Personalized Wealth Management through Case-Based Recommender Systems

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1 Introduction

Wealth management services have become a priority for most financial services companies. As investors are pressing wealth managers to justify their value proposition, turbulences in financial markets reinforce the need to improve the advisory offering with more customized and sophisticated services. As a consequence, a recent trend in wealth management is to improve the advisory process by exploiting recommendation technologies.

However, widespread recommendation approaches, such as content-based (CB) and collaborative filtering (CF), can hardly be put in practice in this domain. In fact, in this domain each user is typically modeled through his *risk profile* and other simple features, while each financial product is described through a *rating* provided by credit rating agencies, an *average yield* and the *category* it belongs to. In this scenario a pure CB strategy is likely to fail since content information is too poor and not meaningful to feed a CB recommendation algorithm. Furthermore, the over-specialization problem, typical of CB recommenders, may collide with the fact that turbulences and fluctuations in financial markets suggest to change and diversify the investments over time. Similarly, CF algorithms can hardly be adopted since they may lead to the well-known problem of *flocking*: given that user-based CF provides recommendations by assuming that a user is interested in the asset classes other people similar to him already invested in, this could move many similar users to invest in the same asset classes at the same time, making the recommendation algorithm victim of potential trader attacks[1].

These dynamics suggest to focus on different recommendation paradigms. Given that financial advisors have to analyze and sift through several *investment portfolios*[2] before providing the user with a solution able to meet his investment goals, the insight behind our recommendation framework is to exploit Case-Based Reasoning (CBR) to tailor investment proposals on the ground of a case base of previously proposed investments.

[1] http://www.technologyreview.com/view/425654/flocking-behaviour-improves-performance-of-financial-traders/
[2] http://en.m.wikipedia.org/wiki/Portfolio_(finance)

2 Methodology

Our recommendation process is based on the typical CBR workflow and is structured in three different steps:

(1) Retrieve and Reuse
Retrieval of similar portfolios is performed by representing each user through a feature vector (risk profile, inferred through the standard *MiFiD* questionnaire[3], investment goals, temporal goals, financial experience, and financial situation have been chosen as features. Each feature is represented on a five-point ordinal scale, from very low to very high). Next, *cosine similarity* is adopted to retrieve the most similar users (along with the portfolios they agreed) from the case base.

(2) Revise
Candidate solutions retrieved by the first step are typically too many to be consulted by a human advisor. Thus, the Revise step further filters this set to obtain the final solutions. To revise the candidate solutions three techniques were compared:

1. a basic (temporal) ranking;
2. a greedy diversification which implements a Greedy algorithm to select the solutions with the best compromise between quality and diversity;
3. FCV, a novel scoring methodology which computes how close to the optimal one is the distribution of the asset classes in the portfolio.

(3) Review and Retain
In the Review step the user and the human advisor can further discuss and modify the portfolio, before generating the final solution for the user. If the monthly yield obtained by the newly recommended portfolio is acceptable, the solution is stored in the case base and can be used in the future as input to resolve similar cases.

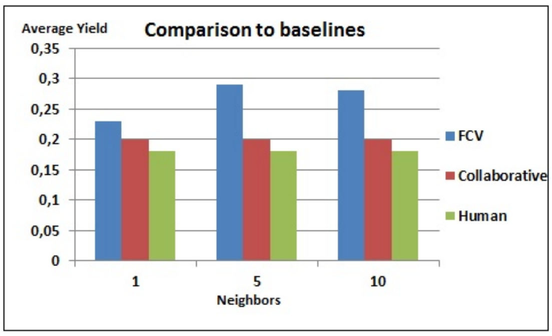

Fig. 1. In vitro evaluation

[3] http://en.wikipedia.org/wiki/Markets_in_Financial_Instruments_Directive

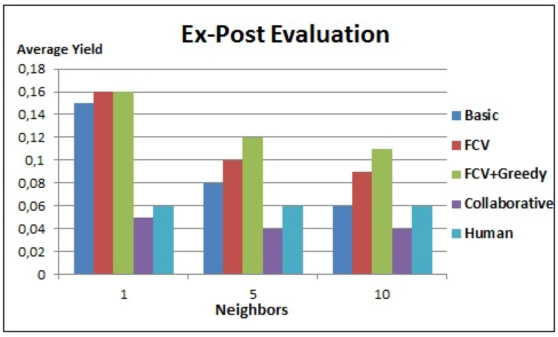

Fig. 2. Ex-post evaluation

The performance of the framework has been evaluated in an experimental session against 1172 real users. Results show that the yield obtained by recommended portfolios overcomes that of portfolios proposed by human advisors in many experimental settings. As shown in Figure 1, FCV significantly outperforms human recommendations (the average monthly yield increases from 0.18 to almost 0.30) for all the neighboorhood (put on the *X axis*) taken into account. The experimental results were further confirmed by an ex-post evaluation performed on real financial data from January to April 2014. As shown in Figure 2, this experiment provided very interesting results: beyond confirming the goodness of FCV-based ranking and the statistically significance of the gap with respect to both collaborative and human baselines, the most interesting outcome was that the combination of the diversification technique with FCV can further improve the performance of the proposed portfolios. This result suggests that the integration of the approaches can make the framework even more effective. This is due to the fact that a combined strategy can merge the advantages of a ranking based on past performance, as FCV, with an algorithm that may lead to more diverse recommendations. This makes the investment strategy better, since the human advisor does not base his investment proposal on a set of very similar portfolios, but rather on a set of *diversified solutions* which is more stable and effective, especially when market fluctuations have to be tackled.

3 Additional Materials

A demo version of the platform is available online[4].

Given that the platform is supposed to be of aid for financial advisors, it lets the advisor to select the current user as well as the recommendation technique to be adopted. Next, the "Recommendation" button shows the most promising portfolios for the target users along with the distribution of the asset classes. The distribution can be further discussed by user and advisor before coming to the final proposal which is stored in the case base.

[4] http://193.204.187.192:8080/OBWFinance/ - Login: 2 - Password: 12345