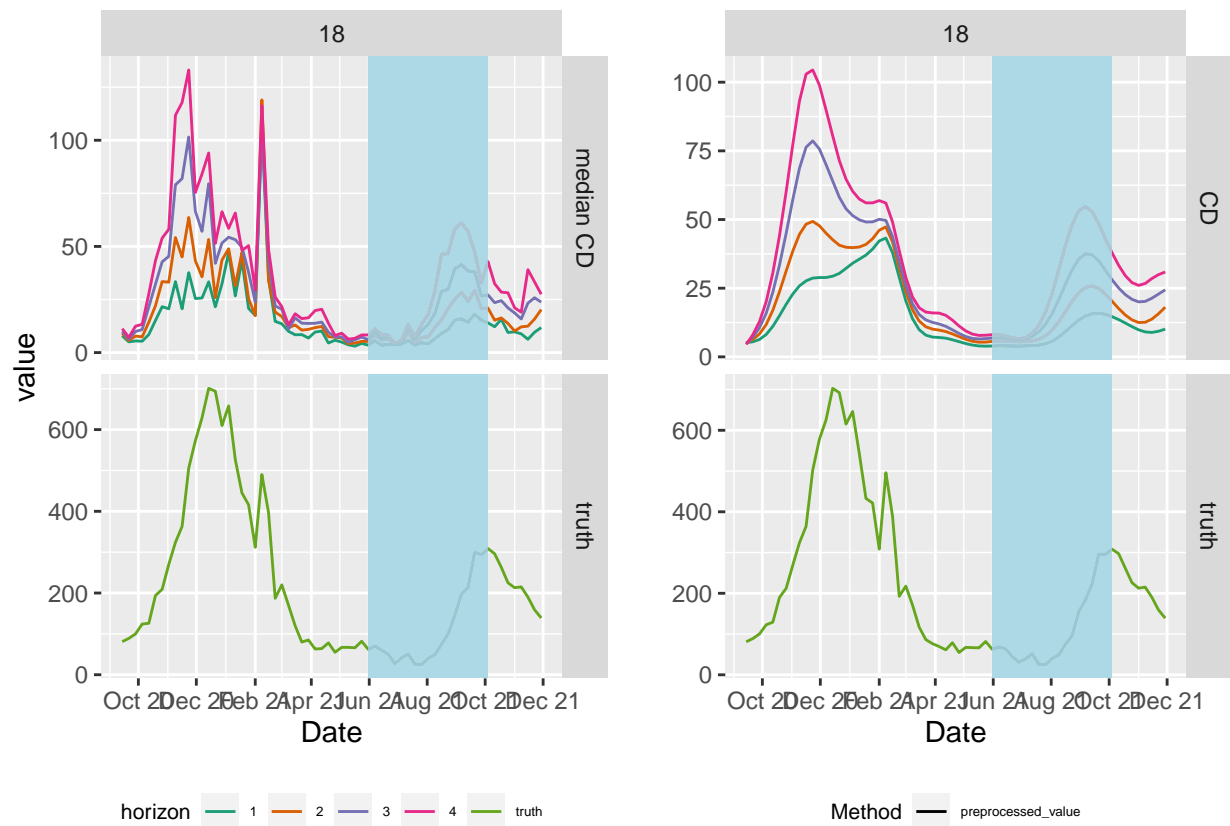


**3 wk ahead – 39**

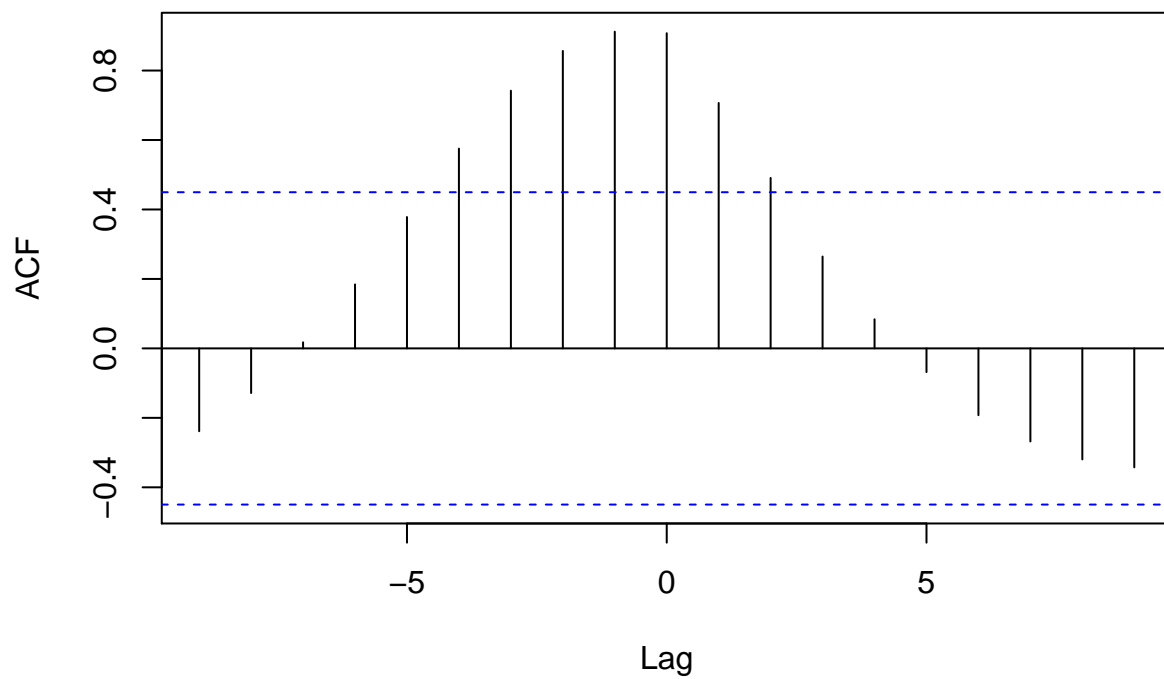


**4 wk ahead – 39**



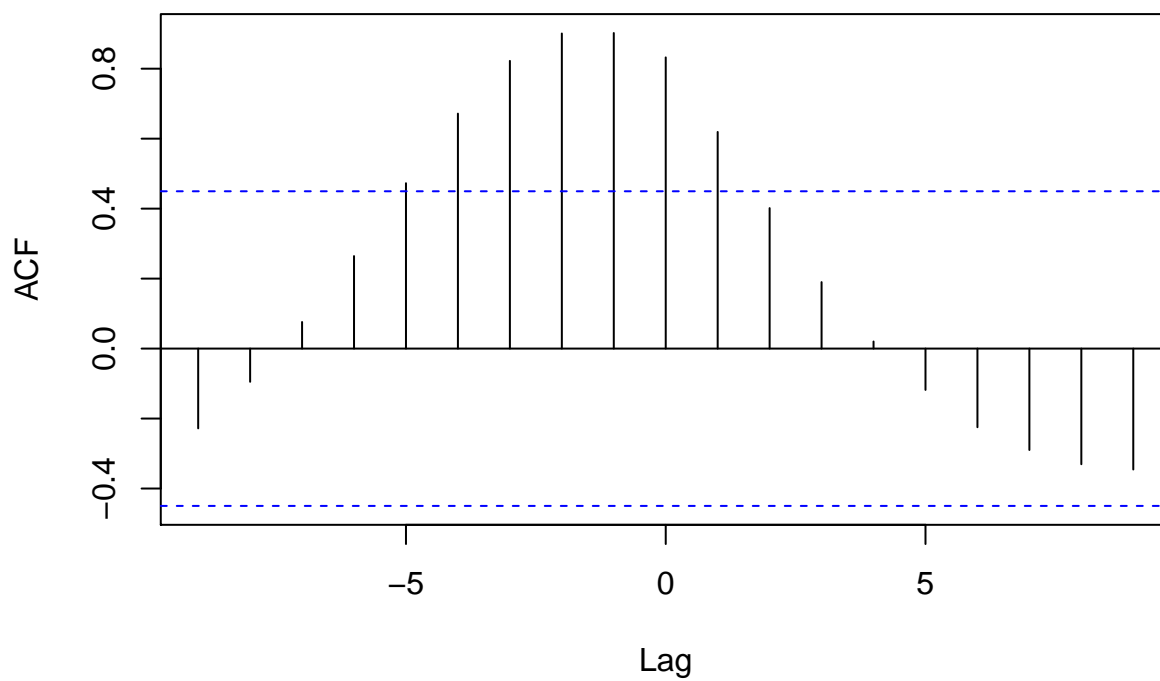


**1 wk ahead – 18**

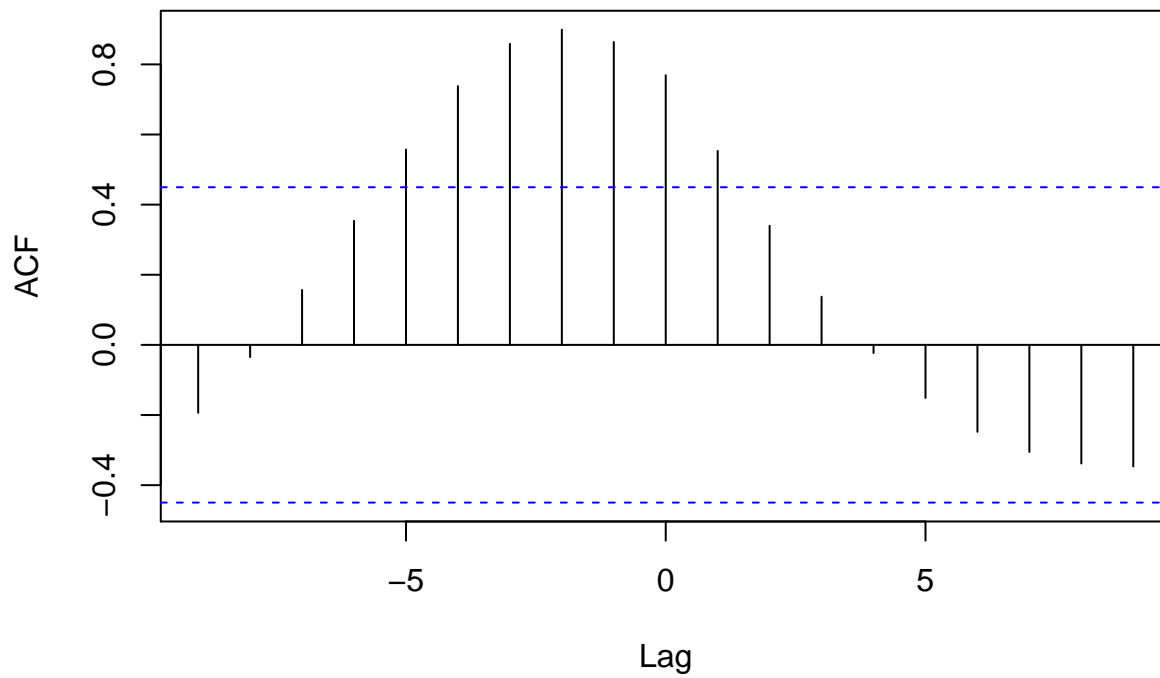




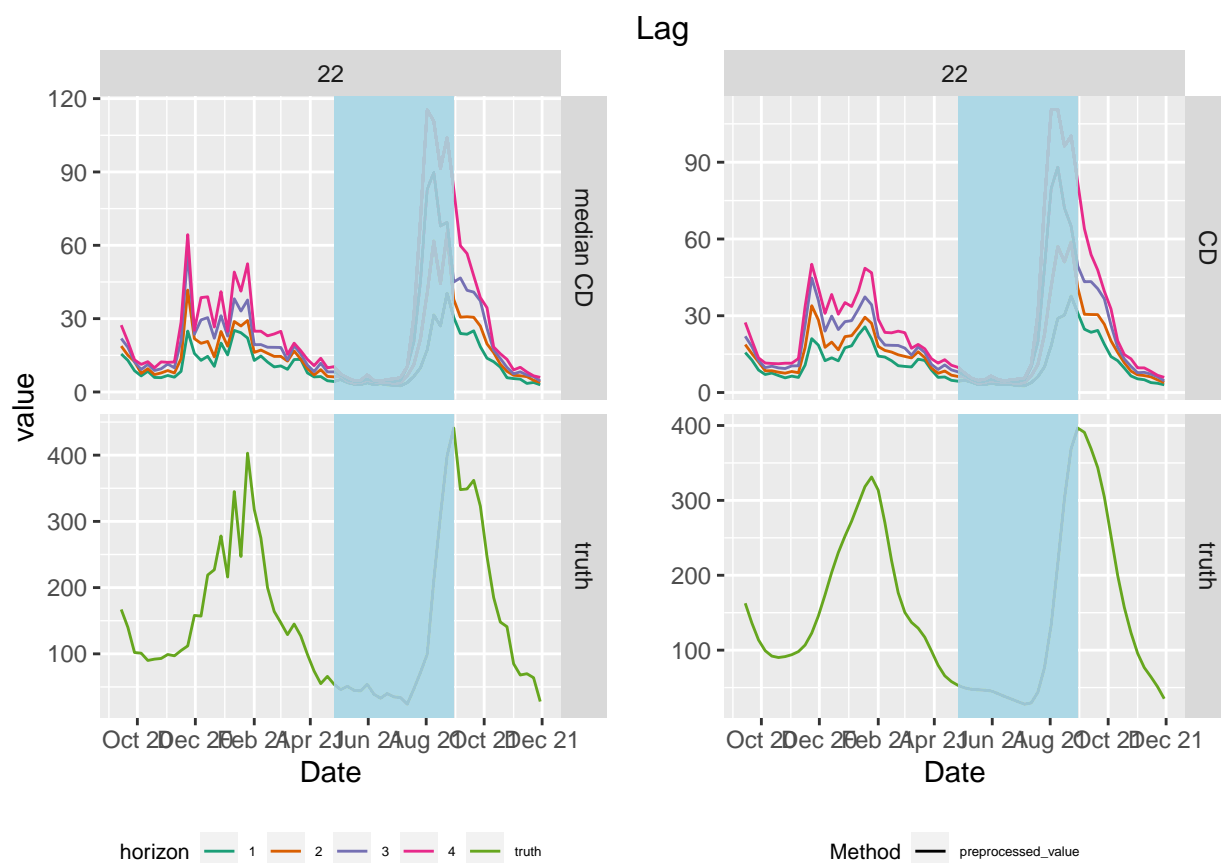
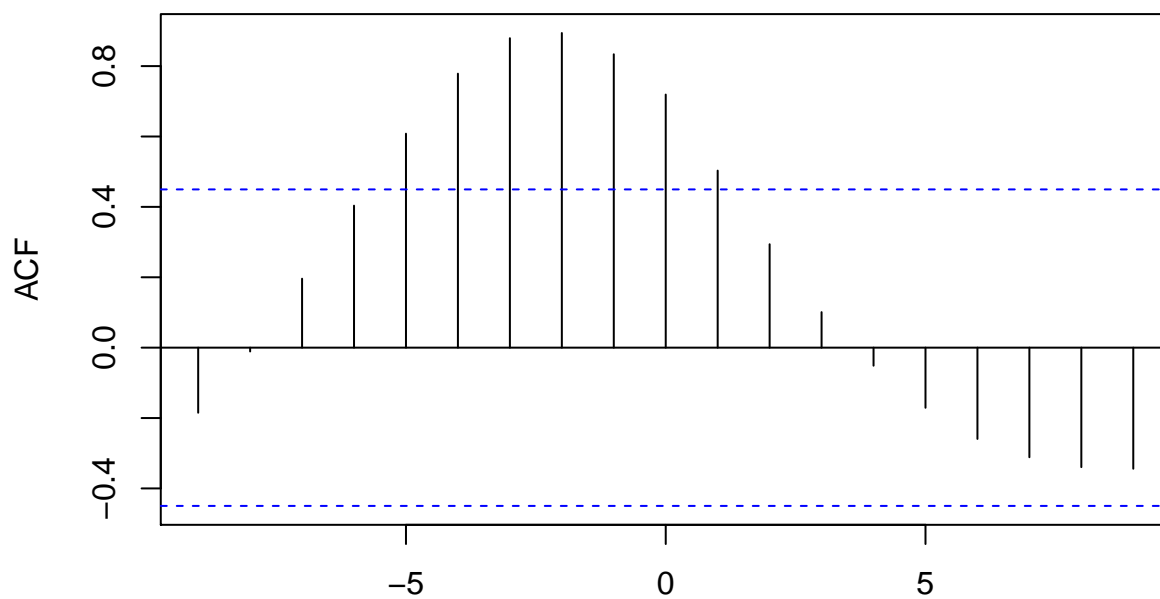
**2 wk ahead – 18**



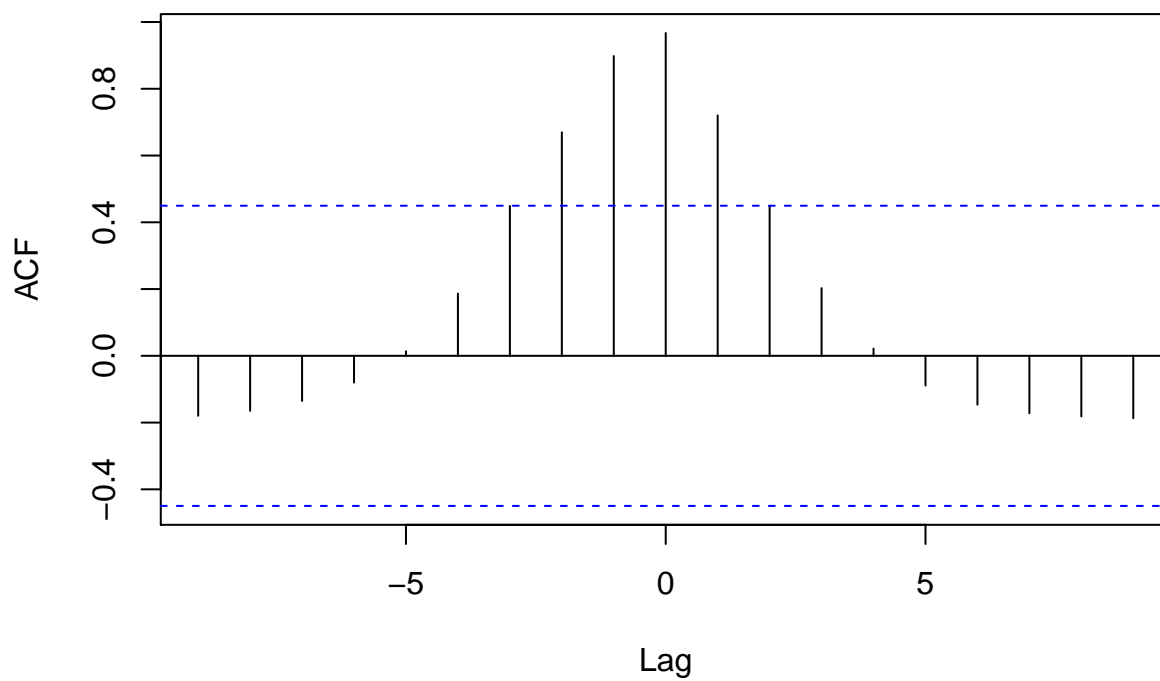
**3 wk ahead – 18**



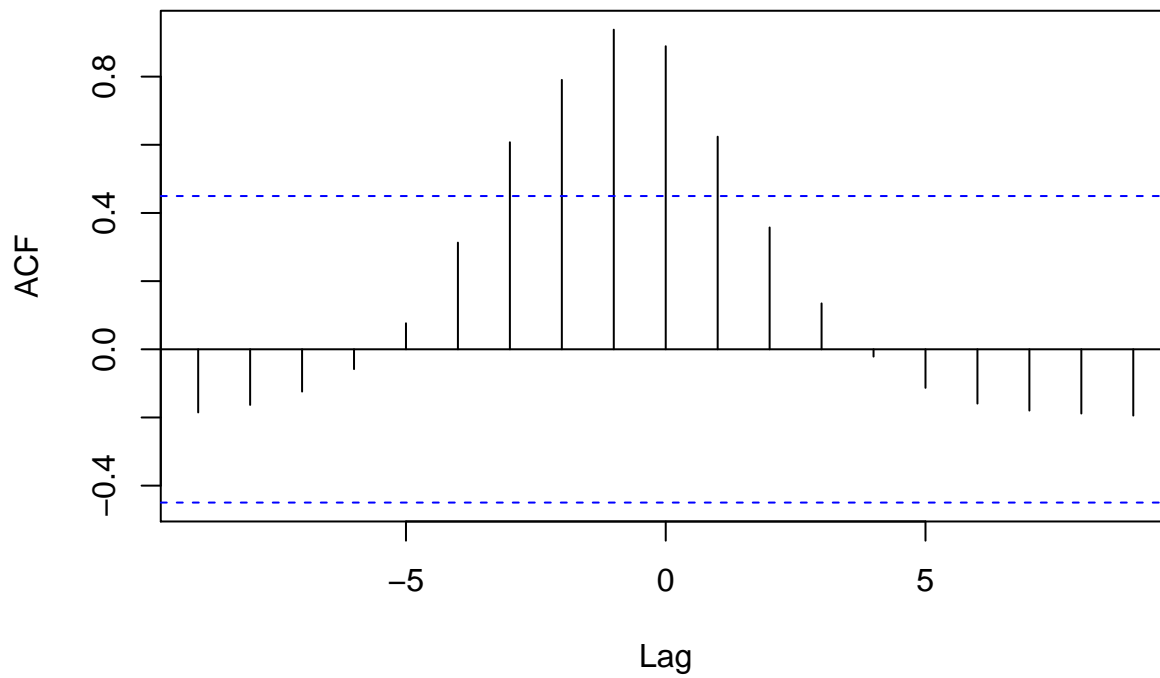
## 4 wk ahead – 18



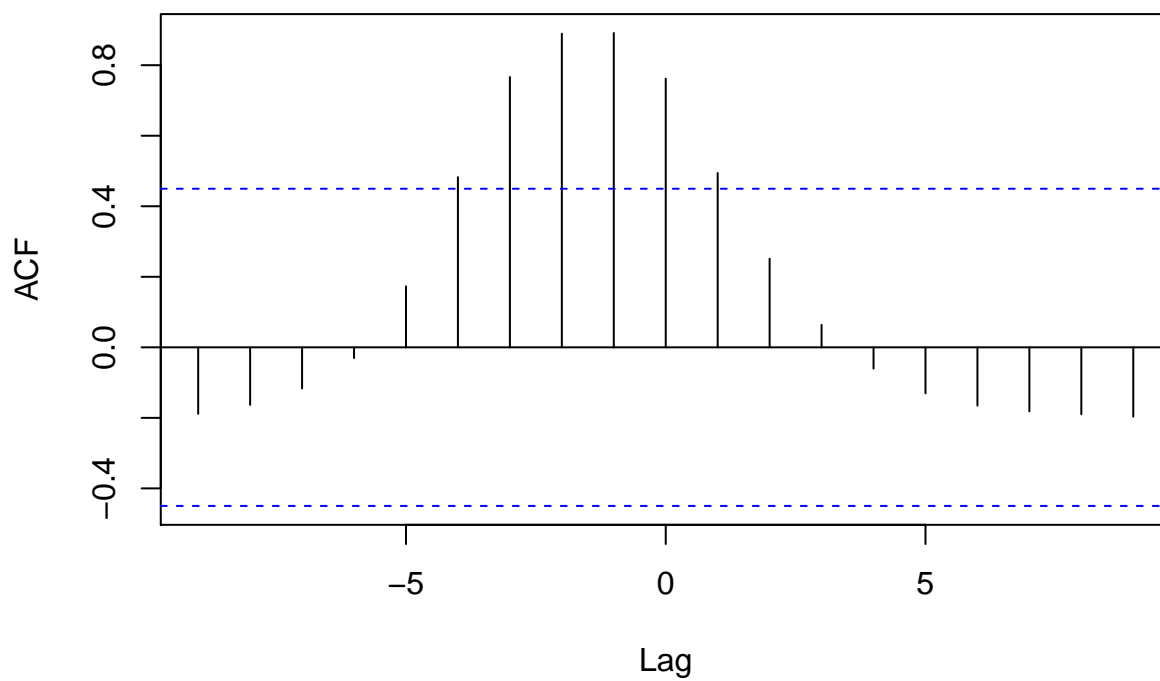
**1 wk ahead – 22**



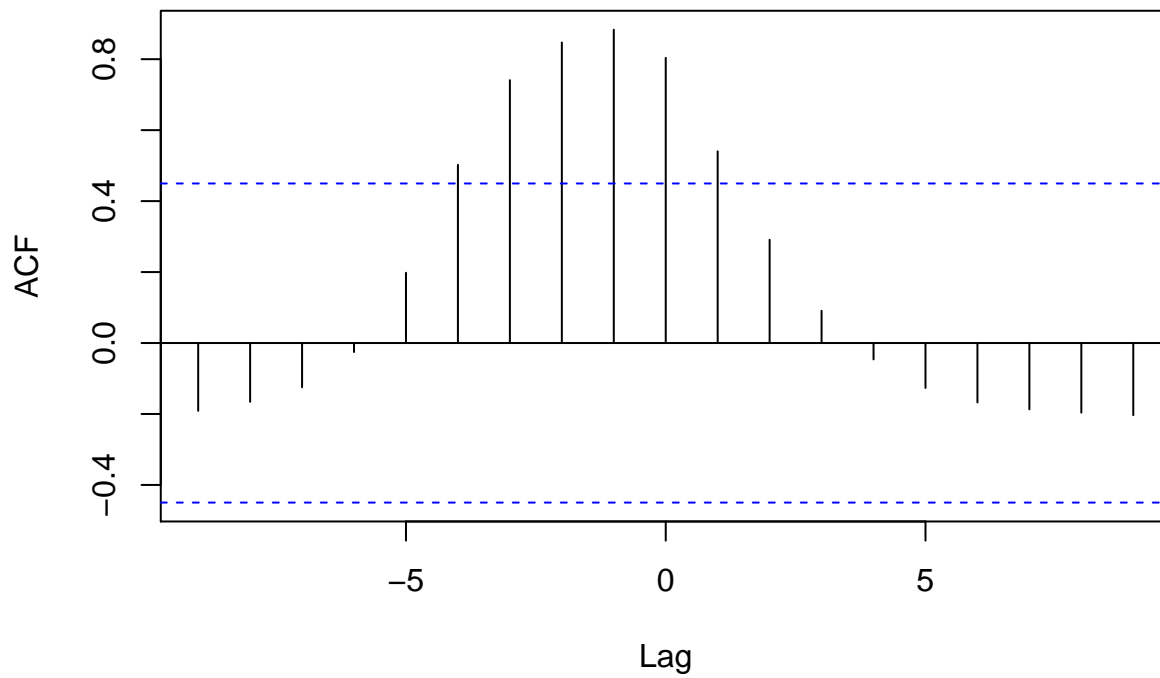
**2 wk ahead – 22**

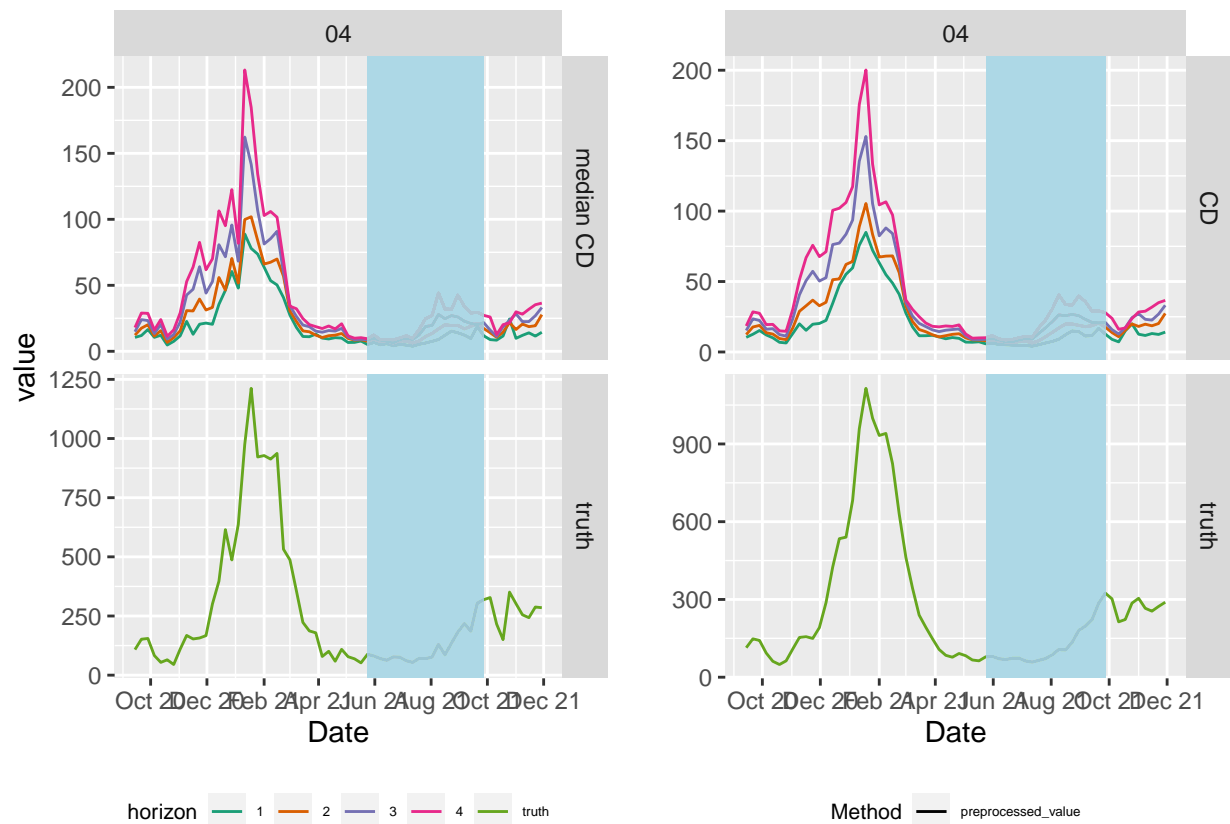


**3 wk ahead – 22**

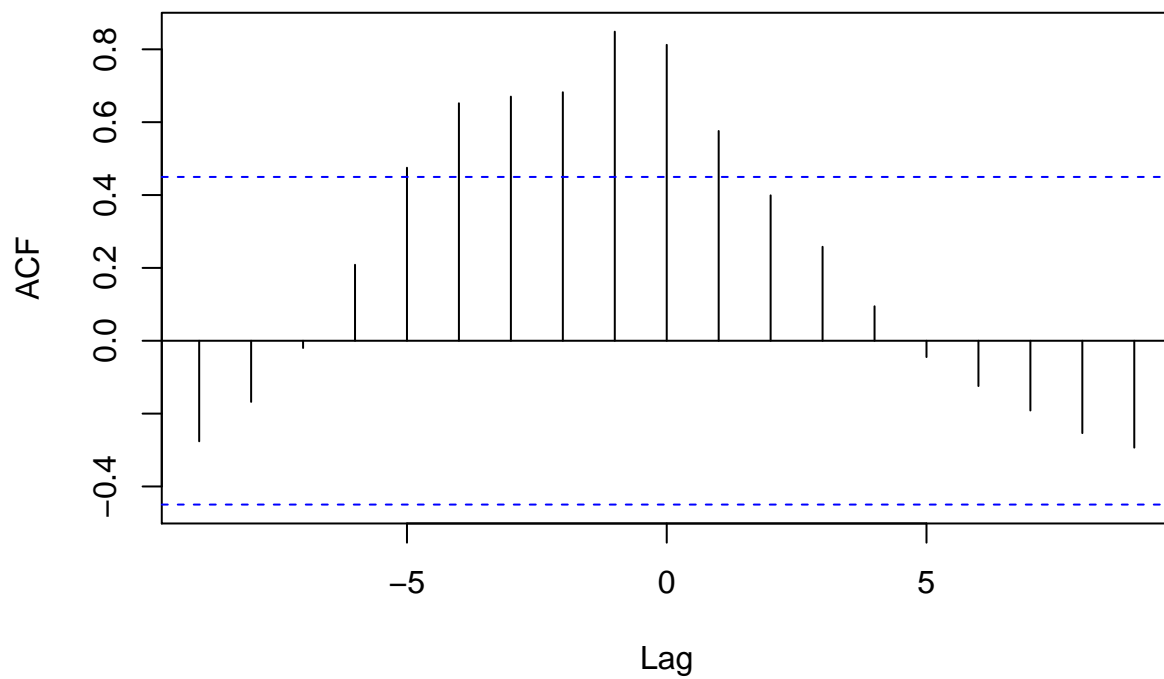


**4 wk ahead – 22**

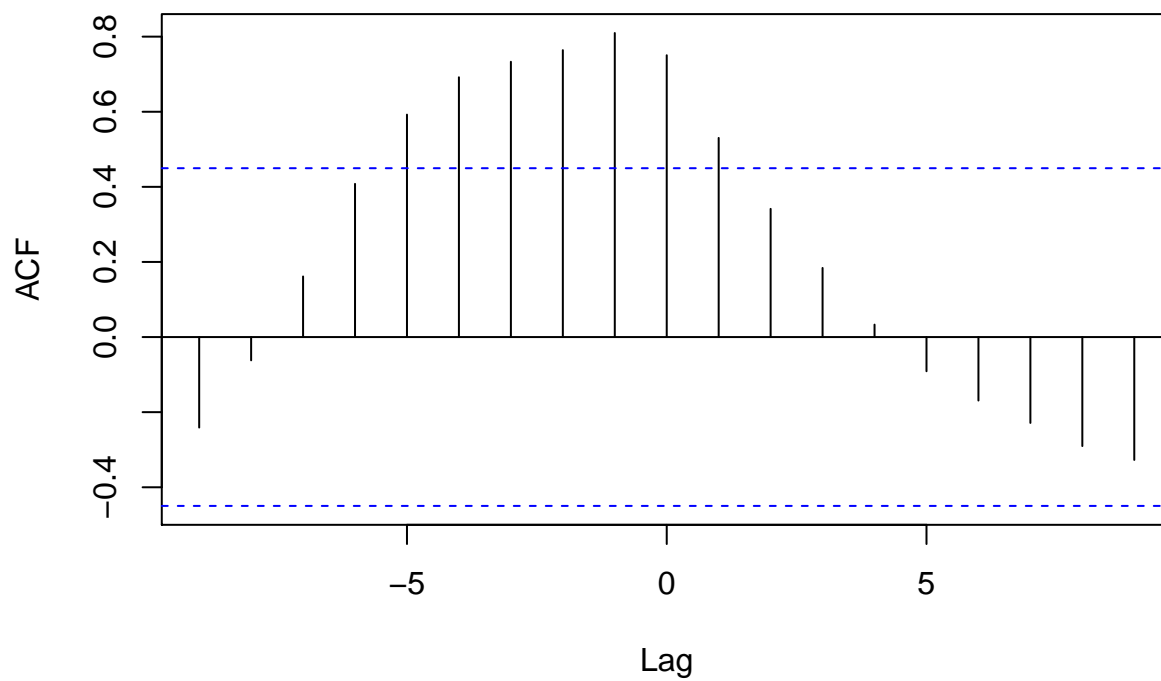




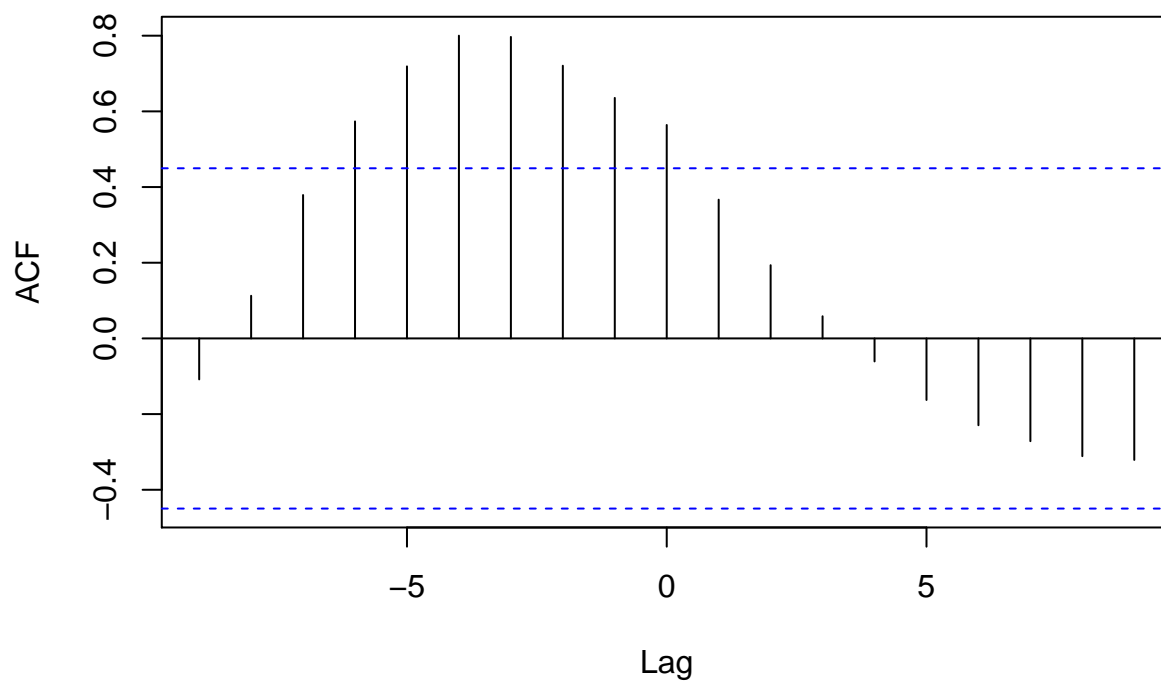
**1 wk ahead – 04**



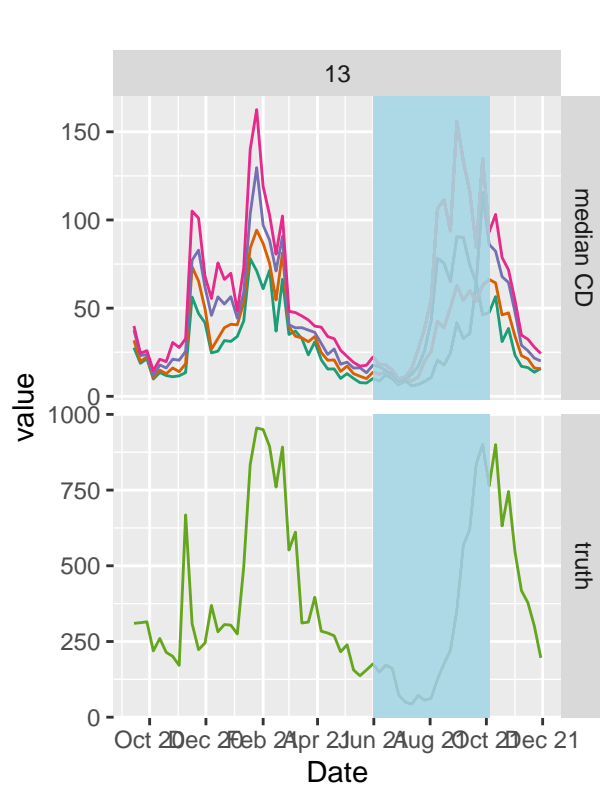
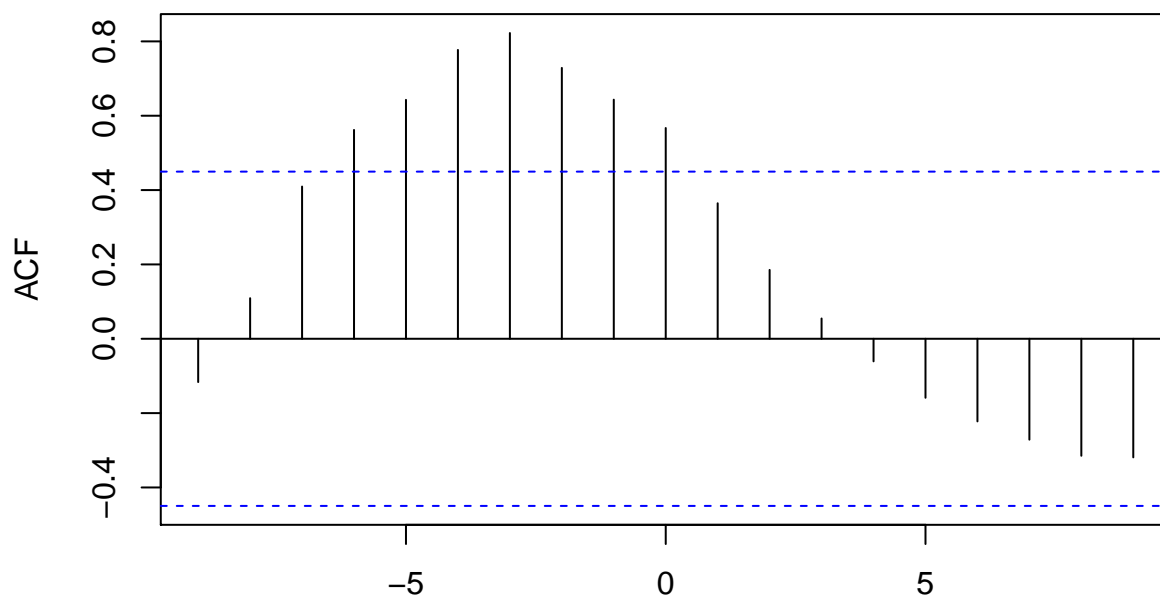
**2 wk ahead – 04**



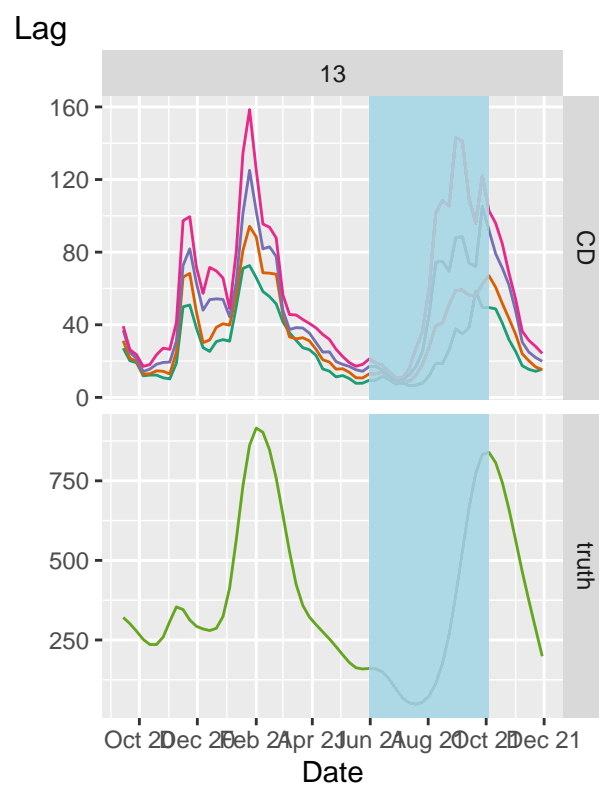
**3 wk ahead – 04**



## 4 wk ahead – 04

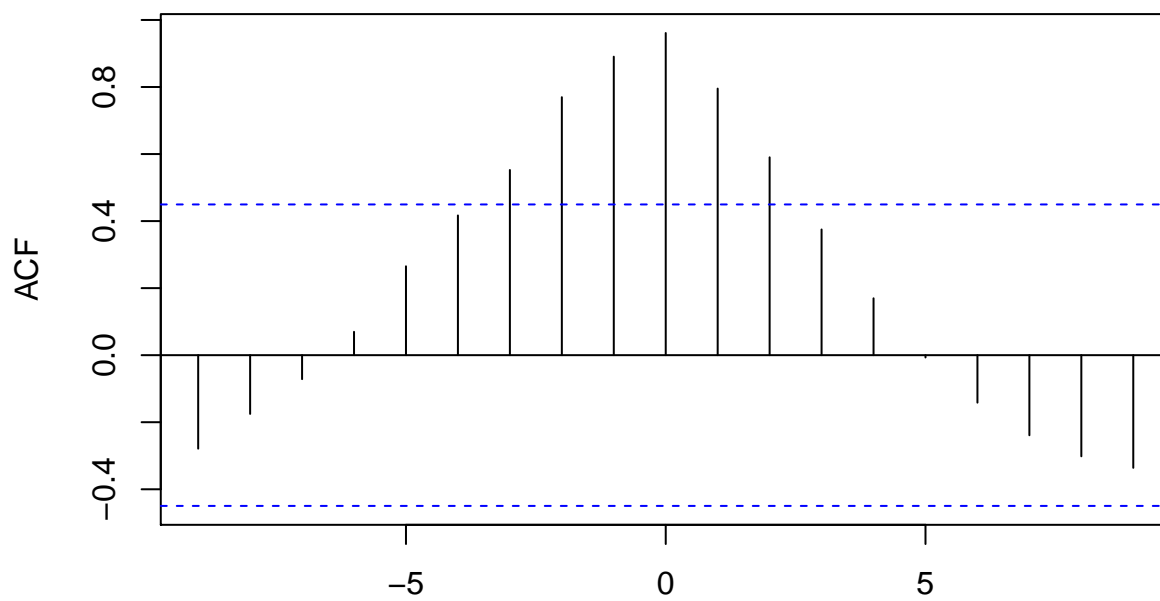


horizon 1 2 3 4 truth

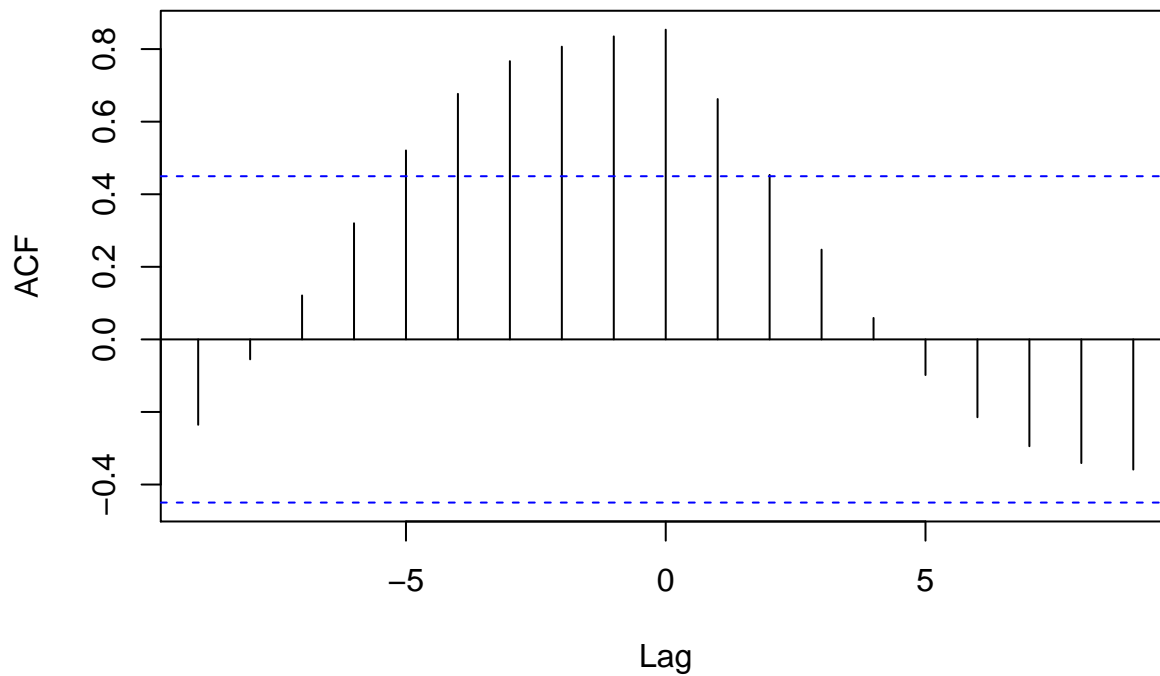


Method preprocessed\_value

**1 wk ahead – 13**

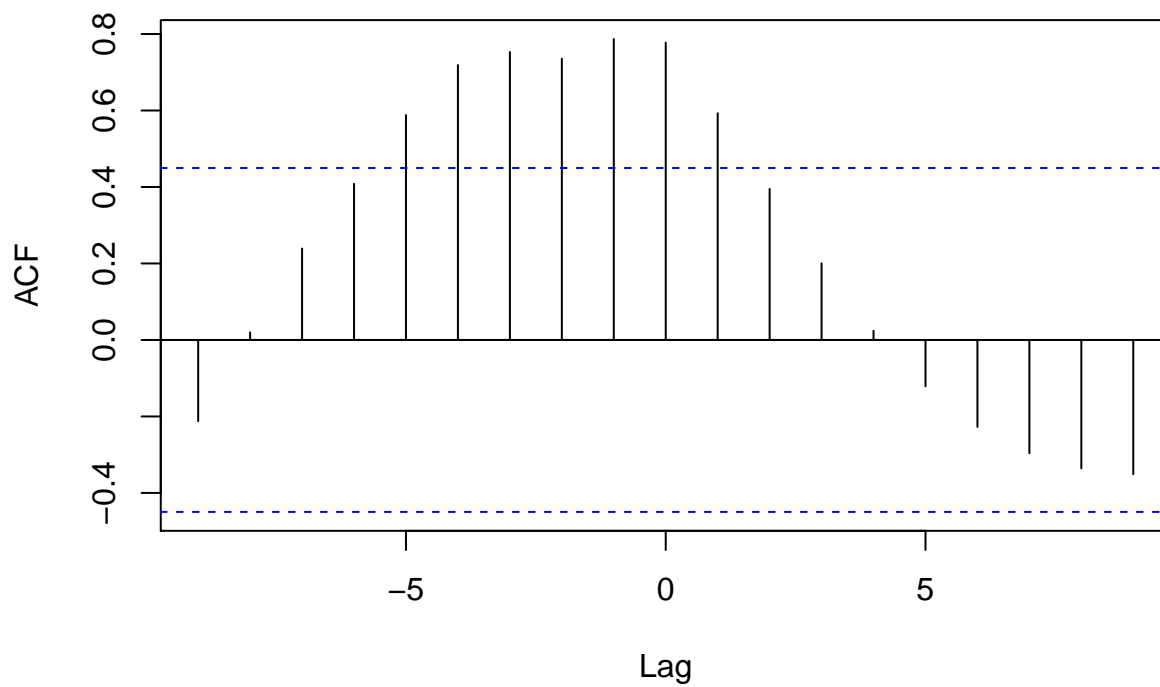


**2 wk ahead – 13**

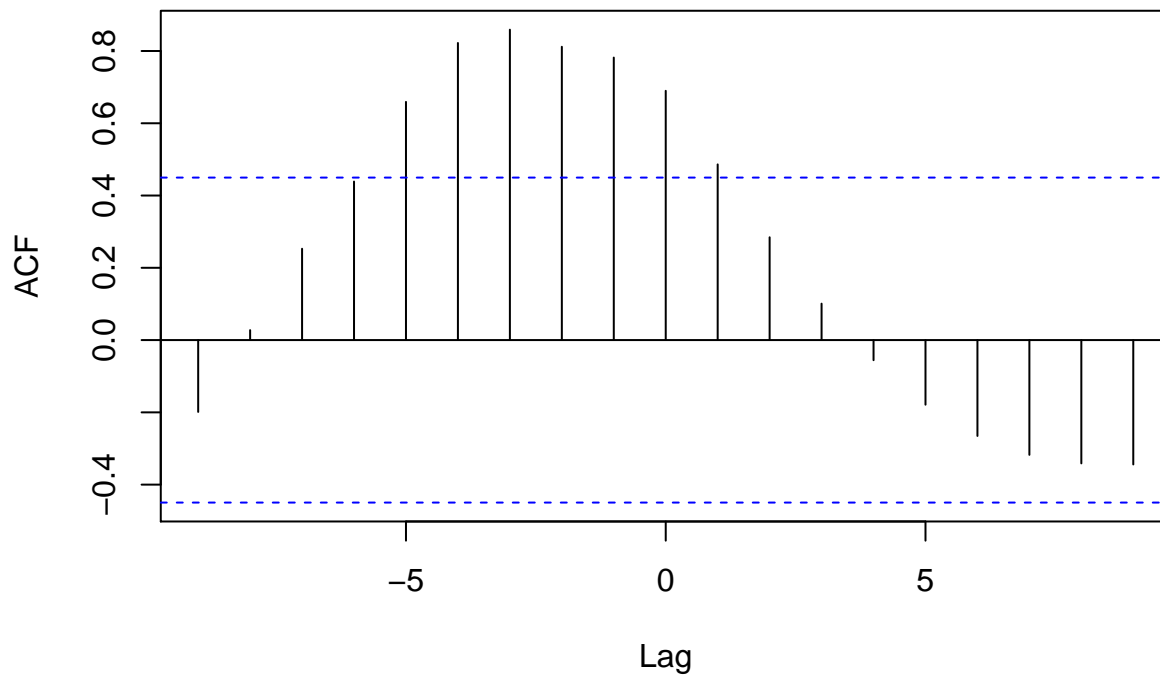


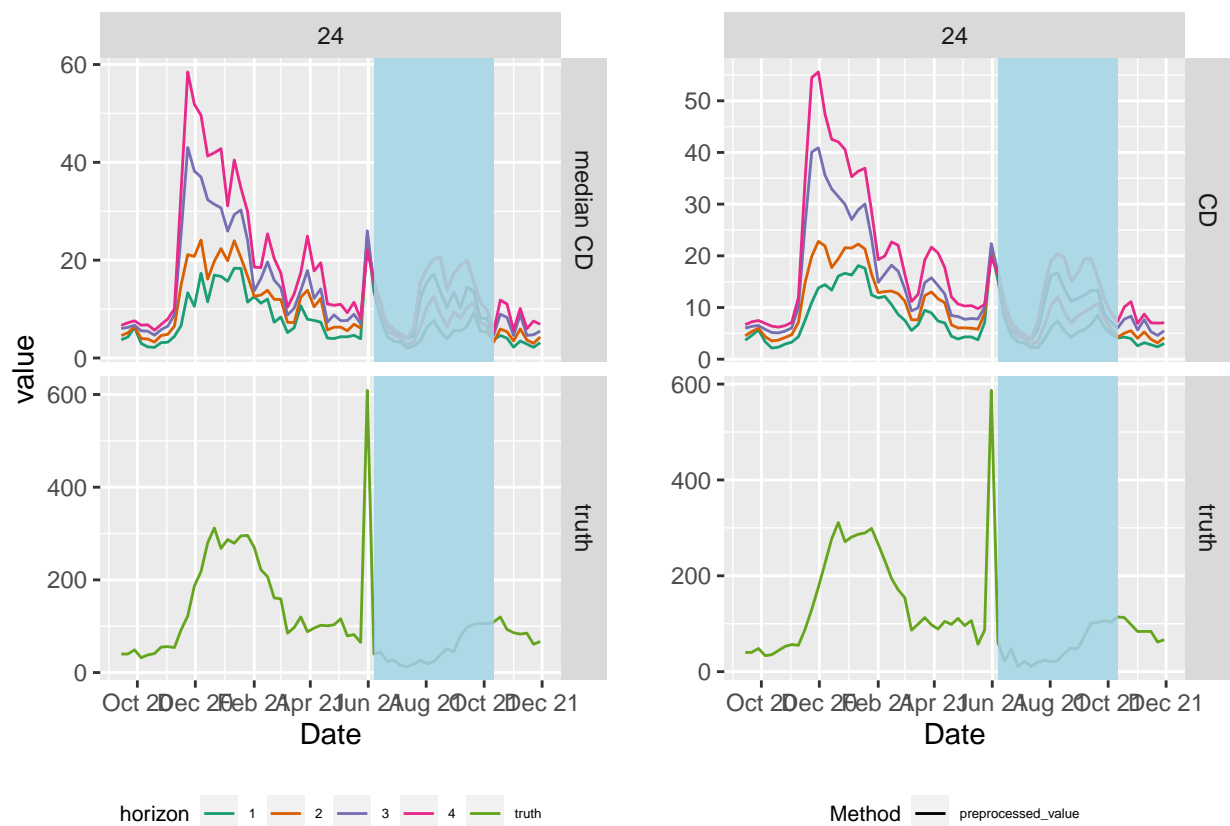


**3 wk ahead – 13**

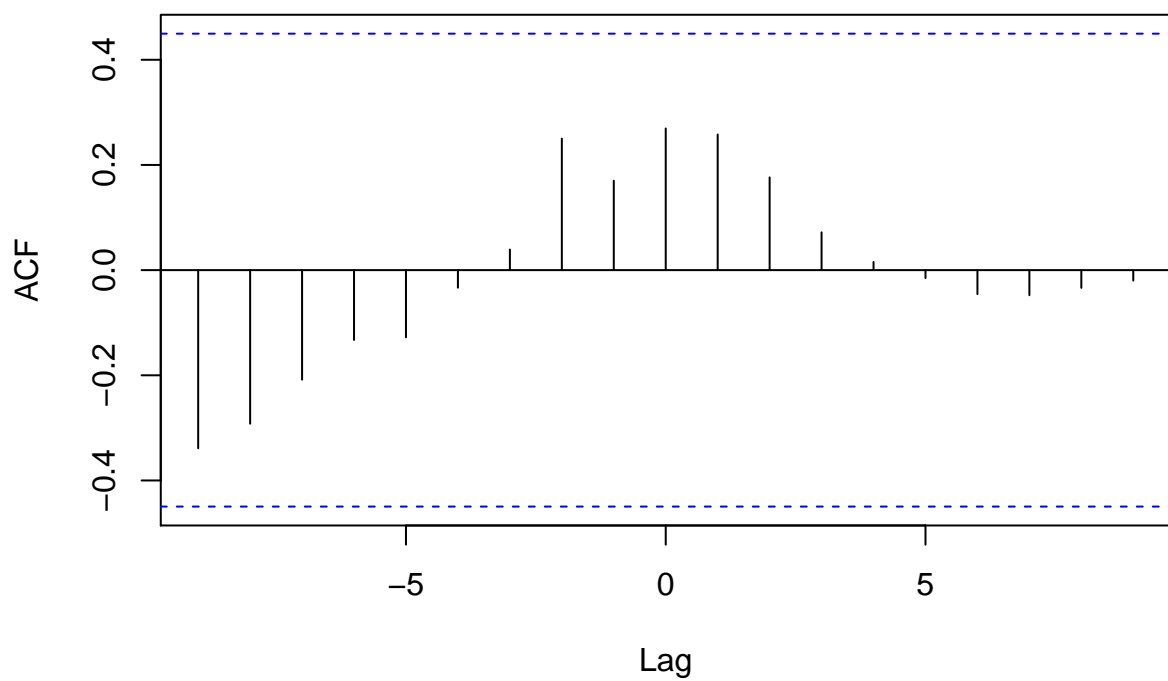


**4 wk ahead – 13**

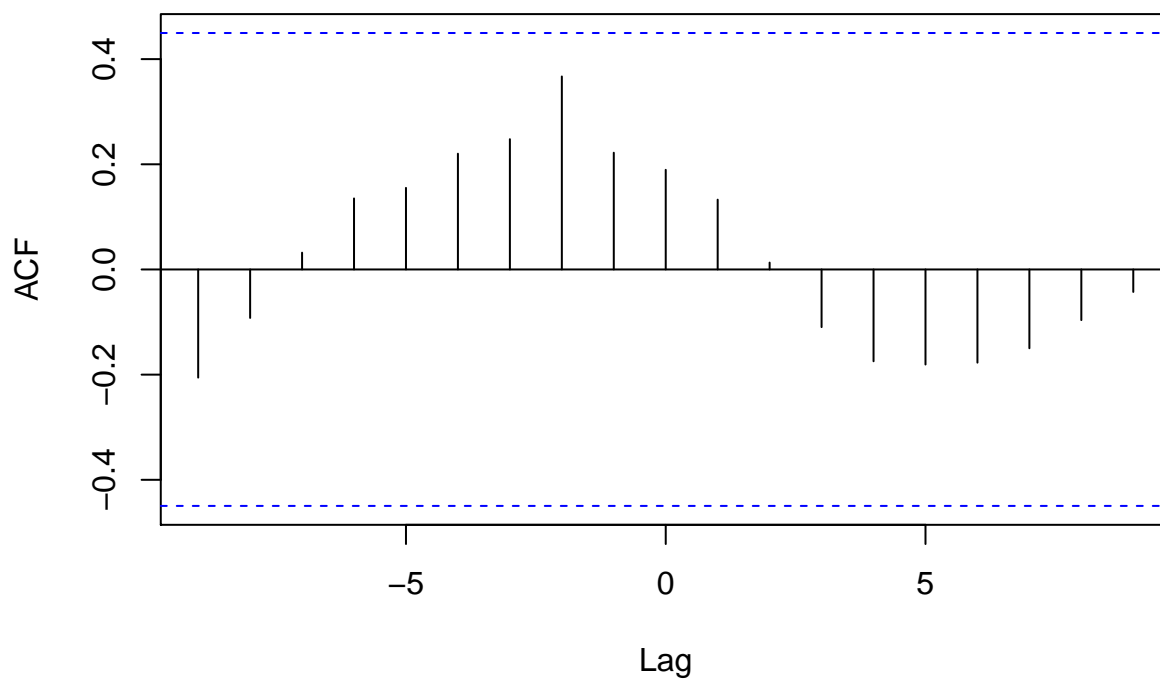




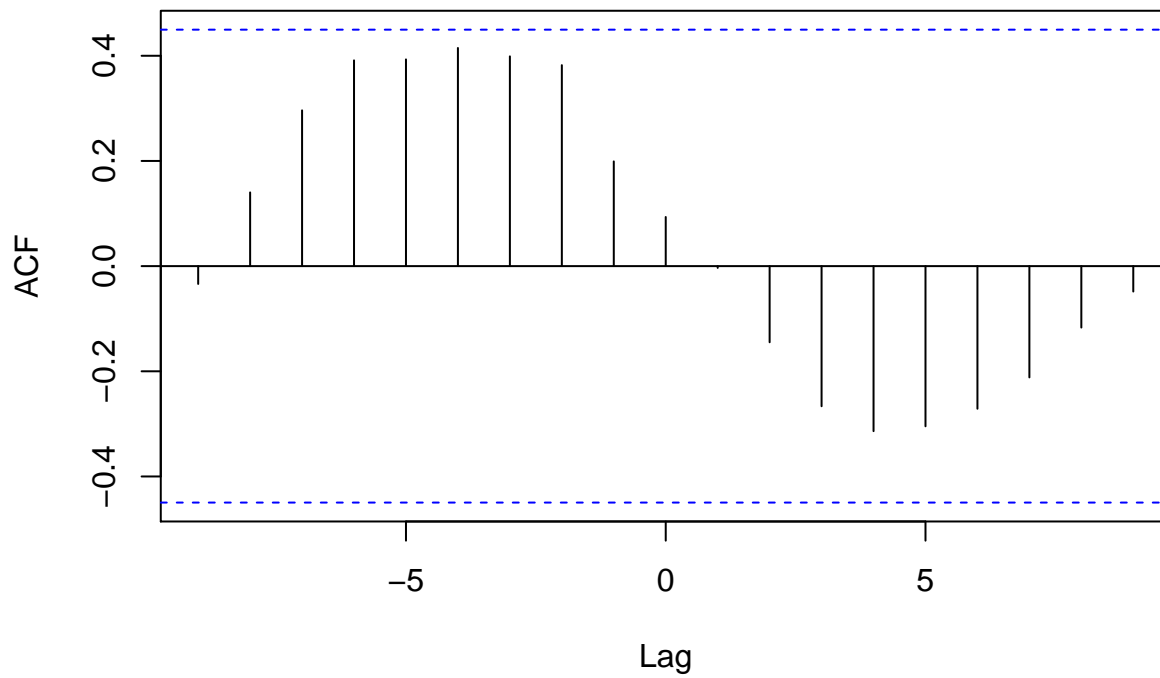
**1 wk ahead – 24**



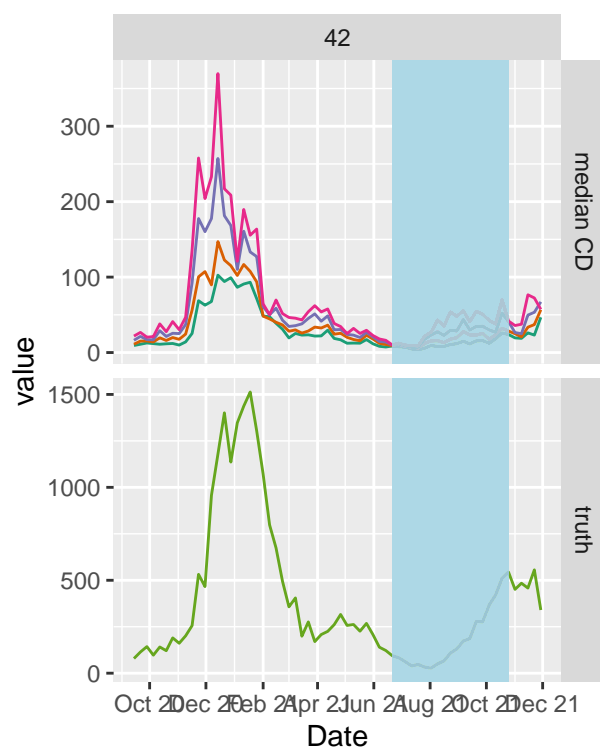
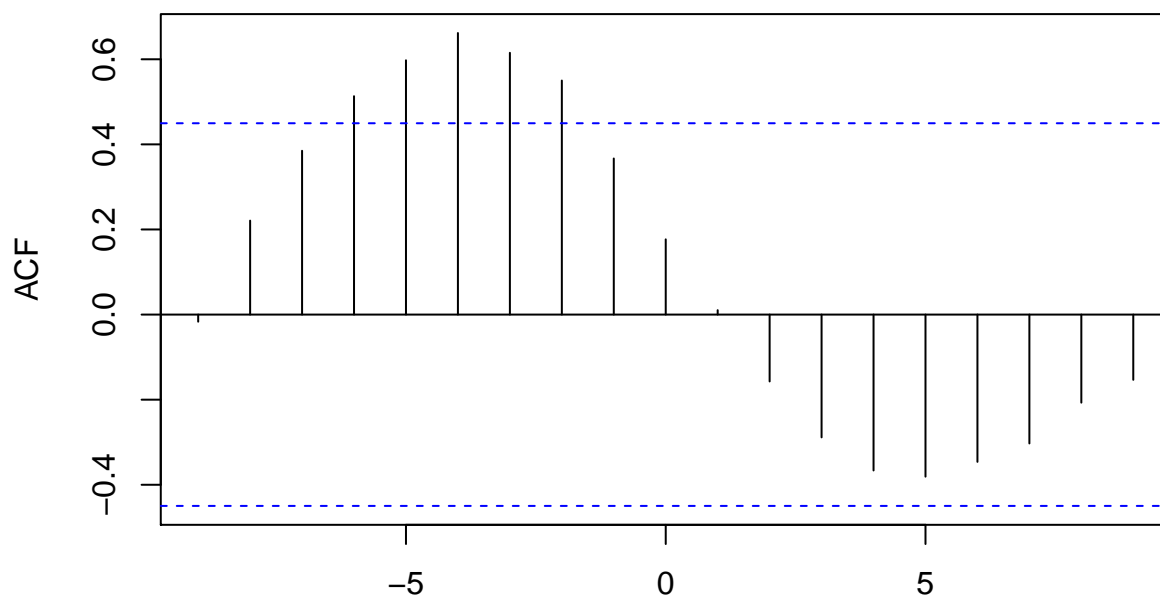
## 2 wk ahead – 24



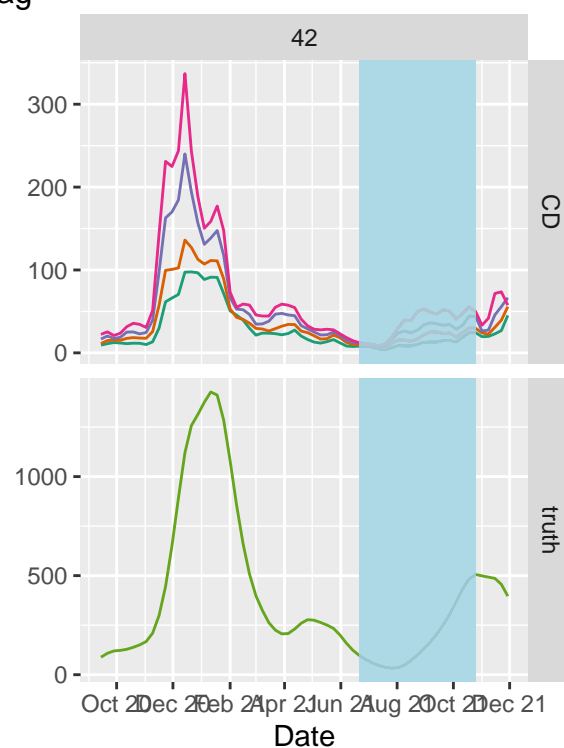
**3 wk ahead – 24**



## 4 wk ahead – 24



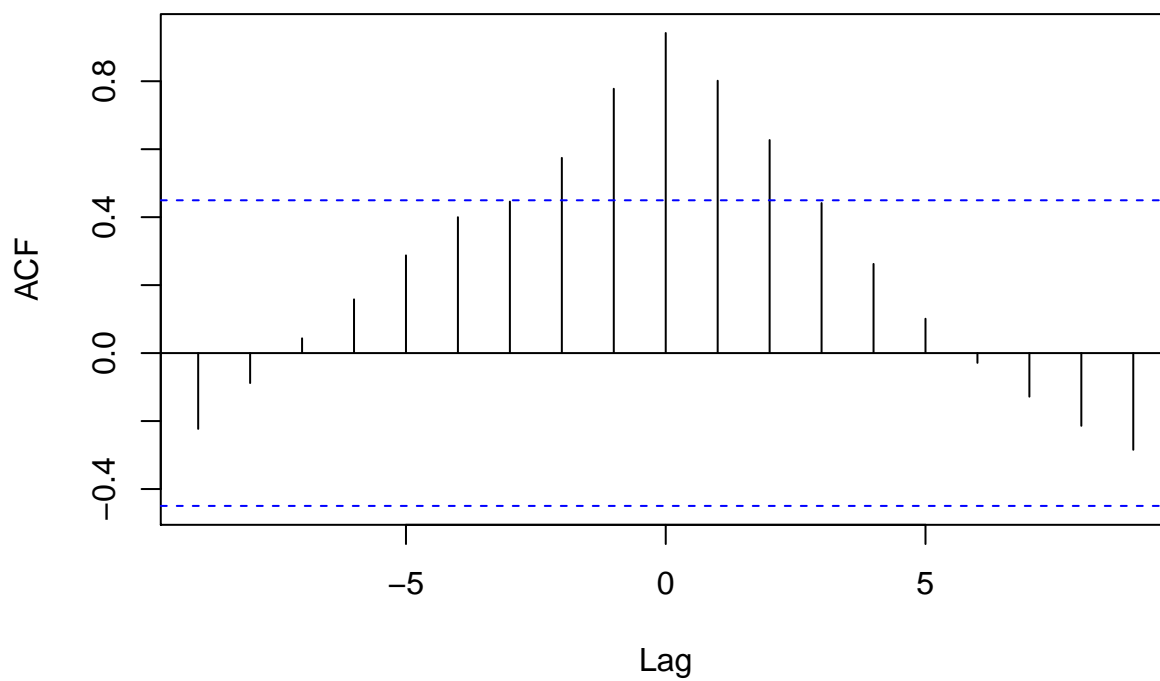
Lag



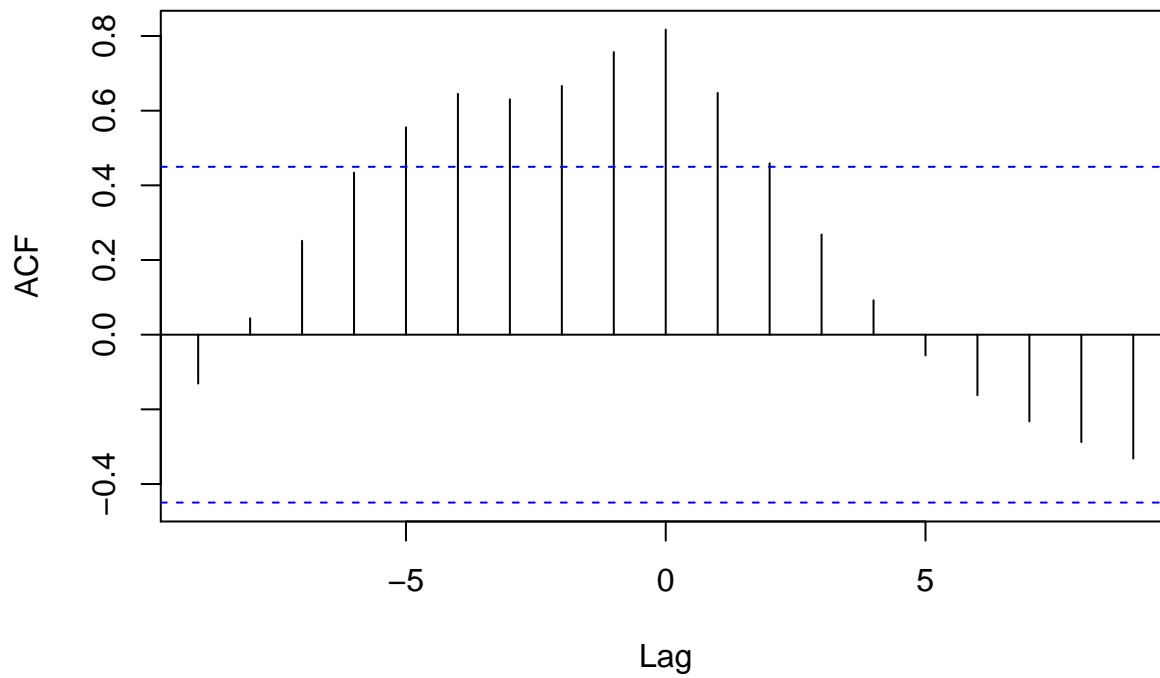
Method preprocessed\_value

Method preprocessed\_value

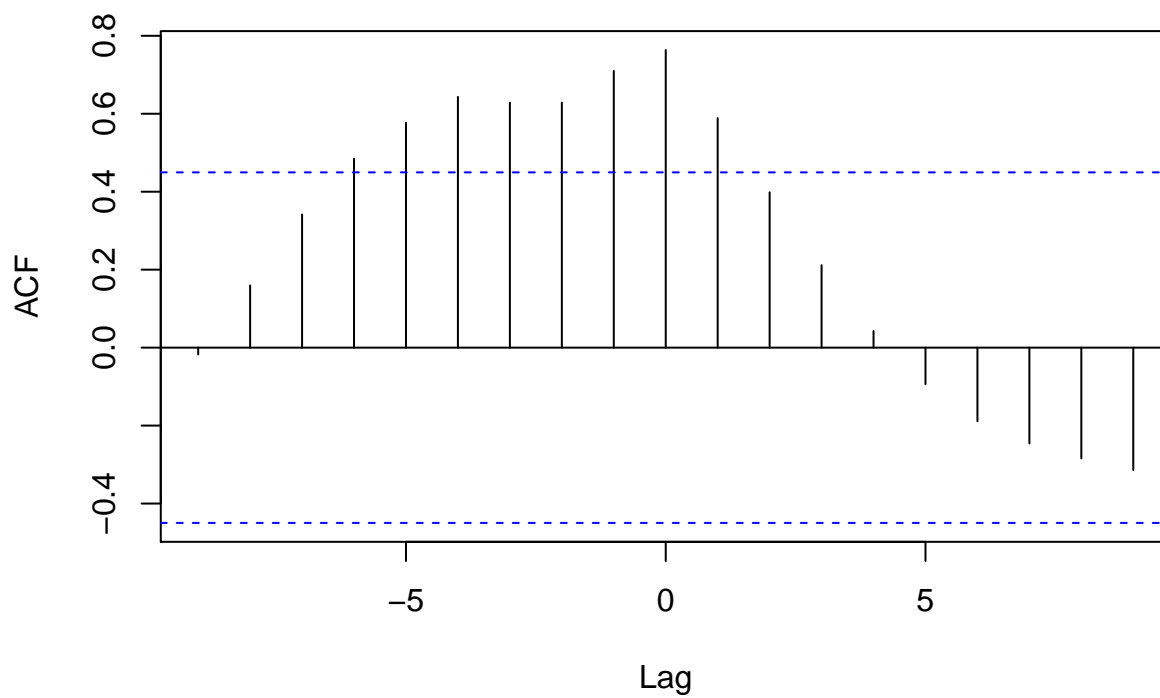
**1 wk ahead – 42**



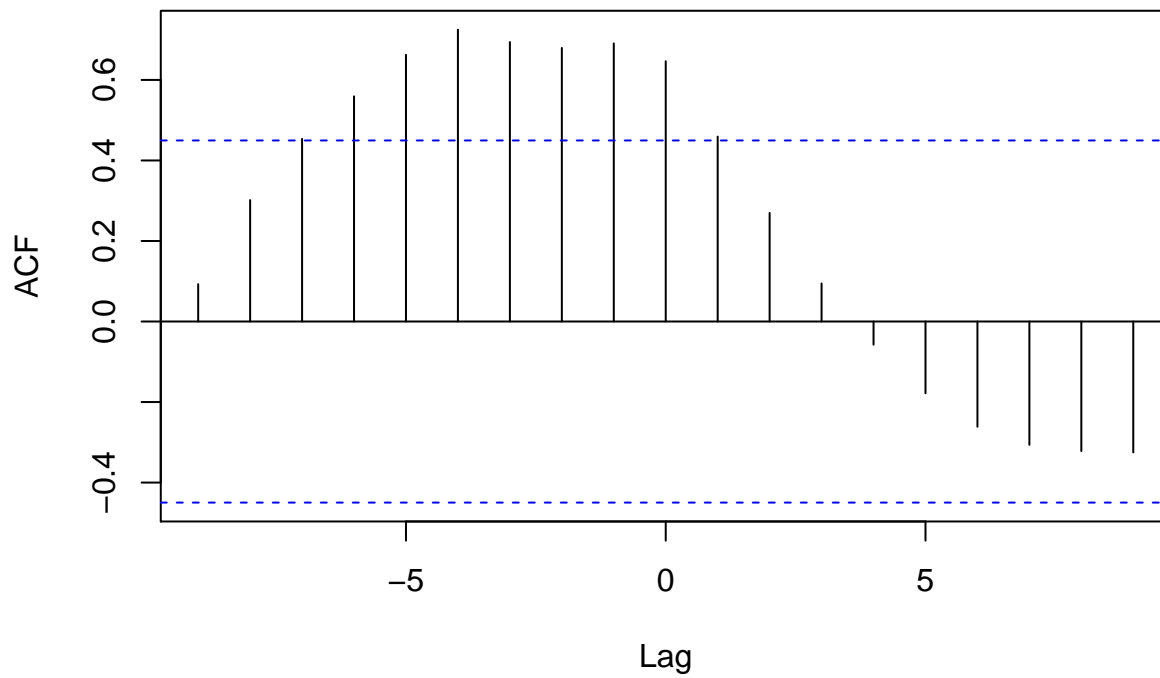
**2 wk ahead – 42**

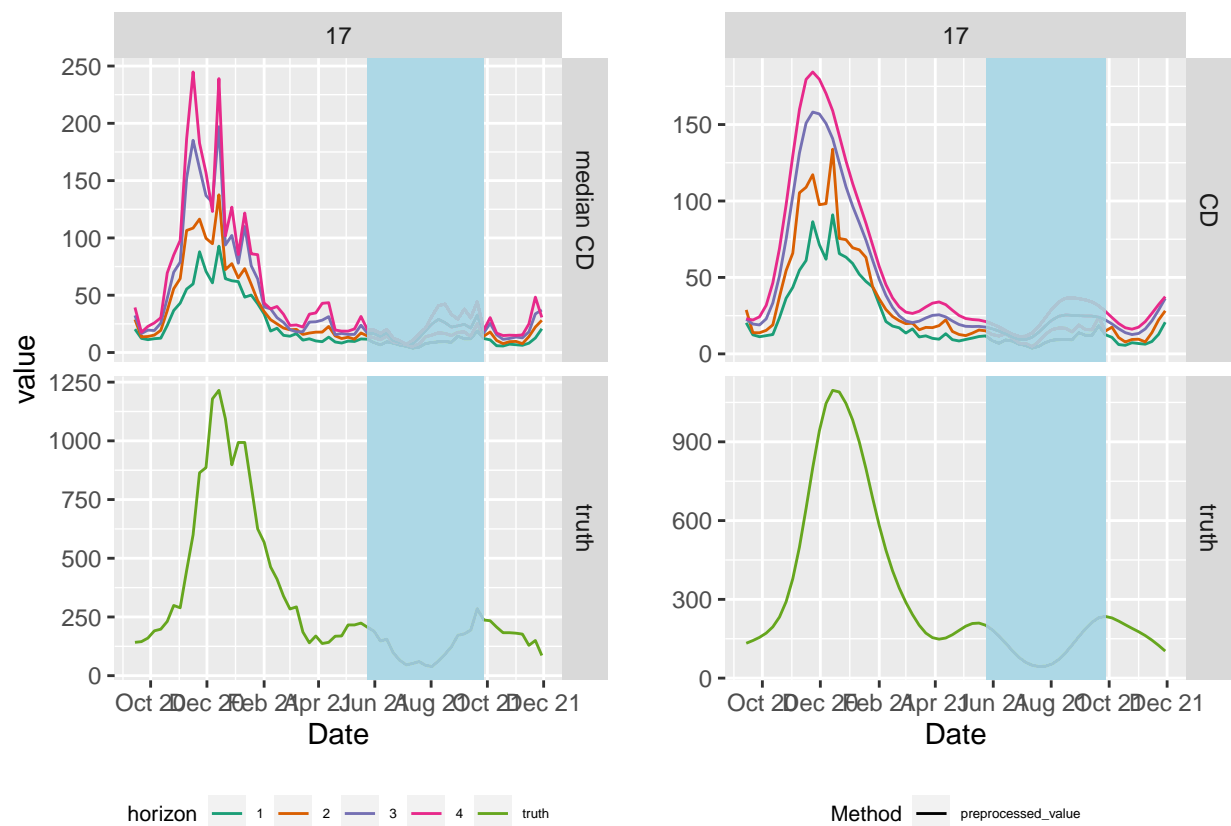


**3 wk ahead – 42**

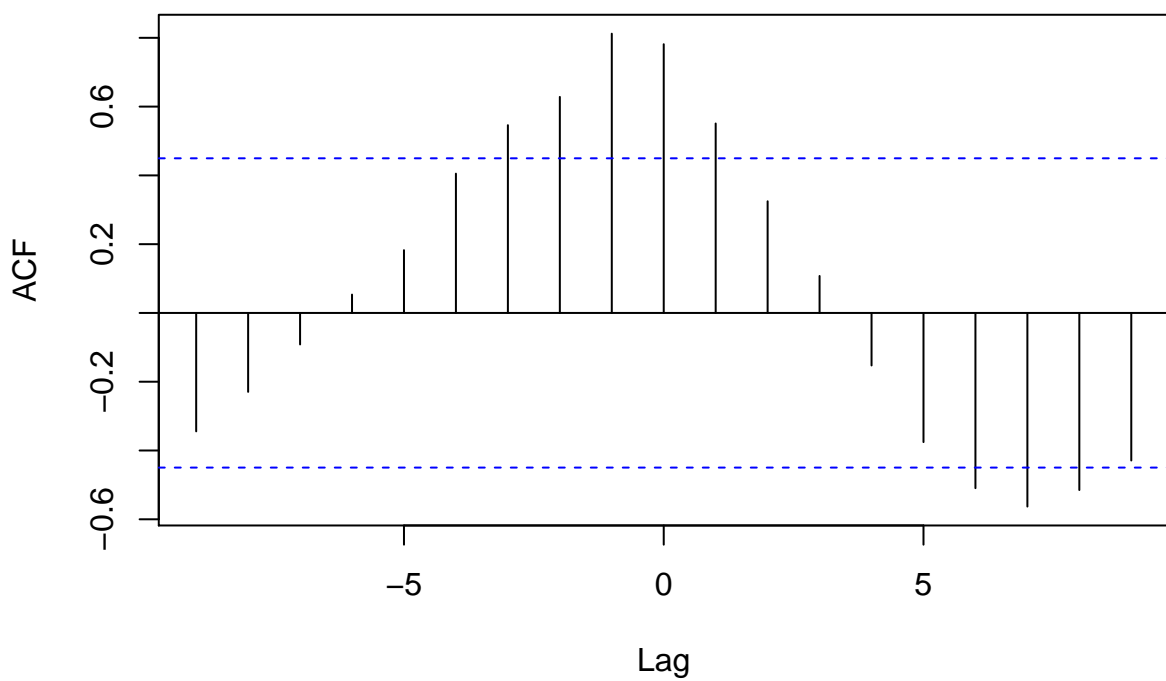


**4 wk ahead – 42**

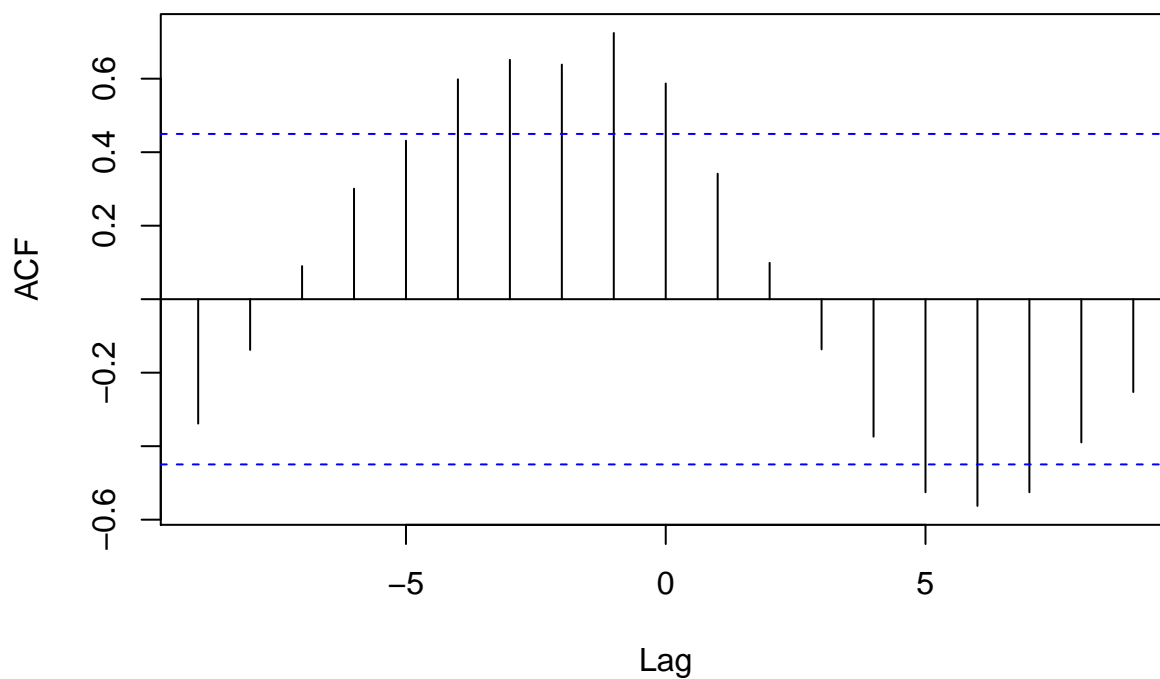




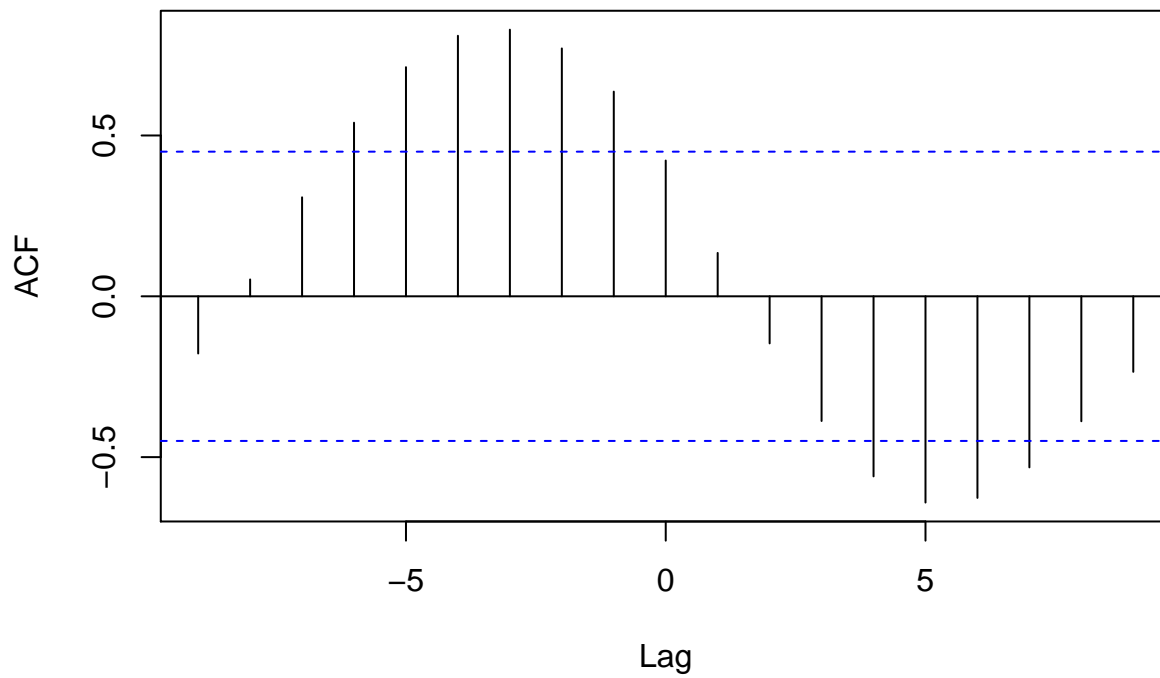
**1 wk ahead – 17**



**2 wk ahead – 17**

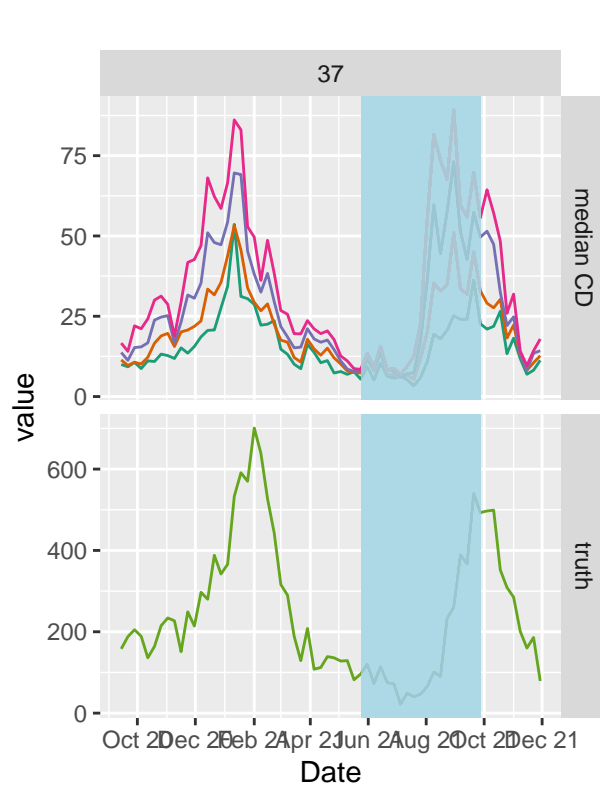
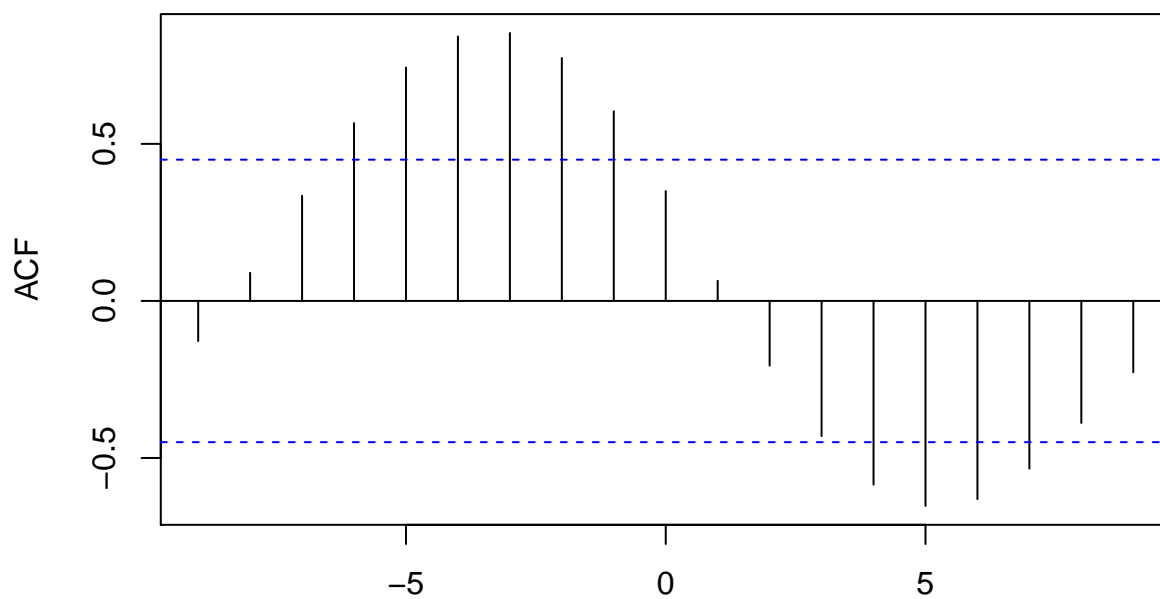


**3 wk ahead – 17**

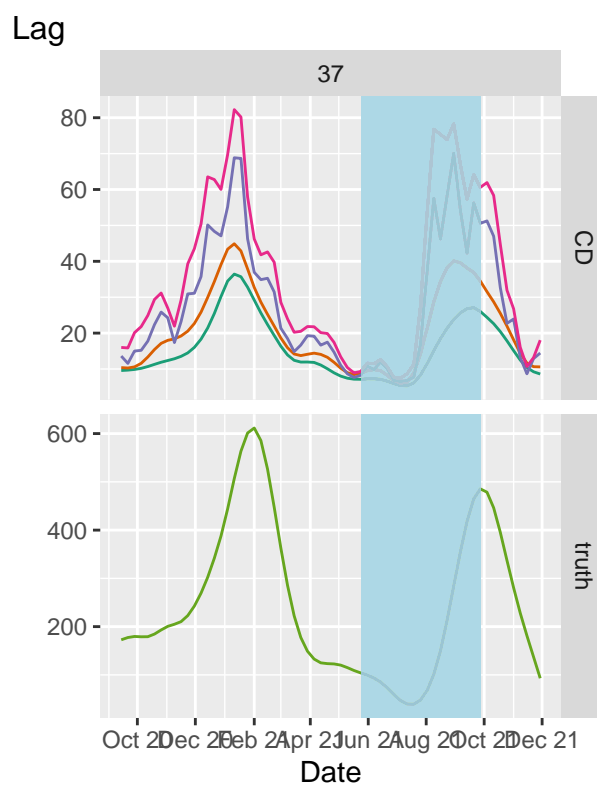




## 4 wk ahead – 17

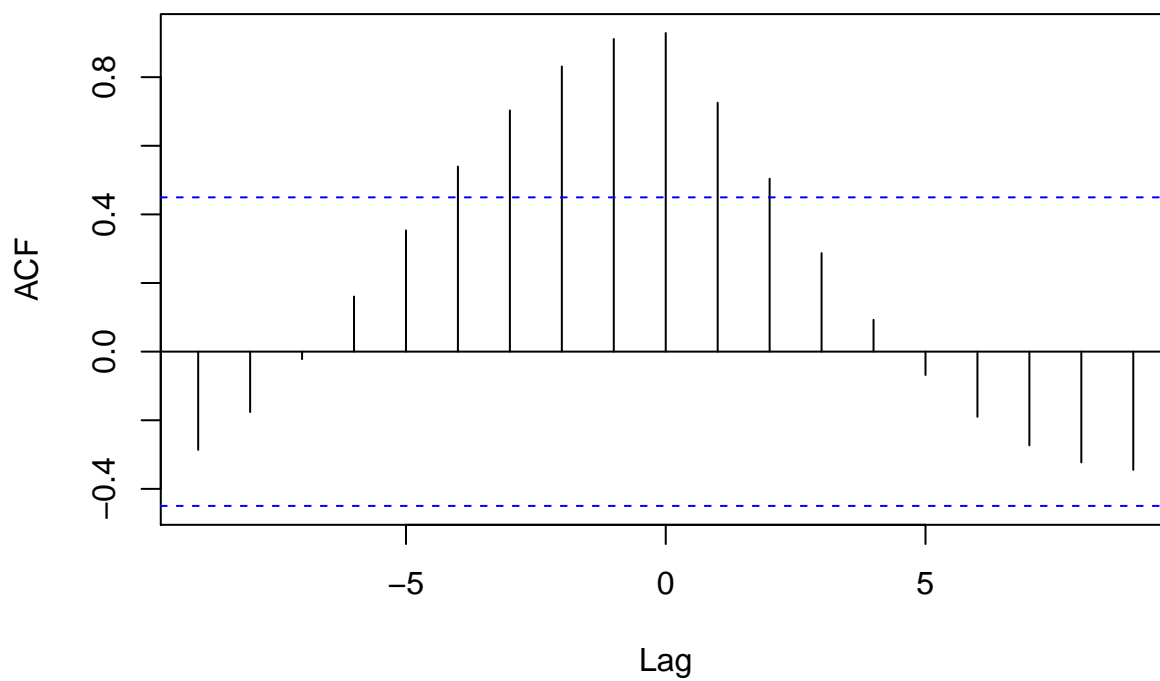


horizon 1 2 3 4 truth

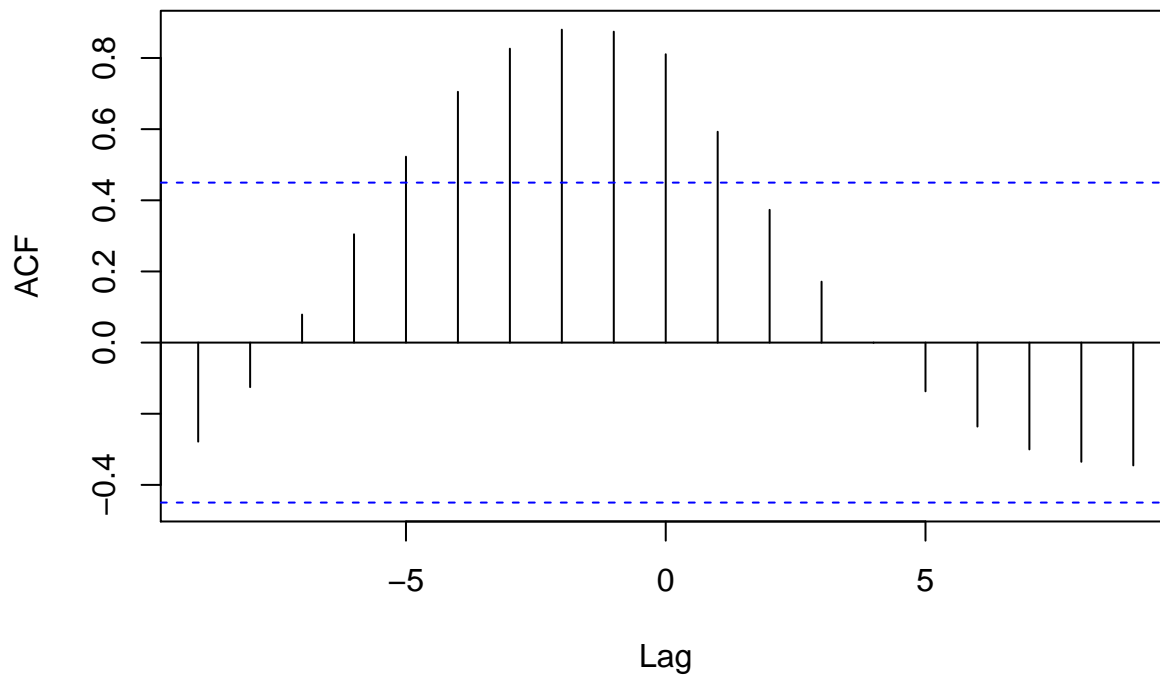


Method preprocessed\_value

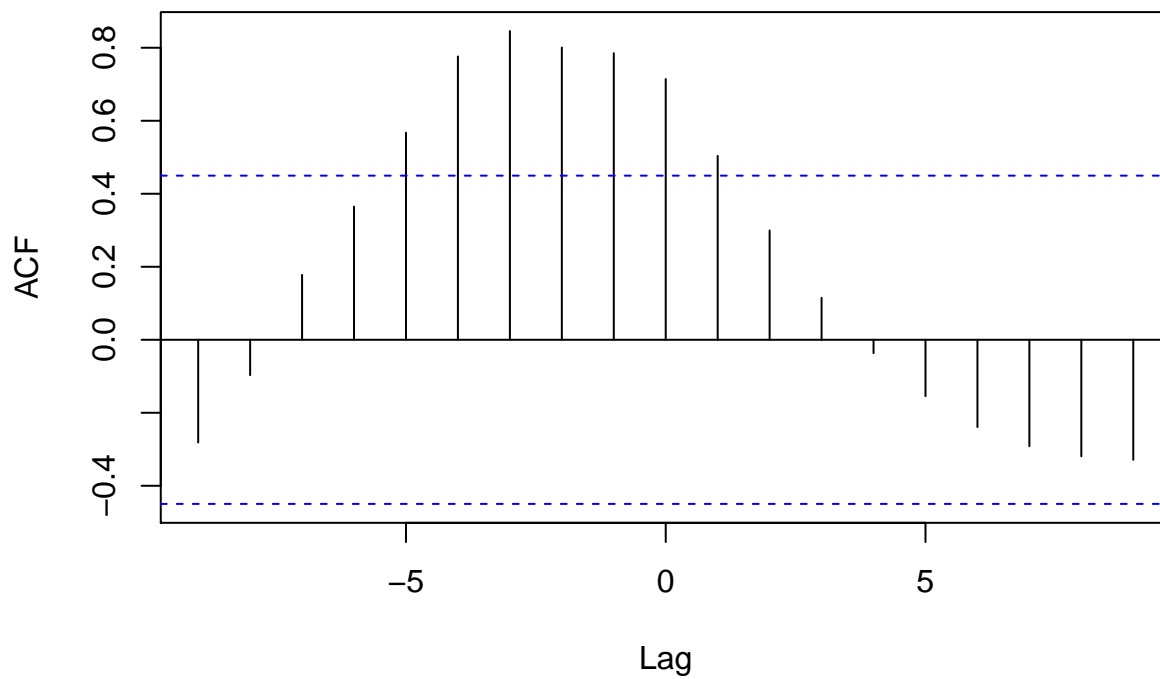
**1 wk ahead – 37**



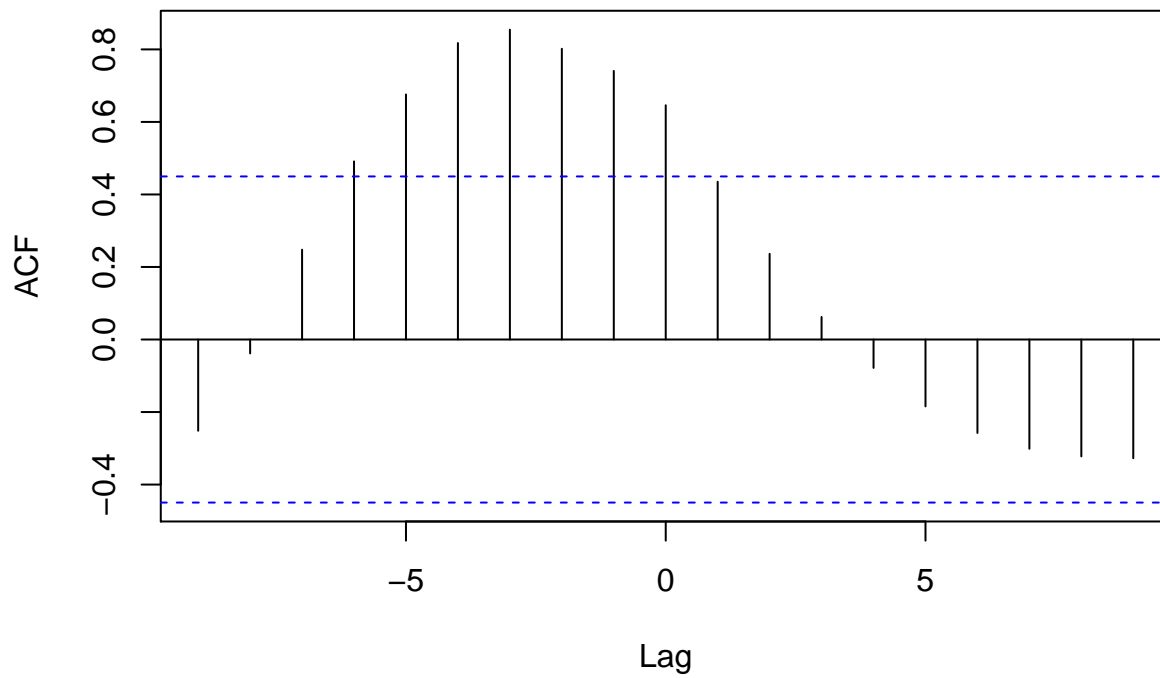
**2 wk ahead – 37**

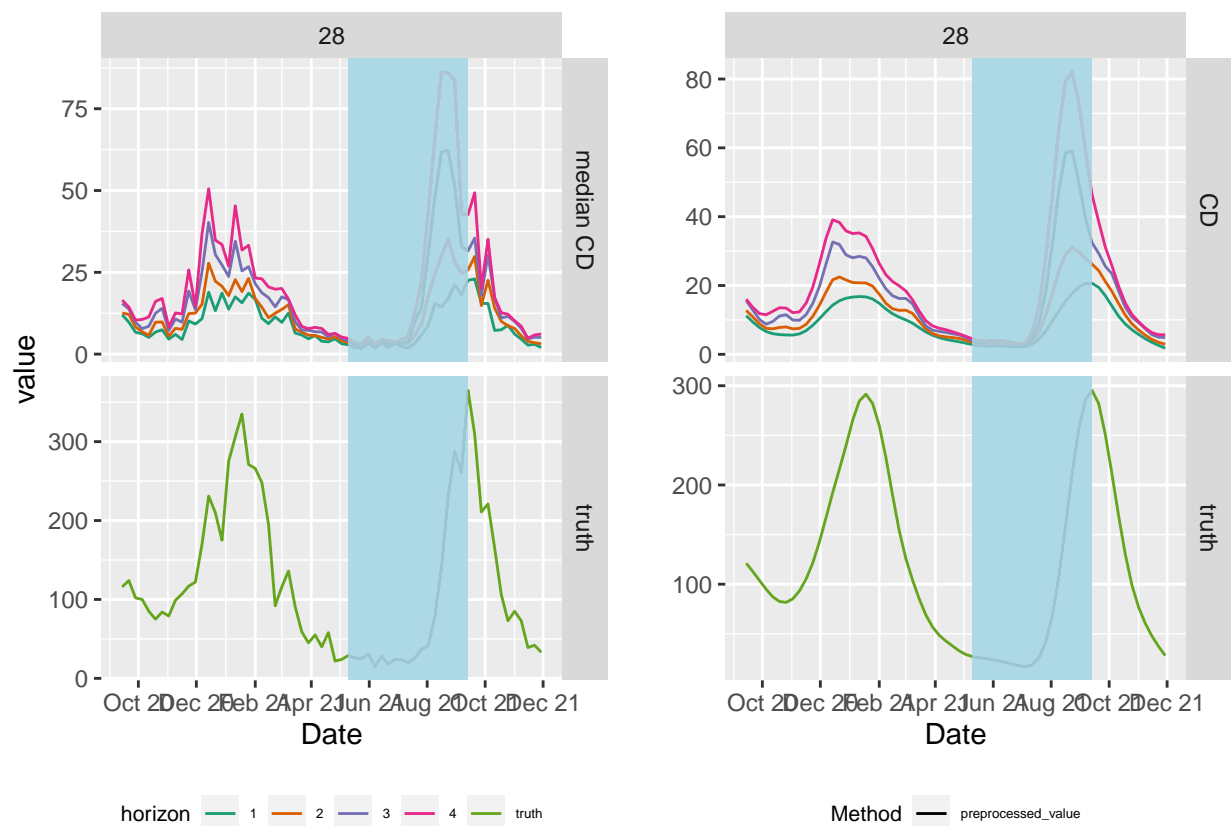


**3 wk ahead – 37**

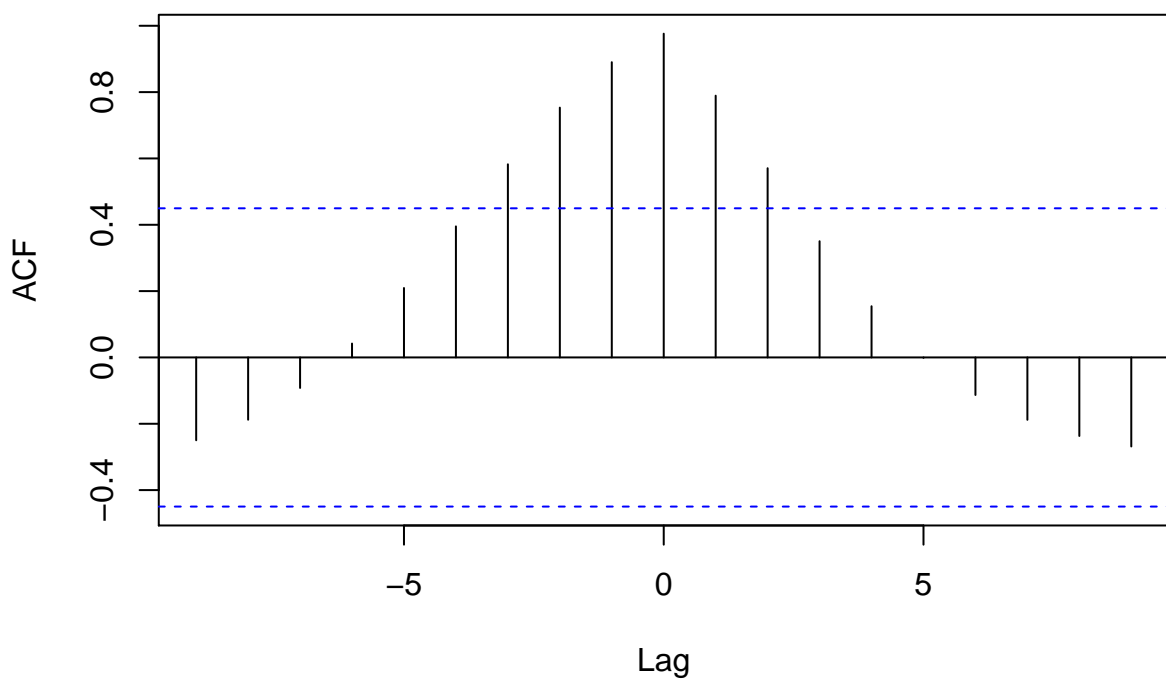


**4 wk ahead – 37**

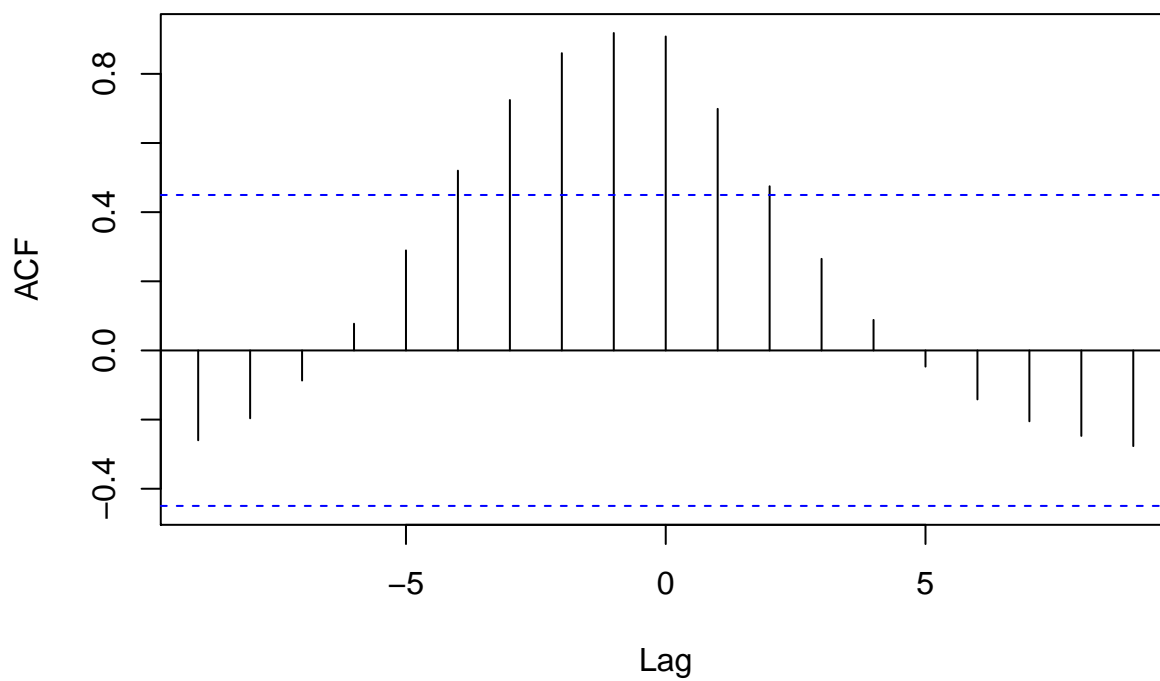




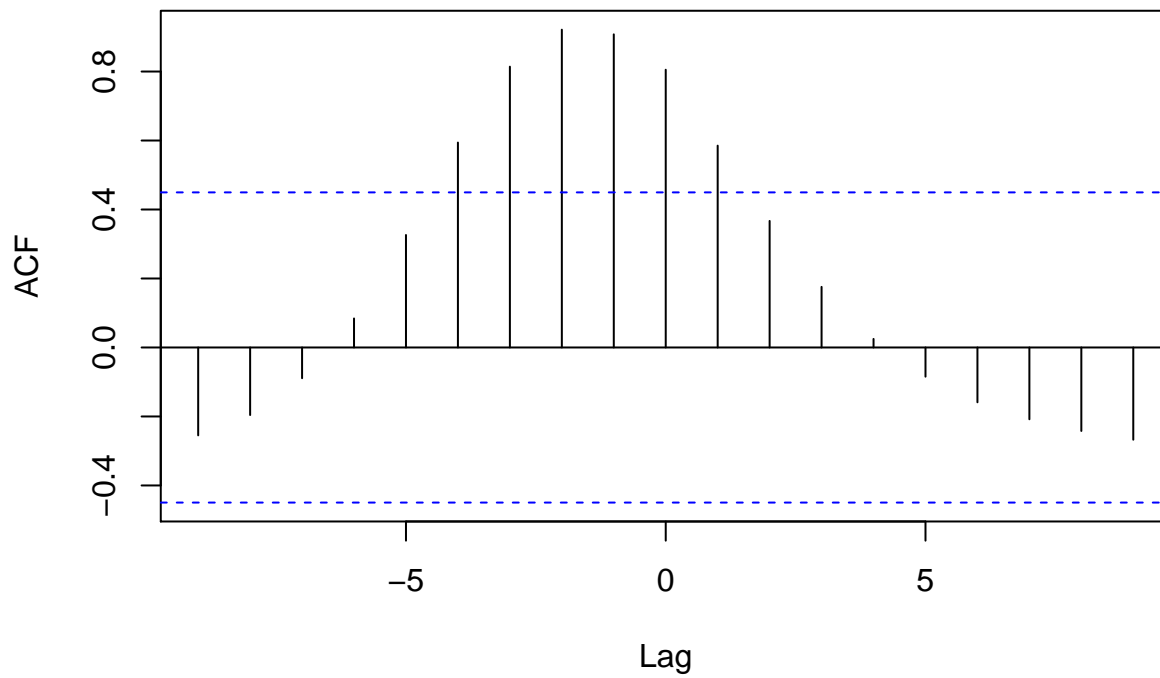
**1 wk ahead – 28**



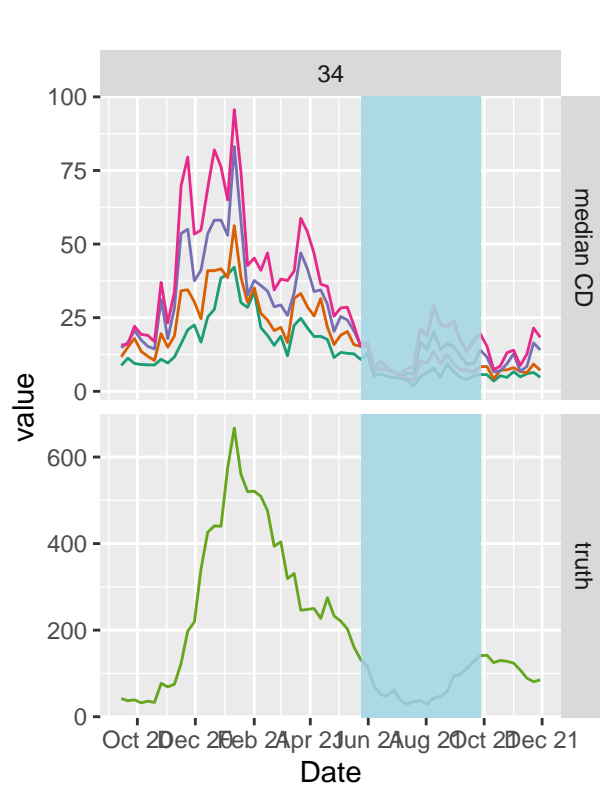
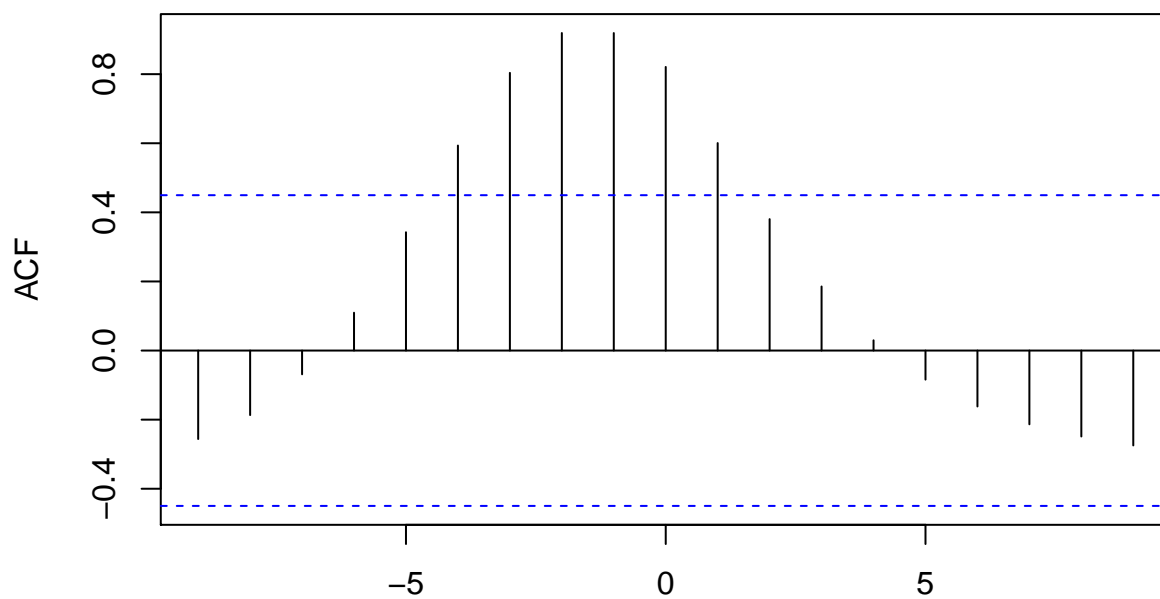
**2 wk ahead – 28**



**3 wk ahead – 28**



## 4 wk ahead – 28

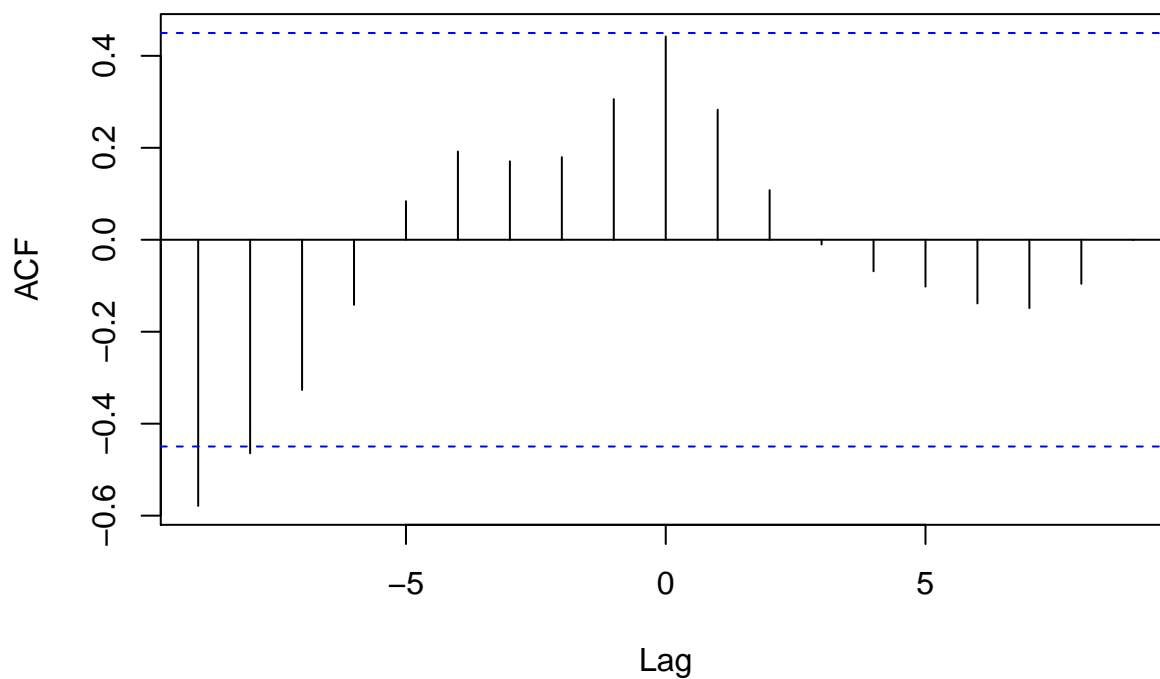


horizon 1 2 3 4 truth

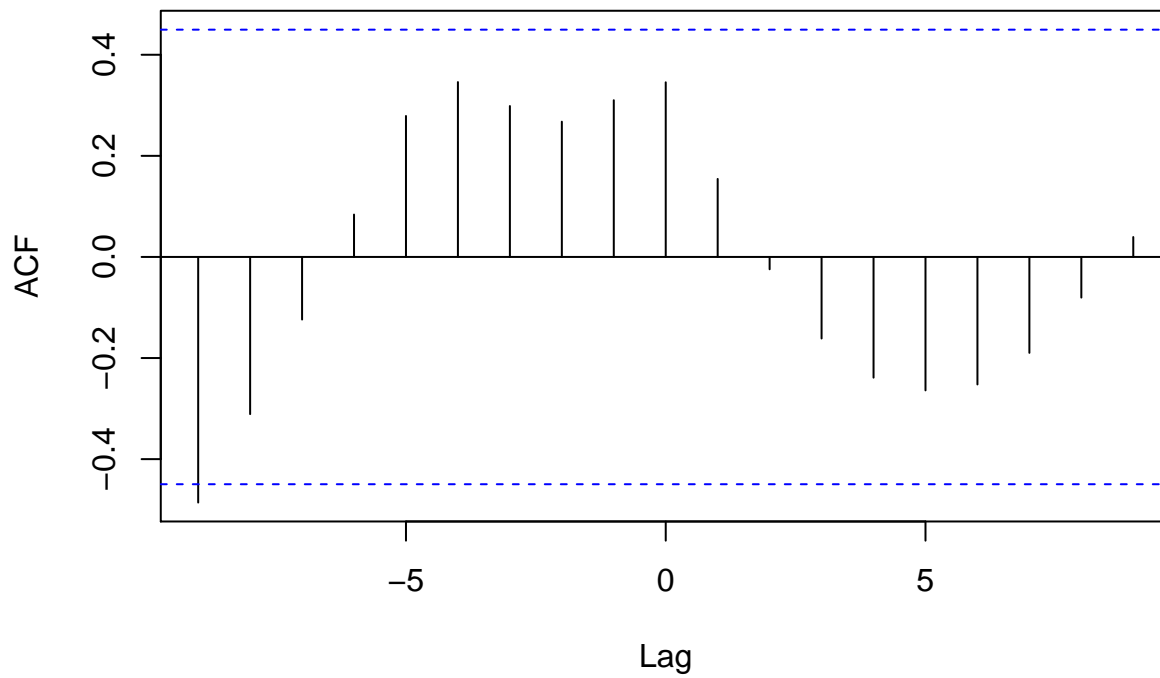


Method preprocessed\_value

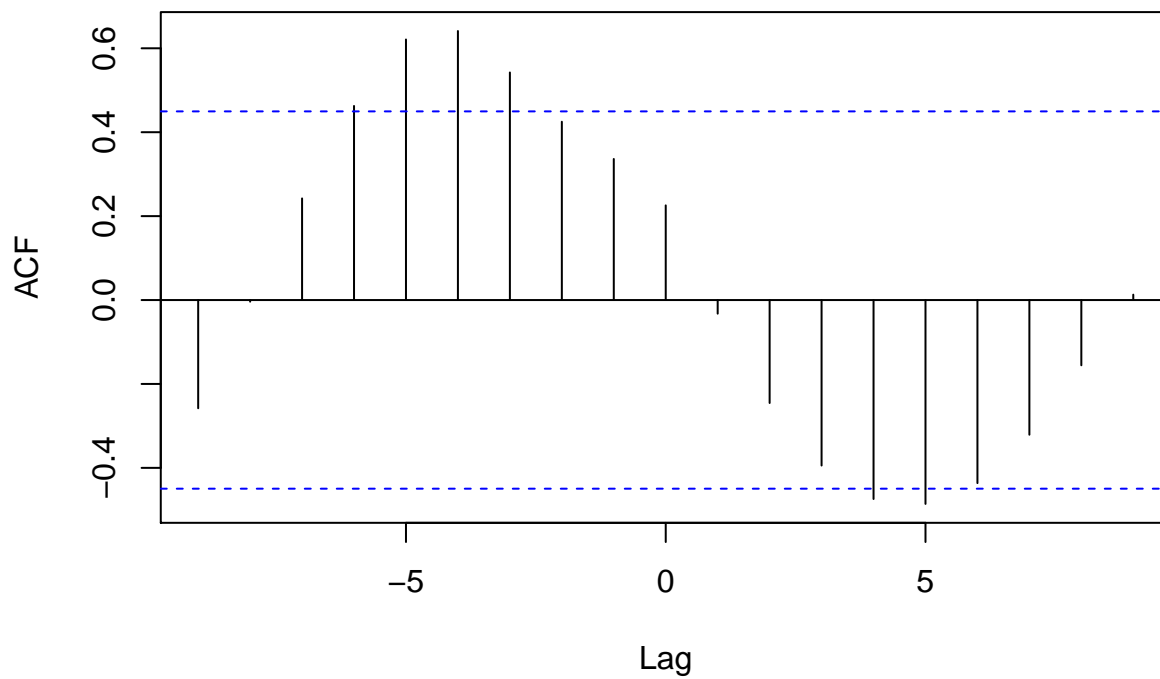
**1 wk ahead – 34**



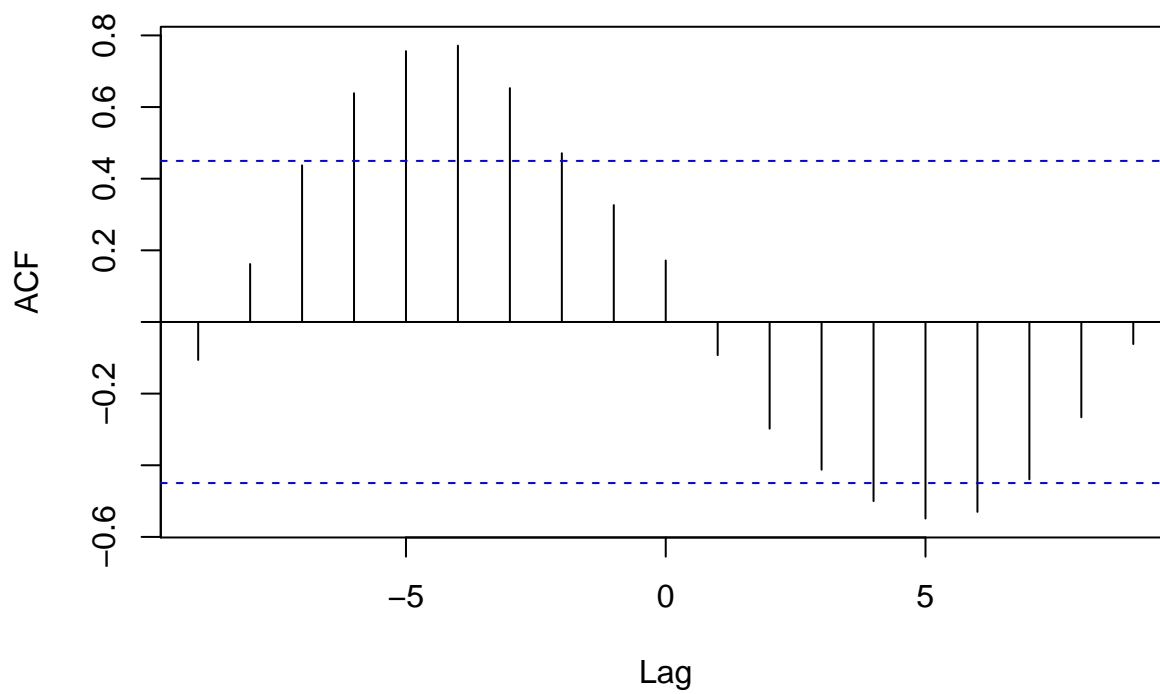
**2 wk ahead – 34**



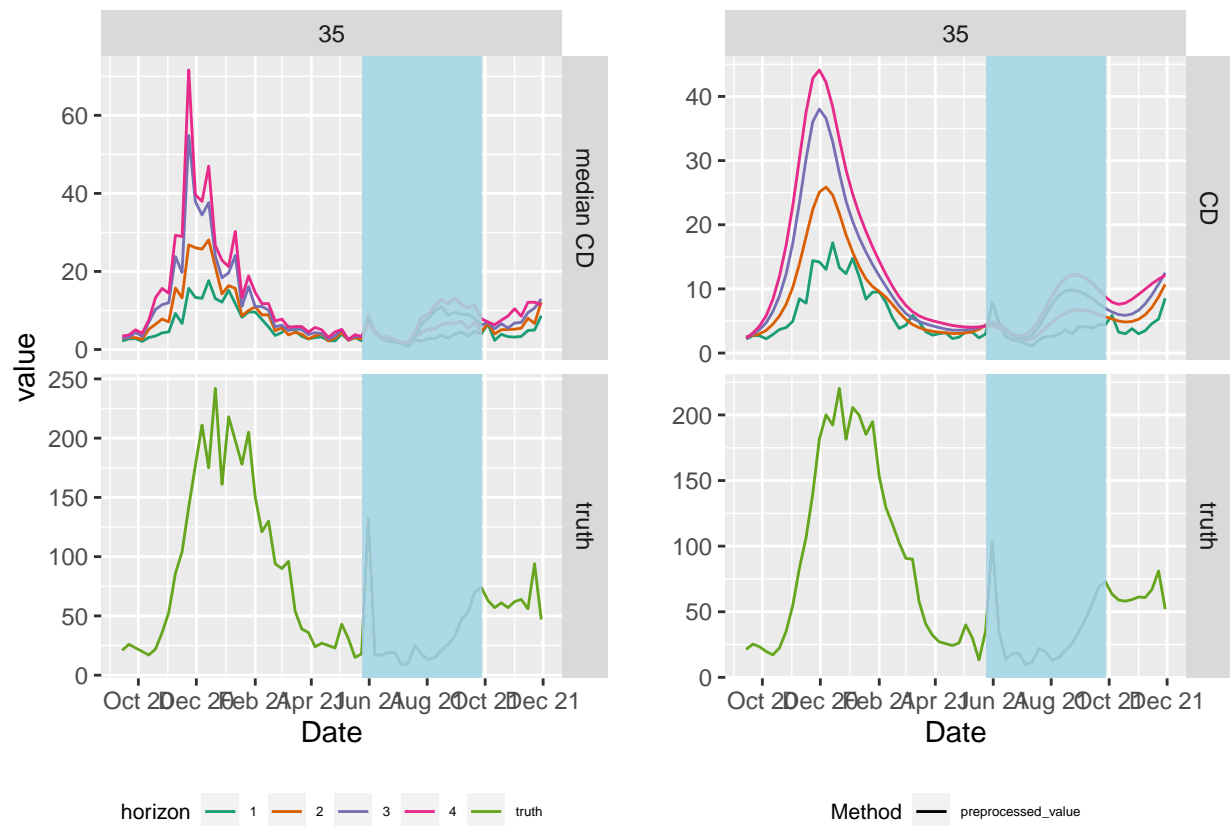
**3 wk ahead – 34**



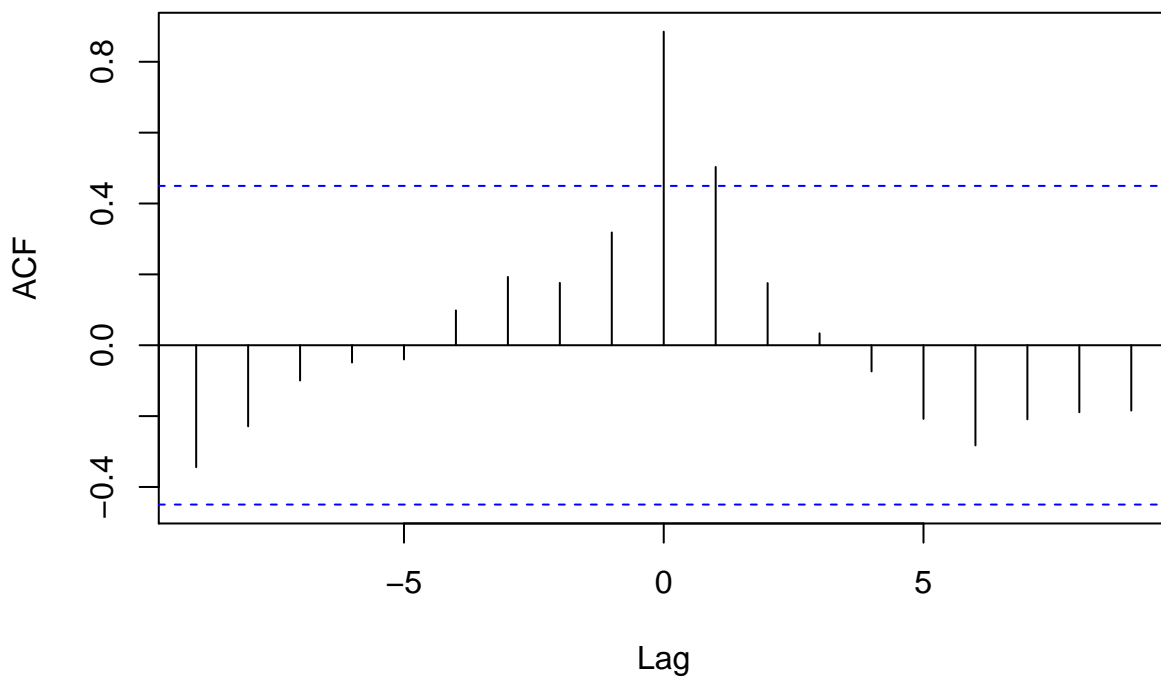
**4 wk ahead – 34**



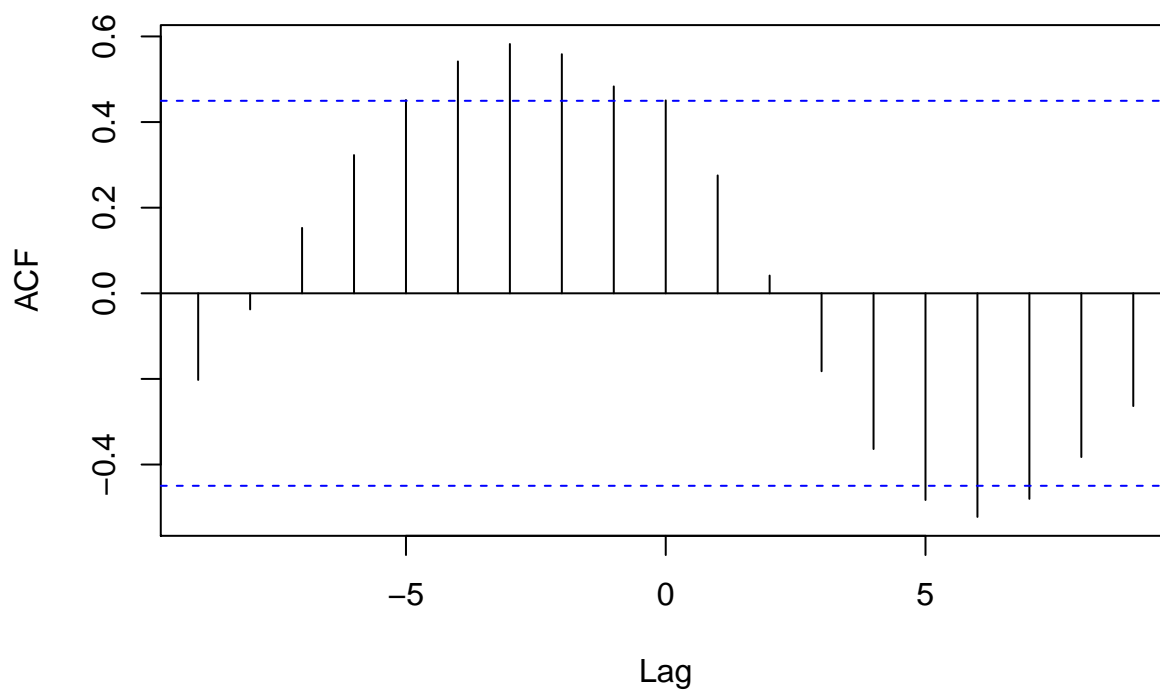




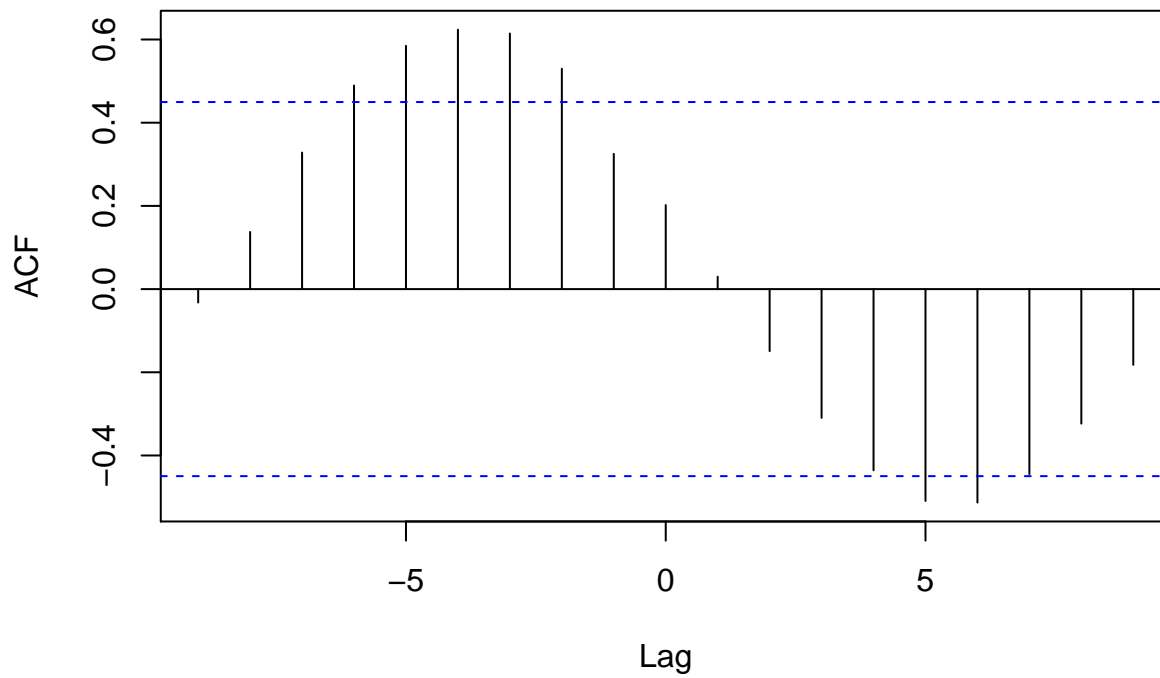
**1 wk ahead – 35**



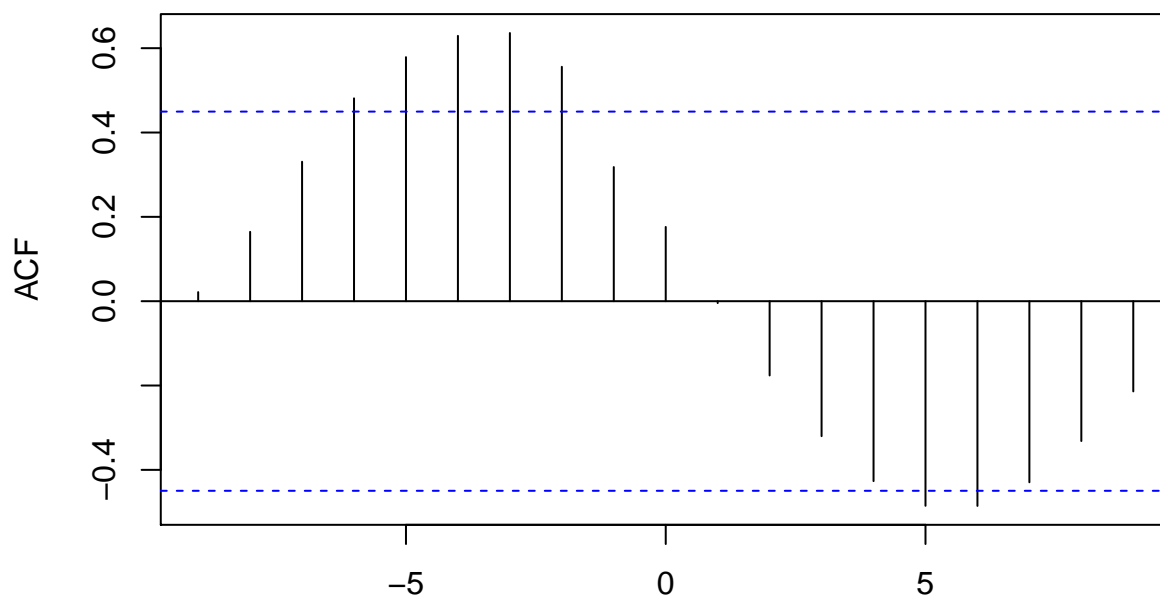
**2 wk ahead – 35**



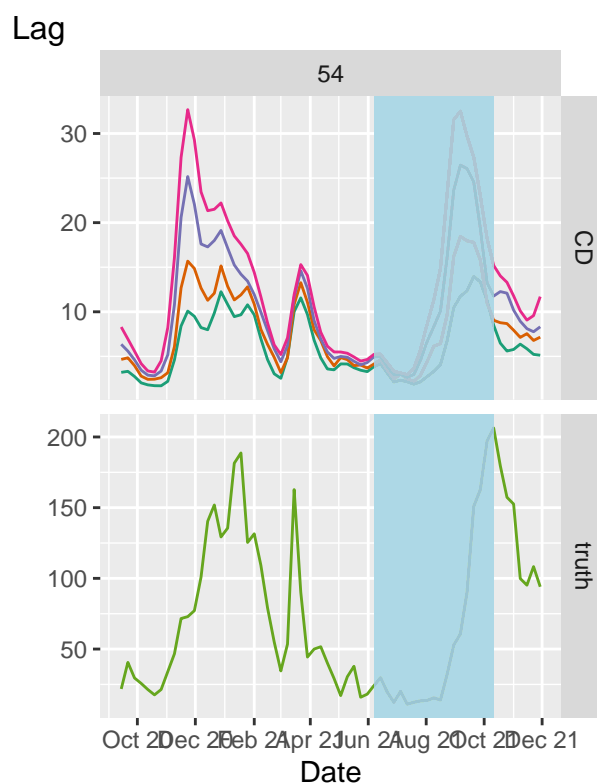
**3 wk ahead – 35**



## 4 wk ahead – 35

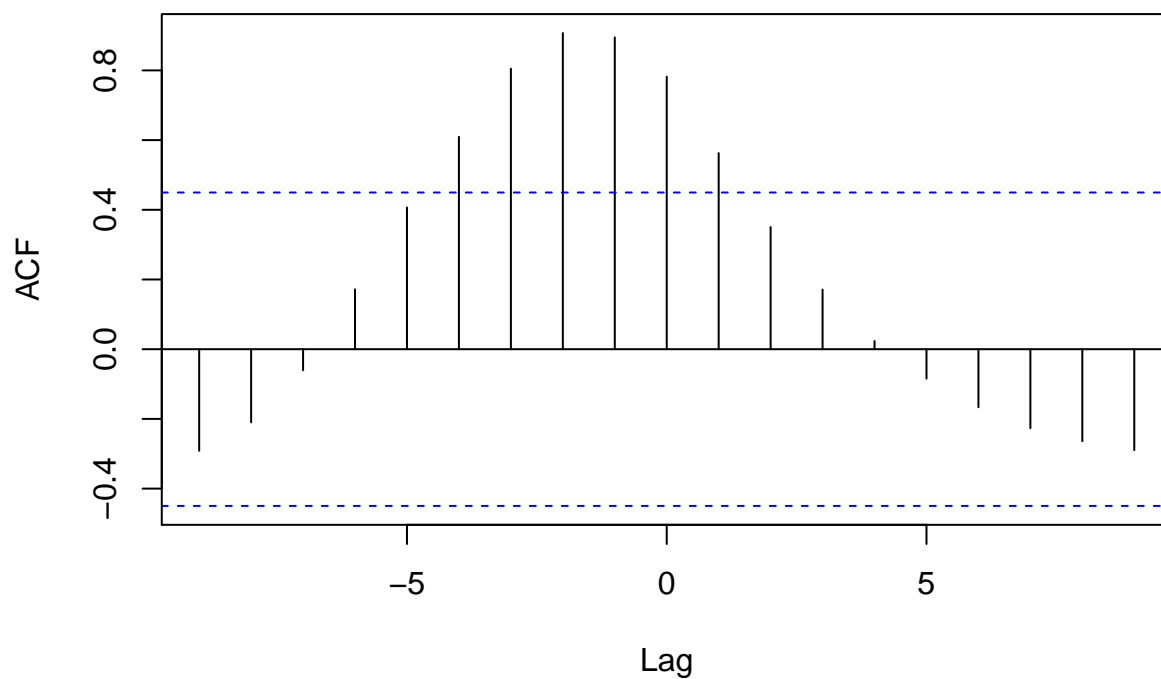


horizon 1 2 3 4 truth

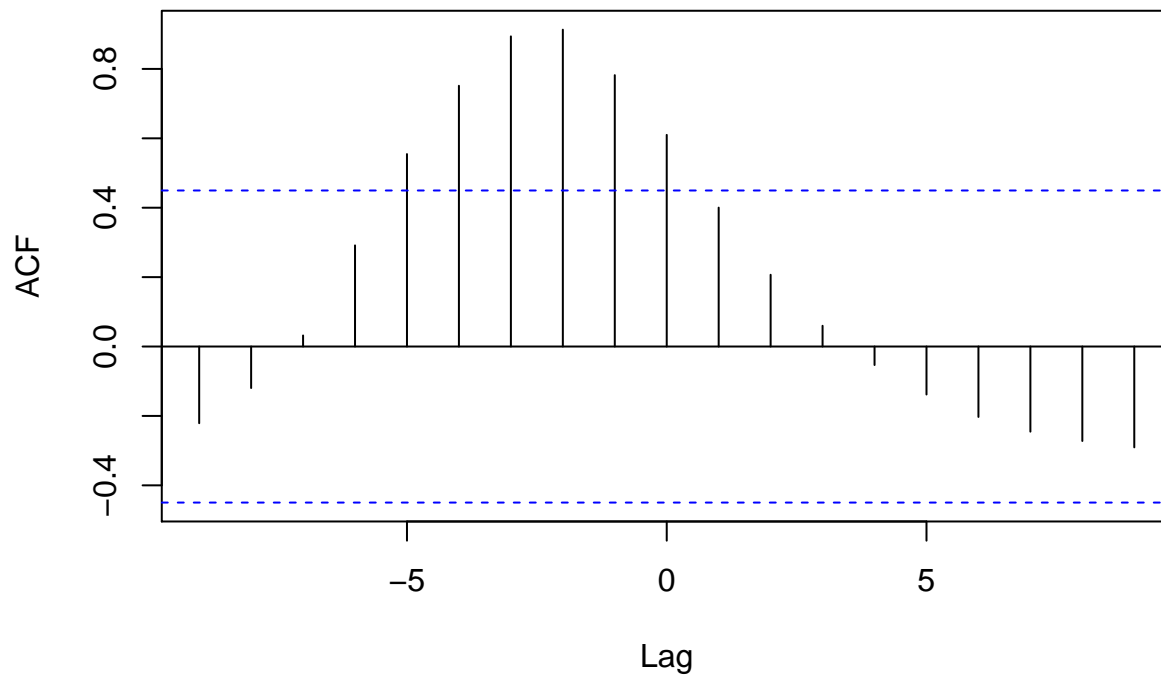


Method preprocessed\_value

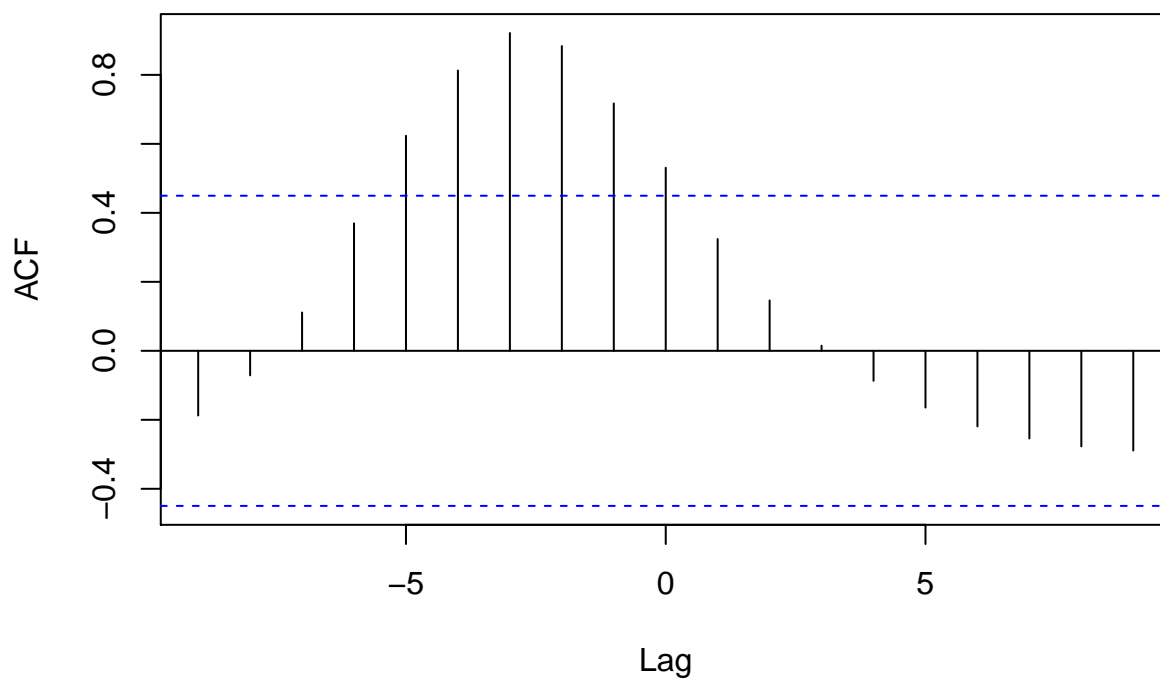
**1 wk ahead – 54**



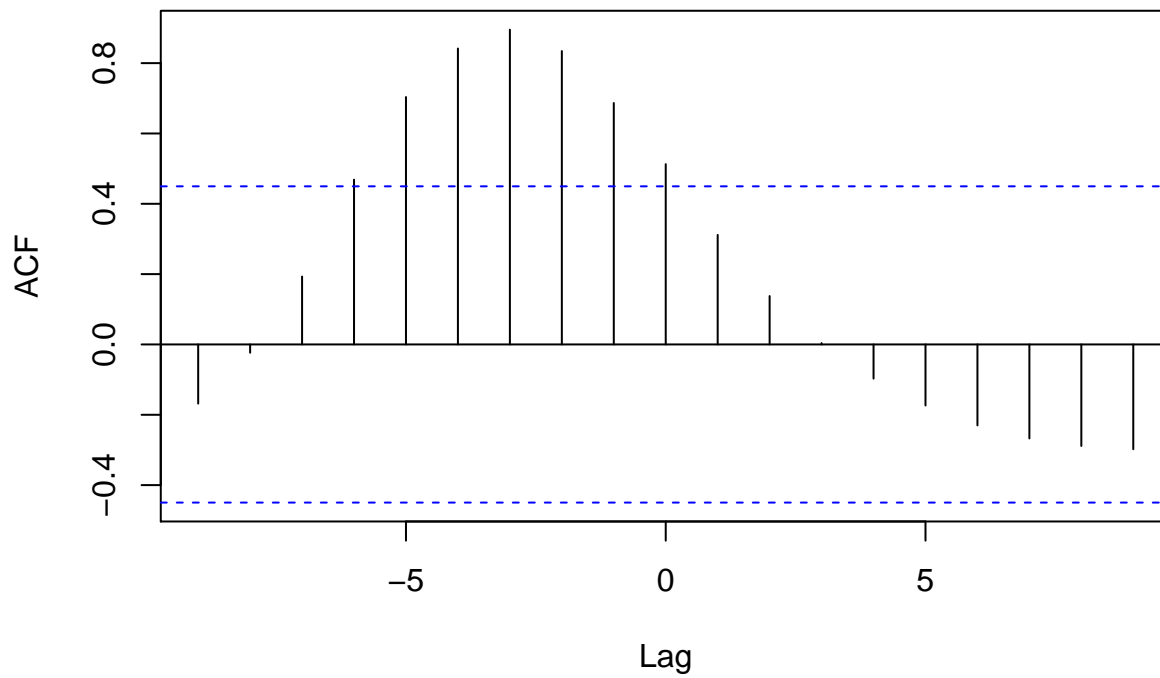
**2 wk ahead – 54**

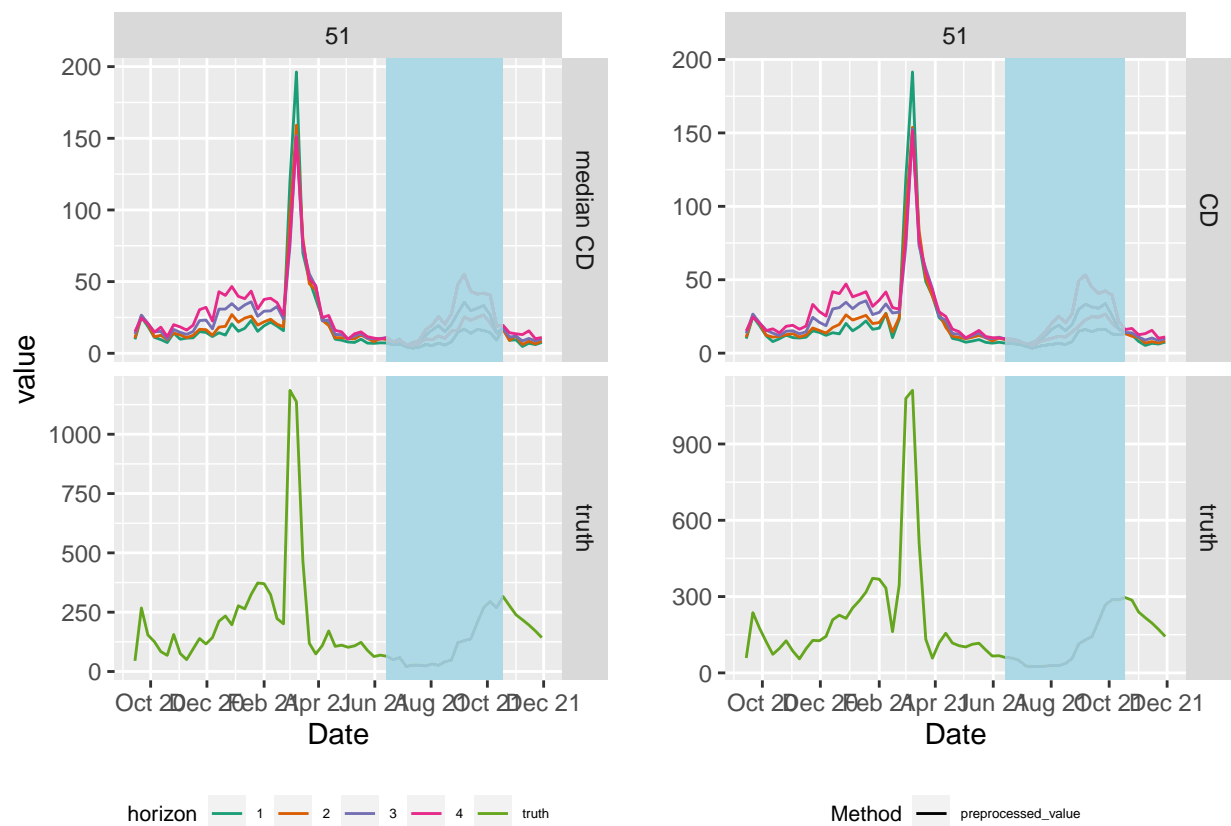


### 3 wk ahead – 54

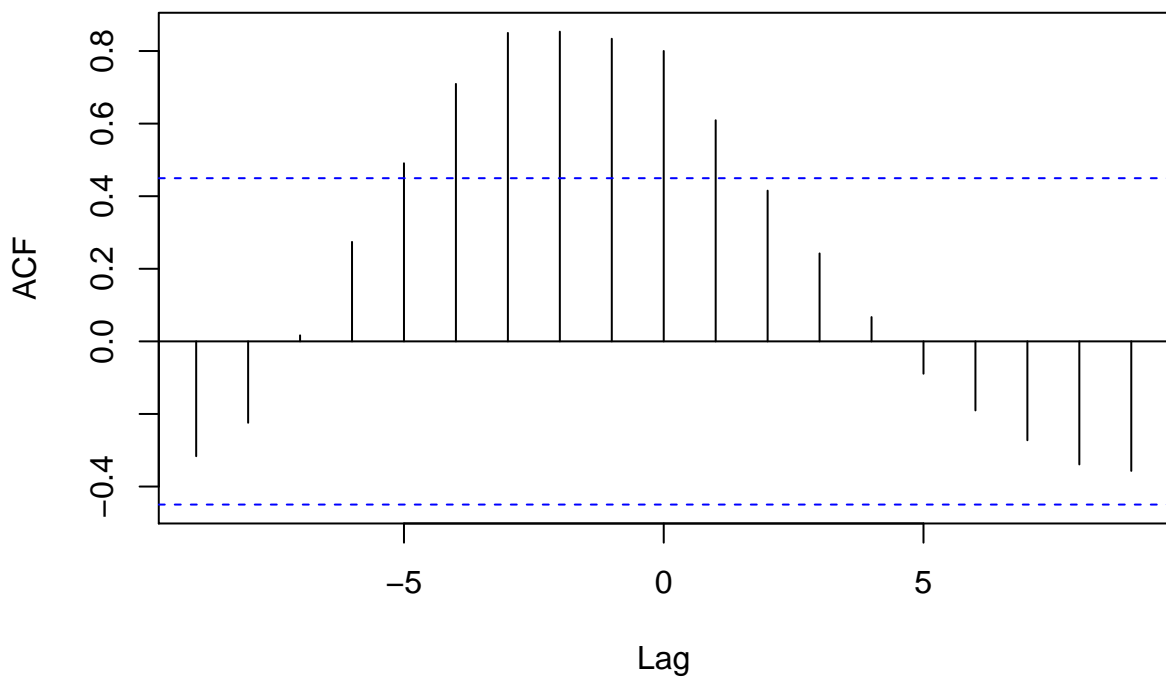


### 4 wk ahead – 54

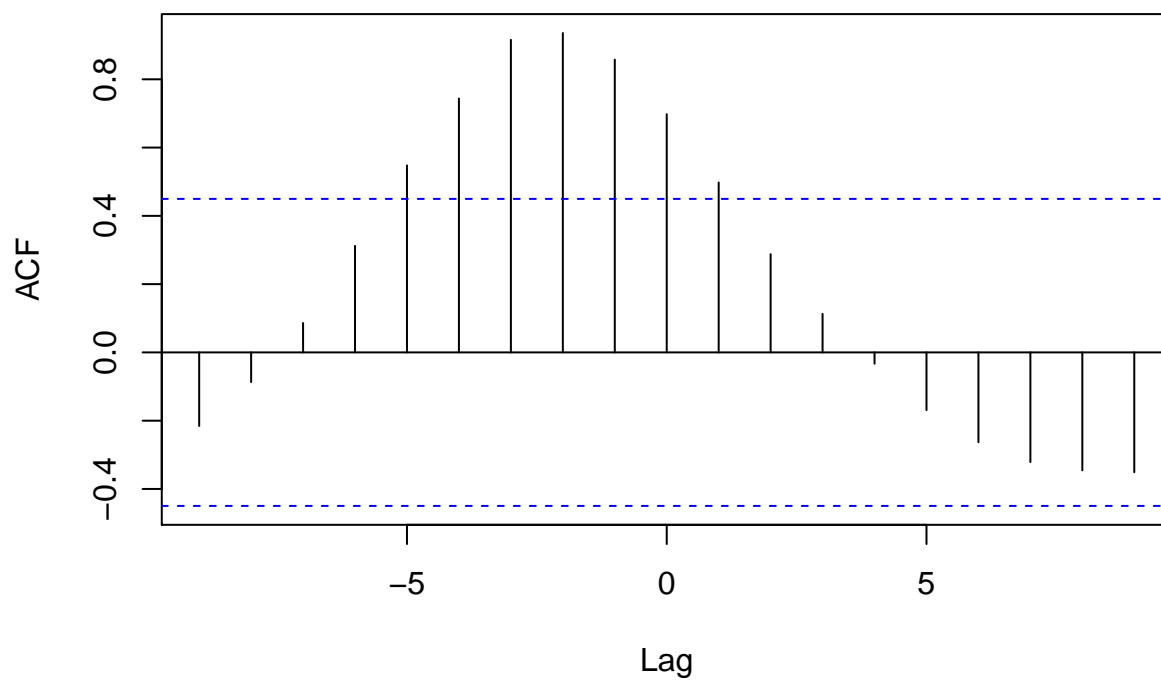




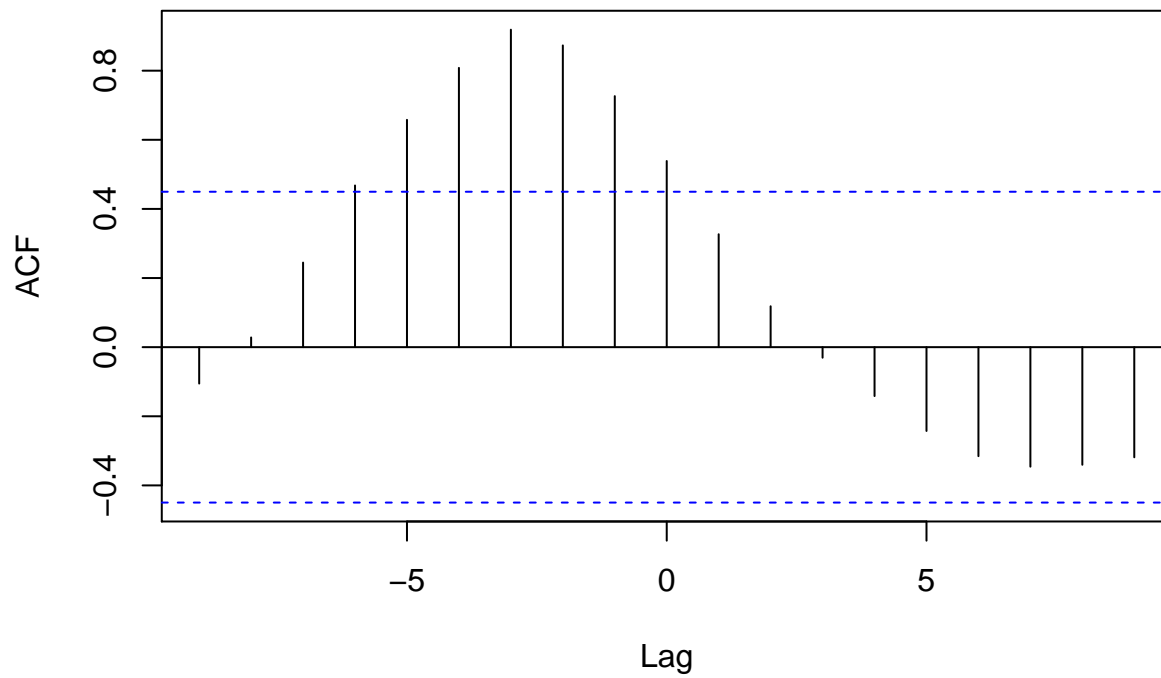
**1 wk ahead - 51**



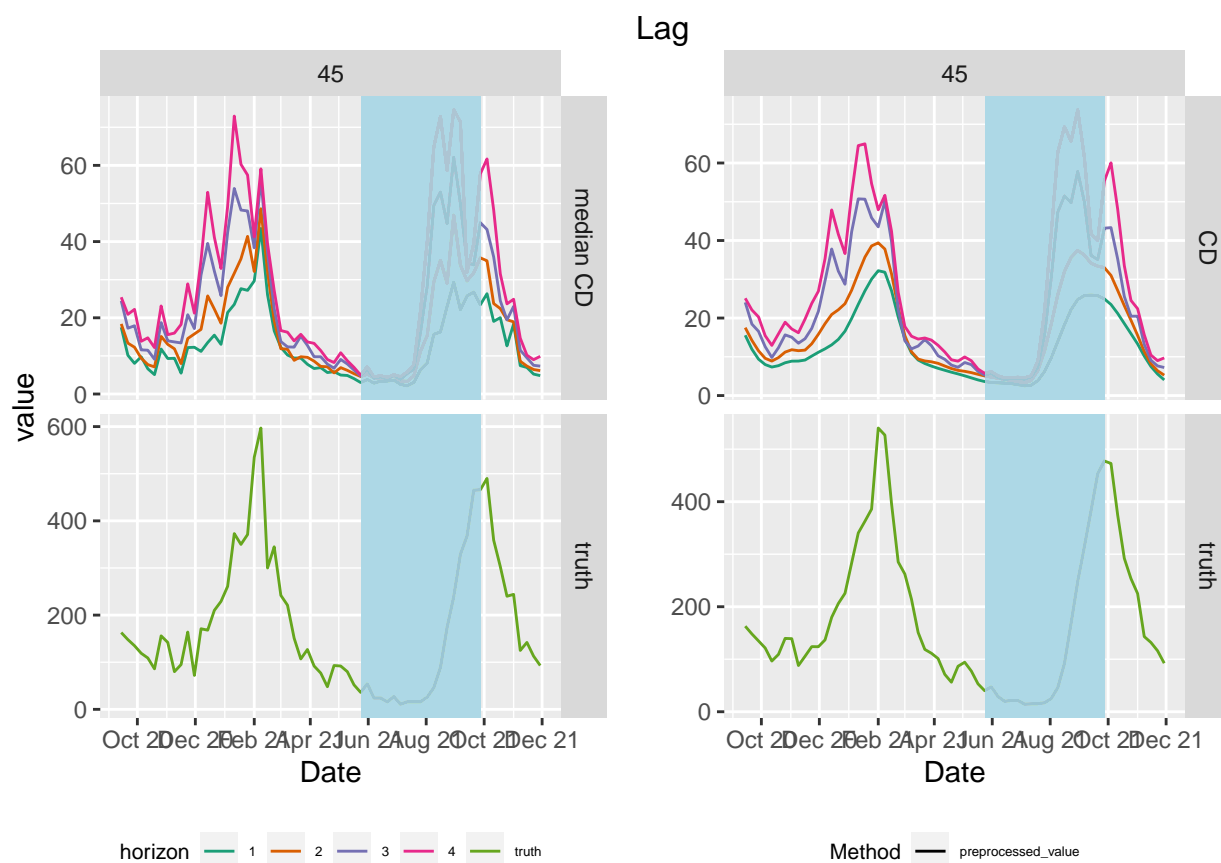
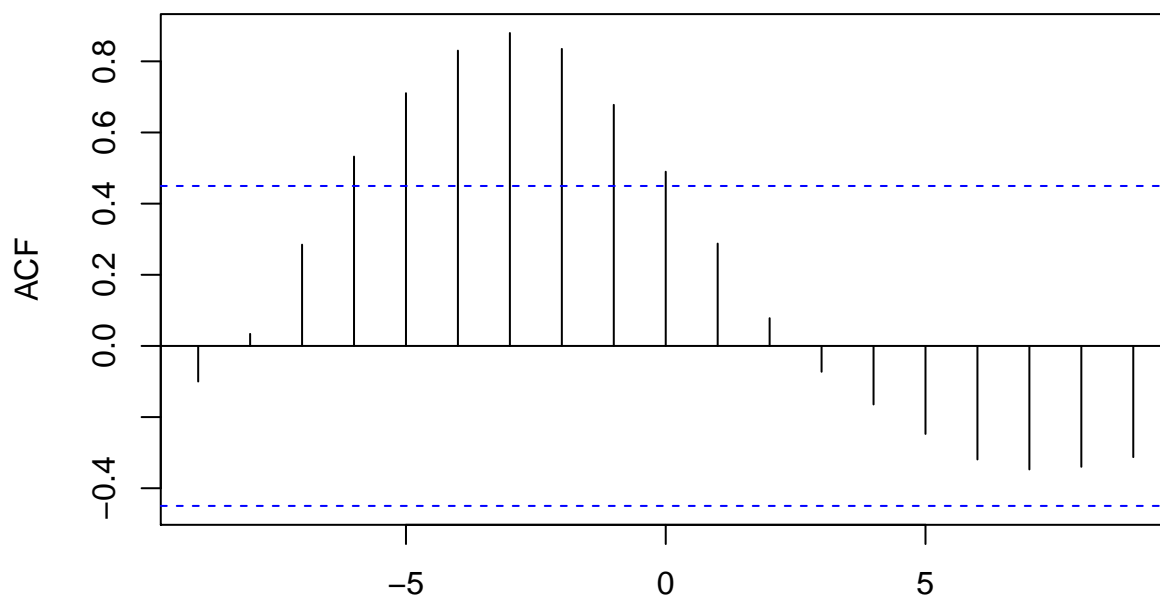
**2 wk ahead – 51**



**3 wk ahead – 51**

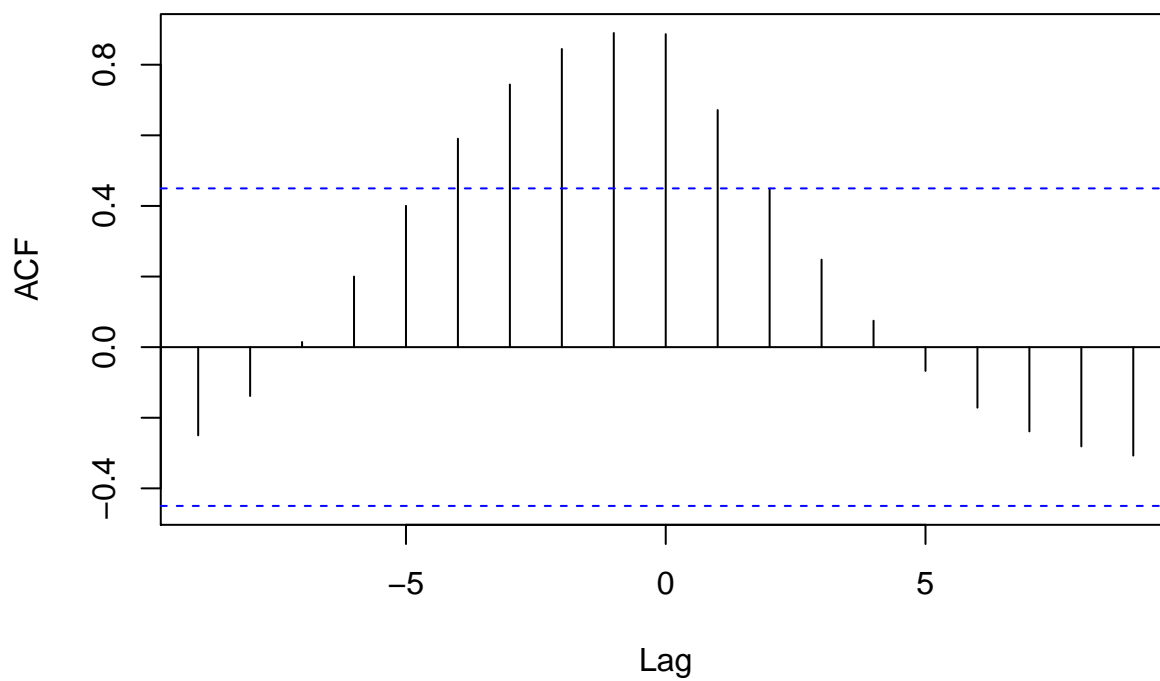


## 4 wk ahead – 51

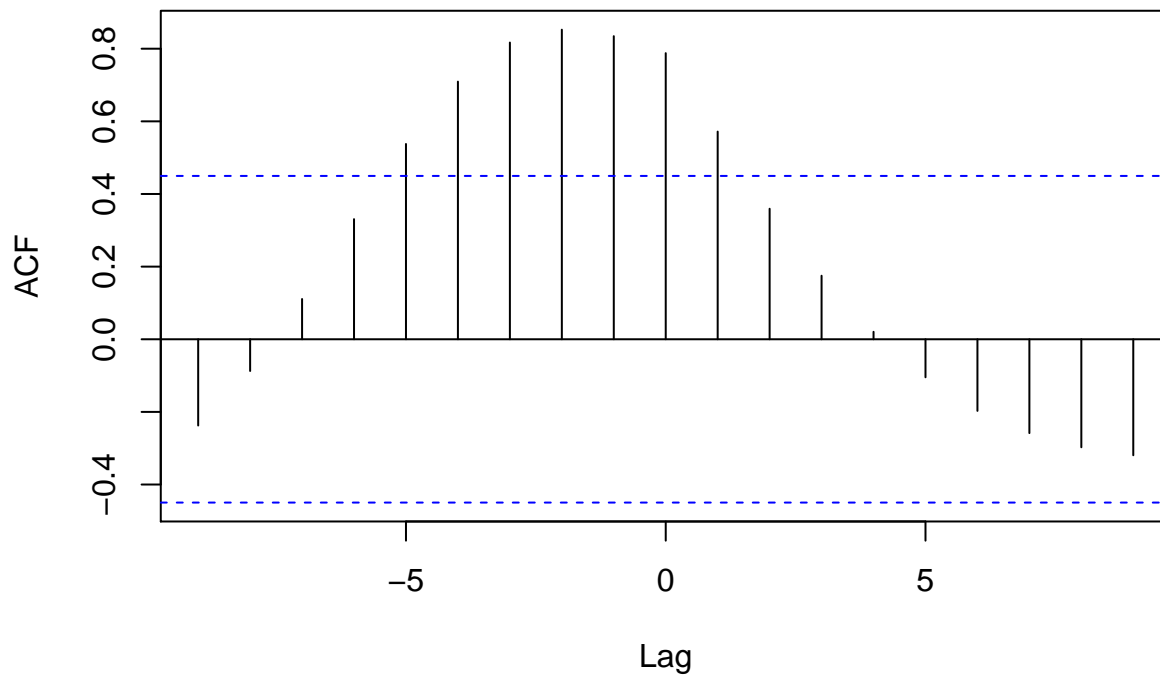




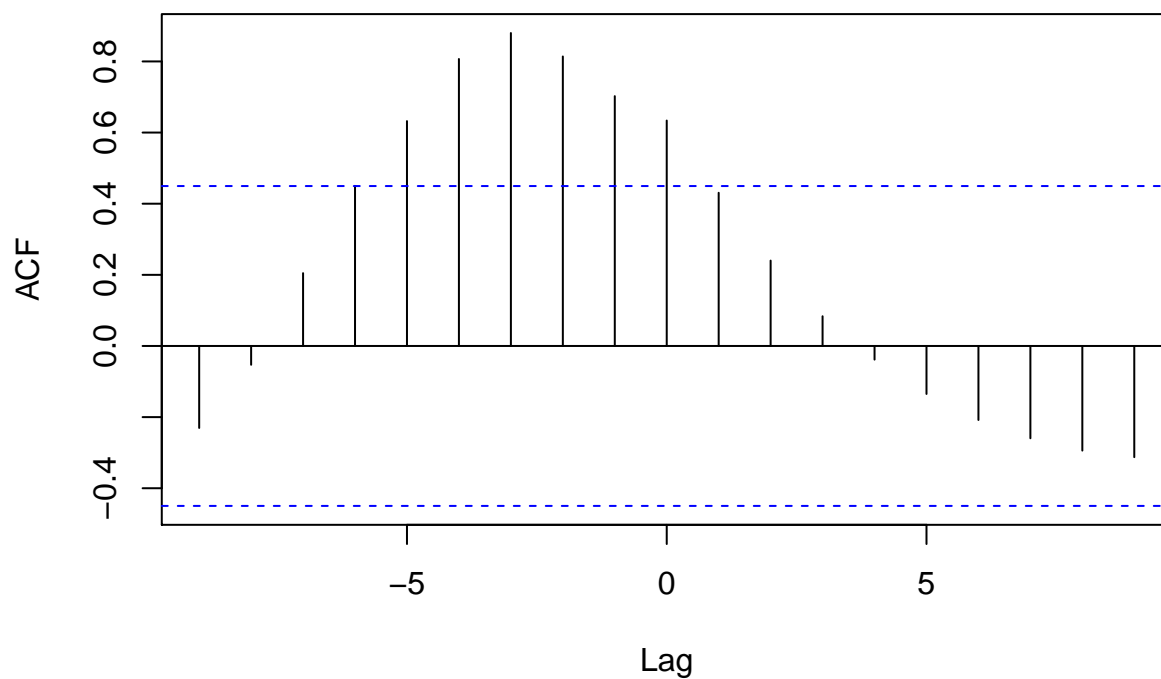
**1 wk ahead – 45**



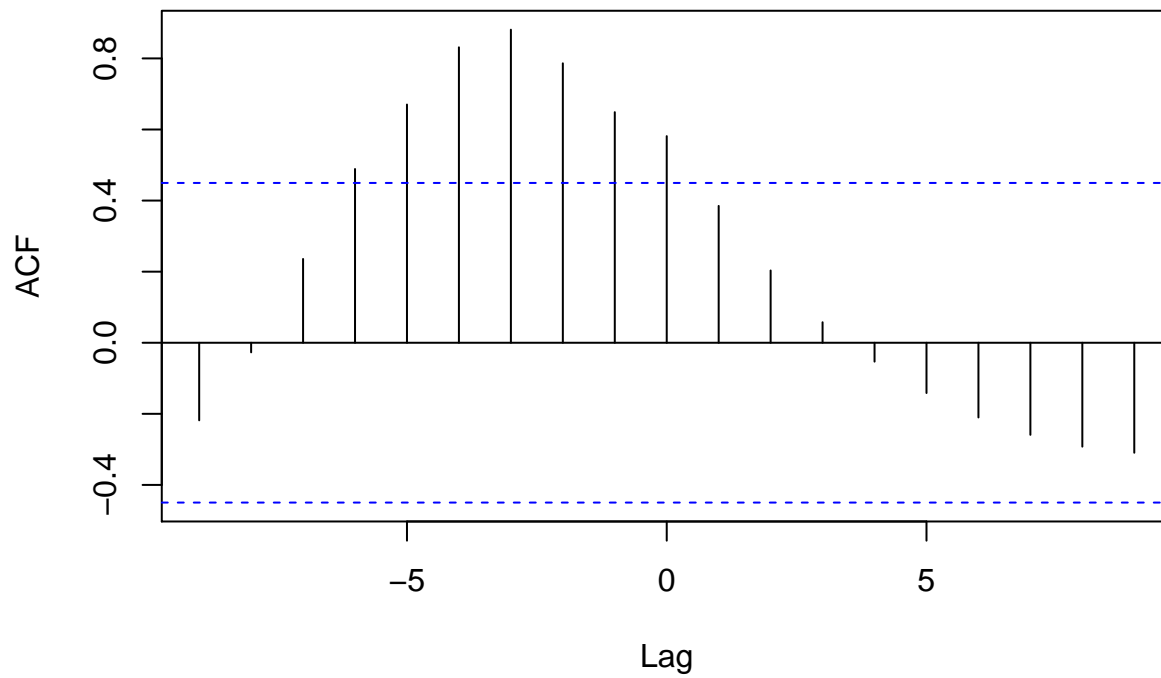
**2 wk ahead – 45**

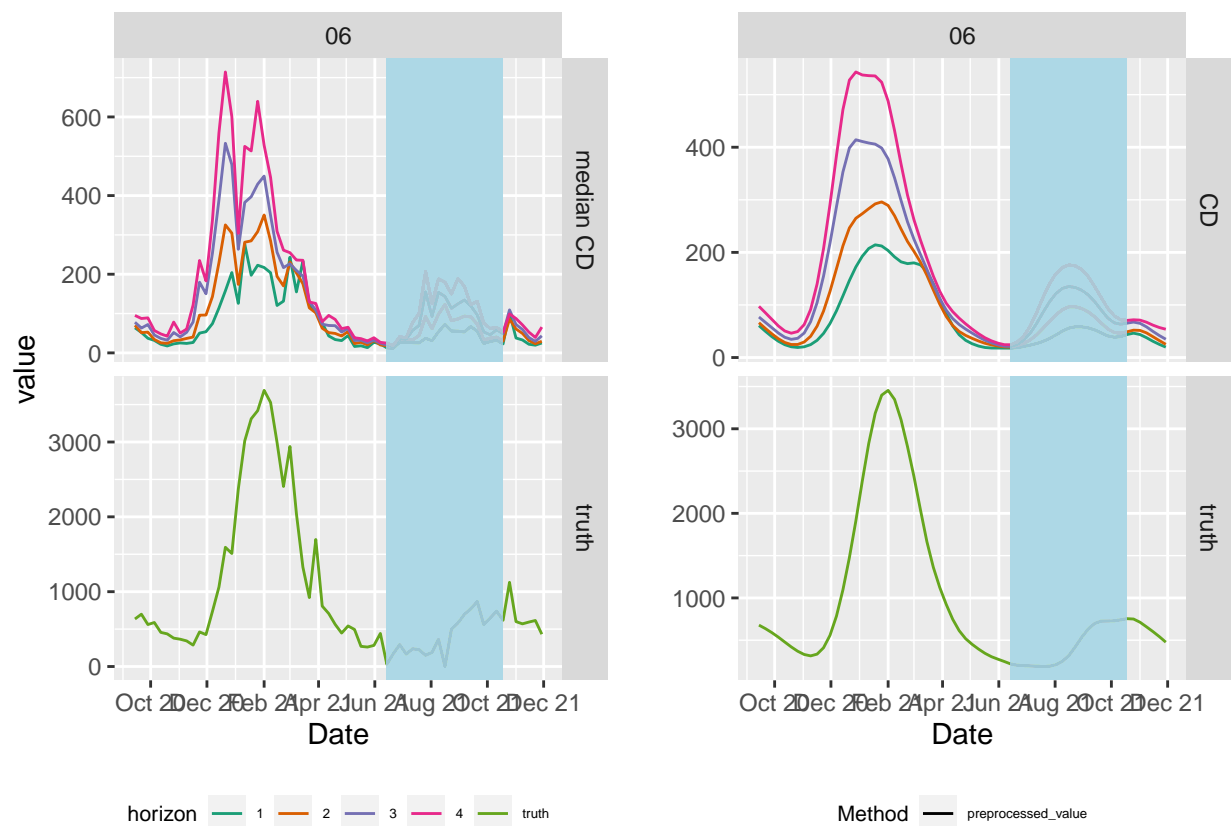


**3 wk ahead – 45**

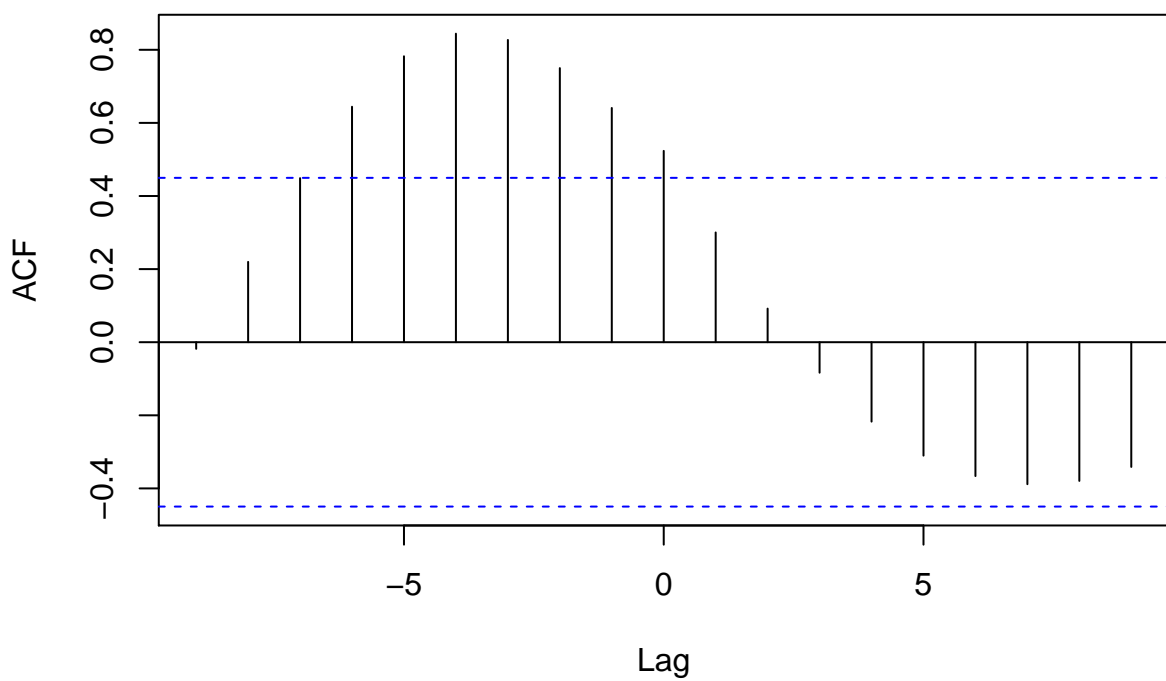


**4 wk ahead – 45**

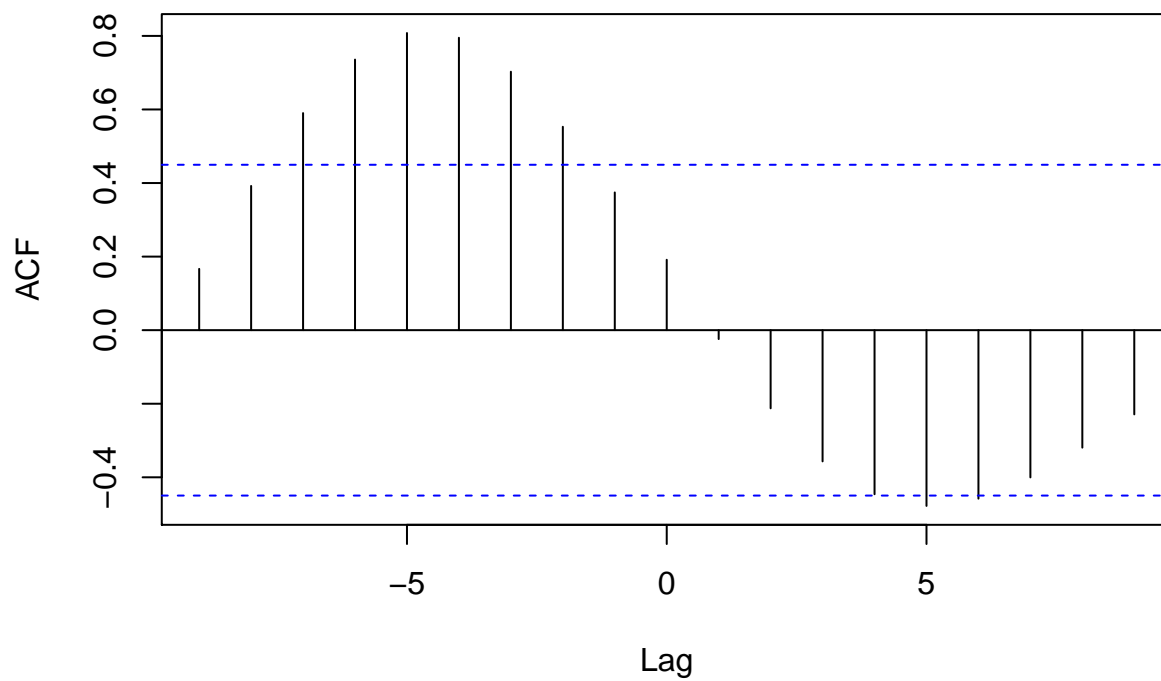




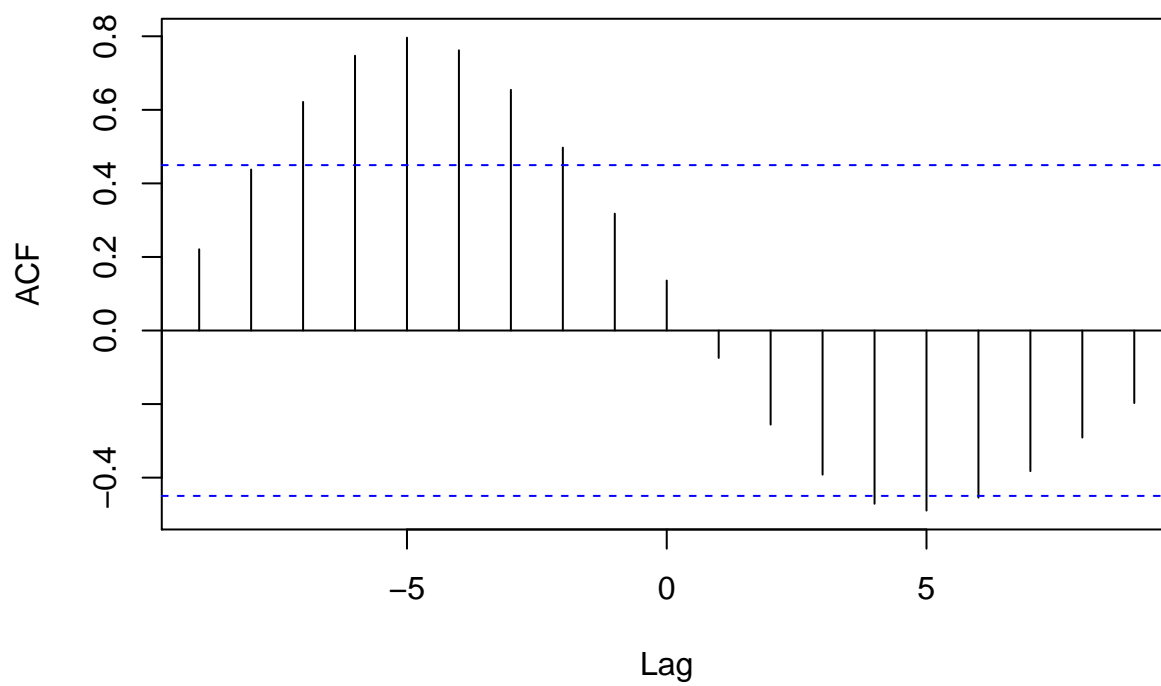
**1 wk ahead – 06**



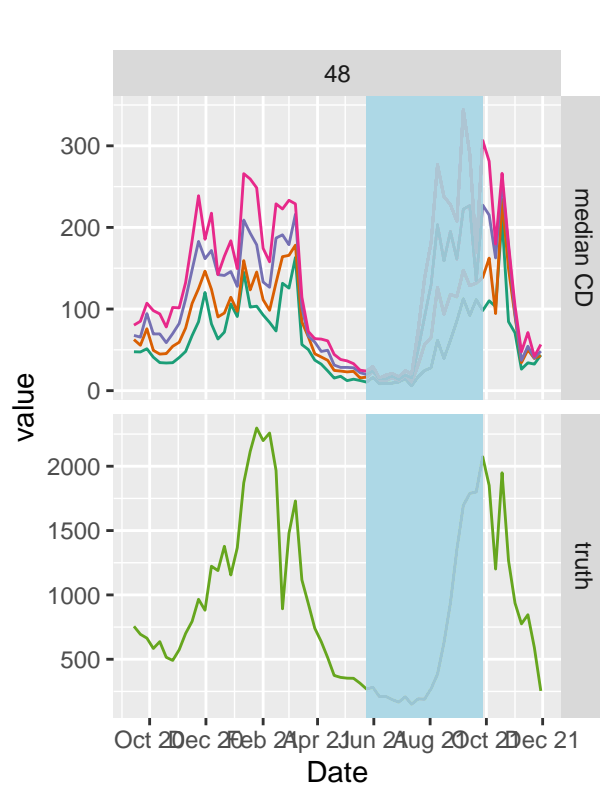
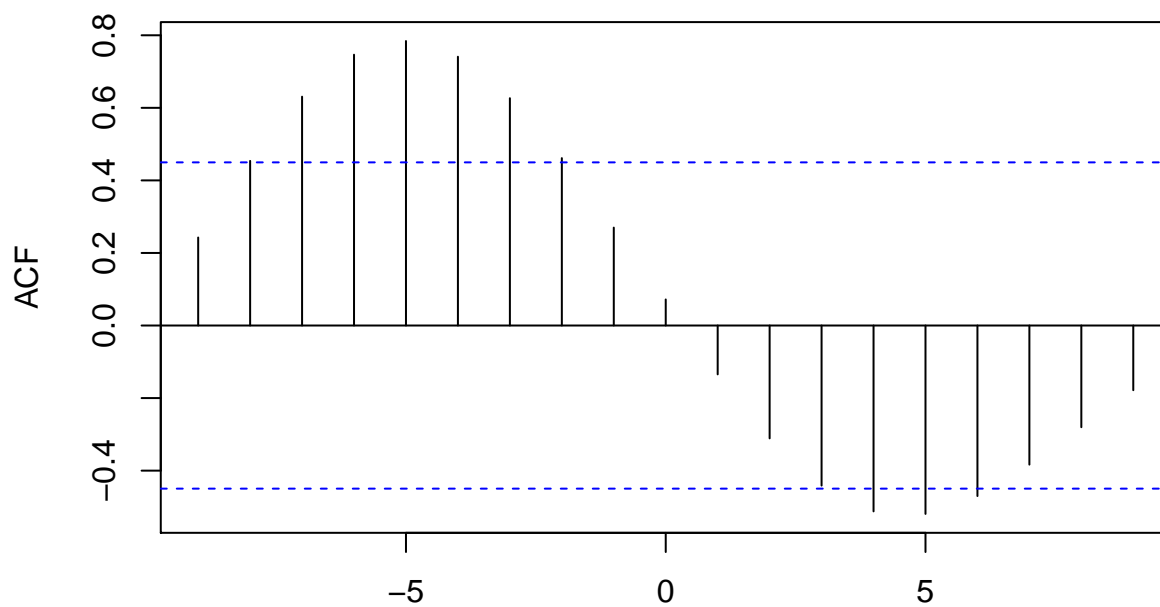
**2 wk ahead – 06**



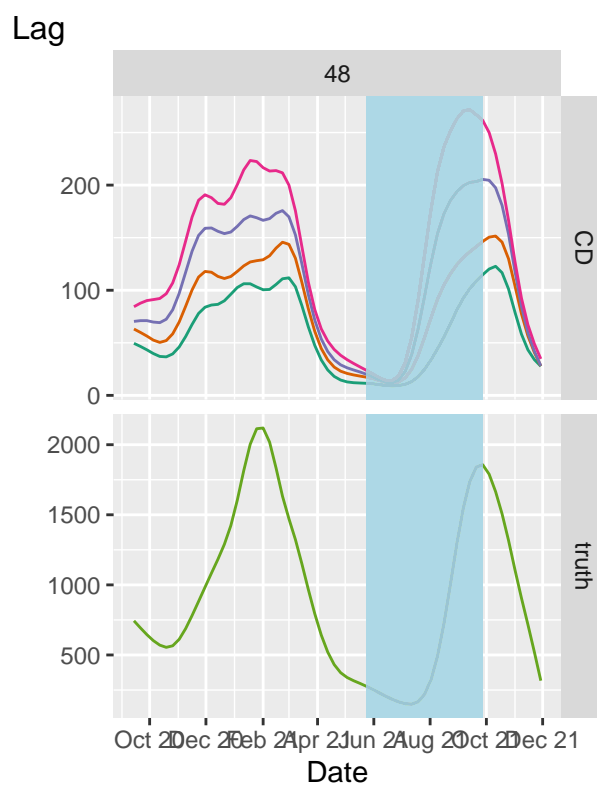
**3 wk ahead – 06**



## 4 wk ahead – 06

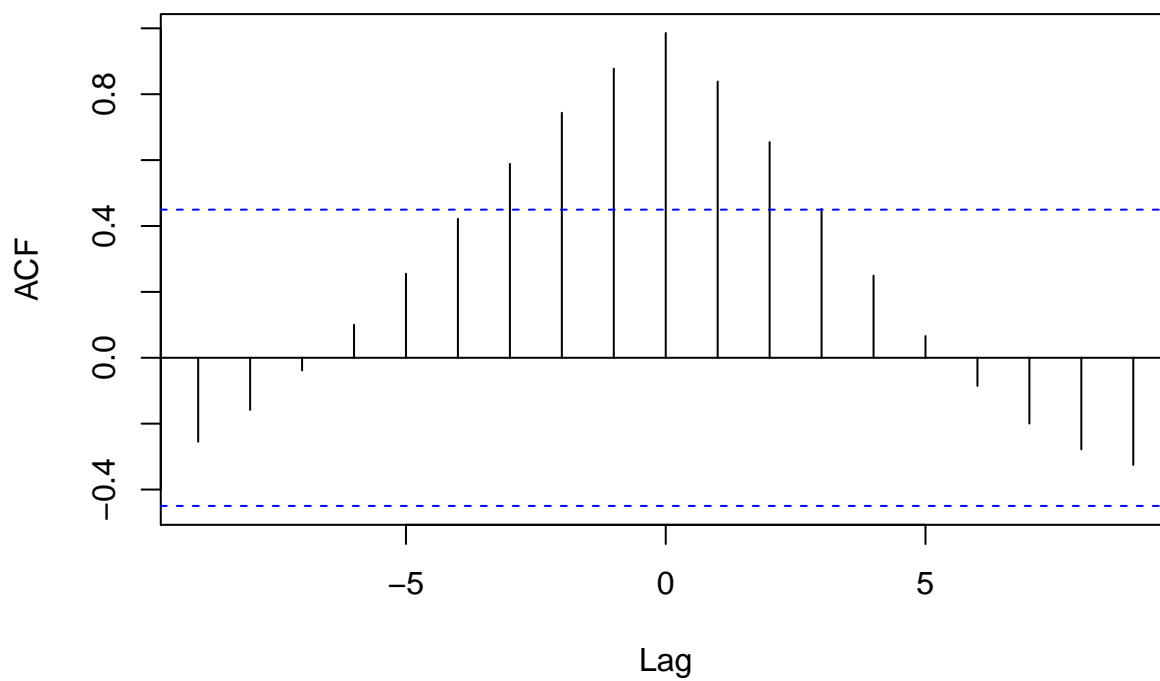


horizon 1 2 3 4 truth

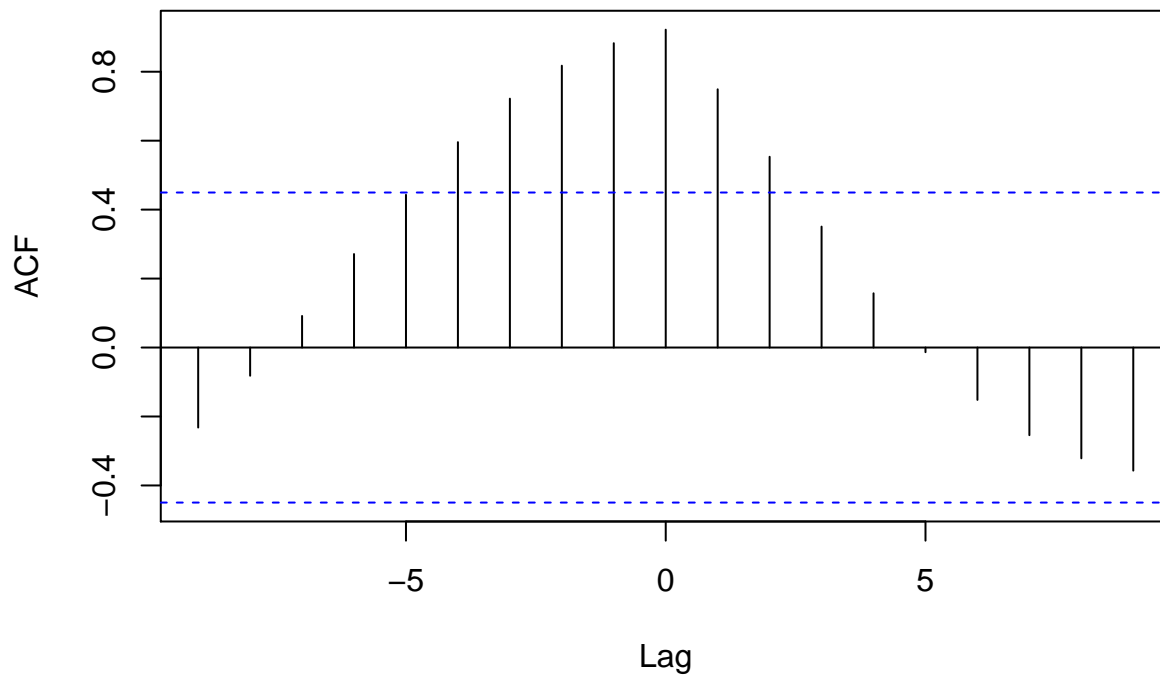


Method preprocessed\_value

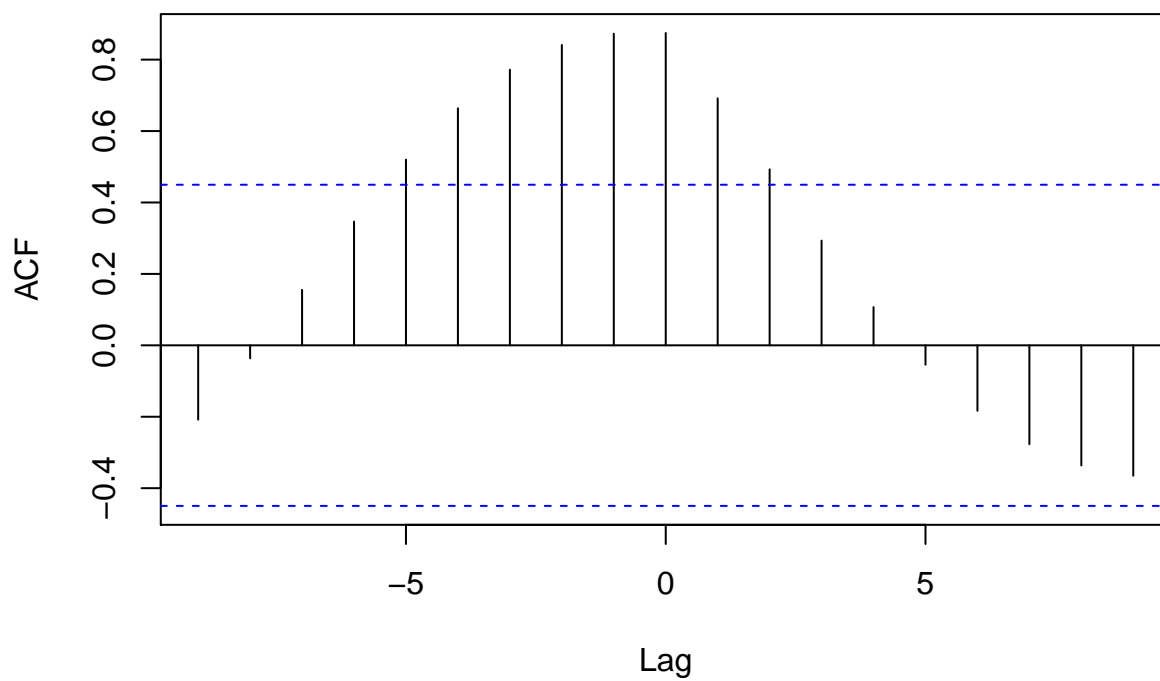
**1 wk ahead – 48**



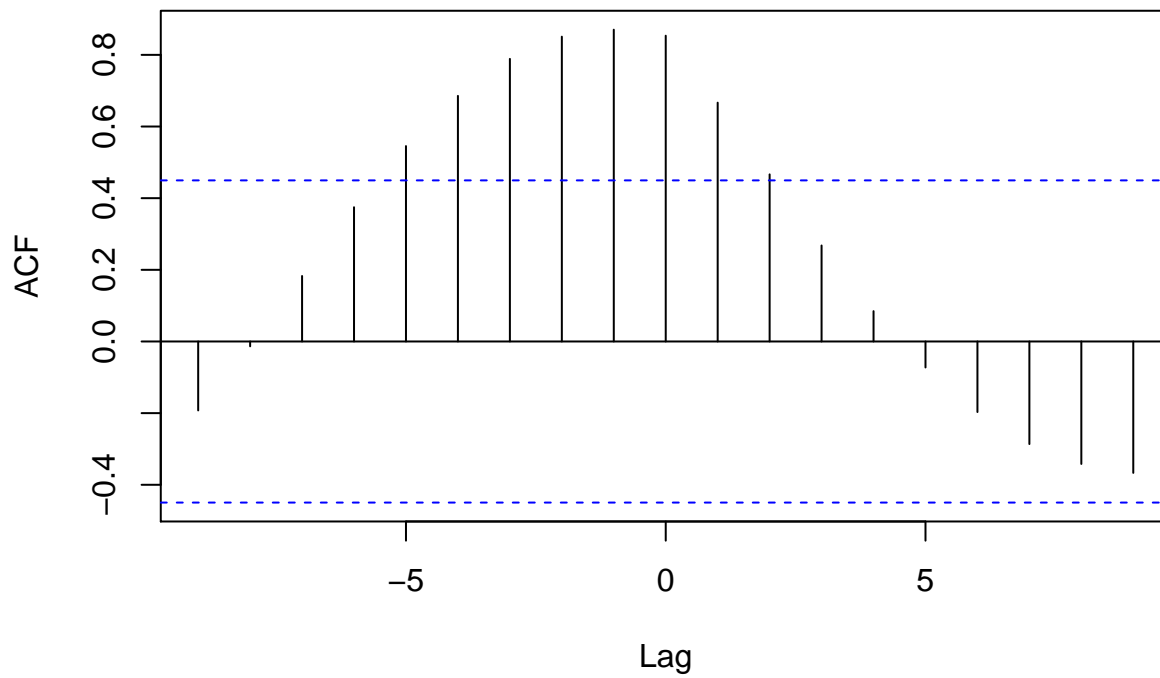
**2 wk ahead – 48**

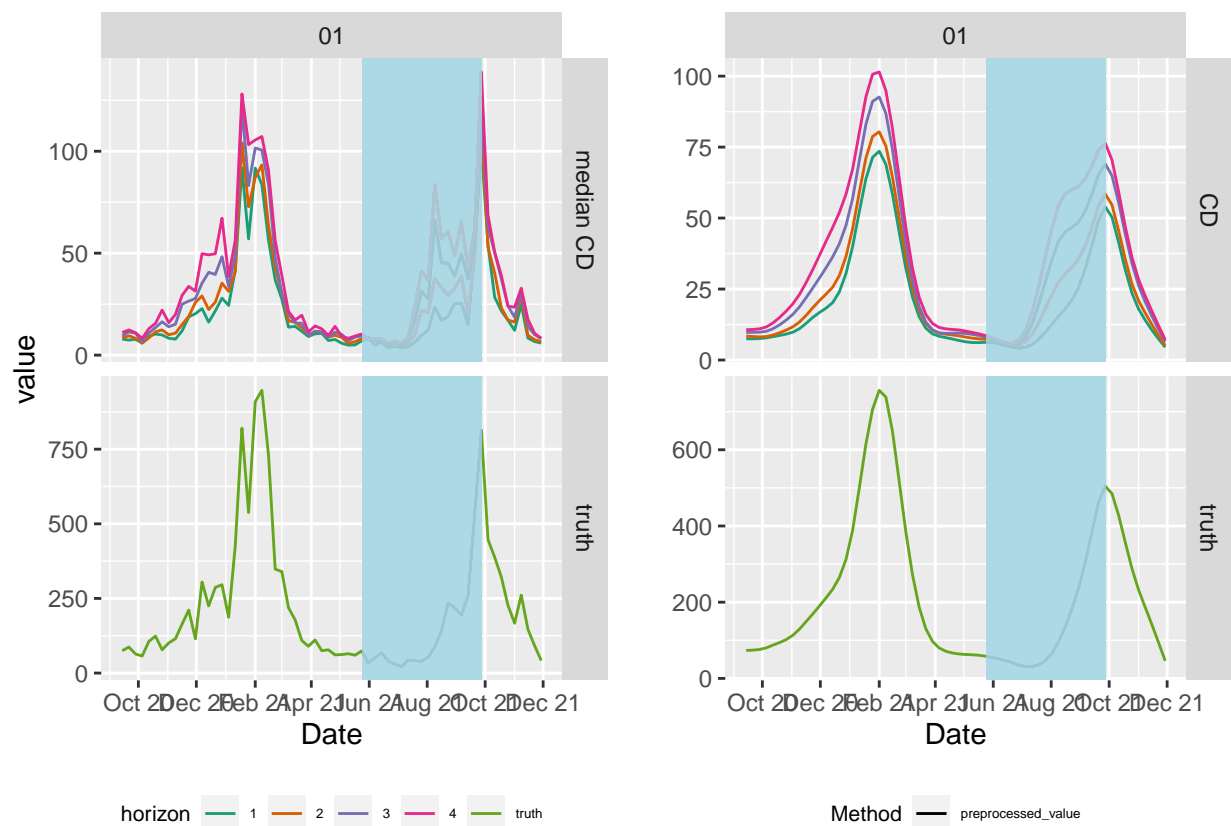


### 3 wk ahead – 48

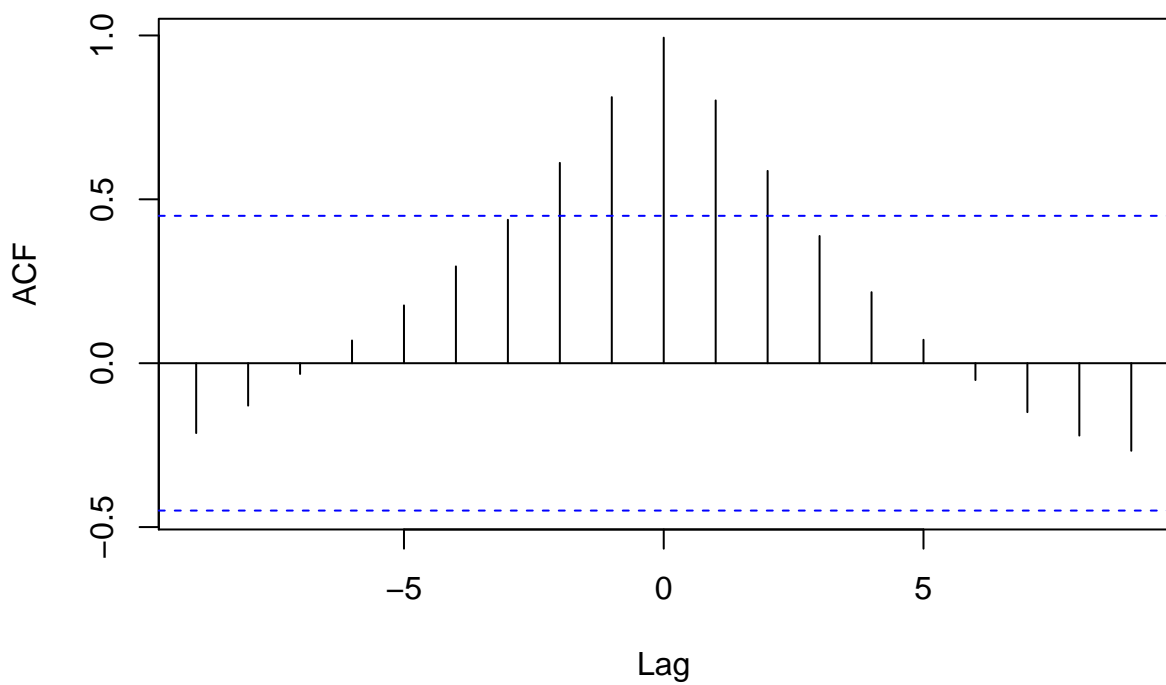


### 4 wk ahead – 48



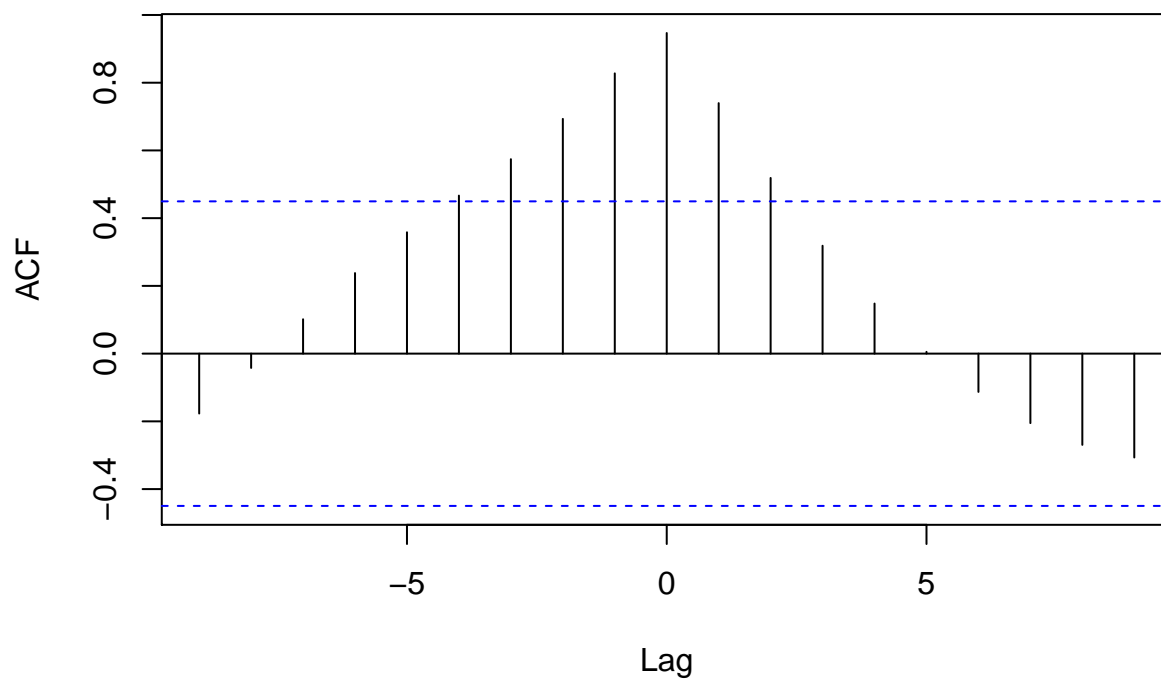


### 1 wk ahead – 01

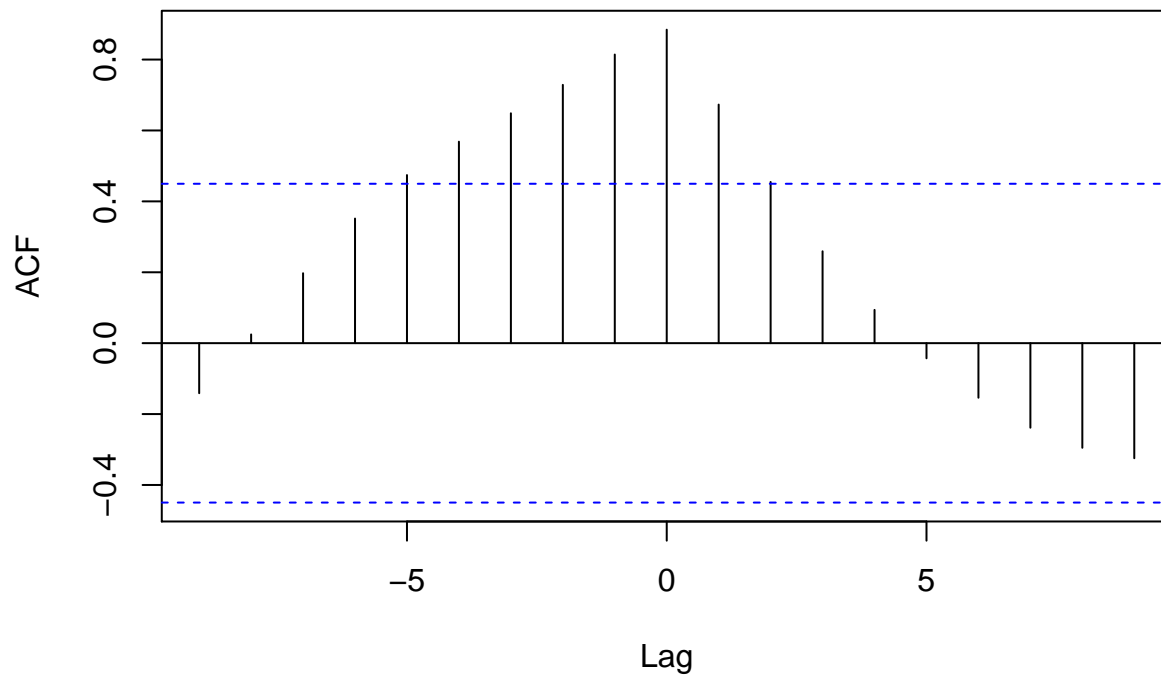




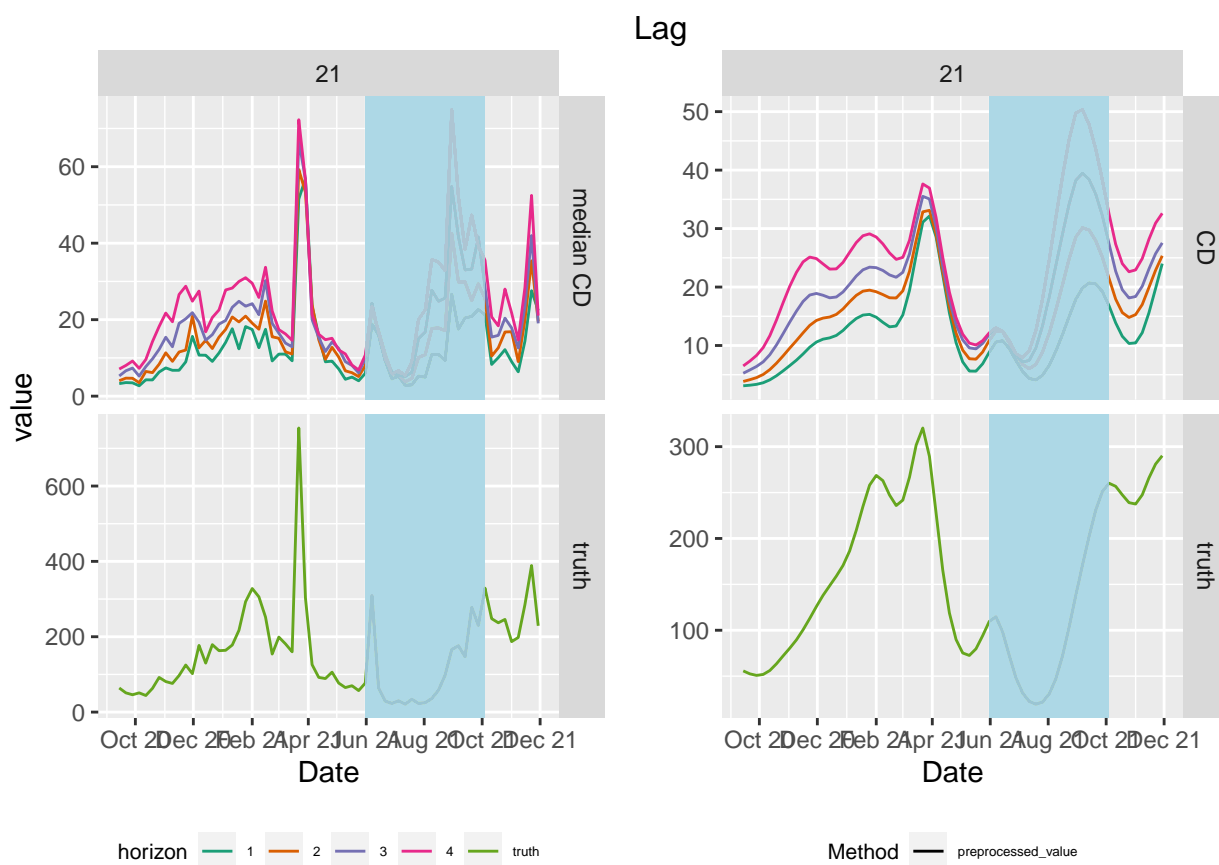
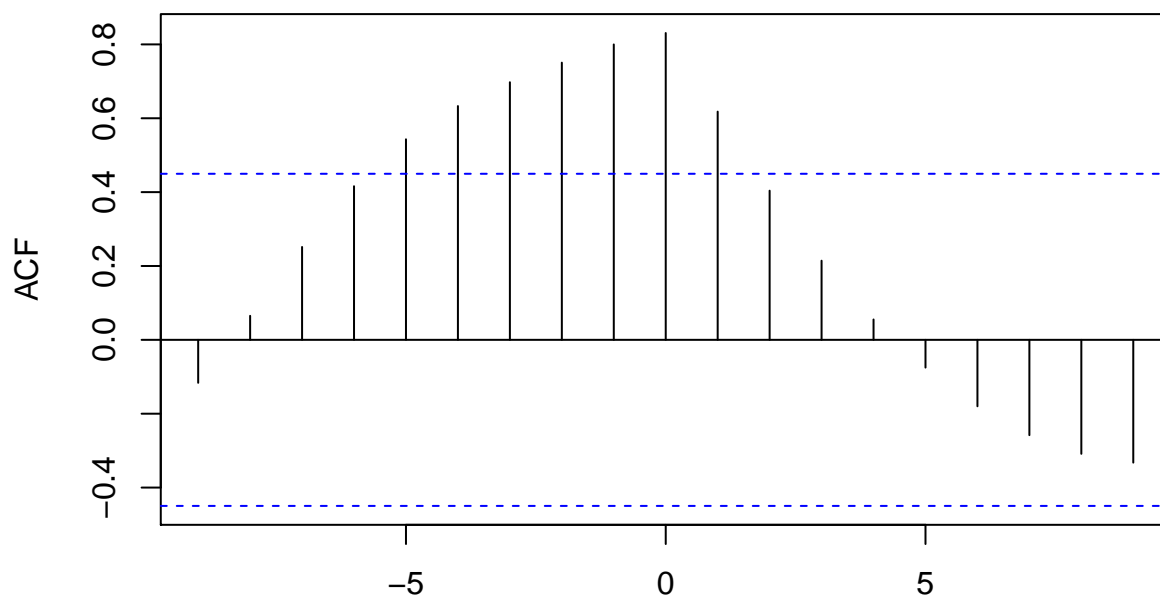
**2 wk ahead – 01**



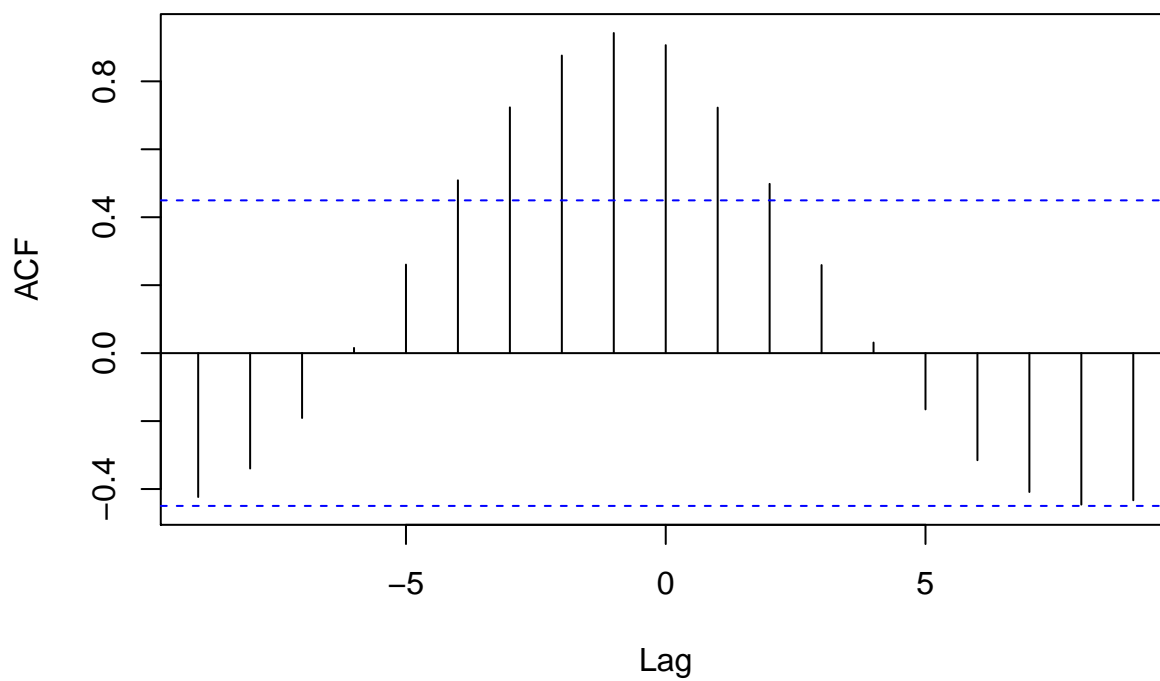
**3 wk ahead – 01**



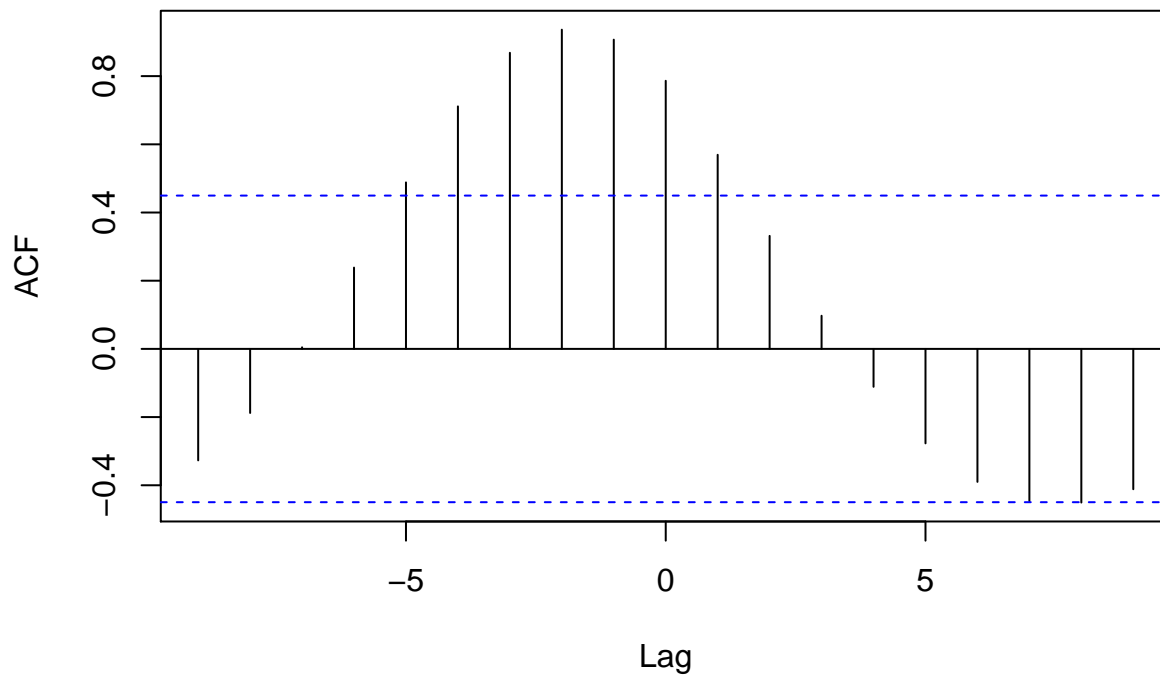
## 4 wk ahead – 01



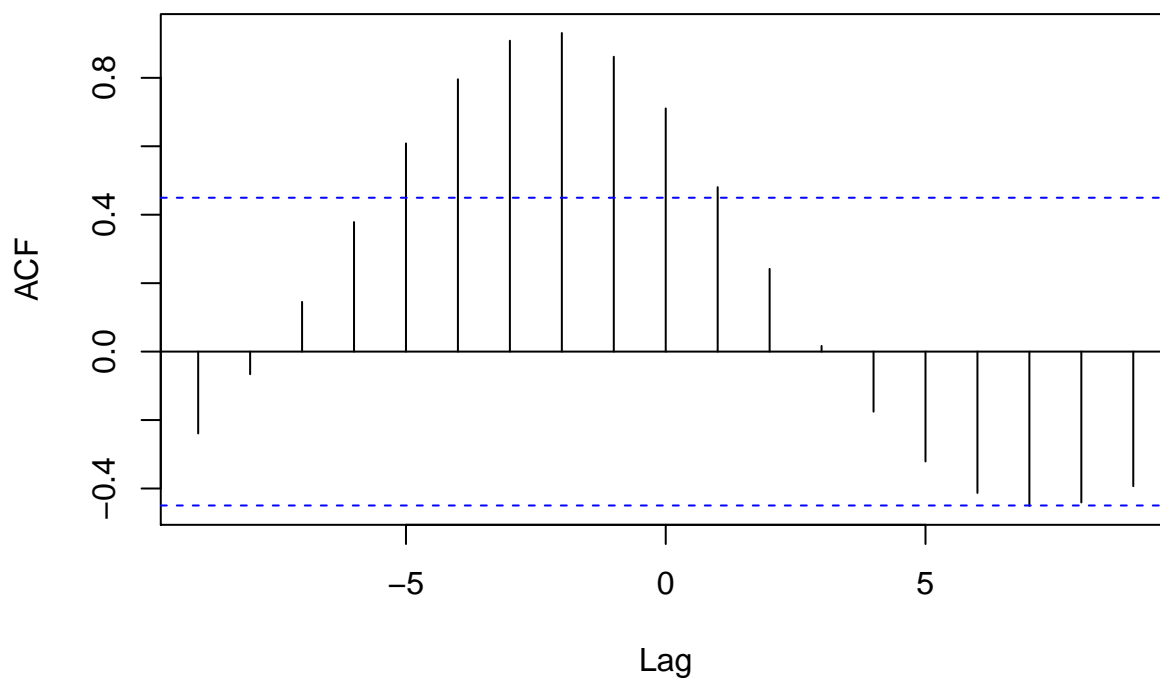
**1 wk ahead – 21**



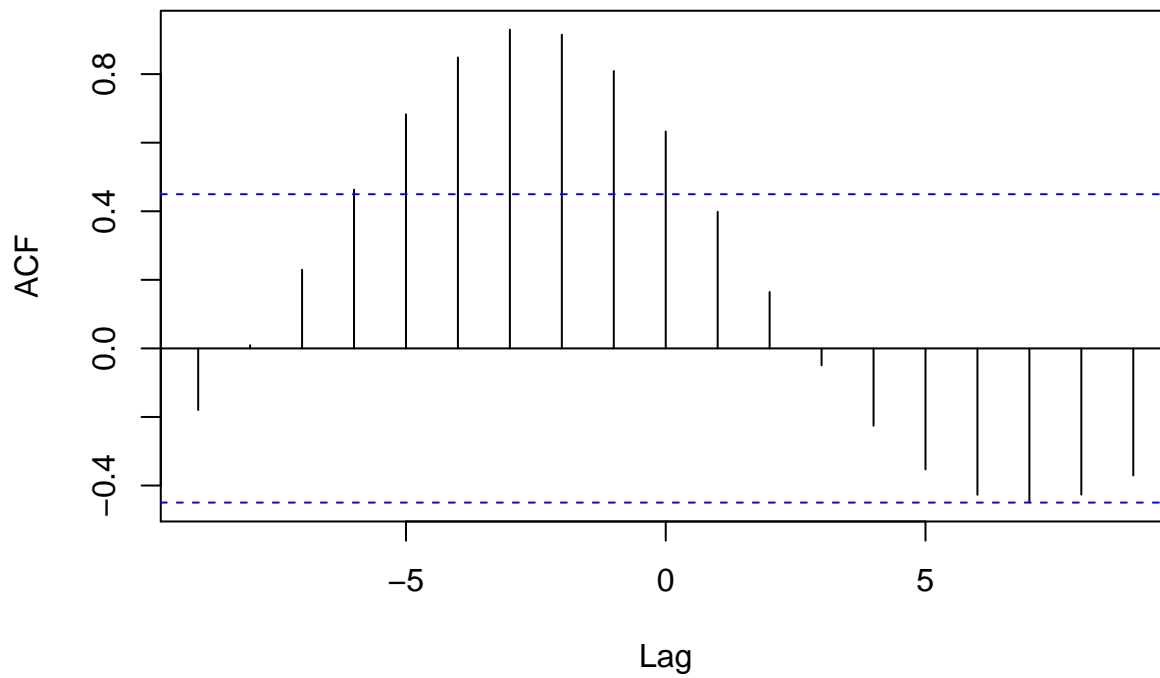
**2 wk ahead – 21**

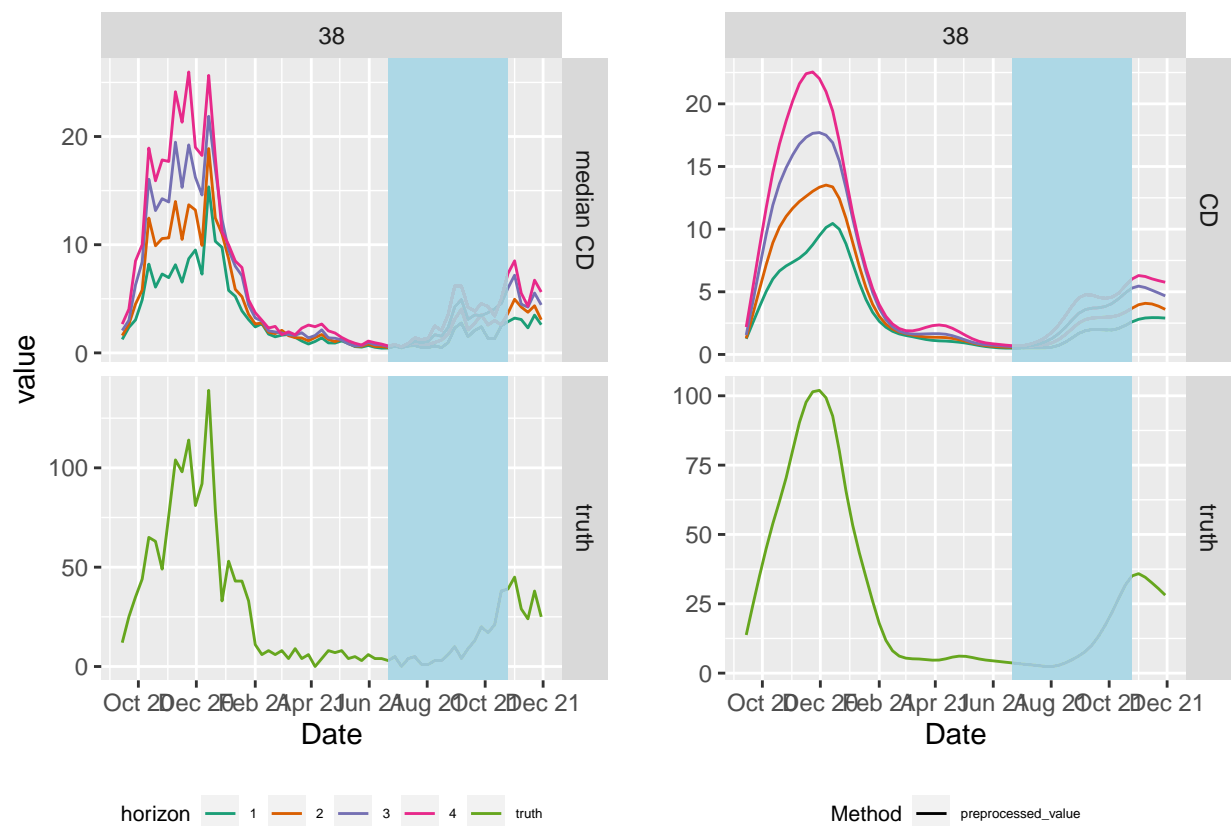


**3 wk ahead – 21**

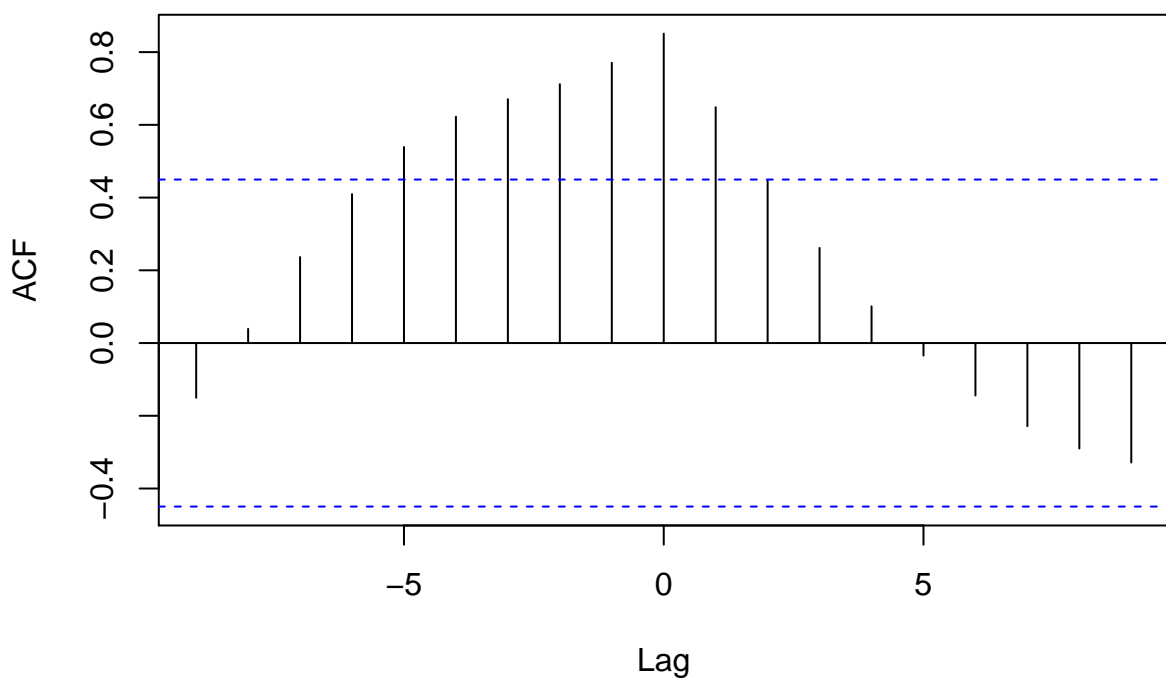


**4 wk ahead – 21**

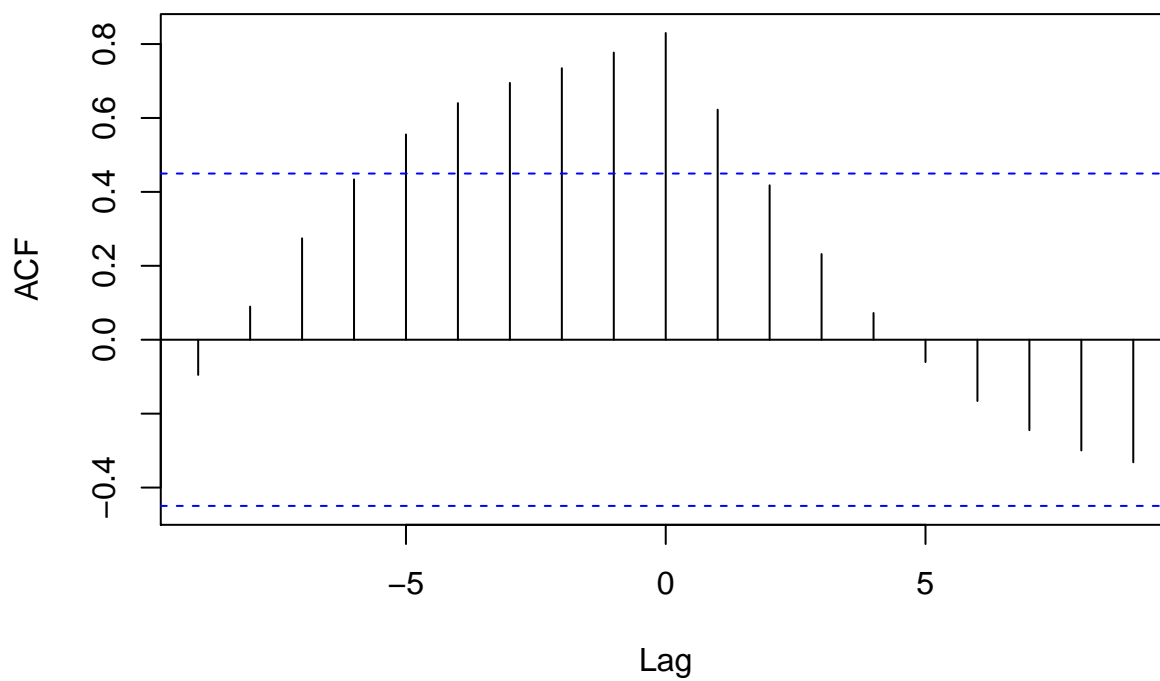




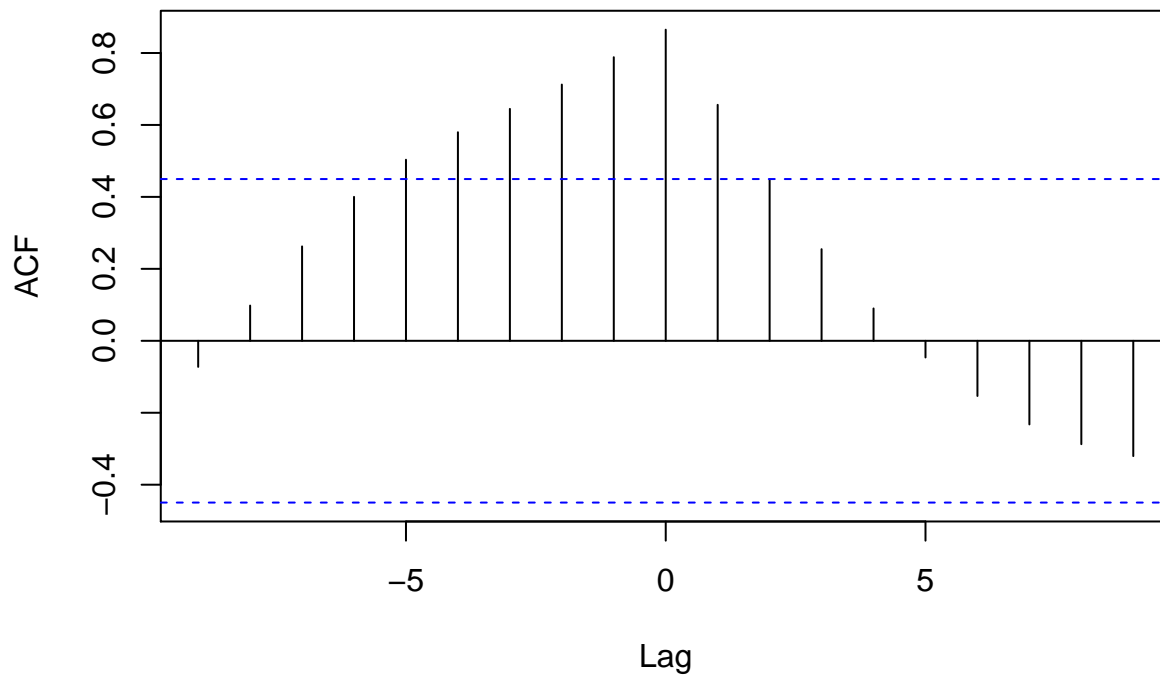
**1 wk ahead - 38**



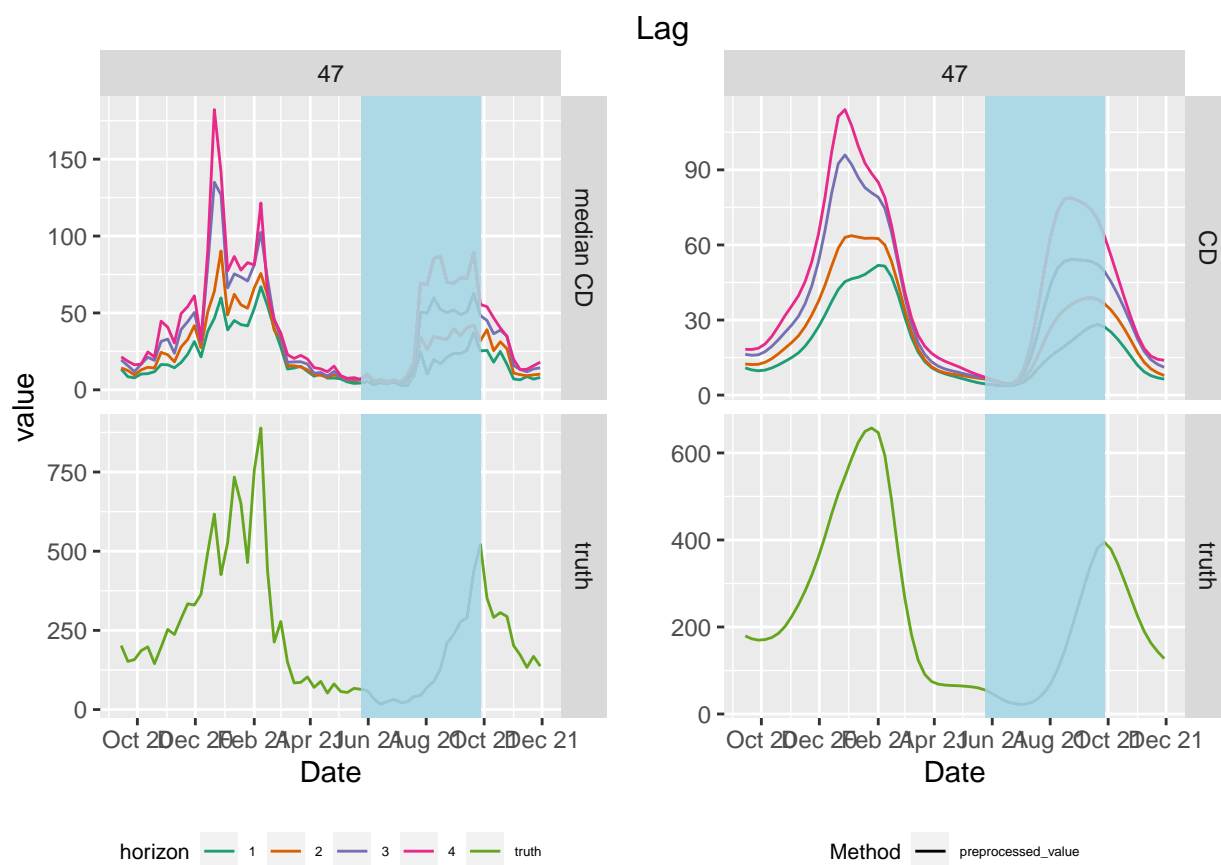
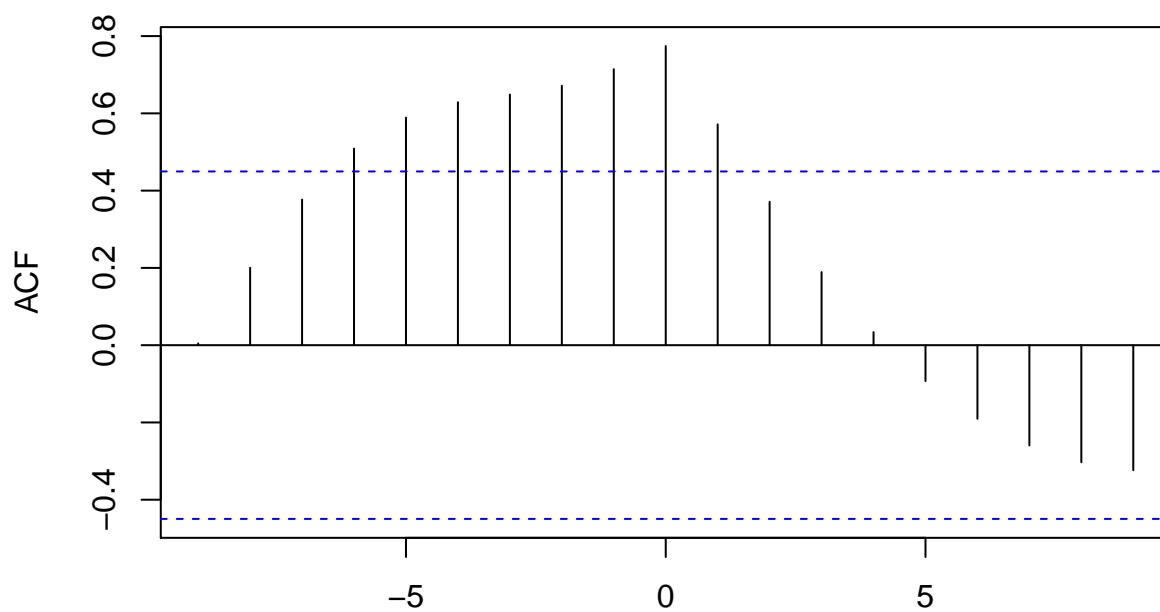
**2 wk ahead – 38**



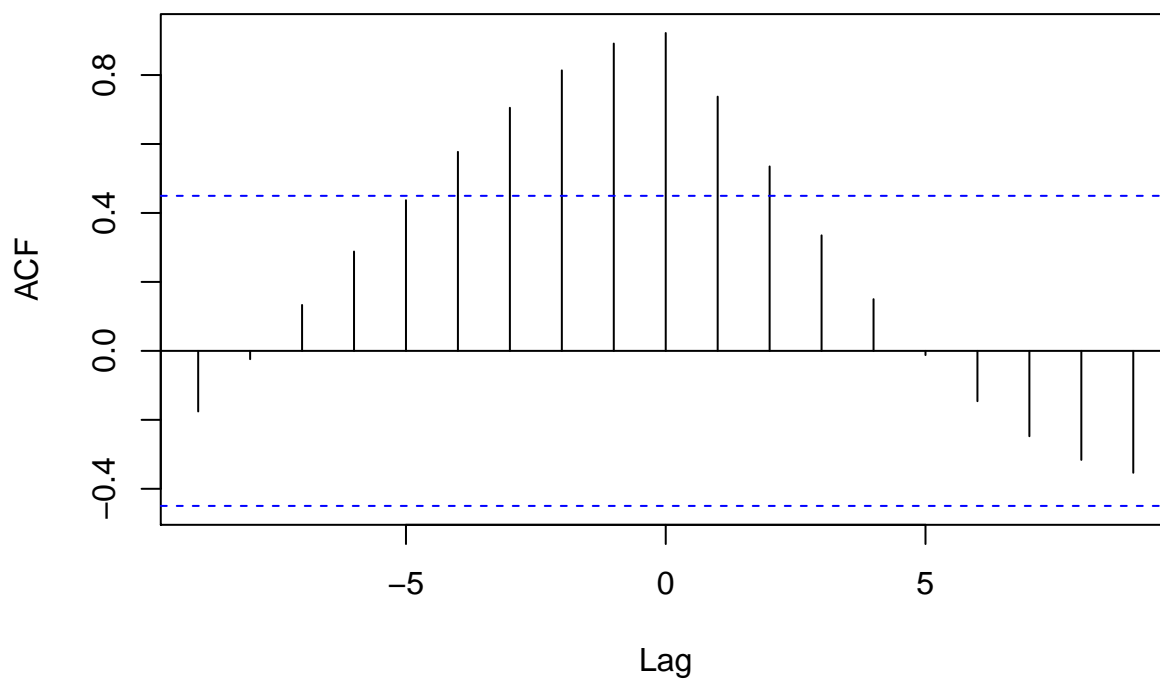
**3 wk ahead – 38**



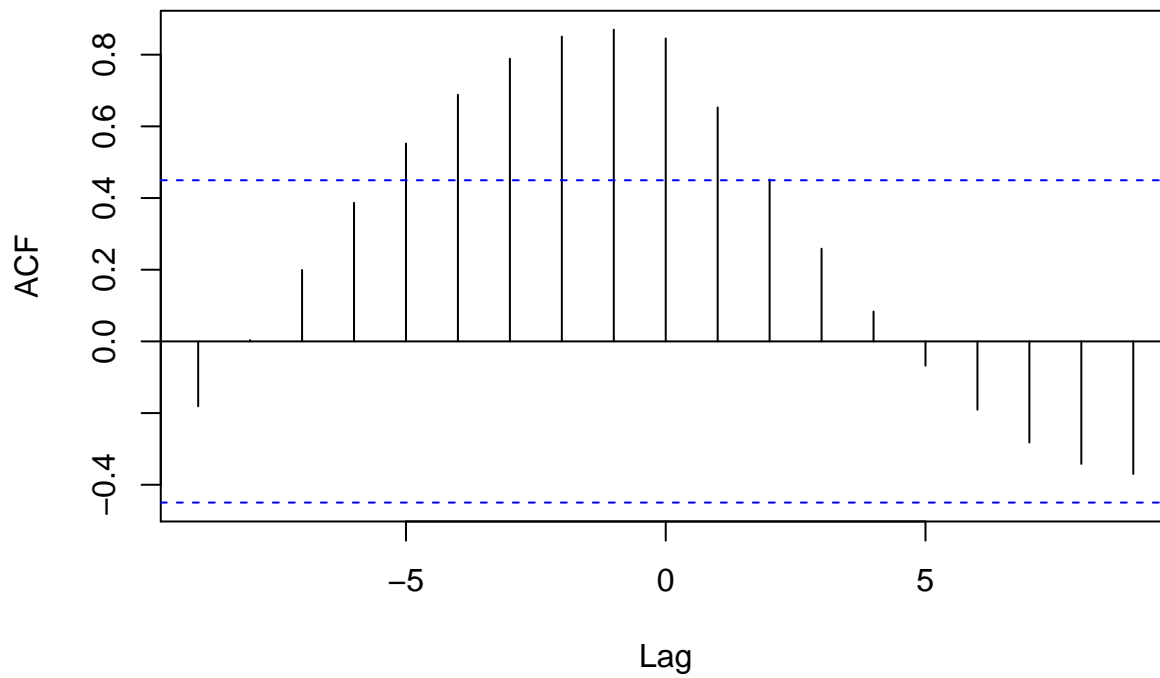
## 4 wk ahead – 38



**1 wk ahead – 47**

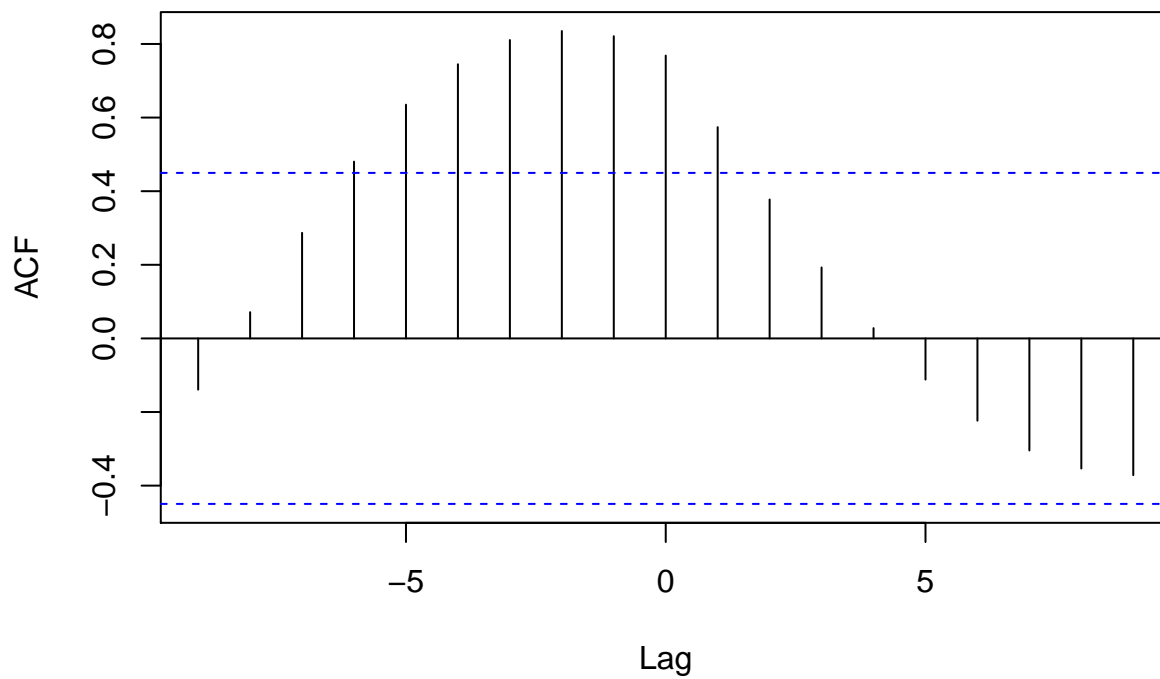


**2 wk ahead – 47**





**3 wk ahead – 47**



**4 wk ahead – 47**

