USER GUIDE FOR LOAN CALCULATOR

Table of Content

Introduction

Let's start with a question: At a point in time in your life, you would like to borrow $5,000 for 2 years to cover for something that are really matters. Let say, there are at least 5 different lenders (possibly, banks, financial institutions, government agencies, individuals, your relatives, and so on). Which one should you go for? To assist you in your decision-making process, we offer you a simple, clear interface with accurate calculation. This small program takes care of probably-sometimes-confusing calculation part based on your inputs in 6 common amortization methods. The application provides user with amount detail you are expected to pay in each payment due. Therefore, you can spend your time and effort on more important things, for example: which offer is more appropriate in your case, how to use that borrowed money wisely. Here, we only focus on cost-benefit in financial aspects.

Content

1. Basic understanding of loan amortization in financial point of view

When borrowing a certain amount of money, borrower usually has to pay back the lender a bigger amount which includes: **Principle** (original amount borrowed) and **Interest Amount** (the cost of borrowing in borrower's view, or the gross profit of lending money in lender's view). The lender evaluate value money he/she gives out, by using interest rate. Interest Rate is the physical form of concept: Time-value of Money. The more value the lender estimates, the higher interest the borrower will be charged

1.1. Basic influential inputs affect loan calculation

Calculation of **Interest Amount** sometimes can be tricky part if the borrower does not have sufficient inputs. Here are the basic influential inputs provided by both parties:

Inputs provided by Lender	Inputs provided by Borrower
- Annual Percentage Rate (APR) - Compounding Period (Daily, Weekly, Bi-weekly, Monthly, Bi-monthly, Quarterly, Semi-annually, Annually) - Amortization Method applied (Fixed Payment, Canadian, Rule-of-87, Fixed Principal, Interest only, No Interest) - Interest charge in case of the **first** longer/shorter period than standard (i.e., standard: 1 month, but first period duration can be less than 1 month or greater than 1 month - First payment date - Points (for deduct APR)	- Loan Amount - Payment Schedule ((Daily, Weekly, Bi-weekly, Monthly, Bi-monthly, Quarterly, Semi-annually, Annually). It can be different from Compounding period - Total number of payments - Start date of borrowing
Other: Number of day in year (364,365,366)	

Borrowers usually pay attention to Annual Percentage Rate(ARP), and immediately evaluate a lender's offer. Sometimes, the negligence of considering other factors such as compounding period, Amortization Method used by each lender, makes good-looking deal become a burden later.

1.2. Interest Amount Calculation

Interest Amount is generally given by the following formula. ARP usually is provided by a lender, then Interest Rate for each payment period will be derived from that.

$$\text{Interest Amount for each period} = \text{Unpaid Principal} * \textbf{Interest Rate} * \text{Duration of each period} \quad (1)$$

- If the compounding period and payment schedule are **the same,** i.e., both are monthly, weekly

$$\text{Interest Rate for each payment (r)} = \frac{\textit{Annual Percentage Rate (APR)}}{\textit{Number of payment in a year}} \quad (2)$$

For example: If APR quoted by lender is 12%, and in case borrower pay back monthly, tinterest rate, then the interest rate applied every month will be 1%

APR	Monthly	Bi-monthly	Semi-annual	Yearly	Weekly	Bi-weekly
12%	1%	2%	6%	12%	0.2308%	0.4615%

- If the compounding period and payment schedule **are different.** Extra step is needed to be done before arriving to the Interest Rate for each payment. *The reason is that the time lender decides to calculate the interest amount is different from the time the borrower actually pays.* The extra step serves purpose of synchronizing the ARP given by Lender to Actual ARP rate (or EAR in financial term) applied to Borrower's payment schedule.

After finding out Actual APR for Borrower's side, Interest Rate for each payment is calculated by using equation (2) by substituting APR by Actual ARP.

Refer to Appendix 1: Mathematics calculation for Actual APR

$$\text{Actual APR} = n_p * \left[\left(1 + \frac{\text{APR}_q}{n_c}\right)^{\frac{n_c}{n_p}} - 1\right] \quad (3)$$

np: Number of payments in a year
nc: Number of compounding period in a year
APRq: Annual Percentage Rate given by Lender

For example: APR quoted by lender at 12%, if lender calculates interest on interest Weekly (Compounding weekly), but borrower pay monthly, then the borrower has to actually pay interest rate of 12.046%, not 12% as he/she might think.

Conversion from APR quoted (12%) to APR actual according to Compounding and Payment schedule

Compounding Schedule	Payment schedule: 1 week	2 week	4 week	1 month	2 month	3 month	4 month	6 month	12 month
1 week	12.000%	12.014%	12.042%	12.046%	12.107%	12.168%	12.229%	12.353%	12.734%
2 week	11.986%	12.000%	12.028%	12.032%	12.093%	12.153%	12.214%	12.338%	12.719%
4 week	11.959%	11.972%	12.000%	12.005%	12.065%	12.125%	12.186%	12.309%	12.688%
1 month	11.954%	11.968%	11.995%	12.000%	12.060%	12.120%	12.181%	12.304%	12.683%
2 month	11.895%	11.909%	11.936%	11.941%	12.000%	12.060%	12.120%	12.242%	12.616%
3 month	11.837%	11.850%	11.877%	11.882%	11.941%	12.000%	12.060%	12.180%	12.551%
4 month	11.780%	11.793%	11.820%	11.824%	11.882%	11.941%	12.000%	12.119%	12.486%
6 month	11.667%	11.680%	11.706%	11.711%	11.768%	11.825%	11.883%	12.000%	12.360%
12 month	11.345%	11.358%	11.382%	11.387%	11.441%	11.495%	11.550%	11.660%	12.000%

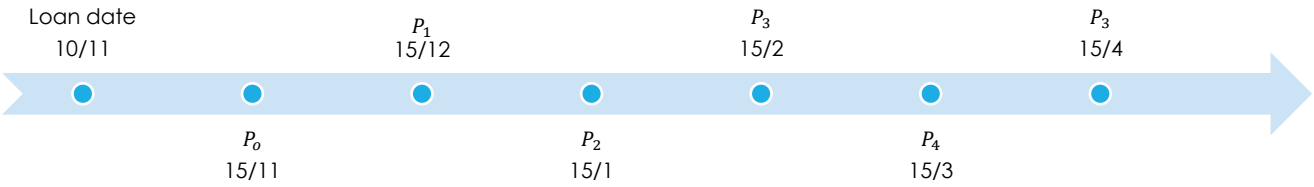
1.3. Unpaid Principal:

It is calculated based on Amortization method which Lender applies to the loan. The application provides 6 common methods.

- **Fixed Payment:** Borrower pays the equal amount of money in each period due

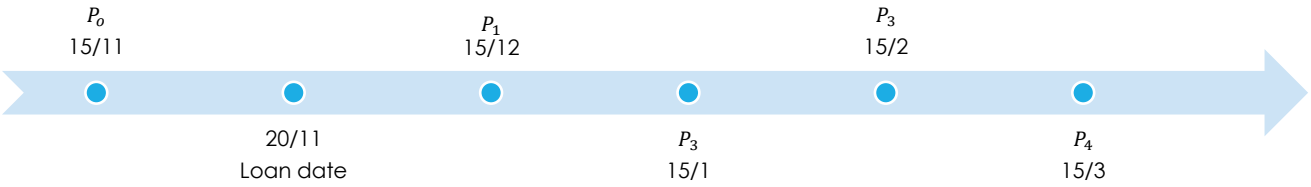
✓ In case the first payment period is **longer** than the length of payment standard, the interest of the extra days -could be will be applied.

For example: Supposed that standard payment period: Monthly in every 15th. Loan date is approved on 10/11, The first payment (P1): 15/12, extra days of 5 days will be from 10/11 to 15/11 (P0). Interest amount on the extra days is calculated on the period 10/11-> 15/11, let's call it IOE. If possible, some lender asks borrower to pay interest on IOE for the period 15/11 (P0) to 15/12(P1), as 26/12 is the time the borrower actually gives out money.



✓ In case the first payment period is **shorter** than length of payment standard, the interest paid in the first payment will be smaller

For example: Supposed that the standard payment period: Monthy in very 15th. Loan date is approved on 20/11, but the first payment date on 15/12 (P1). In the first payment on 15/12 (P1), borrower will pay interest is calculated from 20/11 to 15/12 (P1)



✓ **Points:** Percentage used to deduct the Annual Percentage Rate (ARP). Borrower pays a certain amount of money in advance to buy the points, in order to reduce ARP which is used for the whole life of loan later. For example: ARP quoted is 6.5%, Point: 2%, then ARP given to borrower will be 4.5%.

✓ The fixed amount paid *at the end of every period* will be given by following formula.

Refer Appendix 2: The Mathematics calculation of Ordinary Annuity**.** In this formula: The value of C includes both Interest amount for a period, and a part of Principal; PV:loan amount; n: number of payment; r: periodic interest rate

$$C = \frac{(1+r)^n * r}{(1+r)^n - 1} * PV \quad (4)$$

- **Canadian method:** A special case of Fixed Payment when Compounding period is set to Semi-annually
- **Rule-of-78:** Borrower makes the equal amount of payment every period, which is similar to Fixed Payment. However, borrower pays the biggest portions of interest earlier along with a part of principal. Then, interest payment will be decrease gradually. Total interest in Rule-of-78 and Fixed Payment equal assuming that the borrower is not going to settle the loan before loan agreement, and other input the same.
- **Fixed Principal:** In each period, borrower pays equal part of principal plus interest for this period

$$Payment\ each\ period\ =\ Interest\ amount\ for\ this\ period\ +\ \frac{Loan\ amount}{Total\ number\ of\ payments}$$

- **Interest Only**: Borrower only pays for interest each period, leaves the principal to the last payment.
- **No interest**: Borrower only pays equal parts of principal during payment periods, without any interest

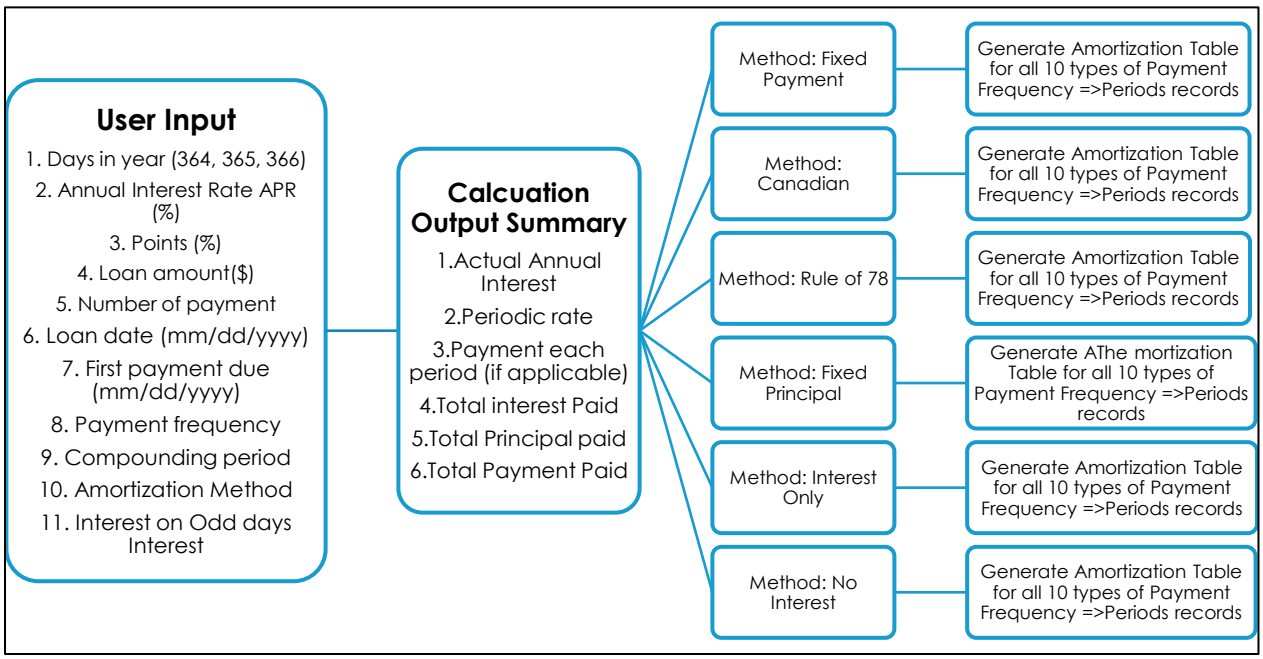
$$Payment\ each\ period\ =\ \frac{Loan\ amount}{Total\ number\ of\ payments}$$

2. Flow data in program's calculation

Starting with the 11 data user keys in the form input, the program generates the calculation result including: Summary Output, Amortization Schedule Table according to the chosen amortization method.

Summary Output gives user the overview of: Actual Annual Interest Rate applied in their case, periodic rate, payment each period (if applicable), Total interest Paid, Total Principal paid, Total Payment Paid for the whole life of the loan

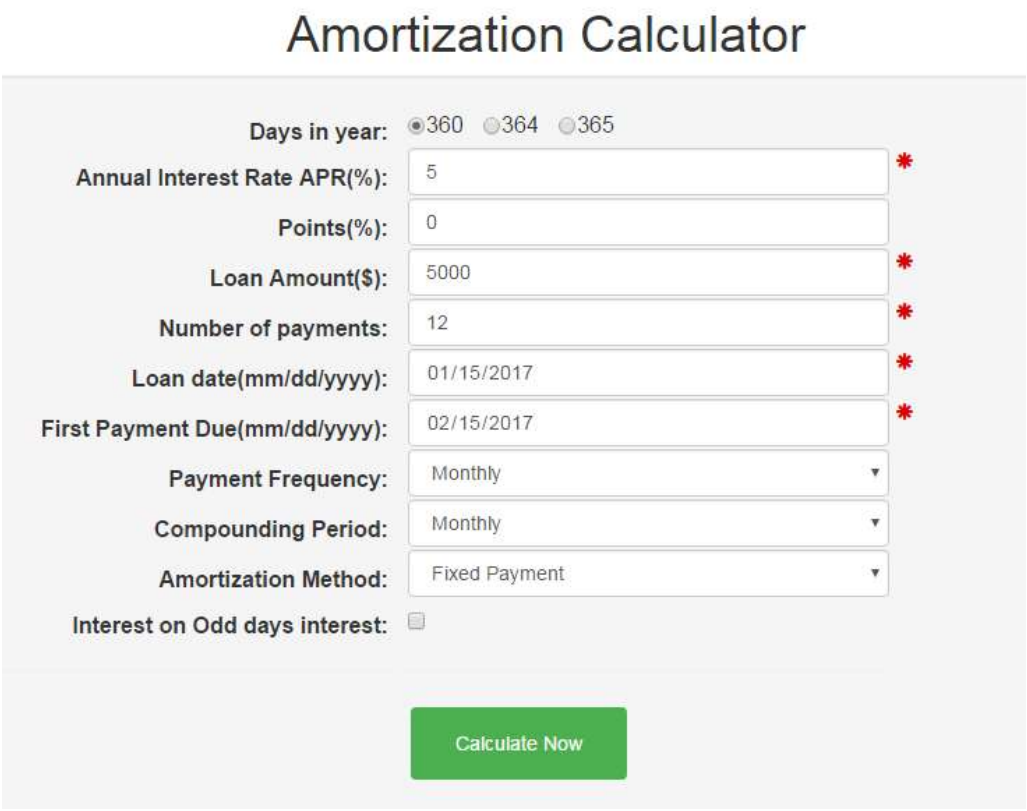
Amortization Schedule Table displays the amount paid each period, and how much it contributes to decrease the unpaid principal, and interest amount for selected amortization method.The figure below depicts the process of data flow in program from input to Output report



3. Collecting data input

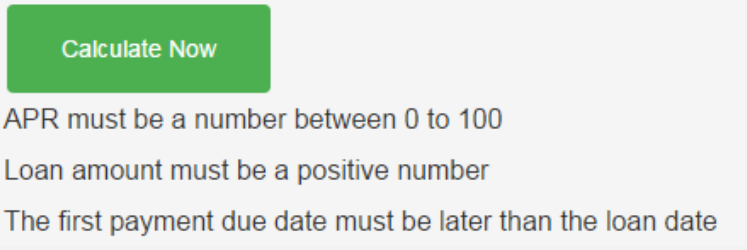
3.1. Form to collect user input

After user collects all necessary data by enquiring the lender, and considers the ability of payback plan. User feeds those data into the form input below



3.2. Error Message for invalid input

When user inputs invalid data, the error message will be displayed after user submit the form. For example: Annual Interest Rate must be within 0 and 100, Loan Amount must be greater than 0, Number of payment must be greater than 0, First payment due must be greater than Loan date

Input	
Output	

4. Fixed Payment Method

4.1. Fixed Payment Method with Points =0

- When user do not have plan to buy any points, the user key in 0 to input field in form input. Supposed that input as follow, the expected output will be

Input key in			Output expected	
# days in year	360		APR new (%)	6.000
Quoted APR	6.00%		Periodic interest (%):	0.500
Points	**0.00%**		Periodic Payment:	$430.33
Loan amount (A)	5,000		Total Interest Paid:	$163.99
#Payments (k)	12		Total Principal Paid:	$5,000.00
Loan date (Approval Date)	15-Jan-17		Total Payment Paid:	$5,163.99
First Payment Due	15-Feb-17			
Payment Frequency	1-month (Monthly)			
Compounding Period	1-month (Monthly)			
Amortization method	Fixed Payment			
Interest on Odd days interest	No			

- How to perform on the program

Input

Output

Outputs:

Payment Interval: 1 month	First payment date(yyyy-mm-dd): 2017-02-15
APR new(%): 6.000	Periodic interest(%): 0.500
Periodic Payment: $430.33	Total Interest Paid: $163.99
Total Principal Paid: $5,000.00	Total Payment Paid: $5,163.99

4.2. Fixed Payment Method with Points >0

- When user has plan to buy points, the user key in points value to input field in form input. Supposed that input as follow, the expected output will be

Input key in			Output expected	
# days in year	360		APR new (%)	4.00
Quoted APR	6.00%		Periodic interest (%):	0.333%
Points	**2.00%**		Periodic Payment:	$425.75
Loan amount (A)	5,000		Total Interest Paid:	$ 208.99
#Payments (k)	12		Total Principal Paid:	$5,000.00
Loan date (Approval Date)	15-Jan-17		Total Payment Paid:	$ 5,208.99
First Payment Due	15-Feb-17		Points payment (2%*5000)	100
Payment Frequency	1-month (Monthly)			
Compounding Period	1-month (Monthly)			
Amortization method	Fixed Payment			
Interest on Odd days interest	No			

- How to perform on the program

Input	**Points(%):** 2
Output	**Outputs:**

Payment Interval: 1 month	First payment date(yyyy-mm-dd): 2017-02-15
APR new(%): 4.000	Periodic interest(%): 0.333
Periodic Payment: $425.75	Total Interest Paid: $208.99
Total Principal Paid: $5,000.00	Total Payment Paid: $5,208.99

4.3. Longer first payment than standard

- When user starts the loan on the date, **before** the typical day the lender is going to collect payment.

User keys explicitly keys in the Loan date and First Payment due date on the form input.

Supposing that the lender collects the debt payment on the 15th every month. The borrower received loan on 10-Jan-2017, it means 5 days earlier, but the first payment due next month on 15-Feb-2017. Therefore, on the first payment on 15-Feb-2017, apart from the fixed payment as other period, it must pay some extra money to cover the interest on the 5 days odd.

Input key in			**Output expected**	
# days in year	360		APR new (%)	6.00%
Quoted APR	6.00%		Periodic interest (%):	0.500%
Points	0.00%		Periodic Payment:	$ 430.33
Loan amount (A)	5,000		Total Interest Paid:	$ 168.15
#Payments (k)	12		Total Principal Paid:	$ 5,000.00
Loan date (Approval Date)	10-Jan-17		Total Payment Paid:	$ 5,168.15
First Payment Due	15-Feb-17		Interest on Extra pay (10/01->15/01)	$ 0.02
Payment Frequency	1-month (Monthly)			
Compounding Period	1-month (Monthly)			
Amortization method	Fixed Payment			
Interest on Odd days interest	No			

- How to perform on the program

Input	**Loan date(mm/dd/yyyy):** 01/10/2017 * **First Payment Due(mm/dd/yyyy):** 02/15/2017 *

Output

Payment Interval: 1 month	First payment date(yyyy-mm-dd): 2017-02-15
APR new(%): 6.000	Periodic interest(%): 0.500
Periodic Payment: $430.33	Total Interest Paid: $168.15
Total Principal Paid: $5,000.00	Total Payment Paid: $5,168.15

Including $0.02 for 5 odd days in the first payment

Amortization Schedule Table

Period	Date	Opening Principal Balance	Periodic Payment	Interest Paid	Principal Reduction	Ending Prin
Approval:	2017-01-10	5,000.00	0.00	[illegible]	0.00	
1	2017-02-15	5,000.00	434.50	29.17	405.33	

4.4. Shorter first payment than standard

- When user starts the loan on the date, **after** the typical day the lender is going to collect payment.

User keys explicitly keys in the Loan date and First Payment due date on the form input.

Supposing that the lender collects the debt payment on the 15th every month. The borrower received loan on 20-Jan-2017, it means 5 days after, but the first payment due next month on 15-Feb-2017. Therefore, on the first payment on 15-Feb-2017, there is no interest on these 5 days

Input key in			Output expected	
# days in year	360		APR new (%)	6.00%
Quoted APR	6.00%		Periodic interest (%):	0.500%
Points	0.00%		Periodic Payment:	$ 430.33
Loan amount (A)	5,000		Total Interest Paid:	$ 159.82
#Payments (k)	12		Total Principal Paid:	$ 5,000.00
Loan date (Approval Date)	20-Jan-17		Total Payment Paid:	$ 5,159.82
First Payment Due	15-Feb-17		Exclude Interest on Extra pay (15/01->20/01)	$ 0.02
Payment Frequency	1-month (Monthly)			
Compounding Period	1-month (Monthly)			
Amortization method	Fixed Payment			
Interest on Odd days interest	No			

- How to perform on the program

Input

Loan date(mm/dd/yyyy): 01/20/2017 *

First Payment Due(mm/dd/yyyy): 02/15/2017 *

Output

Payment Interval: 1 month	First payment date(yyyy-mm-dd): 2017-02-15
APR new(%): 6.000	Periodic interest(%): 0.500
Periodic Payment: $430.33	Total Interest Paid: $159.82
Total Principal Paid: $5,000.00	Total Payment Paid: $5,159.82

Excluded 5 odd days in the 1st payment

Amortization Schedule Table

Period	Date	Opening Principal Balance	Periodic Payment	Interest Paid	Principal Reduction	Ending Principal Bal
Approval:	2017-01-20	5,000.00	0.00	0.[illegible]	0.00	5,0
1	2017-02-15	5,000.00	426.17	20.83	405.33	4,5

4.5. Standard first payment duration

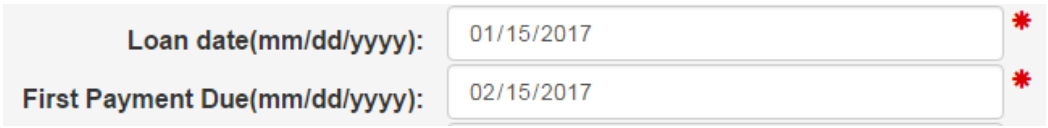
In this case, user input the loan date and first payment due as normal. For example

Supposing that the lender collects the debt payment on the 15th every month. The borrower received loan on 15-Jan-2017, and the first payment due next month on 15-Feb-2017.

Input key in			Output expected	
# days in year	360		APR new (%)	5.93%
Quoted APR	6.00%		Periodic interest (%):	0.494%
Points	0.00%		Periodic Payment:	$ 430.16
Loan amount (A)	5,000		Total Interest Paid:	$ 161.95
#Payments (k)	12		Total Principal Paid:	$ 5,000.00
Loan date (Approval Date)	15-Jan-17		Total Payment Paid:	$ 5,161.95
First Payment Due	15-Feb-17			
Payment Frequency	1-month (Monthly)			
Compounding Period	6-month (Semi-annually)			
Amortization method	Fixed Payment			
Interest on Odd days interest	No			

- How to perform on the program

Input



Output

Payment Interval: 1 month	First payment date(yyyy-mm-dd): 2017-02-15
APR new(%): 5.926	Periodic interest(%): 0.494
Periodic Payment: $430.16	Total Interest Paid: $161.95
Total Principal Paid: $5,000.00	Total Payment Paid: $5,161.95

Amortization Schedule Table

Period	Date	Opening Principal Balance	Periodic Payment	Interest Paid	Principal Reduction	Ending Principal Ba
Approval	2017-01-15	5,000.00	0.00	0.00	0.00	5,0
1	2017-02-15	5,000.00	430.16	24.69	405.47	4,5

4.6. The compounding period and the payment frequency are the same

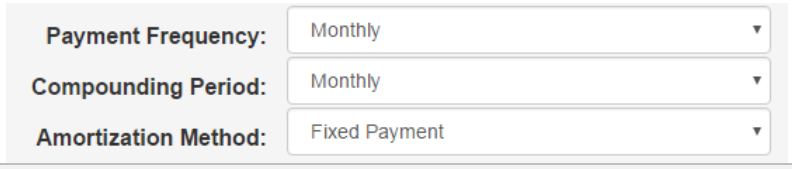
- User decideds to input the same value for compounding period and payment frequency. In that case, There is no different between ARP new and ARP quoted.
- For example, the Payment Frequency: Monthly, Compounding period: Monthly.

Input key in			Output expected:	
# days in year	360		APR new (%)	6.50%
Quoted APR	6.50%		Periodic interest (%):	0.542%
Points	0.00%		Periodic Payment:	$ 431.48
Loan amount (A)	5,000		Total Interest Paid:	$ 177.79
#Payments (k)	12		Total Principal Paid:	$ 5,000.00
Loan date (Approval Date)	15-Jan-17		Total Payment Paid:	$ 5,177.79

First Payment Due	15-Feb-17			
Payment Frequency	1-month (Monthly)			
Compounding Period	1-month (Monthly)			
Amortization method	Fixed Payment			
Interest on Odd days interest	No			

- How to perform on the program

Input



Output

Payment Interval: 1 month	First payment date(yyyy-mm-dd): 2017-02-15
APR new(%): 6.500	Periodic interest(%): 0.542
Periodic Payment: $431.48	Total Interest Paid: $177.79
Total Principal Paid: $5,000.00	Total Payment Paid: $5,177.79

Amortization Schedule Table

Period	Date	Opening Principal Balance	Periodic Payment	Interest Paid	Principal Reduction	Ending Principal Bal
Approval	2017-01-15	5,000.00	0.00	0.00	0.00	5,0
1	2017-02-15	5,000.00	431.48	27.08	404.40	4,5
2	2017-03-15	4,595.60	431.48	24.89	406.59	4,1

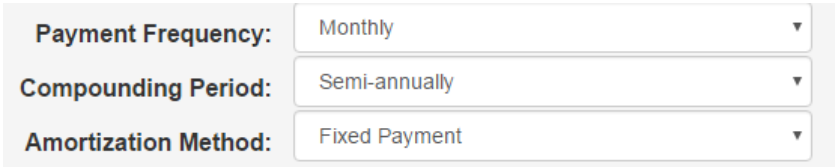
4.7. The compounding period and the payment frequency are different

- User decideds to input the different value for compounding period and payment frequency. In that case, the need of sychonize the ARP new with ARP quoted. For example, the Payment Frequency: Monthly, Compounding period: Semi-annualy.

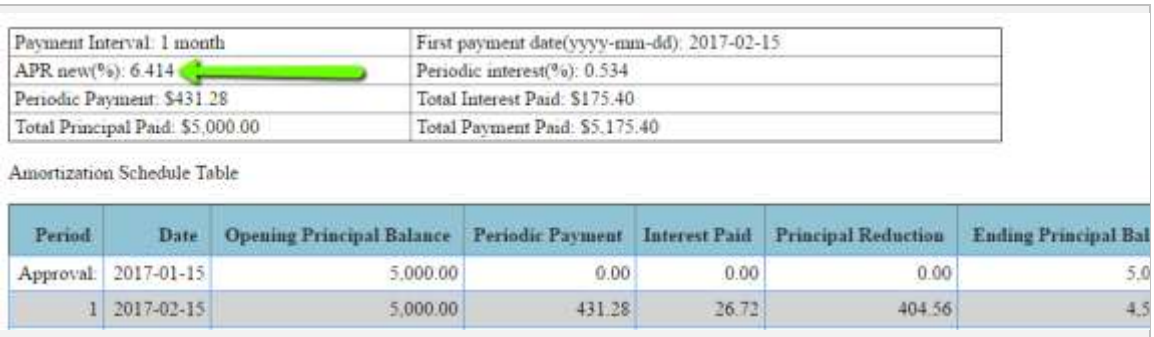
Input key in			Output expected	
# days in year	360		APR new (%)	6.41%
Quoted APR	6.50%		Periodic interest (%):	0.534%
Points	0.00%		Periodic Payment:	$ 431.28
Loan amount (A)	5,000		Total Interest Paid:	$ 175.40
#Payments (k)	12		Total Principal Paid:	$ 5,000.00
Loan date (Approval Date)	15-Jan-17		Total Payment Paid:	$ 5,175.40
First Payment Due	15-Feb-17			
Payment Frequency	1-month (Monthly)			
Compounding Period	6-months (Semi-annually)			
Amortization method	Fixed Payment			
Interest on Odd days interest	No			

- How to perform on the program

Input



Output



Payment Interval: 1 month	First payment date(yyyy-mm-dd): 2017-02-15
APR new(%): 6.414	Periodic interest(%): 0.534
Periodic Payment: $431.28	Total Interest Paid: $175.40
Total Principal Paid: $5,000.00	Total Payment Paid: $5,175.40

Amortization Schedule Table

Period	Date	Opening Principal Balance	Periodic Payment	Interest Paid	Principal Reduction	Ending Principal Bal
Approval	2017-01-15	5,000.00	0.00	0.00	0.00	5,0
1	2017-02-15	5,000.00	431.28	26.72	404.56	4,5

The way to perform on the program applied to 5 following Amortization methods are pretty much the same as Fixed Payment above. The only difference is that instead of selecting Fixed Payment, other amortization method will be chosen.

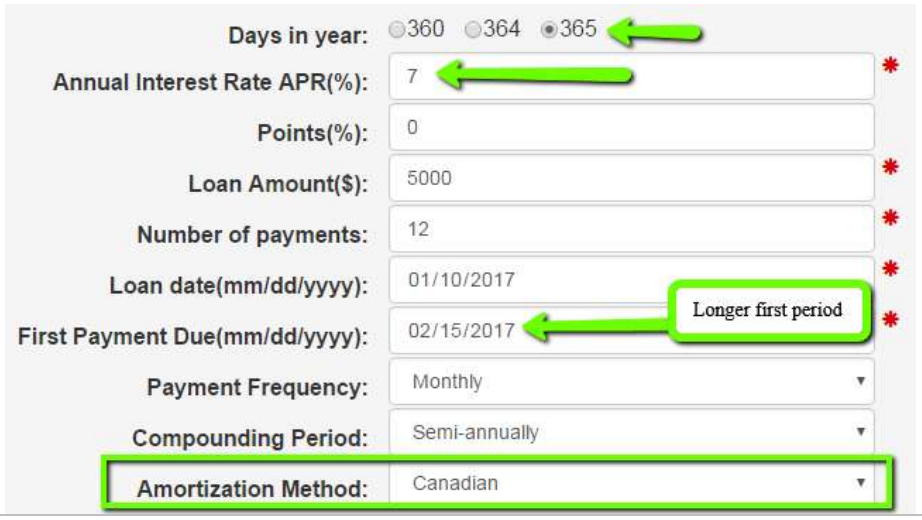
5. Canadian Method

- In nutshell, Canadian Method is a special case of Fixed Payment method where compounding period is set to Semi-annually.
- Note that: In the program, when Canadian method is chosen, regardless of compounding period, it will automatically set default to Semi-annually

Input key in			Output expected:	
# days in year	365		APR new (%)	6.90%
Quoted APR	7.00%		Periodic interest (%):	0.575%
Points	0.00%		Periodic Payment:	$ 432.40
Loan amount (A)	5,000		Total Interest Paid:	$ 175.40
#Payments (k)	12		Total Principal Paid:	$ 5,000.00
Loan date (Approval Date)	10-Jan-17		Total Payment Paid:	$ 5,175.40
First Payment Due	15-Feb-17		Interest on Extra pay: P0 -> P1	**0.03**
Payment Frequency	1-month (Monthly)			
Compounding Period	6-months (Semi-annually)			
Amortization method	Canadian			
Interest on Odd days interest	No			

- How to perform on the program

Input



Output

Payment Interval: 1 month	First payment date(yyyy-mm-dd): 2017-02-15
APR new(%): 6.900	Periodic interest(%): 0.575
Periodic Payment: $432.40	Total Interest Paid: $193.57
Total Principal Paid: $5,000.00	Total Payment Paid: $5,193.57

Amortization Schedule Table

Period	Date	Opening Principal Balance	Periodic Payment	Interest Paid	Principal Reduction	Ending Principal
Approval:	2017-01-10	5,000.00	0.00	0.00	0.00	
1	2017-02-15	5,000.00	437.13	33.48	403.65	
2	2017-03-15	4,596.35	432.40	26.43	405.97	

6. Rule-of-78 Method

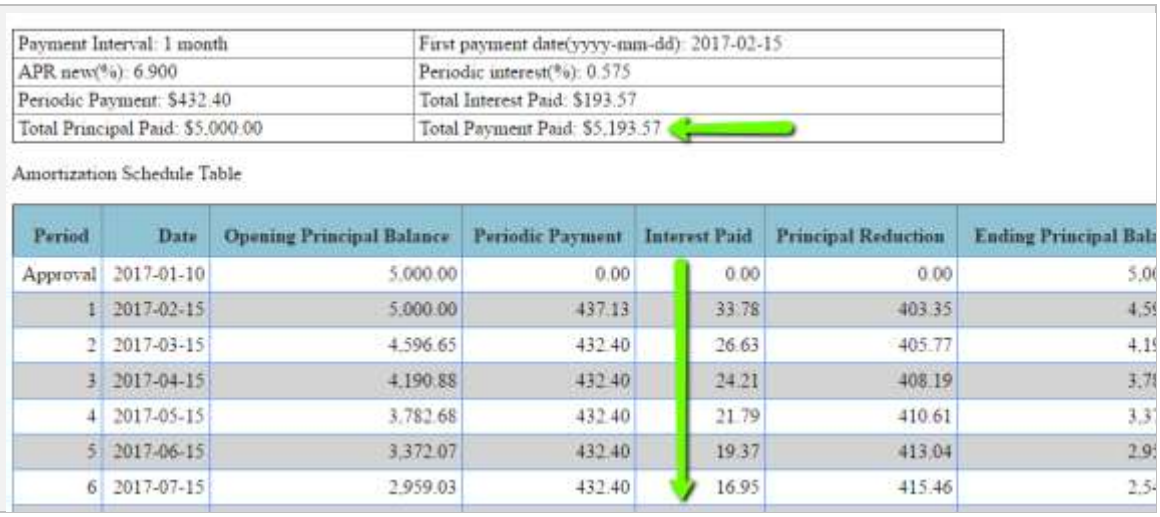
- Borrower makes the equal amount of payment every period, which is similar to Fixed Payment. However, borrower pays the biggest portions of interest earlier along with a part of principal. Then, the interest payment will be decrease gradually. Total interest in Rule-of-78 and Fixed Payment equal assuming that the borrower is not going to settle the loan before loan agreement, and other input the same.
- For example: With the same input value, the Total Payment paid of Rule-of-78 results in the same value as Canadian method (Fixed Payment): $ 5,175.40 in this case.

Input key in			Output expected	
# days in year	365		APR new (%)	6.90%
Quoted APR	7.00%		Periodic interest (%):	0.575%
Points	0.00%		Periodic Payment:	$ 432.40
Loan amount (A)	5,000		Total Interest Paid:	$ 175.40
#Payments (k)	12		Total Principal Paid:	$ 5,000.00
Loan date (Approval Date)	10-Jan-17		Total Payment Paid:	$ 5,175.40
First Payment Due	15-Feb-17		Interest on Extra pay: P0 -> P1	**0.03**
Payment Frequency	1-month (Monthly)			
Compounding Period	6-months (Semi-annually)			
Amortization method	Rule-of-78			
Interest on Odd days interest	No			

- How to perform on the program

Input

Output



Payment Interval: 1 month	First payment date(yyyy-mm-dd): 2017-02-15
APR new(%): 6.900	Periodic interest(%): 0.575
Periodic Payment: $432.40	Total Interest Paid: $193.57
Total Principal Paid: $5,000.00	Total Payment Paid: $5,193.57

Amortization Schedule Table

Period	Date	Opening Principal Balance	Periodic Payment	Interest Paid	Principal Reduction	Ending Principal Bal
Approval	2017-01-10	5,000.00	0.00	0.00	0.00	5,0
1	2017-02-15	5,000.00	437.13	33.78	403.35	4,5
2	2017-03-15	4,596.65	432.40	26.63	405.77	4,1
3	2017-04-15	4,190.88	432.40	24.21	408.19	3,7
4	2017-05-15	3,782.68	432.40	21.79	410.61	3,3
5	2017-06-15	3,372.07	432.40	19.37	413.04	2,9
6	2017-07-15	2,959.03	432.40	16.95	415.46	2,5

7. Fixed Principal Method

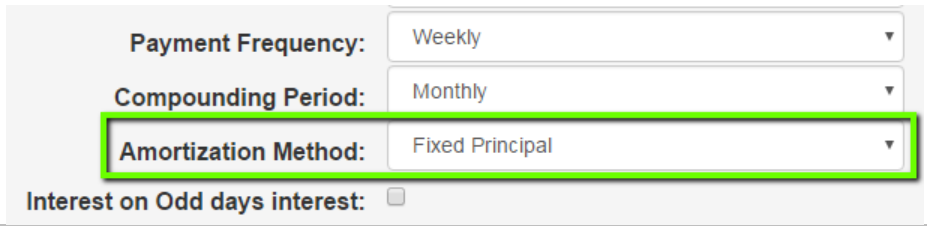
- In each period, borrower pays equal part of principal plus interest for this period. Example as below.

In the result, Periodic Payment is default to show the value of fixed principal, in this case: $3,000 (36,000/12)

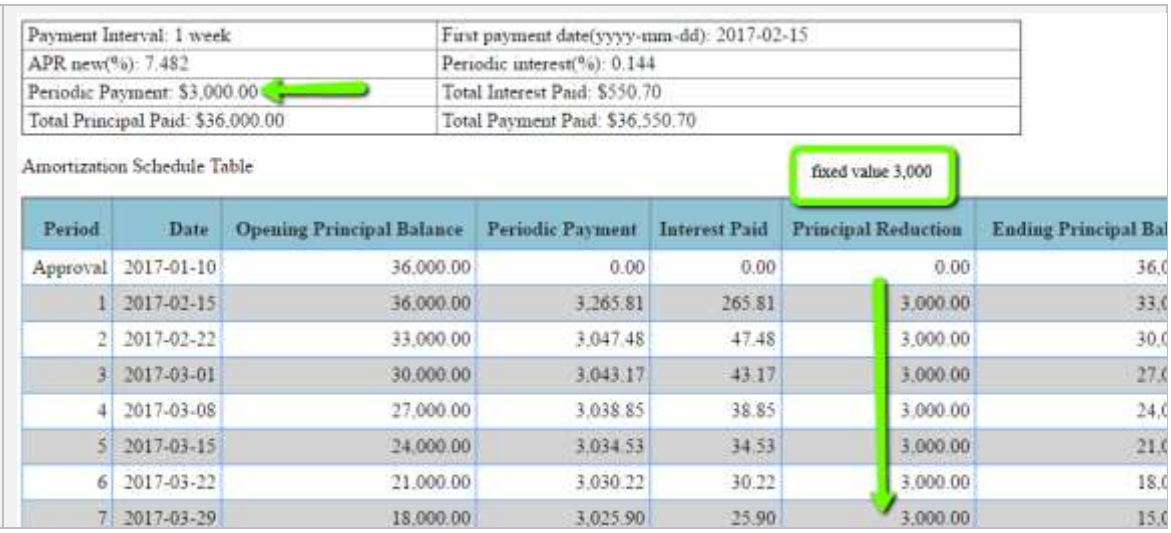
Input key in			Output expected	
# days in year	365		APR new (%)	7.482%
Quoted APR	7.50%		Periodic interest (%):	0.144%
Points	0.00%		Periodic Payment:	$ 3,000.00
Loan amount (A)	36,000		Total Interest Paid:	$ 550.70
#Payments (k)	12		Total Principal Paid:	$ 36,000.00
Loan date (Approval Date)	10-Jan-17		Total Payment Paid:	$ 36,550.70
First Payment Due	15-Feb-17			
Payment Frequency	Weekly			
Compounding Period	Monthly			
Amortization method	Fixed Principal			
Interest on Odd days interest	No			

- How to perform on the program

Input



Output



Payment Interval: 1 week	First payment date(yyyy-mm-dd): 2017-02-15
APR new(%): 7.482	Periodic interest(%): 0.144
Periodic Payment: $3,000.00	Total Interest Paid: $550.70
Total Principal Paid: $36,000.00	Total Payment Paid: $36,550.70

Amortization Schedule Table

fixed value 3,000

Period	Date	Opening Principal Balance	Periodic Payment	Interest Paid	Principal Reduction	Ending Principal Ba
Approval	2017-01-10	36,000.00	0.00	0.00	0.00	36,0
1	2017-02-15	36,000.00	3,265.81	265.81	3,000.00	33,0
2	2017-02-22	33,000.00	3,047.48	47.48	3,000.00	30,0
3	2017-03-01	30,000.00	3,043.17	43.17	3,000.00	27,0
4	2017-03-08	27,000.00	3,038.85	38.85	3,000.00	24,0
5	2017-03-15	24,000.00	3,034.53	34.53	3,000.00	21,0
6	2017-03-22	21,000.00	3,030.22	30.22	3,000.00	18,0
7	2017-03-29	18,000.00	3,025.90	25.90	3,000.00	15,0

8. Interest Only Method

- In each period, borrower only pays interest for this period, and leave the principal payment to the last period. Example as below. In the result, each period except the last one, principal reduction =0, only interest paid exists. In the last period, a huge payment is made consisting of principal and interest for the last.

Input key in			Output expected	
# days in year	365		APR new (%)	7.482%
Quoted APR	7.50%		Periodic interest (%):	0.144%
Points	0.00%		Periodic Payment:	$ 3,000.00
Loan amount (A)	36,000		Total Interest Paid:	$ 550.70
#Payments (k)	12		Total Principal Paid:	$ 36,000.00
Loan date (Approval Date)	15-Jan-17		Total Payment Paid:	$ 36,550.70
First Payment Due	15-Feb-17			
Payment Frequency	Weekly			
Compounding Period	Monthly			
Amortization method	Interest Only			
Interest on Odd days interest	No			

- How to perform on the program

Input

Output

Payment Interval: 1 week	First payment date(yyyy-mm-dd): 2017-02-15
APR new(%): 7.482	Periodic interest(%): 0.144
Periodic Payment: $36,000.00	Total Interest Paid: $798.69
Total Principal Paid: $36,000.00	Total Payment Paid: $36,798.69

Amortization Schedule Table

Period	Date	Opening Principal Balance	Periodic Payment	Interest Paid	Principal Reduction	Ending Principal Bal
Approval	2017-01-15	36,000.00	0.00	0.00	0.00	36,0
1	2017-02-15	36,000.00	228.91	228.91	0.00	36,0
2	2017-02-22	36,000.00	51.80	51.80	0.00	36,0
3	2017-03-01	36,000.00	51.80	51.80	0.00	36,0
4	2017-03-08	36,000.00	51.80	51.80	0.00	36,0
5	2017-03-15	36,000.00	51.80	51.80	0.00	36,0
6	2017-03-22	36,000.00	51.80	51.80	0.00	36,0
7	2017-03-29	36,000.00	51.80	51.80	0.00	36,0
8	2017-04-05	36,000.00	51.80	51.80	0.00	36,0
9	2017-04-12	36,000.00	51.80	51.80	0.00	36,0
10	2017-04-19	36,000.00	51.80	51.80	0.00	36,0
11	2017-04-26	36,000.00	51.80	51.80	0.00	36,0
12	2017-05-03	36,000.00	36,051.80	51.80	36,000.00	
Total			**36,798.69**	**798.69**	**36,000.00**	

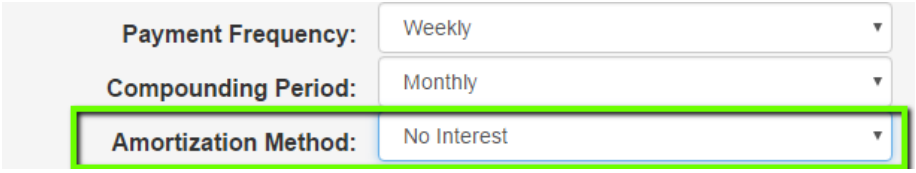
9. No Interest Method

- Borrower only has to pay principal, and no interest involved. Therefore, in each period, a fixed part of loan amount is paid. Example as below. In the result, the fixed amount of $3,000 is paid from the first period until the last one.

Input key in			**Output expected**	
# days in year	365		APR new (%)	7.482%
Quoted APR	7.50%		Periodic interest (%):	0.144%
Points	0.00%		Periodic Payment:	$ 3,000.00
Loan amount (A)	36,000		Total Interest Paid:	$ 550.70
#Payments (k)	12		Total Principal Paid:	$ 36,000.00
Loan date (Approval Date)	15-Jan-17		Total Payment Paid:	$ 36,550.70
First Payment Due	15-Feb-17			
Payment Frequency	Weekly			
Compounding Period	Monthly			
Amortization method	No Interest			
Interest on Odd days interest	No			

- How to perform on the program

Input



Output

Payment Interval: 1 week	First payment date(yyyy-mm-dd): 2017-02-15
APR new(%): 7.482	Periodic interest(%): 0.144
Periodic Payment: $3,000.00	Total Interest Paid: $0.00
Total Principal Paid: $36,000.00	Total Payment Paid: $36,000.00

Amortization Schedule Table

Period	Date	Opening Principal Balance	Periodic Payment	Interest Paid	Principal Reduction	Ending Principal Ba
Approval	2017-01-15	36,000.00	0.00	0.00	0.00	36,0
1	2017-02-15	36,000.00	3,000.00	0.00	3,000.00	33,0
2	2017-02-22	33,000.00	3,000.00	0.00	3,000.00	30,0
3	2017-03-01	30,000.00	3,000.00	0.00	3,000.00	27,0
4	2017-03-08	27,000.00	3,000.00	0.00	3,000.00	24,0
5	2017-03-15	24,000.00	3,000.00	0.00	3,000.00	21,0
6	2017-03-22	21,000.00	3,000.00	0.00	3,000.00	18,0
7	2017-03-29	18,000.00	3,000.00	0.00	3,000.00	15,0
8	2017-04-05	15,000.00	3,000.00	0.00	3,000.00	12,0
9	2017-04-12	12,000.00	3,000.00	0.00	3,000.00	9,0
10	2017-04-19	9,000.00	3,000.00	0.00	3,000.00	6,0
11	2017-04-26	6,000.00	3,000.00	0.00	3,000.00	3,0
12	2017-05-03	3,000.00	3,000.00	0.00	3,000.00	
Total			**36,000.00**	**0.00**	**36,000.00**	

10. Appendix 1: Mathematics calculation for Actual APR

The following explanation is for those want to know why the equation (3) comes to exist.

The proper financial term for Actual ARP is Effective Annual Rate (EAR)

On Lender's side: Amount received after 1 year for $1 lending out:

$$1 + \text{ Effective Annual Rate (EAR)} = \left(1 + \frac{APR_q}{n_c}\right)^{n_c} \quad (4)$$

On Borrower's side: Amount paid after 1 year for $1 borrowing:

$$1 + \text{ Effective Annual Rate (EAR)} = \left(1 + \frac{APR_{actual}}{n_p}\right)^{n_p} \quad (5)$$

After 1 year, the amount lender receives is equal to the amount borrower pays. Therefore, by solving the equation (2) = equation (3), the APR_{actual} can be found on the equation (1))

(n_p: $Number\ of\ payments\ in\ a\ year$

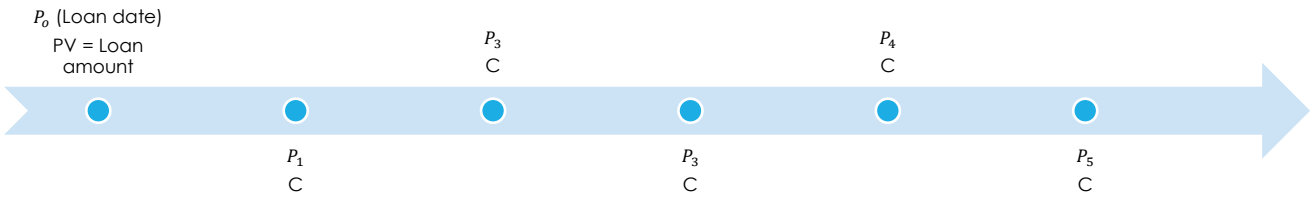
n_c: $Number\ of\ compounding\ period\ in\ a\ year$

APR_q: $Annual\ Percentage\ Rate\ given\ by\ Lender$)

Go Back

11. Appendix 2: Mathematics calculation of Ordinary Annuity

Loan dated on P0 with Loan amount as called Present value(PV). The payment will be made at the end of each period depicted wit P1, P2,.., Pn (n =5, in the example). Let say C be the fixed payment in each period.



✓ The idea is that present value of all payments the borrower makes in those time points in the future must be equal to Loan amount given out on the Loan date P0. How to find out value of payment amount at a point of time in the future as it is on the Loan date? Using Interest Rate. Interest Rate is the physical form of concept: Time-value of Money. Lender expresses the value of money he/she gives out, by using interest rate.

✓ Mechanic process

After calculating actual ARP, using equation (2) to figure out r (Interest rate for each payment period). We convert all amount of C into value at Po as follow:

$$\text{PV} = \frac{C}{1+r} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^3} + \cdots + \frac{C}{(1+r)^n}$$

$$PV = C * \left[\frac{1}{1+r} + \frac{1}{(1+r)^2} + \frac{1}{(1+r)^3} + \cdots + \frac{1}{(1+r)^n}\right] \quad (5)$$

We all know that,

$$A = 1 + q^1 + q^2 + q^3 + q^4 + \cdots + q^n$$

$$q * A = q^1 + q^2 + q^3 + q^4 + \cdots + q^n + q^{n+1}$$

$$(1-q) * A = 1 - q^{n+1}$$

$$A = 1 + q^1 + q^2 + q^3 + q^4 + \cdots + q^n = \frac{1-q^{n+1}}{(1-q)}$$

So, $q^1 + q^2 + q^3 + q^4 + \cdots + q^n = \frac{1-q^{n+1}}{(1-q)} - 1 \quad (6)$

Substitute the result of equation (6) to equation (5) with $q = \frac{1}{1+r}$

The final answer is $C = \frac{(1+r)^n * r}{(1+r)^n - 1} * PV \ (4)$

Go Back