

DAFTAR PUSTAKA

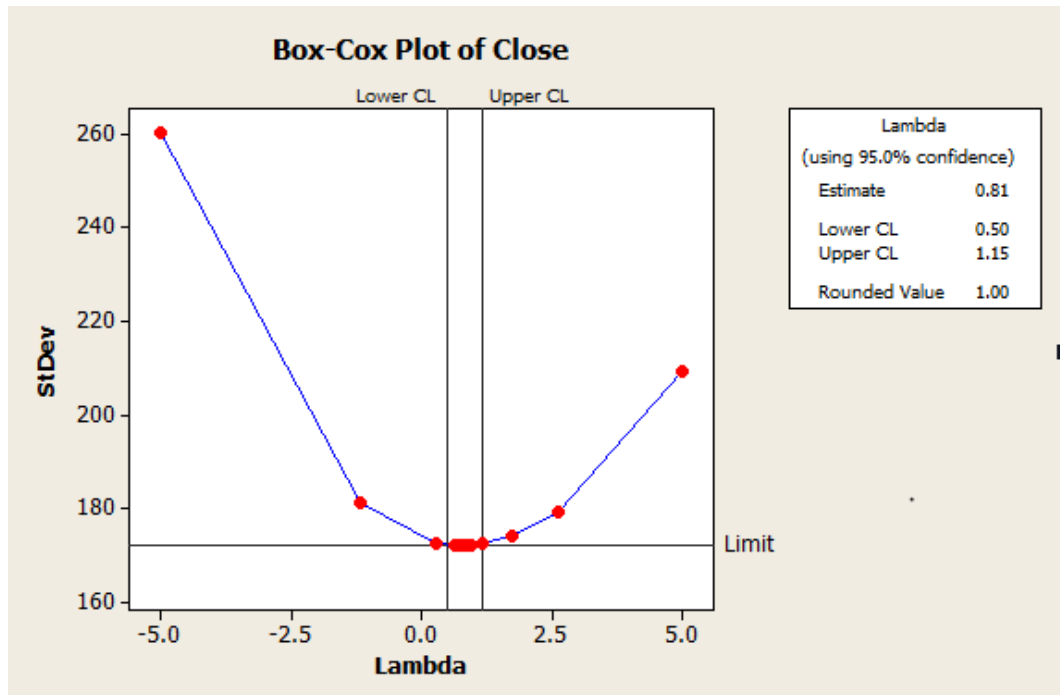
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LAMPIRAN

LAMPIRAN II. Plot Box-Cox



LAMPIRAN III. Dickey-Fuller Test

```
>adf.test(return_data)
Augmented Dickey-Fuller Test
alternative: stationary
```

```
Type 1: no drift no trend
```

lag	ADF	p.value
[1,]	0	-33.7 0.01
[2,]	1	-25.9 0.01
[3,]	2	-20.4 0.01
[4,]	3	-18.1 0.01
[5,]	4	-16.3 0.01
[6,]	5	-14.9 0.01
[7,]	6	-13.0 0.01
[8,]	7	-12.1 0.01

```
Type 2: with drift no trend
```

lag	ADF	p.value
[1,]	0	-33.7 0.01
[2,]	1	-25.9 0.01
[3,]	2	-20.4 0.01
[4,]	3	-18.1 0.01
[5,]	4	-16.3 0.01
[6,]	5	-14.9 0.01
[7,]	6	-13.0 0.01
[8,]	7	-12.1 0.01

```
Type 3: with drift and trend
```

lag	ADF	p.value
[1,]	0	-33.7 0.01
[2,]	1	-26.0 0.01
[3,]	2	-20.5 0.01
[4,]	3	-18.2 0.01
[5,]	4	-16.4 0.01
[6,]	5	-14.9 0.01
[7,]	6	-13.1 0.01
[8,]	7	-12.2 0.01

```
-----
Note: in fact, p.value = 0.01 means p.value <= 0.01
```

LAMPIRAN IV. Signifikansi Parameter ARIMA

```
>#Significant test of Arima
>coeftest(arima001)
```

z test of coefficients:

Estimate	Std. Error	z value	Pr(> z)
ma1	0.09508917	0.02842182	3.3456 0.0008209 ***
intercept	-0.00013061	0.00030195	-0.4325 0.6653427

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

```
>coeftest(arima100)
```

z test of coefficients:

Estimate	Std. Error	z value	Pr(> z)
ar1	0.08697889	0.02721112	3.1964 0.001391 **
intercept	-0.00013259	0.00030210	-0.4389 0.660731

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

```
>coeftest(arima101)
```

z test of coefficients:

Estimate	Std. Error	z value	Pr(> z)
ar1	-0.46356620	0.18956790	-2.4454 0.014470 *
ma1	0.55520626	0.17772391	3.1240 0.001784 **
intercept	-0.00013512	0.00029273	-0.4616 0.644391

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

```
>coeftest(arima200)
```

z test of coefficients:

Estimate	Std. Error	z value	Pr(> z)
ar1	0.09060271	0.02728653	3.3204 0.0008988 ***
ar2	-0.04266192	0.02729197	-1.5632 0.1180132
intercept	-0.00013089	0.00028957	-0.4520 0.6512716

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

```
>coeftest(arima201)
```

z test of coefficients:

Estimate	Std. Error	z value	Pr(> z)
ar1	-0.46164178	0.28305900	-1.6309 0.10291
ar2	0.00168229	0.04362861	0.0386 0.96924
ma1	0.55448484	0.28175894	1.9679 0.04907 *
intercept	-0.00012663	0.00029331	-0.4317 0.66593

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

>coeftest(arima007)

z test of coefficients:

Estimate	Std. Error	z value	Pr(> z)	
ma1	0.08931257	0.02721414	3.2818	0.001031 **
ma2	-0.03015826	0.02781757	-1.0841	0.278301
ma3	0.02818149	0.02796930	1.0076	0.313653
ma4	-0.01646540	0.02725399	-0.6041	0.545746
ma5	-0.00609788	0.02845578	-0.2143	0.830318
ma6	0.00822093	0.02985913	0.2753	0.783068
ma7	0.05078907	0.02892156	1.7561	0.079072 .
intercept	-0.00013040	0.00030899	-0.4220	0.673010

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

>coeftest(arima0012)

z test of coefficients:

Estimate	Std. Error	z value	Pr(> z)	
ma1	0.09203417	0.02732009	3.3687	0.0007551 ***
ma2	-0.03330601	0.02731185	-1.2195	0.2226654
ma3	0.02533417	0.02753210	0.9202	0.3574848
ma4	-0.01306799	0.02745795	-0.4759	0.6341262
ma5	-0.00719059	0.02778790	-0.2588	0.7958150
ma6	0.01063943	0.02760575	0.3854	0.6999363
ma7	0.05065399	0.02825722	1.7926	0.0730364 .
ma8	0.03299171	0.02690140	1.2264	0.2200504
ma9	-0.07986558	0.02734306	-2.9209	0.0034905 **
ma10	-0.01458637	0.02850106	-0.5118	0.6088027
ma11	0.02304019	0.02837017	0.8121	0.4167186
ma12	-0.06362315	0.02963054	-2.1472	0.0317761 *
intercept	-0.00013325	0.00028014	-0.4757	0.6343155

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

>coeftest(arima0019)

z test of coefficients:

Estimate	Std. Error	z value	Pr(> z)	
ma1	0.09258262	0.02708129	3.4187	0.0006292 ***
ma2	-0.02417434	0.02730242	-0.8854	0.3759255
ma3	0.02833354	0.02747531	1.0312	0.3024299
ma4	-0.00490124	0.02751470	-0.1781	0.8586196
ma5	-0.01921747	0.02790590	-0.6887	0.4910420
ma6	-0.00138355	0.02801240	-0.0494	0.9606079
ma7	0.05479839	0.02805101	1.9535	0.0507572 .
ma8	0.03512287	0.02756559	1.2742	0.2026080
ma9	-0.07475380	0.02819931	-2.6509	0.0080276 **
ma10	-0.00681126	0.02828517	-0.2408	0.8097047
ma11	0.02572103	0.02799050	0.9189	0.3581375
ma12	-0.07284528	0.02985730	-2.4398	0.0146962 *

```

ma13      -0.03701060  0.02775963 -1.3333 0.1824489
ma14      -0.00310800  0.02868176 -0.1084 0.9137089
ma15       0.01982241  0.02834521  0.6993 0.4843511
ma16       0.05415266  0.03044864  1.7785 0.0753231 .
ma17       0.04120844  0.03093148  1.3322 0.1827783
ma18       0.01970213  0.02910455  0.6769 0.4984420
ma19      -0.09727335  0.03203337 -3.0366 0.0023924 **
intercept -0.00013059  0.00028046 -0.4656 0.6414898
---

```

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

>coefstest(arima107)

z test of coefficients:

```

Estimate  Std. Error z value Pr(>|z|)
ar1       0.14327321  0.25577172  0.5602 0.57537
ma1      -0.05245020  0.25430186 -0.2063 0.83659
ma2      -0.04266817  0.03636813 -1.1732 0.24070
ma3       0.03228650  0.02893729  1.1157 0.26453
ma4      -0.01971998  0.02806719 -0.7026 0.48231
ma5      -0.00298494  0.02825043 -0.1057 0.91585
ma6       0.00922704  0.02996429  0.3079 0.75813
ma7       0.05166707  0.02873440  1.7981 0.07216 .
intercept -0.00013189  0.00031294 -0.4214 0.67343
---

```

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

>coefstest(arima1012)

z test of coefficients:

```

Estimate  Std. Error z value Pr(>|z|)
ar1       0.27609431  0.27835414  0.9919 0.321255
ma1      -0.18295793  0.27779094 -0.6586 0.510142
ma2      -0.05776573  0.03689601 -1.5656 0.117434
ma3       0.03644394  0.02967331  1.2282 0.219382
ma4      -0.01784730  0.02837781 -0.6289 0.529403
ma5      -0.00348566  0.02835208 -0.1229 0.902153
ma6       0.00907700  0.02794533  0.3248 0.745323
ma7       0.04762253  0.02825555  1.6854 0.091907 .
ma8       0.02054927  0.03061512  0.6712 0.502085
ma9      -0.08816788  0.02959743 -2.9789 0.002893 **
ma10      0.00861874  0.03567635  0.2416 0.809105
ma11      0.02725318  0.02969551  0.9178 0.358748
ma12     -0.07302508  0.03002448 -2.4322 0.015008 *
intercept -0.00013783  0.00027480 -0.5016 0.615960
---

```

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

>coefstest(arima1019)

z test of coefficients:

```

Estimate  Std. Error z value Pr(>|z|)
ar1       0.01525612  0.21353056  0.0714 0.943042

```

```

ma1      0.07757900  0.21177734  0.3663  0.714124
ma2     -0.02558982  0.03372702 -0.7587  0.448012
ma3      0.02879331  0.02815689  1.0226  0.306496
ma4     -0.00549741  0.02871512 -0.1914  0.848176
ma5     -0.01915712  0.02788070 -0.6871  0.492013
ma6     -0.00097391  0.02857257 -0.0341  0.972809
ma7      0.05492714  0.02806179  1.9574  0.050305 .
ma8      0.03448192  0.02896948  1.1903  0.233935
ma9     -0.07522321  0.02895484 -2.5979  0.009378 **
ma10    -0.00558630  0.03298667 -0.1694  0.865521
ma11     0.02592859  0.02814796  0.9212  0.356970
ma12    -0.07331026  0.03055238 -2.3995  0.016418 *
ma13    -0.03585200  0.03219147 -1.1137  0.265403
ma14    -0.00263178  0.02938154 -0.0896  0.928627
ma15     0.02007886  0.02856501  0.7029  0.482107
ma16     0.05402075  0.03048784  1.7719  0.076415 .
ma17     0.04022296  0.03398458  1.1836  0.236585
ma18     0.01895946  0.03089721  0.6136  0.539460
ma19    -0.09785332  0.03287383 -2.9766  0.002914 **
intercept -0.00013076  0.00028022 -0.4666  0.640768
---

```

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

>coeftest(arima207)

z test of coefficients:

```

Estimate  Std. Error  z value  Pr(>|z|)
ar1      -0.32286585  0.14751030 -2.1888  0.028614 *
ar2      -0.78723045  0.14957907 -5.2630  1.417e-07 ***
ma1       0.41513250  0.15108282  2.7477  0.006001 **
ma2       0.78876785  0.15693244  5.0262  5.004e-07 ***
ma3       0.08559520  0.03879481  2.2064  0.027359 *
ma4      -0.02926001  0.03575040 -0.8185  0.413099
ma5       0.00317444  0.03686104  0.0861  0.931372
ma6      -0.04025130  0.03322440 -1.2115  0.225705
ma7       0.03949554  0.03454033  1.1435  0.252847
intercept -0.00012933  0.00029419 -0.4396  0.660233
---

```

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

>coeftest(arima2012)

z test of coefficients:

```

Estimate  Std. Error  z value  Pr(>|z|)
ar1       1.05736985  0.01504379  70.2861 < 2.2e-16 ***
ar2      -0.94758634  0.01512425 -62.6534 < 2.2e-16 ***
ma1      -0.97240587  0.03219722 -30.2015 < 2.2e-16 ***
ma2       0.83157403  0.04288079  19.3927 < 2.2e-16 ***
ma3       0.14338605  0.04569591  3.1378  0.001702 **
ma4      -0.06743754  0.04562008 -1.4782  0.139343
ma5       0.02868810  0.04551203  0.6303  0.528471
ma6      -0.00109904  0.04664515 -0.0236  0.981202
ma7       0.04582967  0.04731781  0.9686  0.332770
ma8      -0.02354741  0.04551600 -0.5173  0.604916

```

```

ma9      -0.05732758  0.04472038  -1.2819  0.199874
ma10     0.09862662  0.04202254   2.3470  0.018926 *
ma11    -0.05682951  0.03733843  -1.5220  0.128006
ma12    -0.04615276  0.03044663  -1.5159  0.129555
intercept -0.00013109  0.00028201  -0.4648  0.642043
---
Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

>coefest(arima2019)

z test of coefficients:

```

Estimate  Std. Error z value Pr(>|z|)
ar1       0.09384391  0.40129282  0.2339  0.81510
ar2      -0.29951627  0.34665085 -0.8640  0.38757
ma1       -0.00028806  0.40014217 -0.0007  0.99943
ma2       0.26196864  0.31582993  0.8295  0.40684
ma3       0.06238767  0.05387920  1.1579  0.24690
ma4      -0.01677189  0.03954458 -0.4241  0.67147
ma5      -0.01036178  0.03319462 -0.3122  0.75492
ma6      -0.00037230  0.03002909 -0.0124  0.99011
ma7       0.04847827  0.03028595  1.6007  0.10945
ma8       0.03075093  0.03375398  0.9110  0.36228
ma9      -0.06527464  0.02982586 -2.1885  0.02863 *
ma10     0.01265094  0.05121128  0.2470  0.80488
ma11     0.00511073  0.03725101  0.1372  0.89088
ma12    -0.08163621  0.03299310 -2.4743  0.01335 *
ma13    -0.02042196  0.04659691 -0.4383  0.66119
ma14    -0.02626199  0.03844208 -0.6832  0.49451
ma15     0.00972188  0.02983580  0.3258  0.74454
ma16     0.05441719  0.03140457  1.7328  0.08313 .
ma17     0.04347770  0.03858335  1.1269  0.25981
ma18     0.03152251  0.03589579  0.8782  0.37985
ma19    -0.09298420  0.03719758 -2.4997  0.01243 *
intercept -0.00013272  0.00028122 -0.4720  0.63696
---
Signif.codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

LAMPIRAN V. Uji *White-Noise* Model ARIMA

```

>#White noise Test
>Box.test(arima001$residuals, lag = 10, type = "Ljung")

Box-Ljung test

data: arima001$residuals
X-squared = 16.911, df = 10, p-value = 0.07637

>Box.test(arima100$residuals, lag = 10, type = "Ljung")

Box-Ljung test

data: arima100$residuals
X-squared = 17.893, df = 10, p-value = 0.0568

>Box.test(arima101$residuals, lag = 10, type = "Ljung")

Box-Ljung test

data: arima101$residuals
X-squared = 12.456, df = 10, p-value = 0.2557

>Box.test(arima200$residuals, lag = 10, type = "Ljung")

Box-Ljung test

data: arima200$residuals
X-squared = 14.516, df = 10, p-value = 0.1507

>Box.test(arima201$residuals, lag = 10, type = "Ljung")

Box-Ljung test

data: arima201$residuals
X-squared = 12.493, df = 10, p-value = 0.2534

>Box.test(arima007$residuals, lag = 10, type = "Ljung")

Box-Ljung test

data: arima007$residuals
X-squared = 9.8234, df = 10, p-value = 0.4561

>Box.test(arima0012$residuals, lag = 10, type = "Ljung")

Box-Ljung test

data: arima0012$residuals
X-squared = 0.11104, df = 10, p-value = 1

>Box.test(arima0019$residuals, lag = 10, type = "Ljung")

```

Box-Ljung test

```
data: arima0019$residuals  
X-squared = 0.15688, df = 10, p-value = 1
```

```
>Box.test(arima107$residuals, lag = 10, type = "Ljung")
```

Box-Ljung test

```
data: arima107$residuals  
X-squared = 9.5222, df = 10, p-value = 0.4834
```

```
>Box.test(arima1012$residuals, lag = 10, type = "Ljung")
```

Box-Ljung test

```
data: arima1012$residuals  
X-squared = 0.099965, df = 10, p-value = 1
```

```
>Box.test(arima1019$residuals, lag = 10, type = "Ljung")
```

Box-Ljung test

```
data: arima1019$residuals  
X-squared = 0.15609, df = 10, p-value = 1
```

```
>Box.test(arima207$residuals, lag = 10, type = "Ljung")
```

Box-Ljung test

```
data: arima207$residuals  
X-squared = 3.8292, df = 10, p-value = 0.9547
```

```
>Box.test(arima2012$residuals, lag = 10, type = "Ljung")
```

Box-Ljung test

```
data: arima2012$residuals  
X-squared = 0.2118, df = 10, p-value = 1
```

```
>Box.test(arima2019$residuals, lag = 10, type = "Ljung")
```

Box-Ljung test

```
data: arima2019$residuals  
X-squared = 0.10031, df = 10, p-value = 1
```

LAMPIRAN VI. Uji Efek Heterokedastisitas

```
>#Heteroskedastisitas with arch.test  
>arch.test(arima101, output = TRUE)  
ARCH heteroscedasticity test for residuals  
alternative: heteroscedastic
```

Portmanteau-Q test:

order	PQ	p.value	
[1,]	4	510	0
[2,]	8	923	0
[3,]	12	1203	0
[4,]	16	1258	0
[5,]	20	1275	0
[6,]	24	1278	0

Lagrange-Multiplier test:

order	LM	p.value	
[1,]	4	825.7	0.00e+00
[2,]	8	306.7	0.00e+00
[3,]	12	191.6	0.00e+00
[4,]	16	102.6	4.22e-15
[5,]	20	80.3	1.68e-09
[6,]	24	65.9	5.14e-06

LAMPIRAN VII Signifikansi Parameter GARCH

```

> #estimation for garch model
> summary(g11)

Call:
garch(x = return_data, order = c(1, 1))

Model:
GARCH(1,1)

Residuals:
    Min       1Q   Median       3Q      Max
-5.6152 -0.5532  0.0815  0.5863  3.7855

Coefficient(s):
      Estimate Std. Error  t value Pr(>|t|)
a0 4.137e-06   8.156e-07   5.073 3.92e-07 ***
a1 1.231e-01   1.448e-02   8.507 < 2e-16 ***
b1 8.313e-01   2.046e-02  40.637 < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Diagnostic Tests:
      Jarque Bera Test

data: Residuals
X-squared = 327.44, df = 2, p-value < 2.2e-16

      Box-Ljung test

data: Squared.Residuals
X-squared = 0.60843, df = 1, p-value = 0.4354

> summary(g12)

Call:
garch(x = return_data, order = c(2, 1))

Model:
GARCH(2,1)

Residuals:
    Min       1Q   Median       3Q      Max
-5.7580 -0.5519  0.0827  0.5901  3.8119

Coefficient(s):
      Estimate Std. Error  t value Pr(>|t|)
a0 5.157e-06   1.097e-06   4.702 2.57e-06 ***
a1 1.692e-01   2.017e-02   8.388 < 2e-16 ***
b1 2.684e-01   9.420e-02   2.849 0.00438 **
b2 5.070e-01   8.430e-02   6.015 1.80e-09 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Diagnostic Tests:
      Jarque Bera Test

data: Residuals
X-squared = 328.25, df = 2, p-value < 2.2e-16

```


Box-Ljung test

data: Squared.Residuals
X-squared = 0.0026046, df = 1, p-value = 0.9593

> summary(g13)

Call:
garch(x = return_data, order = c(3, 1))

Model:
GARCH(3,1)

Residuals:

	Min	1Q	Median	3Q	Max
	-5.68679	-0.56020	0.08321	0.58884	3.81890

Coefficient(s):

	Estimate	Std. Error	t value	Pr(> t)
a0	4.982e-06	NA	NA	NA
a1	1.451e-01	NA	NA	NA
b1	2.776e-01	NA	NA	NA
b2	5.169e-01	NA	NA	NA
b3	1.088e-07	NA	NA	NA

Diagnostic Tests:
Jarque Bera Test

data: Residuals
X-squared = 320.49, df = 2, p-value < 2.2e-16

Box-Ljung test

data: Squared.Residuals
X-squared = 0.10207, df = 1, p-value = 0.7494

> summary(g21)

Call:
garch(x = return_data, order = c(1, 2))

Model:
GARCH(1,2)

Residuals:

	Min	1Q	Median	3Q	Max
	-5.63330	-0.55556	0.07947	0.57735	3.64361

Coefficient(s):

	Estimate	Std. Error	t value	Pr(> t)
a0	6.793e-06	1.355e-06	5.012	5.38e-07 ***
a1	1.848e-01	3.248e-02	5.688	1.28e-08 ***
a2	7.340e-10	3.751e-02	0.000	1
b1	7.487e-01	3.619e-02	20.689	< 2e-16 ***

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

Diagnostic Tests:
Jarque Bera Test

data: Residuals
X-squared = 333.01, df = 2, p-value < 2.2e-16

Box-Ljung test

data: Squared.Residuals
 X-squared = 0.0048766, df = 1, p-value = 0.9443

> summary(g22)

Call:
 garch(x = return_data, order = c(2, 2))

Model:
 GARCH(2,2)

Residuals:

	Min	1Q	Median	3Q	Max
	-5.81212	-0.54641	0.08259	0.58818	3.78233

Coefficient(s):

	Estimate	Std. Error	t value	Pr(> t)
a0	6.345e-06	NA	NA	NA
a1	1.677e-01	NA	NA	NA
a2	2.849e-02	NA	NA	NA
b1	1.179e-01	NA	NA	NA
b2	6.170e-01	NA	NA	NA

Diagnostic Tests:
 Jarque Bera Test

data: Residuals
 X-squared = 332.75, df = 2, p-value < 2.2e-16

Box-Ljung test

data: Squared.Residuals
 X-squared = 0.00025644, df = 1, p-value = 0.9872

> summary(g23)

Call:
 garch(x = return_data, order = c(3, 2))

Model:
 GARCH(3,2)

Residuals:

	Min	1Q	Median	3Q	Max
	-5.47658	-0.55752	0.07872	0.60114	3.89852

Coefficient(s):

	Estimate	Std. Error	t value	Pr(> t)
a0	6.493e-06	NA	NA	NA
a1	1.795e-01	NA	NA	NA
a2	4.390e-02	NA	NA	NA
b1	2.210e-07	NA	NA	NA
b2	3.045e-01	NA	NA	NA
b3	4.031e-01	NA	NA	NA

Diagnostic Tests:
 Jarque Bera Test

data: Residuals
 X-squared = 315.84, df = 2, p-value < 2.2e-16

Box-Ljung test

data: Squared.Residuals
 X-squared = 0.018525, df = 1, p-value = 0.8917

> summary(g31)

Call:
 garch(x = return_data, order = c(1, 3))

Model:
 GARCH(1,3)

Residuals:

	Min	1Q	Median	3Q	Max
	-5.27293	-0.55019	0.07634	0.60418	3.99998

Coefficient(s):

	Estimate	Std. Error	t value	Pr(> t)
a0	2.434e-05	3.796e-06	6.414	1.42e-10 ***
a1	1.616e-01	2.588e-02	6.245	4.24e-10 ***
a2	1.655e-09	2.950e-02	0.000	1.000000
a3	1.200e-01	3.106e-02	3.864	0.000111 ***
b1	3.981e-01	7.880e-02	5.052	4.37e-07 ***

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

Diagnostic Tests:
 Jarque Bera Test

data: Residuals
 X-squared = 316.97, df = 2, p-value < 2.2e-16

Box-Ljung test

data: Squared.Residuals
 X-squared = 0.13977, df = 1, p-value = 0.7085

> summary(g32)

Call:
 garch(x = return_data, order = c(2, 3))

Model:
 GARCH(2,3)

Residuals:

	Min	1Q	Median	3Q	Max
	-5.74780	-0.54420	0.08057	0.57891	3.75006

Coefficient(s):

	Estimate	Std. Error	t value	Pr(> t)
a0	8.114e-06	NA	NA	NA
a1	1.385e-01	NA	NA	NA
a2	9.737e-02	NA	NA	NA
a3	2.803e-02	NA	NA	NA
b1	6.741e-03	NA	NA	NA
b2	6.508e-01	NA	NA	NA

```

Diagnostic Tests:
  Jarque Bera Test

data: Residuals
X-squared = 334.35, df = 2, p-value < 2.2e-16

      Box-Ljung test

data: Squared.Residuals
X-squared = 0.24377, df = 1, p-value = 0.6215

> summary(g33)

Call:
garch(x = return_data, order = c(3, 3))

Model:
GARCH(3,3)

Residuals:
      Min       1Q   Median       3Q      Max
-5.46946 -0.56182  0.07901  0.59035  3.85178

Coefficient(s):
      Estimate Std. Error t value Pr(>|t|)
a0 8.161e-06      NA      NA      NA
a1 1.611e-01      NA      NA      NA
a2 5.027e-02      NA      NA      NA
a3 5.063e-02      NA      NA      NA
b1 1.367e-08      NA      NA      NA
b2 1.631e-01      NA      NA      NA
b3 4.856e-01      NA      NA      NA

Diagnostic Tests:
  Jarque Bera Test

data: Residuals
X-squared = 309.2, df = 2, p-value < 2.2e-16

      Box-Ljung test

data: Squared.Residuals
X-squared = 0.016087, df = 1, p-value = 0.8991

> sum(g11$coef)
[1] 0.9544635

>AIC(g11)
[1] -9001.418
>AIC(g12)
[1] -9000.011
>AIC(g13)
[1] -8990.63
>AIC(g21)
[1] -8990.576
>AIC(g22)

```

[1] -8998.107

>AIC(g23)

[1] -8988.926

>AIC(g31)

[1] -8961.091

>AIC(g32)

[1] -8984.823

>AIC(g33)

[1] -8988.314

LAMPIRAN VIII. Estimasi Parameter Model IGARCH(1,2)

```

> #igarch(1,2)
> igarch12 <- ugarchspec(variance.model=list(model="iGARCH",
garchOrder=c(1,2)),
+                          mean.model=list(armaOrder=c(1,1),
include.mean=TRUE),
+                          distribution.model="norm",
fixed.pars=list(omega=0))
> fit_igarch12 <- ugarchfit(igarch12, data = return_data)
> fit_igarch12
*-----*
*           GARCH Model Fit           *
*-----*
Conditional Variance Dynamics
-----
GARCH Model      : iGARCH(1,2)
Mean Model       : ARFIMA(1,0,1)
Distribution      : norm
Optimal Parameters
-----
      Estimate
mu      0.000242
ar1     -0.650454
ma1      0.695554
omega   0.000000
alpha1   0.087137
beta1    0.400492
beta2    0.512371
LogLikelihood : 4487.902
Information Criteria
-----
Akaike      -6.6561
Bayes       -6.6368
Shibata     -6.6562
Hannan-Quinn -6.6489
> fit_igarch12@fit$hessian
> fit_igarch12@fit$hessian
      [,1]      [,2]      [,3]      [,4]      [,5]
[1,] 20108406.212 -3262.262712 -3662.838604 -9685.7126 035.365114
[2,] -3262.263  2045.934643  2162.812111 -241.1447 -8.352267
[3,] -3662.839  2162.812111  2291.114863 -263.0180 -9.344013
[4,] -9685.713 -241.144725 -263.018007 10206.3269 535.006937
[5,]  1035.365   -8.352267   -9.344013   535.0069  74.336587

```

LAMPIRAN IX. Uji Validasi

```

> #MAPE
> data_actual <- actual_data$return[1:30]

> garch11_mapel <- 0
> igarch12_mapel <- 0
> for (i in 1:30){
+   gama <- abs((data_actual[i]-garch11_forecast@forecast$sigmaFor[i])/
data_actual[i])
+   garch11_mapel <- garch11_mapel + gama
+   igama <- abs((data_actual[i]-igarch12_forecast@forecast$sigmaFor[i])/
data_actual[i])
+   igarch12_mapel <- igarch12_mapel + igama
+ }

> garch11_mape <- garch11_mapel/30
> igarch12_mape <- igarch12_mapel/30

```

>RMSE

```

> error_igarch <- igarch12_forecast@forecast$sigmaFor-data_actual
> error_garch <- garch11_forecast@forecast$sigmaFor-data_actual
> RMSE_igarch <- sqrt(mean(error_igarch))
> RMSE_igarch
> [1] 0.1718244
> RMSE_garch <- sqrt(mean(error_garch))
> RMSE_garch
> [1] 0.1708341

```

LAMPIRAN X. Estimasi Parameter GPD

```

> ts_data <- read.csv(file = "E:/materi kuliah/skripsi/menuju
S.si/return ihsg la1.csv", header = T)
> return_data <- ts_data$return
> N <- length(return_data)
> return_datasort<-sort(return_data, decreasing = T)
> u_length <- (0.1*N)+1
> uN <- round(u_length)
> u <- return_datasort[uN]
> extrim <- return_datasort[1:uN]
> gpdloglik <- function(param){
+   si <- param[1]
+   theta <- param[2]
+   ll <- (-uN*log(theta))-
((1/si)+1)*sum(log(1+((si*extrim)/theta)))
+   return(ll)
+ }
> res <- maxLik(logLik = gpdloglik, start = c(3,2), method =
"NR")
There were 50 or more warnings (use warnings() to see the first
50)
> summary(res)
-----
Maximum Likelihood estimation
Newton-Raphson maximisation, 9 iterations
Return code 2: successive function values within tolerance limit
Log-Likelihood: 429.851
2 free parameters
Estimates:
      Estimate Std. error t value Pr(> t)
[1,] 0.169429060.032887 -4.616 3.91e-06 ***
[2,] 0.005346760.001651 10.998 < 2e-16 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
-----
> GradientMatrix <- res$gradient
> GradientMatrix
[1] -1.591616e-06 -4.456524e-05
> hessianMatrix <- res$hessian
> hessianMatrix
      [,1]      [,2]
[1,] -1712.692 -23147.21
[2,] -23147.209 -679876.62

```


LAMPIRAN XI. Uji Kesesuaian Distribusi

```

> ts_data <- read.csv(file = "E:/materi kuliah/skripsi/menuju
S.si/return ihsg la1.csv", header = T)
> return_data <- ts_data$Return
> N <- length(return_data)
> return_data_sort <- sort(return_data, decreasing = T)
> u_length <- (0.1*N)+1
> uN <- round(u_length)
> u <- return_data_sort[uN]
> extrim <- return_data_sort[1:uN]
> n <- uN-1
> si <- 0.17
> theta <- 0.005
> fxi <- array(0, n)
> D_plus <- array(0, n)
> D_minus <- array(0, n)
> for (i in 1:n){
+   fxi[i] <- 1-(1+((si*extrim[i])/theta))(-1/si)
+   D_plus[i] <- (i/uN)-fxi[i]
+   D_minus[i] <- fxi[i]-((i-1)/uN)
+ }
> D_hitung <- max(max(D_plus), max(D_minus))
> D_hitung

```