

Conditional and Unconditional Regression with No Measurement Error

```
/* reg2ways.sas */
%include 'readsenic.sas';
title2 'Conditional and unconditional regression: No measurement error';

proc reg;
  title3 'Conditional Regression';
  model infrisk = stay census;

proc calis cov;          /* Analyze the covariance matrix (Default is corr) */
  title3 'Unconditional Regression';
  var infrisk stay census; /* Observed vars are in the data set */
  lineqs                /* Simultaneous equations, separated by commas */
    infrisk = betal stay + beta2 census + epsilon;
  std                   /* Variances (not standard deviations) */
    stay = phill,
    census = phi22,
    epsilon = psi;
  /* Specify covariances in the model with the cov
  statement. Unmentioned pairs get covariance zero. */
  cov
    stay census = phi12;
  bounds 0.0 < phill phi22 psi; /* Variances are greater than zero */

proc calis cov;          /* Analyze the covariance matrix (Default is corr) */
  title3 'Unconditional Regression with census re-scaled';
  var infrisk stay census100; /* Observed vars are in the data set */
  lineqs                /* Simultaneous equations, separated by commas */
    infrisk = betal stay + beta2 census100 + epsilon;
  std                   /* Variances (not standard deviations) */
    stay = phill,
    census100 = phi22,
    epsilon = psi;
  /* Specify covariances in the model with the cov
  statement. Unmentioned pairs get covariance zero. */
  cov
    stay census100 = phi12;
  bounds 0.0 < phill phi22 psi; /* Variances are greater than zero */
```

SENIC data 1
 Conditional and unconditional regression: No measurement error
 Conditional Regression

The REG Procedure
 Model: MODEL1
 Dependent Variable: infrisk Prob of acquiring infection in hospital

Number of Observations Read 113
 Number of Observations Used 113

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	61.60134	30.80067	24.24	<.0001
Error	110	139.77848	1.27071		
Corrected Total	112	201.37982			

Root MSE 1.12726 R-Square 0.3059
 Dependent Mean 4.35487 Adj R-Sq 0.2933
 Coeff Var 25.88504

Parameter Estimates

Variable	Label	DF	Parameter Estimate	Standard Error
Intercept	Intercept	1	0.99950	0.56531
stay	Av length of hospital stay, in days	1	0.31908	0.06328
census	Aver # patients in hospital per day	1	0.00145	0.00078668

Parameter Estimates

Variable	Label	DF	t Value	Pr > t
Intercept	Intercept	1	1.77	0.0798
stay	Av length of hospital stay, in days	1	5.04	<.0001
census	Aver # patients in hospital per day	1	1.84	0.0687

SENIC data 2
 Conditional and unconditional regression: No measurement error
 Unconditional Regression

The CALIS Procedure
 Covariance Structure Analysis: Pattern and Initial Values

LINEQS Model Statement

		Matrix	Rows	Columns	-----Matrix Type-----	
Term 1	1	<u>SEL</u>	3	4	SELECTION	
	2	<u>BETA</u>	4	4	EQSBETA	IMINUSINV
	3	<u>GAMMA</u>	4	3	EQSGAMMA	
	4	<u>PHI</u>	3	3	SYMMETRIC	

The 1 Endogenous Variables

Manifest infrisk
 Latent

The 3 Exogenous Variables

Manifest stay census
 Latent
 Error epsilon

SENIC data 3
 Conditional and unconditional regression: No measurement error
 Unconditional Regression

The CALIS Procedure
 Covariance Structure Analysis: Pattern and Initial Values

Manifest Variable Equations with Initial Estimates

infrisk = .*stay + .*census + 1.0000 epsilon
 beta1 beta2

Variances of Exogenous Variables

Variable	Parameter	Estimate
stay	phi11	.
census	phi22	.
epsilon	psi	.

Covariances Among Exogenous Variables

Var1	Var2	Parameter	Estimate
stay	census	phi12	.

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SENIC data
 Conditional and unconditional regression: No measurement error
 Unconditional Regression

The CALIS Procedure
 Covariance Structure Analysis: Maximum Likelihood Estimation

Observations	113	Model Terms	1
Variables	3	Model Matrices	4
Informations	6	Parameters	6

	Variable	Mean	Std Dev
infrisk	Prob of acquiring infection in hospital	4.35487	1.34091
stay	Av length of hospital stay, in days	9.64832	1.91146
census	Aver # patients in hospital per day	191.37168	153.75956

Set Covariances of Exogenous Manifest Variables

stay census

NOTE: Some initial estimates computed by two-stage LS method.

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SENIC data
 Conditional and unconditional regression: No measurement error
 Unconditional Regression

The CALIS Procedure
 Covariance Structure Analysis: Maximum Likelihood Estimation

Vector of Initial Estimates

	Parameter	Estimate	Type
1	beta1	0.31908	Matrix Entry: <u>GAMMA</u> [1:1]
2	beta2	0.00145	Matrix Entry: <u>GAMMA</u> [1:2]
3	phi11	3.65366	Matrix Entry: <u>PHI</u> [1:1]
4	phi12	139.27715	Matrix Entry: <u>PHI</u> [2:1]
5	phi22	23642	Matrix Entry: <u>PHI</u> [2:2]
6	psi	1.24802	Matrix Entry: <u>PHI</u> [3:3]

Conditional and unconditional regression: No measurement error
Unconditional Regression

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The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Levenberg-Marquardt Optimization

Scaling Update of More (1978)

Parameter Estimates	6
Functions (Observations)	6
Lower Bounds	3
Upper Bounds	0

Optimization Start

Active Constraints	0	Objective Function	0
Max Abs Gradient Element	1.554392E-14	Radius	1

Optimization Results

Iterations	0	Function Calls	2
Jacobian Calls	1	Active Constraints	0
Objective Function	0	Max Abs Gradient Element	1.554392E-14
Lambda	0	Actual Over Pred Change	0
Radius	1		

ABSGCONV convergence criterion satisfied.

NOTE: Moore-Penrose inverse is used in covariance matrix.

NOTE: Covariance matrix for the estimates is not full rank.

NOTE: The variance of some parameter estimates is zero or some parameter estimates are linearly related to other parameter estimates as shown in the following equations:

$$\text{phi22} = 23643 - 0.005891 * \text{phi12}$$

SENIC data 7
 Conditional and unconditional regression: No measurement error
 Unconditional Regression

The CALIS Procedure
 Covariance Structure Analysis: Maximum Likelihood Estimation

Fit Function	0.0000
Goodness of Fit Index (GFI)	1.0000
GFI Adjusted for Degrees of Freedom (AGFI)	.
Root Mean Square Residual (RMR)	0.0000
Standardized Root Mean Square Residual (SRMR)	0.0000
Parsimonious GFI (Mulaik, 1989)	0.0000
Chi-Square	0.0000
Chi-Square DF	0
Pr > Chi-Square	<.0001
Independence Model Chi-Square	69.380
Independence Model Chi-Square DF	3
RMSEA Estimate	0.0000
RMSEA 90% Lower Confidence Limit	.
RMSEA 90% Upper Confidence Limit	.
ECVI Estimate	0.1111
ECVI 90% Lower Confidence Limit	.
ECVI 90% Upper Confidence Limit	.
Probability of Close Fit	.
Bentler's Comparative Fit Index	1.0000
Normal Theory Reweighted LS Chi-Square	0.0000
Akaike's Information Criterion	0.0000
Bozdogan's (1987) CAIC	0.0000
Schwarz's Bayesian Criterion	0.0000
McDonald's (1989) Centrality	1.0000
Bentler & Bonett's (1980) Non-normed Index	.
Bentler & Bonett's (1980) NFI	1.0000
James, Mulaik, & Brett (1982) Parsimonious NFI	0.0000
Z-Test of Wilson & Hilferty (1931)	.
Bollen (1986) Normed Index Rhol	.
Bollen (1988) Non-normed Index Delta2	1.0000
Hoelter's (1983) Critical N	.

SENIC data 8
 Conditional and unconditional regression: No measurement error
 Unconditional Regression

The CALIS Procedure
 Covariance Structure Analysis: Maximum Likelihood Estimation

Manifest Variable Equations with Estimates

infrisk =	0.3191*stay	+ 0.00145*census	+ 1.0000 epsilon
Std Err	0.0627 beta1	0.000780 beta2	
t Value	5.0878	1.8554	

VariANCES of Exogenous Variables

Variable	Parameter	Estimate	Standard Error	t Value
stay	phi11	3.65366	0.47577	7.68
census	phi22	23642	0.14408	164089
epsilon	psi	1.24802	0.16677	7.48

Covariances Among Exogenous Variables

Var1	Var2	Parameter	Estimate	Standard Error	t Value
stay	census	phi12	139.27715	24.45425	5.70

SENIC data

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Conditional and unconditional regression: No measurement error
Unconditional Regression

The CALIS Procedure

Covariance Structure Analysis: Maximum Likelihood Estimation

Manifest Variable Equations with Standardized Estimates

$$\text{infrisk} = 0.4548 \cdot \text{stay}_{\text{beta1}} + 0.1659 \cdot \text{census}_{\text{beta2}} + 0.8331 \cdot \text{epsilon}$$

Squared Multiple Correlations

Variable	Error Variance	Total Variance	R-Square
1 infrisk	1.24802	1.79803	0.3059

Correlations Among Exogenous Variables

Var1	Var2	Parameter	Estimate
stay	census	phi12	0.47389

SENIC data 10
 Conditional and unconditional regression: No measurement error
 Unconditional Regression with census re-scaled

The CALIS Procedure
 Covariance Structure Analysis: Pattern and Initial Values

LINEQS Model Statement

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Term 1	1	<u>SEL</u>	3	4	SELECTION	
	2	<u>BETA</u>	4	4	EQSBETA	IMINUSINV
	3	<u>GAMMA</u>	4	3	EQSGAMMA	
	4	<u>PHI</u>	3	3	SYMMETRIC	

The 1 Endogenous Variables

Manifest infrisk
 Latent

The 3 Exogenous Variables

Manifest stay census100
 Latent
 Error epsilon

SENIC data 11
 Conditional and unconditional regression: No measurement error
 Unconditional Regression with census re-scaled

The CALIS Procedure
 Covariance Structure Analysis: Pattern and Initial Values

Manifest Variable Equations with Initial Estimates

infrisk = .*stay + .*census100 + 1.0000 epsilon
 beta1 beta2

Variances of Exogenous Variables

Variable	Parameter	Estimate
stay	phi11	.
census100	phi22	.
epsilon	psi	.

Covariances Among Exogenous Variables

Var1	Var2	Parameter	Estimate
stay	census100	phi12	.

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SENIC data
 Conditional and unconditional regression: No measurement error
 Unconditional Regression with census re-scaled

The CALIS Procedure
 Covariance Structure Analysis: Maximum Likelihood Estimation

Observations	113	Model Terms	1
Variables	3	Model Matrices	4
Informations	6	Parameters	6

	Variable	Mean	Std Dev
infrisk	Prob of acquiring infection in hospital	4.35487	1.34091
stay	Av length of hospital stay, in days	9.64832	1.91146
census100	Aver # patients in hospital per day in 100s	1.91372	1.53760

Set Covariances of Exogenous Manifest Variables

stay census100

NOTE: Some initial estimates computed by two-stage LS method.

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SENIC data
 Conditional and unconditional regression: No measurement error
 Unconditional Regression with census re-scaled

The CALIS Procedure
 Covariance Structure Analysis: Maximum Likelihood Estimation

Vector of Initial Estimates

	Parameter	Estimate	Type
1	beta1	0.31908	Matrix Entry: <u>GAMMA</u> [1:1]
2	beta2	0.14465	Matrix Entry: <u>GAMMA</u> [1:2]
3	phi11	3.65366	Matrix Entry: <u>PHI</u> [1:1]
4	phi12	1.39277	Matrix Entry: <u>PHI</u> [2:1]
5	phi22	2.36420	Matrix Entry: <u>PHI</u> [2:2]
6	psi	1.24802	Matrix Entry: <u>PHI</u> [3:3]

SENIC data 14
Conditional and unconditional regression: No measurement error
Unconditional Regression with census re-scaled

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Levenberg-Marquardt Optimization

Scaling Update of More (1978)

Parameter Estimates	6
Functions (Observations)	6
Lower Bounds	3
Upper Bounds	0

Optimization Start

Active Constraints	0	Objective Function	4.440892E-16
Max Abs Gradient Element	4.369321E-16	Radius	1

Optimization Results

Iterations	0	Function Calls	2
Jacobian Calls	1	Active Constraints	0
Objective Function	4.440892E-16	Max Abs Gradient Element	4.369321E-16
Lambda	0	Actual Over Pred Change	0
Radius	1		

ABSGCONV convergence criterion satisfied.

SENIC data 15
Conditional and unconditional regression: No measurement error
Unconditional Regression with census re-scaled

The CALIS Procedure
Covariance Structure Analysis: Maximum Likelihood Estimation

Fit Function	0.0000
Goodness of Fit Index (GFI)	1.0000
GFI Adjusted for Degrees of Freedom (AGFI)	.
Root Mean Square Residual (RMR)	0.0000
Standardized Root Mean Square Residual (SRMR)	0.0000
Parsimonious GFI (Mulaik, 1989)	0.0000
Chi-Square	0.0000
Chi-Square DF	0
Pr > Chi-Square	<.0001
Independence Model Chi-Square	69.380
Independence Model Chi-Square DF	3
RMSEA Estimate	0.0000
RMSEA 90% Lower Confidence Limit	.
RMSEA 90% Upper Confidence Limit	.
ECVI Estimate	0.1111
ECVI 90% Lower Confidence Limit	.
ECVI 90% Upper Confidence Limit	.
Probability of Close Fit	.
Bentler's Comparative Fit Index	1.0000
Normal Theory Reweighted LS Chi-Square	0.0000
Akaike's Information Criterion	0.0000

Bozdogan's (1987) CAIC	0.0000
Schwarz's Bayesian Criterion	0.0000
McDonald's (1989) Centrality	1.0000
Bentler & Bonett's (1980) Non-normed Index	.
Bentler & Bonett's (1980) NFI	1.0000
James, Mulaik, & Brett (1982) Parsimonious NFI	0.0000
Z-Test of Wilson & Hilferty (1931)	.
Bollen (1986) Normed Index Rho1	.
Bollen (1988) Non-normed Index Delta2	1.0000
Hoelter's (1983) Critical N	.

SENIC data

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Conditional and unconditional regression: No measurement error
 Unconditional Regression with census re-scaled

The CALIS Procedure

Covariance Structure Analysis: Maximum Likelihood Estimation

Manifest Variable Equations with Estimates

infrisk	=	0.3191*stay	+	0.1447*census100	+	1.0000 epsilon
Std Err		0.0627 beta1		0.0780 beta2		
t Value		5.0878		1.8554		

Variances of Exogenous Variables

Variable	Parameter	Estimate	Standard Error	t Value
stay	phi11	3.65366	0.48824	7.48
census100	phi22	2.36420	0.31593	7.48
epsilon	psi	1.24802	0.16677	7.48

Covariances Among Exogenous Variables

Var1	Var2	Parameter	Estimate	Standard Error	t Value
stay	census100	phi12	1.39277	0.30732	4.53

(Standardized estimates skipped)