

free42 Random Math Stuff

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2021-03-19

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Updated: 2021-05-18 21:09:45

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1 Metadata

The home for this HTML file is: <https://richmit.github.io/hp42/math.html>

A PDF version of this file may be found here: <https://richmit.github.io/hp42/math.pdf>

Files related to this document may be found on github: <https://github.com/richmit/hp42>

Directory contents:

<code>src</code>	-	The org-mode file that generated this HTML document
<code>src_42s</code>	-	Ready to convert source listings for 42s code in this document
<code>docs</code>	-	This html document and associated PDF
<code>bin</code>	-	Importable RAW program files

2 Introduction

This org-mode file collects together a handful of mathematical stuff I find useful. Note that in the past I had a collection of simple mathematical functions in this file. That stuff has moved to sfun.org.


```

R↓
XEQ "MXIDN"
x
-
DET
RTN

```

```

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@ Store/Recall variable "CPM"
LBL 98
FS? 64
RCL "CPM"
STO "CPM"
RTN

```

```

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@ Store/Recall variable "X"
LBL 97
FS? 64
RCL "X"
STO "X"
RTN

```

```

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@ Edit matrix
LBL 96
FUNC 11
EDIT
"Enter data; R/S"
└" to end"
PROMPT
EXITALL
RTN

```

```

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
END

```

4 POLY: A collection of polynomial tools

4.1 Menu

Menu	LBL	Description	Inputs	Output
NEW	NEWPLY	Create a polynomial of degree X	X: N	X: P
INTRP	PINTRP	Create interpolating polynomial	Y: XDAT X: YDAT	X: P
□□□□				
EDIT	LBL 78	Edit a polynomial	X: P	X:P
VIEW	VPOLY	View a polynomial	X: P	N/A
SLV2	P2SLV	Solve quadratic polynomial	X: P	Y: root_1 X: root_2
SLV1	P1SLV	Solve linear polynomial	X: P	X: root
R1ST	PR1ST	Find a root	X: P	Z: OPoly Y: DPoly X: root
RNXT	PRNXT	Find next root	Z: OPoly Y: DPoly X: GUESS	Z: OPoly Y: DPoly X: root
□□□□				
VIEW	VPOLY	View the coefficients of a polynomial	X: P	N/A
DFALT	PDEFALT	Deflate polynomial	Y: P X: R	Y: Remainder X: P/(X-R)
EVAL	PEVAL	Evaluate polynomial P @ X	Y: P X: X	X: P(X)
EVAL1	PEVL1	Evaluate polynomial P & P' @ X	Y: P X: X	Y: P(X) X: P'(x)
EVAL2	PEVL2	Evaluate polynomial P, P', & P'' @ X	Y: P X: X	Z: P(X) Y: P''(x) Y: P'(x)
LGRR	PLGRR	Root search (Laguerre's Method)	T: P Z: GUESS Y: ACC X: MAXITR	Z: Status y: P_Val X: root
VIEW	VPOLY	View the coefficients of a polynomial	X: P	N/A
POLY	LBL 98	Store/Recall Current Polynomial		
X	LBL 97	Store/Recall current value of "X"		
□□□□				
□□□□				
□□□□				
EVAL	PWRP	Evaluate wrapped polynomial at X	N/A	X: P("X")

A polynomial is represented as 1xn matrix of coefficients. The first element of the matrix is the coefficient on the highest degree.

4.2 Notes for individual programs

4.2.1 PEVAL, PEVL1, & PEVL2: Evaluating Polynomials

These functions efficiently evaluate a polynomial (and its first and/or second derivative). They are handy for simply evaluating a polynomial repeatedly; however, they are more tuned for use as subroutines in other programs – ex: solvers. Note that the last page of the main menu provides


```

KEY 1 XEQ "PDEFLT"
"EVAL"
KEY 2 XEQ "PEVAL"
"EVAL1"
KEY 3 XEQ "PEVL1"
"EVAL2"
KEY 4 XEQ "PEVL2"
"LGRR"
KEY 5 XEQ "PLGRR"
"VIEW"
KEY 6 XEQ "VPOLY"
KEY 7 GTO 02
KEY 8 GTO 04
KEY 9 GTO 00
MENU
STOP
GTO 03
LBL 04          @@@@ Page 4 of menu POLY
CLMENU
"POLY"
KEY 1 XEQ 98
"X"
KEY 2 XEQ 97
"EVAL"
KEY 6 XEQ "PWRP"
KEY 7 GTO 03
KEY 8 GTO 01
KEY 9 GTO 00
MENU
STOP
GTO 04
LBL 00 @@@@ Application Exit
EXITALL
RTN
@@@@ Free labels start at: 5

```

4.4 Local functions

```

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@@ DSC: Create an interpolateing polynomial
@@@@ IN: Y: X data matrix
@@@@      X: Y data matrix
@@@@ OUT: X: interpolateing polynomial
@@@@ TST: free42_3.0.2.2
@@@@ UPD: 2021-04-28
@@@@ FAQ: X & Y must have the same number of elements, but dimintions may differ.
@@@@ FAQ: Explicitly constructs the vandermonde matrix, and solves the system
@@@@ FAQ: Uses INDEX
@@@@ TC:  xdat:[ 1, 2, 3, 4] ydat:[1, -1, 1, -1] => [-4/3 10 -68/3 15] = [-1.33.. 10 -22.66.. 15]
@@@@ TC:  xdat:[-1, 0, 1, 2] ydat:[-2, 3, -24, -77] => [1, -16, -12, 3]
LBL "PINTRP"
FUNC 21          @@@@ REQ:free42>=2.5.24
LASTK           @@@@ REQ:free42>=3.0
LSTO "_YDAT"     @@@@ YDAT XDAT
DIM?
x
1
DIM "_YDAT"     @@@@ 1 N XDAT -- YDAT is now an Nx1 matrix
R↓             @@@@ N XDAT
R↓             @@@@ XDAT
LSTO "_XDAT"    @@@@ XDAT
XEQ "MXDIAG"    @@@@ MUL      -- nxn diag matrix
LSTO "_MUL"     @@@@ MUL
DIM?            @@@@ N N
R↓
1               @@@@ 1 N
NEWMAT          @@@@ TPL      -- TPL is an nx1 zero matrix
SIGN            @@@@ TPL      -- TPL is now an NX1 1 matrix
LSTO "_TPL"     @@@@ TPL
DIM?            @@@@ 1 N
R↓             @@@@ N
ENTER          @@@@ N N
NEWMAT          @@@@ VM      -- VM is an NXN zero matrix
LSTO "_VM"      @@@@ VM
DIM?            @@@@ N N
R↓             @@@@ N

```



```

"X~"
AIP
|~:"
RCLEL
ARCL ST X
R↓
AVIEW
STOP
1
-
J+
FC? 77
GTO 90
RTN

```

```

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

```

```

@@@ DSC: Find a root
@@@ IN: X: Polynomial
@@@ OUT: Z: Original Polynomial
@@@ Y: Deflated Polynomial
@@@ X: Root
@@@ FAQ: If set, the global variable ACC is used to set accuracy
@@@ TC: [1, -16, -12, 3] => -0.90574, 0.1982, 16.70749
LBL "PR1ST"
FUNC 13
L4STK
XEQ 81      @@@ PLYBAD
RTNERR 5
LSTO "_P"   @@@ P
RAN
RAN
COMPLEX     @@@ Guss Poly
SF 25
RCL "ACC"
FC?C 25
1e-15      @@@ Tol Guss Poly
50         @@@ Itr Tol Guss Poly
XEQ "PLGRR" @@@ Root Pval Stat
O≠? ST Z   @@## TODO: Memory leak in free42 < 3.0.3
RTNERR 6
RCL "_P"   @@@ Poly Root Pval Stat
RCL "_P"   @@@ Poly Poly Root Pval
RCL ST Z   @@@ Root Poly Poly Root
XEQ "PDEFLT" @@@ DPly Rem Poly Root
X<>Y      @@@ Rem DPly Poly Root
R↓        @@@ DPly Poly Root
RCL ST Z   @@@ Root DPly Poly Root
RTN

```

```

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@

```

```

@@@ DSC: Find a another/next root
@@@ in: Z: Original Polynomial
@@@ Y: Deflated Polynomial
@@@ X: Guess
@@@ OUT: Z: Original Polynomial
@@@ Y: Deflated Polynomial or 0 if fully deflated
@@@ X: Root
@@@ FAQ: If set, the global variable ACC is used to set accuracy
LBL "PRNXT"
FUNC 33
L4STK
RCL ST Z   @@@ Poly Gues DPly Poly
LSTO "_P"
R↓        @@@ Gues DPly Poly
RCL ST Y   @@@ DPLY Gues DPly Poly
LSTO "_DP"
XEQ 81     @@@ PLYBAD
RTNERR 5
R↓        @@@ Gues DPly Poly
SF 25
RCL "ACC"
FC?C 25
1e-15     @@@ Tol Gues DPly Poly
50        @@@ Itr Tol Gues DPly
XEQ "PLGRR" @@@ Root Pval Stat
RCL ST Z   @@@ Root Pval Stat

```

```

@@## REQ:free42<3.0.3   @@## TODO: Delete when DM42 >= free42 3.0.3

```

```

X≠0? @### REQ:free42<3.0.3 @### TODO: Delete when DM42 >= free42 3.0.3
0≠? ST Z @### REQ:free42>=3.0.3
RTNERR 6
R↓ @### Root Pval Stat @### REQ:free42<3.0.3 @### TODO: Delete when DM42 >= free42 3.0.3
RCL "_P" @### Poly Root Pval Stat
X<>Y @### Root Poly Pval Stat
-1 @### -1 Root Poly Pval
5 @### 5 -1 Root Poly
XEQ "PLGRR" @### Root Pval Stat
RCL ST X @### Root Root Pval Stat
RCL "_DP" @### DPly Root Root Pval
X<>Y @### Root DPly Root Pval
XEQ "PDEFLT" @### DPly Rem Root Pval
X<>Y
R↓ @### DPly Root Pval
@### TODO: Should check if |Rem| is near zero. If it is not, then we probably converged to a previously found root and removed from DPly
@### TODO: that we we might have diverged, but that is super unlikely. In fact, both cases are quite unlikely. Still good software sho
RCL "_P" @### Poly DPly Root Pval
X<>Y @### DPly Poly Root Pval
RCL ST Z @### Root DPly Poly Root
RTN

@### DSC: RTNNO if X is not a polynomial of degree>0
@### NAM: PLYBAD 81
@### IN: X: Polynomial
@### OUT: N/A
LBL 81
FUNC 00
MAT?
GTO 82
RTNYES
LBL 82
DIM?
x
2
X>Y?
RTNYES
RTNNO

@### DSC: Use Laguerre's method to find a polynomial root
@### IN: T: Polynomial
@### Z: Guess
@### Y: Tolerance
@### X: Maximum Iteration
@### OUT: Z: Reason for exit
@### 0 = A solution has been found.
@### 3 = Bad guess was used.
@### Y: P(X)
@### X: Root
LBL "PLGRR"
FUNC 43
L4STK
LSTO "_I" @### ITR TOL GUESS POLY
R↓ @### TOL GUESS POLY
LSTO "_T"
R↓ @### GUESS POLY
LSTO "_G"
R↓ @### POLY
LSTO "_P"
DIM?
x @### N
LSTO "_N"
@### TODO: Check N>1. Another status: 4 = polynomial is constant
1
- @### N-1
LSTO "_NM1"
R↓
LBL 94
RCL "_P"
RCL "_G"
XEQ "PEVL2" @### P'' P' P ?
RCL ST Z
ABS @### |P| P'' P' P @### REQ:free42>=3.0.3
X<? "_T" @### REQ:free42>=3.0.3

```



```

@@@ Store/Recall variable "X"
LBL 97
FS? 64
RCL "X"
STO "X"
RTN

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@ DSC: Is a number very close to zero
@@@ NAM: ZEROISH 80
LBL 80
FUNC 11
L4STK
ABS
1e-10
X>Y?
RTNYES
RTNNO

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
END

```

5 VEC3: 3D Real Vector Application

This is a simple little application that makes working with 3D vectors less painfull.

5.1 Menu

Menu	Target	
→V	LBL 99	Put stack elements X, Y, & Z into a vector: [Z, Y, X]
V→	LBL 98	Vector contents to stack. [A, B, C] => X: C, Y: B, Z: A
DOT		Dot product
CROSS		Cross product
MAG	FNRM	Euclidian magnitude
VVIEW	LBL 96	View a vector one element at a time – press R/S for next element

5.2 Code for Menu

```

(MJR-generate-42-menu-code "VEC3" 0 tbl 0 1 'stay 'up 'auto #'MJR-custom-gen-lab #'MJR-custom-gen-sub)

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@ (VEC3)
@@@ DSC: Auto-generated menu program
LBL "VEC3"
LBL 01 @@@ Page 1 of menu VEC3
CLMENU
"→V"
KEY 1 XEQ 99
"V→"
KEY 2 XEQ 98
"DOT"
KEY 3 XEQ 02
"CROSS"
KEY 4 XEQ 03
"MAG"
KEY 5 XEQ 04
"VVIEW"
KEY 6 XEQ 96
KEY 9 GTO 00
MENU
STOP
GTO 01
LBL 00 @@@ Application Exit
EXITALL
RTN
LBL 02 @@@ Action for menu key DOT
DOT
RTN
LBL 03 @@@ Action for menu key CROSS
CROSS
RTN
LBL 04 @@@ Action for menu key MAG
FNRM
RTN
@@@ Free labels start at: 5

```



```

AVIEW
STOP
1
+
J+
FC? 77
GTO 54
RTN

```

```

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
@@@ DSC: Make a 3D vector full of zeros
@@@ NAM: VVIEW 95
@@@ IN: N/A
@@@ OUT: X: 1x3 Matrix
@@@ LBL: Used: 53
@@@ TST: free42_3.0.2
@@@ UPD: 2021-04-03
LBL 95
FUNC 01
1
3
NEWMAT
RTN

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@
END

```

6 STATR: Statistics Registers

6.1 Menu

Menu	Code
Σx	FUNC 01; L4STK; Σ REG?; 0; +; RCL IND ST X; " Σx ="; ARCL ST X; AVIEW
Σx^2	FUNC 01; L4STK; Σ REG?; 1; +; RCL IND ST X; " Σx^2 ="; ARCL ST X; AVIEW
Σy	FUNC 01; L4STK; Σ REG?; 2; +; RCL IND ST X; " Σy ="; ARCL ST X; AVIEW
Σy^2	FUNC 01; L4STK; Σ REG?; 3; +; RCL IND ST X; " Σy^2 ="; ARCL ST X; AVIEW
Σxy	FUNC 01; L4STK; Σ REG?; 4; +; RCL IND ST X; " Σxy ="; ARCL ST X; AVIEW
n	FUNC 01; L4STK; Σ REG?; 5; +; RCL IND ST X; "n="; ARCL ST X; AVIEW
$\Sigma \ln x$	FUNC 01; L4STK; Σ REG?; 6; +; RCL IND ST X; " $\Sigma \ln x$ ="; ARCL ST X; AVIEW
$\Sigma \ln x^2$	FUNC 01; L4STK; Σ REG?; 7; +; RCL IND ST X; " $\Sigma (\ln x)^2$ ="; ARCL ST X; AVIEW
$\Sigma \ln y$	FUNC 01; L4STK; Σ REG?; 8; +; RCL IND ST X; " $\Sigma \ln y$ ="; ARCL ST X; AVIEW
$\Sigma \ln y^2$	FUNC 01; L4STK; Σ REG?; 9; +; RCL IND ST X; " $\Sigma (\ln y)^2$ ="; ARCL ST X; AVIEW
$\Sigma \ln x \ln y$	FUNC 01; L4STK; Σ REG?; 10; +; RCL IND ST X; " $\Sigma \ln x \ln y$ ="; ARCL ST X; AVIEW
$\Sigma x \ln y$	FUNC 01; L4STK; Σ REG?; 11; +; RCL IND ST X; " $\Sigma x \ln y$ ="; ARCL ST X; AVIEW
$\Sigma y \ln x$	FUNC 01; L4STK; Σ REG?; 12; +; RCL IND ST X; " $\Sigma y \ln x$ ="; ARCL ST X; AVIEW

6.2 Code

```

(MJR-generate-42-menu-code "STATR" 0 tbl 0 nil 'stay 'up 'auto
#MJR-local-only-gen-lab
(lambda (atrg target row)
  (cl-structuring-bind (menu prog) row
    (mapconcat #'string-trim-left
      (split-string prog ";") "\n"))))

@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@ (STATR)
@@@ DSC: Auto-generated menu program
LBL "STATR"
LBL 01          @@@@ Page 1 of menu STATR
CLMENU
" $\Sigma x$ "
KEY 1 XEQ 04
" $\Sigma x^2$ "
KEY 2 XEQ 05
" $\Sigma y$ "
KEY 3 XEQ 06
" $\Sigma y^2$ "
KEY 4 XEQ 07
" $\Sigma xy$ "
KEY 5 XEQ 08
"n"
KEY 6 XEQ 09
KEY 7 GTO 03
KEY 8 GTO 02

```

```

KEY 9 GTO 00
MENU
STOP
GTO 01
LBL 02          @@@@ Page 2 of menu STATR
CLMENU
"Σlnx"
KEY 1 XEQ 10
"Σlnx†2"
KEY 2 XEQ 11
"Σlny"
KEY 3 XEQ 12
"Σlny†2"
KEY 4 XEQ 13
"Σlnxlny"
KEY 5 XEQ 14
"Σxlny"
KEY 6 XEQ 15
KEY 7 GTO 01
KEY 8 GTO 03
KEY 9 GTO 00
MENU
STOP
GTO 02
LBL 03          @@@@ Page 3 of menu STATR
CLMENU
"Σylnx"
KEY 1 XEQ 16
KEY 7 GTO 02
KEY 8 GTO 01
KEY 9 GTO 00
MENU
STOP
GTO 03
LBL 00 @@@@ Application Exit
EXITALL
RTN
LBL 04          @@@@ Action for menu key Σx
FUNC 01
L4STK
ΣREG?
0
+
RCL IND ST X
"Σx="
ARCL ST X
AVIEW
RTN
LBL 05          @@@@ Action for menu key Σx†2
FUNC 01
L4STK
ΣREG?
1
+
RCL IND ST X
"Σx^2="
ARCL ST X
AVIEW
RTN
LBL 06          @@@@ Action for menu key Σy
FUNC 01
L4STK
ΣREG?
2
+
RCL IND ST X
"Σy="
ARCL ST X
AVIEW
RTN
LBL 07          @@@@ Action for menu key Σy†2
FUNC 01
L4STK
ΣREG?
3
+

```

```

RCL IND ST X
"Σy2="
ARCL ST X
AVIEW
RTN
LBL 08   @@@@ Action for menu key Σxy
FUNC 01
L4STK
ΣREG?
4
+
RCL IND ST X
"Σxy="
ARCL ST X
AVIEW
RTN
LBL 09   @@@@ Action for menu key n
FUNC 01
L4STK
ΣREG?
5
+
RCL IND ST X
"n="
ARCL ST X
AVIEW
RTN
LBL 10   @@@@ Action for menu key Σlnx
FUNC 01
L4STK
ΣREG?
6
+
RCL IND ST X
"Σlnx="
ARCL ST X
AVIEW
RTN
LBL 11   @@@@ Action for menu key Σlnx2
FUNC 01
L4STK
ΣREG?
7
+
RCL IND ST X
"Σ(lnx)2="
ARCL ST X
AVIEW
RTN
LBL 12   @@@@ Action for menu key Σlny
FUNC 01
L4STK
ΣREG?
8
+
RCL IND ST X
"Σlny="
ARCL ST X
AVIEW
RTN
LBL 13   @@@@ Action for menu key Σlny2
FUNC 01
L4STK
ΣREG?
9
+
RCL IND ST X
"Σ(lny)2="
ARCL ST X
AVIEW
RTN
LBL 14   @@@@ Action for menu key Σlnxlny
FUNC 01
L4STK
ΣREG?
10

```

```
+
RCL IND ST X
"Σlnxlny="
ARCL ST X
AVIEW
RTN
LBL 15   @@@@ Action for menu key Σxlny
FUNC 01
L4STK
ΣREG?
11
+
RCL IND ST X
"Σxlny="
ARCL ST X
AVIEW
RTN
LBL 16   @@@@ Action for menu key Σylnx
FUNC 01
L4STK
ΣREG?
12
+
RCL IND ST X
"Σylnx="
ARCL ST X
AVIEW
RTN
@@@@ Free labels start at: 17
END
```

7 EOF