

"TOUT" = x1 , "RH" = x2, "SR" = x3, "PRS"=x4, "WSR"=x5, "WDR"=x6

CENTRO - URBANO

Y_1 (Ozono)

Frecuencia seleccionada: Diario

AIC: 211.26882123184393

MAE: 0.3269579325838216

RMSE: 0.3962866399992485

MAPE: 173.79265351477105

R2: 0.45612541421041186

LjungBox_p: 0.5633611778282951

JarqueBera_p: 6.380483565027273e-07

best_order: (4, 0, 3)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | -0.174120 | 0.174120 | 1.652902e-37 |
| 2 | SR | 0.117190 | 0.117190 | 1.873844e-16 |
| 4 | WSR | -0.048625 | 0.048625 | 4.787353e-07 |
| 3 | PRS | 0.030656 | 0.030656 | 6.316831e-02 |
| 0 | TOUT | 0.027519 | 0.027519 | 3.542631e-01 |
| 5 | WDR | 0.023622 | 0.023622 | 4.167134e-03 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|---------|
| Dep. Variable: | Y_1 | No. Observations: | 1021 |
| Model: | SARIMAX(4, 0, 3) | Log Likelihood | -91.634 |
| Date: | Fri, 05 Dec 2025 | AIC | 211.269 |
| Time: | 06:19:26 | BIC | 280.213 |
| Sample: | 01-01-2022 | HQIC | 237.451 |
| | - 10-17-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|---------|-------|--------|--------|
| x1 | 0.0275 | 0.030 | 0.926 | 0.354 | -0.031 | 0.086 |
| x2 | -0.1741 | 0.014 | -12.799 | 0.000 | -0.201 | -0.147 |
| x3 | 0.1172 | 0.014 | 8.230 | 0.000 | 0.089 | 0.145 |
| x4 | 0.0307 | 0.016 | 1.858 | 0.063 | -0.002 | 0.063 |
| x5 | -0.0486 | 0.010 | -5.035 | 0.000 | -0.068 | -0.030 |
| x6 | 0.0236 | 0.008 | 2.865 | 0.004 | 0.007 | 0.040 |
| ar.L1 | 0.6212 | 0.330 | 1.883 | 0.060 | -0.026 | 1.268 |
| ar.L2 | 0.1642 | 0.316 | 0.520 | 0.603 | -0.455 | 0.784 |
| ar.L3 | 0.5012 | 0.272 | 1.839 | 0.066 | -0.033 | 1.035 |
| ar.L4 | -0.3042 | 0.112 | -2.716 | 0.007 | -0.524 | -0.085 |
| ma.L1 | -0.0611 | 0.335 | -0.182 | 0.855 | -0.718 | 0.596 |
| ma.L2 | -0.2030 | 0.198 | -1.025 | 0.305 | -0.591 | 0.185 |
| ma.L3 | -0.5164 | 0.240 | -2.153 | 0.031 | -0.987 | -0.046 |
| sigma2 | 0.0700 | 0.003 | 25.565 | 0.000 | 0.065 | 0.075 |

| | | | |
|-------------------------|------|-------------------|-------|
| Ljung-Box (L1) (Q): | 0.01 | Jarque-Bera (JB): | 28.49 |
| Prob(Q): | 0.93 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 1.10 | Skew: | 0.25 |
| Prob(H) (two-sided): | 0.39 | Kurtosis: | 3.65 |

Frecuencia seleccionada: Semanal
AIC: -48.45937338836626
MAE: 0.30244264150601036
RMSE: 0.34844531019470876
MAPE: 820.2524929220777
R2: 0.3544022215936229
LjungBox_p: 0.6911346249976722
JarqueBera_p: 0.3114133595610591
best_order: (1, 0, 4)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | -0.186222 | 0.186222 | 8.855747e-14 |
| 4 | WSR | 0.076050 | 0.076050 | 4.320890e-03 |
| 0 | TOUT | 0.071550 | 0.071550 | 1.941540e-01 |
| 2 | SR | 0.038730 | 0.038730 | 3.536513e-01 |
| 5 | WDR | -0.010777 | 0.010777 | 5.575785e-01 |
| 3 | PRS | 0.010484 | 0.010484 | 7.399197e-01 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|---------|
| Dep. Variable: | Y_1 | No. Observations: | 147 |
| Model: | SARIMAX(1, 0, 4) | Log Likelihood | 36.230 |
| Date: | Fri, 05 Dec 2025 | AIC | -48.459 |
| Time: | 06:19:26 | BIC | -12.989 |
| Sample: | 01-02-2022 | HQIC | -34.046 |
| | - 10-20-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|--------|-------|--------|--------|
| x1 | 0.0716 | 0.055 | 1.298 | 0.194 | -0.036 | 0.180 |
| x2 | -0.1862 | 0.025 | -7.457 | 0.000 | -0.235 | -0.137 |
| x3 | 0.0387 | 0.042 | 0.928 | 0.354 | -0.043 | 0.121 |
| x4 | 0.0105 | 0.032 | 0.332 | 0.740 | -0.051 | 0.072 |
| x5 | 0.0761 | 0.027 | 2.854 | 0.004 | 0.024 | 0.128 |
| x6 | -0.0108 | 0.018 | -0.586 | 0.558 | -0.047 | 0.025 |
| ar.L1 | 0.8992 | 0.072 | 12.463 | 0.000 | 0.758 | 1.041 |
| ma.L1 | -0.4303 | 0.123 | -3.511 | 0.000 | -0.670 | -0.190 |
| ma.L2 | 0.0572 | 0.094 | 0.609 | 0.542 | -0.127 | 0.241 |
| ma.L3 | 0.2254 | 0.097 | 2.323 | 0.020 | 0.035 | 0.416 |
| ma.L4 | -0.1354 | 0.134 | -1.008 | 0.313 | -0.399 | 0.128 |
| sigma2 | 0.0351 | 0.005 | 7.647 | 0.000 | 0.026 | 0.044 |

| | | | |
|-------------------------|------|-------------------|-------|
| Ljung-Box (L1) (Q): | 0.05 | Jarque-Bera (JB): | 0.35 |
| Prob(Q): | 0.82 | Prob(JB): | 0.84 |
| Heteroskedasticity (H): | 1.33 | Skew: | -0.10 |
| Prob(H) (two-sided): | 0.33 | Kurtosis: | 3.14 |

PM10 - TRANSFORMACIÓN

Frecuencia seleccionada: Diario
AIC: -142.17974419087813
MAE: 19.35202000210019
RMSE: 28.680288024868332
MAPE: 34.14869456397708
R2: -0.1480999167280459
LjungBox_p: 0.3407926270962032
JarqueBera_p: 0.0
best_order: (3, 1, 1)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 0 | TOUT | 0.115631 | 0.115631 | 6.249782e-09 |
| 3 | PRS | -0.077850 | 0.077850 | 1.128335e-11 |
| 1 | RH | -0.062673 | 0.062673 | 1.121057e-08 |
| 4 | WSR | 0.039865 | 0.039865 | 4.082030e-07 |
| 5 | WDR | -0.019437 | 0.019437 | 1.893085e-03 |
| 2 | SR | -0.004222 | 0.004222 | 7.356647e-01 |

SARIMAX Results

```

=====
Dep. Variable:          PM10      No. Observations:          1021
Model:                SARIMAX(3, 1, 1)      Log Likelihood          82.090
Date:                  Fri, 05 Dec 2025      AIC                    -142.180
Time:                  08:02:33              BIC                    -88.009
Sample:                01-01-2022            HQIC                 -121.608
                  - 10-17-2024
=====

```

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|---------|-------|--------|--------|
| x1 | 0.1156 | 0.020 | 5.810 | 0.000 | 0.077 | 0.155 |
| x2 | -0.0627 | 0.011 | -5.711 | 0.000 | -0.084 | -0.041 |
| x3 | -0.0042 | 0.013 | -0.338 | 0.736 | -0.029 | 0.020 |
| x4 | -0.0778 | 0.011 | -6.789 | 0.000 | -0.100 | -0.055 |
| x5 | 0.0399 | 0.008 | 5.065 | 0.000 | 0.024 | 0.055 |
| x6 | -0.0194 | 0.006 | -3.107 | 0.002 | -0.032 | -0.007 |
| ar.L1 | 0.4835 | 0.033 | 14.685 | 0.000 | 0.419 | 0.548 |
| ar.L2 | -0.0514 | 0.036 | -1.445 | 0.148 | -0.121 | 0.018 |
| ar.L3 | 0.1027 | 0.034 | 3.037 | 0.002 | 0.036 | 0.169 |
| ma.L1 | -0.9302 | 0.017 | -53.790 | 0.000 | -0.964 | -0.896 |
| sigma2 | 0.0497 | 0.002 | 25.229 | 0.000 | 0.046 | 0.054 |

```

=====
Ljung-Box (L1) (Q):                0.00      Jarque-Bera (JB):                29.32
Prob(Q):                          0.97      Prob(JB):                0.00
Heteroskedasticity (H):            1.08      Skew:                    0.02
Prob(H) (two-sided):              0.48      Kurtosis:                3.83
=====

```

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -74.12554817886544

MAE: 15.520654149740196

RMSE: 20.531651602800128

MAPE: 28.761609626813694

R2: -0.05874535424006044

LjungBox_p: 0.8899086070328146

JarqueBera_p: 0.0

best_order: (3, 1, 1)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|----------|
| 1 | RH | -0.072703 | 0.072703 | 0.001697 |
| 3 | PRS | -0.067884 | 0.067884 | 0.012381 |
| 4 | WSR | 0.048904 | 0.048904 | 0.012019 |
| 2 | SR | 0.027686 | 0.027686 | 0.445102 |
| 5 | WDR | -0.009027 | 0.009027 | 0.584830 |
| 0 | TOUT | 0.002155 | 0.002155 | 0.963460 |

SARIMAX Results

```

=====
Dep. Variable:          PM10      No. Observations:          147

```

```

Model:          SARIMAX(3, 1, 1)    Log Likelihood      48.063
Date:           Fri, 05 Dec 2025    AIC                 -74.126
Time:           08:02:33            BIC                 -41.534
Sample:         01-02-2022          HQIC                 -60.882
               - 10-20-2024

Covariance Type: opg

=====
              coef      std err          z      P>|z|      [0.025      0.975]
-----
x1              0.0022      0.047      0.046      0.963      -0.090      0.094
x2             -0.0727      0.023     -3.139      0.002      -0.118     -0.027
x3              0.0277      0.036      0.764      0.445      -0.043      0.099
x4             -0.0679      0.027     -2.501      0.012      -0.121     -0.015
x5              0.0489      0.019      2.512      0.012      0.011      0.087
x6             -0.0090      0.017     -0.546      0.585      -0.041      0.023
ar.L1           0.0374      0.234      0.160      0.873      -0.421      0.496
ar.L2          -0.2748      0.090     -3.062      0.002      -0.451     -0.099
ar.L3          -0.2328      0.140     -1.662      0.096      -0.507      0.042
ma.L1          -0.4056      0.211     -1.921      0.055      -0.819      0.008
sigma2          0.0299      0.003      9.783      0.000      0.024      0.036
=====

Ljung-Box (L1) (Q):                0.01    Jarque-Bera (JB):                13.32
Prob(Q):                           0.94    Prob(JB):                  0.00
Heteroskedasticity (H):             1.74    Skew:                      0.37
Prob(H) (two-sided):                0.06    Kurtosis:                  4.30
=====

```

PM2.5

```

Frecuencia seleccionada: Diario
AIC: 7085.100212496942
MAE: 12.986293299475822
RMSE: 16.388405226863135
MAPE: 51.212653492641856
R2: -1.0362101799177155
LjungBox_p: 0.6561086158966911
JarqueBera_p: 2.340977500320751e-268
best_order: (4, 1, 5)

```

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | 3.869684 | 3.869684 | 2.164641e-20 |
| 0 | TOUT | 3.390221 | 3.390221 | 8.371408e-06 |
| 3 | PRS | -2.487088 | 2.487088 | 3.210962e-09 |
| 2 | SR | 1.395479 | 1.395479 | 4.119761e-03 |
| 4 | WSR | 1.144455 | 1.144455 | 5.796500e-05 |
| 5 | WDR | 0.477638 | 0.477638 | 7.825609e-02 |

SARIMAX Results

```

=====
Dep. Variable:          PM2.5    No. Observations:          1021
Model:                 SARIMAX(4, 1, 5)    Log Likelihood          -3526.550
Date:                 Fri, 05 Dec 2025    AIC                     7085.100
Time:                 08:08:52            BIC                     7163.847
Sample:               01-01-2022          HQIC                    7115.009
               - 10-17-2024

Covariance Type: opg
=====

```

| | coef | std err | z | P> z | [0.025 | 0.975] |
|-------------------------|---------|---------|---------|-------------------|--------|---------|
| ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| x1 | 3.3902 | 0.761 | 4.455 | 0.000 | 1.899 | 4.882 |
| x2 | 3.8697 | 0.418 | 9.254 | 0.000 | 3.050 | 4.689 |
| x3 | 1.3955 | 0.486 | 2.869 | 0.004 | 0.442 | 2.349 |
| x4 | -2.4871 | 0.420 | -5.920 | 0.000 | -3.310 | -1.664 |
| x5 | 1.1445 | 0.285 | 4.021 | 0.000 | 0.587 | 1.702 |
| x6 | 0.4776 | 0.271 | 1.761 | 0.078 | -0.054 | 1.009 |
| ar.L1 | -0.2914 | 0.082 | -3.541 | 0.000 | -0.453 | -0.130 |
| ar.L2 | -0.3448 | 0.064 | -5.414 | 0.000 | -0.470 | -0.220 |
| ar.L3 | -0.3624 | 0.072 | -5.055 | 0.000 | -0.503 | -0.222 |
| ar.L4 | 0.5061 | 0.052 | 9.734 | 0.000 | 0.404 | 0.608 |
| ma.L1 | -0.0274 | 0.089 | -0.308 | 0.758 | -0.201 | 0.147 |
| ma.L2 | 0.0256 | 0.059 | 0.432 | 0.665 | -0.091 | 0.142 |
| ma.L3 | 0.0663 | 0.065 | 1.019 | 0.308 | -0.061 | 0.194 |
| ma.L4 | -0.8024 | 0.057 | -14.072 | 0.000 | -0.914 | -0.691 |
| ma.L5 | -0.0215 | 0.042 | -0.516 | 0.606 | -0.103 | 0.060 |
| sigma2 | 61.2317 | 1.540 | 39.763 | 0.000 | 58.213 | 64.250 |
| ===== | ===== | ===== | ===== | ===== | ===== | ===== |
| Ljung-Box (L1) (Q): | | | 0.01 | Jarque-Bera (JB): | | 1288.09 |
| Prob(Q): | | | 0.93 | Prob(JB): | | 0.00 |
| Heteroskedasticity (H): | | | 1.62 | Skew: | | 0.81 |
| Prob(H) (two-sided): | | | 0.00 | Kurtosis: | | 8.28 |
| ===== | ===== | ===== | ===== | ===== | ===== | ===== |

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: 957.5721351798909

MAE: 5.745416309594452

RMSE: 7.242812104309437

MAPE: 31.24310886181575

R2: 0.0693998265330944

LjungBox_p: 0.9799520402411008

JarqueBera_p: 0.06879871222159889

best_order: (1, 1, 5)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|----------|
| 3 | PRS | -3.684080 | 3.684080 | 0.001293 |
| 0 | TOUT | -3.656052 | 3.656052 | 0.030678 |
| 4 | WSR | 1.974873 | 1.974873 | 0.026774 |
| 2 | SR | 1.730735 | 1.730735 | 0.248698 |
| 1 | RH | 0.946814 | 0.946814 | 0.288043 |
| 5 | WDR | -0.811603 | 0.811603 | 0.303558 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|----------|
| Dep. Variable: | PM2.5 | No. Observations: | 147 |
| Model: | SARIMAX(1, 1, 5) | Log Likelihood | -465.786 |
| Date: | Fri, 05 Dec 2025 | AIC | 957.572 |
| Time: | 08:08:52 | BIC | 995.813 |
| Sample: | 01-02-2022 | HQIC | 973.112 |
| | - 10-20-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|-------|---------|---------|--------|-------|--------|--------|
| ----- | ----- | ----- | ----- | ----- | ----- | ----- |
| x1 | -3.6561 | 1.692 | -2.161 | 0.031 | -6.972 | -0.340 |
| x2 | 0.9468 | 0.891 | 1.062 | 0.288 | -0.800 | 2.693 |
| x3 | 1.7307 | 1.500 | 1.154 | 0.249 | -1.210 | 4.671 |

| | | | | | | |
|--------|---------|--------|--------|-------|---------|---------|
| x4 | -3.6841 | 1.145 | -3.218 | 0.001 | -5.928 | -1.440 |
| x5 | 1.9749 | 0.892 | 2.215 | 0.027 | 0.227 | 3.723 |
| x6 | -0.8116 | 0.789 | -1.029 | 0.304 | -2.358 | 0.735 |
| ar.L1 | -0.2068 | 2.308 | -0.090 | 0.929 | -4.731 | 4.317 |
| ma.L1 | -0.3034 | 2.227 | -0.136 | 0.892 | -4.669 | 4.062 |
| ma.L2 | -0.3547 | 1.525 | -0.233 | 0.816 | -3.343 | 2.633 |
| ma.L3 | -0.2179 | 0.730 | -0.298 | 0.765 | -1.649 | 1.214 |
| ma.L4 | -0.1444 | 0.423 | -0.342 | 0.733 | -0.973 | 0.684 |
| ma.L5 | 0.0219 | 0.263 | 0.083 | 0.934 | -0.494 | 0.538 |
| sigma2 | 45.1067 | 47.037 | 0.959 | 0.338 | -47.085 | 137.298 |

=====

| | | | |
|-------------------------|------|-------------------|------|
| Ljung-Box (L1) (Q): | 0.01 | Jarque-Bera (JB): | 2.91 |
| Prob(Q): | 0.93 | Prob(JB): | 0.23 |
| Heteroskedasticity (H): | 1.93 | Skew: | 0.35 |
| Prob(H) (two-sided): | 0.03 | Kurtosis: | 3.15 |

=====

Y_3 (Nitrogenos)

Frecuencia seleccionada: Diario
AIC: 886.4647626546864
MAE: 0.3944026321275913
RMSE: 0.5458039969082176
MAPE: 217.89492820656827
R2: 0.1945510600947924
LjungBox_p: 0.08119445151610126
JarqueBera_p: 0.0
best_order: (5, 0, 4)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 4 | WSR | 0.194932 | 0.194932 | 1.713015e-46 |
| 3 | PRS | -0.142520 | 0.142520 | 7.207214e-13 |
| 0 | TOUT | -0.060128 | 0.060128 | 1.159477e-01 |
| 5 | WDR | 0.057029 | 0.057029 | 6.582760e-05 |
| 2 | SR | 0.044241 | 0.044241 | 6.850023e-02 |
| 1 | RH | 0.038771 | 0.038771 | 4.671549e-02 |

SARIMAX Results

Dep. Variable: Y_3 No. Observations: 1021
Model: SARIMAX(5, 0, 4) Log Likelihood -427.232
Date: Fri, 05 Dec 2025 AIC 886.465
Time: 06:46:48 BIC 965.243
Sample: 01-01-2022 HQIC 916.383
- 10-17-2024
Covariance Type: opg

=====

| | coef | std err | z | P> z | [0.025 | 0.975] |
|-------|---------|---------|--------|-------|--------|--------|
| x1 | -0.0601 | 0.038 | -1.572 | 0.116 | -0.135 | 0.015 |
| x2 | 0.0388 | 0.019 | 1.989 | 0.047 | 0.001 | 0.077 |
| x3 | 0.0442 | 0.024 | 1.822 | 0.069 | -0.003 | 0.092 |
| x4 | -0.1425 | 0.020 | -7.175 | 0.000 | -0.181 | -0.104 |
| x5 | 0.1949 | 0.014 | 14.317 | 0.000 | 0.168 | 0.222 |
| x6 | 0.0570 | 0.014 | 3.991 | 0.000 | 0.029 | 0.085 |
| ar.L1 | 1.1801 | 0.308 | 3.834 | 0.000 | 0.577 | 1.783 |
| ar.L2 | -1.0986 | 0.265 | -4.141 | 0.000 | -1.619 | -0.579 |
| ar.L3 | 1.4392 | 0.224 | 6.425 | 0.000 | 1.000 | 1.878 |
| ar.L4 | -0.7350 | 0.355 | -2.068 | 0.039 | -1.431 | -0.038 |
| ar.L5 | 0.1878 | 0.099 | 1.894 | 0.058 | -0.007 | 0.382 |

| | | | | | | |
|--------|---------|-------|--------|-------|--------|--------|
| ma.L1 | -0.7360 | 0.309 | -2.379 | 0.017 | -1.342 | -0.130 |
| ma.L2 | 0.7332 | 0.138 | 5.300 | 0.000 | 0.462 | 1.004 |
| ma.L3 | -1.0348 | 0.177 | -5.844 | 0.000 | -1.382 | -0.688 |
| ma.L4 | 0.2756 | 0.274 | 1.007 | 0.314 | -0.261 | 0.812 |
| sigma2 | 0.1352 | 0.002 | 61.647 | 0.000 | 0.131 | 0.139 |

| | | | |
|-------------------------|------|-------------------|----------|
| Ljung-Box (L1) (Q): | 0.01 | Jarque-Bera (JB): | 32267.24 |
| Prob(Q): | 0.91 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 2.38 | Skew: | 2.83 |
| Prob(H) (two-sided): | 0.00 | Kurtosis: | 30.02 |

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -12.609548997361742

MAE: 0.22187609681982476

RMSE: 0.2949974779360867

MAPE: 92.678347558649

R2: 0.5407673600306306

LjungBox_p: 0.49306585721285856

JarqueBera_p: 5.117412811783007e-100

best_order: (1, 0, 2)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|----------|
| 0 | TOUT | -0.206379 | 0.206379 | 0.001381 |
| 4 | WSR | 0.172460 | 0.172460 | 0.000001 |
| 3 | PRS | -0.062617 | 0.062617 | 0.160603 |
| 2 | SR | 0.045094 | 0.045094 | 0.490209 |
| 5 | WDR | 0.014772 | 0.014772 | 0.498192 |
| 1 | RH | -0.006604 | 0.006604 | 0.861573 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|---------|
| Dep. Variable: | Y_3 | No. Observations: | 147 |
| Model: | SARIMAX(1, 0, 2) | Log Likelihood | 16.305 |
| Date: | Fri, 05 Dec 2025 | AIC | -12.610 |
| Time: | 06:46:48 | BIC | 17.089 |
| Sample: | 01-02-2022 | HQIC | -0.542 |
| | - 10-20-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|--------|-------|--------|--------|
| x1 | -0.2064 | 0.065 | -3.199 | 0.001 | -0.333 | -0.080 |
| x2 | -0.0066 | 0.038 | -0.174 | 0.862 | -0.081 | 0.068 |
| x3 | 0.0451 | 0.065 | 0.690 | 0.490 | -0.083 | 0.173 |
| x4 | -0.0626 | 0.045 | -1.403 | 0.161 | -0.150 | 0.025 |
| x5 | 0.1725 | 0.035 | 4.877 | 0.000 | 0.103 | 0.242 |
| x6 | 0.0148 | 0.022 | 0.677 | 0.498 | -0.028 | 0.058 |
| ar.L1 | 0.8412 | 0.179 | 4.698 | 0.000 | 0.490 | 1.192 |
| ma.L1 | -1.2541 | 0.780 | -1.607 | 0.108 | -2.784 | 0.276 |
| ma.L2 | -0.4688 | 0.160 | -2.929 | 0.003 | -0.782 | -0.155 |
| sigma2 | 0.0193 | 0.017 | 1.127 | 0.260 | -0.014 | 0.053 |

| | | | |
|-------------------------|------|-------------------|--------|
| Ljung-Box (L1) (Q): | 0.08 | Jarque-Bera (JB): | 413.82 |
| Prob(Q): | 0.78 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 2.28 | Skew: | 1.84 |
| Prob(H) (two-sided): | 0.01 | Kurtosis: | 10.44 |

Y_4 (So2)

Frecuencia seleccionada: Diario

AIC: -948.6330585767315

MAE: 1.4491980957761759

RMSE: 2.1135877211590137

MAPE: 31.935381356776478

R2: 0.004654347516729995

LjungBox_p: 4.840490884955569e-07

JarqueBera_p: 0.0

best_order: (5, 1, 5)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | -0.051617 | 0.051617 | 3.279451e-10 |
| 2 | SR | 0.016179 | 0.016179 | 9.434218e-02 |
| 4 | WSR | 0.016136 | 0.016136 | 6.210195e-03 |
| 0 | TOUT | 0.010751 | 0.010751 | 4.435948e-01 |
| 3 | PRS | -0.006050 | 0.006050 | 4.914095e-01 |
| 5 | WDR | 0.005642 | 0.005642 | 2.672389e-01 |

SARIMAX Results

```
=====
Dep. Variable:          Y_4      No. Observations:          1021
Model:                SARIMAX(5, 1, 5)      Log Likelihood          491.317
Date:                  Fri, 05 Dec 2025      AIC                  -948.633
Time:                  07:54:57      BIC                  -864.965
Sample:                01-01-2022      HQIC                 -916.855
                  - 10-17-2024
Covariance Type:                opg
=====
```

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|---------|-------|--------|--------|
| x1 | 0.0108 | 0.014 | 0.766 | 0.444 | -0.017 | 0.038 |
| x2 | -0.0516 | 0.008 | -6.285 | 0.000 | -0.068 | -0.036 |
| x3 | 0.0162 | 0.010 | 1.673 | 0.094 | -0.003 | 0.035 |
| x4 | -0.0061 | 0.009 | -0.688 | 0.491 | -0.023 | 0.011 |
| x5 | 0.0161 | 0.006 | 2.736 | 0.006 | 0.005 | 0.028 |
| x6 | 0.0056 | 0.005 | 1.109 | 0.267 | -0.004 | 0.016 |
| ar.L1 | -1.2078 | 0.049 | -24.490 | 0.000 | -1.304 | -1.111 |
| ar.L2 | -1.3405 | 0.077 | -17.508 | 0.000 | -1.491 | -1.190 |
| ar.L3 | -0.7807 | 0.077 | -10.150 | 0.000 | -0.931 | -0.630 |
| ar.L4 | -0.3739 | 0.053 | -6.994 | 0.000 | -0.479 | -0.269 |
| ar.L5 | 0.3084 | 0.033 | 9.464 | 0.000 | 0.245 | 0.372 |
| ma.L1 | 0.7306 | 0.044 | 16.692 | 0.000 | 0.645 | 0.816 |
| ma.L2 | 0.5509 | 0.053 | 10.355 | 0.000 | 0.447 | 0.655 |
| ma.L3 | -0.1725 | 0.043 | -4.016 | 0.000 | -0.257 | -0.088 |
| ma.L4 | -0.3656 | 0.044 | -8.324 | 0.000 | -0.452 | -0.280 |
| ma.L5 | -0.7494 | 0.028 | -26.878 | 0.000 | -0.804 | -0.695 |
| sigma2 | 0.0220 | 0.001 | 37.755 | 0.000 | 0.021 | 0.023 |

```
=====
Ljung-Box (L1) (Q):                0.12      Jarque-Bera (JB):                928.09
Prob(Q):                          0.73      Prob(JB):                  0.00
Heteroskedasticity (H):            0.85      Skew:                      0.57
Prob(H) (two-sided):              0.14      Kurtosis:                  7.54
=====
```

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -183.5454081194613
 MAE: 1.157242677965069
 RMSE: 1.5158827753507778
 MAPE: 24.732972525126566
 R2: 0.21173282264270898
 LjungBox_p: 0.019300416528143596
 JarqueBera_p: 0.0
 best_order: (1, 1, 2)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | -0.089249 | 0.089249 | 4.367398e-07 |
| 4 | WSR | 0.034436 | 0.034436 | 5.784078e-02 |
| 2 | SR | -0.016816 | 0.016816 | 4.697464e-01 |
| 3 | PRS | 0.015906 | 0.015906 | 3.795498e-01 |
| 5 | WDR | 0.006441 | 0.006441 | 5.899854e-01 |
| 0 | TOUT | 0.003371 | 0.003371 | 9.246198e-01 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|----------|
| Dep. Variable: | Y_4 | No. Observations: | 147 |
| Model: | SARIMAX(1, 1, 2) | Log Likelihood | 101.773 |
| Date: | Fri, 05 Dec 2025 | AIC | -183.545 |
| Time: | 07:54:57 | BIC | -153.917 |
| Sample: | 01-02-2022 | HQIC | -171.506 |
| | - 10-20-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|--------|-------|--------|--------|
| x1 | 0.0034 | 0.036 | 0.095 | 0.925 | -0.066 | 0.073 |
| x2 | -0.0892 | 0.018 | -5.052 | 0.000 | -0.124 | -0.055 |
| x3 | -0.0168 | 0.023 | -0.723 | 0.470 | -0.062 | 0.029 |
| x4 | 0.0159 | 0.018 | 0.879 | 0.380 | -0.020 | 0.051 |
| x5 | 0.0344 | 0.018 | 1.897 | 0.058 | -0.001 | 0.070 |
| x6 | 0.0064 | 0.012 | 0.539 | 0.590 | -0.017 | 0.030 |
| ar.L1 | -0.7193 | 0.302 | -2.382 | 0.017 | -1.311 | -0.127 |
| ma.L1 | 0.3756 | 0.307 | 1.225 | 0.220 | -0.225 | 0.976 |
| ma.L2 | -0.3238 | 0.098 | -3.315 | 0.001 | -0.515 | -0.132 |
| sigma2 | 0.0141 | 0.001 | 11.768 | 0.000 | 0.012 | 0.016 |

| | | | |
|-------------------------|------|-------------------|-------|
| Ljung-Box (L1) (Q): | 0.06 | Jarque-Bera (JB): | 79.07 |
| Prob(Q): | 0.81 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 0.87 | Skew: | -0.48 |
| Prob(H) (two-sided): | 0.64 | Kurtosis: | 6.52 |

SUROESTE 2 - URBANO

Y_1 (OZONO)

Frecuencia seleccionada: Diario
 AIC: 345.3395940325213
 MAE: 0.3241988080952791
 RMSE: 0.3939111971520958
 MAPE: 153.55603482209227
 R2: 0.5082795488348025
 LjungBox_p: 0.2951818662034459

JarqueBera_p: 6.100331545461569e-28

best_order: (3, 0, 5)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | -0.205813 | 0.205813 | 1.460478e-33 |
| 2 | SR | 0.103174 | 0.103174 | 1.175007e-19 |
| 4 | WSR | -0.067761 | 0.067761 | 3.557037e-06 |
| 0 | TOUT | 0.064552 | 0.064552 | 6.424231e-02 |
| 3 | PRS | 0.034368 | 0.034368 | 7.922838e-02 |
| 5 | WDR | 0.032808 | 0.032808 | 4.059207e-02 |

SARIMAX Results

```
=====
Dep. Variable:          Y_1      No. Observations:          1021
Model:                SARIMAX(3, 0, 5)      Log Likelihood      -157.670
Date:                Fri, 05 Dec 2025      AIC                  345.340
Time:                07:03:39      BIC                  419.179
Sample:                01-01-2022      HQIC                 373.384
                  - 10-17-2024
=====
```

Covariance Type: opg

```
=====
              coef      std err          z      P>|z|      [0.025      0.975]
-----
x1              0.0646      0.035       1.850      0.064      -0.004      0.133
x2             -0.2058      0.017     -12.073      0.000      -0.239     -0.172
x3              0.1032      0.011       9.071      0.000       0.081      0.125
x4              0.0344      0.020       1.755      0.079      -0.004      0.073
x5             -0.0678      0.015      -4.636      0.000      -0.096     -0.039
x6              0.0328      0.016       2.048      0.041       0.001      0.064
ar.L1           0.0150      0.190       0.079      0.937      -0.357      0.387
ar.L2           0.3099      0.138       2.238      0.025       0.039      0.581
ar.L3           0.6377      0.170       3.752      0.000       0.305      0.971
ma.L1           0.6043      0.191       3.156      0.002       0.229      0.980
ma.L2           0.0068      0.135       0.050      0.960      -0.259      0.272
ma.L3          -0.6088      0.116      -5.244      0.000      -0.836     -0.381
ma.L4          -0.3132      0.070      -4.484      0.000      -0.450     -0.176
ma.L5          -0.0846      0.034      -2.479      0.013      -0.152     -0.018
sigma2          0.0798      0.003     27.296      0.000       0.074      0.085
=====
```

```
=====
Ljung-Box (L1) (Q):                0.00      Jarque-Bera (JB):                121.43
Prob(Q):                          0.98      Prob(JB):                  0.00
Heteroskedasticity (H):            1.43      Skew:                      0.42
Prob(H) (two-sided):              0.00      Kurtosis:                  4.47
=====
```

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -31.233138832634097

MAE: 0.31007549485816327

RMSE: 0.36130197002161746

MAPE: 115.85826311664982

R2: 0.35728487941353637

LjungBox_p: 0.8543617993324917

JarqueBera_p: 0.8627631367815001

best_order: (3, 0, 1)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | -0.234802 | 0.234802 | 1.557401e-20 |
| 0 | TOUT | 0.133982 | 0.133982 | 9.349071e-03 |
| 4 | WSR | 0.091105 | 0.091105 | 2.958285e-02 |

```

2      SR -0.068654    0.068654    5.469618e-02
5      WDR -0.059616    0.059616    1.775796e-01
3      PRS  0.032272    0.032272    3.012784e-01

=====
SARIMAX Results
=====
Dep. Variable:          Y_1    No. Observations:          147
Model:                SARIMAX(3, 0, 1)    Log Likelihood          26.617
Date:                Fri, 05 Dec 2025    AIC          -31.233
Time:                07:03:39    BIC          1.435
Sample:              01-02-2022    HQIC         -17.959
                    - 10-20-2024
Covariance Type:          opg
=====
              coef      std err          z      P>|z|      [0.025      0.975]
-----
x1              0.1340      0.052       2.599      0.009      0.033      0.235
x2             -0.2348      0.025      -9.289      0.000     -0.284     -0.185
x3             -0.0687      0.036      -1.921      0.055     -0.139      0.001
x4              0.0323      0.031       1.034      0.301     -0.029      0.093
x5              0.0911      0.042       2.176      0.030      0.009      0.173
x6             -0.0596      0.044      -1.348      0.178     -0.146      0.027
ar.L1           -0.1568      0.137      -1.148      0.251     -0.424      0.111
ar.L2            0.5594      0.111       5.019      0.000      0.341      0.778
ar.L3            0.3433      0.095       3.618      0.000      0.157      0.529
ma.L1            0.8079      0.124       6.512      0.000      0.565      1.051
sigma2           0.0402      0.005       7.549      0.000      0.030      0.051
=====
Ljung-Box (L1) (Q):                0.00    Jarque-Bera (JB):                0.39
Prob(Q):                          1.00    Prob(JB):                0.82
Heteroskedasticity (H):            1.27    Skew:                    0.01
Prob(H) (two-sided):              0.41    Kurtosis:               2.75
=====

```

PM10 - TRANSFORMACIÓN

Frecuencia seleccionada: Diario

AIC: 355.4121924534329

MAE: 21.259733829012646

RMSE: 32.3143722049684

MAPE: 33.810497512683796

R2: -0.41284578820351436

LjungBox_p: 0.12770751494660518

JarqueBera_p: 0.0

best_order: (5, 1, 3)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 3 | PRS | -0.124036 | 0.124036 | 5.067680e-14 |
| 0 | TOUT | 0.097215 | 0.097215 | 1.066428e-03 |
| 4 | WSR | 0.069618 | 0.069618 | 5.259326e-07 |
| 5 | WDR | -0.043418 | 0.043418 | 1.851728e-03 |
| 2 | SR | 0.016436 | 0.016436 | 3.240149e-01 |
| 1 | RH | -0.010378 | 0.010378 | 4.644865e-01 |

SARIMAX Results

```

=====
Dep. Variable:          PM10    No. Observations:          1021
Model:                SARIMAX(5, 1, 3)    Log Likelihood          -162.706
Date:                Fri, 05 Dec 2025    AIC          355.412
Time:                08:15:54    BIC          429.252
Sample:              01-01-2022    HQIC          383.456

```

- 10-17-2024

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|-------------------------|---------|---------|-------------------|-------|--------|--------|
| x1 | 0.0972 | 0.030 | 3.272 | 0.001 | 0.039 | 0.155 |
| x2 | -0.0104 | 0.014 | -0.731 | 0.464 | -0.038 | 0.017 |
| x3 | 0.0164 | 0.017 | 0.986 | 0.324 | -0.016 | 0.049 |
| x4 | -0.1240 | 0.016 | -7.530 | 0.000 | -0.156 | -0.092 |
| x5 | 0.0696 | 0.014 | 5.017 | 0.000 | 0.042 | 0.097 |
| x6 | -0.0434 | 0.014 | -3.113 | 0.002 | -0.071 | -0.016 |
| ar.L1 | -0.4673 | 0.025 | -18.429 | 0.000 | -0.517 | -0.418 |
| ar.L2 | -0.4315 | 0.030 | -14.256 | 0.000 | -0.491 | -0.372 |
| ar.L3 | 0.5566 | 0.036 | 15.340 | 0.000 | 0.486 | 0.628 |
| ar.L4 | -0.0054 | 0.032 | -0.167 | 0.867 | -0.068 | 0.058 |
| ar.L5 | 0.0811 | 0.031 | 2.654 | 0.008 | 0.021 | 0.141 |
| ma.L1 | 0.1155 | 0.019 | 6.062 | 0.000 | 0.078 | 0.153 |
| ma.L2 | -0.0430 | 0.019 | -2.311 | 0.021 | -0.079 | -0.007 |
| ma.L3 | -0.9346 | 0.018 | -52.343 | 0.000 | -0.970 | -0.900 |
| sigma2 | 0.0801 | 0.003 | 28.752 | 0.000 | 0.075 | 0.086 |
| ===== | | | | | | |
| Ljung-Box (L1) (Q): | | 0.01 | Jarque-Bera (JB): | | 381.32 | |
| Prob(Q): | | 0.93 | Prob(JB): | | 0.00 | |
| Heteroskedasticity (H): | | 1.12 | Skew: | | 0.52 | |
| Prob(H) (two-sided): | | 0.30 | Kurtosis: | | 5.82 | |
| ===== | | | | | | |

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: 36.09921177495954

MAE: 15.80127598927988

RMSE: 19.33712863625134

MAPE: 30.32305493600419

R2: -0.025193140998105656

LjungBox_p: 0.9884612549552779

JarqueBera_p: 0.0

best_order: (1, 1, 1)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|----------|
| 0 | TOUT | -0.176854 | 0.176854 | 0.013451 |
| 3 | PRS | -0.171671 | 0.171671 | 0.000071 |
| 1 | RH | -0.098576 | 0.098576 | 0.005303 |
| 2 | SR | 0.060531 | 0.060531 | 0.286934 |
| 4 | WSR | 0.043504 | 0.043504 | 0.500408 |
| 5 | WDR | 0.037010 | 0.037010 | 0.543190 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|--------|
| Dep. Variable: | PM10 | No. Observations: | 147 |
| Model: | SARIMAX(1, 1, 1) | Log Likelihood | -9.050 |
| Date: | Fri, 05 Dec 2025 | AIC | 36.099 |
| Time: | 08:15:54 | BIC | 62.828 |
| Sample: | 01-02-2022 | HQIC | 46.960 |
| | - 10-20-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|----|---------|---------|--------|-------|--------|--------|
| x1 | -0.1769 | 0.072 | -2.472 | 0.013 | -0.317 | -0.037 |

| | | | | | | |
|--------|---------|-------|---------|-------|--------|--------|
| x2 | -0.0986 | 0.035 | -2.788 | 0.005 | -0.168 | -0.029 |
| x3 | 0.0605 | 0.057 | 1.065 | 0.287 | -0.051 | 0.172 |
| x4 | -0.1717 | 0.043 | -3.973 | 0.000 | -0.256 | -0.087 |
| x5 | 0.0435 | 0.065 | 0.674 | 0.500 | -0.083 | 0.170 |
| x6 | 0.0370 | 0.061 | 0.608 | 0.543 | -0.082 | 0.156 |
| ar.L1 | 0.0106 | 0.111 | 0.095 | 0.924 | -0.208 | 0.229 |
| ma.L1 | -0.8578 | 0.085 | -10.109 | 0.000 | -1.024 | -0.692 |
| sigma2 | 0.0660 | 0.005 | 13.449 | 0.000 | 0.056 | 0.076 |

```

=====
Ljung-Box (L1) (Q):                0.00    Jarque-Bera (JB):                1521.33
Prob(Q):                        0.99    Prob(JB):                        0.00
Heteroskedasticity (H):          2.55    Skew:                            2.38
Prob(H) (two-sided):            0.00    Kurtosis:                       18.19
=====

```

PM2.5

Frecuencia seleccionada: Diario
 AIC: 261.79917528347255
 MAE: 8.018496265820362
 RMSE: 10.377365744227452
 MAPE: 37.94228517133573
 R2: -0.8043580703774158
 LjungBox_p: 0.9862347341067903
 JarqueBera_p: 0.0
 best_order: (1, 1, 3)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | 0.146377 | 0.146377 | 3.534875e-23 |
| 3 | PRS | -0.144270 | 0.144270 | 4.038487e-18 |
| 0 | TOUT | 0.108520 | 0.108520 | 8.476877e-05 |
| 4 | WSR | 0.074857 | 0.074857 | 3.303964e-08 |
| 2 | SR | 0.050779 | 0.050779 | 5.085912e-04 |
| 5 | WDR | -0.035815 | 0.035815 | 5.506214e-03 |

SARIMAX Results

```

=====
Dep. Variable:                PM2.5    No. Observations:                1021
Model:                        SARIMAX(1, 1, 3)    Log Likelihood                    -119.900
Date:                        Fri, 05 Dec 2025    AIC                                261.799
Time:                        08:21:58    BIC                                315.959
Sample:                        01-01-2022    HQIC                               282.368
                                - 10-17-2024

```

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|--------|-------|--------|--------|
| x1 | 0.1085 | 0.028 | 3.931 | 0.000 | 0.054 | 0.163 |
| x2 | 0.1464 | 0.015 | 9.916 | 0.000 | 0.117 | 0.175 |
| x3 | 0.0508 | 0.015 | 3.476 | 0.001 | 0.022 | 0.079 |
| x4 | -0.1443 | 0.017 | -8.678 | 0.000 | -0.177 | -0.112 |
| x5 | 0.0749 | 0.014 | 5.525 | 0.000 | 0.048 | 0.101 |
| x6 | -0.0358 | 0.013 | -2.776 | 0.006 | -0.061 | -0.011 |
| ar.L1 | 0.6142 | 0.114 | 5.407 | 0.000 | 0.392 | 0.837 |
| ma.L1 | -0.9774 | 0.118 | -8.279 | 0.000 | -1.209 | -0.746 |
| ma.L2 | -0.0663 | 0.057 | -1.172 | 0.241 | -0.177 | 0.045 |
| ma.L3 | 0.0909 | 0.064 | 1.412 | 0.158 | -0.035 | 0.217 |
| sigma2 | 0.0740 | 0.003 | 27.348 | 0.000 | 0.069 | 0.079 |

```

=====
Ljung-Box (L1) (Q):                0.00    Jarque-Bera (JB):                80.78

```

| | | | |
|-------------------------|------|-----------|-------|
| Prob(Q): | 0.99 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 0.86 | Skew: | -0.25 |
| Prob(H) (two-sided): | 0.16 | Kurtosis: | 4.29 |

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -8.166455395312596

MAE: 7.170823248303205

RMSE: 8.414803361846085

MAPE: 34.687002003544514

R2: -1.9593445095428499

LjungBox_p: 0.0008680258454297347

JarqueBera_p: 0.0

best_order: (4, 1, 3)

| Variable | Coef | AbsImpact | Pvalue |
|----------|-----------|-----------|----------|
| 4 WSR | 0.186179 | 0.186179 | 0.002782 |
| 3 PRS | -0.093800 | 0.093800 | 0.008742 |
| 2 SR | 0.089524 | 0.089524 | 0.039759 |
| 1 RH | 0.067620 | 0.067620 | 0.027262 |
| 5 WDR | -0.042238 | 0.042238 | 0.286306 |
| 0 TOUT | -0.009919 | 0.009919 | 0.881703 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|--------|
| Dep. Variable: | PM2.5 | No. Observations: | 147 |
| Model: | SARIMAX(4, 1, 3) | Log Likelihood | 18.083 |
| Date: | Fri, 05 Dec 2025 | AIC | -8.166 |
| Time: | 08:21:58 | BIC | 33.215 |
| Sample: | 01-02-2022 | HQIC | 8.649 |
| | - 10-20-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|--------|-------|---------|--------|
| x1 | -0.0099 | 0.067 | -0.149 | 0.882 | -0.141 | 0.121 |
| x2 | 0.0676 | 0.031 | 2.208 | 0.027 | 0.008 | 0.128 |
| x3 | 0.0895 | 0.044 | 2.056 | 0.040 | 0.004 | 0.175 |
| x4 | -0.0938 | 0.036 | -2.622 | 0.009 | -0.164 | -0.024 |
| x5 | 0.1862 | 0.062 | 2.991 | 0.003 | 0.064 | 0.308 |
| x6 | -0.0422 | 0.040 | -1.066 | 0.286 | -0.120 | 0.035 |
| ar.L1 | -0.7221 | 0.123 | -5.859 | 0.000 | -0.964 | -0.481 |
| ar.L2 | -0.7573 | 0.186 | -4.065 | 0.000 | -1.122 | -0.392 |
| ar.L3 | -0.0083 | 0.199 | -0.042 | 0.967 | -0.398 | 0.382 |
| ar.L4 | -0.2287 | 0.112 | -2.038 | 0.042 | -0.449 | -0.009 |
| ma.L1 | 0.2380 | 18.776 | 0.013 | 0.990 | -36.562 | 37.038 |
| ma.L2 | 0.3040 | 25.462 | 0.012 | 0.990 | -49.600 | 50.208 |
| ma.L3 | -0.7236 | 28.281 | -0.026 | 0.980 | -56.154 | 54.707 |
| sigma2 | 0.0430 | 1.681 | 0.026 | 0.980 | -3.251 | 3.337 |

| | | | |
|-------------------------|------|-------------------|-------|
| Ljung-Box (L1) (Q): | 0.05 | Jarque-Bera (JB): | 4.99 |
| Prob(Q): | 0.82 | Prob(JB): | 0.08 |
| Heteroskedasticity (H): | 1.28 | Skew: | -0.01 |
| Prob(H) (two-sided): | 0.40 | Kurtosis: | 3.92 |

Y_3 (Nitrogenos)

Frecuencia seleccionada: Diario

AIC: 903.72690991995

MAE: 0.41347627842933643

RMSE: 0.5417981588072093

MAPE: 204.7474687616994

R2: 0.1226059649470439

LjungBox_p: 0.5860468765675926

JarqueBera_p: 0.0

best_order: (3, 0, 5)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 3 | PRS | -0.217620 | 0.217620 | 2.851316e-19 |
| 0 | TOUT | -0.153117 | 0.153117 | 4.134799e-04 |
| 4 | WSR | 0.131754 | 0.131754 | 5.981656e-07 |
| 5 | WDR | -0.065900 | 0.065900 | 6.096517e-04 |
| 2 | SR | -0.028894 | 0.028894 | 1.694278e-01 |
| 1 | RH | 0.025672 | 0.025672 | 2.734365e-01 |

SARIMAX Results

```
=====
Dep. Variable:          Y_3      No. Observations:          1021
Model:                SARIMAX(3, 0, 5)      Log Likelihood          -436.863
Date:                  Fri, 05 Dec 2025      AIC                      903.727
Time:                  07:08:31              BIC                      977.567
Sample:                01-01-2022           HQIC                     931.771
                   - 10-17-2024
Covariance Type:                opg
=====
```

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|---------|-------|--------|--------|
| x1 | -0.1531 | 0.043 | -3.531 | 0.000 | -0.238 | -0.068 |
| x2 | 0.0257 | 0.023 | 1.095 | 0.273 | -0.020 | 0.072 |
| x3 | -0.0289 | 0.021 | -1.374 | 0.169 | -0.070 | 0.012 |
| x4 | -0.2176 | 0.024 | -8.974 | 0.000 | -0.265 | -0.170 |
| x5 | 0.1318 | 0.026 | 4.992 | 0.000 | 0.080 | 0.183 |
| x6 | -0.0659 | 0.019 | -3.427 | 0.001 | -0.104 | -0.028 |
| ar.L1 | 0.5350 | 0.018 | 29.468 | 0.000 | 0.499 | 0.571 |
| ar.L2 | -0.5011 | 0.023 | -21.690 | 0.000 | -0.546 | -0.456 |
| ar.L3 | 0.9286 | 0.018 | 52.051 | 0.000 | 0.894 | 0.964 |
| ma.L1 | 0.0983 | 0.024 | 4.100 | 0.000 | 0.051 | 0.145 |
| ma.L2 | 0.4278 | 0.028 | 15.372 | 0.000 | 0.373 | 0.482 |
| ma.L3 | -0.6773 | 0.028 | -23.914 | 0.000 | -0.733 | -0.622 |
| ma.L4 | -0.3658 | 0.027 | -13.336 | 0.000 | -0.420 | -0.312 |
| ma.L5 | -0.1277 | 0.026 | -4.897 | 0.000 | -0.179 | -0.077 |
| sigma2 | 0.1378 | 0.003 | 48.423 | 0.000 | 0.132 | 0.143 |

```
=====
Ljung-Box (L1) (Q):                0.01      Jarque-Bera (JB):                10274.47
Prob(Q):                          0.93      Prob(JB):                  0.00
Heteroskedasticity (H):            1.61      Skew:                      2.18
Prob(H) (two-sided):              0.00      Kurtosis:                  17.97
=====
```

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: 39.367451488415284

MAE: 0.22717692575387427

RMSE: 0.2838304654373928
 MAPE: 131.85316674544717
 R2: 0.5833211956779352
 LjungBox_p: 0.4986451979529185
 JarqueBera_p: 0.0
 best_order: (1, 0, 1)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|----------|
| 0 | TOUT | -0.175376 | 0.175376 | 0.011555 |
| 2 | SR | -0.119154 | 0.119154 | 0.025509 |
| 4 | WSR | 0.116130 | 0.116130 | 0.052986 |
| 5 | WDR | -0.068727 | 0.068727 | 0.290244 |
| 1 | RH | -0.063662 | 0.063662 | 0.140746 |
| 3 | PRS | -0.043081 | 0.043081 | 0.411541 |

SARIMAX Results

```

=====
Dep. Variable:          Y_3      No. Observations:          147
Model:                SARIMAX(1, 0, 1)      Log Likelihood      -10.684
Date:                  Fri, 05 Dec 2025      AIC                  39.367
Time:                  07:08:31              BIC                  66.158
Sample:                01-02-2022            HQIC                 50.253
                  - 10-20-2024
=====

```

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|--------|-------|--------|--------|
| x1 | -0.1754 | 0.069 | -2.525 | 0.012 | -0.311 | -0.039 |
| x2 | -0.0637 | 0.043 | -1.473 | 0.141 | -0.148 | 0.021 |
| x3 | -0.1192 | 0.053 | -2.234 | 0.026 | -0.224 | -0.015 |
| x4 | -0.0431 | 0.052 | -0.821 | 0.412 | -0.146 | 0.060 |
| x5 | 0.1161 | 0.060 | 1.935 | 0.053 | -0.001 | 0.234 |
| x6 | -0.0687 | 0.065 | -1.058 | 0.290 | -0.196 | 0.059 |
| ar.L1 | 0.8727 | 0.109 | 8.006 | 0.000 | 0.659 | 1.086 |
| ma.L1 | -0.6480 | 0.140 | -4.620 | 0.000 | -0.923 | -0.373 |
| sigma2 | 0.0676 | 0.003 | 22.580 | 0.000 | 0.062 | 0.073 |

```

=====
Ljung-Box (L1) (Q):                0.16      Jarque-Bera (JB):                2407.84
Prob(Q):                          0.69      Prob(JB):                  0.00
Heteroskedasticity (H):            1.58      Skew:                      3.27
Prob(H) (two-sided):              0.12      Kurtosis:                  21.86
=====

```

Y_4 (So2) - Transformación

Frecuencia seleccionada: Diario
 AIC: -866.2154668628232
 MAE: 1.4683785332854753
 RMSE: 2.1907328692553207
 MAPE: 24.340141617854158
 R2: -0.3881818061715976
 LjungBox_p: 0.4235092906615231
 JarqueBera_p: 0.0
 best_order: (4, 1, 4)

| Variable | Coef | AbsImpact | Pvalue |
|----------|------|-----------|--------|
|----------|------|-----------|--------|

| | | | | |
|---|------|-----------|----------|--------------|
| 1 | RH | -0.055130 | 0.055130 | 5.834383e-10 |
| 3 | PRS | -0.047617 | 0.047617 | 6.262667e-07 |
| 4 | WSR | 0.019235 | 0.019235 | 4.329375e-02 |
| 2 | SR | 0.014454 | 0.014454 | 1.609573e-01 |
| 5 | WDR | 0.007024 | 0.007024 | 4.615533e-01 |
| 0 | TOUT | -0.005604 | 0.005604 | 7.367090e-01 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|----------|
| Dep. Variable: | Y_4 | No. Observations: | 1021 |
| Model: | SARIMAX(4, 1, 4) | Log Likelihood | 448.108 |
| Date: | Fri, 05 Dec 2025 | AIC | -866.215 |
| Time: | 08:19:53 | BIC | -792.376 |
| Sample: | 01-01-2022 | HQIC | -838.172 |
| | - 10-17-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|---------|-------|--------|--------|
| x1 | -0.0056 | 0.017 | -0.336 | 0.737 | -0.038 | 0.027 |
| x2 | -0.0551 | 0.009 | -6.195 | 0.000 | -0.073 | -0.038 |
| x3 | 0.0145 | 0.010 | 1.402 | 0.161 | -0.006 | 0.035 |
| x4 | -0.0476 | 0.010 | -4.983 | 0.000 | -0.066 | -0.029 |
| x5 | 0.0192 | 0.010 | 2.021 | 0.043 | 0.001 | 0.038 |
| x6 | 0.0070 | 0.010 | 0.736 | 0.462 | -0.012 | 0.026 |
| ar.L1 | -0.0192 | 0.086 | -0.222 | 0.824 | -0.188 | 0.150 |
| ar.L2 | -0.3513 | 0.066 | -5.312 | 0.000 | -0.481 | -0.222 |
| ar.L3 | -0.5808 | 0.092 | -6.289 | 0.000 | -0.762 | -0.400 |
| ar.L4 | 0.4252 | 0.038 | 11.128 | 0.000 | 0.350 | 0.500 |
| ma.L1 | -0.4705 | 0.091 | -5.182 | 0.000 | -0.648 | -0.293 |
| ma.L2 | 0.1958 | 0.117 | 1.668 | 0.095 | -0.034 | 0.426 |
| ma.L3 | 0.2868 | 0.123 | 2.341 | 0.019 | 0.047 | 0.527 |
| ma.L4 | -0.7962 | 0.079 | -10.109 | 0.000 | -0.951 | -0.642 |
| sigma2 | 0.0241 | 0.001 | 36.267 | 0.000 | 0.023 | 0.025 |

| | | | |
|-------------------------|------|-------------------|--------|
| Ljung-Box (L1) (Q): | 0.07 | Jarque-Bera (JB): | 889.33 |
| Prob(Q): | 0.80 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 0.98 | Skew: | 0.30 |
| Prob(H) (two-sided): | 0.82 | Kurtosis: | 7.55 |

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -180.9865260698069

MAE: 1.9571405271676336

RMSE: 2.2275947963833045

MAPE: 36.8289416764158

R2: -2.2475057235697244

LjungBox_p: 0.9287676799128202

JarqueBera_p: 0.0

best_order: (2, 0, 1)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | -0.093604 | 0.093604 | 2.362493e-14 |
| 0 | TOUT | -0.024867 | 0.024867 | 3.175009e-01 |
| 4 | WSR | 0.018817 | 0.018817 | 5.185544e-01 |
| 3 | PRS | -0.012148 | 0.012148 | 4.169638e-01 |
| 5 | WDR | -0.008820 | 0.008820 | 7.196944e-01 |
| 2 | SR | -0.007692 | 0.007692 | 7.212222e-01 |

```

=====
SARIMAX Results
=====
Dep. Variable:          Y_4      No. Observations:          147
Model:                  SARIMAX(2, 0, 1)  Log Likelihood              100.493
Date:                   Fri, 05 Dec 2025  AIC                        -180.987
Time:                   08:19:53         BIC                        -151.219
Sample:                 01-02-2022       HQIC                       -168.891
                   - 10-20-2024

Covariance Type:                opg
=====

```

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|--------|-------|--------|--------|
| x1 | -0.0249 | 0.025 | -1.000 | 0.318 | -0.074 | 0.024 |
| x2 | -0.0936 | 0.012 | -7.629 | 0.000 | -0.118 | -0.070 |
| x3 | -0.0077 | 0.022 | -0.357 | 0.721 | -0.050 | 0.035 |
| x4 | -0.0121 | 0.015 | -0.812 | 0.417 | -0.041 | 0.017 |
| x5 | 0.0188 | 0.029 | 0.646 | 0.519 | -0.038 | 0.076 |
| x6 | -0.0088 | 0.025 | -0.359 | 0.720 | -0.057 | 0.039 |
| ar.L1 | 1.3562 | 0.072 | 18.871 | 0.000 | 1.215 | 1.497 |
| ar.L2 | -0.3575 | 0.072 | -4.977 | 0.000 | -0.498 | -0.217 |
| ma.L1 | -0.9995 | 1.139 | -0.878 | 0.380 | -3.232 | 1.233 |
| sigma2 | 0.0139 | 0.016 | 0.869 | 0.385 | -0.017 | 0.045 |

```

=====
Ljung-Box (L1) (Q):                0.50    Jarque-Bera (JB):                0.33
Prob(Q):                          0.48    Prob(JB):                0.85
Heteroskedasticity (H):            1.89    Skew:                    0.10
Prob(H) (two-sided):              0.03    Kurtosis:                3.14
=====

```

NORTE 2 - INDUSTRIAL

Y_1 (OZONO)

Frecuencia seleccionada: Diario
 AIC: 232.55968857695873
 MAE: 0.34799270855878306
 RMSE: 0.4182940977191583
 MAPE: 121.46340428185911
 R2: 0.3963860172118099
 LjungBox_p: 0.3964766849358181
 JarqueBera_p: 2.023924932064266e-15
 best_order: (2, 0, 1)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | -0.142495 | 0.142495 | 6.636553e-22 |
| 2 | SR | 0.121839 | 0.121839 | 5.515327e-14 |
| 4 | WSR | -0.084403 | 0.084403 | 9.547449e-15 |
| 0 | TOUT | -0.058357 | 0.058357 | 6.680272e-02 |
| 5 | WDR | 0.023648 | 0.023648 | 1.276116e-02 |
| 3 | PRS | -0.011343 | 0.011343 | 5.055726e-01 |

```

=====
SARIMAX Results
=====
Dep. Variable:          Y_1      No. Observations:          1021
Model:                  SARIMAX(2, 0, 1)  Log Likelihood              -106.280
Date:                   Fri, 05 Dec 2025  AIC                        232.560
Time:                   07:21:13         BIC                        281.825
Sample:                 01-01-2022       HQIC                       251.267

```

- 10-17-2024

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|-------------------------|---------|---------|---------|-------------------|--------|--------|
| x1 | -0.0584 | 0.032 | -1.833 | 0.067 | -0.121 | 0.004 |
| x2 | -0.1425 | 0.015 | -9.619 | 0.000 | -0.172 | -0.113 |
| x3 | 0.1218 | 0.016 | 7.519 | 0.000 | 0.090 | 0.154 |
| x4 | -0.0113 | 0.017 | -0.666 | 0.506 | -0.045 | 0.022 |
| x5 | -0.0844 | 0.011 | -7.745 | 0.000 | -0.106 | -0.063 |
| x6 | 0.0236 | 0.009 | 2.490 | 0.013 | 0.005 | 0.042 |
| ar.L1 | 1.4903 | 0.034 | 43.323 | 0.000 | 1.423 | 1.558 |
| ar.L2 | -0.4978 | 0.032 | -15.353 | 0.000 | -0.561 | -0.434 |
| ma.L1 | -1.0868 | 0.024 | -45.486 | 0.000 | -1.134 | -1.040 |
| sigma2 | 0.0610 | 0.004 | 16.577 | 0.000 | 0.054 | 0.068 |
| ===== | | | | | | |
| Ljung-Box (L1) (Q): | | | 0.00 | Jarque-Bera (JB): | | 68.19 |
| Prob(Q): | | | 0.98 | Prob(JB): | | 0.00 |
| Heteroskedasticity (H): | | | 1.64 | Skew: | | 0.12 |
| Prob(H) (two-sided): | | | 0.00 | Kurtosis: | | 4.24 |
| ===== | | | | | | |

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -54.10340166337568

MAE: 0.2935384053613612

RMSE: 0.3375005557239387

MAPE: 162.69657900882407

R2: 0.4430788240491551

LjungBox_p: 0.9812274241359114

JarqueBera_p: 0.011396010972098742

best_order: (3, 0, 2)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|----------|
| 1 | RH | -0.145015 | 0.145015 | 0.000004 |
| 0 | TOUT | 0.087073 | 0.087073 | 0.109934 |
| 2 | SR | 0.053656 | 0.053656 | 0.245965 |
| 5 | WDR | -0.039902 | 0.039902 | 0.123310 |
| 4 | WSR | 0.029447 | 0.029447 | 0.358811 |
| 3 | PRS | -0.000447 | 0.000447 | 0.988650 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|---------|
| Dep. Variable: | Y_1 | No. Observations: | 147 |
| Model: | SARIMAX(3, 0, 2) | Log Likelihood | 39.052 |
| Date: | Fri, 05 Dec 2025 | AIC | -54.103 |
| Time: | 07:21:13 | BIC | -18.466 |
| Sample: | 01-02-2022 | HQIC | -39.622 |

- 10-20-2024

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|----|---------|---------|--------|-------|--------|--------|
| x1 | 0.0871 | 0.054 | 1.598 | 0.110 | -0.020 | 0.194 |
| x2 | -0.1450 | 0.031 | -4.615 | 0.000 | -0.207 | -0.083 |
| x3 | 0.0537 | 0.046 | 1.160 | 0.246 | -0.037 | 0.144 |
| x4 | -0.0004 | 0.031 | -0.014 | 0.989 | -0.062 | 0.061 |
| x5 | 0.0294 | 0.032 | 0.918 | 0.359 | -0.033 | 0.092 |
| x6 | -0.0399 | 0.026 | -1.541 | 0.123 | -0.091 | 0.011 |

| | | | | | | |
|--------|---------|-------|--------|-------|--------|-------|
| ar.L1 | 0.5757 | 0.199 | 2.889 | 0.004 | 0.185 | 0.966 |
| ar.L2 | -0.3422 | 0.214 | -1.599 | 0.110 | -0.762 | 0.077 |
| ar.L3 | 0.4809 | 0.113 | 4.267 | 0.000 | 0.260 | 0.702 |
| ma.L1 | -0.1322 | 0.229 | -0.577 | 0.564 | -0.581 | 0.317 |
| ma.L2 | 0.4998 | 0.175 | 2.858 | 0.004 | 0.157 | 0.843 |
| sigma2 | 0.0339 | 0.004 | 7.553 | 0.000 | 0.025 | 0.043 |

```

=====
Ljung-Box (L1) (Q):                0.00    Jarque-Bera (JB):                0.05
Prob(Q):                      1.00    Prob(JB):                      0.98
Heteroskedasticity (H):          1.75    Skew:                          0.04
Prob(H) (two-sided):            0.05    Kurtosis:                      3.01
=====

```

PM10 - TRANSFORMACIÓN

Frecuencia seleccionada: Diario
AIC: 275.58089579793784
MAE: 25.84912249502183
RMSE: 34.44607573042068
MAPE: 41.04885731063146
R2: -0.10745930671931347
LjungBox_p: 0.0008659181540039678
JarqueBera_p: 0.0
best_order: (2, 1, 5)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 0 | TOUT | 0.191824 | 0.191824 | 3.554007e-13 |
| 1 | RH | -0.087656 | 0.087656 | 1.517244e-09 |
| 3 | PRS | -0.079439 | 0.079439 | 1.052230e-07 |
| 4 | WSR | 0.071629 | 0.071629 | 1.420475e-11 |
| 2 | SR | 0.025593 | 0.025593 | 1.669862e-01 |
| 5 | WDR | -0.005429 | 0.005429 | 4.466935e-01 |

SARIMAX Results

```

=====
Dep. Variable:                PM10    No. Observations:                1021
Model:                SARIMAX(2, 1, 5)    Log Likelihood                -123.790
Date:                Fri, 05 Dec 2025    AIC                275.581
Time:                08:24:19    BIC                344.484
Sample:                01-01-2022    HQIC                301.751
                - 10-17-2024

```

Covariance Type: opg

```

=====

```

| | coef | std err | z | P> z | [0.025 | 0.975] |
|-------|---------|---------|----------|-------|--------|--------|
| ----- | | | | | | |
| x1 | 0.1918 | 0.026 | 7.272 | 0.000 | 0.140 | 0.244 |
| x2 | -0.0877 | 0.015 | -6.043 | 0.000 | -0.116 | -0.059 |
| x3 | 0.0256 | 0.019 | 1.382 | 0.167 | -0.011 | 0.062 |
| x4 | -0.0794 | 0.015 | -5.317 | 0.000 | -0.109 | -0.050 |
| x5 | 0.0716 | 0.011 | 6.756 | 0.000 | 0.051 | 0.092 |
| x6 | -0.0054 | 0.007 | -0.761 | 0.447 | -0.019 | 0.009 |
| ar.L1 | -0.4444 | 0.001 | -311.874 | 0.000 | -0.447 | -0.442 |
| ar.L2 | -0.9997 | 0.001 | -767.714 | 0.000 | -1.002 | -0.997 |
| ma.L1 | -0.0591 | 0.053 | -1.119 | 0.263 | -0.163 | 0.044 |
| ma.L2 | 0.5557 | 0.167 | 3.332 | 0.001 | 0.229 | 0.883 |
| ma.L3 | -0.6933 | 0.105 | -6.580 | 0.000 | -0.900 | -0.487 |
| ma.L4 | -0.2660 | 0.062 | -4.315 | 0.000 | -0.387 | -0.145 |
| ma.L5 | -0.0954 | 0.034 | -2.780 | 0.005 | -0.163 | -0.028 |

| | | | | | | |
|--------|--------|-------|-------|-------|-------|-------|
| sigma2 | 0.0742 | 0.014 | 5.158 | 0.000 | 0.046 | 0.102 |
|--------|--------|-------|-------|-------|-------|-------|

```
=====
```

| | | | |
|-------------------------|------|-------------------|-------|
| Ljung-Box (L1) (Q): | 0.01 | Jarque-Bera (JB): | 20.15 |
| Prob(Q): | 0.93 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 1.17 | Skew: | -0.03 |
| Prob(H) (two-sided): | 0.16 | Kurtosis: | 3.69 |

```
=====
```

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -39.31099222467827

MAE: 18.8444449470301363

RMSE: 23.12960624983888

MAPE: 30.335755853590157

R2: 0.045110887558871826

LjungBox_p: 0.9089726774662158

JarqueBera_p: 0.0

best_order: (1, 1, 1)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|----------|
| 1 | RH | -0.125940 | 0.125940 | 0.000092 |
| 4 | WSR | 0.069527 | 0.069527 | 0.015751 |
| 3 | PRS | -0.053171 | 0.053171 | 0.065210 |
| 5 | WDR | 0.040805 | 0.040805 | 0.070531 |
| 2 | SR | -0.018507 | 0.018507 | 0.727029 |
| 0 | TOUT | 0.007151 | 0.007151 | 0.893533 |

SARIMAX Results

```
=====
```

| | | | |
|----------------|------------------|-------------------|---------|
| Dep. Variable: | PM10 | No. Observations: | 147 |
| Model: | SARIMAX(1, 1, 1) | Log Likelihood | 28.655 |
| Date: | Fri, 05 Dec 2025 | AIC | -39.311 |
| Time: | 08:24:19 | BIC | -12.583 |
| Sample: | 01-02-2022 | HQIC | -28.450 |
| | - 10-20-2024 | | |

Covariance Type: opg

```
=====
```

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|--------|-------|--------|--------|
| x1 | 0.0072 | 0.053 | 0.134 | 0.894 | -0.098 | 0.112 |
| x2 | -0.1259 | 0.032 | -3.912 | 0.000 | -0.189 | -0.063 |
| x3 | -0.0185 | 0.053 | -0.349 | 0.727 | -0.122 | 0.085 |
| x4 | -0.0532 | 0.029 | -1.844 | 0.065 | -0.110 | 0.003 |
| x5 | 0.0695 | 0.029 | 2.415 | 0.016 | 0.013 | 0.126 |
| x6 | 0.0408 | 0.023 | 1.808 | 0.071 | -0.003 | 0.085 |
| ar.L1 | 0.3397 | 0.157 | 2.168 | 0.030 | 0.033 | 0.647 |
| ma.L1 | -0.7563 | 0.107 | -7.077 | 0.000 | -0.966 | -0.547 |
| sigma2 | 0.0392 | 0.005 | 7.225 | 0.000 | 0.029 | 0.050 |

```
=====
```

| | | | |
|-------------------------|------|-------------------|------|
| Ljung-Box (L1) (Q): | 0.06 | Jarque-Bera (JB): | 0.92 |
| Prob(Q): | 0.81 | Prob(JB): | 0.63 |
| Heteroskedasticity (H): | 1.35 | Skew: | 0.19 |
| Prob(H) (two-sided): | 0.30 | Kurtosis: | 3.10 |

```
=====
```

PM2.5 - TRANSFORMACION

Frecuencia seleccionada: Diario

AIC: 382.63956647721056

MAE: 6.890106549316632

RMSE: 9.079253577029432

MAPE: 35.75596653516606

R2: -0.20346798316138504

LjungBox_p: 0.36244037228086523

JarqueBera_p: 0.0

best_order: (1, 1, 2)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 0 | TOUT | 0.211950 | 0.211950 | 5.836808e-15 |
| 1 | RH | 0.109078 | 0.109078 | 3.402751e-13 |
| 3 | PRS | -0.103217 | 0.103217 | 6.220699e-10 |
| 5 | WDR | 0.080600 | 0.080600 | 2.368403e-19 |
| 4 | WSR | 0.059662 | 0.059662 | 1.199975e-06 |
| 2 | SR | 0.059199 | 0.059199 | 2.102766e-03 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|----------|
| Dep. Variable: | PM2.5 | No. Observations: | 1021 |
| Model: | SARIMAX(1, 1, 2) | Log Likelihood | -181.320 |
| Date: | Fri, 05 Dec 2025 | AIC | 382.640 |
| Time: | 08:27:55 | BIC | 431.886 |
| Sample: | 01-01-2022 | HQIC | 401.341 |
| | - 10-17-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|---------|-------|--------|--------|
| x1 | 0.2119 | 0.027 | 7.807 | 0.000 | 0.159 | 0.265 |
| x2 | 0.1091 | 0.015 | 7.277 | 0.000 | 0.080 | 0.138 |
| x3 | 0.0592 | 0.019 | 3.075 | 0.002 | 0.021 | 0.097 |
| x4 | -0.1032 | 0.017 | -6.185 | 0.000 | -0.136 | -0.071 |
| x5 | 0.0597 | 0.012 | 4.856 | 0.000 | 0.036 | 0.084 |
| x6 | 0.0806 | 0.009 | 8.995 | 0.000 | 0.063 | 0.098 |
| ar.L1 | 0.4415 | 0.082 | 5.381 | 0.000 | 0.281 | 0.602 |
| ma.L1 | -0.9090 | 0.086 | -10.588 | 0.000 | -1.077 | -0.741 |
| ma.L2 | 0.0021 | 0.067 | 0.031 | 0.975 | -0.130 | 0.134 |
| sigma2 | 0.0835 | 0.003 | 27.538 | 0.000 | 0.078 | 0.089 |

| | | | |
|-------------------------|------|-------------------|-------|
| Ljung-Box (L1) (Q): | 0.00 | Jarque-Bera (JB): | 51.77 |
| Prob(Q): | 1.00 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 1.17 | Skew: | 0.06 |
| Prob(H) (two-sided): | 0.14 | Kurtosis: | 4.10 |

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -7.855576827734261

MAE: 5.171787647300436

RMSE: 6.218020621761753

MAPE: 27.47068334696471

R2: -0.6192679450092871

LjungBox_p: 0.871650309918927

JarqueBera_p: 0.0

```

best_order: (1, 1, 1)
  Variable      Coef  AbsImpact    Pvalue
0      TOUT  0.094417  0.094417  0.129838
4       WSR  0.069684  0.069684  0.028208
3       PRS -0.068369  0.068369  0.055175
5       WDR  0.033922  0.033922  0.167336
1       RH   0.015950  0.015950  0.647026
2       SR -0.001579  0.001579  0.976428

SARIMAX Results
=====
Dep. Variable:          PM2.5    No. Observations:          147
Model:                SARIMAX(1, 1, 1)    Log Likelihood          12.928
Date:                  Fri, 05 Dec 2025    AIC                     -7.856
Time:                  08:27:55           BIC                     18.873
Sample:                01-02-2022         HQIC                    3.005
                  - 10-20-2024
Covariance Type:          opg
=====
              coef      std err          z      P>|z|      [0.025      0.975]
-----
x1              0.0944      0.062      1.515      0.130      -0.028      0.217
x2              0.0159      0.035      0.458      0.647      -0.052      0.084
x3             -0.0016      0.053     -0.030      0.976      -0.106      0.103
x4             -0.0684      0.036     -1.917      0.055      -0.138      0.002
x5              0.0697      0.032      2.194      0.028       0.007      0.132
x6              0.0339      0.025      1.381      0.167      -0.014      0.082
ar.L1           0.3553      0.126      2.817      0.005       0.108      0.603
ma.L1          -0.7938      0.087     -9.155      0.000      -0.964     -0.624
sigma2          0.0488      0.006      7.617      0.000       0.036      0.061
=====
Ljung-Box (L1) (Q):                0.00    Jarque-Bera (JB):                0.36
Prob(Q):                          1.00    Prob(JB):                0.84
Heteroskedasticity (H):            1.76    Skew:                    -0.10
Prob(H) (two-sided):              0.05    Kurtosis:                3.12
=====

```

Y_3 (Nitrogenos)

```

Frecuencia seleccionada: Diario
AIC: 541.9828350717698
MAE: 0.5484652592568221
RMSE: 0.6949832819999935
MAPE: 149.5412210795301
R2: 0.2627417148325084
LjungBox_p: 0.0010210166413130686
JarqueBera_p: 3.883896929448926e-238
best_order: (5, 0, 5)

```

```

  Variable      Coef  AbsImpact    Pvalue
4       WSR  0.210370  0.210370  2.983932e-88
5       WDR  0.073539  0.073539  5.243861e-13
3       PRS -0.071246  0.071246  1.178294e-06
1       RH -0.065493  0.065493  1.518940e-05
0      TOUT -0.020427  0.020427  4.443714e-01
2       SR -0.016714  0.016714  4.322777e-01

SARIMAX Results
=====
Dep. Variable:          Y_3    No. Observations:          1021
Model:                SARIMAX(5, 0, 5)    Log Likelihood          -253.991

```

Date: Fri, 05 Dec 2025 AIC 541.983
Time: 07:22:48 BIC 625.668
Sample: 01-01-2022 HQIC 573.766
- 10-17-2024

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|---------|-------|--------|--------|
| x1 | -0.0204 | 0.027 | -0.765 | 0.444 | -0.073 | 0.032 |
| x2 | -0.0655 | 0.015 | -4.326 | 0.000 | -0.095 | -0.036 |
| x3 | -0.0167 | 0.021 | -0.785 | 0.432 | -0.058 | 0.025 |
| x4 | -0.0712 | 0.015 | -4.859 | 0.000 | -0.100 | -0.043 |
| x5 | 0.2104 | 0.011 | 19.916 | 0.000 | 0.190 | 0.231 |
| x6 | 0.0735 | 0.010 | 7.219 | 0.000 | 0.054 | 0.094 |
| ar.L1 | 1.6872 | 0.079 | 21.341 | 0.000 | 1.532 | 1.842 |
| ar.L2 | -1.6617 | 0.167 | -9.936 | 0.000 | -1.989 | -1.334 |
| ar.L3 | 1.2173 | 0.183 | 6.657 | 0.000 | 0.859 | 1.576 |
| ar.L4 | -0.9082 | 0.129 | -7.035 | 0.000 | -1.161 | -0.655 |
| ar.L5 | 0.6376 | 0.057 | 11.109 | 0.000 | 0.525 | 0.750 |
| ma.L1 | -1.3244 | 0.082 | -16.186 | 0.000 | -1.485 | -1.164 |
| ma.L2 | 1.1261 | 0.139 | 8.076 | 0.000 | 0.853 | 1.399 |
| ma.L3 | -0.6312 | 0.132 | -4.767 | 0.000 | -0.891 | -0.372 |
| ma.L4 | 0.6758 | 0.104 | 6.504 | 0.000 | 0.472 | 0.880 |
| ma.L5 | -0.5140 | 0.056 | -9.138 | 0.000 | -0.624 | -0.404 |
| sigma2 | 0.0934 | 0.004 | 25.288 | 0.000 | 0.086 | 0.101 |

Ljung-Box (L1) (Q): 0.89 Jarque-Bera (JB): 1185.14
Prob(Q): 0.34 Prob(JB): 0.00
Heteroskedasticity (H): 1.79 Skew: 0.69
Prob(H) (two-sided): 0.00 Kurtosis: 8.11

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -84.18418464225593

MAE: 0.3779386796454011

RMSE: 0.463772590039484

MAPE: 154.85676797562155

R2: 0.5146129149967014

LjungBox_p: 0.00021975431894328388

JarqueBera_p: 0.0

best_order: (2, 0, 3)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 4 | WSR | 0.223396 | 0.223396 | 1.741523e-18 |
| 1 | RH | -0.059441 | 0.059441 | 1.118404e-02 |
| 0 | TOUT | -0.040350 | 0.040350 | 3.339222e-01 |
| 5 | WDR | 0.037685 | 0.037685 | 7.190442e-02 |
| 2 | SR | -0.018114 | 0.018114 | 6.856639e-01 |
| 3 | PRS | 0.010774 | 0.010774 | 6.221215e-01 |

SARIMAX Results

Dep. Variable: Y_3 No. Observations: 147
Model: SARIMAX(2, 0, 3) Log Likelihood: 54.092
Date: Fri, 05 Dec 2025 AIC: -84.184
Time: 07:22:48 BIC: -48.630
Sample: 01-02-2022 HQIC: -69.737
- 10-20-2024

| Covariance Type: | | opg | | | | |
|-------------------------|---------|---------|---------|-------------------|--------|--------|
| | coef | std err | z | P> z | [0.025 | 0.975] |
| x1 | -0.0404 | 0.042 | -0.966 | 0.334 | -0.122 | 0.041 |
| x2 | -0.0594 | 0.023 | -2.537 | 0.011 | -0.105 | -0.014 |
| x3 | -0.0181 | 0.045 | -0.405 | 0.686 | -0.106 | 0.070 |
| x4 | 0.0108 | 0.022 | 0.493 | 0.622 | -0.032 | 0.054 |
| x5 | 0.2234 | 0.025 | 8.773 | 0.000 | 0.173 | 0.273 |
| x6 | 0.0377 | 0.021 | 1.800 | 0.072 | -0.003 | 0.079 |
| ar.L1 | 1.8177 | 0.084 | 21.615 | 0.000 | 1.653 | 1.983 |
| ar.L2 | -0.8508 | 0.081 | -10.535 | 0.000 | -1.009 | -0.693 |
| ma.L1 | -1.4798 | 0.119 | -12.404 | 0.000 | -1.714 | -1.246 |
| ma.L2 | 0.4812 | 0.167 | 2.878 | 0.004 | 0.153 | 0.809 |
| ma.L3 | 0.1667 | 0.100 | 1.660 | 0.097 | -0.030 | 0.364 |
| sigma2 | 0.0268 | 0.004 | 7.631 | 0.000 | 0.020 | 0.034 |
| ===== | | | | | | |
| Ljung-Box (L1) (Q): | | | 0.00 | Jarque-Bera (JB): | | 8.04 |
| Prob(Q): | | | 0.98 | Prob(JB): | | 0.02 |
| Heteroskedasticity (H): | | | 1.47 | Skew: | | 0.51 |
| Prob(H) (two-sided): | | | 0.19 | Kurtosis: | | 3.55 |
| ===== | | | | | | |

Y_4 (So2)

Frecuencia seleccionada: Diario
AIC: 2957.4530536008892
MAE: 0.7751689619135362
RMSE: 0.9615583653034434
MAPE: 20.700552607463774
R2: -0.6718360405858341
LjungBox_p: 0.06919115085473541
JarqueBera_p: 0.0
best_order: (5, 1, 5)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | -0.397243 | 0.397243 | 1.602619e-10 |
| 5 | WDR | 0.237619 | 0.237619 | 5.032594e-08 |
| 3 | PRS | -0.161834 | 0.161834 | 1.260258e-02 |
| 2 | SR | -0.062351 | 0.062351 | 4.106897e-01 |
| 0 | TOUT | 0.052904 | 0.052904 | 6.290070e-01 |
| 4 | WSR | -0.005073 | 0.005073 | 9.207626e-01 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|-----------|
| Dep. Variable: | Y_4 | No. Observations: | 1021 |
| Model: | SARIMAX(5, 1, 5) | Log Likelihood | -1461.727 |
| Date: | Fri, 05 Dec 2025 | AIC | 2957.453 |
| Time: | 08:31:55 | BIC | 3041.121 |
| Sample: | 01-01-2022 | HQIC | 2989.231 |
| | - 10-17-2024 | | |

| Covariance Type: | | opg | | | | |
|------------------|---------|---------|--------|-------|--------|--------|
| | coef | std err | z | P> z | [0.025 | 0.975] |
| x1 | 0.0529 | 0.110 | 0.483 | 0.629 | -0.162 | 0.268 |
| x2 | -0.3972 | 0.062 | -6.395 | 0.000 | -0.519 | -0.275 |
| x3 | -0.0624 | 0.076 | -0.823 | 0.411 | -0.211 | 0.086 |

| | | | | | | |
|--------|---------|-------|---------|-------|--------|--------|
| x4 | -0.1618 | 0.065 | -2.495 | 0.013 | -0.289 | -0.035 |
| x5 | -0.0051 | 0.051 | -0.099 | 0.921 | -0.105 | 0.095 |
| x6 | 0.2376 | 0.044 | 5.450 | 0.000 | 0.152 | 0.323 |
| ar.L1 | -1.5191 | 0.030 | -50.194 | 0.000 | -1.578 | -1.460 |
| ar.L2 | -1.2691 | 0.054 | -23.465 | 0.000 | -1.375 | -1.163 |
| ar.L3 | -1.1989 | 0.051 | -23.456 | 0.000 | -1.299 | -1.099 |
| ar.L4 | -0.4171 | 0.047 | -8.923 | 0.000 | -0.509 | -0.326 |
| ar.L5 | 0.2679 | 0.026 | 10.109 | 0.000 | 0.216 | 0.320 |
| ma.L1 | 0.9220 | 1.953 | 0.472 | 0.637 | -2.905 | 4.749 |
| ma.L2 | 0.1518 | 0.138 | 1.097 | 0.273 | -0.120 | 0.423 |
| ma.L3 | 0.0682 | 0.041 | 1.679 | 0.093 | -0.011 | 0.148 |
| ma.L4 | -0.6766 | 0.355 | -1.907 | 0.056 | -1.372 | 0.019 |
| ma.L5 | -0.8912 | 1.830 | -0.487 | 0.626 | -4.477 | 2.695 |
| sigma2 | 1.0294 | 2.115 | 0.487 | 0.627 | -3.116 | 5.175 |

=====

| | | | |
|-------------------------|------|-------------------|---------|
| Ljung-Box (L1) (Q): | 0.33 | Jarque-Bera (JB): | 6720.49 |
| Prob(Q): | 0.56 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 0.49 | Skew: | 1.78 |
| Prob(H) (two-sided): | 0.00 | Kurtosis: | 15.10 |

=====

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: 285.27865906880027

MAE: 0.6877261528180811

RMSE: 0.8144442519947246

MAPE: 17.428270493621174

R2: -0.6612130954799829

LjungBox_p: 0.0016126245453462259

JarqueBera_p: 2.039645834070174e-169

best_order: (4, 1, 5)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|----------|
| 0 | TOUT | 0.545047 | 0.545047 | 0.002575 |
| 1 | RH | -0.491800 | 0.491800 | 0.000020 |
| 2 | SR | -0.297351 | 0.297351 | 0.137964 |
| 3 | PRS | 0.117256 | 0.117256 | 0.268263 |
| 5 | WDR | -0.010015 | 0.010015 | 0.898942 |
| 4 | WSR | 0.006001 | 0.006001 | 0.955266 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|----------|
| Dep. Variable: | Y_4 | No. Observations: | 147 |
| Model: | SARIMAX(4, 1, 5) | Log Likelihood | -126.639 |
| Date: | Fri, 05 Dec 2025 | AIC | 285.279 |
| Time: | 08:31:55 | BIC | 332.345 |
| Sample: | 01-02-2022 | HQIC | 304.405 |
| | - 10-20-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|-------|---------|---------|--------|-------|--------|--------|
| x1 | 0.5450 | 0.181 | 3.014 | 0.003 | 0.191 | 0.899 |
| x2 | -0.4918 | 0.115 | -4.260 | 0.000 | -0.718 | -0.266 |
| x3 | -0.2974 | 0.200 | -1.483 | 0.138 | -0.690 | 0.096 |
| x4 | 0.1173 | 0.106 | 1.107 | 0.268 | -0.090 | 0.325 |
| x5 | 0.0060 | 0.107 | 0.056 | 0.955 | -0.204 | 0.216 |
| x6 | -0.0100 | 0.079 | -0.127 | 0.899 | -0.165 | 0.145 |
| ar.L1 | -0.2546 | 0.183 | -1.389 | 0.165 | -0.614 | 0.105 |

| | | | | | | |
|--------|---------|-------|--------|-------|--------|--------|
| ar.L2 | -1.3816 | 0.159 | -8.697 | 0.000 | -1.693 | -1.070 |
| ar.L3 | -0.0799 | 0.180 | -0.444 | 0.657 | -0.432 | 0.272 |
| ar.L4 | -0.7211 | 0.118 | -6.121 | 0.000 | -0.952 | -0.490 |
| ma.L1 | -0.3063 | 1.070 | -0.286 | 0.775 | -2.404 | 1.792 |
| ma.L2 | 1.3512 | 1.879 | 0.719 | 0.472 | -2.332 | 5.034 |
| ma.L3 | -0.7708 | 1.889 | -0.408 | 0.683 | -4.473 | 2.931 |
| ma.L4 | 0.7061 | 2.643 | 0.267 | 0.789 | -4.474 | 5.886 |
| ma.L5 | -0.5209 | 1.552 | -0.336 | 0.737 | -3.562 | 2.520 |
| sigma2 | 0.3345 | 0.983 | 0.340 | 0.734 | -1.593 | 2.262 |

```

=====
Ljung-Box (L1) (Q):                0.22    Jarque-Bera (JB):                48.97
Prob(Q):                      0.64    Prob(JB):                      0.00
Heteroskedasticity (H):          0.40    Skew:                          0.55
Prob(H) (two-sided):            0.00    Kurtosis:                      5.68
=====

```

SURESTE 3 - INDUSTRIAL

Y_1 (OZONO)

Frecuencia seleccionada: Diario
 AIC: 323.62643524009496
 MAE: 0.3271723882983883
 RMSE: 0.41969390567115683
 MAPE: 229.16267556036073
 R2: 0.35938055087249465
 LjungBox_p: 0.9526213980673802
 JarqueBera_p: 1.9593966626670116e-31
 best_order: (5, 0, 5)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | -0.154046 | 0.154046 | 3.079840e-32 |
| 2 | SR | 0.091980 | 0.091980 | 2.161608e-09 |
| 0 | TOUT | -0.054706 | 0.054706 | 2.053122e-02 |
| 4 | WSR | -0.030756 | 0.030756 | 2.623260e-02 |
| 3 | PRS | -0.007531 | 0.007531 | 5.325965e-01 |
| 5 | WDR | 0.000372 | 0.000372 | 9.753394e-01 |

SARIMAX Results

```

=====
Dep. Variable:          Y_1    No. Observations:          1021
Model:                SARIMAX(5, 0, 5)    Log Likelihood          -144.813
Date:                Fri, 05 Dec 2025    AIC                  323.626
Time:                07:27:18    BIC                  407.311
Sample:                01-01-2022    HQIC                 355.410
                   - 10-17-2024

```

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|----|---------|---------|---------|-------|--------|--------|
| x1 | -0.0547 | 0.024 | -2.316 | 0.021 | -0.101 | -0.008 |
| x2 | -0.1540 | 0.013 | -11.820 | 0.000 | -0.180 | -0.129 |
| x3 | 0.0920 | 0.015 | 5.985 | 0.000 | 0.062 | 0.122 |
| x4 | -0.0075 | 0.012 | -0.624 | 0.533 | -0.031 | 0.016 |
| x5 | -0.0308 | 0.014 | -2.223 | 0.026 | -0.058 | -0.004 |
| x6 | 0.0004 | 0.012 | 0.031 | 0.975 | -0.023 | 0.024 |

| | | | | | | |
|--------|---------|-------|--------|-------|--------|--------|
| ar.L1 | 0.1437 | 0.548 | 0.262 | 0.793 | -0.929 | 1.217 |
| ar.L2 | 0.0752 | 0.346 | 0.217 | 0.828 | -0.603 | 0.753 |
| ar.L3 | 0.7894 | 0.212 | 3.722 | 0.000 | 0.374 | 1.205 |
| ar.L4 | 0.2184 | 0.552 | 0.395 | 0.693 | -0.864 | 1.301 |
| ar.L5 | -0.3117 | 0.200 | -1.557 | 0.120 | -0.704 | 0.081 |
| ma.L1 | 0.4875 | 0.547 | 0.891 | 0.373 | -0.585 | 1.560 |
| ma.L2 | 0.2547 | 0.129 | 1.972 | 0.049 | 0.002 | 0.508 |
| ma.L3 | -0.5804 | 0.234 | -2.484 | 0.013 | -1.038 | -0.122 |
| ma.L4 | -0.5736 | 0.403 | -1.425 | 0.154 | -1.363 | 0.215 |
| ma.L5 | 0.0216 | 0.092 | 0.235 | 0.814 | -0.159 | 0.202 |
| sigma2 | 0.0774 | 0.003 | 28.901 | 0.000 | 0.072 | 0.083 |

=====

| | | | |
|-------------------------|------|-------------------|--------|
| Ljung-Box (L1) (Q): | 0.00 | Jarque-Bera (JB): | 147.45 |
| Prob(Q): | 0.98 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 1.08 | Skew: | 0.51 |
| Prob(H) (two-sided): | 0.46 | Kurtosis: | 4.57 |

=====

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: 12.023569355231764

MAE: 0.2515398932858567

RMSE: 0.3225164395715369

MAPE: 142.42351432156693

R2: 0.4458299858018254

LjungBox_p: 0.9187008568478583

JarqueBera_p: 3.461066012280149e-35

best_order: (3, 0, 2)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 1 | RH | -0.188484 | 0.188484 | 2.550838e-09 |
| 4 | WSR | 0.071604 | 0.071604 | 1.034516e-01 |
| 2 | SR | 0.053063 | 0.053063 | 3.023065e-01 |
| 5 | WDR | -0.039258 | 0.039258 | 3.229976e-01 |
| 3 | PRS | -0.023838 | 0.023838 | 6.348212e-01 |
| 0 | TOUT | 0.019820 | 0.019820 | 7.416441e-01 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|--------|
| Dep. Variable: | Y_1 | No. Observations: | 147 |
| Model: | SARIMAX(3, 0, 2) | Log Likelihood | 5.988 |
| Date: | Fri, 05 Dec 2025 | AIC | 12.024 |
| Time: | 07:27:18 | BIC | 47.661 |
| Sample: | 01-02-2022 | HQIC | 26.505 |
| | - 10-20-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|-------|---------|---------|--------|-------|--------|--------|
| x1 | 0.0198 | 0.060 | 0.330 | 0.742 | -0.098 | 0.138 |
| x2 | -0.1885 | 0.032 | -5.958 | 0.000 | -0.250 | -0.126 |
| x3 | 0.0531 | 0.051 | 1.031 | 0.302 | -0.048 | 0.154 |
| x4 | -0.0238 | 0.050 | -0.475 | 0.635 | -0.122 | 0.075 |
| x5 | 0.0716 | 0.044 | 1.628 | 0.103 | -0.015 | 0.158 |
| x6 | -0.0393 | 0.040 | -0.988 | 0.323 | -0.117 | 0.039 |
| ar.L1 | -0.2366 | 0.334 | -0.709 | 0.478 | -0.891 | 0.418 |
| ar.L2 | 0.1693 | 0.250 | 0.678 | 0.498 | -0.320 | 0.659 |
| ar.L3 | 0.4287 | 0.200 | 2.139 | 0.032 | 0.036 | 0.821 |
| ma.L1 | 0.7988 | 0.357 | 2.238 | 0.025 | 0.099 | 1.498 |

| | | | | | | |
|--------|--------|-------|-------|-------|--------|-------|
| ma.L2 | 0.3489 | 0.334 | 1.045 | 0.296 | -0.305 | 1.003 |
| sigma2 | 0.0536 | 0.005 | 9.880 | 0.000 | 0.043 | 0.064 |

| | | | |
|-------------------------|------|-------------------|--------|
| Ljung-Box (L1) (Q): | 0.03 | Jarque-Bera (JB): | 209.10 |
| Prob(Q): | 0.87 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 1.87 | Skew: | -0.72 |
| Prob(H) (two-sided): | 0.03 | Kurtosis: | 8.72 |

PM10 - TRANSFORMACION

Frecuencia seleccionada: Diario

AIC: 216.81852964508533

MAE: 34.98844948980857

RMSE: 44.95575011638834

MAPE: 63.57551685439676

R2: -0.2585020959186177

LjungBox_p: 0.7900234709424603

JarqueBera_p: 0.0

best_order: (4, 1, 1)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 0 | TOUT | 0.307819 | 0.307819 | 2.671201e-40 |
| 1 | RH | -0.126651 | 0.126651 | 2.736492e-24 |
| 4 | WSR | 0.078329 | 0.078329 | 4.670847e-09 |
| 5 | WDR | 0.038386 | 0.038386 | 1.290823e-04 |
| 3 | PRS | -0.027562 | 0.027562 | 9.358670e-02 |
| 2 | SR | 0.021879 | 0.021879 | 1.502708e-01 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|---------|
| Dep. Variable: | PM10 | No. Observations: | 1021 |
| Model: | SARIMAX(4, 1, 1) | Log Likelihood | -96.409 |
| Date: | Fri, 05 Dec 2025 | AIC | 216.819 |
| Time: | 08:33:43 | BIC | 275.902 |
| Sample: | 01-01-2022 | HQIC | 239.257 |
| | - 10-17-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|---------|-------|--------|--------|
| x1 | 0.3078 | 0.023 | 13.289 | 0.000 | 0.262 | 0.353 |
| x2 | -0.1267 | 0.012 | -10.169 | 0.000 | -0.151 | -0.102 |
| x3 | 0.0219 | 0.015 | 1.439 | 0.150 | -0.008 | 0.052 |
| x4 | -0.0276 | 0.016 | -1.677 | 0.094 | -0.060 | 0.005 |
| x5 | 0.0783 | 0.013 | 5.858 | 0.000 | 0.052 | 0.105 |
| x6 | 0.0384 | 0.010 | 3.828 | 0.000 | 0.019 | 0.058 |
| ar.L1 | 0.4941 | 0.034 | 14.698 | 0.000 | 0.428 | 0.560 |
| ar.L2 | -0.0708 | 0.035 | -2.027 | 0.043 | -0.139 | -0.002 |
| ar.L3 | 0.0323 | 0.032 | 1.015 | 0.310 | -0.030 | 0.095 |
| ar.L4 | -0.0918 | 0.031 | -2.989 | 0.003 | -0.152 | -0.032 |
| ma.L1 | -0.8650 | 0.025 | -34.637 | 0.000 | -0.914 | -0.816 |
| sigma2 | 0.0707 | 0.003 | 23.573 | 0.000 | 0.065 | 0.077 |

| | | | |
|-------------------------|------|-------------------|------|
| Ljung-Box (L1) (Q): | 0.00 | Jarque-Bera (JB): | 3.83 |
| Prob(Q): | 0.98 | Prob(JB): | 0.15 |
| Heteroskedasticity (H): | 1.13 | Skew: | 0.03 |
| Prob(H) (two-sided): | 0.26 | Kurtosis: | 3.30 |

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -32.35668820872353

MAE: 24.09903961803004

RMSE: 28.10390778484725

MAPE: 45.93550570962927

R2: 0.060560276120296574

LjungBox_p: 0.9999794365431032

JarqueBera_p: 0.0

best_order: (1, 0, 1)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 0 | TOUT | 0.153819 | 0.153819 | 5.523949e-04 |
| 1 | RH | -0.148816 | 0.148816 | 9.830673e-08 |
| 4 | WSR | 0.147144 | 0.147144 | 7.265042e-05 |
| 5 | WDR | 0.083020 | 0.083020 | 2.206306e-03 |
| 2 | SR | 0.014988 | 0.014988 | 7.569361e-01 |
| 3 | PRS | 0.007786 | 0.007786 | 8.582066e-01 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|---------|
| Dep. Variable: | PM10 | No. Observations: | 147 |
| Model: | SARIMAX(1, 0, 1) | Log Likelihood | 25.178 |
| Date: | Fri, 05 Dec 2025 | AIC | -32.357 |
| Time: | 08:33:43 | BIC | -5.566 |
| Sample: | 01-02-2022 | HQIC | -21.471 |
| | - 10-20-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|---------|-------|--------|--------|
| x1 | 0.1538 | 0.045 | 3.454 | 0.001 | 0.067 | 0.241 |
| x2 | -0.1488 | 0.028 | -5.330 | 0.000 | -0.204 | -0.094 |
| x3 | 0.0150 | 0.048 | 0.310 | 0.757 | -0.080 | 0.110 |
| x4 | 0.0078 | 0.044 | 0.179 | 0.858 | -0.078 | 0.093 |
| x5 | 0.1471 | 0.037 | 3.967 | 0.000 | 0.074 | 0.220 |
| x6 | 0.0830 | 0.027 | 3.061 | 0.002 | 0.030 | 0.136 |
| ar.L1 | 0.9993 | 0.003 | 344.602 | 0.000 | 0.994 | 1.005 |
| ma.L1 | -0.3324 | 0.076 | -4.359 | 0.000 | -0.482 | -0.183 |
| sigma2 | 0.0413 | 0.005 | 7.667 | 0.000 | 0.031 | 0.052 |

| | | | |
|-------------------------|------|-------------------|------|
| Ljung-Box (L1) (Q): | 0.09 | Jarque-Bera (JB): | 0.84 |
| Prob(Q): | 0.76 | Prob(JB): | 0.66 |
| Heteroskedasticity (H): | 1.36 | Skew: | 0.18 |
| Prob(H) (two-sided): | 0.29 | Kurtosis: | 3.09 |

PM2.5

Frecuencia seleccionada: Diario

AIC: 7383.223440961566

MAE: 9.190715467061294

RMSE: 11.936277012707885

MAPE: 56.13940744892558

R2: -0.7552096297654465

LjungBox_p: 0.0783907149734467

JarqueBera_p: 0.0

best_order: (4, 1, 5)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 0 | TOUT | 8.967145 | 8.967145 | 2.467496e-25 |
| 3 | PRS | -1.063212 | 1.063212 | 1.177332e-01 |
| 4 | WSR | 0.870783 | 0.870783 | 1.227814e-01 |
| 5 | WDR | 0.859381 | 0.859381 | 9.927807e-03 |
| 1 | RH | 0.436407 | 0.436407 | 4.437102e-01 |
| 2 | SR | 0.357714 | 0.357714 | 6.108972e-01 |

SARIMAX Results

```
=====
Dep. Variable:          PM2.5      No. Observations:          1021
Model:                SARIMAX(4, 1, 5)  Log Likelihood          -3675.612
Date:                 Fri, 05 Dec 2025  AIC                      7383.223
Time:                 08:35:16         BIC                      7461.970
Sample:              01-01-2022        HQIC                     7413.132
                  - 10-17-2024
=====
```

Covariance Type: opg

```
=====
              coef      std err          z      P>|z|      [0.025      0.975]
-----
x1              8.9671      0.862     10.400      0.000       7.277     10.657
x2              0.4364      0.570      0.766      0.444      -0.680      1.553
x3              0.3577      0.703      0.509      0.611      -1.020      1.736
x4             -1.0632      0.680     -1.564      0.118      -2.395      0.269
x5              0.8708      0.564      1.543      0.123      -0.235      1.977
x6              0.8594      0.333      2.578      0.010       0.206      1.513
ar.L1           0.2810      0.770      0.365      0.715      -1.228      1.790
ar.L2          -0.8096      0.457     -1.771      0.077      -1.705      0.086
ar.L3           0.0241      0.810      0.030      0.976      -1.563      1.611
ar.L4           0.1717      0.287      0.599      0.549      -0.390      0.733
ma.L1          -0.5831      0.768     -0.759      0.448      -2.088      0.922
ma.L2           0.6178      0.681      0.907      0.365      -0.718      1.954
ma.L3          -0.3046      0.724     -0.421      0.674      -1.724      1.114
ma.L4          -0.4568      0.493     -0.927      0.354      -1.422      0.509
ma.L5          -0.0187      0.161     -0.116      0.908      -0.334      0.296
sigma2         79.3223      3.855     20.577      0.000     71.767     86.878
=====
```

```
=====
Ljung-Box (L1) (Q):              0.00   Jarque-Bera (JB):              27687.16
Prob(Q):                      0.99   Prob(JB):                  0.00
Heteroskedasticity (H):          4.54   Skew:                      1.30
Prob(H) (two-sided):            0.00   Kurtosis:                  28.47
=====
```

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: 956.4619876318204

MAE: 4.918592911703587

RMSE: 6.235741992244046

MAPE: 25.01805851760056

R2: -0.20854679543406784

LjungBox_p: 0.8269777511199664

JarqueBera_p: 3.7114897042261763e-51

best_order: (4, 1, 5)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|----------|-----------|----------|
| 4 | WSR | 2.575685 | 2.575685 | 0.070537 |

| | | | | |
|---|------|-----------|----------|----------|
| 0 | TOUT | 2.368854 | 2.368854 | 0.130427 |
| 5 | WDR | 1.528959 | 1.528959 | 0.210270 |
| 3 | PRS | -1.383743 | 1.383743 | 0.295490 |
| 2 | SR | 0.928293 | 0.928293 | 0.623405 |
| 1 | RH | -0.541068 | 0.541068 | 0.576487 |

SARIMAX Results

```

=====
Dep. Variable:          PM2.5      No. Observations:          147
Model:                SARIMAX(4, 1, 5)  Log Likelihood          -462.231
Date:                  Fri, 05 Dec 2025  AIC                      956.462
Time:                  08:35:16         BIC                      1003.528
Sample:                01-02-2022      HQIC                      975.588
                  - 10-20-2024

Covariance Type:                opg
=====

```

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|---------|-------|--------|--------|
| x1 | 2.3689 | 1.566 | 1.512 | 0.130 | -0.701 | 5.439 |
| x2 | -0.5411 | 0.969 | -0.559 | 0.576 | -2.440 | 1.358 |
| x3 | 0.9283 | 1.891 | 0.491 | 0.623 | -2.777 | 4.634 |
| x4 | -1.3837 | 1.323 | -1.046 | 0.295 | -3.976 | 1.209 |
| x5 | 2.5757 | 1.424 | 1.808 | 0.071 | -0.216 | 5.367 |
| x6 | 1.5290 | 1.220 | 1.253 | 0.210 | -0.863 | 3.921 |
| ar.L1 | -0.9345 | 0.088 | -10.666 | 0.000 | -1.106 | -0.763 |
| ar.L2 | -1.1617 | 0.083 | -14.019 | 0.000 | -1.324 | -0.999 |
| ar.L3 | -0.9132 | 0.106 | -8.603 | 0.000 | -1.121 | -0.705 |
| ar.L4 | -0.7736 | 0.094 | -8.191 | 0.000 | -0.959 | -0.589 |
| ma.L1 | 0.7496 | 0.123 | 6.081 | 0.000 | 0.508 | 0.991 |
| ma.L2 | 0.7499 | 0.136 | 5.531 | 0.000 | 0.484 | 1.016 |
| ma.L3 | 0.4745 | 0.167 | 2.835 | 0.005 | 0.146 | 0.803 |
| ma.L4 | 0.2663 | 0.147 | 1.810 | 0.070 | -0.022 | 0.555 |
| ma.L5 | -0.4354 | 0.100 | -4.350 | 0.000 | -0.632 | -0.239 |
| sigma2 | 41.9395 | 5.599 | 7.491 | 0.000 | 30.966 | 52.913 |

```

=====
Ljung-Box (L1) (Q):                0.04      Jarque-Bera (JB):                1.81
Prob(Q):                          0.84      Prob(JB):                0.40
Heteroskedasticity (H):            2.04      Skew:                    0.17
Prob(H) (two-sided):              0.02      Kurtosis:                3.44
=====

```

Y_3 (Nitrogenos)

Frecuencia seleccionada: Diario

AIC: 945.9603363450328

MAE: 0.6380057587477427

RMSE: 0.7320007512424455

MAPE: 832.3091252711893

R2: -1.4634267197455912

LjungBox_p: 0.516437442862997

JarqueBera_p: 0.0

best_order: (5, 1, 5)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 0 | TOUT | 0.177340 | 0.177340 | 5.296231e-07 |
| 4 | WSR | 0.107901 | 0.107901 | 1.197773e-10 |
| 3 | PRS | -0.086402 | 0.086402 | 8.456000e-04 |
| 5 | WDR | 0.065176 | 0.065176 | 1.857919e-06 |
| 1 | RH | -0.051790 | 0.051790 | 6.112335e-03 |
| 2 | SR | 0.046461 | 0.046461 | 1.043010e-01 |

SARIMAX Results

```

=====
Dep. Variable:          Y_3      No. Observations:          1021
Model:                SARIMAX(5, 1, 5)      Log Likelihood          -455.980
Date:                Fri, 05 Dec 2025      AIC              945.960
Time:                07:28:44      BIC              1029.629
Sample:                01-01-2022      HQIC             977.739
                    - 10-17-2024

```

Covariance Type: opg

```

=====
              coef      std err          z      P>|z|      [0.025      0.975]
-----
x1              0.1773      0.035      5.015      0.000      0.108      0.247
x2             -0.0518      0.019     -2.742      0.006     -0.089     -0.015
x3              0.0465      0.029      1.624      0.104     -0.010      0.103
x4             -0.0864      0.026     -3.337      0.001     -0.137     -0.036
x5              0.1079      0.017      6.440      0.000      0.075      0.141
x6              0.0652      0.014      4.768      0.000      0.038      0.092
ar.L1           -0.2188      0.165     -1.324      0.186     -0.543      0.105
ar.L2            0.5464      0.074      7.431      0.000      0.402      0.691
ar.L3            0.6200      0.113      5.485      0.000      0.398      0.842
ar.L4            0.2147      0.086      2.507      0.012      0.047      0.383
ar.L5           -0.3460      0.055     -6.253      0.000     -0.454     -0.238
ma.L1            0.1174      0.148      0.794      0.427     -0.172      0.407
ma.L2           -1.2657      0.178     -7.092      0.000     -1.616     -0.916
ma.L3           -0.6017      0.182     -3.304      0.001     -0.959     -0.245
ma.L4            0.0429      0.101      0.422      0.673     -0.156      0.242
ma.L5            0.7634      0.104      7.340      0.000      0.560      0.967
sigma2           0.1062      0.026      4.087      0.000      0.055      0.157
=====

```

```

=====
Ljung-Box (L1) (Q):                0.00      Jarque-Bera (JB):                1510.52
Prob(Q):                          0.99      Prob(JB):                          0.00
Heteroskedasticity (H):            2.84      Skew:                              0.56
Prob(H) (two-sided):              0.00      Kurtosis:                          8.87
=====

```

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -0.07522503172011596

MAE: 0.1783314586452633

RMSE: 0.23245262684687867

MAPE: 110.92091489213765

R2: 0.49279289131386084

LjungBox_p: 0.9062571283005748

JarqueBera_p: 1.4628443388973206e-49

best_order: (5, 0, 1)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|----------|
| 4 | WSR | 0.277718 | 0.277718 | 0.000016 |
| 5 | WDR | 0.118887 | 0.118887 | 0.013299 |
| 1 | RH | -0.112821 | 0.112821 | 0.002253 |
| 2 | SR | -0.068378 | 0.068378 | 0.298577 |
| 3 | PRS | -0.057976 | 0.057976 | 0.138886 |
| 0 | TOUT | 0.050481 | 0.050481 | 0.488160 |

SARIMAX Results

```

=====
Dep. Variable:          Y_3      No. Observations:          147
Model:                SARIMAX(5, 0, 1)      Log Likelihood          13.038

```

| | | | |
|------------------|------------------|------|--------|
| Date: | Fri, 05 Dec 2025 | AIC | -0.075 |
| Time: | 07:28:44 | BIC | 38.351 |
| Sample: | 01-02-2022 | HQIC | 15.539 |
| | - 10-20-2024 | | |
| Covariance Type: | opg | | |

Y_4 (So2)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|--------------|
| 2 | SR | 0.108955 | 0.108955 | 1.718580e-07 |
| 4 | WSR | -0.083382 | 0.083382 | 6.879583e-05 |
| 1 | RH | -0.020056 | 0.020056 | 2.213524e-01 |
| 3 | PRS | -0.015436 | 0.015436 | 4.738041e-01 |
| 5 | WDR | 0.011377 | 0.011377 | 4.846381e-01 |
| 0 | TOUT | -0.001824 | 0.001824 | 9.458601e-01 |

| | | | | | | |
|--------|---------|-------|---------|-------|--------|--------|
| x1 | -0.0018 | 0.027 | -0.068 | 0.946 | -0.054 | 0.051 |
| x2 | -0.0201 | 0.016 | -1.223 | 0.221 | -0.052 | 0.012 |
| x3 | 0.1090 | 0.021 | 5.227 | 0.000 | 0.068 | 0.150 |
| x4 | -0.0154 | 0.022 | -0.716 | 0.474 | -0.058 | 0.027 |
| x5 | -0.0834 | 0.021 | -3.980 | 0.000 | -0.124 | -0.042 |
| x6 | 0.0114 | 0.016 | 0.699 | 0.485 | -0.021 | 0.043 |
| ar.L1 | 0.6626 | 0.085 | 7.807 | 0.000 | 0.496 | 0.829 |
| ma.L1 | -1.3410 | 0.097 | -13.850 | 0.000 | -1.531 | -1.151 |
| ma.L2 | 0.3776 | 0.085 | 4.424 | 0.000 | 0.210 | 0.545 |
| sigma2 | 0.0909 | 0.003 | 28.030 | 0.000 | 0.085 | 0.097 |

| | | | |
|-------------------------|------|-------------------|--------|
| Ljung-Box (L1) (Q): | 0.02 | Jarque-Bera (JB): | 155.61 |
| Prob(Q): | 0.88 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 0.96 | Skew: | 0.74 |
| Prob(H) (two-sided): | 0.73 | Kurtosis: | 4.22 |

Warnings:

[1] Covariance matrix calculated using the outer product of gradients (complex-step).

Frecuencia seleccionada: Semanal

AIC: -32.74516854787547

MAE: 2.7316172501371696

RMSE: 4.838605457936486

MAPE: 27.125399006602123

R2: -0.0502211945167903

LjungBox_p: 0.40402312350462655

JarqueBera_p: 2.2633221511271885e-117

best_order: (1, 1, 2)

| | Variable | Coef | AbsImpact | Pvalue |
|---|----------|-----------|-----------|----------|
| 2 | SR | 0.154358 | 0.154358 | 0.005207 |
| 3 | PRS | 0.065304 | 0.065304 | 0.158239 |
| 0 | TOUT | 0.059061 | 0.059061 | 0.320109 |
| 4 | WSR | 0.040726 | 0.040726 | 0.273537 |
| 5 | WDR | 0.040007 | 0.040007 | 0.211182 |
| 1 | RH | -0.034103 | 0.034103 | 0.271761 |

SARIMAX Results

| | | | |
|----------------|------------------|-------------------|---------|
| Dep. Variable: | Y_4 | No. Observations: | 147 |
| Model: | SARIMAX(1, 1, 2) | Log Likelihood | 26.373 |
| Date: | Fri, 05 Dec 2025 | AIC | -32.745 |
| Time: | 08:38:07 | BIC | -3.117 |
| Sample: | 01-02-2022 | HQIC | -20.706 |
| | - 10-20-2024 | | |

Covariance Type: opg

| | coef | std err | z | P> z | [0.025 | 0.975] |
|--------|---------|---------|---------|-------|----------|---------|
| x1 | 0.0591 | 0.059 | 0.994 | 0.320 | -0.057 | 0.175 |
| x2 | -0.0341 | 0.031 | -1.099 | 0.272 | -0.095 | 0.027 |
| x3 | 0.1544 | 0.055 | 2.794 | 0.005 | 0.046 | 0.263 |
| x4 | 0.0653 | 0.046 | 1.411 | 0.158 | -0.025 | 0.156 |
| x5 | 0.0407 | 0.037 | 1.095 | 0.274 | -0.032 | 0.114 |
| x6 | 0.0400 | 0.032 | 1.250 | 0.211 | -0.023 | 0.103 |
| ar.L1 | -0.8829 | 0.043 | -20.582 | 0.000 | -0.967 | -0.799 |
| ma.L1 | 0.5271 | 102.551 | 0.005 | 0.996 | -200.470 | 201.524 |
| ma.L2 | -0.4729 | 48.494 | -0.010 | 0.992 | -95.520 | 94.574 |
| sigma2 | 0.0394 | 4.035 | 0.010 | 0.992 | -7.870 | 7.949 |

| | | | |
|-------------------------|------|-------------------|-------|
| Ljung-Box (L1) (Q): | 0.18 | Jarque-Bera (JB): | 13.86 |
| Prob(Q): | 0.67 | Prob(JB): | 0.00 |
| Heteroskedasticity (H): | 0.99 | Skew: | 0.32 |
| Prob(H) (two-sided): | 0.96 | Kurtosis: | 4.39 |

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