3-白噪声检验

|  |  |  |
| --- | --- | --- |
| Pvalue | lags |  |
| 25.032168 | 5.638178e-07 | 1 |
| 26.000092 | 2.260225e-06 | 2 |
| 26.692562 | 6.829048e-06 | 3 |
| 26.851657 | 2.129990e-05 | 4 |
| 27.060415 | 5.551776e-05 | 5 |
| 28.185095 | 8.671254e-05 | 6 |
| 29.642472 | 1.104207e-04 | 7 |
| 30.090463 | 2.037347e-04 | 8 |
| 30.326396 | 3.859917e-04 | 9 |
| 30.349171 | 7.509103e-04 | 10 |
| 33.454580 | 4.439226e-04 | 11 |
| 62.712054 | 7.198565e-09 | 12 |
| 76.887829 | 4.230084e-11 | 13 |
| 82.178505 | 1.113708e-11 | 14 |
| 82.519599 | 2.410755e-11 | 15 |
| 82.519905 | 5.829391e-11 | 16 |
| 82.848032 | 1.191464e-10 | 17 |
| 85.090167 | 1.086240e-10 | 18 |
| 86.300435 | 1.490222e-10 | 19 |
| 87.000970 | 2.467593e-10 | 20 |
| 88.429575 | 3.007338e-10 | 21 |
| 88.818206 | 5.441487e-10 | 22 |
| 91.693072 | 3.688561e-10 | 23 |
| 92.162235 | 6.304688e-10 | 24 |

4.1-模型定阶

parameters AIC BIC

0 SARIMA(1, 1, 2)x(0, 1, 1, 12) -313.213613 -298.837627

1 SARIMA(1, 1, 1)x(0, 1, 1, 12) -309.449982 -297.949192

2 SARIMA(2, 1, 2)x(0, 1, 1, 12) -312.613624 -295.362440

3 SARIMA(2, 1, 1)x(0, 1, 1, 12) -309.515689 -295.139703

4 SARIMA(1, 1, 3)x(0, 1, 1, 12) -312.252153 -295.000969

.. ... ... ...

59 SARIMA(2, 1, 3)x(0, 1, 0, 12) -261.295031 -244.043847

60 SARIMA(1, 1, 4)x(0, 1, 0, 12) -261.167272 -243.916088

61 SARIMA(4, 1, 1)x(0, 1, 0, 12) -258.361242 -241.110058

62 SARIMA(4, 1, 4)x(0, 1, 0, 12) -265.155404 -239.278628

63 SARIMA(2, 1, 4)x(0, 1, 0, 12) -259.145196 -239.018815

4.2-使用 𝑆𝐴𝑅𝐼𝑀𝐴(𝑝,𝑑,𝑞)(𝑃,𝐷,𝑄)𝑚 建模

SARIMAX Results

==========================================================================================

Dep. Variable: y No. Observations: 144

Model: ARIMA(1, 1, 2)x(0, 1, [1], 12) Log Likelihood 161.607

Date: Wed, 01 Dec 2021 AIC -313.214

Time: 23:53:09 BIC -298.838

Sample: 0 HQIC -307.372

- 144

Covariance Type: opg

=================================================================

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| coef | std | err | z | P>|z| | [0.025 | 0.975] |
| ar.L1 | 0.4252 | 0.311 | 1.369 | 0.171 | -0.183 | 1.034 |
| ma.L1 | -0.9771 | 0.308 | -3.173 | 0.002 | -1.581 | -0.374 |
| ma.L2 | 0.4693 | 0.136 | 3.461 | 0.001 | 0.204 | 0.735 |
| ma.S.L12 | -0.7319 | 0.075 | -9.714 | 0.000 | -0.880 | -0.584 |
| sigma2 | 0.0046 | 0.000 | 9.555 | 0.000 | 0.004 | 0.006 |

=================================================================

Ljung-Box (Q): 32.55 Jarque-Bera (JB): 14.59

Prob(Q): 0.79 Prob(JB): 0.00

Heteroskedasticity (H): 1.94 Skew: 0.48

Prob(H) (two-sided): 0.03 Kurtosis: 4.32

=================================================================

5-模型显著性检验（残差检验）

|  |  |  |
| --- | --- | --- |
| Pvalue | lags |  |
| 0.004386 | 0.947195 | 1 |
| 0.018406 | 0.990839 | 2 |
| 0.034104 | 0.998342 | 3 |
| 0.041396 | 0.999789 | 4 |
| 0.051356 | 0.999969 | 5 |
| 0.051724 | 0.999997 | 6 |
| 0.057083 | 1.000000 | 7 |
| 0.068467 | 1.000000 | 8 |
| 0.090534 | 1.000000 | 9 |
| 0.090539 | 1.000000 | 10 |
| 0.090600 | 1.000000 | 11 |
| 24.995803 | 0.014843 | 12 |
| 25.015141 | 0.022978 | 13 |
| 25.015926 | 0.034410 | 14 |
| 25.019255 | 0.049685 | 15 |
| 25.021872 | 0.069441 | 16 |
| 25.021918 | 0.094220 | 17 |
| 25.025920 | 0.124204 | 18 |
| 25.053041 | 0.158804 | 19 |
| 25.060084 | 0.199142 | 20 |
| 25.060095 | 0.244571 | 21 |
| 25.068202 | 0.293824 | 22 |
| 25.071527 | 0.346608 | 23 |
| 25.071669 | 0.401874 | 24 |

6-拟合+7-预测

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| y | mean | mean\_se | mean\_ci\_lower | mean\_ci\_upper |
| 0 | 1.091513e+06 | 1000.000005 | 1.089553e+06 | 1.093473e+06 |
| 1 | 1.075059e+06 | 1000.000005 | 1.073099e+06 | 1.077019e+06 |
| 2 | 1.186777e+06 | 1000.000005 | 1.184817e+06 | 1.188737e+06 |
| 3 | 1.074022e+06 | 1000.000005 | 1.072062e+06 | 1.075982e+06 |
| 4 | 1.106857e+06 | 1000.000005 | 1.104897e+06 | 1.108817e+06 |
| .. | ... | ... | ... | ... |
| 160 | 2.062858e+06 | 0.261539 | 2.062857e+06 | 2.062858e+06 |
| 161 | 2.451218e+06 | 0.271717 | 2.451217e+06 | 2.451218e+06 |
| 162 | 2.639800e+06 | 0.281543 | 2.639800e+06 | 2.639801e+06 |
| 163 | 2.079882e+06 | 0.291044 | 2.079881e+06 | 2.079882e+06 |
| 164 | 2.476131e+06 | 0.300247 | 2.476131e+06 | 2.476132e+06 |