MATH 8090: Nonstationary Time Series Models

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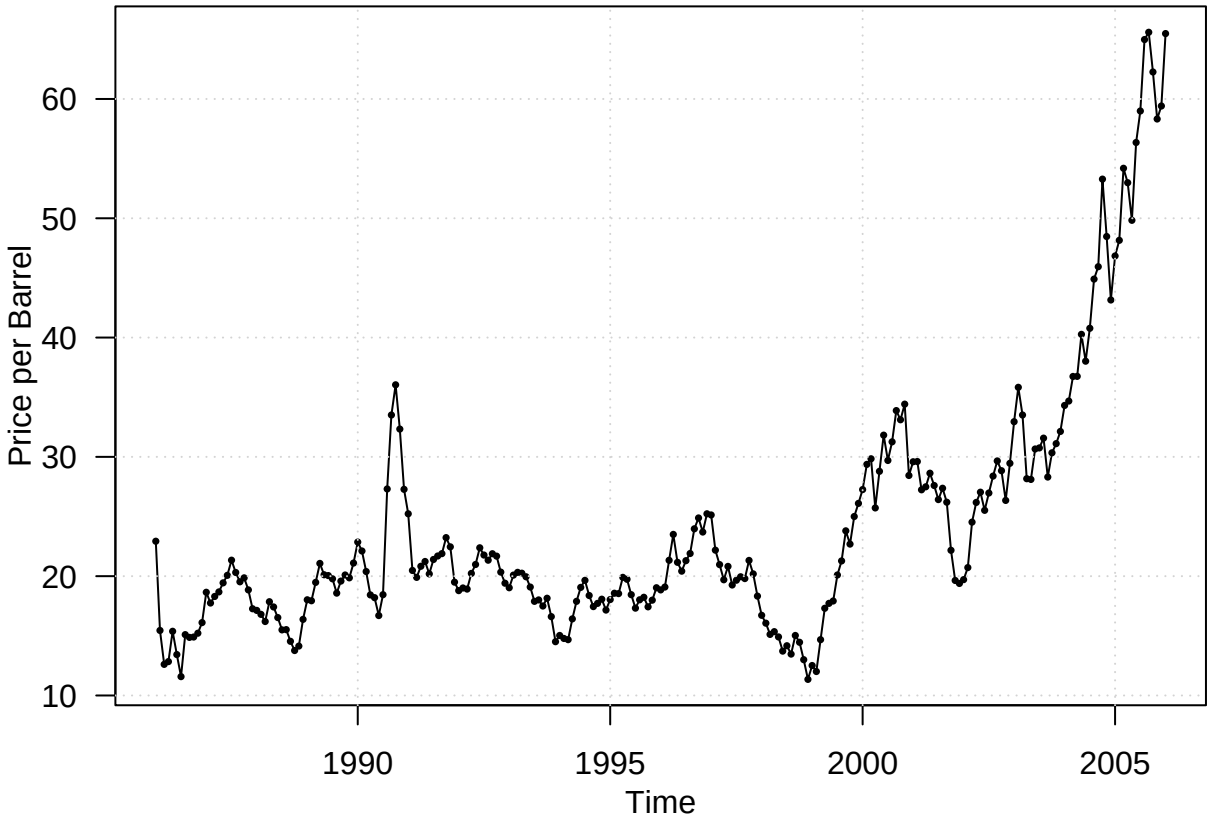
Contents

Monthly Price of Oil: January 1986–January 2006

```
library(TSA)
data(oil.price)

par(las = 1, mgp = c(2, 1, 0), mar = c(3.5, 3.5, 0.8, 0.6))
plot(oil.price, ylab = 'Price per Barrel', type = 'l')
points(oil.price, pch = 16, cex = 0.5)
grid()
```

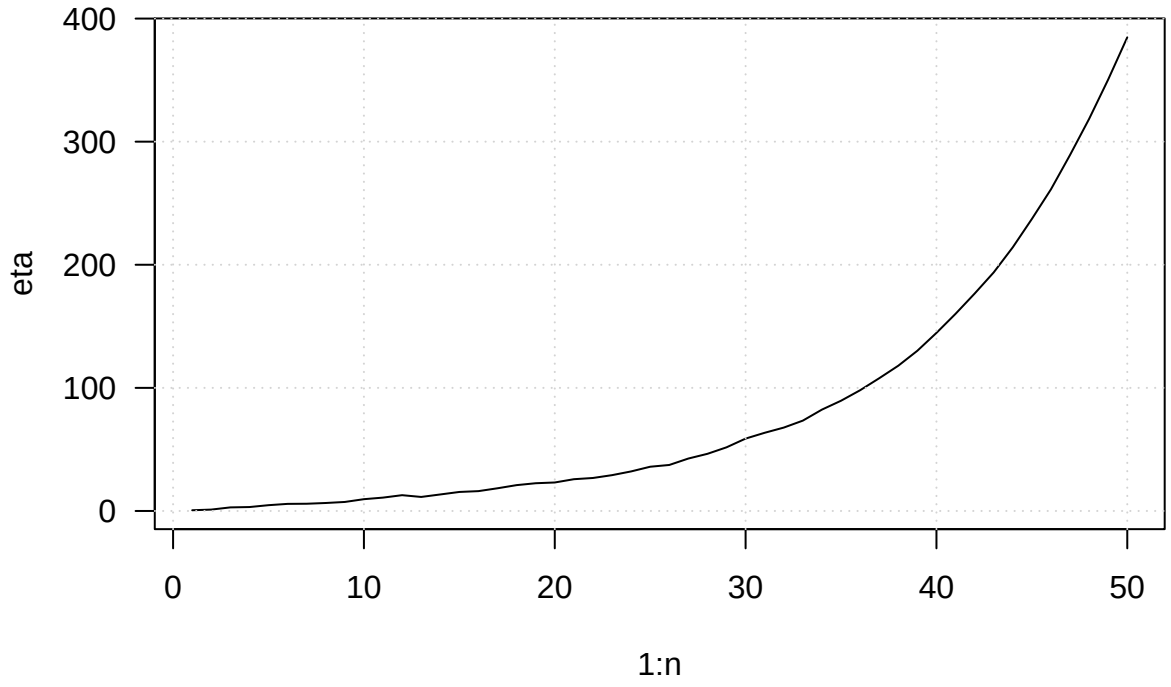


A stationary model does not seem to be reasonable. However, it is also not clear which (deterministic) trend model is appropriate

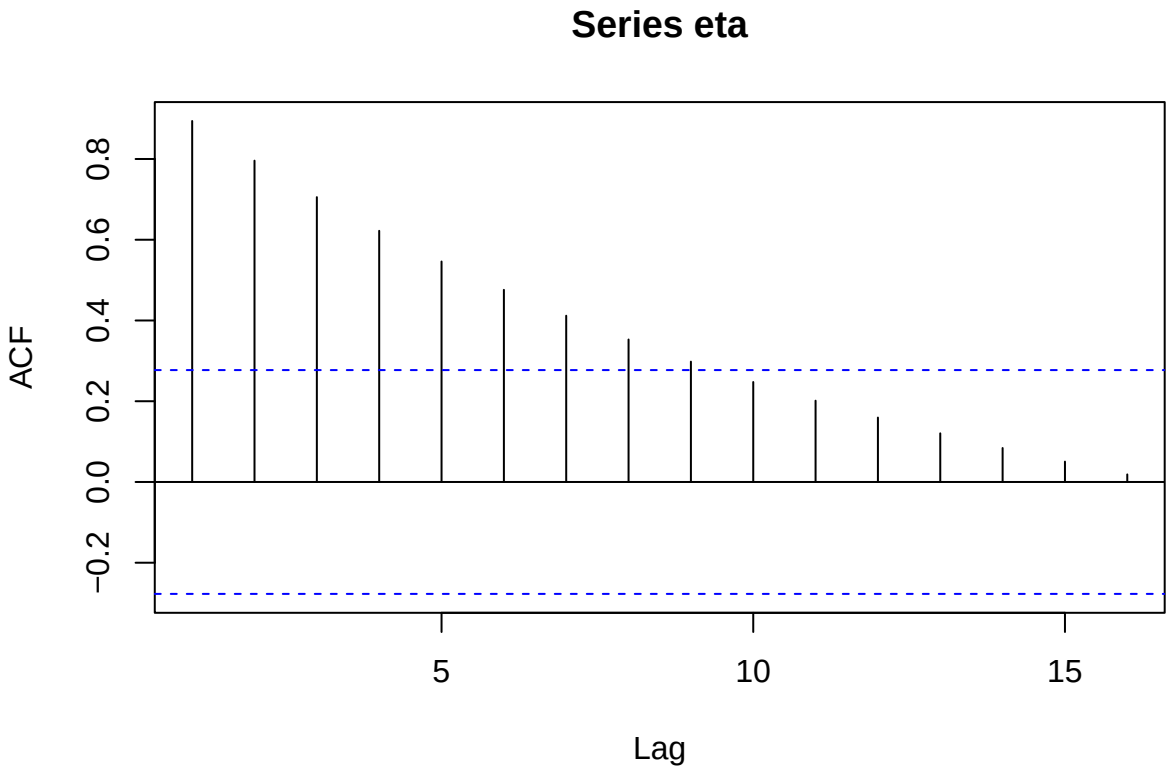
An explosive AR model

$\eta_t = 1.1\eta_{t-1} + Z_t$

```
n <- 50; phi <- 1.1
set.seed(128)
z <- rnorm(n)
eta <- c()
eta[1] <- z[1]
for (i in 2:n) eta[i] <- phi * eta[i - 1] + z[i]
plot(1:n, eta, las = 1, type = "l")
grid()
```



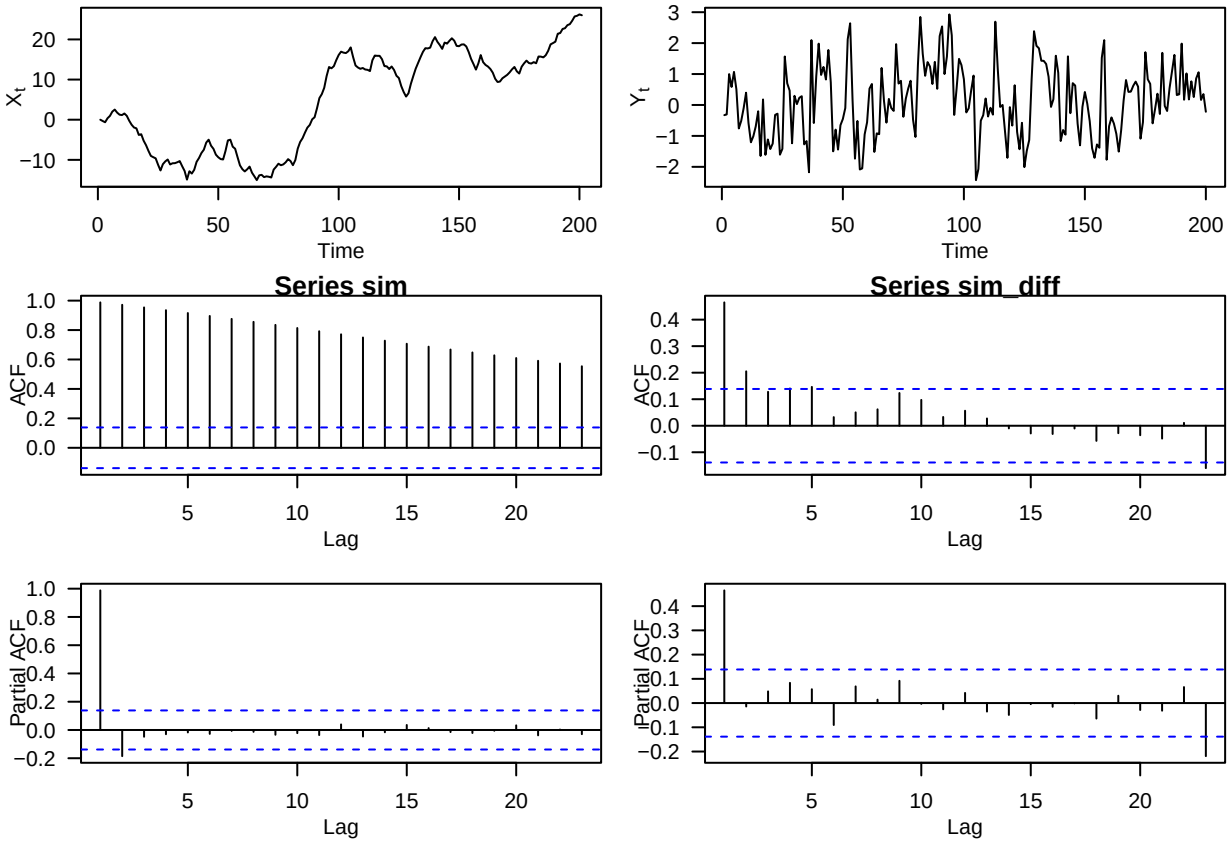

```
acf(eta)
```



ARIMA(1,1,0)

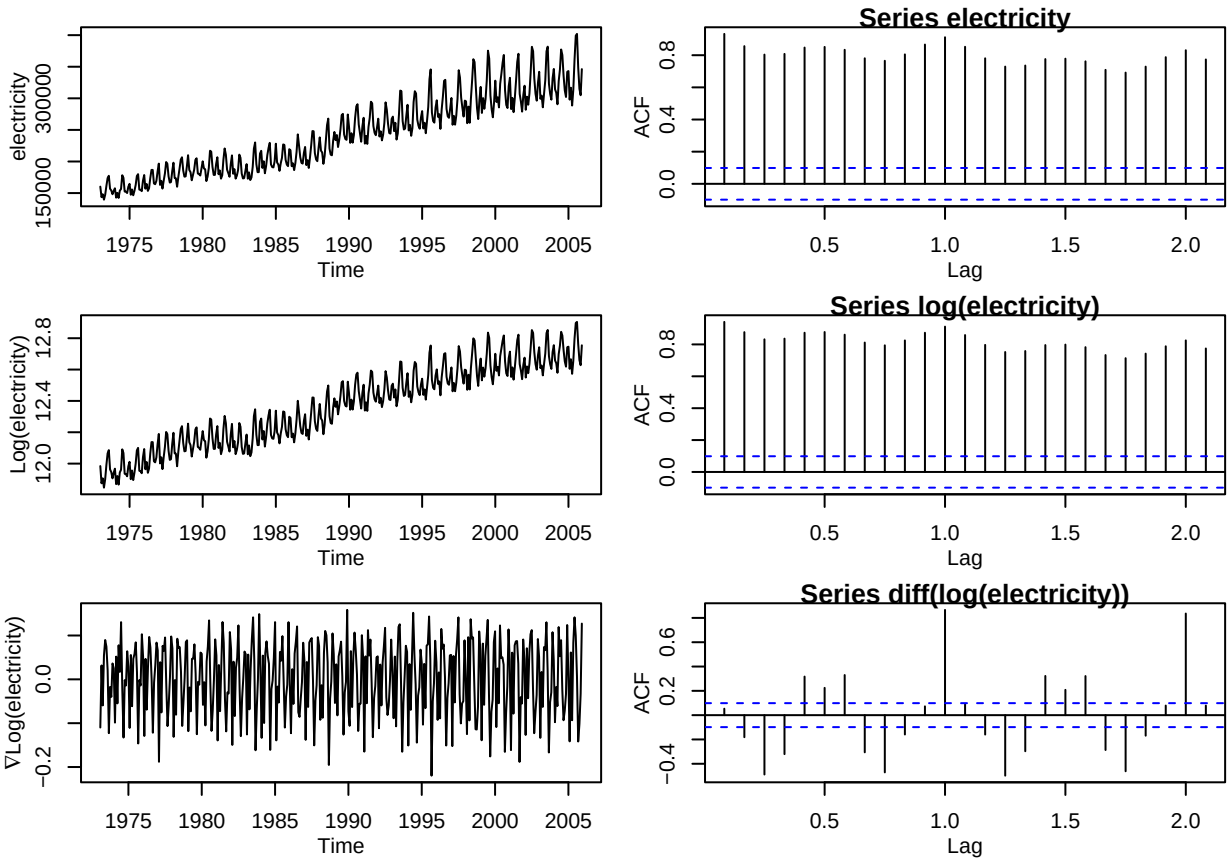
```r
sim <- arima.sim(list(order = c(1, 1, 0), ar = 0.5), n = 200)
sim_diff <- diff(sim)

par(las = 1, mgp = c(2, 1, 0), mar = c(3.5, 3.5, 0.8, 0.6), mfrow = c(3, 2))
plot(1:201, sim, type = "l", ylab = expression(X[t]), xlab = "Time")
plot(1:200, sim_diff, type = "l", ylab = expression(Y[t]), xlab = "Time")
acf(sim)
acf(sim_diff)
pacf(sim)
pacf(sim_diff)
```




```r
library(TSA)
data(electricity)

par(mgp = c(2, 1, 0), mar = c(3.5, 3.5, 0.8, 0.6), mfrow = c(3, 2))
plot(electricity)
acf(electricity)
plot(log(electricity), ylab = "Log(electricity)")
acf(log(electricity))
plot(diff(log(electricity)),
ylab = expression(paste(nabla, 'Log(electricity)')))
acf(diff(log(electricity)))
```


electricity
150000
300000
1975
1980
1985
1990
1995
2000
2005
Time
Series electricity
ACF
0.0
0.4
0.8
0.5
1.0
1.5
2.0
Lag
Log(electricity)
12.0
12.4
12.8
Series log(electricity)
∇Log(electricity)
−0.2
0.0
Series diff(log(electricity))
0.2
0.6
−0.4