Chartered Financial Analyst® Program

Texas Instruments BA II Plus calculator tutorial

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Calculator tutorial – outline

0. Calculator setup and introduction
1. Basic algebra and calculator usage
2. Rates of return
3. Combinatorics (counting rules)
4. Time value of money
5. Cash flow analysis
6. Statistics
7. Other functions

See Solution 1

0. Calculator setup and introduction

0.1 Decimal places

0.2 Algebraic operating system

0.3 The reset feature

0.4 P/Y

1. Basic algebra and calculator usage

1.1 Brackets and basic calculations

1.2 Clearing: →, CE/C, CE/C CE/C, etc

1.3 Memories: STO, RCL

1.4 Constant function, K

1.5 Negative numbers

1.6 Percentages

2. Rates of return

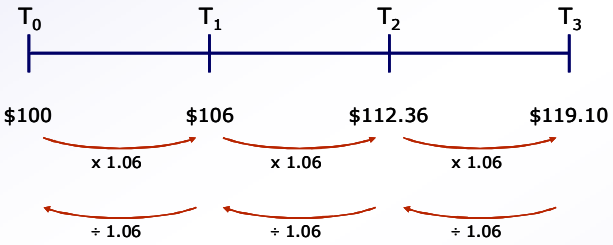
See Solution 2

2. Rates of return

2.1 Compounding

2.2 Discounting

Say r = 6%, n = 3:



In general: $FV = PV \times (1 + r)^n$ "**Compounding**"

$PV = \frac{FV}{(1 + r)^n}$ "**Discounting**"

See Solution 3

2. Rates of return

2.3 Geometric mean and n^{th} root

Example 2.3: A fund manager achieves +15%, -8%, +3%, and +12% in four successive years. What is his average rate of return?

See Solution 4

2. Rates of return

2.4 Interest conversion

2.5 Continuous compounding

2.6 Natural logarithms

Example 2.4: Using the effective annual rate (EAR), **calculate** the holding period return for one year if a bank quotes 6% interest, but pays interest (1) annually, (2) monthly, (3) daily, (4) every second.

$$FV_N = PV \times \left(1 + \frac{r_{nom}}{m}\right)^{m \times N}$$

Example 2.5: What if interest is paid ***continuously***?

Example 2.6: **Calculate** the continuous rate if the one year HPR is 8%.

See Solution 5

3. Combinatorics (counting rules)

3.1 Definition of **factorial**:

$$n! = n \times (n-1) \times (n-2) \times \ldots \times 3 \times 2 \times 1$$

Example 3.1: A manager supervises eight funds and wishes to label them A, B, …, H. **Calculate** the number of ways in which she can do this.

3.2 Definition of **permutations**: $${}_nP_r = \frac{n!}{(n-r)!}$$

Example 3.2: A manager wishes to review three of her eight funds over the first three days next week. **Calculate** the number of ways in which this can be done.

3.3 Definition of **combinations**: $${}_nC_r = \frac{n!}{(n-r)!r!}$$

Example 3.3: A manager wishes to recommend three of her eight funds to a client. **Calculate** the number of ways in which this can be done.

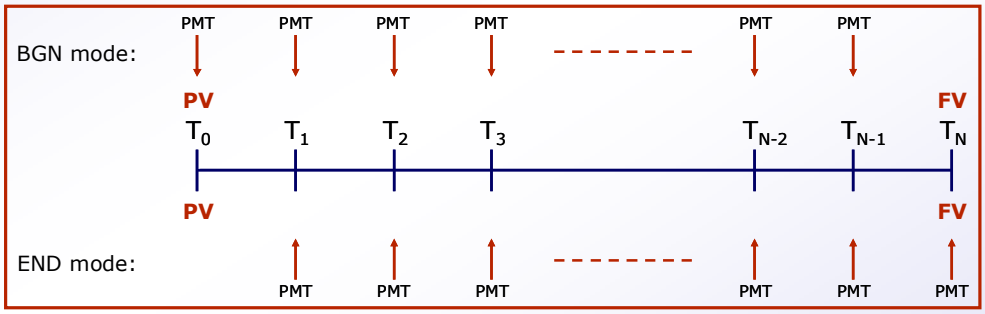
4. Time value of money

4.1 Basic TVM buttons, CLR TVM

4.2 Computing the fifth variable

4.3 BGN vs END mode

4.4 Toothbrush problems (1 of 2)



Quartic Quote: "*N and PMT describe N payments*" (doh!)

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See Solution 6

4. Time value of money

4.1 Basic TVM buttons, CLR TVM

4.2 Computing the fifth variable: getting the signs right!

Example 4.2a: **Calculate** the PV and FV of a four-year annuity paying $2000 at the end of each year, with r = 6%.

Example 4.2b: Shrina and Saahil Patel have just bought a property with a mortgage of €200,000. The quoted interest rate is 6% and the payments will reduce the mortgage to zero over 25 years. **Calculate** the monthly payment, assuming end of month cash flows.

See Solution 7

4. Time value of money

4.2 Computing the fifth variable: getting the signs right!

Example 4.2c: **Calculate** the rate of return needed in order to double the value of a deposit in 10 years.

Example 4.2d: **Calculate** the coupon on a 5 year annual-pay $1000 bond priced at $915.75 to yield 6%.

See Solution 8

4. Time value of money

4.3 BGN vs END mode

Example 4.3: **Calculate** the PV and FV of a four-year annuity paying $2000 at the **start** of each year, with r = 6%.

See Solution 9

4. Time value of money

4.4 Toothbrush problems (1 of 2)

Example 4.4: Jane Jones wishes to save for her daughter's college tuition, starting in 15 years' time. She will need $30,000 at the start of each of four years. Assuming a rate of 6%, **calculate** today's required deposit.

How many other methods can you think of?

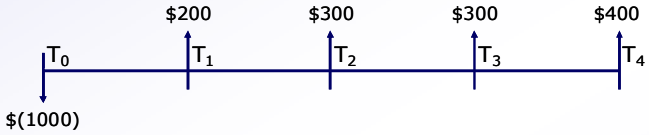
5. Cash flow analysis

See Solution 10

5. Cash flow analysis

5.1 Cash flow function: net present value
5.2 Payback and discounted payback periods
5.3 Internal rate of return

Example 5.1a: **Calculate** the net present value of the following project, using r = 6%.



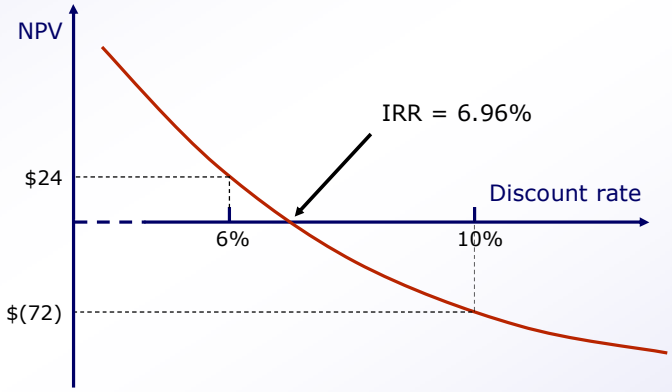
Example 5.1b: Same calculation using a rate of 10%.

Example 5.2: **Calculate** the payback and discounted payback of the cash flows ("Professional" only).

Example 5.3: **Calculate** the internal rate of return of the cash flows.

5: Cash flow analysis – NPV and IRR

For a normal project (cash outflow followed by inflows) one would expect a lower NPV for higher discount rates. Graphically:



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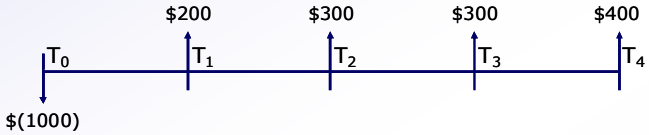
See Solution 11

5. Cash flow analysis

5.4 Repeating cash flows

5.5 Toothbrush problems (2 of 2)

Example 5.4: **Calculate** *again* the net present value of the following project, using r = 6%.



Example 5.5: Jane Jones wishes to save for her daughter's college tuition, starting in 15 years' time. She will need $30,000 at the start of each of four years. Assuming a rate of 6%, **calculate** today's required deposit.

6. Statistics

See Solution 12

6. Statistics

6.1 Single variable discrete data statistics

Example 6.1: An equally weighted fund has shares that produce returns of +15%, -8%, +3%, and +12% in the year. **Calculate** the average performance of the shares and the standard deviation.

Population mean: $\mu = \frac{\sum_{i=1}^{N} X_i}{N}$

Sample mean: $\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$

Pop'n variance: $\sigma^2 = \frac{\sum_{i=1}^{N} (X_i - \mu)^2}{N}$

Pop'n std dev: $\sigma = \sqrt{\frac{\sum_{i=1}^{N} (X_i - \mu)^2}{N}}$

Sample variance: $s^2 = \frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{n-1}$

Sample std dev: $s = \sqrt{\frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{n-1}}$

See Solution 13

6. Statistics

6.2 Weighted data statistics

Example 6.2: A fund has asset weightings as shown in the table below. **Calculate** the fund performance and the standard deviation of the asset returns.

Asset class	Weighting	Return
Equities	0.45	12%
Bonds	0.3	-5%
Real estate	0.1	15%
Commodities	0.15	20%
Total	**1.00**	**8.4%**

7. Other functions

7. Other functions

7.1 Depreciation: depreciation worksheet

2ND DEPR

Example 7.1: Gedi Inc purchases a machine for $40,000. It has an expected useful economic life of five years and Gedi expects to sell the machine for $8,000 at the end of its life.

Calculate the depreciation and net book value in Year 4 using the various depreciation methods.

Straight line method

Year	Dep Exp	Cost	Acc dep	NBV
0		40,000	0	40,000
1	6,400	40,000	6,400	33,600
2	6,400	40,000	12,800	27,200
3	6,400	40,000	19,200	20,800
4	6,400	40,000	25,600	14,400
5	6,400	40,000	32,000	8,000
Total	**32000**			

Sum of years' digits method

Dep Exp	Acc dep	NBV
	0	40,000
10,667	10,667	29,333
8,533	19,200	20,800
6,400	25,600	14,400
4,267	29,867	10,133
2,133	32,000	8,000
32000		

Double declining balance method

Dep Exp	Acc dep	NBV
	0	40,000
16,000	16,000	24,000
9,600	25,600	14,400
5,760	31,360	8,640
640	32,000	8,000
0	32,000	8,000
32000		

7. Other functions

7.2 Breakeven analysis: breakeven worksheet [2ND] [BRKEVN]

Example 7.2a: Rishon Inc sells widgets for $12 that cost the company $10. Fixed costs are $1000. **Calculate** the breakeven sales quantity.

Example 7.2b: **calculate** quantity for profit to be $2000.

Example 7.2c: **calculate** the required sales price to achieve a $5000 profit on 4000 unit sales.

7. Other functions

7.3 Profit function: profit worksheet [2ND] [PROFIT]

Example 7.3: Balagan Inc purchases items for $60 and sells them for $75. **Calculate** the profit margin.

7. Other functions

7.4 Growth calculation: % change worksheet

2ND Δ%

Example 7.4: **Calculate** the rate of return needed in order to double the value of a deposit in 10 years.

See Solution 14

7. Other functions

7.5 Amortisation: amortisation worksheet

2ND AMORT

Example 7.5: Shrina and Saahil Patel have just bought a property with a mortgage of €200,000. The quoted interest rate is 6% and the payments will reduce the mortgage to zero over 25 years. **Calculate** the total interest and principal payments during the first year.

Further information

If you would like to download these slides, including the solutions, please visit:

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For further information and to enquire about our products, our contact details are:

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CFA® – IMC – Financial Modelling – Financial Markets

Calculator tutorial

Solutions

Solution 1

0. Calculator setup and introduction

0.1 Decimal places

Calculator solution 0.1	
2ND FORMAT 9 ENTER	DEC= 9

0.2 Algebraic operating system

Calculator solution 0.2	
(2ND FORMAT)	
↑ 2ND SET	AOS

0.3 The reset feature

0.4 P/Y

Calculator solution 0.4	
2ND P/Y 1 ENTER	P/Y= 1

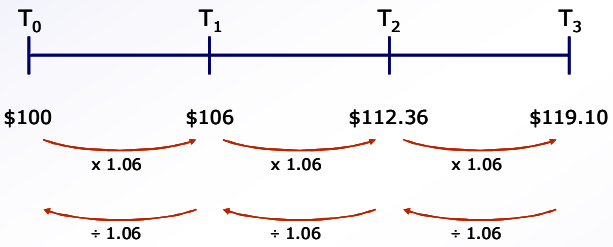
Solution 2

2. Rates of return

2.1 Compounding

2.2 Discounting

Say r = 6%, n = 3:



Calculator solution 2.1

1 0 0 X	
1 . 0 6 y^x 3 =	119.1016

Calculator solution 2.2

1 1 9 . 1 +	
1 . 0 6 y^x 3 =	99.9987 (rounding error)

In general: $FV = PV \times (1 + r)^n$ **"Compounding"**

$PV = \frac{FV}{(1 + r)^n}$ **"Discounting"**

Solution 3

2. Rates of return

2.3 Geometric mean and n^{th} root

Example 2.3: A fund manager achieves +15%, -8%, +3%, and +12% in four successive years. What is his average rate of return?

Calculator solution 2.3

1 . 1 5 X	
0 . 9 2 X	
1 . 0 3 X	
1 . 1 2 =	1.2205
y^x 4 1/x =	1.0511
− 1 =	0.0511

Solution 4

2. Rates of return

2.4 Interest conversion

2.5 Continuous compounding

2.6 Natural logarithms

Example 2.4: Using the effective annual rate (EAR), **calculate** the holding period return for one year if a bank quotes 6% interest, but pays interest (1) annually, (2) monthly, (3) daily, (4) every second.

$$FV_N = PV \times \left(1 + \frac{r_{nom}}{m}\right)^{m \times N}$$

Example 2.5: What if interest is paid ***continuously***?

Example 2.6: **Calculate** the continuous rate if the one year HPR is 8%.

Calculator solution 2.4

2ND ICONV	
6 ENTER	NOM= 6
↑ 1 2 ENTER	C/Y= 12
↑ CPT	EFF= 6.1678
↓ 2 5 0 ENTER	
↑ CPT	EFF= 6.1829

Calculator solution 2.5

. 0 6 2ND e^x − 1 =	0.0618

Calculator solution 2.6

1 . 0 8 LN	0.07696

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Solution 5

3. Combinatorics (counting rules)

3.1 Definition of **factorial**:

$$n! = n \times (n-1) \times (n-2) \times \ldots \times 3 \times 2 \times 1$$

Example 3.1: A manager supervises eight funds and wishes to label them A, B, …, H. **Calculate** the number of ways in which she can do this.

Calculator solution 3.1	
8 2ND x!	40,320

3.2 Definition of **permutations**: $${}_nP_r = \frac{n!}{(n-r)!}$$

Example 3.2: A manager wishes to review three of her eight funds over the first three days next week. **Calculate** the number of ways in which this can be done.

Calculator solution 3.2	
8 2ND nPr 3 =	336

3.3 Definition of **combinations**: $${}_nC_r = \frac{n!}{(n-r)!r!}$$

Example 3.3: A manager wishes to recommend three of her eight funds to a client. **Calculate** the number of ways in which this can be done.

Calculator solution 3.3	
8 2ND nCr 3 =	56

Solution 6

4. Time value of money

4.1 Basic TVM buttons, CLR TVM

4.2 Computing the fifth variable: getting the signs right!

Example 4.2a: **Calculate** the PV and FV of a four-year annuity paying $2000 at the end of each year, with r = 6%.

Calculator solution 4.2a

4 N 6 I/Y	
2 0 0 0 +/- PMT	
0 FV CPT PV	PV=6930.21
0 PV CPT FV	FV=8749.23

Example 4.2b: Shrina and Saahil Patel have just bought a property with a mortgage of €200,000. The quoted interest rate is 6% and the payments will reduce the mortgage to zero over 25 years. **Calculate** the monthly payment, assuming end of month cash flows.

Calculator solution 4.2b

3 0 0 N	
. 5 I/Y	
2 0 0 0 0 0 PV	
0 FV CPT PMT	PMT=-1288.60

Solution 7

4. Time value of money

4.2 Computing the fifth variable: getting the signs right!

Example 4.2c: **Calculate** the rate of return needed in order to double the value of a deposit in 10 years.

Calculator solution 4.2c

1 0 N 1 +/- PV 0 PMT 2 FV CPT I/Y	I/Y= 7.18

Example 4.2d: **Calculate** the coupon on a 5 year annual-pay $1000 bond priced at $915.75 to yield 6%.

Calculator solution 4.2d

5 N 6 I/Y 9 1 5 . 7 5 +/- PV 1 0 0 0 FV CPT PMT	PMT= 40.00

Solution 8

4. Time value of money

4.3 BGN vs END mode

Example 4.3: **Calculate** the PV and FV of a four-year annuity paying $2000 at the **start** of each year, with r = 6%.

Calculator solution 4.3

2ND BGN 2ND SET	BGN
C/CE 4 N 6 I/Y	
2 0 0 0 +/- PMT	
0 FV CPT PV	PV=7346.02
0 PV CPT FV	FV=9274.19
2ND BGN 2ND SET	END

Solution 9

4. Time value of money

4.4 Toothbrush problems (1 of 2)

Example 4.4: Jane Jones wishes to save for her daughter's college tuition, starting in 15 years' time. She will need $30,000 at the start of each of four years. Assuming a rate of 6%, **calculate** today's required deposit.

Calculator solution 4.4	
4 N 6 I/Y	
3 0 0 0 0 PMT	
0 FV CPT PV	PV=-103,953.17
+ 1 . 0 6	
y^x 1 4 =	PV=-45,978.59

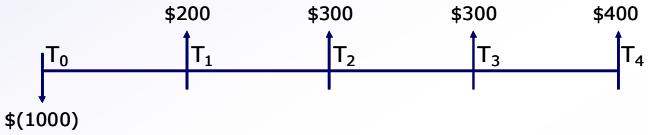
How many other methods can you think of?

Solution 10

5. Cash flow analysis

5.1 Cash flow function: net present value
5.2 Payback and discounted payback periods
5.3 Internal rate of return

Example 5.1a: **Calculate** the net present value of the following project, using r = 6%.



Example 5.1b: Same calculation using a rate of 10%.

Example 5.2: **Calculate** the payback and discounted payback of the cash flows ("Professional" only).

Example 5.3: **Calculate** the internal rate of return of the cash flows.

Calculator solution 5.1a/b, 5.2, 5.3

CF 2ND CLR WORK	
1 0 0 0 +/- ENTER	CFo=-1000
↓ 2 0 0 ENTER	C01= 200
↓ ↓ 3 0 0 ENTER	C02= 300
↓ ↓ 3 0 0 ENTER	C03= 300
↓ ↓ 4 0 0 ENTER	C04= 400
NPV 6 ENTER ↓ CPT	NPV= 24.40
↑ 1 0 ENTER ↓ CPT	NPV= -71.65
↑ 6 ENTER	
↓ ↓ ↓ CPT	PB = 3.5
↓ CPT	DPB= 3.92
IRR CPT	IRR= 6.96

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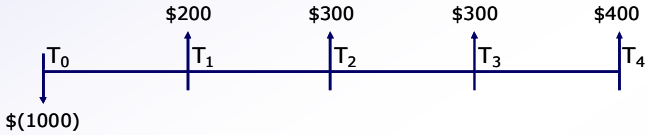
Solution 11

5. Cash flow analysis

5.4 Repeating cash flows

5.5 Toothbrush problems (2 of 2)

Example 5.4: **Calculate** *again* the net present value of the following project, using r = 6%.



Example 5.5: Jane Jones wishes to save for her daughter's college tuition, starting in 15 years' time. She will need $30,000 at the start of each of four years. Assuming a rate of 6%, **calculate** today's required deposit.

Calculator solution 5.4

CF 2ND CLR WORK	
1 0 0 0 +/- ENTER	CFo=-1000
↓ 2 0 0 ENTER	C01= 200
↓ ↓ 3 0 0 ENTER	C02= 300
↓ 2 ENTER	F02= 2
↓ 4 0 0 ENTER	C03= 400
NPV 6 ENTER ↓ CPT	NPV= 24.40

Calculator solution 5.5

CF 2ND CLR WORK	
↓ ↓ 1 4 ENTER	F01= 14
↓ 3 0 0 0 0 ENTER	C02= 30,000
↓ 4 ENTER	F02= 4
NPV 6 ENTER ↓ CPT	NPV= 45,978.59

Solution 12

6. Statistics

6.1 Single variable discrete data statistics

Example 6.1: An equally weighted fund has shares that produce returns of +15%, -8%, +3%, and +12% in the year. **Calculate** the average performance of the shares and the standard deviation.

Population mean: $\mu = \frac{\sum_{i=1}^{N} X_i}{N}$

Sample mean: $\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$

Pop'n variance: $\sigma^2 = \frac{\sum_{i=1}^{N} (X_i - \mu)^2}{N}$

Pop'n std dev: $\sigma = \sqrt{\frac{\sum_{i=1}^{N} (X_i - \mu)^2}{N}}$

Sample variance: $s^2 = \frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{n-1}$

Sample std dev: $s = \sqrt{\frac{\sum_{i=1}^{n} (X_i - \bar{X})^2}{n-1}}$

Calculator solution 6.1

2ND DATA	
2ND CLR WORK	X01 0
1 5 ENTER	X01= 15
↓ ↓ 8 +/- ENTER	X02= -8
↓ ↓ 3 ENTER	X03= 3
↓ ↓ 1 2 ENTER	X04= 12
2ND STAT	LIN etc
2ND SET x 4	1–V
↓ ↓	$\bar{x}$ = 5.5
↓ ↓	σx = 8.958

Solution 13

6. Statistics

6.2 Weighted data statistics

Example 6.2: A fund has asset weightings as shown in the table below. **Calculate** the fund performance and the standard deviation of the asset returns.

Asset class	Weighting	Return
Equities	0.45	12%
Bonds	0.3	-5%
Real estate	0.1	15%
Commodities	0.15	20%
Total	**1.00**	**8.4%**

Calculator solution 6.2

2ND DATA	
2ND CLR WORK	
1 2 ENTER	X01= 12
↓ 4 5 ENTER	Y01= 45
↓ 5 +/- ENTER	X02= -5
↓ 3 0 ENTER	Y02= 30
↓ 1 5 ENTER	X03= 15
↓ 1 0 ENTER	Y03= 10
↓ 2 0 ENTER	X04= 20
↓ 1 5 ENTER	Y04= 15
2ND STAT	1–V
↓ ↓	$\bar{x}$ = 8.4
↓ ↓	σx = 9.178

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Solution 14

7. Other functions

7.5 Amortisation: amortisation worksheet

2ND AMORT

Example 7.5: Shrina and Saahil Patel have just bought a property with a mortgage of €200,000. The quoted interest rate is 6% and the payments will reduce the mortgage to zero over 25 years. **Calculate** the total interest and principal payments during the first year.

Calculator solution 7.5

3 0 0 N	
. 5 I/Y	
2 0 0 0 0 0 PV	
0 FV CPT PMT	PMT=-1288.60
2ND AMORT	P1 = 1
↓ 1 2 ENTER	
↓ ↓	PRN=-3,560
↓	INT=-11,903