Multiple testing in ANOVA and SEM

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Overview

We present two simulated scenarios to illustrate the issue of multiple testing, by looking at false positive rates and power in:

▶ ANOVA

▶ Structural Equation Modeling (SEM)

ANOVA

We simulated 5000 ANOVA with 3 binary predictors (A, B, C) and one continuous predictor (D), under H0 and H1 (y = 1 + 0.20*C + residual).

We present here the results of the simulation under H1.

ANOVA

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Anova Table (Type II tests)

Response: y
         Sum Sq   Df   F value   Pr(>F)
A             1    1    1.1134   0.29135
B             0    1    0.1302   0.71827
C           990    1  986.6354 < 2e-16 ***
D             0    1    0.4122   0.52084
A:B           1    1    0.5640   0.45265
A:C           0    1    0.2892   0.59075
B:C           1    1    0.5126   0.47402
A:D           4    1    4.2249   0.03984 *
B:D           0    1    0.4730   0.49161
C:D           0    1    0.0167   0.89720
A:B:C         0    1    0.1156   0.73384
A:B:D         1    1    1.4762   0.22438
A:C:D         0    1    0.1241   0.72464
B:C:D         0    1    0.4967   0.48097
```
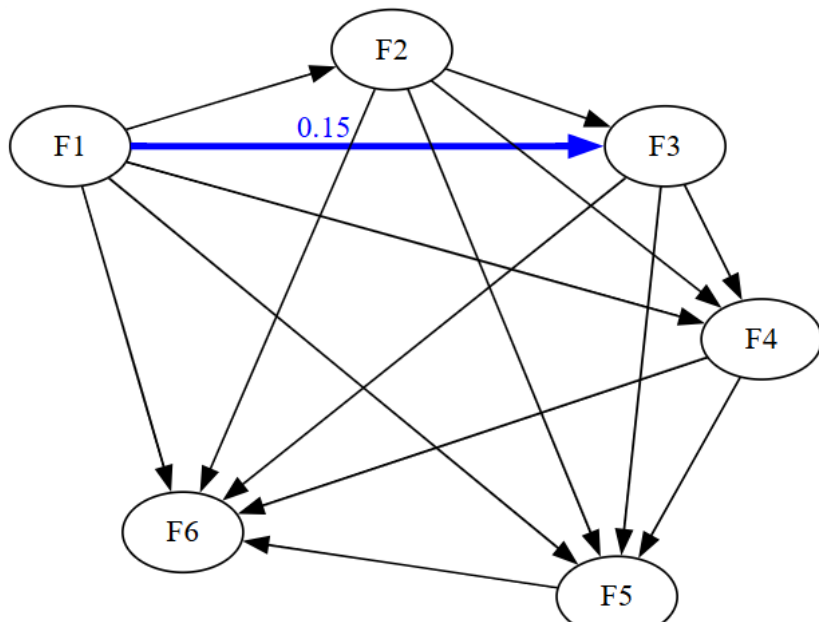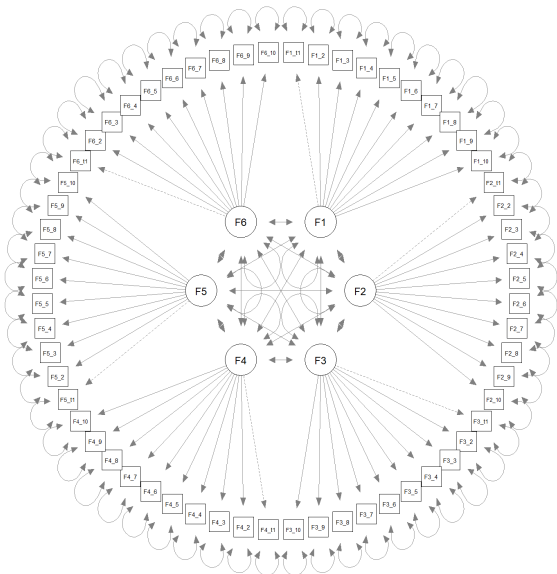
Results of the simulation

Table 1: Under H1 (true effect of C)

Metric	Value
Power	88.8%
Power (after correction; FDR)	60.6%
At least one significant effect	94.2%

SEM

SEM

SEM
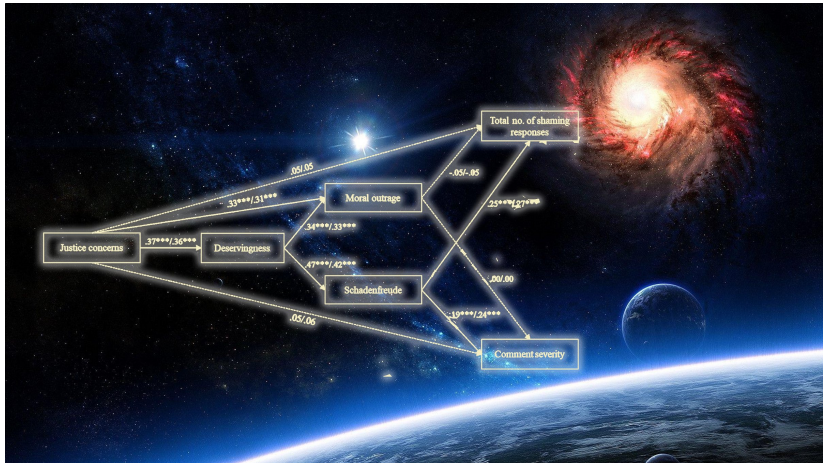
Figure 3: Celestial SEM (from Celestial Mediation)

Results

Table 2: Under H1 (true path F3 ~ F1)

Metric	Value
Power	94.6%
Power (after correction; FDR)	72.8%
At least one significant effect	97.4%