Financial security is critical for both national and individual levels. A sound and stable financial system is prerequisite for sustainable economic growth and thus risk forecast is playing a crucial role in modern financial analysis. Even a tiny improvement in markets forecasting accuracy may have a huge impact on decision making for:
- Risk management — to minimize, financial security monitor, and control the probability and/or impact of unfortunate events.
- Portfolio investment — investments in the form of a group of assets, including transactions in equity securities and debt securities.

Our efforts attempt to design a new framework to improve forecast accuracy for better financial decision making.

**Why Fuzzy Time Series Model?** [1,2]
- Vulnerable to false signals and getting whipsawed back and forth.
- Cannot handle trends well so lags any trend in the data and forth.
- Any indicator unable to detect whether the profitable move of the market is a short lived one or a major.

The advantages of Fuzzy Time Series (FTS) Models:
- Naturally universal approximated (can represent any complex financial models if well designed).
- Linguistic expressions to describe daily observations so that human experience and knowledge can be integrated.
- Ability to deal with vague data with uncertainty and nonlinearity.

**Motivation**

**Weighted Fuzzy Time Series Model**

- Each data point has a corresponding fuzzified number (such as $A_i$, $A_j$) which is determined by the interval length and universe discourse.
- Fuzzy logic relationships (FLRs) are generated by time sequence as:
  - $A_1 \rightarrow A_i$
  - $A_{i+m} \rightarrow A_{i+n+1}$
  - $A_{i+m+1} \rightarrow A_{i+n+2}$
- Since the fuzzified number may have several logic relationships, fuzzy logic relationship groups (FLRGs) are generated as: $A_j \rightarrow A_{j+1}$, $A_{j+2}$, ..., $A_k$

**Challenge:**
- Does each data point have the same effect for current forecast?
- How to handle the situation where index reaches record high or low?

**Approach:**
- Add weight to each data point using chronological-order and volume.
- Incorporate a long-term tendency (LT) with FLRs by the jump theory. e.g. if $A_i \rightarrow A_j$, the jump will be $j-i$ and LT is calculated by all jumps.

**How to be Intelligent?**

- Several parameters such as interval length, weight factors impact forecast performance.
- How to set these parameters intelligent other than markets by markets?

**Approach:**
- Using a novel evolutionary algorithm — Human Learning Optimization (HLO)
- Each parameter can be globally optimized by HLO.

**Forecast Performance**

- Dow Jones Index (DJI)
- German Stock Index (DAX)
- Japanese Stock Index (NIKKEI)
- Taiwan Stock Index (TAIEX)