3-白噪声检验

|  |  |  |
| --- | --- | --- |
| LB | Pvalue | lags |
| 20.635966 | 5.554283e-06 | 1 |
| 21.145840 | 2.559996e-05 | 2 |
| 23.231127 | 3.614217e-05 | 3 |
| 23.987722 | 8.032865e-05 | 4 |
| 24.406322 | 1.813541e-04 | 5 |
| 24.609930 | 4.031490e-04 | 6 |
| 24.881039 | 7.965367e-04 | 7 |
| 25.662927 | 1.199223e-03 | 8 |
| 25.663094 | 2.318901e-03 | 9 |
| 25.849914 | 3.947374e-03 | 10 |
| 30.654471 | 1.249583e-03 | 11 |
| 61.634375 | 1.134876e-08 | 12 |
| 73.448895 | 1.849231e-10 | 13 |
| 75.815890 | 1.676048e-10 | 14 |
| 81.329631 | 3.987157e-11 | 15 |
| 83.301662 | 4.204861e-11 | 16 |
| 83.310126 | 9.848216e-11 | 17 |
| 83.791617 | 1.844729e-10 | 18 |
| 84.186968 | 3.492711e-10 | 19 |
| 84.392430 | 6.966377e-10 | 20 |
| 84.474813 | 1.423644e-09 | 21 |
| 85.891856 | 1.697041e-09 | 22 |
| 86.228788 | 3.026321e-09 | 23 |
| 86.232211 | 6.003967e-09 | 24 |

4.1-模型定阶

parameters AIC BIC

0 SARIMA(1, 1, 1)x(0, 1, 1, 12) -369.075601 -357.574812

1 SARIMA(2, 1, 1)x(0, 1, 1, 12) -368.366765 -353.990779

2 SARIMA(1, 1, 2)x(0, 1, 1, 12) -368.357904 -353.981917

3 SARIMA(2, 1, 2)x(0, 1, 1, 12) -366.365642 -349.114458

4.2-使用 𝑆𝐴𝑅𝐼𝑀𝐴(𝑝,𝑑,𝑞)(𝑃,𝐷,𝑄)𝑚 建模

SARIMAX Results

SARIMAX Results

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

Dep. Variable: y No. Observations: 144

Model: ARIMA(1, 1, 1)x(0, 1, 1, 12) Log Likelihood 188.538

Date: Thu, 02 Dec 2021 AIC -369.076

Time: 00:05:16 BIC -357.575

Sample: 0 HQIC -364.402

- 144

Covariance Type: opg

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

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 0 | coef | stderr | z | P>|z| | [0.025 | 0.975] |
| ar.L1 | 0.3961 | 0.157 | 2.523 | 0.012 | 0.088 | 0.704 |
| ma.L1 | -0.7697 | 0.126 | -6.120 | 0.000 | -1.016 | -0.523 |
| ma.S.L12 | -0.6004 | 0.080 | -7.514 | 0.000 | -0.757 | -0.444 |
| sigma2 | 0.0031 | 0.000 | 8.391 | 0.000 | 0.002 | 0.004 |

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

Ljung-Box (L1) (Q): 0.51 Jarque-Bera (JB): 0.94

Prob(Q): 0.47 Prob(JB): 0.62

Heteroskedasticity (H): 0.33 Skew: 0.20

Prob(H) (two-sided): 0.00 Kurtosis: 3.08

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

5-模型显著性检验（残差检验）

|  |  |  |
| --- | --- | --- |
| LB | Pvalue | lags |
| 0.011129 | 0.915984 | 1 |
| 0.013315 | 0.993364 | 2 |
| 0.013477 | 0.999586 | 3 |
| 0.021922 | 0.999940 | 4 |
| 0.025515 | 0.999995 | 5 |
| 0.025958 | 1.000000 | 6 |
| 0.026122 | 1.000000 | 7 |
| 0.026135 | 1.000000 | 8 |
| 0.030511 | 1.000000 | 9 |
| 0.062582 | 1.000000 | 10 |
| 0.063346 | 1.000000 | 11 |
| 27.080676 | 0.007523 | 12 |
| 27.081000 | 0.012127 | 13 |
| 27.094133 | 0.018718 | 14 |
| 27.097814 | 0.027949 | 15 |
| 27.117415 | 0.040196 | 16 |
| 27.118233 | 0.056356 | 17 |
| 27.121245 | 0.076749 | 18 |
| 27.148294 | 0.101246 | 19 |
| 27.151903 | 0.131044 | 20 |
| 27.156405 | 0.165736 | 21 |
| 27.184603 | 0.204299 | 22 |
| 27.188154 | 0.248044 | 23 |
| 27.212064 | 0.294666 | 24 |

6-拟合+7-预测

----fitted confidence interval: 95 %

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| y | mean | mean\_se | mean\_ci\_lower | mean\_ci\_upper |
| 0 | 124224.999038 | 1000.000002 | 122265.035049 | 126184.963028 |
| 1 | 137721.999559 | 1000.000002 | 135762.035570 | 139681.963548 |
| 2 | 144059.999809 | 1000.000002 | 142100.035820 | 146019.963798 |
| 3 | 148971.999916 | 1000.000002 | 147012.035926 | 150931.963905 |
| 4 | 147447.999971 | 1000.000002 | 145488.035981 | 149407.963960 |
| .. | ... | ... | ... | ... |
| 160 | 393797.244798 | 0.127957 | 393796.994006 | 393797.495590 |
| 161 | 420297.971936 | 0.131430 | 420297.714339 | 420298.229534 |
| 162 | 446753.737288 | 0.134805 | 446753.473074 | 446754.001502 |
| 163 | 377153.072144 | 0.138096 | 377152.801481 | 377153.342808 |
| 164 | 418027.662947 | 0.141309 | 418027.385987 | 418027.939907 |