

# Prediction of Insufficient Accuracy for Mushroom Classification whether Poisonous or Eatable Mushrooms using Support Vector Machine by comparing Logistic Regression to Improve Accuracy

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## Abstract

**Aim:** The main objective of the research study is to improve the good quality production for the better accuracy of eatable or poisonous mushrooms. It ought to be checked for consumable mushrooms. Exact assurance and appropriate distinguishing proof of species are the main safe approach to guarantee that the eatable mushrooms are poisonous, and defend against potential mishaps of burning through harmful one.

**Materials and Methods:** The study used 51 samples with two groups of algorithms and the G-power worth of 80%. The mushrooms were collected from various web sources with recent study findings and threshold 0.05%, confidence interval 95% mean and standard deviation. To predict the Mushroom accuracy rate for already the Logistic Regression (LR) algorithm has found 90.46% of accuracy, therefore this study needs to find better accuracy for accuracy decrease prediction with the Novel Support Vector Machine (SVM) in Machine Learning.

**Results:** This research study found 91.37% of accuracy for poisonous detection on food using the Support Vector Machine algorithm with a statistically significant difference between the two groups ( $p=0.022$ ;  $p<0.05$ ) with 95% confidence interval.

**Conclusion:** This study concludes that the Novel Support Vector Machine algorithm on accuracy is significantly better than the Logistic Regression algorithm.

**Keywords:** Machine Learning, Data Mining, Novel Support Vector Machine, Logistic Regression, Poisonous, Mushrooms.

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## INTRODUCTION

The term mushrooms also called Macrofungi or Macromycetes has been differently characterized by a few creators. They are the meaty, fungi fruit-bearing growths when rainfall, which ordinarily show up over the ground after downpour. They generally fill in timberlands in relationships on woody pieces of trees either as nutrients, saprophyte or as symbionts in the dirt (Nair, Varsha, and Sunil 2021). Mushrooms and parasites overall are non-green creatures lacking chlorophyll (Lima et al. 2021). They can't make their own food from basic inorganic materials, like water, carbon dioxide, and nitrates, utilizing energy from the sun. The manifestations of mushroom harming can fluctuate from slight gastro gastrointestinal inconvenience (McLeod 2020), spewing to death (Mishra et al. 2021). It might likewise fluctuate from gastric bombshell to life undermining organ disappointment bringing about death. Hatching period might go from a day to a little while after which genuine indications will happen and before this time the toxies more likely than not assaulted the kidney (Various 2016). Mushrooms are not only sources of nutrients but also as harmful food items, useful in stopping diseases such as hypertension, diabetes and cancer.

Every year data is doubled, however all of the beneficial statistics appears to be decreased. Area of data mining has arisen over decades to be able to cope with the problem. It has now no longer grown to be the most effective and vital studies area, however it has additionally grown to be one with a massive capacity in the actual world (Eise and Foster 2018). The Multilayer Perceptron is a modeling and forecasting device that makes use of a neural community to version your information (Lintas et al. 2017). It may be used to categorise styles or to expect values out of your information. Because it makes use of a supervised studying technique, it calls for your information to incorporate goals for education in the community. Classification is one of the obligations accomplished via the information mining

process. It is classified as one of the prediction strategies for a massive hidden information. A version produced via information education has to have the ability to differentiate the class of a brand new information mushroom in those families (Tesoriero 2018). The Mushroom, Agaricaceae, belongs to participants of a circle of relatives of fungi with gills (Charles 2020). It is constantly classified into two groups; suitable for eatable or non eatable. The time period mushroom is constantly used to consult suitable for eating species, even as the time period toadstool is used for poisonous species. However, the fungus is constantly changed via means of poisonous (Orywal et al. 2021). This research related work was presented and published in more than 41 indexed journals. Our team has extensive knowledge and research experience that has translate into high quality publications (Bhansali et al. 2021; Jayanth et al. 2021; Sudhakar, Ravel, and Perumal 2021; Sathiyamoorthi et al. 2021; Deepanraj et al. 2021; Raju et al. 2021; Arun Prakash et al. 2020; Kamath et al. 2020; Shanmugam et al. 2021; Rajasekaran et al. 2020; Adhinarayanan et al. 2020; Rajesh et al. 2020; Aurtherson et al. 2021)

The research gap identified is that several works have demonstrated that the performance Logistic Regression provides less accuracy in prediction of mushroom. Hence the aim of this study is to increase the accuracy of predicting the likelihood of poisonous or eatable mushrooms and improve the prediction model using the Support Vector Machine.

## MATERIALS AND METHODS

This research study was carried out at the Machine Learning Laboratory, Department of Computer Science and Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Science, Chennai. This research study uses two groups of classification algorithms used for the study. Group 1 and Group 2 are the Support Vector Machine algorithm and the Logistic Regression algorithm respectively (Kroese et al. 2019). Each sample size was predicted using the G-power tool with version 3.1.10 and resulting in 51 sample sizes with 80% of G-power values and the threshold significant value is set to 0.05 and the confidence interval as 95%. The mushroom dataset which is to be imputed for the proposed work is collected from kaggle.com (Kroese et al. 2019; Prasad and Chanussot 2020) one of the more popular online communities for data scientists and Data Mining practitioners. It allows users to search and find different datasets that they require.

The Mushroom eatable or poisonous dataset is to be imputed for the proposed work is collected from kaggle.com, one of the more popular online communities for data scientists and Data Mining practitioners. It allows users to search and find different datasets that they require. The dataset used here consists of 14 attributes and contains 12 features that can be used to predict mortality by harmful or not mushrooms. The mushrooms dataset has 5125 rows which consists of data for the symptoms that are related to poisonous which also includes duplicate, null and missing values.

Novel Support Vector Machine falls under the category of supervised algorithms. SVM can be used for both classification and Logistic regression. In the classification SVM the decision variable is categorical. For implementing a SVM, the cost function used to evaluate the binary splits called the Gini Index should be calculated. The split creation is done with help of calculating the gini score, splitting the dataset and evaluating the all splits and this is done by creating a root node. It can start building the tree by first deciding when to stop 3 of 12 the growth of the tree by creating the terminal node by setting the maximum tree depth and second, by using recursive splitting. The terminal node is used for the final prediction and recursive splitting is a method used to build the tree.

### Pseudocode of the Support Vector Machine

The following pseudocode is for the SVM algorithm to apply on the mushrooms dataset and also works with the tree model. The pseudocode will take the datasets as input and the final output of the pseudocode will be sent through the parameters Accuracy and the classification.

```
Inputs : Determine the various training and test data.
Outputs: Determine the calculated accuracy.
Select the optimal value of eatable and poisonous for SVM.
while(stopping condition is not met)do
    Implement SVM train step for each data point.
    Implement SVM clasity for testing data points.
end while
Return accuracy
```

### **Pseudocode of the Logistic Regression**

The Logistic Regression has been picked on the grounds that it addresses a structure both intriguing from the Machine Learning viewpoint and from an implanted frameworks point of view. A LR is a straight or non-direct classifier, which is a numerical capacity that can recognize two various types of articles. Training a LR can be represented with the accompanying pseudo code.

- Step1: Initialize all parameters ( $B_0$ ,  $B_1$ , etc.)
- Step 2: Calculate (predict) dependent variable ( $h(x)$ )
- Step 3: Calculate poisonous function ( $\text{poisonous}(h(x), y)$ )
- Step 4: Calculate gradient for poisonous function
- Step 5: Update all parameters
- Step 6: Repeat steps 2 to 5.

### **STATISTICAL ANALYSIS**

At long last, the outcomes gathered from the gathering one and gathering two calculations will be applied utilizing Statistical Package for Social Sciences (SPSS) with adaptation 26 (Rajathi and Chandran 2019). The autonomous example t-test was performed to analyze the exhibitions of the Logistic Regression and Novel Support Vector Machine calculations. The independent variable is the forest attribute in the dataset and other twenty attributes such as odor, population, bruises etc are dependent variables for our study for mushroom prediction.

### **RESULTS**

The Support Vector Machine algorithm and Logistic Regression algorithm are compared with 51 samples by applying various 70% of training and 30% of testing datasets by varying the number of records of the dataset and the outcomes are depicted in Table 1 and the dataset consists of 100 rows where the accuracy of both the SVM and LR algorithm are obtained for 10 iterations. It is observed that the Novel Support Vector Machine algorithm is significantly better than the Logistic Regression algorithm.

From Table 1, the statistical analysis of SVM Algorithm and LR. Mean accuracy value, Standard deviation and accuracy for SVM and LR algorithms are obtained for 10 iterations. It is observed that the SVM algorithm performed better than the LR algorithm.

From Table 2, the Independent sample t-test for significance and standard error are determined. The two tailed significant p values less than 0.05 considered to be statistically significant and 95% confidence intervals were calculated. By statistical analysis SVM gives 1.46 standard deviation with 0.46 standard error and LR gives 2.91 standard deviations with 0.92 standard error the two tailed significant value is less than 0.5 that shows the proposed work gives better results.

In Table 3, observed after performing statistical analysis of 10 samples, SVM obtained 3.24 standard deviations with 1.03 standard error while the LR algorithm obtained 3.24 standard deviations with 1.03 standard error. The two tailed significance value ( $p=0.045$ ) is smaller than 0.05 showed that our hypothesis holds a good value. For changes in the input values (independent variable) the corresponding output values are changed (dependent variables).

The independent sample t-test was used to compare the accuracy of two algorithms and a statistically significant difference was noticed with  $p < 0.05$ . The SVM model obtained 89.6% accuracy. When compared with the other algorithm's performance, the proposed SVM classifier achieved better performance than LR.

The Red dots shown poisonous mushrooms and Green dots shown its eatable mushrooms. The symptom shown here is the rest of the models accuracy comparison as shown in Fig. 1.

The Red dots showed poisonous mushrooms and Green dots showed its eatable mushrooms as shown in Fig. 2.

The data taken for this research study will undergo preprocessing, a step to remove the unwanted, missing values and null values, it has been preprocessed. The results of mushroom analysis classification has accuracy for SVM algorithm having 91.37% and LR having 90.57% across the samples as shown in Fig. 3, and it shows that SVM is significantly better than the LR algorithm.

Finally, compare the mean accuracy of the Novel Support Vector Machine and the Logistic Regression algorithm as shown in Fig. 4, and it shows that the Novel Support Vector Machine is significantly better than the Logistic Regression algorithm.

### **DISCUSSION**

The Support Vector Machine technique proposed by Zhou has an acknowledgment accuracy of over 98%. In view of the great exactness prerequisites and broke down three example arrangement models. Strategic relapse yielded grouping results by examining the viable elements important to recognize poisonous. The accuracy of the SVM strategy is superior to that of calculated relapse. Contrasted with SVM and calculated relapse, SVM accomplished better outcomes as far as eatable exactness. Consequently, SVM is a decent strategy for naturally distinguishing whether a mushroom is harmful (Bellettini et al. 2018).

Various normal mushroom poisonous acknowledgment strategies are presently being used. These strategies utilize various commitments for deciding poisonous, yet they have various limits, like low exactness, unacceptable recognition of obscure poisonous, the requirement for a severe exploratory climate, and adequate expert information and complex test testing methods. To evade the limits of these strategies and apply them to little example information examination, utilize Machine Learning. As opposed to profound neural organizations, which require incredible exertion in hyperparameter tuning, SVM is a lot simpler to prepare and can be applied to various types of information in various areas. The SVM calculation enjoys the accompanying benefits: (1) it has a basic design; (2) it tends to be applied to datasets of various sizes; (3) the testing procedures and taking care of are straightforward; and (4) for our trials, mushroom harmfulness is perceived rapidly. Element based learning and iterative classifiers in the SVM technique have the best exhibition among the three strategies for Machine Learning utilized in this article (Brandon 2020).

Therefore the investigation's results show better performance in both experimental and statistical analysis, but it has some limitations (Lima et al. 2021). They do not perform so well on large data sets. In this research classifier Prediction of Mushroom, Support Vector System has the Higher accuracy 91.36% compared to Logistic Regression classifier 90.57% (Pérez-Rodríguez, Skandamis, and Valdramidis 2018). Support Vector System has better significance then Logistic Regression Classifier and while using the independent sample t-tests.

## CONCLUSION

The main aim of the study is to measure the accuracy in the classification of poisonous or eatable mushrooms. This research study applied the SVM algorithm for detection of mushrooms that are harmful or not achieved and has been compared with the LR algorithm. The results obtained show that the SVM algorithm has found 91.37% of accuracy on mushrooms data than the 90.57% of the LR algorithm.

## DECLARATION

### Conflict of interests

No conflict of interest in this manuscript.

### Authors Contributions

Author MR was involved in data collection, data analysis, and manuscript writing. Author SMS was involved in conceptualization, data validation, and critical review of the manuscripts.

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## TABLES AND FIGURES

**Table 1.** Comparison between SVM and LR algorithm with N=10 samples of the dataset with the highest performance of 91.36% and 90.57% in the sample (when N=1) using the dataset size = 100 and the 70% of training and 30% of testing data.

Sample (N)	Data size / Rows in %	SVM algorithm Accuracy in %	LR algorithm Accuracy in %
1	8125	91.37	90.57

2	7613	90.87	90.12
3	7041	90.23	89.67
4	6582	89.78	89.21
5	5893	89.12	88.45
6	4931	88.67	87.56
7	4078	88.01	86.98
8	3421	87.56	86.23
9	2067	87.21	85.78
10	1924	86.89	85.14

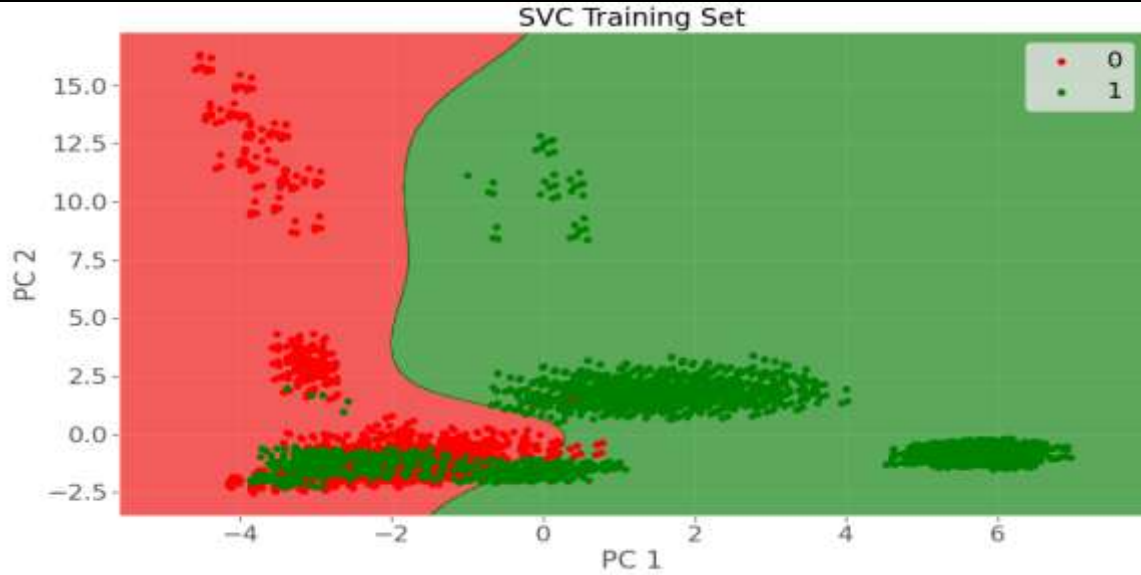
**Table 2.** Statistical results of SVM and LR algorithms. Mean accuracy value, standard deviation and standard error mean for SVM and LR algorithms are obtained for 10 iterations. It is observed that the SVM (89.28%) algorithm performed better than the LR (86.04%) algorithm.

Algorithms (Accuracy)	Sample (N)	Mean	Standard Deviation	Standard Error Mean
SVM algorithm	10	89.28	1.46	0.46
LR algorithm	10	86.04	2.91	0.92

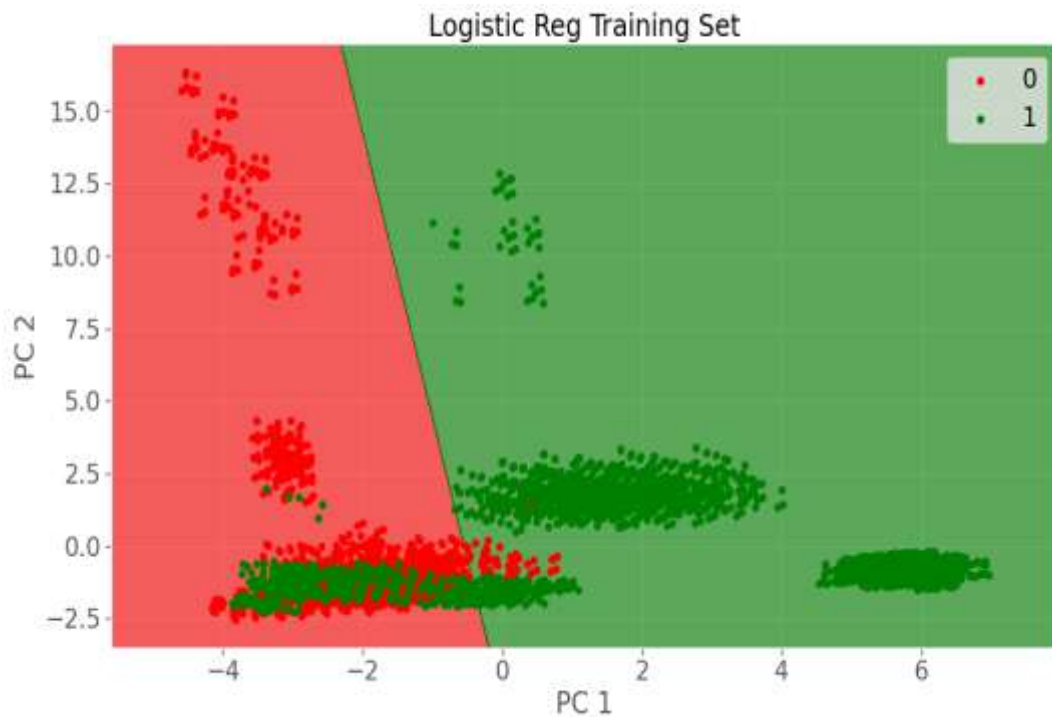
**Table 3.** The Independent sample t-test of the significance level SVM and LR algorithms results with significant values (p=0.022). Therefore both the SVM and the LR algorithms have a significance level less than 0.05 with a 95 % confidence interval.

Accuracy	Levene's Test for Equality of Variances		T-test of Equality of Means					95% of the confidence interval of the Difference	
			t	df	Sig(2-tailed)	Mean Difference	Std Error Difference		
	F	Sig.					Lower	Upper	
Equal Variance Assumed	6.25	0.022	3.146	18	0.003	3.243	1.030	1.077	5.408

Equal Variance Not Assumed	-	-	3.146	13.27	0.006	3.243	1.030	1.020	5.465
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**Fig. 1.** Comparison of accuracy percentage of SVM (Poisonous in Red dots and Eatable in Green dots) across the samples.



**Fig. 2.** Comparison of accuracy percentage of LR(Poisonous in Red dots and Eatable in Green dots) across the samples.

Comparison of accuracies of Support vector Machine and Logistic Regression across the Samples

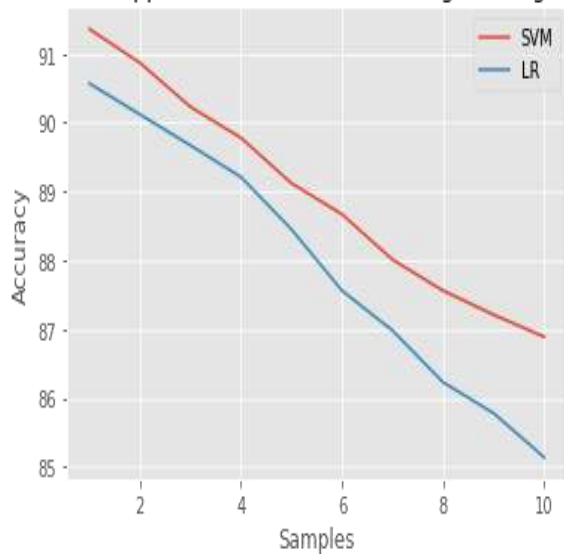


Fig. 3. Result of eatable mushroom classification using SVM (91.38) and LR (90.57) across the samples.

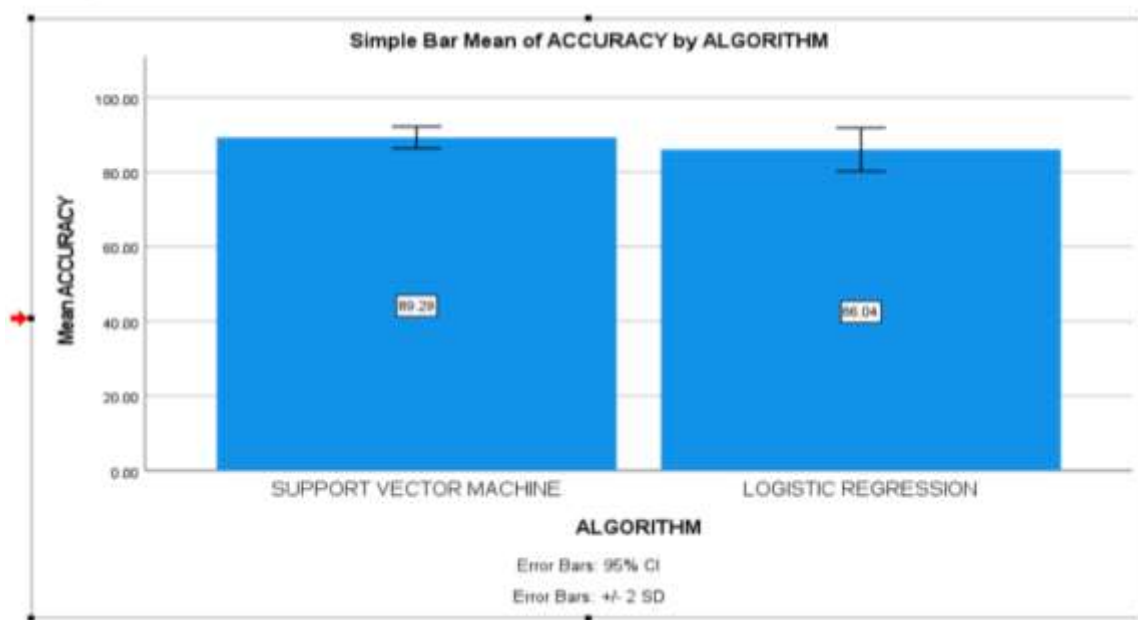


Fig. 4. Comparison of SVM algorithm and LR in terms of mean accuracy. The mean accuracy of SVM is better than LR and the standard deviation of SVM is slightly better than LR algorithm. X-axis: (GROUPS) SVM vs LR algorithm and Y axis: Mean accuracy of prediction  $\pm 2$  SD.