Non recursive model for income data

In non-recursive systems, the calculation and interpretation of R^2 is unclear as the total variance of a *y*-variable may depend on both explanatory *x*-variables and the error variance and on other *y*-variables not in the system. Hayduk (2006) suggested a way to resolve this problem so that an R^2 can be calculated and interpreted for each structural equation. This approach is used in LISREL.

We use the data from Gujarati (1995) to illustrate. Of interest here is the relationship between income and government spending.

The data given in **incomemoney.lsf** are selected macro economic data for the USA for the period 1970 to 1991. This file can be found in the **MVABOOK Examples\Chapter 2** folder.

The variables are:

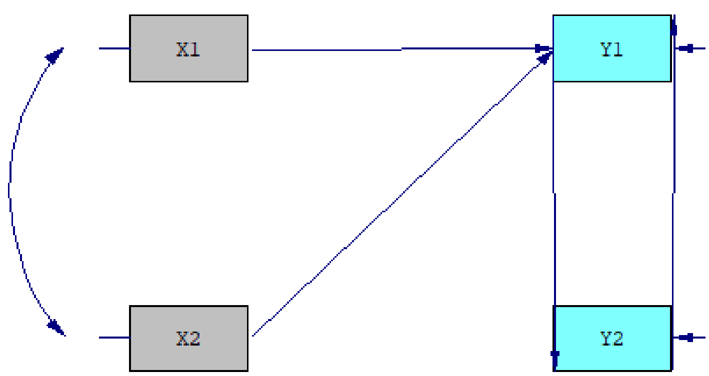
- y_1 = income
- y_2 = money supply
- x_1 = investment expenditure
- x_2 = government spending on goods and services
- x_3 = interest rate on 6-month Treasury bills in %.

All variables except for x_3 are measured in billions of dollars.

incomemoney.lsf

	Y1	Y2	X1	X2	X3
1	10.11	6.28	1.50	2.08	6.56
2	10.97	7.17	1.75	2.24	4.51
3	12.07	8.05	2.06	2.49	4.47
4	13.50	8.61	2.43	2.70	7.18
5	14.59	9.09	2.46	3.06	7.93
6	15.86	10.23	2.26	3.64	6.12
7	17.68	11.64	2.86	3.93	5.27
8	19.74	12.87	3.58	4.26	5.51
9	22.33	13.89	4.34	4.69	7.57
10	24.89	14.97	4.80	5.20	10.02
11	27.08	16.29	4.68	6.13	11.37
12	30.31	17.93	5.58	6.98	13.78
13	31.50	19.52	5.03	7.71	11.08
14	34.05	21.86	5.47	8.40	8.75
15	37.77	23.74	7.19	8.93	9.80
16	40.39	25.69	7.14	9.70	7.66
17	42.69	28.11	7.18	10.28	6.03
18	45.40	29.11	7.49	10.66	6.05
19	49.00	30.71	7.94	11.09	6.92
20	52.51	32.27	8.32	11.82	8.04
21	55.22	33.39	7.99	12.74	7.47
22	56.77	34.40	7.21	13.33	5.49

The conceptual path diagram for this analysis is given below.



Syntax is given in **incomemoney1a.spl**.

incomemoney1a.spl

```
!Income and Money Supply Estimated by ML
!Using SIMPLIS Syntax
Raw Data from File incomemoney.lsf
Equations
Y1 = CONST Y2 X1 X2
Y2 = CONST Y1
End of Problem
```

Reduced Form Equations

```
      Y1 = 0.645*X1 + 3.734*X2, Errorvar.= 1.219, R² = 0.995
Standerr  (0.355)    (0.225)
Z-values   1.818      16.610
P-values   0.069      0.000

      Y2 = 0.396*X1 + 2.295*X2, Errorvar.= 0.406, R² = 0.995
Standerr  (0.218)    (0.138)
Z-values   1.818      16.684
P-values   0.069      0.000
```

The following log-likelihood values and goodness-of-fit chi-squares show that the model fits very well.

```
Log-likelihood Values

                        Estimated Model          Saturated Model
                        ---------------          ---------------
 Number of free parameters(t)       13                       14
 -2ln(L)                       100.162                   99.755
 AIC (Akaike, 1974)*           126.162                  127.755
 BIC (Schwarz, 1978)*          140.346                  143.029

*LISREL uses AIC= 2t - 2ln(L) and BIC = tln(N)- 2ln(L)


                           Goodness-of-Fit Statistics

 Degrees of Freedom for (C1)-(C2)                       1
 Maximum Likelihood Ratio Chi-Square (C1)               0.408 (P = 0.5232)
 Due to Covariance Structure                            0.408
 Due to Mean Structure                                  0.00
 Browne's (1984) ADF Chi-Square (C2_NT)                 0.404 (P = 0.5251)
```