

## Calculations Using Engineering Prefixes 17

Calculation can be executed in NORMAL mode (excluding N-base) using the following 9 types of prefixes.

Prefix	Operation	Unit
k (kilo)	$\text{MATH} \text{ (3) (0)}$	$10^3$
M (Mega)	$\text{MATH} \text{ (3) (1)}$	$10^6$
G (Giga)	$\text{MATH} \text{ (3) (2)}$	$10^9$
T (Tera)	$\text{MATH} \text{ (3) (3)}$	$10^{12}$
m (milli)	$\text{MATH} \text{ (3) (4)}$	$10^{-3}$
$\mu$ (micro)	$\text{MATH} \text{ (3) (5)}$	$10^{-6}$
n (nano)	$\text{MATH} \text{ (3) (6)}$	$10^{-9}$
p (pico)	$\text{MATH} \text{ (3) (7)}$	$10^{-12}$
f (femto)	$\text{MATH} \text{ (3) (8)}$	$10^{-15}$

## Modify Function 18

Decimal calculation results are internally obtained in scientific notation, with up to 14 digits in the mantissa. However, since calculation results are displayed in the form designated by the display notation and the number of decimal places indicated, the internal calculation result may differ from that shown in the display. By using the modify function ( $\text{2ndF}$   $\text{(MDF)}$ ), the internal value is converted to match that of the display, so that the displayed value can be used without change in subsequent operations.

- When using the WriteView editor, if the calculation result is displayed using fractions or irrational numbers, press  $\text{CHANGE}$  to convert it to decimal form first.
- The modify function can be used in NORMAL, STAT, MATRIX, or LIST modes.

## Simulation Calculation (ALGB) 19

If you have to find values consecutively using the same expression, such as plotting a curve line for  $2x^2 + 1$ , or finding the variable values for  $2x + 2y = 14$ , once you enter the expression, all you have to do is to specify the value for the variable in the equation.

Usable variables: A–F, M, X and Y

- Simulation calculations can only be executed in NORMAL mode.
- Calculation ending instructions other than  $\text{=}$  cannot be used.

## Performing calculations

- Press  $\text{MODE}$   $\text{(0)}$ .
- Input an expression with at least one variable.
- Press  $\text{MATH}$   $\text{(1)}$ .
- The variable entry screen will appear. Enter a value, then press  $\text{ENTER}$  to confirm. The calculation result will be displayed after you have entered a value for each variable used in the equation.
  - After completing the calculation, press  $\text{MATH}$   $\text{(1)}$  to perform calculations using the same equation.
  - Variables and numerical values stored in the memories will be displayed in the variable entry screen. If you do not want to change any values, simply press  $\text{ENTER}$ .
  - Performing simulation calculation will cause values in memory to be overwritten with new values.

## Solver Function 20

The solver function finds the value for  $x$  that reduces the entered expression to zero.

- This function uses Newton's method to obtain an approximation. Depending on the function (e.g. periodic) or start value, an error may occur (ERROR 02) due to there being no convergence to the solution for the equation.
- The value obtained by this function may include a margin of error. If it is larger than acceptable, recalculate the solution after changing the "Start" and  $dx$  values.
- Change the "Start" value (e.g. to a negative value) or  $dx$  value (e.g. to a smaller value) if:
  - no solution can be found (ERROR 02).
  - more than two solutions appear to be possible (e.g. a cubic equation).
  - to improve arithmetic precision.
- The calculation result is automatically stored in the X memory.
- Press  $\text{ON/C}$  to exit the solver function.

## Performing solver function

- Press  $\text{MODE}$   $\text{(0)}$ .
- Input an expression with an  $x$  variable.
- Press  $\text{MATH}$   $\text{(2)}$ .
- Enter a "Start" value and press  $\text{ENTER}$ . The default value is "0".
- Enter a  $dx$  value (minute interval).
- Press  $\text{ENTER}$ .

## STATISTICAL CALCULATIONS

Statistical calculations can be performed in STAT mode.

There are eight sub-modes within STAT mode. Press  $\text{MODE}$   $\text{(1)}$ , then press the number key that corresponds to your choice:

- $\text{(0)}$  (Stat 0 [SD]): Single-variable statistics
- $\text{(1)}$  (Stat 1 [LINE]): Linear regression
- $\text{(2)}$  (Stat 2 [QUAD]): Quadratic regression
- $\text{(3)}$  (Stat 3 [E EXP]): Euler exponential regression
- $\text{(4)}$  (Stat 4 [LOG]): Logarithmic regression
- $\text{(5)}$  (Stat 5 [POWER]): Power regression
- $\text{(6)}$  (Stat 6 [INV]): Inverse regression
- $\text{(7)}$  (Stat 7 [G EXP]): General exponential regression

## Statistical Calculations and Variables 21

The following statistics can be obtained for each statistical calculation (refer to the table below):

### Single-variable statistical calculation

Statistics of  $\text{(1)}$  and the value of the normal probability function.

### Linear regression calculation

Statistics of  $\text{(1)}$  and  $\text{(2)}$ . In addition, the estimate of  $y$  for a given  $x$  (estimate  $y'$ ) and the estimate of  $x$  for a given  $y$  (estimate  $x'$ ).

### Quadratic regression calculation

Statistics of  $\text{(1)}$  and  $\text{(2)}$ , and coefficients  $a$ ,  $b$ ,  $c$  in the quadratic regression formula ( $y = a + bx + cx^2$ ). (For quadratic regression calculations, no correlation coefficient ( $r$ ) can be obtained.) When there are two  $x'$  values, each value will be displayed with "1:" or "2:", and stored separately in the X and Y memories.

### Euler exponential regression, logarithmic regression, power regression, inverse regression, and general exponential regression calculations

Statistics of  $\text{(1)}$  and  $\text{(2)}$ . In addition, the estimate of  $y$  for a given  $x$  and the estimate of  $x$  for a given  $y$ . (Since the calculator converts each formula into a linear regression formula before actual calculation takes place, it obtains all statistics, except coefficients  $a$  and  $b$ , from converted data rather than entered data.)

$\text{(1)}$	$\bar{x}$	Mean of samples ( $x$ data)
	$sx$	Sample standard deviation ( $x$ data)
	$\sigma x$	Population standard deviation ( $x$ data)
	$n$	Number of samples
	$\Sigma x$	Sum of samples ( $x$ data)
$\text{(2)}$	$\Sigma x^2$	Sum of squares of samples ( $x$ data)
	$\bar{y}$	Mean of samples ( $y$ data)
	$sy$	Sample standard deviation ( $y$ data)
	$\sigma y$	Population standard deviation ( $y$ data)
	$\Sigma y$	Sum of samples ( $y$ data)
	$\Sigma y^2$	Sum of squares of samples ( $y$ data)
	$\Sigma xy$	Sum of products of samples ( $x$ , $y$ )
	$r$	Correlation coefficient
	$a$	Coefficient of regression equation
	$b$	Coefficient of regression equation
$c$	Coefficient of quadratic regression equation	

- Use  $\text{(ALPHA)}$  and  $\text{(RCL)}$  to perform a variable calculation in STAT mode.
- $\text{(CHANGE)}$  does not function in STAT mode.

## Data Entry and Correction 22

Before entering new data, clear the memory contents ( $\text{2ndF}$   $\text{(CA)}$ ).

### Data entry

Single-variable data

Data  $\text{(DATA)}$

Data  $\text{(C5Y)}$  frequency  $\text{(DATA)}$  (To enter multiples of the same data)

Two-variable data

Data  $x$   $\text{(C5Y)}$  data  $y$   $\text{(DATA)}$

Data  $x$   $\text{(C5Y)}$  data  $y$   $\text{(C5Y)}$  frequency  $\text{(DATA)}$  (To enter multiples of the same data  $x$  and  $y$ )

Note: Up to 100 data items can be entered. With the single-variable data, a data item without frequency assignment is counted as one data item, while an item assigned with frequency is stored as a set of two data items. With the two-variable data, a set of data items without frequency assignment is counted as two data items, while a set of items assigned with frequency is stored as a set of three data items.

## Data correction

Correction before pressing  $\text{(DATA)}$  immediately after a data entry:

Delete incorrect data with  $\text{ON/C}$ , then enter the correct data.

Correction after pressing  $\text{(DATA)}$ :

Use  $\text{(▲)}$  and  $\text{(▼)}$  to display the previously entered data set.

Press  $\text{(▼)}$  to display the data set in ascending (oldest first) order. To reverse the display order to descending (latest first), press the  $\text{(▲)}$  key. Press  $\text{2ndF}$   $\text{(▲)}$  or  $\text{2ndF}$   $\text{(▼)}$  to jump the cursor to the beginning or end of the data set.

Each data set is displayed with "X:", "Y:", or "F:".

DATA SET=4	75.	Data set number
X:	3.	Data x
F:		Frequency
DATA SET=4	21.	Data set number
X:	40.	Data x
Y:	3.	Data y
F:		Frequency

Display and move the cursor to the data item to be modified by using  $\text{(▲)}$  and  $\text{(▼)}$ , enter the correct value, then press  $\text{(DATA)}$  or  $\text{(ENTER)}$ .

- To delete a data set, display and move the cursor to an item of the data set to delete by using  $\text{(▲)}$  and  $\text{(▼)}$ , then press  $\text{2ndF}$   $\text{(CD)}$ . The data set will be deleted.
- To add a new data set, press  $\text{ON/C}$  to exit the display of previously entered data and input the values, then press  $\text{(DATA)}$ .

## Statistical Calculation Formulas 23

Type	Regression formula
Linear	$y = a + bx$
Quadratic	$y = a + bx + cx^2$
Euler exponential	$y = a \cdot e^{bx}$
Logarithmic	$y = a + b \cdot \ln x$
Power	$y = a \cdot x^b$
Inverse	$y = a + b \cdot \frac{1}{x}$
General exponential	$y = a \cdot b^x$

An error will occur when:

- The absolute value of the intermediate result or calculation result is equal to or greater than  $1 \times 10^{100}$ .
- The denominator is zero.
- An attempt is made to take the square root of a negative number.
- No solution exists in the quadratic regression calculation.

## Normal Probability Calculations 24

In STAT mode, the three probability density functions can be accessed under the MATH menu, with a random number used as a normal distribution variable.

Notes:

- $P(t)$ ,  $Q(t)$ , and  $R(t)$  will always take positive values, even when  $t < 0$ , because these functions follow the same principle used when solving for an area.
- Values for  $P(t)$ ,  $Q(t)$ , and  $R(t)$  are given to six decimal places.
- The standardization conversion formula is as follows:

$$t = \frac{x - \bar{x}}{\sigma x}$$

## DRILL MODE

Math Drill:  $\text{MODE}$   $\text{(2)}$   $\text{(0)}$

Math operation questions with positive integers and 0 are displayed randomly. It is possible to select the number of questions and operator type.

Multiplication Table (X Table):  $\text{MODE}$   $\text{(2)}$   $\text{(1)}$

Questions from each row of the multiplication table (1 to 12) are displayed serially or randomly.

To exit DRILL mode, press  $\text{MODE}$  and select another mode.

## Using Math Drill and X Table

- Press  $\text{MODE}$   $\text{(2)}$   $\text{(0)}$  for Math Drill or  $\text{MODE}$   $\text{(2)}$   $\text{(1)}$  for X Table.
- Math Drill:** Use  $\text{(▲)}$  and  $\text{(▼)}$  to select the number of questions (25, 50, or 100).  
**X Table:** Use  $\text{(▲)}$  and  $\text{(▼)}$  to select a row in the multiplication table (1 to 12).
- Math Drill:** Use  $\text{(◀)}$  and  $\text{(▶)}$  to select the operator type for questions (+, -,  $\times$ ,  $\div$ , or  $+ - \times \div$ ).  
**X Table:** Use  $\text{(◀)}$  and  $\text{(▶)}$  to select the order type ("Serial" or "Random").
- Press  $\text{ENTER}$  to start.  
When using Math Drill or X Table (random order only), questions are randomly selected and will not repeat except by chance.