Fuzzy Time Series Forecasting based on Markov Chain with Fuzzy C-Means Clustering (FCM) Partition Algorithm

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Abstract

The author modifies forecasting methods on the concept of fuzzy time series based on Markov Chain using Fuzzy C-Means Clustering (FCM) algorithm as a partitioning method of the universe of discourse. This research use the Average Forecasting Error Rate (AFER) value to get the forecasting accuracy and use MATLAB to obtain the final results. Modification of the method was applied to predict the opening, closing, and highest stock price of *PT. Waskita Karya Tbk* at the beginning of the year 2021. The AFER value acquired for each price are 1,6525%, 1,6776%, dan 1,5032%.

Introduction

Identification the Problem:

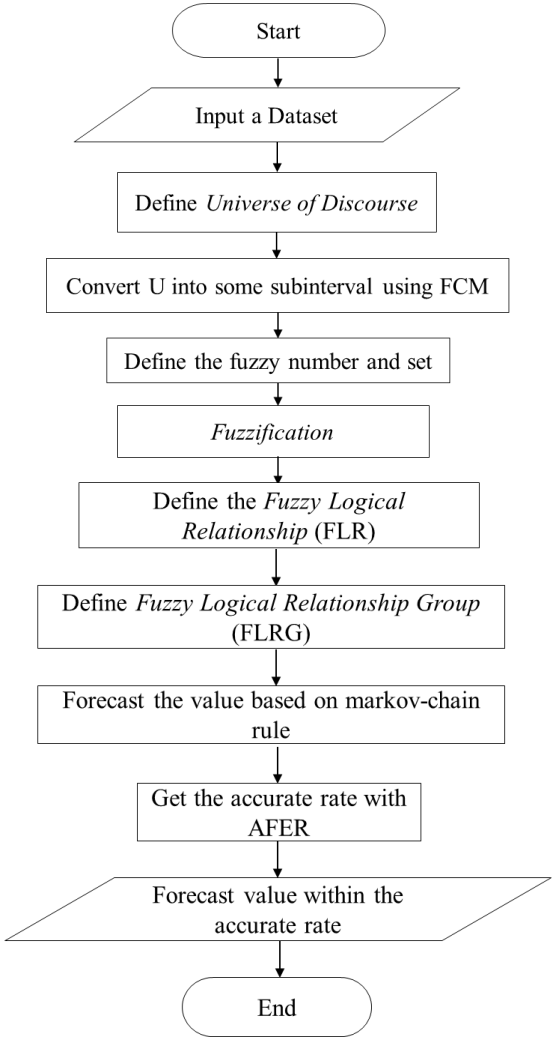
1. How is fuzzy time series algorithm based on markov-chain with fuzzy c-means clustering algorithm?
2. How the accurate rate for the method if it is applied to a dataset?
3. How the comparison without the markov chain concept?

Limit of Research:

1. The fuzzy number is using the triangular number.
2. The type of fuzzy time series is limited in time-invariant fuzzy time series.
3. The parameters for fuzzy c-means clustering is using the default from MATLAB.
4. Application for this ide is applied at domain finance.

Method

1. Define the universe of discourse (U) based on historical dataset*(3-5)*.
2. Convert the U into some of subintervals based on the optimal fuzzy c-means clustering algorithm*(1)*.
3. Define the fuzzy number from the partition above and do some fuzzification on it*(3-5)*.
4. Get the fuzzy logical relationship (FLR) from the dataset*(2)*.
5. Get the fuzzy logical relationship group (FLRG) from all the FLR is defined*(2)*.
6. Build the R matrices based on markov-chain rules*(6)*.
7. Forecast the value based on the markov-chain rules*(6)*.
8. Get the accurate rate with AFER*(7)*.



Result

1. Definiton for the Universe of Discourse (U):

	D_{min}	D_{max}	*Universe of discourse* (U)
Opening Price	1250	2850	$U = [1249,2851]$
Closing Price	1230	2840	$U = [1229,2841]$
Highest Price	1275	2870	$U = [1274,2871]$

2. The optimal cluster for each price based on FCM algorithm:

Opening Price	**Closing Price**	**Highest Price**
87 *Cluster*	90 *Cluster*	84 *Cluster*

3. The forecast result and the accurate rate within markov chain rule:

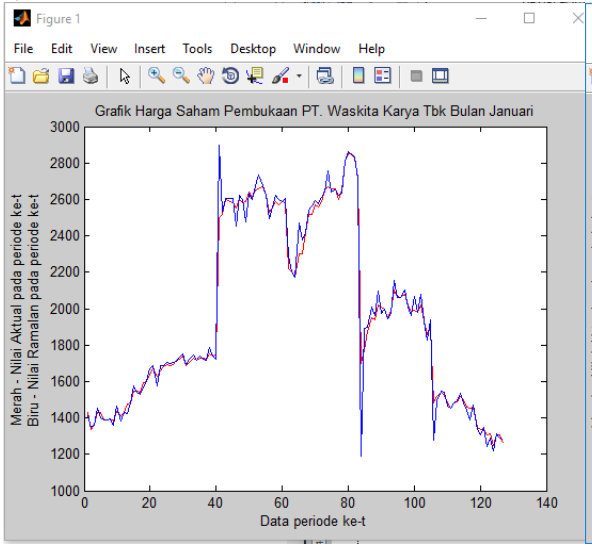
Opening Price	**Closing Price**	**Highest Price**
$U = [1249,2851]$	$U = [1229,2841]$	$U = [1274,2871]$
Forecast value: 1255	Forecast value: 1229.5	Forecast value: 1274.5
AFER: 1.6525%	AFER: 1.6776%	AFER: 1.5032%

4. The forecast result and the accurate rate without markov chain rule:

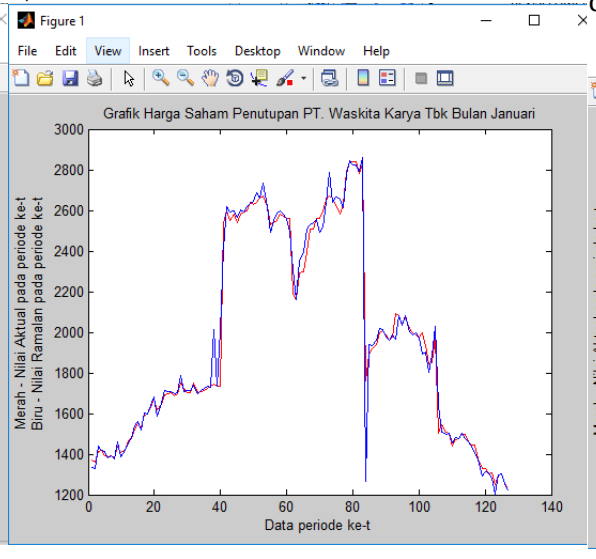
Opening Price	**Closing Price**	**Highest Price**
$U = [1249,2851]$	$U = [1229,2841]$	$U = [1274,2871]$
Forecast value: 1281.6667	Forecast value: 1275	Forecast value: 1330
AFER: 2.9668%	AFER: 3.9747%	AFER: 3.224%

Attachment

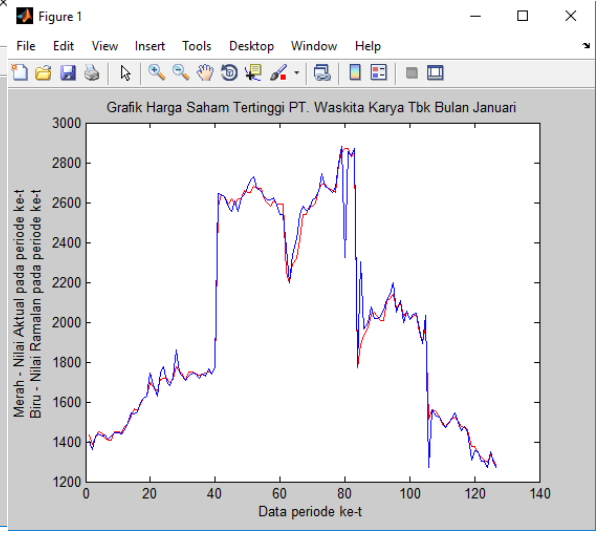
a)



b)



c)



Pictures. Forecast Chart of WSKT stock Price for 2015-2020
(a. opening price; b. closing price; c.highest price)

Literature

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