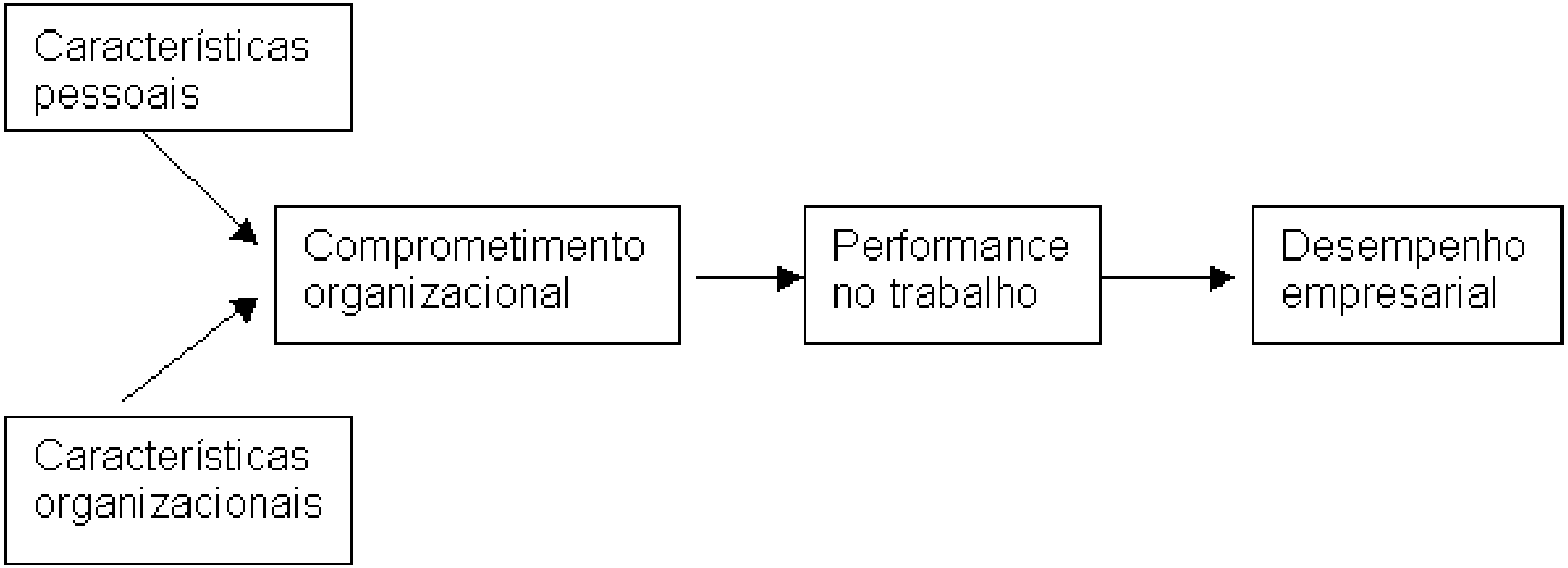
PRO2514 - Pesquisa Quantitativa em Gestão de Operações

Modelagem de Equações Estruturais – Parte 1

Prof. Dr. Renato de Oliveira Moraes

Modelagem de Equações Estruturais



Modelagem de Equações Estruturais

Modelo de mensuração

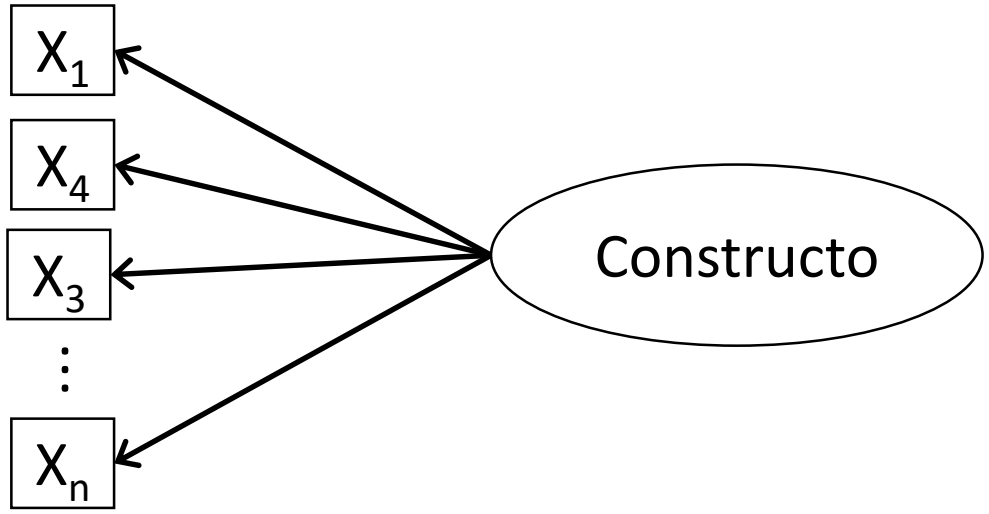
- relação de cada constructo com suas variáveis indicadoras por meio de análise fatorial confirmatória

Modelo Estrutural

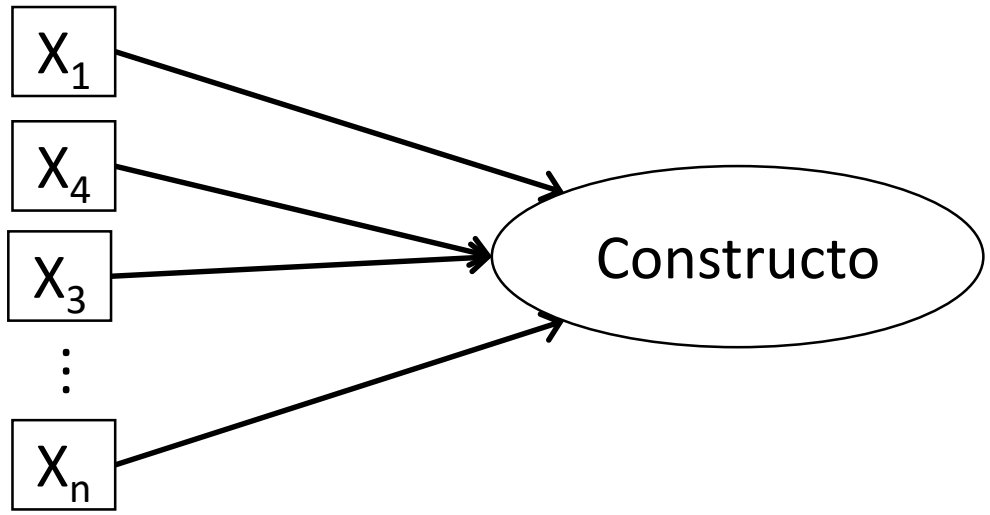
- relações de causalidade entre os constructos latentes por meio da aplicação de múltiplas equações de regressão multivariadas

Modelo de Mensuração

Constructos Reflexivos



Construtos Formativos



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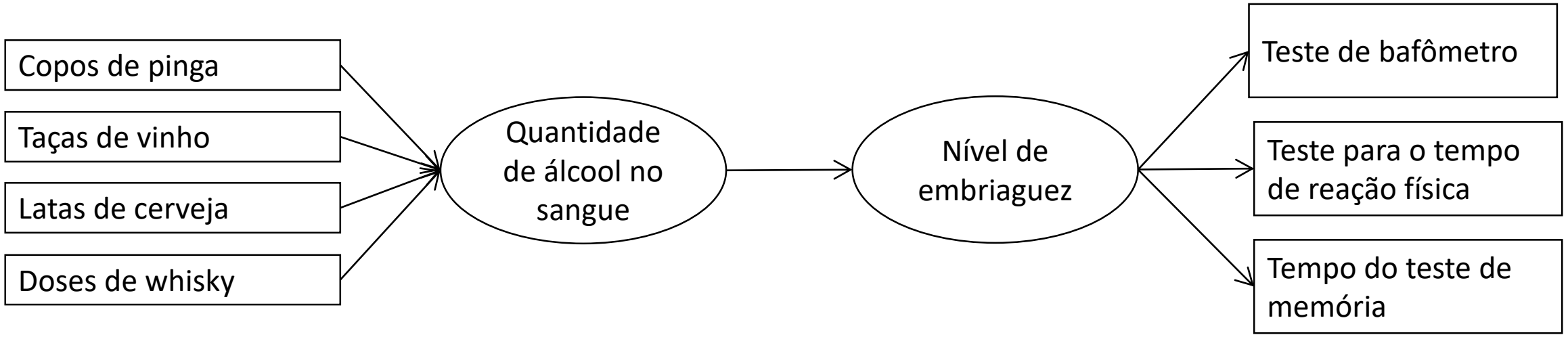
Constructo Formativo

Constructo Reflexivo

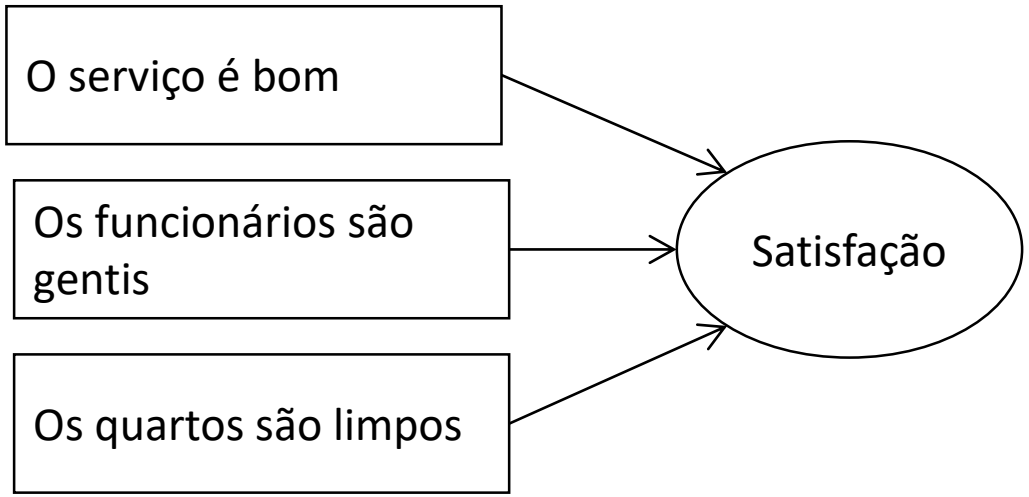


Variáveis observadas e não, necessariamente, correlacionadas

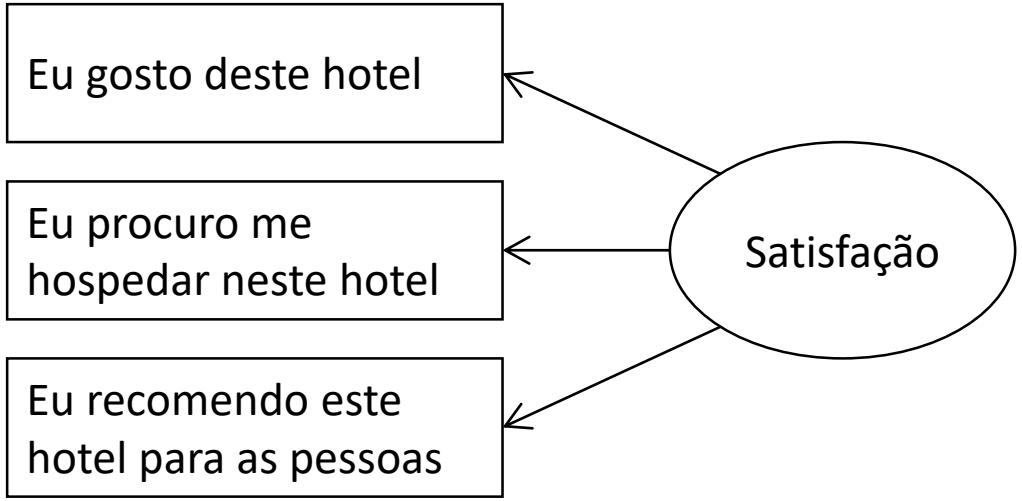
Variáveis observadas e correlacionadas

Satisfação com um hotel

Constructo Formativo



Constructo Reflexivo



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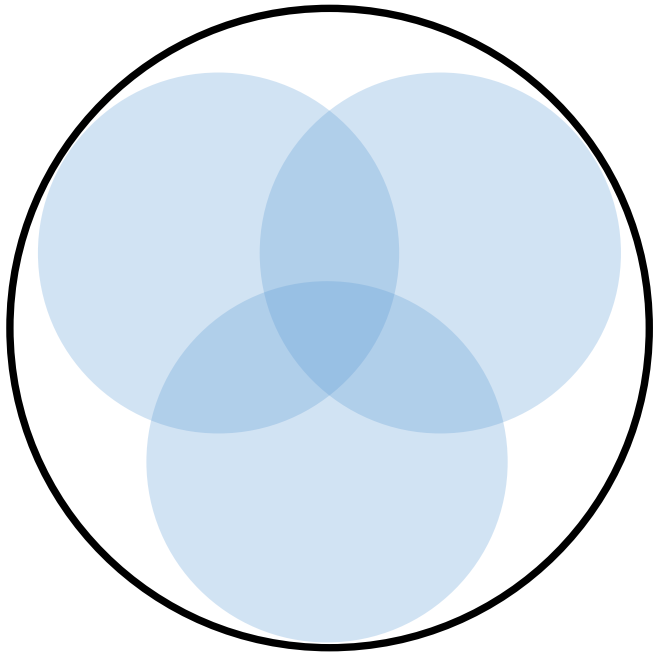
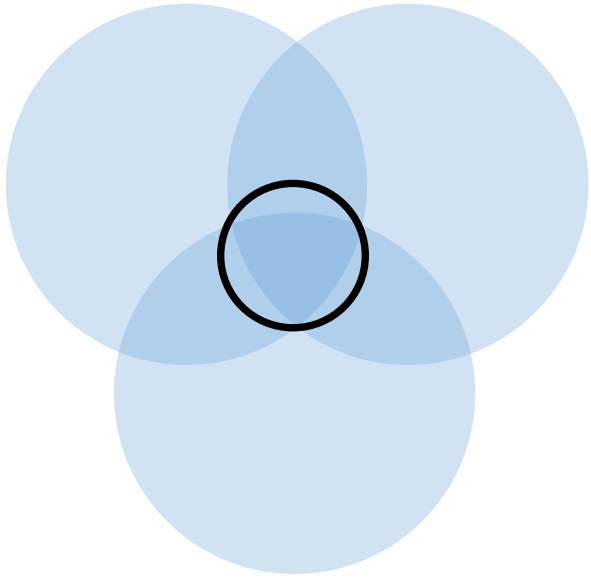
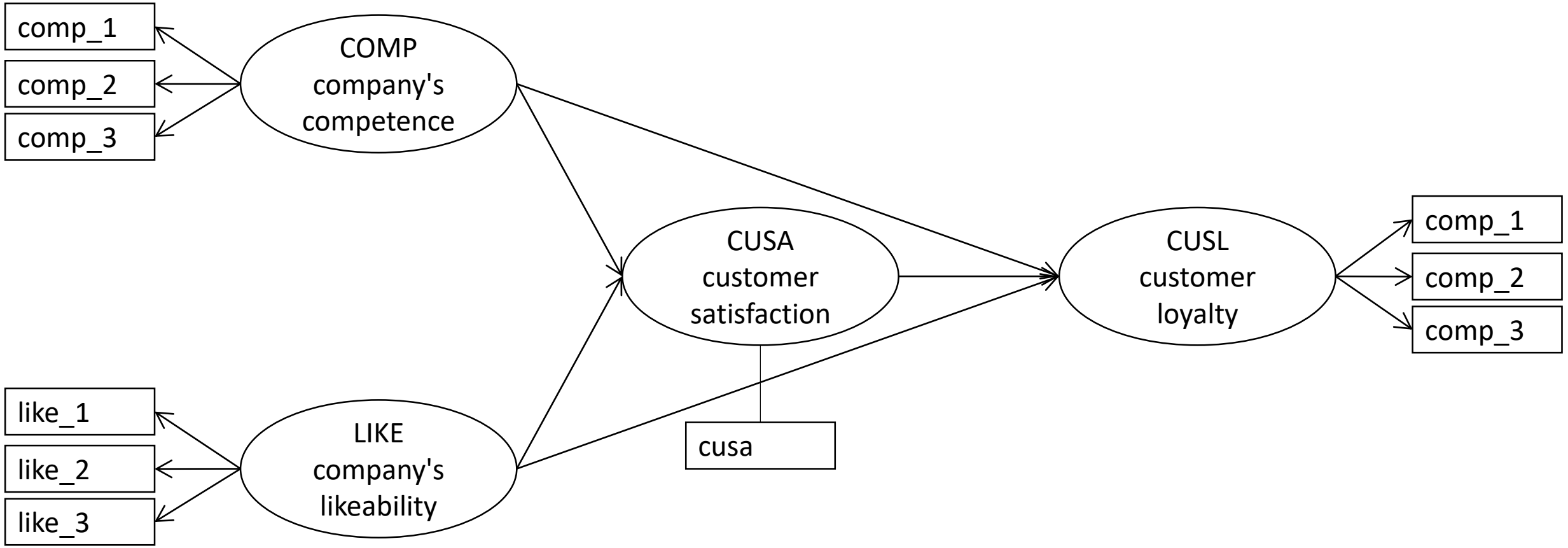
Constructo Formativo



Constructo Reflexivo




comp_1
comp_2
comp_3
COMP
company's
competence
CUSA
customer
satisfaction
CUSL
customer
loyalty
comp_1
comp_2
comp_3
like_1
like_2
like_3
LIKE
company's
likeability
cusa

Indicadores utilizados

Competence (COMP)

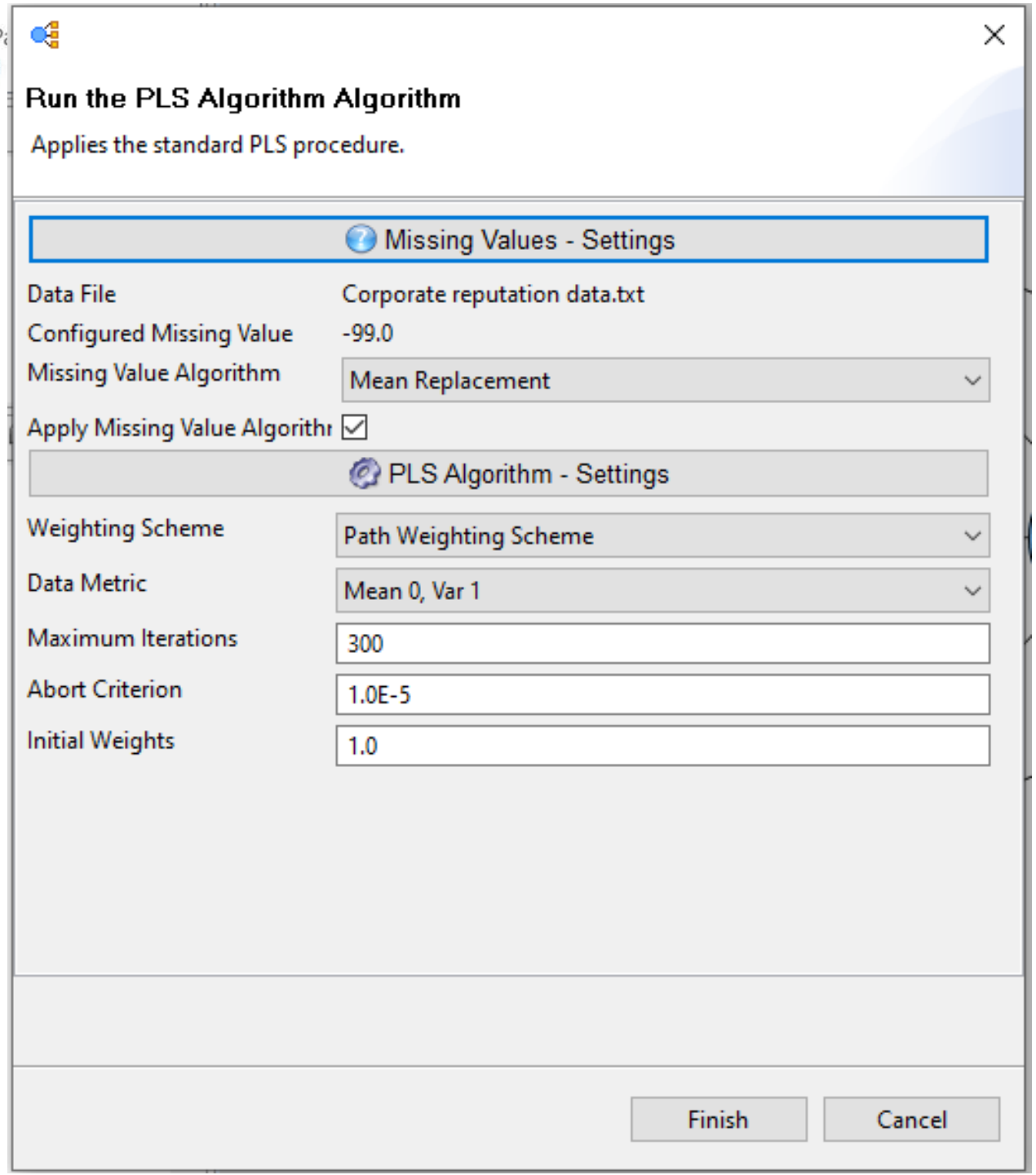
- comp_1: [The company] is a top competitor in its market.
- comp_2: As far as I know, [the company] is recognized worldwide.
- comp_3: I believe that [the company] performs at a premium level.

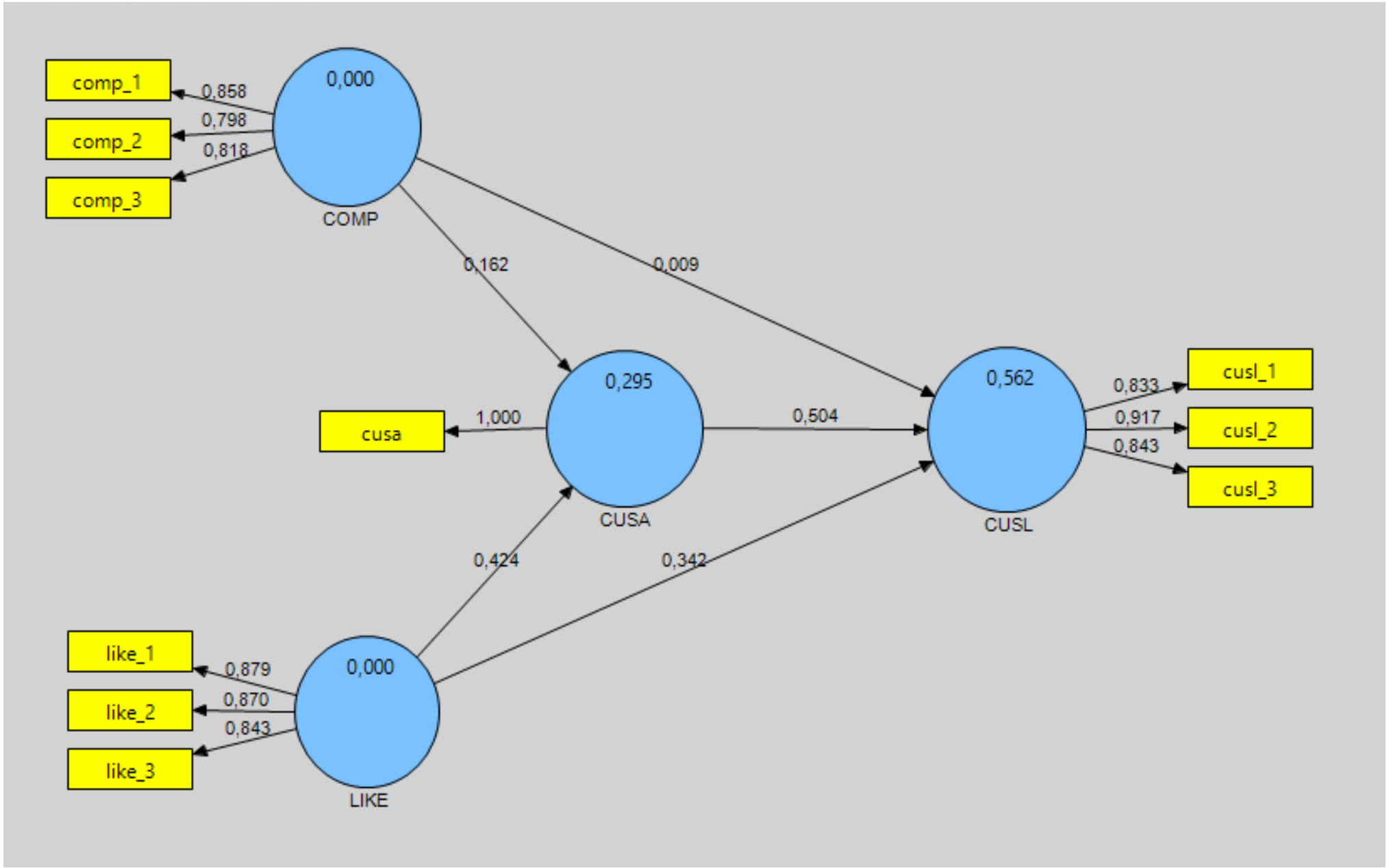
Likeability (LIKE)

- like_1: [The company] is a company that I can better identify with than other companies.
- like_2: [The company] is a company that I would regret more not having if it no longer existed than I would other companies.
- Like_3: I regard [the company] as a likeable company.

Customer Loyalty (CUSL)

- cusl_1: I would recommend [company] to friends and relatives.
- cusl_2: If I had to choose again, I would choose [company] as my mobile phone services provider.
- cusl_3: I will remain a customer of [company] in the future.


Run the PLS Algorithm Algorithm
Applies the standard PLS procedure.
Missing Values - Settings
Data File
Corporate reputation data.txt
Configured Missing Value
-99.0
Missing Value Algorithm
Mean Replacement
Apply Missing Value Algorithr
PLS Algorithm - Settings
Weighting Scheme
Path Weighting Scheme
Data Metric
Mean 0, Var 1
Maximum Iterations
300
Abort Criterion
1.0E-5
Initial Weights
1.0
Finish
Cancel


comp_1
comp_2
comp_3
0,858
0,798
0,818
0,000
COMP
0,162
0,009
cusa
1,000
0,295
CUSA
0,504
0,562
CUSL
0,833
0,917
0,843
cusl_1
cusl_2
cusl_3
0,424
0,342
like_1
like_2
like_3
0,879
0,870
0,843
0,000
LIKE

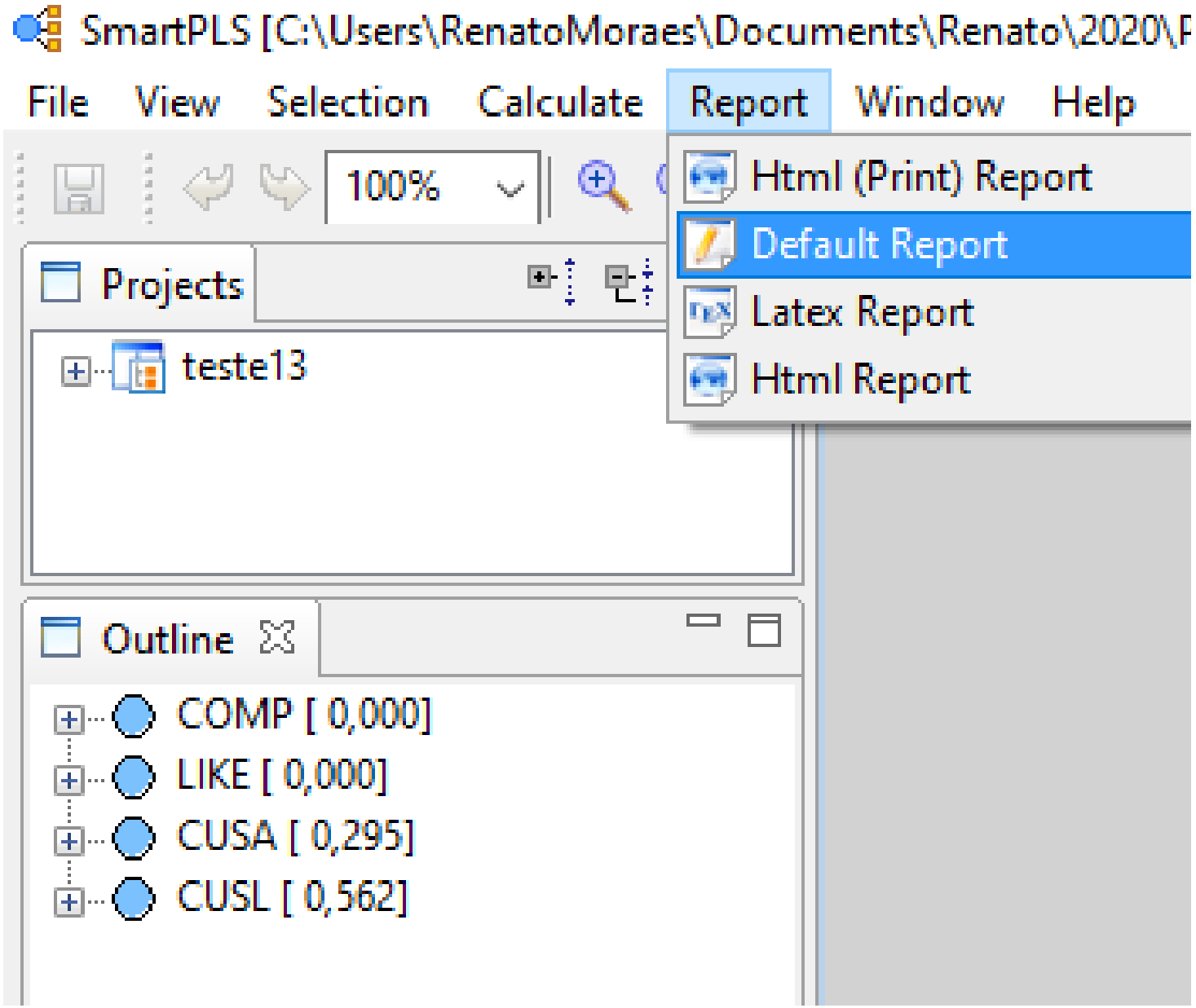
Métricas para avaliação do modelo

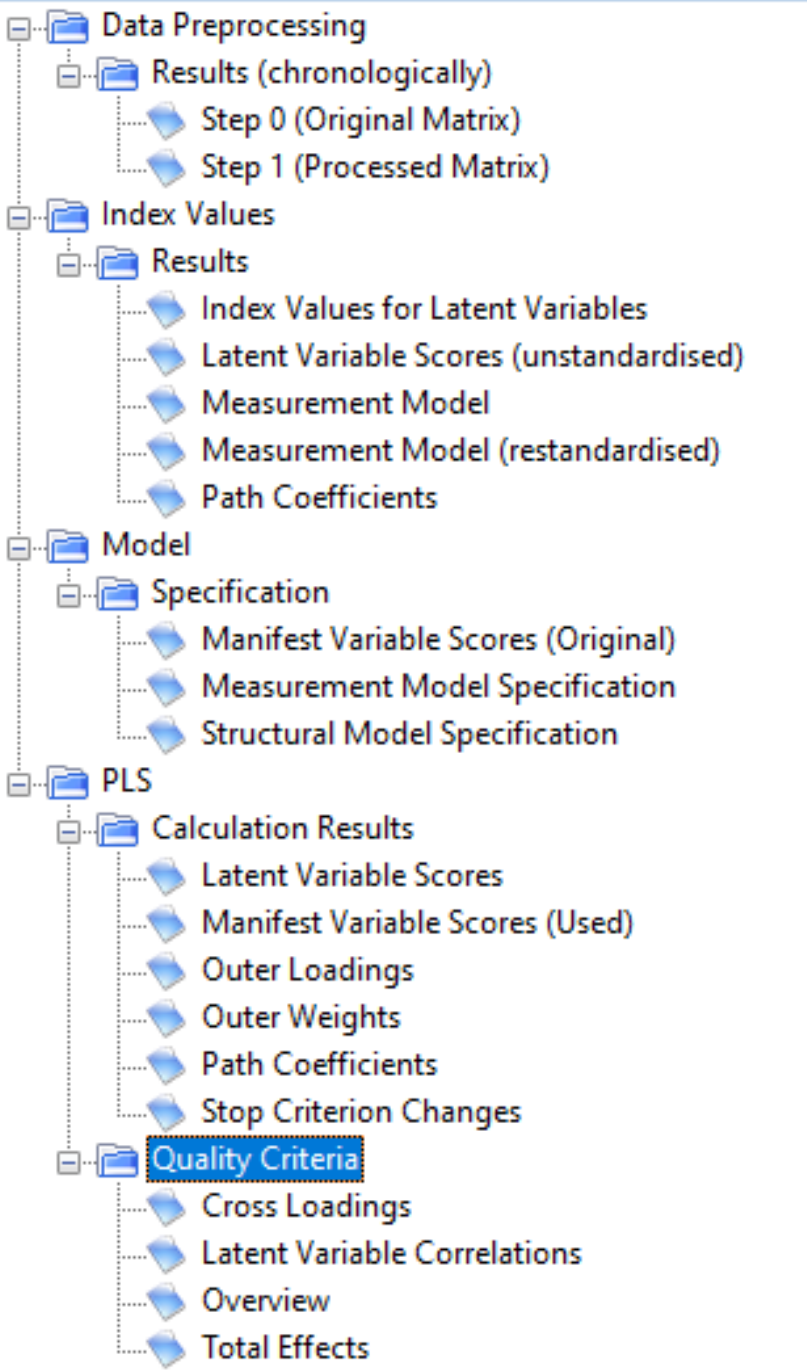
Métricas do modelo de mensuração

- Confiabilidade
- Validade convergente
- Validade discriminante

Métricas do modelo estrutural

- R^2 – variação explicada
- f^2 – tamanho do efeito
- Q^2 = relevância preditiva
- Tamanho e significância dos coeficientes dedos coeficientes do caminho estrutural


SmartPLS [C:\Users\RenatoMoraes\Documents\Renato\2020\P
File
View
Selection
Calculate
Report
Window
Help
100%
Html (Print) Report
Default Report
Latex Report
Html Report
Projects
teste13
Outline
COMP [0,000]
LIKE [0,000]
CUSA [0,295]
CUSL [0,562]


Data Preprocessing
Results (chronologically)
Step 0 (Original Matrix)
Step 1 (Processed Matrix)
Index Values
Results
Index Values for Latent Variables
Latent Variable Scores (unstandardised)
Measurement Model
Measurement Model (restandardised)
Path Coefficients
Model
Specification
Manifest Variable Scores (Original)
Measurement Model Specification
Structural Model Specification
PLS
Calculation Results
Latent Variable Scores
Manifest Variable Scores (Used)
Outer Loadings
Outer Weights
Path Coefficients
Stop Criterion Changes
Quality Criteria
Cross Loadings
Latent Variable Correlations
Overview
Total Effects

Confiabilidade (consistência interna)

Alpha de Cronbach

- $\alpha = \left(\frac{M}{M-1}\right)\left(1 - \frac{\sum_{i=1}^{M} s_i^2}{s_t^2}\right)$

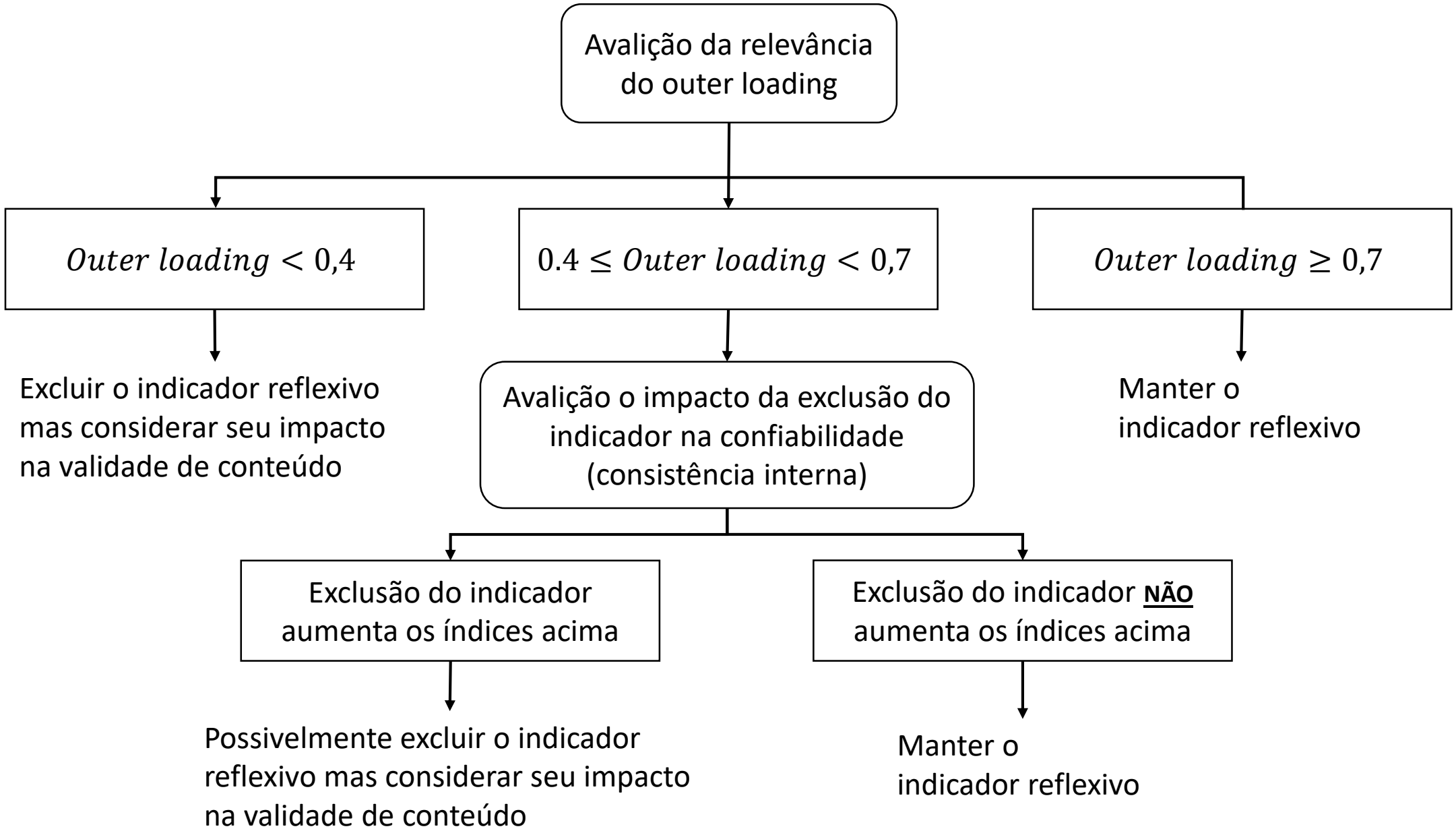
Confiabilidade composta (composite reliability)

- $\rho_c = \frac{\left(\sum_{i=1}^{M} l_i\right)^2}{\left(\sum_{i=1}^{M} l_i\right)^2 + \sum_{i=1}^{M} var(e_i)}$

Overview

	AVE	Composite Reliability	R Square	Cronbach's Alpha	Communality	Redundancy
COMP	0,6806	0,8646	0,0000	0,7760	0,6806	0,0000
CUSA	1,0000	1,0000	0,2946	1,0000	1,0000	0,1149
CUSL	0,7484	0,8991	0,5620	0,8310	0,7484	0,0061
LIKE	0,7471	0,8986	0,0000	0,8310	0,7471	0,0000

Confiabilidade < 0,6 → inaceitável
0,6 < Confiabilidade < 0,7 → aceitável
0,7 < Confiabilidade < 0,9 → satisfatório
Confiabilidade > 0,9 → indesejável
Confiabilidade > 0,95 → problemático


Avalição da relevância do outer loading
$Outer\ loading < 0{,}4$
$0.4 \leq Outer\ loading < 0{,}7$
$Outer\ loading \geq 0{,}7$
Excluir o indicador reflexivo mas considerar seu impacto na validade de conteúdo
Avalição o impacto da exclusão do indicador na confiabilidade (consistência interna)
Manter o indicador reflexivo
Exclusão do indicador aumenta os índices acima
Exclusão do indicador NÃO aumenta os índices acima
Possivelmente excluir o indicador reflexivo mas considerar seu impacto na validade de conteúdo
Manter o indicador reflexivo

Validade Convergente

- Comunalidade – (outer loading)^2

- AVE (Average variance extracted)

$$AVE = \left(\frac{\sum_{i=1}^{M} l_i^2}{M} \right)$$

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Overview

	AVE	Composite Reliability	R Square	Cronbach's Alpha	Communality	Redundancy
COMP	0,6806	0,8646	0,0000	0,7760	0,6806	0,0000
CUSA	1,0000	1,0000	0,2946	1,0000	1,0000	0,1149
CUSL	0,7484	0,8991	0,5620	0,8310	0,7484	0,0061
LIKE	0,7471	0,8986	0,0000	0,8310	0,7471	0,0000

$$AVE = \left(\frac{\sum_{i=1}^{M} l_i^2}{M} \right) \geq 0{,}5$$

Validade Discriminante

- Cross-loadings Analysis

- Fornell-Larcker

Cross-loadings Analysis

	COMP	CUSA	CUSL	LIKE
comp_1	0,858	0,464	0,465	0,607
comp_2	0,799	0,286	0,304	0,460
comp_3	0,818	0,272	0,296	0,497
cusa	0,436	1,000	0,689	0,528
cusl_1	0,430	0,536	0,833	0,557
cusl_2	0,396	0,655	0,917	0,573
cusl_3	0,341	0,593	0,843	0,461
like_1	0,602	0,510	0,561	0,879
like_2	0,523	0,434	0,530	0,870
like_3	0,544	0,420	0,499	0,843

Validade Discriminante

- Cross-loadings Analysis

- Fornell-Larcker

	Y_1	Y_2	Y_3	Y_4
Y_1	$\sqrt{AVE_{Y_1}}$			
Y_2	$Corr_{Y_1Y_2}$	$\sqrt{AVE_{Y_2}}$		
Y_3	$Corr_{Y_1Y_3}$	$Corr_{Y_2Y_3}$	$\sqrt{AVE_{Y_3}}$	
Y_4	$Corr_{Y_1Y_4}$	$Corr_{Y_2Y_4}$	$Corr_{Y_3Y_4}$	$\sqrt{AVE_{Y_4}}$

Fornell-Larcker

Latent Variable Correlations

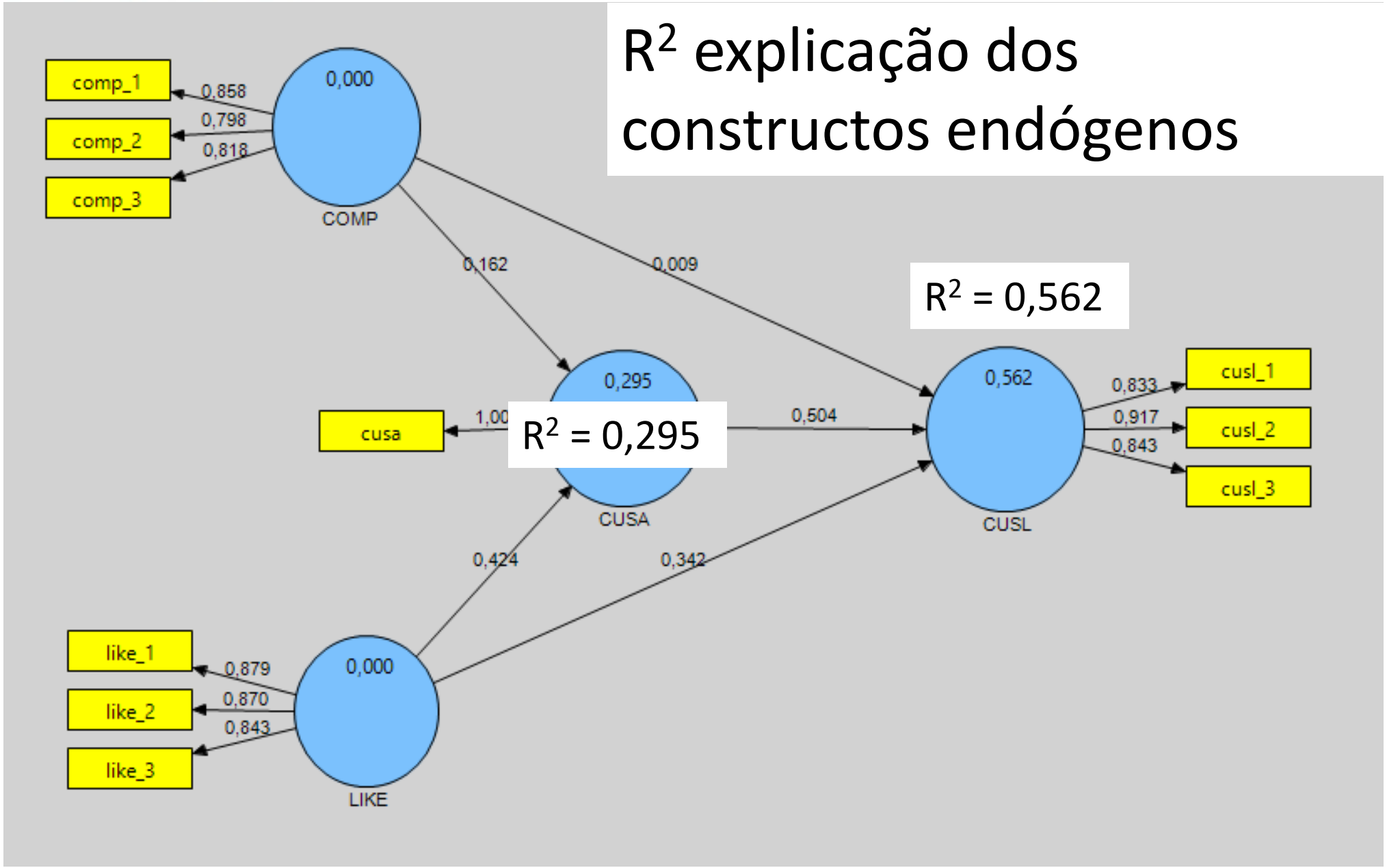
	COMP	CUSA	CUSL	LIKE
COMP	1,0000	0,0000	0,0000	0,0000
CUSA	0,4356	1,0000	0,0000	0,0000
CUSL	0,4496	0,6892	1,0000	0,0000
LIKE	0,6452	0,5284	0,6146	1,0000

	COMP	CUSA	CUSL	LIKE
COMP				
CUSA	0,4356			
CUSL	0,4496	0,6892		
LIKE	0,6452	0,5284	0,6146	

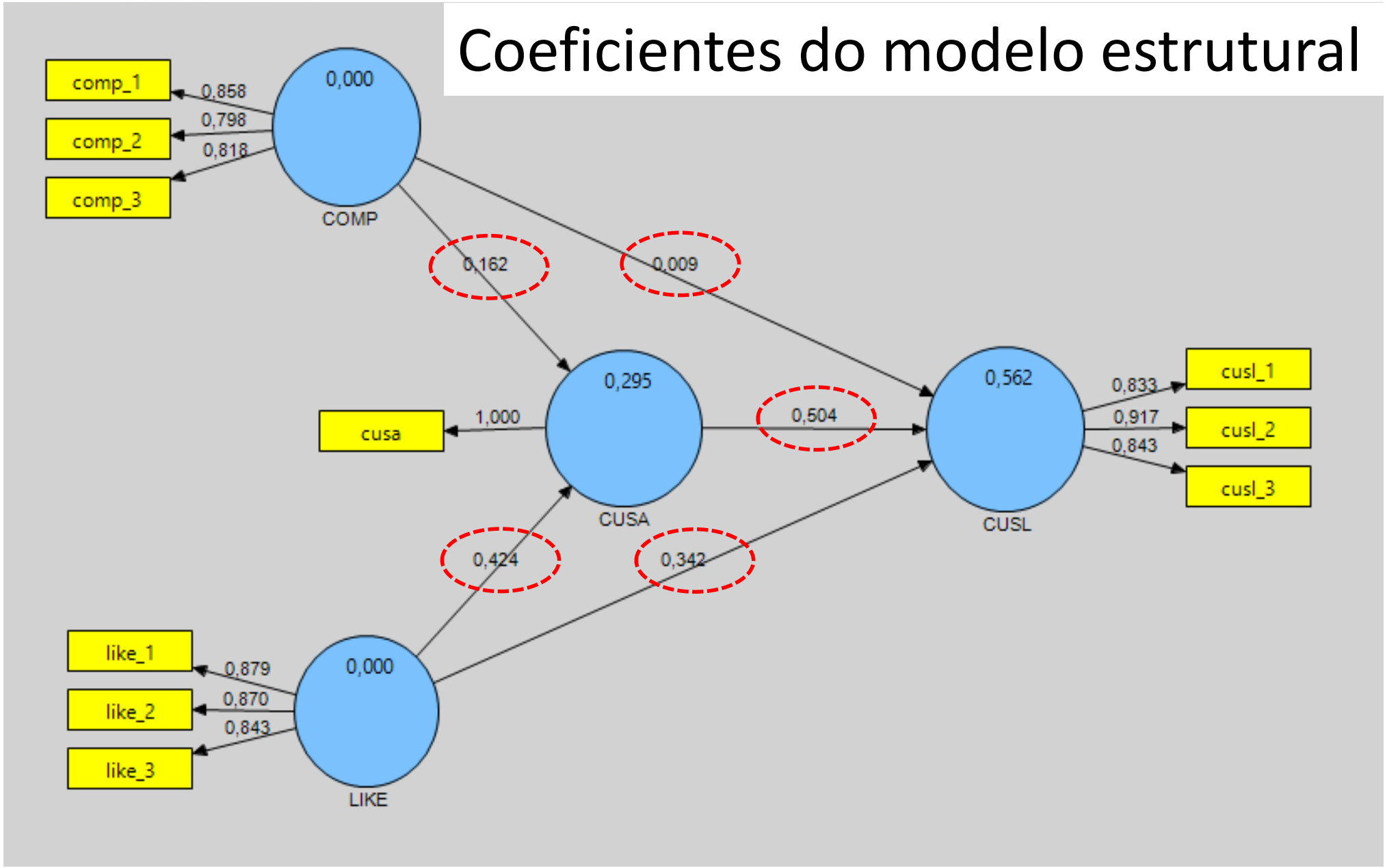
Modelo Estrutural

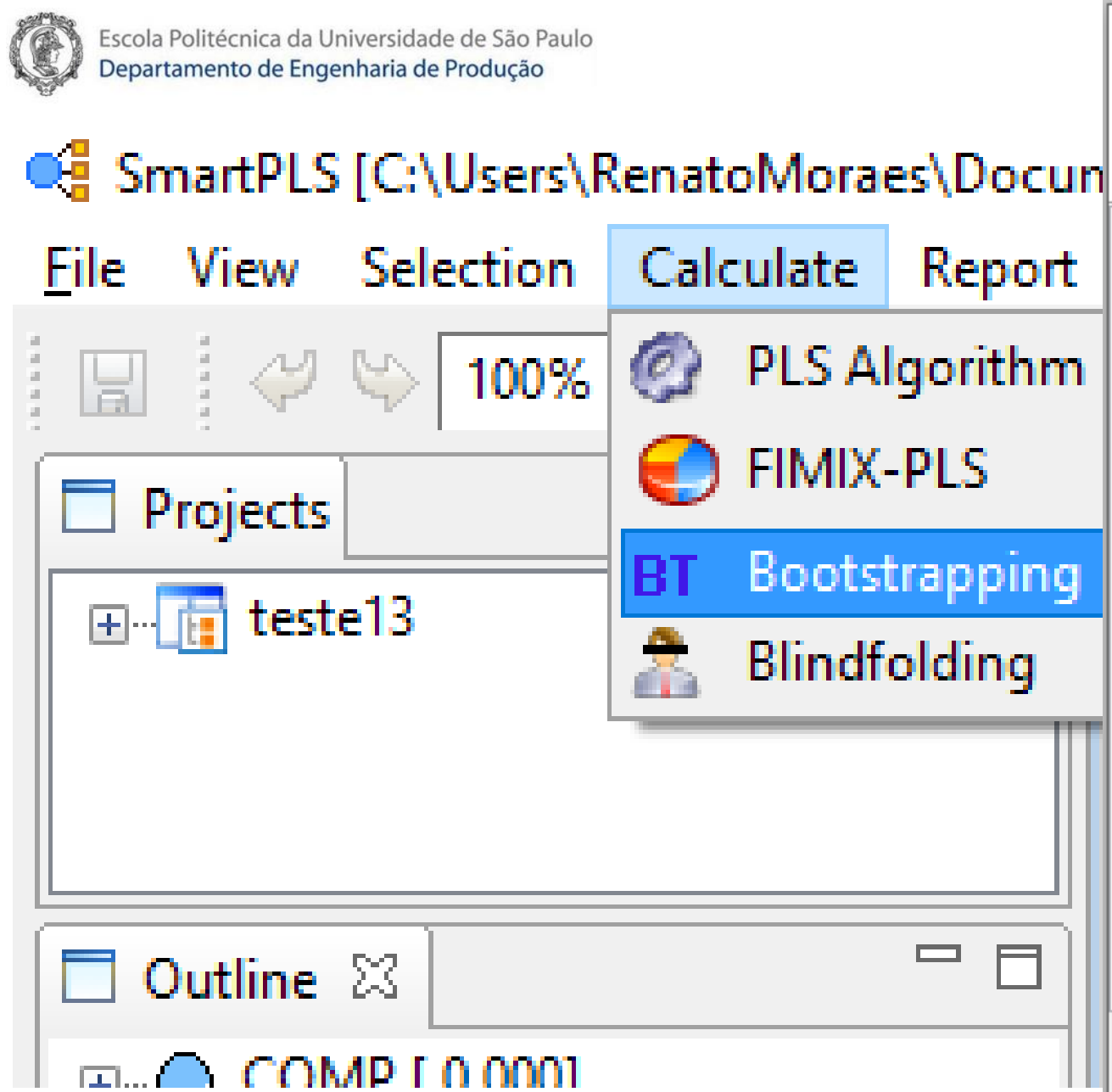
- R^2 explicação dos constructos endógenos
- Coeficientes do modelo estrutural
  - Significância estatística
  - Significância prática
- f^2 poder de explicação dos constructos exógenos
- Q^2 relevância preditiva

R^2 explicação dos constructos endógenos



Coeficientes do modelo estrutural





Run the Bootstrapping Algorithm

Applies the standard bootstrapping procedure.

Missing Values - Settings

Data File	Corporate reputation data.txt
Configured Missing Value	-99.0
Missing Value Algorithm	Mean Replacement
Apply Missing Value Algorithr	☑

PLS Algorithm - Settings

BT Bootstrapping - Settings

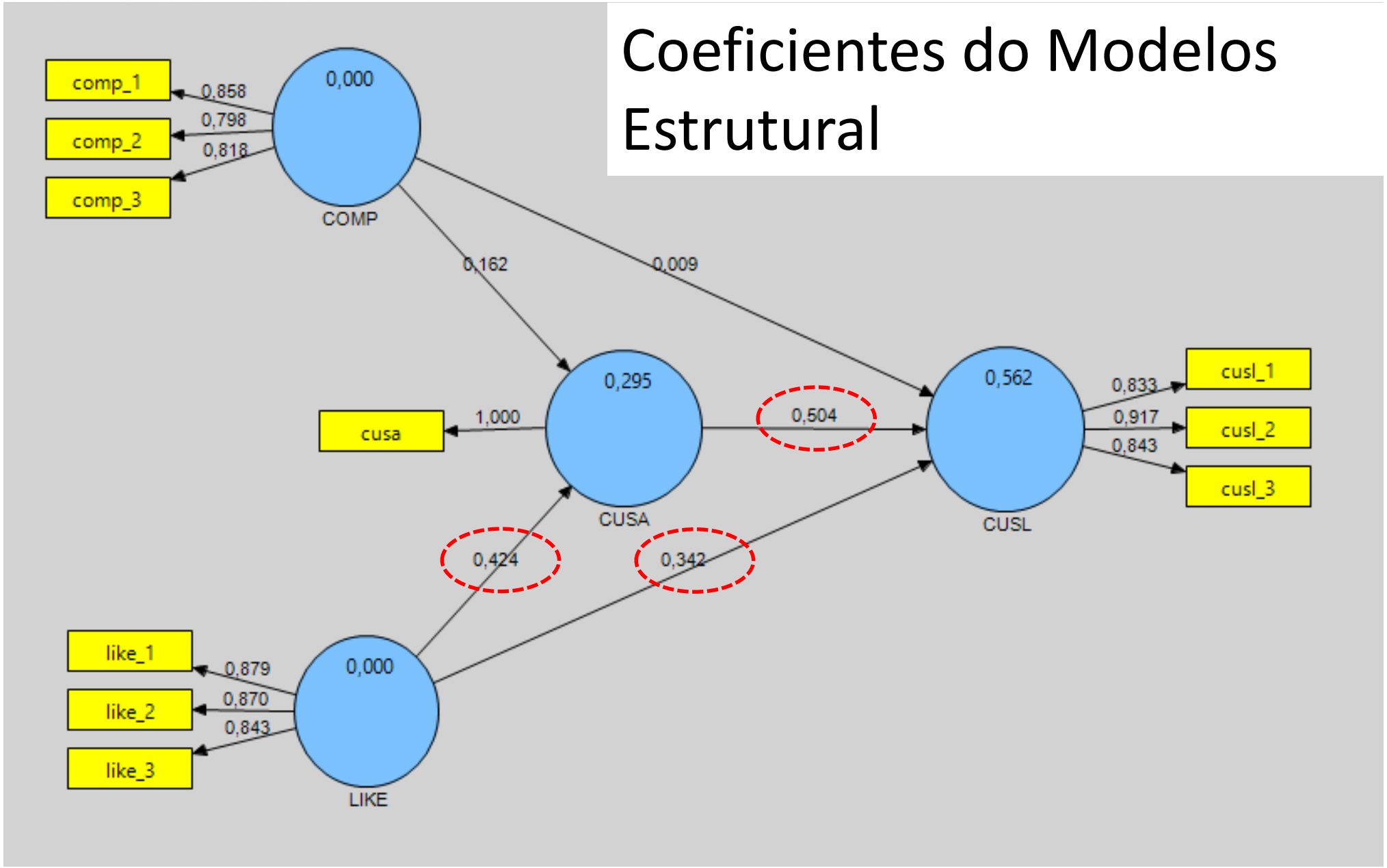
Sign Changes	No Sign Changes
Cases	100
Samples	200

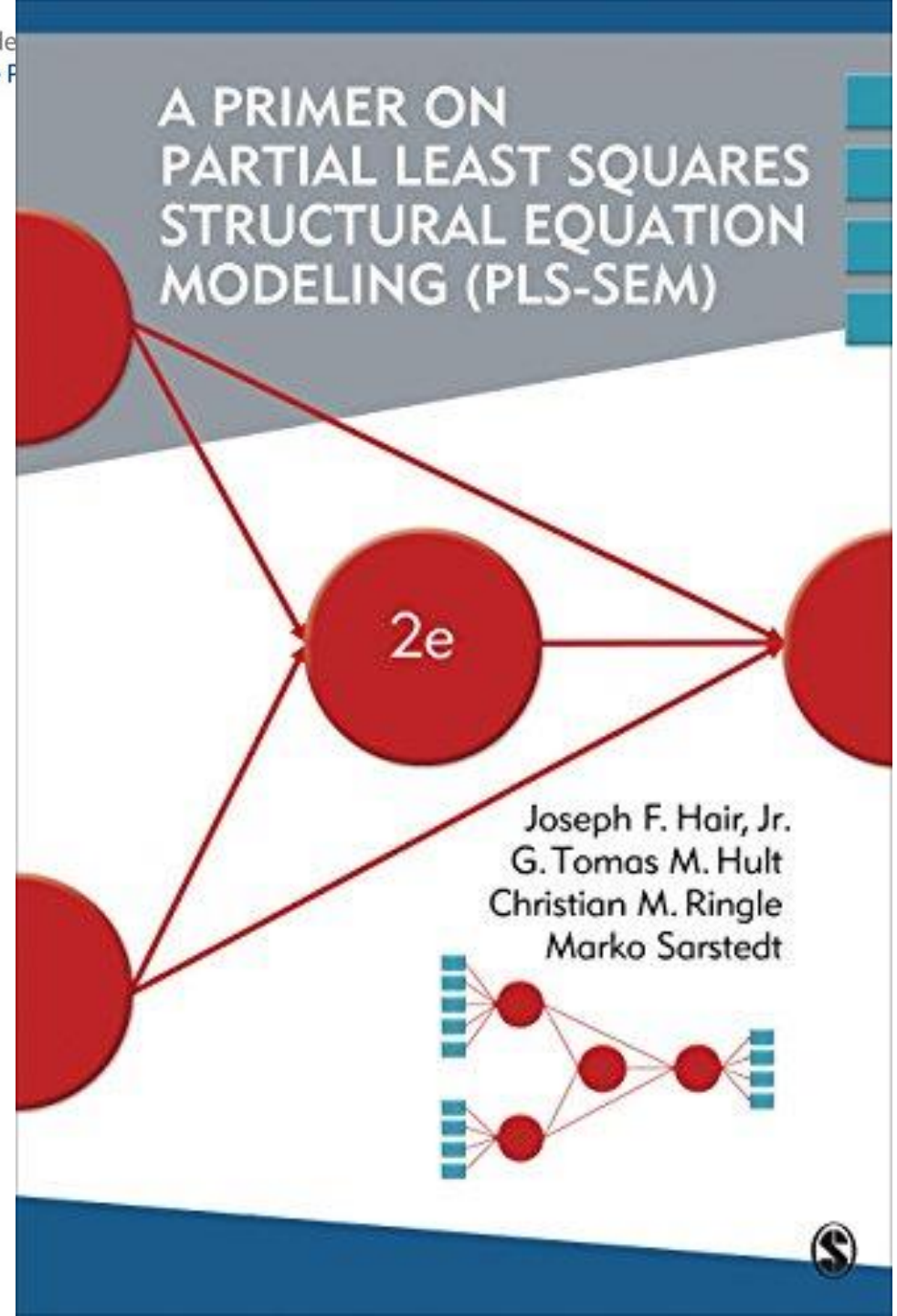
Finish Cancel

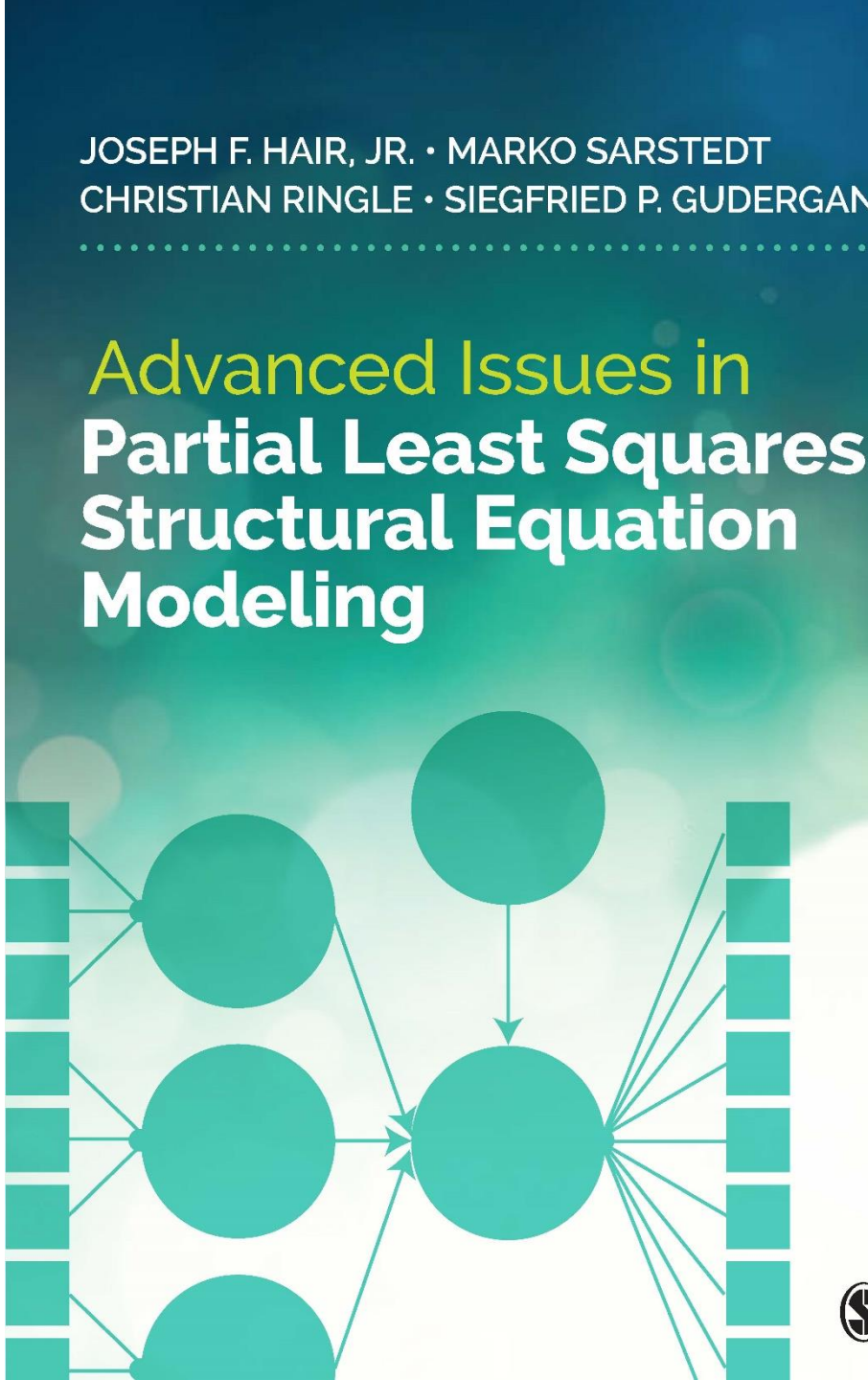
Coeficientes do Modelos Estrutural (Coeficientes de caminho)

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	Standard Error (STERR)	t Statistics (|O/STERR|)
COMP -> CUSA	0,1621	0,1745	0,1218	0,1218	1,3307
COMP -> CUSL	0,0092	0,0154	0,1032	0,1032	0,0889
CUSA -> CUSL	0,5045	0,5147	0,0755	0,0755	6,6843
LIKE -> CUSA	0,4239	0,4213	0,1045	0,1045	4,0554
LIKE -> CUSL	0,3421	0,335	0,1069	0,1069	3,1989

Coeficientes do Modelos Estrutural




A PRIMER ON
PARTIAL LEAST SQUARES
STRUCTURAL EQUATION
MODELING (PLS-SEM)
2e
Joseph F. Hair, Jr.
G. Tomas M. Hult
Christian M. Ringle
Marko Sarstedt


JOSEPH F. HAIR, JR. • MARKO SARSTEDT
CHRISTIAN RINGLE • SIEGFRIED P. GUDERGAN
Advanced Issues in
Partial Least Squares
Structural Equation
Modeling