Neural Networks Models Applied to Brazilian Soybean Production Prediction

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Abbreviated abstract: The objective of this work was to develop artificial neural networks models for prediction of production of Brazilian soybeans and to evaluate which is the most appropriate neural network model for the variables chosen to perform the prediction

Related publications:

- DA SILVA, Lucas Abreu et al. Estimating soybean leaf defoliation using convolutional neural networks and synthetic images. Computers and electronics in agriculture, v. 156, p. 360-368, 2019.
-SCHWALBERT, R. A. et al. Satellite-based soybean yield forecast: Integrating machine learning and weather data for improving crop yield prediction in southern Brazil. Agricultural and Forest Meteorology, Elsevier, v. 284, p. 107886, 2020.

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Problem, Data

- The optimization of agricultural production is necessary, considering that the world population tends to increase and food is needed for everyone;

- In 2017, was projected by the United Nations Organizations (UN) that in 2030 the world population would be 8.6 billion people;

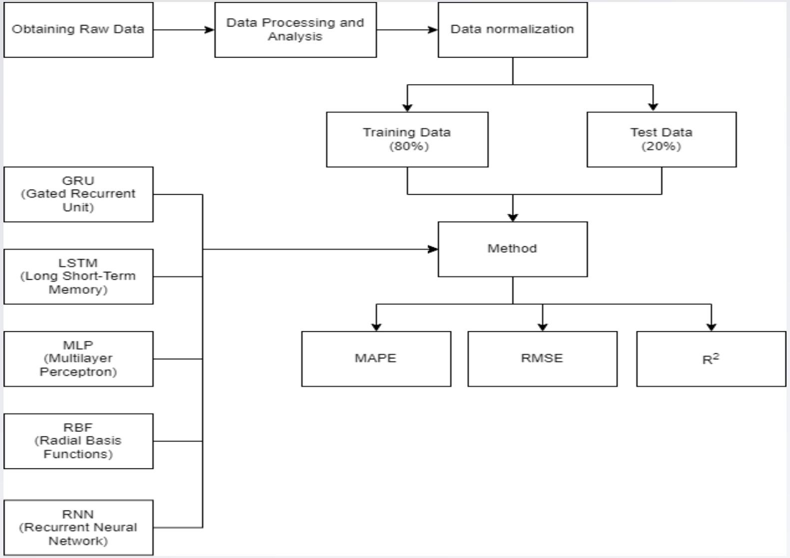
- The objective of this work was to develop artificial neural networks models for prediction of production of Brazilian soybeans and to know which is the most appropriate neural network model for the variables chosen to perform the prediction;

- Previous works didn’t use only soybean price data, planted and harvested area, fiduciary currency values;

- The challenge of this work was to obtain good results with the seven variables used and to have a standard configuration for all (using the same number of neurons, layers, batch size, epochs and a single optimizer).

Methods

- The diagram below summarizes the path taken from obtaining data to generating results and which metrics and models were used.



- The table below shows the results obtained for each neural network model for the first configuration

Table 1: Neural Network Models Used – 1st Configuration

Model	no. Neurons	no. Batch Size	no. Input	Optimizer	Epoch	Loss Function
GRU	64	1	1	Adam	100	MSE
LSTM	64	1	1	Adam	100	MSE
MLP	64	1	1	Adam	100	MSE
RBF	64	1	1	Adam	100	MSE
RNN	64	1	1	Adam	100	MSE

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Results and Conclusions

Table 2: Result of Neural Network Models Used – 1st Configuration

Model	Training Group			Test Group		
	MAPE (%)	RMSE	R2	MAPE (%)	RMSE	R2
GRU	1,359	2.366.857	0,986	0,924	**2.407.925**	**0,911**
LSTM	1,247	2.425.594	0,851	**0,878**	2.452.485	0,908
MLP	1,258	2.381.383	0,986	0,916	2.491.883	0,905
RBF	2,837	2.931.068	0,978	2,627	4.563.573	0,681
RNN	1,213	2.389.956	0,986	1,261	2.545.800	0,901

Table 3: Result of Neural Network Models Used – 2nd Configuration

Model	Training Group			Test Group		
	MAPE (%)	RMSE	R2	MAPE (%)	RMSE	R2
GRU	3,113	3.950.251	0,962	**3,989**	**6.458.671**	**0,568**
LSTM	2,863	3.968.653	0,961	5,398	7.951.184	0,346
MLP	7,058	8.370.229	0,828	6,693	9.231.175	0,118
RBF	13,425	12.952.750	0,588	7,160	9.386.808	0,088
RNN	2,626	3.160.725	0,975	6,399	9.244.228	0,116

- It was possible to evaluate the different proposed models of artificial neural networks through statistical metrics to evaluate the quality of the results;