- **Example 8:** To generate a random number between 0.000 and 0.999

[SHIFT] [Ran#] [=] → 0.664

(The above value is a sample only. Results differ each time.)

- **Example 9:** $3\pi = 9.424777961$

3 [SHIFT] [π] [=]

- **Example 10:** To determine how many different 4-digit values can be produced using the numbers 1 through 7
  - Numbers cannot be duplicated within the same 4-digit value (1234 is allowed, but 1123 is not). ***(840)***

7 [SHIFT] [nPr] 4 [=]

- **Example 11:** To determine how many different 4-member groups can be organized in a group of 10 individuals ***(210)***

10 [nCr] 4 [=]

■ Angle Unit Conversion

- Press [SHIFT] [DRG▸] to display the following menu.

```
D R G
1 2 3
```

- Pressing [1], [2], or [3] converts the displayed value to the corresponding angle unit.
- **Example:** To convert 4.25 radians to degrees

[MODE] ····· [1] (Deg)

4.25 [SHIFT] [DRG▸] [2] (R) [=] → 4.25r, 243.5070629

■ Coordinate Conversion (Pol (*x*, *y*), Rec (*r*, *θ*))

- Calculation results are automatically assigned to variables E and F.
- **Example 1:** To convert polar coordinates (r=2, θ=60°) to rectangular coordinates (x, y) (Deg)

$x = 1$ [SHIFT] [Rec] 2 [,] 60 [)] [=]

$y = 1.732050808$ [RCL] [F]

- Press [RCL] [E] to display the value of x, or [RCL] [F] to display the value of y.

To recall this type of value:	Perform this key operation:
Σx^2	[SHIFT] [S-SUM] [1]
Σx	[SHIFT] [S-SUM] [2]
n	[SHIFT] [S-SUM] [3]
Σy^2	[SHIFT] [S-SUM] [▶] [1]
Σy	[SHIFT] [S-SUM] [▶] [2]
Σxy	[SHIFT] [S-SUM] [▶] [3]
$\bar{x}$	[SHIFT] [S-VAR] [1]
$x\sigma_n$	[SHIFT] [S-VAR] [2]
$x\sigma_{n-1}$	[SHIFT] [S-VAR] [3]
$\bar{y}$	[SHIFT] [S-VAR] [▶] [1]
$y\sigma_n$	[SHIFT] [S-VAR] [▶] [2]
$y\sigma_{n-1}$	[SHIFT] [S-VAR] [▶] [3]
Regression coefficient A	[SHIFT] [S-VAR] [▶] [▶] [1]
Regression coefficient B	[SHIFT] [S-VAR] [▶] [▶] [2]
Regression calculation other than quadratic regression	
Correlation coefficient r	[SHIFT] [S-VAR] [▶] [▶] [3]
$\hat{x}$	[SHIFT] [S-VAR] [▶] [▶] [▶] [1]
$\hat{y}$	[SHIFT] [S-VAR] [▶] [▶] [▶] [2]

- The following table shows the key operations you should use to recall results in the case of quadratic regression.

To recall this type of value:	Perform this key operation:
Σx^3	[SHIFT] [S-SUM] [▶] [▶] [1]
Σx^2y	[SHIFT] [S-SUM] [▶] [▶] [2]
Σx^4	[SHIFT] [S-SUM] [▶] [▶] [3]
Regression coefficient C	[SHIFT] [S-VAR] [▶] [▶] [3]
$\hat{x}_1$	[SHIFT] [S-VAR] [▶] [▶] [▶] [1]
$\hat{x}_2$	[SHIFT] [S-VAR] [▶] [▶] [▶] [2]
$\hat{y}$	[SHIFT] [S-VAR] [▶] [▶] [▶] [3]

- The values in the above tables can be used inside of expressions the same way you use variables.

● Linear Regression

- The regression formula for linear regression is: $y = A + Bx$.

- **Example 2:** To convert rectangular coordinates ($1, \sqrt{3}$) to polar coordinates (r,θ) (Rad)

$r = 2$ [Pol] 1 [,] [√] 3 [)] [=]

$\theta = 1.047197551$ [RCL] [F]

- Press [RCL] [E] to display the value of r, or [RCL] [F] to display the value of θ.

■ Engineering Notation Calculations

- **Example 1:** To convert 56,088 meters to kilometers

→ 56.088×10^3 (km) 56088 [=] [ENG]

- **Example 2:** To convert 0.08125 grams to milligrams

→ 81.25×10^{-3} (mg) 0.08125 [=] [ENG]

Statistical Calculations SD REG

Standard Deviation SD

Use the [MODE] key to enter the SD Mode when you want to perform statistical calculations using standard deviation.

SD ..... [MODE] [2]

- In the SD Mode and REG Mode, the [M+] key operates as the [DT] key.
- Always start data input with [SHIFT] [CLR] [1] (Scl) [=] to clear statistical memory.
- Input data using the key sequence shown below.
  <x-data> [DT]
- Input data is used to calculate values for n, Σx, Σx^2, $\bar{x}$, σ_n and σ_{n-1}, which you can recall using the key operations noted nearby.

To recall this type of value:	Perform this key operation:
Σx^2	[SHIFT] [S-SUM] [1]
Σx	[SHIFT] [S-SUM] [2]
n	[SHIFT] [S-SUM] [3]
$\bar{x}$	[SHIFT] [S-VAR] [1]
σ_n	[SHIFT] [S-VAR] [2]
σ_{n-1}	[SHIFT] [S-VAR] [3]

- **Example:** To calculate σ_{n-1}, σ_n, $\bar{x}$, n, Σx, and Σx^2 for the following data : 55, 54, 51, 55, 53, 53, 54, 52

In the SD Mode:

[SHIFT] [CLR] [1] (Scl) [=] (Stat clear)

55 [DT] → n= SD 1.

Each time you press [DT] to register your input, the number of data input up to that point is indicated on the display (n value).

54 [DT] 51 [DT] 55 [DT]
53 [DT] [DT] 54 [DT] 52 [DT]

Sample Standard Deviation (σ_{n-1}) = ***1.407885953*** [SHIFT] [S-VAR] [3] [=]

Population Standard Deviation (σ_n) = ***1.316956719*** [SHIFT] [S-VAR] [2] [=]

Arithmetic Mean ($\bar{x}$) = ***53.375*** [SHIFT] [S-VAR] [1] [=]

Number of Data (n) = ***8*** [SHIFT] [S-SUM] [3] [=]

Sum of Values (Σx) = ***427*** [SHIFT] [S-SUM] [2] [=]

Sum of Squares of Values (Σx^2) = ***22805*** [SHIFT] [S-SUM] [1] [=]

Data Input Precautions

- [DT] [DT] inputs the same data twice.
- You can also input multiple entries of the same data using [SHIFT] [;]. To input the data 110 ten times, for example, press 110 [SHIFT] [;] 10 [DT].
- You can perform the above key operations in any order, and not necessarily that shown above.
- While inputting data or after inputting data is complete, you can use the [▲] and [▼] keys to scroll through data you have input. If you input multiple entries of the same data using [SHIFT] [;] to specify the data frequency (number of data items) as described above, scrolling through data shows both the data item and a separate screen for the data frequency (Freq).

- You can then edit the displayed data, if you want. Input the new value and then press the [=] key to replace the old value with the new one. This also means that if you want to perform some other operation (calculation, recall of statistical calculation results, etc.), you should always press the [AC] key first to exit data display.
- Pressing the [DT] key instead of [=] after changing a value on the display registers the value you input as a new data item, and leaves the old value as it is.
- You can delete a data value displayed using [▲] and [▼] by pressing [SHIFT] [CL]. Deleting a data value causes all values following it to be shifted up.
- Data values you register are normally stored in calculator memory. The message "Data Full" appears and you will not be able to input any more data if there is no memory left for data storage. If this happens, press the [=] key to display the screen shown below.

```
EditOFF ESC
1       2
```

Press [2] to exit data input without registering the value you just input.
Press [1] if you want to register the value you just input, without saving it in memory. If you do this, however, you will not be able to display or edit any of the data you have input.

- To delete data you have just input, press [SHIFT] [CL].
- After inputting statistical data in the SD Mode or REG Mode, you will be unable to display or edit individual data items any longer after perform either the following operations.
  Changing to another mode
  Changing the regression type (Lin, Log, Exp, Pwr, Inv, Quad)

Regression Calculations REG

Use the [MODE] key to enter the REG Mode when you want to perform statistical calculations using regression.

REG ..... [MODE] [3]

- In the SD Mode and REG Mode, the [M+] key operates as the [DT] key.
- Entering the REG Mode displays screens like the ones shown below.

```
Lin Log Exp ▸
1   2   3
```

[▶] [▼] [▲] [◀]

```
◂Pwr Inv Quad
1   2   3
```

- Press the number key ([1], [2], or [3]) that corresponds to the type of regression you want to use.
  - [1] (Lin): Linear regression
  - [2] (Log): Logarithmic regression
  - [3] (Exp): Exponential regression
  - [▶] [1] (Pwr): Power regression
  - [▶] [2] (Inv): Inverse regression
  - [▶] [3] (Quad): Quadratic regression
- Always start data input with [SHIFT] [CLR] [1] (Scl) [=] to clear statistical memory.
- Input data using the key sequence shown below.
  <x-data> [,] <y-data> [DT]
- The values produced by a regression calculation depend on the values input, and results can be recalled using the key operations shown in the table below.

- **Example:** Atmospheric Pressure vs. Temperature

Temperature	Atmospheric Pressure
10°C	1003 hPa
15°C	1005 hPa
20°C	1010 hPa
25°C	1011 hPa
30°C	1014 hPa

Perform linear regression to determine the regression formula terms and correlation coefficient for the data nearby. Next, use the regression formula to estimate atmospheric pressure at –5°C and temperature at 1000 hPa. Finally, calculate the coefficient of determination (r^2) and sample covariance $\left(\frac{\Sigma xy - n \cdot \bar{x} \cdot \bar{y}}{n-1}\right)$.

In the REG Mode:

[1] (Lin)

[SHIFT] [CLR] [1] (Scl) [=] (Stat clear)

10 [,] 1003 [DT] → n= REG 1.

Each time you press [DT] to register your input, the number of data input up to that point is indicated on the display (n value).

15 [,] 1005 [DT]
20 [,] 1010 [DT] 25 [,] 1011 [DT]
30 [,] 1014 [DT]

Regression Coefficient A = ***997.4*** [SHIFT] [S-VAR] [▶] [▶] [1] [=]

Regression Coefficient B = ***0.56*** [SHIFT] [S-VAR] [▶] [▶] [2] [=]

Correlation Coefficient r = ***0.982607368*** [SHIFT] [S-VAR] [▶] [▶] [3] [=]

Atmospheric Pressure at –5°C = ***994.6***
[(] [(–)] 5 [)] [SHIFT] [S-VAR] [▶] [▶] [▶] [2] [=]

Temperature at 1000 hPa = ***4.642857143***
1000 [SHIFT] [S-VAR] [▶] [▶] [▶] [1] [=]

Coefficient of Determination = ***0.965517241***
[SHIFT] [S-VAR] [▶] [▶] [3] [x^2] [=]

Sample Covariance = ***35***
[(] [SHIFT] [S-SUM] [▶] [3] [–]
[SHIFT] [S-SUM] 3 [×] [SHIFT] [S-VAR] 1 [×]
[SHIFT] [S-VAR] [▶] [1] [)] [÷]
[(] [SHIFT] [S-SUM] 3 [–] 1 [)] [=]

● Logarithmic, Exponential, Power, and Inverse Regression

- Use the same key operations as linear regression to recall results for these types of regression.
- The following shows the regression formulas for each type of regression.

Logarithmic Regression	$y = A + B \cdot \ln x$
Exponential Regression	$y = A \cdot e^{B \cdot x}$ ($\ln y = \ln A + Bx$)
Power Regression	$y = A \cdot x^B$ ($\ln y = \ln A + B \ln x$)
Inverse Regression	$y = A + B \cdot 1/x$

● Quadratic Regression

- The regression formula for quadratic regression is: $y = A + Bx + Cx^2$.

- **Example:**

x_i	y_i
29	1.6
50	23.5
74	38.0
103	46.4
118	48.0

Perform quadratic regression to determine the regression formula terms for the data nearby. Next, use the regression formula to estimate the values for $\hat{y}$ (estimated value of y) for x_i = 16 and $\hat{x}$ (estimated value of x) for y_i = 20.

In the REG Mode:

[▶] [3] (Quad)

[SHIFT] [CLR] [1] (Scl) [=] (Stat clear)

29 [,] 1.6 [DT] 50 [,] 23.5 [DT]
74 [,] 38.0 [DT] 103 [,] 46.4 [DT]
118 [,] 48.0 [DT]

Regression Coefficient A = ***–35.59856934*** [SHIFT] [S-VAR] [▶] [▶] [1] [=]

Regression Coefficient B = ***1.495939413*** [SHIFT] [S-VAR] [▶] [▶] [2] [=]

Regression Coefficient C = ***–6.71629667 × 10⁻³*** [SHIFT] [S-VAR] [▶] [▶] [3] [=]

$\hat{y}$ when x_i is 16 = ***–13.38291067*** 16 [SHIFT] [S-VAR] [▶] [▶] [▶] [3] [=]

$\hat{x}_1$ when y_i is 20 = ***47.14556728*** 20 [SHIFT] [S-VAR] [▶] [▶] [▶] [1] [=]

$\hat{x}_2$ when y_i is 20 = ***175.5872105*** 20 [SHIFT] [S-VAR] [▶] [▶] [▶] [2] [=]

Data Input Precautions

- [DT] [DT] inputs the same data twice.
- You can also input multiple entries of the same data using [SHIFT] [;]. To input the data "20 and 30" five times, for example, press 20 [,] 30 [SHIFT] [;] 5 [DT].
- The above results can be obtained in any order, and not necessarily that shown above.
- Precautions when editing data input for standard deviation also apply for regression calculations.
- Do not use variables A through F, X, or Y to store data when performing statistical calculations. These variables are used for statistical calculation temporary memory, so any data you may have assigned to them may be replaced by other values during statistical calculations.
- Entering the REG Mode and selecting a regression type (Lin, Log, Exp, Pwr, Inv, Quad) clear variables A through F, X, and Y. Changing from one regression type to another inside the REG Mode also clears these variables.

Technical Information

■ When you have a problem.....

If calculation results are not what you expect or if an error occurs, perform the following steps.

1. Press [SHIFT] [CLR] [2] (Mode) [=] to initialize all modes and settings.
2. Check the formula you are working with to confirm it is correct.
3. Enter the correct mode and try performing the calculation again.

If the above steps do not correct the problem, press the [ON] key. The calculator performs a self-check operation and deletes all data stored in memory if any abnormality is detected. Make sure you always keep written copies of all important data.

■ Error Messages

The calculator is locked up while an error message is on the display. Press [AC] to clear the error, or press [◀] or [▶] to display the calculation and correct the problem. See "Error Locator" for details.

Math ERROR

- **Causes**
  - Calculation result is outside the allowable calculation range.
  - An attempt to perform a function calculation using a value that exceeds the allowable input range.
  - An attempt to perform an illogical operation (division by zero, etc.)
- **Action**
  - Check your input values and make sure they are all within the allowable ranges. Pay special attention to values in any memory areas you are using.

Stack ERROR

- **Cause**
  - The capacity of the numeric stack or operator stack is exceeded.
- **Action**
  - Simplify the calculation. The numeric stack has 10 levels and the operator stack has 24 levels.
  - Divide your calculation into two or more separate parts.

Syntax ERROR

- **Cause**
  - An attempt to perform an illegal mathematical operation.
- **Action**
  - Press [◀] or [▶] to display the calculation with the cursor located at the location of the error and make required corrections.

Arg ERROR

- **Cause**
  - Improper use of an argument
- **Action**
  - Press [◀] or [▶] to display the location of the cause of the error and make required corrections.