Researchers' model for TV ad scheduling reaps revenue increase for networks

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Whether it's Flo from Progressive or the Geico gecko, the average TV viewer may not give much thought to commercials outside of whether they're entertaining or not. However, there is a rather complex science

behind what commercials you see and when you see them.

Rensselaer Polytechnic Institute's Sebastian Souyris, an assistant professor of supply chain and analytics who holds the Dean R. Wellington '83 Teaching Professorship in Management at the Lally School of Management, along with his partners, has combined mathematical programming and machine learning to optimize ad schedules. Souyris was joined in research by Sridhar Seshadri, Alan J. and Joyce D. Baltz Professor in the Gies College of Business and Health Innovation Professor in the Carle Illinois College of Medicine at the University of Illinois Urbana-Champaign, and Sriram Subramanian, now the head of Data Science at Pinterest.

The team's work resulted in a model that delivers a 3-5% revenue increase for TV networks, which translated into $60 million annually for one prominent user. This business impact won recognition with the INFORMS Revenue Management & Pricing Section Practice Award in 2022.

"Ad scheduling is a challenging multiperiod, mixed-integer programming problem," Souyris said. "Networks must meet advertisers' campaign goals and maximize revenues. Ads must reach specific target groups within a unique set of constraints, and the number of viewers is uncertain. However, successfully optimizing the schedules reaps great rewards for networks."

Advertising is the primary revenue source for TV networks. In 2022, U.S. advertisers spent over $68 billion on TV ads, which equates to 30% of all advertising.

The team's decision support system synthesizes many complex considerations. Contracts between advertisers and networks specify a certain number of views or impressions by their target demographics

within a certain time frame, as well as a certain number of ads to deliver to the target viewership even if the number of impressions has already been accomplished. The pace of the ads is also outlined, or number of ads per day. Sometimes the time of day, the position of the commercial during the commercial break, and the program during which the ad airs is also specified. On top of that, advertisers don't want their commercials aired next to competitors.

Networks must estimate the number of ads needed to achieve the specified impressions based on past data and how successful the programming is expected to be. They tend to overestimate, too, with the goal of avoiding giving airtime away for free if they are delivering more impressions than promised.

The decision support system has three stages. In the first stage, weights are assigned to ads based on how many impressions still need to be attained. A greater number equals a higher weight. In the second stage, the optimization model assigns the ads to the breaks. In the third stage, a model determines in which position ads will air during the breaks. The system devises the schedule on a daily basis, allowing the integration of the most updated data, such as the Nielsen ratings.

"The three-stage scheduling approach arranges the ads at the level of positions inside the breaks, which is as detailed as possible," Souyris said. "Using our system allows the development of a close-to-optimal ad schedule in a few minutes."

"This is yet another successful application of our faculty's research combining data analytics with mathematical modeling to achieve optimized scheduling and increased profitability," said Chanaka Edirisinghe, acting dean of Rensselaer's Lally School of Management. "Dr. Souyris' three-stage approach pushes the boundary of current state-of-the-art practice in ad scheduling by incorporating multiperiod views

and constraints in a mixed-integer data-driven optimization decision model."

The findings are published in the journal *Operations Research*.

More information: Sebastián Souyris et al, Scheduling Advertising on Cable Television, *Operations Research* (2023). DOI: 10.1287/opre.2022.2430

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