3-白噪声检验

|  |  |  |
| --- | --- | --- |
| LB | Pvalue | lags |
| 6.063043 | 1.380396e-02 | 1 |
| 26.093406 | 2.157192e-06 | 2 |
| 27.837760 | 3.928259e-06 | 3 |
| 34.388073 | 6.203745e-07 | 4 |
| 40.061750 | 1.451156e-07 | 5 |
| 52.743932 | 1.321180e-09 | 6 |
| 52.797066 | 4.065380e-09 | 7 |
| 56.458557 | 2.296361e-09 | 8 |
| 57.346344 | 4.337660e-09 | 9 |
| 57.880759 | 9.103354e-09 | 10 |
| 58.622887 | 1.669151e-08 | 11 |
| 59.207381 | 3.147047e-08 | 12 |
| 61.117072 | 3.313701e-08 | 13 |
| 61.160200 | 7.336148e-08 | 14 |
| 61.360118 | 1.469868e-07 | 15 |
| 67.517804 | 2.704095e-08 | 16 |
| 68.049128 | 4.661139e-08 | 17 |
| 69.048452 | 6.542957e-08 | 18 |
| 69.200774 | 1.248340e-07 | 19 |
| 69.201187 | 2.457998e-07 | 20 |
| 69.201522 | 4.715811e-07 | 21 |
| 69.201837 | 8.827192e-07 | 22 |
| 69.201839 | 1.614157e-06 | 23 |
| 69.219020 | 2.869197e-06 | 24 |

4.1-模型定阶

parameters AIC BIC

0 SARIMA(2, 1, 3)x(0, 0, 0, 0) 216.825918 235.425116

1 SARIMA(3, 1, 3)x(0, 0, 0, 0) 216.271112 237.970177

2 SARIMA(5, 1, 2)x(0, 0, 0, 0) 213.964259 238.763191

3 SARIMA(4, 1, 2)x(0, 0, 0, 0) 217.626090 239.325155

4 SARIMA(2, 1, 4)x(0, 0, 0, 0) 218.587474 240.286539

5 SARIMA(3, 1, 2)x(0, 0, 0, 0) 222.064205 240.663403

6 SARIMA(2, 1, 2)x(0, 0, 0, 0) 226.045534 241.544867

7 SARIMA(4, 1, 3)x(0, 0, 0, 0) 217.841831 242.640763

8 SARIMA(5, 1, 3)x(0, 0, 0, 0) 215.726861 243.625659

9 SARIMA(3, 1, 4)x(0, 0, 0, 0) 220.587295 245.386227

10 SARIMA(2, 1, 5)x(0, 0, 0, 0) 220.587387 245.386318

11 SARIMA(4, 1, 4)x(0, 0, 0, 0) 217.702862 245.601660

12 SARIMA(4, 1, 5)x(0, 0, 0, 0) 215.772598 246.771262

13 SARIMA(5, 1, 4)x(0, 0, 0, 0) 217.608166 248.606830

14 SARIMA(3, 1, 5)x(0, 0, 0, 0) 221.550365 249.449163

15 SARIMA(5, 1, 5)x(0, 0, 0, 0) 215.929945 250.028475

4.2-使用 𝑆𝐴𝑅𝐼𝑀𝐴(𝑝,𝑑,𝑞)(𝑃,𝐷,𝑄)𝑚 建模

SARIMAX Results

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

Dep. Variable: y No. Observations: 165

Model: ARIMA(5, 1, 2) Log Likelihood -98.982

Date: Wed, 01 Dec 2021 AIC 213.964

Time: 23:57:52 BIC 238.763

Sample: 0 HQIC 224.032

- 165

Covariance Type: opg

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | coef | std err | z | P>|z| | [0.025 | 0.975] |
| ar.L1 | 0.5725 | 0.203 | 2.815 | 0.005 | 0.174 | 0.971 |
| ar.L2 | 0.9107 | 0.211 | 4.321 | 0.000 | 0.498 | 1.324 |
| ar.L3 | -0.5453 | 0.106 | -5.151 | 0.000 | -0.753 | -0.338 |
| ar.L4 | -0.4250 | 0.116 | -3.659 | 0.000 | -0.653 | -0.197 |
| ar.L5 | 0.3411 | 0.086 | 3.962 | 0.000 | 0.172 | 0.510 |
| ma.L1 | -0.4703 | 0.212 | -2.221 | 0.026 | -0.885 | -0.055 |
| ma.L2 | -0.5134 | 0.205 | -2.504 | 0.012 | -0.915 | -0.112 |
| sigma2 | 0.1928 | 0.008 | 23.407 | 0.000 | 0.177 | 0.209 |

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

Ljung-Box (L1) (Q): 0.02 Jarque-Bera (JB): 9477.01

Prob(Q): 0.90 Prob(JB): 0.00

Heteroskedasticity (H): 36.04 Skew: -4.73

Prob(H) (two-sided): 0.00 Kurtosis: 39.02

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

5-模型显著性检验（残差检验）

|  |  |  |
| --- | --- | --- |
| LB | Pvalue | lags |
| 0.008406 | 0.926950 | 1 |
| 0.010666 | 0.994681 | 2 |
| 0.016006 | 0.999464 | 3 |
| 0.018043 | 0.999960 | 4 |
| 0.044058 | 0.999979 | 5 |
| 0.059818 | 0.999996 | 6 |
| 0.059820 | 1.000000 | 7 |
| 0.077899 | 1.000000 | 8 |
| 0.183913 | 1.000000 | 9 |
| 0.183938 | 1.000000 | 10 |
| 0.300524 | 1.000000 | 11 |
| 0.302607 | 1.000000 | 12 |
| 0.305406 | 1.000000 | 13 |
| 0.312856 | 1.000000 | 14 |
| 0.317015 | 1.000000 | 15 |
| 0.381629 | 1.000000 | 16 |
| 0.431056 | 1.000000 | 17 |
| 0.712995 | 1.000000 | 18 |
| 0.723209 | 1.000000 | 19 |
| 0.814817 | 1.000000 | 20 |
| 0.819148 | 1.000000 | 21 |
| 0.825985 | 1.000000 | 22 |
| 0.826162 | 1.000000 | 23 |
| 0.845091 | 1.000000 | 24 |

6-拟合+7-预测

----fitted confidence interval: 95 %

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| y | mean | mean\_se | mean\_ci\_lower | mean\_ci\_upper |
| 0 | 124225.067048 | 0.541575 | 124224.005580 | 124226.128516 |
| 1 | 139968.789206 | 0.534869 | 139967.740882 | 139969.837530 |
| 2 | 150175.014079 | 0.499172 | 150174.035720 | 150175.992437 |
| 3 | 148534.548090 | 0.482063 | 148533.603264 | 148535.492917 |
| 4 | 143471.648563 | 0.453826 | 143470.759080 | 143472.538045 |
| .. | ... | ... | ... | ... |
| 172 | 83485.780810 | 1.368221 | 83483.099146 | 83488.462475 |
| 173 | 76169.261076 | 1.377916 | 76166.560411 | 76171.961741 |
| 174 | 77873.733791 | 1.384079 | 77871.021046 | 77876.446535 |
| 175 | 83498.771215 | 1.391108 | 83496.044693 | 83501.497737 |
| 176 | 79231.167233 | 1.397915 | 79228.427370 | 79233.907096 |