Billboard Top 100 for Canadian Equities

Applications of Tensor Methods in Stock Market

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2019 Fields-China
Joint Industrial Problem Solving
Workshop in Finance
The main goal pursued in the problem proposed by Scotiobank at 2019 IPSW is to create a *Billboard Top-100* for Canadian equities, which in turn would enable the bank to

- inspect the underlying trends of *stocks* and *sectors* in a more systematic manner for the purpose of discovering the future big trends before they start,

- provide their customers, especially the traders, with an extremely valuable set of information which are necessary for managing their investment portfolios.
Our Contribution

In this work, we (partially) address all three levels of descriptive, predictive and prescriptive challenges envisioned by the problem provider. More precisely,

- the algorithm developed for the analysis of stock market sectors will be presented by providing relatively detailed information. Our developed algorithm relies mainly on tensor decomposition methods and top-$K$ ranking algorithm. Computational results are further provided.

- the main steps for creating *Billboard Top-100* will further be elucidated which will incorporate the so-called time-homogeneous top-$K$ ranking algorithm. Furthermore, to predict the top-$K$ equities of the future horizons of time, we propose the use of the tensor-on-tensor regression approaches within the framework of the mentioned ranking algorithm.
• **Industry Taxonomy**: One of the popular taxonomies used in North America is the *Global Industry Classification Standard* (GICS), based on which securities are classified into 11 sectors, 24 *industry groups*, 68 *industries* and 175 *sub-industries*.

• According to GICS, the main sectors of the stock market are: 1- Energy, 2- Materials, 3- Industrials, 4- Consumer Discretionary, 5- Consumer Staples, 6- Health Care, 7- Financials, 8- Information Technology, 9- Telecommunication Services, 10- Utilities and 11- Real Estates.
• **Top-\(K\) Ranking Algorithm**: Assume that there exist \(N\) securities each of which having a positive latent weight. The goal of the algorithm is then to identify the top-\(K\) ranked of these \(N\) securities employing their partially revealed pairwise comparisons, where the outcome of each comparison is assumed to be a binary variable (based on the BTL model) indicating the preference within the given pair of the securities.
For instance, let us assume the time interval from 2005-2016 is partitioned based on monthly frequencies. Then, one can obtain the top-$K$ ranked stocks within each month using the mentioned ranking algorithm. Once the top-$K$ securities within each month are identified, then the weight of the $i$th sector, $i = 1, 2, \ldots, 11$ is computed using

$$w_{i}^{\text{sector}} = \frac{\text{#top-}K \text{ stocks belonging to the sector } i}{K}.$$
Analysis of Stock Market Sectors

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Billboard Top 100 for Canadian Securities
Analysis of Stock Market Sectors
Motivations for Using Tensor-based Models

1. The available tensor decomposition algorithms enable one to deal with high-dimensional, incomplete and noisy data used for different purposes such as data imputation, clustering, segmentation, smoothing, etc.

2. The time-homogeneous variant of the top-$K$ ranking algorithm further exploits the temporal (time-dependent) relations which might exist among the provided samples. This in turn provides a more consistent results on top-$K$ ranked securities from one period of time to its consecutive ones which is very much desirable by day traders who manage portfolios containing a fixed number securities.

3. Also, resorting to the tensor-on-tensor regression approaches, one can potentially extend the applications of the smoothed ranking algorithm for prediction purposes.