

# Analysis and Comparison for Innovative Prediction of COVID-19 using Logistic Regression Algorithm over the Decision Tree Algorithm with Improved Accuracy

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## ABSTRACT

**Aim:** The major goal of this research is to increase the accuracy of innovation prediction and examine the COVID-19. **Materials and Method:** This study relied on data collected from Kaggle's website and samples are divided into two groups, GROUP 1 (N=20) for Logistic regression and GROUP 2 (N=20) for Decision tree in accordance with the total sample size calculated using clinical.com by keeping 0.05 alpha error-threshold, 95% confidence interval, enrolment ratio as 0:1, and G power at 80%. It involves the software implementation program in MatLab 2021a validating with 20 validations. **Results:** The accuracy, sensitivity, and precision rates are compared using SPSS software and an Independent sample T-Test. In comparison the Logistic regression 95.98% accuracy with  $P=0.001$ , ( $p<0.05$ ), 94.65% sensitivity (with  $P=0.001$ , ( $p<0.05$ )) and 96.20% precision with  $P=0.001$ , ( $p<0.05$ ) produces a superior outcome than the Decision tree 93.91% accuracy with  $P=0.001$ , ( $p<0.05$ ), 94.33% sensitivity with  $P=0.001$ , ( $p<0.05$ ), 92.00% precision with  $P=0.001$ , ( $p<0.05$ ). **Conclusion:** The Logistic regression algorithm produces better results compared to the Decision tree.

## Keywords

Innovative COVID-19 prediction, Machine learning, Decision tree, Logistic regression, Accuracy.

## Imprint

Garudadri Venkata Sree Charan, Neelam Sanjeev Kumar. Analysis and Comparison for Innovative Prediction of COVID-19 using Logistic Regression Algorithm over the Decision Tree Algorithm with Improved Accuracy. *Cardiometry*; Special issue No. 25; December 2022; p. 897-903; DOI: 10.18137/cardiometry.2022.25.897903; Available from: <http://www.>

[cardiometry.net/issues/no25-december-2022/logistic-regression-algorithm](http://cardiometry.net/issues/no25-december-2022/logistic-regression-algorithm)

## INTRODUCTION

The COVID-19 epidemic has put an enormous strain on the world's healthcare systems. A quick, precise, and effective diagnosis of the virus's severity can aid in resource allocation and prioritization in order to decrease death (Chowdhury et al. 2021). This paper presents a predictive approach using SVM for anticipating a likely COVID-19 epidemic (Zagrouba et al. 2021). This article examines current findings on machine learning techniques employed in connection to COVID-19, they emphasize the promise of machine learning for two primary applications: diagnosis and mortality risk and severity prediction, both of which may be done using publicly available clinical data (Alballa and Al-Turaiki 2021). The increased emphasis on data mining and machine learning approaches might create the ideal atmosphere for the application of change and growth in the medical sector for the prediction of COVID-19 (Albahri et al. 2020).

There were about 12 IEEE Explore and 86 Science-Direct articles found to be associated with this work, which was completed in recent years and reported the developed algorithm and models for innovative predicting and analyzing COVID-19 prediction performance utilizing ML algorithms such as Naive Bayes, SVM, Neural network. This paper builds six prediction models for COVID-19 diagnosis in a comparison analysis employing six different classifiers (Bayes, Logistic, CR, IBK, J48). The best effective classifier for anticipating positive and negative COVID-19 occurrences was found to be the CR meta-classifier (Arpaci et al. 2021). Another study found that chest CT scans confirmed the presence of COVID-19-related pneumonia in 81% of individuals who tested negative with the RT-PCR test (Ai et al. 2020). However, just one research has shown that using multiple ML algorithms on tactile characteristics derived from a chest X-ray, they were able to identify with 93 percent sensitivity and 90 percent specificity (Cavallo et al. 2021). The purpose of this research is to develop and test a combination of ML and radionics features for detecting COVID-19 from a chest X-ray in the context of other viral/bacterial pneumonia and at different levels of sickness (Tamal et al. 2021). A comparative study

indicates a thorough assessment of literature about the significance of ML and its algorithms in the battle against COVID-19 problems in domains of epidemiology, diagnostics, and disease progression (Syeda et al. 2021). Our team has extensive knowledge and research experience that has translate into high quality publications (Chellapa et al. 2020; Lavanya, Kannan, and Arivalagan 2021; Raj R, D, and S 2020; Shilpa-Jain et al. 2021; S, R, and P 2021; Ramadoss, Padmanaban, and Subramanian 2022; S. Wu et al. 2020; Kalidoss, Umapathy, and Rani Thirunavukkarasu 2021; Kaja et al. 2020; Antink et al. 2020; Paul et al. 2020; Malaikolundhan et al. 2020)

The lack of a reliable early COVID-19 diagnostic that eliminates human error is the motivating factor for this study to determine COVID-19 at its initial stages. The writers were machine learning specialists who were able to conduct biological research using the COVID-19 data and the Logistic regression and Decision tree methods. The main objective is to identify COVID-19 with the greatest degree of accuracy possible.

## MATERIALS AND METHODS

The research was carried out at the University simulation lab, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Chennai. The sample size was estimated using clinical.com and previous study outcomes (An et al. 2020) with an alpha error-threshold of 0.05, enrolment ratio of 0:1, 95 percent confidence interval, and power of 80 percent. Group 1 consisted of a Logistic regression algorithm (N=20) and a Decision tree (N=20). This research comprised a total of 40 samples.

The Kaggle website was utilized to obtain the data samples for this investigation. The data set undergoes data reduction techniques to obtain the absolute data required. The data should be given as input to MatLab 2021a to perform classification learning techniques. Input data should be imported to classification learning tools to perform training. The imported data is trained separately for each algorithm i.e, once for the Logistic regression varying with cross-validations from 5 to 24 as in and similarly for the Decision tree with cross-validations from 5 to 24. After validation of data for an algorithm, the confusion matrix should be obtained for each validation (Nawas et al. 2021), which involves the TP (true positive), TN (true negative), FP (false positive), FN (false negative). Accuracy, Sensitivity, and

Precision are calculated with the help of these values given in Equations (1), (2), and (3).

$$Accuracy = \frac{TP + TN}{TP + TN + FP + FN} \quad (1)$$

$$Sensitivity = \frac{TP}{TP + FN} \quad (2)$$

$$Precision = \frac{TP}{TP + FP} \quad (3)$$

## Statistical Analysis

IBM SPSS 27.0.1 was used to compare the accuracy of the Decision tree algorithm with the Support Vector Machine algorithm. Because the variables were unrelated, the accuracy rate was compared using an independent sample COVID-19 data parameters are independent variables and their occurrence in case prediction is the dependent variable. As the variables are independent of each other an independent sample T-Test was used to determine the mean accuracy, mean sensitivity, and mean precision between the two groups, and a performance comparison between the two groups is performed. There are no dependent variables in this study.

## RESULTS

Both the algorithms appear to provide the same COVID-19, with an accuracy rate ranging from 93.91 percent to 95.98 percent as shown in Table 1a and Table 1b. As demonstrated in Table 2, the Logistic regression approach has greater mean accuracy than the Decision tree technique. According to the statistical analysis of Table 2, the Logistic regression has a lower error rate than the Decision tree algorithm. Table 3 shows that using the independent sample T-test, there appears to be a statistically negligible difference ( $P=0.037$  for accuracy,  $P=0.151$  for sensitivity,  $P=0.06$  for precision, with  $P=0.001$ , ( $p<0.05$ ) in both approaches. These findings revealed that the Logistic regression algorithm can predict COVID-19 disease more quickly than the Decision tree. The mean accuracy, sensitivity, and precision of the revolutionary COVID-19 prediction were compared to the Logistic regression method and the Decision tree algorithm in Fig. 1. The confusion matrix of Logistic Regression and Decision Tree, shown in Fig. 2a. and Fig. 2b., provides TP, TN, FP, and FN values that are utilized to calculate accuracy, sensitivity, and precision.

Table 1a

Covid-19 samples using Logistic Regression

Sample	Accuracy	Sensitivity	Precision
1	0.95	0.94	0.94
2	0.95	0.94	0.94
3	0.97	0.94	1
4	0.95	0.94	0.94
5	0.95	0.94	0.94
6	0.95	0.94	0.94
7	0.95	0.94	0.94
8	0.95	0.94	0.94
9	0.97	0.94	0.94
10	0.98	0.95	1
11	0.95	0.94	0.94
12	0.95	0.94	0.94
13	0.95	0.94	0.94
14	0.97	0.94	1
15	0.95	0.94	0.94
16	0.94	0.94	0.94
17	0.97	0.94	1
18	0.95	0.94	0.94
19	0.97	0.94	1
20	0.97	0.94	1

Table 1b

Covid-19 samples using Decision tree

Sample	Accuracy	Sensitivity	Precision
1	0.95	0.94	0.94
2	0.97	0.94	1
3	0.95	0.94	0.94
4	0.95	0.94	0.94
5	0.92	0.91	0.88
6	0.95	0.93	0.94
7	0.9	0.92	0.83
8	0.92	0.94	0.88
9	0.95	0.94	0.94
10	0.92	0.93	0.88
11	0.9	0.92	0.83
12	0.95	0.94	0.94
13	0.92	0.93	0.88
14	0.97	0.92	0.83
15	0.92	0.93	0.94
16	0.95	0.92	0.94
17	0.92	0.93	0.88
18	0.95	0.94	1
19	0.92	0.94	0.88
20	0.95	0.9	0.94

Table 2

Comparison of mean accuracy, sensitivity, and precision using Logistic regression and Decision tree algorithms.

GROUP STATISTICS					
Parameters	Group	N	Mean	Std. Deviation	Std. ErrorMean
Accuracy	Logistic Regression	20	0.9598	0.01321	0.00295
	DecisionTree	20	0.9391	0.02072	0.00463
Sensitivity	Logistic Regression	20	0.9465	0.00269	0.00060
	DecisionTree	20	0.9433	0.00316	0.00071
Precision	Logistic Regression	20	0.9620	0.02563	0.00573
	DecisionTree	20	0.9200	0.04622	0.01033

## DISCUSSION

As demonstrated in Table 2, the logistic regression approach has the highest accuracy (95.98%), sensitivity (94.65%), and precision (96.20%). Table 3 shows that the significant difference has grown marginally, despite the fact that it is not statistically significant. The Logistic regression algorithm is the most straightforward and cost-effective method for predicting COVID-19.

The previous works are (2020-2021), in an alternative study the Decision tree algorithm and Random Forest was used for innovative prediction of COVID-19 in individuals which gave an accuracy of 99.41% for the Decision tree (Villavicencio et al. 2021). In this study, three classifiers are used for analyzing the COVID-19 data, and among them, Logistic regression gave a sensitivity of 82% comparatively lower than the sensitivity in my study (Aljameel et al. 2021). According to the findings of a comparative study, more than half of the research participants experienced coronavirus-related stress, showing that there is a significant association between healthcare professionals and COVID-19-related stress. This study found that supervised learning models such as logistic regression, KNN, and CNN have a maximum accuracy of 92% (Doanvo et al. 2020). The researchers developed a ML-based forecast model that predicts individual patients' survival with greater than 90% accuracy. Precision, recall, and F1-score were derived to illustrate the AI model's ability on the training data more completely (Al-Turjman 2021). This study looks for biomarkers that might assist to predict infection severity using a database of 92 people who have had

Table 3

Independent sample T-test in predicting the accuracy, sensitivity, and precision of COVID-19 using the Logistic regression and Decision tree algorithm. There appears to be an insignificant difference in both methods for Accuracy and precision with  $p > 0.05$

Parameter	Equal Variances	Levene's Test for Equality of Variances		T-test for Equality of Means					
		F	Sig.	t	df	Significance (one-Sided p)	Mean Difference	Std. Error Difference	95% Confidence interval (Upper)
Accuracy	Assumed	4.676	0.037	3.777	38	<.001	0.2076	.00550	.03188
	Not assumed			3.777	32.25	<.001	0.2076	.00550	.03195
Sensitivity	Assumed	2.152	0.151	3.397	38	<.001	0.0031	.00093	.00503
	Not assumed			3.397	37.07	<.001	0.0031	.00093	.00503
Precision	Assumed	8.423	0.006	3.548	38	<.001	0.0419	.01182	.06585
	Not assumed			3.548	29.67	<.001	0.0419	.01182	.06607

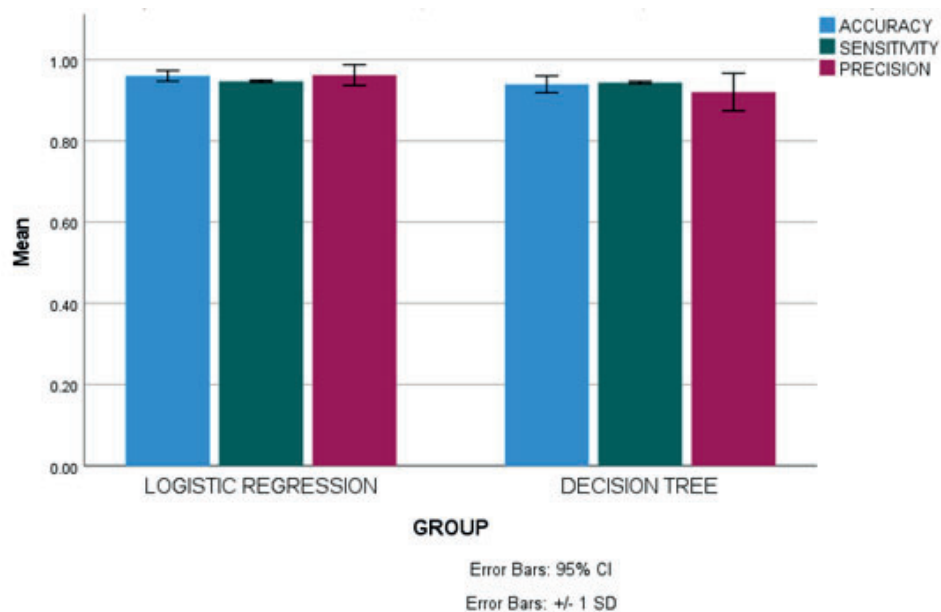


Fig. 1. Bar graph representing the comparison of mean accuracy, sensitivity, and precision of COVID-19 prediction with Logistic regression algorithm and the Decision tree algorithm. Both the techniques appear to produce the same variable results with accuracy ranging from 95.98% to 93.91%. X-axis: Logistic regression vs Decision tree. Y-axis: mean accuracy, sensitivity, and precision detection  $\pm 1$  SD.

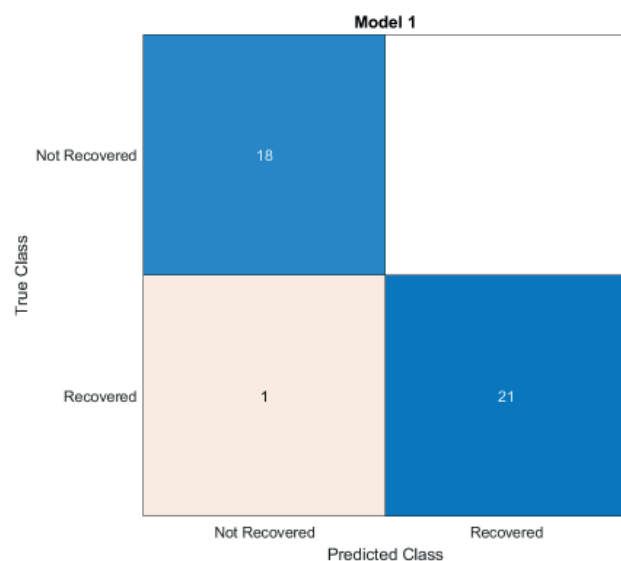


Fig. 2a. Confusion matrix of Logistic regression for K=5. True Positive is found to be 18% and false positive is found to be 1%, true negative is found to be 21% and false negative is found to be 0%.

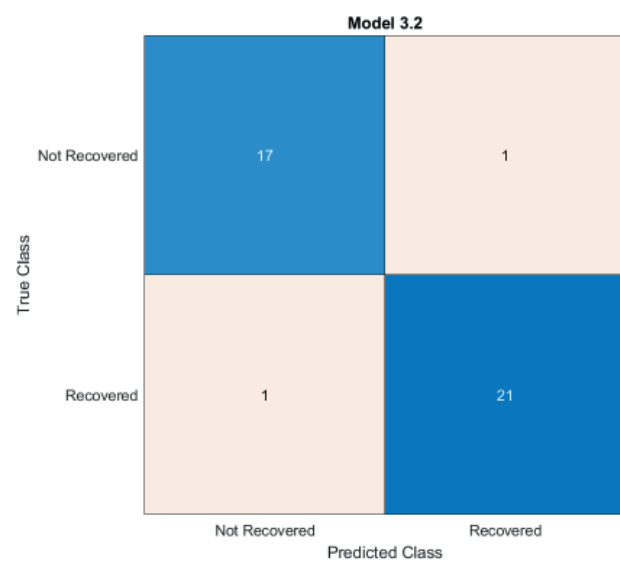


Fig. 2b. Confusion matrix of Decision tree for K=5. True Positive is found to be 17% and false positive is found to be 1%, true negative is found to be 21% and false negative is found to be 1%.

SARS-CoV-2 laboratory testing (Jamshidi et al. 2021). The decision tree achieved a precision of 0.88 percent by interpreting four machine learning models: RF, Gradient boost trees, and NN utilizing permutation feature importance (H. Wu et al. 2021).

Age, gender, and whether or not the patient has a condition or sickness such as diabetes, pneumonia, asthma, obesity, or cardiac issues are all factors that impact the research. Because the data will not be in time series, this will be a big problem. This study represents how COVID-19 detection technology is utilized in the healthcare business and how it can aid with more accurate diagnosis in the near future. As a result, this effort has a bright future since manual forecasting may easily be converted to automated output at a low cost. A larger dataset of real-time applications, paired with more machine learning algorithms, might produce better outcomes. The limitations of this research work are to increase more sample size by capitulating significant accuracy than the existing algorithm in the Innovative detection model and the future scope of this research is to ensemble the simple genetic algorithm in predicting all variants of COVID and classifying the Adaboost for feature extraction.

## CONCLUSION

When compared to the Decision tree the Logistic regression algorithm (95.98%) that runs in MatLab proved to offer higher results in this research of innovative COVID-19 prediction for the Decision tree (93.91%). In addition, the performance of the algorithm improved as the amount of the data grew, which is not seen in other methods. This model is highly efficient and has a lot of promise in terms of predicting and analyzing COVID-19, thus it may be used in hospitals and testing facilities.

## DECLARATION

### Conflicts of Interest

No conflict of interest in this manuscript.

### Author Contributions

Author GVSC was involved in data collection, data analysis & manuscript writing. The author's learning-Based guide NSK was involved in conceptualization, data validation, and critical review of manuscripts.

## Acknowledgment

The authors would like to express their gratitude towards Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences (Formerly known as Saveetha University) for successfully carrying out this work.

## Funding

We thank the following organizations for providing financial support that enabled us to complete the study.

1. Venus Electronics, Chennai
2. Saveetha University
3. Saveetha Institute of Medical And Technical Sciences
4. Saveetha School of Engineering

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