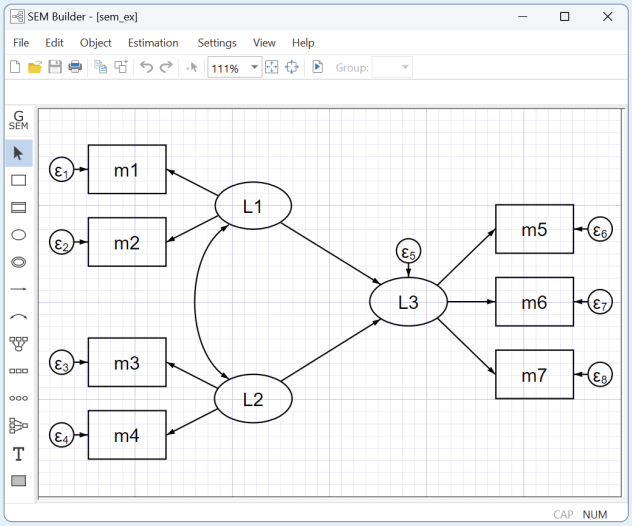
SEM

Structural equation modeling

Stata provides an easy-to-use and comprehensive suite of tools for SEM—everything you need for fitting your model, evaluating model fit, and interpreting results. And all of this is integrated in a complete package for statistics, visualization, data manipulation, and reporting.



▪ Easy model specification
- Path diagram builder
- Intuitive command syntax

▪ Types of models
- Path analysis
- Mediation analysis
- Confirmatory factor analysis (CFA)
- Multiple indicators and multiple causes (MIMIC) models
- Latent growth curve models
- Hierarchical confirmatory factor models
- Multiple-group models
- Models with binary, ordinal, count, nominal, and survival-time outcomes
- Multilevel models
- Latent class analysis (LCA)
- And many more

▪ Interpretation
- Direct, indirect, and total effects
- Standardized and unstandardized estimates

▪ Model fit
- Model x^2
- RMSEA
- CFI
- TLI
- SRMR
- Likelihood-ratio and Wald tests
- Modification indices
- Latent class model statistics

▪ Estimation methods
- Maximum likelihood
- Maximum likelihood with missing values, sometimes called FIML
- Asymptotic distribution free (ADF)

▪ Standard errors
- Satorra–Bentler
- Robust (Huber/White/sandwich estimator)
- Cluster–robust
- Bootstrap
- And more

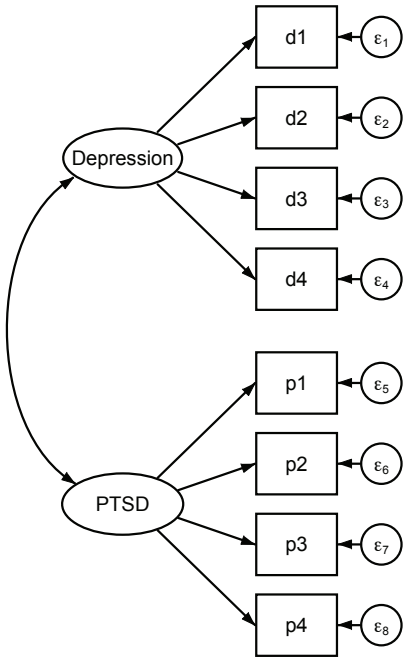
▪ Survey data support
- Sampling weights
- Stratification and poststratification
- Multistage cluster sampling

Use sem to fit linear models

Here we fit a two-factor CFA model with four measurements of depression and four measurements of posttraumatic stress disorder (PTSD). The results are the same whether we use the straightforward command syntax,

```
. sem (Depression -> d1 d2 d3 d4)
      (PTSD -> p1 p2 p3 p4)
```

or draw the path diagram,



Report model fit statistics

Many commands are available for evaluating the fit of our model. For instance,

```
. estat gof, stats(all)
```

Viewer - view sem2.smcl

view sem2.smcl

Dialog ▾ Also see ▾ Jump to ▾

Fit statistic	Value	Description
Likelihood ratio		
chi2_ms(8)	12.648	model vs. saturated
p > chi2	0.125	
chi2_bs(15)	1164.146	baseline vs. saturated
p > chi2	0.000	
Population error		
RMSEA	0.052	Root mean squared error of approximation
90% CI, lower bound	0.000	
upper bound	0.104	
pclose	0.418	Probability RMSEA <= 0.05
Information criteria		
AIC	11707.791	Akaike's information criterion
BIC	11751.669	Bayesian information criterion
Baseline comparison		
CFI	0.996	Comparative fit index
TLI	0.992	Tucker-Lewis index
Size of residuals		
SRMR	0.020	Standardized root mean squared residual
CD	0.988	Coefficient of determination

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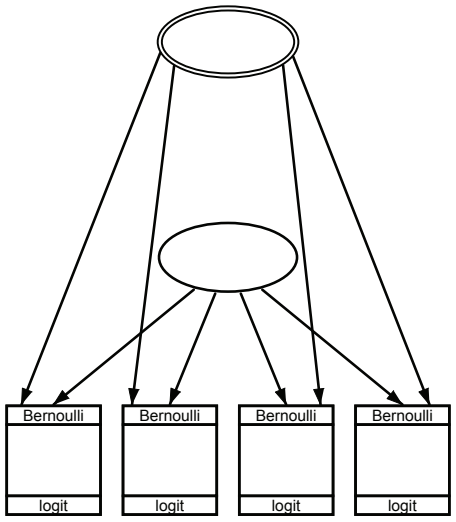
Use gsem to fit multilevel models and models with binary, ordinal, count, or survival-time outcomes

More complex models can be fit just as easily. We now fit a multilevel CFA model with binary measurements of mathematical ability for students nested in schools.




```
. gsem (MathAb SchQual[school] -> q1 q2 q3 q4), logit
```

Viewer - view sem3.smcl

view sem3.smcl

Dialog ▾ Also see ▾ Jump to ▾

Log likelihood = -1348.3644

(1) [q1]SchQual[school] = 1
(2) [q2]MathAb = 1

	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
q1						
SchQual[school]	1	(constrained)				
MathAb	5.277956	4.995708	1.06	0.291	-4.513451	15.06936
_cons	.0413352	.1770215	0.23	0.815	-.3056206	.3882909
q2						
SchQual[school]	.600067	.3447607	1.74	0.082	-.0756516	1.275786
MathAb	1	(constrained)				
_cons	-.449189	.1165887	-3.85	0.000	-.6776987	-.2206793
q3						
SchQual[school]	.3999959	.3008142	1.33	0.184	-.1895891	.989581
MathAb	1.788696	1.10452	1.62	0.105	-.3761236	3.953516
_cons	.1485335	.1070996	1.39	0.165	-.0613779	.3584449
q4						
SchQual[school]	.5925695	.34909	1.70	0.090	-.0916343	1.276773
MathAb	1.071626	.7310121	1.47	0.143	-.3611311	2.504384
_cons	-.3203425	.1152657	-2.78	0.005	-.5462592	-.0944258
var(SchQual[school])	.2483231	.24206			.0367523	1.677838
var(MathAb)	.1050076	.1133871			.0126501	.8716606

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