

Real Estate Portfolio Optimization

Iowa State University CPRE/SE Fall 2019 Capstone

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Problem Statement

- Principal lacks the in house tools to perform portfolio optimization
- Market level data analysis is outsourced
- Currently they must rely on third parties to perform the optimization analysis, which is expensive, slow, and uncustomizable

Project Objective

- Provide an inhouse tool that enables Principal to perform portfolio optimization themselves without the reliance on a third party
- Allow portfolio managers to customize the optimization constraints
- Provide immediate results to portfolio managers
- Reduce costs

Methodology

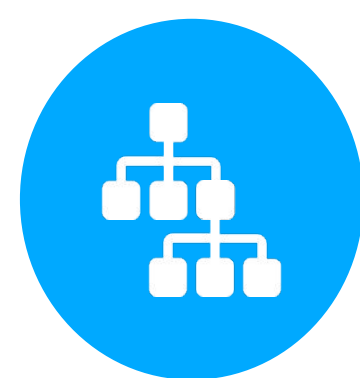
Knowledge Acquisition

Knowledge on portfolio optimization and optimal technologies for implementation were induced via our weekly meetings with Principal and by conducting research online. Literature on Modern Portfolio Theory and Markowitz Optimization was provided by Principal.



Design Layout

The technologies we used were decided by what Principal and our team are familiar with and the languages that best fit the problem. We decided on using Python and Plotly's Dash library to create the Web Application and Microsoft's Power BI for creating data visualizations.



Code Reviews

Git version control and performed code reviews to keep quality high and improve the application and reduce potential bugs. Multiple team members would test new code and provide feedback before accepting a merge request.

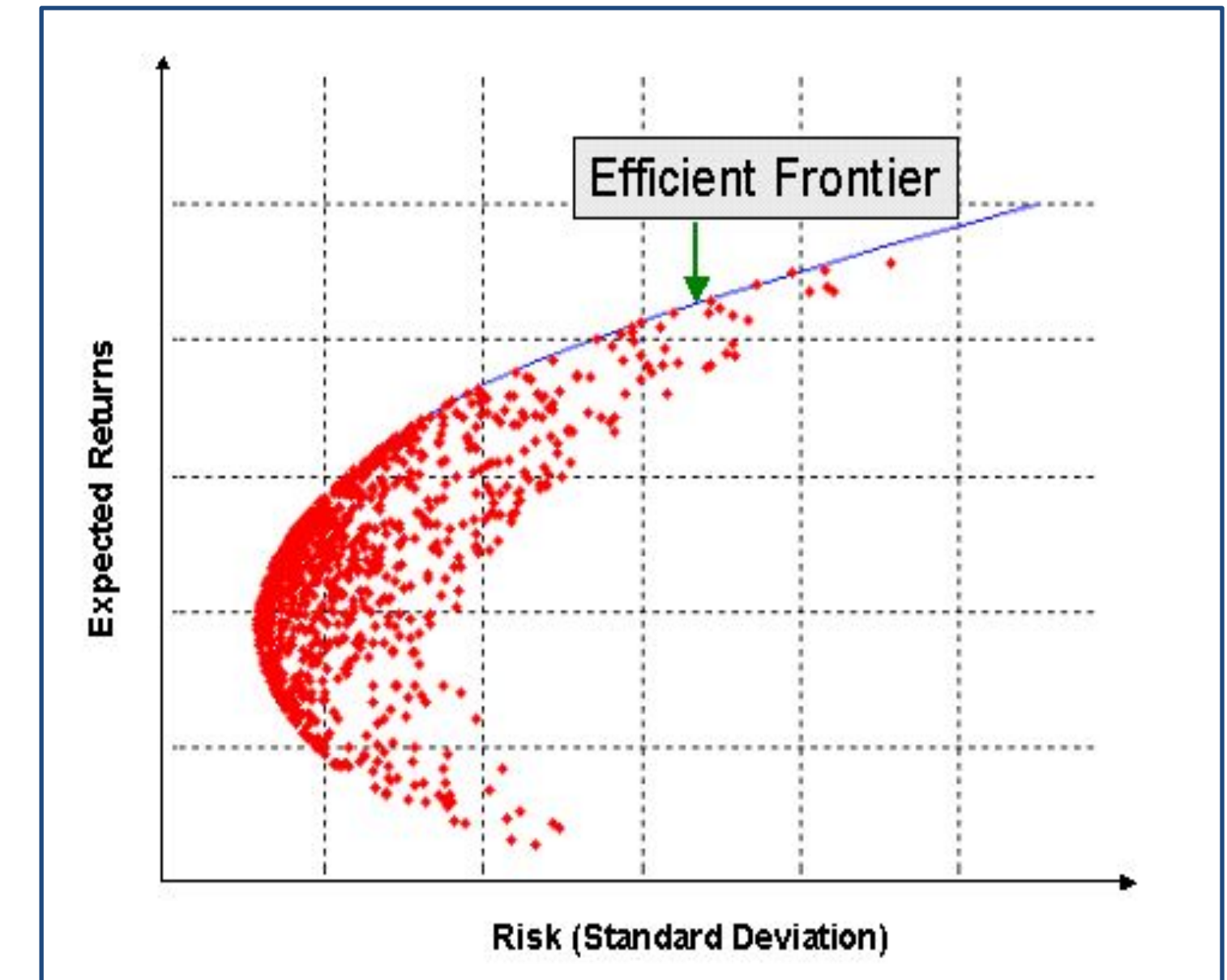


Real Estate Portfolio Optimization Overview

Modern Portfolio Theory (Namely, Markowitz Portfolio Theory)

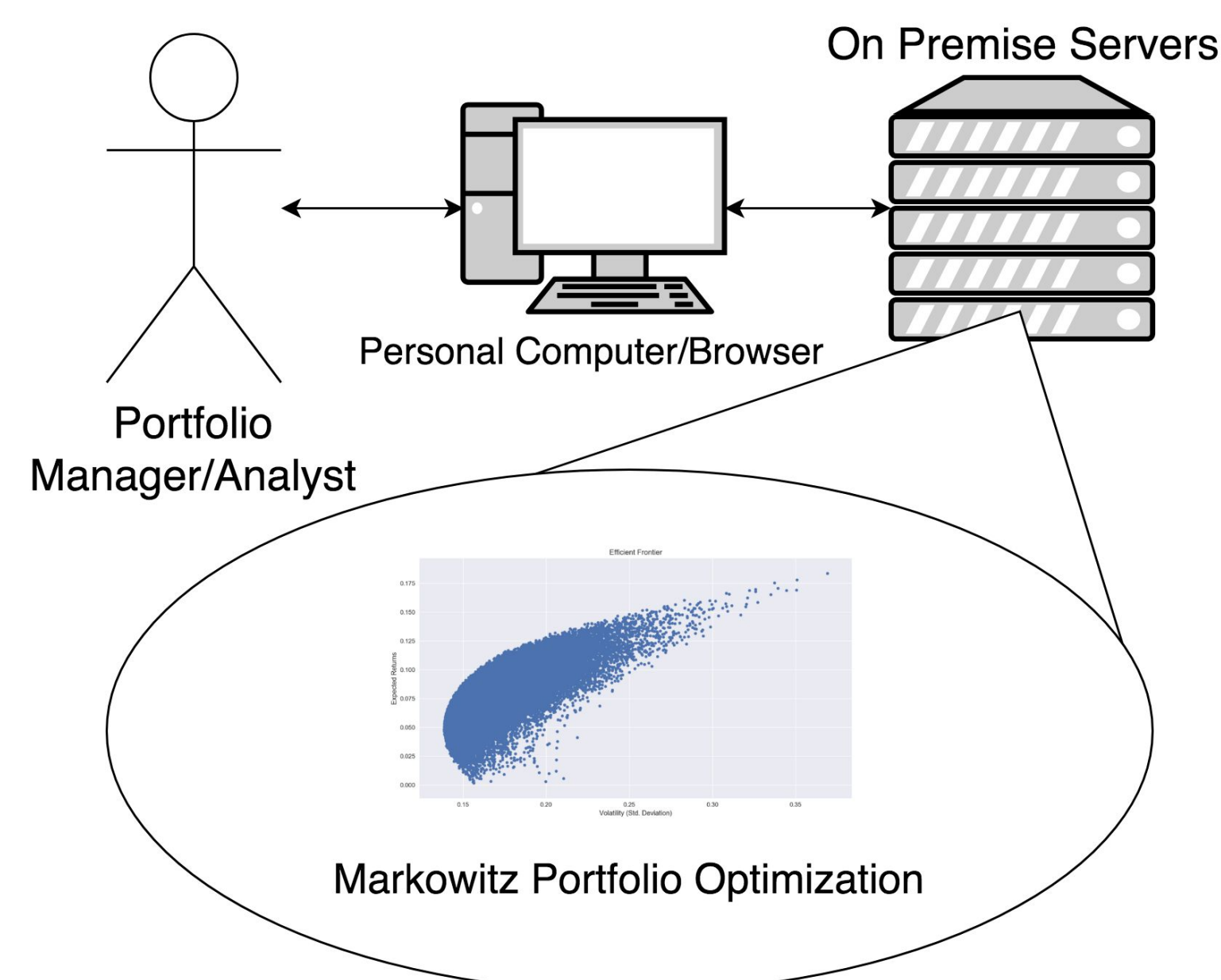
"Modern portfolio theory (MPT) is a theory on how risk-averse investors can construct portfolios to optimize or maximize expected return based on a given level of market risk, emphasizing that risk is an inherent part of higher reward. According to the theory, it's possible to construct an 'efficient frontier' of optimal portfolios offering the maximum possible expected return for a given level of risk. This theory was pioneered by Harry Markowitz in his paper 'Portfolio Selection,' published in 1952 by the Journal of Finance."

- Investopedia (<https://www.investopedia.com/terms/m/modernportfolioteory.asp>)



Concept

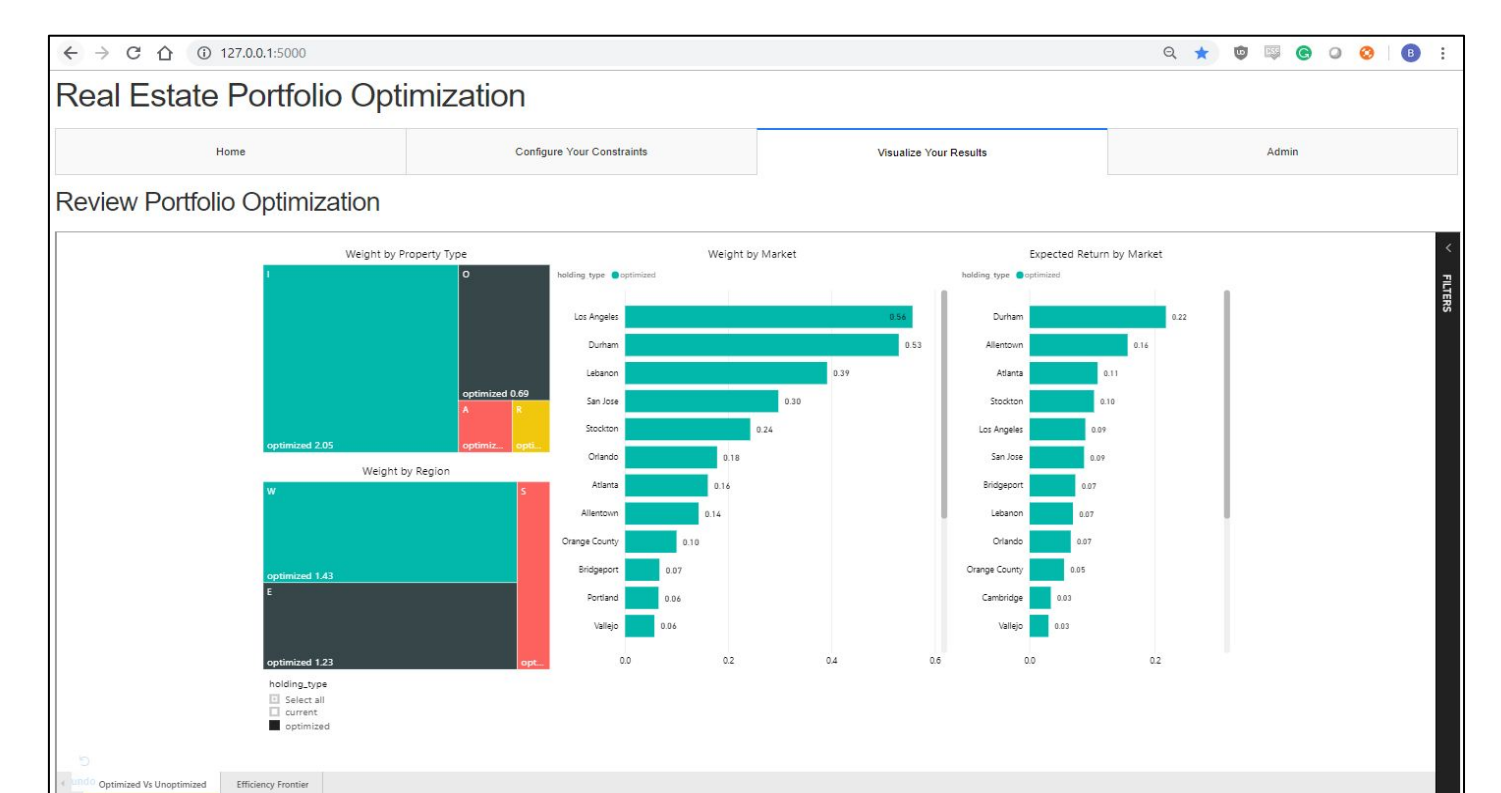
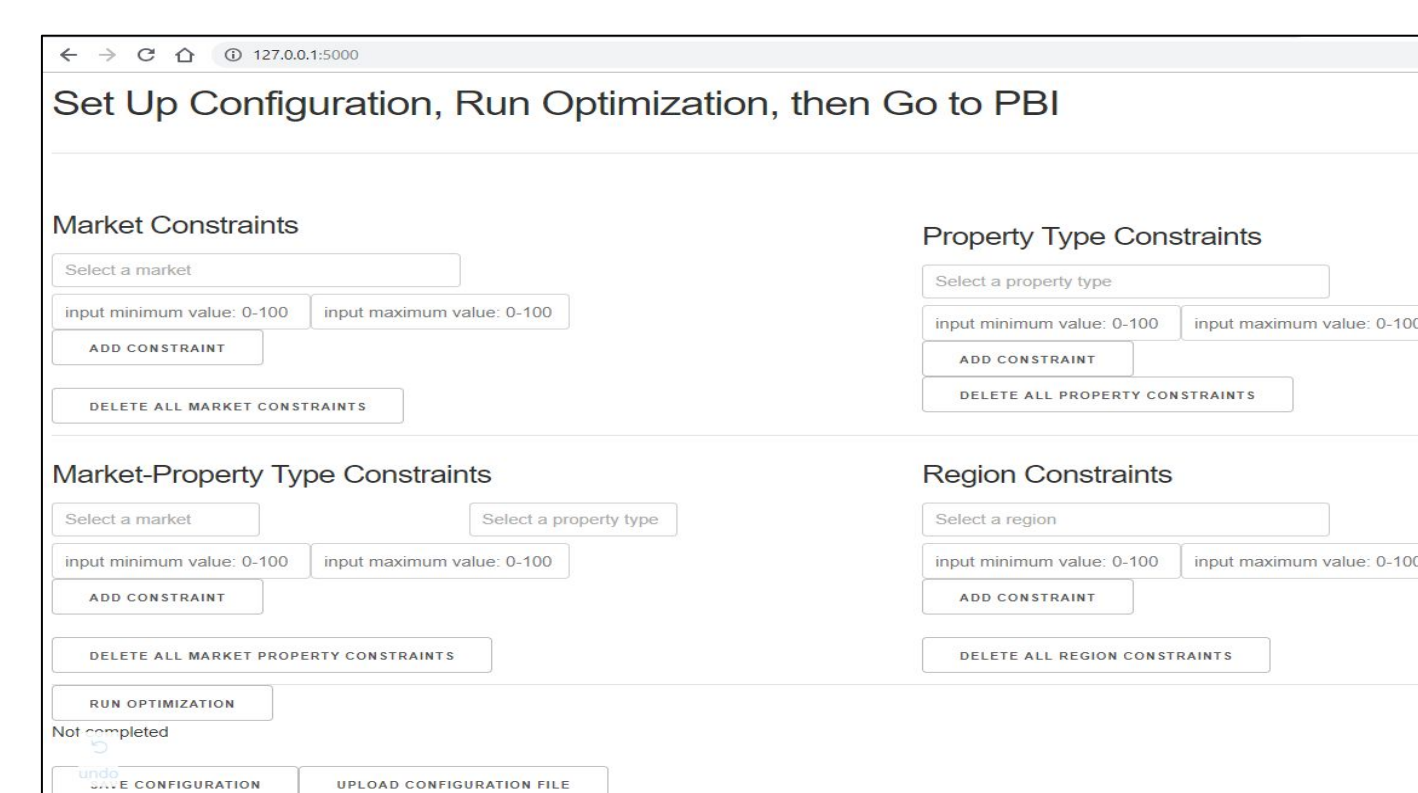
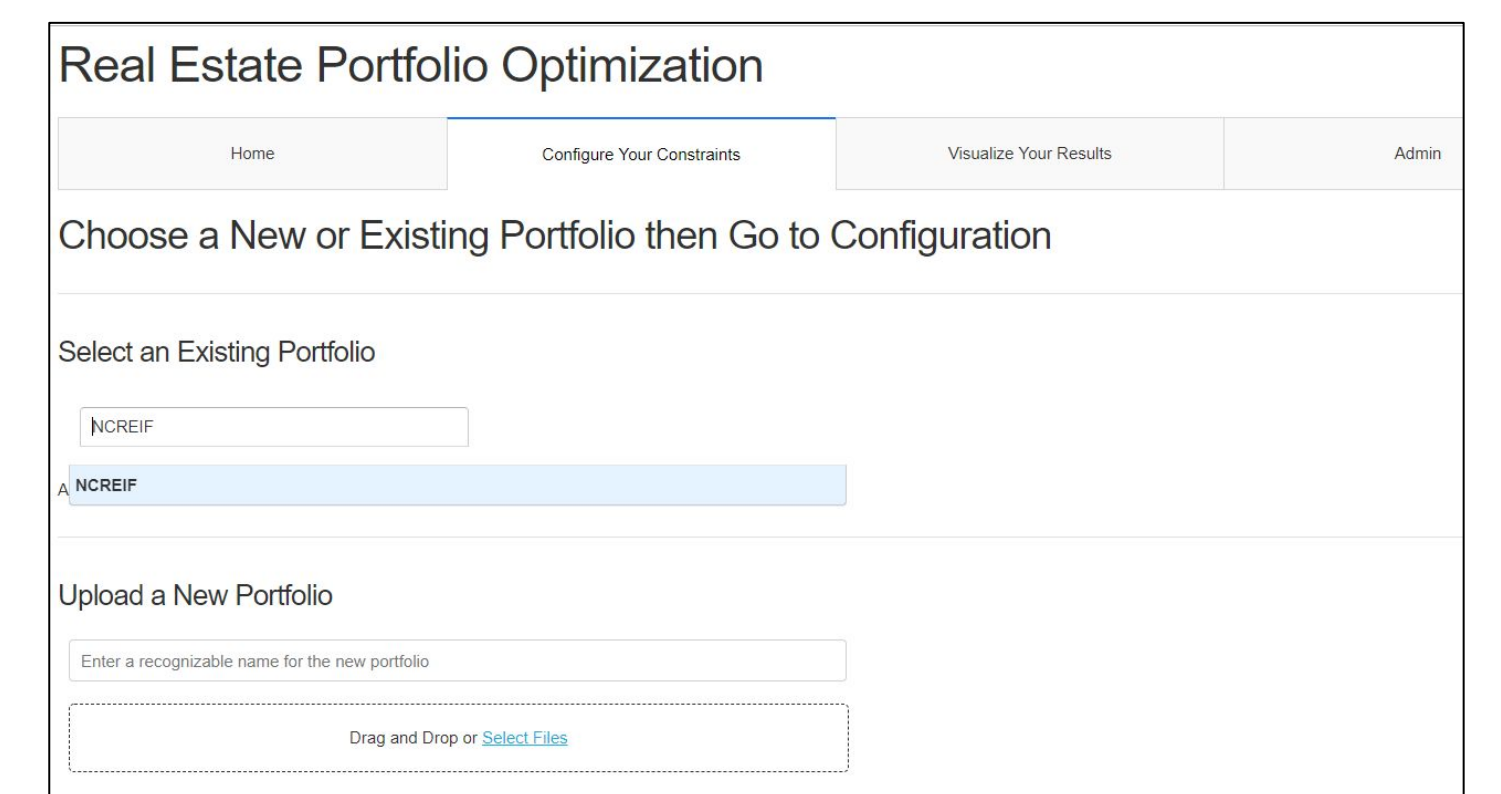
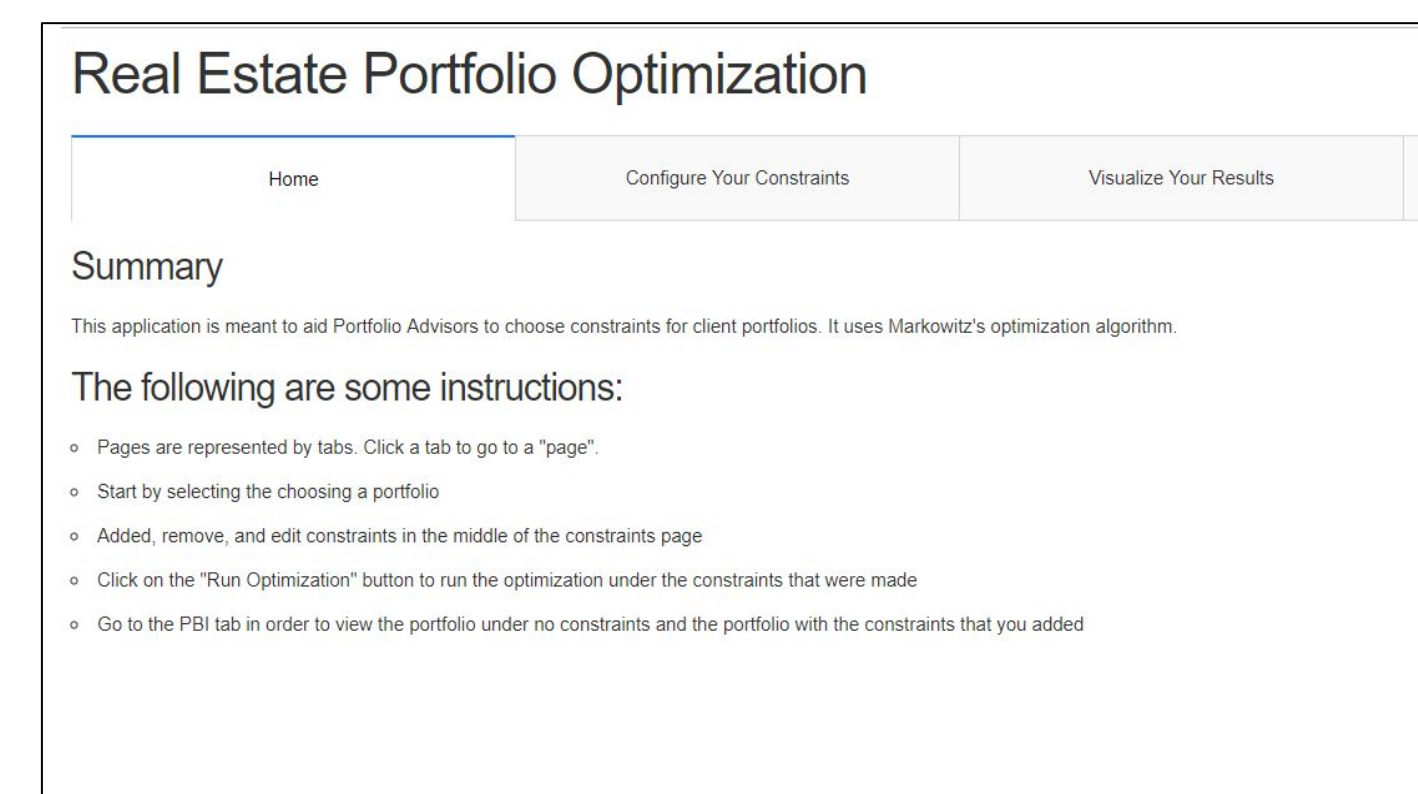
- Input market data and portfolio holdings
- Perform Markowitz portfolio optimization
- Output analytical data visualization



Current State Design

User Interface

- Principal-specific system with features specifically requested by real estate and data science teams
- Upload Portfolio & Create Optimization Constraints
 - Constrain by Market, Property Type, Market & Property Type, or Region
- Power BI Embedded
 - Displays the user's current portfolio vs optimized portfolio vs NCREIF standard portfolio
 - Compares portfolios by the constraints and expected returns



User Testing

- Coordinated with Principal and got our application in front of actual users
- A Google Form was filled out and the results were sent to our frontend designer
 - Results lead to a better and clearer user experience

System Design

- Web Application using Model, View, Control (MVC) design paradigm
- Dash library used for UI styling and Python to transfer data and perform Markowitz optimization
- Power BI generates dynamic data visualizations that allows users to focus on specific aspects of their whole portfolio

