mediation_example

```
library(dplyr)
```

```
Warning: package 'dplyr' was built under R version 4.3.3
```

```
Attaching package: 'dplyr'
```

```
The following objects are masked from 'package:stats':

    filter, lag
```

```
The following objects are masked from 'package:base':

    intersect, setdiff, setequal, union
```

```
library(knitr)
```

```
Warning: package 'knitr' was built under R version 4.3.3
```

```
library(MASS)
```

```
Attaching package: 'MASS'
```

```
The following object is masked from 'package:dplyr':

    select
```

```r
library(parallel)
```

Creating R square mediated function

```r
rsquare_med <- function(data, x, m, y) {
  # Compute correlations among the variables
  rxm <- cor(data[x], data[[m]])
  rxy <- cor(data[[x]], data[[y]])
  rmy <- cor(data[[m]], data[[y]])

  # Regression: m ~ x (to get alpha, first indirect path)
  # Equation 2 in Fairchild, et al
  model1 <- lm(as.formula(paste(m, "~", x)), data = data)
  alpha <- coef(model1)[[x]]

  # Regression: y ~ x + m (to get 'tau_prime' and 'beta')
  # Equation 1 in Fairchild, et al
  model2 <- lm(as.formula(paste(y, "~", x, "+", m)), data = data)

  tau_prime <- coef(model2)[[x]]
  beta <- coef(model2)[[m]]

  # Compute total effect of x on y: tau = tau_prime + (alpha*beta)
  total <- tau_prime + (alpha*beta)


  # Compute effect-size measures
  mediatedeffect <- alpha * beta       # Indirect effect of x on y via M = alpha*beta
  rxmsquared <- rxm^2                  # squared correlation between x and m
  partialrxy_msquared <- ((rxy - rmy * rxm) / sqrt((1 - rmy^2) * (1 - rxmsquared)))^2
  partialrmy_xsquared <- ((rmy - rxy * rxm) / sqrt((1 - rxy^2) * (1 - rxmsquared)))^2
  overallrsquared <- (((rxy^2) + (rmy^2)) - (2 * rxy * rmy * rxm)) / (1 - rxmsquared)
  rsquaredmediated <- (rmy^2) - (overallrsquared - (rxy^2))

  # Create a list of results
  results <- list(
    alpha = alpha,
    beta = beta,
    tau_prime = tau_prime,
    total = total,
```

```
    mediatedeffect = mediatedeffect,
    rxm = rxm,
    rxmsquared = rxmsquared,
    rxy = rxy,
    rmy = rmy,
    partialrxy_msquared = partialrxy_msquared,
    partialrmy_xsquared = partialrmy_xsquared,
    overallrsquared = overallrsquared,
    rsquaredmediated = rsquaredmediated
  )

  return(results)
}
```

Set up the simulation parameters.

```
sample_sizes <- c(50, 100, 200, 500, 1000)
effect_sizes <- c(0.00, 0.14, 0.39, 0.59)  # Null, small, medium, large

# Containing all the conditions
df_params <- expand.grid(
  N = sample_sizes,
  pop_alpha = effect_sizes,
  pop_beta = effect_sizes,
  pop_tau_prime = effect_sizes)
num_reps <- 1000  # Number of replications per condition

# Making some fake data to feed to lavaan
d_fake <-
  data.frame(x = rnorm(sample_sizes),
                m = rnorm(sample_sizes),
                y = rnorm(sample_sizes))
```

```
# Generate some random data (we change this to correct values later)
run_simulation <- function(
    pop_tau_prime = 0,
    pop_alpha    = 0,
    pop_beta     = 0,
    sample_sizes  = 50,
```

```
    num_reps = 10
) {

  # Generate the true values using lavaan
  # Create a lavaan model where all values are constrained to
  # the population values that we want to use
  dgf <- glue::glue("
  # Equation 1 from Fairchild et al., without error term
  y ~ {pop_tau_prime} * x + {pop_beta} * m

  # Equation 2 from Fairchild et al., without error term
  m ~ {pop_alpha} * x

  x ~~ 1 * x
  y ~~ 1 * y
  m ~~ 1 * m"
  )

  # Fit the model, and the implied covariance matrix is the
  # population covariance matrix
  fit <- lavaan::lavaan(model = dgf, data = d_fake)
  summary(fit)
  pop_cov <- lavaan::lavInspect(fit, "cov.all")

  # Using mvrnorm() with empirical = TRUE gives a data frame that
  # will reproduce the population covariance matrix.
  pop_data <-
    MASS::mvrnorm(
      n = sample_sizes,
      mu = c(0, 0, 0),
      Sigma = pop_cov,
      empirical = TRUE
    ) %>% as.data.frame()

  pop_results <- rsquare_med(data = pop_data, x = "x", m = "m", y = "y" ) %>%
    as.data.frame() %>%
    t() %>%
    as.data.frame() %>%
    tibble::rownames_to_column("parameter")
```

```r
  sim_results <- lapply(1:num_reps, function(x) {
    # changing empirical to FALSE means we get a sample

    sim_results_df <-
      sample_data <-
      MASS::mvrnorm(
        n = sample_sizes,
        mu = c(0, 0, 0),
        Sigma = pop_cov,
        empirical = FALSE
      ) %>% as.data.frame()

    sample_results <- rsquare_med(data = sample_data, x = "x", m = "m", y = "y" ) %>%
      as.data.frame()
  }) %>%
    dplyr::bind_rows() %>%
    summarize(across(where(is.numeric), mean)) %>%
    t() %>%
    as.data.frame() %>%
    tibble::rownames_to_column("parameter")

  res_joined <-
    dplyr::full_join(pop_results, sim_results, by = "parameter") %>%
    purrr::set_names("parameter", "pop_r2_med", "sim_r2_med") %>%
    dplyr::mutate(bias = sim_r2_med - pop_r2_med) %>%
    dplyr::filter(parameter == "rsquaredmediated") %>%
    dplyr::mutate(
      pop_alpha = pop_alpha,
      pop_beta = pop_beta,
      pop_tau_prime = pop_tau_prime,
      n = sample_sizes
    ) %>%
    dplyr::select(
      pop_alpha, pop_beta, pop_tau_prime, n,
      pop_r2_med, sim_r2_med, bias
    )
}
```

Now run_simulation for every row in df_params

```
# Define the function to be applied to each row of df_params
sim_function <- function(params) {
  library(dplyr)

  if (params[["N"]] == 50) {
    print(params)
    print(Sys.time())
  }
  run_simulation(
    sample_sizes  = params[["N"]],
    pop_alpha = params[["pop_alpha"]],
    pop_beta = params[["pop_beta"]],
    pop_tau_prime = params[["pop_tau_prime"]],
    num_reps = 1000
  )
}

# Set up a cluster
cl <- makeCluster(detectCores() - 1)

# Export necessary variables and functions to the cluster
clusterExport(cl, c("df_params",
                    "run_simulation",
                    "sim_function",
                    "d_fake",
                    "rsquare_med"))

# Use parLapply to parallelize the apply function
sim_res <- parLapply(cl, 1:nrow(df_params), function(i) sim_function(df_params[i, ]))

# Stop the cluster after the computation is done
stopCluster(cl)


df_sim_res <- dplyr::bind_rows(sim_res)

knitr::kable(df_sim_res)
```

pop_alpha	pop_beta	pop_tau_prime	n	pop_r2_med	sim_r2_med	bias
0.00	0.00	0.00	50	0.0000000	-0.0001467	-0.0001467
0.00	0.00	0.00	100	0.0000000	0.0000476	0.0000476
0.00	0.00	0.00	200	0.0000000	-0.0000116	-0.0000116
0.00	0.00	0.00	500	0.0000000	0.0000021	0.0000021
0.00	0.00	0.00	1000	0.0000000	-0.0000015	-0.0000015
0.14	0.00	0.00	50	0.0000000	0.0000353	0.0000353
0.14	0.00	0.00	100	0.0000000	-0.0001132	-0.0001132
0.14	0.00	0.00	200	0.0000000	-0.0000075	-0.0000075
0.14	0.00	0.00	500	0.0000000	-0.0000260	-0.0000260
0.14	0.00	0.00	1000	0.0000000	0.0000065	0.0000065
0.39	0.00	0.00	50	0.0000000	-0.0006524	-0.0006524
0.39	0.00	0.00	100	0.0000000	0.0000767	0.0000767
0.39	0.00	0.00	200	0.0000000	0.0000147	0.0000147
0.39	0.00	0.00	500	0.0000000	-0.0000273	-0.0000273
0.39	0.00	0.00	1000	0.0000000	-0.0000272	-0.0000272
0.59	0.00	0.00	50	0.0000000	-0.0013317	-0.0013317
0.59	0.00	0.00	100	0.0000000	0.0002015	0.0002015
0.59	0.00	0.00	200	0.0000000	-0.0001211	-0.0001211
0.59	0.00	0.00	500	0.0000000	-0.0000862	-0.0000862
0.59	0.00	0.00	1000	0.0000000	0.0000190	0.0000190
0.00	0.14	0.00	50	0.0000000	0.0000806	0.0000806
0.00	0.14	0.00	100	0.0000000	0.0001681	0.0001681
0.00	0.14	0.00	200	0.0000000	0.0000627	0.0000627
0.00	0.14	0.00	500	0.0000000	-0.0000001	-0.0000001
0.00	0.14	0.00	1000	0.0000000	0.0000055	0.0000055
0.14	0.14	0.00	50	0.0003766	0.0011232	0.0007466
0.14	0.14	0.00	100	0.0003766	0.0002298	-0.0001468
0.14	0.14	0.00	200	0.0003766	0.0005672	0.0001906
0.14	0.14	0.00	500	0.0003766	0.0004477	0.0000710
0.14	0.14	0.00	1000	0.0003766	0.0003534	-0.0000233
0.39	0.14	0.00	50	0.0029153	0.0013332	-0.0015821
0.39	0.14	0.00	100	0.0029153	0.0034459	0.0005305
0.39	0.14	0.00	200	0.0029153	0.0028829	-0.0000325
0.39	0.14	0.00	500	0.0029153	0.0030362	0.0001209
0.39	0.14	0.00	1000	0.0029153	0.0030058	0.0000905
0.59	0.14	0.00	50	0.0066471	0.0069001	0.0002530
0.59	0.14	0.00	100	0.0066471	0.0058771	-0.0007700
0.59	0.14	0.00	200	0.0066471	0.0061500	-0.0004971
0.59	0.14	0.00	500	0.0066471	0.0070315	0.0003844
0.59	0.14	0.00	1000	0.0066471	0.0064435	-0.0002036
0.00	0.39	0.00	50	0.0000000	0.0024625	0.0024625

pop_alpha	pop_beta	pop_tau_prime	n	pop_r2_med	sim_r2_med	bias
0.00	0.39	0.00	100	0.0000000	0.0012575	0.0012575
0.00	0.39	0.00	200	0.0000000	0.0007078	0.0007078
0.00	0.39	0.00	500	0.0000000	0.0003308	0.0003308
0.00	0.39	0.00	1000	0.0000000	0.0001338	0.0001338
0.14	0.39	0.00	50	0.0025809	0.0069174	0.0043365
0.14	0.39	0.00	100	0.0025809	0.0038139	0.0012329
0.14	0.39	0.00	200	0.0025809	0.0036187	0.0010378
0.14	0.39	0.00	500	0.0025809	0.0028050	0.0002241
0.14	0.39	0.00	1000	0.0025809	0.0027364	0.0001555
0.39	0.39	0.00	50	0.0196849	0.0205782	0.0008932
0.39	0.39	0.00	100	0.0196849	0.0212383	0.0015533
0.39	0.39	0.00	200	0.0196849	0.0205699	0.0008850
0.39	0.39	0.00	500	0.0196849	0.0202100	0.0005250
0.39	0.39	0.00	1000	0.0196849	0.0201934	0.0005085
0.59	0.39	0.00	50	0.0439369	0.0449144	0.0009774
0.59	0.39	0.00	100	0.0439369	0.0446680	0.0007311
0.59	0.39	0.00	200	0.0439369	0.0437890	-0.0001479
0.59	0.39	0.00	500	0.0439369	0.0442977	0.0003608
0.59	0.39	0.00	1000	0.0439369	0.0438961	-0.0000408
0.00	0.59	0.00	50	0.0000000	0.0050117	0.0050117
0.00	0.59	0.00	100	0.0000000	0.0025415	0.0025415
0.00	0.59	0.00	200	0.0000000	0.0011148	0.0011148
0.00	0.59	0.00	500	0.0000000	0.0004503	0.0004503
0.00	0.59	0.00	1000	0.0000000	0.0002881	0.0002881
0.14	0.59	0.00	50	0.0050355	0.0103837	0.0053482
0.14	0.59	0.00	100	0.0050355	0.0075663	0.0025308
0.14	0.59	0.00	200	0.0050355	0.0063642	0.0013286
0.14	0.59	0.00	500	0.0050355	0.0055329	0.0004974
0.14	0.59	0.00	1000	0.0050355	0.0053004	0.0002649
0.39	0.59	0.00	50	0.0377903	0.0413018	0.0035115
0.39	0.59	0.00	100	0.0377903	0.0412935	0.0035032
0.39	0.59	0.00	200	0.0377903	0.0396831	0.0018928
0.39	0.59	0.00	500	0.0377903	0.0385411	0.0007507
0.39	0.59	0.00	1000	0.0377903	0.0371177	-0.0006726
0.59	0.59	0.00	50	0.0824718	0.0844556	0.0019838
0.59	0.59	0.00	100	0.0824718	0.0839633	0.0014915
0.59	0.59	0.00	200	0.0824718	0.0838518	0.0013800
0.59	0.59	0.00	500	0.0824718	0.0831618	0.0006900
0.59	0.59	0.00	1000	0.0824718	0.0833478	0.0008760
0.00	0.00	0.14	50	0.0000000	0.0003867	0.0003867
0.00	0.00	0.14	100	0.0000000	0.0001224	0.0001224

pop_alpha	pop_beta	pop_tau_prime	n	pop_r2_med	sim_r2_med	bias
0.00	0.00	0.14	200	0.0000000	0.0000611	0.0000611
0.00	0.00	0.14	500	0.0000000	0.0000483	0.0000483
0.00	0.00	0.14	1000	0.0000000	0.0000187	0.0000187
0.14	0.00	0.14	50	0.0003695	0.0000079	-0.0003617
0.14	0.00	0.14	100	0.0003695	0.0006735	0.0003039
0.14	0.00	0.14	200	0.0003695	0.0002822	-0.0000873
0.14	0.00	0.14	500	0.0003695	0.0004526	0.0000830
0.14	0.00	0.14	1000	0.0003695	0.0004359	0.0000664
0.39	0.00	0.14	50	0.0025378	0.0037919	0.0012540
0.39	0.00	0.14	100	0.0025378	0.0030441	0.0005063
0.39	0.00	0.14	200	0.0025378	0.0028771	0.0003392
0.39	0.00	0.14	500	0.0025378	0.0027552	0.0002173
0.39	0.00	0.14	1000	0.0025378	0.0026038	0.0000660
0.59	0.00	0.14	50	0.0049637	0.0071978	0.0022341
0.59	0.00	0.14	100	0.0049637	0.0053818	0.0004181
0.59	0.00	0.14	200	0.0049637	0.0055197	0.0005560
0.59	0.00	0.14	500	0.0049637	0.0052709	0.0003072
0.59	0.00	0.14	1000	0.0049637	0.0049700	0.0000063
0.00	0.14	0.14	50	0.0000000	0.0002834	0.0002834
0.00	0.14	0.14	100	0.0000000	0.0003049	0.0003049
0.00	0.14	0.14	200	0.0000000	-0.0000002	-0.0000002
0.00	0.14	0.14	500	0.0000000	0.0001317	0.0001317
0.00	0.14	0.14	1000	0.0000000	0.0000040	0.0000040
0.14	0.14	0.14	50	0.0059794	0.0065835	0.0006041
0.14	0.14	0.14	100	0.0059794	0.0062327	0.0002532
0.14	0.14	0.14	200	0.0059794	0.0057380	-0.0002414
0.14	0.14	0.14	500	0.0059794	0.0060198	0.0000403
0.14	0.14	0.14	1000	0.0059794	0.0060654	0.0000860
0.39	0.14	0.14	50	0.0197233	0.0187942	-0.0009291
0.39	0.14	0.14	100	0.0197233	0.0193492	-0.0003740
0.39	0.14	0.14	200	0.0197233	0.0197927	0.0000694
0.39	0.14	0.14	500	0.0197233	0.0199711	0.0002478
0.39	0.14	0.14	1000	0.0197233	0.0198554	0.0001321
0.59	0.14	0.14	50	0.0327473	0.0321978	-0.0005495
0.59	0.14	0.14	100	0.0327473	0.0333527	0.0006054
0.59	0.14	0.14	200	0.0327473	0.0318045	-0.0009428
0.59	0.14	0.14	500	0.0327473	0.0328091	0.0000618
0.59	0.14	0.14	1000	0.0327473	0.0329295	0.0001822
0.00	0.39	0.14	50	0.0000000	0.0018936	0.0018936
0.00	0.39	0.14	100	0.0000000	0.0019290	0.0019290
0.00	0.39	0.14	200	0.0000000	0.0008256	0.0008256

pop_alpha	pop_beta	pop_tau_prime	n	pop_r2_med	sim_r2_med	bias
0.00	0.39	0.14	500	0.0000000	0.0002166	0.0002166
0.00	0.39	0.14	1000	0.0000000	0.0003011	0.0003011
0.14	0.39	0.14	50	0.0156693	0.0171911	0.0015219
0.14	0.39	0.14	100	0.0156693	0.0169481	0.0012789
0.14	0.39	0.14	200	0.0156693	0.0161239	0.0004546
0.14	0.39	0.14	500	0.0156693	0.0155708	-0.0000985
0.14	0.39	0.14	1000	0.0156693	0.0155270	-0.0001422
0.39	0.39	0.14	50	0.0552035	0.0571989	0.0019955
0.39	0.39	0.14	100	0.0552035	0.0555166	0.0003132
0.39	0.39	0.14	200	0.0552035	0.0547451	-0.0004583
0.39	0.39	0.14	500	0.0552035	0.0551859	-0.0000175
0.39	0.39	0.14	1000	0.0552035	0.0550579	-0.0001455
0.59	0.39	0.14	50	0.0949791	0.0951806	0.0002016
0.59	0.39	0.14	100	0.0949791	0.0946790	-0.0003001
0.59	0.39	0.14	200	0.0949791	0.0962489	0.0012698
0.59	0.39	0.14	500	0.0949791	0.0952063	0.0002273
0.59	0.39	0.14	1000	0.0949791	0.0946480	-0.0003311
0.00	0.59	0.14	50	0.0000000	0.0042835	0.0042835
0.00	0.59	0.14	100	0.0000000	0.0018384	0.0018384
0.00	0.59	0.14	200	0.0000000	0.0012905	0.0012905
0.00	0.59	0.14	500	0.0000000	0.0003074	0.0003074
0.00	0.59	0.14	1000	0.0000000	0.0001376	0.0001376
0.14	0.59	0.14	50	0.0216989	0.0258942	0.0041953
0.14	0.59	0.14	100	0.0216989	0.0240471	0.0023482
0.14	0.59	0.14	200	0.0216989	0.0222774	0.0005784
0.14	0.59	0.14	500	0.0216989	0.0223740	0.0006750
0.14	0.59	0.14	1000	0.0216989	0.0218639	0.0001650
0.39	0.59	0.14	50	0.0807782	0.0838801	0.0031019
0.39	0.59	0.14	100	0.0807782	0.0809034	0.0001252
0.39	0.59	0.14	200	0.0807782	0.0804395	-0.0003387
0.39	0.59	0.14	500	0.0807782	0.0809920	0.0002138
0.39	0.59	0.14	1000	0.0807782	0.0806554	-0.0001228
0.59	0.59	0.14	50	0.1410179	0.1451950	0.0041770
0.59	0.59	0.14	100	0.1410179	0.1419313	0.0009133
0.59	0.59	0.14	200	0.1410179	0.1422135	0.0011956
0.59	0.59	0.14	500	0.1410179	0.1399760	-0.0010419
0.59	0.59	0.14	1000	0.1410179	0.1417755	0.0007576
0.00	0.00	0.39	50	0.0000000	0.0022003	0.0022003
0.00	0.00	0.39	100	0.0000000	0.0016355	0.0016355
0.00	0.00	0.39	200	0.0000000	0.0007236	0.0007236
0.00	0.00	0.39	500	0.0000000	0.0002709	0.0002709

pop_alpha	pop_beta	pop_tau_prime	n	pop_r2_med	sim_r2_med	bias
0.00	0.00	0.39	1000	0.0000000	0.0001063	0.0001063
0.14	0.00	0.39	50	0.0025378	0.0037389	0.0012011
0.14	0.00	0.39	100	0.0025378	0.0038597	0.0013219
0.14	0.00	0.39	200	0.0025378	0.0030495	0.0005116
0.14	0.00	0.39	500	0.0025378	0.0028473	0.0003094
0.14	0.00	0.39	1000	0.0025378	0.0025215	-0.0000163
0.39	0.00	0.39	50	0.0174292	0.0178763	0.0004471
0.39	0.00	0.39	100	0.0174292	0.0178647	0.0004355
0.39	0.00	0.39	200	0.0174292	0.0183096	0.0008804
0.39	0.00	0.39	500	0.0174292	0.0175030	0.0000737
0.39	0.00	0.39	1000	0.0174292	0.0177535	0.0003242
0.59	0.00	0.39	50	0.0340895	0.0339011	-0.0001885
0.59	0.00	0.39	100	0.0340895	0.0347271	0.0006376
0.59	0.00	0.39	200	0.0340895	0.0344496	0.0003601
0.59	0.00	0.39	500	0.0340895	0.0339983	-0.0000913
0.59	0.00	0.39	1000	0.0340895	0.0341140	0.0000244
0.00	0.14	0.39	50	0.0000000	0.0026418	0.0026418
0.00	0.14	0.39	100	0.0000000	0.0014399	0.0014399
0.00	0.14	0.39	200	0.0000000	0.0008814	0.0008814
0.00	0.14	0.39	500	0.0000000	0.0003203	0.0003203
0.00	0.14	0.39	1000	0.0000000	0.0000868	0.0000868
0.14	0.14	0.39	50	0.0156615	0.0160572	0.0003957
0.14	0.14	0.39	100	0.0156615	0.0160793	0.0004178
0.14	0.14	0.39	200	0.0156615	0.0159986	0.0003371
0.14	0.14	0.39	500	0.0156615	0.0155636	-0.0000979
0.14	0.14	0.39	1000	0.0156615	0.0159479	0.0002864
0.39	0.14	0.39	50	0.0539317	0.0541447	0.0002130
0.39	0.14	0.39	100	0.0539317	0.0535928	-0.0003388
0.39	0.14	0.39	200	0.0539317	0.0530945	-0.0008372
0.39	0.14	0.39	500	0.0539317	0.0539530	0.0000213
0.39	0.14	0.39	1000	0.0539317	0.0543094	0.0003777
0.59	0.14	0.39	50	0.0889217	0.0879641	-0.0009576
0.59	0.14	0.39	100	0.0889217	0.0886158	-0.0003059
0.59	0.14	0.39	200	0.0889217	0.0896028	0.0006811
0.59	0.14	0.39	500	0.0889217	0.0882288	-0.0006929
0.59	0.14	0.39	1000	0.0889217	0.0884207	-0.0005010
0.00	0.39	0.39	50	0.0000000	0.0021596	0.0021596
0.00	0.39	0.39	100	0.0000000	0.0013927	0.0013927
0.00	0.39	0.39	200	0.0000000	0.0009035	0.0009035
0.00	0.39	0.39	500	0.0000000	0.0005121	0.0005121
0.00	0.39	0.39	1000	0.0000000	-0.0000372	-0.0000372

pop_alpha	pop_beta	pop_tau_prime	n	pop_r2_med	sim_r2_med	bias
0.14	0.39	0.39	50	0.0359269	0.0392405	0.0033136
0.14	0.39	0.39	100	0.0359269	0.0363562	0.0004293
0.14	0.39	0.39	200	0.0359269	0.0365220	0.0005951
0.14	0.39	0.39	500	0.0359269	0.0369012	0.0009743
0.14	0.39	0.39	1000	0.0359269	0.0361660	0.0002391
0.39	0.39	0.39	50	0.1119334	0.1126404	0.0007070
0.39	0.39	0.39	100	0.1119334	0.1122555	0.0003221
0.39	0.39	0.39	200	0.1119334	0.1115049	-0.0004285
0.39	0.39	0.39	500	0.1119334	0.1108835	-0.0010500
0.39	0.39	0.39	1000	0.1119334	0.1125171	0.0005837
0.59	0.39	0.39	50	0.1768152	0.1721745	-0.0046407
0.59	0.39	0.39	100	0.1768152	0.1753200	-0.0014953
0.59	0.39	0.39	200	0.1768152	0.1768564	0.0000411
0.59	0.39	0.39	500	0.1768152	0.1767160	-0.0000992
0.59	0.39	0.39	1000	0.1768152	0.1766281	-0.0001872
0.00	0.59	0.39	50	0.0000000	0.0068179	0.0068179
0.00	0.59	0.39	100	0.0000000	0.0007711	0.0007711
0.00	0.59	0.39	200	0.0000000	0.0017305	0.0017305
0.00	0.59	0.39	500	0.0000000	0.0003811	0.0003811
0.00	0.59	0.39	1000	0.0000000	0.0000483	0.0000483
0.14	0.59	0.39	50	0.0472014	0.0508980	0.0036967
0.14	0.59	0.39	100	0.0472014	0.0482292	0.0010278
0.14	0.59	0.39	200	0.0472014	0.0498115	0.0026102
0.14	0.59	0.39	500	0.0472014	0.0475933	0.0003920
0.14	0.59	0.39	1000	0.0472014	0.0474645	0.0002631
0.39	0.59	0.39	50	0.1457352	0.1469831	0.0012480
0.39	0.59	0.39	100	0.1457352	0.1449077	-0.0008275
0.39	0.59	0.39	200	0.1457352	0.1452969	-0.0004382
0.39	0.59	0.39	500	0.1457352	0.1464097	0.0006745
0.39	0.59	0.39	1000	0.1457352	0.1455032	-0.0002320
0.59	0.59	0.39	50	0.2282044	0.2250634	-0.0031410
0.59	0.59	0.39	100	0.2282044	0.2281855	-0.0000189
0.59	0.59	0.39	200	0.2282044	0.2269607	-0.0012437
0.59	0.59	0.39	500	0.2282044	0.2284434	0.0002390
0.59	0.59	0.39	1000	0.2282044	0.2283824	0.0001780
0.00	0.00	0.59	50	0.0000000	0.0053916	0.0053916
0.00	0.00	0.59	100	0.0000000	0.0026659	0.0026659
0.00	0.00	0.59	200	0.0000000	0.0015103	0.0015103
0.00	0.00	0.59	500	0.0000000	0.0005483	0.0005483
0.00	0.00	0.59	1000	0.0000000	0.0002328	0.0002328
0.14	0.00	0.59	50	0.0049637	0.0091294	0.0041657

pop_alpha	pop_beta	pop_tau_prime	n	pop_r2_med	sim_r2_med	bias
0.14	0.00	0.59	100	0.0049637	0.0070976	0.0021339
0.14	0.00	0.59	200	0.0049637	0.0059808	0.0010171
0.14	0.00	0.59	500	0.0049637	0.0056087	0.0006450
0.14	0.00	0.59	1000	0.0049637	0.0049314	-0.0000324
0.39	0.00	0.59	50	0.0340895	0.0359609	0.0018713
0.39	0.00	0.59	100	0.0340895	0.0344644	0.0003748
0.39	0.00	0.59	200	0.0340895	0.0355512	0.0014616
0.39	0.00	0.59	500	0.0340895	0.0338820	-0.0002075
0.39	0.00	0.59	1000	0.0340895	0.0344292	0.0003396
0.59	0.00	0.59	50	0.0666751	0.0676445	0.0009694
0.59	0.00	0.59	100	0.0666751	0.0659741	-0.0007010
0.59	0.00	0.59	200	0.0666751	0.0675500	0.0008749
0.59	0.00	0.59	500	0.0666751	0.0670116	0.0003365
0.59	0.00	0.59	1000	0.0666751	0.0665785	-0.0000966
0.00	0.14	0.59	50	0.0000000	0.0044501	0.0044501
0.00	0.14	0.59	100	0.0000000	0.0028569	0.0028569
0.00	0.14	0.59	200	0.0000000	0.0010844	0.0010844
0.00	0.14	0.59	500	0.0000000	0.0003899	0.0003899
0.00	0.14	0.59	1000	0.0000000	0.0003747	0.0003747
0.14	0.14	0.59	50	0.0217104	0.0264153	0.0047049
0.14	0.14	0.59	100	0.0217104	0.0235851	0.0018747
0.14	0.14	0.59	200	0.0217104	0.0231370	0.0014266
0.14	0.14	0.59	500	0.0217104	0.0223824	0.0006720
0.14	0.14	0.59	1000	0.0217104	0.0219283	0.0002179
0.39	0.14	0.59	50	0.0789942	0.0798067	0.0008125
0.39	0.14	0.59	100	0.0789942	0.0808629	0.0018687
0.39	0.14	0.59	200	0.0789942	0.0799456	0.0009514
0.39	0.14	0.59	500	0.0789942	0.0795215	0.0005273
0.39	0.14	0.59	1000	0.0789942	0.0798345	0.0008404
0.59	0.14	0.59	50	0.1319135	0.1286557	-0.0032578
0.59	0.14	0.59	100	0.1319135	0.1303778	-0.0015357
0.59	0.14	0.59	200	0.1319135	0.1333726	0.0014591
0.59	0.14	0.59	500	0.1319135	0.1318107	-0.0001028
0.59	0.14	0.59	1000	0.1319135	0.1320558	0.0001423
0.00	0.39	0.59	50	0.0000000	0.0051109	0.0051109
0.00	0.39	0.59	100	0.0000000	0.0022565	0.0022565
0.00	0.39	0.59	200	0.0000000	0.0009411	0.0009411
0.00	0.39	0.59	500	0.0000000	0.0007258	0.0007258
0.00	0.39	0.59	1000	0.0000000	0.0001387	0.0001387
0.14	0.39	0.59	50	0.0472699	0.0499533	0.0026834
0.14	0.39	0.59	100	0.0472699	0.0512386	0.0039686

pop_alpha	pop_beta	pop_tau_prime	n	pop_r2_med	sim_r2_med	bias
0.14	0.39	0.59	200	0.0472699	0.0478967	0.0006268
0.14	0.39	0.59	500	0.0472699	0.0480940	0.0008241
0.14	0.39	0.59	1000	0.0472699	0.0471011	-0.0001688
0.39	0.39	0.59	50	0.1459753	0.1401486	-0.0058266
0.39	0.39	0.59	100	0.1459753	0.1464890	0.0005137
0.39	0.39	0.59	200	0.1459753	0.1435886	-0.0023867
0.39	0.39	0.59	500	0.1459753	0.1466230	0.0006478
0.39	0.39	0.59	1000	0.1459753	0.1458508	-0.0001245
0.59	0.39	0.59	50	0.2270822	0.2244030	-0.0026792
0.59	0.39	0.59	100	0.2270822	0.2252799	-0.0018023
0.59	0.39	0.59	200	0.2270822	0.2258591	-0.0012231
0.59	0.39	0.59	500	0.2270822	0.2267557	-0.0003266
0.59	0.39	0.59	1000	0.2270822	0.2267008	-0.0003814
0.00	0.59	0.59	50	0.0000000	0.0050542	0.0050542
0.00	0.59	0.59	100	0.0000000	0.0052595	0.0052595
0.00	0.59	0.59	200	0.0000000	0.0019803	0.0019803
0.00	0.59	0.59	500	0.0000000	0.0012128	0.0012128
0.00	0.59	0.59	1000	0.0000000	0.0004409	0.0004409
0.14	0.59	0.59	50	0.0616401	0.0655912	0.0039512
0.14	0.59	0.59	100	0.0616401	0.0627001	0.0010600
0.14	0.59	0.59	200	0.0616401	0.0627589	0.0011189
0.14	0.59	0.59	500	0.0616401	0.0612756	-0.0003645
0.14	0.59	0.59	1000	0.0616401	0.0619180	0.0002780
0.39	0.59	0.59	50	0.1833160	0.1808534	-0.0024627
0.39	0.59	0.59	100	0.1833160	0.1862689	0.0029529
0.39	0.59	0.59	200	0.1833160	0.1858288	0.0025127
0.39	0.59	0.59	500	0.1833160	0.1820741	-0.0012420
0.39	0.59	0.59	1000	0.1833160	0.1836455	0.0003295
0.59	0.59	0.59	50	0.2790752	0.2768343	-0.0022409
0.59	0.59	0.59	100	0.2790752	0.2745539	-0.0045213
0.59	0.59	0.59	200	0.2790752	0.2777040	-0.0013712
0.59	0.59	0.59	500	0.2790752	0.2761197	-0.0029555
0.59	0.59	0.59	1000	0.2790752	0.2789428	-0.0001324