

Finance Calculations

A dark blue diagonal gradient bar that starts from the bottom left corner and extends towards the top right corner, covering the lower half of the slide.

Objectives

- Understand the difference between assets, liabilities, and regular expenses
- Understand what is income
- Understand the uses of and how to calculate:
 - Debt Servicing Ratios
 - Time Value of Money
 - Manually
 - Calculator
 - Affordability

Terminology

- **Periods**
 - Weekly - 52 periods per year
 - Bi-weekly - 26 periods per year
 - Semi-monthly - 24 periods per year
 - Monthly - 12 periods per year
 - Quarterly - 4 periods per year
 - Semi-annual - 2 periods per year
- **Amortization** - full length of a loan, usually in relation to a mortgage
- **Term** - a small portion of the amortization period where the interest rate is set
- **Revolving Credit** - Credit that does not have a set term or length of repayment
- **Installment Credit** - credit that has a finite or completion date

Assets vs. Liabilities

Assets

- Holds a value
- Typically owned by a person

Examples

- Cash & Investments
- Houses & Property
- Cars & RV's
- Art, Heirlooms, Other things of value



Liabilities

- Financial responsibility
- Value owed to someone else

Examples

- Mortgages
- Car Loans
- Short & Long term loans
- Other debts owed to other people



Liabilities vs. Expenses



Liabilities

- Financial responsibility
- Value owed to someone else

Examples

- Mortgages
- Car Loans
- Short & Long term loans
- Other debts owed to other people

Expenses

- Regular bill that does not (usually) have interest included.
- Money outflows for daily activities

Examples

- Utilities (heat, power, water, internet, etc.)
- Phone Bill
- Subscriptions (Netflix, Xbox Live, Spotify, etc.)
- Food, Fuel, Entertainment, etc.

Matching Activity

Match the financial entity to its proper category.

Entity	Category

What is income?



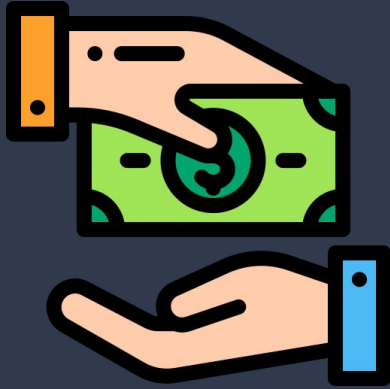
What is income?



In the most basic form, income is money coming in, but when it comes to loans and income verification, this is not necessarily true. Let's talk about some common types of income.

- Employment Income
 - Salary
 - Commission (average)
 - Self-employment (Net income)
- Support Payments
 - Spousal Support
 - Child Support

What is income?



Some types of income are more challenging for income verification and require averaging:

- Investment Income
- Long term disability
- Royalties
- Rental Income*
 - Houses
 - Roommates

Other types of income will not be included in most calculations or require special exceptions:

- Child Tax Benefit**
- Tax Returns
- Climate action incentives
- Short Term Disability
- Employment Insurance ***
- AISH & Income Support

Gross Income VS Net Income



Some calculations use gross income while others use net income, but what is the difference?

- Gross Income - income before all deductions. Usually found by multiplying hourly wage by number of hours worked.
- Net Income - income after all deductions are taken off. Often referred to as your “take-home” income and is the amount on your paycheque.

Knowing what a person’s net income is cannot be estimated or exactly calculated if the individual does not know:

- Estimate Net Income = Gross income x 0.70
- CRA Payroll calculator (Does not include employer deductions) -

<https://www.canada.ca/en/revenue-agency/services/e-services/e-services-businesses/payroll-deductions-online-calculator.html>

Order of Operations



Order of
Operations tells
you how to
complete
multi-step
equations

B - Brackets

E - Exponents

D - Division

M - Multiplication

A - Addition

S - Subtraction

Practice Problems - By Hand

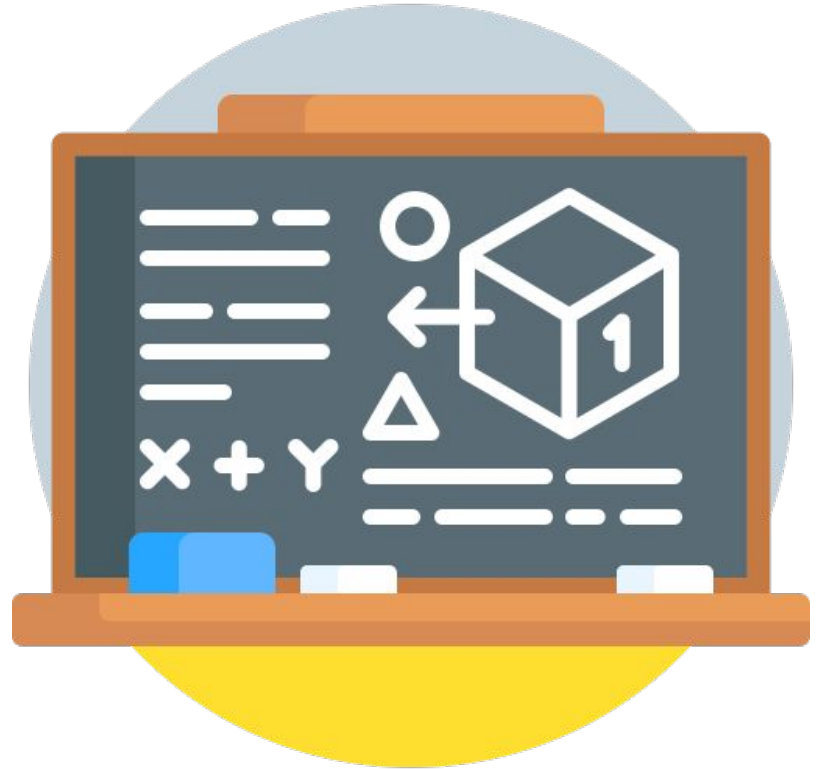
1. 2×2

2. $2 \times 2 + 2$

3. $2 \times (2 + 2)$

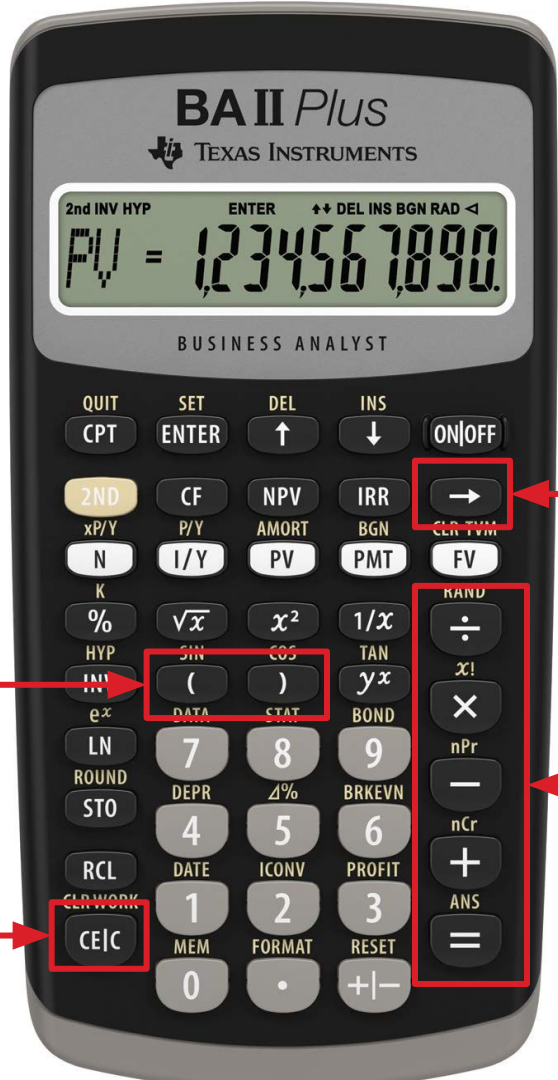
4. $2 \times (2 + 2)^2$

5. $2 + 2 \times 2^2 + (2-1)$



Using your Calculator





BA II Plus
TEXAS INSTRUMENTS

2nd INV HYP ENTER ++ DEL INS BGN RAD <-
PV = 1,234,567.890

BUSINESS ANALYST

QUIT	SET	DEL	INS	
CPT	ENTER	↑	↓	ON/OFF
2ND	CF	NPV	IRR	→
xP/Y	P/Y	AMORT	BGN	CLR TVM
N	I/Y	PV	PMT	FV
K				RAND
%	\sqrt{x}	x^2	$1/x$	÷
HYP	SIN	COS	TAN	x!
INV	()	y^x	×
e^x	DATA	STAT	BOND	nPr
LN	7	8	9	-
ROUND	DEPR	$\Delta\%$	BRKEVN	nCr
STO	4	5	6	+
RCL	DATE	ICONV	PROFIT	ANS
CLR WORK	1	2	3	=
CE/C	MEM	FORMAT	RESET	
	0	.	+/-	

Backspace

Brackets

Regular Math Functions

Clear

Practice Problems - with your calculator

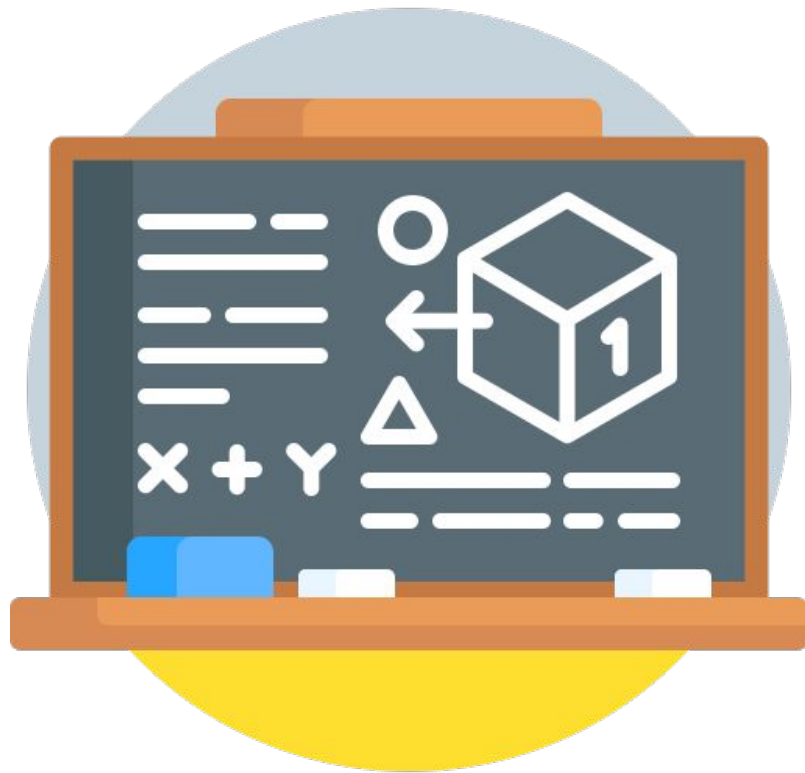
1. 2×2

2. $2 \times 2 + 2$

3. $2 \times (2 + 2)$

4. $2 \times (2 + 2)^2$

5. $2 + 2 \times 2^2 + (2 - 1)$



HOW DO BANKS

QUALIFY MY

MAXIMUM

MORTGAGE





Gross Debt Servicing Ratio

House Liabilities + Taxes + Heat
Gross Monthly Income



Basic Examples

Example 1

- Housing Liabilities = \$1,200
- Taxes & Heat = \$250
- Income = \$3,200

Example 2

- Housing Liabilities = \$2,200
- Taxes & Heat = \$650
- Income = \$7,200

Example 3

- Housing Liabilities = \$1,400
- Taxes & Heat = \$350
- Income = \$2,200

Example One

Manuel



Manuel pays \$1,275 in rent which includes his taxes, water, and gas. He pays \$225 in heat and \$100 for internet. He is currently making \$2,500 gross per month.

Example Two



Robin

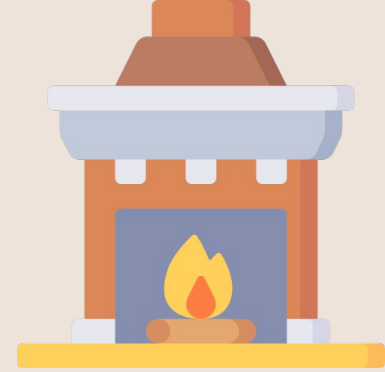
Robin recently signed a contract with a hospital that guarantees an annual salary of \$301,619.00. She is currently paying \$1,508.32 per month for her mortgage plus an additional \$125 in homeowner association fees, and \$290 in condo fees. The monthly property taxes are \$227. She pays \$375 on average for heat.

Example Three

Timothy & SJ



SJ & Timothy decided to live in Timothy's home. The current mortgage payment is \$2,098.13/month with an additional \$325/month in homeowner association fees. Their annual property taxes are \$3,749.00 and they pay \$544/month in heat. Timothy earns \$3,498/biweekly while SJ earning \$7988/monthly. They earn an additional \$1500/month in rental income.



Total Debt Servicing Ratio

Housing Liabilities + Taxes + Heat + Other Debt
Gross Income



Basic Examples

Example 1

- Housing Liabilities = \$1,200
- Taxes & Heat = \$250
- Debt = \$345
- Income = \$3,200

Example 2

- Housing Liabilities = \$2,200
- Taxes & Heat = \$650
- Debt = \$200
- Income = \$7,200

Example 3

- Housing Liabilities = \$1,400
- Taxes & Heat = \$350
- Debt = \$0
- Income = \$2,200

Example One

Manuel



Manuel pays \$1,275 in rent which includes his taxes, water, and gas. He pays \$225 in heat and \$100 for internet. He is currently making \$2,500 gross per month. His monthly student loan payment is \$124.56 and he has a credit card with a maximum of \$5000.00.

Example Two



Robin

Robin's gross monthly income is \$25,134.92. She is currently paying \$1,508.32 per month for her mortgage plus an additional \$125 in homeowner association fees, and \$290 in condo fees. The monthly property taxes are \$227. She pays \$375 on average for heat. She pays \$152.11 for her car loan, and \$1307.98 for her student loan monthly. She has a credit card with a max of \$7,000.00

Example Three

Timothy & SJ



SJ & Timothy decided to live in Timothy's home. The current mortgage payment is \$2,098.13/month with an additional \$325/month in homeowner association fees. Their annual property taxes are \$3,749.00 and they pay \$544/month in heat. The second mortgage is \$1,194.35/month. Timothy earns \$3,498/biweekly while SJ earning \$7988/monthly. They earn an additional \$1500/month in rental income. The car loan is \$199.44/month, student loans are \$555.10/month, and the personal loan is \$140.16/month. Their credit card has a max of \$15,000

Time Value of Money





Time
is
Money

TED Ed

TVM Definitions

Principal Value - PV or present value, starting value at the beginning of the loan or investment

Future Value - FV, value at the end of the payments or term

Payment - PMT, payment used for the loan or invested into the total value. Frequency of payment can change.

N - number of periods, can be number of loan payments or number of investment payments, number of period must match with frequency of payments

Interest - I or R or discount rate, rate of interest being charged or the expected rate of return on an investment.

Term - t, length of term, in years

Formula - Future Value

$$\text{Future value of money} = PV \times \left(1 + \frac{i}{n} \right)^{(n \times t)}$$

Basic Examples

Example 1

- $PV = 3000$
- $I = 0.14$
- $N = 12$
- $T = 5$

Example 2

- $PV = 1000$
- $I = 0.05$
- $N = 2$
- $T = 20$

Example 3

- $PV = 1500$
- $I = 0.08$
- $N = 4$
- $T = 5$

Formula - Present Value

$$\text{Present Value of Money} = \frac{FV}{\left(1 + \frac{i}{n}\right)^{(n \times t)}}$$



Basic Examples

Example 1

- $FV = 100,000$
- $I = 0.05$
- $N = 12$
- $T = 10$

Example 2

- $FV = 25,000$
- $I = 0.10$
- $N = 4$
- $T = 5$

Example 3

- $FV = 50,000$
- $I = 0.22$
- $N = 52$
- $T = 1$

Example One



Manuel

Manuel was given \$1,200 by his mom to save for a house purchase when he graduates. He decided to invest in a high stakes fund with an average return of 22% and annual compounding. If he saves it for the remaining three years of his degree, how much will he have saved?

Example Two



Robin

Robin wants to investment \$100,000 into a high interest savings account with an interest rate of 14% and semi-monthly compounding for her retirement. If she retires in 15 years, how much money will she have when she retires?

Example Three

Timothy & SJ

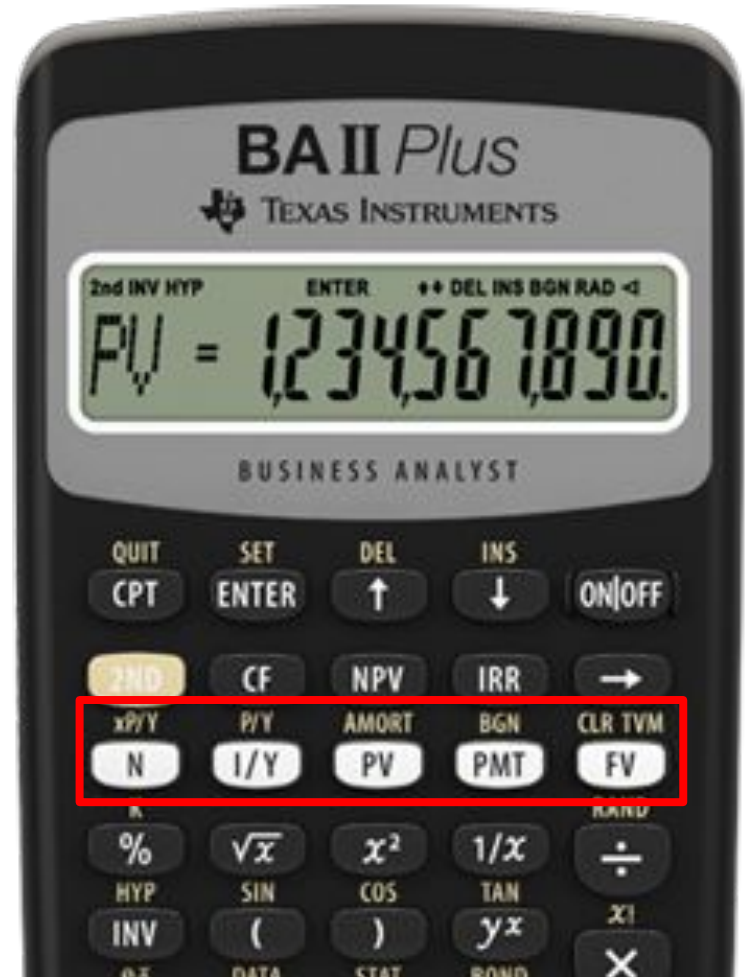


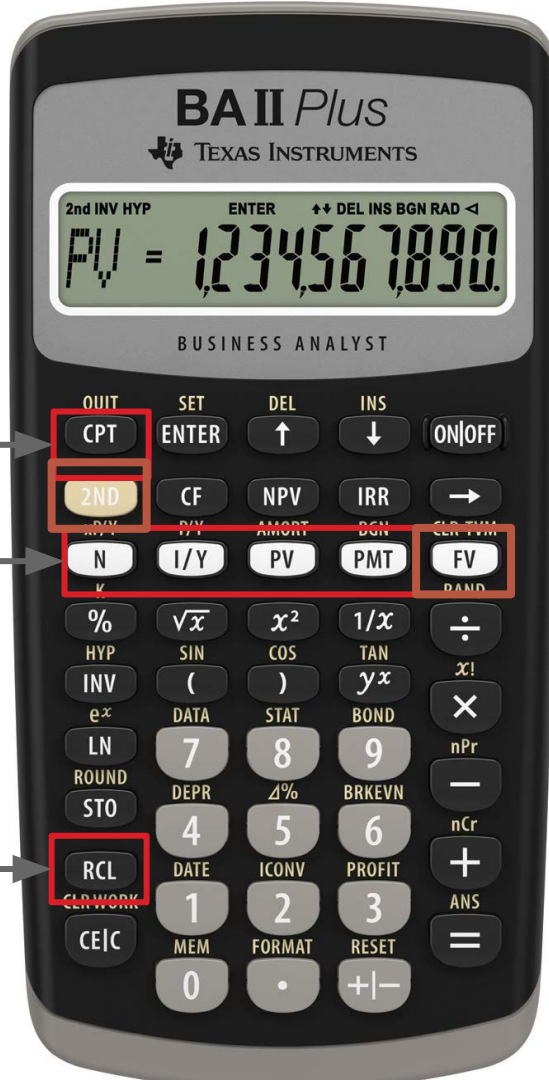
Timothy and SJ want to start saving for retirement. They plan to retire in 40 years and have found a secure mutual fund with an 8% return and monthly compounding. If they want \$1,000,000 when they retire, how much do they need to invest now?

Using your Calculator



BA II Plus Calculator - TVM Functions





Compute

TVM Keys

Recall

How to enter into your TVM:

1. Enter value you want
2. Click respective button

How to clear your TVM:

1. 2nd Button
2. FV button

TVM Walkthrough

Annuity Due Financial Calculator

Example: Present value of an annuity due with four \$500 payments and a discount rate of 10%



Option 1: Set payments to occur at the beginning the periods "BGN"
(MAKE SURE TO SWITCH IT TO END WHEN YOU FINISH THE PROBLEM!)

Option 2 (RECOMMENDED!): Calculate the same way as a normal annuity then multiply answer by $(1+r)$

INPUTS	4	10%	CPT	\$500	0	BGN
	N	I/YR	PV	PMT	FV	
OUTPUT			-\$1743.43			



TVM Walkthrough - No Payments

In the most simplest model when all you have is PV, I/Y, T, and annual compounding

- Enter present value as a negative
- Enter I/Y as the full percentage
- Enter N as the full length of time

Basic Examples

Example 1 - FV

- $N = 5$
- $I/Y = 5$
- $PV = -100$

Example 2 - PV

- $N = 5$
- $I/Y = 5$
- $FV = 1000$

Example 3 - I/Y

- $N = 5$
- $PV = -100$
- $FV = 200$

Example 4 = N

- $I/Y = 5$
- $PV = -500$
- $FV = 1000$

Example One

Manuel



Manuel has \$5000 to invest. He wants to keep it safe and found a low interest savings account with 3% interest compounded annually. If he leaves it in the account for 20 years, how much will it be worth?

Example Two




Robin

Robin has invested \$5,000 into a savings account with a 7% interest rate for her 5 year old daughter's college education. How much will this account be worth when her daughter starts withdrawing at 18?

Example Three

Timothy & SJ



Timothy & SJ want to buy a \$80,000 luxury car in five years. If they invest in a secure mutual fund with an annual return of 15% compounded annually, how much do they need to put in the account today?

TVM Walkthrough

Annuity Due Financial Calculator

Example: Present value of an annuity due with four \$500 payments and a discount rate of 10%



Option 1: Set payments to occur at the beginning the periods "BGN" (MAKE SURE TO SWITCH IT TO END WHEN YOU FINISH THE PROBLEM!)

Option 2 (RECOMMENDED): Calculate the same way as a normal annuity then multiply answer by $(1+r)$

INPUTS	4	10%	CPT	\$500	0	BGN
	N	I/YR	PV	PMT	FV	
OUTPUT			\$-1743.43			



TVM Walkthrough – With Payments Equal

When including payments with the same compounding and payment frequency, the N and I/Y value change.

- $N = \text{length in years} \times \text{payments in 1 year}$
- $I/Y = \text{annual interest} / \text{number of compound periods in 1 year}$

The other values will remain the same.

Basic Examples

Example 1 - FV

- $N = 5 \times 12$
- $I/Y = 5 / 12$
- $PMT = -50$
- $PV = -10,000$

Example 2 - PV

- $N = 5 \times 26$
- $I/Y = 5 / 26$
- $PMT = -20$
- $FV = 10,000$

Example 3 - PMT

- $N = 5 \times 4$
- $I/Y = 5 / 4$
- $PV = -100$
- $FV = 200$

Example 4 = N

- $I/Y = 5/24$
- $PV = -500$
- $PMT = -5$
- $FV = 1000$

Example One

Manuel



Manuel has an excess of \$50 per month to save. He is going to save for retirement by putting the \$50 into a RRSP. He has been guaranteed a return of 5% per year with monthly compounding. If he plans to retire in 45 years, how much will he have saved?

Example Two



Robin

Robin has a student loan with a balance of \$35,000 with 5% interest and biweekly compounding. If she makes a payment of \$500 biweekly, how long will it take it her to pay off her loan?

Example Three

Timothy & SJ



Timothy & SJ want to have \$40,000 in 5 years. They found a fund that averages 14% with monthly compounding. If they put away \$200 per month, how much do they have to invest today to reach their goal?

TVM Walkthrough



For a mortgage of \$300,000 amortized over 30 years at 2.25% compounded semi-annually, calculate the monthly payments.

2ND FV 2ND I/Y

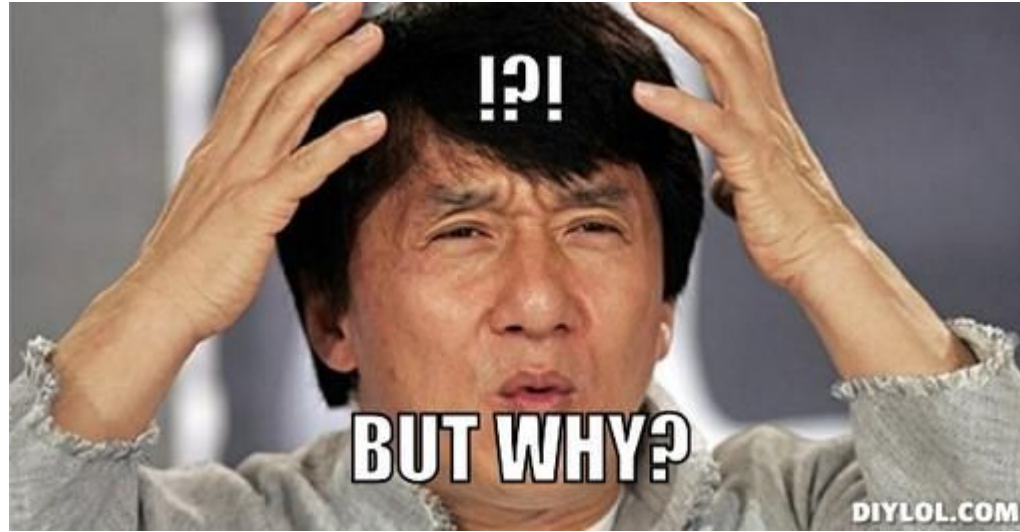
TVM Walkthrough – With Payments Inequal

When including payments where compound and payment period are not the same, the N and I/Y value change.

- N = length in years x payments in 1 year
- I/Y = annual interest

We also use the C/Y and P/Y buttons which can be accessed by clicking 2ND I/Y. The other values will remain the same.

Why would compound not match payment?



Example One

Manuel



Manuel is looking to buy a house. He has been quoted 6.19% semi-annually compounding over 30 years. He plans to make semi-monthly payments of \$1000. How big of a mortgage can he afford?

Example Two



Robin

Robin wants to increase her mortgage payment. She plans to increase her biweekly mortgage payment to \$2000. Her current mortgage is 7% compounded semi-annually. If she owes \$245,000, how long will it take to pay off her mortgage?

Example Three

Timothy & SJ



Timothy & SJ are wanting to refinance their mortgage to free up some extra cash. Their current mortgage has a balance of \$340,000. If they refinance at 6.95% semi annual compounded over 25 years, what is their new monthly mortgage payment?

Putting it all together



Affordability Calculations

Multi-step problems to determine what clients can afford.

1. Find maximum GDSR and TDSR based on income (39% & 44% of Gross income)
2. Assuming the same heating and taxes, solve for housing liabilities using the maximum values from step 1.
 - a. $\text{Max HL} = \text{GDSR} - \text{heat} - \text{taxes}$
 - b. $\text{Max HL} = \text{TDSR} - \text{heat} - \text{taxes} - \text{debt}$
3. Insert the lowest housing liabilities into the PMT section of your TVM solver and solve for PV.

Example One

Manuel

Manuel would like to purchase a house after school. He has shopped around and got quoted 6.19% semi annual compounded for 25 year mortgage. Based on the information below, how expensive of a house can he purchase? (All finances are monthly)

Housing Liabilities

- Rent - \$1,275

Taxes & Heat

- Taxes - Included in rent
- Heat - \$225

Liabilities

- Student Loan - \$124.56
- Credit Card Max - \$5,000

Income

- Work - \$2,500

Checkpoints!



As you are going through Manuel's affordability, here are some checkpoints to see if you match:

1. Total Income = \$2,500
2. Maximum GDSR = \$975.00
3. Maximum TDSR = \$1,100.00
4. Maximum GDSR Housing Liabilities = \$750.00
5. Maximum TDSR Housing Liabilities = \$600.44
6. PV = \$92,213.13

Example Two

Robin

Robin wants to know what is the max mortgage she could get if she sells her condo and expects the same condo and HOA fees. She has been quoted 8% semi annual compound for a 20 year mortgage. (All finances are monthly)

Housing Liabilities

- Mortgage Payment - \$1,508.32
- Homeowner association fees - \$125
- Condo Fees - \$290

Taxes & Heat

- Property Taxes - \$227
- Heat - \$375

Other Debts

- Car Loan - \$152.11
- Student loans - \$1,307.98
- Credit card max - \$7,000

Income

- Salary - \$25,134.92

Checkpoints



As you are going through Robin's affordability, here are some checkpoints to see if you match:

1. Total Income = \$25,134.92
2. Maximum GDSR = \$9 802.62
3. Maximum TDSR = \$11 059.36
4. Maximum GDSR Housing Liabilities = \$8 930.62
5. Maximum TDSR Housing Liabilities = \$8 517.27
6. PV = \$1 028,211.88

Example Three

Timothy & SJ

Timothy & SJ want to know what is the max they mortgage they could afford if they sold their house and bought a property with no HOA fee. The quoted mortgage rate is 7% semi annual compounding over 25 years. (All finances are monthly)

Housing Liabilities

- Mortgage Payment - \$2,098.13 monthly
- Homeowner association fees - \$325 monthly

Taxes & Heat

- Property Taxes - \$312.42
- Heat - \$544

Other Debts

- Second Mortgage - \$1,194.35
- Car Loan - \$199.44
- Student Loans - \$555.10
- Personal Loan - \$140.16
- Credit Card Max - \$15,000

Income

- Timothy - \$7,579
- SJ - \$7,988
- Rental Income - \$1,500

Checkpoints!



As you are going through Timothy and SJ's affordability, here are some checkpoints to see if you match:

1. Total Income = \$16 317.00
2. Maximum GDSR = \$6 363.63
3. Maximum TDSR = \$7 179.48
4. Maximum GDSR Housing Liabilities = \$5 507.21
5. Maximum TDSR Housing Liabilities = \$3 784.01
6. PV = \$540 251.98

Other Resources

Bank Affordability Calculators:

- Mortgage
 - <https://calculators.atb.com/ATBFinancial/en/mortgagePayment/MortgagePayment.jsp>
 - <https://apps.royalbank.com/apps/mortgages/mortgage-payment-calculator/#top-page-content-2>
 - <https://tools.td.com/mortgage-payment-calculator/>

- Loans
 - <https://www.scotiabank.com/ca/en/personal/loans-lines/personal-loan/personal-loan-calculator.html>
 - <https://www.debtcanada.ca/loan-calculator/>
 - https://apps.royalbank.com/uaw0/personalloans/payment?_gl=1*davs3t*_ga*MzAwMTU2NTI5LjE2Njk2Njk5MTE.*_ga_89NPCTDXQR*MTY3MDUzMDQyNy4yLjAuMTY3MDUzMDQyNy42MC4wLjA

Maximum House Price



House price does not equal mortgage

Your mortgage is the amount of the total purchase price that is financed. As such, just adding on a down payment may not accurately reflect how much a person can actually own. What this comes down to is Loan to Value Ratios.

If a client is financing 95% of the house value, that means the mortgage is equivalent to 95% of the house value. Adding on 5% of the mortgage will not be the same as 5% down.

Let's look at some examples.

Mortgage / LTV = Max HP

Example One

Manuel



Manuel has been pre-approved for \$92,213.13. If he wants to put 10% down, what is the maximum house he can afford?

Example Two



Robin

Robin wants to avoid a high ratio mortgage and wants to put down 20%. If she has been pre-approved for \$1,010,707.36, how much does she need for a downpayment?

Example Three

Timothy & SJ



Timothy & SJ have \$80,000 saved up for a downpayment. If they have been pre-approved for \$587 366.86, what is the minimum amount they have to use for a downpayment? How much would you recommend they use?

Table 1: The minimum down payment based on the purchase price of your home

Purchase price of your home	Minimum amount of down payment
\$500,000 or less	<ul style="list-style-type: none">• 5% of the purchase price
\$500,000 to \$999,999	<ul style="list-style-type: none">• 5% of the first \$500,000 of the purchase price• 10% for the portion of the purchase price above \$500,000
\$1 million or more	<ul style="list-style-type: none">• 20% of the purchase price

[More details on Down Payments](#)

Examples Following the Rules

Client	Purchase Price	Minimum Downpayment
Manuel	\$102,459.03	
Robin	\$1,263,384.20	
Timothy & SJ	\$618,280.91	

What can they get?

Client	Maximum Price	Common Features
Manuel	\$100,000	Mobile Home or Apartment, 1-2 Bedrooms, 1-2 bathrooms Lot rent or condo fees extra
Robin	\$1,260,000	Single family home with triple car garage Manicured yard and extra features 3-5+ Bedrooms, 2-4+ bathrooms
Timothy & SJ	\$615,000	Single family home with single car garage and yard 3-5 Bedrooms, 2-4 bathrooms

Mortgage Insurance & Closing Costs



Hidden Costs

On asset secured loans (i.e. car loans), you may have additional fees like GST that need to be accounted for. In Alberta, cars purchased from a dealership must have 5% GST charged. Some dealerships may include this in the price, but not all do.

For mortgages, there are several costs that buyers may not consider. Some of these costs can be incorporated into a mortgage, but not all.

<https://maverickgroupyy.com/closing-costs-alberta/>

Closing Cost	Who Pays?	Estimated Cost
A Deposit	Buyer	\$5-10K
Down Payment	Buyer	5-20% of purchase price
Adjustment Costs (Property Tax)	Buyer	\$0-3,000
Legal Fees	Buyer and Seller	\$1-2,000
Title Insurance	Buyer	\$300
Property Insurance	Buyer	\$500-1,500
Mortgage Insurance	Buyer	Up to 4% of mortgage amount
Property Appraisal	Buyer or Seller	\$500 or less
Home Inspection	Buyer	\$500
Estoppel Certificate	Buyer	\$100
Goods & Services Tax (GST)	Buyer	5% in Alberta (see details)
New Home Warranty	Buyer	\$2,000
Land Transfer Tax	Buyer	\$200-1,000
Real Property Report (RPR)	Seller	\$600
Mortgage Penalties	Seller	Dependant on contract
Realtor Commission	Seller	Dependant on contract

Mortgage Default Insurance

Loan-to-Value	Premium on Total Loan
Up to and including 65%	0.60%
65.01% to 75%	1.70%
75.01% to 80%	2.40%
80.01% to 85%	2.80%
85.01% to 90%	3.10%
90.01% to 95%	4.00%

LTV Ratio	Premium Rate
Up to 65%	0.60%
65.01% - 75%	1.70%
75.01% - 80%	2.40%
80.01% - 85%	2.80%
85.01% - 90%	3.10%
90.01% - 95%	4.00%

Activity Time! <https://www.canadaguaranty.ca/insurance-premium-calculator/>

Check your Knowledge!

