Business Project Management Using Genetic Algorithm for the Marketplace Administration

Alaa obeidat[1*] and Rola Yaqbeh[2]

[1*]Department of Basic Science, Faculty of Science, The Hashemite University, Zarqa, Jordan. alaaf@hu.edu.jo, Orcid: https://orcid.org/0000-0002-4958-8402

[2]Jordan University of Science and Technology, Irbid, Jordan. rolayaqbeh@outlook.com, Orcid: https://orcid.org/0000-0003-4170-666X

Received: February 15, 2023; Accepted: March 28, 2023; Published: May 30, 2023

Abstract

In the sales business, the ultimate goal is to derive more sales and increase the profits for interested stakeholders. Maximizing profit margins from highly demanding products is one of their major objectives. Nowadays, there are varieties of intelligent systems available, which can guide the business owners, entrepreneurs, or managers to make smart decision and lead their business towards success. Out of different options, this research study explores the possibility and elaborates on how their objectives can be achieved through a genetic algorithm? The proposed approach can be adopted by businesses to increase their profits by enhancing low profit yielding products sales using optimized Genetic Algorithm. Initially groups are defined by adding products with high and low sales. After applying the proposed genetic algorithm, a "bundle of three" offers are traced out, to promote the product with poor sales history This study helps the businesses with a decision support model to maximize sales resulting in high profits. In this research, optimization algorithm is used along with variety of operations and methods, by the businesses, in order to reach their respective target goals. This can be achieved by applying an optimization method that has stable and reliable functions, selection methods, population size and mutation rate. The final result is to improve the overall profit of different businesses in the marketplace.

Keywords: Decision Support System, Genetic Algorithm, Marketplace, Products Sales, Optimization.

1 Introduction

Humans have always remained logical. Be it in the stone age or the current era. To survive, the human race always defined different ways to fulfil their needs. Some of which evolved with time and matured enough to be adopted by many other humans as a viable source of survival. Before the concept of money, people used to exchange products of use with each other. With the passage of time and the introduction of paper money, things changed, and different ways of business emerged. Nowadays, with greater chances of businesses come risk factors. The marketplace stands significant and attractive place of investment for potential investors. As a natural human behavior, any investor would like to invest more, in a smarter way, to reduce the risk of loss and to earn the maximum possible profit. With the help of the latest technologies, sophisticated algorithms, high-end computing devices, and the availability of

Journal of Internet Services and Information Security (JISIS), volume: 13, number: 2 (May), pp. 65-80
DOI: *10.58346/JISIS.2023.I2.004*

*Corresponding author: Department of Basic Science, Faculty of Science, The Hashemite University, Zarqa, Jordan.

data to generate patterns and derive predictions, it is possible for an investor to optimize profit-oriented predictions and to evade or minimize the risk factor. It is also a human trait to avoid financial loss and gain profit; therefore, they tend towards profit-oriented investment. In order to address difficult issues with a vast number of potential solutions, stochastic searching and optimizing techniques like GA are appropriate (Huang, Z., 2015).

In the food-related business, it is a common practice for managers to sell out those items which are expiring soon. In some cases, such items are sold fast by placing them “on-sale”, or bundling them with high-demand products, with an attractive offer, to boost their sales and avoid any losses. Apart from the food business, such techniques are used in shops, online retail business sites, and almost any buy or sell businesses. It is not quite straightforward to find products with low demand, products with high demand, or products that will expire soon especially when the manager has a huge inventory to manage. Even after tracing the products, the manager needs to devise a better way to promote the sale of low-demand or expiring products and make the customers buy them. The manager needs to have a viable and ready-to-use solution in order to tackle the such problem and avoid any losses to incur.

There have been many strategies the managers used before the advancement of technology-backed decisions, the manager relied on past experiences of his own or from peers within the same business domain. Nowadays, different algorithms and techniques such as machine learning, data analytics, and decision-making systems are used for such issues. Talking of algorithms, the Genetic Algorithm (GA) is a biologically inspired algorithm and it is one of the widely used algorithms that increases focus, accuracy, performance, and searching mechanism and helps in complementing market-oriented decision making. For a marketer, to increase accuracy and precision in market forecast GA can be considered as one of the strong candidates among others. (Jain, R., 2012) discussed the approach of utilizing a genetic algorithm for array thinning is discussed in the current work. keeping in mind that GA optimization varies from system to system (Izadkhah, H., 2019). Some forecast insights require the processing of winning ratios, others implement payoff ratios, and some might implement profit factors. Businesses can make use of an intelligent ensemble system that can utilize GA optimization to process and generate inventory automatically. The inventory generated using GA optimization has less wastage, therefore maximizing profits. In a wide range of search problems, genetic algorithms (GAs) are reliable, effective, and optimized techniques (Agbele, K., 2012).

Genetic Algorithms have been ignored and have not been discussed in the literature. The fact is that the Genetic algorithm uniquely identifies an optimal offer for product patterns that enhance profit. Moreover, genetic algorithms have different applications including marketing and sales. Other studies have focused mainly on genetic algorithm applications in marketing and sales but it is relatively complex to this research goal. This complexity particularly motivates research based on genetic algorithm applications that can maximize operations and profits. To make a better understanding of the systems that help an organization or business to make a smart and aware decision, there is a need to understand the concept of decision support systems (DSS). A decision support system is generally defined as an information system that supports a business or an organization in decision-making or judgment activities. Once the DSS preliminaries are clear, then the concept of GA is detailed in depth (Obeidat, A., 2022).

Components of a Decision Support System are illustrated in (Figure 1):

1. Model Management System

The model administration tool keeps the models in storage. Managers may use crucial situations to effectively manage related chores. Decisions about the company's financial streams, budgets, and supply and demand for a product or service are informed by these models.

2. User Interface

Like in any software, the DSS has an interface that a manager can use with ease and with high confidentiality. The user interface is the main terminal where a manager interacts with the DSS.

3. Knowledge Base

Both internal (data collected in a Transaction Process System (TPS)) and external (datasets from other sources) contributes to the knowledge base.

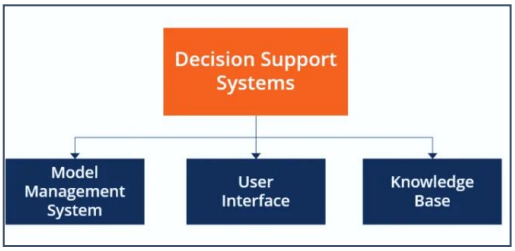

Figure 1: DSS Components (Obeidat, A., 2022)

In this research work, we proposed an approach to find a better way to sell products by combing products with low sales with high-sale products by incorporating the GA. The scope is not limited to better profit only rather, it can also be used for better inventory management (Bhasin, H., 2018) besides other businesses, such as real estate. Where real estate is considered a business with high risks but at the same time it is quite profitable. In the real estate scenario, GA is applicable in matching rental price settings with different parameters associated with the fixation of rent, such as the geographical location of hose units. With the help of GA, it is possible to provide a fair rent that is not overcharged or undercharged. In terms of businesses, a successful business translates to one, which has loyal and returning customers.

The main contributions of this research are as follows:

The rest of the paper is organized as follows: Section 2 presents a review of the literature and contributions to the Genetic algorithm. Section 3 provides an in-depth description of the methods used in our work. Section 4 and Section 5 contain experimental results and discussion. We finally summarize main findings and conclusions in section 6.

2 Literature Review

Literature has suggested the use of Genetic Algorithms in different scenarios including for commercial usages in businesses along with organizations (Metawa, N., 2017). GA delivers businesses with capabilities to avoid time-consuming complexities that are associated with mathematical and statistical procedures, which are quite hectic. In the banking sector, the Genetic Algorithm has been used for a variety of decision-making systems such as fraud detection, renting fixtures, and devising methods for debt recovery. Similarly, the authors in their research work (Karova, M., 2012), proposed a GA-based model to implement a system that ensures lending decisions in a highly organized manner and let the organization have a competitive advantage in the market. The GA-powered framework is capable to carry out effective and efficient optimization of bank objectives to assist in loan portfolio construction. Similarly, within the banking sector, (Reyes, F., 2011) helps optimize the loan sector for better profits and interest rates. The GA helps banks easily devise the loan type, amount, rate of interest, credit, and other related parameters and variables for loan consideration, and let the employees implement the devised plan for better outcome GA is found to provide reproduction, crossover, and mutation (Obeidat,

A., 2022) in a better way helping banks and financial institutes make more profit. It cannot be denied that technology-backed decisions are a key factor in maximizing bank profits.

The GA usage in renewable energy is highlighted in (Huang, S.J., 2008) and provides great answers to the business users' questions such as when they can deplete the energy in use. How to get new energy sources? The patterns that they use in consuming energy? Having clear insights into these questions, the users can plan accordingly and move ahead. All these objectives are accomplished by the means of running the GA-based models after specifying the basic inputs, objectives, process, and desired output. Apart from that, Construction companies also need to save on labour, official inventory, and construction materials to control their running budget and minimize the cost of construction. To further elaborate on the usage in the construction field, underwater structures are quite expensive to construct. They also require highly skilled professionals to achieve success, especially when executing a project in seawater. According to (Metawa, N., 2016), GA is also used in powering the UWCEAS system which requires optimization and configurations for it to work efficiently. The GA ensures the data is efficiently and effectively stored. The optimization using GA increases efficiency in the construction process underwater, greatly assisting in saving on costs which translates to a gain in profits. With GA usage, the profit would have been consumed in the construction project itself and lowering the profit margin (Hartmann, L., 2022).

The authors in a research work (Yu, S., 2011), illustrated that quadratic approximation can be used to improve bilevel evolutionary algorithms. Bilevel optimization problems are generally hard to implement and require the application of GA to modify them. After modification, they can be used in commercial activities effectively.

In the automobile industry, the authors of (Kansal, S., 2020) presented the usage of GA in motor vehicle engineering and tried to solve the Vehicle Routing Problem (VRP). GA provides solutions by assisting in the design of Bi-Directional Decoding (BDD) elements from a genetic chromosome. This is achieved through the improvement of the descendant using the algorithm. This gives car manufacturers to gain more business, making better sales profits and solving most of the related issues in a better way. It is evident from the (Molina, A., 2007) that, the cars developed using this technology have a high chance of selling more due to better functionalities such as security.

GA's role in large-scale flow shop scheduling is detailed in the research work. Flow shops use scheduling to ensure that all operations run-on time with no lags and that orders are fulfilled effectively without delays. (Zhang, Z., 2016) suggested an enhanced collaborative filtering recommendation algorithm called (New Rec) and tests its viability through experiment simulation, demonstrating that it can enhance the quality of the recommendations made by an e-commerce recommendation system.

For Job sop scheduling, the author of (Chen, N., 2022) proposed an elite genetic algorithm with extracted grey processing time in real-world production. They formulated the problem using a mathematical model in order to minimize the makespan. Authors of (Viana, M.S., 2022) improved the GA population using new frequency analysis operator. This operator aids in the management of individuals with low fitness values, which improves the population quality of the algorithms and, as a result, leads to better job scheduling results.

Genetic algorithm has shown a potential advantage in creating a marketing strategy in a day-ahead market, it predicts effective strategies to make better and wiser decisions. In a nutshell, the genetic algorithm provides individuals with information on how to manage various market entities (Metawa, N., 2017), in a more profitable way. Profit-making in an organization involves the implementation of numerous strategies that seek to ensure that the market runs effectively. Therefore, GA is needed to help

marketers conduct critical analysis and therefore be able to make smart moves as far as marketing is concerned. Besides, it is possible to establish a more profitable market while running a 24-hour business schedule. Such advantages are only possible after implementing GA-powered optimization. (Baghdadi, M., 2021) used the genetic algorithm (GA) to precisely extract and enhance the model parameters using the specified datasheet characteristics and the mathematical method circuit equations.

3 Methodology

In this section, the working mechanism of the proposed solution is defined in greater detail. Depicting each stage and with a major example of the subject research work.

3.1. Representation Mechanism

The database is created to store product information, attributes and parameters. The items below are explained for clarity:

- Product name: alphabetical characters (A-Z) are used in this research to denote products being marketed.
- Sales transactions: these represent the number of items sold for each product.
- Offer package: items grouped together for sales promotion.
- The entries in the database correspond to the groups of the products that will be sold as one package. In the proposed application of GAs, each package is represented by a string of three characters and each character represents one product, and this constitutes the configuration string.

The process of deploying GA starts with initialization. This is where a group of datasets is randomly selected from the database in pairs. The pairs represent products and between each pair of products, there is a chromosome picked from the database that is used to make up a configuration string (CS). The database from where all the CSs are collected has its constraints maintained. The database size is usually maintained in a fixed position that is greater than the population size (Kansal, S., 2020) (Wibig, M., 2012). The new strings that are formed initially from the database are used in creating or generating other strings, updating the old ones.

Nonetheless, the fitness function is needed for the sake of interpreting the chromosome in terms of physical representation and evaluating its fitness, which has to be associated with the traits that are desired as outcomes, provided the fitness function measures the quality of the chromosome accurately. The database is used to select the initial generation that consists of two genes of strings; in the beginning, it is considered essential to come up with a good selection for the next generations. The proposition in this research is to generate populations first and then suggest the selection and crossover operations soon afterward.

3.2. Genetic Representation

GA is basically used as a search algorithm in most cases and is mostly applied in solving complex issues. There are mechanics of natural selection as well as natural genetics that drive the workability of GAs. One of them is the use of fitness information instead of using Gradient information. This illustrates that GAs are not much demanding when it comes to requiring information to use in sales and marketing optimization. GA can also be applied in classification, which is a very important operation as far as sales and marketing are concerned. This places GA at a better advantage and favours managers of sales and marketing by ensuring that GA provides more than conventional parameters in optimization and classification, which makes them appropriate for problems that are ill-behaved and spaces that are highly

non-linear for global optimal and adaptive algorithms. GA can be used to solve problems that have multiple objectives or constraints. GA is commonly used to generate high-quality solutions to optimization and search problems by relying on biologically inspired operators such as mutation, crossover, and selection. It follows higher production speed rather than focusing on strategies to fully exploit the benefits of optimized resource utilization. In particular, GA is capable of iteratively making improvements on solutions generated until optimal solutions are generated. The proposed GA is made of a chromosome with a sequence of positive identifiers (integers or characters) that works as IDs of products available in the shop (Figure 2-B). A string, or an alphabet, is used in a GA to represent a person's collection of genes. Binary values are typically utilized (a string of 1s and 0s). We refer to the genes on a chromosome as being encoded the chromosomes have each of its locus representing an item of a group of products to identify a potential offer in the near future. Chromosomes are found to vary in length, but they are restricted to only three at maximum.

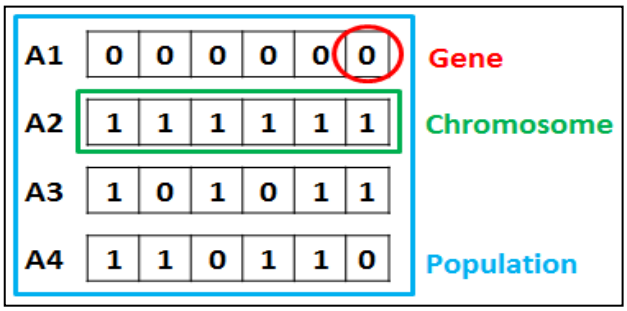

Figure 2-A: Gene, Chromosome and Population Representation

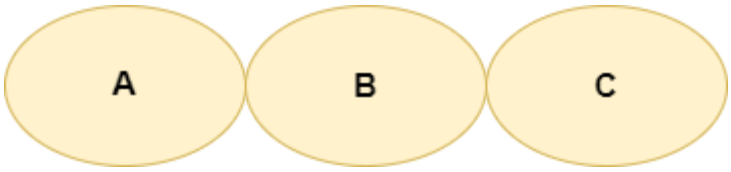

Figure 2-B: Gene Representation

Where A, C, and F are products available in the shop, the order of the products in the chromosome has no effect in the genetic algorithm operations on the chromosome.

3.3. The Architecture of the Proposed System

Departmental stores and hypermarkets are supposed to be aware of the market dynamics and come up with strategies to cope up with the growing competition by increasing the quality of the product. This involves the mixture of products and productivity, etc. Furthermore, state-of-the-art tools and simulations enable businesses to improve their decisions making strategies after going through accurate and actual data. Predictions can be made afterward. The capability of simulation to indicate a real process with uncertainty is important in leading to correct decisions.

A computerized system is applied in the simulation process in the computation of Generic results and the best visualization. The simulation model is later used in the computation of fitness value using the chromosome as the data. By using the genetic operations on population members at the moment as “g”, iteratively until produces a new result that will be used as “g+1”. The initial population “g=0” is generated randomly and applied iteratively. When the optimization process is completed, the appropriate chromosome is simulated as the best offer that increases the overall profit. The chromosome quality is indicated by the profit amount which is generated on the simulation model.

Earlier, this technique was not covered efficiently but, in this research, the first generation covers all aspects of the solution. A novel technique is used to select the initial generation (Figure 3). When the initial generation is generated, the first generation should have all the products in the shop.

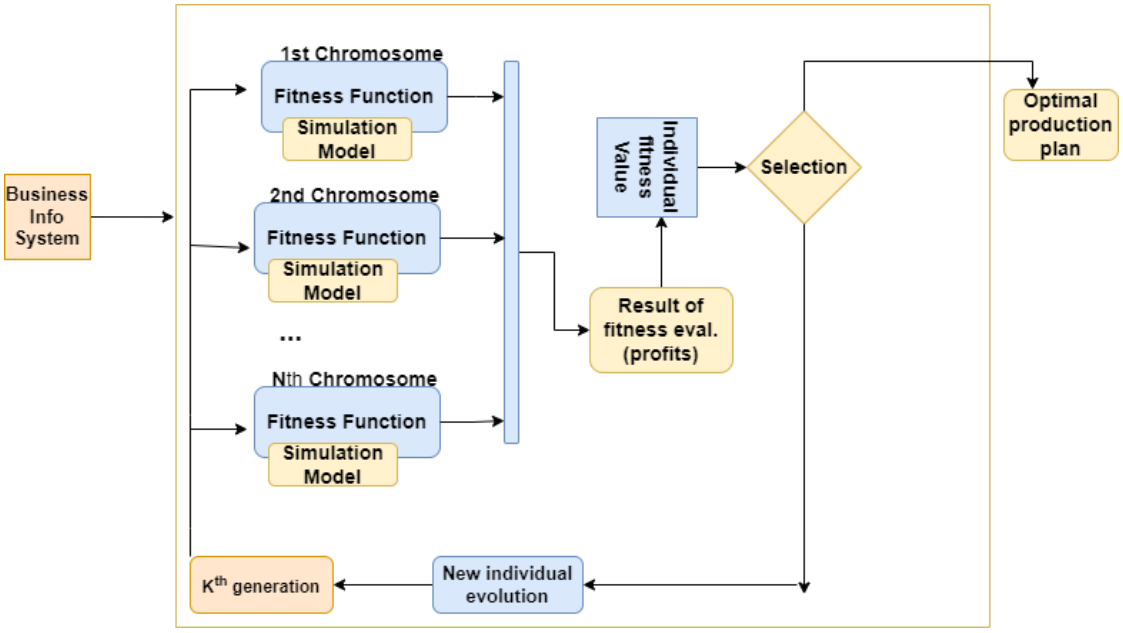

Figure 3: Architecture of the Proposed System

Important guidelines:

- The matrix contains all products: (AB, AE, AC, BD, BF, CD…)
- The first generation consists of pairs of products, and it has to be ensured that each product existed with all the other products at least once regardless of the order of gene (product) in the chromosome (package of the offer).
- Any product must be taken once in every chromosome.
- The system must account for all the products in the inventory or in the shop.

3.4. The Database of DSS

This section describes the database (MS Access) in detail. In the database of the proposed system there are two main tables as shown in the figures below:

- Table to store product information (Figure 4).

Products

ID	Product_Name	Sales_Transaction
A	CD	15
B	LCD	10
C	DVD	2
D	Printer	3
E	LED	40
F	Mouse	12

Figure 4: Products Table

- Table to store chromosomes (package of the offer) (Figure 5).

Chromosomes

Group	Total ST
AB	25
AC	17
AD	18
AE	55
AF	12
BC	13

Figure 5: Chromosomes Table

3.5. Experimental Results

To illustrate the working mechanism of the proposed system. It is depicted with the help of an example in this section

CD, LCD, DVD, Printer, LED, and Mouse are considered to be products that are available for sale in a shop. They have been renamed to A, B, C, D, E, and F to indicate each product in the shop respectively. The sales transactions of each product are as follow: A = 15, B = 10, C = 2, D = 3, E = 40, F = 12. From the numbers it is evident that some of the products are selling fast, with the highest selling item being E. Similarly, on the other hand, product C has the lowest selling pace. Moreover, there are some items whose sales are average.

In order to promote the sale of the under-sale items, there is a dire need to devise a technique which can create offers and suggest the store owners a better technique to increase the profit by promoting the underselling items. The proposed method has the potential to address the issue and guarantee the better profits by predicting better offers.

Two different kinds of the crossover are discussed that the proposed system can possibly use. Each is described with the help of an example.

One-point crossover: this involves taking one position randomly in the first chromosome as a location to make a crossover on the same location of another chromosome. This can result in wrong results after the crossover operation (Mahammed, N., 2020) (Sang, B., 2021).

For example: If the system takes the following chromosomes and comes up a crossover between them at position 1: BCD, AFE. After crossover, the following chromosomes are produced: (ACD, and BFE).

Two-point crossover: this involves taking randomly one position on the first chromosome to come up with the crossover; the location is taking the same for the gene. A different gene is selected in the first chromosome and not necessarily in the same location.

For example: If the system takes the following chromosomes and makes the crossover between them at location 3 then the location in the second chromosome is 2: AEBD, ABF, the following chromosomes are produced after crossover: (AEBF, ABD).

Mutation: offers new information randomly to the genetic-search process and evades being stuck at local optima. It increases population diversity when the population is standardized because of repeated

use. The mutation can cause parent individuals to be different from other chromosomes. (Zhang, Z., 2022) (Hao, J.X., 2015).

For example: If the system takes the following chromosomes, AEBD, ABF, and ADF, it can be noticed that all four chromosomes have an (A gene) in the left-most position. So, if we need another gene in the left other than A, here mutation can be applied on the first chromosome to produce a chromosome with a gene other than A like CEBD.

3.6. Fitness Function

F(i) is obtained from the objective function and applied in successive operations. Fitness is a quality value that measures the efficiency of the productivity of chromosomes. Fitness is applied to allocate the reproductive characteristic of an individual. Those with great fitness have the likelihood of being designated for advanced examination (Sieja, M., 2019) (Katoch, S., 2021).

In this research work, the following fitness function has been used to examine the goodness of chromosomes:

$$F(i)=\sum_{j=1}^{l_i} STg_i \qquad (1)$$

Fi means fitness value of the i-th chromosome, li refers to the length; gi (j) is gene (product) of n-th locus in the i-th chromosome, and (ST) refers to the sales transactions that occur.

3.7. Results

Table 1: Initial Chromosomes

Chromosome	Total ST
AB	25
AC	17
AD	18
AE	55
AF	27
BC	12
BD	13
BE	50
BF	22
CD	5
CE	42
CF	15
DE	43
DF	14
EF	52

1. Then the GA operators are applied as defined:

After applying the GA operators randomly on the first generations, the following chromosomes are generated:

BCD = 15, AFE= 67

After applying the crossover operation on the above chromosomes, the following results are generated:

ACD = 20

BFE = 62 it can be observed that the total sales transactions of the above chromosomes are better than the chromosomes before applying the crossover, due to reason that there is a need to minimize the

gap between the sales transactions for the two chromosomes. This translates to producing two offers of products to maximize sales. On the other hand, if the gap between two chromosomes is big, then this means that one of the offers is good while others are not performing well, which can be attributed to the sales transaction of the products in the offer being very low. Then making the crossover again on the chromosomes ACD, BFE will produce the following results:

AFD= 30 BCE = 50

Now, the gap is reduced; which means the offers tend to be more attractive to the customers. Also, after applying the crossover on AFD, BCE the produced chromosomes are provided as below.

AFC = 29 BDE= 53

Here the produced chromosomes are discarded due to the gap being bigger than the gap in the previous stage. If the procedure is continued, it can be observed that the best offer that can maximize the profits will be ABF=37, CDE= 45.

3.7.1. Pseudo Code of SGA (Simple Genetic Algorithm)

```
Procedure SGA:
 Begin
   Set control parameters;
   {crossover and mutation probabilities, population size, and chromosome length}
   Initialize population;                    {at random}
   Evaluate initial population;              {fitness of initial individuals}
   Repeat
     Select individuals for next generation; {reproduction}
     Perform crossover and mutation;         {obtain new population}
     Evaluate population;                    {fitness of new individuals}
   Until termination condition is reached;
End;
```

Figure 6: SGA Pseudo Code

To determine the fitness function, the overall structure of the SGA described above is followed (Figure 6).

- First, the necessary order duration is embedded into the dataset so that both sets of information can be reliably presented.
- Second, a starting population is determined using purely random times, from the available chromosomes in system DB, and the fitness function value is computed from those data. The k most advantageous chromosomes are saved as the progeny under the parameters in the example.
- Third, individual chromosomes are chosen from the parent population, and the evolution program is activated. The likelihood of the occurrence of Steps 4-6 is established by the control settings.
- Fourth, the evolution program's selection phase is run. Then the elite selection is employed to preserve the original set of chromosomes from each parent, and finally the accumulated k' chromosomal sets are retrieved.
- Fifth, run the evolution code, which includes the crossover phase. By swapping genes at certain crossover locations, two different chromosomes can create a new chromosome through a process known as crossover. A series is split in two chromosomes, and a two-point crossover is used to swap genes between them to create a new chromosome using the method employed in the study's implementation strategy.

- Lastly, even if the fitness function value is determined, that doesn't mean it is the best option. The fundamental design of the termination conditions is mostly influenced by the number of times the variables undergo evolution to account for the fact that the production process varies frequently in practice. Various factors are at play in the termination condition; the enabling will be halted in response to user demand. If the conditions for termination are not met, the process loops back to Step 3 and continues evolving.

3.7.2. Example of Partially Matched Crossover Method

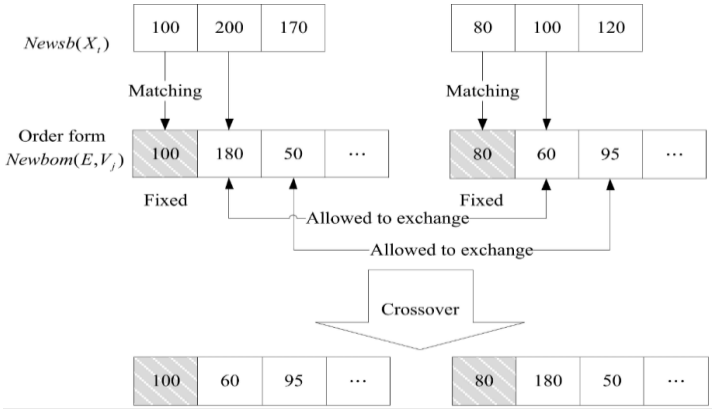

Figure 7: Partial Crossover

This research utilized Partly Matched Crossover (PMX) operators to carry out the gene crossover procedure in addition to the conventional two-point crossover. The size of the gene is the only criterion by which the PMX technique determines whether a fragment is useful (Figure 7). Since this is the case, the matching gene cannot be stored as a potential trading partner. The goal of this method is to prevent a chaotic wandering away from the defined solution space by allowing only fixed chromosomes. It is anticipated that this will lessen the likelihood of an increase in the number of unwanted materials because when adopting an unmatched chromosome swap, the matched chromosomes are fixed.

3.7.3. Generic E-Commerce Model

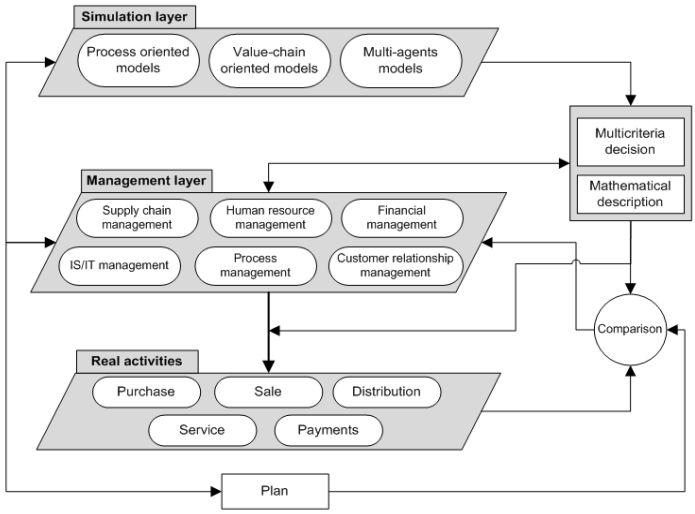

Figure 8: Simulation Model

(Figure 8) illustrates why a simulation should be part of a larger management structure. While software tools are utilized for simulation purposes, it is getting easier to incorporate simulations into the management platform. Modeling economic systems is becoming increasingly common. The benefits of simulation can be attributed to the ability of system developers to study a problem at several levels of abstraction.

3.8. Proposed Algorithm GUI Demonstration

The main interface of a system for the shop (Figure 9) can be accessed by the shop manager only and is mainly used for administrative tasks. If the manager selects all the products from the product interface as shown in (Figure 9), then the customer's interface will look like as in (Figure 10):

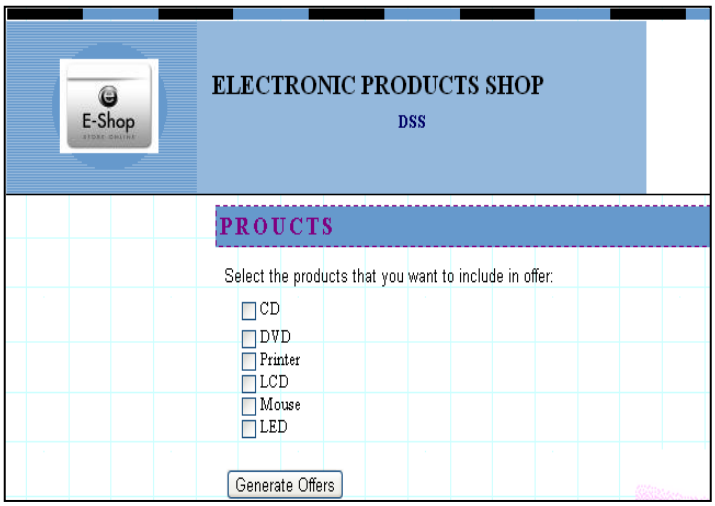

Figure 9: Main Page of the Shop

The customer page (Figure 10) shows the products without an offer. Once the manager uses the proposed technique and creates an offer for sale, the customers will be able to see the offers in a very user-friendly way. The offers are displayed in the offer interface (Figure 11) as shown here:

Figure 10: Customers' page

Figure 11: Special Offers Page

The genetic algorithm can be parallel and distributed as illustrated in (Figure 12). Illustratively, this figure presents a model used in evaluating the effectiveness of genetic models in aiding decision-making processes (Mahammed, N., 2020), which are also applicable in maximizing profits in commerce, businesses, trading, and marketing to name some. A shop basically markets different products in parallel motion, which can be effectively and efficiently powered using GA.

As discussed earlier, GA is a methodology for solving optimization problems based on natural selection driving biological evolution. In every step, the GA produces the parent individually and applies them as they come up with the next generation children. The GA also addresses mixed integer programming where particulars are restricted to a certain value.

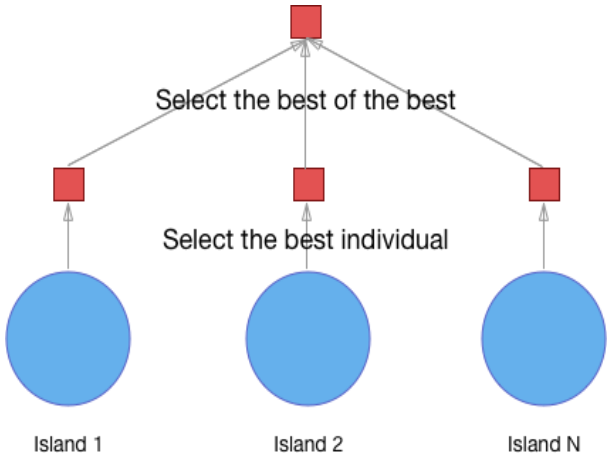

Figure 12: Parallel and Distributed GA

4 Discussion

Limited and unconstrained optimization issues that often update a population have been solved with GA. Existing population members must be the parents of any offspring. The populace grows in favor of the optimal solution over succeeding generations. GA functions based on evolutionary concepts. Selection, crossover, and mutation are some of these processes. This process loops back on itself until the termination condition is met. For real-world optimization problems, GA has several applications. It is clear that GA is useful in a number of circumstances due to its benefits, which include optimization of

profits from several business aspects, as addressed with great detail in the introduction and related works. Benefits can include reducing inventory waste, providing accurate price analysis results, charging for real estate property leasing, and directly or indirectly increasing earnings. Accurate results are one of the extremely important and noteworthy advantages of GA. As described in this study, a locus must be introduced in order to reap the greatest benefits and for the algorithms to operate well. One to three chromosomes make up each chromosome. The locus indicates items that are readily available in a store's inventory, suggesting that they are there.

As far as the market study is concerned, the arrangement of the items in the store is not the most important factor. In addition to the advantages noted from a survey of previous works, this research also revealed the advantage of being able to analyze client behaviour in order to maintain a competitive edge and increase earnings. Business owners may be able to supply customers with what they want and how they need it by recognizing customer trends and learning what the client needs most. This may result in a consumer base that is content and satisfied. This will attract devoted and repeat consumers, which will ultimately result in a boost in income and revenue. Customer pleasure, according to (Metawa, N., 2017), contributes to both increased sales and profit margins.

GA uses fake genetic strings to identify the codes in variable groupings. This suggests that additional algorithms that are useful for boosting company, such Artificial Intelligence (AI), can be used in conjunction with GA optimization. The ability of GA to apply the probabilistic transition rule suggests that it can be used to anticipate future outcomes of a certain market trend for a specific commodity that is being valued. The initialization of variables and character identification are the first steps in the sequential process that the research technique for this study uses. But in this process, genetic labelling is crucial. Since it makes it easier to quickly recognize the various product sets, it is regarded as a basic necessity.

Again, in order for algorithms to function, data must be used to implement them. Since Big Data analytics and other IT components manage data at anytime and anywhere, there is no data that is too much to handle today. Businesses benefit from a competitive edge by being able to employ GA in any industry where prediction is required thanks to the low cost of the GA optimization. GA algorithms can categorize and group elements into sets that are simple to use and comprehend, which can simplify the process. The grouping algorithm aids in determining which products sell more frequently than others.

5 Conclusion

Numerous issues, including the traveling salesperson problem, inductive concept learning, layout issues, and scheduling, can be solved using GA. The necessity to combine an offer on low-demand or expiring items with items that must have a high selling rate makes it challenging to discover the greatest deal on the items in the shop. It is challenging to find goods with such connections to expiring items. By making the best offer on items, the suggested solution streamlines this procedure and improves the efficiency of the purchase process (80%–97. For instance, if the algorithm discovers the greatest offer and the selling rate of the expiring item is 55%, the results show that the sale rate of that item might rise to 85%. In the future, we might research the suggested model to improve the effectiveness of combination and, consequently, the calibre of the solution. Additionally, the decision-makers may alter the suggested algorithm to reduce waste in a number of industries, including the glass, wood, iron, and plastic industries. This work creates a GA-based model for a decision support system; this study created and developed an application with a decision support system; and finally, we employed a novel, alternative technique to choose the initial generation. These are the primary contributions of this study.

References

[1] Agbele, K., Adesina, A., Ekong, D., & Ayangbekun, O. (2012). State-of-the-art review on relevance of genetic algorithm to internet web search. *Applied Computational Intelligence and Soft Computing*, *2012*, 25-25.

[2] Baghdadi, M., Elwarraki, E., Mijlad, N., & Ait Ayad, I. (2021). SIMSCAPE electrical modelling of the IGBT with parameter optimization using genetic algorithm. *Journal of Electrical and Computer Engineering*, *2021*, 1-11.

[3] Bhasin, H., & Gupta, N. (2018). Critical path problem for scheduling using genetic algorithm. *In Soft Computing: Theories and Applications: Proceedings of SoCTA 2016, 1*, 15-24. Springer Singapore.

[4] Chen, N., Xie, N., & Wang, Y. (2022). An elite genetic algorithm for flexible job shop scheduling problem with extracted grey processing time. *Applied Soft Computing*, *131*.

[5] Hao, J.X., Yu, Y., Law, R., & Fong, D.K.C. (2015). A genetic algorithm-based learning approach to understand customer satisfaction with OTA websites. *Tourism Management*, *48*, 231-241.

[6] Hartmann, L., & Wendzel, S. (2022). Anomaly Detection for Industrial Control Systems Through Totally Integrated Automation Portal Project History. *Journal of Wireless Mobile Networks, Ubiquitous Computing, and Dependable Applications*, *13*(3), 4-24.

[7] Huang, S.J., Chiu, N.H., & Chen, L.W. (2008). Integration of the grey relational analysis with genetic algorithm for software effort estimation. *European Journal of Operational Research*, *188*(3), 898-909.

[8] Huang, Z. (2015). A genetic algorithm based Minimal Maximal Load Tree routing algorithm in wireless sensor networks. *Journal of Electrical and Computer Engineering*, *2015*, 59-59.

[9] Izadkhah, H. (2019). Learning based genetic algorithm for task graph scheduling. *Applied Computational Intelligence and Soft Computing*, *2019*.

[10] Jain, R., & Mani, G.S. (2012). Solving" antenna array thinning problem" using genetic algorithm. *Applied Computational Intelligence and Soft Computing*, *2012*, 24-24.

[11] Kansal, S., Kumar, H., Kaushal, S., & Sangaiah, A.K. (2020). Genetic algorithm-based cost minimization pricing model for on-demand IaaS cloud service. *The Journal of Supercomputing*, *76*, 1536-1561.

[12] Kansal, S., Kumar, H., Kaushal, S., & Sangaiah, A.K. (2020). Genetic algorithm-based cost minimization pricing model for on-demand IaaS cloud service. *The Journal of Supercomputing*, *76*, 1536-1561.

[13] Karova, M., & Avramova, N. (2012). A genetic algorithm basic approach for software management project. *In Proceedings of the 13th International Conference on Computer Systems and Technologies*, 103-110.

[14] Katoch, S., Chauhan, S.S., & Kumar, V. (2021). A review on genetic algorithm: past, present, and future. *Multimedia Tools and Applications*, *80*, 8091-8126.

[15] Mahammed, N., Bennabi, S., & Fahsi, M. (2020). Optimizing business process designs with a multiple population genetic algorithm. *In Proceedings of the 10th International Conference on Web Intelligence, Mining and Semantics*, 252-254.

[16] Mahammed, N., Fahsi, M., & Bennabi, S. (2020). Genetic Algorithm Based on Multiple Population in a Business Process Optimization Issue. *In IEEE International Conference on Advanced Aspects of Software Engineering (ICAASE)*, 1-6.

[17] Metawa, N., Elhoseny, M., Hassan, M.K., & Hassanien, A.E. (2016). Loan portfolio optimization using genetic algorithm: a case of credit constraints. *In IEEE 12th international computer engineering conference (ICENCO)*, 59-64.

[18] Metawa, N., Hassan, M.K., & Elhoseny, M. (2017). Genetic algorithm-based model for optimizing bank lending decisions. *Expert Systems with Applications*, *80*, 75-82.

[19] Metawa, N., Hassan, M.K., & Elhoseny, M. (2017). Genetic algorithm-based model for optimizing bank lending decisions. *Expert Systems with Applications*, *80*, 75-82.
[20] Molina, A., Martín-Consuegra, D., & Esteban, A. (2007). Relational benefits and customer satisfaction in retail banking. *International journal of bank marketing*, *25*(4), 253-271.
[21] Obeidat, A., & Al-shalabi, M. (2022). An efficient approach towards network routing using genetic algorithm. *International Journal of Computers Communications & Control*, *17*(5).
[22] Obeidat, A., & Yaqbeh, R. (2022). Smart Approach for Botnet Detection Based on Network Traffic Analysis. *Journal of Electrical and Computer Engineering*, *2022*, 1-10.
[23] Reyes, F., Cerpa, N., Candia-Véjar, A., & Bardeen, M. (2011). The optimization of success probability for software projects using genetic algorithms. *Journal of Systems and Software*, *84*(5), 775-785.
[24] Sang, B. (2021). Application of genetic algorithm and BP neural network in supply chain finance under information sharing. *Journal of Computational and Applied Mathematics*, *384*.
[25] Sieja, M., & Wach, K. (2019). The use of evolutionary algorithms for optimization in the modern entrepreneurial economy: interdisciplinary perspective. *Entrepreneurial Business and Economics Review*, *7*(4), 117-130.
[26] Viana, M.S., Contreras, R.C., & Morandin Junior, O. (2022). A New Frequency Analysis Operator for Population Improvement in Genetic Algorithms to Solve the Job Shop Scheduling Problem. *Sensors*, *22*(12), 1-26.
[27] Wibig, M. (2012). Dynamic programming and genetic algorithm for business processes optimisation. *International Journal of Intelligent Systems and Applications*, *5*(1), 44-51.
[28] Yu, S., Ding, C., & Zhu, K. (2011). A hybrid GA–TS algorithm for open vehicle routing optimization of coal mines material. *Expert Systems with Applications*, *38*(8), 10568-10573.
[29] Zhang, Z., & Zhang, Y. (2022). Optimization Calculation Method and Mathematical Modeling of Big Data Chaotic Model Based on Improved Genetic Algorithm. *Journal of Function Spaces*, *2022*.
[30] Zhang, Z., Xu, G., & Zhang, P. (2016). Research on E-commerce platform-based personalized recommendation algorithm. *Applied computational intelligence and soft computing*, *2016*.

Authors Biography

Alaa Obeidat is received the computer science degree from Yarmouk university in 2000. He received the Master degree in computer science in 2004. Currently he is Researcher at the Hashemite university, Jordan. He can be contacted at E-mail: alaaf@hu.edu.jo, Orcid: https://orcid.org/0000-0002-4958-8402

Rola Yaqbeh is a researcher from Jordan University of Science and Technology, Irbid, Jordan. Received bachelor degree in nursing in 2008. She can be contacted at E-mail: rolayaqbeh@outlook.com, Orcid: https://orcid.org/0000-0003-4170-666X