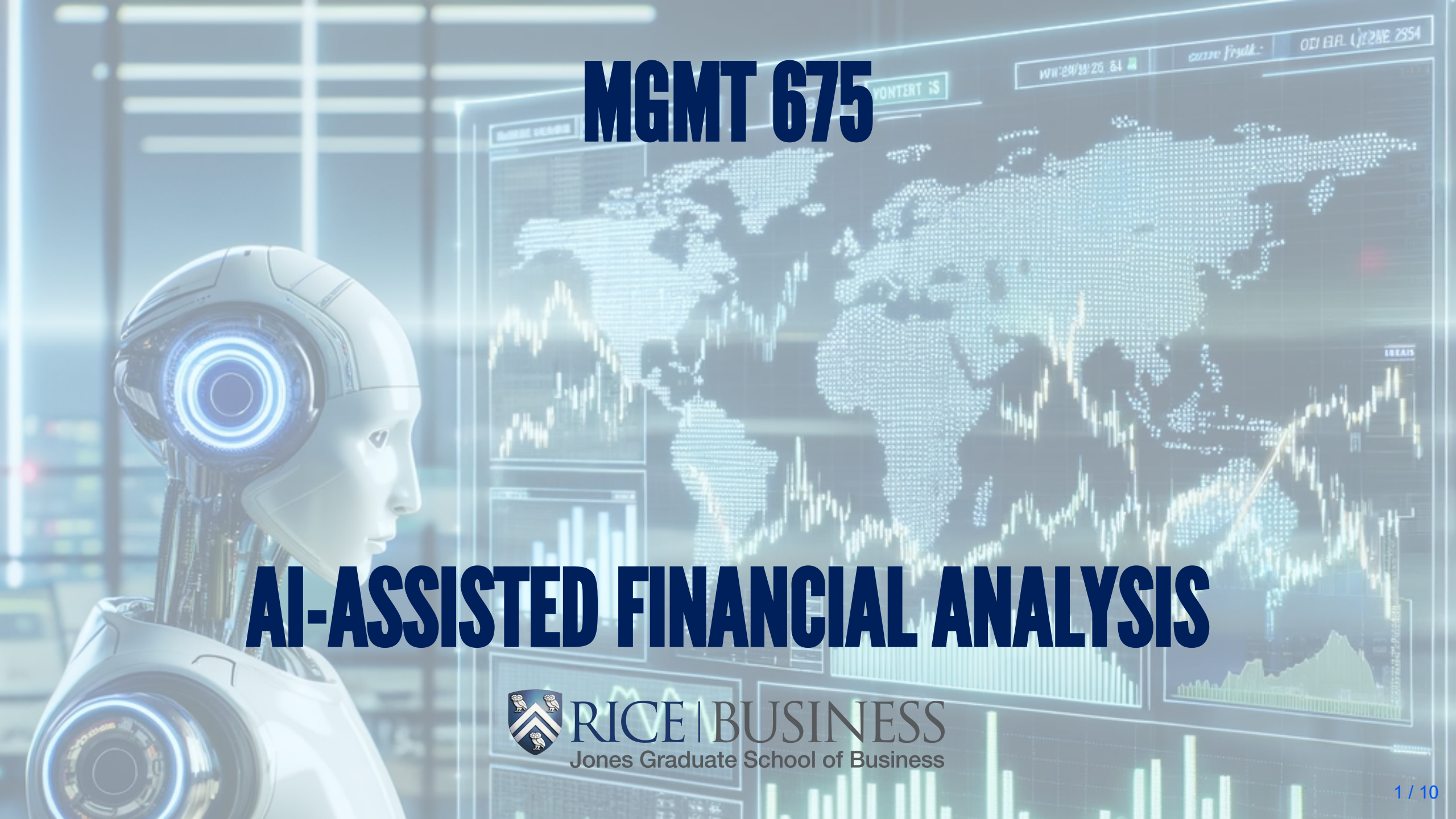
MGMT 675

AI-ASSISTED FINANCIAL ANALYSIS



RICE | BUSINESS
Jones Graduate School of Business

OPTIMAL PORTFOLIOS THE EASY WAY

WE DON'T NEED A NUMERICAL SOLVER

- We can find the tangency portfolio without using any type of numerical solver (if short sales are allowed).
- We don't need cvxopt.
- We do need to solve some equations, but that is fairly easy.
- Can do similar for GMV portfolio and frontier.

EQUATIONS TO SOLVE

- Solve

$$\begin{pmatrix} \mathrm{var}_1 & \cdots & \mathrm{cov}_{1n} \\ \vdots & \vdots & \vdots \\ \mathrm{cov}_{1n} & \cdots & \mathrm{var}_n \end{pmatrix} \begin{pmatrix} w_1 \\ \vdots \\ w_n \end{pmatrix} = \begin{pmatrix} \mu_1 - r_f \\ \vdots \\ \mu_n - r_f \end{pmatrix}$$

- The solution minimizes (1/2) * variance minus risk premium. It is on the capital allocation line.
- Divide by sum of weights to get tangency portfolio.

SOLVE IN EXCEL

- The equations are solved in Excel with the MINVERSE and MMULT functions.
- MMULT(RPREM, MINVERSE(COV))
- RPREM should be in a row
- Result will be in a row

GLOBAL MINIMUM VARIANCE PORTFOLIO

- Solve

$$\begin{pmatrix} \mathrm{var}_1 & \cdots & \mathrm{cov}_{1n} \\ \vdots & \vdots & \vdots \\ \mathrm{cov}_{1n} & \cdots & \mathrm{var}_n \end{pmatrix} \begin{pmatrix} w_1 \\ \vdots \\ w_n \end{pmatrix} = \begin{pmatrix} 1 \\ \vdots \\ 1 \end{pmatrix}$$

- Divide by sum of weights

FRONTIER (HYPERBOLA)

- Solve

$$\begin{pmatrix} \mathrm{var}_1 & \cdots & \mathrm{cov}_{1n} \\ \vdots & \vdots & \vdots \\ \mathrm{cov}_{1n} & \cdots & \mathrm{var}_n \end{pmatrix} \begin{pmatrix} w_1 \\ \vdots \\ w_n \end{pmatrix} = \begin{pmatrix} \mu_1 \\ \vdots \\ \mu_n \end{pmatrix}$$

- Divide by sum of weights
- Put some weight x on the GMV portfolio and 1-x on this portfolio. Vary x and trace out frontier.

EXCEL EXAMPLE

- portfolios.xlsx
- U.S., developed, and emerging from Applied Finance

JULIUS EXAMPLE

- Ask Julius to use yfinance to get Yahoo adjusted closing prices for
  - SPY = S&P 500
  - VBR = Vanguard small-cap value
  - IEF = Treasury bonds
  - UUP = U.S. dollar bullish
- Ask Julius to downsample prices to end-of-month and compute monthly returns as percent changes in the downsampled prices.

- Ask Julius to compute means and covariance matrix as numpy arrays.
- Tell Julius the risk-free rate is 5% and ask Julius to compute the risk premia.
- Ask Julius to multiply the risk premia by the inverse of the covariance matrix.
- Ask Julius to divide the result by the sum of its elements.