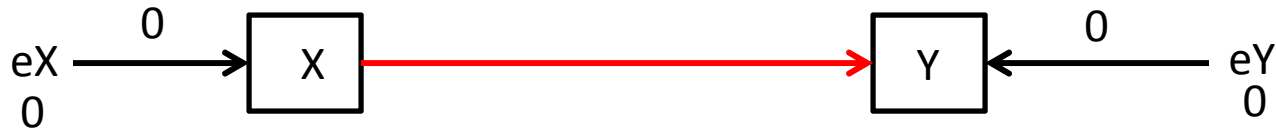


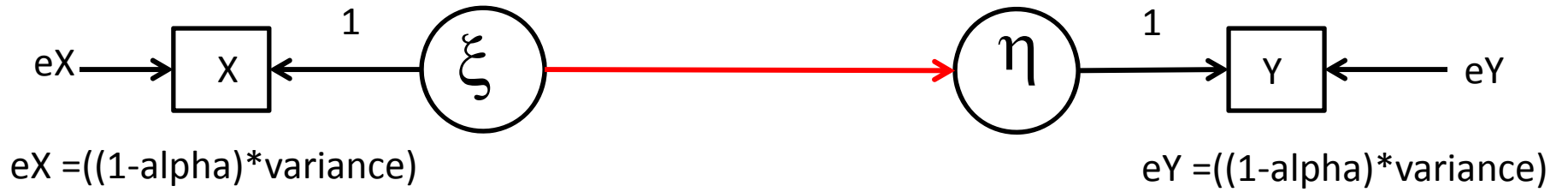
# Bias Comparisons for LSEM, Path Model, CISE-alpha

by R. L. Brown, Ph.D.

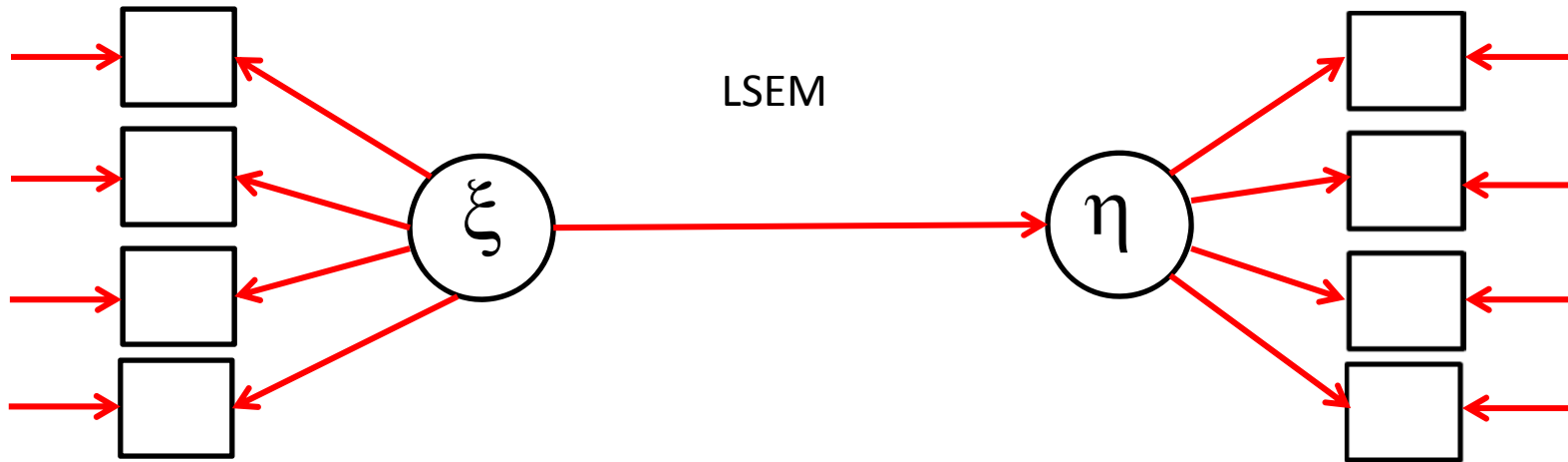
Path



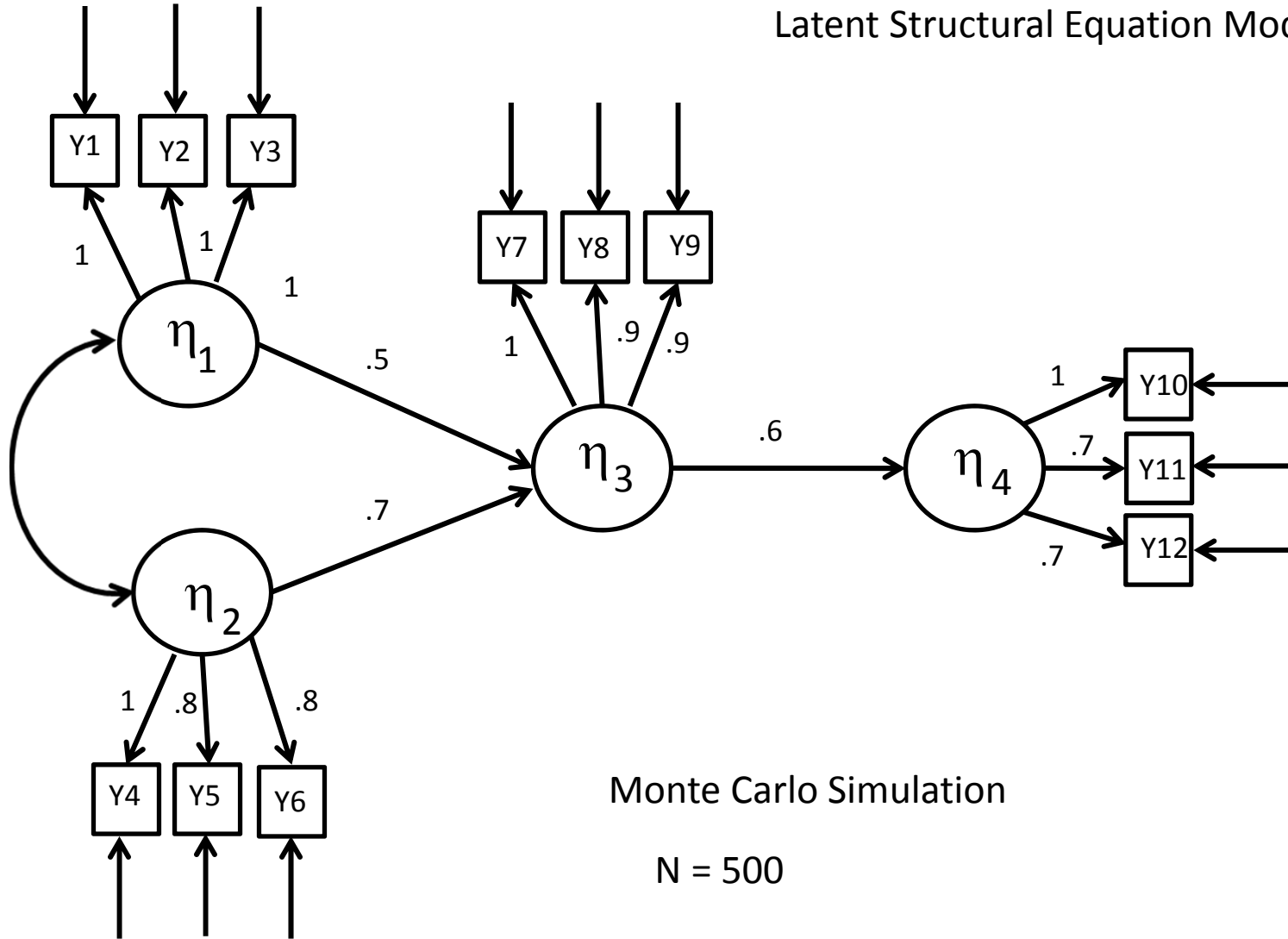
CISE



LSEM



# Latent Structural Equation Model



```
"title: this is an example of a SEM with  
        continuous factor indicators
```

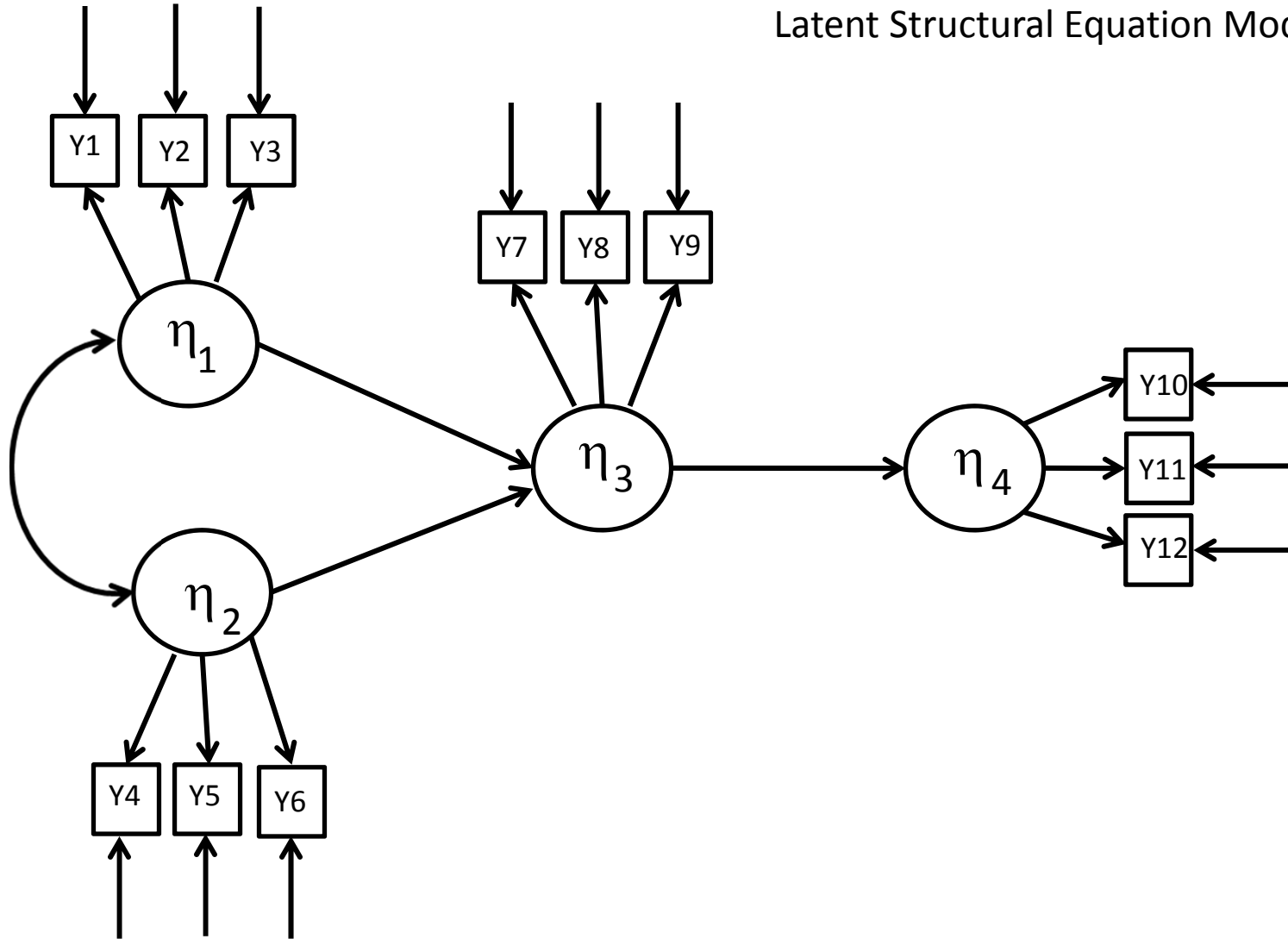
```
montecarlo:  
  names = y1-y12;  
  nobs = 500;  
  nreps = 1;  
  save = ex5.11.dat;
```

```
model montecarlo:  
  
  f1 by y1@1 y2-y3*1;  
  f2 by y4@1 y5-y6*.8;  
  f3 by y7@1 y8-y9*.9;  
  f4 by y10@1 y11-y12*.7;  
  
  y1-y12*1;  
  f1-f2*1;  
  f3-f4*.5;  
  
  f3 on f1*.5 f2*.7;  
  f4 on f3*.6;
```

```
model:  
  
  f1 by y1@1 y2-y3*1;  
  f2 by y4@1 y5-y6*.8;  
  f3 by y7@1 y8-y9*.9;  
  f4 by y10@1 y11-y12*.7;  
  
  y1-y12*1;  
  f1-f2*1;  
  f3-f4*.5;  
  
  f3 on f1*.5 f2*.7;  
  f4 on f3*.6;
```

```
output:  
  tech9;
```

Latent Structural Equation Model



## Latent Structural Equation Model

### INPUT INSTRUCTIONS

```
title: Monte Carlo Study CISE
data: file is MC.dat;
variable: names are y1-y12;
model:
  factor1 by y1-y3;
  factor2 by y4-y6;
  factor3 by y7-y9;
  factor4 by y10-y12;
  factor4 on factor3;
  factor3 on factor1 factor2;
```

## Latent Structural Equation Model

### MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
FACTOR1 BY				
Y1	1.000	0.000	999.000	999.000
Y2	1.183	0.104	11.376	0.000
Y3	0.938	0.087	10.818	0.000
FACTOR2 BY				
Y4	1.000	0.000	999.000	999.000
Y5	0.870	0.085	10.202	0.000
Y6	0.891	0.092	9.735	0.000
FACTOR3 BY				
Y7	1.000	0.000	999.000	999.000
Y8	0.872	0.059	14.699	0.000
Y9	0.882	0.060	14.611	0.000
FACTOR4 BY				
Y10	1.000	0.000	999.000	999.000
Y11	0.826	0.094	8.812	0.000
Y12	0.682	0.089	7.696	0.000
FACTOR4 ON FACTOR3	0.473	0.057	8.306	0.000
FACTOR3 ON FACTOR1	0.563	0.070	8.027	0.000
FACTOR2	0.790	0.086	9.228	0.000
FACTOR2 WITH FACTOR1	-0.030	0.055	-0.545	0.586

MODEL FIT INFORMATION

Number of Free Parameters 40

Loglikelihood

H0 Value -9646.960  
H1 Value -9620.108

Information Criteria

Akaike (AIC) 19373.920  
Bayesian (BIC) 19542.505  
Sample-Size Adjusted BIC 19415.542  
( $n^* = (n + 2) / 24$ )

Chi-Square Test of Model Fit

Value 53.704  
Degrees of Freedom 50  
P-Value 0.3344

RMSEA (Root Mean Square Error Of Approximation)

Estimate 0.012  
90 Percent C.I. 0.000 0.032  
Probability RMSEA  $\leq$  .05 1.000

CFI/TLI

CFI 0.997  
TLI 0.997

Chi-Square Test of Model Fit for the Baseline Model

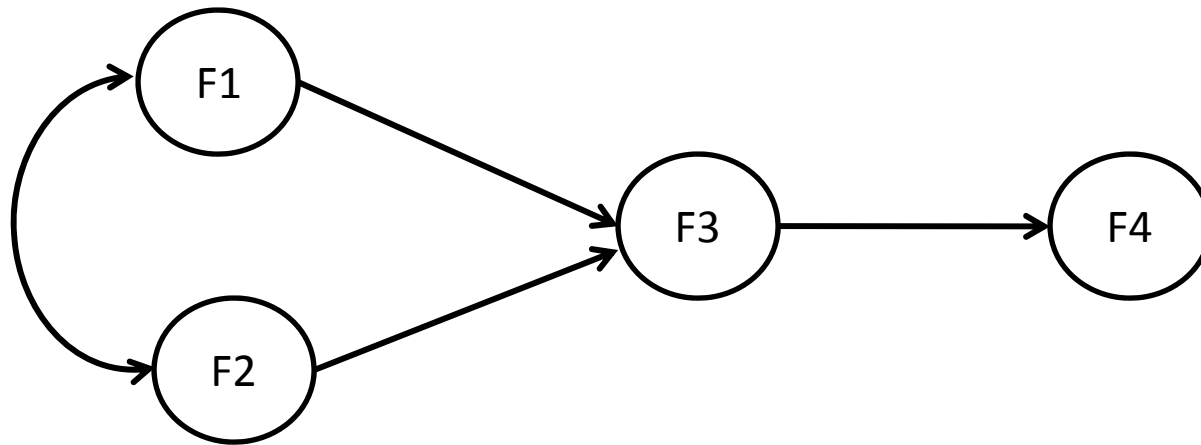
Value 1524.403  
Degrees of Freedom 66  
P-Value 0.0000

SRMR (Standardized Root Mean Square Residual)

Value 0.027



# Path Analysis Model



## Path Analysis Model – zero error

### INPUT INSTRUCTIONS

```
title: Monte Carlo Study CISE
data: file is cise.txt;
variable: names are y1-y12 f1 f2 f3 f4;
usevariable are f1 f2 f3 f4;
model:
    f4 on f3;
    f3 on f1 f2;
    f1 with f2;
```

## Path Analysis Model – zero error

### MODEL RESULTS

		Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
F4	ON				
	F3	0.346	0.033	10.581	0.000
F3	ON				
	F1	0.363	0.039	9.331	0.000
	F2	0.545	0.042	12.994	0.000
F1	WITH				
	F2	-0.033	0.053	-0.613	0.540

MODEL FIT INFORMATION

Number of Free Parameters 12

Loglikelihood

H0 Value -2853.672  
H1 Value -2852.038

Information Criteria

Akaike (AIC) 5731.344  
Bayesian (BIC) 5781.919  
Sample-Size Adjusted BIC 5743.830  
( $n^* = (n + 2) / 24$ )

Chi-Square Test of Model Fit

Value 3.267  
Degrees of Freedom 2  
P-Value 0.1952

RMSEA (Root Mean Square Error Of Approximation)

Estimate 0.036  
90 Percent C.I. 0.000 0.103  
Probability RMSEA  $\leq$  .05 0.536

CFI/TLI

CFI 0.996  
TLI 0.989

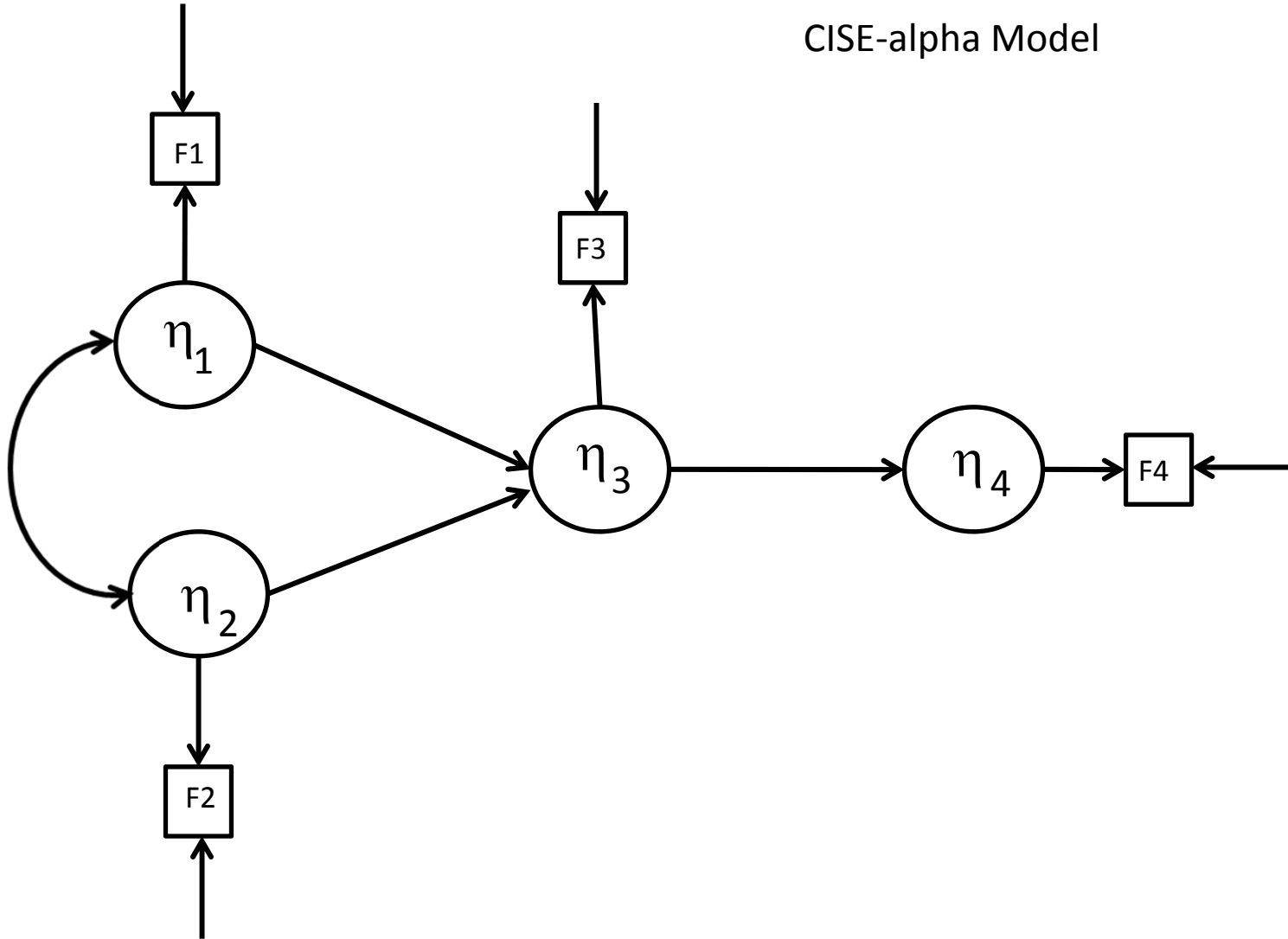
Chi-Square Test of Model Fit for the Baseline Model

Value 306.652  
Degrees of Freedom 5  
P-Value 0.0000

SRMR (Standardized Root Mean Square Residual)

Value 0.018

CISE-alpha Model



## CISE – Alpha Model

### INPUT INSTRUCTIONS

```
title: Monte Carlo Study CISE
data: file is cise.txt;
variable: names are y1-y12 f1 f2 f3 f4;
usevariable are f1 f2 f3 f4;
model:
    factor1 by f1@1;
        f1@0.332;
    factor2 by f2@1;
        f2@0.352;
    factor3 by f3@1;
        f3@0.311;
    factor4 by f4@1;
        f4@0.363;
factor4 on factor3;
factor3 on factor1 factor2;
```

## CISE – Alpha Model

### MODEL RESULTS

	Estimate	S.E.	Est./S.E.	Two-Tailed P-Value
FACTOR1 BY F1	1.000	0.000	999.000	999.000
FACTOR2 BY F2	1.000	0.000	999.000	999.000
FACTOR3 BY F3	1.000	0.000	999.000	999.000
FACTOR4 BY F4	1.000	0.000	999.000	999.000
FACTOR4 ON FACTOR3	0.433	0.041	10.447	0.000
FACTOR3 ON FACTOR1	0.504	0.055	9.112	0.000
FACTOR3 ON FACTOR2	0.795	0.067	11.908	0.000
FACTOR2 WITH FACTOR1	-0.033	0.053	-0.613	0.540

MODEL FIT INFORMATION

Number of Free Parameters 12

Loglikelihood

H0 Value -2853.329  
H1 Value -2852.038

Information Criteria

Akaike (AIC) 5730.659  
Bayesian (BIC) 5781.234  
Sample-Size Adjusted BIC 5743.145  
( $n^* = (n + 2) / 24$ )

Chi-Square Test of Model Fit

Value 2.582  
Degrees of Freedom 2  
P-Value 0.2750

RMSEA (Root Mean Square Error Of Approximation)

Estimate 0.024  
90 Percent C.I. 0.000 0.095  
Probability RMSEA  $\leq$  .05 0.624

CFI/TLI

CFI 0.998  
TLI 0.994

Chi-Square Test of Model Fit for the Baseline Model

Value 307.028  
Degrees of Freedom 6  
P-Value 0.0000

SRMR (Standardized Root Mean Square Residual)

Value 0.015



	Population Value	LSEM	Path	CISE-alpha
ETA1 → ETA3	0.50	0.563	0.363	0.504
ETA2 → ETA3	0.70	0.790	0.545	0.795
ETA3 → ETA4	0.60	0.473	0.346	0.433
		Percent Parameter Bias	Percent Parameter Bias	Percent Parameter Bias
ETA1 → ETA3		+12.6%	-27.4%	+0.8%
ETA2 → ETA3		+12.8%	-22.1%	+13.5%
ETA3 → ETA4		-21.2%	-42.3%	-27.8%

LSEM	Path	CISE-alpha
$\chi^2 = 53.704$	$\chi^2 = 3.267$	$\chi^2 = 2.582$
degrees of freedom = 50	degrees of freedom = 2	degrees of freedom = 2
p = 0.3344	p = 0.1952	p = 0.2750
RMSEA = 0.012	RMSEA = 0.036	RMSEA = 0.024
SRMR = 0.027	SRMR = 0.018	SRMR = 0.015
$\chi^2/\text{degrees of freedom} = 1.07$	$\chi^2/\text{degrees of freedom} = 1.63$	$\chi^2/\text{degrees of freedom} = 1.29$
Free Parameters = 40	Free Parameters = 12	Free Parameters = 12