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Scientific Notebook #152, PA
Research Project

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Contents | Page

Title & Description	1
Optical Disk	3
PVM & TPA Code	10
Listing TPA Code Input Parameters	12
Check min/max for each Input Parameter	20
Results from 1st Set Runs	36
Slides used in 7/13/95 Summary Presentation	43
Slides used in 8/22/95 Student Presentation	50
Mike McKay's slides	55
Conditional CCDF	70
Scatter Plots of select parameters	75
IRS & LHS runs with no fixed parameters	80

Contents | Page

RDM 7/8/96

Project No. 20-5704-192
Project Title: Performance Assessment Research*
Project Dates: 10/1/94 to ~ 4/1/96*
Participants: Randall D. Manteufel
Todd R. Easley

* Note: In early FY96, the Performance Assessment Research Project was merged with the Total System Performance Assessment and Technical Integration Project. This was in response to NRC prioritization of project into Key Technical Issues topics.

RDM 5/28/95

Title:
Variance-based Sensitivity Analysis

Description:
Setpwise multiple-linear regression methods were used in the NRC/CNWRA IPA Phase 2 (Wescott et al., 1995) to perform senstivity studies to determine which input variables have the strongest effects on the output. The methods employed in IPA Phase 2 represent state-of-the-art methods as implemented in reliable and robust commerical statistical software packages (e.g., S-PLUS). Recently however, variance-based sensitivity analysis methods have been developed (McKay, 1995). Variance based method are being developed especially for sensitivity studies where data is input and generated using complex computer programs. The variance based methods possible because the computer code (or model) being studied can repetively be exercised for specific values and combinations of inputs. It appears that variance based methods have a number of significant advantages:

1) the ability to discern a wider suite of important parameters (as well as the top few most important parameters)

2) capture the grouping of parameters which together affect the output,

3) the ability to show which parameters dominate ranges of the output (low, intermediate, or high values of the output).

Variance-based methods have the major drawback of being computationally expensive because the method explores combinations of inputs selected in an iterative manner. Recent advances in computational performance, however, are making variance-based methods viable. It is proposed to develop and apply a variance-based sensitivity analysis using the base-case TPA code developed in IPA Phase 2, and compare the results of the regression-based study (already completed and documented in IPA Phase 2). The base case TPA code has a large number of sampled input parameters of which regression-based methods primarily identified infiltration as the dominant parameter. It is hypothesized that the importance of input variables can be better quantified using a variance-based method.

Products:
A paper will be written that documents the results from this study. This work is being conducted within the scope of the Performance Assessment Research Project, Task 2: Computational Methods. The results of this work will be documented in the Paper on Evaluation of Variance-Based Sensitivity Analysis (IM 5704-192-500, due 9/30/95) and submitted to the NRC.

References:
McKay, M.D., 1995. *Evaluating Prediction Uncertainty*. NUREG/CR-6311. Washington, DC: Nuclear Regulatory Commission.

Wescott, R.G. et al. 1995. Phase 2 Densomstration of the NRC's Capability to Conduct a Performance Assessment for a High-Level Waste Repository. NUREG-1464. Washington, DC: Nuclear Regulatory Commission.

10/20/95
JE

Used Optical Disk to store the files.

Here's how to use it.

You mount the drive /dev/intpd0c.

I am waiting on Derek to show me how to use the software that will allow me to mount the disk.

Once the disk is mounted the files can be read from

/optosun/randalld

optosun is the optical disk

RDM 3/15/96 logon to bren can use guest account, does not require password

put opto disk into drive for SUN computers (not ONYX, SGI)

bren% /bin/opto_mount␣c␣/opto ← will mount

bren % cd /opto/randalld ...
when done get off opto & dismount

bren % cd

bren % /bin/opto_umount␣c

Pages 4 Through 9 Are Intentionally
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25/5/24 | 1996

RDM 8/7/96

Listing for: Ron Janetzke

Fri May 24 16:40:06 1996

Page 1

Procedures for running TPA in PVM mode
==========

Initialize account on master host.
- cd to home account on scratchy.
- tar -xvf /home/scratchy/janetzke/zke/tarpvmfile .
- add PVM environment variables to .cshrc file in home account.
  Check .cshrc in /home/scratchy/janetzke for details.

Initialize account on each slave host.
- cd to /home/???/myaccount
- ftp snowwhite
  get /home/snowwhite/janetzke/tarfile
- tar -xvf tarfile .
- cp /home/sierra/janetzke/zke/tpa/clear to
  /home/sierra/myaccount/zke/tpa/clear
  The above applies to PVM slave host number one (sierra) only.
- add PVM environment variables to .cshrc file in home account.
  Check /home/???/janetzke/.cshrc for details.
- For each slave create /home/???/myaccount/.rhosts with this line:
  scratchy.cnwra.swri.edu myaccount

Prepare a run.
- Clear workspace for TPA slave codes.
  Issue "clear" from the /home/???/myaccount/zke/tpa
  subdirectory on each slave.
- Clear workspace for TPA master code.
  Issue "clear" from the /home/scratchy/myaccount/pvm/tpa
  subdirectory on the master host.
- cd pvm/tpa on master host.
- rm lhsoooo.out if it exists.
- edit TPA_LHS.LGD to the correct number of vectors (100) as needed.
- edit lhs20n.inp for updated seed value. (and other values as required)
- Run LHS
  ../lhs2/lhs.e <TPA_LHS.LGD
- ftp lhsoooo.out to myaccount/zke/tpa/lhsoooo.out on all slaves.
- edit tpa.inp and enter the correct number of vectors.

Start PVM deamons from master host.
- cd myaccount/pvm/tpa
- pvm tpahostfile
  >quit

Start PVM TPA run.
- cd myaccount/pvm/tpa
- ../master/master.e

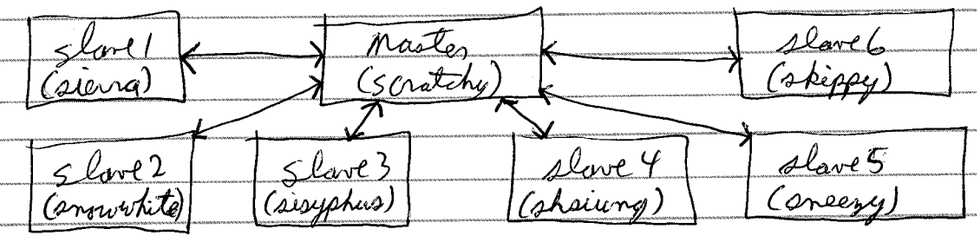
Archive data.
- cd myaccount/pvm/tpa
- mv ???.cum to a safe place with a new name.
- mv lhsoooo.out to a safe place with a new name.
- mv lhs20n.inp to a safe place with a new name.

Halt PVM deamons.
- pvm
  >halt

Go to "Prepare a run".
- Only need to change the input files that are different for the next run

readme

25/5/24/96 Running TPA on 1 master host and 6 slaves.



Moving output files
000050v.cum, lhs0000.out, and lhs20n.inp
to
scratchy/randalld/output/run#.000050v.cum,
" / " / " / " .lhsoooo.out, and
" / " / " / " .lhs20n.inp.

- is the run number.

In order to check if the output is correct, I am writing a C program that takes the inputs in file run#.lhsoooo.out and the output in file run#.000050v.cum and creates a matrix of the inputs with their outputs for each vector.

right now we are doing 50 vector runs.

The matrix can then be plotted to see if the output we are getting is correct.

slave	directory I am using	
sierra	home2/sierra/randalld	stu stoffoff
snowwhite	home/snowwhite/randalld	Amit Ghosh
sisyphus	home2/sisyphus/randalld	Ross Bagtzoglou
shsiung	home/randalld	Simon Hsiung
sneezy	home/sneezy/randalld	Ron Green
skippy	usr/local/skippy/randalld	Tong Song

JE 5/25/1996 RDM 8/7/96

Listing of TPA Code Input Parameters

```
TITLE - oooo20n, new permeabilities for FLOWMOD.
RANDOM SEED    -162791
NOBS   2
NREPS  1
1() CONSTANT    alpha                    C14 gas dispersivity
    0.0
2(X1) LOGNORMAL    AKR(1)                C14 fracture permeability of layer
    6.5e-17   5.5e-15
3(X2) LOGNORMAL    AKR(2)                C14 "
    1.6E-16   1.6e-14
4(X3) LOGNORMAL    AKR(3)                C14 "
    3.24e-17   3.24e-15
5(X4) LOGNORMAL    AKR(4)                C14 "
    9.7E-17   9.7e-15
6(X5) LOGNORMAL    AKR(5)                C14 "
    9.7E-17   9.7e-15
7() CONSTANT    AKR(6)                   C14 "
    9.7E-16
8() CONSTANT    AKR(7)                   C14 "
    9.7E-16
9() CONSTANT    AKR(8)                   C14 "
    9.7E-16
10() CONSTANT    AKR(9)                  C14 "
    9.7E-16
11() CONSTANT    AKR(10)                 C14 "
    9.7E-16
12() CONSTANT    pork(1)                 C14 fracture porousity of layer
    0.00014
13() CONSTANT    pork(2)                 C14 "
    0.000027
14() CONSTANT    pork(3)                 C14 "
    0.000041
15() CONSTANT    pork(4)                 C14 "
    0.000046
16() CONSTANT    pork(5)                 C14 "
    0.000046
17() CONSTANT    pork(6)                 C14 "
    0.000046
18() CONSTANT    pork(7)                 C14 "
    0.000046
19() CONSTANT    pork(8)                 C14 "
    0.000046
20() CONSTANT    pork(9)                 C14 "
    0.000046
21() CONSTANT    pork(10)                C14 "
    0.000046
22(X6) UNIFORM    retardk (1)            C14
    10.0   100.
23(X7) UNIFORM    retardk (2)            C14
    10.0   100.
24(X8) UNIFORM    retardk (3)            C14
    10.0   100.
25(X9) UNIFORM    retardk (4)            C14
    10.0   100.
26(X10) UNIFORM    retardk (5)           C14
    10.0   100.
27() CONSTANT    retardk (6)             C14
    10.0
28() CONSTANT    retardk (7)             C14
    10.0
29() CONSTANT    retardk (8)             C14
    10.0
30() CONSTANT    retardk (9)             C14
    10.0
31() CONSTANT    retardk (10)            C14
    10.0
32(X11) LOGNORMAL    permm (1)           FLOWMOD (matrix perm. for Topopah Spring)
    3.6e-19   1.2e-18
33(X12) LOGNORMAL    permm (2)           FLOWMOD (matrix perm. for Calico Hills v.)
    3.9e-15   2.0e-14
34(X13) LOGNORMAL    permm (3)           FLOWMOD (matrix perm. for Calico Hills z.)
    1.3e-20   6.7e-19
35(X14) LOGNORMAL    permm (4)           FLOWMOD (matrix perm. for Prow Pass)
    1.9e-16   9.6e-16
36(X15) LOGNORMAL    permm (5)           FLOWMOD (matrix perm. for Upper Crater Flat)
    5.1e-18   1.5e-17
37(X16) LOGNORMAL    PERMM (6)           FLOWMOD (matrix perm. for Bull Frog)
    3.5e-16   4.4e-16
38(X17) LOGNORMAL    permm (7)           FLOWMOD (matrix perm. - Middle Crater Flat)
    4.1e-18   1.6e-17
39(X18) LOGNORMAL    permf (1)           FLOWMOD (frac. perm. - Topopah Spring)
    1.1e-16   1.9e-16
40(X19) LOGNORMAL    permf (2)           FLOWMOD (frac. perm. - Calico Hills v.)
    5.6e-16   1.2e-15
41(X20) LOGNORMAL    permf (3)           FLOWMOD (frac. perm. - Calico Hills z.)
    6.2e-16   9.9e-16
42(X21) LOGNORMAL    permf (4)           FLOWMOD (frac. perm. - Prow Pass)
    3.9e-17   8.1e-17
43(X22) LOGNORMAL    permf (5)           FLOWMOD (frac. perm. - Upper Crater Flat)
    6.7e-16   9.8e-16
44(X23) LOGNORMAL    permf (6)           FLOWMOD (frac. perm. - Bull Frog)
    4.9e-17   6.4e-17
45(X24) LOGNORMAL    permf (7)           FLOWMOD (frac. perm. - Middle Crater Flat)
    6.2e-16   9.9e-16
46(X25) UNIFORM    porm (1)              FLOWMOD (matrix por. - Topopah Spring)
    .06   .16
47(X26) UNIFORM    porm (2)              FLOWMOD (matrix por. - Calico Hills v.)
    .330   .560
48(X27) UNIFORM    porm (3)              FLOWMOD (matrix por. - Calico Hills z.)
    .20   .33
49(X28) UNIFORM    porm (4)              FLOWMOD (matrix por. - Prow Pass)
    .24   .40
50(X29) UNIFORM    porm (5)              FLOWMOD (matrix por. - Upper Crater Flat)
    .18   .30
51(X30) UNIFORM    porm (6)              FLOWMOD (matrix por. - Bull Frog)
    .19   .32
52(X31) UNIFORM    porm (7)              FLOWMOD (matrix por. - Middle Crater Flat)
    .18   .30
53() CONSTANT    porf (1)                FLOWMOD (frac. por. - Topopah Spring)
    4.1e-5
54() CONSTANT    porf (2)                FLOWMOD (frac. por. - Calico Hills v.)
    4.6e-5
55() CONSTANT    porf (3)                FLOWMOD (frac. por. - Calico Hills z.)
    4.6e-5
56() CONSTANT    porf (4)                FLOWMOD (frac. por. - Prow Pass)
    1.3e-5
57() CONSTANT    porf (5)                FLOWMOD (frac. por. - Upper Crater Flat)
    4.6e-5
58() CONSTANT    porf (6)                FLOWMOD (frac. por. - Bull Frog)
    1.3e-5
59() CONSTANT    porf (7)                FLOWMOD (frac. por. - Middle Crater Flat)
    4.6e-5
60(X32) UNIFORM    betam (1)             FLOWMOD (Beta, mat. - Topopah Spring)
    1.4   2.2
61(X33) UNIFORM    betam (2)             FLOWMOD (Beta, mat. - Calico Hills v.)
    1.5   4.9
62(X34) UNIFORM    betam (3)             FLOWMOD (Beta, mat. - Calico Hills z.)
    1.2   3.3
63(X35) UNIFORM    betam (4)             FLOWMOD (Beta, mat. - Prow Pass)
    2.0   3.4
64(X36) UNIFORM    betam (5)             FLOWMOD (Beta, mat. - Upper Crater Flat)
    1.5   2.4
65(X37) UNIFORM    betam (6)             FLOWMOD (Beta, mat. - Bull Frog)
    2.3   4.2
66(X38) UNIFORM    betam (7)             FLOWMOD (Beta, mat. - Middle Crater Flat)
    1.5   2.4
67(X39) UNIFORM    betaf (1)             FLOWMOD (Beta, frac. - Topopah Spring)
    3.2   5.3
68(X40) UNIFORM    betaf (2)             FLOWMOD (Beta, frac. - Calico Hills v.)
    3.2   5.3
69(X41) UNIFORM    betaf (3)             FLOWMOD (Beta, frac. - Calico Hills z.)
    3.2   5.3
70(X42) UNIFORM    betaf (4)             FLOWMOD (Beta, frac. - Prow Pass)
    3.2   5.3
71(X43) UNIFORM    betaf (5)             FLOWMOD (Beta, frac. - Upper Crater Flat)
    3.2   5.3
72(X44) UNIFORM    betaf (6)             FLOWMOD (Beta, frac. - Bull Frog)
    3.2   5.3
73(X45) UNIFORM    betaf (7)             FLOWMOD (Beta, frac. - Middle Crater Flat)
    3.2   5.3
74() CONSTANT    grad (1)                FLOWMOD (sat. grad. - Topopah Spring)
    .0026
75() CONSTANT    grad (2)                FLOWMOD (sat. grad. - Calico Hills v.)
    .0026
76() CONSTANT    grad (3)                FLOWMOD (sat. grad. - Calico Hills z.)
    .0026
77() CONSTANT    grad (4)                FLOWMOD (sat. grad. - Prow Pass)
    .0026
78() CONSTANT    grad (5)                FLOWMOD (sat. grad. - Upper Crater Flat)
    .0026
79() CONSTANT    grad (6)                FLOWMOD (sat. grad. - Bull Frog)
    .0026
80() CONSTANT    grad (7)                FLOWMOD (sat. grad. - Middle Crater Flat)
    .0026
81(X46) NORMAL    dispersion             FLOWMOD (dispersion lenght in meters)
    0.3   30.0
82(X47) LOGUNIFORM    infiltration (undisturbed) FLOWMOD infiltration rate (M/yr)
    1.0e-4   5.0E-3
83(X48) LOGUNIFORM    kdm (1) cm         FLOWMOD (Kd - Topopah Spring)
    0.045   4.5
84(X49) LOGUNIFORM    kdm (2)            FLOWMOD (Kd - Calico Hills v.)
    .328   32.8
85(X50) LOGUNIFORM    kdm (3)            FLOWMOD (Kd - Calico Hills z.)
    0.166   16.6
86(X51) LOGUNIFORM    kdm (4)            FLOWMOD (Kd - Prow Pass)
    0.116   11.6
87(X52) LOGUNIFORM    kdm (5)            FLOWMOD (Kd - Upper Crater Flat)
    0.132   13.2
88(X53) LOGUNIFORM    kdm (6)            FLOWMOD (Kd - Bull Frog)
    0.12   12.0
89(X54) LOGUNIFORM    kdm (7)            FLOWMOD (Kd - Middle Crater Flat)
    0.132   13.2
90(X55) LOGUNIFORM    kdm (15) u         FLOWMOD (Kd - Topopah Spring)
    2.0E-5   2.0E-3
91(X56) LOGUNIFORM    kdm (16)           FLOWMOD (Kd - Calico Hills v.)
    0.002   0.2
92(X57) LOGUNIFORM    kdm(17)            FLOWMOD (Kd - Calico Hills z.)
    0.0001   0.01
93() CONSTANT    kdm(18)                 FLOWMOD (Kd - Prow Pass)
    0.0
94(X58) LOGUNIFORM    kdm(19)            FLOWMOD (Kd - Upper Crater Flat)
    8.0E-5   8.0E-3
95(X59) LOGUNIFORM    kdm(20)            FLOWMOD (Kd - Bull Frog)
    0.0002   0.02
96(X60) LOGUNIFORM    kdm(21)            FLOWMOD (Kd - Middle Crater Flat)
    8.0E-5   8.0E-3
97(X61) LOGUNIFORM    kdm (22) am        FLOWMOD (Kd - Topopah Spring)
    0.081   8.1
98(X62) LOGUNIFORM    kdm (23)           FLOWMOD (Kd - Calico Hills v.)
    0.081   8.1
99(X63) LOGUNIFORM    kdm (24)           FLOWMOD (Kd - Calico Hills z.)
    0.17   17.0
100(X64) LOGUNIFORM    kdm (25)          FLOWMOD (Kd - Prow Pass)
    0.45   45.0
101(X65) LOGUNIFORM    kdm (26)          FLOWMOD (Kd - Upper Crater Flat)
    0.136   13.6
102(X66) LOGUNIFORM    kdm (27)          FLOWMOD (Kd - Bull Frog)
    0.014   1.4
103(X67) LOGUNIFORM    kdm (28)          FLOWMOD (Kd - Middle Crater Flat)
    0.136   13.6
104(X68) LOGUNIFORM    kdm (29) np237    FLOWMOD (Kd - Topopah Spring)
    0.00045   0.045
105(X69) LOGUNIFORM    kdm (30)          FLOWMOD (Kd - Calico Hills v.)
    0.00045   0.045
106(X70) LOGUNIFORM    kdm (31)          FLOWMOD (Kd - Calico Hills z.)
    0.00027   0.027
107(X71) LOGUNIFORM    kdm (32)          FLOWMOD (Kd - Prow Pass)
    0.00051   0.051
108(X72) LOGUNIFORM    kdm (33)          FLOWMOD (Kd - Upper Crater Flat)
    0.00022   0.022
109(X73) LOGUNIFORM    kdm (34)          FLOWMOD (Kd - Bull Frog)
    0.00051   0.051
110(X74) LOGUNIFORM    kdm (35)          FLOWMOD (Kd - Middle Crater Flat)
    0.00022   0.022
111(X75) LOGUNIFORM    kdm (8) pu        FLOWMOD (Kd - Topopah Spring)
    0.017   1.7
112(X76) LOGUNIFORM    kdm (9)           FLOWMOD (Kd - Calico Hills v.)
    0.017   1.7
113(X77) LOGUNIFORM    kdm(10)           FLOWMOD (Kd - Calico Hills z.)
    0.0086   0.66
114(X78) LOGUNIFORM    kdm(11)           FLOWMOD (Kd - Prow Pass)
    0.013   1.3
115(X79) LOGUNIFORM    kdm(12)           FLOWMOD (Kd - Upper Crater Flat)
    0.0053   0.53
116(X80) LOGUNIFORM    kdm(13)           FLOWMOD (Kd - Bull Frog)
    0.0094   0.94
117(X81) LOGUNIFORM    kdm(14)           FLOWMOD (Kd - Middle Crater Flat)
    0.0053   0.53
118(X82) LOGUNIFORM    kdm (36) th       FLOWMOD (Kd - Topopah Spring)
    0.0048   0.48
```

skiping constants 1, 7-21, 27, 28-31, 53-58

Taking log of all lognormals and loguniform

skipping 59, 74-80, 93

```
119(X83) LOGUNIFORM    kdm (37)                FLOWMOD (Kd - Calico Hills v.)
         0.034   3.4
120(X84) LOGUNIFORM    kdm(38)                 FLOWMOD (Kd - Calico Hills z.)
         0.017   1.7
121(X85) LOGUNIFORM    kdm(39)                 FLOWMOD (Kd - Prow Pass)
         0.012   1.2
122(X86) LOGUNIFORM    kdm(40)                 FLOWMOD (Kd - Upper Crater Flat)
         0.014   1.4
123(X87) LOGUNIFORM    kdm(41)                 FLOWMOD (Kd - Bull Frog)
         0.013   1.3
124(X88) LOGUNIFORM    kdm(42)                 FLOWMOD (Kd - Middle Crater Flat)
         0.014   1.4
125(X89) LOGUNIFORM    kdm (43) ra226          FLOWMOD (Kd - Topopah Spring)
         0.15   15.0
126(X90) LOGUNIFORM    kdm (44)                FLOWMOD (Kd - Calico Hills v.)
         0.15   15.0
127(X91) LOGUNIFORM    kdm(45)                 FLOWMOD (Kd - Calico Hills z.)
         0.15   15.0
128(X92) LOGUNIFORM    kdm(46)                 FLOWMOD (Kd - Prow Pass)
         0.15   15.0
129(X93) LOGUNIFORM    kdm(47)                 FLOWMOD (Kd - Upper Crater Flat)
         0.12   12.0
130(X94) LOGUNIFORM    kdm(48)                 FLOWMOD (Kd - Bull Frog)
         0.5    50.0
131(X95) LOGUNIFORM    kdm(49)                 FLOWMOD (Kd - Middle Crater Flat)
         0.12   12.0
132(X96) LOGUNIFORM    kdm (50) pb210          FLOWMOD (Kd - Topopah Spring)
         0.00068   0.068
133(X97) LOGUNIFORM    kdm (51)                FLOWMOD (Kd - Calico Hills v.)
         0.0049   0.49
134(X98) LOGUNIFORM    kdm(52)                 FLOWMOD (Kd - Calico Hills z.)
         0.0025   0.25
135(X99) LOGUNIFORM    kdm(53)                 FLOWMOD (Kd - Prow Pass)
         0.0017   0.17
136(X100) LOGUNIFORM   kdm(54)                 FLOWMOD (Kd - Upper Crater Flat)
         0.0020   0.20
137(X101) LOGUNIFORM   kdm(55)                 FLOWMOD (Kd - Bull Frog)
         0.0018   0.18
138(X102) LOGUNIFORM   kdm(56)                 FLOWMOD (Kd - Middle Crater Flat)
         0.0020   0.20
139(X103) LOGUNIFORM   kdm (57) cs             FLOWMOD (Kd - Topopah Spring)
         0.036   3.6
140(X104) LOGUNIFORM   kdm (58)                FLOWMOD (Kd - Calico Hills v.)
         0.024   2.4
141(X105) LOGUNIFORM   kdm(59)                 FLOWMOD (Kd - Calico Hills z.)
         2.2   220.
142(X106) LOGUNIFORM   kdm(60)                 FLOWMOD (Kd - Prow Pass)
         0.22   22.0
143(X107) LOGUNIFORM   kdm(61)                 FLOWMOD (Kd - Upper Crater Flat)
         1.76   176.0
144(X108) LOGUNIFORM   kdm(62)                 FLOWMOD (Kd - Bull Frog)
         0.32   32.0
145(X109) LOGUNIFORM   kdm(63)                 FLOWMOD (Kd - Middle Crater Flat)
         1.76   176.0
146() CONSTANT    kdm (64) i129          FLOWMOD (Kd - Topopah Spring)
         0.0
147() CONSTANT    kdm (65)               FLOWMOD (Kd - Calico Hills v.)
         0.0
148() CONSTANT    kdm(66)                FLOWMOD (Kd - Calico Hills z.)
         0.0
149() CONSTANT    kdm(67)                FLOWMOD (Kd - Prow Pass)
         0.0
150() CONSTANT    kdm(68)                FLOWMOD (Kd - Upper Crater Flat)
         0.0
151() CONSTANT    kdm(69)                FLOWMOD (Kd - Bull Frog)
         0.0
152() CONSTANT    kdm(70)                FLOWMOD (Kd - Middle Crater Flat)
         0.0
153(X110) LOGUNIFORM   kdm (78) tc99          FLOWMOD (Kd - Topopah Spring)
         1.0E-6   1.0E-4
154() CONSTANT    kdm (79)               FLOWMOD (Kd - Calico Hills v.)
         0.0
155() CONSTANT    kdm(80)                FLOWMOD (Kd - Calico Hills z.)
         0.0
156(X111) LOGUNIFORM   kdm(81)                 FLOWMOD (Kd - Prow Pass)
         1.7E-5   1.7E-3
157() CONSTANT    kdm(82)                FLOWMOD (Kd - Upper Crater Flat)
         0.0
158(X112) LOGUNIFORM   kdm(83)                 FLOWMOD (Kd - Bull Frog)
         0.00042   0.042
159() CONSTANT    kdm(84)                FLOWMOD (Kd - Middle Crater Flat)
         0.0
160(X113) LOGUNIFORM   kdm(99) ni59            FLOWMOD (Kd - Topopah Spring)
         0.00037   0.037
161(X114) LOGUNIFORM   kdm(100)                FLOWMOD (Kd - Calico Hills v.)
         0.0027   0.27
162(X115) LOGUNIFORM   kdm(101)                FLOWMOD (Kd - Calico Hills z.)
         0.0014   0.14
163(X116) LOGUNIFORM   kdm(102)                FLOWMOD (Kd - Prow Pass)
         0.0009   0.09
164(X117) LOGUNIFORM   kdm(103)                FLOWMOD (Kd - Upper Crater Flat)
         0.0011   0.11
165(X118) LOGUNIFORM   kdm(104)                FLOWMOD (Kd - Bull Frog)
         0.001   0.1
166(X119) LOGUNIFORM   kdm(105)                FLOWMOD (Kd - Middle Crater Flat)
         0.0011   0.11
167() CONSTANT    kdm(106) c14           FLOWMOD (Kd - Topopah Spring)
         0.0
168() CONSTANT    kdm(107)               FLOWMOD (Kd - Calico Hills v.)
         0.0
169() CONSTANT    kdm(108)               FLOWMOD (Kd - Calico Hills z.)
         0.0
170() CONSTANT    kdm(109)               FLOWMOD (Kd - Prow Pass)
         0.0
171() CONSTANT    kdm(110)               FLOWMOD (Kd - Upper Crater Flat)
         0.0
172() CONSTANT    kdm(111)               FLOWMOD (Kd - Bull Frog)
         0.0
173() CONSTANT    kdm(112)               FLOWMOD (Kd - Middle Crater Flat)
         0.0
174(X120) LOGUNIFORM   kdm(113) se79           FLOWMOD (Kd - Topopah Spring)
         0.00026   0.026
175(X121) LOGUNIFORM   kdm(114)                FLOWMOD (Kd - Calico Hills v.)
         0.0003   0.03
176(X122) LOGUNIFORM   kdm(115)                FLOWMOD (Kd - Calico Hills z.)
         0.00045   0.045
177(X123) LOGUNIFORM   kdm(116)                FLOWMOD (Kd - Prow Pass)
         0.00025   0.025
178(X124) LOGUNIFORM   kdm(117)                FLOWMOD (Kd - Upper Crater Flat)
         0.00036   0.036
```

skipping 146-152, 154, 155, 157, 159, 167-173


```
179(X125) LOGUNIFORM   kdm(118)                FLOWMOD (Kd - Bull Frog)
         0.0013   0.13
180(X126) LOGUNIFORM   kdm(119)                FLOWMOD (Kd - Middle Crater Flat)
         0.00036   0.036
181() CONSTANT    kdm(120) nb94          FLOWMOD (Kd - Topopah Spring)
         0.0
182() CONSTANT    kdm(121)               FLOWMOD (Kd - Calico Hills v.)
         0.0
183() CONSTANT    kdm(122)               FLOWMOD (Kd - Calico Hills z.)
         0.0
184() CONSTANT    kdm(123)               FLOWMOD (Kd - Prow Pass)
         0.0
185() CONSTANT    kdm(124)               FLOWMOD (Kd - Upper Crater Flat)
         0.0
186() CONSTANT    kdm(125)               FLOWMOD (Kd - Bull Frog)
         0.0
187() CONSTANT    kdm(126)               FLOWMOD (Kd - Middle Crater Flat)
         0.0
188() CONSTANT    kdm (71) sn126         FLOWMOD (Kd - Topopah Spring)
         0.0134   1.34
189() CONSTANT    kdm (72)               FLOWMOD (Kd - Calico Hills v.)
         0.097   9.7
190() CONSTANT    kdm(73)                FLOWMOD (Kd - Calico Hills z.)
         0.049   4.9
191() CONSTANT    kdm(74)                FLOWMOD (Kd - Prow Pass)
         0.034   3.4
192() CONSTANT    kdm(75)                FLOWMOD (Kd - Upper Crater Flat)
         0.039   3.9
193() CONSTANT    kdm(76)                FLOWMOD (Kd - Bull Frog)
         0.035   3.5
194() CONSTANT    kdm(77)                FLOWMOD (Kd - Middle Crater Flat)
         0.039   3.9
195() CONSTANT    kdm (85) zr93          FLOWMOD (Kd - Topopah Spring)
         0.00048   0.048
196() CONSTANT    kdm (86)               FLOWMOD (Kd - Calico Hills v.)
         0.0034   0.34
197() CONSTANT    kdm(87)                FLOWMOD (Kd - Calico Hills z.)
         0.0017   0.17
198() CONSTANT    kdm(88)                FLOWMOD (Kd - Prow Pass)
         0.0012   0.12
199() CONSTANT    kdm(89)                FLOWMOD (Kd - Upper Crater Flat)
         0.0014   0.14
200() CONSTANT    kdm(90)                FLOWMOD (Kd - Bull Frog)
         0.0013   0.13
201() CONSTANT    kdm(91)                FLOWMOD (Kd - Middle Crater Flat)
         0.0014   0.14
202() CONSTANT    kdm(92) sr90           FLOWMOD (Kd - Topopah Spring)
         0.008   0.8
203() CONSTANT    kdm(93)                FLOWMOD (Kd - Calico Hills v.)
         0.0034   0.34
204() CONSTANT    kdm(94)                FLOWMOD (Kd - Calico Hills z.)
         0.89   89.0
205() CONSTANT    kdm(95)                FLOWMOD (Kd - Prow Pass)
         0.045   4.5
206() CONSTANT    kdm(96)                FLOWMOD (Kd - Upper Crater Flat)
         0.71   71.0
207() CONSTANT    kdm(97)                FLOWMOD (Kd - Bull Frog)
         0.028   2.8
208() CONSTANT    kdm(98)                FLOWMOD (Kd - Middle Crater Flat)
         0.71   71.0
209(X127) UNIFORM    areao                     FLOWMOD (area of discharge, M**2)
         3.75E4   3.75E5
210(X128) UNIFORM    ecorr(1)                  SOTEC
         100.   150.
211(X129) UNIFORM    ecorr(2)                  SOTEC
         -2.   -.5
212(X130) UNIFORM    ecorr(3)                  SOTEC
         -3.40   -3.
213(X131) UNIFORM    ecorr(4)                  SOTEC
         100.   300.
214(X132) UNIFORM    ecorr(5)                  SOTEC
         0.001   0.023
215(X133) UNIFORM    ecorr(6)                  SOTEC
         1000.   1500.
216(X134) UNIFORM    ecorr(7)                  SOTEC
         1000.   1500.
217(X135) LOGUNIFORM    ecorr(8)                   SOTEC
         1.e-5   0.001
218() CONSTANT    carbon(1)              SOTEC
         1.e-7
219() CONSTANT    carbon(2)              SOTEC
         1.e-5
220() CONSTANT    carbon(3)              SOTEC
         1.786e-2
221() CONSTANT    carbon(4)              SOTEC
         37.
222() CONSTANT    carbon(5)              SOTEC
         5.256e-8
223() CONSTANT    carbon(6)              SOTEC
         3.942e-7
224() CONSTANT    carbon(7)              SOTEC
         32.
225() CONSTANT    carbon(8)              SOTEC
         473.
226() CONSTANT    carbon(9)              SOTEC
         3.
227() CONSTANT    carbon(10)             SOTEC
         0.001
228() CONSTANT    carbon(11)             SOTEC
         6.1e-4
229() CONSTANT    carbon(12)             SOTEC
         7.2e-4
230() CONSTANT    carbon(13)             SOTEC
         4.89e-4
231() CONSTANT    carbon(14)             SOTEC
         2.48e-5
232() CONSTANT    carbon(15)             SOTEC
         6.2e-6
233(X136) LOGUNIFORM    forwar(1)                  SOTEC
         1.0e-5 1.0e-3
234(X137) LOGUNIFORM    forwar(2)                  SOTEC
         1.0e-5 1.0e-3
235(X138) LOGUNIFORM    forwar(3)                  SOTEC
         1.0e-5 1.0e-3
236(X139) LOGUNIFORM    forwar(4)                  SOTEC
         1.0e-5 1.0e-3
237(X140) LOGUNIFORM    forwar(5)                  SOTEC
         1.0e-5 1.0e-3
238(X141) LOGUNIFORM    forwar(6)                  SOTEC
         1.0e-5 1.0e-3
```

skipping 181-208, 218-232

```
239(X142) LOGUNIFORM     forwar(7)                    SOTEC
          1.0e-5 1.0e-3
240(X143) UNIFORM        warea(1)                     SOTEC
          0.0    1.0
241(X144) UNIFORM        warea(2)                     SOTEC
          0.0    1.0
242(X145) UNIFORM        warea(3)                     SOTEC
          0.0    1.0
243(X146) UNIFORM        warea(4)                     SOTEC
          0.0    1.0
244(X147) UNIFORM        warea(5)                     SOTEC
          0.0    1.0
245(X148) UNIFORM        warea(6)                     SOTEC
          0.0    1.0
246(X149) UNIFORM        warea(7)                     SOTEC
          0.0    1.0
247(X150) UNIFORM        rpor(1,1) packing(ep)        SOTEC
          0.08   0.2
248(X151) UNIFORM        rpor(2,1)                    SOTEC
          0.08   0.2
249(X152) UNIFORM        rpor(3,1)                    SOTEC
          0.08   0.2
250(X153) UNIFORM        rpor(4,1)                    SOTEC
          0.08   0.2
251(X154) UNIFORM        rpor(5,1)                    SOTEC
          0.08   0.2
252(X155) UNIFORM        rpor(6,1)                    SOTEC
          0.08   0.2
253(X156) UNIFORM        rpor(7,1)                    SOTEC
          0.08   0.2
254(X157) LOGUNIFORM     rdiff(1,1)                   SOTEC
          5.7e-6 5.7e-3
255(X158) LOGUNIFORM     rdiff(1,2)                   SOTEC
          5.7e-6 5.7e-3
256(X159) LOGUNIFORM     rdiff(1,3)                   SOTEC
          5.7e-6 5.7e-4
257(X160) LOGUNIFORM     rdiff(1,4)                   SOTEC
          5.7e-6 5.7e-4
258(X161) UNIFORM        volmax(1)                    SOTEC
          0.0    1.2
259(X162) UNIFORM        volmax(2)                    SOTEC
          0.0    1.2
260(X163) UNIFORM        volmax(3)                    SOTEC
          0.0    1.2
261(X164) UNIFORM        volmax(4)                    SOTEC
          0.0    1.2
262(X165) UNIFORM        volmax(5)                    SOTEC
          0.0    1.2
263(X166) UNIFORM        volmax(6)                    SOTEC
          0.0    1.2
264(X167) UNIFORM        volmax(7)                    SOTEC
          0.0    1.2
265(X168) LOGNORMAL      rde(1)                       SOTEC
          2.3    131.2
266(X169) LOGNORMAL      rde(3)                       SOTEC
          1.003  1.325
267(X170) LOGNORMAL      rde(4)                       SOTEC
          2.79   165.4
268(X171) LOGNORMAL      rde(5)                       SOTEC
          1.008  1.81
269(X172) LOGNORMAL      rde(2)                       SOTEC
          1.3    33.6
270(X173) LOGNORMAL      rde(6)                       SOTEC
          1.76   77.5
271(X174) LOGNORMAL      rde(7)                       SOTEC
          3.44   245.2
272(X175) LOGNORMAL      rde(8)                       SOTEC
          1.39   40.07
273(X176) LOGNORMAL      rde(9)                       SOTEC
          1.68   69.4
274() CONSTANT           rde(10)                      SOTEC
          1.0
275(X177) LOGNORMAL      rde(12)                      SOTEC
          1.0002 1.016
276(X178) LOGNORMAL      rde(15)                      SOTEC
          1.08   8.81
277() CONSTANT           rde(16)                      SOTEC
          1.0
278(X179) LOGNORMAL      rde(17)                      SOTEC
          1.007  1.65
279() CONSTANT           rde(18)                      SOTEC
          1.0
280() CONSTANT           rde(11)                      SOTEC
          1.23   23.8
281() CONSTANT           rde(13)                      SOTEC
          1.39   40.1
282() CONSTANT           rde(14)                      SOTEC
          1.19   20.5
283() CONSTANT           rde(19)                      SOTEC
          1.0    10.0
284() CONSTANT           rde(20)                      SOTEC
          1.0    10.0
285() CONSTANT           rde(21)                      SOTEC
          1.0    10.0
286() CONSTANT           rde(22)                      SOTEC
          1.0    10.0
287() CONSTANT           rde(23)                      SOTEC
          1.0    10.0
288() CONSTANT           rde(24)                      SOTEC
          1.0    10.0
289() CONSTANT           rde(25)                      SOTEC
          1.0    10.0
290() CONSTANT           rde(26)                      SOTEC
          1.0    10.0
291() CONSTANT           rde(27)                      SOTEC
          1.0    10.0
292() CONSTANT           rde(28)                      SOTEC
          1.0    10.0
293() CONSTANT           rde(29)                      SOTEC
          1.0    10.0
294() CONSTANT           rde(30)                      SOTEC
          1.0    10.0
295() CONSTANT           rde(31)                      SOTEC
          1.0    10.0
296() CONSTANT           rde(32)                      SOTEC
          1.0    10.0
297() CONSTANT           rde(33)                      SOTEC
          1.0    10.0
298() CONSTANT           rde(34)                      SOTEC
          1.0    10.0
```

skipping 274, 277, 279-298


```
299() CONSTANT           rde(35)                      SOTEC
          1.0    10.0
300() CONSTANT           rde(36)                      SOTEC
          1.0    10.0
301(X180) LOGUNIFORM     sol(1) CM                    SOTEC
          2.56e-7    5.e-4
302(X181) LOGUNIFORM     sol(3) U                     SOTEC
          4.e-8      3.e-5
303(X182) LOGUNIFORM     sol(4) AM                    SOTEC
          1.e-6      3.e-4
304(X183) LOGUNIFORM     sol(5) NP                    SOTEC
          1.4e-4     0.0237
305(X184) LOGUNIFORM     sol(2) PU                    SOTEC
          2.e-7      5.e-4
306(X185) LOGUNIFORM     sol(6) TH                    SOTEC
          2.e-12     1.e-4
307(X186) LOGUNIFORM     sol(7) RA                    SOTEC
          9.e-6      9.e-5
308(X187) LOGUNIFORM     sol(8) PB                    SOTEC
          2.1e-6     6.3e-4
309() CONSTANT           sol(9)    CS                 SOTEC
          1.0
310() CONSTANT           sol(10)   I                  SOTEC
          1.0
311() CONSTANT           sol(12)   TC                 SOTEC
          1.0
312(X188) LOGUNIFORM     sol(15)        NI            SOTEC
          2.8e-7     1.7e-3
313() CONSTANT           sol(16)   C                  SOTEC
          1.0
314() CONSTANT           sol(17)   SE                 SOTEC
          1.0
315() CONSTANT           sol(18)   NB                 SOTEC
          1.0
316() CONSTANT           sol(11)   SN                 SOTEC
          5.e-9      3.8e-6
317() CONSTANT           sol(13)   ZR                 SOTEC
          4.e-9      2.e-7
318() CONSTANT           sol(14)   SR                 SOTEC
          8.e-2
319() CONSTANT           sol(19)                      SOTEC
          0.0    1.0
320() CONSTANT           sol(20)                      SOTEC
          0.0    1.0
321() CONSTANT           sol(21)                      SOTEC
          0.0    1.0
322() CONSTANT           sol(22)                      SOTEC
          0.0    1.0
323() CONSTANT           sol(23)                      SOTEC
          0.0    1.0
324() CONSTANT           sol(24)                      SOTEC
          0.0    1.0
325() CONSTANT           sol(25)                      SOTEC
          0.0    1.0
326() CONSTANT           sol(26)                      SOTEC
          0.0    1.0
327() CONSTANT           sol(27)                      SOTEC
          0.0    1.0
328() CONSTANT           sol(28)                      SOTEC
          0.0    1.0
329() CONSTANT           sol(29)                      SOTEC
          0.0    1.0
330() CONSTANT           sol(30)                      SOTEC
          0.0    1.0
331() CONSTANT           sol(31)                      SOTEC
          0.0    1.0
332() CONSTANT           sol(32)                      SOTEC
          0.0    1.0
333() CONSTANT           sol(33)                      SOTEC
          0.0    1.0
334() CONSTANT           sol(34)                      SOTEC
          0.0    1.0
335() CONSTANT           sol(35)                      SOTEC
          0.0    1.0
336() CONSTANT           sol(36)                      SOTEC
          0.0    1.0
337(X189) UNIFORM        funnel(1)                    SOTEC
          0.0    0.4
338(X190) UNIFORM        funnel(2)                    SOTEC
          0.0    0.4
339(X191) UNIFORM        funnel(3)                    SOTEC
          0.0    0.4
340(X192) UNIFORM        funnel(4)                    SOTEC
          0.0    0.4
341(X193) UNIFORM        funnel(5)                    SOTEC
          0.0    0.4
342(X194) UNIFORM        funnel(6)                    SOTEC
          0.0    0.4
343(X195) UNIFORM        funnel(7)                    SOTEC
          0.0    0.4
344 UNIFORM      time                          VOLCANO
    0.0    10000.
345 UNIFORM      u1(dike[0.-.9]/cone[.9-1.]    VOLCANO
    0.0    1.0
346 UNIFORM      u2(dike XO/cone Xcenter)      VOLCANO
    0.0    1.0
347 UNIFORM      u3(dike YO/cone Ycenter)      VOLCANO
    0.0    1.0
348 UNIFORM      u4(dike area)          VOLCANO
    0.0    1.0
349 UNIFORM      u5(dike length)        VOLCANO
    0.0    1.0
350 UNIFORM      u6(dike angle wrt East) VOLCANO
    0.0    1.0
351 UNIFORM      u7(cone radius)        VOLCANO
    0.0    1.0
352 UNIFORM      u8(cone area)          VOLCANO
    0.0    1.0
353 NORMAL       number of holes             drillo
    3.5    27.5
354 UNIFORM      borehole radius             drillo
    0.02   .1
355 UNIFORM      hit indicator               drillo #1
    0.0    1.0
356 UNIFORM      hit indicator               drillo
    0.0    1.0
357 UNIFORM      hit indicator               drillo
    0.0    1.0
358 UNIFORM      hit indicator               drillo
    0.0    1.0
```

skipping 299, 300, 309-336

```
359 UNIFORM     hit indicator     drillo
    0.0    1.0
360 UNIFORM     hit indicator     drillo
    0.0    1.0
361 UNIFORM     hit indicator     drillo
    0.0    1.0
362 UNIFORM     hit indicator     drillo
    0.0    1.0
363 UNIFORM     hit indicator     drillo
    0.0    1.0
364 UNIFORM     hit indicator     drillo
    0.0    1.0
365 UNIFORM     hit indicator     drillo #11
    0.0    1.0
366 UNIFORM     hit indicator     drillo
    0.0    1.0
367 UNIFORM     hit indicator     drillo
    0.0    1.0
368 UNIFORM     hit indicator     drillo
    0.0    1.0
369 UNIFORM     hit indicator     drillo
    0.0    1.0
370 UNIFORM     hit indicator     drillo
    0.0    1.0
371 UNIFORM     hit indicator     drillo
    0.0    1.0
372 UNIFORM     hit indicator     drillo
    0.0    1.0
373 UNIFORM     hit indicator     drillo
    0.0    1.0
374 UNIFORM     hit indicator     drillo
    0.0    1.0
375 UNIFORM     hit indicator     drillo #21
    0.0    1.0
376 UNIFORM     hit indicator     drillo
    0.0    1.0
377 UNIFORM     hit indicator     drillo
    0.0    1.0
378 UNIFORM     hit indicator     drillo
    0.0    1.0
379 UNIFORM     hit indicator     drillo
    0.0    1.0
380 UNIFORM     hit indicator     drillo
    0.0    1.0
381 UNIFORM     hit indicator     drillo
    0.0    1.0
382 UNIFORM     hit indicator     drillo
    0.0    1.0
383 UNIFORM     hit indicator     drillo
    0.0    1.0
384 UNIFORM     hit indicator     drillo
    0.0    1.0
385 UNIFORM     drill time        drillo #1
    100.0 9900.0
386 UNIFORM     drill time        drillo
    100.0 9900.0
387 UNIFORM     drill time        drillo
    100.0 9900.0
388 UNIFORM     drill time        drillo
    100.0 9900.0
389 UNIFORM     drill time        drillo
    100.0 9900.0
390 UNIFORM     drill time        drillo
    100.0 9900.0
391 UNIFORM     drill time        drillo
    100.0 9900.0
392 UNIFORM     drill time        drillo
    100.0 9900.0
393 UNIFORM     drill time        drillo
    100.0 9900.0
394 UNIFORM     drill time        drillo
    100.0 9900.0
395 UNIFORM     drill time        drillo #11
    100.0 9900.0
396 UNIFORM     drill time        drillo
    100.0 9900.0
397 UNIFORM     drill time        drillo
    100.0 9900.0
398 UNIFORM     drill time        drillo
    100.0 9900.0
399 UNIFORM     drill time        drillo
    100.0 9900.0
400 UNIFORM     drill time        drillo
    100.0 9900.0
401 UNIFORM     drill time        drillo
    100.0 9900.0
402 UNIFORM     drill time        drillo
    100.0 9900.0
403 UNIFORM     drill time        drillo
    100.0 9900.0
404 UNIFORM     drill time        drillo
    100.0 9900.0
405 UNIFORM     drill time        drillo #21
    100.0 9900.0
406 UNIFORM     drill time        drillo
    100.0 9900.0
407 UNIFORM     drill time        drillo
    100.0 9900.0
408 UNIFORM     drill time        drillo
    100.0 9900.0
409 UNIFORM     drill time        drillo
    100.0 9900.0
410 UNIFORM     drill time        drillo
    100.0 9900.0
411 UNIFORM     drill time        drillo
    100.0 9900.0
412 UNIFORM     drill time        drillo
    100.0 9900.0
413 UNIFORM     drill time        drillo
    100.0 9900.0
414 UNIFORM     drill time        drillo
    100.0 9900.0
415 UNIFORM     zone              drillo #1
    .0     1.0
416 UNIFORM     zone              drillo
    .0     1.0
417 UNIFORM     zone              drillo
    .0     1.0
418 UNIFORM     zone              drillo
    .0     1.0
```

~~skip~~


```
419 UNIFORM     zone              drillo
    .0     1.0
420 UNIFORM     zone              drillo
    .0     1.0
421 UNIFORM     zone              drillo
    .0     1.0
422 UNIFORM     zone              drillo
    .0     1.0
423 UNIFORM     zone              drillo
    .0     1.0
424 UNIFORM     zone              drillo
    .0     1.0
425 UNIFORM     zone              drillo #11
    .0     1.0
426 UNIFORM     zone              drillo
    .0     1.0
427 UNIFORM     zone              drillo
    .0     1.0
428 UNIFORM     zone              drillo
    .0     1.0
429 UNIFORM     zone              drillo
    .0     1.0
430 UNIFORM     zone              drillo
    .0     1.0
431 UNIFORM     zone              drillo
    .0     1.0
432 UNIFORM     zone              drillo
    .0     1.0
433 UNIFORM     zone              drillo
    .0     1.0
434 UNIFORM     zone              drillo
    .0     1.0
435 UNIFORM     zone              drillo #21
    .0     1.0
436 UNIFORM     zone              drillo
    .0     1.0
437 UNIFORM     zone              drillo
    .0     1.0
438 UNIFORM     zone              drillo
    .0     1.0
439 UNIFORM     zone              drillo
    .0     1.0
440 UNIFORM     zone              drillo
    .0     1.0
441 UNIFORM     zone              drillo
    .0     1.0
442 UNIFORM     zone              drillo
    .0     1.0
443 UNIFORM     zone              drillo
    .0     1.0
444 UNIFORM     zone              drillo
    .0     1.0
445 LOGUNIFORM     infiltration (disturbed)     FLOWMOD infiltration rate (M/yr)
    5.0E-3     1.0e-2
```

This is all 445 inputs. We are only looking at the first 343. Out of these 343 we are skipping all of the contents. This leaves us with 195 inputs. These 195 inputs are labeled X1 - X195. This can be seen on the previous pages.

JE
5/26/1995 Rpm 8/7/96

The 195 inputs are put into a data file ~~as~~ a matrix. There are 50 vectors each one containing 195 inputs. The last column in the matrix is the output for that ~~pat~~ particular vector.

The C-program that takes ~~these~~ the input and outputs the matrix is called tpamatrix. This program takes 4 command line parameters.

1st - run#.000050v.cam
2nd - run#.lhs0000.out
3rd - run#.lhs20n.inp
4th - whatever you want the outputted matrix file to be called.

I am going to use
run#.out

~~#1 is the run which run~~
- This is a number between 1 and 15, since we are going to do 15 runs. Each run will be done with a different seed value.

To test to see if the output is correct we took the matrix for run 1 and printed out all of the minimum and maximum values for the inputs and compared them to ~~the~~ what they should not exceed. Those tables are shown on the next few pages

minmax

Variable	Minimum	Maximum	Minimum	Maximum
x1(L2)	-15.97596	-14.35438	-16.18709	-14.25964
x2(L3)	-15.79588	-14.02825	-15.79588	-13.79588 Min
x3(L4)	-16.196369	-14.79131	-16.48945	-14.48945
x4(L5)	-15.92741	-14.23333	-16.01323	-14.01323
x5(L6)	-15.74714	-14.26959	-16.01323	-14.01323
x6(22)	10.8707	98.405273	10.0	100.0
x7(23)	10.48487	99.800621	10.0	100.0
x8(24)	11.37819	98.698738	10.0	100.0
x9(25)	11.75551	99.929237	10.0	100.0
x10(26)	11.23161	99.978508	10.0	100.0
x11(L32)	-18.443701	-18.003111	-18.443697	-17.920819
x12(L33)	-14.3013	-13.7555	-14.40874	-13.67877
x13(L34)	-19.63159	-18.293921	-19.8860566	-18.173925
x14(L35)	-15.60386	-15.06537	-15.72125	-15.01773
x15(L36)	-17.22658	-16.880119	-17.29293	-16.82391
x16(L37)	-15.4402	-15.37267	-15.45593	-15.3565
x17(L38)	-17.30282	-16.795879	-17.387216	-16.7958800 Max
x18(L39)	-15.93273	-15.75657	-15.9586	-15.72125
x19(L40)	-15.19948	-14.97543	-15.25181	-14.92082
x20(L41)	-15.17838	-15.03654	-15.2076083	-15.0043648
x21(L42)	-16.372511	-16.116751	-16.408935	-16.091515
x22(L43)	-15.16512	-15.02848	-15.173925	-15.0087739
x23(L44)	-16.29855	-16.212351	-16.30980	-16.173820
x24(L45)	-15.20761	-15.03642	-15.2076083	-15.004365 Min
x25(46)	0.06191818	0.15835769	0.06	0.16
x26(47)	0.33141351	0.55757332	0.330	0.560
x27(48)	0.2004928	0.32783049	0.20	0.33
x28(49)	0.2420143	0.3988691	0.24	0.40
x29(50)	0.18208051	0.29870579	0.18	0.30
x30(51)	0.19134019	0.31927341	0.19	0.32
x31(52)	0.1812595	0.2983835	0.18	0.30
x32(60)	1.406641	2.185554	1.4	2.2
x33(61)	1.556229	4.8479009	1.5	4.9
x34(62)	1.224326	3.261004	1.2	3.3
x35(63)	2.0163691	3.3757191	2.0	3.4
x36(64)	1.506068	2.3946991	1.5	2.4
x37(65)	2.3281779	4.1657319	2.3	4.2
x38(66)	1.514726	2.3950369	1.5	2.4
x39(67)	3.2247729	5.26369	3.2	5.3
x40(68)	3.204668	5.2762179	3.2	5.3
x41(69)	3.2295139	5.2708788	3.2	5.3
x42(70)	3.2024169	5.2771902	3.2	5.3
x43(71)	3.2283151	5.298593	3.2	5.3
x44(72)	3.2209921	5.2869601	3.2	5.3
x45(73)	3.232754	5.294558	3.2	5.3
x46(81)	1.787837	25.241461	0.3	30.0
x47(L82)	-3.9745181	-2.330364	-4.0	-2.3010294
x48(L83)	-1.31473	0.62022787	-1.346787	0.6532125
x49(L84)	-0.48004669	1.491094	-0.4841262	1.51587
x50(L85)	-0.74064249	1.180741	-0.7798919	1.220108
x51(L86)	-0.92229998	1.042006	-0.7355420	1.064958
x52(L87)	-0.87549973	1.103533	-0.8794261	1.120574
x53(L88)	-0.89321738	1.041208	-0.7208187	1.0771812
x54(L89)	-0.85247701	1.106987	-0.879426	1.1205739

Page 1

The minimum value was real close to exceed the ~~actual~~ absolute minimum but it is O.K.

the maximum value was exceeded, but this is because of what was logged. Our maximum be being logged was 1.600001 E-17 and then was 1.6 E-17. So I think they just rounded theres, So the output is O.K.

The same thing happened on this as in the above.

JE 5/26/95

This data is incorrect and no longer used. 6/9

minmax

x55(L90)	-4.6915851	-2.7122941	-4.6989700	-2.6989700
x56(L91)	-2.697865	-0.73348141	-2.6989700	-0.6989700
x57(L92)	-3.9976079	-2.038326	-4.0	-2.0
x58(L94)	-4.0679669	-2.1047239	-4.0969100	-2.0969100
x59(L95)	-3.684876	-1.731612	-3.6989700	-1.6989700
x60(L96)	-4.0740538	-2.097765	-4.0969100	-2.0969100
x61(L97)	-1.060867	0.89215922	-1.0715 1498	0.7084850 2
x62(L98)	-1.081157	0.9019922	-1.0715 1498	0.7084850 2
x63(L99)	-0.74995857	1.19346	-0.76955109	1.2304489
x64(L100)	-0.3229216	1.618104	-0.3467874 86	1.653213 5
x65(L101)	-0.84889382	1.124252	-0.8646109	1.1335389 1
x66(L102)	1.832987	0.1113378	-1.8538719 6	0.1461280 36
x67(L103)	-0.82993931	1.1210541	-0.8664610 9	1.1335389 1
x68(L104)	-3.317599	-1.351033	-3.3467875	-1.3467874 86
x69(L105)	-3.319201	-1.348485	-3.3467875	-1.3467874 86
x70(L106)	-3.5557361	-1.590724	-3.5686562 36	-1.5686562 36
x71(L107)	-3.282685	-1.3231961	-3.2924278 2	-1.2924278 2
x72(L108)	-3.6425371	-1.692969	-3.6575773	-1.6575773 2
x73(L109)	-3.2897129	-1.2980731	-3.2924278 2	-1.2924278 2
x74(L110)	-3.6202891	-1.687524	-3.6575773	-1.6575773 2
x75(L111)	-1.73896	0.2257013	-1.7695510 8	0.2304489 2
x76(L112)	-1.75188	0.2119159	-1.7695510 8	0.2304489 2
x77(L113)	-2.175252	-0.1942445	-2.1808436 1	-0.1809856 06
x78(L114)	-1.871943	0.1112827	-1.8860566 5	0.1137433 52
x79(L115)	-2.255702	-0.2826274	-2.2757241	-0.2757241 3
x80(L116)	-1.9879611	-0.028391169	-2.0268721 46	-2.6872146 E-2
x81(L117)	-2.256855	-0.2845189	-2.2757241	-0.2757241
x82(L118)	-2.291249	-0.3497124	-2.3187588	-0.3187588
x83(L119)	-1.454263	0.50567043	-1.4685211	0.5314789
x84(L120)	-1.739509	0.2138534	-1.7695511	0.2304489
x85(L121)	-1.888962	0.072606802	-1.7208188	0.0771812
x86(L122)	-1.836165	0.1145957	-1.8538720	0.1461280
x87(L123)	-1.847333	0.1049836	-1.8860566	0.1137434
x88(L124)	-1.816222	0.1276606	-1.8538720	0.1461280
x89(L125)	-0.81543517	1.159049	-0.8237087	1.1760913
x90(L126)	-0.78780949	1.138894	-0.8237087	1.1760913
x91(L127)	-0.81466472	1.163236	0.8237087	1.1760913
x92(L128)	-0.80932909	1.173755	-0.8237087	1.1760913
x93(L129)	-0.89764208	1.069183	-0.7708188	1.0771812
x94(L130)	-0.28805059	1.6855201	-0.3010300	1.6989700
x95(L131)	-0.89426911	1.068119	-0.7708188	1.0771812
x96(L132)	-3.1293011	-1.191957	-3.1674911	-1.1674911
x97(L133)	-2.2803841	-0.3329908	-2.3078039	-0.3078039
x98(L134)	-2.5874441	-0.63491112	-2.6020600	-0.6020600
x99(L135)	-2.7639561	-0.77015132	-2.7695511	-0.7695511
x100(L136)	-2.6939609	-0.72331828	-2.6989700	-0.6989700
x101(L137)	-2.735148	-0.7800495	-2.7447275	-0.7447275
x102(L138)	-2.684731	-0.7022692	-2.6989700	-0.6989700
x103(L139)	-1.423262	0.53000212	-1.4436975	0.5563025
x104(L140)	-1.596824	0.3440868	-1.6197888	0.3802112
x105(L141)	0.37088981	2.3198991	0.3424227	2.3424227
x106(L142)	-0.62026381	1.309525	-0.6575773	1.3424227
x107(L143)	0.24992099	2.2212851	0.2455127	2.2455127
x108(L144)	-0.4903934	1.486147	-0.4948500	1.5051500
x109(L145)	0.2678135	2.2094181	0.2455127	2.2455127

6/9/95
ZE

see Page 32

minmax

x110(L153)	-5.988451	-4.030561	-6	-4
x111(L156)	-4.744318	-2.7713549	-4.769551	-2.769551
x112(L158)	-3.337563	-1.393427	-3.326750	-1.326750
x113(L160)	-3.4180119	-1.444742	-3.431748	-1.431748
x114(L161)	-2.549175	-0.59490782	-2.568636	-5.686 E-1
x115(L162)	-2.840795	-0.87913603	-2.853872	-.853872
x116(L163)	-3.0201149	-1.073994	-3.045757	-1.045757
x117(L164)	-2.933234	-0.97101343	-2.958607	-.958607 3
x118(L165)	-2.973464	-1.0066971	-3	-1
x119(L166)	-2.9340091	-0.9902615	-2.958607	-.958607
x120(L174)	-3.554558	-1.585234	-3.585027	-1.585027
x121(L175)	-3.496558	-1.524518	-3.522879	-1.522879
x122(L176)	-3.329304	-1.35746	-3.346787	-1.346787
x123(L177)	-3.5891621	-1.631734	-3.60206	-1.60206
x124(L178)	-3.4098561	-1.451907	-3.443697	-1.443697
x125(L179)	-2.876689	-0.89619148	-2.886057	-.886057
x126(L180)	-3.415828	-1.464506	-3.443697	-1.443697
x127(209)	39575.711	371818.5	37500	375000
x128(210)	100.6718	149.02589	100	150
x129(211)	-1.980175	-0.51020718	-2	-.5
x130(212)	-3.3938749	-3.001081	-3.4	-3
x131(213)	102.8135	298.00079	100	300
x132(214)	0.00131156	0.02291115	.001	.023
x133(215)	1002.537	1496.145	1000	1500
x134(216)	1006.119	1499.316	1000	1500
x135(L217)	-4.9786758	-3.0042100	-5	-3
x136(L233)	-4.9807401	-3.0123489	-5	-3
x137(L234)	-4.9861588	-3.0204849	-5	-3
x138(L235)	-4.991468	-3.002012	-5	-3
x139(L236)	-4.9940109	-3.017204	-5	-3
x140(L237)	-4.9609809	-3.0116279	-5	-3
x141(L238)	-4.990828	-3.0014801	-5	-3
x142(L239)	-4.977478	-3.037972	-5	-3
x143(240)	0.0136166	0.99394113	0	1
x144(241)	0.01143163	0.99869293	0	1
x145(242)	0.004413711	0.98463333	0	1
x146(243)	0.01472113	0.98254418	0	1
x147(244)	0.001380039	0.9972924	0	1
x148(245)	0.008188388	0.99969512	0	1
x149(246)	0.01545988	0.98850352	0	1
x150(247)	0.080417648	0.1994071	.08	.2
x151(248)	0.080367967	0.19773731	.08	.2
x152(249)	0.080678888	0.1988394	.08	.2
x153(250)	0.080564931	0.199039	.08	.2
x154(251)	0.080063127	0.19787811	.08	.2
x155(252)	0.080549777	0.19866639	.08	.2
x156(253)	0.081273466	0.1992276	.08	.2
x157(L254)	-5.1967669	-2.273948	-5.244125	-2.244125
x158(L255)	-5.218904	-2.2657449	-5.244125	-2.244125
x159(L256)	-5.2334528	-3.2799621	-5.244125	-2.244125
x160(L257)	-5.2378249	-3.2591529	-5.244125	-2.244125
x161(258)	0.000471659	1.191214	0	1.2
x162(259)	0.01244644	1.197348	0	1.2
x163(260)	0.008424018	1.193668	0	1.2
x164(261)	0.01267957	1.18264	0	1.2

6/9/95
ZE

see page 32

minmax

x165(262)	0.020650391	1.1896681	0	1.2
x166(263)	0.000476703	1.19268	0	1.2
x167(264)	0.005587691	1.1799231	0	1.2
x168(L265)	0.64177239	2.114397	3617278	2.117934
x169(L266)	0.019179041	0.1076108	.0013009	.122216
x170(L267)	0.67363667	1.987365	.445604	2.218536
x171(L268)	0.00017496l	0.2399658	.0034605	.257679
x172(L269)	0.34124571	1.52634	.113943	1.52634 max
x173(L270)	0.41355100	1.644455	.245513	1.889302
x174(L271)	0.76586908	2.1775351	.536558	2.389520
x175(L272)	0.3811866	1.488698	.143015	1.602819
x176(L273)	0.44071269	1.6926301	.225309	1.841359
x177(L275)	0.001000788	0.006575585	.00008685	.0068937
x178(L276)	0.1716103	0.84344631	.0334238	.944976
x179(L278)	0.019609731	0.1875156	.0030295	.317484
x180(L301)	-6.5449901	-3.3441801	-6.591760	-3.30103
x181(L302)	-7.3952322	-4.573153	-7.397940	-4.572879
x182(L303)	-5.9548478	-3.553762	-6	-3.572879
x183(L304)	-3.835916	-1.643853	-3.853872	-1.625252
x184(L305)	-6.656395	-3.338346	-6.698970	-3.30103
x185(L306)	-11.63431	-4.010767	-11.678970	-4
x186(L307)	-5.0355859	-4.0625038	-5.045757	-4.045757
x187(L308)	-5.66399	-3.229794	-5.677781	-3.200659
x188(L312)	-6.531498	-2.7866039	-6.552842	-2.769551
x189(337)	0.003529542	0.39607441	0	.4
x190(338)	0.007335194	0.39548269	0	.4
x191(339)	0.006684865	0.39726299	0	.4
x192(340)	0.007421779	0.39851421	0	.4
x193(341)	0.006948214	0.39753979	0	.4
x194(342)	0.001632247	0.3947863	0	.4
x195(343)	0.003267154	0.39484981	0	.4
y	-1.15509	4.9413128		

6/9/95
2E see page 32

← Maximum values were close, on actually our maximum exceeded what it should have. But this is just because they rounded their maximum before taking the log of it.

2E
5/29/1995 I made some changes to the Matrix class program.
RDM 8/7/96

In the procedure RMatrix::RMatrix I added the line

double_array = NULL;

I added a Shuffle routine to the RMatrix class that shuffles up the numbers in the columns of the matrix.

While writing a program that uses the shuffle routine I have noticed that the data I'm putting into the matrix is ~~returning~~ ~~incorrectly~~ not returning correctly. So I'm now trying to find the error in the Matrix ~~pro~~ Class.

2E
5/30/1995 RDM 8/7/96 The error was in indexing the array.

we are using a single array, but looking at it like a 2-D array.

we were indexing it by

double_array[number_of_rows*(row-1)+col-1]

and it should be indexed by

double_array[number_of_columns*(row-1)+col-1]

As far as I can see I have made all the changes that were necessary involving this error.

I made a shuffle program that reads in a matrix shuffles the elements in the columns and outputs the new matrix.

we needed this so that we could take the lhs0000.out file from the first run, shuffle it up and use it as the new input when we run nostes.e.

I have created 15 lhs0000.out files using different random seed values.

The files are named run#.lhs0000.out.

The shuffle program is named

shuffletpa

and it takes three command line parameters.
~~1) the the matrix you want to shuffle.~~ 2E 5/30/95
1) lhs0000.out file that you want to shuffle, 2) the new output file name and 3) the random seed value.

Old 6/9

Run #	Random Seed Value
1)	-162791
2)	10000
3)	15000
4)	13456
5)	22826
6)	34978
7)	11785
8)	6543
9)	1945
10)	8756
11)	11000
12)	12128
13)	17592
14)	25305
15)	19864

```
/*****************************************************************/

        // Shuffling
void RMatrix::Shuffle(int seedvalue)
{
  double temp;
  int i,j;
  int numshuffles = (number_of_rows * 20);

  srand(seedvalue);
  for(int col=0; col < number_of_columns; col++)
    for(int shufflenum=0; shufflenum < numshuffles; shufflenum++){
      i = rand() % number_of_rows;
      j = rand() % number_of_rows;
      temp = GetValue(i+1,col+1);
      SetTo(i+1,col+1,GetValue(j+1,col+1));
      SetTo(j+1,col+1,temp);
    }
}

/*****************************************************************/
```

The reason the first run is entirely different, is because the random seed value for it is used by the lhs program, and the other ~~over~~ runs are created using the shuffle program.

JE

5/31 I have noticed that the TPA code is no longer working.

Albert and I are trying to find out what is wrong.

We did find that we can check if the slaves are running by typing ps-a in the PVM>.

What we found is that they start off okay, but then after a few minutes we loose one of the slaves. This is why the TPA code locks up.

JE

6/1 Ron and I couldn't figure out how to fix the problem, so we started all over, recreating the files.

Then we did a fifty vector run and it worked we got output.

We are leaving it run over night with another 50 vector run.

JE

6/2 One of the slaves disconnected over night so the program locked up.

I tried to do another 50 vector run, but the PVM doesn't seem to be working.

Instead of running the TPA code through the PVM we are now going to forget the PVM and do a 50 vector run on each slave, this way if one of the slaves goes down we will still get 5 runs.

I have created a script file that will do 8 50 vector runs on each slave. I am going to run it over the weekend.

If everything works ~~with~~ we will have 50 runs when it is all done running.

I have also added a column extractor to the Matrix.C program. It returns the column as a RVector.

the code is on the next page.

```
/*********************************************************************/

RVector RMatrix::GetColumn(int col)
{
  RVector column(number_of_rows);

  for(int i = 1;i <= number_of_rows;i++)
    column[i] = GetValue(i,col);
  return column;
}

/*********************************************************************/
```

JE
6/5/1995 We got 46 runs, but Randy has now informed me that the output that we are
Rom 8/7/96 getting is incorrect.

Ron Janetzke is working on that problem, and when he is done we are going to do one run with 400 vectors.

I have added 8 new procedures to the RVector class.

1) Mu() - which computes the mean of a vector

2) Sigma() - which computes standard deviation of a vector using Mu().

3) SigmaNminus1() - computes standard deviation but uses (N-1) in place of N.

4) SS(mean) - computes sum of squares of deviation measured from the mean

5) Variance() - computes variance of vector data

6) IsSegmentOf(Vin, i, j) - which returns a RVector segment of Vin from Vin[i]... Vin[j].

7) SetColumnToZero() - sets an entire column of a Matrix to zero.

8) IsShuffleOf(old, indexes) - sets an RVector to the values in old, but at the indexes stored in indexes.

JE
6/6/1995 Randy 8/7/96 We are still waiting for the 400 vector run to get done on snowwhite. We have decided to send the same ~~4000~~ 400 vector run out on skippy and we will take which ever one comes back first.

I am adding 6 more procedures to the RVector class.

1) RVector::Minimum(); - ~~calculates~~ Returns the smallest value in a vector.

2) RVector::Maximum(); - Returns the largest value in a vector.

3) RVector::Mean(); - Is the same as Mu on previous page, just has a different name.

4) RVector::Median(); - Computes the median of a vector.

5) RVector::MAD(); - Computes the median absolute deviation of (|X - median|).

6) RVector::RootMeanSquare(); - Calculate the root mean square of a vector.

We have now decided to shuffle up the input of the 400vector run and send out on 30 other machines.

I also added a Sort(); to the RVector class which uses a QuickSort algorithm to sort the vector.

I have also added a Sort to the IVector class, which has a header like this

IVector::Sort(RVector &vector);

This sort doesn't sort the vector, it sorts the IVector, which are indexes into the RVector, based upon the RVector.

So the IVector starts off with a vector like this: 1 2 3 4 5.

And the RVector may look like this:
10 1 8 9 3.

So the RVector doesn't change, but the IVector will now look like this after the sort.

2 5 3 4 1

6/9

25

Run #	Random Seed Value		
1)	original		
2)	15000	24)	100
3)	20000	25)	24585
4)	5000	26)	21364
5)	4000	27)	589
6)	11000	28)	723
7)	25000		
8)	30000		
9)	8999		
10)	3000		
11)	31000		
12)	19000		
13)	6000		
14)	7000		
15)	8000		
16)	9000		
17)	10000		
18)	17000		
19)	3586		
20)	7304		
21)	11504		
22)	16302		
23)	23505		

New seed values

Min/Max tables for run 1 are on the next pages

2E 6/9/95 Min/Max Tables for Run 1

Variable	Minimum	Maximum	10^x(min)	10^x(max)
x1(L2)"akr1"	-16.18709	-14.31585	6.49995E-17	4.83226E-15
x2(L3)"akr2"	-15.70684	-13.87888	1.96408E-16	1.32166E-14
x3(L4)"akr3"	-16.43716	-14.56548	3.6546E-17	2.71969E-15
x4(L5)"akr4"	-15.92593	-14.09427	1.18596E-16	8.04878E-15
x5(L6)"akr5"	-15.94122	-14.04712	1.14493E-16	8.97181E-15
x6(22)"retard1"	10.15811	99.814461	14391630496	6.3232E+99
x7(23)"retard2"	10.02295	99.80587	10542655126	6.3954E+99
x8(24)"retard3"	10.01345	99.802521	10314542220	6.3463E+99
x9(25)"retard4"	10.09882	99.800919	12555094907	6.3229E+99
x10(26)"retard5"	10.01528	99.991463	10358097627	9.8053E+99
x11(L32)"permm1"	-18.43952	-17.92444	3.6348E-19	1.19004E-18
x12(L33)"permm2"	-14.40894	-13.71372	3.89996E-15	1.93321E-14
x13(L34)"permm3"	-19.834629	-18.24333	1.46343E-20	5.71045E-19
x14(L35)"permm4"	-15.70128	-15.01913	1.98939E-16	9.56908E-16
x15(L36)"permm5"	-17.292431	-16.82391	5.09999E-18	1.5E-17
x16(L37)"permm6"	-15.4535	-15.36097	3.51965E-16	4.35542E-16
x17(L38)"permm7"	-17.372641	-16.795879	4.23993E-18	1.6E-17
x18(L39)"permf1"	-15.95861	-15.72125	1.09999E-16	1.89998E-16
x19(L40)"permf2"	-15.25181	-14.92386	5.60003E-16	1.19163E-15
x20(L41)"permf3"	-15.20761	-15.00436	6.19998E-16	9.90011E-16
x21(L42)"permf4"	-16.408939	-16.091511	3.89997E-17	8.10007E-17
x22(L43)"permf5"	-15.16893	-15.00877	6.77751E-16	9.80009E-16
x23(L44)"permf6"	-16.30755	-16.19561	4.9255E-17	6.37368E-17
x24(L45)"permf7"	-15.20713	-15.00436	6.20683E-16	9.90011E-16
x25(46)"porm1"	0.060217131	0.1598295	1.148727799	1.444872416
x26(47)"porm2"	0.33003369	0.55983412	2.138127946	3.629394026
x27(48)"porm3"	0.20014501	0.32992011	1.585422473	2.13756884
x28(49)"porm4"	0.2403613	0.3998788	1.739247148	2.511185529
x29(50)"porm5"	0.18014909	0.2998918	1.514080932	1.994765278
x30(51)"porm6"	0.1901601	0.31972411	1.549387686	2.087969306
x31(52)"porm7"	0.18006571	0.29986131	1.513790272	1.994625239
x32(60)"betam1"	1.40036	2.1988871	25.13969474	158.0837029
x33(61)"betam2"	1.500558	4.8968868	31.663433	78865.45259
x34(62)"betam3"	1.200839	3.295825	15.87957958	1976.173176
x35(63)"betam4"	2.001224	3.3971169	100.2822339	2495.266293
x36(64)"betam5"	1.5002	2.39904	31.63734278	250.6340085
x37(65)"betam6"	2.301486	4.1996222	200.210108	15835.15067
x38(66)"betam7"	1.500285	2.3994811	31.64353544	250.8886993
x39(67)"betaf1"	3.2011399	5.2991948	1589.058552	199156.6443
x40(68)"betaf2"	3.2003601	5.2964001	1586.207869	197879.1791
x41(69)"betaf3"	3.202919	5.2962661	1595.581529	197818.1336
x42(70)"betaf4"	3.2049961	5.2971292	1603.230993	198211.6606
x43(71)"betaf5"	3.204906	5.299324	1602.898417	199215.901
x44(72)"betaf6"	3.2006259	5.296948	1587.178968	198128.9783
x45(73)"betaf7"	3.202558	5.2950058	1594.255779	197244.9078

x46(81)"disp"	0.30000001	30	1.995262361	1E+30
x47(L82)"infil"	-3.9990771	-2.3052289	0.000100213	0.004951891
x48(L83)"KdCM1"	-1.343402	0.6515432	0.045352162	4.482736383
x49(L84)"KdCM2"	-0.48060769	1.515031	0.330668108	32.73640613
x50(L85)"KdCM3"	-0.7779026	1.216138	0.166762117	16.44894316
x51(L86)"KdCM4"	-0.93381429	1.0608211	0.116462393	11.50326435
x52(L87)"KdCM5"	-0.87575632	1.117469	0.133120114	13.10596488
x53(L88)"KdCM6"	-0.92073411	1.078053	0.12002339	11.96886587
x54(L89)"KdCM7"	-0.87604088	1.116636	0.133032919	13.08085104
x55(L90)"KD15U"	-4.6987128	-2.6990621	2.00118E-05	0.001999576
x56(L91)"KD16U"	-2.6942379	-0.70155871	0.002021911	0.198811403
x57(L92)"Kd17U"	-3.9978909	-2.0025721	0.000100487	0.00994095
x58(L94)"Kd19U"	-4.0946221	-2.097898	8.04226E-05	0.007981821
x59(L95)"Kd20U"	-3.6981361	-1.701859	0.000200384	0.019867398
x60(L96)"Kd21U"	-4.0957351	-2.1013319	8.02167E-05	0.007918959
x61(L97)"Kd22Am"	-1.089131	0.9083603	0.081445857	8.09767421
x62(L98)"Kd23Am"	-1.088775	-0.90545648	0.081512648	8.043711397
x63(L99)"Kd24Am"	-0.76686931	1.225608	0.171052998	16.81155942
x64(L100)"Kd25Am"	-0.3418645	1.652606	0.455130039	44.93719913
x65(L101)"Kd26Am"	-0.86417019	1.1321779	0.136719295	13.55744652
x66(L102)"Kd27Am"	-1.852307	0.1426532	0.014050539	1.388843146
x67(L103)"Kd28Am"	-0.86355913	1.130074	0.136911797	13.49192754
x68(L104)"Kd29Np"	-3.3456039	-1.351204	0.000451228	0.044544696
x69(L105)"Kd30Np"	-3.3448009	-1.348442	0.000452063	0.044828891
x70(L106)"Kd31Np"	-3.567292	-1.570868	0.000270837	0.026861608
x71(L107)"Kd32Np"	-3.289542	-1.294765	0.000513403	0.050726512
x72(L108)"Kd33Np"	-3.6562641	-1.658321	0.000220666	0.02196236
x73(L109)"Kd34Np"	-3.291743	-1.2936161	0.000510807	0.050860884
x74(L110)"Kd35Np"	-3.6527281	-1.657783	0.00022247	0.021989583
x75(L111)"Kd8Pu"	-1.769469	0.2277384	0.017003213	1.689422991
x76(L112)"Kd9Pu"	-1.7683851	0.2286462	0.017045702	1.692958062
x77(L113)"Kd10Pu"	-2.1768069	-0.18272249	0.00665569	0.656564671
x78(L114)"Kd11Pu"	-1.884822	0.112598	0.01303701	1.295979107
x79(L115)"Kd12Pu"	-2.2725999	-0.27868181	0.005338265	0.526402799
x80(L116)"Kd13Pu"	-2.021996	-0.027186889	0.009506135	0.939319008
x81(L117)"Kd14Pu"	-2.2736399	-0.2773703	0.005325496	0.527994866
x82(L118)"Kd36Th"	-2.3177421	-0.3229984	0.00481125	0.475336977
x83(L119)"Kd37Th"	-1.465475	0.52772129	0.03423931	3.370709228
x84(L120)"Kd38Th"	-1.766414	0.2258402	0.017123242	1.68205503
x85(L121)"Kd39Th"	-1.920521	0.076541781	0.01200823	1.192729006
x86(L122)"Kd40Th"	-1.852862	0.1426719	0.014032595	1.388902949
x87(L123)"Kd41Th"	-1.881145	0.1096659	0.013147858	1.287258891
x88(L124)"Kd42Th"	-1.8521529	0.1411891	0.014055526	1.384168941
x89(L125)"Kd43Ra"	-0.8195008	1.173578	0.151530201	14.91344579
x90(L126)"Kd44Ra"	-0.82233769	1.17521	0.150543604	14.96959325
x91(L127)"Kd45Ra"	-0.81919402	1.175694	0.151637278	14.98628543

x92(L128)"Kd46Ra"	-0.82155168	1.174522	0.150816313	14.94589752
x93(L129)"Kd47Ra"	-0.91613102	1.077998	0.121302284	11.9673502
x94(L130)"Kd48Ra"	-0.29797751	1.696329	0.503526683	49.69686577
x95(L131)"Kd49Ra"	-0.9166171	1.076048	0.121166594	11.91373676
x96(L132)"Kd50Pb"	-3.1629939	-1.170642	0.000687078	0.067508429
x97(L133)"Kd51Pb"	-2.3082709	-0.312011	0.004917327	0.487516142
x98(L134)"Kd52Pb"	-2.601881	-0.60411608	0.002501031	0.248819218
x99(L135)"Kd53Pb"	-2.768554	-0.7730028	0.001703907	0.168654215
x100(L136)"Kd54Pb"	-2.6960649	-0.70383149	0.002013423	0.197773687
x101(L137)"Kd55Pb"	-2.7416749	-0.74723089	0.001812697	0.178965414
x102(L138)"Kd56Pb"	-2.6944971	-0.69985563	0.002020705	0.19959257
x103(L139)"Kd57Cs"	-1.440292	0.55301982	0.036283402	3.572891435
x104(L140)"Kd58Cs"	-1.618531	0.37715811	0.024069607	2.383186939
x105(L141)"Kd59Cs"	0.3439652	2.3383689	2.207827813	217.9560356
x106(L142)"Kd60Cs"	-0.655882	1.337711	0.220860474	21.76261104
x107(L143)"Kd61Cs"	0.2501806	2.245265	1.779019056	175.89966
x108(L144)"Kd62Cs"	-0.4918817	1.500795	0.322194632	31.68071685
x109(L145)"Kc63Cs"	0.24940459	2.243295	1.775843091	175.1035698
x110(L153)"Kd78Tc"	-5.9981432	4.001667	1.00428E-06	9.96169E-05
x111(L156)"Kd81Tc"	-4.76509	-2.774421	1.71755E-05	0.001681044
x112(L158)"Kd83Tc"	-3.3738539	-1.378512	0.000422811	0.041830013
x113(L160)"Kd99Ni"	-3.431524	-1.435205	0.000370234	0.036710897
x114(L161)"Kd100Ni"	-2.5660989	0.57232988	0.002715821	0.267713406
x115(L162)"Kd101Ni"	-2.8520679	-0.85847342	0.001405828	0.138524496
x116(L163)"Kd102Ni"	-3.0446351	-1.0480011	0.000902329	0.08953625
x117(L164)"Kd103Ni"	-2.9541769	-0.95886481	0.001111279	0.1099348
x118(L165)"Kd104Ni"	-2.9954939	-1.0010231	0.00101043	0.0997647
x119(L166)"Kd105Ni"	-2.9560981	-0.9603852	0.001106374	0.10955061
x120(L174)"Kd113Se"	-3.5811541	-1.589918	0.000262329	0.025768076
x121(L175)"Kd114Se"	-3.5206611	-1.523587	0.000301536	0.029951115
x122(L176)"Kd115Se"	-3.345871	-1.351053	0.000450951	0.044560187
x123(L177)"Kd116Se"	-3.5979271	-1.602919	0.00025239	0.0249506
x124(L178)"Kd117Se"	-3.4421501	-1.446346	0.000361285	0.035781126
x125(L179)"Kd118Se"	-2.8835859	-0.89028621	0.001307417	0.128740085
x126(L180)"Kd119Se"	-3.4393859	-1.444858	0.000363592	0.035903931
x127(209)"aereo"	37545.578	374298.31	#NUM!	#NUM!
x128(210)"ecorr1"	100.0115	149.98579	1.0268E+100	9.6781E+149
x129(211)"ecorr2"	-1.99999	-0.50359583	0.01000023	0.313620303
x130(212)"ecorr3"	-3.3999701	-3.000294	0.000398135	0.000999323
x131(213)"ecorr4"	100.3761	299.7905	2.3774E+100	6.1731E+299
x132(214)"ecorr5"	0.001004669	0.022980619	1.002316014	1.054339844
x133(215)"ecorr6"	1000.628	1499.068	#NUM!	#NUM!
x134(216)"ecorr7"	1001.115	1499.006	#NUM!	#NUM!
x135(L217)"ecorr8"	-4.998765	-3.002131	1.00285E-05	0.000995059
x136(L233)"forwar1"	-4.9994001	-3.001914	1.00138E-05	0.000995603
x137(L234)"forwar2"	-4.996057	-3.0007141	1.0091E-05	0.000998357

x138(L235)"forwar3"	-4.996017	-3.0006969	1.00921E-05	0.000998397
x139(L236)"forwar4"	-4.9959869	-3.0001791	1.00928E-05	0.000999588
x140(L237)"forwar5"	-4.9980421	-3.0005951	1.00452E-05	0.000998631
x141(L238)"forwar6"	-4.9994502	-3.000047	1.00127E-05	0.000999892
x142(L239)"forwar7"	-4.9959941	-3.004554	1.00927E-05	0.000989569
x143(240)"warea1"	0.000948306	0.9981733	1.002185941	9.958027012
x144(241)"warea2"	0.002278416	0.99851722	1.005260032	9.965915947
x145(242)"warea3"	0.000365254	0.99938422	1.000841382	9.985831189
x146(243)"warea4"	0.001176984	0.99900693	1.002713781	9.977159842
x147(244)"warea5"	0.001719857	0.99997038	1.003967969	9.999317998
x148(245)"warea6"	0.001138522	0.9991802	1.002624983	9.981141212
x149(246)"warea7"	0.000905744	0.99872941	1.002087729	9.970786339
x150(247)"rpor11"	0.080231696	0.1997859	1.202906014	1.584112059
x151(248)"rpor21"	0.080170788	0.1999348	1.202737323	1.584655273
x152(249)"rpor31"	0.08028575	0.1999647	1.203055741	1.584764376
x153(250)"rpor41"	0.080041312	0.1997679	1.202378805	1.584046404
x154(251)"rpor51"	0.080003709	0.19998799	1.202274702	1.584849364
x155(252)"rpor61"	0.080201328	0.1998001	1.202821903	1.584163855
x156(253)"rpor71"	0.080267437	0.1998498	1.203005013	1.584345155
x157(L254)"rdiff11"	-5.2433138	-2.247767	5.71066E-06	0.005652401
x158(L255)"rdiff12"	-5.2377219	-2.2495921	5.78466E-06	0.005628697
x159(L256)"rdiff13"	-5.243577	-3.248595	5.7072E-06	0.000564164
x160(L257)"rdiff14"	-5.23947	-3.245208	5.76143E-06	0.000568581
x161(258)"volmax1"	0.002550758	1.197441	1.005890619	15.75581961
x162(259)"volmax2"	0.001530992	1.197137	1.00353146	15.74479462
x163(260)"volmax3"	0.002646752	1.199543	1.00611298	15.83226316
x164(261)"volmax4"	0.002941821	1.1973701	1.006796787	15.75324763
x165(262)"volmax5"	0.002643057	1.197957	1.00610442	15.77455076
x166(263)"volmax6"	0.001303853	1.1996469	1.003006744	15.8360513
x167(264)"volmax7"	0.001318925	1.197674	1.003041553	15.76427492
x168(L265)"rde1"	0.37222949	2.117934	2.356294068	131.2000498
x169(L266)"rde3"	0.001300942	0.1202438	1.003000021	1.318996976
x170(L267)"rde4"	0.50140601	2.2185349	3.17253199	165.3997695
x171(L268)"rde5"	0.003460539	0.2576786	1.008000016	1.810000105
x172(L269)"rde2"	0.143289	1.5263391	1.390877879	33.59998628
x173(L270)"rde6"	0.29106921	1.881945	1.954650928	76.19825048
x174(L271)"rde7"	0.6016106	2.3188951	3.995863094	208.3987454
x175(L272)"rde8"	0.15671229	1.602819	1.43453877	40.06996841
x176(L273)"rde9"	0.2253093	1.8007931	1.680000071	63.21106391
x177(L275)"rde12"	0.000380254	0.006893722	1.00087595	1.016000033
x178(L276)"rde15"	0.03342377	0.9449759	1.080000036	8.810000032
x179(L278)"rde17"	0.003029457	0.21442661	1.006999969	1.638425166
x180(L301)"sol1Cm"	-6.5877781	-3.3036239	2.58358E-07	0.000497023
x181(L302)"sol3U"	-7.3909631	-4.5262799	4.06478E-08	2.9766E-05
x182(L303)"sol4Am"	-5.9938979	-3.5257411	1.01415E-06	0.000298029
x183(L304)"sol5N"	-3.8512599	-1.625487	0.000140845	0.02368716

x184(L305)"sol2Pu"	-6.6948228	-3.301836	2.01919E-07	0.000499073
x185(L306)"sol6Th"	-11.69653	-4.01197	2.01127E-12	9.72814E-05
x186(L307)"sol7Ra"	-5.0456638	-4.0468469	9.00194E-06	8.97745E-05
x187(L308)"sol8Pb"	-5.6739502	-3.2064309	2.1186E-06	0.000621683
x188(L312)"sol15Ni"	-6.5451941	-2.7760999	2.84974E-07	0.001674558
x189(337)"funnel1"	0.000468662	0.3995041	1.001079716	2.509019866
x190(338)"funnel2"	0.000653361	0.3999314	1.001505552	2.511489692
x191(339)"funnel3"	0.000583558	0.3990868	1.001344595	2.506610185
x192(340)"funnel4"	0.000389241	0.3997772	1.000896663	2.510598124
x193(341)"funnel5"	0.000968931	0.3993054	1.002233537	2.507872193
x194(342)"funnel6"	0.000561848	0.39919361	1.00129454	2.507226734
x195(343)"funnel7"	0.000815596	0.3995944	1.001879744	2.509341604
y	-7	1.720788	0.0000001	52.57605548

6/14/28

Table 8-2. Results of Stepwise and Multilinear Regression: *Normalized Release* for Base Case (*oooo*) Scenario[a].

	Variable Name	*Regression Coefficient*	*Confidence Interval*	*Standardized Regression Coefficient*	*Rank Regression Coefficient*	*Elasticity Coefficient*	*Uncertainty Coefficient*
1	INFIL(UN)	4.86E+02	±1.12E+02	0.400	0.417	0.390	0.160
2	ECORR6	-3.35E-03	±1.06E-06	-0.312	-0.348	-2.69	0.0976
3	ECORR7	-2.68E-03	±1.06E-03	-0.248	-0.282	-2.14	0.0619
4	RETARD3	-1.44E-03	5.57E-03	-0.242	-0.216	-0.510	0.0587
5	ECORR8	1.28E+03	±5.72E+02	0.205	0.243	0.176	0.042
6	AKR3	9.34E+14	±4.03E+04	0.213	0.274	0.255	0.046
7	Kd39Th	-7.18E-01	±4.78E-01	-0.148	-0.092	-0.119	0.019
8	ECORR5	-2.79E+01	±2.25E+01	-0.114	-0.082	-0.213	0.0130
9	RETARD1	-6.20E-03	±5.56E-03	-0.104	-0.110	-0.219	0.0108
10	KdCm1	1.43E-01	±1.27E-01	0.104	0.066	0.089	0.0107
11	AKR2	9.79E+13	±8.24E+13	0.110	0.106	0.132	0.0121
12	AKR4	1.60E+14	±1.34E+14	0.120	0.126	0.131	0.0121
13	Kd26Am	4.12E-02	±4.21E-02	0.090	0.074	0.077	0.008
14	SOL4Am	2.03E+03	±2.00E+03	0.094	--[b]	0.068	0.009
15	FORWAR2	5.69E+02	±5.71E+02	0.092	--[b]	0.068	0.008

[a] See Appendix A for a description of the variable names. Coefficients are described in Section 8.4.

[b] Variable not selected.

JE
6/22

25 vector runs starting seedvalues
-The seed values where incremented by
- 100 for each new run

skippy 100
scratchy 30000
snowwhite 40000
sisyphus 50000

50 vector runs starting seedvalues
-The seed values where incremented by
- 100 for each new run

	# of runs
skippy 100	11
sisyphus 50000	11
snowwhite 40000	8
sneezy 10000	3
scratchy 30000	8

JE
6/27

50 v runs with Top 5 fixed
Starting seedvalues

		# of runs
skippy	100	11
sisyphus	50000	~~8~~ 11
snowwhit	40000	2E ~~4~~ 7
sneezy	10000	~~3~~ 4
scratch	30000	8

50 v runs with 8 fixed
starting seedvalues # of runs

skippy	100
sisyphus	50000
snowwhit	40000
sneezy	10000
scratchy	30000

2E
6/30

Table XX: Top 10 Variables using 3 importance indices: F(RT(y)), R^2(RT(y)), and Ra^2(RT(y)).

	8 LHS-50	16 LHS-50	24 LHS-50	32 LHS-50	40 LHS-50
First	x47(L82) "infil" 5.3950 0.40987 0.33390	x47(L82) "infil" 7.1838 0.31585 0.27188	x47(L82) "infil" 9.7197 0.29390 0.26367	x47(L82) "infil" 11.932 0.27697 0.25375	x47(L82) "infil" 13.824 0.26193 0.24298
Second	x134(216) "ecorr7" 2.0053 0.20389 0.10221	x142(L239) "forwar7" 2.5032 0.13767 0.082671	x142(L239) "forwar7" 3.4851 0.12905 0.092023	x142(L239) "forwar7" 3.8367 0.10901 0.080596	x142(L239) "forwar7" 4.3808 0.10052 0.077575
Third	x78(L114) "Kd11Pu" 1.9912 0.20310 0.10110	x134(216) "ecorr7" 2.2853 0.12724 0.071566	x133(215) "ecorr6" 2.8745 0.10908 0.071131	x133(215) "ecorr6" 3.3307 0.096152 0.067283	x133(215) "ecorr6" 3.6160 0.084564 0.061178
Fourth	x62(L98) "Kd23Am" 1.8353 0.19001 0.086476	x133(215) "ecorr6" 2.0247 0.11452 0.057959	x134(216) "ecorr7" 2.7123 0.10339 0.065270	x157(L254) "rdiff11" 3.1728 0.091994 0.063000	x134(216) "ecorr7" 3.5489 0.083016 0.059624
Fifth	x142(L239) "forwar7" 1.7774 0.18481 0.080835	x157(L254) "rdiff11" 1.8070 0.10336 0.046160	x157(L254) "rdiff11" 2.3497 0.090905 0.052218	x134(216) "ecorr7" 3.1239 0.090582 0.061586	x157(L254) "rdiff11" 3.5430 0.082987 0.059564
Sixth	x128(210) "ecorr1" 1.6934 0.17784 0.072823	x168(L265) "rde1" 1.6066 0.092984 0.035108	x135(L217) "ecorr8" 1.4950 0.059714 0.019773	x3(L4) "akr3" 1.7909 0.054047 0.023868	x3(L4) "akr3" 1.9767 0.048027 0.023731
Seventh	x26(47) "porm2" 1.6269 0.17206 0.066304	x158(L255) "rdiff12" 1.5583 0.090377 0.032382	x188(L312) "sol15Ni" 1.4819 0.059279 0.019277	x187(L308) "sol8Pb" 1.5420 0.046890 0.016480	x135(L217) "ecorr8" 1.8153 0.044224 0.019861
Eighth	x156(253) "rpor71" 1.6197 0.17122 0.065508	x156(253) "rpor71" 1.5251 0.088641 0.030519	x168(L265) "rde1" 1.4812 0.059261 0.019252	x135(L217) "ecorr8" 1.5378 0.046703 0.016333	x6(22) "retard1" 1.5787 0.038729 0.014197
Ninth	x27(48) "porm3" 1.5579 0.16575 0.059358	x15(L36) "permm5" 1.4615 0.085322 0.026941	x44(72) "betaf6" 1.4731 0.058979 0.018941	x158(L255) "rdiff12" 1.5299 0.046473 0.016096	x84(L120) "Kd38Th" 1.5785 0.038716 0.014189
Tenth	x23(L44) "permf6" 1.5374 0.16412 0.057369	x48(L83) "KdCM1" 1.4591 0.084747 0.026664	x126(L180) "Kd119Se" 1.4133 0.056711 0.016585	x41(69) "betaf3" 1.4952 0.045522 0.015076	x188(L312) "sol15Ni" 1.4277 0.035143 0.010529

2E
7/11

We now have:

10 400 vector runs
40 50 vector runs with none of the parameters fixed
40 50 vector runs with 5 of the parameters fixed
15 ~~40~~ 50 vector runs with 8 of the parameters fixed
40 50 vector runs with 10 of the parameters fixed

40 50 vector runs with 10 of the parameters Quantiled.
40 50 vector runs with 165 of the parameters Quantiled.

<u>Programs used</u>

10Q.shuffletps.C – Takes a matrix that has 10 parameters Quantiled and sets those 10 columns to certain one of their Quantiled values.
165Q.shuffletps.C – Same as the above, but it does it with 165 parameters instead of 10.

25vRankingProgram.C – Used to calculate the ranking of the 25 vector runs, which we decided not to use.
400vRankingProgram.C – Used to calculate the ranking of the 400 vector runs.

50vRankingProgram.C – Used to calculate the ranking of the 50 vector runs.

400vCreatePlot.C – Used to create the 400vector CCDF plot data.

50vCreatePlot.C – Used to create the 50 vector CCDF plot data.

50vMeanMatrix.C – ~~Used to create a matrix that~~ Took the original input matrix, extracted out the 5 more important parameters, and the y's, and created a new matrix that had the y data meaned, and sorted according to the 5 more important parameters.

50vMedianMatrix.C – Same as above but used Median instead of mean.

6000vCreatePlot.C – Used to create the 6000 vector CCDF plot data.

Create50vlhs.C – took the original 400 vector lhs file, sorted each column, and then took the median of every segment of 8 elements in each column, producing a new 50 vector LHS file.

CreateTop10.C – Took the ~~original 400~~ 50v matrix that had the quantiled value in it extracted the 10 more important columns and stored them in a file.

CreateOthers.C – Same as above but ~~did~~ does it with the 165 Quantiled Matrix.

CreateYtrans – ~~Read~~ reads in the y values from the matrix, and sets the lowest valued y to 1 and the highest valued y to 2000 the other are also numbered in order from 2–1999.

☆ TPAMatrix.c – takes the output ~~file~~ file from the TPA code and combines ~~them~~ it with the input ~~matrix file~~ the file to produce one matrix.

Merge.C – merges all of the matrices produced by TPAMatrix.C into ~~one~~ one matrix.

RankingProgram.C – Original ranking program that copied into 400vector 50vector and 25 vector Ranking Programs.

TPA.F – The tpa source code

shuffletpa.C – takes an the file reads it into a matrix, then shuffles up the elements in each column.

Chschange.c – used to create the ~~titlemodel~~ newlhs.dat file.

Rdm 8/7/96

7/28/1996

JE

~~Fb~~

The Quatiled Values

0 fix

Quatile of .025 = -1.69427 .05 = -1.33244

Quantile of .975 = 1.25593 .95 = 1.09133

5 fix

Quantile of .025 = -.57219 .05 = .466354

Quantile of .975 = .774103 .95 = .711042

10 fix

Quantile of .025 = -.541218 .05 = -.447721

Quantile of .975 = .26875 .95 = .196024

13 fix

Quantile of .025 = -.297196 .05 = -.269488

Quantile of .975 = .089093 .95 = .0558998

7/31

JE

From SNL TSPA-93

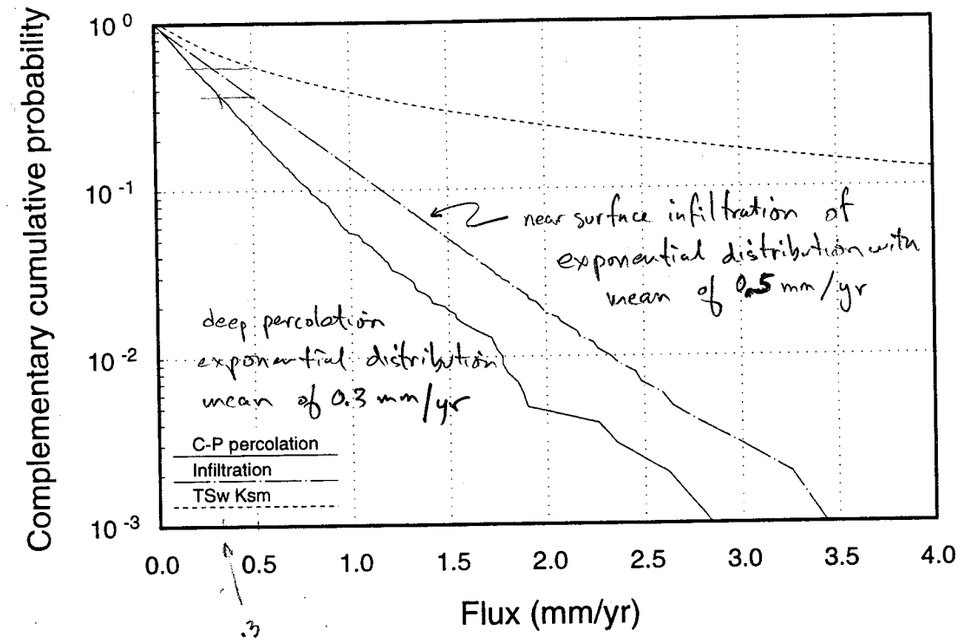


Figure 8-7. Infiltration and percolation flux under "dry" conditions.

JE 7/31/95

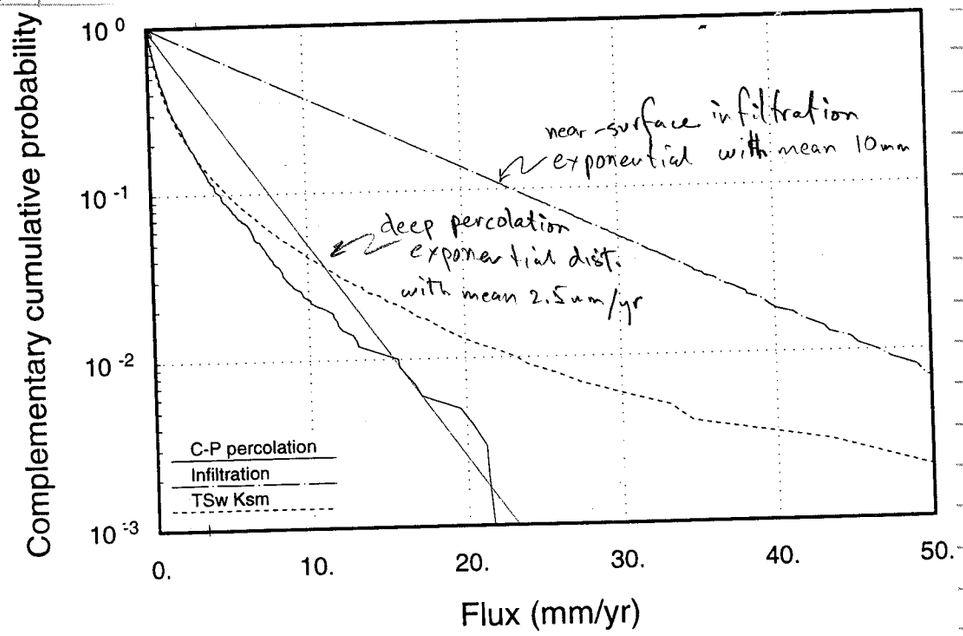


Figure 8-8. Infiltration and percolation flux under "wet" conditions.

PAM 9/5/95

Performance Assessment Research Project

Variance-Based Sensitivity Analysis

NRC PROGRAM ELEMENT MANAGER: JOHN RANDALL

Presented at

PERFORMANCE ASSESSMENT ELEMENT PROGRAM REVIEW
July 13, 1995

Presented by

Randall D. Manteufel

R.G. Baca, CNWRA PA ELEMENT MANAGER

Outline

- **Objectives**

⇒ Investigate Variance-Based Sensitivity Methods

- **Approach**

⇒ Use IPA-2's TPA Code

⇒ Follow McKay's Outline (NUREG/CR-6311)

⇒ Investigate Importance Statistics (F, R^2, R_a^2)

⇒ Quantify Reduction in Variability Of Output

⇒ Verify Conclusions using Conditional CCDFs

- **Accomplishments**

Rpm 9/15/95

Regulatory Basis

- 10 CFR 60.112 - Overall System Performance Objective for the Geologic Repository After Permanent Closure

Technical Issues:

- Evaluation of Most Important Parameters from Complex Models

Key Technical Issues:

- Variability in Model Parameter Values
- Prediction of Future System States

Why Variance-Based Sensitivity?

Benefits:

No Assumption Required about Linearity

Readily integrated with Latin Hypercube Sampling

Can Quantify Effect of Inputs on Output

Drawback:

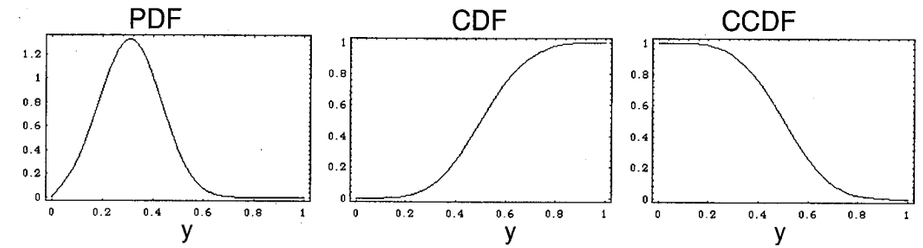
Requires MUCH more computational effort

Rpm 9/15/95

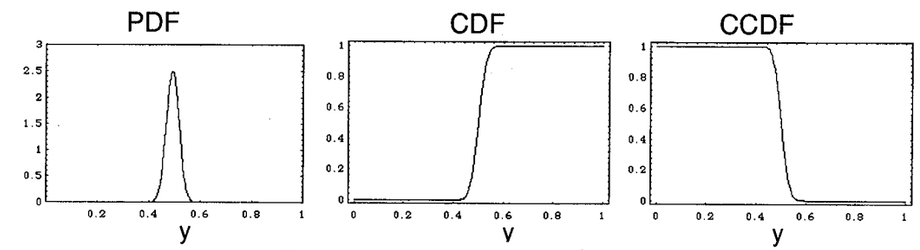
Theory

Model: $y = f(x_1, x_2, \ldots, x_{165})$

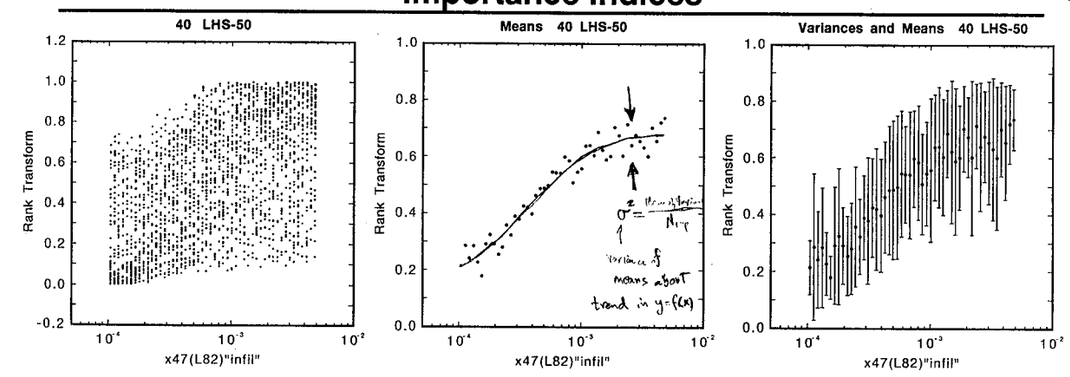
Due to Uncertainty in x's, Output has distribution



If Important Variables are Fixed, then the Variability of Output is Reduced



Importance Indices



Variance Identity:

Total Variance = Explained Variance by trend through Means + Unexplained Variance due to residual uncertainty

Total Variance = Variance of Means + Mean of Variances

Importance of any Variable Determined by Indices:

Variance Ratio: $R^2 = \frac{\text{Variance Of Means}}{\text{Total Variance}}$ ← Explained Variance / Total Variance

Alternative Variance Ratio: $R_a^2 = \frac{\text{Variance Of Means} - (\text{Mean Of Variances})/N_{rep}}{\text{Total Variance}}$ — improved estimate of explained variance

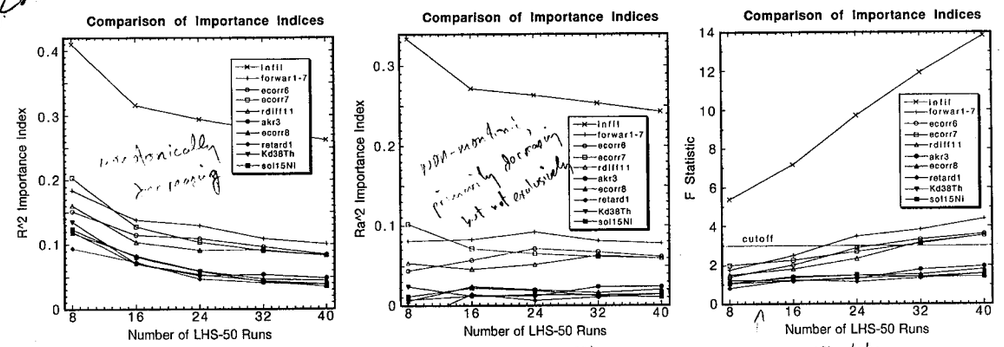
F Statistic: $F = \frac{N_{rep}(\text{Variance Of Means})}{\text{Mean Of Variances}}$ → est. of total variance if no trend in y=f(x) / → est. of total variance if No trend in y=f(x)

$\sigma_{\bar{x}}^2 = \frac{\sigma_x^2}{N}$ where $\bar{x} = \sum x_i / N$

$F = \frac{\text{Variance of Means}}{(\text{Mean of Variances})/N_{rep}}$ ← Variance of means about trend

Comparison of {F, R^2, R_a^2} Importance Indices

RBM 9/5/95



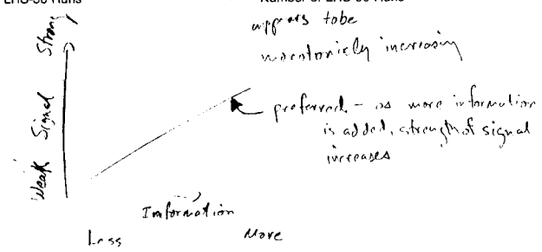
monotonically increasing

non-monotonic, primarily decreasing but not exclusively

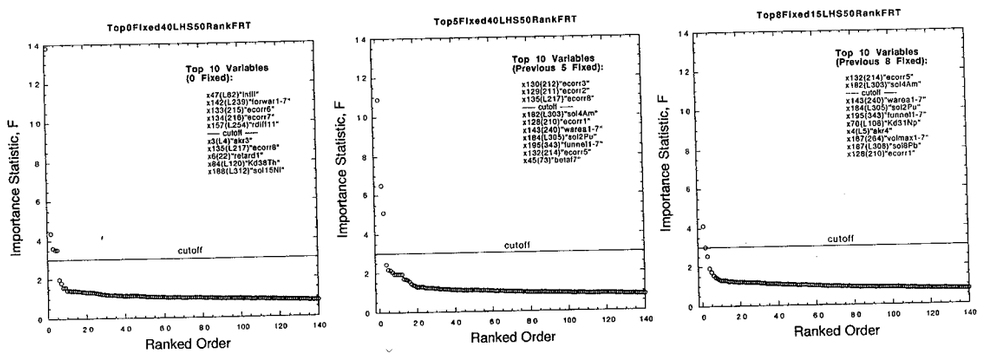
appears to be monotonically increasing

F-statistic Increases as N_{rep} Increases

Prefer F as Importance Indicator



Selecting Most Important Variables



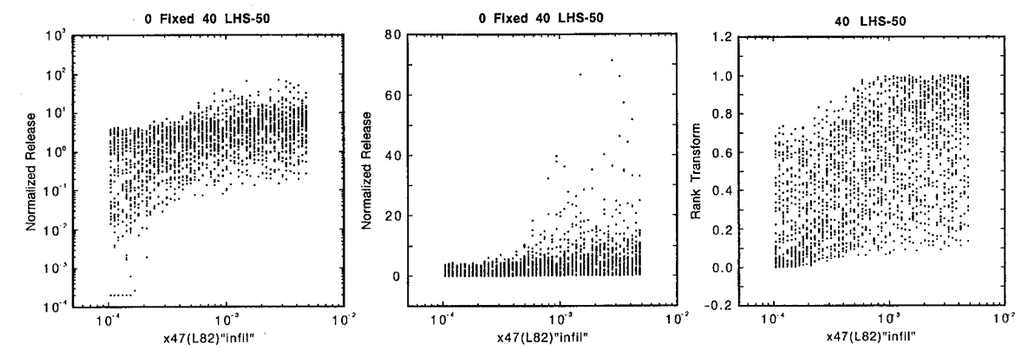
Top 10 Variables this work:
infil forwar1-7 ecorr6 ecorr7 rdiff11 ecorr3 ecorr2 ecorr8 ecorr5 sol4Am

Top 10 Variables from IPA-2, Stepwise and Multilinear Regression (Table 8-2):
infil ecorr6 ecorr7 retard3 ecorr8 akr3 Kd39Th ecorr5 retard1 KdCm1

Top 5 Variables from IPA-2, Kolmogorov-Smirnov and Sign Tests (Table 8-6):
infil ecorr8 akr3 retard2 sol4Am

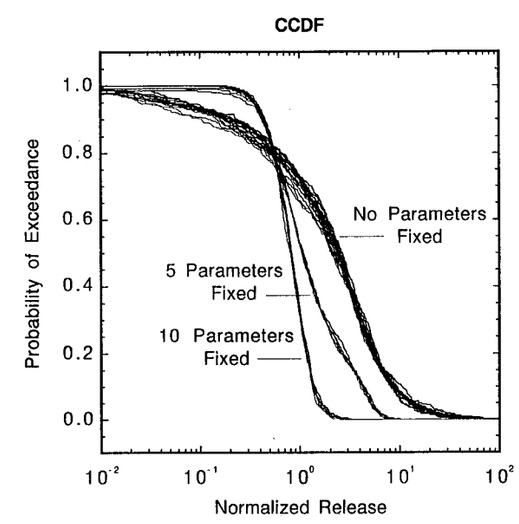
Scatter Plots

RBM 9/5/95



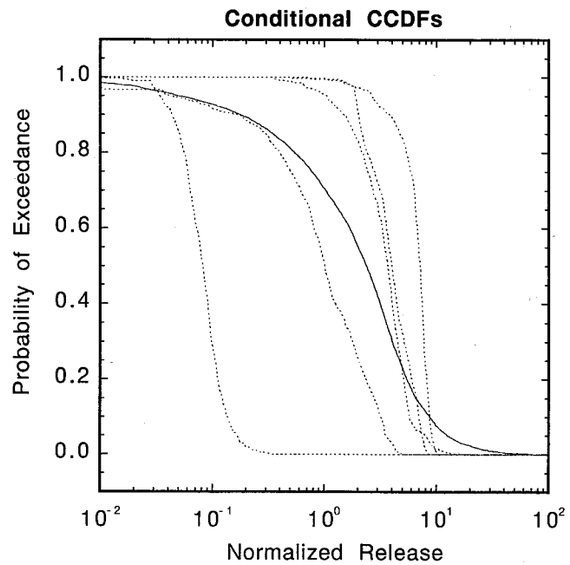
Scatter Plots show Correlation/Importance

Confirmation of Results: Conditional CCDFs



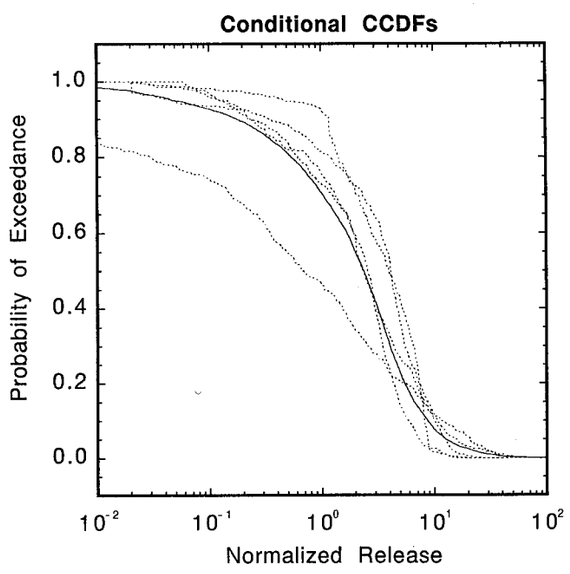
Fixing Top Variables Reduces Output Variability
from factor of ~3000 (from 0.02 up to 60)
to factor of ~15 (from 0.2 up to 3)

Confirmation of Results: Conditional CCDFs



LHS-5 on 10 More Important Parameters
LHS-400 (=8x50) on Less Important Parameters

Confirmation of Results: Conditional CCDFs



LHS-5 on Less Important Parameters
LHS-400 (=8x50) on 10 More Important Parameters

Accomplishments

- **Used IPA-2s TPA code,**

⇒ Identified Top 10 Parameters

- **Identified F-Statistic as Good Importance Measure**

⇒ F ~ 3 for cutoff for 40 LHS-50

- **Quantified Effect of Top 10 Parameters on Output**

⇒ Reduce Variability in Y by over 2 OOM

- **Confirmed Variance-Based Sensitivity Results**

⇒ 40 LHS-(5)50: Coarse Discretization of Most Important Parameters

⇒ 40 LHS-(50)5: Fine Discretization of Most Important Parameters

RDM 9/5/95

TPA Code Runs for Variance-Based Sensitivity Analysis

Performance Assessment Research Project

August 22, 1995

Presented by

Todd R. Easley

Randall D. Manteufel, Senior Research Engineer

R.G. Baca, CNWRA PA Element Manager

Outline

RDM 9/5/95

- **Objective**

  Run TPA code on local Sparc 10 and 20 machines

- **Approach**

  Setup the Sparc 10 and 20 machines

  Run ten 400 vector runs

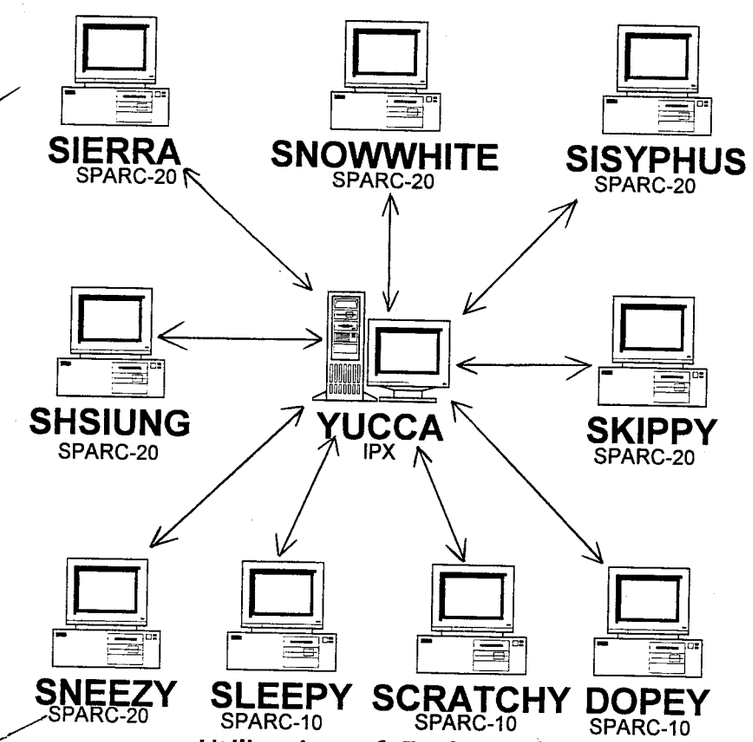
  Run forty 50 vector runs

  Select important parameters and fix them to median

- **Conclusion**

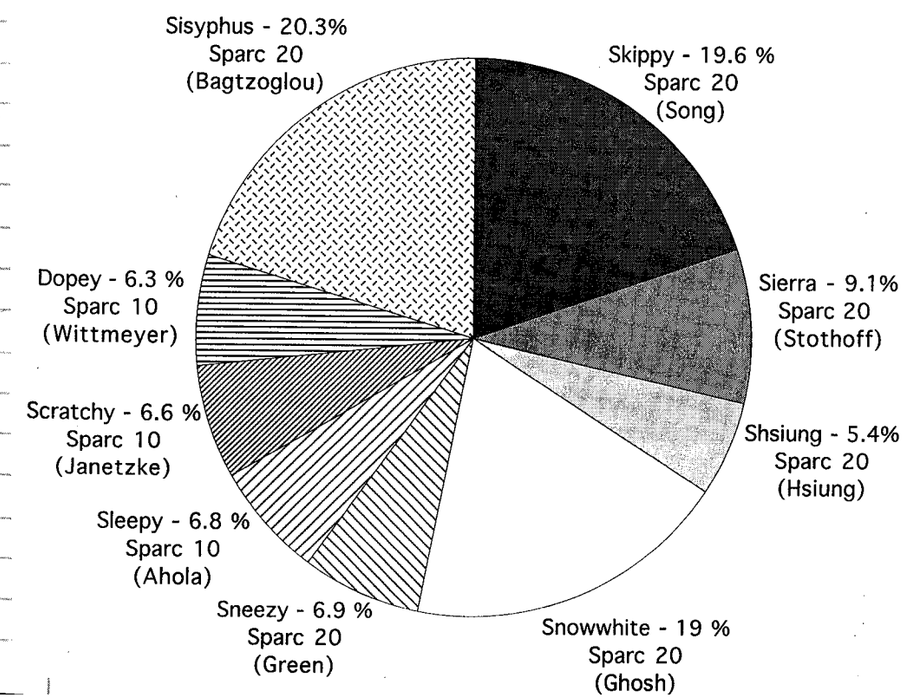
RDM 9/5/95

SYSTEM SETUP FOR RUNNING TPA CODE

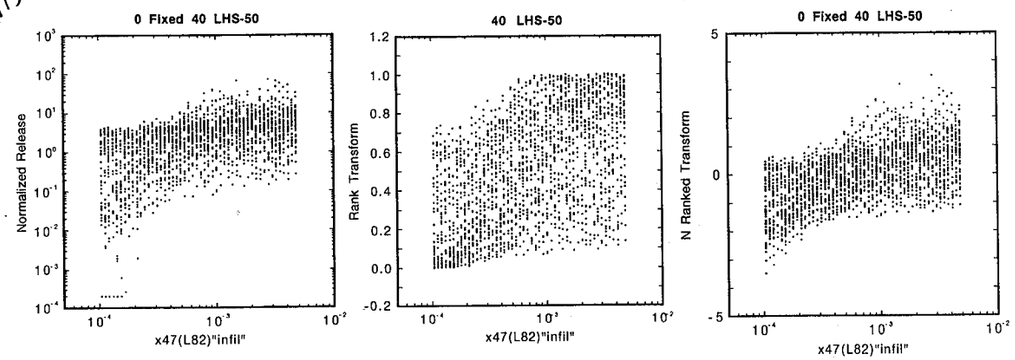


RDM 9/5/95

Utilization of Each Machine

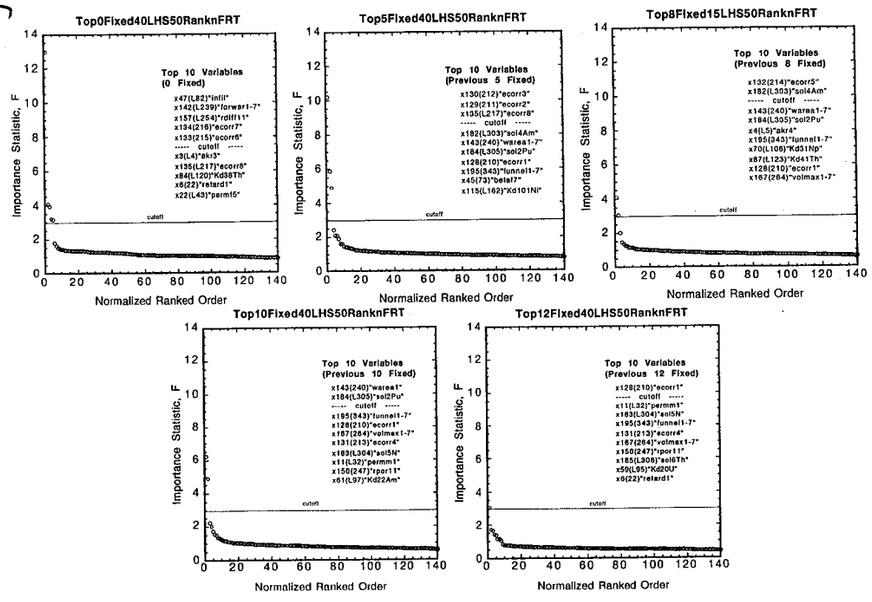


Scatter Plots

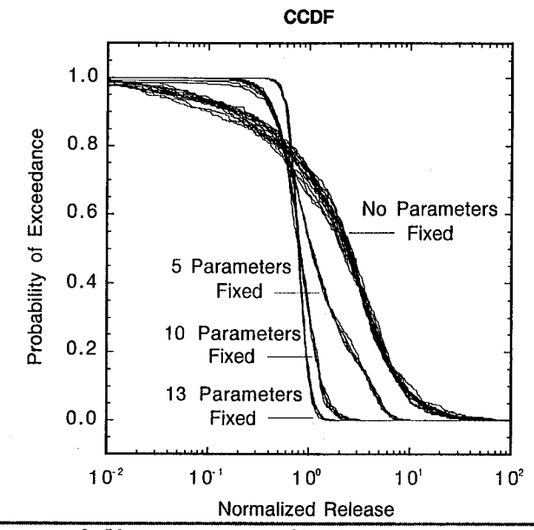


Scatter Plots show Correlation/Importance

Selecting Most Important Variables



Confirmation of Results: Conditional CCDFs



	2.5%	97.5%	Range
0 Fix	.0202	18.030	10^2.95 = 890.0
5 Fix	.2678	5.944	10^1.34 = 22.0
10 Fix	.2880	1.860	10^0.81 = 6.5
13 Fix	.5045	1.228	10^0.386 = 2.4

Cost of Runs on a XMP-Cray

Description	Actual CNWRA Sun Time(hr)	Equivilant XMP-Cray Time(hr)
10 LHS-400 - Shake-down	800	80
160 LHS-25 - try 25 vectors, Shake-down	800	80
40 LHS-50 - 0 Fixed	400	40
40 LHS-50 - 5 Fixed	400	40
15 LHS-50 - 8 Fixed	150	15
40 LHS-50 - 10 Fixed	400	40
40 LHS-50 - Verification Run (10)	400	40
40 LHS-50 - Verification Run (10)	400	40
40 LHS-50 - 12 Fixed	400	40
40 LHS-50 - 17 Fixed	400	40
40 LHS-50 - 13 Fixed	400	40
40 LHS-50 - 40 LHS(5)-50 Verification (13)	400	40
40 LHS-50 - 40 LHS(50)-5 Verification (13)	400	40
6 LHS-400 - New Infiltrations	480	48
Total Hours	6230	623

Effective cost @ $200/hour $124,600

Real Cost of Runs on XMP-Cray

Description	Actual XMP-Cray Time(hr)
2 LHS-400	16
1 LHS-50	1
Total Hours	17
	Effective cost $3,400 @ $200/hour

Conclusions

- Ran and Reran TPA Code
- Identified Most Important Parameters
- Verified Results

Information potentially subject to copyright protection was redacted from this page 55 through page 59. The redacted material is from the following reference:
McKay, M.D., and R.J. Beckman. "Using Variance to Identify Important Inputs." Presentation at the Joint Statistical Meetings, Toronto, Canada, August 15-18, 1994. Los Alamos, New Mexico: Los Alamos National Laboratory.

Information potentially subject to copyright protection was redacted from page 60 through page 68. The redacted material is from the following reference:

McKay, M.D. "Variance-Based Uncertainty and Importance for Nonlinear Models." Presentation to SwRI, San Antonio, Texas, April 27, 1995.

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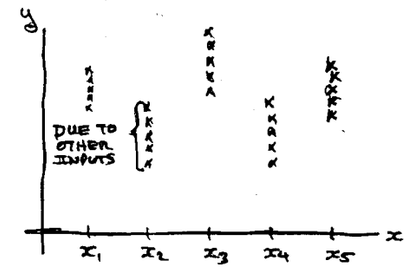
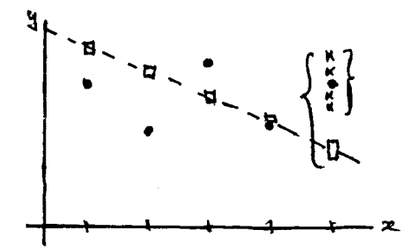
10/15/95



DATA FOR 5 VALUES OF INPUT x.



□ = "PREDICTION" FROM LINEAR METHOD

● = "PREDICTION" FROM NON LINEAR METHOD

BASIS FOR INDICATORS OF IMPORTANCE:

VARIABILITY IN y = VARIABILITY BETWEEN PREDICTIONS (●, □)

+ VARIABILITY WITHIN PREDICTION (x FROM ●)

BREAKDOWNS:

- LINEAR MODEL TOO FAR OFF.
- VARIABILITY FROM OTHER INPUTS MASKS EFFECTS.

RDM 11/8/95

Page #1 - "VarTop10A.lhsmatrix" Wednesday, November 8 9:46 PM 1995

	x47(L82)"infil"	x129(211)"ecorr2"	x130(212)"ecorr3"	x132(214)"ecorr5"	x133(215)"ecorr6"	x134(216)"ecorr7"
0	L 0.000152491	L -1.83795	L -3.35662	L 0.00337188	M 1249.98	M 1249.93
1	ML 0.000329507	ML -1.54371	H -3.04297	ML 0.00768220	H 1445.65	MH 1348.17
2	M 0.000707989	M -1.25041	M -3.20014	MH 0.0163075	ML 1152.25	L 1053.87
3	MH 0.00152598	MH -0.956681	ML -3.27833	H 0.0206186	L 1053.57	H 1446.01
4	H 0.00327175	H -0.662611	MH -3.12171	M 0.0119957	MH 1348.34	ML 1151.95

Page #2 - "VarTop10A.lhsmatrix" Wednesday, November 8 9:46 PM 1995

	x135(217)"ecorr8"	x142(L239)"forwar1-7"	x157(L254)"rdiff11"	x182(L303)"sol4Am"
0	H 0.000607383	M 0.000100132	H 0.00271105	H 0.000162483
1	M 0.000100171	L 1.64611e-05	M 0.000180691	L 1.85744e-06
2	MH 0.000246004	ML 4.05539e-05	MH 0.000702087	M 1.73393e-05
3	ML 4.06238e-05	MH 0.000246699	L 1.20639e-05	MH 5.31292e-05
4	L 1.64682e-05	H 0.000608423	ML 4.68800e-05	ML 5.66294e-06

Page #1 - "RegTop10A.lhsmatrix" Wednesday, November 8 9:47 PM 1995

	x47(L82)"infil"	x129(211)"ecorr2"	x3(L4)"akr3"	x6(22)"retard1"	x133(215)"ecorr6"	x134(216)"ecorr7"
0	L 0.000152491	L -1.83795	L 1.28673e-16	L 19.7098	M 1249.98	M 1249.93
1	ML 0.000329507	ML -1.54371	H 8.16352e-16	ML 37.3709	H 1445.65	MH 1348.17
2	M 0.000707989	M -1.25041	M 3.24345e-16	MH 72.5777	ML 1152.25	L 1053.87
3	MH 0.00152598	MH -0.956681	ML 2.20977e-16	H 90.2258	L 1053.57	H 1446.01
4	H 0.00327175	H -0.662611	MH 4.75025e-16	M 55.0324	MH 1348.34	ML 1151.95

Page #2 - "RegTop10A.lhsmatrix" Wednesday, November 8 9:47 PM 1995

	x135(217)"ecorr8"	x140(L237)"forwar1-7"	x157(L254)"rdiff11"	x8(24)"retard3"
0	H 0.000607383	M 0.000100132	H 0.00271105	H 90.3072
1	M 0.000100171	L 1.64611e-05	M 0.000180691	L 19.7328
2	MH 0.000246004	ML 4.05539e-05	MH 0.000702087	M 54.9795
3	ML 4.06238e-05	MH 0.000246699	L 1.20639e-05	MH 72.6501
4	L 1.64682e-05	H 0.000608423	ML 4.68800e-05	ML 37.4316

RDM 11/8/95

Page #1 - "VarTop10B.lhsmatrix" Wednesday, November 8 9:47 PM 1995

	x130(212)"ecorr3"	x132(214)"ecorr5"	x182(L303)"sol4Am"	x47(L82)"infil"	x129(211)"ecorr2"	x133(215)"ecorr6"
0	L -3.35662	L 0.00337188	L 1.85744e-06	L 0.000152491	M -1.25041	M 1249.98
1	ML -3.27833	ML 0.00768220	H 0.000162483	ML 0.000329507	H -0.662611	MH 1348.34
2	M -3.20014	M 0.0119957	M 1.73393e-05	MH 0.00152598	ML -1.54371	L 1053.57
3	MH -3.12171	MH 0.0163075	ML 5.66294e-06	H 0.00327175	L -1.83795	H 1445.65
4	H -3.04297	H 0.0206186	MH 5.31292e-05	M 0.000707989	MH -0.956681	ML 1152.25

Page #2 - "VarTop10B.lhsmatrix" Wednesday, November 8 9:47 PM 1995

	x134(216)"ecorr7"	x135(217)"ecorr8"	x142(L239)"forwar1-7"	x157(L254)"rdiff11"
0	H 1446.01	M 0.000100171	H 0.000608423	H 0.00271105
1	M 1249.93	L 1.64682e-05	M 0.000100132	L 1.20639e-05
2	MH 1348.17	ML 4.06238e-05	MH 0.000246699	M 0.000180691
3	ML 1151.95	MH 0.000246004	L 1.64611e-05	MH 0.000702087
4	L 1053.87	H 0.000607383	ML 4.05539e-05	ML 4.68800e-05

Page #1 - "RegTop10B.lhsmatrix" Wednesday, November 8 9:47 PM 1995

	x3(L4)"akr3"	x6(22)"retard1"	x8(24)"retard3"	x47(L82)"infil"	x129(211)"ecorr2"	x133(215)"ecorr6"	x134(216)"ecorr7"
0	L 1.28673e-16	L 19.7098	L 19.7328	L 0.000152491	M -1.25041	M 1249.98	H 1446.01
1	ML 2.20977e-16	ML 37.3709	H 90.3072	ML 0.000329507	H -0.662611	MH 1348.34	M 1249.93
2	M 3.24345e-16	M 55.0324	M 54.9795	MH 0.00152598	ML -1.54371	L 1053.57	MH 1348.17
3	MH 4.75025e-16	MH 72.5777	ML 37.4316	H 0.00327175	L -1.83795	H 1445.65	ML 1151.95
4	H 8.16352e-16	H 90.2258	MH 72.6501	M 0.000707989	MH -0.956681	ML 1152.25	L 1053.87

Page #2 - "RegTop10B.lhsmatrix" Wednesday, November 8 9:47 PM 1995

	x135(217)"ecorr8"	x140(L237)"forwar1-7"	x157(L254)"rdiff11"
0	M 0.000100171	H 0.000608423	H 0.00271105
1	L 1.64682e-05	M 0.000100132	L 1.20639e-05
2	ML 4.06238e-05	MH 0.000246699	M 0.000180691
3	MH 0.000246004	L 1.64611e-05	MH 0.000702087
4	H 0.000607383	ML 4.05539e-05	ML 4.68800e-05

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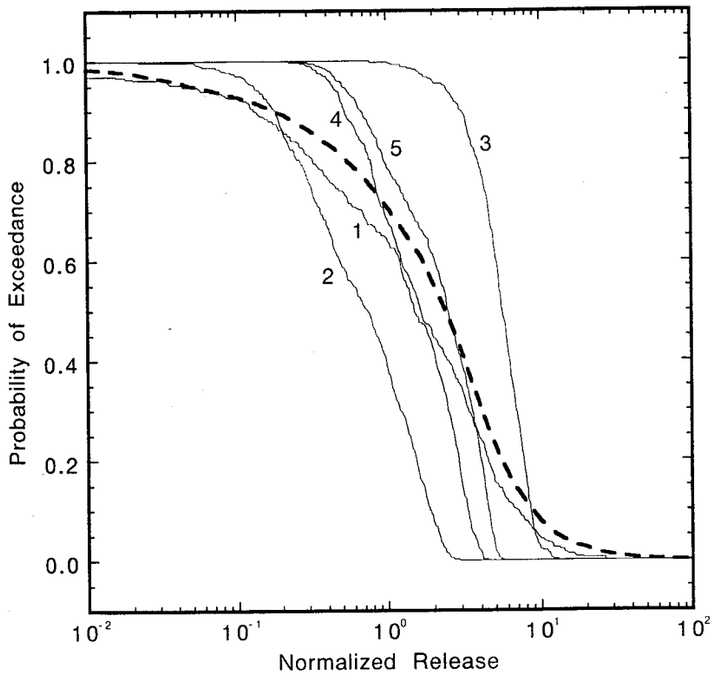
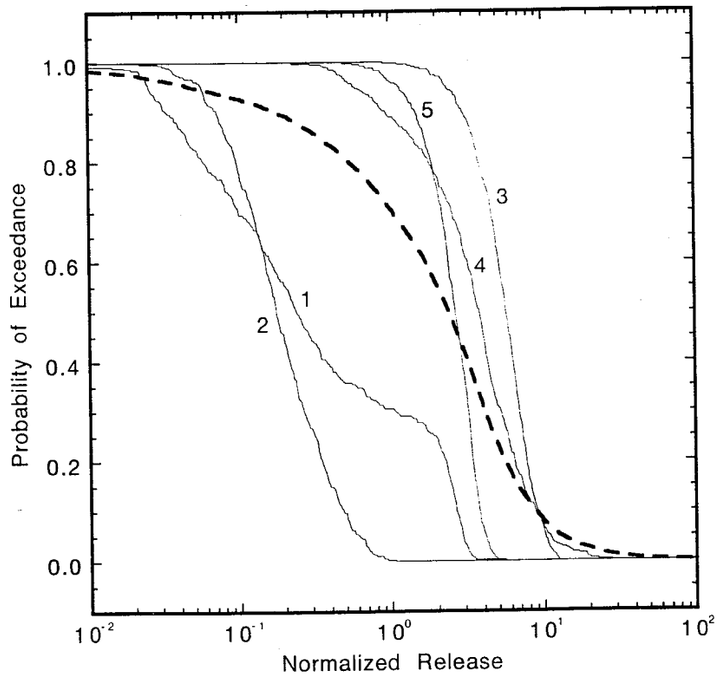
Conditional CCDFs (Var B)



Conditional CCDFs (Reg B)



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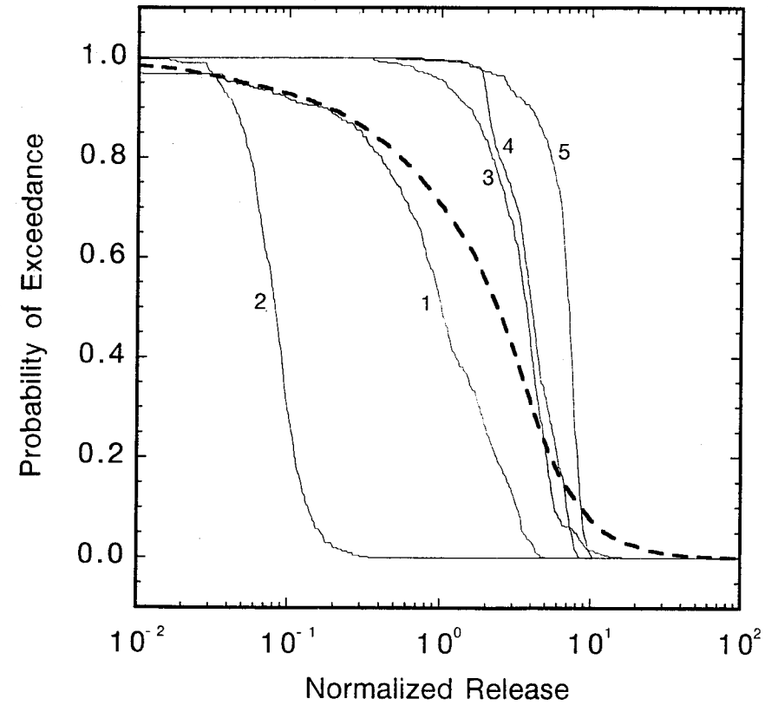
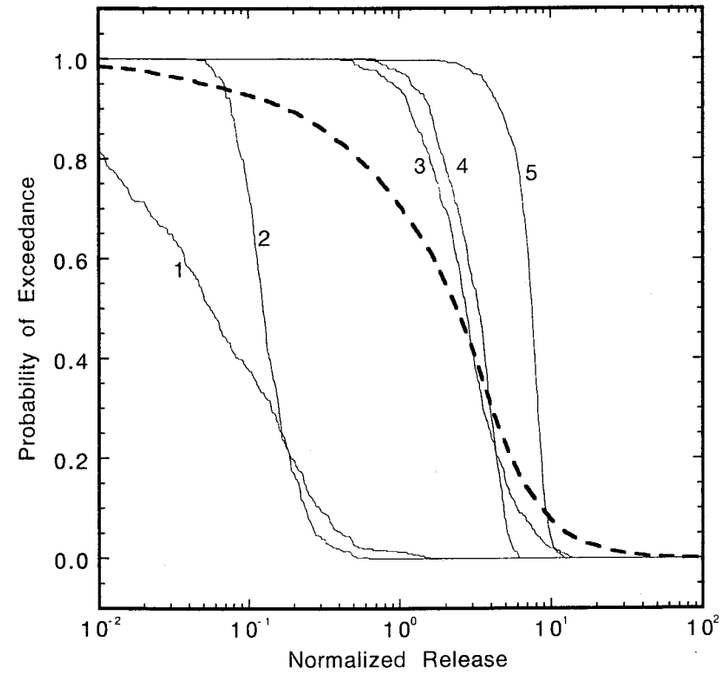
Conditional CCDFs
LHS-5 on 10 More Important Parameters



Conditional CCDFs (Reg A)



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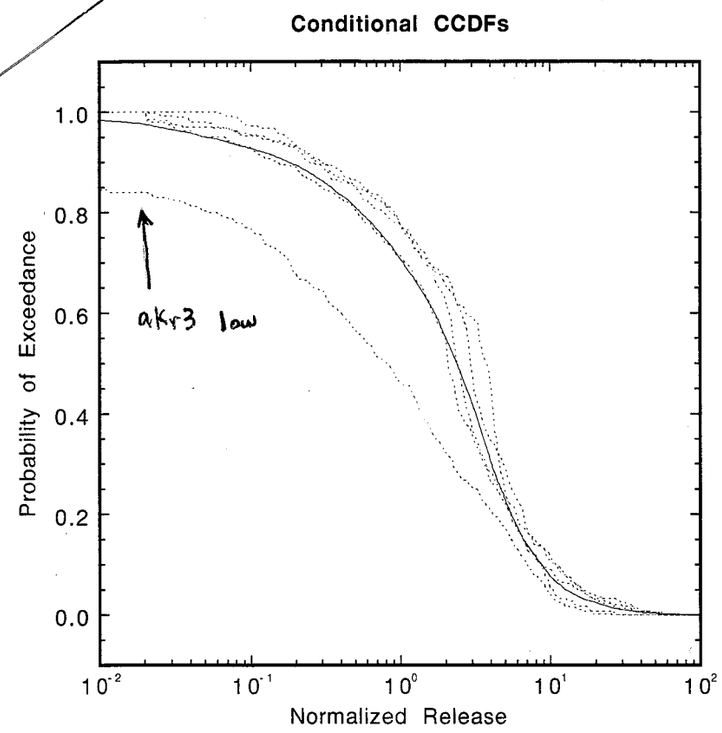

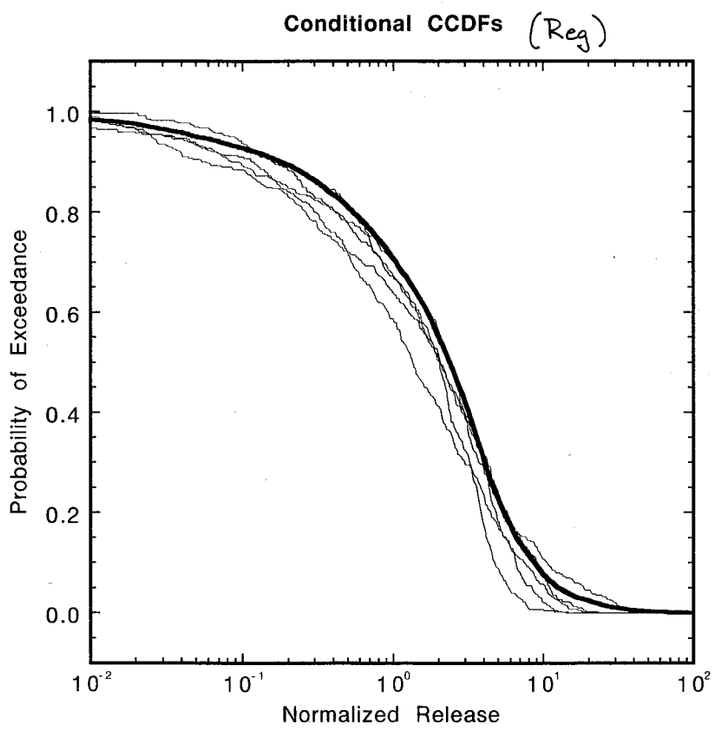

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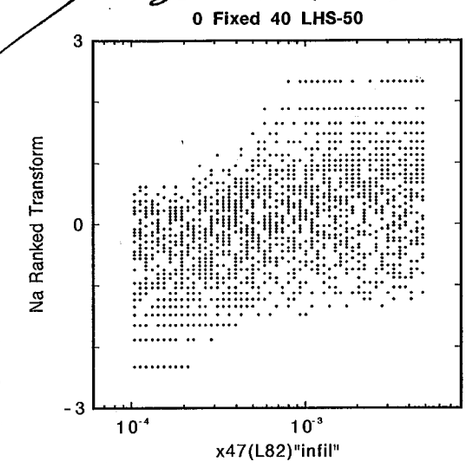
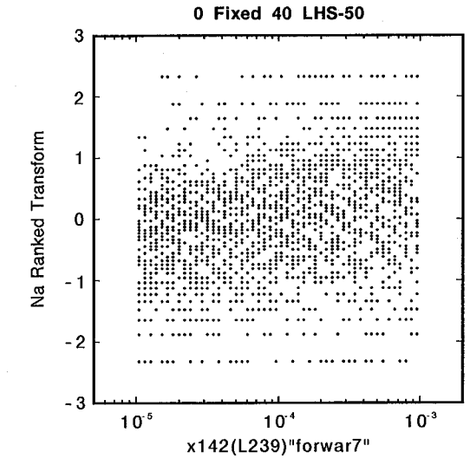
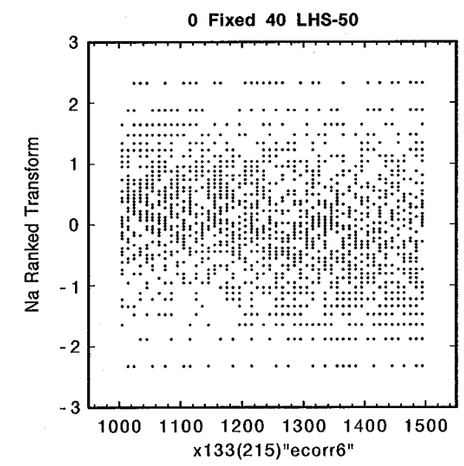
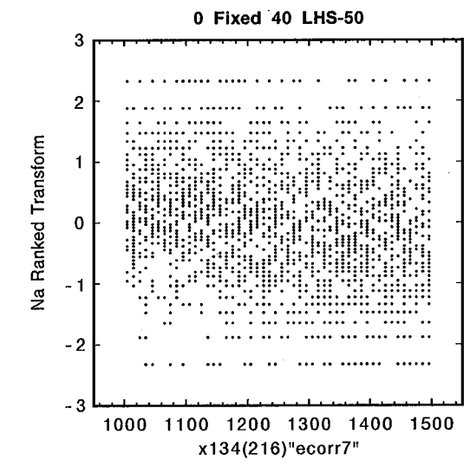
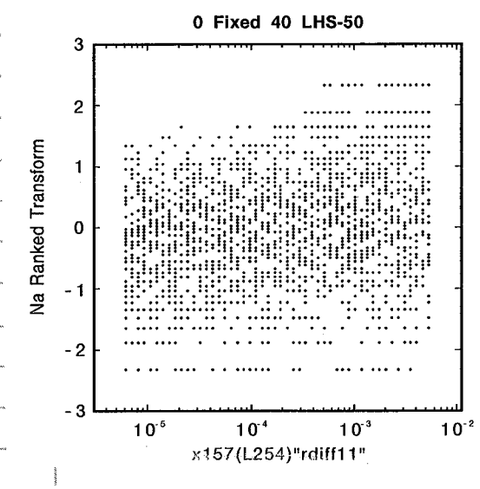
Scatter Plots

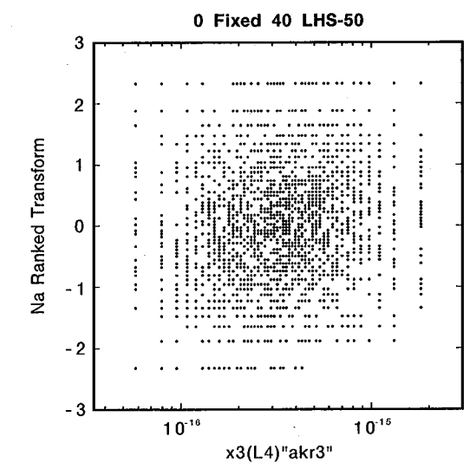












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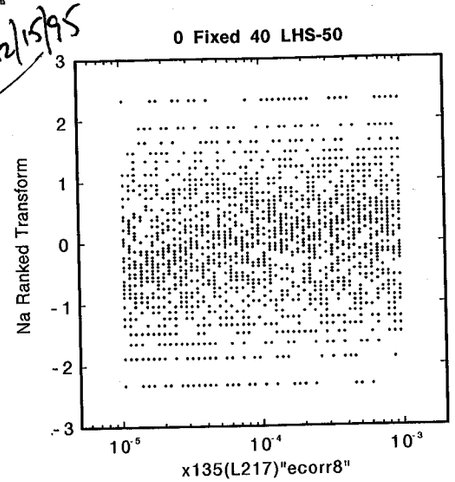
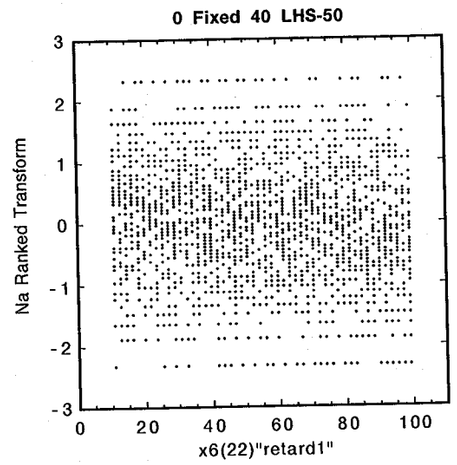
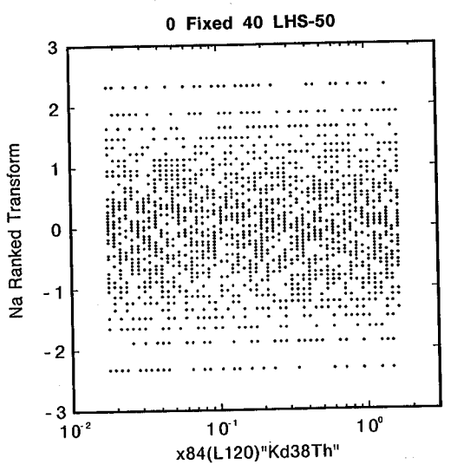
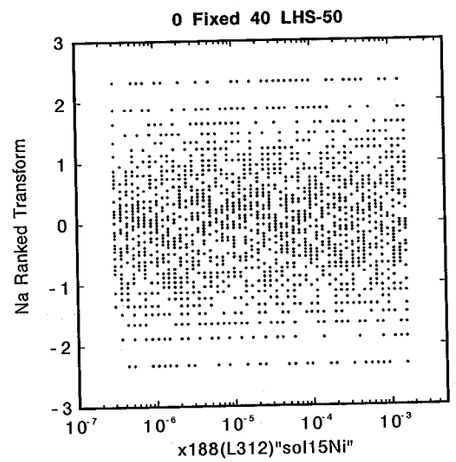
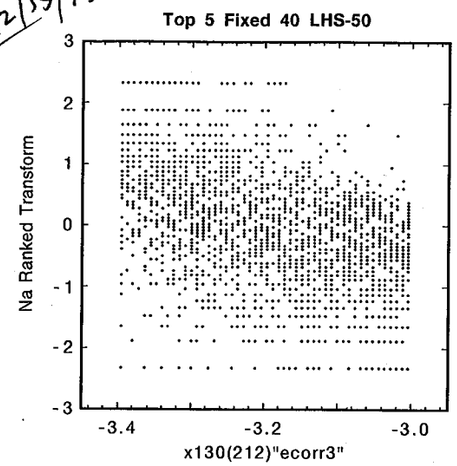

0 Fixed 40 LHS-50
Na Ranked Transform
x135(L217)"ecorr8"

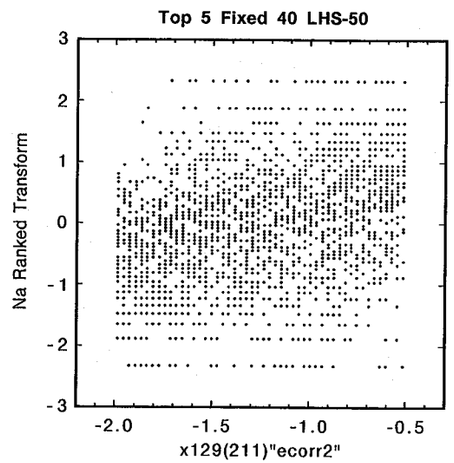

0 Fixed 40 LHS-50
Na Ranked Transform
x6(22)"retard1"

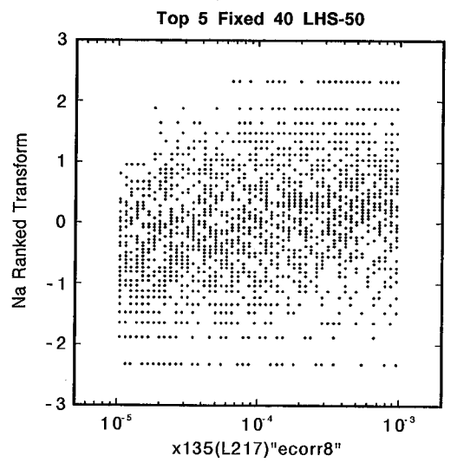

0 Fixed 40 LHS-50
Na Ranked Transform
x84(L120)"Kd38Th"

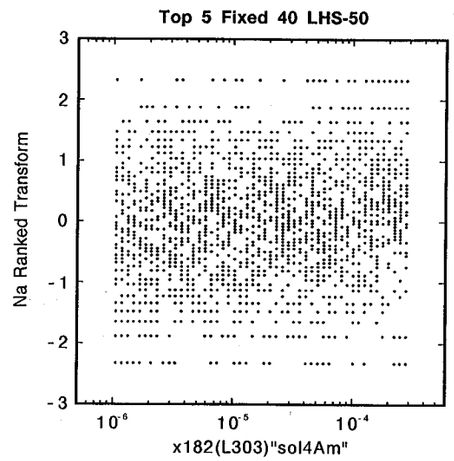

0 Fixed 40 LHS-50
Na Ranked Transform
x188(L312)"sol15Ni"

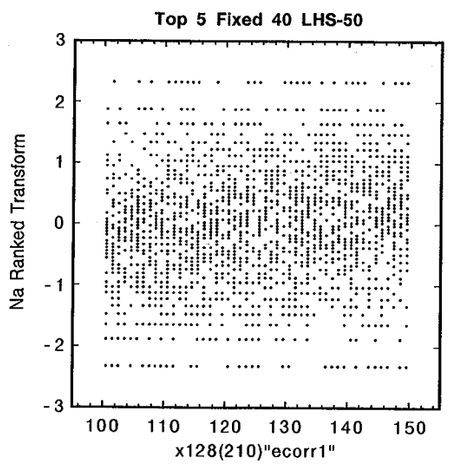
RDM 12/15/95

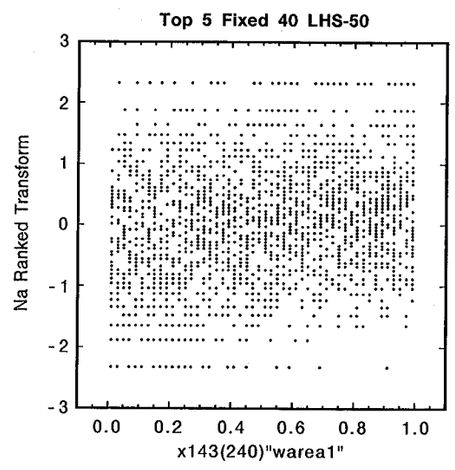












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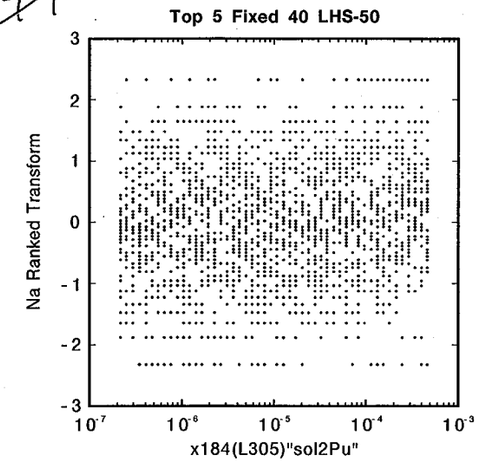
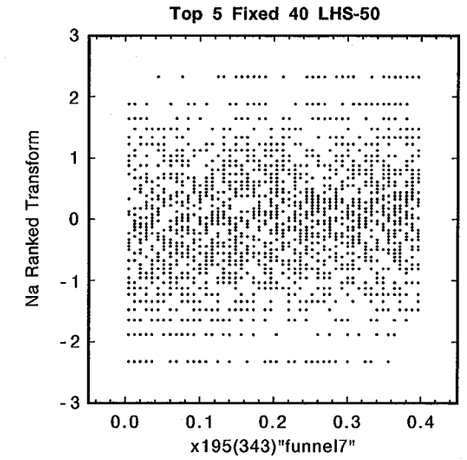
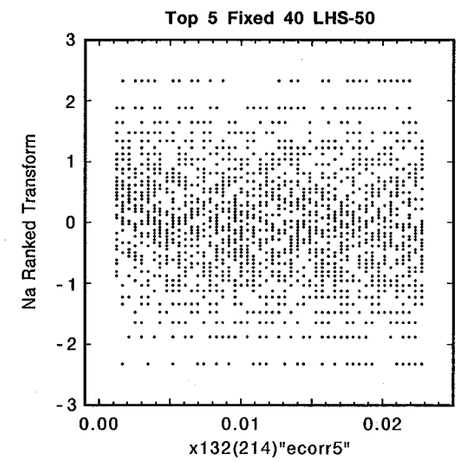
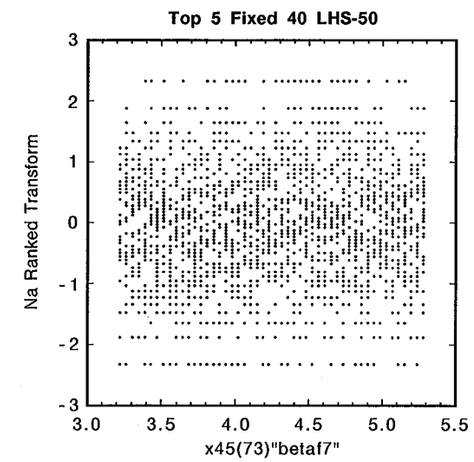








1/29/96
JE

All the output and programs for the new TPA code runs ~~for~~ all located in the directory
on Yucca
/home2/randalld/todd/TPA/TPA96

The output for the TPA code running with
RANDOM_SAMPLE
is in the directory
output

I am going to put the data for the TPA code runs
without RANDOM_SAMPLE in
JE 2/2/96
/home2/Randalld/todd/TPA/TPA96/Next 50v Runs

The TPA input files for the RANDOM_SAMPLE runs already
on the following machines:
sleepy
scratchy
sisyphus

Each input file was created with a different seedvalue.
The seedvalue # is the number on the end of the input file.
Ex.
thsoooo.out.500
↑ seedvalue used to create this file

Each machine has its own set of runs to complete.

~~sleepy~~
scratchy - is running the TPA code for input files
with seedvalues from 6100 to 12000.

JE 1/29/96
sisyphus - is running the TPA code for input files with seedvalues
from 100 to 6000.

to speed the process up we are using a machine to run the TPA
code with these same input files, but going backwards.
This machine is sleepy.

sleepy - is running the TPA code for input file with seedvalues
from 6000 down to 5000 and
12000 down to 9100.

sneezy was used for outfile, and it completed runs using
the files with seedvalues from
3100 to 4900.
The output from these runs are already in the output directory

Each machine is running a script file.

Scratchy is running script file runtpa.2

Sisyphus is running script file runtpa.1

sleepy is running script file runtpa.3

The script file copies the input file thsoooo.out.# to thsoooo.out and
then runs the TPA code by running the script
slave.s

Between each run the script copies the output files into the output
directory on that machine, it then executes the script file clear.

clear - deletes the old output files, so that a new run can be executed

Next page

JE 1/29/96

to run the script file type

runtpa. # &
↑ the number of the script file
the & tells it to run in the background.

DO NOT TYPE clear to clear the screen, because it will not clear it, it will erase the output file, and the code will have to be restarted!

The directory on these machines where the script file and input file are located is:
~~tpa~~ zke/tpa.

the output is in
zke/tpa/output

~~the output files~~
There are two ~~fot~~ output files for each run in the directory:

#.scnrel.fmt - main output
#.pathre.fmt

the scnrel.fmt file is the file that is used to create the CCDF it'd will explain in a minute how to create the ccdf.

First FTP the machine from which you want to get the output, and get the new output files and put these in the output directory on Yucca:
/home1/randolph/~~todd~~/TPA/TPA96/output

JE 1/29/96

The #.scnrel.fmt output files are the ones that are used to create the ccdf.

To create a ccdf:

chdir to the output directory on YUCCA.
The program ../CreateCCDF is the program used to create the CCDF.
by typing ../CreateCCDF followed by enter, the program will tell you what to type on the command line.

Ex of creating a CCDF

../CreateCCDF CCDF.dat 100 10 3100 5 9100 8 ↵

../CreateCCDF - Main program

CCDF.dat - output file name
100 - seed number of the first output file to be read
10 - the number of consecutive output files to be read in
3100 - next seed number of the first output file
5 - the number of consecutive files to read
9100 - the seed number of the first output file
8 = the number of consecutive files to read.

This example will read input files
100..1000
3100..3500
and 9100..9800,
and create a CCDF output file called CCDF.dat.

Setting up the code on a new Machine

Next page

1/31/96
ZE

Setting up the code to run on a new machine.

Get the tarfile from
/home/scratchy/randalld
and put it in your home directory on the new machine.

Untar the file
tar -xvf tarfile

Then ftp scratchy and get the following files:

/home/scratchy/randalld/tpa/tpa.e
" /tyone.dat
" /clear
/slave.s
/home/scratchy/randalld/sotec/sotec.e
" /neftran/nefmks.e
" /c14h/c14h.e
" /ditty/ditty.e

ZE
~~Put them in their corresponding the same directories on the new machine~~
Make sure to put them in their correct directories on the new machine.
They should go into the same directory on the new machine, that they where in on scratchy.

Make sure the .e files and slave.s are executable
if they are not execute the command
chmod u+x ~~name~~ filename

where filename is the name of the file you wish to make executable

FDM 2/2/96

Machine Passwords
~~PVM;USER~~ ZE
pvm;user

Machine Login Name
randalld

ZE 2/2/96

cc:Mail for: Blaine Russell

Subject: PVM accounts
Forwarded: Randall Manteufel 5/17/95 2:23 PM
---------- Forwarded ----------
Subject: PVM accounts
From: Alfred Johnson 5/17/95 3:01 PM
To: Randall Manteufel
---------- End of Forward ----------
To: Blaine Russell

Randy,

I have your account set up on the following workstations:

sisyphus, snowwhite, scratchy, sneezy, skippy, and sierra

Your account information is:

username: randalld
password: pvm;user

I made the account information the same on all these workstations.
Let me know if you need anything else.

...Alfred

MASTER: scratchy.cnwra.swri.edu
129.162.200.79

SLAVES: sierra
Sistu Stothoff 200.86 home2/sierra/randalld 40
snowwhite
Amit Ghosh 200.93 home/snowwhite/randalld 39
sisyphus
Ross Bagtzoglou 200.71 home2/sisyphus/randalld 47
shsiung
Simon Hsiung 200.98 ~~home/shsiung~~ home/randalld ~~26~~ 49
sneezy
Ron Green 209.2 home/sneezy/randalld 29
skippy
Jong Song 200.83 ~~usr~~/local/skippy/randalld 30

22 2/2/96

Plotting CCDF Using KaleidaGraph

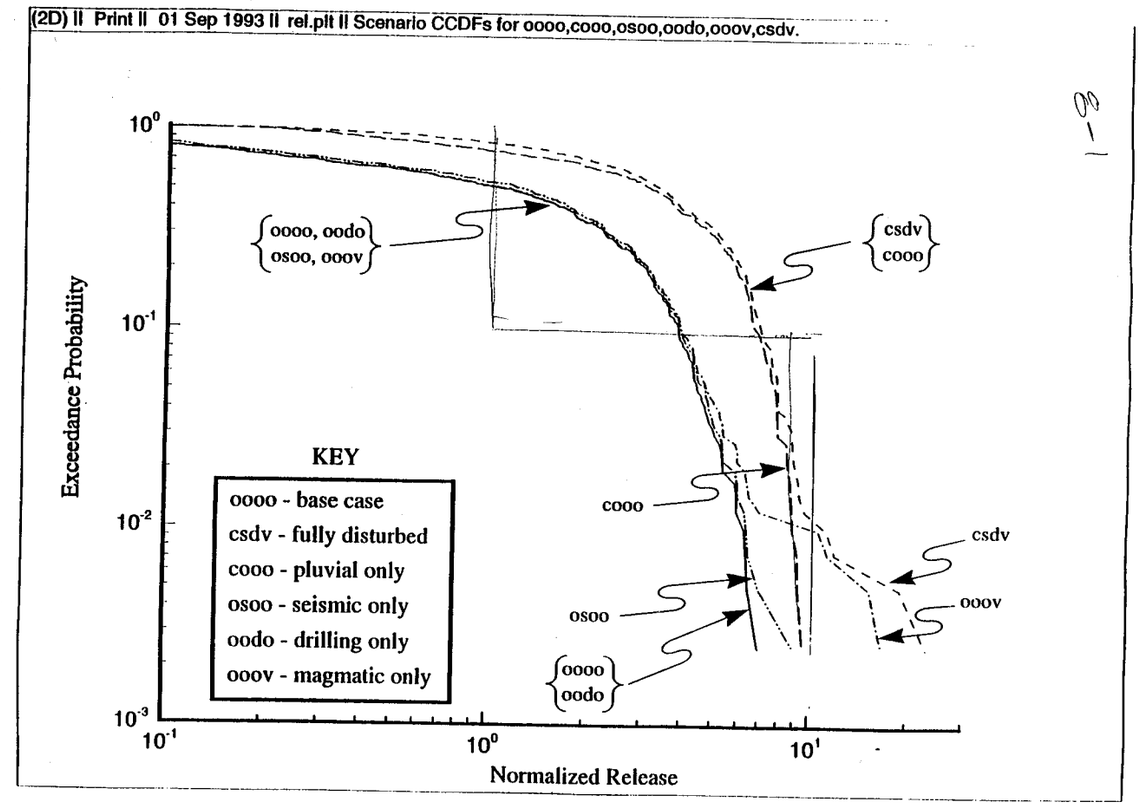
- Using VersaTerm get the CCDF file from YUCCA.
- Open up 6000vCCDF.out located in TODD/TPA 96/ on the mac
- Choose File | import | text while in Kaleidagraph and open the CCDF file that was received from YUCCA.
- You should now have files open in Kaleidagraph.
- Choose Gallery | Linear | Line plot
- Choose the appropriate x and y
- Click on the box that contains the filename, and choose the other file
- Once again choose the appropriate x and y
- Click NewPlot
- It should now plot 2 lines on the same graph.

If you save the graph, the data is saved with it, so there is no need to save the data. Once you have a graph open and you want to see the data that created the graph, there is a little box right above the up-arrow on the scroll bar. Click on the little box, and the data will be displayed.

Using a Template

- Open up one of the older CCDF plots.
- Follow the steps above, but instead of choosing Gallery | Linear, choose Gallery | template.

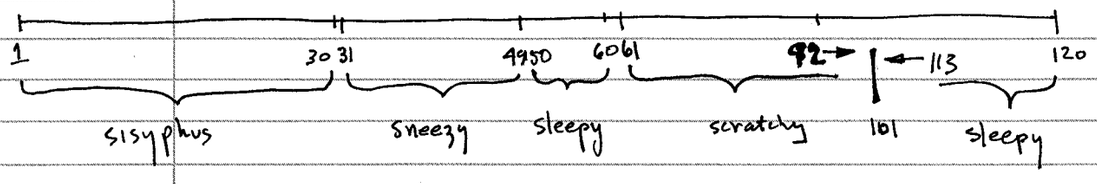
22 2/2/96



RDM 2/8/96

Independent Random Sampling
(pure Monte Carlo)

Machine	File #s to Run	Finished	Total	Subtotal	
sleepy (Mikko Ahola)	6000 – 5000	6000 – 5000	11		
	12000 – 9100	12000 – 11600	5	16	all input & output files
		2/8 11500 – 11300	3	19	copied to Yucca
	Total = ~~33~~	2/16 120 → 101			2/16/96
Scratchy (Ron Janetzke)	6100 – 12000	6100 – 8900	29		
		2/8 9000 – 9200	3	32	all input & output files copied to
	Total = 60				Yucca 2/16/96
Sisyphus (Ross Bagtzakis)	100 – 6000	100 – 3000	30	30	All files input & output copied to Yucca 2/8/96
	Total = 60				
Sneezy (Ron Green)	3100 – 4900	3100 – 4900	19	19	All files input & output copied to Yucca 2/8/96



All runs completed 2/16/96

RDM 2/8/96 moved all output files off of sisyphus ✓ also all LHS input files

ftp sisyphus
cd zke/tpa/output
set prompt
mget *.fmt mget lhs0000.out.*

put on yucca at /home2/randalld/todd/TPA/TPA96/50vRunsIRS
→ Input Files
→ Output Files

moved all output files off sneezy ✓

created script file for sisyphus, started sisyphus on LHS runs running backward from 12000 to 6000

RDM 2/16/96 by copying all input & output files from sleepy & scratchy, the disk usage on /home2 went from 48% → 51%.

Verified all input & output files copied for 120 IRS runs.

cleared-off input & output files on sleepy
copied runtpa.2 onto sleepy to run 61,000 → 120,000 jobs
copied lhs0000.out. ... 61 → 120 from sisyphus to sleepy
started job sleepy% runtpa.2 &
Did same for scratchy, 60 → 59 → 30

RDM 3/4/96 finished running ~~IRS~~ LHS ~~RDM 3/4/96~~ runs, moved files back to YUCCA.
/home2/randalld/todd/TPA/TPA96/50vRunsLHS/OutputFiles

Rom 3/8/96

Run 400 vector jobs
copy larger tpa.e from home/scratchy/janetzke/zke/tpa

Make LHS 400 V input files
move to /home2/randalld/todd/TPA/TPACODE/zke/lhs2
edit TPA_LHS.LGD to get 400 vectors
edit lhs 20n.inp to update seed value
run LHS using:
/lhs2/lhs.e < TPA_LHS.LGD
will create lhs0000.out
mv lhs0000.out lhs0000.out.seed
moved all lhs input file into
yucca/home2/randalld/todd/TPA/TPA96/400vLHS

setup on scratchy
→ jobs: 1500 → 1400 → 1300 → 1200 → 1100 → 1000 → 900

setup on Sleepy
jobs: 800 - 900 - 1000 → 1100 - 1200 - 1300 - 1400 - 1500

Setup on snowwhite
jobs: 100 - 200 - 300 - 400 - 500 - 600 - 700

setup on sisyphus
jobs: 700 - 600 - 500 - 400 - 300 - 200 - 100

5/15/96

```
yucca% pwd
/home2/randalld/todd/TPA/TPA96/400vLHS/OldOutput
yucca% cat movefiles
cp OldOutput/400v.100.scnrel.fmt    Output/scnrel.fmt.500
cp OldOutput/400v.15000.scnrel.fmt  Output/scnrel.fmt.600
cp OldOutput/400v.20000.scnrel.fmt  Output/scnrel.fmt.700
cp OldOutput/400v.3000.scnrel.fmt   Output/scnrel.fmt.800
cp OldOutput/400v.31000.scnrel.fmt  Output/scnrel.fmt.900
cp OldOutput/400v.4000.scnrel.fmt   Output/scnrel.fmt.1600
cp OldOutput/400v.5000.scnrel.fmt   Output/scnrel.fmt.1700
cp OldOutput/400v.7000.scnrel.fmt   Output/scnrel.fmt.1800
cp OldOutput/400v.8999.scnrel.fmt   Output/scnrel.fmt.1900
cp OldOutput/400v.scnrel.fmt        Output/scnrel.fmt.2000
```

Finished some jobs on scratchy. Used old results to make "20" effective LHS-400 runs.

RDM 6/17/96 Moved 400v LHS runs to optical disk attached at back of notebook

```
total 41107
-rw-r--r--  1 guest     5080 Jun 18 08:39 400v.100.scnrel.fmt
-rw-r--r--  1 guest     5080 Jun 18 08:39 400v.15000.scnrel.fmt
-rw-r--r--  1 guest     5080 Jun 18 08:39 400v.20000.scnrel.fmt
-rw-r--r--  1 guest     5080 Jun 18 08:39 400v.3000.scnrel.fmt
-rw-r--r--  1 guest     5080 Jun 18 08:39 400v.31000.scnrel.fmt
-rw-r--r--  1 guest     5080 Jun 18 08:39 400v.4000.scnrel.fmt
-rw-r--r--  1 guest     5080 Jun 18 08:39 400v.5000.scnrel.fmt
-rw-r--r--  1 guest     5080 Jun 18 08:39 400v.7000.scnrel.fmt
-rw-r--r--  1 guest     5080 Jun 18 08:39 400v.8998.scnrel.fmt
-rw-r--r--  1 guest     5080 Jun 18 08:39 400v.scnrel.fmt
-rw-r--r--  1 guest     3615 Jun 18 08:40 jnk2
-rw-r--r--  1 guest      943 Jun 18 08:40 junk
-rw-r--r--  1 guest  2754000 Jun 18 08:31 lhsoooo.out.100
-rw-r--r--  1 guest  2754000 Jun 18 08:32 lhsoooo.out.1000
-rw-r--r--  1 guest  2754000 Jun 18 08:32 lhsoooo.out.1100
-rw-r--r--  1 guest  2754000 Jun 18 08:33 lhsoooo.out.1200
-rw-r--r--  1 guest  2754000 Jun 18 08:33 lhsoooo.out.1300
-rw-r--r--  1 guest  2754000 Jun 18 08:34 lhsoooo.out.1400
-rw-r--r--  1 guest  2754000 Jun 18 08:34 lhsoooo.out.1500
-rw-r--r--  1 guest  2754000 Jun 18 08:35 lhsoooo.out.200
-rw-r--r--  1 guest  2754000 Jun 18 08:35 lhsoooo.out.300
-rw-r--r--  1 guest  2754000 Jun 18 08:36 lhsoooo.out.400
-rw-r--r--  1 guest  2754000 Jun 18 08:36 lhsoooo.out.500
-rw-r--r--  1 guest  2754000 Jun 18 08:37 lhsoooo.out.600
-rw-r--r--  1 guest  2754000 Jun 18 08:37 lhsoooo.out.700
-rw-r--r--  1 guest  2754000 Jun 18 08:38 lhsoooo.out.800
-rw-r--r--  1 guest  2754000 Jun 18 08:38 lhsoooo.out.900
-rw-r--r--  1 guest      576 Jun 18 08:39 movefiles
-rw-r--r--  1 guest    39261 Jun 18 08:30 pathre.fmt.100
-rw-r--r--  1 guest    39261 Jun 18 08:30 pathre.fmt.1000
-rw-r--r--  1 guest    39261 Jun 18 08:30 pathre.fmt.1100
-rw-r--r--  1 guest    39261 Jun 18 08:30 pathre.fmt.1200
-rw-r--r--  1 guest    39261 Jun 18 08:30 pathre.fmt.1300
-rw-r--r--  1 guest    39261 Jun 18 08:30 pathre.fmt.1400
-rw-r--r--  1 guest    39261 Jun 18 08:30 pathre.fmt.1500
-rw-r--r--  1 guest    39261 Jun 18 08:30 pathre.fmt.200
-rw-r--r--  1 guest    39261 Jun 18 08:30 pathre.fmt.300
-rw-r--r--  1 guest    39261 Jun 18 08:30 pathre.fmt.400
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.100
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.1000
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.1100
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.1200
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.1300
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.1400
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.1500
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.1600
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.1700
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.1800
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.1900
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.200
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.2000
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.300
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.400
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.500
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.600
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.700
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.800
-rw-r--r--  1 guest     5080 Jun 18 08:30 scnrel.fmt.900
-rw-r--r--  1 guest      716 Jun 18 08:30 strip.f
```


RDM 6/17/96 Moved 50v LHS onto optical disk

```
total 53130
-rw-r--r--  1 guest     4961 Jun 18 08:23 100.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 100.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 1000.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 1000.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 10000.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 10000.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 10100.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 10100.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 10200.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 10200.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 10300.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 10300.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 10400.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 10400.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 10500.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 10500.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 10600.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 10600.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 10700.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 10700.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 10800.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 10800.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 10900.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 10900.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 1100.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 1100.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 11000.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 11000.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 11100.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 11100.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 11200.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 11200.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 11300.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 11300.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 11400.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 11400.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 11500.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 11500.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 11600.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 11600.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 11700.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 11700.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 11800.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 11800.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 11900.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 11900.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 1200.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 1200.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 12000.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 12000.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 1300.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 1300.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 1400.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 1400.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 1500.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 1500.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 1600.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 1600.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 1700.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 7100.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 7200.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 7200.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 7300.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 7300.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 7400.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 7400.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 7500.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 7500.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 7600.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 7600.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 7700.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 7700.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 7800.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 7800.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 7900.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 7900.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 800.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 800.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 8000.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 8000.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 8100.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 8100.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 8200.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 8200.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 8300.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 8300.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 8400.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 8400.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 8500.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 8500.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 8600.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 8600.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 8700.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 8700.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 8800.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 8800.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 8900.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 8900.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 900.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 900.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 9000.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 9000.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 9100.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 9100.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 9200.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 9200.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 9300.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 9300.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 9400.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 9400.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 9500.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 9500.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 9600.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 9600.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 9700.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 9700.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 9800.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 9800.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 9900.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 1700.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 1800.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 1800.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:23 1900.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:23 1900.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 200.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 200.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 2000.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 2000.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 2100.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 2100.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 2200.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 2200.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 2300.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 2300.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 2400.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 2400.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 2500.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 2500.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 2600.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 2600.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 2700.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 2700.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 2800.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 2800.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 2900.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 2900.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 300.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 300.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 3000.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 3000.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 3100.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 3100.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 3200.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 3200.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 3300.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 3300.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 3400.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 3400.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 3500.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 3500.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 3600.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 3600.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 3700.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 3700.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 3800.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 3800.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 3900.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 3900.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 400.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 400.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 4000.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 4000.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 4100.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 4100.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 4200.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 4200.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 4300.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 4300.scnrel.fmt
-rw-r--r--  1 guest     4961 Jun 18 08:24 4400.pathre.fmt
-rw-r--r--  1 guest      739 Jun 18 08:24 9800.scnrel.fmt
-rw-r--r--  1 guest   139264 Jun 18 09:14 CreateScript
-rw-r--r--  1 guest      546 Jun 18 09:14 CreateScript.C
-rw-r--r--  1 guest      547 Jun 18 09:14 CreateScript2.C
-rw-r--r--  1 guest   344250 Jun 18 09:15 lhsoooo.out.100
-rw-r--r--  1 guest   344250 Jun 18 09:15 lhsoooo.out.1000
-rw-r--r--  1 guest   344250 Jun 18 09:15 lhsoooo.out.10000
-rw-r--r--  1 guest   344250 Jun 18 09:15 lhsoooo.out.10100
-rw-r--r--  1 guest   344250 Jun 18 09:15 lhsoooo.out.10200
-rw-r--r--  1 guest   344250 Jun 18 09:15 lhsoooo.out.10300
-rw-r--r--  1 guest   344250 Jun 18 09:15 lhsoooo.out.10400
-rw-r--r--  1 guest   344250 Jun 18 09:15 lhsoooo.out.10500
-rw-r--r--  1 guest   344250 Jun 18 09:15 lhsoooo.out.10600
-rw-r--r--  1 guest   344250 Jun 18 09:15 lhsoooo.out.10700
-rw-r--r--  1 guest   344250 Jun 18 09:15 lhsoooo.out.10800
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.10900
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.1100
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.11000
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.11100
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.11200
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.11300
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.11400
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.11500
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.11600
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.11700
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.11800
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.11900
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.1200
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.12000
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.1300
-rw-r--r--  1 guest   344250 Jun 18 09:16 lhsoooo.out.1400
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.1500
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.1600
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.1700
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.1800
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.1900
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.200
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.2000
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.2100
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.2200
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.2300
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.2400
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.2500
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.2600
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.2700
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.2800
-rw-r--r--  1 guest   344250 Jun 18 09:17 lhsoooo.out.2900
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.300
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.3000
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.3100
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.3200
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.3300
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.3400
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.3500
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.3600
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.3700
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.3800
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.3900
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.400
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.4000
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.4100
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.4200
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.4300
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.4400
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.4500
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.4600
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.4700
-rw-r--r--  1 guest   344250 Jun 18 09:18 lhsoooo.out.4800
-rw-r--r--  1 guest   344250 Jun 18 09:19 lhsoooo.out.4900
-rw-r--r--  1 guest   344250 Jun 18 09:19 lhsoooo.out.500
-rw-r--r--  1 guest   344250 Jun 18 09:19 lhsoooo.out.5000
-rw-r--r--  1 guest   344250 Jun 18 09:19 lhsoooo.out.5100
-rw-r--r--  1 guest   344250 Jun 18 09:19 lhsoooo.out.5200
-rw-r--r--  1 guest   344250 Jun 18 09:19 lhsoooo.out.5300
-rw-r--r--  1 guest   344250 Jun 18 09:19 lhsoooo.out.5400
-rw-r--r--  1 guest   344250 Jun 18 09:19 lhsoooo.out.5500
-rw-r--r--  1 guest   344250 Jun 18 09:19 lhsoooo.out.5600
-rw-r--r--  1 guest   344250 Jun 18 09:19 lhsoooo.out.5700
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.5800
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.5900
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.600
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.6000
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.6100
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.6200
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.6300
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.6400
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.6500
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.6600
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.6700
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.6800
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.6900
-rw-r--r--  1 guest   344250 Jun 18 09:20 lhsoooo.out.700
-rw-r--r--  1 guest   344250 Jun 18 09:21 lhsoooo.out.7000
-rw-r--r--  1 guest   344250 Jun 18 09:21 lhsoooo.out.7100
-rw-r--r--  1 guest   344250 Jun 18 09:21 lhsoooo.out.7200
-rw-r--r--  1 guest   344250 Jun 18 09:21 lhsoooo.out.7300
-rw-r--r--  1 guest   344250 Jun 18 09:21 lhsoooo.out.7400
-rw-r--r--  1 guest   344250 Jun 18 09:21 lhsoooo.out.7500
-rw-r--r--  1 guest   344250 Jun 18 09:21 lhsoooo.out.7600
-rw-r--r--  1 guest   344250 Jun 18 09:21 lhsoooo.out.7700
-rw-r--r--  1 guest   344250 Jun 18 09:21 lhsoooo.out.7800
-rw-r--r--  1 guest   344250 Jun 18 09:21 lhsoooo.out.7900
-rw-r--r--  1 guest   344250 Jun 18 09:21 lhsoooo.out.800
-rw-r--r--  1 guest   344250 Jun 18 09:21 lhsoooo.out.8000
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.8100
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.8200
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.8300
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.8400
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.8500
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.8600
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.8700
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.8800
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.8900
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.900
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.9000
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.9100
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.9200
-rw-r--r--  1 guest   344250 Jun 18 09:22 lhsoooo.out.9300
-rw-r--r--  1 guest   344250 Jun 18 09:23 lhsoooo.out.9400
-rw-r--r--  1 guest   344250 Jun 18 09:23 lhsoooo.out.9500
-rw-r--r--  1 guest   344250 Jun 18 09:23 lhsoooo.out.9600
-rw-r--r--  1 guest   344250 Jun 18 09:23 lhsoooo.out.9700
-rw-r--r--  1 guest   344250 Jun 18 09:23 lhsoooo.out.9800
-rw-r--r--  1 guest   344250 Jun 18 09:23 lhsoooo.out.9900
-rw-r--r--  1 guest    14598 Jun 18 09:14 runtpa
-rw-r--r--  1 guest     7444 Jun 18 09:14 runtpa.T
-rw-r--r--  1 guest      904 Jun 18 09:24 strip.f
```

RDM
6/17/96

moved 50 v IRS onto optical disk

```
total 42900
-rw-r--r--  1 guest     4961 Jun 18 09:46 100.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 100.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 1000.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 1000.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 10000.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 10000.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 10100.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 10100.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 10200.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 10200.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 10300.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 10300.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 10400.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 10400.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 10500.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 10500.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 10600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 10600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 10700.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 10700.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 10800.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 10800.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 10900.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 10900.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 1100.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 1100.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 11000.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 11000.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 11100.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 11100.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 11200.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 11200.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 11300.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 11300.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 11400.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 11400.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 11500.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 11500.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 11600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 11600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 11700.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 11700.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 11800.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 11800.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 11900.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 11900.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 1200.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 1200.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 12000.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 12000.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 1300.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 1300.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 1400.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 1400.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 1500.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 1500.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 1600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 1600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 1700.pathre.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 1700.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 9800.scnrel.fat
-rw-r--r--  1 guest      562 Jun 18 08:33 constants.dat
-rw-r--r--  1 guest   344250 Jun 18 09:33 thscccc.out.100
-rw-r--r--  1 guest   344250 Jun 18 09:33 thscccc.out.1000
-rw-r--r--  1 guest   344250 Jun 18 09:33 thscccc.out.10000
-rw-r--r--  1 guest   344250 Jun 18 09:33 thscccc.out.10100
-rw-r--r--  1 guest   344250 Jun 18 09:33 thscccc.out.10200
-rw-r--r--  1 guest   344250 Jun 18 09:33 thscccc.out.10300
-rw-r--r--  1 guest   344250 Jun 18 09:33 thscccc.out.10400
-rw-r--r--  1 guest   344250 Jun 18 09:33 thscccc.out.10500
-rw-r--r--  1 guest   344250 Jun 18 09:33 thscccc.out.10600
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.10700
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.10800
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.10900
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.1100
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.11000
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.11100
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.11200
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.11300
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.11400
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.11500
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.11600
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.11700
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.11800
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.11900
-rw-r--r--  1 guest   344250 Jun 18 09:34 thscccc.out.1200
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.12000
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.1300
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.1400
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.1500
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.1600
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.1700
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.1800
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.200
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.2000
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.2100
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.2200
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.2300
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.2400
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.2500
-rw-r--r--  1 guest   344250 Jun 18 09:35 thscccc.out.2600
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.2700
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.2800
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.2900
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.300
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.3000
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.3100
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.3200
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.3300
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.3400
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.3500
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.3600
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.3700
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.3800
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.3900
-rw-r--r--  1 guest   344250 Jun 18 09:36 thscccc.out.400
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.4000
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.4100
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.4200
-rw-r--r--  1 guest      738 Jun 18 09:46 1700.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 1800.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 1800.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 1900.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 1900.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 200.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 200.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 2000.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 2000.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 2100.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 2100.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 2200.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 2200.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 2300.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 2300.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 2400.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 2400.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 2500.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 2500.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 2600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 2600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 2700.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 2700.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 2800.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 2800.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 2900.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 2900.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 300.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 300.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 3000.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 3000.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 3100.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 3100.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 3200.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 3200.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 3300.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 3300.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 3400.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 3400.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 3600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 3600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 3600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 3600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 3700.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 3700.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 3800.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 3800.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 3900.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 3900.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 400.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 400.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 4000.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 4000.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 4100.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 4100.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 4200.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 4200.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 4300.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 4300.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 4400.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 4400.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 4500.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 4500.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 4600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 4600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 4700.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 4700.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 4800.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 4800.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 4900.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 4900.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:45 500.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 500.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:45 5000.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 5000.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 5100.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 5100.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 5200.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 5200.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 5300.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 5300.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 5400.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 5400.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 5500.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 5500.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 5600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 5600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:45 5700.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 5700.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 5800.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 5800.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:45 5900.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 5900.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:45 600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:45 6000.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 6000.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 6100.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 6100.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:45 6200.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 6200.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 6300.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 6300.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 6400.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 6400.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 6500.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 6500.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 6600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 6600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 6700.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 6700.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:45 6800.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:45 6800.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:45 6900.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 6900.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 700.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 700.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:45 7000.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 7000.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 7100.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 7100.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 7200.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 7200.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 7300.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 7300.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 7400.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 7400.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 7500.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 7500.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 7600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 7600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 7700.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 7700.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 7800.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 7800.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 7900.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 7900.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 800.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 800.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 8000.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 8000.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 8100.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 8100.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 8200.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 8200.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 8300.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 8300.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 8400.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 8400.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 8500.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 8500.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 8600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 8600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 8700.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 8700.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 8800.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 8800.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 8900.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 8900.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 900.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 900.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 9000.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 9000.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 9100.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 9100.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 9200.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 9200.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 9300.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 9300.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 9400.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 9400.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 9500.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 9500.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 9600.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 9600.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 9700.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 9700.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 9800.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 9800.scnrel.fat
-rw-r--r--  1 guest     4961 Jun 18 09:46 9900.pathre.fat
-rw-r--r--  1 guest      738 Jun 18 09:46 9900.scnrel.fat
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.4300
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.4400
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.4500
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.4600
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.4700
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.4800
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.4900
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.500
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.5000
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.5100
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.5200
-rw-r--r--  1 guest   344250 Jun 18 09:37 thscccc.out.5300
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.5400
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.5500
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.5600
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.5700
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.5800
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.5900
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.600
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.6000
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.6100
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.6200
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.6300
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.6400
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.6500
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.6600
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.6700
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.6800
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.6900
-rw-r--r--  1 guest   344250 Jun 18 09:39 thscccc.out.700
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.7000
-rw-r--r--  1 guest   344250 Jun 18 09:39 thscccc.out.7100
-rw-r--r--  1 guest   344250 Jun 18 09:39 thscccc.out.7200
-rw-r--r--  1 guest   344250 Jun 18 09:39 thscccc.out.7300
-rw-r--r--  1 guest   344250 Jun 18 09:39 thscccc.out.7400
-rw-r--r--  1 guest   344250 Jun 18 09:39 thscccc.out.7500
-rw-r--r--  1 guest   344250 Jun 18 09:39 thscccc.out.7600
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.7700
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.7800
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.7900
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.800
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.8000
-rw-r--r--  1 guest   344250 Jun 18 09:38 thscccc.out.8100
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.8200
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.8300
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.8400
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.8500
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.8600
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.8700
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.8800
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.8900
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.900
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.9000
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.9100
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.9200
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.9300
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.9400
-rw-r--r--  1 guest   344250 Jun 18 09:40 thscccc.out.9500
-rw-r--r--  1 guest   344250 Jun 18 09:41 thscccc.out.9600
-rw-r--r--  1 guest   344250 Jun 18 09:41 thscccc.out.9700
-rw-r--r--  1 guest   344250 Jun 18 09:41 thscccc.out.9800
-rw-r--r--  1 guest   344250 Jun 18 09:41 thscccc.out.9900
-rw-r--r--  1 guest      467 Jun 18 09:41 logs.dat
-rw-r--r--  1 guest    33461 Jun 18 09:41 newihs.dat
-rw-r--r--  1 guest      904 Jun 18 09:46 strip.f
-rw-r--r--  1 guest     2241 Jun 18 09:41 titles.dat
```


RDM
6/21/96

on yucca% tar␣cvf␣ file.tar␣ subdirectory ⇐ make tar of TPA code
↑ tpacode.tar ↑ TPACODE

from yucca% telnet bren ⇐ telnet to bren
bren% /bin/opto_mount␣ c␣ /opto ⇐ mount optical disk
bren% cd /opto/randalld
bren% ftp yucca ⇐ go ftp to yucca
login name
password
cd todd/TPA
get tpacode.tar ⇐ will copy to optical disk
bren% cd ⇐ get off opto

Now able to clean-up yucca disk, free space
bren% /bin/opto_umount␣ c

Note: to extract files from tar use
tar xvf filename

RDM
6/25/96

test, pmean.m

```
In[719]:=
   Needs["Statistics`HypothesisTests`"]
   Needs["Statistics`ContinuousDistributions`"]

   datx = Table[ p  , {p,1,500,1} ];
   daty = Table[ p+5, {p,1,500,1} ];
   ap = MeanDifferenceTest[ datx, daty, 0.0,
      SignificanceLevel -> 0.05 ]
   ap = MeanDifferenceTest[ datx, daty, 0.0,
      TwoSided -> True,
      SignificanceLevel -> 0.05 ]
Out[706]=
   {OneSidedPValue -> 0.29219,

     Accept null hypothesis at significance level -> 0.05}
Out[707]=
   {TwoSidedPValue -> 0.58438,

     Accept null hypothesis at significance level -> 0.05}
In[708]:=
   xbar = Mean[datx];
   ybar = Mean[daty];
   xmybar = Mean[datx] - Mean[daty];
   varx = Variance[datx];
   vary = Variance[daty];
   n = Length[datx];
   m = Length[daty];
   df = Round[(varx/n + vary/m)^2 /
       (((varx/n)^2)/n + ((vary/m)^2)/m) -2];
   (* varp = ((n-1)*varx +(m-1)*vary)/(m+n-2); *)
   varp = (varx/n +vary/m);
   z = Abs[ N[xmybar / Sqrt[ varp ]] ]
Out[718]=
   0.547176
In[721]:=
   (1-CDF[ NormalDistribution[0,1], z ])*2
Out[721]=
   0.584258
```

*

Needed to check CCDF data and wanted to use FORTRAN subroutine. So wrote pmean.f and check with MATHEMATICA code to be sure it worked properly

```
snowwhite% cat pmean.f
      program main
c
c test pmean
c by rdm June 25, 1996
c
      implicit double precision (a-h,o-z)
      dimension x(500)
      dimension y(500)

      external pmean
      external randn

      print *, ' iseed = ??? '
      read *, iseed
      call setran( iseed )
      n = 500
      m = 500

      do i = 1, n
c      x(i) =  randn( 1.0d0, 1.0d0 )
       x(i) = dble(i)
      enddo

      do i = 1, m
c      y(i) =  randn( 1.0d0, 1.0d0 )
       y(i) = dble(i) + 5.0d0
      enddo

      pval = pmean( x, n, y, m )
      print *, ' pval = ', pval

      stop
      end
```


RDM
6/25/96

```
C=====================================================================
      function pmean( x, n, y, m )
C=====================================================================
c tests to determine if mean(x) = mean(y)
c returns "p" which is the probability that mean(x) .ne. mean(y)
c this is based on method outlined in Rice, 1988 pg 356
      implicit double precision (a-h,o-z)
      dimension x(n)
      dimension y(m)
      external amean
      external avar
      xmean = amean( x, n )
      ymean = amean( y, m )
      xvar  = avar( x, n )
      yvar  = avar( y, n )
c     print *, ' xmean = ', xmean
c     print *, ' ymean = ', ymean
c     print *, ' xvar  = ', xvar
c     print *, ' yvar  = ', yvar
      an = dble(n)
      am = dble(m)
      pvar = xvar/an + yvar/am
c     pvar = ( (an-1.0d0)*xvar +(am-1.0d0)*yvar ) /
c    1      ( am + an - 2.0d0 )
c     print *, ' pooled variance = ', pvar
c     idof = idnint( (xvar/an + yvar/am)**2 /
c    1 ( ((xvar/an)**2)/an + ((yvar/am)**2)/am )) - 2
c     print *, ' idof = ', idof
      z = dabs( (xmean-ymean)/dsqrt(pvar) )
c     print *, ' z = ', z
c     pmean = 2.0d0 - derf((z)/(dsqrt(2.0d0)))
c     pmean = 1.0d0 + derf((z)/(dsqrt(2.0d0)))
      pmean = (1.0d0+ derf((z)/(dsqrt(2.0d0))))/2.0d0
      pmean = (1.0d0-pmean)*2.0d0
      return
      end
```

```
snowwhite% f77 pmean.f
pmean.f:
 MAIN main:
        varrat:
        pmean:
        quantl:
        avar:
        amean:
        irsnew:
        lhsnew:
        quantu:
        ynew:
        quantn:
        setran:
        iranu:
        ran1:
        randn:
        sortqr:
snowwhite% a.out
  iseed = ???
3945
  pval =  0.58425805978948
```

*

Same value as on previous page

RDM
7/25/96

Center for Nuclear Waste Regulatory Analyses

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(210) 522-5160 • FAX (210) 522-5184

September 21, 1995
Contract No. NRC-02-93-005
Account No. 20-5704-192

U.S. Nuclear Regulatory Commission
Attn: Dr. J.D. Randall
Mail Stop T-9 B-3
Washington, DC 20555

Subject: Transmittal of Intermediate Milestone 5704-192-500: Paper on Variance-Based Sensitivity Method

Dear Dr. Randall:

The subject milestone is specified in the Performance Assessment Research Project Plan for FY94-95. The paper, "Application of a Variance-Based Sensitivity Analysis to the Output of a Complex Computer Program," was prepared to fulfill this milestone.

The paper describes a detailed evaluation of a new approach for determining the importance ranking of the many parameters used in complex computer codes. The new approach was originally developed at Los Alamos National Laboratory under the sponsorship of the NRC Office of Nuclear Regulatory Research, Division of Systems Technology. The new variance-based method was tested using the NRC/CNWRA Total-System Performance (TPA) computer code and the Iterative Performance Assessment (IPA) Phase 2 data set. The paper compares the new method to a regression based approach such as used in IPA Phase 2. The advantages and disadvantages of the variance-based method are outlined.

The subject paper fulfills IM 5704-192-500 and is submitted for your review and acceptance. Following your acceptance of the paper, it will be submitted to *Risk Analysis* for journal publication. If you have any questions on this report, please call Bob Baca on (210) 522-3805 or Randy Manteufel at 522-5250.

Sincerely yours,

for B. Sagar
Technical Director

RGB/mag
Enclosure
f:Applica-Trans.ltr
cc: J. Linehan
S. Fortuna
B. Stiltenpole
M. Federline
N. Eisenberg
R. Wescott
V. Colten-Bradley
B. Meehan
B. Morris
N. Costanzi
S. Bahadur
W. Patrick
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RDM
7/25/96

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

RECEIVED
CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES
012910 NOV 22 '95

November 17, 1995

SUBJECT CODE ___-__
PROJECT NO. __-____-___

Budhi Sagar
Center for Nuclear Waste Regulatory Analyses
Southwest Research Institute
6220 Culebra Rd., Building 189
San Antonio, TX 78228-0510

SUBJECT: CLOSING INTERMEDIATE MILESTONES FOR RESEARCH

References:
1) September 28, 1995, letter from CNWRA's Budhi Sagar to NRC's John D. Randall transmitting Intermediate Milestone 5704-174-095-001, "Estimation of the Spatial Distribution of Infiltration Factors at Yucca Mountain, Nevada," (Publication in unspecified journal), (NRC Project Officer: Thomas J. Nicholson)

2) September 27, 1995, letter from CNWRA's Budhi Sagar to NRC's John D. Randall transmitting Intermediate Milestone 5704-036-095-006, "Expert Panel Review of CNWRA Coupled Thermal-Mechanical-Hydrological Processes Research Project," CNWRA 95-021, (NRC Project Officer: Jacob Philip)

3) October 30, 1995, letter from CNWRA's Budhi Sagar to NRC's John D. Randall transmitting Intermediate Milestone 5704-039-095-005, "Study of Flow in a Fracture under Shear: Progress Report," CNWRA 96-001, (NRC Project Officer: Jacob Philip)

4) September 26, 1995, letter from CNWRA's Budhi Sagar to NRC's John D. Randall transmitting Intermediate Milestone 5704-037-095-002, "Seismic Response of Rock Joints and Jointed Rock Mass," NUREG/CR-6388, (NRC Project Officer: Jacob Philip)

5) September 7, 1995 , letter from CNWRA's Budhi Sagar to NRC's John D. Randall transmitting Intermediate Milestone 5704-191-502, "An Improved Method for Modeling Sorption of Radionuclides during Liquid Phase Transport for Performance Assessments of High-Level Waste Repositories," Nuclear Technology, (NRC Project Officer: John D. Randall)

6) September 28, 1995, letter from CNWRA's Budhi Sagar to NRC's John D. Randall transmitting Intermediate Milestone 5704-191-500, "Stochastic Radionuclide Distributions after a Basaltic Eruption for Performance Assessments of Yucca Mountain," Nuclear Technology, (NRC Project Officer: John D. Randall)

7) October 10, 1995, letter from CNWRA's Budhi Sagar to NRC's John D. Randall transmitting Intermediate Milestone 5704-192-601, "Evaluation of Transform-Based Numerical Methods Applied to Richards' Equation," Advances in Water Resources, (NRC Project Officer: John D. Randall)

8) September 21, 1995, letter from CNWRA's Budhi Sagar to NRC's John D. Randall transmitting Intermediate Milestone 5704-192-500, "Application of a Variance-Based Sensitivity Analysis to the Output of a Complex Computer Program," Risk Analysis, (NRC Project Officer: John D. Randall)

Dear Dr. Sagar:

The NRC Project Officers cited with references 1 through 3 have reviewed the documents transmitted with those references and found them to be acceptable. I approve the documents transmitted with references 1 through 3.

Reference 4 is transmits the NUREG/CR version of a previously approved CNWRA report, Intermediate Milestone 5704-037-095-002. This Intermediate Milestone should now be closed.

As the NRC Project Officer for Performance Assessment Research, I have reviewed the papers transmitted with references 5 through 8 and I am enclosing my comments on all four papers. All four papers have editorial comments that their authors may adopt at their discretion. All four papers have technical comments must be accommodated for the papers to be acceptable. The paper transmitted with reference 8 also has policy-related comments that must be accommodated for it to be acceptable.

I believe that all of the mandatory comments on the papers submitted with references 5 through 8 are easy to accommodate and therefore the four respective Intermediate Milestones may be closed with your receipt of this letter. If any of the authors wishes to take issue with my comments, he may contact me by electronic mail or telephone so that we can resolve our differences informally.

Sincerely,

John D. Randall

John D. Randall
Research Program Element Manager
Waste Management Branch
Division of Regulatory Applications
Office of Nuclear Regulatory Research

cc: Shirley L. Fortuna, NMSS/PMDA
Barbara A. Stiltenpole, NMSS/PMDA
Barbara D. Meehan, ADM/DC/TAB1

Comments on Intermediate Milestone 5704-192-500
"Application of a Variance-Based Sensitivity Analysis
to the Output of a Complex Computer Code"
by
Randall D. Manteufel
Commenter: John D. Randall

Page	Comment
	Policy-Related Comments
5	Reference 3 (NUREG-1464, "NRC Iterative Performance Assessment Phase 2") is not, as stated on this page, a performance assessment exercise for the proposed Yucca Mountain repository. All text in this paper that states or implies that the IPA Phase 2 exercise is a Yucca Mountain performance assessment exercise should be corrected. (On this issue NUREG-1464's abstract states that "the results and conclusions presented in this report ... should not be misconstrued to represent the actual performance of the proposed Yucca Mountain repository ..."
5	40 CFR 191 needs a reference. The paper should clarify that 40 CFR 191 is EPA's HLW standard that EPA has to establish a new standard, that will replace 40 CFR 191, specifically for Yucca Mountain.
7	Last line: Replace "the Paintbrush hydrostratigraphic unit" with "one of the hydrostratigraphic units." Insert "hypothetical" before "site."
12	Last line: Replace "the ... Nevada[3,11]." with "a hypothetical HLW repository[3,11]."
21	Penultimate line: Replace "proposed ... Nevada" with "hypothetical HLW repository."
	Technical Comments
14	Lines 1 and 2: That R^2 and R_a^2 decrease with increasing output information may not be counter-intuitive. The text following this table elaborates on this comment.
	Editorial Comments
2	Abstract, penultimate line: Replace "are" with "is."
3	Line 5 below Eq. 1: Replace "describe" with "describes."
4	Line 3: Replace "influence" with "influences."
4	Line 7: Here and elsewhere, correct the split infinitive.
7	Lines 1 and 2: Replace the sentence, "It appears ... negative." with "This paper takes the more readily grasped approach of searching for a positive declaration about a parameter's importance, rather than searching for a negative declaration."
7	Scatter Plots, line 1: Replace "this work" with "the performance assessment exercise done for this paper."

Comments on Intermediate Milestone 5704-192-500
"Application of a Variance-Based Sensitivity Analysis
to the Output of a Complex Computer Code"
by
Randall D. Manteufel
Commenter: John D. Randall

Page	Comment
8	Line 1: Replace "phenomena" with "phenomenon."
8	Lines 3 and 5: The term "orders [or order] of magnitude" should not be hyphenated unless it is used as a modifier. A term like "decades" or "decade" would be more concise and accurate.
8	Line 10: Insert "procedure" after "This."
8	3rd and 2nd lines from bottom: Replace "This appears to be an idea consistent with correlation and regression." with "This approach appears to be consistent with the idea of correlation and regression."
9	Sentence after Eq. 5: Replace this sentence with "The variance identity, Equation 3, is used to develop importance indices."
10	Text around Eq. 6: Put the words "as R^2" ahead of Eq. 6 and insert "that" after "except."
10	6th line from bottom: Replace "by ... to" with "because it is based on."
10	5th and 4th lines from bottom: Replace "Hence ... ratio." with "Hence, an improved importance index, expressed as an alternative variance ratio, has been suggested[7]." Insert Eq. 7 after this sentence.
12	Line 4: Replace "fixed effects" with "fixed-effects." Replace "assumes" with "is based on the assumption that."
13	Lines 3-5: Provide a reference for 40 CFR Part 191.
14	Line 9: Replace "than" with "from."
14	Line 13: Replace each "are" with "is."
14	5th line from bottom: Replace "Figures" with "Figure."
15	Line 7: Replace "are" with "is."
16	Line 5: Replace "were" with "was."
16	Replace "0-fixed case" with "case of no fixed parameters."
16, 17	Paragraph beginning on page 16 and ending on page 17: The discussion in this paragraph is awkward. I suggest that you summarize the results by citing the rations of maximum to minimum outputs and delete the citation of orders of magnitude. Citing orders of magnitude adds no new information.

Comments on Intermediate Milestone 5704-192-500
"Application of a Variance-Based Sensitivity Analysis
to the Output of a Complex Computer Code"
by
Randall D. Manteufel
Commenter: John D. Randall

Page	Comment
18	Line 4: Insert "parameters" after "five."
19	Line 8: Replace "output" with "normalized release."
19	Line 12: Replace "where" with "because."
20	Line 4: Replace "model, however" with "model. However,".
20	Verification Runs, ¶ 1, line 5: Replace "remain" with "remains."
20	4th line from bottom: Replace "location" with "locations."
21	Conclusions, ¶ 1, line 3: Replace "A number of" with "Several."
22	Lines 6 and 7: The term "orders [or order] of magnitude" should not be hyphenated unless it is used as a modifier. A term like "decades" or "decade" would be more concise and accurate.
22	Line 7: Replace "were" with "was."
23	Line 4: Replace "report" with "paper."

Behavior of R^2, R_a^2 and F for large vector and run sizes.

With some rearrangement, Eq. 6 can be rewritten as:

$$R^2 = \frac{\frac{1}{N_R}\sum_{i=1}^{N_V}\left(\sum_{j=1}^{N_R}(y_{ij}-\overline{y}_{..})\right)^2}{\sum_{j=1}^{N_R}\sum_{i=1}^{N_V}(y_{ij}-\overline{y}_{..})^2},$$

where N_R is the number of runs and N_V is the number of vectors. The inner sum in the numerator has positive and negative contributions, whereas the double sum in the denominator has only positive contributions. With the $1/N_R$ coefficient and the always-increasing denominator, one should expect R^2 to decrease as $N_R N_V$ increases.

A comparison of Eqs. 6 and 7 shows that:

$$R_a^2 = R^2 - \frac{\frac{1}{N_R}\sum_{i=1}^{N_V}\sum_{j=1}^{N_R}(y_{ij}-\overline{y}_{i.})^2}{\sum_{j=1}^{N_R}\sum_{i=1}^{N_V}(y_{ij}-\overline{y}_{..})^2}.$$

Clearly, the second term in this equation will decrease as N_R increases and it may decrease as $N_R N_V$ increases. This theoretical observation is consistent with the paper's empirical observation that R_a^2 primarily decreases with N_R.

A comparison of Eqs. 6 and 8 shows that:

$$F = R^2 \frac{N_V}{N_V-1}(N_R-1)\frac{\sum_{i=1}^{N_V}\sum_{j=1}^{N_R}(y_{ij}-\overline{y}_{..})^2}{\sum_{j=1}^{N_R}\sum_{i=1}^{N_V}(y_{ij}-\overline{y}_{i.})^2}.$$

For large values of N_R, F is roughly proportional to $N_R R^2$ and F will increase with N_R, as reflected in Figure 5.

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March 7, 1996
Contract No. NRC-20-93-005
Account No. 20-5708-761

U.S. Nuclear Regulatory Commission
Attn: Ms. Emarsha Whitt
Office of Nuclear Material Safety & Safeguards
Program Management, Policy Development, & Analysis Staff
Mail Stop 8A-23
Washington, DC 20555

Dear Ms. Whitt:

Reference: Letter from John D. Randall on November 17, 1995

Subject: Final Version of IM 5704-192-500, "Application of a Variance-Based Importance Analysis to a Complex Probabilistic Performance Assessment"

Dear Ms. Whitt:

Enclosed is the final version of the paper "Application of a Variance-Based Importance Analysis to a Complex Probabilistic Performance Assessment" which was submitted to the NRC on September 21, 1995 to fulfill the Intermediate Milestone 5704-192-500. The paper was accepted in fulfillment of the IM in a letter on November 17, 1995 by John D. Randall. However, Dr. Randall required some changes to the paper to address both policy-related items before the paper would be acceptable for dissemination through the NRC PDR. The final version of the paper incorporates Dr. Randall's comments as well as comments from reviewers for the journal of *Risk Analysis*. All of the policy-related comments from Dr. Randall have been resolved. Some comments were resolved by deleting paragraphs and rewording the discussion of the application problem. Deleting and reducing some discussion was necessary because the journal required the paper be reduced in length. The final version of the paper should be acceptable to be entered into the NRC PDR.

The other three papers are undergoing similar revisions and will be mailed to you when they are finalized. Please call me if you have any questions.

Sincerely,

Budhi Sagar
Technical Director

lg
Attachment

cc: J. Linehan, S. Fortuna, B. Stiltenpole, B. Meehan, J. Greeves, M. Federline, J. Austin, M. Bell, K. McConnell, V. Colten-Bradley, R. Wescott, W.C. Patrick, CNWRA Directors, CNWRA Element Managers, S. Rowe, SwRI Contracts

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Information potentially subject to copyright protection was redacted from this location, pages 106 through 133. The redacted material is from the reference listed below and was published in a journal.

Application of a Variance-Based Importance Analysis

to a Complex Probabilistic Performance Assessment

Abbreviated Title:

App Variance Importance

by

Randall D. Manteufel

Senior Research Engineer

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RDM 7/25/96 With the completion, submission, and acceptance of IM 5704-192-500, this work is finished. This notebook is being closed and submitted as a QA Record.

ADDITIONAL INFORMATION FOR SCIENTIFIC NOTEBOOK #: 152

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