

Sinusoidal Predictive Model of Nigeria Petroleum Motor Spirit (PMS) Price

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Abstract

Petroleum Motor Spirit (PMS) prices in Nigeria exhibit substantial fluctuations that challenge conventional linear forecasting approaches and complicate policy and market planning. This study applies a seventh-order sinusoidal wave-function model to analyze and predict PMS price dynamics in Nigeria. Annual PMS price data were modeled using a sinusoidal framework designed to capture the recurring oscillatory behavior associated with regulated fuel-pricing systems. A logarithmic transformation and the Least Squares Method (LSM) were employed to reduce data dispersion and obtain robust parameter estimates. Model performance was validated through correlation analysis between observed and predicted prices, while pilot testing was conducted to assess the model's reliability, stability, and predictive relevance. The results demonstrate a high degree of association between actual PMS prices and model estimates, indicating that the sinusoidal structure adequately represents the cyclical behavior of PMS prices during the study period. The findings further suggest that PMS price variations are not explained primarily by linear temporal progression but follow a wave-like pattern consistent with periodic policy adjustments, market interventions, and regulatory decisions. The proposed

model therefore provides a useful analytical framework for interpreting PMS price fluctuations and forecasting future price movements within Nigeria's fuel-pricing regime. This study contributes a nonlinear modeling approach that may support evidence-based fuel-pricing analysis, regulatory planning, and policy decision-making.

Keywords: Cyclical Price Behavior; Fuel Price Forecasting; Least Squares Method; Petroleum Motor Spirit; Sinusoidal Modeling

INTRODUCTION

Persistent fluctuations in the price of Premium Motor Spirit (PMS) in Nigeria have emerged as a critical national issue due to their far-reaching economic and social consequences. As an oil-dependent economy, Nigeria remains highly exposed to disruptions in petroleum pricing, which directly affect government revenue, production costs, and household welfare (Omoregie, 2019). This vulnerability has been further accentuated by structural challenges within the oil sector, including Nigeria's temporary loss of its position as Africa's leading oil producer to Angola, before later reclaiming the status (Ndigwe, 2022). Such production instability has amplified uncertainty within the domestic fuel market and intensified price volatility.

Escalating PMS prices have deepened economic inequality and contributed significantly to rising poverty levels across the country (Egbewole and James, 2018). Given the central role of PMS in transportation, manufacturing, and power generation, fluctuations in fuel prices exert a direct influence on industrial costs, profitability, and overall productivity (Isyaka, 2014). At the global level, fuel price instability has been shown to transmit shocks across transportation systems, commodity prices, and energy consumption patterns (Bosler, 2010).

In Nigeria, the heavy reliance on PMS for energy generation and heating limits substitution possibilities, rendering the economy particularly sensitive to abrupt fuel price increases (Tuo *et al.*, 2011; Moshiri *et al.*, 2006). Compounding this challenge is the persistent problem of pipeline vandalism, which has disrupted production, weakened supply capacity, and undermined Nigeria's position as a major petroleum producer (Balogun, 2015; Okere, 2017). These disruptions have also generated severe environmental consequences, including pollution of farmlands and water resources (Adati, 2012).

Recent literature emphasizes that accurate prediction of PMS prices requires advanced modelling frameworks capable of capturing strong nonlinearities, volatility, and policy-induced shocks inherent in petroleum markets. Empirical evidence shows that machine-learning and hybrid mathematical models outperform conventional econometric approaches in forecasting accuracy (Kumar, 2025; Nguyen et al., 2025). Reservoir Computing models, in particular, have demonstrated significantly lower forecast errors relative to classical and deep-learning benchmarks (Kumar, 2025). The integration of news-based sentiment indicators has further improved predictive performance by incorporating information shocks and policy signals that shape market expectations (Li *et al.*, 2025). Additionally, hybrid frameworks combining LSTM, GRU, ANN, regression techniques, and volatility-sensitive components have been shown to enhance explanatory power and reduce forecast error, especially in short-term horizons (Bharathi and Sujatha, 2025; Amelia and Wulandhari, 2025; Cohen, 2025). Integrating deep learning with econometric volatility models has also yielded superior performance under conditions of heightened market uncertainty (Rao *et al.*, 2025). Collectively, these studies highlight the necessity of robust modelling approaches that explicitly account for volatility and policy shocks in Nigeria's deregulated and highly sensitive PMS pricing environment.

METHODS

This research, aim on developing mathematical predictive model of Nigeria petroleum motor spirit (PMS) price by extending Ogwumu and Ataribu, (2022) research work and adopt (Ogwumu *et al.*, 2025) method of analysis. Nigeria PMS Price has sinusoidal function behavior and has relationship with respect to time; since it fluctuates yearly and periodically. Hence, the considered seventh order function model for the Nigeria PMS Price prediction.

$$I_{\min} = \min \sum_{i=1}^{33} P_i(t) = a \sin t_i^7 + b \sin t_i^6 + c \sin t_i^5 + d \sin t_i^4 + e \sin t_i^3 + f \sin t_i^2 + g \sin t_i + h \quad (0.1)$$

Let take the partial derivatives with respect to each constants to obtain the coefficients values. But at turning point of the minimized LSM, the coefficient best fit the model and the source data providing a robust foundation for the LSM analysis where

$$\frac{\partial I}{\partial a} = \frac{\partial I}{\partial b} = \frac{\partial I}{\partial c} = \frac{\partial I}{\partial d} = \frac{\partial I}{\partial e} = \frac{\partial I}{\partial f} = \frac{\partial I}{\partial g} = \frac{\partial I}{\partial h} = 0$$

Then expand to have

$$\left\{ \begin{array}{l} \sum_{i=1}^{33} (P_i(t) \sin t_i^7 = a \sin t_i^{14} + b \sin t_i^{13} + c \sin t_i^{12} + d \sin t_i^{11} + e \sin t_i^{10} + f \sin t_i^9 + g \sin t_i^8 + h \sin t_i^7) \\ \sum_{i=1}^{33} (P_i(t) \sin t_i^6 = a \sin t_i^{13} + b \sin t_i^{12} + c \sin t_i^{11} + d \sin t_i^{10} + e \sin t_i^9 + f \sin t_i^8 + g \sin t_i^7 + h \sin t_i^6) \\ \sum_{i=1}^{33} (P_i(t) \sin t_i^5 = a \sin t_i^{12} + b \sin t_i^{11} + c \sin t_i^{10} + d \sin t_i^9 + e \sin t_i^8 + f \sin t_i^7 + g \sin t_i^6 + h \sin t_i^5) \\ \sum_{i=1}^{33} (P_i(t) \sin t_i^4 = a \sin t_i^{11} + b \sin t_i^{10} + c \sin t_i^9 + d \sin t_i^8 + e \sin t_i^7 + f \sin t_i^6 + g \sin t_i^5 + h \sin t_i^4) \\ \sum_{i=1}^{33} (P_i(t) \sin t_i^3 = a \sin t_i^{10} + b \sin t_i^9 + c \sin t_i^8 + d \sin t_i^7 + e \sin t_i^6 + f \sin t_i^5 + g \sin t_i^4 + h \sin t_i^3) \\ \sum_{i=1}^{33} (P_i(t) \sin t_i^2 = a \sin t_i^9 + b \sin t_i^8 + c \sin t_i^7 + d \sin t_i^6 + e \sin t_i^5 + f \sin t_i^4 + g \sin t_i^3 + h \sin t_i^2) \\ \sum_{i=1}^{33} (P_i(t) \sin t_i^1 = a \sin t_i^8 + b \sin t_i^7 + c \sin t_i^6 + d \sin t_i^5 + e \sin t_i^4 + f \sin t_i^3 + g \sin t_i^2 + h \sin t_i^1) \\ \sum_{i=1}^{33} (P_i(t) = a \sin t_i^7 + b \sin t_i^6 + c \sin t_i^5 + d \sin t_i^4 + e \sin t_i^3 + f \sin t_i^2 + g \sin t_i^1 + h) \end{array} \right. \quad (0.2)$$

Solving simultaneously, using the source data from the year 1990 to 2022 period of PMS Price volatility in Nigeria to obtain the constant coefficients a, b, c, d, e, f, g, h by using Maple 18 software

Table 1: Computed sinusoidal analysis

(t)	$p(t)$	$\sin t^{14}$	$\sin t^{13}$	$\sin t^{12}$	$\sin t^{11}$	$\sin t^{10}$	$\sin t^9$
0	0.7	0	0	0	0	0	0
1	0.7	2.44736E-25	1.4E-23	8.03E-22	4.6E-20	2.63E-18	1.51E-16
2	3.25	4.0012E-21	1.15E-19	3.28E-18	9.4E-17	2.69E-15	7.71E-14
3	11	1.16392E-18	2.22E-17	4.25E-16	8.11E-15	1.55E-13	2.96E-12
4	11	6.49983E-17	9.31E-16	1.33E-14	1.91E-13	2.74E-12	3.93E-11
5	11	1.46845E-15	1.68E-14	1.93E-13	2.22E-12	2.54E-11	2.91E-10
6	11	1.87067E-14	1.79E-13	1.71E-12	1.64E-11	1.56E-10	1.5E-09
7	11	1.6041E-13	1.32E-12	1.08E-11	8.85E-11	7.26E-10	5.95E-09
8	11	1.02915E-12	7.39E-12	5.31E-11	3.81E-10	2.74E-09	1.97E-08
9	20	5.28877E-12	3.38E-11	2.16E-10	1.38E-09	8.82E-09	5.63E-08
10	22	2.28075E-11	1.31E-10	7.56E-10	4.35E-09	2.5E-08	1.44E-07
11	26	8.53244E-11	4.47E-10	2.34E-09	1.23E-08	6.43E-08	3.37E-07
12	30	2.83784E-10	1.36E-09	6.56E-09	3.15E-08	1.52E-07	7.29E-07
13	40	8.54887E-10	3.8E-09	1.69E-08	7.5E-08	3.33E-07	1.48E-06

14	55	2.36658E-09	9.78E-09	4.04E-08	1.67E-07	6.9E-07	2.85E-06
15	60	6.08987E-09	2.35E-08	9.08E-08	3.51E-07	1.35E-06	5.23E-06
16	65	1.47023E-08	5.33E-08	1.93E-07	7.01E-07	2.54E-06	9.22E-06
17	70	3.35535E-08	1.15E-07	3.92E-07	1.34E-06	4.58E-06	1.57E-05
18	65	7.28427E-08	2.36E-07	7.62E-07	2.47E-06	7.97E-06	2.58E-05
19	65	1.5122E-07	4.64E-07	1.43E-06	4.38E-06	1.34E-05	4.13E-05
20	65	3.01533E-07	8.81E-07	2.58E-06	7.53E-06	2.2E-05	6.43E-05
21	65	5.79707E-07	1.62E-06	4.51E-06	1.26E-05	3.51E-05	9.79E-05
22	141	1.07806E-06	2.88E-06	7.68E-06	2.05E-05	5.47E-05	0.000146
23	97	1.94477E-06	4.98E-06	1.27E-05	3.26E-05	8.33E-05	0.000213
24	97	3.41152E-06	8.38E-06	2.06E-05	5.06E-05	0.000124	0.000306
25	87	5.83208E-06	1.38E-05	3.26E-05	7.72E-05	0.000183	0.000432
26	86.50	9.73466E-06	2.22E-05	5.06E-05	0.000115	0.000263	0.0006
27	86.5	1.58918E-05	3.5E-05	7.7E-05	0.00017	0.000373	0.000822
28	86.5	2.54116E-05	5.41E-05	0.000115	0.000245	0.000522	0.001112
29	145	3.98551E-05	8.22E-05	0.000169	0.000349	0.00072	0.001485
30	145	6.13832E-05	0.000123	0.000245	0.00049	0.000981	0.00196
31	165	9.294E-05	0.00018	0.00035	0.000679	0.001319	0.002559
32	198.7	0.000138474	0.000261	0.000493	0.000929	0.001753	0.003307
$\Sigma =$	2053.85	0.000397121	0.000791	0.001584	0.003189	0.006465	0.013208

Table 2 Continuation of sinusoidal model computational analysis

$\sin t^8$	$\sin t^7$	$\sin t^6$	$\sin t^5$	$\sin t^4$	$\sin t^3$	$\sin t^2$	$\sin t$
0	0	0	0	0	0	0	0
8.64E-15	4.95E-13	2.83E-11	1.62E-09	9.29E-08	5.32E-06	0.000305	0.01746
2.21E-12	6.33E-11	1.81E-09	5.19E-08	1.49E-06	4.26E-05	0.001219	0.034915
5.65E-11	1.08E-09	2.06E-08	3.94E-07	7.52E-06	0.000144	0.002742	0.052359
5.63E-10	8.06E-09	1.16E-07	1.66E-06	2.37E-05	0.00034	0.00487	0.069788
3.34E-09	3.83E-08	4.39E-07	5.04E-06	5.78E-05	0.000663	0.007603	0.087195
1.43E-08	1.37E-07	1.31E-06	1.25E-05	0.00012	0.001144	0.010936	0.104575
4.88E-08	4.01E-07	3.28E-06	2.69E-05	0.000221	0.001812	0.014865	0.121924
1.41E-07	1.01E-06	7.29E-06	5.23E-05	0.000376	0.002699	0.019386	0.139235
3.6E-07	2.3E-06	1.47E-05	9.39E-05	0.0006	0.003833	0.024493	0.156504
8.3E-07	4.78E-06	2.75E-05	0.000158	0.000911	0.005243	0.03018	0.173725
1.76E-06	9.24E-06	4.84E-05	0.000253	0.001328	0.006956	0.03644	0.190893
3.5E-06	1.68E-05	8.1E-05	0.000389	0.001872	0.008999	0.043265	0.208003
6.58E-06	2.92E-05	0.00013	0.000577	0.002565	0.011398	0.050648	0.22505
1.18E-05	4.86E-05	0.000201	0.00083	0.003431	0.014177	0.058578	0.242028
2.02E-05	7.8E-05	0.000301	0.001164	0.004495	0.01736	0.067046	0.258932
3.34E-05	0.000121	0.00044	0.001595	0.005782	0.020969	0.076042	0.275758

5.36E-05	0.000183	0.000626	0.002141	0.00732	0.025025	0.085556	0.292499
8.34E-05	0.00027	0.000873	0.002824	0.009134	0.029547	0.095574	0.309151
0.000127	0.000389	0.001194	0.003666	0.011254	0.034553	0.106086	0.325709
0.000188	0.000549	0.001605	0.00469	0.013707	0.04006	0.117078	0.342167
0.000273	0.000761	0.002124	0.005923	0.016522	0.046083	0.128537	0.358521
0.000389	0.001038	0.002771	0.007393	0.019726	0.052636	0.14045	0.374766
0.000545	0.001395	0.003568	0.009127	0.023348	0.059729	0.1528	0.390897
0.000752	0.001847	0.004539	0.011155	0.027415	0.067373	0.165574	0.406908
0.001021	0.002415	0.005712	0.01351	0.031954	0.075577	0.178756	0.422795
0.001368	0.00312	0.007114	0.016222	0.036991	0.084347	0.192329	0.438554
0.001811	0.003986	0.008777	0.019326	0.042551	0.093687	0.206278	0.454179
0.002368	0.005041	0.010733	0.022853	0.048658	0.103601	0.220585	0.469665
0.003062	0.006313	0.013016	0.026838	0.055334	0.11409	0.235233	0.485008
0.003919	0.007835	0.015663	0.031314	0.062602	0.125152	0.250203	0.500203
0.004967	0.009641	0.018711	0.036314	0.070479	0.136787	0.265478	0.515246
0.006238	0.011768	0.022197	0.041871	0.078983	0.148988	0.281039	0.530131
0.027243	0.056863	0.120479	0.260326	0.577769	1.333022	3.270177	8.974743

Table 3: Continuation sinusoidal model computational analysis

$P(t)\sin t^7$	$P(t)\sin t^6$	$P(t)\sin t^5$	$P(t)\sin t^4$	$P(t)\sin t^3$	$P(t)\sin t^2$	$P(t)\sin t$
0	0	0	0	0	0	0
3.46E-13	1.98E-11	1.14E-09	6.51E-08	3.73E-06	0.000213	0.012222
2.06E-10	5.89E-09	1.69E-07	4.83E-06	0.000138	0.003962	0.113474
1.19E-08	2.27E-07	4.33E-06	8.27E-05	0.001579	0.030157	0.575953
8.87E-08	1.27E-06	1.82E-05	0.000261	0.003739	0.053574	0.767664
4.22E-07	4.83E-06	5.54E-05	0.000636	0.007292	0.083632	0.959142
1.5E-06	1.44E-05	0.000138	0.001316	0.01258	0.120296	1.150326
4.41E-06	3.61E-05	0.000296	0.002431	0.019937	0.163519	1.34116
1.12E-05	8.01E-05	0.000576	0.004134	0.029692	0.21325	1.531585
4.6E-05	0.000294	0.001878	0.011999	0.076667	0.48987	3.130079
0.000105	0.000605	0.003481	0.020039	0.115348	0.66397	3.821954
0.00024	0.001258	0.006591	0.034525	0.180862	0.947448	4.963229
0.000505	0.00243	0.011681	0.056157	0.269981	1.297963	6.240104
0.00117	0.005197	0.023092	0.102607	0.455929	2.025902	9.002004
0.002676	0.011055	0.045676	0.188723	0.779758	3.221768	13.31155
0.004682	0.018083	0.069837	0.26971	1.041622	4.022757	15.53594
0.007881	0.028581	0.103646	0.375858	1.363	4.942747	17.92424
0.012822	0.043837	0.149871	0.512383	1.751743	5.988889	20.47492
0.017543	0.056746	0.183555	0.593738	1.920546	6.212326	20.0948
0.025277	0.077605	0.238265	0.731527	2.245955	6.895596	21.17106

0.035693	0.104314	0.304863	0.890977	2.603922	7.61009	22.24086
0.04949	0.138039	0.385024	1.073922	2.995422	8.354936	23.30388
0.1464	0.390644	1.042367	2.781379	7.42164	19.80339	52.84202
0.135271	0.346054	0.885282	2.264746	5.793721	14.82162	37.91698
0.179162	0.440301	1.082065	2.659236	6.535226	16.06069	39.47008
0.210102	0.496936	1.175359	2.779971	6.575216	15.55177	36.7832
0.269884	0.615395	1.403236	3.199689	7.296001	16.6365	37.93491
0.344828	0.759235	1.671665	3.680635	8.103937	17.84306	39.28645
0.436046	0.92842	1.976771	4.208897	8.961491	19.08061	40.62601
0.915398	1.887387	3.891456	8.02349	16.54301	34.10874	70.32615
1.136038	2.271153	4.540461	9.077235	18.1471	36.27946	72.52945
1.590689	3.087243	5.991786	11.62899	22.56978	43.80391	85.01556
2.338206	4.410615	8.319852	15.69394	29.60387	55.84251	105.3371
7.860171	16.12156	33.50885	70.86924	153.4267	343.1751	805.7341

$$P(t) = 4648.409 + 2017.63 - 6847.29 - 19665.4 + 33189.9 - 14331.2 + 3085.826 - 1.3337 = 2096.528$$

Validation of the model

To test the authenticity of the sinusoidal model, a pilot test was considered to ensure if the model confirms to reality. In order to achieve this, we compare the generated model data with the actual source data in table 4 below

Table 4. Validation of the sinusoidal model result

Year(s)	(t)	P(t)	P(t) model	Absolute Error
1990	0	0.7	-1.3337	2.0337
1991	1	0.7	3.46303	2.76303
1992	2	3.25	6.33674	3.08674
1993	3	11	7.96313	3.03687
1994	4	11	8.93233	2.06767
1995	5	11	9.74415	1.25586
1996	6	11	10.8049	0.19509
1997	7	11	12.4261	1.42605
1998	8	11	14.8245	3.82453
1999	9	20	18.1253	1.87467
2000	10	22	22.3662	0.36618
2001	11	26	27.5043	1.50431
2002	12	30	33.4256	3.42557
2003	13	40	39.9557	0.04429
2004	14	55	46.8738	8.12623
2005	15	60	53.9274	6.07256
2006	16	65	60.8504	4.14961

2007	17	70	67.3811	2.61892
2008	18	65	73.2831	8.28309
2009	19	65	78.3665	13.3665
2010	20	65	82.5099	17.5099
2011	21	65	85.6834	20.6834
2012	22	141	87.9707	53.0294
2013	23	97	89.5917	7.40828
2014	24	97	90.9243	6.07573
2015	25	87	92.5241	5.52408
2016	26	86.50	95.1437	8.64369
2017	27	86.5	99.7492	13.2492
2018	28	86.5	107.535	21.0348
2019	29	145	119.934	25.0663
2020	30	145	138.627	6.37282
2021	31	165	165.549	0.54926
2022	32	198.7	202.888	4.18767
				$\cong 258.856$

The result of the sinusoidal model is confirms to reality and suitable to be use for prediction of premium motor spirit (PMS) price hike, since the absolute error is approximately less and negligible when compare with the source data. In fact, the result indicates vividly that time is not an influencing factor in the pricing of PMS and do not strictly follow a sinusoidal pattern. It is obvious that PMS is influence by a complex set of factor beyond time. Also, we can remark that the model conforms to reality because of the nature of Nigerian fuel price is always ever fluctuating inconsistent and behave in the form of sine wave function.

Correlation between fuel price and sinusoidal model prediction

The computed tabulation of the sinusoidal model results and the sourced data correlation is shown in the table below. The sourced data is represented as $P(t) = x$ and model results $P(t) \text{ model} = y$ respectively.

Table 3 Computation of the sinusoidal Model correlation

x	y	xy	y^2	x^2
0.7	-1.3337	-0.93359	1.778756	0.49
0.7	3.46303	2.424122	11.99259	0.49
3.25	6.33674	20.59439	40.15422	10.5625
11	7.96313	87.59442	63.41142	121

11	8.93233	98.25561	79.78648	121
11	9.74415	107.1856	94.94836	121
11	10.8049	118.854	116.7461	121
11	12.4261	136.6866	154.4067	121
11	14.8245	163.0697	219.7664	121
20	18.1253	362.5066	328.5276	400
22	22.3662	492.056	500.246	484
26	27.5043	715.1121	756.4871	676
30	33.4256	1002.767	1117.269	900
40	39.9557	1598.228	1596.459	1600
55	46.8738	2578.057	2197.15	3025
60	53.9274	3235.646	2908.169	3600
65	60.8504	3955.275	3702.77	4225
70	67.3811	4716.676	4540.21	4900
65	73.2831	4763.401	5370.411	4225
65	78.3665	5093.821	6141.304	4225
65	82.5099	5363.145	6807.887	4225
65	85.6834	5569.419	7341.64	4225
141	87.9707	12403.86	7738.835	19881
97	89.5917	8690.397	8026.676	9409
97	90.9243	8819.655	8267.225	9409
87	92.5241	8049.595	8560.705	7569
86.50	95.1437	8229.929	9052.322	7482.25
86.5	99.7492	8628.309	9949.911	7482.25
86.5	107.535	9301.76	11563.73	7482.25
145	119.934	17390.39	14384.09	21025
145	138.627	20100.94	19217.5	21025
165	165.549	27315.63	27406.57	27225
198.7	202.888	40313.79	41163.42	39481.69
$\sum = 2053.85$	$\sum = 2053.85$	$\sum = 209424.1$	$\sum = 209422.5$	$\sum = 214919$

The calculation of the sinusoidal model correlation of the source data and model data are shown below.

$$\text{The correlation coefficient } (r) = \frac{n\sum xy - \sum x \sum y}{\sqrt{(n\sum x^2 - (\sum x)^2)(n\sum y^2 - (\sum y)^2)}}$$

$$\therefore r = 0.96797$$

The sinusoidal model, with a correlation of 0.96797, is a reliable tool for predicting the cyclical aspects of PMS prices in Nigeria. It aligns well with reality by capturing the recurring patterns in the data and can be effectively used for forecasting under typical market

conditions. However, for a more comprehensive and accurate prediction, especially in the volatile PMS market in Nigeria, the model may need to be complemented with additional approaches that consider sudden and non-cyclical

DISCUSSION

The sinusoidal function model reveals that PMS prices in Nigeria display a clear cyclical pattern over the period 1990–2022. The fitted seventh-order sinusoidal function effectively captures the recurring phases of price stability and escalation observed in the data. Strong alignment between predicted and actual prices, supported by validation and correlation results, confirms the model's ability to explain a substantial portion of PMS price variation, particularly during periods of relative economic stability

The findings indicate that PMS prices are influenced by recurring time-dependent cycles linked to repeated policy interventions and market conditions. While the sinusoidal model successfully captures long-term oscillatory behaviour, deviations arise during abrupt policy shifts and economic shocks. Despite these limitations, the model remains a reliable framework for understanding medium- to long-term price trends

CONCLUSION

The study shows that Nigeria's PMS prices exhibit a strong cyclical pattern that can be effectively modeled using a seventh-order sinusoidal function. The application of the Least Squares Method enabled the model to closely track long-term price oscillations, with validation and correlation analyses confirming strong agreement between predicted and observed prices, particularly during periods of policy stability. Although the model does not fully capture abrupt price changes caused by subsidy reforms, deregulation, and global oil market shocks, it remains a reliable baseline tool for medium to long term forecasting. Overall, the sinusoidal model provides valuable insight into the periodic nature of PMS pricing in Nigeria, with improved performance achievable when combined with policy and macroeconomic variables.

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Conflict of Interests

The authors declare that there is no conflict of interests

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APPENDICES

APPENDIX Table (A)

Time (t)	0	1	2	3	4	5	6	7	8	9	10	11	12
Petrol Price P(t)	0.7	0.7	3.25	11	11	11	11	11	11	20	22	26	30

Time (t)	13	14	15	16	17	18	19	20	21	22	23
Petrol Price P(t)	40	55	60	65	70	65	65	65	65	141	97

Time (t)	24	25	26	27	28	29	30	31	32
Petrol Price P(t)	97	87	86.5	86.5	86.5	145	145	165	198.7

APPENDIX (B)

> **Non Sinusoidal (Polynomial) model**

The maple simultaneous analysis of the constant coefficients

>restart

```
>f1 := (0.000397121·a + 0.000791207·b + 0.001584076·c + 0.003189486·d + 0.006464763·e + 0.013207553·f + 0.027242939·g + 0.056862605·h = 7.860171461 );
```

$$f1 := 0.000397121a + 0.000791207b + 0.001584076c + 0.003189486d + 0.006464763e + 0.013207553f + 0.027242939g + 0.056862605h = 7.860171461$$

```
>f2 := (0.000791207·a + 0.001584076·b + 0.003189486·c + 0.006464763·d + 0.013207553·e + 0.027242939·f + 0.056862605·g + 0.120479257·h = 16.1215621 );
```

$$f2 := 0.000791207a + 0.001584076b + 0.003189486c + 0.006464763d + 0.013207553e + 0.027242939f + 0.056862605g + 0.120479257h = 16.1215621$$

```
>f3 := (0.001584076·a + 0.003189486·b + 0.006464763·c + 0.013207553·d + 0.027242939·e + 0.056862605·f + 0.120479257·g + 0.260326092·h = 33.50884643 );
```

$$f3 := 0.001584076a + 0.003189486b + 0.006464763c + 0.013207553d + 0.027242939e + 0.056862605f + 0.120479257g + 0.260326092h = 33.50884643$$

```
>f4 := (0.003189486·a + 0.006464763·b + 0.013207553·c + 0.027242939·d + 0.056862605·e + 0.120479257·f + 0.260326092·g + 0.577768784·h = 70.86923644 );
```

$$f4 := 0.003189486a + 0.006464763b + 0.013207553c + 0.027242939d + 0.056862605e + 0.120479257f + 0.260326092g + 0.577768784h = 70.86923644$$

```
>f5 := (0.006464763·a + 0.013207553·b + 0.027242939·c + 0.056862605·d + 0.120479257·e + 0.260326092·f + 0.577768784·g + 1.333022477·h = 153.4267087 );
```

$$f5 := 0.006464763a + 0.013207553b + 0.027242939c + 0.056862605d + 0.120479257e + 0.260326092f + 0.577768784g + 1.333022477h = 153.4267087$$

```
>f6 := (0.013207553·a + 0.027242939·b + 0.056862605·c + 0.120479257·d + 0.260326092·e + 0.577768784·f + 1.333022477·g + 3.270177167·h = 343.1751334 );
```

$$f6 := 0.013207553a + 0.027242939b + 0.056862605c + 0.120479257d + 0.260326092e + 0.577768784f + 1.333022477g + 3.270177167h = 343.1751334$$

```
>f7 := (0.027242939·a + 0.056862605·b + 0.120479257·c + 0.260326092·d + 0.577768784·e + 1.333022477·f + 3.270177167·g + 8.974743373·h = 805.7340601);
```

$$f7 := 0.027242939a + 0.056862605b + 0.120479257c + 0.260326092d + 0.577768784e + 1.333022477f + 3.270177167g + 8.974743373h = 805.7340601$$

```
>f8 := (0.056862605·a + 0.120479257·b + 0.260326092·c + 0.577768784·d + 1.333022477·e + 3.270177167·f + 8.974743373·g + 33·h = 2053.85);
```

$$f8 := 0.056862605a + 0.120479257b + 0.260326092c + 0.577768784d + 1.333022477e + 3.270177167f + 8.974743373g + 33h = 2053.85$$

>