Application of PWYW Pricing in Film Industry

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Outline

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Traditional Film Pricing

Traditional film pricing:

- fixed price (high)
- unable to attract more audience

Is there any better pricing model to improving profit as well as attracting more audience?

We introduced the **Pay What You Want** strategy.

Outline

The PWYW (Pay What You Want) Strategy

Theorem

Pay what you want (or PWYW, also referred to as "Value-for-Value model") is a pricing strategy where buyers pay their desired amount for a given commodity, sometimes including zero.

In some cases, a minimum (floor) price may be set, and/or a suggested price may be indicated as guidance for the buyer.

A Successful Example: Selling Album

In 2007, the rock band Radiohead sell their new album In Rainbows using PWYW:

- Consumers can buy the album with any price they want, from 1 pound to 100 pounds or even more.
- Result: both sales volume and the sales multiplied several times.
- And the social effect of Radiohead also rose.

But That Sounds Counter-Intuitive...

- The sales also increase, as well as sales volume
- Most people won't buy with 100 if they can buy with 1

The Explanation

- PWYW subdivide customers and apply price discrimination on precisely every consumer.
- The infinite continuous pricing holds almost all target customers, greatly expands its customer groups.
- The minors who pay high covers the deficit of the majors who pay low.
- Since the margin cost is low enough, there will not be large deficit even if most customers pay the lowest price.
- Setting an appropriate minimum price, with large consumer base, those majors paying low prices still contribute considerable profit.
- The expansion of customer groups also raises the influence of the product.

PWYW Fit Conditions

- low marginal cost (with high marginal income)
- fans economy
- different value estimation

Film Fits all above!

Outline

Film Features

Applying PWYW on film industry, we have to consider some features of films:

- Former audience's evaluation influence later audience numbers.
- The cost is related to screening room but not audience number.
- The audience number of the early screenings are influenced by the hype and are usually higher.

Our Model

Cost function: step function

$$c(x) = [\frac{x}{c_0}] * N_0$$

here x is the number of audiences, c_0 is an integer representing the number of audiences one screening room can hold, N_0 is the cost of running a standard screening room.

Our Model

Every audience i will have a valuation v_i, which is obedient to some kind of random distribution. In practice, it should be some heavy-tailed distribution. v_i will also be affected by the following factors:

- Whether the audience have already seen the movie. If someone have already seen the movie, then it is less likely for that person to see it again, which result in a decrease in their valuation.
- The number of audiences of the previous showing. This factor quantifies the effect of popularity. If a lot of audiences went to the first showing, then these audiences will be part of the promotion of the movieand will have an impact on the second group of audiences' valuations.
- The showing is the first showing or the second showing. The audiences' valuations will be higher in the first showing due to the 'hype'.

Our Model

Fundamental assumption:

- 2 showings (representing 2 stages)
- second showing audience and valuation affected by the first
- theatres have two strategies: fixed price, or PWYW

Our Model

If the theatre use PWYW:

- For any customer, if the movie's price is below their valuation, i.e. p_f or $p_b < v_i$, there will be a certain probability for the customer to go to the movie. This probability can be affected by the number of audiences from the previous showing.
- If a customer goes to a movie, and the movie's pricing is PWYW, there will be a certain probability for the customer to decide to pay their actual valuation v_i.
- Our goal is to maximize the movie theater's utility, generally:

$$u = \sum_i p_i - c$$

.

- Where p_i represents the payment of each audience, and c represents the cost.

Theoretically Analysis

Fixed Price:

- price: p_1 for the first showing, p_2 for the second showing
- $N0$: number of people in the first stage
- p_{g1}: probability of going to the movie if the price is lower than one's valuation
- $f(x)$ is the PDF of valuations, and CDF is $F(x) = \int_{-\infty}^{\infty} f(x)\mathrm{d}x$.
- expected people for the first showing:

$$N_1 = (1 - F(p_1))p_{g1}N_0$$

- expected people for the second showing:

$$N_2 = N_2' + N_1 = g(n_1) + N_1 = N_2 = (1 - F(p_2))p_{g2}N_2$$

Theoretically Analysis

Fixed Price (Cont.):

- cost function (to simplify we use linear): $c = \frac{(n_1+n_2)}{c_0}$
- expected total utility:

$$
\begin{aligned}
u &= n_1 p_1 + n_2 p_2 - c \\
&= p_{g1}(1 - F(p_1))N_0 p_1 + [g(n_1) + N_1]p_{g2}[1 - F(p_2)]p_2 \\
&- \frac{(n_1 + n_2)}{c_0}
\end{aligned}
$$

Where $n_1 = (1 - F(p_1))p_{g1}N_0$.

Theoretically Analysis

Fixed Price (Cont.):

- To analyze, we set the distribution of valuations to be a uniform distribution from 0 to 1.
- Set $g(x) = kx$, so each audience in the first showing will bring k additional potential customer to the second showing.
- expected total utility:

$$u = p_{g1}(1-p_1)N_0p_1 + (k(1-p_1)p_{g1}N_0 + N_1)p_{g2}(1-p_2)p_2 - \frac{(1-p_1)p_{g1}N_0 + (1-p_2)p_{g2}N_2}{c_0}$$

Theoretically Analysis

Fixed Price (Cont.):

- Take the derivative to maximize the theater's utility, we get:

$$p_1 = \frac{1}{2} + \frac{(1 - c_0 p_2)(1 - p_2) p_{g2} k + 1}{2c_0}$$

$$p_2 = \frac{1}{2} + \frac{1}{2c_0}$$

Back substitute p_2 into the expression of p_1, we can get the full expression of p_1.

Theoretically Analysis

PWYW:

- Two direction:
- 1. Find a better pricing to maximize utility of the theater.
- 2. On condition that the utility not falling, maximize the number of audience a.k.a the social effect.
- Either way, the main induction is the same.

Theoretically Analysis

PWYW (Cont.):

- The expected number of audience is still the same as before.

$$\begin{cases} n_1 = (1 - F(p_1))p_{g1}N_0 \\ n_2 = (1 - F(p_2))p_{g2}[g(n_1) + N_1] \end{cases}$$

- Defined p_{pay} as the probability of a audience deciding to pay his actual valuation instead of the baseline price.
- The expected payment for a audience in the first showing:

$$\overline{p_1} = (1 - p_{pay})p_1 + p_{pay} \int_{p_1}^{\infty} f(x) \cdot x \mathrm{d}x$$

- For the second showing:

$$\overline{p_2} = (1 - p_{pay})p_2 + p_{pay} \int_{p_2}^{\infty} f(x) \cdot x \mathrm{d}x$$

Theoretically Analysis

PWYW (Cont.):

- The utility of the theater:

$$
\begin{aligned}
u &= n_1\overline{p_1} + n_2\overline{p_2} - c \\
&= (1 - F(p_1))p_{g1}N_0[(1 - p_{pay})p_1 + p_{pay}\int_{p_1}^{\infty} f(x)\cdot x\mathrm{d}x] \\
&+ (1 - F(p_2))p_{g2}[g(n_1) + N_1] \\
&\cdot [(1 - p_{pay})p_2 + p_{pay}\int_{p_2}^{\infty} f(x)\cdot x\mathrm{d}x] \\
&- \frac{(n_1 + n_2)}{c_0}
\end{aligned}
$$

Theoretically Analysis

PWYW (Cont.):

- Similarly as Fixed Price, we set the distribution of valuations to be a uniform distribution from 0 to 1, and set $g(x) = kx$, then

$$u = (1 - p_1) p_{g1} N_0 [p_1 - p_1 p_{pay} + \frac{p_{pay}}{2} - \frac{p_{pay}}{2} p_1^2]$$
$$+ (1 - p_2) p_{g2} [k(1 - p_1) p_{g1} N_0 + N_1]$$
$$\cdot [p_2 - p_2 p_{pay} + \frac{p_{pay}}{2} - \frac{p_{pay}}{2} p_2^2]$$
$$- \frac{(1 - p_1) p_{g1} N_0 + (1 - p_2) p_{g2} [k(1 - p_1) p_{g1} N_0 + N_1]}{c_0}$$

Theoretically Analysis

PWYW (Cont.):

- To get maximum utility, take partial derivative with respect to p_1 and p_2 and we get two quadratic equations:

$$\frac{3}{2}p_{pay}p_1^2+(p_{pay}-2)p_1+1-\frac{3}{2}p_pay+\frac{1}{c_0}-(\frac{1}{c_0}+\overline{p_2})(1-p_2)p_{g2}k=0$$

$$\frac{3}{2}p_{pay}p_2^2+(p_{pay}-2)p_2+1-\frac{3}{2}p_{pay}+\frac{1}{c_0}=0$$

Solving for p_2 and back substitute it into p_1 will give us desired result.

Outline

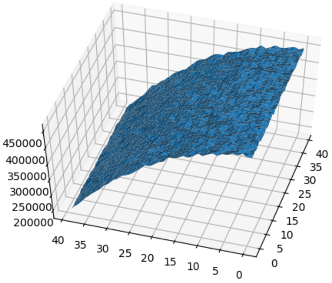
Simulation Work Flow

Input: pricing strategy
Output: utility of theater
Processing:

1. Simulate the lognormal distribution
2. Generate the initial valuation
3. Calculate the total utility of the theater in the first showing
4. Change the valuation of customer in the second showing
5. Simulate the second showing

Simulation Result

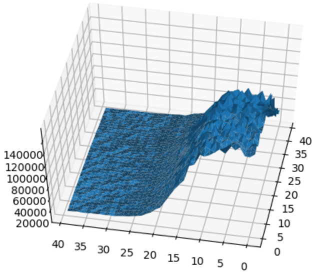
Simulation with PWYW and uniform distribution, :



- The result fits our induction.

Simulation Result

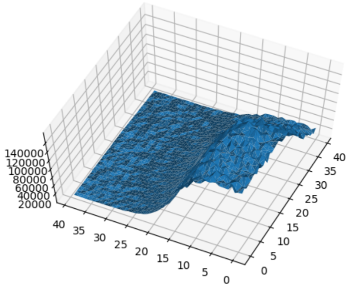
Simulation with PWYW and long tail distribution:



- p_1 is 19, p_2 is 10, get the max net profit 272754.
- The general trend is that the lower the baseline price, the higher net profit you will get.
- But if baseline prices are too low, net profit will go down.

Simulation Result

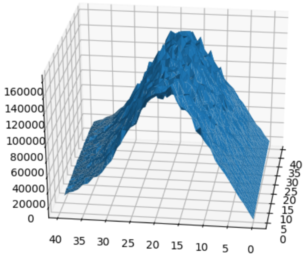
Simulation with PWYW and long tail distribution, setting cost function to linear:



- The result is very similar to that of stage cost function.

Simulation Result

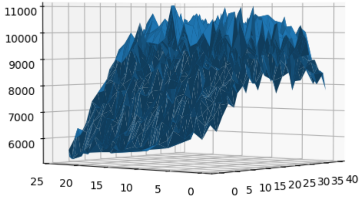
Simulation with Fixed Price and long tail distribution:



- When p_1 is 5 and p_2 is 19, we get the max net profit 175622 (175622¡ 272754).
- As baseline prices rise, the net revenue will rise and drop thereafter which is like a parabola.

Simulation Result

Simulation with PWYW and long tail distribution, z axis depicts audience:



- With $p_1 = 1$ and $p_2 = 6$, we get the most people 11024, as well as higher profit than fixed price.

Outline

Summary and Conclusion

- We did a lot of market investigation and desktop research, considering all kinds of aspects, those full preparation laid our research a solid foundation.
- We abstract out two stages of film screening, and take the influence from the previous audience and audience customer psychology into consideration to make out model realistic.
- We introduce PWYW into film pricing, using both theoretical analysis and random simulation to prove our model gain better result than common model in current market.

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