Goal Programming Project Report

Real Estate Portfolio Analysis

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February 2025

Introduction

For this project, I set out to solve a real-world scenario in real estate using goal programming techniques to determine the most optimal investment strategy. My goal was to simulate the decision-making process for a lottery-winning client interested in purchasing 5 to 10 homes in a high-value area while minimizing risk and maximizing profit.

To do this, I gathered real estate data from Zillow and BrightMLS, focusing on the McLean, Virginia (22101) area—a region known for top-tier schools and amenities. I focused on single and double-family homes with comparable square footage to ensure uniformity in analysis. From an original dataset of 360 listings, I narrowed it down to a sample of 100 homes for detailed analysis.

Using Microsoft Excel, I calculated key financial indicators such as ROI (Return on Investment), standard deviation, and expected profit, which laid the foundation for identifying optimal investment strategies under different risk scenarios.

Scenario

A high-net-worth client has won the lottery and is working with Zillow to purchase between 5 to 10 homes in the McLean, VA area. Their total investment budget is $20,000,000, and they are looking for multiple optimized portfolios that consider both low-risk and high-reward opportunities.

Using price history, current market value, predicted future value, and expense data, I developed models to provide low-, medium-, and high-risk investment portfolios, helping the client choose the most effective strategy based on their comfort with risk.

Goals

1. Identify the current market price for 100 selected homes
2. Compile and analyze 5-year historical price data
3. Calculate ROI and price deviations
4. Provide a Low-Risk optimal portfolio
5. Provide a Medium-Risk optimal portfolio
6. Provide a High-Risk optimal portfolio

Data Analysis

After collecting the data, I assigned each property a unique ID (1–100) and input the address, current market price, and 5 years of price history into Excel. This data served as the basis for ROI and deviation calculations.

ROI Calculations

Using the standard ROI formula: ROI = (New Price - Old Price) / Old Price, I calculated annual ROI across the 5-year span, and a separate ROI for the current market price relative to the previous year.

Standard Deviation

- Historical Standard Deviation: Using STDEV.S on 5 years of ROI
- Current Standard Deviation: Using STDEV.S including current ROI

Expected Profit

Expected Profit = ROI_Year5 × Price_Year5

This helped visualize projected gains assuming year 5 trends continue.

Risk-Adjusted Profit Models

To simulate client risk preferences, I used a risk penalty factor ranging from 0 (high risk) to 1 (risk-averse).

- Historical Risk-Adjusted Profit = (ROI_Year5 × Price_Year1) - (Risk Penalty × StdDev_Historical)
- Future Risk-Adjusted Profit = (ROI_Current × Current Price) - (Risk Penalty × StdDev_Current)

I averaged these to create a Combined Risk-Adjusted Profit model that better reflects the expected return while incorporating volatility.

Decision Variables

1. Risk Penalty: Adjustable value (0 to 1) to simulate risk appetite
2. Buy/Don't Buy binary decision for each home

Constraints

To ensure a realistic model, I applied the following constraints in Excel Solver:

1. Binary Selection: Each home is either purchased (1) or not (0)
2. Budget: Sum(Product of Price and Buy decision) ≤ $20,000,000
3. Number of Homes: Between 5 and 10
4. Total Profit must exceed total investment
5. Risk Penalty must remain within [0, 1]

Solution Outcomes

Low-Risk Portfolio:
- Homes Purchased: 10
- Total Investment: Just under $20M
- Profit: $28.2M

Medium-Risk Portfolio:
- Homes Purchased: 7
- Investment: Well below $20M
- Profit: $35M (Highest among all models)

High-Risk Portfolio:
- Homes Purchased: 8
- Investment: $19.7M
- Profit: ~$28.2M

Conclusion & Recommendation

After analyzing the data, the Medium-Risk Portfolio emerged as the most efficient option—delivering the highest return ($35M) with lower capital investment than the other strategies.

If the client values a greater number of homes over maximizing return, the Low-Risk Portfolio offers a strong alternative, providing 10 homes and nearly matching the high-risk portfolio's return with less exposure.

In summary:
- Choose Medium Risk if maximizing profit is the goal
- Choose Low Risk if maximizing home quantity is the priority

References

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