MA 4780 Homework 5

Benjamin Hendrick

April 10, 2016

Exercise 7.3

Exercise 7.15

Generate the simulated AR(1) model.

```
set.seed(1)
ar1 <- arima.sim(list(order = c(1,0,0), ar = c(-0.7)), n = 100)
```

Part A

Use the `arima` function with method `ML` to find the maximum likelihood estimator of ϕ.

```
ar1.mle <- arima(ar1,order=c(1,0,0),method="ML")
```

The MLE for ϕ is -0.7079663.

Part B

Using the sample size $n = 100$, we can run the `arima` function with method `ML` many times.

```
mle.list <- c()
for(i in 1:1000){
  ar1 <- arima.sim(list(order = c(1,0,0), ar = c(-0.7)), n = 100)
  ar1.mle <- arima(ar1,order=c(1,0,0),method="ML")
  mle.list <- c(mle.list,ar1.mle$coef[1])
}
```
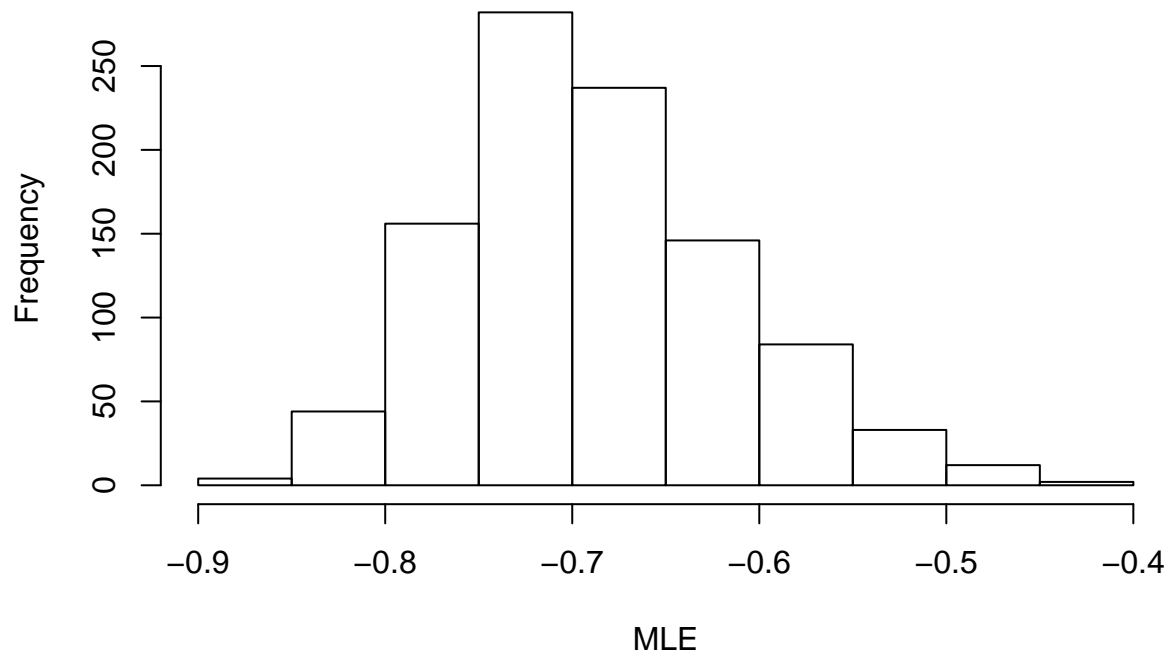
Part C

The center of the sampling distribution is $\mu = $ -0.6877054.

The histogram of the sampling distribution is:

```
hist(x = mle.list,
     main = "MLE for 100 AR(1) Simulations",
     xlab = "MLE")
```

MLE for 100 AR(1) Simulations

Part D

The estimators are unbiased and normally distributed because the sample size is so large. The histogram in Part C implied normality and unbias.

Part E

The variance of the sampling distribution is $\sigma^2 = 0.0055825$.

By 7.4.9 on Page 161 in the text, the variance should approximately be $\frac{1-\phi^2}{n} = \frac{1-0.7^2}{100} = 0.0051$.