Comparing Inventory Costs using Different Order Quantity Methods for Products with Irregular Demand.

Pornkiat Phakdeewongthep[1*], Watanyu Choopak[2],

Pawaris Buasaart[3] and Panpasa Tiongnoi[4]

[1*]College of Logistics and Supply Chain, Suan Sunandha Rajabhat University, Ranong, Thailand.

[234]College of Logistics and Supply Chain, Suan Sunandha Rajabhat University, Ranong, Thailand.

e-Mail: [1*]pornkiat.ph@ssru.ac.th, [2]watanyu.ch@ssru.ac.th,

[3]s66127347008@ssru.ac.th and [4]s66127347002@ssru.ac.th

*Corresponding author

Abstract

This research was comparing inventory costs using different order quantity methods for products with irregular demand. The objective of this research was 1) to calculate total inventory cost using EOQ method. 2) to calculate total inventory cost using Silver Meal method. 3) to calculate total inventory cost using Wagner-Whitin method. 4) to compare inventory costs using the EOQ, Silver Meal, and Wagner-Whitin methods. This research sample group was the top 10 best-selling products, selected using a purposive sampling method. The researchers used secondary data from the stores, covering the period from January to December 2023. This included information such as order data, sales data, expense data, payroll data, and product data. This research methodology were 1) to calculate total inventory cost using EOQ method. 2) to calculate total inventory cost using Silver Meal method. 3) to calculate total inventory cost using Wagner-Whitin method. 4) to compare inventory costs. The results of the research found that 1) Total inventory cost using EOQ method was 96,073.21 THB. 2) Total inventory cost using Silver Meal method was 67,090.42 THB. 3) Total inventory cost using Wagner-Whitin method was 62,833.82 THB. 4) The Silver Meal method could reduce inventory costs by 30.17% more than the EOQ method. The Wagner-Whitin method could reduce inventory costs by 34.60% more than the EOQ method.

Keywords: EOQ, Silver Meal, Wagner-Whitin

1. Introduction

The problem of inventory control in community retail stores stems primarily from ordering based on employee experience, without the use of quantitative calculations or logistics models to aid decision-making (Nampinya et al., 2022). This results in both overstocking and understocking situations, impacting storage costs, ordering costs, and customer service levels (Setthachotsombut et al., 2024). Inefficient inventory management can also lead to obsolete or deteriorated products (Charuchit & Kitjacharoenchai, 2022). Therefore, current inventory management concepts and techniques, such as demand forecasting and optimal order quantity calculations (Choichalam & Lojongheng, 2023), are

being used to reduce overall costs and improve operational efficiency for stores (Saengphanit & Raothanachankun, 2022).

This research compares inventory costs using different order quantity methods for products with irregular demand, based on data from the top 10 best-selling items, details are shown in Tab 1. Three EOQ methods were employed: Economic Order Quantity (EOQ), Silver Meal, and Wagner-Whitin.

Table 1: product top 10 best-selling items.

Item code	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Cost
DR-00006	21	20	69	92	9	60	59	71	66	89	100	83	540
DR-00001	43	34	88	90	47	68	80	92	84	55	54	44	450
DR-00003	26	51	56	46	55	50	49	58	100	73	27	50	528
DR-00002	37	40	101	63	85	78	45	69	45	93	32	61	450
DR-00004	76	54	34	55	89	45	97	34	51	56	55	78	450
DR-00007	51	65	54	91	32	20	69	78	95	57	77	30	445
BD-00002	65	67	10	68	95	91	35	81	53	84	35	48	416
BD-00003	64	70	23	69	69	69	50	38	37	81	76	90	403
BD-00001	89	89	15	35	91	82	32	69	35	84	81	67	383
NC-00001	19	45	70	61	72	88	56	67	41	40	77	58	420

1.1 Research Objective

1. Calculate inventory cost using the EOQ method.
2. Calculate inventory cost using the Silver Meal method.
3. Calculate inventory cost using the Wagner-Whitin method.
4. Compare inventory costs.

2. Principles and theories

2.1 Economic Order Quantity (EOQ)

The Economic Order Quantity (EOQ) theory is a classical inventory management concept developed to determine the most efficient ordering policy for organizations. Its main principle is to balance two opposing types of costs: ordering costs and holding costs (Saengsawang, 2021). Ordering costs arise from activities such as procurement, administration, and transportation, while holding costs include storage, insurance, and the risk of obsolescence (Thasanon & Chaowalitwong, 2022). EOQ assumes stable demand, consistent lead time, and instantaneous replenishment. Under these conditions, the theory aims to identify an optimal order size that minimizes total inventory-related costs and improves operational efficiency without relying on complex decision-making (Saengphanit & Raothanachankun, 2022). The calculation of Economic Order Quantity (EOQ) and total cost (TC) can be calculated as follows:

$$EOQ = \sqrt{\frac{2DS}{H}} \tag{1}$$

$$TC = \frac{DS}{Q} + \frac{Q^{*}H}{2} \tag{2}$$

EOQ = Economic Order Quantity (Q*)
D = Demand
S = Setup or Ordering Cost
H = Holding Cost
Q = Order Quantity
TC = Total Inventory Cost

2.2 Silver Meal

The Silver–Meal heuristic is an inventory and lot-sizing approach used in dynamic demand environments where demand varies over time. Its academic principle focuses on minimizing the average cost per period by determining how many future periods' demand should be covered by a single order (Saisanit & Butrawong, 2023). The method evaluates trade-offs between setup or ordering costs and inventory holding costs across successive periods. It assumes known demand over a planning horizon and makes sequential decisions, stopping when extending the order would increase the average cost. This heuristic supports practical decision-making under time-varying demand conditions. The calculation of Silver Meal, holding cost, average cost and total cost (TC_{SM}) can be calculated as follows:

$$H(t,k) = \sum_{j=1}^{k-1} D_{t+j} * j * h \tag{3}$$

$$AC(t,k) = \frac{S + H(t,k)}{k} \tag{4}$$

$$TC_{SM} = \sum [S + H(t,k)] \tag{5}$$

TC_{SM} = Total Inventory Cost by Silver Meal
AC = Average cost
H = Holding Cost
D_t = Product demand in period t
h = Holding cost per unit per period
k = The number of periods that an order covers
S = Setup or Ordering Cost

2.3 Wagner-Whitin

The Wagner–Whitin model is a foundational academic theory in dynamic lot-sizing and inventory planning. Its core principle is to determine an optimal ordering plan over a finite planning horizon with time-varying demand. The model assumes known demand in each period, fixed ordering costs, and linear holding costs (Sriyom & Khamtri, 2020). Using a dynamic programming approach, it evaluates all feasible ordering decisions to ensure that total inventory-related costs are minimized. Unlike heuristic methods, Wagner–Whitin guarantees an optimal solution under its assumptions and provides a theoretical benchmark for evaluating other lot-sizing techniques (Thuenna-di et al., 2020). The calculation of Wagner-Whitin, dynamic programming, holding cost and total cost (TC_{WW}) can be calculated as follows:

$$DP(i) = Min\ [S + H(i,j) + DP\ (j+1) \tag{6}$$

$$H(i,j) = \sum_{t=i+1}^{j} D_t\ (t-i) * h \tag{7}$$

$$TC_{WW} = \sum [S + H(i,j)] \tag{8}$$

TC_{WW} = Total Inventory Cost by Wagner-Whitin
DP = Dynamic Programming
H = Holding Cost
h = Holding cost per unit per period
S = Setup or Ordering Cost

3. Research Methodology

3.1 Population and Sample

This research involved 13 employees of the case study store, of whom 4 provided key information. The details of this information include: expenses, product list, and sales figures for each product within the case study store.

This research uses a sample of the top 10 best-selling products, employing a purposive sampling method.

3.2 Data Collection

For this research, the researcher used data collected from case study stores from January to December 2023, a period of 12 months. This data pertained to the internal systems of the case study stores, including total expenses, product lists, and sales figures for each item. The researcher consulted relevant research to apply concepts and theories to analyze and determine the Economic Order Quantity (EOQ), Silver Meal and Wagner-Whitin. This data was collected as secondary data.

3.3 Data analysis

1. In determining the parameters, the researchers used key variables, namely the demand rate (D), ordering cost (S), and holding cost (H), referenced from the research paper "Guideline for Reducing Total Inventory Cost by Finding the Economic Order Quantity: A Case Study: Convenience Stores in Nakhon Pathom Province." This research was chosen because it has a relevant context and can be used as supplementary data for analysis (Phakdeewongthep & Nampinyo, 2025).

2. Calculate inventory cost using the EOQ method, where the demand rate (D), ordering cost (S), and holding cost (H) were obtained from the previous study.

3. Calculate inventory cost using the Silver Meal method, where the demand rate (D), ordering cost (S), and holding cost (H) were obtained from the previous study.

4. Calculate inventory cost using the Wagner-Whitin method, where the demand rate (D), ordering cost (S), and holding cost (H) were obtained from the previous study.

5. Compare inventory costs. Inventory cost comparisons will compare inventory costs derived from three methods, EOQ, Silver Meal and Wagner-Whitin method.

4. Results and Discussion

This research was a continuation of previous research using secondary data, for which various values have already been determined. Therefore, the values for this research are: setup or ordering cost (S) is 617 baht per order, and holding cost is 23% of the product cost.

4.1 Calculate inventory cost using the EOQ method.

The results of finding the inventory cost by EOQ method, the researcher used the data of the cost, S=617, holding cost is 23% of product cost. Details are shown in Tab. 2

Table 2: Inventory cost using the EOQ method.

Item code	EOQ
DR-00006	10644.37
DR-00001	9976.58
DR-00003	9802.72
DR-00002	9782.52
DR-00004	9617.76
DR-00007	9531.51
BD-00002	9298.56
BD-00003	9177.22
BD-00001	9144.53
NC-00001	9097.44
Total Inventory Cost	96073.21

4.2 Calculate inventory cost using the Silver Meal method.

The results of finding the inventory cost by Silver Meal method, the researcher used the data of the cost, S=617, holding cost is 23% of product cost. Details are shown in Tab. 3

Table 3: Inventory cost using the Silver Meal method.

Item code	Silver Meal
DR-00006	6463.80
DR-00001	7105.50
DR-00003	7405.60
DR-00002	7553.38
DR-00004	6423.50
DR-00007	6251.00
BD-00002	5993.40
BD-00003	6390.01
BD-00001	7166.87
NC-00001	6337.36
Total Inventory Cost	67090.42

4.3 Calculate inventory cost using the Wagner-Whitin method.

The results of finding the inventory cost by Wagner-Whitin method, the researcher used the data of the cost, S=617, holding cost is 23% of product cost. Details are shown in Tab. 4

Table 4: Inventory cost using the Wagner-Whitin method.

Item code	Wagner-Whitin
DR-00006	6463.80
DR-00001	6488.50
DR-00003	6666.84
DR-00002	6259.63
DR-00004	6385.00
DR-00007	6156.13
BD-00002	5993.40
BD-00003	6288.66
BD-00001	5926.64
NC-00001	6205.22
Total Inventory Cost	62833.82

4.4 Compare inventory costs.

From the data in Tab. 2 , 3 , and 4 , inventory cost data using the EOQ, Silver Meal and Wagner-Whitin methods. Details are shown in Tab 5.

Table 5: Comparing inventory costs.

Item code	EOQ	Silver Meal	Wagner-Whitin
DR-00006	10644.37	6463.80	6463.80
DR-00001	9976.58	7105.50	6488.50
DR-00003	9802.72	7405.60	6666.84
DR-00002	9782.52	7553.38	6259.63
DR-00004	9617.76	6423.50	6385.00
DR-00007	9531.51	6251.00	6156.13
BD-00002	9298.56	5993.40	5993.40
BD-00003	9177.22	6390.01	6288.66
BD-00001	9144.53	7166.87	5926.64
NC-00001	9097.44	6337.36	6205.22
Total Inventory Cost	96073.21	67090.42	62833.82

5. Conclusion

This research was comparing inventory costs using different order quantity methods for products with irregular demand. This research aims 1) to calculate total inventory cost using EOQ method. 2) to calculate total inventory cost using Silver Meal method. 3) to calculate total inventory cost using Wagner-Whitin method. 4) to compare inventory costs using the EOQ, Silver Meal, and Wagner-Whitin methods.

The results of the research found that 1) Total inventory cost using EOQ method was 96,073.21 THB. 2) Total inventory cost using Silver Meal method was 67,090.42 THB. 3) Total inventory cost using Wagner-Whitin method was 62,833.82 THB. 4) The Silver Meal method could reduce inventory costs by 30.17% more than the EOQ method. The Wagner-Whitin method could reduce inventory costs by 34.60% more than the EOQ method.

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