学校编码：10384

学号：17720091150939

厦门大学

# 硕 士 学 位 论 文

# 基于神经网络优化的股指预测模型研究

# Study on the Stock Price Index Forecasting Model Based on Optimized Neural Network

黄堃

指导教师：孟力

专业名称：管理科学与工程

答辩日期：2012年6月

# 厦门大学学位论文原创性声明

本人呈交的学位论文是本人在导师指导下,独立完成的研究成果。本人在论文写作中参考其他个人或集体已经发表的研究成果，均在文中以适当方式明确标明，并符合法律规范和《厦门大学研究生学术活动规范(试行)》。

另外，该学位论文为(　　)课题(组)的研究成果，获得(　　)课题(组)经费或实验室的资助，在(　　)实验室完成。(请在以上括号内填写课题或课题组负责人或实验室名称，未有此项声明内容的，可以不作特别声明。)

声明人(签名)：

年　月　日

# 厦门大学学位论文著作权使用声明

本人同意厦门大学根据《中华人民共和国学位条例暂行实施办法》等规定保留和使用此学位论文，并向主管部门或其指定机构送交学位论文(包括纸质版和电子版)，允许学位论文进入厦门大学图书馆及其数据库被查阅、借阅。本人同意厦门大学将学位论文加入全国博士、硕士学位论文共建单位数据库进行检索，将学位论文的标题和摘要汇编出版，采用影印、缩印或者其它方式合理复制学位论文。

本学位论文属于:

(　　)1.经厦门大学保密委员会审查核定的保密学位论文，于　年　月　日解密，解密后适用上述授权。

(　　)2.不保密，适用上述授权。

(请在以上相应括号内打“√”或填上相应内容。保密学位论文应是已经厦门大学保密委员会审定过的学位论文，未经厦门大学保密委员会审定的学位论文均为公开学位论文。此声明栏不填写的，默认为公开学位论文，均适用上述授权。)

声明人(签名):

年　月　日

# 摘　要

从19世纪建立以后，股票市场的涨跌已经成为反映一个国家国民经济的重要指标。它的作用不仅被政府部门所重视，也成为了广大投资者的关注对象。股票价格的变化和未来发展趋势对投资者来说是非常重要的。对股价预测越准确，投资者就能在风险较小的情况下获得较大的利润。股票市场的变化对于国家的国民经济发展和现代化建设也具有举足轻重的作用。因此对股票价格的预测研究，不仅有利于投资者掌握科学的投资方法，帮助投资者进行科学理性的投资，使投资者在风险最小的情况下获得最大的收益，而且在宏观层面上也具有重大的理论意义和诱人的应用前景。

本文以股票价格预测分析为研究的出发点，以广泛应用于预测实践的BP神经网络技术为基础，探讨了基于模拟退火算法优化的BP神经网络股价预测模型的有效性，并讨论了该预测模型相关参数变化对预测结果的影响。文章通过总结和归纳前人研究的基础上，系统分析评述了应用于股票价格预测的各种分析方法。通过对股票价格的各种预测方法和所面临问题的分析，本文提出了基于模拟退火算法优化的BP神经网络股价预测模型。通过对上证指数的实证分析，并与指数平滑法，ARIMA方法等传统时间序列分析方法的比较可知，改进后的BP神经网络具有良好的预测精度和稳定性，能够很好的预测股票价格。之后，文章从两个方面对这个模型做了更进一步研究。首先本文在这个模型的基础之上提出了滚动预测方法，通过将输出值加入到模型输入值中进行滚动预测未来一段时间的股票指数，由于计算机的限制预测结果并不理想，但为投资者进行股票的中短期预测提供了一种新的思路和方法。其次，本文从神经网络参数优化方面考虑对模型进行优化，通过对隐含层层数和所包含神经元个数的研究，本文找到了确定隐含层层数和神经元个数的关键因素，为研究神经网络的最优结构提供新的方向。

**关键词：**神经网络；模拟退火算法；股票预测；参数优化

# Abstract

Since it was established in the 19th century, the stock market has become an important index of national economy. Its effect is not only valued by the government, but also by the majority of the investors. For stock investors, the more accurate of the trend of the future stock price forecasts, the safer of access to the profit and risk aversion; as for the national economic development and financial construction, the stock prediction also has an important role. The study on the intrinsic nature and forecast of the stock has significant theoretical significance and an attractive prospect. By doing that, we can help investors gauge the investment method, enable investors to better predict and analyze the stock market, select stocks for investment, optimize the portfolio to reduce investment risk and gain maximum benefit.

Taken stock price forecasts as the starting point for this research, taken BP neural network that widely used in the practice of prediction as the base, we explore the validity of the stock price forecast model of BP neural network optimized by simulated annealing algorithm, and we discuss the influence to the results of the forecasting model by amending the related parameters. We reviewed the analytical methods used in the stock price prediction systematically by summarizing previous research. By analyzing variety of forecasting methods and the problems faced by the stock price forecast, this paper presents the BP neural network stock prediction model based on simulated annealing optimization. Through an Empirical Analysis of the Shanghai Composite Index, and compared with the exponential smoothing method and ARIMA, the improved BP neural network has good predictive accuracy and stability and can predict the stock price well. After that, the article makes a further study of this forecasting model from two aspects. First, we proposed rolling forecasting methods on the basis of this model, we scroll to predict the future period stock index by adding the output

value into the model input value. Although the prediction results are not satisfactory because of the restriction of the computer, we provide a new way of thinking and methods in the short-term forecasting of stock price. Secondly, we consider optimizing the model by optimizing neural network parameters; we find the key elements to determine the layer number of the hidden layers and the number of neurons in the hidden layers. It also provides new direction to study on the optimal structure of the neural network.

**Keywords:** Neural Networks; Simulated Annealing Algorithm; Stock Prediction; Parameter Optimization

# 参考资料

[1] 孙金丽,张世英.具有结构转换的GARCH模型及其在中国股市中的应用[J].系统工程,2003,21(6):86-91.
[2] 董长虹.神经网络与应用 [M].北京:国防工业出版社,2005.
[3] Cheol-Ho Park, Scott H. Irwin. What do We Know about the Profitability of Technical Analysis? [J]. Journal of Economic Surveys, 2007, 21(4):786-826.
[4] Matsuba I. Application of neural network sequential associate or to long-term stock price prediction [M]. Singapore, 1991.
[5] Gencay. R. Non-linear prediction of security returns with moving average rules [J].Journal of Forecasting, 1996, 15(3):43-46.
[6] Gencay R. The Predictability of Security Returns with simple Technical Trading Rules [J]. Journal of Empirical Finance, 1998, 5(4):347-359.
[7] Gencay R,Stengos T. Moving Average Rules,Volume and the Predictability of Security Returns with Feed forward networks [J]. Journal of Forecasting, 1998a, 17(5):401-414.
[8] Gencay R. Optimization of Technical Trading Strategies and the Profitability in Security Markets [J]. Economic Letters, 1998b, 59(2):249-254.
[9] Rodriguez, Martel. C. On the profitability of technical trading rules based on artificial neural networks: Evidence from the Madrid stock market [J]. Economics Letters, 2000, 69(1): 35-37.
[10] Altay, E. Satman, M. H. Stock market forecasting: Artificial neural networks and linear regression comparison in an emerging market [J]. Journal of Financial Management and Analysis, 2005, 18(2), 18-33.
[11] Chavamakul T,Enke D. Intelligent Technical Analysis Based Equivolume Charting for Stock Trading Using Neural Network [J]. Expert Systems with Applications, 2008, 34(2):1004-1017.
[12]Yakup Kara. Predicting Direction of Stock Price Index Movement using Artificial Neural Networks and Support Vector Machines: The Sample of the Istanbul Stock Exchange [J]. Expert Systems with Applications, 2011(38):5311-5319.
[13] Pei-Chann Chang, Chen-Hao Liu, Jun-Lin Lin, Chin-Yuan Fan, Celeste S.P. Ng. A neural network with a case based dynamic window for stock trading prediction [J]. Expert Systems with Applications.2009 (36):6889 – 6898.
[14] Alejandro Rodriguez-Gonzalez, Angel Garcia-Crespo, Ricardo Colomo-Palacios, Fernando Guldris Iglesias, Juan Miguel Gomez-Berbis . CAST: Using neural networks to improve trading systems based on technical analysis by means of the RSI financial indicator [J]. Expert Systems with Applications, 2011(38):11489-11500.
[15] Jian-Zhou Wang. Forecasting stock indices with back propagation neural network [J]. Expert Systems with Applications, 2011(38):14346-14355.
[16] Wei Shen, Xiaopen Guo. Forecasting stock indices using radial basis function neural networks optimized by artificial fish swarm algorithm [J]. Knowledge-Based Systems, 2011(24):378-385.
[17] Zhe Liao,Jun Wang. Forecasting model of global stock index by stochastic time effective neural network [J]. Expert Systems with Applications, 2010(37):834-841.
[18]徐迪,马大军,李元熹.基于神经元网络的股票市场预测[J].系统工程,1997(11):19-20.
[19]王培勋.非线性回归的弹性分析在股票投资与行情预测中的应用[J].系统工程理论与实践,2000(8):36-38.
[20]刘红梅.ARIMA模型在股票价格预测中的应用[J].广西轻工业,2008(6):18-19.
[21]孙泉,赵旭峰,钱存华.基于多点加权马尔可夫链模型的股价预测分析[J].南京工业大学学报,2008(5):39-41.
[22]尹恕好,陈通,神经网络对我国资本市场有效性及非线性的实证研究[J].经济管理,2005(12):161-165.
[23]欧阳林群.GA神经网络在证券市场预测中的应用研究[J].武汉理工大学报,2006(11):160-163.

[24]余健,郭平.基于RBF网络的金融时间序列预测[J].湖南工程学院学报,2007(4):32-34.
[25]胡静.神经网络在股票市场预测中的应用研究[D].山东:山东师范大学,2007(4).
[26]高琴.人工神经网络在股市预测模型中的应用[J].微电子学与计算机,2007(11):27-29.
[27]潘林.基于小波分析与神经网络的股票市场预测应用研究[D].武汉:武汉理工大学,2006(11).
[28]李婷婷.基于大数集模糊BP神经网络的金融股票市场的预测[J].科技信息,2008(11):44-46.
[29]张立军,苑迪.基于GA-Elman动态回归神经网络的股价预测模型研究[J].华东经济管理,2008(9):43-45.
[30]王志刚,曾勇,李平.中国股票市场技术分析非线性预测能力的实证检验[J].管理工程学报,2009,23(l):149-153.
[31]苏匡,罗元,方楚贤.基于神经网络对我国股票市场技术分析的实证检验[J].当代经济,2010(7):146-147.
[32]赵焕平等.CAR-BPNN在股票价格预测中的应用[J].计算机仿真,2012(01):348-351.
[33]蔡红,陈荣耀.基于PCA-BP神经网络的股票价格预测研究[J].计算机仿真,2011(03):365-368.
[34]朱元.证券投资学原理[M].北京:立新会计图书出版社,2003.
[35]林俊国.证券投资学[M].北京:经济科学出版社,2006.
[36]任淮秀.证券投资学[M].北京:高等教育出版社,2008.
[37]陈之大,贺学会.证券投资技术分析[M].成都:西南财经大学出版社,1996.
[38]何书元.应用时间序列分析[M].北京:北京大学出版社,2003.
[39]周爱民.金融计量学[M].北京:中国统计出版社,2004.
[40]樊智,张世英.非线性协整建模研究及沪深股市实证分析阴[J].管理科学学报,2005,8(1):73-77.
[41]冯定.神经网络专家系统[M].北京:科学出版社,2006.
[42] 马千里,郑启伦,彭宏,钟谭卫.基于相空间重构理论与递归神经网络相结合的股票短期预测方法田[J].计算机应用研究,2007,24(4):239-245.
[43]李春伟,张骏.基于神经网络的股票中期预测[J].计算机工程与科学,2006,28(5):511-513.
[44]张琪昌,王洪礼.分岔与混沌理论及应用[M].天津:天津人学出版社,2005.
[45]王婷婷,钱晓东.时间序列的非线性趋势预测及应用综述[J].计算机工程与设计.2010,31(7):1545-1549.
[46]Altmare, Maeoretal. Corporate distress diagnosis: comparisons using linear discriminate analysis and neural networks [J]. Journal of Banking and Finance, 1994(18):505-529.
[47]朱大奇,史慧.人工神经网络原理及应用[M]. 北京:科学出版社,2006.
[48]王旭等.人工神经元网络原理与应用[M],沈阳:东北大学出版社,2000.
[49]焦李成.神经网络系统理论[M]. 西安:电子科技大学出版社,1990.
[50]韩力群.人工神经网络教程[M]. 北京:北京邮电大学出版社,2006.
[51]葛哲学等.神经网络理论与MATLAB R2007的实现[M].北京:电子工业出版社,2007.
[52]Kirkpatrick, S., Gelatt, C.D., Vecchi, M.P. Optimization by simulated annealing [J]. Science,1983,220(4598):671-680.
[53]杨汉桥,林晓辉.遗传算法与模拟退火法寻优能力综述[J].机械制造与自动化,2010(2) :73-75.
[54]沈波.基于BP神经网络的股价预测应用研究[D].长沙:湖南大学,2010.
[55]刘红梅.ARIMA模型在股票价格预测中的应用[J].广西轻工业,2008(6):18-19.
[56]高铁梅.计量经济分析方法与建模:EViews应用及实例[M].北京:清华大学出版社,2005.