



ภาคผนวก

ลิขสิทธิ์มหาวิทยาลัยเชียงใหม่

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## ภาคผนวก ก

### ผลการทดสอบความนิ่งของข้อมูล (Unit Root Test)

#### แบบการทดสอบ Augmented Dickey-Fuller Test (ADF)

#### 1. ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend)

##### 1.1 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend) ในกรณี Intercept and Trend

Null Hypothesis: BRENT has a unit root  
Exogenous: Constant, Linear Trend  
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-30.28138	0.0000
Test critical values:		
1% level	-3.967831	
5% level	-3.414597	
10% level	-3.129446	

\*MacKinnon (1996) one-sided p-values.

##### 1.2 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend) ในกรณี Intercept

Null Hypothesis: BRENT has a unit root  
Exogenous: Constant  
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-30.27950	0.0000
Test critical values:		
1% level	-3.437078	
5% level	-2.864399	
10% level	-2.568345	

\*MacKinnon (1996) one-sided p-values.

### 1.3 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์(Brent Blend) ในกรณี None

Null Hypothesis: BRENT has a unit root  
 Exogenous: None  
 Lag Length: 0 (Automatic - based on SIC, maxlag=21)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-30.28805	0.0000
Test critical values:		
1% level	-2.567422	
5% level	-1.941160	
10% level	-1.616473	

\*MacKinnon (1996) one-sided p-values.

## 2. ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

### 2.1 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI) ในกรณี Intercept and Trend

Null Hypothesis: SER01 has a unit root  
 Exogenous: Constant, Linear Trend  
 Lag Length: 2 (Automatic - based on SIC, maxlag=21)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-16.14753	0.0000
Test critical values:		
1% level	-3.967852	
5% level	-3.414607	
10% level	-3.129452	

\*MacKinnon (1996) one-sided p-values.

### 2.2 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI) ในกรณี Intercept

Null Hypothesis: SER01 has a unit root  
 Exogenous: Constant  
 Lag Length: 2 (Automatic - based on SIC, maxlag=21)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-16.15475	0.0000
Test critical values:		
1% level	-3.437093	
5% level	-2.864406	
10% level	-2.568349	

\*MacKinnon (1996) one-sided p-values.

### 2.3 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

ในกรณี None

Null Hypothesis: SER01 has a unit root  
Exogenous: None  
Lag Length: 2 (Automatic - based on SIC, maxlag=21)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-16.15985	0.0000
Test critical values:		
1% level	-2.567427	
5% level	-1.941161	
10% level	-1.616472	

\*MacKinnon (1996) one-sided p-values.

### 3. ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman)

#### 3.1 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบ-โอมาน

(Dubai-Oman) ในกรณี Intercept and Trend

Null Hypothesis: SER01 has a unit root  
Exogenous: Constant, Linear Trend  
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-35.06953	0.0000
Test critical values:		
1% level	-3.967460	
5% level	-3.414415	
10% level	-3.129338	

\*MacKinnon (1996) one-sided p-values.

#### 3.2 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบ-โอมาน

(Dubai-Oman) ในกรณี Intercept

Null Hypothesis: SER01 has a unit root  
Exogenous: Constant  
Lag Length: 0 (Automatic - based on SIC, maxlag=21)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-35.07986	0.0000
Test critical values:		
1% level	-3.436816	
5% level	-2.864283	
10% level	-2.568283	

\*MacKinnon (1996) one-sided p-values.

### 3.3 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบ-โอมาน (Dubai-Oman) ในกรณี None

Null Hypothesis: SER01 has a unit root

Exogenous: None

Lag Length: 0 (Automatic - based on SIC, maxlag=21)

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-35.08489	0.0000
Test critical values:		
1% level	-2.567329	
5% level	-1.941147	
10% level	-1.616481	

\*MacKinnon (1996) one-sided p-values.

## ภาคผนวก ข

### ผลการทดสอบความนิ่งของข้อมูล (Unit Root Test)

#### แบบการทดสอบ Phillips-Perron (PP)

#### 1. ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend)

##### 1.1 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend) ในกรณี Intercept and Trend

##### Blend) ในกรณี Intercept and Trend

Null Hypothesis: BRENT has a unit root  
Exogenous: Constant, Linear Trend  
Bandwidth: 15 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-30.28300	0.0000
Test critical values:		
1% level	-3.967831	
5% level	-3.414597	
10% level	-3.129446	

\*MacKinnon (1996) one-sided p-values.

##### 1.2 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend) ในกรณี Intercept

##### Blend) ในกรณี Intercept

Null Hypothesis: BRENT has a unit root  
Exogenous: Constant  
Bandwidth: 15 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-30.27928	0.0000
Test critical values:		
1% level	-3.437078	
5% level	-2.864399	
10% level	-2.568345	

\*MacKinnon (1996) one-sided p-values.

### 1.3 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend) ในกรณี None

Null Hypothesis: BRENT has a unit root  
 Exogenous: None  
 Bandwidth: 15 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-30.28728	0.0000
Test critical values:		
1% level	-2.567422	
5% level	-1.941160	
10% level	-1.616473	

\*MacKinnon (1996) one-sided p-values.

## 2. ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

### 2.1 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI) ในกรณี Intercept and Trend

Null Hypothesis: SER01 has a unit root  
 Exogenous: Constant, Linear Trend  
 Bandwidth: 11 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-30.20505	0.0000
Test critical values:		
1% level	-3.967831	
5% level	-3.414597	
10% level	-3.129446	

\*MacKinnon (1996) one-sided p-values.

### 2.2 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI) ในกรณี Intercept

Null Hypothesis: SER01 has a unit root  
 Exogenous: Constant  
 Bandwidth: 11 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-30.21918	0.0000
Test critical values:		
1% level	-3.437078	
5% level	-2.864399	
10% level	-2.568345	

\*MacKinnon (1996) one-sided p-values.

## 2.3 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

### ในกรณี None

Null Hypothesis: SER01 has a unit root

Exogenous: None

Bandwidth: 11 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-30.23262	0.0000
Test critical values:		
1% level	-2.567422	
5% level	-1.941160	
10% level	-1.616473	

\*MacKinnon (1996) one-sided p-values.

## 3. ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman)

### 3.1 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบ-โอมาน

#### (Dubai-Oman) ในกรณี Intercept and Trend

Null Hypothesis: SER01 has a unit root

Exogenous: Constant, Linear Trend

Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-35.07265	0.0000
Test critical values:		
1% level	-3.967460	
5% level	-3.414415	
10% level	-3.129338	

\*MacKinnon (1996) one-sided p-values.

### 3.2 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบ-โอมาน

#### (Dubai-Oman) ในกรณี Intercept

Null Hypothesis: SER01 has a unit root

Exogenous: Constant

Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-35.08283	0.0000
Test critical values:		
1% level	-3.436816	
5% level	-2.864283	
10% level	-2.568283	

\*MacKinnon (1996) one-sided p-values.



### 3.3 ผลการทดสอบความนิ่งของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบ-โอมาน (Dubai-Oman) ในกรณี None

Null Hypothesis: SER01 has a unit root

Exogenous: None

Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*
Phillips-Perron test statistic	-35.08782	0.0000
Test critical values:		
1% level	-2.567329	
5% level	-1.941147	
10% level	-1.616481	

\*MacKinnon (1996) one-sided p-values.

ภาคผนวก ค

ผลการทดสอบแบบจำลองระยะยาว (Long Memory TEST)

1. ผลการทดสอบแบบจำลองระยะยาวของราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend)

1.1 ผลการทดสอบแบบจำลองระยะยาวของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend) ในการทดสอบแบบ R/S

Test for Long Memory: R/S Test

Null Hypothesis: no long-term dependence

Test Statistics: BRENT

4.8253\*\*

\* : significant at 5% level, \*\* : significant at 1% level

Total Observ.: 942

1.2 ผลการทดสอบแบบจำลองระยะยาวของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend) ในการทดสอบแบบ Modified R/S

Test for Long Memory: Modified R/S Test

Null Hypothesis: no long-term dependence

Test Statistics: BRENT

3.2732\*\*

\* : significant at 5% level, \*\* : significant at 1% level

Total Observ.: 942

Bandwidth : 7

### 1.3 ผลการทดสอบแบบจำลองระยะยาวของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend) ในการทดสอบแบบ GPH

Test for Long Memory: GPH Test

Null Hypothesis:  $d = 0$

Test Statistics: BRENT

$d$  0.7845

stat 5.5995\*\*

\* : significant at 5% level, \*\* : significant at 1% level

Total Observ.: 942

Number of Freq: 30

### 2. ผลการทดสอบแบบจำลองระยะยาวของราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

#### 2.1 ผลการทดสอบแบบจำลองระยะยาวของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI) ในการทดสอบแบบ R/S

Test for Long Memory: R/S Test

Null Hypothesis: no long-term dependence

Test Statistics: WTI

5.7456\*\*

\* : significant at 5% level, \*\* : significant at 1% level

Total Observ.: 942

## 2.2 ผลการทดสอบแบบจำลองระยะยาวของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI) ในการทดสอบแบบ Modified R/S

Test for Long Memory: Modified R/S Test

Null Hypothesis: no long-term dependence

Test Statistics: WTI

3.3727\*\*

\* : significant at 5% level, \*\* : significant at 1% level

Total Observ.: 942

Bandwidth : 7

## 2.3 ผลการทดสอบแบบจำลองระยะยาวของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI) ในการทดสอบแบบ GPH

Test for Long Memory: GPH Test

Null Hypothesis:  $d = 0$

Test Statistics: WTI

$d$  0.6034

stat 4.307\*\*

\* : significant at 5% level, \*\* : significant at 1% level

Total Observ.: 942

Number of Freq: 30

### 3. ผลการทดสอบแบบจำลองระยะยาวของราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman)

#### 3.1 ผลการทดสอบแบบจำลองระยะยาวของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman) ในการทดสอบแบบ R/S

Test for Long Memory: R/S Test

Null Hypothesis: no long-term dependence

Test Statistics:

Dubai

5.5103\*\*

\* : significant at 5% level, \*\* : significant at 1% level

Total Observ.: 979

#### 3.2 ผลการทดสอบแบบจำลองระยะยาวของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman) ในการทดสอบแบบ Modified R/S

Test for Long Memory: Modified R/S Test

Null Hypothesis: no long-term dependence

Test Statistics:

Dubai

3.3566\*\*

\* : significant at 5% level, \*\* : significant at 1% level

Total Observ.: 979

Bandwidth : 7

### 3.3 ผลการทดสอบแบบจำลองระยะยาวของข้อมูลราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบ-โอมาน (Dubai-Oman) ในการทดสอบแบบ GPH

Test for Long Memory: GPH Test

Null Hypothesis:  $d = 0$

Test Statistics:

Dubai

$d$  0.889

stat 6.4756\*\*

\* : significant at 5% level, \*\* : significant at 1% level

Total Observ.: 979

Number of Freq: 31

ภาคผนวก ง

ผลการทดสอบแบบจำลอง-ไฟการ์ช (ARFIMA-FIGARCH)

1. ผลการทดสอบแบบจำลอง-ไฟการ์ช (ARFIMA-FIGARCH) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend)

1.1 ผลการทดสอบแบบจำลอง ARFIMA(1,d,1)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend)

```

*****
** G@RCH( 1) SPECIFICATIONS **
*****
Dependent variable : BRENT
Mean Equation : ARFIMA (1, d, 1) model.
No regressor in the conditional mean
Variance Equation : FIGARCH (1, d, 1) model
estimated with BBM's method (Truncation order :
1000).
No regressor in the conditional variance
Skewed Student distribution, with 6.1196 degrees of
freedom.
and asymmetry coefficient (log xi) 0.000930619.
Strong convergence using numerical derivatives
Log-likelihood = -2105.23
Please wait : Computing the Std Errors ...
Robust Standard Errors (Sandwich formula)
Coefficient Std.Error t-value t-prob
Cst(M) 0.151452 0.082164 1.843 0.0656
d-Arfima 0.019897 0.044961 0.4425 0.6582
AR(1) -0.236831 0.35879 -0.6601 0.5094
MA(1) 0.241107 0.40241 0.5992 0.5492
Cst(V) 0.090525 0.13152 0.6883 0.4914
d-Figarch 0.433040 0.17304 2.503 0.0125
ARCH(Phi1) 0.247895 0.17390 1.425 0.1544
GARCH(Beta1) 0.637499 0.29003 2.198 0.0282
Asymmetry 0.000931 0.039455 0.02359 0.9812
Tail 6.119601 1.3550 4.516 0.0000
No. Observations : 942 No. Parameters : 10
Mean (Y) : 0.04379 Variance (Y) : 7.01757
Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509
Log Likelihood : -2105.232
The sample mean of squared residuals was used to
start recursion.
The positivity constraint for the FIGARCH (1,d,1) is
observed (0.204459<0.247895<0.52232 and -
0.0154098<0.0276905 valid).
=> See Bollerslev and Mikkelsen (1996) for more
details.
Estimated Parameters Vector :
0.151452; 0.019897;-0.236831; 0.241107; 0.090525;
0.433040; 0.247895; 0.637499; 0.000931; 6.119606

```

**1.2 ผลการทดสอบแบบจำลอง ARFIMA(1,d,2)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ  
รายวันในตลาดเบรนท์ (Brent Blend)**

```

*****
MA(2) -0.021361 0.062610 -0.3412 0.7330
** GARCH(2) SPECIFICATIONS **
Cst(V) 0.097833 0.14629 0.6688 0.5038
*****
d-Figarch 0.423389 0.16871 2.510 0.0123
Dependent variable : BRENT
ARCH(Phi1) 0.240230 0.19335 1.242 0.2144
Mean Equation : ARFIMA (1, d, 2) model.
GARCH(Beta1) 0.620682 0.30853 2.012 0.0445
No regressor in the conditional mean
Asymmetry 0.002921 0.039552 0.07384 0.9412
Variance Equation : FIGARCH (1, d, 1) model
Tail 6.105821 1.3396 4.558 0.0000
estimated with BBM's method (Truncation order :
No. Observations : 942 No. Parameters : 11
1000).
Mean (Y) : 0.04379 Variance (Y) : 7.01757
No regressor in the conditional variance
Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509
Skewed Student distribution, with 6.10582 degrees of
Log Likelihood : -2105.143
freedom.
The sample mean of squared residuals was used to
and asymmetry coefficient (log xi) 0.00292067.
start recursion.
Strong convergence using numerical derivatives
The positivity constraint for the FIGARCH (1,d,1) is
observed (0.197293<0.24023<0.525537 and -
Log-likelihood = -2105.14
0.0203548<0.02665 valid).
Please wait : Computing the Std Errors ...
=> See Bollerslev and Mikkelsen (1996) for more
Robust Standard Errors (Sandwich formula)
details.
Coefficient Std.Error t-value t-prob
Cst(M) 0.154252 0.088754 -1.738 0.0825
Estimated Parameters Vector :
d-Arfima 0.036809 0.068543 0.5370 0.5914 0.154252; 0.036809; -0.309328; 0.295155; -0.021361;
AR(1) -0.309328 0.38300 -0.8076 0.4195 0.097833; 0.423389; 0.240230; 0.620682; 0.002921;
MA(1) 0.295155 0.36804 0.8020 0.4228 6.105826

```



### 1.3 ผลการทดสอบแบบจำลอง ARFIMA(1,d,3)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดเบรนท์ (Brent Blend)

```

*****
MA(3) 0.038402 0.10315 0.3723 0.7098
** GARCH(3) SPECIFICATIONS **
Cst(V) 0.103348 0.15771 0.6553 0.5124
*****
d-Figarch 0.421028 0.15809 2.663 0.0079
Dependent variable : BRENT
ARCH(Phi1) 0.219783 0.23024 0.9546 0.3400
Mean Equation : ARFIMA (1, d, 3) model.
GARCH(Beta1) 0.598299 0.33580 1.782 0.0751
No regressor in the conditional mean
Asymmetry 0.006504 0.041706 0.1559 0.8761
Variance Equation : FIGARCH (1, d, 1) model
Tail 6.199174 1.4123 4.389 0.0000
estimated with BBM's method (Truncation order :
No. Observations : 942 No. Parameters : 12
1000).
Mean (Y) : 0.04379 Variance (Y) : 7.01757
No regressor in the conditional variance
Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509
Skewed Student distribution, with 6.19917 degrees of
Log Likelihood : -2104.909
freedom.
The sample mean of squared residuals was used to
and asymmetry coefficient (log xi) 0.00650392.
start recursion.
Strong convergence using numerical derivatives
The positivity constraint for the FIGARCH (1,d,1) is
observed (0.17727<0.219783<0.526324 and -
Log-likelihood = -2104.91
0.029347<0.0254351 valid).
Please wait : Computing the Std Errors ...
=> See Bollerslev and Mikkelsen (1996) for more
Robust Standard Errors (Sandwich formula)
details.
Coefficient Std.Error t-value t-prob
Cst(M) 0.150765 0.077172 -1.954 0.0510
Estimated Parameters Vector :
d-Arfima -0.000816 0.16920 -0.004824 0.9962 0.150765;-0.000816; 0.109473;-0.087130; 0.002332;
AR(1) 0.109473 1.7372 0.06302 0.9498 0.038402; 0.103348; 0.421028; 0.219783; 0.598299;
MA(1) -0.087130 1.5939 -0.05466 0.9564 0.006504; 6.199179
MA(2) 0.002332 0.048386 0.04820 0.9616

```

#### 1.4 ผลการทดสอบแบบจำลอง ARFIMA(2,d,1)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดเบรนท์ (Brent Blend)

```

*****
MA(1) -0.899826 0.033973 -26.49 0.0000
** GARCH(4) SPECIFICATIONS **
Cst(V) 0.090443 0.13300 0.6800 0.4967
*****
d-Figarch 0.439919 0.18876 2.331 0.0200
Dependent variable : BRENT
ARCH(Phi1) 0.250504 0.17640 1.420 0.1559
Mean Equation : ARFIMA (2, d, 1) model.
GARCH(Beta1) 0.643737 0.30648 2.100 0.0360
No regressor in the conditional mean
Asymmetry -0.001038 0.039901 -0.02602 0.9792
Variance Equation : FIGARCH (1, d, 1) model
Tail 6.016374 1.3004 4.627 0.0000
estimated with BBM's method (Truncation order :
No. Observations : 942 No. Parameters : 11
1000).
Mean (Y) : 0.04379 Variance (Y) : 7.01757
No regressor in the conditional variance
Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509
Skewed Student distribution, with 6.01637 degrees of
Log Likelihood : -2103.529
freedom.
The sample mean of squared residuals was used to
and asymmetry coefficient (log xi) -0.00103821.
start recursion.
Strong convergence using numerical derivatives
The positivity constraint for the FIGARCH (1,d,1) is
observed (0.203818<0.250504<0.520027 and -
Log-likelihood = -2103.53
0.0129936<0.0300537 valid).
Please wait : Computing the Std Errors ...
=> See Bollerslev and Mikkelsen (1996) for more
Robust Standard Errors (Sandwich formula)
details.
Coefficient Std.Error t-value t-prob
Cst(M) 0.197931 0.12676 1.561 0.1188
Estimated Parameters Vector :
d-Arfima 0.164160 0.14900 1.102 0.2708
0.197931; 0.164160; 0.756455; 0.059920;-0.899826;
AR(1) 0.756455 0.13757 5.499 0.0000
0.090443; 0.439919; 0.250504; 0.643737;-0.001038;
AR(2) 0.059920 0.064935 0.9228 0.3564
6.016379

```

1.5 ผลการทดสอบแบบจำลอง ARFIMA(2,d,2)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ  
รายวันในตลาดเบรนท์ (Brent Blend)

```

*****
MA(2) 0.934107 0.047179 19.80 0.0000
** GARCH( 5) SPECIFICATIONS **
Cst(V) 0.100949 0.13238 0.7626 0.4459
*****
d-Figarch 0.437653 0.18009 2.430 0.0153
Dependent variable : BRENT
ARCH(Phi1) 0.234268 0.16599 1.411 0.1585
Mean Equation : ARFIMA (2, d, 2) model.
GARCH(Beta1) 0.627735 0.28533 2.200 0.0281
No regressor in the conditional mean
Asymmetry 0.005758 0.038484 0.1496 0.8811
Variance Equation : FIGARCH (1, d, 1) model
Tail 5.924848 1.2593 4.705 0.0000
estimated with BBM's method (Truncation order :
No. Observations : 942 No. Parameters : 12
1000).
Mean (Y) : 0.04379 Variance (Y) : 7.01757
No regressor in the conditional variance
Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509
Skewed Student distribution, with 5.92485 degrees of
Log Likelihood : -2098.763
freedom.
The sample mean of squared residuals was used to
and asymmetry coefficient (log xi) 0.00575784.
start recursion.
Strong convergence using numerical derivatives
The positivity constraint for the FIGARCH (1,d,1) is
observed (0.190082<0.234268<0.520782 and -
Log-likelihood = -2098.76
0.0205285<0.0277368 valid).
Please wait : Computing the Std Errors ...
=> See Bollerslev and Mikkelsen (1996) for more
Robust Standard Errors (Sandwich formula)
details.
Coefficient Std.Error t-value t-prob
Cst(M) 0.146354 0.084997 -1.722 0.0854
Estimated Parameters Vector :
d-Arfima 0.029008 0.030565 0.9491 0.3428 0.146354; 0.029008;-0.283148;-0.933009; 0.282779;
AR(1) -0.283148 0.051348 -5.514 0.0000 0.934107; 0.100949; 0.437653; 0.234268; 0.627735;
AR(2) -0.933009 0.038208 -24.42 0.0000 0.005758; 5.924853
MA(1) 0.282779 0.070481 4.012 0.0001

```

1.6 ผลการทดสอบแบบจำลอง ARFIMA(2,d,3)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ  
รายวันในตลาดเบรนท์ (Brent Blend)

```

*****
** GARCH( 6) SPECIFICATIONS **
*****
Dependent variable : BRENT
Mean Equation : ARFIMA ( 2, d, 3) model.
No regressor in the conditional mean
Variance Equation : FIGARCH ( 1, d, 1) model
estimated with BBM's method (Truncation order :
1000).
No regressor in the conditional variance
Skewed Student distribution, with 6.2316 degrees of
freedom.
and asymmetry coefficient (log xi) 0.00875048.
Strong convergence using numerical derivatives
Log-likelihood = -2099.48
Please wait : Computing the Std Errors ...
Robust Standard Errors (Sandwich formula)

Coefficient Std.Error t-value t-prob
Cst(M)      0.153868  0.075003  2.051  0.0405
d-Arfima    -0.000082  0.055888 -0.001462  0.9988
AR(1)       0.675572  0.050125  13.48  0.0000
AR(2)      -0.864087  0.038507 -22.44  0.0000
MA(1)      -0.658961  0.074601 -8.833  0.0000

MA(2)       0.867705  0.058315  14.88  0.0000
MA(3)       0.058642  0.058648  0.9999  0.3176
Cst(V)      0.169712  0.25378  0.6687  0.5038
d-Figarch   0.377264  0.13115  2.877  0.0041
ARCH(Phi1)  0.129422  0.35108  0.3686  0.7125
GARCH(Beta1 0.468368  0.44249  1.058  0.2901
Asymmetry   0.008750  0.039377  0.2222  0.8242
Tail        6.231600  1.4175  4.396  0.0000
No. Observations : 942 No. Parameters : 13
Mean (Y) : 0.04379 Variance (Y) : 7.01757
Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509
Log Likelihood : -2099.476
The sample mean of squared residuals was used to
start recursion.
The positivity constraint for the FIGARCH (1,d,1) is
observed (0.091104<0.129422<0.540912 and -
0.0686415<0.0179471 valid).
=> See Bollerslev and Mikkelsen (1996) for more
details.
Estimated Parameters Vector :
0.153868;-0.000082; 0.675572;-0.864087;-0.658961;
0.867705; 0.058642; 0.169712; 0.377264; 0.129422;
0.468368; 0.008750; 6.231605

```

**1.7 ผลการทดสอบแบบจำลอง ARFIMA(3,d,1)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ  
รายวันในตลาดเบรนท์ (Brent Blend)**

*****	MA(1)	0.317308	0.23468	1.352	0.1767
** G@RCH( 7) SPECIFICATIONS **	Cst(V)	0.100544	0.14551	0.6910	0.4898
*****	d-Figarch	0.430786	0.18454	2.334	0.0198
Dependent variable : BRENT	ARCH(Phi1)	0.238512	0.19248	1.239	0.2156
Mean Equation : ARFIMA (3, d, 1) model.	GARCH(Beta1)	0.624875	0.31959	1.955	0.0509
No regressor in the conditional mean	Asymmetry	0.001770	0.039073	0.04529	0.9639
Variance Equation : FIGARCH (1, d, 1) model	Tail	6.028248	1.3607	4.430	0.0000
estimated with BBM's method (Truncation order :	No. Observations :	942	No. Parameters :	12	
1000).	Mean (Y) :	0.04379	Variance (Y) :	7.01757	
No regressor in the conditional variance	Skewness (Y) :	0.34020	Kurtosis (Y) :	9.18509	
Skewed Student distribution, with 6.02825 degrees of	Log Likelihood :	-2103.269			
freedom.	The sample mean of squared residuals was used to				
and asymmetry coefficient (log xi) 0.00176979.	start recursion.				
Strong convergence using numerical derivatives	The positivity constraint for the FIGARCH (1,d,1) is				
Log-likelihood = -2103.27	observed (0.194088<0.238512<0.523071 and -				
Please wait : Computing the Std Errors ...	0.0198568<0.0277595 valid).				
Robust Standard Errors (Sandwich formula)	=> See Bollerslev and Mikkelsen (1996) for more				
	details.				
Coefficient Std.Error t-value t-prob	Estimated Parameters Vector :				
Cst(M)	0.154539	0.080948	-1.909	0.0566	0.154539; 0.015561; -0.310310; 0.000298; 0.022575;
d-Arfima	0.015561	0.10146	0.1534	0.8781	0.317308; 0.100544; 0.430786; 0.238512; 0.624875;
AR(1)	-0.310310	0.25911	-1.198	0.2314	0.001770; 6.028253
AR(2)	0.000298	0.090230	0.003308	0.9974	
AR(3)	0.022575	0.054107	0.4172	0.6766	

1.8 ผลการทดสอบแบบจำลอง ARFIMA(3,d,2)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ  
รายวันในตลาดเบรนท์ (Brent Blend)

```

*****
MA(1) 0.337060 0.030112 11.19 0.0000
** GARCH( 8) SPECIFICATIONS **
MA(2) 0.868007 0.058944 14.73 0.0000
*****
Cst(V) 0.111202 0.14564 0.7635 0.4453
Dependent variable : BRENT d-Figarch 0.427427 0.17165 2.490 0.0129
Mean Equation : ARFIMA (3, d, 2) model. ARCH(Phi1) 0.236312 0.19252 1.227 0.2200
No regressor in the conditional mean GARCH(Beta1) 0.613688 0.30543 2.009 0.0448
Variance Equation : FIGARCH (1, d, 1) model Asymmetry 0.007627 0.039807 0.1916 0.8481
estimated with BBM's method (Truncation order : Tail 5.817573 1.2618 4.610 0.0000
1000). No. Observations : 942 No. Parameters : 13
No regressor in the conditional variance Mean (Y) : 0.04379 Variance (Y) : 7.01757
Skewed Student distribution, with 5.81757 degrees of Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509
freedom. Log Likelihood : -2097.720
and asymmetry coefficient (log xi) 0.00762715. The sample mean of squared residuals was used to
Strong convergence using numerical derivatives start recursion.
Log-likelihood = -2097.72 The positivity constraint for the FIGARCH (1,d,1) is
Please wait : Computing the Std Errors ... observed (0.18626<0.236312<0.524191 and -
Robust Standard Errors (Sandwich formula) 0.0213603<0.0307163 valid).
=> See Bollerslev and Mikkelsen (1996) for more
Coefficient Std.Error t-value t-prob details.
Cst(M) 0.153842 0.088442 -1.739 0.0823
d-Arfima 0.037902 0.060143 0.6302 0.5287 Estimated Parameters Vector :
AR(1) -0.348284 0.077285 -4.506 0.0000 0.153842; 0.037902; -0.348284; -0.870889; -0.018023;
AR(2) -0.870889 0.052303 -16.65 0.0000 0.337060; 0.868007; 0.111202; 0.427427; 0.236312;
AR(3) -0.018023 0.065216 -0.2764 0.7823 0.613688; 0.007627; 5.817578

```

1.9 ผลการทดสอบแบบจำลอง ARFIMA(3,d,3)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ  
รายวันในตลาดเบรนท์ (Brent Blend)

```

*****
** GARCH(9) SPECIFICATIONS **
*****
Dependent variable : BRENT
Mean Equation : ARFIMA (3, d, 3) model.
No regressor in the conditional mean
Variance Equation : FIGARCH (1, d, 1) model
estimated with BBM's method (Truncation order :
1000).
No regressor in the conditional variance
Skewed Student distribution, with 5.82231 degrees of
freedom.
and asymmetry coefficient (log xi) 0.0083338.
Strong convergence using numerical derivatives
Log-likelihood = -2097.66
Please wait : Computing the Std Errors ...

Robust Standard Errors (Sandwich formula)

Coefficient Std.Error t-value t-prob
Cst(M)      0.151571  0.086856  1.745  0.0813
d-Arfima    0.032440  0.057228  0.5669  0.5709
AR(1)       -0.548344  0.45368  -1.209  0.2271
AR(2)       -0.926508  0.13011  -7.121  0.0000
AR(3)       -0.202595  0.41489  -0.4883  0.6254
MA(1)       0.544767  0.50623  1.076  0.2822

MA(2)       0.927700  0.16010  5.795  0.0000
MA(3)       0.192103  0.46836  0.4102  0.6818
Cst(V)      0.109879  0.14325  0.7671  0.4432
d-Figarch   0.429886  0.17488  2.458  0.0141
ARCH(Phi1)  0.237707  0.18922  1.256  0.2093
GARCH(Beta1) 0.617511  0.30462  2.027  0.0429
Asymmetry   0.008334  0.039824  0.2093  0.8343
Tail        5.822305  1.2689  4.588  0.0000
No. Observations : 942 No. Parameters : 14
Mean (Y) : 0.04379 Variance (Y) : 7.01757
Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509
Log Likelihood : -2097.660
The sample mean of squared residuals was used to
start recursion.
The positivity constraint for the FIGARCH (1,d,1) is
observed (0.187625<0.237707<0.523371 and -
0.0203551<0.0309261 valid).
=> See Bollerslev and Mikkelsen (1996) for more
details.
Estimated Parameters Vector :
0.151571; 0.032440;-0.548344;-0.926508;-0.202595;
0.544767; 0.927700; 0.192103; 0.109879; 0.429886;
0.237707; 0.617511; 0.008334; 5.822310

```

## 2. ผลการทดสอบแบบจำลอง-ไฟการ์ช (ARFIMA-FIGARCH) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

### 2.1 ผลการทดสอบแบบจำลอง ARFIMA(1,d,1)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

```

*****
** G@RCH( 1) SPECIFICATIONS **
*****
Dependent variable : WTI
Mean Equation : ARFIMA (1, d, 1) model.
No regressor in the conditional mean
Variance Equation : FIGARCH (1, d, 1) model
estimated with BBM's method (Truncation order :
1000).
No regressor in the conditional variance
Skewed Student distribution, with 8.01241 degrees of
freedom.
and asymmetry coefficient (log xi) -0.0108214.
Strong convergence using numerical derivatives
Log-likelihood = -2192.27
Please wait : Computing the Std Errors ...
Robust Standard Errors (Sandwich formula)

Coefficient Std.Error t-value t-prob
Cst(M)      0.097628  0.056562  1.726  0.0847
d-Arfima    -0.076020  0.15583  -0.4878  0.6258
AR(1)       0.670608  0.16189  4.142  0.0000

*****
** G@RCH( 2) SPECIFICATIONS **
*****
Dependent variable : WTI
Mean Equation : ARFIMA (1, d, 2) model.
No regressor in the conditional mean
MA(1)       -0.583980  0.21484  -2.718  0.0067
Cst(V)      0.204627  0.26234  0.7800  0.4356
d-Figarch   0.389949  0.11094  3.515  0.0005
ARCH(Phi1)  0.156834  0.36715  0.4272  0.6694
GARCH(Beta1) 0.415732  0.41762  0.9955  0.3198
Asymmetry   -0.010821  0.047347 -0.2286  0.8193
Tail        8.012407  2.2329  3.588  0.0004
No. Observations : 942 No. Parameters : 10
Mean (Y) : 0.02752 Variance (Y) : 9.12890
Skewness (Y) : 0.38171 Kurtosis (Y) : 7.37142
Log Likelihood : -2192.270
The sample mean of squared residuals was used to
start recursion.
The positivity constraint for the FIGARCH (1,d,1) is
observed (0.0257833<0.156834<0.536684 and -
0.0577871<0.054482 valid).
=> See Bollerslev and Mikkelsen (1996) for more
details.
Estimated Parameters Vector :
0.097628;-0.076020; 0.670608;-0.583980; 0.204627;
0.389949; 0.156834; 0.415732;-0.010821; 8.012412

```

### 2.2 ผลการทดสอบแบบจำลอง ARFIMA(1,d,2)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

```

*****
** G@RCH( 2) SPECIFICATIONS **
*****
Dependent variable : WTI
Mean Equation : ARFIMA (1, d, 2) model.
No regressor in the conditional mean

```



Variance Equation : FIGARCH (1, d, 1) model ARCH(Phi1) 0.149979 0.36860 0.4069 0.6842  
 estimated with BBM's method (Truncation order : GARCH(Beta1) 0.406452 0.41636 0.9762 0.3292  
 1000). Asymmetry -0.010892 0.048460 -0.2248 0.8222  
 No regressor in the conditional variance Tail 7.960062 2.2052 3.610 0.0003  
 Skewed Student distribution, with 7.96006 degrees of No. Observations : 942 No. Parameters : 11  
 freedom. Mean (Y) : 0.02752 Variance (Y) : 9.12890  
 and asymmetry coefficient (log xi) -0.0108919. Skewness (Y) : 0.38171 Kurtosis (Y) : 7.37142  
 Strong convergence using numerical derivatives Log Likelihood : -2191.938  
 Log-likelihood = -2191.94 The sample mean of squared residuals was used to  
 Please wait : Computing the Std Errors ... start recursion.

Robust Standard Errors (Sandwich formula) The positivity constraint for the FIGARCH (1,d,1) is  
 observed (0.0182999<0.149979<0.537283 and -  
 0.0605303<0.0535212 valid).  
 => See Bollerslev and Mikkelsen (1996) for more  
 details.  
 Estimated Parameters Vector :  
 0.120998; 0.076854; 0.877238; -0.939299; 0.028162;  
 0.210378; 0.388152; 0.149979; 0.406452; -0.010892;  
 7.960067

	Coefficient	Std.Error	t-value	t-prob
Cst(M)	0.120998	0.10188	1.188	0.2353
d-Arfima	0.076854	0.27054	0.2841	0.7764
AR(1)	0.877238	0.10570	8.299	0.0000
MA(1)	-0.939299	0.18703	-5.022	0.0000
MA(2)	0.028162	0.16341	0.1723	0.8632
Cst(V)	0.210378	0.26801	0.7850	0.4327
d-Figarch	0.388152	0.10649	3.645	0.0003

**2.3 ผลการทดสอบแบบจำลอง ARFIMA(1,d,3)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)**

\*\*\*\*\* Skewed Student distribution, with 8.00262 degrees of  
 freedom.  
 \*\* G@RCH( 3) SPECIFICATIONS \*\*  
 \*\*\*\*\* and asymmetry coefficient (log xi) -0.00981794.

Dependent variable : WTI Strong convergence using numerical derivatives  
 Mean Equation : ARFIMA (1, d, 3) model. Log-likelihood = -2191.95  
 No regressor in the conditional mean Please wait : Computing the Std Errors ...

Variance Equation : FIGARCH (1, d, 1) model Robust Standard Errors (Sandwich formula)  
 estimated with BBM's method (Truncation order : Coefficient Std.Error t-value t-prob  
 1000). Cst(M) 0.096024 0.052516 1.828 0.0678  
 No regressor in the conditional variance d-Arfima -0.092881 0.14533 -0.6391 0.5229  
 AR(1) 0.604244 0.21376 2.827 0.0048

MA(1)	-0.496751	0.16329	-3.042	0.0024	Log Likelihood : -2191.953
MA(2)	-0.013691	0.045233	-0.3027	0.7622	The sample mean of squared residuals was used to start recursion.
MA(3)	0.032033	0.042730	0.7497	0.4536	
Cst(V)	0.199909	0.29693	0.6732	0.5010	The positivity constraint for the FIGARCH (1,d,1) is observed (0.0425627<0.174448<0.537235 and -0.0510236<0.0568239 valid).
d-Figarch	0.388294	0.12618	3.077	0.0022	
ARCH(Phi1)	0.174448	0.44930	0.3883	0.6979	=> See Bollerslev and Mikkelsen (1996) for more details.
GARCH(Beta1)	0.430857	0.51474	0.8370	0.4028	
Asymmetry	-0.009818	0.047806	-0.2054	0.8373	Estimated Parameters Vector :
Tail	8.002616	2.2263	3.595	0.0003	
No. Observations :	942	No. Parameters :	12		0.096024;-0.092881; 0.604244;-0.496751;-0.013691;
Mean (Y) :	0.02752	Variance (Y) :	9.12890		0.032033; 0.199909; 0.388294; 0.174448; 0.430857;-
Skewness (Y) :	0.38171	Kurtosis (Y) :	7.37142		0.009818; 8.002621

**2.4 ผลการทดสอบแบบจำลอง ARFIMA(2,d,1)-FIGARCH(1,d,1) ราคาปัดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)**

*****	Cst(M)	0.126974	0.10000	1.270	0.2045
** G@RCH( 4) SPECIFICATIONS **	d-Arfima	-0.089638	0.14464	0.6197	0.5356
*****	AR(1)	0.824426	0.12752	6.465	0.0000
Dependent variable : WTI	AR(2)	0.029578	0.079711	0.3711	0.7107
Mean Equation : ARFIMA (2, d, 1) model.	MA(1)	-0.899816	0.039282	-22.91	0.0000
No regressor in the conditional mean	Cst(V)	0.210369	0.26437	0.7957	0.4264
Variance Equation : FIGARCH (1, d, 1) model	d-Figarch	0.389762	0.10774	3.618	0.0003
estimated with BBM's method (Truncation order :	ARCH(Phi1)	0.150039	0.36513	0.4109	0.6812
1000).	GARCH(Beta1)	0.407129	0.41335	0.9850	0.3249
No regressor in the conditional variance	Asymmetry	-0.013491	0.047440	-0.2844	0.7762
Skewed Student distribution, with 7.94462 degrees of freedom.	Tail	7.944618	2.1894	3.629	0.0003
and asymmetry coefficient (log xi) -0.0134911.	No. Observations :	942	No. Parameters :	11	
Strong convergence using numerical derivatives	Mean (Y) :	0.02752	Variance (Y) :	9.12890	
Log-likelihood = -2191.28	Skewness (Y) :	0.38171	Kurtosis (Y) :	7.37142	
Please wait : Computing the Std Errors ...	Log Likelihood :	-2191.277			
Robust Standard Errors (Sandwich formula)	The sample mean of squared residuals was used to start recursion.				
Coefficient Std.Error t-value t-prob	The positivity constraint for the FIGARCH (1,d,1) is				

observed (0.0173664<0.150039<0.536746 and -  
 0.0604443<0.0540148 valid).  
 => See Bollerslev and Mikkelsen (1996) for more  
 details.

Estimated Parameters Vector :  
 0.126974; 0.089638; 0.824426; 0.029578;-0.899816;  
 0.210369; 0.389762; 0.150039; 0.407129;-0.013491;  
 7.944623

**2.5 ผลการทดสอบแบบจำลอง ARFIMA(2,d,2)-FIGARCH(1,d,1) ราคาปัดน้ำมันดิบแบบ  
 รายวันในตลาดเวสต์เท็กซัส (WTI)**

\*\*\*\*\*  
**\*\* G@RCH( 5) SPECIFICATIONS \*\***  
 \*\*\*\*\*

Cst(V)	0.291349	0.29504	0.9875	0.3237
d-Figarch	0.368892	0.083349	4.426	0.0000
ARCH(Phi1)	0.007769	0.34579	0.02247	0.9821
GARCH(Beta1)	0.250154	0.37174	0.6729	0.5012
Asymmetry	-0.007648	0.044394	-0.1723	0.8633
Tail	7.856995	2.0643	3.806	0.0002

Dependent variable : WTI  
 Mean Equation : ARFIMA (2, d, 2) model.  
 No regressor in the conditional mean  
 Variance Equation : FIGARCH (1, d, 1) model  
 estimated with BBM's method (Truncation order :  
 1000).  
 No regressor in the conditional variance  
 Skewed Student distribution, with 7.85699 degrees of  
 freedom.  
 and asymmetry coefficient (log xi) -0.00764847.  
 Strong convergence using numerical derivatives  
 Log-likelihood = -2188.41  
 Please wait : Computing the Std Errors ...  
 Robust Standard Errors (Sandwich formula)

No. Observations : 942 No. Parameters : 12  
 Mean (Y) : 0.02752 Variance (Y) : 9.12890  
 Skewness (Y) : 0.38171 Kurtosis (Y) : 7.37142  
 Log Likelihood : -2188.414  
 The sample mean of squared residuals was used to  
 start recursion.  
 The positivity constraint for the FIGARCH (1,d,1) is  
 observed (-0.118738<0.00776938<0.543703 and -  
 0.113539<0.0316464 valid).  
 => See Bollerslev and Mikkelsen (1996) for more  
 details.

	Coefficient	Std.Error	t-value	t-prob	Estimated Parameters Vector :
Cst(M)	0.085777	0.087428	0.9811	0.3268	0.085777; 0.024865;-0.038783;-0.953476; 0.032421;
d-Arfima	0.024865	0.033835	0.7349	0.4626	0.931213; 0.291349; 0.368892; 0.007769; 0.250154;-
AR(1)	-0.038783	0.052587	-0.7375	0.4610	0.007648; 7.857000
AR(2)	-0.953476	0.044607	-21.37	0.0000	
MA(1)	0.032421	0.070340	0.4609	0.6450	
MA(2)	0.931213	0.057189	16.28	0.0000	

2.6 ผลการทดสอบแบบจำลอง ARFIMA(2,d,3)-FIGARCH(1,d,1) ราคาปัดน้ำมันดิบแบบ  
รายวันในตลาดเวสต์เท็กซัส (WTI)

```

*****
** G@RCH( 6) SPECIFICATIONS **
*****
Dependent variable : WTI
Mean Equation : ARFIMA (2, d, 3) model.
No regressor in the conditional mean
Variance Equation : FIGARCH (1, d, 1) model
estimated with BBM's method (Truncation order :
1000).
No regressor in the conditional variance
Skewed Student distribution, with 8.23109 degrees of
freedom.
and asymmetry coefficient (log xi) -0.0134485.
Strong convergence using numerical derivatives
Log-likelihood = -2188.55
Please wait : Computing the Std Errors ...
Robust Standard Errors (Sandwich formula)

Coefficient Std.Error t-value t-prob
Cst(M)      0.094722  0.057503  1.647 0.0998
d-Arfima    -0.057632  0.065083 -0.8855
0.3761
AR(1)       1.396460  0.22147  6.305 0.0000
AR(2)       -0.841653  0.16626 -5.062 0.0000
MA(1)       -1.328176  0.25261 -5.258 0.0000

*****
MA(2)        0.780839  0.21173  3.688 0.0002
MA(3)        0.062336  0.076612  0.8137 0.4161
Cst(V)       0.266330  0.32797  0.8121 0.4170
d-Figarch    0.368410  0.089455  4.118 0.0000
ARCH(Phi1)  0.039793  0.47631  0.08355 0.9334
GARCH(Beta1) 0.284927  0.51273  0.5557 0.5785
Asymmetry    -0.013448  0.046945 -0.2865 0.7746
Tail         8.231089  2.3470  3.507 0.0005
No. Observations : 942 No. Parameters : 13
Mean (Y) : 0.02752 Variance (Y) : 9.12890
Skewness (Y) : 0.38171 Kurtosis (Y) : 7.37142
Log Likelihood : -2188.549
The sample mean of squared residuals was used to
start recursion.
The positivity constraint for the FIGARCH (1,d,1) is
observed (-0.083483<0.0397935<0.543863 and -
0.101682<0.0351248 valid).
=> See Bollerslev and Mikkelsen (1996) for more
details.
Estimated Parameters Vector :
0.094722;-0.057632; 1.396460;-0.841653;-1.328176;
0.780839; 0.062336; 0.266330; 0.368410; 0.039793;
0.284927;-0.013448; 8.231094

```

## 2.7 ผลการทดสอบแบบจำลอง ARFIMA(3,d,1)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

```

*****
MA(1) 0.705523 0.19774 3.568 0.0004
** GARCH( 7) SPECIFICATIONS **
Cst(V) 0.224995 0.28496 0.7896 0.4300
*****
d-Figarch 0.379829 0.10785 3.522 0.0004
Dependent variable : WTI
ARCH(Phi1) 0.126344 0.40067 0.3153 0.7526
Mean Equation : ARFIMA (3, d, 1) model.
GARCH(Beta1) 0.376978 0.45077 0.8363 0.4032
No regressor in the conditional mean
Asymmetry -0.015455 0.045375 -0.3406 0.7335
Variance Equation : FIGARCH (1, d, 1) model
Tail 7.794410 2.1599 3.609 0.0003
estimated with BBM's method (Truncation order :
No. Observations : 942 No. Parameters : 12
1000).
Mean (Y) : 0.02752 Variance (Y) : 9.12890
No regressor in the conditional variance
Skewness (Y) : 0.38171 Kurtosis (Y) : 7.37142
Skewed Student distribution, with 7.79441 degrees of
Log Likelihood : -2190.895
freedom.
The sample mean of squared residuals was used to
and asymmetry coefficient (log xi) -0.0154549.
start recursion.
Strong convergence using numerical derivatives
The positivity constraint for the FIGARCH (1,d,1) is
observed (-0.00285137<0.126344<0.540057 and -
Log-likelihood = -2190.89
0.0697902<0.048704 valid).
Please wait : Computing the Std Errors ...
=> See Bollerslev and Mikkelsen (1996) for more
Robust Standard Errors (Sandwich formula)
details.
Coefficient Std.Error t-value t-prob
Cst(M) 0.095930 0.082959 -1.156 0.2478
Estimated Parameters Vector :
d-Arfima 0.016159 0.092910 0.1739 0.8620 0.095930; 0.016159;-0.701906;-0.009470;-0.030631;
AR(1) -0.701906 0.20662 -3.397 0.0007 0.705523; 0.224995; 0.379829; 0.126344; 0.376978;-
AR(2) -0.009470 0.11621 -0.08149 0.9351 0.015455; 7.794415
AR(3) -0.030631 0.052008 -0.5890 0.5560

```

2.8 ผลการทดสอบแบบจำลอง ARFIMA(3,d,2)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ  
รายวันในตลาดเวสต์เท็กซัส (WTI)

```

*****
** GARCH( 8) SPECIFICATIONS **
*****
Dependent variable : WTI
Mean Equation : ARFIMA (3, d, 2) model.
No regressor in the conditional mean
Variance Equation : FIGARCH (1, d, 1) model
estimated with BBM's method (Truncation order :
1000).
No regressor in the conditional variance
Skewed Student distribution, with 7.76532 degrees of
freedom.
and asymmetry coefficient (log xi) -0.000822208.
Strong convergence using numerical derivatives
Log-likelihood = -2185.57
Please wait : Computing the Std Errors ...
Robust Standard Errors (Sandwich formula)

Coefficient Std.Error t-value t-prob
Cst(M)      0.087846  0.081500  -1.078  0.2814
d-Arfima    -0.002518  0.064839 -0.03884  0.9690
AR(1)       -0.363680  0.075097  -4.843  0.0000
AR(2)       -0.917729  0.040767 -22.51  0.0000
AR(3)       0.006662  0.073402  0.09076  0.9277

MA(1)       0.395566  0.011240  35.19  0.0000
MA(2)       0.948724  0.051332  18.48  0.0000
Cst(V)      0.238086  0.25092  0.9488  0.3429
d-Figarch   0.387912  0.091546  4.237  0.0000
ARCH(Phi1)  0.075596  0.28106  0.2690  0.7880
GARCH(Beta1) 0.342016  0.30832  1.109  0.2676
Asymmetry   -0.000822  0.050362 -0.01633  0.9870
Tail        7.765315  2.1081  3.684  0.0002

No. Observations : 942 No. Parameters : 13
Mean (Y) : 0.02752 Variance (Y) : 9.12890
Skewness (Y) : 0.38171 Kurtosis (Y) : 7.37142
Log Likelihood : -2185.574
The sample mean of squared residuals was used to
start recursion.
The positivity constraint for the FIGARCH (1,d,1) is
observed (-0.045896<0.0755965<0.537363 and -
0.0893934<0.0415524 valid).
=> See Bollerslev and Mikkelsen (1996) for more
details.
Estimated Parameters Vector :
0.087846;-0.002518;-0.363680;-0.917729; 0.006662;
0.395566; 0.948724; 0.238086; 0.387912; 0.075596;
0.342016;-0.000822; 7.765320

```

## 2.9 ผลการทดสอบแบบจำลอง ARFIMA(3,d,3)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

*****	MA(2)	0.738704	0.080239	9.206	0.0000
** G@RCH( 9) SPECIFICATIONS **	MA(3)	-0.570813	0.19581	-2.915	0.0036
*****	Cst(V)	0.233371	0.24362	0.9579	0.3383
Dependent variable : WTI	d-Figarch	0.397916	0.10137	3.925	0.0001
Mean Equation : ARFIMA (3, d, 3) model.	ARCH(Phi1)	0.098355	0.27466	0.3581	0.7204
No regressor in the conditional mean	GARCH(Beta1)	0.378740	0.31017	1.221	0.2224
Variance Equation : FIGARCH (1, d, 1) model	Asymmetry	0.006864	0.047024	0.1460	0.8840
estimated with BBM's method (Truncation order :	Tail	7.442955	1.9553	3.807	0.0002
1000).	No. Observations :	942	No. Parameters :	14	
No regressor in the conditional variance	Mean (Y) :	0.02752	Variance (Y) :	9.12890	
Skewed Student distribution, with 7.44295 degrees of	Skewness (Y) :	0.38171	Kurtosis (Y) :	7.37142	
freedom.	Log Likelihood :	-2183.589			
and asymmetry coefficient (log xi) 0.0068638.	The sample mean of squared residuals was used to		start recursion.		
Strong convergence using numerical derivatives	The positivity constraint for the FIGARCH (1,d,1) is		observed (-0.0191756<0.0983552<0.534028 and -		
Log-likelihood = -2183.59	0.0806523<0.0445136 valid).		=> See Bollerslev and Mikkelsen (1996) for more		
Please wait : Computing the Std Errors ...			details.		
Robust Standard Errors (Sandwich formula)			Estimated Parameters Vector :		
	Coefficient Std.Error t-value t-prob		0.105978;-0.074205; 0.272522;-0.690034; 0.635324;-		
Cst(M)	0.105978 0.057256 -1.851 0.0645		0.176850; 0.738704;-0.570813; 0.233371; 0.397916;		
d-Arfima	-0.074205 0.14712 -0.5044 0.6141		0.098355; 0.378740; 0.006864; 7.442960		
AR(1)	0.272522 0.17602 1.548 0.1219				
AR(2)	-0.690034 0.068630 -10.05 0.0000				
AR(3)	0.635324 0.17384 3.655 0.0003				
MA(1)	-0.176850 0.19821 -0.8922 0.3725				

### 3. ผลการทดสอบแบบจำลอง-ไฟการ์ช (ARFIMA-FIGARCH) ราคาปิดน้ำมันดิบแบบรายวันใน ตลาดดูไบโอมาน (Dubai-Oman)

#### 3.1 ผลการทดสอบแบบจำลอง ARFIMA(1,d,1)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดดูไบโอมาน (Dubai-Oman)

```

*****
** G@RCH( 1) SPECIFICATIONS **
*****
Dependent variable : Dubai-Oman
Mean Equation : ARFIMA (1, d, 1) model.
No regressor in the conditional mean
Variance Equation : FIGARCH (1, d, 1) model
estimated with BBM's method (Truncation order :
1000).
No regressor in the conditional variance
Skewed Student distribution, with 7.20052 degrees of
freedom.
and asymmetry coefficient (log xi) -0.00516298.
Strong convergence using numerical derivatives
Log-likelihood = 2286.72
Please wait : Computing the Std Errors ...
Robust Standard Errors (Sandwich formula)
Coefficient Std.Error t-value t-prob
Cst(M) 0.001489 0.00059410 2.506 0.0124
d-Arfima -0.008547 0.075212 -0.1136 0.9095
AR(1) 0.028415 0.37346 0.07608 0.9394
*****
MA(1) -0.129981 0.42016 -0.3094 0.7571
Cst(V) x 10^4 0.176666 0.16763 1.054 0.2922
d-Figarch 0.399955 0.10432 3.834 0.0001
ARCH(Phi1) 0.108350 0.15561 0.6963 0.4864
GARCH(Beta1) 0.449847 0.20788 2.164 0.0307
Asymmetry -0.005163 0.042664 -0.1210 0.9037
Tail 7.200518 1.6718 4.307 0.0000
No. Observations : 979 No. Parameters : 10
Mean (Y) : 0.00050 Variance (Y) : 0.00077
Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495
Log Likelihood : 2286.722
The sample mean of squared residuals was used to
start recursion.
The positivity constraint for the FIGARCH (1,d,1) is
observed (0.0498913<0.10835<0.533348 and -
0.0766603<0.0262976 valid).
=> See Bollerslev and Mikkelsen (1996) for more
details.
Estimated Parameters Vector :
0.001489;-0.008547; 0.028415;-0.129981; 0.176666;
0.399955; 0.108350; 0.449847;-0.005163; 7.200523

```

#### 3.2 ผลการทดสอบแบบจำลอง ARFIMA(1,d,2)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดดูไบโอมาน (Dubai-Oman)

```

*****
** G@RCH( 2) SPECIFICATIONS **
*****
Dependent variable : Dubai-Oman
Mean Equation : ARFIMA (1, d, 2) model.
No regressor in the conditional mean
Variance Equation : FIGARCH (1, d, 1) model
estimated with BBM's method (Truncation order :
1000).
No regressor in the conditional variance
Skewed Student distribution, with 7.13776 degrees of
freedom.
and asymmetry coefficient (log xi) -0.00456614.

```



Strong convergence using numerical derivatives  
 Log-likelihood = 2287.05  
 Please wait : Computing the Std Errors ...  
 Robust Standard Errors (Sandwich formula)

	Coefficient	Std.Error	t-value	t-prob
Cst(M)	0.002082	0.0024716	0.8422	0.3999
d-Arfima	0.213195	0.73566	0.2898	0.7720
AR(1)	0.807287	0.18666	4.325	0.0000
MA(1)	-1.134780	0.57399	-1.977	0.0483
MA(2)	0.209704	0.44478	0.4715	0.6374
Cst(V) x 10 <sup>4</sup>	0.194241	0.19565	0.9928	0.3210
d-Figarch	0.388215	0.10975	3.537	0.0004
ARCH(Phi1)	0.086063	0.18646	0.4616	0.6445
GARCH(Beta1)	0.415506	0.25469	1.631	0.1031
Asymmetry	-0.004566	0.042495	-0.1075	0.9145
Tail	7.137765	1.7096	4.175	0.0000

No. Observations : 979 No. Parameters : 11  
 Mean (Y) : 0.00050 Variance (Y) : 0.00077  
 Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495  
 Log Likelihood : 2287.051  
 The sample mean of squared residuals was used to start recursion.  
 The positivity constraint for the FIGARCH (1,d,1) is observed (0.0272914<0.0860634<0.537262 and -0.0853409<0.0244201 valid).  
 => See Bollerslev and Mikkelsen (1996) for more details.  
 Estimated Parameters Vector :  
 0.002082; 0.213195; 0.807287;-1.134780; 0.209704; 0.194241; 0.388215; 0.086063; 0.415506;-0.004566; 7.137770

### 3.3 ผลการทดสอบแบบจำลอง ARFIMA(1,d,3)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman)

\*\*\*\*\*  
 \*\* G@RCH( 3) SPECIFICATIONS \*\*  
 \*\*\*\*\*

Log-likelihood = 2287.18  
 Please wait : Computing the Std Errors ...  
 Robust Standard Errors (Sandwich formula)

Dependent variable : Dubai-Oman	Coefficient	Std.Error	t-value	t-prob
Mean Equation : ARFIMA (1, d, 3) model.	Cst(M)	0.002204	0.0019591	1.125 0.2608
No regressor in the conditional mean	d-Arfima	0.254397	0.46710	0.5446 0.5861
Variance Equation : FIGARCH (1, d, 1) model estimated with BBM's method (Truncation order : 1000).	AR(1)	0.817070	0.11456	7.132 0.0000
	MA(1)	-1.182561	0.36859	-3.208 0.0014
	MA(2)	0.223507	0.28872	0.7741 0.4391
	MA(3)	0.019987	0.038130	0.5242 0.6003
No regressor in the conditional variance	Cst(V) x 10 <sup>4</sup>	0.196512	0.18902	1.040 0.2988
Skewed Student distribution, with 7.09136 degrees of freedom.	d-Figarch	0.387377	0.10437	3.712 0.0002
and asymmetry coefficient (log xi) -0.00347996.	ARCH(Phi1)	0.084674	0.17966	0.4713 0.6375
Strong convergence using numerical derivatives	GARCH(Beta1)	0.413259	0.23893	1.730 0.0840

Asymmetry -0.003480 0.042158 -0.08255 0.9342 observed (0.0258827<0.0846736<0.537541 and -  
 Tail 7.091357 1.6646 4.260 0.0000 0.0858574<0.0242959 valid).  
 No. Observations : 979 No. Parameters : 12 => See Bollerslev and Mikkelsen (1996) for more  
 Mean (Y) : 0.00050 Variance (Y) : 0.00077 details.  
 Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495 Estimated Parameters Vector :  
 Log Likelihood : 2287.181 0.002204; 0.254397; 0.817070;-1.182561; 0.223507;  
 The sample mean of squared residuals was used to 0.019987; 0.196512; 0.387377; 0.084674; 0.413259;-  
 start recursion. 0.003480; 7.091362  
 The positivity constraint for the FIGARCH (1,d,1) is

### 3.4 ผลการทดสอบแบบจำลอง ARFIMA(2,d,1)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดเบรนท์ (Brent Blend)

\*\*\*\*\*  
 \*\* G@RCH( 4) SPECIFICATIONS \*\*  
 \*\*\*\*\*  
 Dependent variable : Dubai-Oman  
 Mean Equation : ARFIMA (2, d, 1) model.  
 No regressor in the conditional mean  
 Variance Equation : FIGARCH (1, d, 1) model  
 estimated with BBM's method (Truncation order :  
 1000).  
 No regressor in the conditional variance  
 Skewed Student distribution, with 7.1245 degrees of  
 freedom.  
 and asymmetry coefficient (log xi) -0.00658257.  
 Strong convergence using numerical derivatives  
 Log-likelihood = 2288.85  
 Please wait : Computing the Std Errors ...  
 Robust Standard Errors (Sandwich formula)  
 Coefficient Std.Error t-value t-prob  
 Cst(M) 0.001459 0.00060481 2.412 0.0160  
 d-Arfima -0.003215 0.068189 -0.04715 0.9624  
 AR(1) -0.138218 0.083916 -1.647 0.0999  
 AR(2) -0.021102 0.040509 -0.5209 0.6025  
 MA(1) 0.031769 0.13328 0.2384 0.8117  
 Cst(V) x 10^4 0.183201 0.16975 1.079 0.2807  
 d-Figarch 0.399766 0.10900 3.668 0.0003  
 ARCH(Phi1) 0.113786 0.16342 0.6963 0.4864  
 GARCH(Beta1) 0.451131 0.22059 2.045 0.0411  
 Asymmetry -0.006583 0.042590 -0.1546 0.8772  
 Tail 7.124502 1.6486 4.322 0.0000  
 No. Observations : 979 No. Parameters : 11  
 Mean (Y) : 0.00050 Variance (Y) : 0.00077  
 Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495  
 Log Likelihood : 2288.854  
 The sample mean of squared residuals was used to  
 start recursion.  
 The positivity constraint for the FIGARCH (1,d,1) is  
 observed (0.0513649<0.113786<0.533411 and -  
 0.0744886<0.0281603 valid).  
 => See Bollerslev and Mikkelsen (1996) for more  
 details.  
 Estimated Parameters Vector :

0.001459;-0.003215;-0.138218;-0.021102; 0.031769; 7.124507  
 0.183201; 0.399766; 0.113786; 0.451131;-0.006583;

**3.5 ผลการทดสอบแบบจำลอง ARFIMA(2,d,2)-FIGARCH(1,d,1) ราคาปัดน้ำมันดิบแบบ  
 รายวันในตลาดดูไบโอมาน (Dubai-Oman)**

```

*****
** GARCH(5) SPECIFICATIONS **
*****
Dependent variable : Dubai-Oman
Mean Equation : ARFIMA (2, d, 2) model.
No regressor in the conditional mean
Variance Equation : FIGARCH (1, d, 1) model
estimated with BBM's method (Truncation order :
1000).
No regressor in the conditional variance
Skewed Student distribution, with 7.08222 degrees of
freedom.
and asymmetry coefficient (log xi) -0.00738878.
Strong convergence using numerical derivatives
Log-likelihood = 2288.96
Please wait : Computing the Std Errors ...
Robust Standard Errors (Sandwich formula)

Coefficient Std.Error t-value t-prob
Cst(M)      0.001489 0.00064379  2.313 0.0209
d-Arfima    -0.010638 0.080564  0.1320 0.8950
AR(1)       -0.543419 0.19355  -2.808 0.0051
AR(2)       0.223224 0.16698  1.337 0.1816
MA(1)       0.430237 0.18811  2.287 0.0224

MA(2)       -0.307032 0.17485  -1.756 0.0794
Cst(V) x 10^4 0.179569 0.16505  1.088 0.2769
d-Figarch   0.403699 0.10884  3.709 0.0002
ARCH(Phi1)  0.118328 0.15369  0.7699 0.4415
GARCH(Beta1) 0.460400 0.20793  2.214 0.0271
Asymmetry   -0.007389 0.041788 -0.1768 0.8597
Tail        7.082221 1.6715  4.237 0.0000
No. Observations : 979 No. Parameters : 12
Mean (Y) : 0.00050 Variance (Y) : 0.00077
Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495
Log Likelihood : 2288.956
The sample mean of squared residuals was used to
start recursion.
The positivity constraint for the FIGARCH (1,d,1) is
observed (0.0567008<0.118328<0.5321 and -
0.0725943<0.0283729 valid).
=> See Bollerslev and Mikkelsen (1996) for more
details.
Estimated Parameters Vector :
0.001489; 0.010638;-0.543419; 0.223224; 0.430237;-
0.307032; 0.179569; 0.403699; 0.118328; 0.460400;-
0.007389; 7.082226
    
```

### 3.6 ผลการทดสอบแบบจำลอง ARFIMA(2,d,3)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดดูไบโอมาน (Dubai-Oman)

```

*****
** GARCH( 6) SPECIFICATIONS **
*****
Dependent variable : Dubai-Oman
Mean Equation : ARFIMA ( 2, d, 3) model.
No regressor in the conditional mean
Variance Equation : FIGARCH ( 1, d, 1) model
estimated with BBM's method (Truncation order :
1000).
No regressor in the conditional variance
Skewed Student distribution, with 7.0053 degrees of
freedom.
and asymmetry coefficient (log xi) -0.00717592.
Strong convergence using numerical derivatives
Log-likelihood = 2289.3
Please wait : Computing the Std Errors ...
Robust Standard Errors (Sandwich formula)

Coefficient Std.Error t-value t-prob
Cst(M)      0.001446 0.00061249  2.362  0.0184
d-Arfima    -0.007802 0.098640 -0.07909  0.9370
AR(1)       -0.424859 0.10151  -4.185  0.0000
AR(2)        0.361574 0.11705   3.089  0.0021
MA(1)        0.324721 0.12489   2.600  0.0095

MA(2)       -0.405750 0.12193  -3.328  0.0009
MA(3)        0.038205 0.040013  0.9548  0.3399
Cst(V) x 10^4 0.179028 0.16371  1.094  0.2744
d-Figarch   0.405205 0.10787   3.757  0.0002
ARCH(Phi1)  0.119152 0.14963  0.7963  0.4261
GARCH(Beta1) 0.463389 0.20286  2.284  0.0226
Asymmetry   -0.007176 0.041601 -0.1725  0.8631
Tail         7.005305 1.6205  4.323  0.0000

No. Observations : 979 No. Parameters : 13
Mean (Y) : 0.00050 Variance (Y) : 0.00077
Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495
Log Likelihood : 2289.303
The sample mean of squared residuals was used to
start recursion.
The positivity constraint for the FIGARCH (1,d,1) is
observed (0.0581835<0.119152<0.531598 and -
0.0722259<0.0282521 valid).
=> See Bollerslev and Mikkelsen (1996) for more
details.
Estimated Parameters Vector :
0.001446;-0.007802;-0.424859; 0.361574; 0.324721;-
0.405750; 0.038205; 0.179028; 0.405205; 0.119152;
0.463389;-0.007176; 7.005310

```

### 3.7 ผลการทดสอบแบบจำลอง ARFIMA(3,d,1)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดดูไบโอมาน (Dubai-Oman)

```

*****
MA(1) -0.937899 0.057170 -16.41 0.0000
** G@RCH( 7) SPECIFICATIONS **
Cst(V) x 10^4 0.182109 0.17197 1.059 0.2899
*****
d-Figarch 0.398710 0.11352 3.512 0.0005
Dependent variable : Dubai-Oman ARCH(Phi1) 0.121461 0.16722 0.7264 0.4678
Mean Equation : ARFIMA (3, d, 1) model. GARCH(Beta1) 0.454911 0.22843 1.991 0.0467
No regressor in the conditional mean Asymmetry -0.007888 0.042968 -0.1836 0.8544
Variance Equation : FIGARCH (1, d, 1) model Tail 7.145132 1.6597 4.305 0.0000
estimated with BBM's method (Truncation order : No. Observations : 979 No. Parameters : 12
1000). Mean (Y) : 0.00050 Variance (Y) : 0.00077
No regressor in the conditional variance Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495
Skewed Student distribution, with 7.14513 degrees of Log Likelihood : 2289.526
freedom. The sample mean of squared residuals was used to
and asymmetry coefficient (log xi) -0.00788823. start recursion.
Strong convergence using numerical derivatives The positivity constraint for the FIGARCH (1,d,1) is
Log-likelihood = 2289.53 observed (0.0562003<0.121461<0.533763 and -
Please wait : Computing the Std Errors ... 0.0714425<0.0296877 valid).
Robust Standard Errors (Sandwich formula) => See Bollerslev and Mikkelsen (1996) for more
Coefficient Std.Error t-value t-prob details.
Cst(M) 0.001420 0.00057363 2.476 0.0135 Estimated Parameters Vector :
d-Arfima -0.081900 0.096495 -0.8487 0.3962 0.001420;-0.081900; 0.909688; 0.051813;-0.007092;-
AR(1) 0.909688 0.075659 12.02 0.0000 0.937899; 0.182109; 0.398710; 0.121461; 0.454911;-
AR(2) 0.051813 0.062705 0.8263 0.4088 0.007888; 7.145137
AR(3) -0.007092 0.049263 -0.1440 0.8856

```

### 3.8 ผลการทดสอบแบบจำลอง ARFIMA(3,d,2)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดดูไบโอมาน (Dubai-Oman)

```

*****
MA(1) -1.438674 0.29305 -4.909 0.0000
** G@RCH( 8) SPECIFICATIONS **
MA(2) 0.477337 0.25755 1.853 0.0641
*****
Cst(V) x 10^4 0.208912 0.19234 1.086 0.2777
Dependent variable : Dubai-Oman d-Figarch 0.385866 0.10774 3.581 0.0004
Mean Equation : ARFIMA (3, d, 2) model. ARCH(Phi1) 0.082623 0.19383 0.4263 0.6700
No regressor in the conditional mean GARCH(Beta1) 0.403461 0.25841 1.561 0.1188
Variance Equation : FIGARCH (1, d, 1) model Asymmetry -0.004304 0.041759 -0.1031 0.9179
estimated with BBM's method (Truncation order : Tail 6.940120 1.5832 4.384 0.0000
1000). No. Observations : 979 No. Parameters : 13
No regressor in the conditional variance Mean (Y) : 0.00050 Variance (Y) : 0.00077
Skewed Student distribution, with 6.94012 degrees of Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495
freedom. Log Likelihood : 2291.032
and asymmetry coefficient (log xi) -0.00430409. The sample mean of squared residuals was used to
Strong convergence using numerical derivatives start recursion.
Log-likelihood = 2291.03 The positivity constraint for the FIGARCH (1,d,1) is
Please wait : Computing the Std Errors ... observed (0.0175952<0.0826225<0.538045 and -
Robust Standard Errors (Sandwich formula) 0.0866055<0.026236 valid).
=> See Bollerslev and Mikkelsen (1996) for more
Coefficient Std.Error t-value t-prob details.
Cst(M) 0.002521 0.0020397 -1.236 0.2168
d-Arfima 0.277399 0.27967 0.9919 0.3215 Estimated Parameters Vector :
AR(1) 1.048148 0.12066 8.687 0.0000 0.002521; 0.277399; 1.048148;-0.143427;-0.031154;-
AR(2) -0.143427 0.075871 -1.890 0.0590 1.438674; 0.477337; 0.208912; 0.385866; 0.082623;
AR(3) -0.031154 0.053029 -0.5875 0.5570 0.403461;-0.004304; 6.940125

```

### 3.9 ผลการทดสอบแบบจำลอง ARFIMA(3,d,3)-FIGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดดูไบโอมาน (Dubai-Oman)

```

*****
d-Figarch      0.383497  0.10807  3.549  0.0004
** G@RCH( 9) SPECIFICATIONS **
ARCH(Phi1)    0.076684  0.19898  0.3854  0.7000
*****
GARCH(Beta1)  0.396028  0.26477  1.496  0.1350
Dependent variable : Dubai-Oman
Asymmetry     -0.003692  0.041739 -0.08846  0.9295
Mean Equation : ARFIMA (3, d, 3) model.
Tail          6.892350  1.5917  4.330  0.0000
No regressor in the conditional mean
No. Observations : 979 No. Parameters : 14
Variance Equation : FIGARCH (1, d, 1) model
Mean (Y)      : 0.00050 Variance (Y) : 0.00077
estimated with BBM's method (Truncation order :
Skewness (Y)  : 0.08697 Kurtosis (Y) : 6.18495
1000).
Log Likelihood : 2291.137
No regressor in the conditional variance
The sample mean of squared residuals was used to
Skewed Student distribution, with 6.89235 degrees of
start recursion.
freedom.
The positivity constraint for the FIGARCH (1,d,1) is
and asymmetry coefficient (log xi) -0.00369209.
observed (0.0125311<0.0766844<0.538834 and -
Strong convergence using numerical derivatives
0.0888053<0.0254065 valid).
Log-likelihood = 2291.14
=> See Bollerslev and Mikkelsen (1996) for more
Please wait : Computing the Std Errors ...
details.
Robust Standard Errors (Sandwich formula)
Estimated Parameters Vector :
Coefficient Std.Error t-value t-prob
0.002684; 0.325805; 1.076381;-0.223196; 0.004806;-
Cst(M)      0.002684  0.0023616  -1.137  0.2560  1.517634; 0.618209;-0.064514; 0.214088; 0.383497;
d-Arfima    0.325805  0.36673  0.8884  0.3745  0.076684; 0.396028;-0.003692; 6.892355
AR(1)       1.076381  0.13025  8.264  0.0000
AR(2)       -0.223196  0.16147  -1.382  0.1672
AR(3)       0.004806  0.088520  0.05429  0.9567
MA(1)       -1.517634  0.43083  -3.523  0.0004
MA(2)       0.618209  0.49395  1.252  0.2110
MA(3)       -0.064514  0.13887  -0.4646  0.6424
Cst(V) x 10^4 0.214088  0.19837  1.079  0.2808

```

ภาคผนวก จ

ผลการทดสอบแบบจำลอง-ไฟการ์ช (ARFIMA-FIEGARCH)

1. ผลการทดสอบแบบจำลอง-ไฟการ์ช (ARFIMA-FIEGARCH) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend)

1.1 ผลการทดสอบแบบจำลอง ARFIMA(1,d,1)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend)

\*\*\*\*\*  
Log-likelihood = -2097.23  
\*\*\*\*\*  
\*\* SPECIFICATIONS \*\*  
\*\*\*\*\*  
No. Observations : 942 No. Parameters : 12  
Mean (Y) : 0.04379 Variance (Y) : 7.01757  
Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509  
Dependent variable : BRENT  
Log Likelihood : -2097.234  
Mean Equation : ARFIMA (1, d, 1) model.  
Estimated Parameters Vector :  
No regressor in the conditional mean  
0.099927; 0.028626;-0.260564; 0.256196; 1.528837;  
Variance Equation : FIEGARCH (1, d, 1) model  
(Truncation order : 1000).  
0.628952; 0.781601; 0.371268;-0.067642; 0.104101;  
No regressor in the conditional variance  
0.000908; 6.923565  
Skewed Student distribution, with 6.92357 degrees of  
Parameters Names  
freedom. Cst(M) ; d-Arfima ; AR(1) ; MA(1)  
and asymmetry coefficient (log xi) 0.000908162. ; Cst(V) ; d-Figarch ; ARCH(Phi1) ;  
No convergence (no improvement in line search) using  
GARCH(Beta1) ; EGARCH(Theta1) ;  
numerical derivatives EGARCH(Theta2) ; Asymmetry ; Tail ;

1.2 ผลการทดสอบแบบจำลอง ARFIMA(1,d,2)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend)

\*\*\*\*\*  
Variance Equation : FIEGARCH (1, d, 1) model  
\*\*\*\*\*  
\*\* SPECIFICATIONS \*\*  
\*\*\*\*\*  
(Truncation order : 1000).  
No regressor in the conditional variance  
Skewed Student distribution, with 6.87666 degrees of  
freedom.  
Dependent variable : BRENT  
Mean Equation : ARFIMA (1, d, 2) model.  
and asymmetry coefficient (log xi) 7.84648e-005.  
No regressor in the conditional mean



No convergence (no improvement in line search) using numerical derivatives 0.091609; 0.056357;-0.310486; 0.275832;-0.034298; 1.524783; 0.639366; 0.827557; 0.360036;-0.066037;

Log-likelihood = -2096.97 0.100488; 0.000078; 6.876660

No. Observations : 942 No. Parameters : 13 Parameters Names

Mean (Y) : 0.04379 Variance (Y) : 7.01757 Cst(M) ; d-Arfima ; AR(1) ; MA(1)

Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509 ; MA(2) ; Cst(V) ; d-Figarch ;

Log Likelihood : -2096.968 ARCH(Phi1) ; GARCH(Beta1) ;

Estimated Parameters Vector : EGARCH(Theta1) ; EGARCH(Theta2) ;

Asymmetry ; Tail ;

**1.3 ผลการทดสอบแบบจำลอง ARFIMA(1,d,3)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend)**

```

*****
** G@RCH(1) SPECIFICATIONS **
*****
Dependent variable : BRENT
Mean Equation : ARFIMA (1, d, 3) model.
No regressor in the conditional mean
Variance Equation : FIEGARCH (1, d, 1) model
(Truncation order : 1000).
No regressor in the conditional variance
Skewed Student distribution, with 6.898 degrees of
freedom.
and asymmetry coefficient (log xi) -0.00013896.
Strong convergence using numerical derivatives
Log-likelihood = -2096.94
Please wait : Computing the Std Errors ...
Robust Standard Errors (Sandwich formula)

```

MA(2)	-0.028027	0.039354	-0.7122	0.4765
MA(3)	0.007881	0.032424	0.2430	0.8080
Cst(V)	1.523994	0.40193	3.792	0.0002
d-Figarch	0.636753	0.10862	5.862	0.0000
ARCH(Phi1)	0.846246	1.3066	0.6477	0.5174
GARCH(Beta1)	0.361284	0.14745	2.450	0.0145
EGARCH(Theta1)	-0.065508	0.04703	-1.393	0.1640
EGARCH(Theta2)	0.100432	0.055593	1.807	0.0712
Asymmetry	-0.000139	0.019675	-0.007063	0.9944
Tail	6.897998	1.6355	4.218	0.0000

```

No. Observations : 942 No. Parameters : 14
Mean (Y) : 0.04379 Variance (Y) : 7.01757
Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509
Log Likelihood : -2096.940
The sample mean of squared residuals was used to
start recursion.

```

	Coefficient	Std.Error	t-value	t-prob	Estimated Parameters Vector :
Cst(M)	0.090473	0.065194	1.388	0.1655	0.090473; 0.050429;-0.264315; 0.235640;-0.028027;
d-Arfima	0.050429	0.063062	0.7997	0.4241	0.007881; 1.523994; 0.636753; 0.846246; 0.361284;-
AR(1)	-0.264315	0.36871	-0.7169	0.4736	0.065508; 0.100432;-0.000139; 6.898003
MA(1)	0.235640	0.40603	0.5803	0.5618	

#### 1.4 ผลการทดสอบแบบจำลอง ARFIMA(2,d,1)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดเบรนท์ (Brent Blend)

```

*****
MA(1) -0.894641 0.065109 -13.74 0.0000
** G@RCH( 2) SPECIFICATIONS **
*****
d-Figarch 0.627574 0.11373 5.518 0.0000
Dependent variable : BRENT ARCH(Phi1) 0.567469 1.0965 0.5175 0.6049
Mean Equation : ARFIMA (2, d, 1) model. GARCH(Beta1) 0.424124 0.16010 2.649
No regressor in the conditional mean 0.0082
Variance Equation : FIEGARCH (1, d, 1) model EGARCH(Theta1) -0.072194 0.045967 -1.571 0.1166
(Truncation order : 1000). EGARCH(Theta2) 0.107230 0.054528 1.967 0.0495
No regressor in the conditional variance Asymmetry 0.006563 0.023126 0.2838 0.7766
Skewed Student distribution, with 6.8338 degrees of Tail 6.833796 1.6418 4.162 0.0000
freedom. No. Observations : 942 No. Parameters : 13
and asymmetry coefficient (log xi) 0.00656273. Mean (Y) : 0.04379 Variance (Y) : 7.01757
Strong convergence using numerical derivatives Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509
Log-likelihood = -2095.05 Log Likelihood : -2095.045
Please wait : Computing the Std Errors ... The sample mean of squared residuals was used to
Robust Standard Errors (Sandwich formula) start recursion.
Coefficient Std.Error t-value t-prob Estimated Parameters Vector :
Cst(M) 0.127871 0.099873 1.280 0.2007 0.127871; 0.102795; 0.813025; 0.039767;-0.894641;
d-Arfima 0.102795 0.35439 0.2901 0.7718 1.668869; 0.627574; 0.567469; 0.424124;-0.072194;
AR(1) 0.813025 0.33458 2.430 0.0153 0.107230; 0.006563; 6.833801
AR(2) 0.039767 0.20176 0.1971 0.8438

```

#### 1.5 ผลการทดสอบแบบจำลอง ARFIMA(2,d,2)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดเบรนท์ (Brent Blend)

```

*****
Variance Equation : FIEGARCH (1, d, 1) model
** G@RCH( 3) SPECIFICATIONS ** (Truncation order : 1000).
***** No regressor in the conditional variance
Dependent variable : BRENT Skewed Student distribution, with 6.73557 degrees of
Mean Equation : ARFIMA (2, d, 2) model. freedom.
No regressor in the conditional mean and asymmetry coefficient (log xi) -0.00744958.

```

Strong convergence using numerical derivatives  
 EGARCH(Theta1) -0.065499 0.048040 -1.363 .1731  
 Log-likelihood = -2090.06  
 EGARCH(Theta2) 0.103805 0.057118 1.817 0.0695  
 Please wait : Computing the Std Errors ...  
 Asymmetry -0.007450 0.034129 -0.2183 0.8273  
 Robust Standard Errors (Sandwich formula)  
 Tail 6.735570 1.6342 4.122 0.0000  
 Coefficient Std.Error t-value t-prob  
 No. Observations : 942 No. Parameters : 14  
 Cst(M) 0.090138 0.19479 0.4628 0.6436  
 Mean (Y) : 0.04379 Variance (Y) : 7.01757  
 d-Arfima 0.033787 0.045156 0.7482 0.4545  
 Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509  
 AR(1) -0.277168 0.080715 -3.434 0.0006  
 Log Likelihood : -2090.063  
 AR(2) -0.925815 0.045881 -20.18 0.0000  
 The sample mean of squared residuals was used to  
 start recursion.  
 MA(1) 0.275960 0.098399 2.805 0.0051  
 Estimated Parameters Vector :  
 MA(2) 0.929430 0.066295 14.02 0.0000  
 0.090138; 0.033787;-0.277168;-0.925815; 0.275960;  
 Cst(V) 1.303307 0.47316 2.754 0.0060  
 0.929430; 1.303307; 0.634698; 0.632155; 0.442839;-  
 d-Figarch 0.634698 0.12564 5.052 0.0000  
 0.065499; 0.103805;-0.007450; 6.735575  
 ARCH(Phi1) 0.632155 1.2921 0.4893 0.6248  
 GARCH(Beta1) 0.442839 0.23102 1.917 0.0556

**1.6 ผลการทดสอบแบบจำลอง ARFIMA(2,d,3)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend)**

\*\*\*\*\* Robust Standard Errors (Sandwich formula)  
 \*\* G@RCH(4) SPECIFICATIONS \*\* Coefficient Std.Error t-value t-prob  
 \*\*\*\*\*  
 Cst(M) 0.082896 0.11863 0.6988 0.4849  
 Dependent variable : BRENT d-Arfima 0.050689 0.090295 0.5614 0.5747  
 Mean Equation : ARFIMA (2, d, 3) model. AR(1) -0.292309 0.20379 -1.434 0.1518  
 No regressor in the conditional mean AR(2) -0.921235 0.029442 -31.29 0.0000  
 Variance Equation : FIEGARCH (1, d, 1) model MA(1) 0.267697 0.13206 2.027 0.0429  
 (Truncation order : 1000). MA(2) 0.913108 0.089809 10.17 0.0000  
 No regressor in the conditional variance MA(3) -0.026910 0.15221 -0.1768 0.8597  
 Skewed Student distribution, with 6.58697 degrees of Cst(V) 1.311128 0.48656 2.695 0.0072  
 freedom. d-Figarch 0.638616 0.12564 5.083 0.0000  
 and asymmetry coefficient (log xi) -0.00805823. ARCH(Phi1) 0.661263 1.3450 0.4916 0.6231  
 GARCH(Beta1) 0.432134 0.21769 1.985 0.0474  
 Strong convergence using numerical derivatives EGARCH(Theta1) -0.065484 0.049548 -1.322 0.1866  
 Log-likelihood = -2089.99 EGARCH(Theta2) 0.103073 0.060756 1.697 0.0901  
 Please wait : Computing the Std Errors ...

Asymmetry -0.008058 0.022967 -0.3509 0.7258 The sample mean of squared residuals was used to  
 Tail 6.586971 1.9693 3.345 0.0009 start recursion.  
 No. Observations : 942 No. Parameters : 15 Estimated Parameters Vector :  
 Mean (Y) : 0.04379 Variance (Y) : 7.01757 0.082896; 0.050689; -0.292309; -0.921235; 0.267697;  
 Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509 0.913108; -0.026910; 1.311128; 0.638616; 0.661263;  
 Log Likelihood : -2089.990 0.432134; -0.065484; 0.103073; -0.008058; 6.586976

### 1.7 ผลการทดสอบแบบจำลอง ARFIMA(3,d,1)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดเบรนท์ (Brent Blend)

\*\*\*\*\*  
 \*\* G@RCH( 4) SPECIFICATIONS \*\*  
 \*\*\*\*\*  
 Dependent variable : BRENT  
 Mean Equation : ARFIMA (3, d, 1) model.  
 No regressor in the conditional mean  
 Variance Equation : FIEGARCH (1, d, 1) model  
 (Truncation order : 1000).  
 No regressor in the conditional variance  
 Skewed Student distribution, with 6.56106 degrees of  
 freedom.  
 and asymmetry coefficient (log xi) -0.000303726.  
 No convergence (no improvement in line search) using  
 numerical derivatives  
 Log-likelihood = -2094.27

No. Observations : 942 No. Parameters : 14  
 Mean (Y) : 0.04379 Variance (Y) : 7.01757  
 Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509  
 Log Likelihood : -2094.271  
 Estimated Parameters Vector :  
 0.099045; 0.055411; -0.368169; -0.034571; 0.002400;  
 0.335018; 1.520048; 0.629784; 0.501076; 0.481221; -  
 0.069192; 0.101564; -0.000304; 6.561061  
 Parameters Names  
 Cst(M) ; d-Arfima ; AR(1) ; AR(2)  
 ; AR(3) ; MA(1) ; Cst(V) ; d-  
 Figarch ; ARCH(Phi1) ; GARCH(Beta1) ;  
 EGARCH(Theta1) ; EGARCH(Theta2) ;  
 Asymmetry ; Tail ;

### 1.8 ผลการทดสอบแบบจำลอง ARFIMA(3,d,2)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดเบรนท์ (Brent Blend)

\*\*\*\*\*  
 \*\* G@RCH( 4) SPECIFICATIONS \*\*  
 \*\*\*\*\*  
 Dependent variable : BRENT  
 Mean Equation : ARFIMA (3, d, 2) model.  
 No regressor in the conditional mean

Variance Equation : FIEGARCH (1, d, 1) model  
 (Truncation order : 1000).  
 No regressor in the conditional variance  
 Skewed Student distribution, with 6.47879 degrees of  
 freedom.  
 and asymmetry coefficient (log xi) -0.00792398.

No convergence (no improvement in line search) using numerical derivatives 0.102813; 0.053895;-0.375420;-0.861457;-0.032453;  
 Log-likelihood = -2087.76 0.350692; 0.854256; 1.177583; 0.640194; 0.352564;  
 0.476695;-0.076954; 0.119075;-0.007924; 6.478787  
 No. Observations : 942 No. Parameters : 15 Parameters Names  
 Mean (Y) : 0.04379 Variance (Y) : 7.01757 Cst(M) ; d-Arfima ; AR(1) ; AR(2)  
 Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509 ; AR(3) ; MA(1) ; MA(2) ; Cst(V)  
 Log Likelihood : -2087.755 ; d-Figarch ; ARCH(Phi1) ; GARCH(Beta1)  
 Estimated Parameters Vector : ; EGARCH(Theta1) ; EGARCH(Theta2) ;  
 Asymmetry ; Tail ;

**1.9 ผลการทดสอบแบบจำลอง ARFIMA(3,d,3)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเบรนท์ (Brent Blend)**

```

*****
** G@RCH(5) SPECIFICATIONS **
*****
Dependent variable : BRENT
Mean Equation : ARFIMA (3, d, 3) model.
No regressor in the conditional mean
Variance Equation : FIEGARCH (1, d, 1) model
(Truncation order : 1000).
No regressor in the conditional variance
Skewed Student distribution, with 6.51715 degrees of
freedom.
and asymmetry coefficient (log xi) -0.00903841.
Strong convergence using numerical derivatives
Log-likelihood = -2087.66
Please wait : Computing the Std Errors ...
Robust Standard Errors (Sandwich formula)

Coefficient Std.Error t-value t-prob
Cst(M) 0.101405 0.41980 0.2416 0.8092
d-Arfima 0.045755 0.22271 0.2054 0.8373
AR(1) -0.545418 0.33542 -1.626 0.1043
AR(2) -0.911477 0.11208 -8.132 0.0000

*****
AR(3) -0.189026 0.30789 -0.6139 0.5394
MA(1) 0.532027 0.39713 1.340 0.1807
MA(2) 0.910496 0.13833 6.582 0.0000
MA(3) 0.167996 0.40056 0.4194 0.6750
Cst(V) 1.139161 0.65651 1.735 0.0830
d-Figarch 0.638486 0.14988 4.260 0.0000
ARCH(Phi1) 0.382957 1.4112 0.2714 0.7862
GARCH(Beta1) 0.468409 0.38791 1.208 0.2275
EGARCH(Theta1) -0.076394 0.069297 -1.102 0.2706
EGARCH(Theta2) 0.119890 0.064452 1.860 0.0632
Asymmetry -0.009038 0.060889 -0.1484 0.8820
Tail 6.517147 2.2611 2.882 0.0040

No. Observations : 942 No. Parameters : 16
Mean (Y) : 0.04379 Variance (Y) : 7.01757
Skewness (Y) : 0.34020 Kurtosis (Y) : 9.18509
Log Likelihood : -2087.658

The sample mean of squared residuals was used to
start recursion.
Estimated Parameters Vector :
0.101405; 0.045755;-0.545418;-0.911477;-0.189026;
0.532027; 0.910496; 0.167996; 1.139161; 0.638486;
    
```

0.382957; 0.468409;-0.076394; 0.119890;-0.009038; 6.517152

**2. ผลการทดสอบแบบจำลอง-ไฟการ์ช (ARFIMA-FIEGARCH) ราคาปิตน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)**

**2.1 ผลการทดสอบแบบจำลอง ARFIMA(1,d,1)-FIEGARCH(1,d,1) ราคาปิตน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)**

```

*****
AR(1) 0.891738 0.036147 24.67 0.0000
** GARCH(1) SPECIFICATIONS **
MA(1) -0.918040 0.027151 -33.81 0.0000
*****
Cst(V) 1.643668 0.55856 2.943 0.0033
Dependent variable : WTI
d-Figarch 0.730829 0.10084 7.248 0.0000
Mean Equation : ARFIMA (1, d, 1) model.
ARCH(Phi1) 0.185692 1.6393 0.1133 0.9098
No regressor in the conditional mean
GARCH(Beta1) 0.195817 0.80960 0.2419 0.8089
Variance Equation : FIEGARCH (1, d, 1) model
EGARCH(Theta1) -0.112168 0.046013 -2.438 0.0150
(Truncation order : 1000).
EGARCH(Theta2) 0.167116 0.082835 2.017 0.0439
No regressor in the conditional variance
Asymmetry 0.001270 0.020310 0.06254 0.9501
Skewed Student distribution, with 8.63351 degrees of
Tail 8.633514 2.6047 3.315 0.0010
freedom.
No. Observations : 942 No. Parameters : 12
and asymmetry coefficient (log xi) 0.0012702.
Mean (Y) : 0.02752 Variance (Y) : 9.12890
Weak convergence (no improvement in line search)
Skewness (Y) : 0.38171 Kurtosis (Y) : 7.37142
using numerical derivatives
Log Likelihood : -2182.080
Log-likelihood = -2182.08
The sample mean of squared residuals was used to
Please wait : Computing the Std Errors ...
start recursion.
Robust Standard Errors (Sandwich formula)
Estimated Parameters Vector :
Coefficient Std.Error t-value t-prob
0.074591; 0.048411; 0.891738;-0.918040; 1.643668;
Cst(M) 0.074591 0.065606 1.137 0.2558 0.730829; 0.185692; 0.195817;-0.112168; 0.167116;
d-Arfima 0.048411 0.052810 0.9167 0.3595 0.001270; 8.633514

```

## 2.2 ผลการทดสอบแบบจำลอง ARFIMA(1,d,2)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

```

*****
** G@RCH( 2) SPECIFICATIONS **
*****
Dependent variable : WTI
Mean Equation : ARFIMA (1, d, 2) model.
No regressor in the conditional mean
Variance Equation : FIEGARCH (1, d, 1) model
(Truncation order : 1000).
No regressor in the conditional variance
Skewed Student distribution, with 8.63282 degrees of
freedom.
and asymmetry coefficient (log xi) 0.00130854.
Strong convergence using numerical derivatives
Log-likelihood = -2182.08
Please wait : Computing the Std Errors ...
Robust Standard Errors (Sandwich formula)

Coefficient Std.Error t-value t-prob
Cst(M)      0.074870  0.082938  0.9027  0.3669
d-Arfima    0.051462  0.13154  0.3912  0.6957
AR(1)       0.891189  0.041276  21.59  0.0000

MA(1)       -0.920974  0.12513  -7.360  0.0000
MA(2)       0.002311  0.094976  0.02433  0.9806
Cst(V)      1.643194  0.55866  2.941  0.0033
d-Figarch   0.731133  0.10322  7.083  0.0000
ARCH(Phi1)  0.181337  1.6689  0.1087  0.9135
GARCH(Beta1) 0.197642  0.81932  0.2412  0.8094
EGARCH(Theta1)-0.112282  0.046948 -2.392  0.0170
EGARCH(Theta2) 0.167176  0.083106  2.012  0.0445
Asymmetry   0.001309  0.021610  0.06055  0.9517
Tail        8.632822  2.6088  3.309  0.0010
No. Observations : 942 No. Parameters : 13
Mean (Y) : 0.02752 Variance (Y) : 9.12890
Skewness (Y) : 0.38171 Kurtosis (Y) : 7.37142
Log Likelihood : -2182.080
The sample mean of squared residuals was used to
start recursion.

Estimated Parameters Vector :
0.074870; 0.051462; 0.891189; -0.920974; 0.002311;
1.643194; 0.731133; 0.181337; 0.197642; -0.112282;
0.167176; 0.001309; 8.632827

```

## 2.3 ผลการทดสอบแบบจำลอง ARFIMA(1,d,3)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

```

*****
** G@RCH( 3) SPECIFICATIONS **
*****
Dependent variable : WTI
Mean Equation : ARFIMA (1, d, 3) model.
No regressor in the conditional mean

Variance Equation : FIEGARCH (1, d, 1) model
(Truncation order : 1000).
No regressor in the conditional variance
Skewed Student distribution, with 8.47408 degrees of
freedom.
and asymmetry coefficient (log xi) -0.00122537.
Strong convergence using numerical derivatives

```

Log-likelihood = -2182.19  
 Please wait : Computing the Std Errors ...  
 Robust Standard Errors (Sandwich formula)

	Coefficient	Std.Error	t-value	t-prob
Cst(M)	0.058823	0.052848	1.113	0.2660
d-Arfima	-0.082077	0.088708	-0.9252	0.3551
AR(1)	0.629844	0.22241	2.832	0.0047
MA(1)	-0.527829	0.22719	-2.323	0.0204
MA(2)	-0.034209	0.043300	-0.7901	0.4297
MA(3)	0.031133	0.041267	0.7544	0.4508
Cst(V)	1.632852	0.56246	2.903	0.0038
d-Figarch	0.718466	0.10647	6.748	0.0000
ARCH(Phi1)	0.256214	1.2743	0.2011	0.8407
GARCH(Beta1)	0.181199	0.62625	0.2893	0.7724

EGARCH(Theta1)-0.110238 0.041609 -2.649 0.0082  
 EGARCH(Theta2)0.164464 0.083093 1.979 0.0481  
 Asymmetry -0.001225 0.020827 -0.05884 0.9531  
 Tail 8.474083 2.5547 3.317 0.0009  
 No. Observations : 942 No. Parameters : 14  
 Mean (Y) : 0.02752 Variance (Y) : 9.12890  
 Skewness (Y) : 0.38171 Kurtosis (Y) : 7.37142  
 Log Likelihood : -2182.193  
 The sample mean of squared residuals was used to start recursion.  
 Estimated Parameters Vector :  
 0.058823;-0.082077; 0.629844;-0.527829;-0.034209;  
 0.031133; 1.632852; 0.718466; 0.256214; 0.181199;-  
 0.110238; 0.164464;-0.001225; 8.474088

**2.4 ผลการทดสอบแบบจำลอง ARFIMA(2,d,1)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)**

\*\*\*\*\*  
 \*\* G@RCH( 4) SPECIFICATIONS \*\*  
 \*\*\*\*\*

	Coefficient	Std.Error	t-value	t-prob
Cst(M)	0.084455	0.078015	1.083	0.2793
d-Arfima	0.067993	0.096991	0.7010	0.4835
AR(1)	0.866947	0.091637	9.461	0.0000
AR(2)	0.008939	0.060826	0.1470	0.8832
MA(1)	-0.914219	0.030420	-30.05	0.0000
Cst(V)	3.002391	1.0105	2.971	0.0030
d-Figarch	0.740767	0.23583	3.141	0.0017
ARCH(Phi1)	-0.966592	0.057209	-16.90	0.0000
GARCH(Beta1)	0.975715	0.018677	52.24	0.0000
EGARCH(Theta1)-0.147891	0.034565	-4.279	0.0000	
EGARCH(Theta2) 0.169832	0.073933	2.297	0.0218	
Asymmetry	0.027159	0.028966	0.9376	0.3487
Tail	8.716870	2.6706	3.264	0.0011
No. Observations : 942	No. Parameters : 13			
Mean (Y) : 0.02752	Variance (Y) : 9.12890			

Dependent variable : WTI  
 Mean Equation : ARFIMA (2, d, 1) model.  
 No regressor in the conditional mean  
 Variance Equation : FIEGARCH (1, d, 1) model  
 (Truncation order : 1000).  
 No regressor in the conditional variance  
 Skewed Student distribution, with 8.71687 degrees of freedom.  
 and asymmetry coefficient (log xi) 0.0271593.  
 Strong convergence using numerical derivatives  
 Log-likelihood = -2177.47  
 Please wait : Computing the Std Errors ...  
 Robust Standard Errors (Sandwich formula)



Skewness (Y) : 0.38171 Kurtosis (Y) : 7.37142 Estimated Parameters Vector :  
 Log Likelihood : -2177.474 0.084455; 0.067993; 0.866947; 0.008939;-0.914219;  
 The sample mean of squared residuals was used to 3.002391; 0.740767;-0.966592; 0.975715;-0.147891;  
 start recursion. 0.169832; 0.027159; 8.716875

## 2.5 ผลการทดสอบแบบจำลอง ARFIMA(2,d,2)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

\*\*\*\*\*  
 \*\* G@RCH( 5) SPECIFICATIONS \*\*  
 \*\*\*\*\*

MA(1)	0.137799	0.0029247	47.11	0.0000
MA(2)	0.989963	0.0051211	193.3	0.0000
Cst(V)	1.703898	0.59300	2.873	0.0042
d-Figarch	0.728758	0.096671	7.539	0.0000
ARCH(Phi1)	0.417108	1.1032	0.3781	0.7055
GARCH(Beta1)	0.095537	0.37651	0.2537	0.7998
EGARCH(Theta1)	-0.117478	0.040889	-2.873	0.0042
EGARCH(Theta2)	0.154966	0.080881	1.916	0.0557
Asymmetry	-0.004193	0.022562	-0.1858	0.8526
Tail	8.184860	2.3412	3.496	0.0005

Dependent variable : WTI  
 Mean Equation : ARFIMA (2, d, 2) model.  
 No regressor in the conditional mean  
 Variance Equation : FIEGARCH (1, d, 1) model  
 (Truncation order : 1000).  
 No regressor in the conditional variance  
 Skewed Student distribution, with 8.18486 degrees of freedom.  
 and asymmetry coefficient (log xi) -0.00419272.  
 Strong convergence using numerical derivatives  
 Log-likelihood = -2177.63  
 Please wait : Computing the Std Errors ...  
 Robust Standard Errors (Sandwich formula)

Coefficient	Std.Error	t-value	t-prob	Estimated Parameters Vector :
Cst(M)	0.015931	0.086479	0.1842	0.015931; 0.006813;-0.122961;-0.988711; 0.137799;
d-Arfima	0.006813	0.031035	0.2195	0.989963; 1.703898; 0.728758; 0.417108; 0.095537;-
AR(1)	-0.122961	0.0056021	-21.95	0.117478; 0.154966;-0.004193; 8.184865
AR(2)	-0.988711	0.0051481	-192.1	

Log Likelihood : -2177.625  
 The sample mean of squared residuals was used to start recursion.

## 2.6 ผลการทดสอบแบบจำลอง ARFIMA(2,d,3)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

\*\*\*\*\*  
 \*\* G@RCH( 6) SPECIFICATIONS \*\*  
 \*\*\*\*\*

Dependent variable : WTI

Mean Equation : ARFIMA (2, d, 3) model. MA(3) 0.083174 0.054371 1.530 0.1264  
 No regressor in the conditional mean Cst(V) 1.762545 0.51244 3.440 0.0006  
 Variance Equation : FIEGARCH (1, d, 1) model d-Figarch 0.700621 0.14569 4.809 0.0000  
 (Truncation order : 1000). ARCH(Phi1) -0.180326 1.4026 -0.1286 0.8977  
 No regressor in the conditional variance GARCH(Beta1) 0.465196 0.57266 0.8123 0.4168  
 Skewed Student distribution, with 8.50468 degrees of EGARCH(Theta1)-0.114509 0.049242 -2.325 0.0203  
 freedom. EGARCH(Theta2) 0.172216 0.10176 1.692 0.0909  
 and asymmetry coefficient (log xi) 0.00102216. Asymmetry 0.001022 0.019918 0.05132 0.9591  
 Strong convergence using numerical derivatives Tail 8.504675 2.5196 3.375 0.0008  
 Log-likelihood = -2179.68 No. Observations : 942 No. Parameters : 15

Please wait : Computing the Std Errors ...

Robust Standard Errors (Sandwich formula)

	Coefficient	Std.Error	t-value	t-prob
Cst(M)	0.060533	0.043986	1.376	0.1691
d-Arfima	-0.062380	0.041614	-1.499	0.1342
AR(1)	1.337038	0.14873	8.990	0.0000
AR(2)	-0.804033	0.11501	-6.991	0.0000
MA(1)	-1.258041	0.16122	-7.803	0.0000
MA(2)	0.716676	0.14735	4.864	0.0000

Mean (Y) : 0.02752 Variance (Y) : 9.12890  
 Skewness (Y) : 0.38171 Kurtosis (Y) : 7.37142  
 Log Likelihood : -2179.677

The sample mean of squared residuals was used to start recursion.

Estimated Parameters Vector :  
 0.060533;-0.062380; 1.337038;-0.804033;-1.258041;  
 0.716676; 0.083174; 1.762545; 0.700621;-0.180326;  
 0.465196;-0.114509; 0.172216; 0.001022; 8.504680

## 2.7 ผลการทดสอบแบบจำลอง ARFIMA(3,d,1)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)

\*\*\*\*\*  
**\*\* G@RCH( 7) SPECIFICATIONS \*\***  
 \*\*\*\*\*

Dependent variable : WTI  
 Mean Equation : ARFIMA (3, d, 1) model.  
 No regressor in the conditional mean

Variance Equation : FIEGARCH (1, d, 1) model  
 (Truncation order : 1000).  
 No regressor in the conditional variance  
 Skewed Student distribution, with 8.50144 degrees of  
 freedom.

and asymmetry coefficient (log xi) -0.00661707.  
 Strong convergence using numerical derivatives  
 Log-likelihood = -2179.94

Please wait : Computing the Std Errors ...

Robust Standard Errors (Sandwich formula)

	Coefficient	Std.Error	t-value	t-prob
Cst(M)	0.057464	0.075706	0.7591	0.4480
d-Arfima	0.013956	0.064308	0.2170	0.8282
AR(1)	-0.721571	0.20034	-3.602	0.0003
AR(2)	-0.019299	0.092208	-0.2093	0.8343
AR(3)	-0.045161	0.043661	-1.034	0.3012

MA(1)	0.732195	0.19747	3.708	0.0002	Mean (Y)	:	0.02752	Variance (Y)	:	9.12890
Cst(V)	1.298435	0.88396	1.469	0.1422	Skewness (Y)	:	0.38171	Kurtosis (Y)	:	7.37142
d-Figarch	0.785433	0.079275	9.908	0.0000	Log Likelihood	:	-2179.943			
ARCH(Phi1)	1.284728	0.39122	3.284	0.0011	The sample mean of squared residuals was used to					
GARCH(Beta1)	-0.765171	0.17063	-4.484	0.0000	start recursion.					
EGARCH(Theta1)	-0.111358	0.035187	-3.165	0.0016	Estimated Parameters Vector :					
EGARCH(Theta2)	0.171869	0.070766	2.429	0.0153	0.057464; 0.013956; -0.721571; -0.019299; -0.045161;					
Asymmetry	-0.006617	0.020537	-0.3222	0.7474	0.732195; 1.298435; 0.785433; 1.284728; -0.765171; -					
Tail	8.501442	2.6397	3.221	0.0013	0.111358; 0.171869; -0.006617; 8.501447					
No. Observations :	942	No. Parameters :	14							

**2.8 ผลการทดสอบแบบจำลอง ARFIMA(3,d,2)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดเวสต์เท็กซัส (WTI)**

*****	Mean (Y)	:	0.02752	Variance (Y)	:	9.12890			
** G@RCH( 7) SPECIFICATIONS **	Skewness (Y)	:	0.38171	Kurtosis (Y)	:	7.37142			
*****	Log Likelihood	:	-2171.888						
Dependent variable : WTI	Estimated Parameters Vector :								
Mean Equation : ARFIMA (3, d, 2) model.	0.047652; -0.017543; -0.341824; -0.907508; 0.032354;								
No regressor in the conditional mean	0.396069; 0.949081; 3.088828; 0.785915; -0.980545;								
Variance Equation : FIEGARCH (1, d, 1) model	0.981540; -0.146007; 0.170680; 0.022894; 8.237318								
(Truncation order : 1000).	Parameters Names								
No regressor in the conditional variance	Cst(M)	:	d-Arfima	:	AR(1)	:	AR(2)		
Skewed Student distribution, with 8.23732 degrees of freedom.		:	AR(3)	:	MA(1)	:	MA(2)	:	Cst(V)
and asymmetry coefficient (log xi) 0.0228937.		:	d-Figarch	:	ARCH(Phi1)	:	GARCH(Beta1)		
No convergence (no improvement in line search) using numerical derivatives		:	EGARCH(Theta1)	:	EGARCH(Theta2)	:	Asymmetry	:	Tail
Log-likelihood = -2171.89	The tests are not reported since there is no convergence.								
No. Observations :	942	No. Parameters :	15						

2.9 ผลการทดสอบแบบจำลอง ARFIMA(3,d,3)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ  
รายวันในตลาดเวสต์เท็กซัส (WTI)

```

*****
MA(1) -0.479761 0.046395 -10.34 0.0000
** GARCH( 8) SPECIFICATIONS **
MA(2) 0.615733 0.023050 26.71 0.0000
*****
MA(3) -0.878746 0.046775 -18.79 0.0000
Dependent variable : WTI
Cst(V) 3.370834 0.91500 3.684 0.0002
Mean Equation : ARFIMA (3, d, 3) model.
d-Figarch 0.777554 0.21748 3.575 0.0004
No regressor in the conditional mean
ARCH(Phi1) -0.970161 0.047413 -20.46 0.0000
Variance Equation : FIEGARCH (1, d, 1) model
GARCH(Beta1) 0.975552 0.017234 56.61 0.0000
(Truncation order : 1000).
EGARCH(Theta1)-0.139515 0.035551 -3.924 0.0001
No regressor in the conditional variance
EGARCH(Theta2) 0.151527 0.067523 2.244 0.0251
Skewed Student distribution, with 8.02528 degrees of
Asymmetry 0.035253 0.029342 1.201 0.2299
freedom.
Tail 8.025276 2.3311 3.443 0.0006
and asymmetry coefficient (log xi) 0.0352528.
No. Observations : 942 No. Parameters : 16
Strong convergence using numerical derivatives
Mean (Y) : 0.02752 Variance (Y) : 9.12890
Log-likelihood = -2168.37
Skewness (Y) : 0.38171 Kurtosis (Y) : 7.37142
Please wait : Computing the Std Errors ...
Log Likelihood : -2168.371
Robust Standard Errors (Sandwich formula)
The sample mean of squared residuals was used to
start recursion.
Coefficient Std.Error t-value t-prob
Estimated Parameters Vector :
Cst(M) 0.098520 0.077205 1.276 0.2022 0.098520; 0.055540; 0.451215; -0.616645; 0.825694; -
d-Arfima 0.055540 0.068910 -0.8060 0.4205 0.479761; 0.615733; -0.878746; 3.370834; 0.777554; -
AR(1) 0.451215 0.049825 9.056 0.0000 0.970161; 0.975552; -0.139515; 0.151527; 0.035253; -
AR(2) -0.616645 0.027232 -22.64 0.0000 8.025281
AR(3) 0.825694 0.048118 17.16 0.0000

```

### 3. ผลการทดสอบแบบจำลอง-ไฟการ์ช (ARFIMA-FIEGACH) ราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman)

#### 3.1 ผลการทดสอบแบบจำลอง ARFIMA(1,d,1)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman)

```

*****
** SPECIFICATIONS **
*****
Dependent variable : Dubai-Oman
Mean Equation : ARFIMA (1, d, 1) model.
No regressor in the conditional mean
Variance Equation : FIEGARCH (1, d, 1) model
(Truncation order : 1000).
No regressor in the conditional variance
Skewed Student distribution, with 8.37986 degrees of
freedom.
and asymmetry coefficient (log xi) -0.00466304.
No convergence (no improvement in line search) using
numerical derivatives

Log-likelihood = 2294.91
No. Observations : 979 No. Parameters : 12
Mean (Y) : 0.00050 Variance (Y) : 0.00077
Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495
Log Likelihood : 2294.910
Estimated Parameters Vector :
0.001018; 0.012330; 0.028857;-0.128774;-
73578.721376; 1.644836;-1.014139; 0.683186;-
0.054238; 0.049947;-0.004663; 8.379861
Parameters Names
Cst(M) ; d-Arfima ; AR(1) ; MA(1)
; Cst(V) x 10^4 ; d-Figarch ; ARCH(Phi1) ;
GARCH(Beta1) ; EGARCH(Theta1) ;
EGARCH(Theta2) ; Asymmetry ; Tail ;

```

#### 3.2 ผลการทดสอบแบบจำลอง ARFIMA(1,d,2)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman)

```

*****
** SPECIFICATIONS **
*****
Dependent variable : Dubai-Oman
Mean Equation : ARFIMA (1, d, 2) model.
No regressor in the conditional mean
Variance Equation : FIEGARCH (1, d, 1) model
(Truncation order : 1000).
No regressor in the conditional variance
Skewed Student distribution, with 4.26671 degrees of
freedom.

and asymmetry coefficient (log xi) 0.101504.
No convergence (no improvement in line search) using
numerical derivatives

Log-likelihood = 2236.49
No. Observations : 979 No. Parameters : 13
Mean (Y) : 0.00050 Variance (Y) : 0.00077
Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495
Log Likelihood : 2236.492
Estimated Parameters Vector :

```

0.004635; 0.422557; 0.779210; -1.312654; 0.350269; - Cst(M) ; d-Arfima ; AR(1) ; MA(1)  
 1.183902; -0.040446; 0.409244; 0.989941; -0.061308; ; MA(2) ; Cst(V) x 10<sup>4</sup> ; d-Figarch ;  
 0.376272; 0.101504; 4.266707 ARCH(Phi1) ; GARCH(Beta1) ;  
 Parameters Names EGARCH(Theta1) ; EGARCH(Theta2) ;  
 Asymmetry ; Tail ;

**3.3 ผลการทดสอบแบบจำลอง ARFIMA(1,d,3)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman)**

```

*****
** G@RCH (1) SPECIFICATIONS **
*****
Dependent variable : Dubai-Oman
Mean Equation : ARFIMA (1, d, 3) model.
No regressor in the conditional mean
Variance Equation : FIEGARCH (1, d, 1) model
(Truncation order : 1000).
No regressor in the conditional variance
Skewed Student distribution, with 7.67932 degrees of
freedom.
and asymmetry coefficient (log xi) 0.0138801.
Strong convergence using numerical derivatives
Log-likelihood = 2298
Please wait : Computing the Std Errors ...
Robust Standard Errors (Sandwich formula)
    
```

MA(2)	0.245870	0.17516	1.404	0.1607
MA(3)	0.030144	0.043402	0.6945	0.4875
Cst(V) x 10 <sup>4</sup>	-74356.204601	7000.0	-10.62	0.0000
d-Figarch	0.713235	0.082264	8.670	0.0000
ARCH(Phi1)	0.318634	0.58457	0.5451	0.5858
GARCH(Beta1)	0.090184	0.12357	0.7298	0.4657
EGARCH(Theta1)	-0.112451	0.049349	-2.279	0.0229
EGARCH(Theta2)	0.143559	0.046617	3.080	0.0021
Asymmetry	0.013880	0.031079	0.4466	0.6553
Tail	7.679316	1.9223	3.995	0.0001

No. Observations : 979 No. Parameters : 14  
 Mean (Y) : 0.00050 Variance (Y) : 0.00077  
 Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495  
 Log Likelihood : 2297.996  
 The sample mean of squared residuals was used to start recursion.

	Coefficient	Std.Error	t-value	t-prob	Estimated Parameters Vector :
Cst(M)	0.001652	0.0024454	0.6757	0.4994	0.001652; 0.301415; 0.808828; -1.221788; 0.245870;
d-Arfima	0.301415	0.26827	1.124	0.2615	0.030144; -74356.204601; 0.713235; 0.318634;
AR(1)	0.808828	0.073358	11.03	0.0000	0.090184; -0.112451; 0.143559; 0.013880; 7.679321
MA(1)	-1.221788	0.23702	-5.155	0.0000	

### 3.4 ผลการทดสอบแบบจำลอง ARFIMA(2,d,1)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดเบรนท์ (Brent Blend)

```

*****
** G@RCH( 1) SPECIFICATIONS **
*****
Dependent variable : Dubai-Oman
Mean Equation : ARFIMA (2, d, 1) model.
No regressor in the conditional mean
Variance Equation : FIEGARCH (1, d, 1) model
(Truncation order : 1000).
No regressor in the conditional variance
Skewed Student distribution, with 4.53491 degrees of
freedom.
and asymmetry coefficient (log xi) 0.10226.
No convergence (no improvement in line search) using
numerical derivatives
Log-likelihood = 2235.79
No. Observations : 979 No. Parameters : 13
Mean (Y) : 0.00050 Variance (Y) : 0.00077
Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495
Log Likelihood : 2235.789
Estimated Parameters Vector :
0.001928;-0.017305;-0.918913;-0.069062; 0.838206;-
1.468953;-0.029150; 0.435115; 0.989364;-0.053864;
0.354514; 0.102260; 4.534912
Parameters Names
Cst(M) ; d-Arfima ; AR(1) ; AR(2)
; MA(1) ; Cst(V) x 10^4 ; d-Figarch ;
ARCH(Phi1) ; GARCH(Beta1) ;
EGARCH(Theta1) ; EGARCH(Theta2) ;
Asymmetry ; Tail ;

```

### 3.5 ผลการทดสอบแบบจำลอง ARFIMA(2,d,2)-FIEGARCH(1,d,1) ราคาปิด น้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman)

```

*****
** G@RCH( 1) SPECIFICATIONS **
*****
Dependent variable : Dubai-Oman
Mean Equation : ARFIMA (2, d, 2) model.
No regressor in the conditional mean
Variance Equation : FIEGARCH (1, d, 1) model
(Truncation order : 1000).
No regressor in the conditional variance
Skewed Student distribution, with 4.52576 degrees of
freedom.
and asymmetry coefficient (log xi) 0.100093.
No convergence (no improvement in line search) using
numerical derivatives
Log-likelihood = 2235.94
No. Observations : 979 No. Parameters : 14
Mean (Y) : 0.00050 Variance (Y) : 0.00077
Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495
Log Likelihood : 2235.941
Estimated Parameters Vector :
0.001967; 0.003058;-0.737257; 0.101952; 0.633166;-
0.190209;-1.456240;-0.031940; 0.445191; 0.989732;-
0.054965; 0.353488; 0.100093; 4.525762
Parameters Names

```

Cst(M) ; d-Arfima ; AR(1) ; AR(2) EGARCH(Theta1) ; EGARCH(Theta2) ;  
 ; MA(1) ; MA(2) ; Cst(V) x 10<sup>4</sup> ; d- Asymmetry ; Tail ;  
 Figarch ; ARCH(Phi1) ; GARCH(Beta1) ;

### 3.6 ผลการทดสอบแบบจำลอง ARFIMA(2,d,3)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman)

```
*****
** G@RCH( 1) SPECIFICATIONS **
*****
Dependent variable : Dubai-Oman
Mean Equation : ARFIMA (2, d, 3) model.
No regressor in the conditional mean
Variance Equation : FIEGARCH (1, d, 1) model
(Truncation order : 1000).
No regressor in the conditional variance
Skewed Student distribution, with 4.19495 degrees of
freedom.
and asymmetry coefficient (log xi) 0.104598.
No convergence (no improvement in line search) using
numerical derivatives
Log-likelihood = 2236.21
No. Observations : 979 No. Parameters : 15
Mean (Y) : 0.00050 Variance (Y) : 0.00077
Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495
Log Likelihood : 2236.214
Estimated Parameters Vector :
0.006237; 0.491589;-0.104760; 0.654147;-0.492330;-
0.788211; 0.339805;-1.120910;-0.034607; 0.397308;
0.989221;-0.059651; 0.378630; 0.104598; 4.194948
Parameters Names
Cst(M) ; d-Arfima ; AR(1) ; AR(2)
; MA(1) ; MA(2) ; MA(3) ;
Cst(V) x 104 ; d-Figarch ; ARCH(Phi1) ;
GARCH(Beta1) ; EGARCH(Theta1) ;
EGARCH(Theta2) ; Asymmetry ; Tail ;
```

### 3.7 ผลการทดสอบแบบจำลอง ARFIMA(3,d,1)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบรายวันในตลาดดูไบโอมาน (Dubai-Oman)

```
*****
** G@RCH( 1) SPECIFICATIONS **
*****
Dependent variable : Dubai-Oman
Mean Equation : ARFIMA (3, d, 1) model.
No regressor in the conditional mean
Variance Equation : FIEGARCH (1, d, 1) model
(Truncation order : 1000).
No regressor in the conditional variance
Skewed Student distribution, with 8.35754 degrees of
freedom.
and asymmetry coefficient (log xi) -0.0112297.
No convergence (no improvement in line search) using
numerical derivatives
Log-likelihood = 2308.21
No. Observations : 979 No. Parameters : 14
Mean (Y) : 0.00050 Variance (Y) : 0.00077
Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495
```



Log Likelihood : 2308.208 Cst(M) ; d-Arfima ; AR(1) ; AR(2)  
 Estimated Parameters Vector : ; AR(3) ; MA(1) ; Cst(V) x 10<sup>4</sup> ; d-  
 0.000804;-0.100651; 0.908142; 0.056977;-0.007939;- Figarch ; ARCH(Phi1) ; GARCH(Beta1) ;  
 0.934445;-73517.393940; 1.808654;-1.013613;- EGARCH(Theta1) ; EGARCH(Theta2) ;  
 0.468024;-0.143559; 0.062928;-0.011230; 8.357539 Asymmetry ; Tail ;  
 Parameters Names

### 3.8 ผลการทดสอบแบบจำลอง ARFIMA(3,d,2)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดดูไบโอมาน (Dubai-Oman)

\*\*\*\*\*  
 \*\* G@RCH(1) SPECIFICATIONS \*\*  
 \*\*\*\*\*  
 Dependent variable : Dubai-Oman  
 Mean Equation : ARFIMA (3, d, 2) model.  
 No regressor in the conditional mean  
 Variance Equation : FIEGARCH (1, d, 1) model  
 (Truncation order : 1000).  
 No regressor in the conditional variance  
 Skewed Student distribution, with 7.3119 degrees of  
 freedom.  
 and asymmetry coefficient (log xi) 0.00605012.  
 No convergence (no improvement in line search) using  
 numerical derivatives  
 Log-likelihood = 2302.91

No. Observations : 979 No. Parameters : 15  
 Mean (Y) : 0.00050 Variance (Y) : 0.00077  
 Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495  
 Log Likelihood : 2302.912  
 Estimated Parameters Vector :  
 0.001176; 0.024617;-0.106234;-0.171762;-0.022423;-  
 0.031819; 0.133602;-76972.681857; 0.753846;  
 0.810737;-0.649456;-0.127814; 0.173166; 0.006050;  
 7.311900  
 Parameters Names  
 Cst(M) ; d-Arfima ; AR(1) ; AR(2)  
 ; AR(3) ; MA(1) ; MA(2) ; Cst(V)  
 x 10<sup>4</sup> ; d-Figarch ; ARCH(Phi1) ;  
 GARCH(Beta1) ; EGARCH(Theta1) ;  
 EGARCH(Theta2) ; Asymmetry ; Tail ;

### 3.9 ผลการทดสอบแบบจำลอง ARFIMA(3,d,3)-FIEGARCH(1,d,1) ราคาปิดน้ำมันดิบแบบ รายวันในตลาดดูไบโอมาน (Dubai-Oman)

\*\*\*\*\*  
 \*\* G@RCH(2) SPECIFICATIONS \*\*  
 \*\*\*\*\*  
 Dependent variable : Dubai-Oman  
 Mean Equation : ARFIMA (3, d, 3) model.  
 No regressor in the conditional mean

Variance Equation : FIEGARCH (1, d, 1) model  
 (Truncation order : 1000).  
 No regressor in the conditional variance  
 Skewed Student distribution, with 7.42239 degrees of  
 freedom.  
 and asymmetry coefficient (log xi) 0.0115049.

Strong convergence using numerical derivatives	GARCH(Beta1) -0.679358 0.088660 -7.662 0.0000
Log-likelihood = 2304.53	EGARCH(Theta1)-0.147779 0.045667 -3.236 0.0013
Please wait : Computing the Std Errors ...	EGARCH(Theta2)0.136186 0.047582 2.862 0.0043
Robust Standard Errors (Sandwich formula)	Asymmetry 0.011505 0.022476 0.5119 0.6089
	Tail 7.422393 1.8649 3.980 0.0001
	No. Observations : 979 No. Parameters : 16
	Mean (Y) : 0.00050 Variance (Y) : 0.00077
	Skewness (Y) : 0.08697 Kurtosis (Y) : 6.18495
	Log Likelihood : 2304.527
	The sample mean of squared residuals was used to start recursion.
	Estimated Parameters Vector :
	0.004459; 1.009290;-0.116931;-0.268838;-0.027769;-
	1.004022; 0.246144;-0.236703;-81192.981678;
	0.761230; 0.787732;-0.679358;-0.147779; 0.136186;
	0.011505; 7.422398

	Coefficient	Std.Error	t-value	t-prob
Cst(M)	0.004459	0.0020053	2.224	0.0264
d-Arfima	1.009290	0.050823	19.86	0.0000
AR(1)	-0.116931	0.17334	-0.6746	0.5001
AR(2)	-0.268838	0.081058	-3.317	0.0009
AR(3)	-0.027769	0.040616	-0.6837	0.4943
MA(1)	-1.004022	0.16451	-6.103	0.0000
MA(2)	0.246144	0.16535	1.489	0.1369
MA(3)	-0.236703	0.083385	-2.839	0.0046
Cst(V) x 10 <sup>4</sup>	-81192.981678	8191.5	-9.912	0.0000
d-Figarch	0.761230	0.058846	12.94	0.0000
ARCH(Phi1)	0.787732	0.35489	2.220	0.0267

## ประวัติผู้เขียน

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