Time series plot



It is not stationary .

Autocorrelation function



|  |
| --- |
|  **Lag ACF T LBQ** |
|  1 0.572279 6.57 44.22 |
|  2 0.220878 1.97 50.86 |
|  3 0.228981 1.99 58.05 |
|  4 0.360279 3.04 75.98 |
|  5 0.455037 3.59 104.82 |
|  6 0.401016 2.90 127.40 |
|  7 0.423951 2.88 152.83 |
|  8 0.304277 1.95 166.04 |
|  9 0.140086 0.87 168.86 |
|  10 0.088637 0.55 170.00 |
|  11 0.341369 2.11 187.03 |
|  12 0.652766 3.91 249.84 |
|  13 0.291664 1.57 262.49 |
|  14 -0.000732 -0.00 262.49 |
|  15 0.003957 0.02 262.49 |
|  16 0.130422 0.69 265.08 |
|  17 0.209700 1.11 271.85 |
|  18 0.143703 0.75 275.05 |
|  19 0.142870 0.74 278.24 |
|  20 0.015860 0.08 278.28 |
|  21 -0.105638 -0.55 280.06 |
|  22 -0.130465 -0.67 282.80 |
|  23 0.106662 0.55 284.65 |
|  24 0.384724 1.98 308.89 |
|  25 0.043059 0.22 309.19 |
|  26 -0.215298 -1.08 316.93 |
|  27 -0.186684 -0.92 322.80 |
|  28 -0.081912 -0.40 323.94 |
|  29 -0.020570 -0.10 324.01 |
|  30 -0.063426 -0.31 324.71 |
|  31 -0.033087 -0.16 324.90 |
|  32 -0.125955 -0.62 327.71 |
|  33 -0.238772 -1.17 337.89 |

Partial autocorrelation function



|  |
| --- |
|  **Lag PACF T** |
|  1 0.572279 6.57 |
|  2 -0.158551 -1.82 |
|  3 0.264297 3.04 |
|  4 0.198985 2.29 |
|  5 0.238996 2.75 |
|  6 0.078790 0.91 |
|  7 0.292881 3.36 |
|  8 -0.155631 -1.79 |
|  9 -0.092796 -1.07 |
|  10 -0.175032 -2.01 |
|  11 0.350197 4.02 |
|  12 0.382939 4.40 |
|  13 -0.536605 -6.17 |
|  14 0.039127 0.45 |
|  15 -0.157573 -1.81 |
|  16 0.015384 0.18 |
|  17 -0.094868 -1.09 |
|  18 -0.023896 -0.27 |
|  19 -0.116049 -1.33 |
|  20 -0.064989 -0.75 |
|  21 0.083352 0.96 |
|  22 -0.002222 -0.03 |
|  23 0.145011 1.67 |
|  24 0.085521 0.98 |
|  25 -0.190020 -2.18 |
|  26 0.036459 0.42 |
|  27 -0.010052 -0.12 |
|  28 -0.176578 -2.03 |
|  29 -0.062900 -0.72 |
|  30 0.007060 0.08 |
|  31 0.038473 0.44 |
|  32 0.056811 0.65 |
|  33 -0.031717 -0.36 |

**Transformation :**



The value of λ (lamb da) is -0.5 , so we transform W9 to 1/$√w9$

Time series plot after transformation



**Fitting model :**

ARIMA$(2,1,0)×(2,2,0)\_{12}$ :

$$\left(1+0.7988B^{12}+0.4534B^{12}^{2}\right)\left(1+0.2727B+0.254B^{2}\right)\left(1-B^{12}\right)^{2}(1-B)z\_{t}=a\_{t}$$

**Final Estimates of Parameters**

|  |
| --- |
| **Type Coef SE Coef T P** |
| AR 1 -0.2727 0.0945 -2.88 0.005 |
| AR 2 -0.2540 0.0959 -2.65 0.009 |
| SAR 12 -0.7988 0.0932 -8.57 0.000 |
| SAR 24 -0.4534 0.0979 -4.63 0.000 |

All parameters are significant , since p-value < 0.05 .

**Diagnosis checking :**

**Modified Box-Pierce (Ljung-Box) Chi-Square statistic**

|  |
| --- |
| **Lag 12 24 36 48** |
| Chi-Square 5.9 20.4 40.9 51.2 |
| DF 8 20 32 44 |
| P-Value 0.654 0.433 0.134 0.211 |

All p-values are greater than 0.05 .

Autocorrelation function



Partial autocorrelation function





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