

Pasos

1. Procesamos los datos correctamente
 2. Regresión lineal
-

OLS Regression Results

Dep. Variable:	volume_sales	R-squared:	0.833			
Model:	OLS	Adj. R-squared:	0.826			
Method:	Least Squares	F-statistic:	134.2			
Date:	Thu, 20 Nov 2025	Prob (F-statistic):	4.22e-223			
Time:	18:27:48	Log-Likelihood:	-7343.0			
No. Observations:	644	AIC:	1.473e+04			
Df Residuals:	620	BIC:	1.484e+04			
Df Model:	23					
Covariance Type:	nonrobust					
	coef	std err	t	P> t	[0.025	0.975]
Intercept	1.21e+04	2671.315	4.530	0.000	6855.607	1.73e+04
C(supermarket) [T.supermarket-B]	2.319e+04	9730.122	2.383	0.017	4078.902	4.23e+04
C(supermarket) [T.supermarket-D]	-1.051e+05	1.42e+04	-7.402	0.000	-1.33e+05	-7.72e+04
C(variant)[T.standard]	2.624e+04	6175.874	4.249	0.000	1.41e+04	3.84e+04
C(variant)[T.vegan]	7.521e+04	1.85e+04	4.071	0.000	3.89e+04	1.11e+05
C(pack_size)[T.351 - 500 GR]	8.22e+04	5413.805	15.183	0.000	7.16e+04	9.28e+04
C(pack_size)[T.501 - 700 GR]	2.179e+04	3537.727	6.160	0.000	1.48e+04	2.87e+04
C(pack_size)[T.701 - 1000 GR]	-1.993e+04	6573.311	-3.033	0.003	-3.28e+04	-7025.422
C(supermarket) [T.supermarket- B]:C(variant)[T.light]	-1.924e+04	7704.010	-2.497	0.013	-3.44e+04	-4109.905
C(supermarket) [T.supermarket- B]:C(pack_size)[T.351 - 500 GR]	3.004e+04	6014.788	4.995	0.000	1.82e+04	4.19e+04

C]:C(variant)[T.light]						
C(supermarket)						
[T.supermarket-	-5.204e+04	7152.188	-7.276	0.000	-6.61e+04	-3.8e+04
B]:C(variant)[T.standard]						
C(supermarket)						
[T.supermarket-	-3.216e+04	5178.112	-6.210	0.000	-4.23e+04	-2.2e+04
C]:C(variant)[T.standard]						
C(supermarket)						
[T.supermarket-	6.913e+04	7708.818	8.968	0.000	5.4e+04	8.43e+04
D]:C(variant)[T.standard]						
C(supermarket)						
[T.supermarket-	7.112e+04	1.43e+04	4.988	0.000	4.31e+04	9.91e+04
B]:C(variant)[T.vegan]						
C(supermarket)						
[T.supermarket-	-3.356e+04	5564.661	-6.031	0.000	-4.45e+04	-2.26e+04
C]:C(pack_size)[T.351 - 500 GR]						
C(supermarket)						
[T.supermarket-	3.171e+04	7293.879	4.348	0.000	1.74e+04	4.6e+04
D]:C(pack_size)[T.351 - 500 GR]						
C(supermarket)						
[T.supermarket-	2.179e+04	3537.727	6.160	0.000	1.48e+04	2.87e+04
D]:C(pack_size)[T.501 - 700 GR]						
C(supermarket)						
[T.supermarket-	5.548e+04	7817.231	7.097	0.000	4.01e+04	7.08e+04
B]:C(pack_size)[T.701 - 1000 GR]						
C(variant)						
[T.light]:C(pack_size)	3.515e+04	9389.189	3.744	0.000	1.67e+04	5.36e+04
[T.351 - 500 GR]						
C(variant)						
[T.vegan]:C(pack_size)	9.395e-11	1.29e-11	7.287	0.000	6.86e-11	1.19e-10
[T.351 - 500 GR]						
C(variant)						
[T.light]:C(pack_size)	2.179e+04	3537.727	6.160	0.000	1.48e+04	2.87e+04
[T.501 - 700 GR]						
C(variant)						
[T.light]:C(pack_size)	2.423e+04	6821.642	3.552	0.000	1.08e+04	3.76e+04
[T.701 - 1000 GR]						

C(variant)	-4.416e+04	7450.494	-5.928	0.000	-5.88e+04	-2.95e+04
[T.standard]:C(pack_size)						
[T.701 - 1000 GR]						
price:C(supermarket)	-3.204e+04	8711.473	-3.677	0.000	-4.91e+04	-1.49e+04
[T.supermarket-B]						
price:C(supermarket)	1.217e+05	1.45e+04	8.375	0.000	9.32e+04	1.5e+05
[T.supermarket-D]						
price:C(variant)[T.light]	-6.512e+04	9743.408	-6.684	0.000	-8.43e+04	-4.6e+04
price:C(variant)[T.vegan]	-8.96e+04	2e+04	-4.477	0.000	-1.29e+05	-5.03e+04
price:C(pack_size)[T.701 - 1000 GR]	4.872e+04	8836.075	5.513	0.000	3.14e+04	6.61e+04
Omnibus:	108.327	Durbin-Watson:	1.898			
Prob(Omnibus):	0.000	Jarque-Bera (JB):	1530.123			
Skew:	0.176	Prob(JB):	0.00			
Kurtosis:	10.543	Cond. No.	1.47e+16			

Notes:

[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.

[2] The smallest eigenvalue is 6.43e-30. This might indicate that there are strong multicollinearity problems or that the design matrix is singular.

3. Convertimos interacciones significativas del modelo de regresión en variables exógenas

Importante:

Recuerda: coincidiendo interacciones significativas = variables exógenas que meteremos al modelo

4. Lanzamos modelo auto_arima y nos devuelve:

- ARIMA(0,1,0)(0,1,0)[12] : AIC=18700.911, Time=0.38 sec
- ARIMA(0,1,0)(0,1,1)[12] : AIC=inf, Time=23.23 sec
- ARIMA(0,1,0)(1,1,0)[12] : AIC=15113.200, Time=10.78 sec
- ARIMA(0,1,0)(1,1,1)[12] : AIC=inf, Time=28.88 sec
- ARIMA(0,1,1)(0,1,0)[12] : AIC=inf, Time=1.92 sec
- ARIMA(0,1,1)(0,1,1)[12] : AIC=inf, Time=96.38 sec
- ARIMA(0,1,1)(1,1,0)[12] : AIC=inf, Time=88.04 sec
- ARIMA(0,1,1)(1,1,1)[12] : AIC=inf, Time=57.00 sec
- ARIMA(0,1,2)(0,1,0)[12] : AIC=inf, Time=6.35 sec
- ARIMA(0,1,2)(0,1,1)[12] : AIC=inf, Time=78.86 sec
- ARIMA(0,1,2)(1,1,0)[12] : AIC=inf, Time=58.06 sec
- ARIMA(0,1,2)(1,1,1)[12] : AIC=inf, Time=57.61 sec

- ARIMA(0,1,3)(0,1,0)[12] : AIC=inf, Time=12.50 sec
 - ARIMA(0,1,3)(0,1,1)[12] : AIC=inf, Time=56.99 sec
 - ARIMA(0,1,3)(1,1,0)[12] : AIC=inf, Time=82.80 sec
 - ARIMA(0,1,3)(1,1,1)[12] : AIC=inf, Time=70.21 sec
 - ARIMA(1,1,0)(0,1,0)[12] : AIC=15113.277, Time=0.36 sec
 - ARIMA(1,1,0)(0,1,1)[12] : AIC=inf, Time=29.57 sec
 - ARIMA(1,1,0)(1,1,0)[12] : AIC=14983.257, Time=16.95 sec
 - ARIMA(1,1,0)(1,1,1)[12] : AIC=inf, Time=34.50 sec
 - ARIMA(1,1,1)(0,1,0)[12] : AIC=inf, Time=3.38 sec
 - ARIMA(1,1,1)(0,1,1)[12] : AIC=inf, Time=51.97 sec
 - ARIMA(1,1,1)(1,1,0)[12] : AIC=inf, Time=93.29 sec
 - ARIMA(1,1,1)(1,1,1)[12] : AIC=inf, Time=50.14 sec
 - ARIMA(1,1,2)(0,1,0)[12] : AIC=inf, Time=11.54 sec
 - ARIMA(1,1,2)(0,1,1)[12] : AIC=inf, Time=138.71 sec
 - ARIMA(1,1,2)(1,1,0)[12] : AIC=inf, Time=111.73 sec
 - ARIMA(1,1,2)(1,1,1)[12] : AIC=inf, Time=86.58 sec
 - ARIMA(1,1,3)(0,1,0)[12] : AIC=inf, Time=15.24 sec
 - ARIMA(1,1,3)(0,1,1)[12] : AIC=inf, Time=101.63 sec
 - ARIMA(1,1,3)(1,1,0)[12] : AIC=inf, Time=113.73 sec
 - ARIMA(2,1,0)(0,1,0)[12] : AIC=15067.640, Time=0.96 sec
 - ARIMA(2,1,0)(0,1,1)[12] : AIC=inf, Time=26.75 sec
 - ARIMA(2,1,0)(1,1,0)[12] : AIC=14940.126, Time=18.18 sec
 - ARIMA(2,1,0)(1,1,1)[12] : AIC=inf, Time=35.02 sec
 - ARIMA(2,1,1)(0,1,0)[12] : AIC=inf, Time=6.97 sec
 - ARIMA(2,1,1)(0,1,1)[12] : AIC=inf, Time=51.02 sec
 - ARIMA(2,1,1)(1,1,0)[12] : AIC=inf, Time=78.25 sec
 - ARIMA(2,1,1)(1,1,1)[12] : AIC=inf, Time=62.28 sec
 - ARIMA(2,1,2)(0,1,0)[12] : AIC=inf, Time=7.46 sec
 - ARIMA(2,1,2)(0,1,1)[12] : AIC=inf, Time=91.79 sec
 - ARIMA(2,1,2)(1,1,0)[12] : AIC=inf, Time=108.89 sec
 - ARIMA(2,1,3)(0,1,0)[12] : AIC=inf, Time=20.21 sec
 - ARIMA(3,1,0)(0,1,0)[12] : AIC=15033.538, Time=2.24 sec
 - ARIMA(3,1,0)(0,1,1)[12] : AIC=inf, Time=28.82 sec
 - ARIMA(3,1,0)(1,1,0)[12] : AIC=14902.971, Time=21.48 sec
 - ARIMA(3,1,0)(1,1,1)[12] : AIC=inf, Time=39.66 sec
 - ARIMA(3,1,1)(0,1,0)[12] : AIC=inf, Time=7.83 sec
 - ARIMA(3,1,1)(0,1,1)[12] : AIC=inf, Time=73.91 sec
 - ARIMA(3,1,1)(1,1,0)[12] : AIC=inf, Time=59.58 sec
 - ARIMA(3,1,2)(0,1,0)[12] : AIC=inf, Time=10.01 sec
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SARIMAX Results							
Dep. Variable:	y	No. Observations:	644				
Model:	SARIMAX(3, 1, 0)x(1, 1, 0, 12)	Log Likelihood	-7419.486				
Date:	Wed, 19 Nov 2025	AIC	14902.971				
Time:	14:33:56	BIC	15045.285				
Sample:	0 - 644	HQIC	14958.246				
Covariance Type:	opg						
		coef	std err	z	P> z	[0.025	0.975]
C(supermarket)[T.supermarket-B]		-3192.3694	1.41e+04	-0.226	0.821	-3.08e+04	2.45e+04
C(supermarket)[T.supermarket-D]		-7.791e+04	1.5e+04	-5.178	0.000	-1.07e+05	-4.84e+04
C(variant)[T.standard]		2.619e+04	9614.302	2.724	0.006	7346.428	4.5e+04
C(variant)[T.vegan]		5.392e+04	2.74e+04	1.969	0.049	235.540	1.08e+05
C(pack_size)[T.351 - 500 GR]		7.525e+04	8093.340	9.297	0.000	5.94e+04	9.11e+04
C(pack_size)[T.501 - 700 GR]		1.42e+04	5364.942	2.646	0.008	3681.065	2.47e+04
C(pack_size)[T.701 - 1000 GR]		-2.322e+04	1.09e+04	-2.125	0.034	-4.46e+04	-1806.192
C(supermarket)[T.supermarket-B]:C(variant)[T.light]		-1.74e+04	1.19e+04	-1.466	0.143	-4.07e+04	5862.670
C(supermarket)[T.supermarket-C]:C(variant)[T.light]		2.212e+04	8521.618	2.596	0.009	5418.744	3.88e+04
C(supermarket)[T.supermarket-B]:C(variant)[T.standard]		-3.483e+04	1.06e+04	-3.279	0.001	-5.56e+04	-1.4e+04
C(supermarket)[T.supermarket-C]:C(variant)[T.standard]		-3.223e+04	6658.052	-4.841	0.000	-4.53e+04	-1.92e+04
C(supermarket)[T.supermarket-D]:C(variant)[T.standard]		6.842e+04	8013.316	8.539	0.000	5.27e+04	8.41e+04
C(supermarket)[T.supermarket-B]:C(variant)[T.vegan]		5.082e+04	2.39e+04	2.130	0.033	4051.528	9.76e+04
C(supermarket)[T.supermarket-C]:C(pack_size)[T.351 - 500 GR]		-2.522e+04	7861.256	-3.209	0.001	-4.06e+04	-9816.624
C(supermarket)[T.supermarket-D]:C(pack_size)[T.351 - 500 GR]		2.581e+04	8808.127	2.930	0.003	8542.885	4.31e+04
C(supermarket)[T.supermarket-D]:C(pack_size)[T.501 - 700 GR]		1.42e+04	5364.942	2.646	0.008	3681.065	2.47e+04
C(supermarket)[T.supermarket-B]:C(pack_size)[T.701 - 1000 GR]		3.429e+04	1.11e+04	3.090	0.002	1.25e+04	5.6e+04
C(variant)[T.light]:C(pack_size)[T.351 - 500 GR]		2.712e+04	1.61e+04	1.682	0.093	-4487.205	5.87e+04
C(variant)[T.vegan]:C(pack_size)[T.351 - 500 GR]		-2.382e-11	6.583	-3.62e-12	1.000	-12.902	12.902
C(variant)[T.light]:C(pack_size)[T.501 - 700 GR]		1.42e+04	5364.942	2.646	0.008	3681.065	2.47e+04
C(variant)[T.light]:C(pack_size)[T.701 - 1000 GR]		1.803e+04	1.24e+04	1.450	0.147	-6333.147	4.24e+04
C(variant)[T.standard]:C(pack_size)[T.701 - 1000 GR]		-4.125e+04	1.15e+04	-3.596	0.000	-6.37e+04	-1.88e+04
price:C(supermarket)[T.supermarket-B]		-1.19e+04	1.28e+04	-0.929	0.353	-3.7e+04	1.32e+04
price:C(supermarket)[T.supermarket-D]		9.066e+04	1.61e+04	5.633	0.000	5.91e+04	1.22e+05
price:C(variant)[T.light]		-5.29e+04	1.5e+04	-3.527	0.000	-8.23e+04	-2.35e+04
price:C(variant)[T.vegan]		-6.627e+04	3.07e+04	-2.159	0.031	-1.26e+05	-6104.339
price:C(pack_size)[T.701 - 1000 GR]		4.816e+04	1.29e+04	3.738	0.000	2.29e+04	7.34e+04
ar.L1		-0.6415	0.048	-13.286	0.000	-0.736	-0.547
ar.L2		-0.4041	0.049	-8.257	0.000	-0.500	-0.308
ar.L3		-0.2493	0.044	-5.672	0.000	-0.335	-0.163
ar.S.L12		-0.4658	0.038	-12.331	0.000	-0.540	-0.392
sigma2		1.18e+09	1.934	6.1e+08	0.000	1.18e+09	1.18e+09
Ljung-Box (L1) (Q):	3.14	Jarque-Bera (JB):	219.27				
Prob(Q):	0.08	Prob(JB):	0.00				
Heteroskedasticity (H):	2.61	Skew:	0.23				
Prob(H) (two-sided):	0.00	Kurtosis:	5.85				

Importante:

!! Nos fijamos que muchos modelos no convergen.

5. Chequeamos residuos del modelo anterior

Residues Analysis (White Noise)

- [Heteroscedasticity Test] ARCH p-value:
 - 4.80189902198319e-11 -- range(> 0.05)
- [Normality Test] Jarque-Bera p-value:
 - 4**.601860723233844e-50 -- range(> 0.05)**
- [Normality Test] Shapiro-Wilk p-value:

- 7.320723375739127e-12 -- range(> 0.05)
- [Autocorrelation Test] Ljung-Box p-value: lb_stat | lb_pvalue
 - 10 102.058246 2.109089e-17 -- range(> 0.05)
- [Autocorrelation Test first order] Durbin-Watson statistic:
 - 2.1436117794872604 -- range(2.0)

Residues Analysis (Stationarity)

Estadístico ADF: -7.853404794535187 Valor p: 5.5237520752949304e-12 -- es estacionaria si p < 0.05
Valores críticos: 1%: -3.440890045708521 5%: -2.8661904001753618 10%: -2.569246579178572

Importante:

!! Salen muy mal. Y no nos sale ruido blanco

Mejora del modelo

Hacemos un análisis y concluimos que:

SOLUCIÓN: LIMPIEZA DE VARIABLES EXÓGENAS

1. ELIMINANDO VARIABLES CONSTANTES: Eliminando 1 variables constantes:
 - C(variant)[T.vegan]:C(pack_size)[T.351 - 500 GR]
2. ELIMINANDO VARIABLES CON CORRELACIÓN PERFECTA: Eliminando 2 variables con correlación perfecta:
 - C(variant)[T.light]:C(pack_size)[T.501 - 700 GR]
 - C(supermarket)[T.supermarket-D]:C(pack_size)[T.501 - 700 GR]
3. ELIMINANDO VARIABLES ALTAMENTE CORRELACIONADAS ($|r| > 0.95$): Eliminando 3 variables altamente correlacionadas:
 - price:C(supermarket)[T.supermarket-D]
 - price:C(variant)[T.vegan]
 - price:C(pack_size)[T.701 - 1000 GR]
4. VERIFICANDO NÚMERO DE CONDICIÓN DESPUÉS DE LA LIMPIEZA: Número de condición original: 7.48e+17 Número de condición después de limpieza: 2.89e+15  AÚN HAY MULTICOLINEALIDAD EXTREMA  Considera eliminar más variables o usar regularización
5. RESUMEN:
 - Variables originales: 27
 - Variables después de limpieza: 21
 - Variables eliminadas: 6
 - Reducción: 22.2%

6. Volvemos a hacer el modelo auto_arima

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=====
PROBANDO AUTO_ARIMA CON VARIABLES LIMPIAS
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💡 Configuración:
- Variables exógenas: 21
- Observaciones: 644
- Variable dependiente: volume.sales

⌚ Probando auto_arima con variables limpias...
(Esto puede tardar varios minutos)

Performing stepwise search to minimize aic
ARIMA(0,0,0)(0,1,0)[12] intercept : AIC=14917.986, Time=0.35 sec
ARIMA(1,0,0)(1,1,0)[12] intercept : AIC=14795.345, Time=6.94 sec
ARIMA(0,0,1)(0,1,1)[12] intercept : AIC=inf, Time=19.83 sec
ARIMA(0,0,0)(0,1,0)[12] : AIC=18360.693, Time=0.30 sec
ARIMA(1,0,0)(0,1,0)[12] intercept : AIC=14919.841, Time=0.22 sec
ARIMA(1,0,0)(1,1,1)[12] intercept : AIC=inf, Time=21.73 sec
ARIMA(1,0,0)(0,1,1)[12] intercept : AIC=inf, Time=103.21 sec
ARIMA(0,0,0)(1,1,0)[12] intercept : AIC=14794.161, Time=5.77 sec
ARIMA(0,0,0)(1,1,1)[12] intercept : AIC=inf, Time=70.30 sec
ARIMA(0,0,0)(0,1,1)[12] intercept : AIC=inf, Time=80.19 sec
ARIMA(0,0,1)(1,1,0)[12] intercept : AIC=14795.855, Time=11.04 sec
ARIMA(1,0,1)(1,1,0)[12] intercept : AIC=14797.848, Time=23.92 sec
ARIMA(0,0,0)(1,1,0)[12] : AIC=14777.748, Time=7.15 sec
ARIMA(0,0,0)(1,1,1)[12] : AIC=inf, Time=22.77 sec
ARIMA(0,0,0)(0,1,1)[12] : AIC=inf, Time=14.72 sec
ARIMA(1,0,0)(1,1,0)[12] : AIC=14793.366, Time=10.12 sec
ARIMA(0,0,1)(1,1,0)[12] : AIC=14793.888, Time=10.62 sec
ARIMA(1,0,1)(1,1,0)[12] : AIC=14795.881, Time=30.48 sec

Best model: ARIMA(0,0,0)(1,1,0)[12]
Total fit time: 439.849 seconds

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✅ ¡ÉXITO! auto_arima funcionó con las variables limpias
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✓ RESULTADOS DEL MEJOR MODELO:
- Orden ARIMA: (0, 0, 0)
- Orden estacional: (1, 1, 0, 12)
- AIC: 14777.75
- BIC: 14880.07
- Tiempo de ejecución: 439.9 segundos (7.3 minutos)

💡 Comparación:
- Variables originales: 27 → AIC infinito en muchos modelos
- Variables limpias: 21 → AIC: 14777.75
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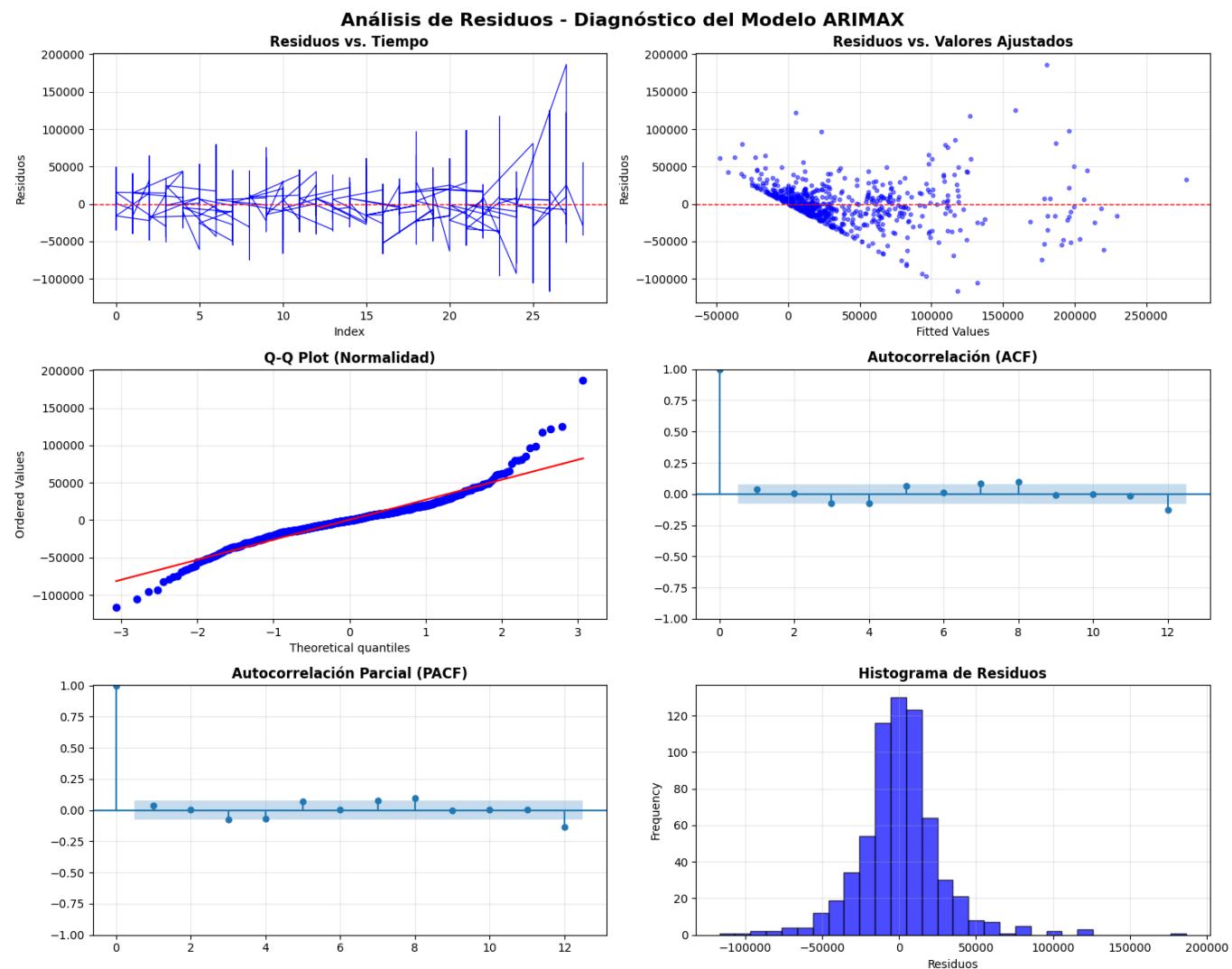
7. Residuos del modelo nuevo

Residues Analysis (White Noise)

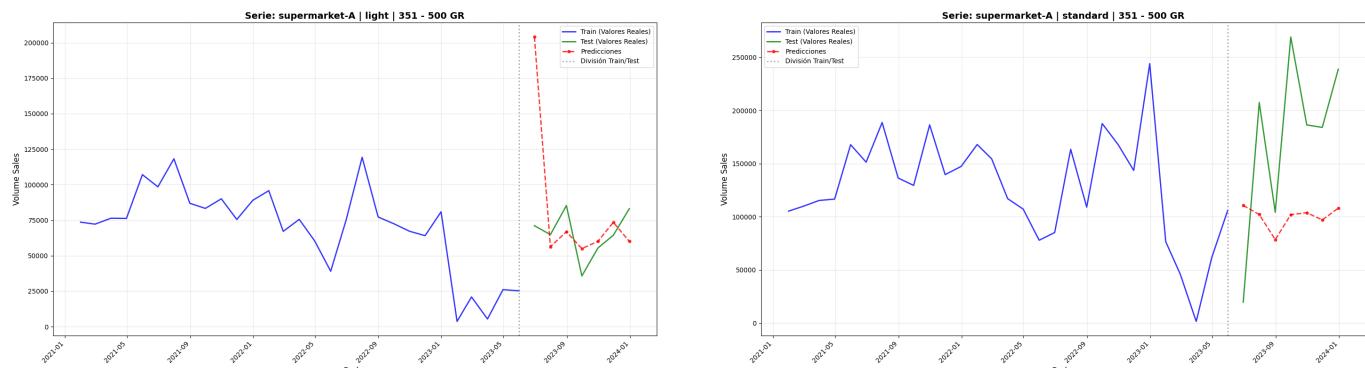
- [Heteroscedasticity Test] ARCH p-value:
 - 0.0003964551491381505 -- range(> 0.05)
- [Normality Test] Jarque-Bera p-value:

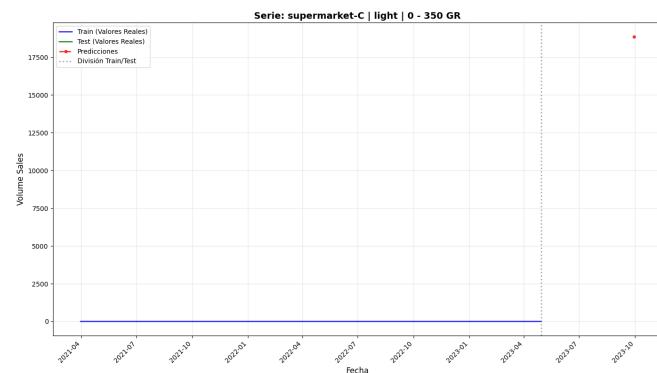
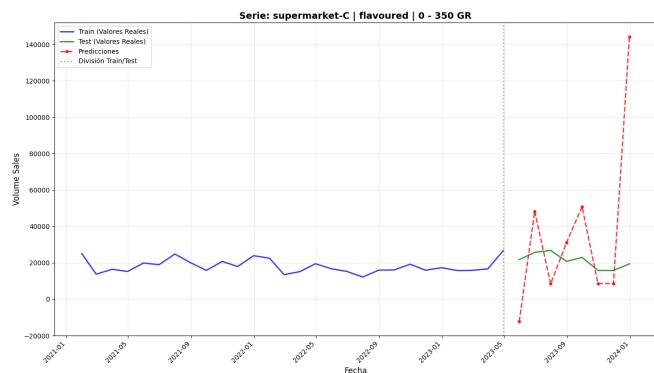
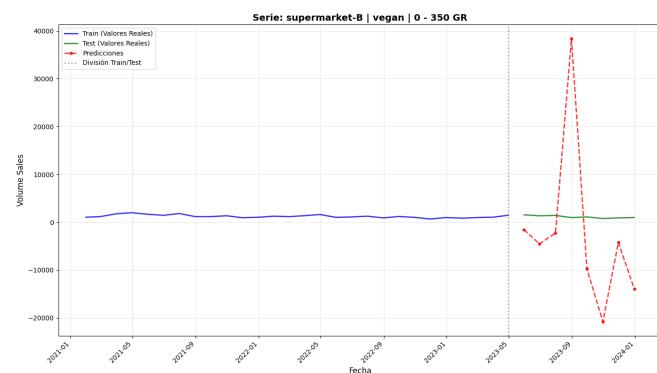
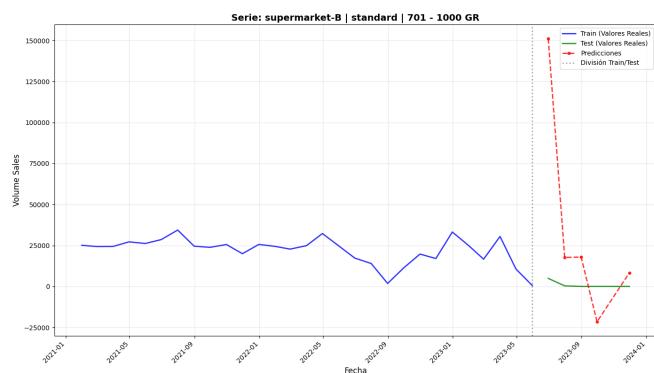
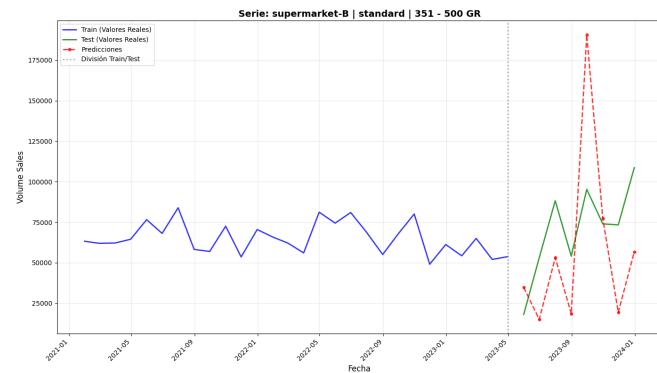
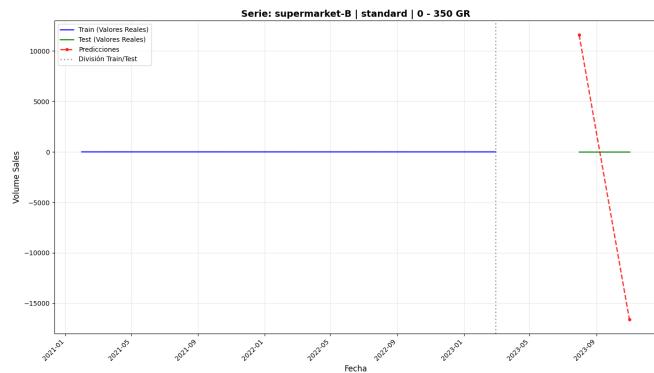
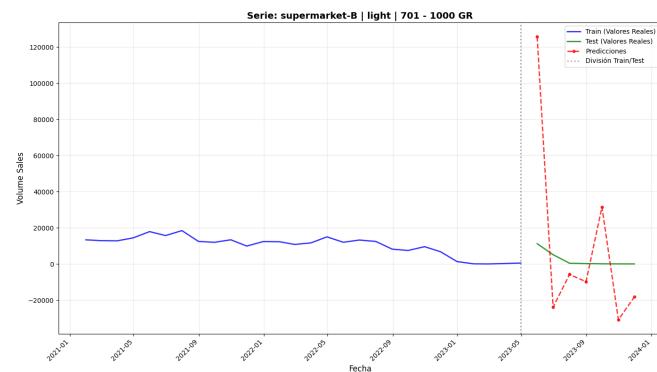
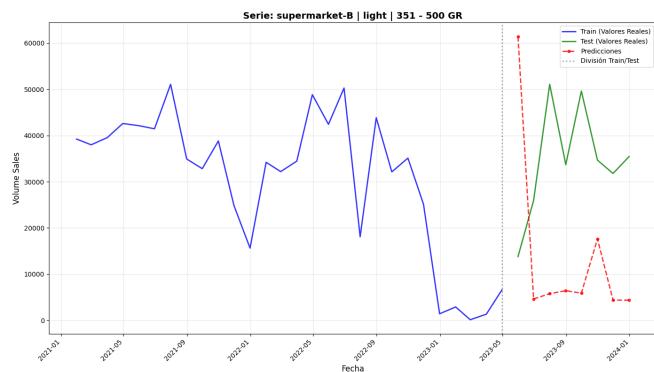
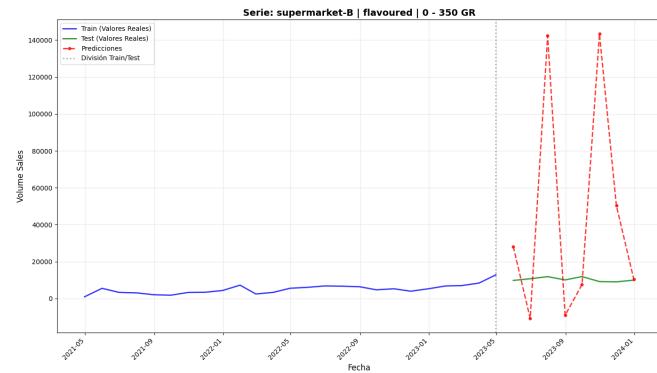
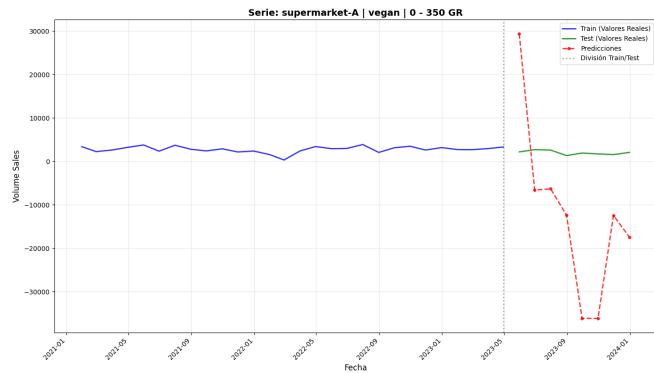
- 2.0787060633904786e-211 -- range(> 0.05)
 - [Normality Test] Shapiro-Wilk p-value:
 - 2.1739187861493027e-17 -- range(> 0.05)
 - [Autocorrelation Test] Ljung-Box p-value:
 - 0.013733 -- range(> 0.05)
 - [Autocorrelation Test first order] Durbin-Watson statistic:
 - 1.9183124656919244 -- range(2.0)
-

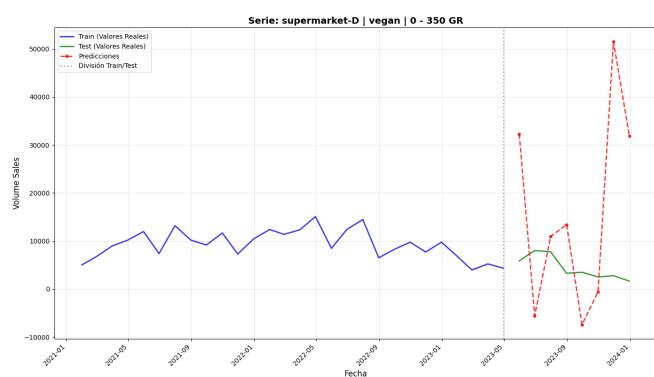
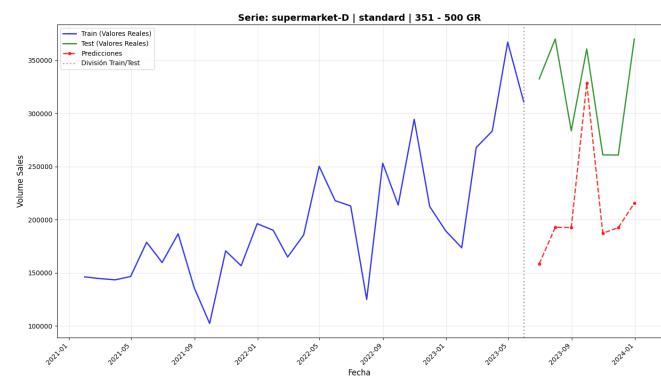
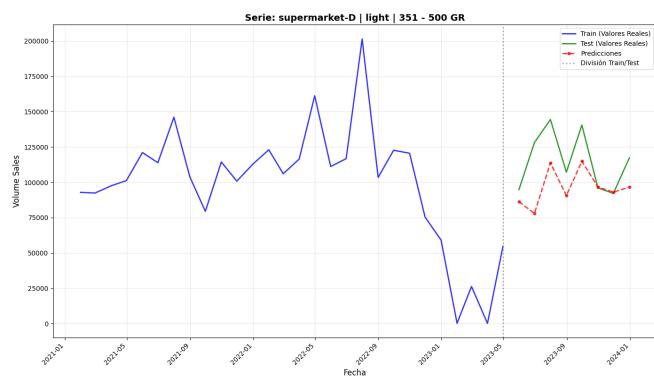
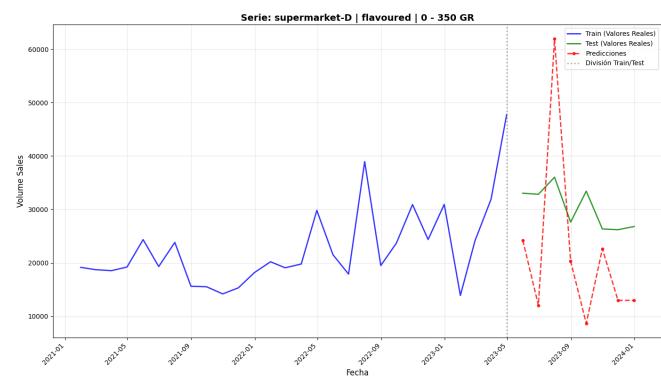
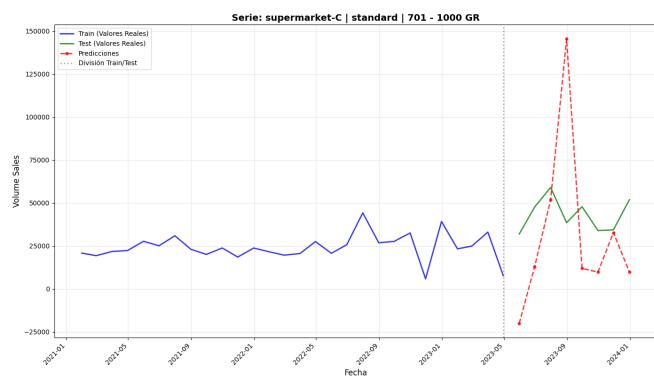
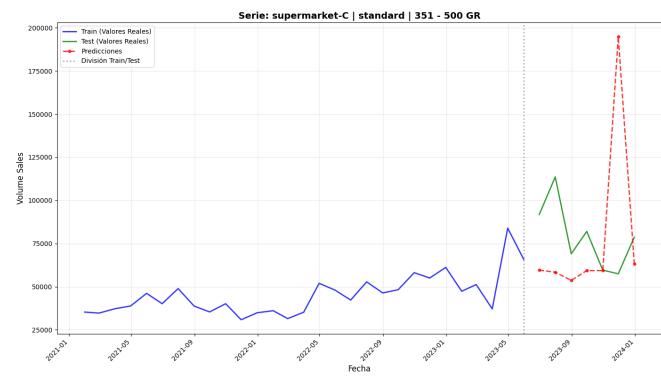
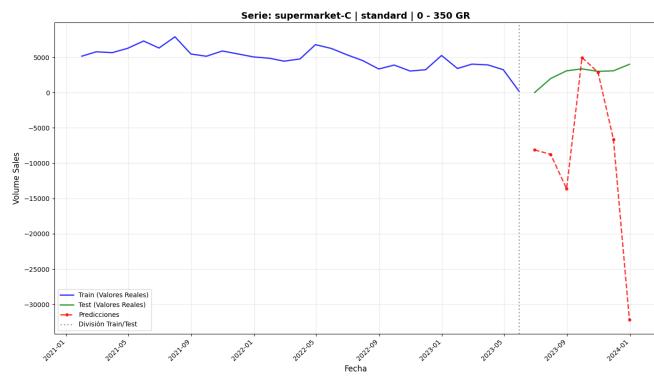
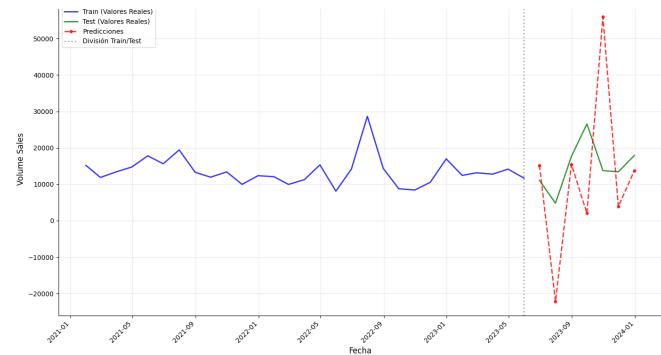
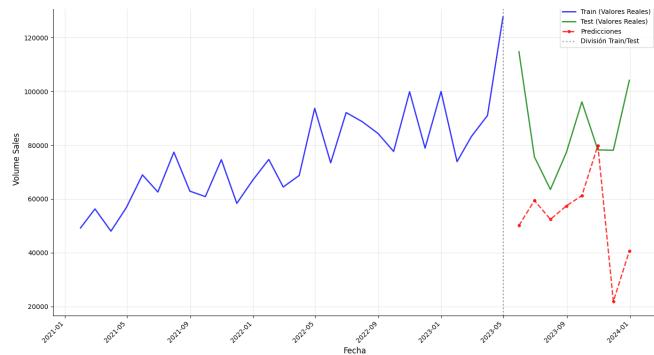
8. Gráficos residuos:



9. Predicciones







10. Probamos haciendo transformación variable objetivo

// Analizamos nuevos resultados

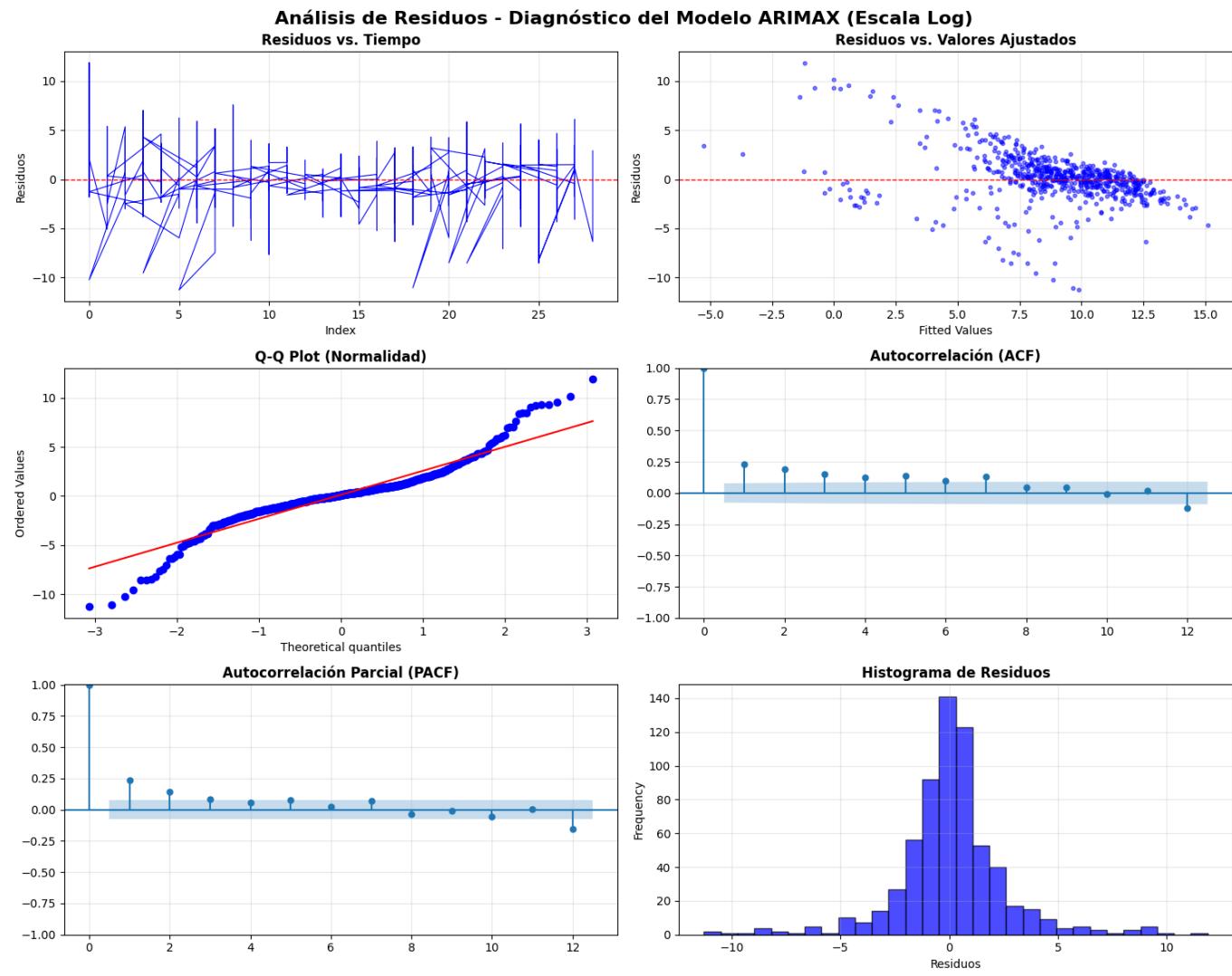
11. Lanzamos modelo auto_arima y nos devuelve:

- **Performing stepwise search to minimize aic**
- ARIMA(0,0,0)(0,1,0)[12] intercept : AIC=3077.780
- ARIMA(1,0,0)(1,1,0)[12] intercept : AIC=2876.553
- ARIMA(0,0,1)(0,1,1)[12] intercept : AIC=inf
- ARIMA(0,0,0)(0,1,0)[12] : AIC=3075.913
- ARIMA(1,0,0)(0,1,0)[12] intercept : AIC=3079.670
- ARIMA(1,0,0)(1,1,1)[12] intercept : AIC=inf
- ARIMA(1,0,0)(0,1,1)[12] intercept : AIC=inf
- ARIMA(0,0,0)(1,1,0)[12] intercept : AIC=2875.121
- ARIMA(0,0,0)(1,1,1)[12] intercept : AIC=inf
- ARIMA(0,0,0)(0,1,1)[12] intercept : AIC=inf
- ARIMA(0,0,1)(1,1,0)[12] intercept : AIC=2876.552
- ARIMA(1,0,1)(1,1,0)[12] intercept : AIC=2878.554
- ARIMA(0,0,0)(1,1,0)[12] : AIC=2873.403
- ARIMA(0,0,0)(1,1,1)[12] : AIC=inf
- ARIMA(0,0,0)(0,1,1)[12] : AIC=inf
- ARIMA(1,0,0)(1,1,0)[12] : AIC=2874.816
- ARIMA(0,0,1)(1,1,0)[12] : AIC=2874.814
- ARIMA(1,0,1)(1,1,0)[12] : AIC=2876.816
- **Best model:** ARIMA(0,0,0)(1,1,0)[12]
- **Total fit time:** 2871.337 seconds

12. Chequeamos residuos del modelo anterior

Residues Analysis (White Noise)

- [Heteroscedasticity Test] ARCH p-value:
 - 0.01174091289335583 -- range(> 0.05)
- [Normality Test] Jarque-Bera p-value:
 - 4.829608521628615e-120 -- range(> 0.05)
- [Normality Test] Shapiro-Wilk p-value:
 - 1.8622387300781965e-19 -- range(> 0.05)
- [Autocorrelation Test] Ljung-Box p-value: lb_stat | lb_pvalue
 - 10 117.992236 1.292208e-20 -- range(> 0.05)
- [Autocorrelation Test first order] Durbin-Watson statistic:
 - 1.5081114222820573 -- range(2.0)



13. Predicciones del modelo con la transformación logarítmica.

Importante:

!! He realizado la destransformación antes de representar las predicciones. Es decir:

- obtenemos las predicciones en escala logarítmica
- revertimos la transformación
- guardamos en un dataframe, que luego representamos en las gráficas.

