

Using Financial and Business Calculators

Most business and financial calculators offer a multitude of powerful functions. Students in the introductory finance course generally do not need to utilize many of these functions and find them confusing. The purpose of this appendix is to provide you with an easy and quick reference guide for some of the most commonly used financial functions. More detailed operational descriptions can be obtained from the owners' manuals accompanying these calculators.

This appendix discusses the basic functions of three calculators, i.e., Hewlett-Packard HP12C and HP10B, and Texas Instruments TIBAI plus. The following sections present some basic information regarding general and financial functions offered by each calculator. Each step is listed as a number followed by a decimal point. A key is shown in the form of a box with its name inside it. The calculations for each financial function have been explained using a problem. The display on the calculator's screen at the completion of each step has also been shown to enable you to confirm your calculations along the way.

I. Hewlett-Packard HP12C:

The HP12C is color coded. The gold key i.e., f refers to the function coded in gold above the key. Similarly, the blue key i.e., g refers to the function coded in blue at the bottom of the key.

The HP12C has a continuous memory. Therefore, turning it off does not affect the information you have stored. If not turned off manually, the calculator will turn off automatically after approximately 8 to 17 minutes of last use.

A. Clearing the calculator display and memory, and setting the decimal points:

Keystrokes				Display	Description
1.	ON	CLX	f REG	0.000000	Clears screen and storage registers.
2.	f	FIN		0.000000	Clears the financial registers.
3.	f	2		0.00	Sets the number of decimal places equal to 2.

- Note: 1. We will be using two decimal places for all the calculations in this appendix.
2. Even though HP12C displays two decimal places, all calculations are performed with ten digit numbers.

B. Using the memory capability:

Example: Before leaving on a sales call one morning, Alfred stored the price of a fax machine (\$1,200) and a printer (\$1,000) in his calculator. Later that day, he sold three fax machines and four printers to a customer. He used his calculator to get the total amount due from this customer in the following way:

Keystrokes	Display	Description
Clear the memory and financial registers.		
1. 1200 STO 1	1,200.00	Stores the price of the fax machine in memory location 1.
4. 1000 STO 2	1,000.00	Stores the price of the printer in memory location 2.
5. ON		Turns the calculator off.
Later that day:		
6. ON	1,000.00	After the sale, Alfred turns the calculator on.
7. RCL 1	1,200.00	Recalls the cost of the fax to the display.
8. 3 x	3,600.00	Multiplies 1,200 by 3 to calculate the cost of the three fax machines.
9. RCL 2	1,000.00	Recalls the cost of the printer.
10. 4 x	4,000.00	Calculates cost of four printers.
11. +	7,600.00	Total amount for this sale.

C. Calculating the present value of a lump sum amount:

Example: Liz anticipates it will cost her \$65,000 to buy a house in eighteen months. How much should she invest today, at an annual interest rate of 15% (interest is compounded monthly), to be able to afford the house in one and a half years?

Keystrokes	Display	Description
Clear the memory and financial registers.		
1. 65000 FV	65,000.00	Records the future cash flow of \$65,000. Continued...

Keystrokes	Display	Description
2. 15 <input type="text" value="g"/> <input type="text" value="12÷"/>	1.25	Records monthly rate of 1.25%.
3. 1.5 <input type="text" value="g"/> <input type="text" value="12x"/>	18.00	Records number of time periods as 18.
4. <input type="text" value="PV"/>	-51,975.99	Calculates the present value of \$65000 in 1.5 years discounted at a monthly rate of 1.25%.

Note: The display in step 4 has a negative sign because it represents a cash outflow (investment) today.

D. Calculating the future value of a lump sum amount:

Example: If John invests \$1,850 today in an asset earning a 10% rate of return (compounded annually), how much will he have after two years?

Keystrokes	Display	Description
Clear the memory and financial registers.		
1. 1850 <input type="text" value="CHS"/> <input type="text" value="PV"/>	-1,850.00	Records the present cash outflow of \$1,850.
2. 10 <input type="text" value="i"/>	10.00	Records annual rate of 10%.
3. 2 <input type="text" value="n"/>	2.00	Records number of time periods as 2.
4. <input type="text" value="FV"/>	2,238.50	Calculates the future value of \$1,850 after 2 years at 10%.

E. (i) Calculating the present value of an annuity:

Example: How much should you invest now so that, starting one year from today, your daughter can receive \$6,000 per year for the next five years? Assume the discount rate is 15%.

Keystrokes	Display	Description
Clear the memory and financial registers.		
1. 6000 <input type="text" value="PMT"/>	6,000.00	Records the amount of the periodic payments.
2. 15 <input type="text" value="i"/>	15.00	Records annual rate of 15%.
Continued...		

Keystrokes	Display	Description
3. 5 n	5.00	Records number of time periods as 5.
4. PV	-20,112.93	Calculates the PV of an annuity.

E.(ii) Calculating the present value of an annuity due:

Example: In this case, instead of receiving payments at the end of each year, your daughter will receive the payments at the beginning of each year. Therefore, her first payment will be received immediately.

There are two methods to calculate the present value of an annuity due.

1. You can calculate the present value of an annuity and multiply it by $(1 + k)$. The formula for present value of annuity due is the same as the formula for calculating the present value of an annuity multiplied by $(1 + k)$, i.e.,

$$PV_0 (\text{annuity due}) = PMT \left[\left(\frac{1}{k} \right) - \left(\frac{1}{k (1 + k)^n} \right) \right] (1 + k)$$

We have already calculated the present value of an annuity in the sub-section E.(i). To find the present value of an annuity due, we will multiply the present value of this annuity by $(1 + k)$.

Keystrokes	Display	Description
Repeat steps 1-4 from section E.(i)		
5. 1.15	1.15	Records the second term $(1 + k)$ in the formula for an annuity due.
6. x	-23,129.87	Calculates the PV of an annuity due.

2. The HP12C allows you to set the timing of the payment. You have to set the payment mode at "BEGIN" and start from the first step. This method is shown below.

Keystrokes	Display	Description
Clear the memory and financial registers.		Displays BEGIN at the bottom of the screen to indicate that payment is made at the beginning of the period.
1. g BEG	BEGIN	
2. 6000 PMT	6,000.00	Records the amount of the periodic payments. Continued...

Keystrokes			Display	Description
3.	15	<input type="text" value="i"/>	15.00	Records annual rate of 15%.
4.	5	<input type="text" value="n"/>	5.00	Records number of time periods as 5.
5.	<input type="text" value="PV"/>		-23,129.87	Calculates the PV of an annuity due.
6.	<input type="text" value="g"/>	<input type="text" value="END"/>		Toggles the key to the default setting i.e., the end of the period.

F.(i) Calculating the future value of an annuity:

Example: You have recently won a lottery for \$10,000. Your winnings will come in five annual payments of \$2,000 each, starting one year from now. If the annual compound rate is 11.4%, how much is the lottery worth at the end of five years?

Keystrokes			Display	Description
Clear the memory and financial registers.				
1.	2000	<input type="text" value="PMT"/>	2,000.00	Records the amount of periodic payments.
2.	11.4	<input type="text" value="i"/>	11.40	Records the annual compound rate of 11.4%.
3.	5	<input type="text" value="n"/>	5.00	Records the number of time periods as 5.
4.	<input type="text" value="FV"/>	<input type="text" value="CHS"/>	12,555.07	Calculates FV of an annuity.

F.(ii) Calculating the future value of an annuity due:

Example: In this case, your winnings will be paid at the beginning, instead of at the end, of each year for five years. So, you are going to get the first payment of your \$10,000 lottery, i.e. \$2,000, immediately!

There are two methods to calculate the future value of an annuity due.

1. You can calculate the future value of an annuity and multiply it by $(1 + k)$. The formula for the future value of an annuity due is the same as the formula for calculating the future value of an annuity multiplied by $(1 + k)$, i.e.,

$$FV_n (\text{annuity due}) = PMT \left[\frac{(1 + k)^n - 1}{k} \right] (1 + k)$$

We have already calculated the future value of annuity in the sub-section F.(i). To find the future value of annuity due, we will multiply the future value of this annuity by $(1 + k)$.

Keystrokes	Display	Description
Repeat steps 1-4 from section F.(i)		
5. 1.114	1.114	Records the second $(1 + k)$ term in the formula for an annuity due.
6. <input type="text" value="x"/>	13,986.35	Calculates the future value of the annuity due.

2. The HP12C also allows you to set the timing of the payment. You have to set the payment mode at "BEGIN" and start from the the first step. This method is shown below.

Keystrokes	Display	Description
Clear the memory and financial registers.		Displays BEGIN at the bottom of the screen to indicate that payment is made at the beginning of the period.
1. <input type="text" value="g"/> <input type="text" value="BEG"/>	BEGIN	
2. 2000 <input type="text" value="PMT"/>	2,000.00	Records the amount of periodic payments.
3. 11.4 <input type="text" value="i"/>	11.40	Records the annual compound rate of 11.4%.
4. 5 <input type="text" value="n"/>	5.00	Records the number of time periods as 5.
5. <input type="text" value="FV"/> <input type="text" value="CHS"/>	13,986.35	Calculates FV of an annuity due.
6. <input type="text" value="g"/> <input type="text" value="END"/>		Toggles the key to the default setting i.e., the end of the period.

G. Calculating the net present value of an annuity:

Example: Jane thinks if she invests \$80,000 by buying property today, she can get \$15,000 in rent from it for each of the next twenty years (the rent will be paid quarterly). If she wants a rate of return of 12% (with quarterly discounting) on her investment, what is the net present value of this project?

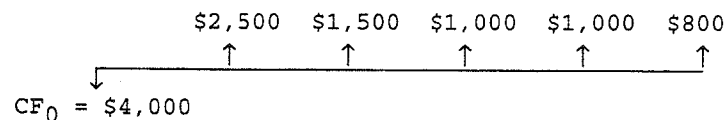
- (i) The annual rate of return will be divided by four, i.e., the quarterly rate of return will be 3%.
- (ii) The number of time periods will be multiplied by four, i.e., 80.
- (iii) The amount of annual rent will be divided by four, i.e., \$3,750.

Keystrokes	Display	Description
Clear memory and financial registers.		
1. 80000 CHS	-80,000.	Change sign to show cash outflow, i.e., initial investment.
2. g CF ₀	-80,000.00	Stores initial investment in financial register.
3. 3750 g CF _j	3,750.00	Stores cash inflow amount.
4. 80 g N _j	80.00	Records the number of time periods as 80.
5. 3 i	3.00	Records the quarterly interest rate of 3%.
6. f NPV	33,252.86	Calculates the net present value of the investment.

H. Calculating the net present value of a series of uneven cash flows:

Problems involving more than 20 cash flows can be solved using this calculator only if there are consecutive equal cash flows. HP12C allows users to store a maximum of 19 cash flow groups, besides the initial investment CF₀. A cash flow group consists of the cash flow amount and its consecutive occurrences (N_j) in the series. As shown in previous sections, the number of times equal cash flows occur consecutively can be stored in the calculator using the N_j key. The maximum value of N_j can be 99.

Example: Beth is planning to buy a Pentium based PC for rental purposes. She has calculated that her cash flows from the investment for the next five years would be as shown below.



If she has to pay an annual interest rate of 9.75%, should she buy the computer?

Keystrokes	Display	Description
Clear memory and financial registers.		
1. 4000 CHS	-4,000.	Change sign to show cash outflow i.e., initial investment.
2. g CF ₀	-4,000.00	Stores initial investment in financial register.

Continued...

Keystrokes			Display	Description
3.	2500	<input type="text" value="g"/> <input type="text" value="CF<sub>j</sub>"/>	2,500.00	Stores first cash inflow amount.
4.	1500	<input type="text" value="g"/> <input type="text" value="CF<sub>j</sub>"/>	1,500.00	Stores second cash inflow amount.
5.	1000	<input type="text" value="g"/> <input type="text" value="CF<sub>j</sub>"/>	1,000.00	Stores the amount of third cash inflow.
6.	2	<input type="text" value="g"/> <input type="text" value="N<sub>j</sub>"/>	2.00	Records that \$1,000 occurs twice, i.e., for both the third and fourth cash inflows.
7.	800	<input type="text" value="g"/> <input type="text" value="CF<sub>j</sub>"/>	800.00	Stores fifth cash inflow.
8.	9.75	<input type="text" value="i"/>	9.75	Records annual interest rate of 9.75%.
9.	<input type="text" value="f"/> <input type="text" value="NPV"/>		1,471.37	Calculates the net present value of the investment.

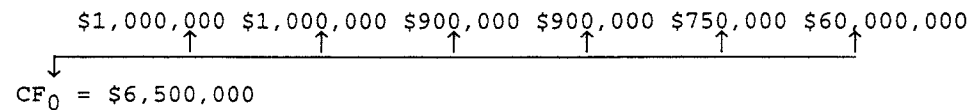
I. Calculating the internal rate of return of an annuity:

Example: ABC Inc. is planning to spend \$35,000 to buy a warehouse. Under the contract, they will receive a yearly rent of \$6,000 (paid semiannually) from the property for the next eight years. What is the internal rate of return for the investment?

Keystrokes			Display	Description
Clear memory and financial registers.				Change sign to show cash outflow i.e., initial investment.
1.	35000	<input type="text" value="CHS"/>	-35,000.	
2.	<input type="text" value="g"/> <input type="text" value="CF<sub>0</sub>"/>		-35,000.00	Stores initial investment in financial register.
3.	3000	<input type="text" value="g"/> <input type="text" value="CF<sub>j</sub>"/>	3,000.00	Stores semi-annual cash inflow amount.
4.	16	<input type="text" value="g"/> <input type="text" value="N<sub>j</sub>"/>	16.00	Stores total number of time periods as 16.
5.	<input type="text" value="f"/> <input type="text" value="IRR"/>		3.98	Calculates the semi-annual IRR.
6.	2	<input type="text" value="x"/>	7.97	Calculates the IRR of the investment.

J. Calculating the internal rate of return of a series of uneven cash flows:

Example: Healthtime has the opportunity to make an investment that requires an initial cash outflow of \$6,500,000. The estimated cash inflows from the project for the next 6 years are shown below. What is the IRR on this investment?



Keystrokes			Display	Description
Clear memory and financial registers.				
1.	6500000	CHS	-6,500,000.	Change sign to show cash outflow i.e., initial investment.
2.	g	CF ₀	-6,500,000.00	Stores initial investment in financial register.
3.	1000000	g	1,000,000.00	Stores first cash inflow amount.
4.	2	g	2.00	Stores first and second cash inflow as \$1,000,000
5.	900000	g	900,000.00	Stores the amount of third cash inflow.
6.	2	g	2.00	Records that \$900,000 occurs twice, i.e., for third and fourth cash inflows.
7.	750000	g	750,000.00	Stores the amount of fifth cash inflow.
8.	60000000	g	60,000,000.00	Stores the amount of sixth cash inflow.
9.	f	IRR	51.88	Calculates the IRR of the cash flow series.

K. Bond valuation with interest compounded annually:

We will not be using the bond functions given on the calculator because for most students at this level, their use tends to entail unnecessary complexity. We will use the calculator to compute values from the bond valuation formula, i.e.,

$$P_0 = \sum_{t=1}^n \frac{I_t}{(1+i)^t} + \frac{P_n}{(1+i)^n}$$

where, P_0 = Bond Price, I_t = Interest Payments,
 P_n = Principal, i = Yield to Maturity,
 t = Number denoting a time period, varies from 0 to n ,
 n = Total number of time periods.

Example: How much would you be willing to pay for a bond today if it pays \$100 in interest annually for 20 years (starting next year), and has a principal payment of \$1,000? The yield to maturity is 15%.

This question can be interpreted as that of finding the NPV of an uneven cash flow series, with the initial cash outflow equal to zero. Hence, we will follow the steps used for calculating NPV to compute the current price of the bond.

Keystrokes			Display	Description
Clear memory and financial registers.				
1. 0	<input type="text" value="g"/>	<input type="text" value="CF<sub>0</sub>"/>	0.00	Stores initial investment as zero in the financial register.
2. 100	<input type="text" value="g"/>	<input type="text" value="CF<sub>j</sub>"/>	100.00	Stores first cash inflow amount.
3. 19	<input type="text" value="g"/>	<input type="text" value="N<sub>j</sub>"/>	19.00	Records that interest payments of \$100 occur 19 times.
4. 1100	<input type="text" value="g"/>	<input type="text" value="CF<sub>j</sub>"/>	1100.00	Stores the amount of last cash inflow (interest + principal).
5. 15	<input type="text" value="i"/>		15.00	Records the yield to maturity as 15%.
6. <input type="text" value="f"/>	<input type="text" value="NPV"/>		687.03	Calculates the initial bond price.

L. Bond valuation with interest compounded semiannually:

Since most bonds pay interest semiannually, we will show the conversion required to calculate the current value of such bonds.

Example: If the bond described in section K pays interest semiannually, the calculations will be:

$I_t = \$50$, $P_n = \$1000$, $i = 7.5\%$, $n = 40$.

Keystrokes			Display	Description
Clear memory and financial registers.				
1.	0	<input type="text" value="g"/> <input type="text" value="CF<sub>0</sub>"/>	0.00	Stores initial investment as zero in the financial register.
2.	50	<input type="text" value="g"/> <input type="text" value="CF<sub>j</sub>"/>	50.00	Stores first cash inflow amount.
3.	39	<input type="text" value="g"/> <input type="text" value="N<sub>j</sub>"/>	39.00	Records that interest payments of only \$50 occur 39 times.
4.	1050	<input type="text" value="g"/> <input type="text" value="CF<sub>j</sub>"/>	1050.00	Stores the amount of last cash inflow (interest + principal payment).
5.	7.5	<input type="text" value="i"/>	7.50	Records the semi-annual YTM as 7.5%.
6.	<input type="text" value="f"/> <input type="text" value="NPV"/>		685.14	Calculates the initial bond price.

M. Linear Regression:

In this section we will find the slope and intercept of the given data.

Example: Assume the following sales figures have been given to you by your marketing instructor and you have to do a linear regression on them.

<u>Sales (Y_t)</u>	<u>Period (X_t)</u>
2.50	1
3.56	2
4.15	3
1.50	4
2.05	5

Keystrokes			Display	Description
Clear memory and financial registers.				
1.	<input type="text" value="f"/> <input type="text" value="Σ"/>		0.00	Clears the statistical registers.
2.	2.50 <input type="text" value="ENTER"/>		2.50	Enter the first Y value.
3.	1 <input type="text" value="Σ+"/>		1.00	Enter the first X value.
4.	3.56 <input type="text" value="ENTER"/>		3.56	Enter the second Y value.
Continued...				

Keystrokes			Display	Description
5.	2	$\Sigma+$	2.00	Enter the second X value.
6.	4.15	ENTER	4.15	Enter the third Y value.
7.	3	$\Sigma+$	3.00	Enter the third X value.
8.	1.50	ENTER	1.50	Enter the fourth Y value.
9.	4	$\Sigma+$	4.00	Enter the fourth X value.
10.	2.05	ENTER	2.05	Enter the fifth Y value.
11.	5	$\Sigma+$	5.00	Enter the fifth X value.
12.	0	g \hat{Y}, r	3.64	Finds the intercept for the regression equation.
13.	STO 0		3.64	Stores the value of the intercept in memory location 1.
14.	0 g \hat{X}, r		12.30	To find the intercept when Y is zero in $Y_t = \alpha + \beta X_t$.
15.	RCL 0		3.64	Recall the value of the intercept stored in memory location 0.
16.	$x \div y$ \div		0.30	Calculates the slope of the regression equation.

The linear regression equation is $Y_t = \alpha + \beta X_t = 3.64 + 0.30X_t$.

Note: If the answer from step 13 is negative, press the CHS key at the end of step 14.

II. Hewlett-Packard HP10B:

The HP10B, like the HP12C, has a continuous memory. So turning off the calculator does not affect the contents stored in the memory. In fact, the calculator automatically turns itself off when not used for more than approximately ten minutes. The calculator keys perform two sets of functions. Pressing the shift key invokes the function written at the top of any key. The shift key is situated on the lower left hand side of the calculator key pad and is yellow in color.

It will be denoted by SHIFT in this appendix.

A. Clearing the calculator display and memory, and setting the decimal points:

Keystrokes				Display	Description
1.	C	SHIFT	CLEAR ALL	0.00	Clears screen and all memory.
2.	SHIFT	DISP	2	0.00	Sets the number of decimal places equal to 2.

- Note: 1. We will be using two decimal places for all the calculations in this appendix.
 2. Even though it displays two decimal digits, the HP10B uses 12 digit accuracy in all calculations.
 3. To erase a part of the entered display, use the ← key.

B. Using the memory capability:

Example: Before leaving on a sales call one morning, Alfred stored the price of a fax machine (\$1,200) and a printer (\$1,000) in his calculator. Later that day, he sold three fax machines and four printers to a customer. He used his calculator to get the total amount due from this customer in the following way:

Keystrokes				Display	Description
Clear all memory.					
1.	1200	SHIFT	STO 1	1,200.00	Stores the price of the fax machine in memory location 1.
2.	1000	SHIFT	STO 2	1,000.00	Stores the price of the printer in memory location 2.
3.	SHIFT	C			Turns the calculator off.
Later that day:					
4.	C			0.00	After the sale, Alfred turns the calculator on.
5.	RCL	1		1,200.00	Recalls the cost of the fax to the display.
6.	x	3	=	3,600.00	Multiplies 1,200 by 3 to calculate the cost of the three fax machines.
7.	→ M			3,600.00	Stores the number in the single storage M register.
8.	RCL	2		1,000.00	Recalls the cost of the printer.
9.	x	4	=	4,000.00	Calculates cost of four printers.

Continued...

Keystrokes	Display	Description
10. <input type="text" value="+"/> <input type="text" value="RM"/> <input type="text" value="="/>	7,600.00	Recalls the cost of 3 fax machines to calculate the total amount for the sale.

C. Calculating the present value of a lump sum amount:

Example: Liz anticipates it will cost her \$65,000 to buy a house in eighteen months. How much should she invest today, at an annual interest rate of 15% (interest is compounded monthly), to be able to afford the house in one and a half years?

Keystrokes	Display	Description
Clear all memory.		
1. 65000 <input type="text" value="FV"/>	65,000.00	Records the future cash flow of \$65,000.
2. 12 <input type="text" value="SHIFT"/> <input type="text" value="P/YR"/>	12.00	Records number of interest periods per year as 12.
3. 15 <input type="text" value="I/YR"/>	15.00	Records annual rate of 15%.
4. 1.5 <input type="text" value="xP/YR"/>	18.00	Records number of time periods as 18.
5. <input type="text" value="PV"/>	-51,975.99	Calculates the present value of \$65000 in 1.5 years discounted at a monthly rate of 1.25%.

Note: The display in step 5 has a negative sign because it represents a cash outflow (investment) today.

D. Calculating the future value of a lump sum amount:

Example: If John invests \$1,850 today in an asset earning a 10% rate of return (compounded annually), how much will he have after two years?

Keystrokes	Display	Description
Clear all memory.		
1. 1850 <input type="text" value="+/-"/> <input type="text" value="PV"/>	-1,850.00	Records the present cash outflow of \$1,850.
2. 1 <input type="text" value="SHIFT"/> <input type="text" value="P/YR"/>	1.00	Records number of interest periods per year as 1.
3. 10 <input type="text" value="I/YR"/>	10.00	Records annual rate of 10%.
		Continued...

Keystrokes		Display	Description
4.	2 N	2.00	Records number of time periods as 2.
5.	FV	2,238.50	Calculates the future value of \$1,850 after 2 years at 10%.

Note: The default setting of P/YR is 12. However, if this setting is changed it does not automatically revert back. Therefore, it is advisable to set this key for each problem to the number of given interest periods per year.

E.(i) Calculating the present value of an annuity:

Example: How much should you invest now so that, starting one year from today, your daughter can receive \$6,000 per year for the next five years? Assume the discount rate is 15%.

Keystrokes		Display	Description
Clear all memory.			
1.	6000 PMT	6,000.00	Records the amount of the periodic payments.
2.	1 SHIFT P/YR	1.00	Records number of interest periods per year as 1.
3.	15 I/YR	15.00	Records annual rate of 15%.
4.	5 N	5.00	Records number of time periods as 5.
5.	PV	-20,112.93	Calculates the PV of an annuity that pays \$6,000 for five periods at 15%.

E.(ii) Calculating the present value of an annuity due:

Example: In this case, instead of receiving payments at the end of each year, your daughter will receive the payments at the beginning of each year. Therefore, her first payment will be received immediately.

There are two methods to calculate the present value of an annuity due.

1. You can calculate the present value of an annuity, as shown in section E.(i), and multiply it by $(1 + k)$. In that case the additional step would be:

Keystrokes	Display	Description
Follow steps 1-5 from section E.(i)		
6. x 1.15	-23,129.87	Calculates the PV of an annuity due that pays \$6,000 for 5 periods at 15%.

2. The HP10B allows you to set the timing of the payment. You have to set the payment mode at "BEGIN" and start from the the first step. This method is shown below.

Keystrokes	Display	Description
Clear all memory.		
1. SHIFT BEG/END	BEGIN	Displays BEGIN at the bottom of the screen to indicate that payment is made at the beginning of the period.
2. 6000 PMT	6,000.00	Records the amount of the periodic payment.
3. 1 SHIFT P/YR	1.00	Records number of interest periods per year as 1.
4. 15 I/YR	15.00	Records annual rate of 15%.
5. 5 N	5.00	Records number of time periods as 5.
6. PV	-23,129.87	Calculates the PV of an annuity due that pays \$6,000 for 5 periods at 15%.
7. SHIFT BEG/END		Toggles the key to the default setting i.e., the end of the period.

F.(i) Calculating the future value of an annuity:

Example: You have recently won a lottery for \$10,000. Your winnings will come in five annual payments of \$2,000 each, starting one year from now. If the annual compound rate is 11.4%, how much is the lottery worth at the end of five years?

Keystrokes	Display	Description
Clear all memory.		
1. 2000 PMT	2,000.00	Records the amount of periodic payments.
2. 1 SHIFT P/YR	1.00	Records number of interest periods per year as 1.
		Continued...

Keystrokes			Display	Description
3.	11.4	I/YR	11.40	Records the annual compound rate of 11.4%.
4.	5	N	5.00	Records the number of time periods as 5.
5.	FV	+/-	12,555.07	Calculates FV of an annuity.

F.(ii) Calculating the future value of an annuity due:

Example: In this case, your winnings will be paid at the beginning, instead of at the end, of each year for five years. So, you are going to get the first payment of your \$10,000 lottery, i.e. \$2,000, immediately!

There are two methods to calculate the future value of an annuity due.

1. You can calculate the future value of an annuity, as shown in section F.(i), and multiply it by $(1 + k)$. In that case the additional step would be:

Keystrokes			Display	Description
Follow steps 1-5 from section F.(i)				Calculates the FV of an annuity due that pays \$2,000 for 5 periods at 11.4%.
6.	x	1.114	13,986.35	

2. The HP10B allows you to set the timing of the payment. You have to set the payment mode at "BEGIN" and start from the first step. This method is shown below.

Keystrokes			Display	Description
Clear all memory.				
1.	SHIFT	BEG/END	BEGIN	Displays BEGIN at the bottom of the screen to indicate that payment is made at the beginning of the period.
2.	2000	PMT	2,000.00	Records the amount of the periodic payment.
3.	1	SHIFT P/YR	1.00	Records number of interest periods per year as 1.
4.	11.4	I/YR	11.40	Records annual rate of 11.4%.
5.	5	N	5.00	Records number of time periods as 5.

Continued...

Keystrokes		Display	Description
6.	<input type="button" value="FV"/> <input type="button" value="+/-"/>	13,986.35	Calculates the FV of an annuity due that pays \$2,000 for 5 periods at 11.4%.
7.	<input type="button" value="SHIFT"/> <input type="button" value="BEG/END"/>		Toggles the key to the default setting i.e., the end of the period.

G. Calculating the net present value of an annuity:

Example: Jane thinks if she invests \$80,000 by buying property today, she can get \$15,000 in rent from it for each of the next twenty years (the rent will be paid quarterly). If she wants a rate of return of 12% (with quarterly discounting) on her investment, what is the net present value of this project?

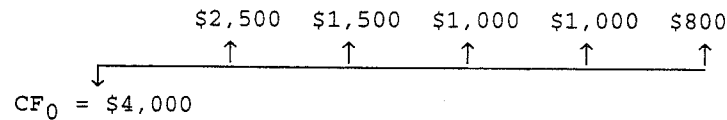
- (i) The annual rate of return will be divided by four, i.e., the quarterly rate of return will be 3%.
- (ii) The number of time periods will be multiplied by four, i.e., 80.
- (iii) The amount of annual rent will be divided by four, i.e., \$3,750.

Keystrokes		Display	Description
Clear all memory.			
1. 80000	<input type="button" value="+/-"/> <input type="button" value="CF<sub>j</sub>"/>	-80,000.00	Change sign to show cash outflow, i.e., initial investment. Stores cash outflow at $j = 0$.
2. 15000	<input type="button" value="÷"/> 4 <input type="button" value="CF<sub>j</sub>"/>	3,750.00	Stores quarterly cash in-flow amount at $j = 1$.
3. 20	<input type="button" value="x"/> 4	4_	Calculates time periods with quarterly payments.
4.	<input type="button" value="SHIFT"/> <input type="button" value="N<sub>j</sub>"/>	80.00	Records the number of time periods as 80.
5. 4	<input type="button" value="SHIFT"/> <input type="button" value="P/YR"/>	4.00	Records number of interest periods per year as 4.
6. 12	<input type="button" value="I/YR"/>	12.00	Records the annual interest rate of 12%.
7.	<input type="button" value="SHIFT"/> <input type="button" value="NPV"/>	33,252.86	Calculates the net present value of the investment.

H. Calculating the net present value of a series of uneven cash flows:

HP10B can store 14 cash flow groups, besides the initial cash investment. A cash flow group comprises the cash flow amount and the number of times it repeats consecutively in the cash flow series. Each cash flow group can have up to 99 cash flows i.e., the maximum value of N_j can be 99.

Example: Beth is planning to buy a Pentium based PC for rental purposes. She has calculated that her expected cash flows from the investment for the next five years would be as shown below.



If she has to pay an annual interest rate of 9.75%, should she buy the computer?

Keystrokes				Display	Description
Clear all memory.					
1.	4000	<div>+/-</div>	<div>CF_j</div>	-4,000.00	Change sign to show cash outflow i.e., initial investment. Stores initial investment at $j = 0$.
2.	2500	<div>CF_j</div>		2,500.00	Stores first cash inflow amount at $j = 1$.
3.	1500	<div>CF_j</div>		1,500.00	Stores second cash inflow amount at $j = 2$.
4.	1000	<div>CF_j</div>		1,000.00	Stores the amount of third cash inflow at $j = 3$.
5.	2	<div>SHIFT</div>	<div>N_j</div>	2.00	Records that \$1,000 occurs twice, i.e., for both the third and fourth cash inflows.
6.	800	<div>CF_j</div>		800.00	Stores the amount of fifth cash inflow at $j = 4$.
7.	1	<div>SHIFT</div>	<div>P/YR</div>	1.00	Records number of interest periods per year as 1.
8.	9.75	<div>I/YR</div>		9.7500	Records annual interest rate of 9.75%.
9.		<div>SHIFT</div>	<div>NPV</div>	1,471.37	Calculates the net present value of the investment.

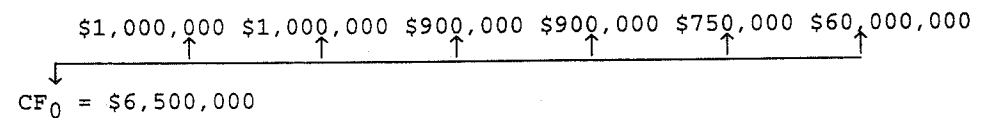
I. Calculating the internal rate of return of an annuity:

Example: ABC Inc. is planning to spend \$35,000 to buy a warehouse. Under the contract, they will receive an after-tax cash flow of \$6,000 (paid semiannually) from the property for the next eight years. What is the internal rate of return for the investment?

Keystrokes			Display	Description
Clear all memory.				
1.	35000	<div>+/-</div> <div>CF_j</div>	-35,000.00	Change sign to show cash outflow i.e., initial investment. Stores initial cash flow at $j = 0$.
2.	6000	<div>÷</div> 2 <div>CF_j</div>	3,000.00	Stores semi-annual cash inflow amount at $j = 1$.
3.	2	<div>SHIFT</div> <div>P/YR</div>	2.00	Records number of interest periods per year as 2.
4.	8	<div>x</div> 2	2_	Double the time periods for semi-annual payments.
5.	<div>SHIFT</div>	<div>N_j</div>	16.00	Stores total number of time periods as 16.
6.	<div>SHIFT</div>	<div>IRR/YR</div>	7.97	Calculates the IRR of the investment.

J. Calculating the internal rate of return of a series of uneven cash flows:

Example: Healthtime has the opportunity to make an investment that requires an initial cash outflow of \$6,500,000. The estimated cash inflows from the project for the next 6 years are shown below. What is the IRR on this investment?



Keystrokes			Display	Description
Clear all memory.				
1.	6500000	<div>+/-</div> <div>CF_j</div>	-6,500,000.00	Change sign to show cash outflow i.e., initial investment. Stores initial investment at $j = 0$.
2.	1000000	<div>CF_j</div>	1,000,000.00	Stores the amount of first cash inflow at $j = 1$.
3.	2	<div>SHIFT</div> <div>N_j</div>	2.00	Stores first and second cash inflow as \$1,000,000
4.	900000	<div>CF_j</div>	900,000.00	Stores the amount of third cash inflow at $j = 2$.
5.	2	<div>SHIFT</div> <div>N_j</div>	2.00	Records that cash inflow of \$900,000 occurs for third and fourth payments.
6.	750000	<div>CF_j</div>	750,000.00	Stores the amount of fifth cash inflow at $j = 3$.

Continued...

Keystrokes		Display	Description
7.	60000000 CF_j	60,000,000.00	Stores the amount of sixth cash inflow at $j = 4$.
8.	SHIFT IRR/YR	51.88	Calculates the IRR of the investment.

K. Bond valuation with interest compounded annually:

Example: How much would you be willing to pay for a bond today if it pays \$100 in interest annually for 20 years (starting next year), and has a principal payment of \$1,000? The yield to maturity is 15%.

This question can be interpreted as that of finding the NPV of an uneven cash flow series, with the initial cash outflow equal to zero. Hence, we will follow the steps used for calculating NPV to compute the current price of the bond.

Keystrokes		Display	Description
Clear all memory.			
1. 0	CF_j	0.00	Stores initial investment as zero and stores it at $j = 0$.
2. 100	CF_j	100.00	Stores first cash inflow amount at $j = 1$.
3. 19	SHIFT N_j	19.00	Records that interest payments of \$100 occur 19 times.
4. 1100	CF_j	1100.00	Stores the amount of last cash inflow (interest + principal) at $j = 2$.
5. 1	SHIFT P/YR	1.00	Records number of interest periods per year as 1.
6. 15	I/YR	15.00	Records the yield to maturity as 15%.
7.	SHIFT NPV	687.03	Calculates the initial bond price.

L. Bond valuation with interest compounded semiannually:

Since most bonds pay interest semiannually, we will show the conversion required to calculate the current value of such bonds.

Example: If the bond described in section K pays interest semiannually, the calculations will be:

$$I_t = \$50, \quad P_n = \$1000, \quad i = 7.5\%, \quad n = 40.$$

Keystrokes		Display	Description
Clear all memory.			
1. 0	CF_j	0.00	Stores initial investment as zero and stores it at $j = 0$.
2. 100	\div 2 CF_j	50.00	Stores first cash inflow amount at $j = 1$.
3. 20	\times 2 $-$ 1	1_	Calculate number of interest periods.
4. SHIFT	N_j	39.00	Stores number of interest periods as 39.
5. 1050	CF_j	1050.00	Stores the amount of last cash inflow (interest + principal) at $j = 2$.
6. 2	SHIFT P/YR	2.00	Records number of interest periods per year as 2.
7. 15	I/YR	15.00	Records the yield to maturity as 15%.
8. SHIFT	NPV	685.14	Calculates the initial bond price.

M. Linear Regression:

In this section we will find the slope and intercept of the given data.

Example: Assume the following sales figures have been given to you by your marketing instructor and you have to do a linear regression on them.

<u>Sales (Y_t)</u>	<u>Period (X_t)</u>
2.50	1
3.56	2
4.15	3
1.50	4
2.05	5

Keystrokes		Display	Description
Clear all memory.			
1. SHIFT	$CL \Sigma$	0.00	Clears the statistical registers.
2. 1	INPUT 2.50 $\Sigma+$	1.00	Enter the first X,Y pair.
3. 2	INPUT 3.56 $\Sigma+$	2.00	Enter the second X,Y pair. Continued...

Keystrokes					Display	Description
4.	3	INPUT	4.15	$\Sigma+$	3.00	Enter the third X,Y pair.
5.	4	INPUT	1.50	$\Sigma+$	4.00	Enter the fourth X,Y pair.
6.	5	INPUT	2.05	$\Sigma+$	5.00	Enter the fifth X,Y pair.
7.	0	SHIFT		\hat{Y}_m	3.64	Finds the Y intercept for the regression equation.
8.	SHIFT	SWAP		+/-	0.30	Finds the slope of the regression equation.

The linear regression equation is $Y_t = \alpha + \beta X_t = 3.64 + 0.30X_t$.

III. Texas Instruments TIBAIPLUS:

TIBAIPLUS can perform four sets of functions. For the purpose of this appendix, only two sets are relevant. The first set of functions are the ones that are written on the keys. The second set is invoked by pressing the white "second function" key, which is situated in the second row from top on the keypad.

This key will be represented by 2nd in this appendix.

The calculator has a continuous memory. Turning off the calculator does not affect the contents stored in the memory, though the display is reset to zero. The calculator automatically turns itself off when not used for more than approximately ten minutes.

A. Clearing the calculator display and memory, and setting the decimal points:

Keystrokes					Display	Description
1.		ON/OFF			0.00	Switch the calculator on.
2.	2nd	QUIT			0.00	Resets the calculator to the standard mode, clears the screen.
3.	2nd	MEM	2nd	CLRWork	MO = 0.00	Clears all the memory locations simultaneously.
4.	2nd	Format	2	ENTER	DEC = 2.0000	Sets the number of decimal places equal to 2.
5.	2nd	QUIT			0.00	Brings the calculator to the standard mode.

To clear each memory location individually, use the following key sequence.