Optimisation Model for Strategic Planning - scheduling and advertising in the TV sector

Mathematical, Modelling and Consulting Skills – MSc Operational Research 2024/2025

1. Introduction

This project is designed to present a small-scale set of competitor TV channels, exploring optimal solutions for maximising viewership through intelligent scheduling for a particular channel and planning a cost-effective advertising strategy. For simplicity this challenge considers 4 channels, streaming movies all the time (each daily programme runs from 7 am until midnight) and allowing 5-min time slots at roughly every 30 minutes of movie streaming.

The students are hired as consultants by a TV channel and are given a blank timeline, along with the planned schedule for 3 competitors. The primary objective of the project is to deliver a systematic methodology to optimise the channel's own viewership (retain existing audience and attract new viewers), whilst adapting to the other channels' scheduling strategy.

Each channel can sell their advertisement slots to their competitors. Advertising in our own TV channel is free of cost in principle but it also means that the slot cannot be sold to others. Furthermore, it can only target an existing audience which is actively watching TV during the respective ad slot. Conversely, deciding to use other channels' advertisement slots costs more money but likely to expand the core audience, based on relevant content that the viewers like. For instance, advertising a horror movie (scheduled to air soon) during a similar genre movie streamed on a competitor channel, is likely to attract potential viewers. However, advertising it during a romance/comedy elsewhere is quite possibly going to be a waste of money.

Each channel chooses their content from the movies catalogue, considering popularity, ratings, box office revenue, genre, release date and other features. They also consider their audience demographics; for example, children are more likely to watch animations, opposed to horrors. There is a streaming cost associated with each movie, as well as revenue which is based on the actual viewership.

The current project is inspired by real-world challenges faced by the broadcasters. The data is simulated by a data scientist, applying relevant knowledge and experience working for clients in the Media sector.

2. Key facts about the data

First and foremost, the simulated data aims to represent realistic distributions and logical relationships but gaps and inconsistencies may be spotted. A real-world database would be likely to

contain these (at a larger scale) and it is part of the consultants' challenge to identify and address discrepancies accordingly, ensuring that the final solutions are still capable of handling these.

Most data features below are self-explanatory. Note that it is not a mandatory requirement to use all variables in the modelling process, it is up to the consultants to decide what part of the information adds value.

Data features:

Movie Database (nearly 6,000 titles which the channels can choose from)**:**

- Movie Title
- IMDb Average Vote (1-10)
- Vote Count
- Release Date
- (Box Office) Revenue
- Run Time
- Budget
- Genre(s)
- Number of Ad Breaks – how many ad slots are available for the duration of the movie
- Runtime with Ads (rounded)
- Children Scaled Popularity
- Adults Scaled Popularity
- Retirees Scaled Popularity

Channels' Schedule Databases (Competitor Channels 0, 1 and 2)

- Date-Time (5-min slots)
- Content Type (Movie/Advert)
- Children Popularity Score
- Adults Popularity Score
- Retirees Popularity Score
- Number of Ad breaks – how many ad slots are available for the duration of the movie
- Prime time factor – movies streamed during the TV prime time incur additional costs but they are expected to have higher audiences
- Children View Counts
    - Baseline count
    - Expected count
    - True count 1 to True Count 9
- Adults View Counts – same structure as above
- Retirees View Counts – same structure as above
- Ad slot price – flat fee + margin, also considering prime time factor

Channels' Conversion Rates (Competitor Channels 0, 1 and 2)

- Date-Time (5-min slots)
- The other columns represent each genre in the movies' catalogue. This conversion matrix shows the probability for a particular slot that advertising on a competitor channel can lead to positive conversion into your own channel.

Channel A Schedule (Your own channel)

- Date-Time (5-min slots)
- Children Baseline View Count
- Adults Baseline View Count
- Retirees Baseline View Count
- Prime time factor

3. Stochastic modelling

Advertising increases the viewership through probabilities. In short, there is no guaranteed outcome, should you advertise on your own channel or your competitors. A key starting point is: if you decide to show a movie X at time T and do not advertise this movie anywhere, how many viewers will this result in? The actual viewership can be considered as the baseline viewership count multiplied by the popularity.

Furthermore, if the movie is advertised, the channel will then get the base expected viewership, plus some conversion depending on how much and where the move is advertised. The conversion rate per each genre/advert slot needs to be used in the model, considering that the movies' catalogue contains multi-genre movies.

4. Key objectives and Constraints

As discussed above, the main objectives of this problem are to maximise overall viewership of your channel through:

- Intelligent scheduling, aligned with the competition's schedules;
- Efficient advertising strategy, combining ads on your own and your competitors' channels.

Each movie has an associated streaming license fee, which can be factored as a functional result of combining the title's popularity, its original budget and box office revenue. The expenses are complemented by advertising costs (using competitor channels' slots). Increasing viewership leads to higher revenue, which is ultimately the measure of success for each channel. The global population shared across the 4 channels is 1 million people.

Each channel would forecast a pre-set advertising budget. The executive boards expect the consultants to define the most optimal budget through a thorough analysis of the optimisation model's results. A sensitivity analysis may suggest tactical amendments of the budget over time, should this drive generation of additional viewership and respectively, revenue from selling advert slots. Note that our channel defines the slot prices to offer to the competitors – the more the viewership is, the more likely it is to sell these slots, as long as the other channels are showing movies which will benefit from advertisement.

5. Timeline and iterative approach

The 'vanilla' model is aimed to optimise the TV channel's schedule and advertisement over the first 7 days, covered by the simulated data starting from 01 October 2024. The consultants are also expected to consider a longer time horizon (12 weeks), implementing a 'learning' element at the end of each Monday, with the goal to optimise the strategy for the following week. This can be constructed as a non-cooperative game theory, where each player aims to adapt their strategy to the other player's changes. The assumption is that each TV channel announces their upcoming

schedule on a weekly basis. Thus, the data inputs should be ingested incrementally, i.e. whilst optimising the schedule and advertising for week X is performed without the knowledge of what the competitors' schedules are for week X+1, X+2 etc (only the past).

There are 10 different actual view counts as possible scenarios. The model's calibration should be based on random pick of one by generating a random integer between 0 and 9.

6. Exploratory Questions

The channel's executive board is willing to listen to the consultants' recommendations for enhancing the optimisation strategy, providing responses (but not limited) to the following questions:

- Our revenue is a functional result of the viewership and respectively, the sold advert slots at a price relative to the size of the active audience. Can you define an optimal pricing strategy for these slots?
- Consider whether a competitor has already shown the movie recently - if you ignore the competition, your optimal model has a high chance of coming up with same optimised schedule as the competitors, which will result in low sales. What is the best tactic to schedule similar movies (popularity, genres etc) to utilise competitors' advert slots efficiently and promote our content to the intermittent audience groups (i.e. those who are likely to convert between channels based on the content)?
- There are operational business costs for running a TV channel (e.g. for staff salaries, equipment, licenses etc) which can be defined as the lower bound for revenue. Falling below this minimum revenue target means that the channel will need to declare bankruptcy and go out of business. Can you determine what this lower bound would be, i.e. minimum revenue you can guarantee?
- In addition to the previous question, note that any increases in the advertising budget are also associated with extra operational cost (e.g. additional staff members), hence this should also result in growth in profit (added revenue minus added operational costs).
- Can you advise on any demographic trends (exploring the 3 age groups)? Should we focus more on one of them? If yes, how would this change our long-term strategy and preferred genres on our channel? If no, why?
- What is the proportional market share for our channel and all competitors? How does the optimisation strategy change this over time? How does this relate to our revenue growth expectations? Is there a 'core' audience our channel can consider as a guaranteed volume each day?
- Can you provide alternative strategies for the content type? For example, would we be better off focusing on old time classics (older movies with higher popularity)? Or more modern titles? Is it more efficient to schedule shorter movies with a bigger variety of genres throughout the day?
- What is the trade-off between showing lower cost productions (which would respectively mean lower fee) and higher box office revenue?