



## Duopoly pricing of software products under free strategy: Limited-feature vs. seeding



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### ABSTRACT

Adopting free strategy in competitive settings is pervasive in the software market. However, previous studies on free trial pay more attention to monopoly case rather than duopoly case. This paper examines the duopoly case in which one firm adopts the limited-feature free trial strategy and the other employs the seeding strategy. We drive the equilibrium prices and profits of two firms, and explore how the optimal prices and profits are affected by the quality and the service level of free trial version, the network intensity and the seeding ratio. We find that the firm adopting the limited-feature free trial strategy is profitable to provide free trial version of its commercial software with lower quality and better service, and the firm which uses seeding strategy may seed more potential consumers to obtain more profit. We discover the impact of the network intensity is negative on the profit of the firm that adopts the limited-feature free strategy. This result is different from the previous literature on limited-feature free trial in monopoly case. Moreover, the firm which employs seeding strategy prefers higher seeding ratio and stronger network intensity.

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### 1. Introduction

A new software product with intrinsic usefulness may be unsuccessful, as it fails to establish a large user base and the strong word-of-mouth effect to attract potential consumers (Katz & Shapiro, 1985). Offering free trial software is an effective strategy for software firms to accelerate the diffusion process, thereby there exist a variety of free trial software products in the market. A famous media player, RealPlayer, with the limited features, is the free trial version of RealPlayer Plus which offers more advanced functionalities, like high quality CD burning, high speed video transmission and music library cleaner. For some antivirus software products, such as McAfee and Kaspersky, consumers could try all of the functionalities for 30 days. When the trial expires, consumers have no access to the products unless purchase them. Math Type, a user-friendly equation editor, offers full functionalities for 30 days. After 30 days, only its starter edition with a few functionalities is allowed to be used. Furthermore, users have opportunities to free download Apps or software products in the App Store, Google Play and other known application platforms when a new App or software releases.

The free trial examples are all the applications of free strategies in the actual market. One form of free strategy is the free trial strategy, including limited-feature free trial, time-locked free trial and hybrid free trial, and the other form is seeding strategy. The differences among these four types of free strategies are the performance of software and the licensing terms. The limited-feature free trial offers a basic version of software product for free, but its commercial version has advanced performance, more features and better service. Under this strategy, the free trial version is under perpetual licensing (Niculescu & Wu, 2014). For instance, Adobe Acrobat has three versions, Reader, Standard and Professional, respectively. Adobe Acrobat Reader can be free downloaded and used without time limit. This version can be used only to read but not create and edit PDFs. The time-locked free trial allows consumers to employ the software with the complete functionality within a limited period. This strategy helps reduce the consumers' uncertainty and is usually adopted by large firms such as Oracle. The hybrid free trial combines the advantages of the first two strategies. Microsoft Office 2010 offers a free trial version with full functionalities for only 60 days. The editing and printing functionalities are disabled after trial period has expired. Seeding strategy is derived from product sampling. It enables a software firm to provide its commercial software with full functionalities for free to a certain percentage of addressable market uniformly in terms of consumer type (Dou, Niculescu, & Wu, 2013). For example, millions

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of college students have access to the Microsoft developer and designer tools free of charge through DreamSpark student program of Microsoft enterprise.

The feasibility of adopting the free strategy is predicated on the characteristics of software products. First, software products belong to the experience goods, consumers might not purchase the goods before trying it or part of it due to the uncertainty about the product quality. In contrast, after trying, they could learn more and verify the quality and other attributes, like functionality, performance, interface, and compatibility issues (Nelson, 1970). Second, software product is a kind of digital goods, so its marginal reproduction cost could be negligible once it has been developed (Shapiro & Varian, 1999). This characteristic makes it possible for firms to provide goods for free. Third, the modular architecture of software products makes it easy to separate, degrade or disable some functions. Hence, there is nearly no cost to provide different versions with different qualities. Finally, the majority of software products exhibit positive network externalities (Shapiro & Varian, 1999). The more consumers use the same software product, the higher network-generated value derives from products. To exploit the benefit from positive network externalities, software developers have the incentive to adopt free strategy to build up a large user base.

Previous studies have examined the monopoly case in which a firm adopts one of the free strategies (Cheng, Li, & Liu, 2015; Cheng & Liu, 2012; Cheng & Tang, 2010; Dou et al., 2013). They explore the issues about whether it is profitable to offer the free trial software, what the optimal price is, how the network intensity affects the profit, and others. Although these literatures help us better understand free trial, the monopolistic environment is restrictive since market competition does play a significant role in software industry. As development tools of product design, Autodesk and Dassault Systemes are competitive relationship, they adopt limited-feature free trial and seeding strategy, respectively. Dassault Systemes provides CATIA V5 Student version which disables saving functionality to students free of charge. Autodesk introduces the Autodesk Clean Tech Partner Program which offers free software bundles to 100 startups in the clean technology field. In the app market for Android and iOS devices, PDF Reader, developed by Kdan Mobile, is regarded as the world's second popular mobile reading software product. Kdan Mobile gives away perpetual license of latest version of PDF Reader premium to some consumers. Adobe Acrobat Reader, operated in Windows and MAC system, is the limited-feature free trial version of the commercial software Adobe Acrobat Professional. Obviously, Adobe adopts the limited-feature free trial strategy while Kdan Mobile employs seeding strategy. Examples of the kind are common in software market. However, few studies examine the competitive scenario. Our paper seeks to fill this gap by examining the two competing firms that one employs the limited-feature free trial strategy and the other adopts the seeding strategy, like Autodesk vs. Dassault Systemes and Adobe vs. Kdan Mobile.

Firms may benefit from offering the free trial software to boost adoption process in three aspects. First, offering free trial software results in more efficient and faster spread of this software product owing to word-of-mouth effects. Second, the free trial version reduces the consumers' uncertainty about the commercial version. Finally, the free trial strategy is helpful to build up a large install base of consumers. Although offering free trial software has many advantages, there is also negative impact on the software providers. When the software firm provides the free trial software along with commercial software products, it risks losing part of the demand of its commercial product. Therefore, how the firms design the quality of free trial version to trade off the installed user base and the demand of its commercial product has become a significant issue for competitive firms.

This paper focuses on analyzing the duopoly case in which one firm selects to adopt the limited feature free trial strategy and the other chooses the seeding strategy. The competitive firms provide the substituted commercial software products simultaneously. Our research aims at answering the following critical questions. First, what is the optimal price of each firm's commercial software product? Second, how do the important parameters (e.g., the network intensity, the seeding ratio, the quality gap between the commercial software and free trial version) affect the equilibrium price and profit of each firm? Third, how do the firms design the free trial version of commercial software?

Our research provides several useful findings. First, we find that the firm adopting the limited-feature free trial is profitable to provide free trial version of its commercial software with lower quality and better service. However, it is also beneficial to the rival firm that employs the seeding strategy. Second, the firm using seeding strategy may seed more potential consumers to obtain more profit because of positive effect of seeding ratio. Moreover, seeding more potential consumers has an adverse impact on the rival firm that employs limited-feature free trial. Finally, we discover the impact of network intensity is negative on the profit of the firm adopting the limited-feature free strategy, while the firm employing seeding strategy prefers higher seeding ratio and stronger network intensity. This result is different from the previous studies on free trial in monopoly case.

The rest of this paper is organized as follows. A summary of literature related to ours is presented in Section 2. We present the general model in Section 3. In Section 4, we discuss how the two firms' optimal price for commercial software and optimal profit change with the influencing factors, such as network intensity and seeding ratio. Conclusions and future research possibilities are summarized in Section 5.

## 2. Literature review

As a widespread practice, the objective of offering the free trial software is to increase the consumers' willingness-to-pay by decreasing the uncertainty of product quality, and to benefit from word-of-mouth (WOM) effects and network externalities. This paper is related to literature on product trial and market seeding.

Product trial is regarded as a key factor in determining purchase intention and brand belief due to consumer's first usage experience. Earlier studies concentrate on the significance of product trial in initial adoption and purchase process. Heiman and Muller (1996) explore the optimal demonstration time to maximize the purchase probability of consumers. Kempf and Smith (1998) develop a structural model of trial processing integrated with advertising model to examine how consumers react when the trial is available. Actually, it is difficult for new software products to achieve market penetration, but offering a free version is essential to encourage initial adoption (Haruvy & Prasad, 2001). Related to limited-feature free trial strategy, Faugere and Tayi (2007) develop a vertical differentiation model to study the optimal design of free software based on evaluation period and product features. The "clone" of commercial software with inferior quality can be considered as a free trial production. An interesting observation is that clones may be the meritorious asset and being cloned is possible for an innovating firm to be more beneficial than dominating the market along. Based on the model in Conner (1995), some papers (Cheng & Liu, 2012; Cheng & Tang, 2010; Cheng et al., 2015) indicate that network intensity plays an important role in deciding which free strategy is optimal for the software provider. Cheng and Tang (2010) investigate the limited-feature free trial strategy and compare it with versioning software. They find that the monopoly prefers to offer free trial software than segment the market

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