



Financial Risk Modeling With Deep Learning

FE800
Spring 2018
2/1/2018

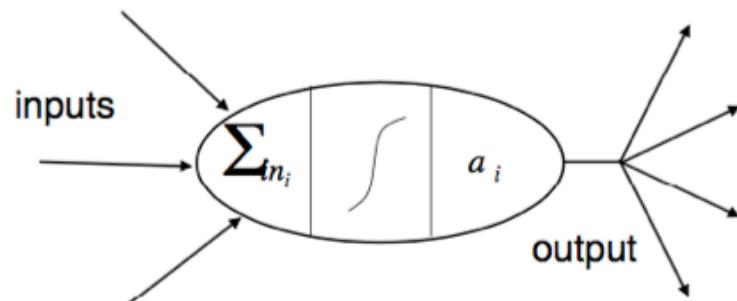
Group 7
Advisor: Dr. Khaldoun Khashanah
Jiaji Dai
Shuda Wang
Huanghaotian Fu



Neural Networks

Neural Networks in Financial Forecasting

- Title: A Neural Network Approach for Credit Risk Evaluation
- Author(s): Eliana Angelini, Giacomo di Tollo, Andrea Roli
- Journal: *The Quarterly Review of Economics and Finance, Volume 48, Issue 4, November 2008, Pages 733-755.*

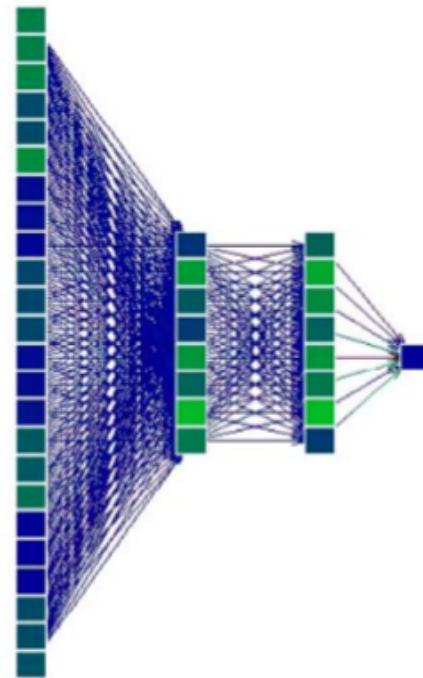


Artificial neuron basic structure.

Neural Networks

Introduction

- Thorough introduction of the neural networks and its network typology, structure, and learning algorithm
- Application of Artificial Neural Network to credit risk assessment



A four layers feedforward network.

Financial Forecasting

Feedforward Artificial Neural Network

- Title: A Combination of Artificial Neural Network and Random Walk Models for Financial Time Series Forecasting
- Author(s): Ratnadip Adhikari, R.K. Agrawal
- Journal: *Neural Computing and Applications, May 2014, Volume 24, Issue 6, Page 1441-1449.*

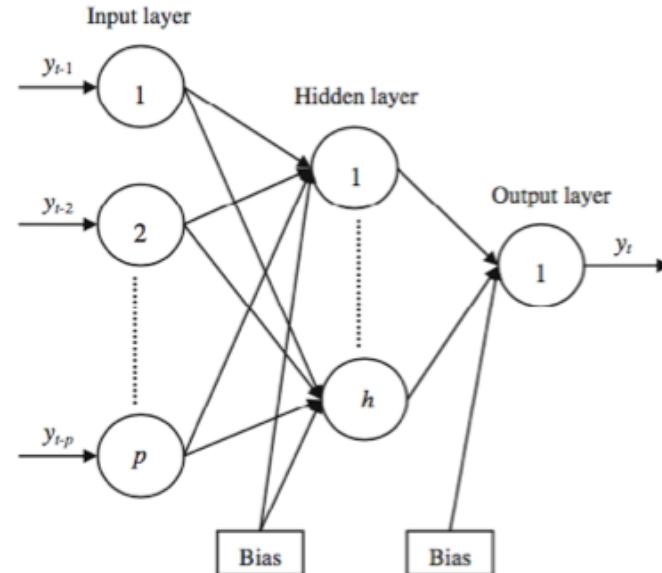


Fig. 1 Structure of a $p \times h \times 1$ MLP network

Financial Forecasting

Random Walk and Artificial Neural Work Model

- Financial forecasting using RW, FANN, and EANN (hybrid model)
- Total Variation = linear part + non-linear part
- Four financial time series data (USD-INR, GBP-USD, S&P 500, IBM)

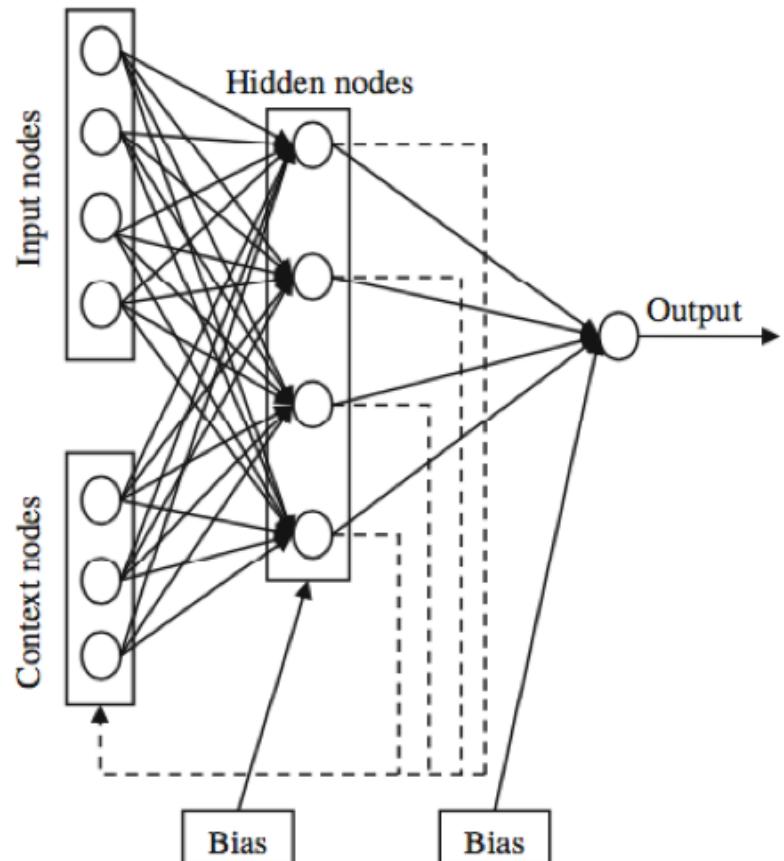


Fig. 2 Architecture of an EANN model



Model Design

Comparing Neural Network with other popular alternatives

- Title: An Artificial Neural Network-GARCH Model for International Stock Return Volatility
- Author(s): R. Glen Donaldson, Mark Kamstarb
- Journal: *Journal of Empirical Finance, January 1997, Volume 4, Issue 1, Page 17-46.*

Model Design

Stock Return Volatility Forecasting

- Seminonparametric nonlinear GARCH model
- ANN has the functional flexibility to capture the nonlinear relationship between past return innovations and future volatility
- Four financial time series data (TSEC, NIKKEI, S&P 500, FTSE)

Method	Forecasted conditional variance				Forecasted standardized returns		
	Mean $\times 10^{-4}$	Std dev $\times 10^{-4}$	Skew	Kurtosis	Std Dev	Skew	Kurtosis
Panel A: S&P500							
Raw data	1.230	9.532	42.679	2042.7	1.000	-2.575	61.484
GARCH	1.143	2.881	13.103	193.41	1.060	-1.042	15.502
EGARCH	0.944	1.159	12.623	241.43	1.105	-1.544	23.425
GJR	1.193	3.607	13.985	220.27	1.059	-0.830	12.097
ANN	1.196	3.688	14.363	232.71	1.059	-0.790	11.626
Panel B: NIKKEI							
Raw data	0.936	6.287	29.380	1034.0	1.000	-0.499	46.154
GARCH	0.929	3.194	15.931	341.95	1.053	-1.024	13.056
EGARCH	0.806	6.127	51.224	2751.6	1.076	-0.761	9.816
GJR	0.912	3.533	18.525	451.06	1.066	-0.728	8.885
ANN	0.850	3.231	20.637	580.83	1.076	-0.735	8.758
Panel C: FTSE							
Raw data	1.200	4.017	22.531	663.96	1.000	-0.901	12.423
GARCH	1.244	1.183	10.147	137.03	0.977	-0.850	11.388
EGARCH	1.211	0.932	9.056	128.04	0.989	-0.789	10.518
GJR	1.257	1.387	11.423	164.79	0.978	-0.811	11.147
ANN	1.270	1.705	14.040	240.56	0.980	-0.737	10.198
Panel D: TSEC							
Raw data	0.762	3.932	22.097	616.25	1.000	-0.418	27.665
GARCH	0.770	1.768	13.489	249.48	1.017	-0.645	8.258
EGARCH	0.687	1.106	12.497	209.68	1.017	-0.602	7.954
GJR	0.772	1.792	13.242	230.53	1.016	-0.647	8.235
ANN	0.765	1.789	13.521	237.71	1.017	-0.666	8.271



References

- Angelini, Eliana, Giacomo Di Tollo, and Andrea Roli. "A Neural Network Approach for Credit Risk Evaluation." *The Quarterly Review of Economics and Finance* 48, no. 4 (November 2008): 733-55.
- Adhikari, Ratnadip, and R.K. Agrawal. "A Combination of Artificial Neural Network and Random Walk Models for Financial Time Series Forecasting." *Neural Computing and Applications* 24, no. 6 (May 2014): 1441-449.
- Donaldson, Glen, and Mark Kamstarb. "An Artificial Neural Network-GARCH Model for International Stock Return Volatility." *Journal of Empirical Finance* 4, no. 1 (January 1997): 17-46.



STEVENS
INSTITUTE *of* TECHNOLOGY
THE INNOVATION UNIVERSITY®

stevens.edu