

Auto-regressive model of order 1

Simulation of AR(1)

Simulate time series of length 100 from four different AR(1) models with α_1 equal to a) -0.9, b) -0.5, c) 0.5, d) 0.9 respectively. For each model:

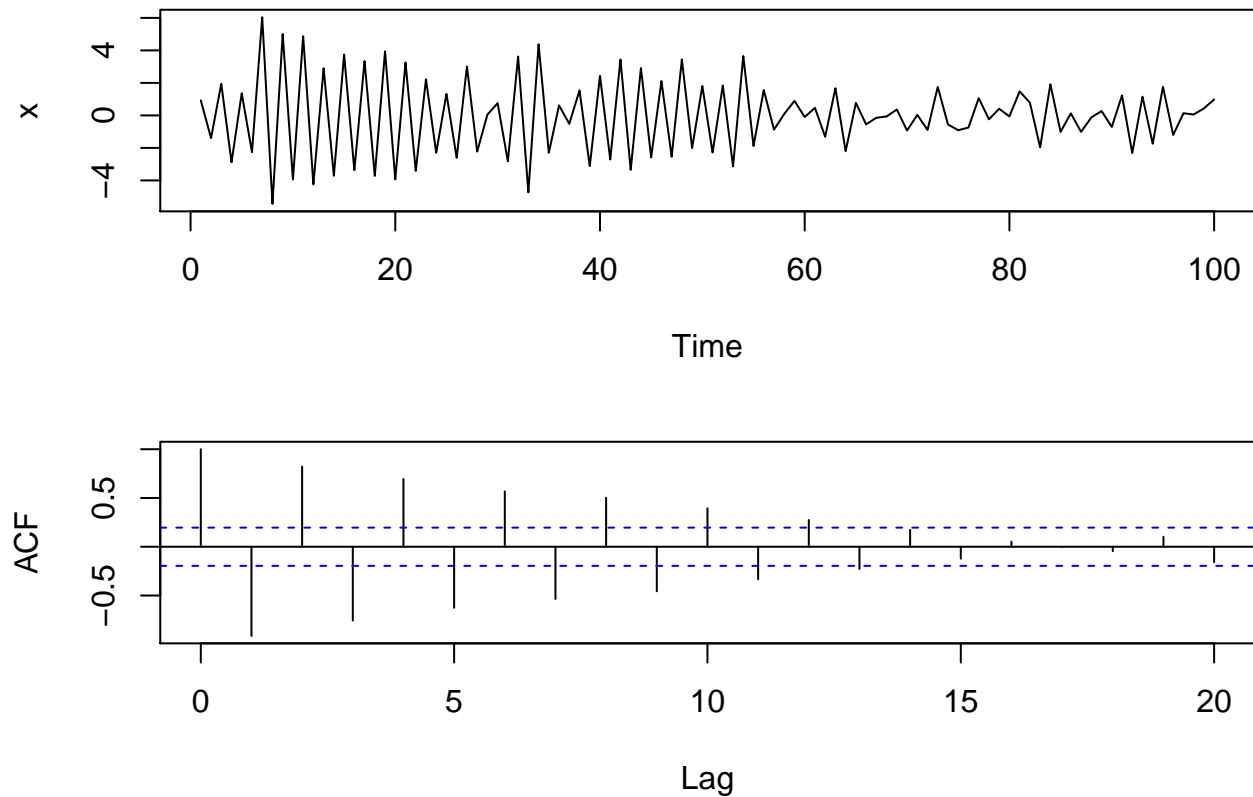
- Plot the correlogram
- Estimate the parameters
- Make predictions for 1 to 10 steps ahead.

Common for all cases:

```
n <- 100  
n_ahead <- 10
```

Case 1: $\alpha_1 = -0.9$

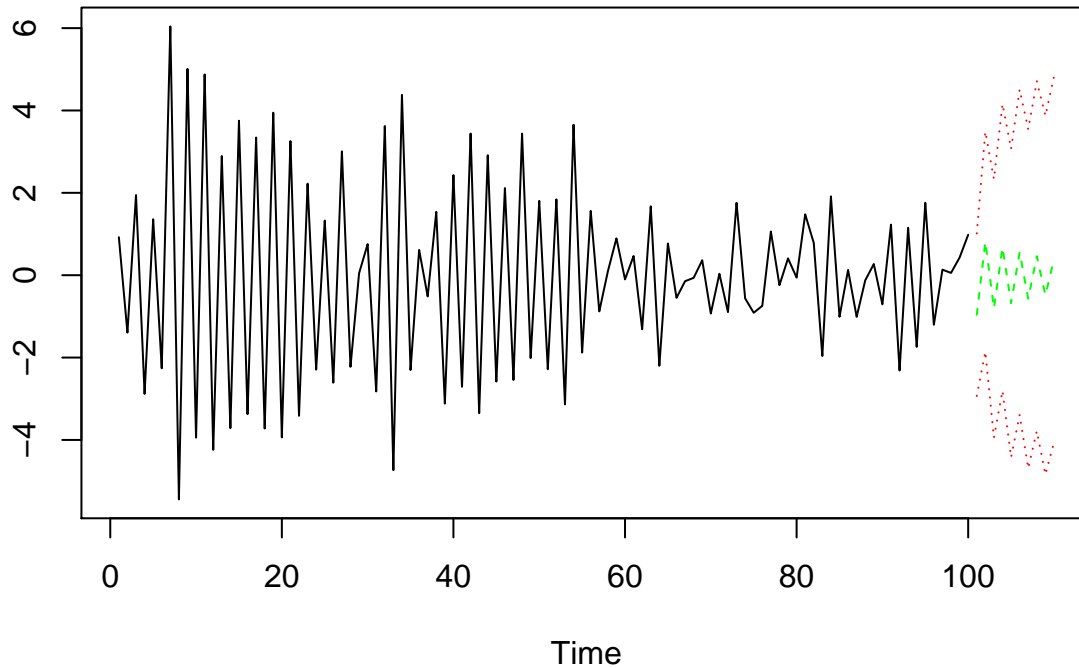
```
alpha1 <- -0.9  
x <- arima.sim(model = list(ar=alpha1), n = n)  
par(mfrow = c(2,1), mar = c(5,4,1,0))  
plot(x)  
acf(x)
```



```
fit <- ar(x)
fit$ar
```

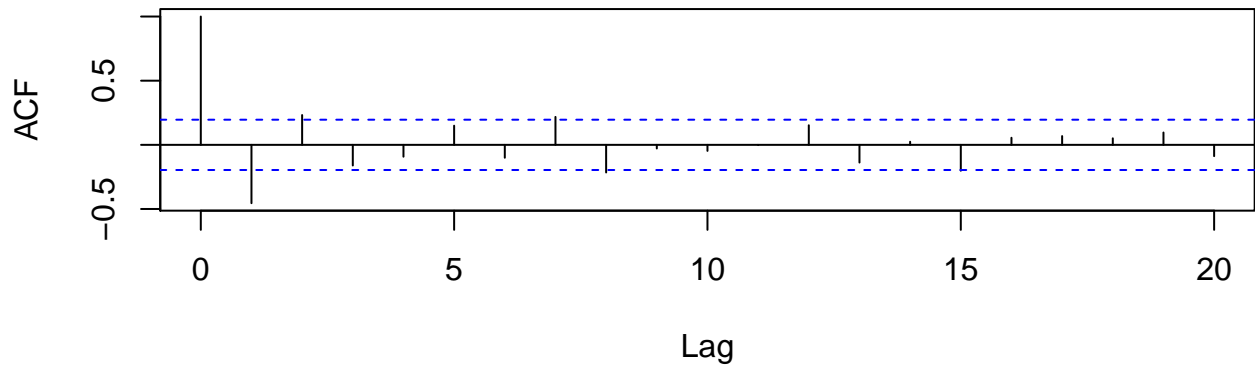
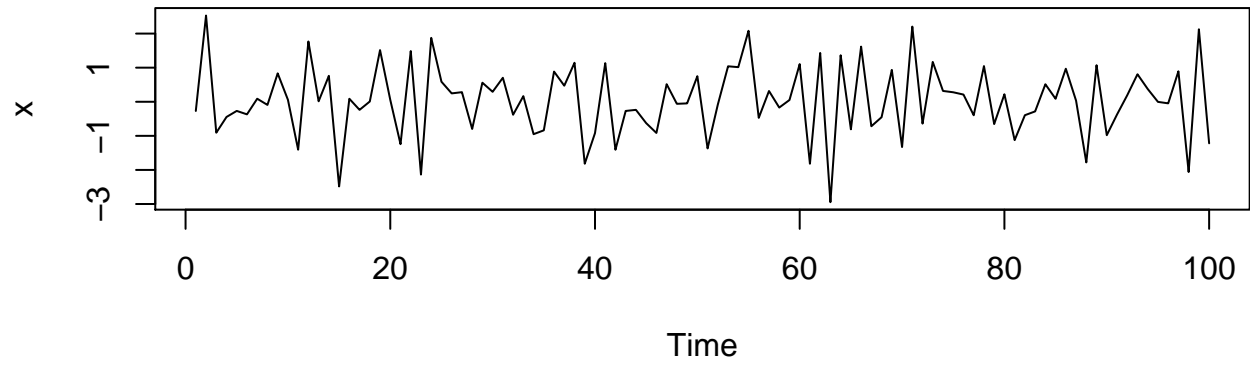
```
## [1] -0.9140956
```

```
pred <- predict(fit, n.ahead = n_ahead)
lower <- pred$pred - 2*pred$se
upper <- pred$pred + 2*pred$se
ts.plot(x, pred$pred, lower, upper, lty = c(1,2,3,3), col = c("black", "green", "red", "red"))
```



Case 2: $\alpha_1 = -0.5$

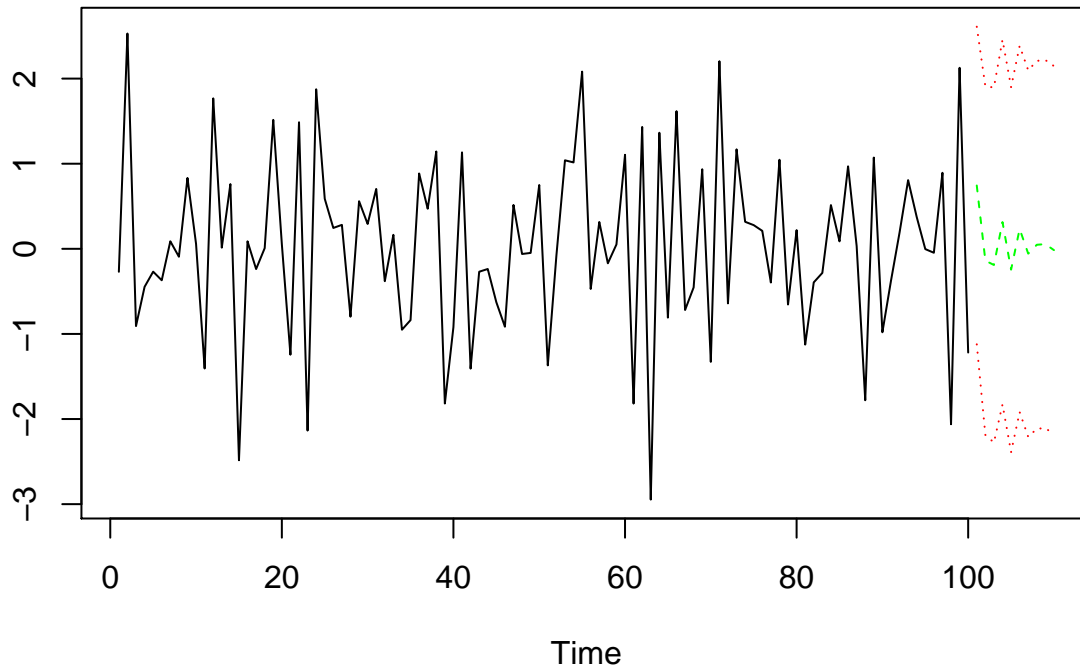
```
alpha1 <- -0.5
x <- arima.sim(model = list(ar=alpha1), n = n)
par(mfrow = c(2,1), mar = c(5,4,1,0))
plot(x)
acf(x)
```



```
fit <- ar(x)
fit$ar
```

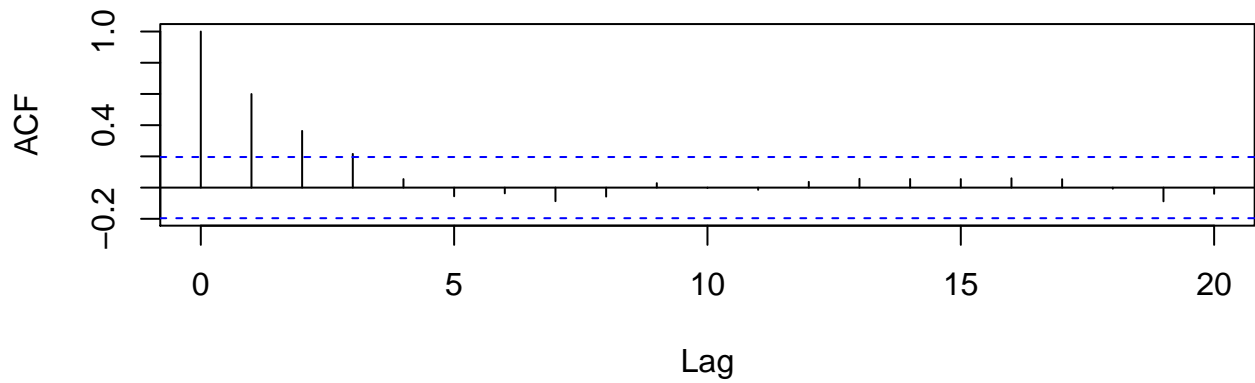
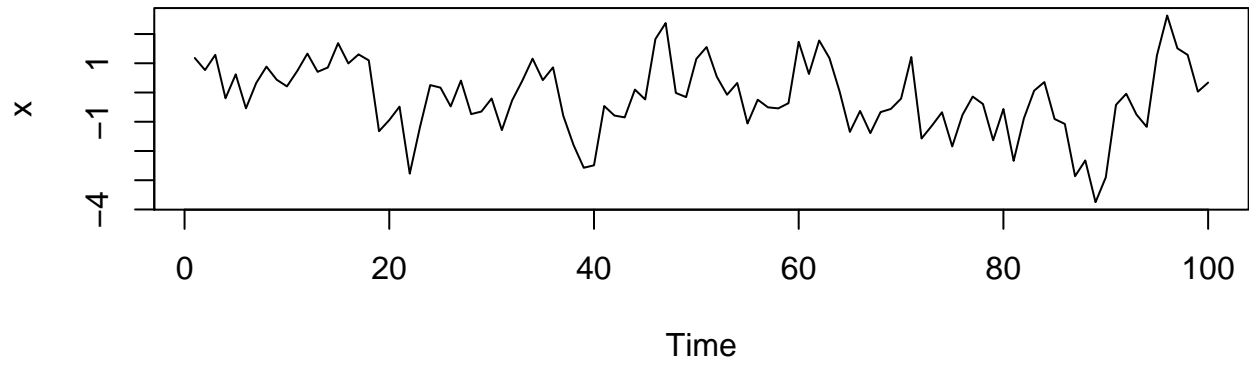
```
## [1] -0.451866303  0.009355068 -0.161559997 -0.240983938
```

```
pred <- predict(fit, n.ahead = n_ahead)
lower <- pred$pred - 2*pred$se
upper <- pred$pred + 2*pred$se
ts.plot(x, pred$pred, lower, upper, lty = c(1,2,3,3), col = c("black", "green", "red", "red"))
```



Case 3: $\alpha_1 = 0.5$

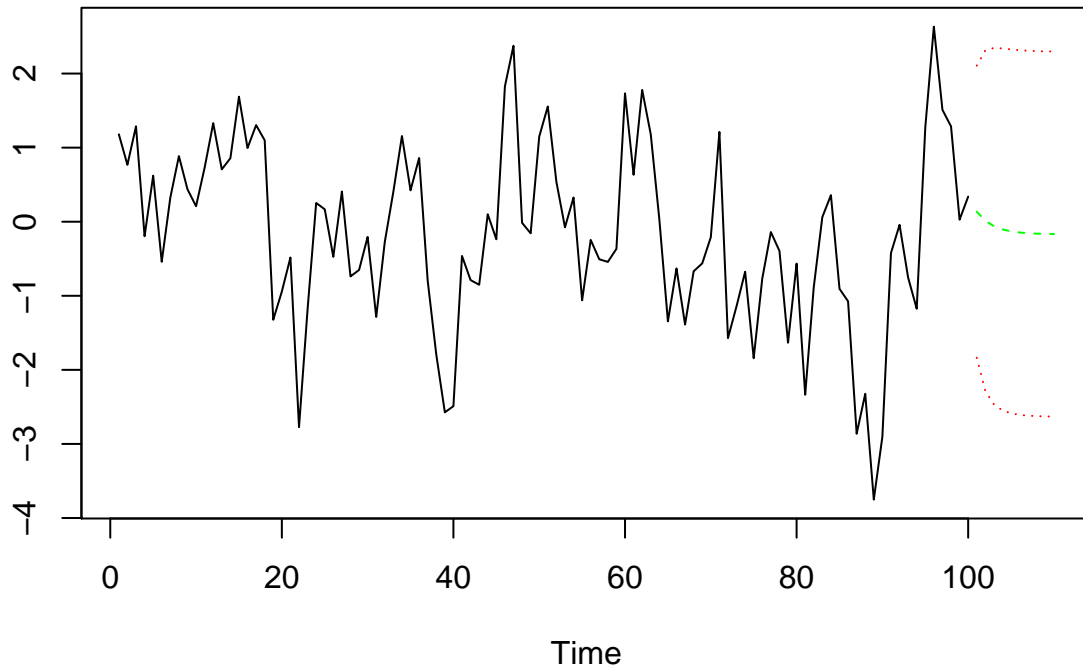
```
alpha1 <- 0.5
x <- arima.sim(model = list(ar=alpha1), n = n)
par(mfrow = c(2,1), mar = c(5,4,1,0))
plot(x)
acf(x)
```



```
fit <- ar(x)
fit$ar

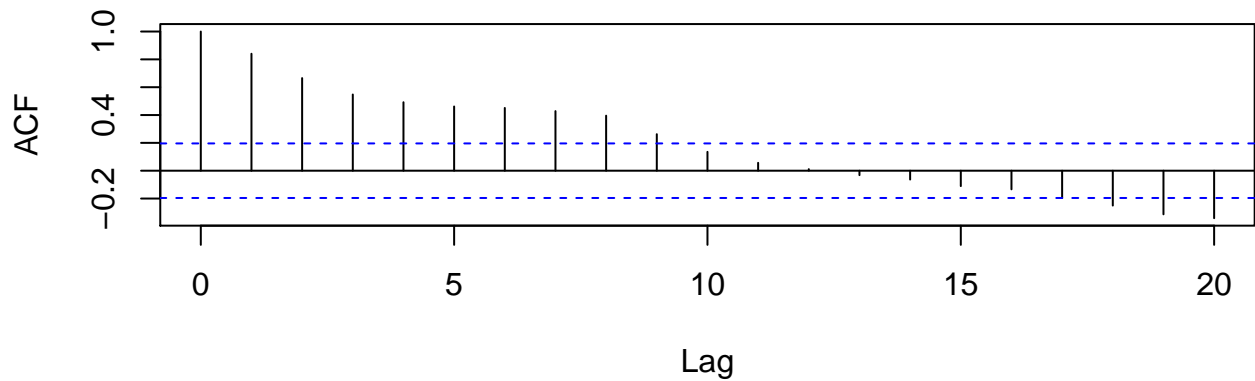
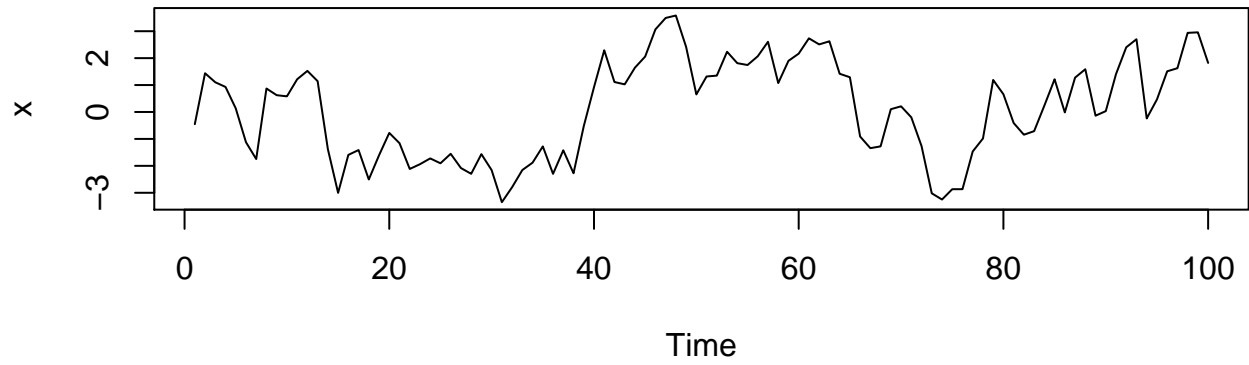
## [1] 0.5995147

pred <- predict(fit, n.ahead = n_ahead)
lower <- pred$pred - 2*pred$se
upper <- pred$pred + 2*pred$se
ts.plot(x, pred$pred, lower, upper, lty = c(1,2,3,3), col = c("black", "green", "red", "red"))
```



Case 4: $\alpha_1 = 0.9$

```
alpha1 <- 0.9
x <- arima.sim(model = list(ar=alpha1), n = n)
par(mfrow = c(2,1), mar = c(5,4,1,0))
plot(x)
acf(x)
```



```

fit <- ar(x)
fit$ar

## [1] 0.951951380 -0.213700668 0.026241782 0.073826800 -0.009115758
## [6] 0.096761764 -0.085827935 0.336464508 -0.342616001

pred <- predict(fit, n.ahead = n_ahead)
lower <- pred$pred - 2*pred$se
upper <- pred$pred + 2*pred$se
ts.plot(x, pred$pred, lower, upper, lty = c(1,2,3,3), col = c("black", "green", "red", "red"))

```

