UBC SAUDER SCHOOL OF BUSINESS

Real Estate Division

## TI BA II Plus Calculator: Illustration of Financial Calculations

The UBC Real Estate Division recommends the HP10 bII+ calculator for use in BUSI and CPD courses. However, students are permitted to use any financial calculator they wish, as long as the calculator is not alphanumeric and programmable. A popular alternative calculator is the Texas Instruments BAII Plus. This document provides instructions for the BAII Plus for students who wish to use this calculator instead. The sections below outline sample problems, illustrating the calculator keystrokes for both the HP and TI calculators.

1. Calculating Nominal and Effective Interest Rates
2. Calculating Payments, with no interest rate conversion
3. Calculating Payments, with interest rate conversion
4. Calculating Outstanding Balances
5. Calculating Principal and Interest Elements
6. Calculating Interest Rates, with interest rate conversion
7. Calculating Net Present Value (NPV) and Internal Rate of Return (IRR)

### Additional Resources

**HP10 bII+:** Students can find many helpful resources in the course materials and on the Course Resources webpage, under Pre-Reading.

**TI BAII Plus:**

- BA II PLUS™ Guidebook - Texas Instruments
  *https://education.ti.com/en-au/guidebook/details/en/ADF11FB65B284B6195B0A7E9502784BA/baiiplus*
- BA II PLUS Phone App: search the Google Play Store or Apple's App Store for options

### TI BAII Plus Orientation: Notes on Functions

| Press | Display | Comments |
|---|---|---|
| 2ND P/Y 12 ENTER | 12 | In a financial calculation, the payment frequency (P/Y) is specified. This becomes the default for the compounding frequency. |
| ↓ 2 ENTER | 2 | If the compounding frequency (C/Y) differs from payment frequency, you can set this in the next step. This is a helpful feature the HP10bII+ does not offer |
| | | |

| | | |
|---|---|---|
| 2ND QUIT | 0 | After completing calculations like interest rate conversions or amortizations, it is necessary to press 2ND QUIT, to leave the 2ND mode before beginning a new calculation. |
| CE\|C | (result from the previous calculation) | This is an alternative step to exit the 2ND mode after completing calculations like interest rate conversions or amortization. This keeps the result from the calculation on the display for further calculation. |
| | | |
| 2ND RESET ENTER | 0 | This erases all calculator entries and resets P/Y and C/Y to 1 as annual is the default setting |
| CF 2ND CLRWORK | 0 | In a cash flow calculation (e.g., NPV), this clears previous cash flow entries. You can also press NPV 2ND CLR WORK and IRR 2ND CLR WORK to clear those variables. |

**Calculating Nominal and Effective Interest Rates**

*Example 1*: You have an interest rate of 9% per annum, compounded semi-annually ($j_2$), which you want to convert to the following equivalents: effective annual ($j_1$), nominal rate, compounded monthly ($j_{12}$), monthly periodic ($i_{mo}$).

HP 10bII+ Steps

| **Press** | **Display** | **Comments** |
|---|---|---|
| 9 ■ NOM% | 9 | Enter stated nominal rate |
| 2 ■ P/YR | 2 | Enter stated compounding frequency |
| ■ EFF% | 9.2025 | Compute effective annual interest rate ($j_1$) |
| 12 ■ P/YR | 12 | Enter desired compounding frequency |
| ■ NOM% | 8.835748 | Compute equivalent nominal rate with desired compounding frequency ($j_{12}$) |
| ÷ 12 = | 0.736312 | Periodic monthly rate ($i_{mo}$) |

BAII Plus Steps

| **Press** | **Display** | **Comments** |
|---|---|---|
| 2ND ICONV 9 ENTER | 9 | Enter stated nominal rate |
| ↑ 2 ENTER | 2 | Enter stated compounding frequency (C/Y) |
| ↑ CPT | 9.2025 | Compute effective annual interest rate ($j_1$) |
| ↓ 12 ENTER | 12 | Enter desired compounding frequency |
| ↓ CPT | 8.835748 | Compute equivalent nominal rate with desired compounding frequency ($j_{12}$) |
| CE\|C | 8.835748 | Leave conversion mode (retain rate) |
| ÷ 12 = | 0.736312 | Periodic monthly rate ($i_{mo}$) |

**Calculating Payments, with no interest rate conversion**

*Example 2*: You have been granted a $100,000 mortgage loan at a rate of 6% per annum, compounded monthly, with a 25-year amortization, and monthly payments, rounded up to the next higher dollar. Calculate the required monthly payment.

HP 10bII+ Steps

| Press | Display | Comments |
|---|---|---|
| 6 I/YR | 6 | Enter stated nominal rate |
| 12 ■ P/YR | 12 | Enter stated compounding frequency (same as desired compounding frequency) |
| 100000 PV | 100,000 | Enter present value |
| 25 x 12 = N | 300 | Enter amortization period in months |
| 0 FV | 0 | Indicates that FV will not be used (loan is fully repaid at the end of 300 months) |
| PMT | -644.301401 | Calculate unrounded monthly payment |
| 645 +/- PMT | -645 | *Rounded monthly payment |

BAII Plus Steps

| Press | Display | Comments |
|---|---|---|
| 6 I/Y | 6 | Enter stated nominal rate |
| 2ND P/Y 12 ENTER | 12 | Enter payment frequency (P/Y) [which is the same as the compounding frequency] |
| 2ND QUIT | 0 | Return to standard calculator mode |
| 100000 PV | 100,000 | Enter present value |
| 25 x 12 = N | 300 | Enter amortization period in months |
| 0 FV | 0 | Indicates that FV will not be used (loan is fully repaid at the end of 300 months) |
| CPT PMT | -644.301401 | Calculate unrounded monthly payment |
| 645 +/- PMT | -645 | *Rounded monthly payment |

*Note: This step is only required if there are further calculations.

**Calculating Payments, with interest rate conversion**

*Example 3*: You have been granted a $100,000 mortgage loan at a rate of 7% per annum, compounded semi-annually, with a 20-year amortization, and monthly payments, rounded up to the next higher dollar. Calculate the required monthly payment.

The payments are monthly, but the stated interest rate is compounded semi-annually. Because these do not match, an interest rate conversion is needed. The nominal rate with semi-annual compounding ($j_2$) must be restated as a nominal rate with monthly compounding ($j_{12}$).

HP 10bII+ Steps

| Press | Display | Comments |
|---|---|---|
| 7 ■ NOM% | 7 | Enter stated nominal rate |
| 2 ■ P/YR | 2 | Enter stated compounding frequency |
| ■ EFF% | 7.1225 | Compute effective annual interest rate ($j_1$) |
| 12 ■ P/YR | 12 | Enter desired compounding frequency |
| ■ NOM% | 6.900047 | Compute equivalent nominal rate with desired compounding frequency ($j_{12}$) |
| 100000 PV | 100,000 | Enter loan amount |
| 20 x 12 = N | 240 | Enter number of monthly payments |
| 0 FV | 0 | Indicates that FV is not to be used (because all the loan is totally repaid at the end of 240 months) |
| PMT | -769.310636 | Calculate unrounded monthly payment |
| 770 +/- PMT | -770 | Rounded monthly payment |

Unlike the HP calculator, the BAII Plus calculator will automatically convert the interest rate when the P/Y and C/Y are entered into the calculator.

BAII Plus Steps

| Press | Display | Comments |
|---|---|---|
| 7 I/Y | 7 | Enter stated nominal interest rate |
| 2ND P/Y 12 ENTER | 12 | Enter desired payment frequency (P/Y) |
| ↓ 2 ENTER | 2 | Enter stated compounding frequency (C/Y) |
| 2ND QUIT | 0 | Return to standard calculator mode |
| 100000 PV | 100,000 | Enter loan amount |
| 20 x 12 = N | 240 | Enter number of monthly payments |
| 0 FV | 0 | Indicates that FV is not to be used (because all the loan is totally repaid at the end of 240 months) |
| CPT PMT | -769.310636 | Calculate unrounded monthly payment |
| 770 +/- PMT | -770 | Rounded monthly payment |

Solving for present value (PV) and amortization (N) are similar to PMT calculations – enter the financial data and solve for the missing element. Calculations for interest rates will be shown in Example 6 below.

**Calculating Outstanding Balances**

*Example 4*: Using the data from Example 3, calculate the outstanding balance owing at the end of a 5-year term.

HP 10bII+ Steps (Example 3 continued)

| Press | Display | Comments |
|---|---|---|
| | -770 | Rounded payments from previous example |
| 60 N FV | -86,075.724073 | *$OSB_{60}$ |

BAII Plus Steps (Example 3 continued)

| Press | Display | Comments |
|---|---|---|
| | -770 | Rounded payments from previous example |
| 60 N | 60 | Number of monthly payments in term |
| CPT FV | -86,075.72407 | *$OSB_{60}$ |

*Note that the outstanding balance can also be calculated using the AMORT function on both calculators. This is illustrated in the next example.

**Calculating Principal and Interest Elements**

*Example 5*: Using the data from Examples 3 and 4, calculate the principal and interest paid in the first month, the principal and interest paid during the first year of the loan, and the principal and interest paid over a 5-year term.

HP 10bII+ Steps (Example 4 continued)

| Press | Display | Comments |
|---|---|---|
| 1 INPUT ■ AMORT | 1-1 | First payment |
| = | -194.99605 | Principal repaid first payment |
| = | -575.00395 | Interest paid first payment |
| 1 INPUT 12 ■ AMORT | 1-12 | Range of payments for Year 1, starting with Payment 1, ending with Payment 12 |
| = | -2,415.391003 | Principal repaid over Year 1 |
| = | -6,824.608997 | Interest paid over Year 1 |
| 1 INPUT 60 ■ AMORT | 1-60 | Range of payments for term, starting with Payment 1, ending with Payment 60 |
| = | -13,924.275927 | Principal repaid during 5-year term |
| = | -32,275.724073 | Interest paid during 5-year term |
| = | 86,075.724073 | *$OSB_{60}$ |

*This step is not required in this example but is shown as an alternative OSB calculation.

BAII Plus Steps (Example 4 continued)

| Press | Display | Comments |
|---|---|---|
| 2ND AMORT 1 ENTER | 1 | Start of payment period (P1) |
| ↓ 1 ENTER | 1 | End of payment period (P2) |
| ↓↓ | -194.99605 | Principal repaid first payment |
| ↓ | -575.00395 | Interest paid first payment |
| ↓ 1 ENTER | 1 | *Start of payment period in Year 1 (P1) |
| ↓12 ENTER | 12 | End of payment period in Year 1 (P2) |
| ↓↓ | -2,415.391003 | Principal repaid over Year 1 |
| ↓ | -6,824.608997 | Interest paid over Year 1 |
| ↓ 1 ENTER | 1 | *Start of payment period in Year 1 (P1) |
| ↓ 60 ENTER | 60 | End of payment period in Year 5 (P2) |
| ↓ | 86,075.72407 | **$OSB_{60}$ |
| ↓ | -13,924.27593 | Principal repaid over 5-year term |
| ↓ | -32,275.72407 | Interest paid during 5-year term |
| 2ND QUIT | 0 | Return to standard calculator mode |

*Optional step (as correct value is already entered)
**This step is not required in this example but is shown as an alternative OSB calculation.

**Calculating Interest Rates, with interest rate conversion**

*Example 6*: A $1,400,000 mortgage calls for monthly payments of $8,469.44 over 25 years. Calculate the annual rate of interest with semi-annual compounding ($j_2$) for this mortgage.

HP 10bII+ Steps

| Press | Display | Comments |
|---|---|---|
| 12 ■ P/YR | 12 | Enter payment frequency |
| 1400000 PV | 1,400,000 | Enter loan amount |
| 25 x 12 = N | 300 | Enter number of monthly payments |
| 8469.44 +/- PMT | -8,469.44 | Enter monthly payment |
| 0 FV | 0 | Loan is fully paid off over 300 months |
| I/YR | 5.436594 | Calculate $j_{12}$ rate |
| ■ EFF% | 5.479579 | $j_1$ rate |
| 2 ■ P/YR | 2 | Enter desired compounding frequency |
| ■ NOM% | 5.406503 | Calculate equivalent $j_2$ rate |

BAII Plus Steps

| Press | Display | Comments |
|---|---|---|
| 2ND P/Y 12 ENTER | 12 | Enter payment frequency |
| 2ND QUIT | 0 | Return to standard calculator mode |
| 1400000 PV | 1,400,000 | Enter present value |
| 8469.44 +/- PMT | -8,469.44 | Enter monthly payment |
| 25 x 12 = N | 300 | Enter number of monthly payments |
| 0 FV | 0 | Loan is fully paid off over 300 months |
| CPT I/Y | 5.346594 | Calculate $j_{12}$ rate |
| 2ND P/Y ↓ 1 ENTER | 1 | Enter C/Y as annual |
| 2ND QUIT | 0 | Return to standard calculator mode |
| CPT I/Y | 5.479579 | Equivalent effective annual rate |
| 2ND P/Y ↓ 2 ENTER | 2 | Enter C/Y as semi-annual |
| 2ND QUIT | 0 | Return to standard calculator mode |
| CPY I/Y | 5.406503 | Equivalent $j_2$ rate |

**Calculating Net Present Value (NPV) and Internal Rate of Return (IRR)**

*Example 7*: Based on the following annual after-tax cash flows for an investment, calculate the NPV and IRR if the investor has a desired yield of $j_1$ = 5%.

| Year | Cash Flow |
|---|---|
| 1 | $25,000 |
| 2 | $28,000 |
| 3 | $30,000 |
| 4 | $31,750 |
| 5 | $32,500 |
| Cost | $100,000 |

HP 10bII+ Steps

| Press | Display | Comments |
|---|---|---|
| ■ C ALL | 0 | Clear all calculator entries, including cash flows and interest rates |
| 5 I/YR | 5 | Investor's desired yield |
| 1 ■ P/YR | 1 | Annual compounding |
| 100000 +/- CFj | -100,000 | $CF_0$ |
| 25000 CFj | 25,000 | $CF_1$ |
| 28000 CFj | 28,000 | $CF_2$ |
| 30000 CFj | 30,000 | $CF_3$ |
| 31750 CFj | 31,750 | $CF_4$ |
| 32500 CFj | 32,500 | $CF_5$ |
| ■ NPV | 26,706.881147 | Calculate NPV |
| ■ IRR/YR | 13.76227 | Calculate IRR |

BAII Plus Steps: Note that annual compounding is the default setting, so this does not need to be set. If a problem involves cash flows and compounding other than annual, use the ICONV mode to convert the rate, and save the result using STO 1. Then in the NPV calculation, use RCL 1 to enter the saved rate as required.

| Press | Display | Comments |
|---|---|---|
| CF 2ND CLR WORK | 0 | Clear all calculator entries, reset P/Y and C/Y to annual; decimal places remain as previous setting |
| CF | 0 | Cash flow worksheet |
| 100000 +/- ENTER | -100,000 | $CF_0$ |
| ↓ 25000 ENTER | 25,000 | C01 |
| ↓↓ 28000 ENTER | 28,000 | C02 |
| ↓↓ 30000 ENTER | 30,000 | C03 |
| ↓↓ 31750 ENTER | 31,750 | C04 |
| ↓↓ 32500 ENTER | 32,500 | C05 |
| CPT NPV 5 ENTER | 5 | Investor's desired yield ($i_a$) |
| ↓ CPT | 26,706.88115 | Calculate NPV |
| IRR CPT | 13.76227 | Calculate IRR |