

Journal

[Mathematics](#) (ISSN 2227-7390)

Manuscript ID

mathematics-2246467

Type

Article

Title

[Fuzzy Discretization on the Multinomial Naïve Bayes Method for Modeling Multiclass Classification of Corn Plant Diseases and Pests](#)

Authors

Yulia Resti * , Chandra Irsan , Adinda Neardiaty , Choirunnisa Annabila , Irsyadi Yani

Topic

[Data Science and Knowledge Discovery](#)

Abstract

As an agricultural commodity, corn functions as food, animal feed, and industrial raw material. Therefore, diseases and pests pose a big challenge to the production of corn plants. Modeling the classification of corn diseases and pests based on digital images is essential for developing an information technology-based early detection system. This plant's early detection technology is beneficial for lowering farmers' losses. The detection system based on digital images is also cost-effective. This paper aims to model the classification of corn diseases and pests based on digital images by implementing fuzzy discretization. Discretization is an essential technique to improve the knowledge extraction process of continuous-type data. It is also essential in some methods where continuous data must be processed or handled. Fuzzy discretization allows classes to have overlapping intervals so that they can handle information that is vague or unclear. We developed hypotheses and proved that different combinations of membership functions in fuzzy discretization affect classification performance. Empirical assessment using Monte Carlo resampling was carried out to obtain generalizability of the performance of the best classification model of all proposed models. The best model is determined based on the number of metrics with the highest value. We hope this work can provide an overview for experts in building early detection systems using classification models when dealing with unclear or vague information about discretizing predictor variables.

Manuscript Information

Received Date

12 February 2023

Revised Date

23 March 2023

Accepted Date

30 March 2023

Published Date

7 April 2023

Submission to First Decision (Days)

45

Submission to Publication (Days)

53

Round of Revision

1

Size of PDF

2799 KiB
 Word Count
 7646
 Page Count
 21
 Figure Count
 8
 Table Count
 8
 Reference Count
 50

Editor Decision
 Decision
 Accept in current form
 Decision Date
 29 March 2023

Authors' Responses to Reviewer's Comments (Reviewer 1)

Author's Notes

Response to Reviewer 1 Comments

Point 1:

Minor:

line 98: (DTC50 -->(DTC50),

line 200-201 : "dimana" stands for ...? please write choose the correct symbol "or" in the last line of the value definition of function (7).

lines 315-321 are identical to lines 322-328.

line 432: "FMN3" --> "FMNB3"

Please check the bibliography: for example item [6], [15], [37].

Response 1:

Minor:

line 98: (DTC50 -->(DTC50), à done, changed in line 101

line 200-201 : "dimana" stands for ...? please write choose the correct symbol "or" in the last line of the value definition of function (7). à done, changed in line 263

lines 315-321 are identical to lines 322-328. à done, changed in lines 387 - 393

line 432: "FMN3" --> "FMNB3" à done, changed in line 567

Please check the bibliography: for example item [6], [15], [37].

[6] à done

[15] à done, changed in [14]

[37] à done, changed in [39]

Author's Notes File

[Report Notes](#)

Review Report Form

Quality of English Language

() English very difficult to understand/incomprehensible

() Extensive editing of English language and style required

() Moderate English changes required

(x) English language and style are fine/minor spell check required

() I am not qualified to assess the quality of English in this paper

	Yes	Can be improved	Must be improved	Not applicable
Does the introduction provide sufficient background and include all relevant references?	(x)	()	()	()
Are all the cited references relevant to the research?	(x)	()	()	()
Is the research design appropriate?	(x)	()	()	()
Are the methods adequately described?	(x)	()	()	()
Are the results clearly presented?	(x)	()	()	()

Are the conclusions supported by the results?	(x)	()	()	()
---	-----	-----	-----	-----

Comments and Suggestions for Authors

In my opinion, this is a very well written paper. It was a pleasure to read the manuscript: the theoretical framework and the related works are correctly reported, the method is sound and well described, the application is worth to be investigated, the experimentation and the results are deeply described and discussed.

My only concern is that for a work to be published in Mathematics, I expect it to have a stronger content in mathematics. At least, the original mathematical content is not enough stressed in the manuscript.

Minor:

line 98: (DTC50 -->(DTC50),

line 200-201 : "dimana" stands for ...? please write choose the correct symbol "or" in the last line of the value definition of function (7).

lines 315-321 are identical to lines 322-328.

line 432: "FMN3" --> "FMNB3"

Please check the bibliography: for example item [6], [15], [37].

Submission Date

12 February 2023

Date of this review

08 Mar 2023 19:06:58

Authors' Responses to Reviewer's Comments (Reviewer 2)

Author's Notes

Point 1: I suggest you to add a Discussion section and compare your finding with other results in the literature. Did you encounter any limitations?

Response 1:

We have added it in section 4.3 (Result & Discussion) in Table 7 and Table 8. Table 7 compares the proposed original and implemented fuzzy discretization model results with previous research. At the same time, in Table 8, we compared the results of the classification of diseases and pests of corn plants in our proposed method with other studies.

Author's Notes File

[Report Notes](#)

Review Report Form

Quality of English Language

() English very difficult to understand/incomprehensible

() Extensive editing of English language and style required

() Moderate English changes required

(x) English language and style are fine/minor spell check required

() I am not qualified to assess the quality of English in this paper

	Yes	Can be improved	Must be improved	Not applicable
Does the introduction provide sufficient background and include all relevant references?	()	(x)	()	()
Are all the cited references relevant to the research?	()	(x)	()	()
Is the research design appropriate?	()	(x)	()	()
Are the methods adequately described?	()	(x)	()	()
Are the results clearly presented?	()	(x)	()	()
Are the conclusions supported by the results?	()	(x)	()	()

Comments and Suggestions for Authors

Dear authors,

It was a pleasure reviewing your paper: interesting topic and well-presented results.
I suggest you to add a Discussion section and compare your finding with other results in the literature.
Did you encounter any limitations?

Kind regards,

Submission Date

12 February 2023

Date of this review

24 Feb 2023 09:13:44

Authors' Responses to Reviewer's Comments (Reviewer 3)

Author's Notes

Point 1: The font format of the text in the formula from 250 to 253 lines in the article is incorrect. It is suggested to modify it (TP,TN,FP,FN).

Response 2:

We refer to [42, 43] for multiclass performance measure
 [42] S. Dinesh and T. Dash, "Reliable Evaluation of Neural Network for Multiclass Classification of Real-world Data," no. 1, 2016, [Online]. Available: <http://arxiv.org/abs/1612.00671>

[43] M. Sokolova and G. Lapalme, "A systematic analysis of performance measures for classification tasks," *Inf. Process. Manag.*, vol. 45, no. 4, pp. 427–437, 2009, doi: 10.1016/j.ipm.2009.03.002.

Point 2: I deem the experimental part of this paper can add a group of comparative experiments of similar algorithms.

Response 2:

We compared our experiment in two parts. The first is our experiment in discretizing predictor variables using a fuzzy approach (Table 7), and the second is our experiment in classifying corn plant diseases based on digital images (Table 8). Table 7 also compares the performance of the proposed original and implemented fuzzy discretization models. Finally, table 8 compares model performance and presents the resampling method as an evaluation method, the number of classes, the number of observations, and the classification method used.

Author's Notes File

[Report Notes](#)

Review Report Form

Quality of English Language

- English very difficult to understand/incomprehensible
- Extensive editing of English language and style required
- Moderate English changes required
- English language and style are fine/minor spell check required
- I am not qualified to assess the quality of English in this paper

	Yes	Can be improved	Must be improved	Not applicable
Does the introduction provide sufficient background and include all relevant references?	(x)	()	()	()
Are all the cited references relevant to the research?	(x)	()	()	()
Is the research design appropriate?	(x)	()	()	()
Are the methods adequately described?	()	(x)	()	()
Are the results clearly presented?	(x)	()	()	()
Are the conclusions supported by the results?	(x)	()	()	()

Comments and Suggestions for Authors

This paper applies fuzzy discretization to polynomial naive Bayesian method. The method was applied to the classification of maize plant diseases and insect pests.

Monte Carlo resampling is used for empirical evaluation to obtain the scalability of the proposed performance model. The best model based on the number of measurements with the highest value is the FMN3 model.

I think the theory of this article is solid, the algorithm is highly interpretable and the experiment is sufficient. I believe this article should be accepted.

2. Minor modification problems :

- (1) The font format of the text in the formula from 250 to 253 lines in the article is incorrect. It is suggested to modify it. (TP,TN,FP,FN)
- (2) I deem the experimental part of this paper can add a group of comparative experiments of similar algorithms.

Submission Date

12 February 2023

Date of this review

24 Feb 2023 00:41:01

Authors' Responses to Reviewer's Comments (Reviewer 4)

Author's Notes

Point 1: The section relating to the state of the art should be modified and enriched.

Response 1:

We modify and enrich our paper's state of the art by adding seven paragraphs on pages three to four.

Point 2: Figure 2 should be better described in the caption as it is central to the paper.

Response 2:

We have described it in the paper title and figure title by adding "multiclass" before "classification" (paper title) and before "corn" (figure title).

Point 3: The datasets used should be better described in tabular form.

Response 3:

In this revised paper, we present a dataset description in tabular form in Table 2.

Point 4: There are no references to the software used and related settings.

Response 4:

We refer to [38, 44]:

[38] M. Kuhn and K. Johnson, *Applied predictive modeling*. 2013. doi: 10.1007/978-1-4614-6849-3.

[44] K. Ramasubramanian and A. Singh, *Machine Learning Using R With Time Series and Industry-Based Use Cases in R*, 2nd ed., vol. 321. New Delhi: Apress, 2019. doi: 10.1007/978-1-4842-4215-5.

Point 5: What happens if the data is organized in the form of a graph/network? A recent paper discussing some related aspects should be cited.

Response 5:

It could be more exciting, but we apologize for not covering this topic in our paper. Instead, we have cited the paper of Giordano et al., 2022 [36] in our paper in line 171.

[36] M. Giordano, L. Maddalena, M. Manzo, and M.R. Guarracino, "Adversarial attacks on graph-level embedding methods: a case study", *Annals of Mathematics and Artificial Intelligence*, pp. 1-27, 2022, doi:10.1007/s10472-022-09811-4.

Author's Notes File

[Report Notes](#)

Review Report Form

Quality of English Language

- English very difficult to understand/incomprehensible
- Extensive editing of English language and style required
- Moderate English changes required
- English language and style are fine/minor spell check required
- I am not qualified to assess the quality of English in this paper

	Yes	Can be improved	Must be improved	Not applicable
Does the introduction provide sufficient background and include all relevant references?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are all the cited references relevant to the research?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Is the research design appropriate?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are the methods adequately described?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are the results clearly presented?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Are the conclusions supported by the results?	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Comments and Suggestions for Authors

The paper presents an interesting idea but should be modified in some of its parts:

- The section relating to the state of the art should be modified and enriched;
- Figure 2 should be better described in the caption as it is central to the paper;
- The datasets used should be better described in tabular form;
- There are no references to the software used and related settings;

- What happens if the data is organized in the form of a graph/network? A recent paper discussing some related aspects should be cited:

Giordano, M., Maddalena, L., Manzo, M., & Guarracino, M. R. (2022). Adversarial attacks on graph-level embedding methods: a case study. *Annals of Mathematics and Artificial Intelligence*, 1-27.

Submission Date

12 February 2023

Date of this review

07 Mar 2023 15:13:37

Review Report Form

Quality of English Language

- English very difficult to understand/incomprehensible
- Extensive editing of English language and style required
- Moderate English changes required
- English language and style are fine/minor spell check required
- I am not qualified to assess the quality of English in this paper

Yes Can be improved Must be improved Not applicable

Does the introduction provide sufficient background and include all relevant references?

Are all the cited references relevant to the research?

Is the research design appropriate?

Are the methods adequately described?

Are the results clearly presented?

Are the conclusions supported by the results?

Comments and Suggestions for Authors

No further modifications are required

Submission Date

12 February 2023

Date of this review

24 Mar 2023 14:04:59