Report on **Bachelor / Master Thesis**

Institute of Economic Studies, Faculty of Social Sciences, Charles University

Student:	**Martin Nedvěd**
Advisor:	**doc. PhDr. Jozef Baruník, Ph.D.**
Title of the thesis:	**Predictability of financial returns across horizons using Deep Learning**

OVERALL ASSESSMENT *(provided in English, Czech, or Slovak):*

Short summary

The aim of this thesis is to investigate the predictability of financial returns. The method used to predict returns is a Long Short-Term Memory (LSTM) network. This machine learning technique is used as it can exploit the different horizon dependencies of the financial time series. Interestingly, the author combines deep neutral networks with fractional differentiation. The results show that LSTM networks work better for shorter horizon forecasting.

Contribution
The strong contribution of the thesis lies in the precise demonstration of how deep learning models can predict financial returns time series when the features are differenced by a factor less than one. The thesis shows that LMTS networks are mostly effective for predicting short-term financial returns. For long-term horizons, the predictive performance is not as high.

Methods
In his thesis, Martin uses advanced machine learning methods to forecast financial returns. Although this task is very challenging for financial time series (high noise ratio, jumps, etc.), Martin applies the methods correctly and the good work in fine-tuning the network leads to promising forecasting results. I appreciate the fractional differentiation of the time series. Using differences with a factor less than one can preserve a significant part of the memory in the time series and it can further improve the predictive capabilities of the models.

Literature
Martin uses relevant and recent literature and quates in a proper way. Furthermore, the literatere review has is above the average.

Manuscript form
The manuscript has a logical structure. The thesis is properly motivated. In general, the text is easy to read, but the results section could be clearer for the reader in some places. However, I understand that it is not easy to describe all important results in this section.

Overall evaluation and suggested questions for the discussion during the defense

Overall, the thesis is an excellent piece of work. Martin shows above all doubts that he understands the literature, applies the methodology correctly and interprets the results in a correct way. In my opinion, the thesis fulfils the requirements for a bachelor thesis at the IES, Faculty of Social Sciences, Charles University, I recommend it for defence and propose a grade of A. The results of the Turnitin analysis do not indicate any significant similarity of the text with other available sources.

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SUMMARY OF POINTS AWARDED *(for details, see below):*

CATEGORY		**POINTS**
Contribution	*(max. 30 points)*	30
Methods	*(max. 30 points)*	30
Literature	*(max. 20 points)*	20
Manuscript Form	*(max. 20 points)*	19
TOTAL POINTS	*(max. 100 points)*	**99**
GRADE	**(A – B – C – D – E – F)**	**A**

NAME OF THE REFEREE: Lukáš Vácha

DATE OF EVALUATION: 8.9.2024

Digitálně podepsáno (8.9.2024)
Lukáš Vácha

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Referee Signature

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EXPLANATION OF CATEGORIES AND SCALE:

CONTRIBUTION: *The author presents original ideas on the topic demonstrating critical thinking and ability to draw conclusions based on the knowledge of relevant theory and empirics. There is a distinct value added of the thesis.*

METHODS: *The tools used are relevant to the research question being investigated, and adequate to the author's level of studies. The thesis topic is comprehensively analyzed.*

LITERATURE REVIEW: *The thesis demonstrates author's full understanding and command of recent literature. The author quotes relevant literature in a proper way.*

MANUSCRIPT FORM: *The thesis is well structured. The student uses appropriate language and style, including academic format for graphs and tables. The text effectively refers to graphs and tables and disposes with a complete bibliography.*

Overall grading:

TOTAL	**GRADE**
91 – 100	**A**
81 - 90	**B**
71 - 80	**C**
61 – 70	**D**
51 – 60	**E**
0 – 50	**F**