3-白噪声检验

|  |  |  |
| --- | --- | --- |
| Pvalue | lags |  |
| 22.274705 | 2.362989e-06 | 1 |
| 22.493286 | 1.305104e-05 | 2 |
| 24.506101 | 1.958353e-05 | 3 |
| 24.903474 | 5.260872e-05 | 4 |
| 26.748884 | 6.383738e-05 | 5 |
| 28.403936 | 7.885125e-05 | 6 |
| 29.167714 | 1.348439e-04 | 7 |
| 30.432631 | 1.772031e-04 | 8 |
| 30.449222 | 3.678002e-04 | 9 |
| 31.785271 | 4.347940e-04 | 10 |
| 32.615161 | 6.072415e-04 | 11 |
| 59.151275 | 3.221843e-08 | 12 |
| 71.210585 | 4.801267e-10 | 13 |
| 71.775142 | 9.189891e-10 | 14 |
| 71.999274 | 1.962665e-09 | 15 |
| 72.016512 | 4.413156e-09 | 16 |
| 74.670525 | 3.335915e-09 | 17 |
| 77.887478 | 2.001888e-09 | 18 |
| 78.404304 | 3.497596e-09 | 19 |
| 82.563030 | 1.435593e-09 | 20 |
| 84.107135 | 1.643454e-09 | 21 |
| 88.057325 | 7.321401e-10 | 22 |
| 96.002807 | 6.840206e-11 | 23 |
| 97.262980 | 8.765205e-11 | 24 |

4.1-模型定阶

parameters AIC BIC

0 SARIMA(1, 1, 1)x(0, 1, 1, 12) -373.098449 -361.597659

1 SARIMA(2, 1, 1)x(0, 1, 1, 12) -374.492060 -360.116074

2 SARIMA(1, 1, 2)x(0, 1, 1, 12) -373.658742 -359.282756

3 SARIMA(2, 1, 2)x(0, 1, 1, 12) -374.006099 -356.754915

4 SARIMA(1, 1, 3)x(0, 1, 1, 12) -373.989012 -356.737828

5 SARIMA(3, 1, 1)x(0, 1, 1, 12) -373.442573 -356.191389

6 SARIMA(3, 1, 2)x(0, 1, 1, 12) -372.786739 -352.660358

7 SARIMA(4, 1, 1)x(0, 1, 1, 12) -372.529914 -352.403533

8 SARIMA(2, 1, 3)x(0, 1, 1, 12) -372.206738 -352.080357

9 SARIMA(1, 1, 4)x(0, 1, 1, 12) -372.031228 -351.904847

10 SARIMA(3, 1, 3)x(0, 1, 1, 12) -370.914549 -347.912970

11 SARIMA(4, 1, 2)x(0, 1, 1, 12) -370.529481 -347.527902

12 SARIMA(2, 1, 4)x(0, 1, 1, 12) -370.255697 -347.254118

13 SARIMA(3, 1, 4)x(0, 1, 1, 12) -371.388555 -345.511779

14 SARIMA(4, 1, 3)x(0, 1, 1, 12) -369.496922 -343.620146

15 SARIMA(4, 1, 4)x(0, 1, 1, 12) -366.254497 -337.502524

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, 1)x(0, 1, 1, 12) Log Likelihood 190.549

Date: Tue, 30 Nov 2021 AIC -373.098

Time: 23:40:00 BIC -361.598

Sample: 0 HQIC -368.425

- 144

Covariance Type: opg

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| coef | std | err | z | P>|z| | [0.025 | 0.975] |
| ar.L1 | -0.2088 | 0.172 | -1.214 | 0.225 | -0.546 | 0.128 |
| ma.L1 | -0.3224 | 0.176 | -1.837 | 0.066 | -0.666 | 0.022 |
| ma.S.L12 | -0.8650 | 0.118 | -7.317 | 0.000 | -1.097 | -0.633 |
| sigma2 | 0.0028 | 0.000 | 6.939 | 0.000 | 0.002 | 0.004 |

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

Ljung-Box (Q): 43.12 Jarque-Bera (JB): 3.57

Prob(Q): 0.34 Prob(JB): 0.17

Heteroskedasticity (H): 0.82 Skew: -0.27

Prob(H) (two-sided): 0.52 Kurtosis: 3.60

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

5-模型显著性检验（残差检验）

|  |  |  |
| --- | --- | --- |
| Pvalue | lags |  |
| 0.010533 | 0.918257 | 1 |
| 0.015362 | 0.992349 | 2 |
| 0.030177 | 0.998618 | 3 |
| 0.051486 | 0.999674 | 4 |
| 0.053926 | 0.999965 | 5 |
| 0.058659 | 0.999996 | 6 |
| 0.062571 | 1.000000 | 7 |
| 0.085014 | 1.000000 | 8 |
| 0.100691 | 1.000000 | 9 |
| 0.100755 | 1.000000 | 10 |
| 0.100903 | 1.000000 | 11 |
| 25.607977 | 0.012191 | 12 |
| 25.635376 | 0.019021 | 13 |
| 25.635456 | 0.028788 | 14 |
| 25.637589 | 0.042009 | 15 |
| 25.657380 | 0.059044 | 16 |
| 25.659471 | 0.080892 | 17 |
| 25.659745 | 0.107796 | 18 |
| 25.684312 | 0.139228 | 19 |
| 25.691381 | 0.176248 | 20 |
| 25.692555 | 0.218415 | 21 |
| 25.692560 | 0.265116 | 22 |
| 25.692569 | 0.315593 | 23 |
| 25.695643 | 0.368787 | 24 |

6-拟合+7-预测

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| y | mean | mean\_se | mean\_ci\_lower | mean\_ci\_upper |
| 0 | 1.900592e+06 | 1000.000003 | 1.898632e+06 | 1.902552e+06 |
| 1 | 2.000243e+06 | 1000.000003 | 1.998283e+06 | 2.002203e+06 |
| 2 | 2.135523e+06 | 1000.000003 | 2.133563e+06 | 2.137483e+06 |
| 3 | 1.934585e+06 | 1000.000003 | 1.932625e+06 | 1.936545e+06 |
| 4 | 2.000282e+06 | 1000.000003 | 1.998322e+06 | 2.002242e+06 |
| .. | ... | ... | ... | ... |
| 160 | 2.820348e+06 | 0.140044 | 2.820348e+06 | 2.820348e+06 |
| 161 | 3.287999e+06 | 0.144128 | 3.287999e+06 | 3.288000e+06 |
| 162 | 3.517673e+06 | 0.148101 | 3.517673e+06 | 3.517673e+06 |
| 163 | 2.817207e+06 | 0.151969 | 2.817207e+06 | 2.817208e+06 |
| 164 | 3.187802e+06 | 0.155741 | 3.187802e+06 | 3.187802e+06 |