11주차 3차시 : R 실습(자기상관 1)

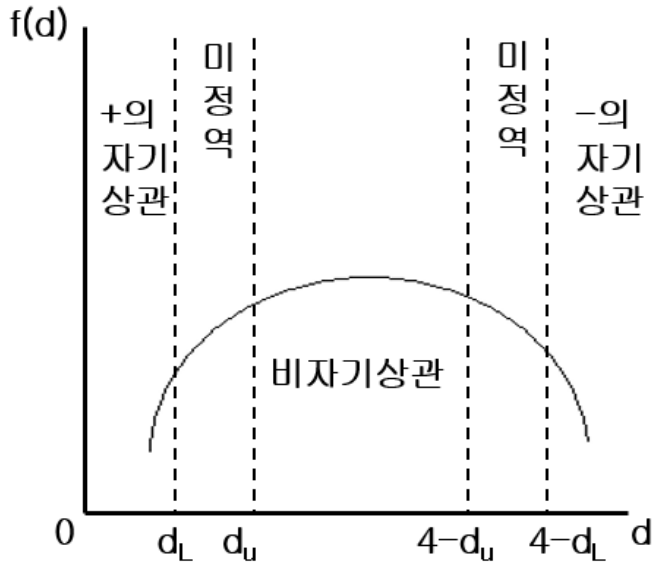
1. 자기상관 1

1.자기상관 1
① DW 검정

$$d = \frac{\sum_{t=2}^{N}(e_t - e_{t-1})^2}{\sum_{t=1}^{N} e_t^2}$$

$$= \frac{\sum_{t=2}^{N} {e_t}^2 + \sum_{t=2}^{N} e_{t-1}^2 - 2\sum_{t=2}^{N} e_t e_{t-1}}{\sum_{t=1}^{N} e_t^2}$$

$$\fallingdotseq 2(1-\hat{\rho})$$



1.자기상관 1
② LM 검정

(예) 다음과 같은 식에 대한 LM 검정은 다음과 같은 순서로 함

$$Y_t = \beta_1 + \beta_2 X_{2t} + \beta_3 X_{3t} + u_t \quad ⓐ$$
$$u_t = \rho u_{t-1} + e_t$$

- 1단계 : ⓐ식의 모형을 추정한 후 다음과 같은 잔차를 구함

$$\hat{u}_t = Y_t - \hat{\beta}_1 - \hat{\beta}_2 X_{2t} - \hat{\beta}_3 X_{3t} \quad ⓑ$$

- 2단계 : ⓑ식에서 구한 잔차를 ⓐ식에 포함되어 있는 설명변수와 $\hat{u}_{t-1}$에 대해 다음과 같은 회귀모형을 추정하는데 이를 보조회귀식(auxiliary regression)이라고 함

$$\hat{u}_t = \alpha_1 + \hat{\alpha}_2 X_{2t} + \hat{\alpha}_3 X_{3t} + \rho \hat{u}_{t-1} + v_t$$

- 이 경우 검정하고자 하는 귀무가설은 $H_0: \rho = 0$ 즉, 자기상관이 없다는 것이며, 귀무가설 하에서 다음의 LM 검정통계량과 그 분포를 구할 수 있음

$$LM = n\,R^2 \sim \chi_1^2$$

- 단, n은 관측치의 수, R^2는 보조회귀식의 결정계수이며 χ^2-분포의 자유도는 1임

1.자기상관 1(b2-ch5-1-rev.R) (download from http://kanggc.iptime.org/em/em.html)

```
library(stargazer)
library(lmtest)
library(orcutt)
sample1<-("http://kanggc.iptime.org/book/data/ar.txt")
sample1_dat<-read.delim(sample1,header=T)
consume<-ts(sample1_dat$consume, start=c(1995.1), frequency=4)
gdp<-ts(sample1_dat$gdp, start=c(1995.1), frequency=4)
ols.res<-lm(consume~gdp)
summary(ols.res)
res<-resid(ols.res)
res
lres<-append(res[1:24], 0, after=0)
lres
res.t<-ts(res)
lres.t<-ts(append(res.t[1:24], 0, after=0))
plot(res,main="Residual plotting(u(t) vs. time)",xlab='time')
plot(lres,res,main="Residual plotting(u(t) vs. u(t-1))")
abline(h=0, v=0)
#DW test
dwtest(ols.res)
```

(계속)

```
#LM test
n<-length(res)
lres.t<-ts(append(res.t[1:24], 0, after=0))
(res.aux<-lm(res.t~gdp+lres.t))
lm<-n*summary(res.aux)$r.squared
lm
(pchisq(lm, df=1, lower.tail=F))

library(tigerstats)
par(mfrow=c(3,1))
pchisqGC(3.841459, df=1, region="above", graph=T)
pchisqGC(2.705543, df=1, region="above", graph=T)
pchisqGC(3.122012, df=1, region="above", graph=T)
```

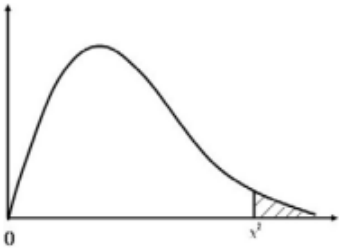
<표 5> Durbin-Watson (5% 유의수준)

n	k'=1		k'=2		k'=3		k'=4		k'=5	
	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U	d_L	d_U
15	1.077	1.361	0.946	1.543	0.814	1.750	0.685	1.977	0.562	2.220
16	1.106	1.371	0.982	1.539	0.857	1.728	0.734	1.935	0.615	2.157
17	1.133	1.381	1.015	1.536	0.897	1.710	0.779	1.900	0.664	2.104
18	1.158	1.391	1.046	1.535	0.933	1.696	0.820	1.872	0.710	2.060
19	1.180	1.410	1.074	1.536	0.967	1.685	0.859	1.848	0.752	2.023
20	1.201	1.411	1.100	1.537	0.998	1.676	0.894	1.828	0.792	1.991
21	1.221	1.420	1.125	1.538	1.026	1.669	0.927	1.812	0.829	1.964
22	1.239	1.429	1.147	1.541	1.053	1.664	0.958	1.797	0.863	1.940
23	1.257	1.437	1.168	1.543	1.078	1.660	0.986	1.785	0.895	1.920
24	1.273	1.446	1.188	1.546	1.101	1.656	1.013	1.775	0.925	1.902
25	1.288	1.454	1.206	1.550	1.123	1.654	1.038	1.767	0.953	1.886
26	1.302	1.461	1.224	1.553	1.143	1.652	1.062	1.759	0.979	1.873
27	1.316	1.469	1.240	1.556	1.162	1.651	1.084	1.753	1.004	1.861
28	1.328	1.476	1.255	1.560	1.181	1.650	1.104	1.747	1.028	1.850
29	1.341	1.483	1.270	1.563	1.198	1.650	1.124	1.743	1.050	1.841
30	1.352	1.489	1.284	1.567	1.214	1.650	1.143	1.739	1.071	1.833
31	1.363	1.496	1.297	1.570	1.229	1.650	1.160	1.735	1.090	1.825
32	1.373	1.502	1.309	1.574	1.244	1.650	1.177	1.732	1.109	1.819
33	1.383	1.508	1.321	1.577	1.258	1.651	1.193	1.730	1.127	1.813
34	1.393	1.514	1.333	1.580	1.271	1.652	1.208	1.728	1.144	1.808
35	1.402	1.519	1.343	1.584	1.283	1.653	1.222	1.726	1.160	1.803
36	1.411	1.525	1.354	1.587	1.295	1.654	1.236	1.724	1.175	1.799
37	1.419	1.530	1.364	1.590	1.307	1.655	1.249	1.723	1.190	1.795
38	1.427	1.535	1.373	1.594	1.318	1.656	1.261	1.722	1.204	1.792
39	1.435	1.540	1.382	1.597	1.328	1.658	1.273	1.722	1.218	1.789
40	1.442	1.544	1.391	1.600	1.338	1.659	1.285	1.721	1.230	1.786
45	1.475	1.566	1.430	1.615	1.383	1.666	1.336	1.720	1.287	1.776
50	1.503	1.585	1.462	1.628	1.421	1.674	1.378	1.721	1.335	1.771
55	1.528	1.601	1.490	1.641	1.452	1.681	1.414	1.724	1.374	1.768
60	1.549	1.616	1.514	1.652	1.480	1.689	1.444	1.727	1.408	1.767
65	1.567	1.629	1.536	1.662	1.503	1.696	1.471	1.731	1.438	1.767
70	1.583	1.641	1.554	1.672	1.525	1.703	1.494	1.735	1.464	1.768
75	1.598	1.652	1.571	1.680	1.543	1.709	1.515	1.739	1.487	1.770
80	1.611	1.662	1.586	1.688	1.560	1.715	1.534	1.743	1.507	1.772
85	1.624	1.671	1.600	1.696	1.575	1.721	1.550	1.747	1.525	1.774
90	1.636	1.679	1.612	1.703	1.589	1.726	1.566	1.751	1.542	1.776
95	1.645	1.687	1.623	1.709	1.602	1.732	1.579	1.755	1.557	1.778
100	1.654	1.694	1.634	1.715	1.613	1.736	1.592	1.758	1.571	1.780
150	1.720	1.746	1.706	1.760	1.693	1.774	1.679	1.778	1.665	1.802
200	1.758	1.778	1.748	1.789	1.738	1.799	1.728	1.810	1.718	1.820

k'= 상수항을 제외한 설명변수의 수

〈표 3〉 χ^2-분포표

$P(X \geq \chi^2_\alpha) = \alpha$



d.f	P=0.995	0.99	0.975	0.95	0.90	0.10	0.05	0.025	0.01	0.005
1	0.000039	0.000157	0.00098	0.00393	0.0158	2.706	3.841	5.023	6.635	7.879
2	0.010	0.0201	0.050	0.103	0.211	4.605	5.991	7.377	9.210	10.596
3	0.071	0.115	0.215	0.352	0.584	6.251	7.815	9.348	11.341	12.838
4	0.206	0.297	0.484	0.711	1.064	7.779	9.488	11.143	13.277	14.860
5	0.411	0.554	0.831	1.145	1.610	9.236	11.070	12.832	15.086	16.749
6	0.675	0.872	1.237	1.635	2.204	10.645	12.592	14.449	16.812	18.547
7	0.989	1.239	1.689	2.167	2.833	12.017	14.067	16.012	18.475	20.277
8	1.344	1.646	2.179	2.733	3.490	13.362	15.507	17.534	20.090	21.955
9	1.734	2.088	2.700	3.325	4.168	14.684	16.919	19.022	21.666	23.589
10	2.155	2.558	3.246	3.940	4.865	15.987	18.307	20.483	23.209	25.188
11	2.603	3.053	3.815	4.575	5.578	17.275	19.675	21.920	24.725	26.756
12	3.073	3.571	4.403	5.226	6.034	18.549	21.026	23.336	26.217	28.299
13	3.565	4.017	5.008	5.892	7.042	19.812	22.362	24.735	27.688	29.819
14	4.074	4.660	5.628	6.517	7.790	21.064	23.685	26.119	29.141	31.319
15	4.600	5.229	6.262	7.261	8.547	22.307	24.996	27.4888	30.578	32.801
16	5.142	5.812	6.907	7.962	9.312	23.542	26.296	28.845	32.000	34.267
17	5.697	6.408	7.564	8.672	10.085	24.769	27.587	30.191	33.409	35.718
18	6.264	7.015	8.230	9.390	10.865	25.989	28.869	31.526	34.805	37.156
19	6.843	7.633	8.906	10.117	11.651	27.204	30.144	32.852	36.191	38.582
20	7.433	8.260	9.590	10.851	12.443	28.412	31.410	34.169	37.566	39.996
21	8.033	8.897	10.282	11.591	13.240	29.615	32.671	35.478	38.932	41.401
22	8.642	9.542	10.982	12.338	14.041	30.813	33.924	36.780	40.289	42.795
23	9.260	10.196	11.688	13.091	14.848	32.007	35.172	38.075	41.638	44.183
24	9.886	10.856	12.401	13.848	15.659	33.196	36.415	39.364	42.980	45.558
25	10.519	11.524	13.119	14.611	16.473	34.382	37.652	40.646	44.314	46.927
26	11.160	12.198	13.843	15.379	17.292	36.563	38.885	41.923	45.642	48.289
27	11.807	12.879	14.573	16.151	18.114	36.741	40.113	43.194	46.963	49.644
28	12.461	13.565	15.307	16.928	18.939	37.916	41.337	44.460	48.278	50.993
29	13.121	14.256	16.047	17.708	19.768	39.087	42.557	45.722	49.588	52.3356
30	13.786	14.953	16.279	18.493	30.599	40.256	43.773	46.979	50.892	53.6720