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# Princing on Dual Channel Supply Chain by Considering Flash Sale Program on Online Channel (Case Study: A3 Printing)

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***Abstrak*—Dual channel supply chain is a combination of offline channel and online channel are running simultaneously as a new structure. Through online channels, consumers can find the best product prices. This is used by companies to implementing promotional prices to attract the attention of online consumers, one of them is by the flash sale program. Promotion aims to stimulate demand for a company's product but along with the increase in demand is not always accompanied by an increase in profit. So it is necessary to consider the selling price of the product during the promotion and how long the promotion will be applied. This research is focused on determining the selling price of products and duration of the promotion as well as the impact using the help of Malpe software and Microsoft Excel. This study concluded that the lower price and the longer duration applied during the flash sale leads on the higher demand but will result in a decrease in profits. So that promotional strategies using the flash sale program can be applied if the company's main goal is only to increase the number of sales.**

***Kata Kunci*—Dual Channel Supply Chain (DCSC), Princing, Flash Sale.**

## I. INTRODUCTION

THE development of information technology, especially in the business sector, has led to transaction methods that are now known as e-commerce. The presence of e-commerce makes the public as consumers have two choices in making transactions, the first is to buy products at an outlet (offline channel) and the second is to transact via the internet (online channel). Based on a survey conducted by SIRCLO in 2019, on average one Indonesian consumer can shop online 3-5 times a month, and spend up to 15% of their monthly income. This is an opportunity that must be fought by the seller. According to Adeinat & Ventura (2018), a significant factor affecting consumers in making choices is the price factor [1]. These conditions can be exploited by companies through promotions such as giving discounts. Sales promotion is a short-term stimulus that is planned to attract the attention of consumers [3]. One popular type of promotion implemented by e-commerce is the flash sale program. Some e-commerce sites that have used this promotion are Shoppe, Tokopedia, and Bukalapak. Flash sale is a product offering at a reduced price and quantity in a short time. According to Agrawal and Abhinav Sareen (2016), a short sale or flash sale, is part of a sales promotion that gives its customers special offers or discounts for certain products for a limited time. in the case of this research study is A3 Printing company, where the company does not have a strategic location, but wants to reach consumers through online channels. to get the attention of consumers is to do a promotion, one of the many promotions implemented by e-commerce is a flash sale program important factor in the flash sale program is the product's selling price during the flash sale program and how long the flash sale duration can be applied [2].

## II. RESEARCH MODEL

The model development chapter will discuss the stages of developing the DCSC model by considering the flash sale program on the online channel. Model development is done by adding the flash sale factor to the online channel.

### *A. Description of the Implemented Promotion System*

The object of observation used in this study is A3 Printing is one of the promos merchandise craftsmen in Surabaya that uses the Dual Channel Supply system. A3 Printing product sales consist of sales through offline channels and online channels. Offline channel is a retailer who receives orders from consumers and then sub-directs it to A3 Printing. In the offline channel, orders for promotional items from consumers are produced by A3 Printing, after the product is distributed to the offline channel, then the offline channel continues to the consumer. Whereas on the online channel, consumers order directly to A3 Printing, after consumer orders are produced by A3 Printing, the product is directly distributed to consumers. To guarantee product availability, A3 Printing has a warehouse to store raw materials that are ready for production into promotional items that are ready for use by consumers. The products to be observed are pin, mug and pen products which do not have many variables in determining the price of each product and can see Figure 1.

In this research problem, A3 Printing adds a flash sale program specifically for sales through online channels with the aim of increasing the number of sales, with the hope of increasing company profits. In addition, A3 Printing still wants to maintain the existence of both channels (offline and online channels) during the implementation of the flash sale program by setting the right price and duration of the flash sale so that sales through offline and online channels continue to run. Things to consider are the price of online channels when the flash sale program, the duration of the flash sale duration, and the effect of online channel prices during the flash sale program on changes in demand on both channels.


Figure 1. (a) pin, (b) mug, (c) pen.

Table 1.
Parameter data

| Product | Parameter | | | | | | |
|---|---|---|---|---|---|---|---|
| | $P_s$ | $P_o$ | $d_s^{max}$ | $P_w$ | $C_u$ | $\beta_1$ | $\rho$ |
| **Pin** | 2000 | 1500 | 310 | 1100 | 600 | 0,060035 | 0,645 |
| **Mug** | 15000 | 11000 | 248 | 9500 | 7550 | 0,006288 | 0,645 |
| **Pen** | 3000 | 2500 | 404 | 2000 | 1550 | 0,048308 | 0,645 |

Table 2.
Parameter Data After Being Optimized

| Product | Parameter | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | $P_s$ | $P_o$ | $d_s^{max}$ | $P_w$ | $C_u$ | $\beta_1$ | $\rho$ | $P_d$ | $\beta_2$ |
| **Pin** | 2000 | 1500 | 310 | 1100 | 600 | 0,060035 | 0,645 | 1235,25 | 0,07032 |
| **Mug** | 15000 | 11000 | 248 | 9500 | 7550 | 0,006288 | 0,645 | 10386,25 | 0,006417 |
| **Pen** | 3000 | 2500 | 404 | 2000 | 1550 | 0,048308 | 0,645 | 2065 | 0,062951 |

In addition, to facilitate research, researchers apply the following research limits and research assumptions.

### *B. Research Limits*

The following are the limitations of the research used in this study:

1. Observations are only made on three products that have the highest demand based on A3 Printing data, namely pins, mugs, and pens.
2. Offline channel sales are used only through A3 Printing partners. retailers. Retailer is another party who orders promotional products to A3 Printing and resells them to end customers.
3. Observation data based on sales during March 2019 - March 2020

### *C. Research Assumptions*

Following are the assumptions used in this study:

1. Only online channels can implement flash sale programs.
2. Customers know that products will be sold offline and online.
3. Customers know when a promo occurs, so Cinderung customers will do the digging when the promotion occurs.
4. Raw materials for promotional products are always available at the central warehouse, so that demand is always met.
5. There are no defective products received by consumers.
6. The number of requests per day is the same and the number of days in 1 month for a numerical trial is assumed to be 30 days.
7. The ratio of customer acceptance to online products for pins, mugs, and pens is the same.

### *D. Models*

This research will be modified to the model developed by Widodo, et. Al (2011) by considering the existence of the flash sale program and the duration of the flash sale that was applied for 1 period [4]. (1 sales period in 1 month (30 days) or 1 year (365 days) so that we get a model to maximize the profit of each channel or the profit of the entire channel. The following is the development of the model produced by this research:

$$D_s(t) = d_s^{max} - \beta_1 \left(\frac{P_s - P_o}{1-\rho}\right)(1-t) - \beta_2 \left(\frac{P_s - P_d}{1-\rho}\right) t \qquad (1)$$

$D_s(t)$ is a demand function on the offline channel by considering the flash sale program on the online channel. $t$ is the duration of the flash sale program, while $(1-t)$ shows the duration without the flash sale program. $\beta_1$ is the ratio of the elasticity of offline channel demand to the price of online channel products without a flash sale program and $\beta_2$is the ratio of the elasticity of offline channel demand to the price of an online channel product with a flash sale program.
$P_s$, $P_o$, $P_d$ is the product selling price on the offline channel, the selling price of the normal product on the online channel, and the selling price of the product when the flash sale

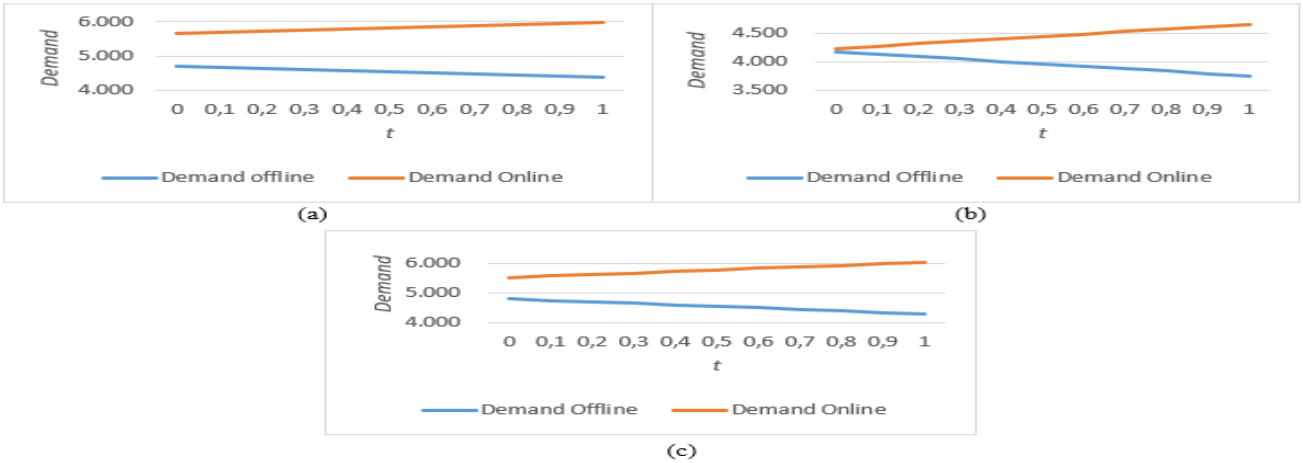


Figure 2. Numerical Effect of *t* on The Amount of Demand; (A) for Product Pin, (B) for Product Mug, (C) For Product Pen.

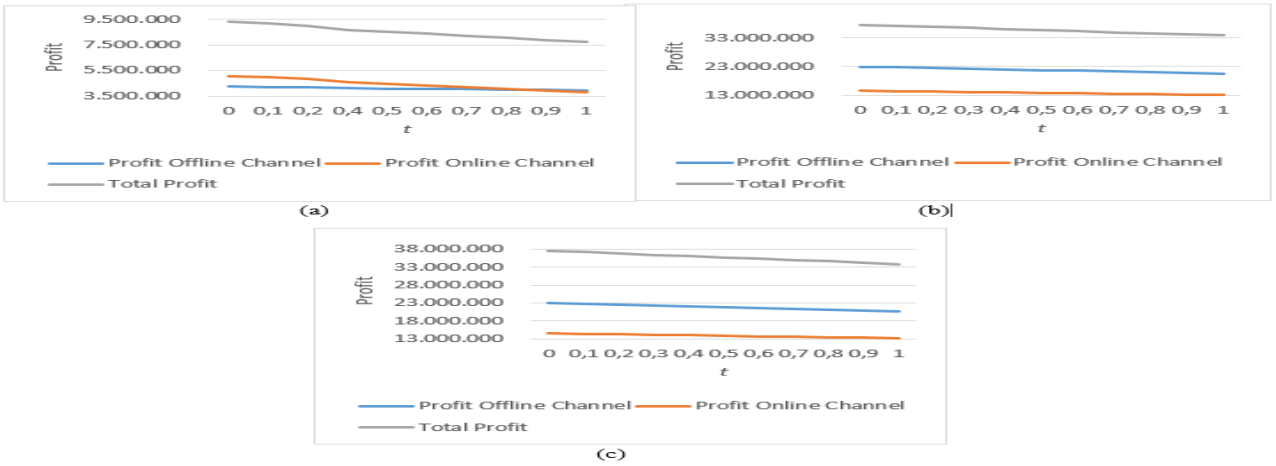


Figure 3. The Effect of *t* on The Profit of Each channel; (a) for Product Pin, (b) for Product Mug, (c) for Product Pen.

program is on the online channel.

The next step is to determine the demand function on the online demand channel by considering the flash sale program. The online demand model is obtained from the reduction of the offline channel demand function before the online channel ($D_s^{lt}$) and the offline channel by considering the online channel ($D_s^{ut}$). Next Equation (2) is an online demand model with a flash sale program $D_o(t)$:

$$\rho D_o(t) = D_s^{lt} - D_s^{ut}$$

$$\rho D_o(t) = (d_s^{max} - \beta_1 P_s(1-t) - \beta_2 P_s t) - \left(d_s^{max} - \beta_1 \left(\frac{P_s - P_o}{1-\rho}\right)(1-t) - \beta_2 \left(\frac{P_s - P_d}{1-\rho}\right) t\right)$$

$$\rho D_o(t) = (-\beta_1 P_s(1-t) - \beta_2 P_s t) - \left(-\beta_1 \left(\frac{P_s - P_o}{1-\rho}\right)(1-t) - \beta_2 \left(\frac{P_s - P_d}{1-\rho}\right) t\right)$$

$$\rho D_o(t) = (-\beta_1 P_s(1-t) - \beta_2 P_s t) + \left(\beta_1 \left(\frac{P_s - P_o}{1-\rho}\right)(1-t) + \beta_2 \left(\frac{P_s - P_d}{1-\rho}\right) t\right)$$

$$D_o(t) = \left(\frac{\beta_1}{\rho}(1-t)\left(\left(\frac{P_s - P_o}{1-\rho}\right) - P_s\right) + \frac{\beta_2}{\rho} t\left(\left(\frac{P_s - P_d}{1-\rho}\right) - P_s\right)\right) \quad (2)$$

The profitability function is divided into 3, namely profitability on the offline channel, online channel, and the entire dual channel supply chain system. The following are the destination functions for offline channels ($G_s(t)$):

$$G_s(t) = D_s(t)(P_s - P_w)$$

$$G_s(t) = \left(d_s^{max} - \beta_1 \left(\frac{P_s - P_o}{1-\rho}\right)(1-t) - \beta_2 \left(\frac{P_s - P_d}{1-\rho}\right) t\right)(P_s - P_w) \quad (3)$$

$d_s^{max}$ is the maximum demand that has ever been obtained by retail. $\rho$ The ratio of consumer acceptance to products through online stores compared to products through conventional stores. $P_w$ is wholesale product prices. the profitability function on the offline channel consists of multiplying the number of demands on the offline channel with the sales profit of each product. The following is the profitability function on the online channel ($G_o(t)$):

$$G_o(t) = {}^{\beta_1}/_{\rho}\left(\left(\frac{P_s - P_o}{1-\rho}\right)(1-t) - P_s\right)(P_o - C_u) + {}^{\beta_2}/_{\rho}\left(\frac{P_s - P_d}{1-\rho}\right) t(P_d - C_u) \quad (4)$$

$${}^{\beta_1}/_{\rho}\left(\left(\frac{P_s - P_o}{1-\rho}\right)(1-t) - P_s\right)(P_o - C_u)$$

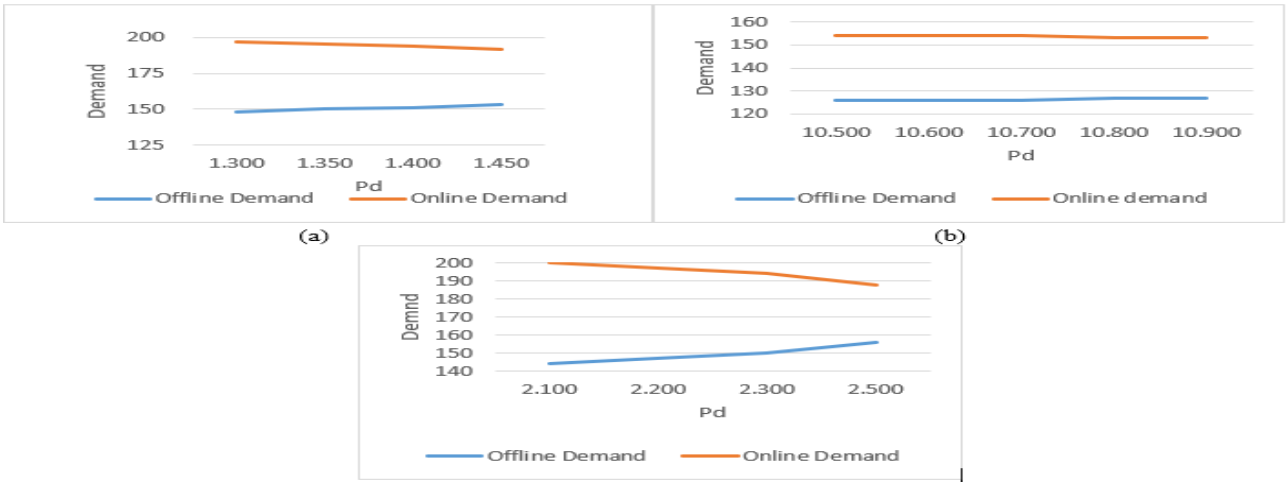


Figure 4. Changes in online channel demand when the flash program is selling with special price variations; (a) for product pin, (b) for product mug, (c) for product pen.

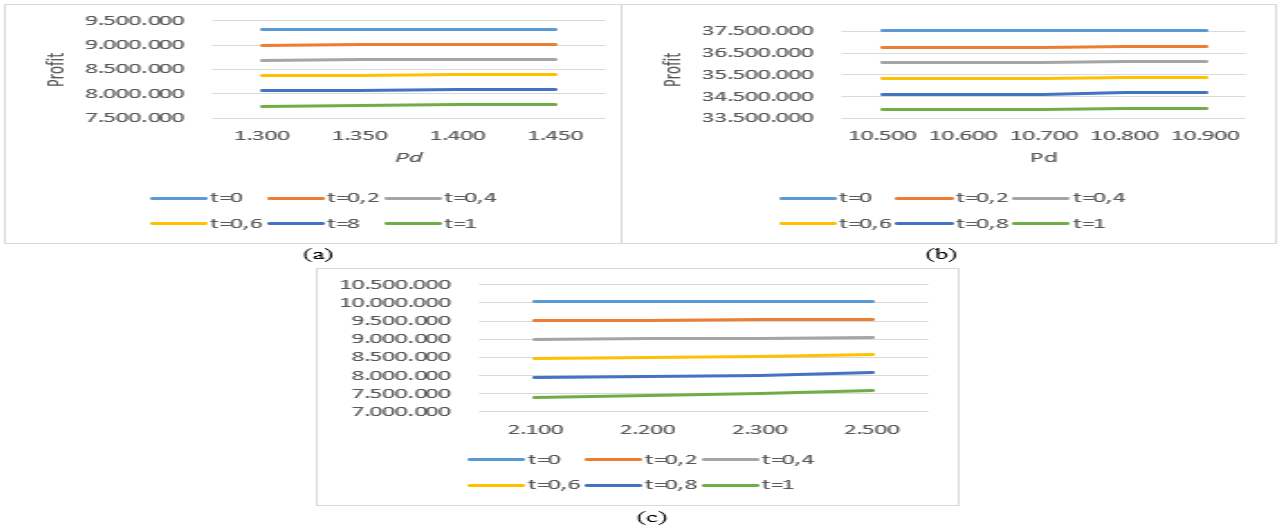


Figure 5. the effect of prices on profits; (a) product pin, (b) product mug, (c) product pen.

shows the profit function on the online channel without flash sale, so the profit function consists of multiplying the number of demands on the online channel multiplied by the sales profit of each product with the selling price of the product on the online channel is normal. while $\beta_2/\rho\left(\frac{P_s-P_d}{1-\rho}\right)t(P_d-C_u)$ shows the profit function on the online channel with flash sale, so the profit function consists of multiplying the number of demands on the online channel multiplied by the profit of selling each product at a special price on the online channel. $C_u$ is cost of product production. So that the total probability function in the dual channel supply chain can be formulated as follows:

$$G(t) = G_s(t) + G_o(t)$$

$$G(t) = \left(\left(d_s^{max} - \beta_1\left(\frac{P_s-P_o}{1-\rho}\right)(1-t) - \beta_2\left(\frac{P_s-P_d}{1-\rho}\right)t\right)(P_s - P_w)\right) + \left(\beta_1/\rho\left(\left(\frac{P_s-P_o}{1-\rho}\right)(1-t) - P_s\right)(P_o - C_u) + \beta_2/\rho\left(\frac{P_s-P_d}{1-\rho}\right)t(P_d-C_u)\right) \quad (5)$$

In the objective function compiled in equation (5) given some limiting functions in the system so that the model can resemble real conditions. Following are the limiting functions given on the model:

1. $P_s \geq P_o > P_d > P_w > C_u > 0$ shows the selling price of products on the offline channel is greater than the selling price of online channel products without a flash sale program, the selling price of products on the online channel without the flash sale program is greater than the online channel price when the flash sale program, the selling price of the product on the online channel when the program flash sale is greater than the wholesale price, and the wholesale price is greater than the cost of production. the cost of goods manufactured must be greater than zero.
2. $D_s(t), D_o(t) \geq 0$ indicates that demand must be above zero.

## III. NUMERICAL SIMULATION

The next step is to do numerical experiments are performed

Tabel 3.
Maximum Total Demand for Each Product

| Product | *Dtot* /month | *Dtot* /day |
|---|---|---|
| **Pin** | 10349 | 345 |
| **Mug** | 8349 | 280 |
| **Pen** | 10315 | 344 |

Tabel 4.
Demand Data Per Day

| Product | *Demand Without Flash Sale* | | *Demand With Flash Sale* | |
|---|---|---|---|---|
| | *offline* | *online* | *Offline* | *Online* |
| **Pin** | 157 | 188 | 146 | 199 |
| **Mug** | 139 | 141 | 125 | 155 |
| **Pen** | 160 | 184 | 143 | 201 |

using parameter data obtained from the observed object. In Table 1, it can be seen the parameter data needed as research input. Then optimization is done with the help of maple software by deriving the objective function on the total profit of the dual channel supply chain to the parameters $P_d$, $\beta_2$, dan *t.* Parameter data after being optimized can see Table 2.
After all parameter data are known, numerical experiments will then be performed to determine the demand for each channel. Total demand consists of total demand on the offline channel and demand on the online channel. so it can be written as follows:

$$D_{tot} = D_s + D_o \quad (6)$$

The following is the formulation of the demand function on the online channel:

$$\beta = \frac{Q_2 - Q_1}{P_1 - Ps} = \frac{D_o - D_s}{P_s - P_o} = \frac{D_o - (D_{tot} - D_o)}{P_s - P_o}$$

$$D_o = \frac{\beta(P_s - P_o) + D_{tot}}{2} \quad (7)$$

When the flash sale program is in progress, $D_o$ will be replaced with $D_d$ (online demand channel when the flash sale program is taking place) and $D_s$ are replaced by $D_{sd}$ (demand offline channel when the flash sale program is taking place). To facilitate calculations, the authors use the maximum total data demand from sales data of A3 Printing companies. Based on sales data of A3 Printing Company, total demand data for each product is obtained Table 3.

Then input the parameter values that are already known in the previous section of the discussion. The *Dtot* value used is data per day, considering that in one month there is a flash sale program, so the$D_o$ value is divided into two, namely online demand without flash sale program and online demand with flash sale program. The following is the portion of offline and online demand per day when without a flash sale program and with a flash sale program based on the results of numerical calculations using the help of maple software.Demand data day can see Table 4.

## IV. ANALISIS SENSITIVITAS

In this section, sensitivity analysis will be carried out by changing parameters which are predicted to have a major effect on the number of sales on the offline channel when the flash sale program and the total profit of the dual channel supply chain are implemented.

Figure 2 show show that the longer duration of the flash sale program is carried out on the online channel, it will have an impact on the increase in the number of demands on the online channel, while the flash sale program on the online channel has an impact on the decrease in the number of demands on the offline channel. This is indicated by the three products (pins, mugs, and pens). Next will be analyzed the effect of t on the profit of each channel as well as the total profit of the dual channel supply chain.

Figure 3 shows that from the perspective of profit on the offline channel, online channel, and total profit has decreased, despite an increase in demand on the online channel. This is due to the increase in demand on the online channel that occurs due to online channel demand during the flash sale program, where the selling price of products on the online channel when the flash program is lower than the normal selling price of the product on the online chaanel $(P_o > P_d)$.

Figure 4 shows that the amount of demand in each channel is influenced by determining the value of $P_d$. The higher the value on of $P_d$ will have an impact on the number of demands on the online channel when the flash sale program decreases, while the demand on the offline channel increases.

Figure 5 shows that the higher price (the less price discount) that is applied when the flash sale program has an impact on the higher profit obtained. inversely proportional to demand, the higher the price (the less discounted price) applied during the flash sale program, the less demand on the online channel.

## V. CONCLUSION

Based on the model that has been developed as well as numerical calculations and analyzes conducted by the author, then the following conclusions can be taken:(1)The existence of a flash sale program on the online channel has an impact on the amount of demand for each channel and the profit of each channel. There are 2 factors tested, namely determining the duration of the flash sale program and determining the promotional price when the flash sale program is on the online channel; (2)The longer duration of the flash sale program has an impact on the higher demand on the online channel and the lower the demand on the offline channel, but this condition does not reflect the profit made by each channel. Based on numerical analysis, it is found that the profit gained in each channel and total profit have decreased with the longer duration of the flash sale program; (3)The lower the selling price of the online channel product prices when the flash sale program is implemented, the greater the impact on the demand obtained on the online channel and the decrease in demand on the offline channel. Meanwhile, from a profit perspective, the lower selling prices of products on the online channel when the flash sale program is taking place has an impact on;(4)Based on observations, it can be concluded that the flash sale program on the online channel is the right strategy to boost the amount of demand on the online channel, but this strategy is not appropriate if it is used

to increase profits obtained by assuming the flash sale program has no impact on sales after the flash program sale.

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