# ONLINE APPENDIX

**Online Appendix M*plus* Syntax, to accompany: Sterba, S.K. (2017). Pattern mixture models for quantifying missing-data uncertainty in longitudinal invariance testing. *Structural Equation Modeling, 24,* 283-300.**

The online appendix provides syntax for a Conventional Longitudinal Factor Model (LFM) and a Pattern Mixture Longitudinal Factor Model (PM-LFM, using each identifying constraint option (1)-(5) from the manuscript). For illustration, syntax is shown for T=3, J=4 (and G=3, for PM-LFM). For illustration, weak longitudinal measurement invariance (MI) is imposed for these models.

**Conventional Longitudinal Factor Model (LFM): Imposing weak longitudinal MI**

```
DATA: FILE = yourdata.dat;
VARIABLE: names =y1-y12;
usevariables= y1-y12 ;
missing=.;
ANALYSIS: estimator=ML;
MODEL:
f1 by y1-y4*(l1-l4);
f2 by y5-y8*(l1-l4);
f3 by y9-y12*(l1-l4);
y1-y12*;
 [y1@0]; [y2-y4*];
 [y5@0]; [y6-y8*];
 [y9@0]; [y10-y12*];
 [f1-f3*];
f1-f3@1;
f1 with f2; f2 with f3; f1 with f3;
```

**Pattern Mixture Longitudinal Factor Model (PM-LFM): Imposing weak longitudinal MI**

```
DATA: FILE = yourdata.dat;
VARIABLE: names =y1-y12 group;
usevariables= y1-y12 ;
missing=.;
grouping is group(1=complete 2=dropt2 3=dropt3);
ANALYSIS: estimator=ML;

MODEL:  !specification for group dropt3
f1 by y1* (l1g3)
      y2 (l2g3)
      y3 (l3g3)
      y4 (l4g3);
f2 by y5* (l5g3)
      y6 (l6g3)
      y7 (l7g3)
      y8 (l8g3);
f3 by y9* (l9g3)
      y10 (l10g3)
      y11 (l11g3)
      y12 (l12g3);
```

```
y1 (t1g3);  y2 (t2g3);      y3 (t3g3);     y4 (t4g3);
y5 (t5g3);  y6 (t6g3);      y7 (t7g3);     y8 (t8g3);
y9 (t9g3);  y10 (t10g3);  y11 (t11g3);  y12 (t12g3);
[y1@0];  [y2] (v2g3);     [y3] (v3g3);    [y4] (v4g3);
[y5@0];  [y6] (v6g3);     [y7] (v7g3);    [y8] (v8g3);
[y9@0];  [y10] (v10g3); [y11] (v11g3); [y12] (v12g3);
[f1] (completemf1); [f2] (completemf2); [f3] (completemf3); f1-f3@1;
f1 with f2 (completef12); f2 with f3 (completef23); f1 with f3 (completef13);

MODEL COMPLETE:  !specification for group complete
f1 by y1* (l1g1)
       y2 (l2g1)
       y3 (l3g1)
       y4 (l4g1);
f2 by y5* (l5g1)
       y6 (l6g1)
       y7 (l7g1)
       y8 (l8g1);
f3 by y9* (l9g1)
       y10 (l10g1)
       y11 (l11g1)
       y12 (l12g1);
y1 (t1g1);  y2 (t2g1);      y3 (t3g1);     y4 (t4g1);
y5 (t5g1);  y6 (t6g1);      y7 (t7g1);     y8 (t8g1);
y9 (t9g1);  y10 (t10g1);  y11 (t11g1);  y12 (t12g1);
[y1@0];  [y2] (v2g1);     [y3] (v3g1);    [y4] (v4g1);
[y5@0];  [y6] (v6g1);     [y7] (v7g1);    [y8] (v8g1);
[y9@0];  [y10] (v10g1); [y11] (v11g1); [y12] (v12g1);
[f1] (completemf1); [f2] (completemf2); [f3] (completemf3); f1-f3@1;
f1 with f2 (completef12); f2 with f3 (completef23); f1 with f3 (completef13);

MODEL DROPT2:  !specification for group dropt2
f1 by y1* (l1g2)
       y2 (l2g2)
       y3 (l3g2)
       y4 (l4g2);
f2 by y5* (l5g2)
       y6 (l6g2)
       y7 (l7g2)
       y8 (l8g2);
f3 by y9* (l9g2)
       y10 (l10g2)
       y11 (l11g2)
       y12 (l12g2);
y1 (t1g2);  y2 (t2g2);      y3 (t3g2);     y4 (t4g2);
y5 (t5g2);  y6 (t6g2);      y7 (t7g2);     y8 (t8g2);
y9 (t9g2);  y10 (t10g2);  y11 (t11g2);  y12 (t12g2);
[y1@0];  [y2] (v2g2);     [y3] (v3g2);    [y4] (v4g2);
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```
[y5@0];  [y6] (v6g2);     [y7] (v7g2);     [y8] (v8g2);
[y9@0];  [y10] (v10g2); [y11] (v11g2); [y12] (v12g2);
[f1] (completemf1); [f2] (completemf2); [f3] (completemf3); f1-f3@1;
f1 with f2* (completef12); f2 with f3* (completef23); f1 with f3* (completef13);

MODEL CONSTRAINT:
    new (pg1 pg2 pg3 l1-l12 t1-t12 v1-v12);
! insert observed proportions of dropout-pattern-group membership
    pg1=.645333333;
    pg2=.177333333;
    pg3=.177333333;

! Computing marginal (across-missingness-pattern) parameters
    l1=l1g1*pg1+l1g2*pg2+l1g3*pg3;
    l2=l2g1*pg1+l2g2*pg2+l2g3*pg3;
    l3=l3g1*pg1+l3g2*pg2+l3g3*pg3;
    l4=l4g1*pg1+l4g2*pg2+l4g3*pg3;
    l5=l5g1*pg1+l5g2*pg2+l5g3*pg3;
    l6=l6g1*pg1+l6g2*pg2+l6g3*pg3;
    l7=l7g1*pg1+l7g2*pg2+l7g3*pg3;
    l8=l8g1*pg1+l8g2*pg2+l8g3*pg3;
    l9=l9g1*pg1+l9g2*pg2+l9g3*pg3;
    l10=l10g1*pg1+l10g2*pg2+l10g3*pg3;
    l11=l11g1*pg1+l11g2*pg2+l11g3*pg3;
    l12=l12g1*pg1+l12g2*pg2+l12g3*pg3;

    t1=t1g1*pg1+t1g2*pg2+t1g3*pg3;
    t2=t2g1*pg1+t2g2*pg2+t2g3*pg3;
    t3=t3g1*pg1+t3g2*pg2+t3g3*pg3;
    t4=t4g1*pg1+t4g2*pg2+t4g3*pg3;
    t5=t5g1*pg1+t5g2*pg2+t5g3*pg3;
    t6=t6g1*pg1+t6g2*pg2+t6g3*pg3;
    t7=t7g1*pg1+t7g2*pg2+t7g3*pg3;
    t8=t8g1*pg1+t8g2*pg2+t8g3*pg3;
    t9=t9g1*pg1+t9g2*pg2+t9g3*pg3;
    t10=t10g1*pg1+t10g2*pg2+t10g3*pg3;
    t11=t11g1*pg1+t11g2*pg2+t11g3*pg3;
    t12=t12g1*pg1+t12g2*pg2+t12g3*pg3;

    v1=0;
    v2=v2g1*pg1+v2g2*pg2+v2g3*pg3;
    v3=v3g1*pg1+v3g2*pg2+v3g3*pg3;
    v4=v4g1*pg1+v4g2*pg2+v4g3*pg3;
    v5=0;
    v6=v6g1*pg1+v6g2*pg2+v6g3*pg3;
    v7=v7g1*pg1+v7g2*pg2+v7g3*pg3;
    v8=v8g1*pg1+v8g2*pg2+v8g3*pg3;
    v9=0;
    v10=v10g1*pg1+v10g2*pg2+v10g3*pg3;
```

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```
    v11=v11g1*pg1+v11g2*pg2+v11g3*pg3;
    v12=v12g1*pg1+v12g2*pg2+v12g3*pg3;

!imposing weak longitudinal MI on marginal loadings
!to relax weak longitudinal MI delete these 8 constraints
L1=L5; L2=L6; L3=L7; L4=L8; L5=L9; L6=L10; L7=L11; L8=L12;
```

**Additional PM-LFM model constraints to be included depending on chosen identification method**

| **Nearest Neighbor (NN) identifying constraints** | **Complete Case (CC) identifying constraints** | **Available Case (AC) identifying constraints** | **Last observation carried forward (LOCF) identifying constraints** | **Nearest Neighbor Difference (NND) identifying constraints** |
|---|---|---|---|---|
| l5g2=l5g3; | l5g2=l5g1; | l5g2=pg3*l5g3+pg1*l5g1; | l5g2=l1g2; | l5g2=l1g2-(L1G3-L5G3); |
| l6g2=l6g3; | l6g2=l6g1; | l6g2=pg3*l6g3+pg1*l6g1; | l6g2=l2g2; | l6g2=l2g2-(L2G3-L6G3); |
| l7g2=l7g3; | l7g2=l7g1; | l7g2=pg3*l7g3+pg1*l7g1; | l7g2=l3g2; | l7g2=l3g2-(L3G3-L7G3); |
| l8g2=l8g3; | l8g2=l8g1; | l8g2=pg3*l8g3+pg1*l8g1; | l8g2=l4g2; | l8g2=l4g2-(L4G3-L8G3); |
| l9g2=l9g3; | l9g2=l9g1; | l9g2=l9g3; | l9g2=l1g2; | l9g2=l5g2-(L5G1-L9G1); |
| l10g2=l10g3; | l10g2=l10g1; | l10g2=l10g3; | l10g2=l2g2; | l10g2=l6g2-(L6G1-L10G1); |
| l11g2=l11g3; | l11g2=l11g1; | l11g2=l11g3; | l11g2=l3g2; | l11g2=l7g2-(L7G1-L11G1); |
| l12g2=l12g3; | l12g2=l12g1; | l12g2=l12g3; | l12g2=l4g2; | l12g2=l8g2-(L8G1-L12G1); |
| t5g2=t5g3; | t5g2=t5g1; | t5g2=pg3*t5g3+pg1*t5g1; | t5g2=t1g2; | t5g2=t1g2-(T1G3-T5G3); |
| t6g2=t6g3; | t6g2=t6g1; | t6g2=pg3*t6g3+pg1*t6g1; | t6g2=t2g2; | t6g2=t2g2-(T2G3-T6G3); |
| t7g2=t7g3; | t7g2=t7g1; | t7g2=pg3*t7g3+pg1*t7g1; | t7g2=t3g2; | t7g2=t3g2-(T3G3-T7G3); |
| t8g2=t8g3; | t8g2=t8g1; | t8g2=pg3*t8g3+pg1*t8g1; | t8g2=t4g2; | t8g2=t4g2-(T4G3-T8G3); |
| t9g2=t9g3; | t9g2=t9g1; | t9g2=t9g3; | t9g2=t1g2; | t9g2=t5g2-(T5G1-T9G1); |
| t10g2=t10g3; | t10g2=t10g1; | t10g2=t10g3; | t10g2=t2g2; | t10g2=t6g2-(T6G1-T10G1); |
| t11g2=t11g3; | t11g2=t11g1; | t11g2=t11g3; | t11g2=t3g2; | t11g2=t7g2-(T7G1-T11G1); |
| t12g2=t12g3; | t12g2=t12g1; | t12g2=t12g3; | t12g2=t4g2; | t12g2=t8g2-(T8G1-T12G1); |
| v6g2=v6g3; | v6g2=v6g1; | v6g2=pg3*v6g3+pg1*v6g1; | v6g2=v2g2; | v6g2=v2g2-(V2G3-V6G3); |
| v7g2=v7g3; | v7g2=v7g1; | v7g2=pg3*v7g3+pg1*v7g1; | v7g2=v3g2; | v7g2=v3g2-(V3G3-V7G3); |
| v8g2=v8g3; | v8g2=v8g1; | v8g2=pg3*v8g3+pg1*v8g1; | v8g2=v4g2; | v8g2=v4g2-(V4G3-V8G3); |
| v10g2=v10g3; | v10g2=v10g1; | v10g2=v10g3; | v10g2=v2g2; | v10g2=v6g2-(V6G1-V10G1); |
| v11g2=v11g3; | v11g2=v11g1; | v11g2=v11g3; | v11g2=v3g2; | v11g2=v7g2-(V7G1-V11G1); |
| v12g2=v12g3; | v12g2=v12g1; | v12g2=v12g3; | v12g2=v4g2; | v12g2=v8g2-(V8G1-V12G1); |
| | | | | |
| l9g3=l9g1; | l9g3=l9g1; | l9g3=l9g1; | l9g3=l5g3; | l9g3=l5g3-(L5G1-L9G1); |
| l10g3=l10g1; | l10g3=l10g1; | l10g3=l10g1; | l10g3=l6g3; | l10g3=l6g3-(L6G1-L10G1); |
| l11g3=l11g1; | l11g3=l11g1; | l11g3=l11g1; | l11g3=l7g3; | l11g3=l7g3-(L7G1-L11G1); |
| l12g3=l12g1; | l12g3=l12g1; | l12g3=l12g1; | l12g3=l8g3; | l12g3=l8g3-(L8G1-L12G1); |
| t9g3=t9g1; | t9g3=t9g1; | t9g3=t9g1; | t9g3=t5g3; | t9g3=t5g3-(T5G1-T9G1); |
| t10g3=t10g1; | t10g3=t10g1; | t10g3=t10g1; | t10g3=t6g3; | t10g3=t6g3-(T6G1-T10G1); |
| t11g3=t11g1; | t11g3=t11g1; | t11g3=t11g1; | t11g3=t7g3; | t11g3=t7g3-(T7G1-T11G1); |
| t12g3=t12g1; | t12g3=t12g1; | t12g3=t12g1; | t12g3=t8g3; | t12g3=t8g3-(T8G1-T12G1); |
| v10g3=v10g1; | v10g3=v10g1; | v10g3=v10g1; | v10g3=v6g3; | v10g3=v6g3-(V6G1-V10G1); |
| v11g3=v11g1; | v11g3=v11g1; | v11g3=v11g1; | v11g3=v7g3; | v11g3=v7g3-(V7G1-V11G1); |
| v12g3=v12g1; | v12g3=v12g1; | v12g3=v12g1; | v12g3=v8g3; | v12g3=v8g3-(V8G1-V12G1); |