multivariate_t7

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1 Multivariate Statistics Test 7

Student: Aleksandr Jan Smoliakov, VU MIF Data Science MSc year 1
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1.1 Input data

Data: File `CZILSWE.sav`, variables

- `happy`: how happy are you (0-extremely unhappy, …, 10-extremely happy)
- `stflife`: how satisfied with life as a whole (0-extremely dissatisfied, …, 10-extremely satisfied)
- `stfgov`: how satisfied with the national government (0-extremely dissatisfied, …, 10-extremely satisfied)
- `stfhlth`: state of health services (0-extremely dissatisfied, …, 10-extremely satisfied)
- `trstep`: trust in the European Parliament (0-no trust at all, …, 10-complete trust)
- `trstun`: trust in the United Nations (0-no trust at all, …, 10-complete trust)
- `trstprt`: trust in political parties (0-no trust at all, …, 10-complete trust)
- `trstprl`: trust in country's parliament (0-no trust at all, …, 10-complete trust)
- `trstplc`: trust in police (0-no trust at all, …, 10-complete trust)
- `trstplt`: trust in politicians (0-no trust at all, …, 10-complete trust)
- `state`: 1-Czech Republic, 2-Israel, 3-Sweden

Task: construct a SEM model.

First of all, let's load the data and take a look.

[387]:

```python
import pandas as pd
import pyreadstat
import semopy

pd.options.display.float_format = "{:.4f}".format
```

[388]:

```python
df_happy, metadata_happy = pyreadstat.read_sav("data/CZILSWE.sav")

df_happy.describe()
```

[388]:

```
       trstprl  trstplc  trstplt  trstprt   trstep   trstun  stflife   stfgov  \
count 186.0000 186.0000 186.0000 184.0000 153.0000 174.0000 184.0000 180.0000
mean    4.2849   4.9839   3.2957   3.4022   3.8693   4.6782   7.1141   4.0667
std     2.7390   2.6943   2.4147   2.3426   2.6024   2.5894   2.1585   2.4645
```

```
min      0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0000
25%      2.0000    3.0000    1.0000    1.0000    2.0000    3.0000    6.0000    2.0000
50%      4.5000    5.0000    3.0000    4.0000    4.0000    5.0000    8.0000    4.0000
75%      6.7500    7.0000    5.0000    5.0000    6.0000    7.0000    9.0000    6.0000
max     10.0000   10.0000    9.0000    9.0000   10.0000   10.0000   10.0000   10.0000

        stfhlth     happy     state
count  183.0000  183.0000  187.0000
mean     5.7377    7.3552    1.9572
std      2.3198    1.7665    0.8021
min      0.0000    1.0000    1.0000
25%      4.0000    6.0000    1.0000
50%      6.0000    8.0000    2.0000
75%      8.0000    8.0000    3.0000
max     10.0000   10.0000    3.0000
```

The `state` variable is categorical, so we will need to create dummy variables for it.

There are missing values in the data, but we will not remove them, because the SEM model can handle them.

[494]:

```
df_happy["state_israel"] = (df_happy["state"] == 2).astype(int)
df_happy["state_sweden"] = (df_happy["state"] == 3).astype(int)

df_happy.columns = df_happy.columns.str.lower()

df_happy.head()
```

[494]:

```
   trstprl  trstplc  trstplt  trstprt  trstep  trstun  stflife  stfgov  \
0   2.0000   2.0000   3.0000   1.0000  0.0000  0.0000   3.0000 10.0000
1   9.0000  10.0000   7.0000   7.0000     NaN     NaN  10.0000  8.0000
2   8.0000   8.0000   8.0000   8.0000  8.0000  8.0000   8.0000  8.0000
3   6.0000   8.0000   5.0000   7.0000     NaN  6.0000   9.0000  5.0000
4   4.0000   3.0000   1.0000   1.0000  4.0000  6.0000   8.0000  2.0000

   stfhlth   happy  state  state_israel  state_sweden
0  10.0000 10.0000 3.0000             0             1
1   9.0000 10.0000 2.0000             1             0
2   8.0000 10.0000 1.0000             0             0
3   8.0000 10.0000 2.0000             1             0
4   8.0000 10.0000 2.0000             1             0
```

1.2 Model

1.2.1 Model description

We will create a SEM model with the following structure:

Observed variables:

- trstprt
- trstprl
- trstplt
- trstplc
- trstep
- trstun
- stflife
- happy
- stfgov
- stfhlth

Latent variables:

- GovTrust - trust in the country's government institutions, measured by trstprt, trstprl, trstplt, trstplc
- GlobalTrust - trust in global institutions, measured by trstun, trstep
- LifeSatisfaction - life satisfaction, measured by stflife, happy
- ServiceSatisfaction - satisfaction with public services, measured by stfgov, stfhlth

The model will have the following paths:

- GlobalTrust -> LifeSatisfaction
- ServiceSatisfaction -> GovTrust

Covariances:

- trstep <-> trstun
- trstprt <-> trstplt
- GovTrust <-> GlobalTrust

[490]:

```
model_description = """
    # Latent variables
    GovTrust =~ trstprt + trstprl + trstplt + trstplc
    GlobalTrust =~ trstep + trstun
    LifeSatisfaction =~ stflife + happy
    ServiceSatisfaction =~ stfgov + stfhlth

    # Paths
    LifeSatisfaction ~ GlobalTrust
    GovTrust ~ ServiceSatisfaction

    # Covariances
    trstep ~~ trstun
    trstprt ~~ trstplt
    GovTrust ~~ GlobalTrust
"""

model = semopy.Model(model_description)
res = model.fit(df_happy)
```

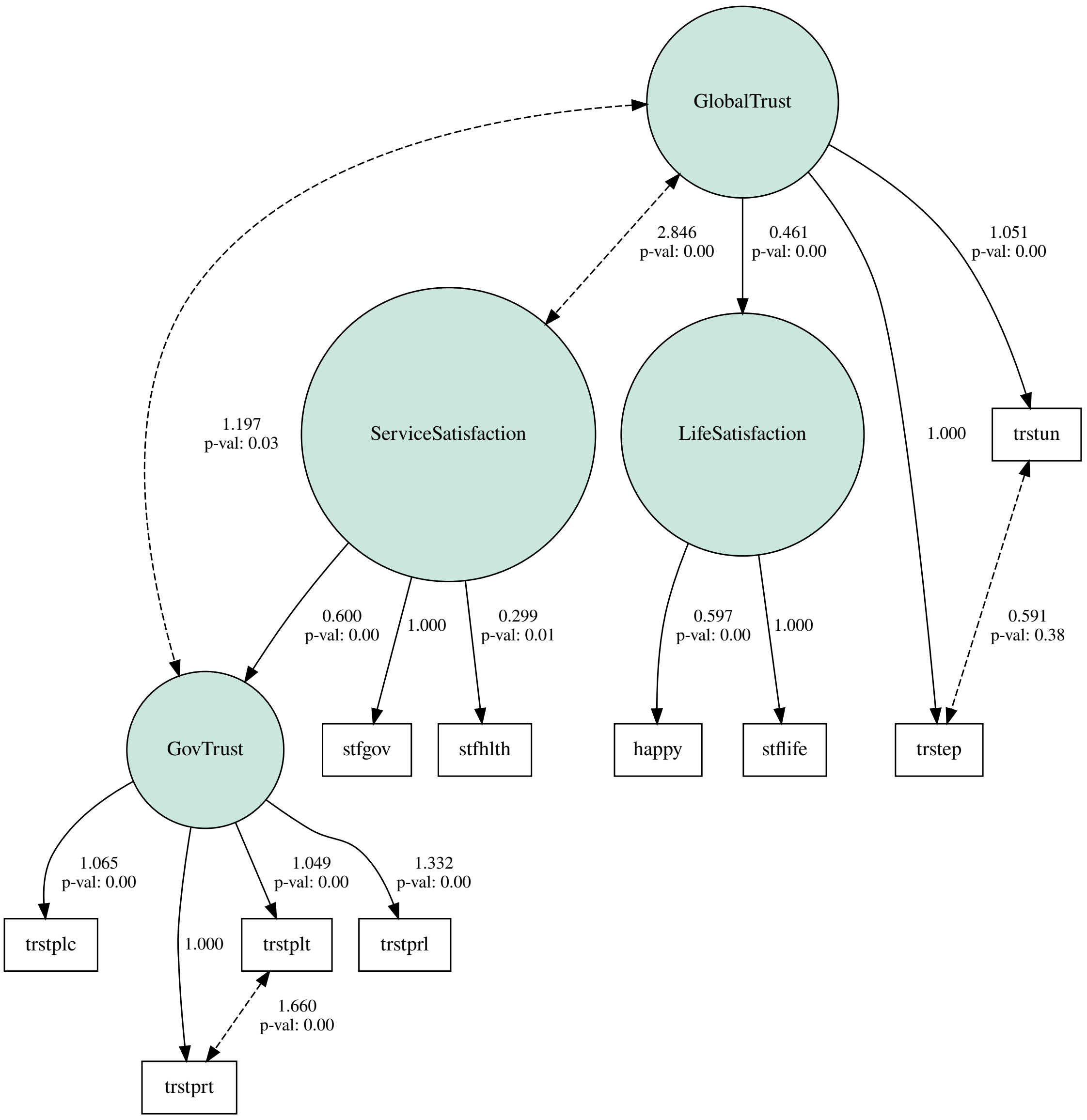
1.2.2 Diagram of the model

Let's draw a diagram of the model with the estimates.

[491]:

```
semopy.plot.semplot(
    model,
    "sem_model.png",
    plot_covs=True,
)
```

[491]:



We've fit the model. The majority of the paths are significant at the 0.05 level. The only exception is the covariance between `trstep` and `trstun`, which is not significant.

1.2.3 Model fit characteristics

The model has the following fit characteristics:

[495]:

```
fit_indices = semopy.calc_stats(model)

fit_indices
```

[495]:

```
       DoF  DoF Baseline    chi2  chi2 p-value  chi2 Baseline    CFI    GFI  \
Value   29            45 43.5473        0.0405      1098.3351 0.9862 0.9604

        AGFI    NFI    TLI  RMSEA     AIC       BIC  LogLik
Value 0.9385 0.9604 0.9786 0.0519 51.5343 135.5431  0.2329
```

Everything looks good, we have a good model fit. Notably:

- Degrees of Freedom = 29
- Chi-square = 43.55
- NC = Chi-square / DoF = 1.50 $<$ 2 (good)
- AGFI = 0.939 $>$ 0.90 (acceptable)
- RMSEA = 0.0519 $<$ 0.10 (almost good at 0.05)
- Chi-square p-value = 0.0405 $>$ 0.01 (good)