SHUOYANG SHI

FINAL PROJECT PRESENTATION
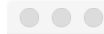
OUTLINE

- **One univariate data:** "manufacturers-index-of-new-order.xlsx"

  ARIMA model

- **One bivariate data:** "pub-prinv.xlsx"

  Transfer Function Model

UNIVARIATE, ARIMA MODEL

- Data:

  Manufacturers' Index of New Orders of Durable Goods for United States
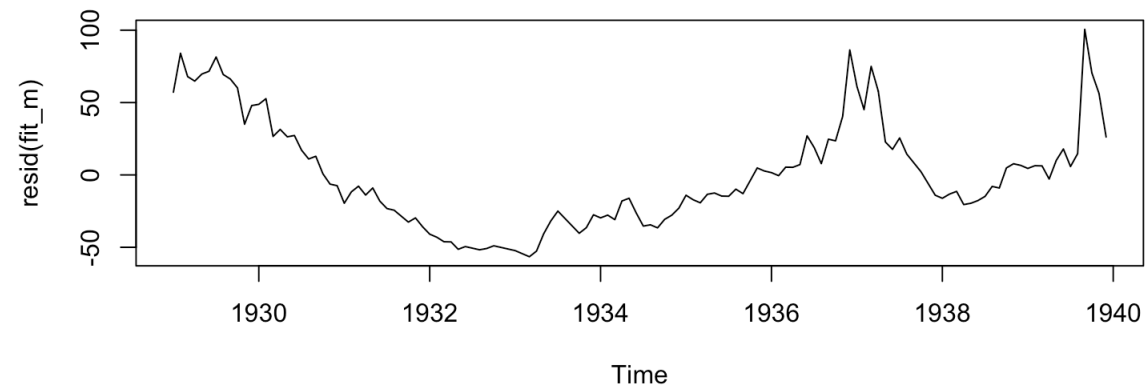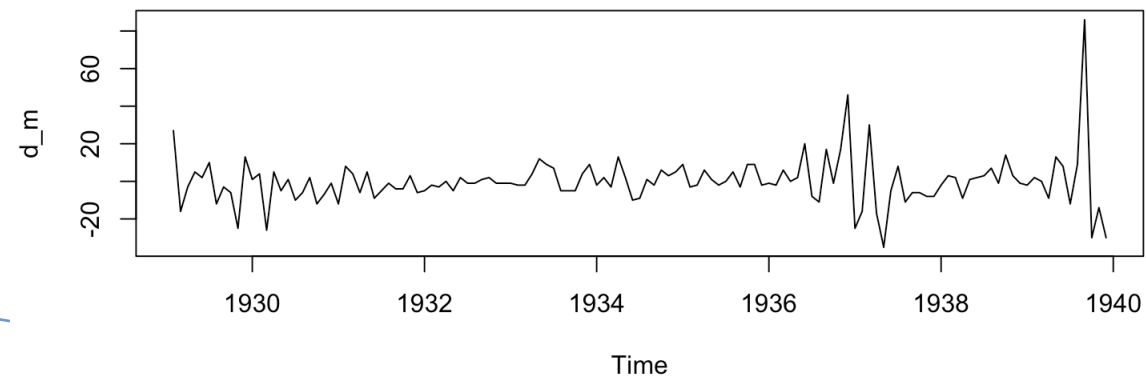
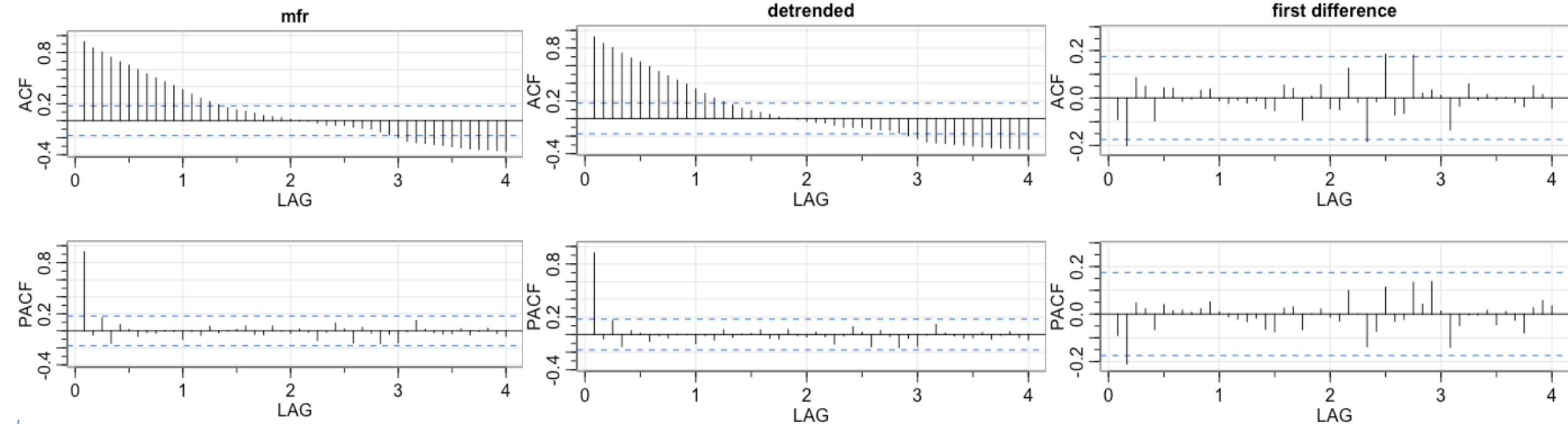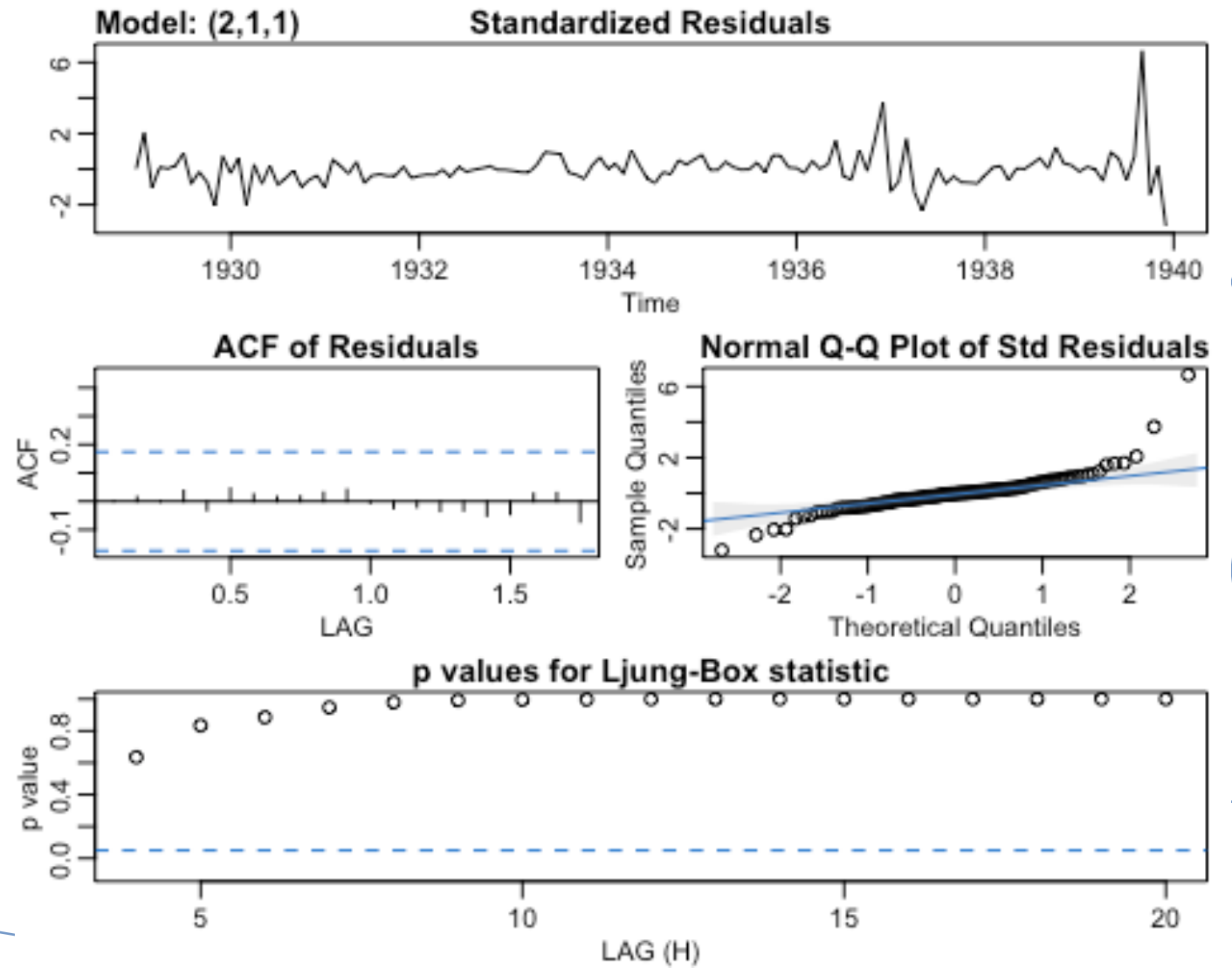- Time:

  1929/01 to 1939/12

UNIVARIATE, ARIMA MODEL

UNIVARIATE, ARIMA MODEL

UNIVARIATE, ARIMA MODEL

```
m_model1 <- sarima(mfr, p=2, d=1, q=2)

m_model2 <- sarima(mfr, p=1, d=1, q=2)

m_model3 <- sarima(mfr, p=2, d=1, q=1)

m_model4 <- sarima(mfr, p=1, d=1, q=1)
```

- Errors: random, no pattern

- QQ plot: normality

- ACF: no spike, errors are white

- P values: above the 5% level,

  no dependence

UNIVARIATE, ARIMA MODEL

```
Call:
stats::arima(x = xdata, order = c(p, d, q), seasonal = list(order = c(P, D,
    Q), period = S), xreg = constant, transform.pars = trans, fixed = fixed,
    optim.control = list(trace = trc, REPORT = 1, reltol = tol))

Coefficients:
         ar1      ar2      ma1  constant
     -0.2298  -0.2400   0.1186   -0.0878
s.e.  0.3279   0.0904   0.3404    0.8452

sigma^2 estimated as 160.4:   log likelihood = -518.52,   aic = 1047.04

$degrees_of_freedom
[1] 127

$ttable
          Estimate      SE t.value p.value
ar1        -0.2298  0.3279 -0.7007  0.4847
ar2        -0.2400  0.0904 -2.6557  0.0089
ma1         0.1186  0.3404  0.3485  0.7280
constant   -0.0878  0.8452 -0.1039  0.9174

$AIC
[1] 7.992636
```
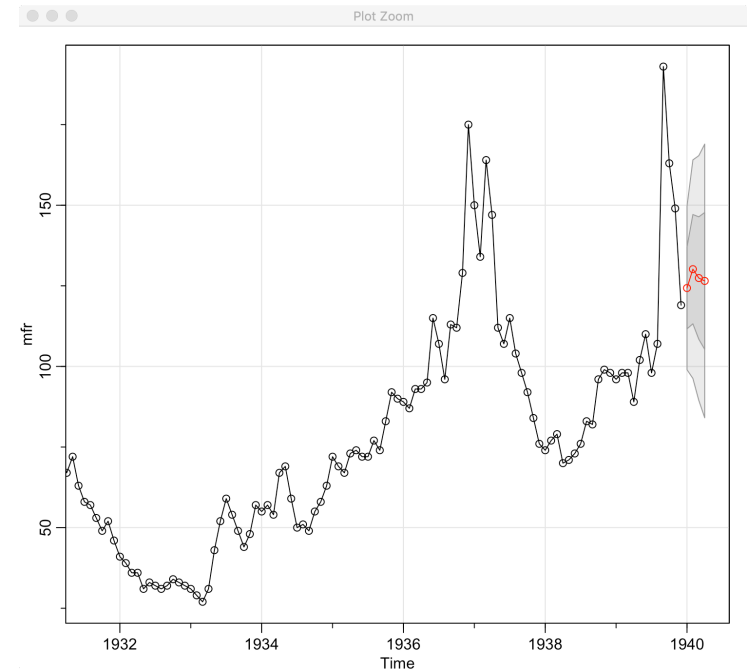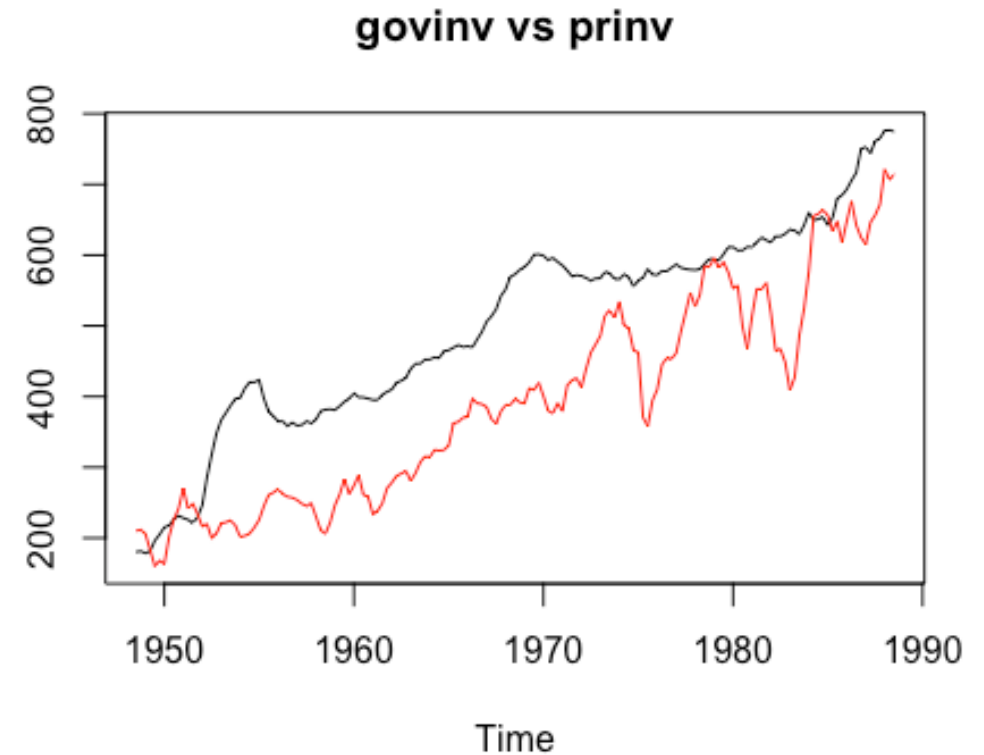
- Model:

$$(1 + 0.2298B + 0.24B2)(1 - B)x_t =$$

$$-0.0878 + (1 + 0.1186B)\, w_t \text{, with } \hat{\sigma}_w = 12.66$$
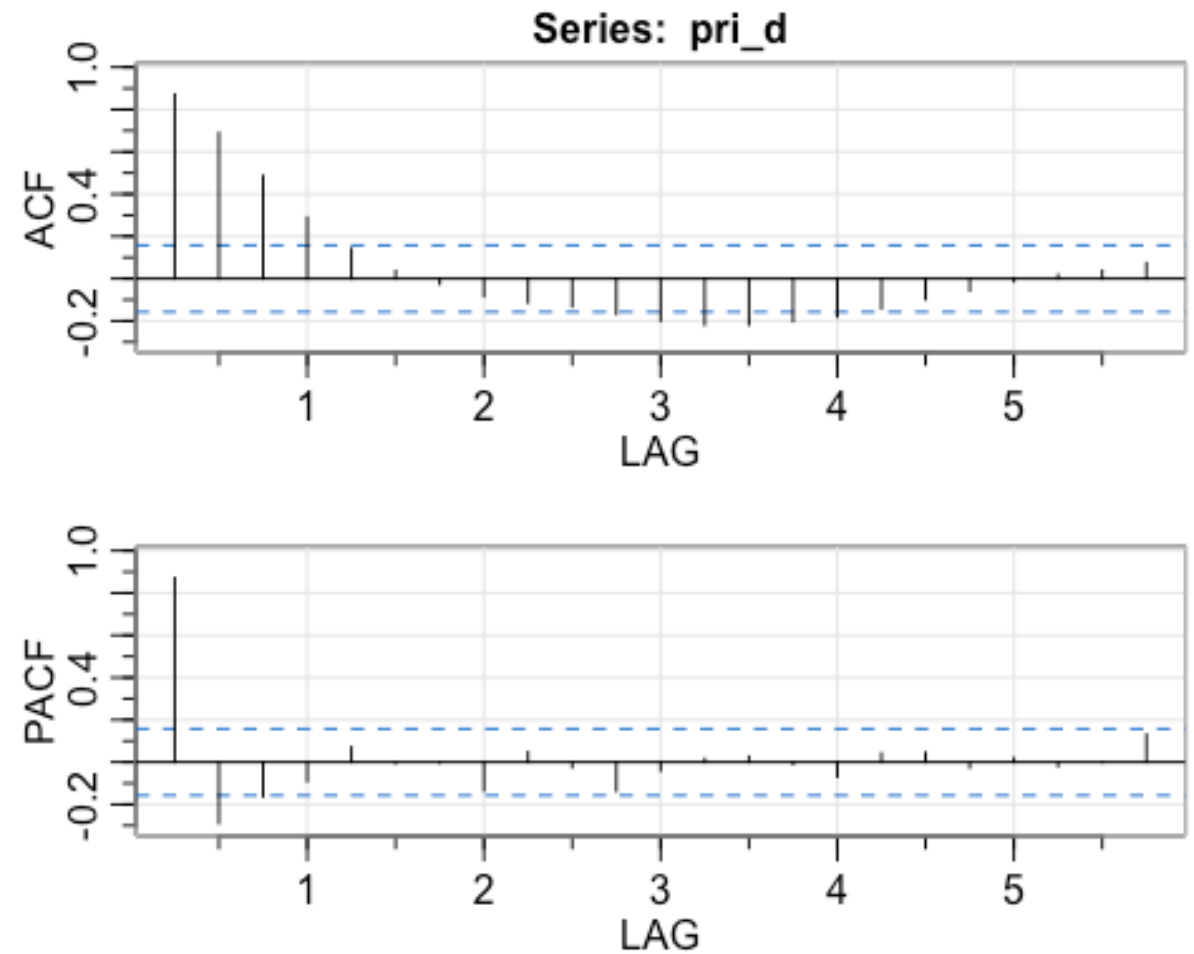
BIVARIATE, TFM

- Data: US economic seasonally adjusted quarterly data

- Time: 1948(Q3) until 1988(Q1)

- Input: prinv (private investment)

- Output: govinv (government investment)

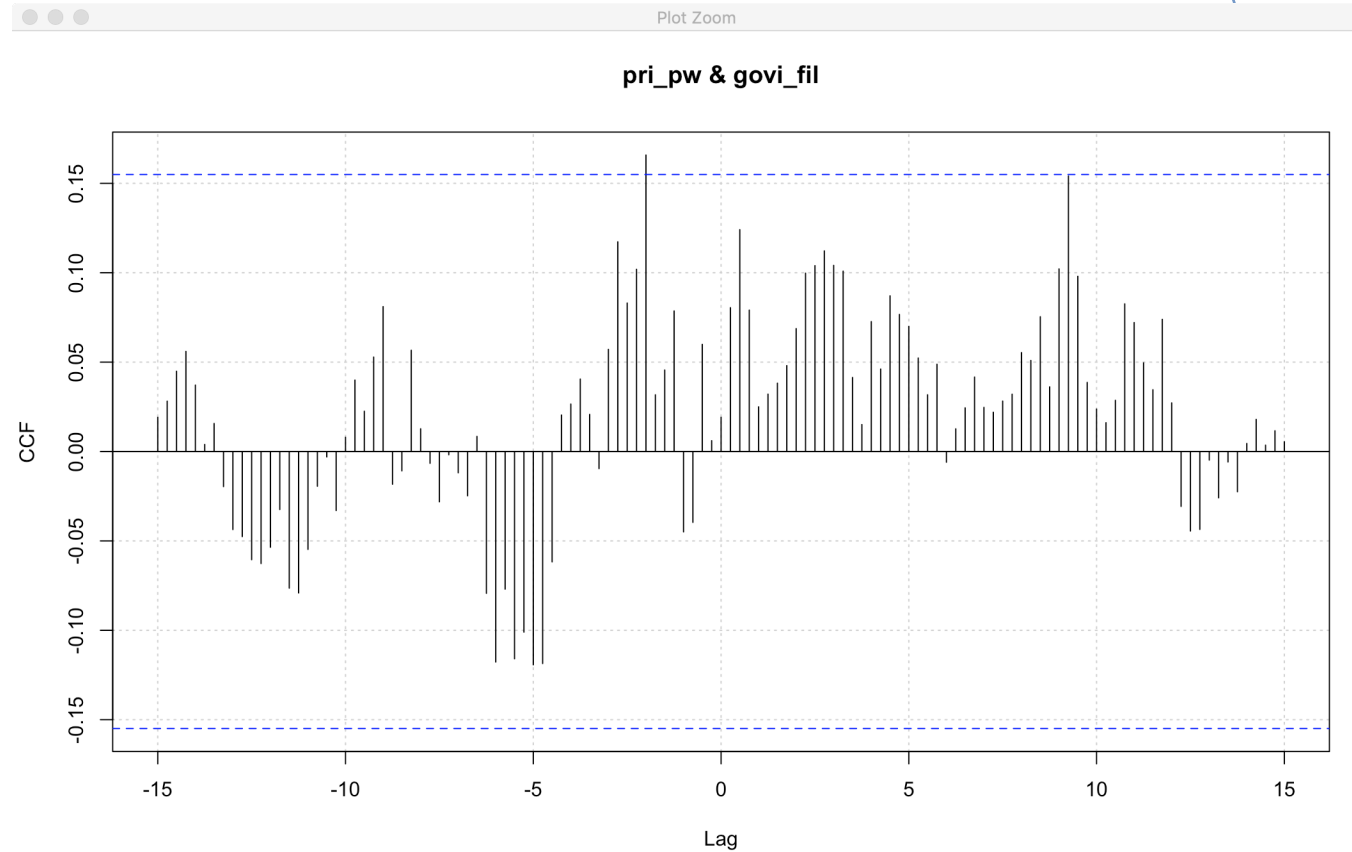
govinv vs prinv

BIVARIATE, TFM

- Detrended prinv series: AR(1)

BIVARIATE, TFM

```
fit = arima(pri_d, order=c(1,0,0))
ar1 = as.numeric(coef(fit)[1]) # = 0.8912
pri_pw = resid(fit)
govi_fil = stats::filter(govinv, filter=c(1, -ar1), sides=1)
ccf(pri_pw, govi_fil, ylab="CCF", na.action=na.omit, panel.first=grid(), 60)
```

- Prewhitened detrended prinv series

- Filtered govinv series

- d=8, $\alpha(B) = \dfrac{\delta_0 B^8}{1 - \omega_1 B}$

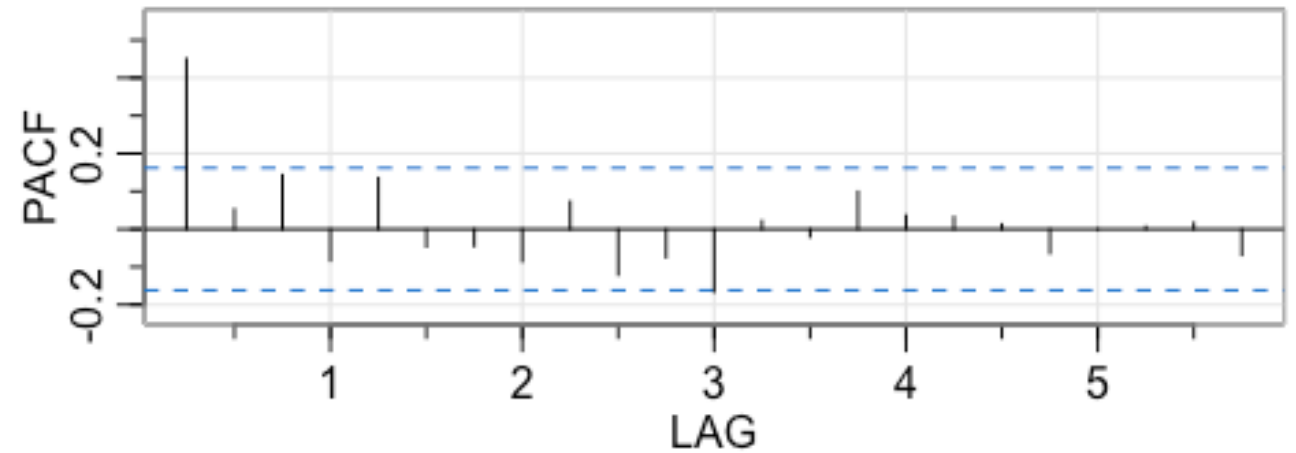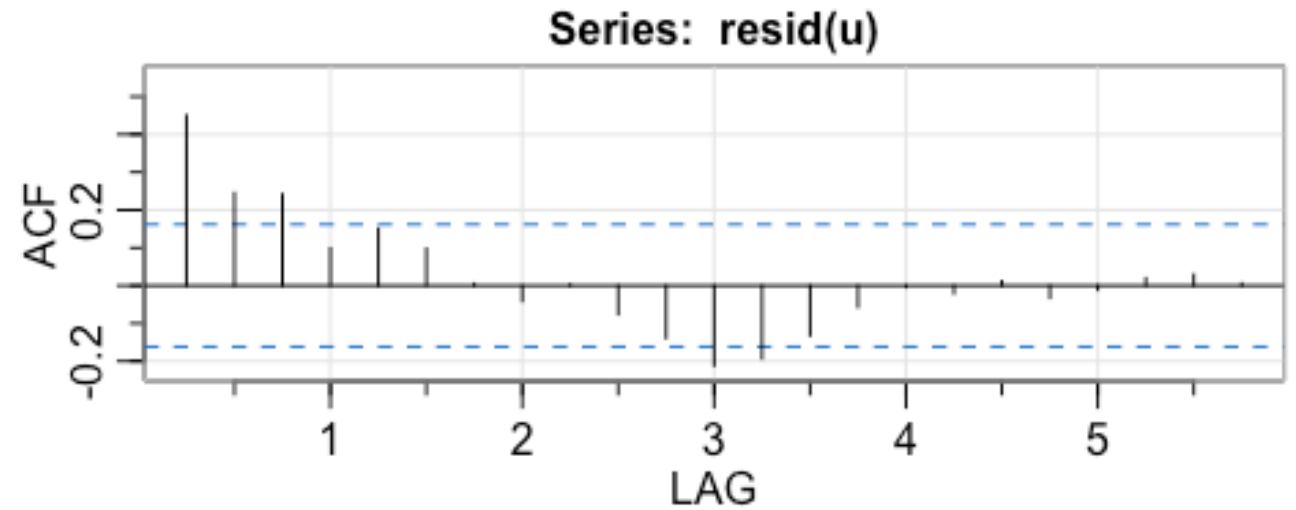$$y_t = \alpha + \omega_1 y_{t-1} + \delta_0 x_{t-8} + u_t$$

pri_pw & govi_fil

BIVARIATE, TFM

## Series: resid(u)


```
gov_pr = ts.intersect(govinv, govL1=stats::lag(govinv,-1),
                      priL8=stats::lag(pri_d,-8))
u = lm(gov_pr[,1]~gov_pr[,2:3], na.action=NULL)
acf2(resid(u)) # suggests ar1
```

BIVARIATE, TFM

```
gov_pr = ts.intersect(govinv, govL1=stats::lag(govinv,-1),
                                priL8=stats::lag(pri_d,-8))
arx = sarima(gov_pr[,1], 1, 0, 0, xreg=gov_pr[,2:3]) # final model
```

- Final model

- Errors: random, no pattern
- QQ plot: normality
- ACF: no spike, errors are white
- P values: above the 5% level,

   no dependence
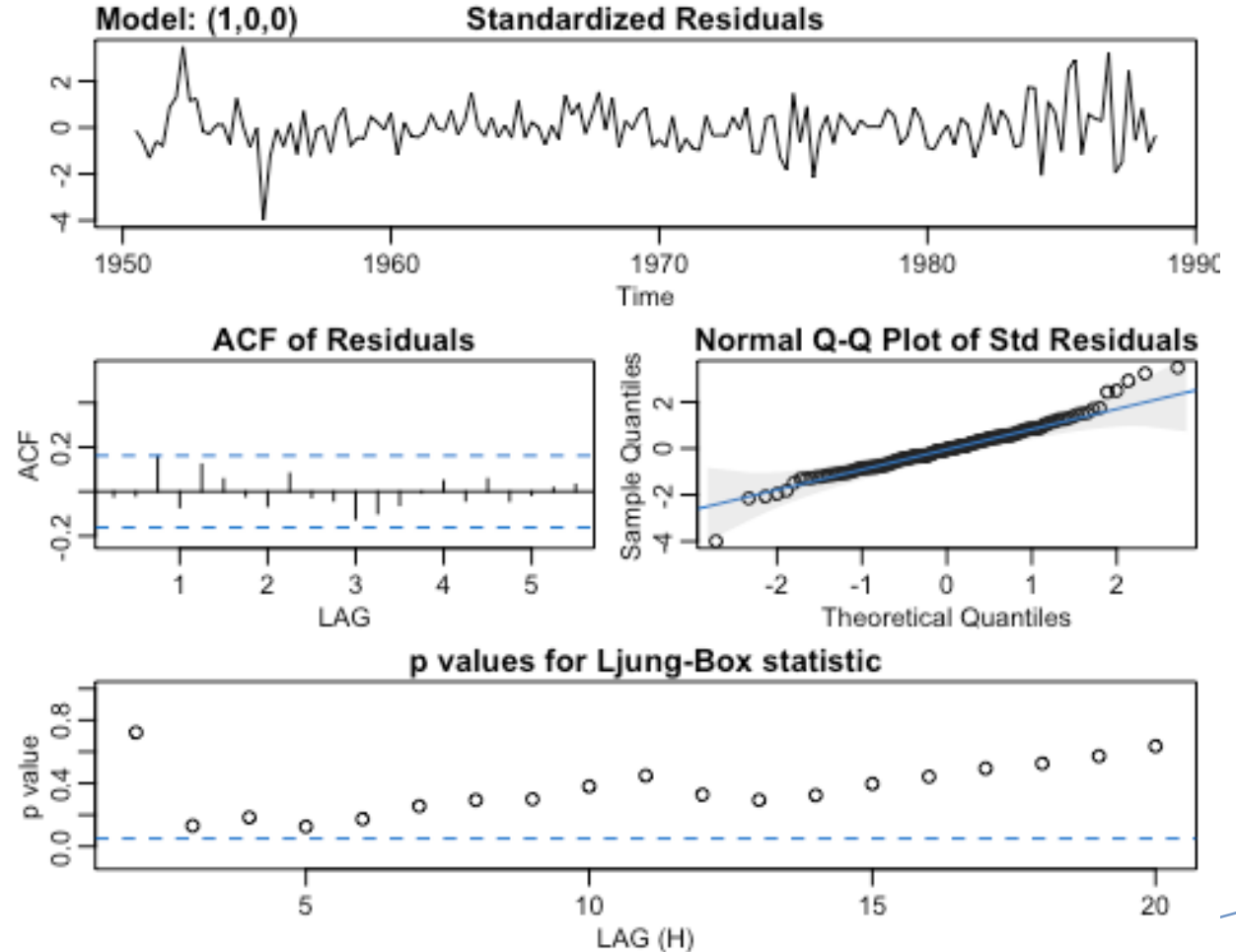
BIVARIATE, TFM

```
Call:
stats::arima(x = xdata, order = c(p, d, q), seasonal = list(order = c(P, D,
    Q), period = S), xreg = xreg, transform.pars = trans, fixed = fixed, optim.control = list(trace = trc,
    REPORT = 1, reltol = tol))

Coefficients:
         ar1  intercept    govL1    priL8
      0.4665     8.6165   0.9905   0.0591
s.e.  0.0753     4.6541   0.0088   0.0223

sigma^2 estimated as 57.83:  log likelihood = -527.62,  aic = 1065.24

$degrees_of_freedom
[1] 149

$ttable
          Estimate      SE   t.value  p.value
ar1         0.4665  0.0753    6.1951   0.0000
intercept   8.6165  4.6541    1.8514   0.0661
govL1       0.9905  0.0088  112.3556   0.0000
priL8       0.0591  0.0223    2.6495   0.0089

$AIC
[1] 6.962322
```

- Equation

$$y_t = \alpha + \omega_1 y_{t-1} + \delta_0 x_{t-8} + u_t$$

- Prediction: 812.17, 849.57, 886.05 and 922.17.

THANKS !