

# Timeseries\_Analysis\_HW3

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06

```
set.seed(1)
phi <- runif(1, -1, 1)
theta <- runif(1, -1, 1)
set.seed(1)
Xt <- arima.sim(n = 100, model = list(ar = phi, ma = theta))
Xt
```

## Time Series:

## Start = 1

## End = 100

## Frequency = 1

```
## [1] 1.86592877 -0.87188639 -0.31204424 -1.90947290 2.58685499 -1.54582734
## [7] 0.72026784 0.61018377 0.29366739 0.24614727 0.65164699 0.24149467
## [13] -0.23872491 -1.89646401 2.01801558 -1.16106488 0.40307885 -1.61994434
## [19] 0.65772393 0.23176836 1.14309473 -0.98636464 0.87654772 -0.56403860
## [25] -1.09877447 0.45249764 -0.50036773 0.27619092 0.98566615 0.01958149
## [31] -0.36889085 -0.03828099 0.77971430 0.01274078 -0.83709874 -0.13875957
## [37] 0.61060124 0.38892888 -0.49130111 1.14025222 -0.36199790 -0.54407211
## [43] 0.75280718 -1.56965873 2.45800355 0.46113986 -1.08997971 -0.43903533
## [49] 1.04265932 -0.76975081 2.79715806 -1.96527770 1.62145627 -0.90883510
## [55] -0.32420691 0.53093348 -2.10224128 2.91309174 -1.58775510 2.87804642
## [61] -1.42989459 -0.16096325 0.86778569 -1.49726869 -0.31254280 0.75864289
## [67] -0.87362026 0.52419099 -0.17177786 -0.52797306 -0.17028724 0.09012143
## [73] 1.17039384 -2.37375957 2.09685386 -0.80234080 1.35423098 -1.21118491
## [79] 1.01583926 -0.30394534 -0.46828603 1.56623653 0.11694997 0.34859062
## [85] 1.24426931 -0.43089047 -1.21734618 0.32414012 -1.23001482 0.41665237
## [91] -0.69469617 0.52657648 -1.16864812 0.93907471 -1.13541062 2.46718664
## [97] -0.89234792 1.14537043 -0.38575259 1.76483111
```

07

난수 생성

```
phis <- c()

set.seed(1)
for (i in 1:500) {
  # time-series data generation
  Xt <- arima.sim(n = 100, model = list(ar = 0.5))

  # saving LSE
  phi_hat <- as.numeric(lm(formula = Xt[-length(Xt)] ~ Xt[-1] + 0)$coef)
  phis <- append(phis, phi_hat)
}

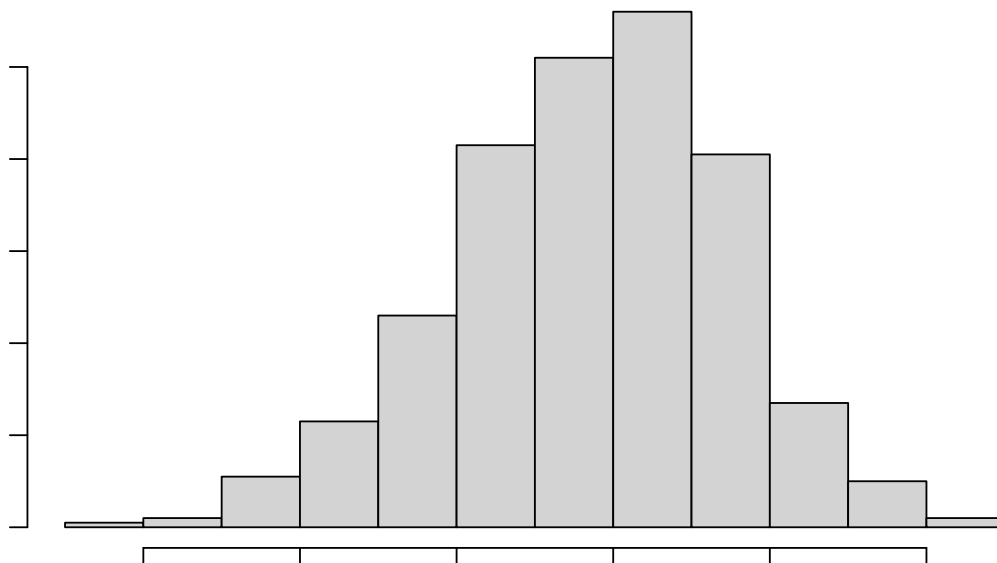
head(phis)
```

```
## [1] 0.5187736 0.4342065 0.3910718 0.5330833 0.4705040 0.4030723
```

히스토그램

```
modified_data <- 10*(phis - 0.5)

hist(modified_data)
```



이론적 값과 비교

```
mean(modified_data)
```

```
## [1] -0.1416625
```

```
var(modified_data)
```

```
## [1] 0.7773941
```

```
# 이론적 값  
0
```

```
## [1] 0
```

```
0.75
```

```
## [1] 0.75
```

$\sigma^2 = 1$ 이다.  $E(X_1^2) = \frac{4}{3}$ 이다. 즉 이론적 분산은 0.75, 이론적 평균은 0이다.

```
set.seed(1)  
Xt <- arima.sim(model = list(order = c(1,0,0), ar = 0.5), n = 100)  
Xt
```

```
## Time Series:  
## Start = 1  
## End = 100  
## Frequency = 1  
## [1] 1.614242003 1.196964238 -0.022758462 -2.226079118 0.011891359  
## [6] -0.038987929 -0.035684228 0.925994097 1.284218243 1.236010443  
## [11] 1.536982593 1.550627597 0.849878782 -1.564412305 -0.162380405  
## [16] -0.137318942 -0.224454978 -1.582979873 -1.269639991 -0.216878436  
## [21] 1.250240334 0.522332440 0.648837831 0.270613875 -1.241752619  
## [26] -1.035870873 -0.912225390 -0.515426092 0.842312326 1.184331911  
## [31] 0.427642359 -0.039540500 0.677193125 0.895259761 -0.241125814  
## [36] -0.828058064 -0.049447070 0.743809390 0.259558483 1.010886968  
## [41] 0.903549364 -0.160251711 0.260993836 -0.998866178 0.933590613  
## [46] 2.447195205 0.856376126 -0.615946563 0.261746346 -0.004181431  
## [51] 2.399527045 1.160523520 1.270001122 0.663002720 -0.411771849  
## [56] -0.017093625 -1.813505441 0.558802141 0.432654409 2.388938875  
## [61] 1.669978966 0.125043052 0.673247880 -0.597473692 -1.552370246  
## [66] -0.484738888 -0.685661317 -0.341725307 -0.096521329 -0.637781611  
## [71] -0.887559538 -0.578958384 0.888607804 -1.079262898 0.054314739  
## [76] 0.360107740 1.243153708 0.317392930 0.528715275 0.531456428  
## [81] -0.276791817 1.069471898 1.695138564 1.547782932 2.360724920  
## [86] 1.738848886 -0.407167766 -0.776849297 -1.613037263 -1.279919268  
## [91] -1.260326311 -0.588047283 -1.204945290 -0.444443872 -0.876806580  
## [96] 1.328883979 1.381149466 1.600748962 1.184559839 2.274456000
```

## LSE 계산

```
as.numeric(lm(formula = Xt[-length(Xt)] ~ Xt[-1] + 0)$coef)
```

```
## [1] 0.5187736
```

## 09

### 데이터 입력

```
Xt <- read.csv('ex_ch3_8.txt', sep = '\n')
Xt <- ts(as.vector(Xt)$data)
Xt
```

```
## Time Series:
## Start = 1
## End = 14
## Frequency = 1
## [1] 72 71 59 44 74 78 81 64 86 87 104 88 84 62
```

[자유아카데미 홈페이지 자료실](#)에서 다운로드할 수 있는 ‘시계열 분석 이론 및 SAS 실습 2판’ 교재의 데이터 파일을 내려받아 활용하였다. 파일명이 교재와 다른데, 3장에서 파일을 활용하는 문제가 하나뿐이어서 이름이 3.8 문제에 대응하는 것으로 되어 있는 파일을 활용하였다.

### CSS 사용(최소제곱추정량)

```
Xt_LSE <- arima(x = Xt, order = c(1, 0, 1), method = 'CSS')
summary(Xt_LSE)
```

```
##      Length Class Mode
## coef    3  -none- numeric
## sigma2   1  -none- numeric
## var.coef  9  -none- numeric
## mask     3  -none- logical
## loglik    1  -none- numeric
## aic       1  -none- logical
## arma      7  -none- numeric
## residuals 14  ts    numeric
## call      4  -none- call
## series    1  -none- character
## code      1  -none- numeric
## n.cond    1  -none- numeric
## nob      1  -none- numeric
## model    10  -none- list
```

$$\hat{\phi}_{LSE} = 0.4405$$

$$\hat{\theta}_{LSE} = 0.0347$$

$$\hat{\mu}_{LSE} = 74.8414$$

ML 사용(최대가능도추정량)

```
Xt_MLE <- arima(x = Xt, order = c(1, 0, 1), method = 'ML')
summary(Xt_MLE)
```

```
##      Length Class Mode
## coef    3  -none- numeric
## sigma2   1  -none- numeric
## var.coef  9  -none- numeric
## mask     3  -none- logical
## loglik    1  -none- numeric
## aic       1  -none- numeric
## arma      7  -none- numeric
## residuals 14  ts    numeric
## call      4  -none- call
## series    1  -none- character
## code      1  -none- numeric
## n.cond    1  -none- numeric
## nobs      1  -none- numeric
## model     10  -none- list
```

$$\hat{\phi}_{MLE} = 0.4109$$

$$\hat{\theta}_{MLE} = 0.0342$$

$$\hat{\mu}_{MLE} = 74.4687$$