13주차 3차시 : R 실습(시차분포모형)

1. Koyck 추정방법
2. Almon 추정방법

1. Koyck 추정방법

- 시차분포모형은 다음과 같음

$$y_t = \alpha + \beta_0 X_t + \beta_1 X_{t-1} + \ldots + \beta_k X_{t-k} + u_t$$

- Koyck은 다음의 시차계수 구조를 가정함

$$\beta_k = \beta_0 \lambda^k$$

- 시차계수 구조를 시차분포모형에 대입하면 정리하면 ⓔ식이 됨

$$y_t = \alpha(1-\lambda) + \beta_0 X_t + \lambda y_{t-1} + v_t \text{ (단, } v_t = u_t - \lambda u_{t-1}) \qquad ⓔ$$

- ⓔ식에서 y_{t-1}대신에 X_{t-1}을 사용하여 OLS로 추정

- OLS로 추정하면 $\hat{\alpha}, \hat{\beta}_0, \hat{\lambda}$을 구할 수 있고, 따라서 $\hat{\beta}_k = \hat{\beta}_0 \hat{\lambda}^k$를 이용하여 시차분포모형의 $\hat{\beta}_k$를 구할 수 있음

1.Koyck 추정방법(b2-ch7-1-new.R) (download from http://kanggc.iptime.org/em/em.html)

```r
library(dLagM)
library(AER)
sample1<-("http://kanggc.iptime.org/book/data/ar.txt")
sample1_dat<-read.delim(sample1,header=T)
#sample1_dat
sample1.ts<-ts(sample1_dat, start=c(1995,1), end=c(2001,1), frequency=4)
cons<-sample1.ts[,1]
gdp<-sample1.ts[,2]
lcons1<-cons[1:24]
lgdp1<-gdp[1:24]

fm.res <- ivreg(cons[2:25] ~ lcons1+gdp[2:25] | lcons1+lgdp1)
summary(fm.res)

data(sample1_dat)
koyck.res<-koyckDlm(x = sample1_dat$gdp,y = sample1_dat$consume)
summary(koyck.res)

lambda<-0.347
beta0<-0.2168
beta1<-beta0*lambda
beta2<-beta0*lambda^2
beta3<-beta0*lambda^3
beta4<-beta0*lambda^4
beta0;beta1;beta2;beta3;beta4
```

```
> koyck.res<-koyckDlm(x = sample1_dat$gdp,y = sample1_dat$consume)

> summary(koyck.res)

Call:
"Y ~ (Intercept) + Y.1 + X.t"

Residuals:
    Min      1Q  Median      3Q     Max
-6435.7  -775.4   191.6  1159.9  3931.7

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 1.992e+04  7.180e+03   2.774   0.0114 *
Y.1         3.470e-01  2.105e-01   1.649   0.1141
X.t         2.168e-01  1.028e-01   2.110   0.0471 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2144 on 21 degrees of freedom
Multiple R-Squared: 0.7252,     Adjusted R-squared: 0.699
Wald test: 24.15 on 2 and 21 DF,  p-value: 3.599e-06

Diagnostic tests:
NULL

                            alpha      beta       phi
Geometric coefficients:  30497.44 0.2168204 0.3469805
```

```
> beta0;beta1;beta2;beta3;beta4
[1] 0.2168
[1] 0.0752296
[1] 0.02610467
[1] 0.009058321
[1] 0.003143237
```

2. Almon 추정방법

- Almon은 시차계수(β_i)가 다음 식과 같이 시차의 길이인 i의 적절한 차수의 다항식의 근사치로 계산할 수 있다고 가정

$$\beta_i = \alpha_0 + \alpha_1 i + \alpha_2 i^2 + \cdots + \alpha_k i^r$$

- 예를 들어, r=2인 경우 다음 식과 같이 2차 다항식이 됨

$$\beta_i = \alpha_0 + \alpha_1 i + \alpha_2 i^2$$

- 2차 다항식을 가정하는 경우 β는 α들과 다음의 관계에 있으므로 $\alpha_0, \alpha_1, \alpha_2$을 알면 β의 값들을 알 수 있음

$$\beta_0 = \alpha_0$$
$$\beta_1 = \alpha_0 + \alpha_1 + \alpha_2$$
$$\beta_2 = \alpha_0 + 2\alpha_1 + 4\alpha_2$$
$$\vdots$$
$$\beta_k = \alpha_0 + k\alpha_1 + k^2\alpha_2$$

- 이를 시차분포모형에 대입하면 다음의 ⓕ식을 얻게 됨

$$y_t = \alpha + \alpha_0 Z_{1t} + \alpha_1 Z_{2t} + \alpha_2 Z_{3t} + u_t \quad ⓕ$$

- ⓕ식을 OLS로 추정하여 $\hat{\alpha}, \hat{\alpha}_0, \hat{\alpha}_1, \hat{\alpha}_2$을 구하고 β와 α의 관계를 이용하여 시차분포모형의 $\hat{\beta}_0, \hat{\beta}_1, \ldots\ldots, \hat{\beta}_k$를 계산

2.Almon 추정방법(b2-ch7-2.R) (download from http://kanggc.iptime.org/em/em.html)

```
library(dLagM) l
ibrary(dynlm)
rm(list=ls())
sample1<-("http://kanggc.iptime.org/book/data/ar.txt")
sample1_dat<-read.delim(sample1,header=T)
sample1.ts<-ts(sample1_dat, start=c(1995,1), end=c(2001,1), frequency=4)
cons<-sample1.ts[,1]
gdp<-sample1.ts[,2]
lgdp1<-gdp[4:24]
lgdp2<-gdp[3:23]
lgdp3<-gdp[2:22]
lgdp4<-gdp[1:21]
summary(dynlm(cons~L(gdp, 0:4)))
```

```
Call:
dynlm(formula = cons ~ L(gdp, 0:4))

Residuals:
    Min      1Q  Median      3Q     Max 
-2992.0  -967.9  -256.1   794.8  3618.7 

Coefficients:
               Estimate Std. Error t value Pr(>|t|)   
(Intercept)   3.241e+04  8.068e+03   4.017  0.00112 **
L(gdp, 0:4)0  5.670e-01  2.149e-01   2.639  0.01860 * 
L(gdp, 0:4)1 -1.094e-01  3.599e-01  -0.304  0.76536   
L(gdp, 0:4)2 -2.122e-02  3.563e-01  -0.060  0.95331   
L(gdp, 0:4)3  5.347e-02  3.693e-01   0.145  0.88681   
L(gdp, 0:4)4 -1.858e-01  2.358e-01  -0.788  0.44296   
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2122 on 15 degrees of freedom
Multiple R-squared:  0.766,	Adjusted R-squared:  0.688 
F-statistic: 9.821 on 5 and 15 DF,  p-value: 0.0002556
```

2.Almon 추정방법(b2-ch7-2.R) (download from http://kanggc.iptime.org/em/em.html)

```
(계속)
z1<-gdp[5:25]+lgdp1+lgdp2+lgdp3+lgdp4
z2<-lgdp1+2*lgdp2+3*lgdp3+4*lgdp4
z3<-lgdp1+4*lgdp2+9*lgdp3+16*lgdp4
(summary(lm.res<-lm(cons[5:25]~z1+z2+z3)))
beta0<-lm.res$coeff[2]
beta1<-lm.res$coeff[2]+lm.res$coeff[3]+lm.res$coeff[4]
beta2<-lm.res$coeff[2]+2*lm.res$coeff[3]+4*lm.res$coeff[4]
beta3<-lm.res$coeff[2]+3*lm.res$coeff[3]+9*lm.res$coeff[4]
beta4<-lm.res$coeff[2]+4*lm.res$coeff[3]+16*lm.res$coeff[4]
(coeff_fdl<-rbind(lm.res$coeff[1],beta0, beta1, beta2, beta3, beta4))
```

```
Call:
lm(formula = cons[5:25] ~ z1 + z2 + z3)

Residuals:
    Min      1Q  Median      3Q     Max 
-3198.0 -1205.6  -101.2   729.5  4031.0 

Coefficients:
              Estimate Std. Error t value Pr(>|t|)    
(Intercept)  3.192e+04  7.705e+03   4.143 0.000681 ***
z1           4.386e-01  1.257e-01   3.491 0.002799 ** 
z2          -3.777e-01  2.273e-01  -1.662 0.114871    
z3           6.313e-02  5.721e-02   1.104 0.285185    
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2033 on 17 degrees of freedom
Multiple R-squared:  0.7566,	Adjusted R-squared:  0.7137 
F-statistic: 17.62 on 3 and 17 DF,  p-value: 1.844e-05

> beta0<-lm.res$coeff[2]
> beta1<-lm.res$coeff[2]+lm.res$coeff[3]+lm.res$coeff[4]
> beta2<-lm.res$coeff[2]+2*lm.res$coeff[3]+4*lm.res$coeff[4]
> beta3<-lm.res$coeff[2]+3*lm.res$coeff[3]+9*lm.res$coeff[4]
> beta4<-lm.res$coeff[2]+4*lm.res$coeff[3]+16*lm.res$coeff[4]
> (coeff_fdl<-rbind(lm.res$coeff[1],beta0, beta1, beta2, beta3, beta4))
        (Intercept)
       3.192060e+04
beta0  4.386243e-01
beta1  1.240260e-01
beta2 -6.431342e-02
beta3 -1.263940e-01
beta4 -6.221560e-02
```

2.Almon 추정방법(b2-ch7-2.R)
(download from http://kanggc.iptime.org/em/em.html)

(계속)

```
almon.res<-polyDlm(x = sample1_dat$gdp,y = sample1_dat$consume, q=4, k=2, show.beta=T)
summary(almon.res)
```

```
> almon.res<-polyDlm(x = sample1_dat$gdp,y = sample1_dat$consume, q=4, k=2, show.beta=T)
Estimates and t-tests for beta coefficients:
        Estimate Std. Error t value P(>|t|)
beta.0    0.4390     0.1260   3.490  0.0028
beta.1    0.1240     0.0608   2.040  0.0572
beta.2   -0.0643     0.1090  -0.589  0.5640
beta.3   -0.1260     0.0583  -2.170  0.0448
beta.4   -0.0622     0.1400  -0.445  0.6620
> summary(almon.res)

Call:
"Y ~ (Intercept) + X.t"

Residuals:
    Min      1Q  Median      3Q     Max
-3198.0 -1205.6  -101.2   729.5  4031.0

Coefficients:
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  3.192e+04  7.705e+03   4.143 0.000681 ***
z.t0         4.386e-01  1.257e-01   3.491 0.002799 **
z.t1        -3.777e-01  2.273e-01  -1.662 0.114871
z.t2         6.313e-02  5.721e-02   1.104 0.285185
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2033 on 17 degrees of freedom
Multiple R-squared:  0.7566,	Adjusted R-squared:  0.7137
F-statistic: 17.62 on 3 and 17 DF,  p-value: 1.844e-05
```