Chapter VI

Fundamental Issues in Automated Market Making

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ABSTRACT

The goal of this chapter is to establish an analytical foundation for electronic market making. We use two classes of models to reason about this domain: structured and relaxed. In our structured model, we will formalize the decision process of a dealer and then use a simple class of trading strategies to highlight several fundamental issues in market making. In our relaxed model, we treat the dealer’s quotes and transaction prices as a simple time series. We apply statistical techniques to discern possible structure in the data and then make conclusions about the dealer’s optimal behavior. Our main interest is a normative automation of the securities dealer’s activities, as opposed to explanatory modeling of human traders, which is the primary concern of earlier studies in this area.
INTRODUCTION

What is market making? In modern financial markets, the market makers (or dealers) are agents who stand ready to buy and sell securities. The rest of market participants are therefore guaranteed to always have a counterparty for their transactions. This renders markets more efficient, orderly, and less volatile. The market maker is remunerated for his or her services by being able to “buy low and sell high.” Instead of a single price at which any trade can occur, the dealer quotes two prices—bid (dealer’s purchase, customer’s sale) and ask (dealer’s sale, customer’s purchase). The ask is higher than the bid, and the difference between the two is called the spread, which is the market maker’s source of revenue. Although market maker’s job description sounds fairly straightforward, his or her impact on the market’s functioning is manifold. A market maker can be seen as a simple auctioneer—someone who intermediates trading and clears the market. In other cases, he or she may be the one responsible for “demand smoothing”—absorbing short-term shocks and preventing price jumps and crashes. A dealer can also be perceived as an “information aggregator” of sorts, since he or she observes the entire order flow and sets quotes accordingly. Finally, and in our opinion most important, a market maker is a source of liquidity in the market—he or she makes trading cheaper for other agents by being always ready to take the opposite side of any trade.

Now that the significance of the market maker’s role has been established, the next question to ask is why it is necessary or desirable to automate this activity. This is an important task from both academic and practical points of view. First of all, we face a formidable intellectual problem: How can a machine automatically update the bid–ask spread, anticipate or react to the changes in supply and demand for a security, manage risk, adjust to market conditions, and so on? Second, this is a great test bed for machine learning and statistical techniques. Finally, creation of an electronic market maker is an attempt to replicate the human decision process, which is widely recognized as being notoriously difficult to model or imitate. The task of making a computer behave like a human has been one of the main goals of AI for decades.

From a more pragmatic point of view, electronic market makers could eventually replace highly paid human professionals, or, more realistically, give these professionals a tool to boost their productivity and their contribution to the markets. Automated dealers, if designed properly, will not engage in market manipulation and other securities laws violations that recently resulted in a number of dealer-centered scandals on both the NASDAQ (Christie & Schultz, 1994) and NYSE (Ip & Craig, 2003) markets. Also, a more in-depth knowledge and understanding of the dealer’s behavior will give us a better guidance in extreme situations (such as market crashes) and will facilitate the regulatory oversight. In recent years, financial markets saw a surge in automated trading strategies to the point that markets populated by electronic traders are becoming a possibility. Many questions arise from this reality, such as “will the markets become extremely volatile and prone to crashes, or will the removal of the human factor make them more rational and stable?” We hope our research can shed some light on what financial evolution holds in store for us.

Last, we expect automated market making to contribute to areas other than finance and artificial intelligence: It can make an impact in disciplines that employ various market mechanisms to solve distributed problems. In robotics, wherein large groups of autonomous robots “buy” and “sell” tasks that have to be accomplished for the greater common
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