Inventory model for multi-perishable goods with limited storage capacity

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Abstract. The warehouse has an important role, namely storing finished products as well as semi-finished, especially in the Agrifood Supply Chain (ASC) which has special characteristics such as limited shelf life, changing variations in demand and prices that can be adjusted to make ASC look more complex and more difficult than other supply chains. In this study, various thoughts are offered to fit the real conditions. Stochastic demand distribution, the presence of constant lead time on each product, exponential decay rates, to limited storage space capacity. Related to this assumption, the ongoing review (Q, r) is aimed at supply policies that are relevant to the agricultural-food supply chain problem. The development of a mathematical model with decision variables Q and r to minimize costs on warehouse procurement is then analyzed using a comparison using parameter ordering costs, storage costs, and shortage costs that have been determined in this study. on items with limited warehouse capacity. In previous research, the process of storing and procuring multi-products did not contain short-lived products. Also, other studies also explain the storage of products in a short shelf life does not contain a shortage of limited storage capacity. It can be done on research that will be carried out adjusted to conditions that occur in the real world It is estimated that it will make a practical contribution and be a reference model of inventory policies for warehouses that have relevant requirements.

1. Introduction

Inventory control is described as the design and management of storage policies for raw materials, semi-finished goods, and finished goods and one of them is the perishable product. Currently, perishable products have deep challenges regarding the process [1] of processing to product storage process in various commodities e.g. medicines, health products, blood storage, agricultural products, Livestock products that have an expiry date. [2] mentions that any perishable items must have shelf life and damage inherent to the product itself. So according to [3], there is increasing complexity to determine the optimal booking in the inventory as it is added perishable into research objects that have different properties compared to non-perishable products. However, when demand is assumed to be random and perishable in accordance with the situation will show results of unsatisfactory performance when resolved by a classic approach without entering the perishable variable.

According to [4], commodity products perishable has a variety of difficult constrains one of which is random lifetimes that have high flexibility to the product life and are affected by some aspects surrounding items such as, temperature, product handling, etc. Coupled with the demand that is always changing in each period will complicate the inventory policy used. By classifying product Inventory system perishable into two categories namely, random lifetime and fixed lifetime.

In general, perishable products have a limited lifespan, such as garment products, blood, medicines, and agricultural products will be depleted if not used before the expiry date, resulting in the cost of the result of damaged products and the wasted [3]. In fact, according to [5], products such as medicines and food require special attention because it has a shelf life restriction that cannot be simply ignored. Which will directly impact the performance of inventory management as described by [6], which records when at least 10% of products-perishable damaged and become garbage before consumers buy. [7] mentions in
the United States in 2006 at least 10.9% of blood platelets become damaged because it has expired the life of the bait as a result of not being done.

In previous research, the first category of research studies was conducted by [5], [8] to [10] implemented the model inventory Replenishment continuous review (Q, R) policy, single item. Among these three studies, [5], [8] which included a constant shelf life of the product with a deterministic lead times distribution. Whereas [9] did not incorporate a lifetime variable or zero lifetime in its research with a constant lead times distribution, likewise with [10] with a stochastic lead times distribution.

The second category of previous research is about perishable items that have been done by [2], [5], [11], [12] mentioning when their models were either used on product storage models using various approaches and constraints and assumptions. However, these studies have not found any studies considering the limitations of warehouse and multi-item capacity therein. Similarly, research conducted by [9], [10] which entered the warehouse capacity limit with a single item, also with [13] with multi-item, but no one considering shelf life period or decaying on the stored product.

Preceded by research conducted by [2], which describes the lot size and reorder point models are appropriate used in inventory that has a gradual change in shelf life due to product damage or decaying using Approach method and analysis of Hadley – Within and use the simulation to develop the model (Q, R). Assuming the inventory review is done routinely or continuously. [2] also explained the relationship of the decaying model and perishable inventory and using the parameters cost, there are setup or ordering cost, replacement cost, holding cost, and atom cost.

Plus, the research has been done by [10] which uses mathematical models and focuses on the problem of limited storage capacity in the warehouse. Unlike [2], research by [10] using four components cost, among others, ordering cost, inventory holding cost on internal storage, inventory holding cost on external storage, and atom cost. Assuming demand and lead time are stochastic, so the demand for lead times is used to use empirical distributions. The development of model conducted by [14], is known to have several assumptions one of them is to use (Q, R) inventory policy on a single item that carries out the procurement continuously.

The purpose of this research is to develop a mathematical model that is appropriate and in accordance with continuous review details (Q, r) that consider the product's shelf life and storage space capacity in the form of simple simulations to determine the flexibility (Q, r) policy of multi-item products. In addition, also to find out the influence of shelf life (lifetime) on the product cost incurred by the warehouse, so as to minimize the costs that must be incurred by the warehouse to store the product in accordance with the demand as a consideration of the warehouse in determining the capacity needed.

2. Literature Review

In previous studies, the first category of research studies was conducted by [8], [5], [9], [10] applied a continuous review inventory replenishment model (Q, r) policy, single item. Among the three studies [8] and [5] included a constant product shelf life with deterministic lead time distribution. Whereas A. [9] did not include the variable lifetime or zero lifetime in his study with a constant lead time distribution, as well as [10] with a stochastic lead time distribution.

The second category of previous research is about perishable items that have been conducted by [11], [12], [5], and [2], said that if their model is well used in the product storage model by using various approaches and limitations and assumptions. However, none of these studies have found any research that considers the limitations of warehouse and multi-item capacity. Same with research conducted by [9] and [10] who put a limit on warehouse capacity with single items, also with [13] with multi-items, but none considered the shelf life or decaying of stored products.

Preceded by research conducted by [2], which explains the lot size and reorder point models that are appropriate for use in inventories that have gradual changes in shelf life due to product damage or decaying using the Hadley - Within method and analysis approach and using simulations for develop a model (Q, r). Assuming inventory review is done regularly or continuously. [2] also explain the relationship of decaying models and perishable inventory and using cost parameters among others, setup or ordering costs, replacement costs, holding costs, and shortage costs.
Added research has been conducted by [10], which uses a mathematical model and focuses on the problem of limited storage capacity in the warehouse. In contrast to [2]'s research, [10] used four cost components including ordering costs, inventory holding costs in internal storage, inventory holding costs in external storage, and shortage costs. Assuming demand and lead time are stochastic, so the demand for lead time just happens using an empirical distribution. The model development carried out by [14], is known to have several assumptions, one of which is to use (Q, r) inventory policies on single items that carry out continuous procurement. According to [14], the fundamental difference between a continuous review and periodic review is at the time of different replenishment orders. In Continuous review, an order is carried out if the inventory position on-hand stock has reached point R or lower than R. While the periodic review depends on the specified review time interval. To support multi-item research, so based on previous research conducted by [15], which explains the heuristic model used in the problem of multiple product procurement with dynamic demand conditions coupled with limited warehouse capacity. By adopting a previous study conducted by [16] for single-item lot sizing with no well-proven capacity, it was able to increase lot-for-lot schedules by combining procurement based on cost-saving priority rules on multi-item capacity problems. Perishable product is an additional problem for the model that will be developed based on previous research conducted by [2], which explains and considers perishability into two general classifications based on product age, namely, fixed lifetime and random lifetime. By adding a multi-product model to be more difficult, this is explained by [4] with a multi-product perishable inventory model where when there are two products, one product has a limited product life of m periods, and one product has a product life infinite. Product units that have a limited product life in the period have a holding cost that is greater or equal to the holding cost of products that have an unlimited shelf life. Same with the procurement cost or procurement costs of products with a limited shelf life will certainly have a greater frequency of ordering compared to products that have an unlimited shelf life.

The formulations listed above are used assuming zero inventory at the beginning and end of the period. Problems using the assumption of initial and ending inventory above zero or positive can be easily solved by allocating initial inventory to meet the demand for the first period plus ending inventory needed to meet demand in the last period. For the record, multi-item problems with limited warehouse capacity result in many problems that arise suddenly and unexpectedly, thus requiring a good initial inventory. Because zero inventory levels at the beginning of the period for all items will have a bad impact going forward.

3. Optimization Model

3.1 Overview

This study uses various parameters that affect the decision variables in this study. The parameters used in this study include, CP = Replenishment Cost (IDR / order), CH = Holding Cost (IDR / unit), CS = Shortage Cost (IDR / unit). Whereas in this study there are 2 decision variables, among others, Q = Replenishment order quantity (unit) and r = Reorder point (unit).

Likewise, the variables that support this research. Among them have a value that has been given previously as variable warehouse capacity which is denoted W; the existence of warehouse capacity in this study is a limitation needed so that inventory levels in the warehouse do not exceed available storage capacity. Then D or d represents the demand in units of units and μD or μd which represents the average demand in units of units within a certain period. The existence of τ and Lt as the Leadtime and Lifetime owned by each commodity product is certainly different so that different reorder points for each commodity are also different.

Every time replenishment is done, several units are damaged within a certain period, ψ in units. So, the expectation of a damaged product at the lead time, ψτ, due to the influence of Lt on perishable products that limits the shelf life of a product. This making product damage. Same with the average unit demand which may occur at a lead time, μd μτ.
Parameter

- $C_R$: Replenishment Cost (IDR/order)
- $C_H$: Holding Cost (IDR/unit)
- $C_S$: Shortage Cost (IDR/unit)

Variable

- $W$: Warehouse capacity (unit)
- $D$: Demand (unit)
- $\mu D$: Demand rate (unit)
- $\tau$: Lead time (hari)
- $L_t$: Life time (hari)
- $\psi$: The unit that was decaying in the period (unit)
- $\mu d \mu \tau$: Lead time demand average (unit)
- $\psi \tau$: Product expectations are decaying at the lead time (unit)
- $P_S$: The probability of a unit shortage that is assumed to be lost sales (unit)
- $E_S$: Expect the number of items that are shortage (unit)
- $W_{Pr}$: Random level of inventory position when ordering (unit)
- $P_i$: Price product-$i$ (IDR)
- $T_p$: Percentage of price weighted (%)
- $T_d$: Percentage of demand weighted (%)

Decision Variable

- $Q$: Replenishment order quantity (unit)
- $r$: Reorder point (unit)

Assumption

1. The product under study is part of food products that are included in the list of necessities that have a finite lifetime.
2. If the inventory position reaches or below the reorder point, it will be ordered again.
3. Data demand or demand is stochastic.
4. Leadtime is constant or fixed in each commodity.
5. One particular commodity has a fixed shelf life and lead time at every replenishment.
6. Do not consider the existence of joint replenishment between products.
7. Storage warehouse capacity is assumed not to change.
8. The warehouse also functions as a market assuming demand of 5% of the total needs of East Java.
9. If there is a shortage, it will be assumed as lost sales.
10. Data were available in the form of historical demand data, lead time of each product, warehouse capacity, and costs that become calculation parameters.
11. The cost of money on holding costs is assumed to be the same for each product.
12. The reduced lifetime of the product does not affect the price reduction of the product, assuming the price of the product is considered to be fixed as long as the product's shelf life is still thereby eliminating the cost of quality.

4. Inventory Model

All items carried out in a certain period do not exceed the available warehouse capacity. This is done to increase the reserves issued and reduce the risks arising from excess product stock, $W \geq \sum_{i=1}^{d} \sum_{t=1}^{d_{it}} d_{it}$, where $W$ as fixed warehouse capacity is the limit in ordering products $i = 1, 2, ..., N$ to meet demand $d$ in periods $t = 1, 2, ..., T$. So, the number of products owned in the warehouse is not permitted to exceed the available warehouse capacity. To find out the average demand for each product $i$ is $\mu D_i = D_i / T$. 

...
For perishable products that have a limited lifetime so it is necessary to find out the number of products that are damaged in each order made,

\[
\psi = \frac{(Q - \mu Di) T}{T} \tag{1}
\]

and we got,

\[
\psi = Q / T - \mu Di \tag{2}
\]

at the inventory level during the cycle that is affected by damage and product demand. The existence of this linkage can be used to determine the safety stock that can be obtained through reorder points minus demand at the time of lead time and damage at the time of lead time.

\[
s = r - \mu Di \tau - \psi \tau = r - Q \tau / T \tag{3}
\]

4.1 Inventory reviews and demand during stockouts.

Having an item with a limited shelf life, coupled with lead time and random requests, making perishable products requires continuous review of storage to anticipate the occurrence of stockout, with the probability of the occurrence of demand with a quantity higher than the stock of goods available at the warehouse, \( PS = P (D > EOH) \). This can be said if the stock of products available at the warehouse has reached the reorder point and makes the incoming demand is higher than the reorder point, \( PS = P (D > r) \) and means that through the probability of a stockout demand,

\[
PS = \sum_{d=r+1}^{D_{\text{max}}} f(d) \tag{4}
\]

we can get an estimate of the number of stockout units that cannot be met,

\[
ES = \sum_{d=r+1}^{D_{\text{max}}} (D - r) f(d) \tag{5}
\]

4.2 Average inventory management costs per cycle.

Assuming that on-hand inventory at the beginning of the cycle is equal to the number of order quantity, \( OH_{\text{begin}} = Q \), then on-hand inventory in the middle of the cycle is the same as the reorder point, \( OH = r \), the amount of on-hand inventory at the end of the cycle is equal to the number of items at the reorder point is added to the estimated product that is not met and then reduced by the average demand for the cycle, \( OH_{\text{end}} = r - D + ES \), so that it is obtained,

\[
OH_{\text{begin}} = Q + r - D + ES = Q + OH_{\text{end}} \tag{6}
\]

In this model it is assumed to only use internal warehouse capacity without involving external parties by entering the external warehouse capacity so that expected over-ordering at warehouse capacity is zero, \( EO = 0 \), Over-ordering is not allowed to occur so that \( IP - W \leq 0 \), this is intended to limit the number of product orders so as not to exceed the warehouse capacity limit previously set.

\[
IP = Q + r + ES \tag{7}
\]

From equation (7) above we can find out the inventory position, \( IP \), by knowing the number of product orders of \( Q \), plus the number of products at \( r \), reorder points, plus the number of items estimated to have a shortage of \( ES \), plus \( \psi \) which is an estimated number of products damaged during lead time. Inventory level in the warehouse can be determined. \( IL = IP - D \), i.e. inventory position is reduced by the amount of demand for several products in one cycle. So, it is known that the total cost in the warehouse is,

\[
TC = \sum \frac{\mu Di (CPi + CSEsi + (CHi Q / \mu Di) EOH)}{Qi + ESi} \tag{8}
\]
With,

\[ EOH = Qi/2 + Ri - \mu d \mu t + ESi \] (9)

4.3 Determine \( r \) and \( Q \) of each item.

The warehouse can determine the number of items to be ordered, \( Q \), through the equation below,

\[ Q = Lti - \mu Li \left( \frac{2\mu Di}{CHt} \left[ CPI + CSI ES + \frac{CHt ESI}{\mu Di} (\mu i - ri - ES/2) - ES \right] \right) \] (10)

Equation (10) above, is obtained based on the basic formula looking for EOQ as initial \( Q \) i.e,

\[ Q = \sqrt{\frac{2\mu Di CPI}{CHt}} \] (11)

Then determine the reorder point with the equation,

\[ r = \mu d \mu t + s \] (12)

With restrictions, the number of items at the reorder point plus the order quantity of a product must not be more than equal to the warehouse capacity owned, \( r + Q \leq W \).

4.4 Determine the capacity allocation of each item.

Considering the function of the warehouse is as a buffer stock of the needs and the limited capacity of the warehouse that is owned so it needs a factor as a difference for each product commodity based on product prices and demand on the product. Assuming priority over the capacity of the warehouse to meet demand and priority on product prices to control prices so that an equation is obtained,

\[ WPr = \left( \frac{Pi}{P_{min}} \times %Tp \right) + \left( \frac{\mu Di}{\mu D_{min}} \times %Td \right) \times W \] (13)

The allocation of warehouse capacity for each product is determined as a limitation on the value of \( Q \) not to order more than the predetermined \( WPr \).

5. Numerical Example.

5.1 Determine \( r \) and \( Q \).

Each of the commodities above has different cost parameters except for replenishment cost (\( CP \)) which has the same cost on each object commodity studied. \( CP \) of onion, \( CP \) of garlic, \( CP \) of red chili, and \( CP \) of cayenne have a value of IDR 94,687 each time a replenishment is performed. As shown in Table 1 above, each type of product has a holding cost (\( CH \)) and a shortage cost (\( CS \)) that varies depending on the supporting costs contained therein.
Generally, demand and prices on products will affect variable costs as an important part of finding the order quantity of a product, but demand and prices on products can also be used as a benchmark for determining the capacity of warehouses for each product commodity. As shown in Table 2 which explains if the distribution of warehouse capacity in each commodity by involving product price factors in a certain time period. By dividing the priority scale by 40% on the price of the product and 60% on the average demand for the product, then each product capacity available at the warehouse can be determined. Onion commodities that have a product sale price of IDR 22,292/kg or IDR 22,292,000 per ton occupies the fourth position of the four commodities so that it becomes the last priority in determining warehouse capacity.

Table 2. Price priority to warehouse capacity.

| Komoditas   | Price (IDR) | Price Priority (40%) | x   | Commodity Prio | WH Capacity (Ton) |
|-------------|-------------|----------------------|-----|----------------|------------------|
| Onion       | 22,292      | 4                    | 1   | 1.1738         | 13.6307          |
| Garlic      | 26,693      | 3                    | 1.1738 | 1.0790         | 10.5687          |
| Red Chili   | 51,488      | 2                    | 1.1738 | 1.7542         | 14.6253          |
| Cayenne     | 75,031      | 1                    | 1.1738 | 3.1162         | 31.1751          |
| Total       |             |                      |      | 7.1232         | 70               |

However, in the aspect of demand, shallots have a fairly high average demand of 6.9738 tons per day and occupy the second position of the four commodities, with the highest demand being cayenne pepper of 10.4998 tons per day. So in determining the capacity of the warehouse, it is necessary to have a simple calculation to get the warehouse capacity of each product where shallots get a portion of 16.48% of the total available capacity and cayenne pepper with the highest priority capacity of 43.75% of the total available capacity as shown in Table 3.

Table 3. Demand priority to warehouse capacity.

| Komoditas   | Ave. demand ton per day | Demand Priority (60%) | x  | Demand % | WH Capacity (Ton) |
|-------------|--------------------------|-----------------------|----|----------|------------------|
| Onion       | 4.3639                   | 3                     | 2.949 | 43.60%  | 30.5206          |
| Garlic      | 3.8386                   | 4                     | 1   | 16.42%   | 11.4968          |
| Red Chili   | 4.8171                   | 2                     | 1   | 20.48%   | 17.4150          |
| Cayenne     | 9.9807                   | 1                     | 1.2897 | 15.10%  | 10.5677          |
| Total       | 22.5453                  | 100%                  |     |          | 70               |

The existence of a warehouse capacity limit on each commodity has an impact on the $IL \leq W$ constraint, namely over-ordering of related products. This certainly will be very important for companies that have limited space in storing products so that it becomes difficult to get access to additional storage space or external warehouses. The distribution of warehouse capacity allocation for each product commodity can be seen in Figure 1 assuming the conditions that have been attached to the previous
table. Then after the storage space capacity of each product is determined, the storage space capacity becomes a limit for each product in determining the number of products to be ordered for $Q$ with no more than the warehouse capacity. That way each product has different $W$, $Q$, and $r$.

![Warehouse capacity allocation of each commodity.](image1)

**Figure 1.** Warehouse capacity allocation of each commodity.

The model in this study can find out the value of each $Q$ and $r$ of each product. These results are listed in Table 4 which explains based on calculations made using certain assumptions and restrictions. For example, in this study using a fixed warehouse capacity of 70 tons. With constant lead time and exponential lifetime, and demand has taken in normal distribution refers to primary data obtained through the East Java food security service.

**Table 4.** $Q$ and $r$ value each commodity.

| Commodity     | Onion       | Garlic     | Red Chili  | Cayenne    |
|---------------|-------------|------------|------------|------------|
| **Warehouse Capacity (Ton)** | 11.5299     | 10.5981    | 17.2637    | 30.6084    |
| **Safety Stock (Ton)**          | 6.6418      | 4.7571     | 6.6421     | 10.5402    |
| **Remaining Capacity (Ton)**    | 4.8881      | 5.8410     | 10.6216    | 20.0682    |
| **Order Quantity ($Q$)**        | 10.8704     | 8.9744     | 13.2310    | 25.9809    |
| **Order Quantity after constraint ($Q$)** | 4.2287 | 4.2174 | 6.5890 | 15.4407 |
| **Reorder point ($r$)**         | 11.0056     | 8.1406     | 11.3435    | 20.5209    |

5.2 Cost and Revenue Analysis.

Based on the above model, the total cost in the warehouse can be known through equation (8), so that it can also be seen the optimal capacity limit needed for each commodity. This refers to the cost, revenue, and profit that can potentially be obtained by the warehouse. This certainly becomes a reference and input for each business model warehouse. However, there is a significant impact on the growing capacity of the warehouse to store these perishable products. As shown in Figure 2, which explains the costs that may be incurred by the warehouse for all related commodities.

At a warehouse capacity of 3 tons to 10 tons, the cost that may be incurred by the warehouse is very high or the highest among others. With a total average demand of 22.54 tons, the capacity of 3 tons certainly does not meet demand, so that the biggest cost burden lies in the shortage cost ($CS$), which is the cost of not meeting the demand for each commodity. With a total cost of IDR 34,128,169,305, and revenue of only IDR. 4,789,759,823 makes 3 tons capacity not an option for warehouses that have high demand.

The high cost occurs to a certain capacity limit, so the difference from the revenue obtained by the warehouse becomes profit. Warehouse issued the lowest cost at the point of 27 tons warehouse capacity. Figure 3 and the detail in Table 5, it shows that the revenue obtained by the warehouse reaches the maximum point and cannot increase again at the point of 29.7 tons with IDR 35,355,860,515. Increased
warehouse capacity, at this point, does not affect the revenue obtained by the warehouse. On the contrary, the costs that must be incurred by the warehouse actually increase, because the holding cost \((CH)\) in the warehouse which continues to increase is not offset by increased demand.

![Figure 2. Cost per warehouse capacity graph.](image1)

![Figure 3. Revenue per warehouse capacity graph.](image2)

After reaching the highest point with the same demand and lifetime conditions and lead time, an increase in warehouse capacity results in a decrease in total profits for all commodities. This is due to the increasing burden of warehouse maintenance which is not offset by increased demand for these commodities.

![Figure 4. Revenue and cost pairing per capacity graph.](image3)

As shown in Figure 4 which compares the amount of warehouse revenue and expenditure to products by taking into account the available warehouse capacity, where the higher the warehouse capacity, the higher the expenditure charged to the storage warehouse. So that it affects the profit per month earned. So, to increase the benefits with a high warehouse capacity, it is necessary to increase the demand accordingly so that it does not burden the storage warehouse. The difference between revenue and cost decreases and becomes increasingly unprofitable to invest in warehouses with a large capacity if it is not matched by large demand.
Table 5. Cost, revenue, & profit per warehouse capacity.

| Total WH Capacity | Cost /month (IDR) | Cost (%) | Revenue /month (IDR) | Revenue (%) | Profit per month (IDR) | Status |
|-------------------|-------------------|----------|----------------------|-------------|------------------------|--------|
| 0                 | -                 | -        | 0.00%                |             |                        |        |
| 3                 | 34,128,169,305    | 551.93%  | 4,789,759,823        | 13.55%      | -29,338,409,482        | Newsboy 4 products |
| 5                 | 31,068,320,232    | 493.48%  | 7,982,933,039        | 22.58%      | -23,085,387,194        | Newsboy 4 products |
| 10                | 23,418,697,550    | 347.35%  | 15,965,866,077       | 45.16%      | -7,452,831,472         | Newsboy 4 products |
| 20                | 8,514,669,269     | 62.65%   | 31,550,515,071       | 89.24%      | 23,035,845,801         | Newsboy 4 products |
| 23.3              | 5,484,749,397     | 4.77%    | 34,814,419,778       | 98.47%      | 29,329,670,380         | Newsboy 4 products |
| 25                | 5,236,392,851     | 0.03%    | 35,176,101,845       | 99.49%      | 29,939,708,993         | Newsboy 4 products |
| 27                | 5,234,953,494     | 0.00%    | 35,310,865,344       | 99.87%      | 30,075,911,851         | Newsboy 4 products |
| 29.7              | 5,369,945,916     | 2.58%    | 35,355,860,515       | 100.00%     | 29,985,914,599         | Newsboy 4 products |
| 30                | 5,389,944,537     | 2.96%    | 35,355,860,515       | 100.00%     | 29,965,915,798         | Newsboy 4 products |
| 40                | 6,069,523,696     | 15.94%   | 35,355,860,515       | 100.00%     | 29,286,336,819         | Newsboy 4 products |
| 50                | 6,746,167,568     | 28.87%   | 35,355,860,515       | 100.00%     | 28,609,692,947         | Newsboy 2 products |
| 60                | 7,424,989,234     | 41.83%   | 35,355,860,515       | 100.00%     | 27,930,871,281         | Newsboy 1 product |
| 70                | 8,103,621,526     | 54.80%   | 35,355,860,515       | 100.00%     | 27,252,238,989         | Newsboy 0 product |
| 80                | 8,785,189,105     | 67.82%   | 35,355,860,515       | 100.00%     | 26,570,671,410         | Newsboy 0 product |
| 90                | 9,469,407,911     | 80.89%   | 35,355,860,515       | 100.00%     | 25,886,452,604         | Newsboy 0 product |
| 100               | 10,152,395,790    | 93.93%   | 35,355,860,515       | 100.00%     | 25,203,464,725         | Newsboy 0 product |
| 110               | 10,834,815,549    | 106.97%  | 35,355,860,515       | 100.00%     | 24,521,044,966         | Newsboy 0 product |
| 114               | 11,115,463,834    | 112.33%  | 35,355,860,515       | 100.00%     | 24,240,396,681         | Newsboy 0 product |
| 120               | 11,515,436,261    | 119.97%  | 35,355,860,515       | 100.00%     | 23,840,424,254         | Newsboy 0 product |

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