# A Proposal for a Simple, Structured, and Easy-to-Use Method for Determining Production Level to Lower Ending Inventory in MSME with Steady Demand and a Culture of Oversupply

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*Abstract*—This paper discusses the problem of having excess inventory in small retail businesses in the Philippines. Extreme excess inventory is usually the result of the culture of having an oversupply by small retail businesses in the Philippines. To address this, a simple, structured, and easyto-use method for determining production level is proposed. The proposed methodology lowers the excess inventory at the end of the day. However, shortages that were not experienced in the past via the businesses' trial-and-error methodology, should still be expected with the proposed methodology but these can be anticipated to be low in occurrence.

*Keywords*—excess inventory, shortage, steady demand, culture of oversupply

# I. INTRODUCTION

The main objective of this paper is to determine the production quantity that would translate to the desired service levels (Radasanu, 2016), i.e., in terms of the costs of inventory excess and shortage, in Micro, Small, and Medium Enterprises (MSMEs) (Lim, 2017) in the Philippines. This is accomplished by:

- Eliciting the desired service level of the MSME
- Translating the desired service level into the culture of production, i.e., actual production quantity, of the MSME

The contribution of this study and similar studies by the author is on the proposal of a supply chain method that will likely be sustainably used because it is based on the culture of production of the user. In particular, this paper proposes a forecasting technique. In the past, more scientificallybased techniques for demand forecasting were suggested as to the industry studied, i.e., techniques that were adopted for a short time but were eventually not used. These previously suggested techniques were recognized by the users to be superior in terms of accuracy, but because they were not aligned with the priorities of the users, they were not utilized after some time. Also, another contribution of this study is the choice of the product and industry for the case study. Aiming to impact more users, a commonly available product that is offered by many of a country's MSMEs is selected as the product in focus. There are also other businesses with products that have demand that are similar in characteristics as this product in focus.

#### A. Product in Focus: Pandesal (Filipino Bread Roll)

This study investigates the case of Pan de Sal (Agaloos, 2022), which is the Filipino Bread Roll. This study has chosen Pan de Sal as the product of interest because it possesses the demand and production characteristics below. These characteristics also similarly describe many other products found in MSME retail stores in the Philippines. Thus, the findings in this study may help Pan de Sal businesses and other similar retail businesses in the Philippines, which are many.

The characteristics of pan de sal business in terms of demand and supply/production:

- (1) Demand
- Regular daily, with little variance across days
- (2) Production
- Regular daily

# II. BEHAVIOR OF DEMAND

In more detail, this study has investigated the demand for Pan de Sal, by looking at the case of two different bakeries, i.e., Bakery 1 from February 28 to April 30, 2023, and Bakery 2 from February 1 to May 3, 2023. In each of these two bakeries, the demand for Pan de Sal was observed for at least eight weeks. Bakery 1 counts demand by the piece while Bakery 2 counts demand by the tray. Each tray has 24 pieces in the case of Bakery 2.

Notice that the graphs of the demand in Figs. 1 and 2 show steady behavior from Mondays through Fridays. On the other hand, on Saturdays and Sundays, the movement of the graphs in Fig. 1 differs from that of Fig. 2. Fig. 1 has a downward movement that is consistent among the curves (weeks). In contrast, Fig. 2 has a more spread, or less consistent behavior among curves (weeks) with some

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# displaying steady behavior following Mondays through Fridays, while some proceed to show upward movement.





Fig. 2. Bakery 2 Pan de sal sales in trays

TABLE I. AVERAGE AND STANDARD DEVIATION OF SOLD PAN DE SAL PER DAY

Bakery	Weekday		Weekend	
	Average sales per day	Standard deviation of sales per day	Average sales per day	Standard deviation of sales per day
Bakery 1	2806 pieces	318 pieces	2346 pieces	445 pieces
Bakery 2	46 trays	6 trays	59 trays	10 trays

Location may affect the weekend, i.e., Saturday and Sunday sales (Justman, 1994):

- (1) Bakery 1 is located in a residential area, with nearby establishments being similar small stores selling fruit shakes (southwest) and food stalls (north). Across the street is a church (12 meters southeast) and nearby is a junk shop (30 meters northeast).
- (2) Bakery 2 is located 120 meters north of a marketplace and 87 meters southeast of a hospital.

#### III. BEHAVIOR OF SUPPLY

While the behavior of demand in the two bakeries was described above, the sections below show the supply of Pan de Sal. In the case of Bakery 1, Bakery 1 keeps the unsold pieces up to the next day to be available for selling. Thus, the available pieces are the sum of the pieces left over from the previous day and the pieces produced on the day. Fig. 3 shows the number of pieces available each day and the number of pieces sold each day.



Fig. 3. Bakery 1 Pan de sal total available and sold in pieces



Fig. 4. Bakery 2 Pan de Sal produced and sold in trays

# A. Cost and Service Level Implications and the "Culture of Production/Supply"

An important question is, "If the sales of Pan de Sal vary not largely around the average from Monday to Friday (note that Table I shows that the standard deviation is at most 19% of the average for Bakery 1 and Bakery 2), why does the business consistently produce an amount greater than the demand for these days?" Oversupply or having more available bread than sold is observed in both Bakery 1 and Bakery.

In the case of Bakery 2, a specific study was conducted in 2017 to determine the number of pieces to produce if the metric was to maximize the payoff in the Pan de Sal business given the costs and revenues. The cost of shortage was determined, as well as the cost of excess. The cost of shortage was computed as profit loss, i.e., revenue–cost, while the cost of excess was set to the cost of producing the unit less salvage value. In that 2017 study, the following costs were established:

Cost of shortage = PhP 0.79

# Cost of excess = PhP 1.21

Thus, when the study proponents were suggesting the number of pieces to produce or be made available each day, using the classic Newsboy model (Lau, 1980) to find the cost-optimal stock to have, the service level was computed to be:

Service Level = 
$$\frac{Cost of shortage}{Cost of shortage + Cost of excess}$$
$$= \frac{0.79}{0.79 + 1.21} = 0.40.$$
(1)

This has led the proponents to suggest production quantities much lower than the highest demand (note: 100% service level is attained at the highest demand), a recommendation that was not fully accepted by the business. Looking at Fig. 4, it may be said that on most of the observed days, the service level is much higher than the demand thus covering 100% service level.

The same can be observed in Bakery 1, Fig. 3 shows that in all points the available number of pieces is much higher than what is sold. This is the scenario when, in fact, the sales per day could be estimated particularly during Mondays through Fridays when fluctuations in sales are small, and thus should not be very challenging to estimate.

#### B. Culture of Production/Supply

Given the above cases of Bakery 1 and Bakery 2, it seems that there are MSMEs in the Philippines that have a culture of "overproduction or oversupply" (Ito, 1992). While the cases of Bakery 1 and Bakery 2 are the only ones discussed in this paper, this has also been observed for cases of other industry businesses such as operating the gift section of an amusement or entertainment center where the inventory of prizes is the product of interest. Similar to Bakery 1 and Bakery 2, stocks of prizes for games in the amusement center are kept much higher than expected redemption because of the thinking that it is better not to have a shortage than to have excess. This last sentence translates to the perception that the cost of wastage is negligible or that the cost of shortage is highly significant.

## IV. THE PROPOSAL OF THIS STUDY

The previous studies that were done on Bakery 1 and Bakery 2, and similarly on other small retail businesses within the country that commonly have the culture of overproducing or oversupplying, have mostly suggested any one or a combination of the following:

- (1) Forecasting techniques-moving averages and with day seasonality
- (2) Stock level-based on finding the probability distribution which is most similar to that being demonstrated by the demand for Pan de Sal then using this as a reference, finding the stock level that is optimal to bring down the cost of wastage and that of excess

However, the above recommendations are not easily transferred to (understood by) the business owner because of their complex characteristics. This is despite the willingness of the business owner to accept recommendations to bring down wastage yet the resistance to deal with shortages. As they say, "sayang ang benta" (might regret a missed sale). Thus, the simplest, easiest to understand, and easiest to remember solution may be more accepted and used sustainably.

A common recommendation of the studies done on Bakery 1 and Bakery 2 is the use of moving averages for forecasting sales, specifically on weekdays when the variability of sales is low. In the two studies, when 80% of the weight is attributed to the most recent sales, i.e., that of the past day, the accuracy of the forecasts improves. Translating that into an easier-to-remember forecasting technique, a simple recommendation of na we forecasting, i.e., forecast the next weekday by the previous weekday (via na we forecasting) with an additional 20%, to ensure that the culture of 100% service level is suggested.

To illustrate:

Forecast for the weekday<sub>i+1</sub> = Actual sales for weekday<sub>i</sub>  $\times$  1.20

This study proposes naïve forecasting because it is easy to use and easy to remember. Furthermore, naïve forecasting can also reflect the fluctuations in historical demand onto the forecasts for future demand. This is needed because completely steady demand does not happen, in reality, for a long period.

#### V. VALIDATION AND DISCUSSIONS

#### A. Validation

This recommendation was tried on Bakery 1 and Bakery 2 using the previous results, i.e., through hindcasting, and the results are shown in the following graphs. Fig. 5 shows that for Bakery 1, the graph of the total available Pan de Sal resulting from the suggested forecasting method is closer to the graph of the total demand, compared to the graphs shown in Fig. 3. Similarly, for Bakery 2, the graph of the total available is closer to the graph of the total demand, compared to what is shown in Fig. 3 and 4 show that the total available is usually greater than the demand, and this is to address the "culture of oversupply" of the MSME.



Fig. 5. Bakery 1 Pan de Sal projected sold and available given the suggested na we forecast



Fig. 6. Bakery 2 projected sold and produced given the suggested na we forecast

With the above formula, the following are provided to the MSME retail business owner:

(1) Structured (as opposed to trial and error) method of determining supply.

- (2) A smaller amount of excess stock at the end of the day. In the case of the two bakeries discussed herein, Bakery 1 excess per day is reduced by at least 70% while Bakery 2 excess per day is reduced by at least 1%.
- (3) An easy-to-remember method because only one recent data point is needed. This is a method by which the culture of tolerating excess and not tolerating shortage, is still, to a large extent, reflected.

In the validation, the suggested forecasting method yielded the following times of shortages:

- (1) 4 out of 41 observations of weekdays for Bakery 1
- (2) 7 out of 61 observations of weekdays for Bakery 2

# B. Discussions

In the previous trial and error method, there were no occurrences of shortages. However, as a drawback of lowering production in the suggested method, there can be occurrences of shortages. However, these can be kept low and even adjusted by increasing the multiplier in the na ïve approach of forecasting. The increase must be carefully done as it compromises with a resulting increase in wastage.

To reiterate, the suggested method for determining the number of pieces to be made available results in a structured, easy-to-understandable, and easy-to-remember way. It is not optimal but it has, so far, shown a potential to be sustainably used by small retail businesses.

While the product of interest in this paper is pan de sal, the suggested method may also work for products with the same demand or sales pattern and where the operations personnel also have the same "culture of supply" as the pan de sal business discussed herein.

Furthermore, this paper focused on steady demand, but the proposed methodology may also apply to fluctuating demand because na we forecasting is utilized. With na we forecasting, the fluctuations in historical demand are reflected in the forecasts for the next periods. This is why na we forecasting (note: an additional 20% is added to ensure a little oversupply) is over other techniques for averaging, e.g., moving averages, and exponential smoothing, because na we forecasting will reflect fluctuations in demand, compared to the other techniques for averaging.

## VI. SUMMARY AND CONCLUSION

In summary and conclusion, this paper has the main objective of determining the production quantity that is translated to the desired performance of actual production on shortage and wastage by the Filipino MSME retail store operations manager. This study investigates the case of Pan de Sal. This study has chosen Pan de Sal as the product of interest because it has regular demand and production. Two case studies, Bakery 1 and Bakery 2, were investigated to see patterns of sales and it was shown that Pan de Sal has sales that vary not largely around the average from Mondays to Fridays. However, on Saturdays and Sundays, the patterns differ between the two bakers. On the side of production or available supply, both cases showed to have oversupply in almost all of the days observed. This is attributed to the "culture of production/supply" such that the owner or operations manager prefers to have excess more than shortage. Given these two conditions of consistency of demand, at least during weekdays, and the culture of oversupply, this study has suggested the use of the na we forecast with a multiplier. The na we forecast brings down the excessive oversupply, however, it causes some points of shortages. This method has been more accepted by small business owners than complex forecasting and inventory management methods recommended in the past.

#### CONFLICT OF INTEREST

The author declares no conflict of interest.

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