Compare the Effects of Different Interest Rates, Time and Compounding on the Cost of Borrowing

> Suppose you need to borrow $1000 to buy something, and you agree to pay 12% interest, compounded* monthly and you will pay the loan back plus interest after 1 year.

* this word will be explained later in this investigation

Press the **[apps]** button, then select **1:Finance… → 1: TVM Solver…**

Enter the following values in the fields shown below:
(Use the **[tab]** button to move your cursor to the next field)

Time to repay loan is 1 year

You will get $1000 at the beginning of the year (PV stands for Present Value)

Since the interest on this loan is compounded monthly, there are 12 Compounds per Year (C/Y)

```
NORMAL FLOAT AUTO REAL RADIAN MP

 N=1
  I%=12
 PV=1000
 PMT=0
 FV=■
 P/Y=1
 C/Y=12
 PMT:END BEGIN
```

Interest rate is 12% per year

The amount you will need to repay after one year is the Future Value (FV). Leave this field blank for now.

When you've entered the above information, **move your cursor to the FV field**.

To ask the calculator to **solve** for FV, press the **[alpha]** button, followed by the **[enter]** button.

(alpha then enter)
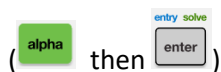
1. What is the Future Value? _____

2. This is the amount which must be repaid, including interest. Why do you think this is a negative value?

Different Interest Rates

3. Explore what happens to the amount owed with different interest rates.
   Determine the Future Value for each of the following interest rates, assuming the other factors remain the same as above.
   a) 1%   b) 3%   c) 6%   d) 11.5%   e) 12.5%   f) 19.7%

4. How does the amount owed (FV) change when the interest rate is lower? Higher?
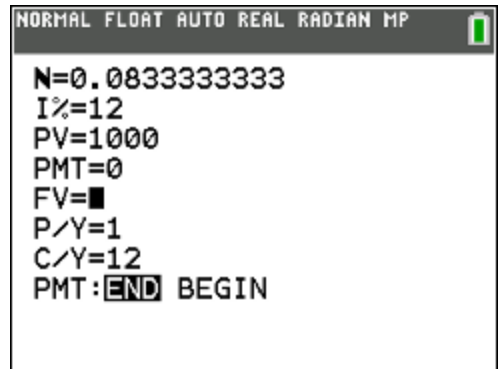
5. Most interest calculations are related to the Bank of Canada's Policy Interest Rate. Do a search for Canada's Policy Interest Rate today.

6. Why do you think interest rates change from time to time?

Term Length (Time of Loan)

The amount owed to repay a loan is directly related to the length of time for the loan.

When the length of time is less than a year, we can enter decimal values or fractions less than 1 in the N field. For a 1 month loan, divide 1 month by 12 months per year...

$N = \frac{1}{12}$ or $N \cong 0.0833333333$. If you enter N = 1 ÷ 12 the calculator will change it to the decimal approximation.

```
NORMAL FLOAT AUTO REAL RADIAN MP    ▯
N=0.0833333333
I%=12
PV=1000
PMT=0
FV=∎
P/Y=1
C/Y=12
PMT:END BEGIN
```

7. Assuming the $1000 loan from above is still earning interest at 12% compounded monthly, determine the amount owed after the following lengths of time:
   a) 1 month   b) 6 months   c) 1 year   d) 2 years   e) 5 years

8. Why should the amount owed depend on time? Does this make sense?

Compounding Frequency

Examine the interest calculated each month with **monthly compounding** of interest.

At the end of the 1st month, 1% of **$1000.00** is calculated and added to the balance owing. $1000.00 + $10.00 = **$1010.00**	At the end of the 2nd month, 1% of **$1010.00** is calculated and added to the balance owing. $1010.00 + $10.10 = **$1020.10**	At the end of the 3rd month, 1% of **$1020.10** is calculated and added to the balance owing. $1020.10 + $10.20 = **$1030.30**	...	At the end of the 12th month, 1% of **$1115.67** is calculated and added to the balance owing. $1115.67 + $11.16 = **$1126.83**

Notice that, since the balance changes, interest is being calculated on interest. The Finance Solver App does all of these compounding calculations in a single step.

9. Does the rate at which interest is compounded have an effect on the amount owed?
   In the Finance Solver, we set C/Y to 12 when a loan is compounded monthly.
   Determine the amount owed for a 1 year, $1000 loan with 12% interest compounded as follows:

   a) weekly   b) semi-monthly   c) semi-annually   d) annually

Answers

1. – $1126.83

2. The negative shows that paying this money is the opposite of receiving this money

3. (all FV values will appear as negatives to indicate repaying the loan)
a) $1010.05   b) $1030.42   c) $1061.68   d) $1121.26   e) $1132.42   f) $1215.80

4. To be discussed with the class.

5. check here https://www.bankofcanada.ca/core-functions/monetary-policy/key-interest-rate/

6. To be discussed with the class.

7. a) $1010.   b) $1061.52   c) $1126.83   d) $1269.73   e) $1816.70

8. To be discussed with the class.

9. a) $1127.34   b) $1127.16   c) $1123.60   d) $1120.00   The amount of interest charged is a little higher
when the interest is compounded more frequently (ie. weekly, rather than monthly or annually)

That's Life!

Consolidation Activity

Imagine you want to buy something which will cost $1000, including taxes.

What will you be buying with the money from your loan? _____

When your teacher comes around to your desk they will roll a die to determine how much money you can afford to pay as a down payment for your purchase, and how long it will take you to pay off your loan. You can simulate rolling a die using an app on the TI-84 CE called **Prob Sim**.

1st Die roll: ☐ $x \ \$100 =$ _____ (multiply by $100 to determine the amount of your down payment)

Your Principal (The PV for the loan) is what's left when you subtract this amount from $1000.

PV = _____

Interest:
- **If your 1st roll was a 1 or 2**, your loan is considered high risk, since your deposit is less than 25% of the value of your purchase. The interest on your loan will be 15% compounded weekly.
- **If your 1st roll was a 3 or 4**, you have a good-sized down payment, and the interest on your loan will be 10%, compounded semi-monthly.
- **If your 1st roll was a 5 or 6**, you have a large downpayment, and you get a preferred rate loan which is only 7%, compounded monthly.

I(%) = _____

CpY = _____

2nd Die roll: ☐ This is the number of months until you can repay your loan.

$N = \dfrac{}{12}$

Enter your values for **N**, **I(%)**, **PV** and **CpY** in the Finance Solver and determine the amount you will have to repay for your loan.

FV = _____

Explain why it is better to have a larger down payment when financing a purchase. Provide at least 2 reasons why this is so.

Why is it better to be able to repay your loan as fast as possible?