Two stage multiple imputation SEM using prostate cancer data

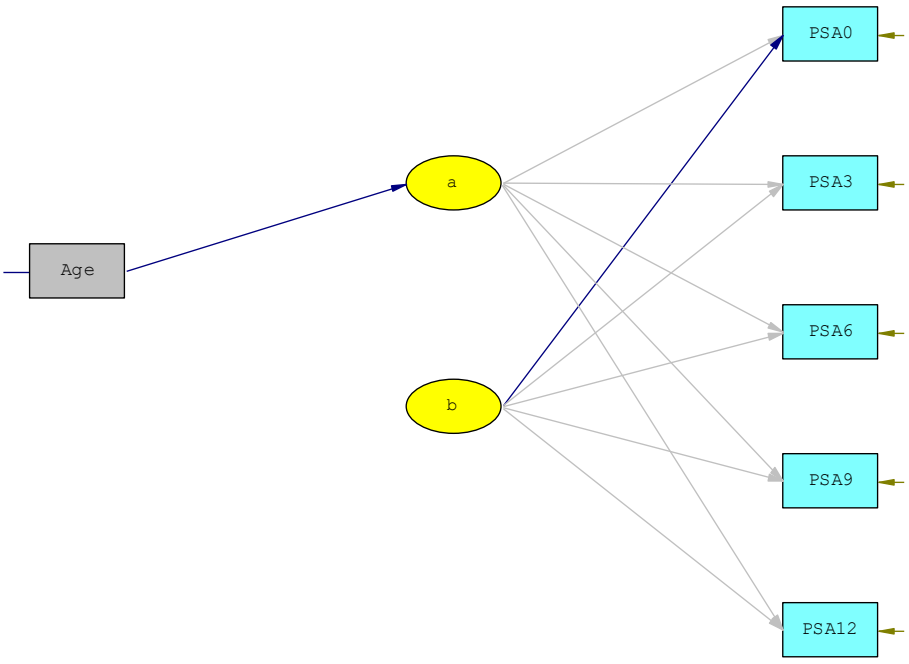
Jöreskog, Olsson, and Wallentin (2016) analyze five repeated PSA scores and the age of prostate cancer patients who received a treatment aimed at reducing the cancer activity in the prostate. The first few observations of the corresponding data file, **PSAVAR.LSF**, are reflected in the image below.

psavar.LSF

	PSA0	PSA3	PSA6	PSA9	PSA12	Age
1	30.40	28.00	26.90	25.20	19.60	69.00
2	27.80	26.70	20.50	18.70	18.80	58.00
3	26.60	21.80	17.80	17.90	14.50	53.00
4	24.80	24.50	20.20	19.80	18.80	61.00
5	33.70	30.30	25.40	27.30	20.10	63.00
6	26.50	24.60	20.90	-9.00	18.90	49.00
7	26.20	24.40	21.80	22.20	18.40	63.00
8	24.80	19.50	18.00	16.10	12.50	49.00
9	28.40	-9.00	22.50	19.40	22.90	63.00
10	26.10	-9.00	23.30	22.00	14.60	56.00
11	28.80	31.30	-9.00	23.10	22.80	68.00
12	29.80	-9.00	25.60	24.50	21.00	67.00
13	22.90	23.90	-9.00	19.40	15.60	47.00
14	30.10	27.70	25.70	20.40	20.80	56.00
15	26.50	-9.00	-9.00	20.00	17.40	57.00

Note that the data values of -9.00 are missing data values. If a different global missing data value code is used, it should be assigned using the **Define Variables** dialog box.

The theoretical model is a linear latent growth curve model for the five PSA scores and the age of the prostate cancer patients. A path diagram of this model is shown in the image below.



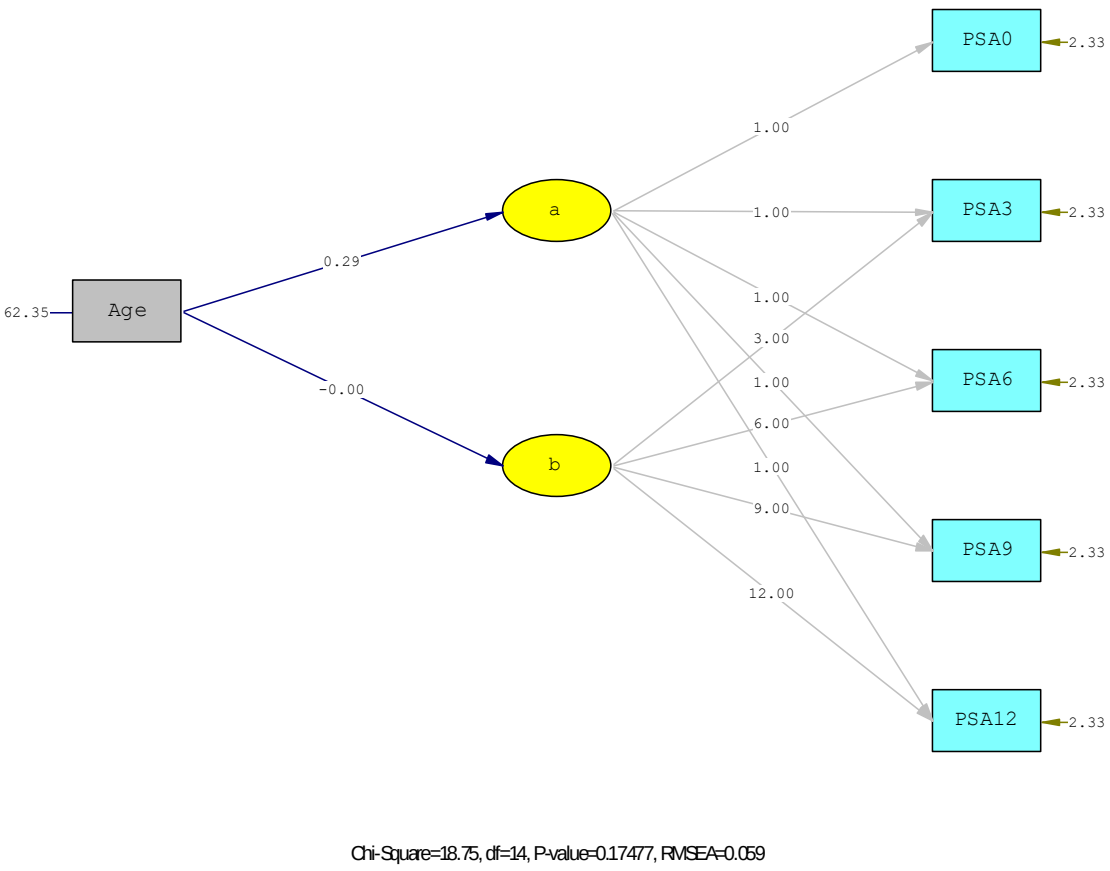
The SIMPLIS syntax file, **PSAVAR3A.SPL**, for fitting the theoretical model above to the average sample mean vector and the average sample covariance matrix of 20 FCS imputations is shown in the image below.

PSAVAR3A.SPL

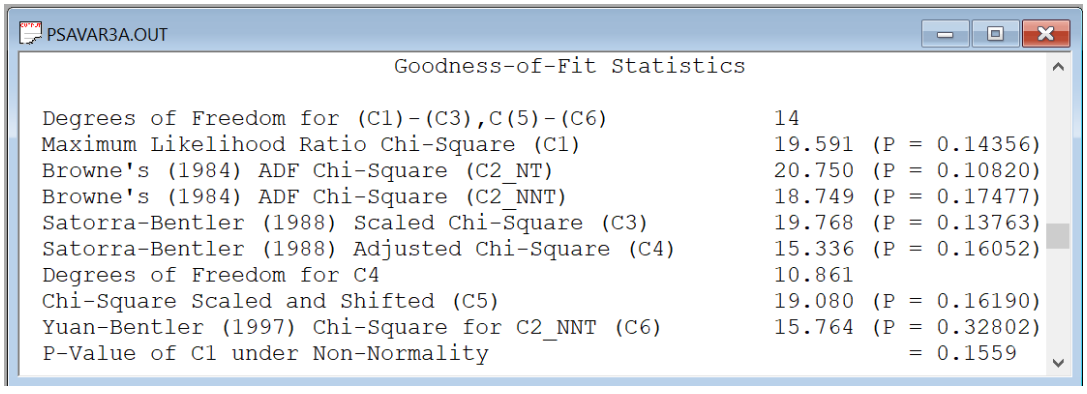
```
Raw Data from File PSAVAR.LSF
Latent Variables: a b
Relationships
PSA0 = 1*a 0*b
PSA3 = 1*a 3*b
PSA6 = 1*a 6*b
PSA9 = 1*a 9*b
PSA12 = 1*a 12*b
a b = Age
Let the Errors of a and b correlate
Equal Error Variances: PSA0 - PSA12
LISREL Output SC MI2S NM=20 IM=FC ME=ULS IX=5917
Path Diagram
End of Problem
```

- Line 1 specifies the raw data file.
- Lines 2 specifies the labels for the latent variables of the model.
- Lines 3 to 11 specify the linear latent growth curve model for the five PSA scores and age.
- Line 12 requests that the results in the output file should be given in terms of the LISREL model for the linear latent growth curve model (LISREL Output). It also requests that the completely standardized solution should be written to the output file (SC) and robust unweighted least squares estimation (ME = ULS). The MI2S option invokes the two-stage multiple imputation SEM method to fit the model to the average sample mean vector and the average sample covariance matrix of the NM = 20 FCS imputations (IM = FC) based on an initial random seed of IX = 5917.
- Line 13 requests a path diagram of the model.
- Line 14 indicates that no more SIMPLIS commands are to be processed.

When the SPL file above is opened in LISREL and the **Run LISREL** button is clicked, the following path diagram is obtained.



The corresponding output file, **PSAVAR3A.OUT**, is opened in a separate window. The corresponding Chi-square test statistic values are shown in the image below.


PSAVAR3A.OUT

```
                    Goodness-of-Fit Statistics

Degrees of Freedom for (C1)-(C3),C(5)-(C6)            14
Maximum Likelihood Ratio Chi-Square (C1)              19.591 (P = 0.14356)
Browne's (1984) ADF Chi-Square (C2_NT)                20.750 (P = 0.10820)
Browne's (1984) ADF Chi-Square (C2_NNT)               18.749 (P = 0.17477)
Satorra-Bentler (1988) Scaled Chi-Square (C3)         19.768 (P = 0.13763)
Satorra-Bentler (1988) Adjusted Chi-Square (C4)       15.336 (P = 0.16052)
Degrees of Freedom for C4                             10.861
Chi-Square Scaled and Shifted (C5)                    19.080 (P = 0.16190)
Yuan-Bentler (1997) Chi-Square for C2_NNT (C6)        15.764 (P = 0.32802)
P-Value of C1 under Non-Normality                             = 0.1559
```

The Chi-square test statistic values depicted above indicate that the linear growth curve model for the five PSA scores and age is supported by the data.

References

Jöreskog, K.G., Olsson, U.H. & Wallentin. F.Y. (2016). *Multivariate Analysis with LISREL*. New York: Springer Publishing.