BACS_HW_Week16_106071041

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Question 1 | Composite Path Models using PLS-PM

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

a. Create a PLS model with specific characteristics

i. Measurement Model

```
# Measurement Model
sec_intxn_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 = "INV", method = orthogonal)
)
```

ii. Strutural Model

```
# Structural Model
sec_intxn_sm <- relationships(
  paths(from = c("REP", "INV", "POL", "FAML", "REP*INV"), to = "SEC"),
  paths(from = "SEC", to = "TRUST")
)
```
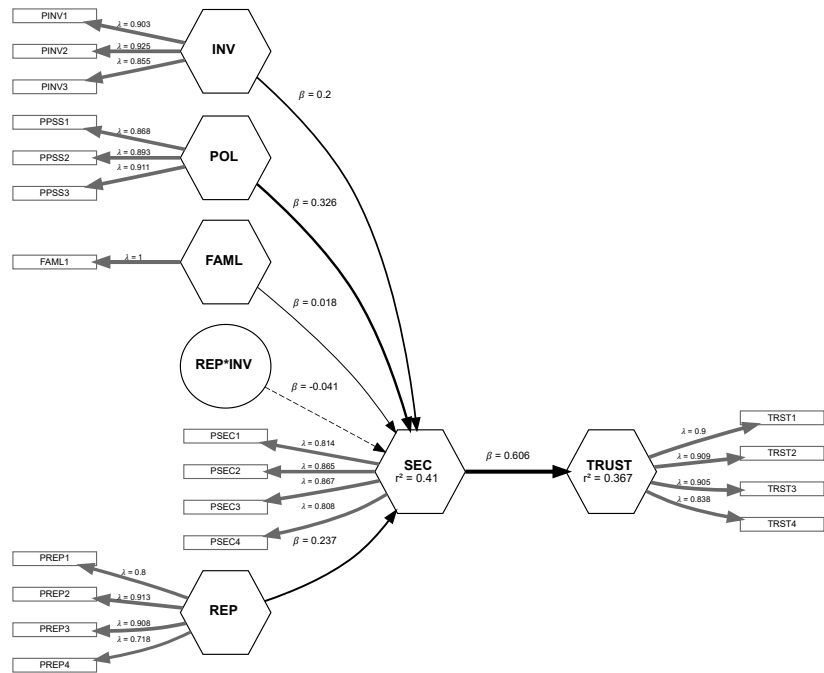
b. Show the following results

```
sec_intxn_pls <- estimate_pls(data = sec,
                         measurement_model = sec_intxn_mm,
                         structural_model = sec_intxn_sm
)
```

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

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

i. Plot a figure of the estimated model

```
plot(sec_intxn_pls)
```

ii. Weights and loadings of composites

```
sec_report <- summary(sec_intxn_pls)
```

```
# Weights
sec_report$weights
```

```
##                 REP   INV   POL  FAML REP*INV   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 0.279 0.000
## PSEC2         0.000 0.000 0.000 0.000   0.000 0.313 0.000
## PSEC3         0.000 0.000 0.000 0.000   0.000 0.306 0.000
## PSEC4         0.000 0.000 0.000 0.000   0.000 0.293 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 0.359 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*PINV1   0.000 0.000 0.000 0.000   0.196 0.000 0.000
## PREP1*PINV2   0.000 0.000 0.000 0.000   0.124 0.000 0.000
## PREP1*PINV3   0.000 0.000 0.000 0.000   0.125 0.000 0.000
## PREP2*PINV1   0.000 0.000 0.000 0.000   0.053 0.000 0.000
## PREP2*PINV2   0.000 0.000 0.000 0.000   0.066 0.000 0.000
## PREP2*PINV3   0.000 0.000 0.000 0.000   0.083 0.000 0.000
## PREP3*PINV1   0.000 0.000 0.000 0.000   0.139 0.000 0.000
## PREP3*PINV2   0.000 0.000 0.000 0.000   0.147 0.000 0.000
## PREP3*PINV3   0.000 0.000 0.000 0.000   0.089 0.000 0.000
## PREP4*PINV1   0.000 0.000 0.000 0.000   0.065 0.000 0.000
## PREP4*PINV2   0.000 0.000 0.000 0.000   0.109 0.000 0.000
## PREP4*PINV3   0.000 0.000 0.000 0.000   0.068 0.000 0.000
```

```
# Loadings
sec_report$loadings
```

```
##               REP    INV    POL   FAML REP*INV    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  0.814  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  0.867  0.000
## PSEC4       0.000  0.000  0.000  0.000  -0.000  0.808  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*PINV1 -0.000 -0.000 -0.000  0.000   0.933 -0.000 -0.000
## PREP1*PINV2 -0.000 -0.000 -0.000  0.000   0.786 -0.000 -0.000
## PREP1*PINV3  0.000  0.000 -0.000  0.000   0.828 -0.000 -0.000
## PREP2*PINV1 -0.000 -0.000 -0.000  0.000   0.942 -0.000  0.000
## PREP2*PINV2  0.000  0.000 -0.000 -0.000   0.982 -0.000  0.000
## PREP2*PINV3  0.000  0.000 -0.000 -0.000   0.954 -0.000  0.000
## PREP3*PINV1 -0.000 -0.000 -0.000 -0.000   0.978 -0.000 -0.000
## PREP3*PINV2 -0.000 -0.000 -0.000 -0.000   0.978 -0.000 -0.000
## PREP3*PINV3  0.000  0.000 -0.000 -0.000   0.935 -0.000  0.000
## PREP4*PINV1  0.000  0.000 -0.000 -0.000   0.822 -0.000  0.000
## PREP4*PINV2  0.000  0.000 -0.000 -0.000   0.881 -0.000  0.000
## PREP4*PINV3 -0.000 -0.000 -0.000  0.000   0.723 -0.000  0.000
```

iii. Regression coefficients of paths between factors

```
sec_report$paths
```

```
##              SEC TRUST
## R^2        0.410 0.367
## AdjR^2     0.403 0.365
## REP        0.237     .
## INV        0.200     .
## POL        0.326     .
## FAML       0.018     .
## REP*INV   -0.041     .
## SEC            . 0.606
```

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

```
boot_pls <- bootstrap_model(sec_intxn_pls, nboot = 1000)
```

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

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

```
summary(boot_pls)
```

```
##
## Results from Bootstrap resamples:  1000
##
## Bootstrapped Structural Paths:
##              Original Est. Bootstrap Mean Bootstrap SD T Stat. 2.5% CI
## REP  -> SEC          0.237          0.236        0.059   4.030   0.119
## INV  -> SEC          0.200          0.199        0.059   3.370   0.082
## POL  -> SEC          0.326          0.333        0.054   6.019   0.226
## FAML -> SEC          0.018          0.016        0.062   0.286  -0.102
## REP*INV -> SEC      -0.041         -0.050        0.046  -0.896  -0.119
## SEC  -> TRUST        0.606          0.608        0.035  17.173   0.536
##              97.5% CI
## REP  -> SEC     0.341
## INV  -> SEC     0.315
## POL  -> SEC     0.440
## FAML -> SEC     0.142
## REP*INV -> SEC  0.111
## SEC  -> TRUST   0.674
##
## Bootstrapped Weights:
##                   Original Est. Bootstrap Mean Bootstrap SD T Stat.
## TRST1 -> TRUST            0.282          0.282        0.015  18.607
## TRST2 -> TRUST            0.280          0.280        0.016  17.694
## TRST3 -> TRUST            0.286          0.285        0.016  18.164
## TRST4 -> TRUST            0.278          0.278        0.020  13.891
## PSEC1 -> SEC              0.279          0.278        0.016  17.872
## PSEC2 -> SEC              0.313          0.313        0.017  18.591
## PSEC3 -> SEC              0.306          0.306        0.016  18.941
## PSEC4 -> SEC              0.293          0.293        0.018  16.415
## PREP1 -> REP              0.215          0.215        0.027   7.899
## PREP2 -> REP              0.334          0.333        0.019  17.299
## PREP3 -> REP              0.349          0.348        0.022  15.957
## PREP4 -> REP              0.287          0.286        0.026  11.144
## PINV1 -> INV              0.363          0.362        0.025  14.804
## PINV2 -> INV              0.395          0.395        0.025  15.730
## PINV3 -> INV              0.359          0.359        0.028  12.819
## PPSS1 -> POL              0.360          0.360        0.023  15.731
## PPSS2 -> POL              0.395          0.396        0.023  17.135
## PPSS3 -> POL              0.367          0.367        0.020  18.767
## FAML1 -> FAML             1.000          1.000        0.000       .
## PREP1*PINV1 -> REP*INV    0.196          0.205        0.185   1.057
## PREP1*PINV2 -> REP*INV    0.124          0.132        0.142   0.872
## PREP1*PINV3 -> REP*INV    0.125          0.139        0.117   1.075
## PREP2*PINV1 -> REP*INV    0.053          0.040        0.118   0.448
## PREP2*PINV2 -> REP*INV    0.066          0.045        0.114   0.581
## PREP2*PINV3 -> REP*INV    0.083          0.076        0.086   0.973
## PREP3*PINV1 -> REP*INV    0.139          0.121        0.101   1.379
## PREP3*PINV2 -> REP*INV    0.147          0.119        0.110   1.340
## PREP3*PINV3 -> REP*INV    0.089          0.076        0.105   0.849
## PREP4*PINV1 -> REP*INV    0.065          0.053        0.113   0.575
## PREP4*PINV2 -> REP*INV    0.109          0.089        0.100   1.093
## PREP4*PINV3 -> REP*INV    0.068          0.069        0.095   0.716
##                    2.5% CI 97.5% CI
## TRST1 -> TRUST       0.252    0.313
## TRST2 -> TRUST       0.250    0.312
## TRST3 -> TRUST       0.253    0.315
## TRST4 -> TRUST       0.238    0.318
## PSEC1 -> SEC         0.249    0.309
## PSEC2 -> SEC         0.279    0.347
## PSEC3 -> SEC         0.277    0.339
## PSEC4 -> SEC         0.260    0.331
## PREP1 -> REP         0.155    0.263
## PREP2 -> REP         0.300    0.375
## PREP3 -> REP         0.307    0.392
## PREP4 -> REP         0.240    0.337
## PINV1 -> INV         0.314    0.414
## PINV2 -> INV         0.345    0.441
## PINV3 -> INV         0.307    0.416
## PPSS1 -> POL         0.314    0.401
## PPSS2 -> POL         0.356    0.446
## PPSS3 -> POL         0.328    0.406
## FAML1 -> FAML        1.000    1.000
## PREP1*PINV1 -> REP*INV -0.300    0.627
## PREP1*PINV2 -> REP*INV -0.177    0.446
## PREP1*PINV3 -> REP*INV -0.091    0.408
## PREP2*PINV1 -> REP*INV -0.251    0.230
## PREP2*PINV2 -> REP*INV -0.242    0.216
## PREP2*PINV3 -> REP*INV -0.137    0.226
## PREP3*PINV1 -> REP*INV -0.096    0.287
## PREP3*PINV2 -> REP*INV -0.183    0.302
## PREP3*PINV3 -> REP*INV -0.200    0.259
## PREP4*PINV1 -> REP*INV -0.223    0.266
```

```
## PREP4*PINV2 -> REP*INV -0.174    0.262
## PREP4*PINV3 -> REP*INV -0.119    0.260
##
## Bootstrapped Loadings:
##                      Original Est. Bootstrap Mean Bootstrap SD T Stat.
## TRST1 -> TRUST              0.900          0.900        0.015  58.295
## TRST2 -> TRUST              0.909          0.910        0.020  45.920
## TRST3 -> TRUST              0.905          0.905        0.021  42.327
## TRST4 -> TRUST              0.838          0.840        0.031  26.866
## PSEC1 -> SEC                0.814          0.814        0.025  32.196
## PSEC2 -> SEC                0.865          0.864        0.025  35.032
## PSEC3 -> SEC                0.867          0.868        0.021  41.109
## PSEC4 -> SEC                0.808          0.808        0.025  32.566
## PREP1 -> REP                0.800          0.800        0.040  20.180
## PREP2 -> REP                0.913          0.914        0.016  57.464
## PREP3 -> REP                0.908          0.909        0.020  46.094
## PREP4 -> REP                0.718          0.718        0.033  21.606
## PINV1 -> INV                0.903          0.903        0.025  36.024
## PINV2 -> INV                0.925          0.925        0.021  43.181
## PINV3 -> INV                0.855          0.856        0.026  32.844
## PPSS1 -> POL                0.868          0.866        0.025  34.424
## PPSS2 -> POL                0.893          0.894        0.014  65.495
## PPSS3 -> POL                0.911          0.910        0.017  53.911
## FAML1 -> FAML               1.000          1.000        0.000       .
## PREP1*PINV1 -> REP*INV      0.933          0.870        0.197   4.739
## PREP1*PINV2 -> REP*INV      0.786          0.760        0.229   3.428
## PREP1*PINV3 -> REP*INV      0.828          0.780        0.212   3.909
## PREP2*PINV1 -> REP*INV      0.942          0.848        0.198   4.756
## PREP2*PINV2 -> REP*INV      0.982          0.883        0.209   4.707
## PREP2*PINV3 -> REP*INV      0.954          0.861        0.210   4.551
## PREP3*PINV1 -> REP*INV      0.978          0.888        0.194   5.031
## PREP3*PINV2 -> REP*INV      0.978          0.890        0.206   4.758
## PREP3*PINV3 -> REP*INV      0.935          0.846        0.215   4.348
## PREP4*PINV1 -> REP*INV      0.822          0.742        0.197   4.166
## PREP4*PINV2 -> REP*INV      0.881          0.795        0.198   4.441
## PREP4*PINV3 -> REP*INV      0.723          0.655        0.188   3.850
##                      2.5% CI 97.5% CI
## TRST1 -> TRUST         0.867    0.927
## TRST2 -> TRUST         0.869    0.942
## TRST3 -> TRUST         0.854    0.940
## TRST4 -> TRUST         0.772    0.893
## PSEC1 -> SEC           0.758    0.859
## PSEC2 -> SEC           0.810    0.906
## PSEC3 -> SEC           0.823    0.906
## PSEC4 -> SEC           0.756    0.853
## PREP1 -> REP           0.712    0.867
## PREP2 -> REP           0.879    0.942
## PREP3 -> REP           0.866    0.941
## PREP4 -> REP           0.650    0.778
## PINV1 -> INV           0.845    0.946
## PINV2 -> INV           0.879    0.960
## PINV3 -> INV           0.799    0.901
## PPSS1 -> POL           0.807    0.906
## PPSS2 -> POL           0.867    0.918
## PPSS3 -> POL           0.873    0.937
## FAML1 -> FAML          1.000    1.000
## PREP1*PINV1 -> REP*INV 0.280    1.093
## PREP1*PINV2 -> REP*INV 0.175    1.077
## PREP1*PINV3 -> REP*INV 0.168    1.059
## PREP2*PINV1 -> REP*INV 0.242    1.085
## PREP2*PINV2 -> REP*INV 0.244    1.108
## PREP2*PINV3 -> REP*INV 0.181    1.085
## PREP3*PINV1 -> REP*INV 0.293    1.108
## PREP3*PINV2 -> REP*INV 0.235    1.101
## PREP3*PINV3 -> REP*INV 0.128    1.073
## PREP4*PINV1 -> REP*INV 0.174    0.996
## PREP4*PINV2 -> REP*INV 0.195    1.025
## PREP4*PINV3 -> REP*INV 0.168    0.912
##
## Bootstrapped HTMT:
##                Original Est. Bootstrap Mean Bootstrap SD 2.5% CI 97.5% CI
## REP  -> INV           0.705          0.702        0.050   0.598    0.791
## REP  -> POL           0.543          0.542        0.059   0.421    0.652
## REP  -> FAML          0.599          0.599        0.056   0.483    0.699
## REP  -> REP*INV       0.000          0.000        0.000   0.000    0.000
## REP  -> SEC           0.595          0.593        0.045   0.496    0.674
## REP  -> TRUST         0.682          0.680        0.044   0.586    0.761
## INV  -> POL           0.498          0.500        0.057   0.390    0.607
## INV  -> FAML          0.494          0.492        0.056   0.382    0.599
## INV  -> REP*INV       0.000          0.000        0.000   0.000    0.000
## INV  -> SEC           0.568          0.566        0.048   0.465    0.655
## INV  -> TRUST         0.563          0.562        0.050   0.467    0.658
## POL  -> FAML          0.596          0.595        0.051   0.488    0.688
```

```
## POL    ->  REP*INV         0.113         0.123         0.040  0.061   0.216
## POL    ->  SEC             0.622         0.625         0.053  0.519   0.722
## POL    ->  TRUST           0.458         0.459         0.058  0.337   0.570
## FAML   ->  REP*INV         0.036         0.059         0.023  0.027   0.116
## FAML   ->  SEC             0.455         0.453         0.053  0.345   0.552
## FAML   ->  TRUST           0.471         0.470         0.053  0.366   0.575
## REP*INV ->  SEC            0.081         0.090         0.028  0.048   0.154
## REP*INV ->  TRUST          0.056         0.076         0.017  0.048   0.113
## SEC    ->  TRUST           0.685         0.684         0.037  0.610   0.750
##
## Bootstrapped Total Paths:
##               Original Est. Bootstrap Mean Bootstrap SD 2.5% CI 97.5% CI
## REP    ->  SEC             0.237         0.236         0.059  0.119   0.341
## REP    ->  TRUST           0.144         0.144         0.038  0.072   0.216
## INV    ->  SEC             0.200         0.199         0.059  0.082   0.315
## INV    ->  TRUST           0.121         0.121         0.037  0.047   0.192
## POL    ->  SEC             0.326         0.333         0.054  0.226   0.440
## POL    ->  TRUST           0.197         0.202         0.036  0.134   0.274
## FAML   ->  SEC             0.018         0.016         0.062 -0.102   0.142
## FAML   ->  TRUST           0.011         0.010         0.038 -0.061   0.087
## REP*INV ->  SEC           -0.041        -0.050         0.046 -0.119   0.111
## REP*INV ->  TRUST         -0.025        -0.030         0.028 -0.073   0.068
## SEC    ->  TRUST           0.606         0.608         0.035  0.536   0.674
```

Question 2 | Common-Factor Models using CB-SEM

a. Create a common factor model with specific characteristics

i. Measurement Model

```
# Measurement Model
sec_cf_mm <- constructs(
  reflective("TRUST", multi_items("TRST", 1:4)),
  reflective("SEC", multi_items("PSEC", 1:4)),
  reflective("REP", multi_items("PREP", 1:4)),
  reflective("INV", multi_items("PINV", 1:3)),
  reflective("POL", multi_items("PPSS", 1:3)),
  reflective("FAML", single_item("FAML1")),
  interaction_term(iv = "REP", moderator = "INV", method = orthogonal)
)
```

ii. Structural Model

```
# Structural Model
sec_cf_sm <- relationships(
  paths(from = c("REP", "INV", "POL", "FAML", "REP*INV"), to = "SEC"),
  paths(from = "SEC", to = "TRUST")
)
```
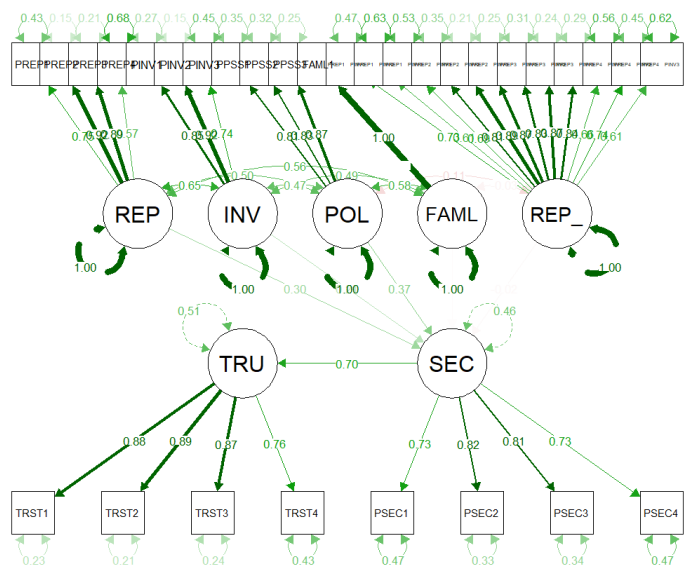
b. Show the following results

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

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

i. Plot a figure of the estimated model

```
plot(sec_cf_pls)
```

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

```
## NULL
```

ii. Loadings of composites

```
sec_cf_report <- summary(sec_cf_pls)
```

```
sec_cf_report$loadings
```

```
##            TRUST       SEC       REP       INV       POL FAML
## TRST1  0.8799615        NA        NA        NA        NA   NA
## TRST2  0.8886292        NA        NA        NA        NA   NA
## TRST3  0.8691222        NA        NA        NA        NA   NA
## TRST4  0.7576208        NA        NA        NA        NA   NA
## PSEC1         NA 0.7310608        NA        NA        NA   NA
## PSEC2         NA 0.8177947        NA        NA        NA   NA
## PSEC3         NA 0.8149511        NA        NA        NA   NA
## PSEC4         NA 0.7258615        NA        NA        NA   NA
## PREP1         NA        NA 0.7549368        NA        NA   NA
## PREP2         NA        NA 0.9199005        NA        NA   NA
## PREP3         NA        NA 0.8872517        NA        NA   NA
## PREP4         NA        NA 0.5650606        NA        NA   NA
## PINV1         NA        NA        NA 0.8543652        NA   NA
## PINV2         NA        NA        NA 0.9229589        NA   NA
## PINV3         NA        NA        NA 0.7401577        NA   NA
## PPSS1         NA        NA        NA        NA 0.8073277   NA
## PPSS2         NA        NA        NA        NA 0.8252803   NA
## PPSS3         NA        NA        NA        NA 0.8672083   NA
## FAML1         NA        NA        NA        NA        NA    1
```

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

```
sec_cf_report$paths
```

```
## $coefficients
##                    SEC     TRUST
## R^2       0.540610045 0.4946551
## REP       0.300978232        NA
## INV       0.214436466        NA
## POL       0.372316364        NA
## FAML     -0.008638191        NA
## REP_x_INV -0.022641595       NA
## SEC                NA 0.7033172
##
## $pvalues
##                   SEC TRUST
## REP       2.578779e-05    NA
## INV       3.803286e-03    NA
## POL       6.934418e-09    NA
## FAML      9.012472e-01    NA
## REP_x_INV 5.770046e-01    NA
## SEC                 NA     0
```

```
## $coefficients
##                    SEC     TRUST
## R^2       0.540610045 0.4946551
## REP       0.300978232        NA
## INV       0.214436466        NA
## POL       0.372316364        NA
## FAML     -0.008638191        NA
## REP_x_INV -0.022641595       NA
## SEC                NA 0.7033172
```