

## 1 The Assignment Task and Instructions

### Japan's Silver Century: Shaping a Prosperous and Healthy Ageing [100 marks]

In the picturesque landscape of Japan, a nation renowned for its remarkable longevity, an enduring financial challenge takes centre stage. With one of the world's highest increasing populations of centenarians as depicted in Figure 1 below, Japan finds itself at the forefront of confronting the intricacies of an ageing society. Here, people are not just living longer, they are also seeking for extended years of vibrant health and vitality. However, this demographic shift has raised a profound and unprecedented challenge in the realm of pension management.

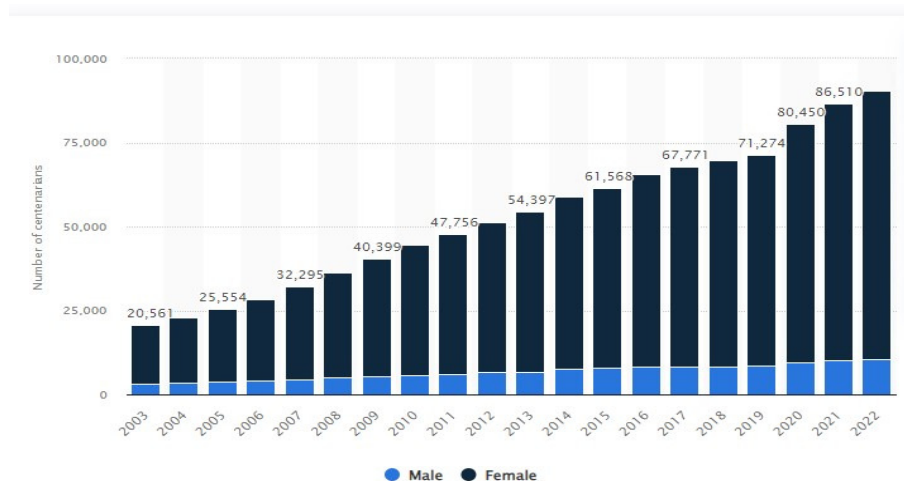


Figure 1: Number of people aged 100 years and older in Japan from 2003 to 2022 by gender: Source [www.statista.com](http://www.statista.com)

Japan's pension system provides a vital lifeline through a basic pension. Yet, as individuals advance in age, the pursuit of a satisfactory quality of life takes on a poignant

significance. The cost of maintaining a decent lifestyle, particularly in terms of soaring medical expenses which increases with age, the complexities of healthcare access, and the noble inflations, has never been more apparent. In response to this pressing issue, majority of the elderly in Japan significantly postpone their retirement to ensure a secure financial future. The aspiration to retire gracefully at a conventional age necessitates the implementation of sophisticated financial strategies and forward-thinking planning well in advance of retirement. As individuals approach retirement, a pivotal phase begins. With a pre-retirement investment horizon spanning from approximately age 40 to 65, one must navigate the complexities of financial markets to secure their financial future. Assume that the current capital of your client is 50,000,000 Yen, as an actuary, you are tasked with investing this capital in a portfolio consisting of securities listed on the Tokyo Stock Exchange (TSE) whose benchmark is the Nikkei 225 Index.

Your investment philosophy will be premised around Harry Markowitz's mean-variance theory. Your task in this assignment is to construct a resilient and well-balanced portfolio consisting of 25 stocks listed on TSE which you can choose from the Assignment Data Folder on the course Moodle site. The choices are limitless, with a wealth of data at your disposal to enhance your financial decision making and portfolio selection. Weekly adjusted closing prices for various stocks listed on the TSE are available from the beginning of 2013 to the 1st of September 2023.

- Using your knowledge of the markets, pick 25 stocks from the Tokyo Stock Exchange (TSE) that can form your dream resilient and well-diversified portfolio.
- You are expected to provide justification of your stock selection highlighting why you have included them in your portfolio. You may utilise publicly available information such as annual reports. You are required to cite where possible to mitigate plagiarism/ poor authorship.
- From the dataset, extract the weekly adjusted closing prices for each stock you have chosen for the period from the beginning of 2013 to the 1st of September 2023.
- After constructing the Japanese portfolio, later questions require you to explore the option of adding stocks from another market to further diversify the portfolio. The chosen market is the vibrant Vietnamese market. Vietnam, in stark contrast to Japan's mature and ageing population, boasts a thriving economy and a youthful, dynamic workforce. To introduce this diversification, you can utilise the Vietnamese listed stocks from the Assignment Data Folder on the course Moodle site.

- Other datasets in the Assignment Data Folder include the exchange rates from Vietnamese Dongs (VDN) to Japanese Yen (JPY), the closing level for the Nikkei 225 Index which is the benchmark in TSE, and the Japan 3-month Government Bond yields.
- Note that for all data analyses in this work, you can ignore any minor misalignments in trading days between different sources of datasets or reasonably adjust the data by yourself.

**Use the TSE stocks to answer 1 - 6 below.**

1. Compute the weekly continuously compounded returns and the corresponding per annum expected return and standard deviation for each stock in your portfolio.
2. What are the weights of each stock in TSE stock only portfolio yielding an expected return of 15% p.a.?
3. Graph the minimum variance frontier for short sales allowed combinations of your stock portfolio.
4. Plot each of the stocks in your portfolio on the risk (standard deviation) - expected return space. Which stocks are mean-variance efficient?
5. Find the weights of the minimum variance portfolio (MVP) where short sales are allowed.
6. Show that an equally weighted portfolio lies inside the minimum variance frontier.

**Questions 7 - 11 involves the TSE Stocks and Stocks on the Vietnamese Stock Exchange.**

7. As highlighted about, Vietnam is an emerging and vibrant economy with high potential for growth. With your diversification mindset, pick 5 stocks from the Vietnamese stock exchange you think may enhance the performance of your portfolio, and justify your selection.
8. Use weekly data for the five Vietnamese stocks and the exchange rate to compute weekly continuously compounded returns for the Vietnamese stocks denominated in Japanese Yen (JPY). Compute annual expected returns and standard deviation of returns for these stocks.

9. Add the Vietnamese stocks to your 25 stock short sales allowed portfolio. Identify the best portfolio with an expected return of 15% p.a. How much risk was eliminated with the addition of the Vietnamese stocks?
10. Plot on the same figure, the minimum variance frontier for
  - (a) the 25-asset short sales allowed portfolio,
  - (b) the 30-asset portfolio (includes the Vietnamese stocks).
11. Using the 30 assets, compute the short sales allowed weights in the best portfolio with an expected return of 15% p.a., where the sum of weights for the Vietnamese stocks is restricted to be less or equal to 6% of the portfolio.

**Questions 12 - 16 involves the TSE Stocks.**

12. Using the 25 TSE stocks, compute the short sales allowed weights for the best portfolio with an expected return of 15% p.a., where the sum of the weights of *Technology and Electronics* stocks is restricted to be at most 10%.
13. Using the 25 TSE stocks, compute and plot the short sales allowed minimum variance frontier where the sum of the weights of *Technology and Electronics* stocks is restricted to be at most 10%. Compare this frontier with the unrestricted frontier.
14. Using the 25 TSE stocks, compute the weights associated with a short-sales not allowed portfolio yielding a return of 15% p.a. Comment on the differences between this weight vector and its short sales allowed equivalent.
15. Compare and contrast the MVP weights for
  - (a) the short sales allowed and
  - (b) the short sales not allowed portfolios consisting of TSE stocks.
16. Following on from 15. above, overlay the short sales allowed minimum variance frontier on the short sales not allowed minimum variance plot. Where does the short sales not allowed restriction cause the greatest and least increase in optimal portfolio risk?

**Questions 17 - 22 involves the TSE Stocks, The Nikkei 225 Index and the Japan 3-month Government Bond.**

17. For the period from the beginning of 2013 to the 1<sup>st</sup> of September 2023, compute weekly holding period returns for the Japan 3-month government bond rates (you need to research on how to compute holding period returns for bonds). What is the per annum average return and standard deviation of the government bond returns?
18. Plot the no short sales allowed minimum variance frontier for a portfolio consisting of 25 TSE stocks plus the government bond.
19. Compare the composition and risk associated with the no short sales portfolios, with a target return of 15% p.a., constructed from
  - (a) 25 stocks,
  - (b) 25 stocks plus 90-day government bond.
20. Compare the composition and risk associated with the no short sales minimum variance portfolios constructed from
  - (a) 25 stocks,
  - (b) 25 stocks plus 90-day government bond.
21. Plot the minimum variance frontier for the 30 stocks (25 TSE stocks plus the Vietnamese stocks) and the 90-day government bond, no short sales allowed portfolio
  - (a) unconstrained,
  - (b) with the constraint that equity comprises 95% of the portfolio.
22. Examine and plot on a histogram the weights of a no short sales allowed portfolio consisting of 30 assets and the 90-day government bond, with a target return of 15% p.a.
  - (a) unconstrained,
  - (b) with the constraint that equity comprises 95% of the portfolio.

**Questions 23 - 25 look at the proposition that expected return is positively related to systematic risk. This notion is central to the capital asset pricing model (CAPM). The next question estimates a Japanese security market line (SML) using the 25 stocks.**

23. Using the Nikkei 225 Index, calculate beta for each of the 25 stocks.

24. Decompose the risk of each stock into a systematic and unsystematic component. Comment upon your results.
25. Estimate a SML by regressing expected return for the 25 stocks. Based on the SML, which stocks seem overpriced and which seem underpriced? What is the implied risk-free rate?

## 2 Submission Requirements

You are expected to submit two files:

1. A PDF file that justifies your selection of stocks (see the first page). In the file you must also summarise key findings from your analyses. The page limit for this file is 5 pages excluding cover page and appendices (Times News Roman font, 12pt font size, 1.5 line spacing).
2. An Excel spreadsheet/ R markdown that contains your analyses and answers for above questions. Marks will be awarded based on the presentation and clarity of your PDF file and your Excel spreadsheet/ R markdown as detailed in the assessment criteria below. Make sure that your responses in either the spreadsheet/ R markdown file are easy to follow. The best way would be to organise the responses chronologically (e.g. each question per “Sheet” on your spreadsheet).

## 3 Assignment Submission Procedure

Assignment reports must be submitted via the Moodle submission box that will be activated on the Course Website. Students are reminded of the risk that technical issues may delay or even prevent their submission (such as internet connection and/or computer breakdowns). Students should then consider allowing enough time (at least 24 hours is recommended) between their submission and the due time.

### **Late Submission**

The submission deadline is 11:59pm of the 10<sup>th</sup> of November 2023. Late submissions will be dealt with according to the school policy as detailed in the course outline.

## 4 Assessment Criteria

Your assignment report will be assessed using the following criteria:

1. Clear and concise justification of stock selection and summary of key findings in the PDF file. [25 marks]
2. Accurate presentation of results in excel or R. [50 marks]
3. Presentation of solutions in excel or R. [20 marks]
4. Follow the formatting and page limit requirements. [5 marks]