

## Description

Below we demonstrate `sem`'s `reliability()` option with the following data:

```
. use https://www.stata-press.com/data/r19/sem_rel
(measurement error with known reliabilities)
. summarize
```

Variable	Obs	Mean	Std. dev.	Min	Max
y	1,234	701.081	71.79378	487	943
x1	1,234	100.278	14.1552	51	149
x2	1,234	100.2066	14.50912	55	150

```
. notes
_dta:
1. Fictional data.
2. Variables x1 and x2 each contain a test score designed to measure X. The
   test is scored to have mean 100.
3. Variables x1 and x2 are both known to have reliability 0.5.
4. Variable y is the outcome, believed to be related to X.
```

See [\[SEM\] sem and gsem option reliability\(\)](#) for background.

## Remarks and examples

Remarks are presented under the following headings:

- [Baseline model \(reliability ignored\)](#)
- [Model with reliability](#)
- [Model with two measurement variables and reliability](#)

## Baseline model (reliability ignored)

```
. sem (y <- x1)
Endogenous variables
  Observed: y
Exogenous variables
  Observed: x1
Fitting target model:
Iteration 0:  Log likelihood = -11629.745
Iteration 1:  Log likelihood = -11629.745
Structural equation model
Estimation method: ml
Log likelihood = -11629.745
Number of obs = 1,234
```

	OIM		z	P> z	[95% conf. interval]	
	Coefficient	std. err.				
Structural						
y						
x1	3.54976	.1031254	34.42	0.000	3.347637	3.751882
_cons	345.1184	10.44365	33.05	0.000	324.6492	365.5876
var(e.y)	2627.401	105.7752			2428.053	2843.115

LR test of model vs. saturated:  $\chi^2(0) = 0.00$       Prob >  $\chi^2 = .$

### Notes:

1. In these data, variable x1 is measured with error.
2. If we ignore that, we obtain a path coefficient for  $y \leftarrow x1$  of 3.55.
3. We also ran this model for  $y \leftarrow x2$ . We obtained a path coefficient of 3.48.

## Model with reliability

```
. sem (x1<-X) (y<-X), reliability(x1 .5)
Endogenous variables
Measurement: x1 y
Exogenous variables
Latent: X
Fitting target model:
Iteration 0: Log likelihood = -11745.845
Iteration 1: Log likelihood = -11661.626
Iteration 2: Log likelihood = -11631.469
Iteration 3: Log likelihood = -11629.755
Iteration 4: Log likelihood = -11629.745
Iteration 5: Log likelihood = -11629.745
Structural equation model
Estimation method: ml
Log likelihood = -11629.745
Number of obs = 1,234
( 1) [x1]X = 1
( 2) [/]var(e.x1) = 100.1036
```

	OIM					
	Coefficient	std. err.	z	P> z	[95% conf. interval]	
Measurement						
x1						
X	1 (constrained)					
_cons	100.278	.4027933	248.96	0.000	99.4885	101.0674
y						
X	7.09952	.352463	20.14	0.000	6.408705	7.790335
_cons	701.081	2.042929	343.17	0.000	697.077	705.0851
var(e.x1)	100.1036 (constrained)					
var(e.y)	104.631	207.3381			2.152334	5086.411
var(X)	100.1036	8.060038			85.48963	117.2157

LR test of model vs. saturated:  $\chi^2(0) = 0.00$

Prob >  $\chi^2 = .$

### Notes:

1. We wish to estimate the effect of  $y < -x1$  when  $x1$  is measured with error (0.50 reliability). To do that, we introduce latent variable  $X$  and write our model as  $(x1 < -X) (y < -X)$ .
2. When we ignored the measurement error of  $x1$ , we obtained a path coefficient for  $y < -x1$  of 3.55. Taking into account the measurement error, we obtain a coefficient of 7.1.

## Model with two measurement variables and reliability

```
. sem (x1 x2<-X) (y<-X), reliability(x1 .5 x2 .5)
Endogenous variables
  Measurement: x1 x2 y
Exogenous variables
  Latent: X
Fitting target model:
Iteration 0:  Log likelihood = -16258.636
Iteration 1:  Log likelihood = -16258.401
Iteration 2:  Log likelihood =  -16258.4
Structural equation model                                Number of obs = 1,234
Estimation method: ml
Log likelihood = -16258.4
( 1)  [x1]X = 1
( 2)  [/]var(e.x1) = 100.1036
( 3)  [/]var(e.x2) = 105.1719
```

	OIM					
	Coefficient	std. err.	z	P> z	[95% conf. interval]	
Measurement						
x1						
X	1 (constrained)					
_cons	100.278	.4037851	248.34	0.000	99.48655	101.0694
x2						
X	1.030101	.0417346	24.68	0.000	.9483029	1.1119
_cons	100.2066	.4149165	241.51	0.000	99.39342	101.0199
y						
X	7.031299	.2484176	28.30	0.000	6.544409	7.518188
_cons	701.081	2.042928	343.17	0.000	697.077	705.0851
var(e.x1)	100.1036 (constrained)					
var(e.x2)	105.1719 (constrained)					
var(e.y)	152.329	105.26			39.31868	590.1553
var(X)	101.0907	7.343656			87.67509	116.5591

LR test of model vs. saturated: chi2(2) = 0.59

Prob > chi2 = 0.7430

### Notes:

1. We wish to estimate the effect of  $y \leftarrow X$ . We have two measures of  $X$ — $x1$  and  $x2$ —both measured with error (0.50 reliability).
2. In the [previous section](#), we used just  $x1$ . We obtained path coefficient 7.1 with standard error 0.4. Using both  $x1$  and  $x2$ , we obtain path coefficient 7.0 and standard error 0.2.
3. We at StataCorp created these fictional data. The true coefficient is 7.

## Also see

[SEM] [sem and gsem option reliability\(\)](#) — Fraction of variance not due to measurement error

[SEM] [Example 1](#) — Single-factor measurement model

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