

OPERATING MANUAL
FOR
TEXAS INSTRUMENTS
BA II PLUS CALCULATOR
(15 pages)

by

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In this manual the sections that are headed as 4.2, 4.3, 4.4, 4.5, & 4.6, roughly conform to the same numbered sections in The Principles of Managerial Finance, 10th ed., by Gitman.

Calculator Set-up.

The default settings for the calculator are two (2) decimal places and twelve (12) payments per year. For our purposes we will want the settings for decimal places to be four (4), and usually the payments per year will be set to one (1).

The sequence of actions that will be undertaken is:

1. turn on the calculator
2. reset calculator (returns the calculator to all of its default settings)
3. set decimal to 4 places
4. clear time value of money (TVM) registers (the third row of 5 keys)
5. set payments/year to 1 & clear

The actual keystrokes for each of the above is shown below. The bold brackets [] indicate a keystroke.

1. turn on the calculator
[ON/OFF]

2. reset calculator (returns the calculator to all of its default settings)

[2nd] [Reset]

After doing **[2nd] [Reset]** you will see on the screen “RST ?” The calculator is asking if you want to reset the calculator. You will also see in small letters at the top of the screen the word “ENTER”. The calculator is prompting you to use the ENTER key, which on this calculator is the key labeled “ENTER” in the top row of keys on the calculator. By pressing the ENTER key, you are telling the calculator that you want to reset it to the default settings. Pressing the CE/C key clears the screen.

[ENTER] [CE/C]

3. set decimal to 4 places

[2nd] [FORMAT]

This keystroke sequence allows you to change several different format features of the calculator, including the number of decimal places. You will note that in addition to the word “ENTER” at the top of the screen, there are two up and down arrows $\uparrow \downarrow$. You can use either the up or down arrow key (in the top row of the calculator) to move through the various formats that you can change. We want to change only the decimal places so stop at the screen that shows “DEC= 2.00”. The next sequence of keystrokes will set the decimal places to 4 and return you to a screen showing only zeroes.

[4] [ENTER] [CE/C] [CE/C] The screen should now show: 0.0000

4. clear time value of money (TVM) registers (the third row of 5 keys)

[2nd] [CLR TVM]

These two keystrokes clear the Time Value of Money (TVM) registers setting them to zero. (The TVM keys are the five keys on the third row of the calculator: N, I/Y, PV, PMT, FV.) Note: turning the calculator off **NEVER** clears these 5 keys--whatever was in them will remain in them, hence we need to clear them using **[2nd] [CLR TVM]**.

5. set payments/year to 1 & clear

[2nd] [P/Y]

You are now in the register that allows you to change the payments per year and you should see: P/Y= 12.0000 If you use the arrow key to move down you will see: C/Y= 12.0000 The C/Y stands for compounding periods per year. In most of our problems the P/Y will be the same as the C/Y, and the way the Finance Group has decided to teach this calculator is to always leave the P/Y = 1 (which means the C/Y should also always equal 1).

FYI: Whenever you change the P/Y, say from 12/yr. to 1/yr., the C/Y automatically

changes to 1/yr. You can however, make them different because if you change the C/Y, the P/Y does NOT change. For example, if the P/Y = 12, you can arrow down to C/Y and set it to say 4, and the P/Y will remain 12. Again, for most problems the P/Y and C/Y will be the same, so it is necessary to set only the P/Y to the desired number, which again will always be = 1. The following strokes set both P/Y & C/Y to 1.

[1] [ENTER] [CE/C] [CE/C]

Steps 4 & 5 should always be done before each new problem. Hereafter this process will be referred to as: CLR TVM & P/Y = 1 & CE & CE.

4.2 Single Amounts

Future Value of a Single Amount

You invest \$325 in an investment that pays 14%/yr. How much will you have at the end of 2 yrs.? As always, first: CLR TVM & P/Y = 1 & CE & CE

The table below is telling you to do the following keystrokes:

[2]	[N]	
[14]	[I/Y]	Note: 14 not .14
[325]	[+/-] [PV]	(an explanation of the negative number is given below)*
[CPT]	[FV]	The CPT sequence is always done last.

The last pair of keystrokes is telling the calculator to compute future value.

2	14	-325		
N	I/Y	PV	PMT	FV

Solve for FV: [CPT] [FV] = **422.3700**

* The PV was entered as a negative because it represents a cash outflow (-) for us. From the context of the problem you will need to determine which \$ flows are negative. Whenever you're in doubt, just enter the PV as negative. In fact, it is probably a good habit to just always enter PV as a negative number. Whenever you get an "Error 5" message, you have forgotten to enter one of the variables as negative.

PV v. PMT: You may be wondering why we did not put the 325 in as a payment rather than a PV. Had we put the 325 in PMT, the calculator would have assumed TWO payments of 325 each because we have N = 2. An amount entered as a PV is assumed to occur just one time (as in this problem, we made one investment of \$325). The calculator assumes that whatever is

entered as a payment (PMT) will occur the same number of times as the number entered for N, in this case 2 times. We use the PMT key later for annuities.

Checking your work:

One way to check your work is to re-enter all of the data and rework the problem, but an easier way is to simply use the **[RCL]** key. To recall data in the TVM registers press **[RCL]** and the appropriate TVM key, say **[N]**. You will see whatever number you entered. Do this for each of the five TVM keys to check if you have entered the correct data, **[RCL][N]**, **[RCL][I/Y]**, etc.

If in the above problem, you find that when you checked N you had entered 22 by mistake. it is not necessary to start over. Simply reenter **[2] [N]** and recompute by pressing **[CPT] [FV]**.

You invest \$400 in an investment that pays 12%. How much will you have at the end of 3 yrs., 7 yrs.? CLR TVM & P/Y = 1 & CE & CE.

For 3 yrs.:

3	12	-400		
N	I/Y	PV	PMT	FV

Solve for FV: **[CPT] [FV] = 561.9712**

For 7 yrs., it is necessary only to enter the NEW data:

7				
N	I/Y	PV	PMT	FV

Solve for FV: **[CPT] [FV] = 884.2726**

Present Value of a Single Amount

You need \$400 to buy texts next year. If you can earn 7%, how much do you need to deposit today? CLR TVM & P/Y = 1 & CE & CE

1	7			400
N	I/Y	PV	PMT	FV

Solve for PV: [CPT] [PV] = -373.8318

More on Present and Future Values

So far the PV and FV problems that we have examined are “single value” problems, i.e., they have a single PV and a single FV and no cash flows in between the PV and FV. In these problems there were 4 variables (N, I/Y, PV, FV). We knew 3 of the variables and solved for either the PV or the FV. In each case we entered the 3 pieces of data we knew and asked the calculator to compute (CPT) the unknown (either PV or FV).

We are not limited to solving for PV or FV. Anyone of the 4 variables can be solved for as long as we know the other 3 variables. In the following we solve for one of the other variables.

You make a 1 yr. investment of \$1,250 and get back \$1,350. What rate have you earned on your investment? CLR TVM & P/Y = 1 & CE & CE.

1		-1250		1350
N	I/Y	PV	PMT	FV

Solve for I/Y: [CPT] [I/Y] = 8.0000

NOTE: if you got an “Error 5” message, it is because you did not enter the PV as a negative number. Either the PV or the FV must be entered as a negative, and in this case PV is the negative.

What is the rate of return (ROR) on an investment that doubles in value every 10 years? (Rule of 72) CLR TVM & P/Y = 1 & CE & CE.

In the following it does not matter what numbers you put in for PV & FV, as long as FV is twice as large as PV (and PV is negative).

10		-50		100
N	I/Y	PV	PMT	FV

Solve for I/Y: [CPT] [I/Y] = 7.1773 percent

The average annual ROR in the stock market is 13.0%. At that rate how long would it take you to double your money in the stock market?

	13	-10		20
N	I/Y	PV	PMT	FV

Solve for N: [CPT] [N] = 5.6714 years

The previous two problems demonstrate the "Rule of 72" which will be explained in class.

4.3 Annuities

Ordinary annuities and annuities due:

Annuities are a series of equal (level) cash flows for a fixed period of time, e.g., a \$500/month car payment for 60 months. In annuities the payments can occur at the beginning of the period or the end of the period. Almost all of our problems will be ordinary annuities, i.e., the cash flows will be at the end of the period, so we want our calculator set to end of period cash flows which is the default setting for the calculator, but it can accidentally get set to beginning of period cash flows.

Check the **END/BGN** \$ flow setting: If the calculator is set to END (cash flows at the end of the period), nothing will show in the upper right hand corner of the screen and we need do nothing. If, however, the calculator is set to BGN (cash flows at the beginning of the period), the letters BGN will always be in the upper right corner of the screen and we need to change it.

For “Ordinary Annuities” set to END (the default setting):

[2nd] [BGN] [2nd] [CLR Work] [C/CE]

For “Annuities Due” set to BGN:

[2nd] [BGN] [2nd] [SET] [C/CE]

You can afford to pay \$632/mo. for a new car. On a 4 yr. loan, the bank charges 12%/yr. How much can you borrow? Note: loan problems are ALWAYS present value of annuity (PVA) problems. CLR TVM & P/Y = 1 & CE & CE.

First, this is monthly loan problem, so we need to think in terms of number of months, so in this problem $N = 48$.

Second, the I/Y that will be entered is 1% not 12%. We’re doing everything in terms of months and the monthly rate = 1% (12%/12).

Overall, this can be confusing. We tend to think in terms of time periods being years, but this is explicitly a monthly time period problem

For this problem, the cash flow time line is:

Month	0	1	2	...	48
Cash Flow		632	632	...	632

The “loan amount” is the PV of the 48 payments of \$632/mo. discounted @ 1%/month.

48	1		632	
N	I/Y	PV	PMT	FV

Solve for PV: [CPT] [PV] = 23,999.5424

**You deposit \$1,000/yr. for 15 yrs. If the account earns 8.5%/yr., how much money will you have in the account at the EOY 15? EOY 45?
CLR TVM & P/Y = 1 & CE & CE.**

For EOY 15:

15	8.5		1000	
N	I/Y	PV	PMT	FV

Solve for FV: [CPT] [FV] = 28,232.2692

For EOY 45: (while not clear, this part assumes that you deposit \$1,000/yr. for 45 yrs.)

45				
N	I/Y	PV	PMT	FV

Solve for FV: [CPT] [FV] = 450,530.3966

Solving for other than PV or FV in annuity problems:

So far the annuity problems have involved solving for either FV or PV. In these problems there were 4 variables (N, I/Y, PMT and either FV or PV). We knew 3 of the variables and solved for either the PV or the FV. In each case we entered the 3 pieces of data we knew and asked the calculator to compute (CPT) the unknown (either PV or FV).

We are not limited to solving for PV or FV. Anyone of the 4 variables can be solved for as long as we know the other 3 variables. In the following problem we solve for one of the other variables (N). The same process can be used to solve for PMT or I/Y.

You are paying off a \$1,000 charge account at the rate of \$20/mo. If the annual rate on the card is 18% (the monthly rate = 1.5%), how long will it take you to pay off the charge card? CLR TVM & P/Y = 1 & CE & CE.

\$ flow time line:

Month	0	1	2	3	...	?
Cash Flow	1000	-20	-20	-20	...	-20

Note: this is a monthly payment problem so N is in months and I/Y is the monthly rate.

	1.5	1000	-20	
N	I/Y	PV	PMT	FV

Solve for N: [CPT] [N] = **93.1111** months

The PMT is entered negatively because it represents a cash outflow (-) for us. Either PV or PMT must be entered as a negative, otherwise you get an Error 5 message.

4.4 Mixed Streams

When a problem involves more than a single future cash flow, the procedure is to simply take the PV (or FV) of each cash flow separately and then add the PVs (or FVs) together.

You currently have \$7,000 in your account, you will add \$4,000/yr. at the end of each of the next 3 yrs., and the account pays 8%. How much will you have in 3 yrs.? 4 yrs.?

We will take the FV of each cash flow and add the 4 FVs together.

Using a time line with multiple cash flows, as below, is a good practice.

\$ flow time line:

Year	0	1	2	3	4
Cash Flow	7000	4000	4000	4000	

1. Calculate the FV of 7000 at EOY 3: CLR TVM & P/Y = 1 & CE & CE.

3	8	-7000		
N	I/Y	PV	PMT	FV

Solve for FV: [CPT] [FV] = **8,817.9840**

2. Calculate the FV of the first 4000 at EOY 3: CLR TVM & P/Y = 1 & CE & CE.

2	8	-4000		
N	I/Y	PV	PMT	FV

Solve for FV: [CPT] [FV] = **4665.6000**

3. Calculate the FV of the second 4000 at EOY 3: (Note: we can use the same inputs as in step 2, except that we change the N to 1.)

1				
N	I/Y	PV	PMT	FV

Solve for FV: [CPT] [FV] = **4,320.0000**

4. Calculate the FV of the third 4000 at EOY 3: In this case the \$4,000 is deposited at the EOY 3 and hence will earn NO interest, therefore its PV = FV = 4000. (If you calculate using N=0, you'll get FV = 4000.0000)
5. Sum the 4 FVs: $8,817.9840 + 4665.6000 + 4,320.0000 + 4000 = \mathbf{21,803.5840}$ @ t = 3.

The second part of the problem wants to know how much you will have in the account at the EOY 4. There are two ways to do this: first, repeat the 4 steps above but increasing the number of time periods in each step by one, i.e., in step 1 the \$7,000 will be in the account for 4 years, not 3 years, etc.; the second way, take the answer from the first part of this problem (\$21,803.5840) and calculate how much it would be worth 1 year later. We'll do the second--it's easier.

1	8	21803.5840		
N	I/Y	PV	PMT	FV

Solve for FV: [CPT] [FV] = 23,547.8707 @ t = 4.

You want to earn 12% on an investment that pays the following cash flows. How much should you pay for it, i.e., what is the PV of these cash flows? CLR TVM & P/Y = 1 & CE & CE.

\$ flow time line:

Year	0	1	2	3	4
Cash Flow		200	400	600	800

This process parallels what was done above for FVs. Merely take the PV of each cash flow separately back to year 0, then add the 4 PVs. Your text (p. 113) gives the 4 individual PVs and their sum, which is **\$1,432.93 @ t = 0.**

4.5 Compounding Interest More Frequently than Annually

You put \$100 into an acct. paying 12%/yr. compounded quarterly. How much will you have at the end of one year? What is the Effective Annual Rate (EAR)? CLR TVM & P/Y = 1 & CE & CE.

Since compounding is quarterly and there are 4 quarters in a year, N = 4 and the I/Y = 3% (12%/4)

4	3	-100		
N	I/Y	PV	PMT	FV

Solve for FV: [CPT] [FV] = 112.5509

Effective Annual Rate (EAR):

In the previous example, we have a 12% rate compounded quarterly. Using the *Interest Conversion Worksheet* we can determine the Effective Annual Rate (EAR).

To get into the Interest Conversion Worksheet: **[2nd] [I Conv]** (the I Conv key is in the second row from the bottom)

To clear the worksheet of any previous numbers: **[2nd] [CLR Work]**

Using the up/down arrows move down through the worksheet and you should see:

NOM =	0.0000	(nominal or observed %)
EFF =	0.0000	(effective annual % after taking into account compounding)
C/Y =	12.0000	(the default setting = 12)

Note: when you are in a particular cell you will see the word “ENTER” on the screen indicating you can enter a value for that cell.

The sequence of actions taken is:

1. Enter the nominal interest rate (Nom %)
2. Enter the compounding periods/year (C/Y)
3. Compute EFF

1. In the NOM= cell: **[12] [ENTER]** and then arrow up or down to C/Y cell.
2. In the C/Y= cell: **[4] [ENTER]** and then arrow up or down to EFF cell.
3. In the EFF= cell: **[CPT]** you should see 12.5509

To get out of any worksheet: **[2nd] [QUIT]**

Note: the C/Y you set in this worksheet is independent of the P/Y you set in the TVM keys.

4.6 Special Applications of Time Value

Remember: all loan amortization problems are PV of annuity (PVA) problems.

A. Annual payment loan.

What is the annual payment on a 5 yr. 15% \$10,000 loan? CLR TVM & P/Y = 1 & CE & CE

5	15	10000		
N	I/Y	PV	PMT	FV

Solve for PMT: [CPT] [PMT] = -2,983.1555

1. Using the amortization worksheet:

The amortization worksheet can be used to determine how much of a loan payment (or series of payments) is interest and how much is principal. In addition, this worksheet will tell you the loan balance after a specific payment. You can use this worksheet **ONLY** after you have entered the loan data which was done above where you calculated the PMT = \$2,983.1555.

To enter the Amortization Worksheet: [2nd] [Amort]

Arrow down through the five cells--P1, P2, BAL, PRN, INT. As you arrow down through these five cells you will note the word "ENTER" on the screen only in cells P1 & P2. These are the only two cells into which you can enter data.

The worksheet allows you to enter either a single payment (so that P1 = P2, e.g., P1 = 1 and P2 = 1) or a range of payments. Below we will amortize a single payment (payment #3), and then amortize a range of payments (payments #1 through #5).

2. Amortizing a single payment:

For the loan above, to determine the principal & interest in a single payment, say payment 3, and determine the loan balance after payment 3 do the following keystrokes.

To enter the Amortization Worksheet: [2nd] [Amort]

1. In the P1= cell: [3] [ENTER] then arrow down to the P2 cell
2. In the P2= cell: [3] [ENTER] Note: P1 & P2 are now both set to 3.

Arrow down through BAL PRN INT and you will see:

BAL = 4,849.7426 (loan balance after P2, i.e, payment 3)
PRN = -1,961.4731 (principal in the 3rd payment--ignore negative sign)
INT = -1,021.6824 (interest in the 3rd payment--ignore negative sign)

The negative signs are telling you PAID (negative \$ flow) that much PRN & INT.

3. Amortizing a range of payments:

To determine the total interest paid over the life of the 5 payment loan enter 1 in cell P1 and 5 in cell P2, then arrow down thru the cells. (You will be amortizing a range of payments--1 through 5, but it can be any range you want, e.g., for payments 2 through 4, P1 = 2 and P2 = 4.)

1. In the P1= cell: **[1] [ENTER]**
2. In the P2= cell: **[5] [ENTER]**

Arrow down through BAL PRN INT and you will see:

BAL = 0.0003 (loan balance after P2, i.e, payment 5)
PRN = -9,999.9997 (total principal in payments 1 through 5)
INT = -4,915.7778 (total interest in payments 1 through 5)

To get out of the Amortization Worksheet: **[2nd] [QUIT]**

Original data:

Loan = \$10,000
Int. rate = 15%
No. of yrs. = 5
Annual PMT = \$2983.1555

B. Monthly payment loan.

What is the monthly payment on the same 5 yr. 15% \$10,000 loan?

This is the same loan from the previous section, but now monthly PMT. Note: the answer is NOT the annual payment we calculated above divided by 12 ($2,983.1555/12 = 248.5963$) CLR TVM & P/Y = 1 & CE & CE.

Since it is a monthly loan and leaving P/Y = 1, N = 60 (5 x 12) and I/Y = 1.25 (15%/12)

60	1.25	-10000		
N	I/Y	PV	PMT	FV

Solve for PMT: **[CPT] [PMT] = 237.8993**

If the monthly payment had instead been determined by dividing the previously calculated annual payment (2983.1555) by 12 to get \$248.5963, then the true rate of interest on the loan could not be 15%. (The 15% loan has a payment = \$237.8993. To solve for true int. rate if the payment = 248.5963:

Use the current data in the TVM registers but change the PMT and compute I/Y

			248.5963	
N	I/Y	PV	PMT	FV

Solve for I/Y: [CPT] [I/Y] = **1.4178**

This is the monthly rate. The annual rate would be 12 times this or 17.0136. (Actually the correct way to do this is more complicated. The true rate = $(1 + i)^{12} - 1 = .1841 = 18.41\%$)