

This is an example of a Confirmatory Factor Analysis using Mplus.

The scale used in this example is Fox K, Corbin C. The physical self-perception profile: Development and preliminary validation. *J Sport Exerc Psychol*. 1989;11(4):408-430. <https://doi:10.1123/jsep.11.4.408>. An example of reporting the results in a journal are presented in the end of this output.

Mplus VERSION 8.4

MUTHEN & MUTHEN

INPUT INSTRUCTIONS

TITLE: PMC data

DATA:

FILE IS C:\PCM data.dat;

VARIABLE: NAMES ARE

PC1 PC2 PC3 PC4 PC5;

USEVARIABLES ARE

PC1 PC2 PC3 PC4 PC5; !5 items

MISSING ALL (-999);

ANALYSIS: TYPE=GENERAL;

ESTIMATOR=MLR;

MODEL:

PMC BY PC1 PC2 PC3 PC4 PC5;

PC4 with PC5; !residuals allowed to correlate based on the fit indices

OUTPUT: SAMP STAND MOD(4);

*** WARNING

Data set contains cases with missing on all variables.

These cases were not included in the analysis.

Number of cases with missing on all variables: 316

1 WARNING(S) FOUND IN THE INPUT INSTRUCTIONS

SUMMARY OF ANALYSIS

Number of groups	1
Number of observations	833 !sample size
Number of dependent variables	5
Number of independent variables	0

Number of continuous latent variables 1

Observed dependent variables

Continuous
PC1 PC2 PC3 PC4 PC5

Continuous latent variables
PMC

Estimator	MLR
Information matrix	OBSERVED
Maximum number of iterations	1000
Convergence criterion	0.500D-04
Maximum number of steepest descent iterations	20
Maximum number of iterations for H1	2000
Convergence criterion for H1	0.100D-03

Input data file(s)
C:\PCM data

Input data format FREE

SUMMARY OF DATA

Number of missing data patterns 6

COVARIANCE COVERAGE OF DATA

Minimum covariance coverage value 0.100

PROPORTION OF DATA PRESENT

	Covariance Coverage				
	PC120	PC220	PC320	PC420	PC520
PC120	0.996				
PC220	0.994	0.998			
PC320	0.992	0.993	0.995		
PC420	0.995	0.996	0.994	0.999	
PC520	0.995	0.996	0.994	0.998	0.999

SAMPLE STATISTICS

ESTIMATED SAMPLE STATISTICS

Means					
	PC1	PC2	PC3	PC4	PC5
	<u>3.839</u>	<u>3.493</u>	<u>3.476</u>	<u>3.221</u>	<u>3.061</u>
Covariances					
	PC120	PC220	PC320	PC420	PC520
PC120	<u>1.090</u>				
PC220	0.794	<u>1.144</u>			
PC320	0.759	0.796	<u>1.316</u>		
PC420	0.738	0.788	0.815	<u>1.369</u>	
PC520	0.665	0.750	0.827	1.006	<u>1.415</u>
Correlations					
	PC120	PC220	PC320	PC420	PC520
PC120	<u>1.000</u>				
PC220	0.711	<u>1.000</u>			
PC320	0.634	0.649	<u>1.000</u>		
PC420	0.604	0.630	0.607	<u>1.000</u>	
PC520	0.535	0.590	0.606	0.723	<u>1.000</u>

MAXIMUM LOG-LIKELIHOOD VALUE FOR THE UNRESTRICTED (H1) MODEL IS -5178.831

UNIVARIATE SAMPLE STATISTICS

UNIVARIATE HIGHER-ORDER MOMENT DESCRIPTIVE STATISTICS

Variable/ Percentiles		Mean/ Variance	Skewness/ Kurtosis	Minimum/ Maximum	% with Min/Max	20%/60%
Sample Size	Median					
40%/80%						
PC120		3.841	-0.727	1.000	3.73%	3.000
4.000	4.000					
	830.000	1.090	0.116	5.000	31.69%	4.000
5.000						
PC220		3.492	-0.374	1.000	4.93%	3.000
3.000	4.000					
	831.000	1.145	-0.354	5.000	19.25%	4.000
4.000						
PC320		3.476	-0.452	1.000	6.51%	2.000
3.000	4.000					
	829.000	1.318	-0.566	5.000	20.39%	4.000
5.000						

PC420		3.221	-0.251	1.000	10.10%	2.000
3.000	3.000					
	832.000	1.369	-0.662	5.000	15.02%	4.000
4.000						
PC520		3.061	-0.144	1.000	13.22%	2.000
3.000	3.000					
	832.000	1.416	-0.738	5.000	12.50%	3.000
4.000						

THE MODEL ESTIMATION TERMINATED NORMALLY

MODEL FIT INFORMATION

Number of Free Parameters 16

Loglikelihood

H0 Value	-5191.741
H0 Scaling Correction Factor for MLR	1.3696
H1 Value	-5178.831
H1 Scaling Correction Factor for MLR	1.4013

Information Criteria

Akaike (AIC)	10415.482
Bayesian (BIC)	10491.082
Sample-Size Adjusted BIC ($n^* = (n + 2) / 24$)	10440.272

Chi-Square Test of Model Fit

Value	16.895*
Degrees of Freedom	4
P-Value	0.0020

! $\chi^2 = >.05$ is acceptable. However, with large or small samples $<.05$ values are often found.

Scaling Correction Factor for MLR	1.5283
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* The chi-square value for MLM, MLMV, MLR, ULSMV, WLSM and WLSMV cannot be used for chi-square difference testing in the regular way. MLM, MLR and WLSM chi-square difference testing is described on the Mplus website. MLMV, WLSMV, and ULSMV difference testing is done using the DIFFTEST option.

RMSEA (Root Mean Square Error Of Approximation)

Estimate	0.062
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! RMSEA $<.05$ good fit, $<.08$ satisfactory

90 Percent C.I.	0.034	0.094
Probability RMSEA $\leq .05$	0.216	

CFI/TLI

CFI	0.990	! >.95 good fit, >.90 satisfactory
TLI	0.974	! >.95 good fit, >.90 satisfactory

Chi-Square Test of Model Fit for the Baseline Model

Value	1252.169
Degrees of Freedom	10
P-Value	0.0000

SRMR (Standardized Root Mean Square Residual)

Value	0.017	!SRMR <.06 acceptable
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MODEL RESULTS

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
PMC	BY				
	PC1	1.000	0.000	999.000	999.000
	PC2	1.064	0.037	28.959	0.000
	PC3	1.059	0.046	22.777	0.000
	PC4	1.030	0.054	18.986	0.000
	PC5	0.981	0.056	17.380	0.000
PC5	WITH				
	PC4	0.272	0.045	6.079	0.000
Intercepts					
	PC1	3.839	0.036	105.924	0.000
	PC2	3.493	0.037	94.215	0.000
	PC3	3.476	0.040	87.354	0.000
	PC4	3.220	0.041	79.425	0.000
	PC5	3.061	0.041	74.272	0.000
Variances					
	PMC	0.726	0.058	12.490	0.000
Residual Variances	!% of the variance cannot be explained with this model				
	PC1	0.365	0.042	8.749	0.000
	PC2	0.323	0.040	8.079	0.000
	PC3	0.503	0.040	12.538	0.000
	PC4	0.599	0.053	11.295	0.000
	PC5	0.716	0.052	13.807	0.000

STANDARDIZED MODEL RESULTS !To be reported

STDYX Standardization

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
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PMC	BY				
PC1		0.816	0.023	36.130	0.000
PC2		0.847	0.019	43.508	0.000
PC3		0.786	0.019	41.264	0.000
PC4		0.750	0.025	29.851	0.000
PC5		0.703	0.025	27.603	0.000

PC5	WITH				
PC4		0.416	0.047	8.880	0.000

Intercepts					
PC1		3.676	0.114	32.232	0.000
PC2		3.266	0.089	36.615	0.000
PC3		3.030	0.083	36.708	0.000
PC4		2.753	0.071	38.640	0.000
PC5		2.574	0.064	39.914	0.000

Variances					
PMC		1.000	0.000	999.000	999.000

Residual Variances					
PC1		0.335	0.037	9.084	0.000
PC2		0.282	0.033	8.544	0.000
PC3		0.382	0.030	12.748	0.000
PC4		0.437	0.038	11.598	0.000
PC5		0.506	0.036	14.131	0.000

STDY Standardization

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
PMC	BY				
PC1		0.816	0.023	36.130	0.000
PC2		0.847	0.019	43.508	0.000
PC3		0.786	0.019	41.264	0.000
PC4		0.750	0.025	29.851	0.000
PC5		0.703	0.025	27.603	0.000
PC520	WITH				
PC4		0.416	0.047	8.880	0.000
Intercepts					
PC1		3.676	0.114	32.232	0.000
PC2		3.266	0.089	36.615	0.000
PC3		3.030	0.083	36.708	0.000
PC4		2.753	0.071	38.640	0.000
PC5		2.574	0.064	39.914	0.000
Variances					
PMC		1.000	0.000	999.000	999.000
Residual Variances					
PC1		0.335	0.037	9.084	0.000
PC2		0.282	0.033	8.544	0.000
PC3		0.382	0.030	12.748	0.000
PC4		0.437	0.038	11.598	0.000

PC5	0.506	0.036	14.131	0.000
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STD Standardization

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
PMC	BY				
	PC1	0.852	0.034	24.980	0.000
	PC2	0.906	0.029	30.735	0.000
	PC3	0.902	0.032	28.244	0.000
	PC4	0.878	0.037	23.851	0.000
	PC5	0.836	0.038	22.256	0.000
PC5	WITH				
	PC4	0.272	0.045	6.079	0.000
Intercepts					
	PC1	3.839	0.036	105.924	0.000
	PC2	3.493	0.037	94.215	0.000
	PC3	3.476	0.040	87.354	0.000
	PC4	3.220	0.041	79.425	0.000
	PC5	3.061	0.041	74.272	0.000
Variances					
	PMC	1.000	0.000	999.000	999.000
Residual Variances					
	PC1	0.365	0.042	8.749	0.000
	PC2	0.323	0.040	8.079	0.000
	PC3	0.503	0.040	12.538	0.000
	PC4	0.599	0.053	11.295	0.000
	PC5	0.716	0.052	13.807	0.000

R-SQUARE

Observed Variable	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
PC1	0.665	0.037	18.065	0.000
PC2	0.718	0.033	21.754	0.000
PC3	0.618	0.030	20.632	0.000
PC4	0.563	0.038	14.926	0.000
PC5	0.494	0.036	13.801	0.000

QUALITY OF NUMERICAL RESULTS

Condition Number for the Information Matrix (ratio of smallest to largest eigenvalue)	0.187E-01
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MODEL MODIFICATION INDICES

NOTE: Modification indices for direct effects of observed dependent variables regressed on covariates may not be included. To include these, request

MODINDICES (ALL).

Minimum M.I. value for printing the modification index 4.000

		M.I.	E.P.C.	Std E.P.C.	StdYX E.P.C.
WITH Statements					
PC2	WITH PC1	9.827	0.096	0.096	0.281
PC3	WITH PC2	5.242	-0.074	-0.074	-0.183
PC5	WITH PC1	7.530	-0.070	-0.070	-0.137
PC5	WITH PC3	10.532	0.092	0.092	0.154

DIAGRAM INFORMATION

Use View Diagram under the Diagram menu in the Mplus Editor to view the diagram.
If running Mplus from the Mplus Diagrammer, the diagram opens automatically.

Diagram output

c:\PMC data

Beginning Time: 13:23:22

Ending Time: 13:23:22

Elapsed Time: 00:00:00

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REPORTING THE RESULTS: !STANDARDIZED MODEL RESULTS (STDYX Standardization)

To test the factor structure of the scale, a confirmatory factor analysis was performed. The construct validity of the scale ($\chi^2(4) = 16.90$, $p < .01$, $CFI = .99$, $TLI = .97$, 90% CI [.034, .094], $RMSEA = .062$, $SRMR = .017$) was confirmed. The residual correlations between items with similar wording ("I am among the best when it comes to joining sport activities" and "I am among the first to join in sport activities") were accepted. Correlated residuals between items using similar wording are sometimes necessary in some models, although they should be used cautiously. The Cronbach alpha for the scale were acceptable ($\alpha = .89$). Based on all indices, the scale provided reliable results for the subsequent analyses.