

## ***A Unified Framework for the Scheduling of Guaranteed Targeted Display Advertising under Reach and Frequency Requirements***

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*We propose a novel mechanism for the allocation and serving of guaranteed targeted display advertising in online media. We show that by using predetermined streams of ads (which we call patterns), we can integrate a variety of interesting features into a website's ad allocation optimization problem which have not been possible before. We consider a new form of contract which allows advertisers to specify the number of unique individuals that should see their ad (reach), and the minimum number of times each individual should be exposed (frequency). Our optimization framework aims for minimal under-delivery and proper spread of each campaign over its targeted demographics. As well, we can incorporate any desired pacing of ads over time at the user level or limit the number of competing brands seen by each individual. We develop a two-phase two-stage solution procedure which gives rise to a novel application of column generation, and then expand our base model to account for randomness in the website visitors' arrival process. Our numerical tests with real industry data show that with proper parallelization, our algorithm has a promising run-time and scalability, and can outperform greedy approaches by nearly 20%.*