TI Programmable 58/59

Math/ Utilities

Quick Reference Guide

CONTENTS

CALCULATING NOTES

Low Battery Indication

If the display flashes erratically, fades out, gives incorrect results or is inconsistent in any way, recharge the battery. Calculator operation can be resumed after several minutes of recharging.

Algebraic Hierarchy

Operations and functions are performed automatically in following order.

1. Math Functions (x^2, cos, etc.)
2. Exponentiation (y^x) and Roots ($\sqrt[x]{y}$)
3. Multiplication, Division
4. Addition, Subtraction
5. Equals

Order applies to each set of parentheses. You can use up to 8 pending operations and 9 open parentheses, except where noted.

Flashing Display

A display flashing off and on indicates that an invalid key sequence has taken place or that the limits of the display have been exceeded. See Appendix B in *Personal Programming* for possible causes.

CONVERSIONS

Angle Formats

2nd D.MS — **DEGREES, MINUTES, SECONDS TO DECIMAL DEGREES** — Converts an angle measured in degrees, minutes and seconds to its decimal degrees equivalent. INV 2nd D.MS reverses this conversion. Also used for time conversions. **Operates on display value only.** Submit 2 digits each for minutes and seconds. Entry and display format is DD.MMSSsss where DD is degrees, MM is minutes, SS is whole seconds and sss is fractional seconds.

Polar to Rectangular

R x⇄t Θ 2nd P→R → **y**; x⇄t → **x**

Rectangular to Polar

x x⇄t **y** INV 2nd P→R → Θ; x⇄t **R**

Only 4 pending operations are available for other uses when using D.MS or Polar/Rectangular conversions.

Angular Conversions

FROM \ TO	Degrees	Radians	Grads
Degrees		$\times \frac{\pi}{180}$	÷ 0.9
Radians	$\times \frac{180}{\pi}$		$\times \frac{200}{\pi}$
Grads	× 0.9	$\times \frac{\pi}{200}$	

STATISTICS

Initialize: 2nd Pgm 1 SBR CLR

Data Entry: x_i x:t y_i 2nd Σ+

Data Entry Removal: x_i x:t y_i INV 2nd Σ+

Trendline Data Entry: x_1 x:t, y_1 2nd Σ+, y_2 2nd Σ+, etc.

Trendline Point Removal: x:t − 1 = x:t y_i INV 2nd Σ+

Calculations	Key Sequence
Mean of y-array	2nd $\bar{x}$
then x-array	x:t
Standard Deviation	
(N − 1 Weighting) of y-array	INV 2nd $\bar{x}$
then x-array	x:t
(N Weighting) of y-array	INV 2nd Op 11 $\sqrt{x}$
then x-array	x:t $\sqrt{x}$
Variance	
(N Weighting) of y-array	2nd Op 11
then x-array	x:t
(N − 1 Weighting) of y-array	2nd $\bar{x}$ x^2
then x-array	x:t x^2
Y-Intercept	2nd Op 12
Slope after y-intercept	x:t
Correlation Coefficient	2nd Op 13
y′ for new x	2nd Op 14
x′ for new y	2nd Op 15

SPECIAL CONTROL OPERATIONS

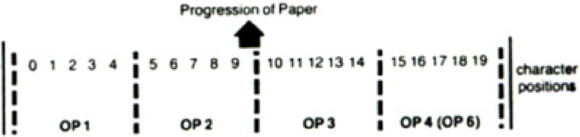
Each special control operation is called by pressing 2nd Op nn where **nn** is the 2-digit code assigned to each operation (short form addressing can be used here). These operations use up to 4 pending operations and 1 subroutine level.

Code	
nn	**Function**
00*	Initialize print register.
01*	Alphanumerics for far left quarter of print column.
02*	Alphanumerics for inside left quarter of print column.
03*	Alphanumerics for inside right quarter of print column.
04*	Alphanumerics for far right quarter of print column.
05*	Print the contents of the print register.
06*	Print last 4 characters of OP 04 with current display.
07*	Plot ⋇ in column 0-19 as specified by the display.
08*	List the labels currently used in program memory.
09	Bring specified library program into program memory.
10	Apply signum function to display register value.
11	Calculate variances.
12	Calculate slope and intercept.
13	Calculate correlation coefficient.
14	Calculate new y prime (y') for an x in the display.
15	Calculate new x prime (x') for a y in the display.
16	Display current partition of memory storage area.
17	Repartition memory storage area.
18	If no error condition exists in a program, set flag 7.
19	If an error condition exists in a program, set flag 7.
20-29	Increment a data register 0-9 by 1.
30-39	Decrement a data register 0-9 by 1.

*Designed specifically for use with optional PC-100A Print Cradle

ALPHANUMERIC PRINT CODES

The first seven control operations allow you to create and print out alphanumeric messages. Twenty characters can be printed on each line. They are assembled and stored in groups of 5 characters at a time as shown below.



Each printed character is represented by a two-digit, row-column address code according to the following table:

	0	1	2	3	4	5	6	7
0		0	1	2	3	4	5	6
1	7	8	9	A	B	C	D	E
2	-	F	G	H	I	J	K	L
3	M	N	O	P	Q	R	S	T
4	.	U	V	W	X	Y	Z	+
5	×	*	√	π	e	(	)	,
6	↑	%	⁝	/	=	'	x	x̄
7	²	?	÷	!	Ⅱ	Δ	Π	Σ

For instance, A is code 13 and + is code 47

PROGRAMMING NOTES

Labels

Any key on the keyboard can be used as a label except 2nd, LRN, Ins, Del, SST, BST, Ind and the numbers 0-9.

DSZ

This instruction can be used with registers 0-9. Entry sequence is 2nd Dsz **X, N** or **nnn** where X is the data register used followed by the transfer address (label N or absolute address nnn).

Flags

Ten flags are available (0-9). Entry sequence for setting, resetting or testing flags is the flag instruction, flag number, then transfer address (testing only).

MEMORY PARTITIONING

Memory area is partitioned in sets of 10 registers where each register can hold a data value or 8 program instructions. To check placement of current partition, press 2nd Op **16.** To repartition, enter number of sets (N) of 10 data registers needed and press 2nd Op **17.**

	Program/Data	
N	**TI-58**	**TI-59**
N < 0 = N		
0	479/00	959/00
1	399/09	879/09
2	319/19	799/19
3	**239/29***	719/29
4	159/39	639/39
5	079/49	559/49
6	000/59	**479/59***
7	Flashing	399/69
8	Flashing	319/79
9	Flashing	239/89
10	Flashing	159/99
N > 10	Flashing	159/99

*Partition when calculator is turned on.

PROGRAM KEY CODES

Key		Key		Key	
Code	Key	Code	Key	Code	Key
00	0	39	cos	72*	STO Ind
↓	↓	40	Ind	73*	RCL Ind
09	9	42	STO	74*	SUM Ind
10	E'	43	RCL	75	–
11	A	44	SUM	76	Lbl
12	B	45	y^x	77	x≥t
13	C	47	CMs	78	Σ+
14	D	48	Exc	79	$\bar{x}$
15	E	49	Prd	80	Grad
16	A'	50	|x|	81	RST
17	B'	52	EE	83*	GTO Ind
18	C'	53	(	84*	Op Ind
19	D'	54	)	85	+
20	CLR	55	÷	86	St flg
22	INV	57	Eng	87	If flg
23	lnx	58	Fix	88	D.MS
24	CE	59	Int	89	π
25	CLR	60	Deg	90	List
27	INV	61	GTO	91	R/S
28	log	62*	Pgm Ind	92*	INV SBR
29	CP	63*	Exc Ind	93	.
30	tan	64*	Prd Ind	94	+/–
32	x⇄t	65	×	95	=
33	x^2	66	Pause	96	Write
34	$\sqrt{x}$	67	x=t	97	Dsz
35	1/x	68	Nop	98	Adv
36	Pgm	69	Op	99	Prt
37	P→R	70	Rad		
38	sin	71	SBR		

*Merged codes

RECORDING MAGNETIC CARDS
(TI-59 Only)

Display When Write Pressed, Card Entered	Calculator Response
1, 2, 3, 4	Writes a card side with this number from the bank of this number (program and/or data) and records current partition on card.
−1, −2, −3, −4	Writes and protects card side with this number from the bank with this number. Also records current partition on card.
Any other number	Card is passed but not recorded. Rightmost two integer digits of display are flashed.

If the display is flashing any value when trying to read or record a card, the card is passed but not read or recorded and the rightmost two integers in the display are flashed.

The calculator should be in standard display format when reading or recording cards.

Only the integer portion of the display is recognized, i.e., 1.234 = 1.

READING MAGNETIC CARDS
(TI-59 Only)

Display When Card Entered	Calculator Response
0	Reads information into bank number listed on card if current partition matches that on card. If partition incorrect, card is passed, but not read — display flashes card side passed.
1, 2, 3, 4	Expects card with this side number to be read — displays that side number. If another side is entered or if partition is incorrect, card is passed but not read — display flashes card side passed.
−1, −2, −3, −4	Forces side to be read into this bank number regardless of the partition or the number on the card. A protected program cannot be forced into any bank or alternate partition.
Any other number	Card is passed but not read — rightmost two integers in display flash.

LIBRARY USER INSTRUCTIONS

The remainder of this booklet contains the User Instructions for each program of the library.

REMOVING AND INSTALLING MODULES. The library module can easily be removed or replaced with another. It is a good idea to leave the module in place in the calculator except when replacing it with another module. Be sure to follow these instructions when you need to remove or replace a module.

CAUTION

Be sure to touch some metal object before handling a module to prevent possible damage by static electricity.

1. Turn the calculator OFF. Loading or unloading the module with the calculator ON may cause the keyboard or display to lock out. Also, shorting the contacts can damage the module or calculator.
2. Slide out the small panel covering the module compartment at the bottom of the back of the calculator.
3. Remove the module. You may turn the calculator over and let the module fall out into your hand.
4. Insert the module, notched end first with the labeled side up into the compartment. The module should slip into place effortlessly.
5. Replace the cover panel, securing the module against the contacts.

MODULE CHECK

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
	Library Module Check			
A1	Select Program		[2nd] [Pgm] 01	
A2	Run Module Check		[SBR] [2nd] [R/S]	10.[1]
	Initialize Linear Regression			
B1	Select Program		[2nd] [Pgm] 01	
B2	Initialize Linear Regression		[SBR] [CLR]	0.

NOTES: 1. The number 10. indicates the Math/Utilities Library.

PROMPTER

MU-02

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program		[2nd] [Pgm] 02	0.
2	Prompt reading of magnetic cards. Print "ENTER CARD N".[1]		[A]	Bank No.
3	Prompt recording of selected bank. Print "ENTER CARD N".[2]	Bank No.	[2nd] [A′]	Bank No.
4	Print "READY".		[B]	0.
5	Print "REPEAT".		[2nd] [B′]	0.
6	Print "RESULT".		[C]	0.
7	Print "OPTION".		[2nd] [C′]	0.
8	Print "BAD COMMAND".		[D]	0.
9	Print "BAD DATA".		[2nd] [D′]	0.
10	Print "UNDERFLOW".		[E]	0.
11	Print "OVERFLOW".		[2nd] [E′]	0.

NOTES:

1. Be sure **[2nd] [Lbl] [=] N [INV] [SBR]** is a subroutine in the first bank read. Repartition the calculator as necessary to read in the desired number of cards. If an error occurs in reading the card (flashing display), press **[R/S]** and insert the card again. *Do not clear the error condition before pressing* **[R/S]**.

2. Records bank N on the card inserted.

ALPHA MESSAGES

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select program.		[2nd] [Pgm] 03	
2	Initialize		[SBR] [CLR]	20.
3a	To enter characters from the diagram: STU VWX YZ% 7 8 9 JKL MNO PQR 4 5 6 ABC DEF GHI 1 2 3 ,'? 0 Key in the number beneath the character, then			
	• If character is on the left		[A]	See note 1.
	• If character is in the center		[B]	
	• If character is on the right		[C]	
3b	To enter a digit (0–9)	digit	[D]	See note 1.

3c	To enter the following symbols: + — X / = . ( )		 [SBR] [+] [SBR] [—] [SBR] [X] [SBR] [÷] [SBR] [=] [SBR] [.] [SBR] [( ] [SBR] [ )]	 See note 1.
3d	To enter a character not listed, enter the print code from page 5 of the Quick Reference Guide	code	[SBR] [SBR]	See note 1.
3e	To leave a blank space		[E]	See note 1.
3f	The following messages may be entered at the beginning of a line: ENTER PRESS PRESS SBR		 [2nd] [D'] [2nd] [E'] [2nd] [E'] [R/S]	 See note 1.
4	To begin a new line (See note 2.)		[2nd] [A']	
5	To enter a specific line	Line No.	[2nd] [C']	20.
	(Go to Step 3)			
6	To print a specific line	Line No.	[2nd] [B']	0.
7	To print lines XX through YY (See note 3.)	XX.YY	[2nd] [B']	0.

NOTES:

1. The number of characters remaining for entry on that line is displayed.
2. This instruction is used when a line contains fewer than 20 characters. When 20 characters have been entered, a new line is automatically started.
3. Two digits are required for each line number following the decimal. For example, to print lines 2 through 5, enter 2.05. When [B'] is used to print more than one line, entering additional lines without resetting the line pointer via [C'] begins storage following the last line printed.
4. If you discover an error during or after entering a line, enter the line number, press **[2nd]** [C'], and reenter the line.
5. Once a line is entered, the pointers are set to enter the next consecutive line.
6. Under normal operation each line is printed as it is entered. To avoid printing, press **[2nd]** **[St flg]** **1** after initialization.
7. Entry begins with line 1 after initialization.
8. Four data registers are used to store each line of your messages, beginning with R_{04}. If your message is K lines long, registers 0 through (4K + 3) must be left available for program use. Check the partitioning to be sure you have enough data registers available.
9. If you want the calculator to begin storing your message in a higher register, you may enter a line number K. This causes the calculator to leave lines 1 through (K-1) blank and begin storing the message in register 4K. R_{00} through R_{03}, as well as the T-register, must be left available for program use.

PRINTER FORMATTING MU-04

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Store alpha message using MU-03, leaving space for data.[1,2]			
2	Select program.		[2nd] [Pgm] 04	
3a	Enter data.	Data	[x≷t]	T-Register
3b	Enter format statement (see note 3)			
	● Without leading zeros		[A]	0.
	● With leading zeros		[2nd] [A′]	0.
	(Repeat step 3 as needed).			
4	Print line.	Line No.	[B]	0.

Notes: 1. It is assumed that the alpha code has been entered using Program MU-03. (See the Example problem).

2. Line 1 of MU-03 may not be used because data registers 4 through 7 are used in this program, MU-04.

3. The format statement is a number consisting of four elements which describe the data entered in step 3a:

(Skip)(Left) . (Right)(Line)

Skip – Number of spaces data is indented from left side of tape.
Left – Number of digits to left of decimal.
Right – Number of decimal digits.
Line – Line number (same as corresponding alpha message).

Each of the elements must be two digits (leading zero if needed).

4. If the data is too large positively or negatively to fit the format specified, asterisks are printed in the spaces allowed for the data.

5. When the data is negative, one space to the left of the decimal is allocated to the minus sign.

6. The decimal point and decimal digits, if any, are not printed when Right = 0.

SUPERPLOTTER

MU-05

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Enter subroutines for user-defined functions. (See Note 1)			
2	Select Program.		[2nd] [Pgm] 05	
3	Enter initial x value.	x_0	[A]	x_0
4	Enter x increment.	Δx	[B]	Δx
5a	Enter minimum y value.[2]	y_{min}	[C]	y_{min}
5b	Enter maximum y value.[2]	y_{max}	[D]	y_{max}
5c	Enter number of tapes desired.[2]	# Tapes	[E]	max. pos. #
6	Enter number of functions.	# Functions	[2nd] [D′]	# Functions
7	Enter number of points to be plotted per function and print graphs.	# Pts.	[2nd] [E′]	Graph[3]

NOTES:

1. Function 1 – Lbl A′   4 – Lbl D′   7 – Lbl B   10 – Lbl E
   Function 2 – Lbl B′   5 – Lbl E′   8 – Lbl C
   Function 3 – Lbl C′   6 – Lbl A   9 – Lbl D

2. Steps 5a, 5b, and 5c must be performed in sequence. If any input is changed, the entire sequence must be repeated.

3. If two functions cross at the same point, an "x" is printed unless both functions are using the same character.

SORTING

MU-06

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select program.		[2nd] [Pgm] 06	
2	Initialize.[1]	0	[E]	0.
3	Repartition if necessary.[2]			
4a	Enter first element.	E_1	[A]	E_1
4b	Enter next element (repeat).	E_i	[A] or [R/S]	E_i
5	Sort.		[B]	0.
6	List sorted data or display first sorted element.[3]		[C] or [R/S]	SE_1
7	Display next sorted element.		[D] or [R/S]	SE_i

NOTES:

1. Stores 0 in R_{00}.
2. Registers 0-n are used where n is the number of elements.
3. Data is printed using INV List function. Press R/S to stop printing and display first sorted element. If the printer is not attached, the first element is displayed immediately.

DATA ARRAYS

MU-07

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
	ENTERING DATA			
1	Select program.		[2nd] [Pgm] 07	
2a	Enter total number of rows and columns in data array.	R.C(INIT)[1]	[2nd] [B′]	R.C
2b	To cancel last row/column isolation automatically set by [2nd] [B′].		[2nd] [StFlg] 0	
	Entering Array Data			
3a	Enter row number of data to be entered.	Row Number	[2nd] [C′]	0.
3b	Enter data items column by column in left to right order.	Data Item	[C]	Data Item
3c	Repeat 3a and 3b for each row of data.			
	Entering Linear Growth Data			
4a	Enter row number of data to be entered.	Row Number	[2nd] [C′]	0.
4b	Enter first data item in row (column 1).	Data Item	[C]	Data Item
4c	Enter growth rate as decimal percent.	Growth[2]	[D]	Last Item

	Entering Single Data Items			
5a	Enter row and column number of data item.	R.C	[2nd] [C']	R.C
5b	Enter data item.	Data Item[3]	[C]	Data Item
	DATA ARRAY COMPUTATIONS			
	Row and Column Totals			
6a	Compute the total of a row.	Row Number	[E]	Row Total[4]
6b	Store row total in last column of row.	Row Total	[C]	Row Total
7a	Compute the total of a column.	Col. Number	[+/–] [E]	Col. Total[4]
7b	Store column total in last row of column.	Col. Total	[C]	Col. Total
	Row and Column Products			
8a	Compute the product of data items in a row.	Row Number	[2nd] [E']	Row Product[4]
8b	Store product of row in last column of row.	Row Product	[C]	Row Product
9a	Compute the product of data items in a column.	Col. Number	[+/–] [2nd] [E']	Col. Product[4]
9b	Store product of column in last row of column	Col. Product	[C]	Col. Product

	Row A □ Row B = Row C **(□ = +, −, X, ÷, or y^x)**			
10a	Enter numbers of rows A and B.	Row A,Row B[5]	[A]	0.
10b	Enter number of row C.	Row C[6]	[B]	0.
10c	Compute Row A □ Row B = Row C[10].		[SBR] [□]	0.
	Row A □ Constant = Row C **(□ = +, −, X, ÷, or y^x)**			
11a	Enter constant value.	Constant	[2nd] [A']	Constant
11b	Enter number of row A.	Row A	[A]	0.
11c	Enter number of row C.	Row C[7]	[B]	0.
11d	Compute Row A □ Constant = Row C[10]		[SBR] [□]	0.
	Constant □ Row B = Row C **(□ = +, −, X, ÷, or y^x)**			
12a	Enter constant value.	Constant	[2nd] [A']	Constant
12b	Enter number of row B.	.Row B[5]	[A]	0.
12c	Enter number of row C.	Row C[7]	[B]	0.
12d	Compute Constant □ Row B = Row C[10]		[SBR] [□]	0.

	Shift Right Row A, result in Row B[4]			
13a	Enter numbers of rows A and B.	Row A.Row B[5]	[A]	0.
13b	Enter positions to be shifted and perform shift.	No. Shifts[4,8]	[2nd] [D′]	0.
	Shift Left Row A, result in Row B[4]			
14a	Enter numbers of rows A and B.	Row A.Row B[5]	[A]	0.
14b	Enter positions to be shifted and perform shift.	No. Shifts[4,8]	[+/–] [2nd] [D′]	0.
	RECALL ARRAY DATA			
	Display Output (Printer Not Connected)			
15a	Enter row number, recall first data item.	Row Number	[+/–] [B]	First Data Item
15b	Recall next data item in row.		[C]	Next Data Item
15c	Repeat 15b for each column.			
16	To print all data items in a row.	Row Number[9]	[+/–]. [B]	Last Data Item

NOTES: 1. Column numbers from 1 through 9 must have a leading zero. A 4 x 6 array is entered as 4.06 [2nd] [B′]. Initialization does not clear stored data; however, **changing array size after entering data will result in mislocated data.**

2. For example, to make each column increase by 50%, enter .5 [D] . This function enters growth data into each column except the last (unless last-row/column isolation has been cancelled in Step 2b.).

3. Next data item in the same row can be entered by simply repeating Step 5b.

4. Operation does not include or affect the content of the last row (or column) unless last-row/column isolation has been cancelled in Step 2b.

5. Row numbers 1 through 9 must have a leading zero, such as .01 for row 1, etc. If a shift operation has the same row number for Row A and Row B, it is only necessary to enter the Row A number.

6. This step may be skipped if the row numbers for Row B and Row C are the same.

7. This step may be skipped if Row C number is the same as the row number in the previous step.

8. Data items in Row B that are not replaced by the shift remain unchanged.

9. Use Fix 0, 2, or 9.

10. For X, ÷, and y^x computations, the sum of Row C is automatically placed in the last column unless last-row/column isolation has been cancelled in Step 2b.

DATA PACKING

MU-08

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select program.		[2nd] [Pgm] 08	
2	Enter format.[1]	Format	[A]	Format.
3a	Enter data.[2,3]	Data	[x≷t]	T-Register.
3b	Enter pseudo register number.	PR[4]		
	● Store.		[B]	Stored Value.
	● Recall.		[C]	Recalled Value.
	● Exchange.		[D]	Recalled Value.

NOTES:

1. Format is stored in R_{01} : N.xxx....Maximum length of a pseudo register is 9 digits. Maximum combined length is 13 digits.
2. Not necessary for Recall.
3. Only integer values may be entered. If the number entered is too large to fit the format, the most significant digits are truncated.
4. There is no pseudo register 0.

PRIME FACTORS

MU-09

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select program.		[2nd] [Pgm] 09	
2	Enter integer and find first prime factor.	Integer	[A]	Factor
3	Display next factor.[1]		[B]	Factor
4	Repeat step 3 until all factors are found.[2]		[B]	1.

NOTES:

[1] Execution time increases with the magnitude of the number and the difference between prime factors.

[2] A flashing 1 is displayed when all factors have been found.

HYPERBOLIC FUNCTIONS

MU-10

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select program.		[2nd] [Pgm] 10	0.
2	Enter argument.	x	[A]	sinh x
3	Enter argument.	x	[2nd] [A′]	$\sinh^{-1} x$
4	Enter argument.	x	[B]	cosh x
5	Enter argument.	x[1]	[2nd] [B′]	$\cosh^{-1} x$
6	Enter argument.	x	[C]	tanh x
7	Enter argument.	x[2]	[2nd] [C′]	$\tanh^{-1} x$

NOTES: 1. $x \geqslant 1$ for $\cosh^{-1}$.

2. $|x| < 1$ for $\tanh^{-1}$.

GAMMA/FACTORIAL

MU-11

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select program.		[2nd] [Pgm] 11	
2a	Calculate $\Gamma(x)$[1]	x	[A]	$\Gamma(x)$
2b	Calculate ln $\Gamma(x)$[2]	x	[2nd] [A′]	ln $\Gamma(x)$
2c	Calculate x![3]	x	[B]	x!
2d	Calculate ln x![4]	x	[2nd] [B′]	ln x!
2e	Calculate n![5]	n	[C]	n!

NOTES:

1. $0 < x \leqslant 70$
2. $0 < x \leqslant 4.5535879 \times 10^{10}$
3. $0 \leqslant x \leqslant 69$
4. $0 \leqslant x \leqslant 4.5535879 \times 10^{10}$
5. $0 \leqslant n \leqslant 69$ (Integers only)

RANDOM NUMBERS

MU-12

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select program.		[2nd] [Pgm] 12	
2	Enter Seed (0 < Seed ≤ 199017).	Seed	[STO] 09	Seed
3	Generate uniformly distributed numbers (one for each key push).		[A]	Random No.
4	Generate normally distributed numbers (one for each key push).		[B]	Random No.

NORMAL DISTRIBUTION

MU-13

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select program.		[2nd] [Pgm] 13	
2a	Enter normal variate.	u[1]	[A]	Q(u)
2b	Enter Q(u).	Q(u)	[B]	u
2c	Enter normal variate.	u[1]	[C]	Z(u)

NOTES: 1. $|u| \leqslant 15.11$, display will flash for u outside this range.

INTERPOLATION

MU-14

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select program.		[2nd] [Pgm] 14	
2	Enter address of x_1 (See Note 1).	Register #	[A]	Register #
3	Enter number of (x,y) pairs	# Points	[2nd] [A′]	# Points
4a	Enter x value.	x_i	[B]	i
4b	Enter y value.	y_i	[C]	i
	Repeat steps 4a and 4b until the number of pairs in step 3 are entered.			
5	Enter value of x_0 and calculate $f(x_0)$	x_0	[D]	$f(x_0)$

NOTES: 1. Program requires three times the number of (x,y) pairs of contiguous data registers starting with R_{18} or above.

2. Step 5 may be repeated for interpolated values at additional points.

ROOTS OF FUNCTION

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Initialize		[RST]	
2	Enter learn mode.		[LRN]	000 00
3	Use [A′] as label.		[2nd] [Lbl] [2nd] [A′]	001 00 002 00
4	Enter f(x) as a series of keystrokes.[1]			
5	End f(x) with [INV] [SBR]		[INV] [SBR]	
6	Exit learn mode.		[LRN]	
7	Select program.		[2nd] [Pgm] 15	
8	Define maximum number of iterations allowed (optional).	Limit	[B]	Limit
9	Enter maximum error.	ϵ	[2nd] [B′]	ϵ
10a	Enter first approximation of root and calculate root to within ϵ, but do not exceed maximum number of iterations specified.[2]	x_0	[C]	Root
	or			
10b	Enter first approximation of root and calculate root to within ϵ with no limit on the number of iterations.[2]	x_0	[2nd] [C′]	Root

NOTES:

1. Enter the subroutine using parentheses only. Do not use [=] or [**CLR**] in the subroutine for f(x).
2. The running time for the program depends on your choice for the initial guess, maximum error, and the nature of f(x).

MINIMAX

MU-16

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Initialize.		[RST]	
2	Select learn mode.		[LRN]	000 00
3	Use A′ as a label.		[2nd] [Lbl] [2nd] [A′]	001 00 002 00
4	Enter f(x) as a series of keystrokes. Do not use [=] or [CLR].			
5	End f(x) with [INV] [SBR].		[INV] [SBR]	xxx 00
6	Leave learn mode.		[LRN]	
7	Select program.		[2nd] [Pgm] 16	
8	Define maximum number of iterations allowed (optional).	LIMIT[1]	[A]	LIMIT
9	Enter search increment.	Δx[2]	[B]	Δx
10a	Enter starting value of x and find next critical value with LIMIT number of iterations.	x_0[3]	[C][5] [2nd] [A′][7] [x≷t]	x_{CRIT} $f(x_{CRIT})$ −1 or 1[4]
	or			
10b	Enter starting value of x and find next critical value.	x_0[3]	[2nd] [C′][6] [2nd] [A′][7] [x≷t]	x_{CRIT} $f(x_{CRIT})$ −1 or 1[4]

11a	Find next larger critical value starting search from previous critical value.		[D]^{5} [2nd] [A′]^{7} [x≷t]	x_{CRIT} $f(x_{CRIT})$ −1 or 1^{4}
	or			
11b	Find next larger critical value starting search from previous critical value.		[2nd] [D′]^{6} [2nd] [A′]^{7} [x≷t]	x_{CRIT} $f(x_{CRIT})$ −1 or 1^{4}

NOTES:

1. LIMIT number of iterations are attempted for each critical value search.
2. Δx must be small enough to avoid "skipping over" a critical value of x. Δx must be greater than zero.
3. $x_0 + \Delta x$ must be less than critical value. Search begins at $x_0 + \Delta x$.
4. −1 indicates $f(x_{CRIT})$ is a maximum.

   1 indicates $f(x_{CRIT})$ is a minimum.
5. Calculate with LIMIT.
6. Calculate without LIMIT.
7. x must be in the display to compute f(x).

ROMBERG INTEGRATION

MU-17

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Initialize.		[RST]	0.
2	Enter learn mode.		[LRN]	000 00
3	Use A′ as a label.		[2nd] [Lbl]	001 00
4	Enter keystrokes for f(x). Assume x is in the display. Do not use [=] or [CLR] in subroutine.			
5	End with [INV] [SBR] .		[INV] [SBR]	xxx 00
6	Exit learn mode.		[LRN]	0.
7	Select program.		[2nd] [Pgm] 17	0.
8	Enter lower limit.	a	[A]	a
9	Enter upper limit.	b	[B]	b
10	Enter accuracy limit.	ϵ	[C]	0.
11	Evaluate integral.		[D]	$\int_a^b f(x)\,dx$

DIFFERENTIAL EQUATIONS

MU-18

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Initialize.		[RST]	0.
2	Enter learn mode.		[LRN]	000 00
3	Use [A′] as a label.		[2nd] [Lbl]	001 00
4	Enter f(x,y) or f(x,y,y′) as a series of keystrokes. Do not use [=] or **[CLR]**. Use register 10 for x, register 11 for y, and register 12 for y′.		[2nd] [A′]	002 00
5	End with **[INV]** **[SBR]**.		[INV] [SBR]	xxx 00
6	Exit learn mode.		[LRN]	0.
7	Select program.		[2nd] [Pgm] 18	0.
8a	Enter initial x.	x_0	[A]	x_0
8b	Enter initial y.	y_0	[B]	y_0
8c	Enter initial y′, if using a second-order equation.	y'_0	[C]	y'_0
9	Enter number of divisions.	n	[D]	n

10	To solve $y' = f(x,y)$: Enter value of independent variable for which the solution is desired.	$\overline{x}$	[E]	$\overline{y}$
	or			
11a	To solve $y'' = f(x,y,y')$: Enter value of independent variable for which the solution is desired.	$\overline{x}$	[2nd] [E']	$\overline{y}$
11b	Display slope at $\overline{x}$.		[x⪰t]	$\overline{y}'$

DISCRETE FOURIER SERIES

MU-19

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select program.		[2nd] [Pgm] 19	
2	Enter number of equally spaced observations from f(t).	# Points	[A]	# Points
3	Enter Y_1 address![1]	Register #	[B]	Register #
4	Enter Y_K, start with Y_1 and repeat Step 4 until the number of values entered in Step 2 have been entered.	Y_K	[C]	Y_K
5	Enter the order of coefficients to be calculated.	n	[D] [$x \rightleftarrows t$]	a_n b_n

NOTES: 1. The value entered represents the first register alloted to data storage, Register 16 or above.

CALCULATOR STATUS

MU-20

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select program.		[2nd] [Pgm] 20	
2	Save calculator status.[1]		[A]	0.
3	Initialize calculator status.[1]		[2nd] [A']	0.
4	Flags set status.[1]		[B]	Flags set.
5	Fix-decimal status.[1]		[2nd] [B']	No. fixed.
6	Partitioning status.[1]		[C]	10-Reg. sets
7	Printer connect status.[1]	0	[2nd] [C']	0.(flag 0)
8	Angular mode status.[1]		[D]	0 = D, −1 = R, 1 = G
9	Open parentheses status.[1]		[E]	No. parentheses open

NOTE: 1. See Conditions and Limitations on the previous page for details about status subroutines.

VARIABLE ARITHMETIC MU-21

STEP	PROCEDURE	ENTER	PRESS	DISPLAY
1	Select Program.		[2nd] [Pgm] 21	
2	Store Variable A	A	[2nd] [E'] [A]	A
3	Store Variable B	B	[2nd] [E'] [B]	B
4	Store Variable C	C	[2nd] [E'] [C]	C
5	Store Variable D	D	[2nd] [E'] [D]	D
6	Store Variable E	E	[2nd] [E'] [E]	E
7	Recall Variable A (see note 1)		[A]	A
8	Recall Variable B (see note 1)		[B]	B
9	Recall Variable C (see note 1)		[C]	C
10	Recall Variable D (see note 1)		[D]	D
11	Recall Variable E (see note 1)		[E]	E
12	Compute Variable A (see note 2)		[2nd] [A'] [A]	A
13	Compute Variable B (see note 2)		[2nd] [A'] [B]	B
14	Compute Variable C (see note 2)		[2nd] [A'] [C]	C
15	Compute Variable D (see note 2)		[2nd] [A'] [D]	D
16	Compute Variable E (see note 2)		[2nd] [A'] [E]	E

NOTES:

1. If before pressing keys [A] – [E], a numeric entry (other than zero) is made that may be cleared with the [CE] key, the display will flash when [A] – [E] is pressed and the operation must be repeated.

2. In order to compute a variable, a subroutine for performing the computation must be stored in program memory under the appropriate label. (For example, a user-defined subroutine for computing variable A must be stored in program memory under label A.) Direct storing and recalling of variables in the subroutine may be desirable. The registers associated with the variables are $A - R_{21}$, $B - R_{22}$, $C - R_{23}$, $D - R_{24}$, $E - R_{25}$.

NOTES

NOTES

NOTES

TEXAS INSTRUMENTS
INCORPORATED
DALLAS, TEXAS

Printed in U.S.A.