Application of the Markowitz Model to Football Player Valuation: A Portfolio Optimization Approach

Finance Project Presentation

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Overview

Introduction and Motivation

- **Real-World Challenge:** Managing a football team's transfer budget effectively is critical for both financial stability and competitiveness.
- **Dynamic Player Market:** Player values fluctuate due to performance, market demand, and external factors.
- **Adaptation of Financial Principles:** Applying portfolio optimization techniques (Markowitz Model) allows data-driven decision-making for strategic investments.
- **Impact:** Enhances club managers' ability to maximize returns while mitigating risk in the transfer market.

Data Collection: Objective and Source

- **Objective:**
  - Collect market value data for football players.
  - Calculate expected returns (growth in value).
  - Measure risk (how much the values change).
  - Build a balanced portfolio of players to optimize the transfer budget.

- **Source of Data:**
  - Data was taken from **Transfermarket**, a trusted website for football player data.
  - Transfermarket provides:
    - Accurate player market values.
    - Data recorded at different time points.
    - Reliable information used by football clubs worldwide.

Key Data Points

- **What data was collected?**
  - Player names.
  - Market values (in crores) recorded at different times (10 different time points for each player).
  - Growth in player value over time.

- **Dataset Overview:**
  - 20 well-known football players were included.
  - Market value data was organized in a table format.
  - Values were tracked over time to understand trends.

Challenges and Results

- **Challenges:**
  - Market values change often due to:
    - Injuries or fitness issues.
    - Transfers to new clubs.
    - Performance in matches.
  - Keeping the data up-to-date and consistent was difficult.

- **Results of Data Collection:**
  - The collected data is ready for:
    - Calculating returns and risks.
    - Building a player portfolio using the Markowitz model.
  - It helps in making better transfer decisions for football clubs.

Model Setup

- **Objective: Minimize Portfolio Variance**

$$\min_{\omega} \omega^T \Sigma \omega$$

where ω is the vector of portfolio weights, and Σ is the covariance matrix of asset returns.

- **Constraint 1: Achieve Desired Return Threshold** c

$$\mu^T \omega \geq c$$

where μ is the vector of expected returns.

- **Constraint 2: Weight Bounds for Each Asset**

$$a \leq \omega_i \leq b \quad \forall i$$

a, b represent the minimum and maximum portfolio weight limits for each asset.

Model Setup(Contd.)

- **Constraint 3: No Short Selling (Non-Negativity)**

$$\omega_i \geq 0 \quad \forall i$$

- **Objective: Predict Future Market Price of Players**
  Using the continuous compounding formula:

$$S_p = S_0 \cdot e^{r \cdot t}$$

  where:
  - S_p: Predicted market price at time t
  - S_0: Initial market price of the player
  - r: Rate of return (assumed constant)
  - t: Time elapsed since initial valuation

Optimization Process and Implementation

- **Optimization Challenges in the Markowitz Model:**
  - Non-linear constraints and real-world data idiosyncrasies.
  - Data often exhibits non-normal distributions.
- **Numerical Solvers and Iterative Algorithms:**
  - Solvers adjust portfolio weights iteratively to find optimal solutions.
  - Maximizes expected return or minimizes risk while satisfying constraints.
  - Algorithms used may include:
    - Gradient descent
    - Quadratic programming
    - Evolutionary algorithms

Optimization Process and Implementation(Contd.)

- **Dynamic Adaptation with Predictive Analytics:**
  - Model used for player value prediction:

$$S_p = S_0 \cdot e^{r \cdot t}$$

  - Future market values of players projected based on past performance and market trends.
  - Projections integrated into optimization for dynamic portfolio adjustments.

- **Web Platform Implementation:**
  - The model is integrated and deployed on a web platform.
  - Users can:
    - Select players
    - Specify investment amounts
    - Predict future market values
  - Facilitates practical application of the Markowitz model in a user-friendly environment.

Implementation Details

Technologies Used:

- **Frontend:** HTML, CSS, JavaScript
- **Backend:** Flask (Python API)
- **Model Implementation:**
  - Developed in Python using the `cvxopt` package for optimization.
  - Output sent to JavaScript via API for display on the interface.

Features:

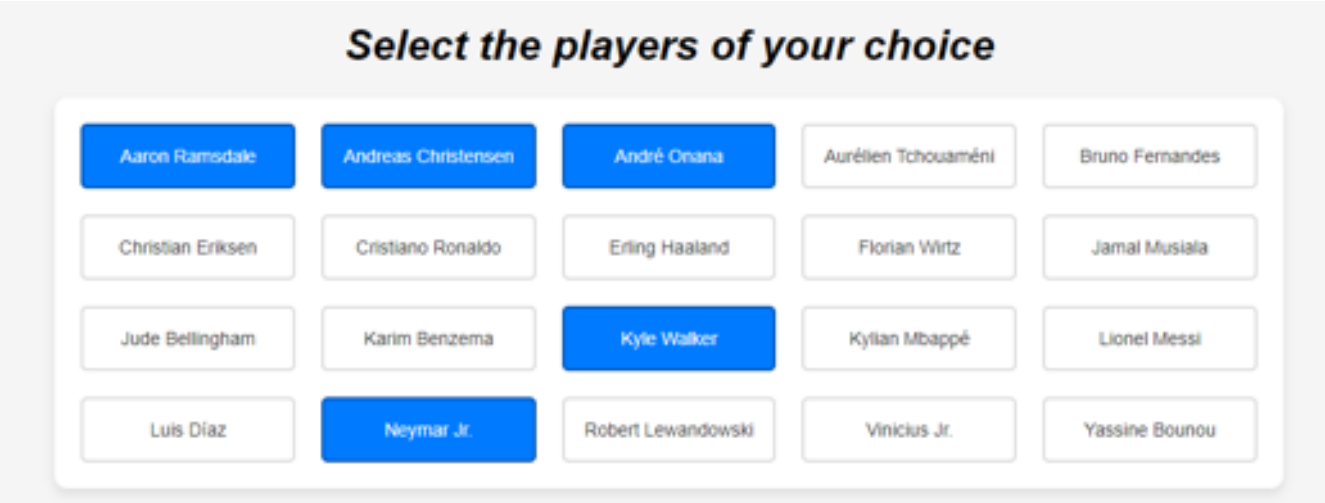
- Pool of players to select from.
- Slider to choose total investment amount.
- Input field to specify the year for future value predictions.

Outputs:

- Portfolio allocation (amount to invest in each player).
- Future value of selected players.

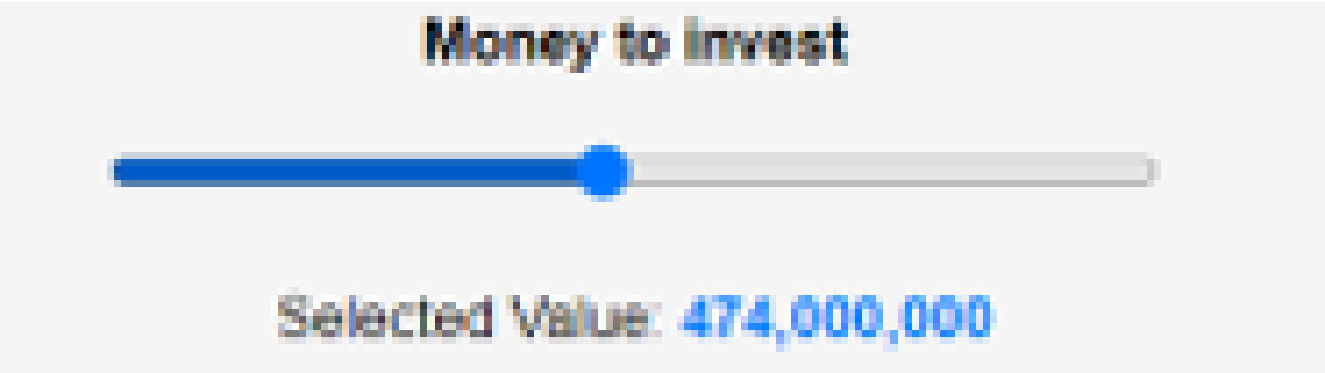
Component 1: Player Pool

- **Description:** Interactive list of players to select from.



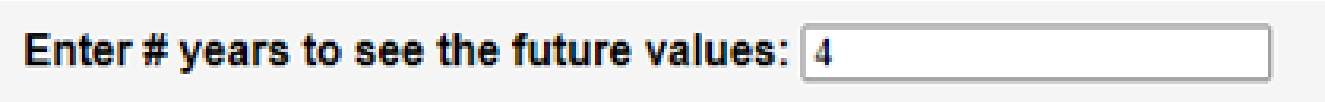
Component 2: Investment Slider

- **Description:** Slider to choose the total money to invest.



Component 3: Year Input Field

- **Description:** Input field to specify the year for future value predictions.



Component 4: Results Display

- **Description:** Optimized investment amounts and future value predictions.

Player	Value	Future value (in million)
Neymar Jr.	79041649.16	2739.1910542863943
Kyle Walker	8858135.42	580.2292333874581
André Onana	367953188.81	14.178685931153376
Andreas Christensen	17078121.46	33.97512841700334
Aaron Ramsdale	1068905.15	22.742345502134203

Conclusion: Key Takeaways

- **Application of Markowitz Model:**
  - Successfully applied to football player market values.
  - Novel framework for managing investments in sports.
- **Web-Based Implementation:**
  - Interactive tool to manage football player portfolios.
  - Predicts future values using $S_p = S_0 \cdot e^{r \cdot t}$.
- **Results:**
  - Enhanced decision-making for financial expenditures.
  - Strategic foresight for club managers and sports analysts.
- **Future Work:**
  - Explore dynamic risk-return models.
  - Integrate real-time data for agile decision-making.
  - Extend methodology to other sports and domains.

Demo Link: Click here to access the demo

Thank You