Supplementary Materials for Yuan, Zhang, and Deng

September 14, 2015

1 Using WebSEM for Data Analysis

The fit indices for mean structures with growth curve models developed in this article are currently available in WebSEM, which is free online software that allows researchers to conduct SEM analysis through path diagrams (Zhang & Yuan, 2012-2015).[1] In this section, we illustrate how to obtain the fit indices in WebSEM through the linear model with equal error variances in Example 4 used in the paper. A video with instructions on how to conduct the data analysis is also available on YouTube (`https://youtu.be/1ydG3IxBIsM`).

To use WebSEM, one needs to provide a data file and draw a path diagram. The data file should be a free format text file with the extension name txt. The data file can be generated using any text editor or the default editor within WebSEM. Both raw data and summary data can be used. If raw data are used, the first line of the data file should be variable names and the rest are data entries. If summary data are used, the first row includes the variable names. The second row provides the value of the sample size that is repeated for each column of data. The third row includes information on the sample means. The rest is the full sample covariance matrix. For example, the summary data in the data file for Example 4 are given below. Clearly, there are six variables named close1, close2, close3, close4, close5 and gender, respectively, and the sample size is 851. Note that the value 851 repeats itself 6 times.

```
close1   close2   close3   close4   close5   gender
851      851      851      851      851      851
37.9542  37.2785  37.0463  36.5696  36.1363  0.4900
6.3944   3.2716   4.1435   3.7058   4.1286   -0.0940
3.2716   7.5282   6.0804   5.1597   5.7608   -0.0390
4.1435   6.0804   10.7290  6.5672   7.2365   -0.1521
3.7058   5.1597   6.5672   10.2920  7.6463   -0.1104
4.1286   5.7608   7.2365   7.6463   12.9085  -0.1469
-0.0940  -0.0390  -0.1521  -0.1104  -0.1469  0.2502
```

WebSEM provides an intuitive and interactive interface to draw path diagram for a model for data analysis. Information on how to use the interface can be found in Zhang and Yuan (2012-2015). The path diagram for the linear growth curve model drawn by WebSEM is given in Figure 2a. The video on YouTube showed how to draw a path diagram interactively. Because the use of summary data instead of raw data, we put "`data=cov`" in the control field of WebSEM. Furthermore, to request the fit indices for the mean structure, type "`mean.fit`" in the control field; otherwise, only fit indices for the combined mean and covariance structure will be produced.

The output of WebSEM by running the analysis is shown below.[2] Test Statistics and Fit Indices for both mean and covariance, covariance only, and mean only are given at the beginning of the output. For example, for evaluating both mean and covariance together, the chi-square statistic is 81.653 with 17 degrees of freedom. The corresponding p-value is essentially 0. The CFI is 0.971, NFI is 0.964, NNFI is 0.961 and RMSEA is 0.067. For mean only, the chi-square statistics is 5.073 (p-value = 0.167) and RMSEA is 0.028.

[1] Zhang, Z. & Yuan, K.-H. (2012-2015). WebSEM: Structural equation modeling online [Manual available at http://psychstat.org/websem]. Retrievable from https://websem.psychstat.org.

[2] The known parameters are removed from the output to save space.

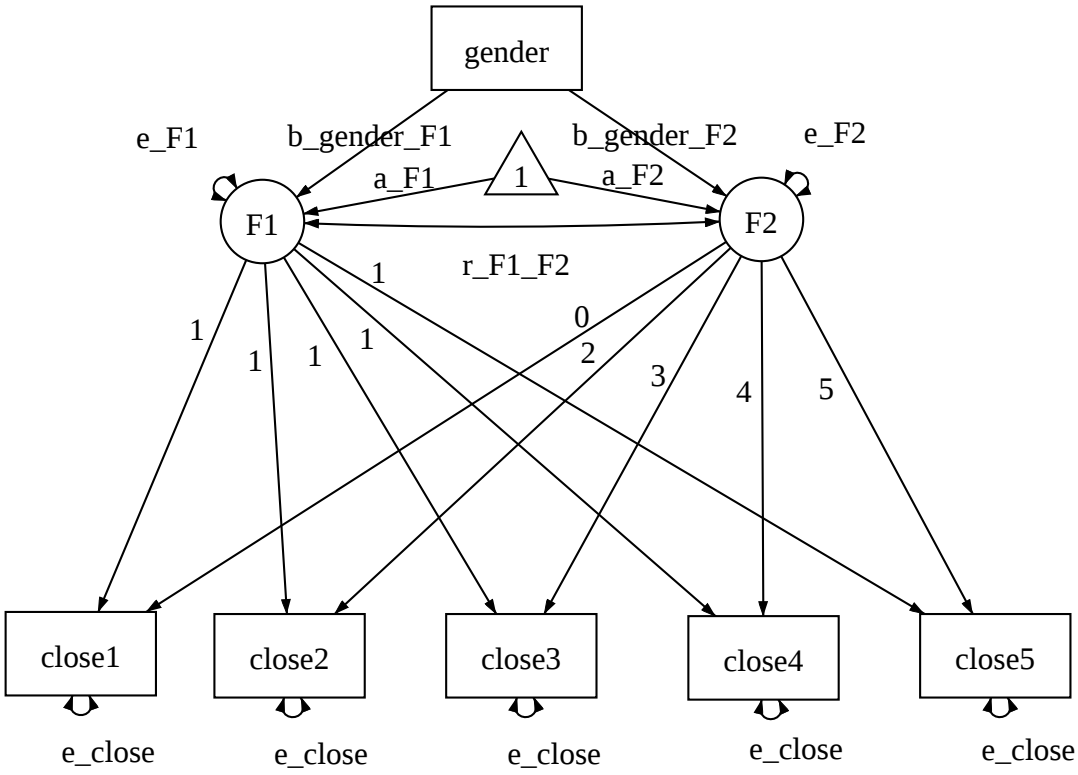


Figure 1: Path diagram for the linear growth curve model with equal error variances. The path diagram was drawn by WebSEM.

```
Test Statistics and Fit Indices
Fit for both mean and covariance
          Chi-square statistic   81.653
          Degrees of freedom     17
          p-value        0
          Chi-square statistic (baseline model)  2272.4
          Degrees of freedom (baseline model)    23
          CFI            0.971
          NFI            0.964
          NNFI           0.961
          RMSEA          0.067
Fit for covariance only
          Chi-square statistic   76.586
          Degrees of freedom     14
          p-value        0
          Chi-square statistic (baseline model)  1971.2
          Degrees of freedom (baseline model)    19
          CFI            0.968
          NFI            0.961
          NNFI           0.956
          RMSEA          0.072
Fit for mean only
          Chi-square statistic   5.073
          Degrees of freedom     3
          p-value        0.167
          Chi-square statistic (baseline model)  287.88
          Degrees of freedom (baseline model)    4
          CFI            0.993
          NFI            0.982
          NNFI           0.99
          RMSEA          0.028
Parameter Estimates
                   Estimate  Std.err  Z-value  P(>|z|)
Latent variables:
  F1 =~
    close1            1.000
    close2            1.000
    close3            1.000
    close4            1.000
    close5            1.000
  F2 =~
    close1            0.000
    close2            2.000
    close3            3.000
    close4            4.000
    close5            5.000

Regressions:
  F1 ~
    gendr (b__F1)    -0.289    0.163   -1.770    0.077
  F2 ~
    gendr (b__F2)    -0.052    0.043   -1.216    0.224
```

```
Covariances:
  F1 ~~
    F2      (r_F1)      0.249     0.056     4.420     0.000

Intercepts:
    F1      (a_F1)     38.141     0.114   334.196     0.000
    F2      (a_F2)     -0.333     0.030   -11.169     0.000
    close1              0.000
    close2              0.000
    close3              0.000
    close4              0.000
    close5              0.000

Variances:
    F1      (e_F1)      2.956     0.284    10.399     0.000
    F2      (e_F2)      0.136     0.020     6.804     0.000
    close1 (e_cl)       3.696     0.103    35.728     0.000
    close2 (e_cl)       3.696     0.103    35.728     0.000
    close3 (e_cl)       3.696     0.103    35.728     0.000
    close4 (e_cl)       3.696     0.103    35.728     0.000
    close5 (e_cl)       3.696     0.103    35.728     0.000
```

Path diagrams and complete output for all models used in the paper are available as supplementary materials at http:// .

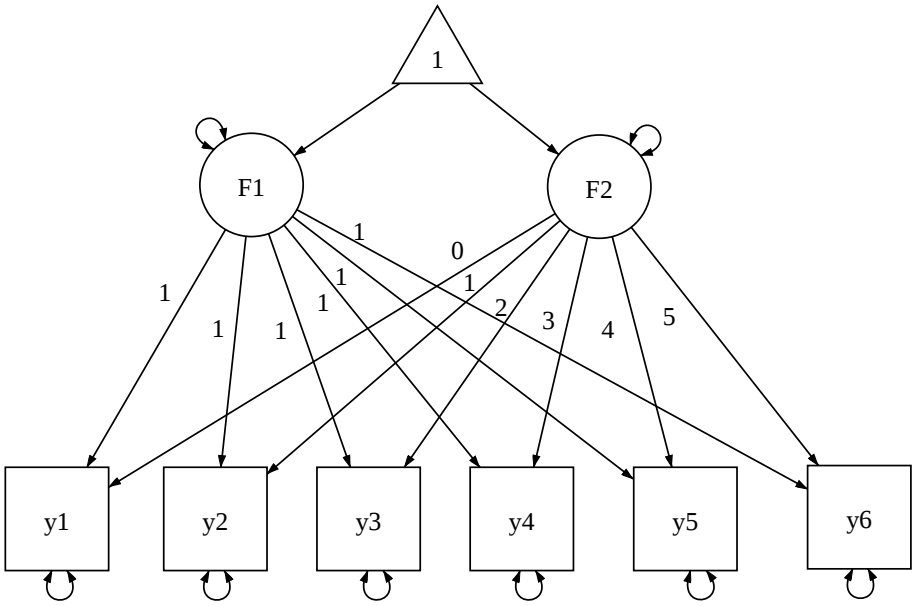
1.1 Example 1

The summary data used in this example are given below. The model in Figure 2a is used.

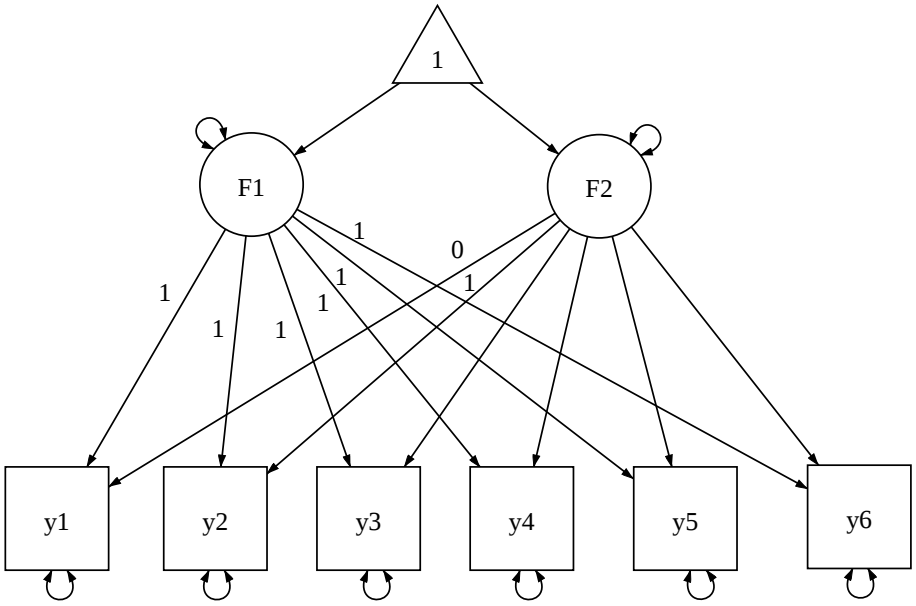
```
y1    y2    y3    y4    y5    y6
200   200   200   200   200   200
1.0   1.5   2.0   2.5   3.0   3.5
2.0   2.0   2.0   2.5   3.0   3.5
2.0   4.0   4.5   6.0   7.5   9.0
2.0   4.5   8.0  10.0  12.0  14.5
2.5   6.0  10.0  14.0  16.5  20.0
3.0   7.5  12.0  16.5  22.0  26.0
3.5   9.0  14.5  20.0  26.0  32.0
```

The output of WebSEM by running the analysis is shown below.

```
Test Statistics and Fit Indices
Fit for both mean and covariance
          Chi-square statistic   82.686
          Degrees of freedom     16
          p-value        0
          Chi-square statistic (baseline model)  2010.6
          Degrees of freedom (baseline model)    20
          CFI            0.966
          NFI            0.959
          NNFI           0.958
          RMSEA          0.144
Fit for covariance only
          Chi-square statistic   82.686
          Degrees of freedom     12
          p-value        0
```



(a) A linear growth curve model



(b) A nonlinear growth curve model

Figure 2: Path diagrams for models used in Examples 1-4

```
          Chi-square statistic (baseline model)  1923.8
          Degrees of freedom (baseline model)    15
          CFI            0.963
          NFI            0.957
          NNFI           0.954
          RMSEA          0.172
Fit for mean only
          Chi-square statistic   0
          Degrees of freedom     4
          p-value        1
          Chi-square statistic (baseline model)  46.505
          Degrees of freedom (baseline model)    5
          CFI            1
          NFI            1
          NNFI           1.12
          RMSEA          0
Parameter Estimates
                   Estimate  Std.err  Z-value  P(>|z|)
Latent variables:
  F1 =~
    y1                1.000
    y2                1.000
    y3                1.000
    y4                1.000
    y5                1.000
  F2 =~
    y1                0.000
    y2                1.000
    y3                2.000
    y4                3.000
    y5                4.000
  F1 =~
    y6                1.000
  F2 =~
    y6                5.000

Covariances:
  F1 ~~
    F2     (r_F1)     0.378    0.100    3.779    0.000

Intercepts:
    F2                0.500    0.073    6.819    0.000
    F1                1.000    0.094   10.667    0.000
    y1                0.000
    y2                0.000
    y3                0.000
    y4                0.000
    y5                0.000
    y6                0.000

Variances:
    y1                0.532    0.103    5.186    0.000
    y2                0.642    0.085    7.590    0.000
    y3                1.040    0.119    8.740    0.000
```

```
    y4                1.087     0.125     8.715     0.000
    y5                0.595     0.090     6.627     0.000
    F1                1.444     0.181     7.970     0.000
    F2                1.044     0.108     9.710     0.000
    y6                0.483     0.127     3.807     0.000
```

1.2 Example 2

The summary data used in this example are given below. The same model in Figure 2a is used.

```
y1    y2    y3    y4    y5    y6
200.0 200.0 200.0 200.0 200.0 200.0
1.0   1.5   2.0   2.5   3.0   3.5
2.0   2.2   2.0   2.5   3.0   3.5
2.2   4.0   4.5   6.0   7.5   9.0
2.0   4.5   8.0  10.2  12.0  14.5
2.5   6.0  10.2  14.0  16.5  20.0
3.0   7.5  12.0  16.5  22.0  26.2
3.5   9.0  14.5  20.0  26.2  32.0
```

The output of the analysis is given below.

```
Test Statistics and Fit Indices
Fit for both mean and covariance
          Chi-square statistic   188.53
          Degrees of freedom     16
          p-value        0
          Chi-square statistic (baseline model)  2255.5
          Degrees of freedom (baseline model)    20
          CFI            0.923
          NFI            0.916
          NNFI           0.904
          RMSEA          0.232
Fit for covariance only
          Chi-square statistic   188.53
          Degrees of freedom     12
          p-value        0
          Chi-square statistic (baseline model)  2168.6
          Degrees of freedom (baseline model)    15
          CFI            0.918
          NFI            0.913
          NNFI           0.898
          RMSEA          0.271
Fit for mean only
          Chi-square statistic   0
          Degrees of freedom     4
          p-value        1
          Chi-square statistic (baseline model)  46.193
          Degrees of freedom (baseline model)    5
          CFI            1
          NFI            1
          NNFI           1.121
          RMSEA          0
Parameter Estimates
                    Estimate  Std.err  Z-value  P(>|z|)
```

```
Latent variables:
  F1 =~
    y1                1.000
    y2                1.000
    y3                1.000
    y4                1.000
    y5                1.000
  F2 =~
    y1                0.000
    y2                1.000
    y3                2.000
    y4                3.000
    y5                4.000
  F1 =~
    y6                1.000
  F2 =~
    y6                5.000

Covariances:
  F1 ~~
    F2      (r_F1)    0.326    0.103    3.160    0.002

Intercepts:
    F2                0.500    0.074    6.797    0.000
    F1                1.000    0.097   10.321    0.000
    y1                0.000
    y2                0.000
    y3                0.000
    y4                0.000
    y5                0.000
    y6                0.000

Variances:
    y1                0.288    0.073    3.957    0.000
    y2                0.438    0.058    7.525    0.000
    y3                1.188    0.130    9.115    0.000
    y4                1.226    0.134    9.180    0.000
    y5                0.405    0.064    6.311    0.000
    F1                1.687    0.192    8.793    0.000
    F2                1.065    0.108    9.838    0.000
    y6                0.255    0.093    2.751    0.006
```

1.3 Example 3

The summary data for Example 3 are given below.

```
y1    y2    y3    y4    y5    y6
200.0 200.0 200.0 200.0 200.0 200.0
1.2   1.5   2.0   2.5   3.0   3.2
2.0   1.5   2.0   2.5   3.0   3.5
1.5   4.0   4.5   6.0   7.5   9.0
2.0   4.5   8.0   9.5  12.0  14.5
2.5   6.0   9.5  14.0  16.5  20.0
3.0   7.5  12.0  16.5  22.0  25.5
```

```
  3.5   9.0  14.5  20.0  25.5  32.0
```

The linear growth curve model in Figure 2a is first fitted to the data and the output is given below.

```
Test Statistics and Fit Indices
Fit for both mean and covariance
          Chi-square statistic   7.733
          Degrees of freedom     16
          p-value        0.956
          Chi-square statistic (baseline model)  1716.8
          Degrees of freedom (baseline model)    20
          CFI            1
          NFI            0.995
          NNFI           1.006
          RMSEA          0
Fit for covariance only
          Chi-square statistic   0.075
          Degrees of freedom     12
          p-value        1
          Chi-square statistic (baseline model)  1653
          Degrees of freedom (baseline model)    15
          CFI            1
          NFI            1
          NNFI           1.009
          RMSEA          0
Fit for mean only
          Chi-square statistic   7.697
          Degrees of freedom     4
          p-value        0.103
          Chi-square statistic (baseline model)  42.64
          Degrees of freedom (baseline model)    5
          CFI            0.902
          NFI            0.819
          NNFI           0.877
          RMSEA          0.068
Parameter Estimates
                    Estimate  Std.err  Z-value  P(>|z|)
Latent variables:
  F1 =~
    y1                 1.000
    y2                 1.000
    y3                 1.000
    y4                 1.000
    y5                 1.000
  F2 =~
    y1                 0.000
    y2                 1.000
    y3                 2.000
    y4                 3.000
    y5                 4.000
  F1 =~
    y6                 1.000
  F2 =~
    y6                 5.000
```

```
Covariances:
  F1 ~~
    F2                0.499    0.094    5.327    0.000

Intercepts:
    F2                0.429    0.073    5.902    0.000
    F1                1.162    0.087   13.304    0.000
    y1                0.000
    y2                0.000
    y3                0.000
    y4                0.000
    y5                0.000
    y6                0.000

Variances:
    y1                0.999    0.146    6.819    0.000
    y2                1.007    0.122    8.223    0.000
    y3                0.994    0.116    8.599    0.000
    y4                0.995    0.122    8.127    0.000
    y5                1.018    0.151    6.761    0.000
    F1                0.991    0.158    6.266    0.000
    F2                0.994    0.105    9.440    0.000
    y6                1.024    0.204    5.015    0.000
```

The nonlinear growth curve model in Figure 2b is then fitted to the data and the output is given below.

```
Test Statistics and Fit Indices
Fit for both mean and covariance
          Chi-square statistic   6.429
          Degrees of freedom     12
          p-value        0.893
          Chi-square statistic (baseline model)  1716.8
          Degrees of freedom (baseline model)    20
          CFI            1
          NFI            0.996
          NNFI           1.005
          RMSEA          0
Fit for covariance only
          Chi-square statistic   1.14
          Degrees of freedom     8
          p-value        0.997
          Chi-square statistic (baseline model)  1653
          Degrees of freedom (baseline model)    15
          CFI            1
          NFI            0.999
          NNFI           1.008
          RMSEA          0
Fit for mean only
          Chi-square statistic   5.315
          Degrees of freedom     4
          p-value        0.256
          Chi-square statistic (baseline model)  40.555
          Degrees of freedom (baseline model)    5
          CFI            0.963
          NFI            0.869
```

```
          NNFI            0.954
          RMSEA           0.041
Parameter Estimates
                    Estimate  Std.err  Z-value  P(>|z|)
Latent variables:
  F1 =~
    y1                 1.000
    y2                 1.000
    y3                 1.000
    y4                 1.000
    y5                 1.000
  F2 =~
    y1                 0.000
    y2                 1.000
    y3                 2.079    0.178   11.705    0.000
    y4                 3.159    0.276   11.435    0.000
    y5                 4.239    0.380   11.168    0.000
  F1 =~
    y6                 1.000
  F2 =~
    y6                 5.193    0.472   10.993    0.000

Covariances:
  F1 ~~
    F2                 0.490    0.092    5.313    0.000

Intercepts:
    F2                 0.410    0.080    5.143    0.000
    F1                 1.165    0.090   12.987    0.000
    y1                 0.000
    y2                 0.000
    y3                 0.000
    y4                 0.000
    y5                 0.000
    y6                 0.000

Variances:
    y1                 1.003    0.147    6.827    0.000
    y2                 1.002    0.122    8.180    0.000
    y3                 0.994    0.116    8.600    0.000
    y4                 0.990    0.122    8.085    0.000
    y5                 0.989    0.152    6.490    0.000
    F1                 1.005    0.165    6.081    0.000
    F2                 0.899    0.200    4.493    0.000
    y6                 1.064    0.208    5.115    0.000
```

1.4 Example 4

The summary data for Example 4 are given below.

```
y1    y2    y3    y4    y5    y6
200.0 200.0 200.0 200.0 200.0 200.0
1.2   1.5   2.0   2.5   3.0   3.1
2.0   1.5   2.0   2.5   3.0   3.5
```

```
1.5   4.0   4.5   6.0   7.5   9.0
2.0   4.5   8.0   9.5  12.0  14.5
2.5   6.0   9.5  14.0  16.5  20.0
3.0   7.5  12.0  16.5  22.0  25.5
3.5   9.0  14.5  20.0  25.5  32.0
```

The linear growth curve model in Figure 2a is first fitted to the data and the output is given below.

```
Test Statistics and Fit Indices
Fit for both mean and covariance
          Chi-square statistic   12.701
          Degrees of freedom     16
          p-value        0.695
          Chi-square statistic (baseline model)  1715
          Degrees of freedom (baseline model)    20
          CFI            1
          NFI            0.993
          NNFI           1.002
          RMSEA          0
Fit for covariance only
          Chi-square statistic   0.244
          Degrees of freedom     12
          p-value        1
          Chi-square statistic (baseline model)  1653
          Degrees of freedom (baseline model)    15
          CFI            1
          NFI            1
          NNFI           1.009
          RMSEA          0
Fit for mean only
          Chi-square statistic   12.519
          Degrees of freedom     4
          p-value        0.014
          Chi-square statistic (baseline model)  45.286
          Degrees of freedom (baseline model)    5
          CFI            0.789
          NFI            0.724
          NNFI           0.736
          RMSEA          0.103
Parameter Estimates
                    Estimate  Std.err  Z-value  P(>|z|)
Latent variables:
  F1 =~
    y1                 1.000
    y2                 1.000
    y3                 1.000
    y4                 1.000
    y5                 1.000
  F2 =~
    y1                 0.000
    y2                 1.000
    y3                 2.000
    y4                 3.000
    y5                 4.000
  F1 =~
```

```
    y6                1.000
  F2 =~
    y6                5.000

Covariances:
  F1 ~~
    F2                0.500    0.094    5.336    0.000

Intercepts:
    F2                0.415    0.073    5.708    0.000
    F1                1.180    0.087   13.497    0.000
    y1                0.000
    y2                0.000
    y3                0.000
    y4                0.000
    y5                0.000
    y6                0.000

Variances:
    y1                0.997    0.146    6.807    0.000
    y2                1.009    0.123    8.227    0.000
    y3                0.992    0.116    8.588    0.000
    y4                0.995    0.123    8.098    0.000
    y5                1.029    0.153    6.743    0.000
    F1                0.990    0.158    6.254    0.000
    F2                0.993    0.105    9.432    0.000
    y6                1.062    0.209    5.081    0.000
```

The nonlinear growth curve model in Figure 2b is then fitted to the data and the output is given below.

```
Test Statistics and Fit Indices
Fit for both mean and covariance
          Chi-square statistic   10.609
          Degrees of freedom     12
          p-value        0.563
          Chi-square statistic (baseline model)  1715
          Degrees of freedom (baseline model)    20
          CFI            1
          NFI            0.994
          NNFI           1.001
          RMSEA          0
Fit for covariance only
          Chi-square statistic   1.928
          Degrees of freedom     8
          p-value        0.983
          Chi-square statistic (baseline model)  1653
          Degrees of freedom (baseline model)    15
          CFI            1
          NFI            0.999
          NNFI           1.007
          RMSEA          0
Fit for mean only
          Chi-square statistic   8.725
          Degrees of freedom     4
          p-value        0.068
```

```
          Chi-square statistic (baseline model)  41.978
          Degrees of freedom (baseline model)    5
          CFI            0.872
          NFI            0.792
          NNFI           0.84
          RMSEA          0.077
Parameter Estimates
                   Estimate  Std.err  Z-value  P(>|z|)
Latent variables:
  F1 =~
    y1                1.000
    y2                1.000
    y3                1.000
    y4                1.000
    y5                1.000
  F2 =~
    y1                0.000
    y2                1.000
    y3                2.077    0.177   11.720    0.000
    y4                3.155    0.275   11.452    0.000
    y5                4.232    0.378   11.185    0.000
  F1 =~
    y6                1.000
  F2 =~
    y6                5.144    0.467   11.012    0.000

Covariances:
  F1 ~~
    F2                0.487    0.092    5.270    0.000

Intercepts:
    F2                0.401    0.080    5.030    0.000
    F1                1.178    0.090   13.147    0.000
    y1                0.000
    y2                0.000
    y3                0.000
    y4                0.000
    y5                0.000
    y6                0.000

Variances:
    y1                1.000    0.147    6.797    0.000
    y2                1.003    0.123    8.185    0.000
    y3                0.993    0.116    8.590    0.000
    y4                0.989    0.123    8.045    0.000
    y5                0.990    0.154    6.424    0.000
    F1                0.997    0.165    6.048    0.000
    F2                0.910    0.202    4.499    0.000
    y6                1.114    0.211    5.268    0.000Test Statistics and Fit Indic
Fit for both mean and covariance
          Chi-square statistic   10.609
          Degrees of freedom     12
          p-value        0.563
          Chi-square statistic (baseline model)  1715
```

```
          Degrees of freedom (baseline model)    20
          CFI            1
          NFI            0.994
          NNFI           1.001
          RMSEA          0
Fit for covariance only
          Chi-square statistic   1.928
          Degrees of freedom     8
          p-value        0.983
          Chi-square statistic (baseline model)  1653
          Degrees of freedom (baseline model)    15
          CFI            1
          NFI            0.999
          NNFI           1.007
          RMSEA          0
Fit for mean only
          Chi-square statistic   8.725
          Degrees of freedom     4
          p-value        0.068
          Chi-square statistic (baseline model)  41.978
          Degrees of freedom (baseline model)    5
          CFI            0.872
          NFI            0.792
          NNFI           0.84
          RMSEA          0.077
Parameter Estimates
                   Estimate  Std.err  Z-value  P(>|z|)
Latent variables:
  F1 =~
    y1                1.000
    y2                1.000
    y3                1.000
    y4                1.000
    y5                1.000
  F2 =~
    y1                0.000
    y2                1.000
    y3                2.077    0.177   11.720    0.000
    y4                3.155    0.275   11.452    0.000
    y5                4.232    0.378   11.185    0.000
  F1 =~
    y6                1.000
  F2 =~
    y6                5.144    0.467   11.012    0.000

Covariances:
  F1 ~~
    F2                0.487    0.092    5.270    0.000

Intercepts:
    F2                0.401    0.080    5.030    0.000
    F1                1.178    0.090   13.147    0.000
    y1                0.000
    y2                0.000
```

```
    y3                0.000
    y4                0.000
    y5                0.000
    y6                0.000

Variances:
    y1                1.000    0.147    6.797    0.000
    y2                1.003    0.123    8.185    0.000
    y3                0.993    0.116    8.590    0.000
    y4                0.989    0.123    8.045    0.000
    y5                0.990    0.154    6.424    0.000
    F1                0.997    0.165    6.048    0.000
    F2                0.910    0.202    4.499    0.000
    y6                1.114    0.211    5.268    0.000
```

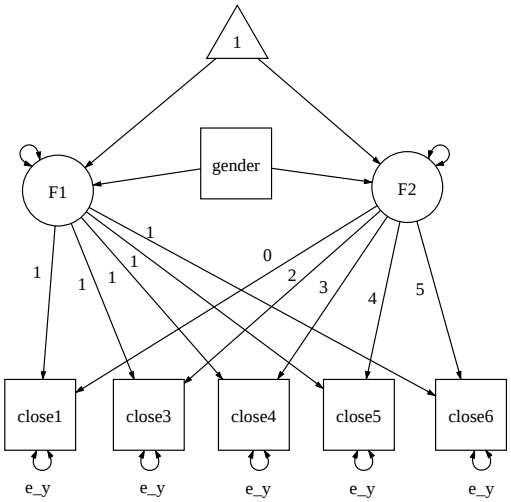
1.5 Example 5.

The data used in this example are given below.

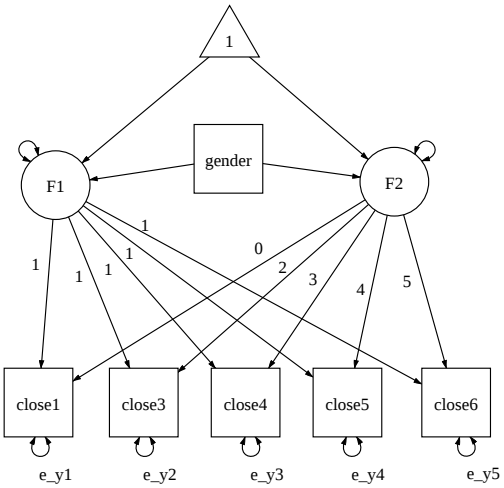
```
close1 close3 close4 close5 close6 gender
851 851 851 851 851 851
37.9542 37.2785 37.0463 36.5696 36.1363 0.4900
6.3944 3.2716 4.1435 3.7058 4.1286 -0.0940
3.2716 7.5282 6.0804 5.1597 5.7608 -0.0390
4.1435 6.0804 10.7290 6.5672 7.2365 -0.1521
3.7058 5.1597 6.5672 10.2920 7.6463 -0.1104
4.1286 5.7608 7.2365 7.6463 12.9085 -0.1469
-0.0940 -0.0390 -0.1521 -0.1104 -0.1469 0.2502
```

The output for the linear model with a covariate and with equal error variance in Figure 3a is given below.

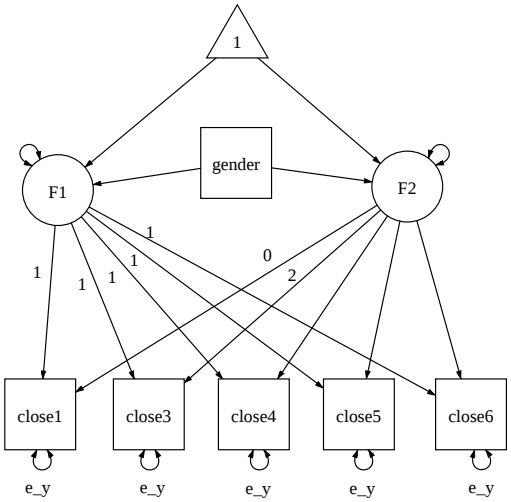
```
Test Statistics and Fit Indices
Fit for both mean and covariance
          Chi-square statistic   81.653
          Degrees of freedom     17
          p-value        0
          Chi-square statistic (baseline model)  2272.4
          Degrees of freedom (baseline model)    23
          CFI            0.971
          NFI            0.964
          NNFI           0.961
          RMSEA          0.067
Fit for covariance only
          Chi-square statistic   76.586
          Degrees of freedom     14
          p-value        0
          Chi-square statistic (baseline model)  1971.2
          Degrees of freedom (baseline model)    19
          CFI            0.968
          NFI            0.961
          NNFI           0.956
          RMSEA          0.072
Fit for mean only
          Chi-square statistic   5.073
```



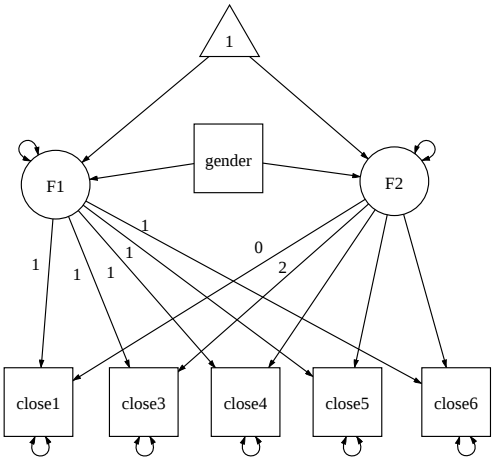
(a) Linear model with equal error variances



(b) Linear model with unequal error variances



(c) Nonlinear model with equal error variances



(d) Nonlinear model with unequal error variances

Figure 3: Path diagrams for growth curve models used in Example 5

```
          Degrees of freedom     3
          p-value        0.167
          Chi-square statistic (baseline model)  287.88
          Degrees of freedom (baseline model)    4
          CFI            0.993
          NFI            0.982
          NNFI           0.99
          RMSEA          0.028
Parameter Estimates
                    Estimate  Std.err  Z-value  P(>|z|)
Latent variables:
  F1 =~
    close1            1.000
    close3            1.000
    close4            1.000
    close5            1.000
    close6            1.000
  F2 =~
    close1            0.000
    close3            2.000
    close4            3.000
    close5            4.000
    close6            5.000

Regressions:
  F1 ~
    gender           -0.289    0.163   -1.770    0.077
  F2 ~
    gender           -0.052    0.043   -1.216    0.224

Covariances:
  F1 ~~
    F2                0.249    0.056    4.420    0.000

Intercepts:
    F2               -0.333    0.030  -11.169    0.000
    F1               38.141    0.114  334.196    0.000
    close1            0.000
    close3            0.000
    close4            0.000
    close5            0.000
    close6            0.000

Variances:
    close1  (e_y)     3.696    0.103   35.728    0.000
    close3  (e_y)     3.696    0.103   35.728    0.000
    close4  (e_y)     3.696    0.103   35.728    0.000
    close5  (e_y)     3.696    0.103   35.728    0.000
    close6  (e_y)     3.696    0.103   35.728    0.000
    F1                2.956    0.284   10.399    0.000
    F2                0.136    0.020    6.804    0.000
```

The output for the linear model with a covariate and with unequal error variance in Figure 3b is given below.

```
Test Statistics and Fit Indices
Fit for both mean and covariance
          Chi-square statistic   58.463
          Degrees of freedom     13
          p-value        0
          Chi-square statistic (baseline model)  2148.6
          Degrees of freedom (baseline model)    19
          CFI            0.979
          NFI            0.973
          NNFI           0.969
          RMSEA          0.064
Fit for covariance only
          Chi-square statistic   53.862
          Degrees of freedom     10
          p-value        0
          Chi-square statistic (baseline model)  1971.2
          Degrees of freedom (baseline model)    15
          CFI            0.978
          NFI            0.973
          NNFI           0.966
          RMSEA          0.072
Fit for mean only
          Chi-square statistic   4.606
          Degrees of freedom     3
          p-value        0.203
          Chi-square statistic (baseline model)  285
          Degrees of freedom (baseline model)    4
          CFI            0.994
          NFI            0.984
          NNFI           0.992
          RMSEA          0.025
Parameter Estimates
                   Estimate  Std.err  Z-value  P(>|z|)
Latent variables:
  F1 =~
    close1            1.000
    close3            1.000
    close4            1.000
    close5            1.000
    close6            1.000
  F2 =~
    close1            0.000
    close3            2.000
    close4            3.000
    close5            4.000
    close6            5.000

Regressions:
  F1 ~
    gender           -0.274    0.162   -1.685    0.092
  F2 ~
    gender           -0.052    0.043   -1.224    0.221

Covariances:
```

```
  F1 ~~
    F2                0.242    0.065    3.713    0.000

Intercepts:
    F2               -0.330    0.030  -11.108    0.000
    F1               38.128    0.114  335.599    0.000
    close1            0.000
    close3            0.000
    close4            0.000
    close5            0.000
    close6            0.000

Variances:
    close1 (e_y1)     3.522    0.275   12.811    0.000
    close3 (e_y2)     2.986    0.182   16.385    0.000
    close4 (e_y3)     4.000    0.236   16.945    0.000
    close5 (e_y4)     3.660    0.238   15.411    0.000
    close6 (e_y5)     4.504    0.318   14.145    0.000
    F1                3.051    0.301   10.148    0.000
    F2                0.127    0.023    5.607    0.000
```

The output for the nonlinear model with a covariate and with equal error variance in Figure 3c is given below.

```
Test Statistics and Fit Indices
Fit for both mean and covariance
          Chi-square statistic   78.959
          Degrees of freedom     14
          p-value        0
          Chi-square statistic (baseline model)  2272.4
          Degrees of freedom (baseline model)    23
          CFI            0.971
          NFI            0.965
          NNFI           0.953
          RMSEA          0.074
Fit for covariance only
          Chi-square statistic   75.991
          Degrees of freedom     11
          p-value        0
          Chi-square statistic (baseline model)  1971.2
          Degrees of freedom (baseline model)    19
          CFI            0.967
          NFI            0.961
          NNFI           0.942
          RMSEA          0.083
Fit for mean only
          Chi-square statistic   2.972
          Degrees of freedom     3
          p-value        0.396
          Chi-square statistic (baseline model)  285.6
          Degrees of freedom (baseline model)    4
          CFI            1
          NFI            0.99
          NNFI           1
          RMSEA          0
```

```
Parameter Estimates
                   Estimate  Std.err  Z-value  P(>|z|)
Latent variables:
  F1 =~
    close1            1.000
    close3            1.000
    close4            1.000
    close5            1.000
    close6            1.000
  F2 =~
    close1            0.000
    close3            2.000
    close4            3.043    0.285   10.677    0.000
    close5            4.027    0.374   10.769    0.000
    close6            5.413    0.511   10.601    0.000

Regressions:
  F1 ~
    gender           -0.289    0.163   -1.781    0.075
  F2 ~
    gender           -0.050    0.040   -1.238    0.216

Covariances:
  F1 ~~
    F2                0.235    0.056    4.225    0.000

Intercepts:
    F2               -0.312    0.043   -7.274    0.000
    F1               38.114    0.117  325.411    0.000
    close1            0.000
    close3            0.000
    close4            0.000
    close5            0.000
    close6            0.000

Variances:
    close1  (e_y)     3.683    0.104   35.490    0.000
    close3  (e_y)     3.683    0.104   35.490    0.000
    close4  (e_y)     3.683    0.104   35.490    0.000
    close5  (e_y)     3.683    0.104   35.490    0.000
    close6  (e_y)     3.683    0.104   35.490    0.000
    F1                3.035    0.295   10.302    0.000
    F2                0.122    0.030    4.056    0.000
```

The output for the nonlinear model with a covariate and with equal error variance in Figure 3d is given below.

```
Test Statistics and Fit Indices
Fit for both mean and covariance
         Chi-square statistic   57.928
         Degrees of freedom     10
         p-value        0
         Chi-square statistic (baseline model)  2148.6
         Degrees of freedom (baseline model)    19
         CFI            0.977
```

```
          NFI            0.973
          NNFI           0.957
          RMSEA          0.075
Fit for covariance only
          Chi-square statistic   54.587
          Degrees of freedom     7
          p-value        0
          Chi-square statistic (baseline model)  1971.2
          Degrees of freedom (baseline model)    15
          CFI            0.976
          NFI            0.972
          NNFI           0.948
          RMSEA          0.089
Fit for mean only
          Chi-square statistic   3.345
          Degrees of freedom     3
          p-value        0.341
          Chi-square statistic (baseline model)  284.99
          Degrees of freedom (baseline model)    4
          CFI            0.999
          NFI            0.988
          NNFI           0.998
          RMSEA          0.012
Parameter Estimates
                   Estimate  Std.err  Z-value  P(>|z|)
Latent variables:
  F1 =~
    close1            1.000
    close3            1.000
    close4            1.000
    close5            1.000
    close6            1.000
  F2 =~
    close1            0.000
    close3            2.000
    close4            2.988    0.266   11.245    0.000
    close5            3.961    0.348   11.397    0.000
    close6            5.138    0.464   11.075    0.000

Regressions:
  F1 ~
    gender           -0.274    0.162   -1.687    0.092
  F2 ~
    gender           -0.052    0.042   -1.233    0.218

Covariances:
  F1 ~~
    F2                0.239    0.066    3.606    0.000

Intercepts:
    F2               -0.326    0.043   -7.541    0.000
    F1               38.120    0.117  325.996    0.000
    close1            0.000
    close3            0.000
```

```
    close4            0.000
    close5            0.000
    close6            0.000

Variances:
    close1            3.523    0.275   12.817    0.000
    close3            2.987    0.183   16.368    0.000
    close4            4.009    0.239   16.763    0.000
    close5            3.690    0.244   15.130    0.000
    close6            4.431    0.340   13.033    0.000
    F1                3.072    0.309    9.953    0.000
    F2                0.124    0.032    3.863    0.000
```