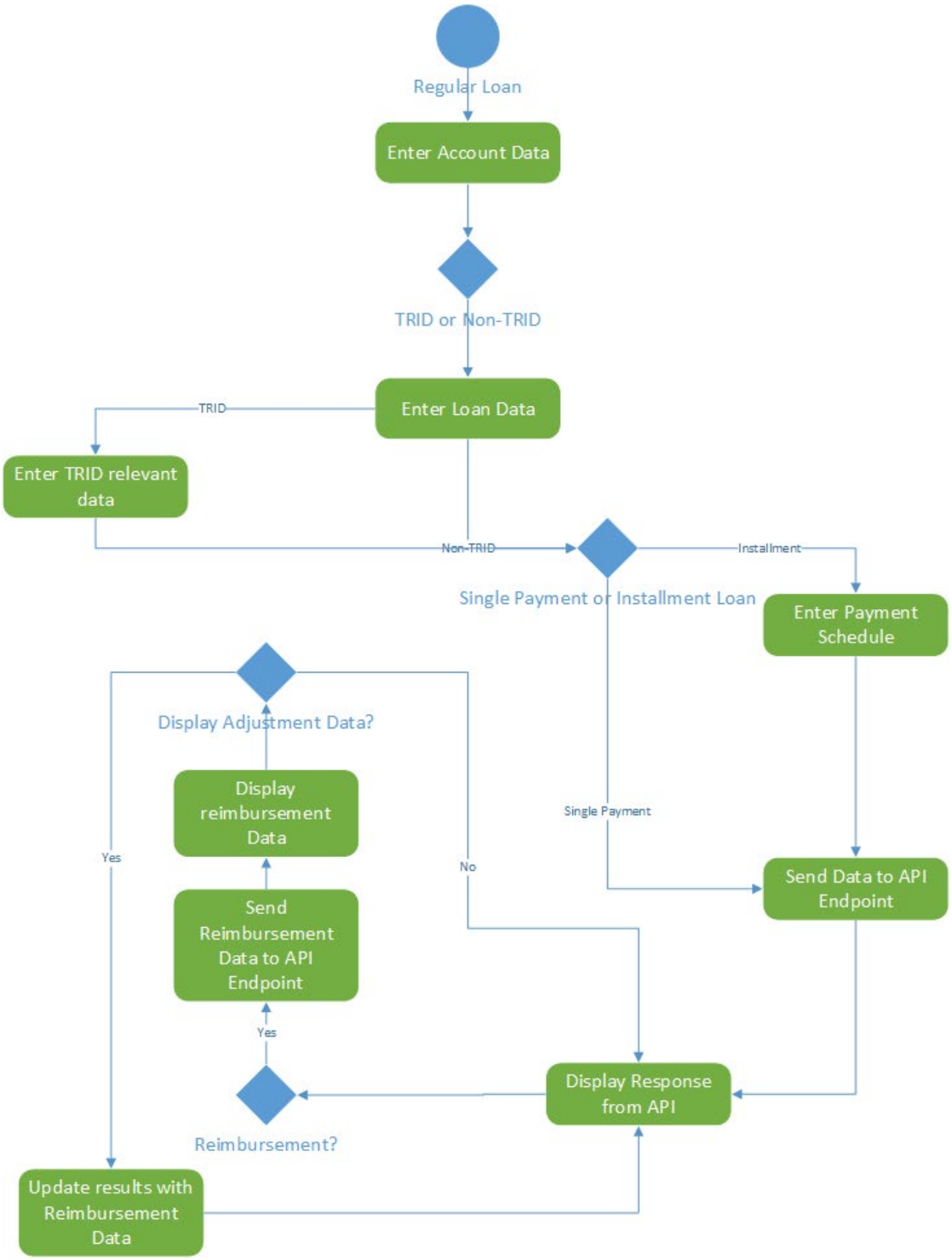
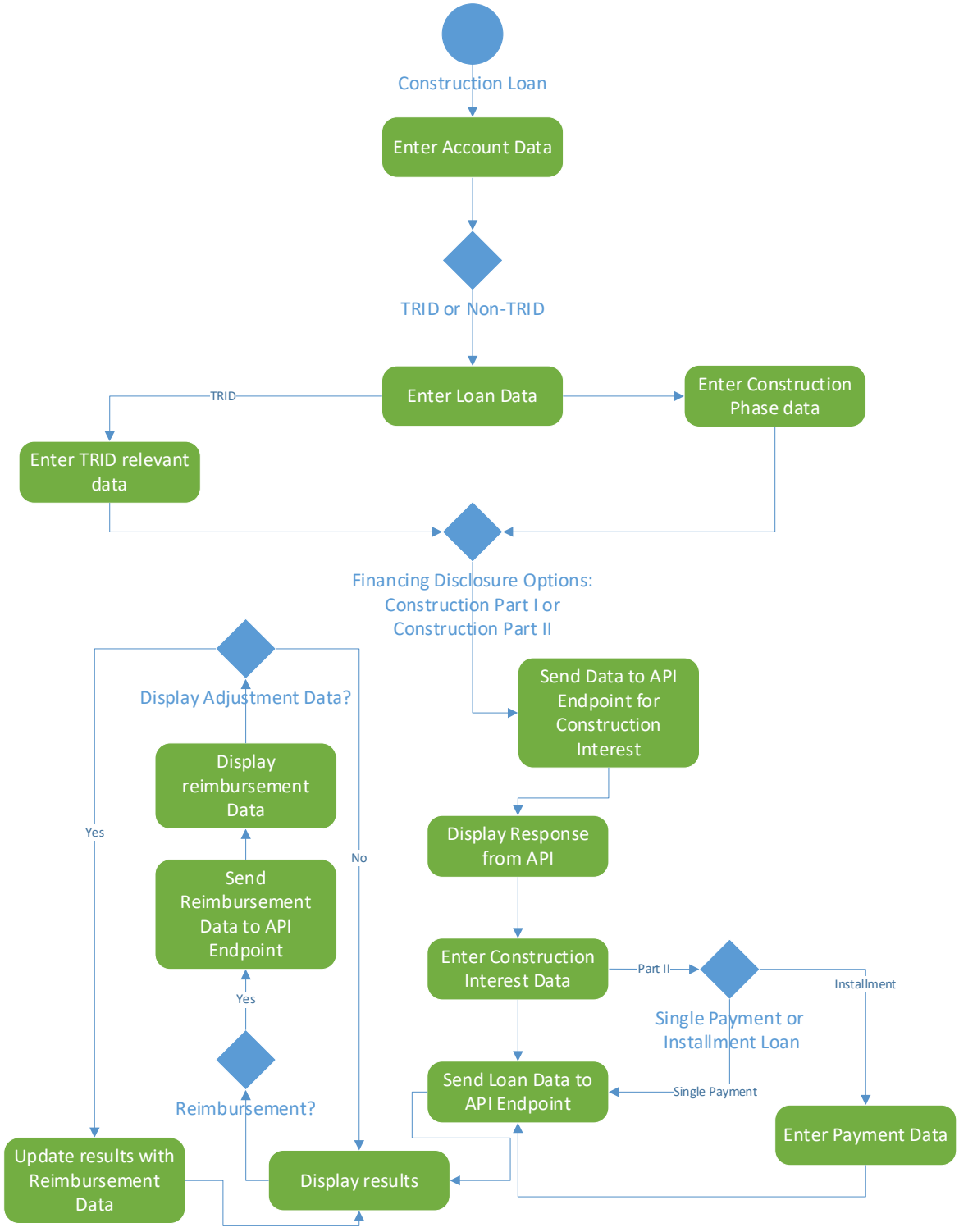
FFIEC Federal Disclosure Computational Tools

APR Calculator Formula Document

APR Loan Verification Workflows




Construction Loan
Enter Account Data
TRID or Non-TRID
TRID
Enter Loan Data
Enter Construction Phase data
Enter TRID relevant data
Financing Disclosure Options: Construction Part I or Construction Part II
Send Data to API Endpoint for Construction Interest
Display Response from API
Enter Construction Interest Data
Part II
Installment
Single Payment or Installment Loan
Single Payment
Send Loan Data to API Endpoint
Enter Payment Data
Display Adjustment Data?
Yes
No
Display reimbursement Data
Send Reimbursement Data to API Endpoint
Yes
Reimbursement?
Update results with Reimbursement Data
Display results

APR Tool Formulas

Regular APR Loans

The APR Tool follows Appendix J of Regulation Z to calculate **APRs** using the Actuarial Method. When the amount financed and payment schedule are known, the APR can be determined by formulas in Appendix J. An accurate APR will amortize the amount financed with a given payment schedule. Here is a sample loan:

$1,000.00	Loan amount
$ 25.00	Loan fee (prepaid finance charge)
$ 975.00	Amount financed ($1,000 - $25.00 = $975.00)
$ 340.00	Monthly payment amount
3	Number of payments
27.4849%	APR
.022904	Monthly rate (.274849/12)

APR calculation

APR Tool Input

Amount Financed = $975

Monthly installment Loan

Payment Schedule (see definition below):

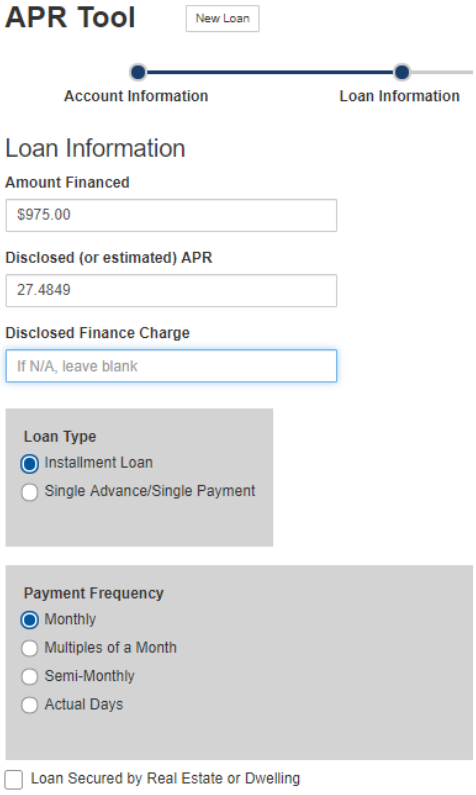
Payment Stream = 1
Payment Amount - $340
Number of Payments = 3
Unit Periods = 1
Odd Days = 0

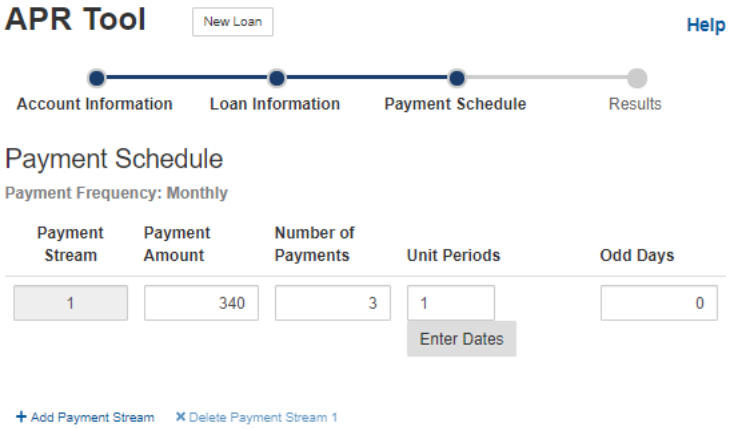
Note: A payment schedule is comprised of one or more of payment streams. A payment stream includes the following:

- Payment Stream Number
- Payment Amount
- Number of Payments
- Unit Periods
- Odd Days

It is important to note that a payment includes any payment of principal, interest or any other finance charge made separately after consummation.

APR Tool input for the sample loan:


APR Tool
New Loan
Account Information
Loan Information
Loan Information
Amount Financed
$975.00
Disclosed (or estimated) APR
27.4849
Disclosed Finance Charge
If N/A, leave blank
Loan Type
Installment Loan
Single Advance/Single Payment
Payment Frequency
Monthly
Multiples of a Month
Semi-Monthly
Actual Days
Loan Secured by Real Estate or Dwelling


APR Tool
New Loan
Help
Account Information
Loan Information
Payment Schedule
Results
Payment Schedule
Payment Frequency: Monthly
Payment Stream
Payment Amount
Number of Payments
Unit Periods
Odd Days
1
340
3
1
Enter Dates
0
+ Add Payment Stream
× Delete Payment Stream 1

Math Algorithm

Symbols

A_k = The amount of the kth advance.

q_k = The number of full unit-periods from the beginning of the term of the transaction to the kth advance.

e_k = The fraction of a unit-period in the time interval from the beginning of the term of the transaction to the kth advance.

m = The number of advances.

P_j = The amount of the jth payment.

t_j = The number of full unit-periods from the beginning of the term of the transaction to the jth payment.

f_j = The fraction of a unit-period in the time interval from the beginning of the term of the transaction to the jth payment

n = The number of payments.

i = The percentage rate of finance charge per unit-period, expressed as a decimal equivalent.

$\ddot{a}_{\overline{x}|}$ = The present value of 1 per unit-period for x unit-periods, first payment due immediatley.

$$= 1 + \frac{1}{(1+i)} + \frac{1}{(1+i)^2} + \ldots\ldots\ldots + \frac{1}{(1+i)^{x-1}}$$

w = The number of unit-periods per year.

I = wi x 100 = The nominal annual percentage rate.

General equation

The general equation in section (8) of Appendix J to Regulation Z sets forth the relationship among the terms of a transaction:

$$\frac{A_1}{(1+e_1 i)(1+i)^{q_1}} + \frac{A_2}{(1+e_2 i)(1+i)^{q_2}} + \ldots + \frac{A_m}{(1+e_m i)(1+i)^{q_m}} = \frac{P_1}{(1+f_1 i)(1+i)^{t_1}} + \frac{P_2}{(1+f_2 i)(1+i)^{t_2}} + \ldots + \frac{P_n}{(1+f_n i)(1+i)^{t_n}}$$

In the given example, the calculation breaks down to:

Month 1
975 x .022904 = $22.33 (accrued FC)
975 + 22.33 – $340 = $657.33

Month 2
$657.33 x .022904 = $15.06 (accrued FC)
$657.33 + 15.06 – $340.00 = $332.39

Month 3
332.39 x .022904 = $7.61 (accrued FC)
332.39 + 7.61 – $340.00 = $0.00

The complex equation is simplified for the given loan as shown below:

$$A = \frac{P1}{(1+i)^1} + \frac{P2}{(1+i)^2} + \frac{P3}{(1+i)^3} \quad \rightarrow \quad 975 = \frac{340}{(1+i)^1} + \frac{340}{(1+i)^2} + \frac{340}{(1+i)^3}$$

Solve for i

Follow the exact steps as outlined in the solution of general equation by iteration process in Other Calculations section of this document, and the iteration process will solve i.

Note that additional advances are entered in APR Tool and plugged into the formula to calculate A as negative payments.

In the given example, the iteration process solves i = 0.022904

APR = i × 12 × 100 = 27.48%

The APR agrees with the APR Tool output for the loan.

Other disclosure calculation

Amount Financed for Disclosure = Amount Financed + Sum of Advances in Payment Schedule
Total of Payments = Sum of Payments in Payment Schedule
Finance Charge = Total of Payments - Amount Financed

In the given example, these are the results:

Amount Financed for Disclosure = $975 + $0 = $975

Total of Payments = $340 × 3 = $1,020

Finance Charge = $1,020 - $975 = $45

The results agree with the APR Tool output as shown below in Figure 1.

Disclosure Information - Output

Amount Financed
$975.00
Finance Charge
$45.00
Total of Payments
$1,020.00
Annual Percentage Rate
27.4849%
Loan Regularity
Regular

Loan Information - Original Input

Amount Financed
$975.00
Disclosed (estimated) APR
27.4849%
Disclosed Finance Charge
$0.00
Loan Secured by Real Estate or Dwelling
No
Payment Frequency
Monthly (Installment Loan)
Loan Subject to TRID
No

Payment Frequency

Payment Stream	Payment Amount	Number of Payments	Whole Unit Periods	Odd Days
1	$340.00	3	1	0

Figure 1 APR Tool calculated disclosure for the regular APR loan sample

APR and Finance Charge Tolerance

Finance Charge Tolerance

When an amount is entered as disclosed finance charge, it is checked against the APR Tool calculated finance charge.

Legal Finance Charge Tolerance is determined as follows:

- If a loan is secured by Real Estate, FC-T = $100.
- If a loan is not secured by Real Estate,
  - If amount financed ≤ $1,000, FC-T = $5
  - If amount financed > $1000, FC FC-T T = $10

When the calculated FC > the disclosed FC, and the difference > FC-T ➔ FC Understated (violation)

When the disclosed FC > the calculated FC, and the difference > FC-T ➔ FC Overstated (violation)

Except when a loan is secured by real estate and finance charge is overstated, it is NOT a violation.

Whenever a disclosed finance charge is understated, reimbursement option should be shown to allow reimbursement calculation.

APR Tolerance

Legal APR Tolerance is determined as follows:

- If it is a regular loan, APR-T =1/8 of 1%
- If it is an irregular loan, APR-T = ¼ of 1%

Refer to the Regular vs Irregular Loan definitions in the Other Calculations section to determine if a loan is regular/irregular

When the calculated APR > the disclosed APR, and the difference > APR-T ➔ APR Understated

When the disclosed APR > the calculated APR, and the difference > APR-T ➔ APR Overstated

When a loan is secured by real estate

- If both disclosed APR and disclosed finance charge are overstated, alert the user if this is a finance charge input error. If a FC input error, the disclosed APR is considered accurate if it does not exceed the greater of (1) the APR plus the legal APR Tolerance, or (2) the APR generated by the FC error. Otherwise, it is a violation.

- If disclosed APR is understated and the disclosed finance charge is understated but within tolerance, alert the user if this is a finance charge input error. If a FC input error, the disclosed APR is considered accurate if it is not lower than the lower of (1) the APR minus the legal APR tolerance, or (2) the understated APR generated by the FC error. Otherwise, it is a violation.

  (see https://www.consumercomplianceoutlook.org/2011/first-quarter/mortgage-disclosure-improvement-act/).

Obvious Error Rule

When APR is disclosed accurately (within legal tolerance) and disclosed finance charge is so significantly understated that a disclosed value is 10% or less than of the calculated value, then Obvious Error Rule applies.

When finance charge is disclosed accurately (within legal tolerance) and disclosed APR is so significantly understated that a disclosed APR is 10% or less than of the calculated APR, then Obvious Error Rule applies.

Construction Loans[1]

APR Tool follows Appendix D – Multiple Advance Construction Loans, of Regulation Z, to estimate construction interest and calculate disclosures.

Depending how a creditor chooses to disclose, construction loan calculation is categorized as follows:

- Part I – Construction Period Disclosed Separately
- Part II – Construction and Permanent Financing Disclosed as One Transaction

Both Part I and Part II follow the same algorithm to estimate construction interest. The following subsections describe how construction interests are estimated and how Part I and Part II disclosures are calculated.

Estimated Interest

We use a simple construction loan as an example to illustrate the estimate of interest during the construction period.

A $50,000 loan commitment at 10.5% interest with a 5-month construction period and a prepaid finance charge of 2 points.

APR Tool input

Loan Commitment Amount = $50,000

Annual Simple Interest rate = 10.5%

Prepaid Finance Charge = $1,000

Subsequently Paid Finance Charge = $0

Interest Accrual: Whole Months (360/360)

Construction Phase Time Period = 5 Months

[1] This section contains construction loan examples NOT subject to TRID. The "Loan Subject to TRID" box is not checked for these examples. It also applies to multiple advance loans that are not construction loans but are covered by Appendix D.

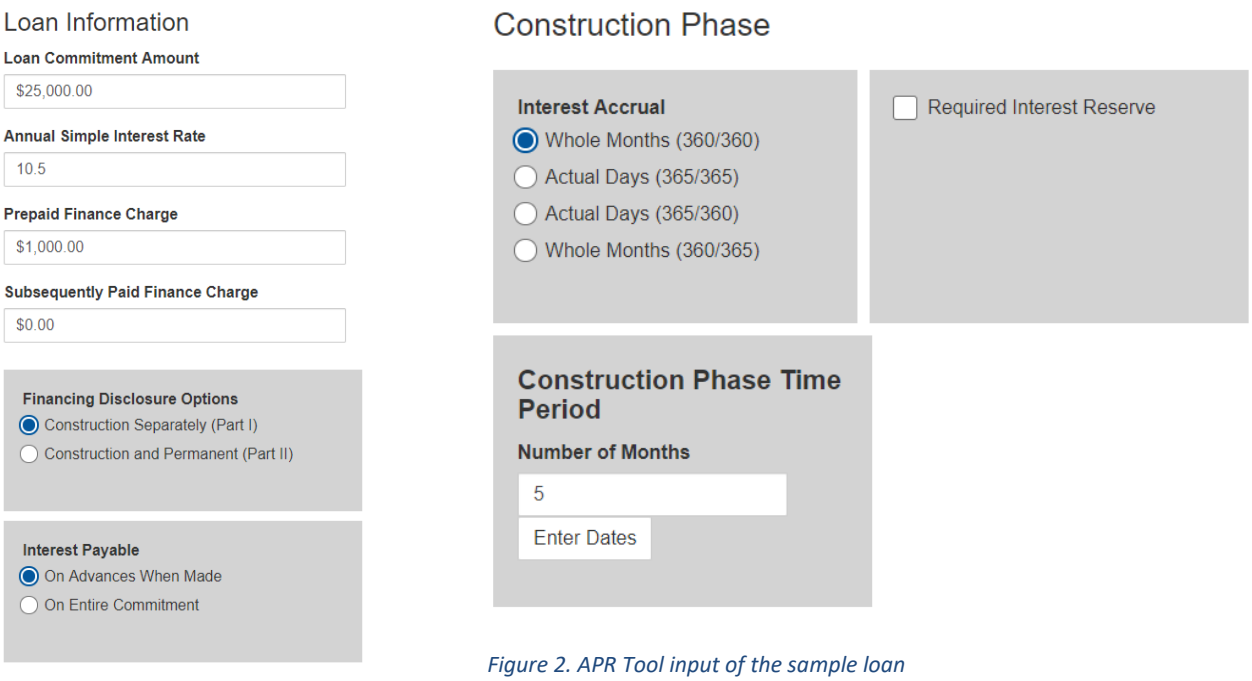


Figure 2. APR Tool input of the sample loan

There are a few input options in Figure 2 that affect the calculation of the interest:

- Interest Payable:
  - On Advance When Made
  - On Entire Commitment
- Interest Accrual:
  - Whole Months (360/360)
  - Actual Days (365/365)
  - Actual Days (365/360)
  - Other
- Required Interest Reserve

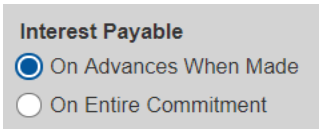
These options and how they affect the calculation are discussed in detail in the next section.

Interest calculation

The following steps calculate the interest during construction periods.

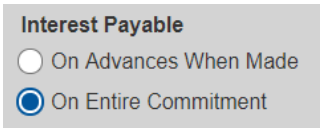
Step 1: Determine the loan commitment amount for interest calculation (LA)

Select the appropriate Interest Payable option to determine this amount.



LA = Half of the Loan Commitment Amount

LA = ½ × $50,000 = $25,000



LA = The Loan Commitment Amount

LA = $50,000

In the given example, LA = $25,000

Step 2: Determine interest rate by the time unit (i)

- Whole Months (360/360)
  - Monthly interest rate
  - i = Annual Simple Interest Rate ÷ 12
- Actual Days (365/365)
  - Daily interest rate
  - i = Annual Simple Interest Rate ÷ 365
- Actual Days (365/360)
  - Daily interest rate
  - i = Annual Simple Interest Rate ÷ 360
- Whole Months (360/365)
  - Monthly interest rate
  - i = Annual Simple Interest Rate ÷ 12

In the given example, i = (10.5% ÷ 12) x 5

Step 3: Determine the total construction period in term of time units (t)

In the given example, the construction period is 5 months and it is a whole month 360/360 interest payable type. Therefore t = 1.

Step 4: Calculate the interest
Estimated Interest = LA × i × t

Where LA, i and t have been determined in Step 1, 2, 3 respectively

In the given example:

Estimated interest = $25,000 × (10.5% ÷ 12) × 5 = $1,093.75

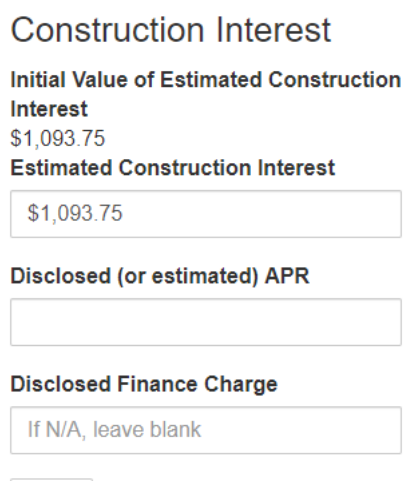


Figure 3 APR Tool estimated interest for the sample loan

Step 5: Calculate the additional interest with Required Interest Reserve option
Additional interest is calculated by applying half the estimated interest (as calculated in Step 4) at the contract interest rate for the entire construction period.

For the given example, the additional interest when Required Interest Reserve option is selected:

Additional Interest for Interest Reserve = (½ × $1,093.75) × (10.5% ÷ 12) × 5 = $23.93

Total estimated interest with Interest Reserve = $1,093.75 + $23.93 = $1,117.68

Part I Disclosure Calculation

We use the same sample loan as in the Estimated Interest section.

APR Tool input

The input is the same as in the Estimated Interest calculation:

Loan Commitment Amount = $50,000

Annual Simple Interest rate = 10.5%

Prepaid Finance Charge = $1,000

Subsequently Paid Finance Charge = $0

Interest Accrual: Whole Months (360/360)

Construction Phase Time Period = 5 Months

With the addition of estimated construction interest

Estimated Construction Interest = $1,093.75

APR calculation

Part I APR is calculated as a single payment loan that matures at the end of the construction period.

Step 1: Determine Amount Financed for calculation purpose (AFc) :

AFc = = ½ × Loan Commitment Amount – Prepaid Finance Charge

In the given example, AFc = ½ × $50,000 - $1,000 = $24,000

Step 2: Determine Payment for calculation purpose (Pc):

Pc = AFc + Finance Charge Where Finance Charge is calculated as described in the Other Disclosure Calculation section.

In the given example, Pc = $24,000 + $2,093.75 = $26,093.75

Step 3: Calculate Present Value for payment

Apply the Present Value formula. The details in variable definitions are defined in the other Calculations section of this document.

$PV = \frac{Pc}{(1+i)^t}$ This formula is for single advance, single advance loan with terms of one year or less.

The formula for any term measured in months is:

$$PV = \frac{P}{(1 + fi)\,(1 + i)^t}$$

Step 4: Applying the iteration process as described in the Other Calculations section to calculate APR. See Figure 4, in orange box, APR is calculated to be 20.9375% for the example.

Annual Percentage Rate
20.9375%

The formula in Appendix D to calculate interest and the APR is not an actuarial formula (it is the U.S. Rule simple interest method with no compounding) but APRWin does use an actuarial formula for any term to calculate the APR for single advance, single payment loans.

For this example, t = 1, f = 0, i = (20.9375/12) x 5 = .087239583

$$24{,}000 = \frac{26{,}093.75}{[1 + (0/.087239583)] \times 1.087239583} \qquad \frac{26{,}093.75}{1.087239583} = 24{,}000$$

Therefore, APR = .087239583 ÷ 5 x 12 = .209375 = 20.94% APR

Other disclosure calculation

Amount Financed (AF) = Loan Commitment Amount – Prepaid Finance Change
Finance Change (FC) = Estimated Interest + Prepaid Finance Charge + Subsequently Paid Finance Charge
Total Of Payment (TOP) = Amount Financed + Finance Charge

In the given example, these are the results:

AF = $50,000 - $1,000 = $49,000

FC = $1,093.75 + $1,000 + $0 = $2,093.75

TOP = AF + FC = $51,093.75

They agree with APR Tool output as depicted in Figure 4 (green box) below.

Figure 4 APR Tool calculated disclosure for the sample loan (Part I)

Part II Disclosure Calculation

We use a similar loan as in the Estimated Interest section:

$50,000 loan commitment at 10.5% interest with a 5-month construction period and a prepaid finance charge of 2 points, followed by 30-year permanent financing at the same rate with monthly amortization payments of $457.37.

APR Tool input

Copy all the inputs used in the Estimated Interest example:

Loan Commitment Amount = $50,000

Annual Simple Interest rate = 10.5%

Prepaid Finance Charge = $1,000

Subsequently Paid Finance Charge = $0

Interest Accrual: Whole Months (360/360)

Construction Phase Time Period = 5 Months

Estimated Construction Interest = $1,093.75

In addition, Part II includes payment schedule as input. In the given example, the payment schedule includes one payment stream:

Payment Stream = 1,

Payment Amount = $457.37

Number of Payments = 360

Unit Periods = 3

Odd Days = 15

The UP and OD are calculated by adding ½ the construction period to the period from the end of the construction period to the date of the first payment.

In this example, 5÷2 + 1 = 3.5 = 3 full Unit Periods and 15 Odd Days (months are considered to have 30 days and ½ of 30 = 15 days).

APR Calculation

The APR calculation for a Part II loan follows the same algorithm used to calculate the APR for a regular APR loan. Refer to the Math Algorithms for details.

For construction loans, amount financed is not a direct input in APR Tool. Instead, for APR calculation purpose only, it is a calculated as follows:

AF_C = Loan Commitment Amount – Prepaid Finance Charge – Subsequently Paid Finance Charge – Estimated Construction Interest

The rest of the inputs are all treated the same as a regular APR loan for the purpose of calculating APR.

For the given example, AFc = $50,000 - $1,000 - $0 - $1,093.75 = $47,906.25

After applying all inputs to the Math Algorithms, APR is calculated to be 10.7523% for the example. See the orange box in Figure 5.

Annual Percentage Rate
10.7523%

Other disclosure calculation

Amount Financed (AF) = Loan Commitment Amount – Prepaid Finance Change
Total Of Payment (TOP) = Sum of all payments in the Payment Schedule + Estimated Construction Interest + Subsequently Paid Finance Charge
Finance Change (FC) = Total Of Payment – Amount Financed

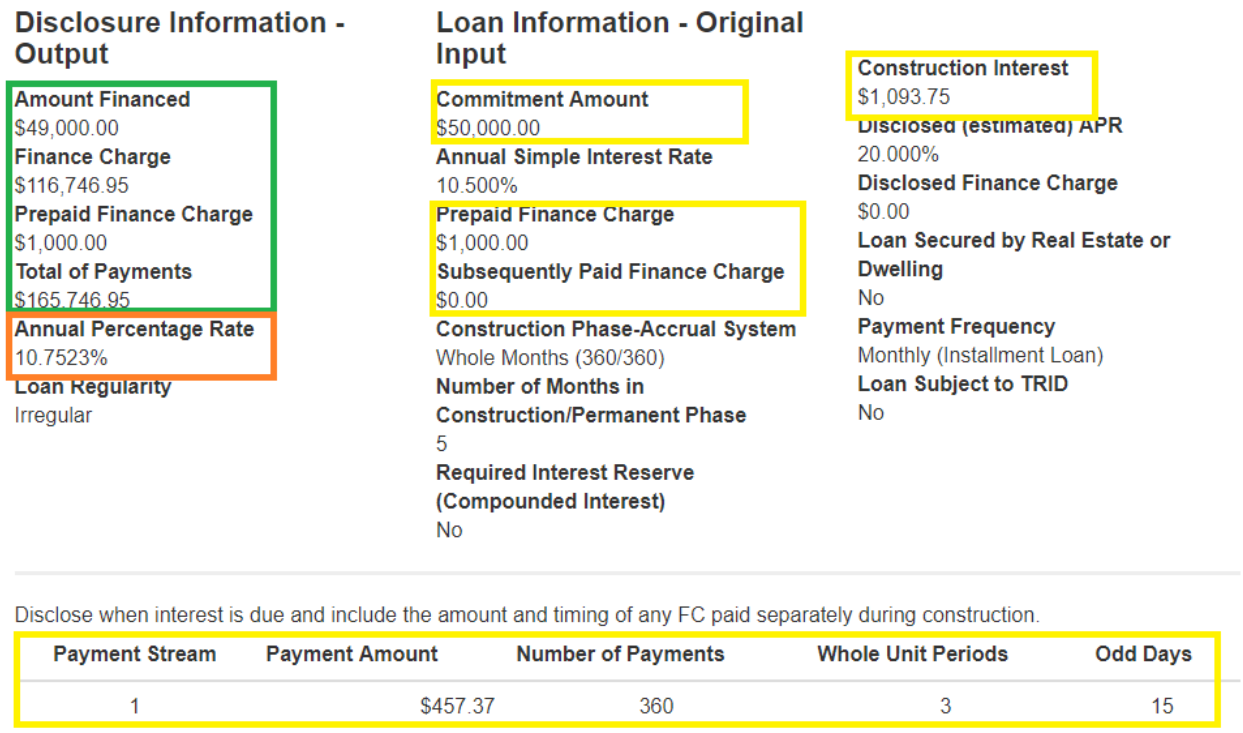
In the given example, these are the results:

AF = $50,000 - $1,000 = $49,000

TOP = 360 × $457.37 + $1,093.75 + $0 = $165,746.95

FC = $165,746.95 - $49,000 = $116,746.95

They agree with APR Tool output as depicted in Figure 5 (green box) below.



Disclosure Information - Output

Amount Financed
$49,000.00
Finance Charge
$116,746.95
Prepaid Finance Charge
$1,000.00
Total of Payments
$165,746.95
Annual Percentage Rate
10.7523%
Loan Regularity
Irregular

Loan Information - Original Input

Commitment Amount
$50,000.00
Annual Simple Interest Rate
10.500%
Prepaid Finance Charge
$1,000.00
Subsequently Paid Finance Charge
$0.00
Construction Phase-Accrual System
Whole Months (360/360)
Number of Months in Construction/Permanent Phase
5
Required Interest Reserve (Compounded Interest)
No

Construction Interest
$1,093.75
Disclosed (estimated) APR
20.000%
Disclosed Finance Charge
$0.00
Loan Secured by Real Estate or Dwelling
No
Payment Frequency
Monthly (Installment Loan)
Loan Subject to TRID
No

Disclose when interest is due and include the amount and timing of any FC paid separately during construction.

Payment Stream	Payment Amount	Number of Payments	Whole Unit Periods	Odd Days
1	$457.37	360	3	15

Figure 5 APR Tool calculated disclosure for the sample loan (Part II)

APR and Finance Charge Tolerance

Same as regular APR loans. Refer to the APR and Finance Charge Tolerance section for details.

Obvious Error Rule

Same as regular APR loans. Refer to the Obvious Error Rule section for details.

TRID Calculation

Total Of Payments (TOP) and Total Interest Percentage (TIP) are calculated according to the formulas in document “TILA-RESPA Integrated Disclosures Formulas”. The document was provided to development team by the subject matter experts.

TILA-RESPA Integrated Disclosures Formulas

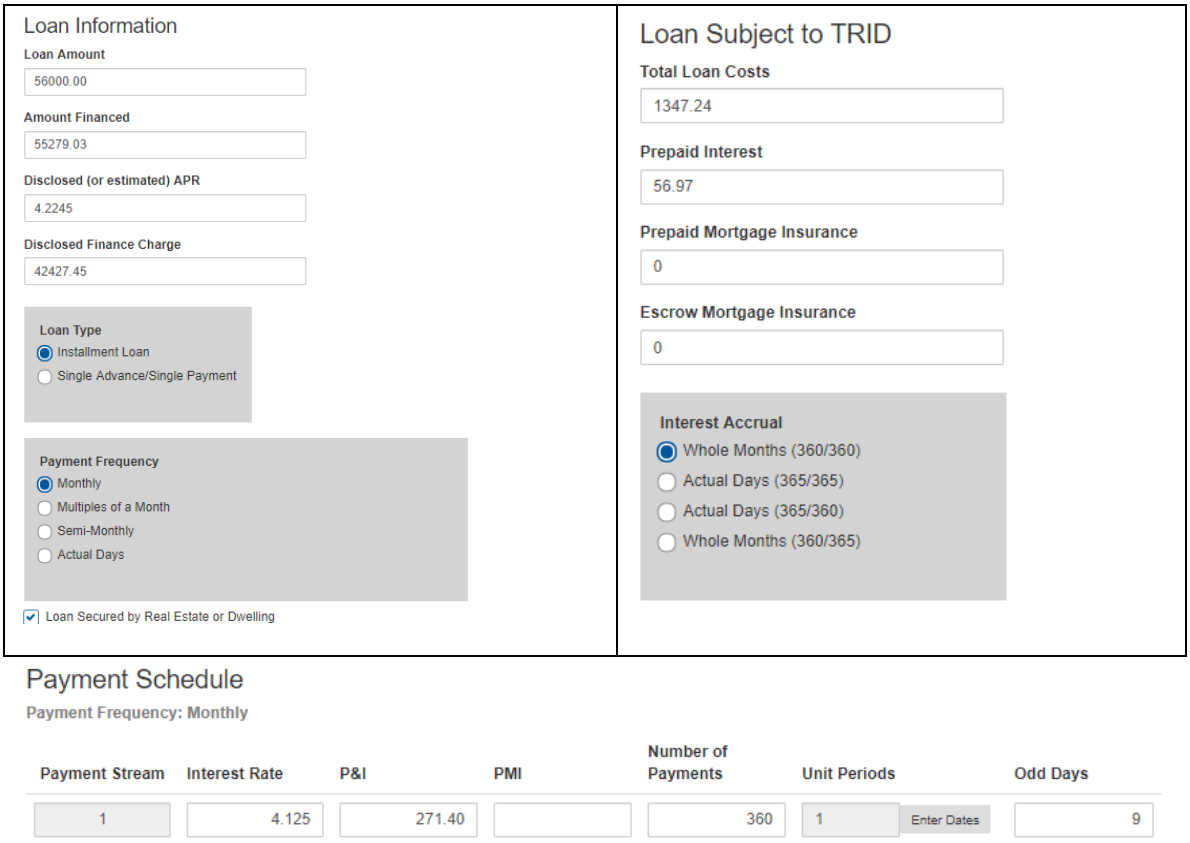
For closed-end mortgage loan applications received on or after October 3, 2015, there are also three new formulas. The following table provides an overview of these formulas.

Formula Fields	12 CFR 1026	Closing Disclosure Location	Calculations
Total of Payments: – Principal – Interest – Mortgage Insurance – Borrower’s Loan Costs – Prepaid Interest	.38(o)(1) .38(f)(4) .38(g)(2)	Page 5, Loan Calculations Page 2, Box D Page 2, Box F	Sum of P+I over the term of the loan + Mortgage Insurance + Borrower’s Total Loan Costs + Prepaid Interest = Total of Payments
Total Interest Percentage: – Principal – Interest – Loan Amount – Prepaid Interest	.38(o)(5) .38(b) .38(g)(2)	Page 5, Loan Calculations Page 1, Loan Terms Page 2, Box F	Sum of all monthly P+I + Prepaid Interest - Loan Amount = Total Interest ÷ Loan Amount = Total Interest Percentage

The Total of Payments calculation is the total the borrower will have paid after they make all payments of principal, interest, mortgage insurance, prepaid interest, and loan costs, as scheduled.

The Total Interest Percentage is what the consumer will pay over the life of the loan, expressed as a percentage of the amount of credit extended.

Regular APR Loan Example



Loan Information

Loan Amount: 56000.00

Amount Financed: 55279.03

Disclosed (or estimated) APR: 4.2245

Disclosed Finance Charge: 42427.45

Loan Type
- (•) Installment Loan
- ( ) Single Advance/Single Payment

Payment Frequency
- (•) Monthly
- ( ) Multiples of a Month
- ( ) Semi-Monthly
- ( ) Actual Days

[✓] Loan Secured by Real Estate or Dwelling

Loan Subject to TRID

Total Loan Costs: 1347.24

Prepaid Interest: 56.97

Prepaid Mortgage Insurance: 0

Escrow Mortgage Insurance: 0

Interest Accrual
- (•) Whole Months (360/360)
- ( ) Actual Days (365/365)
- ( ) Actual Days (365/360)
- ( ) Whole Months (360/365)

Payment Schedule

Payment Frequency: Monthly

Payment Stream	Interest Rate	P&I	PMI	Number of Payments	Unit Periods		Odd Days
1	4.125	271.40		360	1	Enter Dates	9

Sum of P& I = $271.40 × 360 = $97,704

Mortgage Insurance = prepaid mortgage insurance (prepaid finance charge) + postpaid (post-closing) mortgage insurance[2]

Total Loan Cost = $1,347.24

Prepaid Interest = $56.97

TOP = Sum of P&I + Mortgage Insurance + Total Loan Cost + Prepaid Interest

= $97,704 + $0 + $1,347.24 + $56.97

= $99,108.21

[2] Mortgage insurance does not include property or hazard insurance.

Total Interest = Sum of P&I + Prepaid Interest – Loan Amount

= $97,704 + $56.97 - $56,000

= $41,760.97

TIP = $\frac{Total\ Interest}{Loan\ Amount} \times 100 = \frac{41{,}760.97}{56{,}000} \times 100 = 74.573\%$

TOP and TIP calculation agree with APR Tool output as shown below.

Disclosure Information - Output

Amount Financed
$55,279.03
Finance Charge
$42,424.97
Total of Payments
$99,108.21
Annual Percentage Rate
4.2245%
Loan Regularity
Regular
Total Interest Percentage
74.573%

Loan Information - Original Input

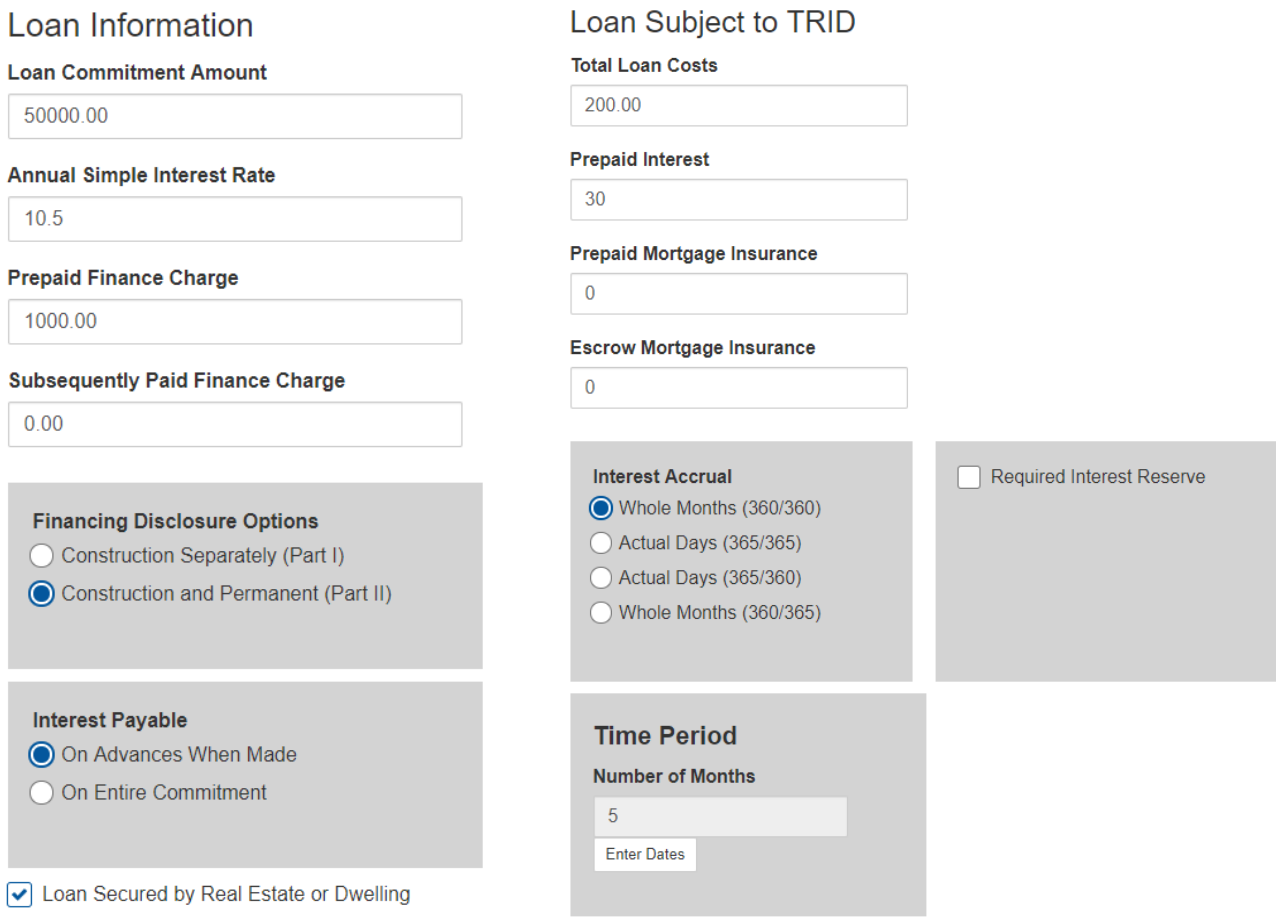
Loan Amount
$56,000.00
Amount Financed
$55,279.03
Disclosed (estimated) APR
4.2245%
Disclosed Finance Charge
$42,427.45
Loan Secured by Real Estate or Dwelling
Yes
Payment Frequency
Monthly (Installment Loan)
Interest Accrual Type
Whole Months (360/360)
Loan Subject to TRID
Yes
Total Loan Cost
$1,347.24
Prepaid Interest
$56.97
Prepaid Mortgage Insurance
$0.00
Escrow Mortgage Insurance
$0.00

Payment Frequency

Payment Stream	Interest Rate	P&I	PMI	Payment Amount	Number of Payments	Whole Unit Periods	Odd Days
1	4.125%	$271.40		$271.40	360	1	9

Construction and Permanent (Part II) Loan Example [3]

$50,000 loan commitment at 10.5% interest with a 5-month construction period and a prepaid finance charge of 2 points, followed by 30-year permanent financing at the same rate with monthly amortization payments of $457.37,Total loan cost is $200 and the prepaid interest $30.



[3] Part II TRID calculations are more comprehensive than Part I calculations, hence the inculsion of this as an example. Users can follow the straight forward formulas for Part I to confirm generation of accurate results.

Construction Interest

Initial Value of Estimated Construction Interest
$1,093.75
Estimated Construction Interest

$1,093.75

Disclosed (or estimated) APR

10

Disclosed Finance Charge

0

Loan Type

- (●) Installment Loan
- ( ) Single Advance/Single Payment

Payment Frequency

- (●) Monthly
- ( ) Multiples of a Month
- ( ) Semi-Monthly
- ( ) Actual Days

Payment Schedule

Payment Frequency: Monthly

Payment Stream	Interest Rate	P&I	PMI	Number of Payments	Unit Periods		Odd Days
1	10.5	457.37		360	3	Enter Dates	15

Sum of P&I = $457.37 x 360 = $164,653.20

Mortgage Insurance = Sum of PMI + Prepaid Mortgage Insurance + Escrow Mortgage Insurance = $0

Total Loan Cost = $200.00

Prepaid Interest = $30.00

TOP = Sum of P&I + Mortgage Insurance + Construction Interest + Total Loan Cost + Prepaid Interest

= $164,653.20 + $0 + $1093.75 + $200 + $30

= $165,976.95

Total Interest = Sum of P&I + Prepaid Interest – Loan Amount

= $164,653.20 + $30 - $50000

= $114,683.20

TIP = $\frac{Total\ Interest}{Loan\ Amount} \times 100 = \frac{114,683.20}{50,000} \times 100 = 229.366\%$

TOP and TIP calculation agree with APR Tool output as shown below.

Disclosure Information - Output

Amount Financed
$49,000.00
Finance Charge
$116,746.95
Prepaid Finance Charge
$1,000.00
Total of Payments
$165,976.95
Annual Percentage Rate
10.7523%
Loan Regularity
Irregular
Total Interest Percentage
229.366%

Loan Information - Original Input

Commitment Amount
$50,000.00
Annual Simple Interest Rate
10.500%
Prepaid Finance Charge
$1,000.00
Subsequently Paid Finance Charge
$0.00
Construction Phase-Accrual System
Whole Months (360/360)
Number of Months in Construction/Permanent Phase
5
Required Interest Reserve (Compounded Interest)
No

Construction Interest
$1,093.75
Disclosed (estimated) APR
10.000%
Disclosed Finance Charge
$0.00
Loan Secured by Real Estate or Dwelling
Yes
Payment Frequency
Monthly (Installment Loan)
Loan Subject to TRID
Yes
Total Loan Cost
$200.00
Prepaid Interest
$30.00
Prepaid Insurance
$0.00
Escrow Insurance
$0.00

Disclose when interest is due and include the amount and timing of any FC paid separately during construction.

Payment Stream	Interest Rate	P&I	PMI	Number of Payments	Whole Unit Periods	Odd Days
1	10.500%	$457.37		360	3	15

Reimbursement Calculation [4]

APR Reimbursement Tolerance

For irregular loans, APR Reimbursement Tolerance is ¼ of 1%.

For regular loans, APR Reimbursement Tolerance is as follows:

- ¼ of 1% if loan term is 10 years or less
- 1/8 of 1% if loan term is over 10 years

The following checks determine if a loan is subject to reimbursement:

- No reimbursement if obvious error rule applies
    - See the obvious error rule for details.
- Subject to reimbursement if disclosed finance charge is understated by more than the legal finance charge tolerance
    - See the finance charge tolerance section for details.
- Subject to reimbursement if disclosed APR is understated by more than the APR reimbursement tolerance

    Special rule for mortgage loans:

    - If both disclosed the APR and disclosed finance charge are overstated, alert the user if this is a finance charge input error. If a FC input error, the disclosed APR is considered accurate if it does not exceed the greater of (1) the APR plus the legal APR Tolerance, or (2) the APR generated by the FC error. Otherwise, it is a violation.

    - If disclosed APR is understated and the disclosed finance charge is understated but within tolerance, alert the user if this is a finance charge input error. If a FC input error, the disclosed APR is considered accurate if it is not lower than the lower of (1) the APR minus the legal APR tolerance, or (2) the understated APR generated by the FC error. Otherwise, it is a violation.

Math Algorithm

Sample loan:

Amount Financed: $4,910

Disclosed APR: 9.430%

[4] Reimbursements must follow guidance set forth in the FFIEC's Administrative Enforcement of the Truth in Lending Act. See the Help file for more information.

The link can be found here: https://www.govinfo.gov/content/pkg/FR-1998-09-08/pdf/98-24057.pdf

Disclosed Finance Charge: $700

Not secured by real estate

Payment Schedule:

Payment Stream	Payment Amount	Number of Payments	Whole Unit Periods	Odd Days
1	$160.00	36	1	0

Calculated APR: 10.6782%

Calculated Finance Charge: $850

Reimbursement Tolerance: 0.25%

Reimbursement for APR adjustment

Step 1: Adjust disclosed APR by the reimbursement tolerance APR

Adjusted APR = Disclosed APR + Reimbursement Tolerance APR

= 9.430% + 0.25%

= 9.680%

Step 2: Calculate Present Value of all payments with Adjusted APR

PV-Payments $= \frac{P_1}{(1+f_1 i)(1+i)^{t_1}} + \frac{P_2}{(1+f_2 i)(1+i)^{t_2}} + \cdots + \frac{P_n}{(1+f_n i)(1+i)^{t_n}}$

See the present value formula explanation in the Other Calculations section.

In the example,

$f_1 = f_2 = \cdots = f_{36} = 0$

$P_1 = P_2 = \cdots = P_{36} = 160$

i = Adjusted APR ÷12 ÷100 = 0.0080666666666667

PV-Payments $= \frac{160}{(1+0.0080666666666667)^1} + \frac{160}{(1+0.0080666666666667)^2} + \cdots + \frac{160}{(1+0.0080666666666667)^{36}}$

= 4981.760877459268

Step 3: Calculate Present Value of all advances with Adjusted APR

PV-Advances = $\frac{A_1}{(1+e_1 i)(1+i)^{q_1}} + \frac{A_2}{(1+e_2 i)(1+i)^{q_2}} + \cdots + \frac{A_n}{(1+e_n i)(1+i)^{q_n}}$

There are not additional advances in the payment schedule. Therefore,

PV-Advances = Amount Financed = 4,910

Step 4: Calculate Prorate Factor

Prorate Factor $= \frac{PV-Advances}{PV-Payments}$

$= \frac{4910}{4981.760877459268}$

= 0.9855952786124358

Step 5: Calculate Adjusted Payments

Adjusted Payment = Payment Amount × Prorate Factor

= 160 × 0.9855952786124358

= 157.6952445779897

Step 6: Calculate Adjusted Final Payment

1. Payment Adjustment Amount (P_{adj}) = Payment Amount – Adjusted Payment

   P_{adj} = 160 - 157.6952445779897

   = 2.3047554220103

   Explanation: Calculates the reimbursable "per/payment adjustment" by subtracting the adjusted payment from the original payment = Padj.

2. Present Value of all Payment Adjustments

   PV-P_{adj} $= \frac{P_{adj}}{(1+f_1 i)(1+i)^{t_1}} + \frac{P_{adj}}{(1+f_2 i)(1+i)^{t_2}} + \cdots + \frac{P_{adj}}{(1+f_n i)(1+i)^{t_n}}$

   $= \frac{2.3047554220103}{(1+0.0080666666666667)^1} + \frac{2.3047554220103}{(1+0.0080666666666667)^2} + \cdots + \frac{2.3047554220103}{(1+0.0080666666666667)^{36}}$

   = 71.76087745926901

   Explanation: Calculates the "aggregate present value" (PV-Padj) of reimbursable per/payment adjustments as of the loan date.

3. Calculates odd day adjustment "if last payment has any odd days"

   Odd Day Adjustment = PV-Padj × Daily Interest Rate × Number of Odd Days for the last payment

   The last payment in this loan doesn't have any odd days; therefore, Odd Day Adjustment = 0.

   Explanation: (1) "… if last payment has any odd days" means that there are one or more odd days remaining after counting full unit periods backwards from the date of the last payment to the loan date; and (2) if there were odd days between the loan date and final payment date, the "odd day adjustment" would be the value of PV-Padj from Step 2, which is as of the loan date, subtracted from the value of PV-Padj, calculated as of the end of the odd-day period.

4. Total PV-P_{adj} = PV-P_{adj} + Odd Day Adjustment

   = 71.76087745926901

   Explanation: Ensures that Total PV-P_{adj} includes an Odd Day Adjustment, if applicable. If there are no odd days, the value of Total PV-Padj is the same as PV-P_{adj}, under Step 2, as of loan date, which means the Odd Day Adjustment is 0. If there are odd days, the value of Total PV-Padj is as of the end of the odd day period under Step 3.

5. Calculate future value of Total PV-P_{adj} to the last payment date

   FV-P_{adj} = Total PV-P_{adj} × $(1+i)^n$

   = 71.76087745926901 × $(1+0.0080666666666667)^{36}$

   = 95.82986948278899

   Explanation: Calculate the APR Adjustment as of the final payment date by determining the future value of PV-Padj from Step 4, as of the date of the final payment = FV-Padj.

   APR Adjustment as of Final Payment Date = FV-P_{adj} = 95.82986948278899

Reimbursement Information

Using reimbursement tolerance of 0.25%

Adjusted APR	Prorate Factor	APR Adjustment as of Final Payment Date
9.680%	0.9855952786124351	($95.83)

Payment Stream	Original Payment Amount	Adjusted Payment Amount	Number of Payments	Whole Unit Periods	Odd Days
1	$160.00	$157.70	36	1	0

Finance Charge Adjustment

Additional FC Tolerance = Dollar difference between (1) FC reflected by Actual APR and (2) Adjusted FC reflected by Adjusted APR (actual APR – APR reimbursement tolerance)

Finance Charge Adjustment = Calculated Finance Charge – Adjusted Finance Charge

Adjusted Finance Charge = Disclosed Finance Charge + Additional Finance Charge Tolerance

Follow the same steps in the Reimbursement for APR Adjustment section to calculate Additional Finance Charge Tolerance:

Step 1: Finance Charge Adjusted APR = Calculated APR – Reimbursement Tolerance APR

= 10.6782% - 0.25%

= 10.4282%

i = 10.4282% ÷ 12 ÷ 100 = 0.0086901666666667

Follow the same Reimbursement for APR Adjustment Steps 2 – 4 to calculate Prorate Factor using the new Adjusted APR in this section's Step 1.

- PV-Payments = 4927.838259820248
- PV-Advances = 4910
- Prorated Factor = 0.9963801044434241

Additional Finance Charge Tolerance = (1 – Prorate Factor) × Total of Payments in Payment Schedule

= (1 – 0.9963801044434241) × 36 × 160

= 20.85059840587715

Adjusted Finance Charge = Disclosed Finance Charge + Additional Finance Charge Tolerance

= 700 + 20.85059840587715

= 720.8505984058772

Finance Charge Adjustment = Calculated Finance Charge – Adjusted Finance Charge

= 850 - 720.8505984058772

= 129.1494015941229

Reimbursement Information

Using reimbursement tolerance of 0.25%

Adjusted APR	Prorate Factor	APR Adjustment as of Final Payment Date
9.680%	0.9855952786124351	($95.83)

Payment Stream	Original Payment Amount	Adjusted Payment Amount	Number of Payments	Whole Unit Periods	Odd Days
1	$160.00	$157.70	36	1	0

Number of Prior Payments

Show Adjustment

Finance Charge Adjustment (using APR of 10.428%): ($129.15)

Lump Sum / Payment Reduction Method calculation

Additional Input: Number of Prior Payments

In our example,

Number of Prior Payments = 6

Adjusted APR = 9.680%

Payment Schedule with Adjusted Payment Amount:

Payment Stream	Original Payment Amount	Adjusted Payment Amount	Number of Payments	Whole Unit Periods	Odd Days
1	$160.00	$157.70	36	1	0

Follow the same sub-steps in the Reimbursement for APR Adjustment Step 6. Calculate Adjusted Payment to the time of last payment made. In this example, calculate the adjusted payment to when 6th payment is made.

1. Payment Adjustment Amount (P_{adj}) = Payment Amount – Adjusted Payment
   P_{adj} = 160 - 157.6952445779897
   = 2.3047554220103
2. Present Value of Payment Adjustments for the payments prior to the last payment made
   PV-P_{adj} = $\frac{2.3047554220103}{(1+0.0080666666666667)^1} + \frac{2.3047554220103}{(1+0.0080666666666667)^2} + \cdots + \frac{2.3047554220103}{(1+0.0080666666666667)^6}$
   = 13.44635544217646

3. Calculate odd day adjustment if last payment has an odd dayOdd Day Adjustment = PV-P_{adj} × Daily Interest Rate × Number of Odd Days for the last payment made
   The last payment in this loan doesn't have an odd day; therefore, Odd Day Adjustment = 0.

   Explanation: (1) "… if last payment has any odd days" means that there are one or more odd days remaining after counting full unit periods backwards from the date of the last payment to the loan date; and (2) if there were odd days between the loan date and final payment date, the "odd day adjustment" would be the value of PV-Padj from Step 2, which is as of the loan date, subtracted from the value of PV-Padj, calculated as of the end of the odd-day period.

4. Total PV-P_{adj} = PV-P_{adj} + Odd Day Adjustment
   = 13.44635544217646

5. Calculate future value of Total PV-P_{adj} to the last payment made date
   FV-P_{adj} = Total PV-P_{adj} × $(1+i)^n$
   = 13.44635544217646 × $(1+0.0080666666666667)^6$
   = 14.110425603412752

Lump Sum/Payment Reduction Method reimbursement = 14.110425603412752

Lump Sum Method calculation

Lump Sum Method reimbursement = Lump Sum/Payment Reduction Method reimbursement +

Present Value (at last payment made time) of all future P_{adj} in payment schedule

In this example, the second part is interpreted as follows:

Present Value (at 6th payment made time) of all P_{adj} from 7th payment and on.

Steps to calculate the second part

1. Payment Adjustment Amount (P_{adj}) = Payment Amount – Adjusted Payment
   P_{adj} = 160 - 157.6952445779897
   = 2.3047554220103
2. Present Value (at loan date) of Payment Adjustments for all future payments
   PV-P_{adj} = $\frac{2.3047554220103}{(1+0.0080666666666667)^7} + \frac{2.3047554220103}{(1+0.0080666666666667)^8} + \cdots + \frac{2.3047554220103}{(1+0.0080666666666667)^{36}}$
   = 58.31452201709255
3. Calculate odd day adjustment if last payment has an odd day
   Odd Day Adjustment = PV-P_{adj} × Daily Interest Rate × Number of Odd Days for the last payment made
   The last payment in this loan doesn't have an odd day; therefore, Odd Day Adjustment = 0. (See item 3 under step 6 above).

4. Total PV-P_{adj} = PV-P_{adj} + Odd Day Adjustment

= 58.31452201709255

5. Calculate future value of Total PV-P_{adj} to the last payment made (6th)
   FV-P_{adj} = Total PV-P_{adj} × $(1+i)^6$
   = 58.31452201709255 × $(1+0.0080666666666667)^6$
   = 61.194479653556744

Lump Sum Method reimbursement = 14.110425603412752 + 61.194479653556744

= 75.304905256969496

Reimbursement Information

Using reimbursement tolerance of 0.25%

Adjusted APR	Prorate Factor	APR Adjustment as of Final Payment Date
9.680%	0.9855952786124351	($95.83)

Payment Stream	Original Payment Amount	Adjusted Payment Amount	Number of Payments	Whole Unit Periods	Odd Days
1	$160.00	$157.70	36	1	0

Number of Prior Payments

6 Show Adjustment

Lump Sum/ Payment Reduction Method

Payments 1-6 ($14.11)

Lump Sum Method

Payments 1-36 ($75.30)

Finance Charge Adjustment (using APR of 10.428%): ($129.15)

Fed Calendar Calculation

Single Payment/Single Advance

***Unit Period Calculations*:**

- If the loan term is less than a year and is equal to a whole number of months, the number of unit-periods in the term = 1, and the number of unit-periods per year is 12 divided by the number of months in the term or 365 divided by the number of days in the loan term.
- If the loan term is less than a year and is not equal to a whole number of months, the number of unit-periods in the term is 1, and the number of unit-periods per year is 365 divided by the number of days in the loan term.

- If the unit-period is a year, the number of full unit-periods is the number of full years (each equal to 12 months) measured from the loan maturity date back to the loan date, which = the user input value divided by 12 and rounded down to the nearest whole number.

***Odd Days Calculations*:**

- A loan term of less than or equal to one year has no odd days.
- As stated under "Unit Period Calculations" above, if the unit-period is a year, the number of full unit-periods between 2 dates is the number of full years (each equal to 12 months) measured back from the later date. The remaining fraction of a unit-period is

    - (A) The remaining number of months divided by 12 [The code calculates odd days by first getting the remainder number of months using (the number of months input by the user mod 12). The result is multiplied by 30, because according to Appendix J, each month is 30 days. This breaks down how many odd days are remaining.] if the remaining interval is equal to a whole number of months, or
    - (B) The remaining number of days divided by 365 if the remaining interval is not equal to a whole number of months.

Installment Loans

- **Monthly:**
  - Calculate the number of whole months between the loan date and the payment date**, counting backwards**. Check the last day of the month for each date. If both are the last day of the month and the number of days in the payment date month is smaller than the number of days in the loan date month, then add 1 to the month duration. Round down to nearest whole number for number of unit periods.

- **Multiples of a month:**
  - Use the same method as monthly to find the month duration. Then divide that number by the number of months in the unit period as selected by the user. Round down to the nearest whole number for number of unit periods

- **Semi-monthly:**
  - Use the same method as monthly to find the month duration. Multiply that number by 2 to get the initial number of unit periods. Calculate the odd days. If the odd days are greater than 15, subtract 15 from the odd days and add one to the number of unit periods. Repeat until the number of odd days is below 15.

- **Actual Days:**
  - Calculate the number of days between the payment date and loan date. Divide that number by the number of days in the unit period as input by the user. Round down to the nearest whole number.

Odd Days Calculations:

- **Monthly –**
  - Subtract the day of the month of the loan date from the day of the month of the payment date (e.g., for 2/28/2018, the day of the month would be 28) to get the initial difference. Then check loan and payment dates to see if the day of the month are the end of month for their month (e.g., 2/28/2018 would be the end of month date of February). If they are both the last days of their month, then set the difference to 0. If they are not both the end of the month, check specifically for February. If the loan date is in February and the payment date is greater than the last day of the month for the loan date, then subtract the payment date day of month (e.g., for March 30, the date would be 30) from last day in February to get the date difference. Or, if the payment date is the last day of February, add 2 or 3 to the difference depending on if there are 28 or 29 days in February. Or, if the payment date is not in February, add 1 to the difference if the end of last day of the month is 30. Do nothing if the last day of the month is 31.
  - If the difference is greater than or equal to 0, return that value. Otherwise add value of the last day of the month for the loan date to the difference.

***Multiples of a month*:**

- Odd Days is calculated back from the payment date to the loan date. Calculate the number of months to offset the payment date by multiplying the number of months in the unit period * the number of unit periods.
- If the number of months in the unit period is 12, calculate how many leap years fall between the two dates. Then calculate the odd days based on a 365 or 366 day year (366 for leap year). To calculate the odd days, use the same equation as calculating odd days for Installment Loan Actual Day Payment Frequency.
- If the number of months in the unit period is not 12, then first check if the payment date is February 28th (or 29th on leap year). If it is, set the offset days to the end of the month date for the loan date minus the end of month date for the payment date (would be 28 or 29). Then subtract the number of offset months from the payment date to get a new date. Find the number of months between the loan date and the new date and multiply by 30 (Appendix J has 30 days between any two months. So find remaining number of whole months and multiply by 30 to get days). Then use the same algorithm to calculate the number of odd days between the loan date and the new date, as is used to calculate the number of odd days for the installment loan monthly payment frequency. Add the three numbers together (monthsbetween, daysbetween, and offsetdays) to generate the number of odd days.

***Semi-Monthly*:**

- Use the same algorithm to calculate Odd days as is used for monthly. Then subtract 15 from odd days until odd days is less than 15.

***Actual Days*:**

- Calculate the total number of days between the payment date and loan date. Then subtract that number from the number of days in the unit period * the number of unit periods.

```
var duration = pDate.diff(lDate, 'day');
let units = Math.floor(totalDays / daysInUP);
return totalDays - (daysInUP * units)
```

Other Calculations

Present Value (PV) formula

P = Payment Amount

i = percentage rate of finance charge per unit-period, expressed as a decimal equivalent

t = number of full unit-periods from the beginning of the term of the transaction to the payment (yes, but don't forget that within those two dates, count full unit periods backwards towards the loan date; any days left over are off days)

f = fraction of a unit-period in the time interval from the beginning of the term of the transaction to the payment

$$PV = \frac{P}{(1+fi)(1+i)^t}$$

Solution of general equation by iteration process

The following steps are the excerpt from Section (b)(9) in Appendix J to Regulation Z.

(9) Solution of general equation by interation process. (i) The general equation in paragraph (b)(8) of this section, when applied to a simple transaction in which a loan of $1000 is repaid by 36 monthly payments of $33.61 each, takes the special form:

$$A = \frac{33.61\ \ddot{a}_{\overline{36}|}}{(1+i)}$$

Step 1: Let I_1 = estimated annual percentage rate = 12.50 %
Evaluate expression for A, letting i = I_1/(100w) = .010416667
Result (referred to as A′) = 1004.674391

Step 2: Let $I_2 = I_1 + .1$ = 12.60 %
Evaluate expression for A, letting i = I_2/(100w) = .010500000
Result (referred to as A′′) = 1003.235366

Step 3: Interpolate for I (annual percentage rate):

$$I = I_1 + .1\left[\frac{(A-A')}{(A''-A')}\right]$$

$$= 12.50 + .1\left[\frac{(1000.000000 - 1004.674391)}{(1003.235366 - 1004.674391)}\right] = 12.82483042\ \%$$

Step 4: First iteration, let I_1 = 12.82483042 % and repeat
Steps 1, 2, and 3 obtaining a new I = 12.82557859 %
Second iteration, let I_1 = 12.82557859 % and repeat
Steps 1, 2, and 3 obtaining a new I = 12.82557529 %

Regular vs Irregular Loan

An irregular transaction is one that includes one or more of the following features: multiple advances, irregular payment periods, or irregular payment amounts (other than an irregular first period or an irregular first or final payment. Anything not irregular is considered regular.

Regular Loan

A regular loan is one that has all of the following characteristics:

A single advance.

No more than three payment streams.

All payments are equal in amount (except the first and/or last payment, either or both of which can be irregular).

All payment periods are equal (except the first payment period can be irregular).

Example 1: A monthly payment loan with 45 days to the first payment, a first payment amount of $600, followed by 34 payments of $500 each, followed by a final, 36th payment of $5,000, is a regular loan.

Example 2: Same as Example 1, except the rate is a variable rate tied to the lender's prime rate. If a loan is not a regular loan, it is considered an irregular loan.

Military APR (MAPR) Functionality

The APR Tool interface includes the 'Military' and 'Regular & Military' options as two of four loan types.

- If 'Military' is chosen:
  - Loan Subject to TRID becomes disabled.
  - On the Loan Information page, (if Military or Regular Military is selected) 'Military' is added to "Amount Financed" making the sub-heading 'Military Amount Financed'.
  - 'Military info' for these three fields (*military amount financed, military annual percentage rate, and military APR*) were added under the 'Output' section on the Results Screen.
- MAPR includes a few more fees than regular loan (added to amount financed): Application fee and Credit fee. (These fees apply to the calculation of amount financed that the user does OUTSIDE of the application, and are things to note in the Help alone.)
- The interface also includes the potential noncompliance that involves comparing military APR with regular APR to identify potential violations in military APR.
- The MAPR calculations remains the same as the APR calculations, however, the tolerance rate for the MAPR is 36%.