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**LAMPIRAN****Lampiran 1 Data Curah Hujan di Kota Makassar**

| Tanggal    | Curah Hujan |
|------------|-------------|
| 01-01-2021 | 76          |
| 02-01-2021 | 31,5        |
| 03-01-2021 | 3           |
| 04-01-2021 | 49,8        |
| 05-01-2021 | 57,8        |
| 06-01-2021 | 66          |
| 07-01-2021 | 0,7         |
| 08-01-2021 | 93,3        |
| 09-01-2021 | 5,8         |
| 10-01-2021 | 0,8         |
| 11-01-2021 | 11          |
| 12-01-2021 | 1,8         |
| 13-01-2021 | 0           |
| 14-01-2021 | 0,8         |
| 15-01-2021 | 54,6        |
| 16-01-2021 | 109,4       |
| 17-01-2021 | 42,1        |
| 18-01-2021 | 61,9        |
| 19-01-2021 | 111         |
| 20-01-2021 | 12,6        |
| 21-01-2021 | 27,7        |
| 22-01-2021 | 61,9        |
| 23-01-2021 | 11,7        |
| 24-01-2021 | 19,1        |
| 25-01-2021 | 100,9       |
| 26-01-2021 | 5,4         |
| 27-01-2021 | 19          |
| 28-01-2021 | 47,1        |
| 29-01-2021 | 49,3        |
| 30-01-2021 | 51,9        |
| 31-01-2021 | 11,1        |
| 01-02-2021 | 24,9        |
| 02-02-2021 | 3,5         |
| ...        | ...         |
| 28-05-2023 | 0           |
| 29-05-2023 | 0           |
| 30-05-2023 | 0           |
| 31-05-2023 | 0           |

**Lampiran 2 Uji Augmented Dickey-Fuller**

Null Hypothesis: CURAH\_HUJAN has a unit root

Exogenous: Constant, Linear Trend

Lag Length: 4 (Automatic - based on SIC, maxlag=36)

|                                        | t-Statistic | Prob.* |
|----------------------------------------|-------------|--------|
| Augmented Dickey-Fuller test statistic | -8.312196   | 0.0000 |
| Test critical values: 1% level         | -3.970761   |        |
| 5% level                               | -3.416027   |        |
| 10% level                              | -3.130293   |        |

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

## Augmented Dickey-Fuller Test Equation

Dependent Variable: D(CURAH\_HUJAN)

Method: Least Squares

Date: 08/28/24 Time: 07:53

Sample (adjusted): 1/06/2021 12/31/2022

Included observations: 725 after adjustments

| Variable            | Coefficient | Std. Error            | t-Statistic | Prob.  |
|---------------------|-------------|-----------------------|-------------|--------|
| CURAH_HUJAN(-1)     | -0.456033   | 0.054863              | -8.312196   | 0.0000 |
| D(CURAH_HUJAN(-1))  | -0.263897   | 0.054205              | -4.868504   | 0.0000 |
| D(CURAH_HUJAN(-2))  | -0.128694   | 0.050765              | -2.535109   | 0.0115 |
| D(CURAH_HUJAN(-3))  | -0.108677   | 0.045881              | -2.368700   | 0.0181 |
| D(CURAH_HUJAN(-4))  | -0.134552   | 0.037114              | -3.625414   | 0.0003 |
| C                   | 6.090669    | 1.876802              | 3.245238    | 0.0012 |
| @TREND("1/01/2021") | -0.002896   | 0.004035              | -0.717809   | 0.4731 |
| R-squared           | 0.358596    | Mean dependent var    | -0.024276   |        |
| Adjusted R-squared  | 0.353236    | S.D. dependent var    | 27.93867    |        |
| S.E. of regression  | 22.46875    | Akaike info criterion | 9.071736    |        |
| Sum squared resid   | 362478.4    | Schwarz criterion     | 9.116016    |        |
| Log likelihood      | -3281.504   | Hannan-Quinn criter.  | 9.088825    |        |
| F-statistic         | 66.90307    | Durbin-Watson stat    | 2.026455    |        |
| Prob(F-statistic)   | 0.000000    |                       |             |        |

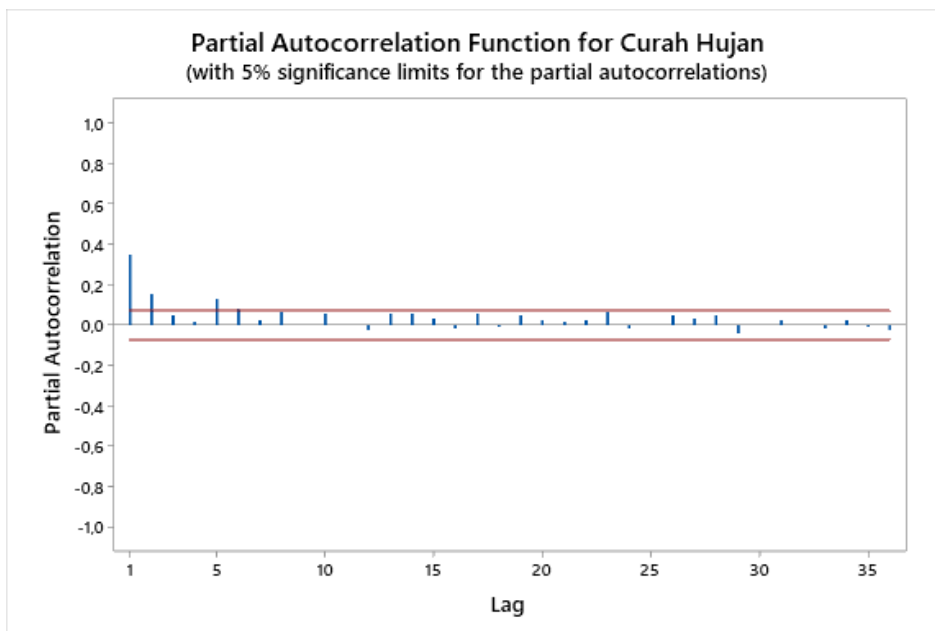
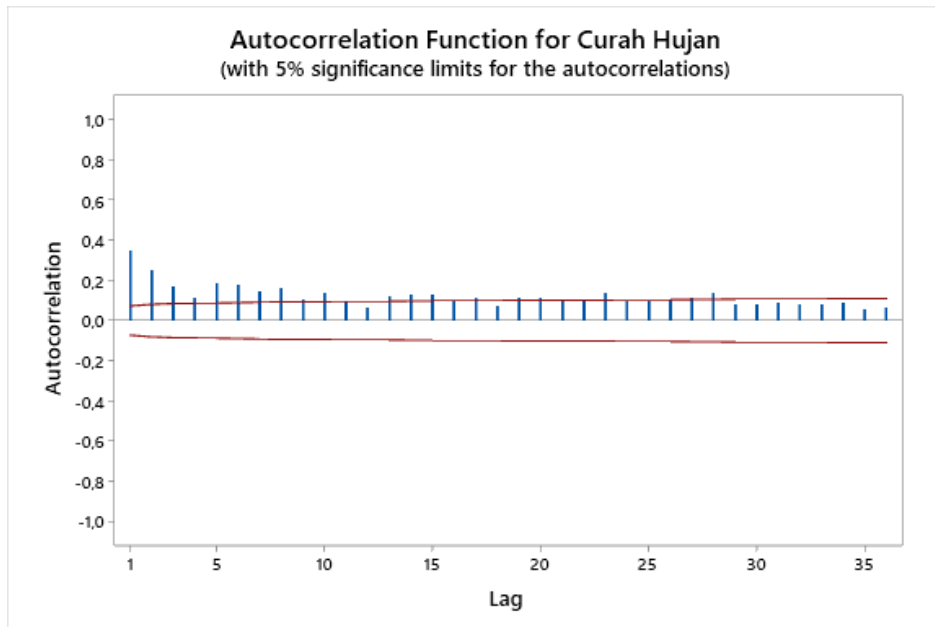
### Lampiran 3 ACF dan PACF

Date: 08/28/24 Time: 07:56

Sample: 1/01/2021 12/31/2022

Included observations: 730

| Autocorrelation                                                                     | Partial Correlation                                                                 |    | AC    | PAC    | Q-Stat | Prob  |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----|-------|--------|--------|-------|
|    |    | 1  | 0.345 | 0.345  | 87.476 | 0.000 |
|    |    | 2  | 0.252 | 0.151  | 134.17 | 0.000 |
|    |    | 3  | 0.169 | 0.050  | 155.18 | 0.000 |
|    |    | 4  | 0.112 | 0.014  | 164.47 | 0.000 |
|    |    | 5  | 0.182 | 0.130  | 189.00 | 0.000 |
|    |    | 6  | 0.180 | 0.083  | 213.01 | 0.000 |
|    |    | 7  | 0.144 | 0.022  | 228.29 | 0.000 |
|    |    | 8  | 0.160 | 0.063  | 247.30 | 0.000 |
|    |    | 9  | 0.103 | -0.003 | 255.11 | 0.000 |
|    |    | 10 | 0.133 | 0.056  | 268.30 | 0.000 |
|    |    | 11 | 0.100 | -0.002 | 275.74 | 0.000 |
|    |    | 12 | 0.066 | -0.021 | 278.97 | 0.000 |
|    |    | 13 | 0.115 | 0.057  | 288.90 | 0.000 |
|    |    | 14 | 0.126 | 0.054  | 300.69 | 0.000 |
|    |    | 15 | 0.125 | 0.030  | 312.45 | 0.000 |
|    |    | 16 | 0.091 | -0.016 | 318.71 | 0.000 |
|    |    | 17 | 0.112 | 0.053  | 328.05 | 0.000 |
|    |    | 18 | 0.076 | -0.011 | 332.38 | 0.000 |
|    |    | 19 | 0.116 | 0.050  | 342.49 | 0.000 |
|    |    | 20 | 0.111 | 0.021  | 351.69 | 0.000 |
|  |  | 21 | 0.100 | 0.010  | 359.21 | 0.000 |
|  |  | 22 | 0.103 | 0.022  | 367.23 | 0.000 |
|  |  | 23 | 0.135 | 0.063  | 381.04 | 0.000 |
|  |  | 24 | 0.095 | -0.010 | 387.93 | 0.000 |
|  |  | 25 | 0.093 | -0.001 | 394.43 | 0.000 |
|  |  | 26 | 0.108 | 0.046  | 403.33 | 0.000 |
|  |  | 27 | 0.116 | 0.031  | 413.50 | 0.000 |
|  |  | 28 | 0.138 | 0.041  | 427.90 | 0.000 |
|  |  | 29 | 0.079 | -0.039 | 432.62 | 0.000 |
|  |  | 30 | 0.083 | 0.006  | 437.85 | 0.000 |
|  |  | 31 | 0.091 | 0.025  | 444.20 | 0.000 |
|  |  | 32 | 0.077 | -0.001 | 448.75 | 0.000 |
|  |  | 33 | 0.076 | -0.015 | 453.15 | 0.000 |
|  |  | 34 | 0.092 | 0.023  | 459.67 | 0.000 |
|  |  | 35 | 0.058 | -0.008 | 462.30 | 0.000 |
|  |  | 36 | 0.059 | -0.019 | 464.94 | 0.000 |



**Lampiran 4** Pendugaan Model ARIMA Sementara

AR (2)

Dependent Variable: CURAH\_HUJAN

Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 08/28/24 Time: 08:38

Sample: 1/01/2021 12/31/2022

Included observations: 730

Convergence achieved after 51 iterations

Coefficient covariance computed using outer product of gradients

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.  |
|--------------------|-------------|-----------------------|-------------|--------|
| C                  | 11.38142    | 2.583257              | 4.405841    | 0.0000 |
| AR(1)              | 0.296096    | 0.019664              | 15.05766    | 0.0000 |
| AR(2)              | 0.153796    | 0.024576              | 6.257929    | 0.0000 |
| SIGMASQ            | 516.8450    | 15.82647              | 32.65699    | 0.0000 |
| R-squared          | 0.141329    | Mean dependent var    | 11.25164    |        |
| Adjusted R-squared | 0.137781    | S.D. dependent var    | 24.55073    |        |
| S.E. of regression | 22.79677    | Akaike info criterion | 9.096823    |        |
| Sum squared resid  | 377296.8    | Schwarz criterion     | 9.121991    |        |
| Log likelihood     | -3316.341   | Hannan-Quinn criter.  | 9.106533    |        |
| F-statistic        | 39.83081    | Durbin-Watson stat    | 2.011094    |        |
| Prob(F-statistic)  | 0.000000    |                       |             |        |
| Inverted AR Roots  | .57         | -.27                  |             |        |

AR (2) tanpa konstanta

Dependent Variable: CURAH\_HUJAN

Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 08/28/24 Time: 08:39

Sample: 1/01/2021 12/31/2022

Included observations: 730

Convergence achieved after 52 iterations

Coefficient covariance computed using outer product of gradients

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.  |
|--------------------|-------------|-----------------------|-------------|--------|
| AR(1)              | 0.362783    | 0.019264              | 18.83209    | 0.0000 |
| AR(2)              | 0.219681    | 0.023678              | 9.277734    | 0.0000 |
| SIGMASQ            | 546.8495    | 11.44290              | 47.78940    | 0.0000 |
| R-squared          | 0.091480    | Mean dependent var    | 11.25164    |        |
| Adjusted R-squared | 0.088981    | S.D. dependent var    | 24.55073    |        |
| S.E. of regression | 23.43301    | Akaike info criterion | 9.150739    |        |
| Sum squared resid  | 399200.1    | Schwarz criterion     | 9.169614    |        |

|                    |           |                      |          |
|--------------------|-----------|----------------------|----------|
| Log likelihood     | -3337.020 | Hannan-Quinn criter. | 9.158021 |
| Durbin-Watson stat | 2.041591  |                      |          |

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|                   |     |      |
|-------------------|-----|------|
| Inverted AR Roots | .68 | -.32 |
|-------------------|-----|------|

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## ARMA (2,1)

Dependent Variable: CURAH\_HUJAN

Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 08/28/24 Time: 09:25

Sample: 1/01/2021 12/31/2022

Included observations: 730

Convergence achieved after 67 iterations

Coefficient covariance computed using outer product of gradients

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| Variable | Coefficient | Std. Error | t-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| C        | 14.47836    | 7.565012   | 1.913858    | 0.0560 |
| AR(1)    | 1.194611    | 0.033707   | 35.44098    | 0.0000 |
| AR(2)    | -0.205641   | 0.029030   | -7.083762   | 0.0000 |
| MA(1)    | -0.929525   | 0.021409   | -43.41843   | 0.0000 |
| SIGMASQ  | 500.4176    | 13.36045   | 37.45514    | 0.0000 |

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|                    |           |                       |          |
|--------------------|-----------|-----------------------|----------|
| R-squared          | 0.168621  | Mean dependent var    | 11.25164 |
| Adjusted R-squared | 0.164034  | S.D. dependent var    | 24.55073 |
| S.E. of regression | 22.44702  | Akaike info criterion | 9.067962 |
| Sum squared resid  | 365304.8  | Schwarz criterion     | 9.099421 |
| Log likelihood     | -3304.806 | Hannan-Quinn criter.  | 9.080099 |
| F-statistic        | 36.76122  | Durbin-Watson stat    | 2.022736 |
| Prob(F-statistic)  | 0.000000  |                       |          |

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|                   |     |     |
|-------------------|-----|-----|
| Inverted AR Roots | .99 | .21 |
| Inverted MA Roots | .93 |     |

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## ARMA (2,1) tanpa konstanta

Dependent Variable: CURAH\_HUJAN

Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 08/28/24 Time: 09:27

Sample: 1/01/2021 12/31/2022

Included observations: 730

Convergence achieved after 64 iterations

Coefficient covariance computed using outer product of gradients

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| Variable | Coefficient | Std. Error | t-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| AR(1)    | 1.210313    | 0.027883   | 43.40669    | 0.0000 |
| AR(2)    | -0.212638   | 0.027087   | -7.850126   | 0.0000 |

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|                    |           |                       |           |        |
|--------------------|-----------|-----------------------|-----------|--------|
| MA(1)              | -0.940428 | 0.015075              | -62.38417 | 0.0000 |
| SIGMASQ            | 502.4147  | 10.55423              | 47.60314  | 0.0000 |
| <hr/>              |           |                       |           |        |
| R-squared          | 0.165303  | Mean dependent var    | 11.25164  |        |
| Adjusted R-squared | 0.161854  | S.D. dependent var    | 24.55073  |        |
| S.E. of regression | 22.47627  | Akaike info criterion | 9.070751  |        |
| Sum squared resid  | 366762.7  | Schwarz criterion     | 9.095919  |        |
| Log likelihood     | -3306.824 | Hannan-Quinn criter.  | 9.080461  |        |
| Durbin-Watson stat | 2.026763  |                       |           |        |
| <hr/>              |           |                       |           |        |
| Inverted AR Roots  | 1.00      | .21                   |           |        |
| Inverted MA Roots  | .94       |                       |           |        |

## ARMA (2,2)

Dependent Variable: CURAH\_HUJAN

Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 08/28/24 Time: 09:29

Sample: 1/01/2021 12/31/2022

Included observations: 730

Convergence achieved after 75 iterations

Coefficient covariance computed using outer product of gradients

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.    |
|--------------------|-------------|-----------------------|-------------|----------|
| C                  | 14.61877    | 7.767731              | 1.881987    | 0.0602   |
| AR(1)              | 1.415474    | 0.121240              | 11.67495    | 0.0000   |
| AR(2)              | -0.422376   | 0.118935              | -3.551315   | 0.0004   |
| MA(1)              | -1.157065   | 0.129184              | -8.956715   | 0.0000   |
| MA(2)              | 0.203105    | 0.115148              | 1.763853    | 0.0782   |
| SIGMASQ            | 498.9841    | 13.49892              | 36.96474    | 0.0000   |
|                    |             |                       |             |          |
| R-squared          | 0.171002    | Mean dependent var    |             | 11.25164 |
| Adjusted R-squared | 0.165277    | S.D. dependent var    |             | 24.55073 |
| S.E. of regression | 22.43032    | Akaike info criterion |             | 9.067827 |
| Sum squared resid  | 364258.4    | Schwarz criterion     |             | 9.105578 |
| Log likelihood     | -3303.757   | Hannan-Quinn criter.  |             | 9.082392 |
| F-statistic        | 29.86877    | Durbin-Watson stat    |             | 2.006758 |
| Prob(F-statistic)  | 0.000000    |                       |             |          |
|                    |             |                       |             |          |
| Inverted AR Roots  | .99         | .43                   |             |          |
| Inverted MA Roots  | .94         | .22                   |             |          |

## ARMA (2,2) tanpa konstanta

Dependent Variable: CURAH\_HUJAN

Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 08/28/24 Time: 09:30

Sample: 1/01/2021 12/31/2022

Included observations: 730

Convergence achieved after 57 iterations

Coefficient covariance computed using outer product of gradients

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.    |
|--------------------|-------------|-----------------------|-------------|----------|
| AR(1)              | 1.431972    | 0.113558              | 12.61010    | 0.0000   |
| AR(2)              | -0.433426   | 0.113037              | -3.834389   | 0.0001   |
| MA(1)              | -1.169603   | 0.121860              | -9.597951   | 0.0000   |
| MA(2)              | 0.209258    | 0.111376              | 1.878838    | 0.0607   |
| SIGMASQ            | 500.8421    | 10.66989              | 46.93978    | 0.0000   |
| R-squared          | 0.167915    | Mean dependent var    |             | 11.25164 |
| Adjusted R-squared | 0.163325    | S.D. dependent var    |             | 24.55073 |
| S.E. of regression | 22.45654    | Akaike info criterion |             | 9.070363 |
| Sum squared resid  | 365614.7    | Schwarz criterion     |             | 9.101822 |
| Log likelihood     | -3305.683   | Hannan-Quinn criter.  |             | 9.082500 |
| Durbin-Watson stat | 2.009101    |                       |             |          |
| Inverted AR Roots  | 1.00        | .43                   |             |          |
| Inverted MA Roots  | .95         | .22                   |             |          |

ARMA (2,3)

Dependent Variable: CURAH\_HUJAN

Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 08/28/24 Time: 09:34

Sample: 1/01/2021 12/31/2022

Included observations: 730

Convergence achieved after 81 iterations

Coefficient covariance computed using outer product of gradients

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.    |
|--------------------|-------------|-----------------------|-------------|----------|
| C                  | 14.65604    | 7.755129              | 1.889851    | 0.0592   |
| AR(1)              | 1.106941    | 0.272124              | 4.067780    | 0.0001   |
| AR(2)              | -0.117618   | 0.267551              | -0.439608   | 0.6604   |
| MA(1)              | -0.854512   | 0.274360              | -3.114566   | 0.0019   |
| MA(2)              | 0.022865    | 0.200943              | 0.113788    | 0.9094   |
| MA(3)              | -0.096767   | 0.051226              | -1.889040   | 0.0593   |
| SIGMASQ            | 497.5952    | 13.60962              | 36.56203    | 0.0000   |
| R-squared          | 0.173310    | Mean dependent var    |             | 11.25164 |
| Adjusted R-squared | 0.166449    | S.D. dependent var    |             | 24.55073 |
| S.E. of regression | 22.41457    | Akaike info criterion |             | 9.067802 |
| Sum squared resid  | 363244.5    | Schwarz criterion     |             | 9.111845 |

|                   |           |                      |          |
|-------------------|-----------|----------------------|----------|
| Log likelihood    | -3302.748 | Hannan-Quinn criter. | 9.084795 |
| F-statistic       | 25.26197  | Durbin-Watson stat   | 1.996517 |
| Prob(F-statistic) | 0.000000  |                      |          |

|                   |     |           |           |
|-------------------|-----|-----------|-----------|
| Inverted AR Roots | .99 | .12       |           |
| Inverted MA Roots | .94 | -.04+.32i | -.04-.32i |

ARMA (2,3) tanpa konstanta

Dependent Variable: CURAH\_HUJAN

Method: ARMA Maximum Likelihood (OPG - BHHH)

Date: 08/28/24 Time: 09:35

Sample: 1/01/2021 12/31/2022

Included observations: 730

Convergence achieved after 66 iterations

Coefficient covariance computed using outer product of gradients

| Variable | Coefficient | Std. Error | t-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| AR(1)    | 1.123772    | 0.259768   | 4.326056    | 0.0000 |
| AR(2)    | -0.126045   | 0.258735   | -0.487157   | 0.6263 |
| MA(1)    | -0.867459   | 0.262036   | -3.310454   | 0.0010 |
| MA(2)    | 0.027583    | 0.194490   | 0.141824    | 0.8873 |
| MA(3)    | -0.098101   | 0.051555   | -1.902820   | 0.0575 |
| SIGMASQ  | 499.4488    | 10.94250   | 45.64302    | 0.0000 |

|                    |           |                       |          |
|--------------------|-----------|-----------------------|----------|
| R-squared          | 0.170230  | Mean dependent var    | 11.25164 |
| Adjusted R-squared | 0.164500  | S.D. dependent var    | 24.55073 |
| S.E. of regression | 22.44076  | Akaike info criterion | 9.070342 |
| Sum squared resid  | 364597.6  | Schwarz criterion     | 9.108093 |
| Log likelihood     | -3304.675 | Hannan-Quinn criter.  | 9.084907 |
| Durbin-Watson stat | 1.998599  |                       |          |

|                   |      |           |           |
|-------------------|------|-----------|-----------|
| Inverted AR Roots | 1.00 | .13       |           |
| Inverted MA Roots | .95  | -.04+.32i | -.04-.32i |

# Lampiran 5 Uji *Ljung-Box* Model ARIMA

ARMA (2,1) tanpa konstanta

Date: 08/28/24 Time: 09:46

Sample: 1/01/2021 12/31/2022

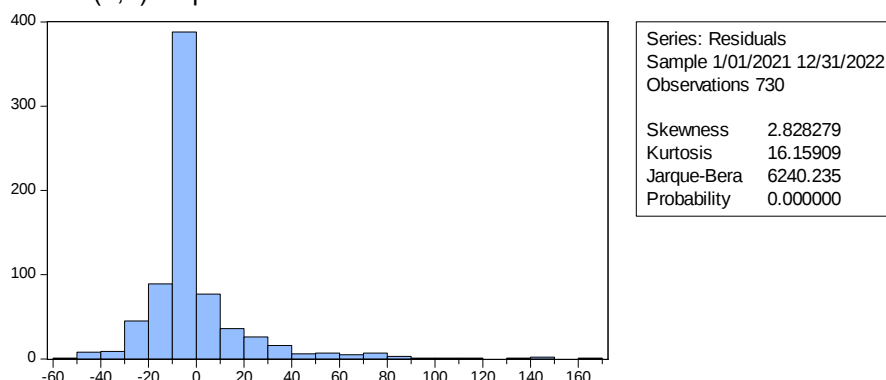
Included observations: 730

Q-statistic probabilities adjusted for 3 ARMA terms

| Autocorrelation | Partial Correlation | AC        | PAC    | Q-Stat | Prob  |
|-----------------|---------------------|-----------|--------|--------|-------|
|                 |                     | 1 -0.018  | -0.018 | 0.2299 |       |
|                 |                     | 2 0.062   | 0.062  | 3.0516 |       |
|                 |                     | 3 -0.006  | -0.004 | 3.0823 |       |
|                 |                     | 4 -0.070  | -0.075 | 6.7236 | 0.010 |
|                 |                     | 5 0.041   | 0.040  | 7.9692 | 0.019 |
|                 |                     | 6 0.031   | 0.042  | 8.6895 | 0.034 |
|                 |                     | 7 -0.018  | -0.024 | 8.9304 | 0.063 |
|                 |                     | 8 0.035   | 0.025  | 9.8556 | 0.079 |
|                 |                     | 9 -0.051  | -0.041 | 11.765 | 0.067 |
|                 |                     | 10 0.014  | 0.012  | 11.912 | 0.103 |
|                 |                     | 11 -0.027 | -0.027 | 12.468 | 0.132 |
|                 |                     | 12 -0.076 | -0.076 | 16.817 | 0.052 |
|                 |                     | 13 -0.003 | -0.009 | 16.825 | 0.078 |
|                 |                     | 14 0.002  | 0.015  | 16.827 | 0.113 |
|                 |                     | 15 0.012  | 0.011  | 16.927 | 0.152 |
|                 |                     | 16 -0.037 | -0.051 | 17.954 | 0.159 |
|                 |                     | 17 0.010  | 0.018  | 18.028 | 0.206 |
|                 |                     | 18 -0.050 | -0.041 | 19.887 | 0.176 |
|                 |                     | 19 0.017  | 0.015  | 20.105 | 0.216 |
|                 |                     | 20 0.002  | 0.002  | 20.108 | 0.269 |
|                 |                     | 21 -0.010 | -0.014 | 20.177 | 0.323 |
|                 |                     | 22 -0.010 | -0.014 | 20.249 | 0.380 |
|                 |                     | 23 0.043  | 0.045  | 21.630 | 0.361 |
|                 |                     | 24 -0.015 | -0.014 | 21.811 | 0.410 |
|                 |                     | 25 -0.010 | -0.027 | 21.881 | 0.467 |
|                 |                     | 26 0.009  | 0.019  | 21.949 | 0.523 |
|                 |                     | 27 0.010  | 0.015  | 22.025 | 0.578 |
|                 |                     | 28 0.055  | 0.046  | 24.307 | 0.502 |
|                 |                     | 29 -0.028 | -0.035 | 24.899 | 0.525 |
|                 |                     | 30 -0.006 | -0.013 | 24.922 | 0.579 |
|                 |                     | 31 0.010  | 0.017  | 24.996 | 0.628 |
|                 |                     | 32 -0.009 | 0.002  | 25.053 | 0.676 |
|                 |                     | 33 -0.011 | -0.026 | 25.153 | 0.718 |
|                 |                     | 34 0.020  | 0.012  | 25.457 | 0.747 |
|                 |                     | 35 -0.028 | -0.008 | 26.048 | 0.761 |
|                 |                     | 36 -0.025 | -0.037 | 26.514 | 0.781 |

### Lampiran 6 Uji Jarque-Bera Model ARIMA

ARMA (2,1) tanpa konstanta



### Lampiran 7 Uji Lagrange Multiplier Model ARIMA

ARMA (2,1) tanpa konstanta

Heteroskedasticity Test: ARCH

|               |          |                     |        |
|---------------|----------|---------------------|--------|
| F-statistic   | 48.38022 | Prob. F(1,727)      | 0.0000 |
| Obs*R-squared | 45.48631 | Prob. Chi-Square(1) | 0.0000 |

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 08/28/24 Time: 09:55

Sample (adjusted): 1/02/2021 12/31/2022

Included observations: 729 after adjustments

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.  |
|--------------------|-------------|-----------------------|-------------|--------|
| C                  | 373.5228    | 72.93619              | 5.121228    | 0.0000 |
| RESID^2(-1)        | 0.249535    | 0.035875              | 6.955589    | 0.0000 |
| R-squared          | 0.062395    | Mean dependent var    | 499.0536    |        |
| Adjusted R-squared | 0.061106    | S.D. dependent var    | 1969.149    |        |
| S.E. of regression | 1908.038    | Akaike info criterion | 17.94828    |        |
| Sum squared resid  | 2.65E+09    | Schwarz criterion     | 17.96088    |        |
| Log likelihood     | -6540.147   | Hannan-Quinn criter.  | 17.95314    |        |
| F-statistic        | 48.38022    | Durbin-Watson stat    | 2.043943    |        |
| Prob(F-statistic)  | 0.000000    |                       |             |        |

**Lampiran 8** Pendugaan Model GARCH Sementara

ARMA (2,1) - GARCH(1,0)

Dependent Variable: CURAH\_HUJAN

Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)

Date: 08/28/24 Time: 10:08

Sample: 1/01/2021 12/31/2022

Included observations: 730

Convergence achieved after 61 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

GARCH = C(4) + C(5)\*RESID(-1)^2

| Variable           | Coefficient | Std. Error            | z-Statistic | Prob.    |
|--------------------|-------------|-----------------------|-------------|----------|
| AR(1)              | 1.045180    | 0.011978              | 87.25483    | 0.0000   |
| AR(2)              | -0.047810   | 0.011591              | -4.124810   | 0.0000   |
| MA(1)              | -0.908148   | 0.004562              | -199.0790   | 0.0000   |
| Variance Equation  |             |                       |             |          |
| C                  | 86.99887    | 3.323505              | 26.17684    | 0.0000   |
| RESID(-1)^2        | 2.451498    | 0.134267              | 18.25842    | 0.0000   |
| R-squared          | 0.147063    | Mean dependent var    |             | 11.25164 |
| Adjusted R-squared | 0.144716    | S.D. dependent var    |             | 24.55073 |
| S.E. of regression | 22.70489    | Akaike info criterion |             | 8.583299 |
| Sum squared resid  | 374777.3    | Schwarz criterion     |             | 8.614758 |
| Log likelihood     | -3127.904   | Hannan-Quinn criter.  |             | 8.595436 |
| Durbin-Watson stat | 1.738066    |                       |             |          |
| Inverted AR Roots  | 1.00        | .05                   |             |          |
| Inverted MA Roots  | .91         |                       |             |          |

ARMA (2,1) - GARCH(1,1)

Dependent Variable: CURAH\_HUJAN

Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)

Date: 08/28/24 Time: 10:09

Sample: 1/01/2021 12/31/2022

Included observations: 730

Failure to improve likelihood (non-zero gradients) after 48 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

GARCH = C(4) + C(5)\*RESID(-1)^2 + C(6)\*GARCH(-1)

| Variable | Coefficient | Std. Error | z-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
|----------|-------------|------------|-------------|-------|

|                    |           |                       |           |        |
|--------------------|-----------|-----------------------|-----------|--------|
| AR(1)              | 1.156861  | 2.74E-05              | 42156.98  | 0.0000 |
| AR(2)              | -0.156864 | 0.004939              | -31.75992 | 0.0000 |
| MA(1)              | -0.797735 | 0.055388              | -14.40265 | 0.0000 |
| Variance Equation  |           |                       |           |        |
| C                  | 4.167746  | 0.287867              | 14.47803  | 0.0000 |
| RESID(-1)^2        | 0.219551  | 0.016848              | 13.03114  | 0.0000 |
| GARCH(-1)          | 0.846367  | 0.006752              | 125.3563  | 0.0000 |
| R-squared          | 0.130533  | Mean dependent var    | 11.25164  |        |
| Adjusted R-squared | 0.128141  | S.D. dependent var    | 24.55073  |        |
| S.E. of regression | 22.92384  | Akaike info criterion | 8.449957  |        |
| Sum squared resid  | 382040.4  | Schwarz criterion     | 8.487708  |        |
| Log likelihood     | -3078.234 | Hannan-Quinn criter.  | 8.464522  |        |
| Durbin-Watson stat | 2.114799  |                       |           |        |
| Inverted AR Roots  | 1.00      | .16                   |           |        |
| Inverted MA Roots  | .80       |                       |           |        |

ARMA (2,1) - GARCH(1,2)

Dependent Variable: CURAH\_HUJAN

Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)

Date: 08/28/24 Time: 10:11

Sample: 1/01/2021 12/31/2022

Included observations: 730

Failure to improve likelihood (non-zero gradients) after 53 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

GARCH = C(4) + C(5)\*RESID(-1)^2 + C(6)\*GARCH(-1) + C(7)\*GARCH(-2)

| Variable          | Coefficient | Std. Error         | z-Statistic | Prob.  |
|-------------------|-------------|--------------------|-------------|--------|
| AR(1)             | 0.534460    | 0.013816           | 38.68287    | 0.0000 |
| AR(2)             | 0.136289    | 0.016269           | 8.377025    | 0.0000 |
| MA(1)             | -0.174958   | 0.019911           | -8.787112   | 0.0000 |
| Variance Equation |             |                    |             |        |
| C                 | 14.97212    | 0.465181           | 32.18556    | 0.0000 |
| RESID(-1)^2       | 0.475482    | 0.030255           | 15.71591    | 0.0000 |
| GARCH(-1)         | -0.015767   | 0.001144           | -13.77787   | 0.0000 |
| GARCH(-2)         | 0.685034    | 0.010530           | 65.05769    | 0.0000 |
| R-squared         | 0.098046    | Mean dependent var | 11.25164    |        |

|                    |           |                       |          |
|--------------------|-----------|-----------------------|----------|
| Adjusted R-squared | 0.095565  | S.D. dependent var    | 24.55073 |
| S.E. of regression | 23.34818  | Akaike info criterion | 8.423727 |
| Sum squared resid  | 396315.1  | Schwarz criterion     | 8.467769 |
| Log likelihood     | -3067.660 | Hannan-Quinn criter.  | 8.440719 |
| Durbin-Watson stat | 2.042841  |                       |          |

|                   |     |      |
|-------------------|-----|------|
| Inverted AR Roots | .72 | -.19 |
| Inverted MA Roots | .17 |      |

#### ARMA (2,1) - GARCH(2,1)

Dependent Variable: CURAH\_HUJAN

Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)

Date: 08/28/24 Time: 10:15

Sample: 1/01/2021 12/31/2022

Included observations: 730

Failure to improve likelihood (non-zero gradients) after 53 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

GARCH = C(4) + C(5)\*RESID(-1)^2 + C(6)\*RESID(-2)^2 + C(7)\*GARCH(-1)

| Variable | Coefficient | Std. Error | z-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| AR(1)    | 1.096836    | 0.008214   | 133.5369    | 0.0000 |
| AR(2)    | -0.096841   | 0.000724   | -133.6726   | 0.0000 |
| MA(1)    | -0.806326   | 0.051787   | -15.57000   | 0.0000 |

#### Variance Equation

|             |           |          |           |        |
|-------------|-----------|----------|-----------|--------|
| C           | 4.242707  | 0.321971 | 13.17730  | 0.0000 |
| RESID(-1)^2 | 0.261851  | 0.031512 | 8.309543  | 0.0000 |
| RESID(-2)^2 | -0.058827 | 0.025387 | -2.317234 | 0.0205 |
| GARCH(-1)   | 0.852799  | 0.007477 | 114.0500  | 0.0000 |

|                    |           |                       |          |
|--------------------|-----------|-----------------------|----------|
| R-squared          | 0.136414  | Mean dependent var    | 11.25164 |
| Adjusted R-squared | 0.134038  | S.D. dependent var    | 24.55073 |
| S.E. of regression | 22.84619  | Akaike info criterion | 8.446211 |
| Sum squared resid  | 379456.4  | Schwarz criterion     | 8.490254 |
| Log likelihood     | -3075.867 | Hannan-Quinn criter.  | 8.463204 |
| Durbin-Watson stat | 1.986533  |                       |          |

|                   |      |     |
|-------------------|------|-----|
| Inverted AR Roots | 1.00 | .10 |
| Inverted MA Roots | .81  |     |

#### ARMA (2,1) - GARCH(2,2)

Dependent Variable: CURAH\_HUJAN

Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)

Date: 08/28/24 Time: 10:11

Sample: 1/01/2021 12/31/2022

Included observations: 730

Failure to improve likelihood (singular hessian) after 94 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

GARCH = C(4) + C(5)\*RESID(-1)^2 + C(6)\*RESID(-2)^2 + C(7)\*GARCH(-1)  
+ C(8)\*GARCH(-2)

| Variable           | Coefficient | Std. Error            | z-Statistic | Prob.  |
|--------------------|-------------|-----------------------|-------------|--------|
| AR(1)              | 1.218416    | 0.054629              | 22.30359    | 0.0000 |
| AR(2)              | -0.218979   | 0.054642              | -4.007543   | 0.0001 |
| MA(1)              | -0.917479   | 0.009750              | -94.10308   | 0.0000 |
| Variance Equation  |             |                       |             |        |
| C                  | 10.38041    | 0.924375              | 11.22965    | 0.0000 |
| RESID(-1)^2        | 0.451719    | 0.045653              | 9.894542    | 0.0000 |
| RESID(-2)^2        | -0.000488   | 0.015308              | -0.031849   | 0.9746 |
| GARCH(-1)          | 0.016150    | 0.010381              | 1.555742    | 0.1198 |
| GARCH(-2)          | 0.671044    | 0.020412              | 32.87465    | 0.0000 |
| R-squared          | 0.162471    | Mean dependent var    | 11.25164    |        |
| Adjusted R-squared | 0.160167    | S.D. dependent var    | 24.55073    |        |
| S.E. of regression | 22.49888    | Akaike info criterion | 8.390883    |        |
| Sum squared resid  | 368007.2    | Schwarz criterion     | 8.441218    |        |
| Log likelihood     | -3054.672   | Hannan-Quinn criter.  | 8.410303    |        |
| Durbin-Watson stat | 2.080913    |                       |             |        |
| Inverted AR Roots  | 1.00        | .22                   |             |        |
| Inverted MA Roots  | .92         |                       |             |        |

# Lampiran 9 Uji Ljung-Box Model GARCH

ARMA (2,1)- GARCH(1,2)

Date: 08/28/24 Time: 10:24

Sample: 1/01/2021 12/31/2022

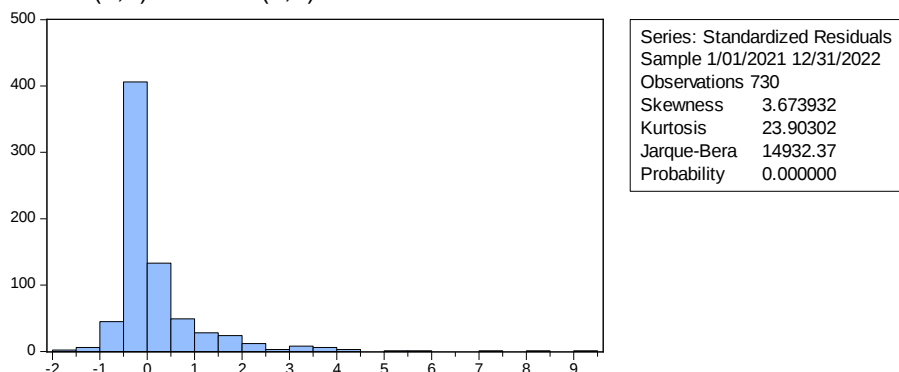
Included observations: 730

Q-statistic probabilities adjusted for 3 ARMA terms

| Autocorrelation | Partial Correlation | AC        | PAC    | Q-Stat | Prob* |
|-----------------|---------------------|-----------|--------|--------|-------|
|                 |                     | 1 -0.068  | -0.068 | 3.4321 |       |
|                 |                     | 2 -0.103  | -0.108 | 11.196 |       |
|                 |                     | 3 -0.050  | -0.066 | 13.044 |       |
|                 |                     | 4 -0.045  | -0.067 | 14.558 | 0.000 |
|                 |                     | 5 0.019   | -0.003 | 14.831 | 0.001 |
|                 |                     | 6 -0.019  | -0.034 | 15.087 | 0.002 |
|                 |                     | 7 -0.004  | -0.014 | 15.099 | 0.004 |
|                 |                     | 8 -0.001  | -0.011 | 15.100 | 0.010 |
|                 |                     | 9 -0.010  | -0.016 | 15.175 | 0.019 |
|                 |                     | 10 0.045  | 0.038  | 16.647 | 0.020 |
|                 |                     | 11 -0.047 | -0.045 | 18.308 | 0.019 |
|                 |                     | 12 0.031  | 0.031  | 19.026 | 0.025 |
|                 |                     | 13 0.035  | 0.034  | 19.959 | 0.030 |
|                 |                     | 14 -0.039 | -0.028 | 21.081 | 0.033 |
|                 |                     | 15 0.007  | 0.008  | 21.118 | 0.049 |
|                 |                     | 16 0.069  | 0.075  | 24.634 | 0.026 |
|                 |                     | 17 -0.019 | -0.008 | 24.912 | 0.035 |
|                 |                     | 18 -0.026 | -0.014 | 25.421 | 0.045 |
|                 |                     | 19 0.029  | 0.037  | 26.047 | 0.053 |
|                 |                     | 20 0.005  | 0.008  | 26.063 | 0.073 |
|                 |                     | 21 -0.023 | -0.017 | 26.479 | 0.089 |
|                 |                     | 22 -0.006 | -0.007 | 26.508 | 0.117 |
|                 |                     | 23 0.002  | 0.001  | 26.511 | 0.150 |
|                 |                     | 24 -0.028 | -0.030 | 27.118 | 0.167 |
|                 |                     | 25 -0.004 | -0.015 | 27.129 | 0.206 |
|                 |                     | 26 0.019  | 0.007  | 27.401 | 0.239 |
|                 |                     | 27 -0.031 | -0.029 | 28.129 | 0.255 |
|                 |                     | 28 0.055  | 0.045  | 30.460 | 0.208 |
|                 |                     | 29 -0.014 | -0.020 | 30.608 | 0.243 |
|                 |                     | 30 0.030  | 0.045  | 31.302 | 0.259 |
|                 |                     | 31 -0.031 | -0.028 | 32.043 | 0.273 |
|                 |                     | 32 -0.001 | -0.002 | 32.043 | 0.318 |
|                 |                     | 33 0.019  | 0.019  | 32.332 | 0.352 |
|                 |                     | 34 0.039  | 0.053  | 33.483 | 0.348 |
|                 |                     | 35 -0.008 | -0.008 | 33.534 | 0.393 |
|                 |                     | 36 -0.022 | -0.010 | 33.920 | 0.423 |

\*Probabilities may not be valid for this equation specification.

**Lampiran 10 Uji Jarque-Bera Model GARCH**  
**ARMA (2,1)- GARCH(1,2)**



**Lampiran 11 Uji Lagrange Multiplier Model GARCH**  
**ARMA (2,1)- GARCH(1,2)**

Heteroskedasticity Test: ARCH

|               |          |                     |        |
|---------------|----------|---------------------|--------|
| F-statistic   | 0.181091 | Prob. F(1,727)      | 0.6706 |
| Obs*R-squared | 0.181544 | Prob. Chi-Square(1) | 0.6700 |

Test Equation:

Dependent Variable: WGT\_RESID^2

Method: Least Squares

Date: 08/28/24 Time: 10:28

Sample (adjusted): 1/02/2021 12/31/2022

Included observations: 729 after adjustments

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.  |
|--------------------|-------------|-----------------------|-------------|--------|
| C                  | 1.053599    | 0.191939              | 5.489249    | 0.0000 |
| WGT_RESID^2(-1)    | -0.015781   | 0.037084              | -0.425548   | 0.6706 |
| R-squared          | 0.000249    | Mean dependent var    | 1.037191    |        |
| Adjusted R-squared | -0.001126   | S.D. dependent var    | 5.073839    |        |
| S.E. of regression | 5.076695    | Akaike info criterion | 6.089938    |        |
| Sum squared resid  | 18736.85    | Schwarz criterion     | 6.102535    |        |
| Log likelihood     | -2217.782   | Hannan-Quinn criter.  | 6.094798    |        |
| F-statistic        | 0.181091    | Durbin-Watson stat    | 1.999359    |        |
| Prob(F-statistic)  | 0.670563    |                       |             |        |

# Lampiran 12 Uji Asimetris GARCH

Date: 08/28/24 Time: 10:35

Sample: 1/01/2021 12/31/2022

Included observations: 730

Correlations are asymptotically consistent approximations

| RESIDUAL_KUADARAT,RE                                                                | RESIDUAL_KUADARAT,RE                                                                | i  | lag     | lead    |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----|---------|---------|
|    |    | 0  | 0.7044  | 0.7044  |
|    |    | 1  | 0.1929  | -0.1203 |
|    |    | 2  | 0.1690  | -0.1026 |
|    |    | 3  | 0.0278  | -0.0755 |
|    |    | 4  | 0.0282  | -0.0359 |
|    |    | 5  | 0.0850  | 0.0716  |
|    |    | 6  | 0.0216  | 0.0967  |
|    |    | 7  | 0.0117  | 0.0049  |
|    |    | 8  | 0.0715  | 0.0083  |
|    |    | 9  | 0.0207  | -0.0032 |
|    |    | 10 | 0.0874  | 0.0364  |
|    |    | 11 | 0.0162  | 0.0048  |
|    |    | 12 | 0.0253  | -0.0289 |
|    |    | 13 | 0.0162  | 0.0382  |
|    |    | 14 | 0.0003  | 0.0590  |
|    |    | 15 | 0.0240  | 0.0447  |
|    |    | 16 | 0.0363  | -0.0067 |
|    |    | 17 | 0.0372  | 0.0412  |
|    |    | 18 | 0.0257  | 0.0001  |
|    |    | 19 | 0.0583  | 0.0652  |
|   |   | 20 | 0.0245  | 0.0170  |
|  |  | 21 | 0.0077  | 0.0658  |
|  |  | 22 | 0.0203  | 0.0129  |
|  |  | 23 | 0.0524  | 0.0452  |
|  |  | 24 | 0.0108  | -0.0195 |
|  |  | 25 | 0.0292  | 0.0388  |
|  |  | 26 | 0.0395  | 0.0234  |
|  |  | 27 | 0.0282  | 0.1031  |
|  |  | 28 | 0.0472  | 0.0104  |
|  |  | 29 | -0.0062 | -0.0159 |
|  |  | 30 | -0.0244 | 0.0211  |
|  |  | 31 | 0.0205  | 0.0005  |
|  |  | 32 | 0.0348  | 0.0086  |
|  |  | 33 | 0.0802  | 0.0180  |
|  |  | 34 | 0.0382  | 0.0180  |
|  |  | 35 | -0.0116 | -0.0024 |
|  |  | 36 | -0.0083 | 0.0036  |

**Lampiran 13 Uji Sign Bias GARCH**

Dependent Variable: U2

Method: Least Squares

Date: 11/20/24 Time: 05:50

Sample (adjusted): 1/02/2021 12/31/2022

Included observations: 729 after adjustments

| Variable              | Coefficient | Std. Error            | t-Statistic | Prob.    |
|-----------------------|-------------|-----------------------|-------------|----------|
| C                     | 89.41878    | 172.8197              | 0.517411    | 0.6050   |
| DUMMY1                | 3.464358    | 201.3485              | 0.017206    | 0.9863   |
| DUMMY1*GARCH21RES(-1) | -33.92949   | 7.655492              | -4.432046   | 0.0000   |
| DUMMY2*GARCH21RES(-1) | 31.95823    | 4.571160              | 6.991274    | 0.0000   |
| R-squared             | 0.096845    | Mean dependent var    |             | 508.8210 |
| Adjusted R-squared    | 0.093108    | S.D. dependent var    |             | 1936.903 |
| S.E. of regression    | 1844.530    | Akaike info criterion |             | 17.88331 |
| Sum squared resid     | 2.47E+09    | Schwarz criterion     |             | 17.90850 |
| Log likelihood        | -6514.466   | Hannan-Quinn criter.  |             | 17.89303 |
| F-statistic           | 25.91393    | Durbin-Watson stat    |             | 2.068727 |
| Prob(F-statistic)     | 0.000000    |                       |             |          |

**Lampiran 14** Pendugaan Model T-GARCH Sementara

ARMA (2,1) T-GARCH(1,1)

Dependent Variable: CURAH\_HUJAN

Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)

Date: 08/31/24 Time: 05:53

Sample: 1/01/2021 12/31/2022

Included observations: 730

Failure to improve likelihood (non-zero gradients) after 77 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

$$\text{GARCH} = C(4) + C(5) \cdot \text{RESID}(-1)^2 + C(6) \cdot \text{RESID}(-1)^2 \cdot (\text{RESID}(-1) < 0) + C(7) \cdot \text{GARCH}(-1)$$

| Variable                  | Coefficient | Std. Error            | z-Statistic | Prob.  |
|---------------------------|-------------|-----------------------|-------------|--------|
| AR(1)                     | 1.160978    | 2.05E-05              | 56698.67    | 0.0000 |
| AR(2)                     | -0.161084   | 0.001444              | -111.5716   | 0.0000 |
| MA(1)                     | -0.891460   | 0.007014              | -127.1017   | 0.0000 |
| Variance Equation         |             |                       |             |        |
| C                         | 5.872477    | 0.539373              | 10.88759    | 0.0000 |
| RESID(-1)^2               | 0.193395    | 0.014551              | 13.29087    | 0.0000 |
| RESID(-1)^2*(RESID(-1)<0) | 0.365826    | 0.089383              | 4.092805    | 0.0000 |
| GARCH(-1)                 | 0.800118    | 0.012292              | 65.09141    | 0.0000 |
| R-squared                 | 0.158041    | Mean dependent var    | 11.25164    |        |
| Adjusted R-squared        | 0.155725    | S.D. dependent var    | 24.55073    |        |
| S.E. of regression        | 22.55830    | Akaike info criterion | 8.423104    |        |
| Sum squared resid         | 369953.5    | Schwarz criterion     | 8.467147    |        |
| Log likelihood            | -3067.433   | Hannan-Quinn criter.  | 8.440096    |        |
| Durbin-Watson stat        | 1.998242    |                       |             |        |
| Inverted AR Roots         | 1.00        | .16                   |             |        |
| Inverted MA Roots         | .89         |                       |             |        |

ARMA (2,1) T-GARCH(1,2)

Dependent Variable: CURAH\_HUJAN

Method: ML - ARCH

Date: 08/31/24 Time: 08:00

Sample: 1/01/2021 12/31/2022

Included observations: 730

Failure to improve likelihood (singular hessian) after 96 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

$$\text{GARCH} = C(4) + C(5)*\text{RESID}(-1)^2 + C(6)*\text{RESID}(-1)^2*(\text{RESID}(-1)<0) + C(7)*\text{GARCH}(-1) + C(8)*\text{GARCH}(-2)$$

| Variable | Coefficient | Std. Error | z-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| AR(1)    | 1.239855    | 0.057238   | 21.66127    | 0.0000 |
| AR(2)    | -0.240254   | 0.057174   | -4.202162   | 0.0000 |
| MA(1)    | -0.921691   | 0.010816   | -85.21805   | 0.0000 |

#### Variance Equation

|                           |           |          |           |        |
|---------------------------|-----------|----------|-----------|--------|
| C                         | 10.03386  | 0.864550 | 11.60588  | 0.0000 |
| RESID(-1)^2               | 0.477357  | 0.052500 | 9.092464  | 0.0000 |
| RESID(-1)^2*(RESID(-1)<0) | -0.108221 | 0.061622 | -1.756218 | 0.0791 |
| GARCH(-1)                 | 0.020353  | 0.008148 | 2.498100  | 0.0125 |
| GARCH(-2)                 | 0.672984  | 0.020511 | 32.81156  | 0.0000 |

|                    |           |                       |          |
|--------------------|-----------|-----------------------|----------|
| R-squared          | 0.161860  | Mean dependent var    | 11.25164 |
| Adjusted R-squared | 0.159555  | S.D. dependent var    | 24.55073 |
| S.E. of regression | 22.50708  | Akaike info criterion | 8.390172 |
| Sum squared resid  | 368275.4  | Schwarz criterion     | 8.440506 |
| Log likelihood     | -3054.413 | Hannan-Quinn criter.  | 8.409591 |
| Durbin-Watson stat | 2.117557  |                       |          |

|                   |      |     |
|-------------------|------|-----|
| Inverted AR Roots | 1.00 | .24 |
| Inverted MA Roots | .92  |     |

ARMA (2,1) T-GARCH(2,1)

Dependent Variable: CURAH\_HUJAN

Method: ML - ARCH

Date: 08/31/24 Time: 08:03

Sample: 1/01/2021 12/31/2022

Included observations: 730

Convergence achieved after 105 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

$$\text{GARCH} = C(4) + C(5)*\text{RESID}(-1)^2 + C(6)*\text{RESID}(-1)^2*(\text{RESID}(-1)<0) + C(7)*\text{RESID}(-2)^2 + C(8)*\text{GARCH}(-1)$$

| Variable | Coefficient | Std. Error | z-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| AR(1)    | 1.088971    | 0.041796   | 26.05463    | 0.0000 |
| AR(2)    | -0.091891   | 0.041996   | -2.188082   | 0.0287 |
| MA(1)    | -0.868567   | 0.021643   | -40.13150   | 0.0000 |

## Variance Equation

|                           |           |                       |           |        |
|---------------------------|-----------|-----------------------|-----------|--------|
| C                         | 5.549712  | 0.811522              | 6.838645  | 0.0000 |
| RESID(-1)^2               | 0.439616  | 0.053443              | 8.225847  | 0.0000 |
| RESID(-1)^2*(RESID(-1)<0) | 0.619732  | 0.103064              | 6.013089  | 0.0000 |
| RESID(-2)^2               | -0.338160 | 0.047229              | -7.159996 | 0.0000 |
| GARCH(-1)                 | 0.821092  | 0.022149              | 37.07131  | 0.0000 |
| R-squared                 | 0.151504  | Mean dependent var    | 11.25164  |        |
| Adjusted R-squared        | 0.149170  | S.D. dependent var    | 24.55073  |        |
| S.E. of regression        | 22.64570  | Akaike info criterion | 8.385640  |        |
| Sum squared resid         | 372825.8  | Schwarz criterion     | 8.435974  |        |
| Log likelihood            | -3052.758 | Hannan-Quinn criter.  | 8.405059  |        |
| Durbin-Watson stat        | 1.892754  |                       |           |        |
| Inverted AR Roots         | 1.00      | .09                   |           |        |
| Inverted MA Roots         | .87       |                       |           |        |

ARMA (2,1) T-GARCH(2,2)

Dependent Variable: CURAH\_HUJAN

Method: ML - ARCH

Date: 08/31/24 Time: 08:07

Sample: 1/01/2021 12/31/2022

Included observations: 730

Failure to improve likelihood (non-zero gradients) after 105 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

$$\text{GARCH} = C(4) + C(5)*\text{RESID}(-1)^2 + C(6)*\text{RESID}(-1)^2*(\text{RESID}(-1)<0) + C(7)*\text{RESID}(-2)^2 + C(8)*\text{GARCH}(-1) + C(9)*\text{GARCH}(-2)$$

| Variable | Coefficient | Std. Error | z-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| AR(1)    | 0.822442    | 0.081019   | 10.15118    | 0.0000 |
| AR(2)    | -0.030804   | 0.030423   | -1.012523   | 0.3113 |
| MA(1)    | -0.604251   | 0.071984   | -8.394233   | 0.0000 |

## Variance Equation

|                           |           |          |           |        |
|---------------------------|-----------|----------|-----------|--------|
| C                         | 5.520107  | 0.510224 | 10.81898  | 0.0000 |
| RESID(-1)^2               | 0.311378  | 0.025916 | 12.01487  | 0.0000 |
| RESID(-1)^2*(RESID(-1)<0) | 2.401094  | 0.583775 | 4.113049  | 0.0000 |
| RESID(-2)^2               | -0.183244 | 0.030580 | -5.992345 | 0.0000 |
| GARCH(-1)                 | 0.481943  | 0.104004 | 4.633897  | 0.0000 |
| GARCH(-2)                 | 0.317102  | 0.088998 | 3.563035  | 0.0004 |

|                    |           |                       |          |
|--------------------|-----------|-----------------------|----------|
| R-squared          | 0.086104  | Mean dependent var    | 11.25164 |
| Adjusted R-squared | 0.083590  | S.D. dependent var    | 24.55073 |
| S.E. of regression | 23.50225  | Akaike info criterion | 8.474072 |
| Sum squared resid  | 401562.5  | Schwarz criterion     | 8.530698 |
| Log likelihood     | -3084.036 | Hannan-Quinn criter.  | 8.495919 |
| Durbin-Watson stat | 1.750886  |                       |          |
| <hr/>              |           |                       |          |
| Inverted AR Roots  | .78       | .04                   |          |
| Inverted MA Roots  | .60       |                       |          |

# Lampiran 15 Uji Ljung-Box Model T-GARCH

Date: 08/31/24 Time: 19:28

Sample: 1/01/2021 12/31/2022

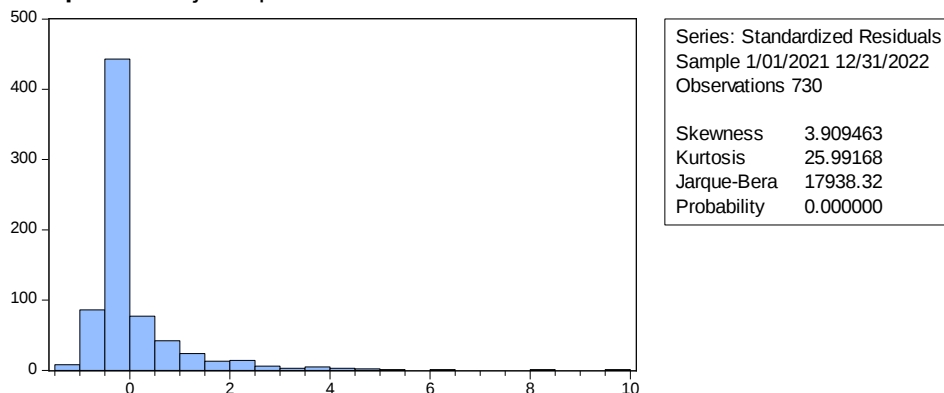
Included observations: 730

Q-statistic probabilities adjusted for 3 ARMA terms

| Autocorrelation | Partial Correlation | AC | PAC    | Q-Stat | Prob*  |
|-----------------|---------------------|----|--------|--------|--------|
|                 |                     | 1  | 0.006  | 0.006  | 0.0285 |
|                 |                     | 2  | -0.005 | -0.005 | 0.0445 |
|                 |                     | 3  | -0.040 | -0.040 | 1.2321 |
|                 |                     | 4  | -0.046 | -0.046 | 2.8193 |
|                 |                     | 5  | 0.004  | 0.004  | 2.8327 |
|                 |                     | 6  | -0.056 | -0.058 | 5.1086 |
|                 |                     | 7  | 0.000  | -0.003 | 5.1087 |
|                 |                     | 8  | -0.032 | -0.034 | 5.8506 |
|                 |                     | 9  | -0.006 | -0.010 | 5.8770 |
|                 |                     | 10 | 0.033  | 0.027  | 6.6683 |
|                 |                     | 11 | -0.065 | -0.069 | 9.8221 |
|                 |                     | 12 | 0.020  | 0.015  | 10.133 |
|                 |                     | 13 | 0.026  | 0.027  | 10.632 |
|                 |                     | 14 | -0.050 | -0.058 | 12.527 |
|                 |                     | 15 | 0.018  | 0.014  | 12.765 |
|                 |                     | 16 | 0.087  | 0.094  | 18.395 |
|                 |                     | 17 | -0.026 | -0.039 | 18.887 |
|                 |                     | 18 | -0.015 | -0.014 | 19.064 |
|                 |                     | 19 | 0.040  | 0.051  | 20.267 |
|                 |                     | 20 | -0.012 | -0.015 | 20.368 |
|                 |                     | 21 | -0.005 | -0.001 | 20.384 |
|                 |                     | 22 | -0.014 | -0.009 | 20.541 |
|                 |                     | 23 | -0.020 | -0.020 | 20.847 |
|                 |                     | 24 | -0.035 | -0.026 | 21.791 |
|                 |                     | 25 | 0.013  | 0.008  | 21.914 |
|                 |                     | 26 | 0.034  | 0.026  | 22.790 |
|                 |                     | 27 | -0.027 | -0.014 | 23.349 |
|                 |                     | 28 | 0.030  | 0.017  | 24.020 |
|                 |                     | 29 | -0.036 | -0.043 | 24.981 |
|                 |                     | 30 | -0.001 | 0.015  | 24.982 |
|                 |                     | 31 | -0.046 | -0.057 | 26.611 |
|                 |                     | 32 | 0.005  | -0.005 | 26.633 |
|                 |                     | 33 | 0.004  | 0.011  | 26.645 |
|                 |                     | 34 | 0.022  | 0.022  | 27.017 |
|                 |                     | 35 | 0.014  | -0.009 | 27.167 |
|                 |                     | 36 | -0.016 | -0.007 | 27.367 |

\*Probabilities may not be valid for this equation specification.

### Lampiran 16 Uji Jarque-Bera Model T-GARCH



### Lampiran 17 Uji Lagrange Multiplier Model T-GARCH

Heteroskedasticity Test: ARCH

|               |          |                     |        |
|---------------|----------|---------------------|--------|
| F-statistic   | 0.005271 | Prob. F(1,727)      | 0.9421 |
| Obs*R-squared | 0.005286 | Prob. Chi-Square(1) | 0.9420 |

Test Equation:

Dependent Variable: WGT\_RESID^2

Method: Least Squares

Date: 08/31/24 Time: 19:33

Sample (adjusted): 1/02/2021 12/31/2022

Included observations: 729 after adjustments

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.    |
|--------------------|-------------|-----------------------|-------------|----------|
| C                  | 1.001845    | 0.192550              | 5.203042    | 0.0000   |
| WGT_RESID^2(-1)    | -0.002693   | 0.037089              | -0.072602   | 0.9421   |
| R-squared          | 0.000007    | Mean dependent var    |             | 0.999150 |
| Adjusted R-squared | -0.001368   | S.D. dependent var    |             | 5.097801 |
| S.E. of regression | 5.101287    | Akaike info criterion |             | 6.099603 |
| Sum squared resid  | 18918.82    | Schwarz criterion     |             | 6.112200 |
| Log likelihood     | -2221.305   | Hannan-Quinn criter.  |             | 6.104463 |
| F-statistic        | 0.005271    | Durbin-Watson stat    |             | 1.999962 |
| Prob(F-statistic)  | 0.942142    |                       |             |          |

# Lampiran 18 Uji Asimetris T-GARCH

Date: 12/02/24 Time: 05:26

Sample: 1/01/2021 12/31/2022

Included observations: 730

Correlations are asymptotically consistent approximations

| RESIDUAL_TGARCH,RESI                                                                | RESIDUAL_TGARCH,RESI                                                                | i  | lag     | lead    |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----|---------|---------|
|    |    | 0  | 0.7181  | 0.7181  |
|    |    | 1  | -0.0370 | 0.1793  |
|    |    | 2  | -0.0597 | 0.1376  |
|    |    | 3  | -0.1477 | 0.0019  |
|    |    | 4  | -0.1491 | 0.0021  |
|    |    | 5  | -0.0555 | 0.0520  |
|    |    | 6  | -0.0143 | -0.0057 |
|    |    | 7  | -0.0818 | -0.0121 |
|    |    | 8  | -0.0746 | 0.0508  |
|    |    | 9  | -0.0891 | -0.0019 |
|    |    | 10 | -0.0478 | 0.0552  |
|    |    | 11 | -0.0718 | -0.0181 |
|    |    | 12 | -0.0995 | -0.0111 |
|    |    | 13 | -0.0342 | -0.0187 |
|    |    | 14 | -0.0035 | -0.0301 |
|   |   | 15 | -0.0008 | -0.0026 |
|  |  | 16 | -0.0438 | 0.0130  |
|  |  | 17 | 0.0012  | 0.0142  |
|  |  | 18 | -0.0393 | 0.0016  |
|  |  | 19 | 0.0273  | 0.0318  |
|  |  | 20 | -0.0159 | -0.0002 |
|  |  | 21 | 0.0367  | -0.0116 |
|  |  | 22 | -0.0140 | 0.0008  |
|  |  | 23 | 0.0180  | 0.0303  |
|  |  | 24 | -0.0496 | -0.0083 |
|  |  | 25 | 0.0029  | 0.0127  |
|  |  | 26 | -0.0141 | 0.0224  |
|  |  | 27 | 0.0707  | 0.0049  |
|  |  | 28 | -0.0118 | 0.0169  |
|  |  | 29 | -0.0385 | -0.0303 |
|  |  | 30 | -0.0155 | -0.0377 |
|  |  | 31 | -0.0391 | 0.0144  |
|  |  | 32 | -0.0309 | 0.0257  |
|  |  | 33 | -0.0219 | 0.0590  |
|  |  | 34 | -0.0184 | 0.0124  |
|  |  | 35 | -0.0355 | -0.0315 |
|  |  | 36 | -0.0298 | -0.0215 |

**Lampiran 19 Uji Sign Bias**

Dependent Variable: U2\_T-GARCH

Method: Least Squares

Date: 12/02/24 Time: 20:10

Sample (adjusted): 1/16/2021 12/31/2022

Included observations: 715 after adjustments

| Variable                             | Coefficient | Std. Error            | t-Statistic | Prob.  |
|--------------------------------------|-------------|-----------------------|-------------|--------|
| C                                    | 838.6940    | 143.8159              | 5.831720    | 0.0000 |
| DUMMY1_T-GARCH                       | -462.6452   | 167.5064              | -2.761956   | 0.0059 |
| DUMMY1_T-GARCH*RESIDUAL_T-GARCH(-15) | -0.350667   | 4.028787              | -0.087040   | 0.9307 |
| DUMMY2_T-GARCH*RESIDUAL_T-GARCH(-15) | 0.138439    | 5.779846              | 0.023952    | 0.9809 |
| R-squared                            | 0.010631    | Mean dependent var    | 497.8135    |        |
| Adjusted R-squared                   | 0.006456    | S.D. dependent var    | 1977.610    |        |
| S.E. of regression                   | 1971.215    | Akaike info criterion | 18.01627    |        |
| Sum squared resid                    | 2.76E+09    | Schwarz criterion     | 18.04185    |        |
| Log likelihood                       | -6436.815   | Hannan-Quinn criter.  | 18.02614    |        |
| F-statistic                          | 2.546617    | Durbin-Watson stat    | 1.563496    |        |
| Prob(F-statistic)                    | 0.054935    |                       |             |        |

**Lampiran 20 Pendugaan Model E-GARCH Sementara**

ARMA (2,1) E-GARCH(1,1)

Dependent Variable: CURAH\_HUJAN

Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)

Date: 08/31/24 Time: 06:31

Sample: 1/01/2021 12/31/2022

Included observations: 730

Failure to improve likelihood (singular hessian) after 93 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

$$\text{LOG}(\text{GARCH}) = \text{C}(4) + \text{C}(5) * \text{ABS}(\text{RESID}(-1) / @\text{SQRT}(\text{GARCH}(-1))) + \text{C}(6)$$

$$* \text{RESID}(-1) / @\text{SQRT}(\text{GARCH}(-1)) + \text{C}(7) * \text{LOG}(\text{GARCH}(-1))$$

| Variable | Coefficient | Std. Error | z-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| AR(1)    | 1.168533    | 0.052942   | 22.07194    | 0.0000 |
| AR(2)    | -0.170001   | 0.053044   | -3.204927   | 0.0014 |
| MA(1)    | -0.876661   | 0.008916   | -98.32346   | 0.0000 |

| Variance Equation             |           |                       |           |          |  |
|-------------------------------|-----------|-----------------------|-----------|----------|--|
| C(4)                          | 0.196684  | 0.037379              | 5.261930  | 0.0000   |  |
| C(5)                          | 0.389073  | 0.059862              | 6.499459  | 0.0000   |  |
| C(6)                          | -0.042148 | 0.041825              | -1.007712 | 0.3136   |  |
| C(7)                          | 0.925416  | 0.012430              | 74.44911  | 0.0000   |  |
| R-squared                     | 0.155122  | Mean dependent var    |           | 11.25164 |  |
| Adjusted R-squared            | 0.152798  | S.D. dependent var    |           | 24.55073 |  |
| S.E. of regression            | 22.59737  | Akaike info criterion |           | 8.389699 |  |
| Sum squared resid             | 371236.0  | Schwarz criterion     |           | 8.433742 |  |
| Log likelihood                | -3055.240 | Hannan-Quinn criter.  |           | 8.406691 |  |
| Durbin-Watson stat            | 2.040661  |                       |           |          |  |
| Inverted AR Roots             | 1.00      | .17                   |           |          |  |
| Inverted MA Roots             | .88       |                       |           |          |  |
| ARMA (2,1) E-GARCH(1,2)       |           |                       |           |          |  |
| Heteroskedasticity Test: ARCH |           |                       |           |          |  |
| F-statistic                   | 0.000697  | Prob. F(1,727)        |           | 0.9790   |  |
| Obs*R-squared                 | 0.000698  | Prob. Chi-Square(1)   |           | 0.9789   |  |

Test Equation:

Dependent Variable: WGT\_RESID^2

Method: Least Squares

Date: 09/01/24 Time: 05:29

Sample (adjusted): 1/02/2021 12/31/2022

Included observations: 729 after adjustments

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.  |
|--------------------|-------------|-----------------------|-------------|--------|
| C                  | 0.999439    | 0.175027              | 5.710204    | 0.0000 |
| WGT_RESID^2(-1)    | 0.000979    | 0.037089              | 0.026392    | 0.9790 |
| R-squared          | 0.000001    | Mean dependent var    | 1.000419    |        |
| Adjusted R-squared | -0.001375   | S.D. dependent var    | 4.614981    |        |
| S.E. of regression | 4.618151    | Akaike info criterion | 5.900606    |        |
| Sum squared resid  | 15504.96    | Schwarz criterion     | 5.913203    |        |
| Log likelihood     | -2148.771   | Hannan-Quinn criter.  | 5.905466    |        |
| F-statistic        | 0.000697    | Durbin-Watson stat    | 1.999927    |        |
| Prob(F-statistic)  | 0.978952    |                       |             |        |

ARMA (2,1) E-GARCH(2,1)

Dependent Variable: CURAH\_HUJAN

Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)

Date: 08/31/24 Time: 08:12

Sample: 1/01/2021 12/31/2022

Included observations: 730

Failure to improve likelihood (non-zero gradients) after 213 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

LOG(GARCH) = C(4) + C(5)\*ABS(RESID(-1)/@SQRT(GARCH(-1))) + C(6)

\*ABS(RESID(-2)/@SQRT(GARCH(-2))) + C(7)\*RESID(-1)  
/@SQRT(GARCH(-1)) + C(8)\*LOG(GARCH(-1))

| Variable | Coefficient | Std. Error | z-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| AR(1)    | -1.953935   | 8.20E-05   | -23836.25   | 0.0000 |
| AR(2)    | -0.954320   | 0.006917   | -137.9760   | 0.0000 |
| MA(1)    | -25304.96   | 972.5197   | -26.01999   | 0.0000 |

#### Variance Equation

|      |           |          |           |        |
|------|-----------|----------|-----------|--------|
| C(4) | -13.61827 | 0.472388 | -28.82860 | 0.0000 |
| C(5) | 1.158308  | 2.502232 | 0.462910  | 0.6434 |
| C(6) | 0.814737  | 0.071209 | 11.44156  | 0.0000 |
| C(7) | 0.593684  | 2.503366 | 0.237154  | 0.8125 |
| C(8) | 0.094073  | 0.030699 | 3.064362  | 0.0022 |

|                    |          |                       |           |
|--------------------|----------|-----------------------|-----------|
| R-squared          | 1.000000 | Mean dependent var    | 11.25164  |
| Adjusted R-squared | 1.000000 | S.D. dependent var    | 24.55073  |
| S.E. of regression | 0.003352 | Akaike info criterion | -10.38925 |
| Sum squared resid  | 0.008169 | Schwarz criterion     | -10.33891 |
| Log likelihood     | 3800.075 | Hannan-Quinn criter.  | -10.36983 |
| Durbin-Watson stat | 0.266435 |                       |           |

Inverted AR Roots      -.96      -.99

Inverted MA Roots      25304.96

Estimated MA process is noninvertible

ARMA (2,1) E-GARCH(2,2)

Dependent Variable: CURAH\_HUJAN

Method: ML ARCH - Normal distribution (BFGS / Marquardt steps)

Date: 08/31/24 Time: 08:12

Sample: 1/01/2021 12/31/2022

Included observations: 730

Convergence achieved after 104 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

$\text{LOG}(\text{GARCH}) = \text{C}(4) + \text{C}(5) * \text{ABS}(\text{RESID}(-1) / @\text{SQRT}(\text{GARCH}(-1))) +$   
 $\text{C}(6)$   
 $* \text{ABS}(\text{RESID}(-2) / @\text{SQRT}(\text{GARCH}(-2))) + \text{C}(7) * \text{RESID}(-1)$   
 $/ @\text{SQRT}(\text{GARCH}(-1)) + \text{C}(8) * \text{LOG}(\text{GARCH}(-1)) +$   
 $\text{C}(9) * \text{LOG}(\text{GARCH}(-2))$

| Variable           | Coefficient | Std. Error            | z-Statistic | Prob.    |
|--------------------|-------------|-----------------------|-------------|----------|
| AR(1)              | 1.152509    | 0.051217              | 22.50245    | 0.0000   |
| AR(2)              | -0.158100   | 0.051706              | -3.057668   | 0.0022   |
| MA(1)              | -0.867650   | 0.017993              | -48.22062   | 0.0000   |
| Variance Equation  |             |                       |             |          |
| C(4)               | 0.155527    | 0.059221              | 2.626194    | 0.0086   |
| C(5)               | 0.726847    | 0.063390              | 11.46626    | 0.0000   |
| C(6)               | -0.380403   | 0.080526              | -4.723994   | 0.0000   |
| C(7)               | -0.141417   | 0.046090              | -3.068267   | 0.0022   |
| C(8)               | 1.098461    | 0.156232              | 7.030979    | 0.0000   |
| C(9)               | -0.159855   | 0.139574              | -1.145310   | 0.2521   |
| R-squared          | 0.155037    | Mean dependent var    |             | 11.25164 |
| Adjusted R-squared | 0.152713    | S.D. dependent var    |             | 24.55073 |
| S.E. of regression | 22.59851    | Akaike info criterion |             | 8.367740 |
| Sum squared resid  | 371273.5    | Schwarz criterion     |             | 8.424367 |
| Log likelihood     | -3045.225   | Hannan-Quinn criter.  |             | 8.389587 |
| Durbin-Watson stat | 2.028013    |                       |             |          |
| Inverted AR Roots  | .99         | .16                   |             |          |
| Inverted MA Roots  | .87         |                       |             |          |

# Lampiran 21 Uji *Ljung-Box* Model E-GARCH

Date: 09/01/24 Time: 05:32

Sample: 1/01/2021 12/31/2022

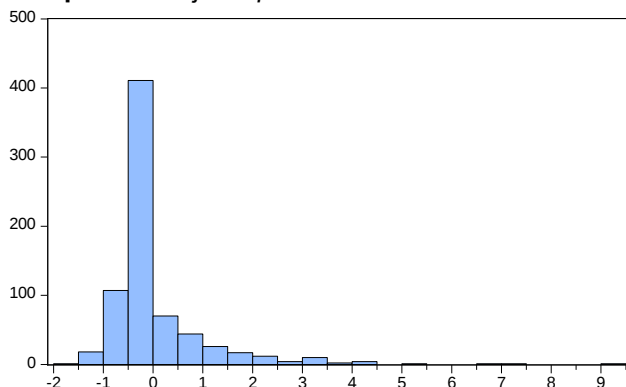
Included observations: 730

Q-statistic probabilities adjusted for 3 ARMA terms

| Autocorrelation | Partial Correlation | AC        | PAC    | Q-Stat | Prob* |
|-----------------|---------------------|-----------|--------|--------|-------|
|                 |                     | 1 -0.019  | -0.019 | 0.2661 |       |
|                 |                     | 2 0.011   | 0.011  | 0.3612 |       |
|                 |                     | 3 -0.029  | -0.029 | 0.9770 |       |
|                 |                     | 4 -0.061  | -0.062 | 3.7265 | 0.054 |
|                 |                     | 5 0.024   | 0.022  | 4.1483 | 0.126 |
|                 |                     | 6 -0.037  | -0.036 | 5.1506 | 0.161 |
|                 |                     | 7 -0.006  | -0.011 | 5.1736 | 0.270 |
|                 |                     | 8 -0.011  | -0.013 | 5.2625 | 0.385 |
|                 |                     | 9 -0.022  | -0.022 | 5.6251 | 0.466 |
|                 |                     | 10 0.024  | 0.018  | 6.0672 | 0.532 |
|                 |                     | 11 -0.058 | -0.057 | 8.5513 | 0.382 |
|                 |                     | 12 -0.012 | -0.018 | 8.6584 | 0.469 |
|                 |                     | 13 0.021  | 0.021  | 9.0013 | 0.532 |
|                 |                     | 14 -0.049 | -0.049 | 10.780 | 0.462 |
|                 |                     | 15 0.016  | 0.003  | 10.970 | 0.531 |
|                 |                     | 16 0.063  | 0.068  | 13.975 | 0.376 |
|                 |                     | 17 -0.030 | -0.033 | 14.664 | 0.402 |
|                 |                     | 18 -0.029 | -0.040 | 15.283 | 0.431 |
|                 |                     | 19 0.038  | 0.047  | 16.370 | 0.427 |
|                 |                     | 20 -0.009 | -0.008 | 16.434 | 0.493 |
|                 |                     | 21 -0.006 | -0.015 | 16.462 | 0.560 |
|                 |                     | 22 -0.020 | -0.018 | 16.763 | 0.606 |
|                 |                     | 23 -0.002 | -0.001 | 16.765 | 0.668 |
|                 |                     | 24 -0.033 | -0.033 | 17.578 | 0.676 |
|                 |                     | 25 0.003  | -0.002 | 17.584 | 0.730 |
|                 |                     | 26 0.031  | 0.025  | 18.300 | 0.741 |
|                 |                     | 27 -0.029 | -0.020 | 18.924 | 0.756 |
|                 |                     | 28 0.045  | 0.037  | 20.470 | 0.722 |
|                 |                     | 29 -0.037 | -0.042 | 21.515 | 0.715 |
|                 |                     | 30 -0.001 | 0.007  | 21.516 | 0.762 |
|                 |                     | 31 -0.030 | -0.035 | 22.224 | 0.771 |
|                 |                     | 32 -0.003 | -0.010 | 22.230 | 0.811 |
|                 |                     | 33 -0.001 | -0.002 | 22.231 | 0.846 |
|                 |                     | 34 0.023  | 0.029  | 22.621 | 0.863 |
|                 |                     | 35 -0.001 | -0.020 | 22.622 | 0.890 |
|                 |                     | 36 -0.018 | -0.020 | 22.868 | 0.907 |

\*Probabilities may not be valid for this equation specification.

### Lampiran 22 Uji Jarque-Bera Model E-GARCH



Series: Standardized Residuals  
Sample 1/01/2021 12/31/2022  
Observations 730

Skewness 3.479905  
Kurtosis 21.49092  
Jarque-Bera 11873.24  
Probability 0.000000

### Lampiran 23 Uji Lagrange Multiplier Model E-GARCH

Heteroskedasticity Test: ARCH

|               |          |                     |        |
|---------------|----------|---------------------|--------|
| F-statistic   | 0.000697 | Prob. F(1,727)      | 0.9790 |
| Obs*R-squared | 0.000698 | Prob. Chi-Square(1) | 0.9789 |

Test Equation:

Dependent Variable: WGT\_RESID^2

Method: Least Squares

Date: 09/01/24 Time: 05:33

Sample (adjusted): 1/02/2021 12/31/2022

Included observations: 729 after adjustments

| Variable           | Coefficient | Std. Error            | t-Statistic | Prob.  |
|--------------------|-------------|-----------------------|-------------|--------|
| C                  | 0.999439    | 0.175027              | 5.710204    | 0.0000 |
| WGT_RESID^2(-1)    | 0.000979    | 0.037089              | 0.026392    | 0.9790 |
| R-squared          | 0.000001    | Mean dependent var    | 1.000419    |        |
| Adjusted R-squared | -0.001375   | S.D. dependent var    | 4.614981    |        |
| S.E. of regression | 4.618151    | Akaike info criterion | 5.900606    |        |
| Sum squared resid  | 15504.96    | Schwarz criterion     | 5.913203    |        |
| Log likelihood     | -2148.771   | Hannan-Quinn criter.  | 5.905466    |        |
| F-statistic        | 0.000697    | Durbin-Watson stat    | 1.999927    |        |
| Prob(F-statistic)  | 0.978952    |                       |             |        |

# Lampiran 24 Uji Asimetris E-GARCH

Date: 12/02/24 Time: 21:05

Sample: 1/01/2021 12/31/2022

Included observations: 730

Correlations are asymptotically consistent approximations

| RESIDUAL_EGARCH,RESI                                                                | RESIDUAL_EGARCH,RESI                                                                | i  | lag     | lead    |
|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|----|---------|---------|
|    |    | 0  | 0.7072  | 0.7072  |
|    |    | 1  | -0.0789 | 0.1708  |
|    |    | 2  | -0.0585 | 0.1365  |
|    |    | 3  | -0.1423 | 0.0003  |
|    |    | 4  | -0.1394 | -0.0022 |
|    |    | 5  | -0.0462 | 0.0507  |
|    |    | 6  | -0.0113 | -0.0076 |
|    |    | 7  | -0.0823 | -0.0181 |
|    |    | 8  | -0.0718 | 0.0488  |
|    |    | 9  | -0.0869 | -0.0065 |
|    |    | 10 | -0.0450 | 0.0550  |
|    |    | 11 | -0.0718 | -0.0189 |
|    |    | 12 | -0.0985 | -0.0114 |
|    |    | 13 | -0.0315 | -0.0186 |
|    |    | 14 | -0.0047 | -0.0322 |
|    |    | 15 | -0.0039 | -0.0067 |
|    |    | 16 | -0.0471 | 0.0111  |
|    |    | 17 | 0.0006  | 0.0123  |
|    |    | 18 | -0.0422 | -0.0032 |
|    |    | 19 | 0.0268  | 0.0306  |
|   |   | 20 | -0.0201 | -0.0003 |
|  |  | 21 | 0.0351  | -0.0128 |
|  |  | 22 | -0.0184 | -0.0021 |
|  |  | 23 | 0.0166  | 0.0296  |
|  |  | 24 | -0.0527 | -0.0118 |
|  |  | 25 | 0.0038  | 0.0102  |
|  |  | 26 | -0.0160 | 0.0218  |
|  |  | 27 | 0.0699  | 0.0037  |
|  |  | 28 | -0.0176 | 0.0186  |
|  |  | 29 | -0.0397 | -0.0284 |
|  |  | 30 | -0.0148 | -0.0391 |
|  |  | 31 | -0.0397 | 0.0125  |
|  |  | 32 | -0.0302 | 0.0217  |
|  |  | 33 | -0.0217 | 0.0581  |
|  |  | 34 | -0.0188 | 0.0142  |
|  |  | 35 | -0.0362 | -0.0304 |
|  |  | 36 | -0.0296 | -0.0227 |

**Lampiran 25 Uji Sign Bias E-GARCH**

Dependent Variable: U2\_E-GARCH

Method: Least Squares

Date: 12/02/24 Time: 20:11

Sample (adjusted): 1/17/2021 12/31/2022

Included observations: 714 after adjustments

| Variable                             | Coefficient | Std. Error            | t-Statistic | Prob.  |
|--------------------------------------|-------------|-----------------------|-------------|--------|
| C                                    | 809.0134    | 139.9455              | 5.780918    | 0.0000 |
| DUMMY1_E-GARCH                       | -436.2087   | 162.9010              | -2.677754   | 0.0076 |
| DUMMY1_E-GARCH*RESIDUAL_E-GARCH(-16) | -0.907448   | 3.795007              | -0.239116   | 0.8111 |
| DUMMY2_E-GARCH*RESIDUAL_E-GARCH(-16) | 4.250007    | 6.042440              | 0.703359    | 0.4821 |
| R-squared                            | 0.010757    | Mean dependent var    | 487.4180    |        |
| Adjusted R-squared                   | 0.006577    | S.D. dependent var    | 1920.041    |        |
| S.E. of regression                   | 1913.716    | Akaike info criterion | 17.95707    |        |
| Sum squared resid                    | 2.60E+09    | Schwarz criterion     | 17.98268    |        |
| Log likelihood                       | -6406.673   | Hannan-Quinn criter.  | 17.96696    |        |
| F-statistic                          | 2.573509    | Durbin-Watson stat    | 1.548432    |        |
| Prob(F-statistic)                    | 0.053009    |                       |             |        |

**Lampiran 26** Validasi Data Menggunakan Testing

| Tanggal    | Aktual | GARCH  | T-GARCH | E-GARCH |
|------------|--------|--------|---------|---------|
| 01-01-2023 | 1      | 12,361 | 4,687   | 0,694   |
| 02-01-2023 | 0      | -3,441 | 8,725   | 0,650   |
| 03-01-2023 | 9,6    | 9,609  | 8,174   | 4,184   |
| 04-01-2023 | 42,1   | 2,164  | 17,126  | 2,774   |
| 05-01-2023 | 90,7   | 27,048 | 15,595  | 11,350  |
| 06-01-2023 | 28     | -3,139 | -0,254  | 1,521   |
| 07-01-2023 | 27,8   | 3,256  | 1,858   | 1,296   |
| 24-01-2023 | 19,2   | 0,000  | 0,000   | 0,000   |
| 25-01-2023 | 14,3   | 0,000  | 0,000   | 0,000   |
| ...        | ...    | ...    | ...     | ...     |
| 24-05-2023 | 0      | 0,000  | 0,000   | 0,000   |
| 25-05-2023 | 0      | 0,000  | 0,000   | 0,000   |
| 26-05-2023 | 0      | 0,000  | 0,000   | 0,000   |
| 27-05-2023 | 0      | 0,000  | 0,000   | 0,000   |
| 28-05-2023 | 0      | 0,000  | 0,000   | 0,000   |
| 29-05-2023 | 0      | 0,000  | 0,000   | 0,000   |
| 30-05-2023 | 0      | -0,055 | 0,437   | 0,005   |
| 31-05-2023 | 0      | 0,786  | 0,674   | 0,328   |
| MAPE       |        | 1,234  | 1,330   | 0,924   |
| RMSEP      |        | 33,411 | 29,357  | 32,641  |

**Lampiran 27 Model Akhir ARMA-E-GARCH (1,2)**

Dependent Variable: CURAH\_HUJAN

Method: ML - ARCH

Date: 09/01/24 Time: 05:43

Sample: 1/01/2021 5/31/2023

Included observations: 881

Convergence achieved after 83 iterations

Coefficient covariance computed using outer product of gradients

Presample variance: backcast (parameter = 0.7)

$$\text{LOG}(\text{GARCH}) = \text{C}(4) + \text{C}(5) * \text{ABS}(\text{RESID}(-1) / @\text{SQRT}(\text{GARCH}(-1))) + \text{C}(6)$$

$$* \text{RESID}(-1) / @\text{SQRT}(\text{GARCH}(-1)) + \text{C}(7) * \text{LOG}(\text{GARCH}(-1)) + \text{C}(8)$$

$$* \text{LOG}(\text{GARCH}(-2))$$

| Variable | Coefficient | Std. Error | z-Statistic | Prob.  |
|----------|-------------|------------|-------------|--------|
| AR(1)    | 1.162240    | 0.039810   | 29.19496    | 0.0000 |
| AR(2)    | -0.183859   | 0.040560   | -4.533046   | 0.0000 |
| MA(1)    | -0.849515   | 0.009336   | -90.99675   | 0.0000 |

## Variance Equation

|      |           |          |           |        |
|------|-----------|----------|-----------|--------|
| C(4) | 0.288607  | 0.025984 | 11.10719  | 0.0000 |
| C(5) | 0.719213  | 0.050295 | 14.29989  | 0.0000 |
| C(6) | -0.259514 | 0.044387 | -5.846677 | 0.0000 |
| C(7) | 0.285806  | 0.020764 | 13.76450  | 0.0000 |
| C(8) | 0.598994  | 0.020529 | 29.17867  | 0.0000 |

|                    |           |                       |          |
|--------------------|-----------|-----------------------|----------|
| R-squared          | 0.164881  | Mean dependent var    | 11.88014 |
| Adjusted R-squared | 0.162978  | S.D. dependent var    | 25.91896 |
| S.E. of regression | 23.71297  | Akaike info criterion | 8.479957 |
| Sum squared resid  | 493703.9  | Schwarz criterion     | 8.523372 |
| Log likelihood     | -3727.421 | Hannan-Quinn criter.  | 8.496559 |
| Durbin-Watson stat | 2.013423  |                       |          |

|                   |     |     |
|-------------------|-----|-----|
| Inverted AR Roots | .97 | .19 |
| Inverted MA Roots | .85 |     |

**Lampiran 28** Nilai Peramalan Data Curah Hujan

| Tanggal    | Forecast Curah Hujan |
|------------|----------------------|
| 01/06/2023 | 0,294                |
| 02/06/2023 | 0,249                |
| 03/06/2023 | 0,212                |
| 04/06/2023 | 0,180                |
| 05/06/2023 | 0,153                |
| 06/06/2023 | 0,130                |
| 07/06/2023 | 0,110                |
| 08/06/2023 | 0,094                |
| 09/06/2023 | 0,080                |
| 10/06/2023 | 0,068                |
| 11/06/2023 | 0,057                |
| 12/06/2023 | 0,049                |
| 13/06/2023 | 0,041                |
| 14/06/2023 | 0,035                |
| 15/06/2023 | 0,030                |
| 16/06/2023 | 0,025                |
| 17/06/2023 | 0,022                |
| 18/06/2023 | 0,018                |
| 19/06/2023 | 0,016                |
| 20/06/2023 | 0,013                |
| 21/06/2023 | 0,011                |
| 22/06/2023 | 0,010                |
| 23/06/2023 | 0,008                |
| 24/06/2023 | 0,007                |
| 25/06/2023 | 0,006                |
| 26/06/2023 | 0,005                |
| 27/06/2023 | 0,004                |
| 28/06/2023 | 0,004                |
| 29/06/2023 | 0,003                |
| 30/06/2023 | 0,003                |