Real Estate Portfolio Optimization

Midpoint Presentation

Friday October 26, 2018

Iowa State University

Senior Design

ARIN: Analytics Research Intelligence Network

analytics@scale

Principal®

Meet the Team

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Project Lead / Backend

Software Engineering

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Test Engineer / Frontend

Computer Engineering

Nickolas Moeller

Report Manager / Backend

Software Engineering

Leelabari Fulbel

Meeting Facilitator / Frontend

Software Engineering

Colton Goode

Meeting Scribe / Backend

Computer Engineering, Management of Information Systems

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Bottom Line Up Front

Our mission is to design and develop a portfolio optimization system that meets the unique needs of a commercial real estate portfolio manager.

Project Scope

1. Gather requirements. Master the real estate domain and portfolio optimization.
2. Design the system and create a working prototype.
3. Test, iterate, and report out.

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Agenda

- Intro to Portfolio Optimization
- The Problem and Plan
- Preliminary Results
- Next Steps

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Portfolio Optimization

1 Calculate Inputs

Portfolio optimization requires estimates of expected return and the asset covariance matrix

2 Local Knowledge

Allow the user to express their beliefs about a given asset, market, lifecycle, or property type

3 Define Constraints

The user defines portfolio constraints.

e.g. The portfolio's allocation to NYC must be 35-40%

4 Optimize

Algorithm searches for the mixture of assets that minimizes the objective function (e.g. risk-adjusted return)

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The Problem Facing Principal

Lacking an Internal Portfolio Optimization Tool

No portfolio optimization currently being done in house

Lacking capabilities:

- representing data in graphs
- automatically optimizing with constraints
- repeating this analysis swiftly

Market Level Data Analysis is Outsourced

Costar - expensive, lengthy reports

Costar Lacks:

- customization/configuration of analysis
- the ability to extend the report into more niche analysis
- cannot have access to confidential fund data

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The Solution

A software that enables PM's to perform their own portfolio optimizations

Efficient, Reliable

Distributed software available from any computer

Easy to run similar optimizations at future times

Cost Effective

Reduces reliance on Costar

Optimizations can be done internally, by any PM at their leisure

Flexible, Extendable

Use your data to get your results the way you want them

The software is open for suggestions by its users!

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Preliminary Results

Markowitz in Python

Utilizes NCREIF data

Optimization is done per market

Configurable property type and timeframe

Python Flask Server

Flask server boilerplate

Two endpoints configured:

- optimization form
- optimized weights response

Frontend Design Investigation

User interface mockups were created

Frontend framework

- Dash

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Screen flowchart

represents a viewable page

represents transition from one page to another

Home Page

- import a portfolio

View unoptimized data page

- show current portfolio holdings by geography, region, etc. in pie/bar graphs
- summarize expected risk and return

Options page

- Update expected returns
- optional custom constraints
- import new expected returns

View optimized data page

- show optimized portfolio holdings by geography, region, etc. in pie/bar graphs
- give recommended actions as to what to buy and sell based on return and risk

User will click the import button to upload portfolio data via a csv file

User can view data and then move on to the options page

User presses the optimize button to send the data to the backend

Can also view efficient frontier graph with comparison to current portfolio and export results via email

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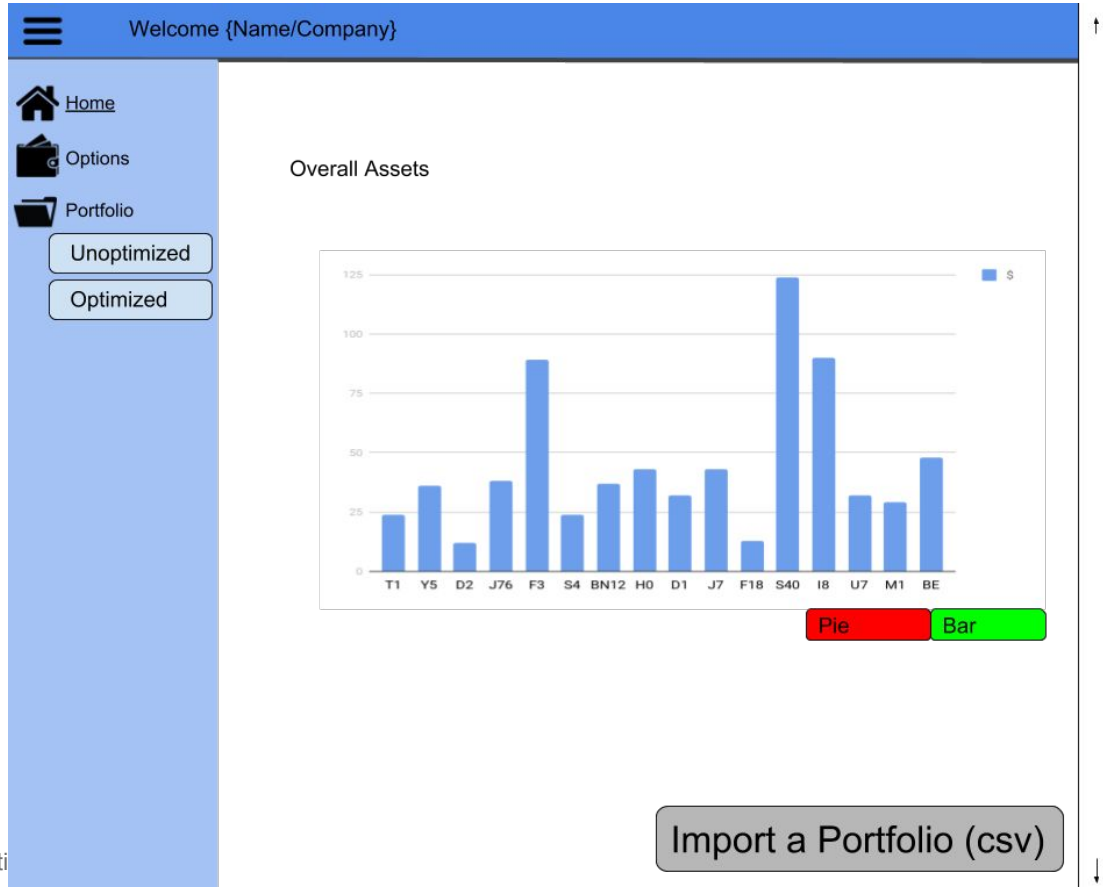
Start your Optimization Experience Right



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Analyze your Portfolio on Various parameters

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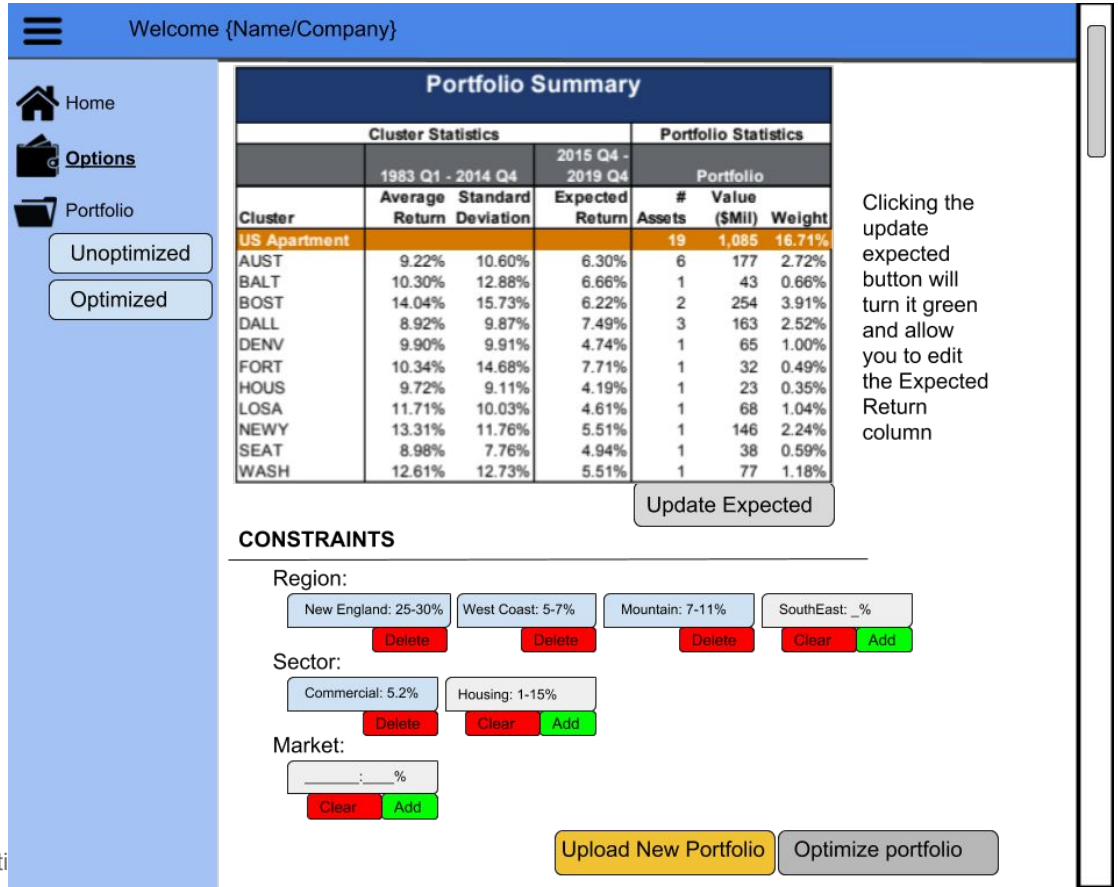
Define your Portfolio's Custom Constraints



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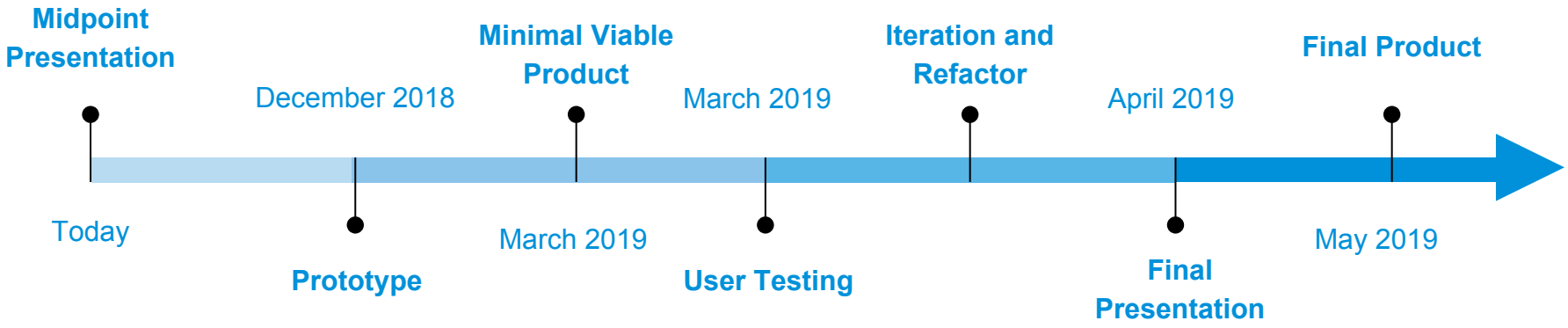
Project Timeline



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Thank You – Questions?

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END OF PRESENTATION

Following slides hold information/notes that may or maynot be added to the presentation.

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Round 1 Feedback (Ben)

- It would be great to cover the requirements you have discovered so far. Shows the audience that you are creating a solution fit for their needs and paints the picture of what they could do with it.

- Can you briefly touch on the basics and benefits of portfolio optimization in the intro? What are the risks or downsides of not using portfolio optimization? This helps remind the audience of the immense value your tool could create. You could consider using the slide on the next page.

- I am proposing a small change for the first few slides.
  1) Title slide
  2) Team intro
  3) Bottom Line Up Front – 10 seconds to highlight why they should care about the next 20 slides
  4) Agenda – Remove team intro as a section. Add a new section or go to 3. Either is ok.

- Be consistent with the location and size of the title of each slide. Aim for “Action Titles”. e.g. “Define your portfolio’s custom constraints” is better than “UI Mockup – Options Panel”

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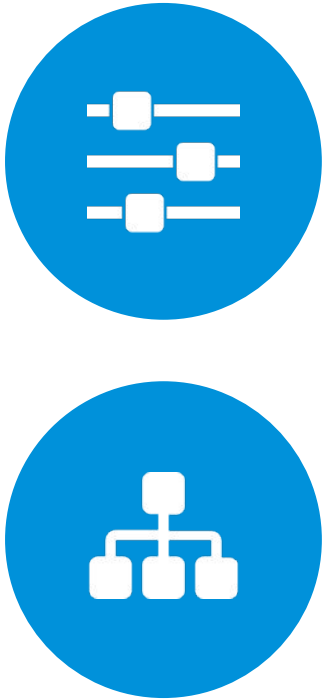
Project Objectives

1. Literature review of portfolio optimization
2. Gather requirements from researchers and portfolio managers including use cases, constraints, & best practices
3. Prototype constrained optimization models in R or Python
4. Propose a design for a user interface that can initialize optimization models and portfolio simulations. Design visualizations and summary statistics for the current portfolio, optimal portfolios, and simulation results
5. Prototype the proposed system using open source libraries
6. Test prototype on a sample dataset from existing fund and review for accuracy
7. Present buy/sell recommendations to the portfolio managers with a description of how the action will impact the portfolio



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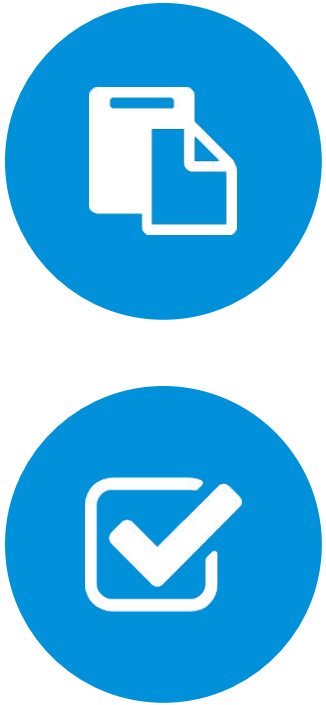
Project Deliverables

1. Working prototype of user interface using sample fund data
2. Well documented code and data sources needed to reproduce results and handoff to process owners
3. Detailed report describing project background, methodology, results, and next steps.
4. Documentation describing the current system and a proposal for maintenance and improvements
5. Midpoint and final presentations to Principal stakeholders
6. Project poster providing a visual snapshot of written report



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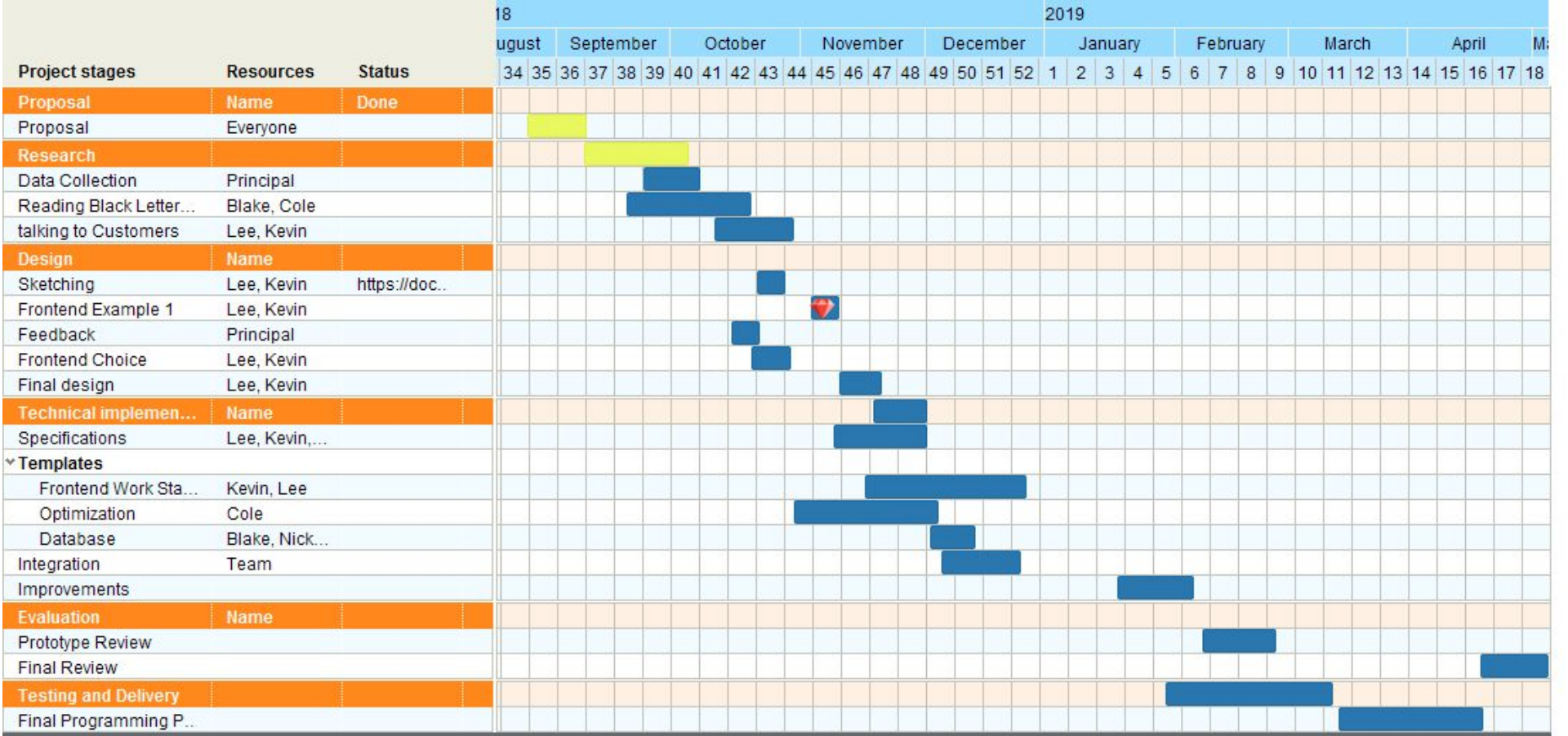
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2019
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September
October
November
December
January
February
March
April
34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
Project stages
Resources
Status
Proposal
Name
Done
Proposal
Everyone
Research
Data Collection
Principal
Reading Black Letter...
Blake, Cole
talking to Customers
Lee, Kevin
Design
Name
Sketching
Lee, Kevin
https://doc..
Frontend Example 1
Lee, Kevin
Feedback
Principal
Frontend Choice
Lee, Kevin
Final design
Lee, Kevin
Technical implemen...
Name
Specifications
Lee, Kevin,...
Templates
Frontend Work Sta...
Kevin, Lee
Optimization
Cole
Database
Blake, Nick...
Integration
Team
Improvements
Evaluation
Name
Prototype Review
Final Review
Testing and Delivery
Final Programming P..
Projectname:
Showcase Tom'splanner
Date:
06-02-2017
Comments:
This is a dummy schedule. You can experiment with it as much as you want.
Phase completed
Client side
Intern
....
Meeting team
Report management
Draft report
Milestone

Portfolio Optimization

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PO3 – Real Estate Portfolio Optimization

Purpose ***(What is the project motivation?)***	• PGRE PMs lack tools to run scenario analysis and optimize portfolios • PMs need recommendations to buy/sell properties that increase expected return or reduce risk of current portfolios • Today, portfolio optimizations are conducted by a third-party (Costar). Results are compiled into a lengthy report. This process is slow and costly.
Objectives ***(What are we going to do?)***	• Literature review of portfolio optimization (Markowitz, Black-Litterman) • Gather requirements from researchers and portfolio managers including use cases, constraints, best practices • Prototype constrained Markowitz and Black-Litterman optimization models in R or python • Propose a design for a user interface that can initialize simulation/optimization and displays visualizations and summary statistics of current portfolio, optimal portfolios, and simulation results • Prototype the proposed system using open source software, preferably Shiny by RStudio • Test prototype on a sample dataset from USPA fund and review for accuracy • Present buy/sell recommendations to the portfolio managers with a description of how the action will impact the portfolio (e.g. reduce risk, increase expected return)
Output ***(What are the project deliverables?)***	• Working prototype of user interface using USPA fund data • Well documented code and data sources needed to reproduce results and handoff to PGRE process owners • Detailed report describing project background, methodology, results, and next steps. • Documentation describing the current system and a proposal for maintenance/improvements • Midpoint and final presentation to PGRE stakeholders • Project poster providing a visual snapshot of written report
Outcome ***(Expected impact on organization?)***	• PMs able to make timely and informed investment decisions • Maximize expected returns and reduce risk of property portfolios • Reduce lead time and costs associated with third-party reports • Systematic solution reduces burden of ad-hoc requests to research team, shifting focus to higher-order tasks

Classification: Internal Use

Charter – Real Estate Portfolio Optimization

1. Objectives
(What do we want to achieve with this stream?)
(What is/are the goal(s)?)

Issues/Challenges:
- Student team unfamiliar with Real Estate domain
- Student team unfamiliar with portfolio optimization
- No current systems to benchmark
- Finding the appropriate level of user intervention

Objectives:
- Literature review of portfolio optimization
- Gather requirements from researchers and portfolio managers including use cases, constraints, best practices
- Prototype constrained Markowitz and Black-Litterman optimization Propose a design for a user interface that can initialize simulation/optimization and displays visualizations and summary statistics of current portfolio, optimal portfolios, and simulation results
- Prototype the proposed system using open source softwareTest prototype on a sample dataset from USPA fund and review for accuracy
- Present buy/sell recommendations to the portfolio managers with a description of how the action will impact the portfolio

2. Scope
(What are the boundaries of the work: in vs. out?)
(Establish the tennis court)

In-Scope:
- USPA fund
- Asset return series from 2007-2018
- Markowitz and B-L optimization methods

Out of Scope:
- Other PGRE funds
- Other optimization methods

3. Must Wins
(What needs to be done to achieve our objectives?)
(Factors Critical to project success)

- Need input from USPA stakeholders throughout the project
- Team must become familiar with open source tools for data analysis and app development (R Shiny, Dash, etc.)
- Team must become competent with optimization methodology and implementation using open source tools

4. Key Milestones
(When will important deliverable be provided?)
Date – Milestone

- 08/31 – Project kickoff in DSM
- 10/24 – Quarterly update 1
- 12/14 – Quarterly update 2; students start break
- 1/14 – Students resume project
- 3/8 – Quarterly update 3
- 5/3 – Final presentation
- 5/10 – Final deliverables due

5. Deliverables
(What are the tangible results to deliver?)
(Key deliverables during the project lifecycle)

- Working prototype of user interface using USPA fund data
- Well documented code and data sources needed to reproduce results and handoff to PGRE process owners
- Detailed report describing project background, methodology, results, and next steps.
- Documentation describing the current system and a proposal for maintenance/improvements
- Midpoint and final presentation to PGRE stakeholders
- Project poster providing a visual snapshot of written report

6. Team
(Who will contribute to deliver the stream?)
(Identify Key players)

Project Sponsor: Arthur Jones

Project Lead / Manager: Ben Harlander

Team members: Jonathan Ling, Q Mabasa, 6 ISU EE/SE students

Key Stakeholders: USPA fund managers, …

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Bottom Line Up Front

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