MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
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# REPORT ON

# INVESTMENT MANAGEMENT

**TOPIC:** ***Planning a Client's Wealth Over a 5-year Horizon***

## CAPSTONE PROJECT
## BY
## THE UNIVERSITY OF GENEVA

***Submitted by***

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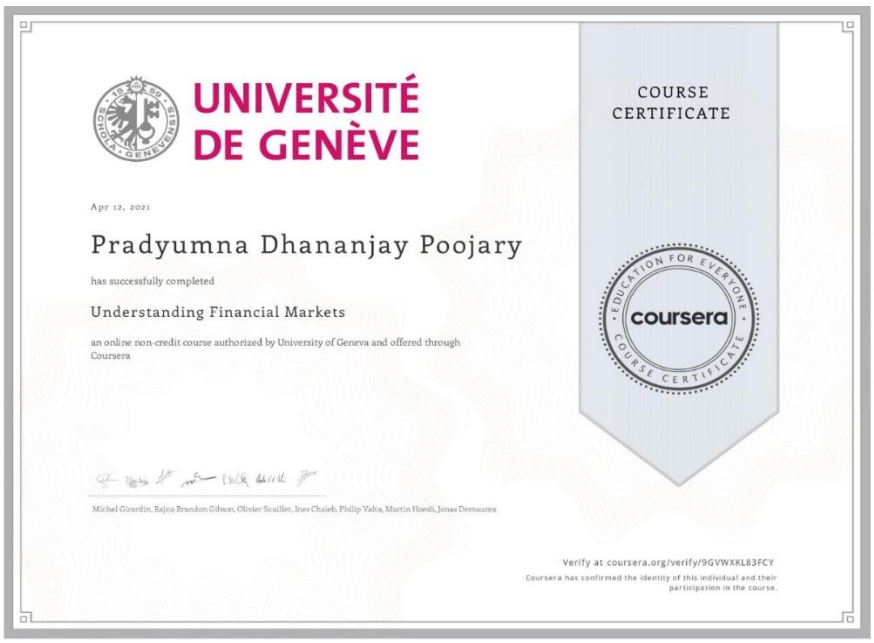
July-2021

# CERTIFICATES

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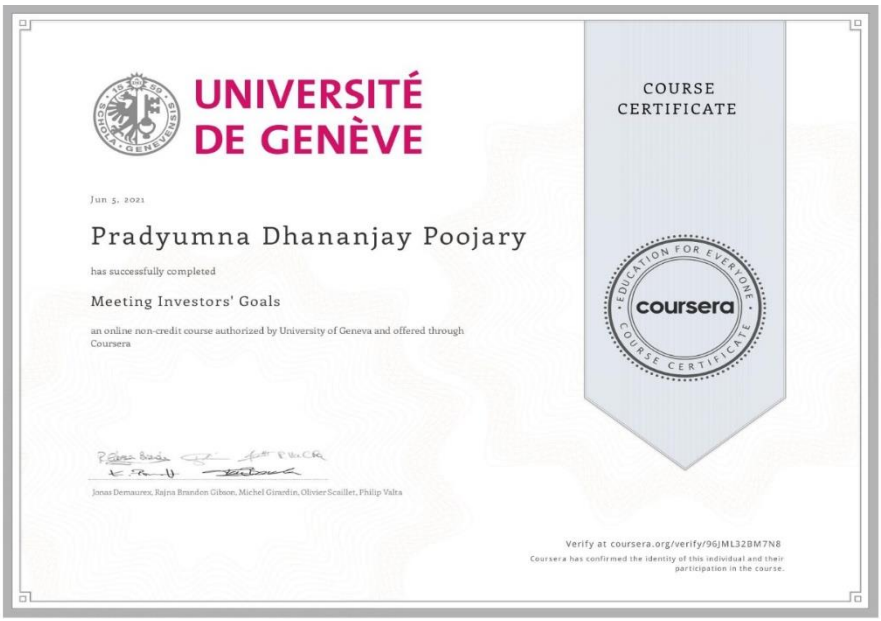


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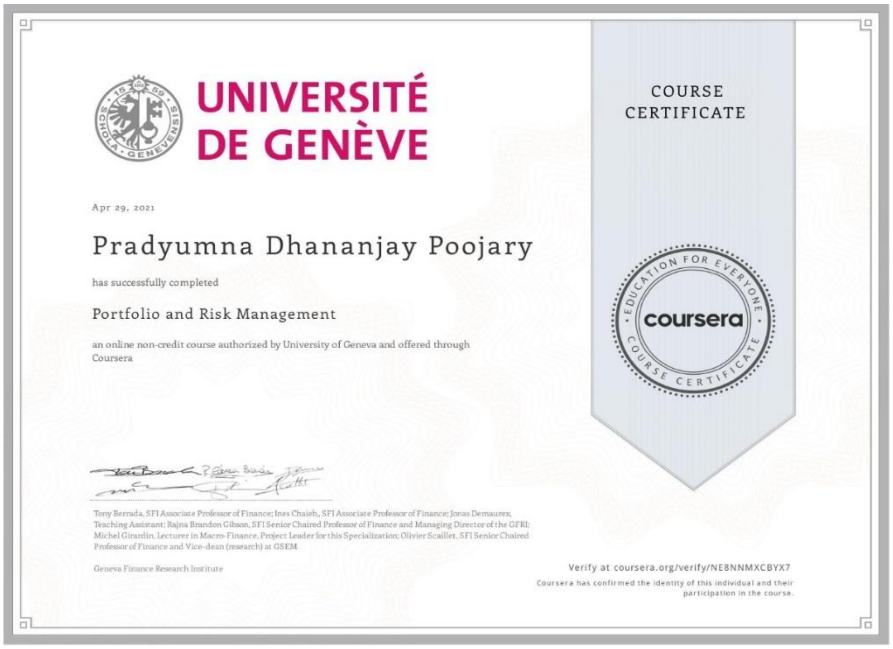

UNIVERSITÉ DE GENÈVE

COURSE CERTIFICATE

Apr 29, 2021

Pradyumna Dhananjay Poojary

has successfully completed

Portfolio and Risk Management

an online non-credit course authorized by University of Geneva and offered through Coursera

Tony Berrada, SFI Associate Professor of Finance; Ines Chaieb, SFI Associate Professor of Finance; Jonas Demaurex, Teaching Assistant; Rajna Brandon Gibson, SFI Senior Chaired Professor of Finance and Managing Director of the GFRI; Michel Girardin, Lecturer in Macro-Finance, Project Leader for this Specialization; Olivier Scaillet, SFI Senior Chaired Professor of Finance and Vice-dean (research) at GSEM

Geneva Finance Research Institute

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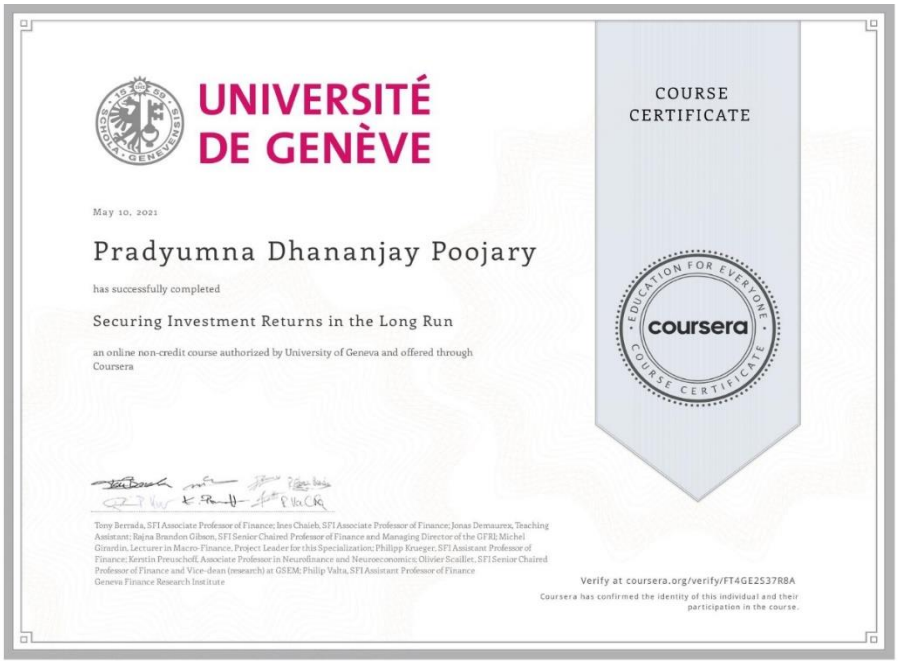
*URL:* https://coursera.org/share/efccc94ab6793da6605ae8f09d48f5c4



UNIVERSITÉ DE GENÈVE

COURSE CERTIFICATE

May 10, 2021

Pradyumna Dhananjay Poojary

has successfully completed

Securing Investment Returns in the Long Run

an online non-credit course authorized by University of Geneva and offered through Coursera

Tony Berrada, SFI Associate Professor of Finance; Ines Chaieb, SFI Associate Professor of Finance; Jonas Demaurex, Teaching Assistant; Rajna Brandon Gibson, SFI Senior Chaired Professor of Finance and Managing Director of the GFRI; Michel Girardin, Lecturer in Macro-Finance, Project Leader for this Specialization; Philipp Krueger, SFI Assistant Professor of Finance; Kerstin Preuschoff, Associate Professor in Neurofinance and Neuroeconomics; Olivier Scaillet, SFI Senior Chaired Professor of Finance and Vice-dean (research) at GSEM; Philip Valta, SFI Assistant Professor of Finance

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# PROBLEM STATEMENT

Planning your client's wealth over a 5-year horizon by initially preparing a client profile, discussing the investment policy, reporting and rebalancing asset allocation and the final reporting using portfolio asset allocation and investment valuation models and techniques.

**Material used to prepare the client profile**:

**Client name: JOHN LAM**

John Lam is a successful 54-year-old commercial lawyer with his own firm. He's married and has two children (aged 19 and 22). He works hard and values the success this has bought him. John lives in an average suburban house and drives a top of the range VW Passat estate; he dresses well but not flashily and his idea of partying is lunch with friends at a restaurant by the lake. John keeps a low profile but acts as a mentor to a number of young lawyers and takes part as a member of various committees in the legal life of the city, but never appears as a spokesperson. His business is successful and the need for detailed attention is less. His goal is now to spend more time with family, friends and children.

John made his money through hard work and he doesn't believe in a free lunch. His total wealth amounts to USD 8mio. He is willing to help his children out in their future entrepreneurial activities, but expects them to make their own way until then. His expenses are covered by his salary and he wishes to grow his wealth through investments but does not think he could stomach to see his portfolio lose more than one third of its value in the process.

You have been working with John for eight years. You have been recommending an investment strategy annually. Five years ago, you suggested the following asset allocation, which was in line with his risk profile at that time: 60% equities, 35% bonds, and 5% cash. John, however, chose to be more aggressive to take advantage of a recent rally in emerging markets and lost almost 40% of his invested assets. Two years ago, you proposed a more conservative strategy. John followed your advice but soon expressed dissatisfaction with missed market trend opportunities and low returns. Last year, when you recommended again a more aggressive strategy with an allocation of 50% equities, 40% bonds, and 10% cash, he actually desired a much more conservative position to respond to a recent concern about decelerating growth in developed countries, requesting 30% equities, 30% bonds, and 40% cash.

Currently, John has the idea that he should go out of consumer equity investments and be more in IT equity investments, which have come into fashion following the latest virtual reality boom and the new wave of social media IPOs. Although he is not an expert in new technologies, John has been an occasional reader of IT magazines ever since he bought shares in several new tech firms. He is confident that their stock price will go past their all-time high which was reached 6 years ago. John has made some good calls over the past decade. He invested in three different successful companies, making decent returns and never keeping his positions open for more than a year. Being a hard worker, John regularly revisits his past fruitful trades and finds that he nearly always had a feeling whether the trades were going to end up being winners or losers. “If only I was able to listen more to my intuition…” he often says. When he talks to you about investments he made, he turns into a storyteller for a moment. Whether big gains or losses, his face lights up as he revisits past trades and remembers the excitement of watching his positions change in value.

## Introduction

The purpose of this Investment Policy Statement is to establish a clear understanding between the client and the wealth manager as to the investment goals and policies applicable to the investor's investment portfolio.

This Investment Policy Statement will:

- Establish reasonable objectives and guidelines in the investment of the investor's assets
- Set forth a target portfolio indicative of the risk levels, allocations and return targets that the client's money will typically be invested to achieve. The customized investment strategy and target portfolio allocation illustrated for you are approximate based on individual cash requirements, re-balancing tolerance, economic and market conditions.

This has been developed from an evaluation of many key factors which impact the investor's specific situation, risk tolerance and investment objectives. This is not a contract, but rather a summary of the investment philosophy that the financial representative will seek to pursue on behalf of the investor.

## Client's Investment Goals

- Mr. John wants to help out his children in their future entrepreneurial activities.
- His expenses are covered by his salary but he wishes to grow his wealth through investments so that he can spend more time with his family, friends and children.
- Triggering emotions ("*When he talks to you about investments he made, he turns into a storyteller for a moment. Whether big gains or losses, his face lights up as he revisits past trades and remembers the excitement of watching his positions change in value.*")
- He does not have any incoming expense in the near future.

## Cognitive Biases and Risk Tolerance

- Recency bias *("Five years ago, you suggested the following asset allocation, which was in line with his risk profile at that time: 60% equities, 35% bonds, and 5% cash. John, however, chose to be more aggressive to take advantage of a recent rally in emerging markets and lost almost 40% of his invested assets. Two years ago, you proposed a more conservative strategy. John followed your advice but soon expressed dissatisfaction with missed market trend opportunities and low returns. Last year, when you recommended again a more aggressive strategy with an allocation of 50% equities, 40% bonds, and 10% cash, he actually desired a much more conservative position to respond to a recent concern about decelerating growth in developed countries, requesting 30% equities, 30% bonds, and 40% cash. Currently, John has the idea that he should go out of consumer equity investments and be*

*more in IT equity investments, which have come into fashion following the latest virtual reality boom and the new wave of social media IPOs.")*

- Disposition effect *("Although he is not an expert in new technologies, John has been an occasional reader of IT magazines ever since he bought shares in several new tech firms. He is confident that their stock price will go past their all-time high which was reached 6 years ago. John has made some good calls over the past decade. He invested in three different successful companies, making decent returns and never keeping his positions open for more than a year.")*

- Hindsight bias *("Being a hard worker, John regularly revisits his past fruitful trades and finds that he nearly always had a feeling whether the trades were going to end up being winners or losers. "If only I was able to listen more to my intuition…" he often says.")*

- Mr. John Lam is susceptible to fear in financial markets as he demands for a more conservative position in his portfolio in response to a recent concern about decelerating growth in developed countries.

Mr. John Lam experiences the Recency bias which occurs while defining the investment universe.
One can overcome this bias using the following methods:

- Don't rely solely on readily available data
- Get out of your comfort zone and
- Do some extensive research

He also experiences the Disposition bias which occurs while adjusting and rebalancing the portfolio over time.
One can overcome this bias using the following methods:

- Stick to your original and carefully designed strategy
- Your buy and sell orders should be dictated by this strategy only

## Investment Profile

Mr John Lam seems to be a balanced investor corresponding to his requests to take advantage of recent market rallies by deviating from the advised investment strategy and his tendency to shift his equity investments into the IT sector which have come in fashion following the latest virtual reality boom and the new wave of social media IPOs but nevertheless maintaining a conservative position in response to a recent concern about decelerating growth in developed countries.

## Age and Retirement Horizon

The following data can be inferred from the profile of Mr. John Lam:

He is currently 54 years old. He intends to now spend more time with his family, friends and children.

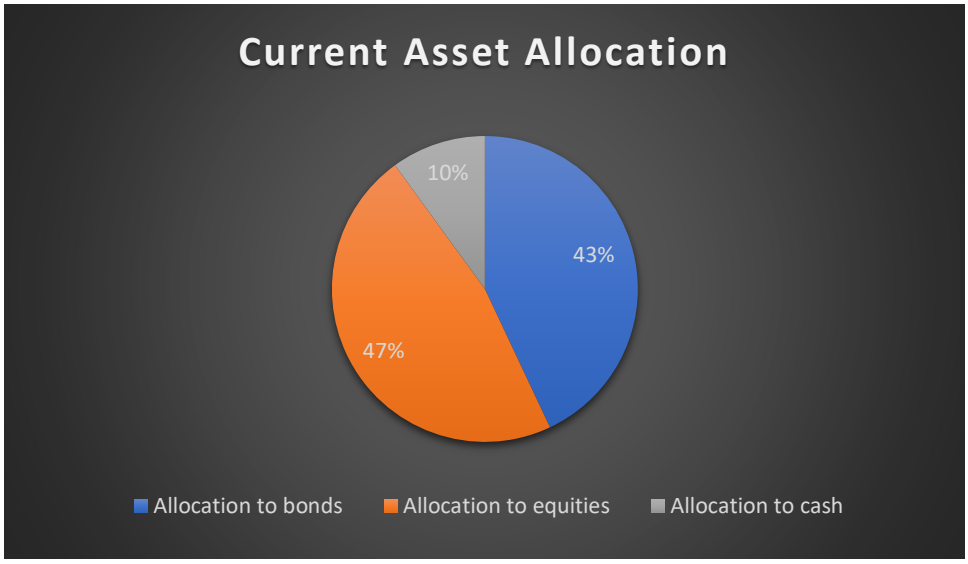
It is critically important to keep the financial representative updated if the retirement objectives begin to change for any reason.

## Asset Allocation

Asset classification is depicted below for the portfolio(s) in this report. The ratios depicted for Stocks, Bonds, Cash, and Other, are reflective of current value for the portfolio(s) shown and are subject to change along with changes to the portfolio value.

Portfolio asset allocations are defined as follows:

- Stocks: Individual equities, along with equity portions of mutual funds and ETFs.
- Bonds: Individual bonds, along with fixed income portions of mutual funds and ETFs.
- Cash: Cash, Money Market funds, along with portions of mutual funds and ETFs allocated to cash. Other: Non-Traded REITs/DPPs, Variable Annuities and any other custom allocation.




To construct portfolios, we need 3 main types of information on financial assets:

- The anticipated (or expected) returns
- The risk associated to those returns which can be measured using the standard deviation of the returns
- The dependence between the returns of the different asset classes.

The following set of data has been used to compute the monthly and yearly returns over the past 11 years:

| | DATE | WORLD BONDS INDEX | WORLD BONDS INDEX | WORLD EQUITIES INDEX | WORLD EQUITIES INDEX | 3-MONTHS CASH USD | 3-MONTHS CASH USD |
|---|---|---|---|---|---|---|---|
| | | price | (holding) return | price | (holding) return | price | (holding) return |
| 1 | 01-01-2050 | 100 | | 100 | | 100 | |
| 2 | 01-02-2050 | 98.5374677 | -1.46% | 102.7858681 | 2.79% | 100.7010138 | 0.70% |
| 3 | 01-03-2050 | 98.60465116 | 0.07% | 101.7153902 | -1.04% | 101.4284099 | 0.72% |
| 4 | 01-04-2050 | 97.23514212 | -1.39% | 102.1575178 | 0.43% | 102.1859571 | 0.75% |
| 5 | 01-05-2050 | 98.52196382 | 1.32% | 103.6309396 | 1.44% | 102.9472732 | 0.75% |
| 6 | 01-06-2050 | 96.44444444 | -2.11% | 101.2627599 | -2.29% | 103.6633626 | 0.70% |
| 7 | 01-07-2050 | 98.38242894 | 2.01% | 101.0650245 | -0.20% | 104.3869898 | 0.70% |
| 8 | 01-08-2050 | 102.8630491 | 4.55% | 110.6843787 | 9.52% | 105.0955414 | 0.68% |
| 9 | 01-09-2050 | 99.40568475 | -3.36% | 108.0461558 | -2.38% | 105.7777108 | 0.65% |
| 10 | 01-10-2050 | 101.2919897 | 1.90% | 110.9061494 | 2.65% | 106.4975691 | 0.68% |
| 11 | 01-11-2050 | 102.1395349 | 0.84% | 106.9441695 | -3.57% | 107.1872762 | 0.65% |
| 12 | 01-12-2050 | 103.0645995 | 0.91% | 111.5902453 | 4.34% | 107.8958278 | 0.66% |
| 13 | 01-01-2051 | 104.3255814 | 1.22% | 114.5891991 | 2.69% | 108.6081483 | 0.66% |
| 14 | 01-02-2051 | 102.9457364 | -1.32% | 109.3820313 | -4.54% | 109.2601666 | 0.60% |
| 15 | 01-03-2051 | 101.3643411 | -1.54% | 103.1439732 | -5.70% | 109.9951004 | 0.67% |
| 16 | 01-04-2051 | 100.3617571 | -0.99% | 94.59327901 | -8.29% | 110.7111898 | 0.65% |
| 17 | 01-05-2051 | 100.0516796 | -0.31% | 96.52862215 | 2.05% | 111.4611993 | 0.68% |
| 18 | 01-06-2051 | 103.374677 | 3.32% | 106.6442338 | 10.48% | 112.1885953 | 0.65% |
| 19 | 01-07-2051 | 105.2713178 | 1.83% | 105.62526 | -0.96% | 112.931067 | 0.66% |
| 20 | 01-08-2051 | 108.5684755 | 3.13% | 105.590722 | -0.03% | 113.6660008 | 0.65% |
| 21 | 01-09-2051 | 107.7209302 | -0.78% | 94.90957492 | -10.12% | 114.3632458 | 0.61% |
| 22 | 01-10-2051 | 108.9250646 | 1.12% | 86.81938817 | -8.52% | 115.0755663 | 0.62% |
| 23 | 01-11-2051 | 113.7932817 | 4.47% | 92.14552035 | 6.13% | 115.7577356 | 0.59% |
| 24 | 01-12-2051 | 115.6795866 | 1.66% | 92.08371541 | -0.07% | 116.4436739 | 0.59% |
| 25 | 01-01-2052 | 116.8217054 | 0.99% | 93.21781598 | 1.23% | 117.1069988 | 0.57% |
| 26 | 01-02-2052 | 119.7416021 | 2.50% | 96.43813648 | 3.45% | 117.6761015 | 0.49% |
| 27 | 01-03-2052 | 119.7777778 | 0.03% | 103.9815716 | 7.82% | 118.2866619 | 0.52% |
| 28 | 01-04-2052 | 115.4263566 | -3.63% | 101.3045691 | -2.57% | 118.8595334 | 0.48% |
| 29 | 01-05-2052 | 117.2041344 | 1.54% | 104.1686023 | 2.83% | 119.4324049 | 0.48% |
| 30 | 01-06-2052 | 117.0542636 | -0.13% | 103.9409743 | -0.22% | 119.986432 | 0.46% |
| 31 | 01-07-2052 | 115.8294574 | -1.05% | 99.43527245 | -4.33% | 120.5593035 | 0.48% |
| 32 | 01-08-2052 | 118.3049096 | 2.14% | 102.2690091 | 2.85% | 121.1246372 | 0.47% |
| 33 | 01-09-2052 | 120.5943152 | 1.94% | 102.2645656 | 0.00% | 121.6635887 | 0.44% |
| 34 | 01-10-2052 | 125.3126615 | 3.91% | 104.8795611 | 2.56% | 122.1987713 | 0.44% |
| 35 | 01-11-2052 | 126.625323 | 1.05% | 105.9657932 | 1.04% | 122.6849584 | 0.40% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 36 | 01-12-2052 | 128.6046512 | 1.56% | 100.8652693 | -4.81% | 123.1447631 | 0.37% |
| 37 | 01-01-2053 | 135.2918863 | 5.20% | 108.1311881 | 7.20% | 123.5706479 | 0.35% |
| 38 | 01-02-2053 | 132.8888372 | -1.78% | 105.8946973 | -2.07% | 123.9550748 | 0.31% |
| 39 | 01-03-2053 | 132.1498708 | -0.56% | 104.0563031 | -1.74% | 124.3771907 | 0.34% |
| 40 | 01-04-2053 | 130.749354 | -1.06% | 97.18565317 | -6.60% | 124.7804621 | 0.32% |
| 41 | 01-05-2053 | 131.6847545 | 0.72% | 99.86487742 | 2.76% | 125.1912712 | 0.33% |
| 42 | 01-06-2053 | 135.7260465 | 3.07% | 103.6392207 | 3.78% | 125.5719293 | 0.30% |
| 43 | 01-07-2053 | 139.5245478 | 2.80% | 101.1207701 | -2.43% | 125.9488185 | 0.30% |
| 44 | 01-08-2053 | 142.7750904 | 2.33% | 100.1191664 | -0.99% | 126.3068632 | 0.28% |
| 45 | 01-09-2053 | 146.7700258 | 2.80% | 102.3158677 | 2.19% | 126.62345 | 0.25% |
| 46 | 01-10-2053 | 148.2428424 | 1.00% | 100.7911437 | -1.49% | 126.9438058 | 0.25% |
| 47 | 01-11-2053 | 144.2168475 | -2.72% | 98.34015342 | -2.43% | 127.2603927 | 0.25% |
| 48 | 01-12-2053 | 141.9275969 | -1.59% | 99.48051528 | 1.16% | 127.6033619 | 0.27% |
| 49 | 01-01-2054 | 142.7750904 | 0.60% | 100.4092053 | 0.93% | 127.9425621 | 0.27% |
| 50 | 01-02-2054 | 144.4924031 | 1.20% | 100.7634729 | 0.35% | 128.2403045 | 0.23% |
| 51 | 01-03-2054 | 148.4455814 | 2.74% | 102.8385841 | 2.06% | 128.5644292 | 0.25% |
| 52 | 01-04-2054 | 150.9177778 | 1.67% | 109.4179832 | 6.40% | 128.8772472 | 0.24% |
| 53 | 01-05-2054 | 154.1314729 | 2.13% | 113.3947074 | 3.63% | 129.2051408 | 0.25% |
| 54 | 01-06-2054 | 155.1487855 | 0.66% | 116.0597933 | 2.35% | 129.5254966 | 0.25% |
| 55 | 01-07-2054 | 154.9235659 | -0.15% | 114.4623576 | -1.38% | 129.8646968 | 0.26% |
| 56 | 01-08-2054 | 156.1457881 | 0.79% | 116.990705 | 2.21% | 130.203897 | 0.26% |
| 57 | 01-09-2054 | 160.0396899 | 2.49% | 121.5933558 | 3.93% | 130.5280217 | 0.25% |
| 58 | 01-10-2054 | 162.0394832 | 1.25% | 119.6753826 | -1.58% | 130.867222 | 0.26% |
| 59 | 01-11-2054 | 160.852093 | -0.73% | 121.9995314 | 1.94% | 131.1951155 | 0.25% |
| 60 | 01-12-2054 | 160.4229974 | -0.27% | 117.5497772 | -3.65% | 131.5418535 | 0.26% |
| 61 | 01-01-2055 | 161.4603618 | 0.65% | 120.960158 | 2.90% | 131.8885916 | 0.26% |
| 62 | 01-02-2055 | 163.7713178 | 1.43% | 129.4720726 | 7.04% | 132.2051785 | 0.24% |
| 63 | 01-03-2055 | 160.6791214 | -1.89% | 126.0528049 | -2.64% | 132.5782987 | 0.28% |
| 64 | 01-04-2055 | 160.7080103 | 0.02% | 120.7583831 | -4.20% | 132.9740323 | 0.30% |
| 65 | 01-05-2055 | 162.0803618 | 0.85% | 124.7138996 | 3.28% | 133.4149927 | 0.33% |
| 66 | 01-06-2055 | 159.9968992 | -1.29% | 124.9130489 | 0.16% | 133.8672596 | 0.34% |
| 67 | 01-07-2055 | 162.6340052 | 1.65% | 123.9215441 | -0.79% | 134.3534467 | 0.36% |
| 68 | 01-08-2055 | 165.034522 | 1.48% | 127.49694 | 2.89% | 134.8509403 | 0.37% |
| 69 | 01-09-2055 | 163.8082687 | -0.74% | 129.7782697 | 1.79% | 135.3597407 | 0.38% |
| 70 | 01-10-2055 | 163.9554005 | 0.09% | 125.6242098 | -3.20% | 135.9137678 | 0.41% |
| 71 | 01-11-2055 | 167.56677 | 2.20% | 129.2513118 | 2.89% | 136.4904082 | 0.42% |
| 72 | 01-12-2055 | 164.9704393 | -1.55% | 122.9807354 | -4.85% | 137.123582 | 0.46% |
| 73 | 01-01-2056 | 165.5143669 | 0.33% | 124.929611 | 1.58% | 137.7567557 | 0.46% |
| 74 | 01-02-2056 | 168.5002067 | 1.80% | 122.9676069 | -1.57% | 138.3635473 | 0.44% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 75 | 01-03-2056 | 173.609354 | 3.03% | 123.9162927 | 0.77% | 139.0457167 | 0.49% |
| 76 | 01-04-2056 | 184.2222222 | 6.11% | 128.5512597 | 3.74% | 139.7165794 | 0.48% |
| 77 | 01-05-2056 | 186.9565891 | 1.48% | 134.5709808 | 4.68% | 140.4062865 | 0.49% |
| 78 | 01-06-2056 | 191.9687339 | 2.68% | 135.6697354 | 0.82% | 141.0696114 | 0.47% |
| 79 | 01-07-2056 | 194.1951421 | 1.16% | 135.7533538 | 0.06% | 141.7480119 | 0.48% |
| 80 | 01-08-2056 | 193.5796899 | -0.32% | 140.7242086 | 3.66% | 142.4226435 | 0.48% |
| 81 | 01-09-2056 | 188.0610853 | -2.85% | 138.766446 | -1.39% | 143.0595862 | 0.45% |
| 82 | 01-10-2056 | 190.8613437 | 1.49% | 140.7866194 | 1.46% | 143.7153733 | 0.46% |
| 83 | 01-11-2056 | 192.651938 | 0.94% | 139.4103485 | -0.98% | 144.352316 | 0.44% |
| 84 | 01-12-2056 | 195.1421705 | 1.29% | 145.0442935 | 4.04% | 145.011872 | 0.46% |
| 85 | 01-01-2057 | 197.0217571 | 0.96% | 148.3076351 | 2.25% | 145.6638902 | 0.45% |
| 86 | 01-02-2057 | 194.4878553 | -1.29% | 151.1878264 | 1.94% | 146.2593751 | 0.41% |
| 87 | 01-03-2057 | 194.2746253 | -0.11% | 152.0286565 | 0.56% | 146.8812422 | 0.43% |
| 88 | 01-04-2057 | 193.2636176 | -0.52% | 154.609518 | 1.70% | 147.4842649 | 0.41% |
| 89 | 01-05-2057 | 192.4126098 | -0.44% | 156.563039 | 1.26% | 148.1174387 | 0.43% |
| 90 | 01-06-2057 | 192.771938 | 0.19% | 156.2715863 | -0.19% | 148.7393058 | 0.42% |
| 91 | 01-07-2057 | 194.0347804 | 0.66% | 158.1909732 | 1.23% | 149.3837862 | 0.43% |
| 92 | 01-08-2057 | 198.5001034 | 2.30% | 153.3835179 | -3.04% | 150.0395734 | 0.44% |
| 93 | 01-09-2057 | 198.0347804 | -0.23% | 152.8189923 | -0.37% | 150.6802849 | 0.43% |
| 94 | 01-10-2057 | 199.8124031 | 0.90% | 159.3384043 | 4.27% | 151.339841 | 0.44% |
| 95 | 01-11-2057 | 202.9092506 | 1.55% | 159.9154524 | 0.36% | 151.9767836 | 0.42% |
| 96 | 01-12-2057 | 205.8487855 | 1.45% | 167.9713031 | 5.04% | 152.6288019 | 0.43% |
| 97 | 01-01-2058 | 204.1540568 | -0.82% | 165.694215 | -1.36% | 153.2883579 | 0.43% |
| 98 | 01-02-2058 | 198.5775711 | -2.73% | 167.3399232 | 0.99% | 153.8913805 | 0.39% |
| 99 | 01-03-2058 | 196.8568475 | -0.87% | 169.1348923 | 1.07% | 154.5622432 | 0.44% |
| 100 | 01-04-2058 | 195.6737468 | -0.60% | 164.3490485 | -2.83% | 155.2180304 | 0.42% |
| 101 | 01-05-2058 | 194.921137 | -0.38% | 171.1243653 | 4.12% | 155.9039686 | 0.44% |
| 102 | 01-06-2058 | 198.6610853 | 1.92% | 181.3246052 | 5.96% | 156.5597558 | 0.42% |
| 103 | 01-07-2058 | 202.02 | 1.69% | 190.7149176 | 5.18% | 157.2343874 | 0.43% |
| 104 | 01-08-2058 | 198.623876 | -1.68% | 196.4270277 | 3.00% | 157.9127878 | 0.43% |
| 105 | 01-09-2058 | 199.4905426 | 0.44% | 184.1811652 | -6.23% | 158.5836505 | 0.42% |
| 106 | 01-10-2058 | 204.3429457 | 2.43% | 195.6346722 | 6.22% | 159.2733577 | 0.43% |
| 107 | 01-11-2058 | 207.3854264 | 1.49% | 187.5456973 | -4.13% | 159.9442204 | 0.42% |
| 108 | 01-12-2058 | 204.2331783 | -1.52% | 190.1479683 | 1.39% | 160.6414653 | 0.44% |
| 109 | 01-01-2059 | 204.6325065 | 0.20% | 189.1697939 | -0.51% | 161.350017 | 0.44% |
| 110 | 01-02-2059 | 206.6642377 | 0.99% | 197.8996417 | 4.61% | 161.9907285 | 0.40% |
| 111 | 01-03-2059 | 208.6319897 | 0.95% | 208.4244586 | 5.32% | 162.7105868 | 0.44% |
| 112 | 01-04-2059 | 206.4047028 | -1.07% | 216.5889729 | 3.92% | 163.400294 | 0.42% |
| 113 | 01-05-2059 | 210.0969509 | 1.79% | 218.9141315 | 1.07% | 164.1050767 | 0.43% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 114 | 01-06-2059 | 210.2228941 | 0.06% | 213.4082399 | -2.52% | 164.7797083 | 0.41% |
| 115 | 01-07-2059 | 209.6057881 | -0.29% | 222.0585087 | 4.05% | 165.4769532 | 0.42% |
| 116 | 01-08-2059 | 210.2575711 | 0.31% | 215.8198446 | -2.81% | 166.181736 | 0.43% |
| 117 | 01-09-2059 | 218.2309561 | 3.79% | 192.9976611 | -10.57% | 166.8601364 | 0.41% |
| 118 | 01-10-2059 | 230.3202584 | 5.54% | 186.5131911 | -3.36% | 167.5309991 | 0.40% |
| 119 | 01-11-2059 | 234.9567959 | 2.01% | 213.6120346 | 14.53% | 168.1453285 | 0.37% |
| 120 | 01-12-2059 | 232.5546253 | -1.02% | 220.4366338 | 3.19% | 168.7709645 | 0.37% |
| 121 | 01-01-2060 | 235.9501292 | 1.46% | 232.2637981 | 5.37% | 169.4003694 | 0.37% |
| 122 | 01-02-2060 | 233.1614987 | -1.18% | 237.3665437 | 2.20% | 169.9807787 | 0.34% |
| 123 | 01-03-2060 | 224.8213437 | -3.58% | 228.7174868 | -3.64% | 170.629028 | 0.38% |
| 124 | 01-04-2060 | 226.3796899 | 0.69% | 241.3717467 | 5.53% | 171.2584329 | 0.37% |
| 125 | 01-05-2060 | 226.3602584 | -0.01% | 251.051492 | 4.01% | 171.91422 | 0.38% |
| 126 | 01-06-2060 | 222.2790181 | -1.80% | 239.6708988 | -4.53% | 172.5511627 | 0.37% |
| 127 | 01-07-2060 | 218.7122997 | -1.60% | 253.6208408 | 5.82% | 173.2257943 | 0.39% |
| 128 | 01-08-2060 | 223.6181912 | 2.24% | 248.9769867 | -1.83% | 173.9117326 | 0.40% |
| 129 | 01-09-2060 | 225.7271318 | 0.94% | 251.5713807 | 1.04% | 174.5939019 | 0.39% |
| 130 | 01-10-2060 | 229.2837726 | 1.58% | 246.503577 | -2.01% | 175.3062224 | 0.41% |
| 131 | 01-11-2060 | 228.7541085 | -0.23% | 257.790251 | 4.58% | 176.0147741 | 0.40% |
| 132 | 01-12-2060 | 226.7203618 | -0.89% | 267.4885782 | 3.76% | 176.7685524 | 0.43% |
| 133 | 01-01-2061 | 227.3852713 | 0.29% | 287.2485892 | 7.39% | 177.544944 | 0.44% |

# RISK RETURN TRADE-OFF

The risk-return trade-off states that the potential return rises with an increase in risk. Using this principle, individuals associate low levels of uncertainty with low potential returns, and high levels of uncertainty or risk with high potential returns. According to the risk-return trade-off, invested money can render higher profits only if the investor will accept a higher possibility of losses.

The risk-return trade-off is the trading principle that links high risk with high reward. The appropriate risk-return trade-off depends on a variety of factors including an investor's risk tolerance, the investor's years to retirement and the potential to replace lost funds. Time also plays an essential role in determining a portfolio with the appropriate levels of risk and reward. For example, if an investor has the ability to invest in equities over the long term, that provides the investor with the potential to recover from the risks of bear markets and participate in bull markets, while if an investor can only invest in a short time frame, the same equities have a higher risk proposition.

Investors use the risk-return trade-off as one of the essential components of each investment decision, as well as to assess their portfolios as a whole. At the portfolio level, the risk-return trade-off can include assessments of the concentration or the diversity of holdings and whether the mix presents too much risk or a lower-than-desired potential for returns.

When an investor considers high-risk-high-return investments, the investor can apply the risk-return trade-off to the vehicle on a singular basis as well as within the context of the portfolio as a whole.

That said, the risk-return trade-off also exists at the portfolio level. For example, a portfolio composed of all equities presents both higher risk and higher potential returns. Within an all-equity portfolio, risk and reward can be increased by concentrating investments in specific sectors or by taking on single positions that represent a large percentage of holdings. For investors, assessing the cumulative risk-return trade-off of all positions can provide insight on whether a portfolio assumes enough risk to achieve long-term return objectives or if the risk levels are too high with the existing mix of holdings.

The following metrics have been calculated for Mr. John Lam using the given data over the past 11 years:

| | in percentages | in USD terms |
|---|---|---|
| ***Average (expected) yearly return*** | 9.07% | 7,25,341 |
| ***Volatility of yearly return*** | 7.29% | 5,83,522 |
| ***Lowest expected return in 68% of the time*** | 1.77% | 1,41,819 |
| ***Highest expected return in 68% of the time*** | 16.36% | 13,08,863 |

## STRATEGIC ASSET ALLOCATION

Strategic asset allocation is a portfolio strategy. The investor sets target allocations for various asset classes and rebalances the portfolio periodically. The portfolio is rebalanced to the original allocations when they deviate significantly from the initial settings due to differing returns from the various assets.

In strategic asset allocation, the target allocations depend on several factors: the investor's risk tolerance, time horizon, and investment objectives. Also, the allocations may change over time as the parameters change. Strategic asset allocation is compatible with a buy-and-hold strategy as opposed to tactical asset allocation, which is more suited to an active trading approach. Strategic and tactical asset allocation styles are based on modern portfolio theory, which emphasizes diversification to reduce risk and improve portfolio returns.

The reduction of risk due to diversification is really at the heart of the portfolio construction.

# TACTICAL ASSET ALLOCATION

Tactical asset allocation is an active management portfolio strategy that shifts the percentage of assets held in various categories to take advantage of market pricing anomalies or strong market sectors. This strategy allows portfolio managers to create extra value by taking advantage of certain situations in the marketplace. It is a moderately active strategy since managers return to the portfolio's original asset mix once reaching the desired short-term profits.

Tactical asset allocation is the process of taking an active stance on the strategic asset allocation itself and adjusting long-term target weights for a short period to capitalize on the market or economic opportunities. For example, assume that data suggests that there will be a substantial increase in demand for commodities over the next 18 months. It may be prudent for an investor to shift more capital into that asset class to take advantage of the opportunity.

Tactical shifts may also come within an asset class. Assume the 45% strategic allocation of stocks consists of 30% large-cap and 15% small-cap holdings. If the outlook for small-cap stocks does not look favourable, it may be a wise tactical decision to shift the allocation within stocks to 40% large-cap and 5% small-cap for a short time until conditions change.

Usually, tactical shifts range from 5% to 10%, though they may be lower. In practice, it is unusual to adjust any asset class by more than 10% tactically. This large adjustment would show a fundamental problem with the construction of the strategic asset allocation.

Tactical asset allocation is different from rebalancing a portfolio. During rebalancing, trades are made to bring the portfolio back to its desired strategic asset allocation. Tactical asset allocation adjusts the strategic asset allocation for a short time, with the intention of reverting to the strategic allocation once the short-term opportunities disappear.

## FED MODEL

The model can be used as valuation tool to help allocating between equities and bonds.

Chairman Alan Greenspan in 1997 stated:

"…changes in this ratio [P/E of S&P 500 index] have often been inversely related to changes in the long term treasury yields, but this year's stock price gains were not matched by a significant decline in interest rates. As a result, the yield on ten-year treasury notes now exceeds the ratio of twelve month ahead earnings to prices by the largest amount since 1991, when earnings were depressed by the economic slowdown."

Designing a Tactical Asset Allocation for Mr. John Lam using the FED valuation model as a valuation tool on the given set of data:

| | DATE | WORLD BONDS INDEX | WORLD BONDS INDEX | WORLD BONDS INDEX | WORLD EQUITIES INDEX | WORLD EQUITIES INDEX |
|---|---|---|---|---|---|---|
| | | price | yield | (holding) return | price | P/E ratio |
| 1 | 01-01-2050 | 100 | 7.5416 | | 100 | 14.793 |
| 2 | 01-02-2050 | 98.5374677 | 7.6786 | -1.46% | 102.7858681 | 15.617 |
| 3 | 01-03-2050 | 98.60465116 | 7.8368 | 0.07% | 101.7153902 | 15.446 |
| 4 | 01-04-2050 | 97.23514212 | 7.8159 | -1.39% | 102.1575178 | 15.091 |
| 5 | 01-05-2050 | 98.52196382 | 7.7562 | 1.32% | 103.6309396 | 11.61 |
| 6 | 01-06-2050 | 96.44444444 | 7.6266 | -2.11% | 101.2627599 | 12.176 |
| 7 | 01-07-2050 | 98.38242894 | 7.4302 | 2.01% | 101.0650245 | 13.299 |
| 8 | 01-08-2050 | 102.8630491 | 7.4484 | 4.55% | 110.6843787 | 14.926 |
| 9 | 01-09-2050 | 99.40568475 | 7.5198 | -3.36% | 108.0461558 | 15.902 |
| 10 | 01-10-2050 | 101.2919897 | 7.5483 | 1.90% | 110.9061494 | 15.62 |
| 11 | 01-11-2050 | 102.1395349 | 7.6323 | 0.84% | 106.9441695 | 15.728 |
| 12 | 01-12-2050 | 103.0645995 | 7.6618 | 0.91% | 111.5902453 | 15.589 |
| 13 | 01-01-2051 | 104.3255814 | 8.0249 | 1.22% | 114.5891991 | 16.007 |
| 14 | 01-02-2051 | 102.9457364 | 8.3679 | -1.32% | 109.3820313 | 17.448 |
| 15 | 01-03-2051 | 101.3643411 | 8.6251 | -1.54% | 103.1439732 | 16.572 |
| 16 | 01-04-2051 | 100.3617571 | 8.5903 | -0.99% | 94.59327901 | 15.171 |
| 17 | 01-05-2051 | 100.0516796 | 8.4862 | -0.31% | 96.52862215 | 12.08 |
| 18 | 01-06-2051 | 103.374677 | 8.3588 | 3.32% | 106.6442338 | 12.304 |
| 19 | 01-07-2051 | 105.2713178 | 8.3552 | 1.83% | 105.62526 | 13.454 |
| 20 | 01-08-2051 | 108.5684755 | 8.6884 | 3.13% | 105.590722 | 15.039 |
| 21 | 01-09-2051 | 107.7209302 | 8.9134 | -0.78% | 94.90957492 | 14.697 |
| 22 | 01-10-2051 | 108.9250646 | 8.7913 | 1.12% | 86.81938817 | 13.251 |
| 23 | 01-11-2051 | 113.7932817 | 8.5809 | 4.47% | 92.14552035 | 11.908 |
| 24 | 01-12-2051 | 115.6795866 | 8.2524 | 1.66% | 92.08371541 | 13.015 |
| 25 | 01-01-2052 | 116.8217054 | 8.2635 | 0.99% | 93.21781598 | 13.202 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 26 | 01-02-2052 | 119.7416021 | 7.9137 | 2.50% | 96.43813648 | 13.833 |
| 27 | 01-03-2052 | 119.7777778 | 8.0614 | 0.03% | 103.9815716 | 15.205 |
| 28 | 01-04-2052 | 115.4263566 | 7.953 | -3.63% | 101.3045691 | 15.943 |
| 29 | 01-05-2052 | 117.2041344 | 7.9875 | 1.54% | 104.1686023 | 14.394 |
| 30 | 01-06-2052 | 117.0542636 | 8.0939 | -0.13% | 103.9409743 | 14.055 |
| 31 | 01-07-2052 | 115.8294574 | 8.0873 | -1.05% | 99.43527245 | 16.195 |
| 32 | 01-08-2052 | 118.3049096 | 7.8818 | 2.14% | 102.2690091 | 15.898 |
| 33 | 01-09-2052 | 120.5943152 | 7.661 | 1.94% | 102.2645656 | 16.141 |
| 34 | 01-10-2052 | 125.3126615 | 7.5329 | 3.91% | 104.8795611 | 16.196 |
| 35 | 01-11-2052 | 126.625323 | 7.5023 | 1.05% | 105.9657932 | 16.413 |
| 36 | 01-12-2052 | 128.6046512 | 7.3929 | 1.56% | 100.8652693 | 16.663 |
| 37 | 01-01-2053 | 135.2918863 | 7.1701 | 5.20% | 108.1311881 | 15.786 |
| 38 | 01-02-2053 | 132.8888372 | 7.2827 | -1.78% | 105.8946973 | 16.842 |
| 39 | 01-03-2053 | 132.1498708 | 7.4083 | -0.56% | 104.0563031 | 16.257 |
| 40 | 01-04-2053 | 130.749354 | 7.2746 | -1.06% | 97.18565317 | 15.826 |
| 41 | 01-05-2053 | 131.6847545 | 7.2616 | 0.72% | 99.86487742 | 14.273 |
| 42 | 01-06-2053 | 135.7260465 | 7.3193 | 3.07% | 103.6392207 | 14.833 |
| 43 | 01-07-2053 | 139.5245478 | 7.1898 | 2.80% | 101.1207701 | 14.664 |
| 44 | 01-08-2053 | 142.7750904 | 7.038 | 2.33% | 100.1191664 | 15.159 |
| 45 | 01-09-2053 | 146.7700258 | 6.9375 | 2.80% | 102.3158677 | 14.572 |
| 46 | 01-10-2053 | 148.2428424 | 7.0169 | 1.00% | 100.7911437 | 15.409 |
| 47 | 01-11-2053 | 144.2168475 | 6.921 | -2.72% | 98.34015342 | 15.462 |
| 48 | 01-12-2053 | 141.9275969 | 6.9536 | -1.59% | 99.48051528 | 16.046 |
| 49 | 01-01-2054 | 142.7750904 | 6.7611 | 0.60% | 100.4092053 | 16.455 |
| 50 | 01-02-2054 | 144.4924031 | 6.5398 | 1.20% | 100.7634729 | 16.621 |
| 51 | 01-03-2054 | 148.4455814 | 6.3081 | 2.74% | 102.8385841 | 16.875 |
| 52 | 01-04-2054 | 150.9177778 | 6.2768 | 1.67% | 109.4179832 | 17.472 |
| 53 | 01-05-2054 | 154.1314729 | 6.3688 | 2.13% | 113.3947074 | 16.767 |
| 54 | 01-06-2054 | 155.1487855 | 6.2293 | 0.66% | 116.0597933 | 16.911 |
| 55 | 01-07-2054 | 154.9235659 | 5.9772 | -0.15% | 114.4623576 | 17.268 |
| 56 | 01-08-2054 | 156.1457881 | 5.7663 | 0.79% | 116.990705 | 18.767 |
| 57 | 01-09-2054 | 160.0396899 | 5.5506 | 2.49% | 121.5933558 | 19.313 |
| 58 | 01-10-2054 | 162.0394832 | 5.3092 | 1.25% | 119.6753826 | 19.21 |
| 59 | 01-11-2054 | 160.852093 | 5.4252 | -0.73% | 121.9995314 | 19.226 |
| 60 | 01-12-2054 | 160.4229974 | 5.2932 | -0.27% | 117.5497772 | 19.16 |
| 61 | 01-01-2055 | 161.4603618 | 5.1231 | 0.65% | 120.960158 | 18.872 |
| 62 | 01-02-2055 | 163.7713178 | 5.2959 | 1.43% | 129.4720726 | 19.443 |
| 63 | 01-03-2055 | 160.6791214 | 5.8047 | -1.89% | 126.0528049 | 19.48 |
| 64 | 01-04-2055 | 160.7080103 | 5.9994 | 0.02% | 120.7583831 | 19.454 |

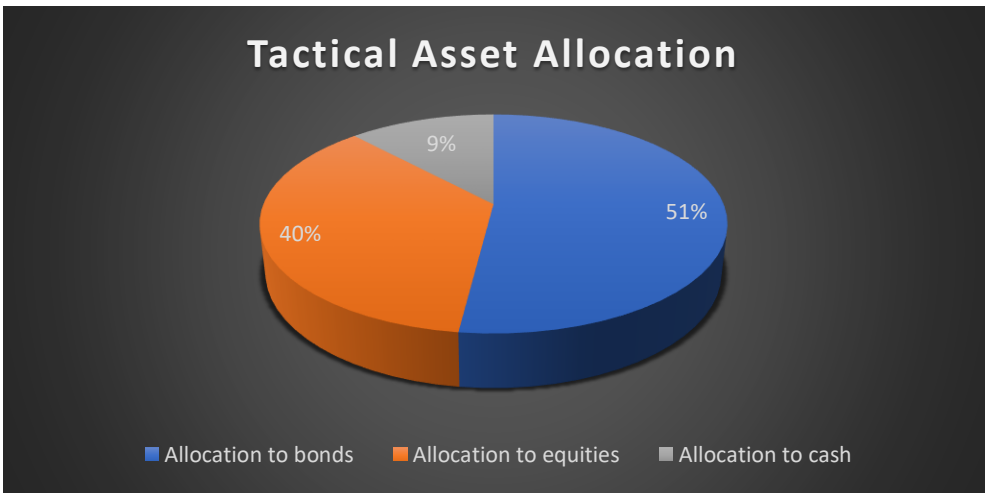
| | | | | | | |
|---|---|---|---|---|---|---|
| 65 | 01-05-2055 | 162.0803618 | 6.2216 | 0.85% | 124.7138996 | 16.712 |
| 66 | 01-06-2055 | 159.9968992 | 6.4294 | -1.29% | 124.9130489 | 16.73 |
| 67 | 01-07-2055 | 162.6340052 | 6.4943 | 1.65% | 123.9215441 | 17.162 |
| 68 | 01-08-2055 | 165.034522 | 6.6935 | 1.48% | 127.49694 | 17.432 |
| 69 | 01-09-2055 | 163.8082687 | 6.8317 | -0.74% | 129.7782697 | 17.773 |
| 70 | 01-10-2055 | 163.9554005 | 6.9512 | 0.09% | 125.6242098 | 17.493 |
| 71 | 01-11-2055 | 167.56677 | 7.0442 | 2.20% | 129.2513118 | 17.135 |
| 72 | 01-12-2055 | 164.9704393 | 6.9785 | -1.55% | 122.9807354 | 16.698 |
| 73 | 01-01-2056 | 165.5143669 | 7.0215 | 0.33% | 124.929611 | 15.908 |
| 74 | 01-02-2056 | 168.5002067 | 6.8869 | 1.80% | 122.9676069 | 15.819 |
| 75 | 01-03-2056 | 173.609354 | 6.7484 | 3.03% | 123.9162927 | 15.52 |
| 76 | 01-04-2056 | 184.2222222 | 6.4927 | 6.11% | 128.5512597 | 15.011 |
| 77 | 01-05-2056 | 186.9565891 | 6.2186 | 1.48% | 134.5709808 | 14.363 |
| 78 | 01-06-2056 | 191.9687339 | 5.9695 | 2.68% | 135.6697354 | 14.773 |
| 79 | 01-07-2056 | 194.1951421 | 5.9296 | 1.16% | 135.7533538 | 14.944 |
| 80 | 01-08-2056 | 193.5796899 | 6.0608 | -0.32% | 140.7242086 | 15.678 |
| 81 | 01-09-2056 | 188.0610853 | 5.7752 | -2.85% | 138.766446 | 15.734 |
| 82 | 01-10-2056 | 190.8613437 | 5.754 | 1.49% | 140.7866194 | 15.853 |
| 83 | 01-11-2056 | 192.651938 | 5.6523 | 0.94% | 139.4103485 | 15.719 |
| 84 | 01-12-2056 | 195.1421705 | 5.4175 | 1.29% | 145.0442935 | 15.557 |
| 85 | 01-01-2057 | 197.0217571 | 5.3796 | 0.96% | 148.3076351 | 16.224 |
| 86 | 01-02-2057 | 194.4878553 | 5.4719 | -1.29% | 151.1878264 | 16.354 |
| 87 | 01-03-2057 | 194.2746253 | 5.786 | -0.11% | 152.0286565 | 16.806 |
| 88 | 01-04-2057 | 193.2636176 | 5.7395 | -0.52% | 154.609518 | 16.35 |
| 89 | 01-05-2057 | 192.4126098 | 5.7565 | -0.44% | 156.563039 | 15.055 |
| 90 | 01-06-2057 | 192.771938 | 5.8531 | 0.19% | 156.2715863 | 15.398 |
| 91 | 01-07-2057 | 194.0347804 | 5.8138 | 0.66% | 158.1909732 | 16.777 |
| 92 | 01-08-2057 | 198.5001034 | 5.6549 | 2.30% | 153.3835179 | 16.28 |
| 93 | 01-09-2057 | 198.0347804 | 5.582 | -0.23% | 152.8189923 | 16.533 |
| 94 | 01-10-2057 | 199.8124031 | 5.3643 | 0.90% | 159.3384043 | 16.814 |
| 95 | 01-11-2057 | 202.9092506 | 5.1063 | 1.55% | 159.9154524 | 17.13 |
| 96 | 01-12-2057 | 205.8487855 | 5.0851 | 1.45% | 167.9713031 | 17.232 |
| 97 | 01-01-2058 | 204.1540568 | 5.1454 | -0.82% | 165.694215 | 17.134 |
| 98 | 01-02-2058 | 198.5775711 | 4.9842 | -2.73% | 167.3399232 | 17.543 |
| 99 | 01-03-2058 | 196.8568475 | 5.168 | -0.87% | 169.1348923 | 17.947 |
| 100 | 01-04-2058 | 195.6737468 | 5.2522 | -0.60% | 164.3490485 | 17.573 |
| 101 | 01-05-2058 | 194.921137 | 5.1663 | -0.38% | 171.1243653 | 16.912 |
| 102 | 01-06-2058 | 198.6610853 | 5.0269 | 1.92% | 181.3246052 | 18.308 |
| 103 | 01-07-2058 | 202.02 | 4.8745 | 1.69% | 190.7149176 | 19.102 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 104 | 01-08-2058 | 198.623876 | 4.8734 | -1.68% | 196.4270277 | 19.896 |
| 105 | 01-09-2058 | 199.4905426 | 4.7405 | 0.44% | 184.1811652 | 19.838 |
| 106 | 01-10-2058 | 204.3429457 | 4.6514 | 2.43% | 195.6346722 | 19.213 |
| 107 | 01-11-2058 | 207.3854264 | 4.5022 | 1.49% | 187.5456973 | 19.607 |
| 108 | 01-12-2058 | 204.2331783 | 4.4088 | -1.52% | 190.1479683 | 18.261 |
| 109 | 01-01-2059 | 204.6325065 | 4.2144 | 0.20% | 189.1697939 | 18.623 |
| 110 | 01-02-2059 | 206.6642377 | 4.2286 | 0.99% | 197.8996417 | 18.525 |
| 111 | 01-03-2059 | 208.6319897 | 4.1638 | 0.95% | 208.4244586 | 20.227 |
| 112 | 01-04-2059 | 206.4047028 | 4.1516 | -1.07% | 216.5889729 | 21.024 |
| 113 | 01-05-2059 | 210.0969509 | 4.1767 | 1.79% | 218.9141315 | 21.696 |
| 114 | 01-06-2059 | 210.2228941 | 3.9701 | 0.06% | 213.4082399 | 21.092 |
| 115 | 01-07-2059 | 209.6057881 | 4.0445 | -0.29% | 222.0585087 | 20.537 |
| 116 | 01-08-2059 | 210.2575711 | 3.8794 | 0.31% | 215.8198446 | 22.017 |
| 117 | 01-09-2059 | 218.2309561 | 3.4644 | 3.79% | 192.9976611 | 20.476 |
| 118 | 01-10-2059 | 230.3202584 | 3.3283 | 5.54% | 186.5131911 | 19.036 |
| 119 | 01-11-2059 | 234.9567959 | 3.4119 | 2.01% | 213.6120346 | 18.386 |
| 120 | 01-12-2059 | 232.5546253 | 3.3348 | -1.02% | 220.4366338 | 20.992 |
| 121 | 01-01-2060 | 235.9501292 | 3.3944 | 1.46% | 232.2637981 | 21.342 |
| 122 | 01-02-2060 | 233.1614987 | 3.6862 | -1.18% | 237.3665437 | 22.716 |
| 123 | 01-03-2060 | 224.8213437 | 3.6957 | -3.58% | 228.7174868 | 22.323 |
| 124 | 01-04-2060 | 226.3796899 | 3.616 | 0.69% | 241.3717467 | 23.438 |
| 125 | 01-05-2060 | 226.3602584 | 3.7613 | -0.01% | 251.051492 | 24.094 |
| 126 | 01-06-2060 | 222.2790181 | 4.0237 | -1.80% | 239.6708988 | 23.484 |
| 127 | 01-07-2060 | 218.7122997 | 4.0944 | -1.60% | 253.6208408 | 23.431 |
| 128 | 01-08-2060 | 223.6181912 | 4.3049 | 2.24% | 248.9769867 | 24.305 |
| 129 | 01-09-2060 | 225.7271318 | 4.3383 | 0.94% | 251.5713807 | 22.981 |
| 130 | 01-10-2060 | 229.2837726 | 4.4441 | 1.58% | 246.503577 | 22.937 |
| 131 | 01-11-2060 | 228.7541085 | 4.2685 | -0.23% | 257.790251 | 22.249 |
| 132 | 01-12-2060 | 226.7203618 | 4.4159 | -0.89% | 267.4885782 | 23.768 |
| 133 | 01-01-2061 | 227.3852713 | 4.7087 | 0.29% | 287.2485892 | 24.296 |

Using the above set of data and applying the FED model as a valuation tool, it can be inferred that the allocation to bonds has to be increased by decreasing the allocation to equities in Tactical Asset Allocation (TAA) since the earnings yield of the long term government bond comes up to be 6.1634% whereas the earnings yield of the stock market is 5.8038%.

Tactical Asset Allocation of Mr. John Lam

| [John Lam]'s TAA | Max. pos. deviation for SAA | Max. neg. deviation from SAA |
|---|---|---|
| 51% | +9% | -9% |
| 40% | +11% | -11% |
| 9% | +5% | -5% |
| 100% | | |




| | in percentages | in USD terms |
|---|---|---|
| Average (expected) yearly return | 6.16% | 4,95,800 |
| Volatility of yearly return | 8.22% | 6,12,957 |
| Lowest expected return in 68% of the time | -2.06% | -1,17,157 |
| Highest expected return in 68% of the time | 14.38% | 11,08,757 |

Three additional years of data corresponding to the three years since the meeting with the client Mr. John have been added to the "Data" sheet. The three years data is as follows:

| DATE | WORLD BONDS INDEX | WORLD BONDS INDEX | WORLD BONDS INDEX | WORLD EQUITIES INDEX | WORLD EQUITIES INDEX | WORLD EQUITIES INDEX | 3-MONTHS CASH USD | 3-MONTHS CASH USD |
|---|---|---|---|---|---|---|---|---|
| | price | yield | (holding) return | price | P/E ratio | (holding) return | | (holding) return |
| 01-02-2061 | 220.6163307 | 4.6891 | -2.98% | 272.4366095 | 25.039 | -5.16% | 178.2987223 | 0.42% |
| 01-03-2061 | 221.412093 | 4.5106 | 0.36% | 274.4931388 | 24.48 | 0.75% | 179.1391852 | 0.47% |
| 01-04-2061 | 225.0771059 | 4.3484 | 1.66% | 288.2089896 | 24.299 | 5.00% | 179.979648 | 0.47% |
| 01-05-2061 | 218.1672351 | 4.5494 | -3.07% | 278.6298288 | 23.909 | -3.32% | 180.8577997 | 0.49% |
| 01-06-2061 | 220.9585013 | 4.3415 | 1.28% | 273.9055879 | 24.187 | -1.70% | 181.7058003 | 0.47% |
| 01-07-2061 | 225.2428941 | 4.4279 | 1.94% | 280.5158895 | 23.958 | 2.41% | 182.587721 | 0.49% |
| 01-08-2061 | 222.4825323 | 4.3634 | -1.23% | 271.346338 | 24.093 | -3.27% | 183.4922549 | 0.50% |
| 01-09-2061 | 222.4287855 | 4.3935 | -0.02% | 281.7889502 | 23.497 | 3.85% | 184.4043267 | 0.50% |
| 01-10-2061 | 219.3955039 | 4.293 | -1.36% | 264.0325506 | 23.88 | -6.30% | 185.3691629 | 0.52% |
| 01-11-2061 | 218.586615 | 4.2552 | -0.37% | 260.1883233 | 21.868 | -1.46% | 186.3189236 | 0.51% |
| 01-12-2061 | 221.5324548 | 3.9563 | 1.35% | 244.4991578 | 22.498 | -6.03% | 187.2988354 | 0.53% |
| 01-01-2062 | 229.4735401 | 3.9241 | 3.58% | 246.6649566 | 22.33 | 0.89% | 188.2636717 | 0.52% |
| 01-02-2062 | 231.2180879 | 3.9245 | 0.76% | 252.3063748 | 21.56 | 2.29% | 189.0777522 | 0.43% |
| 01-03-2062 | 230.7753488 | 3.6601 | -0.19% | 229.6869761 | 21.333 | -8.97% | 189.9106773 | 0.44% |
| 01-04-2062 | 221.4181395 | 3.9034 | -4.05% | 212.1812299 | 19.448 | -7.62% | 190.6380733 | 0.38% |
| 01-05-2062 | 223.0516796 | 4.0421 | 0.74% | 232.8984096 | 20.558 | 9.76% | 191.3353183 | 0.37% |
| 01-06-2062 | 221.448062 | 3.9227 | -0.72% | 226.7469996 | 21.359 | -2.64% | 191.9534165 | 0.32% |
| 01-07-2062 | 219.2751421 | 3.9646 | -0.98% | 221.2471673 | 20.816 | -2.43% | 192.5526703 | 0.31% |
| 01-08-2062 | 224.8084755 | 3.8357 | 2.52% | 217.2609502 | 20.444 | -1.80% | 193.1406173 | 0.31% |
| 01-09-2062 | 232.9102842 | 3.6754 | 3.60% | 203.9852072 | 20.293 | -6.11% | 193.6946444 | 0.29% |
| 01-10-2062 | 235.0245478 | 3.6218 | 0.91% | 186.2185067 | 17.444 | -8.71% | 194.1996759 | 0.26% |
| 01-11-2062 | 238.2948837 | 3.6015 | 1.39% | 193.761134 | 19.965 | 4.05% | 194.6142539 | 0.21% |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 01-12-2062 | 232.6312145 | 3.8415 | -2.38% | 199.4073996 | 21.449 | 2.91% | 194.9534542 | 0.17% |
| 01-01-2063 | 227.2018088 | 3.7708 | -2.33% | 202.6871013 | 21.764 | 1.64% | 195.2587344 | 0.16% |
| 01-02-2063 | 223.2168475 | 3.8344 | -1.75% | 195.4013888 | 21.081 | -3.59% | 195.5187879 | 0.13% |
| 01-03-2063 | 224.0795866 | 4.0589 | 0.39% | 198.0848546 | 20.815 | 1.37% | 195.8089926 | 0.15% |
| 01-04-2063 | 223.9214987 | 3.9629 | -0.07% | 202.996732 | 21.457 | 2.48% | 196.0916594 | 0.14% |
| 01-05-2063 | 232.8141602 | 4.0088 | 3.97% | 196.96772 | 20.854 | -2.97% | 196.385633 | 0.15% |
| 01-06-2063 | 238.7176744 | 3.7963 | 2.54% | 192.6583398 | 20.124 | -2.19% | 196.6682999 | 0.14% |
| 01-07-2063 | 249.24677 | 3.6642 | 4.41% | 181.1381805 | 18.391 | -5.98% | 196.9547356 | 0.15% |
| 01-08-2063 | 252.8481654 | 3.4058 | 1.44% | 162.8309897 | 16.409 | -10.11% | 197.2411714 | 0.15% |
| 01-09-2063 | 257.617416 | 3.194 | 1.89% | 166.9604085 | 16.632 | 2.54% | 197.5125316 | 0.14% |
| 01-10-2063 | 257.9408269 | 3.27 | 0.13% | 152.6206509 | 15.816 | -8.59% | 197.7876606 | 0.14% |
| 01-11-2063 | 258.6313695 | 3.2619 | 0.27% | 161.3502967 | 15.913 | 5.72% | 198.0401764 | 0.13% |
| 01-12-2063 | 257.0839793 | 3.2012 | -0.60% | 167.9971562 | 16.039 | 4.12% | 198.2738477 | 0.12% |
| 01-01-2064 | 271.4941085 | 3.1296 | 5.61% | 160.0091698 | 16.145 | -4.75% | 198.4924434 | 0.11% |

The updated summary statistics for the Strategic Asset Allocation by including the above additional 3 years of data are as follows:

| | | |
|---|---|---|
| **Average (expected) yearly return** | **5.93%** | **$4,74,059** |
| **Volatility of yearly return** | **9.01%** | **$7,20,291** |
| **Lowest expected return in 68% of the time** | **-3.08%** | **-$2,46,232** |
| **Highest expected return in 68% of the time** | **14.93%** | **$11,94,351** |

**VS**

Previous summary statistics excluding the additional 3 years of data:

| | | |
|---|---|---|
| **Average (expected) yearly return** | **9.07%** | **$7,25,341** |
| **Volatility of yearly return** | **7.29%** | **$5,83,522** |
| **Lowest expected return in 68% of the time** | **1.77%** | **$1,41,819** |
| **Highest expected return in 68% of the time** | **16.36%** | **$13,08,863** |

From the above set of summary statistics, it can be inferred that:

- The average yearly returns decreased due to the net fall in the return of the equity index for the last 3 years.
- The yearly volatilities increased due to the net fall in the return of the equity index for the last 3 years.
- The asset class responsible for these changes is the equities asset class.

Since we had already predicted the overvaluation of the equities asset class in our previous meeting using the FED valuation model, we had thus developed an optimal tactical asset allocation for Mr. John Lam considering the above factors and reducing the allocation to equities, hence optimizing the returns.

**Summary statistics of Total Asset Allocation devised for Mr. John Lam**:

| | | |
|---|---|---|
| **Average (expected) yearly return** | 6.16% | 4,95,800 |
| **Volatility of yearly return** | 8.22% | 6,12,957 |
| **Lowest expected return in 68% of the time** | -2.06% | -1,17,157 |
| **Highest expected return in 68% of the time** | 14.38% | 11,08,757 |

**VS**

**Summary statistics of Strategic Asset Allocation without TAA:**

| | | |
|---|---|---|
| **Average (expected) yearly return** | 5.93% | 4,74,059 |
| **Volatility of yearly return** | 9.01% | 7,20,291 |
| **Lowest expected return in 68% of the time** | -3.08% | -2,46,232 |
| **Highest expected return in 68% of the time** | 14.93% | 11,94,351 |

# VALUE-AT-RISK

Value at risk (VaR) is a statistic that measures and quantifies the level of financial risk within a firm, portfolio, or position over a specific time frame. This metric is most commonly used by investment and commercial banks to determine the extent and occurrence ratio of potential losses in their institutional portfolios. Risk managers use VaR to measure and control the level of risk exposure. One can apply VaR calculations to specific positions or whole portfolios or to measure firm-wide risk exposure.

VaR modelling determines the potential for loss in the entity being assessed and the probability of occurrence for the defined loss. One measures VaR by assessing the amount of potential loss, the probability of occurrence for the amount of loss, and the timeframe.

**HISTORICAL APPROACH** (For Asymmetric distributions)

- From a history of portfolio loss returns, compute the $99^{th}$ percentile of the distribution of these historical returns.
- In other words, find the loss return so that only 1% of the historical loss returns are larger than this number.

**VARIANCE-COVARIANCE APPROACH** (For Symmetric distributions)

- This method assumes that stock returns are normally distributed. In other words, it requires that we estimate only two factors—an expected (or average) return and a standard deviation—which allow us to plot a normal distribution curve.
- The idea behind the variance-covariance is similar to the ideas behind the historical method—except that we use the familiar curve instead of actual data.

$$VaR\ (a_1, a_2, \ldots, a_n, \alpha) = -\mu + z_\alpha \sigma$$

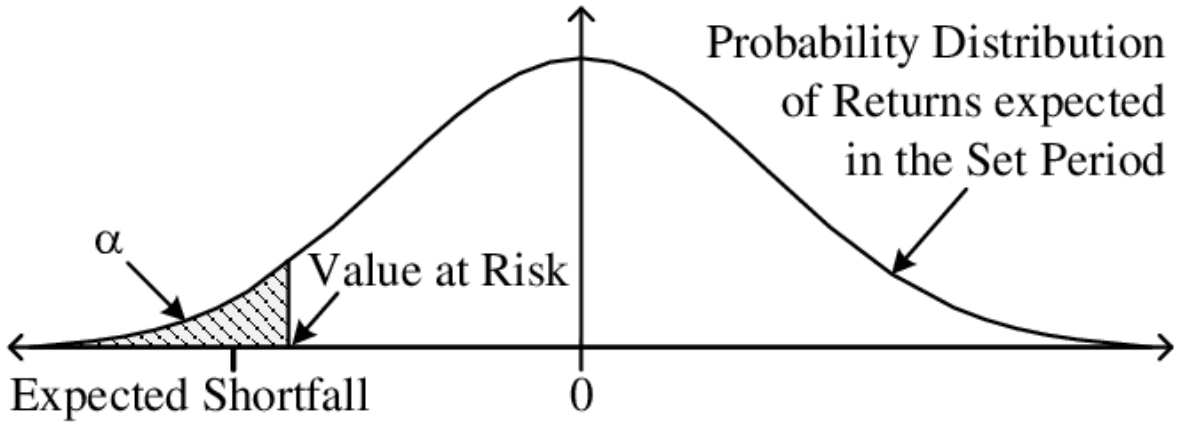
WHERE $\mu$ is the average of the portfolio returns

$\sigma$ is the standard deviation of the returns

$\alpha$ is the confidence level and $z_\alpha$ is the quantile of gaussian distribution

## EXPECTED SHORTFALL

Expected shortfall (ES) is a risk measure—a concept used in the field of financial risk measurement to evaluate the market risk or credit risk of a portfolio. The "expected shortfall at q% level" is the expected return on the portfolio in the worst of cases. ES is an alternative to value at risk that is more sensitive to the shape of the tail of the loss distribution.




- The Expected Shortfall is the average of the losses that are beyond the $99^{th}$ percentile of the loss distribution assuming α=99% .
- Suppose the VaR is equal to $1 million, then the Expected Shortfall is the average of the losses that exceed $1 million.

**HISTORICAL APPROACH**

- From a history of portfolio loss returns, compute the sum of the loss returns that are above VaR.
- Then divide this sum by the total number of portfolio loss returns times (1-α).

**VARIANCE-COVARIANCE APPROACH**

- This method assumes that stock returns are normally distributed.
- The idea behind the variance-covariance is similar to the ideas behind the historical method—except that we use the familiar curve instead of actual data.

$$ES(a_1, a_2, \ldots, a_n, \alpha) = -\mu + \sigma \phi(z_\alpha) / (1-\alpha)$$

WHERE $\mu$ is the average of the portfolio returns

$\sigma$ is the standard deviation of the returns

$\alpha$ is the confidence level and $z_\alpha$ is the quantile of gaussian distribution

$\phi(z_\alpha)$ is the density of the gaussian distribution

## RISK MANAGEMENT

---

### Risk management: Variance-covariance approach:

| Risk management: Variance-covariance approach | In Percentages | In USD terms |
|---|---|---|
| **Average return (μ)** | 0.50% | 39,868 |
| **Standard deviation of returns (σ)** | 2.14% | 1,71,429 |
| **Value-at-risk (95%)** | -3.04% | -2,42,990 |
| **Phi** | 0.1023 | |
| **Expected shortfall (95%)** | -3.89% | -3,10,756 |

- The Value-at-risk calculated here indicates that there is a 5% chance of losing more than -2.80% in returns or $2,24,351.
- The Expected Shortfall calculated here indicates that the average return might be -3.60% in the 5% of worst months.

## Risk management: Historical approach

| Risk management: Historical approach | In Percentages | In USD terms |
|---|---|---|
| **Value-at-risk (95%)** | -3.21% | -2,56,969 |
| **Sum of returns that are below the VaR** | -42.64% | |
| **Expected shortfall (95%)** | -5.08% | -4,06,112 |

- The Value-at-risk calculated here indicates that there is a 5% chance of losing more than -2.90% in returns or $2,32,263.
- The Expected Shortfall calculated here indicates that the average return might be -3.32% in the 5% of worst months.

The risk management quantities computed through the variance-covariance and historical approaches are not equal.

It can be inferred that the returns of the SAAs (and our client's TAA) are not normally distributed (otherwise, both approaches would have yielded the same numbers).

Three additional years of data have been added to the "Data" sheet for devising an appropriate Tactical Asset Allocation strategy. The three years data is as follows:

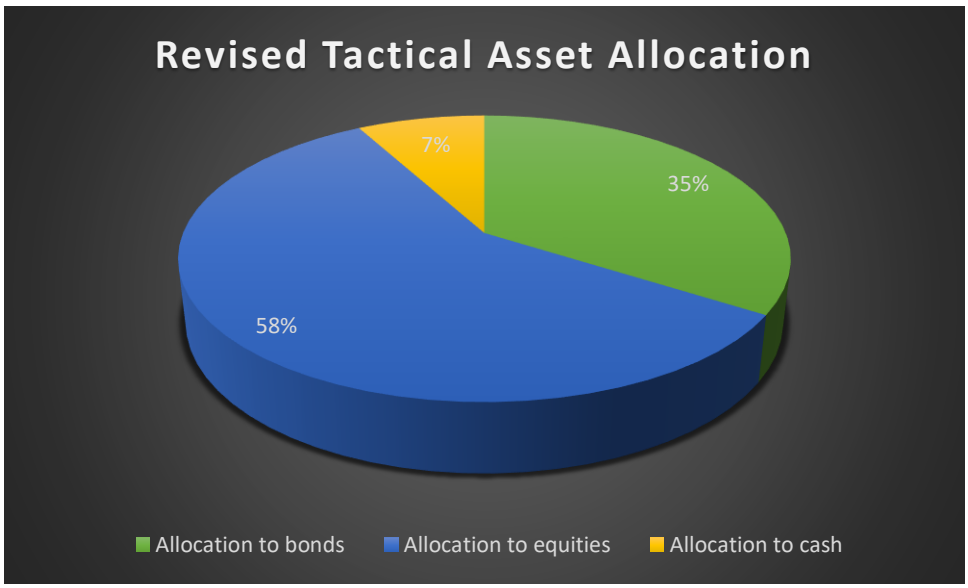
| DATE | WORLD BONDS INDEX | WORLD BONDS INDEX | WORLD BONDS INDEX | WORLD EQUITIES INDEX | WORLD EQUITIES INDEX | WORLD EQUITIES INDEX | 3-MONTHS CASH USD | 3-MONTHS CASH USD |
|---|---|---|---|---|---|---|---|---|
| | price | yield | (holding) return | price | P/E ratio | (holding) return | | (holding) return |
| 01-02-2061 | 220.6163307 | 4.6891 | -2.98% | 272.4366095 | 25.039 | -5.16% | 178.2987223 | 0.42% |
| 01-03-2061 | 221.412093 | 4.5106 | 0.36% | 274.4931388 | 24.48 | 0.75% | 179.1391852 | 0.47% |
| 01-04-2061 | 225.0771059 | 4.3484 | 1.66% | 288.2089896 | 24.299 | 5.00% | 179.979648 | 0.47% |
| 01-05-2061 | 218.1672351 | 4.5494 | -3.07% | 278.6298288 | 23.909 | -3.32% | 180.8577997 | 0.49% |
| 01-06-2061 | 220.9585013 | 4.3415 | 1.28% | 273.9055879 | 24.187 | -1.70% | 181.7058003 | 0.47% |
| 01-07-2061 | 225.2428941 | 4.4279 | 1.94% | 280.5158895 | 23.958 | 2.41% | 182.587721 | 0.49% |
| 01-08-2061 | 222.4825323 | 4.3634 | -1.23% | 271.346338 | 24.093 | -3.27% | 183.4922549 | 0.50% |
| 01-09-2061 | 222.4287855 | 4.3935 | -0.02% | 281.7889502 | 23.497 | 3.85% | 184.4043267 | 0.50% |
| 01-10-2061 | 219.3955039 | 4.293 | -1.36% | 264.0325506 | 23.88 | -6.30% | 185.3691629 | 0.52% |
| 01-11-2061 | 218.586615 | 4.2552 | -0.37% | 260.1883233 | 21.868 | -1.46% | 186.3189236 | 0.51% |
| 01-12-2061 | 221.5324548 | 3.9563 | 1.35% | 244.4991578 | 22.498 | -6.03% | 187.2988354 | 0.53% |
| 01-01-2062 | 229.4735401 | 3.9241 | 3.58% | 246.6649566 | 22.33 | 0.89% | 188.2636717 | 0.52% |
| 01-02-2062 | 231.2180879 | 3.9245 | 0.76% | 252.3063748 | 21.56 | 2.29% | 189.0777522 | 0.43% |
| 01-03-2062 | 230.7753488 | 3.6601 | -0.19% | 229.6869761 | 21.333 | -8.97% | 189.9106773 | 0.44% |
| 01-04-2062 | 221.4181395 | 3.9034 | -4.05% | 212.1812299 | 19.448 | -7.62% | 190.6380733 | 0.38% |
| 01-05-2062 | 223.0516796 | 4.0421 | 0.74% | 232.8984096 | 20.558 | 9.76% | 191.3353183 | 0.37% |
| 01-06-2062 | 221.448062 | 3.9227 | -0.72% | 226.7469996 | 21.359 | -2.64% | 191.9534165 | 0.32% |
| 01-07-2062 | 219.2751421 | 3.9646 | -0.98% | 221.2471673 | 20.816 | -2.43% | 192.5526703 | 0.31% |
| 01-08-2062 | 224.8084755 | 3.8357 | 2.52% | 217.2609502 | 20.444 | -1.80% | 193.1406173 | 0.31% |
| 01-09-2062 | 232.9102842 | 3.6754 | 3.60% | 203.9852072 | 20.293 | -6.11% | 193.6946444 | 0.29% |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 01-10-2062 | 235.0245478 | 3.6218 | 0.91% | 186.2185067 | 17.444 | -8.71% | 194.1996759 | 0.26% |
| 01-11-2062 | 238.2948837 | 3.6015 | 1.39% | 193.761134 | 19.965 | 4.05% | 194.6142539 | 0.21% |
| 01-12-2062 | 232.6312145 | 3.8415 | -2.38% | 199.4073996 | 21.449 | 2.91% | 194.9534542 | 0.17% |
| 01-01-2063 | 227.2018088 | 3.7708 | -2.33% | 202.6871013 | 21.764 | 1.64% | 195.2587344 | 0.16% |
| 01-02-2063 | 223.2168475 | 3.8344 | -1.75% | 195.4013888 | 21.081 | -3.59% | 195.5187879 | 0.13% |
| 01-03-2063 | 224.0795866 | 4.0589 | 0.39% | 198.0848546 | 20.815 | 1.37% | 195.8089926 | 0.15% |
| 01-04-2063 | 223.9214987 | 3.9629 | -0.07% | 202.996732 | 21.457 | 2.48% | 196.0916594 | 0.14% |
| 01-05-2063 | 232.8141602 | 4.0088 | 3.97% | 196.96772 | 20.854 | -2.97% | 196.385633 | 0.15% |
| 01-06-2063 | 238.7176744 | 3.7963 | 2.54% | 192.6583398 | 20.124 | -2.19% | 196.6682999 | 0.14% |
| 01-07-2063 | 249.24677 | 3.6642 | 4.41% | 181.1381805 | 18.391 | -5.98% | 196.9547356 | 0.15% |
| 01-08-2063 | 252.8481654 | 3.4058 | 1.44% | 162.8309897 | 16.409 | -10.11% | 197.2411714 | 0.15% |
| 01-09-2063 | 257.617416 | 3.194 | 1.89% | 166.9604085 | 16.632 | 2.54% | 197.5125316 | 0.14% |
| 01-10-2063 | 257.9408269 | 3.27 | 0.13% | 152.6206509 | 15.816 | -8.59% | 197.7876606 | 0.14% |
| 01-11-2063 | 258.6313695 | 3.2619 | 0.27% | 161.3502967 | 15.913 | 5.72% | 198.0401764 | 0.13% |
| 01-12-2063 | 257.0839793 | 3.2012 | -0.60% | 167.9971562 | 16.039 | 4.12% | 198.2738477 | 0.12% |
| 01-01-2064 | 271.4941085 | 3.1296 | 5.61% | 160.0091698 | 16.145 | -4.75% | 198.4924434 | 0.11% |

Using the above set of data and applying the FED model as a valuation tool, it can be inferred that the allocation to equities has to be increased by decreasing the allocation to bonds in Tactical Asset Allocation (TAA) since the earnings yield of the long-term government bond comes up to be 3.9056% whereas the earnings yield of the stock market is 4.7990%.

The recent collapse of the equity market increased the risk of your portfolio beyond our previous estimates. This translates into a jump in the yearly volatility of the returns of portfolio of nearly 1%. On the other hand, this fall in the price of equities opens the door for attractive investment opportunities and I would like to suggest the following adjustments to your portfolio.

# TACTICAL ASSET ALLOCATION




## Summary Statistics:

| | *in percentages* | *in USD terms* |
|---|---|---|
| *Average (expected) yearly return* | 5.69% | 4,55,232 |
| *Volatility of yearly return* | 10.55% | 8,43,835 |
| *Lowest expected return in 68% of the time* | -4.86% | -3,88,603 |
| *Highest expected return in 68% of the time* | 16.24% | 12,99,067 |

Risk management: Variance-covariance approach

| | *in **percentages*** | ***in USD terms*** |
|---|---|---|
| *Average return (μ)* | 0.46% | 36,719 |
| *Standard deviation of returns (σ)* | 2.71% | 2,16,573 |
| *Value-at-risk (95%)* | -4.01% | -3,20,626 |
| *Phi* | 0.1023 | |
| *Expected shortfall (95%)* | -5.08% | -4,06,236 |

Risk management: Historical approach

| | *in percentages* | *in USD terms* |
|---|---|---|
| *Value-at-risk (95%)* | -4.62% | -3,69,820 |
| *Sum of returns that are below the VaR* | -42.02% | |
| *Expected shortfall (95%)* | -5.00% | -4,00,208 |

Two additional years of data corresponding to the two years since the meeting with the client Mr. John have been added to the "Data" sheet. The two years data is as follows:

| DATE | WORLD BONDS INDEX | WORLD BONDS INDEX | WORLD BONDS INDEX | WORLD EQUITIES INDEX | WORLD EQUITIES INDEX | WORLD EQUITIES INDEX | 3-MONTHS CASH USD | 3-MONTHS CASH USD |
|---|---|---|---|---|---|---|---|---|
| | price | yield | (holding) return | price | P/E ratio | (holding) return | | (holding) return |
| 01-02-2064 | 274.6984496 | 2.998 | 1.18% | 156.440843 | 16.34 | -2.23% | 198.6733502 | 0.09% |
| 01-03-2064 | 280.4414987 | 2.9241 | 2.09% | 152.0304743 | 15.189 | -2.82% | 198.8768703 | 0.10% |
| 01-04-2064 | 279.9020155 | 3.039 | -0.19% | 152.8234358 | 15.195 | 0.52% | 199.0653149 | 0.09% |
| 01-05-2064 | 285.3536951 | 2.7619 | 1.95% | 164.6015197 | 15.528 | 7.71% | 199.2575284 | 0.10% |
| 01-06-2064 | 295.3397416 | 2.5086 | 3.50% | 174.8132723 | 16.222 | 6.20% | 199.4384352 | 0.09% |
| 01-07-2064 | 292.7466667 | 3.0425 | -0.88% | 176.6151087 | 17.216 | 1.03% | 199.6118042 | 0.09% |
| 01-08-2064 | 282.3012403 | 3.3009 | -3.57% | 177.8990762 | 16.978 | 0.73% | 199.7776354 | 0.08% |
| 01-09-2064 | 280.0940052 | 3.3416 | -0.78% | 183.9282901 | 16.68 | 3.39% | 199.9283911 | 0.08% |
| 01-10-2064 | 298.1754522 | 3.4103 | 6.46% | 187.5143909 | 17.293 | 1.95% | 200.0904534 | 0.08% |
| 01-11-2064 | 291.4880103 | 3.3792 | -2.24% | 195.2795967 | 17.258 | 4.14% | 200.244978 | 0.08% |
| 01-12-2064 | 299.0484238 | 3.3677 | 2.59% | 199.6081647 | 16.813 | 2.22% | 200.4070403 | 0.08% |
| 01-01-2065 | 311.9760207 | 3.2119 | 4.32% | 209.3123493 | 17.052 | 4.86% | 200.5653337 | 0.08% |
| 01-02-2065 | 313.3260465 | 3.2012 | 0.43% | 213.2149479 | 17.595 | 1.86% | 200.7123205 | 0.07% |
| 01-03-2065 | 313.6301292 | 3.0624 | 0.10% | 218.3526356 | 17.58 | 2.41% | 200.870614 | 0.08% |
| 01-04-2065 | 318.6463049 | 3.4139 | 1.60% | 215.8053023 | 16.969 | -1.17% | 201.0213696 | 0.08% |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 01-05-2065 | 303.915969 | 3.5924 | -4.62% | 210.3993892 | 17.009 | -2.50% | 201.183432 | 0.08% |
| 01-06-2065 | 306.5497674 | 3.6458 | 0.87% | 210.3844429 | 15.755 | -0.01% | 201.3492632 | 0.08% |
| 01-07-2065 | 307.8798966 | 3.5456 | 0.43% | 213.3785492 | 16.072 | 1.42% | 201.5414767 | 0.10% |
| 01-08-2065 | 306.3193798 | 3.3459 | -0.51% | 207.947793 | 15.682 | -2.55% | 201.7600724 | 0.11% |
| 01-09-2065 | 313.3128165 | 3.2899 | 2.28% | 208.9140507 | 15.077 | 0.46% | 201.9975125 | 0.12% |
| 01-10-2065 | 316.2424806 | 3.1917 | 0.94% | 214.6705958 | 15.354 | 2.76% | 202.2688727 | 0.13% |
| 01-11-2065 | 326.6466667 | 3.2047 | 3.29% | 217.2498414 | 15.216 | 1.20% | 202.5553085 | 0.14% |
| 01-12-2065 | 338.7039276 | 3.0668 | 3.69% | 230.1466757 | 15.673 | 5.94% | 202.8907398 | 0.17% |
| 01-01-2066 | 342.2689922 | 3.1066 | 1.05% | 234.6032971 | 15.6 | 1.94% | 203.2525534 | 0.18% |

# PERFORMANCE RATIOS

## SHARPE RATIO

The Sharpe ratio was developed by Nobel laureate William F. Sharpe and is used to help investors understand the return of an investment compared to its risk.1 2 The ratio is the average return earned in excess of the risk-free rate per unit of volatility or total risk. Volatility is a measure of the price fluctuations of an asset or portfolio.

Subtracting the risk-free rate from the mean return allows an investor to better isolate the profits associated with risk-taking activities. The risk-free rate of return is the return on an investment with zero risk, meaning it's the return investors could expect for taking no risk. The yield for a U.S. Treasury bond, for example, could be used as the risk-free rate.

Generally, the greater the value of the Sharpe ratio, the more attractive the risk-adjusted return.

$$Sharpe\ Ratio = \frac{R_p - R_f}{\sigma_p}$$

$R_p$ = Return of portfolio

$R_f$ = Risk-Free rate

$\sigma_p$ = Standard deviation of portfolio's excess return

## SORTINO RATIO

The Sortino ratio is a variation of the Sharpe ratio that differentiates harmful volatility from total overall volatility by using the asset's standard deviation of negative portfolio returns—downside deviation—instead of the total standard deviation of portfolio returns. The Sortino ratio takes an asset or portfolio's return and subtracts the risk-free rate, and then divides that amount by the asset's downside deviation. The ratio was named after Frank A. Sortino.

The Sortino ratio is a useful way for investors, analysts, and portfolio managers to evaluate an investment's return for a given level of bad risk. Since this ratio uses only the downside deviation as its risk measure, it addresses the problem of using total risk, or standard deviation, which is important because upside volatility is beneficial to investors and isn't a factor most investors worry about.

$$\text{Sortino Ratio} = \frac{< R > - R_f}{\sigma_d}$$

Where,

$< R >$ = Expected Return

$R_f$ = The Risk Free Rate of Return

$\sigma_d$ = Standard Deviation of Negative Asset Returns

## MAR RATIO

MAR ratio is a measurement of returns adjusted for risk that can be used to compare the performance of commodity trading advisors, hedge funds, and trading strategies. The MAR ratio is calculated by dividing the compound annual growth rate (CAGR) of a fund or strategy since its inception by its most significant drawdown. The higher the ratio, the better the risk-adjusted returns.

For example, if Fund A has registered a compound annual growth rate (CAGR) of 30% since inception, and has had a maximum drawdown of 15% in its history, its MAR ratio is 2. If Fund B has a CAGR of 35% and a maximum drawdown of 20%, its MAR ratio is 1.75. While Fund B has a higher absolute growth rate, on a risk-adjusted basis, Fund A would be deemed to be superior because of its higher MAR ratio.

$$\text{Mar Ratio} = \frac{\text{Compound Annual Rate of Return}}{\text{Maximum Drawdown}}$$

*Summary statistics of Mr. John Lam (before devising an efficient asset allocation strategy) if original asset allocation of 30% bond, 30% equities and 40% cash was followed:*

| | in percentages | in USD terms |
|---|---|---|
| Average (expected) yearly return | 2.87% | 2,29,576 |
| Volatility of yearly return | 7.39% | 5,90,918 |
| Lowest expected return in 68% of the time | -4.52% | -3,61,343 |
| Highest expected return in 68% of the time | 10.26% | 8,20,494 |

**Risk management: Variance-covariance approach**

| Risk management: Variance-covariance approach | in percentages | in USD terms |
|---|---|---|
| Average return (μ) | 0.23% | 18,489 |
| Standard deviation of returns (σ) | 1.56% | 1,24,426 |
| Value-at-risk (95%) | -2.34% | -1,86,814 |
| Phi | 0.1023 | |
| Expected shortfall (95%) | -2.95% | -2,35,999 |

## Risk management: Historical approach

| Risk management: Historical approach | in percentages | in USD terms |
|---|---|---|
| Value-at-risk (95%) | -2.54% | -2,03,002 |
| Sum of returns that are below the VaR | -8.46% | -6,76,864 |
| Expected shortfall (95%) | -2.82% | -2,25,621 |

## Performance ratios

| Performance ratios | |
|---|---|
| Average monthly excess return | 0.01% |
| Standard deviation of monthly (excess) returns | 1.60% |
| Sharpe ratio | 0.003 |
| Standard deviation of returns below the mean | 1.03% |
| Sortino ratio | 0.005 |
| CAGR | 2.66% |
| Biggest drawdown | -3.35% |
| MAR | 0.795 |

*Final summary statistics of Mr. John Lam's portfolio after designing an appropriate Strategic and Tactical Asset Allocation plan for his wealth over the span of 5 -years :*

| | in percentages | in USD terms |
|---|---|---|
| ***Average (expected) yearly return*** | 4.40% | 3,52,054 |
| ***Volatility of yearly return*** | 12.45% | 9,96,244 |
| ***Lowest expected return in 68% of the time*** | -8.05% | -6,44,190 |
| ***Highest expected return in 68% of the time*** | 16.85% | 13,48,298 |

**Risk management: Variance-covariance approach**

| ***Risk management: Variance-covariance approach*** | in percentages | in USD terms |
|---|---|---|
| ***Average return (μ)*** | 0.34% | 27,185 |
| ***Standard deviation of returns (σ)*** | 2.31% | 1,84,936 |
| ***Value-at-risk (95%)*** | -3.47% | -2,77,959 |
| ***Phi*** | 0.1023 | |
| ***Expected shortfall (95%)*** | -4.39% | -3,51,064 |

**Risk management: Historical approach**

| *Risk management: Historical approach* | in percentages | in USD terms |
|---|---|---|
| *Value-at-risk (95%)* | -3.53% | -2,82,672 |
| *Sum of returns that are below the VaR* | -12.27% | |
| *Expected shortfall (95%)* | -4.09% | -3,27,164 |

**Performance ratios**

| *Performance ratios* | |
|---|---|
| *Average monthly excess return* | 0.11% |
| *Standard deviation of monthly (excess) returns* | 2.36% |
| *Sharpe ratio* | 0.048 |
| *Standard deviation of returns below the mean* | 1.48% |
| *Sortino ratio* | 0.077 |
| *CAGR* | 3.83% |
| *Biggest drawdown* | -5.08% |
| *MAR* | 0.753 |

The tactical asset allocation recommended allowed to dampen the impact of the recent equity market crash since the initial asset allocation has a MAR ratio that is lower than the actual portfolio. This was caused by a reduction in risk which translates into smaller drawdowns.

## REFERENCES

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*The data sets used in the project were extracted from the Capstone Project in Coursera which was included in the minor specialization course on Investment Management offered by the University of Geneva.*