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N <- 300
Nsims <- 20 * 1000

maxFollow <- 84
cens.type <- "weibull"
##### Forest search criteria
hr.threshold <- 1.25 # Initital candidates
hr.consistency <- 1 # Candidates for many splits

pconsistency.threshold <- 0.9
stop.threshold <- 0.95

maxk <- 2
nmin.fs <- 60
pstop_futile <- 0.7

# Limit timing for forestsearch
max.minutes <- 3
m1.threshold <- Inf # Turning this off (Default)
# pconsistency.threshold<-0.70 # Minimum threshold (will choose max among
# subgroups satisfying)
fs.splits <- 400 # How many times to split for consistency
# vi is % factor is selected in cross-validation --> higher more important
vi.grf.min <- (-1) * 0.2 # This is default (to NOT exclude via VI)
# Null, turns off grf screening
d.min <- 10 # Min number of events for both arms (d0.min=d1.min=d.min)
# default=5

##### Virtual twins analysis Counter-factual difference
##### (C-E) >= vt.threshold Large values in favor of C
##### (control)
vt.threshold <- 0.225 # For VT delta
treat.threshold <- 0

maxdepth <- 2
n.min <- 60
ntree <- 1000

# GRF criteria
dmin.grf <- 12 # For GRF delta
# Note: For CRT this represents dmin.grf/2 RMS for control (-dmin.grf/2 for
# treatment)
frac.tau <- 0.6

# For forestsearch algorithm use same as GRF
frac.tau_fs <- 0.6
dmin.grf_fs <- 12
maxdepth_fs <- 2

label.analyses <- c("FS1", "GRF", "VT(24)", "VT#(24)", "VT(36)", "VT#(36)", "GRF.60")
# Classification table names
est_names <- c("$FS_{g}$", "$FS_{lg}$", "$GRF$", "$GRF_{60}$", "$VT(24)$", "{$VT}^{\backslash\#}(24)$",
"$VT(36)$", "{$VT}^{\backslash\#}(36)$")

outcome.name <- c("y.sim")

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event.name <- c("event.sim")
id.name <- c("id")
treat.name <- c("treat")

cox.formula.sim <- as.formula(paste("Surv(y.sim,event.sim)~treat"))
cox.formula.adj.sim <- as.formula(paste("Surv(y.sim,event.sim)~treat+v1+v2+v3+v4+v5"))

get.FS <- TRUE
get.VT <- TRUE
get.GRF <- TRUE

fl_prefix <- paste0("oc_sims=", Nsims, "_")

out.loc <- paste0("results/", fl_prefix)

# m1 -censoring adjustment
muC.adj <- log(1.5)

# 0, 3, or 5
n_add_noise <- 5

mindex <- "m4c"
file.index <- "v0-4cuts"

z1_frac <- 0.25

if (mindex == "m4a") {
  k.z3 <- 1
  k.treat <- 0.9
  pH_super <- 0.125 # non-NULL re-defines z1_frac
}

if (mindex == "m4aB") {
  k.z3 <- 1
  k.treat <- 0.9
  pH_super <- 0.2 # non-NULL re-defines z1_frac
}

if (mindex == "m4b") {
  k.z3 <- 1
  k.treat <- 1.25
  pH_super <- 0.3 # non-NULL re-defines z1_frac
}

if (mindex == "m4c") {
  k.z3 <- 1
  k.treat <- 1.5
  pH_super <- 0.3 # non-NULL re-defines z1_frac
}

model.index <- paste0(mindex, "-Noise=", "")
model.index <- paste0(model.index, n_add_noise, "")

if (is.null(pH_super)) {
  # pH_check<-with(gbsg,mean(pgr<=quantile(pgr,c(z3_frac),1,0) &

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# er<=quantile(er,z1_frac)))
pH_check <- with(gbsg, mean(meno == 0 & er <= quantile(er, z1_frac)))
cat("Underlying pH_super", c(pH_check), "\n")
}

# pH_super specified If pH_super then override z1_frac and find z1_frac to
# yield pH_super

if (!is.null(pH_super)) {
  # Approximate Z1 quantile to yield pH proportion
  z1_q <- uniroot(propH.obj4, c(0, 1), tol = 1e-04, pH.target = pH_super)$root
  # pH_check<-with(gbsg,mean(pgr<=quantile(pgr,c(z3_frac),1,0) &
  # er<=quantile(er,z1_q)))
  pH_check <- with(gbsg, mean(meno == 0 & er <= quantile(er, z1_q)))
  cat("pH", c(pH_check), "\n")
  rel_error <- (pH_super - pH_check)/pH_super
  if (abs(rel_error) >= 0.1)
    stop("pH_super approximation relative error exceeds 10%")
  z1_frac <- z1_q
  cat("Underlying pH_super", c(pH_check), "\n")
}

## pH 0.3002915
## Underlying pH_super 0.3002915

# Bootstrap on log(hr) scale converted to HR (est.loghr=TRUE & est.scale='hr')
est.loghr <- TRUE
est.scale <- "hr"
t.start.all <- proc.time()[3]

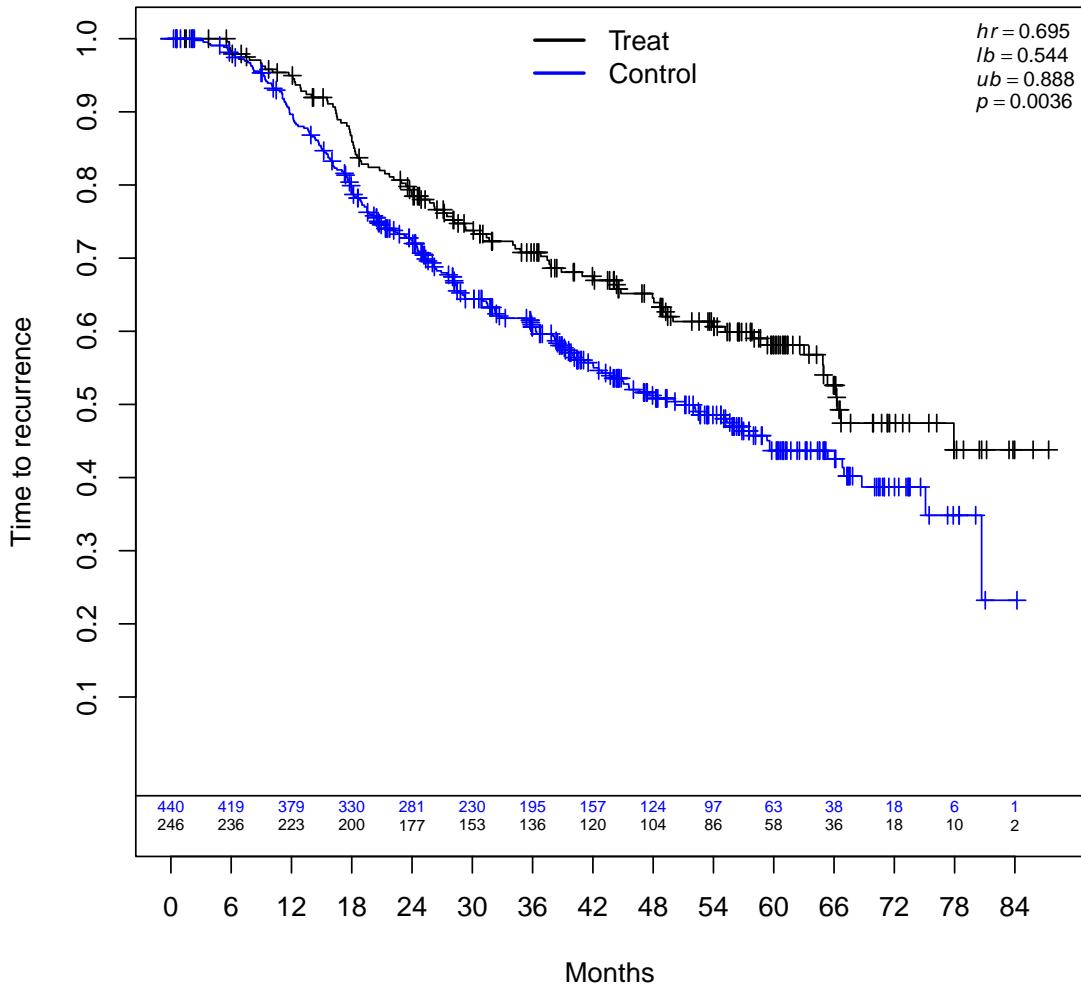
# Classification table names Note: within tab_tests (summary.VTFS) we rename so
# that denominator in ppu(hatH) is # hatH Manuscript section 3.2 will be
# updated accordingly

stat_names <- c("any(H)", "${sens}(\hat{H})${", "${sens}(\hat{H}^C){${", "${ppv}(\hat{H})${",
  "${ppv}(\hat{H}^C){${", "${avg}\sqrt{\hat{H}}\sqrt{${", "${min}\sqrt{\hat{H}}\sqrt{${",
  "${max}\sqrt{\hat{H}}\sqrt{${", "${avg}\sqrt{\hat{H}^C}\sqrt{${", "${min}\sqrt{\hat{H}^C}\sqrt{${",
  "${max}\sqrt{\hat{H}^C}\sqrt{${"

if (!get.FS) est_names <- est_names[-c(1:3)]


mod.harm <- "null"
this.dgm <- get.dgm4.OC(mod.harm = mod.harm, N = N, k.treat = k.treat, model.index = model.index,
  sol_tol = 10^-8, hrH.target = hrH.target, cens.type = cens.type, out.loc = out.loc,
  file.index = file.index, details = TRUE, parms_torand = FALSE)

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```
## Super-population empirical harm and non-harm hazard ratios= NA 0.5517234
## Causal HR (empirical ITT)= 0.5517234

dgm <- this.dgm$dgm
output.file <- this.dgm$out.file

if (!is.null(output.file) & !grepl(mod.harm, output.file)) stop("Wrong file name for mod.harm")

# Show first simulation ans1 <- oc_analyses_m4_FS4(1)

t.start <- proc.time()[3]
res <- foreach(sim = seq_len(Nsims), .options.future = list(seed = TRUE), .combine = "rbind",
    .errorhandling = "pass") %dofuture% {
    ans <- oc_analyses_m4FourCuts_FS4(sim)
    return(ans)
}

## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 45.33113 2
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##   leaf.node control.mean control.size control.se depth
## 1          2      -6.60     256.00      1.60      1
## 2          4      -8.24     200.00      1.81      2
##   leaf.node control.mean control.size control.se depth
## 1          2      -6.6      256.0      1.6      1
## GRF subgroup NOT found
## NO GRF cuts meeting delta(RMST): dmin.grf= 12
## # of continuous/categorical characteristics 6 6
## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## Default cuts included (1st 20)
## Categorical: z1 z2 z3 z4 z5 grade3
## # of candidate subgroup factors= 25
## [1] "size <= 29.6"    "size <= 25"      "size <= 21"      "size <= 35"
## [5] "noise1 <= 0"     "noise1 <= -0.6"   "noise1 <= 0.7"   "noise2 <= 0"
## [9] "noise2 <= -0.7"   "noise2 <= 0.7"    "noise3 <= 0"     "noise3 <= -0.7"
## [13] "noise3 <= 0.8"   "noise4 <= 0"     "noise4 <= -0.8"  "noise4 <= 0.7"
## [17] "noise5 <= -0.1"   "noise5 <= -0.8"   "noise5 <= 0.5"   "z1"
## [21] "z2"                "z3"           "z4"           "z5"
## [25] "grade3"
## Number of factors evaluated= 25
## Confounders per grf screening q4 q23 q16 q19 q3 q20 q5 q24 q2 q17 q22 q8 q14 q11 q21 q10 q1 q12 q7 q
##          Factors Labels VI(grf)
## 4      size <= 35      q4  0.0947
## 23      z4      q23  0.0735
## 16      noise4 <= 0.7  q16  0.0710
## 19      noise5 <= 0.5  q19  0.0693
## 3      size <= 21      q3  0.0624
## 20      z1      q20  0.0518
## 5      noise1 <= 0      q5  0.0417
## 24      z5      q24  0.0413
## 2      size <= 25      q2  0.0411
## 17      noise5 <= -0.1 q17  0.0411
## 22      z3      q22  0.0400
## 8      noise2 <= 0      q8  0.0379
## 14      noise4 <= 0      q14 0.0352
## 11      noise3 <= 0      q11 0.0336
## 21      z2      q21  0.0299
## 10      noise2 <= 0.7   q10 0.0297
## 1      size <= 29.6    q1  0.0280
## 12      noise3 <= -0.7  q12 0.0271
## 7      noise1 <= 0.7    q7  0.0263
## 13      noise3 <= 0.8   q13 0.0237
## 9      noise2 <= -0.7   q9  0.0236
## 18      noise5 <= -0.8   q18 0.0209
## 6      noise1 <= -0.6   q6  0.0208
## 25      grade3      q25  0.0177
## 15      noise4 <= -0.8   q15 0.0176
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1275
## Approximately 5% of max_count met: minutes 0.00205
## Approximately 10% of max_count met: minutes 0.00315
## Approximately 20% of max_count met: minutes 0.006033333
## Approximately 33% of max_count met: minutes 0.008883333
## Approximately 50% of max_count met: minutes 0.01401667
## Approximately 75% of max_count met: minutes 0.02173333

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## Approximately 90% of max_count met: minutes 0.02563333
## # of subgroups evaluated based on (up to) maxk-factor combinations 1275
## % of all-possible combinations (<= maxk) 100
## k.max= 2
## Events criteria for control,exp= 10 10
## # of subgroups with events less than criteria: control, experimental 179 333
## # of subgroups with sample size less than criteria 543
## # of subgroups meeting all criteria = 705
## # of subgroups fitted (Cox model estimable) = 705
## *Subgroup Searching Minutes==* 0.02736667
## Number of subgroups meeting HR threshold 0
## NO subgroup candidate found (FS)
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 45.33113 2
##   leaf.node control.mean control.size control.se depth
## 1       2      -6.60      256.00      1.60      1
## 2       4      -8.24      200.00      1.81      2
##   leaf.node control.mean control.size control.se depth
## 1       2      -6.6      256.0      1.6      1
## GRF subgroup NOT found
## NO GRF cuts meeting delta(RMST): dmin.grf= 12
## # of continuous/categorical characteristics 6 6
## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## CV lambda = 0.04773978
## 12 x 1 sparse Matrix of class "dgCMatrix"
##           s0
## z1      .
## z2      .
## z3      .
## z4      0.43629892
## z5     -0.52002399
## size    .
## grade3 .
## noise1 .
## noise2 -0.03740061
## noise3 .
## noise4 .
## noise5 .
## Cox-LASSO selected: z4 z5 noise2
## Cox-LASSO not selected: z1 z2 z3 size grade3 noise1 noise3 noise4 noise5
## Default cuts included from Lasso:
## Categorical after Lasso: z4 z5
## # of candidate subgroup factors= 21
## [1] "size <= 29.6"    "size <= 25"      "size <= 21"      "size <= 35"
## [5] "noise1 <= 0"     "noise1 <= -0.6"   "noise1 <= 0.7"   "noise2 <= 0"
## [9] "noise2 <= -0.7"   "noise2 <= 0.7"    "noise3 <= 0"     "noise3 <= -0.7"
## [13] "noise3 <= 0.8"   "noise4 <= 0"     "noise4 <= -0.8"   "noise4 <= 0.7"
## [17] "noise5 <= -0.1"   "noise5 <= -0.8"   "noise5 <= 0.5"    "z4"
## [21] "z5"
## Number of factors evaluated= 21
## Confounders per grf screening q4 q20 q16 q19 q3 q17 q8 q5 q21 q2 q14 q11 q10 q7 q12 q1 q18 q6 q9 q15
##          Factors Labels VI(grf)
## 4      size <= 35      q4  0.1035
## 20      z4        q20  0.0892

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## 16 noise4 <= 0.7      q16  0.0833
## 19 noise5 <= 0.5      q19  0.0786
## 3   size <= 21        q3   0.0651
## 17 noise5 <= -0.1     q17  0.0495
## 8   noise2 <= 0        q8   0.0494
## 5   noise1 <= 0        q5   0.0474
## 21           z5        q21  0.0472
## 2   size <= 25        q2   0.0465
## 14 noise4 <= 0        q14  0.0398
## 11 noise3 <= 0        q11  0.0393
## 10 noise2 <= 0.7      q10  0.0371
## 7   noise1 <= 0.7      q7   0.0346
## 12 noise3 <= -0.7     q12  0.0324
## 1   size <= 29.6       q1   0.0302
## 18 noise5 <= -0.8     q18  0.0270
## 6   noise1 <= -0.6     q6   0.0262
## 9   noise2 <= -0.7     q9   0.0258
## 15 noise4 <= -0.8     q15  0.0247
## 13 noise3 <= 0.8      q13  0.0232
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 903
## Approximately 5% of max_count met: minutes 0.001816667
## Approximately 10% of max_count met: minutes 0.002066667
## Approximately 20% of max_count met: minutes 0.006366667
## Approximately 33% of max_count met: minutes 0.008283333
## Approximately 50% of max_count met: minutes 0.0115
## Approximately 75% of max_count met: minutes 0.0166
## Approximately 90% of max_count met: minutes 0.01888333
## # of subgroups evaluated based on (up to) maxk-factor combinations 903
## % of all-possible combinations (<= maxk) 100
## k.max= 2
## Events criteria for control,exp= 10 10
## # of subgroups with events less than criteria: control, experimental 140 232
## # of subgroups with sample size less than criteria 393
## # of subgroups meeting all criteria = 486
## # of subgroups fitted (Cox model estimable) = 486
## *Subgroup Searching Minutes=** 0.02021667
## Number of subgroups meeting HR threshold 0
## NO subgroup candidate found (FS)
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 45.32879 2
##   leaf.node control.mean control.size control.se depth
## 1         2       -4.25      284.00      1.46      1
## 11        4       -6.05      111.00      2.27      2
## 4         7       -7.56      122.00      2.36      2
##   leaf.node control.mean control.size control.se depth
## 1         2       -4.25      284.00      1.46      1
## GRF subgroup NOT found
## NO GRF cuts meeting delta(RMST): dmin.grf= 12
## # of continuous/categorical characteristics 6 6
## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## Default cuts included (1st 20)
## Categorical: z1 z2 z3 z4 z5 grade3
## # of candidate subgroup factors= 26
## [1] "size <= 27.9"    "size <= 25"      "size <= 20"      "size <= 34"

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## [5] "noise1 <= 0.1" "noise1 <= -0.7" "noise1 <= 0.7" "noise2 <= 0"
## [9] "noise2 <= -0.1" "noise2 <= -0.6" "noise2 <= 0.7" "noise3 <= 0"
## [13] "noise3 <= -0.7" "noise3 <= 0.7" "noise4 <= 0" "noise4 <= -0.8"
## [17] "noise4 <= 0.7" "noise5 <= 0.1" "noise5 <= -0.5" "noise5 <= 0.8"
## [21] "z1" "z2" "z3" "z4"
## [25] "z5" "grade3"
## Number of factors evaluated= 26
## Confounders per grf screening q24 q1 q2 q16 q22 q25 q15 q18 q5 q20 q12 q3 q21 q8 q26 q9 q23 q7 q10 q
## Factors Labels VI(grf)
## 24 z4 q24 0.0994
## 1 size <= 27.9 q1 0.0618
## 2 size <= 25 q2 0.0614
## 16 noise4 <= -0.8 q16 0.0614
## 22 z2 q22 0.0599
## 25 z5 q25 0.0580
## 15 noise4 <= 0 q15 0.0546
## 18 noise5 <= 0.1 q18 0.0431
## 5 noise1 <= 0.1 q5 0.0425
## 20 noise5 <= 0.8 q20 0.0385
## 12 noise3 <= 0 q12 0.0382
## 3 size <= 20 q3 0.0346
## 21 z1 q21 0.0338
## 8 noise2 <= 0 q8 0.0308
## 26 grade3 q26 0.0295
## 9 noise2 <= -0.1 q9 0.0288
## 23 z3 q23 0.0273
## 7 noise1 <= 0.7 q7 0.0260
## 10 noise2 <= -0.6 q10 0.0234
## 19 noise5 <= -0.5 q19 0.0234
## 6 noise1 <= -0.7 q6 0.0233
## 4 size <= 34 q4 0.0229
## 11 noise2 <= 0.7 q11 0.0224
## 13 noise3 <= -0.7 q13 0.0206
## 14 noise3 <= 0.7 q14 0.0188
## 17 noise4 <= 0.7 q17 0.0157
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1378
## Approximately 5% of max_count met: minutes 0.002916667
## Approximately 10% of max_count met: minutes 0.0053
## Approximately 20% of max_count met: minutes 0.0095
## Approximately 33% of max_count met: minutes 0.01625
## Approximately 50% of max_count met: minutes 0.02488333
## Approximately 75% of max_count met: minutes 0.03638333
## Approximately 90% of max_count met: minutes 0.04121667
## # of subgroups evaluated based on (up to) maxk-factor combinations 1378
## % of all-possible combinations (<= maxk) 100
## k.max= 2
## Events criteria for control,exp= 10 10
## # of subgroups with events less than criteria: control, experimental 203 440
## # of subgroups with sample size less than criteria 575
## # of subgroups meeting all criteria = 752
## # of subgroups fitted (Cox model estimable) = 752
## *Subgroup Searching Minutes=* 0.04413333
## Number of subgroups meeting HR threshold 0
## NO subgroup candidate found (FS)
## FS: GRF stage for cut selection with dmin,tau= 12 0.6

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## tau, maxdepth= 45.32879 2
##   leaf.node control.mean control.size control.se depth
## 1       2      -4.25     284.00      1.46      1
## 11      4      -6.05     111.00      2.27      2
## 4       7      -7.56     122.00      2.36      2
##   leaf.node control.mean control.size control.se depth
## 1       2      -4.25     284.00      1.46      1
## GRF subgroup NOT found
## NO GRF cuts meeting delta(RMST): dmin.grf= 12
## # of continuous/categorical characteristics 6 6
## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## CV lambda = 0.04396711
## 12 x 1 sparse Matrix of class "dgCMatrix"
##           s0
## z1       .
## z2       .
## z3       .
## z4       0.7509354
## z5      -0.9007276
## size     .
## grade3   .
## noise1   .
## noise2   .
## noise3   .
## noise4   .
## noise5   .
## Cox-LASSO selected: z4 z5
## Cox-LASSO not selected: z1 z2 z3 size grade3 noise1 noise2 noise3 noise4 noise5
## Default cuts included from Lasso:
## Categorical after Lasso: z4 z5
## # of candidate subgroup factors= 22
## [1] "size <= 27.9"    "size <= 25"      "size <= 20"      "size <= 34"
## [5] "noise1 <= 0.1"   "noise1 <= -0.7"  "noise1 <= 0.7"   "noise2 <= 0"
## [9] "noise2 <= -0.1"  "noise2 <= -0.6"  "noise2 <= 0.7"   "noise3 <= 0"
## [13] "noise3 <= -0.7" "noise3 <= 0.7"   "noise4 <= 0"    "noise4 <= -0.8"
## [17] "noise4 <= 0.7"  "noise5 <= 0.1"  "noise5 <= -0.5" "noise5 <= 0.8"
## [21] "z4"              "z5"
## Number of factors evaluated= 22
## Confounders per grf screening q21 q1 q2 q16 q22 q15 q18 q5 q20 q12 q3 q8 q6 q7 q9 q4 q14 q19 q11 q13
##          Factors Labels VI(grf)
## 21        z4     q21  0.1197
## 1  size <= 27.9     q1  0.0803
## 2  size <= 25      q2  0.0719
## 16 noise4 <= -0.8   q16 0.0685
## 22        z5     q22  0.0659
## 15 noise4 <= 0     q15 0.0602
## 18 noise5 <= 0.1    q18 0.0529
## 5  noise1 <= 0.1    q5  0.0505
## 20 noise5 <= 0.8    q20 0.0493
## 12 noise3 <= 0     q12 0.0427
## 3   size <= 20      q3  0.0387
## 8  noise2 <= 0     q8  0.0346
## 6  noise1 <= -0.7   q6  0.0313
## 7  noise1 <= 0.7    q7  0.0302

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## 9 noise2 <= -0.1      q9  0.0287
## 4    size <= 34        q4  0.0278
## 14   noise3 <= 0.7    q14  0.0273
## 19   noise5 <= -0.5    q19  0.0273
## 11   noise2 <= 0.7    q11  0.0248
## 13   noise3 <= -0.7    q13  0.0246
## 10   noise2 <= -0.6    q10  0.0232
## 17   noise4 <= 0.7    q17  0.0196
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 990
## Approximately 5% of max_count met: minutes 0.002233333
## Approximately 10% of max_count met: minutes 0.0036
## Approximately 20% of max_count met: minutes 0.007033333
## Approximately 33% of max_count met: minutes 0.01148333
## Approximately 50% of max_count met: minutes 0.01623333
## Approximately 75% of max_count met: minutes 0.02393333
## Approximately 90% of max_count met: minutes 0.02735
## # of subgroups evaluated based on (up to) maxk-factor combinations 990
## % of all-possible combinations (<= maxk) 100
## k.max= 2
## Events criteria for control,exp= 10 10
## # of subgroups with events less than criteria: control, experimental 160 313
## # of subgroups with sample size less than criteria 417
## # of subgroups meeting all criteria = 537
## # of subgroups fitted (Cox model estimable) = 537
## *Subgroup Searching Minutes=* 0.02943333
## Number of subgroups meeting HR threshold 0
## NO subgroup candidate found (FS)
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 45.42348 2
##     leaf.node control.mean control.size control.se depth
## 2      3       -6.97      291.00      1.49      1
## 21     5       -14.58      77.00      2.86      2
## 3      6       6.45       63.00      2.91      2
## 4      7       -9.23      144.00      2.02      2
##     leaf.node control.mean control.size control.se depth
## 3      6       6.45       63.00      2.91      2
## GRF subgroup found
## All splits
## [1] "noise5 <= -0.51" "noise3 <= -0.7"  "noise5 <= 0.01"
## Terminating node at max.diff (sg.harm.id)
## [1] "noise5 <= 0.00807090609630402"
## # of continuous/categorical characteristics 6 6
## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## Default cuts included (1st 20)
## Categorical: z1 z2 z3 z4 z5 grade3
## Factors per GRF: noise5 <= -0.51 noise3 <= -0.7 noise5 <= 0.01
## Initial GRF cuts included noise5 <= -0.51 noise3 <= -0.7 noise5 <= 0.01
## # of candidate subgroup factors= 30
## [1] "noise5 <= -0.51" "noise3 <= -0.7"  "noise5 <= 0.01"  "size <= 29.7"
## [5] "size <= 27"       "size <= 21"      "size <= 35"      "noise1 <= -0.1"
## [9] "noise1 <= -0.8"   "noise1 <= 0.7"   "noise2 <= -0.1"   "noise2 <= -0.8"
## [13] "noise2 <= 0.5"   "noise3 <= 0.1"   "noise3 <= 0"     "noise3 <= -0.6"
## [17] "noise3 <= 0.8"   "noise4 <= 0.1"   "noise4 <= 0"     "noise4 <= -0.6"
## [21] "noise4 <= 0.8"   "noise5 <= 0"     "noise5 <= -0.7"  "noise5 <= 0.7"

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## [25] "z1"                  "z2"                  "z3"                  "z4"
## [29] "z5"                  "grade3"
## Number of factors evaluated= 30
## Confounders per grf screening q28 q3 q25 q30 q22 q1 q19 q29 q26 q11 q12 q8 q5 q23 q2 q16 q6 q18 q27 q
## Factors Labels VI(grf)
## 28          z4    q28  0.1662
## 3   noise5 <= 0.01      q3   0.0948
## 25          z1    q25  0.0595
## 30          grade3 q30  0.0417
## 22          noise5 <= 0  q22  0.0416
## 1   noise5 <= -0.51    q1   0.0410
## 19          noise4 <= 0  q19  0.0396
## 29          z5    q29  0.0379
## 26          z2    q26  0.0366
## 11          noise2 <= -0.1 q11  0.0331
## 12          noise2 <= -0.8 q12  0.0325
## 8   noise1 <= -0.1     q8   0.0296
## 5    size <= 27        q5   0.0271
## 23          noise5 <= -0.7 q23  0.0247
## 2   noise3 <= -0.7     q2   0.0243
## 16          noise3 <= -0.6 q16  0.0242
## 6    size <= 21        q6   0.0230
## 18          noise4 <= 0.1 q18  0.0217
## 27          z3    q27  0.0212
## 4    size <= 29.7       q4   0.0205
## 14          noise3 <= 0.1 q14  0.0204
## 17          noise3 <= 0.8 q17  0.0196
## 24          noise5 <= 0.7 q24  0.0183
## 13          noise2 <= 0.5 q13  0.0173
## 9   noise1 <= -0.8     q9   0.0172
## 15          noise3 <= 0  q15  0.0172
## 20          noise4 <= -0.6 q20  0.0160
## 21          noise4 <= 0.8 q21  0.0147
## 10          noise1 <= 0.7 q10  0.0108
## 7    size <= 35        q7   0.0079
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1830
## Approximately 5% of max_count met: minutes 0.005316667
## Approximately 10% of max_count met: minutes 0.008333333
## Approximately 20% of max_count met: minutes 0.01756667
## Approximately 33% of max_count met: minutes 0.02496667
## Approximately 50% of max_count met: minutes 0.03443333
## Approximately 75% of max_count met: minutes 0.04885
## Approximately 90% of max_count met: minutes 0.0554
## # of subgroups evaluated based on (up to) maxk-factor combinations 1830
## % of all-possible combinations (<= maxk) 100
## k.max= 2
## Events criteria for control,exp= 10 10
## # of subgroups with events less than criteria: control, experimental 321 496
## # of subgroups with sample size less than criteria 754
## # of subgroups meeting all criteria = 1004
## # of subgroups fitted (Cox model estimable) = 1004
## *Subgroup Searching Minutes=* 0.05971667
## Number of subgroups meeting HR threshold 6
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 6

```

```

## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##   n E d1 HR L(HR) q28.0 q28.1 q3.0 q3.1 q25.0 q25.1
## 1 64 29 17 1.63 0.77 0 0 0 1 0 0
## 2 62 28 17 1.60 0.75 0 0 0 0 0 0
## 3 81 38 21 1.30 0.68 0 0 0 1 0 0
## 4 75 36 20 1.28 0.66 0 0 0 1 0 0
## 5 79 37 21 1.27 0.66 0 0 0 0 0 0
## 6 65 35 18 1.26 0.65 0 0 0 0 0 0
## Consistency 0.83
## Consistency 0.77
## Consistency 0.5425
## Subgroup Consistency Minutes= 0.09938333
## NO subgroup found (FS)
## Minutes forestsearch overall= 0.1663833
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 45.42348 2
##   leaf.node control.mean control.size control.se depth
## 2      3       -6.97     291.00      1.49      1
## 21     5       -14.58     77.00      2.86      2
## 3      6        6.45     63.00      2.91      2
## 4      7       -9.23    144.00      2.02      2
##   leaf.node control.mean control.size control.se depth
## 3      6        6.45     63.00      2.91      2
## GRF subgroup found
## All splits
## [1] "noise5 <= -0.51" "noise3 <= -0.7" "noise5 <= 0.01"
## Terminating node at max.diff (sg.harm.id)
## [1] "noise5 <= 0.00807090609630402"
## # of continuous/categorical characteristics 6 6
## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## CV lambda = 0.04541205
## 12 x 1 sparse Matrix of class "dgCMatrix"
##           s0
## z1 .
## z2 .
## z3 .
## z4 0.7803413
## z5 -0.6626916
## size .
## grade3 .
## noise1 0.0240149
## noise2 .
## noise3 .
## noise4 .
## noise5 .
## Cox-LASSO selected: z4 z5 noise1
## Cox-LASSO not selected: z1 z2 z3 size grade3 noise2 noise3 noise4 noise5
## Default cuts included from Lasso:
## Categorical after Lasso: z4 z5
## Factors per GRF: noise5 <= -0.51 noise3 <= -0.7 noise5 <= 0.01
## Initial GRF cuts included noise5 <= -0.51 noise3 <= -0.7 noise5 <= 0.01
## Factors included per GRF (not in lasso) noise5 <= -0.51 noise3 <= -0.7 noise5 <= 0.01
## # of candidate subgroup factors= 26
## [1] "noise5 <= -0.51" "noise3 <= -0.7" "noise5 <= 0.01" "size <= 29.7"

```

```

## [5] "size <= 27"      "size <= 21"      "size <= 35"      "noise1 <= -0.1"
## [9] "noise1 <= -0.8"  "noise1 <= 0.7"   "noise2 <= -0.1"  "noise2 <= -0.8"
## [13] "noise2 <= 0.5"   "noise3 <= 0.1"   "noise3 <= 0"    "noise3 <= -0.6"
## [17] "noise3 <= 0.8"   "noise4 <= 0.1"   "noise4 <= 0"    "noise4 <= -0.6"
## [21] "noise4 <= 0.8"   "noise5 <= 0"    "noise5 <= -0.7"  "noise5 <= 0.7"
## [25] "z4"              "z5"
## Number of factors evaluated= 26
## Confounders per grf screening q25 q3 q19 q22 q26 q1 q11 q8 q16 q12 q5 q2 q23 q17 q18 q6 q14 q15 q4 q
##          Factors Labels VI(grf)
## 25          z4     q25  0.2192
## 3  noise5 <= 0.01    q3  0.1034
## 19  noise4 <= 0    q19  0.0524
## 22  noise5 <= 0    q22  0.0482
## 26          z5     q26  0.0445
## 1  noise5 <= -0.51  q1   0.0443
## 11  noise2 <= -0.1  q11  0.0424
## 8   noise1 <= -0.1  q8   0.0375
## 16  noise3 <= -0.6  q16  0.0330
## 12  noise2 <= -0.8  q12  0.0328
## 5   size <= 27     q5   0.0311
## 2  noise3 <= -0.7  q2   0.0279
## 23  noise5 <= -0.7  q23  0.0263
## 17  noise3 <= 0.8  q17  0.0256
## 18  noise4 <= 0.1  q18  0.0255
## 6   size <= 21     q6   0.0246
## 14  noise3 <= 0.1  q14  0.0226
## 15  noise3 <= 0    q15  0.0220
## 4   size <= 29.7   q4   0.0213
## 24  noise5 <= 0.7  q24  0.0209
## 13  noise2 <= 0.5  q13  0.0204
## 9   noise1 <= -0.8  q9   0.0195
## 20  noise4 <= -0.6  q20  0.0161
## 21  noise4 <= 0.8  q21  0.0147
## 10  noise1 <= 0.7  q10  0.0140
## 7   size <= 35     q7   0.0099
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1378
## Approximately 5% of max_count met: minutes 0.00415
## Approximately 10% of max_count met: minutes 0.0074
## Approximately 20% of max_count met: minutes 0.01336667
## Approximately 33% of max_count met: minutes 0.02003333
## Approximately 50% of max_count met: minutes 0.02795
## Approximately 75% of max_count met: minutes 0.03698333
## Approximately 90% of max_count met: minutes 0.04458333
## # of subgroups evaluated based on (up to) maxk-factor combinations 1378
## % of all-possible combinations (<= maxk) 100
## k.max= 2
## Events criteria for control,exp= 10 10
## # of subgroups with events less than criteria: control, experimental 262 384
## # of subgroups with sample size less than criteria 574
## # of subgroups meeting all criteria = 741
## # of subgroups fitted (Cox model estimable) = 741
## *Subgroup Searching Minutes=* 0.04928333
## Number of subgroups meeting HR threshold 6
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) =  6

```

```

## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##   n E d1 HR L(HR) q25.0 q25.1 q3.0 q3.1 q19.0 q19.1
## 1 64 29 17 1.63 0.77 0 0 0 1 0 0
## 2 62 28 17 1.60 0.75 0 0 0 0 0 0
## 3 81 38 21 1.30 0.68 0 0 0 1 0 0
## 4 75 36 20 1.28 0.66 0 0 0 1 0 0
## 5 79 37 21 1.27 0.66 0 0 0 0 0 0
## 6 65 35 18 1.26 0.65 0 0 0 0 0 0
## Consistency 0.83
## Consistency 0.77
## Consistency 0.5425
## Subgroup Consistency Minutes= 0.1055
## NO subgroup found (FS)
## Minutes forestsearch overall= 0.1648667

t.now <- proc.time() [3]
t.min <- (t.now - t.start)/60

print(table(res$analysis))

##
##      FS1     FS1g      GRF    GRF.60   VT(24)   VT(36) VT#(24) VT#(36)
##      20000    20000    20000    20000    20000    20000    20000    20000

check <- c(c(table(res$analysis)) - Nsims)
if (all(check != 0)) stop("All analyses not complete")

dgm_alt <- dgm
outres <- out.results(res = res, dgm = dgm, output.file = output.file, t.min = t.min,
                      out_analysis = "FS1")

## [1] "results/oc_sims=20000_m4c-Noise=5_N=300_null_ktreat=1.5_v0-4cuts.Rdata"
##      sim sizeH_true propH_true sizeHc_true propHc_true any.H size.H size.Hc
##      <int>     <num>     <num>     <int>     <num> <num> <num> <int>
## 1:    1       0       0       300       1       0       0     300
## 2:    1       0       0       300       1       0       0     300
## 3:    1       0       0       300       1       0       0     300
## 4:    1       0       0       300       1       0       0     300
## 5:    1       0       0       300       1       0       0     300
## 6:    1       0       0       300       1       0       0     300
##      ppv      npv specificity sensitivity found.1 found.2 found.both found.al3
##      <lgcl> <num>     <num>     <num> <int> <int> <num> <num>
## 1:    NA     1       1       NA     0     0       0       0
## 2:    NA     1       1       NA     0     0       0       0
## 3:    NA     1       1       NA     NA     NA       NA       NA
## 4:    NA     1       1       NA     NA     NA       NA       NA
## 5:    NA     1       1       NA     0     0       0       0
## 6:    NA     1       1       NA     0     0       0       0
##      hr.H.true hr.Hc.true hr.H.hat hr.Hc.hat b1.H    b2.H b1.Hc      b2.Hc
##      <lgcl>     <num>     <num>     <num> <lgcl> <lgcl> <num>     <num>
## 1:      NA 0.6000708      NA 0.6000708      NA     NA     0 0.04834743
## 2:      NA 0.6000708      NA 0.6000708      NA     NA     0 0.04834743
## 3:      NA 0.6000708      NA 0.6000708      NA     NA     0 0.04834743
## 4:      NA 0.6000708      NA 0.6000708      NA     NA     0 0.04834743
## 5:      NA 0.6000708      NA 0.6000708      NA     NA     0 0.04834743
## 6:      NA 0.6000708      NA 0.6000708      NA     NA     0 0.04834743

```

```

##      p.cens analysis   taumax    hr.itt     l.itt      u.itt hr.adj.itt l.adj.itt
##      <num>   <char>   <num>   <num>   <num>   <num>   <num>   <num>
## 1:  0.45      FS1 75.55189 0.6000708 0.4404799 0.8174834 0.5166355 0.37681
## 2:  0.45      FS1g 45.33113 0.6000708 0.4404799 0.8174834 0.5166355 0.37681
## 3:  0.45      GRF 75.55189 0.6000708 0.4404799 0.8174834 0.5166355 0.37681
## 4:  0.45      GRF.60 45.33113 0.6000708 0.4404799 0.8174834 0.5166355 0.37681
## 5:  0.45      VT(24) 75.55189 0.6000708 0.4404799 0.8174834 0.5166355 0.37681
## 6:  0.45      VT#(24) 75.55189 0.6000708 0.4404799 0.8174834 0.5166355 0.37681
##      u.adj.itt l.H.true u.H.true l.Hc.true u.Hc.true l.H.hat u.H.hat l.Hc.hat
##      <num>   <lgcl>   <lgcl>   <num>   <num>   <num>   <num>   <num>
## 1: 0.708347      NA      NA 0.4404799 0.8174834      NA      NA 0.4404799
## 2: 0.708347      NA      NA 0.4404799 0.8174834      NA      NA 0.4404799
## 3: 0.708347      NA      NA 0.4404799 0.8174834      NA      NA 0.4404799
## 4: 0.708347      NA      NA 0.4404799 0.8174834      NA      NA 0.4404799
## 5: 0.708347      NA      NA 0.4404799 0.8174834      NA      NA 0.4404799
## 6: 0.708347      NA      NA 0.4404799 0.8174834      NA      NA 0.4404799
##      u.Hc.hat
##      <num>
## 1: 0.8174834
## 2: 0.8174834
## 3: 0.8174834
## 4: 0.8174834
## 5: 0.8174834
## 6: 0.8174834
## Subgroup HRs: H, H^c, Causal= NA 0.5517234 0.5517234
## Simulations= 20000
## Avg censoring= 0.501857
## Min,Max,Avg tau.max= 59.38268 83.94994 78.95074
## P(H) approximation at causal(Hrc), n=60, approx= 0.5517234 0.008107176
## P(H) approximation at plim(Hrc), n=60, approx= 0.5427458 0.007193425
## Minutes,hours 93.4978 1.558297
##          FS1    FS1g     GRF   GRF.60   VT(24)  VT#(24)  VT(36)  VT#(36)
##      any.H 0.040  0.040  0.130  0.070  0.010  0.000  0.020  0.010
##      sensH  NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN
##      sensHc 0.990  0.990  0.970  0.980  1.000  1.000  0.990  1.000
##      ppH 0.000  0.000  0.000  0.000  0.000  0.000  0.000  0.000
##      ppHc 1.000  1.000  1.000  1.000  1.000  1.000  1.000  1.000
##      Avg(#H) 73.000 73.000 74.000 71.000 71.000 69.000 74.000 70.000
##      minH 61.000 61.000 60.000 60.000 60.000 60.000 60.000 60.000
##      maxH 150.000 150.000 160.000 136.000 125.000 102.000 138.000 125.000
##      Avg(#Hc) 297.000 297.000 291.000 295.000 299.000 300.000 298.000 300.000
##      minHc 150.000 150.000 140.000 164.000 175.000 198.000 162.000 175.000
##      maxHc 300.000 300.000 300.000 300.000 300.000 300.000 300.000 300.000
##      hat(H*)  NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN
##      hat(hat[H]) 1.991  1.992  1.726  1.515  1.095  1.283  1.130  1.496
##      hat(Hc*) 0.693  0.697  0.636  0.622  0.607  0.632  0.614  0.638
##      hat(hat[Hc]) 0.499  0.502  0.460  0.474  0.513  0.513  0.511  0.497
##      hat(H*)all  NaN   NaN   NaN   NaN   NaN   NaN   NaN   NaN
##      hat(Hc*)all 0.543  0.543  0.543  0.543  0.543  0.543  0.543  0.543
##      hat(ITT)all 0.543  0.543  0.543  0.543  0.543  0.543  0.543  0.543
##      hat(ITTadj)all 0.488  0.488  0.488  0.488  0.488  0.488  0.488  0.488

missC <- tab_tests(res = res)

pA <- as.character(round(outres$pAnyH.approx2, 4))

```

```
tabsim_missC <- get_tabsim(missC = missC, pA = pA, est_names = est_names, stat_names = stat_names,
    mod.harm = mod.harm, Nsims = Nsims)
```

Table 1: Average classification rates: $\text{avg}|\hat{H}|$, $\text{min}|\hat{H}|$, and $\text{max}|\hat{H}|$, denote the average, minimum, and maximum of the number of subjects in the estimated subgroup \hat{H} (analogously for \hat{H}^c). Note that under the null $\text{sens}(\hat{H})$ is undefined and $\text{ppv}(\hat{H}) = 0$.

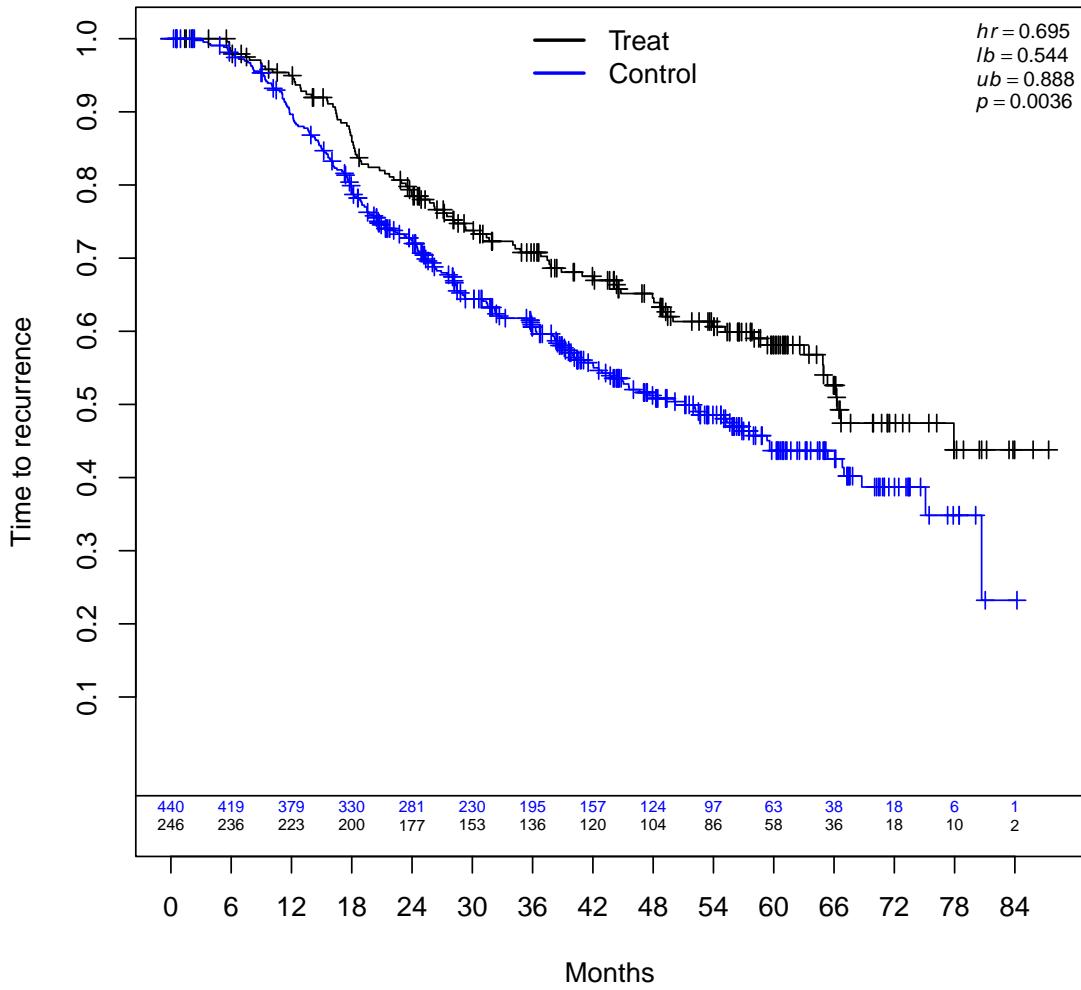
| | FS_g | FS_{lg} | GRF | GRF_{60} | $VT(24)$ | $VT^{\#}(24)$ | $VT(36)$ | $VT^{\#}(36)$ |
|----------------------------|--------|-----------|-------|------------|----------|---------------|----------|---------------|
| Finding H | | | | | | | | |
| $\text{any}(H)$ | 0.04 | 0.04 | 0.13 | 0.07 | 0.01 | 0 | 0.02 | 0.01 |
| $\text{sens}(\hat{H})$ | . | . | . | . | . | . | . | . |
| $\text{sens}(\hat{H}^c)$ | 0.99 | 0.99 | 0.97 | 0.98 | 1 | 1 | 0.99 | 1 |
| $\text{ppv}(\hat{H})$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| $\text{ppv}(\hat{H}^c)$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Size of H and H-complement | | | | | | | | |
| $\text{avg} \hat{H} $ | 73 | 73 | 74 | 71 | 71 | 69 | 74 | 70 |
| $\text{min} \hat{H} $ | 61 | 61 | 60 | 60 | 60 | 60 | 60 | 60 |
| $\text{max} \hat{H} $ | 150 | 150 | 160 | 136 | 125 | 102 | 138 | 125 |
| $\text{avg} \hat{H}^c $ | 297 | 297 | 291 | 295 | 299 | 300 | 298 | 300 |
| $\text{min} \hat{H}^c $ | 150 | 150 | 140 | 164 | 175 | 198 | 162 | 175 |
| $\text{max} \hat{H}^c $ | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |

Note: Number of simulations= 20000 .

Note: Probability approximation= 0.0072 .

```
mod.harm <- "alt"
hrH.target <- 2

this.dgm <- get.dgm4.OC(mod.harm = mod.harm, N = N, k.treat = k.treat, model.index = model.index,
    sol_tol = 10^-8, hrH.target = hrH.target, cens.type = cens.type, out.loc = out.loc,
    file.index = file.index, details = TRUE, parms_torand = FALSE)
```



```

## Super-population empirical harm and non-harm hazard ratios= 1.999999 0.557631
## Causal HR (empirical ITT)= 0.7363833

dgm <- this.dgm$dgm
output.file <- this.dgm$out.file

if (!is.null(output.file) & !grepl(mod.harm, output.file)) stop("Wrong file name for mod.harm")

# Show first simulation ans1 <- oc_analyses_m4_FS4(2)

t.start <- proc.time()[3]
res <- foreach(sim = seq_len(Nsims), .options.future = list(seed = TRUE), .combine = "rbind",
    .errorhandling = "pass") %dofuture% {
    ans <- oc_analyses_m4FourCuts_FS4(sim)
    return(ans)
}

## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 49.06126 2

```

```

##   leaf.node control.mean control.size control.se depth
## 1      2      -2.85     256.00      1.95      1
## 2      5       7.97      82.00      3.50      2
## 3      6      -7.10     146.00      2.45      2
##   leaf.node control.mean control.size control.se depth
## 2      5       7.97      82.00      3.50      2
## GRF subgroup found
## All splits
## [1] "noise5 <= -0.4"  "noise2 <= -0.77" "noise5 <= 1.07"
## Terminating node at max.diff (sg.harm.id)
## [1] "noise2 <= -0.768600960339892"
## # of continuous/categorical characteristics 6 6
## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## Default cuts included (1st 20)
## Categorical: z1 z2 z3 z4 z5 grade3
## Factors per GRF: noise5 <= -0.4 noise2 <= -0.77 noise5 <= 1.07
## Initial GRF cuts included noise5 <= -0.4 noise2 <= -0.77 noise5 <= 1.07
## # of candidate subgroup factors= 28
## [1] "noise5 <= -0.4"  "noise2 <= -0.77" "noise5 <= 1.07"  "size <= 29.6"
## [5] "size <= 25"      "size <= 21"      "size <= 35"      "noise1 <= 0"
## [9] "noise1 <= -0.6"  "noise1 <= 0.7"  "noise2 <= 0"    "noise2 <= -0.7"
## [13] "noise2 <= 0.7"  "noise3 <= 0"   "noise3 <= -0.7" "noise3 <= 0.8"
## [17] "noise4 <= 0"    "noise4 <= -0.8" "noise4 <= 0.7"  "noise5 <= -0.1"
## [21] "noise5 <= -0.8" "noise5 <= 0.5"  "z1"           "z2"
## [25] "z3"              "z4"            "z5"           "grade3"
## Number of factors evaluated= 28
## Confounders per grf screening q6 q25 q7 q3 q24 q23 q22 q19 q1 q27 q4 q14 q26 q5 q11 q8 q17 q20 q21 q
##          Factors Labels VI(grf)
## 6      size <= 21      q6  0.1003
## 25      z3            q25  0.0794
## 7      size <= 35      q7  0.0733
## 3      noise5 <= 1.07  q3  0.0687
## 24      z2            q24  0.0653
## 23      z1            q23  0.0463
## 22      noise5 <= 0.5  q22  0.0453
## 19      noise4 <= 0.7  q19  0.0404
## 1      noise5 <= -0.4  q1   0.0389
## 27      z5            q27  0.0365
## 4      size <= 29.6   q4   0.0359
## 14      noise3 <= 0   q14  0.0345
## 26      z4            q26  0.0334
## 5      size <= 25      q5   0.0311
## 11      noise2 <= 0   q11  0.0304
## 8      noise1 <= 0   q8   0.0298
## 17      noise4 <= 0   q17  0.0295
## 20      noise5 <= -0.1  q20  0.0288
## 21      noise5 <= -0.8  q21  0.0227
## 15      noise3 <= -0.7  q15  0.0193
## 10      noise1 <= 0.7  q10  0.0189
## 13      noise2 <= 0.7  q13  0.0166
## 12      noise2 <= -0.7  q12  0.0161
## 9      noise1 <= -0.6  q9   0.0158
## 16      noise3 <= 0.8  q16  0.0143
## 28      grade3        q28  0.0106

```

```

## 18 noise4 <= -0.8      q18  0.0103
## 2 noise2 <= -0.77      q2   0.0076
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1596
## Approximately 5% of max_count met: minutes 0.0028
## Approximately 10% of max_count met: minutes 0.004083333
## Approximately 20% of max_count met: minutes 0.006516667
## Approximately 33% of max_count met: minutes 0.01075
## Approximately 50% of max_count met: minutes 0.0155
## Approximately 75% of max_count met: minutes 0.02465
## Approximately 90% of max_count met: minutes 0.02916667
## # of subgroups evaluated based on (up to) maxk-factor combinations 1596
## % of all-possible combinations (<= maxk) 100
## k.max= 2
## Events criteria for control,exp= 10 10
## # of subgroups with events less than criteria: control, experimental 252 309
## # of subgroups with sample size less than criteria 713
## # of subgroups meeting all criteria = 855
## # of subgroups fitted (Cox model estimable) = 855
## *Subgroup Searching Minutes= 0.03105
## Number of subgroups meeting HR threshold 49
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 49
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##    n  E d1   HR L(HR) q6.0 q6.1 q25.0 q25.1 q7.0 q7.1 q3.0 q3.1 q24.0 q24.1
## 1  67 42 22 1.89  1.03   0   0   0   0   1   0   0   0   0   0   0
## 2  67 42 22 1.89  1.03   1   0   0   0   1   0   0   0   0   0   0
## 3  63 42 20 1.80  0.98   0   0   0   0   0   0   0   0   0   0   0
## 4  72 45 25 1.71  0.95   0   0   0   0   0   0   0   0   0   0   1
## 5  70 43 28 1.69  0.90   0   0   0   0   0   0   0   0   0   0   0
## 6  69 41 23 1.56  0.84   0   0   0   0   0   0   0   0   0   0   0
## 7  80 60 31 1.56  0.94   0   0   0   0   1   0   0   0   0   0   0
## 8  74 58 29 1.52  0.90   0   0   0   0   0   0   0   0   0   0   1
## 9  78 57 31 1.48  0.88   0   0   0   0   0   0   0   0   0   0   0
## 10 61 37 19 1.48  0.77   0   0   0   0   0   0   0   0   0   0   0
## Consistency 0.95
## # of splits= 400
## Model, % Consistency Met= !{size <= 35} 0.95
## SG focus= hr
## Subgroup Consistency Minutes= 0.02448333
## Subgroup found (FS)
## Minutes forestsearch overall= 0.06066667
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 49.06126 2
##   leaf.node control.mean control.size control.se depth
## 1        2       -2.85     256.00      1.95      1
## 2        5        7.97     82.00      3.50      2
## 3        6       -7.10    146.00      2.45      2
##   leaf.node control.mean control.size control.se depth
## 2        5        7.97     82.00      3.50      2
## GRF subgroup found
## All splits
## [1] "noise5 <= -0.4"  "noise2 <= -0.77" "noise5 <= 1.07"
## Terminating node at max.diff (sg.harm.id)
## [1] "noise2 <= -0.768600960339892"
## # of continuous/categorical characteristics 6 6

```

```

## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## CV lambda = 0.03751062
## 12 x 1 sparse Matrix of class "dgCMatrix"
##          s0
## z1      0.06313344
## z2      .
## z3      0.28641313
## z4      0.57548664
## z5     -0.61782376
## size    .
## grade3 .
## noise1 .
## noise2 -0.06786117
## noise3 .
## noise4 .
## noise5 .
## Cox-LASSO selected: z1 z3 z4 z5 noise2
## Cox-LASSO not selected: z2 size grade3 noise1 noise3 noise4 noise5
## Default cuts included from Lasso:
## Categorical after Lasso: z1 z3 z4 z5
## Factors per GRF: noise5 <= -0.4 noise2 <= -0.77 noise5 <= 1.07
## Initial GRF cuts included noise5 <= -0.4 noise2 <= -0.77 noise5 <= 1.07
## Factors included per GRF (not in lasso) noise5 <= -0.4 noise2 <= -0.77 noise5 <= 1.07
## # of candidate subgroup factors= 26
## [1] "noise5 <= -0.4" "noise2 <= -0.77" "noise5 <= 1.07" "size <= 29.6"
## [5] "size <= 25"      "size <= 21"      "size <= 35"      "noise1 <= 0"
## [9] "noise1 <= -0.6"  "noise1 <= 0.7"   "noise2 <= 0"    "noise2 <= -0.7"
## [13] "noise2 <= 0.7"  "noise3 <= 0"    "noise3 <= -0.7" "noise3 <= 0.8"
## [17] "noise4 <= 0"    "noise4 <= -0.8"  "noise4 <= 0.7" "noise5 <= -0.1"
## [21] "noise5 <= -0.8" "noise5 <= 0.5"   "z1"           "z3"
## [25] "z4"             "z5"
## Number of factors evaluated= 26
## Confounders per grf screening q24 q6 q7 q3 q23 q22 q1 q19 q4 q25 q8 q26 q14 q11 q17 q5 q20 q15 q9 q2
##          Factors Labels VI(grf)
## 24          z3    q24  0.1086
## 6           size <= 21   q6   0.1004
## 7           size <= 35   q7   0.0713
## 3    noise5 <= 1.07   q3   0.0712
## 23          z1    q23  0.0556
## 22    noise5 <= 0.5   q22  0.0444
## 1    noise5 <= -0.4   q1   0.0416
## 19    noise4 <= 0.7   q19  0.0415
## 4     size <= 29.6   q4   0.0398
## 25          z4    q25  0.0366
## 8    noise1 <= 0     q8   0.0352
## 26          z5    q26  0.0352
## 14   noise3 <= 0     q14  0.0340
## 11   noise2 <= 0     q11  0.0335
## 17   noise4 <= 0     q17  0.0326
## 5    size <= 25     q5   0.0301
## 20   noise5 <= -0.1   q20  0.0285
## 15   noise3 <= -0.7   q15  0.0279
## 9    noise1 <= -0.6   q9   0.0205
## 21   noise5 <= -0.8   q21  0.0205

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## 10 noise1 <= 0.7 q10 0.0199
## 13 noise2 <= 0.7 q13 0.0182
## 12 noise2 <= -0.7 q12 0.0143
## 16 noise3 <= 0.8 q16 0.0143
## 18 noise4 <= -0.8 q18 0.0135
## 2 noise2 <= -0.77 q2 0.0106
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1378
## Approximately 5% of max_count met: minutes 0.00235
## Approximately 10% of max_count met: minutes 0.0039
## Approximately 20% of max_count met: minutes 0.0061
## Approximately 33% of max_count met: minutes 0.00945
## Approximately 50% of max_count met: minutes 0.01385
## Approximately 75% of max_count met: minutes 0.0222
## Approximately 90% of max_count met: minutes 0.02636667
## # of subgroups evaluated based on (up to) maxk-factor combinations 1378
## % of all-possible combinations (<= maxk) 100
## k.max= 2
## Events criteria for control,exp= 10 10
## # of subgroups with events less than criteria: control, experimental 223 257
## # of subgroups with sample size less than criteria 612
## # of subgroups meeting all criteria = 739
## # of subgroups fitted (Cox model estimable) = 739
## *Subgroup Searching Minutes= 0.02791667
## Number of subgroups meeting HR threshold 41
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 41
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##   n E d1 HR L(HR) q24.0 q24.1 q6.0 q6.1 q7.0 q7.1 q3.0 q3.1 q23.0 q23.1
## 1 67 42 22 1.89 1.03 0 0 0 0 1 0 0 0 0 0 0 0
## 2 67 42 22 1.89 1.03 0 0 1 0 1 0 0 0 0 0 0
## 3 63 42 20 1.80 0.98 0 0 0 0 0 0 0 0 0 0 1
## 4 70 43 28 1.69 0.90 0 0 0 0 0 0 0 0 0 0 0
## 5 69 41 23 1.56 0.84 0 0 0 0 0 0 0 0 0 0 0
## 6 80 60 31 1.56 0.94 0 1 0 0 0 0 0 0 0 0 1
## 7 78 57 31 1.48 0.88 0 0 0 0 0 0 0 0 0 0 0
## 8 61 37 19 1.48 0.77 0 0 0 0 0 0 0 0 0 0 0
## 9 74 42 24 1.47 0.79 0 0 0 0 0 0 0 0 0 0 0
## 10 61 40 20 1.43 0.76 0 1 0 0 0 0 0 0 0 0 0
## Consistency 0.95
## # of splits= 400
## Model, % Consistency Met= !{size <= 35} 0.95
## SG focus= hr
## Subgroup Consistency Minutes= 0.0232
## Subgroup found (FS)
## Minutes forestsearch overall= 0.05636667
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 47.98043 2
##   leaf.node control.mean control.size control.se depth
## 1 2 -3.81 170.00 2.10 1
## 2 3 4.92 130.00 2.58 1
## 11 4 -8.26 80.00 2.96 2
## 4 7 7.43 114.00 2.72 2
##   leaf.node control.mean control.size control.se depth
## 4 7 7.43 114.00 2.72 2
## GRF subgroup found

```

```

## All splits
## [1] "z2 <= 0"           "noise4 <= 0.29" "z1 <= 0"
## Terminating node at max.diff (sg.harm.id)
## [1] "z1 <= 0"
## # of continuous/categorical characteristics 6 6
## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## Default cuts included (1st 20)
## Categorical: z1 z2 z3 z4 z5 grade3
## Factors per GRF: z2 <= 0 noise4 <= 0.29 z1 <= 0
## Initial GRF cuts included z2 <= 0 noise4 <= 0.29 z1 <= 0
## # of candidate subgroup factors= 27
## [1] "noise4 <= 0.29" "size <= 27.9"   "size <= 25"      "size <= 20"
## [5] "size <= 34"       "noise1 <= 0.1"   "noise1 <= -0.7" "noise1 <= 0.7"
## [9] "noise2 <= 0"       "noise2 <= -0.1"  "noise2 <= -0.6" "noise2 <= 0.7"
## [13] "noise3 <= 0"       "noise3 <= -0.7"  "noise3 <= 0.7"  "noise4 <= 0"
## [17] "noise4 <= -0.8"    "noise4 <= 0.7"   "noise5 <= 0.1"  "noise5 <= -0.5"
## [21] "noise5 <= 0.8"    "z1"            "z2"            "z3"
## [25] "z4"              "z5"            "grade3"
## Number of factors evaluated= 27
## Confounders per grf screening q24 q17 q22 q3 q2 q1 q15 q6 q14 q26 q25 q4 q21 q23 q16 q13 q19 q5 q12
## Factors Labels VI(grf)
## 24          z3     q24  0.0991
## 17 noise4 <= -0.8  q17  0.0654
## 22          z1     q22  0.0605
## 3   size <= 25    q3   0.0567
## 2   size <= 27.9   q2   0.0535
## 1   noise4 <= 0.29  q1   0.0471
## 15  noise3 <= 0.7  q15  0.0468
## 6   noise1 <= 0.1   q6   0.0444
## 14  noise3 <= -0.7  q14  0.0400
## 26          z5     q26  0.0397
## 25          z4     q25  0.0369
## 4   size <= 20    q4   0.0348
## 21  noise5 <= 0.8  q21  0.0338
## 23          z2     q23  0.0318
## 16  noise4 <= 0    q16  0.0305
## 13  noise3 <= 0    q13  0.0304
## 19  noise5 <= 0.1  q19  0.0303
## 5   size <= 34    q5   0.0290
## 12  noise2 <= 0.7  q12  0.0275
## 10  noise2 <= -0.1  q10  0.0262
## 9   noise2 <= 0    q9   0.0237
## 27          grade3 q27  0.0237
## 20  noise5 <= -0.5  q20  0.0228
## 8   noise1 <= 0.7   q8   0.0217
## 7   noise1 <= -0.7  q7   0.0154
## 11  noise2 <= -0.6  q11  0.0145
## 18  noise4 <= 0.7   q18  0.0135
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1485
## Approximately 5% of max_count met: minutes 0.0031
## Approximately 10% of max_count met: minutes 0.005966667
## Approximately 20% of max_count met: minutes 0.009433333
## Approximately 33% of max_count met: minutes 0.01551667
## Approximately 50% of max_count met: minutes 0.02283333

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## Approximately 75% of max_count met: minutes 0.03336667
## Approximately 90% of max_count met: minutes 0.0404
## # of subgroups evaluated based on (up to) maxk-factor combinations 1485
## % of all-possible combinations (<= maxk) 100
## k.max= 2
## Events criteria for control,exp= 10 10
## # of subgroups with events less than criteria: control, experimental 216 339
## # of subgroups with sample size less than criteria 621
## # of subgroups meeting all criteria = 828
## # of subgroups fitted (Cox model estimable) = 828
## *Subgroup Searching Minutes= 0.04376667
## Number of subgroups meeting HR threshold 56
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 56
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##   n E d1  HR L(HR) q24.0 q24.1 q17.0 q17.1 q22.0 q22.1 q3.0 q3.1 q2.0 q2.1
## 1 96 61 29 1.95  1.17    0    1    0    0    0    1    0    0    0    0    0
## 2 73 36 20 1.89  0.98    0    0    0    0    0    0    0    0    0    0    0
## 3 79 41 23 1.75  0.94    0    0    0    0    0    0    0    0    0    0    0
## 4 95 57 29 1.73  1.03    0    0    0    0    0    0    1    0    0    0    0
## 5 61 38 20 1.71  0.90    0    1    0    0    0    0    0    0    0    0    0
## 6 68 53 27 1.70  0.98    0    1    0    0    0    0    0    0    0    0    0
## 7 64 34 19 1.68  0.85    0    1    0    0    0    0    0    0    0    1    0    0
## 8 72 45 22 1.67  0.93    0    1    0    0    0    0    0    0    0    0    0    0
## 9 106 63 33 1.66  1.01    0    1    0    0    0    0    0    0    0    0    0    0
## 10 71 44 24 1.65  0.91   0    1    0    0    0    0    0    0    0    0    0    0
## Consistency 0.995
## # of splits= 400
## Model, % Consistency Met= {z3} {z1} 0.995
## SG focus= hr
## Subgroup Consistency Minutes= 0.03203333
## Subgroup found (FS)
## Minutes forestsearch overall= 0.08255
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 47.98043 2
##   leaf.node control.mean control.size control.se depth
## 1      2       -3.81     170.00      2.10      1
## 2      3        4.92     130.00      2.58      1
## 11     4       -8.26      80.00      2.96      2
## 4      7        7.43     114.00      2.72      2
##   leaf.node control.mean control.size control.se depth
## 4      7        7.43     114.00      2.72      2
## GRF subgroup found
## All splits
## [1] "z2 <= 0"      "noise4 <= 0.29" "z1 <= 0"
## Terminating node at max.diff (sg.harm.id)
## [1] "z1 <= 0"
## # of continuous/categorical characteristics 6 6
## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## CV lambda = 0.03590407
## 12 x 1 sparse Matrix of class "dgCMatrix"
## 
## z1 .
## z2 .

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```

## z3      0.3594938
## z4      0.9719108
## z5     -0.9809366
## size    .
## grade3 .
## noise1 .
## noise2 .
## noise3 .
## noise4 .
## noise5 .
## Cox-LASSO selected: z3 z4 z5
## Cox-LASSO not selected: z1 z2 size grade3 noise1 noise2 noise3 noise4 noise5
## Default cuts included from Lasso:
## Categorical after Lasso: z3 z4 z5
## Factors per GRF: z2 <= 0 noise4 <= 0.29 z1 <= 0
## Initial GRF cuts included z2 <= 0 noise4 <= 0.29 z1 <= 0
## Factors included per GRF (not in lasso) z2 <= 0 noise4 <= 0.29 z1 <= 0
## # of candidate subgroup factors= 26
## [1] "noise4 <= 0.29" "size <= 27.9"   "size <= 25"      "size <= 20"
## [5] "size <= 34"       "noise1 <= 0.1"   "noise1 <= -0.7"  "noise1 <= 0.7"
## [9] "noise2 <= 0"       "noise2 <= -0.1"   "noise2 <= -0.6"  "noise2 <= 0.7"
## [13] "noise3 <= 0"       "noise3 <= -0.7"   "noise3 <= 0.7"   "noise4 <= 0"
## [17] "noise4 <= -0.8"   "noise4 <= 0.7"   "noise5 <= 0.1"   "noise5 <= -0.5"
## [21] "noise5 <= 0.8"   "z3"           "z4"           "z5"
## [25] "z2 <= 0"          "z1 <= 0"
## Number of factors evaluated= 26
## Confounders per grf screening q22 q17 q3 q26 q2 q15 q6 q1 q4 q14 q24 q23 q19 q5 q13 q16 q10 q21 q25
## Factors Labels VI(grf)
## 22      z3    q22  0.1122
## 17 noise4 <= -0.8   q17  0.0648
## 3      size <= 25    q3   0.0634
## 26      z1 <= 0     q26  0.0614
## 2      size <= 27.9   q2   0.0504
## 15 noise3 <= 0.7    q15  0.0454
## 6      noise1 <= 0.1   q6   0.0448
## 1      noise4 <= 0.29   q1   0.0442
## 4      size <= 20     q4   0.0399
## 14 noise3 <= -0.7    q14  0.0385
## 24      z5    q24  0.0385
## 23      z4    q23  0.0354
## 19 noise5 <= 0.1     q19  0.0325
## 5      size <= 34     q5   0.0319
## 13 noise3 <= 0     q13  0.0312
## 16 noise4 <= 0     q16  0.0305
## 10 noise2 <= -0.1    q10  0.0299
## 21 noise5 <= 0.8     q21  0.0295
## 25      z2 <= 0     q25  0.0291
## 12 noise2 <= 0.7     q12  0.0282
## 20 noise5 <= -0.5    q20  0.0263
## 8      noise1 <= 0.7   q8   0.0245
## 9      noise2 <= 0     q9   0.0231
## 11 noise2 <= -0.6    q11  0.0167
## 7      noise1 <= -0.7   q7   0.0156
## 18 noise4 <= 0.7     q18  0.0124
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1378

```

```

## Approximately 5% of max_count met: minutes 0.0032
## Approximately 10% of max_count met: minutes 0.006133333
## Approximately 20% of max_count met: minutes 0.009383333
## Approximately 33% of max_count met: minutes 0.01485
## Approximately 50% of max_count met: minutes 0.0213
## Approximately 75% of max_count met: minutes 0.031
## Approximately 90% of max_count met: minutes 0.036933333
## # of subgroups evaluated based on (up to) maxk-factor combinations 1378
## % of all-possible combinations (<= maxk) 100
## k.max= 2
## Events criteria for control,exp= 10 10
## # of subgroups with events less than criteria: control, experimental 199 310
## # of subgroups with sample size less than criteria 559
## # of subgroups meeting all criteria = 783
## # of subgroups fitted (Cox model estimable) = 783
## *Subgroup Searching Minutes== 0.04003333
## Number of subgroups meeting HR threshold 56
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 56
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##      n E d1   HR L(HR) q22.0 q22.1 q17.0 q17.1 q3.0 q3.1 q26.0 q26.1 q2.0 q2.1
## 1  96 61 29 1.95  1.17    0     1     0     0     0     0     1     0     0     0
## 2  73 36 20 1.89  0.98    0     0     0     0     0     0     0     0     0     0
## 3  79 41 23 1.75  0.94    0     0     0     0     0     0     0     0     0     0
## 4  95 57 29 1.73  1.03    0     0     0     0     0     0     0     1     0     0
## 5  61 38 20 1.71  0.90    0     1     0     0     0     0     0     0     0     0
## 6  68 53 27 1.70  0.98    0     1     0     0     0     0     0     0     0     0
## 7  64 34 19 1.68  0.85    0     1     0     0     0     0     1     0     0     0
## 8  72 45 22 1.67  0.93    0     1     0     0     0     0     0     0     0     0
## 9  106 63 33 1.66  1.01    0     1     0     0     0     0     0     0     0     0
## 10 71 44 24 1.65  0.91    0     1     0     0     0     0     0     0     0     0
## Consistency 0.995
## # of splits= 400
## Model, % Consistency Met= {z3} !{z1 <= 0} 0.995
## SG focus= hr
## Subgroup Consistency Minutes= 0.03001667
## Subgroup found (FS)
## Minutes forestsearch overall= 0.07901667
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 45.36853 2
##   leaf.node control.mean control.size control.se depth
## 1        2       -5.62      176.00      2.00      1
## 2        3        5.14      124.00      2.53      1
## 3        4        8.89       78.00      3.09      2
## 4        5       -7.27      80.00      2.89      2
## 5        6        4.88      63.00      3.53      2
## 6        7       -9.76      79.00      2.88      2
##   leaf.node control.mean control.size control.se depth
## 3        4        8.89      78.00      3.09      2
## GRF subgroup found
## All splits
## [1] "noise1 <= -0.07" "noise5 <= 0.01" "noise4 <= -0.06"
## Terminating node at max.diff (sg.harm.id)
## [1] "noise5 <= 0.00807090609630402"
## # of continuous/categorical characteristics 6 6

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```

## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## Default cuts included (1st 20)
## Categorical: z1 z2 z3 z4 z5 grade3
## Factors per GRF: noise1 <= -0.07 noise5 <= 0.01 noise4 <= -0.06
## Initial GRF cuts included noise1 <= -0.07 noise5 <= 0.01 noise4 <= -0.06
## # of candidate subgroup factors= 30
## [1] "noise1 <= -0.07" "noise5 <= 0.01" "noise4 <= -0.06" "size <= 29.7"
## [5] "size <= 27" "size <= 21" "size <= 35" "noise1 <= -0.1"
## [9] "noise1 <= -0.8" "noise1 <= 0.7" "noise2 <= -0.1" "noise2 <= -0.8"
## [13] "noise2 <= 0.5" "noise3 <= 0.1" "noise3 <= 0" "noise3 <= -0.6"
## [17] "noise3 <= 0.8" "noise4 <= 0.1" "noise4 <= 0" "noise4 <= -0.6"
## [21] "noise4 <= 0.8" "noise5 <= 0" "noise5 <= -0.7" "noise5 <= 0.7"
## [25] "z1" "z2" "z3" "z4"
## [29] "z5" "grade3"
## Number of factors evaluated= 30
## Confounders per grf screening q26 q27 q2 q28 q22 q3 q25 q1 q29 q11 q5 q8 q15 q23 q14 q24 q18 q17 q4 q
## Factors Labels VI(grf)
## 26      z2    q26  0.1636
## 27      z3    q27  0.1613
## 2   noise5 <= 0.01    q2  0.1153
## 28      z4    q28  0.0785
## 22      noise5 <= 0  q22  0.0542
## 3   noise4 <= -0.06  q3  0.0409
## 25      z1    q25  0.0309
## 1   noise1 <= -0.07  q1  0.0291
## 29      z5    q29  0.0266
## 11  noise2 <= -0.1  q11 0.0252
## 5   size <= 27     q5  0.0211
## 8   noise1 <= -0.1  q8  0.0208
## 15  noise3 <= 0   q15 0.0208
## 23  noise5 <= -0.7  q23 0.0177
## 14  noise3 <= 0.1  q14 0.0175
## 24  noise5 <= 0.7  q24 0.0168
## 18  noise4 <= 0.1  q18 0.0158
## 17  noise3 <= 0.8  q17 0.0153
## 4   size <= 29.7   q4  0.0145
## 19  noise4 <= 0   q19 0.0141
## 16  noise3 <= -0.6  q16 0.0130
## 13  noise2 <= 0.5  q13 0.0121
## 12  noise2 <= -0.8  q12 0.0119
## 9   noise1 <= -0.8  q9  0.0115
## 30      grade3  q30  0.0104
## 6   size <= 21     q6  0.0101
## 21  noise4 <= 0.8  q21 0.0100
## 20  noise4 <= -0.6  q20 0.0089
## 7   size <= 35     q7  0.0072
## 10  noise1 <= 0.7  q10 0.0048
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1830
## Approximately 5% of max_count met: minutes 0.004066667
## Approximately 10% of max_count met: minutes 0.008333333
## Approximately 20% of max_count met: minutes 0.01538333
## Approximately 33% of max_count met: minutes 0.025
## Approximately 50% of max_count met: minutes 0.03513333
## Approximately 75% of max_count met: minutes 0.04775

```

```

## Approximately 90% of max_count met: minutes 0.05418333
## # of subgroups evaluated based on (up to) maxk-factor combinations 1830
## % of all-possible combinations (<= maxk) 100
## k.max= 2
## Events criteria for control,exp= 10 10
## # of subgroups with events less than criteria: control, experimental 293 321
## # of subgroups with sample size less than criteria 701
## # of subgroups meeting all criteria = 1078
## # of subgroups fitted (Cox model estimable) = 1078
## *Subgroup Searching Minutes== 0.05716667
## Number of subgroups meeting HR threshold 183
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 183
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##      n   E d1    HR L(HR) q26.0 q26.1 q27.0 q27.1 q2.0 q2.1 q28.0 q28.1 q22.0
## 1  70  45 23 3.04  1.62    0     0     0     1     0     0     0     0     0     0
## 2  70  45 23 3.04  1.62    0     0     0     1     0     0     0     0     0     0
## 3  64  44 24 2.85  1.53    0     0     0     1     0     0     0     0     0     0
## 4  85  51 28 2.80  1.57    0     1     0     0     0     0     0     0     0     0
## 5  85  51 28 2.80  1.57    0     1     0     0     0     0     0     0     0     0
## 6  66  44 23 2.44  1.33    0     0     0     1     0     0     0     0     0     0
## 7  94  63 32 2.40  1.44    0     0     0     1     0     0     0     0     0     0
## 8  72  43 27 2.36  1.26    0     1     0     0     0     0     0     0     0     0
## 9  90  61 35 2.32  1.39    0     0     0     1     0     0     0     0     0     0
## 10 93  63 34 2.28  1.36    0     0     0     1     0     0     0     0     0     0
##      q22.1
## 1      0
## 2      0
## 3      0
## 4      0
## 5      0
## 6      0
## 7      0
## 8      0
## 9      0
## 10     0
## Consistency 1
## # of splits= 400
## Model, % Consistency Met= {z3} {noise1 <= -0.07} 1
## SG focus= hr
## Subgroup Consistency Minutes= 0.02946667
## Subgroup found (FS)
## Minutes forestsearch overall= 0.0931
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 45.36853 2
##      leaf.node control.mean control.size control.se depth
## 1          2        -5.62       176.00      2.00      1
## 2          3         5.14       124.00      2.53      1
## 3          4         8.89        78.00      3.09      2
## 4          5        -7.27       80.00      2.89      2
## 5          6         4.88       63.00      3.53      2
## 6          7        -9.76       79.00      2.88      2
##      leaf.node control.mean control.size control.se depth
## 3          4         8.89        78.00      3.09      2
## GRF subgroup found

```

```

## All splits
## [1] "noise1 <= -0.07" "noise5 <= 0.01" "noise4 <= -0.06"
## Terminating node at max.diff (sg.harm.id)
## [1] "noise5 <= 0.00807090609630402"
## # of continuous/categorical characteristics 6 6
## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## CV lambda = 0.03128063
## 12 x 1 sparse Matrix of class "dgCMatrix"
##           s0
## z1      0.114944573
## z2      .
## z3      0.553874965
## z4      0.974097466
## z5     -0.737588173
## size    .
## grade3 .
## noise1  0.082835678
## noise2  0.017275498
## noise3  .
## noise4  .
## noise5 -0.001910096
## Cox-LASSO selected: z1 z3 z4 z5 noise1 noise2 noise5
## Cox-LASSO not selected: z2 size grade3 noise3 noise4
## Default cuts included from Lasso:
## Categorical after Lasso: z1 z3 z4 z5
## Factors per GRF: noise1 <= -0.07 noise5 <= 0.01 noise4 <= -0.06
## Initial GRF cuts included noise1 <= -0.07 noise5 <= 0.01 noise4 <= -0.06
## Factors included per GRF (not in lasso) noise1 <= -0.07 noise5 <= 0.01 noise4 <= -0.06
## # of candidate subgroup factors= 28
## [1] "noise1 <= -0.07" "noise5 <= 0.01" "noise4 <= -0.06" "size <= 29.7"
## [5] "size <= 27"      "size <= 21"      "size <= 35"      "noise1 <= -0.1"
## [9] "noise1 <= -0.8"   "noise1 <= 0.7"   "noise2 <= -0.1"   "noise2 <= -0.8"
## [13] "noise2 <= 0.5"   "noise3 <= 0.1"   "noise3 <= 0"     "noise3 <= -0.6"
## [17] "noise3 <= 0.8"   "noise4 <= 0.1"   "noise4 <= 0"     "noise4 <= -0.6"
## [21] "noise4 <= 0.8"   "noise5 <= 0"     "noise5 <= -0.7"  "noise5 <= 0.7"
## [25] "z1"              "z3"            "z4"            "z5"
## Number of factors evaluated= 28
## Confounders per grf screening q26 q2 q27 q22 q3 q25 q28 q1 q11 q24 q23 q18 q8 q15 q14 q4 q5 q13 q19 q16
##          Factors Labels VI(grf)
## 26          z3    q26  0.2530
## 2  noise5 <= 0.01      q2    0.1186
## 27          z4    q27  0.0926
## 22  noise5 <= 0      q22  0.0578
## 3  noise4 <= -0.06    q3    0.0413
## 25          z1    q25  0.0369
## 28          z5    q28  0.0337
## 1  noise1 <= -0.07    q1    0.0288
## 11  noise2 <= -0.1     q11   0.0241
## 24  noise5 <= 0.7     q24   0.0232
## 23  noise5 <= -0.7     q23   0.0222
## 18  noise4 <= 0.1     q18   0.0220
## 8   noise1 <= -0.1     q8    0.0219
## 15  noise3 <= 0       q15   0.0212
## 14  noise3 <= 0.1     q14   0.0203

```

```

## 4      size <= 29.7      q4  0.0201
## 5      size <= 27       q5  0.0188
## 13     noise2 <= 0.5    q13 0.0181
## 19     noise4 <= 0     q19  0.0172
## 17     noise3 <= 0.8    q17  0.0161
## 12     noise2 <= -0.8   q12  0.0155
## 16     noise3 <= -0.6   q16  0.0154
## 9      noise1 <= -0.8   q9   0.0137
## 21     noise4 <= 0.8    q21  0.0114
## 6      size <= 21       q6   0.0112
## 20     noise4 <= -0.6   q20  0.0099
## 10     noise1 <= 0.7    q10  0.0078
## 7      size <= 35       q7   0.0072
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1596
## Approximately 5% of max_count met: minutes 0.003533333
## Approximately 10% of max_count met: minutes 0.006683333
## Approximately 20% of max_count met: minutes 0.01345
## Approximately 33% of max_count met: minutes 0.02121667
## Approximately 50% of max_count met: minutes 0.02983333
## Approximately 75% of max_count met: minutes 0.0407
## Approximately 90% of max_count met: minutes 0.04628333
## # of subgroups evaluated based on (up to) maxk-factor combinations 1596
## % of all-possible combinations (<= maxk) 100
## k.max= 2
## Events criteria for control,exp= 10 10
## # of subgroups with events less than criteria: control, experimental 261 285
## # of subgroups with sample size less than criteria 603
## # of subgroups meeting all criteria = 945
## # of subgroups fitted (Cox model estimable) = 945
## *Subgroup Searching Minutes=* 0.04951667
## Number of subgroups meeting HR threshold 140
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 140
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##   n E d1  HR L(HR) q26.0 q26.1 q2.0 q2.1 q27.0 q27.1 q22.0 q22.1 q3.0 q3.1
## 1  70 45 23 3.04  1.62   0    1    0    0    0    0    0    0    0    0    0    0
## 2  70 45 23 3.04  1.62   0    1    0    0    0    0    0    0    0    0    0    0
## 3  64 44 24 2.85  1.53   0    1    0    0    0    0    0    0    0    0    0    0
## 4  66 44 23 2.44  1.33   0    1    0    0    0    0    0    0    0    0    0    0
## 5  94 63 32 2.40  1.44   0    1    0    0    0    0    0    0    0    0    0    0
## 6  90 61 35 2.32  1.39   0    1    0    0    0    0    0    0    0    0    0    0
## 7  93 63 34 2.28  1.36   0    1    0    0    0    0    0    0    0    0    0    0
## 8  69 50 31 2.20  1.23   0    1    0    1    0    0    0    0    0    0    0    0
## 9  68 49 31 2.18  1.20   0    1    0    0    0    0    0    0    0    1    0    0
## 10 89 72 41 2.15  1.32   0    1    0    0    0    0    0    0    0    0    0    0
## Consistency 1
## # of splits= 400
## Model, % Consistency Met= {z3} {noise1 <= -0.07} 1
## SG focus= hr
## Subgroup Consistency Minutes= 0.03228333
## Subgroup found (FS)
## Minutes forestsearch overall= 0.08936667

t.now <- proc.time()[3]
t.min <- (t.now - t.start)/60

```

```

print(table(res$analysis))

##
##      FS1     FS1g      GRF   GRF.60   VT(24)   VT(36) VT#(24) VT#(36)
##    20000    20000    20000    20000    20000    20000    20000    20000

check <- c(c(table(res$analysis)) - Nsims)
if (all(check != 0)) stop("All analyses not complete")

dgm_alt <- dgm

outres <- out.results(res = res, dgm = dgm, output.file = output.file, t.min = t.min,
                      out_analysis = "FS1")

## [1] "results/oc_sims=20000_m4c-Noise=5_N=300_alt_ktreat=1.5_hrH=2_v0-4cuts.Rdata"
##      sim.sizeH_true propH_true sizeHc_true propHc_true any.H size.H size.Hc
##      <int>       <num>      <num>       <int>      <num> <num> <num> <int>
## 1:    1        80 0.2666667    220 0.7333333    1    67  233
## 2:    1        80 0.2666667    220 0.7333333    1    67  233
## 3:    1        80 0.2666667    220 0.7333333    1   101 199
## 4:    1        80 0.2666667    220 0.7333333    1    82 218
## 5:    1        80 0.2666667    220 0.7333333    1    80 220
## 6:    1        80 0.2666667    220 0.7333333    1    80 220
##      ppv      npv specificity sensitivity found.1 found.2 found.both found.al3
##      <num>      <num>      <num>      <num>      <num>      <num>      <num>
## 1: 0.20 0.7681818 0.7253219 0.2388060    0    0      0      0
## 2: 0.20 0.7681818 0.7253219 0.2388060    0    0      0      0
## 3: 0.40 0.6863636 0.7587940 0.3168317    NA    NA      NA      NA
## 4: 0.35 0.7545455 0.7614679 0.3414634    NA    NA      NA      NA
## 5: 1.00 1.0000000 1.0000000 1.0000000    0    0      0      0
## 6: 1.00 1.0000000 1.0000000 1.0000000    0    0      0      0
##      hr.H.true hr.Hc.true hr.H.hat hr.Hc.hat      b1.H      b2.H      b1.Hc
##      <num>      <num>      <num>      <num>      <num>      <num>      <num>
## 1: 1.559409 0.6836811 1.891602 0.6831815 0.33219378 -0.1083970 -0.0004996335
## 2: 1.559409 0.6836811 1.891602 0.6831815 0.33219378 -0.1083970 -0.0004996335
## 3: 1.559409 0.6836811 1.599971 0.6172136 0.04056242 -0.4000284 -0.0664675443
## 4: 1.559409 0.6836811 1.405952 0.7059411 -0.15345651 -0.5940473 0.0222599774
## 5: 1.559409 0.6836811 1.559409 0.6836811 0.00000000 -0.4405908 0.0000000000
## 6: 1.559409 0.6836811 1.559409 0.6836811 0.00000000 -0.4405908 0.0000000000
##      b2.Hc      p.cens analysis taumax hr.itt l.itt u.itt
##      <num>      <num> <char> <num>      <num>      <num>      <num>
## 1: 0.12555050 0.4033333    FS1 81.76877 0.8477298 0.6315583 1.137893
## 2: 0.12555050 0.4033333    FS1g 49.06126 0.8477298 0.6315583 1.137893
## 3: 0.05958259 0.4033333    GRF 81.76877 0.8477298 0.6315583 1.137893
## 4: 0.14831011 0.4033333    GRF.60 49.06126 0.8477298 0.6315583 1.137893
## 5: 0.12605013 0.4033333    VT(24) 81.76877 0.8477298 0.6315583 1.137893
## 6: 0.12605013 0.4033333    VT#(24) 81.76877 0.8477298 0.6315583 1.137893
##      hr.adj.itt l.adj.itt u.adj.itt l.H.true u.H.true l.Hc.true u.Hc.true
##      <num>      <num>      <num>      <num>      <num>      <num>
## 1: 0.8490589 0.6265376 1.150611 0.9351283 2.600451 0.4758943 0.9821926
## 2: 0.8490589 0.6265376 1.150611 0.9351283 2.600451 0.4758943 0.9821926
## 3: 0.8490589 0.6265376 1.150611 0.9351283 2.600451 0.4758943 0.9821926
## 4: 0.8490589 0.6265376 1.150611 0.9351283 2.600451 0.4758943 0.9821926
## 5: 0.8490589 0.6265376 1.150611 0.9351283 2.600451 0.4758943 0.9821926

```

```

## 6: 0.8490589 0.6265376 1.150611 0.9351283 2.600451 0.4758943 0.9821926
##      1.H.hat   u.H.hat   1.Hc.hat   u.Hc.hat
##      <num>     <num>     <num>     <num>
## 1: 1.0260505 3.487313 0.4870878 0.9582194
## 2: 1.0260505 3.487313 0.4870878 0.9582194
## 3: 0.9467982 2.703751 0.4287005 0.8886217
## 4: 0.7789088 2.537782 0.5015604 0.9936048
## 5: 0.9351283 2.600451 0.4758943 0.9821926
## 6: 0.9351283 2.600451 0.4758943 0.9821926
## Subgroup HRs: H, H^c, Causal= 1.999999 0.557631 0.7363833
## Simulations= 20000
## Avg censoring= 0.4375567
## Min,Max,Avg tau.max= 58.28239 83.94548 78.62153
## P(H) approximation at causal(H), n(sg)=60, approx= 1.999999 60 0.8326675
## P(H) approximation at causal(H), Avg(n(sg)), approx= 1.999999 90 0.9052625
## P(H) approximation at plim(H), Avg(n(sg)), approx= 2.246475 90 0.9522671
## Minutes,hours 123.6496 2.060826
##          FS1    FS1g     GRF   GRF.60   VT(24)  VT#(24)  VT(36)  VT#(36)
## any.H       0.970   0.960   0.960   0.870   0.510   0.560   0.530   0.650
## sensH       0.680   0.660   0.730   0.620   0.350   0.420   0.380   0.520
## sensHc      0.930   0.930   0.880   0.870   0.950   0.960   0.950   0.960
## ppH         0.780   0.750   0.700   0.590   0.390   0.450   0.400   0.550
## ppHc        0.880   0.870   0.890   0.860   0.790   0.810   0.800   0.840
## Avg(#H)     78.000  77.000  95.000  96.000  83.000  83.000  85.000  85.000
## minH        61.000  61.000  60.000  60.000  60.000  60.000  60.000  60.000
## maxH        143.000 143.000 229.000 230.000 172.000 176.000 180.000 191.000
## Avg(#Hc)    225.000 226.000 209.000 216.000 258.000 254.000 255.000 245.000
## minHc       157.000 157.000 71.000  70.000  128.000 124.000 120.000 109.000
## maxHc       300.000 300.000 300.000 300.000 300.000 300.000 300.000 300.000
## hat(H*)     2.278   2.285   2.277   2.319   2.451   2.450   2.468   2.439
## hat(hat[H]) 2.588   2.571   2.213   2.071   2.191   2.286   2.261   2.386
## hat(Hc*)    0.555   0.555   0.555   0.555   0.559   0.555   0.558   0.555
## hat(hat[Hc]) 0.592   0.597   0.550   0.574   0.637   0.618   0.622   0.595
## hat(H*)all  2.246   2.246   2.246   2.246   2.246   2.246   2.246   2.246
## hat(Hc*)all 0.553   0.553   0.553   0.553   0.553   0.553   0.553   0.553
## hat(ITT)all 0.849   0.849   0.849   0.849   0.849   0.849   0.849   0.849
## hat(ITTadj)all 0.896   0.896   0.896   0.896   0.896   0.896   0.896   0.896

missC <- tab_tests(res = res)

pA <- as.character(round(outres$pAnyH.approx2, 4))

tabsim_missC <- get_tabsim(missC = missC, pA = pA, est_names = est_names, stat_names = stat_names,
                           mod.harm = mod.harm, Nsims = Nsims)

```

```

t.done <- proc.time()[3]
t.min <- (t.done - t.start.all)/60
cat("Minutes and hours to finish", c(t.min, t.min/60), "\n")

## Minutes and hours to finish 217.5104 3.625174

cat("Minutes and hours per 10,000 to finish", (10000/Nsims) * c(t.min, t.min/60),
"\n")

## Minutes and hours per 10,000 to finish 108.7552 1.812587

```

Table 2: Average classification rates: $\text{avg}|\hat{H}|$, $\text{min}|\hat{H}|$, and $\text{max}|\hat{H}|$, denote the average, minimum, and maximum of the number of subjects in the estimated subgroup \hat{H} (analogously for \hat{H}^c). Note that under the null $\text{sens}(\hat{H})$ is undefined and $\text{ppv}(\hat{H}) = 0$.

| | FS_g | FS_{lg} | GRF | GRF_{60} | $VT(24)$ | $VT^{\#}(24)$ | $VT(36)$ | $VT^{\#}(36)$ |
|----------------------------|--------|-----------|-------|------------|----------|---------------|----------|---------------|
| Finding H | | | | | | | | |
| $\text{any}(H)$ | 0.97 | 0.96 | 0.96 | 0.87 | 0.51 | 0.56 | 0.53 | 0.65 |
| $\text{sens}(\hat{H})$ | 0.68 | 0.66 | 0.73 | 0.62 | 0.35 | 0.42 | 0.38 | 0.52 |
| $\text{sens}(\hat{H}^C)$ | 0.93 | 0.93 | 0.88 | 0.87 | 0.95 | 0.96 | 0.95 | 0.96 |
| $\text{ppv}(\hat{H})$ | 0.78 | 0.75 | 0.7 | 0.59 | 0.39 | 0.45 | 0.4 | 0.55 |
| $\text{ppv}(\hat{H}^C)$ | 0.88 | 0.87 | 0.89 | 0.86 | 0.79 | 0.81 | 0.8 | 0.84 |
| Size of H and H-complement | | | | | | | | |
| $\text{avg} \hat{H} $ | 78 | 77 | 95 | 96 | 83 | 83 | 85 | 85 |
| $\text{min} \hat{H} $ | 61 | 61 | 60 | 60 | 60 | 60 | 60 | 60 |
| $\text{max} \hat{H} $ | 143 | 143 | 229 | 230 | 172 | 176 | 180 | 191 |
| $\text{avg} \hat{H}^C $ | 225 | 226 | 209 | 216 | 258 | 254 | 255 | 245 |
| $\text{min} \hat{H}^C $ | 157 | 157 | 71 | 70 | 128 | 124 | 120 | 109 |
| $\text{max} \hat{H}^C $ | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |

Note: Number of simulations= 20000 .

Note: Probability approximation= 0.9053 .

```
# cat('Machine=', c(Sys.info()[[4]]), '\n') cat('Number of
# cores=', c(detectCores(logical = FALSE)), '\n')
require(benchmarkme)
my_system <- get_cpu()
my_ram <- get_ram()
cat("Running on system:", c(my_system$model_name), "\n")

## Running on system: AMD Ryzen Threadripper PRO 5995WX 64-Cores

cat("with number of cores and cpu/GB=", c(my_system$no_of_cores, round(c(my_ram)/10^9,
  0)), "\n")

## with number of cores and cpu/GB= 128 270
```