FTSE 100 Returns and Volatility estimation using Higher Order Neural Networks

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Overview

1. Introduction
2. Modelling
   Returns
   Volatility
3. Data
4. Simulations
5. Results
6. Conclusion
• Returns and Volatility
• Trading *decisions*
• *ARMA-GARCH* widely used in literature
• Financial data is *complex* and *non-linear*
\[ \epsilon_t = \sigma \tilde{z}_t \]
HONNs are functions of the FXPHONN
Generalised AutoRegressive Conditional Heteroskedasticity (GARCH)

\[ \epsilon_t = \sigma_t \epsilon_t \]

\[ LLF = \frac{1}{2} \sum_{t=1}^{N} \left( \log(2\pi \sigma_t) + \frac{\epsilon_t^2}{\sigma_t} \right) \]

Volatility
Data

\[ r_t = 100 \times (\log(p_t) - \log(p_{t-1})) \]
Results: Returns

(a) The residual plot shows a trend over time, with a peak in 2006. The skewness is calculated as -0.3904, and the kurtosis as 7.9794.

(b) The frequency distribution plot indicates that the data is normally distributed with a standard deviation of 1.335.

(c) The autocorrelation coefficients are shown for different lags. The coefficients are close to zero, indicating no significant correlation.

(d) The residual squared plot shows no significant trend, indicating that the residuals are homoscedastic.
Results: Returns 2

AIC

- Linear
- FPXHONN
- CPHONN
- NN
- HorizHONN
- CHONN

RMSEo

- NN
- Linear
- FPXHONN
- CPHONN
- CHONN
- HorizHONN

Hit Rate

- NN
- FPXHONN
- CPHONN
- CHONN
- HorizHONN
- Linear
Results: Volatility

(a) Daily volatility over the years 2002 to 2008.

(b) Frequency distribution of volatility values.

(c) AutoCorrelation Coefficients for standardized residuals.

(d) Standardized Residuals and their squares for different lags.

Results: Volatility
Results: Volatility 2

- Kurtosis = 3.2290
- Skewness = -0.2720
- $\sigma = 1.0007$

<table>
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<tr>
<th>Year</th>
<th>Frequency</th>
<th>Standardized Residual</th>
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<tbody>
<tr>
<td>2002</td>
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<td>0</td>
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<tr>
<td>2004</td>
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<tr>
<td>2006</td>
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<td>2008</td>
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- AIC
- RMSEo
• Higher Order Neural Networks allow for better results compared to Linear models
• Most effective when used to model returns
• NNs provided highest Hit Rates
• Small models give better out-of-sample results
• A combination of HONNs and Volatility estimation models least error and no volatility
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Q&A
This work compared Higher Order Neural Networks (HONN) with Neural Networks, and linear regression for short term forecasting of stock market index daily returns.

Two new HONNs, the Correlation HONN (CHONN) and the Horizontal HONN (HorizHONN) outperform all other models tested in terms of the Akaike Information Criterion, out-of-sample root mean square error, of FTSE100 and NASDAQ giving out-of-sample Hit Rates of up to 60% with AIC improvement up to 6.2%. New hybrid models for volatility estimation are formed by combining CHONN with E/GARCH are compared with conventional EGARCH, providing up to 2.1% and 2.7% AIC improvement for FTSE100 and NASDAQ.