

# Auto-regressive model of order 1

## Simulation of AR(1)

Simulate time series of length 100 from four different AR(1) models with  $\alpha_1$  equal to a) -0.9, b) -0.5, c) 0.5, d) 0.9 respectively. For each model:

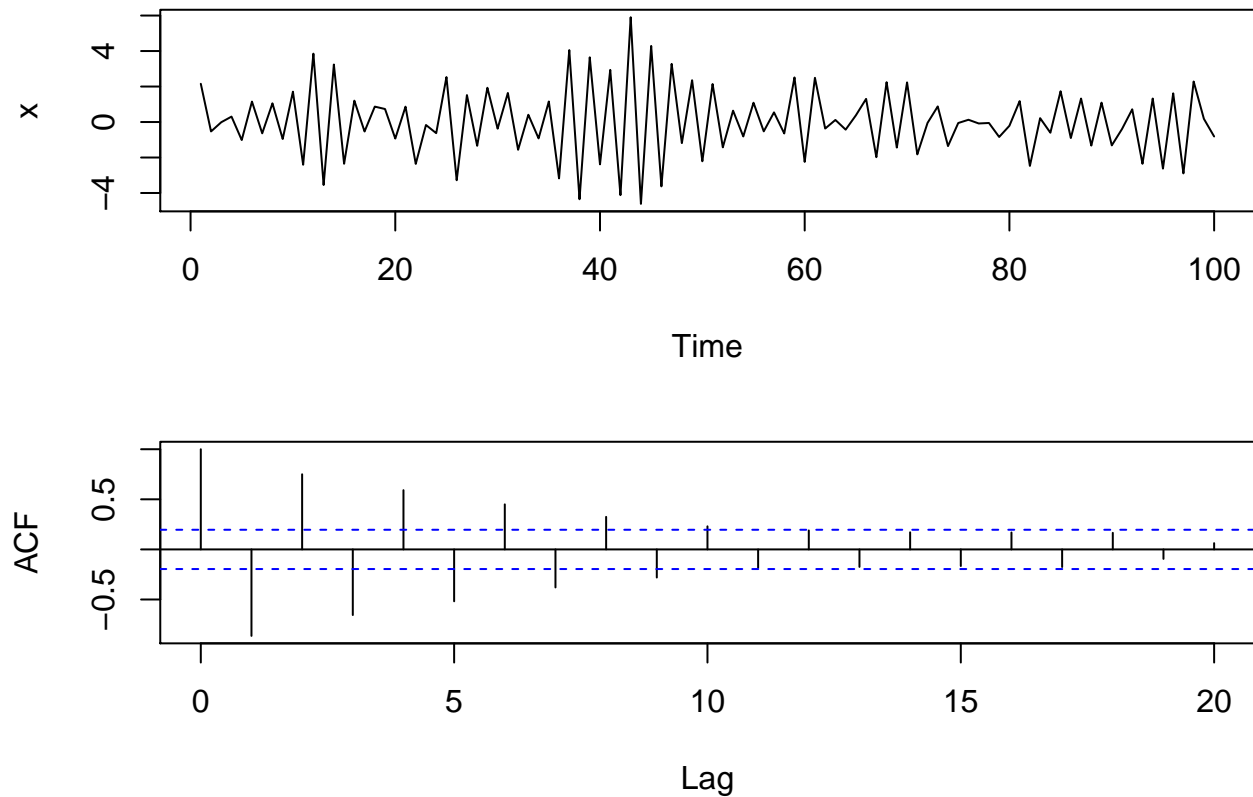
- Plot the correlogram
- Estimate the parameters
- Make predictions for 1 to 10 steps ahead.

Common for all cases:

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

Case 1:  $\alpha_1 = -0.9$

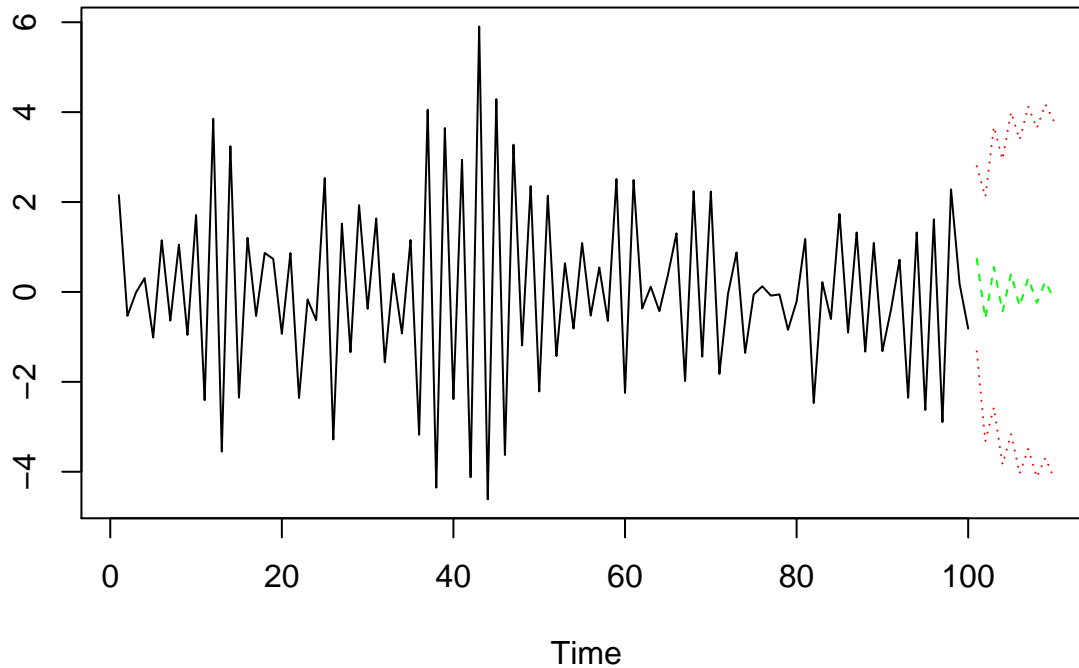
```
alpha1 <- -0.9
x <- arima.sim(model = list(ar=alpha1), n = n)
par(mfrow = c(2,1), mar = c(5,4,1,0))
plot(x)
acf(x)
```



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

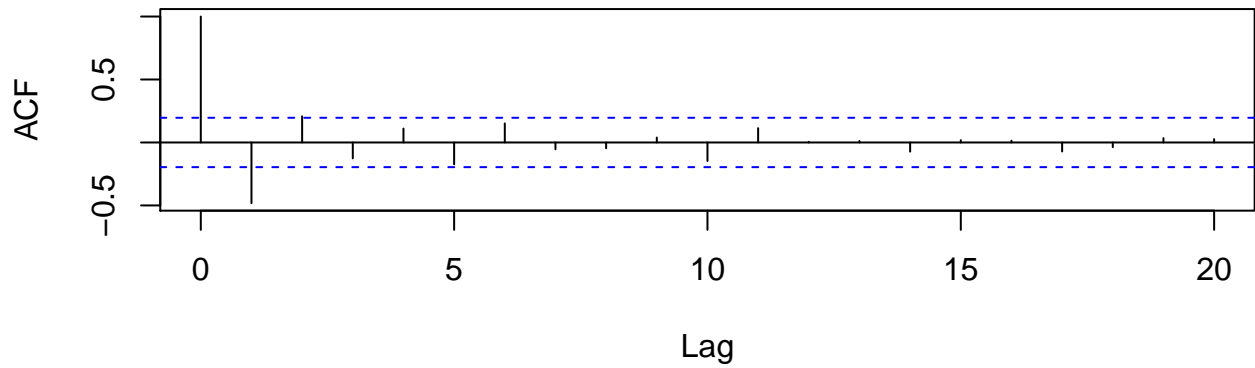
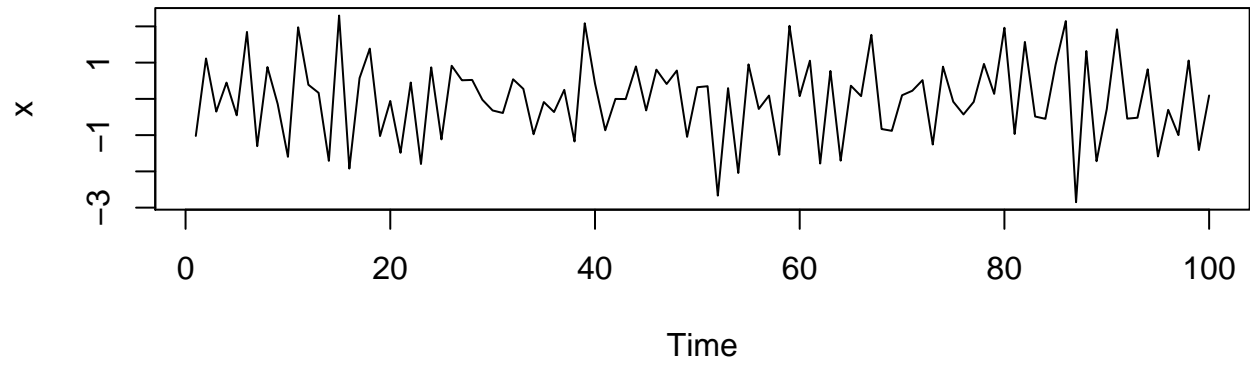
```
## [1] -0.8633731
```

```
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:  $\alpha_1 = -0.5$

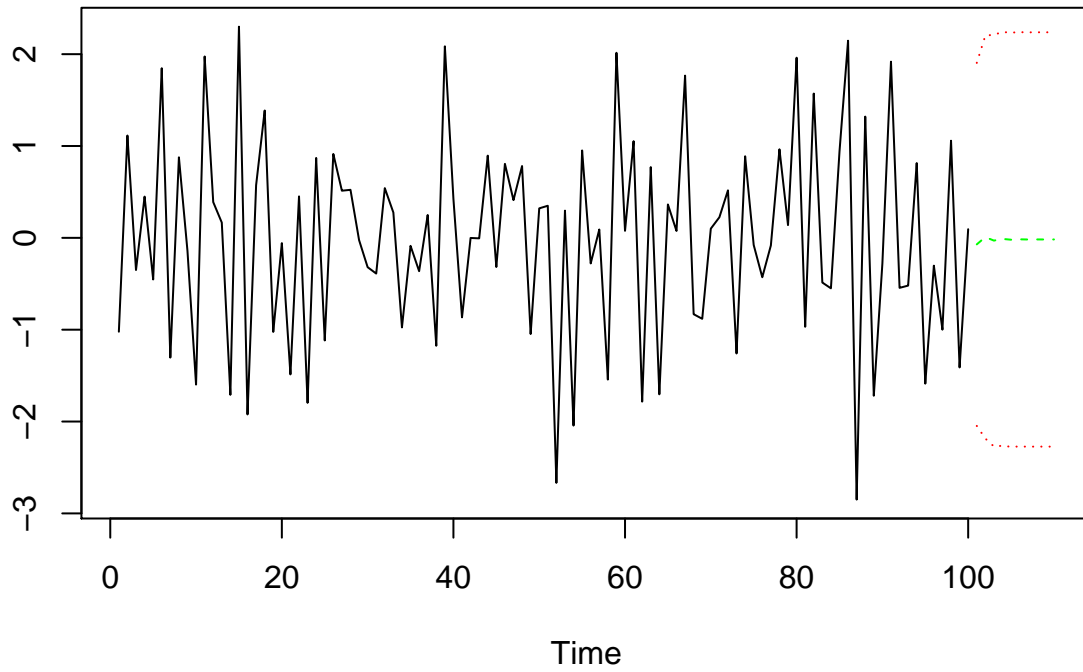
```
alpha1 <- -0.5
x <- arima.sim(model = list(ar=alpha1), n = n)
par(mfrow = c(2,1), mar = c(5,4,1,0))
plot(x)
acf(x)
```



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

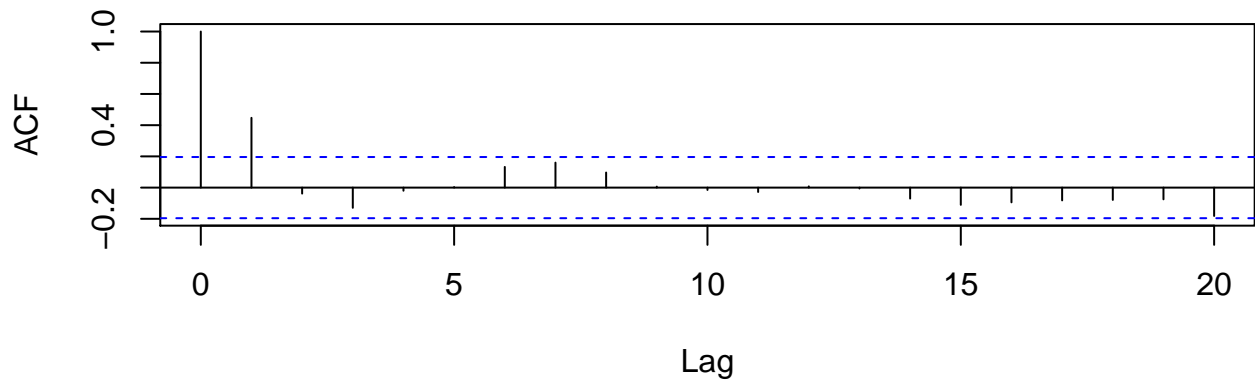
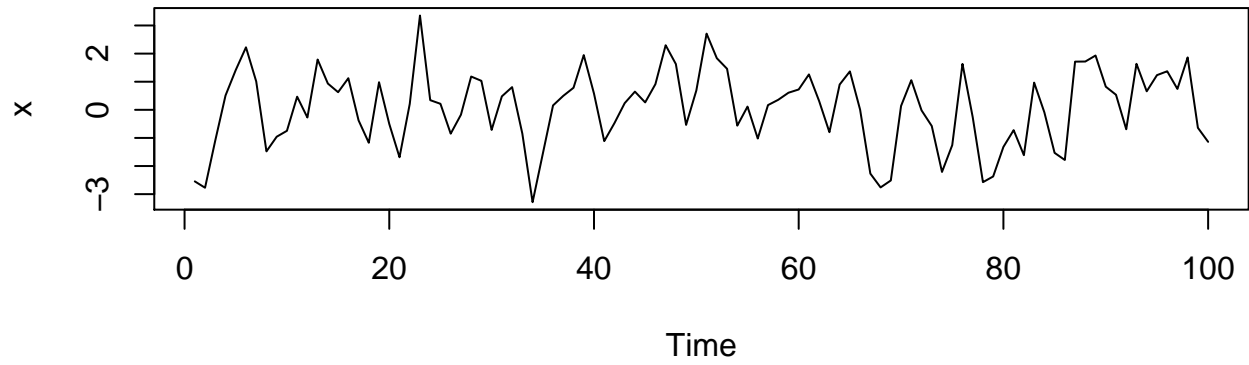
```
## [1] -0.4822487
```

```
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:  $\alpha_1 = 0.5$

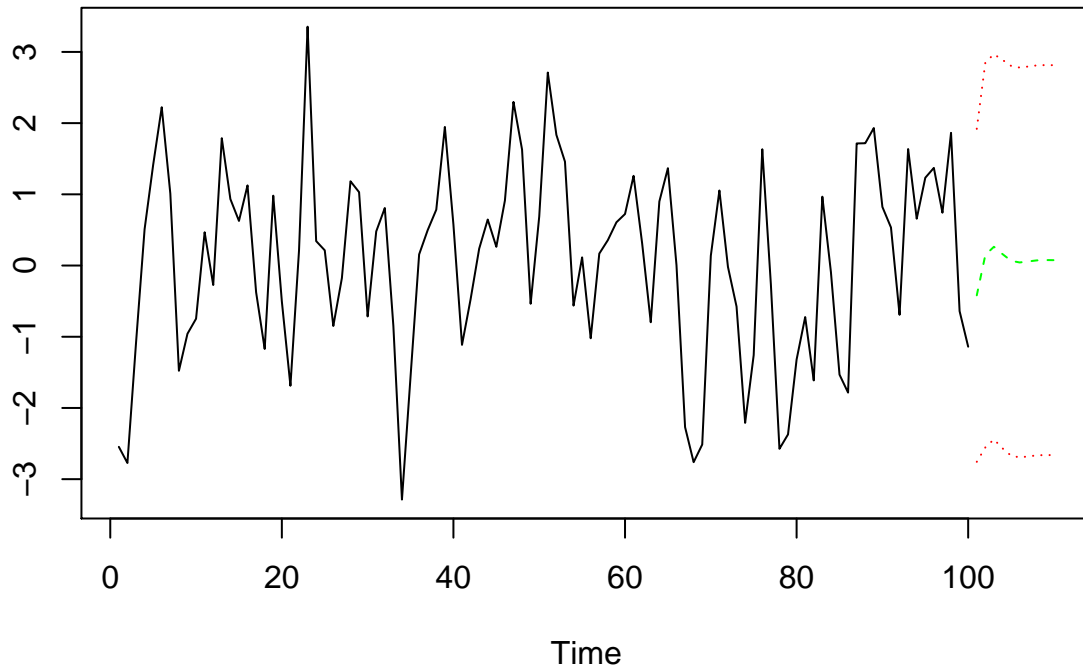
```
alpha1 <- 0.5
x <- arima.sim(model = list(ar=alpha1), n = n)
par(mfrow = c(2,1), mar = c(5,4,1,0))
plot(x)
acf(x)
```



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

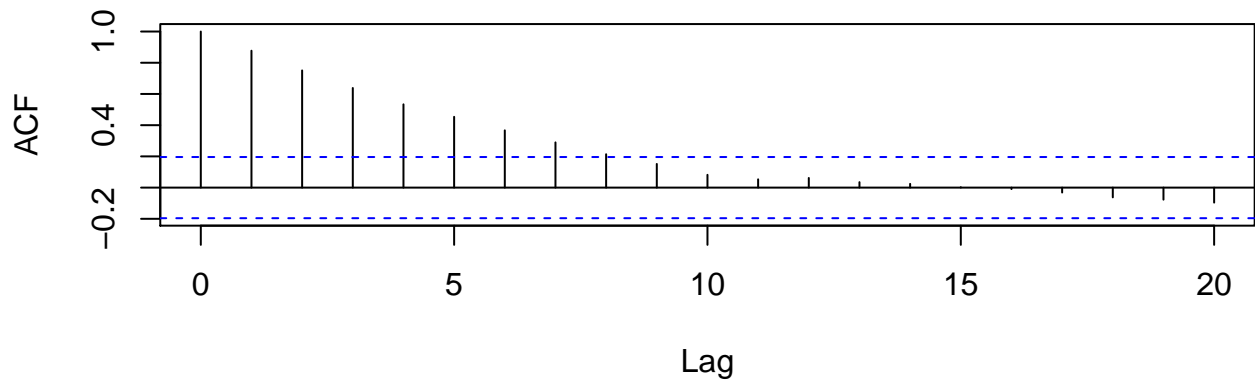
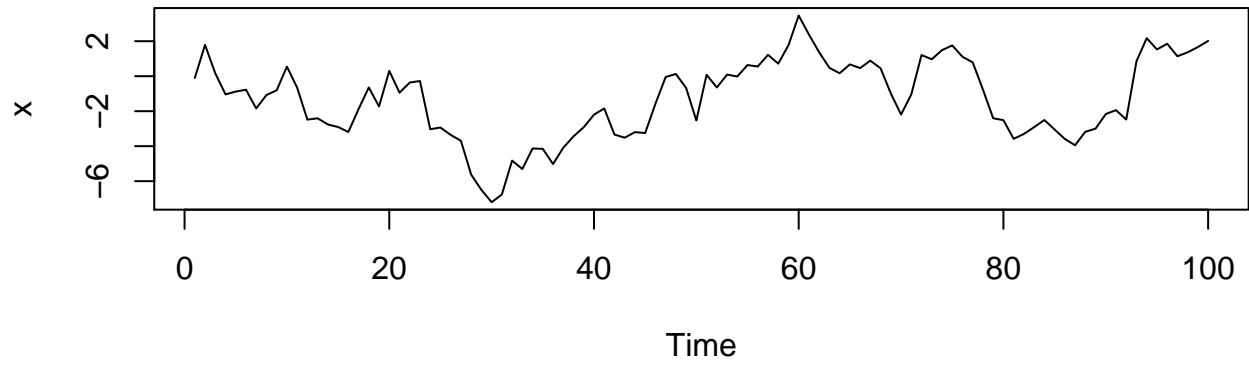
## [1] 0.5803586 -0.2979246

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] 0.8772291
```

```
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"))
```

