MKL Cox (MKCox)

We will be mimicing example 1, two factors with linear relatophsip with the hazard function $h(X) = (X_1 + 2 * X_2)$, from 'Fenchel duality of Cox partial likelihood and its application in survival kernel learning' Wilson et. al (2020).

Loading data and plotting data

```
library(RMKL)
library(ggplot2)
library(survival)
library(gbm)
```

```
## Loaded gbm 2.1.5
```

```
library(randomForestSRC)
```

```
##
##  randomForestSRC 2.9.3
##
##  Type rfsrc.news() to see new features, changes, and bug fixes.
##
```

```
library(kernlab)
```

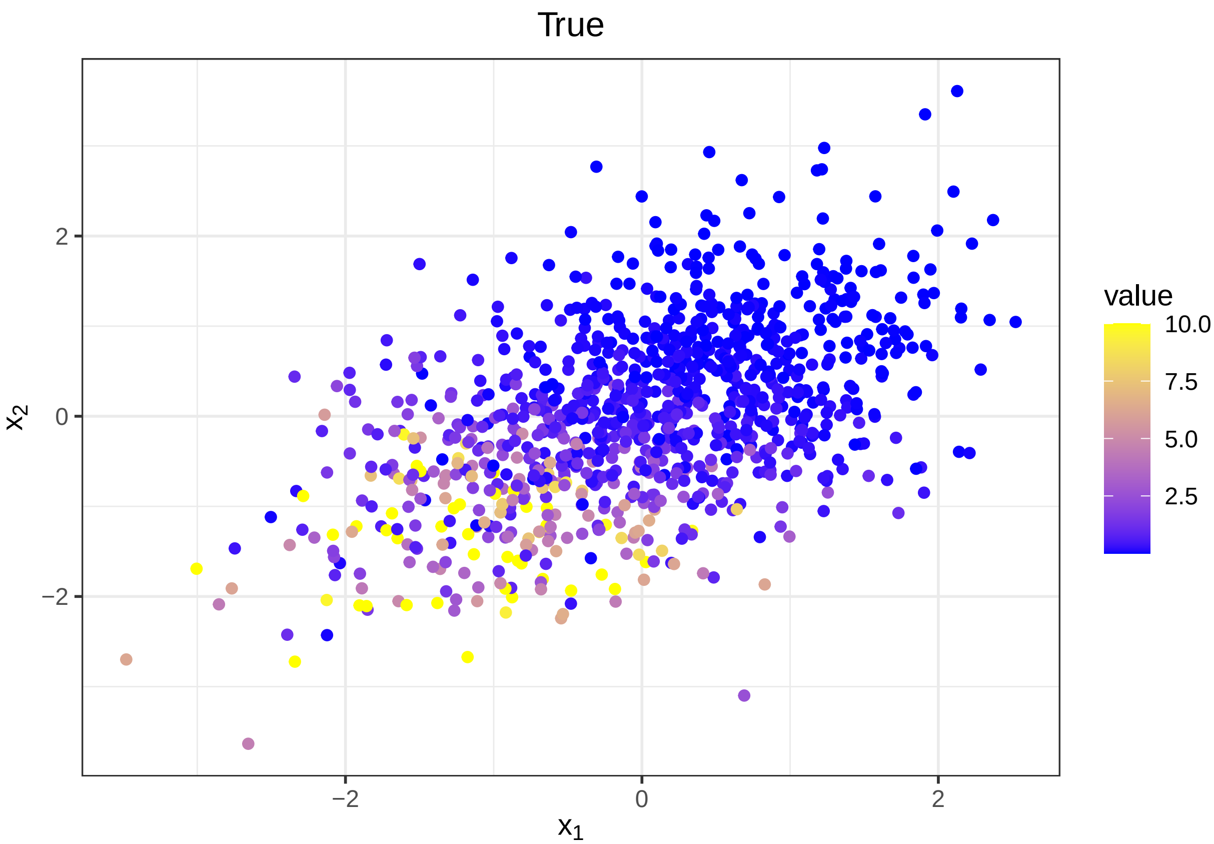
```
##
## Attaching package: 'kernlab'
```

```
## The following object is masked from 'package:ggplot2':
##
##     alpha
```

```
data(Surv_data)
head(Surv_data)
```

```
##            x1         x2        time status
## 1  0.70152066  0.8990872 0.040041376   TRUE
## 2 -0.21223395 -0.6490695 1.230534188   TRUE
## 3 -0.08404824  1.4702301 0.005509966   TRUE
## 4  0.86906459  0.4015776 0.437023163   TRUE
## 5 -1.88954937 -1.9095317 4.220627369   TRUE
## 6 -0.58108709  0.1864732 0.138348879   TRUE
```

```
ggplot(Surv_data, aes(x = x1, y = x2, color = time)) + geom_point() + scale_color_gradient(low = 'blue'
labs(color = 'value', title = 'True',x = expression(x[1]), y = expression(x[2])) + theme_bw() + theme(p
```




```
print
```

```
## function (x, ...)
## UseMethod("print")
## <bytecode: 0x5574d5cbbc58>
## <environment: namespace:base>
```

#Cox model

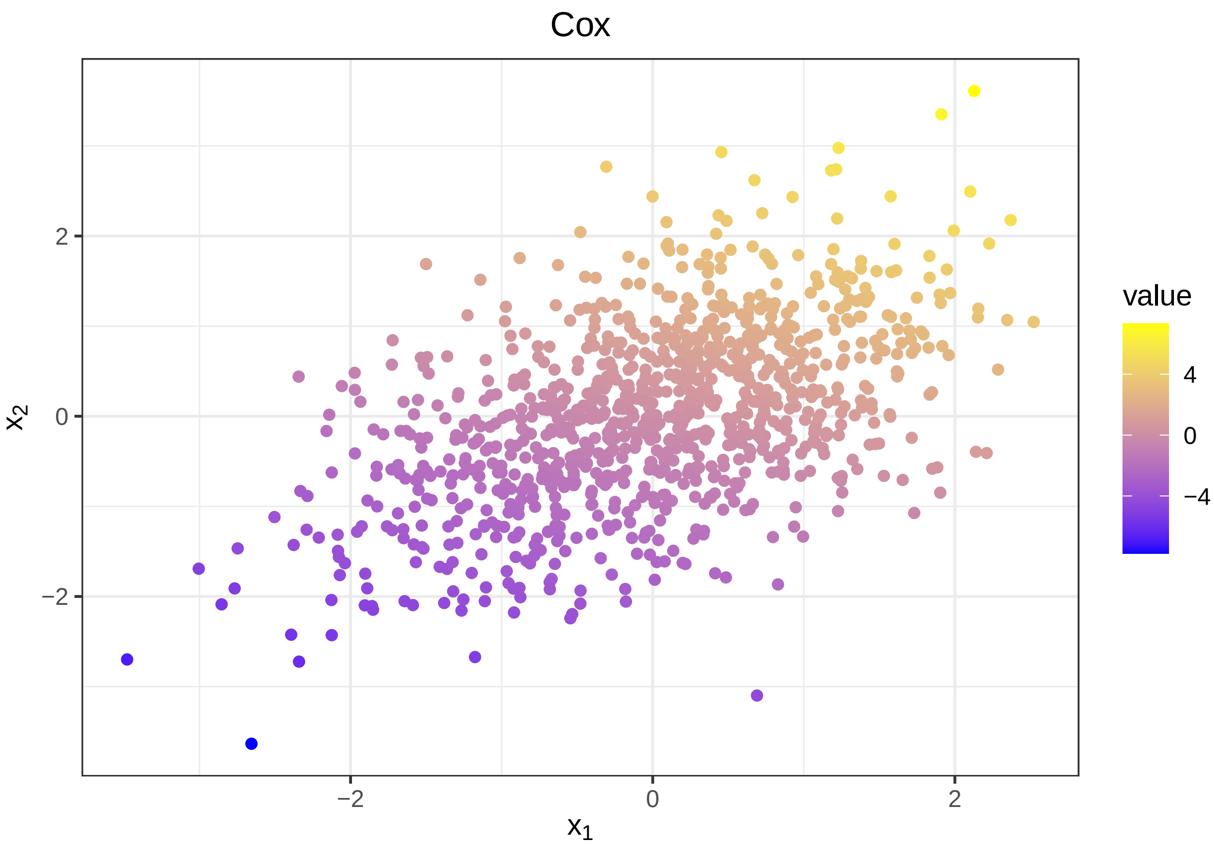
```
fit=coxph(Surv(Surv_data$time, Surv_data$status) ~ Surv_data$x1 + Surv_data$x2, method = "breslow")
fit2 <- step(fit, direction='both', k = log(dim(Surv_data)[1]))
```

```
## Start:  AIC=8815.32
## Surv(Surv_data$time, Surv_data$status) ~ Surv_data$x1 + Surv_data$x2
##
##                  Df    AIC
## <none>              8815.3
## - Surv_data$x1  1 9078.6
## - Surv_data$x2  1 9524.6
```

```
cox_pred=predict(fit, as.data.frame(Surv_data[,1:2]))
summary(fit)$concordance[1]
```

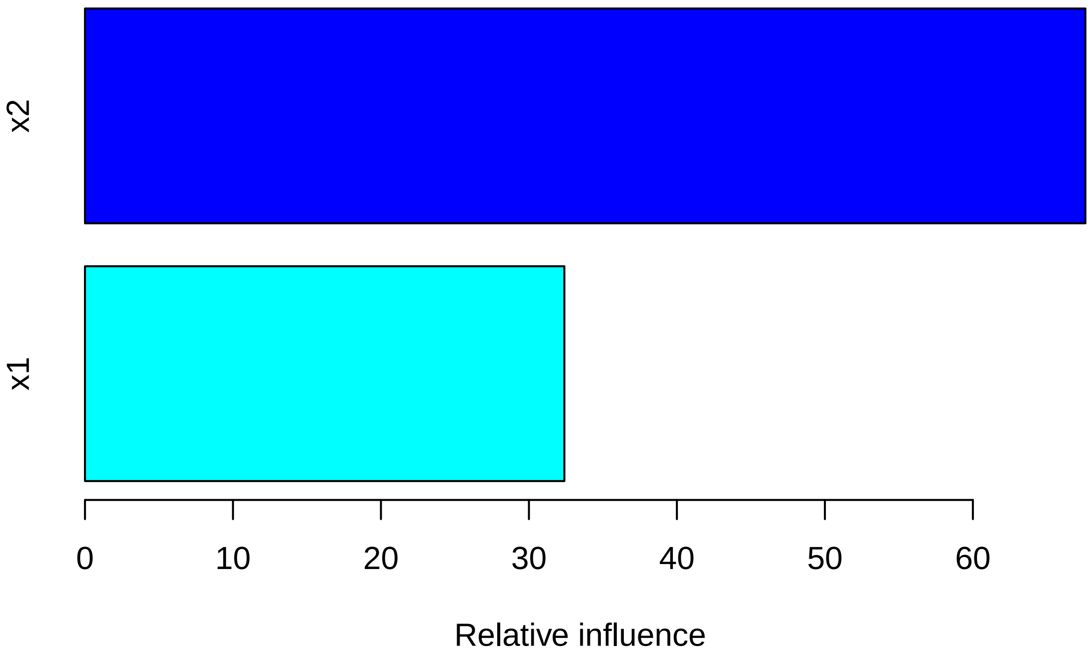
```
##        C
## 0.831493
```

```
Surv_data$Cox = cox_pred
ggplot(Surv_data, aes(x = x1, y = x2, color = Cox)) + geom_point() + scale_color_gradient(low = 'blue',
```



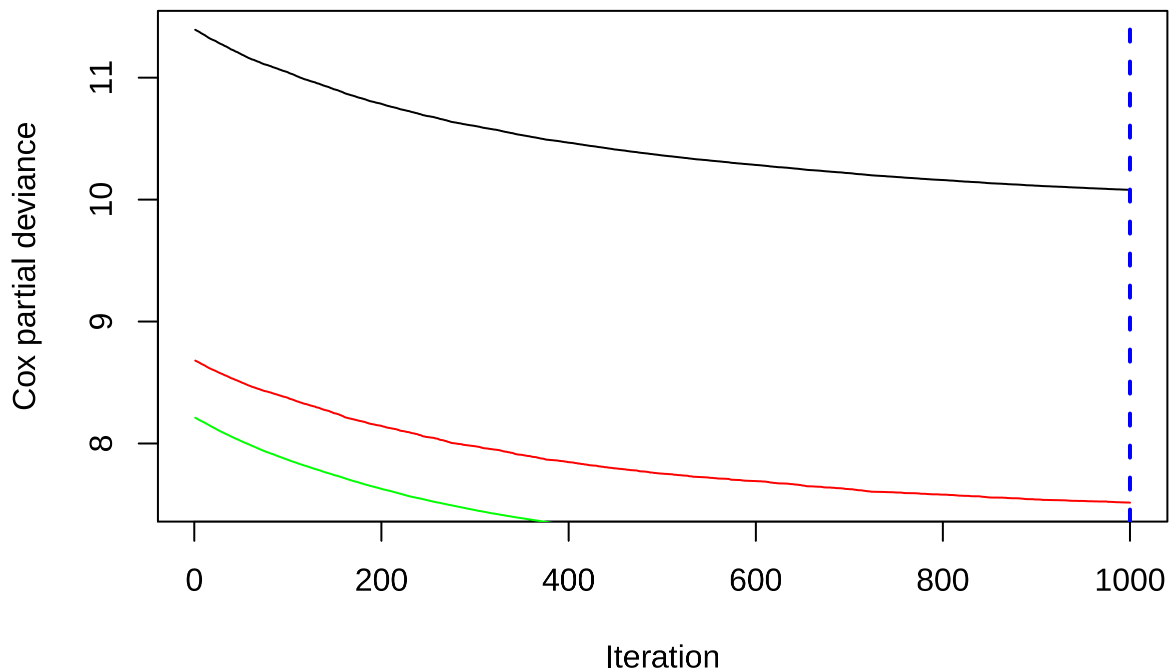
#Gradient Boosting

```
gbm1 <- gbm(Surv(time, status) ~ x1 + x2,       # formula
              data=Surv_data,                  # dataset
              distribution="coxph",
              n.trees=1000,                 # number of trees
              shrinkage=0.005,              # shrinkage or learning rate, 0.001 to 0.1 usually work
              interaction.depth=1,          # 1: additive model, 2: two-way interactions, etc
              bag.fraction = 0.5,           # subsampling fraction, 0.5 is probably best
              train.fraction = 0.8,         # fraction of data for training, first train.fraction*N used f
              cv.folds = 5,                 # do 5-fold cross-validation
              verbose = F)              #  print progress
summary(gbm1)
```

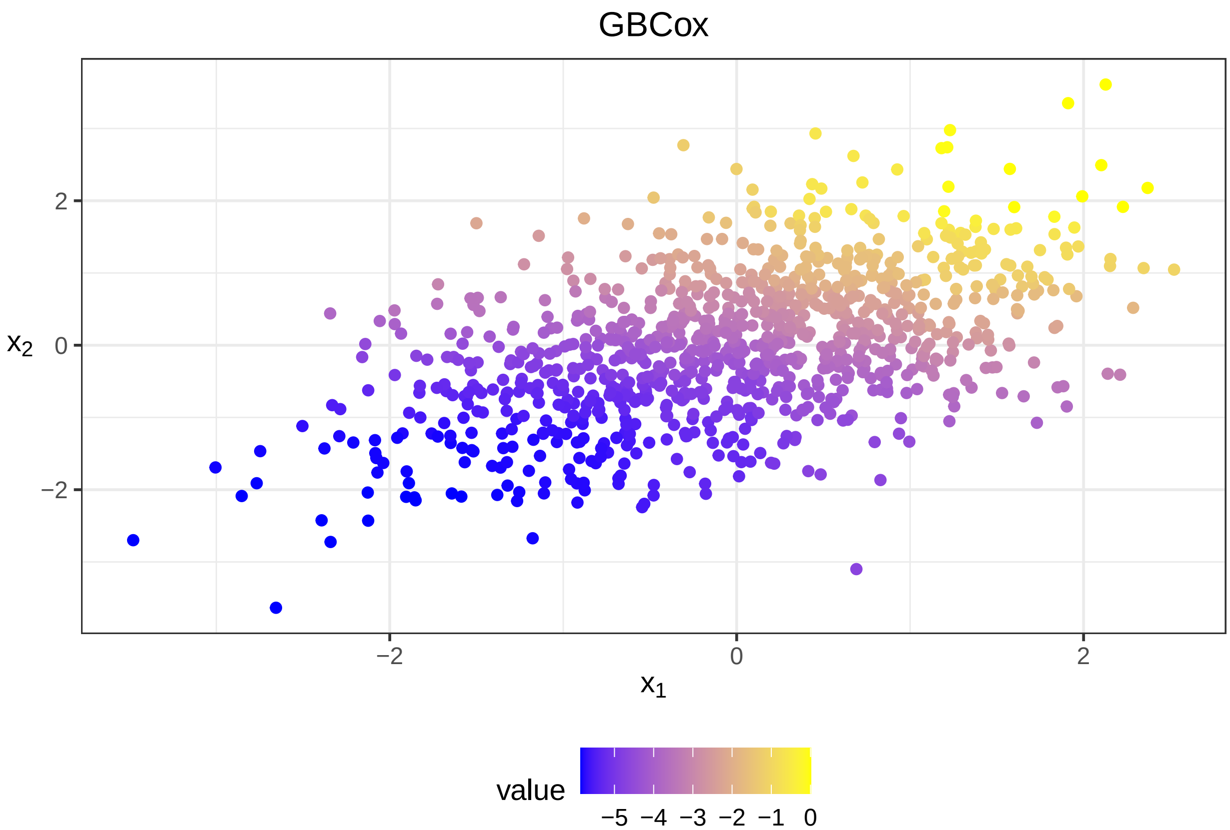



```
##     var  rel.inf
## x2  x2 67.60328
## x1  x1 32.39672
```

```
best.iter <- gbm.perf(gbm1,method = "cv")
```




```
gpred2=predict(gbm1,Surv_data,best.iter)
Surv_data$GBM = gpred2
ggplot(Surv_data, aes(x = x1, y = x2, color = GBM)) + geom_point() + scale_color_gradient(low = 'blue',
```

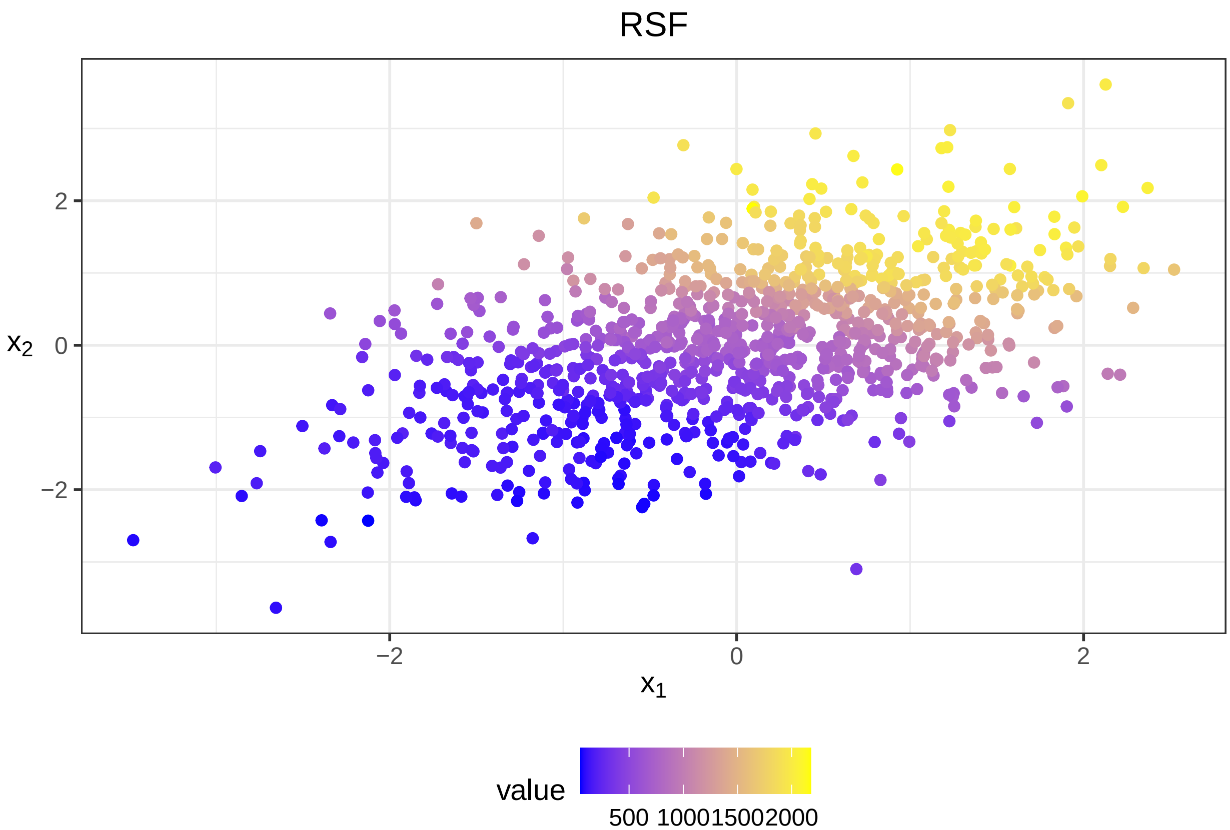



```
gbm.con = survConcordance(Surv(time, status) ~ GBM, Surv_data)$con
gbm.con
```

```
## concordant
##  0.8323063
```

#Random Survival Forest

```
modrf <-  rfsrc(Surv(time, status) ~ x1 + x2, data = Surv_data, nsplit = 10)
prerf <- predict(modrf, Surv_data, outcome = 'test')$predicted.oob
Surv_data$RSF = prerf
ggplot(Surv_data, aes(x = x1, y = x2, color = RSF)) + geom_point() + scale_color_gradient(low = 'blue',
```

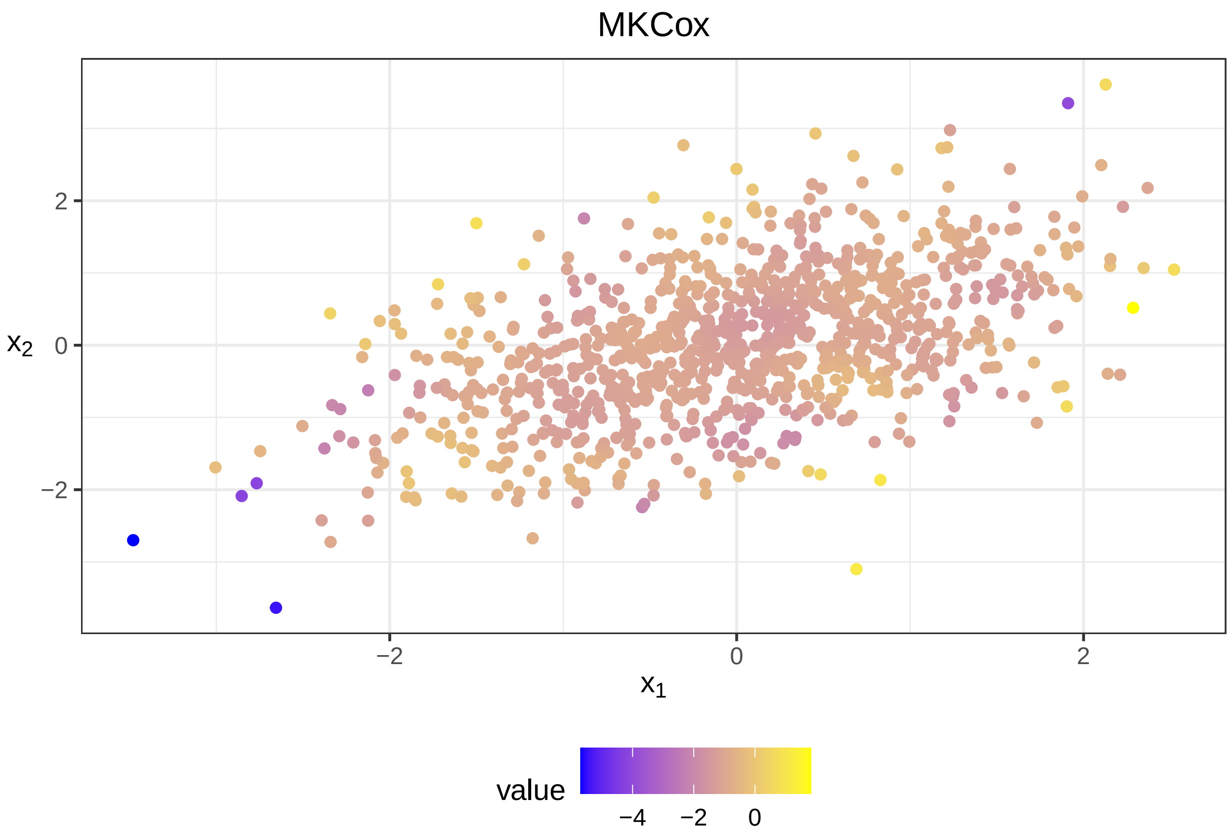



```
RSF.con = survConcordance(Surv(time, status) ~ RSF, Surv_data)$con
RSF.con
```

```
## concordant
##  0.8201503
```

#MKCox

```
rho0 <- .001*(Surv_data$status - seq(0, 10, length.out = dim(Surv_data)[1]))
klist <- list(kernelMatrix(rbfdot(1), as.matrix(Surv_data[,1:2])),
              kernelMatrix(vanilladot(), as.matrix(Surv_data[,1:2])))
kk <- simplify2array(klist)
modmkl <- SurvMKL(y = Surv_data$time, del = Surv_data$status, K = kk, rho =  rho0, C = 0.005, lambda = (
mkl = predict_Surv(modmkl, kk)
Surv_data$MKCox = mkl
ggplot(Surv_data, aes(x = x1, y = x2, color = MKCox)) + geom_point() + scale_color_gradient(low = 'blue
```




```r
MKCox.con = survConcordance(Surv(time, status) ~ MKCox, Surv_data)$con
MKCox.con
```

```
## concordant
##  0.5566168
```