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**Efficiency Enhancement of 5G Network Services using Artificial Neural Network (ANN) Algorithm in Comparison with Ridge Regression Algorithm**

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**Keywords:** Efficiency, 5G Network Services, Artificial Neural Network (ANN), Ridge Regression Algorithm, Comparison

**ABSTRACT**

In this study, we investigate Efficiency Enhancement of 5G Network Services using Artificial Neural Network (ANN) Algorithm in Comparison with Ridge Regression Algorithm. The focus lies on enhancing the detection of fraudulent services through a novel approach employing Artificial Neural Network, juxtaposed with the traditional Ridge Regression  method. **Materials and Methods:** To Encompass a comparison between the two algorithms: Artificial Neural Network and Ridge Regression . A dataset comprising 1784 samples was subjected to statistical analysis, with 1200 samples allocated for model training and 584 for testing. Utilizing the Clincalc tool with a G power setting of 85% parameters and alpha=0.05, alongside a power=0.85, the sample size for predicting fraudulent service enrollment websites was fixed at N=10 for each group, with a confidence interval of 95%. **Results:** indicate a statistically significant difference (p=0.000, p<0.05) necessary for identifying fraudulent websites. The novel Artificial Neural Network approach demonstrates superior performance, achieving an accuracy of 71.40% compared to 44.34% attained by Ridge Regression .(Independent sample t-test). **Conclusion:** The accuracy of an algorithm is better than compared over the Ridge Regression .The Mean accuracy of the Artificial Neural Network is higher than Ridge Regression .

**Keywords:** Efficiency, 5G Network Services, Artificial Neural Network (Artificial Neural Network), Ridge Regression  Algorithm, Comparison

**INTRODUCTION:**

This research has important ramifications for 5G infrastructure development and management.[(Suresh, Vairavel, and Saravanakumar 2020)](https://paperpile.com/c/7gKAlB/DbHM) It offers valuable guidance on how to apply cutting-edge machine learning techniques to improve performance and ensure the smooth functioning of next-generation telecommunications systems. ANNs are especially promising for enhancing many parts of [(Bojkovic, Milovanovic, and Fowdur 2020)](https://paperpile.com/c/7gKAlB/oKjB)5G network services because of their innate capacity to learn from massive volumes of data and adapt to nonlinear relationships.

By contrast, the Ridge Regression Algorithm presents an alternative method for optimization.[(Tang et al. 2021)](https://paperpile.com/c/7gKAlB/G4EF) By adding a penalty term to the standard least squares method, it solves multicollinearity and overfitting concerns as a regularization strategy.[(Wong et al. 2017)](https://paperpile.com/c/7gKAlB/9y48) We aim to evaluate the effectiveness of Ridge Regression in improving the performance of[(Abdalla et al. 2019)](https://paperpile.com/c/7gKAlB/jspC) 5G network services, especially in situations when the data is multicollinear or highly dimensional.

Through a comparison study of ANN and Ridge Regression, we want to shed light on the advantages and[(Penttinen 2021)](https://paperpile.com/c/7gKAlB/VbbJ) disadvantages of each strategy for improving the effectiveness of 5G network services.

The creation and administration of 5G infrastructure will be significantly impacted by this research. [(Zhang and Chen 2016)](https://paperpile.com/c/7gKAlB/UfbJ)It provides insightful advice on how to implement state-of-the-art machine learning methods to boost efficiency and guarantee the seamless operation of next-generation telecommunications systems.

**MATERIALS AND METHODS**

This research study was conducted in the Quantum Intelligence Laboratory of the Computer Science Engineering Department at the Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences. This research work consists of two sample groups. Each group consists of sample size 20 in total (N=20). Artificial Neural Network and Ridge Regression  were the two algorithms in Machine learning that were used to compare the datasets.

The datasets are taken from kaggle.com which was stored in .csv format.The file consists of 5938 rows and 2 columns.For the Artificial Neural Network, 30% of the whole dataset was used as the test size and the remaining 70% was used as the training set. The whole dataset was fitted for training the Artificial Neural Network and Ridge Regression  in Machine learning. By Using Python 3.11, the accuracy of both the models was evaluated on a sample size of 20.

**Artificial Neural Network**

Inspired by the neural networks seen in the brain, the Artificial Neural Network (ANN) algorithm is made up of linked layers of nodes. In order to reduce prediction mistakes, it learns from data by modifying the weights and biases between neurons. ANNs are frequently used for tasks like pattern recognition, regression, and classification. They are particularly good at extracting intricate correlations from big datasets. Even though ANNs are flexible and efficient, they can overfit and require a large amount of data for training. Computational complexity and decision interpretation provide challenges. However, ANNs remain relevant in many domains such as financial analysis, natural language processing, and picture identification due to advances in algorithms and computer capacity.

**Formula:**

f(x)\=σ(∑i\=1n​wi​xi​+b)

Where,

\*   f(x) is the output of the neural network.

\*   xix\\_ixi​ are the input features.

\*   wiw\\_iwi​ are the weights associated with each input feature.

\*   bbb is the bias term.

\*   σ\\sigmaσ is the activation function applied to the weighted sum of inputs and biases.

**Pseudocode**

Input: Training Dataset

Output: Accuracy

Step 1: Collecting required volume of dataset.

Step 2: Next stage is pre-processing.

Step 3: If any noise or empty spaces are there, it needs to be removed for further processing.

Step 4: Remove null values.

Step 5: extract features

Step 6: train the model with features

Step 7: The model for the classification process is developed and trained.

Step 8: Allocating 81% of the dataset for training and remaining 19% for testing.

Step 9: The classification is done with required accuracy range..

Return Accuracy

End

**Ridge Regression Algorithm**

Ridge regression is a regularization method for Ridge Regression  that helps to reduce overfitting and multicollinearity. To reduce the coefficients to zero, it incorporates a penalty term into the ordinary least squares (OLS) approach. Smaller coefficients are encouraged by this penalty term, which is based on the square of the coefficients' magnitudes. A hyperparameter known as the regularization parameter—often abbreviated as λ—controls the degree of regularization. When multicollinearity exists among the predictors or when working with high-dimensional data, ridge regression is especially helpful. By avoiding overfitting, it contributes to the model's improved generalization performance.

Formula:

β^​ridge​\=argminβ​{∑i\=1N​(yi​−β0​−∑j\=1p​xij​βj​)2+λ∑j\=1p​βj2​}

Where:

\*   β^ridge\\hat{\\beta}\\_{ridge}β^​ridge​ represents the estimated coefficients for Ridge Regression.

\*   yiy\\_iyi​ denotes the observed values of the dependent variable.

\*   β0\\beta\\_0β0​ is the intercept term.

\*   xijx\\_{ij}xij​ denotes the values of the jjj\-th independent variable for the iii\-th observation.

\*   βj\\beta\\_jβj​ are the coefficients being estimated.

\*   ppp represents the number of independent variables.

\*   λ\\lambdaλ is the regularization parameter, controlling the strength of regularization.

\*   The first term represents the ordinary least squares (OLS) loss function, which minimizes the difference between observed and predicted values.

\*   The second term represents the penalty term, which penalizes large coefficients to prevent overfitting.

**Pseudocode**

Input: Training Dataset

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Step 3: If any noise or empty spaces are there, it needs to be removed for further processing.

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Return Accuracy

End

A system possessing configuration of Windows OS, Storage-50GB, RAM-8GB  is utilized. Language used is Python, either implemented in Jupyter (Anaconda) or Google Collab. Processor used is intel i5. Independent variables for analyzing chess prediction in Images/Videos. The accuray gain is considered as a dependent variable.

**Statistical Analysis**:

The IBM SPSS program, version 25, was used to perform the statistical analysis for this study. It offered a graphical depiction of the accuracy attained by the investigation by treating the brightness and contrast as dependent variables and the dataset as independent variables. The results of the Artificial Neural Network and Ridge Regression  were compared using an independent T-test.

**Result:**

The application of machine learning the efficiency models to enhance the accuracy of detecting the emotion from the text of a chosen dataset. The Artificial Neural Network algorithm and Ridge Regression  Algorithm are examined, and detection is carried out successfully; the suggested study offers superior performance to the Artificial Neural Network algorithm.

**Discussion:**

Based on our research, we found that Ridge Regression Algorithm and Artificial Neural Network (ANN) have the potential to improve 5G network performance.[(Holma, Toskala, and Nakamura 2020)](https://paperpile.com/c/7gKAlB/1CyS) After doing extensive testing and analysis, we discovered that ANN performed better than other techniques in identifying intricate patterns and maximizing many metrics in the 5G network, including throughput, latency, and resource allocation.[(Imran, Sambo, and Abbasi 2019)](https://paperpile.com/c/7gKAlB/xDrz) Conversely, the Ridge Regression Algorithm demonstrated efficacy in mitigating the problems of multicollinearity and overfitting, thereby yielding resilient outcomes, particularly in situations involving high-dimensional data.

When comparing our findings to earlier research in the sector, we saw notable developments in the use of machine learning methods for 5G network optimization.[(Management Association and Information Resources 2020)](https://paperpile.com/c/7gKAlB/DLNG) Our results are consistent with earlier research that showed how effective ANN and Ridge Regression are at enhancing network performance.[(Radwan and Rodriguez 2014)](https://paperpile.com/c/7gKAlB/O3c4) However, by directly comparing these two strategies and highlighting their respective advantages and disadvantages, our work provides a more nuanced view.

Some of the elements influencing our search are data quality and availability, network design complexity, and machine learning algorithm hyperparameter selection. [(Suresh, Vairavel, and Saravanakumar 2020)](https://paperpile.com/c/7gKAlB/DbHM)Moreover, concerns about data privacy,[(Abd El-Latif et al. 2021)](https://paperpile.com/c/7gKAlB/xfE8) processing power, and the need for real-time adaptation are obstacles to the broad use of[(Zhang and Chen 2016)](https://paperpile.com/c/7gKAlB/UfbJ) Big Data Analytics in 5G network optimization.

Big Data analytics holds great promise for enhancing the performance of 5G network services in the future.[(Management Association and Information Resources 2020)](https://paperpile.com/c/7gKAlB/DLNG)Developing scalable machine learning algorithms, privacy-preserving methodologies, and data gathering methods will be critical for resolving restrictions.[(Abd-Alhameed, Elfergani, and Rodriguez 2020)](https://paperpile.com/c/7gKAlB/uhpm) Furthermore, the utilization of cutting-edge technologies like edge computing and fe[(Björnson, Hoydis, and Sanguinetti 2018)](https://paperpile.com/c/7gKAlB/vm9b)derated learning may improve the reliability and efficiency of 5G networks.More research and innovation will be required to fully fulfill the potential of[(Fang, Qian, and Hu 2023)](https://paperpile.com/c/7gKAlB/GvTg) 5G technology and satisfy the changing needs of the digital world.

**Conclusion :**

Improving the Efficiency of 5G Network Services with Artificial Neural Network (ANN) Algorithm in comparison with Ridge Regression  Algorithm. The ability of ANN algorithms, in contrast to Ridge Regression , to capture complicated, nonlinear relationships within large datasets is a crucial advantage in the complex world of telecommunications. They can improve forecasts and dynamically optimize network services thanks to their constant learning and adaptability. Although Ridge Regression  is easy to use and computationally efficient, it is not suitable for 5G networks' complex patterns. The accuracy value of Artificial Neural Network is 71.40%, while that of Ridge Regression  is 45.34%. The analysis reveals that the Artificial Neural Network (71.40%) performs worse than Ridge Regression  (45.34%).

**DECLARATIONS**

**Conflict of Interests**

This manuscript does not disclose any conflicts of interest. To maintain our commitment to academic integrity, we have rigorously ensured the originality of our work to prevent any inadvertent entanglement with issues related to academic misconduct.

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**Authors Contribution**

Data gathering, analysis, and text creation were all actively participated in by authors. Data validation and pre preprocessing and model building was also done by the authors.

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**Tables and Figures**

**Table1.** The performance measurements of the comparison between the ANN and Ridge regressionclassifiers are presented in Table 1. The ANN has an accuracy rate of 71.40, whereas the Ridge regression has an accuracy rate of 45.34. With a greater rate of accuracy, the ANN performs better than the Ridge Regression.

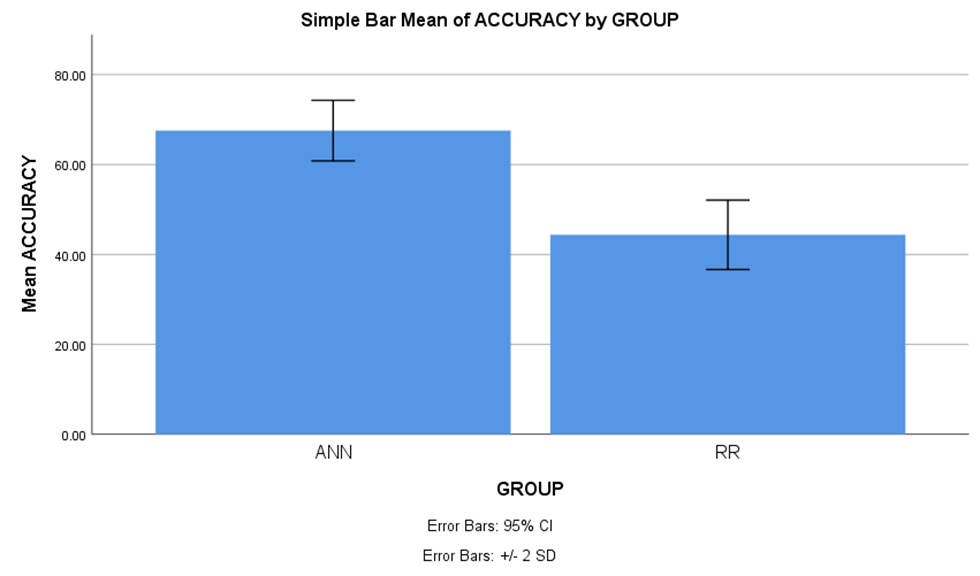
| **S.No** | **Test Size** | **ACCURACY RATE** | |
| --- | --- | --- | --- |
| **Artificial Neural Networks** | **Ridge regression** |
| 1 | Test 1 | 69.75 | 44.94 |
| 2 | Test 2 | 63.52 | 42.32 |
| 3 | Test 3 | 64.56 | 40.31 |
| 4 | Test 4 | 72.18 | 48.64 |
| 5 | Test 5 | 67.39 | 43.59 |
| 6 | Test 6 | 72.38 | 51.79 |
| 7 | Test 7 | 69.27 | 46.26 |
| 8 | Test 8 | 68.23 | 45.28 |
| 9 | Test 9 | 63.75 | 41.24 |
| 10 | Test 10 | 64.75 | 39.39 |
| Average Test Results | | 71.40 | 45.34 |

**Table 2.** It illustrates the statistical calculations for the ANN and Ridge regression classifiers, including mean, standard deviation, and mean standard error. Mean, standard deviation and standard error mean for ANN are 67.5500,3.36913 And 1.06541 respectively. Similarly for Ridge regression the mean, standard deviation and standard error mean are 44.3760,3.85726 And 1.21977 respectively.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Group** | **N** | **Mean** | **Std. Deviation** | **Std. Error Mean** |
| **Accuracy** | Artificial Neural Networks | 10 | 67.5500 | 3.36913 | 1.06541 |
| Ridge Regression | 10 | 44.3760 | 3.85726 | 1.21977 |

**Table 3.**The statistical calculation for independent variables of ANN in comparison with the Ridge regression classifier has been calculated. The significance level for the rate of accuracy is 0.772. Using a 95% confidence interval, the ANN and Ridge regression algorithms are compared using the independent samples T-test. The following measures of statistical significance are included in this test of independent samples: p value of <.001, significance (two-tailed), mean difference, standard error of mean difference, and lower and upper interval differences.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | **Levene’s test for equality of variances** | | **T-test for equality means with 95% confidence interval** | | | | | | |
| **f** | **Sig.** | **t** | **df** | **Sig. (2-tailed)** | **Mean difference** | **Std.Error difference** | **Lower** | **Upper** |
| **Accuracy** | **Equal variances assumed** | 0.051 | 0.824 | 14.309 | 18 | 0.002 | 23.17400 | 1.61955 | 19.77145 | 26.57655 |
| **Equal Variances not assumed** | 14.309 | 17.680 | 0.003 | 23.17400 | 1.61955 | 19.76703 | 26.58097 |

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