Method Description

General Information

Type of Entry (*Academic, Practitioner, Researcher, Student*)	**Researcher**
First Name	**Vilém**
Last Name	**Novák**
Country	**Czech Republic**
Type of Affiliation (*University, Company-Organization, Individual*)	**Organization**
Affiliation	**University of Ostrava, Institute for Research and Applications of Fuzzy Modelling, NSC IT4Innovations**

Team Members (*if applicable*):

1st Member	
First Name	Vilém
Last Name	Novák
Country	Czech Republic
Affiliation	University of Ostrava, Institute for Research and Applications of Fuzzy Modelling, NSC IT4Innovations
2nd Member	
First Name	Viktor
Last Name	Pavliska
Country	Czech Republic
Affiliation	University of Ostrava, Institute for Research and Applications of Fuzzy Modelling, NSC IT4Innovations
3rd Member	
First Name	Linh
Last Name	Nguyen
Country	Czech Republic
Affiliation	University of Ostrava, Institute for Research and Applications of Fuzzy Modelling, NSC IT4Innovations

Information about the method utilized

Name of Method	**Linguistic Fuzzy Logic Forecaster (LFL Forecaster)**
Type of Method (*Statistical, Machine Learning, Combination, Other*)	**Soft computing, Statistical**
Short Description (up to 200 words)	**LFL Forecaster is a specialized software tool for an analysis and**

	forecasting of time series developed by the Institute for Research and applications of Fuzzy Modeling (IRAFM), University of Ostrava, Czech Republic. It is mainly based on two methods originally developed by members of IRAFM: (1) the Fuzzy Transform and (2) the Perception-based Logical Deduction (part of Fuzzy Natural Logic techniques).

Extended Description:

Assumption

Assume that we have a time series data:

$$X(t), t=0,1,\dots,n \quad ,$$

which can be additively decomposed into a trend-cycle, a seasonal component and an irregular component

$$X(t)=TC(t)+S(t)+R(t) \quad .$$

Future values of the time series can be determined as a sum of future values of those components.

Procedure

Step 1: split the data $X(t)$ into learning and validation sets: Q^L and Q^V

On the basis of the learning set, Q^L, we find the best model of the time series where we measure quality of the model on the validation set, Q^V .

Step 2: predict future values of the trend-cycle TC

- **Step 2.1:** *apply the direct fuzzy transform of higher degree (direct F^m- transform) to Q^L to transform it into a sequence of polynomials (direct F^m- transform components)*
- **Step 2.2:** *forecast future direct F^m- transform components using techniques of Fuzzy Natural Logic (FNL) and pattern model.*
- **Step 2.3:** *apply the inverse fuzzy transform of higher degree (inverse F^m- transform) to the future direct F^m- transform components to obtain the future values of the trend-cycle*

Step 3: predict future values of the seasonal component $S(t)$

- **Step 3.1:** *seasonal component is modeled as linear combination of several previous seasons*
- **Step 3.2:** *compute coefficients of linear combination from historical data by the least square method of over-determined linear equations*