

Debugging SS

Debugging: What's a bug?

A **software bug** is an error, flaw, failure, or fault in a computer program or system that causes it to produce an incorrect or unexpected result, or to behave in unintended ways.



September 9, 1947

9/9

Friday
 27th
 May 337

1545

Relay #70 Panel F
(moth) in relay.

First actual case of bug being found.
incident started.

1700 and tangent started.
1700 closed down.

Why it's important to learn debugging

“As soon as we started programming, we found to our surprise that it wasn't as easy to get programs right as we had thought. Debugging had to be discovered. I can remember the exact instant when **I realized that a large part of my life from then on was going to be spent in finding mistakes in my own programs**”.

Maurice Wilkes 1913-2010 (early computing pioneer)

Bug symptoms during run time

```
Initial statistics: 3 variables; iteration 0; function evaluation 0; phase 1
Function value -1.#IND000e+000; maximum gradient component mag 4.3026e+004
Var   Value      Gradient   !Var   Value      Gradient   !Var   Value      Gradient
 1 -1.0000  1.#QNBe+000 ! 2  0.0834  4.3026e+004 ! 3  0.0165  9.4370e+003
1 2 -log(L): 1.#QNAN  Sbio: 1.#QNAN 1.#QNAN
```

- Bad news when you see any of:
 - -1.#IND000e+000
 - #IND
 - 1.#QNANBe+000
 - 1.#QNAN
 - 1.#INF
 - -1.#INF
 - NA

Bug symptoms

```
C:\Windows\system32\cmd.exe
Error: Invalid index 0 used for array range [1, 10] in "int& ivector::operator<>
(int i)".
array bound exceeded -- index too low

C:\Juan\Courses\SIO_2013\SS3\Class\Simple>
```

```
C:\Windows\system32\cmd.exe
reading from STARTER.SS
reading from data file
Data read sucessful 999

reading forecast file
reading from control  file

C:\Juan\Courses\SIO_2013\SS3\Class\Simple>
```

```
C:\Windows\system32\cmd.exe
reading forecast file
reading from control  file
EXIT - see warning

C:\Juan\Courses\SIO_2013\SS3\Class\Simple>
```

```
C:\Windows\system32\cmd.exe
reading from STARTER.SS
CRITICAL error reading starter file 0

C:\Juan\Courses\SIO_2013\SS3\Class\Simple>
```

Debugging options in SS

Multiple options to identify why a model has problems:

- Command line messages
- echoinput.sso
- warnings.sso
- ParmTrace.sso
- ss_new files

Command line messages

- Ignore message:

Error trying to open data input file ss3.dat

ADMB looks for the default .dat file using the same name as the .exe. Not a problem since you named your own .dat

- If you get past Estimating...please wait... then the structure of the inputs is OK.

Volume of information controlled in starter.ss file

run display detail (0,1,2)

```
44 variables; iteration 70; function evaluation 92; phase 4
Function value 4.3480791e+003; maximum gradient component mag -2.5948e+003
Var Value Gradient !Var Value Gradient !Var Value Gradient
1 0.00878 -4.8265e+001 : 2 0.1010 -2.4893e+002 : 3 0.1341 -3.2733e+001
4 0.1546 -6.2460e+001 : 5 0.1688 -2.6864e+001 : 6 -0.5865 -2.5948e+003
7 0.9620 -4.8753e+000 : 8 0.5227 -1.0007e+002 : 9 -0.3251 2.6285e+001
10 0.3911 -5.7788e+001 : 11 -0.3115 2.6518e+001 : 12 -0.3115 2.6888e+001
13 0.5408 -9.8645e+001 : 14 -0.3249 2.5555e+001 : 15 -0.3202 2.6259e+001
```

0

```
44 variables; iteration 90; function evaluation 112; phase 4
Function value 4.3475519e+003; maximum gradient component mag -4.3426e-002
Var Value Gradient !Var Value Gradient !Var Value Gradient
1 0.00871 -8.3688e-004 : 2 0.1008 -4.2018e-003 : 3 0.1356 -5.8226e-004
4 0.1541 -1.1667e-003 : 5 0.1717 -3.9274e-004 : 6 -0.5863 -4.3426e-002
7 0.9808 -2.9823e-005 : 8 0.5188 -1.8357e-003 : 9 -0.3281 4.4194e-004
10 0.3972 -7.2101e-004 : 11 -0.3150 4.3585e-004 : 12 -0.3173 4.3250e-004
13 0.5391 -1.7930e-003 : 14 -0.3215 4.8449e-004 : 15 -0.3215 4.6114e-004
16 0.5297 -1.4446e-003 : 17 -0.3142 4.1373e-004 : 18 -0.3092 4.3531e-004
19 0.4311 -7.1769e-004 : 20 -0.3279 4.5272e-004 : 21 0.3885 -3.2858e-004
22 -0.3147 4.2555e-004 : 23 0.4014 -2.8296e-004 : 24 0.4344 -2.8281e-004
25 -0.3022 4.3286e-004 : 26 -0.3031 4.5500e-004 : 27 0.4008 -2.5662e-004
28 -0.2366 4.5286e-004 : 29 0.1805 3.7851e-004 : 30 -0.2535 4.8362e-004
31 0.2764 2.0910e-004 : 32 -0.1973 5.1274e-004 : 33 0.1744 4.8332e-004
34 0.2878 5.7562e-004 : 35 -0.2042 5.2575e-004 : 36 -0.1907 5.6176e-004
37 0.0117 5.6045e-004 : 38 -0.2159 4.0932e-004 : 39 0.2196 -6.7828e-005
40 -0.3898 -1.7543e-005 : 41 0.0202 -1.4865e-003 : 42 -0.2683 2.8685e-004
43 -0.2488 -4.8306e-005 : 44 -0.6782 9.7385e-005 :
4 351 -log(L): 4347.55 Sphio: 55556.1 2204.47
```

1

```
Catch 1.76319e-005 0 0 EQU_L_catch 0
4 349 -log(L): 4347.55 Sphio: 55556.2 2204.47
CPUE 0 3.19601 7.36374
LEN 1519.35 307.585 0
AGE 1718.1 350.171 0
L-at-A 104.905 91.6137 0
Recr 243.815
Parm_Priors 1.44561
Parm_devs 0
SoftBound 0.00179111
F_ballpark 0
Catch 1.76317e-005 0 0 EQU_L_catch 0
4 350 -log(L): 4347.55 Sphio: 55556.1 2204.47
44 variables; iteration 90; function evaluation 112; phase 4
Function value 4.3475519e+003; maximum gradient component mag -4.3426e-002
Var Value Gradient !Var Value Gradient !Var Value Gradient
1 0.00871 -8.3688e-004 : 2 0.1008 -4.2018e-003 : 3 0.1356 -5.8226e-004
4 0.1541 -1.1667e-003 : 5 0.1717 -3.9274e-004 : 6 -0.5863 -4.3426e-002
```

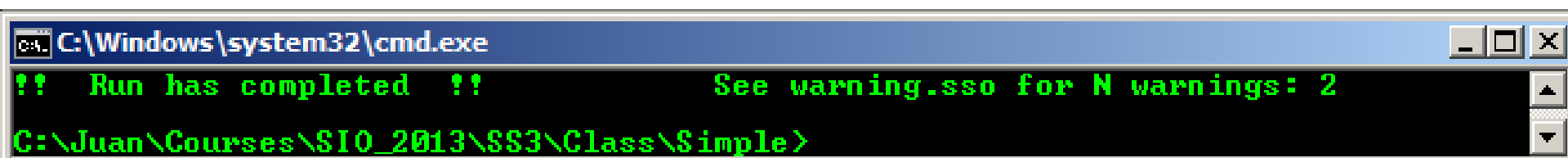
2

echoinput.sso file

- An annotated echo of the input files
- Start at bottom and read backward, looking for first mismatch with input files.
- Good things to find:
 - `finish reading starter.ss`
 - `data read successful`
 - `done reading forecast`
 - `999` If you see `999`, we got to the end of the control file successfully!

warning.sso file

- Contains a list of warnings generated during program execution.
- Note in command line if $N \text{ warnings} > 0$



```
cmd C:\Windows\system32\cmd.exe
!! Run has completed !! See warning.sso for N warnings: 2
C:\Juan\Courses\SIO_2013\SS3\Class\Simple>
```

The screenshot shows a Windows command prompt window. The title bar reads 'cmd C:\Windows\system32\cmd.exe'. The command prompt displays the message '!! Run has completed !!' in green text, followed by 'See warning.sso for N warnings: 2' in green text. The current directory is 'C:\Juan\Courses\SIO_2013\SS3\Class\Simple'.

- Includes
 - notification of errors in input files
 - some advice on parameter settings

ParmTrace.sso file

- The contents of this output can be used to determine which values are changing when a model approaches a crash condition. It also can be used to investigate patterns of parameter changes as model convergence slowly moves along a ridge

ParmTrace.sso file

- Parameter Trace
- 0=omit
- 1=write good iterations and active parms
- 2= write good iterations and all parms;
- 3= write every_iter and all parms
- 4= write every_iter and active parms

ParmTrace.sso example

4= write every_iter and active parms

Phase	Iter	ObjFun	Change	SPB_start	SPB_end	SR_LN(R0)	SizeSel_1I	SizeSel_1I	SizeSel_1I	SizeSel_1I	SizeSel_2I	SizeSel_2I
1	1	920.54	-1.00E+30	2.12E+06	533671	14.7	-3	-1.5	-0.2	0	-3	-1.5
1	2	920.519	-0.02003	2.12E+06	532433	14.699	-3	-1.5	-0.2	0	-3	-1.5
1	3	920.316	-0.20331	2.10E+06	520119	14.6893	-3	-1.5	-0.2	0	-3	-1.5
.
.
.
1	27	898.59	0	1.31E+06	46792.8	14.2202	-3	-1.5	-0.2	0	-3	-1.5
2	28	898.599	0.009442	1.31E+06	46792.8	14.2202	-3	-1.5	-0.2	0	-3	-1.5
2	29	898.579	-0.01056	1.31E+06	46793.2	14.2202	-3	-1.50001	-0.2	5.01E-05	-3	-1.50001
2	30	898.379	-0.19997	1.31E+06	46797.5	14.2202	-3.00003	-1.50016	-0.20001	0.000551	-3.00002	-1.50014

ss_new files

If the model runs, but crashes during estimation

- Run without estimating anything using

```
ss3 -noest
```

- Backup input files and replace with those produced by model, copying

```
starter.ss_new to starter.ss
```

```
forecast.ss_new to forecast.ss
```

```
control.ss_new to chosen control file name
```

```
starter.ss_new to chosen data file name
```

Bad Hessian

- Output file Report.sso includes information on parameter uncertainty
- In some cases, Hessian matrix does not invert, and Report file is not produced.
- Run model again using
`ss3 -nohess`
 - (optional) start from final values in previous run by changing starter file to:
`1 # 0=use init values in control file; 1=use ss3.par`