

**THE UNIVERSITY OF CHICAGO**  
**Graduate School of Business**  
 Business 41202, Spring Quarter 2007, Mr. Ruey S. Tsay

**Solutions to Homework Assignment #2**

The commands and output are in a separate file.

**Assignment:**

1. Analysis of Decile 1 portfolio returns.

- (a) ACF and PACF

Lag	1	2	3	4	5	6	7	8	9	10	11	12
ACF	0.23	-0.00	-0.08	-0.03	-0.02	-0.05	-0.05	-0.09	-0.08	-0.00	0.08	0.27
PACF	0.23	-0.06	-0.07	0.00	-0.02	-0.05	-0.03	-0.08	-0.06	0.02	0.06	0.24
Lag	13	14	15	16	17	18	19	20	21	22	23	24
ACF	0.02	-0.05	-0.09	-0.02	-0.04	-0.09	-0.08	-0.05	-0.06	-0.05	0.05	0.25
PACF	-0.11	-0.03	-0.06	-0.00	-0.05	-0.07	-0.04	-0.00	-0.05	-0.06	0.04	0.17

- (b)  $Q(12) = 69.65$  with p-value close to zero. Reject the null hypothesis, i.e. there are serial correlations in the returns.

- (c) The t-ratio is 5.64, which is large compared with  $N(0, 1)$ . Thus,  $\rho_{12}$  is not zero.

2. Analysis of Decile 9 returns.

- (a) ACF

Lag	1	2	3	4	5	6	7	8	9	10	11	12
ACF	0.14	-0.06	-0.03	-0.06	-0.01	0.00	-0.01	-0.08	-0.03	0.04	-0.04	0.01

- (b)  $Q(12) = 16.81$  with p-value 0.16. Cannot reject the null hypothesis of no serial correlations.

3. Analysis of CPI index.

- (a) ACF and PACF of  $c_t$  series.

Lag	1	2	3	4	5	6	7	8	9	10	11	12
ACF	0.58	0.60	0.56	0.50	0.57	0.55	0.53	0.56	0.55	0.56	0.50	0.50
PACF	0.58	0.39	0.21	0.07	0.22	0.16	0.07	0.12	0.11	0.12	-0.05	0.01

- (b) ACF of  $d_t = c_t - c_{t-1}$ .

Lag	1	2	3	4	5	6	7	8	9	10	11	12
ACF	-0.52	0.06	0.02	-0.15	0.10	0.01	-0.06	0.04	-0.03	0.10	-0.09	0.04

(c) The fitted model is

$$(1 - 0.98B)(c_t - 0.32) = (1 - 0.82B + 0.07B^2 - 0.10B^3 - 0.11B^4 + 0.19B^5)a_t,$$

with  $\sigma_a^2 = 0.034$ .

4. Analysis of the growth rate of U.S. GNP  $x_t$ .

(a) The fitted model is

$$(1 - 0.42B - 0.20B^2 + 0.16B^3)(x_t - 0.017) = a_t,$$

with  $\sigma_a^2 = 9.3 \times 10^{-5}$ .

(b) The characteristic equation of the model has a pair of complex roots. Thus, there exist business cycles. The average length of the cycles is 11.6 quarters.

(c) Prediction

Step	1	2	3	4
Forecast	0.014	0.016	0.017	0.017
Std.Err	0.0097	0.0105	0.0111	0.0111

5. Analysis of Decile 9 returns.

(a) The fitted model is

$$r_t = 0.011 + (1 + 0.16B)a_t, \quad \sigma_a^2 = 0.0027.$$

(b) Yes, the model is adequate based on checking by “tsdiag” command and the residual  $Q(12) = 8.23$  with p-value 0.77.

(c) Prediction

Step	1	2	3	4
Forecast	0.009	0.011	0.011	0.011
Std.Err	0.052	0.053	0.053	0.053

Note that for MA(1) model, the forecasts go to the mean after 1-step.