Thomas Delaney – BDC Blog

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**Introduction**

Hi, my name is Thomas Delaney, I’m a PhD student in the University of Bristol, and I did an NIPF/EPSRC funded placement during the summer of 2018.

* **Myself –** I’m originally from Ireland. My PhD is in Computer Science, but I focus on computational neuroscience. I started in September of 2016 and I’m due to graduate in 2020. I did my undergraduate BA in Mathematics in Trinity College Dublin, and I did an MSc in Informatics in the University of Edinburgh. I also worked in finance for 3 years after graduating from Trinity College Dublin.
* **The Host Company, CheckRisk -** CheckRisk is a small, specialist provider of risk services to over £70 billion of risk assets globally. CheckRisk's team of investment professionals have decades of experience within financial markets, asset management, and behavioural finance disciplines. The Data Science department at CheckRisk specialises taking a multi-disciplinary computational approach to address the challenges in financial risk modelling, forecasting, and simulation.
* **Proposed Work -** During the placement, I did research in the most up-to-date time series forecasting techniques. In particular, focussing on ensemble statistical methods, and techniques using recurrent neural networks. My first task was to write a literature review of cutting edge forecasting techniques. My second task was to implement a statistical ensemble technique on some financial data supplied by CheckRisk. My third and final task was to implement a forecasting technique using recurrent neural networks. My primary contact in CheckRisk was Dr. David Greenwood, CheckRisk’s Head of Data Science. Dr. Greenwood has two doctorates, as if one isn’t enough.

**Valuable Experience**

Before going into the details of what I did during the placement, here are the reasons why this placement was such a valuable experience for me:

1. It gave me the chance to do some practical work in an industrial environment after a few years in academia.
2. It allowed me to learn about forecasting and time-series analysis.
3. It allowed me to enhance my knowledge of statistics and machine learning.
4. It gave me a chance to learn the R programming language.
5. The experience I have gained should improve my future employment prospects.
6. It gave me the chance to network with some of CheckRisks’s partners, including learning about the methods used by CheckRisk’s recruiting partners.
7. Dr. Greenwood and CheckRisk are willing to provide me with a positive reference when I need it in the future.

I would 100% recommend a placement like this to other PhD students. Some of the skills you learn will probably be applicable to your PhD, and the experience and contacts will be useful in your post-PhD life.

**Month 1: Literature Review**

I started on the 16th of July. My first task was to prepare a literature review of the most up-to-date forecasting methods. This took the first five weeks of the placement. Dr. Greenwood recommended that I take a look at the results of the recent ‘M4 Competition’, a competition for forecasting methods, in order to familiarise myself with advanced methods. It was clear that I needed to research ensemble forecasting methods, and hybrids of statistical and machine learning methods. Firstly I learned about the basic methods of forecasting, and how these methods are combined to create ensemble forecasting methods. Then I learned about recurrent neural networks. Then, through learning about the winner of the M4 competition, I learned about how these neural networks are combined with statistical forecasting to create ‘hybrid’ methods. Throughout the month I prepared documentation on everything I learned and collaborated with Dr. Greenwood when finishing the document.

* **What did I learn:** During this month, I learned a great deal about forecasting; something that I had never studied before. Not only did I learn about the forecasting methods, but I also learned in which industries forecasting is necessary, and which methods are more useful in what contexts.

**Month 2: Implementation of Meta-Learning Method**

For the second month of the placement, I implemented the runner-up of the M4 competition. The method is called the ‘Meta-Learning Method’ because, given a set of features from a time-series, it learns the best statistical method to use for forecasting that time-series. Our main objective was to assess how useful the Meta-Leaning method is for financial forecasting specifically.

To achieve this, I used real-world financial data provided by CheckRisk, and trained a version of the method using financial data only. I compared the performance of the meta-learning method to the simpler forecasting methods used in the meta-learning framework. We also had a secondary aim to see if any ‘transfer-learning’ was possible, that is, to see if the method’s performance on financial data could be improved by using non-financial data in training.

* What did I learn: During this month I learned a lot about three things.
  + The methods used in financial forecasting and the limitations on those methods.
  + The statistical side of forecasting.
  + How to use the programming language ‘R’.

**Month 3: Implementation of Statistical-Machine Learning Hybrid Method**

During the last month of the placement, I learned about the machine learning methods used in forecasting. Specifically, I learned about recurrent neural networks such as LSTM networks, GRU networks, and JANET networks. I also learned about the winner of the M4 competition, which is a hybrid statistical-machine learning method that uses statistics to capture the trend and amplitude components of a time-series, and uses a recurrent neural network to forecast the volatility and any cyclic elements. I then implemented a simplified hybrid statistical-machine learning method using a GRU network, and compared the performance of this method to simpler statistical methods.

* **What did I learn:** This last month was great for adding to my previous knowledge of neural networks, and getting a chance to implement a neural network as opposed to the theoretical work that I usually undertake.