

**PEMROGRAMAN MARKOV REGIME SWITCHING PADA PERAMALAN
HARGA MINYAK DUNIA MENGGUNAKAN SOFTWARE R**

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**YOGYAKARTA
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Program R Markov Regime Switching Pada Peramalan Harga Minyak Dunia

```
>setwd(D:\\nendra\\penelitian nendra\\penelitian 2019\\PDP 2019\\data pdp 2019)
#mengakses data harga minyak
> dir()
[1] "daily.txt"      "daily_oilprice.txt" "dailyclose.txt"
[4] "dailyclose.xls" "dailyii.txt"      "dataminyak.xls"
[7] "monthly.txt"   "monthly_oilprice.txt" "oildata.txt"
[10] "oildata.xls"
> data=read.table("dailyclose.txt",header=T) #mendefinisikan data yang akan dianalisis
> data=ts(data,start=1,freq=1) #mendefinisikan data runtun waktu
> plot(data,ylab="price",main=" Daily Crude Oil Price",col="blue") #membuat plot data
> library(tseries)
Registered S3 method overwritten by 'quantmod':
  method      from
as.zoo.data.frame zoo

'tseries' version: 0.10-47

'tseries' is a package for time series analysis and computational
finance.

See 'library(help="tseries")' for details.

> jarque.bera.test(data) #uji normalitas data

      Jarque Bera Test

data: data
X-squared = 48.446, df = 2, p-value = 3.021e-11

> library(car)
Loading required package: carData
> powerTransform(data) #transformasi Box.Cox
Estimated transformation parameter
  data
1.531795
> jarque.bera.test(data^1.531795) #uji normalitas hasil transformasi Box.Cox

      Jarque Bera Test

data: data^1.531795
X-squared = 1.3976, df = 2, p-value = 0.4972

> adf.test(data^1.531795) #uji stasioneritas

      Augmented Dickey-Fuller Test

data: data^1.531795
Dickey-Fuller = -1.921, Lag order = 10, p-value = 0.6117
alternative hypothesis: stationary

> library(urca)
```

```

> out=ur.df(data^1.531795,type="trend",lags=5)
> summary(out)

#####
# Augmented Dickey-Fuller Test Unit Root Test #
#####

Test regression trend

Call:
lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)

Residuals:
    Min     1Q   Median     3Q    Max
-198.110  -7.843   0.855   8.457 179.723

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  2.6979457  1.5621289   1.727  0.0844 .
z.lag.1     -0.0058213  0.0033918  -1.716  0.0864 .
tt          -0.0004595  0.0012728  -0.361  0.7181
z.diff.lag1 -0.1509838  0.0281893  -5.356 1.01e-07 ***
z.diff.lag2 -0.0233395  0.0284998  -0.819  0.4130
z.diff.lag3  0.0115456  0.0285049   0.405  0.6855
z.diff.lag4  0.0269436  0.0284927   0.946  0.3445
z.diff.lag5  0.0492469  0.0281520   1.749  0.0805 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 16.23 on 1260 degrees of freedom
Multiple R-squared:  0.02814, Adjusted R-squared:  0.02274
F-statistic: 5.211 on 7 and 1260 DF, p-value: 7.15e-06

Value of test-statistic is: -1.7163 1.1589 1.7332

Critical values for test statistics:
    1pct 5pct 10pct
tau3 -3.96 -3.41 -3.12
phi2  6.09  4.68  4.03
phi3  8.27  6.25  5.34

> out2=ur.df(diff(log(data^1.531795)),type="trend",lags=5)
> summary(out2)

#####
# Augmented Dickey-Fuller Test Unit Root Test #
#####

Test regression trend

Call:
lm(formula = z.diff ~ z.lag.1 + 1 + tt + z.diff.lag)

Residuals:

```

Min 1Q Median 3Q Max
 -1.46618 -0.02302 0.00167 0.02341 1.16970

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	1.588e-03	4.252e-03	0.374	0.708836
z.lag.1	-1.400e+00	1.030e-01	-13.598	< 2e-16 ***
tt	-2.679e-06	5.776e-06	-0.464	0.642813
z.diff.lag1	-6.640e-02	9.458e-02	-0.702	0.482752
z.diff.lag2	-2.675e-01	8.247e-02	-3.243	0.001212 **
z.diff.lag3	-2.921e-01	6.772e-02	-4.313	1.74e-05 ***
z.diff.lag4	-2.447e-01	4.946e-02	-4.947	8.55e-07 ***
z.diff.lag5	-9.895e-02	2.804e-02	-3.529	0.000432 ***

 Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.07517 on 1259 degrees of freedom
 Multiple R-squared: 0.7074, Adjusted R-squared: 0.7057
 F-statistic: 434.8 on 7 and 1259 DF, p-value: < 2.2e-16

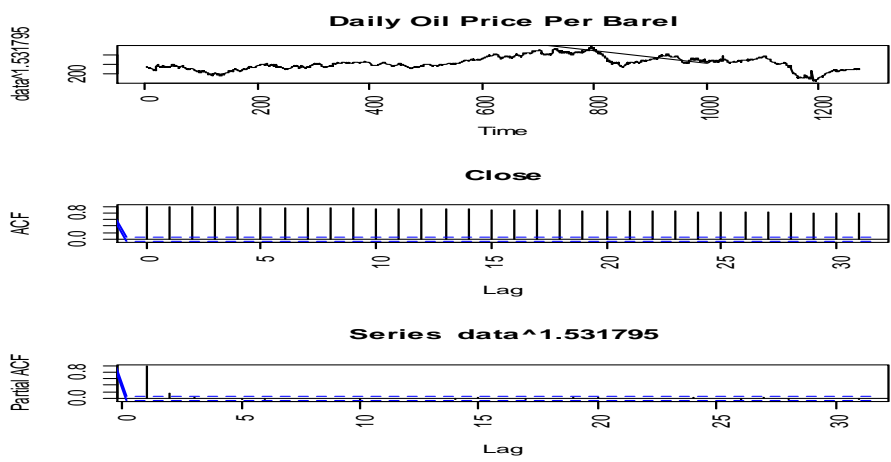
Value of test-statistic is: -13.5983 61.6399 92.4599

Critical values for test statistics:

	1pct	5pct	10pct
tau3	-3.96	-3.41	-3.12
phi2	6.09	4.68	4.03
phi3	8.27	6.25	5.34

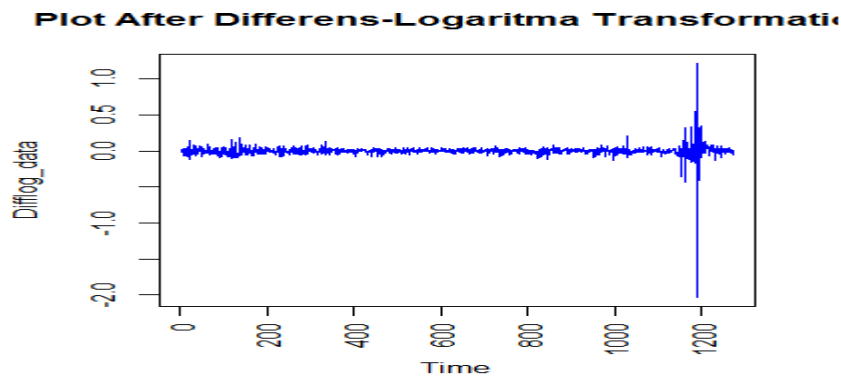


```
> win.graph()
> par(mfrow=c(3,1))
> ts.plot(data^1.531795,main="Daily Oil Price Per Barel")
> acf(data^1.531795)
> pacf(data^1.531795)
```



```
> Difflog_data<-diff(log(data^1.531795),differences=1)
```

```
> ts.plot(Difflog_data,col="blue",main="Plot After Differens-Logaritma Transformation")
```



```
> library(forecast)
```

```
> Difflog_data<-ts(Difflog_data)
```

```
> ArimaModel.1<-
```

```
Arima(Difflog_data,order=c(1,1,0),seasonal=list(order=c(0,0,0),period=NA),include.mean=FALSE)
```

```
> summary(ArimaModel.1)
```

```
Series: Difflog_data
```

```
ARIMA(1,1,0)
```

```
Coefficients:
```

```
ar1
```

```
-0.6341
```

```
s.e. 0.0217
```

```
sigma^2 estimated as 0.01143: log likelihood=1039.04
```

```
AIC=-2074.08 AICc=-2074.07 BIC=-2063.78
```

```
Training set error measures:
```

```
ME RMSE MAE MPE MAPE MASE ACF1
```

```
Training set -5.343443e-05 0.1068437 0.04195004 NaN Inf 0.8719573 -0.304576
```

```
> ArimaModel.2<-
```

```
Arima(Difflog_data,order=c(2,1,0),seasonal=list(order=c(0,0,0),period=NA),include.mean=FALSE)
```

```
> summary(ArimaModel.2)
```

```
Series: Difflog_data
```

```
ARIMA(2,1,0)
```

```
Coefficients:
```

```
ar1 ar2
```

```
-0.9382 -0.4790
```

```
s.e. 0.0246 0.0246
```

```
sigma^2 estimated as 0.00881: log likelihood=1205.09
```

```
AIC=-2404.19 AICc=-2404.17 BIC=-2388.74
```

```
Training set error measures:
```

```
ME RMSE MAE MPE MAPE MASE ACF1
```

```
Training set -5.670151e-05 0.09374843 0.03918967 NaN Inf 0.8145813 -0.1629717
```

```
> summary(ArimaModel.6)
```

```
Series: Difflog_data
```

```
ARIMA(2,1,1)
```

Coefficients:

```
      ar1  ar2  ma1
-0.4496 -0.1805 -1.0000
s.e. 0.0276 0.0276 0.0028
```

sigma^2 estimated as 0.005735: log likelihood=1474.89
AIC=-2941.79 AICc=-2941.76 BIC=-2921.2

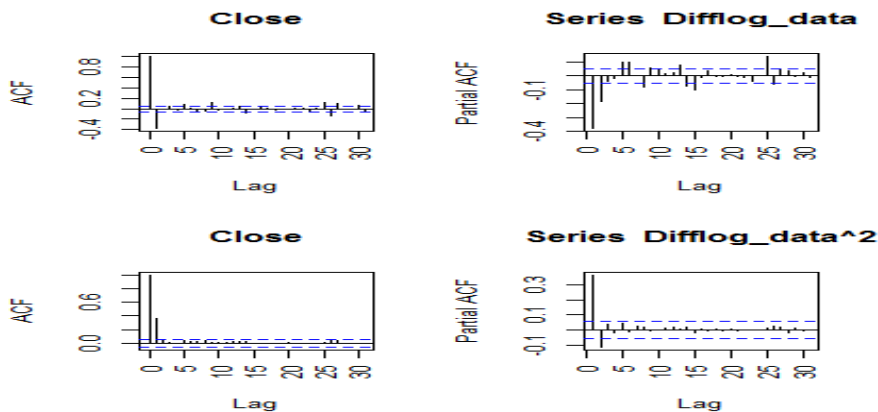
Training set error measures:

```
      ME  RMSE  MAE MPE MAPE  MASE  ACF1
Training set -4.824755e-05 0.07561343 0.0353092 NaN Inf 0.7339234 -0.007927738
```

```
> tsdiag(ArimaModel.6)
> pred.data=predict(ArimaModel.6,n.ahead=6)
> pred.data
$pred
Time Series:
Start = 1274
End = 1279
Frequency = 1
[1] 0.0211338937 -0.0005291679 -0.0038028810 0.0015800776 -0.0002490327
[6] -0.0003985270

$se
Time Series:
Start = 1274
End = 1279
Frequency = 1
[1] 0.07576225 0.08304282 0.08305958 0.08323807 0.08328155 0.08328204
```

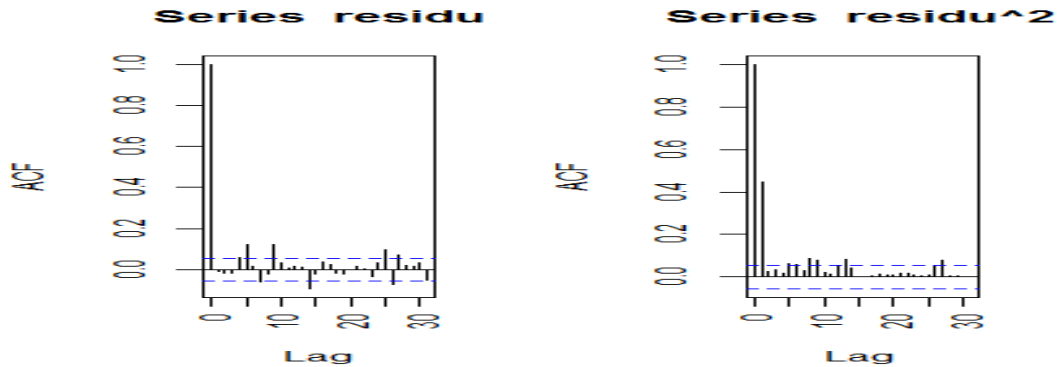
```
> pred.data.low=pred.data$pred-1.96*pred.data$se
> pred.data.up=pred.data$pred+1.96*pred.data$se
> freq=frequency(data)
> fit.data=fitted(ArimaModel.6)
> par(mfrow=c(2,2))
> acf(Difflog_data)
> pacf(Difflog_data)
> par(mfrow=c(1,2))
> pacf(Difflog_data^2)
> acf(Difflog_data^2)
```



```

> par(mfrow=c(1,2))
> residu=ArimaModel.6$residuals
> acf(residu)
> acf(residu^2)

```



```

> library(rugarch)
> spec1<-
ugarchspec(variance.model=list(model="sGARCH",garchOrder=c(1,1),submodel=NULL,external.regressors=NU
LL,variance.targeting=FALSE),mean.model=list(armaOrder=c(0,1),external.regressors=NULL,distribution.model
="norm",start.pars=list(),fixed.pars=list()))
> garch1.1<-ugarchfit(spec=spec1,data=Difflog_data,solver.control=list(trace=0))
> garch1.1

```

```

*-----*
*   GARCH Model Fit   *
*-----*

```

Conditional Variance Dynamics

```

-----
GARCH Model   : sGARCH(1,1)
Mean Model    : ARFIMA(2,0,1)
Distribution   : norm

```

Optimal Parameters

```

-----
Estimate Std. Error t value Pr(>|t|)
mu      0.001548  0.000758  2.04289 0.041064
ar1     0.493232  0.369395  1.33525 0.181796
ar2     0.022636  0.052693  0.42958 0.667500
ma1     -0.582981  0.367125 -1.58797 0.112294
omega   0.000038  0.000011  3.48882 0.000485
alpha1  0.163067  0.022259  7.32576 0.000000
beta1   0.835933  0.020293 41.19218 0.000000

```

Robust Standard Errors:

```

Estimate Std. Error t value Pr(>|t|)
mu      0.001548  0.001028  1.50585 0.132105
ar1     0.493232  0.254524  1.93786 0.052640
ar2     0.022636  0.041490  0.54558 0.585358
ma1     -0.582981  0.260282 -2.23981 0.025104
omega   0.000038  0.000029  1.27729 0.201502
alpha1  0.163067  0.052752  3.09119 0.001994

```

beta1 0.835933 0.050368 16.59662 0.000000

LogLikelihood : 2354.069

Information Criteria

Akaike -3.6875
Bayes -3.6591
Shibata -3.6875
Hannan-Quinn -3.6768

Weighted Ljung-Box Test on Standardized Residuals

	statistic	p-value
Lag[1]	2.253	0.1334
Lag[2*(p+q)+(p+q)-1][8]	4.207	0.6717
Lag[4*(p+q)+(p+q)-1][14]	7.333	0.4951

d.o.f=3
H0 : No serial correlation

Weighted Ljung-Box Test on Standardized Squared Residuals

	statistic	p-value
Lag[1]	12.60	0.0003849
Lag[2*(p+q)+(p+q)-1][5]	13.35	0.0012270
Lag[4*(p+q)+(p+q)-1][9]	14.11	0.0058559

d.o.f=2

Weighted ARCH LM Tests

	Statistic	Shape	Scale	P-Value
ARCH Lag[3]	0.4625	0.500	2.000	0.4964
ARCH Lag[5]	0.8719	1.440	1.667	0.7713
ARCH Lag[7]	1.5319	2.315	1.543	0.8149

Nyblom stability test

Joint Statistic: 1.834
Individual Statistics:
mu 0.05142
ar1 0.31885
ar2 0.21796
ma1 0.30972
omega 0.14767
alpha1 0.26572
beta1 0.12161

Asymptotic Critical Values (10% 5% 1%)

Joint Statistic: 1.69 1.9 2.35
Individual Statistic: 0.35 0.47 0.75

Sign Bias Test

	t-value	prob	sig
Sign Bias	2.688	0.007282	***
Negative Sign Bias	1.058	0.290066	

Positive Sign Bias 2.604 0.009317 ***
Joint Effect 13.436 0.003783 ***

Adjusted Pearson Goodness-of-Fit Test:

```
-----  
group statistic p-value(g-1)  
1 20 76.08 8.723e-09  
2 30 77.52 2.657e-06  
3 40 94.45 1.688e-06  
4 50 102.14 1.313e-05
```

Elapsed time : 0.559032

```
> spec2<-  
ugarchspec(variance.model=list(model="sGARCH",garchOrder=c(2,1),submodel=NULL,external.regressors=NU  
LL,variance.targeting=FALSE),mean.model=list(armaOrder=c(2,1),external.regressors=NULL,distribution.model  
="norm",start.pars=list(),fixed.pars=list()))  
Warning message:  
unidentified option(s) in mean.model:  
distribution.model start.pars fixed.pars  
> garch1.1<-ugarchfit(spec=spec2,data=Difflog_data,solver.control=list(trace=0))  
> garch2.1<-ugarchfit(spec=spec2,data=Difflog_data,solver.control=list(trace=0))  
> garch2.1
```

```
*-----*  
*      GARCH Model Fit      *  
*-----*
```

Conditional Variance Dynamics

```
-----  
GARCH Model   : sGARCH(2,1)  
Mean Model    : ARFIMA(2,0,1)  
Distribution   : norm
```

Optimal Parameters

```
-----  
Estimate Std. Error t value Pr(>|t|)  
mu      0.001548  0.000761  2.035778 0.041773  
ar1     0.492809  0.369852  1.332448 0.182713  
ar2     0.022617  0.053049  0.426341 0.669859  
ma1     -0.582572  0.367659 -1.584542 0.113070  
omega   0.000038  0.000011  3.342202 0.000831  
alpha1  0.163058  0.029576  5.513237 0.000000  
alpha2  0.000000  0.042320  0.000002 0.999998  
beta1   0.835941  0.027373 30.539368 0.000000
```

Robust Standard Errors:

```
Estimate Std. Error t value Pr(>|t|)  
mu      0.001548  0.001041  1.487876 0.136784  
ar1     0.492809  0.255308  1.930250 0.053576  
ar2     0.022617  0.044943  0.503232 0.614801  
ma1     -0.582572  0.263123 -2.214070 0.026824  
omega   0.000038  0.000035  1.073714 0.282951  
alpha1  0.163058  0.070356  2.317605 0.020471  
alpha2  0.000000  0.094973  0.000001 0.999999
```

beta1 0.835941 0.079261 10.546755 0.000000

LogLikelihood : 2354.069

Information Criteria

Akaike -3.6859
Bayes -3.6535
Shibata -3.6860
Hannan-Quinn -3.6737

Weighted Ljung-Box Test on Standardized Residuals

	statistic	p-value
Lag[1]	2.253	0.1333
Lag[2*(p+q)+(p+q)-1][8]	4.206	0.6722
Lag[4*(p+q)+(p+q)-1][14]	7.331	0.4954

d.o.f=3
H0 : No serial correlation

Weighted Ljung-Box Test on Standardized Squared Residuals

	statistic	p-value
Lag[1]	12.60	0.0003847
Lag[2*(p+q)+(p+q)-1][8]	13.96	0.0040155
Lag[4*(p+q)+(p+q)-1][14]	15.13	0.0235850

d.o.f=3

Weighted ARCH LM Tests

	Statistic	Shape	Scale	P-Value
ARCH Lag[4]	0.5104	0.500	2.000	0.4750
ARCH Lag[6]	0.9681	1.461	1.711	0.7569
ARCH Lag[8]	1.3970	2.368	1.583	0.8586

Nyblom stability test

Joint Statistic: 3.0438

Individual Statistics:

mu 0.0514
ar1 0.3189
ar2 0.2178
ma1 0.3098
omega 0.1477
alpha1 0.2657
alpha2 0.2191
beta1 0.1216

Asymptotic Critical Values (10% 5% 1%)

Joint Statistic: 1.89 2.11 2.59

Individual Statistic: 0.35 0.47 0.75

Sign Bias Test

	t-value	prob	sig
Sign Bias	2.688	0.007281	***

Negative Sign Bias 1.058 0.290063
Positive Sign Bias 2.604 0.009314 ***
Joint Effect 13.436 0.003782 ***

Adjusted Pearson Goodness-of-Fit Test:

```
-----  
group statistic p-value(g-1)  
1 20 76.08 8.723e-09  
2 30 77.52 2.657e-06  
3 40 94.45 1.688e-06  
4 50 101.82 1.433e-05
```

Elapsed time : 0.425024

```
> spec3<-  
ugarchspec(variance.model=list(model="eGARCH",garchOrder=c(1,1),submodel=NULL,external.regressors=NU  
LL,variance.targeting=FALSE),mean.model=list(armaOrder=c(2,1),external.regressors=NULL,distribution.model  
="norm",start.pars=list(),fixed.pars=list()))  
Warning message:  
unidentified option(s) in mean.model:  
distribution.model start.pars fixed.pars  
> garch1.1<-ugarchfit(spec=spec3,data=Difflog_data,solver.control=list(trace=0))  
> egarch1.1<-ugarchfit(spec=spec3,data=Difflog_data,solver.control=list(trace=0))  
> egarch1.1
```

```
*-----*  
* GARCH Model Fit *  
*-----*
```

Conditional Variance Dynamics

```
-----  
GARCH Model : eGARCH(1,1)  
Mean Model : ARFIMA(2,0,1)  
Distribution : norm
```

Optimal Parameters

```
-----  
Estimate Std. Error t value Pr(>|t|)  
mu 0.000752 0.000494 1.52228 0.127940  
ar1 0.468926 0.027502 17.05056 0.000000  
ar2 -0.005535 0.011219 -0.49338 0.621743  
ma1 -0.537767 0.026204 -20.52233 0.000000  
omega -0.106455 0.042247 -2.51982 0.011741  
alpha1 -0.078123 0.016565 -4.71616 0.000002  
beta1 0.980380 0.006549 149.69708 0.000000  
gamma1 0.331124 0.031423 10.53778 0.000000
```

Robust Standard Errors:

```
Estimate Std. Error t value Pr(>|t|)  
mu 0.000752 0.000431 1.74440 0.081088  
ar1 0.468926 0.016904 27.74041 0.000000  
ar2 -0.005535 0.005417 -1.02185 0.306850  
ma1 -0.537767 0.017185 -31.29351 0.000000  
omega -0.106455 0.113784 -0.93559 0.349482  
alpha1 -0.078123 0.026309 -2.96947 0.002983
```

beta1 0.980380 0.016076 60.98546 0.000000
gamma1 0.331124 0.095845 3.45480 0.000551

LogLikelihood : 2365.51

Information Criteria

Akaike -3.7039
Bayes -3.6715
Shibata -3.7039
Hannan-Quinn -3.6917

Weighted Ljung-Box Test on Standardized Residuals

	statistic	p-value
Lag[1]	0.4976	0.4805
Lag[2*(p+q)+(p+q)-1][8]	3.0082	0.9968
Lag[4*(p+q)+(p+q)-1][14]	6.2617	0.7037

d.o.f=3
H0 : No serial correlation

Weighted Ljung-Box Test on Standardized Squared Residuals

	statistic	p-value
Lag[1]	45.60	1.451e-11
Lag[2*(p+q)+(p+q)-1][5]	46.71	5.570e-13
Lag[4*(p+q)+(p+q)-1][9]	47.96	3.974e-12

d.o.f=2

Weighted ARCH LM Tests

	Statistic	Shape	Scale	P-Value
ARCH Lag[3]	0.5112	0.500	2.000	0.4746
ARCH Lag[5]	1.0385	1.440	1.667	0.7215
ARCH Lag[7]	2.2430	2.315	1.543	0.6659

Nyblom stability test

Joint Statistic: 1.3583
Individual Statistics:
mu 0.054362
ar1 0.300058
ar2 0.183253
ma1 0.289792
omega 0.403938
alpha1 0.005432
beta1 0.406846
gamma1 0.222768

Asymptotic Critical Values (10% 5% 1%)

Joint Statistic: 1.89 2.11 2.59
Individual Statistic: 0.35 0.47 0.75

Sign Bias Test

t-value	prob sig
---------	----------

```
Sign Bias      3.2732 1.092e-03 ***
Negative Sign Bias 0.6902 4.902e-01
Positive Sign Bias 6.4399 1.693e-10 ***
Joint Effect   44.3752 1.256e-09 ***
```

Adjusted Pearson Goodness-of-Fit Test:

```
-----
group statistic p-value(g-1)
1  20  73.19  2.691e-08
2  30  84.12  2.847e-07
3  40  94.57  1.623e-06
4  50 102.77  1.103e-05
```

Elapsed time : 0.616035

```
> library(MSwM)
> mod=lm(Difflog_data~1)
> mod
```

```
Call:
lm(formula = Difflog_data ~ 1)
```

```
Coefficients:
(Intercept)
-0.0001487
```

```
> mod.mswm=mwmFit(mod,k=2,p=1,sw=c(T,T,F),control=list(parallel=F))
```

Warning message:

```
In matrix(hessian[-c(1:(long + mi))], nrow = object["k"], byrow = T) :
data length [3] is not a sub-multiple or multiple of the number of rows [2]
```

```
> summary(mod.mswm)
```

Markov Switching Model

```
Call: mwmFit(object = mod, k = 2, sw = c(T, T, F), p = 1, control = list(parallel = F))
```

```
      AIC      BIC logLik
-4048.764 -3999.577 2028.382
```

Coefficients:

Regime 1

```
-----
      Estimate Std. Error t value Pr(>|t|)
(Intercept)(S)  0.9947   0.0501  19.854 < 2.2e-16 ***
Difflog_data_1(S) -2.4756   0.0018 -1375.333 < 2.2e-16 ***
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Residual standard error: 0.04821965

Multiple R-squared: 0.997

Standardized Residuals:

Min Q1 Med Q3 Max
-6.125870e-02 -1.938241e-43 -3.602693e-48 -1.494319e-53 1.036691e-01

Regime 2

Estimate Std. Error t value Pr(>|t|)
(Intercept)(S) -0.0002 0.0185 -0.0108 0.991383
Difflog_data_1(S) -0.1348 0.0501 -2.6906 0.007132 **

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.04821965
Multiple R-squared: 0.04162

Standardized Residuals:

Min Q1 Med Q3 Max
-0.441577961 -0.019575904 0.002150999 0.019920041 0.342152773

Transition probabilities:

Regime 1 Regime 2
Regime 1 0.3697066 0.002348276
Regime 2 0.6302934 0.997651724
> resid.reg1=msmResid(mod.mswm, 1)
> resid.reg1

2	3	4	5	6	7
-0.96707002	-1.06068382	-1.06345458	-1.02482197	-0.96709781	-1.14891126
8	9	10	11	12	13
-1.01374814	-1.07985911	-0.99344478	-1.02417391	-0.99426064	-1.14751784
14	15	16	17	18	19
-0.98917527	-1.14494011	-1.16552173	-0.91800520	-0.91425471	-0.53152392
20	21	22	23	24	25
-0.63562730	-0.79764609	-1.27064050	-0.90875893	-0.97706972	-1.05560924
26	27	28	29	30	31
-1.06468377	-1.08523567	-0.88932402	-1.12456745	-1.02824380	-0.85871369
32	33	34	35	36	37
-0.79118714	-1.08917563	-1.11154521	-0.85682969	-1.11022301	-1.09338038
38	39	40	41	42	43
-0.93154166	-0.97178111	-1.07427486	-0.93181201	-1.01842861	-0.99713817
44	45	46	47	48	49
-0.90349943	-0.86187087	-0.83597298	-1.00037462	-0.86218726	-1.05957104
50	51	52	53	54	55
-1.20752607	-1.03098464	-1.00492496	-0.98714333	-0.96852064	-1.11768031
56	57	58	59	60	61
-1.03475215	-1.01789880	-1.00622246	-1.08192580	-1.07523217	-0.96839530
62	63	64	65	66	67
-0.75754135	-0.96731834	-0.96621753	-0.97419803	-0.90415631	-1.15942338
68	69	70	71	72	73
-1.11870869	-1.08645607	-1.01904227	-1.01046422	-1.14884228	-1.13794001
74	75	76	77	78	79
-1.05045615	-0.94255873	-1.09020411	-0.99519850	-1.02000708	-0.95806438
80	81	82	83	84	85
-0.82860086	-0.88828583	-1.02780985	-1.11597195	-0.99285708	-1.04812574
86	87	88	89	90	91
-1.12876960	-0.92997367	-1.19020611	-1.22719683	-1.02322329	-1.04686392
92	93	94	95	96	97
-1.08403291	-1.08481034	-0.87872349	-0.96460061	-1.21002114	-1.06575556
98	99	100	101	102	103

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608 609 610 611 612 613
-0.98557186 -1.02254156 -0.94665761 -0.90514968 -0.95264022 -0.96908293

614	615	616	617	618	619
-0.97877265	-1.02274424	-0.98096126	-1.00987804	-1.02638804	-0.96409862
620	621	622	623	624	625
-0.90980059	-0.93060394	-0.98585966	-0.97193414	-1.05310598	-1.05109713
626	627	628	629	630	631
-0.95612404	-0.94073375	-1.04569228	-1.08907096	-1.07909015	-1.10762853
632	633	634	635	636	637
-1.08386132	-1.11530525	-0.99156122	-0.96507546	-0.88686927	-0.94024312
638	639	640	641	642	643
-0.96832107	-0.98668838	-0.98140452	-0.90939039	-0.93925160	-0.99503959
644	645	646	647	648	649
-1.08219001	-1.09433476	-1.02842055	-0.94594367	-0.91314608	-1.02881664
650	651	652	653	654	655
-1.10962699	-1.01099923	-0.89240645	-1.05284292	-1.02882625	-0.97338397
656	657	658	659	660	661
-0.95193428	-0.93102441	-0.97908426	-0.87154964	-0.91090553	-1.00851594
662	663	664	665	666	667
-0.91037370	-1.02080558	-1.03269250	-1.03237130	-1.00810836	-1.09703828
668	669	670	671	672	673
-0.96814390	-0.99900084	-1.02067811	-1.05090294	-0.86286593	-0.84145337
674	675	676	677	678	679
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680	681	682	683	684	685
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686	687	688	689	690	691
-0.98920889	-0.99842950	-1.05303666	-0.94535112	-0.93831878	-0.90188380
692	693	694	695	696	697
-0.97679658	-1.03989079	-0.87747886	-0.99726045	-1.02434929	-0.97327938
698	699	700	701	702	703
-0.97221638	-0.98517617	-0.99924236	-0.98539922	-0.94633898	-1.00668582
704	705	706	707	708	709
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710	711	712	713	714	715
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716	717	718	719	720	721
-0.96801332	-0.97339968	-0.97303353	-1.02302795	-1.08143973	-0.96721976
722	723	724	725	726	727
-1.01308689	-0.94411339	-0.96442588	-0.83400933	-0.96832870	-0.81298513
728	729	730	731	732	733
-0.86223648	-0.94441474	-0.96311164	-1.02634911	-1.02841748	-0.94924923
734	735	736	737	738	739
-0.98678438	-1.06051282	-1.19165469	-0.98269179	-1.02324307	-1.15518948
740	741	742	743	744	745
-0.97839791	-0.94153210	-0.93443063	-0.99744719	-1.12148851	-0.94236990
746	747	748	749	750	751
-0.94497539	-0.99819061	-1.01340854	-0.94628098	-1.09425210	-1.02673934
752	753	754	755	756	757
-0.93304239	-1.00908395	-0.96250645	-1.03615203	-1.12198352	-0.98342151
758	759	760	761	762	763
-0.95824693	-1.02257533	-1.05087592	-1.10077086	-0.95808331	-0.95671897
764	765	766	767	768	769
-0.94386694	-0.93102320	-0.96680630	-0.97644492	-0.94196333	-0.99404879
770	771	772	773	774	775
-0.99175357	-0.92467059	-0.96442261	-1.01756999	-1.01635687	-1.07899404
776	777	778	779	780	781
-1.04797700	-1.00061079	-0.96820888	-0.87534543	-0.97314087	-1.08298410
782	783	784	785	786	787

-0.97446297 -0.97838202 -0.91575694 -0.93331565 -1.01226979 -0.96792862
788 789 790 791 792 793
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794 795 796 797 798 799
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800 801 802 803 804 805
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806 807 808 809 810 811
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812 813 814 815 816 817
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818 819 820 821 822 823
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> resid.reg2

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27	28	29	30	31
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1122 1123 1124 1125 1126
-3.495137e-02 -2.159967e-02 -1.854191e-02 -2.928647e-02 -1.884150e-02
1127 1128 1129 1130 1131
3.292613e-02 1.091326e-02 -1.805032e-02 -1.951616e-02 -7.975307e-03
1132 1133 1134 1135 1136
1.079718e-02 3.900237e-02 1.268704e-02 1.985635e-02 6.532310e-03
1137 1138 1139 1140 1141
-3.109678e-03 3.574539e-02 1.907927e-02 -9.349052e-03 -3.911236e-02
1142 1143 1144 1145 1146
-2.413434e-02 -4.865901e-02 -4.238495e-02 -5.714390e-02 -8.460656e-02
1147 1148 1149 1150 1151
-1.680076e-02 7.246580e-02 2.408376e-02 -1.095502e-02 -3.065212e-02

1152	1153	1154	1155	1156
-1.662296e-01	-3.861409e-01	-1.167960e-01	1.422675e-01	-4.220539e-02
1157	1158	1159	1160	1161
-7.860060e-02	1.857220e-03	-6.338894e-02	-9.723146e-02	-1.081281e-01
1162	1163	1164	1165	1166
-4.415780e-01	2.695344e-01	-1.352777e-01	-8.603651e-02	1.160832e-01
1167	1168	1169	1170	1171
5.898951e-02	3.618565e-02	-1.187416e-01	-9.211139e-02	-1.002096e-01
1172	1173	1174	1175	1176
-2.638403e-02	2.770328e-02	-8.601014e-03	3.362066e-01	2.183355e-01
1177	1178	1179	1180	1181
-1.038320e-01	-1.680822e-01	7.165564e-02	-1.367176e-01	8.736098e-03
1182	1183	1184	1185	1186
-4.834683e-02	-1.727484e-01	-4.056058e-02	-2.283539e-03	-1.283991e-01
1187	1188	1189	1190	1191
-1.239040e-01	1.199348e+00	-1.864607e+00	2.163111e-01	3.421528e-01
1192	1193	1194	1195	1196
7.771469e-02	-1.897971e-02	-4.101650e-01	-1.083536e-01	2.980878e-01
1197	1198	1199	1200	1201
3.843676e-01	1.210295e-01	-8.314480e-02	1.275258e-01	3.040903e-01
1202	1203	1204	1205	1206
2.657574e-03	-3.300917e-02	7.188359e-02	5.416176e-03	-3.311883e-02
1207	1208	1209	1210	1211
9.647743e-02	-1.562354e-02	1.279003e-01	1.185102e-01	5.686369e-02
1212	1213	1214	1215	1216
8.250323e-02	4.290004e-02	5.052764e-02	2.593617e-02	-2.772825e-02
1217	1218	1219	1220	1221
-1.548501e-02	6.005388e-02	-6.178430e-02	3.217482e-02	8.460598e-02
1222	1223	1224	1225	1226
2.601082e-03	5.150568e-03	5.911223e-02	2.787514e-02	7.793401e-03
1227	1228	1229	1230	1231
8.606988e-02	4.501562e-02	-8.224074e-02	1.826585e-02	2.995799e-02
1232	1233	1234	1235	1236
-1.279292e-01	-2.092321e-02	-2.882777e-02	6.081926e-02	6.002172e-02
1237	1238	1239	1240	1241
-9.764683e-03	3.302871e-02	4.040462e-02	5.749887e-03	2.664842e-02
1242	1243	1244	1245	1246
3.376292e-04	-9.253551e-02	1.610382e-02	-5.107605e-03	-2.671869e-02
1247	1248	1249	1250	1251
6.983065e-02	-6.629641e-03	1.925178e-02	3.466897e-02	-4.992821e-03
1252	1253	1254	1255	1256
7.617916e-03	9.915922e-04	1.066800e-02	-4.709003e-02	2.916945e-02
1257	1258	1259	1260	1261
-7.528752e-03	-6.068606e-03	6.819762e-03	3.538502e-02	-1.201368e-02
1262	1263	1264	1265	1266
-8.098351e-03	8.924123e-04	7.170801e-03	4.367716e-02	3.743785e-03
1267	1268	1269	1270	1271
-3.074738e-02	4.247292e-03	-4.647722e-03	1.679912e-02	-1.821747e-02
1272	1273			
5.957642e-03	-4.959462e-02			

Manual Penggunaan Program

Program R yang merupakan hasil dari kolaborasi riset dari statistikan di seluruh dunia. Sejak muncul pertama kali tahun 1992 di Universitas Auckland, New Zealand oleh Ross Ihaka dan Robert Gentleman, aplikasi ini mengalami perkembangan dari masa ke masa. Sampai dengan akhir tahun 2020, edisi terbarunya (versi 4.0.2) menyediakan suatu sistem analisis komputasi yang sangat lengkap sesuai keperluan statistika modern. Sifat multiplatform dan tidak berbayar yang dimiliki R menjadikan program ini banyak dipilih berbagai kalangan untuk membantu kegiatan analisis statistika.

Pemrograman komputer dengan R yang diajarkan ini tidak membutuhkan langkah yang kompleks. Pengguna dapat menjalankan program dengan urutan langkah sebagai berikut.

1. Siapkan komputer yang dimiliki.
2. Lakukan instalasi aplikasi R yang bisa didapat secara gratis di CRAN-archive pada alamat situs <http://cran.r-project.org>
3. Jalankan program R yang telah diinstal pada komputer anda.
4. Lakukan penginstalan R Commander yang diperlukan untuk analisis Markov Regime Switching ini, dengan pilih menu **Packages/Install package(s) from local zip files....**, arahkan lokasi pada dialog **Look in** ke direktori **library/Rcmdr**
5. **Jalankan pustaka ini dengan perintah**
>library(Rcmdr)
6. Lakukan kembali untuk penginstalan R Commander plugin econometrics, dengan pilih menu **Packages/Install package(s) from local zip files....**, arahkan lokasi pada dialog **Look in** ke direktori **library/rmetrics**
7. **Jalankan pustaka ini dengan perintah**
>library(RcmdrPlugin.Econometrics)
8. Setelah program R dijalankan maka akan muncul tampilan R Console yaitu jendela utama sebagai tempat membuat perintah.
9. Kopikan syntax R yang ada di atas pada jendela R Console
10. Output numerik program dapat dilihat pada jendela yang sama pada jendela R Console, sedangkan output grafik dapat dilihat pada jendela R Graphics Device.

11. Apabila anda ingin bekerja dengan data yang lain, maka gantilah direktori file pada direktori dimana file yang akan diolah berada. (mengganti nama file pada syntax yang diberi kotak merah di atas).
12. Output hasil peramalan harga minyak dunia dapat dilihat pada halaman setelah ini.

Hasil Output Matlab

INISIALISASI:

Akurasi_awal_sbilm_GA_2 =

0

IMPROVISASI ALGORITMA GENETIKA:

Parameter_GA =

0.4342

akurasi_GA =

66.0436

Parameter_GA =

0.8664

akurasi_GA =

66.0436

No Akurasi Selisih C

TABEL_JAWAB =

1.0000	66.0436	0	0.6781
2.0000	66.0436	0	0.8664

Akurasi_Sebelum_GA =

66.0436

Akurasi_Setelah_GA =

66.0436

INISIALISASI:

Akurasi_awal_sbilm_GA_2 =

0

IMPROVISASI ALGORITMA GENETIKA:

Parameter_GA =

0.0156

akurasi_GA =

66.0436

Parameter_GA =

0.7190

akurasi_GA =

66.0436

No Akurasi Selisih C

TABEL_JAWAB =

1.0000	66.0436	0	0.6117
2.0000	66.0436	0	0.7190

Akurasi_Sebelum_GA =

66.0436

Akurasi_Setelah_GA =

66.0436



REPUBLIK INDONESIA
KEMENTERIAN HUKUM DAN HAK ASASI MANUSIA

SURAT PENCATATAN CIPTAAN

Dalam rangka perlindungan ciptaan di bidang ilmu pengetahuan, seni dan sastra berdasarkan Undang-Undang Nomor 28 Tahun 2014 tentang Hak Cipta, dengan ini menerangkan:

Nomor dan tanggal permohonan : EC00202057639, 9 Desember 2020

Pencipta

Nama : **Nendra Mursetya Somasih Dwipa dan Bintang Wicaksono**

Alamat : Perum Deggung Asri No. 5 RT 001/RW 035 Tridadi Sleman, Sleman, DI YOGYAKARTA, 55511

Kewarganegaraan : Indonesia

Pemegang Hak Cipta

Nama : **Nendra Mursetya Somasih Dwipa dan Bintang Wicaksono**

Alamat : PERum Deggung Asri No. 5 RT 001/ RW 035 Tridadi, Sleman, Sleman, DI YOGYAKARTA, 55511

Kewarganegaraan : Indonesia

Jenis Ciptaan : **Program Komputer**

Judul Ciptaan : **PEMROGRAMAN MARKOV REGIME SWITCHING PADA PERAMALAN HARGA MINYAK DUNIA MENGGUNAKAN SOFTWARE R**

Tanggal dan tempat diumumkan untuk pertama kali di wilayah Indonesia atau di luar wilayah Indonesia : 9 Desember 2020, di Yogyakarta

Jangka waktu perlindungan : Berlaku selama 50 (lima puluh) tahun sejak Ciptaan tersebut pertama kali dilakukan Pengumuman.

Nomor pencatatan : 000224585

adalah benar berdasarkan keterangan yang diberikan oleh Pemohon.

Surat Pencatatan Hak Cipta atau produk Hak terkait ini sesuai dengan Pasal 72 Undang-Undang Nomor 28 Tahun 2014 tentang Hak Cipta.

a.n. MENTERI HUKUM DAN HAK ASASI MANUSIA
DIREKTUR JENDERAL KEKAYAAN INTELEKTUAL



Dr. Freddy Harris, S.H., LL.M., ACCS.
NIP. 196611181994031001

Disclaimer:

Dalam hal pemohon memberikan keterangan tidak sesuai dengan surat pernyataan, Menteri berwenang untuk mencabut surat pencatatan permohonan.