Smart City and Future of Urban Planning based on Predictive Analysis by Adoption of Information Technology

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ABSTRACT
Predictive analytics is a term mainly used in statistical and analytics techniques. This term is drawn from statistics, machine learning, database techniques and optimization techniques. It has roots in classical statistics. It predicts the future by analyzing current and historical data. The future events and behaviour of variables can be predicted using the models of predictive analytics. A score is given by mostly predictive analytics models. A higher score indicates the higher likelihood of occurrence of an event and a lower score indicates the lower likelihood of occurrence of the event. Historical and transactional data patterns are exploited by these models to find out the solution for many business and science problems. These models are helpful in identifying the risk and opportunities for every individual customer, employee or manager of an organization. With the increase in attention towards decision support solutions, the predictive analytics models have dominated in this field. In this paper, we will present a review of process, techniques and applications of predictive analytics.

KEYWORDS: Predictive Analysis, Urban Planning, Innovation Adoption, Machine Learning

1.0 INTRODUCTION

Predictive analytics, a branch in the domain of advanced analytics, is used in predicting the future events. It analyses the current and historical data in order to make predictions about the future by employing the techniques from statistics, data mining, machine learning, and artificial intelligence [1-15]. It brings together the information technology, business modeling process, and management to make a prediction about the future. Businesses can appropriately use big data for their profit by successfully applying the predictive analytics. It can help organizations in becoming proactive, forward looking and anticipating trends or behaviour based on the data. It has grown significantly alongside the growth of big data systems [2-19]. Suppose an example of an E-Retailing company, XYZ Inc. The company runs its retailing business worldwide through internet and sells variety of products. Millions of customer visit the website of XYZ to search a product of their interest. They look for the features, price, offers related to that product listed on the website of XYZ [15-25]. There are many products which sells are dependent on season. For example, demand of air conditioner increases in summers and demand of geysers increases in winter. The customers search for the product depending the season. Here the XYZ Company will collect all the search data of customers that in which season, customers are interested in which products. The price range an individual customer is interested in. How customers are attracted seeing offers on a product [1-15]. What other products are bought by customers in combination with one product. On the basis of this collected data, XYZ Company will apply analytics and identify the requirement of customer. It will find out which individual customer will be attracted by which type of recommendation and then approach customers through emails and messages [17-22]. They will let the customer know that there is such type of offer on the products customer has on its website. If the customer come to the website again to buy that product, then the company will offer the other products which have been sold in combination to other customers. If a customer start buying a frequently, then the company reduce offer or increase price for that individual customer. This is just an instance and there are many more applications of predictive analytics [12-26]. Predictive analytics has not a limited application in e- retailing. It has a wide range of application in many domains. Insurance companies collect the data of working professional from a third party and identifies which type of working professional would be interested in which type of insurance plan and they approach them to attract towards its products [1-25]. Banking companies apply predictive analytics models to identify credit card risks and fraudulent customer and become alert from those type of customers. Organizations involved in financial investments identify the stocks which may give a good return on their investment and they even predict the future performance of stocks based on the past and

current performance [25-39]. Many other companies are applying predictive models in predicting the sale of their products if they are making such type of investment in manufacturing. Pharmaceutical companies may identify the medicines which have a lower sale in a particular area and become alert on expiry of those medicines [2-19]. There has been a long history of using predictive models in the tasks of predictions. Earlier, the statistical models were used as the predictive models which were based on the sample data of a large-sized data set. With the improvements in the field of computer science and the advancement of computer techniques, newer techniques have been developed and better and better algorithms been introduced over the period of time. The machine learning models have a very well track record of being used as predictive models. Artificial neural networks brought the revolution in the field of predictive analytics. Based on the input parameters, the output or future of any value can be predicted [20-26]. Now with the advancements in the field of machine learning and the development of deep learning techniques, there is a trend nowadays of using deep learning models in predictive analytics and they are being applied in a full swing in this task. This paper opens a scope of development of new models for the task of predictive analytics [27-31]. There is also an opportunity to add additional features to the existing models to improve their performance in the task. Predictive analytics involves several steps through which a data analyst can predict the future based on the current and historical data [22-39].

2.0 LITERATURE REVIEW

We conducted This section describes the proposed approach to predictive analysis for social processes. Though there is a long history of working with predictive analytics and it has been applied widely in many domains for decades, today is the era of predictive analytics due to the advancement of technologies and dependency on data [1-10]. Many organizations are tending towards predictive analytics in order to increase their bottom line and profit. There are several reasons for this attraction: Growth in the volume and types of data is the reason to use predictive analytics to find insights from large-sized data. Faster, cheaper, and user-friendly computers are available for processing. A variety of software is available and more developments are going on in software which are easy to use for users. The competitive environment of growing the organization with profit and the economic conditions of the organization push them to use the predictive analytics [2-8]. With the development of easy to use and interactive software and its availability, predictive analytics is not being limited to the statisticians and mathematicians. It is being used in a full swing by business analysts and managerial decision process. Some of the most common opportunities in the field of predictive can be listed [3-12]. Detecting Fraud: Detection and prevention of criminal behavior patterns can be improved by combining the multiple analysis methods. The growth in cybersecurity is becoming a concern. The behavioral analytics may be applied to monitor the actions on the network in real time. It may identify the abnormal activities that may lead to a fraud [4-17]. Threats may also be detected by applying this concept. Reduction of Risk: Likelihood of default by a buyer or a consumer of a service may be assessed in advance by the credit score applying the predictive analytics. The credit score is generated by the predictive model using all the data related to the person's creditworthiness. This is applied by credit card issuers and insurance companies to identify the fraudulent customers. Marketing Campaign Optimization: The response of customers on purchase of a product may be determined by applying predictive analytics. It may also be used to promote the cross-sale opportunities [5-18]. It helps the businesses to attract and retain the most profitable customers. Operation Improvement: Forecasting on inventory and managing the resources can be achieved by applying the predictive models. To set the prices of tickets, airlines may use predictive analytics. To maximize its occupancy and increasing the revenue, hotels may use predictive models to predict the number of guests on a given night. An organization may be enabled to function more efficiently by applying the predictive analytics [6-14]. Clinical Decision Support System: Expert systems based on predictive models may be used for diagnosis of a patient. It may also be used in the development of medicines for a disease. The presentation is structured to realize three objectives: 1.) provide reachability- based definitions for basic predictive analysis tasks; 2.) develop a rigorous, tractable methodology for reachability analysis; and 3.) derive efficient (reachability-based) algorithms for performing predictive analysis [13-24]. We now provide quantitative definitions for predictability assessment, identification of useful measurable, early warning, and robust prediction. Assume the behavior about which predictions are to be made and the measurable upon which these predictions

can be based have been used to specify the system SSI and ISS, respectively. Denote by the social process of interest, and suppose it is modeled using the stochastic hybrid system (S-HDS) framework developed in [15-25]. For instance, we often specify the warning accuracy and indicator in such a way that if the indicator is observed then the probability of event occurrence exceeds the given threshold. Note that this definition for warning analysis and warning indicators captures the essence of the informal usage of these terms and is also convenient for formal analysis. The previous section formulates predictive analysis problems as reachability questions. In this section we show that these reachability questions can be addressed by adopting an analysis methodology which is related to familiar Lyapunov function stability analysis [1-9]. More specifically, we seek a scalar function of the system state that permits conclusions to be made regarding reachability without computing system trajectories. We refer to these as "altitude functions" to provide an intuitive sense of their role in reachability analysis: if some measure of "altitude" is low on the ISS and high on an SSI, and if the expected rate of change of altitude along system trajectories is no increasing, then it is unlikely for trajectories to reach this SSI from the ISS [13-23]. We begin with an investigation of (probabilistic) reachability on infinite time horizons. The following result is proved in [1-9] and is instrumental in our development Thus the search for altitude functions can be formulated as a convex programming problem [9-17]. Moreover, if the system of interest admits a polynomial description (i.e., the system vector fields are polynomials and system sets are semi algebraic) and if we restrict our search to polynomial altitude functions, then the search can be carried out using sum of squares (SOS) optimization [18-26]. Importantly, this approach is tractable: for fixed polynomial degrees, the computational complexity of the associated SOS program grows polynomial in the dimension of the continuous state space, the cardinality of the discrete state set, and the dimension of the parameter space Having formulated predictive analysis for social processes in terms of system reachability and presented a methodology for assessing reachability, we are now in a position to derive algorithms for predictive analysis. In what follows we focus on the tasks of predictability assessment and early warning analysis; algorithms for identifying measurable with predictive power and forming predictions are developed in [27-39]. A decision tree is a classification model but it can be used in regression as well. It is a tree-like model which relates the decisions and their possible consequences. The consequences may be the outcome of events, cost of resources or utility. In its tree-like structure, each branch represents a choice between a number of alternatives and its every leaf represents a decision. Based on the categories of input variables, it partitions data into subsets. It helps the individuals in decision analysis. Ease of understanding and interpretation make the decision trees popular to use [1-11]. It has the internal nodes labeled with the questions related to the decision. All the branches coming out from a mode are labeled with the possible answers to that question. The external nodes of the tree called the leaves, are labeled with the decision of the problem. This model has the property to handle the missing data and it is also useful in selecting the preliminary variables. They are often referred as generative models of induction rules that work on the empirical data. It uses most of the data in the dataset and minimizes the level of questions [12-25]. Along with these properties, the decision trees have several advantage and disadvantages. New possible scenarios can be added to the model which reflects the flexibility and adaptability of the model. It can be integrated with other decision models as per the requirement. They have limitation to adopt the changes. A small change in the data leads to the large change in the structure. They lag behind in the accuracy of prediction in comparison to other predictive models. The calculation is complex in this model especially on the use of uncertain data [26-39].

3.0 RESEARCH MODEL

To develop a predictive model, it must be cleared that what is the aim of prediction. Through the prediction, the type of knowledge which will be gained should be defined. For example, a pharmaceutical company wants to know the forecast on the sale of a medicine in a particular area to avoid expiry of those medicines. The data analysts sit with the clients to know the requirement of developing the predictive model and how the client will be benefitted from these predictions. It will be identified that which data of client will be required in developing the model After knowing the requirement of the client organization, the analyst will collect the datasets, may be from different sources, required in developing the predictive model. This may be a complete list of customers who use or check the products of the company. This data may be in the structured form or in unstructured form. The analyst verifies the data collected from the clients at their own site. Data analysts analyze the collected data and prepare it for analysis and to be used in the model. The unstructured data is converted into a structured form in this step. Once the complete data is available in the structured

form, its quality is then tested. There are possibilities that erroneous data is present in the main dataset or there are many missing values against the attributes, these all must be addressed. The effectiveness of the predictive model totally depends on the quality of data. The analysis phase is sometimes referred to as data mugging or massaging the data that means converting the raw data into a format that is used for analytics. The predictive analytics process employs many statistical and machine learning technique. Probability theory and regression analysis are most important techniques which are popularly used in analytics. Similarly, artificial neural networks, decision tree, support vector machines are the tools of machine learning which are widely used in many predictive analytics tasks. All the predictive analytics models are based on statistical and/or machine learning techniques. Hence the analysts apply the concepts of statistics and machine learning in order to develop predictive models. Machine learning techniques have an advantage over conventional statistical techniques, but techniques of statistics must be involved in developing any predictive model. In this phase, a model is developed based on statistical and machine learning techniques and the example dataset. After the development, it is tested on the test dataset which a part of the main collected dataset to check the validity of the model and if successful, the model is said to be fit. Once fitted, the model can make accurate predictions on the new data entered as input to the system. In many applications, the multi-model solution is opted for a problem. After the successful tests in predictions, the model is deployed at the client's site for everyday predictions and decision- making process. The results and reports are generated by the model nor managerial process. The model is consistently monitored to ensure whether it is giving the correct results and making the accurate predictions. Here we have seen that predictive analytics is not a single step to make predictions about the future. It is a step-by-step process which involves multiple processes from requirement collection to deployment and monitoring for effective utilization of the system in order to make it a system in decision-making process Though there is a long history of working with predictive analytics and it has been applied widely in many domains for decades, today is the era of predictive analytics due to the advancement of technologies and dependency on data. Many organizations are tending towards predictive analytics in order to increase their bottom line and profit. Regression is one of the most popular statistical technique which estimates the relationship between variables. It models the relationship between a dependent variable and one or more independent variables. It analyzes how the value of dependent variable changes on changing the values of independent variables in the modeled relation. This modeled relation between dependent and independent relation. In the context of the continuous data, which is assumed to have a normal distribution, the regression model finds the key pattern in large datasets. It is used to find out the effect of specific factors influence the movement of a variable. In regression, the value of a response variable is predicted on the basis of a predictor variable. In this case, a function known as regression function is used with all the independent variables to map them with the dependent variables. In this technique, the variation of the dependent variable is characterized by the prediction of the regression function using a probability distribution. There are two types of regression models are used in predictive analytics for prediction or forecasting, the linear regression model, and the logistic regression model. The linear regression model is applied to model the linear relation between dependent and independent variables. A linear function is used as regression function in this model. On the other hand, the logistics regression when there are categories of dependent variables. Through this model, unknown values of discrete variables are predicted are predicted on the basis of known values of independent variables. It can assume a limited number of values in prediction. Artificial neural network, a network of artificial neurons based on biological neurons, simulates the human nervous system capabilities of processing the input signals and producing the outputs. This is a sophisticated model that is capable of modeling the extremely complex relations. The architecture of a general purpose artificial neural network.

4.0 CONCLUSION

This technique is used in predictive analytics as a machine learning technique. It is mainly used in classification and regression-based applications. It is like an ensemble model which ensembles the predictions of weak predictive models that are decision trees. It is a boosting approach in which resamples the dataset many times and generate results as a weighted average of the resampled datasets. It has the advantage that it is less prone to over fitting which the limitation of many machine learning models. Use of decision trees in this model helps in fitting the data fairly and the boosting improves the fitting of data. It is supervised kind of machine learning technique popularly used in predictive analytics. With associative learning algorithms, it analyzes the data for classification and

regression. However, it is mostly used in classification applications. It is a discriminative classifier which is defined by a hyper plane to classify examples into categories. It is the representation of examples in a plane such that the examples are separated into categories with a clear gap. The new examples are then predicted to belong to a class as which side of the gap they fall. It belongs to the category of supervised learning algorithms in the branch of machine learning. These model are developed by training several similar type models and finally combining their results on prediction. In this way, the accuracy of the model is improved. Development in this way reduce the bias and reduce the variance of the model. It helps in identifying the best model to be used with new data. There are many applications of predictive analytics in a variety of domains. From clinical decision analysis to stock market prediction where a disease can be predicted based on symptoms and return on a stock, investment can be estimated respectively. In banking and financial industries, there is a large application of predictive analytics. In both the industries data and money is crucial part and finding insights from those data and the movement of money is a must. The predictive analytics helps in detecting the fraudulent customers and suspicious transactions. It minimizes the credit risk on which theses industries lend money to its customers. It helps in cross-sell and up-sell opportunities and in retaining and attracting the valuable customers. For the financial industries where money is invested in stocks or other assets, the predictive analytics forecasts the return on investments and helps in investment decision making process. The predictive analytics helps the retail industry in identify the customers and understanding what they need and what they want. By applying this technique, they predict the behavior of customers towards a product. The companies may fix prices and set special offers on the products after identifying the buying behavior of customers. It also helps the retail industry in predicting that how a particular product will be successful in a particular season. They may campaign their products and approach to customers with offers and prices fixed for individual customers. The predictive analytics also helps the retail industries in improving their supply-chain. They identify and predict the demand for a product in the specific area may improve their supply of products. The pharmaceutical sector uses predictive analytics in drug designing and improving their supply chain of drugs. By using this technique, these companies may predict the expiry of drugs in a specific area due to lack of sale. The insurance sector uses predictive analytics models in identifying and predicting the fraud claims filed by the customers. The health insurance sector using this technique to find out the customers who are most at risk of a serious disease and approach them in selling their insurance plans which be best for their investment. The oil and gas industries are using the predictive analytics techniques in forecasting the failure of equipment in order to minimize the risk. They predict the requirement of resources in future using these models. The need for maintenance can be predicted by energy-based companies to avoid any fatal accident in future. The government agencies are using big data-based predictive analytics techniques to identify the possible criminal activities in a particular area. They analyze the social media data to identify the background of suspicious persons and forecast their future behavior. The governments are using the predictive analytics to forecast the future trend of the population at country level and state level. In enhancing the cybersecurity, the predictive analytics techniques are being used in full swing.There has been a long history of using predictive models in the tasks of predictions. Earlier, the statistical models were used as the predictive models which were based on the sample data of a large-sized data set. With the improvements in the field of computer science and the advancement of computer techniques, newer techniques have been developed and better and better algorithms been introduced over the period of time. The developments in the field of artificial intelligence and machine learning have changed the world of computation where intelligent computation techniques and algorithms are introduced. The machine learning models have a very well track record of being used as predictive models. Artificial neural networks brought the revolution in the field of predictive analytics. Based on the input parameters, the output or future of any value can be predicted. Now with the advancements in the field of machine learning and the development of deep learning techniques, there is a trend nowadays of using deep learning models in predictive analytics and they are being applied in a full swing in this task. This paper opens a scope of development of new models for the task of predictive analytics. There is also an opportunity to add additional features to the existing models to improve their performance in the task.

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