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Video Games: Reason and Revenue in a Blockbuster Promotion

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The Promotion

Blockbuster Video stores in my area ran an early-return promotion on selected New Releases: *Return designated titles before 8:00 P.M. on their due date*, they advertised, *and get a dollar off the rental of an Old Release*.

The promotion was a mechanism for altering the *return curve* of popular titles. Ordinarily the *return curve* for videos is out of phase with the *demand curve*. The return rate rises just before closing, when customer demand is waning; the demand rate peaks earlier. As a result, popular titles can be out of stock during the high-demand period, but back in stock during the subsequent, lower-demand period.

If Blockbuster could redistribute the returns to approximate the *demand curve*, more of these titles would rent again (i.e., turn over) the same night, which would have a positive effect on revenue. On the other hand, the early-return discount necessary to stimulate the turnover would have a negative effect.

Was this promotion likely to increase revenue? Even with the promotion up and running, it's hard to judge its impact. Many variables randomly affect the period-to-period change in a store's revenue—variables like the weather, the competing entertainment options, and the popularity of new titles entering the store's inventory. The indeterminate influence of such things obscures the promotion's net effect.

But there is a way to evaluate the promotion: Examine it in the abstract to find its underlying mathematical structure; then use that structure to predict the promotion's influence on revenue.

The Controlling Variables

Here's how we'll proceed. We'll create a simplified situation, ignoring all variables unaffected by the promotion's presence or absence. In our simplified situation, we'll require a store to collect the same revenue with the promotion as it collects without it. When that happens, what are the controlling variables and what values do they take on?

The two controlling variables are *additional turnovers* and *exercised discounts*. Let's define these terms.

Additional turnovers. With a promotion in effect, more high-demand titles will turn over again on the day of their return. Subtract the number of high-demand turnovers when there isn't a promotion from the number of high-demand turnovers when there is. The difference is the *additional turnovers*.

turnovers with promotion - turnovers without promotion
= additional turnovers

Exercised discounts. With the promotion in effect, all customers who return their promoted titles early will receive a dollar off the rental price of an Old Release. Their use of that discount is an *exercised discount*.

Unearned discounts. Some customers return their videos before 8:00 P.M.—with or without the promotion—and their returns always turn over again on the due date. These are *regular* early returns: They don't generate new turnovers (and new revenue) because they don't increase the store's inventory of available cassettes. Nonetheless, they too are awarded a discount. Their discount is *unearned*—a free ride.

Earned discounts. Other customers return their videos before 8:00 P.M. because the promotion induces them to. These are *additional* early returns: They generate new turnovers (and new revenue) because they increase the store's inventory of available cassettes, thereby supplying previously unmet demand. Their discount is *earned*.

For the promotion to succeed, the store's revenue from the *additional turnovers* must be sufficient to offset both the *unearned* and the *earned* discounts.

The Breakeven Ratio

What we need to know is this: What is the *breakeven ratio*, the ratio of *additional turnovers* to *exercised discounts* at which a store's revenue with the promotion will equal its revenue without the promotion? With this critical information, we can assess the likelihood that a store can exceed the ratio's value and increase its revenue.

The required ratio of *additional turnovers* to *exercised discounts* is equal to a fractional expression that relates the fee changes in two subsets of renters. Subset *A*, represented in the faction's numerator, generates a lower average fee during the promotion. Subset *B*, represented in the faction's numerator, generates a higher average fee.

Renters in Subset A. Subset A consists of all patrons who, during the promotion, rent a high-demand title on Day 1 and return it early on Day 2.

After the patrons in Subset *A* return a high-demand title, they'll rent another video—their Next Rental. (They may rent their Next Rental immediately or later.) What their Next Rental will be depends on the absence or presence of the promotion.

If there is no promotion, the Next Rental will be either an Old Release (which rented for $2 when I encountered the promotion) or a New Release (which rented for $3). The collective choices of all the patrons in Subset A will result in some *average fee* for the Next Rental—a fee between two and three dollars.

If there is a promotion, the Next Rental will be a Discounted Old Release—generating a fee of one dollar. The promotional discount reduces A's *average* Next Rental *fee* from what it otherwise would have been.

Subset A's *average fee decrease* per rental is the difference between an *average* Next Rental *fee* and a *discounted* Next Rental *fee*. It can be as little as one dollar—the $2 Old Release fee minus the $1 discount. Or it can be as much as two dollars—the $3 New Release fee minus the $1 discount.

The numerator of the fraction is, then, the *average fee decrease* on Subset A's Next Rental as *A* exercises the promotional discount.

average Next Rental fee - discounted Next Rental fee
= average fee decrease in Subset A

Renters in Subset B. Subset B consists of all patrons who on Day 2 want to rent a New Release and who do find an acceptable New Release in stock if there is a promotion, but don't find an acceptable New Release in stock if there isn't a promotion.

When there is no promotion, there will be an inadequate supply of New Releases. Subset B renters, finding no acceptable New Release in stock, will have two options to fall back on:

- *trade down* to an Old Release (which rents for $2),
- *forgo* the rental altogether (and pay no rental fee).

On the other hand, when there is a promotion, the supply of New Releases will increase (as videos that previously were returned too late to re-rent now become available earlier in the evening). Subset B patrons, now finding acceptable New Releases in stock, will rent them. These *additional turnovers* will increase the average fee that Subset B patrons generate. How much?

The *average fee increase* per rental is the difference between a New Release Rental and an average Fallback Rental. It can be as little as one dollar—the $3 New Release minus a $2 *trade down* Old Release. Or it can be as much as three dollars—the $3 New Release minus a $0 *forgone* rental.

The denominator is, then, the *average fee increase* on Subset B's rental as B *trades up* to a New Release.

New Release fee - average Fallback fee
= average fee increase in Subset B

Summary of the breakeven ratio. To recap, the fractional expression is the *average fee decrease* per rental in Subset A divided by the *average fee increase* per rental in Subset B. And the value of this expression is the required ratio of *additional turnovers to exercised discounts*—the value at which the revenue with the promotion is the same as the revenue without the promotion.

$$\frac{\text{(average Next Rental fee) - (discounted Next Rental fee)}}{\text{(New Release fee) - (average Fallback Rental fee)}}$$

$$= \frac{\text{average fee decrease in Subset A}}{\text{average fee increase in Subset B}}$$

$$= \frac{\text{additional turnovers}}{\text{exercised discounts}}$$

$$= \text{the breakeven ratio}$$

The Breakeven Ratio's Range of Values.

Rental fees. A store's rental fees determine the *breakeven ratio's* range of values. During this promotion, Blockbuster was renting New Releases for $3, Old Releases for $2, and Discounted Releases for $1.

We'll use these prices to find the range's highest and lowest values. We'll also calculate two intermediate values.

Average rental fees. We start by assuming that the *average fee* for a Next Rental is either the maximum, $3 (i.e., everybody's Next Rental is a New Release), or the minimum, $2 (i.e., everybody's Next Rental is an Old Release). Likewise, we assume that the *average fee* for a Fallback Rental is either the maximum, $2 (i.e., everybody's Fallback Rental is an Old Release), or the minimum, $0 (i.e., everybody's Fallback Rental is No Rental at all).

Fee combinations. The various pairings of these maximums and minimums give us four combinations:

1. A $3 Next Rental for Subset A with a $2 Fallback Rental for Subset B.
2. A $2 Next Rental for Subset A with a $2 Fallback Rental for Subset B.
3. A $3 Next Rental for Subset A with a $0 Fallback Rental for Subset B.
4. A $2 Next Rental for Subset A with a $0 Fallback Rental for Subset B.

We insert a combination of values into the fractional expression

$$\frac{\text{(average Next Rental fee) - (discounted Next Rental fee)}}{\text{(New Release fee) - (average Fallback Rental fee)}}$$

putting the fees from Subset A in the numerator and the fees from Subset B in the denominator. Then we do the calculation (keeping in mind that a Discounted Next Rental always equals $1 and a New Rental always equals $3). There is a separate calculation for each combination. See Table 1.

Table 1. Breakeven Ratio for Maximum and Minimum Fee Combinations

Subset A Renters				Subset B Renters				
Average Next Rental Fee	minus	Discounted Next Rental Fee	divided by	New Release Fee	minus	**Fallback Rental Fee**	equals	Breakeven Ratio
($**3**	-	$1)	/	($3	-	$**2**)	=	2/1
($**2**	-	$1)	/	($3	-	$**2**)	=	1/1
($**3**	-	$1)	/	($3	-	$**0**)	=	2/3
($**2**	-	$1)	/	($3	-	$**0**)	=	1/3

The range of values. Each calculation gives the *break-even ratio* for one pairing of Next and Fallback Rental fees. The *break-even ratio* is the factor by which a store's turnovers must increase for it to recoup the revenue it will lose on the discounted rental. Our results show that the ratio's range extends from a high of 2/1 to a low of 1/3.

Understanding the Values

A value of 1 or greater. Whenever the *break-even ratio* equals 1 or greater, the store will lose revenue on the promotion. That's because those values require the number of *additional turnovers* to equal or exceed the number of *exercised discounts*. This is impossible: Not all discounts will produce *additional turnovers*. Here's why.

Without a promotion, all early returns (of the videos we're considering) turn over again the same day; if they didn't, the promotion would be pointless. These are *regular turnovers*; they always occur—promotion or no promotion. With a promotion, the number of early returns increases; these *additional early returns* result in *additional turnovers*. For every early return there is a discount, but only the *additional early returns* generate *additional turnovers*. There are always fewer *additional turnovers* than discounts. If each discount is exercised, the ratio of *additional turnovers* to *exercised discounts* must be less than 1.

A value less than 1. Theoretically, a store can achieve any *breakeven ratio* whose value is less than 1 and greater than or equal to 1/3 (the bottom of the range). But practical considerations reduce the upper limit.

To get some perspective, we'll do three things.

- First, we'll determine a likely range of values for the *breakeven ratio*.
- Having done that, we'll introduce a second kind of number, the *additional early-return factor* (defined below), which is derived from the *breakeven ratio*.
- Finally, we'll evaluate the range of *additional early-return factors* that corresponds to the range of *breakeven factors*. That will be revealing.

How the rental mix affects the breakeven ratio. Recall that the *breakeven ratio* is determined by the value of the expression

$$\frac{\text{(average Next Rental fee) - (discounted Next Rental fee)}}{\text{(New Release fee) - (average Fallback Rental fee)}}$$

In this expression, there are two variables: the *average* Next Rental *fee* and the *average* Fallback Rental *fee*. (The other items are constants.) The *average* Next Rental *fee* is determined by the mix of New and Old Release rentals in Subset A. The *average* Fallback Rental *fee* is determined by the mix of Tradedowns and Forgone Rentals in Subset B.

For Subset A, it is reasonable to assume that New Releases comprise roughly 50% to 70% of the rental mix. (New Releases are more popular than Old Releases.)

Constraints on forgone rentals. Subset B is more complicated. As we learned above, the *breakeven ratio* must have a value that is less than 1.

The lower limit. When we combine that fact with the fact that Subset A's New Release rentals lie in the 50%-to-70% range (i.e., the *average rental fee* is somewhere between $2.50 and 2.70), the mathematical outcome is this: Forgone Rentals must comprise more than 25% of Subset B's Fallback Rental mix; 25%+ is the lower limit for Forgone Rentals in the Fallback mix.

Why 25%? Without the promotion, at least 50% of Subset A's rentals are assumed to be New Releases, so the average rental fee is no lower than $2.50. As each Subset A patron substitutes a $1.00 Discounted Rental for his Average Rental, the store gives up $1.50 in revenue. This $1.50 loss must be recaptured from Subset B renters, whose average Tradeup must contribute $1.50, or more, in offsetting revenue. When a Subset B renter trades up from a Forgone Rental, the store collects $3 in new revenue ($3 - $0 = $3); when a Subset B renter trades up from an Old Release, the store collects $1 in new revenue ($3 - $2 = $1). If 25% of Subset B renters trade up from a Forgone Rental, the average offsetting revenue per rental will be $1.50—which equals 25%($3) + 75%($1)—and the *breakeven ratio* will be exactly 1, an impossible value to achieve, as previously discussed. Therefore, for the breakeven ratio to fall below 1, Forgone Rentals must comprise more than 25% of Subset B's Fallback Rental mix.

The upper limit. The upper limit for Forgone Rentals is constrained by practical considerations. Consider this: If Forgone Rentals are 100% of the fallback mix, all patrons who found their high-demand preference out of stock rented nothing to replace it. Most customers don't behave this way; rather than return home empty-handed, they'll rent some other title as a substitute. So, an upper extreme of 100% is virtually impossible.

Let's be overly generous and say that as many as 70% of Subset B patrons *forgo* a rental when they find their New Release preference out of stock. That limits Forgone Rentals to a range whose bottom exceeds 25% and whose top doesn't climb above 70%.

Constraints on the breakeven ratio. The promotion is now fenced in by three conditions:

- The *breakeven ratio* must be less than 1.
- The percentage of new Next Rentals in Subset *A* must be in the 50%-to-70% range.
- The percentage of *forgone* Fallback Rentals in Subset *B* must be within the 25%-to-70% range.

These conditions yield *breakeven ratio* values ranging from a high of .9444 to a low of .625. We will now relate these values to *early returns*.

The Additional Early Returns Factor

Corresponding to every *breakeven ratio* value is another number, the *additional early returns* factor. The *additional early returns* factor is the multiple by which pre-promotion *early returns* must increase if the promotion is going to generate breakeven revenue. This multiple is equal to the expression

$$\frac{\text{breakeven ratio}}{1 - \text{breakeven ratio}} - 1$$

Inserting into this expression the value .9444, the highest value arising from the three preceding conditions, we get a multiple of 16 times the regular number of early returns: [.9444/(1-.9444)] -1 = [.9444/.0556] -1 = 17-1 = 16. At the highest *breakeven ratio*, the promotion will have to increase early returns (of promoted titles) by an astounding 1600% to achieve breakeven revenue.

Now let's drop down to the other end of the range. Inserting into the expression the value .625, the lowest value arising from the three preceding conditions, we get a multiple of 2/3 times the regular number of early returns: [.625/(1-.625)] -1 = [.625/.375] -1 = 1.67 –1 = .67 = 2/3. Even at the bottom of the range, the promotion will have to increase early returns by an unlikely 67%.

Furthermore, all *additional early returns* must turnover again the same day. If the store fails on either count, it will lose revenue.

Other negative factors. The situation grows worse. Other negative factors are also at work. Our practical minimum *breakeven ratio* of .625 corresponds to 50% New Releases in the Next Rental mix, 70% Forgone Rentals in the Fallback Rental mix. But in reality, the percentage of New Releases will likely be higher; the percentage of Forgone Rentals, lower.

The mathematical dynamics of the promotion are such that the *additional early returns* factor must rise as: (1) the percentage of New Releases in the Next Rental mix increases and/or (2) the percentage of Forgone Rentals in the Fallback Rental mix decreases. So in all likelihood, the actual *additional early-returns* factor for breakeven revenue will exceed the practical-range minimum of 67%.

What are the chances that a store can increase early returns by more than 67%? Not very good.

Extra Rentals

The promotion has another aspect that still might save the day for Blockbuster.

The promotion requires early returnees to exercise their discounts at the same time they return their promoted videos. This "use it or lose it" rule induces some people to rent their Next Rental sooner than usual.

If enough early returnees treat their Discounted Rental as an Extra Rental (a cheap title rented in addition to their usual Next Rental), their Extra Rental will offset the revenue lost when other early returnees treat their Discounted Rental as their Next Rental (a cheap title rented in lieu of their usual, higher-priced selection).

What percentage of early returnees must exercise their discount as an Extra Rental for the store to generate the same revenue with the promotion as without it? The percentage varies and is affected by several things:

- the rental fees for different classes of videos,
- the *average rental fee*,
- the proportion of *additional turnovers* (if any) to *early returns*, and
- the source of those *additional turnovers*—Are they from patrons who previously substituted an Old Release for an unavailable New Release, or from patrons who forwent a rental altogether?

As you can see from the last two points, *additional turnovers* play a critical role in determining the breakeven percentage of Extra Rentals.

A store will encounter one of four situations with respect to turnovers: (1) no *additional turnovers*; (2) *additional turnovers*, all of which come from Forgone Rentals; (3) *additional turnovers*, all of which come from substituted Old Releases; and (4) *additional turnovers*, coming from both Forgone Rentals and substituted Old Releases.

A mathematical model of the promotion. All four situations are covered by the following equation, which models the conditions for breakeven revenue. The equation gives the percentage of Extra Rentals, *X*, required for the promotion's revenue to offset the cost of the discount.

$$X = (1 + ge - \{ [D + (f + g)eN] / A\})$$

where:

All input and output percentages are expressed as their decimal equivalents.

e is the percentage increase in early returns; this increase is the *additional early returns*.

f is the percentage of *additional early returns* resulting in turnovers by customers who previously substituted nothing for an out-of-stock New Release; $f = 1-g$.

g is the percentage of *additional early returns* resulting in turnovers by customers who previously substituted an Old Release for an out-of-stock New Release; $g = 1-f$.

D is the Discounted Fee.

N is the New Release Fee.

A is the Average Rental Fee.

A is equal to *n[New Release Fee]+[1-n][Old Release Fee]*,
where:

n is the percentage of New Releases in the pre-promotion rental mix, and
(1-n) is the percentage of Old Releases in the pre-promotion rental mix.

(Were a store to rent no New Releases, the *average rental fee* would equal the Old Release fee. Under these conditions the promotion would be impossible and the *X* value would be meaningless.)

Let us reiterate. For the promotion to achieve breakeven revenue, *X* percent of early return discounts must be exercised as Extra Rentals.

The equation for this breakeven *X* reveals that *X* must increase as:

- the ratio of *additional early returns* to *all early returns* decreases (i.e., as *e* decreases),
- the ratio of *substitute rentals* to *forgone rentals* increases (i.e., as *g* increases),
- the *average rental fee*, *A*, increases.

The discount exercise period. If the promotion is to succeed, a critical percentage of discounts must be exercised as Extra Rentals. However, the percentage of Extra Rentals that a store can achieve is constrained by the duration of the *discount exercise period*.

As the *discount exercise period* grows longer, the likelihood that customers will use the discount for an Extra Rental grows smaller—the pressure to "use it or lose it" decreases. More customers will find that the longer *discount exercise period* includes the date when, as a matter of course, they would transact their Next Rental. Thus, a longer *discount exercise period* lets more customers rent on their regular schedule and still take advantage of the discounted title (selecting a discounted title in lieu of their normal, more expensive Next Rental). This threatens revenue.

Blockbuster must have recognized the threat since it required patrons to exercise the discount at the time of the early return. The requirement, however, is a double-edged sword. A shorter *discount exercise period* indirectly reduces the percentage of *additional turnovers*, *e*. Customers who can't use another video within the limited *discount exercise period* won't inconvenience themselves to return their promoted videos early. That will reduce the supply of *additional early returns* (on which *additional turnovers* depend).

The *discount exercise period* can be shortened to increase the percentage of Extra Rentals or it can be lengthened to increase the percentage of *additional early returns*. But it cannot be adjusted to make the two rise simultaneously. Any plan to increase Extra Rentals and *additional turnovers* in tandem is logically flawed.

Is the Promotion Viable?

Applying the equation. To assess the overall viability of the promotion, we will use the above equation to evaluate two different scenarios, determining for each the percentage of Extra Rentals, *X*, needed for breakeven revenue. The scenarios differ in the values we assign to *e*, *g*, and *A*. (We don't adjust *D* and *N*; they're constants. And we don't need to worry about *f*; since *f = 1-g*.)

Best-case scenario. In the *best-case* scenario, we make the following assumptions about a store:

- 50% of the early returns are *e*, *additional early returns* (i.e., early returns generated by the promotion).
- 50% of the *additional turnovers* are *g*, *tradeups* from an Old Release to a New Release.
- The *average rental fee*, *A*, is $2.50 (which is to say, prior to the promotion 50% of the rentals were New Releases; 50% were Old Releases: (.5*$3) + (.5*$2) = $1.50 + $1.00 = $2.50.

The promotion is unlikely to encounter values more favorable to its cause than these. To achieve breakeven revenue with these values, 25% of the discounts need to be exercised as Extra Rentals: *X* = 25%.

Reasonable-case scenario. In the *reasonable-case* scenario, we make these, more realistic, assumptions about a store:

- 10% of the early returns are *e*, *additional early returns* (i.e., early returns generated by the promotion).
- 75% of the *additional turnovers* are *g*, *tradeups* from an Old Release to a New Release.
- The *average rental fee*, *A*, is $2.60 (which is to say, prior to the promotion 60% of the rentals were New Releases; 40% were Old Releases: (.6*$3) + (.4*$2) = $1.80 + $0.80 = $2.60.

To achieve breakeven revenue with these more realistic values, 57.5% of the discounts must be exercised as Extra Rentals: X = 57.5%.

Conclusion. It is most improbable that the promotion could induce more than half of the participants to rent an Extra video, as required by the *reasonable-case* scenario. Indeed, it would be a feat if the promotion could induce even a quarter of the participants to rent an Extra video, as required by the *best-case* scenario.

Our calculations strongly suggest that the promotion will lower—not increase—revenue. Perhaps Blockbuster came to realize this as well. Several months after my first encounter with the promotion, I ran into it again in another part of the country. Things had changed. The reward for an early return was no longer a Discounted Rental. It was a bag of popcorn.

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