3-白噪声检验

|  |  |  |
| --- | --- | --- |
| LB | Pvalue | lags |
| 0.614735 | 4.330106e-01 | 1 |
| 27.827140 | 9.065949e-07 | 2 |
| 30.985647 | 8.559838e-07 | 3 |
| 35.077591 | 4.477952e-07 | 4 |
| 41.365703 | 7.914645e-08 | 5 |
| 46.824985 | 2.027711e-08 | 6 |
| 47.645407 | 4.176520e-08 | 7 |
| 47.647914 | 1.153491e-07 | 8 |
| 47.647994 | 2.971494e-07 | 9 |
| 47.680686 | 7.097850e-07 | 10 |
| 49.241064 | 8.565745e-07 | 11 |
| 50.102843 | 1.340174e-06 | 12 |
| 51.973249 | 1.362271e-06 | 13 |
| 52.261248 | 2.539610e-06 | 14 |
| 52.986940 | 3.875309e-06 | 15 |
| 55.585755 | 2.848332e-06 | 16 |
| 56.571776 | 3.822092e-06 | 17 |
| 56.717366 | 6.862802e-06 | 18 |
| 56.862691 | 1.200076e-05 | 19 |
| 56.862899 | 2.153223e-05 | 20 |
| 56.923323 | 3.688526e-05 | 21 |
| 57.076131 | 5.984925e-05 | 22 |
| 57.157631 | 9.733920e-05 | 23 |
| 57.216927 | 1.561407e-04 | 24 |

4-建模，参数估计

parameters AIC BIC

0 SARIMA(3, 1, 5)x(0, 0, 0, 0) 60.716903 88.615701

1 SARIMA(4, 1, 5)x(0, 0, 0, 0) 73.776681 104.775345

2 SARIMA(1, 1, 5)x(0, 0, 0, 0) 92.434276 114.133341

3 SARIMA(2, 1, 3)x(0, 0, 0, 0) 95.535538 114.134736

4 SARIMA(4, 1, 0)x(0, 0, 0, 0) 100.440446 115.939779

5 SARIMA(3, 1, 2)x(0, 0, 0, 0) 98.492638 117.091837

6 SARIMA(0, 1, 2)x(0, 0, 0, 0) 108.458600 117.758199

7 SARIMA(5, 1, 0)x(0, 0, 0, 0) 99.409670 118.008869

8 SARIMA(2, 1, 5)x(0, 0, 0, 0) 93.578697 118.377629

9 SARIMA(1, 1, 3)x(0, 0, 0, 0) 102.971713 118.471045

10 SARIMA(0, 1, 5)x(0, 0, 0, 0) 100.111084 118.710283

11 SARIMA(4, 1, 1)x(0, 0, 0, 0) 100.152053 118.751252

12 SARIMA(3, 1, 3)x(0, 0, 0, 0) 97.535530 119.234595

13 SARIMA(2, 1, 4)x(0, 0, 0, 0) 97.535536 119.234601

14 SARIMA(1, 1, 4)x(0, 0, 0, 0) 100.866469 119.465667

15 SARIMA(4, 1, 2)x(0, 0, 0, 0) 99.774277 121.473342

16 SARIMA(1, 1, 2)x(0, 0, 0, 0) 110.137611 122.537077

17 SARIMA(0, 1, 3)x(0, 0, 0, 0) 110.423572 122.823038

18 SARIMA(5, 1, 1)x(0, 0, 0, 0) 101.148231 122.847296

19 SARIMA(3, 1, 4)x(0, 0, 0, 0) 98.201843 123.000775

20 SARIMA(3, 1, 1)x(0, 0, 0, 0) 108.810109 124.309441

21 SARIMA(0, 1, 4)x(0, 0, 0, 0) 109.521145 125.020477

22 SARIMA(4, 1, 4)x(0, 0, 0, 0) 97.586233 125.485031

23 SARIMA(4, 1, 3)x(0, 0, 0, 0) 101.659906 126.458838

24 SARIMA(5, 1, 2)x(0, 0, 0, 0) 101.772446 126.571377

25 SARIMA(2, 1, 2)x(0, 0, 0, 0) 111.673455 127.172787

26 SARIMA(5, 1, 3)x(0, 0, 0, 0) 103.646160 131.544957

27 SARIMA(5, 1, 5)x(0, 0, 0, 0) 99.961624 134.060155

28 SARIMA(2, 1, 0)x(0, 0, 0, 0) 125.310308 134.609908

29 SARIMA(5, 1, 4)x(0, 0, 0, 0) 105.525142 136.523806

30 SARIMA(3, 1, 0)x(0, 0, 0, 0) 124.660627 137.060092

31 SARIMA(2, 1, 1)x(0, 0, 0, 0) 126.378681 138.778146

32 SARIMA(0, 1, 0)x(0, 0, 0, 0) 151.111527 154.211394

33 SARIMA(1, 1, 1)x(0, 0, 0, 0) 146.277067 155.576667

34 SARIMA(1, 1, 0)x(0, 0, 0, 0) 152.515068 158.714801

35 SARIMA(0, 1, 1)x(0, 0, 0, 0) 152.779644 158.979377

SARIMAX Results

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

Dep. Variable: y No. Observations: 165

Model: ARIMA(3, 1, 5) Log Likelihood -21.358

Date: Wed, 01 Dec 2021 AIC 60.717

Time: 20:12:40 BIC 88.616

Sample: 0 HQIC 72.043

- 165

Covariance Type: opg

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

------------------------------------------------------------------------------

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| coef | std | err | z | P>|z| | [0.025 | 0.975] |
| ar.L1 | 0.8643 | 0.070 | 12.346 | 0.000 | 0.727 | 1.002 |
| ar.L2 | -0.9938 | 0.034 | -29.471 | 0.000 | -1.060 | -0.928 |
| ar.L3 | 0.8501 | 0.068 | 12.557 | 0.000 | 0.717 | 0.983 |
| ma.L1 | -1.0476 | 1.233 | -0.850 | 0.395 | -3.464 | 1.368 |
| ma.L2 | 1.9647 | 0.343 | 5.722 | 0.000 | 1.292 | 2.638 |
| ma.L3 | -1.9558 | 2.370 | -0.825 | 0.409 | -6.602 | 2.690 |
| ma.L4 | 0.9972 | 0.286 | 3.491 | 0.000 | 0.437 | 1.557 |
| ma.L5 | -0.9570 | 1.207 | -0.793 | 0.428 | -3.324 | 1.410 |
| sigma2 | 0.0696 | 0.087 | 0.802 | 0.423 | -0.101 | 0.240 |

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

Ljung-Box (Q): 16.61 Jarque-Bera (JB): 36341.25

Prob(Q): 1.00 Prob(JB): 0.00

Heteroskedasticity (H): 17.74 Skew: -7.11

Prob(H) (two-sided): 0.00 Kurtosis: 74.53

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

5-模型显著性检验（残差检验）

|  |  |  |
| --- | --- | --- |
| Pvalue | lags |  |
| 0.009890 | 0.920784 | 1 |
| 0.022745 | 0.988692 | 2 |
| 0.034012 | 0.998349 | 3 |
| 0.038845 | 0.999814 | 4 |
| 0.061303 | 0.999952 | 5 |
| 0.069333 | 0.999993 | 6 |
| 0.069400 | 0.999999 | 7 |
| 0.103076 | 1.000000 | 8 |
| 0.124633 | 1.000000 | 9 |
| 0.138489 | 1.000000 | 10 |
| 0.143080 | 1.000000 | 11 |
| 0.143628 | 1.000000 | 12 |
| 0.169616 | 1.000000 | 13 |
| 0.174012 | 1.000000 | 14 |
| 0.184841 | 1.000000 | 15 |
| 0.187756 | 1.000000 | 16 |
| 0.218891 | 1.000000 | 17 |
| 0.268978 | 1.000000 | 18 |
| 0.326113 | 1.000000 | 19 |
| 0.391355 | 1.000000 | 20 |
| 0.398231 | 1.000000 | 21 |
| 0.401078 | 1.000000 | 22 |
| 0.409636 | 1.000000 | 23 |
| 0.410054 | 1.000000 | 24 |

6-拟合+7-预测

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| y | mean | mean\_se | mean\_ci\_lower | mean\_ci\_upper |
| 0 | 1.900591e+06 | 0.371030 | 1.900591e+06 | 1.900592e+06 |
| 1 | 1.982540e+06 | 0.365372 | 1.982539e+06 | 1.982540e+06 |
| 2 | 2.162133e+06 | 0.337908 | 2.162132e+06 | 2.162134e+06 |
| 3 | 2.005250e+06 | 0.337906 | 2.005250e+06 | 2.005251e+06 |
| 4 | 1.874595e+06 | 0.327254 | 1.874594e+06 | 1.874595e+06 |
| .. | ... | ... | ... | ... |
| 172 | 1.149999e+06 | 0.887391 | 1.149998e+06 | 1.150001e+06 |
| 173 | 1.366039e+06 | 0.903343 | 1.366037e+06 | 1.366041e+06 |
| 174 | 1.542174e+06 | 0.913724 | 1.542172e+06 | 1.542175e+06 |
| 175 | 1.407212e+06 | 0.921809 | 1.407210e+06 | 1.407214e+06 |
| 176 | 1.334117e+06 | 0.929266 | 1.334115e+06 | 1.334118e+06 |