Dynamic SEM on ESM Data

Structural Equation Modeling Course Project - KU Leuven

MohammadHossein Manuel Haqiqatkhah - R0607671

2019-08-23

Introduction

Experience sampling method (ESM)

```
m_pa.na.simp <- "

  pa.1 =~ mood_relaxed.1 + sat.f*mood_satisfi.1 + ent.f*mood_enthus.1 + che.f*mood_cheerf.1 + str.f*mood

  na.1 =~ dow.f*mood_down.1 + irr.f*mood_irritat.1 + lon.f*mood_lonely.1 + anx.f*mood_anxious.1 + sus.f

  pa.1 ~~ na.1

"

f_pa.na.simp <- sem(m_pa.na.simp, data = d.l, std.lv = TRUE)

f_pa.na.simp %>% summary(standardized = TRUE) %>% kable(format = "latex")
```

```
## lavaan 0.6-4 ended normally after 42 iterations
##
##   Optimization method                           NLMINB
##   Number of free parameters                         25
##
##                                                   Used       Total
##   Number of observations                          1473        1476
##
##   Estimator                                         ML
##   Model Fit Test Statistic                    2007.575
##   Degrees of freedom                                53
##   P-value (Chi-square)                           0.000
##
## Parameter Estimates:
##
##   Information                                 Expected
##   Information saturated (h1) model          Structured
##   Standard Errors                             Standard
##
## Latent Variables:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   pa.1 =~
##     md_rl.1           0.504    0.018   28.785    0.000    0.504    0.677
##     md_st.1 (st.f)    0.870    0.021   42.386    0.000    0.870    0.882
##     md_nt.1 (ent.)    0.733    0.018   39.933    0.000    0.733    0.851
```

```
##     md_ch.1 (ch.f)    0.730    0.018   41.052    0.000    0.730    0.865
##     md_st.1 (str.)    0.727    0.019   39.103    0.000    0.727    0.839
##   na.1 =~
##     md_dw.1 (dw.f)    0.641    0.016   40.486    0.000    0.641    0.866
##     md_rr.1 (irr.)    0.327    0.031   10.421    0.000    0.327    0.279
##     md_ln.1 (ln.f)    0.409    0.011   38.897    0.000    0.409    0.844
##     md_nx.1 (anx.)    0.187    0.008   24.493    0.000    0.187    0.603
##     md_ss.1 (ss.f)    0.308    0.014   22.176    0.000    0.308    0.555
##     md_gl.1 (gu.f)    0.358    0.011   33.979    0.000    0.358    0.771
##     md_db.1 (do.f)    0.498    0.022   22.974    0.000    0.498    0.572
##
## Covariances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##   pa.1 ~~
##     na.1             -0.748    0.014  -52.651    0.000   -0.748   -0.748
##
## Variances:
##                    Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
##    .mood_relaxed.1    0.300    0.012   25.400    0.000    0.300    0.541
##    .mood_satisfi.1    0.215    0.011   19.759    0.000    0.215    0.221
##    .mood_enthus.1     0.205    0.009   21.673    0.000    0.205    0.277
##    .mood_cheerf.1     0.179    0.009   20.894    0.000    0.179    0.251
##    .mood_strong.1     0.222    0.010   22.169    0.000    0.222    0.296
##    .mood_down.1       0.137    0.007   18.340    0.000    0.137    0.250
##    .mood_irritat.1    1.260    0.047   26.899    0.000    1.260    0.922
##    .mood_lonely.1     0.067    0.003   19.837    0.000    0.067    0.287
##    .mood_anxious.1    0.061    0.002   25.513    0.000    0.061    0.637
##    .mood_suspic.1     0.213    0.008   25.871    0.000    0.213    0.692
##    .mood_guilty.1     0.087    0.004   22.887    0.000    0.087    0.405
##    .mood_doubt.1      0.510    0.020   25.756    0.000    0.510    0.673
##     pa.1              1.000                              1.000    1.000
##     na.1              1.000                              1.000    1.000
```

```
f_pa.na.simp %>% fitmeasures() %>% kable(format = "latex")
```

lhs	op	rhs	label	exo	est	se	z	pvalue	std.lv	
pa.1	=~	mood_relaxed.1		0	0.5044226	0.0175241	28.78454	0	0.5044226	0.
pa.1	=~	mood_satisfi.1	sat.f	0	0.8701933	0.0205300	42.38635	0	0.8701933	0.
pa.1	=~	mood_enthus.1	ent.f	0	0.7326649	0.0183471	39.93349	0	0.7326649	0.
pa.1	=~	mood_cheerf.1	che.f	0	0.7302201	0.0177878	41.05182	0	0.7302201	0.
pa.1	=~	mood_strong.1	str.f	0	0.7269635	0.0185909	39.10312	0	0.7269635	0.
na.1	=~	mood_down.1	dow.f	0	0.6407339	0.0158261	40.48591	0	0.6407339	0.
na.1	=~	mood_irritat.1	irr.f	0	0.3265554	0.0313377	10.42054	0	0.3265554	0.
na.1	=~	mood_lonely.1	lon.f	0	0.4091703	0.0105194	38.89691	0	0.4091703	0.
na.1	=~	mood_anxious.1	anx.f	0	0.1866864	0.0076222	24.49261	0	0.1866864	0.
na.1	=~	mood_suspic.1	sus.f	0	0.3080713	0.0138919	22.17627	0	0.3080713	0.
na.1	=~	mood_guilty.1	gui.f	0	0.3576612	0.0105261	33.97861	0	0.3576612	0.
na.1	=~	mood_doubt.1	dou.f	0	0.4979041	0.0216721	22.97448	0	0.4979041	0.
pa.1	~~	na.1		0	-0.7484952	0.0142162	-52.65082	0	-0.7484952	-0.
mood_relaxed.1	~~	mood_relaxed.1		0	0.3000788	0.0118140	25.40022	0	0.3000788	0.
mood_satisfi.1	~~	mood_satisfi.1		0	0.2151375	0.0108878	19.75949	0	0.2151375	0.
mood_enthus.1	~~	mood_enthus.1		0	0.2051689	0.0094666	21.67298	0	0.2051689	0.
mood_cheerf.1	~~	mood_cheerf.1		0	0.1788457	0.0085597	20.89386	0	0.1788457	0.
mood_strong.1	~~	mood_strong.1		0	0.2216833	0.0099996	22.16912	0	0.2216833	0.
mood_down.1	~~	mood_down.1		0	0.1366204	0.0074494	18.33973	0	0.1366204	0.
mood_irritat.1	~~	mood_irritat.1		0	1.2602615	0.0468509	26.89943	0	1.2602615	0.
mood_lonely.1	~~	mood_lonely.1		0	0.0674456	0.0034000	19.83690	0	0.0674456	0.
mood_anxious.1	~~	mood_anxious.1		0	0.0611087	0.0023952	25.51336	0	0.0611087	0.
mood_suspic.1	~~	mood_suspic.1		0	0.2128483	0.0082274	25.87074	0	0.2128483	0.
mood_guilty.1	~~	mood_guilty.1		0	0.0871821	0.0038092	22.88696	0	0.0871821	0.
mood_doubt.1	~~	mood_doubt.1		0	0.5100244	0.0198025	25.75552	0	0.5100244	0.
pa.1	~~	pa.1		0	1.0000000	0.0000000	NA	NA	1.0000000	1.
na.1	~~	na.1		0	1.0000000	0.0000000	NA	NA	1.0000000	1.

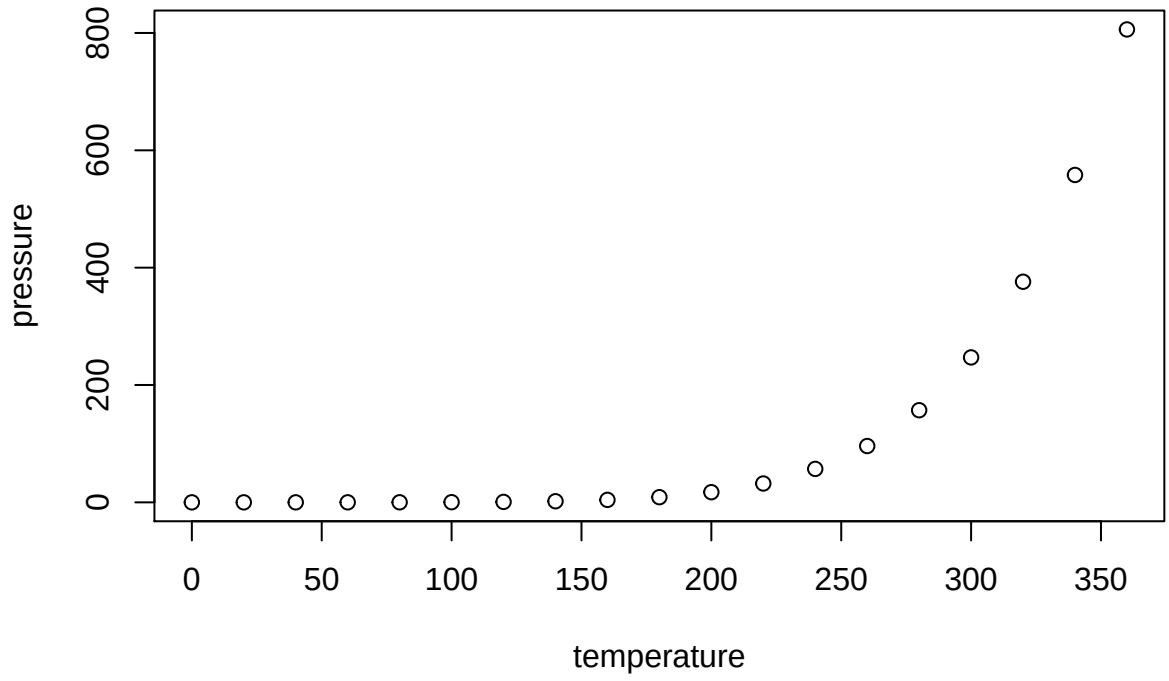
	x
npar	2.500000e+01
fmin	6.814580e-01
chisq	2.007575e+03
df	5.300000e+01
pvalue	0.000000e+00
baseline.chisq	1.176004e+04
baseline.df	6.600000e+01
baseline.pvalue	0.000000e+00
cfi	8.328571e-01
tli	7.918598e-01
nnfi	7.918598e-01
rfi	7.874157e-01
nfi	8.292883e-01
pnfi	6.659437e-01
ifi	8.330427e-01
rni	8.328571e-01
logl	-1.385744e+04
unrestricted.logl	-1.285366e+04
aic	2.776489e+04
bic	2.789726e+04
ntotal	1.473000e+03
bic2	2.781784e+04
rmsea	1.582293e-01
rmsea.ci.lower	1.523426e-01
rmsea.ci.upper	1.641946e-01
rmsea.pvalue	0.000000e+00
rmr	8.533906e-02
rmr_nomean	8.533906e-02
srmr	1.071187e-01
srmr_bentler	1.071187e-01
srmr_bentler_nomean	1.071187e-01
crmr	1.164502e-01
crmr_nomean	1.164502e-01
srmr_mplus	1.071186e-01
srmr_mplus_nomean	1.071186e-01
cn_05	5.308938e+01
cn_01	5.958273e+01
gfi	8.158106e-01
agfi	7.289288e-01
pgfi	5.543328e-01
mfi	5.150623e-01
ecvi	1.396860e+00

```
f_pa.na.simp %>% modificationindices() %>% kable(format = "latex")
```

	lhs	op	rhs	mi	epc	sepc.lv	sepc.all	sepc.nox
28	pa.1	=~	mood_down.1	31.5420842	-0.1272078	-0.1272078	-0.1719715	-0.1719715
29	pa.1	=~	mood_irritat.1	321.5896574	-0.9193428	-0.9193428	-0.7863377	-0.7863377
30	pa.1	=~	mood_lonely.1	118.3580436	0.1632110	0.1632110	0.3367746	0.3367746
31	pa.1	=~	mood_anxious.1	57.8494515	0.0893182	0.0893182	0.2883325	0.2883325
32	pa.1	=~	mood_suspic.1	8.5932763	-0.0635797	-0.0635797	-0.1146081	-0.1146081
33	pa.1	=~	mood_guilty.1	25.2674730	0.0766152	0.0766152	0.1651928	0.1651928
34	pa.1	=~	mood_doubt.1	223.2521193	-0.5033271	-0.5033271	-0.5781426	-0.5781426
35	na.1	=~	mood_relaxed.1	35.9595805	0.1576754	0.1576754	0.2117409	0.2117409
36	na.1	=~	mood_satisfi.1	1.2059120	-0.0288465	-0.0288465	-0.0292534	-0.0292534
37	na.1	=~	mood_enthus.1	5.1428833	-0.0547279	-0.0547279	-0.0635355	-0.0635355
38	na.1	=~	mood_cheerf.1	1.6786043	-0.0299078	-0.0299078	-0.0354424	-0.0354424
39	na.1	=~	mood_strong.1	1.1227332	0.0261852	0.0261852	0.0302329	0.0302329
40	mood_relaxed.1	~~	mood_satisfi.1	17.1805474	0.0345935	0.0345935	0.1361504	0.1361504
41	mood_relaxed.1	~~	mood_enthus.1	1.6530864	-0.0098873	-0.0098873	-0.0398477	-0.0398477
42	mood_relaxed.1	~~	mood_cheerf.1	3.1743803	0.0130900	0.0130900	0.0565046	0.0565046
43	mood_relaxed.1	~~	mood_strong.1	1.1419201	-0.0084213	-0.0084213	-0.0326511	-0.0326511
44	mood_relaxed.1	~~	mood_down.1	54.4331678	0.0474938	0.0474938	0.2345641	0.2345641
45	mood_relaxed.1	~~	mood_irritat.1	406.2214796	-0.3342962	-0.3342962	-0.5436050	-0.5436050
46	mood_relaxed.1	~~	mood_lonely.1	23.1882130	0.0210598	0.0210598	0.1480331	0.1480331
47	mood_relaxed.1	~~	mood_anxious.1	2.0556834	0.0053632	0.0053632	0.0396052	0.0396052
48	mood_relaxed.1	~~	mood_suspic.1	29.5256898	-0.0376983	-0.0376983	-0.1491657	-0.1491657
49	mood_relaxed.1	~~	mood_guilty.1	3.6690193	-0.0089732	-0.0089732	-0.0554771	-0.0554771
50	mood_relaxed.1	~~	mood_doubt.1	1.0111015	0.0108205	0.0108205	0.0276590	0.0276590
51	mood_satisfi.1	~~	mood_enthus.1	11.6029086	0.0287570	0.0287570	0.1368769	0.1368769
52	mood_satisfi.1	~~	mood_cheerf.1	5.5328015	-0.0193952	-0.0193952	-0.0988771	-0.0988771
53	mood_satisfi.1	~~	mood_strong.1	23.0056389	-0.0408917	-0.0408917	-0.1872451	-0.1872451
54	mood_satisfi.1	~~	mood_down.1	3.5472197	-0.0115552	-0.0115552	-0.0674003	-0.0674003
55	mood_satisfi.1	~~	mood_irritat.1	26.0407616	-0.0800491	-0.0800491	-0.1537334	-0.1537334
56	mood_satisfi.1	~~	mood_lonely.1	12.4603236	0.0146909	0.0146909	0.1219593	0.1219593
57	mood_satisfi.1	~~	mood_anxious.1	8.6824972	0.0104347	0.0104347	0.0910063	0.0910063
58	mood_satisfi.1	~~	mood_suspic.1	7.5665752	-0.0180622	-0.0180622	-0.0844069	-0.0844069
59	mood_satisfi.1	~~	mood_guilty.1	0.0276961	-0.0007397	-0.0007397	-0.0054009	-0.0054009
60	mood_satisfi.1	~~	mood_doubt.1	9.6780679	-0.0316871	-0.0316871	-0.0956598	-0.0956598
61	mood_enthus.1	~~	mood_cheerf.1	25.9567101	-0.0370762	-0.0370762	-0.1935531	-0.1935531
62	mood_enthus.1	~~	mood_strong.1	0.7820154	0.0067285	0.0067285	0.0315497	0.0315497
63	mood_enthus.1	~~	mood_down.1	0.3349424	-0.0033212	-0.0033212	-0.0198371	-0.0198371
64	mood_enthus.1	~~	mood_irritat.1	0.7921077	-0.0130967	-0.0130967	-0.0257558	-0.0257558
65	mood_enthus.1	~~	mood_lonely.1	1.1200340	-0.0041222	-0.0041222	-0.0350423	-0.0350423
66	mood_enthus.1	~~	mood_anxious.1	7.6954203	-0.0092119	-0.0092119	-0.0822703	-0.0822703
67	mood_enthus.1	~~	mood_suspic.1	3.1090953	0.0108582	0.0108582	0.0519597	0.0519597
68	mood_enthus.1	~~	mood_guilty.1	0.2741393	0.0021804	0.0021804	0.0163029	0.0163029
69	mood_enthus.1	~~	mood_doubt.1	0.0078586	0.0008468	0.0008468	0.0026177	0.0026177
70	mood_cheerf.1	~~	mood_strong.1	30.3259637	0.0405744	0.0405744	0.2037730	0.2037730
71	mood_cheerf.1	~~	mood_down.1	9.8860547	-0.0171353	-0.0171353	-0.1096214	-0.1096214
72	mood_cheerf.1	~~	mood_irritat.1	0.1497994	0.0054025	0.0054025	0.0113796	0.0113796
73	mood_cheerf.1	~~	mood_lonely.1	0.2132938	0.0017079	0.0017079	0.0155509	0.0155509
74	mood_cheerf.1	~~	mood_anxious.1	28.9207886	0.0169424	0.0169424	0.1620633	0.1620633
75	mood_cheerf.1	~~	mood_suspic.1	0.7135827	-0.0049349	-0.0049349	-0.0252934	-0.0252934
76	mood_cheerf.1	~~	mood_guilty.1	1.7647128	0.0052501	0.0052501	0.0420447	0.0420447
77	mood_cheerf.1	~~	mood_doubt.1	14.9507364	-0.0350388	-0.0350388	-0.1160151	-0.1160151
78	mood_strong.1	~~	mood_down.1	9.5031860	-0.0181958	-0.0181958	-0.1045554	-0.1045554
79	mood_strong.1	~~	mood_irritat.1	6.7445603	0.0393353	0.0393353	0.0744194	0.0744194
80	mood_strong.1	~~	mood_lonely.1	6.5253586	0.0102353	0.0102353	0.0837062	0.0837062
81	mood_strong.1	~~	mood_anxious.1	5 0.1380634	-0.0012699	-0.0012699	-0.0109107	-0.0109107
82	mood_strong.1	~~	mood_suspic.1	9.2077409	0.0192320	0.0192320	0.0885366	0.0885366
83	mood_strong.1	~~	mood_guilty.1	14.7351860	0.0164489	0.0164489	0.1183197	0.1183197
84	mood_strong.1	~~	mood_doubt.1	43.0541994	-0.0645068	-0.0645068	-0.1918419	-0.1918419

Including Plots

You can also embed plots, for example:



Note that the `echo = FALSE` parameter was added to the code chunk to prevent printing of the R code that generated the plot.

Load cache from a latter code chunk

Sometimes we may want to insert an object value early in the document, when the object has not been created. For example, you may want to mention a result in your abstract using an inline R expression, but the result is calculated later in the report.

One solution is to `save()` the workspace in a `.RData` file in the end of the document, and `load()` it in the beginning, e.g.

In the end of the document, you save the workspace:

Then you can use `NOT YET AVAILABLE` after `everything.RData` is loaded. When it is not available, you will see `x` as `NOT YET AVAILABLE`.

The function `load_cache()` is an alternative solution, which allows you to load the value of an object from a specific code chunk, when the chunk has been cached.

For example, there is no object called `y` that has been created in this document yet, but we can still insert it here: `6.2831853`, as long as it will be created in the code chunk with the label `test-a` later.

The first time you compile the document, you will see `y` is `NOT AVAILABLE`, but when you compile it for the second time, you will see its value `6.2831853`.

You do not have to specify the object name in `load_cache()`, in which case the database will just be loaded, and you can use any objects available in the database as if they had been computed by the code chunk later.