

---

## ESTABLISHMENT OF A RELATION BETWEEN SCHEDULE OF TV SERIES AND ALLOCATION OF COMMERCIALS

Raghav Garg\*<sup>1</sup>, Pratham Jain\*<sup>2</sup>, Richa Parekh\*<sup>3</sup>, Rishi Agrawal\*<sup>4</sup>, Romit Bose\*<sup>5</sup>

\*<sup>1,2,3,4,5</sup>Student, SYBBA, NMIMS ASMSOC, Mumbai Campus.

---

### ABSTRACT

Today, life without Television is unimaginable. The sheer happiness people derive from television in India cannot be described. Now, for something of such large scale and affecting such a huge number of lives, revenues of equal scales must flow in for sustaining this phenomenon. And this role of sustainability is played by something called advertisement. Television advertisement is an important source of income for the television industry. Television networks sell advertising slots to clients by the shows on which the commercials air. The networks also need to decide the location the commercial will air during the show. Keeping this in mind, it is our objective to bring out how commercial ads help Television channels grow, viewership and TRP influence the occurrence of these ads, and how calculatedly, shows are associated with commercials based on revenues. For the research, our case has been shaped in the form of an assignment problem. The assignment problem is a special case of a linear programming problem. Its goal consists in assigning  $m$  resources to  $n$  tasks on a one-to-one basis. The aim of looking into an assignment problem is to discover an assignment among two or more sets of elements, which could minimize the total cost of all matched pairs. In this case, the intention was to pair ads/commercials with TV shows and series and also finding out about minimum costs, and what better option can be there apart from Assignment Problems when the case involves allocation and apportionment. We have made two assignment problems to ensure optimal scheduling of commercials as well as to ensure maximum revenues for the Television Network. The assignment problems, presented by us, enable these TV channels to maximize revenues and the ad companies to minimize costs, by coinciding with the shows having the highest viewership, i.e., TRP. By doing this, these networks can optimize their schedule by scheduling the most popular shows during prime time (peak hours for television in India), thereby increasing their revenues.

**Keywords:** Television Scheduling, Advertisement Scheduling, Assignment Problem And TRP Maximisation.

---

### I. INTRODUCTION

Television is one of the most famous media for people to get information and an indispensable source of entertainment. Today, life without Television is unimaginable. It has become a household term and perhaps, an important part of all our lives. Talking specifically about India, the emotions of the normal viewer are connected with Television. The sheer happiness people derive from it cannot be described. Indian prime time television shows are divided into various categories like family drama, comedy shows, satire shows, crime shows, mythological shows, reality shows, youth show, and sports shows.

Now, for something of such large scale and affecting such a huge number of lives, it is important that revenues of equal scales flow in for sustaining this phenomenon. And this role of sustainability is played by something called advertisement. Television advertising has become one of the most popular forms of commercial advertising since its inception, owing to the fact that it supports both audio and visual content as means of exposing viewers to the desired promotional message. Television advertising has a far greater impact on society than radio, newspapers, or magazines.

Television advertising is intended to affect consumer behaviour by encouraging consumerism, mostly by urging consumers to transfer from one brand to another or to stay loyal to the one they have. To some extent, advertising may also be concerned with developing a market for new products. Consequently, television advertisement is an important source of income for the television industry. No wonder, in the financial year 2020, revenue from television commercials in India was over 262 billion Indian rupees (TV Advertising Revenue in India, 2020). Aside from the pandemic, television continued to lead the Indian advertising business due to its broad popular appeal and dependability. The fact that television ads accounted for 37 percent of the entire advertising expenditure across India in 2019, proves the aforesaid fact (Advertising and Marketing, 2021). Despite widespread digital adoption, television continues to attract customers from a diverse range of

industries. Television networks sell advertising slots to clients by the shows on which the commercials air. The networks also need to decide the location the commercial will air during the show. Traditional econometric models suggest that tele advertising has a clear and significant positive effect on company sales in the current period. Research finds out that advertisement scheduling has a great impact on customers watching the ad.

Keeping this in mind, it is our objective to bring out how commercial ads help Television channels grow, viewership and TRP influence the occurrence of these ads and how calculatedly, shows are associated to commercials on the basis of revenues.

## II. LITERATURE REVIEW

TV advertisement is an important source of income for the television industry. Television networks sell advertising slots to clients by the shows on which the commercials air. The networks also need to decide the location the commercial will air during the show. Research finds out that advertisement scheduling has a great impact on customers watching the ad. Effective advertising scheduling improves efficiency, makes customers watch the advertisement, and boosts product sales. Various constraints regarding advertisement schedule are peak sale season, competitor advertising media strategies, and various regulations. There are several criteria to be fulfilled during the process too, they include, no two competing products can be promoted in the same break, the beginning and end have higher consumer rating hence are more desired by the clients, they also need to ensure equitable rotation among positions within a break. The process of scheduling commercials by television networks if done manually is quite tiresome and time-taking. (Bollapragada & Garbiras, 2004) They have formulated the commercial scheduling problem as an integer program and develop near-optimal heuristics for automatically scheduling the commercials to meet all the requirements. This algorithm had been in production at the NBC (National Broadcasting Company) Network, a prominent television broadcaster in the United States of America, since April 2002 (paper published in May-June 2004). The algorithm runs schedules for commercials for the upcoming several weeks. In case of infeasibilities, the user can run the algorithm on a show-by-show basis as well. This algorithm provided a variety of benefits to the user. It eliminated the risk of lost revenues due to human scheduling errors, thereby improving accuracy. It also made the entire process more efficient by reducing the number of people required for such scheduling making the entire process more automated and cost-effective (M. S. Wuang, 2010). This study shows an Ant Colony Optimization (ACO) heuristic for making a mechanism that helps to solve the problem of advertisement schedule. Research has provided various solutions according to the scheduling objective. The main aim is to maximize customer satisfaction and income generation at the same time minimizing the cost penalty.

The role of operations research in advertising to find out how to spend money optimally in advertisement to get the maximum benefit of this investment (Sanishtha Bhatia, 2018). It primarily focuses on the media selection and budgeting aspect of the advertising procedure. Information Technology impacts the movie industrial model business at each stage of the system, beginning from the creation to the release of a movie and even beyond. An electronic chain value model has been used and as per the conclusions, the employment of mobile advertising, music online, online gaming, and e-community is still less but has caught pace. (Casassus & Wei) Due to the rapid rise in IT, some key players are losing out in the value chain and the customer chain. However, this risk is very much welcome as the opportunities offered by the Information Technology industry have more weightage, something which the consumers cannot possibly imagine. Linear programming has been used to formulate the effects of various constraints including a budget, search engine optimization, etc to arrive at allocations to maximize the return on investment. Based on various qualitative and quantitative techniques, a dynamic model has been analyzed to ensure flexibility, cost-benefit analysis and to improve the effectiveness of decision making, allowing them to use the model to allocate among several products, maximizing effectiveness based on Demand and consumer perception. Another problem is that how can the television stations receive and broadcast the advertisement order put forth by some advertising agency or company, on a fixed ad break and thus, maximize revenue. The problem analyses how factors like show structure, distinct rate scores for distinct groups of the target audience, limited time inventory, and avoidance of competition can affect revenues. (Agyei, 2018) The formulation in the form of a mixed-integer linear programming model is used to derive conclusions. By using this model, the network's revenue increases. Thus, the problem proves itself capable of getting good quality assignments for optimal allocation of TV commercials. (JHA, Aug 2013) The paper talks

about the television rating system in India which is going through the most controversial and transitional phase since its inception. In an industry run by and large on advertisement revenue, virtually all decisions for creating content on television are taken based on audiences' preference of content and the depths of their pockets. While the methodology of the rating agency TAM has always been under the scanner and the industry has been mulling an alternate system for quite some time now, it is for the first time that a big segment of the industry has openly boycotted the ratings and has gone to the extent of unsubscribing its data. This research aims to look into the pros and cons of various controversies surrounding TAM and the reasons behind it

TV is extremely popular and has become an indispensable source of entertainment. The prime time for television in India is between 7 p.m. and 12 a.m. Indian prime time television shows are divided into various categories like family drama, comedy shows, satire shows, crime shows, mythological shows, reality shows, youth show, and sports shows (Wei Lin, 1997) Networks take actions to maximize their viewership and households watch the shows that they find interesting. TRP of a network depends on factors like household demographic, viewer habits, show content, and competition amongst networks. (Sidhu, July-2019 ) Determining the TRP of a serial or a channel can be done through the mining of Television audience ratings. Data Mining, the extraction of concealed prescient data from extensive databases, is a capable innovation with extraordinary potential to enable organizations to concentrate on the most critical data in their information distribution centers. Data Mining apparatuses foresee future patterns and practices, enabling organizations to make proactive, learning-driven choices. TRPs can forecast the popularity of particular TV programs. People don't know about the value of television ratings, how much people's opinions are important and useful for the television industry.

Various techniques used in the research are incorporating agent methodology, game theory, and genetic algorithms. Networks use game theory as they predict competitor's strategies and accordingly develop their schedule. (Premchandani, 2015) Categorization of viewers is done in two categories, the ones who spent 1-3 hours watching television daily as a low media consumption group and the ones who spent 3-5 hours watching television daily into a high media consumption group. Viewers in the low media consumption group prefer watching sports and youth shows in their leisure time whereas viewers in the high media consumption group enjoy the other varieties of programs broadcasted during prime time.

The difference between Hollywood and Bollywood cinema industry is that later shows the lack of use of Operations Techniques and has the potential to increase its effectiveness by moving away from "Masala" which is dominant in the Indian cinematic industries to proper methods that can maximize profits. In (Amla Chaturvedi, 2018) analysis has been done on how Hollywood conducts its OR to maximize profit from screen time and has laid emphasis on adaptation of the same technique in Bollywood and to improve its understanding in Operations Research. Some of the weaknesses found are the quality of certain shows may not be found good by the viewers and household demographics needs to be worked upon as some households watch television up to the late night. Moreover, there can be a lot more TV networks to compete within the practical application, and also OTT platforms can affect the industry as well. With the expanding measure of viewer construct content in light of the web, there has been a rise of research fields that utilizes opinion examination to exploit and process this information. There is also a future scope where a system can be constructed to predict the TV show popularity using Sentiment Analysis in Social Networking websites.

### III. RESEARCH OBJECTIVES

- To analyse how to optimize commercial scheduling during television shows.
- To understand the dynamic model that should be used to spend money optimally in advertisement to get the maximum benefit.
- To understand how the television rating system in India works and what changes can be made to it in the future.
- To conduct primary research on real-time viewers and connect their preferences with our model.
- To get maximum viewership by choosing the optimal network schedule.
- To study the factors that determine the TRP and viewership of a program or channel.

#### IV. RESEARCH METHODOLOGY

For the research, our case has been shaped in the form of an assignment problem. The assignment problem is a special case of linear programming problem; it is one of the fundamental combinational optimization problems in the branch of optimization or operations research in mathematics. Its goal consists in assigning  $m$  resources to  $n$  tasks one a one-to-one basis.

The aim of looking into assignment problem is to discover an assignment among two or more sets of elements, which could minimize the total cost of all matched pairs. Thus, the applicability of assignment problems is very wide and found in diverse situations, some of the examples being, assigning machines to factory orders, assigning sales / marketing personnel to sales territories, contractors to bidders by way of systematic bid-evaluation, assigning classes to teachers and accountants to accounts of clients, to name a few. In this case, the intention was to pair ads/commercials with TV shows and series, and also finding out about minimum costs, and what better option can be there apart from Assignment Problems when the case involves allocation and apportionment.

#### V. ANALYSIS AND FINDINGS

Assignment problems are a special case of fundamental combinational optimization problems in the Operations Research branch of mathematics. Its goal is to assign certain number of resources to tasks with the objective of minimising costs or maximising profit. An important condition of assignment problem is that only one job can be assigned to one person.

We have made two assignment problems to ensure optimal scheduling of commercials as well to ensure maximum revenues for the Television Network. This assignment problem can easily be solved using the Hungarian Method (HAM). It is solved in 2 phases. The first focuses on row and column reductions whereas the second focuses on optimization. The Television Network we have chosen is Sab TV which is one of the most popular TV channels in the country and has shown which are watched by people of all sections of the society.

	7:30pm to 8:00pm	8:00pm to 8:30pm	8:30pm to 9:00pm	9:00pm to 9:30pm	10:00pm to 10:30pm	10:30pm to 11:00pm
Hero - Gayab Mode On	t1	t2	t3	t4	t5	t6
Ziddi Dil Maane Na	t7	t8	t9	t10	t11	t12
Tarrak Mehta Ka Ooltah Chashmah	t13	t14	t15	t16	t17	t18
Wagle Ki Duniya	t19	t20	t21	t22	t23	t24
Maddam Sir	t25	t26	t27	t28	t29	t30
Jijaji Chatt Par Hain	t31	t32	t33	t34	t35	t36

**Figure 1:** Assignment Problem showing TRP of various shows at different time slots

**Source:** The Authors

The first assignment problem is a maximization type of assignment problem. It depicts the TRP of various shows at different time slots. In India, the primetime for television shows commences from 7:30 pm up until 11:00 pm. The average episode length is 30 minutes per episode. Hence, there are six time slots of 30 minutes each. The shows we have taken are Hero- Gayab Mode on, Ziddi Dil Maane Na, Tarak Mehta ka Ooltah Chashmah, Wagle ki duniya, Maddam Sir and Jijaji Chatt Par Hain.

The rows represent the TV shows and the columns represent the time slots. Here, “t” represents the TRP for each show at each time slot. The channel can use this assignment problem to maximize TRP by allocating the shows with the highest TRP at the most desirable time slot.

	7:30pm to 8:00pm	8:00pm to 8:30pm	8:30pm to 9:00pm	9:00pm to 9:30pm	10:00pm to 10:30pm	10:30pm to 11:00pm
Hero - Gayab Mode On	r1	r2	r3	r4	r5	r6
Ziddi Dil Maane Na	r7	r8	r9	r10	r11	r12
Tarrak Mehta Ka Ooltah Chashmah	r13	r14	r15	r16	r17	r18
Wagle Ki Duniya	r19	r20	r21	r22	r23	r24
Maddam Sir	r25	r26	r27	r28	r29	r30
Jijaji Chatt Par Hain	r31	r32	r33	r34	r35	r36

Figure 2: Assignment Problem showing revenue of various shows at different time slots

Source: The Authors

The second assignment problem is also a maximization type of assignment problem. It depicts advertisement revenue of various shows at different time slots. The primetime for television shows commences from 7:30 pm up until 11:00 pm. The rows represent the TV shows and the columns represent the time slots. Here, “r” represents the advertisement revenue for each show at each time slot. This assignment problem can be used to maximize advertisement revenue that the network can earn by showing different shows at the most desirable time slot.

## VI. CONCLUSION

Over the past 5 years, TV Channels have faced widespread competitions from various OTT Platforms like Netflix, Amazon Prime etc. This has been followed by a sharp decline in the popularity of these channels especially since the onset of the pandemic. In this situation, maximising revenue along with optimum utilization of resources is the need of the hour for any TV Channel.

The assignment problems, presented above by us, enable these TV channels to maximise revenues and the ad companies to minimise costs, by coinciding them with the shows having the highest viewership, i.e., TRP. By doing this, these networks can optimise their schedule by scheduling the most popular shows during the prime time (peak hours for television in India), thereby increasing their revenues.

## VII. LIMITATIONS

The assignment problem developed above, shows the network’s Programme scheduling for prime time i.e., between 7:30 pm to 11:00 pm. No focus has been made for the rest of the time which can be very useful in determining the network’s full-day schedule.

Competitive analysis has not been done which can change the network’s schedule due to the competitor’s best show in the prime time and will also affect the network’s advertisement revenue at the time.

Time frames can be divided for various demographic divisions like school-going kids, college youth, and generation wise also. This will make a better model for advertising companies to choose their time slot according to their target youth. Primetime for another network can be different according to their audience as for networks designated for kids have prime time in the evening and for news channels, it is generally morning and late evening time slots. On special occasions that provide exceptional TRPs to the network, like weekends and movie premiers, the advertisement at that time can be charged much more due to more reach. With TRPs and advertisement revenue available in numbers will give a proper schedule to network schedulers. Overall, this model cannot be used as it is by the network schedulers but this can be used as a basis for developing their network schedules.

## VIII. RECOMMENDATIONS

Every TV channel and TV show’s main goal is to increase their TRP and revenue. Below is a list of suggestions that we think can work. According to us, they can develop a model by working on competitive analysis and taking competitive networks into account. This can help everyone with new ideas and can help everyone to grow. They should Consider advertising company’s requirements and their target audience to suit their needs. This will benefit both the TV show and the advertising company. It will result an increase in the revenue of the advertising company and TRP of the show. Another problem they need to solve is that how can the television stations receive and broadcast the advertisement order put forth by some advertising agency or company, on a

fixed ad break and thus, to maximize revenue. They can analyse the factors like show structure, distinct rate scores for distinct groups of the target audience, limited time inventory, and avoidance of competition can affect revenues. They can formulate a mixed-integer linear programming model to derive conclusions. By using this model, they can get better results and increase their revenue.

#### **IX. REFERENCES**

- [1] Advertising and Marketing. (2021, April 26). Retrieved from Statista:  
<https://www.statista.com/statistics/388426/television-advertising-expenditures-share-india/>
- [2] Agyei, W. (2018). Mathematical Model for Television Commercial Allocation Problem. *International Journal of Scientific & Technology Research*, Volume 7, Issue 10 , 1-5.
- [3] Amla Chaturvedi, A. P. (2018). Application of Operations Research in Planning of Films. *JETIR*, 118-124.
- [4] Bollapragada, S., & Garbiras, M. (2004). Scheduling Comemrcials on Broadcast Television. *informs*, 337-345.
- [5] Casassus, F., & Wei, J. (n.d.). Development of Value Increasing Model for Movie Industry. By the College of Business, University of West Florida, 50-62.
- [6] JHA, S. (Aug 2013). TELEVISION RATING SYSTEM IN INDIA. *International Journal of Communication* , 6.
- [7] M. S. Wuang, C. L. (2010). Scheduling of Television Commercials. *IEEE Explore*, 803-807.
- [8] Premchandani, S. (2015). A Discriminant Analysis of Viewers' Perception towards Prime Time Television . *Pacific Business Review International*, 31-38.
- [9] Sanishtha Bhatia, S. S. (2018). Applications of operations research in advertising media. *International Journal of Advance Research and Development*, 86-91.
- [10] Sidhu, A. (July-2019 ). Factors determining the trp . *International Journal of Scientific & Engineering* , 9.
- [11] TV Advertising Revenue in India. (2020, Sep). Retrieved from Statista:  
<https://www.statista.com/statistics/233489/tv-advertising-revenue-in-india/>
- [12] Wei Lin, R. N. (1997). Automated Television Scheduling Via Evolving Agents. *IEEE Explore*, 691-696.