Assignment 3: Financing Calculator

Team 5 : Jihyun Lim, Jisun Lim, Sangmi Jeong*

April 10, 2019

1 Overview

As Bank A requested, we would like to make a financing calculator for customer to help them better understand their payment schedules. With this calculator, produced by the function "F.Cal()" in programming language R, Bank A can improve customer service quality, and customers can get the idea of the reproduction of the numbers for each repayment type. Users can simply plug in some information such as loan amount, number of payments, compounding information, APR, repayment types to the calculator, which will automatically generate schedules and graphs for customers.

2 Program Outline

2.1 Terminologies

Terminologies used in the program are:

- Loan amount: total amount of money customers are authorized to borrow
- Annual Percentage Rate(APR): annual rate charged for borrowing
- Compounding Period: a span of time between when interest is compounded and when it will be compounded again
- Repayment Period: the time over which customers will have to make regular payments to ensure the loan balance is paid in fully by agreed upon date
- Interest-Only Period: a period of time customers only have to pay interests on a loan

2.2 Repayment types

There are three repayment types by Scanlon et al. (2008) and customers should be able to choose one of the followings:

1. **Even Total Payment**[1]**:** Each payment including interest and principal is the same all the time. Customers would prefer this type the most because the number doesn't change and it is easy to remember.
2. **Even Principal Payment:** Each payment includes accrued interest and equal installment of principal. Compared to the Even Total Payment, it charges customers more at the beginning and less at the end. Therefore, there are more chances that customers who are financially stable and willing to pay initial(extra) burden will choose this type over others.
3. **Balloon Payment:** Each payment includes interest only and the last payment is the sum of the last interest and principal. It may not be a favourite choice for Bank A because it will take a long time to get the principal repaid when there is uncertainty whether customers can actually repay the loan.

*Yonsei University, Korea (Email: jlim0316@gmail.com / jisun.lim@daum.net / sangm1j@naver.com)

[1]For calculation, we use the formula: https://www.thebalance.com/loan-payment-calculations-315564

(a) Even Total Payment

Num	Payment Dates	Total Payment	Principal	Interest	Unpaid Balance
0	2019-04-10	0	0	0	1,000,000
1	2019-05-10	168,373	165,456	2,917	834,544
2	2019-06-10	168,373	165,939	2,434	668,605
3	2019-07-10	168,373	166,423	1,950	502,182
4	2019-08-10	168,373	166,908	1,465	335,274
5	2019-09-10	168,373	167,395	978	167,879
6	2019-10-10	168,373	167,879	494	0

(b) Even Principal Payment

Num	Payment Dates	Total Payment	Principal	Interest	Unpaid Balance
0	2019-04-10	0	0	0	1,000,000
1	2019-05-10	169,584	166,667	2,917	833,333
2	2019-06-10	169,098	166,667	2,431	666,666
3	2019-07-10	168,611	166,667	1,944	499,999
4	2019-08-10	168,125	166,667	1,458	333,332
5	2019-09-10	167,639	166,667	972	166,665
6	2019-10-10	167,151	166,665	486	0

(c) Balloon Payment

Num	Payment Dates	Total Payment	Principal	Interest	Unpaid Balance
0	2019-04-10	0	0	0	1,000,000
1	2019-05-10	2,917	0	2,917	1,000,000
2	2019-06-10	2,917	0	2,917	1,000,000
3	2019-07-10	2,917	0	2,917	1,000,000
4	2019-08-10	2,917	0	2,917	1,000,000
5	2019-09-10	2,917	0	2,917	1,000,000
6	2019-10-10	1,002,917	1,000,000	2,917	0

Table 1: Payment schedule table for each repayment type
Loan amount of 1,000,000 Won, repayment for 0.5 Year, APR=3.5%, compounded monthly

3 How to Process

Users can input some information into this financing caculator as below. After this step, users can show customers graphs and payment schedule table generated. Please refer to **5 Sample Report** for the graphs and payment schedule table.

```
> F.Cal()
Enter the Loan Amount (Unit:Won): 1000000
Enter the Repayment Period (Year(s)): 0.5
Choose the compounding period :
      1=Monthly / 2=Quarterly / 3=Semi-annually / 4=Annually
1: 1
Enter the Annual Percentage Rate (%): 3.5
Choose the repayment types:
      1=Even Total Payment / 2=Even Principal Payment / 3=Balloon Payment
1: 1
If necessary, enter the Interest-Only Period (Year(s)): 0
```

4 Comment

- **No comparison between repayment type no.1 and no.2:** since we are on the side of Bank A, we decided not to show a chart comparing payment schedules of Even Total Payment and those of Even Principal Payment, which could lead customers who tend to pay less as possible to choose the former. In the same sense, we did not print the effective rates for each case so as not to reveal the profit margin to customers.

- **Round vs. Ceiling:** to make values positive integers, we used not only "round" function for interests but also "ceiling" function for values in terms of principal payments, because the sum of principal payments will be less than the loan amount if we use the "round" function.

5 Sample Report

This is a sample report[2] customers can get from bank A:

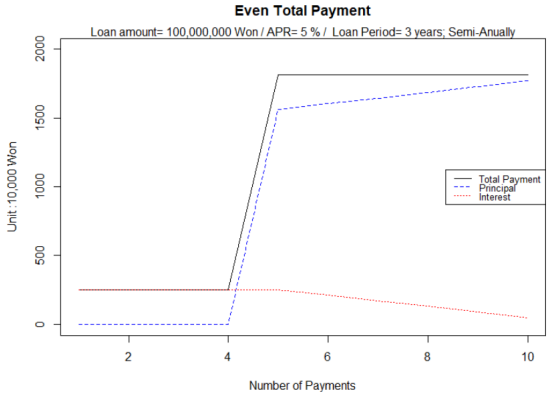
Table 2: Sample Report for Even Total Payment

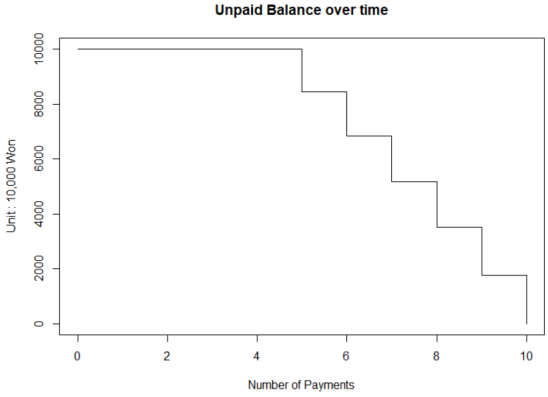
(a) Loan Data

Loan Amount	100,000,000 Won
Annual Percentage Rate	5 %
Repayment Period	3 Year(s)
Interest-only Period	2 Year(s)
Frequency of Payment	Semi-Anually
Start Date	2019-04-10

(b) Summary

Total Loan Period	5 Year(s)
Number of Payments	10
Rate(per period)	(approx.) 2.5 %
Payment(per period)	2,500,000 Won
Total Interest Paid	18,929,988 Won
Total Payments	118,929,988 Won





(c) Payment Schedule

Num	Payment Dates	Total Payment	Principal	Interest	Unpaid Balance
0	2019-04-10	0	0	0	100,000,000
1	2019-10-10	2,500,000	0	2,500,000	100,000,000
2	2020-04-10	2,500,000	0	2,500,000	100,000,000
3	2020-10-10	2,500,000	0	2,500,000	100,000,000
4	2021-04-10	2,500,000	0	2,500,000	100,000,000
5	2021-10-10	18,154,998	15,654,998	2,500,000	84,345,002
6	2022-04-10	18,154,998	16,046,373	2,108,625	68,298,629
7	2022-10-10	18,154,998	16,447,532	1,707,466	51,851,097
8	2023-04-10	18,154,998	16,858,721	1,296,277	34,992,376
9	2023-10-10	18,154,998	17,280,189	874,809	17,712,187
10	2024-04-10	18,154,998	17,712,187	442,811	0

Table (2a) shows input factors to the calculator and Table (2b) shows the brief summary of Table(2c). Two graphs in the middle show payments and unpaid balance over the loan period respectively.

References

Scanlon, K., Lunde, J. & Whitehead, C. (2008), 'Mortgage product innovation in advanced economies: more choice, more risk', *European journal of housing policy* **8**(2), 109–131.

[2]Due to limitation of space, we were only able to generate the report of the repayment type 1(Even Total Payment). Using the calculator, similar reports will be generated for the other repayment types as well.