Mathematical Model on Premium Motor Spirit Dispensing: The Nigeria Situation

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Abstract

This paper focused on the problem of under dispensing (under delivery) ofpremium motor spirit (PMS) otherwise called FUEL, the effectand remedy. The short, medium and long term approaches as it affects the Nigeria consumers. The objective of this paper is to develop comparative models for dispensing pms with little input from the regulatory agencies. The aim of this model is to dispense the exact quantity ofpms in litersto potential customers. This model will enhance car parts manufacturing firms or automobile manufacturing companies to develop and installed the device in future cars. The device read correspondingly with the exact measureable quantity oflitersbased on the department of petroleum resources (DPR) measuring device (Seraphin Can in digital form).It indicates the number of liters of pms left in the vehicle and also indicate the quantity of pms purchased instantly. The implication is that every Nigerian purchasing pmswill be confident of the exact quantity of fuelpurchased; this on the other hand will reduce the cost of monitoring private pms marketers that engaged in sharp practices. In general, we proposed that in the near future all vehicles should be designed to have this device installed. The advantage of this model is numerous, it is capable of indicating precisely the quantity of pms consumed from Warri to Lagos and otherwise.It also reveals the pms dispensing

stations with slow burning fuel (quality fuel) and fast burning fuel (adulterated fuel), this will enable potential customers to patronize the best pms stations. In general, the model has numerousadvantages and few disadvantages. One of suchdisadvantage maybe argument over which of the measuring device is accurate or not hence this is the area government and its regulatory agencies need to support this project.

Keywords: Premium motor spirit; Dispensing; Under dispensing;Liters; Device

1. Introduction

Nigeria is a nation with abundant petroleum resources with only three refineries. The refining capacity(ies) of these refineries are less than 50% hence Nigerians depends majorly on fuel importation. In recent times, the Nigerian government was engaged insubsidizing the price of fuel. The nation Nigeria is fruitful in numerous areas and barren with patriotism and honesty. This does notimply that Nigerians are not patriotic in the business parlance. In the local environment where retail petroleum outlets operate, their sharp practices are more gruesome than the $2.1 billion arm scandal in Nigeria. This is so considering the epileptic powerand frequent power outage in most part of the country were majority of Nigerians result to self-help electricity generation thereby concentrating on pms to power various sizes of generators[1]. Worst still is the lordship of independent petroleum retail outlet operators on over 170millions Nigerians; this lordship is necessitated due to lack of policy implementation, monitoring, patriotism and honesty by the regulating agencies.

It might interest you to know that when potential customers whether a motorist or domestic user want to purchase this product from some of these outlets, these retail outlets via their dispensing agents under dispense the product to the customers. In some cases, the price of the product

differs so also their dispensing inaccuracies differ. In some situation, the customers result to self-help by challenging fuel attendants for under-dispensing quantity of pms. Basically greed is the cause of this public manipulation and lack of goodwill by constituted authorities to enforce the needful. On the basis of this, the solutions to Nigerian problems as it pertains to this discussion lies on altitudinal change and quality orientation on the right of citizens to quality services.

For instance, the department of petroleum resources (DPR) which is the federal government regulatory agency sealed some pms stations due to under-dispensing and hike in pms price. This often occur whenpotential customers request to purchase ten liters of pms, the contrary is the case because less than ten liters will be dispensed into the car or gallon. In practice, the meter nozzle has been adjusted to dispense less than ten liters. In real-time, the meter will display ten liters, what a crime?[2]. For instance, theDPR sealed twelve pms stations bordering on hike in price and under dispensing[3]. These pms stations were sealed for one month as punishment[3][4].

A case for discussion: when a customer request to purchase ten liters of pms, the dispensing agent via the adjusted dispensing pump meter only dispenses seven liters as against the ten literspaid for. For instance, the weights and measures unit of the federal ministry of trade and investment visited some pms stations and discovered that some pms stations were under dispensing pms to the public[5]. In January 21, 2015 the weights and measures unit of the federal ministry of trade and investment sealed some pms stations due to under dispensing and sharp practices[6][7].

In Asaba, Delta state, it was discovered that most pms stations under dispense pms to the public[8].The Ekiti state government through Ekiti petroleum product regulatory agency sealed three pms stations due to under dispensing and other related sharp practices.

It was revealed that the programmable pms dispensing pump is more vulnerable to manipulation. It is very possible for electronic manipulation through networking of the dispensing machines, these maybe classified as high-tech sharp practices. Further investigation showed that the pms retail outlets objectives for inventing this sharp practice is for profit making. It was reported that for each 33,000 liters of pms purchased by the retail outlet operators after transportation they make #4profit perliters when the Federal government was subsidizing the price of fuel. It was further revealed that due to under-dispensing of pms to the purchasing public, the public losses about #3.8 billion daily to these greedy few Nigerian business class. To stop this commercial ingenuity, the DPR occasionally do perform routine check to determine if the quantity demanded is accurately dispensed. To ensure that standards are met, the DPR often use the ten liters Seraphin Can to measure to determine if the quantity dispensed conforms to global standard. With the ten liters Seraphin Can, the regulatory agencies will be able to determine if the dispensing meter is adjusted or not[9].

This paper concisely discusses mathematical models that reveal sharp practices in retail petroleum outlet operators in Nigeria and its remedy (ies). The focus is on developing mathematical models that will reveal and eliminate sharp practices by retail agents. The objective of this discussion is to avail every Nigerian the right to quality service delivery with respect to exact quantity demanded to exact quantity delivered (EQD-EQD) not the contrary. If the precise model is developed into a device, the device among other advantages will provide insight on comparable pms consumption purchased from different fuel stations. This will inform the

customer on fast and slow burning fuel. On the device end, it will indicate digitally the quantity of fuel in the car on arrival and quantity after purchase. This is updated automatically since the device indicates the quantity of fuel dispensed into the car using standard measuring guage (Seraphin Can) as approved by the regulatory agency in Nigeria and elsewhere were such sharp practices are observed globally. The device will adaptively compute the quantity of fuel consumed per trip by indicating the quantity consumed and quantity left on the screen board.

The rest of this discussion is organized as follows; Section Two describes the mathematical models while comparative analysis is contained in Section Three. Conclusion is contained in Section Four.

2. The PMS Dispensing models

These models are developed to reveal the sharp practices perpetuated by some retail fuel station owners, a common phenomenon in Nigeria. The first model is applicable to exact pms dispensing meter and best practice across the globe whereas the second model is adjusted pms dispensing meter. The objective of the second model is to reveal how Nigerians are cheated when purchasing pms in some fuel stations. The first model provides precise measurement as stipulated by the regulatory agencies whereas the second model reveals how the dispensing machine is adjusted to earn them more profit at the expense of the public.

I. Precise PMSDispensing Model

The precise pms dispensing model is described in Equation (1);

$$Q(k) = p\pi(\varepsilon) + e^{\pi\alpha}(k) = L + \hat{L} \qquad (1)$$

where L denotes the quantity of pms (fuel) on arrival to the fuel station, $p = 0.0078125, \pi = \frac{22}{7}$ and $\varepsilon = 1$. $\hat{L}$ denote the quantity of pms purchased on arrival to the fuel station, where k is the number of liters of fuel requested by the potential customer and $\alpha = 0.0001$. $Q(k)$ is the sum of the total liters of pms in the container or car when departing the fuel station.

The model structure in Figure 1 has a recovery memory of 720 hours. $Q(k)$ is digital in nature indicating the exact liters of fuel in a car, say 12liters, 20 liters, etc.It assists with the aid of the indicator function to indicate the quantity of fuel consumed per trip.

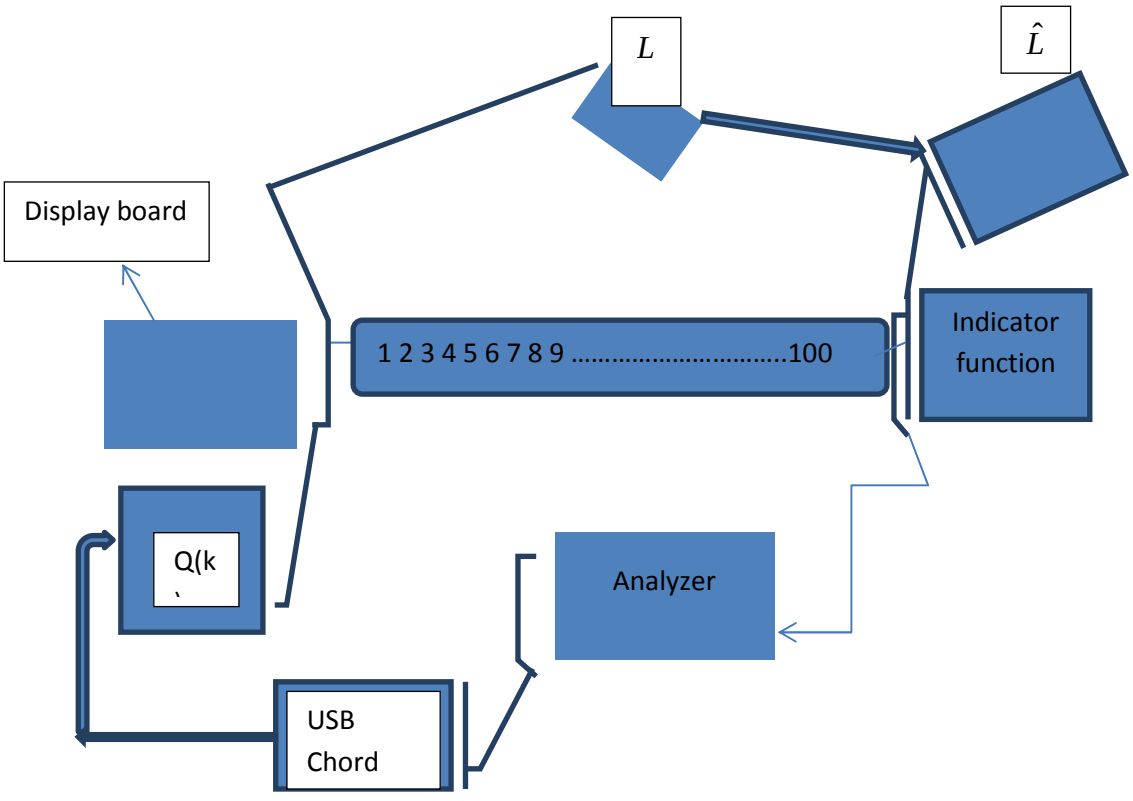

Figure 1: Model structure

Functions

i. The digital reserve indicator L summarizes the quantity of fuel in the car on arrival. It is automatically updated when the fuel tank is opened, that is, if this device is installed in the car. It adaptively and recursively sends signal to the display board thereby displaying the quantity of fuel in the car.

ii. The digital input reader $\hat{L}$ update and summarize the total quantity of fuel in the car.

iii. The indicator function automatically updates the display board reading precisely the quantity of pms dispensed into the car.

iv. The analyzer compares the quantity of fuel dispensed with standard measuring device in the chip and confirm, green implies accurate; red implies inaccurate. In this case, if the customer request for 20 liters of fuel by virtue of accuracy the input reader will communicate to the analyzer which signal the display board to display. If the display board displays 20 liters, itindicates green, hence the dispensing machine is accurate but if otherwise it will display the exact quantity dispensed and indicatesred (error) and the difference of under dispensed is displayed on the screen.

v. The USB chord consist of chip that record all information regarding quantity of fuel in the car for the past 720hours. The information is activated and displayed on the display board.

vi. The display board is a mini screen that accompanies the device; it is external in the dash board of the car to display information regarding quantity of fuel and consumption. It functions also includes displaying the quantity of fuel consumed per

trip. For instance,a trip from Warri to Lagos, Benin to Sokoto, the system will automatically display the quantity of fuel consumed and quantity left as reserve. This type of system will also assist in efficient trip plan.

vii. Where $Q(k)$ is the total quantity of fuel in the car.

viii. This device can also be installed in a customize gallons used to purchase fuel. These specialized gallons will help reduce under dispensing of pms to the public. The application of this device will decrease physical presence of the regulatory agency officials in monitoring the retail outlet operators.

II. Adjusted PMS Dispensing Model

The adjusted PMS dispensing model can be described mathematically as in Equation (2). This equation in comparison to Equation (1) reveals the sharp practices perpetuated by retail outlet operators in the petroleum sector in Nigeria. This model is termed adjusted pms dispensing model because it typically portrays the Nigeria situation as practiced by most pms retail outlet operators as they under dispense pms to the public.

$$Q^{-}(k) = p\pi(\varepsilon) + e^{\pi\alpha}(k) = L + \hat{L} - w(k) \qquad (2)$$

where w is the weight of the product to be withheld, w is user defined but is bounded between $0.1, 0.15, 0.2, 0.25, 0.3$, in this discussion. This model is an assumed replica of the adjusted PMS dispenser used in dispensing pms at fuel stations. Suppose $w = 0.1,$ this implies that this model will dispenses 90 percent of whatever quantity of pms the customer requested for while the customer assumed that the precise quantity was sold to him/her. In doing this, the accumulated

10 percent for whatever quantity of pms sold is assumed to be withheld as extra profit. Nearly all fuel stations inNigeria including the federal capital territory adopt this model. This is evidence in our discussion in section one. In some instances, the government regulating agenciesdo apprehend and often the case the pms station is shutdown or their licenses withdrawn, although this occurs infrequent.

Advantage of the models

i. Both models indicates the quantity of pms in the car at any given time.

ii. it reveals the consumption rate of pms per trip.

iii. the model is designed to enhance and indicate the overall totalliters of pms in a car via it digital display board.

iv. it automatically compares the pms dispensed to potential customers to the standard measuring device approved by government regulatory agencies.

v. it is a comparative model (device) if commercialized and installed in a car, this is so because it read precisely the quantity dispensed. For instance, if a customer request for 35 liters of pms, as the pms attendant is dispensing, the device will adaptively and recursively indicate the precise quantity of pms dispensed. That is reading theliters of pms dispensed into the car as the pms attendant is dispensing. In this case, the customer can easily detect if the required quantity was dispensed or not by comparison.

vi. if argument occurs the recovery and printable memory can be used to analyze the content.

vii. if this model is transformed into device, the 720 hours of recovery/printable memory is useful and unique.

3. Comparative Analysis

Table 1 consists of the quantity of pms demanded and the quantities of pms dispensed by the various models. The table also consists of the differences by comparing the dispensing characteristics of the two models to the original quantity of pms requested by the customers. For this detail, **bold** indicates the difference in liters between exact model and the adjusted model while *italics* indicates the difference in liters between the actual quantity of pms requested and the quantity dispensed using the adjusted model.

Table 1: Quantity demanded and quantity dispensed based on models

Quantity of pmsliters	Exact model $Q(k)$	Adjusted model $Q^{-}(k)$	$D_{lit} = Q(k) - Q^{-}(k)$ *(D=EL-AM)*
2	2.02514	1.82514	**0.2** (*0.17486*)
4	4.02574	3.62574	**0.4**(*0.37426*)
5	5.02604	4.52604	**0.5***(0.47396)*
7	7.02664	6.32664	**0.7***(0.67336)*
8	8.02694	7.22694	**0.8***(0.77306)*
9	9.02724	8.12724	**0.9***(0.87276)*
10	10.2484	9.02754	**1.0**(*0.97246)*
12	12.02814	10.82814	**1.2**(*1.17186)*
15	15.02904	13.52904	**1.5**(*1.47096)*
20	20.03054	18.03054	**2.0**(*1.96946)*
22	22.03114	19.83114	**2.2**(*2.16886*)
25	25.03204	22.53204	**2.5**(*2.46796)*
30	30.03354	27.03354	**3.0**(*2.9646)*
36	36.03534	32.43534	**3.6**(*3.56466)*
40	40.03654	36.03654	**4.0**(*3.96346)*
50	50.03954	45.03954	**5.0**(*4.96046)*
60	60.04254	54.04254	**6.0**(*5.95746)*
65	65.04404	58.54404	**6.5***(6.45596)*
70	70.04554	63.04554	**7.0**(*6.95446)*
75	75.04704	67.54704	**7.5**(*7.45296)*
80	80.04854	72.04854	**8.0**(*7.95146)*
85	85.05004	76.55004	**8.5**(*8.44996)*
90	90.005154	81.05154	**8.95**(*8.94846)*
95	95.05304	85.55304	**9.5**(*9.44696)*
100	100.05454	90.05454	**10.0**(*9.94546)*

EL: exact quantity demanded; AM: adjusted model

3.1 Discussion and analysis

In Table 1 using Equations (1) and (2) we observed that the first model precisely dispense the required quantities of product requested by potential customer while model two categorically under-dispense or under-deliver the product even when the customer has paid for the required quantity. From the table, the numbers in bold depict the difference between the two models while the numbers in italics represent the difference in liters between the actual quantity of pms demanded and the quantity of pms dispensed using the adjusted model. Both differences are similar.

In general, we performed comparison using these models to obtain information to determine the level of product under delivery by the pms station operators. The analysis revealed that the more quantity customers purchased the more under dispensing is observed the contrary is true for small quantity purchased. From the above representation, we observed that the model specifically reveals under dispensing in which the potential customer will not notice the difference between the requested quantity and the dispensed quantity. For instance, those people that requested for two liters of pms will hardly understand that they were under dispensed with 0.2 liter of pms. The models typically revealed the economic crime committed against the Nigerian people that regularly purchase this product for their cars and for self-help electricity generation (powering of generator).

Although in the case of Nigeria, the regulatory agency saddled with the responsibility of monitory availability, sales and distribution of the premium motor spirit (Fuel) often arrest the agents perpetuating such act and punished them but the crux is that these agents are not readily available to perform their statutory responsibilities everywhere. Based on this and among other things to save the Nigerian populace from the greedy few retail pms operators, we recommend that this model be transformed into a device that can be installed in existing cars and inbuilt in

new (future) generation cars. The basic function of this model cum device is to digitally update the quantity of pms dispensed into the car or the customized gallon designed based on the standard pms measurement. This device will automatically read the quantity of pms dispensed into the car in comparison to the quantity of pms machine displayed. The device will assist to reduce the sharp practice and benefit users in many ways.

The device consists of recovery memory which provide historical data on last purchase and quantity left on arrival, this entirely will be displayed on the display board once the fuel tank is opened. The function of this device when the fuel tank is opened is that the sensor will recursively and adaptively activates the display board. In this case, we say quantity requested should be equal to quantity delivered (QR=QD). Another advantage of this device is that it will assist to reduce the duties of the regulatory agencies. Such device if developed will need government approval and recommendation to avoid argument when potential customers are potential prey to such fuel station dispensing operators.

In Figure 2, the difference between the precise model (red) and quantity demanded (black) is similar while the difference between the adjusted model (blue), precise model(red) and quantity demanded(black) is noticeable as the quantity of pms purchased increases. In Figure 3, the difference in liters between the two models to the quantity demanded are almost similar.

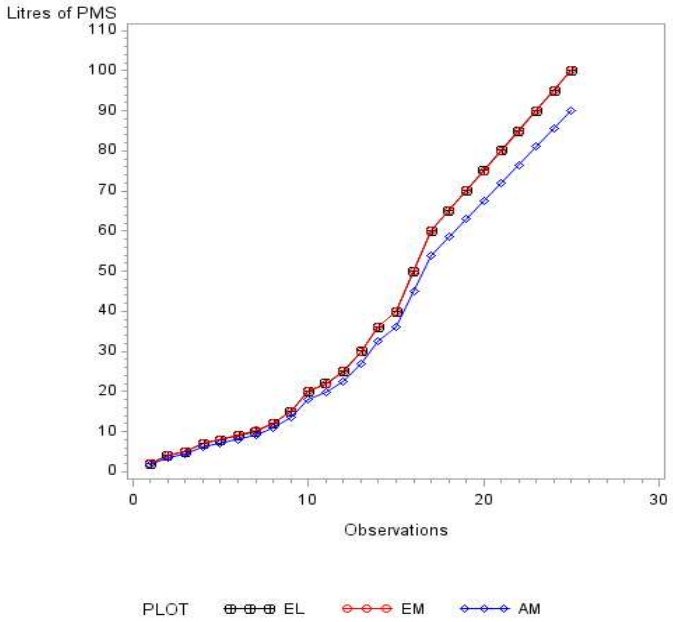

Fig. 2 Model comparison

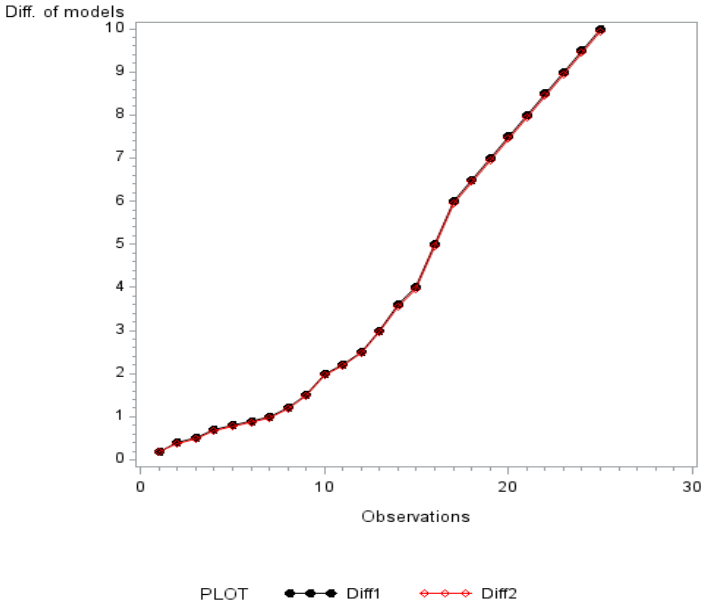

Figure 3: Model difference

Diff1 implies EM-AM (**bold**) and Diff2 implies EL-AM *(italics)*.: EM implies precise model

4. Conclusion

In practice, most pms retail outlet operators often use the adjusted model while few adopt the precise model in Nigeria.The models, specifically model two revealed that under dispensing of pms product to potential customers is practicable and tractable. This phenomena ingenuitycan be adjusted easily when the need arises due to pre-information on the monitoring team visitation to the facilities. This also implies that the correction factor $+w(k)$ can be added to Equation (2) foraccurate pms delivery within reasonable minutes during crisis to escape wrong doing.From the table, we observed that under dispensing is not easily noticeable by potential customers when few liters of pms are purchased whereas if more quantity of pms are purchased the difference becomes glaring as shown in Figure 2. On the other hand, it revealedthecomparative difference between the exact quantity demanded, quantity of pms dispensed by the proposed models, this is depicted in Figure3. In general, the digital reading of the proposed device will help both literate and illiterate customers to detect the exact quantity of pms sold to them. This device is designed to read like digital clock. The benefits of this device cannot be over emphasized. These models are comparative in practice and hence required government policy to enable the business community for implementation. The comparative consequence is due to the sharp practice and under dispensing of pms to the Nigerian public by greedy fuel retail outlet operators in Nigeria. Conclusively, model two helps to reveal the ugly trend in retail fuel marketing in Nigeria at the expense of the potential customers. Worst still, the government and its functionaries are victims of this petroleum cabal.

Recommendations

The regulatory agencies should assume more responsibilities as field officers or field operators; ii) they should expand their drag net to all the local government areas in the federation; iii) they should display contact numbers to enable aggrieved customers to contact then; iv) they should

collaborate with notable organizations to provide the Seraphin Can to the public for comparative determination of dispensing machines across the nation and (v) model 1 should be adopted and implemented.

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