DYNAMIC OPTIMIZATION OF GOOGLE ADVERTISING STAFFING PLAN

Balancing Cost, Revenue, and Service Quality

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INTRODUCTION

Google's ad agents drive growth, but static staffing can't keep up with fluctuating demand. This study proposes a dynamic, month-by-month model to **cut costs**, **reduce wait times**, and **maximize revenue** by aligning agent support with real-time needs.

MODELING APPROACH

Method I: Linear Programming

Linear Programming (LP) provides globally optimal staffing and assignment decisions under cost and capacity constraints across the full planning horizon.

Minimize:
Σ_m(A[m]×monthly salary+F[m]×firing cost−S[m]×revenue uplift+W[m]×waiting cost penalty)

Decision Variables	Process
Available Agents (A[m]) New Hires (N[m]) Fired Agents (F[m]) Assigned Advertisers (S[m]) Waiting Advertisers (W[m]) Dropped Advertisers (D[m]) Graduated Advertisers (G[m])	Data Loading → Decision Variables Defining → Constraints Formulating → PuLP (coin-or branch and cut) → Optimal Solution
Constraints	
Waiting Pool Dynamics (W[m]) Dropped Advertisers (D[m]) Graduated Advertisers (G[m]) Hiring/Firing Constraints (N[m], F[m]) Required Agents Capacity (A[m]) Agent Availability Dynamics (A[m+1]) Total Agent Count (T[m])	

Figure 1. LP Model Building Process

Method II: Dynamic Programming Algorithm

When managing interlinked constraints and discrete decisions, such as hiring, firing, assigning, or waiting, a Dynamic Programming (DP) framework would also be a great choice.

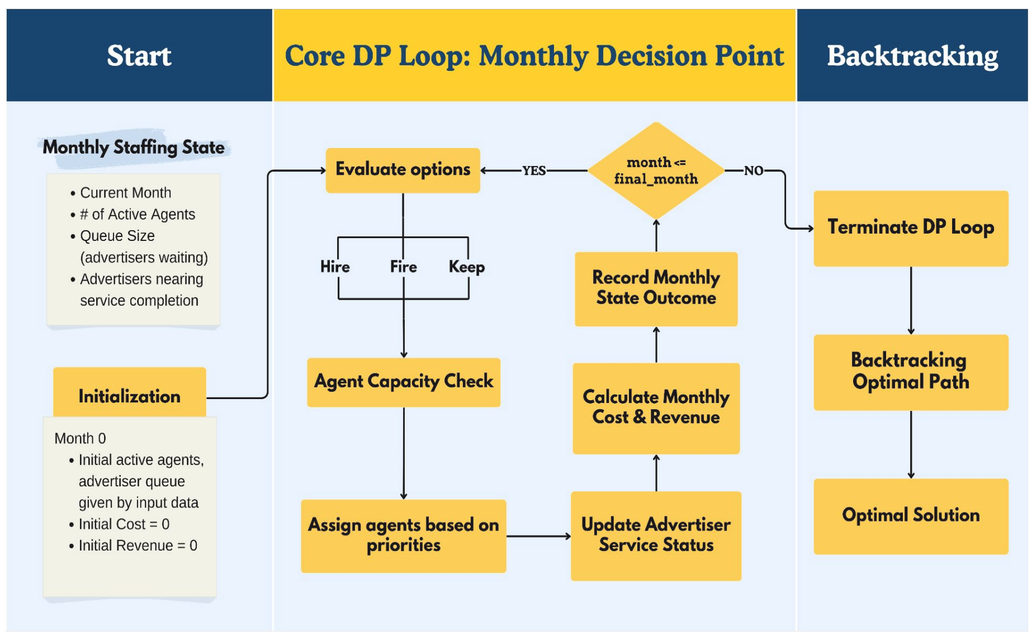


Figure 2. DP Algorithm Flowchart

- Validation of Previous LP Model
- Introducing Hire/Fire Limits
- Consistent Findings with Previous LP Model

VALIDATED RESULTS

Revenue: $151.5M, Cost: $34.6M, Net Profit: $117M

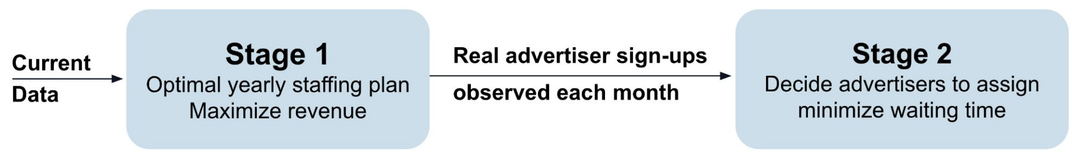
- **Revenue Analysis**: Advertiser growth and budget increases fueled revenue.
  - Revenue grew steadily, peaking in Sep–Oct due to higher advertiser assignments.
  - High Nov–Dec revenue aligned with seasonal ad demand
- **Cost Analysis**: Early restructuring paved the way for sustained efficiency.
  - A January spike from firing 450 agents resulted in high upfront costs.
  - Costs stabilized throughout the year, with minor adjustments for salaries and staffing.

Figure 3. Cross-Validated result from Method I, which is very close to Method II. The line plot shows the net profit each month; the bar plot shows the number of agents hired/fired each month.

LIMITATIONS

- **Waiting Pool Management**: A Strict 60-day removal policy may result in unnecessary revenue loss
- Unrealistic hiring/firing rates
- Limited historical data

ALTERNATIVE WAY – TWO-STAGE OPTIMIZATION



- ☺ Increase forecast accuracy, more adaptive and responsive.
- ☺ Maximizes returns by focusing on high-value advertisers.
- ☹ More complex: Requires real-time/near real-time data and computational resources.
- ☹ Implementation demands accurate, up-to-date data management.

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