HW13

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Contents

- Gen AI Usage: I use Gen AI to refine my grammar, verify my reasoning and adjust to cleaner code.
- Students who helped: 113078505, 113078502, and 113078514, helped with conclusion reasoning.

0.1 Question 1) Composite Path Models using PLS-PM

```
library(seminr)
sec = read.csv("security_data_sem.csv")
```

0.1.1 a. Create a PLS path model using SEMinR, with all the following characteristics:

0.1.2 i. Measurement model – all constructs are measured as composites:

0.1.3 1. Trust in website (TRUST): items TRST1 - TRST4

0.1.4 2. Perceived security of website (SEC): items PSEC1 - PSEC4

0.1.5 3. Reputation of website (REP): items PREP1 - PREP4

0.1.6 4. Investment in website (INV): items PINV1 - PINV3

0.1.7 5.Perception of privacy policies (POL): items PPSS1 - PPSS3

0.1.8 6. Familiarity with website (FAML): item FAML1

(see the documentation of SEMinR for making single item constructs) ### 7. Interaction between REP and POL (use orthogonalized product terms)

```
sec_mm <- constructs(
composite("TRUST", multi_items("TRST", 1:4)),
composite("SEC", multi_items("PSEC", 1:4)),
composite("REP", multi_items("PREP", 1:4)),
composite("INV", multi_items("PINV", 1:3)),
```

```
composite("POL", multi_items("PPSS", 1:3)),
composite("FAML", single_item("FAML1")),
interaction_term(iv="REP", moderator="POL", method=orthogonal)
)
```

0.1.9 ii. Structural Model – paths between constructs as shown in this causal model:

REP + INV + POL + FAML + (REP POL) → SEC → TRUST

```
sec_sm <- relationships(
paths(from = c("REP", "INV", "POL", "FAML", "REP*POL"), to = "SEC"),
paths(from = "SEC", to = "TRUST")
)
```

0.1.10 b. Show us the following results in table or figure formats:

0.1.11 i. Plot a figure of the estimated model

```
sec_pls <- estimate_pls(data = sec,
measurement_model = sec_mm,
structural_model = sec_sm)
```

```
## Generating the seminr model
```

```
## All 405 observations are valid.
```

```
plot(sec_pls)
```

0.1.12 ii. Weights and loadings of composites

```
summary(sec_pls)$weights
```

```
##               REP   INV   POL  FAML REP*POL   SEC TRUST
## TRST1       0.000 0.000 0.000 0.000   0.000 0.000 0.282
## TRST2       0.000 0.000 0.000 0.000   0.000 0.000 0.280
## TRST3       0.000 0.000 0.000 0.000   0.000 0.000 0.286
## TRST4       0.000 0.000 0.000 0.000   0.000 0.000 0.278
## PSEC1       0.000 0.000 0.000 0.000   0.000 0.277 0.000
## PSEC2       0.000 0.000 0.000 0.000   0.000 0.315 0.000
## PSEC3       0.000 0.000 0.000 0.000   0.000 0.307 0.000
## PSEC4       0.000 0.000 0.000 0.000   0.000 0.292 0.000
## PREP1       0.215 0.000 0.000 0.000   0.000 0.000 0.000
## PREP2       0.334 0.000 0.000 0.000   0.000 0.000 0.000
## PREP3       0.349 0.000 0.000 0.000   0.000 0.000 0.000
## PREP4       0.287 0.000 0.000 0.000   0.000 0.000 0.000
## PINV1       0.000 0.363 0.000 0.000   0.000 0.000 0.000
## PINV2       0.000 0.395 0.000 0.000   0.000 0.000 0.000
```

```
## PINV3       0.000 0.358 0.000 0.000   0.000 0.000 0.000
## PPSS1       0.000 0.000 0.360 0.000   0.000 0.000 0.000
## PPSS2       0.000 0.000 0.395 0.000   0.000 0.000 0.000
## PPSS3       0.000 0.000 0.367 0.000   0.000 0.000 0.000
## FAML1       0.000 0.000 0.000 1.000   0.000 0.000 0.000
## PREP1*PPSS1 0.000 0.000 0.000 0.000   0.239 0.000 0.000
## PREP1*PPSS2 0.000 0.000 0.000 0.000   0.031 0.000 0.000
## PREP1*PPSS3 0.000 0.000 0.000 0.000   0.021 0.000 0.000
## PREP2*PPSS1 0.000 0.000 0.000 0.000   0.046 0.000 0.000
## PREP2*PPSS2 0.000 0.000 0.000 0.000  -0.104 0.000 0.000
## PREP2*PPSS3 0.000 0.000 0.000 0.000  -0.228 0.000 0.000
## PREP3*PPSS1 0.000 0.000 0.000 0.000  -0.341 0.000 0.000
## PREP3*PPSS2 0.000 0.000 0.000 0.000   0.095 0.000 0.000
## PREP3*PPSS3 0.000 0.000 0.000 0.000   0.108 0.000 0.000
## PREP4*PPSS1 0.000 0.000 0.000 0.000   0.443 0.000 0.000
## PREP4*PPSS2 0.000 0.000 0.000 0.000   0.382 0.000 0.000
## PREP4*PPSS3 0.000 0.000 0.000 0.000   0.271 0.000 0.000
```

```
summary(sec_pls)$loadings
```

```
##                REP    INV    POL   FAML REP*POL    SEC  TRUST
## TRST1        0.000  0.000  0.000  0.000  -0.000  0.000  0.900
## TRST2        0.000  0.000  0.000  0.000  -0.000  0.000  0.909
## TRST3        0.000  0.000  0.000  0.000  -0.000  0.000  0.905
## TRST4        0.000  0.000  0.000  0.000  -0.000  0.000  0.838
## PSEC1        0.000  0.000  0.000  0.000  -0.000  0.813  0.000
## PSEC2        0.000  0.000  0.000  0.000  -0.000  0.865  0.000
## PSEC3        0.000  0.000  0.000  0.000  -0.000  0.868  0.000
## PSEC4        0.000  0.000  0.000  0.000  -0.000  0.807  0.000
## PREP1        0.800  0.000  0.000  0.000   0.000  0.000  0.000
## PREP2        0.913  0.000  0.000  0.000   0.000  0.000  0.000
## PREP3        0.908  0.000  0.000  0.000   0.000  0.000  0.000
## PREP4        0.718  0.000  0.000  0.000   0.000  0.000  0.000
## PINV1        0.000  0.903  0.000  0.000  -0.000  0.000  0.000
## PINV2        0.000  0.925  0.000  0.000  -0.000  0.000  0.000
## PINV3        0.000  0.855  0.000  0.000  -0.000  0.000  0.000
## PPSS1        0.000  0.000  0.868  0.000   0.000  0.000  0.000
## PPSS2        0.000  0.000  0.893  0.000  -0.000  0.000  0.000
## PPSS3        0.000  0.000  0.911  0.000   0.000  0.000  0.000
## FAML1        0.000  0.000  0.000  1.000  -0.000  0.000  0.000
## PREP1*PPSS1 -0.000 -0.000 -0.000 -0.000   0.581 -0.000 -0.000
## PREP1*PPSS2  0.000 -0.000 -0.000 -0.000   0.510 -0.000 -0.000
## PREP1*PPSS3 -0.000 -0.000 -0.000 -0.000   0.506 -0.000 -0.000
## PREP2*PPSS1 -0.000 -0.000 -0.000 -0.000   0.509 -0.000 -0.000
## PREP2*PPSS2  0.000 -0.000  0.000 -0.000   0.421  0.000  0.000
## PREP2*PPSS3 -0.000 -0.000 -0.000  0.000   0.336  0.000  0.000
## PREP3*PPSS1 -0.000 -0.000 -0.000  0.000   0.236  0.000  0.000
## PREP3*PPSS2  0.000 -0.000 -0.000 -0.000   0.555 -0.000 -0.000
## PREP3*PPSS3 -0.000 -0.000 -0.000  0.000   0.466 -0.000 -0.000
## PREP4*PPSS1  0.000 -0.000  0.000  0.000   0.900 -0.000 -0.000
## PREP4*PPSS2 -0.000 -0.000 -0.000 -0.000   0.836 -0.000  0.000
## PREP4*PPSS3  0.000 -0.000  0.000  0.000   0.859 -0.000  0.000
```

0.1.13 iii. Regression coefficients of paths between factors

```
summary(sec_pls)$paths
```

```
##            SEC TRUST
## R^2      0.420 0.367
## AdjR^2   0.412 0.365
## REP      0.247     .
## INV      0.181     .
## POL      0.339     .
## FAML     0.011     .
## REP*POL -0.105     .
## SEC          . 0.606
```

0.1.14 iv. Bootstrapped path coefficients: t-values, 95% CI

```
set.seed(1234)
boot_pls <- bootstrap_model(sec_pls, nboot = 1000)
```

```
## Bootstrapping model using seminr...
```

```
## SEMinR Model successfully bootstrapped
```

```
boot_paths <- summary(boot_pls)$bootstrapped_paths
boot_paths
```

```
##                  Original Est. Bootstrap Mean Bootstrap SD T Stat. 2.5% CI
## REP  ->  SEC             0.247          0.244        0.058   4.291   0.133
## INV  ->  SEC             0.181          0.186        0.059   3.064   0.065
## POL  ->  SEC             0.339          0.343        0.054   6.324   0.237
## FAML  ->  SEC            0.011          0.010        0.059   0.177  -0.109
## REP*POL  ->  SEC        -0.105         -0.023        0.125  -0.835  -0.196
## SEC  ->  TRUST           0.606          0.607        0.036  16.864   0.534
##                  97.5% CI
## REP  ->  SEC        0.351
## INV  ->  SEC        0.298
## POL  ->  SEC        0.443
## FAML  ->  SEC       0.121
## REP*POL  ->  SEC    0.189
## SEC  ->  TRUST      0.673
```

```
library(knitr)
kable(boot_paths[, c("T Stat.", "2.5% CI", "97.5% CI")])
```

	T Stat.	2.5% CI	97.5% CI
REP -> SEC	4.2914721	0.1325117	0.3505377
INV -> SEC	3.0640078	0.0650637	0.2978819

	T Stat.	2.5% CI	97.5% CI
POL -> SEC	6.3241035	0.2365280	0.4432797
FAML -> SEC	0.1768553	-0.1085740	0.1213585
REP*POL -> SEC	-0.8347361	-0.1958244	0.1894831
SEC -> TRUST	16.8640636	0.5342549	0.6727855

0.2 Question 2) Common-Factor Models using CB-SEM

0.2.1 a. Create a common factor model using SEMinR, with the following characteristics:

0.2.2 i. Either respecify all the constructs as being reflective(), or use the as.reflective() function to convert your earlier measurement model to being entirely reflective.

0.2.3 ii. Use the same structural model as before (you can just reuse it again!)

```
sec_cf_mm <- as.reflective(sec_mm)

sec_cf_pls <- estimate_cbsem(
data = sec,
measurement_model = sec_cf_mm,
structural_model = sec_sm
)
```

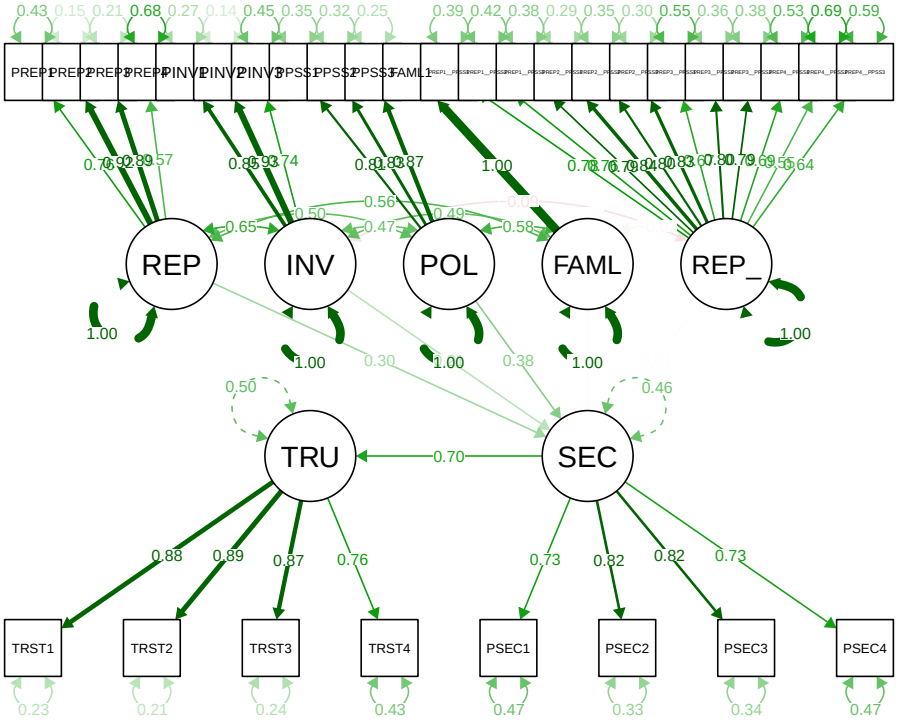
```
## Generating the seminr model for CBSEM
```

0.2.4 b. Show us the following results in table or figure formats

0.2.5 i. Plot a figure of the estimated model (it will look different from your PLS model!)

```
plot(sec_cf_pls)
```

```
## Plotting of lavaan models using semPlot.
```




```
## NULL
```

0.2.6 ii. Loadings of composites

```
summary(sec_cf_pls)$loadings
```

```
## $coefficients
##           TRUST       SEC       REP       INV       POL FAML
## TRST1 0.8800240        NA        NA        NA        NA   NA
## TRST2 0.8886342        NA        NA        NA        NA   NA
## TRST3 0.8690644        NA        NA        NA        NA   NA
## TRST4 0.7575988        NA        NA        NA        NA   NA
## PSEC1        NA 0.7308766        NA        NA        NA   NA
## PSEC2        NA 0.8173481        NA        NA        NA   NA
## PSEC3        NA 0.8151708        NA        NA        NA   NA
## PSEC4        NA 0.7260444        NA        NA        NA   NA
## PREP1        NA        NA 0.7551328        NA        NA   NA
## PREP2        NA        NA 0.9199208        NA        NA   NA
## PREP3        NA        NA 0.8871362        NA        NA   NA
## PREP4        NA        NA 0.5650059        NA        NA   NA
## PINV1        NA        NA        NA 0.8520004        NA   NA
## PINV2        NA        NA        NA 0.9257476        NA   NA
## PINV3        NA        NA        NA 0.7388750        NA   NA
```

```
## PPSS1        NA        NA        NA        NA 0.8051533   NA
## PPSS2        NA        NA        NA        NA 0.8272576   NA
## PPSS3        NA        NA        NA        NA 0.8674335   NA
## FAML1        NA        NA        NA        NA        NA    1
##
## $significance
##                              Std Estimate         SE      t-Value   2.5% CI
## TRUST -> TRST1                  0.8800240 0.02272091 0.000000e+00 0.8354919
## TRUST -> TRST2                  0.8886342 0.03330783 0.000000e+00 0.8233521
## TRUST -> TRST3                  0.8690644 0.03749444 0.000000e+00 0.7955767
## TRUST -> TRST4                  0.7575988 0.04846748 0.000000e+00 0.6626042
## SEC -> PSEC1                    0.7308766 0.03679205 0.000000e+00 0.6587655
## SEC -> PSEC2                    0.8173481 0.04480183 0.000000e+00 0.7295381
## SEC -> PSEC3                    0.8151708 0.03728082 0.000000e+00 0.7421017
## SEC -> PSEC4                    0.7260444 0.03811841 0.000000e+00 0.6513337
## REP -> PREP1                    0.7551328 0.04464916 0.000000e+00 0.6676220
## REP -> PREP2                    0.9199208 0.02635333 0.000000e+00 0.8682692
## REP -> PREP3                    0.8871362 0.04015103 0.000000e+00 0.8084416
## REP -> PREP4                    0.5650059 0.04585583 0.000000e+00 0.4751302
## INV -> PINV1                    0.8520004 0.04489927 0.000000e+00 0.7639994
## INV -> PINV2                    0.9257476 0.04556425 0.000000e+00 0.8364433
## INV -> PINV3                    0.7388750 0.04511601 0.000000e+00 0.6504492
## POL -> PPSS1                    0.8051533 0.04355300 0.000000e+00 0.7197910
## POL -> PPSS2                    0.8272576 0.02807169 0.000000e+00 0.7722381
## POL -> PPSS3                    0.8674335 0.03273664 0.000000e+00 0.8032708
## FAML -> FAML1                   1.0000000 0.00000000           NA 1.0000000
## REP_x_POL -> PREP1_x_PPSS1      0.7781584 0.05799871 0.000000e+00 0.6644831
## REP_x_POL -> PREP1_x_PPSS2      0.7597768 0.05931838 0.000000e+00 0.6435149
## REP_x_POL -> PREP1_x_PPSS3      0.7879106 0.05013554 0.000000e+00 0.6896467
## REP_x_POL -> PREP2_x_PPSS1      0.8447368 0.03649041 0.000000e+00 0.7732169
## REP_x_POL -> PREP2_x_PPSS2      0.8034561 0.03639411 0.000000e+00 0.7321250
## REP_x_POL -> PREP2_x_PPSS3      0.8342444 0.03536430 0.000000e+00 0.7649317
## REP_x_POL -> PREP3_x_PPSS1      0.6736451 0.12948898 1.967997e-07 0.4198514
## REP_x_POL -> PREP3_x_PPSS2      0.8011944 0.03780427 0.000000e+00 0.7270994
## REP_x_POL -> PREP3_x_PPSS3      0.7902063 0.06416741 0.000000e+00 0.6644405
## REP_x_POL -> PREP4_x_PPSS1      0.6854770 0.06906812 0.000000e+00 0.5501059
## REP_x_POL -> PREP4_x_PPSS2      0.5531922 0.06212434 0.000000e+00 0.4314307
## REP_x_POL -> PREP4_x_PPSS3      0.6405843 0.05794029 0.000000e+00 0.5270234
##                               97.5% CI
## TRUST -> TRST1               0.9245562
## TRUST -> TRST2               0.9539164
## TRUST -> TRST3               0.9425522
## TRUST -> TRST4               0.8525933
## SEC -> PSEC1                 0.8029877
## SEC -> PSEC2                 0.9051581
## SEC -> PSEC3                 0.8882399
## SEC -> PSEC4                 0.8007551
## REP -> PREP1                 0.8426435
## REP -> PREP2                 0.9715724
## REP -> PREP3                 0.9658307
## REP -> PREP4                 0.6548817
## INV -> PINV1                 0.9400013
## INV -> PINV2                 1.0150518
## INV -> PINV3                 0.8273007
```

```
## POL -> PPSS1                0.8905156
## POL -> PPSS2                0.8822771
## POL -> PPSS3                0.9315961
## FAML -> FAML1               1.0000000
## REP_x_POL -> PREP1_x_PPSS1 0.8918338
## REP_x_POL -> PREP1_x_PPSS2 0.8760387
## REP_x_POL -> PREP1_x_PPSS3 0.8861744
## REP_x_POL -> PREP2_x_PPSS1 0.9162567
## REP_x_POL -> PREP2_x_PPSS2 0.8747873
## REP_x_POL -> PREP2_x_PPSS3 0.9035572
## REP_x_POL -> PREP3_x_PPSS1 0.9274389
## REP_x_POL -> PREP3_x_PPSS2 0.8752894
## REP_x_POL -> PREP3_x_PPSS3 0.9159721
## REP_x_POL -> PREP4_x_PPSS1 0.8208480
## REP_x_POL -> PREP4_x_PPSS2 0.6749536
## REP_x_POL -> PREP4_x_PPSS3 0.7541452
```

0.2.7 iii. Regression coefficients of paths between factors, and their p-values

```
# Regression coefficients
summary(sec_cf_pls)$paths$coefficients
```

```
##                    SEC     TRUST
## R^2        0.540381651 0.4951084
## REP        0.299536782        NA
## INV        0.214253245        NA
## POL        0.376401499        NA
## FAML      -0.008837653        NA
## REP_x_POL  0.008355287        NA
## SEC                 NA 0.7036394
```

```
# P-values
summary(sec_cf_pls)$paths$pvalues
```

```
##                     SEC TRUST
## REP       3.817182e-05    NA
## INV       3.534482e-03    NA
## POL       4.380975e-09    NA
## FAML      8.996836e-01    NA
## REP_x_POL 8.516847e-01    NA
## SEC                 NA     0
```