Report on Bachelor / Master Thesis

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

Student:	**Iordosopol Ana**
Advisor:	**Prof. PhDr. Ladislav Krištoufek, Ph.D.**
Title of the thesis:	**Non-Fungible Tokens (NFTs): A hype or hope? Analysis of random NFT portfolios**

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

Short summary

The thesis consists of extensive overview of the NFTs history and current development, its advantages and challenges compared to other assets. The author uses daily data from 2021 and 2022 for two cryptocurrencies and several NFTs categories.

Minimum variance, Maximum return, mean-variance and equal weighted portfolios are selected firstly just cryptocurrencies without NFTs and then with NFTs included. These optimal portfolios were selected from a subset of portfolios which were randomly generated, they are rebalanced monthly and out-of-sample. From these results, it seems that adding NFTs to our portfolio would not improve the performance of our portfolio.

Contribution

The thesis is mainly descriptive of NFTs. It introduces the topic of NFTs to the reader. In the empirical part we can see several portfolios based on different constraints, with and without NFTs and we can see the difference in their performance.

Methods

The thesis discusses using random portfolios as a performance measure. This method is a way to compare the performance of particular portfolio against a number of random portfolios with the same constraints and thus it can be a measure of investors skill.

The author generates a number of portfolios without and with NFTs included.
Optimal portfolios (based on minimum variance, maximum return and mean-variance constraints) were selected from these random porfolios and we see a comparison of these portfolios when they can include NFTs and when they cannot. The final porfolio returns are out of sample (optimization is based on the previous month of data) and the weights can change each month. The random portfolios that were generated are used as a way to limit the space of possible portfolios when finding these optimal portfolios.

There are two hypothesis stated in the thesis:

1) The optimal portfolios will contain NFTs if they are allowed to.
2) Optimal portfolios with NFTs and cryptocurrencies will have better performance than optimal portfolios with cryptocurrencies only.

I miss a comparison of these selected portfolios with the set of random portfolios. Even though this seems to be discussed on p.46, this approach does not appear later on in the empirical part. Because of this inconsistency, I am not sure the author fully understands the methods applied.

Literature

The general overview of the NFTs is presented as well as literature related to viability of NFTs as financial asset, its valuation and its connectedness of other types of assets. The author also provides an overview of performance measurement using random portfolios but this is not later used in the empirical part.

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Manuscript form

The whole thesis has around 70 standardized pages of text. Writing in a more compact way would improve the reading experience. Tables and figures are low quality and not self-contained, there is inconstistent spacing between paragraphs, and things like: *"Chyba! Nenalezen zdroj odkazů.."*.

The english language itself is mostly fine in this thesis. However, the connection between individual sentences inside the paragraphs and between sections would improve the flow of the text and its readability. R code and data are included, the code works and its outputs correspond to the presented outputs in the empirical section.

The ordering of the chapters and subsections could be improved. For example, section 'Research Objectives' seems out of place and unclear. The two hypothesis stated here are based on the methodology and terms which were not introduced yet.

The author cites the literature used, however does not adhere fully to the citation standards and there are multiple mistakes. For example:

- Incorrect in text citations. For example Nadini (2022) should be Nadini et al. (2022). Incorrectly used parenthesis of some of the in-text citations.
- Hor et al. (2022) (six authors) are cited in text as Gecko 2022. In the references section it mentions only the first author by name.
- In text I found Dowling 2021a and Downing 2022a. In references there are two Dowling 2022 entries but one of them with wrong first name.
- Newspaper articles and similar resources are cited as footnotes only – only the URL is provided in the footnotes.
- Chohan and Paschen (2022) or Zamyatin et al. (2021) are only in the references section
- Rubinstein and Kroese (2016) is mentioned in text but missing from the references section.

Minor comments:

- Writing out S&P 500 Index instead of the ticker SPX would be more clear in the text. (p15)
- DeFi was written out in unabreviated form only after it was mentioned twice in the text in its short form.
- The summary statistics are missing skewness and kurtosis.

Suggested questions/topics for the discussion during the defense:

- The price of CryptoPunks or other NTFs groups is only an estimate – an average price of cryptopunks which were sold that day. This time series is then highly dependent on the liquidity of the market (and does change rapidly based on whether the most expensive NTFs were traded that day or not). Is there other way of obtaining NFTs data that would alleviate this problem? Are these estimated prices and their corresponding returns comparable to bitcoin or other assets? If we wanted to diversify our portfolio using NFTs, how would it work?

- The time series of prices are smoothed (exponential moving average with manually selected smoothing period of 7 and 10 days for crypto and NTF respectively) and outliers in returns are replaced with median value. What is the motivation behind this? How does it affect the variance of the returns? How does it affect the final results? How is this problem treated in relevant literature? What could be better value than median to replace the return outliers with?

- Show what happens if you apply EWMA on the time series of prices and then take returns. How can we interpret these returns? Or to keep things simpler, consider moving average(2).

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- Can you explain why is the covariance between the daily prices much higher than covariance between returns (figures 10 and 11)?

- Following the discussion of descriptive statistics on p.55: If we are minimizing volatility of the portfolio, is it possible that addition of higher volatility asset into a portfolio could help lower the overall volatility of the portfolio?

- Regarding the second hypothesis you conclude *''Given all that, we the hypothesis of a better performance of portfolios with NFTs included has to be rejected.''* Discuss how you arrive at this conclusion. Could you formally test your hypothesis?

In my view, the thesis does fullfil the requirements for a bachelor thesis at IES, Faculty of Social Sciences, Charles University; That is, I suggest a grade E.

The results of the Turnitin analysis do indicate significant text similarity with other available sources. This is mainly regarding pages 33-37 where author uses parts coming from other sources with only minor adjustments. These sources all seem to be cited in the thesis but the parts were not quoted.

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

CATEGORY		**POINTS**
Contribution	*(max. 30 points)*	16
Methods	*(max. 30 points)*	20
Literature	*(max. 20 points)*	15
Manuscript Form	*(max. 20 points)*	10
TOTAL POINTS	*(max. 100 points)*	**61**
GRADE	**(A – B – C – D – E – F)**	**D**

NAME OF THE REFEREE: Lenka Nechvátalová

DATE OF EVALUATION: 13.1.2023

Digitally signed (13.1.2023):
Lenka Nechvátalová

Referee Signature

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**