A6: Blackbox methods, KNN for Numeric Prediction tasks

100 Points Possible

11/18/2025

Attempt 1

In Progress

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Unlimited Attempts Allowed

11/21/2025

Details

A6 Blackbox methods, KNN

Instructions

This assignment covers 2 weeks of course material. You'll need both weeks of lecture and tutorial content to complete it. You may consider starting and completing the components you are able to after the BlackBox methods module (MLP and SVM), then complete the KNN portion after that module's content is complete.

Input files: *NA_sales_filtered.csv (https://utah.instructure.com/courses/1177344/files/184306479/download?wrap=1) (https://utah.instructure.com/courses/1177344/files/184306479/download?download_frd=1)* video game sales dataset from Assignment 4. The target variable is still NA_Sales for numeric prediction using Blackbox methods.

Packages required: Install caret, RWeka, kernlab, rminer, matrixStats, and knitr packages.

Task I

Create A6_yourLastName_yourFirstName.Rmd to meet the following requirements:

Use at least 3 metrics such as (MAE, MAPE, RAE, RMSE, RMSPE, RRSE) throughout the assignment. Be consistent for easy model comparison.

Code chunk 1- Package load, data import, inspection, and partitioning (10%)

A. Load all the required packages

B. Import the NA_sales_filtered.csv and partition the dataset to the training set and testing set

i. Import NA_sales_filtered.csv and set stringsAsFactors = False.

ii. Create a data frame with all of the variables except for *Name*.

iii. Transform character variables except for Name to factors.

iv. Create the training and testing sets based on percentage split – 70% for training and 30% for testing.

Code chunk 2 - Build and evaluate neural network models for numeric prediction tasks (20%)

A. Build and evaluate MLP models for numeric prediction with the video game sales data (imported and prepared in 1B).

i. Build an MLP model on MultilayerPerceptron()'s default setting on the training set. Evaluate the model performance on the training set and testing set.

ii. Build a two-hidden-layer MLP model and change one of the other hyper-parameter values – e.g. the learning rate on the training set. Evaluate the model performance on the training set and testing set.

Code chunk 3 - Build and evaluate SVM (ksvm) models for numeric prediction tasks (20%)

A. Build and evaluate ksvm models for numeric prediction with the video game sales data (imported and prepared in 1B).

i. Build a model on ksvm()'s default setting on the training set. Evaluate the model performance on the training set and testing set.

ii. Build a ksvm model using a different kernel function on the training set. Use the default C value. Evaluate the model performance on the training set and testing set.

iii. Build a ksvm model using a different cost value (i.e. C= c, where c>1) on the training set. Evaluate the model performance on the training set and testing set.

Code chunk 4 - Build and evaluate KNN (IBk) models for numeric prediction tasks (20%)

A. Build and evaluate IBk models for numeric prediction with the video game sales data (imported and prepared in 1B).

i. Build a model on IBk()'s default setting on the training set. Evaluate the model performance on the training set and testing set.

ii. Build an IBk model using a different K value on the training set. Hold other parameters at the default setting. Evaluate the model performance on the training set and testing set.

iii. Build an IBk model using a weighted voting approach (e.g. I=TRUE) on the training set. Evaluate the model performance on the training set and testing set.

iv. Build an IBk model by automatically selecting K (i.e., X=TRUE) on the training set. Evaluate the model performance on the training set and testing set. *Recall that the default k is 1 in IBk and that it is always the 'best' k for training, I would not expect your best k to be 1 for this section.*

Code chunk 5 - Cross-validation function for numeric prediction models (10%)

A. Define a named function (e.g., cv_function) for cross-validation evaluation of classification or numeric prediction models with df, target, nFolds, seedVal, **method** and metrics_list for input. Since method is a parameter we would expect to have 1 cv_function for all models. Not separate, specialized cv_functions with the model hardcoded within the function.

B. The function should generate a table of fold-by-fold performance metrics, and means and standard deviations of performance over all of the folds.

Code chunk 6 - 3 fold cross-validation of MLP, ksvm and IBk models (13%)

A. Use the default settings of MultilayerPerceptron(), ksvm and IBk to perform cross-validation for numeric prediction with the video game sales data (imported and prepared in 1B).

Others:

- Add some simple descriptive text in the text area before the code chunk.
- Add a name or description of each code chunk in {r}. Make sure that you include all the code and output from executing code when rendering A6_yourLastName_yourFirstName.Rmd to HTML.
- Feel free to add comment lines with the requirement item numbers (e.g., # 3.A or # 3.B) to your code cell to help TAs and instructors easily identify your code that addresses a particular requirement.

Task II Reflections(7%):

1. Using KSVM model performance results. Describe the parameter changes and their impact (e.g. significantly increase or decrease) on performance metrics of numeric prediction models. Discuss the reasons for these performance changes?

2. Using MLP model performance results. Describe the parameter changes and their impact (e.g. significantly increase or decrease) on performance metrics of numeric prediction models. Also describe the parameter changes and their impact (e.g. significantly increase or decrease) on running

speed of building and evaluating numeric prediction models. Discuss the reasons for these performance changes?

3. What have you learned from building each of these models and the modeling impact of your adjustments to the hyperparameters or dataset? If you were explaining the results of these models to a supervisor what would you say about them? Attempt to do more than just state facts here, interpret the results. Coding is great, interpretation of output is even more important. Discuss each model. Write at least 150 words.

Additional questions:

1. Using IBk model performance results. Describe the parameter changes and their impact (e.g. significantly increase or decrease) on performance metrics of numeric prediction models. Discuss the reasons for these performance changes?

2. Did you notice a difference in the runtime in using IBk and the other two? Why might IBk be different? What are the differences in how the algorithms operate?

3. In an emergency situation your manager needs you to generate a prediction by the end of the work day. Accuracy is important but equally so is getting the prediction ready as soon as possible. How would you tackle this situation using black box models?

Submission

Use the RMD header to include assignment title, author name – you, and the file creation date. Also, include header specifications to generate a table of contents and section numbers of your code chunks.

Render A6_yourLastName_yourFirstName.Rmd to HTML output.

Submit two files – A6_yourLastName_yourFirstName.Rmd and A6_yourLastName_yourFirstName.html, (or another output format) generated from rendering (or knitting) A6_yourLastName_yourFirstName.Rmd.

(Please do not compress these two files into one zip file. Submit them as separate files. Be sure that the HTML output file contains assignment title, author name – you, the file creation date, and table of content including section numbers.)

View Rubric

blackbox methods		
Criteria	**Ratings**	**Points**

Criteria	Ratings			Points
1.A. Load all required packages in RStudio. Use getwd() and setwd() to the current working directory in RStudio.	**Full Marks** 5 pts	**Partially** 0.1 to 5 pts	**No Marks** 0 to 0 pts	/5 pts
1.B.i. Import NA_sales_filtered.csv and set stringsAsFactors = False.	**Full Marks** 1 pts	**Partially** 0.1 to 1 pts	**No Marks** 0 to 0 pts	/1 pts
1.B.ii. Create a data frame with all of the variables except for Name.	**Full Marks** 1 pts	**Partially** 0.1 to 1 pts	**No Marks** 0 to 0 pts	/1 pts
1.B.iii. Transform character variables to factors.	**Full Marks** 1 pts	**Partially** 0.1 to 1 pts	**No Marks** 0 to 0 pts	/1 pts
1.B.iv. Create the training and testing sets based on the target variable (70% for training and 30% for testing).	**Full Marks** 2 pts	**Partially** 1 pts	**No Marks** 0 pts	/2 pts
2.A.i. Build a MLP model by default setting on the training set for NA_sales_filtered data. Evaluate the model performance on the training set and testing set.	**Full Marks** 7.6 to 10 pts	**Partially** 0.1 to 7.5 pts	**No Marks** 0 to 0 pts	/10 pts

Criteria	Ratings			Points
2.A.ii. Build a two-hidden-layer MLP model and change one of the other parameter values. Evaluate the model performance on the training set and testing set.	**Full Marks** 8.34 to 10 pts	**Partially** 0.1 to 8.33 pts	**No Marks** 0 to 0 pts	/10 pts
3.A.i. Build a ksvm model by default setting on the training set for NA_sales_filtered data. Evaluate the model performance on the training set and testing set.	**Full Marks** 4.1 to 6 pts	**Partially** 0.1 to 4 pts	**No Marks** 0 to 0 pts	/6 pts
3.A.ii. Build a ksvm model using a different kernel function on the training set. Use the default C value. Evaluate the model performance on the training set and testing set.	**Full Marks** 6.1 to 8 pts	**Partially** 0.1 to 6 pts	**No Marks** 0 to 0 pts	/8 pts
3.A.iii. Build a ksvm model using a different cost value on the training set. Evaluate the model performance on the training set and testing set.	**Full Marks** 4.1 to 6 pts	**Partially** 0.1 to 4 pts	**No Marks** 0 to 0 pts	/6 pts

Criteria	Ratings			Points
4.A.i. Build an IBK model by default setting on the training set for NA_sales_filtered data. Evaluate the model performance on the training set and testing set.	**Full Marks** 4.1 to 5 pts	**Partially** 0.1 to 4 pts	**No Marks** 0 to 0 pts	/5 pts
4.A.ii. Build an IBk model using a different K value on the training set. Hold other parameters at the default setting. Evaluate the model performance on the training set and testing set.	**Full Marks** 4.1 to 5 pts	**Partially** 0.1 to 4 pts	**No Marks** 0 to 0 pts	/5 pts
4.A.iii. Build an IBk model using a weighted voting approach (e.g. I=TRUE) on the training set. Evaluate the model performance on the training set and testing set.	**Full Marks** 4.1 to 5 pts	**Partially** 0.1 to 4 pts	**No Marks** 0 to 0 pts	/5 pts
4.A.iv. Build an IBk model by automatically selecting K (i.e., X=TRUE) on the training set. Evaluate the model performance on the training set and testing set.	**Full Marks** 4.1 to 5 pts	**Partially** 0.1 to 4 pts	**No Marks** 0 to 0 pts	/5 pts

Criteria	Ratings			Points
5.A. Define a named function (e.g., cv_function) for cross-validation evaluation of classification or numeric prediction models with df, target, nFolds, seedVal, method and metrics_list for input.	**Full Marks** 6.1 to 7 pts	**Partially** 0.1 to 6 pts	**No Marks** 0 to 0 pts	/7 pts
5.B. Generate a table of fold-by-fold performance metrics, and means and standard deviations of performance over all folds.	**Full Marks** 2.1 to 3 pts	**Partially** 0.1 to 2 pts	**No Marks** 0 to 0 pts	/3 pts
6.A. Use the default settings of MultilayerPerceptron(), ksvm and IBk to perform cross-validation for numeric prediction by NA_sales_filtered data.	**Full Marks** 12.14 to 13 pts	**Partially** 0.1 to 12.13 pts	**No Marks** 0 to 0 pts	/13 pts

Criteria	Ratings			Points
What have you learned from building each of these models and the modeling impact of your adjustments to the hyperparameters or dataset? If you were explaining the results of these models to a supervisor what would you say about them? Attempt to do more than just state facts here, interpret the results. Coding is great, interpretation of output is even more important. Discuss each model. Write at least 150 words.	Full Marks 4.1 to 5 pts	Partially 0.1 to 4 pts	No Marks 0 to 0 pts	/5 pts
Reflection view longer description	Full Marks 1.7 to 2 pts	Partially 0.1 to 1.6 pts	No Marks 0 to 0 pts	/2 pts
Additional Questions view longer description	Full Marks 0 pts		No Marks 0 to 0 pts	/0 pts

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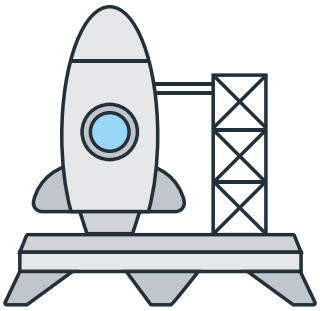

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