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Optimization of Various Factors of Growing Items by Using PSO

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ABSTRACT

Economic order/production quantity (EOQ/EPQ) models have usually been presented for mechanized products. Incorporating some important features of a specific group of products, different EOQ/EPQ models have been projected in literature. This study proposes a new class of inventory models, i.e. a model for a specific type of listing items: growing items. We compute the optimal order quantity of the growing items at the start of a growing cycle, the finest length of the growing cycle and the optimal total profit. A sensitivity analysis is accessible to study the effect of the main parameters of the model in terms of its verdict variables and objective function. The results of the sensitivity analysis suggest that production costs are the most critical parameter.

This paper proposed a novel methodology utilizing PSO in extroverted assembling frameworks with cradles has two objectives: to meet production target and diminish stock general cost. This paper presents a novel methodology, in vision of optimal control theory, to accomplish both objectives all the while by on-control amend of the production rate of every machine.

Key words: PSO-Particle Swarm Optimization, EPQ, Optimal Control Theory

1. INTRODUCTION

The first economic order quantity (EOQ) sculpt was formulated by Harris (1913). The basic traditional EOQ model is used to conclude the optimal order quantity, with the aim of minimizing overall costs, including share and ordering costs, such that demand is met. Many variants of the EOQ model have been proposed in current decades. Economic production quantity (EPQ) is one of the initial extensions of EOQ, where the necessary assumption is that two organizations – a buyer and a producer – are involved in the dilemma and the order is placed from buyer to the producer. [1]

In EPQ, on the other hand, it is tacit that the buyer and producer are the same organization. As a consequence, in EOQ the sort quantity is assumed to be received at once, while, in EPQ, items are assumed to be acknowledged gradually over time. Traditional EOQ/EPQ models can be applied to most products. However, as of their inability to incorporate specific features of some product categories, particular models have been projected for some specific types of products. For example, there is a investigate stream on EOQ/EPQ models for perishable products for example food, vegetables, milk (Nahmias, 1982; Padmanabhan and Vrat, 1995; Dye and Ouyang, 2005; Chung and Liao, 2006). While, in traditional models, it is totally assumed that inventory items can be stored for an infinite amount of time, for fragile products, this assumption needs to be relaxed, which is why split models have been proposed. Imperfect products, akin to electronic products are another type of product that has received increasing awareness in the last decade (see, for example, Salameh and Jaber, 2000; Cárdenas-Barrón, 2000; Goyal and Cárdenas-Barrón, 2002; Rezaei, 2005; Wee et al., 2007; Rezaei and Salimi, 2012). For flawed items, the implicit assumption is that not all the established (produced) items are of perfect quality. Other examples of specific products are repairable products, for instance military products (Mabini et al., 1992; Richter, 1996), and reusable products (Koh et al., 2002; Choi et al., 2007), for example soft drink bottles. [2,3]

What all the models that have been developed in the prose have in common is that the inventory items remain unchanged throughout storage time (like many manufacturing products: computers, cars), or even shrink (like fragile products: vegetables, fruits). [4]

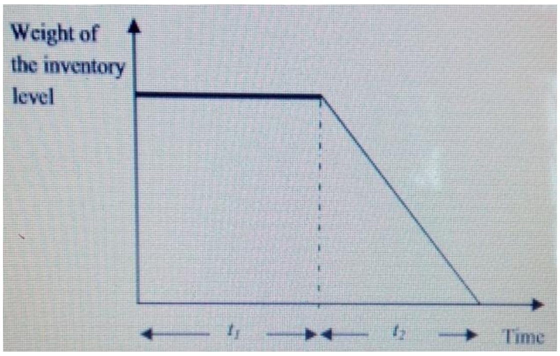


Figure-1: Behaviour of Regular Item over Time [3]

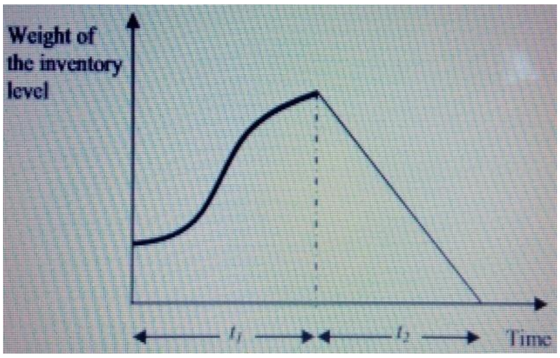


Figure-2: Behaviour of Growing Item over Time [3]

We can, however, too think of growing items, such as poultry, and livestock. The weight of the inventory level of a usual item is usually unchanged when it is not consumed (during time period t_1 in Fig. 1). For example, a supermarket store one hundred shampoos on the ledge. Without ordering extra shampoos, the weight of the list level decreases if one or more shampoos are sold (during t_2), and otherwise remains unchanged (during t_1). For rising items, however, the weight of the inventory level increases over time period t_1. For example, at the commencement of a growing cycle, a company buys a hundred chicks, with an overall weight of 400 g, and following a few days the weight of the inventory level may increase to 1200 g, with no ordering extra chicks. Figs. 1 and 2 show the behaviour of regular items and growing items, correspondingly, over time. A literature review reveals that no systematic research has been devoted to these kinds of stuff in the area of inventory management. Due to the importance of these items, we argue that additional attention should be paid to the development of specific EOQ/ EPQ models for these items. In this paper, we expand a general model for these items, which can be extended for dissimilar growing items. However, to make the model more specific, we extend our general model for a specific kind of poultry. [5,6]

The goal of this paper is to choose when and by the amount to renew stock in order to minimize the aggregate of expenses per unit time. We accept consistent survey, with the goal that stock can be renewed at what point the stock level drops adequately low. With the altered demand rate, deficiencies can be avoided by renewing stock each time the stock level drops to zero, and this additionally will reduce the holding cost.

2. MATHEMATICAL MODELING

In this section, we rest initiate the notations, and then develop the model.

Notations:-

y- Number of prepared items wt weight of unit item at time t

p- Purchasing price per weight unit s selling price per weight unit

c_f- feeding cost per unit item

h -annual holding cost per weight unit

K- set-up rate per growing cycle

Q_t- total weight of inventory at time t

d -annual order rate

A- Asymptotic weight

k -growth rate

n -shape parameter of the increase function

b -integration constant of the growth function

A common mathematical model is presented, which can be used for different growing items. We consider a state where a company buys newborn animals (e.g. poultry and livestock), raises them, and then slaughters plus sells them to the market.[5] The company wants to decide the optimal quantity of new born animals (e.g. one-day chicks) to be purchased, and the finest day to slaughter them, in order to meet demand. With these two result variables and the company's annual demand, we are able to calculate the finest number of times the facilities should be set up to start a new cycle of newborn animals. The finest values of these decision variables are the values at which the total profit of the company is maximized. [7,8]

The total profit purpose is as follows:

Total profit= total revenue–total costs **Equation-1**

The total revenue is the amount of total sales of the slaughtered animals. The total costs are made up of the total purchasing outlay of newborn animals, the total costs of production, which mainly consists of feeding costs, the whole cost of holding slaughtered animals during the sales period and, finally, the total cost associated with set up the facilities for a new growing cycle. So, the total profit function would look as follows:

Total profit= total revenue– (total purchasing cost + total production cost + total holding cost+ total setup cost) **Equation-2**

Let y be the numeral of newborn animals the company orders from the supplier at each growing cycle, and w_0 and w_1 the initial weight (the weight of newborn animals) and the final mass (the weight of slaughtered animals), respectively. Considering the selling price s plus purchasing price p, the total revenue would be syw_1, as the total purchasing costs would be pyw_0. As the newborn animals grow, their production (feeding) costs differ over time. If we assume a general function for production (feeding) costs f (t), the whole feeding costs would be $c_f y\int_0^{t1} f(t)dt$ where c_f is the feeding cost per unit and t_1 is the length of the rising cycle at the end of which the animals are slaughtered. [9,10]

As mentioned before, the asset costs are associated with the slaughtered animals, which mean that company pays the holding cost for period t_2. Considering h as the annual holding costs per weight unit, and $(yw_{1/}2)$ as the average weight of the record during storage period, the total holding costs would be $ht_2(yw_{1/}2)$. To end with, considering set-up costs K, the total profit function per cycle would be as follows:

$TP = syw_1 - pyw_0 - c_f y\int_0^{t1} f(t)dt - ht_2\frac{yw1}{2} – k$ **Equation-3**

3. PROPOSED WORK

In planned model, utilizations of optimal control theory to administration science, all in all, and to production arranging, specially, are turned out to be entirely productive. Normally, with the optimal control theory, finest control systems came to be connected to production arranging issues. The production stock matter for assembling frameworks, which is liable to instabilities, for example, request variances, machine disappointments plus others, has pulled in the deliberation of various scientists. In this strategy the state variables are the support levels, the control variables are the machine formation rates, and the yield variable is the objective production (the demand).

3.1. Proposed Algorithm

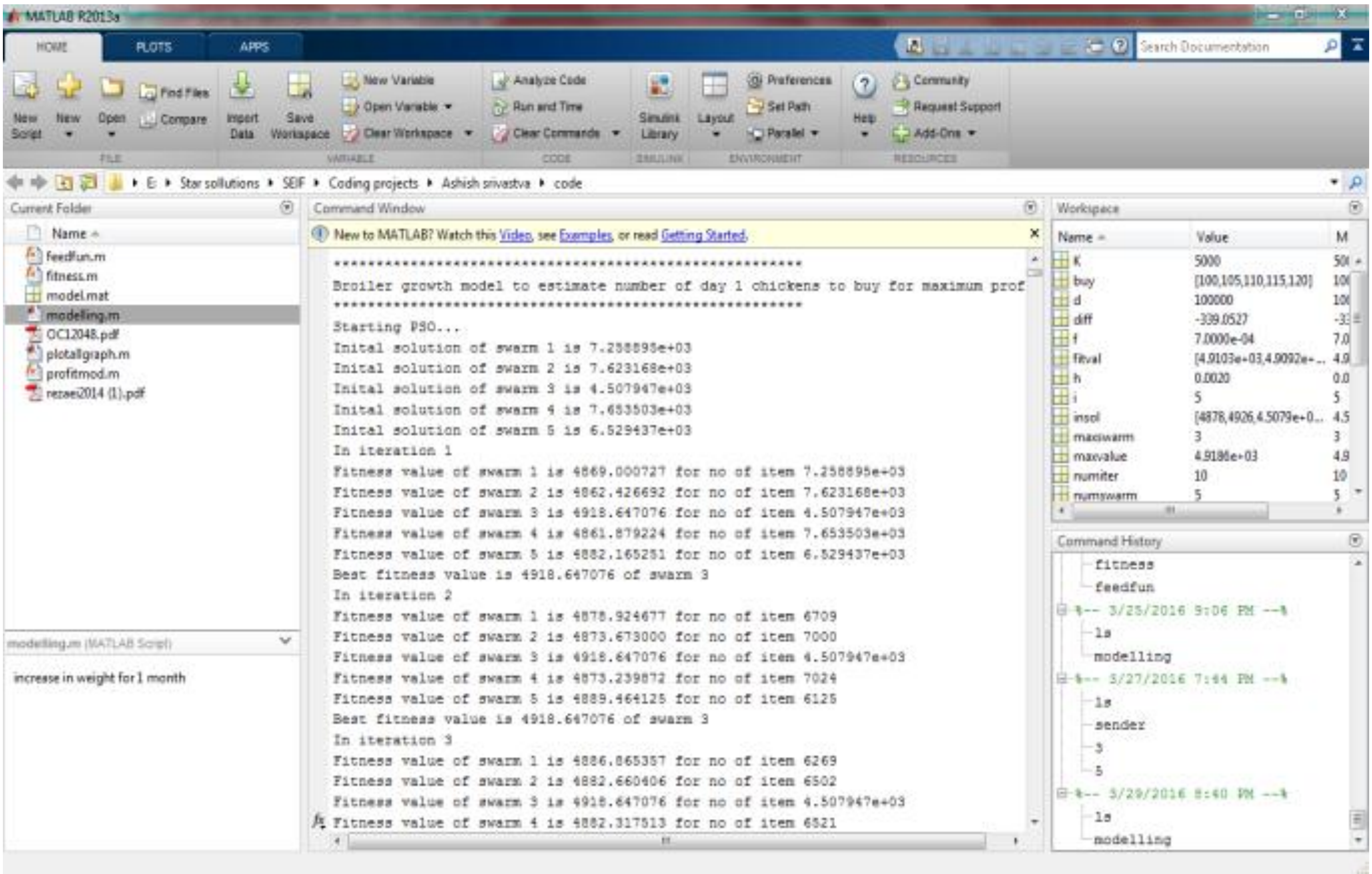
Particle Swarm Optimization- The basic thought behind the advancement of PSO is the social sharing of data with people of a populace. PSO calculations are led by utilizing laypeople of particles, relating to people as on account of transformative calculations. Remembering its best possess position builds up the molecule's experience suggesting a nearby inquiry alongside worldwide hunt growing up out of the neighbouring background or the experience of the entire swarm.[6]

```
Initialize parameters
Initialize population
Evaluate
Do {
Find best particle
Find best global
Update production
Update current capacity
Evaluate
} While (End)
```

By nearby variation, called best model, every molecule moves towards its best past position and towards the best molecule in its partial neighbourhood. On top of it, molecule plus worldwide bests are resolved to redesign the speed first. At that point the near position of every molecule is overhauled with the present speed. Assessment is again performed to list the wellness of the particles in the swarm. This circle is ended with a halting model predetermined in proceed. [11,12]

3.2. Proposed Implementation

We generate the optimal expected cost and the optimal base stock levels regarding the development request data state and limit.



```
*********************************************************
Broiler growth model to estimate number of day 1 chickens to buy for maximum prof
*********************************************************
Starting PSO...
Inital solution of swarm 1 is 7.258895e+03
Inital solution of swarm 2 is 7.623168e+03
Inital solution of swarm 3 is 4.507947e+03
Inital solution of swarm 4 is 7.653503e+03
Inital solution of swarm 5 is 6.529437e+03
In iteration 1
Fitness value of swarm 1 is 4869.000727 for no of item 7.258895e+03
Fitness value of swarm 2 is 4862.426692 for no of item 7.623168e+03
Fitness value of swarm 3 is 4918.647076 for no of item 4.507947e+03
Fitness value of swarm 4 is 4861.879224 for no of item 7.653503e+03
Fitness value of swarm 5 is 4882.165251 for no of item 6.529437e+03
Best fitness value is 4918.647076 of swarm 3
In iteration 2
Fitness value of swarm 1 is 4878.924677 for no of item 6709
Fitness value of swarm 2 is 4873.673000 for no of item 7000
Fitness value of swarm 3 is 4918.647076 for no of item 4.507947e+03
Fitness value of swarm 4 is 4873.239872 for no of item 7024
Fitness value of swarm 5 is 4889.464125 for no of item 6125
Best fitness value is 4918.647076 of swarm 3
In iteration 3
Fitness value of swarm 1 is 4886.865357 for no of item 6269
Fitness value of swarm 2 is 4882.660406 for no of item 6502
Fitness value of swarm 3 is 4918.647076 for no of item 4.507947e+03
Fitness value of swarm 4 is 4882.317513 for no of item 6521
```

Name	Value	M
K	5000	50(
buy	[100,105,110,115,120]	10(
d	100000	10(
diff	-339.0527	-3:
f	7.0000e-04	7.0
fitval	[4.9103e+03,4.9092e+...	4.9
h	0.0020	0.0
i	5	5
insol	[4878,4926,4.5079e+0...	4.5
maxswarm	3	3
maxvalue	4.9186e+03	4.9
numiter	10	10
numswarm	5	5

```
fitness
feedfun
%-- 3/25/2016 9:06 PM --%
ls
modelling
%-- 3/27/2016 7:44 PM --%
ls
sender
3
5
%-- 3/29/2016 8:40 PM --%
ls
modelling
```

Figure-3: Proposed Iterative Approach to Calculate Cost

We demonstrate that the most favourable base stock level reductions as one approach the end of the arranging skyline. This carry out recommends that with less remaining periods to end, the maker needs less inventories to wrap the potential popularity and lack in limit. As time gets closer to the terminal period, the manufacturer has fewer periods to complete stock to smooth the vacillations sought after and regulate for capacity shortages.

4. RESULTS

The Figure 4 illustrates compassion information and per unit change for EOQ model. Best Number of chicken to buy for maximum profit = 7177

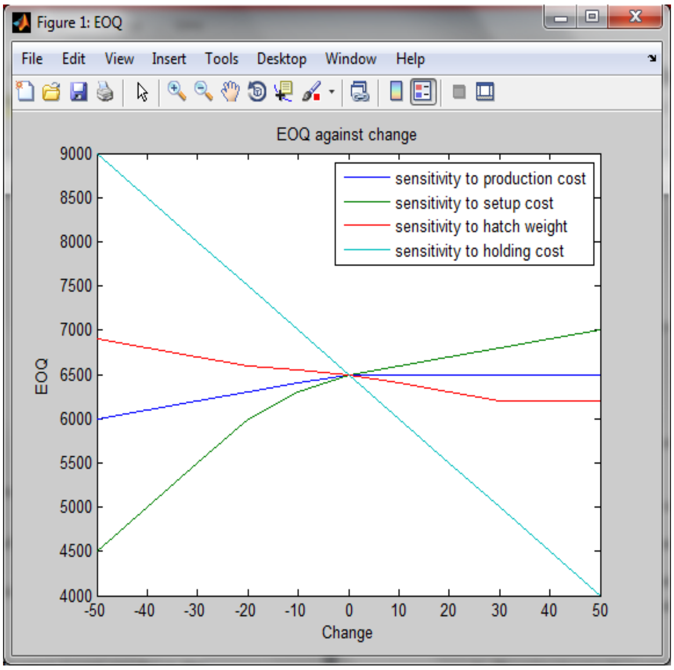


Figure-4: Proposed EOQ Model for Sensitivity to Change

Figure 5 illustrate the profit decreases per unit weight change. It uses PSO modelling to create the comparison. It takes the information from the live industry of chicken growing farm.

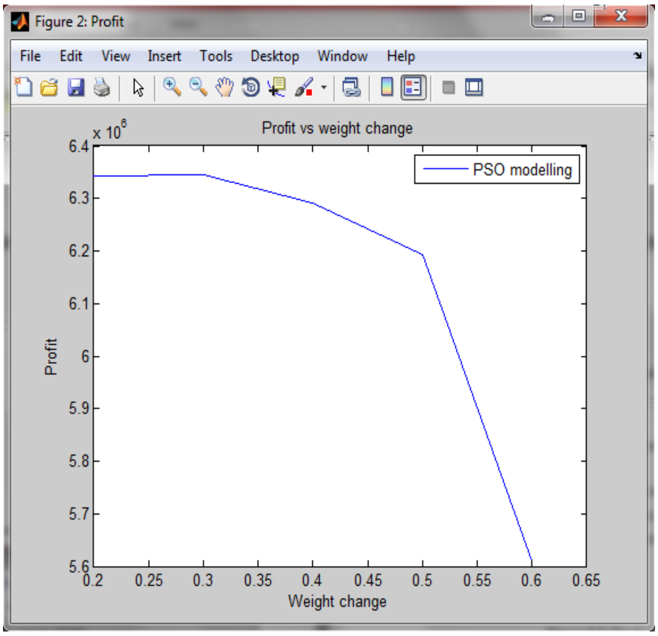


Figure-5: Graph Results for Profit vs. Weight Change

Figure 6 and figure 7 represent graph outcome for Profit vs. Production cost change and Profit vs. Sell Price change. It in fact takes the data from the live industry of chicken growing farm. It helps in knowing the dissimilar impact of different factors on different financial aspects.

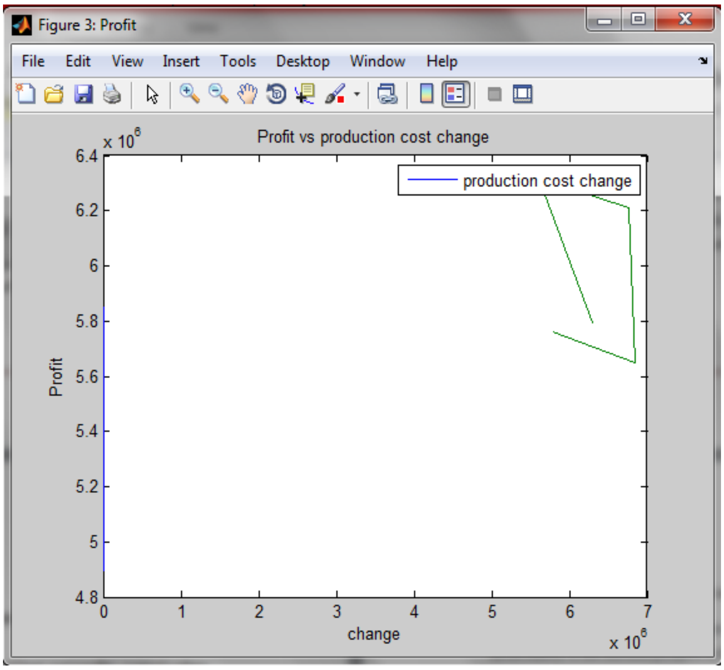


Figure-6: Graph Results for Profit vs. Production Cost Change

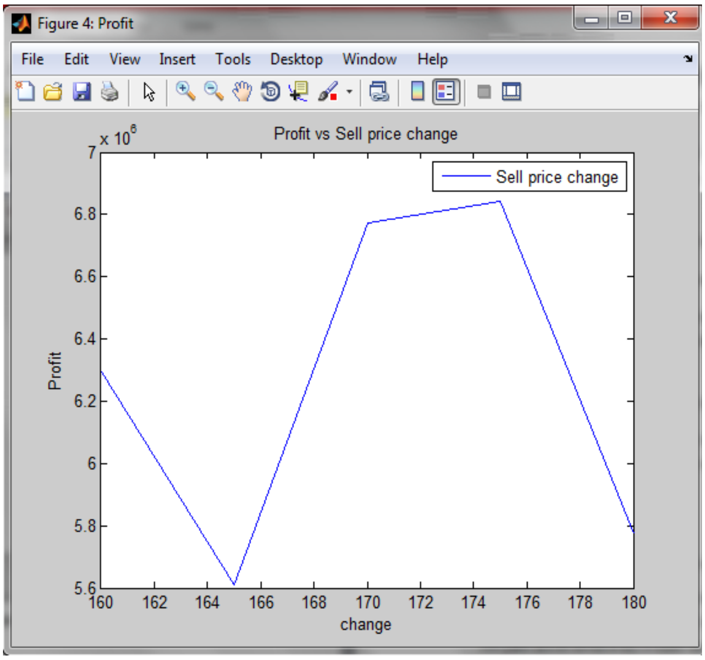


Figure-7: Graph results for Profit vs. sell price change

Figure 8 shows the relation among profits of the work with the changing price of buying it.

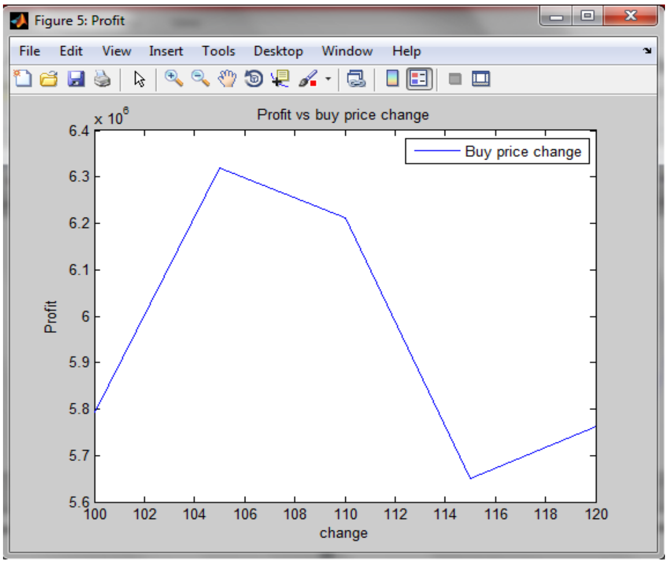


Figure-8: Graph Results for Profit vs. Buy Price Change

5. CONCLUSIONS

In this paper, we accessible a mathematical model designed to optimize the record of growing items like poultry. We considered a situation where a company buys new born animals raise them and then sells them to the market. The company wants to conclude the optimal order quantity of the new born animals, and the finest day to slaughter them, considering its annual demand. Overall profits are planned by subtracting the total costs from the total revenue, which is the amount of the total sales of the raised animals. The whole costs consist of the total purchasing costs of the new born animals, the whole production (feeding) costs, the total asset cost and the total set-up costs. The value of the two decision variables was resolute for a maximization of the overall profits function.

The research work is decisive study of PSO algorithm by keeping the vital parameters into consideration. It is clear from the over discussion that PSO has limited applicability for the reason that of trapping in local minima which can be avoided by using in combination with PSO. PSO is functional on continuous variables.

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