



# Enhancing Non-Profit Project Outcomes through Predictive Modelling and Real-Time Data Analysis

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## Author's contribution

The sole author designed, analysed, interpreted and prepared the manuscript.

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## ABSTRACT

**Aims:** To discuss the applications of predictive modelling and real-time data analysis to non-profit project outcomes. The procedures and relevant algorithms are to be examined together with relevant case studies. Future research gaps that should be bridged are also discussed.

**Problem Statement:** Numerous advantages attached to project outcomes have been identified. However, there are series of steps and procedures that are supposed to be taken which are limited with the application of computer programs to enhance their effectiveness.

**Significance of Study:** The use of advanced predictive modeling and real-time data analysis are required to enhance non-profit project outcomes which entails using data analysis techniques and sophisticated algorithms. The use of these advanced techniques can lead to better resource allocation, improved decision-making, and enhanced overall project success rates in the non-profit sector.

**Methodology:** The method used in writing this review involved consultation of recent literatures in the area of non-profit project outcomes and applications of predictive modelling and real-time data analysis.

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**Discussion:** The use of predictive modeling techniques in project outcomes is necessary in order to improve their efficiencies. The article addresses different predictive modeling approaches, such as decision trees and statistical models, and how to use them to improve project results in the fields of health and education. Predictive real-time data analytics models and models for designing predictive analytics algorithms in enhancing non-profit project outcomes were discussed to include statistical models, linear regression models, multiple regression models, multivariate regression model and decision tree. Health and education were used as case studies of predictive modelling and real-time data analysis application in non-profit project outcomes. This literature review article revealed some gaps that are needed to be bridged in order to improve the efficiency of predictive modelling and real-time data analysis an enhancers to non-profit project outcomes.

**Conclusion:** Predictive real-time data analytics and algorithms are crucial instruments for improving the results of non-profit projects. When used in case studies, they exhibited notable outcomes.

*Keywords: Predictive modelling; real-time data analysis; non-profit project outcomes; algorithms; decision tree.*

## 1. INTRODUCTION

The existing results after the creation of products and services are termed project outcomes. These are transformations in people, policies and communities that are aimed in order to attain the set goals [1]. Project outcomes are inestimable for businesses due to their ability to create deliverables in order to meet their goals and purposes. Outcomes can be negative or positive and sometimes occur accidentally. Advantages of understanding project outcomes include (1) provision of a general purpose for the project, (2) discovering of means via which clients' needs can be met, (3) determining whether business objectives are met, (4) learning of lessons for upcoming projects and identification of areas that call for improvement, and lastly (5) assist in ensuring that all sections of the project are in line with the end goal [2]. These aforementioned statements are measurable and specific for a non-profit sector to know when the set goals are accomplished. Project outcomes usually pay attention to the broad mission while leading to creations. The events or materials that are created due to the project are the project outputs or the deliverables and products. However, project outputs and project outcomes are both constructed from the project but they slightly vary in nature.

Project outputs can be easily measured since they usually entail reaching a particular number. Most times, the project outputs are created by the companies in order to designate their plan based on production and also create the project outcome in order to discuss what necessitates the project when designing it. There are steps which act as useful tools for a non-profit sector to

follow in order to measure her project outcomes [3]. First is the concise definition of the outcome to be achieved. In order to execute this, the organization should specify the intended nature of impacts via the review of company's mission and the kind of clients it is presently dealing with. Consideration should also be given to the kinds of new clients the organization intend to attract and how a difference can be made with the products and services. A list of desired outcomes should be created to serve as a guide for future projects. The attributes of an excellent goal are measurable, specific, relevant, attainable and time-based. Secondly, quantifiable measures which are the true success representations of the organization's goals should be designed in order to evaluate the project outcomes success. Also, the existing relationship between the project outputs and outcomes should be accessed. There is need to review the project outcomes in order to observe if they are achieved via project outputs or work. There are times that a project output is successful but doesn't achieve its outcome. It is necessary to review and see if the hoping change happened. A logic model should be adopted when measuring the outcomes in order to get a visual picture of the project and if the expected result is reached [4].

Furthermore, the progress of the project outcomes should be tracked in order to observe the effects which may take some period of time since project outcomes tend to have a wider impact. In lieu of this, a method for tracking the progress should be chosen. Also, the outcomes should be reviewed from time to time in order to evaluate the effect it had on the client once the project is completed. This can be achieved via

recording of data measurements and comparing with the initial outcome goals at the beginning of the project. With reference to this evaluation, one can make adjustments for upcoming projects in order to create outputs with resilient effects on the outcome [5]. Many non-profit sectors struggle to know the significant data is significant and the left over on their financial statements. Some data may be significant for-profit sector and remain irrelevant to the non-profit organizations. Thus, it is difficult to determine the sufficient impacts which are useful in evaluating the guide for future decisions.

Being conscious of outcome metrics and capable of tracking the progress over some period of time can be helpful in measuring the growth of an organization and reveal to stakeholders the real means via which funds are being spent. This kind of honest and open communication can build the organization's reputation and credibility which in return encourages both the existing and new donors to financially support the cause. With a clear knowledge of various processes effectiveness that influence these outcome metrics, inefficient processes can be simplified and streamlined by decision-makers and thus, increase the organization's growth impact on the populations [2].

There exist numerous groups of stakeholders, besides the organization's employees and decision-makers, who possess conferred interest in the outcome metrics. The board members are charged with the responsibility of holding the organization accountable which reveals outcome metrics to be a key factor of their guidance [4]. They could order benchmarks that some outcome metrics should be reached within a time frame. Potential donors are interested in knowing if the organization is trustworthy, reputable and efficient. They are equally interested in sighting and approving the organization's before they have the enthusiasm to donate. Charity assessors give information that probable donors usually rely on comprehensively when selecting where to give. The availability of accessible and up-to-date outcome metrics is essential not only to the information viewers on the websites but also to the evaluators. It is important to allow comparison between organizations with the potentials of collecting donors.

Community members are another stakeholder to outcome metrics and they give utmost attention to organization's outreach efforts. This is principally real for churches. The positive impact

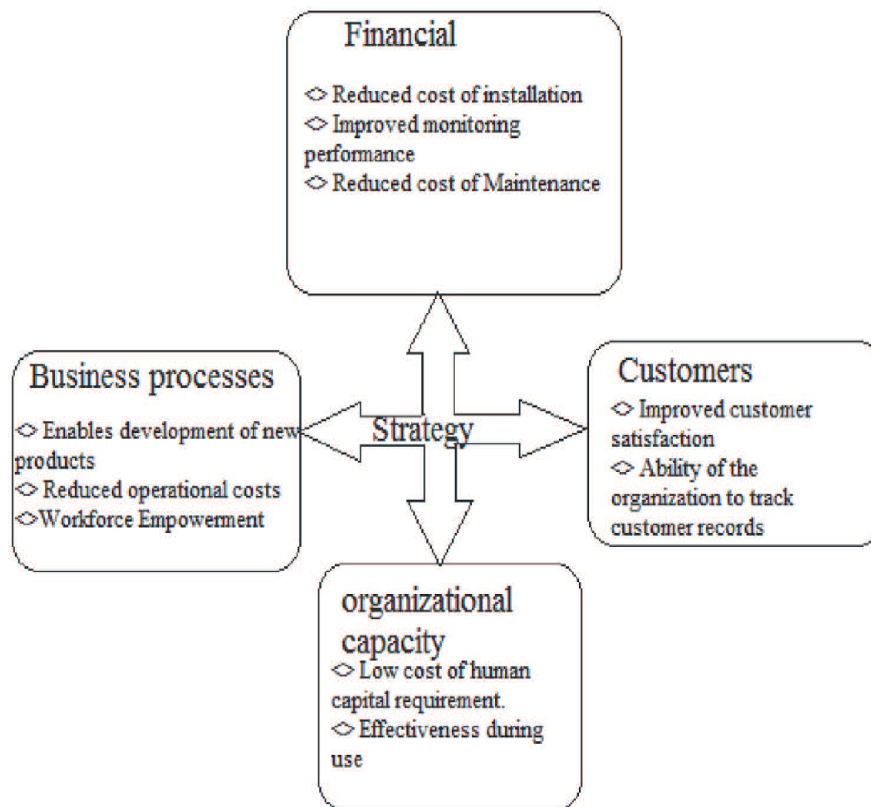
that non-profits endeavor to make frequently spreads outside the populations they serve and the entire community. Other non-profits are aware when organization is performing excellently well. Based on this fact, they may want to learn more in order to serve their populations. As a non-profit organization, it's usually not an easy task to evaluate the success and impact of your services and programs [6]. Funding acquisition may be a difficult task or making improvements to serve the targeted population better when the outcomes understanding are vague. This lack of clarity can also cause uncertainty and frustration because non-profit leaders are subjected to questioning in knowing whether their efforts are truthfully making a difference. Without accurate data, it's difficult to recognize areas that need improvement and make informed decisions [1].

With all the aforementioned challenges, advanced predictive modeling and real-time data analysis are adopted to enhance non-profit project outcomes which involves the use of data analysis techniques and sophisticated algorithms. A process via which a model is created in order to forecast the possible outcomes with reference to data collected from present and past events is called predictive modelling. Predictive analytics entails using modeling and statistics techniques to forecast future outcomes [7]. Both the historical and current data patterns are observed and plotted to evaluate the recurrence possibility of those patterns. It determines a possible outcome based on an evaluation of historical and current data. The data types usually utilized in prediction include CRM data, transactional data, customer service data, advertising data, demographic data and economic data. Regression, decision trees and neural networks are kinds of predictive models. Predictive analytics utilizes past trends to evaluate the possibility that those trends will reoccur. It depends on a series of methods to make these evaluations, including data mining, artificial intelligence, modeling, machine learning and statistics [8].

Businesses utilize predictive analytics in fine-tuning their operations and take decisions on whether current products are worthy of being invested on. Predictive analytics are used by investors in deciding where they can invest their money. Predictive analytics are being utilized by internet retailers in fine-tuning purchase recommendations to their users in order to increase their sales [7]. Predictive modeling is

currently an important tool for businesses intending to gain a competitive edge in their corresponding industries. Through patterns identification and historical data analysis, predictive modeling can assist businesses in making more optimize processes, informed decisions and increase overall performance. The benefits of predictive modeling techniques include (1) enhancement of decision-making, (2) improvement in the accuracy of data, (3) increasing operational efficiency, (4) giving greater insights into customer behavior and (5) reduction in uncertainties and risks. With reference to incorporating predictive modeling into decision-making processes, there are many benefits attached such as (1) cost savings which involves identification of opportunities and optimization of processes for effective improvements and realization of substantial cost savings, (2) competitive advantage which allows companies that effectively leverage predictive modeling to gain a competitive stand in their industry and (3) accuracy improvement via helping businesses in making more accurate forecasts and predictions resulting in better decision-making. Fig. 1 is the organogram of predictive model implementation in a business organization [9].

There are various ways via which predictive models can be classified and in real sense different kinds of models can be merged to obtain best results. The most noticeable difference exists between supervised and unsupervised models. Supervised models adopt the recent machine learning techniques like neural networks to recognize the patterns embedded in data which has been labeled already. Unsupervised models utilize traditional statistics to directly group the data directly with the aid of techniques such as time series analysis, logistic regression and decision trees. The huge difference between the two methodologies is that more care must be taken with supervised models in order to effectively label data sets upfront. Using different model types has been proved to be more domain-specific rather than industry-specific. There are some specific cases in which standard statistical regression analysis proved to be the best predictive power while more sophisticated models exhibited excellent results in other cases. Selection of the right model by data scientists is very imperative once the sample data has been gathered [10].



**Fig. 1. Organogram of predictive model implementation in a business organization**

Successful utilization of predictive analytics is a function of unconstrained access to enough volumes of clean, accurate and relevant data. Predictive models like those utilizing k-means clustering and decision trees can be extraordinarily sophisticated. However, neural network happens to be the most complex part which involves training of computers in order to forecast outcome. Machine learning utilizes a neural network to develop correlations in extraordinarily large data sets via learning and patterns identification within the data. It's crucial to maintain predictive analytics for creation of important business insights because not everything this technology brings up is vital. Nonetheless, the potential to utilize more data in predictive modeling has limited advantages. Too much data can alter the calculation and come up with an erroneous outcome. Also, the massive volumes of data involved in predictive modeling is a big challenge in ensuring the privacy and security is maintained [11]. The present study enhancing Non-Profit Project Outcomes through Predictive Modelling and Real-Time Data Analysis.

## **2. PREDICTIVE REAL-TIME DATA ANALYTICS MODELS**

The most prominent models for predictive real-time data analysis are classification model, forecast model, clustering model, time series model and outliers model. The classification model is recognized as the simplest model because data is categorized for direct and simple query response. The clustering model: This model merges data together via their common attributes [7]. The methodology involves grouping people or things with shared behaviors or attributes and then plans ways for each group on a broader scale. A typical example is the determination of credit risk for a loan applicant using the previous applicants' characteristics who are in similar category or situation. In forecast model, a numerical value that depends on learning from historical data is utilized to work on any scenario. Typical examples are (1) the determination of the total number of calls a customer support agent should be able to handle on daily or weekly basis and (2) response to the total number of lettuce a restaurant should order in the upcoming week. To achieve this, the system checks and adopt records of historical data. The time series model analyses an order of data points using time as the basis. An example is the prediction of the total number of stroke patients the hospital might admit in the coming

week, month or the rest of the year using the number of patients admitted to the hospital in the last four months as the historical data [10]. It is obvious that a single metric determined and compared over time is thus more significant than a simple average. In outliers model, outlying and abnormal data points are analyzed. An example is when a bank uses an outlier model to detect fraud via questioning whether a transaction is not within customer's usual buying nature or whether an expense in a particular category is abnormal or normal.

## **3. MODELS FOR DESIGNING PREDICTIVE ANALYTICS ALGORITHMS IN ENHANCING NON-PROFIT PROJECT OUTCOMES**

The various applicable models for designing predictive analytics algorithms for the purpose of enhancing non-profit project outcomes include statistical models, linear regression models, multiple regression models, multivariate regression model and decision tree.

### **3.1 Statistical Models**

A common and prominent statistical model of the predictive analytics algorithms is the time series algorithm classified into time-domain algorithms and frequency-based algorithms. The time-domain algorithms are adopted and utilized during cross-correlation and auto-correlation analyses. The frequency-domain algorithms comprise of wavelength and spectral analyses. The market segmentation algorithm is another frequently utilized statistical algorithm which is broadly utilized in customer profiling based on priorities or particular characteristics of a business [12].

### **3.2 Linear Regression Models**

Linear regression algorithms are adopted in modeling of existing relationships between design (independent) and observed (dependent) variables. The methodology involves using least squares method in fitting of best line resulting into the minimal sum of squared errors (SSEs) between the experimental and predicted data points [13]. Linear regression algorithms are adopted in decisions making in cases like determining the most appropriate marketing strategy to attain optimized sales when particular investment channels are adopted. Also, upstream power, downstream power and

downstream signal-to-noise ratio had once been considered as adopted variables in the prediction of truck rolls within seven days in a Cable Company located in the United States with the aid of a linear regression program. The statistically relevant results significant provided a perception on the required interventions to avoid truck roll.

### 3.3 Multiple Regression Models

Multiple regression analyses as predictive analytics algorithms are usually adopted in scenarios where product pricing becomes a priority across an industry like marketing organizations and real estate pricing purposely to launch the impact of a campaign. It is a broadened division of regressions that combines both nonlinear and linear regressions and utilizes explanatory variables to execute an analysis [14]. Multiple regression algorithms has found wide application in practical scenarios like analysis of a device behavior, social science research or in insurance companies for the estimation of the worthiness of a claim. In the past, factors which affected the outcome of a referendum where the United Kingdom decided to leave the European Union were examined with the aid of multiple regression analysis. In the process, multivariate regression analysis was applied to combine the Logistic (Logit) Model with real data purposely to know the statistically relevant factors with high impact on the voting choice in a concurrent manner. Age, voters' gender and educational background were revealed as statistically significant factors based on the results obtained from the multiple regressions. However, the country of birth was statistically not significant to study [15].

### 3.4 Multivariate Regression Model

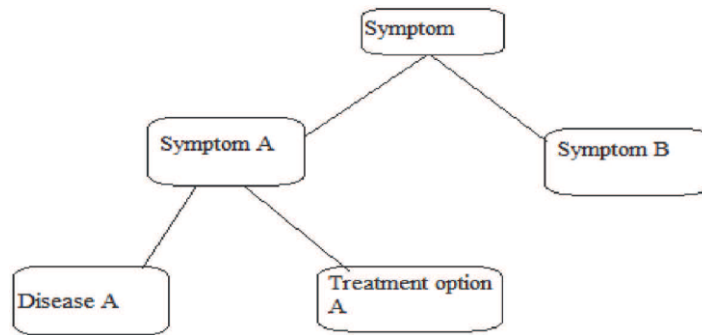
A number of independent variables was used to predict the value of a single variable in multivariate regression models. Also, it is utilized to evaluate the existing relationship between responses and predictors. The predictors are made up of categorical, continuous, or a mixture of both. Multivariate analysis evaluates probability distributions of multivariate with reference to their impacts on the experimental data. A typical example of this type of model is the multivariate analysis of covariance (MANOVA) which executes the analysis of variance that handles cases where more than one variable is simultaneously analyzed. On the other hand, principal component analysis (PCA)

is a multivariate analysis that allows the formation of a new group of orthogonal variables with the same data just like the original set. A global delivery company called DHL had once utilized multivariate regression analysis in its Global Trade Barometer program for the prediction of global trade future status [5]. They applied a machine-learning language in the input of collected data that are related to various intermediate commodities ranging from bumpers, clothes or mobile devices. Multivariate analysis PAAs and artificial intelligence were leveraged by the program to develop a single data that allows knowing the effects of some variables on a single variable. The output can be utilized by stakeholders in decisions making like benchmarking on the forecasts to comprehend the industry's competitiveness and to plan the ability for upcoming demands of their services.

### 3.5 Decision Tree

Decision-tree algorithms are categorized among supervised learning algorithms. They are usually adopted in model development for tackling classification and regression problems. The main objective of decision tree creation is to generate values which can be utilized in the prediction of outcomes of a specific group or target variables via the application of learning decision rules gathered from past data. Problems are solved using the basic ideology of tree representation of algorithms [10]. In the different decision tree internal nodes, corresponding attributes are utilized while class label is created at the leaf node. A typical example is the recent artificial intelligence (AI) chatbot developed by a British plugin company called Pouch. It tells customers about the available discounts on Black Fridays. It utilizes the decision-tree logic to comprehend and interpret people's preferences; and it is equally made available Facebook Messenger users. The decision tree allows users to find the directory based on codes such as preferences voucher codes, their brands, products and departments.

In the area of medicine, the decision tree concept has been applied via a chatbot program with code which allows the mapping out of symptoms and the peculiar descriptions taken by people to explain their health issues. The mechanism of operation was based on the principle of artificial intelligence. This was achieved via corporation with developers from Microsoft's unit of healthcare innovation in the establishment of a tool that ease decision-making with reference to



**Fig. 2. Conceptual framework for the chatbot of the decision tree utilized by aurora health care**

patient care. The input is made available via answers obtained from a set of questions based on the presented symptoms. The chatbot familiarizes with the answers and brings out the treatment plan suggestions after revealing the possible causes. The algorithm allows the development of a command task for decision making on if further clinical care is needed by the patient. The patient clicks a section which reserves a place for him or her from the drop downs in a line at an Aurora urgent care center. Fig. 2 represents the conceptual framework for the chatbot [16].

#### **4. CASES OF PREDICTIVE MODELLING AND REAL-TIME DATA ANALYSIS APPLICATION IN NON-PROFIT PROJECT OUTCOMES**

Predictive modelling and real-time data analysis have found wide relevant applications in areas like marketing, education, health, manufacturing, fraud detection, stock market, human resources and so on for their non-profit project outcomes.

##### **4.1 Health**

The methods of identifying patients with high risk of heart failure is needed with little or no human involvement. Medical practitioners working at Harris Methodist Hospital in Dallas have seized the opportunities of machine languages such as Javascript, Java and Python in developing a machine learning algorithm which allows identification of high heart failure risk patients so as to make provision for them with improved intensive treatment [13].

In another study area (Texas Hospital), predictive analytics algorithms was extensively adopted in the prediction of resource requirements and was

able to reduce 30-day rate of readmission of heart failure patients. The data gotten from patients admission number of those readmitted and patients with heart failure in the past months were used to execute the analysis. The most frequently adopted method is a written computer program using JavaScript, Java or C in which an algorithm is generated to create a regression equation which can be utilized in predicting upcoming readmission rates. The number of readmissions in the past months is the dependent variable while the number of patients with heart failures is the independent variable. The response gives a regression equation which can be utilized together with the present number of patients with heart failure in order to forecast future readmission rates [17].

In another scenario, predictive analytics algorithms were adopted in conducting scans on medical records in order to create the most applicable care which can result in an upgrading in patient outcomes at the Harris Methodist Hospital in Dallas Quite a number of data attributes such as the volume of glucose in blood and blood pressure were accounted by the algorithm in order to behave as an identifier of patients experiencing heart failure risk. The algorithm generated a 30-day risk mark which stands as the possible heart failure incidence. This allows physicians to lay emphasis on patients who require intensive care. Python and PHP are the frequently used programming languages [18]. The risk mark is evaluated via the creation of an algorithm that determines the p-value with the aid of a computer program. The likelihood of heart failure was determined using a particular level of significance. The blood pressure and volume of glucose present in the blood were considered as the input variables. The level of significance was the analytic program output which could be 0.05 or any

recommended value by the hospital. A patient having his values falling within the significance value is predicted with heart failure risk and the treatment effectiveness measures should be upgraded in order to promote his health [12]. An algorithm that evaluates multiple regressions having two independent variables (blood pressure and volume of glucose in blood) is created. The output regression equation in a computer program is made up of the independent variables input sections. The program is run and the created regression value is utilized in predicting heart failure possibility in a

patient. The intervention entails a computer program creation with reference to machine learning languages where patients' data was being recorded by the practitioners and the relationship between the values of blood pressure and blood glucose volume to heart failure was calculated. Under this, a notification is made available to the practitioners in cases where the blood glucose levels or blood pressure attains a specific value [6]. Fig. 3 represents the algorithm framework adopted in testing patients at heart failure risk.

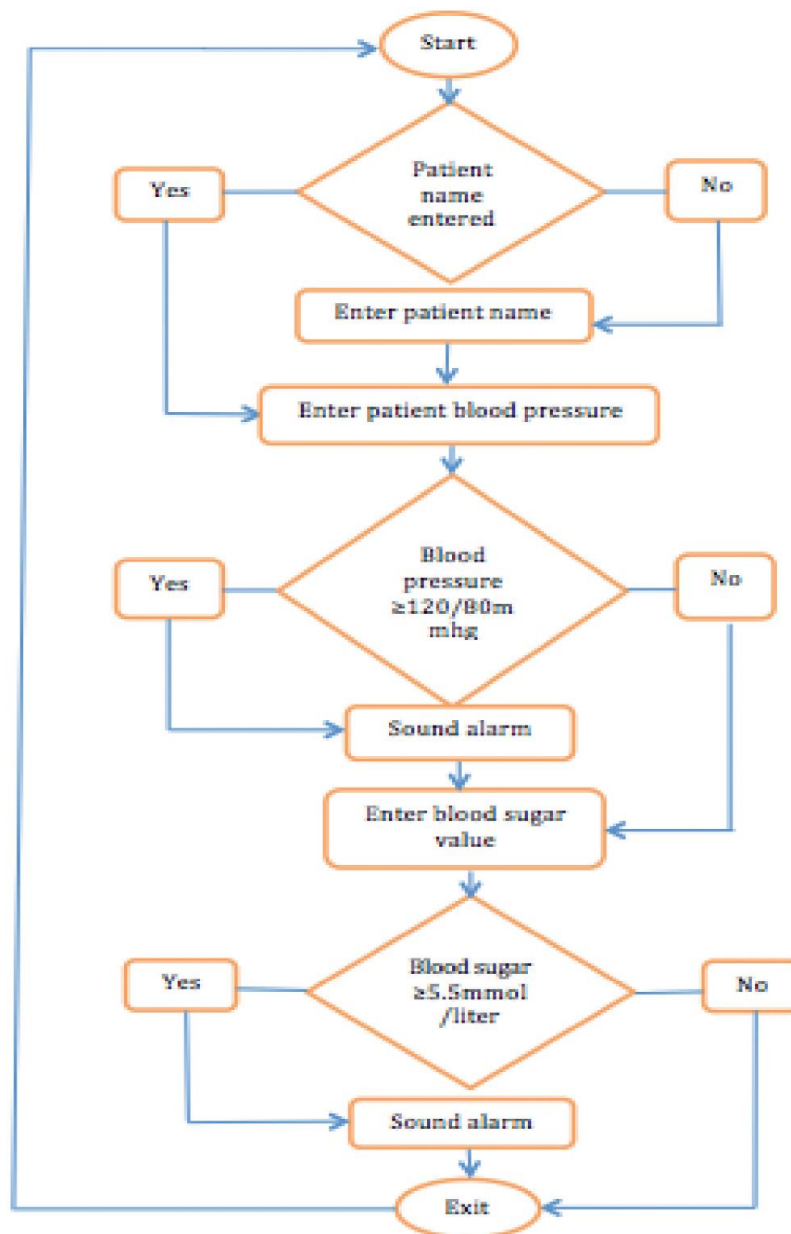


Fig. 3. Algorithm framework adopted in testing patients at heart failure risk



## 4.2 Education

The management of Southern Methodist University applied machine learning (ML) program as the most appropriate approach to attain an accurate prediction of their students' future performance using their present performance as the basis. Predictive analytics have been applied by numerous institutions in predicting their students' future performances based on their historic performance scores [19].

The analysis executed entails inputting of raw data into the package and following the regression analysis step. The regression preliminary result is basically a regression value related to the present student's performance and is a factor which allows future performance prediction. A standardized coefficient is the final outcome and behaves as a predictor of a student's performance in future tests with reference to the present performance [20].

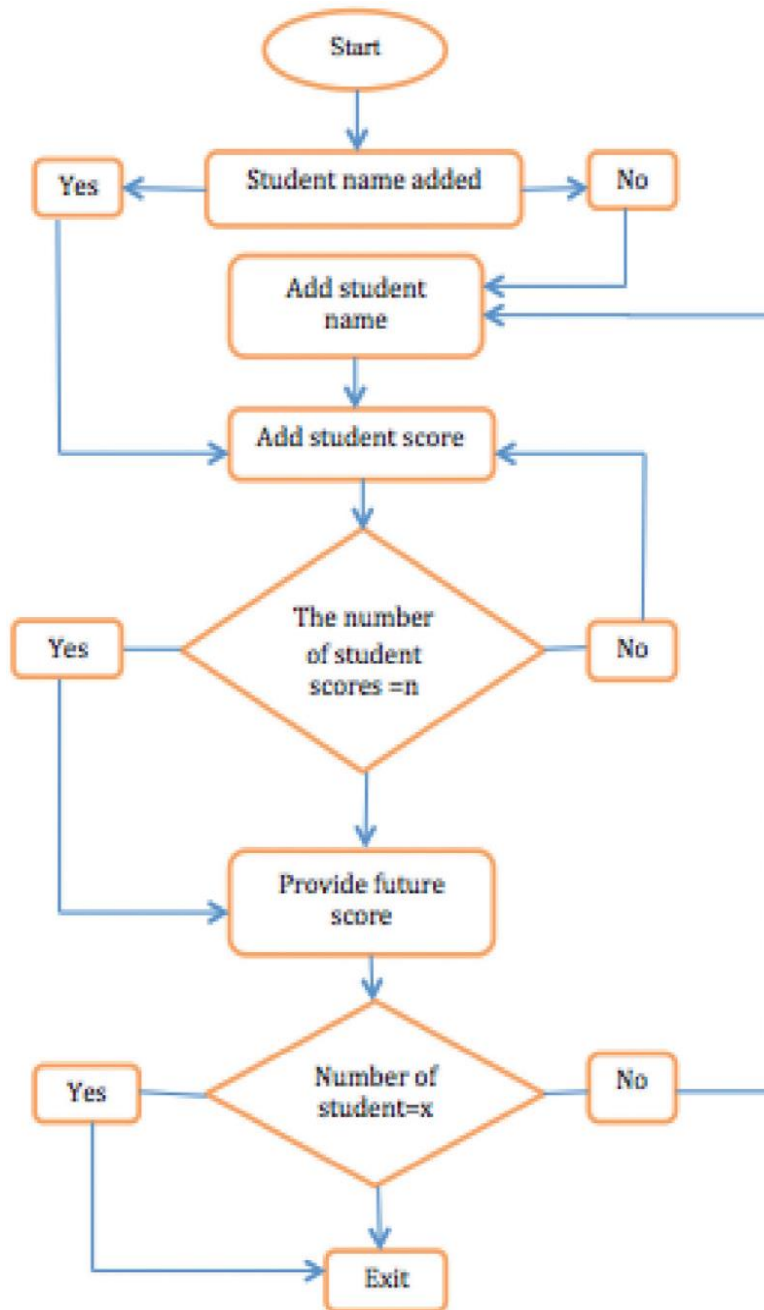


Fig. 4. Flowchart of the required design using computer decision frameworks

The application of ML algorithm was recommended as the intervention strategy which evaluates the students' scores regression value. This can then be applied in predicting their performances in the next academic periods. GNU PSPP is the recommended statistical package which possess the attributes that allow statistical measures evaluation such as cluster analysis, multiple linear regression, reliability analysis and simple linear regression. The GNU PSP application was installed into the computer system after which the machine codes design was executed which then returns specific values of performance after inputting the necessary information [21]. The computer program comprises decision making points and input points based on the required outputs. The algorithm design occurs immediately after the GNU PSP computer application installation. Fig. 4 represents the flowchart of the required design using computer decision frameworks.

## 5. FUTURE RESEARCH DIRECTIONS

The application of predictive modelling and real-time data analysis in enhancing non-profit project outcomes has been critically discussed with reference to case studies in the area of health and education. However, there are some research gaps that are needed to be bridged for future research purposes. Studies have examined the application of this methodologies in some areas. However, studies on information gathering from patients via the use of social media applications for data accuracy is still scanty. Doing this will expand the scope of the work and data collection shall be made easy. Additionally, questionnaires can be distributed via online platforms to enable patients share their opinions on the effectiveness of the methodology.

Though studies have been conducted in different areas such as education, health, agriculture and so on, broad examination of sub-section in each of these areas of specialization is still very limited. Many studies conducted in the area of health have focused majorly on patients with heart-related illness. Other sub-sections such as checking the application of predictive modelling and real-time data analysis in patients with malaria, lung related illness, kidney diseases, optical problems and so on. In the area of education, emphasis was majorly on students' outputs without

investigating the contributory effect of the teachers.

Nonetheless, several studies examined the use of the methodology in information gathering from patients without looking critically at the required training for the medical personals who will investigate the effectiveness. There is need to counter check the computer controlled system with the manually operated one. The studies of the cost effectiveness of the process is also limited. There is need for future researchers to examine the cost analysis of the system. There are applicable software that can be utilized in this regard.

## 6. CONCLUSION

Project outcomes are the existing results after the creation of products and services. They usually pay attention to the broad mission while leading to creations. Advantages of understanding project outcomes include provision of a general purpose for the project, discovering of means via which clients' needs can be met, determining whether business objectives are met, learning of lessons for upcoming projects and identification of areas that call for improvement, and lastly assist in ensuring that all sections of the project are in line with the end goal. However, the use of predictive modeling techniques in project outcomes is necessary in order to improve their efficiencies. Various advantages of predictive modeling techniques were stated. Predictive real-time data analytics models and models for designing predictive analytics algorithms in enhancing non-profit project outcomes were discussed to include statistical models, linear regression models, multiple regression models, multivariate regression model and decision tree. Health and education were used as case studies of predictive modelling and real-time data analysis application in non-profit project outcomes. In conclusion, predictive real-time data analytics models and predictive analytics algorithms are essential tools that can enhance non-profit project outcomes.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author hereby declares that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

## COMPETING INTERESTS

Author has declared that no competing interests exist.

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