```r
library(flexsurv)

## Loading required package:  survival
## Loading required package:  splines

library(boot)

##
## Attaching package:  'boot'
##
## The following object is masked from 'package:survival':
##
##    aml

library(randomForestSRC)

## Loading required package:  parallel
##
##  randomForestSRC 1.5.5
##
##  Type rfsrc.news() to see new features, changes, and bug fixes.
##

library(timeROC)

## Loading required package:  pec
## Loading required package:  mvtnorm
## Loading required package:  timereg

library(risksetROC)

## Loading required package:  MASS

library(ggplot2)

## Loading required package:  methods

library(RColorBrewer)
pal = brewer.pal(4, "Dark2")
names(pal) = c("gg", "km0", "mskcc.pre", "mskcc.post")
```

1 Preparation

Construct a *preoperative* function based on the Brennan nomogram. The preoperative nature will mean that most prognostic components will need to be marginalized out.

So the preoperative MSKCC score would be:

$$S = 1.4 + 6.1 + 0.8 + 18.2 + 18.9 + 15 + 9 + 15 * Back.pain + 3 * Weight.Loss + -2/15 * Age + 12 + 3\,[Sex = M] + 51\,[Hea \tag{1}$$

```r
fit.mskcc = list(
        inputs = list(
        History.Diagnosis.AgeAt = list(
                margins = data.frame(value = 65, fraction = 1),
                scorefunc = function(x) { x = x; -2/15*pmin(pmax(x, 0), 90) + 12 }),
        Patient.Sex = list(
```

Variable	Preoperative?	Available?	Marginals
Age	Yes	Yes	Linear. 90 =>0, 30 =>8. Therefore $f(x) = -2/15(x - 90) = -2/15x +$
Sex	Yes	Yes	Male risk delta 3
Portal Vein	NO		14.4% YES, risk delta 10, marginal 1.4
Splenectomy	NO		9.9% YES, risk delta 62, marginal 6.1
Margin of resection	NO		20.7% POS, risk delta 4, marginal 0.8
Head.vs.Other	Yes	Yes	Head risk delta 51
Differentiation	NO		14.2% Well, risk delta 0, marginal 0
			56.4% Mod, risk delta 14, marginal 7.9
			29.5% Poor, risk delta 35, marginal 10.3. Overall marginal 18.2
Posterior.margin	NO		86.0% POS, risk delta 22, marginal 18.9
Numb.pos.nodes	NO		Mean 2.1, approx marginal 15
Numb.neg.nodes	NO		Mean 16.9, approx marginal 9
Back.pain	Yes	NO	13.7% YES, risk delta 15, marginal 2.0
T.stage	Yes	Yes	
Weight Loss	Yes	NO	53.7% YES, risk delta 3, marginal 1.6
Max.path.axis	Yes	Yes	

```
                margins = data.frame(value = c("M", "F"), fraction = c(0.501, 1-0.501)),
                scorefunc = function(x) { 3*I(x == "M") }),
        Portal.Vein = list(
                margins = data.frame(value = c(TRUE, FALSE), fraction = c(0.144, 1-0.144)),
                scorefunc = function(x) { 10*I(x == TRUE) }),
        Splenectomy = list(
                margins = data.frame(value = c(TRUE, FALSE), fraction = c(0.099, 1-0.099)),
                scorefunc = function(x) { 62*I(x == TRUE) }),
        Treat.MarginPositive = list(
                margins = data.frame(value = c(TRUE, FALSE), fraction = c(0.207, 1-0.207)),
                scorefunc = function(x) { 4*I(x == TRUE) }),
        Path.LocationBody = list(
                margins = data.frame(value = c(FALSE, TRUE), fraction = c(0.894, 1-0.894)),
                scorefunc = function(x) { 51*I(x == TRUE) }),
        Path.Differentiation = list(
                margins = data.frame(value = c("1", "2", "3", "4"), fraction = c(0.142, 0.564, 1-0.142-0
                scorefunc = function(x) { 14*I(x == "2") + 35*I(x == "3") + 35*I(x == "4") }),
        Posterior.Margin = list(
                margins = data.frame(value = c(TRUE, FALSE), fraction = c(0.86, 1-0.86)),
                scorefunc = function(x) { 22*I(x == TRUE) }),
        Path.LN.Involved = list(
                margins = data.frame(value = 2.1, fraction = 1),
                scorefunc = function(x) {
                        x = pmin(40, pmax(x, 0))
                        fitfun = splinefun(c(0, 1, 2, 3, 4, 10, 15, 20, 25, 30, 35, 40), c(0, 14.56, 24.
                        fitfun(x)
                }),
        Path.LN.Negative = list(
                margins = data.frame(value = 16.9, fraction = 1),
                scorefunc = function(x) { (pmin(pmax(x, 0), 90)-90)*-11/90 }),
        Back.pain = list(
                margins = data.frame(value = c(TRUE, FALSE), fraction = c(0.137, 1-0.137)),
                scorefunc = function(x) { 15*I(x == TRUE) }),
        Stage.pT.Simplified = list(
                margins = data.frame(value = c("T1", "T2", "T34"), fraction = c(0.037, 0.119, 1-0.037-0.
```

```
                scorefunc = function(x) { 36*I(x == "T1") + 11*I(x == "T34") }),
                # The following matches the original Brennan nomogram, but was not used as there are too
                # tumours in either the NSWPCN *or* the MSKCC cohorts -- how the T4 coefficient was ever
                # I'll never know.  The T34 coefficient of 11 was arrived at as (0.828*10+(1-0.037-0.119
                # being a frequency-weighted average of the T3 and T4 coefficients.
                # margins = data.frame(value = c("T1", "T2", "T3", "T4"), fraction = c(0.037, 0.119, 0.8
                # scorefunc = function(x) { 36*I(x == "T1") + 10*I(x == "T3") + 63*I(x == "T4") }),
        Weight.loss = list(
                margins = data.frame(value = c(TRUE, FALSE), fraction = c(0.537, 1-0.537)),
                scorefunc = function(x) { 3*I(x == TRUE) }),
        Path.Size = list(
                margins = data.frame(),
                scorefunc = function(x) {
                        x = pmin(16, pmax(x, 0))
                        fitfun = splinefun(c(0, 1, 2, 3, 4, 6, 8, 10, 12, 14, 16), c(0, 29.74, 59.48, 86
                        fitfun(x)
                }) ),
        outputs = list(
                DSS12mo = function(s) {
                        x = pmax(50, pmin(350, s))
                        fitfun = splinefun(c(79.0323, 115.02, 165.524, 197.278, 221.774, 242.339, 261.08
                        y = fitfun(x)
                        pmax(0, pmin(1, y))
                },
                DSS24mo = function(s) {
                        x = pmax(50, pmin(350, s))
                        fitfun = splinefun(c(71.1694, 97.7823, 129.536, 153.73, 174.294, 193.347, 211.79
                        y = fitfun(x)
                        pmax(0, pmin(1, y))
                },
                DSS36mo = function(s) {
                        x = pmax(50, pmin(350, s))
                        fitfun = splinefun(c(69.3548, 101.109, 125.302, 145.867, 164.919, 183.367, 202.7
                        y = fitfun(x)
                        pmax(0, pmin(1, y))
                })
        )

applyNomogram = function(nomogram, data)
{
        scores = rowSums(sapply(names(nomogram$inputs), function(input) {
                if (input %in% colnames(data)) {
                        return(nomogram$inputs[[input]]$scorefunc(data[,input]))
                }
                warning(sprintf("Marginalizing missing variable: %s", input))
                margin_score = sum(nomogram$inputs[[input]]$scorefunc(nomogram$inputs[[input]]$margins$v
                return(rep(margin_score, nrow(data)))
        }))

        outputs = sapply(nomogram$outputs, function(f) f(scores))
        cbind(Score = scores, outputs)
}
```

2 Model and data loading

Trained models:

```
temp = readRDS("05_final_model.rds")
fit.gg = temp$gg
fit.km0 = temp$km0
data.nswpcn = temp$data.train
```

```
data.glasgow = readRDS("06_Glasgow.rds")
data.glasgow = data.glasgow[data.glasgow$Path.Type %in% c("Pancreatic Adenocarcinoma", "Pancreatic adeno
data.glasgow$Path.LN.Negative = data.glasgow$Path.LN.Inspected - data.glasgow$Path.LN.Involved
data.glasgow$History.Diagnosis.AgeAt = data.glasgow$History.Diagnosis.AgeAt.Cent + 68
data.glasgow$Path.Size = data.glasgow$Path.Size.Cent + 30
data.glasgow$SexM = data.glasgow$Patient.Sex == "M"
data.glasgow$AgeCent = data.glasgow$History.Diagnosis.AgeAt.Cent
data.glasgow$SizeCent = data.glasgow$Path.Size.Cent
data.glasgow$A2 = data.glasgow$Molec.S100A2.DCThresh
data.glasgow$A4 = data.glasgow$Molec.S100A4.DCThresh
data.glasgow$LocBody = data.glasgow$Path.Location != "HOP"
data.glasgow$Time = data.glasgow$History.Death.EventTimeDays
data.glasgow$DSD = data.glasgow$History.DSDeath.Event
```

```
scores.apgi = read.csv("./data/APGI_20150214.csv")
data.apgi = readRDS("../biosurv/data/01_cpvs.rds")
data.apgi$A2 = scores.apgi$A2[match(data.apgi$Patient.ID, scores.apgi$PatientID)]
data.apgi$A4 = scores.apgi$A4[match(data.apgi$Patient.ID, scores.apgi$PatientID)]
rm(scores.apgi)

data.apgi$Path.LN.Inspected = data.apgi$Path.Nodes.Regional.Total
data.apgi$Path.LN.Involved = data.apgi$Path.Nodes.Regional.Involved
data.apgi$Path.LN.Negative = data.apgi$Path.LN.Inspected - data.apgi$Path.LN.Involved
data.apgi$History.Diagnosis.AgeAt = data.apgi$History.Diagnosis.AgeAtYears
data.apgi$History.Diagnosis.AgeAt.Cent = data.apgi$History.Diagnosis.AgeAt - 68
data.apgi$Path.Size = data.apgi$Path.TumourSizeMm
data.apgi$Path.Size.Cent = data.apgi$Path.Size - 30
data.apgi$Patient.Sex = data.apgi$Patient.Gender
data.apgi$SexM = data.apgi$Patient.Sex == "M"
data.apgi$Treat.MarginPositive = data.apgi$Treat.Surgery.ExcisionStatus != "R0"
data.apgi$AgeCent = data.apgi$History.Diagnosis.AgeAt.Cent
data.apgi$SizeCent = data.apgi$Path.Size.Cent
data.apgi$A2 = data.apgi$A2 == 1
data.apgi$A4 = data.apgi$A4 == 1
data.apgi$Stage.pT = data.apgi$Staging.pT
data.apgi$Stage.pT.Simplified = c("T1" = "T1", "T2" = "T2", "T3" = "T34", "T4" = "T34")[as.character(dat
data.apgi$Path.LocationBody = !grepl("head", data.apgi$Path.TumourLocation, ignore.case = TRUE)
data.apgi$Path.LocationBody[data.apgi$Path.TumourLocation == ""] = NA
data.apgi$Path.Differentiation = data.apgi$Path.Grade
data.apgi$LocBody = data.apgi$Path.LocationBody
data.apgi$Time = data.apgi$Surv.EventTimeFromSurg.DSDeath
data.apgi$DSD = data.apgi$Surv.Event.DSDeath
```

```r
temp.sel = apply(!is.na(data.apgi[,c("Path.LN.Inspected", "Path.LN.Involved", "Path.LN.Negative", "SexM'
data.apgi = data.apgi[temp.sel,]
```

```r
summary(data.nswpcn)

##    Patient.ID   Patient.Sex Cohort.ICGC     History.PreviousMalignancy
##  Min.   :   4   F:120       Mode :logical   Mode :logical
##  1st Qu.: 305   M:120       FALSE:240       FALSE:219
##  Median : 621               NA's :0         TRUE :21
##  Mean   : 618                               NA's :0
##  3rd Qu.:1030
##  Max.   :1453
##
##  History.FdrWithPancCancer History.FdrWithAnyCancer History.Diagnosis.Date
##  Mode :logical             Mode :logical            Min.   :1994-03-09
##  FALSE:230                 FALSE:202                1st Qu.:1998-06-26
##  TRUE :8                   TRUE :38                 Median :2001-05-24
##  NA's :2                   NA's :0                  Mean   :2000-12-19
##                                                     3rd Qu.:2003-06-16
##                                                     Max.   :2006-08-14
##
##  History.Diagnosis.AgeAt History.AlcoholLevel History.Smoking.Status
##  Min.   :28.0            0:151                Never  :140
##  1st Qu.:62.0            1: 45                Ceased : 48
##  Median :69.0            2: 22                Current: 52
##  Mean   :67.5            3: 22
##  3rd Qu.:75.0
##  Max.   :87.0
##
##  History.Smoking.PackYears History.Comorbid.Diabetes
##  Min.   : 2.0              Mode :logical
##  1st Qu.:20.0              FALSE:181
##  Median :25.0              TRUE :59
##  Mean   :31.9              NA's :0
##  3rd Qu.:50.0
##  Max.   :80.0
##  NA's   :185
##  History.Comorbid.ChronicPancreatitis History.Recurrence.Event
##  Mode :logical                        Min.   :0.000
##  FALSE:229                            1st Qu.:1.000
##  TRUE :11                             Median :1.000
##  NA's :0                              Mean   :0.971
##                                       3rd Qu.:1.000
##                                       Max.   :1.000
##
##  History.Recurrence.Date History.DSDeath.Event History.Death.Date
##  Min.   :1994-07-21      Min.   :0.000         Min.   :1995-01-12
##  1st Qu.:1999-09-16      1st Qu.:1.000         1st Qu.:1999-11-30
##  Median :2002-06-03      Median :1.000         Median :2002-11-21
##  Mean   :2002-03-05      Mean   :0.963         Mean   :2002-08-01
##  3rd Qu.:2005-01-08      3rd Qu.:1.000         3rd Qu.:2005-04-21
##  Max.   :2009-01-29      Max.   :1.000         Max.   :2011-10-03
##  NA's   :79
```

```
##  History.Followup.Date History.Death.EventTimeDays Treat.Resected
##  Min.   :2009-10-24    Min.   :  26                Mode:logical
##  1st Qu.:2009-10-24    1st Qu.: 274                TRUE:240
##  Median :2009-10-24    Median : 476                NA's:0
##  Mean   :2010-01-06    Mean   : 592
##  3rd Qu.:2010-02-12    3rd Qu.: 771
##  Max.   :2010-06-03    Max.   :2701
##  NA's   :237
##  Treat.ProcedureWhipple Treat.MarginPositive Treat.Chemo.Any
##  Mode :logical          Mode :logical        Mode :logical
##  FALSE:44               FALSE:137            FALSE:97
##  TRUE :196              TRUE :103            TRUE :117
##  NA's :0                NA's :0              NA's :26
##
##
##
##  Treat.Chemo.Adjuvant Treat.Chemo.Adjuvant.GE3Cycles
##  Mode :logical        Mode :logical
##  FALSE:169            FALSE:197
##  TRUE :71             TRUE :43
##  NA's :0              NA's :0
##
##
##
##  Treat.Chemo.Palliative Treat.Chemo.PalliativeDC Treat.Chemo.GEM
##  Mode :logical          Mode :logical            Mode :logical
##  FALSE:1                FALSE:170                FALSE:151
##  TRUE :65               TRUE :70                 TRUE :88
##  NA's :174              NA's :0                  NA's :1
##
##
##
##  Treat.Radio     Path.LocationBody   Path.Size    Path.Bilirubin.Preop
##  Mode :logical   Mode :logical     Min.   : 8.0   Min.   : 0.06
##  FALSE:197       FALSE:196         1st Qu.:25.0   1st Qu.: 0.69
##  TRUE :43        TRUE :44          Median :30.0   Median : 3.63
##  NA's :0         NA's :0           Mean   :33.6   Mean   : 7.31
##                                    3rd Qu.:40.0   3rd Qu.:10.72
##                                    Max.   :90.0   Max.   :45.03
##                                                   NA's   :96
##  Path.Ca199.Preop Path.Bilirubin.Postop Path.Ca199.Postop
##  Min.   :     1   Min.   : 0.12         Min.   :    1
##  1st Qu.:    73   1st Qu.: 0.47         1st Qu.:   17
##  Median :   218   Median : 0.70         Median :   77
##  Mean   :  2803   Mean   : 1.95         Mean   : 1571
##  3rd Qu.:   842   3rd Qu.: 1.30         3rd Qu.:  278
##  Max.   :101075   Max.   :25.38         Max.   :31760
##  NA's   :162      NA's   :100           NA's   :137
##         Path.Subtype Path.Differentiation Path.LN.Involved
##  Adenosquamous: 18   1: 16                Min.   : 0.00
##  Large Cell   :  0   2:157                1st Qu.: 0.00
##  Mucinous     :  5   3: 67                Median : 1.00
##  NotSpecified : 38   4:  0                Mean   : 1.76
##  Papillary    :  2                        3rd Qu.: 2.00
```

```
##  Tubular      :177                        Max.   :12.00
##                                           NA's   :3
##  Path.LN.Inspected Path.Invasion.Vascular Path.Invasion.Perineural
##  Min.   : 0.00     Mode :logical          Mode :logical
##  1st Qu.: 5.00     FALSE:128              FALSE:58
##  Median : 8.00     TRUE :112              TRUE :182
##  Mean   : 9.68     NA's :0                NA's :0
##  3rd Qu.:13.00
##  Max.   :52.00
##  NA's   :20
##  Stage.pT  Stage.pN   Stage.pM   Molec.BNIP3.NucInt Molec.BNIP3.CytoInt
##  Tis:  0   N0  : 80   M0  :177   0   :  6           0   :  1
##  T1 : 18   N1  :156   M1  :  8   1   :200           1   :125
##  T2 : 32   NA's:  4   NA's: 55   2   : 21           2   : 74
##  T3 :190                         3   :  2           3   : 29
##  T4 :  0                         NA's: 11           NA's: 11
##
##
##  Molec.CCND1.CytoLo Molec.CCND1.CytoHi Molec.CCND1.MembLo
##  0   :152           0   :71            0   :96
##  1   : 34           1   :87            1   :68
##  2   :  4           2   :32            2   :18
##  3   :  1           3   : 1            3   : 9
##  NA's: 49           NA's:49            NA's:49
##
##
##  Molec.CCND1.MembHi Molec.Grb7.Int Molec.Grb7.Percent Molec.HCNT3PlusHENT1
##  0   :29            0   :49        Min.   :  0.0      Mode :logical
##  1   :86            1   :90        1st Qu.:  3.0      FALSE:93
##  2   :45            2   :42        Median : 18.0      TRUE :94
##  3   :31            3   : 7        Mean   : 31.6      NA's :53
##  NA's:49            NA's:52        3rd Qu.: 58.5
##                                    Max.   :100.0
##                                    NA's   :52
##  Molec.HENT1.Percent Molec.HENT1.Int Molec.HER2      Molec.HOXB2.Percent
##  Min.   :  0.0       0   : 17        Mode :logical   Min.   :  0.0
##  1st Qu.: 11.2       1   :114        FALSE:36        1st Qu.: 35.0
##  Median : 42.5       2   : 51        TRUE :10        Median : 70.0
##  Mean   : 44.4       3   : 12        NA's :194       Mean   : 59.6
##  3rd Qu.: 75.0       NA's: 46                        3rd Qu.: 85.0
##  Max.   :100.0                                       Max.   :100.0
##  NA's   :46                                          NA's   :42
##  Molec.HOXB2.Int Molec.RON.Int Molec.S100A2.Int Molec.S100A2.Percent
##  0   : 14        0   : 19      0:87             Min.   :  0.0
##  1   :137        1   :110      1:59             1st Qu.:  0.0
##  2   : 33        2   : 59      2:56             Median : 10.0
##  3   : 14        3   : 10      3:38             Mean   : 28.1
##  NA's: 42        NA's: 42                       3rd Qu.: 60.0
##                                                 Max.   :100.0
##
##  Molec.S100A2.StromaScore Molec.S100A4.CytoInt Molec.S100A4.CytoPercent
##  Mode :logical            0:70                 Min.   :  0.0
##  FALSE:175                1:89                 1st Qu.:  0.0
##  TRUE :22                 2:40                 Median : 10.0
```

```
##  NA's :43                 3:41                 Mean   : 34.8
##                                                3rd Qu.: 75.0
##                                                Max.   :100.0
##
##  Molec.S100A4.NucInt Molec.S100A4.NucPercent Stage.Overall
##  0:78                Min.   :  0.0           IIB    :117
##  1:66                1st Qu.:  0.0           IIA    : 41
##  2:62                Median :  5.0           IB     : 12
##  3:34                Mean   : 26.4           IV     :  8
##                      3rd Qu.: 60.0           IA     :  7
##                      Max.   :100.0           (Other):  0
##                                              NA's   : 55
##  History.Death.Event Molec.S100A4.DCThresh Molec.S100A2.DCThresh
##  Min.   :0.000       Mode :logical         Mode :logical
##  1st Qu.:1.000       FALSE:60              FALSE:203
##  Median :1.000       TRUE :180             TRUE :37
##  Mean   :0.996       NA's :0               NA's :0
##  3rd Qu.:1.000
##  Max.   :1.000
##
##  Stage.pT.Simplified Path.Ca199.Preop.Cent Path.Ca199.Postop.Cent
##  T1 : 18             Min.   :-5.38         Min.   :-3.97
##  T2 : 32             1st Qu.:-1.09         1st Qu.:-1.14
##  T34:190             Median : 0.00         Median : 0.37
##                      Mean   : 0.09         Mean   : 0.62
##                      3rd Qu.: 1.36         3rd Qu.: 1.66
##                      Max.   : 6.14         Max.   : 6.40
##                      NA's   :162           NA's   :137
##  History.Diagnosis.AgeAt.Cent History.Smoking.PackYears.Cent
##  Min.   :-40.00               Min.   :-28.00
##  1st Qu.: -6.00               1st Qu.:-10.00
##  Median :  1.00               Median : -5.00
##  Mean   : -0.51               Mean   :  1.89
##  3rd Qu.:  7.00               3rd Qu.: 20.00
##  Max.   : 19.00               Max.   : 50.00
##                               NA's   :185
##  Path.Size.Cent   Path.Bilirubin.Preop.Cent Path.Bilirubin.Postop.Cent
##  Min.   :-22.00   Min.   :-3.39             Min.   :-0.53
##  1st Qu.: -5.00   1st Qu.:-2.76             1st Qu.:-0.18
##  Median :  0.00   Median : 0.18             Median : 0.06
##  Mean   :  3.56   Mean   : 3.86             Mean   : 1.30
##  3rd Qu.: 10.00   3rd Qu.: 7.27             3rd Qu.: 0.66
##  Max.   : 60.00   Max.   :41.58             Max.   :24.74
##                   NA's   :96                NA's   :100
##  History.Diagnosis.Date.Cent Path.LN.InvolvedFraction Path.LN.Negative
##  Min.   :-2867              Min.   :0.000            Min.   : 0.00
##  1st Qu.:-1297              1st Qu.:0.000            1st Qu.: 4.00
##  Median : -234              Median :0.143            Median : 7.00
##  Mean   : -389              Mean   :0.217            Mean   : 7.85
##  3rd Qu.:  519              3rd Qu.:0.333            3rd Qu.:11.00
##  Max.   : 1674              Max.   :1.000            Max.   :45.00
##                             NA's   :21               NA's   :20
##    SexM           Ca199          DiagYearCent         Time
##  Mode :logical   Mode :logical   Min.   :-7.849   Min.   :  26
```

```
## FALSE:120        FALSE:26         1st Qu.:-3.551   1st Qu.: 274
## TRUE :120        TRUE :52         Median :-0.639   Median : 474
## NA's :0          NA's :162        Mean   :-1.065   Mean   : 589
##                                   3rd Qu.: 1.422   3rd Qu.: 764
##                                   Max.   : 4.583   Max.   :2701
##
##    DSD             AgeCent         LocBody           SizeCent
## Mode :logical   Min.   :-40.00   Mode :logical   Min.   :-22.00
## FALSE:9         1st Qu.: -6.00   FALSE:196       1st Qu.: -5.00
## TRUE :231       Median :  1.00   TRUE :44        Median :  0.00
## NA's :0         Mean   : -0.51   NA's :0         Mean   :  3.56
##                 3rd Qu.:  7.00                   3rd Qu.: 10.00
##                 Max.   : 19.00                   Max.   : 60.00
##
##     A2              A4             SizePlus
## Mode :logical   Mode :logical   Min.   : 0.00
## FALSE:203       FALSE:60        1st Qu.: 0.00
## TRUE :37        TRUE :180       Median : 0.00
## NA's :0         NA's :0         Mean   : 7.35
##                                 3rd Qu.:10.00
##                                 Max.   :60.00
##
```

```
summary(data.glasgow)
```

```
##   Patient.ID        Patient.Sex History.Diagnosis.AgeAt Treat.Procedure
##  Length:189         F: 89       Min.   :37.5            Length:189
##  Class :character   M:100       1st Qu.:57.8            Class :character
##  Mode  :character               Median :64.0            Mode  :character
##                                 Mean   :62.6
##                                 3rd Qu.:69.4
##                                 Max.   :86.0
##
##  Path.Location
##  Length:189
##  Class :character
##  Mode  :character
##
##
##
##
##                                                              Path.Type
##  Pancreatic Adenocarcinoma                                        :156
##  Pancreatic adenocarcinoma                                        : 32
##  Pancreatic Adenocarcinom                                         :  1
##  Pancreatic adenocarcinoma arising form IPMN                      :  0
##  Pancreatic adenocarcinoma arising from mucnous cystic neoplsm:  0
##  Pancreatic Adenocarcinoma arising IPMN                           :  0
##  (Other)                                                          :  0
##  Path.Differentiation Path.Grade Stage.pT  Stage.pN
##  1: 12                Low :128   Tis:  0   N0: 33
##  2:117                High: 61   T1 :  1   N1:156
##  3: 60                           T2 : 13
##  4:  0                           T3 :171
```

```
##                                 T4 :  4
##
##
##  Path.Invasion.Perineural Path.Invasion.Vascular Path.LN.Inspected
##  Mode :logical            Mode :logical          Min.   : 1.0
##  FALSE:13                 FALSE:96               1st Qu.:13.0
##  TRUE :176                TRUE :93               Median :20.0
##  NA's :0                  NA's :0                Mean   :20.2
##                                                  3rd Qu.:27.0
##                                                  Max.   :53.0
##
##  Path.LN.InvolvedFraction Treat.MarginPositive Treat.VeinResection
##  Min.   :0.00             Mode :logical        Mode :logical
##  1st Qu.:0.05             FALSE:51             FALSE:158
##  Median :0.14             TRUE :138            TRUE :31
##  Mean   :0.20             NA's :0              NA's :0
##  3rd Qu.:0.27
##  Max.   :1.00
##
##    Path.Size    History.Death.EventTimeDays History.Death.Cause
##  Min.   : 5.0   Min.   :   8                0:  9
##  1st Qu.:25.0   1st Qu.: 233                1:161
##  Median :30.0   Median : 501                2: 19
##  Mean   :32.7   Mean   : 673
##  3rd Qu.:40.0   3rd Qu.: 915
##  Max.   :65.0   Max.   :3531
##
##  Treat.Chemo.Adjuvant Treat.Chemo.Neoadjuvant Molec.S100A2.DCThresh
##  Mode :logical        Mode :logical           Mode :logical
##  FALSE:110            FALSE:188               FALSE:127
##  TRUE :79             TRUE :1                 TRUE :62
##  NA's :0              NA's :0                 NA's :0
##
##
##
##  Molec.S100A4.DCThresh Treat.ProcedureWhipple Path.LocationBody
##  Mode :logical         Mode:logical           Mode :logical
##  FALSE:55              TRUE:189               FALSE:189
##  TRUE :134             NA's:0                 NA's :0
##  NA's :0
##
##
##
##  History.DSDeath.Event History.ACDeath.Event Path.LN.Involved
##  Mode :logical         Mode :logical         Min.   : 0.00
##  FALSE:28              FALSE:9               1st Qu.: 1.00
##  TRUE :161             TRUE :180             Median : 2.00
##  NA's :0               NA's :0               Mean   : 3.57
##                                              3rd Qu.: 5.00
##                                              Max.   :32.00
##
##  History.Diagnosis.AgeAt.Cent Path.Size.Cent   Stage.pT.Simplified
##  Min.   :-30.55               Min.   :-25.00   T1 :  1
##  1st Qu.:-10.19               1st Qu.: -5.00   T2 : 13
```

```
##  Median : -4.00              Median :  0.00   T34:175
##  Mean   : -5.37              Mean   :  2.72
##  3rd Qu.:  1.43              3rd Qu.: 10.00
##  Max.   : 18.00              Max.   : 35.00
##
##  Path.LN.Negative    SexM           AgeCent          SizeCent
##  Min.   : 0.0     Mode :logical   Min.   :-30.55   Min.   :-25.00
##  1st Qu.:10.0     FALSE:89        1st Qu.:-10.19   1st Qu.: -5.00
##  Median :16.0     TRUE :100       Median : -4.00   Median :  0.00
##  Mean   :16.6     NA's :0         Mean   : -5.37   Mean   :  2.72
##  3rd Qu.:23.0                     3rd Qu.:  1.43   3rd Qu.: 10.00
##  Max.   :47.0                     Max.   : 18.00   Max.   : 35.00
##
##      A2              A4           LocBody             Time
##  Mode :logical   Mode :logical   Mode :logical   Min.   :   8
##  FALSE:127       FALSE:55        FALSE:189       1st Qu.: 233
##  TRUE :62        TRUE :134       NA's :0         Median : 501
##  NA's :0         NA's :0                         Mean   : 673
##                                                  3rd Qu.: 915
##                                                  Max.   :3531
##
##     DSD
##  Mode :logical
##  FALSE:28
##  TRUE :161
##  NA's :0
##
##
##
```

```
summary(data.apgi)
```

```
##   Patient.ID        Patient.Gender                     Patient.Ethnicity
##  Length:75          Female:34      Asian                          : 7
##  Class :character   Male  :41      Asian, White/Caucasian         : 0
##  Mode  :character                  Black/African                  : 1
##                                    Black/African, White/Caucasian: 0
##                                    White/Caucasian               :67
##
##
##                    Patient.Country History.LastFollowup.Date
##  Australia               :75     Min.   :2008-04-14
##  Italy                   : 0     1st Qu.:2011-02-03
##  New Zealand             : 0     Median :2012-05-09
##  Puerto Rico             : 0     Mean   :2012-06-02
##  United Kingdom          : 0     3rd Qu.:2013-11-06
##  United States of America: 0     Max.   :2014-09-08
##
##  History.Smoking.PackYears History.Diagnosis.Date
##  Min.   :  0.75            Min.   :2004-12-30
##  1st Qu.: 12.00            1st Qu.:2009-11-28
##  Median : 27.50            Median :2010-05-28
##  Mean   : 30.98            Mean   :2010-06-08
##  3rd Qu.: 44.06            3rd Qu.:2010-11-29
```

```
##  Max.   :123.75            Max.   :2012-02-17
##  NA's   :43
##  History.Diagnosis.AgeAtYears History.Surgery.Date
##  Min.   :47.0                 Min.   :2004-12-30
##  1st Qu.:60.5                 1st Qu.:2009-12-05
##  Median :67.0                 Median :2010-06-01
##  Mean   :66.8                 Mean   :2010-06-16
##  3rd Qu.:74.0                 3rd Qu.:2011-01-19
##  Max.   :84.0                 Max.   :2012-02-17
##
##                                                                 Treat.Surgery.Procedure
##  Classic Whipple                                                          :55
##  Classic Whipple, Exploratory laparotomy                                  : 3
##  PPPD                                                                     : 3
##  Splenectomy, Subtotal Panc/L sided Panc or distal Panc                   : 3
##  Subtotal Panc/L sided Panc or distal Panc                                : 3
##  Cholecystectomy, Cholecystojejunostomy/Hepaticojejunostomy, Classic Whipple: 1
##  (Other)                                                                  : 7
##  Treat.Surgery.ExcisionStatus Treat.Surgery.Margin.Pancreatic
##  R0:51                        <2 mm   : 2
##  R1:20                        Clear   :65
##  R2: 4                        Involved: 2
##                               NA's    : 6
##
##
##
##  Treat.Surgery.MarginSizeMm.Pancreatic Treat.Surgery.Margin.Periunc
##  Min.   : 0.00                         <2 mm   :16
##  1st Qu.: 5.00                         Clear   :36
##  Median :10.00                         Involved:11
##  Mean   : 9.94                         NA's    :12
##  3rd Qu.:10.00
##  Max.   :40.00
##  NA's   :15
##  Treat.Surgery.MarginSizeMm.Periunc Treat.Surgery.Margin.PVGroove
##  Min.   : 0.00                      <2 mm   :18
##  1st Qu.: 1.00                      Clear   :37
##  Median : 2.20                      Involved:10
##  Mean   : 6.92                      NA's    :10
##  3rd Qu.:10.00
##  Max.   :40.00
##  NA's   :24
##  Treat.Surgery.MarginSizeMm.PVGroove Treat.Surgery.Margin.Retrop
##  Min.   : 0.0                        <2 mm   :19
##  1st Qu.: 1.0                        Clear   :46
##  Median : 2.0                        Involved: 5
##  Mean   : 3.8                        NA's    : 5
##  3rd Qu.: 4.0
##  Max.   :25.0
##  NA's   :24
##  Treat.Surgery.MarginSizeMm.Retrop Treat.Surgery.Margin.CBD
##  Min.   : 0.10                     <2 mm   : 0
##  1st Qu.: 1.00                     Clear   :58
##  Median : 3.00                     Involved: 0
```

```
##  Mean   : 5.29                     NA's    :17
##  3rd Qu.: 8.00
##  Max.   :25.00
##  NA's   :14
##  Treat.Surgery.MarginSizeMm.CBD Treat.Surgery.Margin.Duodenal
##  Min.   : 3.0                   Clear   :40
##  1st Qu.:11.5                   Involved: 0
##  Median :20.0                   NA's    :35
##  Mean   :21.9
##  3rd Qu.:30.0
##  Max.   :50.0
##  NA's   :31
##  Treat.Surgery.MarginSizeMm.Duodenal Treat.Surgery.Margin.Gastric
##  Min.   : 20.0                       Clear:39
##  1st Qu.: 47.5                       NA's :36
##  Median : 75.0
##  Mean   : 75.0
##  3rd Qu.:102.5
##  Max.   :130.0
##  NA's   :73
##  Treat.Surgery.MarginSizeMm.Gastric Treat.Surgery.Margin.Comments
##  Min.   : 20                        Length:75
##  1st Qu.: 40                        Class :character
##  Median : 60                        Mode  :character
##  Mean   : 60
##  3rd Qu.: 80
##  Max.   :100
##  NA's   :73
##                            Path.HistoType
##  Pancreatic Ductal Adenocarcinoma:75
##  Acinar Cell Carcinoma           : 0
##  Ampullary Adenocarcinoma        : 0
##  Carcinoid Tumour                : 0
##  Cholangiocarcinoma              : 0
##  Clear Cell Carcinoma            : 0
##  (Other)                         : 0
##                     Path.HistoType.Subtype Path.Grade
##  Gastric                        : 0         1: 3
##  Intestinal                     : 0         2:47
##  Mixed                          : 0         3:23
##  Not otherwise Specified (NOS):10           4: 2
##  Pancreatobiliary               :10
##  Squamous                       : 0
##  NA's                           :55
##       Path.TumourLocation Path.TumourSizeMm Path.Invasion.PN
##  Head            :55       Min.   :15.0      Absent : 9
##  Head (Uncinate): 9        1st Qu.:28.0      Present:66
##  Body            : 7       Median :35.0
##  Tail            : 3       Mean   :36.9
##  Ampulla         : 1       3rd Qu.:43.0
##                  : 0       Max.   :90.0
##  (Other)         : 0
##  Path.Invasion.VS Path.Nodes.Regional.Total Path.Nodes.Regional.Involved
##  Absent :22       Min.   : 2.0              Min.   : 0.00
```

```
##  Present:51       1st Qu.:13.0              1st Qu.: 1.00
##  NA's   : 2       Median :16.0              Median : 3.00
##                   Mean   :18.6              Mean   : 3.03
##                   3rd Qu.:23.5              3rd Qu.: 4.00
##                   Max.   :46.0              Max.   :13.00
##
##  Path.Nodes.SepRec.Total Path.Nodes.SepRec.Involved
##  Min.   : 2.0            Min.   : 0.00
##  1st Qu.:13.0            1st Qu.: 1.00
##  Median :16.0            Median : 3.00
##  Mean   :18.6            Mean   : 3.03
##  3rd Qu.:23.5            3rd Qu.: 4.00
##  Max.   :46.0            Max.   :13.00
##
##                                   Staging.Version Staging.pM Staging.pN
##  pTNM AJCC 6th Ed 2002                    :12     M0  : 2    N0:16
##  pTNM AJCC 7th Ed 2010                    :63     M1  : 4    N1:59
##  pTNM AJCC 7th Ed 2010 (Ampulla)          : 0     NA's:69
##  pTNM AJCC 7th Ed 2010 (Cholangiocarcinoma): 0
##  pTNM AJCC 7th Ed 2010 (Neuroendocrine)    : 0
##
##
##  Staging.pT Staging.Stage    History.Recurrence History.Recurrence.Date
##  Tis: 0     IA : 1        Not observed:15       Min.   :2007-12-31
##  T1 : 1     IB : 1        Suspected   : 2       1st Qu.:2010-10-25
##  T2 : 3     IIA:13        Confirmed   :56       Median :2011-04-11
##  T3 :70     IIB:55        NA's        : 2       Mean   :2011-06-29
##  T4 : 1     III: 1                              3rd Qu.:2012-02-28
##             IV : 4                              Max.   :2014-08-27
##                                                 NA's   :17
##  History.Recurrence.Site.Stomach History.Recurrence.Site.Peritoneum
##  Mode :logical                   Mode :logical
##  FALSE:75                        FALSE:67
##  NA's :0                         TRUE :8
##                                  NA's :0
##
##
##
##  History.Recurrence.Site.PancRemnant History.Recurrence.Site.PancBed
##  Mode :logical                       Mode :logical
##  FALSE:70                            FALSE:64
##  TRUE :5                             TRUE :11
##  NA's :0                             NA's :0
##
##
##
##  History.Recurrence.Site.Other History.Recurrence.Site.Omentum
##  Mode :logical                 Mode :logical
##  FALSE:69                      FALSE:74
##  TRUE :6                       TRUE :1
##  NA's :0                       NA's :0
##
##
##
```

```
##  History.Recurrence.Site.Mesentery History.Recurrence.Site.LymphNodes
##  Mode :logical                     Mode :logical
##  FALSE:74                          FALSE:61
##  TRUE :1                           TRUE :14
##  NA's :0                           NA's :0
##
##
##
##  History.Recurrence.Site.Lung History.Recurrence.Site.Liver
##  Mode :logical                Mode :logical
##  FALSE:60                     FALSE:51
##  TRUE :15                     TRUE :24
##  NA's :0                      NA's :0
##
##
##
##  History.Recurrence.Site.Brain History.Recurrence.Site.Bone
##  Mode :logical                 Mode :logical
##  FALSE:73                      FALSE:71
##  TRUE :2                       TRUE :4
##  NA's :0                       NA's :0
##
##
##
##                     History.Status History.Death.Date
##  Alive - With Disease       : 7     Min.   :2008-05-13
##  Alive - Without Disease    :13     1st Qu.:2010-12-20
##  Deceased - Of Disease      :51     Median :2011-12-28
##  Deceased - Of Other Cause  : 4     Mean   :2011-11-08
##  Deceased - Of Unknown Cause: 0     3rd Qu.:2012-09-08
##                                     Max.   :2014-01-26
##                                     NA's   :20
##                       History.Death.Cause Surv.Event.Death
##  Cancer Death (Pancreatic)       :51       Min.   :0.000
##  Died of Treatment Complication  : 2       1st Qu.:0.000
##  Cancer Death (Other) - Lung ca  : 1       Median :1.000
##  Other (please specify) - Suicide: 1       Mean   :0.733
##  Other (please specify)          : 0       3rd Qu.:1.000
##  (Other)                         : 0       Max.   :1.000
##  NA's                            :20
##  Surv.EventTimeFromDiag.Death Surv.EventTimeFromSurg.Death
##  Min.   :  56                 Min.   :  62
##  1st Qu.: 386                 1st Qu.: 362
##  Median : 653                 Median : 655
##  Mean   : 753                 Mean   : 745
##  3rd Qu.:1007                 3rd Qu.:1010
##  Max.   :2848                 Max.   :2848
##
##  Surv.EventTimeFromRec.Death Surv.Event.DSDeath
##  Min.   :   3.0              Min.   :0.00
##  1st Qu.:  65.8              1st Qu.:0.00
##  Median : 202.0              Median :1.00
##  Mean   : 287.4              Mean   :0.68
##  3rd Qu.: 371.2              3rd Qu.:1.00
```

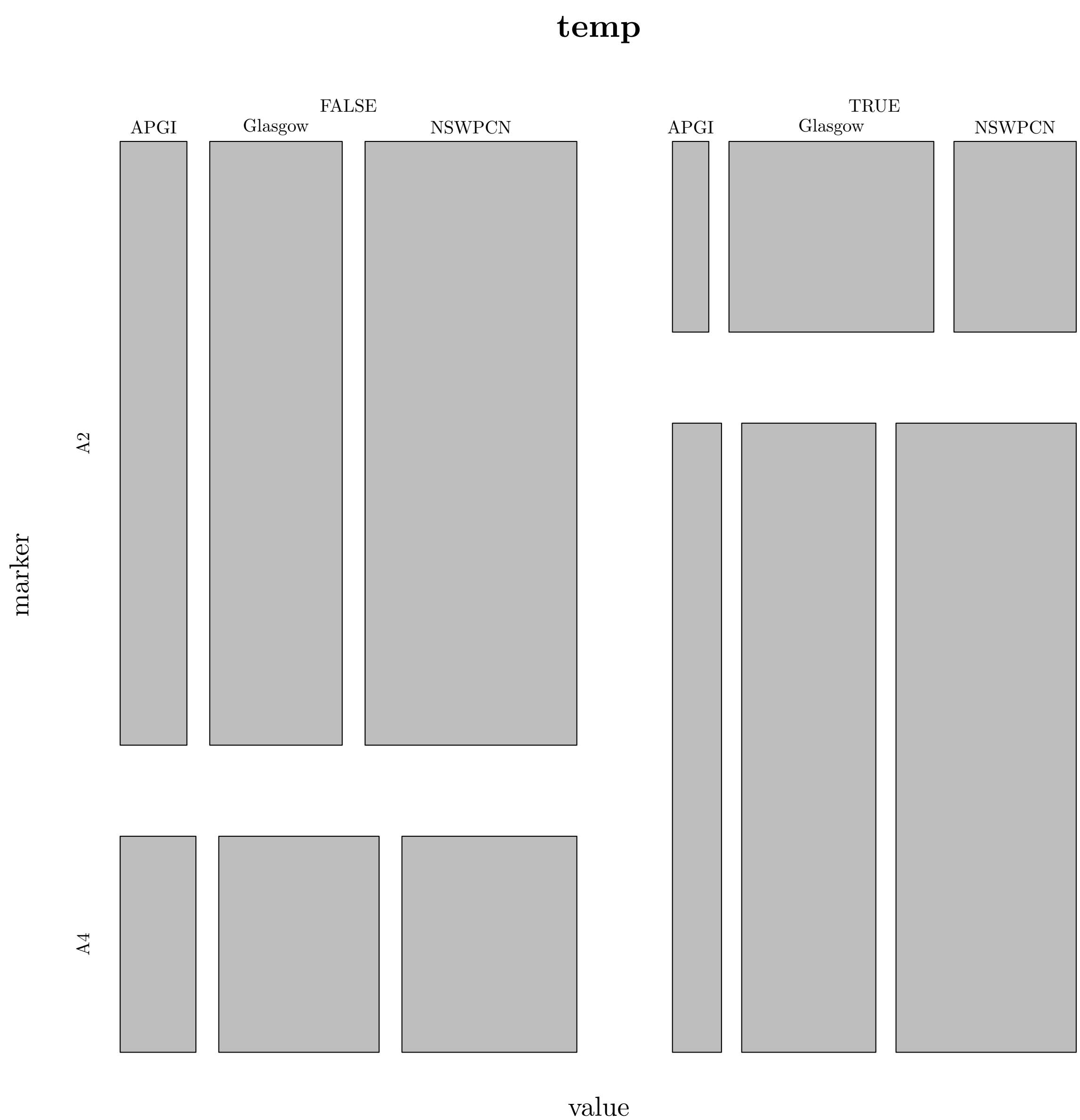
```
##  Max.   :1333.0              Max.   :1.00
##  NA's   :17
##  Surv.EventTimeFromDiag.DSDeath Surv.EventTimeFromSurg.DSDeath
##  Min.   :  31                   Min.   :  37
##  1st Qu.: 386                   1st Qu.: 362
##  Median : 653                   Median : 655
##  Mean   : 752                   Mean   : 743
##  3rd Qu.:1007                   3rd Qu.:1010
##  Max.   :2848                   Max.   :2848
##
##  Surv.EventTimeFromRec.DSDeath Surv.Event.Recurrence
##  Min.   :   3.0                Min.   :0.000
##  1st Qu.:  65.8                1st Qu.:1.000
##  Median : 202.0                Median :1.000
##  Mean   : 287.1                Mean   :0.767
##  3rd Qu.: 371.2                3rd Qu.:1.000
##  Max.   :1333.0                Max.   :1.000
##  NA's   :17                    NA's   :2
##  Surv.EventTimeFromDiag.Recurrence Surv.EventTimeFromSurg.Recurrence
##  Min.   :  31                      Min.   : -15
##  1st Qu.: 241                      1st Qu.: 231
##  Median : 388                      Median : 377
##  Mean   : 540                      Mean   : 532
##  3rd Qu.: 698                      3rd Qu.: 705
##  Max.   :1954                      Max.   :1954
##  NA's   :2                         NA's   :2
##      A2              A4          Path.LN.Inspected Path.LN.Involved
##  Mode :logical   Mode :logical   Min.   : 2.0      Min.   : 0.00
##  FALSE:64        FALSE:26        1st Qu.:13.0      1st Qu.: 1.00
##  TRUE :11        TRUE :49        Median :16.0      Median : 3.00
##  NA's :0         NA's :0         Mean   :18.6      Mean   : 3.03
##                                  3rd Qu.:23.5      3rd Qu.: 4.00
##                                  Max.   :46.0      Max.   :13.00
##
##  Path.LN.Negative History.Diagnosis.AgeAt History.Diagnosis.AgeAt.Cent
##  Min.   : 2.0     Min.   :47.0           Min.   :-21.00
##  1st Qu.: 9.0     1st Qu.:60.5           1st Qu.: -7.50
##  Median :13.0     Median :67.0           Median : -1.00
##  Mean   :15.6     Mean   :66.8           Mean   : -1.15
##  3rd Qu.:21.0     3rd Qu.:74.0           3rd Qu.:  6.00
##  Max.   :44.0     Max.   :84.0           Max.   : 16.00
##
##    Path.Size    Path.Size.Cent   Patient.Sex    SexM
##  Min.   :15.0   Min.   :-15.00   Female:34   Mode :logical
##  1st Qu.:28.0   1st Qu.: -2.00   Male  :41   FALSE:75
##  Median :35.0   Median :  5.00               NA's :0
##  Mean   :36.9   Mean   :  6.89
##  3rd Qu.:43.0   3rd Qu.: 13.00
##  Max.   :90.0   Max.   : 60.00
##
##  Treat.MarginPositive    AgeCent          SizeCent      Stage.pT
##  Mode :logical        Min.   :-21.00   Min.   :-15.00   Tis: 0
##  FALSE:51             1st Qu.: -7.50   1st Qu.: -2.00   T1 : 1
##  TRUE :24             Median : -1.00   Median :  5.00   T2 : 3
```

```
##  NA's :0              Mean   : -1.15   Mean   :  6.89   T3 :70
##                       3rd Qu.:  6.00   3rd Qu.: 13.00   T4 : 1
##                       Max.   : 16.00   Max.   : 60.00
##
##  Stage.pT.Simplified Path.LocationBody Path.Differentiation
##  Length:75           Mode :logical     1: 3
##  Class :character    FALSE:64          2:47
##  Mode  :character    TRUE :11          3:23
##                      NA's :0           4: 2
##
##
##
##   LocBody             Time           DSD
##  Mode :logical   Min.   :  37   Min.   :0.00
##  FALSE:64        1st Qu.: 362   1st Qu.:0.00
##  TRUE :11        Median : 655   Median :1.00
##  NA's :0         Mean   : 743   Mean   :0.68
##                  3rd Qu.:1010   3rd Qu.:1.00
##                  Max.   :2848   Max.   :1.00
##
```

```
temp = table(value = c(data.nswpcn$A2, data.glasgow$A2, data.apgi$A2, data.nswpcn$A4, data.glasgow$A4, d
temp
```

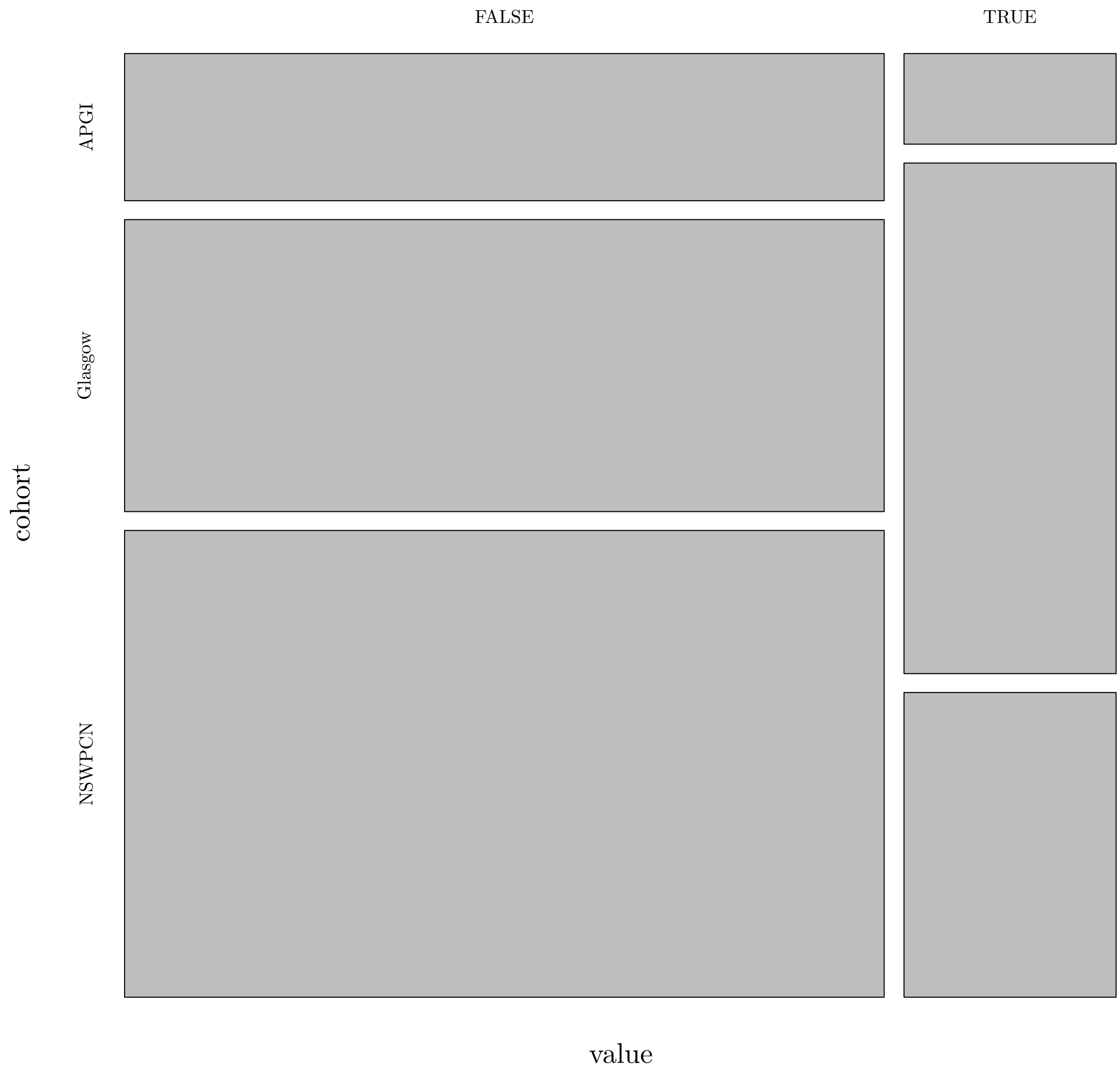
```
## , , cohort = APGI
##
##        marker
## value    A2  A4
##   FALSE  64  26
##   TRUE   11  49
##
## , , cohort = Glasgow
##
##        marker
## value    A2  A4
##   FALSE 127  55
##   TRUE   62 134
##
## , , cohort = NSWPCN
##
##        marker
## value    A2  A4
##   FALSE 203  60
##   TRUE   37 180
```

```
plot(temp)
```

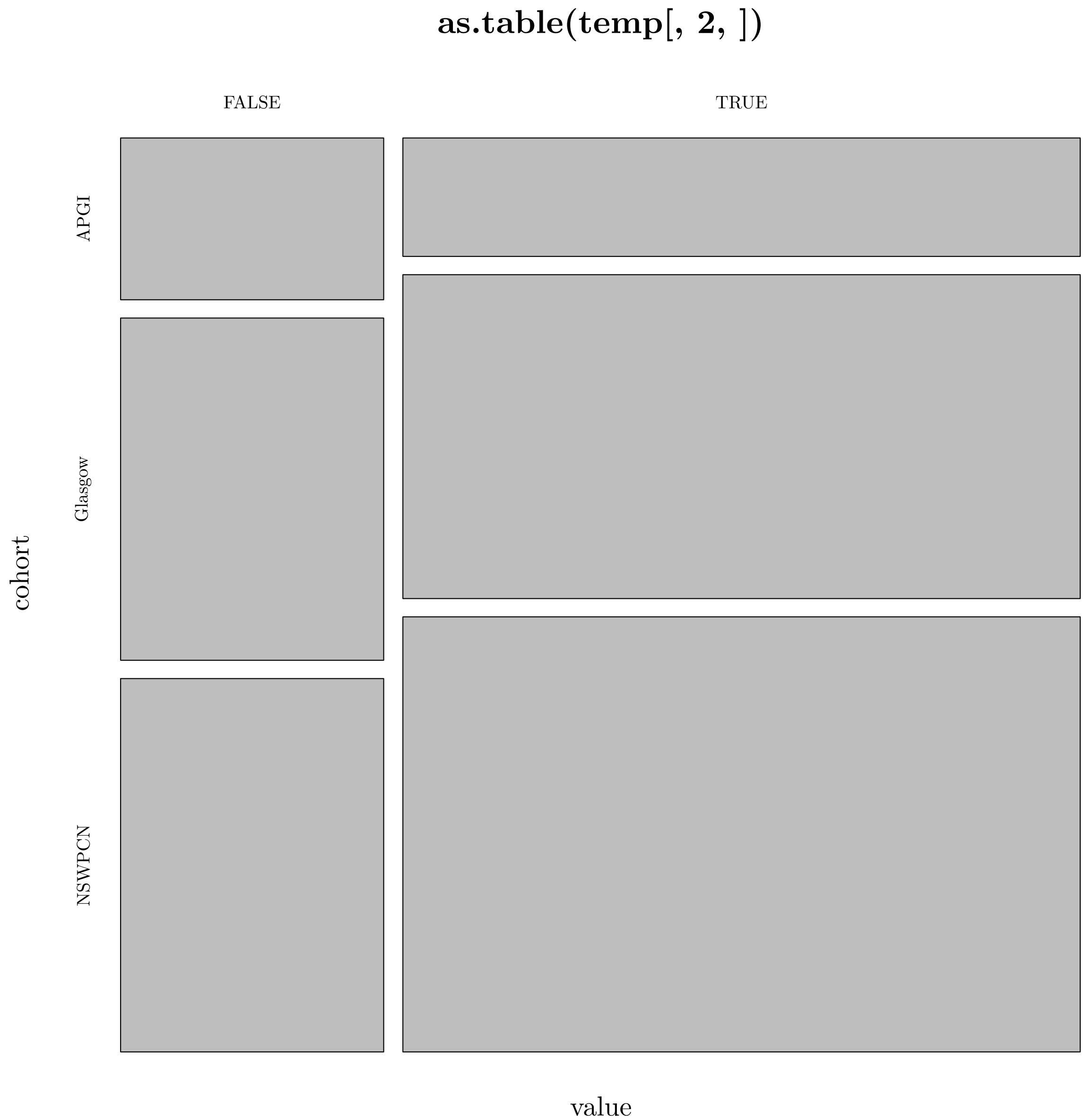



```
plot(as.table(temp[,1,]))
```

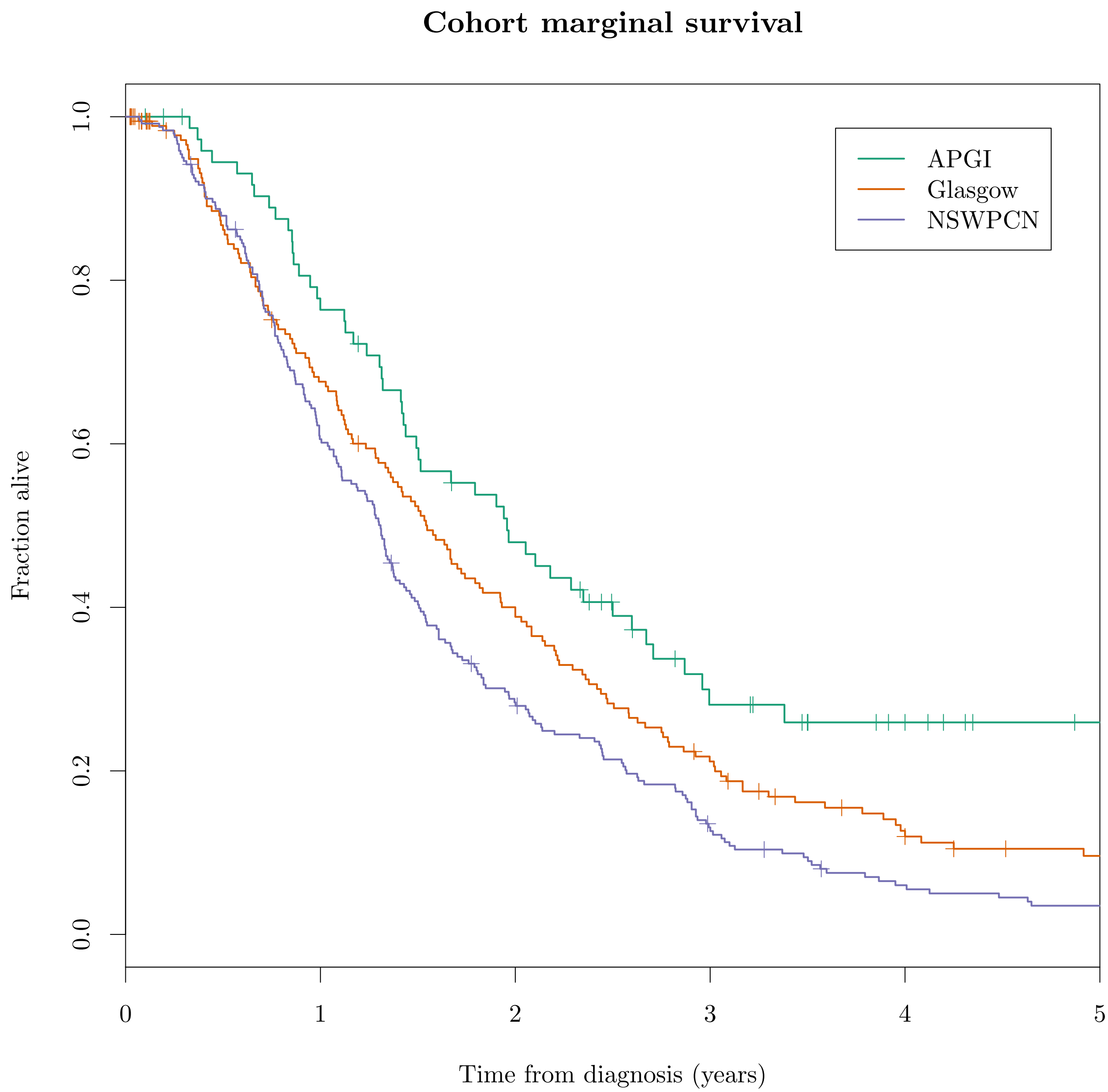
as.table(temp[, 1,])




```
plot(as.table(temp[,2,]))
```




```
temp.time = c(data.nswpcn$Time, data.glasgow$Time, data.apgi$Time) / 365.25
temp.dsd = c(data.nswpcn$DSD, data.glasgow$DSD, data.apgi$DSD)
temp.cohort = factor(rep(c("NSWPCN", "Glasgow", "APGI"), c(nrow(data.nswpcn), nrow(data.glasgow), nrow(d
temp.survfit = survfit(Surv(temp.time, temp.dsd) ~ temp.cohort)
plot(temp.survfit, col = pal[1:3], xlim = c(0, 5), lwd = 2, main = "Cohort marginal survival", xlab = "T
legend("topright", legend = c("APGI", "Glasgow", "NSWPCN"), col = pal[1:3], inset = 0.05, lwd = 2)
```



3 Score calculation

```
temp = applyNomogram(fit.mskcc, data.glasgow)

## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Portal.Vein
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Splenectomy
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Posterior.Margin
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Back.pain
```

```
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Weight.loss

mskcc_post.linpred.glasgow = temp[,1]
mskcc_post.12mo.glasgow = temp[,2]
mskcc_post.24mo.glasgow = temp[,3]
mskcc_post.36mo.glasgow = temp[,4]
temp = applyNomogram(fit.mskcc, data.glasgow[,c("History.Diagnosis.AgeAt", "Patient.Sex", "Path.Locatior

## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Portal.Vein
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Splenectomy
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Treat.MarginPositive
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Path.Differentiation
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Posterior.Margin
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Path.LN.Involved
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Path.LN.Negative
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Back.pain
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Weight.loss

mskcc_pre.linpred.glasgow = temp[,1]
mskcc_pre.12mo.glasgow = temp[,2]
mskcc_pre.24mo.glasgow = temp[,3]
mskcc_pre.36mo.glasgow = temp[,4]

temp = applyNomogram(fit.mskcc, data.apgi)

## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Portal.Vein
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Splenectomy
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Posterior.Margin
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Back.pain
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Weight.loss

mskcc_post.linpred.apgi = temp[,1]
mskcc_post.12mo.apgi = temp[,2]
mskcc_post.24mo.apgi = temp[,3]
mskcc_post.36mo.apgi = temp[,4]
temp = applyNomogram(fit.mskcc, data.apgi[,c("History.Diagnosis.AgeAt", "Patient.Sex", "Path.LocationBoc

## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Portal.Vein
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Splenectomy
```

```
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Treat.MarginPositive
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Path.Differentiation
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Posterior.Margin
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Path.LN.Involved
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Path.LN.Negative
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Back.pain
## Warning in FUN(c("History.Diagnosis.AgeAt", "Patient.Sex", "Portal.Vein", :  Marginalizing
missing variable:  Weight.loss
```

```
mskcc_pre.linpred.apgi = temp[,1]
mskcc_pre.12mo.apgi = temp[,2]
mskcc_pre.24mo.apgi = temp[,3]
mskcc_pre.36mo.apgi = temp[,4]
```

Get approximate linear predictors from the GG model, by just calculating the location term.

```
val.prob.times = seq(0, max(c(data.glasgow$Time, data.apgi$Time)), 1)
```

```
gg.path.glasgow = summary(fit.gg, newdata = data.glasgow, ci = FALSE)
temp.coefs = coef(fit.gg)
gg.linpred.glasgow = sapply(1:length(temp.coefs), function(coef_i) {
        # if (names(temp.coefs)[coef_i] == "SexMTRUE") {
 #        rep(0, nrow(data.val))
        # } else
        if (names(temp.coefs)[coef_i] %in% colnames(data.glasgow)) {
                temp.coefs[coef_i] * data.glasgow[,names(temp.coefs)[coef_i]]
        } else if (gsub("TRUE$", "", names(temp.coefs)[coef_i]) %in% colnames(data.glasgow)) {
                temp.coefs[coef_i] * data.glasgow[,gsub("TRUE$", "", names(temp.coefs)[coef_i])]
        } else {
                rep(0, nrow(data.glasgow))
        } })
gg.linpred.glasgow = -rowSums(gg.linpred.glasgow)       # Negate to bring into concordance with the dire
temp = summary(fit.gg, newdata = data.glasgow, ci = FALSE)
gg.prob.glasgow = sapply(temp, function(x) approx(x[,1], x[,2], xout = val.prob.times, yleft = 1, yright
colnames(gg.prob.glasgow) = rownames(data.glasgow)
```

```
gg.path.apgi = summary(fit.gg, newdata = data.apgi, ci = FALSE)
temp.coefs = coef(fit.gg)
gg.linpred.apgi = sapply(1:length(temp.coefs), function(coef_i) {
        # if (names(temp.coefs)[coef_i] == "SexMTRUE") {
 #        rep(0, nrow(data.val))
        # } else
        if (names(temp.coefs)[coef_i] %in% colnames(data.apgi)) {
                temp.coefs[coef_i] * data.apgi[,names(temp.coefs)[coef_i]]
        } else if (gsub("TRUE$", "", names(temp.coefs)[coef_i]) %in% colnames(data.apgi)) {
                temp.coefs[coef_i] * data.apgi[,gsub("TRUE$", "", names(temp.coefs)[coef_i])]
```

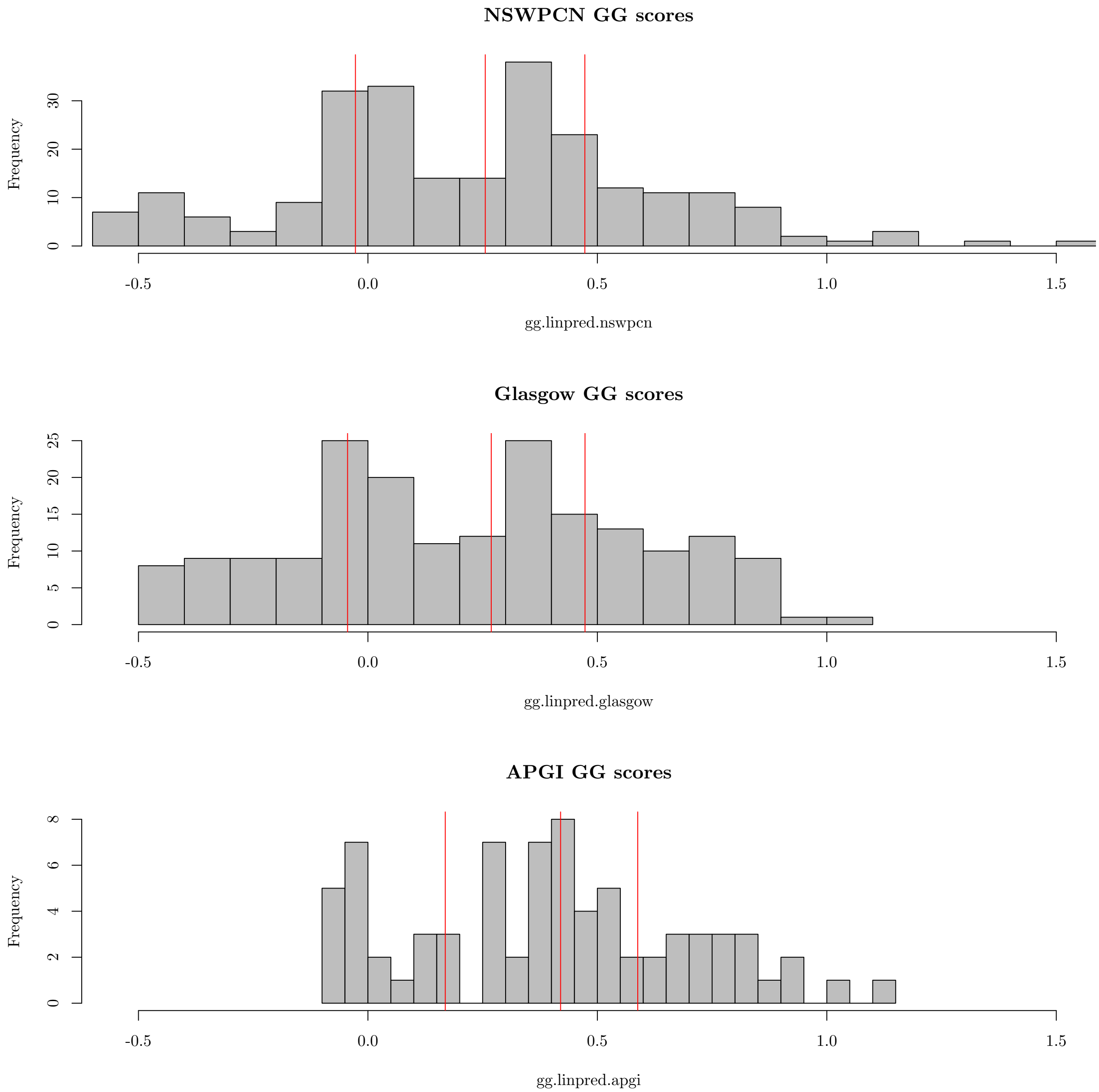
```
        } else {
                rep(0, nrow(data.apgi))
        } })
gg.linpred.apgi = -rowSums(gg.linpred.apgi)     # Negate to bring into concordance with the direction of
temp = summary(fit.gg, newdata = data.apgi, ci = FALSE)
gg.prob.apgi = sapply(temp, function(x) approx(x[,1], x[,2], xout = val.prob.times, yleft = 1, yright =
colnames(gg.prob.apgi) = rownames(data.apgi)
```

```
gg.linpred.nswpcn = sapply(1:length(temp.coefs), function(coef_i) {
        # if (names(temp.coefs)[coef_i] == "SexMTRUE") {
 #        rep(0, nrow(data.val))
        # } else
        if (names(temp.coefs)[coef_i] %in% colnames(data.glasgow)) {
                temp.coefs[coef_i] * data.nswpcn[,names(temp.coefs)[coef_i]]
        } else if (gsub("TRUE$", "", names(temp.coefs)[coef_i]) %in% colnames(data.nswpcn)) {
                temp.coefs[coef_i] * data.nswpcn[,gsub("TRUE$", "", names(temp.coefs)[coef_i])]
        } else {
                rep(0, nrow(data.nswpcn))
        } })
gg.linpred.nswpcn = -rowSums(gg.linpred.nswpcn)         # Negate to bring into concordance with the dire
temp = summary(fit.gg, newdata = data.nswpcn, ci = FALSE)
gg.prob.nswpcn = sapply(temp, function(x) approx(x[,1], x[,2], xout = val.prob.times, yleft = 1, yright
colnames(gg.prob.nswpcn) = rownames(data.nswpcn)
```

4 Validation

4.1 Altman diagnostic 1: score histograms

```
par(mfrow = c(3, 1))
hist(gg.linpred.nswpcn, main = "NSWPCN GG scores", xlim = range(c(gg.linpred.nswpcn, gg.linpred.glasgow,
abline(v = quantile(gg.linpred.nswpcn, probs = c(0.25, 0.5, 0.75)), col = "red")
hist(gg.linpred.glasgow, main = "Glasgow GG scores", xlim = range(c(gg.linpred.nswpcn, gg.linpred.glasgo
abline(v = quantile(gg.linpred.glasgow, probs = c(0.25, 0.5, 0.75)), col = "red")
hist(gg.linpred.apgi, main = "APGI GG scores", xlim = range(c(gg.linpred.nswpcn, gg.linpred.glasgow, gg.
abline(v = quantile(gg.linpred.apgi, probs = c(0.25, 0.5, 0.75)), col = "red")
```




```r
par(mfrow = c(1, 1))
```

4.2 Altman method 1 (D,F)

```r
summary(coxph(Surv(Time, DSD) ~ mskcc_post.linpred.glasgow, data.glasgow))

## Call:
## coxph(formula = Surv(Time, DSD) ~ mskcc_post.linpred.glasgow,
##     data = data.glasgow)
##
##   n= 189, number of events= 161
##
```

```
##                                 coef exp(coef) se(coef)    z Pr(>|z|)
## mskcc_post.linpred.glasgow 0.01682   1.01696  0.00428 3.93  8.4e-05
##
##                            exp(coef) exp(-coef) lower .95 upper .95
## mskcc_post.linpred.glasgow      1.02      0.983      1.01      1.03
##
## Concordance= 0.584  (se = 0.026 )
## Rsquare= 0.081   (max possible= 0.999 )
## Likelihood ratio test= 15.9  on 1 df,   p=6.79e-05
## Wald test            = 15.5  on 1 df,   p=8.43e-05
## Score (logrank) test = 15.7  on 1 df,   p=7.56e-05
```

```r
summary(coxph(Surv(Time, DSD) ~ mskcc_pre.linpred.glasgow, data.glasgow))
```

```
## Call:
## coxph(formula = Surv(Time, DSD) ~ mskcc_pre.linpred.glasgow,
##     data = data.glasgow)
##
##   n= 189, number of events= 161
##
##                              coef exp(coef) se(coef)    z Pr(>|z|)
## mskcc_pre.linpred.glasgow 0.0118    1.0118   0.0105 1.12     0.26
##
##                           exp(coef) exp(-coef) lower .95 upper .95
## mskcc_pre.linpred.glasgow      1.01      0.988     0.991      1.03
##
## Concordance= 0.585  (se = 0.026 )
## Rsquare= 0.006   (max possible= 0.999 )
## Likelihood ratio test= 1.15  on 1 df,   p=0.284
## Wald test            = 1.25  on 1 df,   p=0.263
## Score (logrank) test = 1.25  on 1 df,   p=0.264
```

```r
summary(coxph(Surv(Time, DSD) ~ mskcc_post.linpred.apgi, data.apgi))
```

```
## Call:
## coxph(formula = Surv(Time, DSD) ~ mskcc_post.linpred.apgi, data = data.apgi)
##
##   n= 75, number of events= 51
##
##                            coef exp(coef) se(coef)   z Pr(>|z|)
## mskcc_post.linpred.apgi 0.01626   1.01639  0.00452 3.6  0.00032
##
##                         exp(coef) exp(-coef) lower .95 upper .95
## mskcc_post.linpred.apgi      1.02      0.984      1.01      1.03
##
## Concordance= 0.701  (se = 0.044 )
## Rsquare= 0.14   (max possible= 0.993 )
## Likelihood ratio test= 11.3  on 1 df,   p=0.000754
## Wald test            = 12.9  on 1 df,   p=0.000319
## Score (logrank) test = 13.3  on 1 df,   p=0.000268
```

```r
summary(coxph(Surv(Time, DSD) ~ mskcc_pre.linpred.apgi, data.apgi))
```

```
## Call:
## coxph(formula = Surv(Time, DSD) ~ mskcc_pre.linpred.apgi, data = data.apgi)
```

```
##
##   n= 75, number of events= 51
##
##                             coef exp(coef) se(coef)    z Pr(>|z|)
## mskcc_pre.linpred.apgi 0.00329   1.00330  0.00673 0.49     0.62
##
##                          exp(coef) exp(-coef) lower .95 upper .95
## mskcc_pre.linpred.apgi         1      0.997      0.99      1.02
##
## Concordance= 0.475  (se = 0.044 )
## Rsquare= 0.003   (max possible= 0.993 )
## Likelihood ratio test= 0.23  on 1 df,   p=0.634
## Wald test            = 0.24  on 1 df,   p=0.625
## Score (logrank) test = 0.24  on 1 df,   p=0.624
```

```
summary(coxph(Surv(Time, DSD) ~ gg.linpred.glasgow, data.glasgow))
```

```
## Call:
## coxph(formula = Surv(Time, DSD) ~ gg.linpred.glasgow, data = data.glasgow)
##
##   n= 189, number of events= 161
##
##                       coef exp(coef) se(coef)    z Pr(>|z|)
## gg.linpred.glasgow 0.805     2.236    0.239 3.37  0.00075
##
##                      exp(coef) exp(-coef) lower .95 upper .95
## gg.linpred.glasgow      2.24      0.447       1.4      3.57
##
## Concordance= 0.607  (se = 0.026 )
## Rsquare= 0.059   (max possible= 0.999 )
## Likelihood ratio test= 11.4  on 1 df,   p=0.000725
## Wald test            = 11.3  on 1 df,   p=0.000754
## Score (logrank) test = 11.5  on 1 df,   p=0.000705
```

```
summary(coxph(Surv(Time, DSD) ~ gg.linpred.apgi, data.apgi))
```

```
## Call:
## coxph(formula = Surv(Time, DSD) ~ gg.linpred.apgi, data = data.apgi)
##
##   n= 75, number of events= 51
##
##                  coef exp(coef) se(coef)    z Pr(>|z|)
## gg.linpred.apgi 1.79      5.99     0.48 3.73  0.00019
##
##                  exp(coef) exp(-coef) lower .95 upper .95
## gg.linpred.apgi      5.99      0.167      2.34      15.4
##
## Concordance= 0.645  (se = 0.044 )
## Rsquare= 0.169   (max possible= 0.993 )
## Likelihood ratio test= 13.8  on 1 df,   p=0.000198
## Wald test            = 13.9  on 1 df,   p=0.000194
## Score (logrank) test = 14.3  on 1 df,   p=0.000152
```

```
anova(coxph(Surv(Time, DSD) ~ offset(gg.linpred.glasgow) + gg.linpred.glasgow, data.glasgow))
```

```
## Analysis of Deviance Table
##  Cox model: response is Surv(Time, DSD)
## Terms added sequentially (first to last)
##
##                      loglik Chisq Df Pr(>|Chi|)
## NULL                   -678
## gg.linpred.glasgow   -678  0.66  1       0.41
```

```
anova(coxph(Surv(Time, DSD) ~ offset(gg.linpred.apgi) + gg.linpred.apgi, data.apgi))
```

```
## Analysis of Deviance Table
##  Cox model: response is Surv(Time, DSD)
## Terms added sequentially (first to last)
##
##                   loglik Chisq Df Pr(>|Chi|)
## NULL                -181
## gg.linpred.apgi   -180  2.71  1      0.099
```

Booyah.

4.3 Altman method 2 (F)

```
summary(coxph(Surv(Time, DSD) ~ offset(mskcc_pre.linpred.glasgow) + AgeCent + SexM + SizeCent + A2 + A4,
```

```
## Warning in fitter(X, Y, strats, offset, init, control, weights = weights, :  Ran out of
iterations and did not converge
## Error in fitter(X, Y, strats, offset, init, control, weights = weights, :  NA/NaN/Inf in
foreign function call (arg 6)
```

```
summary(coxph(Surv(Time, DSD) ~ offset(mskcc_post.linpred.glasgow) + AgeCent + SexM + SizeCent + A2 + A4
```

```
## Call:
## coxph(formula = Surv(Time, DSD) ~ offset(mskcc_post.linpred.glasgow) +
##     AgeCent + SexM + SizeCent + A2 + A4, data = data.glasgow)
##
##   n= 189, number of events= 161
##
##               coef exp(coef)  se(coef)      z Pr(>|z|)
## AgeCent    0.22744   1.25538   0.00862  26.39  < 2e-16
## SexMTRUE  -4.18282   0.01526   0.29544 -14.16  < 2e-16
## SizeCent   0.07140   1.07401   0.01910   3.74  0.00019
## A2TRUE    -2.96537   0.05154   0.41042  -7.23    5e-13
## A4TRUE     5.40464 222.43685   0.28361  19.06  < 2e-16
##
##          exp(coef) exp(-coef) lower .95 upper .95
## AgeCent     1.2554     0.7966  1.23e+00    1.2768
## SexMTRUE    0.0153    65.5506  8.55e-03    0.0272
## SizeCent    1.0740     0.9311  1.03e+00    1.1150
## A2TRUE      0.0515    19.4019  2.31e-02    0.1152
## A4TRUE    222.4369     0.0045  1.28e+02  387.8075
##
## Concordance= 0.588  (se = 0.026 )
## Rsquare= 0.982   (max possible= 1 )
## Likelihood ratio test= 757  on 5 df,   p=0
```

```
## Wald test            = 1654  on 5 df,   p=0
## Score (logrank) test = 1745  on 5 df,   p=0
```

```
summary(coxph(Surv(Time, DSD) ~ offset(gg.linpred.glasgow) + AgeCent + SexM + SizeCent + A2 + A4, data.g
```

```
## Call:
## coxph(formula = Surv(Time, DSD) ~ offset(gg.linpred.glasgow) +
##     AgeCent + SexM + SizeCent + A2 + A4, data = data.glasgow)
##
##   n= 189, number of events= 161
##
##               coef exp(coef) se(coef)     z Pr(>|z|)
## AgeCent  -0.03105   0.96943  0.00872 -3.56  0.00037
## SexMTRUE  0.63117   1.87981  0.16671  3.79  0.00015
## SizeCent  0.02245   1.02270  0.00767  2.93  0.00343
## A2TRUE    0.33327   1.39553  0.17564  1.90  0.05776
## A4TRUE   -0.05074   0.95052  0.18482 -0.27  0.78367
##
##          exp(coef) exp(-coef) lower .95 upper .95
## AgeCent      0.969      1.032     0.953     0.986
## SexMTRUE     1.880      0.532     1.356     2.606
## SizeCent     1.023      0.978     1.007     1.038
## A2TRUE       1.396      0.717     0.989     1.969
## A4TRUE       0.951      1.052     0.662     1.365
##
## Concordance= 0.676  (se = 0.026 )
## Rsquare= 0.184   (max possible= 0.999 )
## Likelihood ratio test= 38.4  on 5 df,   p=3.19e-07
## Wald test            = 39  on 5 df,   p=2.4e-07
## Score (logrank) test = 40.5  on 5 df,   p=1.19e-07
```

```
summary(coxph(Surv(Time, DSD) ~ offset(mskcc_pre.linpred.apgi) + AgeCent + SexM + SizeCent + A2 + A4, da
```

```
## Warning in fitter(X, Y, strats, offset, init, control, weights = weights, :  Ran out of
iterations and did not converge
## Error in fitter(X, Y, strats, offset, init, control, weights = weights, :  NA/NaN/Inf in
foreign function call (arg 6)
```

```
summary(coxph(Surv(Time, DSD) ~ offset(mskcc_post.linpred.apgi) + AgeCent + SexM + SizeCent + A2 + A4, d
```

```
## Warning in fitter(X, Y, strats, offset, init, control, weights = weights, :  Ran out of
iterations and did not converge
## Error in fitter(X, Y, strats, offset, init, control, weights = weights, :  NA/NaN/Inf in
foreign function call (arg 6)
```

```
summary(coxph(Surv(Time, DSD) ~ offset(gg.linpred.apgi) + AgeCent + SexM + SizeCent + A2 + A4, data.apgi
```

```
## Warning in coxph(Surv(Time, DSD) ~ offset(gg.linpred.apgi) + AgeCent + SexM + :  X matrix
deemed to be singular; variable 2
```

```
## Call:
## coxph(formula = Surv(Time, DSD) ~ offset(gg.linpred.apgi) + AgeCent +
##     SexM + SizeCent + A2 + A4, data = data.apgi)
##
##   n= 75, number of events= 51
##
```

```
##              coef exp(coef) se(coef)    z Pr(>|z|)
## AgeCent  0.02122   1.02145  0.01775 1.20     0.23
## SexMTRUE      NA        NA  0.00000   NA       NA
## SizeCent 0.01257   1.01265  0.00833 1.51     0.13
## A2TRUE   0.05042   1.05171  0.38919 0.13     0.90
## A4TRUE   0.36722   1.44371  0.32143 1.14     0.25
##
##          exp(coef) exp(-coef) lower .95 upper .95
## AgeCent       1.02      0.979     0.987      1.06
## SexMTRUE        NA         NA        NA        NA
## SizeCent      1.01      0.988     0.996      1.03
## A2TRUE        1.05      0.951     0.490      2.26
## A4TRUE        1.44      0.693     0.769      2.71
##
## Concordance= 0.652  (se = 0.044 )
## Rsquare= 0.064   (max possible= 0.992 )
## Likelihood ratio test= 4.94  on 4 df,   p=0.293
## Wald test            = 4.69  on 4 df,   p=0.32
## Score (logrank) test = 4.74  on 4 df,   p=0.315
```

Still strong evidence of misspecification or poor fit. However, the above calibration slope was not significantly different from 1. Hmm. This doesn't necessarily sink the method, but will need checking as we go along.

4.4 Altman method 3 (D)

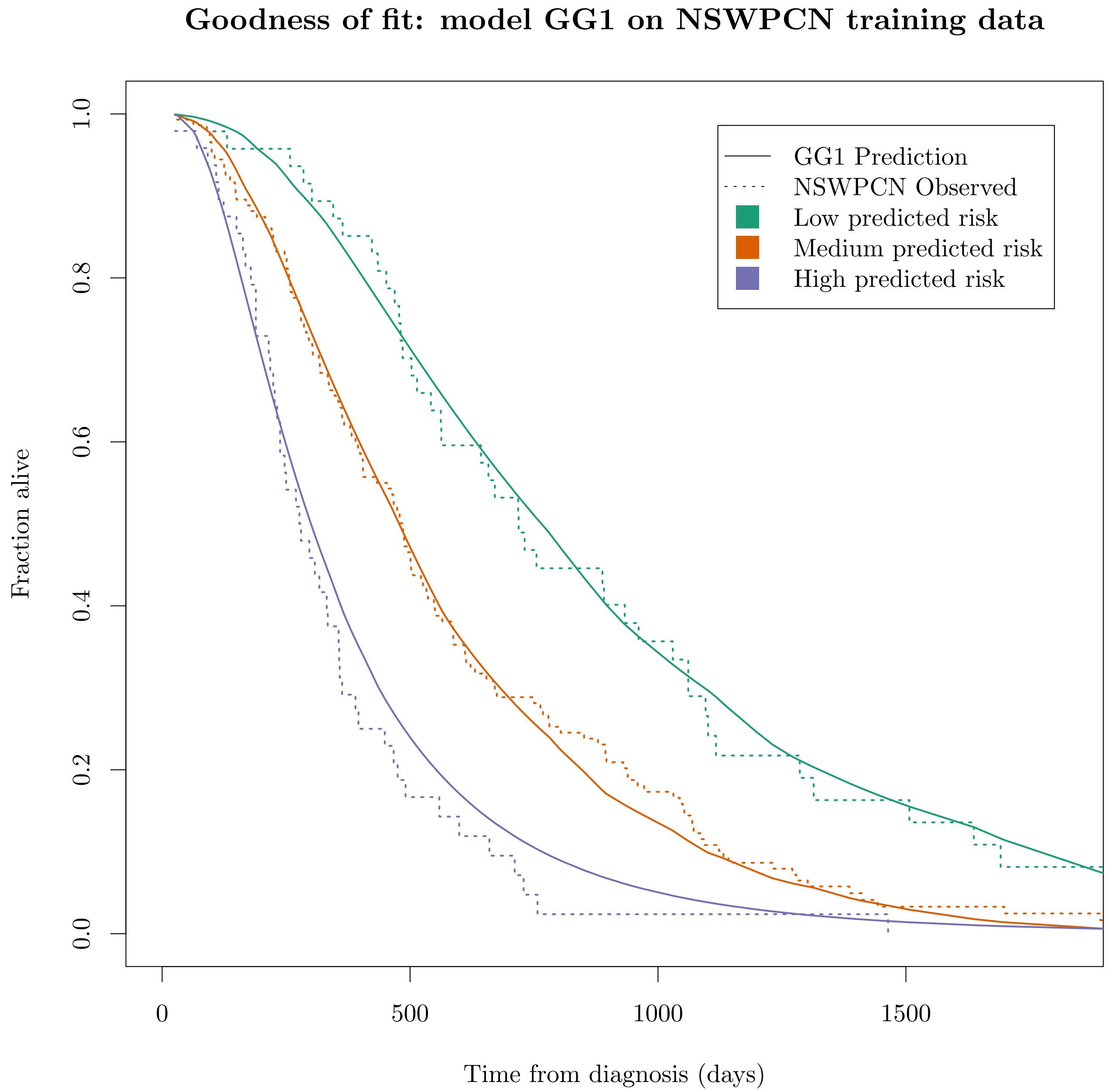
Look at the CIs above.

4.5 Altman method 4 (D,C)

```
group_quantiles = c(0, 0.2, 0.8, 1)
gg.groups.nswpcn = cut(gg.linpred.nswpcn, quantile(gg.linpred.nswpcn, group_quantiles), labels = FALSE)
temp.alpha = 0.1
```

```
temp.km = survfit(Surv(data.nswpcn$Time, data.nswpcn$DSD) ~ gg.groups.nswpcn, conf.int = 1-temp.alpha)
temp.km = data.frame(surv = temp.km$surv, group = rep(gsub(".*=", "", names(temp.km$strata)), temp.km$st
temp.pred = summary(fit.gg, newdata = data.nswpcn, ci = FALSE)
temp.pred.times = temp.pred[[1]][,1]
temp.pred.ests = sapply(temp.pred, function(x) x[,2])
temp.pred.ests = tapply(1:ncol(temp.pred.ests), gg.groups.nswpcn, function(is) apply(temp.pred.ests[,is]
temp.pred.lower = sapply(temp.pred.ests, function(x) x[1,])
temp.pred.meds = sapply(temp.pred.ests, function(x) x[2,])
temp.pred.upper = sapply(temp.pred.ests, function(x) x[3,])
temp.pred = data.frame(surv = as.vector(temp.pred.meds), group = rep(colnames(temp.pred.meds), each = nr
temp.data = rbind(temp.km, temp.pred)
# ggplot(temp.data, aes(x = time, y = surv, colour = group, fill = group, ymax = upper, ymin = lower, li
#  geom_step() +
#  xlim(0, 5*365) +
#  labs(title = "Goodness of fit: model GG1 on NSWPCN training data", x = "Time from diagnosis (days)",

plot(0 ~ 0, type = "n", xlim = c(0, 5*365), ylim = c(0, 1), main = "Goodness of fit: model GG1 on NSWPCN
temp.pal = brewer.pal(length(unique(gg.groups.nswpcn)), "Dark2")
```

```r
names(temp.pal) = sort(unique(gg.groups.nswpcn))
for (temp.i in factor(sort(unique(gg.groups.nswpcn))))
{
        lines(surv ~ time, temp.data[as.character(temp.data$group) == as.character(temp.i) & temp.data$e
        lines(surv ~ time, temp.data[as.character(temp.data$group) == as.character(temp.i) & temp.data$e
}
legend("topright", inset = 0.05, legend = c("GG1 Prediction", "NSWPCN Observed", "Low predicted risk", "
```

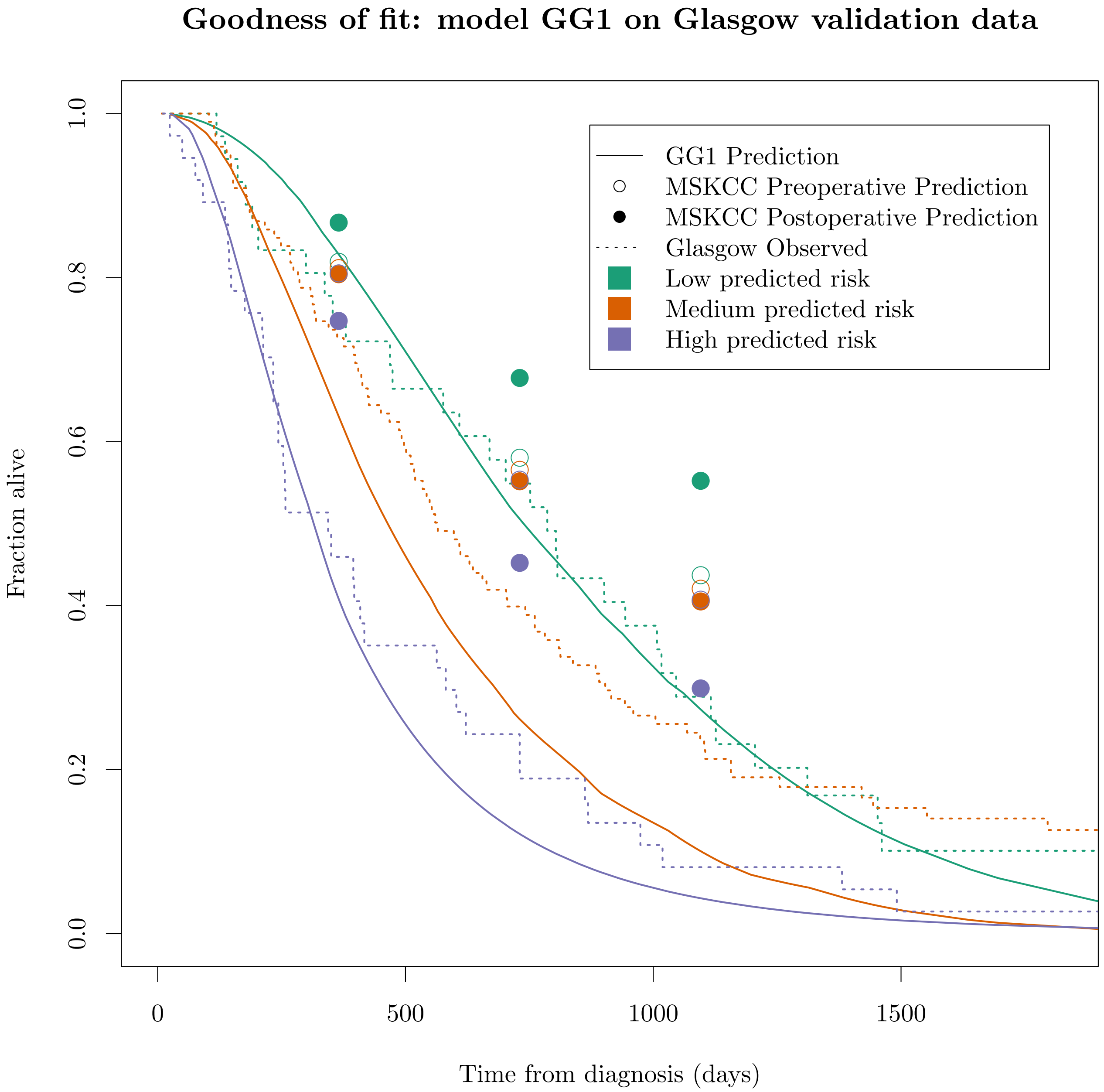



```r
summary(coxph(Surv(data.nswpcn$Time, data.nswpcn$DSD) ~ factor(gg.groups.nswpcn)))

## Call:
## coxph(formula = Surv(data.nswpcn$Time, data.nswpcn$DSD) ~ factor(gg.groups.nswpcn))
##
##   n= 239, number of events= 230
```

```
##    (1 observation deleted due to missingness)
##
##                             coef exp(coef) se(coef)    z Pr(>|z|)
## factor(gg.groups.nswpcn)2 0.532     1.703    0.176 3.03   0.0025
## factor(gg.groups.nswpcn)3 1.328     3.775    0.219 6.06  1.3e-09
##
##                           exp(coef) exp(-coef) lower .95 upper .95
## factor(gg.groups.nswpcn)2      1.70      0.587      1.21       2.4
## factor(gg.groups.nswpcn)3      3.78      0.265      2.46       5.8
##
## Concordance= 0.618  (se = 0.019 )
## Rsquare= 0.138   (max possible= 1 )
## Likelihood ratio test= 35.5  on 2 df,   p=1.96e-08
## Wald test            = 37.9  on 2 df,   p=6.01e-09
## Score (logrank) test = 40.7  on 2 df,   p=1.46e-09
```

```
mskcc_pre.groups.glasgow = cut(mskcc_pre.linpred.glasgow, quantile(mskcc_pre.linpred.glasgow, group_quan
mskcc_post.groups.glasgow = cut(mskcc_post.linpred.glasgow, quantile(mskcc_post.linpred.glasgow, group_q
gg.groups.glasgow = cut(gg.linpred.glasgow, quantile(gg.linpred.glasgow, group_quantiles), labels = FALS

temp.km = survfit(Surv(data.glasgow$Time, data.glasgow$DSD) ~ gg.groups.glasgow, conf.int = 1-temp.alpha
temp.km = data.frame(surv = temp.km$surv, group = rep(gsub(".*=", "", names(temp.km$strata)), temp.km$st
temp.pred = summary(fit.gg, newdata = data.glasgow, ci = FALSE)
temp.pred.times = temp.pred[[1]][,1]
temp.pred.ests = sapply(temp.pred, function(x) x[,2])
temp.pred.ests = tapply(1:ncol(temp.pred.ests), gg.groups.glasgow, function(is) apply(temp.pred.ests[,is
temp.pred.lower = sapply(temp.pred.ests, function(x) x[1,])
temp.pred.meds = sapply(temp.pred.ests, function(x) x[2,])
temp.pred.upper = sapply(temp.pred.ests, function(x) x[3,])
temp.pred = data.frame(surv = as.vector(temp.pred.meds), group = rep(colnames(temp.pred.meds), each = nr
temp.data = rbind(temp.km, temp.pred)
temp.predpre.12mo = simplify2array(tapply(mskcc_pre.12mo.glasgow, mskcc_pre.groups.glasgow, quantile, pr
temp.predpre.24mo = simplify2array(tapply(mskcc_pre.24mo.glasgow, mskcc_pre.groups.glasgow, quantile, pr
temp.predpre.36mo = simplify2array(tapply(mskcc_pre.36mo.glasgow, mskcc_pre.groups.glasgow, quantile, pr
temp.predpost.12mo = simplify2array(tapply(mskcc_post.12mo.glasgow, mskcc_post.groups.glasgow, quantile,
temp.predpost.24mo = simplify2array(tapply(mskcc_post.24mo.glasgow, mskcc_post.groups.glasgow, quantile,
temp.predpost.36mo = simplify2array(tapply(mskcc_post.36mo.glasgow, mskcc_post.groups.glasgow, quantile,
temp.data2 = data.frame(
        surv = c(temp.predpre.12mo[2,], temp.predpre.24mo[2,], temp.predpre.36mo[2,], temp.predpost.12mo
        group = factor(rep(sort(unique(mskcc_pre.groups.glasgow)), 6)),
        time = rep(c(12, 24, 36)/12*365.25, each = 3),
        upper = c(temp.predpre.12mo[3,], temp.predpre.24mo[3,], temp.predpre.36mo[3,], temp.predpost.12m
        lower = c(temp.predpre.12mo[1,], temp.predpre.24mo[1,], temp.predpre.36mo[1,], temp.predpost.12m
        est = rep(c("MSKCC Preoperative", "MSKCC Postoperative"), each = 9))
# ggplot(temp.data, aes(x = time, y = surv, colour = group, fill = group, ymax = upper, ymin = lower, li
#  geom_step() +
#  xlim(0, 5*365) +
#  geom_line(data = temp.data2) +
#  labs(title = "Goodness of fit: model GG1 on Glasgow validation data", x = "Time from diagnosis (days)

plot(0 ~ 0, type = "n", xlim = c(0, 5*365), ylim = c(0, 1), main = "Goodness of fit: model GG1 on Glasgo
temp.pal = brewer.pal(length(unique(gg.groups.glasgow)), "Dark2")
names(temp.pal) = sort(unique(gg.groups.glasgow))
```

```
for (temp.i in factor(sort(unique(gg.groups.glasgow))))
{
        lines(surv ~ time, temp.data[as.character(temp.data$group) == as.character(temp.i) & temp.data$e
        lines(surv ~ time, temp.data[as.character(temp.data$group) == as.character(temp.i) & temp.data$e
        points(surv ~ time, temp.data2[as.character(temp.data2$group) == as.character(temp.i) & temp.dat
        points(surv ~ time, temp.data2[as.character(temp.data2$group) == as.character(temp.i) & temp.dat
}
legend("topright", inset = 0.05, legend = c("GG1 Prediction", "MSKCC Preoperative Prediction", "MSKCC Po
```




```
summary(coxph(Surv(data.glasgow$Time, data.glasgow$DSD) ~ factor(gg.groups.glasgow)))

## Call:
## coxph(formula = Surv(data.glasgow$Time, data.glasgow$DSD) ~ factor(gg.groups.glasgow))
##
```

```
##   n= 188, number of events= 160
##    (1 observation deleted due to missingness)
##
##                              coef exp(coef) se(coef)    z Pr(>|z|)
## factor(gg.groups.glasgow)2 0.0794    1.0826   0.2074 0.38   0.7019
## factor(gg.groups.glasgow)3 0.6662    1.9468   0.2438 2.73   0.0063
##
##                            exp(coef) exp(-coef) lower .95 upper .95
## factor(gg.groups.glasgow)2      1.08      0.924     0.721      1.63
## factor(gg.groups.glasgow)3      1.95      0.514     1.207      3.14
##
## Concordance= 0.577  (se = 0.023 )
## Rsquare= 0.049   (max possible= 0.999 )
## Likelihood ratio test= 9.37  on 2 df,   p=0.00923
## Wald test            = 10.4  on 2 df,   p=0.00543
## Score (logrank) test = 10.8  on 2 df,   p=0.00463
```

```
summary(coxph(Surv(data.glasgow$Time, data.glasgow$DSD) ~ factor(mskcc_pre.groups.glasgow)))
```

```
## Call:
## coxph(formula = Surv(data.glasgow$Time, data.glasgow$DSD) ~ factor(mskcc_pre.groups.glasgow))
##
##   n= 188, number of events= 160
##    (1 observation deleted due to missingness)
##
##                                     coef exp(coef) se(coef)    z Pr(>|z|)
## factor(mskcc_pre.groups.glasgow)2 0.764     2.147    0.217 3.52  0.00043
## factor(mskcc_pre.groups.glasgow)3 0.762     2.143    0.260 2.93  0.00338
##
##                                   exp(coef) exp(-coef) lower .95 upper .95
## factor(mskcc_pre.groups.glasgow)2      2.15      0.466      1.40      3.28
## factor(mskcc_pre.groups.glasgow)3      2.14      0.467      1.29      3.57
##
## Concordance= 0.563  (se = 0.023 )
## Rsquare= 0.077   (max possible= 0.999 )
## Likelihood ratio test= 15.1  on 2 df,   p=0.000535
## Wald test            = 13.1  on 2 df,   p=0.00144
## Score (logrank) test = 13.6  on 2 df,   p=0.00109
```

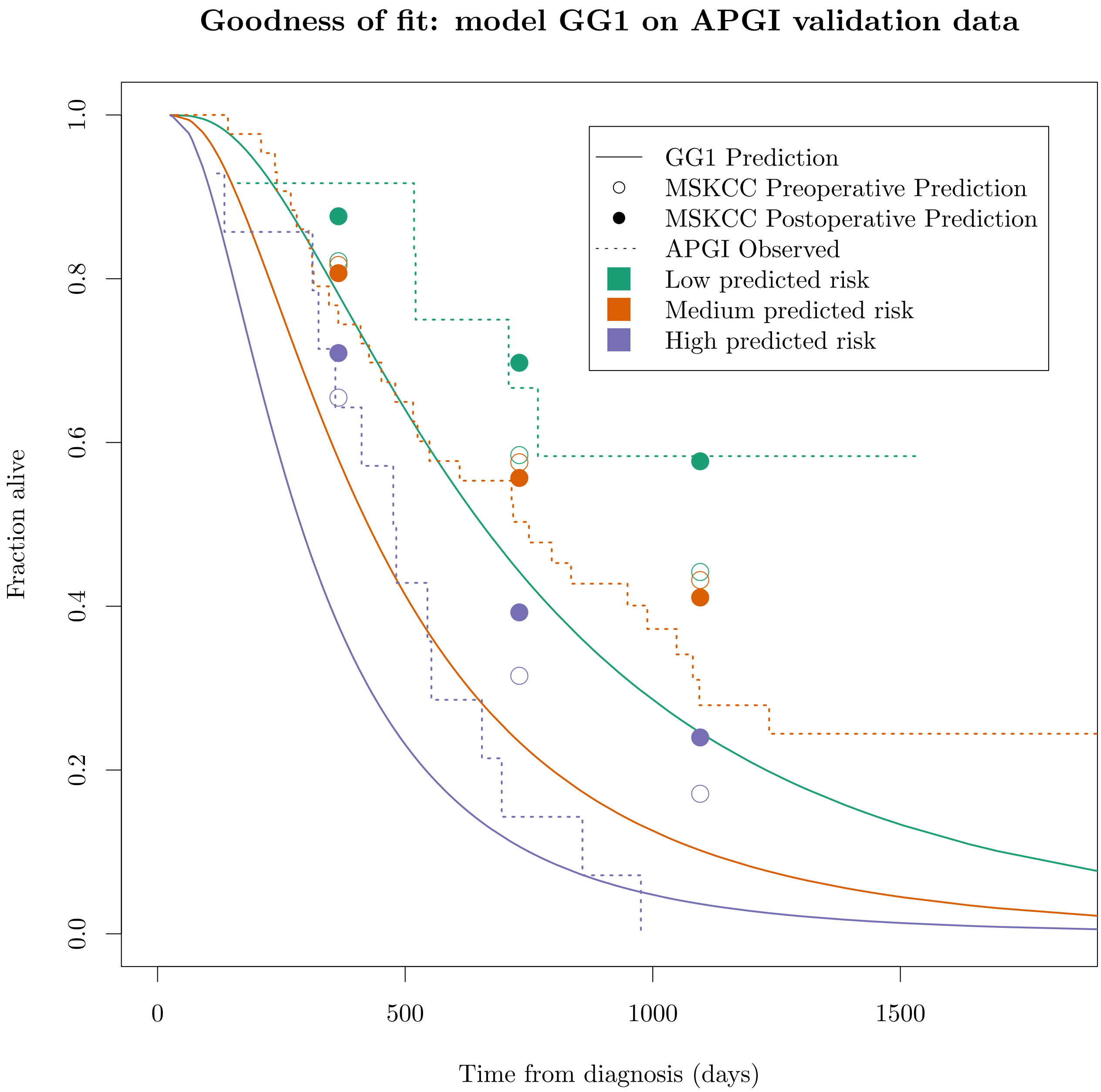
```
summary(coxph(Surv(data.glasgow$Time, data.glasgow$DSD) ~ factor(mskcc_post.groups.glasgow)))
```

```
## Call:
## coxph(formula = Surv(data.glasgow$Time, data.glasgow$DSD) ~ factor(mskcc_post.groups.glasgow))
##
##   n= 188, number of events= 160
##    (1 observation deleted due to missingness)
##
##                                      coef exp(coef) se(coef)   z Pr(>|z|)
## factor(mskcc_post.groups.glasgow)2 0.631     1.879    0.218 2.9  0.00378
## factor(mskcc_post.groups.glasgow)3 0.990     2.691    0.261 3.8  0.00015
##
##                                    exp(coef) exp(-coef) lower .95
## factor(mskcc_post.groups.glasgow)2      1.88      0.532      1.23
## factor(mskcc_post.groups.glasgow)3      2.69      0.372      1.61
##                                    upper .95
```

```
## factor(mskcc_post.groups.glasgow)2      2.88
## factor(mskcc_post.groups.glasgow)3      4.49
##
## Concordance= 0.579  (se = 0.023 )
## Rsquare= 0.081   (max possible= 0.999 )
## Likelihood ratio test= 15.8  on 2 df,   p=0.000372
## Wald test            = 14.7  on 2 df,   p=0.00066
## Score (logrank) test = 15.3  on 2 df,   p=0.000484
```

```
mskcc_pre.groups.apgi = cut(mskcc_pre.linpred.apgi, quantile(mskcc_pre.linpred.apgi, group_quantiles), l
mskcc_post.groups.apgi = cut(mskcc_post.linpred.apgi, quantile(mskcc_post.linpred.apgi, group_quantiles)
gg.groups.apgi = cut(gg.linpred.apgi, quantile(gg.linpred.apgi, group_quantiles), labels = FALSE)

temp.km = survfit(Surv(data.apgi$Time, data.apgi$DSD) ~ gg.groups.apgi, conf.int = 1-temp.alpha)
temp.km = data.frame(surv = temp.km$surv, group = rep(gsub(".*=", "", names(temp.km$strata)), temp.km$st
temp.pred = summary(fit.gg, newdata = data.apgi, ci = FALSE)
temp.pred.times = temp.pred[[1]][,1]
temp.pred.ests = sapply(temp.pred, function(x) x[,2])
temp.pred.ests = tapply(1:ncol(temp.pred.ests), gg.groups.apgi, function(is) apply(temp.pred.ests[,is],
temp.pred.lower = sapply(temp.pred.ests, function(x) x[1,])
temp.pred.meds = sapply(temp.pred.ests, function(x) x[2,])
temp.pred.upper = sapply(temp.pred.ests, function(x) x[3,])
temp.pred = data.frame(surv = as.vector(temp.pred.meds), group = rep(colnames(temp.pred.meds), each = nr
temp.data = rbind(temp.km, temp.pred)
temp.predpre.12mo = simplify2array(tapply(mskcc_pre.12mo.apgi, mskcc_pre.groups.apgi, quantile, probs =
temp.predpre.24mo = simplify2array(tapply(mskcc_pre.24mo.apgi, mskcc_pre.groups.apgi, quantile, probs =
temp.predpre.36mo = simplify2array(tapply(mskcc_pre.36mo.apgi, mskcc_pre.groups.apgi, quantile, probs =
temp.predpost.12mo = simplify2array(tapply(mskcc_post.12mo.apgi, mskcc_post.groups.apgi, quantile, probs
temp.predpost.24mo = simplify2array(tapply(mskcc_post.24mo.apgi, mskcc_post.groups.apgi, quantile, probs
temp.predpost.36mo = simplify2array(tapply(mskcc_post.36mo.apgi, mskcc_post.groups.apgi, quantile, probs
temp.data2 = data.frame(
        surv = c(temp.predpre.12mo[2,], temp.predpre.24mo[2,], temp.predpre.36mo[2,], temp.predpost.12mo
        group = factor(rep(sort(unique(mskcc_pre.groups.apgi)), 6)),
        time = rep(c(12, 24, 36)/12*365.25, each = 3),
        upper = c(temp.predpre.12mo[3,], temp.predpre.24mo[3,], temp.predpre.36mo[3,], temp.predpost.12m
        lower = c(temp.predpre.12mo[1,], temp.predpre.24mo[1,], temp.predpre.36mo[1,], temp.predpost.12m
        est = rep(c("MSKCC Preoperative", "MSKCC Postoperative"), each = 9))
# ggplot(temp.data, aes(x = time, y = surv, colour = group, fill = group, ymax = upper, ymin = lower, li
#  geom_step() +
#  xlim(0, 5*365) +
#  geom_line(data = temp.data2) +
#  labs(title = "Goodness of fit: model GG1 on APGI validation data", x = "Time from diagnosis (days)",

plot(0 ~ 0, type = "n", xlim = c(0, 5*365), ylim = c(0, 1), main = "Goodness of fit: model GG1 on APGI v
temp.pal = brewer.pal(length(unique(gg.groups.apgi)), "Dark2")
names(temp.pal) = sort(unique(gg.groups.apgi))
for (temp.i in factor(sort(unique(gg.groups.apgi))))
{
        lines(surv ~ time, temp.data[as.character(temp.data$group) == as.character(temp.i) & temp.data$e
        lines(surv ~ time, temp.data[as.character(temp.data$group) == as.character(temp.i) & temp.data$e
        points(surv ~ time, temp.data2[as.character(temp.data2$group) == as.character(temp.i) & temp.dat
        points(surv ~ time, temp.data2[as.character(temp.data2$group) == as.character(temp.i) & temp.dat
}
```

```r
legend("topright", inset = 0.05, legend = c("GG1 Prediction", "MSKCC Preoperative Prediction", "MSKCC Po
```




```r
summary(coxph(Surv(data.apgi$Time, data.apgi$DSD) ~ factor(gg.groups.apgi)))

## Call:
## coxph(formula = Surv(data.apgi$Time, data.apgi$DSD) ~ factor(gg.groups.apgi))
##
##   n= 72, number of events= 50
##    (3 observations deleted due to missingness)
##
##                           coef exp(coef) se(coef)    z Pr(>|z|)
## factor(gg.groups.apgi)2 0.784     2.190    0.484 1.62   0.1051
## factor(gg.groups.apgi)3 1.689     5.413    0.533 3.17   0.0015
##
```

```
##                          exp(coef) exp(-coef) lower .95 upper .95
## factor(gg.groups.apgi)2      2.19      0.457     0.849      5.65
## factor(gg.groups.apgi)3      5.41      0.185     1.905     15.38
##
## Concordance= 0.609  (se = 0.039 )
## Rsquare= 0.153   (max possible= 0.993 )
## Likelihood ratio test= 11.9  on 2 df,   p=0.00254
## Wald test            = 12  on 2 df,   p=0.00249
## Score (logrank) test = 13.4  on 2 df,   p=0.00124
```

```
summary(coxph(Surv(data.apgi$Time, data.apgi$DSD) ~ factor(mskcc_pre.groups.apgi)))
```

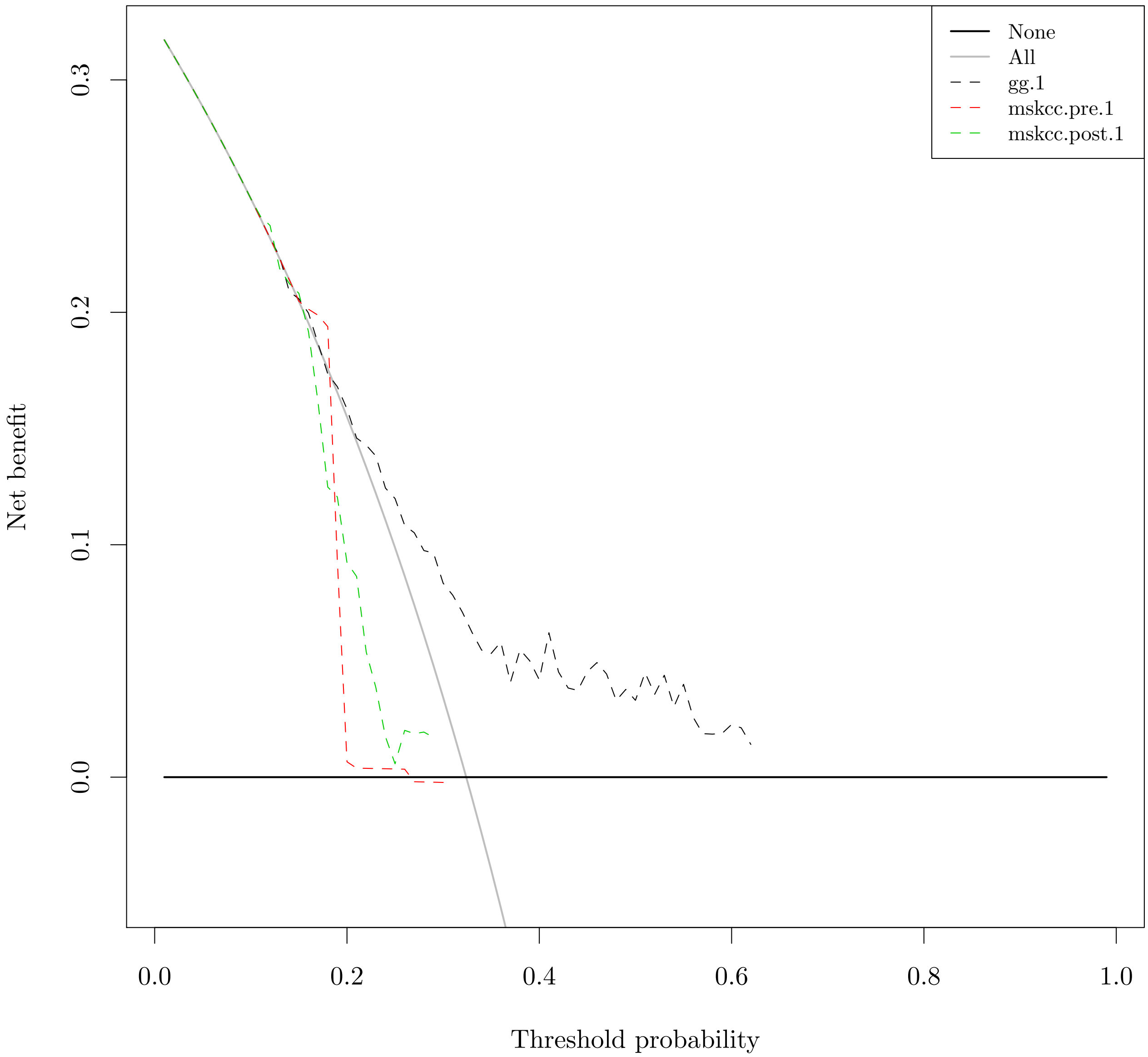
```
## Call:
## coxph(formula = Surv(data.apgi$Time, data.apgi$DSD) ~ factor(mskcc_pre.groups.apgi))
##
##   n= 74, number of events= 50
##    (1 observation deleted due to missingness)
##
##                                   coef exp(coef) se(coef)     z Pr(>|z|)
## factor(mskcc_pre.groups.apgi)2 -0.412     0.662    0.367 -1.12     0.26
## factor(mskcc_pre.groups.apgi)3 -0.058     0.944    0.449 -0.13     0.90
##
##                                 exp(coef) exp(-coef) lower .95 upper .95
## factor(mskcc_pre.groups.apgi)2     0.662       1.51     0.322      1.36
## factor(mskcc_pre.groups.apgi)3     0.944       1.06     0.392      2.27
##
## Concordance= 0.559  (se = 0.037 )
## Rsquare= 0.023   (max possible= 0.993 )
## Likelihood ratio test= 1.7  on 2 df,   p=0.428
## Wald test            = 1.75  on 2 df,   p=0.417
## Score (logrank) test = 1.77  on 2 df,   p=0.412
```

```
summary(coxph(Surv(data.apgi$Time, data.apgi$DSD) ~ factor(mskcc_post.groups.apgi)))
```

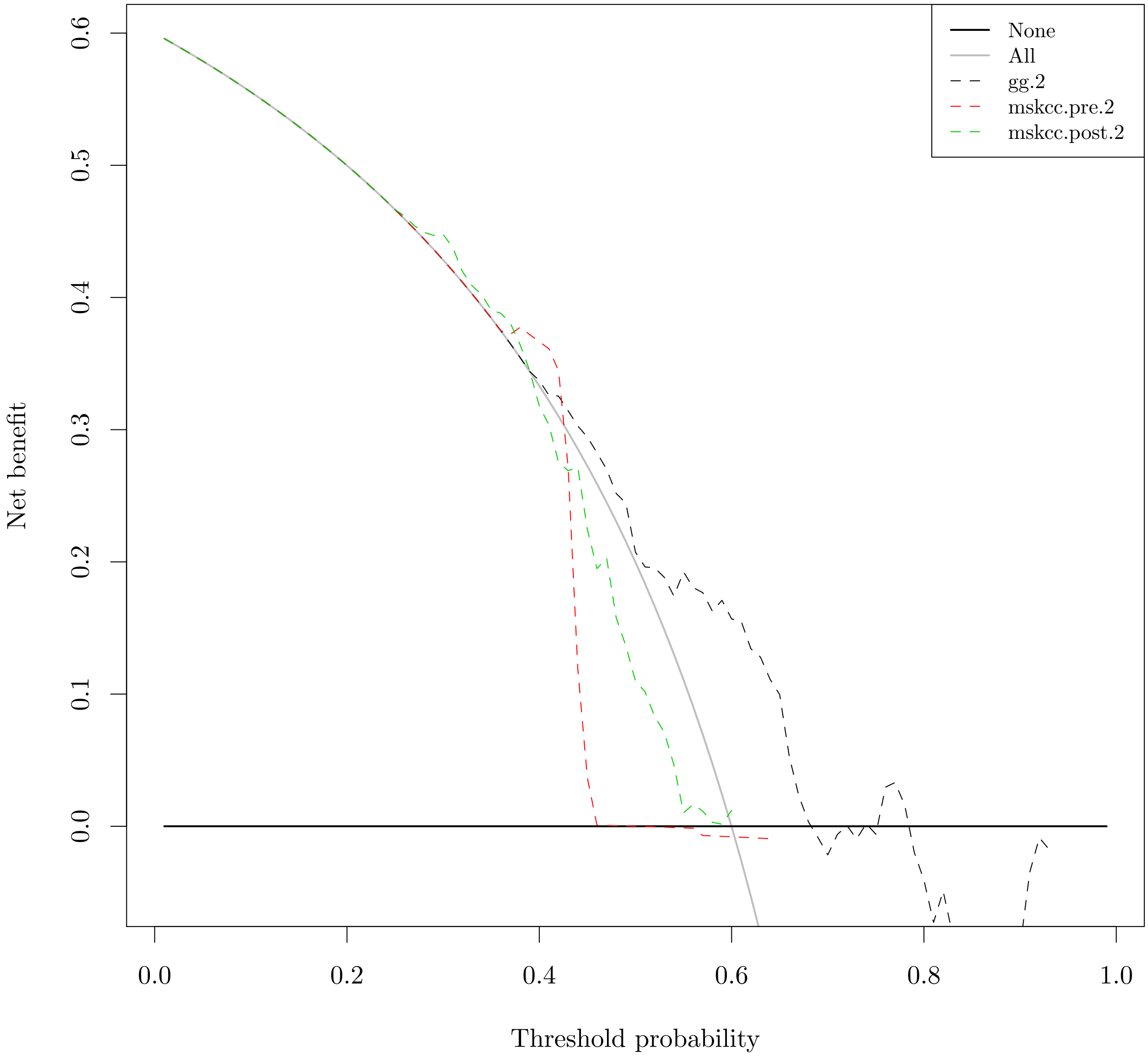
```
## Call:
## coxph(formula = Surv(data.apgi$Time, data.apgi$DSD) ~ factor(mskcc_post.groups.apgi))
##
##   n= 74, number of events= 51
##    (1 observation deleted due to missingness)
##
##                                   coef exp(coef) se(coef)    z Pr(>|z|)
## factor(mskcc_post.groups.apgi)2 1.526     4.598    0.531 2.87   0.0041
## factor(mskcc_post.groups.apgi)3 1.812     6.125    0.576 3.15   0.0016
##
##                                 exp(coef) exp(-coef) lower .95 upper .95
## factor(mskcc_post.groups.apgi)2      4.60      0.217      1.62      13.0
## factor(mskcc_post.groups.apgi)3      6.12      0.163      1.98      18.9
##
## Concordance= 0.624  (se = 0.04 )
## Rsquare= 0.184   (max possible= 0.993 )
## Likelihood ratio test= 15.1  on 2 df,   p=0.000539
## Wald test            = 10.1  on 2 df,   p=0.00628
## Score (logrank) test = 12.3  on 2 df,   p=0.00208
```

Decision curve analysis.

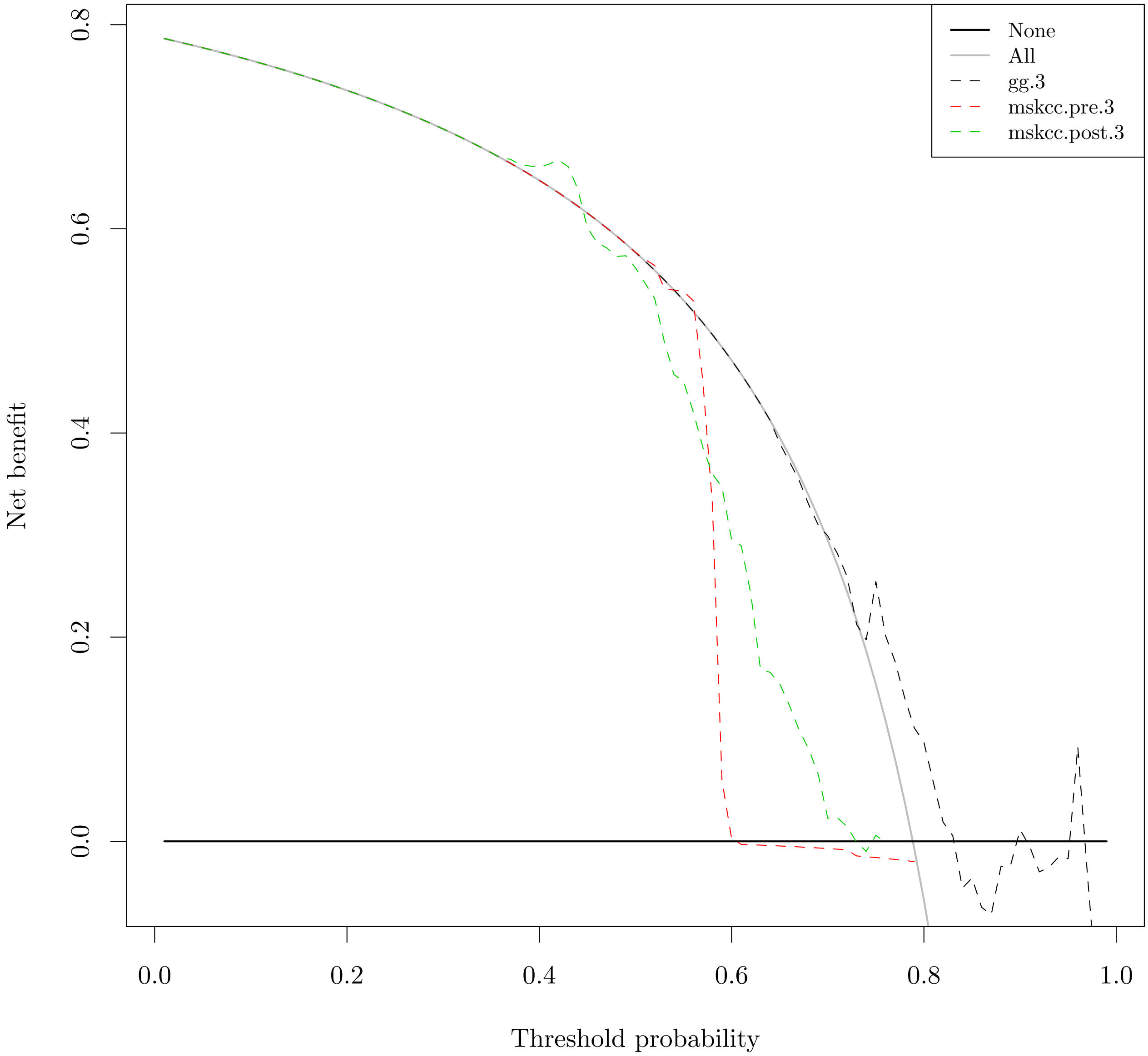
```
source("stdca.R")
temp.data = data.frame(Time = data.glasgow$Time, DSD = data.glasgow$DSD*1,
    gg.1 = 1-gg.prob.glasgow[val.prob.times == 365,], gg.2 = 1-gg.prob.glasgow[val.prob.times == 365*2,]
    mskcc.pre.1 = 1-mskcc_pre.12mo.glasgow, mskcc.pre.2 = 1-mskcc_pre.24mo.glasgow, mskcc.pre.3 = 1-mskc
    mskcc.post.1 = 1-mskcc_post.12mo.glasgow, mskcc.post.2 = 1-mskcc_post.24mo.glasgow, mskcc.post.3 = 1
invisible(stdca(data = temp.data, outcome = "DSD", ttoutcome = "Time", predictors = c("gg.1", "mskcc.pre

## [1] "gg.1: No observations with risk greater than 63% that have followup through the timepoint select
## [2] "mskcc.pre.1: No observations with risk greater than 32%, and therefore net benefit not calculabl
## [3] "mskcc.post.1: No observations with risk greater than 30% that have followup through the timepoin
```



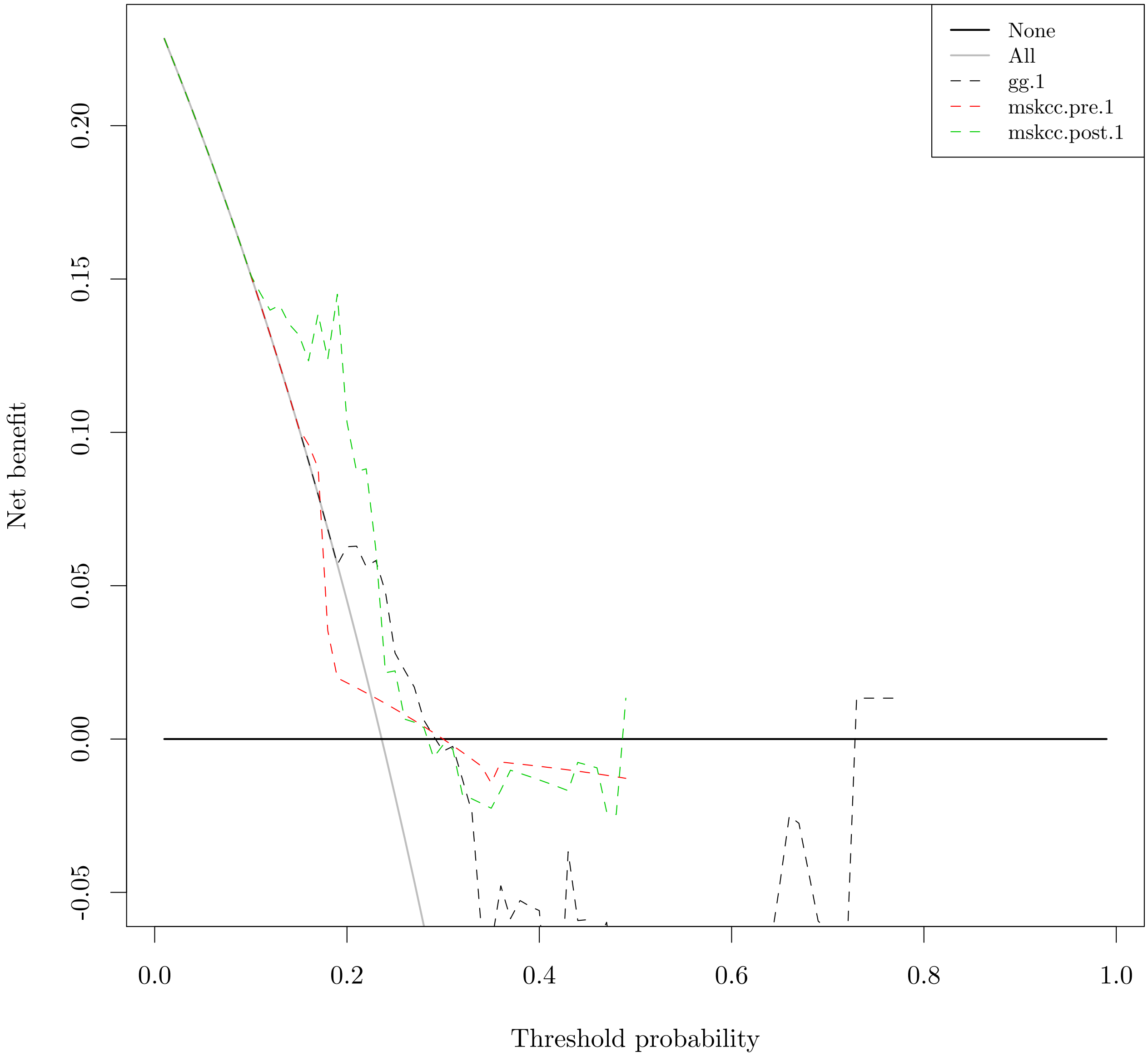

```
invisible(stdca(data = temp.data, outcome = "DSD", ttoutcome = "Time", predictors = c("gg.2", "mskcc.pre

## [1] "gg.2: No observations with risk greater than 94% that have followup through the timepoint select
## [2] "mskcc.pre.2: No observations with risk greater than 65%, and therefore net benefit not calculabl
## [3] "mskcc.post.2: No observations with risk greater than 61% that have followup through the timepoin
```



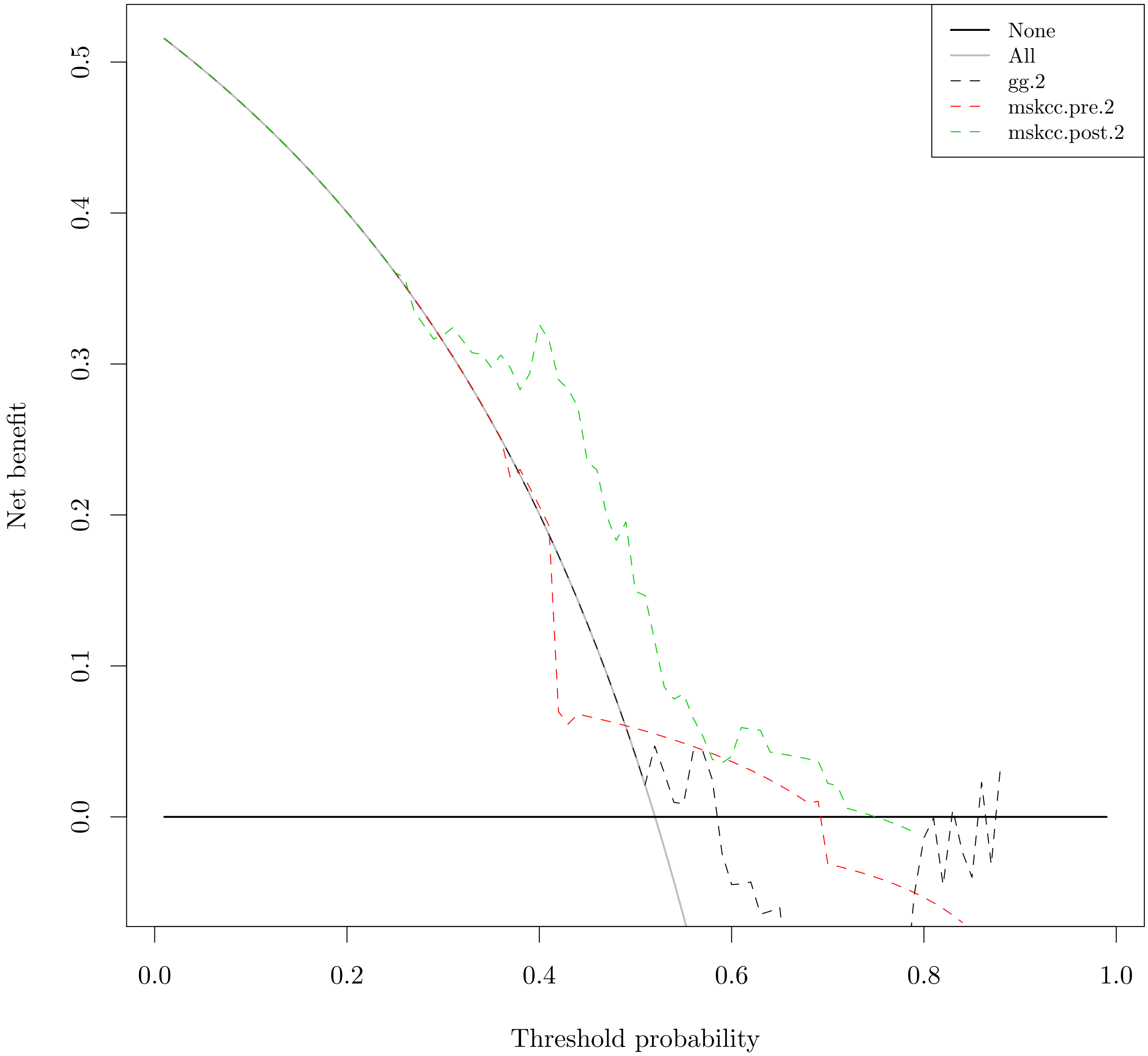

```
invisible(stdca(data = temp.data, outcome = "DSD", ttoutcome = "Time", predictors = c("gg.3", "mskcc.pre

## [1] "mskcc.pre.3: No observations with risk greater than 80%, and therefore net benefit not calculabl
## [2] "mskcc.post.3: No observations with risk greater than 77% that have followup through the timepoin
```



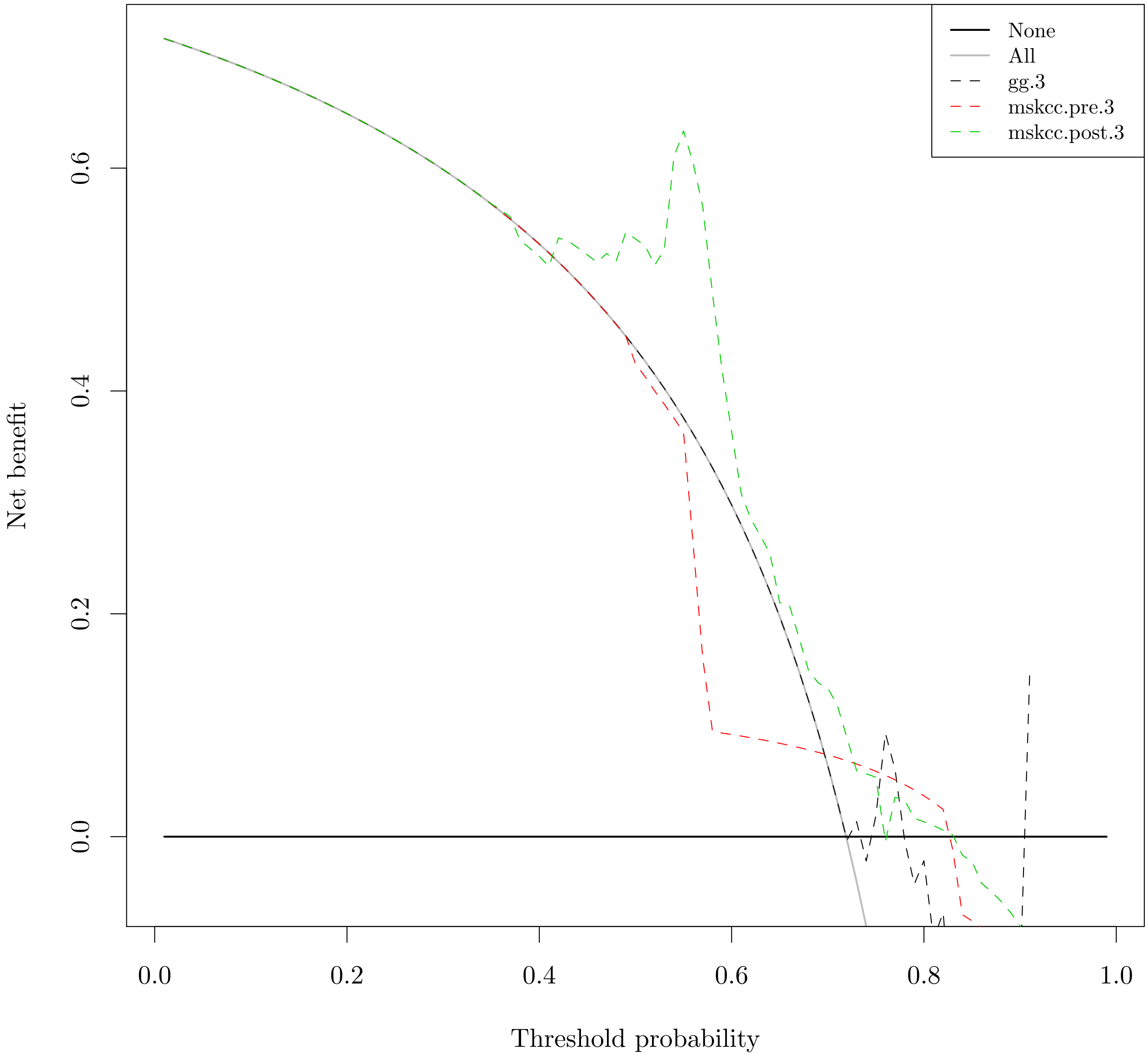

```
temp.data = data.frame(Time = data.apgi$Time, DSD = data.apgi$DSD*1,
    gg.1 = 1-gg.prob.apgi[val.prob.times == 365,], gg.2 = 1-gg.prob.apgi[val.prob.times == 365*2,], gg.3
    mskcc.pre.1 = 1-mskcc_pre.12mo.apgi, mskcc.pre.2 = 1-mskcc_pre.24mo.apgi, mskcc.pre.3 = 1-mskcc_pre.
    mskcc.post.1 = 1-mskcc_post.12mo.apgi, mskcc.post.2 = 1-mskcc_post.24mo.apgi, mskcc.post.3 = 1-mskcc
invisible(stdca(data = temp.data, outcome = "DSD", ttoutcome = "Time", predictors = c("gg.1", "mskcc.pre

## [1] "gg.1: No observations with risk greater than 78%, and therefore net benefit not calculable in th
## [2] "mskcc.pre.1: No observations with risk greater than 50%, and therefore net benefit not calculabl
## [3] "mskcc.post.1: No observations with risk greater than 50%, and therefore net benefit not calculab
```




```
invisible(stdca(data = temp.data, outcome = "DSD", ttoutcome = "Time", predictors = c("gg.2", "mskcc.pre

## [1] "gg.2: No observations with risk greater than 89% that have followup through the timepoint select
## [2] "mskcc.pre.2: No observations with risk greater than 85%, and therefore net benefit not calculabl
## [3] "mskcc.post.2: No observations with risk greater than 80% that have followup through the timepoin
```




```
invisible(stdca(data = temp.data, outcome = "DSD", ttoutcome = "Time", predictors = c("gg.3", "mskcc.pre

## [1] "gg.3: No observations with risk greater than 92% that have followup through the timepoint select
## [2] "mskcc.pre.3: No observations with risk greater than 95%, and therefore net benefit not calculabl
## [3] "mskcc.post.3: No observations with risk greater than 92% that have followup through the timepoin
```



4.6 Brier score

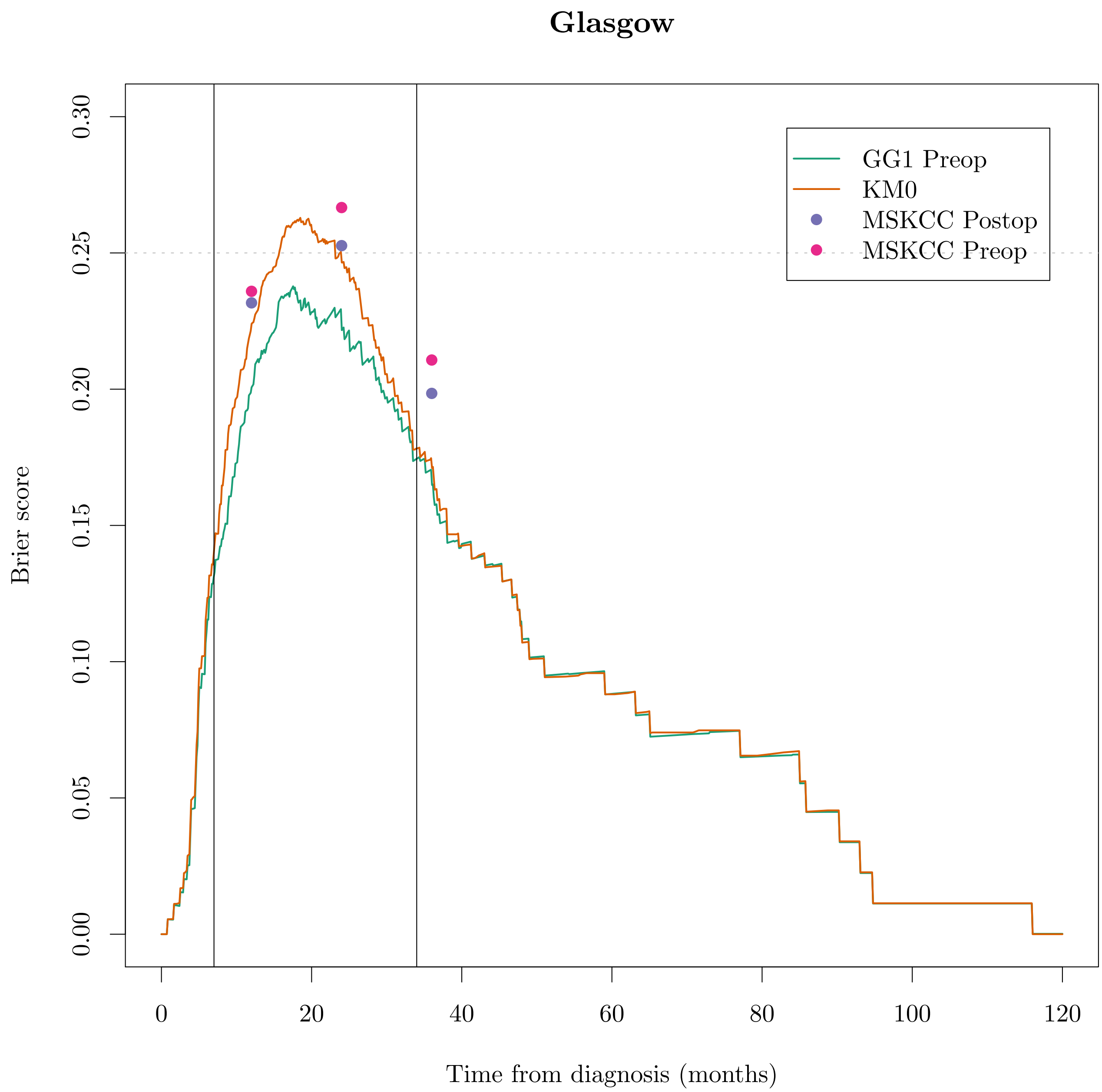
```
calcIBS = function(surv, pred, pred_times, max_time, min_time = 0)
{
        stopifnot(nrow(surv) == nrow(pred) && length(pred_times) == ncol(pred))

        n = nrow(surv)
        marg_survfit = survfit(surv ~ 1)
        marg_censfit = survfit(Surv(surv[,1], !surv[,2]) ~ 1)
        marg_surv_func = approxfun(marg_survfit$time, marg_survfit$surv, method = "constant", yleft = 1,
        marg_cens_func = approxfun(marg_censfit$time, marg_censfit$surv, method = "constant", yleft = 1,

        pred_funcs = apply(pred, 1, function(pat_preds) approxfun(pred_times, pat_preds, yleft = 1, yrig

        indiv_patient_bsc = function(pat_i, tstars)
        {
```

```
                observed_time = surv[pat_i, 1]
                observed_event = surv[pat_i, 2]
                pred_func = pred_funcs[[pat_i]]
                category = 1*(observed_time <= tstars & observed_event) + 2*(observed_time > tstars) + 3
                bsc = rep(NA, length(tstars))
                bsc[category == 1] = pred_func(tstars[category == 1])^2 / marg_cens_func(observed_time)
                bsc[category == 2] = (1 - pred_func(tstars[category == 2]))^2 / marg_cens_func(tstars[ca
                bsc[category == 3] = 0
                bsc
        }

        bsc_func = function(tstars) { rowMeans(sapply(1:n, function(pat_i) indiv_patient_bsc(pat_i, tsta

        weight_func = function(tstars) { (1 - marg_surv_func(tstars)) / (1 - marg_surv_func(max_time)) }

        # Be slack and do trapezoidal int. with a fine grid.  It should be possible
        # to calulate the int. exactly but I cbfed.
        int_grid = seq(min_time, max_time, length.out = 1e3)
        bsc_vals = bsc_func(int_grid)
        weight_vals = weight_func(int_grid)
        int_vals = bsc_vals * weight_vals
        ibsc = (2*sum(int_vals) - int_vals[1] - int_vals[length(int_vals)]) * (diff(range(int_grid))) /

        return(list(bsc = bsc_vals, weights = weight_vals, eval_times = int_grid, ibsc = ibsc))
}

calcBSsingle = function(surv, pred, pred_time)
{
        n = nrow(surv)
        obs_time = surv[,1]
        obs_event = surv[,2]
        marg_censfit = survfit(Surv(obs_time, !obs_event) ~ 1)
        marg_cens_func = approxfun(marg_censfit$time, marg_censfit$surv, method = "constant", yleft = 1,

        brier_val = rep(NA, n)
        cat = 1*I(obs_time <= pred_time & obs_event) + 2*I(obs_time > pred_time) + 3*I(obs_time <= pred_
        brier_val[cat == 1] = (pred[cat == 1])^2 / marg_cens_func(obs_time[cat == 1])
        brier_val[cat == 2] = (1-pred[cat == 2])^2 / marg_cens_func(pred_time)
        brier_val[cat == 3] = 0

        mean(brier_val)
}
```

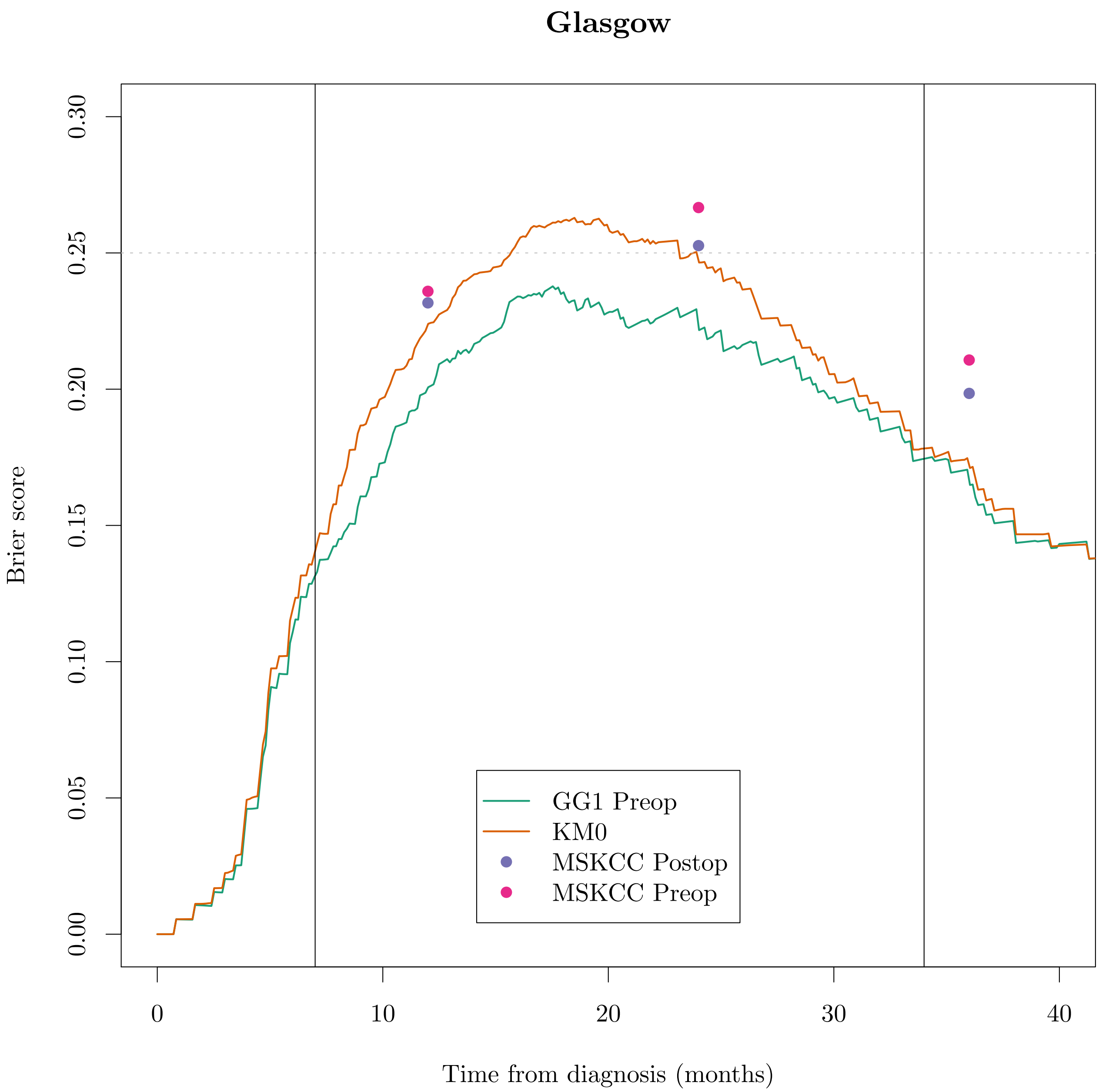
```
mskcc_post.12mo.glasgow.brier = calcBSsingle(Surv(data.glasgow$Time, data.glasgow$DSD), mskcc_post.12mo.
mskcc_post.24mo.glasgow.brier = calcBSsingle(Surv(data.glasgow$Time, data.glasgow$DSD), mskcc_post.24mo.
mskcc_post.36mo.glasgow.brier = calcBSsingle(Surv(data.glasgow$Time, data.glasgow$DSD), mskcc_post.36mo.
mskcc_pre.12mo.glasgow.brier = calcBSsingle(Surv(data.glasgow$Time, data.glasgow$DSD), mskcc_pre.12mo.gl
mskcc_pre.24mo.glasgow.brier = calcBSsingle(Surv(data.glasgow$Time, data.glasgow$DSD), mskcc_pre.24mo.gl
mskcc_pre.36mo.glasgow.brier = calcBSsingle(Surv(data.glasgow$Time, data.glasgow$DSD), mskcc_pre.36mo.gl
gg.path.glasgow.brier = calcIBS(Surv(data.glasgow$Time, data.glasgow$DSD), t(sapply(gg.path.glasgow, fun
km0.path.glasgow.brier = calcIBS(Surv(data.glasgow$Time, data.glasgow$DSD), matrix(fit.km0$surv, nrow =
```

```
mskcc_post.12mo.apgi.brier = calcBSsingle(Surv(data.apgi$Time, data.apgi$DSD), mskcc_post.12mo.apgi, 12/
mskcc_post.24mo.apgi.brier = calcBSsingle(Surv(data.apgi$Time, data.apgi$DSD), mskcc_post.24mo.apgi, 24/
mskcc_post.36mo.apgi.brier = calcBSsingle(Surv(data.apgi$Time, data.apgi$DSD), mskcc_post.36mo.apgi, 36/
mskcc_pre.12mo.apgi.brier = calcBSsingle(Surv(data.apgi$Time, data.apgi$DSD), mskcc_pre.12mo.apgi, 12/12
mskcc_pre.24mo.apgi.brier = calcBSsingle(Surv(data.apgi$Time, data.apgi$DSD), mskcc_pre.24mo.apgi, 24/12
mskcc_pre.36mo.apgi.brier = calcBSsingle(Surv(data.apgi$Time, data.apgi$DSD), mskcc_pre.36mo.apgi, 36/12
gg.path.apgi.brier = calcIBS(Surv(data.apgi$Time, data.apgi$DSD), t(sapply(gg.path.apgi, function(x) x[
km0.path.apgi.brier = calcIBS(Surv(data.apgi$Time, data.apgi$DSD), matrix(fit.km0$surv, nrow = nrow(data
```

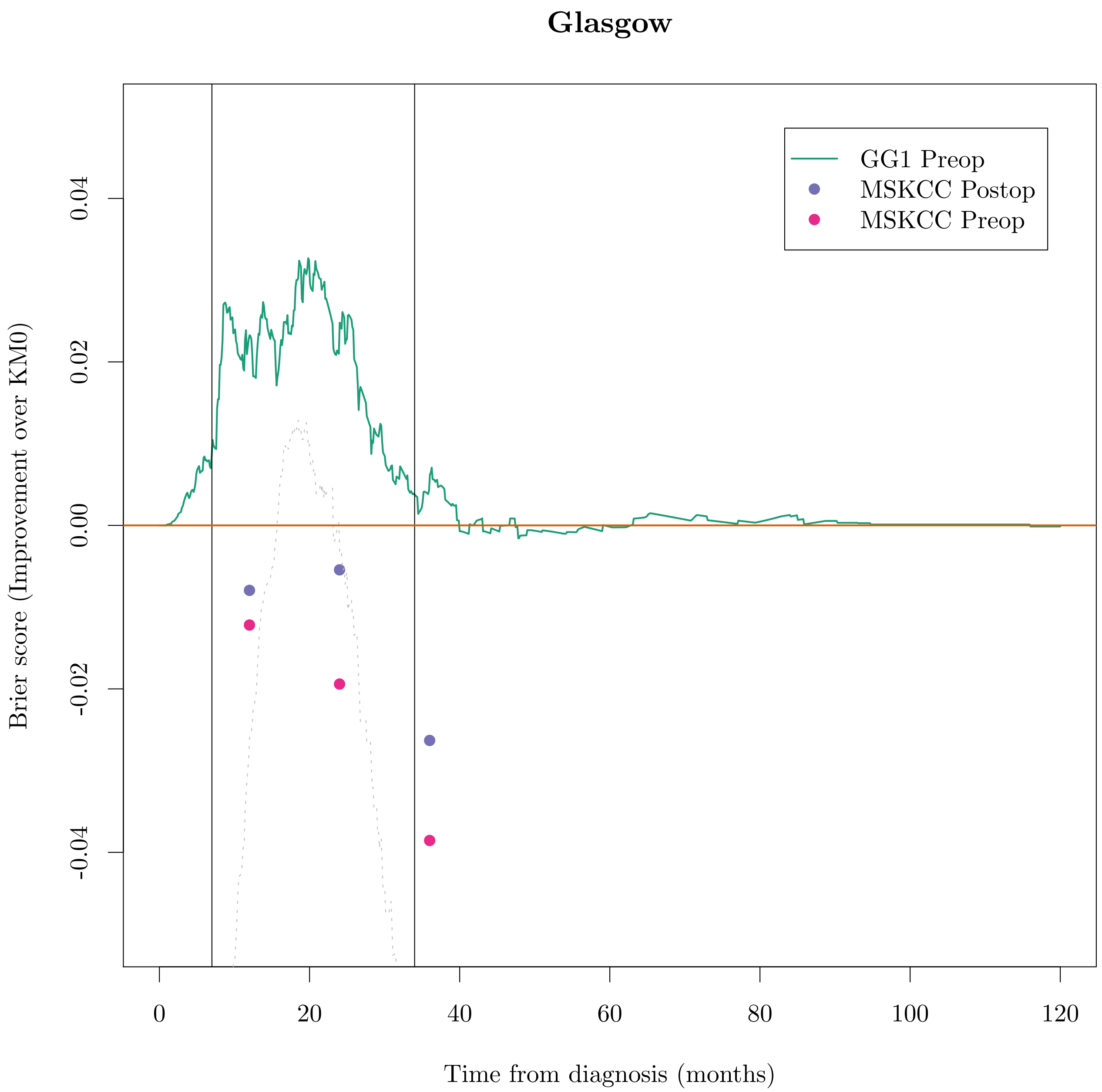
```
plot(gg.path.glasgow.brier$eval_times/365.25*12, gg.path.glasgow.brier$bsc, col = pal["gg"], type = "l",
lines(gg.path.glasgow.brier$eval_times/365.25*12, km0.path.glasgow.brier$bsc, col = pal["km0"], lwd = 2)
points(c(12, 24, 36), c(mskcc_post.12mo.glasgow.brier, mskcc_post.24mo.glasgow.brier, mskcc_post.36mo.gl
points(c(12, 24, 36), c(mskcc_pre.12mo.glasgow.brier, mskcc_pre.24mo.glasgow.brier, mskcc_pre.36mo.glasg
abline(h = 0.25, col = "grey", lty = "dotted")
abline(v = c(7, 34))
legend("topright",
        legend = c(     "GG1 Preop",    "KM0",          "MSKCC Postop",         "MSKCC Preop"),
        pch = c(        NA,                     NA,             16,                             16),
        col = c(        pal["gg"],              pal["km0"], pal["mskcc.pre"],   pal["mskcc.post"]),
        lty = c(        "solid",                "solid",        NA,                             NA),
        inset = 0.05, lwd = 2)
```



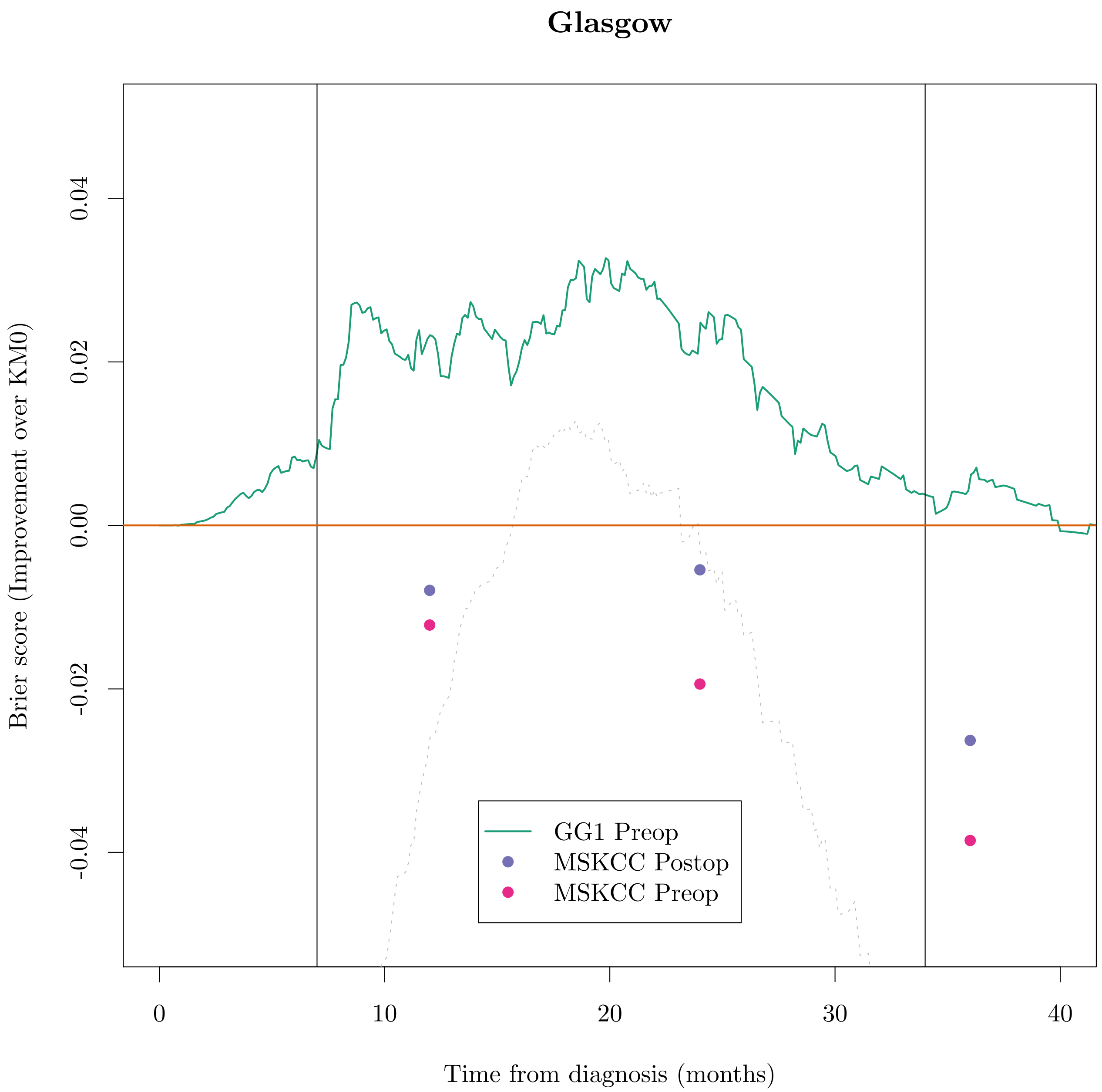

```r
plot(gg.path.glasgow.brier$eval_times/365.25*12, gg.path.glasgow.brier$bsc, col = pal["gg"], type = "l",
lines(gg.path.glasgow.brier$eval_times/365.25*12, km0.path.glasgow.brier$bsc, col = pal["km0"], lwd = 2)
points(c(12, 24, 36), c(mskcc_post.12mo.glasgow.brier, mskcc_post.24mo.glasgow.brier, mskcc_post.36mo.gl
points(c(12, 24, 36), c(mskcc_pre.12mo.glasgow.brier, mskcc_pre.24mo.glasgow.brier, mskcc_pre.36mo.glasg
abline(h = 0.25, col = "grey", lty = "dotted")
abline(v = c(7, 34))
legend("bottom",
        legend = c(     "GG1 Preop",    "KM0",          "MSKCC Postop",         "MSKCC Preop"),
        pch = c(        NA,                     NA,             16,                             16),
        col = c(        pal["gg"],              pal["km0"], pal["mskcc.pre"],   pal["mskcc.post"]),
        lty = c(        "solid",                "solid",        NA,                             NA),
        inset = 0.05, lwd = 2)
```



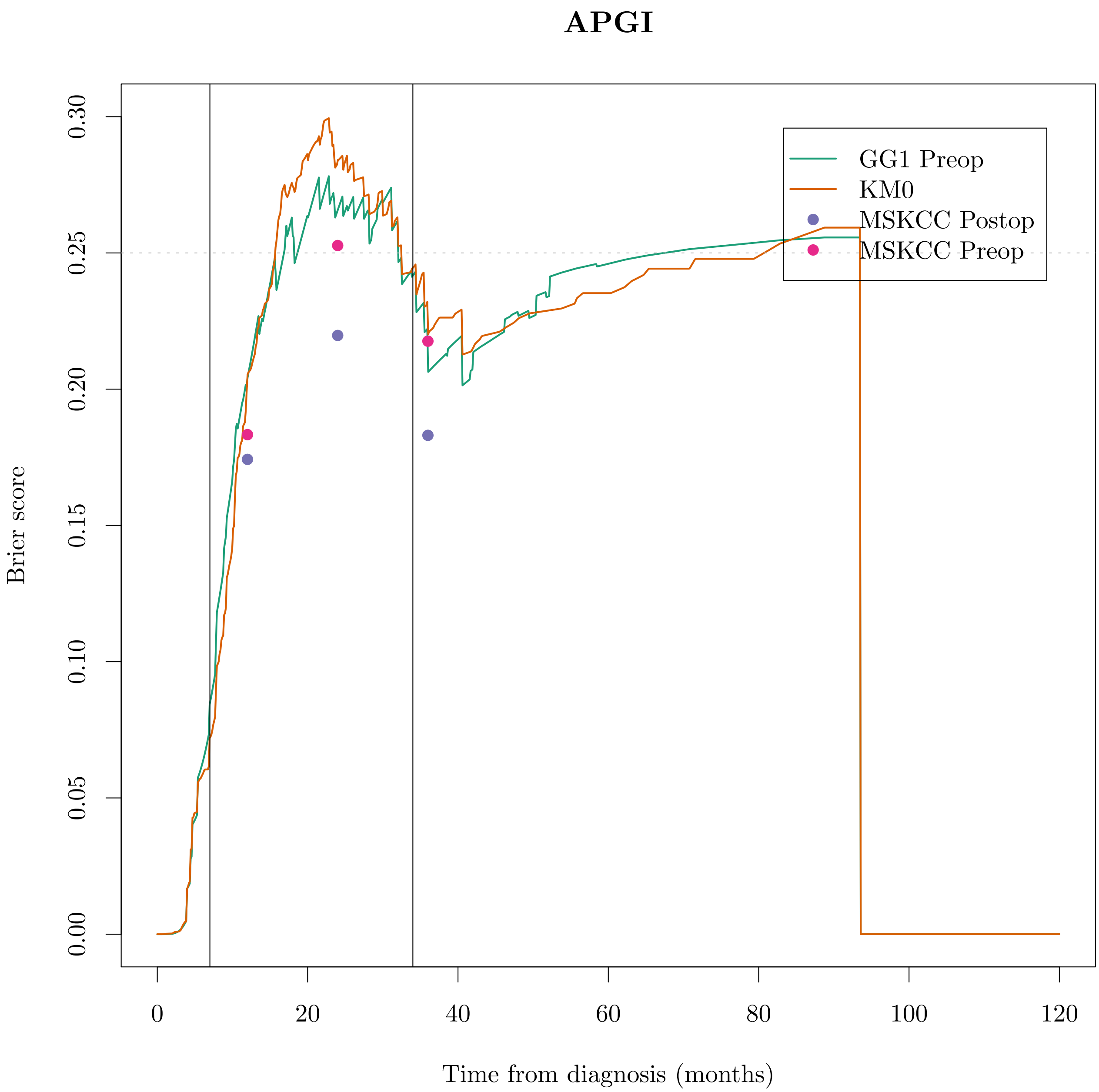

```
plot(gg.path.glasgow.brier$eval_times/365.25*12, km0.path.glasgow.brier$bsc - gg.path.glasgow.brier$bsc,
points(c(12, 24, 36), approx(km0.path.glasgow.brier$eval_times/365.25*12, km0.path.glasgow.brier$bsc, c(
points(c(12, 24, 36), approx(km0.path.glasgow.brier$eval_times/365.25*12, km0.path.glasgow.brier$bsc, c(
lines(gg.path.glasgow.brier$eval_times/365.25*12, km0.path.glasgow.brier$bsc - 0.25, col = "grey", lty =
abline(v = c(7, 34))
abline(h = 0, col = pal["km0"], lwd = 2)
legend("topright",
        legend = c(      "GG1 Preop",    "MSKCC Postop",         "MSKCC Preop"),
        pch = c(         NA,                       16,                              16),
        col = c(         pal["gg"],                pal["mskcc.pre"],       pal["mskcc.post"]),
        lty = c(         "solid",                  NA,                              NA),
        inset = 0.05, lwd = 2)
```



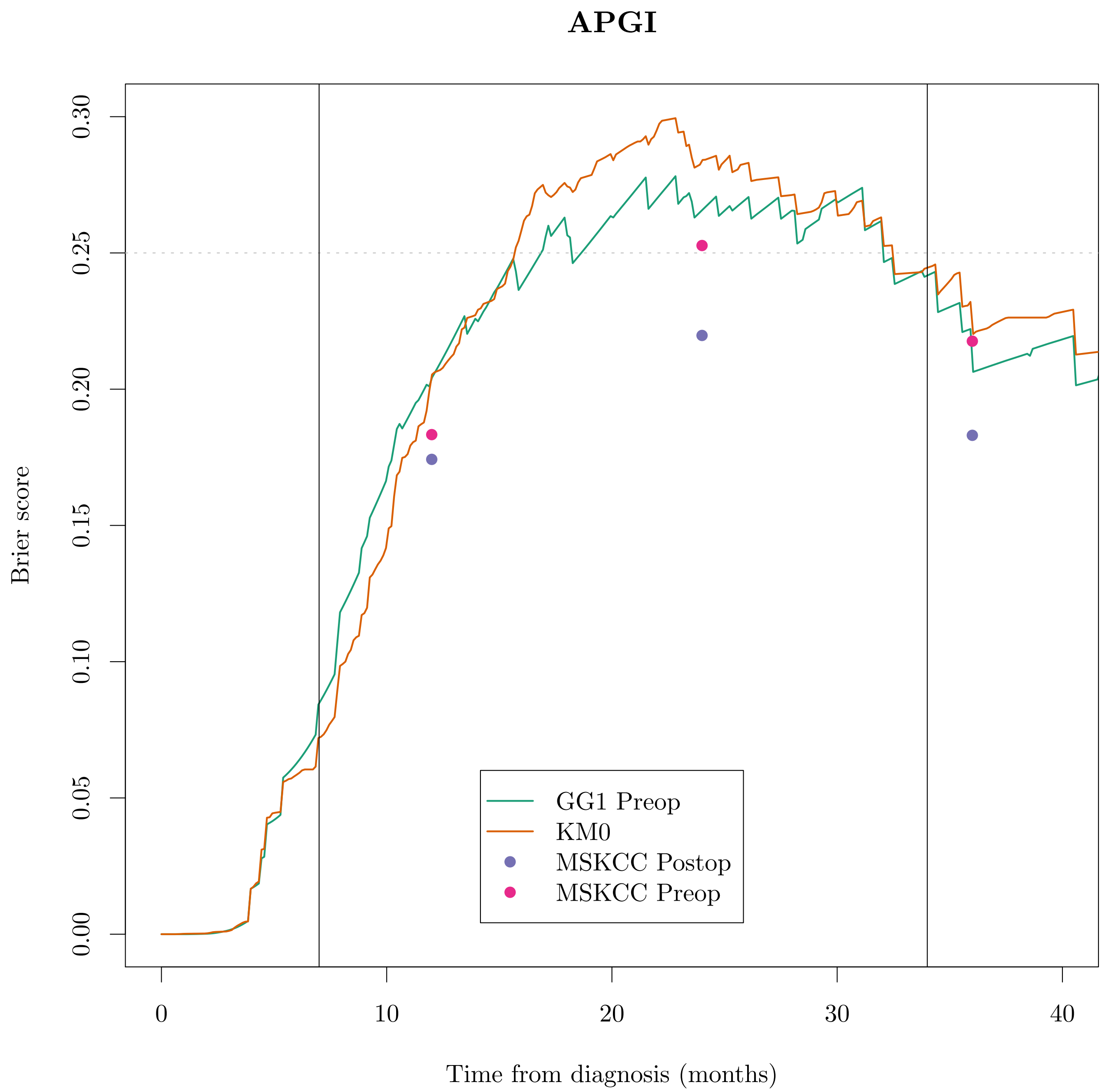

```
plot(gg.path.glasgow.brier$eval_times/365.25*12, km0.path.glasgow.brier$bsc - gg.path.glasgow.brier$bsc,
points(c(12, 24, 36), approx(km0.path.glasgow.brier$eval_times/365.25*12, km0.path.glasgow.brier$bsc, c(
points(c(12, 24, 36), approx(km0.path.glasgow.brier$eval_times/365.25*12, km0.path.glasgow.brier$bsc, c(
lines(gg.path.glasgow.brier$eval_times/365.25*12, km0.path.glasgow.brier$bsc - 0.25, col = "grey", lty =
abline(v = c(7, 34))
abline(h = 0, col = pal["km0"], lwd = 2)
legend("bottom",
        legend = c(      "GG1 Preop",    "MSKCC Postop",         "MSKCC Preop"),
        pch = c(         NA,                        16,                              16),
        col = c(         pal["gg"],                 pal["mskcc.pre"],       pal["mskcc.post"]),
        lty = c(         "solid",                   NA,                              NA),
        inset = 0.05, lwd = 2)
```




```r
plot(gg.path.apgi.brier$eval_times/365.25*12, gg.path.apgi.brier$bsc, col = pal["gg"], type = "l", ylim
lines(gg.path.apgi.brier$eval_times/365.25*12, km0.path.apgi.brier$bsc, col = pal["km0"], lwd = 2)
points(c(12, 24, 36), c(mskcc_post.12mo.apgi.brier, mskcc_post.24mo.apgi.brier, mskcc_post.36mo.apgi.bri
points(c(12, 24, 36), c(mskcc_pre.12mo.apgi.brier, mskcc_pre.24mo.apgi.brier, mskcc_pre.36mo.apgi.brier)
abline(h = 0.25, col = "grey", lty = "dotted")
abline(v = c(7, 34))
legend("topright",
        legend = c(     "GG1 Preop",    "KM0",          "MSKCC Postop",         "MSKCC Preop"),
        pch = c(        NA,                     NA,             16,                             16),
        col = c(        pal["gg"],              pal["km0"], pal["mskcc.pre"],   pal["mskcc.post"]),
        lty = c(        "solid",                "solid",        NA,                             NA),
        inset = 0.05, lwd = 2)
```

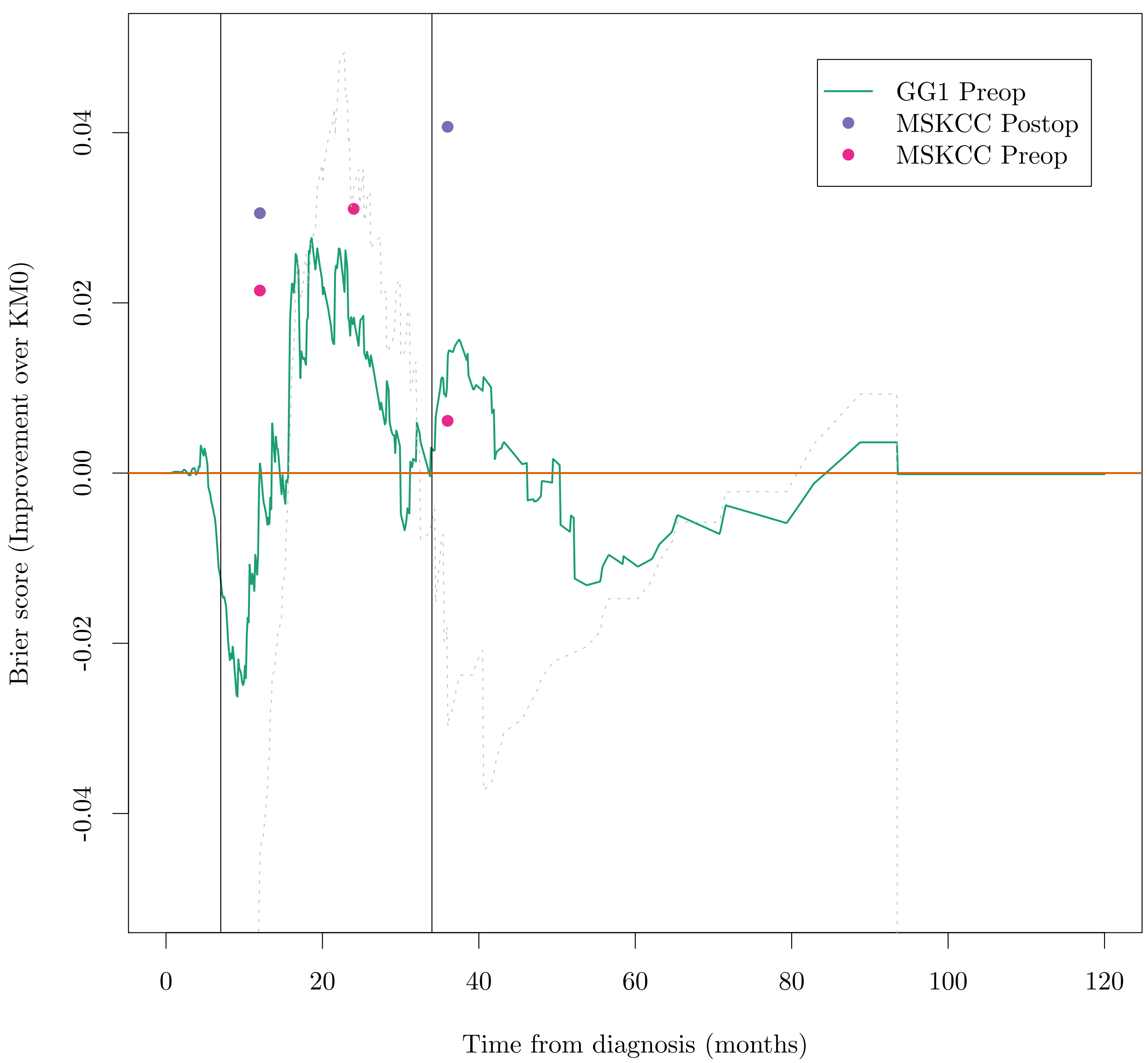



```
plot(gg.path.apgi.brier$eval_times/365.25*12, gg.path.apgi.brier$bsc, col = pal["gg"], type = "l", ylim
lines(gg.path.apgi.brier$eval_times/365.25*12, km0.path.apgi.brier$bsc, col = pal["km0"], lwd = 2)
points(c(12, 24, 36), c(mskcc_post.12mo.apgi.brier, mskcc_post.24mo.apgi.brier, mskcc_post.36mo.apgi.bri
points(c(12, 24, 36), c(mskcc_pre.12mo.apgi.brier, mskcc_pre.24mo.apgi.brier, mskcc_pre.36mo.apgi.brier)
abline(h = 0.25, col = "grey", lty = "dotted")
abline(v = c(7, 34))
legend("bottom",
        legend = c(     "GG1 Preop",    "KM0",          "MSKCC Postop",         "MSKCC Preop"),
        pch = c(        NA,                     NA,             16,                             16),
        col = c(        pal["gg"],              pal["km0"], pal["mskcc.pre"],   pal["mskcc.post"]),
        lty = c(        "solid",                "solid",        NA,                             NA),
        inset = 0.05, lwd = 2)
```

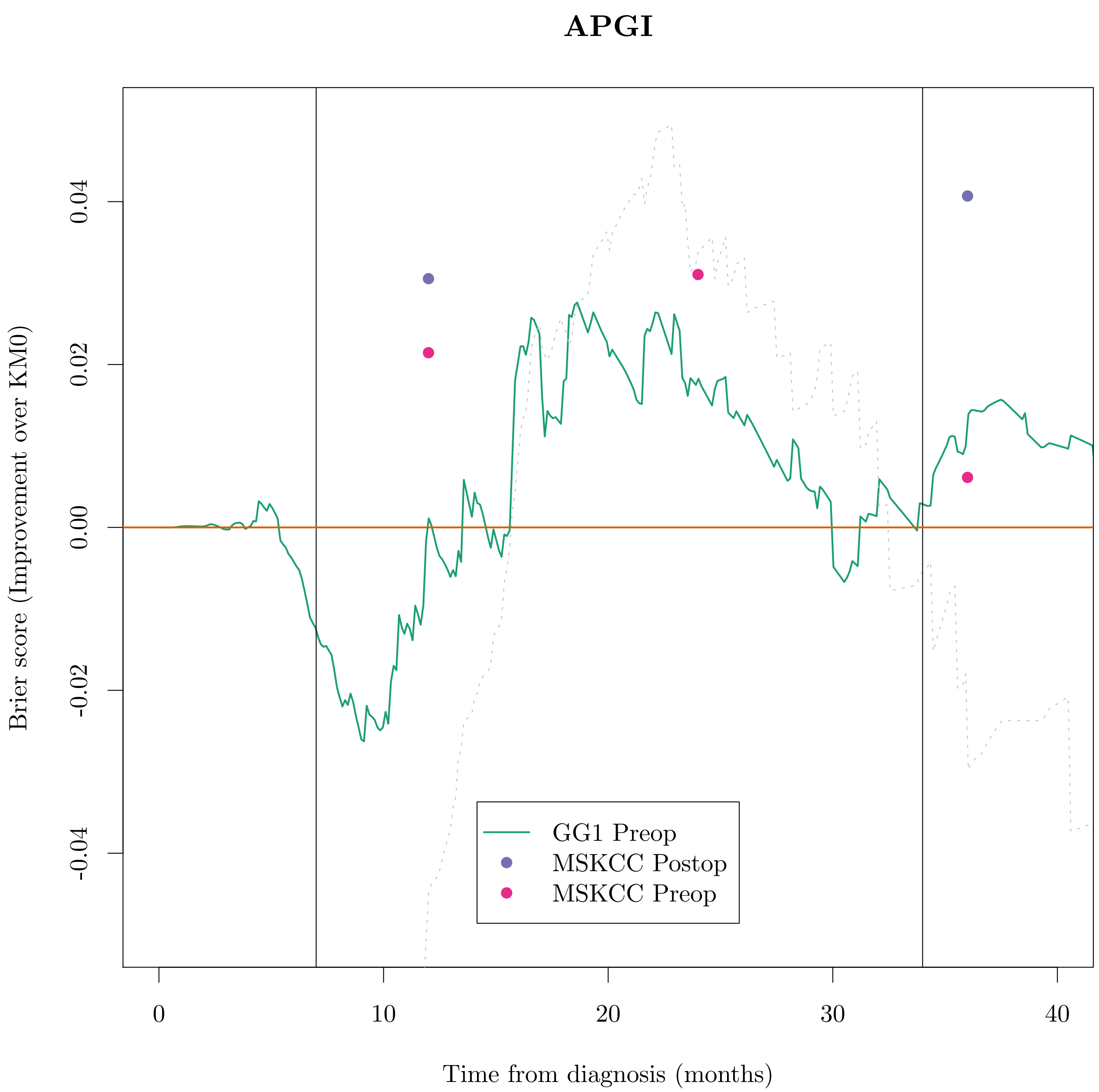



```
plot(gg.path.apgi.brier$eval_times/365.25*12, km0.path.apgi.brier$bsc - gg.path.apgi.brier$bsc, col = pa
points(c(12, 24, 36), approx(km0.path.apgi.brier$eval_times/365.25*12, km0.path.apgi.brier$bsc, c(12, 24
points(c(12, 24, 36), approx(km0.path.apgi.brier$eval_times/365.25*12, km0.path.apgi.brier$bsc, c(12, 24
lines(gg.path.apgi.brier$eval_times/365.25*12, km0.path.apgi.brier$bsc - 0.25, col = "grey", lty = "dott
abline(v = c(7, 34))
abline(h = 0, col = pal["km0"], lwd = 2)
legend("topright",
        legend = c(     "GG1 Preop",    "MSKCC Postop",         "MSKCC Preop"),
        pch = c(        NA,                     16,                             16),
        col = c(        pal["gg"],              pal["mskcc.pre"],       pal["mskcc.post"]),
        lty = c(        "solid",                NA,                             NA),
        inset = 0.05, lwd = 2)
```

APGI




```
plot(gg.path.apgi.brier$eval_times/365.25*12, km0.path.apgi.brier$bsc - gg.path.apgi.brier$bsc, col = pa
points(c(12, 24, 36), approx(km0.path.apgi.brier$eval_times/365.25*12, km0.path.apgi.brier$bsc, c(12, 24
points(c(12, 24, 36), approx(km0.path.apgi.brier$eval_times/365.25*12, km0.path.apgi.brier$bsc, c(12, 24
lines(gg.path.apgi.brier$eval_times/365.25*12, km0.path.apgi.brier$bsc - 0.25, col = "grey", lty = "dott
abline(v = c(7, 34))
abline(h = 0, col = pal["km0"], lwd = 2)
legend("bottom",
        legend = c(     "GG1 Preop",    "MSKCC Postop",         "MSKCC Preop"),
        pch = c(        NA,                     16,                             16),
        col = c(        pal["gg"],              pal["mskcc.pre"],       pal["mskcc.post"]),
        lty = c(        "solid",                NA,                             NA),
        inset = 0.05, lwd = 2)
```




```
probs_bs_boot_func_glasgow = function(d, i) {
        bs.mskcc.postop.12 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), mskcc_post.12mo.glasgow[i], 12/12*3
        bs.mskcc.postop.24 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), mskcc_post.24mo.glasgow[i], 24/12*3
        bs.mskcc.postop.36 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), mskcc_post.36mo.glasgow[i], 36/12*3
        bs.mskcc.preop.12 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), mskcc_pre.12mo.glasgow[i], 12/12*365
        bs.mskcc.preop.24 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), mskcc_pre.24mo.glasgow[i], 24/12*365
        bs.mskcc.preop.36 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), mskcc_pre.36mo.glasgow[i], 36/12*365

        bs.gg.vals = t(sapply(gg.path.glasgow[i], function(path) approx(path[,1], path[,2], c(12, 24, 36
        rownames(bs.gg.vals) <- NULL
        bs.gg.12 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), bs.gg.vals[,1], 12/12*365.25)
        bs.gg.24 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), bs.gg.vals[,2], 24/12*365.25)
        bs.gg.36 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), bs.gg.vals[,3], 36/12*365.25)
```

```
        bs.km0.vals = approx(fit.km0$time, fit.km0$surv, c(12, 24, 36)/12*365.25)$y
        bs.km0.12 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), rep(bs.km0.vals[1], nrow(d[i,])), 12/12*365.
        bs.km0.24 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), rep(bs.km0.vals[2], nrow(d[i,])), 24/12*365.
        bs.km0.36 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), rep(bs.km0.vals[3], nrow(d[i,])), 36/12*365.

        result = c(
                bs.gg.12 - bs.km0.12,                   bs.mskcc.preop.12 - bs.km0.12,
                bs.gg.12 - bs.mskcc.preop.12,
                bs.gg.24 - bs.km0.24,                   bs.mskcc.preop.24 - bs.km0.24,
                bs.gg.24 - bs.mskcc.preop.24,
                bs.gg.36 - bs.km0.36,                   bs.mskcc.preop.36 - bs.km0.36,
                bs.gg.36 - bs.mskcc.preop.36)

        names(result) <- NULL
        result
}

set.seed(20150208)
deltaBrier.boot.glasgow = boot(data.glasgow, probs_bs_boot_func_glasgow, R = 500)
deltaBrier.boot.glasgow.cis = t(sapply(1:ncol(deltaBrier.boot.glasgow$t), function(i) boot.ci(deltaBrier
colnames(deltaBrier.boot.glasgow.cis) = c("level", "lowindex", "highindex", "lci", "uci")
rownames(deltaBrier.boot.glasgow.cis) = c(
        "12:gg-km0", "12:pre-km0", "12:gg-pre",
        "24:gg-km0", "24:pre-km0", "24:gg-pre",
        "36:gg-km0", "36:pre-km0", "36:gg-pre")
deltaBrier.boot.glasgow
```

```
##
## ORDINARY NONPARAMETRIC BOOTSTRAP
##
##
## Call:
## boot(data = data.glasgow, statistic = probs_bs_boot_func_glasgow,
##     R = 500)
##
##
## Bootstrap Statistics :
##      original     bias    std. error
## t1* -0.023252 -5.591e-04    0.011020
## t2*  0.012000  5.097e-04    0.014791
## t3* -0.035252 -1.069e-03    0.018703
## t4* -0.024707 -1.173e-03    0.011163
## t5*  0.020378  1.780e-04    0.020822
## t6* -0.045085 -1.351e-03    0.022651
## t7* -0.006137 -3.073e-04    0.006092
## t8*  0.039775 -9.123e-06    0.018277
## t9* -0.045912 -2.982e-04    0.018448
```

```
deltaBrier.boot.glasgow.cis
```

```
##            level lowindex highindex        lci        uci
## 12:gg-km0   0.95    19.36     493.3 -0.0438016  0.0001641
## 12:pre-km0  0.95    10.07     485.4 -0.0179132  0.0401415
## 12:gg-pre   0.95     9.88     485.4 -0.0753277 -0.0035136
## 24:gg-km0   0.95    17.35     492.2 -0.0471870 -0.0023731
```

```
## 24:pre-km0  0.95    11.87     487.8 -0.0189747  0.0617515
## 24:gg-pre   0.95    19.24     493.3 -0.0845755  0.0024417
## 36:gg-km0   0.95    15.48     490.9 -0.0174246  0.0056702
## 36:pre-km0  0.95     7.75     482.0  0.0002576  0.0703455
## 36:gg-pre   0.95    17.88     492.7 -0.0791661 -0.0078058
```

```
probs_bs_boot_func_apgi = function(d, i) {
        bs.mskcc.postop.12 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), mskcc_post.12mo.apgi[i], 12/12*365.
        bs.mskcc.postop.24 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), mskcc_post.24mo.apgi[i], 24/12*365.
        bs.mskcc.postop.36 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), mskcc_post.36mo.apgi[i], 36/12*365.
        bs.mskcc.preop.12 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), mskcc_pre.12mo.apgi[i], 12/12*365.25
        bs.mskcc.preop.24 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), mskcc_pre.24mo.apgi[i], 24/12*365.25
        bs.mskcc.preop.36 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), mskcc_pre.36mo.apgi[i], 36/12*365.25

        bs.gg.vals = t(sapply(gg.path.apgi[i], function(path) approx(path[,1], path[,2], c(12, 24, 36)/1
        rownames(bs.gg.vals) <- NULL
        bs.gg.12 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), bs.gg.vals[,1], 12/12*365.25)
        bs.gg.24 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), bs.gg.vals[,2], 24/12*365.25)
        bs.gg.36 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), bs.gg.vals[,3], 36/12*365.25)

        bs.km0.vals = approx(fit.km0$time, fit.km0$surv, c(12, 24, 36)/12*365.25)$y
        bs.km0.12 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), rep(bs.km0.vals[1], nrow(d[i,])), 12/12*365.
        bs.km0.24 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), rep(bs.km0.vals[2], nrow(d[i,])), 24/12*365.
        bs.km0.36 = calcBSsingle(Surv(d$Time[i], d$DSD[i]), rep(bs.km0.vals[3], nrow(d[i,])), 36/12*365.

        result = c(
                bs.gg.12 - bs.km0.12,                   bs.mskcc.preop.12 - bs.km0.12,
                bs.gg.12 - bs.mskcc.preop.12,
                bs.gg.24 - bs.km0.24,                   bs.mskcc.preop.24 - bs.km0.24,
                bs.gg.24 - bs.mskcc.preop.24,
                bs.gg.36 - bs.km0.36,                   bs.mskcc.preop.36 - bs.km0.36,
                bs.gg.36 - bs.mskcc.preop.36)

        names(result) <- NULL
        result
}

set.seed(20150208)
deltaBrier.boot.apgi = boot(data.apgi, probs_bs_boot_func_apgi, R = 500)
deltaBrier.boot.apgi.cis = t(sapply(1:ncol(deltaBrier.boot.apgi$t), function(i) boot.ci(deltaBrier.boot.
colnames(deltaBrier.boot.apgi.cis) = c("level", "lowindex", "highindex", "lci", "uci")
rownames(deltaBrier.boot.apgi.cis) = c(
        "12:gg-km0", "12:pre-km0", "12:gg-pre",
        "24:gg-km0", "24:pre-km0", "24:gg-pre",
        "36:gg-km0", "36:pre-km0", "36:gg-pre")
deltaBrier.boot.apgi

##
## ORDINARY NONPARAMETRIC BOOTSTRAP
##
##
## Call:
## boot(data = data.apgi, statistic = probs_bs_boot_func_apgi, R = 500)
```

```
##
##
## Bootstrap Statistics :
##      original      bias    std. error
## t1* -0.00113 -0.0011691    0.015701
## t2* -0.02190 -0.0009299    0.018710
## t3*  0.02077 -0.0002392    0.028129
## t4* -0.01807  0.0005315    0.013458
## t5* -0.03102 -0.0029566    0.030885
## t6*  0.01295  0.0034881    0.034386
## t7* -0.01368  0.0004382    0.008461
## t8* -0.00230 -0.0019783    0.031044
## t9* -0.01138  0.0024165    0.031451
```

```
deltaBrier.boot.apgi.cis
```

```
##              level lowindex highindex      lci      uci
## 12:gg-km0    0.95    14.99     490.7 -0.02914 0.029597
## 12:pre-km0   0.95    19.61     493.7 -0.05458 0.021352
## 12:gg-pre    0.95    11.55     487.5 -0.03594 0.073835
## 24:gg-km0    0.95    14.16     490.0 -0.04298 0.010080
## 24:pre-km0   0.95    24.25     495.0 -0.08215 0.036547
## 24:gg-pre    0.95     6.77     478.8 -0.06156 0.073555
## 36:gg-km0    0.95     6.89     480.5 -0.03200 0.001481
## 36:pre-km0   0.95    13.87     489.6 -0.06168 0.053566
## 36:gg-pre    0.95    15.08     490.8 -0.06278 0.051051
```

```
temp.time = gsub(":.*", "", rownames(deltaBrier.boot.glasgow.cis))
temp.methodpos = gsub(".*:", "", gsub("-.*", "", rownames(deltaBrier.boot.glasgow.cis)))
temp.methodneg = gsub(".*-", "", rownames(deltaBrier.boot.glasgow.cis))
temp.methods = sort(unique(c(temp.methodpos, temp.methodneg)))
tapply(1:length(temp.time), temp.time, function(is) {
        res = matrix(0, nrow = length(temp.methods), ncol = length(temp.methods))
        rownames(res) = temp.methods
        colnames(res) = temp.methods
        # Make res signed.  0 => NS.  +1 => row is better than col (BS_row - BS_col < 0).  -1 => row is
        res[cbind(temp.methodpos[is], temp.methodneg[is])] = (sign(deltaBrier.boot.glasgow.cis[is, "uci'
        res[cbind(temp.methodneg[is], temp.methodpos[is])] = (sign(deltaBrier.boot.glasgow.cis[is, "uci'
        res
})
```

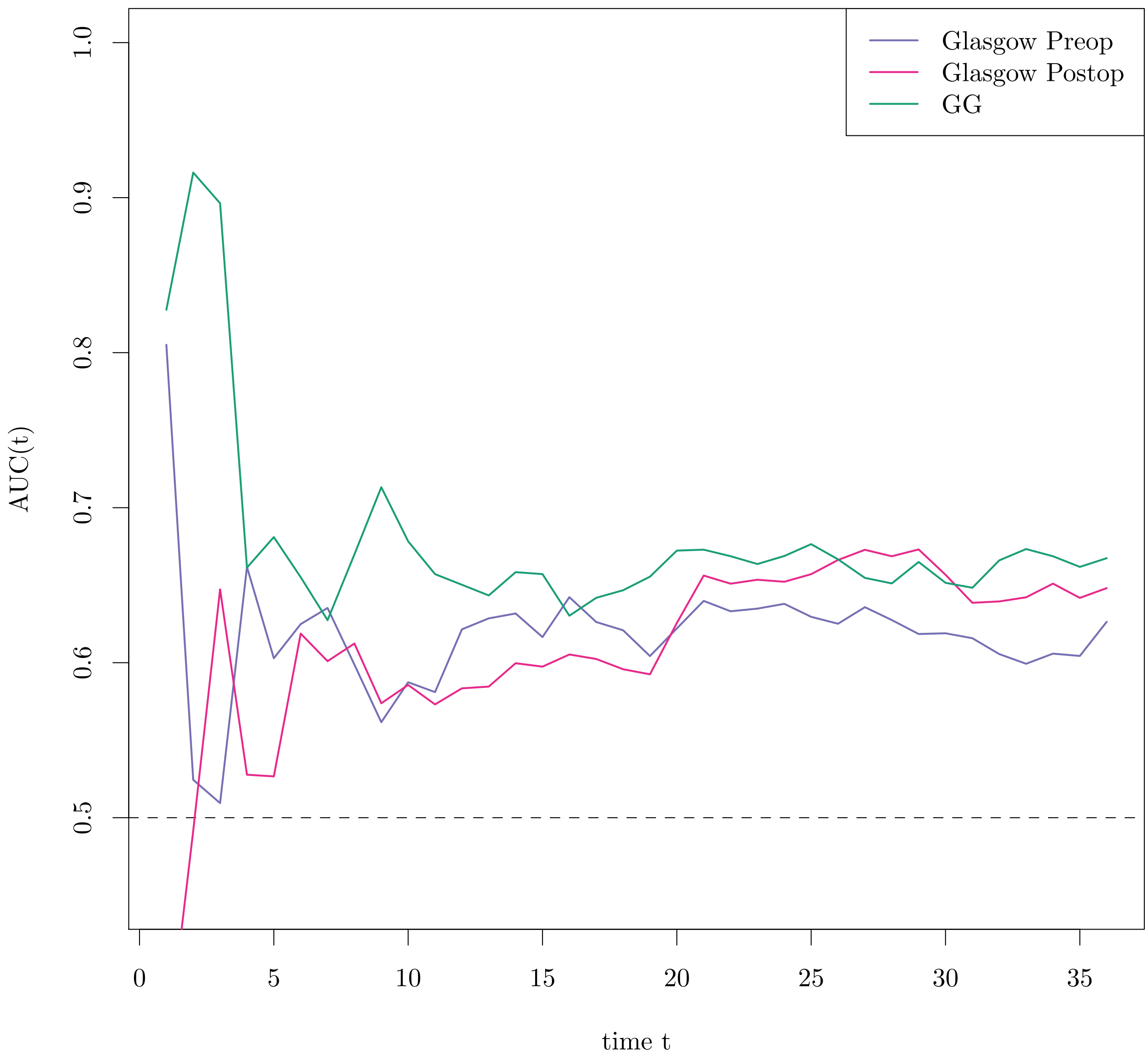
```
## $`12`
##     gg km0 pre
## gg   0   0   1
## km0  0   0   0
## pre -1   0   0
##
## $`24`
##     gg km0 pre
## gg   0   1   0
## km0 -1   0   0
## pre  0   0   0
##
## $`36`
```

```
##     gg km0 pre
## gg   0   0   1
## km0  0   0   1
## pre -1  -1   0
```

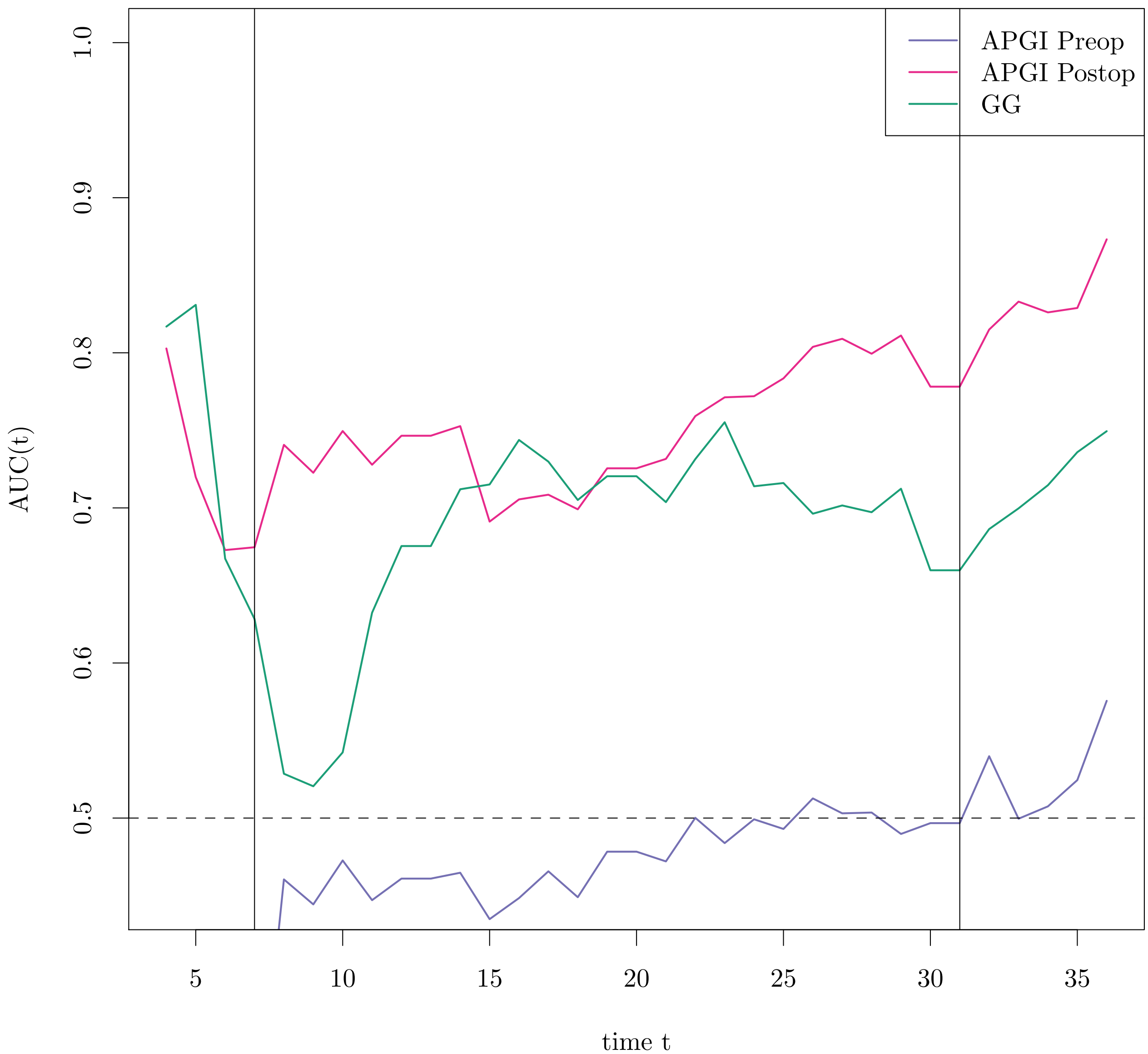
```
temp.time = gsub(":.*", "", rownames(deltaBrier.boot.apgi.cis))
temp.methodpos = gsub(".*:", "", gsub("-.*", "", rownames(deltaBrier.boot.apgi.cis)))
temp.methodneg = gsub(".*-", "", rownames(deltaBrier.boot.apgi.cis))
temp.methods = sort(unique(c(temp.methodpos, temp.methodneg)))
tapply(1:length(temp.time), temp.time, function(is) {
        res = matrix(0, nrow = length(temp.methods), ncol = length(temp.methods))
        rownames(res) = temp.methods
        colnames(res) = temp.methods
        # Make res signed.  0 => NS.  +1 => row is better than col (BS_row - BS_col < 0).  -1 => row is
        res[cbind(temp.methodpos[is], temp.methodneg[is])] = (sign(deltaBrier.boot.apgi.cis[is, "uci"])
        res[cbind(temp.methodneg[is], temp.methodpos[is])] = (sign(deltaBrier.boot.apgi.cis[is, "uci"])
        res
})

## $`12`
##     gg km0 pre
## gg   0   0   0
## km0  0   0   0
## pre  0   0   0
##
## $`24`
##     gg km0 pre
## gg   0   0   0
## km0  0   0   0
## pre  0   0   0
##
## $`36`
##     gg km0 pre
## gg   0   0   0
## km0  0   0   0
## pre  0   0   0
```

Cumulative-dynamic:

```
mskcc_pre.cdroc.glasgow = timeROC(data.glasgow$Time/365.25*12, data.glasgow$DSD, mskcc_pre.linpred.glasg
mskcc_post.cdroc.glasgow = timeROC(data.glasgow$Time/365.25*12, data.glasgow$DSD, mskcc_post.linpred.gla
gg.cdroc.glasgow = timeROC(data.glasgow$Time/365.25*12, data.glasgow$DSD, gg.linpred.glasgow, cause = 1,
plotAUCcurve(mskcc_pre.cdroc.glasgow, conf.int = FALSE, add = FALSE, col = pal["mskcc.pre"])
plotAUCcurve(mskcc_post.cdroc.glasgow, conf.int = FALSE, add = TRUE, col = pal["mskcc.post"])
plotAUCcurve(gg.cdroc.glasgow, conf.int = FALSE, add = TRUE, col = pal["gg"])
legend("topright", legend = c("Glasgow Preop", "Glasgow Postop", "GG"), col = c(pal["mskcc.pre"], pal["m
```

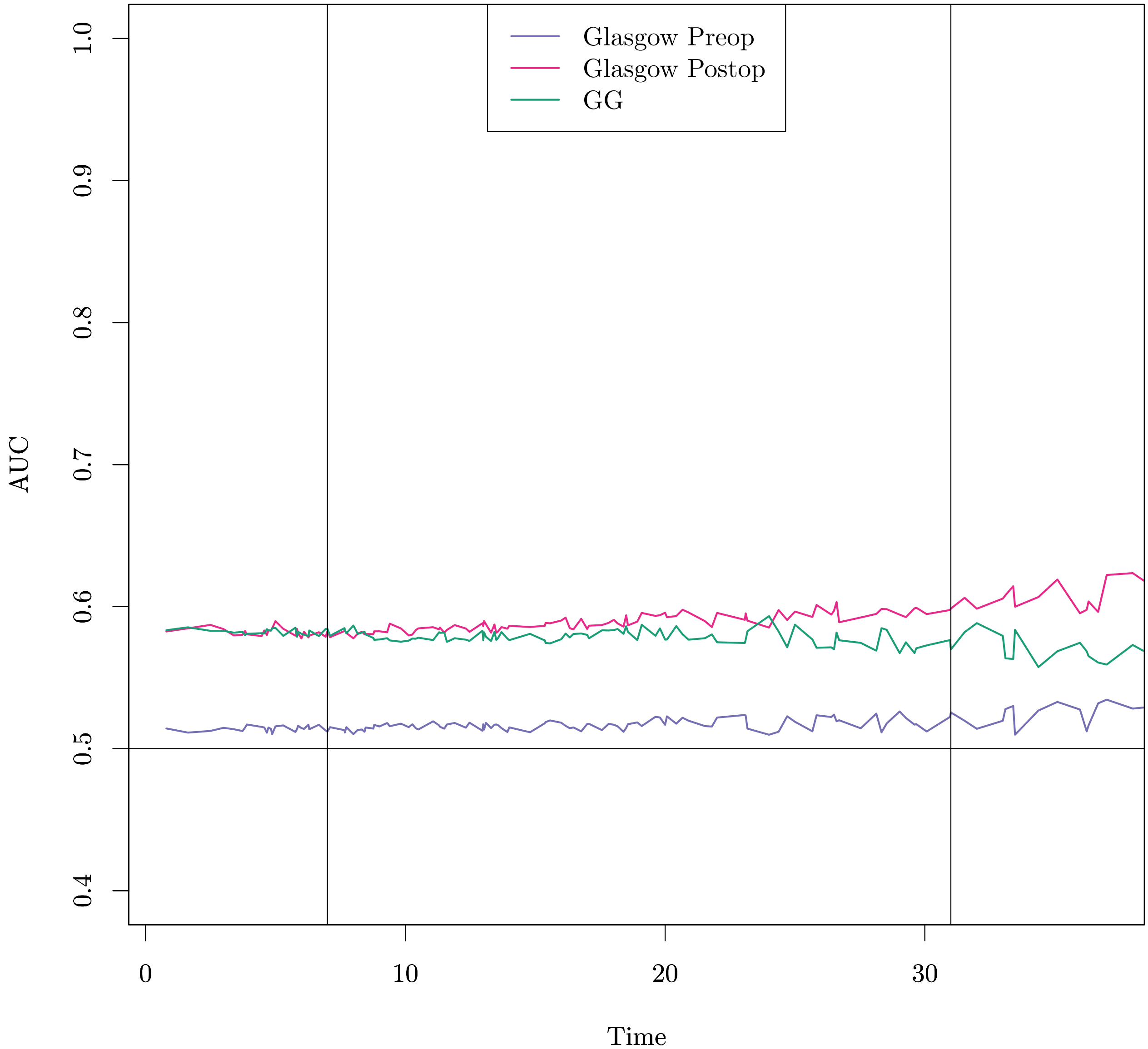



```r
mskcc_pre.cdroc.apgi = timeROC(data.apgi$Time/365.25*12, data.apgi$DSD, mskcc_pre.linpred.apgi, cause =
mskcc_post.cdroc.apgi = timeROC(data.apgi$Time/365.25*12, data.apgi$DSD, mskcc_post.linpred.apgi, cause
gg.cdroc.apgi = timeROC(data.apgi$Time/365.25*12, data.apgi$DSD, gg.linpred.apgi, cause = 1, times = sec
plotAUCcurve(mskcc_pre.cdroc.apgi, conf.int = FALSE, add = FALSE, col = pal["mskcc.pre"])
plotAUCcurve(mskcc_post.cdroc.apgi, conf.int = FALSE, add = TRUE, col = pal["mskcc.post"])
plotAUCcurve(gg.cdroc.apgi, conf.int = FALSE, add = TRUE, col = pal["gg"])
legend("topright", legend = c("APGI Preop", "APGI Postop", "GG"), col = c(pal["mskcc.pre"], pal["mskcc.p
abline(v = c(7, 31))
```

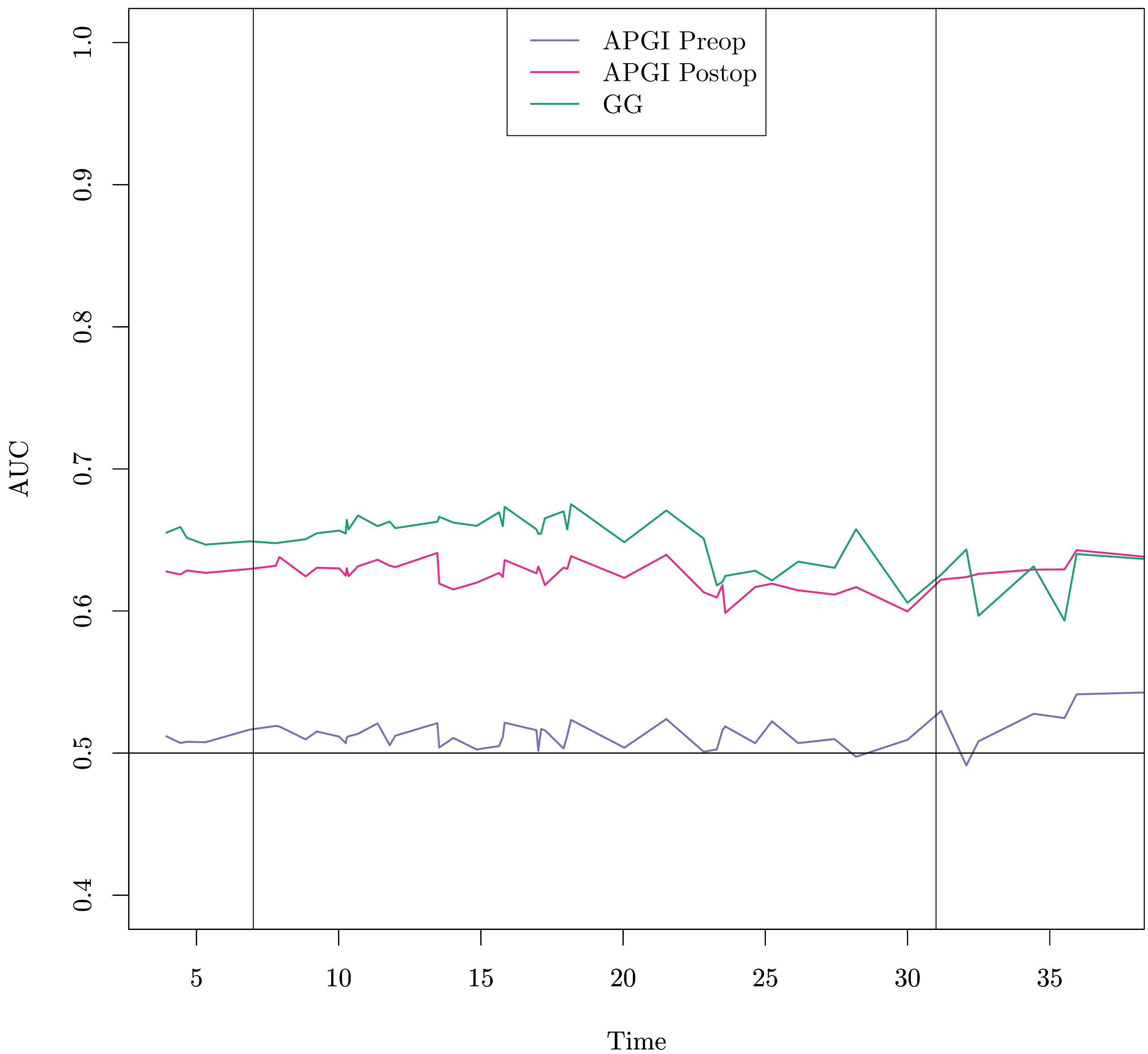


Incident-dynamic:

```
invisible(risksetAUC(data.glasgow$Time/365.25*12, status = data.glasgow$DSD, marker = mskcc_pre.linpred.
par(new = TRUE)
invisible(risksetAUC(data.glasgow$Time/365.25*12, status = data.glasgow$DSD, marker = mskcc_post.linpred
par(new = TRUE)
invisible(risksetAUC(data.glasgow$Time/365.25*12, status = data.glasgow$DSD, marker = gg.linpred.glasgow
par(new = TRUE)
legend("top", legend = c("Glasgow Preop", "Glasgow Postop", "GG"), col = c(pal["mskcc.pre"], pal["mskcc.
abline(v = c(7, 31))
```




```r
invisible(risksetAUC(data.apgi$Time/365.25*12, status = data.apgi$DSD, marker = mskcc_pre.linpred.apgi,
par(new = TRUE)
invisible(risksetAUC(data.apgi$Time/365.25*12, status = data.apgi$DSD, marker = mskcc_post.linpred.apgi,
par(new = TRUE)
invisible(risksetAUC(data.apgi$Time/365.25*12, status = data.apgi$DSD, marker = gg.linpred.apgi, tmax =
par(new = TRUE)
legend("top", legend = c("APGI Preop", "APGI Postop", "GG"), col = c(pal["mskcc.pre"], pal["mskcc.post"]
abline(v = c(7, 31))
```


APGI Preop
APGI Postop
GG
AUC
1.0
0.9
0.8
0.7
0.6
0.5
0.4
5
10
15
20
25
30
35
Time