ASRM 406 F25 Project

Due 12/12

In this project, you will write a mathematical research paper on two topics. Use academic conventions to cite your sources, including a bibliography.

The audience for this paper will be other students who have taken linear algebra but are not familiar with your topic. The length is 2,000-5,000 words. Your paper will include examples and graphics to demonstrate your results. You may work in groups of 1 or 2.

Topic 1: Mean Variance Portfolio Theory

Use the following data as an example in your explanations:

$$\mu = \begin{bmatrix} 0.2 \\ 0.1 \\ 0.08 \end{bmatrix}, \qquad \Sigma = \begin{bmatrix} 0.3 & 0 & 0 \\ 0 & 0.1 & 0 \\ 0 & 0 & 0.2 \end{bmatrix}$$

- Describe diversification, the efficient frontier, and CAPM.
- Describes the assumptions of CAPM.
- Find the weights and variance of the minimum variance portfolio using matrices.
- Derive a formula for the weights and variance for a given target return.
- Find a formula for the weights and return for a given target risk.
- Explain how the procedure changes when you introduce a risk-free asset.
- Choose an extension of mean variance portfolio analysis and describe it.

Topic 2: Linear Regression

Use the following data as an example in your explanations:

y	2.3	-0.6	11.7	0.1	3.2	1.3
x_1	1	2	3	4	5	6
x_2	2	1	6	3	4	5

- Explain how to define distances between vectors and subspaces.
- Describe orthogonal projections and minimum distances to subspaces.
- Explain the formula for multiple linear regression using matrices.
- Describe the assumptions of linear regressions.
- Derive and explain the normal equations and how they relate to least squares.
- Derive the formula for the coefficient vector.
- Describe the interpretation of your coefficients.
- Choose an extension of linear regression and describe it.