The Innovation of Probabilistic Selling Strategy: A Review and Future Research

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Abstract. Probabilistic selling is a sales strategy that a seller hides the specific characteristics of a product to the consumer until the consumer make a purchase. Probabilistic selling is getting increasingly popular and can be seen in people's daily lives frequently, and there are many studies about it. Previous literature reviews in this field have provided a detailed classification and summary of the probabilistic selling papers that existed at that time. However, there have been some articles studying the new changes in probability sales, or proposing new perspectives on the mechanism of probabilistic selling these years. This article mainly focuses on articles in the field of probabilistic selling that have emerged in recent years and have not been included in previous review literature. It is divided into three parts: the application of probabilistic selling in some industries aside from commonly discussed fields, new changes in probabilistic selling models, and new insights proposed by researchers on consumer behavior or probabilistic selling mechanisms.

Keywords: Probabilistic selling, Review Literature, Loot box, Return policy

1 Introduction

Probabilistic selling refers to a seller providing a consumer with probabilistic/opaque goods, which consists of multiple component goods. Consumers who purchase probabilistic goods have a probability of obtaining any of these items. In practice, probabilistic products can also be called blind boxes. Probabilistic selling has a huge market size. Data shows that the global blind box market, which is a part of the probabilistic selling market, has achieved a market size of $13.82 in 2024 and is projected to reach $14.72 billion in 2025, further expanding to $31.2 billion by 2030 (Fu, Ga, Li and Du, 2025 [5]). And probabilistic selling is becoming increasingly popular in some industries like tourism, booking opaque hotels or airline tickets at low prices has become a popular choice for many people when traveling. It gains such a lot popularity among a wide range of consumers, making research on probabilistic selling necessary.

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1.1 Probabilistic selling in literature

Fay and Xie (2008) [4] were the first to define and study the strategy of probabilistic selling, they explained the effectiveness of probabilistic selling. After their research, there are also many articles that study probabilistic selling from various perspectives, at present, research in the field of probabilistic selling has become quite comprehensive.

Goensch (2020) [7] organized the literature on probabilistic selling (referred to as incompletely specific products in the paper) and divided the literature into three streams: strategic operations management, empirics and operations management. This paper provided a comprehensive summary of probabilistic sales literature. But in recent years, many new themes have emerged in the field of probabilistic selling, so I think it is necessary to conduct a review on the literature in recent years.

1.2 Focus

This paper mainly focuses on new research about probabilistic selling, and divides these articles into three categories based on the researchers' innovative perspectives.

The fields that mainly adopt probabilistic selling now are the tourism and toy industries. In addition to these fields, the gaming industry often provides players with products in uncertain forms, like loot box provided by some online games like figure 1 (Chen et al, 2021 [1]). Section II focuses on literature studying marketing behavior in new fields from the perspective of probabilistic selling.

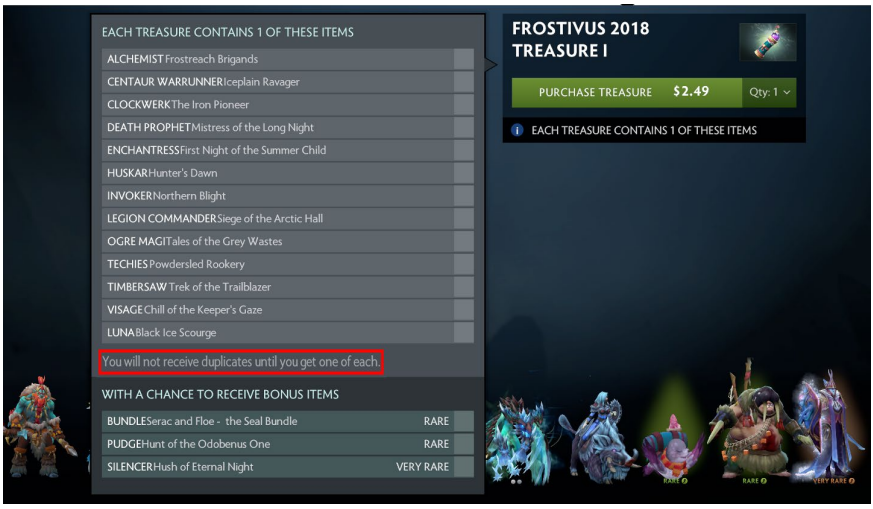

Fig. 1. Loot boxes provided by some online games

Probabilistic selling strategy is keeping being improved to meet market or policy needs. For example, as shown in Figure 2, some hotels on the Lastminute website allows consumers to make free cancel by paying higher when booking opaque hotels. And the combination of probabilistic selling and customization has become a trend in

practice. Section III focuses on the literature that studies the innovation of probabilistic selling strategy.

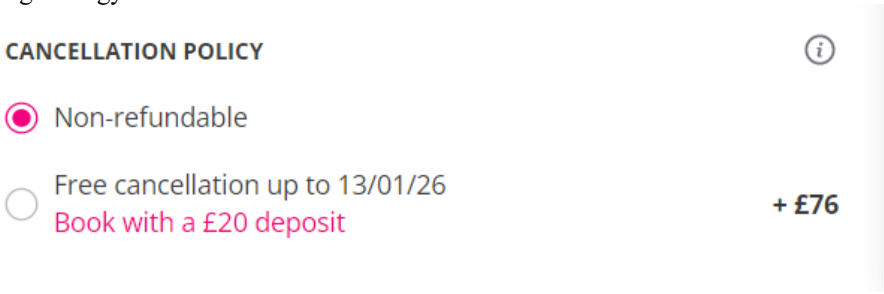

Fig. 2. Return policy in some hotels on Lastminute.

Research related to probabilistic selling typically assumes that consumers are rational. But some papers also take the irrationality of consumers into account, such as assuming that consumers are risk averse, and conduct research on probabilistic selling strategies based on these conditions. Section IV focuses on the literature that proposes new insights into consumer behavior thus explaining the underlying mechanism of probabilistic selling strategy's effectiveness.

These articles are listed in Table 1.

Table 1. Summary of literature research methods and model settings.

	Vertical differentiation	Periods	Products	Bounded budget	Rational consumers	Return policy	Remarks
Application in new fields							
Chen and Fang (2023)	Yes	n	pp	Yes	Yes	No	Gacha games
Fu et al. (2025)	Yes	n	pp	Yes	Yes	No	Repeated purchase
Chen et al. (2021)	Yes	n	pp [cp]	No [yes]	Yes	No [salvage]	Loot boxes
Miao and Jain (2024)	No	n	pp [cp & pp]	No [yes]	Yes [no]	No	Loot boxes
Gao and Wu (2023)	Yes	1	pp	No	Yes	No	Counterfeits
Sales mode							
Wang et al. (2017)	No	1	cp & pp	No	Yes	Yes	Fit uncertainty
Mao et al. (2020)	No	1	cp & pp	No	Yes	Yes	Fit uncertainty
Yin and Huang (2025)	No	1	cp & pp	No	Yes	No	Customization
Insights into consumer behavior							
Guo et al. (2023)	Yes	1	cp & pp	No	No	No	Anticipated regrets
Zheng et al. (2019)	Yes	1	cp & pp	No	No [yes]	No	Salient thinkers
Chen et al. (2023)	Yes	1	cp & pp	No	No [yes]	No	Salient thinkers

pp/cp refers to probabilistic/component product.

2 Application in New Fields

The strategy of probabilistic selling is mainly adopted by tourism and toy industries. But aside from these fields, this strategy have also been adopted in some other fields like game industry, and there are some studies on it. This section focuses on the application of probabilistic sales in some new fields.

2.1 Gacha game/Loot box

The iteration of mobile devices leads to the expansion of online games including gacha games. Chen and Fang (2023) [2] think gacha pulls is close to probabilistic products with vertical-differentiated results. They set up a two-stage Stackelberg model to characterize the interaction between consumer and seller, and used a Markov Decision Process to describe the consumer's behavior. They first discussed single-item gacha game and pointed out that it can maximize a seller's profit only by exploiting a whale property gacha game, which means a rational consumer would either continue playing the gacha until this consumer get the item or just not pull. Furthermore, by dividing a gacha game into several whale property subgame, they demonstrated the equivalence between gacha game and auction. They than chose two typical kinds of gacha game and detailed discussion on these gacha games was held by discussing different mechanisms.

Although Fu et al. (2025) [5] did not research gacha games, I still put this paper here for it is mainly about consumers' behavior of repeated purchase, thus close to the strategy of gacha game. They assume that consumers have bounded budget and are risk averse. The probabilistic products provided by retailer are composed of vertical-differentiated component products, and the retailer makes probabilistic product designing and inventory management decision jointly. The retailer should set the probability of getting a high-quality product lower than a threshold as the profit of probabilistic selling strategy decrease with the probability. And adopting a probabilistic selling strategy can increase retailer's profit.

A loot box is a random allocation of virtual products that differs from gacha game to some extent in practice. Chen et al. (2021) [1] mainly discussed two strategies of designing loot box: unique box and traditional box. The former refers to the strategy with no same item guarantee, while the latter without. And two other strategies were discussed: grand bundle and separate selling. This paper pointed out that a myopic purchasing strategy is asymptotically optimal for consumer purchasing unique box, and optimal for consumer purchasing traditional box. When the number of the items is finite, these four strategies were compared in detail. When the number of items tends towards infinity, unique box strategy is asymptotically optimal and superior to traditional box strategy. Furthermore, they held discussion on the designing of multi-item loot box with vertical-differentiated items and found that the strategy of unique box still takes dominance over the strategy of traditional box. Transparency of the probability can not be ignored too, deviation from the announced allocation probabilities would bring more revenue. Moreover, with salvage system, traditional box and unique box are superior to separate selling.

Miao and Jain (2024) [11] also discussed loot boxes. They divide the consumer group into three segments with different taste. The seller can choose between traditional selling and only loot box. It is the optimal strategy that a consumer with extreme taste would buy loot box repeatedly until they get the item while a consumer with moderate taste would only buy once. When the valuation of consumers with moderate taste is high, the seller would set equal probabilities and consumers with extreme and moderate taste both have some surplus, or the seller would adopt an asymmetric strategy and the surplus of consumers with moderate taste would be zero while the surplus of half of the extreme-taste consumers would increase. The strategy of loot box dominates traditional selling if the consumer' valuation for a less preferred product is low and both the moderate-taste consumers' valuation for products and the number of consumers with extreme taste are both high. Besides, loot box is actually beneficial to consumer surplus and social welfare. The profit yielded by adopting loot box increases while consumers' surplus decreases considering the addictiveness of loot box. And under the condition of budget constraint, loot box can still achieve a higher return.

These findings about gacha games or loot box have important implications for industry practitioners, such as they should make more use of whale property gacha games to maximize profits.

2.2 Counterfeits

Counterfeits are common in many situations. Gao and Wu (2023) [6] proposed that these goods with a certain probability of receiving counterfeits can be regarded as probabilistic goods from customers' perspective. There exist a manufacturer and a unit mass of monopolistic retailers. There're expert consumers who can tell a counterfeit and novice consumers who can't. This paper uses mixed-strategy equilibrium to describe retailers' behavior, where every retailer sets a price and allocation probability as well as decides whether to sell authentic products or counterfeits. The behavior of retailers is determined by wholesale price. If the wholesale price is high, retailers would only serve the expert consumers and not produce counterfeits. If the wholesale price is low, retailers would serve both types of consumers and not produce counterfeits. Only when wholesale prices are moderate, retailers would sell counterfeits and serve both types of consumers. Furthermore, when the level of penalty is low, manufacturer would set the wholesale price high enough to serve only the expert consumers, while retailers would serve two types of consumers and sell counterfeits when the level of penalty is moderate or high. And when the penalty is moderate, a stricter regulation would lead to a lower probability of authentic product if the proportion of expert consumer is large enough. And the reason is that the manufacturer has motivation to raise wholesale price when counterfeits are regulated strictly, which makes retailers raise the probability of counterfeits.

This paper showed that sometimes a stricter regulation may actually lead to more counterfeits, which can serve as an inspiration for regulators.

3 Sales Mode

People are also keeping improving the strategy of probabilistic selling to meet various market demands. Many literature have discussed these improvements in depth, and this section summarizes some of these literature.

3.1 Return policy

Wang et al. (2017) [12] discussed the combination of return policy and probabilistic selling in a stylized Hotelling model. A consumer who is unsatisfied with the product needs to pay a restocking fee to return the product. They found out that it can increase the retailer's benefit by adopting return policy only when the restocking fee is sufficiently high.

Mao et al. (2020) [10] considered the scenario where retailers adopting probabilistic selling strategy only provide component products with unconditional return policy, and studied the scenarios of incomplete market coverage and complete market coverage separately. And in a full coverage market, the retailer would adopt the strategy of probabilistic selling only when the consumer satisfaction is high enough comparing to traditional selling. And in a incomplete coverage market, the retailer would adopt the strategy of probabilistic selling only when the probabilities of two component products are close.

3.2 Customization

Mass customization and probabilistic selling seem to have completely opposite mechanisms, but Yin and Huang (2025) [13] pointed out that the combination of these two strategies has become an trend in practice. Customization reduces the customers' preference-mismatch-cost coefficient, and the extent is up to the degree of customization. When the cost of products is sufficiently high while the level of customization is low, probabilistic selling and customization are complements，or they are substitutes. Customization can achieve the expansion of sales effectively, thus decreasing the expansion brought by probabilistic selling. And probabilistic selling can raise the price only when the customization level is sufficiently low. When the level of customization is sufficiently high, customization lead to the full coverage on the market, thus reducing the effect of probabilistic selling on prices. Furthermore, when the level of customization is determined endogenously, the retailer have sufficient motivation to raise the level of customization if the customization cost coefficient is low enough，making these two strategies substitutes.

From this paper, it can be learned that a retailer adopting probabilistic selling strategy can also employ customization of low level to increase profit.

4 Insights Into Consumer Behavior

One of the streams of literature about probabilistic selling is to propose insights into consumers' behavior. Huang and Yu (2014) [9] use consumers' limited rationality to explain the effectiveness of probabilistic selling. And many people also studied probabilistic selling strategy based on consumer behavior after this paper. This section collects and organizes these articles.

4.1 Anticipated regret

Guo et al. (2023) [8] pointed out that consumers would experience regret or euphoria for the decision. Consumers would experience euphoria when getting high-quality products, or they will experience regret. They divided the customers into high-valuation consumers with more attention to the regret and low-valuation consumers focusing on the euphoria when getting a high-quality product. When consumers are insensitive to anticipated regret, the retailer would set the probability of getting a high-quality product to be zero. When the low-valuation consumers' anticipated regret increases, the retailer tend to increase the probability to encourage low-valuation consumers to buy probabilistic goods. When the anticipated regret of high-valuation consumers increases, they tend to purchase the high-quality products, and the retailer can increase the price of high-quality products. The existence of anticipated regret of consumers can make probabilistic selling more profitable than traditional selling when taking anticipated regret into consideration.

4.2 Salient thinkers

Zheng et al. (2019) [14] considered the presence of salient thinkers in the market. They first considered the scenario where consumers are rational, and the probabilistic selling strategy would never be optimal since it has no cost-quality advantage over component products, and the retailer decide whether to sell one product or both based on the cost-quality ratios of two products. Then they discussed the scenario where consumers are salient thinkers. When there is no probabilistic goods in the market, two kinds of component products have the same salient attribute, the retailer's strategy is similar to that of a rational consumer, but needs to provide low-quality products as a decoy product when selling high-quality products. But the presence of salient thinking makes the price attribute salient, thus may weaken the effect of price discrimination. If there're probabilistic goods, the salient attributes of products can be distinct. They found that the probabilistic selling would never be the best strategy if the high-quality product has a cost-quality advantage over low-quality product, for the effect of price discrimination not longer plays a role. But if the low-quality product has a cost-quality advantage over high-quality product, the retailer can always gain more profit by applying probabilistic selling strategy because there exists space for price discrimination. And even when the cost-quality ratio of low-quality products is low, the retailer can still use gain more profits by setting low-quality products as the decoy products.

Chen et al. (2023) [3] discussed probabilistic selling in a distribution channel with a retailer and a manufacture, and considered the existence of salient thinkers in the market as one of the necessary conditions for the existence of probabilistic products. The price of component products is set by manufacture while the retailer gets a proportion of price as fee per transaction. And the retailer can also choose to sell probabilistic products and set a retail price for these products. They found that the strategy of probabilistic selling is never optimal when consumers are rational. It turns out that only when there exist salient thinkers and huge quality difference between two component products would the retailer adopt probabilistic selling, because a huge quality difference attracts the attention of salient thinkers. The introduction of probabilistic products would result in a stronger effect of price discrimination and the sales lost of component products. And probabilistic selling is also profitable for manufacturer. Moreover, this paper also considered improving channel performance through centralized channels and revenue sharing contracts.

These articles showed that practitioners should pay more attention to consumers' psychological activities, for these psychological activities can have an impact on consumer behavior.

5 Conclusion and Future Research

This paper summarizes recent literature in the field of probabilistic selling from three perspectives: application in new fields, innovation in sales mode, and new insights into consumer behavior, comprehensively discusses the focus of probabilistic sales research in recent years and provides insights into the practical implications of research conclusions.

5.1 Mechanism in gacha game/Loot box

In previous studies on gacha games, consumers would only stop purchasing gacha pulls when they drew the desired items or encountered budget constraints. However, in practice, some game operators may provide players with a mechanism to ensure that they can obtain the desired items within a limited number of gacha pulls in practice, which is called “baodi” in Chinese (means minimum guarantee) and “tenjo” in Japanese (means “roof top”). Therefore, the future research on gacha games can focus on the “baodi” mechanism and discuss why this mechanism exists in some games. In addition, gacha pulls do not necessarily require players to make purchases, and players can also obtain a certain number of gacha pulls by completing in-game tasks (such as daily login). And future research on gacha games can disucss how this characteristic will affect the revenue of game operators and consumer surplus.

5.2 Driving factors of returns

In the literature of probabilistic selling, consumers’ return behavior is mainly driven by two factors, namely strategic return and unfit return, the former refers to a consumer

purchasing a low-priced probabilistic product and returning it when it turns out to be the unwanted product, while the latter refers to consumer simply feeling that the product do not meet expectations after getting it. Currently, most literature combining probability selling strategy and return policy adopts the latter mechanism, with less literature using the former one. And the literature on return policies is relatively crude, rather than comprehensively studying the impact of return policy on probabilistic selling in a general context. Therefore, future research combining probability sales and return policies can focus more on the impact of consumers' strategic return behavior on merchants, as well as how retailers should use this behavior to create greater profits for themselves.

What's more, as stated in the previous literature conclusion, consumer psychological factors and behaviors influenced by them can have a significant impact on probabilistic selling. Thus in the future research on probabilistic selling, more attention should be paid to consumers' psychological factors, and these consumer behaviors should be fully discussed in different field contexts and combined with different mechanisms.

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