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A Decision Support Framework for Optimal Pricing and Advertising of Digital Music as Durable Goods

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Abstract: With the recent rising popularity of music streaming platforms, consumers are now able to enjoy music as a service, playing music for free without paying to obtain the ownership, the threat to the record labels' financial prospect is eminent. We propose a novel decision support framework to assist the record label in making better informed decisions in the post-release management timeframe to maximise the expected profit. By identifying the musical product as a durable goods, we model the consumers' consumption rule with forward-looking behaviour, viewing music streaming as the consumers' option of delayed consumption, making purchase only when the expected discounted lifetime utility exceeds the expected utility from streaming. Our proposed decision support framework has the record label use both the price and advertising as instrument of control in achieving maximised expected discounted profit, playing strategically in anticipating to the consumers' decisions using an interactive Markov chain. We show in our illustrative example the proposed decision support framework is able to make decisions dynamically and performs substantially better than other single control variable decision tools.

Keywords: decision support systems, optimal stopping, durable goods, consumer choice model, optimal pricing, digital music

1. INTRODUCTION

The digital revolution has posted major challenges to the producers of information goods. Having produced a product that is digitalised and can be copied and transferred easily over the internet, producers in the music, film, or even the gaming industry has been constantly learning and searching for new ways to improve sales of their products despite the consumers having options to obtain these products free-of-charge somewhere around the internet. Recently, a new challenge arrives as the cloud streaming platforms gain popularity among consumers in these markets. Take the music market as an example, the new streaming method for music distribution known as music as a service (MaaS) has gain notable usage; for the year 2014, there's a growth of nearly 40% streaming revenue as reported by IFPI (2015). Despite the continual surge in user base, the streaming platform remain less preferred by the record labels because of the disastrous financial prospect of the per-play streaming revenue (Generator Research 2013), where selling one song can be hundred times more profitable than a streaming play. In fact, Taylor Swift pulled her entire music catalogue from the Spotify streaming platform in 2014 in order to drive more people into purchasing her music (Time 2014), this signifies the record labels' strong interest in profiting from selling their musical product. In this sense, how to effectively lead the consumers into making more purchases is a question that urgently needs more exploration.

To date, the amount of academic research on music streaming is still scarce, and few have been focusing on improving the profitability of the record labels in their study. One solution was the two-sided market model proposed by Thomes (2013). In the theoretical model, the revenue of the record label is compensated by advertising playing intermittently while the consumers stream the music free-of-charge. The conceptual framework by Papies et al. (2011) made use of a free music downloading scheme subsidized by advertising revenue, and shown the advertising-based model holds the potential to attract more customers. Alternative pricing schemes such as bundling (Breidert and Hahsler 2007, Shiller and Waldfogel 2011) with revenue sharing (Shiller and Waldfogel 2013) are solutions favoured by researchers. Regardless of the solutions proposed by researchers, the prior literature have viewed the uniform pricing scheme adopted by major retail/streaming platforms as inefficient, especially for digitalised information goods which are costless to reproduce.

One aspect which distinguishes the proposed solution from the above-mentioned studies is the treatment of the musical product as durable goods instead of consumables. Musical product as durable goods means the act of purchasing

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the musical product can yield a stream of utility to the consumers overtime, giving the consumers the option to postpone the purchase in expectation to yielding a higher future utility. As a result, the record label can employ a variety of ways to lure the consumer into making the purchasing decision every period, opening up a new array of possibilities for management and control decisions. In this respect, the proposed research is unique and entirely novel.

Our proposed solution is a time-series management and control framework incorporating the decision-making process of both the record label and the consumers with forward-looking behaviour. The main inspiration of this research is from the literature of new product diffusion, in which the consumers learn about the new product over time. In various marketing and management studies, the diffusion patterns are modelled and analysed to forecast the sales of a new product. For example, Moe and Fader (2002) used a mixture-Weibull distribution to model the temporal sales pattern of music CD, by predicting the purchase timing decision of 2 separate segments of consumers, the sales of music CD can be effectively anticipated. Both Lee et al. (2003) and Ainslie et al. (2005) were successful in predicting the sales of music album and movie box office with the hierarchical Bayesian model based on logistic diffusion process. This research, however, is more similar to the approaches adapted by Hui et al. (2008) and Eliashberg et al. (2000); in their models to forecast DVD sales and movie box office, the consumer choice is modelled on an individual-level decision making basis rather than on a prespecified population-level distribution function. The consumers in our model are set to derive utility based on an individualised instantaneous utility function for purchasing or streaming, and behave based on the utility maximising decision rule by considering their discounted lifetime utility. Since we are treating the musical product as durable goods, forward-looking behaviour (e.g., Hui et al. 2008, Song and Chintagunta 2003) is incorporated into the decision rule of the consumer, this is done by allowing the consumer to have an expectation of the future market state, i.e., forecast the state of market diffusion based on current market state, and decide the optimal time to make a purchase. The core of our proposed solution is the decision-support of a profit maximising record label. Taking inspiration of those marketing and management studies, where the level of advertising expenditure and word-of-mouth activities are analysed to obtain sales forecast, we tweak the idea a little bit and make the advertising expenditure as control variable alongside with the price of the musical product, so the record label can have a grab of the diffusion process and steer the consumers' consumption decision when the consumers are making decisions based on their expectation of future diffusion state. By defining a vector of market population frequencies that adopts to the advertising expenditure and consumers' purchasing decision, our proposed solution can provide good managerial insight to the record label.

The remainder of this paper is organised as follows: In Section 2, we provide a basic setup to our proposed solution and give detailed specification to different elements in the model. Section 3 presents an illustrative example to demonstrate the working of the proposed solution, and draw management implications from our example. Finally, we conclude our paper in Section 4 with directions for future research.

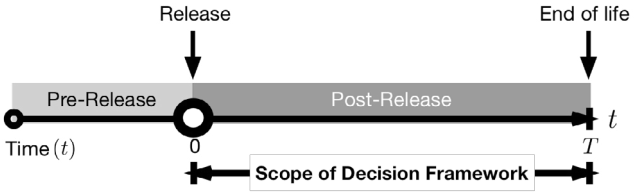

Fig. 1. Scope in Applying the Proposed Decision-Support Framework

2. MODEL

In this section, we give a detailed description of the proposed decision-support framework for post-release product lifecycle management of the digitalised musical product.

2.1 Basic Model Setup

The proposed decision-support framework is aimed to help the record label to make optimised decision during the post-release management timeframe as shown in Fig. 1. As indicated in the figure, there are two important events identified on the timeline: the release date and the end of life date. The release date, defined as time $t = 0$, represents the time period the musical product is first released to the market. The end of life date, defined as time $t = T$, represents the designated time period where the record label is no longer making any more decisions on the given digitalised musical product. Given the characteristics of a digitalised product, the given musical product would not be completely off the market when it reaches the end of life. Instead, it will become part of the long-tail of the internet marketplace, continue to generate revenues for the record label when someone stumbles upon it and makes a consumption decision. However, as the record label is no longer actively promoting the title beyond its end of life, any potential revenue generated past that time period will not affect the decisions of the record label anymore.

For every period within the post-release management timeframe, both the record label and the consumers in the market would make a decision to improve their individual welfare; in particular, the record label makes decisions to maximise its net present profit (Π_t), and the consumers are making decisions to maximise their individual-level net present utility (U_{it}). Refer to Fig. 2, the record label would set a market price p on the release date at time $t = 0$, and the consumers will make their consumption decisions D^C_{i0} for time $t = 0$ accordingly. From time $t = 1$ to $t = T$, the record label makes a management decision (D^L_t) every period and the consumers react with an individual-level consumption decision (D^C_{it}) accordingly. From the perspective of the consumers, the consumption decision is an optimal stopping problem, by choosing between the act of purchasing, streaming, or not consuming the musical product, the consumers are searching for the utility-maximised time period to exit the market. On the other hand, the management decisions make up for a stochastic feedback control problem for the record label.