

Option-Pricing with Artificial Neural Networks: A Literature Review

Bachelorarbeit

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1 Introduction

If you type “Artificial Neural Networks” (ANN) into the search field of Google, you get 4,780,000 hits.¹ Derived from the functionality of the human brain and assigned to technical construct ANNs serve to solve a variety of problems. Since the beginning of the 90s neural networks find general approval in the field of finance because they allow investigating complex tasks very fast and simple. Amongst other things they are used to determine prices of derivatives. Hence, they serve as an alternative to the well known methods to calculate option prices like the Black-Scholes Formula.² The first approach to price option via artificial neural networks have been done by Gultekin, et al. (1982) which was a hybrid ANN and performed well as an option pricing mechanism (OPM).³ The first pure ANN for option pricing was developed by Malliaris & Salchenberger (1993) which also forecasted well.⁴

There are just a few literature reviews in the field of information systems.⁵ It is even harder to find literature reviews in the field of ANNs specialized on option pricing. The only way a literature review is done in this particular field is to include it in one’s own research paper on OPM via ANN.⁶

The aim of this thesis is to do a literature review on OPM with the help of ANN. Furthermore the scope of this article covers the detection of the kind of ANNs, which are most valuable as an OPM and if they perform better than the parametric approaches. Considering this, the literature research will cover the last eight years to examine the latest developments in the field of ANN.

The following part of the thesis is divided into five parts. Section two focuses on how to do a literature review in general. Based on this, the third part will cover the research process of this article and explain which papers were reviewed and why. Furthermore the search terms will be defined and the part of the journal ranking will be explained. Afterwards, the fourth is

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² Cf. (Black & Scholes, 1973).

³ Cf. (Gultekin, et al., 1982).

⁴ Cf. (Malliaris & Salchenberg, 1993).

⁵ Cf. (Webster & Watson, 2002), p. 13.

⁶ Cf. (Lajbcygier, 2004), p. 466.

about theory concerning ANNs in general followed by the fifth part which deals with basics on option pricing. Section six points out the similarities and differences of the journal articles. The last part is a conclusion, which will show, if ANNs are really suitable for forecasting option prices.

2 How to Do a Literature Review

There are two different variations on how to effectively search for existing literature on the field of research.

- The search based on keywords/search terms
- The backwards and forward directed literature research

The backward and forward directed literature research is only possible if a keyword search is done upfront. Otherwise no basic literature on the topic would be available to start from.

The kind of direction of literature research is depending on the procedure and the goals which should be achieved. In the backward search one can look at the literature of other authors, by referring to the list of references provide by them. The specified literature offers a list of references itself, based on which the search can be broadened.⁷ This method can be used, to look at the basics to get an overview on the topic. Since this type of search, however, can only rely on historical data, the claim of timeliness is to be questioned. When facing forward search, the relevant literature for the subject is identified via the help of keywords. The major point is to find out, who cited the found articles. This can be checked directly on the internet through services such as Google Scholar. With this method it is possible to detect changes in the prevailing opinion over time. As literature generalizes rather than specializes over time, this kind of search is suitable for questioning individual aspects of the subject area more accurately.

According to vom Brocke, et al. (2009), it is also important that the search process is designed for readers of the work as transparent as possible in order to let them search through the available literature more efficiently, or maybe even save time while doing

⁷ Cf. (vom Brocke, et al., 2009), p. 2.

to be analyzed, if the developed model can be used for estimating American options in the real world. Haugh & Kogan (2004) do not provide such information in their paper. This could lead to potential future research based on this article.

7 Conclusion

The papers reviewed in this thesis all implicate that it is reasonable to estimate options via ANN. All used ANNs perform better than their parametric counterparts. Most of the studies also advise to use hybrid neural networks based on the BS model. Due to the fact, that the BS model is accountable for 80% of the option price¹³⁹, this proceeding seems legitimate. In this case, the ANN is able to improve the accuracy of option pricing and thus providing more opportunities for market practitioners, while being fairly simple to implement.

In the considered papers there was only one which actually provided a practical application on how to use these option pricing mechanisms to make profit in the real market. The field of ANN for option pricing should be more focused on how practitioners can use the provided theories to implement them. Another interesting field of research, which goes beyond the scope of this thesis, would be to examine if ANNs are really used to estimate option prices or if practitioners still stick to the “old” parametric models.

Only a few papers were chosen for this literature review. Seeing how many papers have been published in the last eight years shows how much interest and effort in the field of option pricing with ANN is taken. Nonetheless, the articles imply that it is a topic for more potential research. This comes from the fact that today there is no general approach on how to prize options correctly with ANN, whether they are European or American style. The future research will indicate, if there will ever be such a “One size fits most” ANN for option pricing.

¹³⁹ Cf. (Hommel, et al., 2003), p. 348.