Fantasy Football Optimization

Student Project: Global and Multi-Objective Optimization

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Generated by a student, not by AI

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Overview

- **Context**: Fantasy Football team selection via *inverse optimization*.
- **Methodologies**: Metaheuristics (PSO, DE, ES).
- **Objective**: Balance budget, positions, and performance to achieve the best score.

Introduction

- Fantasy Football involves managing teams under budget and positional constraints.
- *Inverse Optimization* adapts the scoring function based on historical data.
- A multi-manager auction is used for player assignments.

Theoretical Background

Inverse Optimization

Adjusting the cost/reward function so that observed solutions appear near-optimal.

Metaheuristics

- **PSO**: Inspired by swarm behavior.
- **DE**: Evolves solutions using vector differences.
- **ES**: Uses Gaussian mutations with selection strategies.

Scoring Function and Fitness Logic

Player Scoring Function: Computes the score based on:

- Goals, assists, yellow/red cards, rating, and penalties.

Fitness Function: Evaluates a bid vector with penalties for:

- Exceeding budget, unbalanced positions, etc.

Example Code:

```
def score_player(player):
goals = getattr(player, '
    goals_scored', 0)
assists = getattr(player, '
    assists', 0)
yellow_cards = getattr(player,
     'yellow_cards', 0)
red_cards = getattr(player, '
    red_cards', 0)
rating = getattr(player, '
    fantasy_rating', 6.0)
penalties = getattr(player, '
    penalties_scored', 0)

score = (0.5 * goals +
```

Manager Strategies

Each manager uses a metaheuristic to generate bids:

- **PSO**: Using the `pyswarm` library.
- **DE**: Using `scipy.optimize.differential_evolution`.
- **ES**: Implemented via `deap`.

PSO Strategy Example:

```
def manager_strategy_pso(manager, players_not_assigned):
    # Define lower and upper bounds for bids
    lb = np.zeros(len(players_not_assigned))
    ub = np.full(len(players_not_assigned), max_bid_per_player)

    # Define fitness function for PSO
    best_bids, _ = pso(fitness_func, lb, ub,
```

Multi-Manager Auction and Forced Assignments

- **Auction Process**: Each manager submits bids for unassigned players.
- **Conflict Resolution**: The player is assigned to the highest bidder.
- **Forced Assignments**: If position minimums are not met, players are assigned at a base cost.

Graphical Analysis: Manager Distribution

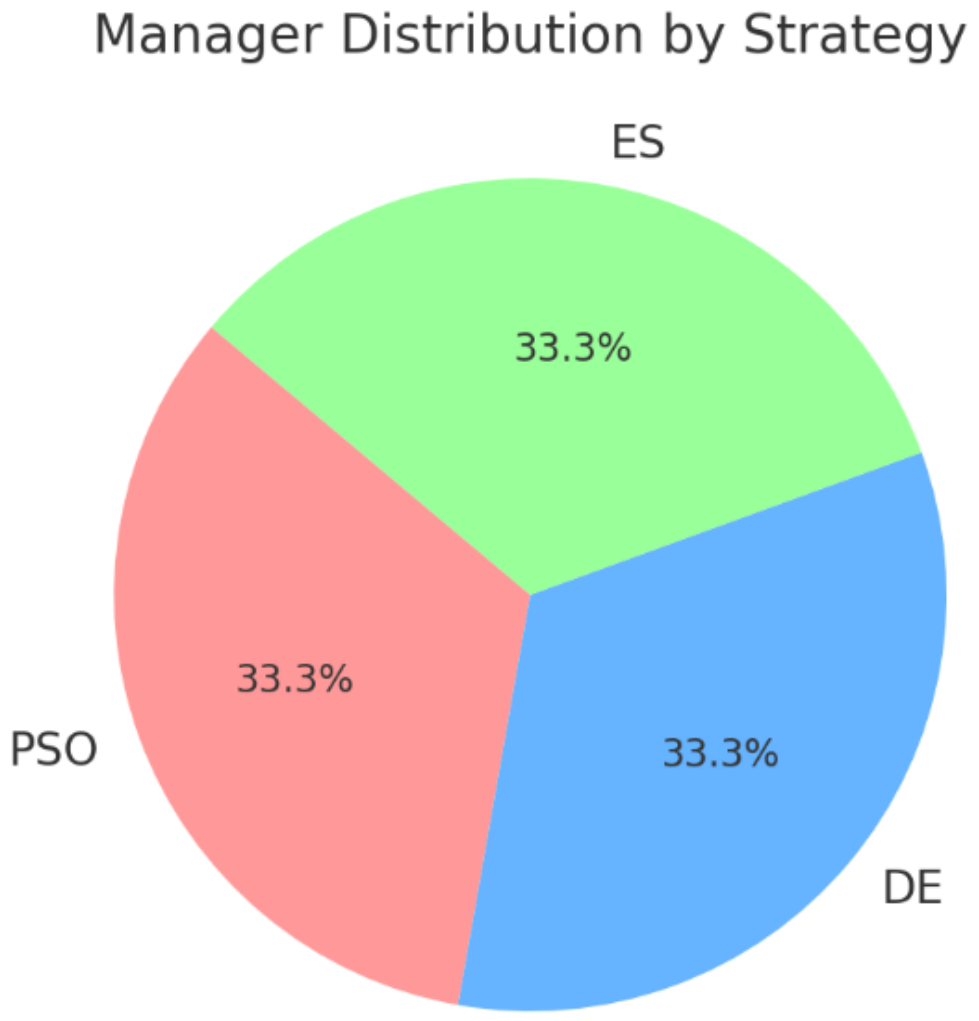

Figure: Distribution of Managers by Strategy.

Graphical Analysis: Player Score Distribution

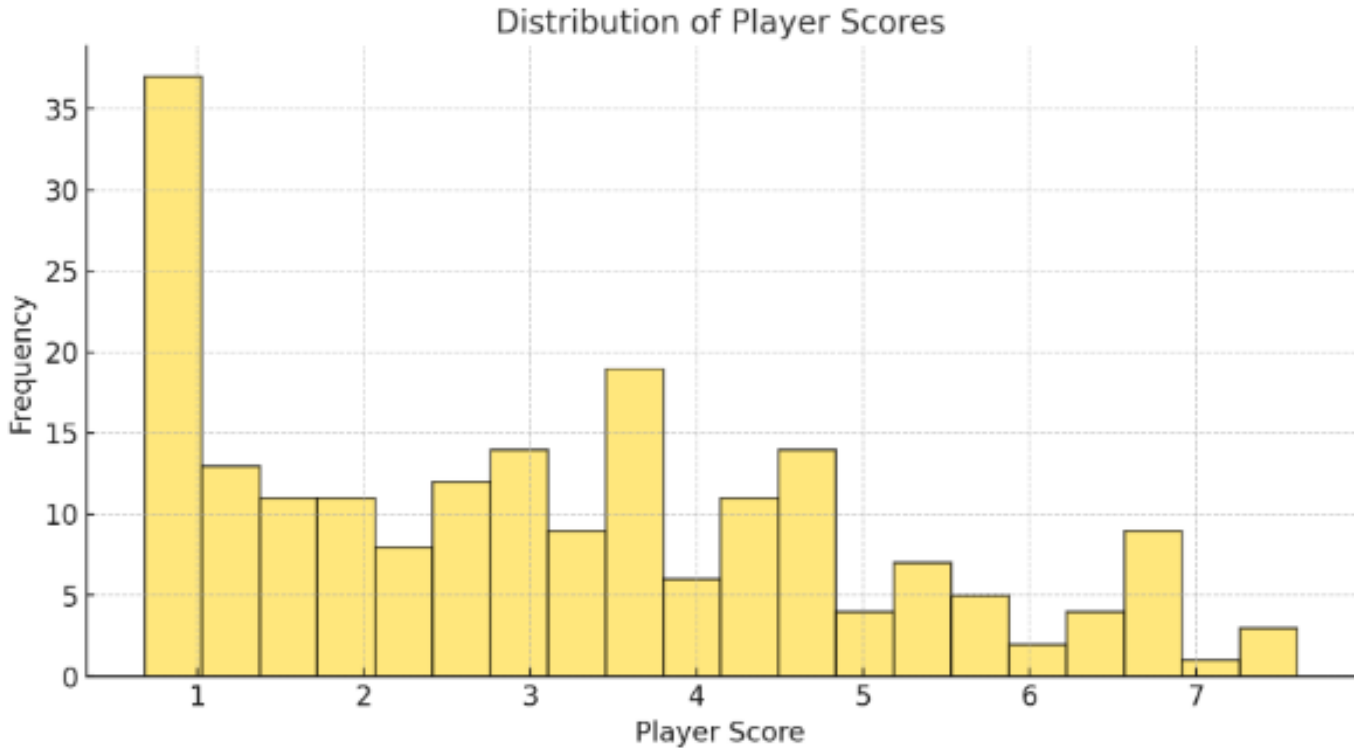

Figure: Distribution of Player Scores.

Graphical Analysis: Budget Usage

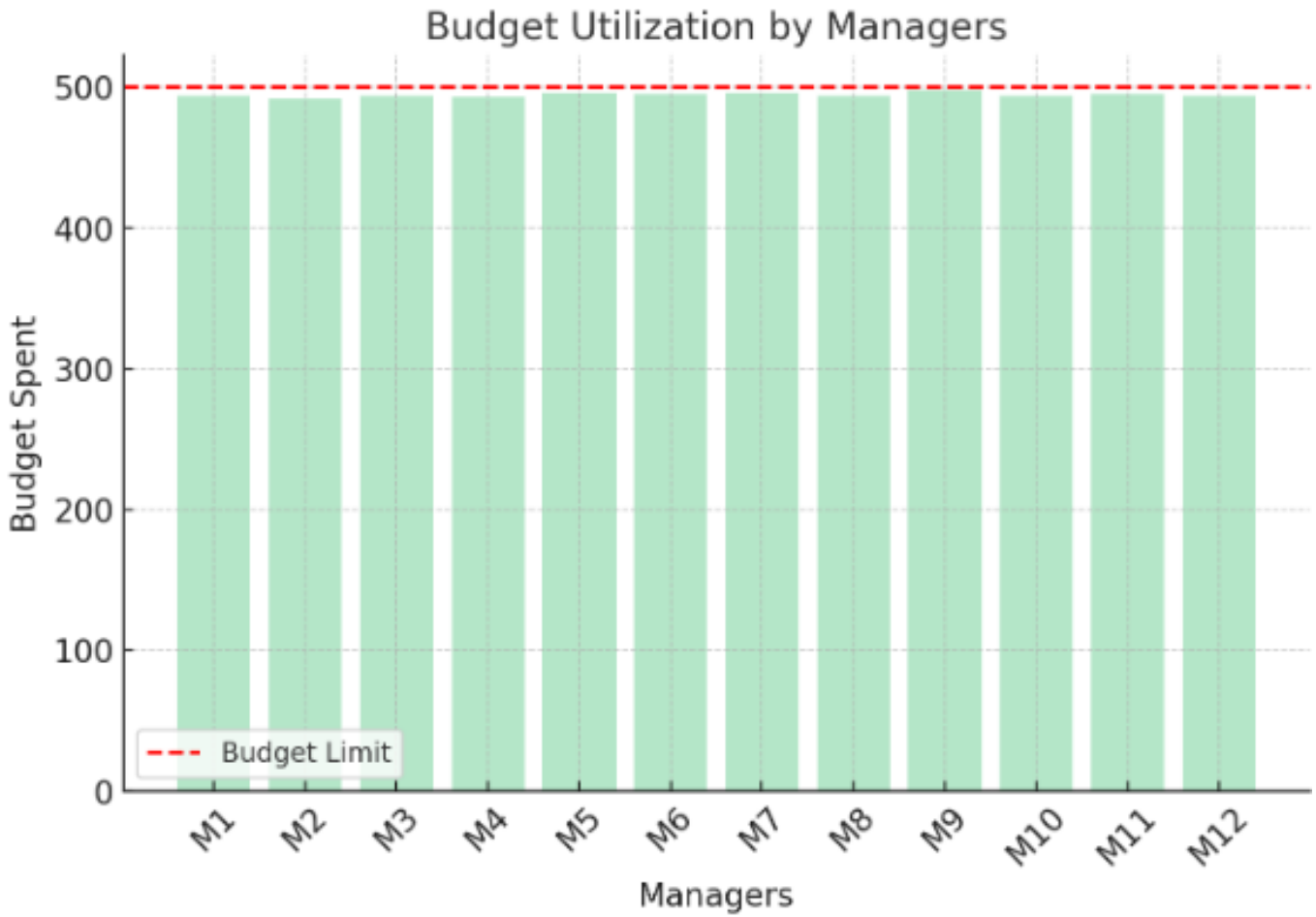

Figure: Budget Usage by Managers.

Graphical Analysis: Forced Assignments

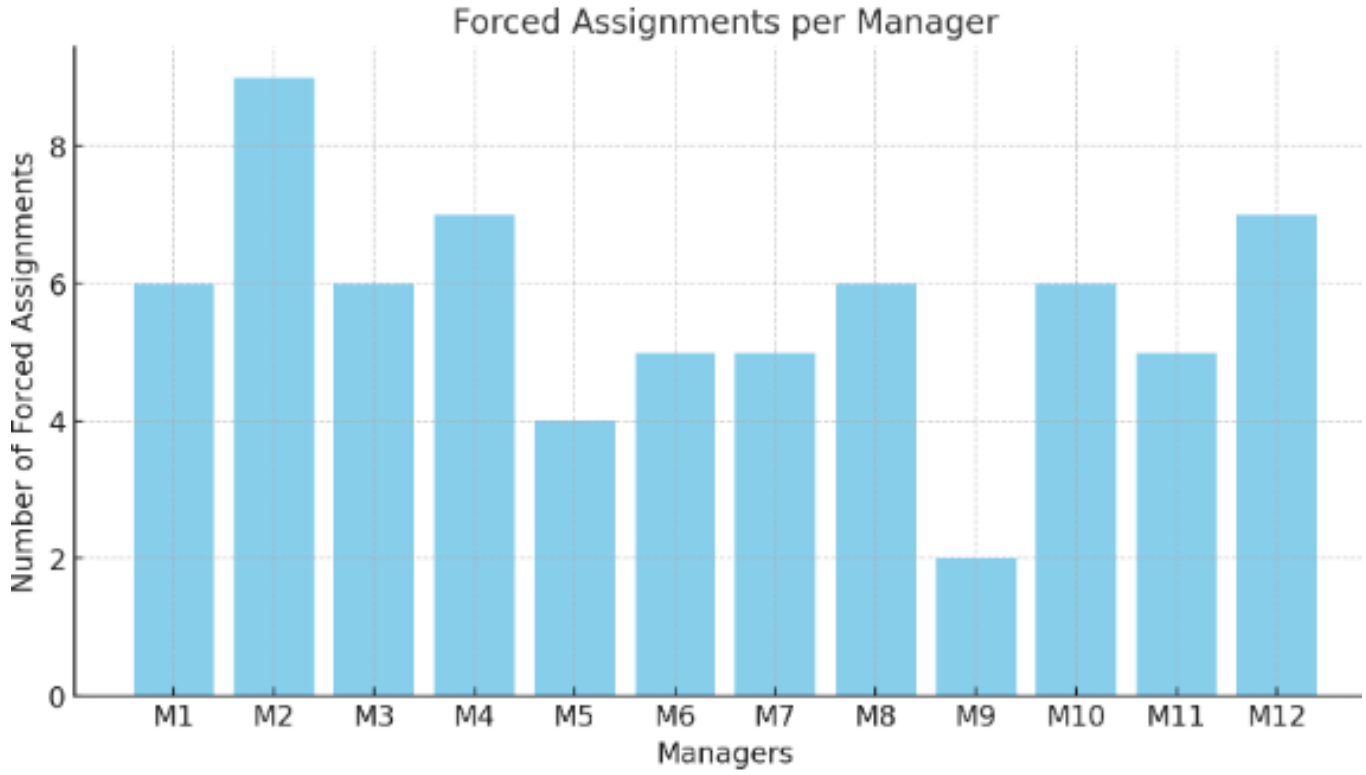

Figure: Number of Forced Assignments per Manager.

Graphical Analysis: Average Team Score

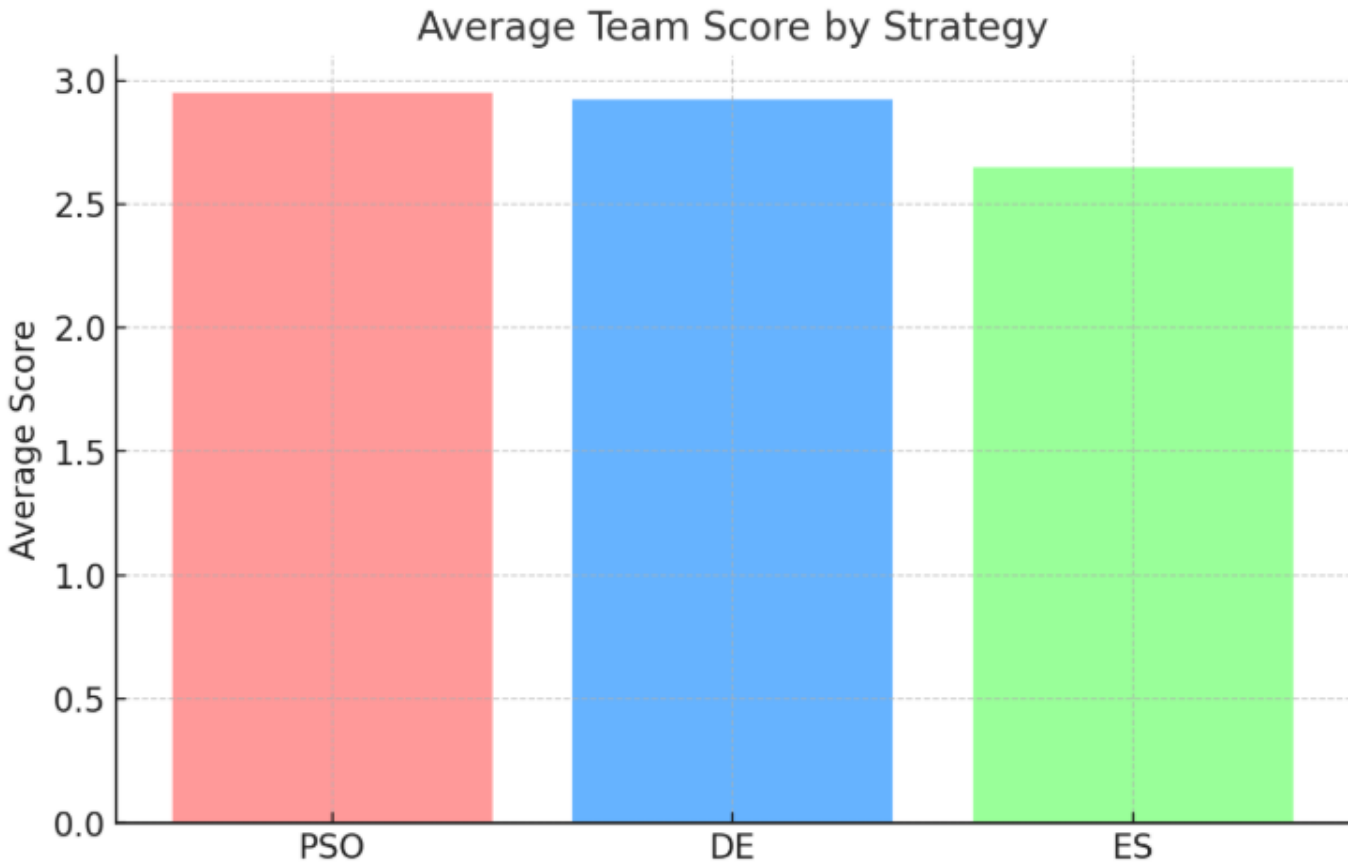

Figure: Average Team Score by Strategy (PSO, DE, ES).

Tabular Analysis: Manager Recap

Table: Manager Recap Table

Manager	Strat	Forced	Spent	Leftover	Objective
Manager_1	PSO	6	494.0	0.0	52.91
Manager_2	DE	9	492.0	0.0	51.48
Manager_3	PSO	6	494.0	0.0	44.46
Manager_4	DE	7	493.0	0.0	53.64
Manager_5	ES	4	496.0	0.0	49.18
Manager_6	ES	5	495.0	0.0	46.02
Manager_7	PSO	5	496.0	0.0	47.00
Manager_8	DE	6	494.0	0.0	55.32
Manager_9	ES	2	498.0	0.0	44.23
Manager_10	DE	6	494.0	0.0	46.59
Manager_11	ES	5	495.0	0.0	39.99
Manager_12	PSO	7	494.0	0.0	53.23

Tabular Analysis: Performance by Strategy

Table: Performance by Strategy

Strategy	Managers	Avg Total Score	Avg Team Score
PSO	4	49.40	2.95
DE	4	51.76	2.92
ES	4	44.85	2.65

Tabular Analysis: Player Score Summary

Table: Player Score Summary

	Best	**Worst**	**Average**
Player Scores	12.90	0.68	2.80

Overall Discussion

- **Manager Distribution:** A balanced manager distribution ensures diverse search behavior.
- **Player Score Distribution:** Highlights the need for careful budget allocation.
- **Budget Usage and Forced Assignments:** Indicate effective resource management.
- **Average Team Score:** All strategies (PSO, DE, ES) perform competitively.
- **Player Score Summary:** Only a few players achieve elite performance, emphasizing strategic selection.

Conclusions and Future Directions

Conclusions

- Effective integration of metaheuristics with inverse optimization.
- Balanced approach towards budget, position constraints, and overall score.

Future Work

- Develop a user-friendly GUI or web interface.
- Provide suggestions for optimal starting lineups.
- Explore hybrid approaches and reinforcement learning techniques.

Questions?

Thank you for your attention!