

```

N <- 700
Nsims <- 200

maxFollow <- 84
cens.type <- "weibull"
##### Forest search criteria
hr.threshold <- 1.25 # Initial 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
ml.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("$FS_{g}$", "$FS_{lg}$", "$GRF$", "$GRF_{60}$", "$VT(24)$", "${VT}^{\\#}(24)$",
"$VT(36)$", "${VT}^{\\#}(36)$")

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 <- "m4a"
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 0.122449
## Underlying pH_super 0.122449

# 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]

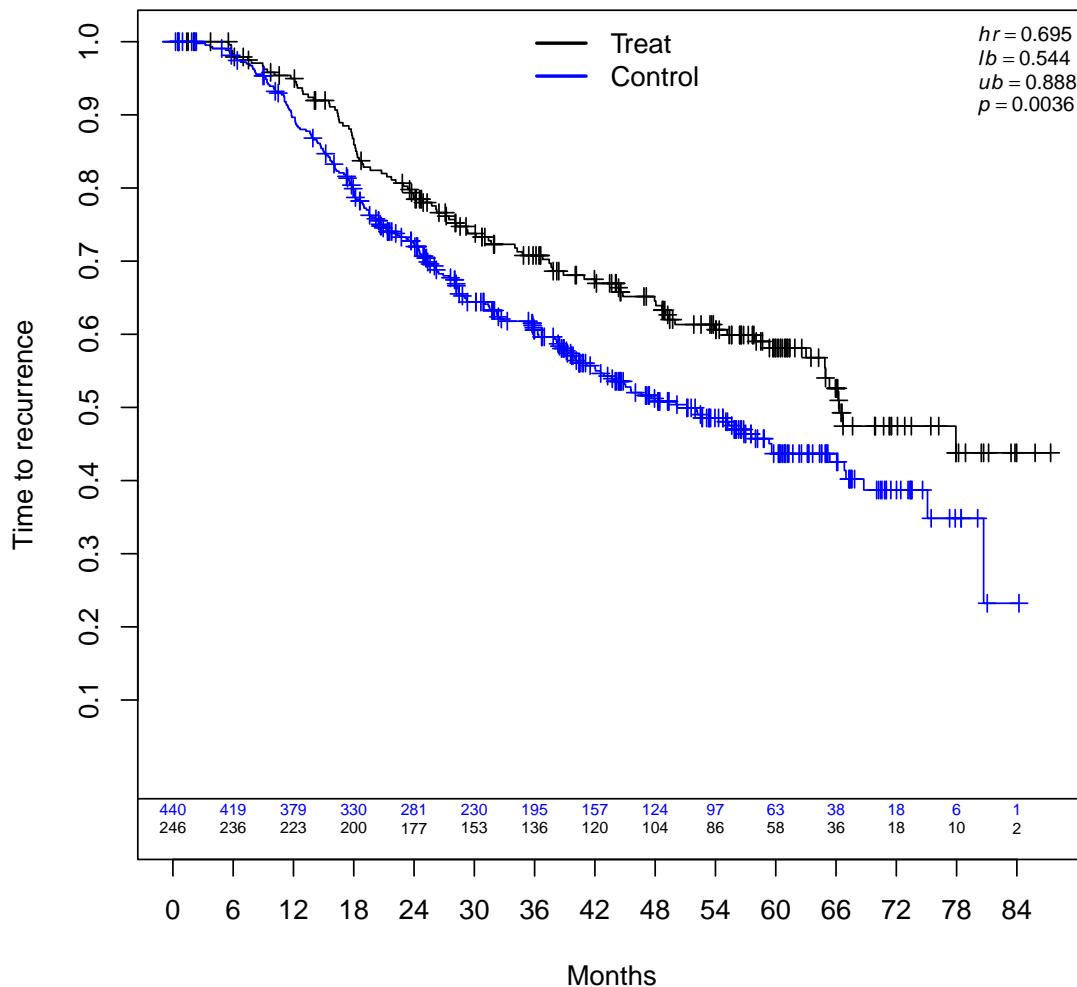
# Classification table names Note: within tab_tests (summary.VTFS) we rename so
# that denominator in ppv(hatH) is # hatH Manuscript section 3.2 will be
# updated accordingly

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

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)

```



```
## Super-population empirical harm and non-harm hazard ratios= NA 0.701027
## Causal HR (empirical ITT)= 0.701027

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= 49.01796 2
```

```

##      leaf.node control.mean control.size control.se depth
## 1          2          3.61          62.00          3.59    1
## 2          3          -4.56          638.00          1.14    1
## 11         4          -3.71          291.00          1.63    2
## 21         5           4.82           71.00          3.76    2
## 4          7          -7.43          306.00          1.62    2
##      leaf.node control.mean control.size control.se depth
## 21         5           4.82           71.00          3.76    2
## 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 <= 29.4" "size <= 25" "size <= 20" "size <= 35"
## [5] "noise1 <= 0" "noise1 <= -0.6" "noise1 <= 0.7" "noise2 <= 0"
## [9] "noise2 <= -0.8" "noise2 <= 0.7" "noise3 <= 0" "noise3 <= -0.7"
## [13] "noise3 <= 0.6" "noise4 <= 0" "noise4 <= -0.7" "noise4 <= 0.7"
## [17] "noise5 <= 0" "noise5 <= -0.6" "noise5 <= 0.7" "z1"
## [21] "z2" "z3" "z4" "z5"
## [25] "grade3"
## Number of factors evaluated= 25
## Confounders per grf screening q21 q16 q23 q9 q17 q4 q6 q11 q24 q7 q22 q14 q5 q8 q20 q10 q19 q13 q25
##      Factors Labels VI(grf)
## 21          z2      q21 0.1153
## 16 noise4 <= 0.7      q16 0.0897
## 23          z4      q23 0.0692
## 9 noise2 <= -0.8      q9 0.0585
## 17 noise5 <= 0      q17 0.0535
## 4 size <= 35      q4 0.0515
## 6 noise1 <= -0.6      q6 0.0466
## 11 noise3 <= 0      q11 0.0441
## 24          z5      q24 0.0373
## 7 noise1 <= 0.7      q7 0.0345
## 22          z3      q22 0.0324
## 14 noise4 <= 0      q14 0.0320
## 5 noise1 <= 0      q5 0.0316
## 8 noise2 <= 0      q8 0.0301
## 20          z1      q20 0.0286
## 10 noise2 <= 0.7      q10 0.0283
## 19 noise5 <= 0.7      q19 0.0276
## 13 noise3 <= 0.6      q13 0.0270
## 25          grade3      q25 0.0262
## 1 size <= 29.4      q1 0.0256
## 12 noise3 <= -0.7      q12 0.0249
## 15 noise4 <= -0.7      q15 0.0242
## 3 size <= 20      q3 0.0207
## 18 noise5 <= -0.6      q18 0.0205
## 2 size <= 25      q2 0.0201
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1275
## Approximately 5% of max_count met: minutes 0.001383333
## Approximately 10% of max_count met: minutes 0.0026
## Approximately 20% of max_count met: minutes 0.004833333

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## Approximately 33% of max_count met: minutes 0.008183333
## Approximately 50% of max_count met: minutes 0.0124
## Approximately 75% of max_count met: minutes 0.01908333
## Approximately 90% of max_count met: minutes 0.02313333
## # 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 58 83
## # of subgroups with sample size less than criteria 136
## # of subgroups meeting all criteria = 1117
## # of subgroups fitted (Cox model estimable) = 1117
## *Subgroup Searching Minutes=* 0.02508333
## Number of subgroups meeting HR threshold 2
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 2
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##   n  E d1  HR L(HR) q21.0 q21.1
## 1 82 31 19 1.49 0.72 0 0
## 2 86 41 24 1.31 0.70 0 0
## Consistency 0.7075
## Consistency 0.6075
## Subgroup Consistency Minutes= 0.02505
## NO subgroup found (FS)
## Minutes forestsearch overall= 0.06898333
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 49.01796 2
##   leaf.node control.mean control.size control.se depth
## 1 2 3.61 62.00 3.59 1
## 2 3 -4.56 638.00 1.14 1
## 11 4 -3.71 291.00 1.63 2
## 21 5 4.82 71.00 3.76 2
## 4 7 -7.43 306.00 1.62 2
##   leaf.node control.mean control.size control.se depth
## 21 5 4.82 71.00 3.76 2
## 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 = 0.02832378
## 12 x 1 sparse Matrix of class "dgCMatrix"
##           s0
## z1 0.06989458
## z2 .
## z3 .
## z4 0.48246098
## z5 -0.74548621
## size .
## grade3 .
## noise1 -0.03624845
## noise2 .
## noise3 .
## noise4 .
## noise5 .

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```

## Cox-LASSO selected: z1 z4 z5 noise1
## Cox-LASSO not selected: z2 z3 size grade3 noise2 noise3 noise4 noise5
## Default cuts included from Lasso:
## Categorical after Lasso: z1 z4 z5
## # of candidate subgroup factors= 22
## [1] "size <= 29.4" "size <= 25" "size <= 20" "size <= 35"
## [5] "noise1 <= 0" "noise1 <= -0.6" "noise1 <= 0.7" "noise2 <= 0"
## [9] "noise2 <= -0.8" "noise2 <= 0.7" "noise3 <= 0" "noise3 <= -0.7"
## [13] "noise3 <= 0.6" "noise4 <= 0" "noise4 <= -0.7" "noise4 <= 0.7"
## [17] "noise5 <= 0" "noise5 <= -0.6" "noise5 <= 0.7" "z1"
## [21] "z4" "z5"
## Number of factors evaluated= 22
## Confounders per grf screening q16 q9 q21 q4 q17 q6 q22 q11 q7 q19 q14 q13 q8 q5 q20 q10 q3 q12 q2 q1
## Factors Labels VI(grf)
## 16 noise4 <= 0.7 q16 0.1162
## 9 noise2 <= -0.8 q9 0.0830
## 21 z4 q21 0.0825
## 4 size <= 35 q4 0.0601
## 17 noise5 <= 0 q17 0.0554
## 6 noise1 <= -0.6 q6 0.0519
## 22 z5 q22 0.0485
## 11 noise3 <= 0 q11 0.0456
## 7 noise1 <= 0.7 q7 0.0407
## 19 noise5 <= 0.7 q19 0.0392
## 14 noise4 <= 0 q14 0.0376
## 13 noise3 <= 0.6 q13 0.0360
## 8 noise2 <= 0 q8 0.0347
## 5 noise1 <= 0 q5 0.0336
## 20 z1 q20 0.0336
## 10 noise2 <= 0.7 q10 0.0332
## 3 size <= 20 q3 0.0308
## 12 noise3 <= -0.7 q12 0.0294
## 2 size <= 25 q2 0.0284
## 15 noise4 <= -0.7 q15 0.0283
## 18 noise5 <= -0.6 q18 0.0266
## 1 size <= 29.4 q1 0.0246
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 990
## Approximately 5% of max_count met: minutes 0.001133333
## 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 0.0091
## Approximately 50% of max_count met: minutes 0.01216667
## Approximately 75% of max_count met: minutes 0.01771667
## Approximately 90% of max_count met: minutes 0.02133333
## # 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 51 74
## # of subgroups with sample size less than criteria 118
## # of subgroups meeting all criteria = 851
## # of subgroups fitted (Cox model estimable) = 851
## *Subgroup Searching Minutes=* 0.0235
## Number of subgroups meeting HR threshold 2
## Subgroup candidate(s) found (FS)

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## # of candidate subgroups (meeting HR criteria) = 2
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##      n E d1   HR L(HR) q16.0 q16.1
## 1 82 31 19 1.49  0.72    0    0
## 2 86 41 24 1.31  0.70    0    0
## Consistency 0.7075
## Consistency 0.6075
## Subgroup Consistency Minutes= 0.0305
## NO subgroup found (FS)
## Minutes forestsearch overall= 0.07011667
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 46.46312 2
##      leaf.node control.mean control.size control.se depth
## 2          3          -3.95          665.00          0.98    1
## 1          4          -7.01          223.00          1.69    2
## 3          6          4.48          115.00          2.20    2
## 4          7          -4.45          348.00          1.36    2
##      leaf.node control.mean control.size control.se depth
## 3          6          4.48          115.00          2.20    2
## 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= 27
## [1] "size <= 29.5"  "size <= 25"      "size <= 20"      "size <= 35"
## [5] "noise1 <= 0"    "noise1 <= -0.6"  "noise1 <= 0.6"   "noise2 <= 0"
## [9] "noise2 <= -0.1" "noise2 <= -0.7"  "noise2 <= 0.6"   "noise3 <= 0"
## [13] "noise3 <= -0.1" "noise3 <= -0.6"  "noise3 <= 0.5"   "noise4 <= 0"
## [17] "noise4 <= -0.6" "noise4 <= 0.7"   "noise5 <= 0"     "noise5 <= -0.6"
## [21] "noise5 <= 0.6"  "z1"              "z2"              "z3"
## [25] "z4"             "z5"              "grade3"
## Number of factors evaluated= 27
## Confounders per grf screening q26 q27 q18 q3 q22 q16 q19 q9 q25 q5 q17 q11 q15 q24 q23 q10 q21 q13 q
##      Factors Labels VI(grf)
## 26          z5      q26 0.1853
## 27         grade3     q27 0.1543
## 18 noise4 <= 0.7     q18 0.0799
## 3      size <= 20      q3 0.0523
## 22          z1      q22 0.0521
## 16 noise4 <= 0      q16 0.0417
## 19 noise5 <= 0      q19 0.0297
## 9  noise2 <= -0.1     q9 0.0296
## 25          z4      q25 0.0281
## 5      noise1 <= 0     q5 0.0261
## 17 noise4 <= -0.6     q17 0.0239
## 11 noise2 <= 0.6      q11 0.0233
## 15 noise3 <= 0.5      q15 0.0226
## 24          z3      q24 0.0219
## 23          z2      q23 0.0212
## 10 noise2 <= -0.7     q10 0.0205
## 21 noise5 <= 0.6      q21 0.0203
## 13 noise3 <= -0.1     q13 0.0201

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## 6  noise1 <= -0.6      q6  0.0184
## 14 noise3 <= -0.6     q14  0.0184
## 2    size <= 25       q2   0.0177
## 20 noise5 <= -0.6     q20  0.0169
## 8    noise2 <= 0      q8   0.0165
## 12   noise3 <= 0      q12  0.0156
## 7    noise1 <= 0.6    q7   0.0153
## 1    size <= 29.5     q1   0.0145
## 4    size <= 35       q4   0.0138
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1485
## Approximately 5% of max_count met: minutes 0.0018
## Approximately 10% of max_count met: minutes 0.003366667
## Approximately 20% of max_count met: minutes 0.0062
## Approximately 33% of max_count met: minutes 0.01365
## Approximately 50% of max_count met: minutes 0.0189
## Approximately 75% of max_count met: minutes 0.02795
## Approximately 90% of max_count met: minutes 0.03368333
## # 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 68 89
## # of subgroups with sample size less than criteria 146
## # of subgroups meeting all criteria = 1311
## # of subgroups fitted (Cox model estimable) = 1311
## *Subgroup Searching Minutes=* 0.03663333
## Number of subgroups meeting HR threshold 3
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 3
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##   n  E d1  HR L(HR) q26.0 q26.1 q27.0
## 1 67 43 21 1.69 0.93    0    0    0
## 2 89 29 19 1.50 0.70    0    1    0
## 3 90 40 19 1.25 0.67    0    0    0
## Consistency 0.8975
## Consistency 0.7225
## Consistency 0.505
## Subgroup Consistency Minutes= 0.04391667
## NO subgroup found (FS)
## Minutes forestsearch overall= 0.10675
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 46.46312 2
##   leaf.node control.mean control.size control.se depth
## 2         3        -3.95        665.00        0.98    1
## 1         4        -7.01        223.00        1.69    2
## 3         6         4.48        115.00        2.20    2
## 4         7        -4.45        348.00        1.36    2
##   leaf.node control.mean control.size control.se depth
## 3         6         4.48        115.00        2.20    2
## 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 = 0.03764233

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```

## 12 x 1 sparse Matrix of class "dgCMatrix"
##           s0
## z1      0.1689114
## z2     -0.1191971
## z3      .
## z4      0.6568802
## z5     -0.7593997
## size     .
## grade3   .
## noise1   .
## noise2   .
## noise3   .
## noise4   .
## noise5   .
## Cox-LASSO selected: z1 z2 z4 z5
## Cox-LASSO not selected: z3 size grade3 noise1 noise2 noise3 noise4 noise5
## Default cuts included from Lasso:
## Categorical after Lasso: z1 z2 z4 z5
## # of candidate subgroup factors= 25
## [1] "size <= 29.5"  "size <= 25"      "size <= 20"      "size <= 35"
## [5] "noise1 <= 0"     "noise1 <= -0.6"  "noise1 <= 0.6"   "noise2 <= 0"
## [9] "noise2 <= -0.1"  "noise2 <= -0.7"  "noise2 <= 0.6"   "noise3 <= 0"
## [13] "noise3 <= -0.1"  "noise3 <= -0.6"  "noise3 <= 0.5"   "noise4 <= 0"
## [17] "noise4 <= -0.6"  "noise4 <= 0.7"   "noise5 <= 0"     "noise5 <= -0.6"
## [21] "noise5 <= 0.6"   "z1"              "z2"              "z4"
## [25] "z5"
## Number of factors evaluated= 25
## Confounders per grf screening q25 q18 q22 q3 q16 q24 q19 q9 q11 q5 q23 q15 q17 q7 q13 q2 q6 q21 q14 q1
##           Factors Labels VI(grf)
## 25           z5      q25 0.2102
## 18 noise4 <= 0.7    q18 0.0883
## 22           z1      q22 0.0746
## 3      size <= 20    q3 0.0677
## 16 noise4 <= 0      q16 0.0457
## 24           z4      q24 0.0407
## 19 noise5 <= 0      q19 0.0368
## 9  noise2 <= -0.1    q9 0.0356
## 11 noise2 <= 0.6     q11 0.0332
## 5      noise1 <= 0    q5 0.0319
## 23           z2      q23 0.0285
## 15 noise3 <= 0.5     q15 0.0273
## 17 noise4 <= -0.6    q17 0.0253
## 7      noise1 <= 0.6    q7 0.0244
## 13 noise3 <= -0.1    q13 0.0244
## 2      size <= 25     q2 0.0243
## 6      noise1 <= -0.6    q6 0.0235
## 21 noise5 <= 0.6     q21 0.0224
## 14 noise3 <= -0.6    q14 0.0221
## 8      noise2 <= 0      q8 0.0197
## 20 noise5 <= -0.6    q20 0.0197
## 12 noise3 <= 0       q12 0.0195
## 10 noise2 <= -0.7    q10 0.0194
## 4      size <= 35     q4 0.0180
## 1      size <= 29.5    q1 0.0166
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1275

```

```

## Approximately 5% of max_count met: minutes 0.001633333
## Approximately 10% of max_count met: minutes 0.0029
## Approximately 20% of max_count met: minutes 0.005183333
## Approximately 33% of max_count met: minutes 0.008683333
## Approximately 50% of max_count met: minutes 0.01458333
## Approximately 75% of max_count met: minutes 0.02168333
## Approximately 90% of max_count met: minutes 0.02603333
## # 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 64 79
## # of subgroups with sample size less than criteria 130
## # of subgroups meeting all criteria = 1118
## # of subgroups fitted (Cox model estimable) = 1118
## *Subgroup Searching Minutes=* 0.02821667
## Number of subgroups meeting HR threshold 3
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 3
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##      n  E d1  HR L(HR) q25.0 q25.1 q18.0
## 1 67 43 21 1.69 0.93      0      0      0
## 2 89 29 19 1.50 0.70      0      1      0
## 3 90 40 19 1.25 0.67      0      0      0
## Consistency 0.8975
## Consistency 0.7225
## Consistency 0.505
## Subgroup Consistency Minutes= 0.0363
## NO subgroup found (FS)
## Minutes forestsearch overall= 0.08076667
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 48.40408 2
##      leaf.node control.mean control.size control.se depth
## 1          2          4.78          100.00          2.69      1
## 2          3          -3.45          600.00          1.11      1
## 3          4          4.78          100.00          2.69      2
## 4          5          -6.36          115.00          2.38      2
## 5          6          4.07          131.00          2.65      2
## 6          7          -5.28          354.00          1.39      2
##      leaf.node control.mean control.size control.se depth
## 1          2          4.78          100.00          2.69      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= 28
## [1] "size <= 28.9" "size <= 25" "size <= 20" "size <= 35"
## [5] "noise1 <= 0" "noise1 <= -0.6" "noise1 <= 0.7" "noise2 <= 0"
## [9] "noise2 <= -0.1" "noise2 <= -0.7" "noise2 <= 0.7" "noise3 <= 0"
## [13] "noise3 <= -0.1" "noise3 <= -0.6" "noise3 <= 0.6" "noise4 <= 0.1"
## [17] "noise4 <= 0" "noise4 <= -0.6" "noise4 <= 0.7" "noise5 <= 0"
## [21] "noise5 <= -0.6" "noise5 <= 0.7" "z1" "z2"

```

```

## [25] "z3"          "z4"          "z5"          "grade3"
## Number of factors evaluated= 28
## Confounders per grf screening q13 q27 q12 q14 q25 q22 q21 q3 q10 q18 q5 q11 q23 q19 q17 q26 q8 q20 q
##          Factors Labels VI(grf)
## 13 noise3 <= -0.1    q13  0.0987
## 27          z5      q27  0.0893
## 12   noise3 <= 0    q12  0.0664
## 14 noise3 <= -0.6    q14  0.0532
## 25          z3      q25  0.0459
## 22 noise5 <= 0.7    q22  0.0440
## 21 noise5 <= -0.6    q21  0.0402
## 3      size <= 20    q3   0.0398
## 10 noise2 <= -0.7    q10  0.0379
## 18 noise4 <= -0.6    q18  0.0369
## 5      noise1 <= 0    q5   0.0344
## 11 noise2 <= 0.7    q11  0.0336
## 23          z1      q23  0.0307
## 19 noise4 <= 0.7    q19  0.0302
## 17 noise4 <= 0      q17  0.0297
## 26          z4      q26  0.0293
## 8      noise2 <= 0    q8   0.0286
## 20 noise5 <= 0      q20  0.0278
## 28          grade3   q28  0.0272
## 1      size <= 28.9    q1   0.0265
## 24          z2      q24  0.0228
## 6 noise1 <= -0.6    q6   0.0216
## 7 noise1 <= 0.7    q7   0.0212
## 2      size <= 25    q2   0.0203
## 16 noise4 <= 0.1    q16  0.0181
## 15 noise3 <= 0.6    q15  0.0161
## 4      size <= 35    q4   0.0147
## 9 noise2 <= -0.1    q9   0.0147
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1596
## Approximately 5% of max_count met: minutes 0.001883333
## Approximately 10% of max_count met: minutes 0.00395
## Approximately 20% of max_count met: minutes 0.007083333
## Approximately 33% of max_count met: minutes 0.01155
## Approximately 50% of max_count met: minutes 0.01658333
## Approximately 75% of max_count met: minutes 0.02358333
## Approximately 90% of max_count met: minutes 0.02865
## # 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 77 96
## # of subgroups with sample size less than criteria 155
## # of subgroups meeting all criteria = 1409
## # of subgroups fitted (Cox model estimable) = 1409
## *Subgroup Searching Minutes=* 0.03198333
## Number of subgroups meeting HR threshold 10
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 10
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##      n E d1  HR L(HR) q13.0 q13.1 q27.0 q27.1 q12.0 q12.1 q14.0 q14.1 q25.0
## 1 89 43 24 1.75 0.95 0 0 0 0 0 0 0 0 0

```

```

## 2 82 42 24 1.72 0.93 0 1 0 0 0 0 0 0 0
## 3 93 50 26 1.34 0.77 0 0 0 0 0 1 0 0 0
## 4 96 49 23 1.32 0.75 0 0 0 0 0 0 0 0 0
## 5 109 62 31 1.32 0.80 0 0 0 0 0 0 0 0 1
## 6 84 43 21 1.30 0.71 0 0 0 0 0 0 0 0 0
## 7 88 45 27 1.28 0.70 0 1 0 0 0 0 0 0 0
## 8 89 52 29 1.28 0.74 0 0 0 0 0 0 0 0 0
## 9 141 74 36 1.25 0.79 0 0 0 0 0 0 0 0 0
## 10 95 48 28 1.25 0.70 0 0 0 0 0 1 0 0 0
## q25.1
## 1 0
## 2 0
## 3 0
## 4 0
## 5 0
## 6 0
## 7 0
## 8 0
## 9 0
## 10 0
## Consistency 0.9425
## # of splits= 400
## Model, % Consistency Met= {noise1 <= 0} !{noise2 <= 0.7} 0.9425
## Consistency 0.9275
## # of splits= 400
## Model, % Consistency Met= {noise3 <= -0.1} !{noise2 <= 0.7} 0.9275
## Consistency 0.695
## Number of subgroups meeting consistency criteria=
## Pcons N g m K M.1 M.2
## <num> <num> <char> <char> <num> <char> <char>
## 1: 0.9425 89 7 1 2 {noise1 <= 0} !{noise2 <= 0.7}
## 2: 0.9275 82 2 2 2 {noise3 <= -0.1} !{noise2 <= 0.7}
## [1] "{noise1 <= 0}" " !{noise2 <= 0.7}"
## % consistency criteria met= 0.9425
## SG focus= hr
## Subgroup Consistency Minutes= 0.03623333
## Subgroup found (FS)
## Minutes forestsearch overall= 0.0826
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 48.40408 2
## leaf.node control.mean control.size control.se depth
## 1 2 4.78 100.00 2.69 1
## 2 3 -3.45 600.00 1.11 1
## 3 4 4.78 100.00 2.69 2
## 4 5 -6.36 115.00 2.38 2
## 5 6 4.07 131.00 2.65 2
## 6 7 -5.28 354.00 1.39 2
## leaf.node control.mean control.size control.se depth
## 1 2 4.78 100.00 2.69 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 = 0.01950472

```

```

## 12 x 1 sparse Matrix of class "dgCMatrix"
##              s0
## z1      0.076348853
## z2     -0.184227994
## z3      .
## z4      0.385228005
## z5     -1.005230469
## size     .
## grade3   0.066936453
## noise1   0.009930945
## noise2   .
## noise3  -0.015751109
## noise4   .
## noise5   .
## Cox-LASSO selected: z1 z2 z4 z5 grade3 noise1 noise3
## Cox-LASSO not selected: z3 size noise2 noise4 noise5
## Default cuts included from Lasso:
## Categorical after Lasso: z1 z2 z4 z5 grade3
## # of candidate subgroup factors= 27
## [1] "size <= 28.9"  "size <= 25"      "size <= 20"      "size <= 35"
## [5] "noise1 <= 0"     "noise1 <= -0.6"  "noise1 <= 0.7"   "noise2 <= 0"
## [9] "noise2 <= -0.1"  "noise2 <= -0.7"  "noise2 <= 0.7"   "noise3 <= 0"
## [13] "noise3 <= -0.1"  "noise3 <= -0.6"  "noise3 <= 0.6"   "noise4 <= 0.1"
## [17] "noise4 <= 0"     "noise4 <= -0.6"  "noise4 <= 0.7"   "noise5 <= 0"
## [21] "noise5 <= -0.6"  "noise5 <= 0.7"   "z1"              "z2"
## [25] "z4"              "z5"              "grade3"
## Number of factors evaluated= 27
## Confounders per grf screening q13 q26 q12 q14 q22 q3 q18 q19 q10 q21 q11 q24 q5 q25 q20 q27 q23 q8 q
##           Factors Labels VI(grf)
## 13 noise3 <= -0.1    q13  0.1146
## 26          z5      q26  0.0959
## 12  noise3 <= 0      q12  0.0664
## 14 noise3 <= -0.6    q14  0.0562
## 22 noise5 <= 0.7     q22  0.0451
## 3    size <= 20      q3   0.0417
## 18 noise4 <= -0.6    q18  0.0413
## 19 noise4 <= 0.7     q19  0.0373
## 10 noise2 <= -0.7    q10  0.0364
## 21 noise5 <= -0.6    q21  0.0340
## 11 noise2 <= 0.7     q11  0.0339
## 24          z2      q24  0.0339
## 5    noise1 <= 0     q5   0.0317
## 25          z4      q25  0.0317
## 20 noise5 <= 0       q20  0.0311
## 27          grade3  q27  0.0279
## 23          z1      q23  0.0275
## 8    noise2 <= 0     q8   0.0269
## 17 noise4 <= 0       q17  0.0263
## 6    noise1 <= -0.6  q6   0.0250
## 1    size <= 28.9    q1   0.0236
## 7    noise1 <= 0.7   q7   0.0210
## 2    size <= 25      q2   0.0190
## 9    noise2 <= -0.1  q9   0.0186
## 4    size <= 35      q4   0.0184
## 15 noise3 <= 0.6     q15  0.0184

```

```

## 16 noise4 <= 0.1      q16 0.0160
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1485
## Approximately 5% of max_count met: minutes 0.001483333
## Approximately 10% of max_count met: minutes 0.003083333
## Approximately 20% of max_count met: minutes 0.006116667
## Approximately 33% of max_count met: minutes 0.009633333
## Approximately 50% of max_count met: minutes 0.01408333
## Approximately 75% of max_count met: minutes 0.02118333
## Approximately 90% of max_count met: minutes 0.02553333
## # 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 75 94
## # of subgroups with sample size less than criteria 153
## # of subgroups meeting all criteria = 1301
## # of subgroups fitted (Cox model estimable) = 1301
## *Subgroup Searching Minutes=* 0.02821667
## Number of subgroups meeting HR threshold 9
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 9
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##      n E d1 HR L(HR) q13.0 q13.1 q26.0 q26.1 q12.0 q12.1 q14.0 q14.1 q22.0
## 1  89 43 24 1.75 0.95      0      0      0      0      0      0      0      0
## 2  82 42 24 1.72 0.93      0      1      0      0      0      0      0      0
## 3  93 50 26 1.34 0.77      0      0      0      0      0      1      0      0
## 4  96 49 23 1.32 0.75      0      0      0      0      0      0      0      0
## 5  84 43 21 1.30 0.71      0      0      0      0      0      0      0      0
## 6  88 45 27 1.28 0.70      0      1      0      0      0      0      0      0
## 7  89 52 29 1.28 0.74      0      0      0      0      0      0      0      0
## 8 141 74 36 1.25 0.79      0      0      0      0      0      0      0      0
## 9  95 48 28 1.25 0.70      0      0      0      0      0      1      0      0
## Consistency 0.9425
## # of splits= 400
## Model, % Consistency Met= ![noise2 <= 0.7] {noise1 <= 0} 0.9425
## Consistency 0.9275
## # of splits= 400
## Model, % Consistency Met= {noise3 <= -0.1} ![noise2 <= 0.7] 0.9275
## Consistency 0.695
## Number of subgroups meeting consistency criteria=
##      Pcons      N      g      m      K      M.1      M.2
##      <num> <num> <char> <char> <num>      <char>      <char>
## 1: 0.9425    89      6      1      2 ![noise2 <= 0.7] {noise1 <= 0}
## 2: 0.9275    82      2      2      2 {noise3 <= -0.1} ![noise2 <= 0.7]
## [1] "![noise2 <= 0.7]" "{noise1 <= 0}"
## % consistency criteria met= 0.9425
## SG focus= hr
## Subgroup Consistency Minutes= 0.0383
## Subgroup found (FS)
## Minutes forestsearch overall= 0.07901667

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)
##      200      200      200      200      200      200      200      200

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=200_m4a-Noise=5_N=700_null_ktreat=0.9_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          700          1  0    0    700
## 2:      1          0          0          700          1  0    0    700
## 3:      1          0          0          700          1  1    69   631
## 4:      1          0          0          700          1  0    0    700
## 5:      1          0          0          700          1  0    0    700
## 6:      1          0          0          700          1  0    0    700
##      ppv      npv specificity sensitivity found.1 found.2 found.both
##      <lgcl>      <num>      <num>      <num>      <int> <int> <num>
## 1:      NA 1.0000000          1          NA          0    0    0
## 2:      NA 1.0000000          1          NA          0    0    0
## 3:      NA 0.9014286          1          0          NA    NA    NA
## 4:      NA 1.0000000          1          NA          NA    NA    NA
## 5:      NA 1.0000000          1          NA          0    0    0
## 6:      NA 1.0000000          1          NA          0    0    0
##      found.al3 hr.H.true hr.Hc.true hr.H.hat hr.Hc.hat b1.H b2.H b1.Hc
##      <num>      <lgcl>      <num>      <num>      <num> <lgcl> <lgcl> <num>
## 1:      0      NA 0.6155054          NA 0.6155054      NA    NA 0.00000000
## 2:      0      NA 0.6155054          NA 0.6155054      NA    NA 0.00000000
## 3:      NA      NA 0.6155054 2.406676 0.5325424      NA    NA -0.08296298
## 4:      NA      NA 0.6155054          NA 0.6155054      NA    NA 0.00000000
## 5:      0      NA 0.6155054          NA 0.6155054      NA    NA 0.00000000
## 6:      0      NA 0.6155054          NA 0.6155054      NA    NA 0.00000000
##      b2.Hc p.cens analysis taumax hr.itt l.itt u.itt
##      <num> <num> <char> <num> <num> <num> <num>
## 1: -0.08552157 0.4642857 FS1 81.69660 0.6155054 0.5014207 0.755547
## 2: -0.08552157 0.4642857 FS1g 49.01796 0.6155054 0.5014207 0.755547
## 3: -0.16848455 0.4642857 GRF 81.69660 0.6155054 0.5014207 0.755547
## 4: -0.08552157 0.4642857 GRF.60 49.01796 0.6155054 0.5014207 0.755547
## 5: -0.08552157 0.4642857 VT(24) 81.69660 0.6155054 0.5014207 0.755547
## 6: -0.08552157 0.4642857 VT#(24) 81.69660 0.6155054 0.5014207 0.755547
##      hr.adj.itt l.adj.itt u.adj.itt l.H.true u.H.true l.Hc.true u.Hc.true
##      <num> <num> <num> <lgcl> <lgcl> <num> <num>
## 1: 0.5906047 0.480604 0.7257825      NA      NA 0.5014207 0.755547
## 2: 0.5906047 0.480604 0.7257825      NA      NA 0.5014207 0.755547
## 3: 0.5906047 0.480604 0.7257825      NA      NA 0.5014207 0.755547
## 4: 0.5906047 0.480604 0.7257825      NA      NA 0.5014207 0.755547
## 5: 0.5906047 0.480604 0.7257825      NA      NA 0.5014207 0.755547
## 6: 0.5906047 0.480604 0.7257825      NA      NA 0.5014207 0.755547
##      l.H.hat u.H.hat l.Hc.hat u.Hc.hat
##      <num> <num> <num> <num>
## 1:      NA      NA 0.5014207 0.7555470
## 2:      NA      NA 0.5014207 0.7555470
```



```

## 3: 1.043941 5.548289 0.4297038 0.6599928
## 4:      NA      NA 0.5014207 0.7555470
## 5:      NA      NA 0.5014207 0.7555470
## 6:      NA      NA 0.5014207 0.7555470
## Subgroup HRs: H, Hc, Causal= NA 0.701027 0.701027
## Simulations= 200
## Avg censoring= 0.4639286
## Min,Max,Avg tau.max= 73.23816 83.95272 81.74969
## P(H) approximation at causal(Hrc), n=60, approx= 0.701027 0.03417324
## P(H) approximation at plim(Hrc), n=60, approx= 0.7101067 0.03691648
## Minutes,hours 5.579933 0.09299889
##
##          FSl      FSlg      GRF      GRF.60      VT(24) VT#(24)      VT(36) VT#(36)
## any.H          0.370    0.330    0.720    0.400    0.040    0.020    0.040    0.030
## sensH          NaN     NaN     NaN     NaN     NaN     NaN     NaN     NaN
## sensHc         0.950    0.960    0.910    0.950    1.000    1.000    1.000    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)        88.000    89.000    93.000    80.000    87.000    72.000    74.000    64.000
## minH           61.000    61.000    60.000    60.000    60.000    67.000    63.000    60.000
## maxH           166.000    166.000    206.000    136.000    151.000    77.000    94.000    73.000
## Avg(#Hc)       667.000    671.000    634.000    668.000    697.000    699.000    697.000    698.000
## minHc          534.000    534.000    494.000    564.000    549.000    623.000    606.000    627.000
## maxHc          700.000    700.000    700.000    700.000    700.000    700.000    700.000    700.000
## hat(H*)         NaN     NaN     NaN     NaN     NaN     NaN     NaN     NaN
## hat(hat[H])     1.896    1.916    1.747    1.542    1.403    1.499    1.194    1.276
## hat(Hc*)        0.739    0.739    0.725    0.728    0.740    0.719    0.721    0.705
## hat(hat[Hc])    0.651    0.651    0.638    0.661    0.680    0.665    0.683    0.659
## hat(H*)all      NaN     NaN     NaN     NaN     NaN     NaN     NaN     NaN
## hat(Hc*)all     0.710    0.710    0.710    0.710    0.710    0.710    0.710    0.710
## hat(ITT)all     0.710    0.710    0.710    0.710    0.710    0.710    0.710    0.710
## hat(ITTadj)all  0.669    0.669    0.669    0.669    0.669    0.669    0.669    0.669

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)

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)

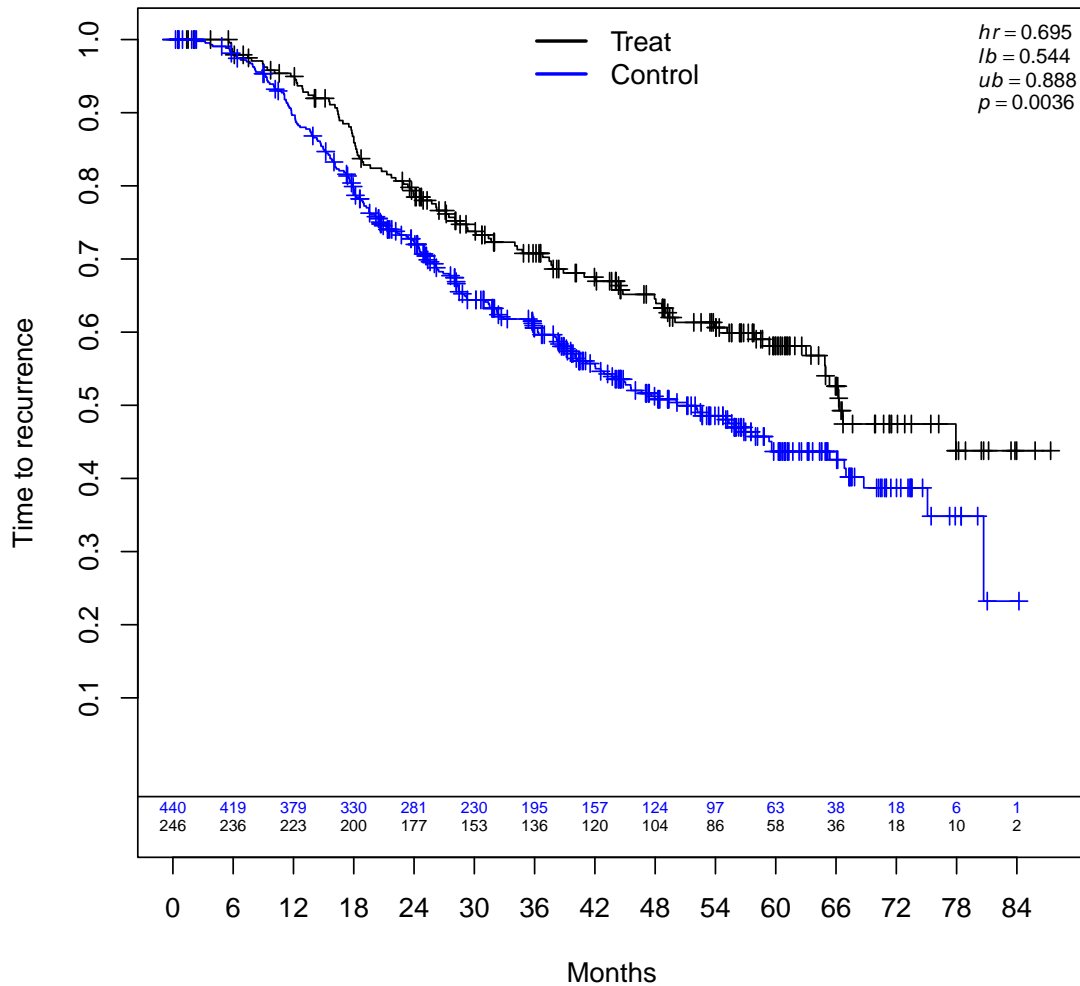
```

Table 1: Average classification rates: $avg|\hat{H}|$, $min|\hat{H}|$, and $max|\hat{H}|$, 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 $sens(\hat{H})$ is undefined and $ppv(\hat{H}) = 0$.

	FS_g	FS_{lg}	GRF	GRF_{60}	$VT(24)$	$VT^\#(24)$	$VT(36)$	$VT^\#(36)$
Finding H								
any(H)	0.37	0.33	0.72	0.4	0.04	0.02	0.04	0.03
$sens(\hat{H})$
$sens(\hat{H}^C)$	0.95	0.96	0.91	0.95	1	1	1	1
$ppv(\hat{H})$	0	0	0	0	0	0	0	0
$ppv(\hat{H}^C)$	1	1	1	1	1	1	1	1
Size of H and H-complement								
$avg \hat{H} $	88	89	93	80	87	72	74	64
$min \hat{H} $	61	61	60	60	60	67	63	60
$max \hat{H} $	166	166	206	136	151	77	94	73
$avg \hat{H}^C $	667	671	634	668	697	699	697	698
$min \hat{H}^C $	534	534	494	564	549	623	606	627
$max \hat{H}^C $	700	700	700	700	700	700	700	700

Note: Number of simulations= 200 .

Note: Probability approximation= 0.0369 .



```

## Super-population empirical harm and non-harm hazard ratios= 2.000007 0.6466405
## Causal HR (empirical ITT)= 0.7057463

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= 48.86072 2
##   leaf.node control.mean control.size control.se depth
## 1         2      -4.40      509.00      1.23      1
## 2         3       2.55      191.00      2.30      1
## 3         4       1.75      167.00      2.21      2
## 4         5      -9.07      114.00      2.68      2
## 5         6      -7.66      240.00      1.82      2
## 6         7       4.63      179.00      2.15      2
##   leaf.node control.mean control.size control.se depth
## 6         7       4.63      179.00      2.15      2
## 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 <= 29.4" "size <= 25" "size <= 20" "size <= 35"
## [5] "noise1 <= 0" "noise1 <= -0.6" "noise1 <= 0.7" "noise2 <= 0"
## [9] "noise2 <= -0.8" "noise2 <= 0.7" "noise3 <= 0" "noise3 <= -0.7"
## [13] "noise3 <= 0.6" "noise4 <= 0" "noise4 <= -0.7" "noise4 <= 0.7"
## [17] "noise5 <= 0" "noise5 <= -0.6" "noise5 <= 0.7" "z1"
## [21] "z2" "z3" "z4" "z5"
## [25] "grade3"
## Number of factors evaluated= 25
## Confounders per grf screening q21 q22 q20 q16 q9 q4 q24 q10 q6 q23 q17 q11 q14 q8 q5 q7 q15 q25 q12
##   Factors Labels VI(grf)
## 21         z2      q21 0.2104
## 22         z3      q22 0.1464
## 20         z1      q20 0.1355
## 16 noise4 <= 0.7      q16 0.0499
## 9  noise2 <= -0.8      q9 0.0357
## 4   size <= 35      q4 0.0297
## 24         z5      q24 0.0272
## 10 noise2 <= 0.7      q10 0.0263
## 6  noise1 <= -0.6      q6 0.0262
## 23         z4      q23 0.0262

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## 17      noise5 <= 0      q17 0.0260
## 11      noise3 <= 0      q11 0.0240
## 14      noise4 <= 0      q14 0.0236
## 8       noise2 <= 0      q8  0.0221
## 5       noise1 <= 0      q5  0.0209
## 7       noise1 <= 0.7    q7  0.0203
## 15      noise4 <= -0.7   q15 0.0194
## 25              grade3   q25 0.0183
## 12      noise3 <= -0.7   q12 0.0177
## 19      noise5 <= 0.7    q19 0.0174
## 3       size <= 20       q3  0.0168
## 1       size <= 29.4     q1  0.0161
## 2       size <= 25       q2  0.0159
## 13      noise3 <= 0.6    q13 0.0155
## 18      noise5 <= -0.6   q18 0.0125
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1275
## Approximately 5% of max_count met: minutes 0.0015
## Approximately 10% of max_count met: minutes 0.00415
## Approximately 20% of max_count met: minutes 0.007583333
## Approximately 33% of max_count met: minutes 0.01196667
## Approximately 50% of max_count met: minutes 0.017
## Approximately 75% of max_count met: minutes 0.02486667
## Approximately 90% of max_count met: minutes 0.03026667
## # 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 58 79
## # of subgroups with sample size less than criteria 136
## # of subgroups meeting all criteria = 1117
## # of subgroups fitted (Cox model estimable) = 1117
## *Subgroup Searching Minutes=* 0.0327
## Number of subgroups meeting HR threshold 14
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 14
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##      n E d1  HR L(HR) q21.0 q21.1 q22.0 q22.1 q20.0 q20.1 q16.0 q16.1 q9.0
## 1    95 78 44 1.74 1.11    0    0    0    1    0    1    0    0    0
## 2    79 47 26 1.54 0.87    0    0    0    1    0    0    0    0    0
## 3    82 31 19 1.50 0.73    0    0    0    0    0    0    0    0    0
## 4    74 39 18 1.49 0.79    0    0    0    1    0    0    0    0    0
## 5   122 95 52 1.48 0.98    0    1    0    0    0    1    0    0    0
## 6   100 80 41 1.47 0.94    0    0    0    0    0    1    0    0    0
## 7    72 39 25 1.43 0.74    0    0    0    1    0    0    1    0    0
## 8    77 55 30 1.41 0.83    0    0    0    0    0    1    0    0    0
## 9    86 41 24 1.37 0.73    0    0    0    0    0    0    0    0    0
## 10   93 53 30 1.34 0.78    0    1    0    0    0    0    0    0    0
##      q9.1
## 1      0
## 2      1
## 3      1
## 4      0
## 5      0
## 6      0
## 7      0

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## 8      0
## 9      1
## 10     1
## Consistency 0.9675
## # of splits= 400
## Model, % Consistency Met= {z3} {z1} 0.9675
## Number of subgroups meeting consistency criteria=
##      Pcons      N      g      m      K      M.1      M.2
##      <num> <num> <char> <char> <num> <char> <char>
## 1: 0.9675   95    3      1      2   {z3}   {z1}
## [1] "{z3}" "{z1}"
## % consistency criteria met= 0.9675
## SG focus= hr
## Subgroup Consistency Minutes= 0.02005
## Subgroup found (FS)
## Minutes forestsearch overall= 0.06415
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 48.86072 2
##      leaf.node control.mean control.size control.se depth
## 1          2          -4.40          509.00          1.23    1
## 2          3          2.55          191.00          2.30    1
## 3          4          1.75          167.00          2.21    2
## 4          5          -9.07          114.00          2.68    2
## 5          6          -7.66          240.00          1.82    2
## 6          7          4.63          179.00          2.15    2
##      leaf.node control.mean control.size control.se depth
## 6          7          4.63          179.00          2.15    2
## 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 = 0.0313058
## 12 x 1 sparse Matrix of class "dgCMatrix"
##              s0
## z1      0.28876957
## z2      .
## z3      0.01851673
## z4      0.41993396
## z5     -0.71701803
## size    .
## grade3   .
## noise1 -0.02649584
## noise2  .
## noise3  .
## noise4  .
## noise5  .
## Cox-LASSO selected: z1 z3 z4 z5 noise1
## Cox-LASSO not selected: z2 size grade3 noise2 noise3 noise4 noise5
## Default cuts included from Lasso:
## Categorical after Lasso: z1 z3 z4 z5
## # of candidate subgroup factors= 23
## [1] "size <= 29.4" "size <= 25" "size <= 20" "size <= 35"
## [5] "noise1 <= 0" "noise1 <= -0.6" "noise1 <= 0.7" "noise2 <= 0"
## [9] "noise2 <= -0.8" "noise2 <= 0.7" "noise3 <= 0" "noise3 <= -0.7"

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## [13] "noise3 <= 0.6" "noise4 <= 0" "noise4 <= -0.7" "noise4 <= 0.7"
## [17] "noise5 <= 0" "noise5 <= -0.6" "noise5 <= 0.7" "z1"
## [21] "z3" "z4" "z5"
## Number of factors evaluated= 23
## Confounders per grf screening q21 q20 q16 q9 q23 q10 q22 q4 q6 q14 q17 q7 q11 q15 q5 q13 q8 q19 q12
## Factors Labels VI(grf)
## 21 z3 q21 0.2624
## 20 z1 q20 0.1532
## 16 noise4 <= 0.7 q16 0.0612
## 9 noise2 <= -0.8 q9 0.0522
## 23 z5 q23 0.0342
## 10 noise2 <= 0.7 q10 0.0336
## 22 z4 q22 0.0309
## 4 size <= 35 q4 0.0304
## 6 noise1 <= -0.6 q6 0.0294
## 14 noise4 <= 0 q14 0.0289
## 17 noise5 <= 0 q17 0.0277
## 7 noise1 <= 0.7 q7 0.0274
## 11 noise3 <= 0 q11 0.0253
## 15 noise4 <= -0.7 q15 0.0248
## 5 noise1 <= 0 q5 0.0226
## 13 noise3 <= 0.6 q13 0.0221
## 8 noise2 <= 0 q8 0.0217
## 19 noise5 <= 0.7 q19 0.0216
## 12 noise3 <= -0.7 q12 0.0214
## 3 size <= 20 q3 0.0195
## 2 size <= 25 q2 0.0174
## 1 size <= 29.4 q1 0.0172
## 18 noise5 <= -0.6 q18 0.0148
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1081
## Approximately 5% of max_count met: minutes 0.001516667
## Approximately 10% of max_count met: minutes 0.003133333
## Approximately 20% of max_count met: minutes 0.006016667
## Approximately 33% of max_count met: minutes 0.0098
## Approximately 50% of max_count met: minutes 0.01443333
## Approximately 75% of max_count met: minutes 0.023
## Approximately 90% of max_count met: minutes 0.02748333
## # of subgroups evaluated based on (up to) maxk-factor combinations 1081
## % 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 52 71
## # of subgroups with sample size less than criteria 119
## # of subgroups meeting all criteria = 941
## # of subgroups fitted (Cox model estimable) = 941
## *Subgroup Searching Minutes=* 0.0299
## Number of subgroups meeting HR threshold 12
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 12
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
## n E d1 HR L(HR) q21.0 q21.1 q20.0 q20.1 q16.0 q16.1 q9.0 q9.1 q23.0
## 1 95 78 44 1.74 1.11 0 1 0 1 0 0 0 0
## 2 79 47 26 1.54 0.87 0 1 0 0 0 0 0 1
## 3 82 31 19 1.50 0.73 0 0 0 0 0 0 0 1
## 4 74 39 18 1.49 0.79 0 1 0 0 0 0 0 0

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## 5 100 80 41 1.47 0.94 0 0 0 1 0 0 0 0 1
## 6 72 39 25 1.43 0.74 0 1 0 0 1 0 0 0 0
## 7 77 55 30 1.41 0.83 0 0 0 1 0 0 0 0 0
## 8 86 41 24 1.37 0.73 0 0 0 0 0 0 0 1 0
## 9 147 85 48 1.32 0.86 0 1 0 0 0 0 0 0 0
## 10 90 64 32 1.31 0.80 0 0 0 1 0 0 0 0 0
## q23.1
## 1 0
## 2 0
## 3 0
## 4 0
## 5 0
## 6 0
## 7 0
## 8 0
## 9 0
## 10 0
## Consistency 0.9675
## # of splits= 400
## Model, % Consistency Met= {z3} {z1} 0.9675
## Number of subgroups meeting consistency criteria=
## Pcons N g m K M.1 M.2
## <num> <num> <char> <char> <num> <char> <char>
## 1: 0.9675 95 1 1 2 {z3} {z1}
## [1] "{z3}" "{z1}"
## % consistency criteria met= 0.9675
## SG focus= hr
## Subgroup Consistency Minutes= 0.02066667
## Subgroup found (FS)
## Minutes forestsearch overall= 0.07231667
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 49.66844 2
## leaf.node control.mean control.size control.se depth
## 2 3 -3.17 665.00 1.09 1
## 1 4 7.31 62.00 3.46 2
## 21 5 -4.98 184.00 1.89 2
## 3 6 -6.35 291.00 1.50 2
## 4 7 2.70 163.00 2.60 2
## leaf.node control.mean control.size control.se depth
## 1 4 7.31 62.00 3.46 2
## GRF subgroup found
## All splits
## [1] "size <= 22" "noise2 <= -0.62" "noise2 <= 0.23"
## Terminating node at max.diff (sg.harm.id)
## [1] "noise2 <= -0.62303751449031"
## # 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: size <= 22 noise2 <= -0.62 noise2 <= 0.23
## Initial GRF cuts included size <= 22 noise2 <= -0.62 noise2 <= 0.23
## # of candidate subgroup factors= 30
## [1] "size <= 22" "noise2 <= -0.62" "noise2 <= 0.23" "size <= 29.5"
## [5] "size <= 25" "size <= 20" "size <= 35" "noise1 <= 0"

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## [9] "noise1 <= -0.6" "noise1 <= 0.6" "noise2 <= 0" "noise2 <= -0.1"
## [13] "noise2 <= -0.7" "noise2 <= 0.6" "noise3 <= 0" "noise3 <= -0.1"
## [17] "noise3 <= -0.6" "noise3 <= 0.5" "noise4 <= 0" "noise4 <= -0.6"
## [21] "noise4 <= 0.7" "noise5 <= 0" "noise5 <= -0.6" "noise5 <= 0.6"
## [25] "z1" "z2" "z3" "z4"
## [29] "z5" "grade3"
## Number of factors evaluated= 30
## Confounders per grf screening q29 q27 q21 q30 q3 q19 q25 q6 q8 q26 q20 q28 q10 q22 q14 q12 q9 q24 q1
## Factors Labels VI(grf)
## 29 z5 q29 0.1840
## 27 z3 q27 0.1033
## 21 noise4 <= 0.7 q21 0.0825
## 30 grade3 q30 0.0518
## 3 noise2 <= 0.23 q3 0.0506
## 19 noise4 <= 0 q19 0.0397
## 25 z1 q25 0.0369
## 6 size <= 20 q6 0.0354
## 8 noise1 <= 0 q8 0.0299
## 26 z2 q26 0.0266
## 20 noise4 <= -0.6 q20 0.0263
## 28 z4 q28 0.0257
## 10 noise1 <= 0.6 q10 0.0206
## 22 noise5 <= 0 q22 0.0206
## 14 noise2 <= 0.6 q14 0.0205
## 12 noise2 <= -0.1 q12 0.0200
## 9 noise1 <= -0.6 q9 0.0196
## 24 noise5 <= 0.6 q24 0.0187
## 18 noise3 <= 0.5 q18 0.0184
## 13 noise2 <= -0.7 q13 0.0179
## 16 noise3 <= -0.1 q16 0.0177
## 1 size <= 22 q1 0.0170
## 17 noise3 <= -0.6 q17 0.0168
## 15 noise3 <= 0 q15 0.0165
## 23 noise5 <= -0.6 q23 0.0158
## 5 size <= 25 q5 0.0148
## 4 size <= 29.5 q4 0.0142
## 7 size <= 35 q7 0.0131
## 2 noise2 <= -0.62 q2 0.0129
## 11 noise2 <= 0 q11 0.0122
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1830
## Approximately 5% of max_count met: minutes 0.01788333
## Approximately 10% of max_count met: minutes 0.03723333
## Approximately 20% of max_count met: minutes 0.0443
## Approximately 33% of max_count met: minutes 0.06016667
## Approximately 50% of max_count met: minutes 0.07665
## Approximately 75% of max_count met: minutes 0.09845
## Approximately 90% of max_count met: minutes 0.10905
## # 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 84 102
## # of subgroups with sample size less than criteria 184
## # of subgroups meeting all criteria = 1604
## # of subgroups fitted (Cox model estimable) = 1604

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## *Subgroup Searching Minutes=* 0.1152167
## Number of subgroups meeting HR threshold 24
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 24
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##      n  E d1  HR L(HR) q29.0 q29.1 q27.0 q27.1 q21.0 q21.1 q30.0 q30.1 q3.0
## 1    89 34 24 1.97 0.94      0      1      0      0      0      0      0      0      0
## 2   129 47 31 1.89 1.03      0      1      0      0      0      0      0      0      1
## 3    67 43 21 1.88 1.03      0      0      0      0      0      0      0      0      0
## 4    91 75 38 1.76 1.11      0      0      0      1      0      0      0      0      0
## 5    63 28 16 1.54 0.72      0      0      0      0      0      0      0      0      0
## 6   155 58 33 1.42 0.85      0      1      0      1      0      0      0      0      0
## 7    84 46 27 1.42 0.79      0      0      0      1      0      0      0      0      0
## 8    94 41 21 1.42 0.76      0      0      0      0      0      0      0      0      0
## 9    90 31 17 1.42 0.70      0      1      0      0      0      0      0      0      0
## 10   66 29 16 1.40 0.67      0      0      0      0      0      0      0      0      1
##      q3.1
## 1      0
## 2      0
## 3      0
## 4      0
## 5      0
## 6      0
## 7      0
## 8      0
## 9      0
## 10     0
## Consistency 0.94
## # of splits= 400
## Model, % Consistency Met= {z5} !{noise2 <= 0.6} 0.94
## Consistency 0.965
## # of splits= 400
## Model, % Consistency Met= {z5} !{noise2 <= 0.23} 0.965
## Number of subgroups meeting consistency criteria=
##      Pcons      N      g      m      K      M.1      M.2
##      <num> <num> <char> <char> <num> <char>      <char>
## 1: 0.965    129      2      2      2    {z5} !{noise2 <= 0.23}
## 2: 0.940     89      7      1      2    {z5} !{noise2 <= 0.6}
## [1] "{z5}"          "!{noise2 <= 0.23}"
## % consistency criteria met= 0.965
## SG focus= hr
## Subgroup Consistency Minutes= 0.04595
## Subgroup found (FS)
## Minutes forestsearch overall= 0.2522
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 49.66844 2
##      leaf.node control.mean control.size control.se depth
## 2          3        -3.17        665.00        1.09      1
## 1          4         7.31         62.00         3.46      2
## 21         5        -4.98        184.00         1.89      2
## 3          6        -6.35        291.00         1.50      2
## 4          7         2.70        163.00         2.60      2
##      leaf.node control.mean control.size control.se depth
## 1          4         7.31         62.00         3.46      2
## GRF subgroup found

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## All splits
## [1] "size <= 22"          "noise2 <= -0.62" "noise2 <= 0.23"
## Terminating node at max.diff (sg.harm.id)
## [1] "noise2 <= -0.62303751449031"
## # of continuous/categorical characteristics 6 6
## Continuous characteristics: size noise1 noise2 noise3 noise4 noise5
## Categorical characteristics: z1 z2 z3 z4 z5 grade3
## CV lambda = 0.03691251
## 12 x 1 sparse Matrix of class "dgCMatrix"
##              s0
## z1      0.4177310
## z2      .
## z3      .
## z4      0.6493759
## z5     -0.7253380
## size    .
## grade3  .
## noise1  .
## noise2  .
## noise3  .
## noise4  .
## noise5  .
## Cox-LASSO selected: z1 z4 z5
## Cox-LASSO not selected: z2 z3 size grade3 noise1 noise2 noise3 noise4 noise5
## Default cuts included from Lasso:
## Categorical after Lasso: z1 z4 z5
## Factors per GRF: size <= 22 noise2 <= -0.62 noise2 <= 0.23
## Initial GRF cuts included size <= 22 noise2 <= -0.62 noise2 <= 0.23
## Factors included per GRF (not in lasso) size <= 22 noise2 <= -0.62 noise2 <= 0.23
## # of candidate subgroup factors= 27
## [1] "size <= 22"          "noise2 <= -0.62" "noise2 <= 0.23" "size <= 29.5"
## [5] "size <= 25"          "size <= 20"      "size <= 35"      "noise1 <= 0"
## [9] "noise1 <= -0.6"      "noise1 <= 0.6"    "noise2 <= 0"      "noise2 <= -0.1"
## [13] "noise2 <= -0.7"      "noise2 <= 0.6"    "noise3 <= 0"      "noise3 <= -0.1"
## [17] "noise3 <= -0.6"      "noise3 <= 0.5"    "noise4 <= 0"      "noise4 <= -0.6"
## [21] "noise4 <= 0.7"      "noise5 <= 0"      "noise5 <= -0.6"   "noise5 <= 0.6"
## [25] "z1"                  "z4"                "z5"
## Number of factors evaluated= 27
## Confounders per grf screening q27 q21 q3 q19 q6 q25 q8 q22 q26 q20 q12 q13 q9 q14 q16 q10 q17 q24 q1
##          Factors Labels VI(grf)
## 27          z5      q27 0.2170
## 21 noise4 <= 0.7    q21 0.0881
## 3  noise2 <= 0.23    q3 0.0540
## 19 noise4 <= 0      q19 0.0487
## 6   size <= 20      q6 0.0475
## 25          z1      q25 0.0442
## 8   noise1 <= 0      q8 0.0388
## 22 noise5 <= 0      q22 0.0297
## 26          z4      q26 0.0293
## 20 noise4 <= -0.6    q20 0.0287
## 12 noise2 <= -0.1    q12 0.0283
## 13 noise2 <= -0.7    q13 0.0283
## 9   noise1 <= -0.6    q9 0.0270
## 14 noise2 <= 0.6     q14 0.0265
## 16 noise3 <= -0.1    q16 0.0255

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## 10  noise1 <= 0.6    q10  0.0249
## 17  noise3 <= -0.6   q17  0.0235
## 24  noise5 <= 0.6    q24  0.0235
## 18  noise3 <= 0.5    q18  0.0221
## 1    size <= 22      q1   0.0219
## 23  noise5 <= -0.6   q23  0.0213
## 5    size <= 25      q5   0.0193
## 15   noise3 <= 0     q15  0.0184
## 7    size <= 35      q7   0.0181
## 4    size <= 29.5    q4   0.0176
## 2    noise2 <= -0.62 q2   0.0144
## 11   noise2 <= 0     q11  0.0132
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1485
## Approximately 5% of max_count met: minutes 0.002583333
## Approximately 10% of max_count met: minutes 0.005666667
## Approximately 20% of max_count met: minutes 0.010083333
## Approximately 33% of max_count met: minutes 0.017233333
## Approximately 50% of max_count met: minutes 0.026
## Approximately 75% of max_count met: minutes 0.04046667
## Approximately 90% of max_count met: minutes 0.04675
## # 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 79 91
## # of subgroups with sample size less than criteria 163
## # of subgroups meeting all criteria = 1281
## # of subgroups fitted (Cox model estimable) = 1281
## *Subgroup Searching Minutes=* 0.05115
## Number of subgroups meeting HR threshold 16
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 16
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##      n  E d1  HR L(HR) q27.0 q27.1 q21.0 q21.1 q3.0 q3.1 q19.0 q19.1 q6.0 q6.1
## 1    89 34 24 1.97  0.94    0    1    0    0    0    0    0    0    0    0
## 2   129 47 31 1.89  1.03    0    1    0    0    1    0    0    0    0    0
## 3    67 43 21 1.88  1.03    0    0    0    0    0    0    0    0    0    1
## 4    63 28 16 1.54  0.72    0    0    0    0    0    0    0    0    0    0
## 5    90 31 17 1.42  0.70    0    1    0    0    0    0    0    0    0    0
## 6    66 29 16 1.40  0.67    0    0    0    0    1    0    0    0    0    0
## 7    79 47 27 1.37  0.77    0    1    0    0    0    0    0    0    0    0
## 8   103 61 35 1.33  0.80    0    0    0    0    0    0    0    1    0    0
## 9    90 41 20 1.32  0.71    0    0    0    0    0    0    0    0    0    1
## 10   63 36 21 1.32  0.68    0    0    0    0    0    0    0    0    0    0
## Consistency 0.94
## # of splits= 400
## Model, % Consistency Met= {z5} !{noise2 <= 0.6} 0.94
## Consistency 0.965
## # of splits= 400
## Model, % Consistency Met= {z5} !{noise2 <= 0.23} 0.965
## Number of subgroups meeting consistency criteria=
##      Pcons      N      g      m      K      M.1      M.2
##      <num> <num> <char> <char> <num> <char>      <char>
## 1: 0.965    129      1      2      2    {z5} !{noise2 <= 0.23}
## 2: 0.940     89      5      1      2    {z5} !{noise2 <= 0.6}

```

```

## [1] "{z5}"          "{noise2 <= 0.23}"
## % consistency criteria met= 0.965
## SG focus= hr
## Subgroup Consistency Minutes= 0.04018333
## Subgroup found (FS)
## Minutes forestsearch overall= 0.1604
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 49.27616 2
##   leaf.node control.mean control.size control.se depth
## 1         2         2.62         346.00         1.59     1
## 2         3        -4.46         354.00         1.43     1
## 3         4         2.24         192.00         2.19     2
## 4         5        -5.55         201.00         1.85     2
## 5         6        -5.40         208.00         1.86     2
## 6         7         11.47          99.00         2.77     2
##   leaf.node control.mean control.size control.se depth
## 6         7         11.47          99.00         2.77     2
## GRF subgroup found
## All splits
## [1] "z3 <= 0"          "noise3 <= -0.11" "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: z3 <= 0 noise3 <= -0.11 z1 <= 0
## Initial GRF cuts included z3 <= 0 noise3 <= -0.11 z1 <= 0
## # of candidate subgroup factors= 29
## [1] "noise3 <= -0.11" "size <= 28.9"      "size <= 25"      "size <= 20"
## [5] "size <= 35"      "noise1 <= 0"      "noise1 <= -0.6"  "noise1 <= 0.7"
## [9] "noise2 <= 0"      "noise2 <= -0.1"  "noise2 <= -0.7"  "noise2 <= 0.7"
## [13] "noise3 <= 0"      "noise3 <= -0.1"  "noise3 <= -0.6"  "noise3 <= 0.6"
## [17] "noise4 <= 0.1"    "noise4 <= 0"      "noise4 <= -0.6"  "noise4 <= 0.7"
## [21] "noise5 <= 0"      "noise5 <= -0.6"  "noise5 <= 0.7"   "z1"
## [25] "z2"              "z3"              "z4"              "z5"
## [29] "grade3"
## Number of factors evaluated= 29
## Confounders per grf screening q24 q14 q27 q13 q15 q25 q28 q22 q1 q11 q26 q4 q19 q20 q18 q23 q12 q21
##           Factors Labels VI(grf)
## 24         z1      q24  0.1150
## 14 noise3 <= -0.1 q14  0.0757
## 27         z4      q27  0.0692
## 13 noise3 <= 0     q13  0.0651
## 15 noise3 <= -0.6 q15  0.0522
## 25         z2      q25  0.0493
## 28         z5      q28  0.0474
## 22 noise5 <= -0.6 q22  0.0447
## 1 noise3 <= -0.11 q1   0.0441
## 11 noise2 <= -0.7 q11  0.0439
## 26         z3      q26  0.0311
## 4          size <= 20 q4   0.0303
## 19 noise4 <= -0.6 q19  0.0268
## 20 noise4 <= 0.7  q20  0.0246

```

```

## 18      noise4 <= 0      q18 0.0243
## 23      noise5 <= 0.7    q23 0.0239
## 12      noise2 <= 0.7    q12 0.0235
## 21      noise5 <= 0      q21 0.0235
## 6       noise1 <= 0      q6  0.0217
## 29      grade3          q29 0.0207
## 7       noise1 <= -0.6    q7  0.0197
## 16      noise3 <= 0.6    q16 0.0177
## 9       noise2 <= 0      q9  0.0171
## 3       size <= 25       q3  0.0160
## 8       noise1 <= 0.7    q8  0.0160
## 2       size <= 28.9     q2  0.0153
## 17      noise4 <= 0.1    q17 0.0153
## 5       size <= 35       q5  0.0134
## 10      noise2 <= -0.1   q10 0.0123
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1711
## Approximately 5% of max_count met: minutes 0.01681667
## Approximately 10% of max_count met: minutes 0.0301
## Approximately 20% of max_count met: minutes 0.05428333
## Approximately 33% of max_count met: minutes 0.08473333
## Approximately 50% of max_count met: minutes 0.1121
## Approximately 75% of max_count met: minutes 0.1281667
## Approximately 90% of max_count met: minutes 0.13625
## # of subgroups evaluated based on (up to) maxk-factor combinations 1711
## % 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 84 93
## # of subgroups with sample size less than criteria 162
## # of subgroups meeting all criteria = 1512
## # of subgroups fitted (Cox model estimable) = 1512
## *Subgroup Searching Minutes=* 0.1419833
## Number of subgroups meeting HR threshold 116
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 116
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##      n   E d1   HR L(HR) q24.0 q24.1 q14.0 q14.1 q27.0 q27.1 q13.0 q13.1 q15.0
## 1    99   72 45 3.37  2.05    0     1     0     0     0     0     0     0     0
## 2   126   87 53 2.41  1.56    0     1     0     0     0     0     0     0     0
## 3    89   48 28 2.38  1.31    0     0     0     0     0     0     0     0     0
## 4   144  100 61 2.22  1.48    0     0     0     0     0     1     0     0     0
## 5    94   63 36 2.02  1.22    0     1     0     1     0     0     0     0     0
## 6    94   63 36 2.02  1.22    0     1     0     0     0     0     0     0     0
## 7    98   66 38 1.96  1.19    0     1     0     0     0     0     0     1     0
## 8    82   43 25 1.93  1.05    0     0     0     1     0     0     0     0     0
## 9    82   43 25 1.93  1.05    0     0     0     0     0     0     0     0     0
## 10  194  123 73 1.87  1.30    0     0     0     0     0     1     0     0     0
##      q15.1
## 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= {z1} {z3} 1
## Number of subgroups meeting consistency criteria=
##      Pcons      N      g      m      K      M.1      M.2
##      <num> <num> <char> <char> <num> <char> <char>
## 1:      1      99      12      1      2      {z1}      {z3}
## [1] "{z1}" "{z3}"
## % consistency criteria met= 1
## SG focus= hr
## Subgroup Consistency Minutes= 0.02368333
## Subgroup found (FS)
## Minutes forestsearch overall= 0.2386333
## FS: GRF stage for cut selection with dmin,tau= 12 0.6
## tau, maxdepth= 49.27616 2
##      leaf.node control.mean control.size control.se depth
## 1           2           2.62          346.00          1.59      1
## 2           3          -4.46          354.00          1.43      1
## 3           4           2.24          192.00          2.19      2
## 4           5          -5.55          201.00          1.85      2
## 5           6          -5.40          208.00          1.86      2
## 6           7          11.47           99.00          2.77      2
##      leaf.node control.mean control.size control.se depth
## 6           7          11.47           99.00          2.77      2
## GRF subgroup found
## All splits
## [1] "z3 <= 0"          "noise3 <= -0.11" "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 = 0.02467306
## 12 x 1 sparse Matrix of class "dgCMatrix"
##              s0
## z1      0.37615274
## z2     -0.04466734
## z3      .
## z4      0.39116047
## z5     -1.00896509
## size      .
## grade3  0.01906426
## noise1   .
## noise2   .
## noise3 -0.03028410
## noise4   .
## noise5   .
## Cox-LASSO selected: z1 z2 z4 z5 grade3 noise3
## Cox-LASSO not selected: z3 size noise1 noise2 noise4 noise5
## Default cuts included from Lasso:
## Categorical after Lasso: z1 z2 z4 z5 grade3
## Factors per GRF: z3 <= 0 noise3 <= -0.11 z1 <= 0

```

```

## Initial GRF cuts included z3 <= 0 noise3 <= -0.11 z1 <= 0
## Factors included per GRF (not in lasso) z3 <= 0 noise3 <= -0.11
## # of candidate subgroup factors= 29
## [1] "noise3 <= -0.11" "size <= 28.9"      "size <= 25"      "size <= 20"
## [5] "size <= 35"      "noise1 <= 0"      "noise1 <= -0.6"  "noise1 <= 0.7"
## [9] "noise2 <= 0"      "noise2 <= -0.1"   "noise2 <= -0.7"  "noise2 <= 0.7"
## [13] "noise3 <= 0"      "noise3 <= -0.1"   "noise3 <= -0.6"  "noise3 <= 0.6"
## [17] "noise4 <= 0.1"    "noise4 <= 0"      "noise4 <= -0.6"  "noise4 <= 0.7"
## [21] "noise5 <= 0"      "noise5 <= -0.6"   "noise5 <= 0.7"   "z1"
## [25] "z2"              "z4"              "z5"              "grade3"
## [29] "z3 <= 0"
## Number of factors evaluated= 29
## Confounders per grf screening q24 q14 q26 q13 q25 q15 q27 q1 q11 q22 q29 q4 q19 q18 q12 q21 q20 q23
##      Factors Labels VI(grf)
## 24      z1      q24 0.1169
## 14 noise3 <= -0.1 q14 0.0803
## 26      z4      q26 0.0667
## 13 noise3 <= 0    q13 0.0652
## 25      z2      q25 0.0511
## 15 noise3 <= -0.6 q15 0.0496
## 27      z5      q27 0.0487
## 1 noise3 <= -0.11 q1 0.0457
## 11 noise2 <= -0.7 q11 0.0429
## 22 noise5 <= -0.6 q22 0.0424
## 29      z3 <= 0    q29 0.0306
## 4      size <= 20  q4 0.0297
## 19 noise4 <= -0.6 q19 0.0274
## 18 noise4 <= 0    q18 0.0250
## 12 noise2 <= 0.7  q12 0.0249
## 21 noise5 <= 0    q21 0.0241
## 20 noise4 <= 0.7  q20 0.0230
## 23 noise5 <= 0.7  q23 0.0228
## 6      noise1 <= 0 q6 0.0212
## 28      grade3    q28 0.0208
## 7 noise1 <= -0.6  q7 0.0180
## 16 noise3 <= 0.6  q16 0.0172
## 8 noise1 <= 0.7   q8 0.0167
## 3      size <= 25  q3 0.0166
## 9      noise2 <= 0  q9 0.0164
## 17 noise4 <= 0.1  q17 0.0157
## 2      size <= 28.9 q2 0.0154
## 5      size <= 35  q5 0.0135
## 10 noise2 <= -0.1 q10 0.0118
## Number of possible configurations (<= maxk): maxk, # <= maxk 2 1711
## Approximately 5% of max_count met: minutes 0.003133333
## Approximately 10% of max_count met: minutes 0.006416667
## Approximately 20% of max_count met: minutes 0.01236667
## Approximately 33% of max_count met: minutes 0.02068333
## Approximately 50% of max_count met: minutes 0.03273333
## Approximately 75% of max_count met: minutes 0.05255
## Approximately 90% of max_count met: minutes 0.0632
## # of subgroups evaluated based on (up to) maxk-factor combinations 1711
## % 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 84 93
## # of subgroups with sample size less than criteria 162
## # of subgroups meeting all criteria = 1512
## # of subgroups fitted (Cox model estimable) = 1512
## *Subgroup Searching Minutes=* 0.0688
## Number of subgroups meeting HR threshold 116
## Subgroup candidate(s) found (FS)
## # of candidate subgroups (meeting HR criteria) = 116
## SGs (1st 10) meeting screening thresholds sorted by sg_focus= hr
##      n    E d1    HR L(HR) q24.0 q24.1 q14.0 q14.1 q26.0 q26.1 q13.0 q13.1 q25.0
## 1    99    72 45 3.37  2.05      0      1      0      0      0      0      0      0      0
## 2   126    87 53 2.41  1.56      0      1      0      0      0      0      0      0      0
## 3    89    48 28 2.38  1.31      0      0      0      0      0      0      0      0      0
## 4   144   100 61 2.22  1.48      0      0      0      0      0      1      0      0      0
## 5    94    63 36 2.02  1.22      0      1      0      1      0      0      0      0      0
## 6    94    63 36 2.02  1.22      0      1      0      0      0      0      0      0      0
## 7    98    66 38 1.96  1.19      0      1      0      0      0      0      0      1      0
## 8    82    43 25 1.93  1.05      0      0      0      1      0      0      0      0      0
## 9    82    43 25 1.93  1.05      0      0      0      0      0      0      0      0      0
## 10   194   123 73 1.87  1.30      0      0      0      0      0      1      0      0      0
##      q25.1
## 1         0
## 2         1
## 3         0
## 4         0
## 5         0
## 6         0
## 7         0
## 8         0
## 9         0
## 10        1
## Consistency 1
## # of splits= 400
## Model, % Consistency Met= {z1} !{z3 <= 0} 1
## Number of subgroups meeting consistency criteria=
##      Pcons      N      g      m      K      M.1      M.2
##      <num> <num> <char> <char> <num> <char>      <char>
## 1:      1    99     12     1     2  {z1} !{z3 <= 0}
## [1] "{z1}"      "{z3 <= 0}"
## % consistency criteria met= 1
## SG focus= hr
## Subgroup Consistency Minutes= 0.02296667
## Subgroup found (FS)
## Minutes forestsearch overall= 0.1485167

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)
##      200      200      200      200      200      200      200      200

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=200_m4a-Noise=5_N=700_alt_ktreat=0.9_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          95 0.1357143          605 0.8642857      1      95      605
## 2:      1          95 0.1357143          605 0.8642857      1      95      605
## 3:      1          95 0.1357143          605 0.8642857      1     181      519
## 4:      1          95 0.1357143          605 0.8642857      0       0      700
## 5:      1          95 0.1357143          605 0.8642857      0       0      700
## 6:      1          95 0.1357143          605 0.8642857      0       0      700
##      ppv      npv specificity sensitivity found.1 found.2 found.both
##      <num>      <num>      <num>      <num>      <num> <num>      <num>
## 1: 1.0000000 1.0000000 1.0000000 1.0000000      0       0       0
## 2: 1.0000000 1.0000000 1.0000000 1.0000000      0       0       0
## 3: 0.6631579 0.8049587 0.9383430 0.3480663      NA      NA      NA
## 4: 0.0000000 1.0000000 0.8642857 0.0000000      NA      NA      NA
## 5: 0.0000000 1.0000000 0.8642857 0.0000000      0       0       0
## 6: 0.0000000 1.0000000 0.8642857 0.0000000      0       0       0
##      found.al3 hr.H.true hr.Hc.true hr.H.hat hr.Hc.hat      b1.H      b2.H
##      <num>      <num>      <num>      <num>      <num>      <num>      <num>
## 1:      0      1.74466 0.5577464 1.744660 0.5577464 0.0000000 -0.2553474
## 2:      0      1.74466 0.5577464 1.744660 0.5577464 0.0000000 -0.2553474
## 3:      NA      1.74466 0.5577464 1.459944 0.4959567 -0.2847159 -0.5400632
## 4:      0      1.74466 0.5577464      NA 0.6688550      NA      NA
## 5:      0      1.74466 0.5577464      NA 0.6688550      NA      NA
## 6:      0      1.74466 0.5577464      NA 0.6688550      NA      NA
##      b1.Hc      b2.Hc      p.cens analysis      taumax      hr.itt      l.itt
##      <num>      <num>      <num>      <char>      <num>      <num>      <num>
## 1: 0.00000000 -0.08889407 0.4514286      FS1 81.43453 0.668855 0.5464683
## 2: 0.00000000 -0.08889407 0.4514286      FS1g 48.86072 0.668855 0.5464683
## 3: -0.06178971 -0.15068378 0.4514286      GRF 81.43453 0.668855 0.5464683
## 4: 0.11110856 0.02221450 0.4514286      GRF.60 48.86072 0.668855 0.5464683
## 5: 0.11110856 0.02221450 0.4514286      VT(24) 81.43453 0.668855 0.5464683
## 6: 0.11110856 0.02221450 0.4514286      VT#(24) 81.43453 0.668855 0.5464683
##      u.itt hr.adj.itt l.adj.itt u.adj.itt l.H.true u.H.true l.Hc.true
##      <num>      <num>      <num>      <num>      <num>      <num>      <num>
## 1: 0.8186513 0.6827343 0.5565269 0.8375626 1.105971 2.752186 0.4437854
## 2: 0.8186513 0.6827343 0.5565269 0.8375626 1.105971 2.752186 0.4437854
## 3: 0.8186513 0.6827343 0.5565269 0.8375626 1.105971 2.752186 0.4437854
## 4: 0.8186513 0.6827343 0.5565269 0.8375626 1.105971 2.752186 0.4437854
## 5: 0.8186513 0.6827343 0.5565269 0.8375626 1.105971 2.752186 0.4437854
## 6: 0.8186513 0.6827343 0.5565269 0.8375626 1.105971 2.752186 0.4437854
##      u.Hc.true      l.H.hat      u.H.hat      l.Hc.hat      u.Hc.hat
##      <num>      <num>      <num>      <num>      <num>
## 1: 0.7009717 1.1059709 2.752186 0.4437854 0.7009717
## 2: 0.7009717 1.1059709 2.752186 0.4437854 0.7009717
## 3: 0.7009717 0.9876672 2.158051 0.3894210 0.6316379
## 4: 0.7009717      NA      NA 0.5464683 0.8186513
## 5: 0.7009717      NA      NA 0.5464683 0.8186513

```

```
## 6: 0.7009717      NA      NA 0.5464683 0.8186513
## Subgroup HRs: H, H^c, Causal= 2.000007 0.6466405 0.7057463
## Simulations= 200
## Avg censoring= 0.4526929
## Min,Max,Avg tau.max= 76.87848 83.83312 81.53591
## P(H) approximation at causal(H), n(sg)=60, approx= 2.000007 60 0.8273339
## P(H) approximation at causal(H), Avg(n(sg)), approx= 2.000007 89 0.899075
## P(H) approximation at plim(H), Avg(n(sg)), approx= 2.108206 89 0.9244183
## Minutes, hours 5.16515 0.08608583
##
##          FSl      FSlg      GRF      GRF.60      VT(24) VT#(24)      VT(36) VT#(36)
## any.H      0.950      0.880      0.980      0.760      0.370      0.520      0.390      0.490
## sensH      0.750      0.610      0.600      0.490      0.270      0.420      0.290      0.440
## sensHc     0.980      0.960      0.910      0.950      0.980      0.980      0.990      0.990
## ppH        0.760      0.610      0.520      0.440      0.260      0.400      0.290      0.430
## ppHc       0.970      0.950      0.940      0.930      0.910      0.930      0.910      0.930
## Avg(#H)    86.000      87.000      110.000      102.000      95.000      92.000      89.000      89.000
## minH       61.000      61.000      62.000      61.000      62.000      60.000      60.000      60.000
## maxH      129.000      151.000      327.000      203.000      146.000      152.000      132.000      123.000
## Avg(#Hc)   619.000      624.000      593.000      623.000      665.000      652.000      665.000      656.000
## minHc     571.000      549.000      373.000      497.000      554.000      548.000      568.000      577.000
## maxHc     700.000      700.000      700.000      700.000      700.000      700.000      700.000      700.000
## hat(H*)    2.147      2.170      2.115      2.208      2.291      2.303      2.397      2.328
## hat(hat[H]) 2.251      2.204      1.959      1.893      2.023      2.119      2.060      2.208
## hat(Hc*)   0.654      0.655      0.656      0.650      0.657      0.649      0.646      0.655
## hat(hat[Hc]) 0.655      0.657      0.639      0.649      0.666      0.657      0.660      0.659
## hat(H*)all 2.108      2.108      2.108      2.108      2.108      2.108      2.108      2.108
## hat(Hc*)all 0.655      0.655      0.655      0.655      0.655      0.655      0.655      0.655
## hat(ITT)all 0.755      0.755      0.755      0.755      0.755      0.755      0.755      0.755
## hat(ITTadj)all 0.745      0.745      0.745      0.745      0.745      0.745      0.745      0.745

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 10.98555 0.1830925

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 549.2775 9.154625

# 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: Apple M1 Ultra
```

Table 2: Average classification rates: $avg|\hat{H}|$, $min|\hat{H}|$, and $max|\hat{H}|$, 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 $sens(\hat{H})$ is undefined and $ppv(\hat{H}) = 0$.

	FS_g	FS_{lg}	GRF	GRF_{60}	$VT(24)$	$VT^\#(24)$	$VT(36)$	$VT^\#(36)$
Finding H								
$any(H)$	0.95	0.88	0.98	0.76	0.37	0.52	0.39	0.49
$sens(\hat{H})$	0.75	0.61	0.6	0.49	0.27	0.42	0.29	0.44
$sens(\hat{H}^C)$	0.98	0.96	0.91	0.95	0.98	0.98	0.99	0.99
$ppv(\hat{H})$	0.76	0.61	0.52	0.44	0.26	0.4	0.29	0.43
$ppv(\hat{H}^C)$	0.97	0.95	0.94	0.93	0.91	0.93	0.91	0.93
Size of H and H-complement								
$avg \hat{H} $	86	87	110	102	95	92	89	89
$min \hat{H} $	61	61	62	61	62	60	60	60
$max \hat{H} $	129	151	327	203	146	152	132	123
$avg \hat{H}^C $	619	624	593	623	665	652	665	656
$min \hat{H}^C $	571	549	373	497	554	548	568	577
$max \hat{H}^C $	700	700	700	700	700	700	700	700

Note: Number of simulations= 200 .

Note: Probability approximation= 0.8991 .

```
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= 20 69
```