Heywood Cases on the Latent Variable

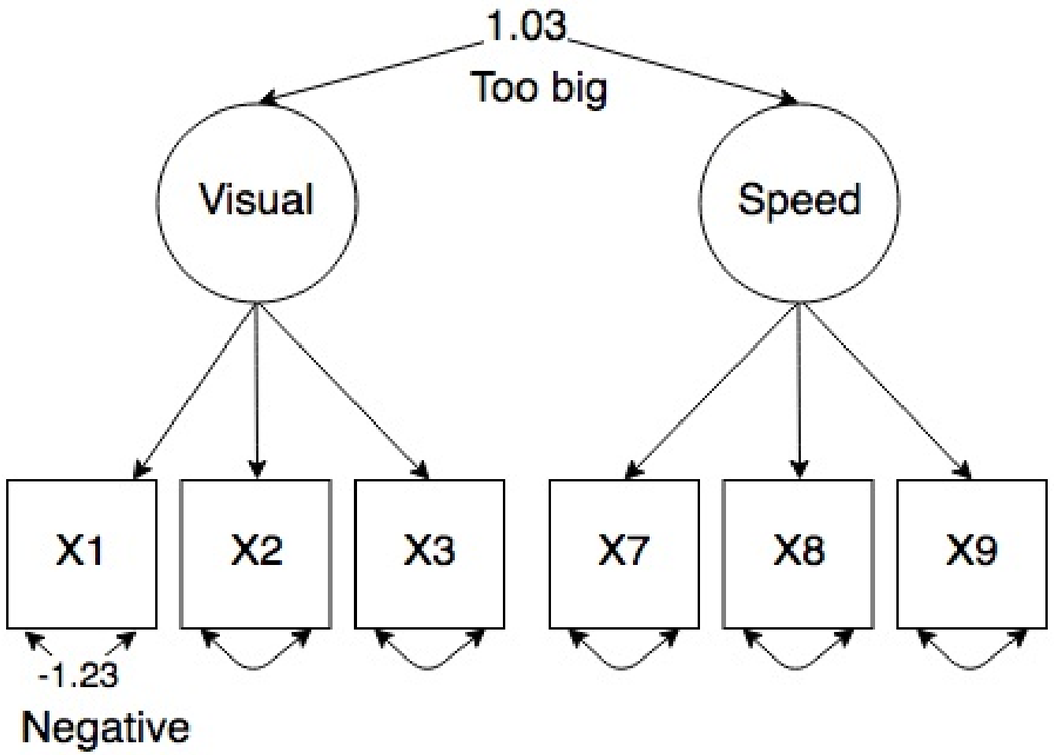
STRUCTURAL EQUATION MODELING WITH LAVAAN IN R

Erin Buchanan
Professor

datacamp

Heywood Cases

- Correlations that are out of bounds
- Negative variances



A Latent Variable Example

```
epi.model <- 'extraversion =~ V3 + V7 + V11 + V15
    neuroticism =~ V1 + V5 + V9 + V13
    lying =~ V4 + V8 + V12 + V16'
epi.fit <- cfa(model = epi.model, data = epi)
```

```
Warning message:
In lav_object_post_check(object) :
  lavaan WARNING: covariance matrix of latent variables
                  is not positive definite;
                  use inspect(fit,"cov.lv") to investigate.
```

How to Find the Error

```
summary(epi.fit, standardized = TRUE,
        fit.measures = TRUE)
```

```
Covariances:
                   Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
  extraversion ~~
    neuroticism    -0.011    0.002   -6.822    0.000   -0.894   -0.894
    lying          -0.012    0.002   -6.801    0.000   -0.777   -0.777
  neuroticism ~~
    lying           0.012    0.002    7.023    0.000    0.982    0.982
```

How to Fix the Error

```
#original model
epi.model <- 'extraversion =~ V3 + V7 + V11 + V15
    neuroticism =~ V1 + V5 + V9 + V13
    lying =~ V4 + V8 + V12 + V16'
```

```
#respecify the model
epi.model2 <- 'extraversion =~ V3 + V7 + V11 + V15
    neuroticism_lie =~ V1 + V5 + V9 + V13 + V4 + V8 + V12 + V16'

epi.fit2 <- cfa(model = epi.model2, data = epi)
summary(epi.fit2, standardized = T, fit.measures = T)
```

How to Fix the Error (2)

```
Covariances:
                   Estimate Std.Err z-value P(>|z|)  Std.lv Std.all
  extraversion ~~
    neuroticism_li -0.011   0.002  -6.939   0.000  -0.843  -0.843
```

Let's practice!

STRUCTURAL EQUATION MODELING WITH LAVAAN IN R

Heywood Cases on the Manifest Variables

STRUCTURAL EQUATION MODELING WITH LAVAAN IN R

Erin Buchanan
Professor

datacamp

Why Negative Variances?

- Reasons a negative variance might occur:
  - The model might be misspecified or under identified
  - Smaller sample size or sampling fluctuations
  - Manifest variables have different scales
  - Data is skewed or otherwise non-normal

Negative Variance Example

```
negative.model <- 'latent1 =~ V1 + V2 + V3
    latent2 =~ V4 + V5 + V6'
negative.fit <- cfa(negative.model, data = negative_data)
```

```
Warning message:
In lavaan::lavaan(model = negative.model,
  data = negative_data,  :
  lavaan WARNING: model has NOT converged!
```

Summarize to View Heywood Case

```
summary(negative.fit, standardized = TRUE,
        fit.measures = TRUE, rsquare = TRUE)
```

```
** WARNING ** lavaan (0.5-23.1097) did
   NOT converge after 10000 iterations
** WARNING ** Estimates below are most likely unreliable
```

```
Variances:
         Estimate  Std.Err z-value P(>|z|)  Std.lv  Std.all
   .V2    -3949.334      NA                -3949.334 -211.745
   .V5    11885.910      NA                11885.910 615.668
```

Investigate R-Square Output

```
R-Square:
                   Estimate
    V1                0.001
    V2                   NA
    V3                0.000
    V4               -0.000
    V5             -614.668
    V6               -0.000
```

```
var(negative_data$V2)
```

```
18.83833
```

Update the Model

```
negative.model <- 'latent1 =~ V1 + V2 + V3
    latent2 =~ V4 + V5 + V6
    V2 ~~ 18.83833*V2'

negative.fit <- cfa(negative.model,
                    data = negative_data)

summary(negative.fit,
        standardized = TRUE,
        fit.measures = TRUE,
        rsquare = TRUE)
```

New Updated Output

```
Variances:
          Estimate  Std.Err  z-value  P(>|z|)   Std.lv  Std.all
   .V2      18.838                               18.838    0.962
   .V1       7.655    1.145    6.687    0.000    7.655    0.772
   .V3      16.100    1.580   10.189    0.000   16.100    0.848
   .V4      13.866    1.017   13.638    0.000   13.866    0.876
   .V5       8.851    5.472    1.617    0.106    8.851    0.400
   .V6      12.336    0.599   20.596    0.000   12.336    0.956
    latent1  2.261    1.128    2.004    0.045    1.000    1.000
    latent2  1.956    0.875    2.236    0.025    1.000    1.000
```

Negative Variance Example (5)

```
R-Square:
                   Estimate
    V2                0.038
    V1                0.228
    V3                0.152
    V4                0.124
    V5                0.600
    V6                0.044
```

Let's practice!

STRUCTURAL EQUATION MODELING WITH LAVAAN IN R

Create Diagrams with semPaths()

STRUCTURAL EQUATION MODELING WITH LAVAAN IN R

Erin Buchanan
Professor

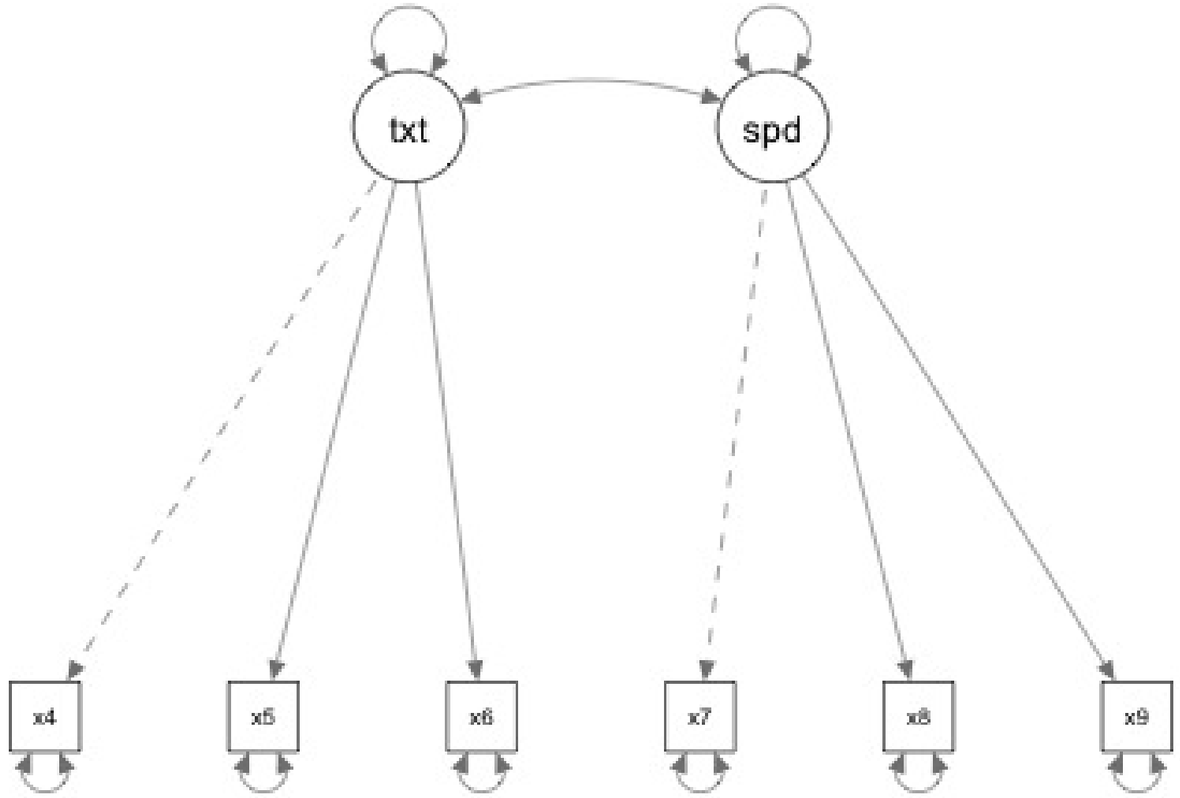
semPlot and semPaths()

```
library(lavaan)
library(semPlot)
```

```
twofactor.model <- 'text =~ x4 + x5 + x6
    speed =~ x7 + x8 + x9'
twofactor.fit <- cfa(model = twofactor.model,
                     data = HolzingerSwineford1939)
```

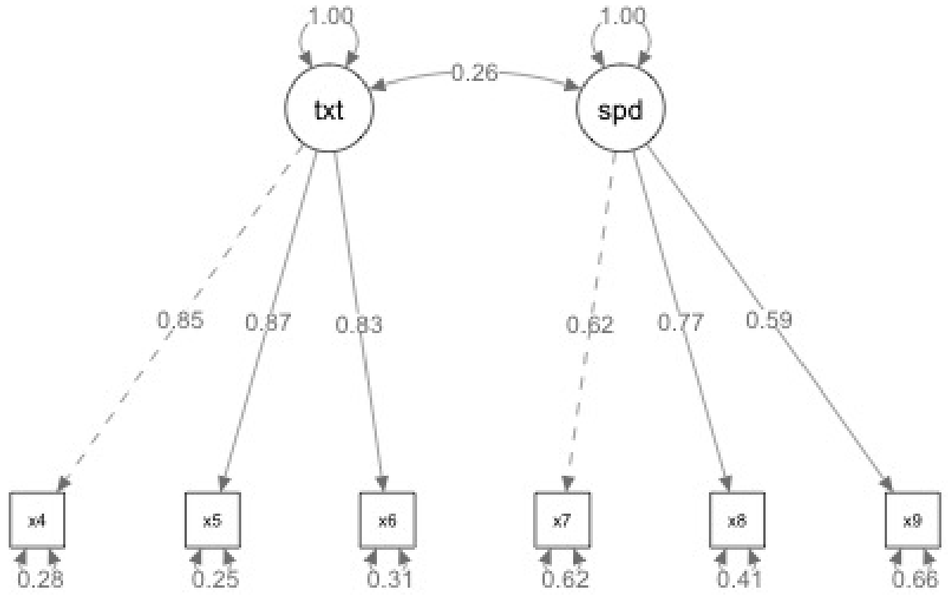
```
semPaths(object = twofactor.fit)
```

semPaths() Default Output



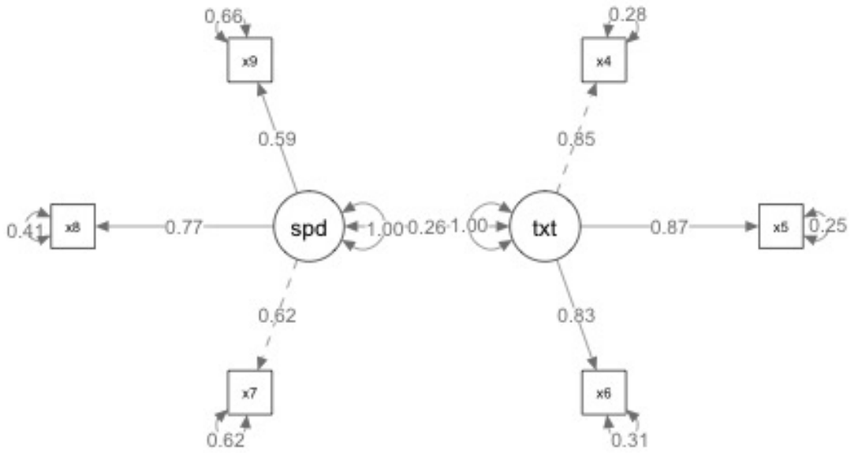
Editing the Picture

```
semPaths(object = twofactor.fit,
         whatLabels = "std",
         edge.label.cex = 1)
#whatLabels can also be "par"
```



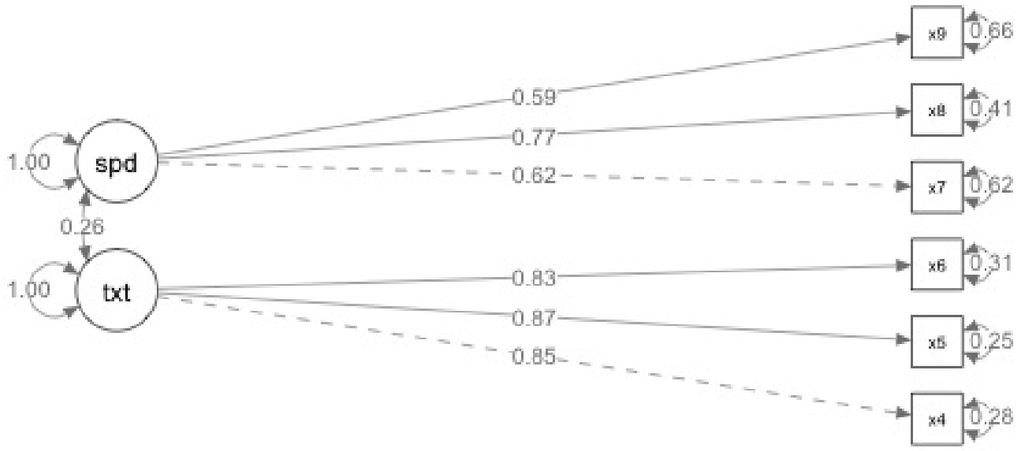
Picture Layout

```
semPaths(object = twofactor.fit,
           whatLabels = "std",
           edge.label.cex = 1,
           layout = "circle")
#layout options are tree, circle, spring, tree2, circle2
```



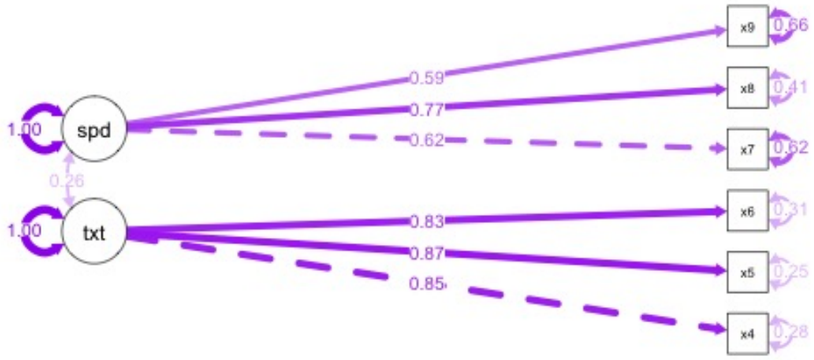
Picture Rotation

```
semPaths(object = twofactor.fit,
           whatLabels = "std",
           edge.label.cex = 1,
           layout = "tree", rotation = 2)
#rotation options are 1, 2, 3, 4 for tree layouts
```



Color Visualization

```
semPaths(object = twofactor.fit,
         whatLabels = "std",
         edge.label.cex = 1,
         layout = "tree", rotation = 2,
         what = "std", edge.color = "purple")
#what options include par and std
```



Let's practice!

STRUCTURAL EQUATION MODELING WITH LAVAAN IN R