**Emperor International Journal of Management**

Received: November 2022
Accepted: November 2022
Published: December 2023

www.eijm.mayas.info

e-ISSN: 2583-1267

Volume - II Issue – 12 December- 2023

# Artificial Intelligence – based Multiple Regression Algorithm to Indicate Human Development in the Workplace

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**ABSTRACT**
There are particular difficulties in integrating human growth into the human workplace. Potential, poverty, and productivity are the three fundamental obstacles to human development. Maintaining employee skill development and training is a problem that human resource development frequently tackles. Employees must broaden their knowledge and acquire new skills as demands and trends change. In this study, an Artificial Intelligence-based Multiple Regression Algorithm (MRA) is employed to indicate human development in the workplace and is termed as AI-MRA. This MRA is compared with the existing models such as Random Forest, Naïve Bayes, and a hybrid model of Convolutional Neural Network withVariable-Length Markov Modelling (CNN-VMM) based on the parameters such as accuracy, sensitivity, specificity, precision, and recall. It is observed from the results that the proposed model has outperformed other existing algorithms.
**Keywords:** Human Development, Artificial Intelligence-based Multiple Regression Algorithm (AI-MRA), Random Forest, Naïve Bayes, Convolutional Neural Network withVariable-Length Markov Modelling (CNN-VMM)

## I. INTRODUCTION

The purpose of this study is to assess how successfully Multiple Linear Regression (MLR) and Artificial Neural Network (ANN) models forecast employee development. AI is a key technology of the current Fourth Industrial Revolution (4IR), which has the ability to combine human behaviour and intelligence into robots or systems. As a result, AI-based modelling is necessary to create an intelligent automated system that meets modern standards.

The estimate mechanism used in this investigation was multiple linear regression, a data mining method. Because it can offer an estimate using sales data, this strategy was chosen [1]. In this paper, a Hoeffding bound-based evolutionary algorithm (HEA) for regression or approximation problems with a large quantity of learning samples is provided [2]. The goal of this work was to simulate monthly precipitation at the Famagusta and Nicosia stations in northern Cyprus using together traditional linear techniques and AI-based methods. The results also established that ANFIS (Adaptive Neuro-Fuzzy Inference System)-based models outperform models made using other relevant methodologies [3]. The authors were able to create a useful automatic core feature recognitionalong with counting application by merging the Faster R-CNN algorithm with a self-developed batch processing in addition to counting tool. This application can count and report structured identification results while also enabling high-speed recognition of target characteristics among multiple photos [4]. Finally, this study provides a reinforcement learning-based nonlinear boost converter control method [5].

### Literature Review

This research introduces a unique optimization technique called "poor and wealthy" (PRO). The suggested approach is evaluated and the simulation outcomes are compared with those of several other cutting-edge and well-known optimization strategies using 33 test functions [6]. Experimental results that includes statistical analyses, demonstrated that NEATSA (neutrosophic-entropy-based adaptive thresholding segmentation algorithm) can partition the central regions of MR images very clearly when compared to other well-known image segmentation techniques obtainable in the existing research works on the pattern recognition and computer vision domains [7]. The rate of population growth in the Gunung Malela District was the subject of this study. Multiple linear regression was used as the estimation method in this investigation. This method was chosen because it has the potential to produce a network of links by predicting or projecting population growth using previous data [8]. This work [9] provides comprehensive descriptions of ACO-based transmission methods for both fixed and mobile WSNs. The purpose of the research (this study) is to show how Artificial Neural Networks (ANN) may be utilised to anticipate the movement of stock prices [10]. The idea of the existing study is to show and evaluate the effectiveness of the special KLR-Bagging (Kernel Logistic Regression) and MARS-Bagging (Multivariate Adaptive Regression Splines) ensembles in landslide susceptibility [11]. This work employs a special three-step hybrid intelligent prediction model that combines a feature extraction method with other intelligent modelling approaches [12]. Recent advances in ICT technologies, particularly with IoT, big data, and CPPS, allow us to adopt the necessary flexibility, responsiveness, and intelligence to handle difficulties in business, claim the authors [13]. The findings show that the

suggested ANN-based condition monitoring strategy may predict severe deterioration of the components under observation [14]. The authors came to the conclusion that Industrial Artificial Intelligence had been used to solve a variety of industrially challenging challenges (IAI). Additionally, they recommended the IAI approach of Privacy-Enhanced Federated Learning (PEFL) [15]. The goal of this study is to show how AI and cloud computing may enhance the adaptability, reliability, and insight of systems in smart factories. To that end, we provide a thorough analysis and defence of the use of AI in a Cloud-Assisted Smart Factory (CaSF) [16]. This article describes the uses of artificial intelligence, why it is developing so quickly, and how it incorporates human behaviour [17]. In the study, a complicated mechanical system crucial to industry—the vehicle wheel suspension system—is identified using Q2 (Qualitatively Truthful Quantitative Learning) learning [18]. To accurately predict events in the healthcare sector, authors have suggested a two-level approach termed EPTs-TL [19]. The findings of the investigations have shown that AI-assisted CM may increase manufacturing's flexibility and effectiveness. AI's use to CM (customised manufacturing) has both advantages and disadvantages [20].

**Proposed System**

Among other types of AI, interactive, analytical, textual, functional, and visual AI may be used to increase an application's intelligence and capacity for problem-solving in the real world. Nevertheless, it is difficult to create an effective AI model because to the dynamic nature and variety of real-world problems and data. AI modelling is used in modern technological systems to create clever and creative methods for a variety of real-world applications, including healthcare, business, agriculture, finance, smart cities, cyber security, and others. This study offers a thorough understanding of "AI-based modelling," along with the fundamentals and prospective uses of a multiple regression algorithm. The suggested system's flowgraph is shown in Figure 1. A multiple regression model is used in this study to examine the degree of human development in every specific job. The workers are examined using a variety of factors, including both individual and collective events, in this regression model. In addition to timely delivery of the task, the employee's performance is assessed based on their active engagement in its completion. Along with the advancement of the firm, it is equally concerned with the personal growth of each person.

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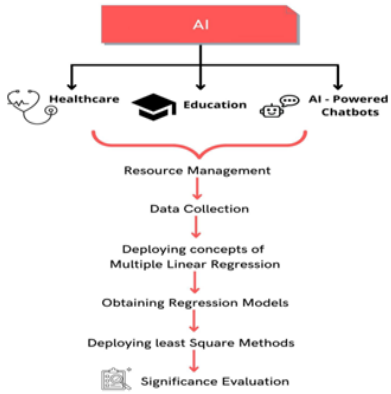


**Figure 1: Process Flow of the Proposed Model**

It is a challenging task to monitor and evaluate the performance of the individual employees of bigger organization holding numerous persons under various categories are involved. In the traditional system, the employees are evaluated manually as they are very few in numbers. But in recent scenario, it is highly difficult for manual evaluation and hence the organizations are moving towards the utilization of trending technologies to perform the tasks. In this view, the proposed system makes utilization of Artificial Intelligence to complete the task of human development in the workplaces.

One method for making predictions is known as multiple regressions, and it may include together of linear and nonlinear regressions. One definition of the multiple regression models is as the Equation (1).

$$\{y = b_0 + b_1x_1 + b_2x_2 + \cdots + b_nx_n + \varepsilon \approx N(0, \sigma^2) \quad 1)$$

where, y denotes the regression, $x_1$, $x_2$, $x_3$, $x_4$, and $x_5$ denotes the proportion, $b_0$, $b_1$,..., $b_n$ denote the regression coefficients.

The approach that requires the work may be used to get the regression coefficients. The following Equation (2) is a definition of the sum of the squared errors.

$$f(x_i) = \sum_{i=1}^{n} (y_i - b_0 - b_1x_{i1} - \cdots - b_nx_{nn})^2 \quad 2)$$

Then, stipulate that there is no change in the partial derivative of the regression coefficient is calculated using Equation (3).

$$\frac{\partial f(x)}{\partial b_0} = \frac{\partial f(x)}{\partial b_1} = \cdots = \frac{\partial f(x)}{\partial b_n} = 0 \quad 3)$$

The following Equation (4) is an example of an equation set for the regression coefficients.

$$\{nb_0 + b_1\sum x_{i1} + \cdots + b_n = \sum y_i b_0 \sum x_{i1} + b_1 \sum x_{i1}^2 + \cdots + b_n \sum x_{in}x_{i1}$$
$$= \sum x_{i1}y_i \ldots\ldots\ldots\ldots b_0 \sum x_{in} + b_1 \sum x_{i1}x_{in} + \cdots + b_n \sum x_{in}^2 4)$$
$$= \sum x_{in}y_i$$

On the basis of the equation set, one is able to compute the ideal regression coefficients of $b_0$, $b_1$,..., and $b_n$. The R, F, and t tests were executed in order to bring the accuracy of the model derived from the multiple regression analysis up a notch. The multiple correlation coefficients, denoted by the letter R, may be defined as in the following Equation (5).

$$R = \sqrt{1 - \frac{\sum_{i=1}^{n}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{n}\left(y_i - \underline{y}_i\right)^2}}, \quad 5)$$

where, $y_i$ represents the measured, I is the each sample, and y is the average zone for each sample (m).
It is possible to test the overall regression coefficient by using F in the Equation (6).

$$F = \frac{n-m-1}{m} \cdot \frac{R^2}{1-R^2} \quad 6)$$

Where m is the number of independent variables, or the number of primary factors that predict the level, and n represents the number of samples taken in total.
In the F distribution, the multiple regression prediction model is accessible if the value of F is greater than F>F (m, n−m−1). Each regression coefficient may be evaluated using t, which stands for t-test as represented as in Equation (7).

$$t_j = \frac{\ddot{b}_j}{\sqrt{c_{jj}.\sigma}}, \quad 7)$$

Where $t_j$ is the computed value used to determine whether or not to accept hypothesis $H_0$ for a specific saliency level, $c_{jj}$ is the (j+1)th member on the primary diagonal of the matrix $c=(x^Tx)^{-1}$, and is the allowable deviation of the controlled variable. If the expression if

$|t_i| = t_{\frac{\alpha}{2}}(m-n-1), c_i$, then the variable $x_j$ has a significant influence on y;
otherwise, the component need to be removed.

The performance metrics such as accuracy, sensitivity, recall and precision. Application of Artificial Intelligence based Multiple Regression Algorithm to Indicate the Human Development in the Workplace is compared with other existing works such as:

- Convolutional Neural Network- Variable-Length Markov Modelling (CNN-VMM)-(Zhang et al. (2021)) [20]
- Random forest- (Zhang et al. (2021)) [21]
- Naïve Bayes-(Chakraborty et al. (2021) [22]

The degree to which a classifier's predictions coincide during the assessment phase with the actual value of a label is referred to as its accuracy. It is also possible to describe it as a percentage of correct evaluations in relation to the whole number of examinations. The Equation (9) is used to determine the accuracy of the measurement.

$$\text{Accuracy} = \frac{(B+A)}{(B+A+D+C)} \quad 9)$$

Where,
A is the True Positive; B denotes the True Negative; C represents the False Positive, and
D as False Negative

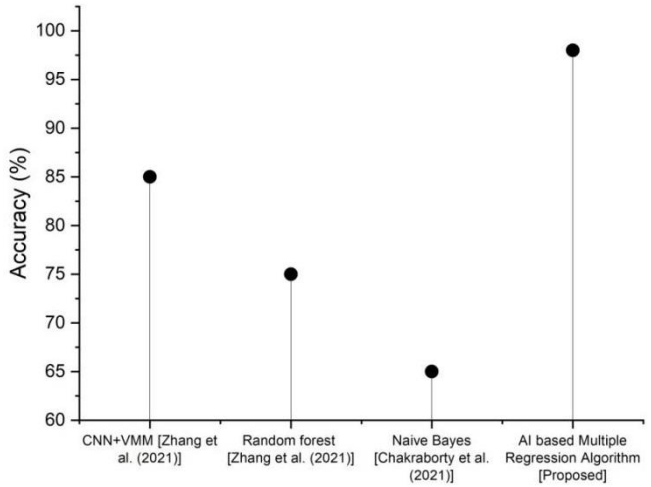


**Figure 2: Comparison of Accuracy**

Figure 2 depicts the accuracy for proposed and existing methods. A proposed method has a higher accuracy when compared to the existing methods such as CNN-VMM, Random forest and Naïve Bayes. Table 1 shows the result of accuracy for existing and proposed methodologies.

**Table 1: Result of accuracy**

| Algorithm/ Model | Accuracy (%) |
|---|---|
| **CNN+VMM** | 85 |
| **Random forest** | 75 |
| **Naive Bayes** | 65 |
| **AI based Multiple Regression Algorithm [Proposed]** | 98 |

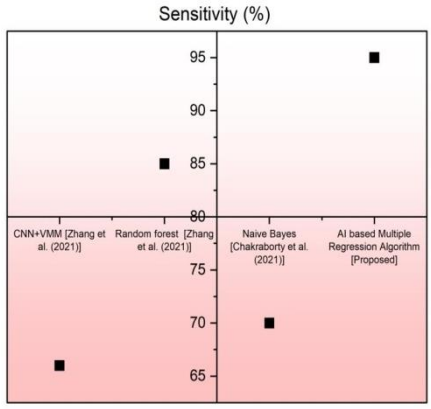


**Figure 3: Comparison of Sensitivity**

The term "sensitivity analysis" (SA) refers to "a method to determine the robustness of an assessment by examining the extent to which results are affected by changes in methods, models, values of unmeasured variables, or assumptions." The target of conducting a sensitivity analysis is to classify "results that are most dependent on questionable or unsupported assumptions," according to the definition of the term. Comparisons of sensitivity are illustrated in Figure 3. When compared to the proposed works the existing methods have a lower sensitivity. Table 2 shows the result of sensitivity for existing and proposed methodologies.

**Table 2: Result of sensitivity**

| Algorithms | Sensitivity (%) |
|---|---|
| **CNN+VMM** | 66 |
| **Random forest** | 85 |
| **Naive Bayes** | 70 |
| **AI based Multiple Regression Algorithm [Proposed]** | 95 |

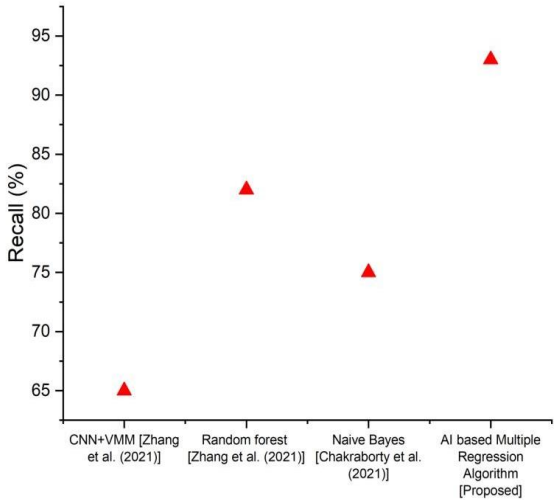


**Figure 4: Comparison of Recall**

The proportion of cases that the classifier correctly recognizes as positive is referred to as the recall, and it is what decides whether or not the data set is complete. When a False Negative leads to a considerable amount of additional cost. One of the performance criteria that are used to determine which model is superior is called recall. The calculation of recall is performed using Equation (10). Figure 4 depicts the comparison of recall. Recall is higher in proposed methods and lower in existing methods. Table 3 shows the result of recall for existing and proposed methodologies.

**Table 3: Result of recall**

| **Algorithm** | Recall (%) |
|---|---|
| **CNN+VMM** | 65 |
| **Random forest** | 82 |
| **Naive Bayes** | 75 |
| **AI based Multiple Regression Algorithm [Proposed]** | 93 |

$$\text{Recall}=\frac{A}{A+D} \quad (10)$$

Precision is one of the most essential metrics for accuracy. It is computed as the percentage of correctly categorized cases to all occurrences of predicatively positive data, as shown in Equation (11), which is one of the most important metrics for accuracy.

$$\text{Precision}=\frac{A}{A+C} \quad (11)$$

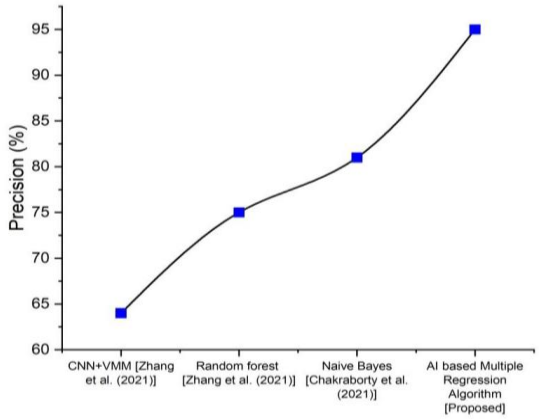


**Figure 5: Comparison of precision**

Comparisons of precision are showed in Figure 5. The proposed methods (AI-MRA) have a higher in precision level when compared to the existing works. Table 4 shows the result of precision for existing and proposed methodologies.

**Table 4: Result of precision**

| **Algorithm** | Precision (%) |
|---|---|
| **CNN+VMM** | 64 |
| **Random forest** | 75 |
| **Naive Bayes** | 81 |
| **AI based Multiple Regression Algorithm [Proposed]** | 95 |

## II. CONCLUSION

The use of modern intelligent technologies to make more informed decisions about the business process is made possible by AI, which is recognised as a most important technology in this area. This increases productivity and profitability across the board. Similar to how earlier industrial revolutions significantly increased monetary activity in the manufacturing, trading, transportation, and other sectors, the AI revolution can pave the way for development. This study attempts to offer a thorough overview of AI-based modelling for decision-makers to utilise as a reference in many real-world scenarios and application domains. We may use a number of machine learning techniques to help computers recognise patterns or rules in the data provided and make predictions based on those patterns or rules.

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