ANALYSING THE MEASUREMENT MODEL IN SEM

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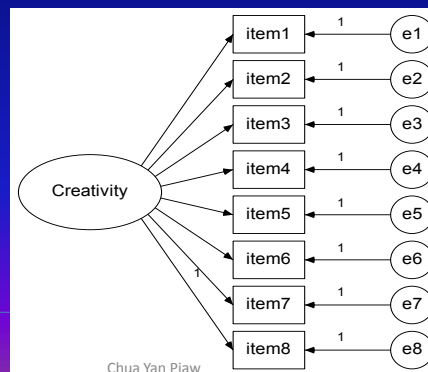
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MEASUREMENT MODEL

A measurement model has:

1. A latent construct
2. Measurement items for the construct
3. Measurement errors

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Validity

Three aspects of measurement model

Uni-dimensionality – uni-dimensionality achieved when an item have factor loading ≥ .50 for the latent construct. Item with lower factor loading should be deleted.

Validity

Convergent validity – achieved when all the items are statistically significant (CR > ± 1.96)

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Validity

Construct validity – achieved if the Fitness indexes achieved.
GFI ≥ .90,
CFI ≥ .90,
RMSEA ≤ .08,
Ratio (ChiSQ/df) ≤ 5.0

Discriminant validity – achieved when no redundant item in the model. or correlation between each pairs of latent constructs is ≤ .90 (Byrne, 2001).
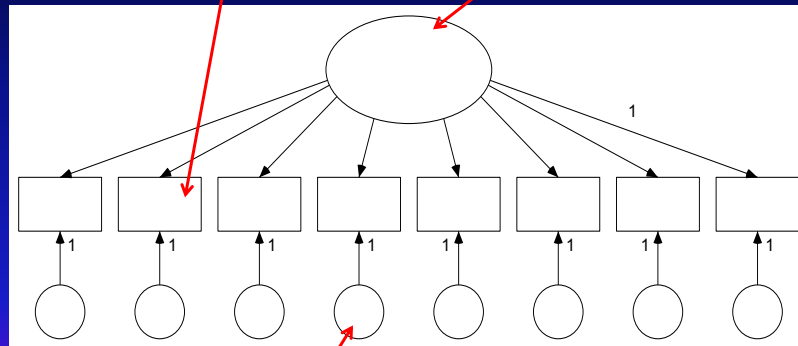
Reliability – Internal consistency reliability (using SPSS)

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•The schematic diagram in AMOS for a measurement model
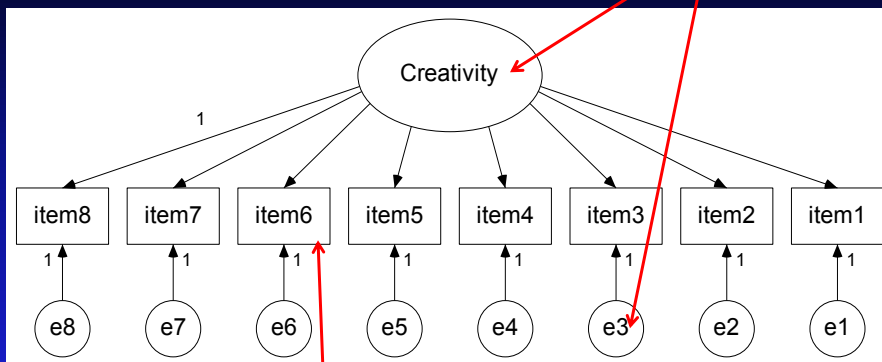
A measurement item

A latent construct

A measurement error

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•Naming the variables

Exogenous

Creativity

item8 item7 item6 item5 item4 item3 item2 item1

e8 e7 e6 e5 e4 e3 e2 e1

Endogenous

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•Hair et al. (1995, 2010) - suggested at least four fit indexes needed for construct validity of a measurement model:

•RMSEA, GFI, CFI and Chisq/df

Name of category	Index	Criteria
Discrepancy Chi Square	Chisq	P>.05
Root Mean Square of Error Approximation	RMSEA	RMSEA < .08 Acceptable - ≤ .10
Goodness of Fit Index	GFI	GFI >.90
Comparative Fit Index	CFI	CFI >.90
Chi Square/Degrees of Freedom	Chisq/df	Chi square/ df < 5.0
Adjusted Goodness of Fit	AGFI	AGFI > .90
Tucker-Lewis Index	TLI	TLI >.90
Normed Fit Index	NFI	NFI >.90

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To view construct construct validity results, click the title icon and type the requirements.
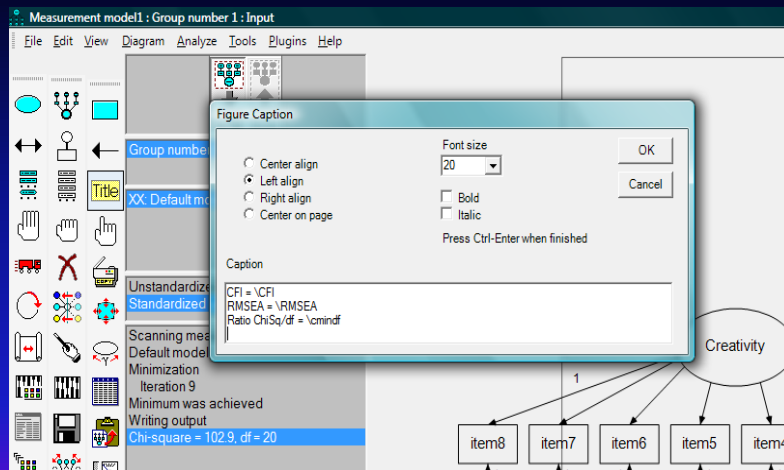
Title

Chi-square = \cmin
df =\df
p = \p
GFI = \GFI
CFI = \CFI
RMSEA = \RMSEA
Ratio ChiSq/df = \cmindf

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•Title
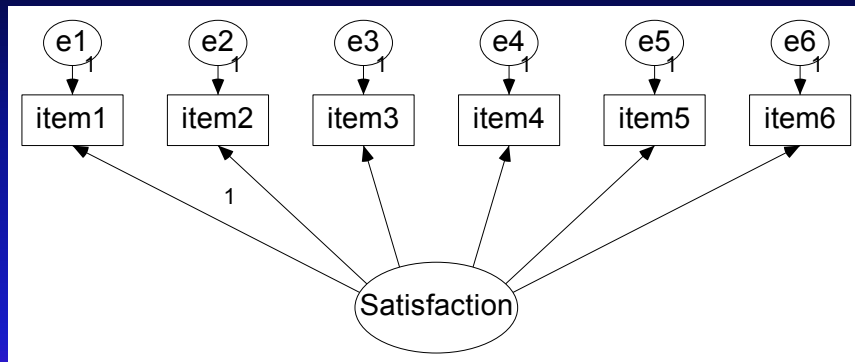

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Measurement model

Example 1:

A researcher creates six item for Online Buying Satisfaction.

Refer to data MM1, analysis validity and reliability of the measurement model Satisfaction.
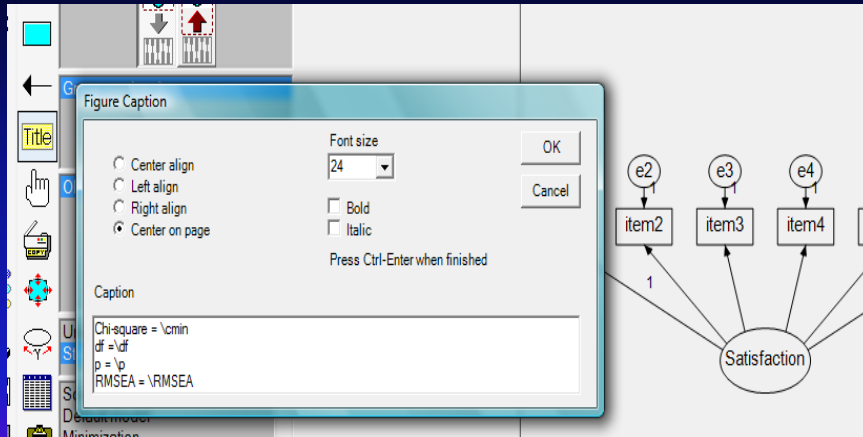
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Drawing the model

Checking normality

Assessment of normality (Group number 1)

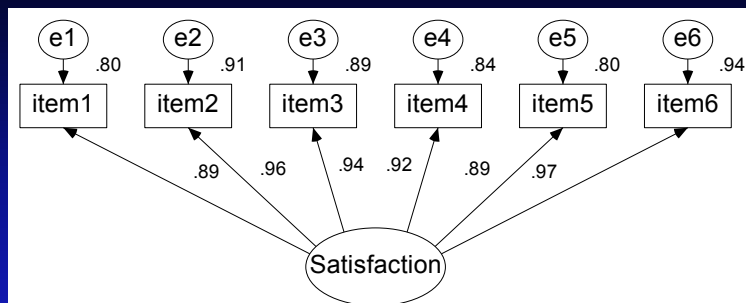| Variable	min	max	skew	c.r.	kurtosis	c.r.
item6	3.000	10.000	.358	1.170	-.221	-.361
item5	3.000	10.000	.359	1.172	.239	.391
item4	3.000	9.000	.281	.916	-.851	-1.389
item3	3.000	10.000	.054	.176	-.634	-1.035
item2	3.000	9.000	.236	.769	-.609	-.995
item1	2.000	9.000	.038	.125	-.650	-1.061
Multivariate					7.348	3.000

Labelling model fits

Result

Chi-square = 4.327
df =9
p = .889
RMSEA = .000
GFI = .977
CFI = 1.000
Ratio ChiSq/df = .481

Text output

Regression Weights: (Group number 1 - Default model)

			Estimate	S.E.	C.R.	P	Label
item1	<---	Satisfaction	1.000				
item2	<---	Satisfaction	.998	.075	13.301	***	
item3	<---	Satisfaction	1.046	.082	12.699	***	
item4	<---	Satisfaction	.933	.079	11.829	***	
item5	<---	Satisfaction	.862	.078	10.996	***	
item6	<---	Satisfaction	1.056	.075	14.002	***	

Standardized Regression Weights: (Group number 1 - Default model)

			Estimate
item1	<---	Satisfaction	.894
item2	<---	Satisfaction	.955
item3	<---	Satisfaction	.941
item4	<---	Satisfaction	.917
item5	<---	Satisfaction	.892
item6	<---	Satisfaction	.971

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Report

The factor loading of items of the satisfaction model are > .50.

All of the items are significantly represent the concept of online buying satisfaction (p < .05)

The model is valid for the population of the study.

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Not all the model will fit the data collected from the population.

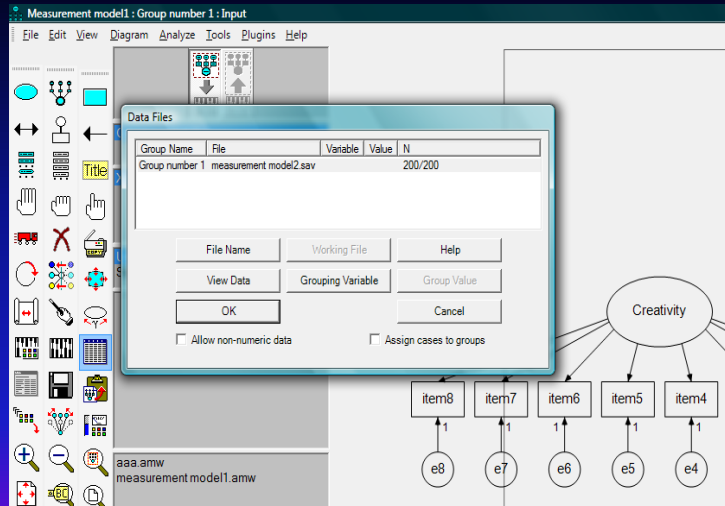Modification of model need to be done if the proposed model does not fit the data.

Example 2:

A researcher creates eight items to measure Creativity. Refer to data Measurement Model2, analysis validity and reliability of the model.

•Data file
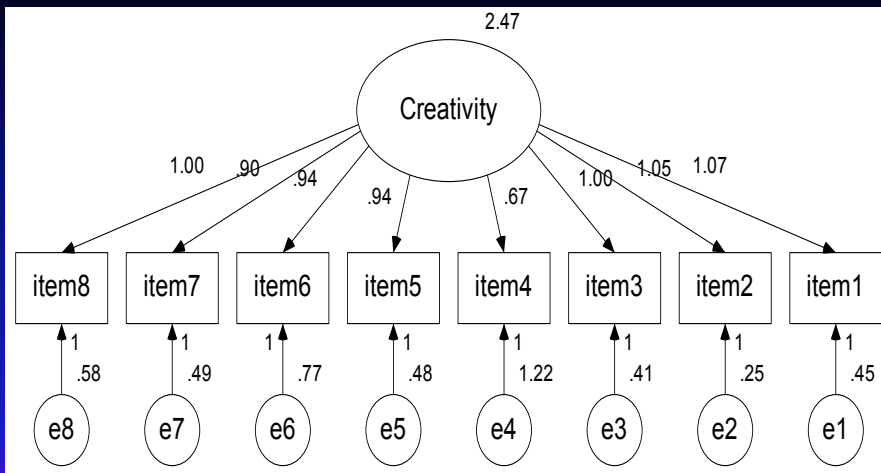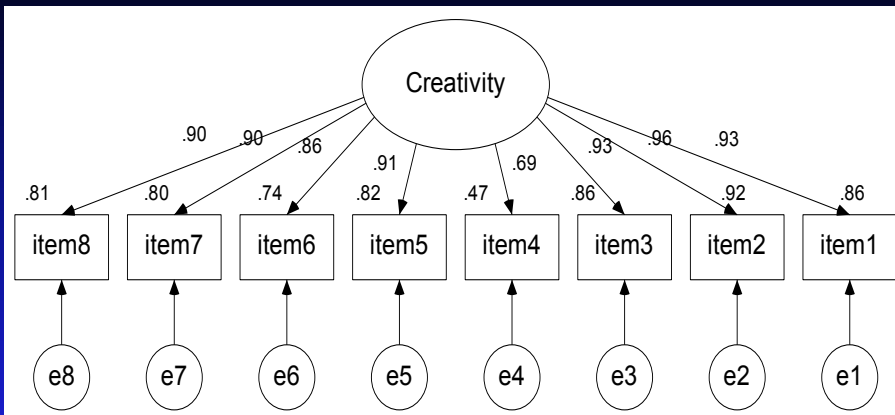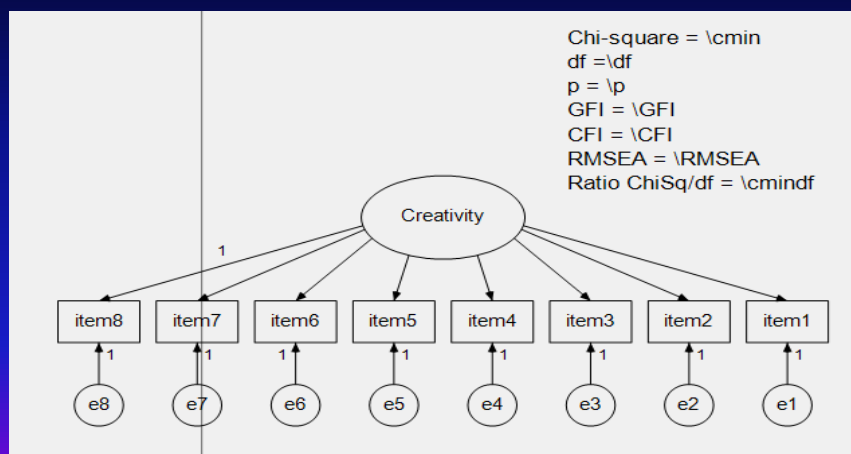
•Output – unstandardised estimate

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•**Factor loadings ≥ .5, ranging from .69 to .93.**
•**The items has high uni-dimensionality validity.**
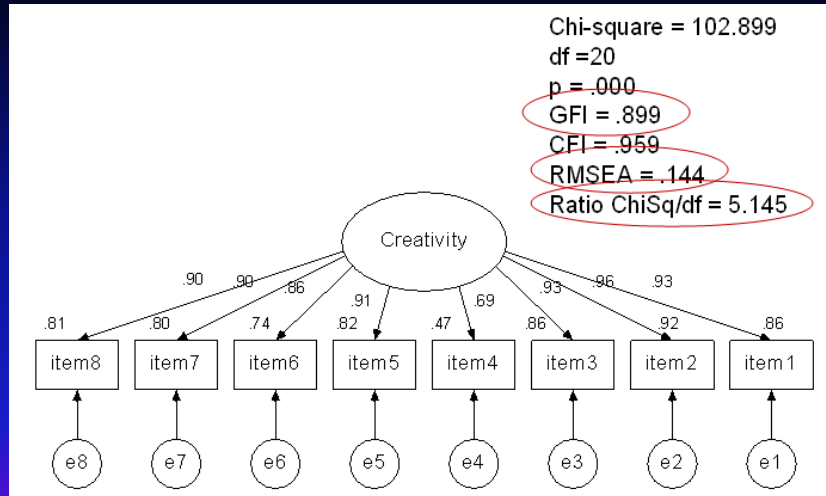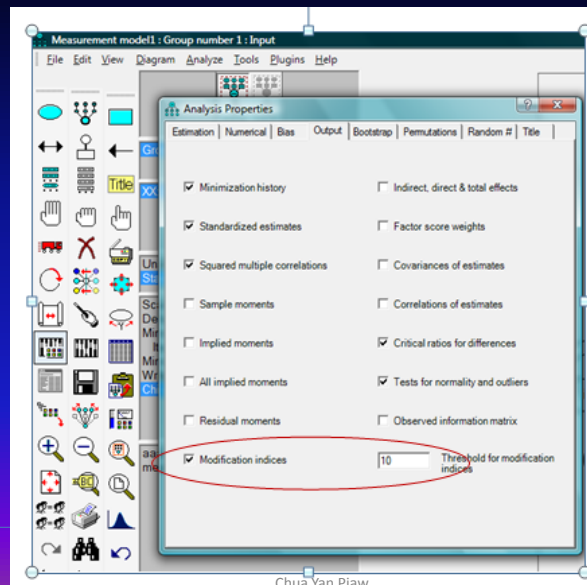• **The items are highly correlated to the latent construct.**

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•Input

Chi-square = \cmin
df =\df
p = \p
GFI = \GFI
CFI = \CFI
RMSEA = \RMSEA
Ratio ChiSq/df = \cmindf
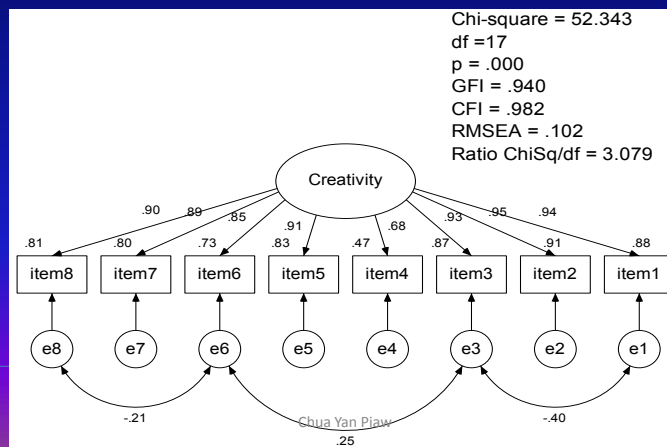
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•**Output**

•**Modification Indices**

•**Output**

measurement model1.amw
⊞ Analysis Summary
··· Notes for Group
⊞ Variable Summary
··· Parameter summary
··· Assessment of normality
··· Observations farthest from th
⊞ Notes for Model
⊞ Estimates
⊞ Modification Indices
··· Minimization History
⊞ Pairwise Parameter Comparis

Modification Indices (Group number 1 - Default model)

Covariances: (Group number 1 - Default model)

	M.I.	Par Change
e3 <--> e1	21.561	-.165
e6 <--> e3	17.235	.186
e8 <--> e6	10.928	-.171

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Set e3-e1 and e8-e6 as "free parameter estimate" by connecting them with double-headed arrow. To tell the computer that the two variable are correlated. Example, by connecting e1-e3, the ChiSq value will reduce 21.56.

Chi-square = 52.343
df =17
p = .000
GFI = .940
CFI = .982
RMSEA = .102
Ratio ChiSq/df = 3.079

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•After modification

Name of index	Requirement	Value	Result
GFI	≥ .90	.94	Achieved
CFI	≥ .90	.98	Achieved
RMSEA	≤ .08	.10	Achieved
Ratio ChiSQ/df	≤ 5.0	3.1	Achieved

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•Exercise

•Using the data file Measurement model1, analysis the validity and reliability of the items for the latent construct named Physical strength.

• Report the item that should be dropped from the model and the measurement errors which should be set as free parameters in the analysis.
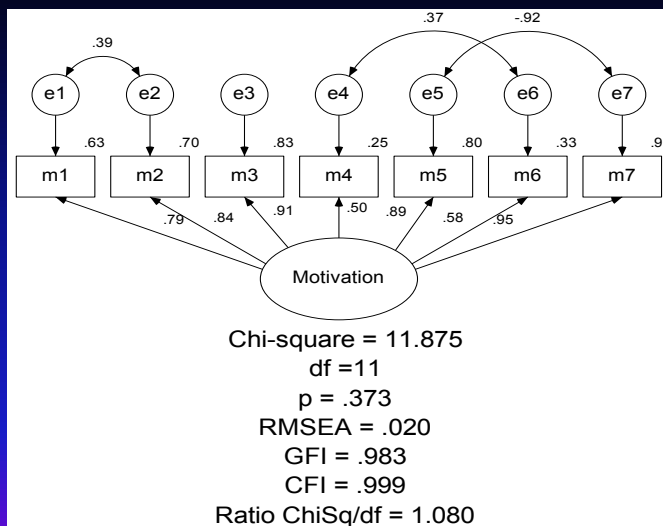
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Exercise 2

Analyse the validity and reliability of the items for Motivation and Performance using the data file Measurement Model3.

Items M1 – M7 are measurement items for the latent construct Motivation, while items P1-P8 are for latent construct Performance.
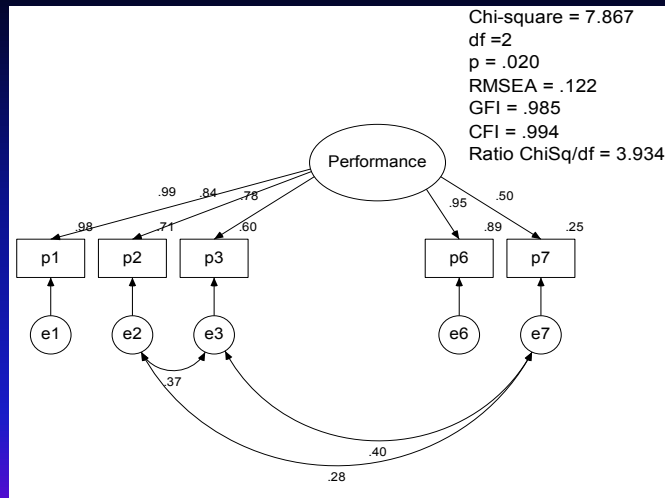
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Motivation

Chi-square = 11.875
df =11
p = .373
RMSEA = .020
GFI = .983
CFI = .999
Ratio ChiSq/df = 1.080

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Performance

Chi-square = 7.867
df =2
p = .020
RMSEA = .122
GFI = .985
CFI = .994
Ratio ChiSq/df = 3.934

• **Can the construct validity of the measurement model be improved?** Chua Yan Piaw

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Sample size
If sample size is smaller than needed for a full model (complete structural model with all items with each measurement models), then:
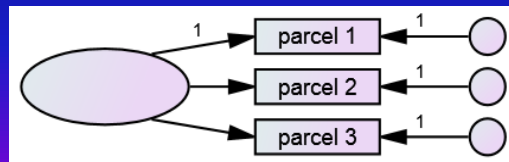
A. Item parceling
Item parceling - reduce the indicators for a measurement model. If the total items is 14, put them into 3 parcels, with 5, 5 and 4 items
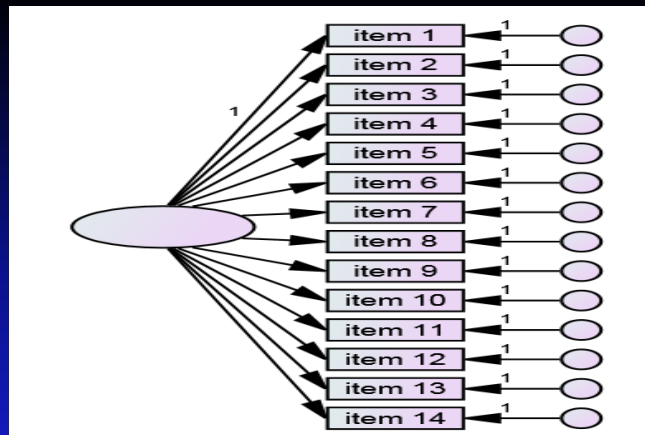
Parcel1 = 5 items
parcel 2 = 5 items
parcel 3 = 4 items

Item parceling

1. Used **factor loadings to get the factor loading (doing a factor analysis in SPSS).**
2. Arrange the item in order based on loading. Click **"Sort by size"** in the Factor analysis.
3. Put the item in **equal 3**, then distributed randomly each **triplet in the 3 parcels**, to create 3 parcels for the measurement model.

Mean score for each parcel (mean score is better because near to the original scores of the three items – but for **ordinal** data, it should be in total score)
Item parcelling reduces the number of distinct parameters (& df), so the model is relevant to the smaller sample size.

B. Using Path model

Change the full model to a path model
By changing the items of measurement model into a measurement indicator – it will reduce the number of distinct parameters (in text output). So the small sample size is now relevant to the model.

But this way will reduce the accurate of data because error will occur.

It depends on the objectives of your study.

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Thanks

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