Using a Financial Calculator

Financial calculators

Financial calculators can be used to solve many financial problems. In this course, we will use financial calculators to solve two types of problems:
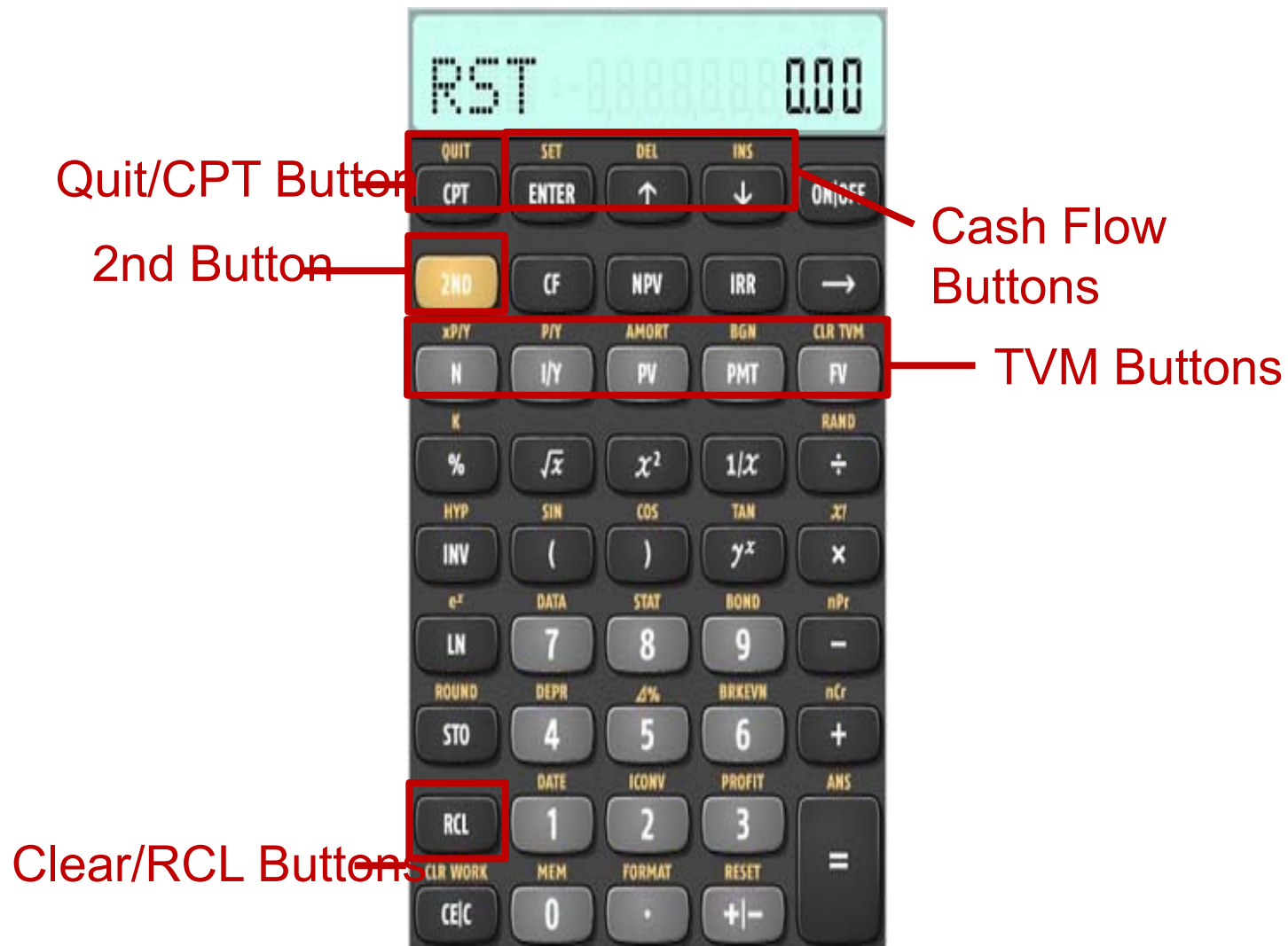
- Time Value of Money (TVM) problems.
- Cash Flow Worksheet problems.

This section will describe these types of problems and show how a financial calculator can be used to quickly solve the types of problems introduced in this lecture.

Please familiarize yourself with your financial calculator and make sure you're able to use your calculator to solve the problems in this section. That way, we can spend less energy on the algebra, and focus on the finance!

Financial calculators

Calculator used here: *TI BA II Plus*

Time Value of Money Problems

TVM problems

Time Value of Money (TVM) problems involve cash flows that fit the following structure:

PV   PMT   PMT   …   PMT   FV+PMT

| Period 1 | Period 2 | … | Period N-1 | Period N |

Interest Rate = I/Y, Frequency = P/Y

Where a negative value indicates an outflow and:

     PV = Present value, initial cash flow, or principal balance

     PMT = Periodic payment

     FV = Final cash flow or ending balance

   I/Y= Interest rate per year

     N = Number of periods

     P/Y = Payments per year

     TVM problems require setting the payments per year (*P/Y*) and providing four of the five main inputs (*PV, PMT, FV, I/Y,* and *N*). The calculator will then compute the remaining value.

TVM: Pricing a bond

Earlier, we calculated the price of a bond as the present value of its cash flows.

Ex. We looked at $1,000 worth of a five-year corporate bond that pays annual coupons of 6%, or $60. The cash flows for this bond are:

	$60	$60	$60	$60	$1,060
	Year 1	Year 2	Year 3	Year 4	Year 5

Bond Price
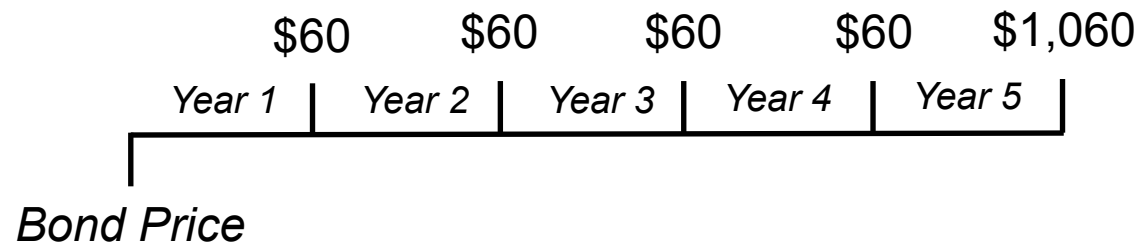
We found that the price of this bond is $1,043 when the discount rate is 5%.

Because these cash flows fit the Time Value of Money structure, we can easily calculate this price using a financial calculator…

TVM: Pricing a bond

Ex. (continued)
The cash flows may be put into the TVM structure as follows:

PV $60 $60 $60 $60 $1,000 + $60

| Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |

Interest Rate = 5%, Frequency = 1

And the present value, which is the price of the bond, can be found accordingly:

Time Value of Money	
P/Y	1
PMT	$60
N	5
FV	$1,000
I/Y	5%
PV=	-$1,043.29

This $1,043 is the price we found earlier. Note that it is negative because a bond-buyer must *pay* $1,043 to *receive* the $60 and $1,000 payments.

TVM: Pricing a bond

With your *TI BA II Plus* financial calculator, the keystrokes are:

Step (1/3): Set the payments per year to 1:

To	Press	Display
Set payments per year to 1.	[2nd], [P/Y], 1, [Enter]	P/Y = 1.00
Return to standard-calculator mode	[2nd], [Quit]	0.00

Step (2/3): Input your four known TVM inputs:

To	Press	Display
Enter periodic payment	60, [PMT]	PMT = 60.00
Enter number of payments	5, [N]	N = 5.00
Enter final payment	1000, [FV]	FV = 1,000
Enter annual interest rate	5, [I/Y]	I/Y = 5.00

Step (3/3): Solve for the remaining unknown TVM value (PV):

To	Press	Display
Compute the present value	[CPT][PV]	PV = -1,043.29

TVM: Pricing a bond

Earlier, we also claimed that the price of the bond falls to $959 if the interest rate increases from 5% to 7%. We can easily calculate that with a *TI BA II Plus*.

Step (1/3): Verify that the calculator stored the previous TVM inputs:

To	Press	Display
Verify that the FV is still 1,000	[RCL], [FV]	FV = 1,000.00
Verify that PMT is still 60	[RCL], [PMT]	PMT = 60.00
Verify that N is still 5	[RCL], [N]	N = 5.00

Step (2/3): Change the interest rate:

To	Press	Display
Enter new interest rate	7, [I/Y]	I/Y = 7.00

Step (3/3): Compute the new price (PV):

To	Press	Display
Compute the new price	[CPT], [PV]	PV = -959.00

Clearing the TVM inputs

When you're finished with a set of TVM problems, it is good practice to clear the stored values from memory.

Step (1/2): Clear the TVM inputs:

To	Press	Display
Clear TVM inputs	[2nd], [CLR TVM]	959.00

Step (2/2): Verify that all of the TVM inputs are now zero:

To	Press	Display
Verify that N is now zero	[RCL], [N]	N = 0.00
Verify that I/Y is now zero	[RCL], [I/Y]	I/Y = 0.00
Verify that PV is now zero	[RCL], [PV]	PV = 0.00
Verify that PMT is now zero	[RCL], [PMT]	PMT = 0.00
Verify that FV is now zero	[RCL], [FV]	FV = 0.00

Interest compounding and discounting

The TVM function can also be used to solve simple interest compounding and discounting functions. Interest compounding and discounting problems have the following structure:

P   F

| Year 1 | Year 2 | ... | Year T-1 | Year T |

Interest Rate = r, Frequency = 1
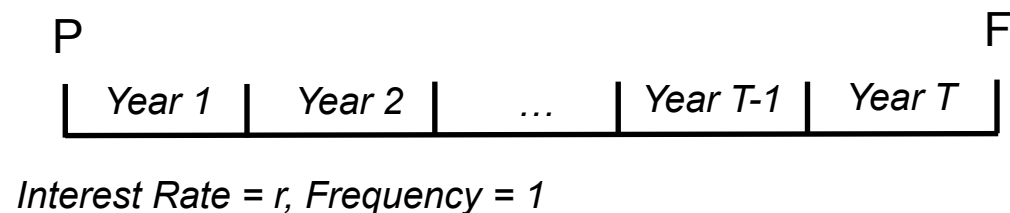
Note that this is a TVM problem with the periodic payment set to zero.

TVM and interest compounding

Ex. Earlier, we saw that that $100,000 deposited into a bank account earning 2% interest will more than double to $220,804 in 40 years.

This can be calculated manually:

Or as a TVM problem. The cash flow diagram for this problem is:

F = ?

| Year 1 | Year 2 | … | Year 39 | Year 40 |

Interest Rate = 2%, Frequency = 1

($100,000)
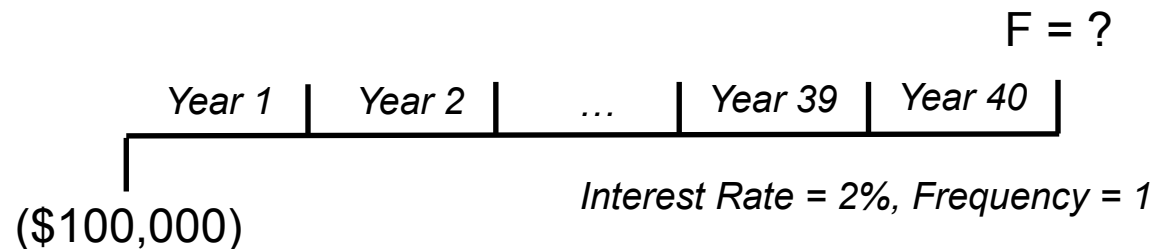
Note that the initial deposit is a cash *outflow* and must be entered as a negative in a financial calculator. **Mind your cash outflows and inflows** – if you don't enter cash flows with the correct signs, you will get odd results…

TVM and interest compounding

Ex. (continued)

A financial calculator can be used to find the final value (note that the final value is positive because a bank withdrawal is a cash *inflow*):

Time Value of Money	
P/Y	1
PV	-$100,000
N	40
PMT	$0
I/Y	2%
FV=	$220,804

To	Press	Display
Enter deposit amount	100000, [+|-], [PV]	PV = 100,000.00
Enter number of periods	40, [N]	N = 40.00
Set payment to zero	0, [PMT]	PMT = 0.00
Enter annual interest rate	2, [I/Y]	I/Y = 2.00
Compute final balance	[CPT], [FV]	FV = 220,803.97

Note: The payments per year (P/Y) should be set to 1 from the last problem. If not, you must set it.

TVM and discounting

Ex. Earlier, we saw that that the present value of $110,000 to be received 10 years from now is $42,410 when the interest rate is 10%.

This can be calculated manually:

Or as a TVM problem. The cash flow diagram for this problem is:

PV = ?   F = $110,000

| | Year 1 | Year 2 | ... | Year 9 | Year 10 | |

Interest Rate = 10%, Frequency = 1

This can be solved with a financial calculator. What do you think the sign on P will be? Why?

TVM and discounting

Ex. (continued) With a financial calculator:

Time Value of Money	
P/Y	1
FV	$110,000
N	10
PMT	$0
I/Y	10%
PV=	-$42,410

The sign of the present value is negative. This is because you must *pay* $42,410 today in exchange for $110,000 in ten years. If it was positive, that would mean it would be fair if somebody gave you $42,410 today *and* $110,000 in ten years!

To	Press	Display
Enter final value	110000, [FV]	FV = 110,000.00
Enter number of periods	10, [N]	N = 10.00
Set payment to zero	0, [PMT]	PMT = 0.00
Enter annual interest rate	10, [I/Y]	I/Y = 10.00
Compute present value	[CPT], [PV]	PV = -42,409.76

Note: The payments per year (P/Y) should be set to 1 from the earlier. If not, you must set it.

Cash Flow Worksheet Problems

Cash Flow Worksheet problems

Cash Flow Worksheet problems are the second type of problem we will use our financial calculators to solve. In these problems, we input an arbitrary series of cash flows:

$$CF_0 \quad C_1 \quad C_2 \quad \cdots \quad C_{N-1} \quad C_N$$

| Period 1 | Period 2 | … | Period N-1 | Period N |

And, given an interest rate, we can compute the **NPV**.

Or, we can just compute the **IRR**.

Cash Flow Worksheet: NPV and IRR

Ex. Consider a business project that requires an initial investment of $15,000. It will pay $5,000 a year for the first 5 years, then $10,000 per year for the next 10 years.

Calculate the NPV of this project using a discount rate of 20%.

Then calculate the IRR.

Ans. The cash flows of the project are:

$5,000   … $5,000 $10,000… $10,000

| Year 1 | … | Year 5 | Year 6 | … | Year 15 |
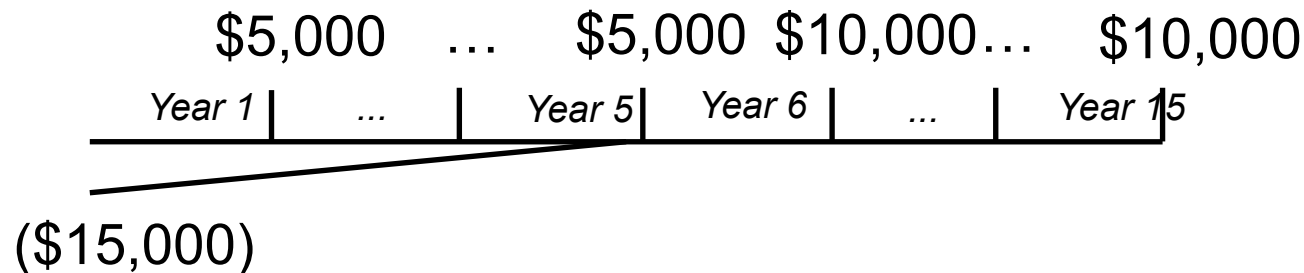
($15,000)

These cash flows may be input into a financial calculator and the NPV and IRR can be computed…

Ans. (continued)

The initial cash flow is *negative* $15,000. The first periodic cash flow is $5,000 and occurs for five years. The second periodic cash flow is $10,000 and occurs for ten years. Inputting these into a financial calculator we can solve for the NPV and IRR:

Cash Flow Worksheet	
CF_0	-$15,000
C01	$5,000
F01	5
C02	$10,000
F02	10
I	20%
NPV=	$16,801.67
IRR=	39.24%

Cash Flow Worksheet: NPV and IRR

With your *TI BA II Plus* financial calculator, first enter the cash flows into the Cash Flow Worksheet. The keystrokes are:

Step (1/4): Open the Cash Flow Worksheet and enter the cash flows:

To	Press	Display
Open cash flow worksheet	[CF]	CF0 = 0.00
Enter today's cash flow (as a cost)	15000, [+|-], [ENTER]	CF0 = -15,000.00
Move to first cash flow	[DOWN ARROW]	C01 = 0.00
Enter first cash flow	5000, [ENTER]	C01 = 5,000.00
Move to first cash flow frequency	[DOWN ARROW]	F01 = 0.00
Enter first cash flow frequency	5, [ENTER]	F01 = 5.00
Move to second cash flow	[DOWN ARROW]	C02 = 0.00
Enter second cash flow	10000, [ENTER]	C02 = 10,000.00
Move to second cash flow frequency	[DOWN ARROW]	F02 = 0.00
Enter second cash flow frequency	10, [ENTER]	F02 = 10.00

Cash Flow Worksheet: NPV and IRR

It is also good practice to verify that you've entered the cash flows correctly. You can scroll through the worksheet to see the cash flows you've entered.

Step (2/4): Scroll through the Cash Flow Worksheet to check your inputs:

To	Press	Display
Move to third cash flow	[DOWN ARROW]	C03 = 0.00
Move to third cash flow frequency	[DOWN ARROW]	F03 = 0.00
Move to today's cash flow	[DOWN ARROW]	CF0 = -15,000.00
Move to first cash flow	[DOWN ARROW]	C01 = 5,000.00
Move to first cash flow frequency	[DOWN ARROW]	F01 = 5.00
Move to second cash flow	[DOWN ARROW]	C02 = 10,000.00
Move to second cash flow frequency	[DOWN ARROW]	F02 = 10.00

Make sure all inputs are correct in the display. If they are not, re-enter the any incorrect inputs. Note that you can also move through the worksheet using the [UP ARROW] button.

Cash Flow Worksheet: NPV and IRR

After your cash flows are stored, compute the NPV and IRR.

Step (2/4): Open the NPV Worksheet and compute the NPV:

To	Press	Display
Open NPV worksheet	[NPV]	I = 0.00
Enter interest rate	20, [ENTER]	I = 20.00
Move to NPV	[DOWN ARROW]	NPV = 0.00
Compute NPV	[CPT]	NPV = 16,801.67

Step (3/4): Open the IRR Worksheet and compute the IRR:

To	Press	Display
Open IRR worksheet	[IRR]	IRR = 0.00
Compute IRR	[CPT]	IRR = 39.24

Clearing the Cash Flow Worksheet

When you're finished with a Cash Flow Worksheet problem, it is good practice to clear the Cash Flow Worksheet.

Step (1/2): Clear the Cash Flow Worksheet:

To	Press	Display
Open cash flow worksheet	[CF]	CF0 = -15,000
Clear cash flow worksheet	[2nd], [CLR WORK]	CF0 = 0.00

Step (2/2): Exit the Cash Flow Worksheet:

To	Press	Display
Return to standard-calculator mode	[2nd], [Quit]	0.00

NPV of an MBA

Earlier, we found the NPV an MBA. This required too many cash flows to compute by hand, so let's do it using a financial calculator.

The cash flows were:

$30k $30k   … $30k

Year 1   Year 2   Year 3 | Year 4 | … | Year 42

$0   ($125k)($125k)
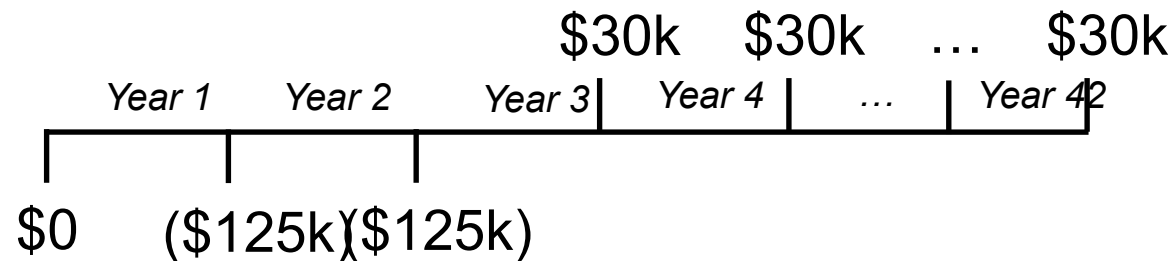
And we discounted the cash flows using an interest rate of 8%.

Can you see what the inputs should be for a financial calculator?

NPV of an MBA

To compute the NPV of an MBA, you should input the following into your financial calculator:

Cash Flow Worksheet	
CF_0	$0
C01	-$125,000
F01	2
C02	$30,000
F02	40
I	8%
NPV=	**$83,794.92**

This is the same answer we claimed earlier.

Do you remember what keys to press to calculate this NPV?

NPV of an MBA

With your *TI BA II Plus* financial calculator, the keystrokes are:

To	Press	Display
Open cash flow worksheet	[CF]	CF0 = 0.00
Enter today's cash flow	0, [ENTER]	CF0 = 0.00
Move to first cash flow	[DOWN ARROW]	C01 = 0.00
Enter first cash flow	125000, [+|-], [ENTER]	C01 = -125,000
Move to first cash flow frequency	[DOWN ARROW]	F01 = 0.00
Enter first cash flow frequency	2, [ENTER]	F01 = 2.00
Move to second cash flow	[DOWN ARROW]	C02 = 0.00
Enter second cash flow	30000, [ENTER]	C02 = 30,000
Move to second cash flow frequency	[DOWN ARROW]	F02 = 0.00
Enter second cash flow frequency	40, [ENTER]	F02 = 40.00
Open NPV worksheet	[NPV]	I = 0.00
Enter interest rate	8, [ENTER]	I = 8.00
Move to NPV	[DOWN ARROW]	NPV = 0.00
Compute NPV	[CPT]	NPV = 83,794.92