SIR 정보 모형의 금융기관 적용방안에 관한 연구

류현욱1)

A Study on SIR information model and its application to Financial Institutions

HyunWook Ryu3)

요 약

의학분야에서는 오래전부터 전염병의 전파경로를 예측할 수 있는 모형개발을 위해 연구해왔다. 소수의 감염자가 인구집단 내 다수를 감염시키는 과정에서 감염자의 수가 어떤 속도로 증가되고 회복되는지를 통해 주어진 변수에 따른 전파 경로 및 확산속도 등을 파악하는 데 기여한 바 있다. 이는 교통네트워크를 추정하는 의학분야에서 정보의 효율을 감지하는 SNS 등 경영과학 분야에 까지 연구 된 바 있다.

자산관리분야에서 자기주도형 투자자가 증가하고 있는 상황에서 세분화된 고객층에 맞춤형 대응의 효과성을 살펴보기 위해 SIR 모형을 적용했다. 미분방정식 기반의 동모형을 통해 고객관계관리(CRM) 시스템의 시뮬레이션 모형을 설정했다. 본 연구에서는 확장형 모형인 SEI로 정보흐름과 의사결정공간을 추정했으며 구간별로 어떤 전략적 접근법이 적절할 수 있는지에 대해 고찰했다. 그 결과 자산관리로의 잠재적 고객(일정 자산 보유)은 범용의 접근전략 수준에 따라 특정 서비스에 노출되며, 구체적인 시스템적 접근 내지는 콘텐츠 수준에 따라 특정 상품을 거래하는 속도에 해당하는 계수간 베타에 영향을 준다. 이는 나아가 재투자 의사결정 수준에 까지 영향을 줄 수 있게 된다.

본 연구는 자산관리 비즈니스 환경 변화와 고객관리체계를 살펴보고 정보의 효율이 투자 내지는 재투자로 이어지는 효과를 연구모형을 통해 분석하고 전략적 방향을 도출한다.

핵심어: SIR 모형, 자산관리, 금융, 정보, 고객관리

Abstract

In the field of biological medicine, researchers have studied to develop epidemic spreading model since quite a while ago. The studies show how a contagious disease could spread; the speed to which small number of progressor infect many others in the group of the susceptible, and how fast those are recovered. The prediction contributes to figure out what variables lead to the greatest influence(s). Studies have been

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1 (Professor) 11644 Department of Global Trade & Management, Shinhan Univ., 95 Hoam-ro, Uijeongbu-si, Gyeonggi, Korea
email: ryuhw@shinhan.ac.kr
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conducted on scientific engineering area such as estimating transportation network, and on management science area such as detecting information flow(s) in Social Network Services.

With the number of self-directed investors increased in wealth management field, this paper applies SIR model to examine the effectiveness of information provided via CRM system. The differential equation-based model is utilized in order to project simulation out of decision making process via information flow(s). The model is customized to SEI where a potential client is exposed to particular firm in wealth management industry, and makes investment decision as the firm approaches and provides 'proper contents' in a timely manner. The model suggests that Beta parameter increases the rate of individuals moving from susceptible status to a firm's management sight; the exposed. Injecting proper contents to the exposed makes the exposed clients decide particular investment(s), and further leads to re-investment.

This study presents the changes in the recent business environment of wealth management, and presents whether an information leads to investment decision.

Keywords : SIR model, Wealth Management, Finance, Information, CRM

1. Introduction

The 4th industrial revolution accelerates Merger and Acquisitions while traditional industry is stagnant. Business restructuring follows behind, and governments continue to promote ventures and SMEs. A growing equity initiatives increases the coverage of risk capital in capital market. The revenue model of securities firms in Korea lean much towards brokerage commission. Many are eager to upgrade their WM (wealth management) business models by developing such functions as asset R&D, WM business unit restructuring, operating system innovation and platforms launch. While majority of clients are stock-oriented and per-employee asset size are relatively small, fundamental change of sales approaches would be necessary to secure specific competencies for WM base expansion.

A recent posture review from one of the major securities firms points out that it needs to improve product competitiveness and to carry forward solution diversification. It also suggests investment management sales approach to advisory-service model where independent products are currently provided. This fee-based business model would not go easy unless ones redefine client-oriented innovation. The innovation begins with providing right information at the right time. The key to arrange investment is to figure out the velocity parameter. Understanding how fast people are attracted with information provided would capacitate firms to arrange investment(s).

In biological medicine field, such problem has been solved with differential equations named SIR (Susceptible-Infected-Recovered) model; that is a mechanism of which certain diseases are spread from being susceptible, to get infected, and to be recovered. The model proposes

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2) This work is modified and expanded from the working paper. [10]
time-variant structure of how the number of people becomes infected, and of how the rate of being infected slows down once it reaches certain level.

Many studies have modified extended model(s), injected different variations, and applied to various fields. [1], [3], [4], [7], [8], [12] This study considers the basic SIR model and modifies to develop a particular model to explain how information flows and clients react to make investment decisions. Some studies work on disease spreading pattern with causal analysis of movement of population. Some studies utilize transportation network via passenger airline data. Recent research utilize local bus transportation data and mobile-phone location data to project the spread parameters. [5], [6] In engineering field, several researches are observed with theoretical models. One study is conducted upon the information source detection under S-I model. [9] Others include computational complexity in the nodes and information propagation under SIR model. [11], [15] The work related to management science include information values and dissemination process on social network utilizing S-SEIR model; that is, information dissemination on social network is influenced by certain parameters. [13] Another study finds that turst plays important role in connecting users online social network as the data can not be interpreted by machines yet. [14]

Although previous literatures have utilized epidemic spreading model(s) to various fields, none has yet applied to financial sector. The main purpose of this paper is to interpret how information flows through investment decision-making process by analyzing modified SIR model. The analysis includes fractional order thus one could understand what and when to approach to its client(s). This paper is organized as follows. The next section states the background information about the WM industry. The research model is presented in the following, and the paper ends with a conclusion.

2 Financial industry in Korea

The WM service industry has gradually been in need of expansion due to the following states. First, economic stagnation with low interest rate means that traditional yield-bearing asset such as real estate soured, and individuals show a greater concern over reducing tax payments. This makes the household asset composition change with higher portion of financial assets to greater than 37 percent, and the people have interest in overseas asset markets bearing relatively higher yields. Second, elderly society means the greater concern over aged preparation, especially in financial perspective. It also drives the respective firms having longer
relationship with clients, and customized approaches onto meeting per-generation needs. Increase in millennium-generation requires further service in digital platform, and more importantly, self-directed with cost-sensitive. Last but not least, stronger financial consumer sovereignty leads to more compliance expense and strict policy applied to maintain the transparency.

3. WM business and decision-making process

Unlike commission-based brokerage business where an institution should maximize trading volume, fee-based advisory service business would have to increase clients' return by maintaining long-term partnership with the clients. The new innovation direction would include the followings; (i) coping with clients by segment with consideration of cost-to-serve, (ii) providing individual customized services, (iii) offering the customized product proposition via service platform, and (iv) establishing process for data analytics of client needs. The customized services by segment and type is presented in Fig. 1.

![Fig. 1] SEI Tailored WM service structure for individual clients

The investment decision is processed through the contacts of sales representatives and/or private associates, and the system platform exists primarily for one-way push service purposes. One reason for this supply-centered business flow is the insufficient knowledge about the information flow. The following section discusses research model.
4. The SEI model

The basic SIR (Susceptible-Infectious-Removed) model is meaningful to understand the dynamics of epidemic spreading to which Kermark and Makendrick originally propose. [4]

\[
\frac{dS}{dt} = - f(\beta) \cdot S \cdot I
\]

\[
\frac{dI}{dt} = f(\beta) \cdot S \cdot I - f(\gamma) \cdot I
\]

\[
\frac{dR}{dt} = f(\gamma) \cdot I
\]

where \( f(\beta) \) is the contact rate function and \( f(\gamma) \) is removal rate function.

The formula (1) explains that the number of population being susceptible decreases as time goes by, and the parameter beta is the rate of how fast it is shifted. The number of being susceptible becomes infected, and the number increases at its earlier stage and gradually decreases as time passes. The bigger the parameter beta coefficient is, the population becomes more susceptible, and the velocity to get infectious increases. The basic diagram is shown in Fig. 2.

![SIR model for spread parameters inserted](image)

When it applies to investment decision model of SEI where SEI mean Susceptible, Exposed, Invested respectively as shown in model (2).
A modified model can be developed with the assumption of re-investment occurred as an investment takes place, and information continues to be available to those invested as shown in Fig. 3.

\[
S = -\beta \cdot S \cdot E
\]

\[
E = \beta \cdot S \cdot E - \gamma \cdot E
\]

\[
I = \gamma \cdot I
\]

\[
(S + E + I) = -\beta \cdot S \cdot E + (\beta \cdot S \cdot E - \gamma \cdot E) + \gamma \cdot I
\]

A modified model can be developed with the assumption of re-investment occurred as an investment takes place, and information continues to be available to those invested as shown in Fig. 3.

\[
S' = -\beta \cdot S \cdot E + \gamma \cdot I
\]

\[
E' = \beta \cdot S \cdot E - \gamma \cdot E
\]

\[
I' = \gamma \cdot E - \gamma \cdot I
\]

5. Conclusion

Mathematical approach with differential equation has long been utilized to predict the spread of disease. Many studies have proposed variation models to different fields such as information technology and management. In financial sector where wealth management has drawn more attention recently, conventional CRM tool is often subject to question in terms of its effectiveness.

This study presents framework with a modified model of which information spreading and investment decision(s) made. Once certain number of potential investors (susceptible to
information transmitted from financial firms) move to client group, they become exposed to further information. When the information is relevant enough, it leads the exposed ‘client’ to make investment decision. Then those belong to ‘invested’, would become again exposed to further information to re-invest or to make additional investment(s). Heretofore, retail client information has been fragmentary, and the data collected by sales associates is in descriptive sentences, which makes it difficult to analyze systematically. Besides, many existing CRMs are implemented for the purpose of managing and monitoring sales activities rather than meeting the client needs. Since the SEI model is studied, one would understand what to collect and provide at which stage of investment decision process. For example, while the data for clients’ information and their investment activities could be retrieved via user inputs, system platform collects investment activities such as the type of products and cash withdrawals, their interests from searching results, and investment outcome from products and/or portfolios. Together with employees’ input data of client profile from the contact experience(s), job/asset class, and capital requirements, processed data analysis makes the report periodic, customized, and client-oriented.

The contribution of this research is twofold. One is that this is the first study to apply the SIR model to financial sector, and the other one is to evoke the significance of information value where the contact rate function beta and the rate function gamma to be invested are the core coefficients shifting numbers in each group. What really matters is not the population exposed but the number of individual to become invested. Besides, some information penetrate more aggressively than others, and it is difficult to measure the quality of information for empirical analysis. Further research would need to make up for these drawbacks.

References


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