

Économétrie – TD 4 : ARMA & Pétrole

Fadli Aaron - Université de Tours — Master 1 (2025-2026)

```
library(astsa)
library(forecast)
```

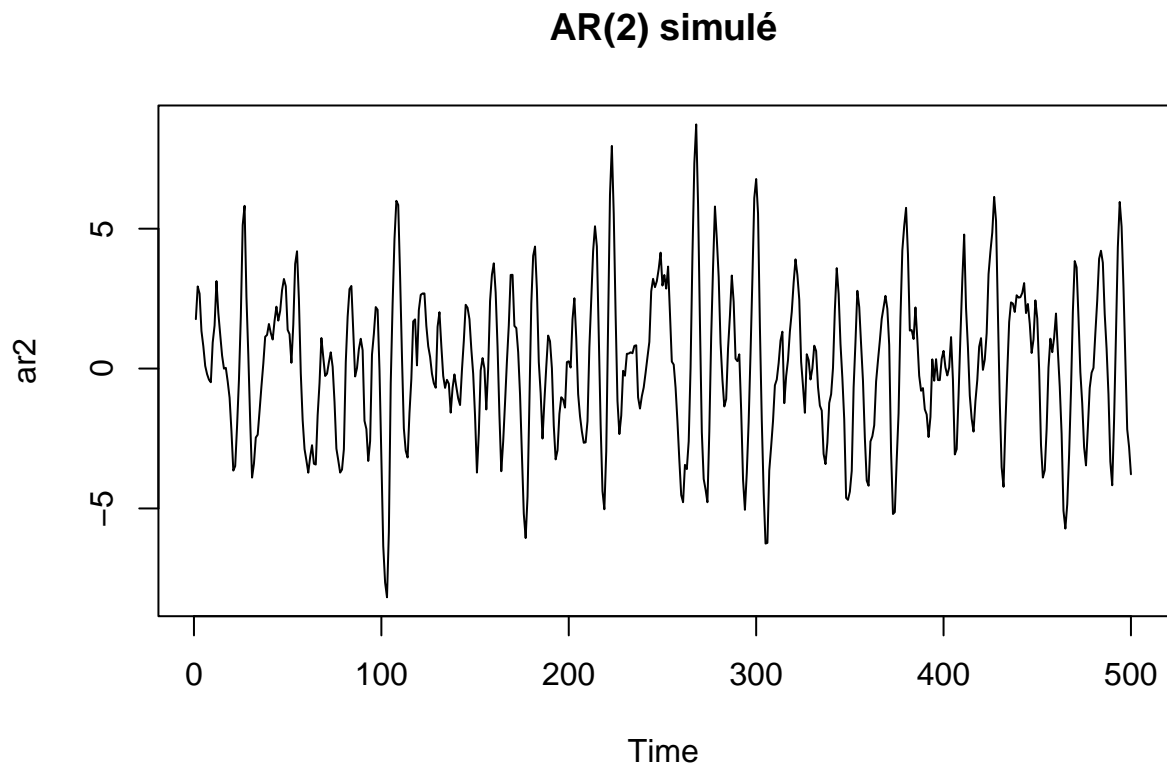
Exercice 1 : Estimation des paramètres d'un ARMA

1. Simulation d'un AR(2)

Série :

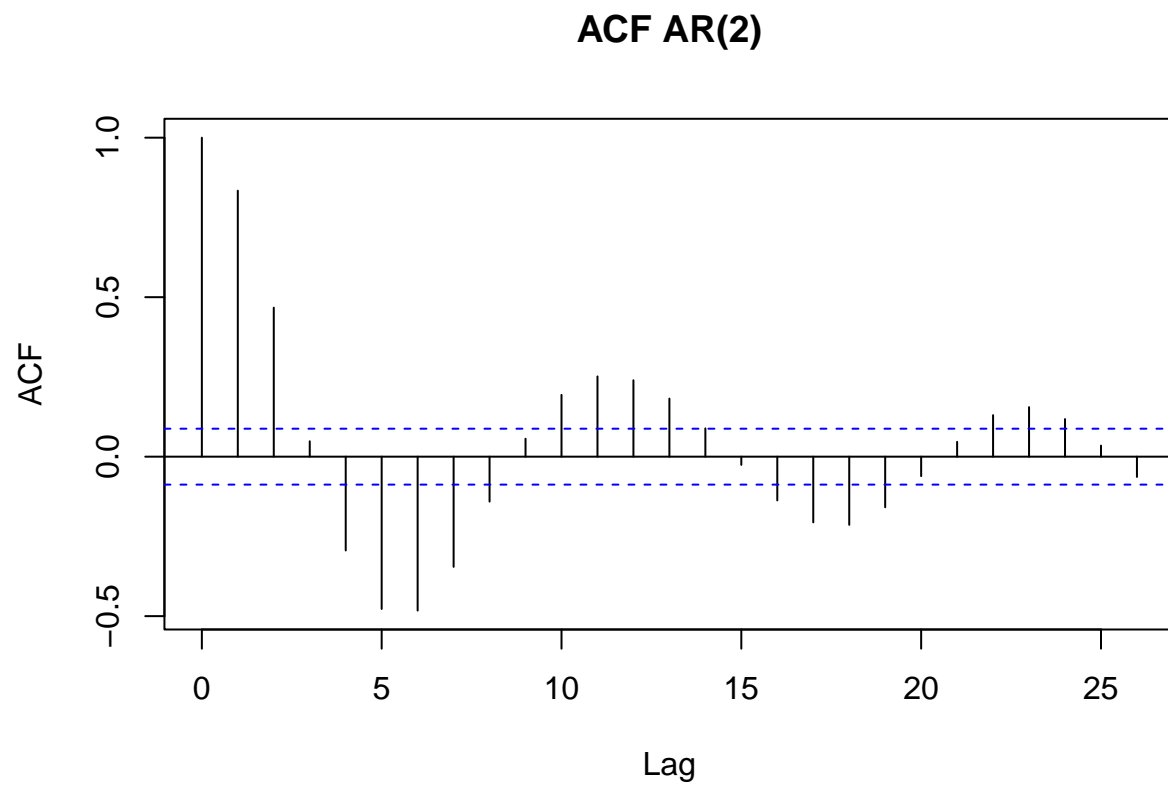
$$X_t = 1.5X_{t-1} - 0.75X_{t-2} + \varepsilon_t, \varepsilon_t \sim BB(0, 1)$$

```
set.seed(123)
ar2 <- arima.sim(list(ar = c(1.5, -0.75)), n = 500)
plot(ar2, main = "AR(2) simulé")
```



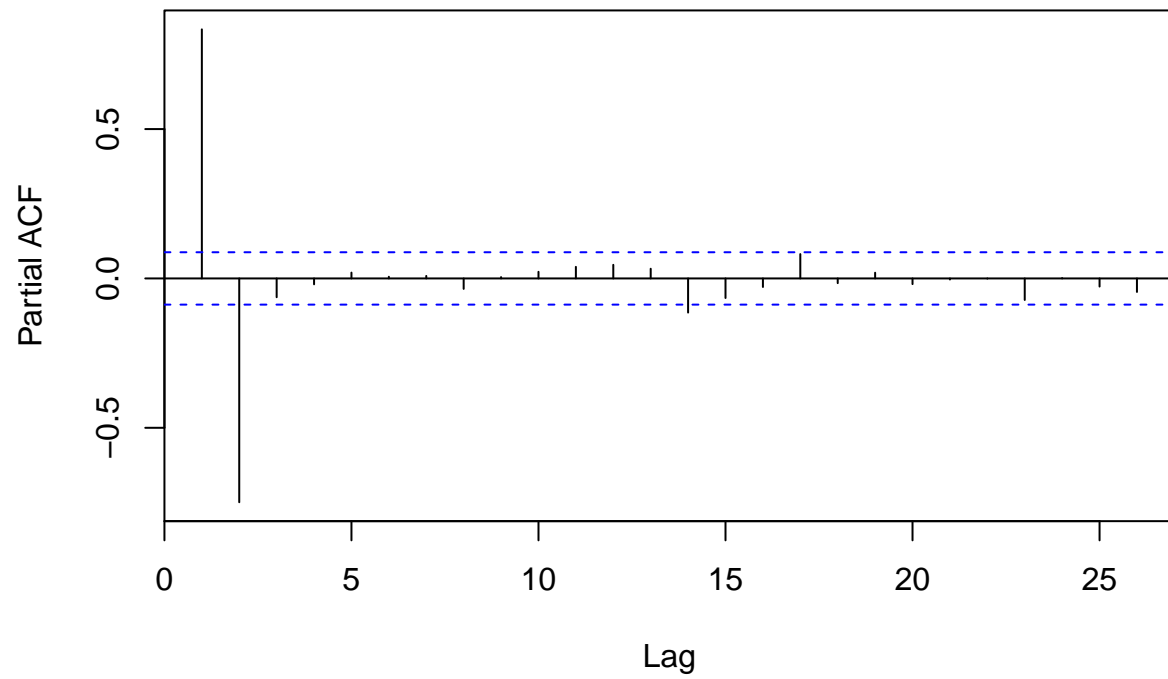
2. ACF et PACF

```
acf(ar2, main = "ACF AR(2)")
```



```
pacf(ar2, main = "PACF AR(2)")
```

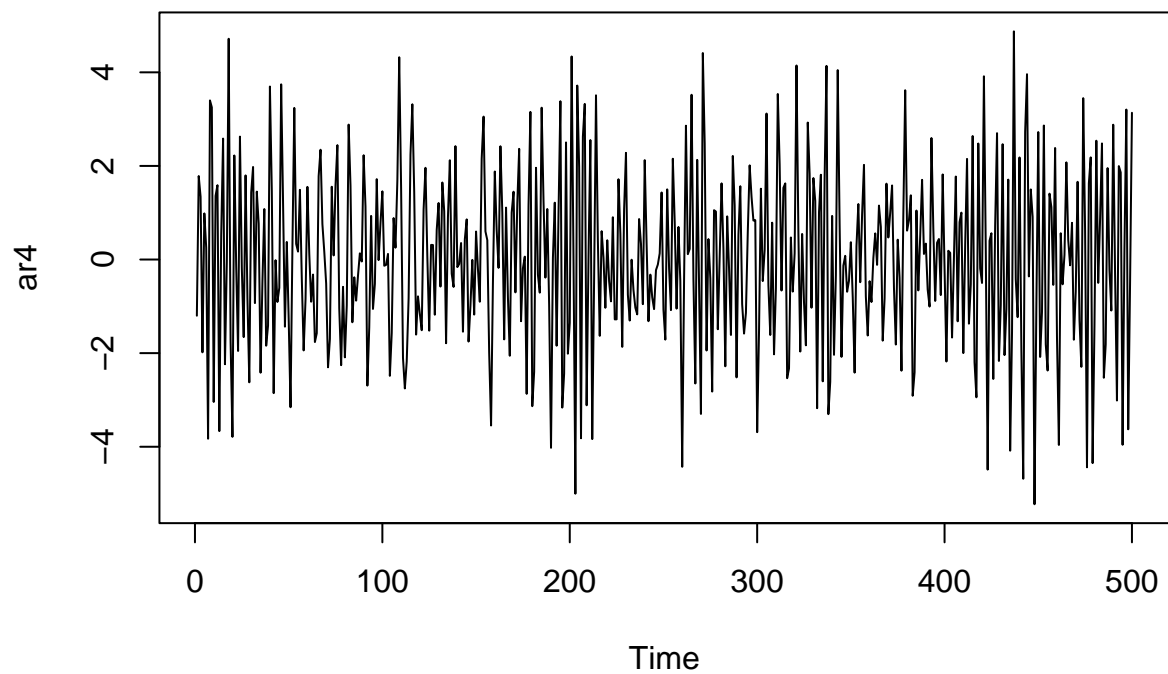
PACF AR(2)



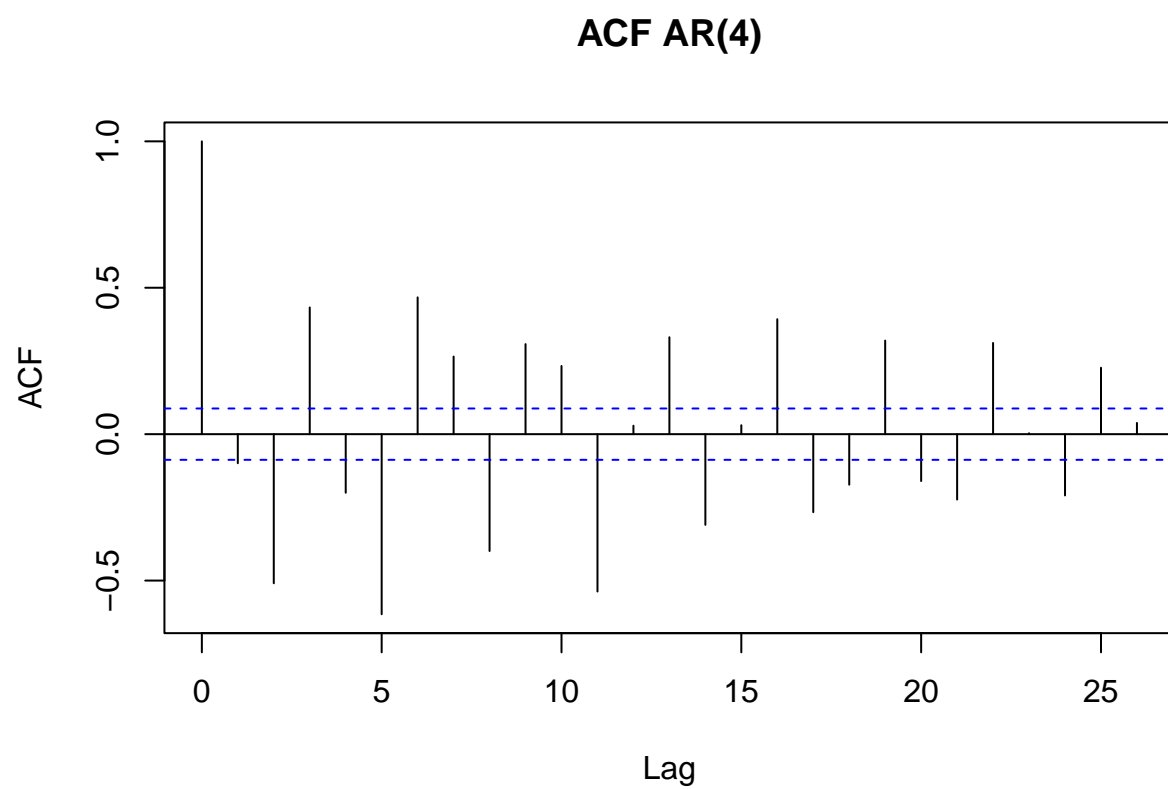
3. Simulation d'un AR(4)

```
set.seed(123)
ar4 <- arima.sim(list(ar = c(0.4, -0.75, 0.5, -0.7)), n = 500)
plot(ar4, main = "AR(4) simulé")
```

AR(4) simulé

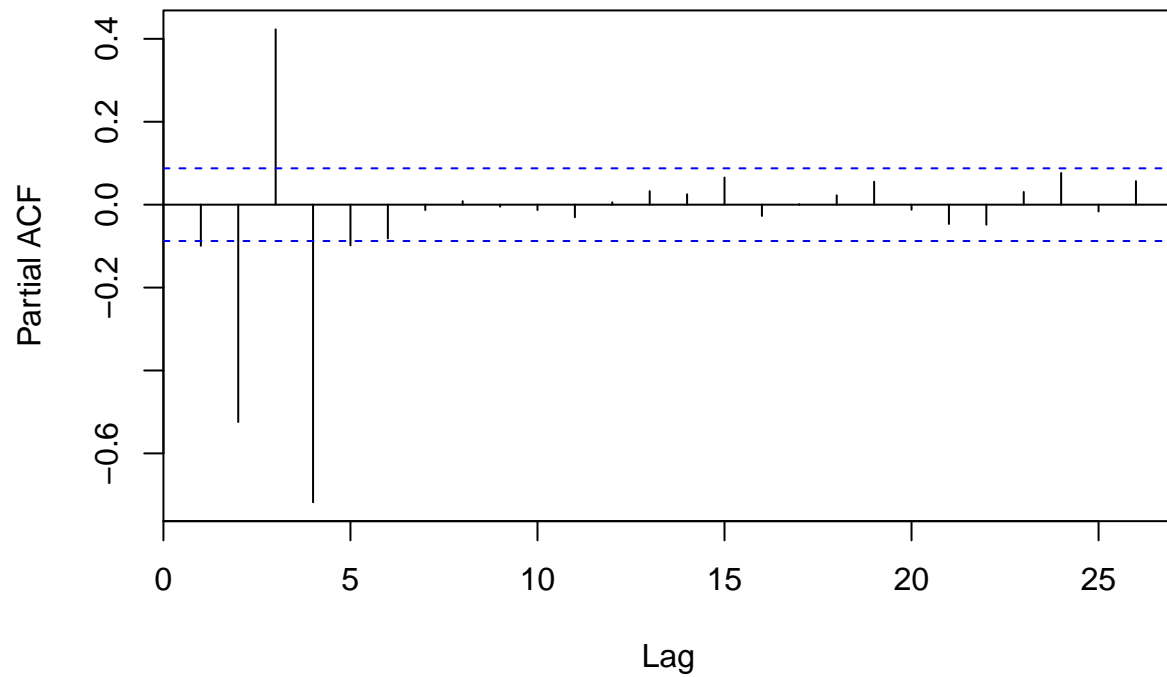


```
acf(ar4, main="ACF AR(4)")
```



```
pacf(ar4, main="PACF AR(4)")
```

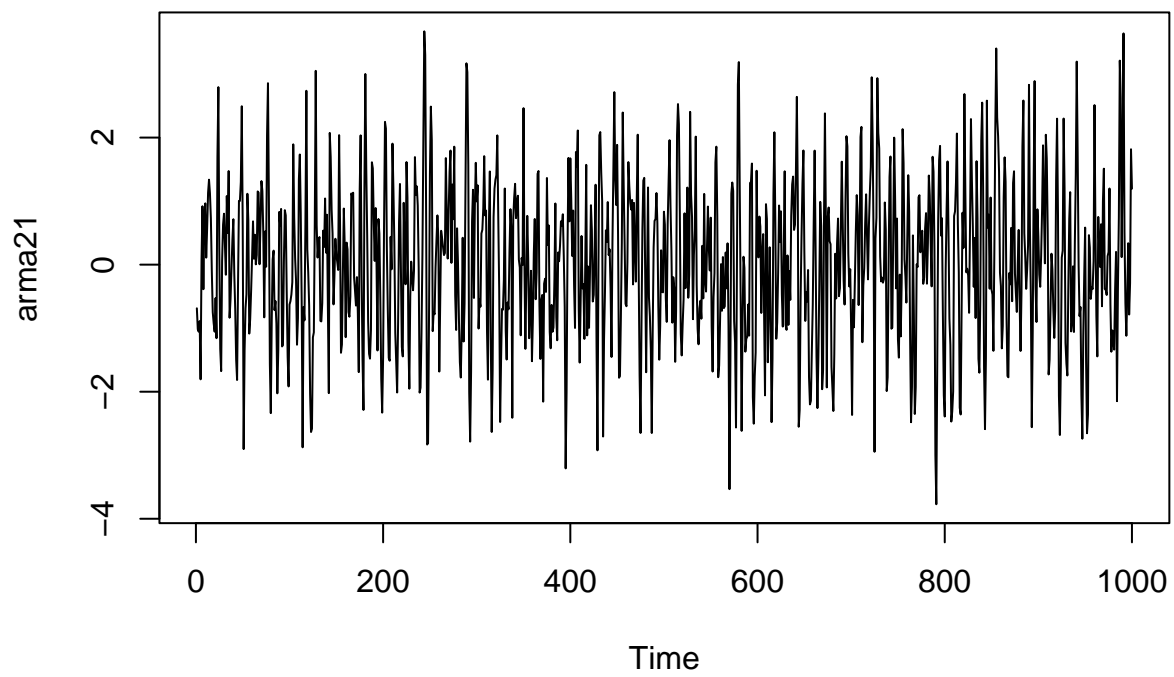
PACF AR(4)



4. Simulation et estimation d'un ARMA(2,1)

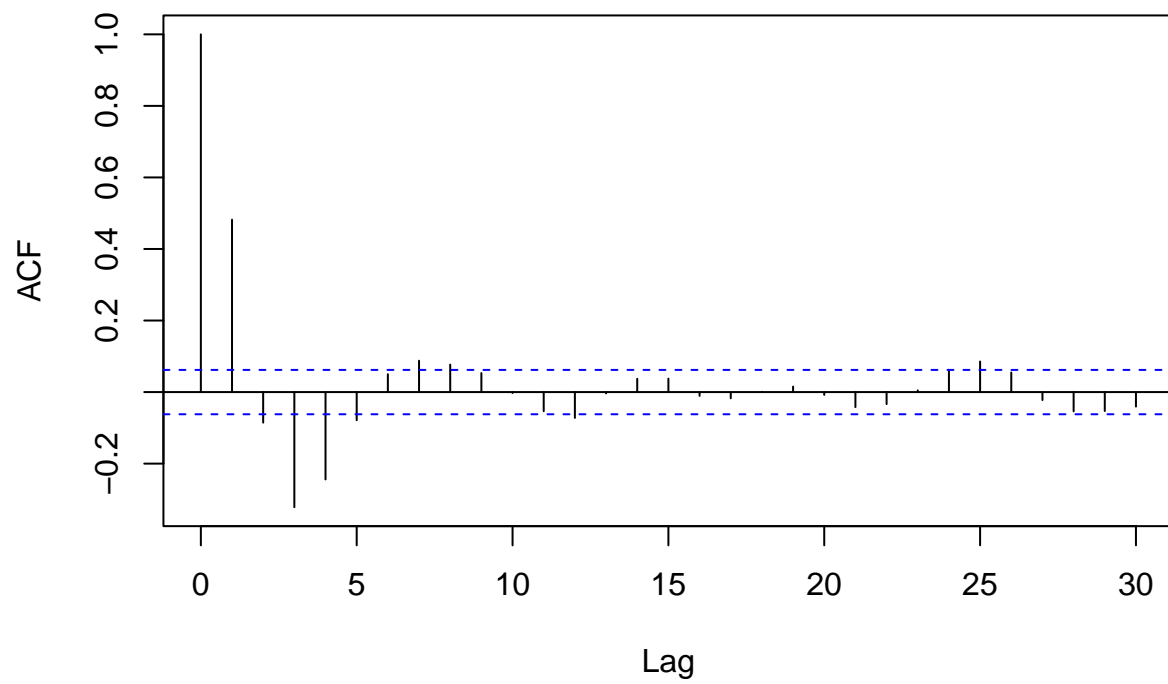
```
set.seed(123)
arma21 <- arima.sim(list(ar=c(0.89, -0.5), ma=-0.23), n=1000)
plot(arma21, main="ARMA(2,1) simulé")
```

ARMA(2,1) simulé

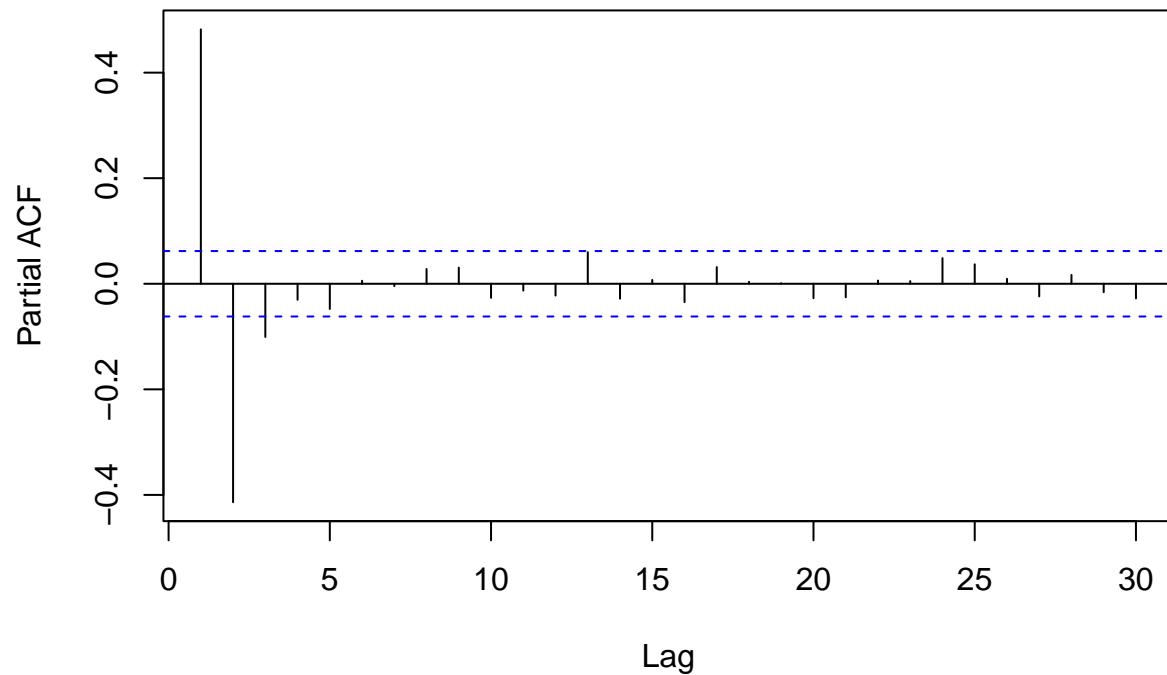


```
acf(arma21); pacf(arma21)
```

Series arma21



Series arma21



auto.arima

```
library(forecast)
fit_auto <- auto.arima(arma21, stationary=TRUE, seasonal=FALSE)
fit_auto
```

Series: arma21 ARIMA(2,0,1) with zero mean

Coefficients: ar1 ar2 ma1 0.9008 -0.5183 -0.2685 s.e. 0.0629 0.0349 0.0736

$\sigma^2 = 1.003$: log likelihood = -1419.23 AIC=2846.45 AICc=2846.49 BIC=2866.08

Estimation

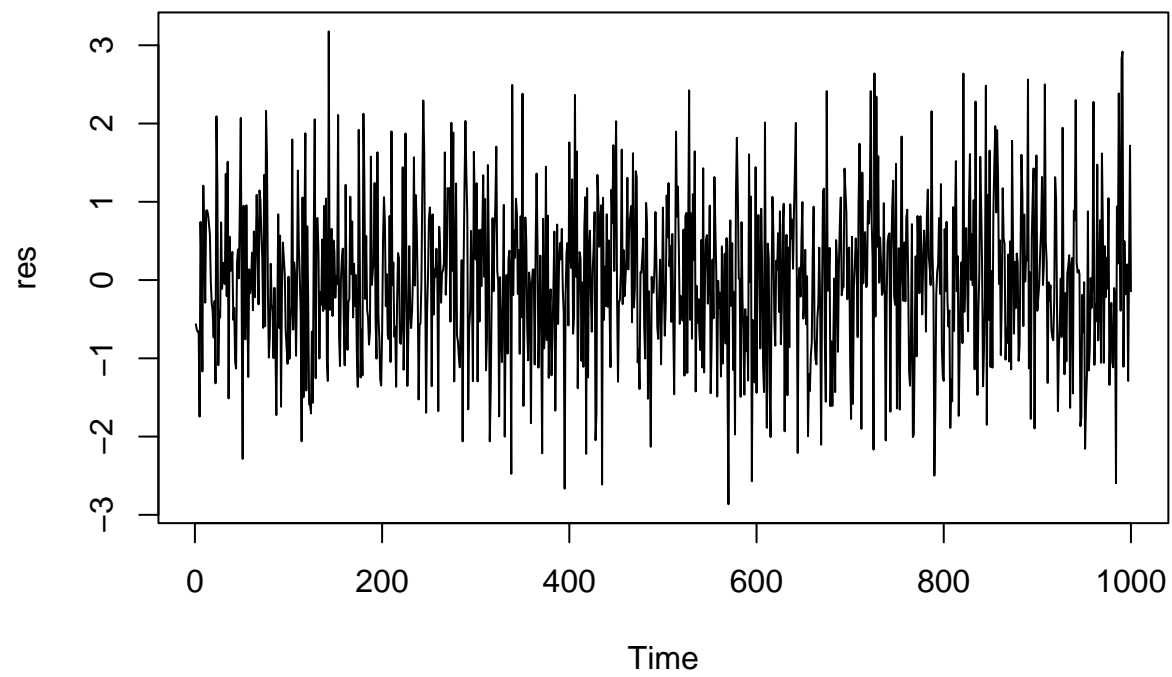
```
fit <- arima(arma21, order=c(2,0,1))
fit
```

Call: arima(x = arma21, order = c(2, 0, 1))

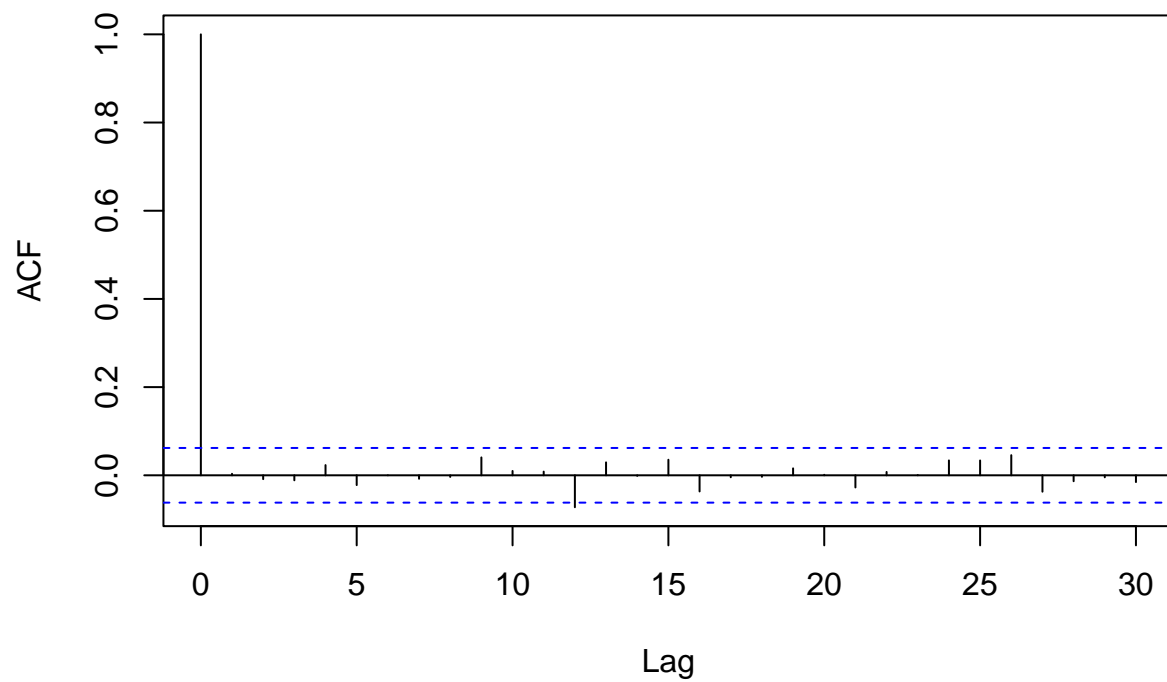
Coefficients: ar1 ar2 ma1 intercept 0.9018 -0.5190 -0.2701 0.0251 s.e. 0.0629 0.0348 0.0736 0.0374

σ^2 estimated as 0.9994: log likelihood = -1419, aic = 2848

```
res <- residuals(fit)
plot(res, type="l"); acf(res)
```



Series res



```
Box.test(res, lag=15, type="Ljung")
```

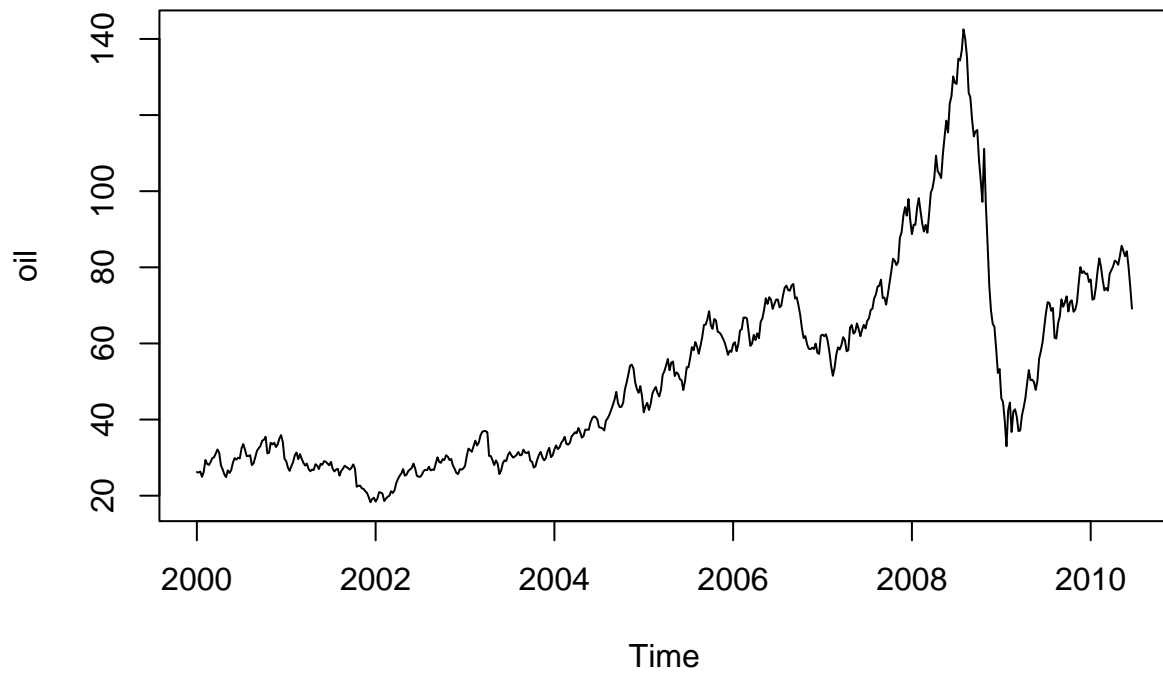
Box-Ljung test

data: res X-squared = 10.633, df = 15, p-value = 0.7781

Exercice 2 : Série pétrolière

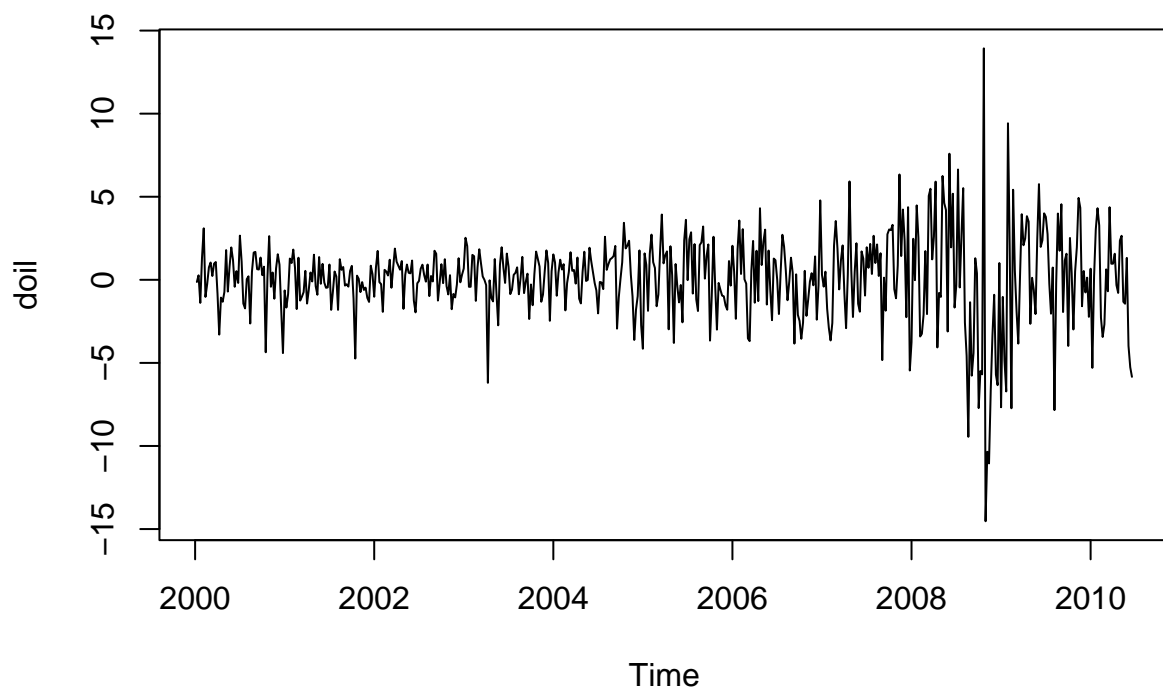
```
library(astsa)  
plot(oil, main="Prix du pétrole")
```

Prix du pétrole



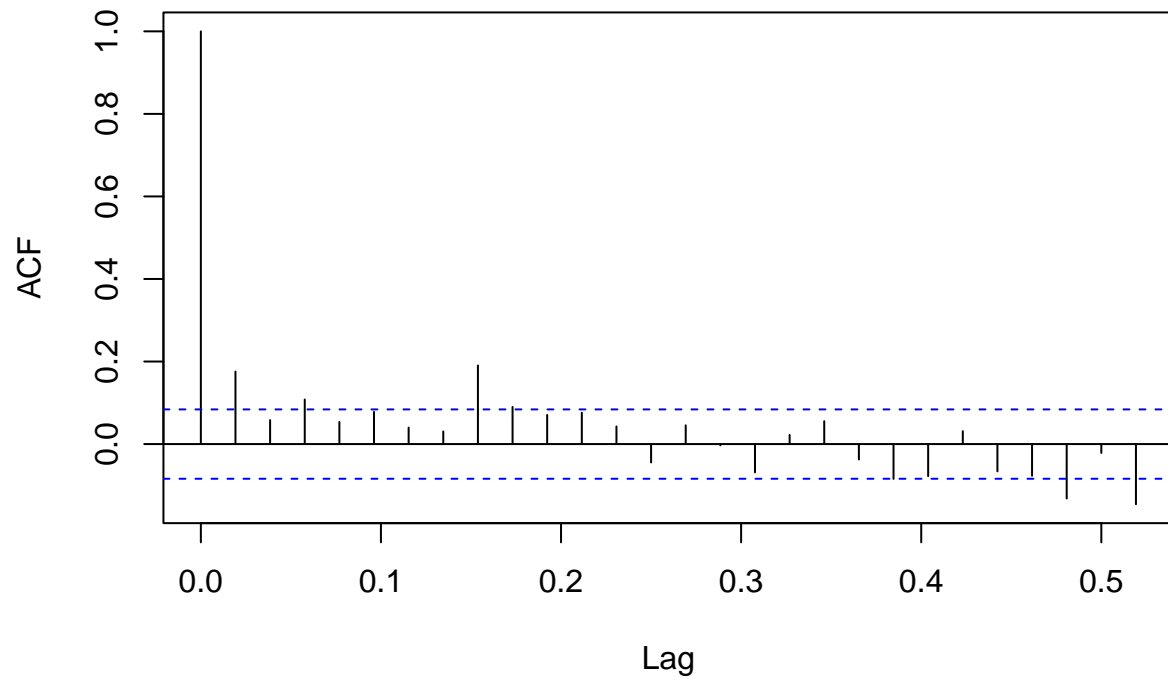
Différenciation

```
doil <- diff(oil)
plot(doil)
```

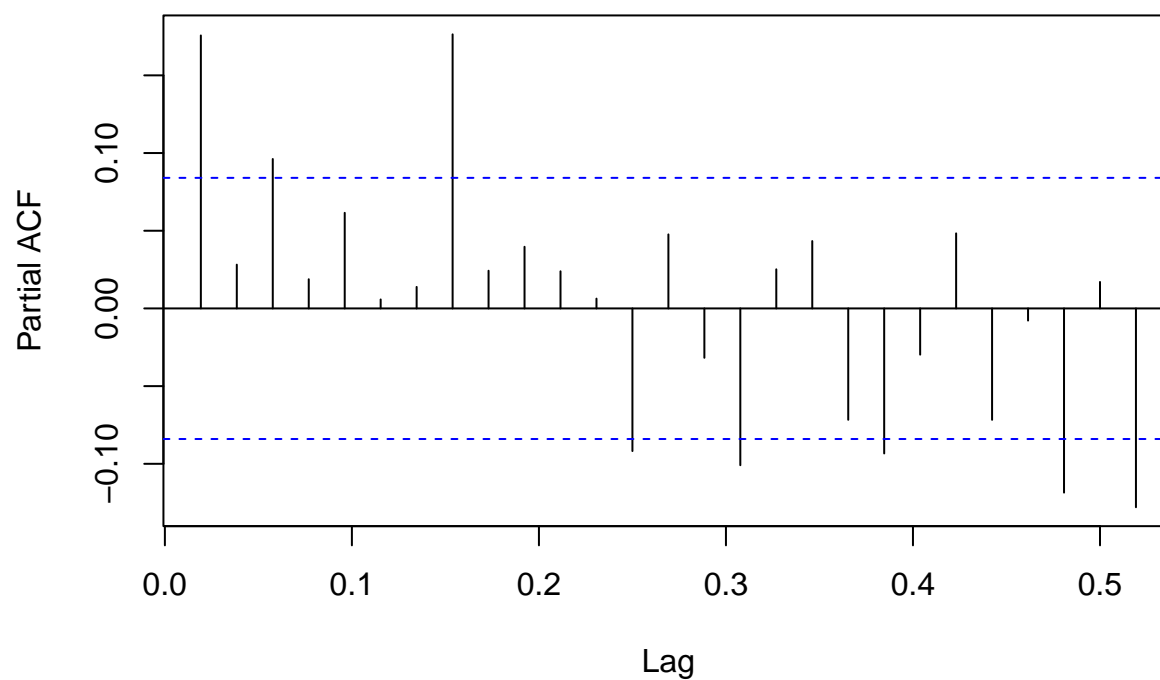


```
acf(doil); pacf(doil)
```

Series doil



Series doil



ARMA sur série différenciée

```
fit_d <- auto.arima(doil, stationary=TRUE, seasonal=FALSE)
fit_d
```

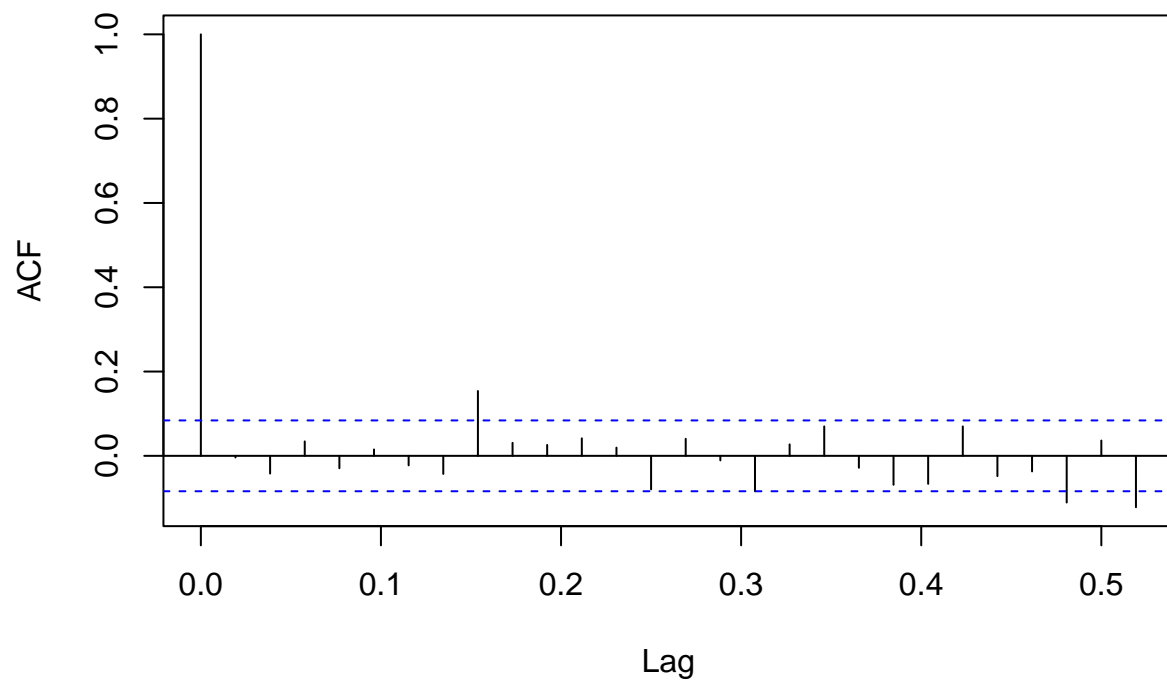
Series: doil ARIMA(1,0,2) with zero mean

Coefficients: ar1 ma1 ma2 0.8943 -0.7337 -0.0724 s.e. 0.0483 0.0658 0.0465

$\sigma^2 = 6.431$: log likelihood = -1276.68 AIC=2561.35 AICc=2561.43 BIC=2578.55

```
acf(residuals(fit_d)); Box.test(residuals(fit_d), lag=15)
```

Series residuals(fit_d)

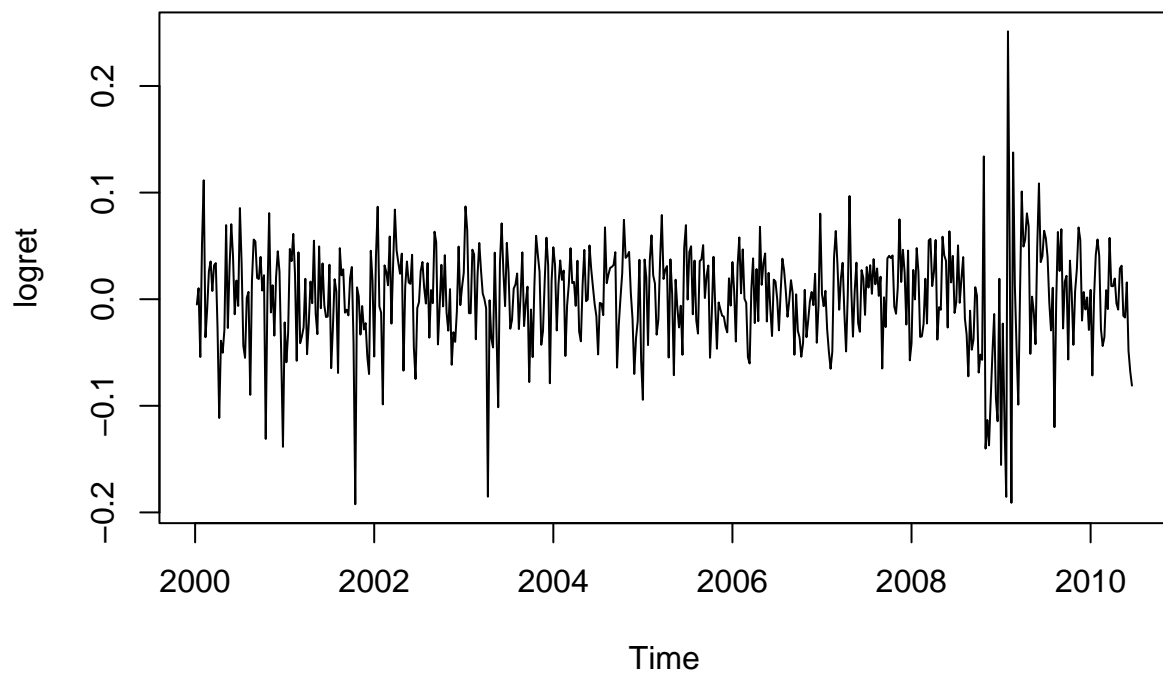


Box-Pierce test

data: residuals(fit_d) X-squared = 22.787, df = 15, p-value = 0.08878

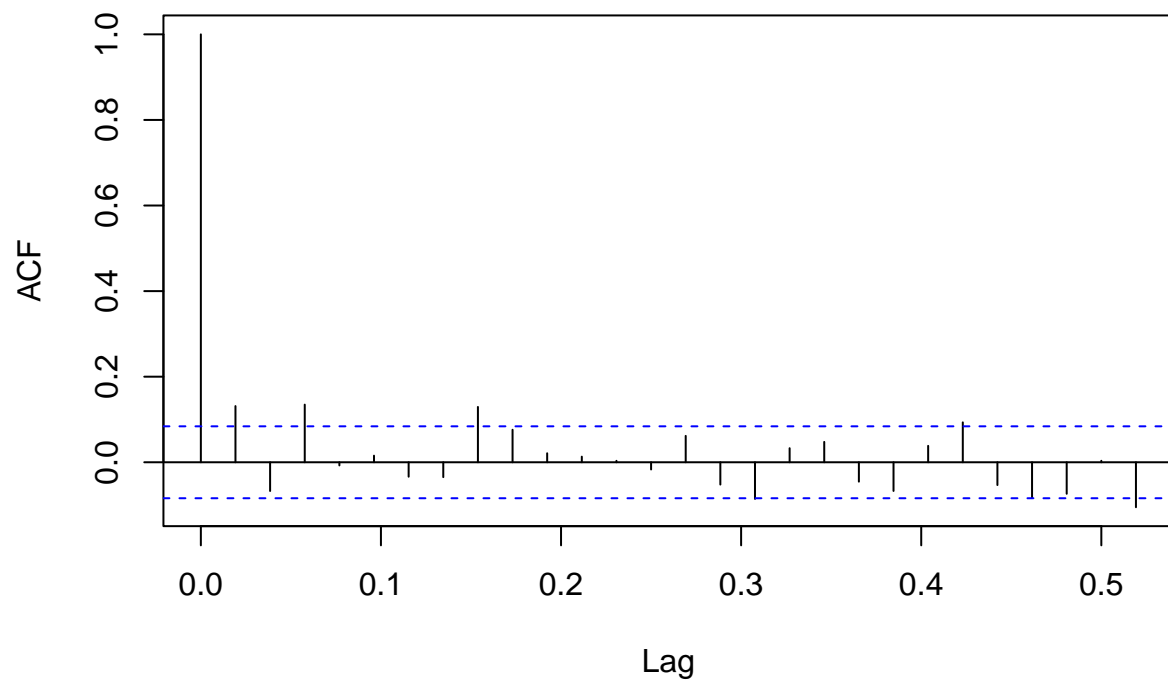
Log-rendements

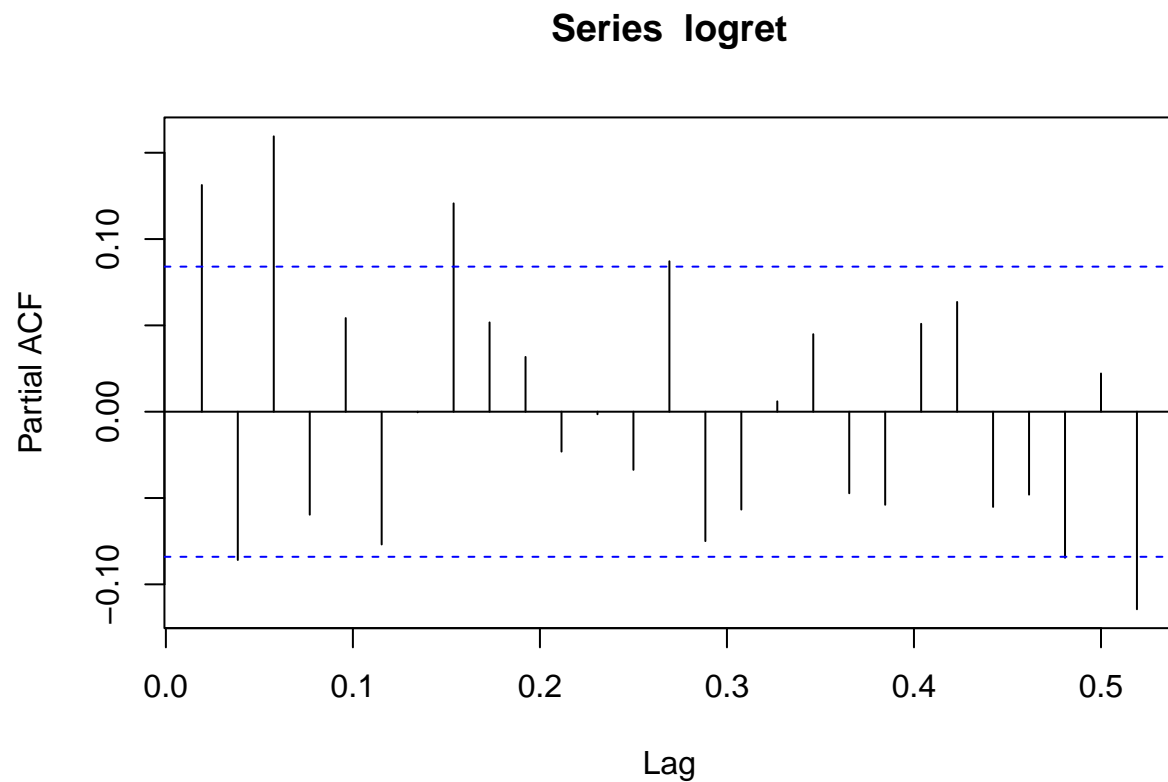
```
logret <- diff(log(oil))  
plot(logret)
```

```
acf(logret); pacf(logret)
```

Series logret





ARMA sur log-rendements

```
fit_lr <- auto.arima(logret, stationary=TRUE, seasonal=FALSE)
fit_lr
```

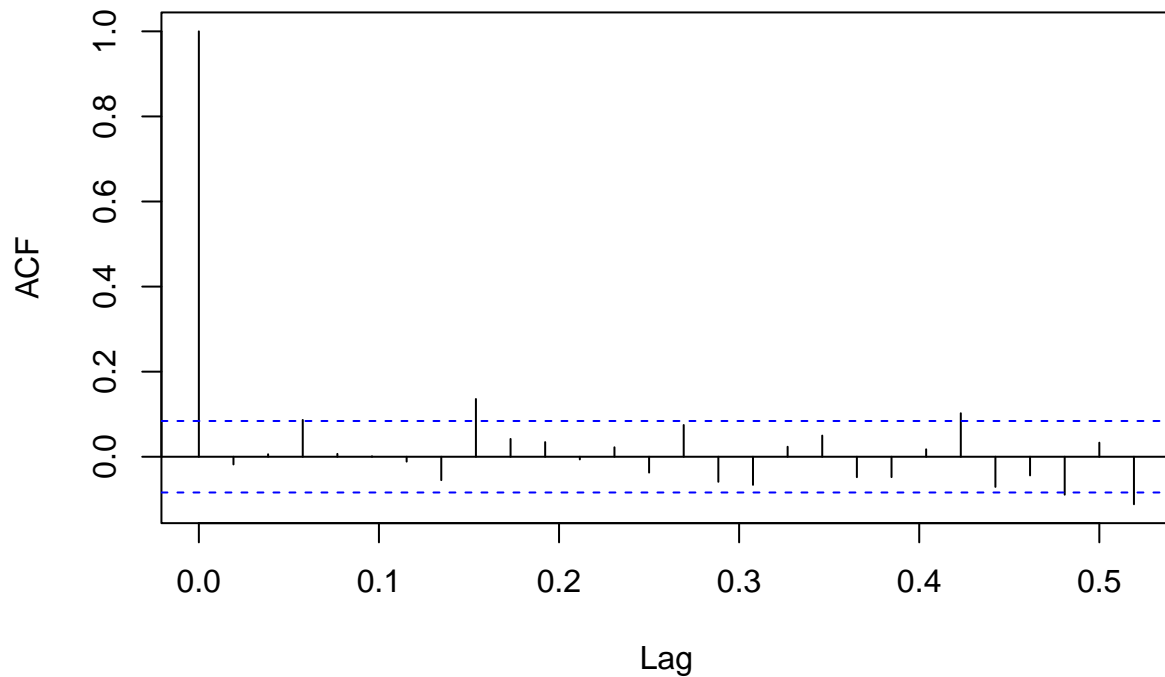
Series: logret ARIMA(1,0,1) with zero mean

Coefficients: ar1 ma1 -0.5253 0.7142 s.e. 0.0872 0.0683

$\sigma^2 = 0.002112$: log likelihood = 904.58 AIC=-1803.15 AICc=-1803.11 BIC=-1790.25

```
acf(residuals(fit_lr)); Box.test(residuals(fit_lr), lag=15)
```

Series residuals(fit_lr)



Box-Pierce test

data: residuals(fit_lr) X-squared = 23.599, df = 15, p-value = 0.07222

Comparaison ARMA(2,2) & ARMA(3,3)

```
fit22 <- arima(logret, order=c(2,0,2))
fit33 <- arima(logret, order=c(3,0,3))
fit22; fit33
```

Call: arima(x = logret, order = c(2, 0, 2))

Coefficients: ar1 ar2 ma1 ma2 intercept 0.3234 0.4806 -0.1259 -0.6168 0.0017 s.e. 0.1445 0.0943 0.1385 0.0990 0.0026

sigma² estimated as 0.002098: log likelihood = 905.41, aic = -1798.82

Call: arima(x = logret, order = c(3, 0, 3))

Coefficients: ar1 ar2 ar3 ma1 ma2 ma3 intercept 0.0674 -0.6295 -0.3632 0.0964 0.5091 0.5992 0.0017 s.e. 0.1096 0.0924 0.1232 0.0926 0.0883 0.1049 0.0022

sigma² estimated as 0.002061: log likelihood = 910.21, aic = -1804.42

Fin du document