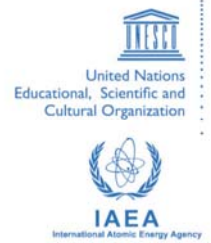




**The Abdus Salam
International Centre for Theoretical Physics**



2163-7

**College on Soil Physics: Soil Physical Properties and Processes under
Climate Change**

30 August - 10 September, 2010

**ILLUSTRATION OF AN EXAMPLE OF THE STATE-SPACE APPROACH
USING ASTSA (APPLIED STATISTICAL TIME SERIES ANALYSIS)
SOFTWARE**

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ILLUSTRATION OF AN EXAMPLE OF THE STATE-SPACE APPROACH USING ASTSA (APPLIED STATISTICAL TIME SERIES ANALYSIS) SOFTWARE

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Introduction

This text has the objective to illustrate a complete example the application of the software ASTSA. Here are some explanations on the "state" code that I have used and which was programmed by Shumway (1988):

Four columns of data (soil water content SWC, soil organic matter SOM, clay content CC, and aggregate stability AS) were normalized with respect to their mean and standard deviation using the equation:

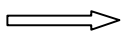
$$xsc = (Xdat - (\text{mean} - 2 \text{ std})) / 4 \text{ std}$$

The normalized data were saved as the file <trieste.prm>. Notice that the file must be saved space delimited. Tab delimited will not work!

Here follows the file <trieste.prm> with four variables data normalized.

Column

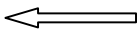
- 1: Soil water content SWC;
- 2: Soil organic matter SOM;
- 3: Clay content CC;
- 4: Aggregate stability AS.



-0.0817	1.1783	-0.0651	0.5111
-0.1539	1.0587	-0.0651	0.2936
-0.0396	1.0587	0.0967	-0.0330
-0.0034	0.7002	0.1507	0.4442
0.1109	0.6603	0.1507	0.1918
0.0748	0.7798	0.0428	0.2367

0.1410	0.9392	0.1507	0.8909
0.0989	0.7798	0.0428	0.6135
0.0267	0.7400	0.2586	0.7498
0.0989	0.5009	0.3664	0.5410
0.2554	0.6603	0.4204	0.5748
0.1049	0.5408	0.2586	0.0715
0.2614	0.5408	-0.0111	0.1582
0.5323	0.3814	0.1507	0.4226
0.3577	0.3017	0.2586	0.0277
0.4721	0.5408	0.4743	0.0735
0.2735	0.5408	0.3664	0.4618
0.3276	0.4213	0.3664	0.6484
0.4721	0.5806	0.2586	0.4675
0.3337	0.5806	0.2586	0.3581
0.3096	0.6205	0.2586	0.3658
0.3096	0.7002	0.2586	0.2168
0.3096	0.4213	0.3664	0.6131
0.5143	0.7002	0.2586	0.2267
0.4119	0.8595	0.2586	0.1310
0.4059	0.4611	0.2586	0.1796
0.5383	0.7798	0.3664	0.2447
0.4360	0.5806	0.5283	0.5690
0.4119	0.8197	0.2586	0.7771
0.5865	0.6205	0.2586	0.8517
0.3156	0.7798	0.2586	0.9207
0.5022	0.7002	0.2586	0.7734
0.2614	0.7798	0.5822	0.5531
0.8393	0.6603	0.5822	0.5864
0.6768	0.8197	0.5283	0.8059
0.5263	0.6603	0.3664	0.4886
0.4480	0.7400	0.3664	0.4963
0.9597	0.6603	0.5822	0.8014
0.6166	0.7002	0.4743	0.8946
0.7310	0.3814	0.4743	0.7546
0.6708	0.5009	0.5822	0.5214
0.5865	0.5408	0.6901	0.7599
0.6467	0.4611	0.5822	0.5013
0.7069	0.5408	0.5822	0.0820
0.7972	0.6205	0.6901	0.9715
0.7069	0.7798	0.7440	0.9135
0.8213	0.3814	0.8519	0.7024
0.9778	0.8197	0.7440	0.7722
1.0139	0.3814	0.9598	0.8831
0.8273	0.3814	0.7440	0.7423
0.8875	0.3416	0.6361	0.7337
0.7490	0.4611	0.6901	0.7010
0.5022	0.3017	0.6361	0.8282

0.4902	0.4611	0.7440	0.7394
0.3577	0.2619	0.6361	0.7193
0.6828	0.4611	0.7440	0.5703
0.3397	0.3416	0.8519	0.6928
0.5444	0.3017	1.0677	0.6860
0.7791	0.1025	0.8519	0.4432
0.5624	0.3017	0.7440	0.5005
0.5143	0.3416	0.7440	0.6512
0.6407	0.1424	0.6361	0.1482
0.5383	0.3017	0.6361	0.0685
0.5383	0.3416	0.5283	0.7079
0.7611	0.2619	0.7440	0.3923
0.6286	0.4611	0.5822	0.7513
0.6527	0.2619	0.6361	0.4966
0.5805	0.1822	0.6361	0.5096
0.7430	0.4213	0.6361	0.2894
0.5805	0.5408	0.8519	0.3124
0.5022	0.4611	0.6361	0.2658
0.5684	0.6603	0.6361	0.2837
0.5203	0.1822	0.7440	0.3282
0.4781	0.1822	0.7440	0.4282
0.5444	0.0228	0.5283	0.4342
0.5323	0.3017	0.7440	0.1223
0.7189	0.2619	0.5283	0.4290
0.6768	0.2619	0.7440	0.4600
0.7551	0.1424	0.4204	0.1213
0.7370	0.2619	0.7440	0.4851
0.6286	0.1822	0.6361	0.5698
0.6888	0.1822	0.7440	0.5451
0.6347	0.0228	0.6361	0.4054
0.4119	-0.0568	0.6361	0.3765

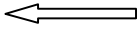


Next a parameter file is written, including file names, data information, and initial conditions for the estimation.

As an example, the file <trieste.txt> follows:

trieste.prn	(name of input data file)
trieste.out	(name of parameter output file)
strieste.out	(name of output of the estimates)
84 4	(number of data points, number of series in file)
4 4	(dimension of matrices, usually the number of series in analysis)
1 2 3 4	(column number of series that shall be used in the analysis, in this case: SWC, SOM, CC, AS)
0 0 0 0	(initial estimates of first data point of the series, will be optimized)

```
.1 0 0 0 0 .1 0 0 0 0 0 .1      (initial estimate of state covariance, the higher, the more
flexibility is given to the estimate of the first data point, this matrix is not optimized)
1 0 0 0 0 1 0 0 0 0 0 1      (initial estimate of transition matrix)
.1 0 0 0 0 .1 0 0 0 0 0 .1      (initial estimate of state covariance matrix)
.1 .1 .1 .1                    (measurement variances)
1 0 0 0 0 1 0 0 0 0 0 1      (measurement matrix)
```

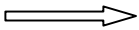


After starting the program <state>, you are asked for the name of the parameter input file, number of iterations, if you want detrending (y/n), forecasting. I usually set the number of iterations to 300, but the program is terminated when the transition matrix converges at 0.005, i.e., that the largest change of any transition coefficient from iteration k-1 to k is smaller than 0.5 %.

For this example, the solution converged after 161 iterations. Here follows the output parameter file <trieste.out> reporting the state after each iteration:

The state equation is written using the last transition matrix after the solution converged.

<trieste.out>



Iteration 1

Initial Mean

-3.372785E-02 .4251336 -1.491211E-02 .1541909

Initial Variances

.1
.1
.1
.1

Transition Matrix

.6407168 5.850731E-02 .1978915 9.451926E-02
2.977619E-02 .8061988 -1.255376E-02 .1179114
.1929867 2.282156E-02 .6598225 .1122457
.1279817 .1727082 8.834367E-02 .5957959

Relative Convergence= 1

State Covariance Matrix

4.777895E-02 1.366911E-03 5.808785E-03 3.253891E-03
1.366911E-03 5.562903E-02 9.048553E-05 5.53894E-03
5.808762E-03 9.050823E-05 4.784789E-02 3.197034E-03

3.253891E-03 5.538963E-03 3.197012E-03 5.055219E-02

Measurement Variances

4.988904E-02 .0523508 4.868516E-02 5.778823E-02

-2 log L= -407.335

Iteration 2

Initial Mean

-.1152796 .8478333 -.0891192 .2730116

Initial Variances

.1

.1

.1

.1

Transition Matrix

.5799738 5.477656E-02 .2739158 9.315998E-02

3.525546E-02 .8284709 -4.177506E-02 .1282054

.2566679 7.717549E-03 .6112735 .1205181

.1753394 .2233449 .1010427 .4968009

Relative Convergence= 1.9571

State Covariance Matrix

2.921547E-02 7.943426E-04 3.734861E-03 1.62908E-03

7.943426E-04 3.546944E-02 -.0005673 3.382047E-03

3.734884E-03 -.0005673 2.878791E-02 1.696836E-03

1.629103E-03 3.382047E-03 1.696859E-03 3.489592E-02

Measurement Variances

2.793513E-02 3.088344E-02 2.654431E-02 3.814406E-02

-2 log L= -642.3769

Iteration 3

Initial Mean

-.1888897 1.132355 -.1471604 .3444094

Initial Variances

.1

.1

.1

.1

Transition Matrix

.5706521 5.331521E-02 .3101322 7.383315E-02
 5.457015E-02 .8532363 -6.407665E-02 .1108699
 .2757021 2.724554E-03 .6165898 .1071838
 .2118337 .2430152 9.438454E-02 .4527517
 Relative Convergence= 1.832592

State Covariance Matrix

1.922601E-02 8.224078E-04 2.17633E-03 6.378492E-04
 8.224078E-04 2.336454E-02 -5.859875E-04 1.785188E-03
 2.17633E-03 -5.859875E-04 1.849109E-02 8.85532E-04
 6.378038E-04 1.785165E-03 8.855093E-04 2.693985E-02

Measurement Variances

.0178521 2.028737E-02 1.635357E-02 2.908534E-02

-2 log L= -770.0905

Iteration 4

Initial Mean

-.2359613 1.258283 -.1520735 .3850268

Initial Variances

.1
 .1
 .1
 .1

Transition Matrix

.5856861 5.681592E-02 .3175735 5.132887E-02
 7.993343E-02 .8728788 -8.167616E-02 8.620524E-02
 .2649067 5.444909E-03 .6468349 8.893599E-02
 .2432656 .2476937 7.393993E-02 .4392868
 Relative Convergence= .4996144

State Covariance Matrix

1.394771E-02 8.685475E-04 1.228469E-03 5.308787E-05
 8.685702E-04 1.668367E-02 -5.432083E-04 9.033793E-04
 1.228446E-03 -5.432765E-04 1.303037E-02 5.313101E-04
 5.313328E-05 9.03402E-04 5.313101E-04 .0229566

Measurement Variances

1.295993E-02 1.497972E-02 1.134515E-02 2.473415E-02

-2 log L= -852.2478

Iteration 5

Initial Mean

-.2713971 1.294603 -.1255844 .4148268

Initial Variances

.1
.1
.1
.1

Transition Matrix

.6128565 6.132196E-02 .3069336 3.216751E-02
.1017085 .889752 -9.540257E-02 6.350477E-02
.2398663 9.150032E-03 .68624 7.315328E-02
.2705551 .2452787 4.671833E-02 .442321
Relative Convergence= .5956743

State Covariance Matrix

1.114759E-02 8.380073E-04 6.773812E-04 -3.20321E-04
8.379164E-04 1.298818E-02 -5.197071E-04 4.286085E-04
6.773812E-04 -5.19639E-04 1.012614E-02 4.429136E-04
-3.203437E-04 4.286539E-04 4.428909E-04 2.098011E-02

Measurement Variances

1.053895E-02 1.238334E-02 8.785712E-03 2.254251E-02

-2 log L= -898.1995

Iteration 6

Initial Mean

-.2982231 1.298585 -9.806863E-02 .4434789

Initial Variances

.1
.1
.1
.1

Transition Matrix

.6434181 6.530818E-02 .2877316 1.787391E-02
.1158994 .9033315 -.1032855 4.538414E-02
.2126692 .0121844 .7233818 6.149401E-02

.293426 .2399693 1.943856E-02 .452062
 Relative Convergence= 1.403384

State Covariance Matrix

9.592919E-03 7.603509E-04 3.628958E-04 -5.867595E-04
 7.603736E-04 1.081124E-02 -4.965464E-04 1.713889E-04
 3.629185E-04 -4.965918E-04 8.533727E-03 5.015192E-04
 -5.867822E-04 1.713889E-04 5.015192E-04 1.999492E-02

Measurement Variances

9.354251E-03 1.120008E-02 7.449064E-03 2.135839E-02

-2 log L= -920.9266

Iteration 7

Initial Mean

-.3119591 1.293073 -8.339319E-02 .4720712

Initial Variances

.1
 .1
 .1
 .1

Transition Matrix

.6716315 6.827747E-02 .2673269 7.714958E-03
 .1231695 .9136918 -.1057778 3.162174E-02
 .1898088 .0147303 .7527502 5.327141E-02
 .3123203 .2340732 -4.38959E-03 .4626388
 Relative Convergence= 5.428331

State Covariance Matrix

8.645738E-03 6.629172E-04 1.937321E-04 -7.933208E-04
 6.629172E-04 9.408428E-03 -4.74067E-04 3.880546E-05
 1.937548E-04 -4.739534E-04 7.616383E-03 6.311734E-04
 -7.933208E-04 3.880546E-05 6.311734E-04 1.949901E-02

Measurement Variances

8.815379E-03 1.076287E-02 6.754411E-03 2.065831E-02

-2 log L= -931.4516

Iteration 8

Initial Mean

-.3146417 1.28448 -7.963976E-02 .498886

Initial Variances

.1

.1

.1

.1

Transition Matrix

.6952621 7.025459E-02 .249358 4.491503E-04

.1261697 .9216494 -.1051944 2.119587E-02

.1728642 1.694005E-02 .7738699 4.746347E-02

.3282776 .2287506 -2.411999E-02 .4713792

Relative Convergence= 16.17678

State Covariance Matrix

7.991564E-03 5.635534E-04 1.132148E-04 -9.59578E-04

5.635761E-04 8.415063E-03 -4.570825E-04 -2.077648E-05

1.132148E-04 -4.571279E-04 7.052512E-03 7.85646E-04

-9.596007E-04 -2.077648E-05 7.85646E-04 1.925162E-02

Measurement Variances

8.627383E-03 1.071551E-02 6.410447E-03 2.020407E-02

-2 log L= -936.4449

Iteration 9

Initial Mean

-.3121418 1.275184 -8.062802E-02 .522824

Initial Variances

.1

.1

.1

.1

Transition Matrix

.7144006 7.155549E-02 .2345748 -4.964057E-03

.1271848 .9279749 -.1035091 1.311821E-02

.1610143 .0187734 .7885057 4.325982E-02

.3421948 .2244364 -4.034141E-02 .4776358

Relative Convergence= 1.09048

State Covariance Matrix

7.482847E-03 4.72364E-04 8.387792E-05 -1.094795E-03
4.723413E-04 7.652896E-03 -4.474549E-04 -3.919147E-05
8.387792E-05 -4.473868E-04 6.678036E-03 9.402321E-04
-1.09475E-03 -3.916877E-05 9.402321E-04 1.913738E-02

Measurement Variances

8.634467E-03 1.086087E-02 6.262126E-03 1.988349E-02

-2 log L= -939.1515

Iteration 10

Initial Mean

-.3086857 1.266443 -8.236866E-02 .5438919

Initial Variances

.1
.1
.1
.1

Transition Matrix

.7300029 7.248756E-02 .2224687 -9.201016E-03
.1275145 .9331605 -.1017367 6.661829E-03
.1528817 2.021222E-02 .7986832 4.008315E-02
.3546474 .2211608 -5.387045E-02 .4816693

Relative Convergence= .9691607

State Covariance Matrix

7.052263E-03 3.923688E-04 8.122126E-05 -1.205785E-03
3.923688E-04 7.034551E-03 -4.434132E-04 -3.64894E-05
8.124397E-05 -4.434586E-04 6.40742E-03 1.083079E-03
-1.205785E-03 -3.65121E-05 1.083056E-03 1.909853E-02

Measurement Variances

8.749408E-03 1.108919E-02 6.22345E-03 1.963984E-02

-2 log L= -940.9309

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Iteration 151

Initial Mean

-.314539 1.266497 -1.937176E-02 1.17581

Initial Variances

.1
.1
.1
.1

Transition Matrix

.9116966 7.074924E-02 6.094342E-02 -2.421624E-02
.1793628 .9712795 -.12503 -5.170462E-02
.0495155 3.390892E-02 .9456304 -1.238308E-02
.7035516 .2574961 -.2942737 .3375235

Relative Convergence= 6.552606E-03

State Covariance Matrix

1.203469E-03 -8.34624E-04 2.042453E-04 -2.68918E-03
-8.347148E-04 1.993111E-03 -6.522224E-04 -3.432319E-04
2.04268E-04 -6.522224E-04 6.404831E-04 2.451034E-03
-2.689203E-03 -3.431411E-04 2.451011E-03 2.993527E-02

Measurement Variances

1.401541E-02 1.456829E-02 1.131318E-02 7.612207E-03

-2 log L= -962.1385

Iteration 152

Initial Mean

-.314459 1.266535 -1.935858E-02 1.177021

Initial Variances

.1
.1
.1
.1

Transition Matrix

.9118998 7.070215E-02 6.072339E-02 -2.414808E-02
.1793132 .971301 -.1249462 -5.175339E-02
4.944421E-02 .0339409 .9457557 -1.246123E-02
.7040113 .2576459 -.2944752 .3371176
Relative Convergence= 6.271158E-03

State Covariance Matrix

1.199064E-03 -8.360545E-04 2.040636E-04 -2.690565E-03
-8.360545E-04 1.993157E-03 -6.540162E-04 -3.423918E-04
2.040409E-04 -6.540389E-04 6.37009E-04 2.453077E-03
-2.690588E-03 -3.424145E-04 2.453077E-03 2.998193E-02

Measurement Variances

1.402248E-02 1.456999E-02 1.131774E-02 7.567519E-03

-2 log L= -962.1896

Iteration 153

Initial Mean

-.3143882 1.266583 -.0193397 1.178224

Initial Variances

.1
.1
.1
.1

Transition Matrix

.9121155 7.065187E-02 6.048978E-02 -2.407492E-02
.1792565 .9713231 -.1248571 -5.180087E-02
.0493689 3.397367E-02 .9458869 -1.253962E-02
.7044846 .2578006 -.2946918 .336718
Relative Convergence= 6.251413E-03

State Covariance Matrix

1.194931E-03 -8.370536E-04 2.039728E-04 -2.691814E-03

-8.370536E-04 1.993066E-03 -6.556511E-04 -3.415743E-04
 2.039728E-04 -6.55583E-04 6.334441E-04 2.455325E-03
 -2.691814E-03 -3.415516E-04 2.455348E-03 3.002805E-02

Measurement Variances

1.402997E-02 1.457183E-02 1.132201E-02 7.523174E-03

-2 log L= -962.239

Iteration 154

Initial Mean

-.3143073 1.266628 -1.931766E-02 1.179412

Initial Variances

.1
 .1
 .1
 .1

Transition Matrix

.9123184 7.060064E-02 6.026707E-02 -2.400573E-02
 .1791884 .9713447 -.1247562 -5.184706E-02
 4.929478E-02 3.400236E-02 .9460136 -1.261372E-02
 .7049698 .2579525 -.2949183 .3363223

Relative Convergence= 5.874609E-03

State Covariance Matrix

1.190753E-03 -8.378029E-04 2.040182E-04 -2.692926E-03
 -8.377348E-04 1.993202E-03 -6.569453E-04 -3.406434E-04
 2.039274E-04 -6.569226E-04 6.302198E-04 2.45755E-03
 -2.692926E-03 -3.406434E-04 2.457528E-03 3.007376E-02

Measurement Variances

1.403706E-02 1.457363E-02 1.132631E-02 7.479152E-03

-2 log L= -962.2899

Iteration 155

Initial Mean

-.3142131 1.266672 -1.928869E-02 1.180585

Initial Variances

.1
 .1

.1
.1

Transition Matrix

.9125299 7.055014E-02 6.003026E-02 -2.393388E-02
.1791274 .9713651 -.1246689 -5.189018E-02
4.927509E-02 3.402956E-02 .94608 -1.268555E-02
.7054525 .2580997 -.2951491 .3359331
Relative Convergence= 5.662137E-03

State Covariance Matrix

1.18653E-03 -8.385749E-04 2.034959E-04 -2.694244E-03
-8.385976E-04 1.993338E-03 -6.584894E-04 -3.397578E-04
2.034959E-04 -6.58444E-04 6.272452E-04 2.459526E-03
-2.69413E-03 -3.397351E-04 2.459526E-03 3.011928E-02

Measurement Variances

1.404384E-02 1.457504E-02 1.133027E-02 7.435463E-03

-2 log L= -962.3367

Iteration 156

Initial Mean

-.3141214 1.266722 -1.923562E-02 1.18175

Initial Variances

.1
.1
.1
.1

Transition Matrix

.9127292 7.049928E-02 5.981822E-02 -2.386548E-02
.1790894 .9713818 -.1246036 -.0519299
4.920281E-02 3.405834E-02 .9462044 -1.276023E-02
.7059179 .2582442 -.295366 .3355429
Relative Convergence= 5.852484E-03

State Covariance Matrix

1.182125E-03 -8.395513E-04 2.033824E-04 -2.69547E-03
-8.395286E-04 1.993475E-03 -6.598291E-04 -3.388723E-04
2.03337E-04 -6.598518E-04 6.242025E-04 2.461706E-03
-2.695447E-03 -3.389404E-04 2.461729E-03 3.016433E-02

Measurement Variances

1.405094E-02 1.457641E-02 1.133393E-02 7.392102E-03

-2 log L= -962.3804

Iteration 157

Initial Mean

-.3140348 1.266782 -1.920905E-02 1.182904

Initial Variances

.1

.1

.1

.1

Transition Matrix

.9129323 7.045013E-02 5.959442E-02 -2.379506E-02

.1790309 .9713993 -.1245198 -.0519688

4.915746E-02 .03409 .9463015 -1.283392E-02

.706398 .2583881 -.2955983 .3351618

Relative Convergence= 5.741958E-03

State Covariance Matrix

1.177969E-03 -8.40346E-04 2.031553E-04 -2.696673E-03

-8.40346E-04 1.993656E-03 -6.614866E-04 -3.381002E-04

2.031553E-04 -6.614639E-04 6.213869E-04 2.46384E-03

-2.696696E-03 -3.380775E-04 2.463818E-03 3.020895E-02

Measurement Variances

.0140583 1.457779E-02 1.133762E-02 7.34906E-03

-2 log L= -962.4266

Iteration 158

Initial Mean

-.313949 1.266825 -1.919103E-02 1.184049

Initial Variances

.1

.1

.1

.1

Transition Matrix

.9131084 7.040338E-02 5.939914E-02 -2.372814E-02
 .1789733 .9714177 -.1244314 -5.200982E-02
 4.908198E-02 .0341204 .9464264 -1.290746E-02
 .7068518 .2585291 -.2958037 .3347822
 Relative Convergence= 5.697411E-03

State Covariance Matrix

1.174223E-03 -8.41277E-04 2.030418E-04 -2.697672E-03
 -8.411861E-04 1.993792E-03 -6.63008E-04 -3.372601E-04
 2.030418E-04 -6.629853E-04 6.184124E-04 2.466134E-03
 -2.697672E-03 -3.373055E-04 2.466134E-03 3.025357E-02

Measurement Variances

.0140654 1.457915E-02 1.134103E-02 7.306337E-03

-2 log L= -962.4721

Iteration 159

Initial Mean

-.3138728 1.266866 -1.918311E-02 1.185186

Initial Variances

.1
 .1
 .1
 .1

Transition Matrix

.9132943 7.035724E-02 5.918963E-02 -.0236625
 .1788968 .9714358 -.1243284 -5.205032E-02
 4.901125E-02 3.414841E-02 .9465407 -1.297572E-02
 .7073107 .2586669 -.296023 .3344114
 Relative Convergence= 5.260693E-03

State Covariance Matrix

1.170408E-03 -8.417993E-04 2.032007E-04 -2.698717E-03
 -8.418447E-04 1.993974E-03 -6.642115E-04 -3.3642E-04
 2.031553E-04 -6.643023E-04 6.157557E-04 2.468586E-03
 -2.698671E-03 -3.363973E-04 2.468563E-03 3.029778E-02

Measurement Variances

1.407188E-02 1.458052E-02 1.134457E-02 7.263911E-03

-2 log L= -962.5181

Iteration 160

Initial Mean

-.3137919 1.266902 -1.916699E-02 1.186313

Initial Variances

.1

.1

.1

.1

Transition Matrix

.9134971 7.031218E-02 5.897249E-02 -2.359585E-02

.1788591 .9714511 -.1242591 -.0520863

4.898128E-02 3.418268E-02 .9466231 -1.305107E-02

.7077752 .2587962 -.2962493 .3340505

Relative Convergence= 5.773157E-03

State Covariance Matrix

1.166389E-03 -8.42821E-04 2.026785E-04 -2.69992E-03

-8.429118E-04 1.994088E-03 -6.663913E-04 -3.357161E-04

2.027239E-04 -6.66255E-04 6.129628E-04 2.470584E-03

-2.699897E-03 -3.356252E-04 2.47063E-03 .0303416

Measurement Variances

1.407812E-02 1.458174E-02 1.134782E-02 7.221805E-03

-2 log L= -962.5623

Iteration 161

Initial Mean

-.3137077 1.266942 -1.916385E-02 1.187429

Initial Variances

.1

.1

.1

.1

Transition Matrix

.9136859 7.026269E-02 5.876194E-02 -2.353143E-02

.1788296 .9714648 -.1242072 -5.212222E-02

4.891815E-02 .0342045 .9467272 -1.311319E-02

.7082351 .2589375 -.2964616 .3336791

Relative Convergence= 4.737651E-03

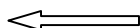
State Covariance Matrix

1.162234E-03 -8.438428E-04 2.028829E-04 -2.700987E-03
 -8.436384E-04 1.99411E-03 -6.667546E-04 -3.347397E-04
 2.026785E-04 -6.668681E-04 6.104424E-04 2.472968E-03
 -2.700896E-03 -3.348759E-04 2.473059E-03 3.038497E-02

Measurement Variances

.0140851 1.458339E-02 1.135101E-02 7.179997E-03

-2 log L= -962.6094

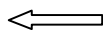


The respective estimates for the series are given in the output file of estimates <strieste.out>

Innovation residues				Normalized estimated values				Standard deviations			
SWC	SOM	CC	AS	SWC	SOM	CC	AS	SWC	SOM	CC	AS
0.1450	0.0631	-0.0594	0.0034	-0.2267	1.1152	-0.0056	0.5092	0.0530	0.0673	0.0464	0.0786
-0.1136	-0.0359	-0.0434	-0.1164	-0.1436	1.0152	0.0144	0.2879	0.0458	0.0572	0.0424	0.0768
-0.0170	0.0470	0.1119	-0.3583	-0.0417	0.9332	0.0262	0.0433	0.0422	0.0527	0.0395	0.0766
-0.0503	-0.2723	0.1114	0.1930	0.0221	0.8638	0.0778	0.3993	0.0404	0.0507	0.0372	0.0764
0.0217	-0.1695	0.0443	-0.1720	0.0888	0.8114	0.0883	0.2167	0.0395	0.0498	0.0354	0.0763
-0.0695	0.0428	-0.0963	-0.0698	0.1292	0.8072	0.0990	0.2736	0.0390	0.0494	0.0340	0.0762
-0.0272	0.2107	0.0147	0.5579	0.1197	0.7995	0.1510	0.8002	0.0388	0.0493	0.0330	0.0761
-0.0873	0.0284	-0.1285	0.0780	0.1360	0.7442	0.1701	0.6169	0.0386	0.0492	0.0321	0.0761
-0.1673	0.0115	0.0887	0.2836	0.1440	0.6853	0.2099	0.7130	0.0385	0.0491	0.0315	0.0760
-0.0923	-0.1797	0.1638	0.0600	0.1724	0.6091	0.2344	0.5446	0.0385	0.0491	0.0310	0.0760
0.0448	0.0860	0.1767	0.1770	0.1855	0.5634	0.2553	0.5335	0.0384	0.0490	0.0306	0.0760
-0.1462	-0.0110	-0.0240	-0.3439	0.2284	0.5256	0.2380	0.1271	0.0384	0.0490	0.0303	0.0760
0.0021	0.0121	-0.2776	-0.1151	0.2697	0.5086	0.2445	0.1742	0.0384	0.0490	0.0301	0.0760
0.2604	-0.1607	-0.0921	0.1173	0.3046	0.4718	0.2767	0.3768	0.0384	0.0490	0.0300	0.0760
0.0281	-0.1909	-0.0175	-0.3788	0.3516	0.4512	0.2693	0.0837	0.0384	0.0490	0.0299	0.0760
0.1137	0.1020	0.1943	-0.2344	0.3816	0.4754	0.2707	0.1289	0.0384	0.0490	0.0298	0.0760
-0.1365	0.0773	0.0613	0.1071	0.3724	0.5090	0.2887	0.4536	0.0384	0.0490	0.0297	0.0760
-0.0646	-0.0572	0.0463	0.1927	0.3583	0.5154	0.3071	0.6079	0.0384	0.0490	0.0297	0.0760
0.0892	0.1369	-0.0871	-0.0250	0.3520	0.5281	0.3006	0.4622	0.0384	0.0490	0.0297	0.0760
-0.0700	0.0994	-0.0844	-0.1071	0.3490	0.5503	0.2920	0.3717	0.0384	0.0490	0.0296	0.0760
-0.0898	0.1103	-0.0733	-0.0731	0.3498	0.5737	0.2892	0.3678	0.0384	0.0490	0.0296	0.0760
-0.0837	0.1590	-0.0650	-0.2280	0.3680	0.5908	0.2823	0.2682	0.0384	0.0490	0.0296	0.0760
-0.0878	-0.1679	0.0585	0.1921	0.3699	0.5940	0.3105	0.5597	0.0384	0.0490	0.0296	0.0760
0.1238	0.1788	-0.0853	-0.2766	0.3938	0.6087	0.2932	0.2573	0.0384	0.0490	0.0296	0.0760
-0.0204	0.2815	-0.0737	-0.3111	0.4230	0.6412	0.2828	0.1751	0.0384	0.0490	0.0296	0.0760
-0.0462	-0.2106	-0.0538	-0.2742	0.4682	0.6511	0.2902	0.2100	0.0384	0.0490	0.0296	0.0760
0.0744	0.1598	0.0430	-0.2158	0.5023	0.6863	0.2966	0.2848	0.0384	0.0490	0.0296	0.0760

-0.0660	-0.0922	0.1934	0.0499		0.5150	0.7123	0.3231	0.5638		0.0384	0.0490	0.0296	0.0760
-0.0977	0.1907	-0.1225	0.1770		0.5034	0.7468	0.3410	0.7434		0.0384	0.0490	0.0296	0.0760
0.0979	-0.0614	-0.1216	0.1919		0.5026	0.7454	0.3662	0.8144		0.0384	0.0490	0.0296	0.0760
-0.1883	0.1229	-0.1450	0.2392		0.4850	0.7544	0.3879	0.8743		0.0384	0.0490	0.0296	0.0760
0.0386	0.0214	-0.1410	0.0923		0.4980	0.7336	0.4074	0.7452		0.0384	0.0490	0.0296	0.0760
-0.2128	0.1067	0.1761	-0.0880		0.5278	0.7170	0.4215	0.5747		0.0384	0.0490	0.0296	0.0760
0.3740	-0.0090	0.1632	0.0180		0.5714	0.6918	0.4491	0.5875		0.0384	0.0490	0.0296	0.0760
0.1158	0.1748	0.0529	0.1887		0.5710	0.6973	0.4744	0.7601		0.0384	0.0490	0.0296	0.0760
-0.0645	-0.0199	-0.1382	-0.2172		0.5951	0.6871	0.4723	0.5150		0.0384	0.0490	0.0296	0.0760
-0.1406	0.0631	-0.1264	-0.1213		0.6240	0.6859	0.4857	0.5230		0.0384	0.0490	0.0296	0.0760
0.3878	-0.0378	0.1023	0.1900		0.6512	0.6546	0.5320	0.7738		0.0384	0.0490	0.0296	0.0760
-0.0384	0.0263	-0.0685	0.1581		0.6475	0.6303	0.5632	0.8667		0.0384	0.0490	0.0296	0.0760
0.0874	-0.2923	-0.0819	-0.0044		0.6662	0.5795	0.5875	0.7421		0.0384	0.0490	0.0296	0.0760
0.0130	-0.0830	0.0007	-0.1780		0.6859	0.5625	0.5944	0.5611		0.0384	0.0490	0.0296	0.0760
-0.0814	-0.0164	0.1004	0.1313		0.6845	0.5617	0.6202	0.7295		0.0384	0.0490	0.0296	0.0760
-0.0083	-0.0749	-0.0325	-0.1719		0.7100	0.5512	0.6202	0.5028		0.0384	0.0490	0.0296	0.0760
0.0484	0.0291	-0.0327	-0.5132		0.7650	0.5646	0.6042	0.1933		0.0384	0.0490	0.0296	0.0760
0.1107	0.0858	0.0927	0.4720		0.7559	0.5918	0.6602	0.8935		0.0384	0.0490	0.0296	0.0760
0.0097	0.2309	0.0982	0.1633		0.7537	0.5734	0.6861	0.8881		0.0384	0.0490	0.0296	0.0760
0.1211	-0.2128	0.1898	-0.0558		0.7830	0.5212	0.7073	0.7164		0.0384	0.0490	0.0296	0.0760
0.2424	0.3122	0.0379	0.0841		0.7863	0.5073	0.7265	0.7694		0.0384	0.0490	0.0296	0.0760
0.2334	-0.2121	0.2396	0.1312		0.7886	0.4546	0.7586	0.8619		0.0384	0.0490	0.0296	0.0760
-0.0015	-0.1265	-0.0419	-0.0420		0.7718	0.4324	0.7585	0.7479		0.0384	0.0490	0.0296	0.0760
0.0696	-0.1289	-0.1551	0.0092		0.7478	0.4248	0.7569	0.7269		0.0384	0.0490	0.0296	0.0760
-0.0624	0.0178	-0.0999	-0.0045		0.7130	0.4316	0.7502	0.7118		0.0384	0.0490	0.0296	0.0760
-0.2832	-0.1510	-0.1422	0.1449		0.6690	0.4315	0.7531	0.8061		0.0384	0.0490	0.0296	0.0760
-0.2209	0.0575	-0.0203	0.0827		0.6372	0.4236	0.7491	0.7361		0.0384	0.0490	0.0296	0.0760
-0.3057	-0.1388	-0.1135	0.1195		0.6183	0.4016	0.7507	0.6977		0.0384	0.0490	0.0296	0.0760
0.0878	0.1205	0.0136	0.0402		0.6205	0.3759	0.7500	0.5777		0.0384	0.0490	0.0296	0.0760
-0.2753	-0.0128	0.1238	0.1910		0.6102	0.3477	0.7637	0.6750		0.0384	0.0490	0.0296	0.0760
-0.0227	-0.0098	0.3362	0.1942		0.6145	0.2980	0.7768	0.6555		0.0384	0.0490	0.0296	0.0760
0.1994	-0.1490	0.0836	-0.0316		0.6289	0.2611	0.7648	0.4443		0.0384	0.0490	0.0296	0.0760
-0.0598	0.1186	-0.0403	0.0919		0.6092	0.2765	0.7492	0.4872		0.0384	0.0490	0.0296	0.0760
-0.0882	0.1372	-0.0208	0.2330		0.5843	0.2810	0.7429	0.5869		0.0384	0.0490	0.0296	0.0760
0.0652	-0.0802	-0.1162	-0.3032		0.6082	0.2687	0.7045	0.1770		0.0384	0.0490	0.0296	0.0760
-0.0524	0.1034	-0.0868	-0.2505		0.6253	0.3028	0.6748	0.1228		0.0384	0.0490	0.0296	0.0760
-0.0464	0.1064	-0.1583	0.4034		0.6032	0.3319	0.6927	0.6202		0.0384	0.0490	0.0296	0.0760
0.2089	-0.0012	0.0664	-0.0820		0.6180	0.3155	0.6833	0.4190		0.0384	0.0490	0.0296	0.0760
0.0315	0.2137	-0.1045	0.3294		0.5864	0.3307	0.6945	0.6898		0.0384	0.0490	0.0296	0.0760
0.0694	-0.0404	-0.0426	-0.0308		0.5844	0.3062	0.6885	0.5054		0.0384	0.0490	0.0296	0.0760
-0.0120	-0.0982	-0.0385	0.0467		0.5729	0.3009	0.6863	0.4948		0.0384	0.0490	0.0296	0.0760
0.1607	0.1783	-0.0372	-0.1575		0.5691	0.3137	0.6663	0.3218		0.0384	0.0490	0.0296	0.0760
-0.0333	0.2435	0.1941	-0.1104		0.5564	0.3355	0.6553	0.3448		0.0384	0.0490	0.0296	0.0760
-0.1209	0.1078	-0.0228	-0.1858		0.5515	0.3442	0.6408	0.3051		0.0384	0.0490	0.0296	0.0760
-0.0387	0.2752	-0.0007	-0.1553		0.5553	0.3388	0.6362	0.3241		0.0384	0.0491	0.0297	0.0760
-0.0908	-0.2831	0.1270	-0.1434		0.5761	0.2897	0.6482	0.3641		0.0385	0.0491	0.0297	0.0760
-0.1307	-0.1862	0.1056	-0.0276		0.5810	0.2574	0.6572	0.4373		0.0385	0.0491	0.0297	0.0760
-0.0454	-0.2752	-0.1235	-0.0157		0.5862	0.2300	0.6577	0.4149		0.0387	0.0492	0.0298	0.0760
-0.0367	0.0829	0.0971	-0.2931		0.6070	0.2258	0.6371	0.1829		0.0388	0.0493	0.0299	0.0760
0.1442	0.0255	-0.1040	0.0892		0.6110	0.2255	0.6470	0.4084		0.0391	0.0494	0.0300	0.0760

0.0886	0.0088	0.1130	0.0253		0.6146	0.2062	0.6535	0.4426		0.0395	0.0497	0.0301	0.0760
0.1509	-0.1026	-0.2266	-0.3369		0.6404	0.1882	0.6351	0.1810		0.0401	0.0501	0.0304	0.0760
0.1147	0.0185	0.1258	0.1073		0.6332	0.1865	0.6543	0.4785		0.0410	0.0508	0.0307	0.0760
-0.0092	-0.0642	-0.0073	0.0812		0.6157	0.1662	0.6650	0.5624		0.0424	0.0520	0.0312	0.0760
0.0685	-0.0449	0.0960	0.0450		0.6013	0.1339	0.6718	0.5414		0.0446	0.0542	0.0319	0.0761
0.0097	-0.1817	-0.0274	-0.0828		0.5912	0.1040	0.6660	0.4198		0.0478	0.0582	0.0332	0.0761
-0.2020	-0.2108	-0.0256	-0.0489		0.5745	0.0931	0.6581	0.3845		0.0528	0.0658	0.0355	0.0767



The number of columns of this file is 3 times the number of variables in the analysis, i.e. in this case 12 columns. The first block of four columns includes the innovation residuals for variables 1, 2, 3, 4. The second block of columns (6-9) includes the normalized estimates of soil water content SWC, soil organic matter SOM, clay content CC, and aggregate stability AS, and the third block (11-14) are the standard errors of estimation for the four variables.

I recommend Shumway's book (Shumway, 1988 and Shumway & Stoffer, 2000) as an important reference to study.

Acknowledgments

To CNPq and FAPERGS for financial support.

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