



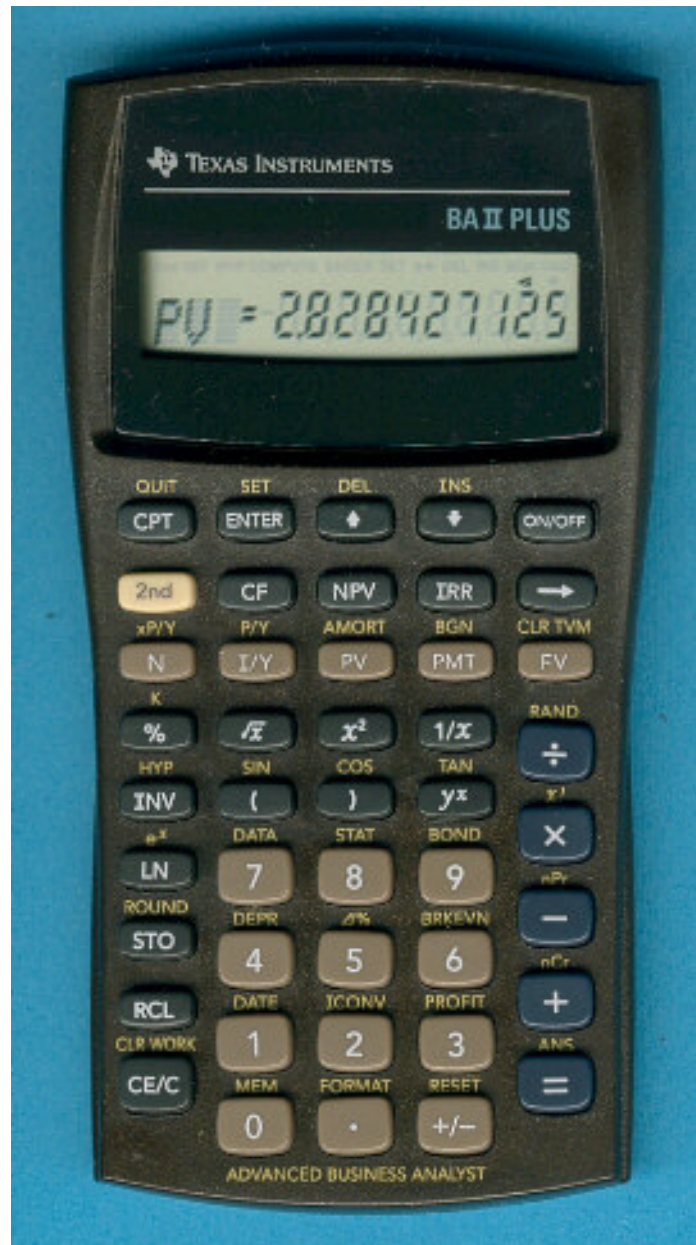
**AUTORITÉ  
DES MARCHÉS  
FINANCIERS**

# **USER GUIDE**

**Texas Instrument BA II Plus Calculator**

**April 2007**

## GENERAL INFORMATION



The Texas Instrument BA II Plus financial calculator was designed to support the many possible applications in the areas of financial analysis and banking.

The explanations below will make it easier for you to use the calculator.

- By default, the calculator operates in financial mode.
- The **ON/OFF** key is used to turn the calculator on and off.
- The **2ND** key is often used to access financial applications. Press this key when you want to apply the functions displayed in yellow at the top of the keys.
- The **FORMAT** feature lets you select the number of decimal points to be displayed by the calculator. If you want to display:
  - a *fixed decimal point*, press 2ND and then FORMAT, enter a number from 0 to 8 to specify the number of decimal points, and then press ENTER.
  - a *floating decimal point*, press 2ND and then FORMAT, enter the number 9, and then press ENTER. The number of decimals displayed will vary depending on the calculations up to a maximum of nine decimals.

To perform the calculator exercises in this document, it is best to use a *floating decimal point* format.

- Setting the number of payment periods and interest-calculation periods in a financial calculation (the P/Y and C/Y functions).
  - **P/Y** function: this function sets the number of annual payments. The default value is one payment per year. To change the number of annual payments, press the 2ND and P/Y keys, enter the required value, and then press ENTER (for example, 12 for 12 monthly payments).
  - **C/Y** function: this function sets the number of interest-calculation periods. By default, the number of interest-calculation periods is the same as the number entered for the P/Y variable. To change it, press 2ND, P/Y and ↓, and then enter the number of periods and press ENTER.

Example where the C/Y differs from the P/Y: monthly payments on a personal loan on which interest is calculated quarterly (1, 4):

| Sequence of entries       | Display  | Explanation  |
|---------------------------|----------|--|
| 2ND > P/Y > 12 > ENTER    | P/Y = 12 | Enters a monthly payment period (12 months).                                     |
| 2ND > P/Y > ↓ > 4 > ENTER | C/Y = 4  | Enters a quarterly interest-calculation period (4 three-month periods per year). |

N. B.: It is important to follow the sequence of entries without pressing any other key.

- The **BGN** function lets you activate the beginning-of-period or the end-of-period payment. To understand the configuration of this function, simply press the 2ND and BGN keys. To the left of your screen, you will then see the END or BGN letters.

To activate the beginning-of-period payment calculation, simply press the 2ND, BGN, 2ND and SET keys. The BGN indicator then appears in the upper-right area of the display screen. To return to END, simply repeat the 2ND, BGN, 2ND and SET sequence: the BGN indicator will disappear.

- The **CE/C** key clears the on-screen data without deleting any numerical values that have been entered.
- The **CLR TVM** function cancels the numeric values and calculation commands and resets the calculator's default financial values. Before performing each calculation, users are advised to cancel all previously used numerical values by pressing the 2ND and CLR TVM keys.

These keys, however, do not affect the beginning-of-year payment (BGN) mode or end-of-period payment (END) mode or the values attributed to P/Y and C/Y. Therefore, it is important to make sure that these values have been programmed before performing a calculation.

## FINANCIAL CALCULATIONS

Most financial calculations are carried out using the following seven keys:

| Financial keys | These keys are used to designate or calculate:  |
|----------------|---|
| <b>N</b>       | The number of periods.  |
| <b>I/Y</b>     | The nominal interest rate.  |
| <b>PV</b>      | The present value of an investment.   |
| <b>FV</b>      | The future value of an investment.  |
| <b>PMT</b>     | The periodic payment of an amortized loan or a split annuity.   |
| <b>CPT</b>     | Compute key.  |
| <b>BGN</b>     | Indicates whether the calculations include the payments made at the beginning or at the end of each period. |

### Note:

By convention, the present value of an investment is a negative value. The calculator is programmed this way; therefore, in calculations of future values or per-period payments, if the present value is entered as a negative value, the future value or the value of the payments will be positive. The opposite is also true. It is therefore important to be thorough and refer to the calculator's user guide, if necessary.

### Sample calculation of the future value (FV) of a single payment

Someone wishes to invest \$4,000 in a registered retirement savings plan (RRSP) for a five-year period.

Insurer A proposes an annual compound interest rate of 6%, whereas insurer B proposes a nominal rate of 5.95% compounded on a semi-annual basis. The following two tables should help you determine which insurer is proposing the best investment.

### Insurer A

| Sequence of entries   | Display          | Explanation                                   |
|-----------------------|------------------|---|
| CE/C > 2ND > CLR TVM  | 0                | Resets the default values.                    |
| 2ND > P/Y > 1 > ENTER | P/Y = 1          | Enters an annual payment period.              |
| CE/C > CE/C           | 0                | Exits the entry of the P/Y variable.          |
| 5 > N                 | N = 5            | Enters a five-year period.                    |
| 6 > I/Y               | I/Y = 6          | Enters an annual interest rate of 6%.         |
| 4,000 > +/- > PV      | PV = - 4,000     | Enters the present value of the investment.   |
| CPT > FV              | FV = 5,352.90231 | Calculates the final value of the investment. |

### Insurer B

| Sequence of entries   | Display           | Explanation                                   |
|-----------------------|-------------------|---|
| CE/C > 2ND > CLR TVM  | 0                 | Resets the default values.                    |
| 2ND > P/Y > 2 > ENTER | P/Y = 2           | Enters a semi-annual payment period.          |
| CE/C > CE/C           | 0                 | Exits the entry of the P/Y variable.          |
| 5 > 2ND > xP/Y > N    | N = 10            | Enters the number of periods over five years. |
| 5.95 > I/Y            | I/Y = 5.95        | Enters a nominal interest rate of 5.95%.      |
| 4,000 > +/- > PV      | PV = - 4,000      | Enters the present value of the investment.   |
| CPT > FV              | FV = 5,362.632027 | Calculates the final value of the investment. |

The investment proposed by Insurer B returns a greater cumulative value, after five years, of approximately \$9.73.

### Calculating the future value of an annuity

A client would like to invest \$2,500 per year over the next five years. He would like to know what the cumulative value of the investment would be in five years if the annual realized rate were 5% in a situation where the investment is made at the beginning of the year and in a situation where the investment is made at the end of the year.

➤ **\$2,500 investment made at the beginning of the year**

| Sequence of entries   | Display           | Explanation  |
|-----------------------|-------------------|--|
| CE/C > 2ND > CLR TVM  | 0                 | Resets the default values.                                 |
| 2ND > BGN > 2ND > SET | BGN               | Activates the calculation of beginning-of-period payments. |
| 2ND > P/Y > 1 > ENTER | P/Y = 1           | Enters an annual payment period.                           |
| CE/C > CE/C           | 0                 | Exits the entry of the P/Y variable.                       |
| 2,500 > +/- > PMT     | PMT = - 2,500     | Enters the amount of the annual investment.                |
| 5 > N                 | N = 5             | Enters the number of periods.                              |
| 5 > I/Y               | I/Y = 5           | Enters the annual interest rate.                           |
| CPT > FV              | FV = 14,504.78203 | Calculates the cumulative value of the annuity.            |

➤ **\$2,500 investment made at the end of the year**

| Sequence of entries   | Display           | Explanation  |
|-----------------------|-------------------|--|
| CE/C > 2ND > CLR TVM  | 0                 | Resets the default values.                           |
| 2ND > BGN > 2nd > SET | END               | Activates the calculation of end-of-period payments. |
| 2ND > P/Y > 1 > ENTER | P/Y = 1           | Enters an annual payment period.                     |
| CE/C > CE/C           | 0                 | Exits the entry of the P/Y variable.                 |
| 2,500 > +/- > PMT     | PMT = - 2,500     | Enters the amount of the annual investment.          |
| 5 > N                 | N = 5             | Enters the number of periods.                        |
| 5 > I/Y               | I/Y = 5           | Enters the annual interest rate.                     |
| CPT > FV              | FV = 13,814.07812 | Calculates the cumulative value of the annuity.      |

Obviously, an investment made at the beginning of the year will result in a higher cumulative value (other variables being equal), as the interest will begin to accumulate on the very first day.

## Calculating the payment of a personal or mortgage loan

The process of calculating a personal or mortgage loan consists of:

- ❑ Determining the known variables;
- ❑ Entering the number of payment periods (P/Y) and the number of interest-calculation periods (C/Y);
- ❑ Calculating the unknown variable.

### Sample calculation of a personal loan repayment

Mary wants to borrow \$15,000 to purchase a new car, and she wants to repay the loan over a five-year period. If the bank demands a nominal rate of 6% compounded on a monthly basis, what would be the monthly repayment (end of period)?

Known variables:

- nominal rate: (6%,12)
- term of the loan: five years (60 monthly payments)
- capital borrowed: \$15,000
- Number of annual payments: 12
- Number of interest-calculation periods: 12

The monthly repayment can be calculated using the following operations:

| Sequence of entries    | Display           | Explanation  |
|------------------------|-------------------|--|
| CE/C > 2ND > CLR TVM   | 0                 | Resets the default values.                             |
| 2ND > P/Y > 12 > ENTER | P/Y = 12          | Enters a monthly payment period.                       |
| CE/C > CE/C            | 0                 | Exits the entry of the P/Y variable.                   |
| 5 > 2ND > xP/Y > N     | N = 60            | Enters the number of monthly payments over five years. |
| 6 > I/Y                | I/Y = 6           | Enters the nominal interest rate.                      |
| 15,000 > +/- > PV      | PV = - 15,000     | Enters the amount of the loan.                         |
| CPT > PMT              | PMT = 289.9920229 | Calculates the amount of the monthly payments.         |

To repay this loan over a five-year period, the monthly repayment amount would be \$289.99.

### Sample calculation of a mortgage loan repayment

Claude buys a home for \$125,000 and makes a \$40,000 cash downpayment. To finance the balance, the bank offers him an \$85,000 mortgage loan at a nominal rate of 6% compounded on a semi-annual basis.

What monthly payments will be required to repay this mortgage over a 20-year term?

What will the mortgage balance be after five years?

To answer these two questions, the known variables must first be determined:

- nominal rate: (6%, 2)
- term of the loan: 20 years (240 monthly payments)
- capital borrowed: \$85,000

The monthly mortgage repayment can be calculated using the following operations:

| Sequence of entries       | Display           | Explanation  |
|---------------------------|-------------------|--|
| CE/C > 2ND > CLR<br>TVM   | 0                 | Resets the default values.                                   |
| 2ND > P/Y > 12 ><br>ENTER | P/Y = 12          | Enters a monthly payment period.                             |
| ↓ > 2 > ENTER             | C/Y = 2           | Enters a semi-annual interest-calculation period.            |
| CE/C > CE/C               | 0                 | Exits the entry of the C/Y variable.                         |
| 20 > 2ND > xP/Y > N       | N = 240           | Enters the number of monthly payments over a 20-year period. |
| 6 > I/Y                   | I/Y = 6           | Enters the nominal interest rate.                            |
| 85,000 > +/- > PV         | PV = - 85,000     | Enters the loan amount.                                      |
| CPT > PMT                 | PMT = 605.3601756 | Calculates the monthly repayment amount.                     |

To repay this loan over a 20-year period, the monthly repayment amount would be \$605.36.

The balance of the mortgage loan after five years is calculated using the following operations, after having computed the monthly payment of \$605.36:

| Sequence of entries  | Display           | Explanation  |
|--|-------------------|--|
| Do not change the data already entered for the financial variables |                   |  |
| 5 > 2ND > xP/Y > N   | N = 60            | Enters the number of monthly payments over a five-year period. |
| CPT > FV   | FV = 72,076,74454 | Calculates the loan balance after 60 monthly payments.         |

The balance of the mortgage loan after five years is therefore \$72,076.74.

In financial mathematics, it is often a good idea to double-check calculations. In this example, another way to calculate the mortgage balance after 5 years would be to calculate the present value of monthly payments of \$605.36 over 15 years, i.e., the remaining term of the loan.

The balance of the mortgage loan after five years can be calculated using the following operations:

| Sequence of entries    | Display            | Explanation   |
|------------------------|--------------------|---|
| CE/C > 2ND > CLR TVM   | 0                  | Resets the default values.  |
| 2ND > P/Y > 12 > ENTER | P/Y = 12           | Enters a monthly payment period.                                  |
| ↓ > 2 > ENTER          | C/Y = 2            | Enters a semi-annual interest-calculation period.                 |
| CE/C > CE/C            | 0                  | Exits the entry of the C/Y variable.                              |
| 15 > 2ND > xP/Y > N    | N = 180            | Enters the number of monthly payments for the 15 remaining years. |
| 6 > I/Y                | I/Y = 6            | Enters the nominal interest rate.                                 |
| 605.3601756 > PMT      | PMT = 605.3601756  | Enters the amount of the monthly payments.                        |
| CPT > PV               | PV = -72,076.74454 | Calculates the loan balance after 60 monthly payments.            |

The balance of the mortgage loan after five years is therefore \$72,076.74.

## Self-Evaluation Exercise

**Question 1.** You borrow \$75,000 to buy a house and agree to repay the loan in 20 years at an interest rate of (6.5%, 2). How much lower would your monthly payment be with a (6%, 2) interest rate?

- a) \$555.38
- b) \$534.15
- c) \$21.24
- d) \$24.21
- e) \$34.24

**Question 2.** What nominal rate, compounded semi-annually, lets you double your capital in ten years (rounded off)?

- a) 6%
- b) 7%
- c) 8%
- d) 9%
- e) 10%

**Question 3.** You are thinking about purchasing a \$10,000 bond maturing at par in nine years with annual coupons at the rate of 7%. How much will you have to pay if you want a compound annual return of 8%?

- a) \$4,372.82
- b) \$9,002.49
- c) \$9,375.31
- d) \$10,000.00
- e) \$10,375.31

**Question 4.** What will your mortgage loan balance be after four years if the following conditions apply (round off to the nearest dollar)?

Amount of the loan: \$110,000

Interest rate: (8%, 2)

Term of the loan: 25 years with monthly repayments

- a) \$103,361
- b) \$93,360
- c) \$83,953
- d) \$98,360
- e) \$100,630

**Question 5.** What is the cumulative value after seven years of a monthly investment of \$500 (made at the end of each month) if the nominal rate is (9%, 12) (round off to the nearest dollar)?

- a) \$48,213
- b) \$43,000
- c) \$53,000
- d) \$55,813
- e) \$58,213

## Answer Sheet

**Answer 1.** You borrow \$75,000 to buy a house and agree to repay the loan in 20 years at an interest rate of (6.5%, 2). How much lower would your monthly payment be with an interest rate of (6%, 2)?

- a) \$555.38
- b) \$534.15
- c) \$21.24**
- d) \$24.21
- e) \$34.24

The correct answer is **c**).

Reason:

| Sequence of entries                                | Display           | Explanation  |
|--|-------------------|--|
| CE/C > 2ND > CLR TVM                               | 0                 | Resets the default values.                                   |
| 2ND > P/Y > 12 > ENTER                             | P/Y = 12          | Enters a monthly payment period.                             |
| ↓ > 2 > ENTER                                      | C/Y = 2           | Enters a semi-annual interest-calculation period.            |
| CE/C > CE/C  | 0                 | Exits the entry of the C/Y variable.                         |
| 75,000 > +/- > PV                                  | PV = - 75,000     | Enters the loan amount.                                      |
| 6.5 > I/Y  | I/Y = 6.5         | Enters the nominal interest rate.                            |
| 20 > 2ND > xP/Y > N                                | N = 240           | Enters the number of monthly payments over a 20-year period. |
| CPT > PMT  | PMT = 555.3753129 | Calculates the amount of the monthly payment.                |
| Do not clear the values of the financial variables |                   |  |
| 6 > I/Y  | I/Y = 6           | Enters the second nominal interest rate.                     |
| CPT > PMT  | PMT = 534.1413314 | Calculates the amount of the monthly payment.                |

Therefore,  $\$555.38 - \$534.14 = \$21.24$

**Answer 2.** What nominal rate, compounded semi-annually, lets you double your capital in ten years (rounded off)?

- a) 6%
- b) 7%**
- c) 8%
- d) 9%
- e) 10%

The correct answer is **b**).

Reason:

| Sequence of entries   | Display           | Explanation  |
|-----------------------|-------------------|--|
| CE/C > 2ND > CLR TVM  | 0                 | Resets the default values.                                   |
| 2ND > P/Y > 2 > ENTER | P/Y = 2           | Enters a semi-annual payment period.                         |
| CE/C > CE/C           | 0                 | Exits the entry of the C/Y variable.                         |
| 10 > 2ND > xP/Y > N   | N = 20            | Enters the number of monthly payments over a 10-year period. |
| 1,000 > +/- > PV      | PV = - 1,000      | Enters the present value of the investment.                  |
| 2,000 > FV            | FV = 2,000        | Enters the final value of the investment.                    |
| CPT > I/Y             | I/Y = 7.052984768 | Calculates the semi-annual interest rate.                    |

Note: The values of \$1,000 and \$2,000 were chosen arbitrarily. Any value and double that amount would have given the same answer.

**Answer 3.** You are thinking about purchasing a \$10,000 bond maturing at par in nine years with annual coupons at the rate of 7%. How much will you have to pay if you want a compound annual return of 8%?

- a) \$4,372.82
- b) \$9,002.49
- c) \$9,375.31**
- d) \$10,000.00
- e) \$10,375.31

The correct answer is c).

Reason:

| Sequence of entries   | Display             | Explanation                                       |
|-----------------------|---------------------|---|
| CE/C > 2ND > CLR TVM  | 0                   | Resets the default values.                        |
| 2ND > P/Y > 1 > ENTER | P/Y = 1             | Enters an annual payment period.                  |
| CE/C > CE/C           | 0                   | Exits the entry of the C/Y variable.              |
| 10 000 > FV           | FV = 10 000         | Enters the value of the bond at maturity.         |
| 9 > N                 | N = 9               | Enters the number of periods.                     |
| 8 > I/Y               | I/Y = 8             | Enters the annual interest rate.                  |
| CPT > PV              | PV = -5,002.489671  | Calculates the present value of the bond.         |
| CE/C > 2ND > CLR TVM  | 0                   | Resets the default values.                        |
| 700 > PMT             | PMT = 700           | Enters the value of a coupon (7% × \$10,000).     |
| 8 > I/Y               | I/Y = 8             | Enters the annual interest rate.                  |
| 9 > N                 | N = 9               | Enters the number of periods.                     |
| CPT > PV              | PV = - 4,372.821538 | Calculates the present value of interest coupons. |

Therefore, the amount payable is  $\$5,002.49 + \$4,372.82 = \$9,375.31$ .

**Answer 4.** What will your mortgage loan balance be after four years if the following conditions apply (round off to the nearest dollar)?

Amount of the loan: \$110,000

Interest rate: (8%, 2)

Term: 25 years with monthly repayments

- a) **\$103,361**
- b) \$93,360
- c) \$83,953
- d) \$98,360
- e) \$100,630

The correct answer is **a**).

Reason:

| Sequence of entries  | Display             | Explanation  |
|--|---------------------|--|
| CE/C > 2ND > CLR TVM   | 0                   | Resets the default values.                                   |
| 2ND > P/Y > 12 > ENTER   | P/Y = 12            | Enters a monthly payment period.                             |
| ↓ > 2 > ENTER  | C/Y = 2             | Enters a semi-annual interest-calculation period.            |
| CE/C > CE/C  | 0                   | Exits the entry of the C/Y variable.                         |
| 25 > 2ND > xP/Y > N  | N = 300             | Enters the number of monthly payments over a 25-year period. |
| 8 > I/Y  | I/Y = 8             | Enters the nominal interest rate.                            |
| 110,000 > +/- > PV   | PV = - 110,000      | Enters the loan amount.                                      |
| CPT > PMT  | PMT = 839.5348005   | Calculates the amount of monthly payments.                   |
| After four years: Do not clear the values of the financial variables |                     |  |
| 21 > 2ND > xP/Y > N  | N = 252             | Enters the number of monthly payments over 21 years.         |
| CPT > PV   | PV = - 103,360.9468 | Calculates the loan balance after 48 monthly payments.       |

The mortgage balance after four years is \$103,361.

- Answer 5.** What is the cumulative value after seven years of a monthly investment of \$500 (made at the end of each month) if the nominal rate is (9%, 12) (round off to the nearest dollar)?
- a) \$48,213
  - b) \$43,000
  - c) \$53,000
  - d) \$55,813
  - e) \$58,213**

The correct answer is **e**).

Reason:

| Sequence of entries    | Display           | Explanation   |
|------------------------|-------------------|---|
| CE/C > 2ND > CLR TVM   | 0                 | Resets the default values.                              |
| 2ND > P/Y > 12 > ENTER | P/Y = 12          | Enters a monthly payment period.                        |
| CE/C > CE/C            | 0                 | Exits the entry of the P/Y variable.                    |
| 7 > 2ND > xP/Y > n     | N = 84            | Enters the number of monthly payments over seven years. |
| 9 > I/Y                | I/Y = 9           | Enters the nominal interest rate.                       |
| 500 > +/- > PMT        | PMT = - 500       | Enters the amount of the monthly investment.            |
| CPT > FV               | FV = 58,213.46422 | Calculates the cumulative value after seven years.      |

The cumulative value after seven years is \$58,213.