Tutorial letter 102/3/2016

Elementary Quantitative Methods

QMI1500

Semesters 1 and 2

Department of Decision Sciences

This tutorial letter contains instructions for the use of SHARP EL-738.

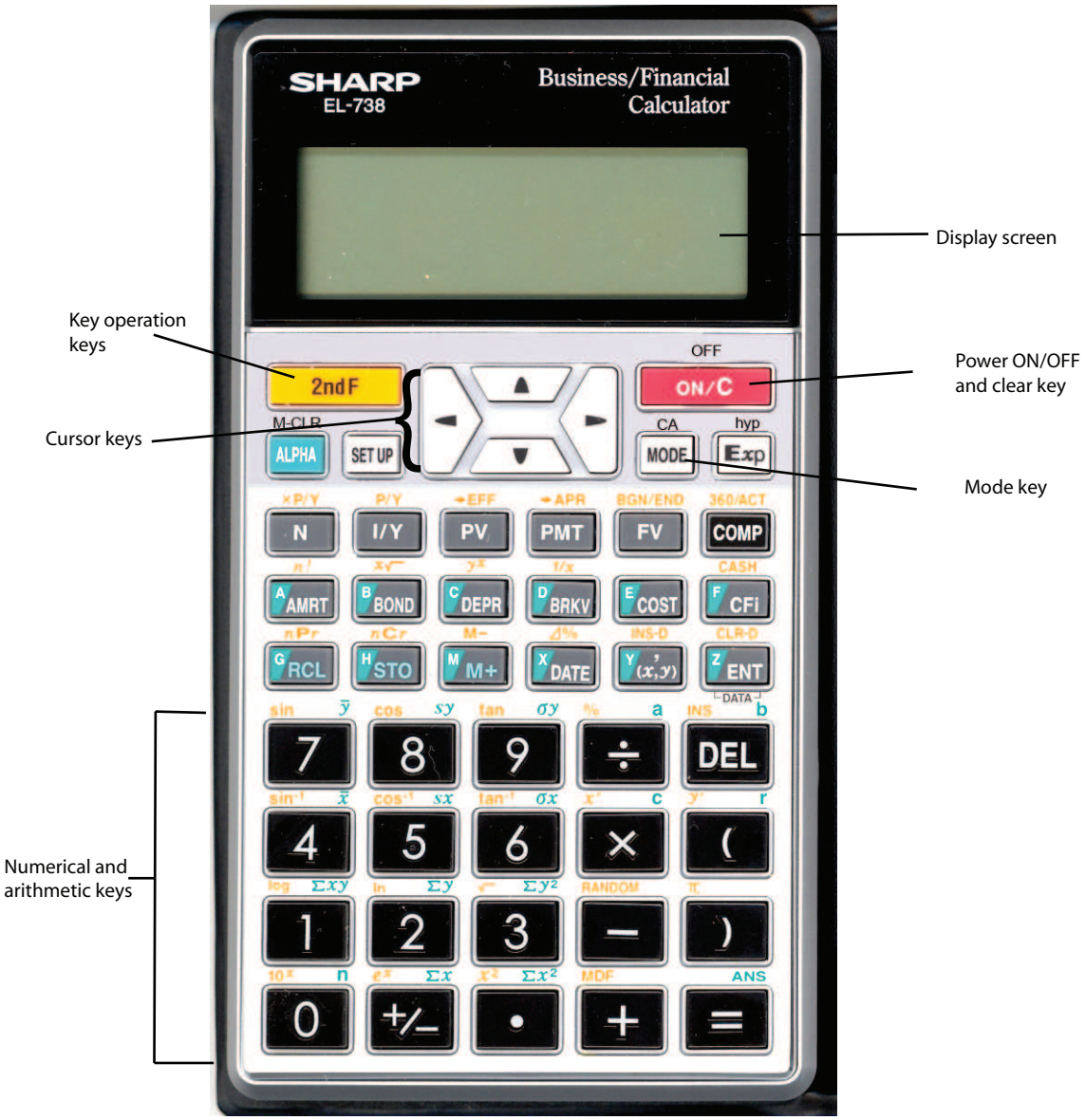
Bar code

1 USING THE RECOMMENDED CALCULATOR

The SHARP EL-738 calculator is recommended for this module. The advantage of this calculator is that it can do basic calculations, financial calculations and statistical calculations. You may use any **financial calculator**, but assistance will only be given for the SHARP EL-738 calculator.

Most of the keys can perform two functions. To perform a function written on the key, you simply press the key. To perform a function written on the surface just above the key, first press the orange **2ndF** key to activate it to perform the function when pressed.

1.1 Normal calculation mode



(i) Switch on your calculator

Before using your calculator for the first time, reset (initialise) it. Press the RESET switch located on the back of the calculator with the tip of a ballpoint pen.

After resetting the calculator, the initial display of the NORMAL mode appears.

NOTE:

Pressing [2ndF] [M-CLR] 1 [=] will also erase all stored data in the memory and restore the calculator's default setting.

Note that the numbers 0, ..., 9 will not be written in blocks, but all functions that appear on the calculator will be written in blocks.

(ii) The SET UP menu

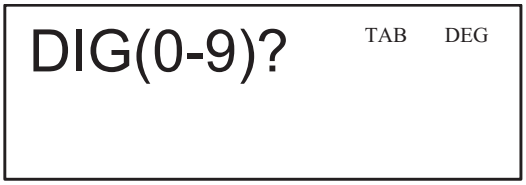
Press the [SET UP] key to display the SET UP menu.

appears on the screen. Press the [▶] arrow three times and

will appear on the screen.

A menu item can be selected by using the [◀] [▶] keys (the selected number will blink). Press the [=] key.

To set the number of decimals that will be displayed, press **SET UP** 0 0.



appears on the screen.
Press 2 to select two decimals

If you want four decimals press **SET UP** 0, 0, 4.

(However, we will use two decimals. Press **SET UP** 0, 0, 2.)

NOTE: The calculator uses a decimal point (0.00) where we use the decimal comma (0,00).

(iii) Selecting a MODE

Press **MODE**.

The menu display appears

Press 0.

appears on the screen

(iv) Normal mode

The NORMAL mode allows you to perform financial, arithmetic or scientific calculations.

(v) Calculator keys

The keys are classified according to the work they do.

The following keys are worth mentioning:

- ON: [ON/C]

  Last key, first row. To switch on the calculator. The [ON/C] key also clears the screen. To preserve the batteries, the calculator turns itself off after about 10 minutes.

- OFF: [OFF / ON/C]

  The orange function on the red [ON/C] key. Press [2ndF] [ON/C] to switch your calculator off.

- NUMERIC KEYS: 1, 2, 3, ..., 9, 0

  These keys are used to enter numbers.

- MULTIPLICATION [X]

  Second last key, third last row.

- DIVISION [÷]

  Second last key, sixth row.

- EQUAL [=]

  Last key, last row.

- CLEAR [ON/C]

  Last key, first row.

- BRACKETS [(] [)]

  Last key, third last row and second last row.

  Use the [(] and [)] keys to place parentheses around parts of expressions. The closing parenthesis [)] may be omitted.

- NEGATIVE [+/-]

  Second key, last row.

  This key is used to enter a negative number or change the sign of a number, while the [−] key is used for the operation of subtraction. Note the different ways in which subtraction, with the long dash, and the sign of the number, with a small dash, are displayed.

  For example: $3 - 2$ and 3+(-2).

  Example:

  Add 8 to -5

  Press 8 [+] [+/-] 5 [=]

The answer is 3.

Subtract -5 from 8.

Press 8 [−] 5 [=]

The answer is 13.

Subtract -5 from -8.

Press [+/-] 8 [−] [+/-] 5 [=]

The answer is -3.

Add -5 to -8

Press [+/-] 5 [+] [+/-] 8 [=]

The answer is -13.

- DELETE: [DEL]

  If you made a mistake, press [DEL] (last key, sixth row) to erase the number and then enter the correct number to continue.

  If you want to change a number or sign after you have pressed [=] use the [◄] cursor to move to the place where you want to change it. Enter the new number or sign, then press [DEL] and continue.

- INSERT: [INS]

  Use the [◄] cursor to move to the place where you want to insert a number. Press [2ndF] [INS] (sixth row, last key) and enter the number. The cursor will flicker after the inserted number.

- TO THE POWER key [y^x].

  The [2ndF] third key, fourth row

  Example:

  Calculate 2^3.

  Enter the base number first, that is press 2.

  Then press [2ndF] [y^x] 3 [=]

  The answer is 8,00.

  If the power consists of more than one term, use brackets for the power.

  Example:

  Calculate $(3^2)^4$

  Press [(] 3 [2ndF] [y^x] 2 [)] [2ndF] [y^x] 4 [=]

  The answer is 6 561,00.

  Example:

  Calculate $5^{2/3}$

  Press 5 [2ndF] [y^x] [(] 2 [÷] 3 [)] [=]

  The answer is 2,92.

- SQUARE: (x^2)

  Use the power key.

  Example:

  Calculate 4^2.

  Press 4 [2ndF] [y^x] 2 [=]

  The answer is 16.

  Example:

  Calculate 10^{-1}

  Press 10 [2ndF] [y^x] [+/-] 1 [=]

  The answer is 0,10.

  Calculate $\frac{1}{5^2}$

  Press 1 [÷] 5 [2ndF] [y^x] 2 [=]

  The answer is 0,04.

- SQUARE ROOT: $\sqrt{x}$

  Use the [$\sqrt[x]{}$] key. [2ndF] third key, forth row.

  Example:

  Calculate $\sqrt{64}$. $\sqrt{64}$ means $\sqrt[2]{64}$.

  Press 2 [2ndF] [$\sqrt[x]{}$] 64 [=]

  The answer is 8.

  Example:

  Calculate $\sqrt[3]{64}$.

  Press 3 [2ndF] [$\sqrt[x]{}$] 64 [=]

  The answer is 4.

  Example:

  Calculate $\sqrt[4]{3^3}$

  Press 4 [2ndF] [$\sqrt[x]{}$] 3 [2ndF] [y^x] 3 [=]

  The answer is 2,28.

- NUMERIC FRACTIONS

  Example:

  Calculate $\frac{3}{4} - \frac{1}{2}$

  Press 3 [÷] 4 [−] 1 [÷] 2 [=]

  The answer is 0,25.

  Calculate $\frac{1}{2} + \frac{2}{3} + \frac{3}{5}$

  Press 1 [÷] 2 [+] 2 [÷] 3 [+] 3 [÷] 5 [=]

  The answer is 1,77.

- LOGARITHM to the base e: ln

  Example:

  Calculate ln 3.

  Press [2ndF] [ln], (second key, second last row) 3 [=]

  The answer is 1,10.

  Example:

  Calculate ln $\left(\frac{1\,253}{1479}\right)$.

  Press [2ndF] ln [(] 1 253 [÷] 1 479 [)] [=]

  The answer is $-0{,}17$.

- THE EXPONENTIAL FUNCTION: e^x – The inverse of ln.

  Example:

  Calculate $e^{1{,}10}$.

  Press [2ndF] [e^x] (2nd key, last row)

  1.10 [=]

  The answer is 3.

- MEMORY: M+

  The calculator has 11 temporary memories (A-H and X-Z), one independent memory (M) and one last answer memory (ANS).

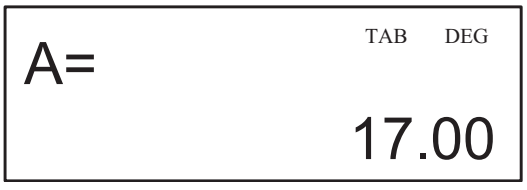
  To store a value in temporary memory, press [STO] and the variable in which you want to store it.

  Example: Store 17 in A.

  Press 17 [STO] (fifth row, second key) [A] (first key, fourth row).

  appears on the screen.

  If you want to recall the value stored in A, press [RCL] (first key, fifth row) [A].



  appears on the screen.

To add and store values in the independent memory use the **M+** key.

Example: Add and store 19, 21 and 25 in independent memory.

Press 19 **M+** (third key, fifth row).

21 **M+**

25 **M+**

To recall the answer, press **RCL** **M+**.

The answer is 65.

To clear the register, press **2ndF** **M-CLR**.

appears on the screen.

Press 0.

appears on the screen.

Press 0.

appears on the screen.

- ERROR
  If ERROR 1 appears on the screen after you have done a calculation press the ◀ key and the cursor will flicker where you made the mistake, press **DEL** and continue by pressing =.
- PERCENTAGE (Fourth key, sixth row)
  Example:
  Calculate 25% of R1 800.
  Press 1 800 × 25 **2ndF** **%**.
  The answer is 450,00.

- PERMUTATION

  To use the factorial key [n!]

  Example: Determine 5!

  Press 5 [2ndF] [n!] (first key, fourth row) [=]

  The answer is 120.

  Permutations ${}_nP_r$

  Example: Determine ${}_{10}P_5$.

  Press 10 [2ndF] [${}_nP_r$] 5 [=]

  The answer is 30 240.

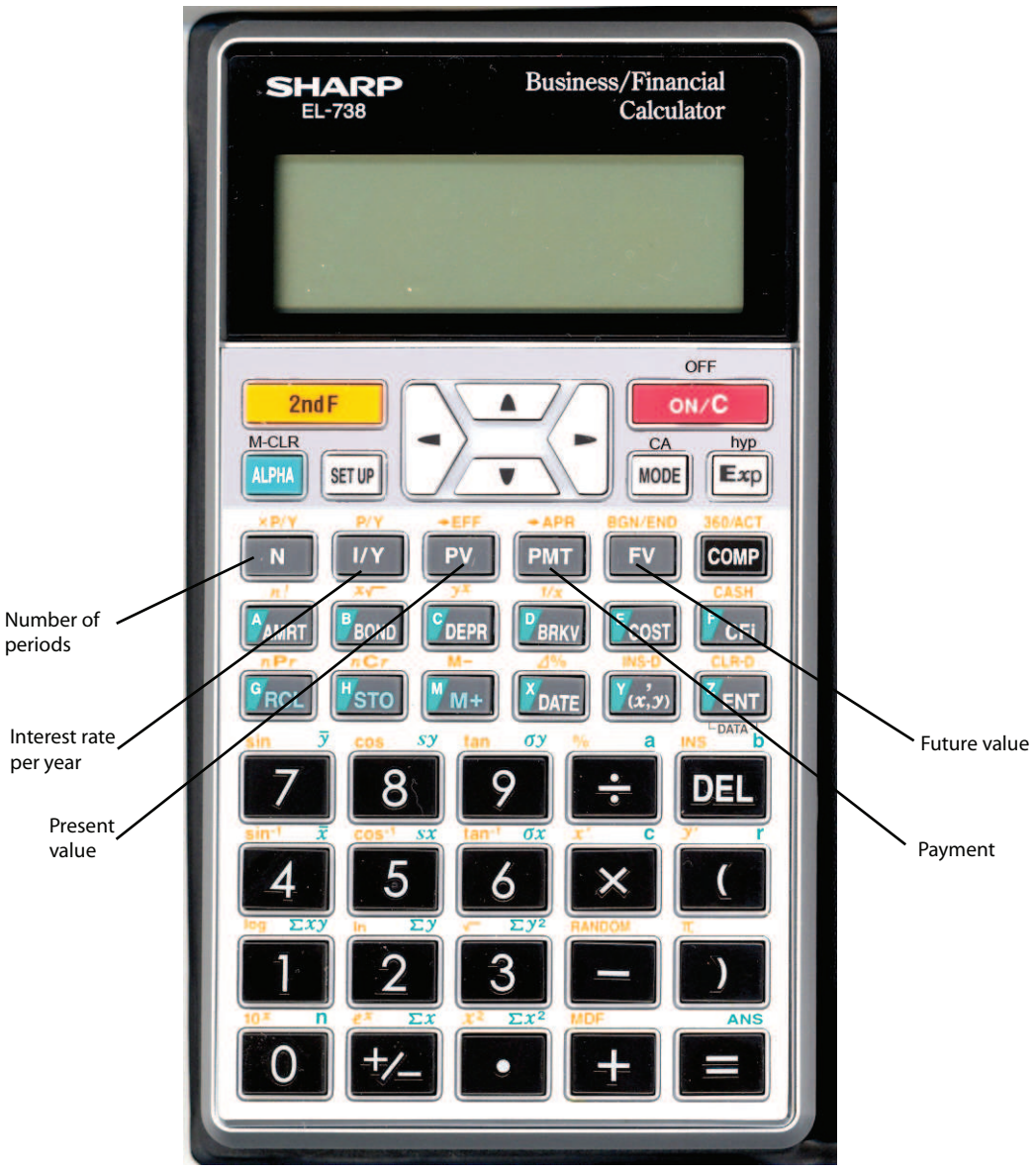
  Combination ${}_nP_r$

  Example: Determine ${}_4C_2$.

  Press 4 [2ndF] [${}_nC_r$] 2 [=]

  The answer is 6.

1.2 Financial calculator mode



(i) Normal mode

The NORMAL mode allows us to use the financial keys. The financial keys [N], [1/Y], [PV], [PMT], [FV] can only be used when the exponent in the applicable formula consists of a single number (not a product or sum of numbers).

Before using the financial keys, first clear the register by pressing [2ndF] [M-CLR] 0, 0.

(ii) Interest and discount

- **Simple interest**

$$I = Prt$$

∗ Determine the amount of interest received if R1 200 is invested for 4 years at 14% simple interest per year.

$$\begin{aligned} I &= Prt \\ &= 1\,200 \times 14\% \times 4 \\ &= 1\,200 \times 0{,}14 \times 4 \\ &= 672{,}00 \end{aligned}$$

The interest received is R672,00. We cannot use the financial keys because there is no exponent in the formula.

Key in as

1 200 [×] 0.14 [×] 4 [=]

The answer is 672,00.

$$S = P\,(1 + rt)$$

∗ Determine the accumulated amount for if R2 400 is invested for 42 months at a 9% simple interest rate per year.

$$\begin{aligned} S &= 2\,400\left(1 + 9\% \times \tfrac{42}{12}\right) \\ &= 2\,400\left(1 + 0{,}09 \times \tfrac{42}{12}\right) \\ &= 3\,156{,}00. \end{aligned}$$

The accumulated amount is R3 156,00.

Key in as

2 400 [(] 1 [+] 0.09 [×] 42 [÷] 12 [)] [=]

The answer is 3 156,00.

∗ Determine the simple interest rate if R3 600 accumulates to R5 760 in five years' time.

$$\begin{aligned} S &= P\,(1 + rt) \\ 5\,760 &= 3\,600\,(1 + r \times 5) \\ 1 + 5r &= \tfrac{5\,760}{3\,600} \\ 5r &= \tfrac{5\,760}{3\,600} - 1 \\ r &= \left(\tfrac{5\,760}{3\,600} - 1\right) \div 5 \\ &= 0{,}12 \end{aligned}$$

The simple interest rate is 12%.

Key in as

(5 760 ÷ 3 600 − 1) ÷ 5 =

The answer is 0,12, that is, 12%.

- **Simple discount**

$$P = S\,(1 - dt)$$

∗ Determine the present value of a promissory note that is worth R2 500 15 months later, and the applicable discount rate is 10,24% per year.

$$\begin{aligned} P &= S\,(1 - dt) \\ P &= 2\,500\left(1 - 0{,}1024 \times \tfrac{15}{12}\right) \\ &= 2\,180{,}00 \end{aligned}$$

The present value is R2 180,00.

Key in as

2 500 (1 − 0.1024 × 15 ÷ 12) =

The answer is 2 180,00.

∗ Determine the time under consideration (in months) if a simple interest rate of 11,76% is equivalent to a 10,25% simple discount rate.

By manipulating

$$S = P\,(1 + rt) \text{ and } P = S\,(1 - dt)$$

we get

$$r = \frac{d}{1 - dt}$$

and

$$t = \left(1 - \frac{d}{r}\right) \div d.$$

Substituting the values, we get

$$\begin{aligned} t &= \left(1 - \tfrac{0{,}1025}{0{,}1176}\right) \div 0{,}1025 \\ &= 1{,}25. \end{aligned}$$

The time under consideration is 1,25 years, or 15 months.

Key in as

(1 − 0.1025 ÷ 0.1176) ÷ 0.1025 =

The answer is 1,25 years, that is, 15 months.

- **Compound interest**

$$S = P\left(1 + \frac{j_m}{m}\right)^{tm} \text{ or } S = P\left(1 + r\right)^t$$

We use our financial keys to do the calculations because there is only one exponent in the formula:

$$S = P\left(1 + r\right)^t$$

NB: The interest rate must be entered into the calculator as a percentage and *NOT* as a decimal because the calculator has been preprogrammed to automatically divide the interest rate by a hundred. Remember that it is convention to enter either the present value or future value as a negative amount.

∗ Calculate the future value if R5 000 is invested for five years at 15% per year compounded monthly.

$$\begin{aligned} S &= P\left(1 + r\right)^t \\ &= 5\,000\left(1 + \tfrac{0{,}15}{12}\right)^{5\times 12} \\ &= 10\,535{,}91 \end{aligned}$$

The future value is R10 535,91.

Key in as

[2ndF] [CA] (to clear the register).

First enter the number of compounding periods.

[2ndF] [P/Y] (second key, third row) 12 [ENT] (sixth key, fifth row)

[ON/C]

[+/−] 5 000 [PV]

15 [I/Y]

5 [2ndF] [×P/Y] (first key, third row) [N]

To check if you have entered the correct values press [RCL] and the financial key that you want to check. If the value is incorrect, enter the new value, press the financial key and continue.

[COMP] [FV]

The answer is 10 535,91.

∗ Determine the time under consideration if R5 000 is invested at 15% per year, compounded half yearly, and the accumulated amount is R10 000.

$$\begin{aligned} S &= P\left(1 + r\right)^t \\ 10\,000 &= 5\,000\left(1 + \tfrac{0{,}15}{2}\right)^{t\times 2} \\ t &= 4{,}79 \end{aligned}$$

The time under consideration is 4,79 years.

Key in as

[2ndF] [CA]

[2ndF] [P/Y] 2 [ENT]

[ON/C]

[+/−] 10 000 [FV]

5 000 [PV]

15 [I/Y]

[COMP] [N]

N = 9.5844 appears on the screen. Because the number of compounding periods is half yearly, divide the answer by two.

Press [÷] 2 [=].

4.79 appears on the screen.

(iii) Annuities

- **Present value**

$$\begin{aligned} P &= Ra_{\overline{n}|i} \\ &= R\left[\frac{(1+i)^n-1}{i(1+i)^n}\right] \end{aligned}$$

∗ Calculate the present value of R1 600 quarterly payments for five years at an interest rate of 20% per year, compounded quarterly.

$$\begin{aligned} P &= 1\,600a_{\overline{5\times4}|0,20\div4} \\ &= 19\,939{,}54. \end{aligned}$$

The present value is R19 939,54.

Key in as

[2ndF] [CA]

[2ndF] [P/Y] 4 [ENT]

[ON/C]

[+/−] 1 600 [PMT]

5 [2ndF] [×P/Y] [N]

20 [I/Y]

[COMP] [PV]

The answer is 19 939,54.

- **Future value**

$$\begin{aligned} S &= Rs_{\overline{n}|i} \\ &= R\left[\frac{(1+i)^n-1}{i}\right]. \end{aligned}$$

  * Determine the future value of R400 monthly payments made for five years at 16% interest per year, compounded monthly.

$$\begin{aligned} S &= 400s_{\overline{5\times 12}|0,16\div 12} \\ &= 36\,414{,}21. \end{aligned}$$

  The future value is R36 414,21.

  Key in as

  2ndF **CA**

  2ndF **P/Y** 12 **ENT**

  ON/C

  +/− 400 **PMT**

  5 **2ndF** **×P/Y** **N**

  16 **I/Y**

  COMP **FV**

  The answer is 36 414,21.

- **Amortisation**

  * Draw up an amortisation schedule for a loan of R5 000 which is repaid in annual payments over five years at an interest rate of 15% per year.

$$\begin{aligned} P &= Ra_{\overline{n}|i} \\ 5\,000 &= Ra_{\overline{5}|0,15} \\ R &= 1\,491{,}58 \end{aligned}$$

  Key in as

  2ndF **CA**

  2ndF **P/Y** 1 **ENT**

  ON/C

  +/− 5 000 **PV**

  5 **2ndF** **×P/Y** **N**

  15 **I/Y**

  COMP **PMT**

  1 491.58 appears on the screen.

Press **AMRT** (fourth row, first key) 1

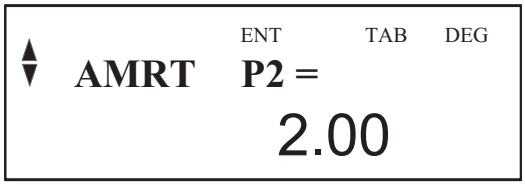
▼ (Down arrow) 1 **ENT**

Press ▼ BALANCE = −4 258.42 appears on the screen.

Press ▼ $\sum$ PRINCIPAL = 741.58 appears on the screen.

Press ▼ $\sum$ INTEREST = 750.00 appears on the screen.

Press [▼ 2 **ENT**] twice



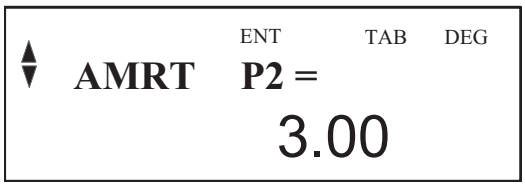
appears on the screen.

Press ▼ BALANCE = −3 405.60

Press ▼ $\sum$ PRINCIPAL = 852.82

Press ▼ $\sum$ INTEREST = 638.70

Press [▼ 3 **ENT**] twice



appears on the screen.

Press ▼ BALANCE = −2 424.86

Press ▼ $\sum$ PRINCIPAL = 980.74

Press ▼ $\sum$ INTEREST = 510.84

Press [▼ 4 **ENT**] twice

Press ▼ BALANCE = −1 297.01

Press ▼ $\sum$ PRINCIPAL = 1 127.83

Press ▼ $\sum$ INTEREST = 363.73

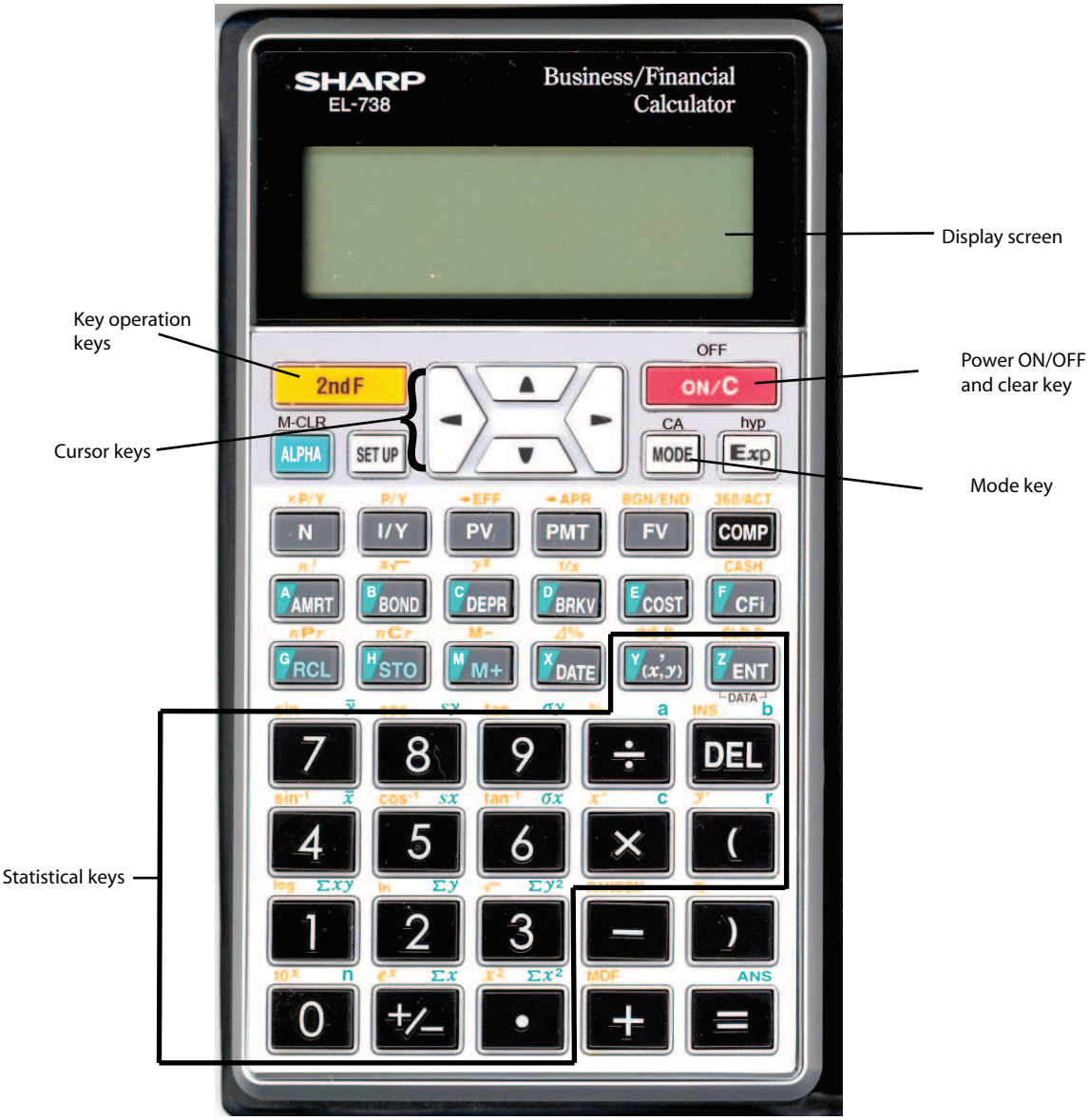
Press [▼ 5 **ENT**] twice

Press ▼ BALANCE = 0.02

Press ▼ $\sum$ PRINCIPAL = 1 297.03

Press ▼ $\sum$ INTEREST = 194.55

1.3 Statistical mode



Given a data set, the calculator's STAT function can be used to calculate certain statistical values such as the average (mean), standard deviation and the equation of a linear line.

Change to the stat mode.

Press **MODE** 1, 0

appears on the screen.

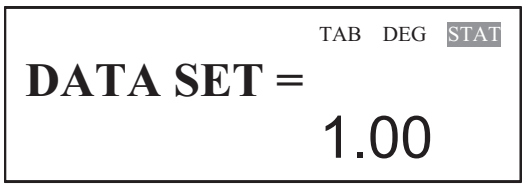
(i) Mean

* Determine the mean of the following values: 25; 30; 26; 15; 40; 35

Key the first data value in:

25 **DATA** (last key, fifth row)

The calculator displays



This means that it accepted the first data point. Keep on entering the data until the last one.

30 **DATA**

26 **DATA**

15 **DATA**

40 **DATA**

35 **DATA**

The calculator should display 6.

Calculate the mean.

Press **ON/C**

appears on the screen.

Press **RCL** (first key, fifth row) $\bar{x}$ (first key, seventh row)

appears on the screen.

The mean is 28,50.

(ii) Standard deviation

* Determine the standard deviation of the above data.

Without re-entering the data, press **ON/C** **RCL** sx (second key, seventh row).

The standard deviation is 8,69.

(iii) Formula for a straight line

Please note: The calculator takes the a-value as the y-intercept and the b-value as the slope. It therefore determines the equation of a straight line

$$y = bx + a.$$

Press **MODE** 1 1

appears on the screen.

Example: Determine the equation for the straight line passing through the points (1; 3) and (3; 7).

Key in as

1 x,y - (fifth key, fifth row) 3 **DATA**

3 x,y 7 **DATA**

RCL **a** (fourth key, sixth row)

$a = 1$ appears on the screen.

RCL **b** (fifth key, sixth row)

b = 2 appears on the screen.

The equation for the straight line is

$$y = 2x + 1.$$