```r
N <- 700
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 <- 0.5

# 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 <- 0.2
# 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
frac.tau_fs <- 0.6

label.analyses <- c("FS1", "GRF", "VT(24)", "VT#(24)", "VT(36)", "VT#(36)", "GRF.60")
# Classification table names
est_names <- c("$FS_{1}$", "$FS_{1g}$", "$GRF$", "$GRF_{60}$", "$VT(24)$", "${VT}^{\\#}(24)$",
    "$VT(36)$", "${VT}^{\\#}(36)$")

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

```r
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 <- c("oc_s20k_")
out.loc <- paste0("results/", fl_prefix)

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

# 0, 3, or 5
n_add_noise <- 3

model.index <- "m4a-FS4-mk2-Noise3"
file.index <- "v0a"

k.z3 <- 1
k.treat <- 0.9

hrHs <- c(0, 1, 1.5, 2, 2.5, 3)

nsize <- paste0("N=", N)
treat.id <- paste0("ktreat=", k.treat)

flist_all <- NULL
f1 <- NULL
# Start with null
if (hrHs[1] == 0) {
    f1 <- fl_prefix
    f1 <- paste0(f1, model.index, sep = "_")
    f1 <- paste0(f1, nsize, sep = "_")
    f1 <- paste0(f1, "null", sep = "_")
    f1 <- paste0(f1, treat.id, sep = "_")
    f1 <- paste0(f1, file.index, sep = ".")
    f1 <- paste0(f1, "Rdata")
}

flist_all <- c(flist_all, f1)
if (hrHs[1] == 0) {
    for (hh in 2:length(hrHs)) {
        hrH.id <- paste0("hrH=", hrHs[hh])
        fh <- fl_prefix
        fh <- paste0(fh, model.index, sep = "_")
        fh <- paste0(fh, nsize, sep = "_")
        fh <- paste0(fh, "alt", sep = "_")
        fh <- paste0(fh, treat.id, sep = "_")
        fh <- paste0(fh, hrH.id, sep = "_")
        fh <- paste0(fh, file.index, sep = ".")
        fh <- paste0(fh, "Rdata")
```

```
        flist_all <- c(flist_all, fh)
    }
}

z1_frac <- 0.25  # Default model index 'm1' (The 1st quartile of z1=er)
pH_super <- 0.125  # non-NULL re-defines z1_frac

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

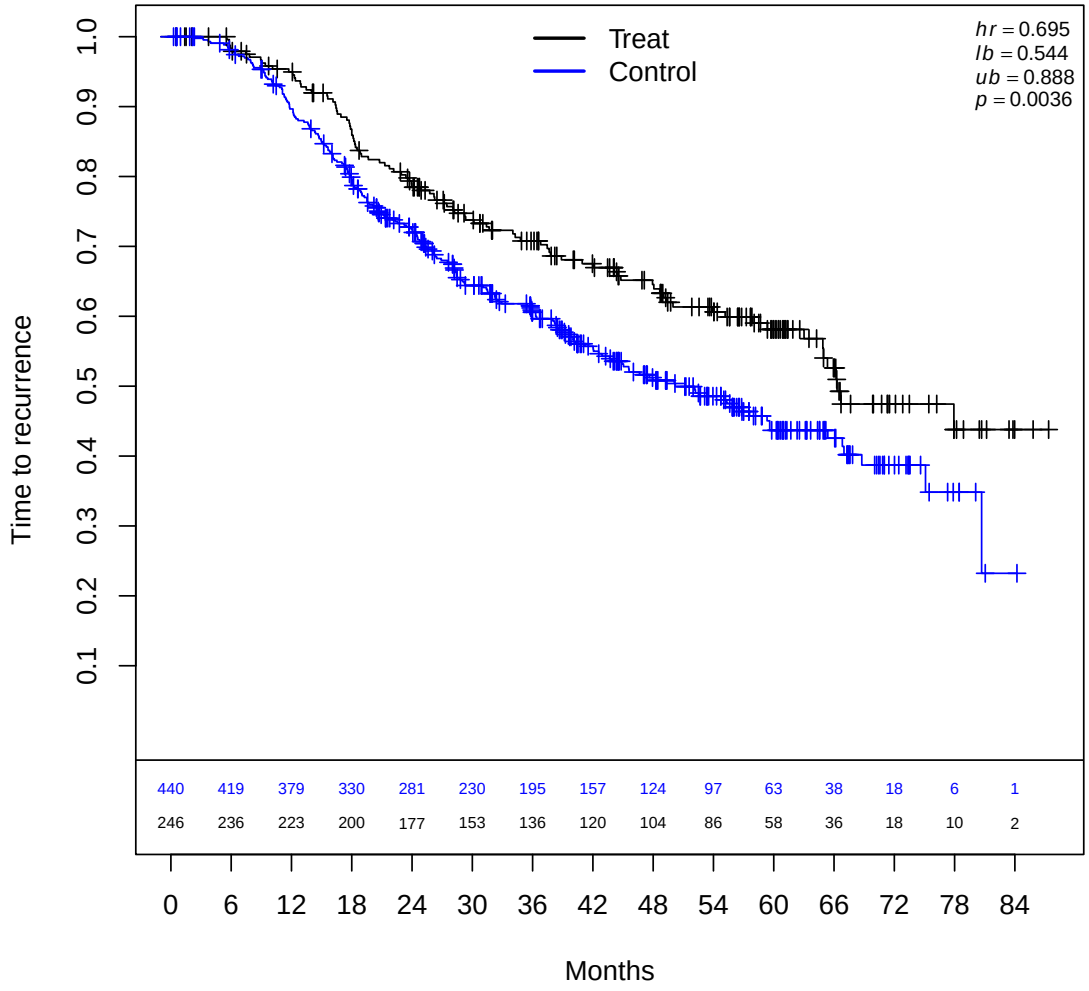
```
# Bootstrap on log(hr) scale converted to HR (est.loghr=TRUE & est.scale='hr')
est.loghr <- TRUE
est.scale <- "hr"
t.start.all <- proc.time()[3]

# 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(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")

t.start <- proc.time()[3]
res <- simPar({
    ans.analyses <- oc_analyses_m4_FS4(sim)
}, sims = Nsims, seed = 8316951, counter = "sim", export = fun_arg_list)
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 = "FSl")
```

```
## [1] "results/oc_s20k_m4a-FS4-mk2-Noise3_N=700_null_ktreat=0.9_v0a.Rdata"
##    sim sizeH_true propH_true sizeHc_true propHc_true any.H size.H size.Hc ppv
## 1:   1          0          0         700           1     0      0     700  NA
## 2:   1          0          0         700           1     0      0     700  NA
## 3:   1          0          0         700           1     0      0     700  NA
## 4:   1          0          0         700           1     1    116     584  NA
## 5:   1          0          0         700           1     0      0     700  NA
## 6:   1          0          0         700           1     0      0     700  NA
##          npv specificity sensitivity found.1 found.2 found.both found.al3
## 1: 1.0000000           1          NA       0       0          0         0
## 2: 1.0000000           1          NA       0       0          0         0
## 3: 1.0000000           1          NA      NA      NA         NA        NA
## 4: 0.8342857           1           0      NA      NA         NA        NA
## 5: 1.0000000           1          NA       0       0          0         0
## 6: 1.0000000           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
## 1:        NA   0.677239       NA 0.6772390   NA   NA  0.00000000 -0.02378796
## 2:        NA   0.677239       NA 0.6772390   NA   NA  0.00000000 -0.02378796
## 3:        NA   0.677239       NA 0.6772390   NA   NA  0.00000000 -0.02378796
## 4:        NA   0.677239 1.242411 0.5939277   NA   NA -0.08331127 -0.10709924
## 5:        NA   0.677239       NA 0.6772390   NA   NA  0.00000000 -0.02378796
## 6:        NA   0.677239       NA 0.6772390   NA   NA  0.00000000 -0.02378796
##       p.cens analysis   taumax   hr.itt     l.itt     u.itt hr.adj.itt
## 1: 0.4971429      FSl 83.32785 0.677239 0.5482269 0.8366111  0.6501308
## 2: 0.4971429     FSlg 49.99671 0.677239 0.5482269 0.8366111  0.6501308
## 3: 0.4971429      GRF 83.32785 0.677239 0.5482269 0.8366111  0.6501308
## 4: 0.4971429   GRF.60 49.99671 0.677239 0.5482269 0.8366111  0.6501308
## 5: 0.4971429   VT(24) 83.32785 0.677239 0.5482269 0.8366111  0.6501308
## 6: 0.4971429  VT#(24) 83.32785 0.677239 0.5482269 0.8366111  0.6501308
##    l.adj.itt u.adj.itt l.H.true u.H.true l.Hc.true u.Hc.true   l.H.hat  u.H.hat
## 1: 0.5259035 0.8037026       NA       NA 0.5482269 0.8366111        NA       NA
## 2: 0.5259035 0.8037026       NA       NA 0.5482269 0.8366111        NA       NA
## 3: 0.5259035 0.8037026       NA       NA 0.5482269 0.8366111        NA       NA
## 4: 0.5259035 0.8037026       NA       NA 0.5482269 0.8366111 0.7564816 2.040478
## 5: 0.5259035 0.8037026       NA       NA 0.5482269 0.8366111        NA       NA
## 6: 0.5259035 0.8037026       NA       NA 0.5482269 0.8366111        NA       NA
##     l.Hc.hat  u.Hc.hat
## 1: 0.5482269 0.8366111
## 2: 0.5482269 0.8366111
## 3: 0.5482269 0.8366111
## 4: 0.4696121 0.7511522
## 5: 0.5482269 0.8366111
## 6: 0.5482269 0.8366111
## Subgroup HRs: H, H^c, Causal= NA 0.701027 0.701027
## Simulations= 20000
## Avg censoring= 0.4616874
```

```
## Min,Max,Avg tau.max= 70.70459 83.995 81.67393
## P(H) approximation at causal(Hrc), n=60, approx= 0.701027 0.03395513
## P(H) approximation at plim(Hrc), n=60, approx= 0.7074425 0.03587355
## Minutes,hours 99.7598 1.662663
##                     FSl    FSlg     GRF  GRF.60  VT(24) VT#(24)  VT(36) VT#(36)
## any.H             0.020   0.110   0.610   0.270   0.040   0.020   0.060   0.030
## sensH               NaN     NaN     NaN     NaN     NaN     NaN     NaN     NaN
## sensHc            1.000   0.990   0.920   0.970   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)         126.000  92.000  94.000  81.000  79.000  76.000  81.000  77.000
## minH             62.000  61.000  60.000  60.000  60.000  60.000  60.000  60.000
## maxH            299.000 294.000 351.000 234.000 192.000 149.000 186.000 151.000
## Avg(#Hc)        697.000 690.000 643.000 678.000 697.000 698.000 695.000 698.000
## minHc           401.000 406.000 349.000 466.000 508.000 551.000 514.000 549.000
## 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])       1.677   1.891   1.696   1.577   1.280   1.423   1.373   1.620
## hat(Hc*)          0.803   0.761   0.728   0.725   0.737   0.741   0.737   0.749
## hat(hat[Hc])      0.695   0.670   0.643   0.657   0.692   0.688   0.685   0.685
## hat(H*)all          NaN     NaN     NaN     NaN     NaN     NaN     NaN     NaN
## hat(Hc*)all       0.707   0.707   0.707   0.707   0.707   0.707   0.707   0.707
## hat(ITT)all       0.707   0.707   0.707   0.707   0.707   0.707   0.707   0.707
## hat(ITTadj)all    0.665   0.665   0.665   0.665   0.665   0.665   0.665   0.665

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)
```

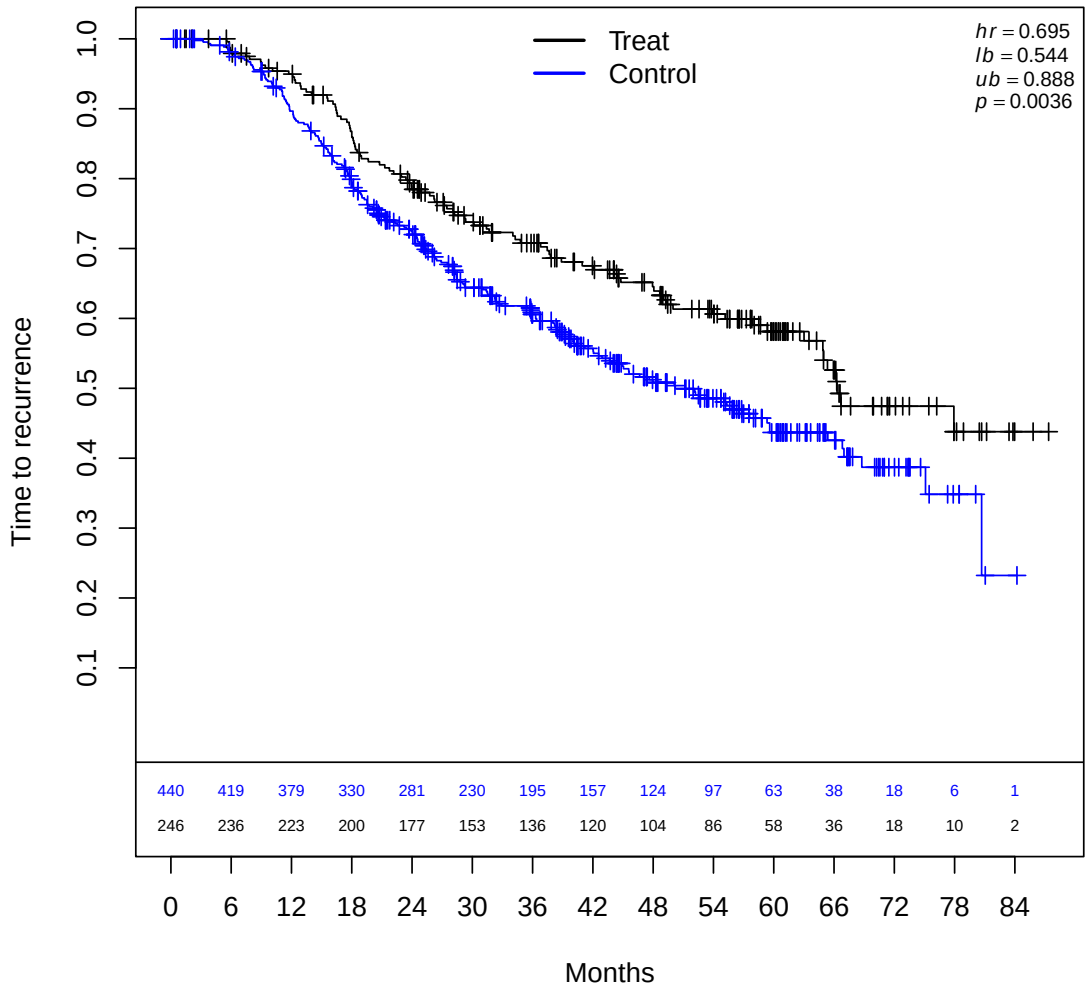
Table 1: Average classification rates: $avg|\hat{H}|$, $min|\hat{H}|$, and $max|\hat{H}|$, denote the average, minimum, and maximum of the number of subjects in the estimated subgroup $\hat{H}$ (analogously for $\hat{H}^c$). Note that under the null $sens(\hat{H})$ is undefined and $ppv(\hat{H}) = 0$.

	FS_l	FS_{lg}	GRF	GRF_{60}	$VT(24)$	$VT^{\#}(24)$	$VT(36)$	$VT^{\#}(36)$
Finding H								
any(H)	0.02	0.11	0.61	0.27	0.04	0.02	0.06	0.03
$sens(\hat{H})$	.	.	.	.	.	.	.	.
$sens(\hat{H}^C)$	1	0.99	0.92	0.97	1	1	0.99	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								
$avg\|\hat{H}\|$	126	92	94	81	79	76	81	77
$min\|\hat{H}\|$	62	61	60	60	60	60	60	60
$max\|\hat{H}\|$	299	294	351	234	192	149	186	151
$avg\|\hat{H}^C\|$	697	690	643	678	697	698	695	698
$min\|\hat{H}^C\|$	401	406	349	466	508	551	514	549
$max\|\hat{H}^C\|$	700	700	700	700	700	700	700	700

Note: Number of simulations= 20000 .

Note: Probability approximation= 0.0359 .

```
mod.harm <- "alt"
hrH.target <- 2
this.dgm <- get.dgm4(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= 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")

t.start <- proc.time()[3]
res <- simPar({
    ans.analyses <- oc_analyses_m4_FS4(sim)
}, sims = Nsims, seed = 8316951, counter = "sim", export = fun_arg_list)
```

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

print(table(res$analysis))
```

```
##
##     FSl    FSlg     GRF  GRF.60  VT(24)  VT(36) VT#(24) VT#(36)
##   20000   20000   20000   20000   20000   20000   20000   20000
```

```r
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 = "FSl")
```

```
## [1] "results/oc_s20k_m4a-FS4-mk2-Noise3_N=700_alt_ktreat=0.9_hrH=2_v0a.Rdata"
##    sim sizeH_true propH_true sizeHc_true propHc_true any.H size.H size.Hc
## 1:   1         85  0.1214286         615   0.8785714     1    109     591
## 2:   1         85  0.1214286         615   0.8785714     1    109     591
## 3:   1         85  0.1214286         615   0.8785714     1    146     554
## 4:   1         85  0.1214286         615   0.8785714     0      0     700
## 5:   1         85  0.1214286         615   0.8785714     1     85     615
## 6:   1         85  0.1214286         615   0.8785714     1     85     615
##          ppv       npv specificity sensitivity found.1 found.2 found.both
## 1: 1.0000000 0.9609756   1.0000000   0.7798165       0       0          0
## 2: 1.0000000 0.9609756   1.0000000   0.7798165       0       0          0
## 3: 0.2117647 0.7918699   0.8790614   0.1232877      NA      NA         NA
## 4: 0.0000000 1.0000000   0.8785714   0.0000000      NA      NA         NA
## 5: 1.0000000 1.0000000   1.0000000   1.0000000       0       0          0
## 6: 1.0000000 1.0000000   1.0000000   1.0000000       0       0          0
##    found.al3 hr.H.true hr.Hc.true hr.H.hat hr.Hc.hat        b1.H       b2.H
## 1:         0  1.506201  0.6653353 1.478681 0.6485153 -0.02752021 -0.5213264
## 2:         0  1.506201  0.6653353 1.478681 0.6485153 -0.02752021 -0.5213264
## 3:        NA  1.506201  0.6653353 1.556994 0.6446769  0.05079310 -0.4430131
## 4:         0  1.506201  0.6653353       NA 0.7838874          NA         NA
## 5:         0  1.506201  0.6653353 1.506201 0.6653353  0.00000000 -0.4938062
## 6:         0  1.506201  0.6653353 1.506201 0.6653353  0.00000000 -0.4938062
##         b1.Hc        b2.Hc    p.cens analysis   taumax    hr.itt     l.itt
## 1: -0.0168200  0.001874810 0.4785714      FSl 77.92977 0.7838874 0.6377874
## 2: -0.0168200  0.001874810 0.4785714     FSlg 46.75786 0.7838874 0.6377874
## 3: -0.0206584 -0.001963588 0.4785714      GRF 77.92977 0.7838874 0.6377874
## 4:  0.1185522  0.137246969 0.4785714   GRF.60 46.75786 0.7838874 0.6377874
## 5:  0.0000000  0.018694811 0.4785714   VT(24) 77.92977 0.7838874 0.6377874
## 6:  0.0000000  0.018694811 0.4785714  VT#(24) 77.92977 0.7838874 0.6377874
##        u.itt hr.adj.itt l.adj.itt u.adj.itt  l.H.true u.H.true l.Hc.true
## 1: 0.9634551  0.8263705 0.6715974  1.016812 0.9418972 2.408587 0.5267352
## 2: 0.9634551  0.8263705 0.6715974  1.016812 0.9418972 2.408587 0.5267352
## 3: 0.9634551  0.8263705 0.6715974  1.016812 0.9418972 2.408587 0.5267352
## 4: 0.9634551  0.8263705 0.6715974  1.016812 0.9418972 2.408587 0.5267352
## 5: 0.9634551  0.8263705 0.6715974  1.016812 0.9418972 2.408587 0.5267352
## 6: 0.9634551  0.8263705 0.6715974  1.016812 0.9418972 2.408587 0.5267352
##    u.Hc.true   l.H.hat  u.H.hat  l.Hc.hat  u.Hc.hat
## 1: 0.8404053 0.9639631 2.268237 0.5102219 0.8242924
## 2: 0.8404053 0.9639631 2.268237 0.5102219 0.8242924
```

```
## 3: 0.8404053 1.0145166 2.389543 0.5083670 0.8175360
## 4: 0.8404053        NA       NA 0.6377874 0.9634551
## 5: 0.8404053 0.9418972 2.408587 0.5267352 0.8404053
## 6: 0.8404053 0.9418972 2.408587 0.5267352 0.8404053
## Subgroup HRs: H, H^c, Causal= 2.000007 0.6466405 0.7057463
## Simulations= 20000
## Avg censoring= 0.4500922
## Min,Max,Avg tau.max= 68.71539 83.99076 81.62406
## P(H) approximation at causal(H), n(sg)=60, approx= 2.000007 60 0.8282634
## P(H) approximation at causal(H), Avg(n(sg)), approx= 2.000007 89 0.8998467
## P(H) approximation at plim(H), Avg(n(sg)), approx= 2.122868 89 0.9279966
## Minutes,hours 127.5697 2.126161
##                    FSl    FSlg     GRF  GRF.60  VT(24) VT#(24)  VT(36) VT#(36)
## any.H            0.710   0.830   0.940   0.710   0.440   0.490   0.420   0.560
## sensH            0.640   0.740   0.660   0.520   0.370   0.440   0.340   0.520
## sensHc           0.980   0.980   0.930   0.960   0.990   0.990   0.990   0.990
## ppH              0.600   0.710   0.600   0.470   0.360   0.430   0.330   0.500
## ppHc             0.950   0.970   0.950   0.940   0.920   0.930   0.920   0.940
## Avg(#H)         96.000  93.000 106.000 101.000  92.000  92.000  93.000  92.000
## minH            61.000  61.000  60.000  60.000  60.000  60.000  60.000  60.000
## maxH           353.000 353.000 349.000 299.000 196.000 196.000 247.000 198.000
## Avg(#Hc)       631.000 623.000 601.000 628.000 660.000 654.000 661.000 648.000
## minHc          347.000 347.000 351.000 401.000 504.000 504.000 453.000 502.000
## maxHc          700.000 700.000 700.000 700.000 700.000 700.000 700.000 700.000
## hat(H*)          2.250   2.227   2.155   2.238   2.385   2.385   2.412   2.378
## hat(hat[H])      2.083   2.191   1.997   1.976   2.192   2.262   2.220   2.299
## hat(Hc*)         0.657   0.654   0.653   0.649   0.654   0.654   0.654   0.652
## hat(hat[Hc])     0.658   0.653   0.643   0.649   0.663   0.657   0.662   0.653
## hat(H*)all       2.123   2.123   2.123   2.123   2.123   2.123   2.123   2.123
## hat(Hc*)all      0.653   0.653   0.653   0.653   0.653   0.653   0.653   0.653
## hat(ITT)all      0.756   0.756   0.756   0.756   0.756   0.756   0.756   0.756
## hat(ITTadj)all   0.744   0.744   0.744   0.744   0.744   0.744   0.744   0.744

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)
```

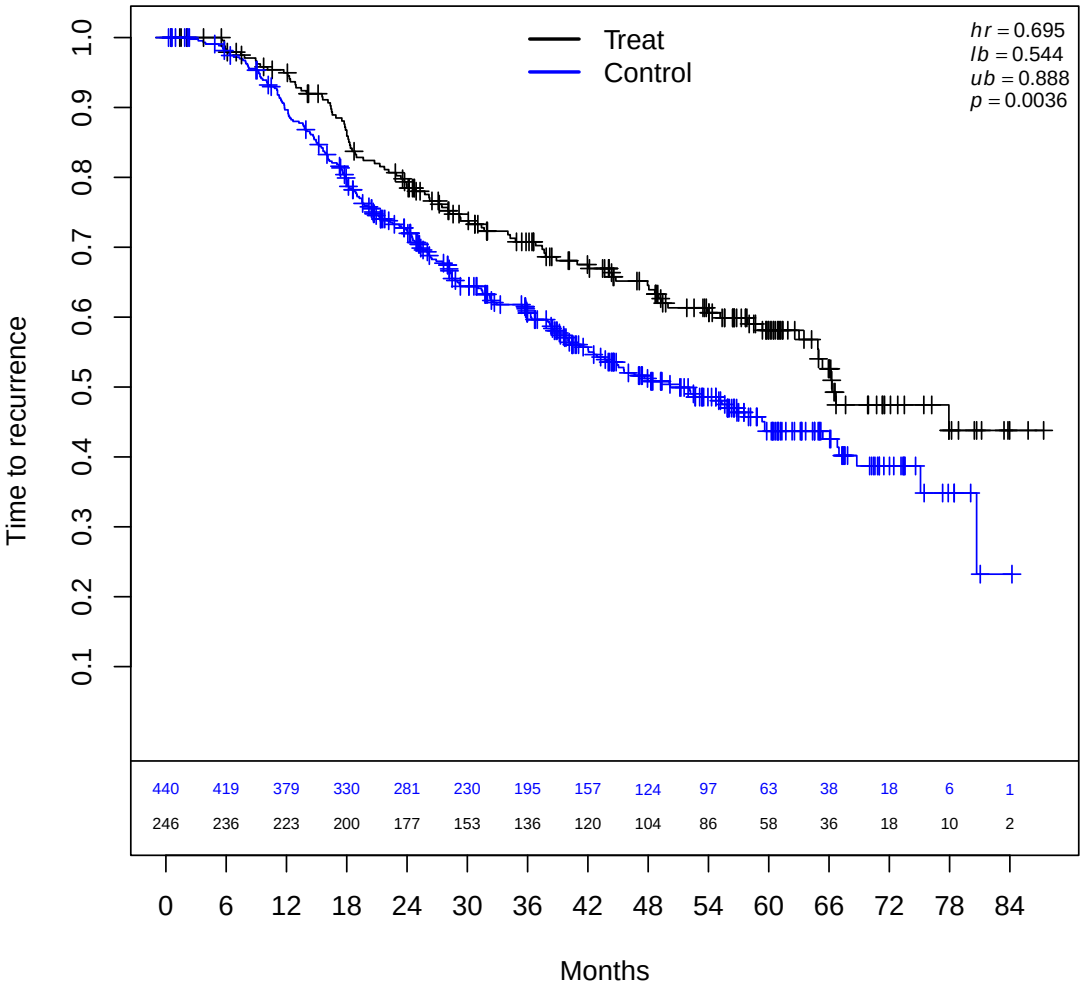
```
mod.harm <- "alt"
hrH.target <- 2.5
this.dgm <- get.dgm4(mod.harm = mod.harm, N = N, k.treat = k.treat, model.index = model.index,
    sol_tol = 10^-8, hrH.target = hrH.target, cens.type = cens.type, out.loc = out.loc,
    file.index = file.index, details = TRUE, parms_torand = FALSE)
```

Table 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_l	FS_{lg}	GRF	GRF_{60}	$VT(24)$	$VT^{\#}(24)$	$VT(36)$	$VT^{\#}(36)$
Finding H								
any(H)	0.71	0.83	0.94	0.71	0.44	0.49	0.42	0.56
$sens(\hat{H})$	0.64	0.74	0.66	0.52	0.37	0.44	0.34	0.52
$sens(\hat{H}^C)$	0.98	0.98	0.93	0.96	0.99	0.99	0.99	0.99
$ppv(\hat{H})$	0.6	0.71	0.6	0.47	0.36	0.43	0.33	0.5
$ppv(\hat{H}^C)$	0.95	0.97	0.95	0.94	0.92	0.93	0.92	0.94
Size of H and H-complement								
$avg\|\hat{H}\|$	96	93	106	101	92	92	93	92
$min\|\hat{H}\|$	61	61	60	60	60	60	60	60
$max\|\hat{H}\|$	353	353	349	299	196	196	247	198
$avg\|\hat{H}^C\|$	631	623	601	628	660	654	661	648
$min\|\hat{H}^C\|$	347	347	351	401	504	504	453	502
$max\|\hat{H}^C\|$	700	700	700	700	700	700	700	700

Note: Number of simulations= 20000 .

Note: Probability approximation= 0.8998 .



```
## Super-population empirical harm and non-harm hazard ratios= 2.499996 0.6466405
## Causal HR (empirical ITT)= 0.7125876

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")

t.start <- proc.time()[3]
res <- simPar({
    ans.analyses <- oc_analyses_m4_FS4(sim)
}, sims = Nsims, seed = 8316951, counter = "sim", export = fun_arg_list)
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_s20k_m4a-FS4-mk2-Noise3_N=700_alt_ktreat=0.9_hrH=2.5_v0a.Rdata"
##    sim sizeH_true propH_true sizeHc_true propHc_true any.H size.H size.Hc
## 1:   1         85  0.1214286         615   0.8785714     1     85     615
## 2:   1         85  0.1214286         615   0.8785714     1     85     615
## 3:   1         85  0.1214286         615   0.8785714     1    133     567
## 4:   1         85  0.1214286         615   0.8785714     0      0     700
## 5:   1         85  0.1214286         615   0.8785714     1     85     615
## 6:   1         85  0.1214286         615   0.8785714     1     85     615
##          ppv       npv specificity sensitivity found.1 found.2 found.both
## 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: 0.2117647 0.8130081   0.8818342   0.1353383      NA      NA         NA
## 4: 0.0000000 1.0000000   0.8785714   0.0000000      NA      NA         NA
## 5: 1.0000000 1.0000000   1.0000000   1.0000000       0       0          0
## 6: 1.0000000 1.0000000   1.0000000   1.0000000       0       0          0
##    found.al3 hr.H.true hr.Hc.true hr.H.hat hr.Hc.hat       b1.H       b2.H
## 1:         0  1.800236  0.6653353 1.800236 0.6653353  0.0000000 -0.6997600
## 2:         0  1.800236  0.6653353 1.800236 0.6653353  0.0000000 -0.6997600
## 3:        NA  1.800236  0.6653353 1.634649 0.6699374 -0.1655863 -0.8653463
## 4:         0  1.800236  0.6653353       NA 0.7991789         NA         NA
## 5:         0  1.800236  0.6653353 1.800236 0.6653353  0.0000000 -0.6997600
## 6:         0  1.800236  0.6653353 1.800236 0.6653353  0.0000000 -0.6997600
##          b1.Hc      b2.Hc    p.cens analysis   taumax    hr.itt     l.itt
## 1: 0.000000000 0.01869481 0.4771429      FS1 77.92977 0.7991789 0.6504514
## 2: 0.000000000 0.01869481 0.4771429     FS1g 46.75786 0.7991789 0.6504514
## 3: 0.004602089 0.02329690 0.4771429      GRF 77.92977 0.7991789 0.6504514
## 4: 0.133843623 0.15253843 0.4771429   GRF.60 46.75786 0.7991789 0.6504514
```

```
## 5: 0.000000000 0.01869481 0.4771429   VT(24) 77.92977 0.7991789 0.6504514
## 6: 0.000000000 0.01869481 0.4771429  VT#(24) 77.92977 0.7991789 0.6504514
##        u.itt hr.adj.itt l.adj.itt u.adj.itt l.H.true u.H.true l.Hc.true
## 1: 0.9819133  0.8636224 0.7016851  1.062932 1.124822  2.88121 0.5267352
## 2: 0.9819133  0.8636224 0.7016851  1.062932 1.124822  2.88121 0.5267352
## 3: 0.9819133  0.8636224 0.7016851  1.062932 1.124822  2.88121 0.5267352
## 4: 0.9819133  0.8636224 0.7016851  1.062932 1.124822  2.88121 0.5267352
## 5: 0.9819133  0.8636224 0.7016851  1.062932 1.124822  2.88121 0.5267352
## 6: 0.9819133  0.8636224 0.7016851  1.062932 1.124822  2.88121 0.5267352
##    u.Hc.true  l.H.hat  u.H.hat  l.Hc.hat  u.Hc.hat
## 1: 0.8404053 1.124822 2.881210 0.5267352 0.8404053
## 2: 0.8404053 1.124822 2.881210 0.5267352 0.8404053
## 3: 0.8404053 1.039054 2.571644 0.5307223 0.8456704
## 4: 0.8404053       NA       NA 0.6504514 0.9819133
## 5: 0.8404053 1.124822 2.881210 0.5267352 0.8404053
## 6: 0.8404053 1.124822 2.881210 0.5267352 0.8404053
## Subgroup HRs: H, H^c, Causal= 2.499996 0.6466405 0.7125876
## Simulations= 20000
## Avg censoring= 0.447504
## Min,Max,Avg tau.max= 68.71539 83.99076 81.6078
## P(H) approximation at causal(H), n(sg)=60, approx= 2.499996 60 0.9330791
## P(H) approximation at causal(H), Avg(n(sg)), approx= 2.499996 89 0.9743293
## P(H) approximation at plim(H), Avg(n(sg)), approx= 2.685038 89 0.9843563
## Minutes,hours 124.0249 2.067082
##                    FSl    FSlg     GRF  GRF.60  VT(24) VT#(24)  VT(36) VT#(36)
## any.H            0.860   0.960   0.980   0.860   0.710   0.790   0.660   0.810
## sensH            0.790   0.900   0.800   0.710   0.660   0.750   0.600   0.780
## sensHc           0.980   0.990   0.950   0.960   0.990   0.990   0.990   0.990
## ppH              0.760   0.880   0.720   0.640   0.640   0.730   0.580   0.770
## ppHc             0.970   0.990   0.970   0.960   0.960   0.970   0.950   0.970
## Avg(#H)         95.000  91.000 106.000 105.000  93.000  92.000  93.000  92.000
## minH            61.000  61.000  60.000  60.000  60.000  60.000  60.000  60.000
## maxH           212.000 218.000 350.000 316.000 203.000 192.000 250.000 226.000
## Avg(#Hc)       619.000 613.000 596.000 610.000 634.000 628.000 639.000 626.000
## minHc          488.000 482.000 350.000 384.000 497.000 508.000 450.000 474.000
## maxHc          700.000 700.000 700.000 700.000 700.000 700.000 700.000 700.000
## hat(H*)          2.741   2.720   2.700   2.757   2.864   2.831   2.907   2.827
## hat(hat[H])      2.465   2.638   2.371   2.323   2.688   2.713   2.714   2.743
## hat(Hc*)         0.655   0.653   0.653   0.649   0.653   0.652   0.652   0.652
## hat(hat[Hc])     0.658   0.653   0.645   0.648   0.657   0.654   0.657   0.652
## hat(H*)all       2.685   2.685   2.685   2.685   2.685   2.685   2.685   2.685
## hat(Hc*)all      0.653   0.653   0.653   0.653   0.653   0.653   0.653   0.653
## hat(ITT)all      0.773   0.773   0.773   0.773   0.773   0.773   0.773   0.773
## hat(ITTadj)all   0.772   0.772   0.772   0.772   0.772   0.772   0.772   0.772

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")
```

Table 3: 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_l	FS_{lg}	GRF	GRF_{60}	$VT(24)$	$VT^{\#}(24)$	$VT(36)$	$VT^{\#}(36)$
Finding H								
any(H)	0.86	0.96	0.98	0.86	0.71	0.79	0.66	0.81
$sens(\hat{H})$	0.79	0.9	0.8	0.71	0.66	0.75	0.6	0.78
$sens(\hat{H}^C)$	0.98	0.99	0.95	0.96	0.99	0.99	0.99	0.99
$ppv(\hat{H})$	0.76	0.88	0.72	0.64	0.64	0.73	0.58	0.77
$ppv(\hat{H}^C)$	0.97	0.99	0.97	0.96	0.96	0.97	0.95	0.97
Size of H and H-complement								
$avg|\hat{H}|$	95	91	106	105	93	92	93	92
$min|\hat{H}|$	61	61	60	60	60	60	60	60
$max|\hat{H}|$	212	218	350	316	203	192	250	226
$avg|\hat{H}^C|$	619	613	596	610	634	628	639	626
$min|\hat{H}^C|$	488	482	350	384	497	508	450	474
$max|\hat{H}^C|$	700	700	700	700	700	700	700	700

Note: Number of simulations= 20000 .

Note: Probability approximation= 0.9743 .

```
## Minutes and hours to finish 351.7339 5.862232

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 175.867 2.931116

cat("Machine=", c(Sys.info()[[4]]), "\n")

## Machine= pop-os

cat("Number of cores=", c(detectCores(logical = FALSE)), "\n")

## Number of cores= 128
```