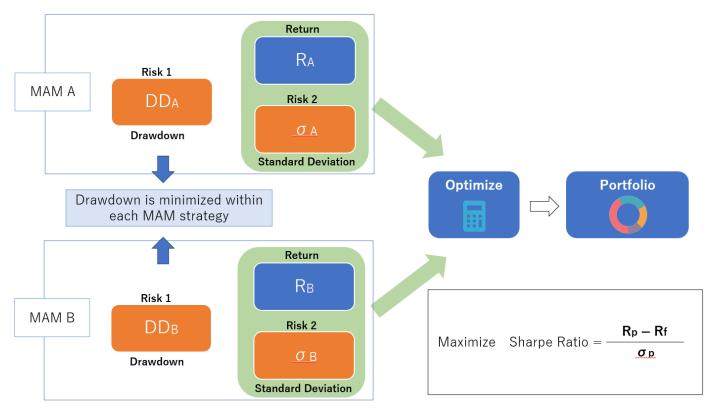## Table of contents

Optimal Portfolio Construction Process (Optimal Investment Ratio to Each EA) – Statistical System

Step	Work Content	Operation	Statistics/Function
1	Calculate the return of each EA (dependent variable) and the mean, variance, and standard deviation of each factor (independent variable).	Use the "basic statistics" of "data analysis".	Basic Statistics
2	Calculate the variance-covariance matrix of the return of each EA (dependent variable) and each factor (independent variable).	Use the "covariance" of "data analysis".	Covariance Matrix
3	Calculate the correlation coefficient between the return of each EA (dependent variable) and each factor (independent variable).	Use the "correlation" of "data analysis".	Correlation
4	Extract principal components from each factor (independent variable) and use these principal components as "independent variables" to conduct PCR model (Principal Component Regression) and PLS model (Partial Least Squares Regression) to predict the dependent variable (next month's return rate of EA). The following two types of regression analyses are conducted: PCR Model: "Principal components are calculated through principal component analysis regardless of the dependent variable." PLS Model: "Constructed to maximize the covariance between the dependent variable and the principal components, it's a model that considers the dependent variable."	Check the correlation coefficients outputted in step 3. ① Extract principal components from each factor (explanatory variable) using principal component analysis, and perform regression analysis using the principal components as explanatory variables. ⇒ "Principal Component Regression (PCR model)" ② A model that is created so that the covariance between the target variable and the principal component is maximized, and considers the target variable. ⇒ "Partial Least Squares Regression Analysis (PLS model)"	Correlation & Multiple Regression Analysis

5		Multiply the coefficients outputted from the regression analysis by the factor values, add the intercept, and predict the return for the next month.	Regression Equation Results
6	Calculate the optimal investment ratio for each EA (each strategy).	Using the "variance-covariance matrix" calculated in step 2 and the "predicted return (expected return)" calculated in step 8, compute the optimal investment ratio.	Portfolio Construction

Conceptual Image of Optimal Asset Allocation

Item	Policy
Return	Probability x Random Variable Estimation of Impact (Estimation of Probability) Constructing a factor model using **AI** to estimate returns (Using **AI** to determine which factors to use)
Risk (Standard Deviation)	・Using past standard deviation as the expected future standard deviation. (In the next phase, the expected standard deviation will be calculated using the ARCH model or the GARCH model. An algorithm will be introduced here.)
Covariance and orrelation coefficient	・Using past values as the expected future covariance and correlation coefficient. (In the next phase, the multivariate GARCH will be used. An algorithm will be introduced here.)
Optimization	Quadratic Programming

Regarding AI-based analysis for deriving the optimal asset allocation:

1. Portfolio Optimization Method: Mean-Variance Method

2. Risk-Return Estimation: For the return (expected profit rate), it is assumed that it is estimated from the multi-factor by AI (including optimal factor selection). However, AI estimation is limited to cases where optimal estimation is possible, and usually, our own market outlook is taken into account.

⑴ Return (Expected Profit Rate)

   Probability × Random Variable: Estimate of impact (probability estimation). Construct a factor model using AI and estimate the return (use AI to determine which factors should be used).

   Estimate of impact (probability estimation): Construct a factor model using AI and estimate the return (using AI to determine which factors to use).

   Construct a factor model using AI and estimate the return (using AI for factor selection as well).

⑵ Risk (Standard Deviation)

Use past standard deviations as expected future standard deviations. Introduce an algorithm and estimate the expected standard deviation using the ARCH model or the GARCH model.

⑶ Covariance & Correlation Coefficient

Use past values as expected future covariance and correlation coefficients (introduce an algorithm and use multivariate GARCH).

⑷ Optimization

Quadratic Programming

3. Rebalancing: Monthly or ad hoc

4. AI Usage Points: Return (Expected Profit Rate) Estimation, Factor Selection