



ADOBE DEV CRAFT



REAL TIME BIDDING SYSTEM

TEAM : ACCESS DENIED

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Idea & Approach – Real-Time Bidding (RTB) System



Core Idea & Objective

We propose the development of an intelligent bidding optimization system for Demand-Side Platforms (DSPs) in Real-Time Bidding (RTB). Our solution ensures optimal bid placement, budget efficiency, and maximized advertiser outcomes by leveraging predictive modeling and AI-driven bidding strategies.

01 Data Processing & Feature Engineering

We process large-scale bid logs using chunked loading (100K rows/batch) for memory efficiency. Features include user behavior, ad slot characteristics, and time-based trends. Historical bidding patterns enhance market insights.

02 Predictive Modeling for Bidding

Our CTR model (AUC 0.8803) predicts click probability, while the CVR model (AUC 0.8516) estimates conversions. A market price estimator helps optimize bid amounts, reducing overspending. It is trained on 1 day data.

03 Budget Optimization Strategy

We implement adaptive bid pacing to prevent early budget depletion. Priority-based bidding aligns ad spend with business goals, ensuring high-value conversions get preference.

04 Real-Time Bidding Engine Implementation

A LightGBM-powered decision engine ensures bid responses under 5ms, balancing speed and accuracy for seamless real-time auctions.

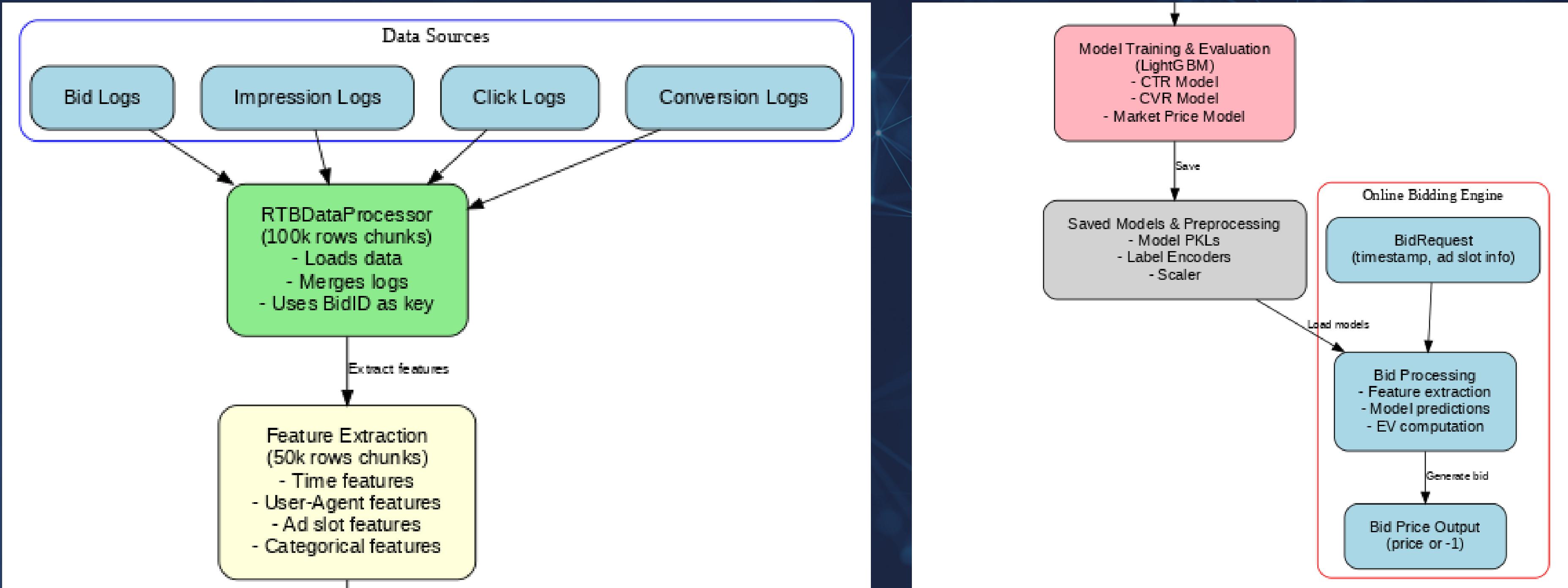
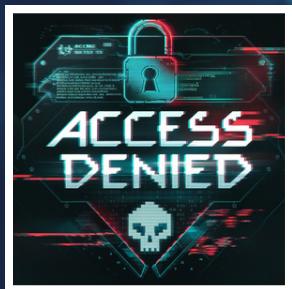
Key Highlights

- AI-driven bid decision-making for smarter ad placements.
- Market price estimation prevents overbidding and maximizes ROI.
- Real-time execution with bid response time under 5ms.
- Dynamic budget pacing optimizes spend distribution over time.





Flow Diagram

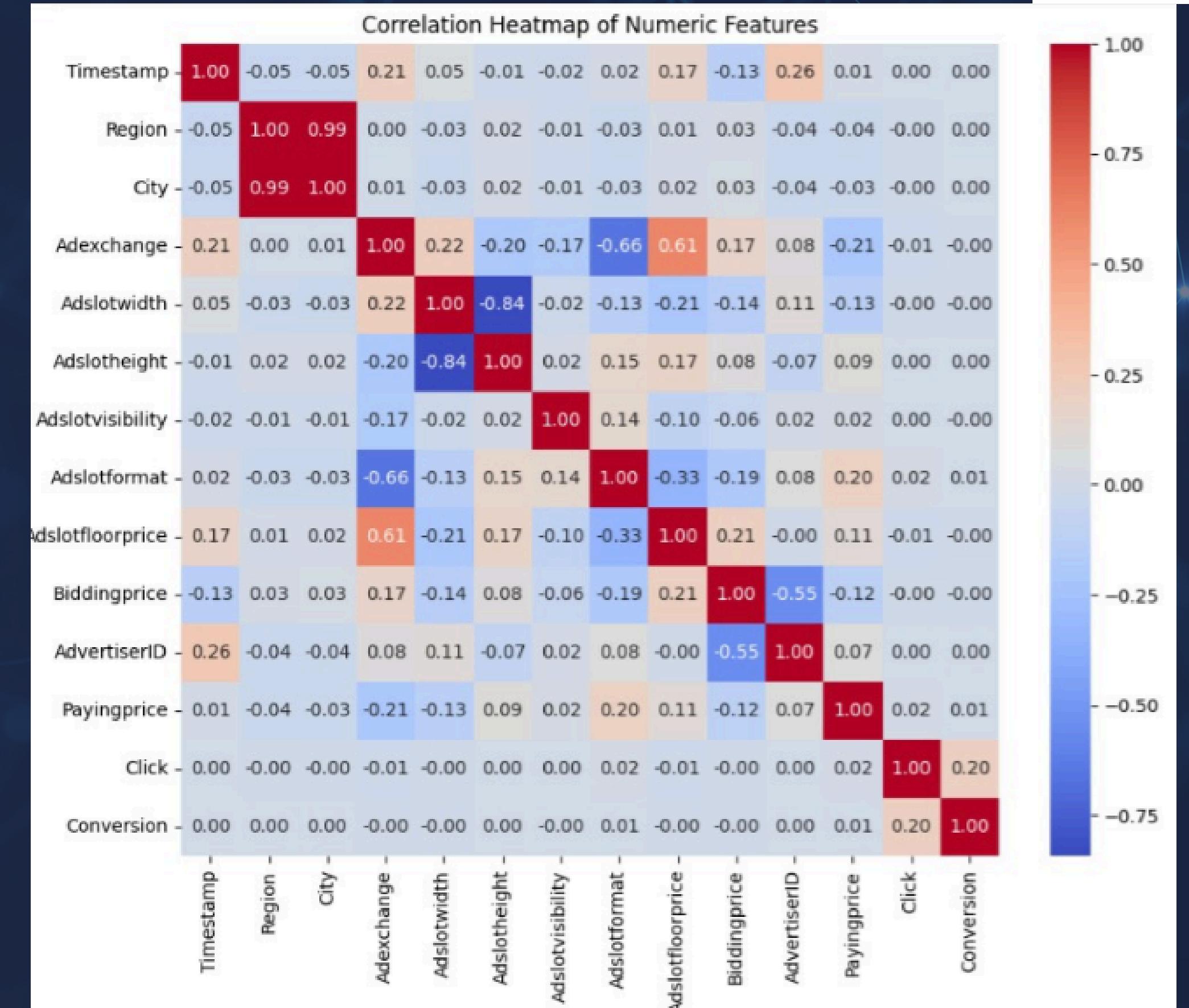




Exploratory Data Analysis



HeatMap of Co-relations

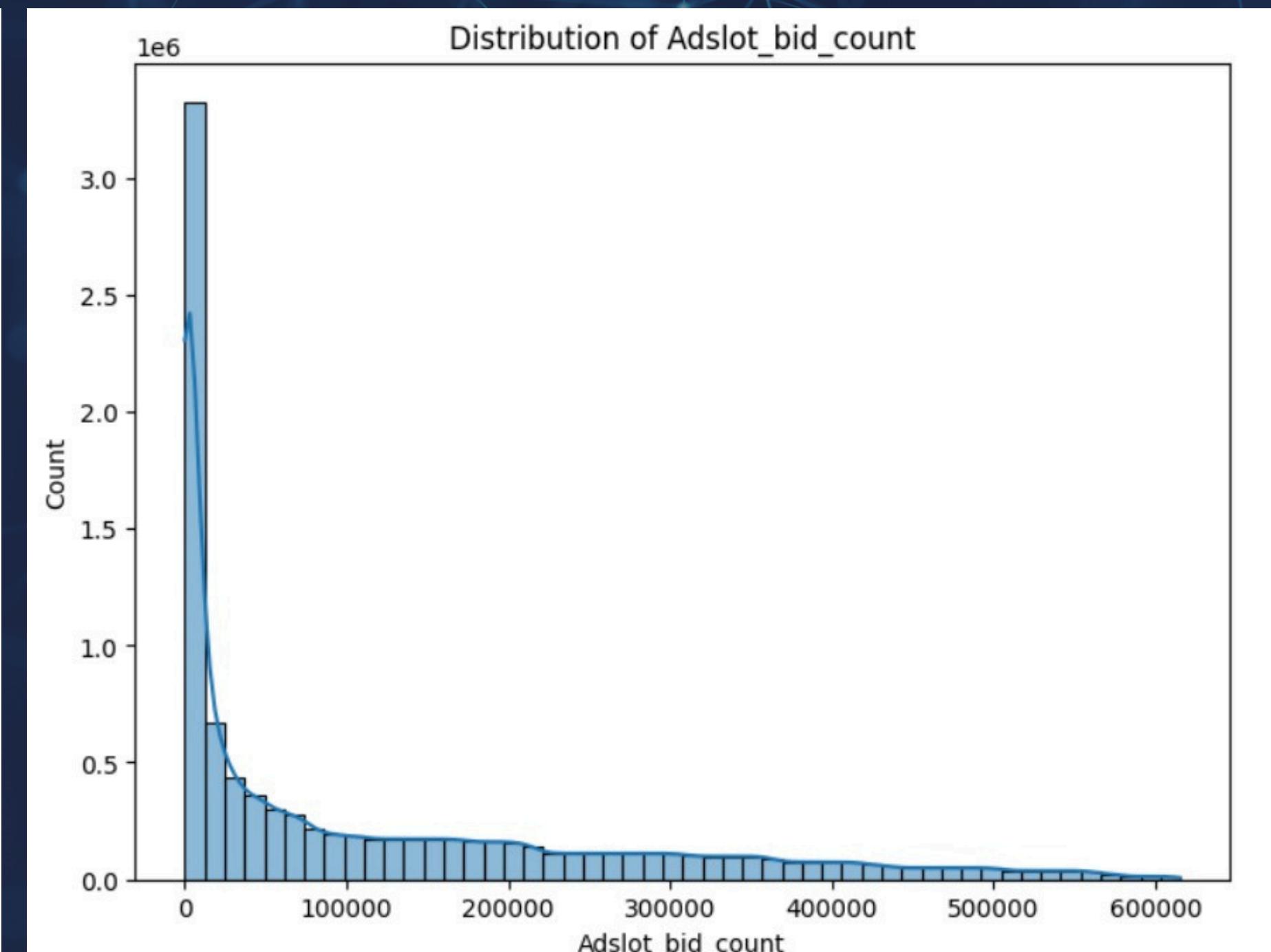
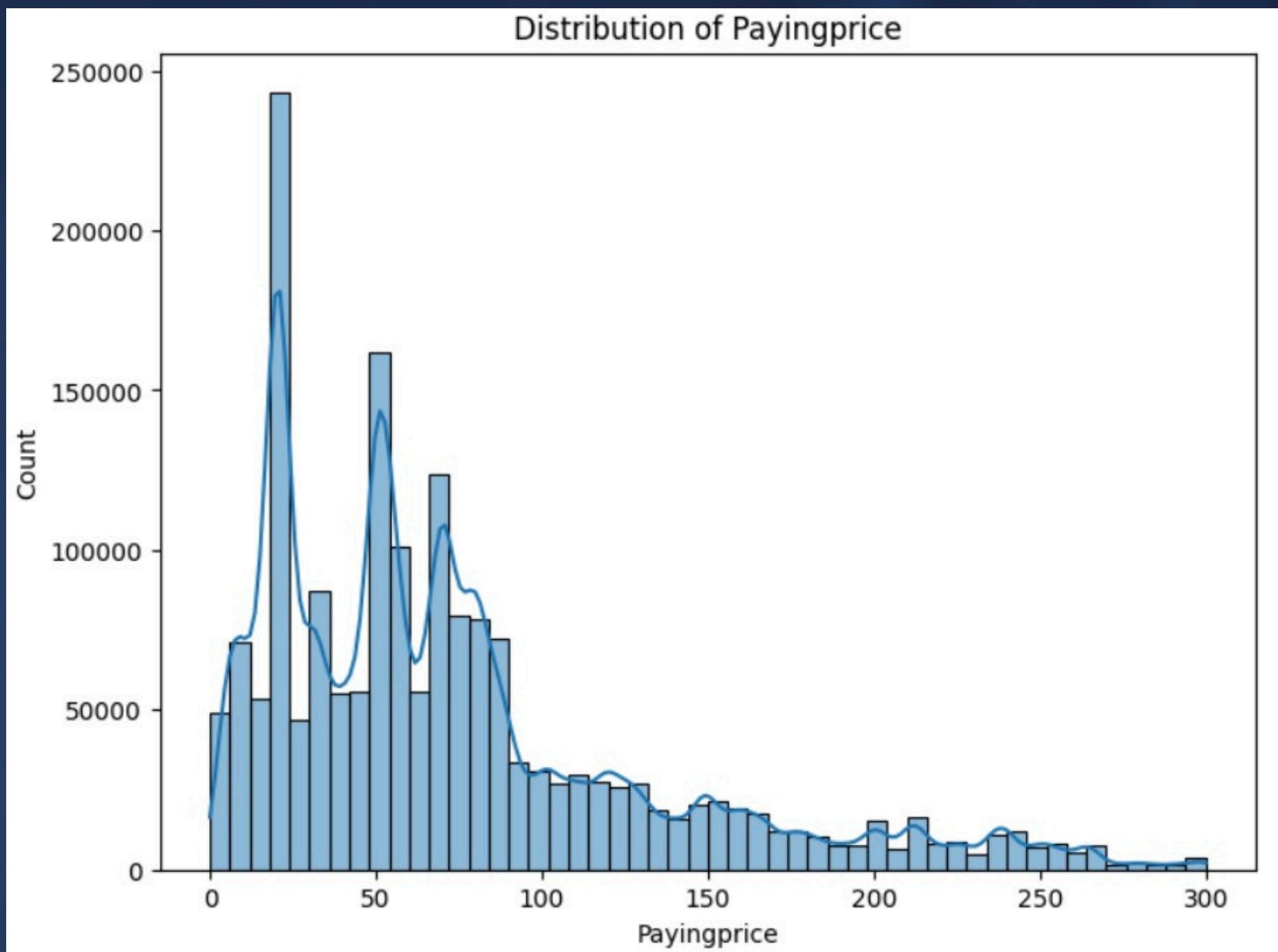




Exploratory Data Analysis



Histograms for Paying Price and Adslot Bid count

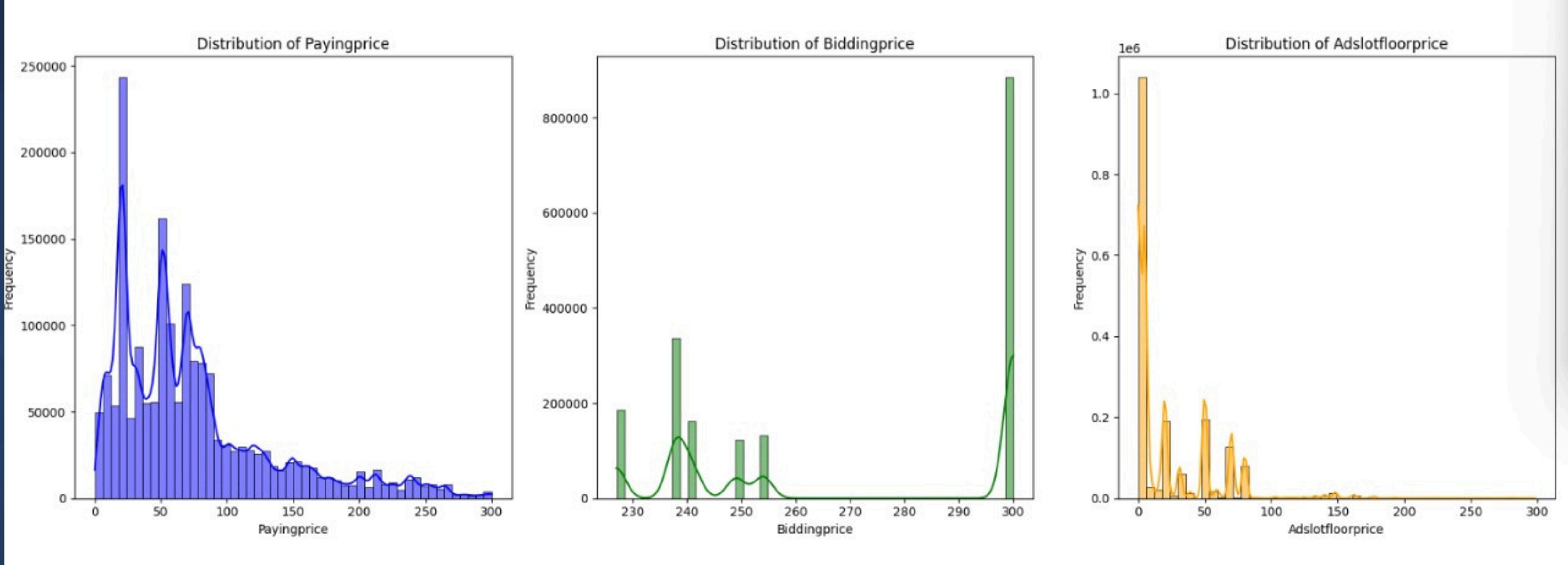




Exploratory Data Analysis



Line-Charts for PayingPrice, BiddingPrice and AdSlotFloorPrice

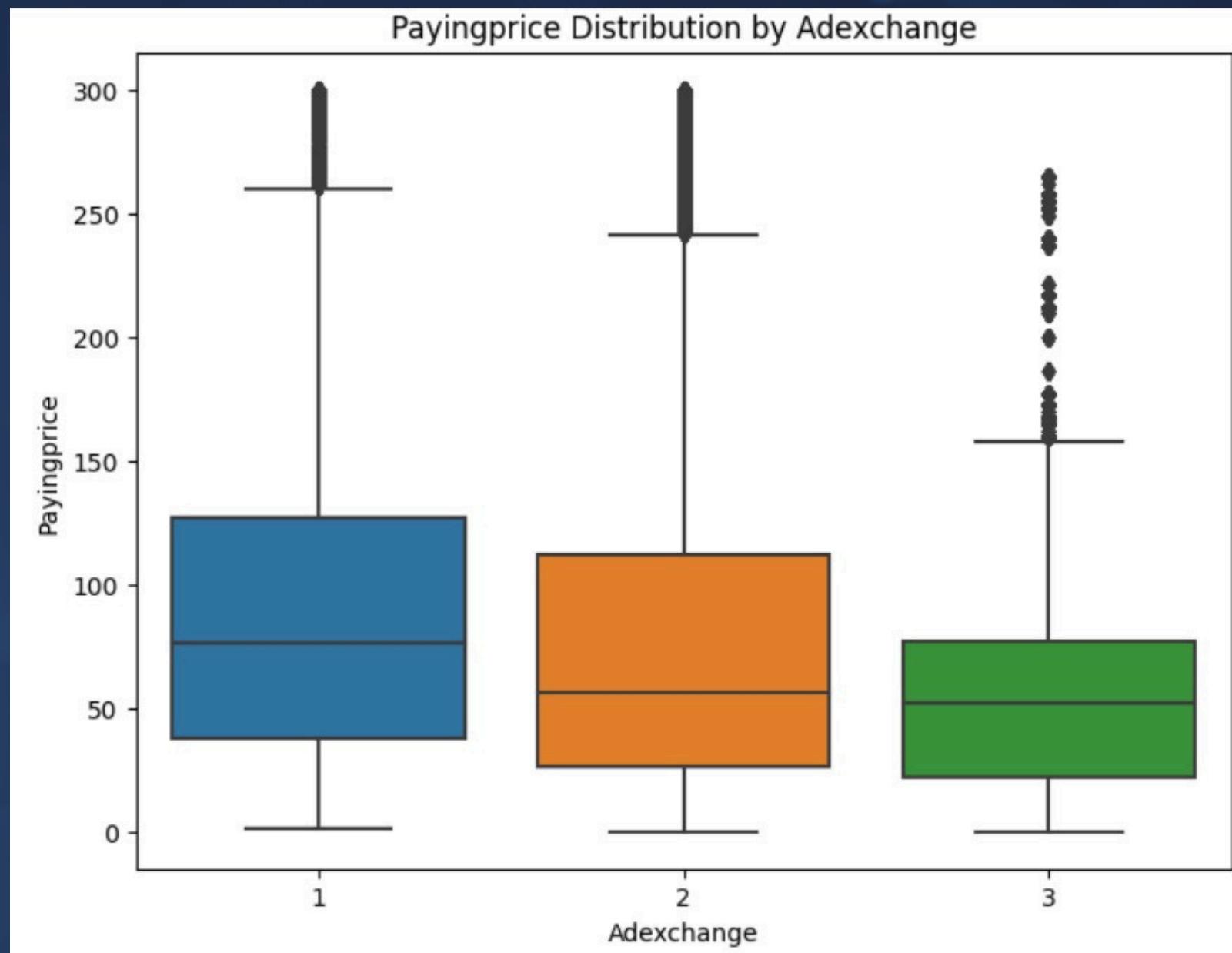




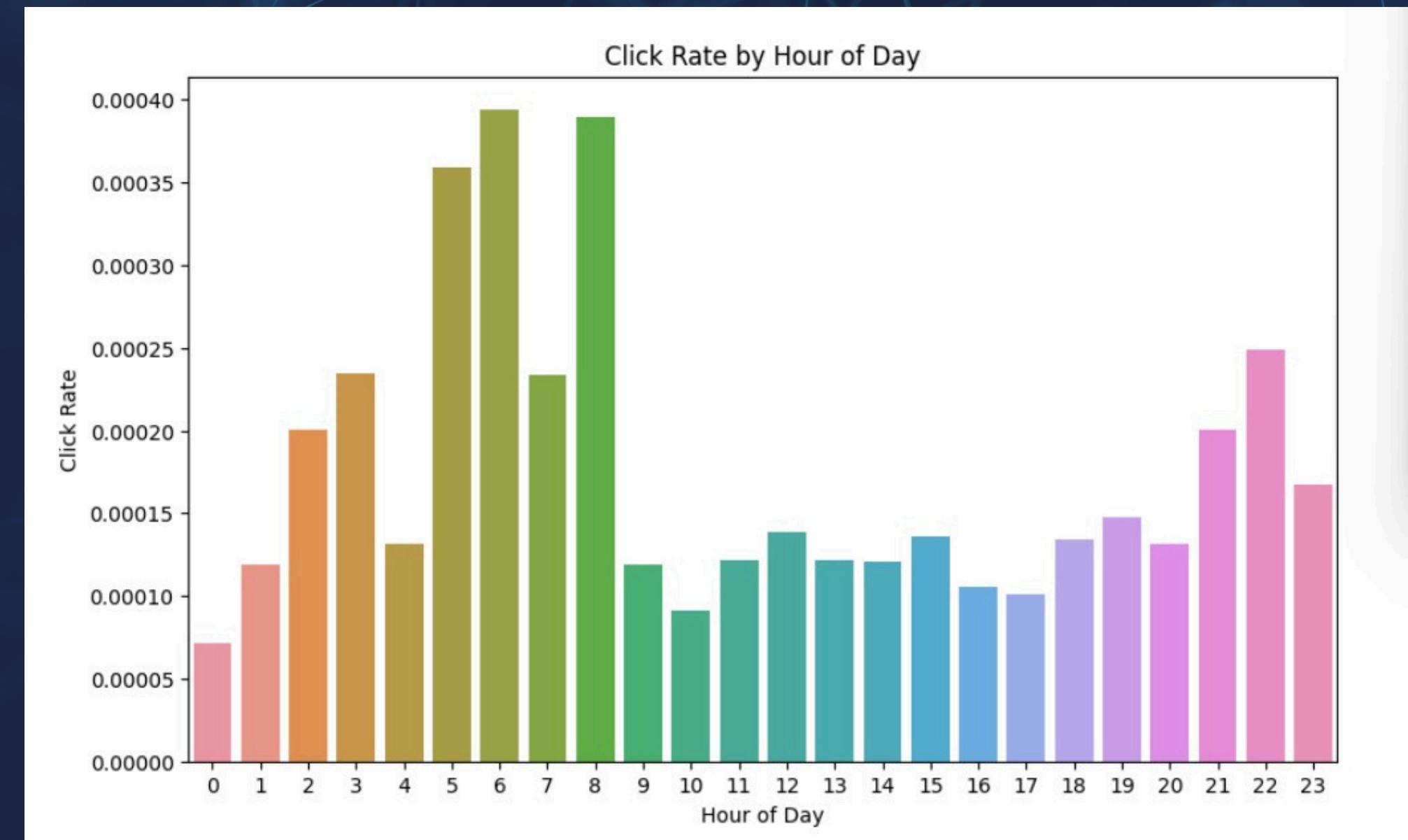
Exploratory Data Analysis



Box-Plot for Paying Price grouped by AdExchange



Bar-Char of Click Rate based on Timestamp

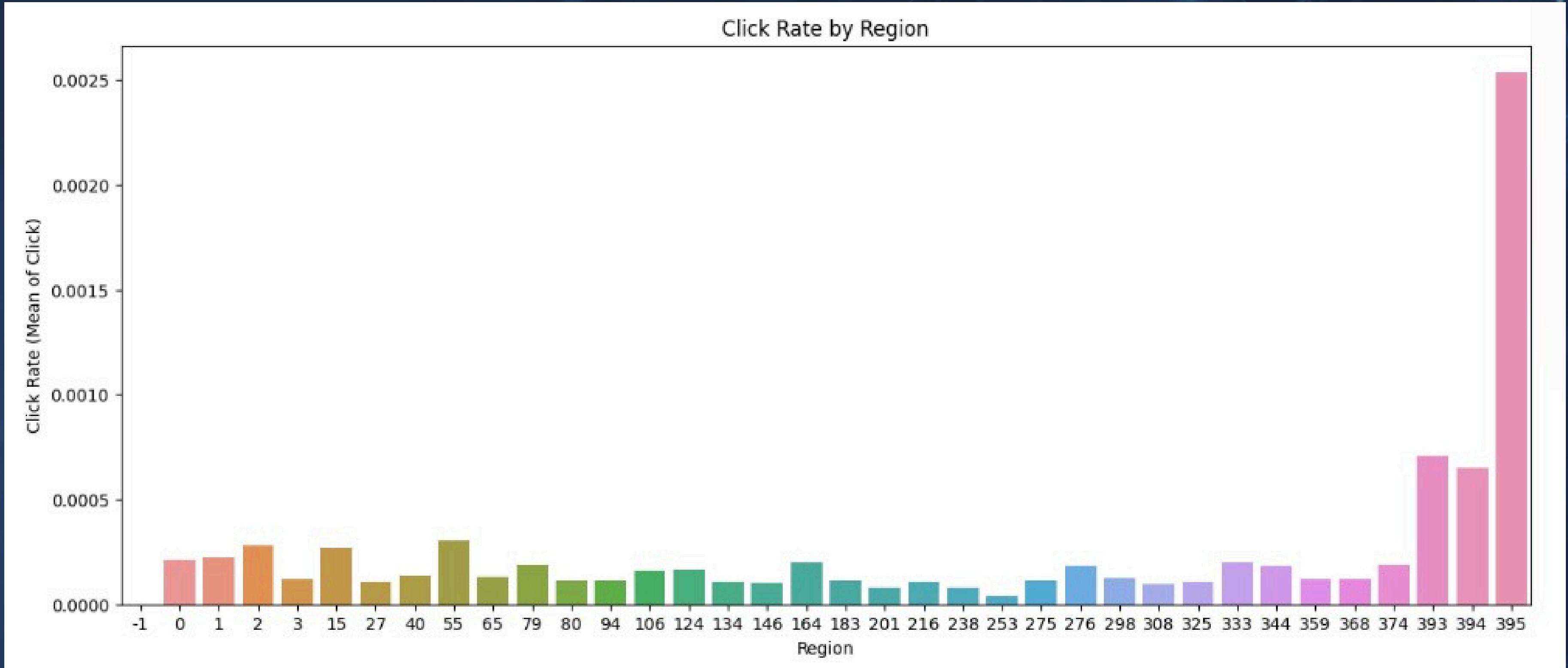




Exploratory Data Analysis



Bar-Chart for Region vs Click Rate





Bidding Strategy



Expected Value (EV) Calculation

$$EV = CTR + (Conversion_Weight \times CVR)$$

Optimizations For Constraints

- Parallel Processing: Setting `n_jobs=-1` enables multi-core processing
- Numba JIT (Just-In-Time) Optimization: Speeds up numeric feature scaling

Bid Price Decision Rules

1. Low Expected Value → No Bid

2. High Expected Value → Competitive Bidding

If EV is significant, bid is set to Market Price $\times 1.02$.

3. Budget Constraints Applied

Ensure bids remain within the advertiser's budget:

- Budget < 5000 : Bid is adjusted between 260 – 300
- Budget < 10000 : Bid is adjusted between 300 – 400
- Budget > 10000 : Bid is adjusted between 400 – 500



Results & Inference Time



Inference time: 3.98 ms

CTR: 0.2830, CVR: 0.7716, Market Price: 118.32

Average inference time: 3.98 ms

Max inference time: 3.98 ms

Min inference time: 3.98 ms

Bid Price: 260

Bid Price: 260

Inference time: 4.15 ms

CTR: 0.6659, CVR: 0.3190, Market Price: 124.74

Average inference time: 4.15 ms

Max inference time: 4.15 ms

Min inference time: 4.15 ms

Bid Price: -1



Tech Stack



Pandas	Load, Process, Merge
NumPy	Process Numeric Arrays
LGBM	Predict Bid Outcomes
SKlearn	Preprocess, Split, Evaluate
Numba	Faster Numerical Calculation



Future scope



Model Optimization

Currently only limited data has been used due to time and resource constraints. Further training on the entire dataset will help in considerably increasing AUC and improving model reliability.

Dynamic Budget Pacing

Develop a more sophisticated mechanism to adjust bids based on remaining budget and real-time performance.

Feature Enrichment and Scalability Testing

Integrate additional contextual features or real-time user behavior signals. Stress-test the bidding engine under simulated high-load conditions.

thank
you