Psychophysics of Consumer’s Sequence Preference of E-commerce Loan Repayments

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Abstract. As E-commerce shopping has been growing rapidly in China, many consumers use loans to make a purchase, and then payoff the loan by installments. Recently studies show that all amortizing loans can be viewed a sequence of payments, and consumers prefer a decreasing sequence for a car loan. In this paper, we investigated consumers’ preference of payment sequence for a less valued online purchased commodity, a smart phone. Results show consumers prefer constant sequence over decreasing sequence, indicating that consumers have unique perception of sequence for a smaller amount and shorter term loan, and they may choose constant sequence for convenience. E-commerce credit provider shall stick with the constant repayment plan.

1. Introduction
Empirical researches show that people have strong preference over sequence of both positive and negative outcomes. 'preference for improvement’ has been widely observed in different cases. In general, a majority of participants prefered saving the best for last, i.e. increasing sequence for rewards, while decreasing sequence for penalties. As loan payments can be considered a sequence of penalty, some researches also found people prefer decreasing profile over increasing profile. However, constant monthly payment is the most common payment plan for E-commerce loan. To discover if there is any room to improve consumer’s satisfaction, we examined consumer’s preference of a constant sequence payment plan and a decreasing sequence payment plan.

2. Description of Loan and Amortization Schedule
Previous studies used a car loan to evaluate consumers perception of payment plans. Sine few people buy cars online, we used a less valued smart phone and shorter term consumer loan for instead.

2.1. Constant Monthly Payment
Firstly, the monthly payment of a constant sequence is equivalence to an annuity,

\[ MP_c = \frac{r(1+r)^n}{(1+r)^n-1} \]  

(1)

where \( n \) be the number of month, \( r \) the loan rate.

2.2. Decreasing Sequence of Monthly Payment
Secondly, we designed a decreasing sequence of loan payment plan using Rambaud’s setting. The monthly principal repaid is variable in arithmetic progression, whose first term is \( A \) and common difference is \( d \).
• $A_1 = A$
• $A_2 = A + d$
• $A_3 = A + 2d$
... 
• $A_n = A + (n-1)d$

Let $n$ be the number of months, $L$ the amount of loan, $r$ the loan rate. Monthly payment $M'_n$ is the sum of monthly principal payment $A_n$ and interest payment of remaining balance $R_n$.

$$M'_n = A_n + R_n$$  \hspace{1cm} (2)

$$R_n = (L - \sum_{1}^{n-1} A_n) r$$  \hspace{1cm} (3)

Substitute eq(3) into eq(2),

$$M'_n = A + (n-1)d + (L - \sum_{1}^{n-1} A_n) r$$  \hspace{1cm} (4)

$$M'_{n-1} = A + (n-2)d + (L - \sum_{1}^{n-1} A_n + A_{n-1}) r$$  \hspace{1cm} (5)

Note that $M'_n = M'_{n-1} + d - A_{n-1} r$, as $M'_{n-1} = d - A_{n-1} r, M'_{n-2} = d - A_{n-2} r$, then we have $(M'_n - M'_{n-1}) - (d - A_{n-1} r) - (d - A_{n-2} r) = dr$. Hence, $M'_n$ is an arithmetic progression of the second order, the general solution is,

$$M'_n = M'_1 + (n-1)(M'_2 - M'_1) + \frac{(n-1)(n-2)}{2} (d r)$$

$$= -\frac{d r}{2} n^2 + (d - Ar + \frac{3}{2} d r) n + A + Lr + Ar - d - dr$$  \hspace{1cm} (6)

The general solution of $R_n$ is,

$$R_n = (9000 - (n-1)A - \frac{(n-1)(n-2)}{2} d) r$$  \hspace{1cm} (7)

3. Empirical Evidence

This paper examined the loan payment plans in the context of smart phone purchased online. Two payment plans are constant monthly payment plan and decreasing principal payment plan.

3.1. Method

Participants are asked to imagine a scenario where they are employed in a large company where they are earning RMB 4000 after tax (1 USD≈6.7 RMB). They want to buy a new smart phone online which costs RMB 9000 but at this moment they do not have enough money. Therefore, the shopping platform offers a loan with a fixed interest rate of 9% (monthly rate is 9%/12=0.75%), the term of the loan is 12 months, payments will be due every month, and they can choose from 2 payment plans. The first plan is a constant payment plan, (substitute $L=9000, n=12, r=0.75\%$ into eq(1), then the constant payment $MP_n=787.06$. The second plan is a decreasing profile with principal payment, first month’s principal repayment is 1300RMB, and 1200RMB for 2nd month. The principal repayment drops 100 RMB each month, i.e.$d=-100$, and then substitute $d$ into eq(6) to get the $MP'_n$, see table 1 for monthly payments of the two plans.
| Month | Constant (median value) | Decreasing (median value) |
|-------|-------------------------|---------------------------|
| 1     | ¥787.06                 | ¥817.50                   |
| 2     | ¥787.06                 | ¥811.88                   |
| 3     | ¥787.06                 | ¥806.25                   |
| 4     | ¥787.06                 | ¥800.63                   |
| 5     | ¥787.06                 | ¥795.00                   |
| 6     | ¥787.06                 | ¥789.38                   |
| 7     | ¥787.06                 | ¥783.75                   |
| 8     | ¥787.06                 | ¥778.13                   |
| 9     | ¥787.06                 | ¥772.50                   |
| 10    | ¥787.06                 | ¥766.88                   |
| 11    | ¥787.06                 | ¥761.25                   |
| 12    | ¥787.06                 | ¥755.63                   |

3.2. Evaluation
Participants had to evaluate each loan plan using a 7-point format, where 1 is the score for a plan they would never choose and 7 is the score for the best plan.

3.3. Procedure
The questionnaire was presented in a paper-pencil version in person at a Chinese University. No incentives were given for participation. It averagely took 10 minutes to finish the questionnaire.

3.4. Participants
The sample consisted of 56 students, all majored in finance, all have experience of using credit to shop online, including 19 male participants and 37 female participants. The average age is 22.51, with standard deviation of 0.63.

4. Results and Discussion
The results obtained from the questionnaire show that the constant profile was evaluated (median value: 4.17) better than the decreasing profile (median value: 4.03). Participants’ sequence preference is consistent regardless of gender (for male, 4.30>4.02, for females, 4.10>4.03), see table 2 for the median values of the survey sorted by gender.

|          | Constant (median value) | Decreasing (median value) |
|----------|-------------------------|---------------------------|
| Male     | 4.30                    | 4.02                      |
| Female   | 4.10                    | 4.03                      |
| Group    | 4.17                    | 4.03                      |

This preliminary test shows a different result from previous researches, according to Rambaud et al. (2019), decreasing sequence is evaluated as the best option due to consumer’s q-exponential discounting function. The present value of a loan is increasing with respect to $d$ (the common difference of the principal payment sequence). If $d$ is negative, the repayments of principal are
concentrated at the beginning of the term of the loan, and the present value or the subjective value of the loan is smaller comparing to other plans.

A possible reason to this divergence is that Rambaud et al. (2019)’s study never includes constant sequence (only rising, falling, and fixed principal plans). According to Read et al. (2002), “For one-year earnings, for example, the most important explanation was convenience, which led to a strong overall preference for constant-component sequences” and “The desire for convenience would not emerge in a study that focuses on comparing rising and falling sequences, because neither have a particularly convenient shape”. Another uniqueness of this paper is that it examined a 1-yr E-commerce loan instead of a 5-yr car loan or even a longer-term home residential mortgage. It appears that consumers put more emphasis on convenience for a shorter term and less valued loan.

This paper found a strong preference for constant payment plan, and “convenience” is the most reasonable explanation to this phenomenon. Consumers chose constant plan because of convenience, and they care more about convenience for a shorter term E-commerce loan. The result of this paper suggests that E-commerce credit providers should only consider constant plan when extend credit to their customers. From a financial point of view all proposals are equivalent, for the interest rate is the same. However, a constant repayment plan can meet consumer’s need of convenience, and thus improve consumer’s satisfaction of loan service. Future studies shall focus on the interaction effect between the term and the value of loan, which may also have an impact over customer’s preference.

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