Aquarius Engineering Notes

June 1 - July 1, 2007

(c) Don Baker 2007

31 May 07

$D_1 = 0.43685$ $D_2 = 0.29601$ $D_3 = 6.1708$ $D_4 = 7.1708$

$D_5 = 12.956$ $D_6 = 6.2479$ $D_7 = 5.2479$ $D_8 = 0.1e-4$

$D_9 = 0.37321$

---

1 June 07

my 3107a data → my 3107a.wk1

Unresolved error. Replace abs-err column in vs with err.^a plot in TC-3D $r = \frac{he}{he+hh}$

Get discernable surfaces in err(r, mu), err(mu, he), (r, ms)

drop in corner err(mu, ms) → err(0,0)

much less so in err(mu, hh), err(mu, hu) (ms, he) (mu, Q), (ms, hh)

my 3007a.wk4

~~Pat~~ Strong patterns in err(R, Mu) err(He, mu), not err(ms, mu), err(He, ms) with diagonal strings of dots in the vertical organized on He

Bingo: its err(He, $\hat{Q}/Q$) an overall correction that gets stronger for higher He

Seems to be $x = He$ $y = Q_h/Q$ error $= z$

$z = (y-1)f(x)$ or $Q_h - Q = \left(\frac{Q_h}{Q} - 1\right)(a + bHe) = \frac{Q_h - Q}{Q} f(He)$

$Q = f(He)$ done? Not according to TC-2D

~~$Q_h/Q = 1 + F_1 \cdot (Q_h - Q) \rightarrow Q_h = Q + F_1 (Q_h - Q) \cdot Q$~~

For $0 \le He \le 0.155$ $(Q_h/Q) = 4(Q_h - Q) + 1$

$Q_h = 4(Q_h - Q)Q + Q \rightarrow Q_h - Q = 4Q(Q_h - Q) \Rightarrow Q = \frac{1}{4} = 0.25$

The "strings" in He-related data apparently come only from the fact that the experiment was set up in discrete values of Q

7 June 07

mg3007a.wk4 → TC3D

Some evidence for a regression fit (small s^2) of Q_h/Q to $(H_e, H_u, (m_u^2+m_s^2)^{1/2})$ — doesn't help

Need to check fit with entire data set to see if h_u or h_h has any other effect, such as in $w = h_e/\sqrt{h_h \cdot h_u + \epsilon}$

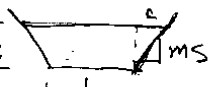
Fit $\frac{Q}{b\sqrt{g h_e^3}} = f \Rightarrow \hat{Q} = f \cdot b\sqrt{g h_e^3}$, $\varepsilon = \hat{Q} - Q$

Suppose it produces $\bar{\hat{Q}} - \bar{Q} = a = \frac{1}{N}\Sigma(\hat{Q}-Q) = \frac{1}{N}(\Sigma\hat{Q} - \Sigma Q)$

$Q = \hat{Q} + a = a + f b\sqrt{g h_e^3}$ $\quad f = \frac{Q-a}{b\sqrt{g h_e^3}}$

Velocity into notch? : Upstream $\sim \frac{Q(\epsilon f s)}{h_e + h_u}$

Assume mostly straight flow $\Rightarrow$



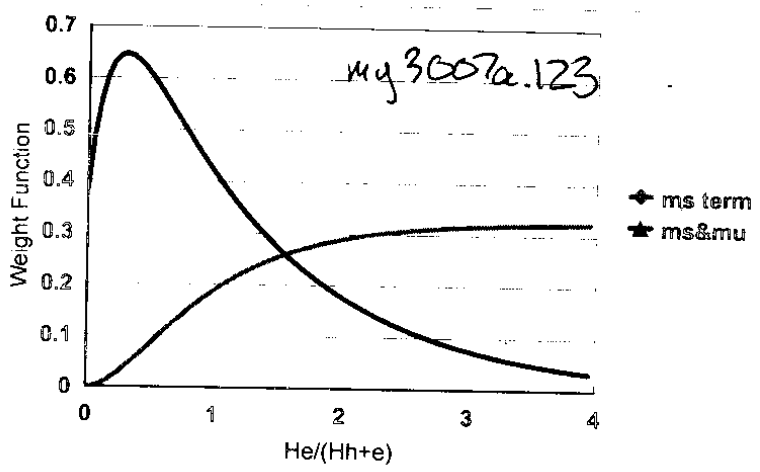
$ms = \frac{c}{h_e}$

$A = h_e(b+c) = h_e(b + ms \cdot h_e)$

But it may necessary to consider the tilted area, A_T

something like $h_e(b + h_e(m_s^2 + m_u^2)^{1/2})$?

$v \sim Q/A$



2 June 07

simanh6.for 8 & 32 inch data fits (~~my~~ scaleta4.prn)

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + D_2\left[1 + \frac{D_3 \exp(-D_4 r) - D_4 \exp(-D_3 r)}{D_4 - D_3}\right]\frac{h_e m_s}{b}$$

$$+ D_5\left[\frac{\exp(-D_6(r+D_8)) - \exp(-D_7(r+D_8))}{D_7 - D_6}\right]\left[\frac{h_e^2}{b^2}(m_s^2 + m_u^2)\right]^{D_9}$$

FITC0

iseed1 = 421 iseed2 = 966 Initial $D_1 = 0.469$

$D_2 = 0.325$ $D_3 = 2.7$ $D_4 = 1.48$ $D_5 = 4.93$ $D_6 = 0.86$

$D_7 = 5.37$ $D_8 = 0.108$ $D_9 = 0.373$ $r = h_e/(h_e + 10^{-10})$

→ jn0207a1,2,3.prn Scale test against my 16 rawb 16-in data

Calculate err = $\hat{Q}_i - Q_i$ instead of $|\hat{Q}_i - Q_i|$ for output, but use mean $|\hat{Q}_i - Q|$ for objective function. Take out penalties from final calculation for output. Leave squared error in objective function when $|\hat{Q}_i - Q_i| > 1$

→ $D_4 = 19.999$ $D_3 = 18.999$ opt = 33.024

mean err = -1.1474 NG Open up coef D_4 & D_7 to +50 upper bound. Run again, but with $D_1 = 0.48$, $D_2 = 0.31$

$D_3 = 19.$ $D_4 = 20$, $D_5 = 4.4$ $D_6 = 5.4$ $D_7 = 0.62$ $D_8 = 10^{-5}$

$D_9 = 0.37$ Still not good

set $ub_3 = 40$ $D_3 = 20$ $ub_4 = 60$ $D_4 = 21$

$ub_6 = 40$ $D_6 = 1.0$ $ub_7 = 60$ $D_7 = 6$ Run again

$D_9 = 0.1$ Still not good - bad

D_3 & D_4 are jumping all around while the others are settling, Trying to approximate a very fast rise, or a constant

Final $D_1 = 0.48022$ $D_2 = 0.30920$ $D_3 = 20.565$ $D_4 = 19.564$,

$D_6 = 0.62271$ $D_7 = 5.3679$ $D_8 = 10^{-5}$ $D_9 = 0.068147$

mean err = -1.14906 std-err = 0.203 Scale mean err = -0.141 std err = 0.542

2 June 07

simanh6

Seems to need r increasing slower, $r \leq 1$

Set $r = h_e/(h_h + h_e)$ → jn0207b1, 2, 3.prn

$D_1 = 0.48$ $D_2 = 0.31$ $D_3 = 5$ $D_4 = 6$, $D_5 = 4.4$,

$D_6 = 0.62$ $D_7 = 5.4$ $D_8 = 10^{-5}$ $D_9 = 0.1$ Same iseeb

→ D_3 & D_4 still bouncing around a lot

~~Even worse~~ opt = 0.116, ~~mean~~ en = −0.00937

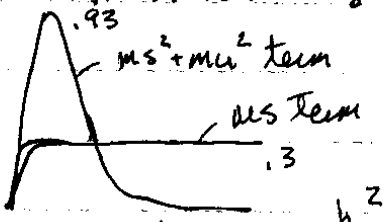
std en = 0.218 rel en = 0.0939 std rel en = 0.121

Scaling mean en = −1.02 ~~std~~ rms en = 1.697 std en = 1.356

mean rel en = 0.622 std rel en = 0.418 $D_1 = 0.20173$

$D_2 = 0.30584$ $D_3 = 21.438$ $D_4 = 22.439$ $D_5 = 9.3073$

$D_6 = 3.1457$ $D_7 = 4.1457$ $D_8 = 10^{-5}$ $D_9 = 0.035243$



Rerun again, but with $r = \dfrac{h_e^2}{h_e^2 + b \cdot h_h}$ → jn0207c1, 2, 3.prn

D_3 & D_4 are still more variable than the others w/ large Vm

opt = 0.0952 mean en = −0.0166 std en = 0.159 rel en = 0.104

std rel en = 0.135 ‖ Scaling mean en = −0.813

rms en = 1.27 ~~std en = 0.974 std rel en =~~

std en = 0.974 rel en = 0.359 std rel en = 0.232

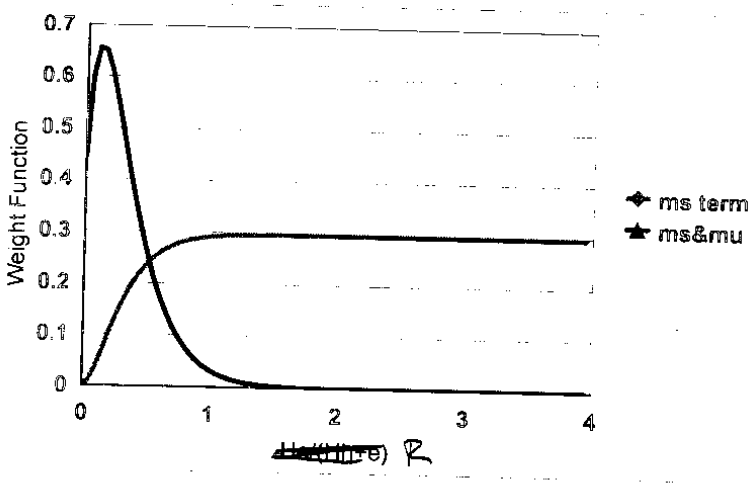
$D_1 = 0.40817$ $D_2 = 0.29662$ $D_3 = 5.5718$ $D_4 = 6.5718$

$D_5 = 9.7646$ $D_6 = 5.9578$ $D_7 = 4.9578$ $D_8 = 0.064916$

$D_9 = 0.36866$

2 June 07

Last run gave more realistic looking weighting functions (jn0207c)



jn0207d — $r = \frac{h_e^2}{h_e^3 + h_h^2}$ $D_1 = 0.41$ $D_2 = 0.3$

$D_3 = 5.6$ $D_4 = 6.6$ $D_5 = 9.8$ $D_6 = 6$ $D_7 = 5$

$D_8 = 0.065$ $D_9 = 0.37$ ⟹ opt = 0.183

mean err = -0.00049 std err = 0.309 rel err = 0.1395

std rel err = 0.167 || Scale mean err = -0.93 rms err = 1.53

std err = 1.21 rel err = 0.49 std rel err = 0.33

$D_1 = 0.25833$ $D_2 = 0.28285$ $D_3 = 40$ $D_4 = 60$ Not Good

$D_5 = 9.2183$ $D_6 = 3.1382$ $D_7 = 4.3318$ $D_8 = 0.011955$

$D_9 = 0.095804$

TC-3D: $err \simeq a + bR^2 + cR^{2.5} + dR^3$ $r^2 = 0.1533$

Need different approach to weighting function for ms term

Go back to polynomial?

3 June 07

simauh6.for REWORK FIT → FITC1

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left\{ \underbrace{D_2 + D_3 r + D_4 r^2 + D_5 r^3}_{>0} \right\} \frac{h_e}{b} ms - \\ + D_6 \left\{ \exp(-D_7 (r + D_8)) - \exp(-(D_7+1)(r+D_8)) \right\} \left\{ \frac{h_c^2}{b^2} (ms^2 + \mu_e^2) \right\}^{D_9}$$

$D_1 > 0 \quad D_6 > 0 \quad D_7 > 0 \quad D_8 > 0 \quad D_9 > 0$

jn0307a1,2,3.prn ← same iseeds, $r = \frac{h_c^2}{h_e^2 + h_h^2 \cdot b}$

$lb_i = 0.00001 \quad ub_i = 20 \quad lb_{2,3,4,5} = -20$

Initial D_i's: $D_1 = 0.41$, $D_2 = 0.30$, $D_3 = D_4 = D_5 = 0$

$D_6 = 9.8 \quad D_7 = 5.0 \quad D_8 = 0.064 \quad D_9 = 0.37$

FINAL: aft = 0.0899 mean-en = $-5(10^{-3})$ std en = 0.149

rel en = 0.0904 std rel en = 0.1144

Scale mean en = −0.894 rms-en = 1.392 std en = 1.067

mean rel en = 0.392 std rel en = 0.251

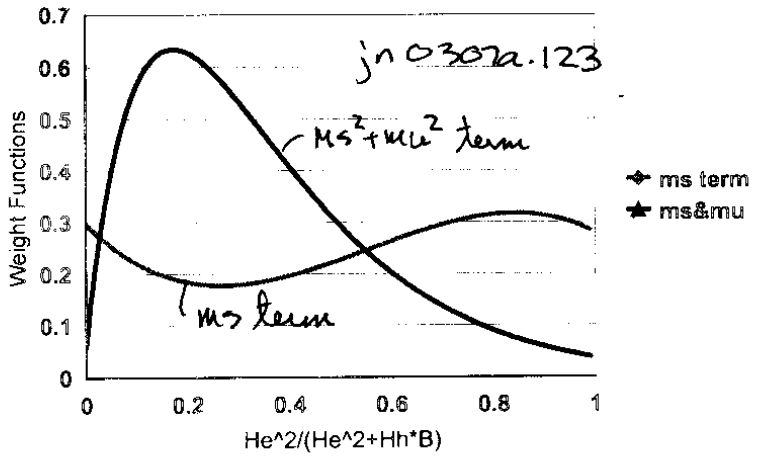
~~Run again jn0307b1,2,3.prn ← done but $r = \frac{h_c^2}{h_e^2 + h_h^2}$~~

Find $D_1 = 0.42246 \quad D_2 = 0.29866 \quad D_3 = -1.0068$

$D_4 = 2.9664 \quad D_5 = -1.4784 \quad D_6 = 9.5492 \quad D_7 = 5.0500$

$D_8 = 0.0064916 \quad D_9 = 0.38465$

~~Run again jn0~~



3 June 07

Simauh6.for

jr0307b ← run again, but with $lb_2 = -20$

→ opt = 0.0989, errors worse, not the best fit

Set Initial $D_3 = -1$ $D_4 = 2.5$ $D_5 = -1.5$ and run again

→ opt = 0.0986 again mean er = $5.5(10^{-3})$ std er = 0.165

rel er = 0.0877 std rel er = 0.106

Scale mean er = −0.901 rms-er = 1.400 std er = 1.072

mean rel er = 0.397 std rel er = 0.253

$D_1 = 0.41797$ $D_2 = 0.71686$ $D_3 = -3.0425$ $D_4 = 5.0576$

$D_5 = -2.9072$ $D_6 = 8.8716$ $D_7 = 4.8397$ $D_8 = 0.0064916$

$D_9 = 0.37570$ (NG) ms term goes negative

Change penalty for term<0

from rel = rel+100 in fit to rel+1000 & run again

Even worse opt = 0.138

Change penalty to My Fit rel = rel + 1000 * C1, etc run again

Much better - just needed a fresh in the right direction

opt = 0.0862 mean er = 0.00278 std er = 0.149

$\overline{\text{rel er}}$ = 0.0720 std rel er = 0.0922 $r = \dfrac{h_e^2}{h_e^2 + b h_h}$

Scale tst : mean er = −0.924

rms er = 1.424

std er = 1.084

$\overline{\text{rel er}}$ = 0.412

std rel er = 0.252

$D_1 = 0.40810$ $D_2 = 0.29343$

$D_3 = -0.94234$ $D_4 = 2.2872$

$D_5 = -1.3625$ $D_6 = 9.0656$

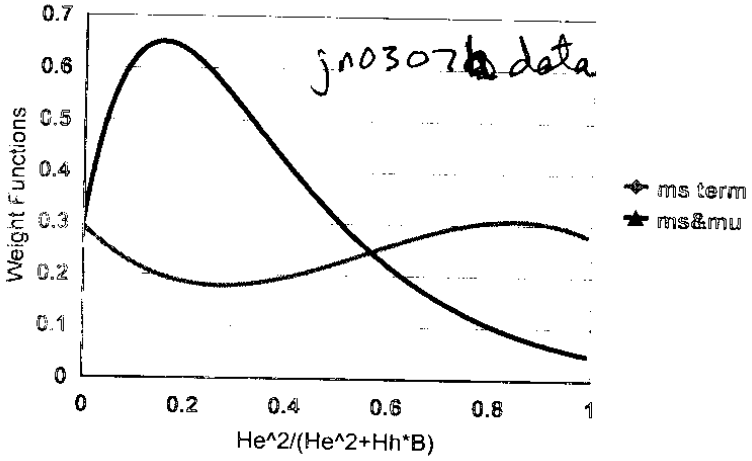
$D_7 = 4.6369$ $D_8 = 0.041485$

$D_9 = 0.37191$

plot weight function

3/June 07

$$r = \frac{h_e^2}{h_e^2 + bh_h}$$



LAB NOTES 16 July 01

Bob Sappington's estimates of flume CFS measurement error for plywood breach experiment

CFS :	0.125	0.25	0.5	1	2	3	4	6
±CFSer :	.009	.005	.003	.01	.006	.015	0.1	0.06
%CFSer :	7.2	2.0	0.6	1.6	0.3	0.5	2.5	1.0

mean %CFS er ~ 1.96% rms %CFSer = 2.88%

---

simanh6.for (contd) rss error =

jn0307c1,2,3.prn ← $r = \frac{h_e^2}{h_e^2 + h_h^2}$ using FITC1

Same iseeds INITIAL $D_1 = 0.41$ $D_2 = 0.29$ $D_3 = -0.94$ $D_4 = 2.3$

$D_5 = -1.4$ $D_6 = 9.1$ $D_7 = 4.6$ $D_8 = 0.04$ $D_9 = 0.37$

opt = 0.142 mean er = 0.00123 std er = 0.262 ~~rel er =~~

rel er = 0.0831 std rel er = 0.0912

Scale test: mean er = -1.46 rms er = 2.42 std er = 1.93

mean rel er = 96.7 std rel er = 119.0

$D_1 = 10^{-5}$ $D_2 = 0.49711$ $D_3 = -1.3693$ $D_4 = 2.5743$

$D_5 = -1.4240$ $D_6 = 8.2067$ $D_7 = 2.1722$ $D_8 = 0.12270$

$D_9 = 0.043820$

3 June 07

simanh6.for

jn0307d ← run again with new iseed1 = 210

iseed2 = 178 → comes back to exactly the same solution.

jn0307d ← rerun with ~~$r = \frac{h_e}{h_e}$~~ $r = \frac{h_e}{h_e + \sqrt{b \cdot h_n}}$

opt = 0.099959 mean err = 4e-3 std err = 0.165

$\overline{\text{ret err}}$ = 0.0966 std rel err = 0.113

Scale test: mean err = -0.843 rms err = 1.332 std err = 1.032

$\overline{\text{ret err}}$ = 0.361 std rel err = 0.256

D_1 = 0.41193 D_2 = 0.82717 D_3 = -1.7444 D_4 = 1.6450

D_5 = -0.42321 D_6 = 11.772 D_7 = 5.3846 $D_8 = 10^{-5}$

D_9 = 0.29610

jn0307e ← run again w/ $r = \frac{h_e}{h_n + 10^{-10}}$

opt = 0.565 mean err = -0.0834 std err = 0.687 $\overline{\text{ret err}}$ = 0.187

std rel err = 0.172

Scale test: mean err = -0.0264 rms err = 0.586 std error = 0.585

$\overline{\text{ret err}}$ = 0.156 std rel err = 0.111 D_1 = 0.636 D_2 = 2.1095

D_3 = -6.9322 D_4 = 8.9265 D_5 = -3.9131 D_6 = 4.6840

D_7 = 0.34520 D_8 = 6.8078 D_9 = 0.24943

jn0307f ← redo $r = h_e^2 / h_e^2 + b h_n$ as a check

fopt = 0.0854 mean err = 0.00492 std err = 0.148 $\overline{\text{ret err}}$ = 0.0712

std rel err = 0.0915 || Scale test mean err = -0.919

rms err = 1.419 std err = 1.081 $\overline{\text{ret err}}$ = 0.408 std rel err = 0.251

D_1 = 0.40995 D_2 = 0.26582 D_3 = -0.77977 D_4 = 2.0269

D_5 = -1.2375 D_6 = 9.0792 D_7 = 4.6424 D_8 = 0.043373

D_9 = 0.37328 same order of mag

3 Jan 07

simanh6 (contd) Fit c1

jn0307g ← $r = h_e / (h_e^2 + b h_h)^{1/2}$

qt = 0.149 mean enol = −0.0253 std en = 0.246

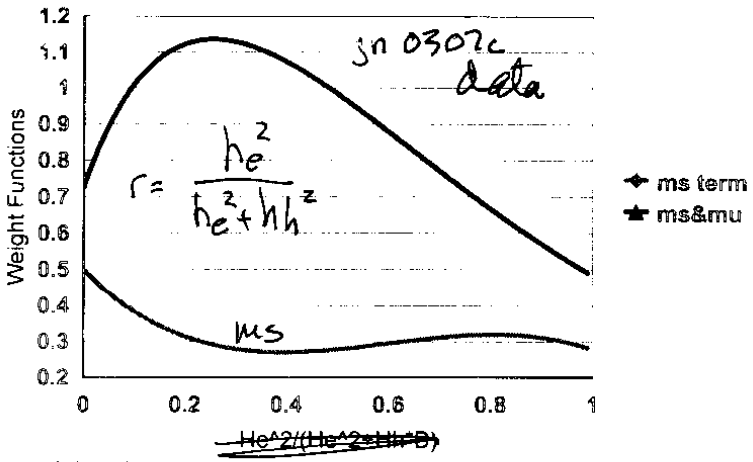
rel en = 0.101 std rel en = 0.109 || Scale test:

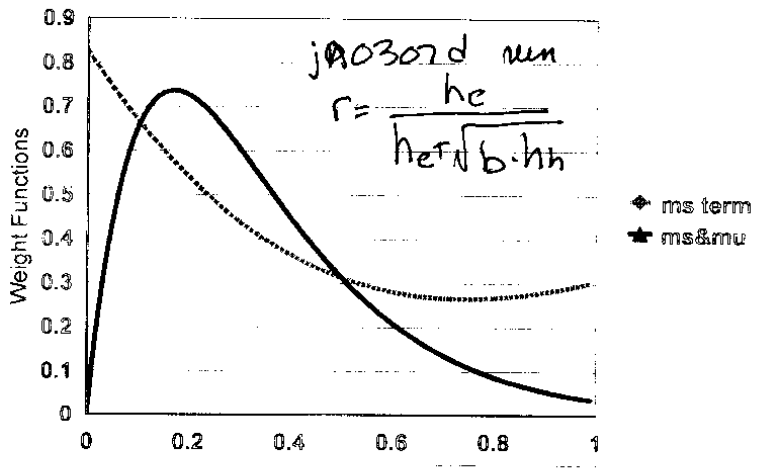
mean en = −1.532 rms en = 2.46 std en = 1.922 ret en = 96.5

std rel en = 118.7 $D_1 = 10^{-5}$ $D_2 = 0.6530$ $D_3 = -1.108$

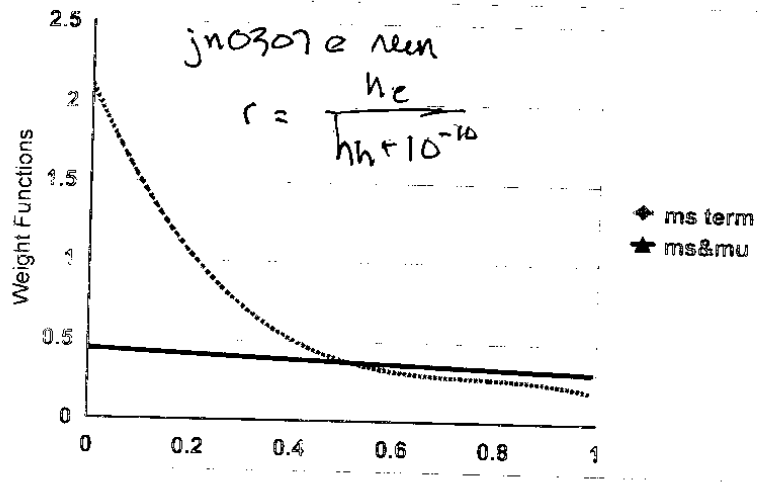
$D_4 = 1.727$ $D_5 = -1.017$ $D_6 = 8.54$ $D_7 = 2.51$

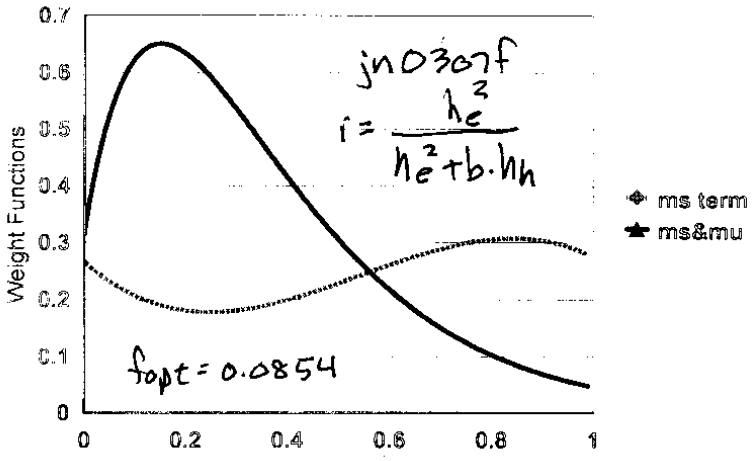
$D_8 = 10^{-5}$ $D_9 = 0.998$ NG





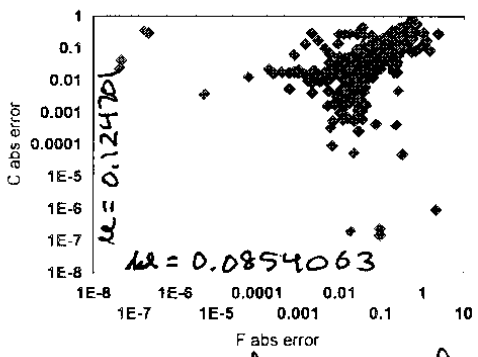
3 Jun 07

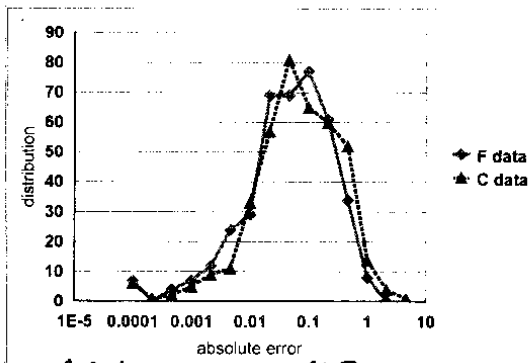




Compare data fit for Fit C1 w/ $r = \frac{h_e^2}{h_e^2 + b \cdot h_h}$ jn0307f to $r = \frac{h_e^2}{h_e^2 + h_h^2}$ jn0307c

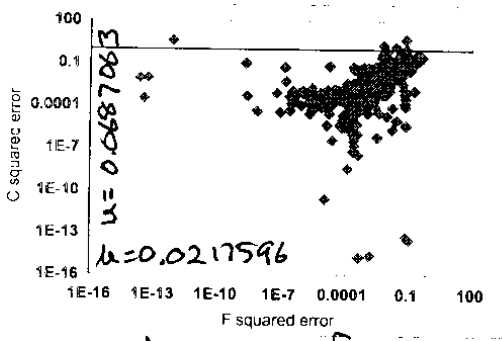
Use

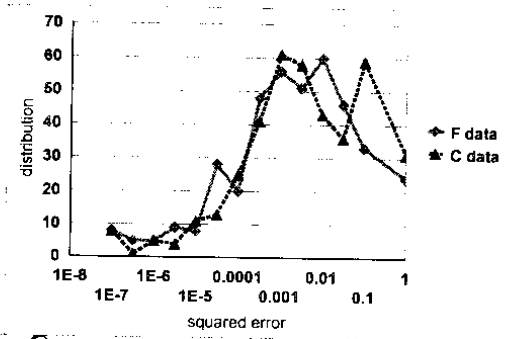




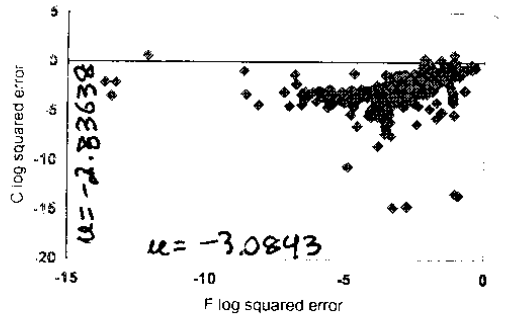
Li-sq goodness of fit = 0.0001682

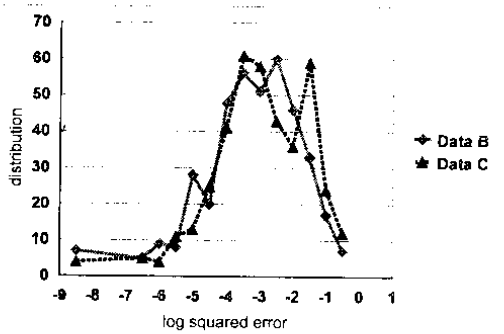
4 June 07





chi-sq gof = 3.72e-9

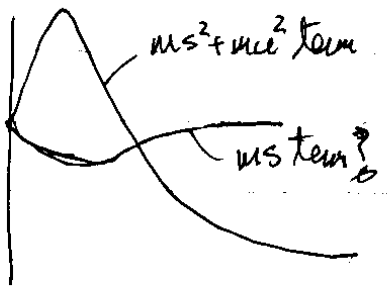




chi-square GOF = 8e-7

Conclusion: null hypothesis, that there is no difference between the distributions of error, is rejected at the 0.02% level (absolute error) at worst i.e. $r = \frac{h_e^2}{h_e^2 + b \cdot h_h}$ is best $\frac{8}{32}$ in data

Plots suggest that ms-term weight might have a transient downwards that disappears



4 June 07

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left[D_2 + D_3 \frac{\exp(-D_4(r+D_5)) - \exp(-D_6(r+D_5))}{D_6 - D_4}\right]\left(\frac{h_e m_s}{b}\right)^{D_7}$$

$$+ D_8\left[\frac{\exp(-D_9(r+D_{10})) - \exp(-D_{11}(r+D_{10}))}{D_{11} - D_9}\right]\left(\frac{h_e^2}{b^2}(m_s^2 + m_u^2)\right)^{D_{12}}$$

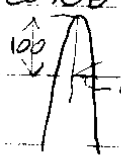
FITC2

simanh7.for

Modify simanh6.for to use FITC2 on scaleca4.prn 8 & 32 in data

$0 = t_1 = 1 - (d_6 - d_4)^{2n}$ $\quad (d_6 - d_4)^{2n} = 1$ $\quad 2n \ln(d_6 - d_4) = 0$

→ that could be [illegible] a number of such coef. differed by 1



$d_6 - d_4 = 0$ $\quad 100 - \alpha(d_6 - d_4)^2 = 0$ $\quad \alpha(0.01)^2 = 100$

$\alpha = \frac{100}{10^{-4}} = 10^6$

Say $t = 100 - (\alpha(d_6 - d_4))^2 = 0$ @ $|d_6 - d_4| = 0.01$

$\alpha^2(0.01)^2 = 100$ $\quad \alpha^2 = \frac{10^2}{10^{-4}} = 10^6$ $\quad \alpha = 1000$

$lb_i = 0.00001$ $\quad ub_i = 20$ except $ub_i = -20$, $i = 3, 4, 6, 9, 11$

Initial $D_1 = 0.4$ $D_2 = 0.3$, $D_3 = -0.1$ $D_4 = 2$ $D_5 = 0.01$ $D_6 = 1$

$D_7 = 1$ $D_8 = 2$ $D_9 = 4$ $D_{10} = 0.01$ $D_{11} = 3$ $D_{12} = 0.35$

iseed1 = 174 $\quad$ iseed2 = 698 $\quad r = h_e^2/(h_e^2 + b h_h)$

Blow up on $D_1 = 0.94194$ $D_2 = 15.403$ $D_3 = -14.663$

$D_4 = -0.26213$ $D_5 = 6.5336$ $D_6 = -0.25214$ $D_7 = 1.8073$

$D_8 = 7.3061$ $D_9 = -20$ $D_{10} = 5.0083$ $D_{11} = 20$ $D_{12} = 13.222$

~~set $lb_{5,10} = 0.00001$ and try again~~

$lb_i = 0.00001$, $i = 4, 6, 9, 11$, the rest -20 blow up again

set $lb_i = 0.00001$ $i = 5, 10$ & try again blow up again

set all $lb_i = 0.00001$ except $lb_i = -20$, $i = 2, 3$ & try again

blow up again Add penalty to $r + D_5$ or $r + D_{10} < 0$ and try again — blows up to a huge negative no.

4 June 07

Found mistake & fixed. Set $lk_i = -2$, $i = 5, 10$ & again
$f_{opt} \rightarrow$ huge < 0 again. Fix t_1, t_2 code in fit
and try again WORKS

FINAL ($f_{opt} = 0.07765$) mean err = 0.003678

std err = 0.1424 $\overline{\text{rel err}}$ = 0.06117 std rel err = 0.08994

Scale test: mean err = -0.7817 rms err = 1.2284

std err = 0.9478 $\overline{\text{rel err}}$ = 0.3386 std rel err = 0.2246

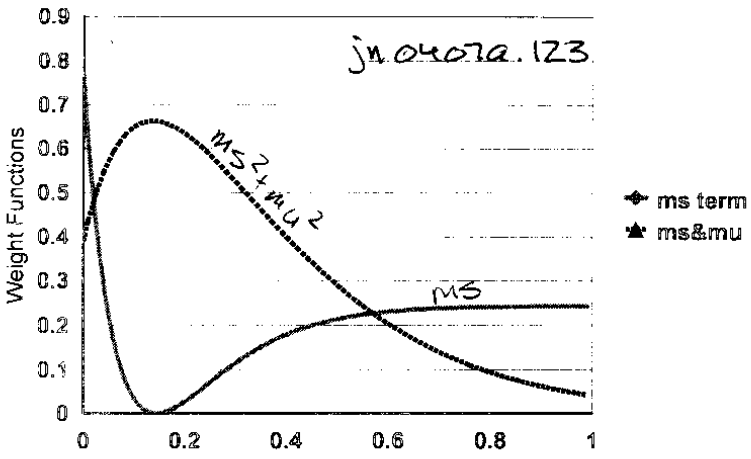
$D_1 = 0.43376$ $D_2 = 0.24410$ $D_3 = -6.7678$ $D_4 = 10.092$

$D_5 = -0.047469$ $D_6 = 10.308$ $D_7 = 1.1322$ $D_8 = 9.3604$

$D_9 = 5.1996$ $D_{10} = 0.055346$ $D_{11} = 5.1838$ $D_{12} = 0.39633$

VM_i largest ($\sim 10^{-4}$) for 3, 4 & 6

jn0407a.123 ← plot coef results in weight terms ms & $ms^2 + ma^2$
and distributions of absolute errors

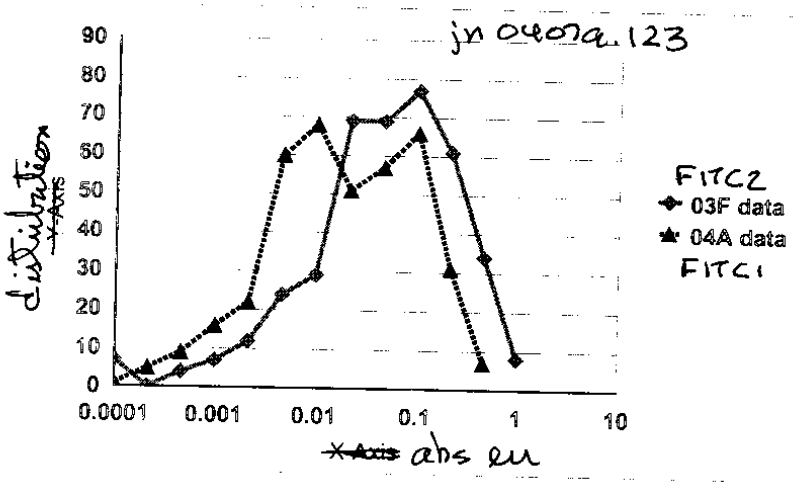


jn0307f data - Fit C1 mean abs error Q = 0.0854063

jn0407a data - Fit C2 " = 0.0776502

chi-square test for goodness of fit = 0.0009122

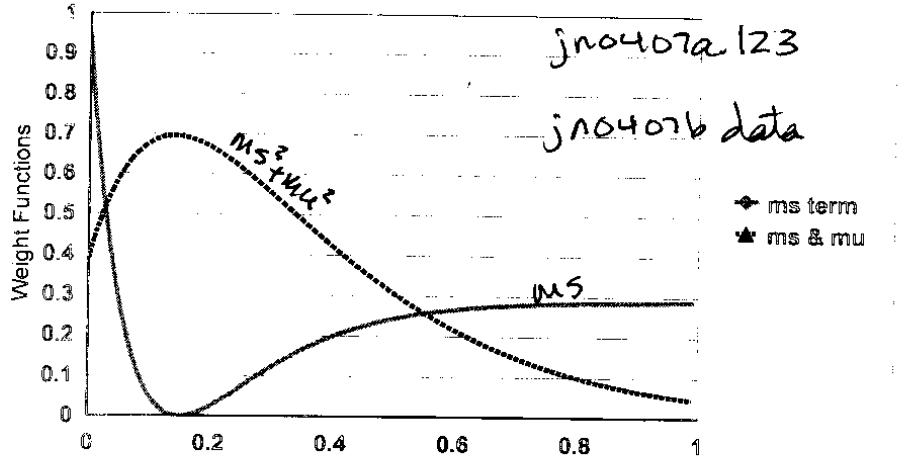
4 June 07

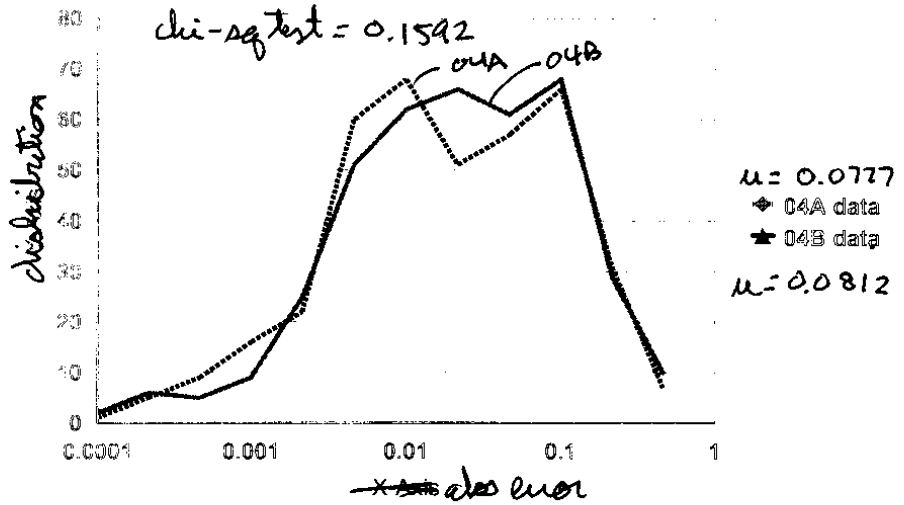


jn04o7b : Set penalty on D_7 $rel = rel + (D_7 - 1)^2 \cdot 10$
change t_1 & t_2 penalties to allow $(d_6 - d_4)$ & $(D_a - D_4)$
to get within 0.001 Initial $D_1 = 0.43$ $D_2 = 0.24$
$D_3 = -6.8$ $D_4 = 10.1$ $D_5 = -0.05$ $D_6 = 10.3$ $D_7 = 1.0$
$D_8 = 9.4$ $D_9 = 5.3$ $D_{10} = 0.055$ $D_{11} = 5.2$ $D_{12} = 0.4$
→ fopt = 0.0812186 mean en = 1.58e-4 std-en = 0.143
$\overline{rel\ en}$ = 0.0646566 std rel en = 0.0913400
Scale test : mean en = -0.840816 rms-en = 1.30
std en = 0.987 $\overline{rel\ en}$ = 0.379 std rel en = 0.232
$D_1 = 0.40013$ $D_2 = 0.28929$ $D_3 = -7.8216$ $D_4 = 12.401$
$D_5 = -0.050518$ $D_6 = 7.6766$ $D_7 = 1.0024$ $D_8 = 9.8110$
$D_9 = 5.1249$ $D_{10} = 0.051794$ $D_{11} = 5.2618$ $D_{12} = 0.38233$

5 June 07

http://www.neelib.org/opt/simann.f
www.freewebs.com/nehle_economics/rps.pdf
ftp://ftp.hao.ucar.edu:122/archive/pikaia
www.unb.br/iq/Kleber/GSA/artigo2/node2.html
goffe.osweg.edu





5 June 07

Starting point:

$$\frac{Q}{b\sqrt{g}h_e^3} = D_1 + \left[D_2 + D_3 r + D_4 r^2 + D_5 r^3\right]\left(\frac{h_e}{b}\right)^{D_6} ms + \left[D_7 + D_8 r + D_9 r^2 + D_{10} r^3\right]\left(\frac{h_e}{b}\right)^{D_{11}} \left(ms^2 + mu^2\right)^{D_{12}}$$ FITC3

simanh7.for scaletest $r = \frac{h_c^2}{h_e^2 + b \cdot hh}$, penalties $i = 1, 6, 11, 12$

jn0507a ← FITC3, on $[D_2 r \cdots]$ and $[D_7 + \cdots] < 0$ $lb_i = 0.00001$ $ub_i = 20$

initial $D_1 = 0.43$, $D_2 = 0.24$, $D_{i=8,9,10}^{3,4,5} = 0$, $lb_i = -20$ otherwise

$D_7 = 0.8$ $D_6 = 1$ $D_{11} = 0.6$, $D_{12} = 0.3$

~~fopt = 0.0643342 mean en = -0.00957 std en = 0.1091~~

~~rel en = 0.06558 std rel error = 0.09161~~

~~Scale test BAD mean en = 10^+29 rms en = 10^+30~~

~~$D_1 = 0.46471$ $D_2 = -0.092892$ $D_3 = 1.4468$ $D_4 = -2.4539$~~

~~$D_5 = 1.3387$ $D_6 = 9.3008$ $D_7 = 0.99288$ $D_8 = -1.6167$~~

~~$D_9 = 0.67375$ $D_{10} = -0.04747$ $D_{11} = 0.79138$ $D_{12} = 0.28479$~~

fopt = 0.0679754 mean en = -0.0165 std en = 0.1378

rel en = 0.0519215 std rel en = 0.0858

Scale test: Mean error $= 2.10^{+30}$ rms-en $= 7(10^{+30})$

$D_1 = 0.47365$ $D_2 = 0.10664$ $D_3 = 1.0255$ $D_4 = -2.0$~~82~~ 812

$D_5 = 1.2569$ $D_6 = 1.0902$ $D_7 = 0.93942$ $D_8 = -0.23750$

$D_9 = -2.0288$ $D_{10} = 1.3269$ $D_{11} = 0.73229$ $D_{12} = 0.16884$

5 June 07

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left[D_2 + D_3 r + D_4 r^2 + D_5 r^3 + D_6 r^4\right]\frac{h_e}{b} ms + \left[D_7 + D_8 r + D_9 r^2 + D_{10} r^3 + D_{11} r^4\right]\left(\frac{h_e}{b}\right)^{D_{12}} \left(ms^2 + mc^2\right)^{D_{13}}$$ FITC4

~~modify simanh7 for 13 parameters~~

Run first, reverse the input scale test

jn0507b ← FITC3 ← my raw16b.prn Some initial conditions

fopt = 0.2195 mean en = -0.0369 std en = 0.341

rel en = 0.142 std rel en = 0.135

Scale test means d error ∝ 10^{30}

$D_1 = 0.47493$ $D_2 = -0.023367$ $D_3 = 2.7541$ $D_4 = -6.9154$

$D_5 = 4.5295$ $D_6 = 1.1721$ $D_7 = 4.4486$ $D_8 = -13.948$

$D_9 = 14.523$ $D_{10} = -5.0233$ $D_{11} = 2.1631$

$D_{12} = 0.32559$

simanh8 - modify for 13 param & fitC4

$D_i = 0$ except $D_1 = 0.43$, $D_2 = 0.24$, $D_7 = 0.8$, $D_{12} = 0.6$, $D_{13} = 0.3$

$lb_i = -20$ except $lb_j = 0.00001$, $j = 1, 12, 13$, $ub_i = 20$

jn0507c ← my16raw.b w/scalecap.prn for scale test

fopt = 0.185127 Worse than 3rd-order FITC3

mean en = 0.0315 std en = 0.302 rel en = 0.182 std rel en = 0.233

Scale test also worse 10^{+41} errors

$D_1 = 0.47452$ $D_2 = 4.1328$ $D_3 = -15.596$ $D_4 = 14.521$

$D_5 = 4.9150$ $D_6 = -7.7070$ $D_7 = 0.14266$ $D_8 = -0.77036$

$D_9 = 5.1954$ $D_{10} = -9.0701$ $D_{11} = 4.5023$ $D_{12} = 0.56085$

$D_{13} = 0.56543$ $ms^2 + mc^2$ term goes to -4.61 @ r = 1

NG!

5 June 07

Run again with much heavier penalty on neg coef.
Not much better fope = 0.1513 Scale test blown

$D_1 = 0.48258$ $D_2 = 1.0912$ $D_3 = -1.5521$ $D_4 = -5.2986$

$D_5 = 14.017$ $D_6 = -7.9490$ $D_7 = 3.0522$ $D_8 = -6.7541$

$D_9 = 1.6357$ $D_{10} = 5.9392$ $D_{11} = -3.8731$ $D_{12} = 1.1813$

$D_{13} = 10^{-5}$

Try just odd powers of r

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left[D_2 + D_3 r + D_4 r^3 + D_5 r^5 + D_6 r^7\right]\frac{h_e}{b} ms$$

$$+ \left[D_7 + D_8 r + D_9 r^3 + D_{10} r^5 + D_{11} r^7\right]\left(\frac{h_e}{b}\right)^{D_{12}} (ms^2 + mu^2)^{D_{13}} \quad \text{FITC5}$$

jn0507d $\xleftarrow{\text{FITC5}}$ scaletaϕ

fope = 0.1161 mean-err = 0.004398 std err = 0.188

Scale errors 10^{34} to 10^{71} BAD

$D_1 = 0.46234$ $D_2 = 2.1471$ $D_3 = -6.3579$ $D_4 = 12.727$

$D_5 = -12.727$ $D_6 = 4.5244$ $D_7 = 0.70936$ $D_8 = -0.097605$

$D_9 = -0.12373$ $D_{10} = -2.8691$ $D_{11} = 2.3900$ $D_{12} = 0.63179$

$D_{13} = 0.076763$

Now try even powers

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left[D_2 + D_3 r^2 + D_4 r^4 + D_5 r^6 + D_6 r^8\right]\frac{h_e}{b} ms \quad \text{FITC6}$$

$$+ \left[D_7 + D_8 r^2 + D_9 r^4 + D_{10} r^6 + D_{11} r^8\right]\left(\frac{h_e}{b}\right)^{D_{12}} (ms^2 + mu^2)^{D_{13}}$$

jn0607a $\xleftarrow{\text{FITC6}}$ scaletaϕ, $r = h_e^2/(h_e^2 + b \cdot h_n)$

Same initial conditions

6 June 07

simanh2, Fit66 (cont'd) jn0607a

fope = 0.0544716 Scale runs exchanged again, maybe due to penalties

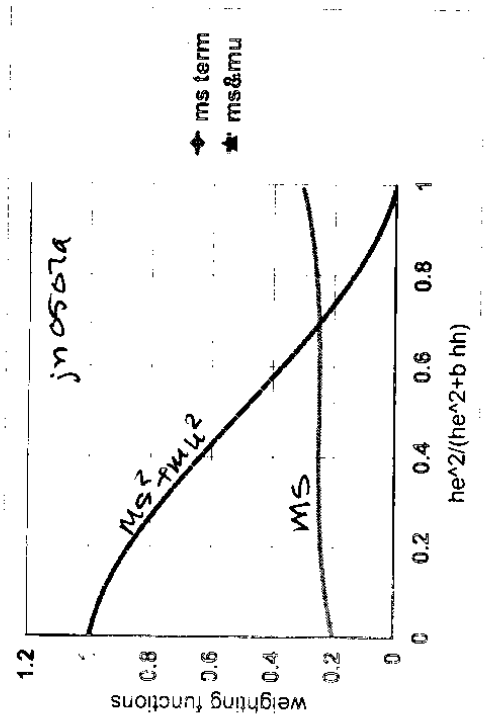
$D_1 = 6.47298$ $D_2 = 0.22194$ $D_3 = -1.2476$ $D_4 = 7.4769$
$D_5 = -12.519$ $D_6 = 6.3849$ $D_7 = 0.75755$ $D_8 = -2.4851$
$D_9 = 3.1321$ $D_{10} = -1.2927$ $D_{11} = -0.11159$ $D_{12} = 0.86905$
$D_{13} = 0.34465$

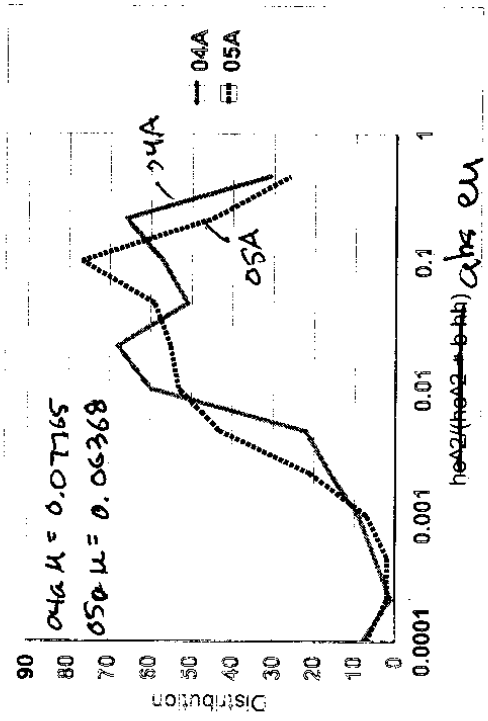
Had wrong $r = he/hh+\epsilon$ in scale for all those runs rerun again

Need to rerun everything from jn03? Fix scale + rerun

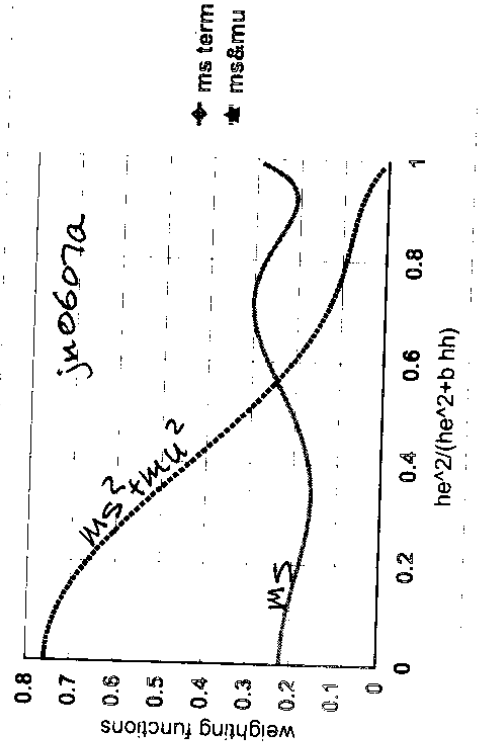
fope = 0.0544716 mean en = -0.00205 std en = 0.09732
rel en = 0.056475 std rel en = 0.08568

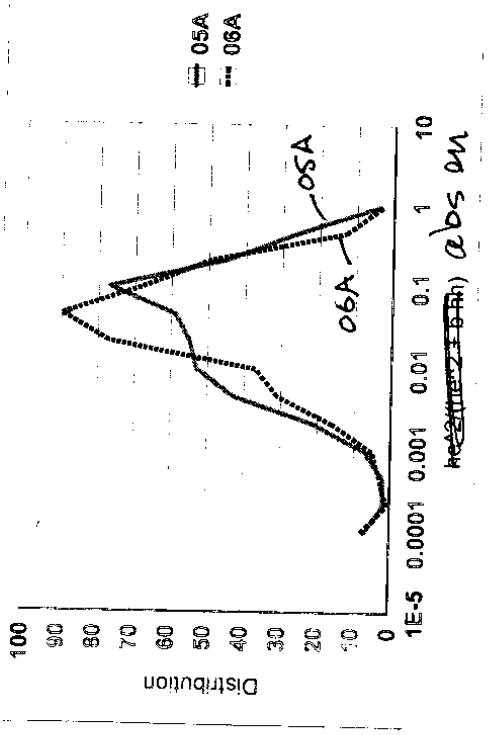
Scale test: mean en = -0.265 rms en = 0.518 std en = 0.445
rel en = 0.1323 std rel en = 0.0970





6 June 07





FITS3

jn0507a: ~~fope = 0.067954 mean en = -0.0165~~

~~rel en = 0.0519215 std rel en = 0.0858 std en = 0.1398~~

Rerun for scale test: Better (slightly) result; fope = 0.0636760

mean en = -0.01399 std-en = 0.119 rel en = 0.05215

std rel en = 0.08599 || Scale test: mean en = -0.184

rms en = 0.513 std en = 0.479 rel en = 0.1218 std rl = 0.1025

Changes in D_i: $D_1 = 0.47359$, $D_2 = 0.19994$

$D_3 = 0.32354$ $D_4 = -0.69620$ $D_5 = 0.48035$ $D_6 = 1.0954$

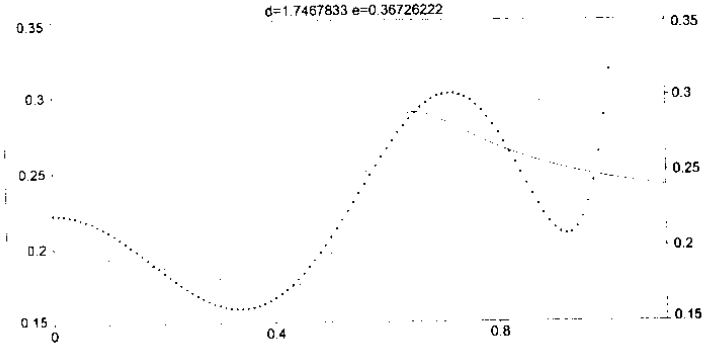
$D_7 = 0.99471$ $D_8 = -0.25859$ $D_9 = -2.1620$ $D_{10} = 1.4259$

$D_{11} = 0.73695$ $D_{12} = 0.14490$

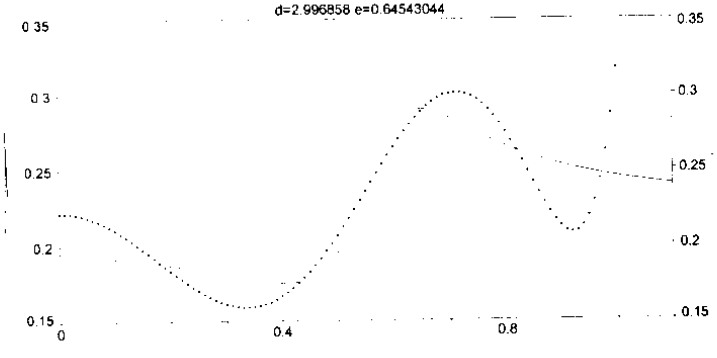
6 June 07

What could fit MS term?

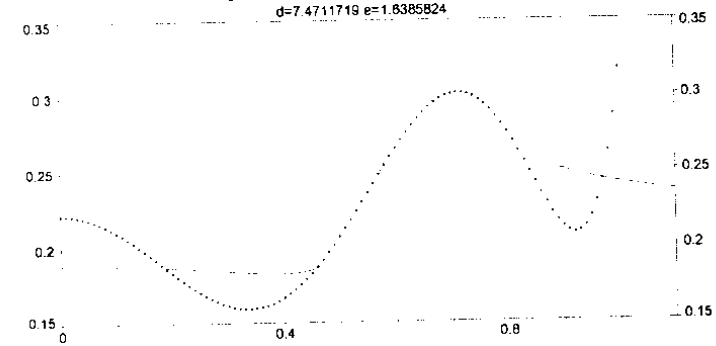
E:\Programs\TCWIN4\CLIPBRD.WK3
Rank 2016 Eqn 7933 $y=(a+cx^{0.5}+ex)/(1+bx^{0.5}+dx)$ [NL]
r^2=0.82177787 DF Adj r^2=0.81239776 FitStdErr=0.019775688 Fstat=110.66341
a=0.19943093 b=-2.6287029 c=-0.53769464
d=1.7467833 e=0.36726222



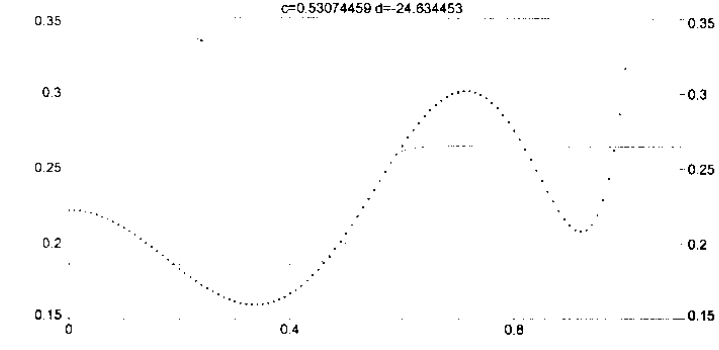
E:\Programs\TCWIN4\CLIPBRD.WK3
Rank 2017 Eqn 7903 $y=(a+cx+ex^2)/(1+bx+dx^2)$ [NL]
r^2=0.81434871 DF Adj r^2=0.80457759 FitStdErr=0.020183653 Fstat=105.27462
a=0.19515766 b=-3.3914956 c=-0.69221879
d=2.996858 e=0.64543044



E:\Programs\TCWIN4\CLIPBRD.WK3
Rank 2018 Eqn 7923 $y=(a+cx^2+ex^4)/(1+bx^2+dx^4)$ [NL]
r^2=0.79666713 DF Adj r^2=0.7859654 FitStdErr=0.02112295 Fstat=94.033057
a=0.18865879 b=-5.109564 c=-1.0166693
d=7.4711719 e=1.8385824



E:\Programs\TCWIN4\CLIPBRD.WK3
Rank 691 Eqn 8013 [LgstcDoseRsp] $y=a+b/(1+(x/c)^d)$
r^2=0.67965608 DF Adj r^2=0.66630841 FitStdErr=0.02637599 Fstat=68.599855
a=0.18601025 b=0.078914244
c=0.53074459 d=-24.634453



Fits of the MS-Term weighting function for the 31 OCT 07a data

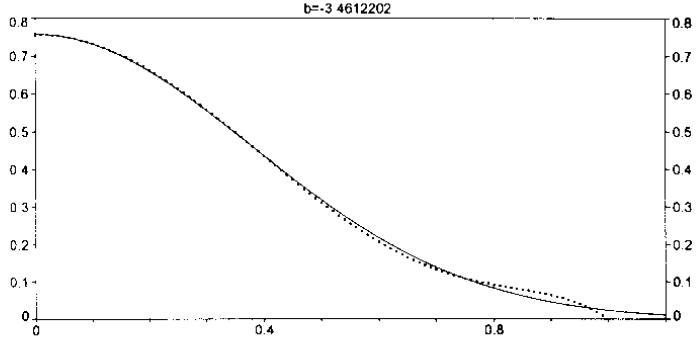
jn0607a data

Rank 1 Eqn 25 $\ln y = a + bx^2$

r^2=0.99890414 DF Adj r^2=0.99888177 FitStdErr=0.0085724595 Fstat=90240.759

a=-0.27672726

b=-3.4612202



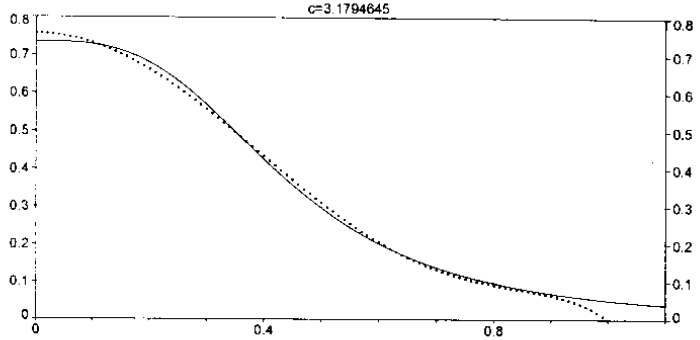
jn0607a data

Rank 98 Eqn 8076 [LgstcDoseRsp_] $y = a/(1+(x/b)^c)$

r^2=0.99721726 DF Adj r^2=0.99713119 FitStdErr=0.013729931 Fstat=17559.529

a=0.735016 b=0.44262723

c=3.1794645



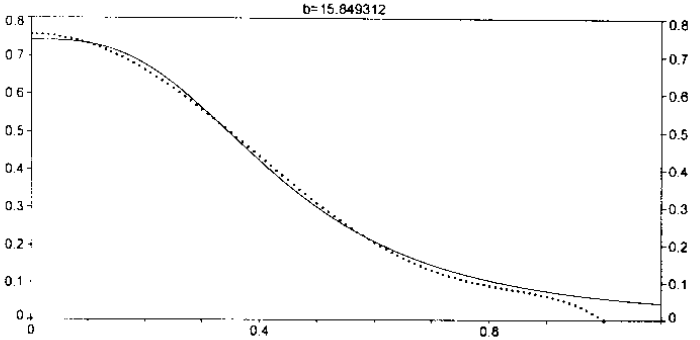
jn0607a data

Rank 2 Eqn 49 $y^{-1} = a + bx^3$

r^2=0.9966208 DF Adj r^2=0.99655184 FitStdErr=0.015053378 Fstat=29197.913

a=1.3482235

b=15.849312



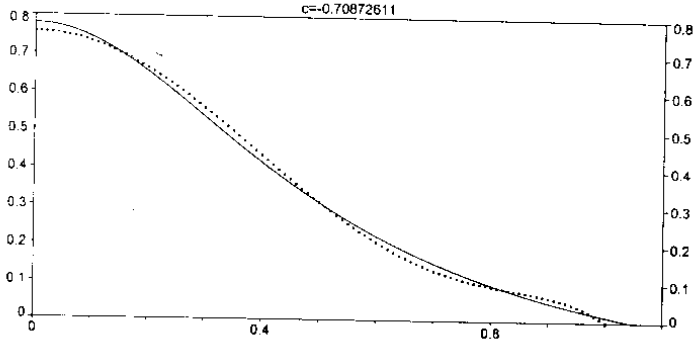
jn0607a data

Rank 118 Eqn 7401 $y = (a+cx^2)/(1+bx^2)$

r^2=0.99665273 DF Adj r^2=0.99654921 FitStdErr=0.01505834 Fstat=14589.805

a=0.77868563 b=3.7507129

c=-0.70872611



Fit to as^2+mc^2 term weighting function from jn0607a data

6 Jun 07

6 Jun 07

simanh7.for jn0607b $\xleftarrow{\text{FITC6}}$ scaletap.prn

Use ~~h_e~~ $r = h_e^2/(h_e^2 + h_h^2)$ Clearly worse

fope = 0.126 mean err = 0.00467 std err = 0.212 ~

$\overline{\text{rel err}}$ = 0.114 std rel err = 0.127 || Scale: mean err = -0.229

rms-err = 0.553, std err = 0.503 $\overline{\text{rel err}}$ = 0.145 std rel err = 0.111

D_1 = 0.47325 D_2 = 0.29676 D_3 = -1.0308 D_4 = 6.7586

D_5 = -12.545 D_6 = 6.8388 D_7 = 0.46612 D_8 = -1.2492

D_9 = 3.0324 D_{10} = -3.3736 D_{11} = 1.1243 D_{12} = 0.22189

D_{13} = 0.28092

~~jn0~~ Rerun overwritten jn0507b $\xleftarrow{\text{FITC3}}$ mg16rawb

fope = 0.0946085 mean err = 0.002372 std err = 0.1772

$\overline{\text{rel err}}$ = 0.0488634 std rel err = 0.0534105

Scale test: Mean err = -0.420 rms err = 0.804 std err = 0.686

$\overline{\text{rel err}}$ = 0.188 std rel err = 0.164

D_1 = 0.46965 D_2 = -0.018623 D_3 = 2.1905 D_4 = -4.9850

D_5 = 3.1568 D_6 = 1.1269 D_7 = 0.92715 D_8 = -1.8704

D_9 = 1.3651 D_{10} = -0.42162 D_{11} = 0.88896 D_{12} = 0.37168

Use logistic function to fit ms-term

simanh8.for

Modify simanh7.for to use FITC7

$ms^2 + mu^2$ term fit in TC-2D:

$$0.758166 - 2.50745 r^2 + 3.25429 r^4 - 1.502816 r^6$$

r^2 = 0.999995 Fit std err = 0.00057

7 Jun 07

$D_1 > 0$ $D_2 > 0$ $D_4 > 0$ $D_5 > 0$ D_6 D_7

$$\frac{P}{b\sqrt{g}\,h_e^3} = D_1 + \left[D_2 + D_3/(1+(r/D_4)^{D_5})\right]\left(\frac{h_e}{b}\right)^{D_6} M_S^{D_7}$$
$$\left[D_8 + D_9 r^2 + D_{10} r^4 + D_{11} r^6\right]\left(\frac{h_e}{b}\right)^{D_{12}} (M_S^2 + M_I^2)^{D_{13}}$$ FITC7

$D_8 \geq 0$ $D_{12} > 0$ $D_{13} > 0$

> 0

jn0707a ← FITC7 scaletab $r^2 = h_e^2/(h_e^2 + bh_n)$

Initial $D_1 = 0.47$, $D_2 = 0.186$ $D_3 = 0.08$ $D_4 = 0.53$

$D_5 = -10.$ $D_6 = 1$ $D_7 = 1$ $D_8 = 0.7558$ $D_9 = -2.51$

$D_{10} = 3.25$ $D_{11} = -1.5$ $D_{12} = 0.8$ $D_{13} = 0.4$ $ah_i = 20$

$lb_i = 0.00001$ $lb_i = -20$, $i = 3, 9, 10, 11$ $lb_5 = -30$

fopt = 0.0509709 mean en = -0.005303 std en = 0.09777

rel en = 0.049202 std rel en = 0.08555 || Scale test

mean en = -0.113 rms-en = 0.573 std en = 0.561

rel en = 0.134 std rel en = 0.115

$D_1 = 0.48230$ $D_2 = 0.24936$ $D_3 = 10.896$ $D_4 = 9.4484$

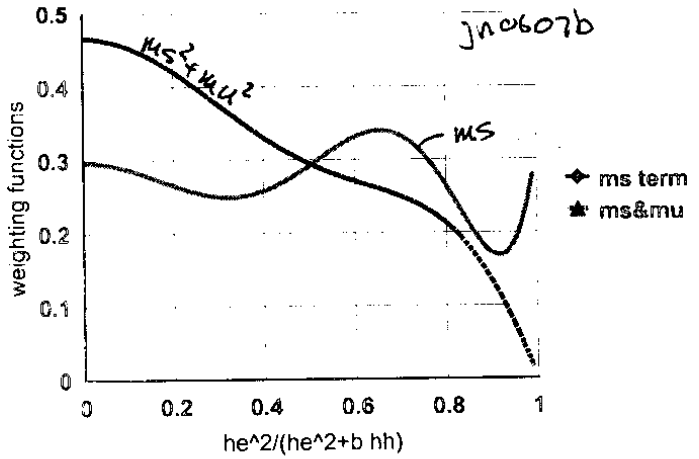
$D_5 = -2.4491$ $D_6 = 1.1181$ $D_7 = 1.0476$ $D_8 = 1.4714$

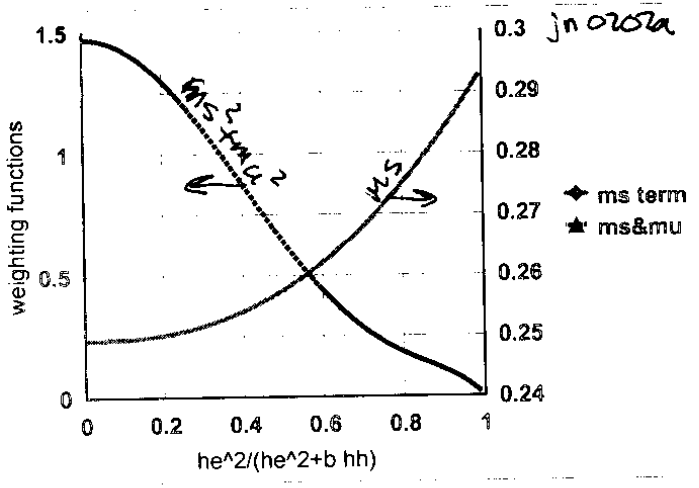
$D_9 = -4.5330$ $D_{10} = 5.4810$ $D_{11} = -2.4191$ $D_{12} = 0.84768$

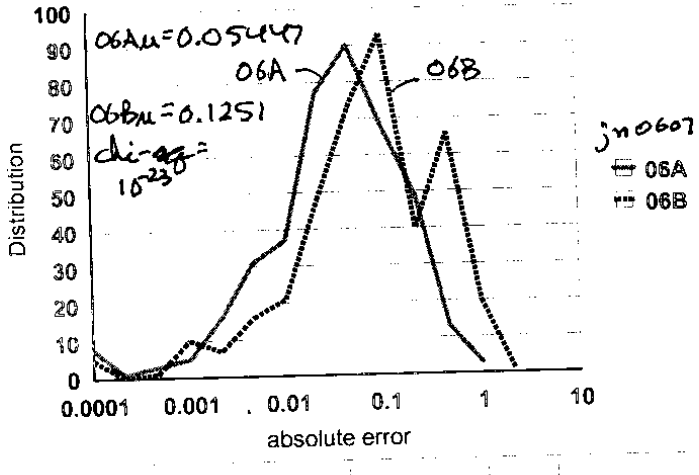
$D_{13} = 0.014111$

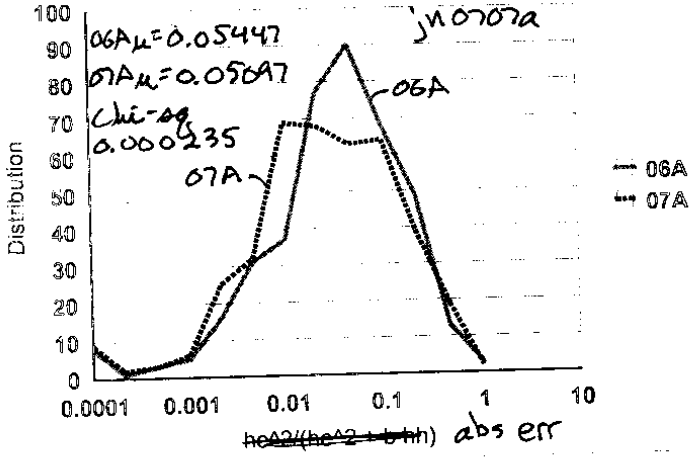
Compared to jn0607a: jn0707a > chi-sq = 0.0002353

	mean abs en
jn0607a	0.0544716
jn0707a	0.0509709


jn0607b
$ms^2+\mu^2$
ms
weighting functions
he^2/(he^2+b hh)
ms term
ms&mu


jn0707a
$ms^2+\mu^2$
ms
weighting functions
he^2/(he^2+b hh)
ms term
ms&mu


06Aμ=0.05447
06A
06B
06Bμ=0.1251
chi-sq=
10^{-23}
Distribution
absolute error
jn0607
06A
06B


06Aμ=0.05447
07Aμ=0.05097
chi-sq
0.000235
jn0707a
06A
07A
Distribution
he^2/(he^2+b hh) abs err
06A
07A

Jun07

7 Jun 07

simanh8 jn0707b $\xleftarrow{\text{FITC8}}$ scaleta0

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left[D_2 + \frac{D_3}{1+(r/D_4)^{D_5}}\right]\left(\frac{h_e}{b}\right)^{D_6} ms^{D_7} \qquad r = \frac{h_e^2}{h_e^2 + b h_h}$$

$$+ \left[D_8 + \frac{D_9}{1+(r/D_{10})^{D_{11}}}\right]\left(\frac{h_e}{b}\right)^{D_{12}} (ms^2 + mu^2)^{D_{13}}$$

FITC8
$D_5 = -2.45$

Initial $D_1 = 0.482$, $D_2 = 0.249$ $D_3 = 10.9$ $D_4 = 9.45$

$D_6 = 1$ $D_7 = 1$ $D_8 = 1.47$ $D_9 = 1$ $D_{10} = 1$ $D_{11} = 1$

$D_{12} = 0.85$ $D_{13} = 0.4$ $lb_i = -20$, $i = 3,4,5,9,10,11$ $r = -D_{10}$

$lb_i = 0.00001$, $i = 1,2,6,7,8,12,13$ Large penalties on $r = -D_4$

dabs(c1).lt.0.01 10^4 $c1^2$ $(0.01)^2 = 10^{-4}$

± 0.01 $(0.0001 - c1^2)\,10^8 \times 10$

Mild penalty for $D_6 \neq 1$, $D_7 \neq 1$

rel = rel + ~~0.001~~ 0.1 * dabs(d(6) - 1) + ~~0.001~~ 0.1 * dabs(d(7) - 1) in fcn

fopt = 0.0732672 Note $D_3 = 19.9999$

Set $ub_3 = 40$ and try again → jn0707b change iseeds

fopt = 0.1821 w/ $D_3 = -15.069$

$D_1 = 1.38e\text{-}5$ $D_2 = 1.4469$ $D_3 = -15.069$ $D_4 = 10.342$

$D_5 = 10.342$ $D_6 = 0.58093$ $D_7 = 0.0011589$ $D_8 = 1.8361$

$D_9 = -1.8312$ $D_{10} = 2.7116$ $D_{11} = 7.925$ $D_{12} = 0.23002$ $D_{13} = 2.1475$

constants
-13.6221
0.0049

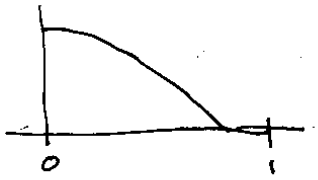
Change iseeds & try again → jn0707b

$-5 \le D_4, D_{10} < 6$ → fopt = 0.1879, even worse

$D_1 = 10^{-5}$ $D_2 = 1.7538$ $D_3 = -6.9731$ etc

7jan07

FitCg - allow ms^2+mc^2 term to go to zero with logistic function → jn0707c (avoid $\frac{1}{0}$ when $r=0$)



$D_4>0$ $D_{10}>0$, $D_5, D_{11}>0$

Initial $D_1=0.473$ $D_2=0.186$, $D_3=0.079$, $D_4=0.531$

$D_5=2$, $D_6=1$, $D_7=1$, $D_8=-0.081$ $D_9=0.83$

$D_{10}=0.477$ $D_{11}=2.61$ $D_{12}=0.8$ $D_{13}=0.4$

~~$D_i>0$ $i=1,2,4,5,6,7,10,11,12$~~ → jn0707c

fopt = 0.0446598 mean en = -0.007388

std en = 0.08812 rel en = 0.04780 std rel en = 0.05153

Scale: Mean en = -0.24728 rms en = 0.4965 std en = 0.4307

rel en = 0.1289 std rel en = 0.09160

$D_1=0.48225$ $D_2=0.29739$ $D_3=-0.11702$ $D_4=0.61476$

$D_5=7.6280$ $D_6=1.1186$ $D_7=1.0425$ $D_8=-0.14297$

$D_9=0.87839$ $D_{10}=0.53815$ $D_{11}=2.6528$ $D_{12}=0.84125$

$D_{13}=0.31408$ chi sq w/ jn0707a = 0.1780 no sig diff.

Exponent of ms^2+mc^2 is a lot more realistic

$b g^{1/2} h_e^{3/2} \left(\frac{h_e}{b}\right)^{0.87839} \approx b^{1/8} g^{1/2} h_e^{2.378}$ $\frac{4.75678}{2}$ $\frac{.87839}{.31408} = 2.797$

Suppose @ $r=1$ $D_8 + \frac{D_9}{1+(1/D_{10})^{D_{11}}} = 0$, $D_8 = -\frac{D_9}{1+D_{10}^{-D_{11}}}$

8 Jun 07

Make up new data file to include possible contraction effects for $\theta = \pi/2$ and $\phi = 0$

Import my16rawb.prn into 1-2-3 and sort on f_i(asc), θ(des), h_h, h_u, ~~h_e~~ Q

rewriteaφ.for rewrite files in comma-delineated form

my16rawb.~~for~~ prn → jn0716aφ.prn (comma-delineated) for importation

scaletaφ.prn → jn07832φ.prn to 1-2-3

~~jn07w~~ weirdatφ.prn weirdat~~φ~~1.prn

Import jn0716aφ.prn & jn07832φ.prn into separate sheets in 1-2-3

Sort 16-in data, jn0716aφ, on ϕ, θ, h_h, h_u, Q

and take only the data for $\phi = 0$, 0.245 & 0.464 into the 3rd sheet. ($m_s = 0, 1:4$; $1:2.5$)

Sort that data on θ and delete for $\theta < 0.785$, leaving $\theta = 1.571, 0.785$ or $m_u = 0, 1:1$

Add to ~~that~~ the remainder all the 8 & 32-inch data

Resort on b, θ, ϕ, h_h, Q, h_u — save in weirdat1

simanh9.for copy scaleaφ → weirdatφ

modify simanh8 - drop scale test

weirdat~~φ~~1 → FITC9 w/ $r = h_e^2 / h_e^2 + b \cdot h_h$ → jn0807a1,a2.prn

put some randomness back into LM; on line ~568 | Initial

$D_1 = 0.48$ $D_2 = 0.3$ $D_3 = -0.11$ $D_4 = 0.61$ $D_5 = 7.6$

$D_6 = 1.1$ $D_7 = 1.$ $D_8 = -0.14$ $D_9 = 0.88$ $D_{10} = 0.54$

$D_{11} = 2.7$ $D_{12} = 0.84$ $D_{13} = 0.31$, $ub = 20$, $lb = 10^{-5}$, $lb_i = -20$, $i = 3, 8, 9$

8 jun 07

simanh9.for (cont'd)

jn0807a: fope = 0.07349936 mean er = -0.0208

std er = 0.1345 rel er = 0.0556290 std rel er = 0.0786424

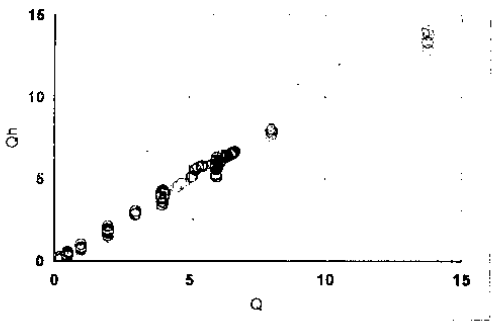
$D_1 = 0.47202$ $D_2 = 0.30378$ $D_3 = -0.10906$ $D_4 = 0.64399$

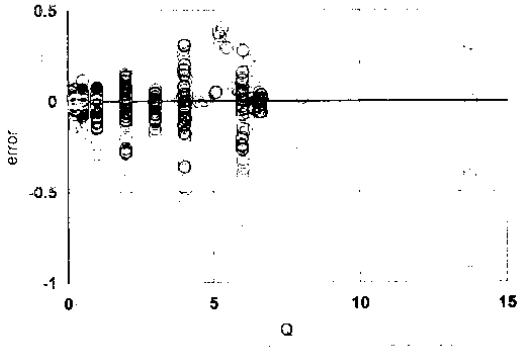
$D_5 = 7.3553$ $D_6 = 1.0867$ $D_7 = 1.0332$ $D_8 = -0.14746$

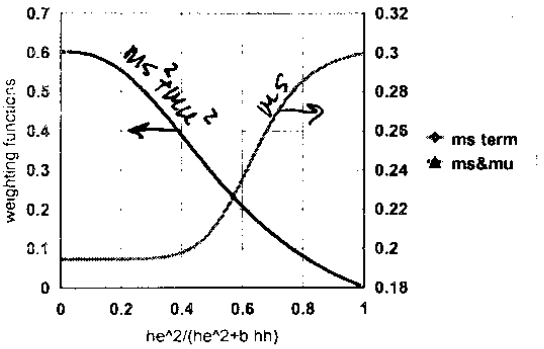
$D_9 = 0.75027$ $D_{10} = 0.57579$ $D_{11} = 2.5204$ $D_{12} = 0.79751$

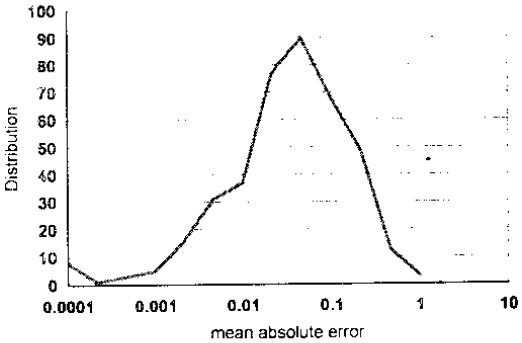
$D_{13} = 0.37552$

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left[D_2 + \frac{D_3}{1 + (r/D_4)^{D_5}} \right] \left(\frac{h_e}{b} \right)^{D_6} ms^{D_7} + \left[D_8 + \frac{D_9}{1 + (r/D_{10})^{D_{11}}} \right] \left(\frac{h_e}{b} \right)^{D_{12}} (ms^2 + mu^2)^{D_{13}}$$





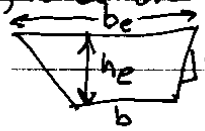




8 Jun 07

Now suppose that contraction can be calculated by taking the mean velocity through the cross-section of the jet, as without accounting for drag of the water surface at the verge $\frac{Q(cfs)}{A(ft^2)} \rightarrow \frac{L^3/T}{L^2} \rightarrow \frac{L}{T}$, since we have no information either on drag at the verge or on upstream velocity.

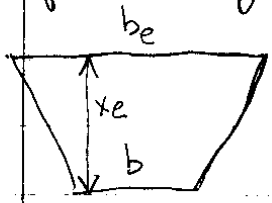
First, take the vertical cross-section of the assumed jet

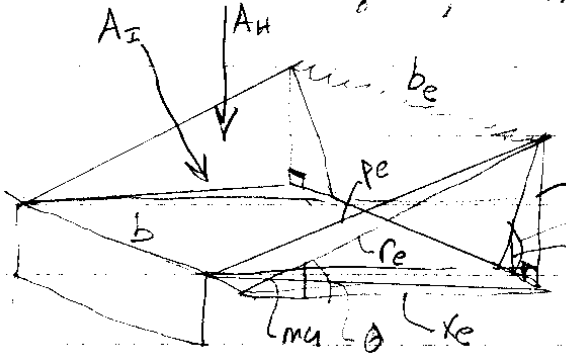


$ms = H/V = \frac{\frac{1}{2}(b_e - b)}{h_e} \Rightarrow b_e = b + 2 \cdot ms \cdot h_e$

$A = \frac{b+b_e}{2} \cdot h_e = \frac{b+b+2 \cdot ms \cdot h_e}{2} \cdot h_e = (b + ms\,h_e)h_e = A_V$

Now, suppose that the velocity is dominated by water falling through the inclined cross-section formed by the highest geometric edges of the breach





$ms = \frac{1}{\tan\alpha}$

$mu = 1/\tan\theta$

$mu = \frac{x_e}{h_e}$

$x_e = mu \cdot h_e$

$A_H = \frac{1}{2}(b+b_e)x_e = \frac{b+b+2ms\,he}{2} \cdot mu\,he = (b + ms\,he)mu \cdot he$

$r_e = (x_e^2 + h_e^2)^{1/2} = (mu^2 h_e^2 + h_e^2)^{1/2} = h_e(1+mu^2)^{1/2}$

$A_I = \frac{1}{2}(b+b_e)r_e = (b+ms\,he)(1+mu^2)^{1/2} h_e$

Visualizing the flow, the contraction has to be less as $mu > 0$, so long as there is a head available

to take the flow. Has to increase as $h_s \to 0$

What can make Q/A into a dimensionless variable

$$\frac{Q/A}{\sqrt{gL}} \to \frac{L^3}{T}\cdot\frac{1}{L^2}\cdot\frac{1}{\sqrt{L/T^2\cdot L}}$$ What for L? h_e, b or h_u $h_e + h_u$?

$\frac{Q}{A\sqrt{gh_e}}$ → dimensionless V

b can → 0 giving a ÷0 problem but velocity per unit width may be relevant $Q/A\sqrt{gb}$

Higher velocity, more contraction, less flow

$$\frac{Q}{b\sqrt{gh_e^3}} = F \to \frac{Q}{b\sqrt{gh_e^3}} = \frac{1}{1+Q/A\sqrt{gb}}F \text{ maybe}$$

$$\text{or } \frac{Q}{b\sqrt{gh_e^3}} = \frac{1}{1+(Q/A\sqrt{gb})^D}F \to \frac{Q}{b\sqrt{gh_e^3}} + \frac{Q^{D+1}}{b\sqrt{gh_e^3}(A\sqrt{gb})^D} = F$$

$$\frac{Q}{b\sqrt{gh_e^3}} = \frac{1}{1+(Q/A\sqrt{gb})^{D_{12}}}F$$

$$F = D_1 + \left[D_2 + \frac{D_3}{1+(r/D_4)^{D_5}}\right]\frac{h_e}{b}ms + \left[D_6 + \frac{D_7}{1+(r/D_8)^{D_9}}\right]\left(\frac{h_e^2}{b^2}(ms^2+mu^2)\right)^{D_{11}}$$

First check FITC9 w/ $D_6 = D_7 = 1$, $D_{12} = 2D_{13}$:

$$\frac{Q}{b\sqrt{gh_e^3}} = D_1 + \left[D_2 + \frac{D_3}{1+(r/D_4)^{D_5}}\right]\frac{h_e ms}{b} + \left[D_6 + \frac{D_7}{1+(r/D_8)^{D_9}}\right]\left[\frac{h_e^2}{b^2}(ms^2+mu^2)\right]^{D_{10}}$$

FITDØ

as with FITC9 - allow $D_6 + D_7/(1+(r/D_8)^{D_9})$ to be less than one or zero

8 June 07

s.man h9 (cont'd)

weirdat1 $\xrightarrow{\text{FIT D4}}$ jn0807b, w $r = h_e^2 / h_e^2 + b h_h$

Initial $D_1 = 0.47$ $D_2 = 0.3$ $D_3 = -0.11$ $D_4 = 0.64$ $D_5 = 7.4$

$D_6 = -0.14$ $D_7 = 0.75$ $D_8 = 0.58$ $D_9 = 2.5$ $D_{10} = 0.38$

$lb_i = 10^{-5}$ except $lb_i = -20$, $i = 3, 6, 7$ $ub_i = 20$ iseed1 = 632,970

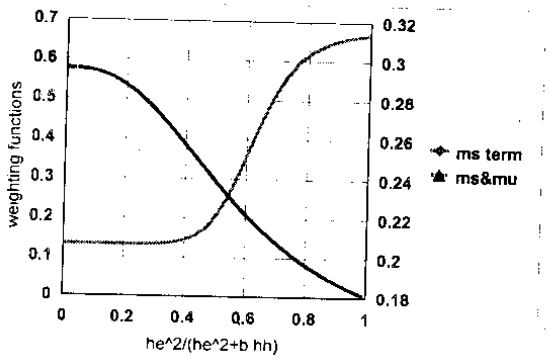
fopt = 0.0749190 mean err = -0.024371 stderr = 0.1368

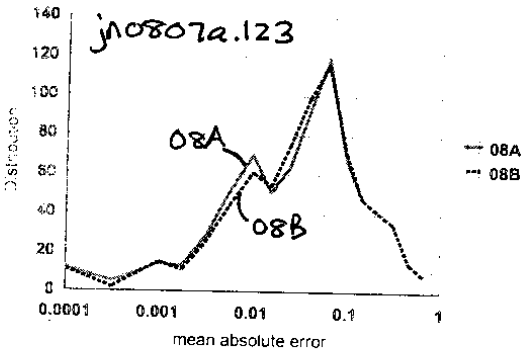
rel err = 0.0572265 stdrel err = 0.0797331

$D_1 = 0.46368$ $D_2 = 0.31562$ $D_3 = -0.10892$ $D_4 = 0.62622$

$D_5 = 8.3817$ $D_6 = -0.14736$ $D_7 = 0.72394$ $D_8 = 0.59488$

$D_9 = 2.5737$ $D_{10} = 0.37716$





chi square test = 0.318 between jn0807a & jn0807b

FITD1: change second term to $\left[\left(\frac{h_e}{b}\right)^{2.5}(ms^2 + mu^2)\right]^{D_{10}}$

→ jn0807c1, c2.prn

NO GOOD fopt = 0.0862949 ms term weight reduced to a constant. Not physical. chi-sq test = 0.000935

8 Jan 07

simaaniϕ.for modify simanh9.for to pass $q(i)^{h_e d_b}$ into fit from fcn – doesn't make sense to use it, though, since it can only be an unknown in fit

$$\frac{\hat{Q}}{b\sqrt{g h_e^3}} = \text{FITD}\phi = Q_\pi \frac{\hat{Q}^*}{b\sqrt{g h_e^3}} = \frac{Q_\pi}{1+\left(Q^*/A\sqrt{gb}\right)^{D_{11}}}$$

$$Q^* = Q_\pi\, b\sqrt{g h_e^3} \qquad \frac{Q^*}{A\sqrt{gb}} = \frac{Q_\pi\, b\sqrt{h_e^3}}{A\sqrt{b}} = \frac{Q_\pi}{A}\sqrt{b h_e^3} \text{ dimensionless}$$

$$\frac{\hat{Q}}{b\sqrt{g h_e^3}} = \frac{Q_\pi}{1+\left[\frac{Q_\pi\sqrt{b h_e^3}}{A}\right]^{D_1}}$$

(Not appropriate for V-notch weirs where $b = \phi$)

Fit D2: $$\frac{Q}{b\sqrt{g h_e^3}} = \frac{Q^*}{1+\left(Q^*\sqrt{b h_e^3}/A_v\right)^{D_{11}}}, \quad r = \frac{h_e^2}{h_e^2 + b\cdot h_h}$$

$$Q^* = D_1 + \left[D_2 + \frac{D_3}{1+(r/D_4)^{D_5}}\right]\frac{h_e\cdot m_s}{b} + \underbrace{\left[D_6 + \frac{D_7}{1+(r/D_8)^{D_9}}\right]}_{\geq 0}\left[\frac{h_e^2}{b^2}(m_s^2+m_u^2)\right]^{D_{10}}$$

$A_v = (b + m_s\cdot h_e)h_e$

$ub_i = 20$ $lb_i = 10^{-5}$, $lb_i = -20$, $i = 3,6,7,11$

Initial: $D_1 = 0.47$ $D_2 = 0.3$ $D_3 = -0.11$, $D_4 = 0.64$ $D_5 = 7.4$

$D_6 = -0.14$ $D_7 = 0.75$ $D_8 = 0.58$ $D_9 = 2.5$ $D_{10} = 0.38$ $D_{11} = \cancel{0.25}$ 0.1

→ jn0807d1,d2.prn $ub_{10} = 2$

fopt = 0.0811645 mean err = −0.0173 std err = 0.1374

~~rel err = 0.06593~~ std rel err = 0.08498

$D_1 = 0.93877$ $D_2 = 0.63857$ $D_3 = -0.12681$ $D_4 = 0.74443$

$D_5 = 20.000$ $D_6 = -10.440$ $D_7 = 11.912$ $D_8 = 9.6435$

$D_9 = 0.84101$ $D_{10} = 0.36547$ $D_{11} = -0.046232$

8 Jun 07

simanig.for Initial $D_{11} = 0.001$

Set $uh_i = 2$, $i = 4,8$ change iseed = 822,369 try again

→ jn0807e fopt = 0.1336 NO GOOD

Put in the values for jn0807b output, $D_{11} = 0$ &

try again → jn0807e → starts off with fopt = 2.6

Comment out the "velocity" adjustment & try again

→ starts of at fopt = 0.0749

No wonder $q_s = \dfrac{q_s}{\left(1 + \left(\frac{q_s\sqrt{bh_e^3}}{A}\right)^{D_{11}}\right)} \rightarrow \dfrac{q_s}{2}$ for $D_{11} = 0$

Rewrite FITD2 $\dfrac{Q}{b\sqrt{gh_e^3}} = \dfrac{Q^*}{1 + D_{11}\left(Q^*\sqrt{bh_e^3}/A_v\right)^{D_{12}}}$

Set $D_{11} = 0$, $D_{12} = 1$ initially, try again → jn0807e

fopt = ~~0.73~~ 0.0731318 mean err = -0.023208

std err = 0.137218 $\overline{\text{rel err}}$ = 0.05611774 std rel err = 0.080013

$D_1 = 0.46199$ $D_2 = 0.31537$ $D_3 = -0.059133$ $D_4 = 0.63498$

$D_5 = 10.6722$ $D_6 = -0.16713$ $D_7 = 0.72699$ $D_8 = 0.60872$

$D_9 = 2.3935$ $D_{10} = 0.35722$ $D_{11} = -0.050113$ $D_{12} = 3.9609$

chi-sq test w/ baseline jn0807b w/ fopt = 0.074919

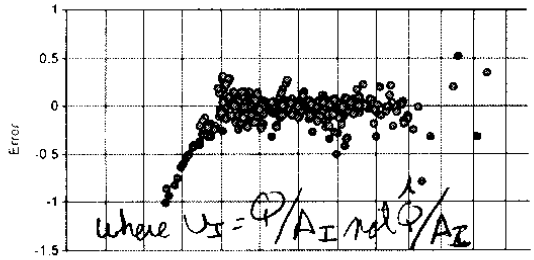
is 0.755 ⟹ no sig difference start same but $D_{11} = 0.00011$

jn0807f ← Use A_H for area in FITD2, run again $D_{12} = 0.0001$

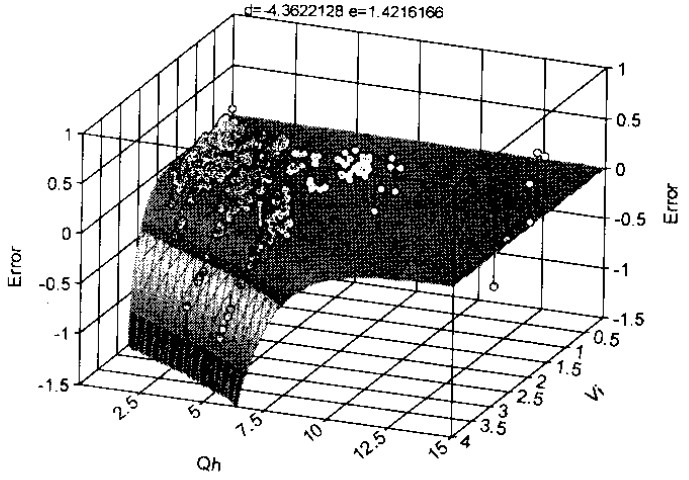
9jun07

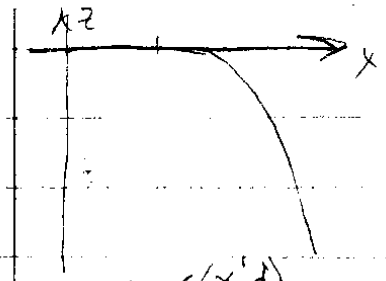
k:\dmbreach\arsflume\simanh\jn0807b.wk4

$(Q_h - Q) = f(V_I, Q_h)$



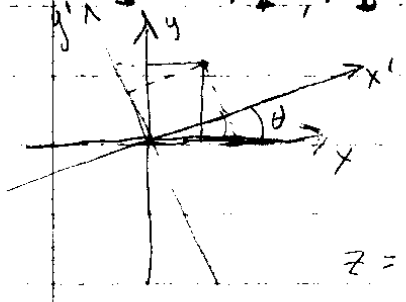
k:\dmbreach\arsflume\simanh\jn0807b.wk4
Rank 59 Eqn 2037 z=LOGISTICX(a,b,c)*LOGISTICY(1,d,e)
r^2=0.4396126 DF Adj r^2=0.43577958 FitStdErr=0.1026862 Fstat=143.5598
a=-988.7204 b=4.2945126 c=0.25576211
d=-4.3622128 e=1.4216166





$z = a - be^{c(x-d)} + 0 \cdot y$

$V_I = \hat{Q}/A_I$, $A_I = (b + ms \cdot he)\, he\, (1 + m^2)^{1/2}$

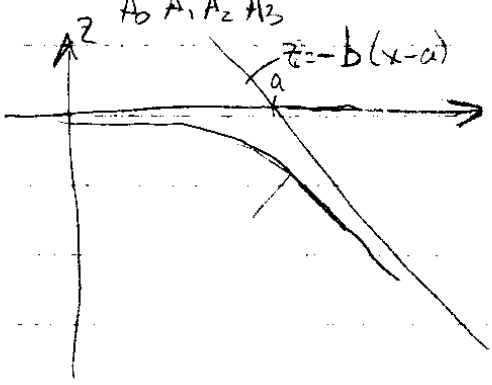


$z = a - be^{c((x'\cos\theta - y'\sin\theta) - d)} + 0 \cdot [x'\sin\theta + y'\cos\theta]$

$z = a - be^{cx'\cos\theta}\, e^{-cy'\sin\theta}\, e^{-cd} \rightarrow a - be^{c(x\cos\theta - y\sin\theta)}$

$z = f(a, b, c, \theta)$ $z = A_0 + A_1 e^{A_2(x\cos(A_3) - y\sin(A_3))}$

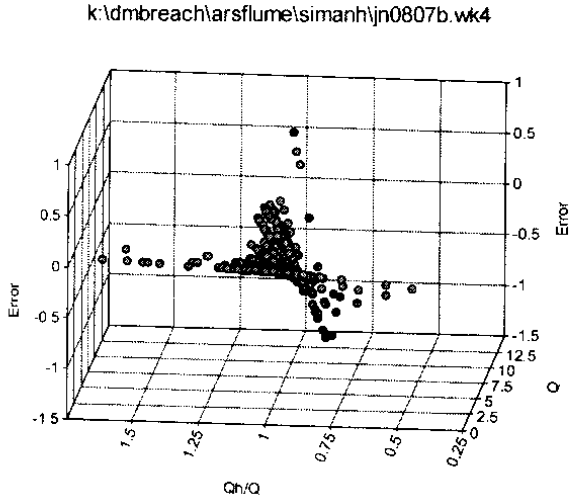
$A_0\ A_1\ A_2\ A_3$

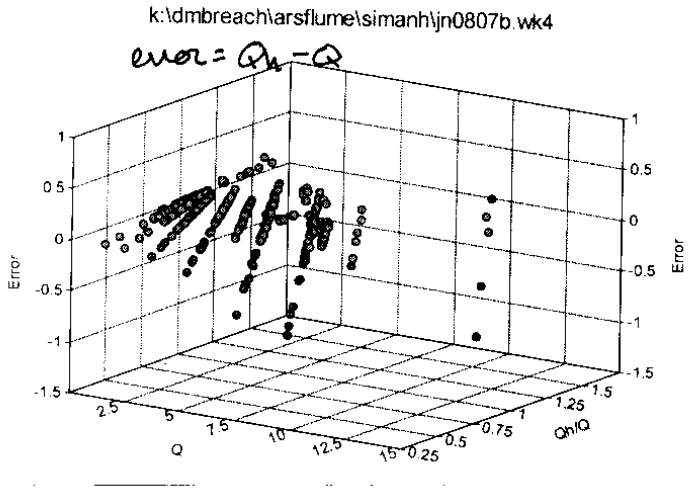


$x \rightarrow -\infty$, $z \rightarrow 0-$

$x \rightarrow \infty$, $z \rightarrow -b(x-a)$

9 jun 07





Suppose $Q_h - Q = f(Q) \cdot Q_h/Q = \alpha Q \frac{Q_h}{Q} = \alpha Q_h$

$Q_h(1-\alpha) = Q \Rightarrow Q_h > Q$ for $\alpha > 0$

$\alpha = \frac{Q_h - Q}{Q_h}$, set up column in jn0807b.wk4

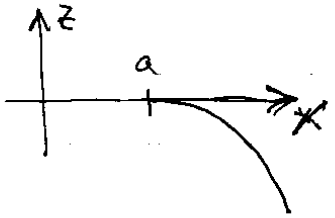
Possible variables: V_h, ~~Q_h/Q~~, dim-V_i, Q/A_i, $1/(A_i(M_s)$

$(F_i)(V_v) V_h, V_i$ $\quad \alpha = 1 - Q/Q_h = \frac{Q_h - Q}{Q_h}$

No apparent correlations to the physical variables same dead ends as before. Can't seem to find any evidence for an additional contraction factor or difference

10 June 07

Try a simpler fit to $Q_h - Q = f(Q_h, Q/A_i)$



$z = b(x-a)^c$, $x \to a$ $\quad X = Q_h \cos\theta + Q/A_i \sin\theta$

$-a_1(X-a_0)^{a_2}$ $\quad X = Q_h \cos a_3 - Q/A_i \sin a_3$

10 June 07

TC-3D ← jn0804a.wk4

fit user1.udf to $x = Q/A_i$, $y = Q_h$, $z = Q_h - Q$

$z = a + b\exp(c(f_1 - d))$

$f_1 = x\cos\theta - y\sin\theta$ $z = a0 + a1\exp(a2(f1 - a3))$

$r^2 = 0.4408$ $a = -0.0018664428$ $b = -0.206765$

$c = 3.908502$ $d = 2.1502935$ $e = 0.1841908$

Fitted $\varepsilon_u = 0.10258$

fit user2.udf $r^2 = 0.49188$ Fitted $E_u = 0.097714$

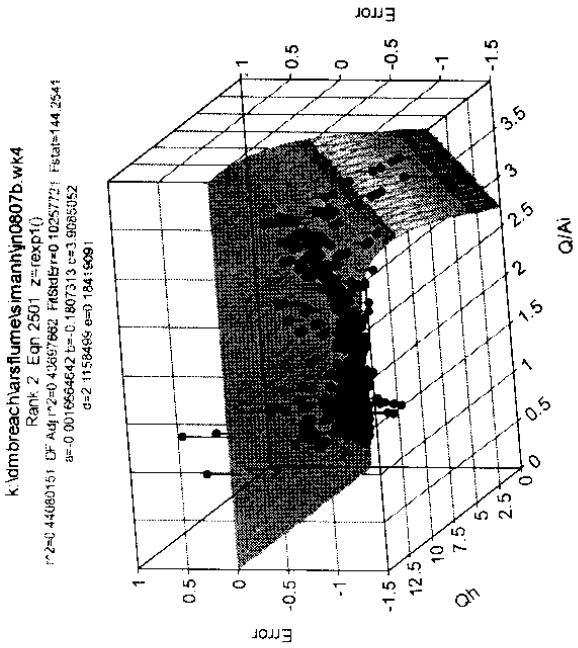
$a = 1.6487645$ $b = 1.3381208$ $c = 0.1966584$

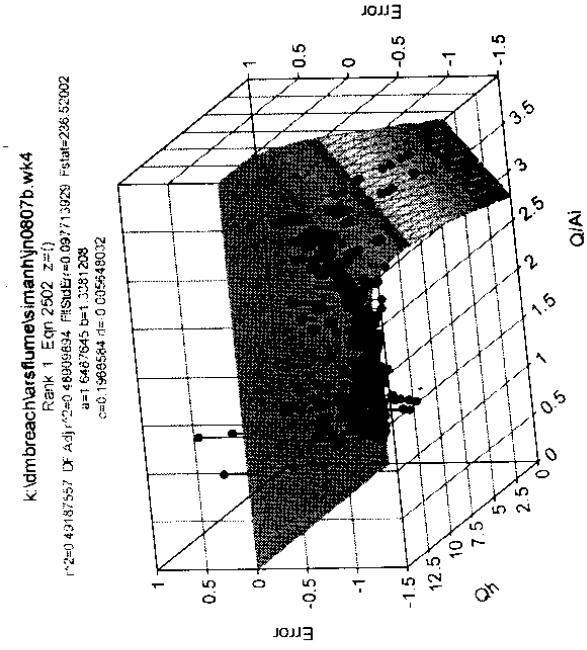
$d = -0.00564803 2$

$f_1 = x\cos c - y\sin c$ $f_2 = d - b\cdot|f_1 - a|^2$

$z = if(f_1 \geq a, f_2, else\ d)$

Try $x = V_i = Q_h/A_i$, $y = Q_h$ ← won't fit user equations





10 June 07

for user1: $f1 = \frac{Q}{A_i} 0.983085 - 0.183151\, Q_h$

$Q_h - Q \simeq -0.001666 - 0.2068 \exp(3.908502\,(f1 - 2.1503))$

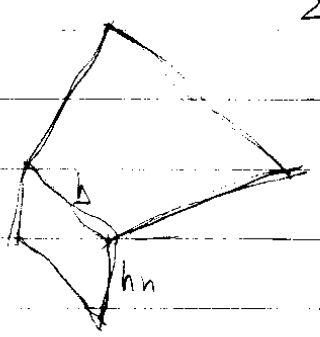
$\simeq -0.011666 - 0.2068 \exp\left(3.84239 \frac{Q}{A_i} - 0.715847\, Q_h - 8.47045\right)$

Only an implicit solution

Nevertheless for some value of Q_h and range of $Q/A_i > V_0$ $\quad Q_h - Q \propto -\frac{Q^2}{A_i^2}$

$Q_h \propto Q - \frac{Q^2}{A_i^2} \qquad Q^2 - A_i^2 Q - A_i^2 Q_h \propto 0$

$Q \propto \frac{-A_i^2 \pm \sqrt{A_i^4 + 4A_i^2 Q_h}}{2} = \frac{A_i^2 (A_i^2 + 4Q_h)^{1/2} - A_i^2}{2}$



$\frac{A_i}{b\, h_h} = \frac{\cancel{b}(ms + h_e) h_e (1 + mu^2)^{1/2}}{\cancel{b} \cdot h_h} =$

$\frac{A_i}{A_i + b \cdot h_h} \qquad \frac{h_e^2 + A_i}{A_i + h_e^2 + b \cdot h_h}$

simani1.for

Modify simanfc0.for add ai(nd) to common/r1/

calculate $a_i(i) = (b_i + ms_i \cdot he_i)(mu_i^2 + 1)^{1/2} he_i$

$r = (w) = a_{i_i} / (a_i + b \cdot h_h)$ jn1007a $\xleftarrow{\text{FITD0}}$ weirdat1

$$\text{FITD0} \quad \frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left[D_2 + \frac{D_3}{1 + (r/D_4)^{D_5}}\right] \frac{h_e \cdot ms}{b} + \left[D_6 + \frac{D_7}{1 + (r/D_8)^{D_9}}\right] \left[\frac{h_e^2}{b^2}(ms^2 + mu^2)\right]^{D_{10}}$$

fopt = 0.1981

mean err = -0.031562 std err = 0.3450 rel err = 0.09333

std err = 0.08741 $\quad D_1 = 0.45702 \quad D_2 = 0.33195$

$D_3 = -0.29267 \quad D_4 = 0.70317 \quad D_5 = 20.00 \quad D_6 = -0.36179$

$D_7 = 0.83426 \quad D_8 = 0.96876 \quad D_9 = 8.1099 \quad D_{10} = 0.31271$

11 June 07

~~simani0.for~~

~~Modify simani1.for, use FITD0 but change to~~

~~$r = h_e^2/(h_e^2 + d(11)\cdot b\cdot h_h)$~~

~~simanh9.for~~ rewriteao.for

Use rewriteao.for to complete set of weirdat files: weirdat0.prn – all 8 & 32 inch data

weirdat1.prn – all 8 & 32 inch data plus 16-inch data for smaller values of ms & mu

weirdat2.prn – all 16-inch data

weirdat3.prn – all 8, 16 & 32-inch data

simanh9.for $r = h_e^2/(h_e^2 + b\cdot h_h)$ 979,763

jn1107a $\xleftarrow{\text{FITD0}}$ weirdat2, new iseeds, same initial D_i & limits as 8 Jan 07 for jn0807b run, $lb_i = -20$, $i = 3,6,7$

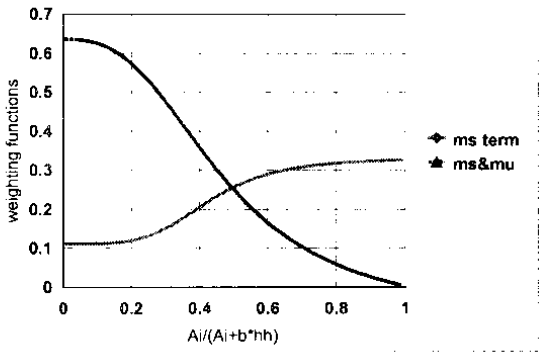
fopt = 0.0862876 mean err = 0.0015848 ~~std err~~ std err = 0.16157

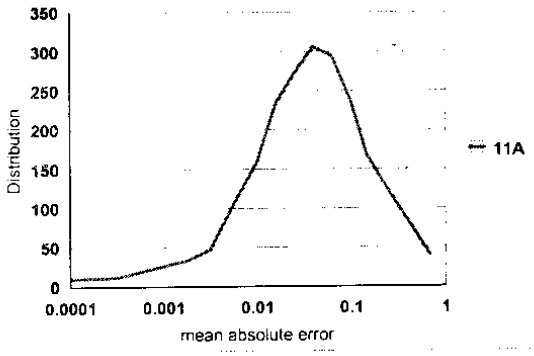
~~std rel err~~ rel err = 0.0468630 std rel err = 0.0525286

$D_1 = 0.46351$, $D_2 = 0.33285$ $D_3 = -0.22188$ $D_4 = 0.42935$

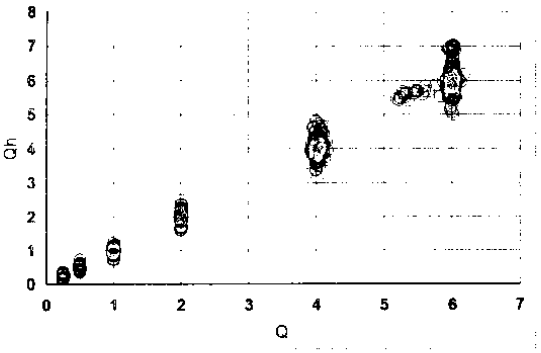
$D_5 = 4.2594$ $D_6 = -0.077826$ $D_7 = 0.71359$ $D_8 = 0.47206$

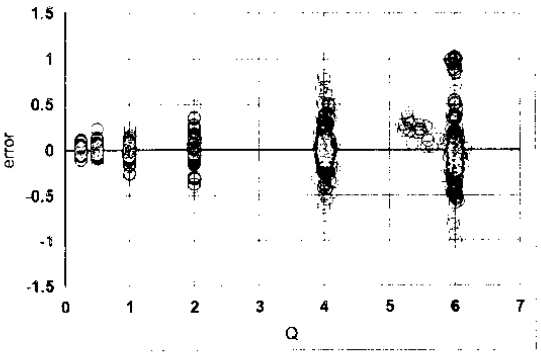
$D_9 = 2.7346$ $D_{10} = 0.37915$





11 June 07





simanh9.for

jn1102b ← FITDØ weirdat3 new iseeds, 350, 339

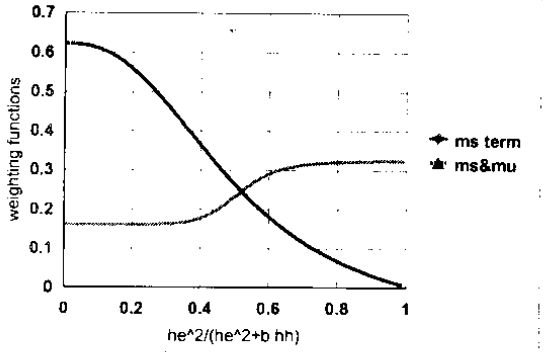
same I.C. fopt = 0.0844181 mean err = 0.0015961

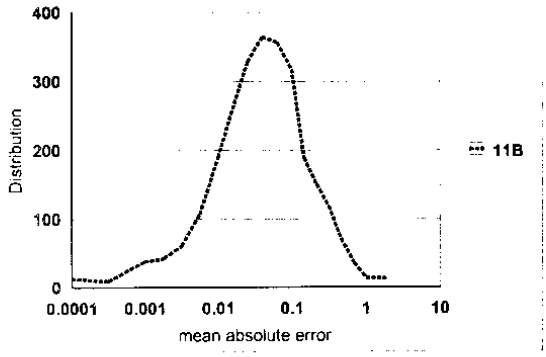
std err = 0.161714 rel err = 0.0490745 std rel err = 0.0593504

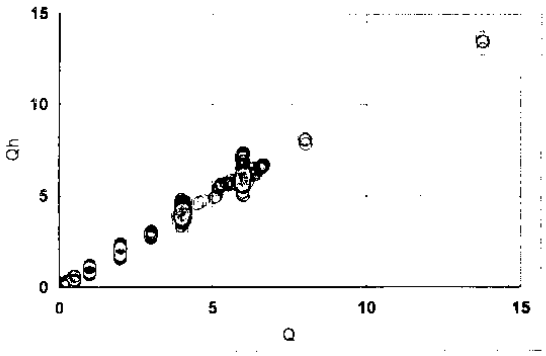
D_1 = ~~0.0~~ 0.46342 D_2 = 0.32459 D_3 = -0.16306 D_4 = 0.51441

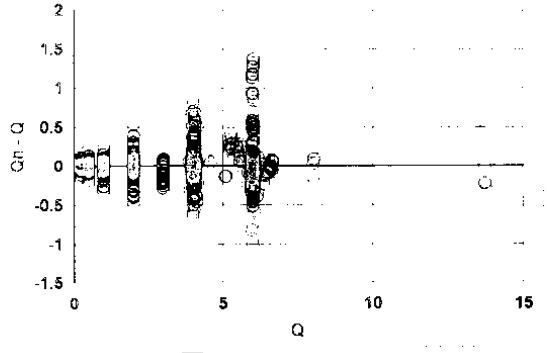
D_5 = ~~0.51441~~ 8.6838 D_6 = -0.10813 D_7 = 0.73077 D_8 = 0.50789

D_9 = 2.5213 D_{10} = 0.38428









11 June 07

siman ~~h9~~ iz.for

Modify siman h9.for to 6 parameters for FIT1

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 \left(\frac{h_e}{h_u + h_e}\right)^{D_2} \left(\frac{h_e}{h_h + h_e}\right)^{D_3} \left(\frac{h_e}{b}\right)^{D_4} \cos^{D_5}\phi \sin^{D_6}\theta$$

jn1107c ← weirdat3.prn

$v_1 = h_e,\ v_2 = h_u,\ v_3 = h_h,\ v_4 = b,\ v_5 = \phi,\ v_6 = \theta$

IC: leave iseeds the same $D_1 = 0.67$, $D_2 = D_3 = D_4 = D_5 = D_6 = 1$

$D_1 > 0$, $-20 \le D_i \le 20$ otherwise

fopt = 0.393648 mean err = 0.0227529

std err = 0.508581 rel err = 0.233086 std rel err = 0.224798

---

12 June 07

D. Temple eq. 20

$$Q = \left\{ \frac{2g}{C_1} \left[C_2 C_3 h_e (b + C_3 h_e \tan\phi) \right]^2 h_e \left[1 - C_3 \left(1 - \frac{C_4}{2}\right) \right] \right\}^{1/2}$$

Replace $\frac{1}{C_1}\left[1 - C_3\left(1 - \frac{C_4}{2}\right)\right]$ by C_1 to get

$$Q = \left\{ C_1 2g h_e \left[C_2 C_3 h_e (b + C_3 h_e \tan\phi) \right]^2 \right\}^{1/2}$$

$$= \left\{ C_1 2g \left[C_2 C_3 b h_e + C_2 C_3^2 h_e^2 \tan\phi \right]^2 \right\}^{1/2}$$

Replace $C_1 C_3^2 C_2^2$ by C_1 to get

$$Q = \left\{ C_1 2g \left[b h_e + C_3 h_e^2 \tan\phi \right]^2 h_e \right\}^{1/2}$$

~~Replace $\sqrt{\ }$ by C_1 to get~~

Replace $(C_1 2)^{1/2}$ by C_1 to get

C_3 C_2

12 Jun 07

$Q = C_1\sqrt{g}\,h_e\left[b h_e + C_2 h_e^2 \tan\phi\right]$

Well, it's his theory, let him make it work.

---

simani3.for

Modify simanh2.for & FITD3

$$\frac{Q}{b\sqrt{g}h_e^3} = D_1 + \left[D_2 + \frac{D_3}{1+(r/D_4)^{D_5}}\right]\frac{h_e m_s}{b} \qquad \text{(FITD3)}$$

$$+\left[D_6 + \frac{D_7}{1+(r/D_8)^{D_9}}\right]\left[\frac{h_e^2}{b^2}(m_s^2+m_{cl}^2)\right]^{D_{10}}$$

$$r = \frac{h_e^2}{h_e^2 + D_{11}\, b\cdot h_h + D_{12}\, a_i}, \qquad a_i = (b+m_s h_e)(1+m_{cl}^2)^{1/2} h_e$$

iseed = 930,252 Initial: $D_1 = 0.463$, $D_2 = 0.325$, $D_3 = -0.163$

$D_4 = 0.524$, $D_5 = 8.68$ $D_6 = -0.108$ $D_7 = 0.731$ $D_8 = 0.588$

$D_9 = 2.52$ $D_{10} = 0.384$ $D_{11} = 1$, $D_{12} = 0$

$ub_i = 20$ $lb_i = 0.00001$ except $lb_i = -20$, $i = 3, 6, 7$,

$lb_i = -5$, $i = 11, 12$ jn1207a ← coeirdat1

NO GOOD — completely insensitive to the values of D_{12} which fluctuated wildly & threw off the rest of the calculation

$\Rightarrow$ fopt = 0.5247

Run again for $ub_{10} = 1.0$ $r = \dfrac{h_e^2 + D_{12} a_i}{h_e^2 + D_{11} b\cdot h_h}$ $-5 \le D_{11,12} \le 5$ same files

NO GOOD $D_{10} \to 1$, Insensitive to D_4, D_5 & D_{12}

fopt = 0.5310

Remove D_{12} & try again for $0 \le D_{11} \le 5$, Run again, same files. Still insensitive to D_4 & D_5, $D_{10} \to 1$ fopt = 0.526

NO GOOD

12 June 07

simani3.for

~~Drop back to 10 parameters to double check~~

Had $b \cdot h_e$ instead of $b \cdot h_h$ – go back to

$$r = \frac{h_e^2}{h_e^2 + D_{11} b \cdot h_h + D_{12} a_i}$$ & try again, same files

$0 < D_{10} \le 1$, $0 < D_8 < 5$, $-5 < D_{12} < 5$

Starts off $f_{opt} \simeq 0.0872$ this time

→ $f_{opt} = 0.074948$, mean err $= -0.0253$ std err $= 0.1373$

$\overline{\text{rel err}} = 0.057064$ std rel err $= 0.079851$

Not as good, but little different from j0807a or jn0807b

D_{12} still jumping around w/ poor sensitivity / $D_{11} = 0.87122$, $D_{12} = -1.6946$

jn1207b $\xleftarrow{\text{FITD3}}$ w/ $r = \dfrac{h_e^2 + D_{12} a_i}{h_e^2 + b \cdot h_h \cdot D_{11}}$ weird at 1

Insensitive to D_{12}, $f_{opt} = 0.1184$ NO GOOD

Rerun w/ 11 parameters: $r = h_e^2 (h_e + D_{11} b \cdot h_h)$ same files

$10^{-5} \le D_{11} \le 5$ $f_{opt} = 0.0748762$ mean err $= -0.0244404$

std err $= 0.137202$ $\overline{\text{rel err}} = 0.0573185$ std rel err $= 0.0799100$

$D_1 = 0.46313$ $D_2 = 0.31610$ $D_3 = -0.10714$ $D_4 = 0.58668$

$D_5 = 7.2021$ $D_6 = -0.12627$ $D_7 = 0.70588$ $D_8 = .52919$

$D_9 = 2.3439$ $D_{10} = 0.37603$ $D_{11} = 1.2389$

---

13 June 07

simani4.for

FITD4

$$\hat{Q} = \frac{\hat{Q}}{\sqrt{g h_e^3}} = \left(\overset{D_1}{a_0} + \overset{D_2}{a_1}\phi + \overset{D_3}{a_2}\theta + \overset{D_4}{a_3}\phi^2 + \overset{D_5}{a_4}\theta^2 + \overset{D_6}{a_5}\phi\theta\right)$$

$$+ \left(\overset{D_7}{b_0} + \overset{D_8}{b_1}\phi + \overset{D_9}{b_2}\theta + \overset{D_{10}}{b_3}\phi^2 + \overset{D_{11}}{b_4}\theta^2 + \overset{D_{12}}{b_5}\phi\theta\right)\frac{h_e}{b}\left(ms^2 + mu^2\right)^{1/2}$$

13 June 07

Siman i4.for

jn1307a $\xleftarrow{\text{FITD4}}$ weirdat (~~16~~ 32 & 8 all inch data)

$D_i = 10^{-5}$ except $D_1 = 0.437$, $D_7 = 0.731$, $lb_i = -20$, except $lb_i = 0$, $i = 1, 7$, $ub_i = 20$ NG fopt too large, stops early

Divide values from 12 July 07 by $\sqrt{32}$ & try again:

~~Ini: $D_1 = 0.69$, $D_2 = .02$ $D_3 = -.062$ $D_4 = -.053$ $D_5 = .0055$ $D_6 = .044$ $D_7 = 1.3$ $D_8 = .06$ $D_9 = -.3$ $D_{10} = .004$ $D_{11} = .017$ $D_{12} = 0.21$~~ Still bombs Found error in SUB FIT, try again Still bombs. Take out forgotten penalty for $D_6, D_7 \neq 1$ Still bombs. ~~Add ms factor to 1st terms of eq.~~ Set all $D_i = 0$ except $D_1 = 0.69$, $D_2 = 1.3$. Multiply 1st term (c1) by ms & try again. Still bombs. Multiply only $D_2 - D_6$ by ms Still bombs. Um_i are dropping to fast and fopt is huge no uphill jumps are being accepted. Change lb, ub range to ± 5: Mistake in FIT - $D_2 * D_4$ and $D_8 * D_{10}$ Fix & ~~try again~~ take out factor of ms & try again, NG Fix another error in FIT & try again. Works

fopt = 0.735659 mean err = -0.04999 std err = 0.790

rel err = 0.2975 std rel err = 0.2144 $D_1 = 0.12989$

$D_2 = -2.1411$ $D_3 = 2.4040$ $D_4 = 2.4065$ $D_5 = 4.8804$

$D_6 = -1.8847$ $D_7 = 0.39506$ $D_8 = 0.12543$ $D_9 = -0.41239$

$D_{10} = -.36451$ $D_{11} = -3.9205$ $D_{12} = 1.4509$

jn1307b $\xleftarrow{\text{FITD4}}$ weirdat2 $-20 \le D_i \le 20$ except $D_1, D_7 > 0$

Initial $D_1 = 0.13$, $D_7 = 0.4$ → fopt = 0.605170 mean err = 0.04487

~~rel err~~ std err = 0.69805 ~~std~~ rel err = 0.27881 std rel err = 0.22218

13 June 07

~~jn1307b~~ jn1307b (cont'd)

$D_1 = 1.3363$, $D_2 = 0.18038$ $D_3 = -0.65839$ $D_4 = -0.12152$

$D_5 = 0.088661$ $D_6 = 0.052464$ $D_7 = .58036e\text{-}8$ $D_8 =$

-0.11894 $D_9 = -0.80515$ $D_{10} = 0.11428$ $D_{11} = 0.4002$

$D_{12} = 0.34252$ $f_{opt} = 0.605170$

Try again with new iseed = 732, 63, $D_i = 0$ except $D_1 = 3.5/\sqrt{32}^{0.62}$

$D_7 = 2.5/\sqrt{32}^{0.94}$ $-10 \le D_i \le 10 \xrightarrow{\text{FITD4 weirdat2}}$ jn1307c

$f_{opt} = 0.604834$ mean en = 0.0436807 std en = 0.6979

rel en = 0.278208 std rel en = 0.2222 n = 2281

$D_1 = 1.3579$ $D_2 = 0.16370$ $D_3 = -0.71973$ $D_4 = -0.11557$

$D_5 = 0.11890$ $D_6 = 0.062072$ $D_7 = -0.011013$ $D_8 = -0.11634$

$D_9 = -0.76732$ $D_{10} = 0.10982$ $D_{11} = 0.38086$ $D_{12} = 0.33726$

jn1307d ~~FITD4~~ FITD5 weirdat0

$$\frac{Q}{b\sqrt{g h_0^3}} = D_1 + \left[D_2\phi + D_3\theta + D_4\phi^2 + D_5\theta^2 + D_6\phi\theta\right]\frac{h_e}{b} + \left[D_7 + D_8\phi + D_9\theta + D_{10}\phi^2 + D_{11}\theta^2 + D_{12}\phi\theta\right]\frac{h_e}{b}\sqrt{m_s^2 + m_{cc}^2}$$

FITD5 Same IC, but iseed = 4908, 914

$f_{opt} = 0.666104$ mean en = 0.0410617 std en = 0.73692

rel en = 0.30564 std rel en = 0.21357

$D_1 = 1.0816$ $D_2 = -0.35850$ $D_3 = -0.34645$ $D_4 = 0.18449$

$D_5 = -0.037446$ $D_6 = 0.52007$ $D_7 = -0.016212$ $D_8 = 0.035076$

$D_9 = -0.45677$ $D_{10} = 0.036122$ $D_{11} = 0.055594$ $D_{12} = 0.19390$

NOT REPRODUCING 2001 RESULTS. WHY?

Because it was limited to $h_h = 1$ data

13 June 07

jn1307e $\xleftarrow{\text{FITD4}}$ 16rawhh1 by simani4.for

fopt = 0.0717173 mean err = -0.0016687 std err = 0.108065

$\overline{\text{rel err}}$ = 0.0457932 $\overline{\text{std rel err}}$ = 0.0495745

D_1 = 0.68665 D_2 = 0.20259 D_3 = -0.037235 D_4 = -0.20065

D_5 = -0.028911 D_6 = 0.041575 D_7 = 0.44260 D_8 = -0.078288

D_9 = -0.46517 D_{10} = 0.11677 D_{11} = 0.083613 D_{12} = 0.26533

simanh9.for

jn1307f $\xleftarrow{\text{FITD0}}$ raw16hh1 Not ~~very~~ as sensitive to D_4 & D_5

fopt = 0.0638344 mean err = 0.010631 std err = 0.107001

$\overline{\text{rel err}}$ = 0.0416262 std rel err = 0.0441668

D_1 = 0.54451 D_2 = 0.30446 D_3 = -0.22370 D_4 = 0.41412

D_5 = 1.0802 D_6 = -0.46195 D_7 = 1.0154 D_8 = 0.72504

D_9 = 1.7904 D_{10} = 0.49280

---

14 June 07

FIT D5

$$\frac{\hat{Q}}{b\sqrt{g h_e^3}} = D_1 + D_2 r + D_3 r^2 + \left[D_4 + \frac{D_5}{1+(r/D_6)^{D_7}}\right]\frac{h_e\, ms}{b} + \left[D_8 + \frac{D_9}{1+(r/D_{10})^{D_{11}}}\right]\left[\frac{h_e^2}{b^2}(ms^2+mu^2)\right]^{D_{12}}$$

simani5.for modify simanh9.for to FITD5

Calculate $C1 = D_1 + D_2 r + D_3 r^2$ if $C1 < 0$ rel = rel - 10·C1

$C3 = D_4 + D_5/(1+(r/D_6)^{D_7})$ if $C3 < 0$ rel = rel - 10C3

$C5 = D_8 + D_9/(\cdots)$ if $C_5 < 0$, $C_5 = 0$

$D_1 > 0$, $D_6 > 0$, $D_{10} > 0$, $D_{12} > 0$, otherwise ~~$-5 \le D_i < 5$~~

$-10 \le D_i < 10$

14 June 07

simanis.for (cont'd)

jn1407a ← FITD5 ← weirdat1 INITIAL

$D_1 = 0.463$ $D_2 = 10^{-4}$ $D_3 = 10^{-4}$ $D_4 = .325$ $D_5 = -.163$

$D_6 = .574$ $D_7 = 8.68$ $D_8 = -.108$ $D_9 = .73$ $D_{10} = .508$

$D_{11} = 2.52$ $D_{12} = .384$ NO GOOD

→ fopt = 0.1557, D_6 & D_7 → 1, Insensitive to D_{11}

Competing coefficients

Change FITD5 front end to $D_1 + D_2 r^1 + D_3 r^3$ +

try again with same files but iseed = 787,400 NG

Results nearly the same — change to $D_1 + D_2 r^2 + D_3 r^4$

& run again — NG, same general result. Delete files

---

14 June 07

CAN CUBIC SPLINES MAKE A BETTER FIT?

Richard L. Burden & J. Douglas Faires, Numerical Analysis 3rd Ed, Prindle, Weber & Schmidt, Boston, 1978-85. Algorithm 3.4 on p 122 – unclamped splines

For each weighting function, $w1(r)$, $w2(r)$, $0 \le r \le 1$, $r = h_e^2/h_e^2 + bhh$, set six points, $r = 0, 0.2, 0.4, 0.6, 0.8, 1.0$ or 7 points, $r = 0, 1/6, 1/3, 1/2, 2/3, 5/6, 1$ and let simulated annealing vary the value of the weight, $w1(r_i)$, $w_2 r_i$, $i = 0, 5$ or 6

Then fit the points, $(r, w1)_i$, $(r, w2)_j$, with cubic splines,

Then calculate all of the weights, $w1_j$, $w2_j$, $i = 1, n$, and apply them to the fitting function

19 Jun 07

$$\left[\frac{Q}{b\sqrt{g h_e^3}}\right]_j = \overset{0.46342}{\cancel{D_1}} + w_{1j}\frac{h_{ej}\cdot ms_j}{b_j} + w_{2j}\left[h_e/b\right]^{0.19214}(ms^2+mu^2)^{0.38428}$$

FITD6

taking the D_1, & D_{10} constants from the fit of jn1107b

$\alpha \to e \quad l \to p$

subroutine fcn (nd, d, rel) $\quad x_{j+1} - x_j = h$

implicit real*8 a1(nd), a2(nd), b1(nd), b2(nd),

\+ c1(nd), c2(nd), d1(nd), d2(nd), d(nd), u(nd), p(nd),

\+ z(nd), x(nd), e(nd), u(nd) ← common /c1/

nx = nd/2-1 (nd has to be even $\quad$ d goes from 1 to nd

← h = 1.d0/dble(nx)

do i = 0, nx $\quad$ a1 goes from 0 to nx

a1(i) = d(i+1) $\quad$ x(i) = dble(i)*h

a2(i) = d(nx+i+1)

end do $\quad$ i = 0, nx : e1(i) = e(i)

e2(i) = e(nx+i+1)

do i = 1, nx-1

e(i) = 3.d0*(a1(i+1) - 2.d0 a1(i) + a1(i-1))/h

e(nx+i+1) = 3.d0*(a2(i+1) - 2.d0*a2(i) + a2(i-1))/h

end do

p(0) = 1.d0 ; p(nx+1) = 1.

u(0) = 0.d0 ; u(nx+1) = 0.d0

z(0) = 0.d0 ; z(nx+1) = 0.d0

do i = 1, nx-1

p(i) = (4.d0 - u(i-1))*h ; p(nx+1+i) = (4.d0 - u(nx+i))*h

u(i) = h/p(i) $\quad$ u(nx+1+i) = h/p(nx+1+i)

z(i) = (e(i) - h*z(i-1))/p(i)

z(nx+1+i) = (e(nx+1+i) - h*z(nx+i))/p(nx+1+i)

end do

19 Jun 07

(subroutine fcn) $\alpha \to e$ $l \to p$

```
p(nx) = 1.d0      p(nx+1+nx) = 1.d0
z(nx) = 0.d0      z(nx+1+nx) = 0.d0
c1(nx) = 0.d0     c2(nx) = 0.d0
do j = nx-1, 0, -1
   c1(j) = z(j) - u(j) * c1(j+1)
   c2(j) = z(nx+1+j) - u(nx+1+j) * c2(j+nx+1)
   b1(j) = (a1(j+1) - a1(j)) / (3.d0 * h * (1 - c1(j+1) - 2.d0 * c1(j)))
   b2(j) = (a2(j+1) - a2(j)) / (3.d0 * h * (1 - c2(j+1) - 2.d0 * c2(j)))
   d1(j) = (c1(j+1) - c1(j)) / (3.d0 * h)
   d2(j) = (c2(j+1) - c2(j)) / (3.d0 * h)
enddo
+ gr = 32.174d0, ..., std = 0.d0, ~~dummy = 0.d0~~
do i = 1, np
   r(i) = he(i) * he(i) / (he(i) * he(i) + b(i) * hh(i))
   j = int(r(i)/h) ?  xx = r(i) * x(j) ?
   w1 = a1(j) + xx * (b1(j) + xx * (c1(j) + xx * d1(j)))
   w2 = a2(j) + xx * (b2(j) + xx * (c2(j) + xx * d2(j)))
   qpih = 0.46342d0 + w1 * hb(i) * ms(i)
+        + w2 * (hb(i) ** 0.19214d0) -
+            * ((mu(i) * mu(i) + ms(i) * ms(i)) ** 0.38428d0)
...
```

fit

22 June 07

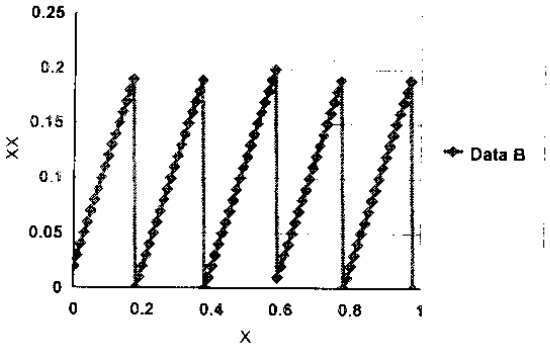
splinetst4.for

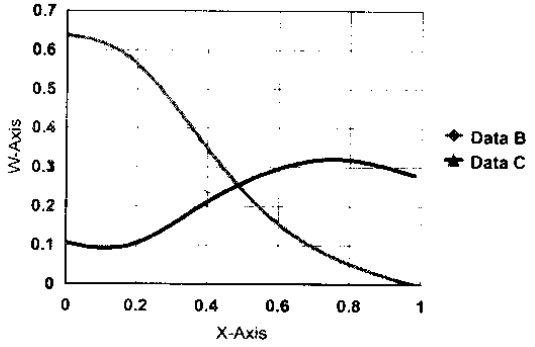
Try out natural cubic spline algorithm from Burden + Faires p 122. Need to separate more arrays into 2, fix errors

splinetst1.for

Fix errors, set y(i), i=1, n = .64, .58, .37, .17, .06, 0., 0.11, 0.1, 0.2, 0.29, 0.32, 0.28 Got it working good

n=12





23 Jun 07

simani6.for spline-fit weighting functions, n=12

$$\frac{Q}{\rho_N g h_e^3} = 0.46342 + \frac{w1\, h_e\, ms}{b} + w2\left(\frac{h_e}{b}\right)^{0.19214}\left(ms^2+mu^2\right)^{0.38428}$$

w1, w2 = spline fits to $D_1 - D_{12}$, rw = 0, 0.2, 0.4, 0.6, 0.8, 1

rw =	0.0	0.2	0.4	0.6	0.8	1	iseed → 439,575
D_i =	0.62	0.56	0.36	0.18	0.07	0.0	i = 1, 6 } initial
D_i =	0.15	0.15	0.2	0.29	0.32	0.32	i = 7, 12 }

$lb_i = 0$ $ub_i = 1.5$, but w1>0, w2>0

jn2307a ← weirdat1 NG got into a high fapt trap & didn't converge properly. Put slightly different constraint on fapt if $\hat{q} - q > 1$ or $\hat{q} - q > 2$ ⇒ *5 and *10 set $ub_i = 1$

try again after fixing call error in fcn

23 June 07

simanib (cont'd)

NG - gets into a trap, starting at T= 0.16173 where all the moves are uphill & rejected. Should never happen ~~Add a constraint~~ No wonder - plot of w1 & w2 from jn2307a2 shows very discontinuous functions x() arrays defined as different things in different places & got them mixed up. Use xr( ) for knot positions in rw & x() for simulated annealing search parameters only fopt = 0.12238 mean err = -0.05127 std err = 0.19702 rel err = 0.072362 std rel err = 0.0878337

D_1 = 0.19190 D_2 = 0.52511 D_3 = 0.32852 D_4 = 0.34581

D_5 = 0.28562 D_6 = 0.31701 D_7 = 0.18371 D_8 = 0.26601

D_9 = 0.21653 D_{10} = 0.17642 D_{11} = 0.12126 D_{12} = 0.0029733

jn2307b ← weirdat1 Change fobj ~~back~~ to

~~rel1 = rel1*rel1 when q̂ q > 1 in fcn~~

if(rel1.gt.1.d0) rel1 = (rel1-1.d0)**2+rel1

→ fopt = 0.104374 mean err = -0.031996 std err = 0.200779

rel err = 0.0690245 std rel err = 0.0849348

D_1 = 0.20972 D_2 = 0.51006 D_3 = 0.35348 D_4 = 0.31397

D_5 = 0.30108 D_6 = 0.31631 D_7 = 0.18076 D_8 = 0.27044

D_9 = 0.23935 D_{10} = 0.19982 D_{11} = 0.11232 D_{12} = .0034614

jn2307c ← weirdat1 change iseed & fobj & initial D_i

23 June 07

jn2307c Reverse D_{1-6} & D_{7-12} initial values

xr	0	0.2	0.4	0.6	0.8	1	
D_{1-6}	0.15	0.15	0.2	0.29	0.32	0.32	Initial values
D_{7-12}	0.62	0.56	0.36	0.18	0.07	0.0	

rel1 = $|\hat{Q} - Q|$ only

fopt = 0.101011 mean err = -0.0197 std err = 0.218515

rel err = 0.0669218 std rel err = 0.0829500

D_1 = 0.15982 D_2 = 0.51672 D_3 = 0.29324 D_4 = 0.32217

D_5 = 0.29422 D_6 = 0.31658 D_7 = 0.19608 D_8 = 0.27263

D_9 = 0.27388 D_{10} = 0.19615 D_{11} = 0.11719 D_{12} = 0.0032707

Need to do 14 parameters & let the constants 0.46342 & 0.38428 change & see what happens

---

24 Jun 07

simani7.for

$$\frac{Q}{b\sqrt{g h_e^3}} = D_{13} + \frac{w_1 h_e M_s}{b} + w_2 \left(\frac{h_e}{b}\right)^{D_{14}/2} (mu^2 + ms^2)^{D_{14}}$$

$$w_{1j} = a_{1j} + b_{1j}(r - xr_j) + c_{1j}(r - xr_j)^2 + d_{1j}(r - xr_j)^3$$
$$w_{2j} = a_{2j} + b_{2j}(r - xr_j) + c_{2j}(r - xr_j)^2 + d_{2j}(r - xr_j)^3$$
spline fits

$r = h_e^2 / (h_e^2 + b \cdot hh)$

Initial $D_i, i = 1,12$ the same, $D_{13} = 0.46$, $D_{14} = 0.38$, $lb_i = 0$, $ub_i = 1$

jn2407a ← weirdael fopt = $\frac{1}{np} \sum |\hat{Q} - Q|$

fopt = 0.0994286 mean err = -0.025894 std err = 0.229261

rel err = 0.0671349 std rel err = 0.0835046

24 June 07

sinaani 7, jn 2407a

$D_1 = 0.23592$ $D_2 = 0.47597$ $D_3 = 0.28906$ $D_4 = 0.30562$

$D_5 = 0.29562$ $D_6 = 0.31628$ $D_7 = 0.18427$ $D_8 = 0.27365$

$D_9 = 0.27909$ $D_{10} = 0.20153$ $D_{11} = 0.11283$ $D_{12} = 0.005825$

$D_{13} = 0.45789$ $D_{14} = 0.40157$

jn 2407b

Add two more knots per weight → $D^{w_1}_{1-8}$, $D^{w_2}_{9-16}$, D_{17}, D_{18}

Initial $D_i = 6.3$, $i = 1,8$ $D_9 = 0.18$ $D_{16} = 0.27$ $D_{11} = 6.28$

$D_{12} = 0.26$ $D_{13} = 0.20$ $D_{14} = 0.15$, $D_{15} = 0.08$ $D_{16} = 0.0$

$D_{17} = 0.46$ $D_{18} = 0.40$ || $fopt = 0.0976033$

$mean\ en = -0.02001$ $std\ en = 0.238898$ $ret\ en = 0.0663531$

$std\ ret\ en = 0.0833311$ $D_{17} = 0.45795$ $D_{18} = 0.40574$

$D_1 = 0.48294$ $D_2 = 0.37990$ $D_3 = 0.42294$ $D_4 = 0.26530$

$D_5 = 0.31350$ $D_6 = 0.28599$ $D_7 = 0.29858$ $D_8 = 0.31633$

$D_9 = 0.16965$ $D_{10} = 0.26441$ $D_{11} = 0.28739$ $D_{12} = 0.28390$

$D_{13} = 0.19760$ $D_{14} = 0.16727$ $D_{15} = 0.078574$ $D_{16} = 0.0057428$

jn 2407c

go to 11 knots per weighting functions $D^{w_1}_1 - D_{11}$, $D^{w_2}_{12} - D_{22}$, D_{23}, D_{24}

$fopt = 0.0960298$ $mean\ en = -0.0191493$, ~~$ret\ en$~~ =

$ret\ en = 0.0654018$ $std\ ret\ en = 0.0831315$

$D_1 = 0.42089$ $D_2 = 0.36843$ $D_3 = 0.42492$ $D_4 = 0.36840$

$D_5 = 0.29517$ $D_6 = 0.26623$ $D_7 = 0.31813$ $D_8 = 0.29261$

$D_9 = 0.30600$ $D_{10} = 0.32156$ $D_{11} = 0.31554$ $D_{12} = 0.17382$

$D_{13} = 0.24045$ $D_{14} = 0.27654$ $D_{15} = 0.28889$ $D_{16} = 0.30766$

24 June 07

$D_{17} = 0.23345$ $D_{18} = 0.19426$ $D_{19} = 0.16173$ $D_{20} = 10270$

$D_{21} = 0.057832$ $D_{22} = 0.0053677$ $D_{23} = 0.45878$ $D_{24} = 0.41064$

w2 functional values look "reasonable" but not w1 — too oscillatory.

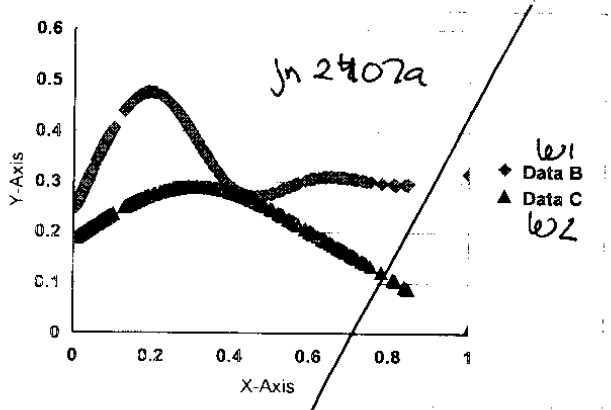
jn2407d ← weirdue1

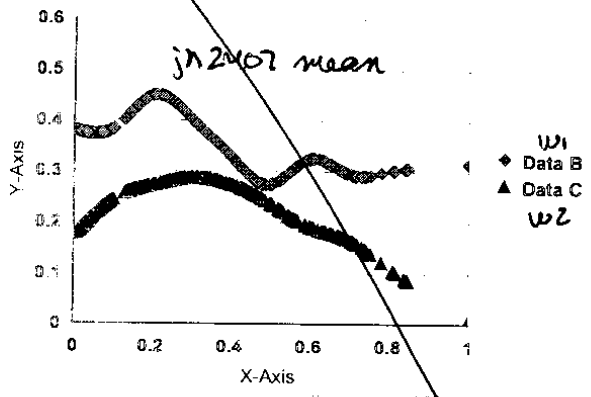
Take out constraint that w1>0, w2>0. Put back

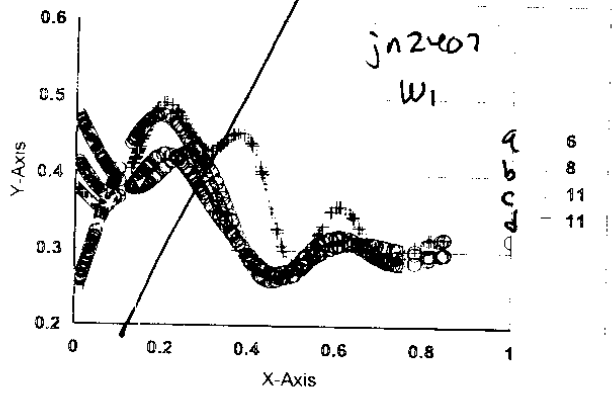
if(rel1.gt.1.d0) rel1 = ~~rel1*rel1 (rel1-1.d0)**2~~ rel1*rel1

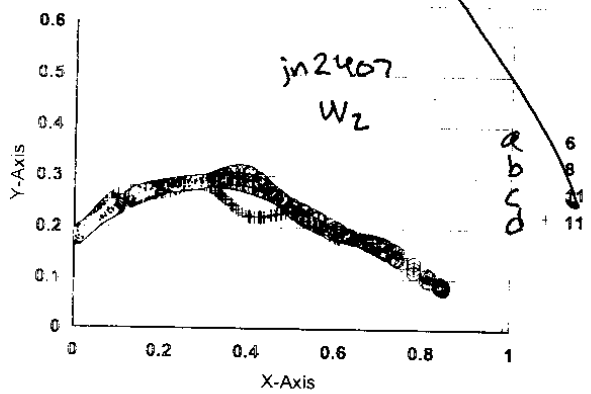
Not much different. Can't see the problem (jn0807b → fopt=0.075 std err=0.14) here fopt=0.103431 std err=0.199823, much worse

Looks a bit like the results for jn0607b, FITC6 (fopt=0.126 std err=0.212) with oscillatory MS weighting term









2 ue jun 07

simani7.for

jn2407e ← weirdat3, 11 knots per weighting function

top τ = 0.109365 mean err = -0.00343768 std err = 0.198841

rel err = 0.0584806 std rel err = 0.0665394

D_1 = 0.25749 D_2 = 0.11186 D_3 = 0.18256 D_4 = 0.18964

D_5 = 0.19734 D_6 = 0.36133 D_7 = 0.36787 D_8 = 0.33260

D_9 = 0.30147 D_{10} = 0.35819

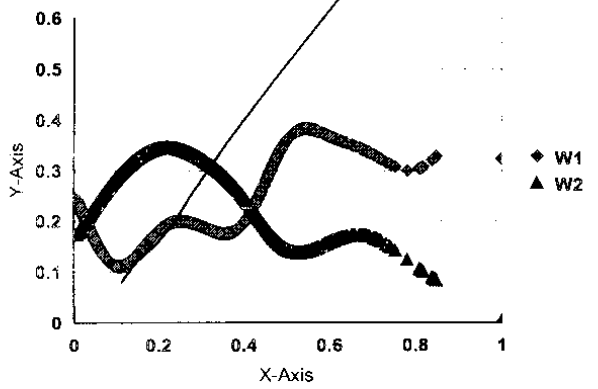
D_{11} = 0.32375 || D_{12} = 0.16571 D_{13} = 0.28661 D_{14} = 0.34521

D_{15} = 0.32373 D_{16} = 0.24658 D_{17} = 0.14473 D_{18} = 0.15944

D_{19} = 0.16864 D_{20} = 0.11254 D_{21} = 0.057903 D_{22} = 0.0051522

D_{23} = 0.45890 D_{24} = 0.37707

Still not good enough. Looks more like the logistic functions than for the other data sets, but not by much



8

25 June 07

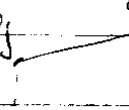
Suppose using splines is not tight enough - allows to much freedom in the fit, or not enough. Try piecewise linear with 11 knots

25 June 07

simani8.for

$$\frac{Q}{b\sqrt{g}he^3} = D_1 + \frac{w_1 he Ks}{b} + w_2\left[\left(\frac{he}{b}\right)^2 (mu^2 + MS^2)\right]^{D_2}$$ ← error in simani7 of $D_{24}/2$ — FITD7

$w_{1j} = a_{1j} + b_{1j}(r - Xr_j)$ $w_{2j} = a_{2j} + b_{2j}(r - Xr_j)$, $Xr_j \le r \le Xr_{j+1}$



$\frac{w - a_j}{r - Xr_j} = \frac{a_{j+1} - a_j}{Xr_{j+1} - Xr_j} = b_j$ In this case $h = Xr_{j+1} - Xr_j = \frac{1}{nx}$

$j = 0, nx$

$D_1, D_2, D_3 = D_{13}$ $D_{14} = D_{24}$ $n = 24$ $nx = 10$

a_{1j} a_{2j}

Found error in simani7 ← had $\left(\frac{he}{b}\right)^{D_{24}/2}$ instead of $\left(\frac{he}{b}\right)^{2 \cdot D_{24}}$

Fixed try again

simani7.for

jn2507a ← weirdat1, n=24, nx=10

fopt = 0.0711695 mean en = -0.0243056 std en = 0.132560

reten = 0.0573977 std rel en = 0.0811073

$D_1 = 0.15940e\text{-}5$ $D_2 = 0.11802$ $D_3 = 0.12258$ $D_4 = 0.24394$

$D_5 = 0.15356$ $D_6 = 0.28916$ $D_7 = 0.17570$ $D_8 = 0.26666$

$D_9 = 0.27667$ $D_{10} = 0.28416$ $D_{11} = 0.31378$

$D_{12} = 0.69869$ $D_{13} = 0.58026$ $D_{14} = 0.58764$ $D_{15} = 0.45340$

$D_{16} = 0.40939$ $D_{17} = 0.25179$ $D_{18} = 0.26116$ $D_{19} = 0.14272$

$D_{20} = 0.099897$ $D_{21} = 0.018354$ $D_{22} = 0.0036917$

$D_{23} = 0.46227$ $D_{24} = 0.37811$ MUCH BETTER

jn2507b ← weirdat3, zone initials

fopt = 0.0789216 mean en = 0.0010426 std en = ~~0.144~~ 0.144579

reten = 0.0475905 std reten = 0.0584653

25 Jan 07

jn2507b (cont'd)

$D_1 = 0.12861$ $D_2 = 0.066283$ $D_3 = 0.12778$ $D_4 = 0.16952$

$D_5 = 0.16349$ $D_6 = 0.29931$ $D_7 = 0.28132$ $D_8 = 0.26054$

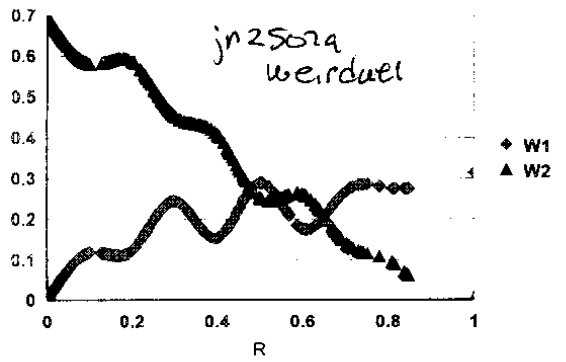
$D_9 = 0.31436$ $D_{10} = 0.28396$ $D_{11} = 0.32178$

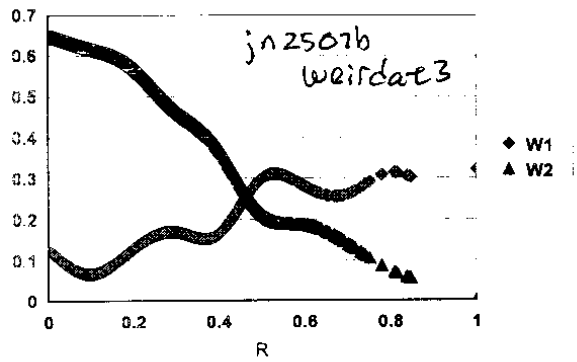
$D_{12} = 0.65161$ $D_{13} = 0.61753$ $D_{14} = 0.57359$ $D_{15} = 0.46780$

$D_{16} = 0.37696$ $D_{17} = 0.21550$ $D_{18} = 0.18728$ $D_{19} = 0.14270$

$D_{20} = 0.076061$ $D_{21} = 0.040433$ $D_{22} = 0.0018133$

$D_{23} = 0.46732$ $D_{24} = 0.38312$





simani8.for

jn2507c ← weirdat3, n=24, nX=10, piecewise linear fit

$D_1 = 0.47$, $D_2 = 0.38$, $D_{3-7} = 0.1$, $D_8 = 0.2$, $D_{9-13} = 0.3$, $D_{14-24} = 0.7$,

0.65, 0.62, 0.60, 0.55, 0.48, 0.35, 0.21, 0.1, 0.05, 0 ameiseed

fopt = 0.0789153 meanen = 0.00114552 stden = 0.145532

reten = 0.0476777 stdreten = 0.0586249

$D_1 = 0.46774$ $D_2 = 0.38609$ $D_3 = 0.10211$ $D_4 = 0.051512$

$D_5 = 0.14455$ $D_6 = 0.16912$ $D_7 = 0.14256$ $D_8 = 0.33384$ $D_9 = 0.27737$

$D_{10} = 0.26252$ $D_{11} = 0.31860$ $D_{12} = .28124$ $D_{13} = .32182$ $D_{14} = .65037$

$D_{15} = .62332$ $D_{16} = .56995$ $D_{17} = .46775$ $D_{18} = .38831$ $D_{19} = .19071$

$D_{20} = .18801$ $D_{21} = .14043$ $D_{22} = .078325$ $D_{23} = .036785$ $D_{24} = .0016544$

25 Jun 07

weirdat4.prn ← 8" data, weirdat5.prn ← 32" data

siman i 8. foc

jn2507d ← 8" data, weirdat4 fopt = 0.0341042

meanen = -0.0122972 stdmen = 0.0657530 reten = 0.0451673

stdreten = 0.0888027 D_1 = 0.44373 D_2 = 0.37009

D_3 = 0.093525 D_4 = .23036 D_5 = .18253 D_6 = .22245 D_7 = .13996

D_8 = .19655 D_9 = .27892 D_{10} = .26029 D_{11} = .31903 D_{12} = .28018

D_{13} = .31548 D_{14} = .61289 D_{15} = .52209 D_{16} = .58065 D_{17} = .98435

D_{18} = .44404 D_{19} = .29707 D_{20} = .20423 D_{21} = .15486 D_{22} = 0.084914

D_{23} = .044871 D_{24} = 0.0093670

jn2507e ← 16" data, weirdat2 fopt = 0.0811220

meanen = -1.645e-4 stdmen = 0.148819 reten = 0.0463442

stdreten = 0.0530886 D_1 = 0.46099 D_2 = 0.38546

D_3 = .12622 D_4 = .054279 D_5 = .14663 D_6 = .16214 D_7 = .18178

D_8 = .35318 D_9 = .33320 D_{10} = .33339 D_{11} = .28825 D_{12} = .82151

D_{13} = .32705 D_{14} = .65852 D_{15} = .63253 D_{16} = .57325

D_{17} = .47985 D_{18} = .36079 D_{19} = .18407 D_{20} = .18429 D_{21} = .19132

D_{22} = .99748 D_{23} = .15439 D_{24} = 0.0044103

jn2507f ← 16" data, again iseed = 514, ~~3051~~ 10 fopt = .0811221

the very same answer — overwrite the data

jn2507f ← 32" data fopt = 0.0943888 meanen = 0.02643

~~reten~~ ~~stdmen~~ = 0.140468 reten = 0.0431101 stdreten = 0.0605567

D_1 = .45671 D_2 = .19966 D_3 = .99985 D_4 = .055092 D_5 = .51062

D_6 = .28e-6 D_7 = .21268 D_8 = .51178 D_9 = .38137 D_{10} = .21517

25 Jan 07

jn2507f (cont'd)

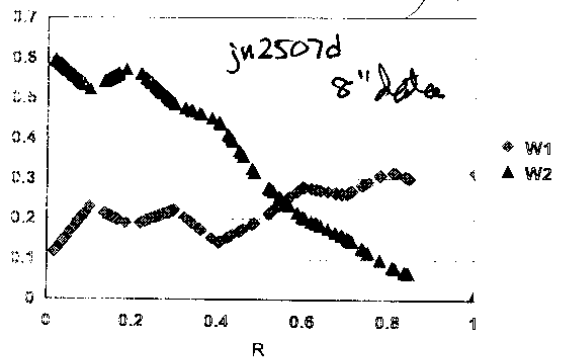
D_{11} = .31284 D_{12} = .70926 D_{13} = .14794 D_{14} = .44212

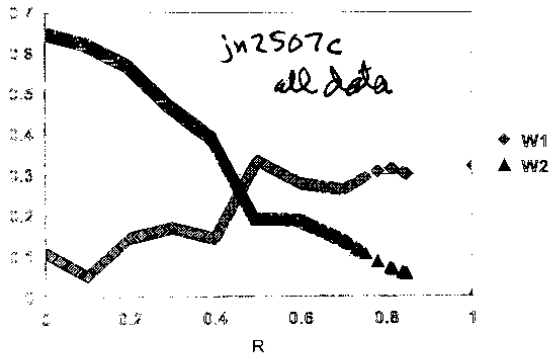
D_{15} = .49129 D_{16} = .64827 D_{17} = .37697 D_{18} = .48897

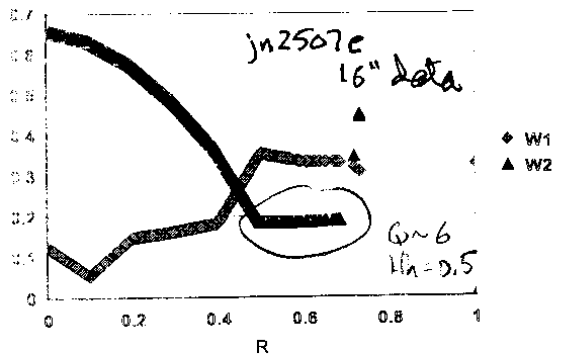
D_{19} = .11058 D_{20} = .55880 D_{21} = .30988 D_{22} = .57458

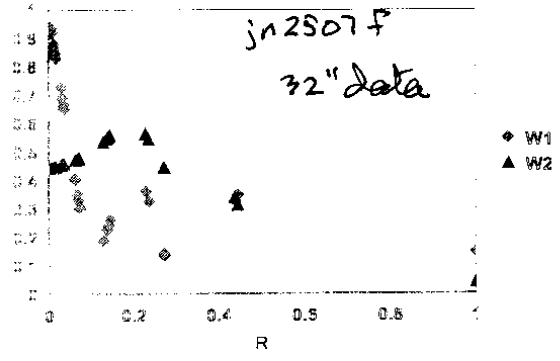
D_{23} = .26083 D_{24} = .041698

26 Jun 07

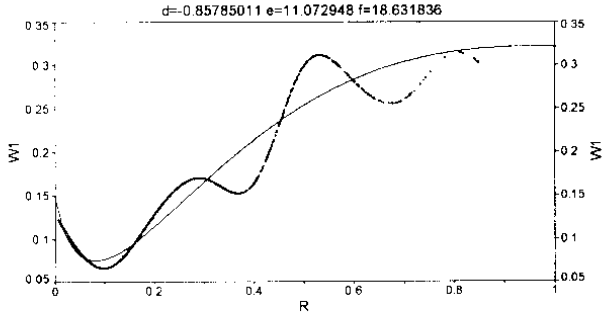




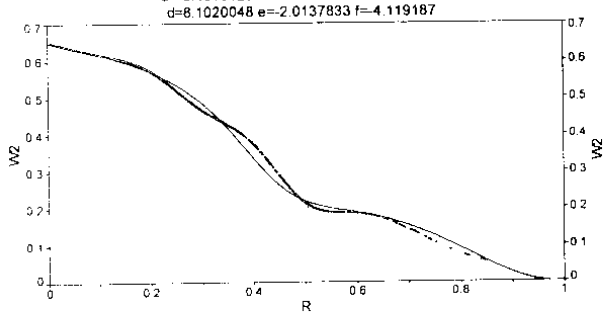




K:\dmbreach\arsflume\simani\jn2507b2.prn
Rank 211 Eqn 7904 y=(a+cx+ex2)/(1+bx+dx2+fx3) [NL]
r2=0.97955154 DF Adj r2=0.97950568 FitStdErr=0.014979727 Fstat=25637.923
a=0.14900646 b=13.733678 c=-0.76657812
d=-0.85785011 e=11.072948 f=18.631836



K:\dmbreach\arsflume\simani\jn2507b2.prn
Rank 2432 Eqn 7104 lny=(a+cx+ex2)/(1+bx+dx2+fx3)
r2=0.99900731 DF Adj r2=0.99900508 FitStdErr=0.0088352982 Fstat=538603.95
a=-0.4313129 b=-4.9000371 c=1.6860997
d=8.1020048 e=-2.0137833 f=-4.119187



26 Jun 07

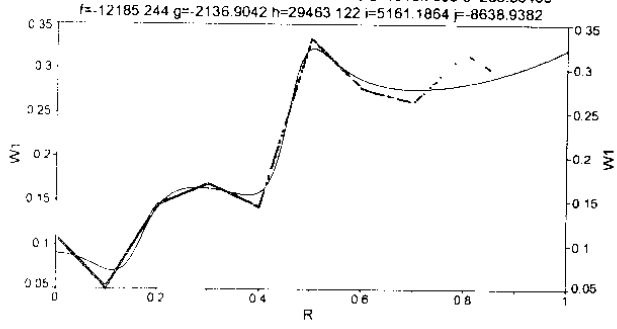
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 43 Eqn 7928 y=(a+cx2+ex4+gx6+ix8)/(1+bx2+dx4+fx6+hx8+jx10) [NL]

r^2=0.99575727 DF Adj r^2=0.99574138 FitStdErr=0.0070086514 Fstat=69678.99

a=0.08987362 b=-51.422134 c=-6.8991115 d=1616.7059 e=265.86433

f=-12185.244 g=-2136.9042 h=29463.122 i=5161.1864 j=-8638.9382



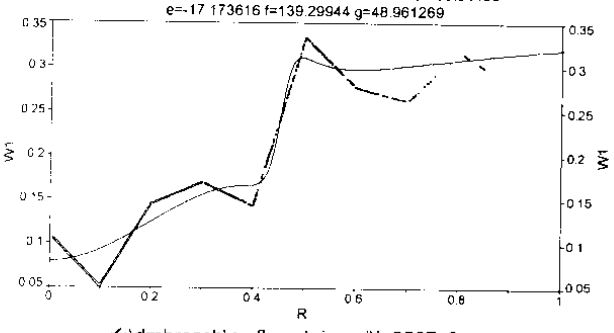
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 2550 Eqn 7925 y=(a+cx2+ex4+gx6)/(1+bx2+dx4+fx6) [NL]

r^2=0.98084487 DF Adj r^2=0.98079473 FitStdErr=0.014883687 Fstat=22829.048

a=0.079825801 b=-3.4655392 c=1.1483332 d=-33.94459

e=-17.173616 f=139.29944 g=48.961269



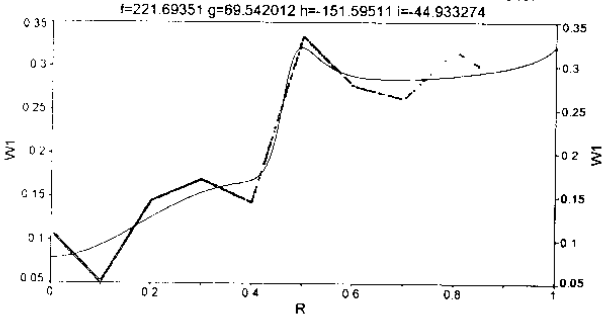
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 71 Eqn 7927 y=(a+cx2+ex4+gx6+ix8)/(1+bx2+dx4+fx6+hx8) [NL]

r^2=0.98170097 DF Adj r^2=0.98163933 FitStdErr=0.014552731 Fstat=17925.035

a=0.079257928 b=-1.5621388 c=1.4629058 d=-53.373773 e=-20.9497

f=221.69351 g=69.542012 h=-151.59511 i=-44.933274



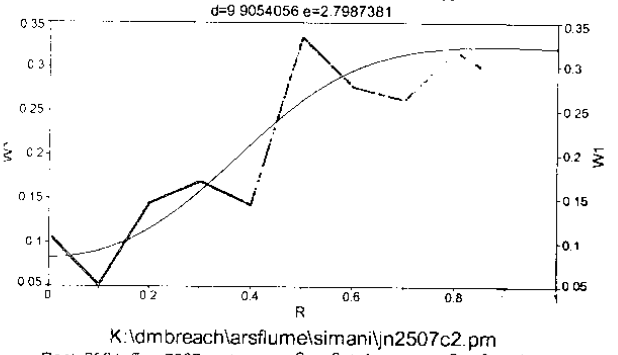
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 2548 Eqn 7923 y=(a+cx2+ex4)/(1+bx2+dx4) [NL]

r^2=0.96527576 DF Adj r^2=0.96521088 FitStdErr=0.020031898 Fstat=18604.028

a=0.082948899 b=0.62951063 c=0.82396033

d=9.9054056 e=2.7987381



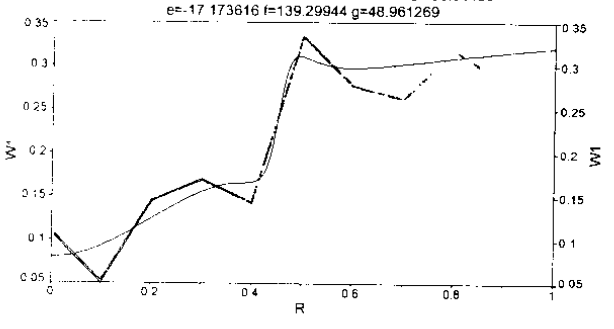
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 77 Eqn 7925 y=(a+cx2+ex4+gx6)/(1+bx2+dx4+fx6) [NL]

r^2=0.98084487 DF Adj r^2=0.98079473 FitStdErr=0.014883687 Fstat=22829.048

a=0.079825801 b=-3.4655392 c=1.1483332 d=-33.94459

e=-17.173616 f=139.29944 g=48.961269



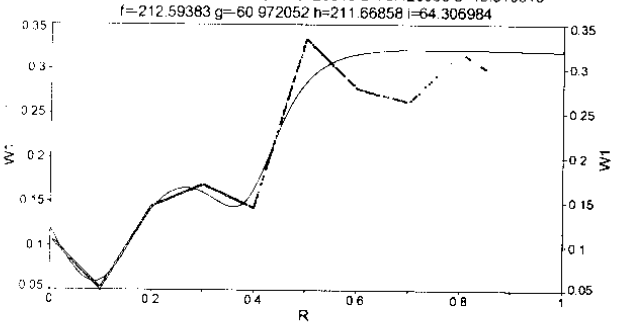
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 2534 Eqn 7907 y=(a+cx+ex2+gx3+ix4)/(1+bx+dx2+fx3+hx4) [NL]

r^2=0.99102823 DF Adj r^2=0.99099801 FitStdErr=0.010189888 Fstat=36907.704

a=0.1192576 b=-12.049509 c=-2.3726343 d=76.420069 e=19.510913

f=-212.59383 g=-60.972052 h=211.66858 i=64.306984



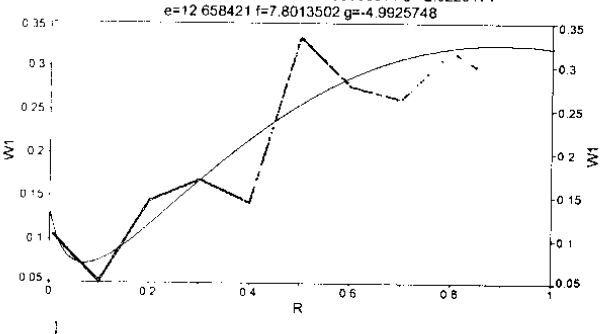
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 220 Eqn 7905 y=(a+cx+ex2+gx3)/(1+bx+dx2+fx3) [NL]

r^2=0.97134053 DF Adj r^2=0.97126551 FitStdErr=0.018205477 Fstat=15110.398

a=0.13248172 b=15.644569 c=-0.58689511 d=-2.0225171

e=12.658421 f=7.8013502 g=-4.9925748



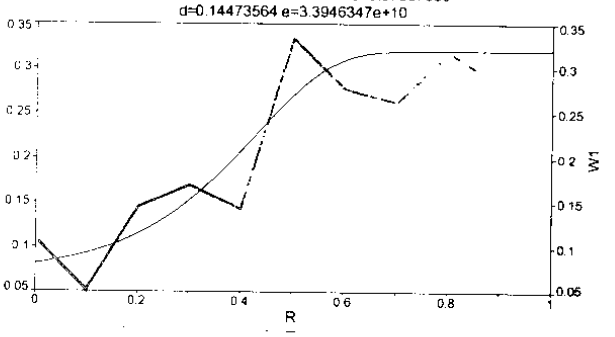
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 2634 Eqn 8092 [AsymSigR] y=a+b(1-(1+exp((x+d)ln(21/e-1)-c)/d))-e)

r^2=0.96529614 DF Adj r^2=0.9652313 FitStdErr=0.020026018 Fstat=18615.348

a=0.068990467 b=0.25084126 c=0.37867996

d=0.14473564 e=3.3946347e+10



26 Jan 07

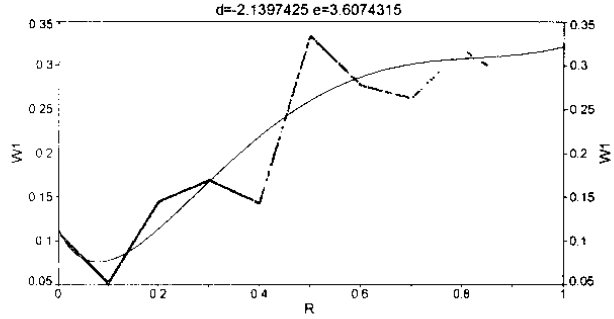
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 533 Eqn 4461 y=a+bx+cx2lnx+dx2.5+ex3

r²=0.97046054 DF Adj r²=0.97040535 FitStdErr=0.018475958 Fstat=21986.888

a=0.11323184 b=-1.2591752 c=-4.059379

d=-2.1397425 e=3.6074315



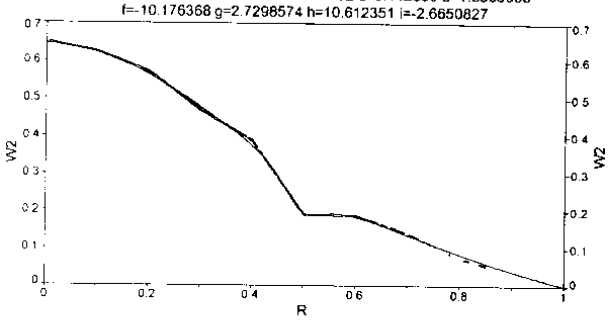
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 29 Eqn 7907 y=(a+cx+ex2+gx3+ix4)/(1+bx+dx2+fx3+hx4) [NL]

r²=0.99989302 DF Adj r²=0.99989266 FitStdErr=0.0029086517 Fstat=3123045.7

a=0.6450077 b=-3.963948 c=-2.5598182 d=6.442893 e=1.8565068

f=-10.176368 g=2.7298574 h=10.612351 i=-2.6650827



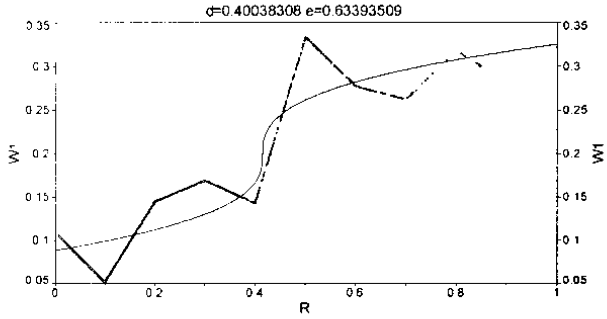
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 2637 Eqn 8095 [Impulse] y=a+b((x-c)/d)[(x-c)/d]-e

r²=0.96137546 DF Adj r²=0.96130329 FitStdErr=0.021126979 Fstat=16657.815

a=0.19939975 b=0.10982751 c=0.41529915

d=0.40038308 e=0.63393509



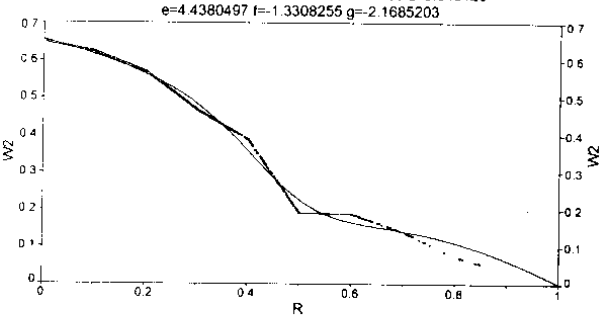
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 68 Eqn 7905 y=(a+cx+ex2+gx3)/(1+bx+dx2+fx3) [NL]

r²=0.99925864 DF Adj r²=0.9992567 FitStdErr=0.0076542448 Fstat=600924.87

a=0.65584534 b=-3.9029153 c=-2.9242065 d=5.040123

e=4.4380497 f=-1.3308255 g=-2.1685203



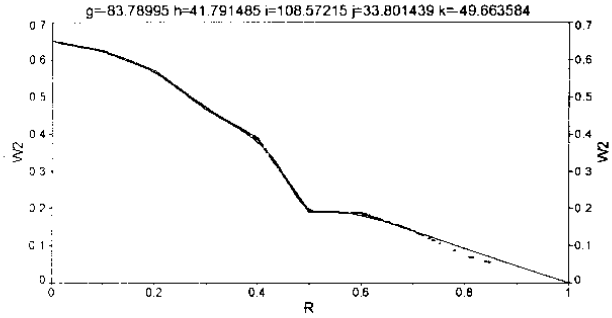
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 23 Eqn 7909 y=(a+cx+ex2+gx3+ix4+kx5)/(1+bx+dx2+fx3+hx4+jx5) [NL]

r²=0.99993087 DF Adj r²=0.99993059 FitStdErr=0.002339058 Fstat=3863547.2

a=0.65222242 b=-8.4072411 c=-5.8656154 d=38.923964 e=30.135207 f=-81.030603

g=-83.78995 h=41.791485 i=108.57215 j=33.801439 k=-49.663584



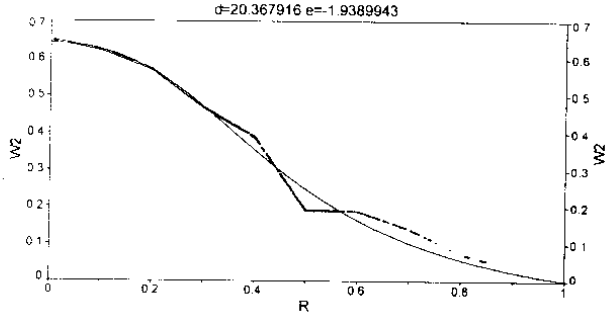
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 109 Eqn 7923 y=(a+cx2+ex4)/(1+bx2+dx4) [NL]

r²=0.99865633 DF Adj r²=0.99865382 FitStdErr=0.01030082 Fstat=497405.61

a=0.6423362 b=4.7221226 c=1.3455712

d=20.367916 e=-1.9389943



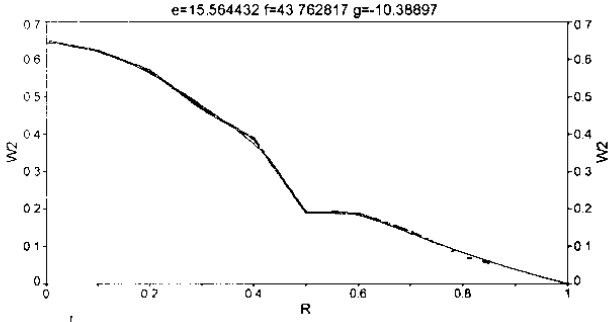
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 31 Eqn 7925 y=(a+cx2+ex4+gx6)/(1+bx2+dx4+fx6) [NL]

r²=0.99989265 DF Adj r²=0.99989237 FitStdErr=0.0029126251 Fstat=4152705.8

a=0.64475622 b=-5.3876517 c=-5.7612387 d=-4.1645057

e=15.564432 f=43.762817 g=-10.38897



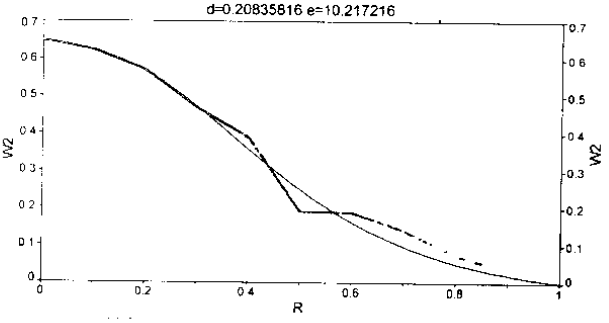
K:\dmbreach\arsflume\simani\jn2507c2.prn

Rank 112 Eqn 8090 [AsymSig] y=a+b/(1+exp(-(x-dln(21/e-1)-c)/d))e

r²=0.99861022 DF Adj r²=0.99860763 FitStdErr=0.010476051 Fstat=480882.53

a=0.65225452 b=-0.68240467 c=0.44132091

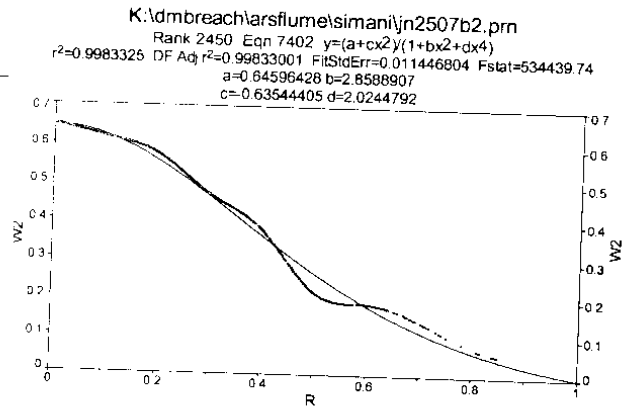
d=0.20835816 e=10.217216

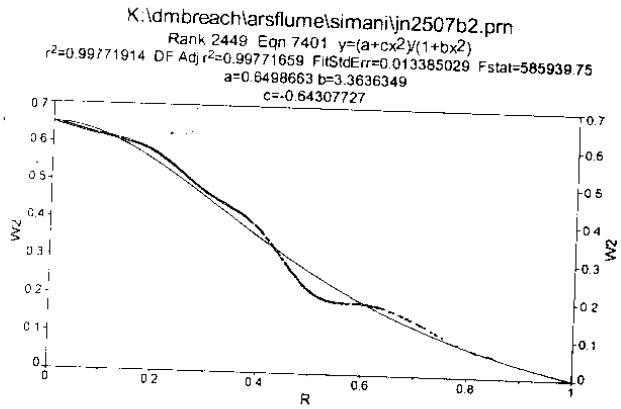


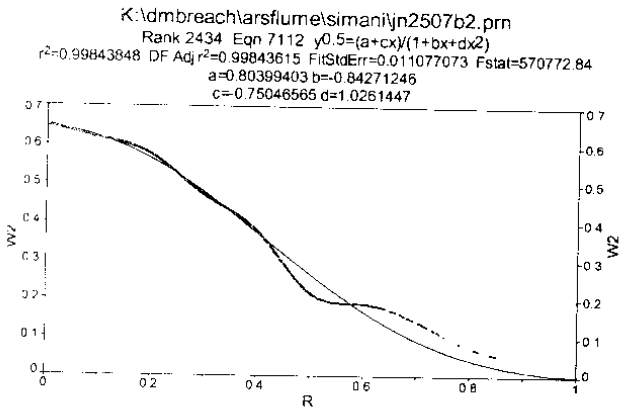
26 Jan 07

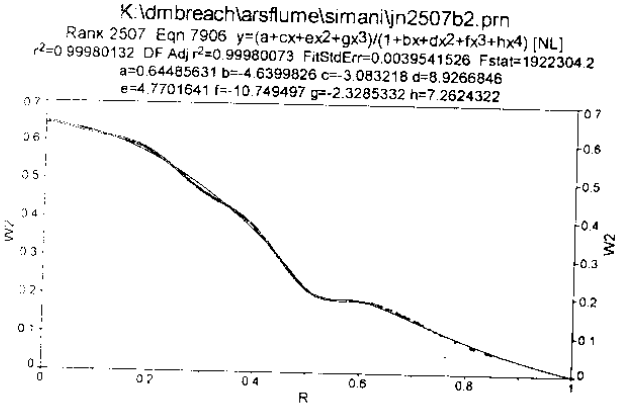
Can't tell where the flat spot exists in jn2507e data for $0.5 < r < 0.7$
It seems to happen mostly for $Q = 6$ cfs, $H_h = 0.5$. They should have run a lot more data varying H_h to get r values between 0.7 and 1. Or even 0.5 and 1

Need to try rational functions for w1 & w2, either start at # II parameters & work down, or at 3 & work up until the point of diminishing returns can be determined by chi-sq test.









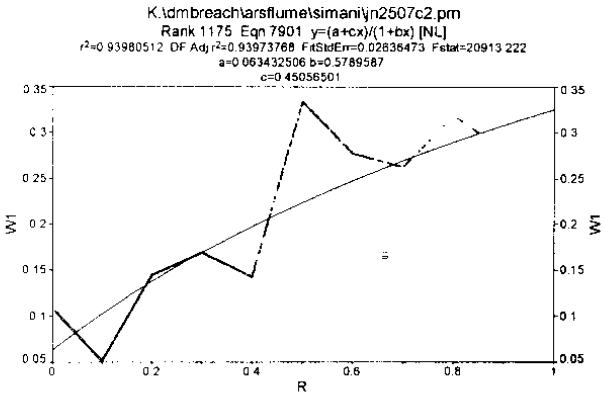
$$w_1 = \frac{a + cx + ex^2}{1 + bx + dx^2 + fx^3} = \frac{D_2 + D_4 r + D_6 r^2}{1 + D_3 r + D_5 r^2 + D_7 r^3}$$ Initial

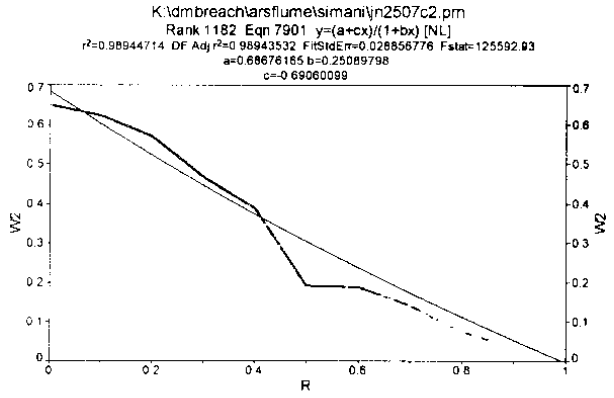
$D_2 = 0.149$ $D_3 = 13.73$ $D_4 = -0.767$ $D_5 = -0.858$ $D_6 = 11.07$ $D_7 = 18.63$

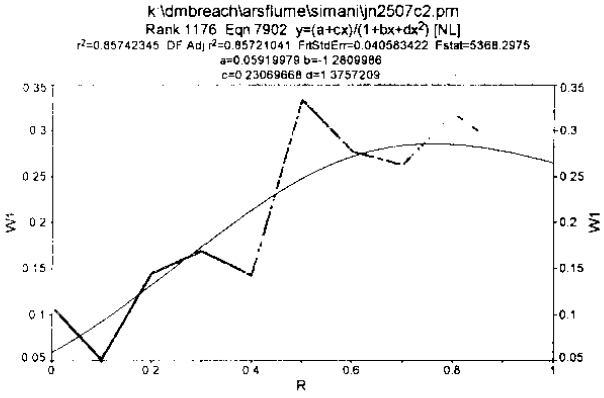
$$w_2 = \frac{D_8 + D_{10} r + D_{12} r^2}{1 + D_9 r + D_{11} r^2 + D_{13} r^3}$$ Initial $D_8 = -0.431$ $D_9 = -4.9$ $D_{10} = 1.686$

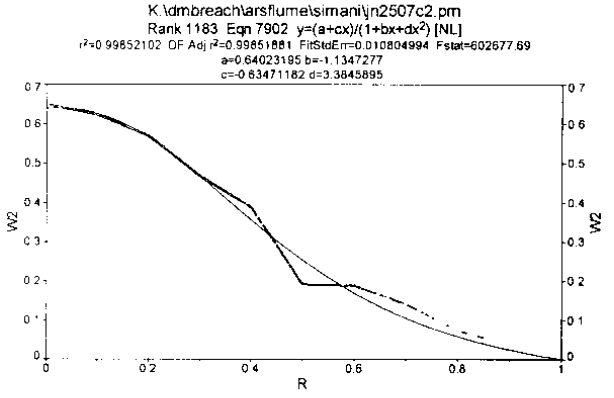
$D_{11} = 8.1$ $D_{12} = -2.014$ $D_{13} = -4.12$

26 June 07









simani9.for (modify simani5.for)

$$\cancel{\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \frac{D_2+D_3 r}{1+D_4 r}\left(\frac{h_e}{b}\right) MS + \frac{D_5+D_6 r}{1+D_7 r}\left(\frac{h_e^2}{b^2}(MS^2+MU^2)\right)^{D_8}}$$ FITD8

jn2607a $\xleftarrow{\text{FITD8}}$ weirdat1, Eat penalties to keep $1+D_4 r \neq 0$, $1+D_7 r \neq 0$, $(D_2+D_3 r)/(1+D_4 r) > 0$, $(D_5+D_6 r)/(1+D_7 r) > 0$

iseed = 326,224 Initial: $D_1 = 0.47$, $D_2 = 0.063$, $D_3 = 0.45$

$D_4 = 0.58$, $D_5 = 0.687$, $D_6 = -0.69$, $D_7 = 0.25$, $D_8 = 0.38$

$\cancel{lb_{1,2,5,8}} = 0$ $lb_{1,2,5,8} = 1.d-8$, $lb_{i\,other} = -10$, $ub_i = 10$

$\cancel{ub_{1,2,5,8} = 2}$ $f_{opt} = 0.0825659$ $\cancel{mean\ err = -0.024047}$

$\cancel{std\ err = 0.145984}$ $\cancel{rel\ err = 0.066327}$ $\cancel{std\ rel\ err = 0.085403}$

$\cancel{D_1 = 0.46181}$ $\cancel{D_2 = 0.10479e-4}$ $\cancel{D_3 = 1.4237}$ $\cancel{D_4 = 3.5817}$

$\cancel{D_5 = 0.77878}$ $\cancel{D_6 = -0.77080}$ $\cancel{D_7 = 0.77729}$ $\cancel{D_8 = 0.35200}$

26 Jun 07

FITD8 ~~FITD9~~ $\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \frac{D_3 + D_5 r}{1 + D_4 r}\left(\frac{h_e}{b}\right) ms + \frac{D_6 + D_8 r}{1 + D_9 r}\left[\frac{h_e^2}{b^2}(ms^2 + mu^2)\right]^{D_2}$

REWORK FIT

Add w1 & w2 calc. to output file, reset ~~lb2 = -2 = lb~~

$lb_{1,2} = 1.d-8$ $lb_{3,5} = -2$ $lb_i = -10$, $ub_{1,2,3,5} = 2$ $ub_i = 10$

jn2607b $\xleftarrow{\text{FITD8}}$ weirdat6 Initial D_i: $D_1 = 0.46$, $D_2 = 0.35$

$D_3 = 1.e-4$, $D_4 = 3.6$, $D_5 = 1.4$, $D_6 = 0.779$, $D_7 = 0.78$, $D_8 = -0.77$

weirdat6 – take 32" data out of weirdat1, leaving 8" data & 16 inch data from steep sides + upstream dam slope.

fopt = 0.0775710 mean err = −0.02784 std err = 0.1369

$\overline{\text{rel err}}$ = 0.066025 std rel err = 0.086504 $D_1 = 0.45886$

$D_2 = 0.34745$ $D_3 = -0.014556$ $D_4 = 3.6919$ $D_5 = 1.4820$

$D_6 = 0.76191$ $D_7 = 0.68977$ $D_8 = -0.75371$ → jn2607a.123

Have values of r to fit up to about r = 0.8. ~~Gappe~~ There is a gap between 0.8 < r < 1.

Compare to jn0807b, weirdat1 $\xrightarrow{\text{FITD0}}$ fopt = 0.0749190

simanh9.for FITD0 27 Jun 07

jn2707a $\xleftarrow{\text{FITD0}}$ weirdat6

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left[D_2 + \frac{D_3}{1 + (r/D_4)^{D_5}}\right]\frac{h_e ms}{b} + \left[D_6 + \frac{D_7}{1 + (r/D_8)^{D_9}}\right]\left[\frac{h_e^3}{b^2}(ms^2 + mu^2)\right]^{D_{10}}$$

Same init values as jn1307f fopt = 0.0687283

mean err = −0.021664 std err = 0.124366 $\overline{\text{rel err}}$ = 0.0571218

std rel err = 0.0810232 $D_1 = 0.46380$ $D_2 = 0.32667$

$D_3 = -0.10862$ $D_4 = 0.69441$ $D_5 = 9.7195$ $D_6 = -0.18616$

$D_7 = 0.73402$ $D_8 = 0.64918$ $D_9 = 2.6158$ $D_{10} = 0.37585$

27 Jan 07

sinaan i8.for piecewise linear w(r), 11 knots

jn2707b ← weirdat6 same init @ jn2507f

fopt = 0.0653735 meanen = -0.02581 stdev = 0.125223

retem = 0.056165 stdretem = 0.0830050 D_1 = 0.45921

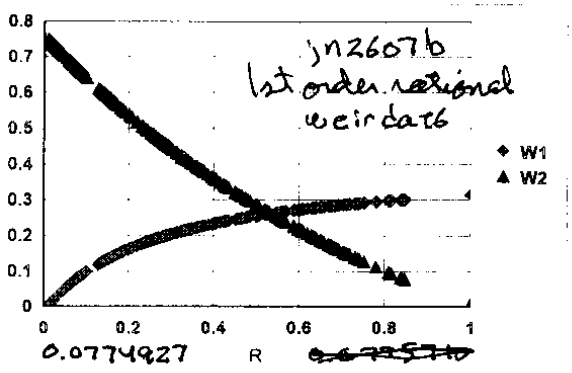
D_2 = 0.36844 D_3 = 0.67e-6 D_4 = .27268 D_5 = .24199 D_6 = .25563

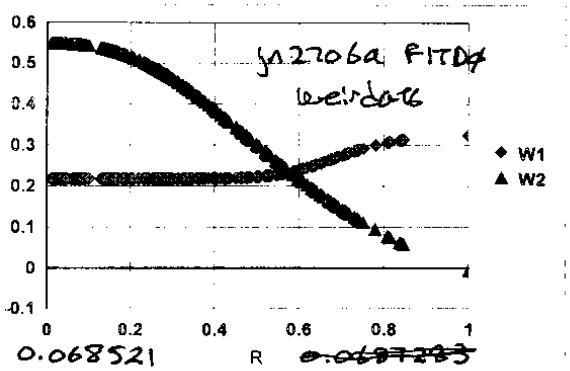
D_7 = .13837 D_8 = .28542 D_9 = .18408 D_{10} = .26604 D_{11} = .31224

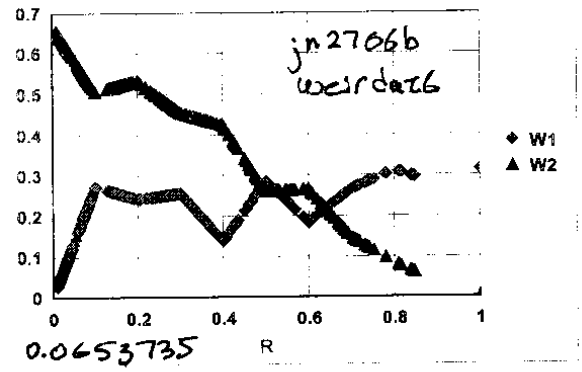
D_{12} = .28033 D_{13} = .31460 D_{14} = .67333 D_{15} = .50647 D_{16} = .53260

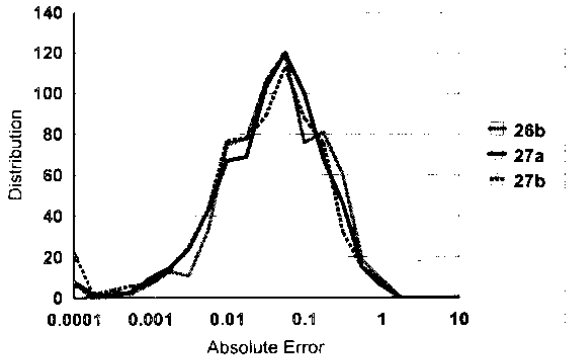
D_{17} = .45457 D_{18} = .42446 D_{19} = .26069 D_{20} = .26555 D_{21} = .14764

D_{22} = .085639 D_{23} = .037470 D_{24} = .0045048









CHI-SQ TESTS OF FIT	j2706a	jn2706b
jn2607a.123	jn2607b .00498	1.9e-6
	jn2707a ~~.02653~~	.02653

None are significantly alike to the 2.7% level (5% level)

27 Jan 07

simani9 for FITD9

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left[\frac{D_3 + D_5 r}{1 + D_4 r + D_9 r^2}\right]\frac{h_e M_s}{b} + \left[\frac{D_6 + D_8 r}{1 + D_7 r + D_{10} r^2}\right]\left[\frac{h_e^2}{b^2}(M_s^2 + M_u^2)\right]^{D_2}$$

Reset initial D_i to output of jn2607b, $D_{9,10} = 0$ $lb_i = -10$ | iseed = 600, 648

except $lb_{1,2} = 10^{-5}$, $lb_{3,5} = -2$, $ub_i = 10$, except $ub_{1,2,3,5} = 2$

jn2707c $\xleftarrow{\text{FITD9}}$ weirdat6 fopt = 0.0710468 mean err = −0.0248725

$\overline{\text{rel err}}$ = 0.0579854 std rel err = 0.0820531 D_1 = 0.45981

D_2 = 0.37039 D_3 = .11778 D_4 = 7.2456 D_5 = 1.7140 D_6 = .58626

D_7 = −.89804 D_8 = −.58022 D_9 = −2.5149 D_{10} = 1.7371

mean abs error = 0.0707166

FITE0

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left[\frac{D_3 + D_5 r + D_{11} r^2}{1 + D_4 r + D_9 r^2}\right]\frac{h_e M_s}{b} \quad \text{jn2707d} \leftarrow \text{weirdat6}$$

$$+ \left[\frac{D_6 + D_8 r + D_{12} r^2}{1 + D_7 r + D_{10} r^2}\right]\left[\frac{h_e^2}{b^2}(M_s^2 + M_u^2)\right]^{D_2}$$

Reset initial to output of jn2707c | Reset initials to those above $\left.\begin{matrix} D_{11} \\ D_{12} \end{matrix}\right\} = 0$

fopt = 0.0710236 mean err = −0.02434 std err = 0.1279

$\overline{\text{rel err}}$ = 0.058063 std rel err = .082045 D_1 = 0.45986

D_2 = 0.37109 D_3 = .12490 D_4 = 7.3355 D_5 = 1.6981 D_6 = .58902

D_7 = −.88397 D_8 = −.57597 D_9 = −2.3943 D_{10} = 1.7558

D_{11} = .076021 D_{12} = −.0069492

FITE1 $$\frac{Q}{b + \sqrt{g h_e^3}} = D_1 + \left[\frac{D_3 + D_5 r + D_{11} r^2}{1 + D_4 r + D_9 r^2 + D_{13} r^3}\right]\frac{h_e M_s}{b}$$

$$+ \left[\frac{D_6 + D_8 r + D_{12} r^2}{1 + D_7 r + D_{10} r^2 + D_{14} r^3}\right] \quad \text{FITE1}$$

27 Jun 07

jn2707e ← FITE1 ← weirdat6 fopt = 0.0705373

mean en	std en	retem	std rel en
-0.024357	0.127566	0.057903	0.0821475

$D_1 = .45971$ $D_2 = .37135$ $D_3 = .12900$ $D_4 = 8.0721$ $D_5 = 1.6712$

$D_6 = .57482$ $D_7 = -1.1855$ $D_8 = -.56318$ $D_9 = -3.6148$

$D_{10} = 2.7165$ $D_{11} = .42394$ $D_{12} = -.0059412$ $D_{13} = 1.5037$

$D_{14} = -.80764$ Very little difference in w1 & w2 from jn2707d

FITE2

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left[\frac{D_3 + D_5 r + D_{11} r^2 + D_{15} r^3}{1 + D_4 r + D_8 r^2 + D_{13} r^3}\right]\frac{h_e M_s}{b} + \left[\frac{D_6 + D_8 r + D_{12} r^2 + D_{16} r^3}{1 + D_7 r + D_{10} r^2 + D_{14} r^3}\right]\left[\frac{h_e^2}{b^2}\left(M_s^2 + M_{tt}^2\right)\right]^{D_2}$$

jn2707f ← FITE2 ← weirdat6 ~~fopt = 0.0703038~~ Blew up somehow

Huge values of w & Q std en = "INF"

$$.4601 + \left[\frac{.18 + 1.3r + .56r^2 + 4.4r^3}{1 + 7.7r - 4.8r^2 + 2.6r^3}\right]\left[\frac{.56 + .56r + .008r^2 - .005r^3}{1 + 1.4r + 3.1r^2 - 1.1r^3}\right]$$

Huge numbers in w1 only, not w2 ← misspelled variable

fix & run again, fopt = 0.0703077 mean en = -0.02348

std en = 0.1274 retem = 0.057698 std rel en = 0.082060

$D_1 = .46010$ $D_2 = .37237$ $D_3 = .17114$ $D_4 = 7.5721$

$D_5 = 1.3571$ $D_6 = .56080$ $D_7 = -1.3992$ $D_8 = -.56022$

$D_9 = -4.7446$ $D_{10} = 3.2089$ $D_{11} = .44521$ $D_{12} = .0034498$

$D_{13} = 2.5487$ $D_{14} = -1.1952$ $D_{15} = .055807$ $D_{16} = .0014024$

FITE3

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \left[\frac{D_3 + D_5 r + D_{11} r^2 + D_{15} r^3}{1 + D_4 r + D_9 r^2 + D_{13} r^3 + D_{17} r^4}\right]\frac{h_e M_s}{b} + \left[\frac{D_6 + D_8 r + D_{12} r^2 + D_{16} r^3}{1 + D_7 r + D_{10} r^2 + D_{14} r^3 + D_{18} r^4}\right]\left[\frac{h_e^2}{b^2}\left(M_s^2 + M_{tt}^2\right)\right]^{D_2}$$

27 Jan 07

FITE4 $\frac{Q_n}{b\sqrt{g h_e^3}} = D_1 + \left[\frac{D_3 + D_5 r + D_{11} r^2 + D_{15} r^3}{1 + D_4 r + D_9 r^2 + D_{13} r^3 + D_{19} r^4}\right] \frac{h_e}{b} + \left[\frac{1}{1 + D_7 r + D_{10} r^2 + D_{16} r^3}\right]$

jn2707g ← FITE3 weirdat6 $f_{opt} = 0.0698178$

mean en	std en	ret en	std rel en
-0.0250865	0.12694	0.0574254	0.0820492

$D_1 = .46055$ $D_2 = .37377$ $D_3 = .24918$ $D_4 = 7.2272$ $D_5 = .89002$

$D_6 = .53210$ $D_7 = -1.6439$ $D_8 = -.54154$ $D_9 = -6.3611$ $D_{10} = 3.4079$

$D_{11} = .42378$ $D_{12} = .006016$ $D_{13} = 1.4707$ $D_{14} = -.80276$ $D_{15} = -.02538$

$D_{16} = .0087996$ $D_{17} = 1.5418$ $D_{18} = -.55898$

jn2707h ← FITE3 weirdat6 now set $lb_i = -30$, except $lb_{1,2} = .00001$

$ub_i = 30$ iseed = 458,329 $f_{opt} = 0.0697991$

-0.02387	0.1268	0.057417	.081967

$D_1 = .46037$ $D_2 = .37126$ $D_3 = .24296$ $D_4 = 7.6006$ $D_5 = .94830$

$D_6 = .54458$ $D_7 = -1.4811$ $D_8 = -.53409$ $D_9 = -6.9063$ $D_{10} = 3.1213$

$D_{11} = .31317$ $D_{12} = .0043577$ $D_{13} = 1.5493$ $D_{14} = -.69780$ $D_{15} = .10511$

$D_{16} = -.0091152$ $D_{17} = 1.8424$ $D_{18} = -.33836$

jn2707i ← FITE3 weirdat Find initial fit w/ TableCurve2D

w1: $\frac{-0.03986 + 5.09485 r - 18.977 r^2 + 30.6414 r^3}{1 + 3.8156 r - 11.633 r^2 + 59.843 r^3}$ Set $lb_i = -100$

w2: $\frac{0.68788 - 6.5216 r + 34.9193 r^2 - 28.891 r^3}{1 - 6.11135 r + 25.658 r^2 + 31.9 r^3}$ $ub_i = 100$

$f_{opt} = 0.0682356$ mean en = -0.02542 std en = 0.1268

ret en = 0.0574920 std rel en = 0.0825189

jn2707i (cont'd)

$D_1 = .45987$ $D_2 = .37185$ $D_3 = -.041233$ $D_4 = .13485$

$D_5 = 4.3883$ $D_6 = .77325$ $D_7 = 1.0000$ $D_8 = -3.9636$

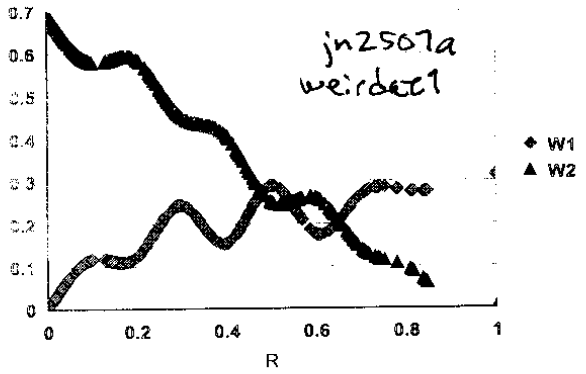
$D_9 = -3.6705$ $D_{10} = 13.672$ $D_{11} = -19.595$ $D_{12} = 32.103$

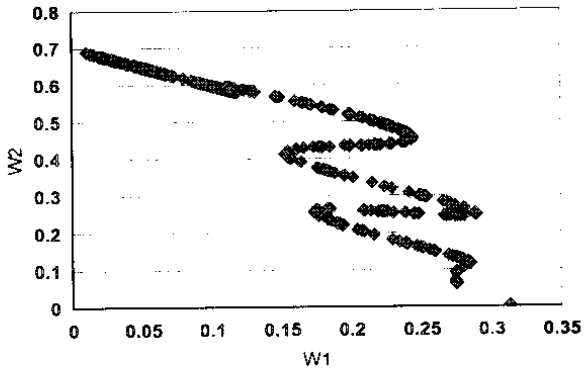
$D_{13} = 32.186$ $D_{14} = 27.867$ $D_{15} = 31.712$ $D_{16} = -28.675$

$D_{17} = 21.784$ $D_{18} = 36.542$

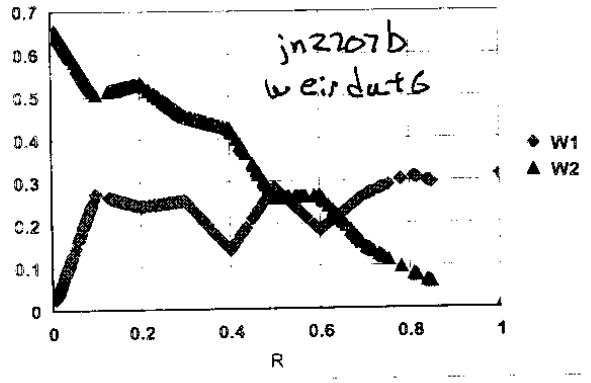
---

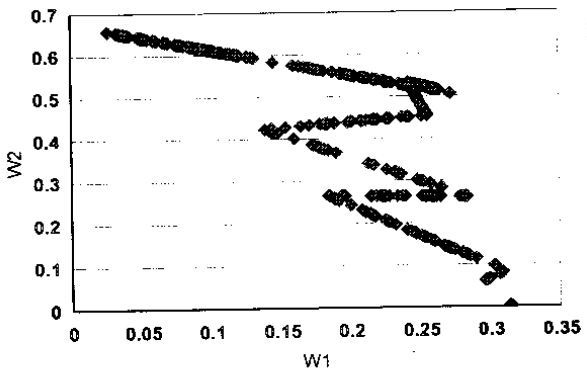
29 June 07





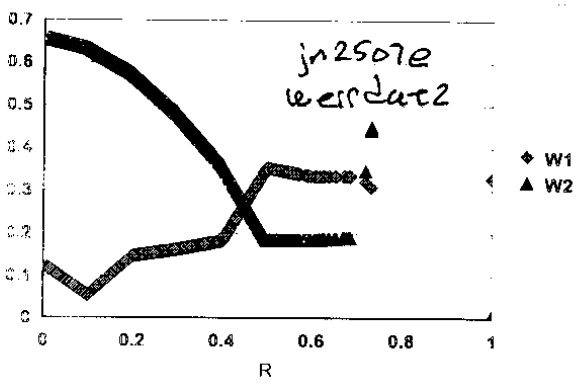
separate cubic spline fits to w1 & w2 ~~for~~ on 8+32" data + steep 16" data

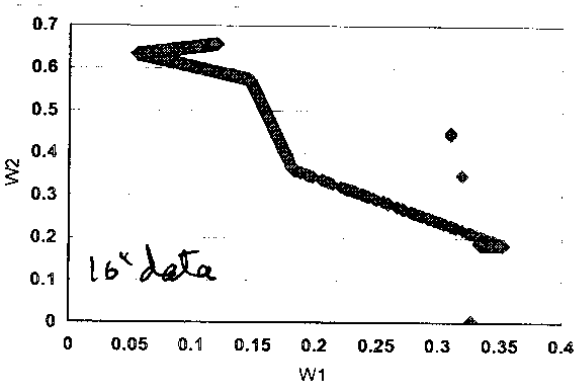




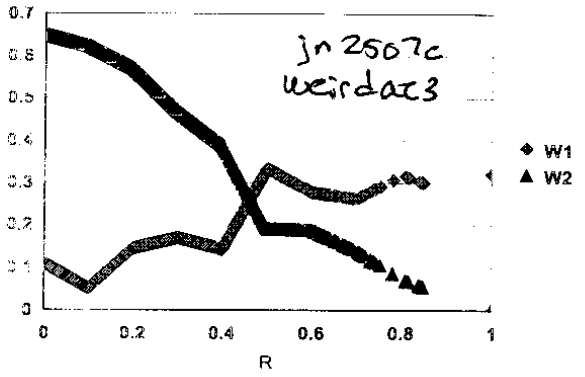
separate piecewise linear fits, w1 & w2. 8" data + steep 16" data. The relationship between w1 & w2 does not look physically realistic.

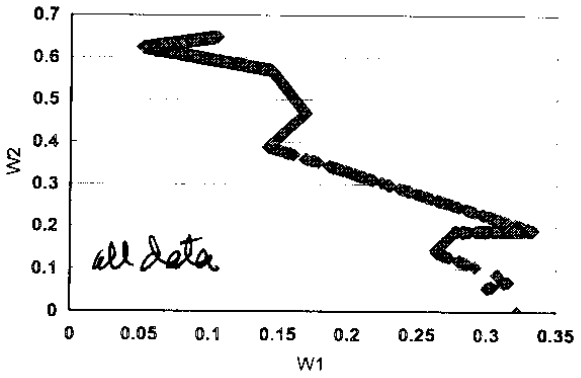
29 Jan 07

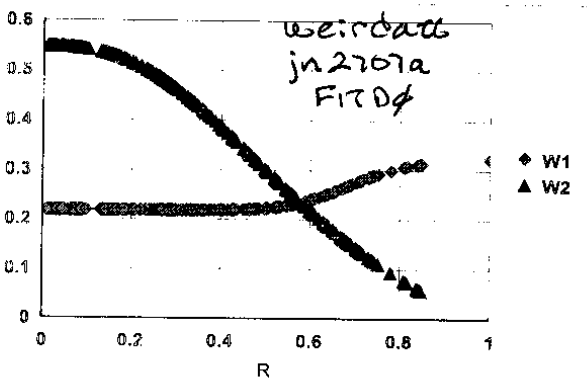


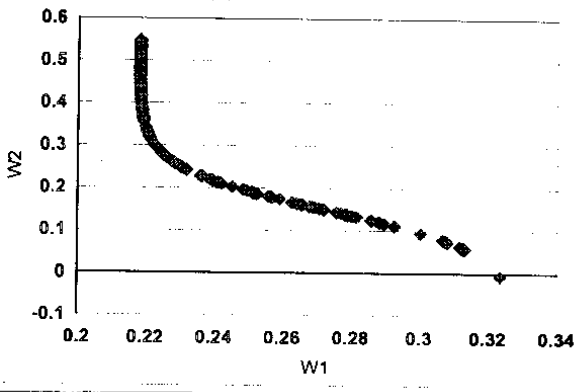


Separate piecewise linear fits, w1 & w2







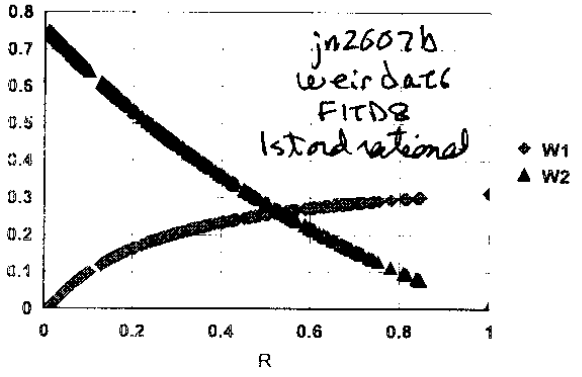


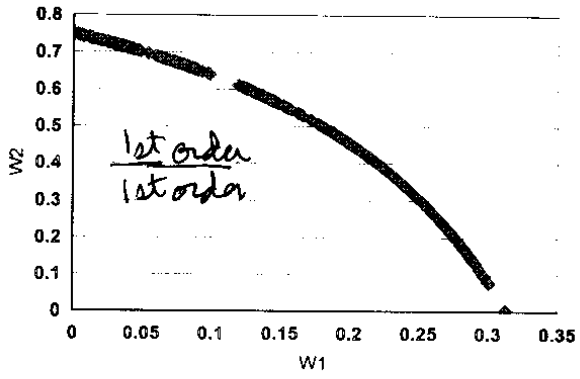
separate logistic function fits, w1 & w2, 8" data + step 16" data

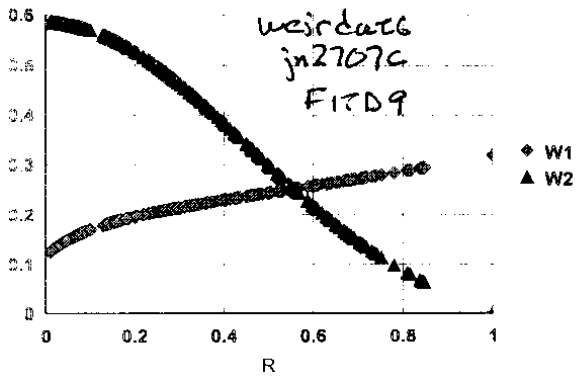
Next set (jn2507b, g2707c, h, i) are rational polynomial fits, separately for w1 & w2

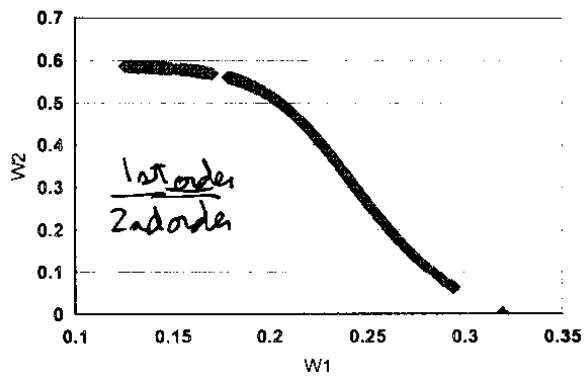
jn2707i uses wider limits on rational polynomial parameters than jn2707h + initial values from TableCurve 2D fits to piecewise linear results of 3rd order/3rd order polynomials

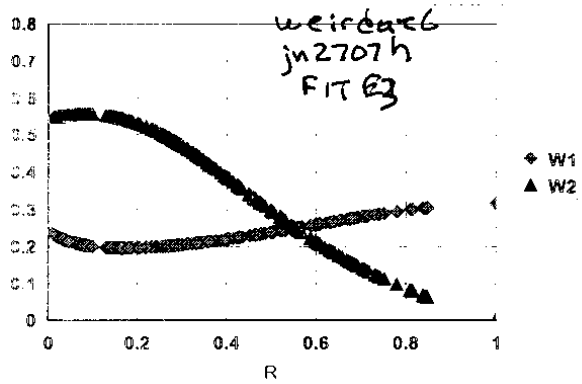
22 June 07

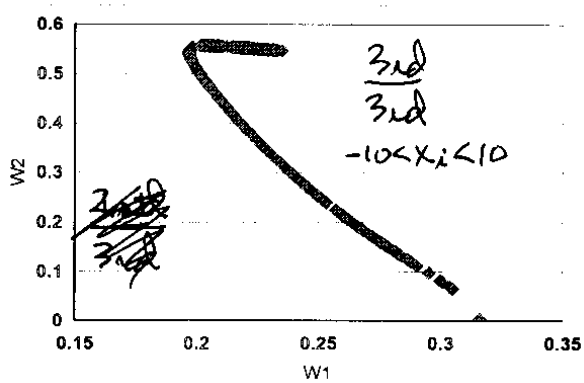

jn2607b
weirdat6
FITD8
1st ord rational
W1
W2
R

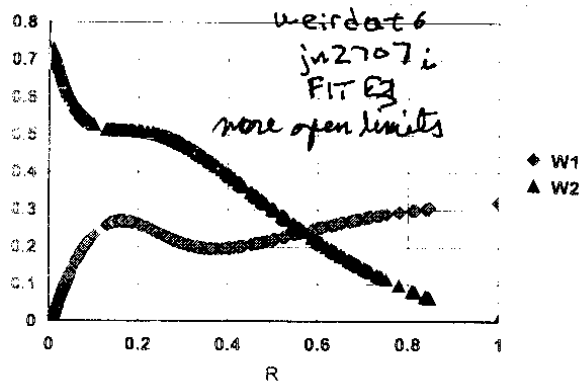

1st order
1st order
W2
W1

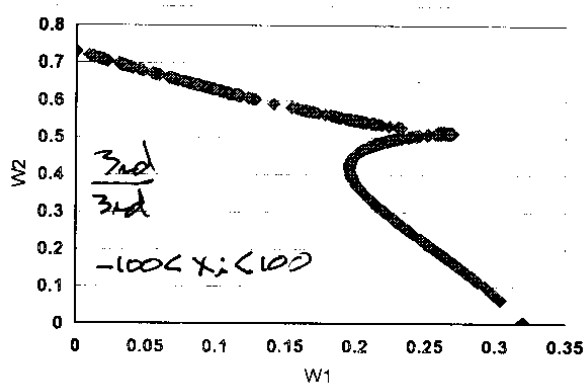

weirdat6
jn2707c
FITD9
W1
W2
R


1st order
2nd order
W2
W1

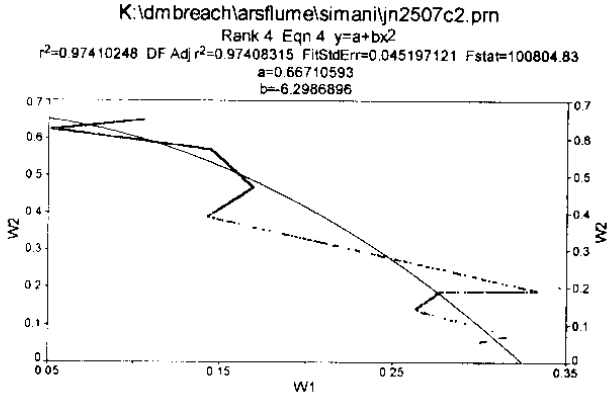

weirdat6
jn2707h
FIT Eq
W1
W2
R

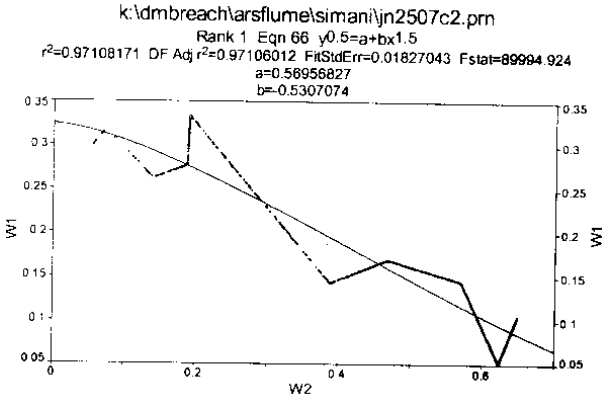

3rd
3rd
-10<Xi<10
W2
W1


weirdat6
jn2707i
FIT Eq
more open limits
W1
W2
R


3rd
3rd
-100<Xi<100
W2
W1

29 jan 07





Suppose that W2 is a piecewise linear function of W1 with knots at 0, 0.05, .1, .15, .2, .25, .3, .35, .4 (9)
And W1 is a piecewise linear function of R with 11 knots at $r = 0, 0.1, 0.2, \cdots, 0.9, 1.0$

simanj8.for

Modify simani8.for to FITE4

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \frac{w_1(r)\, h_e m_s}{b} + w_2(w_1)\left[\left(\frac{h_e}{b}\right)^2 (m_s^2 + m_u^2)\right]^{D_2}$$

$w_1(r)$ - piecewise linear w/ 11 knots, $D_3 - D_{13}$ @ $r = 0, 0.1, \cdots, 1$

$w_2(w_1)$ - piecewise lin w/ 9 knots, $D_{14} - D_{22}$ @ $w_1 = 0, 0.05, \cdots, 0.4$

$ar_0 = X_{13}$ $\quad ar_{nr} = X_{13+nr}$ $\quad aw_0 = X_{14}$ $\quad aw_8 = X_{14+nw}$

$nr + nw + 4 = 10 + 8 + 4 = 22$

$0 < D_1 < 1 \quad 0 < D_2 < .7 \quad 0 < D < .4$

iseed = 381,266 $D_1 = 0.47$, $D_2 = 0.38$, $D_{3-13} = 0.1, 0.125, 0.150, \cdots, 0.35$

$0 < D < 1.6$

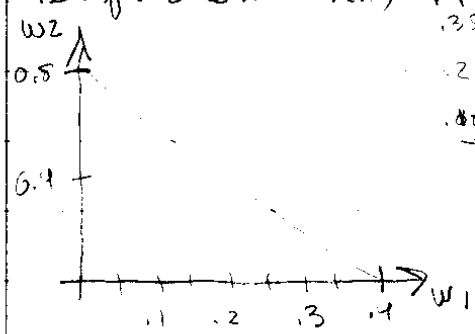
$D_{14-22} = 0.8, 0.7, 0.6, \cdots 0$ weirdat6 → jn2907a

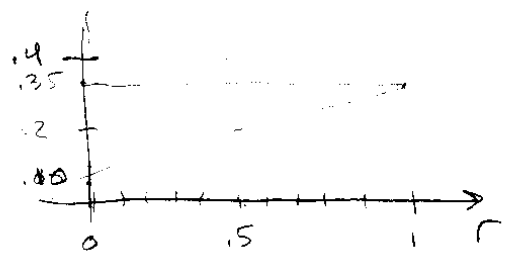
~~fopt = 6.2519 too soon - rejecting a large number of explicit trials repeatedly~~

29 Jan 07

jn2907a : $D_1 = 0.46342$, $D_2 = 0.29183$ || $D_3 = 0.15547$,
$D_4 = .17261$ $D_5 = .18034$ $D_6 = .15168$ $D_7 = .19899$
$D_8 = .11577$ $D_9 = .23140$ $D_{10} = .22151$ $D_{11} = .09335$
$D_{12} = .23202$ $D_{13} = .18409$ ||
$D_{14} = .27922$ $D_{15} = .39918$ $D_{16} = .12408$ $D_{17} = 1.0109$
$D_{18} = .16377$ $D_{19} = .26908$ $D_{20} = .80999$ $D_{21} = .97493$
$D_{22} = 1.0997$ NG Relations are extremely discontinuous, especially $w2(w1)$

1st function $w_1(r)$





$nr = 10$

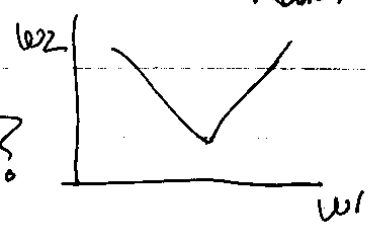
$hr = 0.1$

$nw = 8$

$hw = 0.05$

found mistake - divided by h instead of hw ~ line 143
Make sure that interpolation indices stay 0-(nr-1) and (nw-1)
Set penalties for $w1<0$ and $w2<0$ RUN AGAIN jn2907a
NO GOOD

$f_{opt} = 0.081293$
when mean obs $= 1.2$?



simanj1.for

Use $w2 = D_{14} + D_{15} w_1^2$ from fit on previous page

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \frac{w_1(r)\, h_e M_s}{b} + \left[D_{14} + D_{15} w_1^2\right]\left[\frac{h_e^2}{b^2}(M_s^2 + M_u^2)\right]^{D_2}$$

$w_1(r) = 11$ knots, D_3 to D_{13} FITES

29 Jan 07

siman j1.for (cont'd) INIT & limits

$0 \le D_{3-13} \le 0.6$, $0 \le D_{14} \le 1$, $-20 \le D_{15} \le 1.2$

$0 \le D_1 = 0.97 \le 1$ $0 \le D_2 = 0.38 \le .5$ $D_3 = 0.1$, $D_4 = 0.15$, ... $D_{13} = 0.35$

j2907b ← FITES weirdo 6 $D_{14} = 0.667$ $D_{15} = -6.3$

fopt = 0.0713306 meanen = -0.02559 stden = 0.1295

sqrten = 0.0577867 stdsqrten = 0.0820665 $D_1 = 0.46165$

$D_2 = .37665$ | $D_3 = .5e-7$ $D_4 = .14349$ $D_5 = .066189$ $D_6 = .16997$

$D_7 = .19193$ $D_8 = .24219$ $D_9 = .26074$ $D_{10} = .28178$

$D_{11} = .29325$ $D_{12}^* = .57495$ $D_{13}^* = .10280$ | $D_{14} = .64434$

$D_{15} = -6.4126$ | *fit insensitive to these value due to lack of data

Actual mean abs error = 0.83375 stdabsen = 2.298

Something is wrong with fopt

siman j2.for

Change penalties on w1 & w2 to be like those on c1 & c2 in fitc in siman j9.for → jn2907c, try again

Put limit on jr ≤ ns-1 in main body

NO GOOD fopt is a huge negative number

Change if statements on lines 158 & 166 from if(w1... to if(dabs(w1)...

Try again BETTER → fopt = 0.1310, actual mean abs. error = 0.2546 even worse What the hell?

Leave in the limit jr ≤ ns-1, take out w1 ≥ 0 limits

Leave in w2 > 0 limits, Try again → jn2907c

fopt = 0.1310 but actual mean abs. error is still .2546

Found ns & nw reversed in a parameter statement in fcn

fix & try again - goes to false min with fopt = 0.1279

but at least fopt is correct

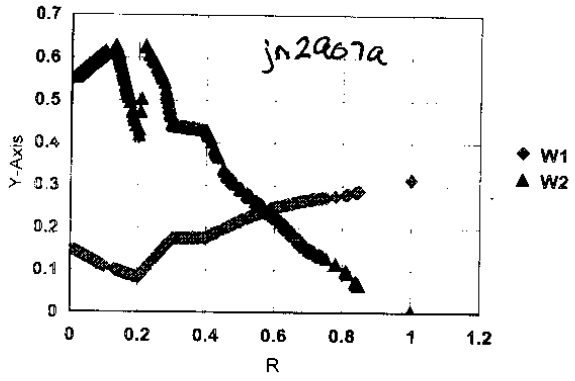
29 June 07

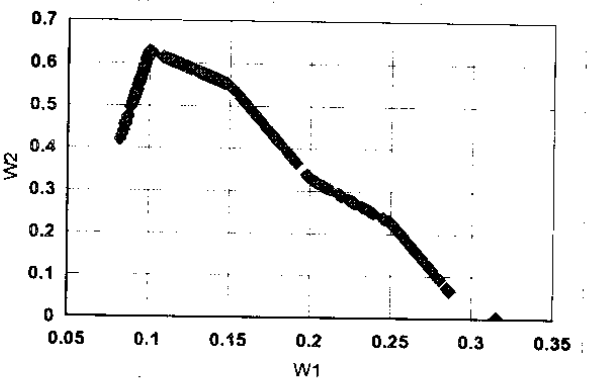
Rename output files jn2907b ~~out~~ change isced & 459 5994
try again → jn2907c w/ $D_3 = .12$, $D_4 = .17$, $D_5 = .2$
$D_6 = .21$ $D_7 = .22$, $D_8 = .24$ $D_9 = .26$ $D_{10} = .28$ $D_{11} = .29$
$D_{12} = .3$ $D_{13} = .31$ $D_{14} = .667$ $D_{15} = -6.3$ $D_1 = .47$ $D_2 = .38$
fopt = 0.0680983

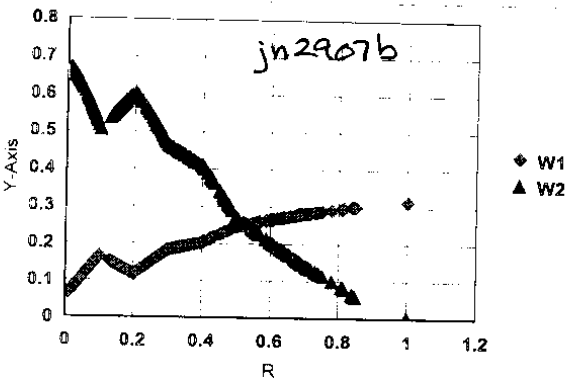
simanj.f.for jn29079 ~~separate~~ piecewise linear $w_1(r)$ & $w_2(w_1)$
Try to correct this & rerun it. → ~~simanj~~ jn29079
fopt = 0.0652705 mean en = -0.02366 std en = 0.1086
rel en = 0.0552663 std rel en = 0.0821123
$D_1 = .46045$ $D_2 = .35912$ | $D_3 = .15159$ $D_4 = .10860$
$D_5 = 0.081917$ $D_6 = .17464$ $D_7 = .17709$ $D_8 = .21765$
$D_9 = .24891$ $D_{10} = .26706$ $D_{11} = .27701$ $D_{12} = .29678$
$D_{13} = .31489$ | $D_{14} = .78372$ $D_{15} = .03905$ $D_{16} = .62814$
$D_{17} = .54974$ $D_{18} = .32878$ $D_{19} = .22813$ $D_{20} = .0051945$
$D_{21} = .0017393$ $D_{22} = 1.3763$

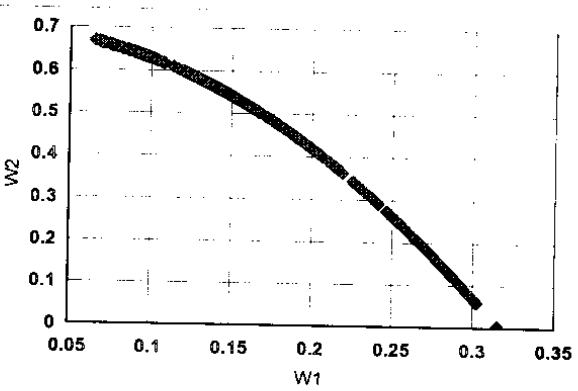
jn29079 piecewise linear $w_1(r)$, $w_2 = a + b w_1^2$
fopt = 0.06527 mean en = -.024515 std en = 0.12627
rel en = 0.057227 std rel en = .082382 $D_1 = .46137$ $D_2 = .37477$
$D_3 = .054046$ $D_4 = .16616$ $D_5 = .11640$ $D_6 = .18348$
$D_7 = .20358$ $D_8 = .24698$ $D_9 = .26552$ $D_{10} = .28192$ $D_{11} = .29487$
$D_{12} = .31000$ $D_{13} = .31509$ | $D_{14} = .69889$ $D_{15} = -7.0026$

29 June 07

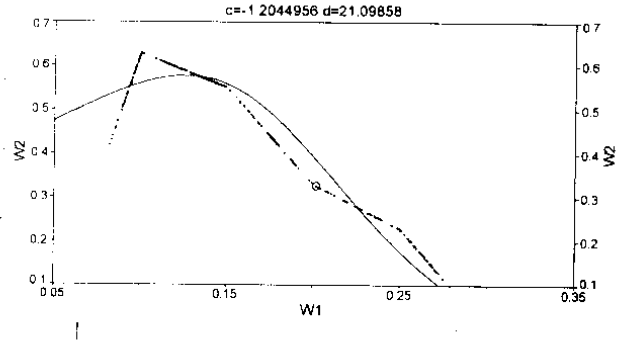




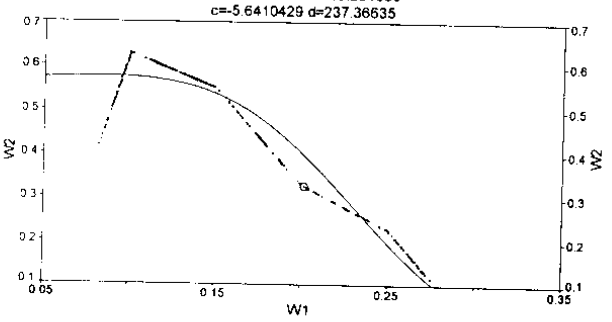




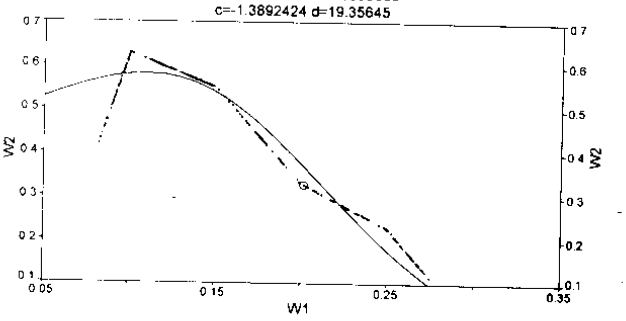
k:\dmbreach\arsflume\simanj\jn2907a2.prn
Rank 2124 Eqn 7002 y=(a+cx)/(1+bx+dx2)
r^2=0.98692595 DF Adj r^2=0.9858507 FitStdErr=0.029043961 Fstat=17513.071
a=0.38394781 b=-7.4047549
c=-1.2044956 d=21.09858



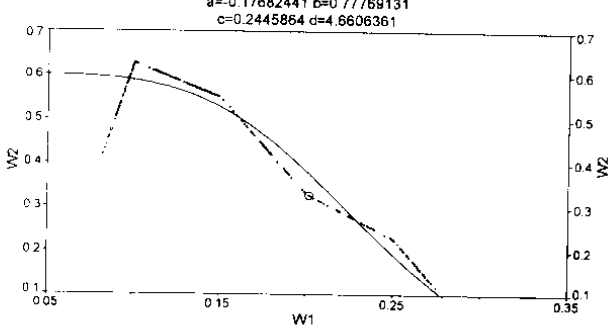
k:\dmbreach\arsflume\simanj\jn2907a2.prn
Rank 2124 Eqn 7402 y=(a+cx2)/(1+bx2+dx4)
r^2=0.98598709 DF Adj r^2=0.98590644 FitStdErr=0.03006872 Fstat=16324.157
a=0.56861323 b=-13.261308
c=-5.6410429 d=237.36635



k:\dmbreach\arsflume\simanj\jn2907a2.prn
Rank 2126 Eqn 7902 y=(a+cx)/(1+bx+dx2) [NL]
r^2=0.98982048 DF Adj r^2=0.98976189 FitStdErr=0.025627983 Fstat=22558.852
a=0.44573326 b=-6.6358065
c=-1.3892424 d=19.35645



k:\dmbreach\arsflume\simanj\jn2907a2.prn
Rank 2761 Eqn 8013 {LgstcDoseRsp} y=a+b/(1+(x/c)d)
r^2=0.98760218 DF Adj r^2=0.98753082 FitStdErr=0.028282866 Fstat=18480.965
a=-0.17682441 b=0.77769131
c=0.2445864 d=4.6606361



30 June 07

simanj2.for

Modified simanj1 FITES

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + w_1(r)\frac{h_e m_s}{b} + \left[\frac{D_{14}+D_{16}w_1^2}{1+D_{15}w_1+D_{17}w_1^2}\right]\left[\frac{h_e^2}{b^2}(m_s^2+m_c^2)\right]^{D_2}$$

D_3–D_{13} piecewise linear

$$r = \frac{h_e^3}{h_e^2+bh_h}$$

$$w_2 = \frac{D_{14}+D_{16}w_1}{1+D_{15}w_1+D_{17}w_1^2}$$

TC2D of 7902

Init: $D_1=.46$ $D_2=.375$ $D_3=.05$ $D_4=.17$ $D_5=.12$ $D_6=.18$
$D_7=.20$ $D_8=.25$ $D_9=.27$ $D_{10}=.28$ $D_{11}=.29$ $D_{12}=.31$
$D_{13}=.32$ ~~$D_{14}=.57$ $D_{15}=-13.3$ $D_{16}=-5.6$ $D_{17}=$~~
$D_{14}=.45$ $D_{15}=-6.6$ $D_{16}=-1.4$ $D_{17}=19.4$ iseed = 65 85

Set penalty if $|1+D_{15}w_1+D_{17}w_1^2| < 10^{-6}$. If $w_2<0$ set $w_2=0$ but no penalty. $w_1<0$ can't exist because $D_{3\text{-}13}>0$

$0<D_1<1$, $0<D_2<6.5$, $0<D_{3\text{-}13}<0.8$, $0<D_{14}<1$, $-20<D_{15}<20$
$-30<D_{16,17}<30$ toc = 0.0748007 mean en = −0.0266
std en = 0.1347 rel en = 0.0593954 std rel en = 0.0826954

$D_1=0.46038$ $D_2=.37147$ $D_3=.33796$ $D_4=.32973$ $D_5=.33207$
$D_6=.32582$ $D_7=.32255$ $D_8=.31682$ $D_9=.31244$ $D_{10}=.31063$
$D_{11}=.30786$ $D_{12}=.30584$ $D_{13}=.30449$ | $D_{14}=$ ~~.31665~~ .38134
$D_{15}=-7.2836$ $D_{16}=-7.6131$ $D_{17}=25.027$ MG

$$\frac{d}{dw}\left[\frac{D_{14}+D_{16}w}{1+D_{15}w+D_{17}w^2}\right] = \frac{D_{16}}{1+D_{15}w+D_{17}w^2} - \frac{(D_{14}+D_{16}w)(D_{15}+2D_{17}w)}{(1+D_{15}w+D_{17}w^2)^2}$$

$$= \frac{D_{16}(1+D_{15}w+D_{17}w^2)-(D_{14}+D_{16}w)(D_{15}+2D_{17}w)}{(1+D_{15}w+D_{17}w^2)^2}$$

$w=0$

$\rightarrow$ ~~$D_{16}-D_{14}\cdot D_{15}+\cdots$~~ so if $D_{16}-D_{14}\cdot D_{15}<0$ it is more likely

30 Jun 07

simanj2.for

jn3007b $\xleftarrow{\text{FITE6}}$ weirdat6. Set penalty for ~~$D_{16} - D_{14} \cdot D_{15}$~~ > 0

$$\frac{d}{dw}\left[\ \cdots\ \right] = \frac{D_{16} - D_{14}\cdot D_{15} - 2D_{14}D_{17}w - D_{16}D_{17}w^2}{(\ \cdots\ )^2}$$

Set penalty for $D_{16} - D_{14}D_{15} - 0.6D_{14}D_{17} - 0.09D_{16}D_{17} > 0$

$D_{16} - D_{14}D_{15} - (0.6D_{14} + 0.09D_{16})D_{17} > 0$

$-7.6131 - (.38134(-7.2836)) - (0.6\cdot 0.38134 - 0.09\cdot 7.6131)(25.027)$

$+2.7775 \qquad .22880 \qquad .68518$

$-.45638$

$+11.42182$

~~Retry, set $w = 0.25$~~

~~$D_{16} - D_{14}D_{15} - (0.5D_{14} + .0625D_{16})D_{17} > 0 \rightarrow$ jn3007b~~

~~fopt = 0.0750261, mean err = −0.02588 std err = 0.1347~~

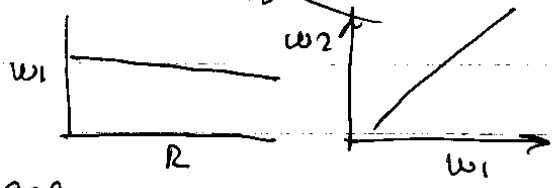
~~rel err = .05924 std rel err = .08242 D_1 = .46123 D_2 = 37463~~

~~D_3 = .33759 D_4 = .33022 D_5 = .33237 D_6 = .32611 D_7 = .32263~~

~~D_8 = .31627 D_9 = .31132 D_{10} = .30938 D_{11} = .30619 D_{12} = .30375~~

~~D_{13} = .30225 D_{14} = .69166 D_{15} = −4.8421 D_{16} = −3.5773~~

~~D_{17} = 11.850 NO GOOD~~



Add another penalty for the average slope of $w_1(r)$ for $i = 3, 12$; $ts = ts + xopt(i+1) - xopt(i)$ ($ts = 0$)

if $ts > 0$ rel = rel + ts·10 Try again → ~~jn3007b~~

Found coef error in fcn for w2. Fix, leave in penalties → jn3007a

No change in the output graphs (fopt = 0.07456)

Take out ~~w1(r) slope~~ penalties & try again MUCH BETTER

fopt = 0.0673407 mean err = −0.02399 std err = 0.1259

rel err = 0.0563825 std rel err = 0.0821553

30 Jan 07

jn3007a (cont'd) $D_1 = 0.46139$ $D_2 = 0.37287$

$D_3 = .17636$ $D_4 = .20186$ $D_5 = .19213$ $D_6 = .20996$

$D_7 = .21942$ $D_8 = .24396$ $D_9 = .25473$ $D_{10} = .26965$

$D_{11} = .28148$ $D_{12} = .30594$ $D_{13} = .31493$ $D_{14} = .46944$

$D_{15} = -7.3694$ $D_{16} = -1.4827$ $D_{17} = 20.113$

simanj3.for Modify simanj2.for

change $w_2(w_1)$ to $D_{14} + D_{15}/(1+(w_1/D_{16})^{D_{17}})$ FIT E7

Initial values $D_{14} = -0.177$ ~~-0.369~~ $D_{15} = 0.778$ $D_{16} = 0.295$

$D_{17} = 4.66$ $-2 < D_{14} < 0$ $0 < D_{15} < 2$ $0.001 < D_{16} < 0.4$

~~$1 < D_{17} < 20$~~ fplt = 0.0675529 jn3007b

meanen = −0.02413 stdev = 0.1260 reten = .0573986

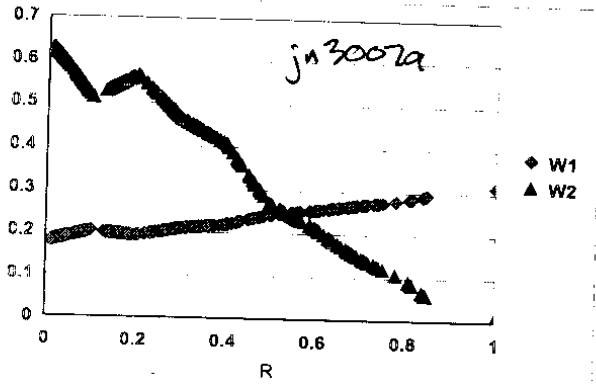
std rel en = .0826553 $D_1 = .46081$ $D_2 = .37230$

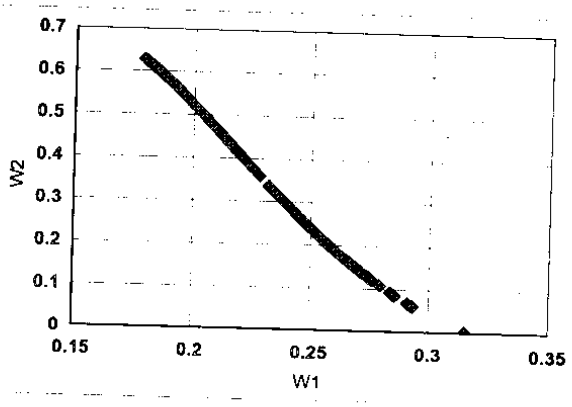
$D_3 = .087042$ $D_4 = .19217$ $D_5 = .15925$ $D_6 = .19714$

$D_7 = .20992$ $D_8 = .24102$ $D_9 = .25400$ $D_{10} = .27086$

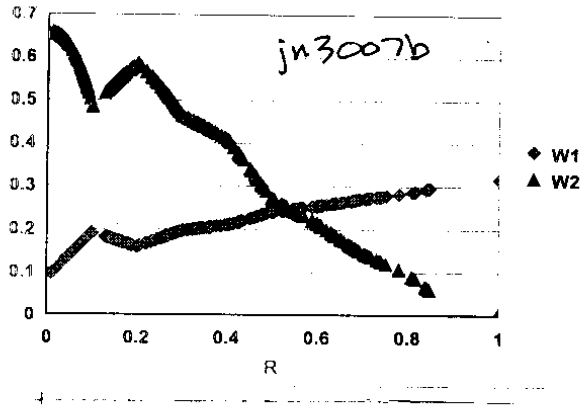
$D_{11} = .28417$ $D_{12} = .30918$ $D_{13} = .31811$ $D_{14} = -0.17825$

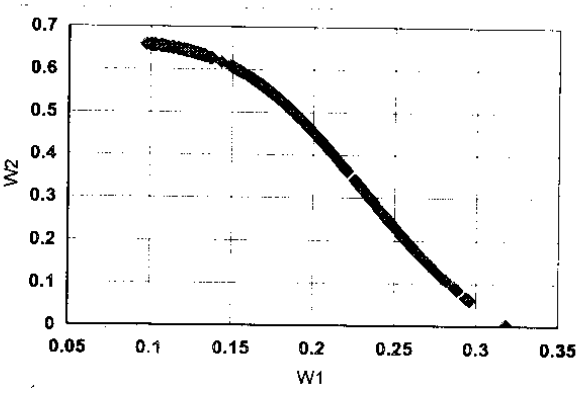
$D_{15} = .84360$ $D_{16} = .24728$ $D_{17} = 5.1394$

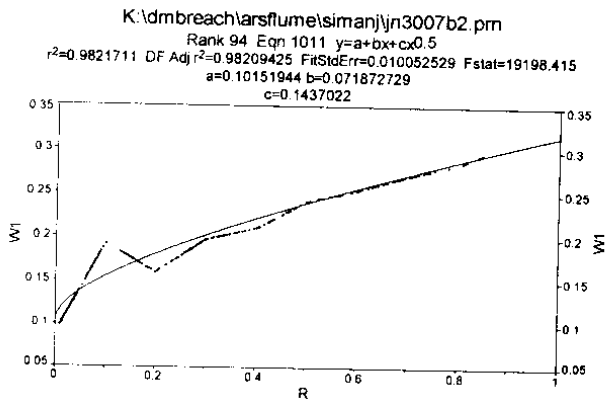


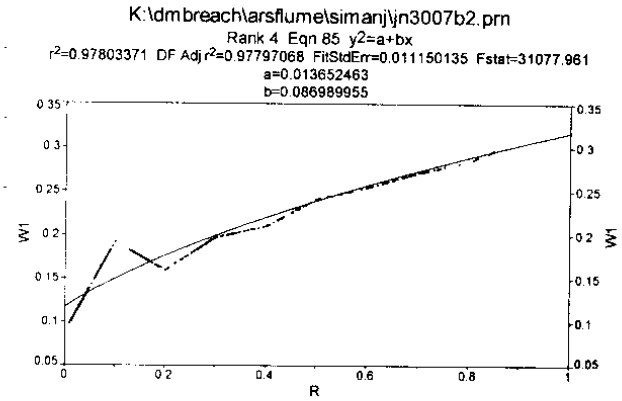


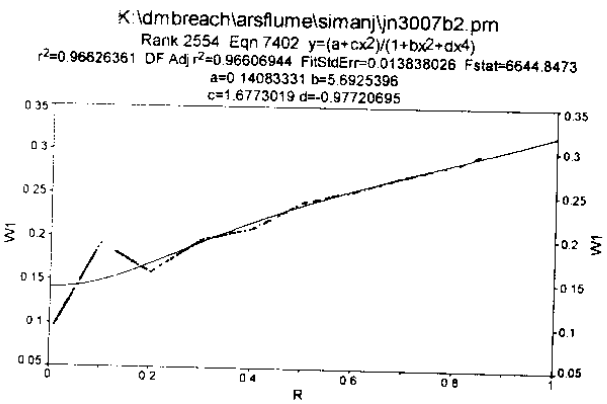
30 Jun 07

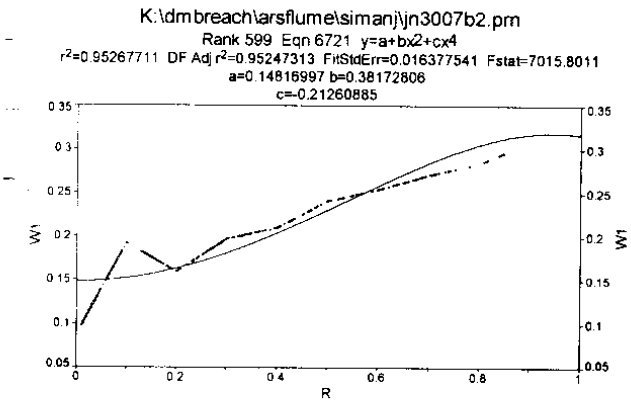












simanj4.for ~~copy simanj3.for~~ 1 July 07

~~Make $w_1(r)$ a function instead~~ Modify simanj3.for

Add possible corrections for contraction of jet due to steep sides

$$\frac{Q}{b\sqrt{g h_e^3}} = D_1 + \frac{w_1 h_e m_s}{b}\left(1 + D_{1e} e^{-D_{1a} m_s}\right) + w_2 \left[\frac{h_e^2}{b^2}\left(m_s^2 + m_u^2\right)\right]^{D_2}\left(1 + D_{2e} e^{-D_{2,1}\left(m_s^2 + m_u^2\right)}\right)$$

FITE8

1 July 07

simanj4.for (cont'd)

Feed in 30676 solution back into IC to 3 sig digits

$0 \le D_{18}^{0} \le 1$, $0 \le D_{19}^{1} \le 20$, $0 \le D_{20}^{0} \le 1$, $0 \le D_{21}^{1} \le 20$

jl0107a ← FITE8 ← weirdat6 fopt = 0.0637664

meanen = -0.02579 std en = 0.1241 reten = .055902 std rel en = .082933

D_1 = 0.45851 D_2 = .38476 | D_3 = .072991 D_4 = .17937 D_5 = .14881

D_6 = .19842 D_7 = .21315 D_8 = .24370 D_9 = .25871 D_{10} = .27439

D_{11} = .28703 D_{12} = .30926 D_{13} = .31712 | D_{14} = -.18885 D_{15} = .80431

D_{16} = .25646 D_{17} = 5.4381 | D_{18} = 0.8e-5 D_{19} = 15.680 | D_{20} = 1.0000

D_{21} = 11.290 ← solution insensitive to this value

jl0107b FITE8 ← weirdat6 : Set $-2 \le D_{18}^{.101} \le 2$, $-2 \le D_{20}^{1.0} \le 2$

D_{19} = 15.7 D_{20} = 11.3 + soln jl0107a to 3 digits D_1 - D_{17}

fopt = 0.0632120 mean en = -.023665 std en = 0.1223

reten = .0555402 std rel en = .0821072 D_1 = .96066

D_2 = .38427 | D_3^* = .019975 D_4 = .17689 D_5 = .11181 D_6 = .19256

D_7 = .20633 D_8 = .24044 D_9 = .25476 D_{10} = .27228 D_{11} = .28592

D_{12} = .30957 D_{13} = .31808 | D_{14} = -.19012 D_{15} = .78836, D_{16} = .25589

D_{17} = 5.1139 | D_{18} = -.070968 D_{19}^* = 2.2004 | D_{20}^* = 1.8670 D_{21} = 19.998

* solution least sensitive to these coef.

Note - Possible fallacy in this approach. The "correction" coefficients are cancelled out as $m_s \to 0$, $m_a \to 0$. Try an overall coef. FITE9

$$\frac{Q}{b\sqrt{ghe^3}} = \left(1 + D_{18} e^{-D_{19} m_s} + D_{20} e^{-D_{20}(m_s^2 + m_a^2)}\right)\left[D_1 + \ldots\right]$$

FITE8 E7

1 July 07

Simanj5.for overall contraction coef.. modify simanj6

$$\frac{Q}{b\sqrt{g h_e^3}} = \left[1 + D_{18} e^{-D_{19} ms} + D_{20} e^{-D_{21}(ms^2+mu^2)}\right]\left[D_1 + w_1(r)\frac{h_e ms}{b} + w_2(w_1)\left\{\frac{h_e^2}{b^2}(ms^2+mu^2)\right\}^{D_2}\right] \quad \text{FITE9}$$

$r = \frac{h_e^2}{h_e^2 + b h_h}$, $w_1(r) = 1$ | not piecewise lin, $w_2(w_1) = \left[D_{14} + \frac{D_{15}}{1+(w_1/D_{16})^{D_{17}}}\right]$

If the correction factor, $sc < 0$, set $sc = 0$ and increase fopt by $-1000 \cdot sc$ | Start with same IC, but $D_{20} = 0.01$, reset $0 \le D_{19} \le 50$, $0 \le D_{21} \le 50$

jl0107c $\xleftarrow{\text{FITE9}}$ weirdat6 fopt = 0.0637474 mean err = −0.02781

std err = 0.1231 rel err = 0.0549969 std rel err = 0.0790494

$D_1 = .46857$ $D_2 = .37820$ | $D_3^* = .014598$ $D_4 = .17145$ $D_5 = .093724$

$D_6 = .18896$ $D_7 = .20284$ $D_8 = .23713$ $D_9 = .25317$ $D_{10} = .26904$

$D_{11} = .28273$ $D_{12} = .30483$ $D_{13} = .31366$ | $D_{14} = -.19056$ $D_{15} = .78759$

$D_{16} = .25555$ $D_{17} = 5.3533$ | $D_{18} = -0.034567$ $D_{19}^* = 1.0125$

$D_{20} = .11758$ $D_{21}^* = 12.459$ * least sensitive

Need to drop piecewise linear w_1 to cut down on # of coefficients & try new things.

simanj6.for copy + modify simani9 FITFØ

$$\frac{Q}{b\sqrt{g h_e^3}} = sc(ms, mu)\left[D_1 + w_1(r)\frac{h_e ms}{b} + w_2(w_1)\left[\frac{h_e^2}{b^2}(ms^2+mu^2)\right]^{D_2}\right]$$

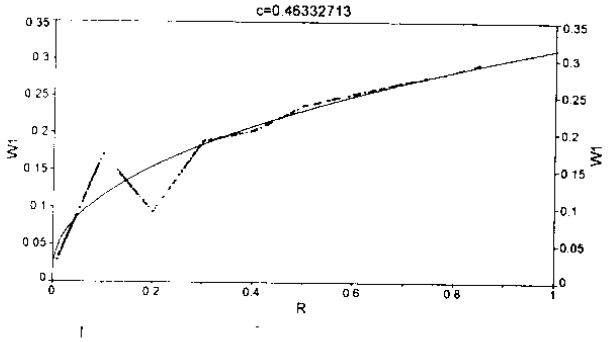
$$sc(ms, mu) = 1 + D_{10} e^{-D_{11} ms} + D_{12} e^{-D_{13}(ms^2+mu^2)}$$

$w_1(r) = D_3 + D_4 r + D_5 r^{1/2}$ $\quad w_2(w_1) = D_6 + \frac{D_7}{1+(w_1/D_8)^{D_9}}$

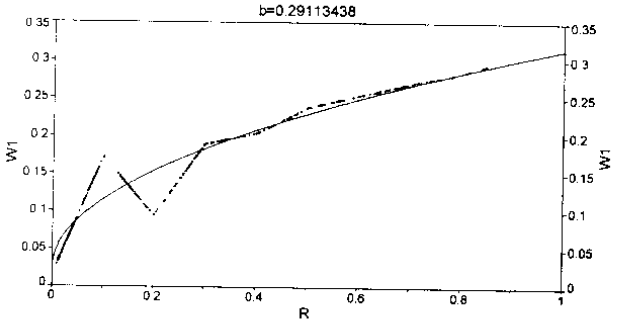
$r = \frac{h_e^2}{h_e^2 + b h_h}$

1 July 07

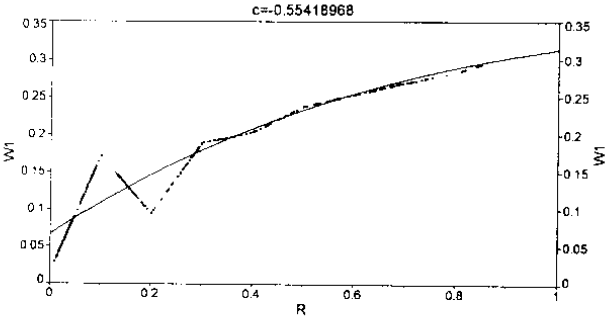
K:\dmbreach\arsflume\simanj\jl0107c2.prn
Rank 140 Eqn 8010 [Power] y=a+bxc
r^2=0.9731046 DF Adj r^2=0.97298868 FitStdErr=0.01556733 Fstat=12609.108
a=0.01213739 b=0.30104164
c=0.46332713



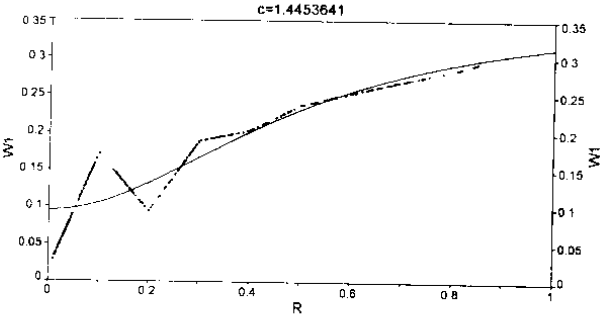
K:\dmbreach\arsflume\simanj\jl0107c2.prn
Rank 2 Eqn 12 y=a+bx0.5
r^2=0.97289197 DF Adj r^2=0.97281419 FitStdErr=0.015617546 Fstat=25050.83
a=0.022960559
b=0.29113438



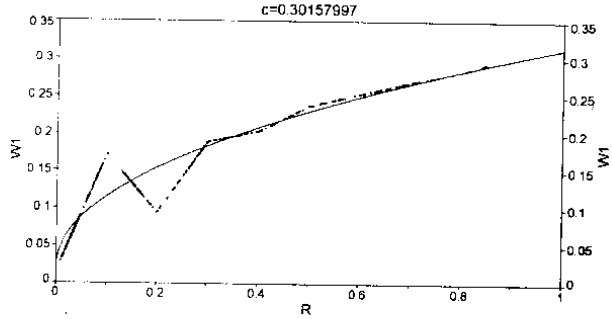
K:\dmbreach\arsflume\simanj\jl0107c2.prn
Rank 99 Eqn 1020 y=a+bx+ce-x
r^2=0.96685943 DF Adj r^2=0.96671659 FitStdErr=0.017280453 Fstat=10167.313
a=0.62062757 b=-0.10363586
c=-0.55418968



K:\dmbreach\arsflume\simanj\jl0107c2.prn
Rank 2538 Eqn 7401 y=(a+cx2)/(1+bx2)
r^2=0.95124618 DF Adj r^2=0.95103604 FitStdErr=0.02095943 Fstat=6799.6583
a=0.095106342 b=3.9155888
c=1.4453641



K:\dmbreach\arsflume\simanj\jl0107c2.prn
Rank 91 Eqn 1011 y=a+bx+cx0.5
r^2=0.9729309 DF Adj r^2=0.97281422 FitStdErr=0.015617521 Fstat=12525.956
a=0.020658624 b=-0.008552322
c=0.30157997



IC: $D_1 = .469$ $D_2 = .378$

$D_3 = .0207$ $D_4 = -.00855$

$D_5 = .301$ $D_6 = -.191$

$D_7 = .788$ $D_8 = .256$

$D_9 = 5.35$ $D_{10} = -.0346$

$D_{11} = 1.013$ $D_{12} = 0.118$ $D_{13} = 12.5$

$0 \le D_1 \le 1$, $0 \le D_2 \le 0.8$, $0 \le D_3 \le 1$, $-1 \le D_4 \le 1$, $-1 \le D_5 \le 1$

$-1 \le D_6 < 0$, $0 \le D_7 \le 2$, $0.001 \le D_8 \le 0.5$, $1 \le D_9 \le 200$ $hb = v_1$

$-2 \le D_{10} \le 2$, $0 \le D_{11} \le 30$, $-2 \le D_{12} \le 2$, $0 \le D_{13} \le 30$ $rw = v_2$

Write out r, w1, w2, sc in 2.prn output file $ms = v_3$

topt = 0.0667746 mean err = -0.322e-4 $mu = v_4$

std err = 0.123354 rel err = 0.0558805 std rel err = 0.0785408

jl0107d FITF0 weirdat6

1 July 07

simanj6.for (cont'd)

$$\frac{Q}{b\sqrt{g h_e^3}} = \left[1 + D_{10} e^{-D_{11} ms} + D_{12} e^{-D_{13}(ms^2+mu^2)}\right]\left[\frac{D_1 + w_1(r) h_e ms}{b} + w_2(w_1)\left(\frac{h_e^2}{b^2}(ms^2+mu^2)\right)^{D_2}\right]$$

FITF1 $r = \frac{h_e^2}{h_e^2 + b h_n}$

$w_1(r) = (D_3 + D_4 r^2)/(1 + D_5 r^2)$ $-1 \le D_3 = 0.0951 \le 1$

$-20 \le D_4 = 1.445 \le 20$ $0 \le D_5 = 3.92 \le 20$

$D_1 = .46686$ $D_2 = .36640$ $D_3 = .024837$ $D_4 = -.014419$

$D_5 = .30233$ $D_6 = -.18503$ $D_7 = .79076$ $D_8 = .25440$

$D_9 = 5.5054$ $D_{10} = -.033943$ $^*D_{11} = 1.2191$ $D_{12} = .12093$

$^*D_{13} = 14.353$ FITF0 *least sensitive coef

jl0107e $\xleftarrow{\text{FITF1}}$ weirdat6 ~~Not so good solution is very insensitive to D_5~~ ~~fopt = 0.0680023 mean err = -4.2e-3 std err = 0.1250 $\overline{\text{rel err}}$ = 0.0564233 std rel err = 0.0791023 D_1 = 0.45861 D_2 =~~ Had an error in fit RERUN

fopt = 0.0682165 mean err = 7.76e-6 std err = .1272

$\overline{\text{rel err}}$ = 0.0562129 std rel err = 0.0796441 D_1 = 0.45599

D_2 = .38038 D_3 = .17101 D_4 = 1.4017 D_5 = 4.0461 D_6 = -.35011

D_7 = .92472 D_8 = .29220 D_9 = 7.1691 D_{10} = -.012236

D_{11}^* = 10.581 D_{12} = .12512 D_{13}^* = 14.860 *soln least sensitive

FITF2 Substitute $w_1(r) = D_3 + D_4 r^{D_5}$ into FITF1

$0 \le D_3 = 0.0121 \le 0.5$, $-1 \le D_4 = 0.301 \le 1$, $-1 \le D_5 = .463 \le 1$

jl0107f $\xleftarrow{\text{FITF2}}$ weirdat6 fopt = 0.0666439

1 July 07

jl0107f $\xleftarrow{\text{FITF2}}$ weirdat6 fopt = 0.0666439 $\overline{err}$ = 1e-3

std err = .1232 $\overline{rel\ err}$ = 0.0559792 std rel err = .0785913

D_1 = .46579 D_2 = .36777 D_3 = .010612 D_4 = .30327 D_5 = .49814

D_6 = -.17085 D_7 = .77564 D_8 = .24889 D_9 = 5.2159 ~~D_{10} = -0.035~~

D_{10} = -0.035659 D_{11}^* = 1.4026 D_{12} = .12514 D_{13}^* = 13.616

* soln least sensitive to these

~~Now try separate "contraction" coefficients for the separate terms~~ $\cancel{\frac{Q}{b\sqrt{ghe^3}} = [D_1 + D_2 e^{-D_3 ms} + D_4 e^{-D_5 (ms^2}}$

Add a coefficient of power, D_{14}, to the overall contraction coef for : $(ms^2+mu^2)^{D_{14}}$: $\left[1 + D_{10} e^{-D_{11} ms} + D_{12} e^{-D_{13}(ms^2+mu^2)^{D_{14}}}\right]$

FITF3

jl0107g $\xleftarrow{\text{FITF3}}$ weirdat6 $0 \le D_{14} = 1 \le 2$

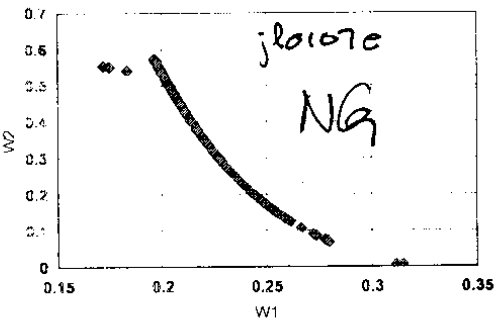
fopt = 0.0664145 mean err = -9.7e-4 std err = 0.1221

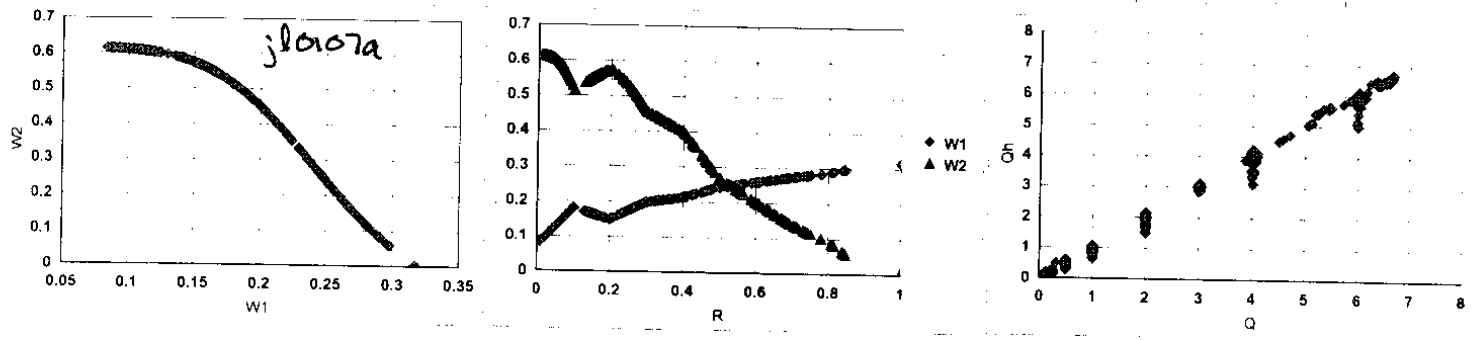
$\overline{rel\ err}$ = 0.0559233 std rel err = 0.0784649 D_1 = .46954

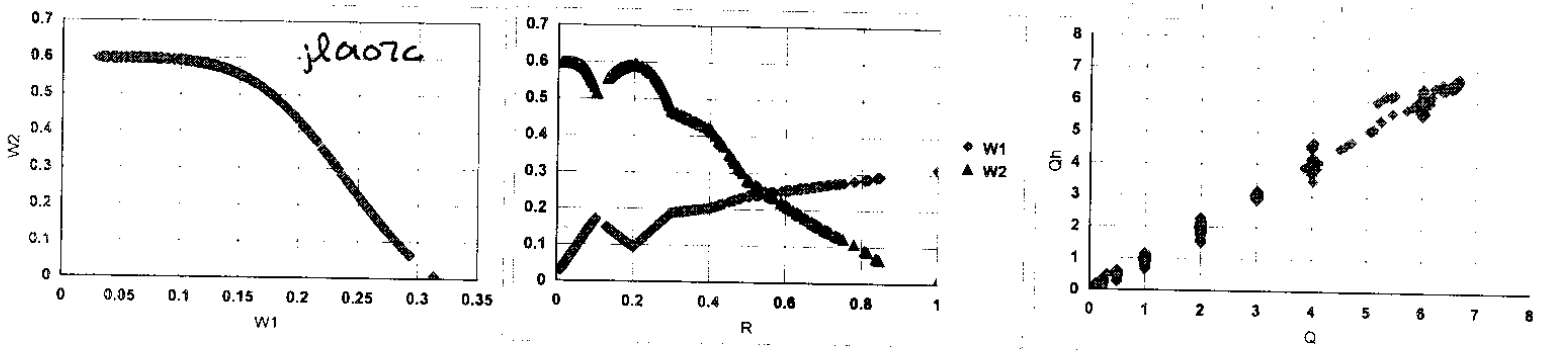
D_2 = .36726 D_3 = 0.011055 D_4 = .30009 D_5 = .53613

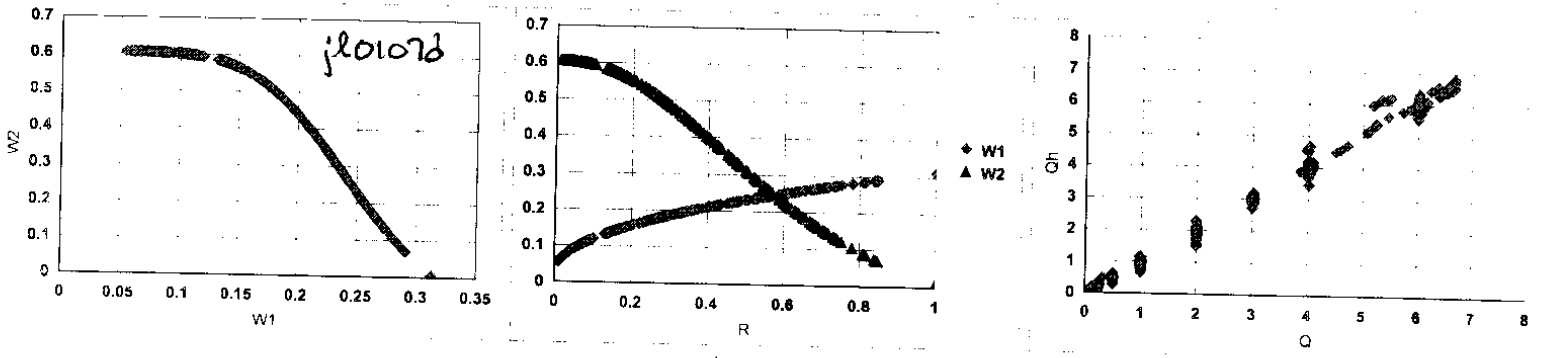
D_6 = -.17114 D_7 = .77995 D_8 = .24277 D_9 = 4.8859 D_{10} = -.044676

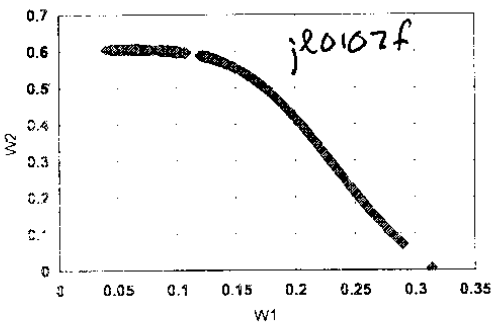
D_{11} = 1.3906 D_{12} = .12184 D_{13} = 29.999 D_{14} = 1.3019

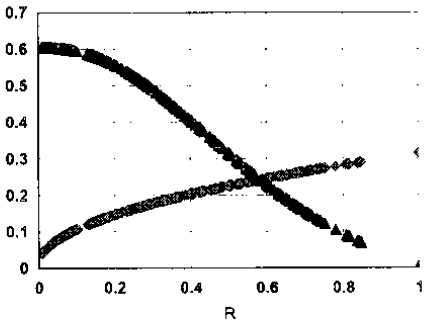


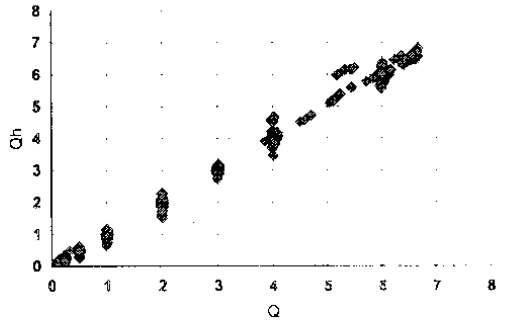

jl0107a
W2
W1
R
Q
Qh
W1
W2

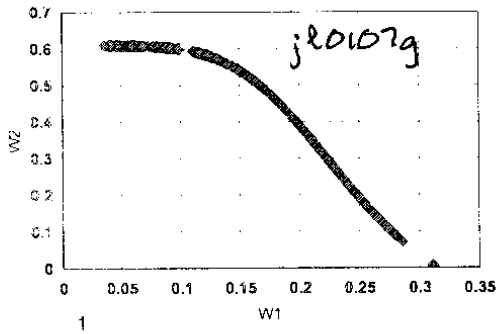

jl0107c
W2
W1
R
Q
Qh
W1
W2

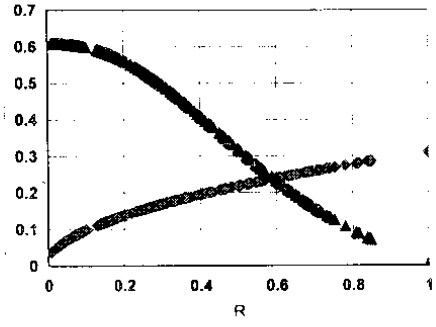

jl0107d
W2
W1
R
Q
Qh
W1
W2

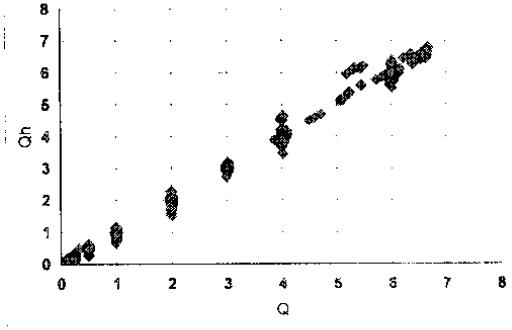


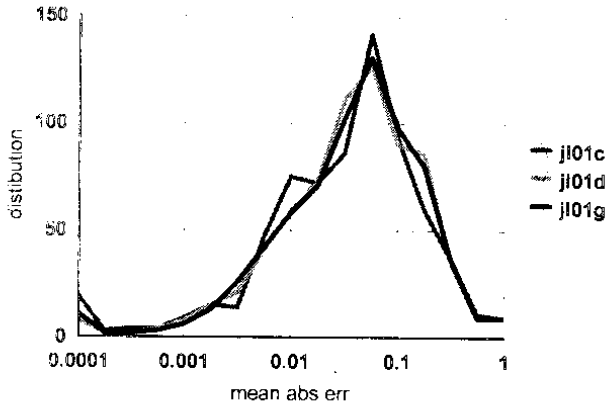










jl0107a	1						
jl0107b	0.437624375	1					
jl0107c	0.037373665	0.31083273	1				
jl0107d	0.000014148	0.000088336	0.000512513	1			
jl0107e	0.000000013	0.000719622	0.004835739	0.50047153	1		
jl0107f	0.001735931	0.013363504	0.059411274	0.786605713	0.076964141	1	
jl0107g	0.000258745	0.002506272	0.014595751	0.993969893	0.134868991	0.992115599	1
stds err	0.109572745	0.107290574	0.105357152	0.1038157	0.105318396	0.103709532	0.102536611
mean abs err	0.063766329	0.063211969	0.063747318	0.066575393	0.067701568	0.066444667	0.066215787
	jl0107a	jl0107b	jl0107c	jl0107d	jl0107e	jl0107f	jl0107g

Ch: 2 goodness of fit