Estimating Variance of Simple Defined Variable Main and Low-Order Interaction Effects

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```
knitr::opts_chunk$set(fig.width=15, fig.height=8)
```

```
rm(list=ls())
library(Matrix)
library(tidyverse)
library(ggplot2)
library(ggpubr)
library(ranger)
library(MixMatrix)
library(mvtnorm)
library(stringr)
library(parallel)

cores <- detectCores()
clust <- makeCluster(6)

source('C:/Users/feix_/iCloudDrive/Studium Master/CQM - Thesis Internship/Thesis-VariableEffects/Baseli

parallel::clusterEvalQ(clust,
                       expr = {source('C:/Users/feix_/iCloudDrive/Studium Master/CQM - Thesis Internshi
```

Simulation

```
n <- c(40, 400, 4000) ; num.trees <- 2000 ; repeats <- 150; cor <- c(0, 0.8)
k <- c(0.2, 1); node_size <- c(1); pdp <- F; ale <- F
formulas <- c("2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5")
longest_latex_formula <- "2x_1+4x_2-3x_3+2.2x_4-1.5x_5"




#parallel::clusterExport(cl = clust, varlist = 'formulas')
scenarios <- data.frame(expand.grid(n, num.trees, formulas, repeats,
cor, k, node_size, pdp, ale))
colnames(scenarios) = c("N", "N_Trees", "Formula", "Repeats",
"Correlation", "k", "Node_Size", "pdp", "ale")
scenarios$k_idx <- (scenarios$k == unique(scenarios$k)[1])
scenarios[,"Formula"] <- as.character(scenarios[,"Formula"]) ### Formula became Factor
scenarios["Longest_Latex_formula"] <- longest_latex_formula
```

```
scenarios <- split(scenarios, seq(nrow(scenarios)))
#Run Simulation
system.time(result <- parLapply(cl = clust,
                                X = scenarios,
                                fun = sim_multi))
```

```
##     user   system  elapsed
##     0.50     1.07 12735.10
```

```
if (!pdp | !ale) {
 print_results(result)
}
```

```
## Setting 1: N = 40 ; k = 0.2 N_Trees = 2000 ; Correlation = 0 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5
## Mean(s) of simulated RF Variable Effect(s):
##   1.217565 2.790033 -1.902225 1.375821 -0.8154653
## Mean(s) of simulated LM Variable Effect(s):
##   2.004803 4.015994 -3.025325 2.176777 -1.523452
## True Variable Effect(s):
##   2 4 -3 2.2 -1.5
## Standard Error of simulated Variable Effects (RF):
##   1.455096 2.006898 1.684165 1.423086 1.128102 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   1.4612 2.5558 1.902245 1.555293 1.13325 .
## Number of Smaller Nulls:
##   0 0 0 0 0
##
## Setting 2: N = 400 ; k = 0.2 N_Trees = 2000 ; Correlation = 0 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5
## Mean(s) of simulated RF Variable Effect(s):
##   1.562228 4.058901 -3.110447 1.918525 -1.064274
## Mean(s) of simulated LM Variable Effect(s):
##   1.99515 3.99199 -2.999605 2.201033 -1.499398
## True Variable Effect(s):
##   2 4 -3 2.2 -1.5
## Standard Error of simulated Variable Effects (RF):
##   0.8191169 1.741125 1.405067 0.905302 0.6835168 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.8251109 1.798984 1.474548 0.969633 0.6024378 .
## Number of Smaller Nulls:
##   0 0 0 0 0
##
## Setting 3: N = 4000 ; k = 0.2 N_Trees = 2000 ; Correlation = 0 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5
## Mean(s) of simulated RF Variable Effect(s):
##   2.15485 4.577168 -3.28809 2.389786 -1.443165
## Mean(s) of simulated LM Variable Effect(s):
##   1.998911 3.998929 -3.001441 2.200821 -1.499022
## True Variable Effect(s):
##   2 4 -3 2.2 -1.5
## Standard Error of simulated Variable Effects (RF):
##   0.6829146 1.126833 0.8905297 0.7888336 0.4242482 .
```

```
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.8681628 1.245235 1.002063 1.008327 0.7313813 .
## Number of Smaller Nulls:
##   0 0 0 0 0
##
## Setting 4: N = 40 ; k = 0.2 N_Trees = 2000 ; Correlation = 0.8 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5
## Mean(s) of simulated RF Variable Effect(s):
##   1.036504 2.290806 -0.5602887 1.09361 -0.1173266
## Mean(s) of simulated LM Variable Effect(s):
##   1.892918 4.044226 -3.024775 2.234801 -1.480491
## True Variable Effect(s):
##   2 4 -3 2.2 -1.5
## Standard Error of simulated Variable Effects (RF):
##   1.223562 1.690344 0.6578945 1.466059 0.7243077 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   1.375694 1.992637 0.7744263 1.337779 0.8575761 .
## Number of Smaller Nulls:
##   0 0 0 0 0
##
## Setting 5: N = 400 ; k = 0.2 N_Trees = 2000 ; Correlation = 0.8 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5
## Mean(s) of simulated RF Variable Effect(s):
##   1.551259 3.57209 -2.065099 1.776022 -0.8908226
## Mean(s) of simulated LM Variable Effect(s):
##   1.995867 3.994914 -3.00547 2.194426 -1.482698
## True Variable Effect(s):
##   2 4 -3 2.2 -1.5
## Standard Error of simulated Variable Effects (RF):
##   0.8789985 1.406966 0.7622897 0.9765879 0.5702657 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.9222685 1.480177 0.9195441 1.015459 0.6232207 .
## Number of Smaller Nulls:
##   0 0 0 0 0
##
## Setting 6: N = 4000 ; k = 0.2 N_Trees = 2000 ; Correlation = 0.8 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5
## Mean(s) of simulated RF Variable Effect(s):
##   1.821841 3.917537 -2.885811 2.180065 -1.289304
## Mean(s) of simulated LM Variable Effect(s):
##   1.999429 4.005597 -2.998898 2.201144 -1.506458
## True Variable Effect(s):
##   2 4 -3 2.2 -1.5
## Standard Error of simulated Variable Effects (RF):
##   0.6504551 1.001177 0.7827296 0.752524 0.5024441 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.7512083 0.9141902 0.9235857 0.8030766 0.5694453 .
## Number of Smaller Nulls:
##   0 0 0 0 0
##
## Setting 7: N = 40 ; k = 1 N_Trees = 2000 ; Correlation = 0 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5
## Mean(s) of simulated RF Variable Effect(s):
##   1.001893 2.771626 -1.90762 1.206578 -0.7611074
```

```
## Mean(s) of simulated LM Variable Effect(s):
##   1.95857 4.003665 -3.006324 2.23086 -1.50316
## True Variable Effect(s):
##   2 4 -3 2.2 -1.5
## Standard Error of simulated Variable Effects (RF):
##   0.5416919 0.7021957 0.6250553 0.5967416 0.4355133 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.6030116 0.8155655 0.7414982 0.6322718 0.5579793 .
## Number of Smaller Nulls:
##   0 0 0 0 0
##
## Setting 8: N = 400 ; k = 1 N_Trees = 2000 ; Correlation = 0 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5
## Mean(s) of simulated RF Variable Effect(s):
##   1.515876 3.687522 -2.643776 1.795437 -0.9903057
## Mean(s) of simulated LM Variable Effect(s):
##   2.003686 4.002138 -2.995333 2.202641 -1.499579
## True Variable Effect(s):
##   2 4 -3 2.2 -1.5
## Standard Error of simulated Variable Effects (RF):
##   0.3389902 0.4633848 0.3909954 0.3191853 0.2601194 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.3284477 0.4601504 0.4044476 0.3461854 0.259773 .
## Number of Smaller Nulls:
##   0 0 0 0 0
##
## Setting 9: N = 4000 ; k = 1 N_Trees = 2000 ; Correlation = 0 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5
## Mean(s) of simulated RF Variable Effect(s):
##   1.839375 3.903959 -2.877252 2.063122 -1.283432
## Mean(s) of simulated LM Variable Effect(s):
##   1.996366 3.999174 -3.000697 2.199825 -1.501865
## True Variable Effect(s):
##   2 4 -3 2.2 -1.5
## Standard Error of simulated Variable Effects (RF):
##   0.1977916 0.2595523 0.2554439 0.2092191 0.1732199 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.2362517 0.2644763 0.2536273 0.2414064 0.1936537 .
## Number of Smaller Nulls:
##   0 0 0 0 0
##
## Setting 10: N = 40 ; k = 1 N_Trees = 2000 ; Correlation = 0.8 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5
## Mean(s) of simulated RF Variable Effect(s):
##   1.063125 1.953844 -0.3750719 1.074481 -0.1121433
## Mean(s) of simulated LM Variable Effect(s):
##   2.025776 4.014529 -3.020625 2.219554 -1.550872
## True Variable Effect(s):
##   2 4 -3 2.2 -1.5
## Standard Error of simulated Variable Effects (RF):
##   0.4353009 0.4846332 0.2883206 0.4347673 0.2949015 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.4983487 0.5544662 0.331978 0.5016625 0.3492173 .
## Number of Smaller Nulls:
```

```
##   0 0 0 0 0
##
## Setting 11: N = 400 ; k = 1 N_Trees = 2000 ; Correlation = 0.8 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5
## Mean(s) of simulated RF Variable Effect(s):
##   1.263316 3.029392 -1.494745 1.439272 -0.6633157
## Mean(s) of simulated LM Variable Effect(s):
##   1.986373 3.990399 -2.9849 2.211752 -1.501239
## True Variable Effect(s):
##   2 4 -3 2.2 -1.5
## Standard Error of simulated Variable Effects (RF):
##   0.2883095 0.3509585 0.2449668 0.2842854 0.19199 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.3118418 0.3766101 0.2550039 0.3114706 0.2232389 .
## Number of Smaller Nulls:
##   0 0 0 0 0
##
## Setting 12: N = 4000 ; k = 1 N_Trees = 2000 ; Correlation = 0.8 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-1.5*x.5
## Mean(s) of simulated RF Variable Effect(s):
##   1.546688 3.629889 -2.325367 1.77635 -0.9543565
## Mean(s) of simulated LM Variable Effect(s):
##   2.002737 3.99825 -2.999011 2.19731 -1.497765
## True Variable Effect(s):
##   2 4 -3 2.2 -1.5
## Standard Error of simulated Variable Effects (RF):
##   0.2123249 0.235877 0.176553 0.2271634 0.1601699 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.2047353 0.2276832 0.1967589 0.2457548 0.1815069 .
## Number of Smaller Nulls:
##   0 0 0 0 0
```

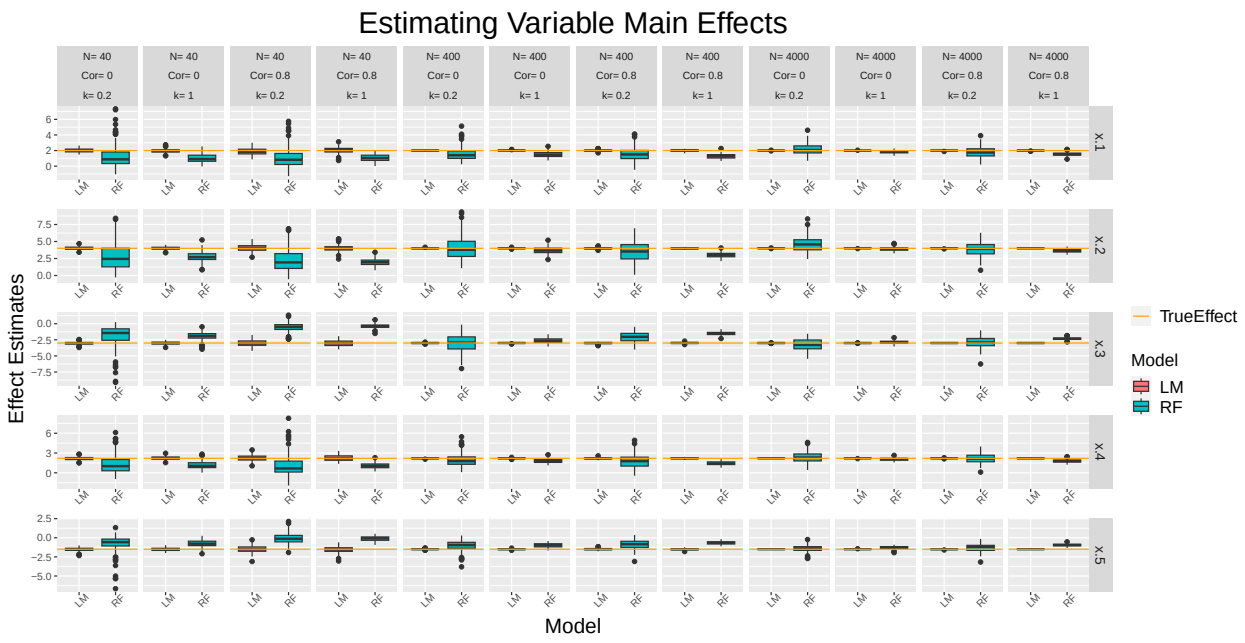
```
effect_plots <- plot_effects(result)
```

```
## `summarise()` has grouped output by 'N', 'cor', 'k', 'num.trees', 'node_size',
## 'variable'. You can override using the `.groups` argument.
```

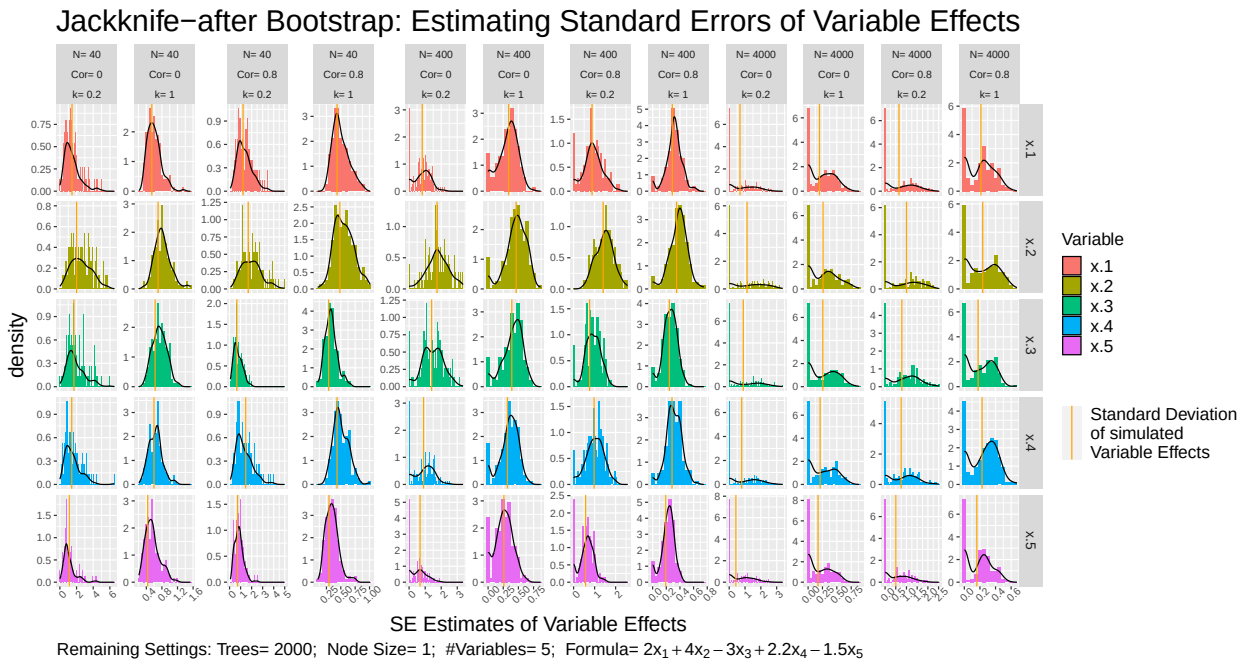
```
se_plot <- plot_se(result)
```

```
## `summarise()` has grouped output by 'N', 'cor', 'k', 'num.trees', 'node_size',
## 'variable'. You can override using the `.groups` argument.
```

```
effect_plots
```


Estimating Variable Main Effects
Effect Estimates
Model
TrueEffect
Model
LM
RF
Remaining Settings: Trees= 2000; Node Size= 1; #Variables= 5; Formula= $2x_1 + 4x_2 - 3x_3 + 2.2x_4 - 1.5x_5$

```
se_plot
```


Jackknife−after Bootstrap: Estimating Standard Errors of Variable Effects
density
SE Estimates of Variable Effects
Variable
x.1
x.2
x.3
x.4
x.5
Standard Deviation of simulated Variable Effects
Remaining Settings: Trees= 2000; Node Size= 1; #Variables= 5; Formula= $2x_1 + 4x_2 - 3x_3 + 2.2x_4 - 1.5x_5$

```r
n <- c(40, 400, 4000) ; num.trees <- 2000 ; repeats <- 150; cor <- c(0, 0.8)
k <- c(0.2, 1); node_size <- c(1); pdp <- F; ale <- F
formulas <- c("2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3")
longest_latex_formula <- "2x_1+4x_2-3x_3+2.2x_4-x_3x_4"




#parallel::clusterExport(cl = clust, varlist = 'formulas')
scenarios <- data.frame(expand.grid(n, num.trees, formulas, repeats,
cor, k, node_size, pdp, ale))
colnames(scenarios) = c("N", "N_Trees", "Formula", "Repeats",
"Correlation", "k", "Node_Size", "pdp", "ale")
scenarios$k_idx <- (scenarios$k == unique(scenarios$k)[1])
scenarios[,"Formula"] <- as.character(scenarios[,"Formula"]) ### Formula became Factor
scenarios["Longest_Latex_formula"] <- longest_latex_formula
scenarios <- split(scenarios, seq(nrow(scenarios)))
#Run Simulation
system.time(result <- parLapply(cl = clust,
                                X = scenarios,
                                fun = sim_multi))
```

```
##     user   system  elapsed
##     0.75     1.36 18270.87
```

```r
if (!pdp | !ale) {
 print_results(result)
}
```

```
## Setting 1: N = 40 ; k = 0.2 N_Trees = 2000 ; Correlation = 0 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3
## Mean(s) of simulated RF Variable Effect(s):
##   1.224822 3.866461 -2.126428 1.339336 0
## Mean(s) of simulated LM Variable Effect(s):
##   2.025038 3.980115 -2.993022 2.21659 0
## True Variable Effect(s):
##   2 4 -3 2.2 0
## Standard Error of simulated Variable Effects (RF):
##   1.238316 2.514367 1.865694 1.449204 0 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   1.4839 3.124492 2.040295 1.531561 0 .
## Number of Smaller Nulls:
##   0 0 0 0
##
## Setting 2: N = 400 ; k = 0.2 N_Trees = 2000 ; Correlation = 0 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3
## Mean(s) of simulated RF Variable Effect(s):
##   1.875848 4.459949 -3.01741 1.877691 0
## Mean(s) of simulated LM Variable Effect(s):
##   1.994797 3.99534 -2.999174 2.197765 0
## True Variable Effect(s):
##   2 4 -3 2.2 0
## Standard Error of simulated Variable Effects (RF):
```

```
##   0.9801509 1.616456 1.315356 0.7237123 0 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.9663387 1.809967 1.388793 0.976725 0 .
## Number of Smaller Nulls:
##   0 0 0 0
##
## Setting 3: N = 4000 ; k = 0.2 N_Trees = 2000 ; Correlation = 0 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3
## Mean(s) of simulated RF Variable Effect(s):
##   2.105592 4.448023 -3.293135 2.336205 0
## Mean(s) of simulated LM Variable Effect(s):
##   2.000791 3.998248 -2.999134 2.200604 0
## True Variable Effect(s):
##   2 4 -3 2.2 0
## Standard Error of simulated Variable Effects (RF):
##   0.6983365 1.105763 0.9242389 0.7565395 0 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.8576996 1.341475 1.012439 0.9200703 0 .
## Number of Smaller Nulls:
##   0 0 0 0
##
## Setting 4: N = 40 ; k = 0.2 N_Trees = 2000 ; Correlation = 0.8 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3
## Mean(s) of simulated RF Variable Effect(s):
##   1.505663 3.043304 -0.4662696 1.351039 0
## Mean(s) of simulated LM Variable Effect(s):
##   2.001676 4.020848 -3.006514 2.192052 0
## True Variable Effect(s):
##   2 4 -3 2.2 0
## Standard Error of simulated Variable Effects (RF):
##   1.451588 2.242049 0.6269124 1.485522 0 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   1.517724 2.223996 0.7972788 1.557742 0 .
## Number of Smaller Nulls:
##   0 0 0 0
##
## Setting 5: N = 400 ; k = 0.2 N_Trees = 2000 ; Correlation = 0.8 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3
## Mean(s) of simulated RF Variable Effect(s):
##   1.712013 3.778938 -1.96742 1.86328 0
## Mean(s) of simulated LM Variable Effect(s):
##   1.995041 3.994512 -2.997299 2.200191 0
## True Variable Effect(s):
##   2 4 -3 2.2 0
## Standard Error of simulated Variable Effects (RF):
##   1.008162 1.480496 0.8738525 1.114174 0 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   1.075582 1.536662 0.8751007 1.136807 0 .
## Number of Smaller Nulls:
##   0 0 0 0
##
## Setting 6: N = 4000 ; k = 0.2 N_Trees = 2000 ; Correlation = 0.8 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3
## Mean(s) of simulated RF Variable Effect(s):
```

```
##   1.937486 3.777364 -2.853376 2.168659 0
## Mean(s) of simulated LM Variable Effect(s):
##   1.998196 4.002461 -3.001356 2.199769 0
## True Variable Effect(s):
##   2 4 -3 2.2 0
## Standard Error of simulated Variable Effects (RF):
##   0.9139719 1.019602 0.7852259 0.833859 0 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.93213 1.029062 0.8648703 0.8886819 0 .
## Number of Smaller Nulls:
##   0 0 0 0
##
## Setting 7: N = 40 ; k = 1 N_Trees = 2000 ; Correlation = 0 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3
## Mean(s) of simulated RF Variable Effect(s):
##   1.079441 3.048293 -2.003919 1.317129 0
## Mean(s) of simulated LM Variable Effect(s):
##   2.00192 3.992258 -3.034568 2.191641 0
## True Variable Effect(s):
##   2 4 -3 2.2 0
## Standard Error of simulated Variable Effects (RF):
##   0.5106242 0.7960005 0.6537467 0.6865648 0 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.6353065 0.8488769 0.7723834 0.6790131 0 .
## Number of Smaller Nulls:
##   0 0 0 0
##
## Setting 8: N = 400 ; k = 1 N_Trees = 2000 ; Correlation = 0 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3
## Mean(s) of simulated RF Variable Effect(s):
##   1.597426 3.8925 -2.760712 1.905268 0
## Mean(s) of simulated LM Variable Effect(s):
##   2.002041 4.002488 -2.993005 2.210335 0
## True Variable Effect(s):
##   2 4 -3 2.2 0
## Standard Error of simulated Variable Effects (RF):
##   0.2847513 0.4424226 0.3257734 0.3103262 0 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.3432185 0.4738204 0.4194413 0.3658005 0 .
## Number of Smaller Nulls:
##   0 0 0 0
##
## Setting 9: N = 4000 ; k = 1 N_Trees = 2000 ; Correlation = 0 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3
## Mean(s) of simulated RF Variable Effect(s):
##   1.938047 3.963012 -2.945273 2.10261 0
## Mean(s) of simulated LM Variable Effect(s):
##   2.000579 3.999622 -2.997906 2.200573 0
## True Variable Effect(s):
##   2 4 -3 2.2 0
## Standard Error of simulated Variable Effects (RF):
##   0.2468456 0.2620717 0.2685169 0.2369734 0 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.2065173 0.2772618 0.2548906 0.2390378 0 .
```

```
## Number of Smaller Nulls:
##   0 0 0 0
##
## Setting 10: N = 40 ; k = 1 N_Trees = 2000 ; Correlation = 0.8 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3
## Mean(s) of simulated RF Variable Effect(s):
##   1.303334 2.462367 -0.2703509 1.477325 0
## Mean(s) of simulated LM Variable Effect(s):
##   1.996959 3.929463 -2.957092 2.283534 0
## True Variable Effect(s):
##   2 4 -3 2.2 0
## Standard Error of simulated Variable Effects (RF):
##   0.5121374 0.5764876 0.3679123 0.5376444 0 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.56177 0.6195271 0.3811737 0.5722954 0 .
## Number of Smaller Nulls:
##   0 0 0 0
##
## Setting 11: N = 400 ; k = 1 N_Trees = 2000 ; Correlation = 0.8 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3
## Mean(s) of simulated RF Variable Effect(s):
##   1.484429 3.427357 -1.526094 1.644404 0
## Mean(s) of simulated LM Variable Effect(s):
##   2.00624 4.010347 -3.018372 2.201716 0
## True Variable Effect(s):
##   2 4 -3 2.2 0
## Standard Error of simulated Variable Effects (RF):
##   0.3631694 0.3654545 0.2643568 0.3155215 0 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.3459087 0.4122468 0.3038525 0.3752308 0 .
## Number of Smaller Nulls:
##   0 0 0 0
##
## Setting 12: N = 4000 ; k = 1 N_Trees = 2000 ; Correlation = 0.8 ; Minimum Node Size = 1 ;
## Formula = 2*x.1+4*x.2-3*x.3+2.2*x.4-x.4*x.3
## Mean(s) of simulated RF Variable Effect(s):
##   1.733467 3.863037 -2.412724 1.980601 0
## Mean(s) of simulated LM Variable Effect(s):
##   2.001457 4.000355 -3.001031 2.19978 0
## True Variable Effect(s):
##   2 4 -3 2.2 0
## Standard Error of simulated Variable Effects (RF):
##   0.2543958 0.2705289 0.218069 0.2509832 0 .
## Mean of Standard Errors Estimates of Variable Effects (RF):
##   0.2451926 0.2765929 0.2388123 0.2679703 0 .
## Number of Smaller Nulls:
##   0 0 0 0
```

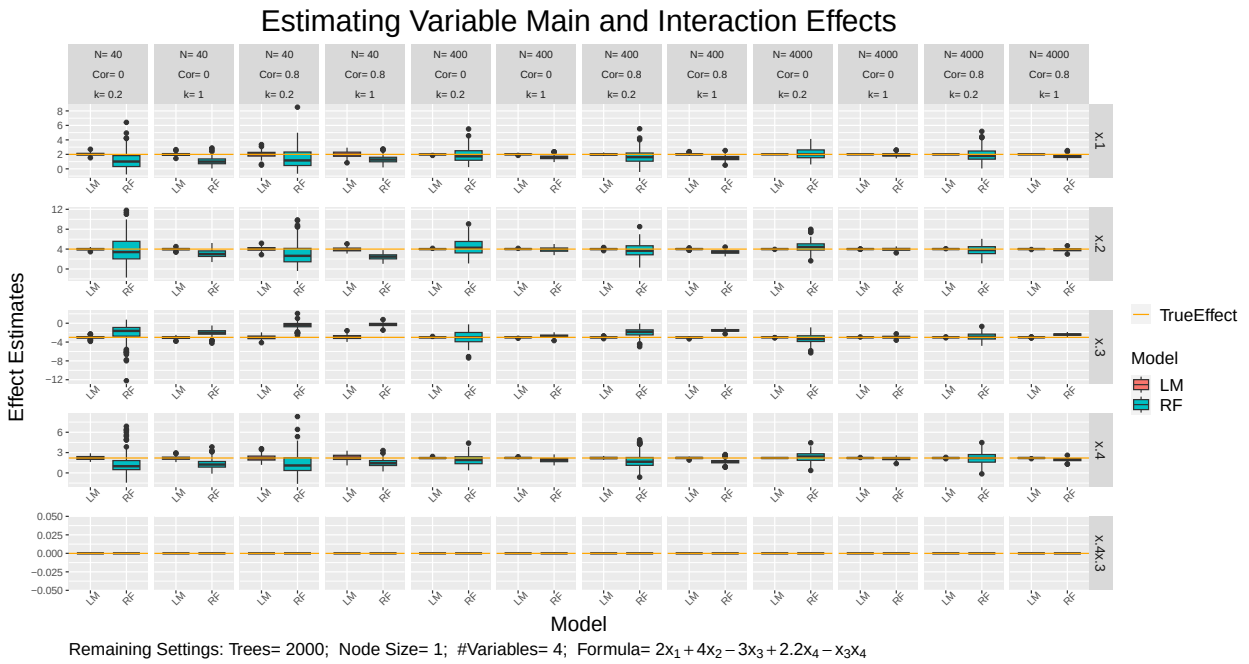
```
effect_plots <- plot_effects(result)
```

```
## `summarise()` has grouped output by 'N', 'cor', 'k', 'num.trees', 'node_size',
## 'variable'. You can override using the `.groups` argument.
```

```
se_plot <- plot_se(result)
```

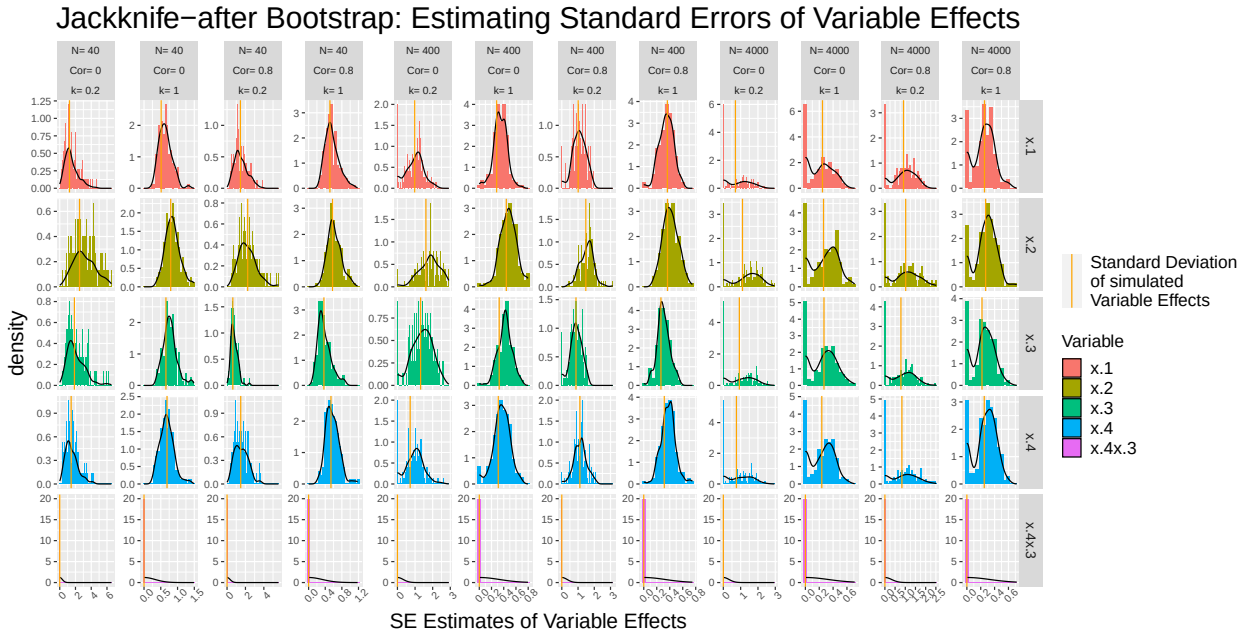
```
## `summarise()` has grouped output by 'N', 'cor', 'k', 'num.trees', 'node_size',
## 'variable'. You can override using the `.groups` argument.
```

```
effect_plots
```



Remaining Settings: Trees= 2000; Node Size= 1; #Variables= 4; Formula= $2x_1 + 4x_2 - 3x_3 + 2.2x_4 - x_3x_4$

```
se_plot
```



Remaining Settings: Trees= 2000; Node Size= 1; #Variables= 4; Formula= $2x_1 + 4x_2 - 3x_3 + 2.2x_4 - x_3x_4$