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# AUTOMATED MARKET MAKING

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## ABSTRACT

The role of a market maker is to provide liquidity on an exchange by quoting bid and ask prices for a small discount or premium to the market price. Automated market making is an active strategy that continuously makes the market in one or more assets. Automated market making has been extensively studied, and an optimal market making algorithm has been proposed by Avellaneda & Stoikov (2008). In this paper, we review the state of the art in optimal market making, and then propose a simplified market making model that relies on only two parameters: spread and discount. We also demonstrate the performance of the model in simulations.

**Keywords** Exchange · Liquidity · Automated Market Making

## 1 Introduction

Market makers create liquidity on a market by quoting bid and ask prices for a trading asset near the market price. Market makers profit by quoting asks at a premium, and bids at a discount, to the market price. This premium or discount is referred to as the market maker *spread*. Market makers realize the spread each time an order is matched at their quoted price. The *arrival rate* of orders is lower for market makers that charge high spreads, and both spread and arrival rate must be balanced for a market maker to maximize profit. The market maker must also manage the *inventory* of cash and asset available to fulfill market demand, as well as the opportunity cost of taking a net long position in inventory. In all, the market maker must consider:

- The spread charged
- The arrival rate of orders
- Available inventory of cash and asset
- Opportunity cost of holding inventory

While profitable market making is a complex and multidimensional problem, it has also been extensively studied in the literature.

## 2 Headings: first level

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## 2.1 Headings: second level

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$$\xi_{ij}(t) = P(x_t = i, x_{t+1} = j | y, v, w; \theta) = \frac{\alpha_i(t) a_{ij}^{w_t} \beta_j(t+1) b_j^{v_{t+1}}(y_{t+1})}{\sum_{i=1}^N \sum_{j=1}^N \alpha_i(t) a_{ij}^{w_t} \beta_j(t+1) b_j^{v_{t+1}}(y_{t+1})} \quad (1)$$

### 2.1.1 Headings: third level

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## 3 Examples of citations, figures, tables, references

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[1, 2] and see [3].

The documentation for natbib may be found at

<http://mirrors.ctan.org/macros/latex/contrib/natbib/natnotes.pdf>

Of note is the command `\citet`, which produces citations appropriate for use in inline text. For example,

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produces

Hasselmo, et al. (1995) investigated...

<https://www.ctan.org/pkg/booktabs>

### 3.1 Figures

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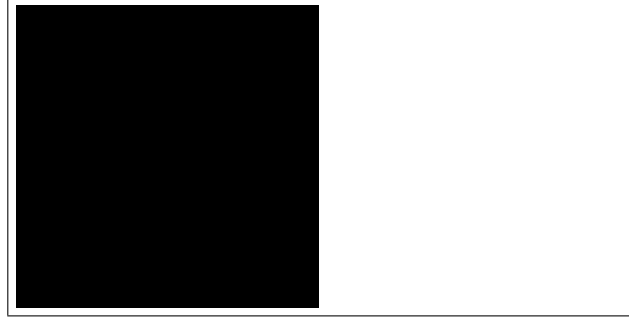


Figure 1: Sample figure caption.

Table 1: Sample table title

Part		
Name	Description	Size ( $\mu\text{m}$ )
Dendrite	Input terminal	$\sim 100$
Axon	Output terminal	$\sim 10$
Soma	Cell body	up to $10^6$

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### 3.2 Tables

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## References

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<sup>1</sup>Sample of the first footnote.