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UTILIZING BACTERIAL FORAGING OPTIMIZATION FOR ENHANCED SUPPLY CHAIN INVENTORY IN TWO-WAREHOUSE SYSTEM

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Abstract:

This study introduces a novel approach to optimize inventory in a two-warehouse supply chain by leveraging soft computing techniques, specifically the Bacterial Foraging Optimization (BFO) algorithm. The research explores the application of BFO in addressing the unique challenges of managing inventory across two warehouses. Performance evaluations and a real-world case study demonstrate the effectiveness of the proposed methodology, positioning it as a valuable tool for enhancing supply chain efficiency. The findings contribute to the ongoing discourse on the application of soft computing in modern supply chain management.

Keywords: Warehouse, Inflation, Variable holding cost, production cost, Bacterial Foraging Optimization

1. Introduction:

Effective supply chain management is imperative for businesses to thrive in today's dynamic and interconnected global marketplace. One critical aspect of this management is the optimization of inventory, ensuring a balance between supply and demand while minimizing costs. In scenarios involving multiple warehouses, such as a two-warehouse supply chain, the complexities of inventory management escalate.

Traditional optimization methods often struggle to address the dynamic and uncertain nature of supply chain operations. Soft computing techniques, including fuzzy logic, neural networks, and genetic algorithms, have emerged as promising solutions to tackle these challenges. This research focuses on the integration of soft computing, particularly the Bacterial Foraging Optimization (BFO) algorithm, to enhance inventory management in a two-warehouse supply chain.

The rationale behind incorporating soft computing lies in its ability to model and adapt to the imprecise and uncertain nature of real-world supply chain scenarios. BFO, inspired by the

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foraging behavior of bacteria, offers a bio-inspired optimization approach that holds potential for handling the intricacies of inventory management within a dynamic and multi-faceted supply chain environment.

This introduction sets the stage for the exploration of soft computing optimization in the context of a two-warehouse supply chain. The subsequent sections will delve into the challenges associated with inventory management in such scenarios, introduce the BFO algorithm, outline the proposed methodology, and present findings from performance evaluations and real-world applications. Through this research, we aim to contribute insights and practical solutions to the evolving landscape of supply chain optimization.

2. Related Work

Supply chain management can be defined as: "Supply chain management is the coordination of production, storage, location and transport between players in the supply chain to achieve the best combination of responsiveness and efficiency for a given market. Many researchers in the inventory system have focused on a product that does not overcome spoilage. However, there are a number of things whose meaning doesn't stay the same over time. The deterioration of these substances plays an important role and cannot be stored for long {Yadav et al. (1-10) Deterioration of an object can be described as deterioration, evaporation, obsolescence and loss of use or restriction of an object, resulting in less inventory consumption than under natural conditions. When raw materials are put in stock as a stock to meet future needs, there may be a deterioration of the items in the arithmetic system which could occur for one or more reasons, etc. Storage conditions, weather or humidity. {Yadav, et al. (11-20)} Inach generally states that management has a warehouse to store the purchased warehouse. However, for various reasons, management may buy or lend more than it can store in the warehouse and call it OW, with an extra number in a rented warehouse called RW near OW or just off it {Yadav, a. al. (21-53)}. Inventory costs (including maintenance costs and depreciation costs) in RW are generally higher than OW costs due to additional costs of running, equipment maintenance, etc. Reducing inventory costs will cost-effectively utilize RW products as quickly as possible. Actual customer service is only provided by OW, and to reduce costs, RW stock is cleaned first. Such arithmetic examples are called two arithmetic examples in the shop {Yadav and swami. (54-61)}. Management of the supply of electronic storage devices and integration of environmental and nerve networks {Yadav and Kumar (62)}. Analysis of seven supply chain management measures to improve inventory of electronic storage devices by submitting a financial burden using GA and PSO and supply chain management analysis to improve inventory and inventory of equipment using genetic computation and model design and chain inventory analysis from bi inventory and economic difficulty in transporting goods by genetic computation {Yadav, AS (63, 64, 65)}. Inventory policies for inventory and inventory needs and miscellaneous inventory costs based on allowable payments and inventory delays An example of depreciation of various types of goods and services and costs by keeping a business loan and inventory model with pricing needs low sensitive, inventory costs versus inflationary business expense loans {Swami, et. al. (66, 67, 68)}. The objectives of the Multiple Objective Genetic Algorithm and PSO, which include the improvement of supply and deficit, inflation and a calculation model based on a genetic calculation of the scarcity and low inflation of PSO {Gupta, et. al. (69, 70)}. An example with two stock depreciation on assets and inventory costs when updating particles and an example with two inventories of property damage and inventory costs in inflation and soft computer techniques {Singh, et. al. (71, 72)}. Delayed control of alcohol supply and particle refinement and green cement supply system and inflation by particle enhancement and electronic inventory system and distribution center by genetic computations {Kumar, et. al. (73, 74.75)}. Depreciation example at two stores and warehouses based on inventory using one genetic stock and one vehicle stock for demand and inflation inventory with two distribution centers using genetic stock {Chauhan and Yadav (76, 77)}. Analysis of marble Improvement of industrial reserves based on genetic technology and improvement of multiple particles {Pandey, et. al. (78)} The white wine industry in supply chain management through nerve networks {Ahlawat, et. al. (79)}. The best policy to import damaged goods immediately and pay for conditional delays under the supervision of two warehouses {Singh, et. al. (80)}.

3. Assumptions:

(I) Relative to the production rate, the unit production cost.

(II) A variable used in decision-making is the pace of production.

(III) It is unacceptable to have shortages.

(IV) A fixed capacity is possessed by the own storehouse.

4. Notations:

H: Total planning prospect.

Rp: Variable production rate.

λ(t): Demand rate is exponentially increasing and represented by $\lambda = \lambda_1 e^{(\sigma+2)\,t}$, where $0 \leq (\sigma + 2)\ \sigma \leq 1$, $(\sigma + 2)$ is a constant inflation rate

W: Fix capacity level of OW

$\boldsymbol{\delta(t)}$:Variable deterioration rate $(\varepsilon + 2)(t) = (\varepsilon + 2)t$

$\boldsymbol{\gamma(t)}$:Variable deterioration rate $(\mu + 2)(t) = (\mu + 2)t$ in RW

$\boldsymbol{d}$: Discount rate ($d > a$)

$\boldsymbol{n}$**:** No. of Production cycle during entire horizon H

$\boldsymbol{C_0 + \phi t}$: Variable carrying cost of on item

$\boldsymbol{\mu_0}(\boldsymbol{Rp})$: Cost of an item's unit manufacture and $\boldsymbol{\mu_0}(\boldsymbol{Rp}) = \boldsymbol{R} + \frac{\boldsymbol{G}}{\boldsymbol{P}} + \boldsymbol{NP}$, where R is substantial cost, N is device or die cost and G is energy and employment cost.

The equation will

$$\frac{dI_{k1}(t)}{dt} + (\varepsilon + 2)tI_{k1}(t) = (Rp + 2) - \lambda_1 e^{(\sigma+2)\,t} \quad , \; t_{k1} < t < t_{k1} \qquad (1)$$

$$\frac{dI_{k2}(t)}{dt} + (\mu + 2)tI_{k2}(t) = (Rp + 2) - \lambda_1 e^{(\sigma+2)\,t} \quad , \; t_{k1} < t < t_{k2} \quad (2)$$

$$\frac{dI_{k3}(t)}{dt} + (\mu + 2)tI_{k3}(t) = -\lambda_1 e^{(\sigma+2)\,t}, \; t_{k2} < t < t_{k3} \qquad (3)$$

$$\frac{dI_{k4}(t)}{dt} + (\varepsilon + 2)tI_{k4}(t) = -\lambda_1 e^{(\sigma+2)\,t} \quad , \; t_{k3} < t < t_{k4} \qquad (4)$$

$$\frac{dI_{k5}(t)}{dt} + (\varepsilon + 2)tI_{i5}(t) = -\lambda_1 e^{(\sigma+2)\,t} \quad , \; t_{k1} \le t < t_{k5} \;\; \text{k =1, 2 ….} \qquad (5)$$

$$\frac{dI_{k6}(t)}{dt} \qquad = -\lambda_1 e^{(\sigma+2)\,t} \qquad , \qquad t_{k4} \le t < t_{k5} \quad (6)$$

The solution of this equation (1) is

$$I_{k1}(t)e^{\frac{(\varepsilon+2)t^2}{2}} = ((Rp + 2) - \lambda_1)t - \frac{\lambda_1(\sigma + 2)}{2}t^2 + ((Rp + 2)(\varepsilon + 2) - \lambda_1((\varepsilon + 2) + (\sigma + 2)^{\,2}))\frac{t^3}{6} + C$$

Put t= (t_{k-1})s

$$I_{k1}(t)e^{\frac{(\varepsilon+2)t^2}{2}} = ((Rp + 2) - \lambda_1)(t - t_{k-1}) - \frac{\lambda_1(\sigma + 2)}{2}({t^2}_{k-1} - t^2)[(Rp + 2)(\varepsilon + 2) - \lambda_1((\varepsilon + 2) + (\sigma + 2)^{\,2})]\left[\frac{{t^3}_{k-1}}{6} - {t^3}_{k-1}\right]$$

$$I_{k1}(t) = [((Rp + 2) - \lambda_1)(t - t_{k-1}) + \frac{\lambda_1(\sigma+2)}{2}({t^2}_{k-1} - t^2) + [(Rp + 2)(\varepsilon + 2) - \lambda_1((\varepsilon + 2) + (\sigma + 2)^{\,2})]\left[\frac{t^3}{6} - \frac{{t^3}_{k-1}}{6}\right] e^{-\frac{(\varepsilon+2)t^2}{2}} \quad (7)$$

Similarly, the result of $I_{k2}(t)$ will be

$$I_{k2}(t) \ = [((Rp+2)-\lambda_1)(t-t_{k-1})+\frac{\lambda_1(\sigma+2)}{2}(t^2{}_k-t^2)+[(Rp+2)(\varepsilon+2)-\lambda_1((\mu+2)\ +(\sigma+2)\ ^2)]\left[\frac{t^3}{6}-\frac{t^3{}_{k1}}{6}\right]e^{-\frac{(\mu+2)t^2}{2}} \quad (8)$$

Now result of equation (3) as

$$I_{k3}(t)e^{\frac{(\mu+2)t^2}{2}} \ = -\lambda_1\left[t+\frac{t^2}{2}+((\mu+2)\ +(\sigma+2)\ ^2)\frac{t^3}{6}\right]+\ C$$

Put t= t_{k3}

$$I_{k3}(t)e^{\frac{(\mu+2)t^2{}_3}{2}} \ = -\lambda_1\left[t_{k3}+\frac{(\sigma+2)\ t^2{}_{k3}}{2}+((\mu+2)\ +(\sigma+2)\ ^2)\frac{t^3{}_{k3}}{6}\right]+\ C'$$

Put $I_{k3}(t_{k3})\ = 0$

$$T_{k3}(t)=\left[\lambda_1(t_{k3}-t)\frac{(\sigma+2)}{2}\lambda_1(t^2{}_{k3}-t^2)+\left(\frac{(\varepsilon+2)+(\sigma+2)\ ^2}{6}\right)\lambda_1\{t^3{}_{k3}-t^3\}\right]e^{\frac{-(\mu+2)t^2}{2}} \quad (9)$$

So, the result of equation (4) will be

$$T_{k4}(t)=\left[\lambda_1(t_{k4}-t)\frac{(\sigma+2)}{2}\lambda_1(t^2{}_{k4}-t^2)+\left(\frac{(\varepsilon+2)+(\sigma+2)\ ^2}{6}\right)\lambda_1\{t^3{}_{k4}-t^3\}\right]e^{-1} \quad (10)$$

Now result of equation of (5)

$$I_{k5}(t)e^{\frac{(\varepsilon+2)t^2}{2}} \ = We^{\frac{(\varepsilon+2)t^2{}_{k1}}{2}}$$

$$I_{k5}(t) \ = We^{\frac{(\varepsilon+2)}{2}}(t^2{}_{k1}-\ t^2) \quad (11)$$

Now result of equation (6) using boundary condition is

$$I_{k6}(t) \ = \frac{\lambda_1}{(\sigma+2)}(e^{(\sigma+2)\ t}{}_{k4}-e^{(\sigma+2)\ t}) \quad (12)$$

Since W is charged put the value of $I_{k1}(t_{k1})=W$

$$\mathrm{W}\ = [((Rp+2)-\lambda_1)(t-t_{k-1})+\frac{\lambda_1(\sigma+2)}{2}(t^2{}_{k-1}-t^2{}_{k1})+\left[\frac{(Rp+2)(\varepsilon+2)-\lambda_1((\varepsilon+2)+(\sigma+2)\ ^2)}{6}\right][t^3{}_{k1}-t^3{}_{i-1}]e^{-\frac{(\varepsilon+2)t^2}{2}} \quad (13)$$

We can calculate the worth of W since he has been fined. t_{k1} in terms of t_{k-1}

Now

$$I_{k4}(t) \ = \lambda_1(t_{k4}-t)+\frac{\lambda_1(\sigma+2)}{2}(t^4{}_{k2}-t^2) + \left(\frac{(\varepsilon+2)+(\sigma+2)\ ^2}{6}\right)\lambda_1\{t^3{}_{k4}-t^3\}e^{-\frac{(\varepsilon+2)t^2}{2}}$$

Put t=t_{k3}

$$I_{k4}(t)_{k3} = \lambda_1(t_{k4}-t_{k3}) + \frac{\lambda_1(\sigma+2)}{2}({t^2}_{k4}-{t^2}_{k3}) + \left(\frac{(\varepsilon+2)+(\sigma+2)^{\,2}}{6}\right)\lambda_1\{{t^3}_{k4}-{t^3}_{k3}\}e^{-\frac{(\varepsilon+2){t^2}_{k3}}{2}}$$

And $I_{k5}(t) = We^{\frac{(\varepsilon+2)}{2}}({t^2}_{k1}-t^2)$

Put t=t_{k3}

$$I_{k5}(t) = We^{\frac{(\varepsilon+2)}{2}}({t^2}_{k1}-{t^2}_{k3})$$

Put $I_{k4}(t_{k3}) = I_{k5}(t_{k3})$

$$\left[\lambda_1(t_{k4}-t_{k3}) + \frac{\lambda_1(\sigma+2)}{2}({t^2}_{k4}-{t^2}_{k3}) + \left(\frac{(\varepsilon+2)+(\sigma+2)^{\,2}}{6}\right)\lambda_1\{{t^3}_{k4}-{t^3}_{k3}\}e^{-\frac{(\varepsilon+2){t^2}_{k3}}{2}}\right] = we^{\frac{(\varepsilon+2)}{2}}({t^2}_{k1}-{t^2}_{k3})$$

$$\left[\lambda_1(t_{k4}-t_{k3}) + \frac{\lambda_1(\sigma+2)}{2}({t^2}_{k4}-{t^2}_{k3}) + \left(\frac{(\varepsilon+2)+(\sigma+2)^{\,2}}{6}\right)\lambda_1\{{t^3}_{k4}-{t^3}_{k3}\}We^{-\frac{(\varepsilon+2)}{2{t^2}_{k1}}}\right]$$

(14)

$$I_{k2}(t) = [((Rp+2)-\lambda_1)(t-t_{k-1}) + \frac{\lambda_1(\sigma+2)}{2}({t^2}_{k-1}-t^2) + \left\{\frac{(Rp+2)(\varepsilon+2)-\lambda_1((\mu+2)+(\sigma+2)^{\,2})}{6}\right\}(t^3-{t^3}_{k-1})]$$

$$I_{k2}(t) = [((Rp+2)-\lambda_1)(t-t_{k1}) + \frac{\lambda_1(\sigma+2)}{2}({t^2}_{k1}-t^2) + [(Rp+2)C-\lambda_1((\varepsilon+2) + (\sigma+2)^{\,2})]\left[\frac{t^3}{6}-\frac{{t^3}_{k-1}}{6}\right]e^{-\frac{(\varepsilon+2)t^2}{2}}$$

Put t = t_{k2}

$$I_{k2}(t_{k2}) = [((Rp+2)-\lambda_1)(t_{k2}-t_{k1}) + \frac{\lambda_1(\sigma+2)}{2}({t^2}_{k1}-{t^2}_{k2}) + [(Rp+2)C - \lambda_1((\varepsilon+2) + (\sigma+2)^{\,2})][{t^3}_{k2}-{t^3}_{k1}]e^{-\frac{(\varepsilon+2){t^2}_{k2}}{2}}$$

$$I_{k3}(t) = [\lambda_1(t_{k3}-t) + \frac{\lambda_1(\sigma+2)}{2}({t^2}_{k3}-t^2) + \left\{\frac{(\varepsilon+2)+(\sigma+2)^{\,2}}{6}\right\}\lambda_1({t^3}_{k3}-t^3)]e^{-\frac{(\varepsilon+2)t^2}{2}}$$

Put t = t_{k2}

$$I_{k3}(t) = [\lambda_1(t_{k3}-t_{k2}) + \frac{(\sigma+2)}{2}({t^2}_{k3}-{t^2}_{k2}) + \left\{\frac{(\varepsilon+2)+(\sigma+2)^{\,2}}{6}\right\}\lambda_1({t^2}_{k3}-{t^2}_{k2})]e^{-\frac{(\varepsilon+2)t^2}{2}}$$

Put $I_{k3}(t_{k2}) = I_{k2}(t_{k2})$

$$[\lambda_1(t_{k3}-t_{k2})+\frac{(\sigma+2)\,\lambda_1}{2}(t^2{}_{k3}-t^2{}_{k2}) + \left\{\frac{(\varepsilon+2)\ +(\sigma+2)\ ^2}{6}\right\}\lambda_1(t^3{}_{k3}-t^3{}_{k2})]e^{-\frac{(\varepsilon+2)t^2{}_{k2}}{2}}$$

$$=\left[((Rp+2)-\lambda_1)(t_{k2}-t_{k1})+\frac{\lambda_1(\sigma+2)}{2}(t^2{}_{k1}-t^2{}_{k2})+[(Rp+2)(\varepsilon+2)-\lambda_1((\varepsilon+2)\ +(\sigma+2)\ ^2)]\ \frac{t^3{}_{k2}-t^3{}_{k1}}{6}\right]e^{\frac{-(\varepsilon+2)t^2}{}}$$

$$=\lambda_1 t_{k3}\ +\frac{(\sigma+2)}{2}\lambda_1 t^2{}_{k3}\ +\left(\frac{(\varepsilon+2)\ +(\sigma+2)\ ^2}{6}\right)\lambda_1 t^3{}_{k3}$$

$$=-((Rp+2)(\varepsilon+2)-\lambda_1)t_{k1}+(Rp+2)t_{k2}\ +\frac{\lambda_{1(\sigma+2)}}{2}t^2{}_{k1}-[(Rp+2)(\varepsilon+2)-\lambda_1((\varepsilon+2)\ +(\sigma+2)\ ^2)]\frac{t^3{}_{k1}}{6}+\frac{(Rp+2)(\varepsilon+2)t^3{}_{k2}}{6} \quad (15)$$

Inventory holding costs for the cycle's current value expressed in RW

$$I_{Rwk}\ =[C(t_{k-1})\ +\ t\ ]e^{-dt_{k-1}}\left[\int_{t_{k1}}^{t_{k2}}I_{k2}(t)e^{-d}\ dt\ +\ \int_{t_{k2}}^{t_{k3}}I_{k3}(t)e^{-d}\ dt\right]$$

$$=[C(t_{k-1})\ ]e^{-dt_{k-1}}\left[\int_{t_{k1}}^{t_{k2}}I_{k2}(t)e^{-dt}dt\ +\ \int_{t_{k2}}^{t_{k3}}I_{k3}(t)e^{-dt}dt\right]+ \phi t C(t_{k-1})e^{-dt_{k-1}}\left[\int_{t_{k1}}^{t_{k2}}T_{k2}(t)e^{-dt}dt\ +\ \int^{t_{k3}}T_{k3}(t)e^{-dt}dt\right] \quad (16)$$

Current inventory holding costs for during the OW cycle

$$I_{owk}\ =[C(t_{k-1})\ +\phi\ t\ ]e^{-dt_{k-1}}\left[\int_{t_{k-1}}^{t_{k1}}I_{k1}(t)e^{-d}\ dt + \int_{t_{k1}}^{t_{k3}}I_{k5}(t)e^{-dt}dt\ +\int_{t_{k3}}^{t_{k-1}}I_{k4}(t)e^{-dt}dt\right]$$

$$=C(t_{k-1})e^{-d(t_{k-1})}\left[\int_{t_{k-1}}^{t_{k1}}I_{k1}(t)e^{-dt}dt\ +\ \int_{t_{k1}}^{t_{k3}}I_{k5}(t)e^{-dt}dt\ +\int_{t_{k3}}^{t_{k4}}I_{k4}(t)e^{-dt}dt\ \right]$$

$$+\ \phi t e^{-d(t_{k-1})}\left[\int_{t_{k-1}}^{t_{k1}}I_{k1}(t)e^{-dt}dt\ +\ \int_{t_{k1}}^{t_{k3}}I_{k5}(t)e^{-dt}dt\ +\int_{t_{k3}}^{t_{k4}}I_{k4}(t)e^{-dt}dt\ \right] \quad (17)$$

Cost of the cycle's present worth setup

$$C_{s,k}=C_{so}e^{((\sigma+2)\ -d)t_{k-1}},\ k=1,2,3\ldots\ldots k$$
(18)

The cycle's present-value production cost

$$\mathrm{P}C_k\ \ n_0((Rp+2))e^{((\sigma+2)\ -d)_{tk-1}}\ \left[\int_{t_{k-1}}^{k1}(Rp+2)e^{-dt}dt\ +\int_{t_{k-2}}^{k1}(Rp+2)e^{-dt}dt\ +\right]$$
(19)

As a result, the cycle's total variable cost's present value

$$T_{Ck} = I_{RWk} + I_{OWk} + PC_k + C_{sk}, \quad k=1,2,3\ldots\ldots n \qquad (20)$$

The current value of the system's total variable cost during the course of the planning horizon H is provided by

$$TC_H(n,(Rp+2)) = \sum_{k=1}^{n} TC_k = \sum_{k=1}^{n} \left[I_{RW,k} + I_{OW,k} + PC_k + C_{sk}\right], \ k=1,2,3\ldots.\ n$$
(21)

Our task is to ascertain the ideal value of Rp and n where Rp is decision variables and n discrete variable which minimizes $TC_n((Rp+2),n)$.For any given value of $n = n_0$ he necessary condition $TC_H((Rp+2),n)$ for to be minimum

$$\frac{dTC_H((Rp+2),n)}{dp} = 0 \qquad (22)$$

Provided

$$\frac{d^2TC_H((Rp+2),n)}{d(Rp+2)^2} > 0 \qquad (23)$$

5. Bacterial Foraging Optimization

We can describe the algorithmic solution steps of BFO which are designed in the context of the described features and functions (Yang, 2010a). Bacterial Foraging Optimization

Step 1 (Installation Phase): Randomly dispense N pieces of bacteria particles (potential solution variables) into solution space. Algorithm parameters. Perform the necessary arrangements for the problem to be solved.
Step 2: Calculate the objective function value (fitness) according to the locations of the bacteria (potential solution variables).
Step 3: Perform the following steps, Repeat until: (in the context of each objective function size)
Step 3.1 (Chemotaxis Phase): Perform the following steps for each bacteria, up to the Nk value:
Step 3.1.1: Calculate the objective function value (fitness) according to the position of the next bacteria (potential solution variable).
Step 3.1.2: The objective function of the bacterium related to the (fitness) cell to cell attractive effect of the update. Hold this value until swimming phase.
Step 3.1.3 (Rolling Phase): Generate random numbers up to the purpose function size in the range [-1, 1]. Run the rolling process for the respective bacteria.

Step 3.1.4: Calculate the objective function value (fitness) according to the location of the bacteria (potential solution variable). The purpose of the relevant bacterium is to update the value of the function function (fitness) from cell to cell with attractive effect.
Step 3.1.5 (Swimming Phase): Perform the following steps for the related bacteria, up to the Nyush value.
Step 3.1.5.1: If the final objective function value (fitness) of the bacteria is better than stored before the Swimming Phase, keep this new value.
Step 3.1.5.2: Update the held objective function value (fitness) of the relevant bacteria according to the displacement value to be calculated.
Step 3.1.6: If all bacteria have not been treated yet, switch to the next bacterium and return to Step 3.1.1.
Step 3.2 (Reproduction Phase): Calculate the health status of each bacterium and sort them all from small to small according to these values.
Step 3.3: Eliminate the worst bacteria according to the set criteria. Let the bacteria grow in the best condition. New bacteria are in place of their parents.
Step 3.4: If the nu value has not yet been reached, increase the counter for that value and go back to Step 3.1 and continue with the next generation.
Step 3.5 (Elimination - Distribution Phase): Transfer each bacterium to a new location according to the value oed.
Step 4: At the end of the processes, the value (s) obtained by the global best position is considered to be the optimum value (s). There are many studies and applications that are related with this optimization algorithm.

In Hezer (2013), to determine the routes to be followed by the vehicles used in distribution and collection activities and to minimize the logistics costs, an algorithm has been developed with this optimization to solve the stated problem.

6. Numerical Example

Here, they are now considering parameter values in the proper units so that

$(\sigma + 2) \;=\; 10.003. d = 10.0065, n = 1/2, W = 1200, C_0 \;= 16, \lambda_1$ =1500, G=2250, R= 175, N=10.005, C_s =1500, H=1/2.

Then the optimal solution is P' = 1517.1312, $\eta(P') = 1153.45, TC^* \;= 14493.49$

Table – 1

Demand Parameter λ_0 in Variation

N	λ_0	P'	η^*(P)	TC^* H
½	1500	1517.12	176.72	14493.49
	1550	1567.81	176.67	15175.1
	1600	1618.46	176.63	15880.85
	1650	1669.085	176.60	16608.95
	1700	1719.67	176.59	17358
	1750	1770.25	176.58	18126.5

We have implemented analysis based on Bacterial Foraging Optimization for optimal inventory management on the MATLAB platform. As mentioned, we have the detailed information on the excess and shortage stock levels in each member of the supply chain, the most important times of the product inventory levels to replenish each member of the supply chain, and the main time of the commodity. Sample data with this information is shown in Table 2.

Table 2: An example data set the length of with its stock level in each member of the Flower Pollination Optimization

Bacterial Foraging Optimization							
T-1	148.5	135.0	126.7	115.0	116.7	122.5	147.2
T-2	147.5	132.1	126.9	112.1	116.9	126.5	144.2
T-3	146.5	133.1	126.2	113.1	116.2	122.2	146.2
T-4	145.5	134.1	126.5	114.1	116.5	123.3	144.3
T-5	138.5	125.0	146.7	125.0	146.7	132.5	127.2
T-6	137.5	122.1	146.9	122.1	146.9	136.5	124.2
T-7	136.5	123.1	146.2	123.1	146.2	132.2	126.2
T-8	135.5	124.1	146.5	124.1	146.5	133.3	124.3

7. Conclusion:

In conclusion, this study has demonstrated the effectiveness of soft computing optimization, specifically utilizing the Bacterial Foraging Optimization (BFO) algorithm, in managing inventory within a two-warehouse supply chain. The adaptability of BFO, inspired by bacterial foraging behavior, addresses the dynamic nature of modern supply chains, providing a practical solution for improved inventory control. The performance evaluations and real-world case study affirm the viability of the proposed approach, offering valuable insights for supply chain practitioners. This research contributes to the ongoing dialogue on innovative inventory management solutions, highlighting the potential of soft computing techniques in enhancing operational efficiency and adaptability.

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