

Your Paper

You

April 28, 2016

Abstract

Your abstract.

1 Question 1: Presenting the data

The following plots show the time series of the prices at zip2000, zip2800, zip7400, zip8900 and the consumer price index(cpi), discount and 30 real estate bond rate(real30yr).

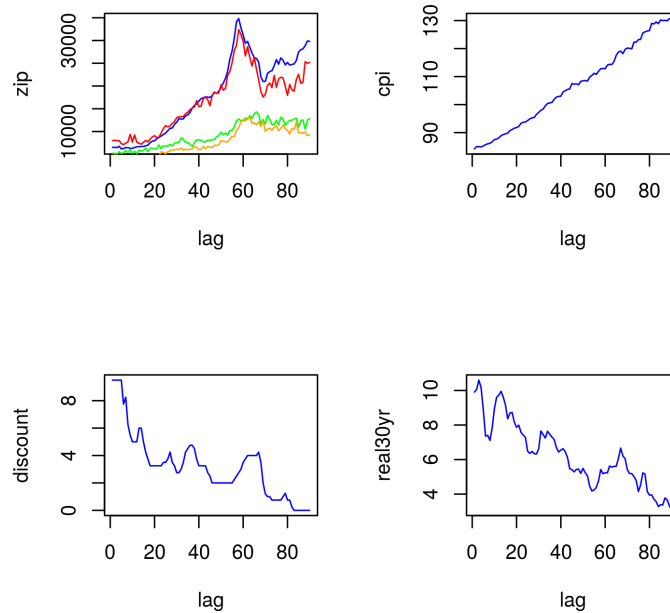


Figure 1: Prices, cpi, discount and real30yr without transformations.

As we can see the series are far from being stationary, so transformations are needed. We try with the first difference at each series.

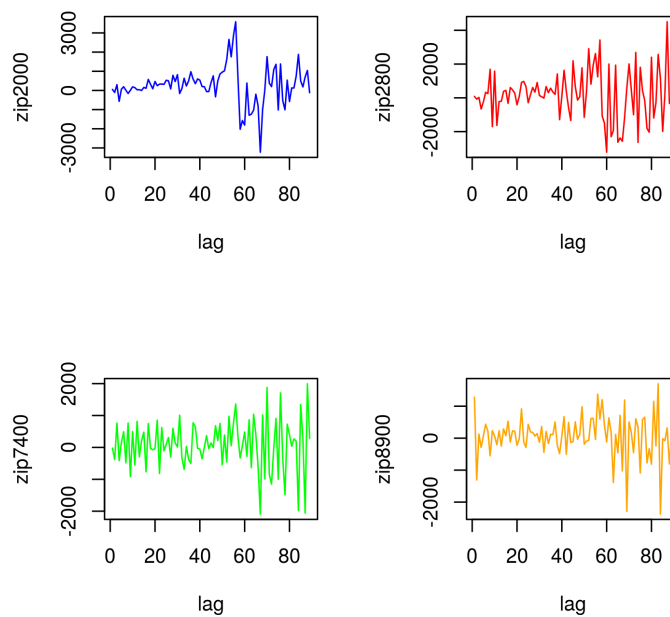


Figure 2: First difference of prices.

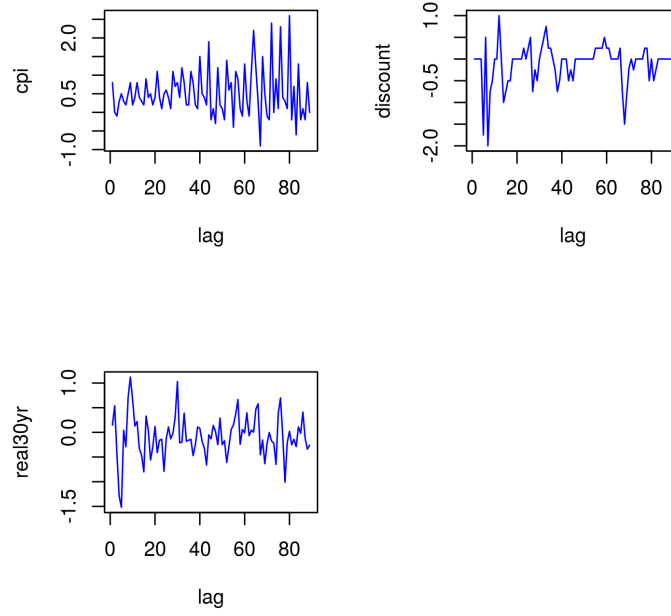


Figure 3: First difference of cpi, discount and real30yr.

Now the values oscillate around 0. However, we can see how in the variance increase over time in the prices series. That can be fixed with a logarithmic transformation.

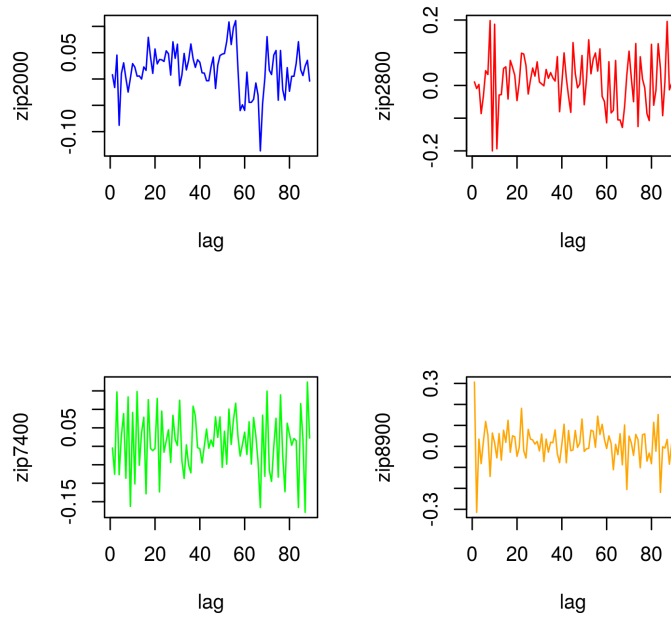


Figure 4: First difference and logarithmic transformation of prices.

We can see how in the Figure 4, the prices variance are more compact.

2 Question 2: ACF, PACF, CCF

In the following plots the ACF and PACF are presented for non-transformed and transformed Zips, cpi, discount and real30yr.

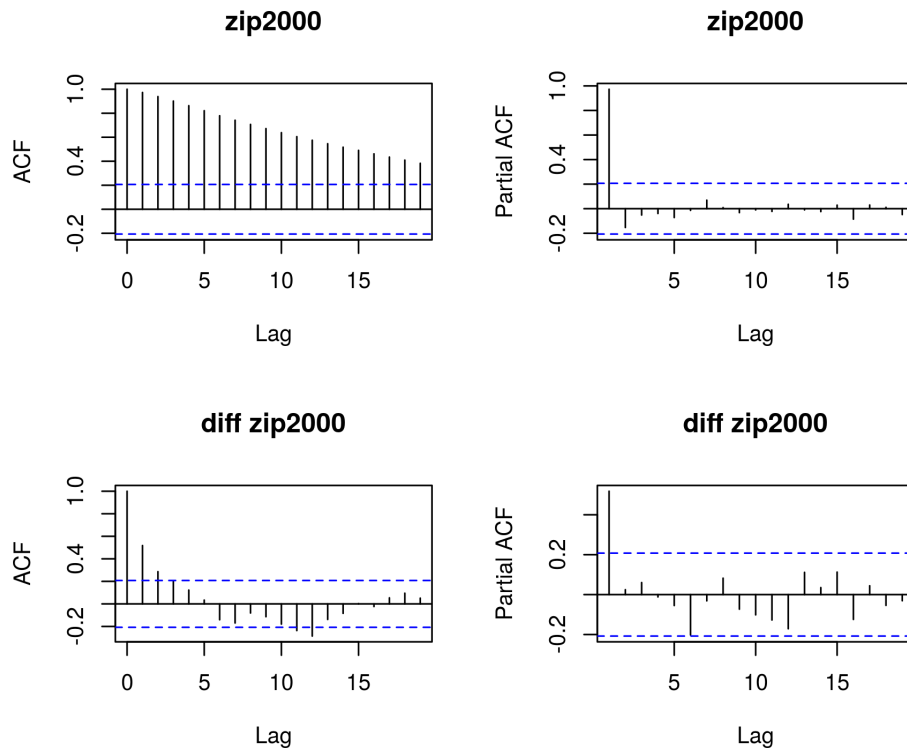


Figure 5: ACF and PACF zip 2000.

Zip2000 series ACF and PACF are slightly under-differentiated. The sharp cut at PACF, and the ACF suggest a 2 or 3 AR term.

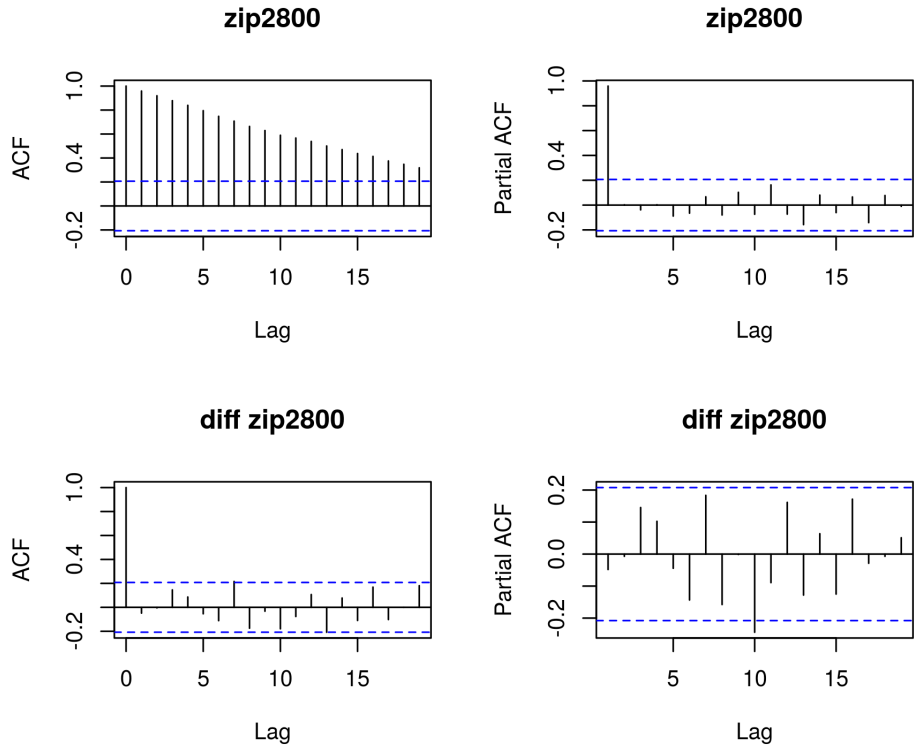


Figure 6: ACF and PACF zip 2800.

The zip2000 series ACF and PACF do not suggest any further update besides the differentiation.

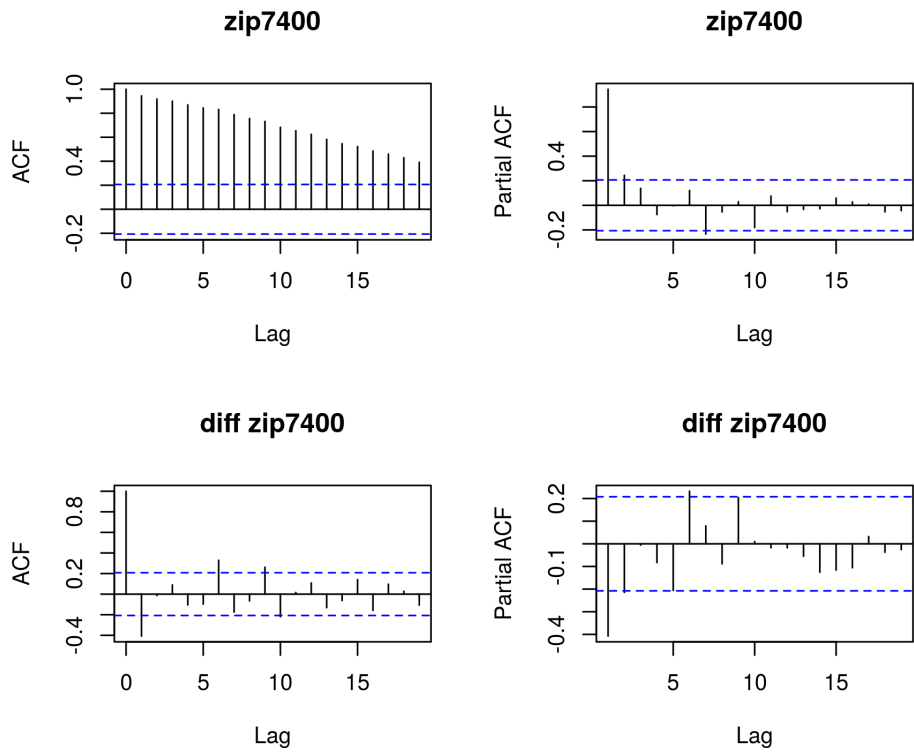


Figure 7: ACF and PACF zip 7400.

Zip7400 series is slightly over-differentiated. This suggest a MA(1) term.

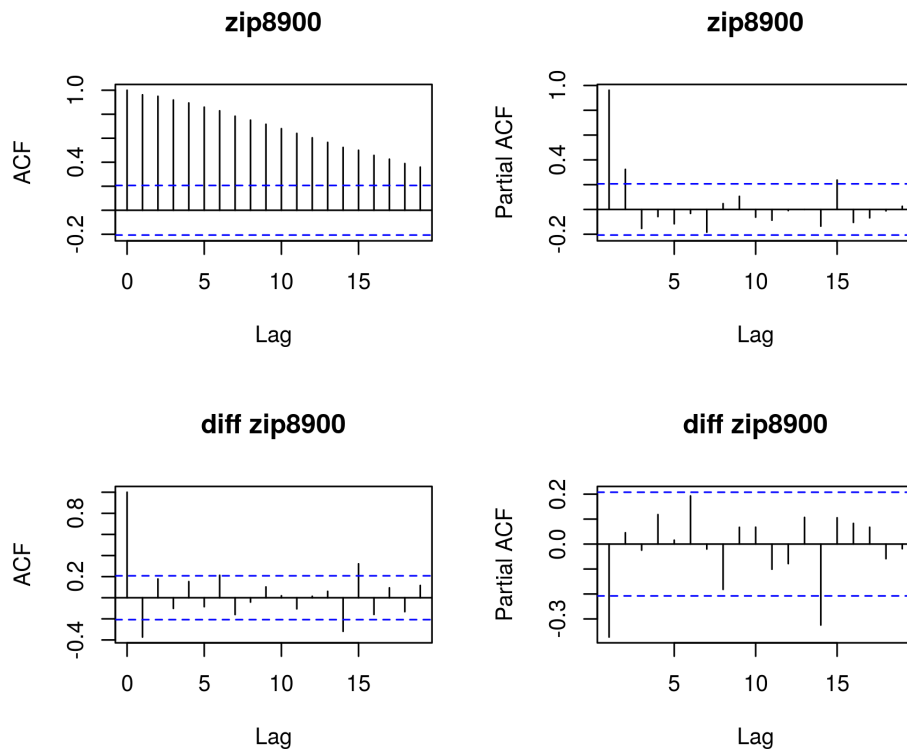


Figure 8: ACF and PACF zip 8900.

Zip8900 series is also slightly over-differentiated. This suggest, again, a MA(1) term.

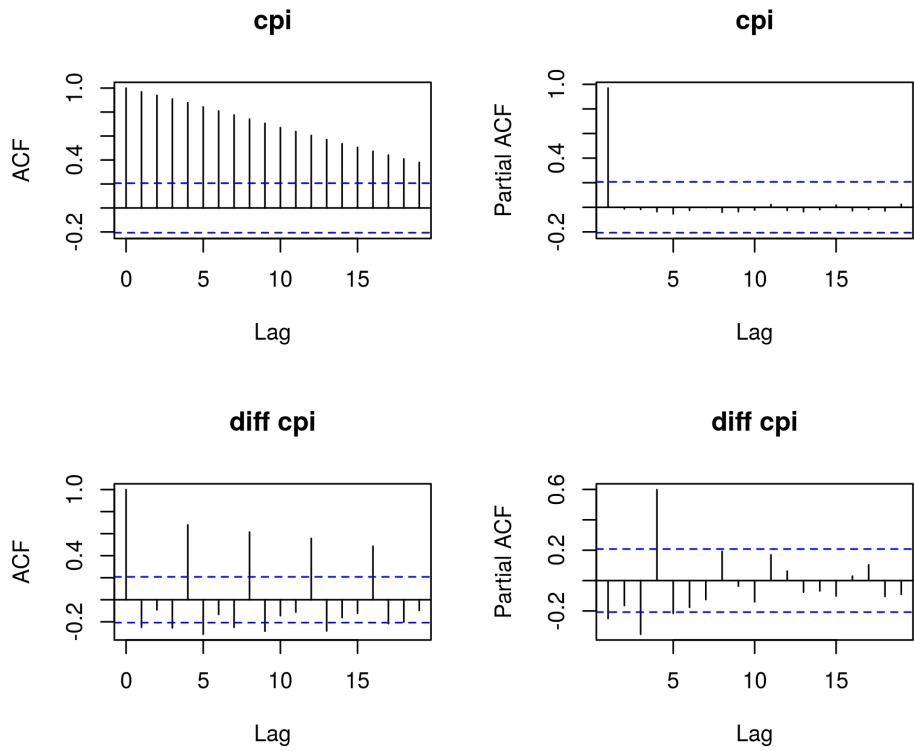


Figure 9: ACF and PACF cpi.

CPI series show a clear seasonal pattern with a period of 4.

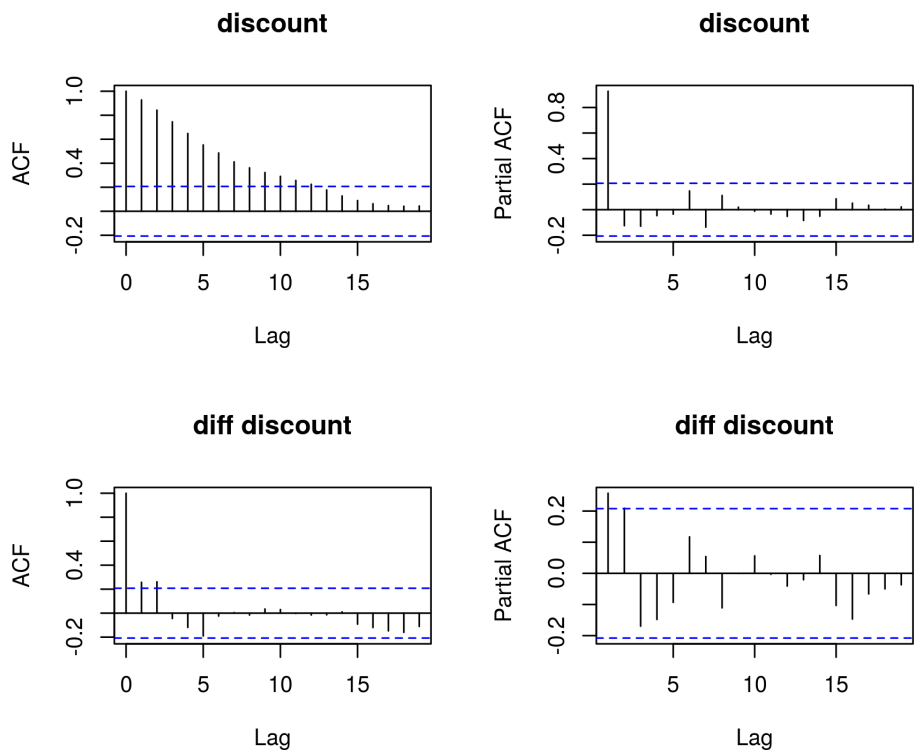


Figure 10: ACF and PACF discount.

Discount series suggests a AR(1) term.

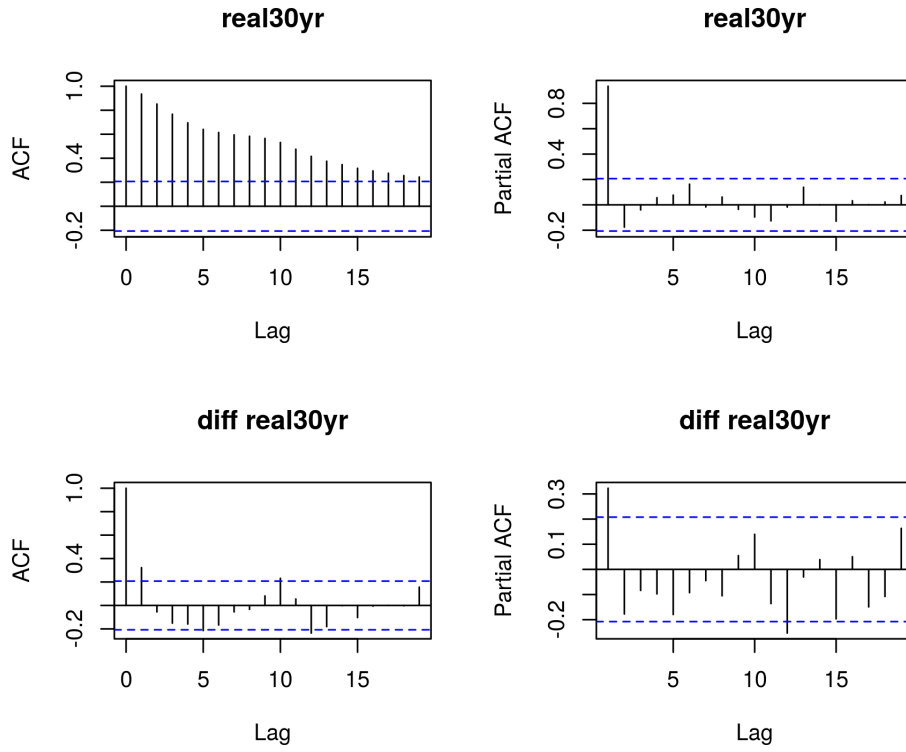


Figure 11: ACF and PACF zip real30yr.

real30yr series also suggests a AR(1) term.

Here some CCF plots are shown. We can not substract much information from them since the correlations are propagated along the lags. Pre-whitening is necessary, which will be made after constructing the ARIMA models. The rest of the CCF plots are at appendix A.

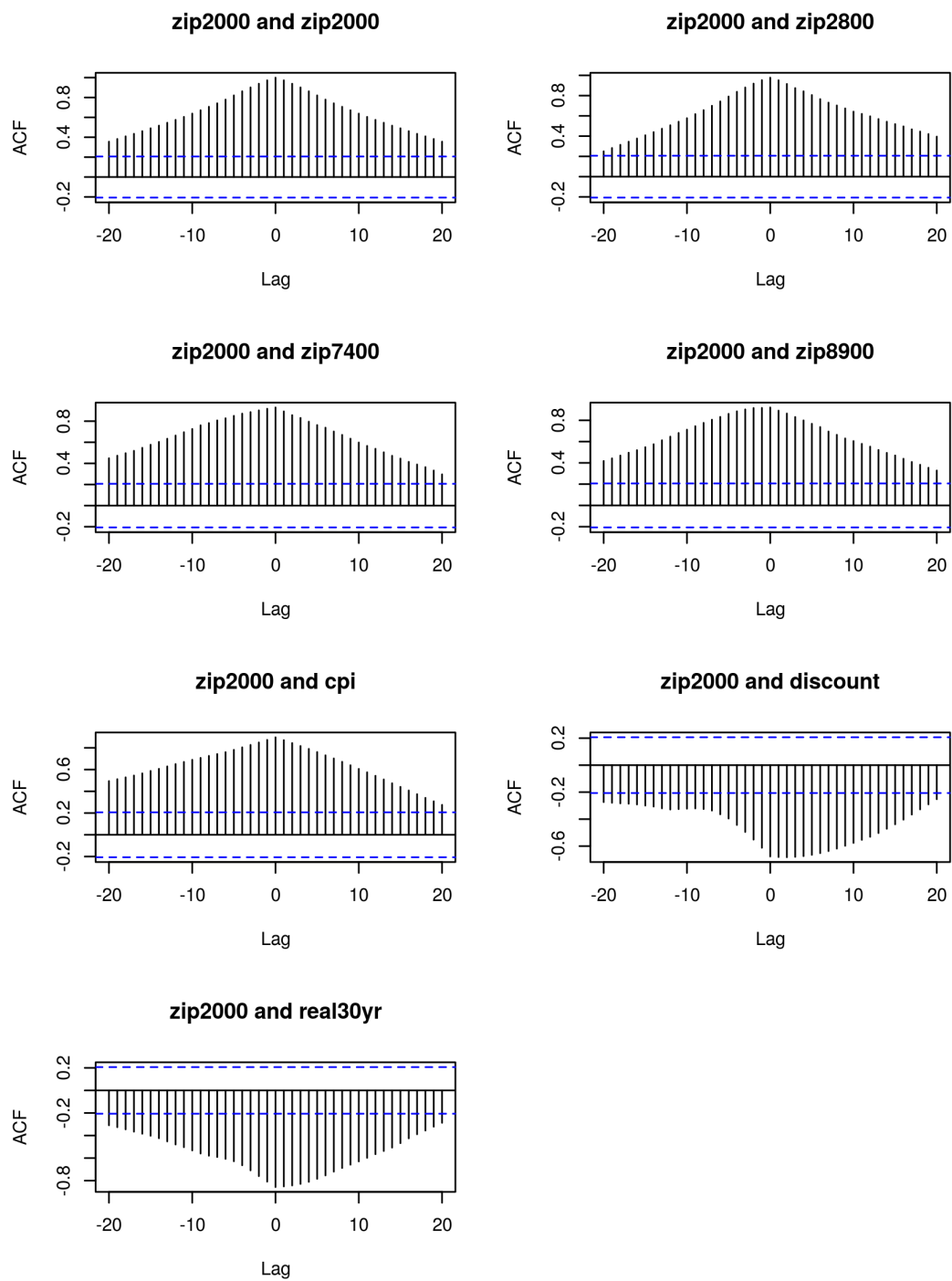


Figure 12: CCF

3 Question 3: Individual ARIMA models

The following ARIMA models have being fit for each of the series, following the criteria mentioned in the question 2.

- **Zip2000:** ARMA(1,1,0)
- **Zip2800:** ARMA(0,1,0)
- **Zip7400:** ARMA(0,1,1)
- **Zip8900:** ARMA(0,1,1)
- **cpi:** ARMA(0,1,0)x(0,1,1)
- **discount:** ARMA(1,1,0)
- **real30yr:** ARMA(1,1,0)

We aimed to make simple models, rather than more accurate but very complex models. As stated in the assignment, we will go through model building of some of the series. Here we show cpi ARIMA building. If we look at the first non-seasonal difference ACF and PACF plots in Figure 13, we can see how clearly a seasonal difference of period 4 is needed.

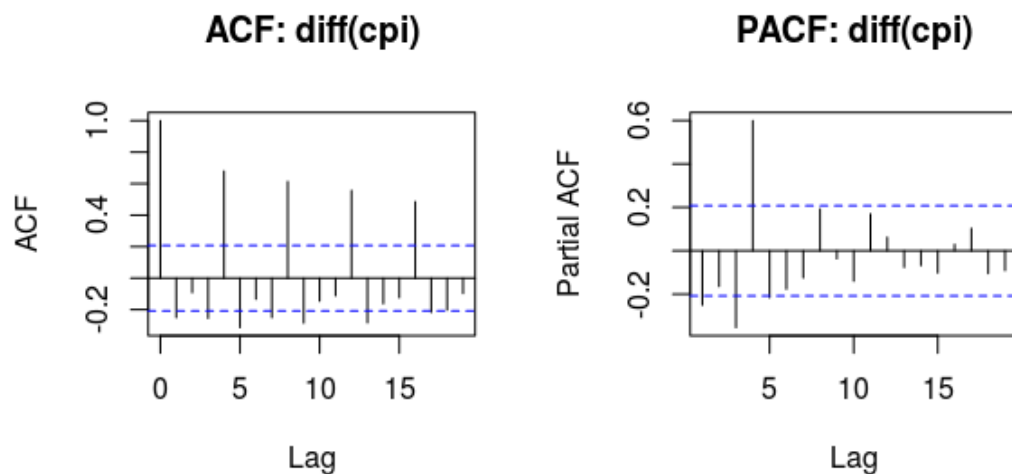


Figure 13: ACF and PACF from diff(cpi)

A ARIMA(0,1,0)x(0,1,0), i.e and ARIMA model twice difference, one seasonal and one non-seasonal. Now if we look at the remaining residuals in Figure 14, a seasonal AR term is suggested.

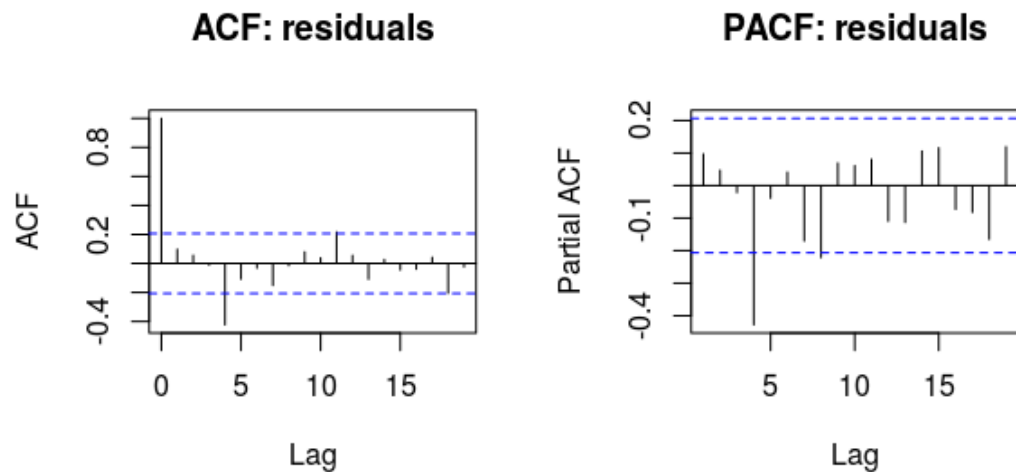


Figure 14: ACF and PACF from ARMA(0,1,0)x(0,1,0) residuals

If we look at the new residuals we have in Figure 15, we do not find any relevant auto-correlation left.

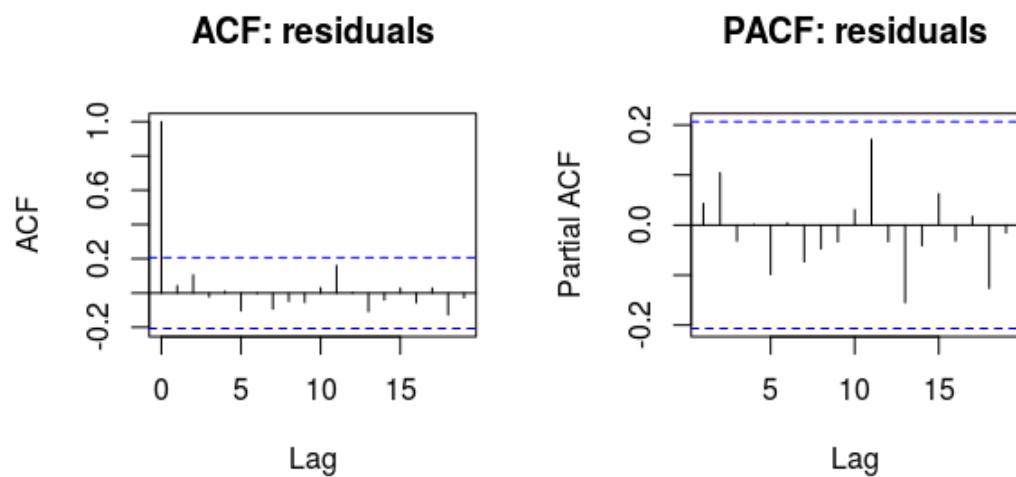


Figure 15: ACF and PACF from ARMA(0,1,0)x(0,1,1) residuals

The QQplot from Figure 16 look like a good approximation of white noise. Also the **sign test** give us 42 negative residuals against 47 positive, which is also a good result.

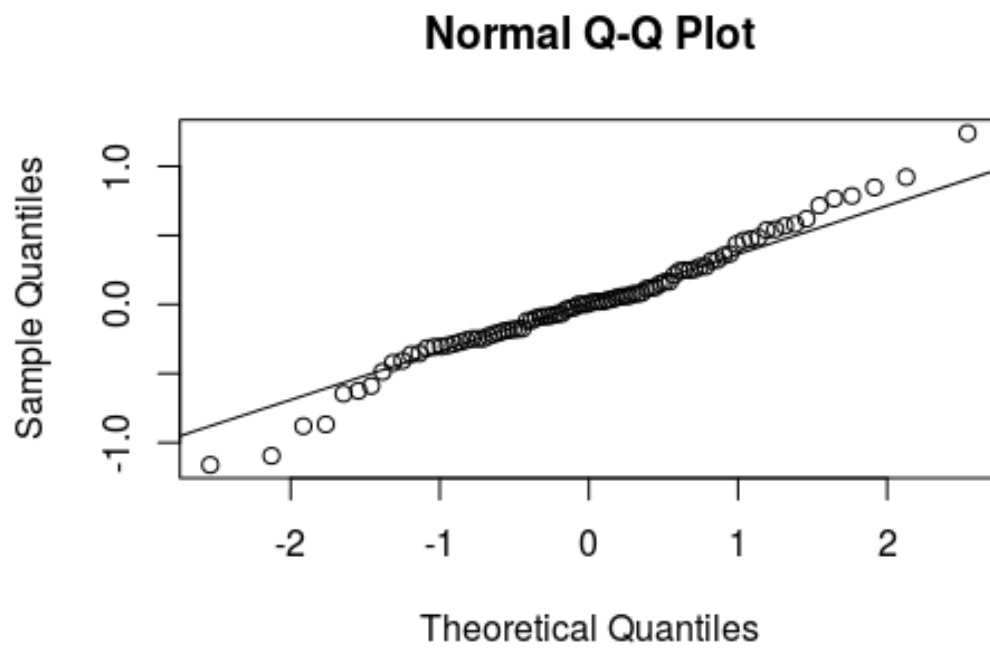


Figure 16: ACF and PACF from ARMA(0,1,0)x(0,1,1) residuals

4 Question 4: Multivariate model selection

5 Appendix A: CCF plots from question 3

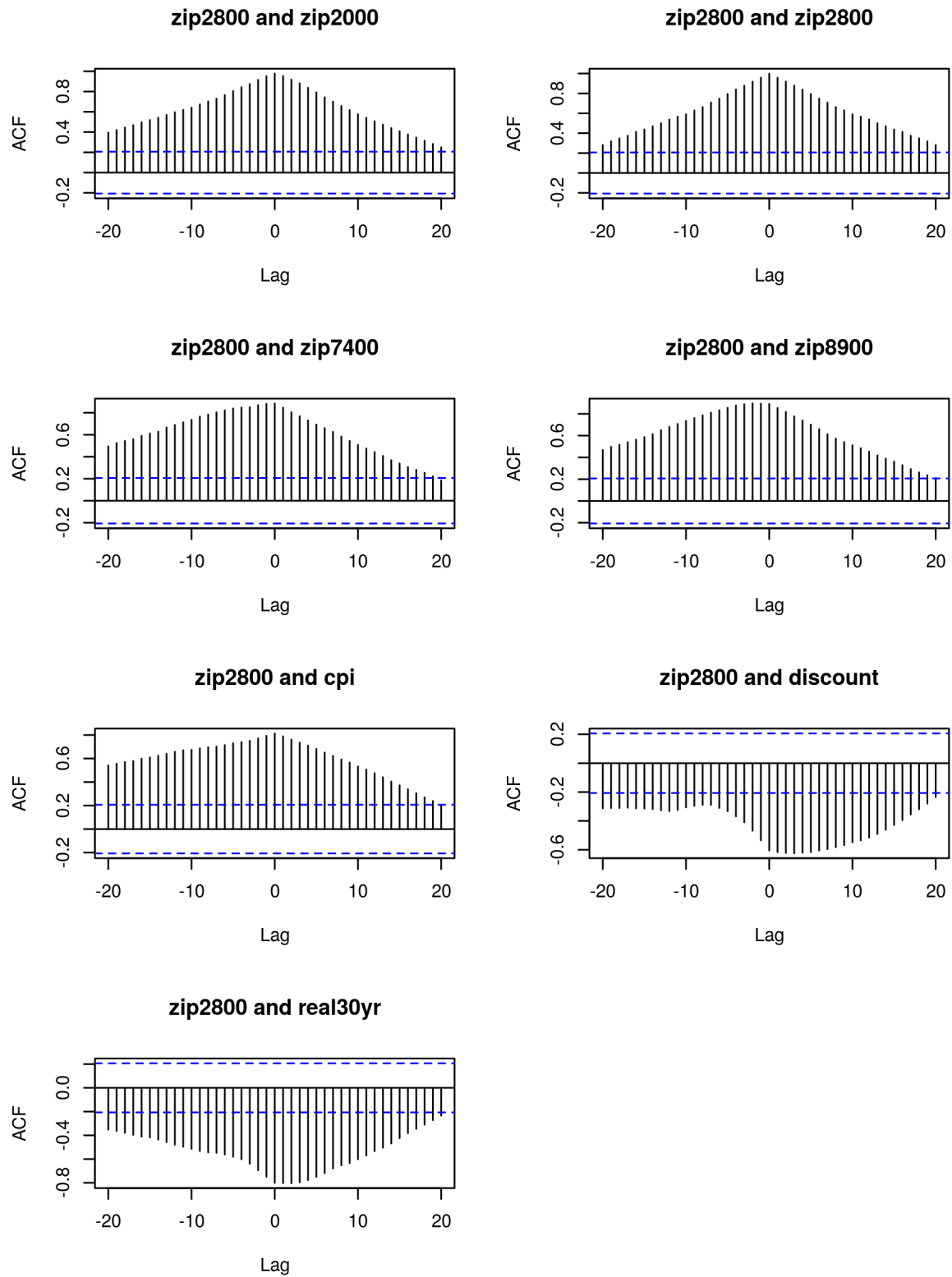


Figure 17: CCF

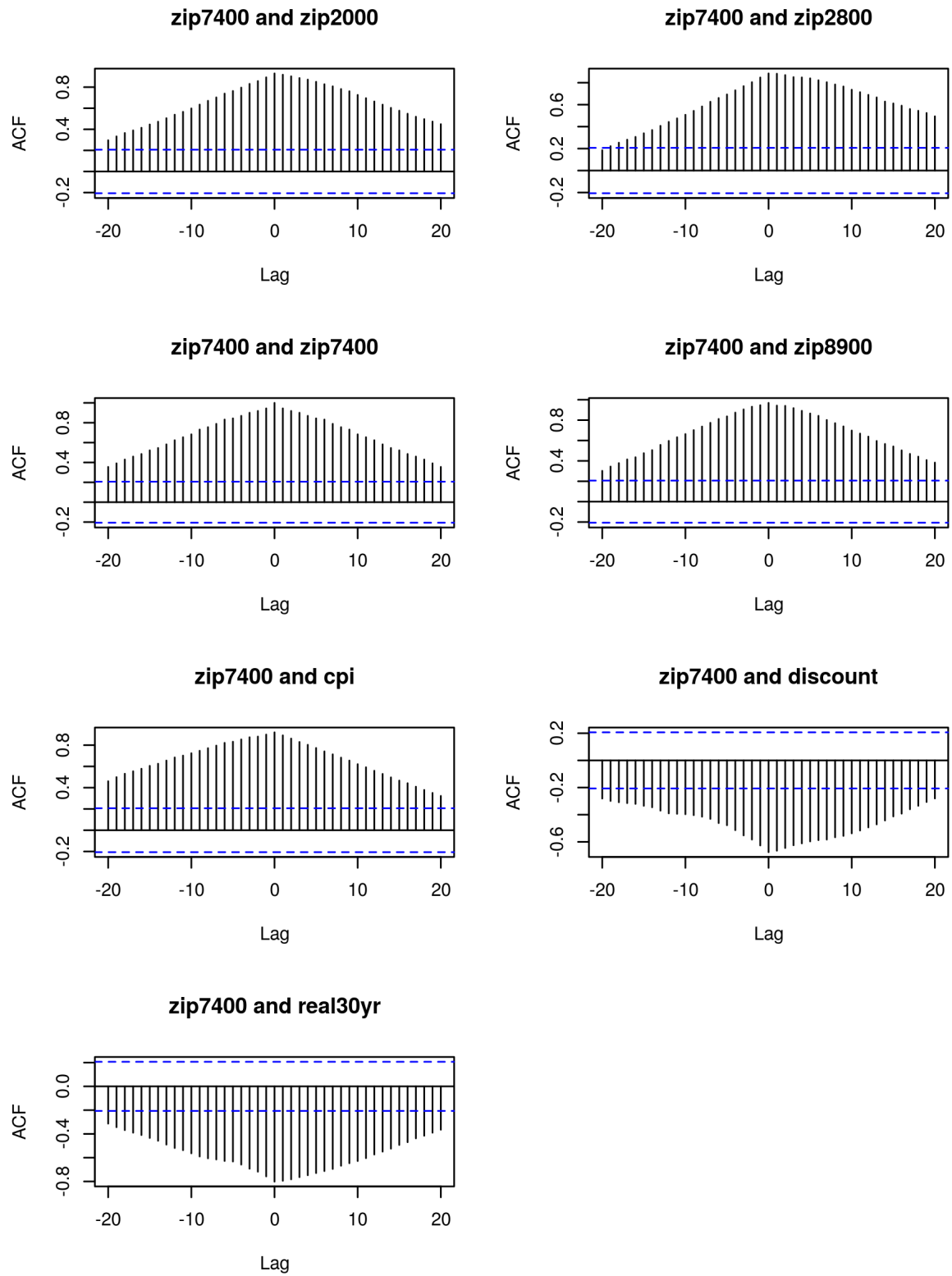


Figure 18: CCF

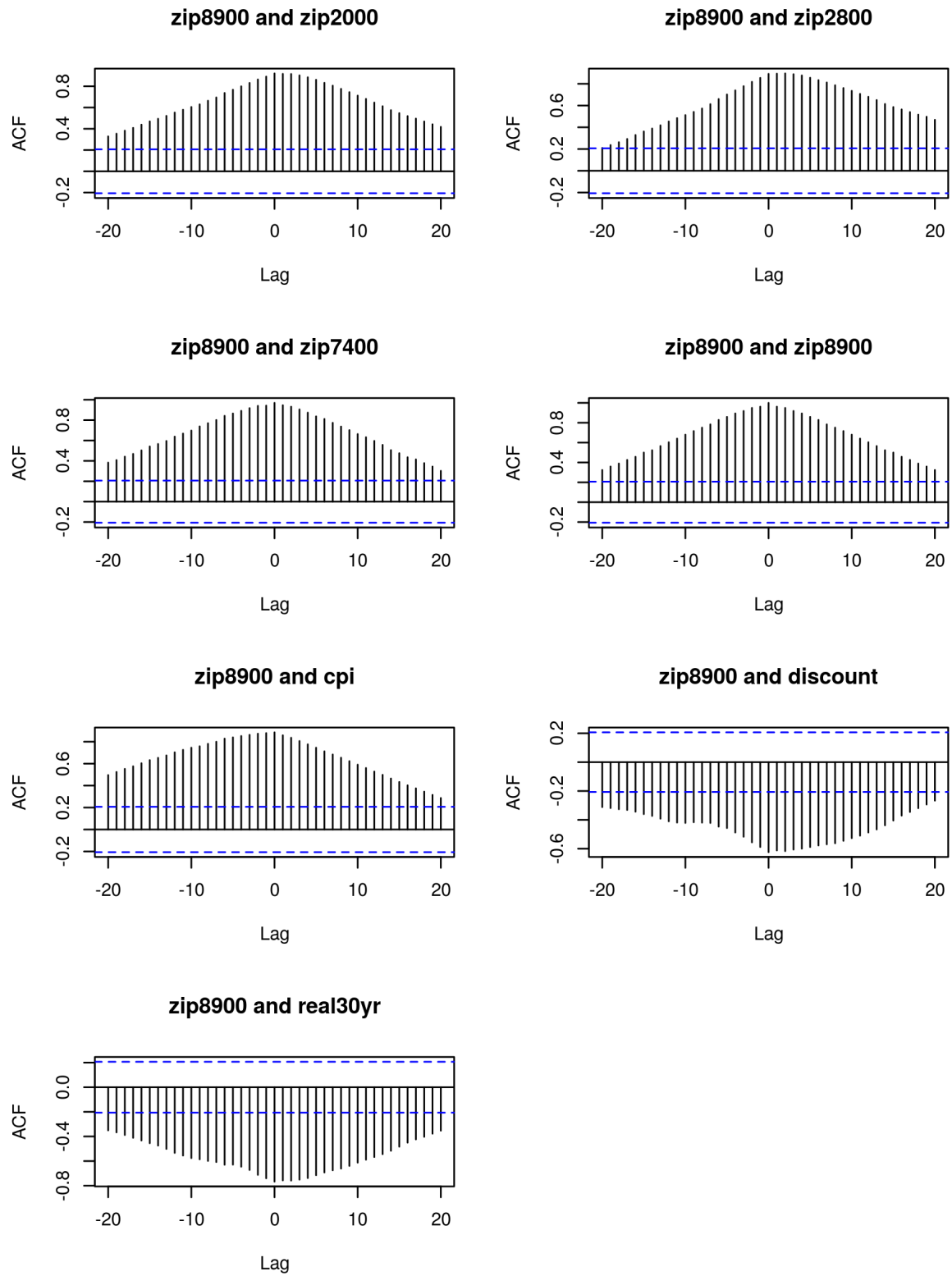


Figure 19: CCF

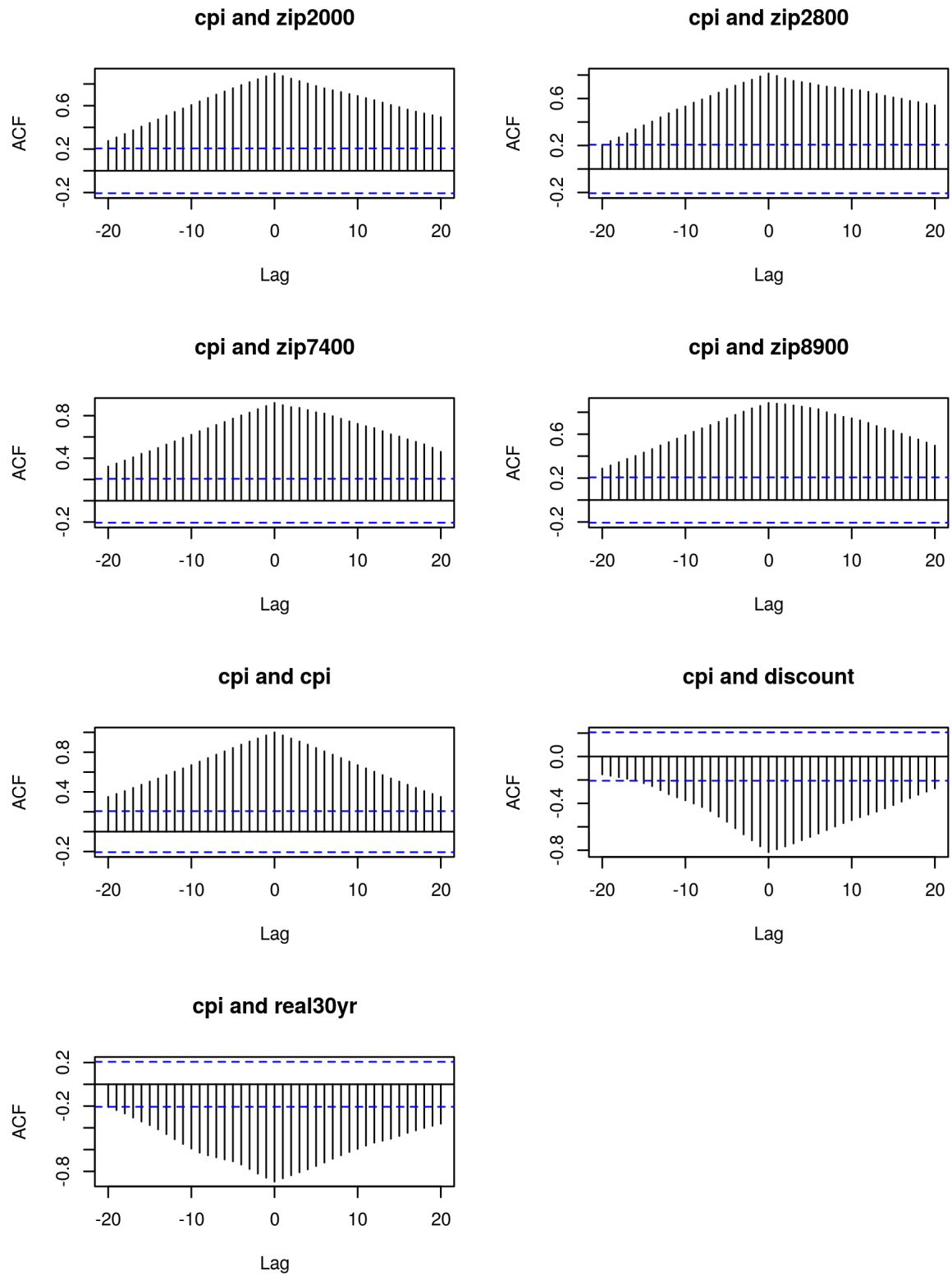


Figure 20: CCF

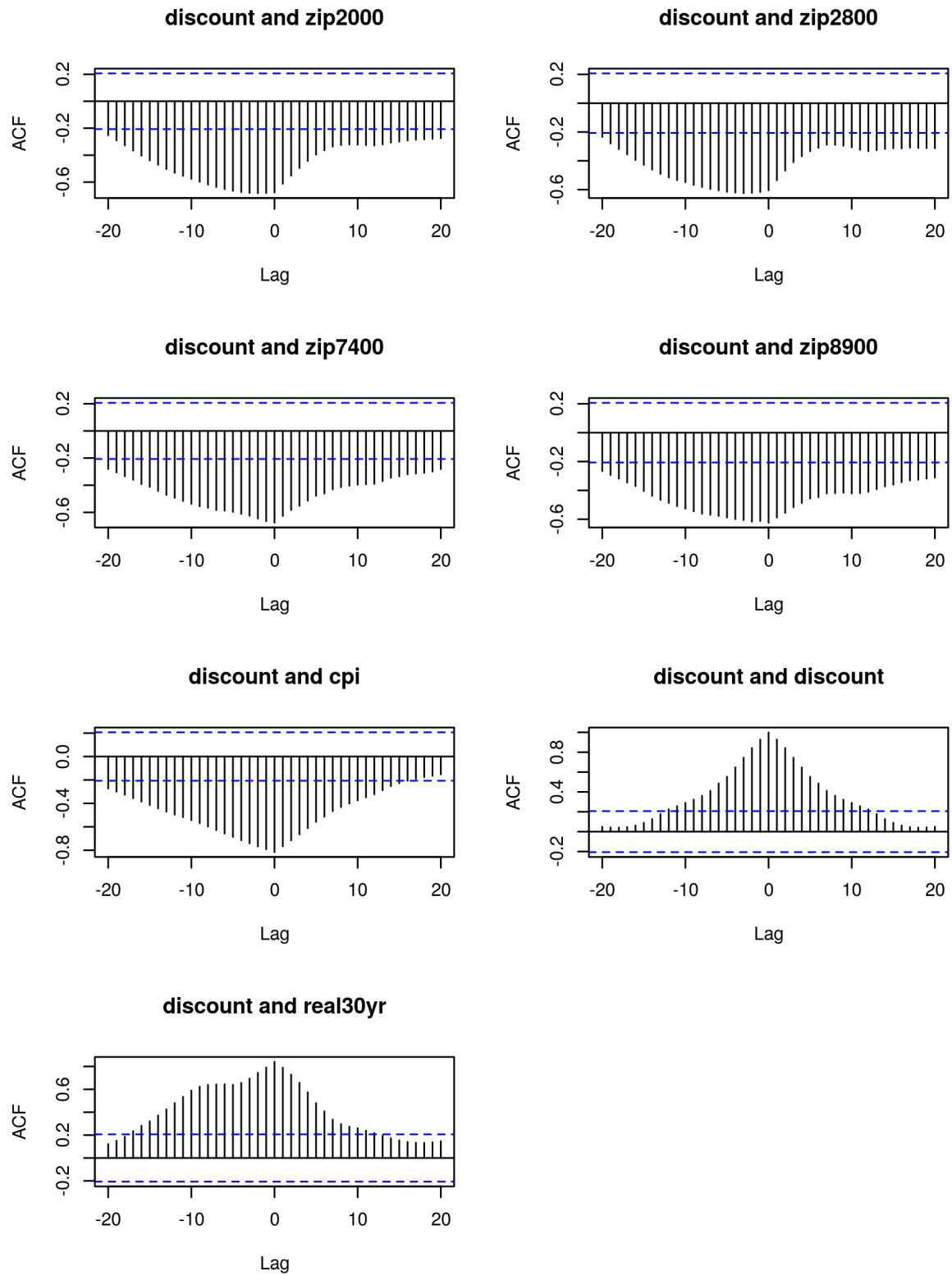


Figure 21: CCF

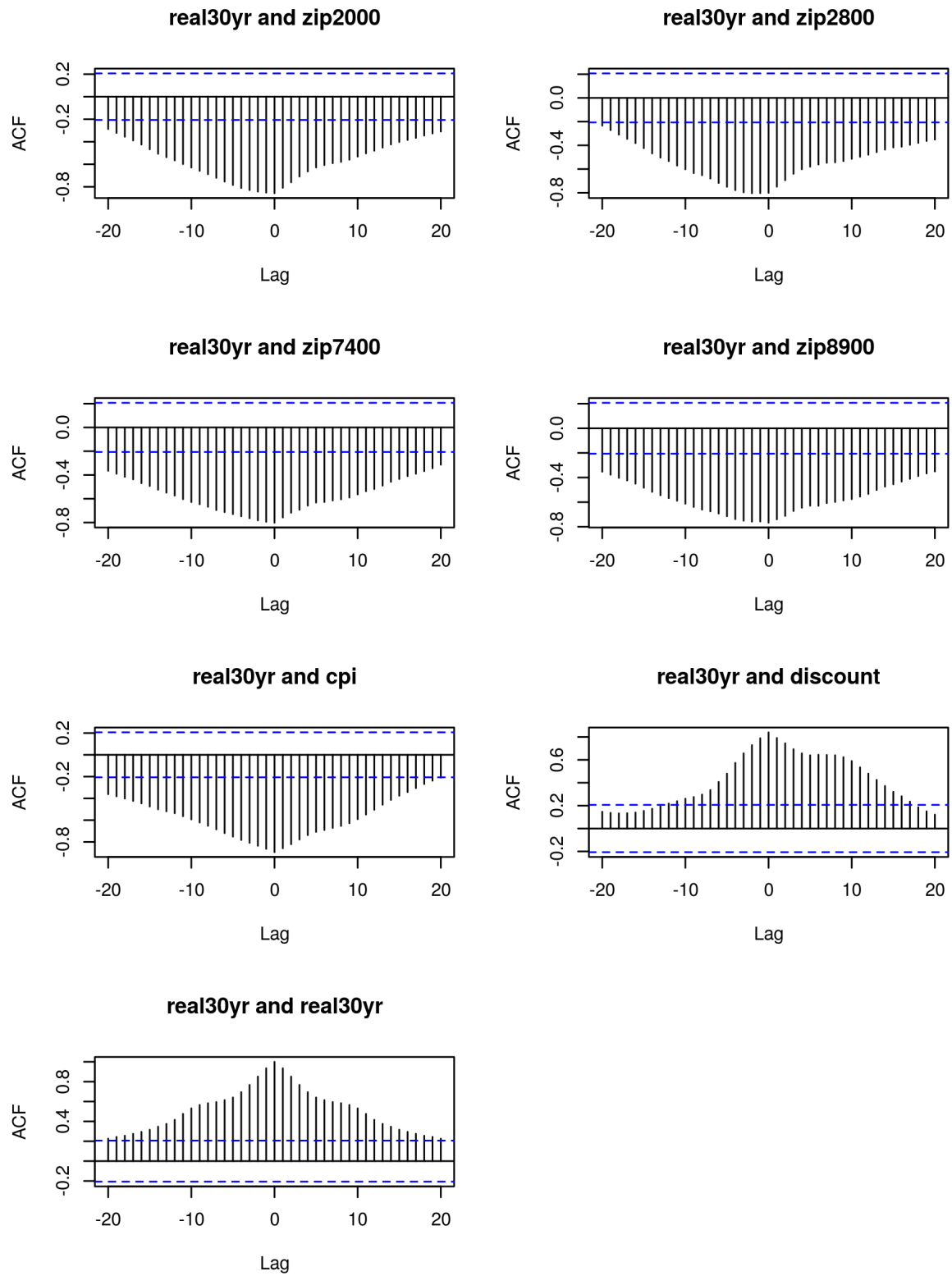


Figure 22: CCF