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Pricing Algorithms For a Two-sided Internet Advertisement Market

Akinwumi, Joseph

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*Boston University*
ABSTRACT:

- The Google AdSense Program is a successful internet advertisement program where Google places contextual adverts on third-party websites and shares the resulting revenue with each publisher.
- Advertisers have budgets and bid on ad slots while publishers set reserve prices for the ad slots on their websites.
- Following previous modelling efforts[1], we model the program as a two-sided market with advertisers on one side and publishers on the other.
- We show a reduction from the Generalised Assignment Problem (GAP) to the problem of computing the revenue maximising allocation and pricing of publisher slots under a first-price auction.
- GAP is APX-hard but a (1-1/e) approximation is known [2].
- We compute truthful and revenue-maximizing prices and allocation of ad slots to advertisers under a second-price auction.
- The auctioneer's revenue is within (1-1/e) second-price optimal allocation and pricing of publisher slots under a first-price auction.

PROBLEM DEFINITION:

We are given n publishers (1 < i ≤ n), m advertisers (1 < j ≤ m) and an auctioneer such that:
- advertisers j have budgets B_j and bid b_{ij} on ad slot i.
- v_{ij} is the valuation of advertiser j for slot i.
- P_j is the truthful second price charged to advertiser j for slot i.
- each publisher has only one slot.
- publishers set a reserve price R_j for the slot on their website.
- each publisher's objective is to maximize ad slot revenue.
- each advertiser's objective is to maximize surplus.

Auctioneer's Goal: truthful allocation and ad slot prices to maximize publishers' revenue and advertisers' social welfare?

AUCTIONEER'S GOAL:

maximize \sum_{i=1}^{n} \sum_{j=1}^{m} A_{ij} P_{ij} \quad (Publishers) \quad \sum_{i=1}^{n} \sum_{j=1}^{m} A_{ij} v_{ij} \leq B_j \quad \forall j

maximize \sum_{i=1}^{n} \sum_{j=1}^{m} A_{ij} (v_{ij} - P_j) \quad (Advertisers) \quad \sum_{i=1}^{m} A_{ij} \leq 1 \quad \forall i

TRUTHFUL & REVENUE-MAXIMIZING AUCTION:

- Phase 1: Revenue Maximization
  - Exclude each advertiser j from the auction.
  - Run APPROX-GAP [2] to compute the 2nd price vector of advertiser j.

- Phase 2: Winner Determination
  - Advertiser j demands a set S_j of ad slots.
  - Obtain IP relaxation of combinatorial allocation (CA-IP).
  - Prove allocation monotonicity for known-single minded, additive valuation (v_j) bidders.
  - Obtain convex decomposition of fractional allocation into polynomially-many 1 integral vectors [3].
  - Satisfy all bids with x_j = 1 with probability \lambda_j based on the integral vectors obtained from the decomposition.

CONCLUSION & FUTURE WORK:

- The auctioneer's revenue is within (1-1/e) second-price optimal.
- Our model can be extended for online or incomplete information.

REFERENCE: