

Project 3: Portfolio management

1 Outline Brief

The project task is to formulate and evaluate a detailed strategy for the following scenario associated with a group syndicate to play in a lottery. Two and a half years ago, at the start of your degree, you as a group made an agreement to buy a lottery ticket every week and if you win a substantial amount of money, you would invest most of it as a group so that your wealth grows further over the following 5 to 10 year period. Last week your group won a lottery and you decided to collectively invest 10M GBP of the 12.5M prize money. Using this 10M GBP, you would like to create and then successfully manage a stock portfolio yourselves with the aim of having a good return in about ten years' time. Before committing the money to form a portfolio, you (as trained mathematicians with good knowledge of finance) decided to first do a detailed study of possibilities on the market and create and test a prototype of your future portfolio management system.

2 Task

To create and test the prototype, you decided to use data available at the yahoo finance web-site¹. You are aiming at (i) a recipe to pick stocks such that your portfolio is likely to be profitable for some period of time and is to carry low risk of loss of your initial investment² and at (ii) an algorithm for regular adjustments of the portfolio reflecting changes on the market. These two tasks are related. Note that these tasks are typical for Asset Management firms (and there are many students' competitions in this area).

In your first prototype you may assume, e.g., that there is no transaction costs in adjusting your portfolio but your final prototype could be more sophisticated.

To have confidence in the prototype before using real money, you need to test it on real data from, e.g., yahoo finance, by using a part of data for calibration of your prototype and the other part – for testing (i.e. doing so-called back testing). You start with back testing and then you can do some real-time test runs of your system as well. An ideal prototype would take data automatically from yahoo and have an interface which is easy to use.

In creating the prototype, you will be using your knowledge of financial markets, including understanding of stock behaviour and knowledge of ideas from financial engineering; statistical analysis, including time series analysis; optimisation; computational skills. For analysis of financial data and for creating the prototype itself, you may use any software and its choice should be driven by demands of tasks you will be dealing with and also by the expertise available within the group.

It is expected that the group will not know much about available types of stocks as well as of theories related to portfolio management. An important first task is to search for and comprehend the corresponding information using various bibliographic sources. To help you, some initial references are provided at the end of this description but there are a lot of other sources (books, research papers, Web-sites, videos on youtube and so on).

3 Deliverables

The task deliverables should illustrate the group competence in financial modelling, facilitation of informative quantitative decision making, in using statistical and mathematical tools at the level expected of a recent mathematics graduate as well as identify further development.

¹It is permitted to use any other data source which is freely available and which could help in creating the system.

²As a group, you might decide to risk a part or all of your initial investment in order to aim for a higher return. Then you may adjust the task accordingly.

The Group should provide **(i)** a substantial but concise technical report on your solution to the task. **(ii)** A working piece of software (if you wish so, it could be implemented in different computer languages/packages but should have some automatic/semi-automatic connectivity) which is an implementation of your algorithms for portfolio selection and adjustment according to changes on the market. The software should be accompanied by a one-page users' guide as an Appendix to a substantial project report. The user guide should specify all the details (e.g. all packages needed to run the software, version of the programming environment used, etc.) allowing the assessors to test the software. **(iii)** An oral presentation. The report is expected to be a maximum of 25 pages of text (i.e., not counting appendices or table of contents, it should be single-spaced in 12pt font). The oral presentation is maximum of 15 minutes.

You are required to provide an oral report supported by a Powerpoint presentation of your project outcomes during the Workshop Session, Friday 15th March 2024 from 9am, and prepared to answer questions.

References

- [1] Bennett, M.J., Hugen, D.L. Financial analytics with R. Cambridge University Press, 2016. [available as ebook at UoN]
- [2] Bodie Z., Kane A., Marcus, A.J. Investments. McGraw, 2014. [several copies are available at Business Library]
- [3] Brodie, J., Daubechies I., De Mol C., Giannone, D., Loris I. Sparse and stable Markowitz portfolios. PNAS vol. 106, no. 30 (2009), 12267-12272. [research article available via UoN or google]
- [4] Elton, E.J., Gruber M.J., Brown S.J., Goetzmann, W.N. Modern portfolio theory and investment analysis. Wiley. [several copies of various editions are available at Business Library and Hallward Library]
- [5] Francis, J.C., Kim, D. Modern portfolio theory: foundations, analysis, and new developments + website. [available as ebook at UoN and a few copies at Business Library]
- [6] Johnson, R.S. Equity markets and portfolio analysis. Bloomberg Press, 2014. [available as ebook at UoN]
- [7] Markowitz, H.M. Harry Markowitz: selected works, World Scientific, 2008. [available as ebook at UoN]