INVENTORY AGE PREDICTION USING DEEP LEARNING ALGORITHMS IN ALCHOLIC BEVERAGE INDUSTRY

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Abstract

This thesis focuses on the prediction of inventory age in warehouses for an alcoholic beverage company operating. The main objective is to minimize storage costs, a significant portion of the total costs, by accurately predicting the duration of product storage in the warehouse, specifically for perishable goods like alcohol, inventory age is crucial to prevent spoilage and losses.

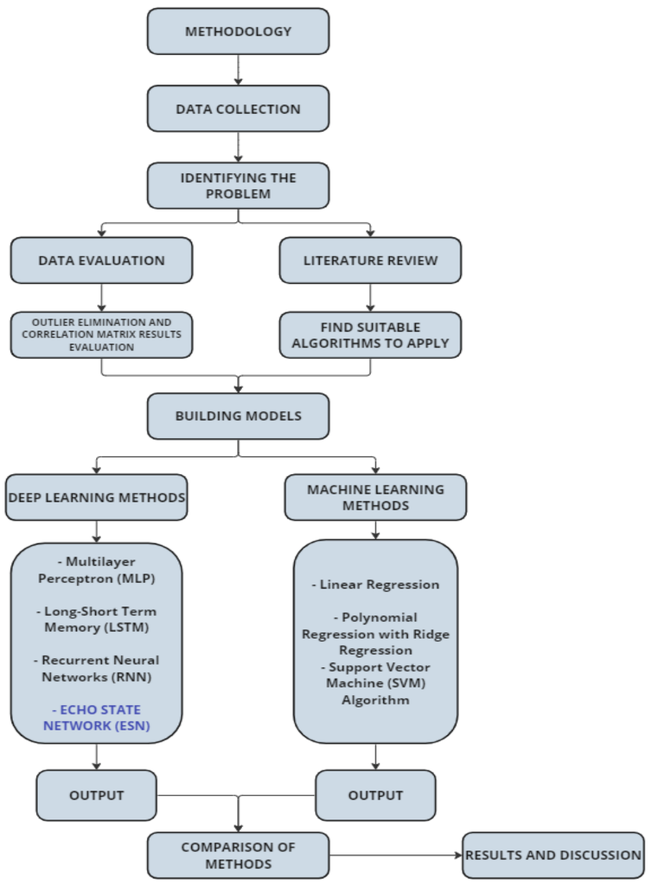

Fig 1. Inventory Age Histogram

After the feature evaluation and data selection part was done, 10 features remained in the data matrix with the target value, the inventory age.

Tab 1. Final State of The Data Matrix

DNo_Code	MG	Goods	Quantity	Unit_Code	Net_Liter	Quantity_Lt	Delivery_No	Shelf_Life	Storage_Time	Inventory_Age
1	[illegible]	[illegible]	144.00	1	10.00	1440.00	322890	180.00	135.00	3.00
1	[illegible]	[illegible]	117.00	1	10.00	1170.00	322890	180.00	135.00	3.00
2	[illegible]	[illegible]	495.00	1	10.00	4950.00	322890	180.00	135.00	3.00
3	[illegible]	[illegible]	396.00	2	10.00	3960.00	323261	120.00	75.00	11.00
1	[illegible]	[illegible]	132.00	2	10.00	1320.00	323261	180.00	135.00	32.00
1	[illegible]	[illegible]	198.00	2	10.00	1980.00	323261	180.00	135.00	15.00
1	[illegible]	[illegible]	66.00	2	10.00	660.00	323261	180.00	135.00	13.00
1	[illegible]	[illegible]	132.00	2	10.00	1320.00	323261	180.00	135.00	13.00
2	[illegible]	[illegible]	10.00	3	12.00	120.00	322834	270.00	210.00	49.00
1	[illegible]	[illegible]	10.00	3	12.00	120.00	322834	120.00	75.00	29.00
3	[illegible]	[illegible]	90.00	3	12.00	1080.00	322834	180.00	135.00	25.00
2	[illegible]	[illegible]	90.00	3	12.00	1080.00	322834	180.00	135.00	40.00
2	[illegible]	[illegible]	27.00	2	7.20	194.40	322834	180.00	135.00	5.00
1	[illegible]	[illegible]	20.00	4	7.20	144.00	322834	180.00	135.00	27.00
2	[illegible]	[illegible]	30.00	2	8.00	240.00	322834	180.00	135.00	31.00
1	[illegible]	[illegible]	90.00	1	12.00	1080.00	322834	180.00	135.00	28.00
3	[illegible]	[illegible]	90.00	1	12.00	1080.00	322834	180.00	135.00	29.00
3	[illegible]	[illegible]	20.00	1	7.92	158.40	322834	180.00	135.00	52.00
3	[illegible]	[illegible]	20.00	1	7.92	158.40	322834	180.00	135.00	52.00
1	[illegible]	[illegible]	20.00	1	7.92	158.40	322834	180.00	135.00	51.00

Conclusion

First, data collection is made with a great severity considering it is a criticially important parf of the problem. Due to the fact that data needs to be relevant, it requires a balanced distribution, high quantity and should not include outliers. Then, feature selection and data evaluation is done by observing the correlation matrix. Next, statistical analysis is applied to acquire important values like mean, min, max and variance. Three Machine Learning (Linear, Polynomial with Ridge, SVM) models are constructed for understanding complexity of the problem. Four Deep Learning algorithms (MLP, RNN, LSTM, ESN) are modeled for better prediction results. The results are compared for deciding the best model for this problem and deficincies are observed. After the observation, it is seen that in Tab 2. ESN model has the best results.

Tab 2. Final Scores of Each Model

Model Results	MSE	RMSE	R-Squared	MAE
Linear Regression	121.49	11.02	0.23	8.67
Polynomial Regression with Ridge Regression	52.13	7.22	0.59	5.25
Support Vector Machine (SVM)	176.25	13.27	0.11	8.86
Multilayer Perceptron (MLP	94.99	9.74	0.4	5.47
Recurrent Neural Networks (RNN)	51.45	7.17	0.68	4.73
Echo State Networks (ESN)	**25.54**	**5.05**	**0.85**	**0.94**

Tab 3. Actual and Predicted Values of ESN Model

	Actual		Predicted
	0		0
0	8.0	0	7.990764
1	24.0	1	24.131321
2	9.0	2	8.961814
3	26.0	3	25.991750
4	20.0	4	18.994441
5	52.0	5	52.024000
6	29.0	6	31.001704
7	6.0	7	5.996421
8	29.0	8	28.987104
9	7.0	9	6.999748

Echo State Network (ESN) has the best prediction scores with, 0.85 r-squared score, among all the deep learning models. After ESN model is selected, actual and predicted values of ESN models are displayed. For this inventory age problem it has seen that, Echo State Networks (ESN) is the most sufficient algorithm to predict inventory age for alcoholic beverage inventory dataset.