Risk-Evaluation: Breast Cancer Royston-Altman

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1 Evaluation of RISK survival models

This document highlights the use of

- RRPlot(),
- CoxRiskCalibration(), and
- CalibrationProbPoissonRisk(),

for the evaluation (RRPlot), and calibration of cox models (CoxRiskCalibration) or logistic models (CalibrationProbPoissonRisk) of survival data.

Furthermore, it can be used to evaluate any Risk index that reruns the probability of a future event on external data-set.

This document will use the survival::rotterdam, and survival::gbsg data-sets to train and predict the risk of cancer recurrence after surgery. Both Cox and Logistic models will be trained and evaluated.

Here are some sample plots returned by the evaluated functions:

1.1 The libraries

```
library(survival)
library(FRESA.CAD)
```

```
## Loading required package: Rcpp
```

```
## Loading required package: stringr
```

```
## Loading required package: miscTools
```

```
## Loading required package: Hmisc
```

```
##
## Attaching package: 'Hmisc'

## The following objects are masked from 'package:base':
##
##     format.pval, units

## Loading required package: pROC

## Type 'citation("pROC")' for a citation.

##
## Attaching package: 'pROC'

## The following objects are masked from 'package:stats':
##
##     cov, smooth, var
```

```
#source("~/GitHub/FRESA.CAD/R/RRPlot.R")
#source("~/GitHub/FRESA.CAD/R/PoissonEventRiskCalibration.R")
op <- par(no.readonly = TRUE)
pander::panderOptions('digits', 3)
#pander::panderOptions('table.split.table', 400)
pander::panderOptions('keep.trailing.zeros',TRUE)
```

1.2 Breast Cancer Royston-Altman data

1.2.1 data(gbsg, package="survival") and data(rotterdam, package="survival")

```
gbsgdata <- gbsg
rownames(gbsgdata) <- gbsgdata$pid
gbsgdata$pid <- NULL

odata <-rotterdam
rownames(odata) <- odata$pid
odata$pid <- NULL
odata$rfstime <- odata$rtime
odata$status <- odata$recur
odata$rtime <- NULL
odata$recur <- NULL

odata <- odata[,colnames(odata) %in% colnames(gbsgdata)]

odata$size <- 10*(odata$size=="<=20") +
  35*(odata$size=="20-50") +
  60*(odata$size==">50")

data <- as.data.frame(model.matrix(Surv(rfstime,status)~.*.,odata))

data$`(Intercept)` <- NULL

dataBrestCancerTrain <- cbind(time=odata[rownames(data),"rfstime"],status=odata[rownames(data),"status"]

colnames(dataBrestCancerTrain) <-str_replace_all(colnames(dataBrestCancerTrain),":","_")
colnames(dataBrestCancerTrain) <-str_replace_all(colnames(dataBrestCancerTrain)," ","")
colnames(dataBrestCancerTrain) <-str_replace_all(colnames(dataBrestCancerTrain),"\\.","_")
colnames(dataBrestCancerTrain) <-str_replace_all(colnames(dataBrestCancerTrain),"-","_")
```

```
colnames(dataBrestCancerTrain) <-str_replace_all(colnames(dataBrestCancerTrain),">","_")
dataBrestCancerTrain$time <- dataBrestCancerTrain$time/365 ## To years


pander::pander(table(odata[rownames(data),"status"]),caption="rotterdam")
```

Table 1: rotterdam

0	1
1464	1518

1.2.2 data(gbsg, package="survival") data conditioning

```
gbsgdata <- gbsgdata[,colnames(odata)]
data <- as.data.frame(model.matrix(Surv(rfstime,status)~.*.,gbsgdata))

data$`(Intercept)` <- NULL

dataBrestCancerTest <- cbind(time=gbsgdata[rownames(data),"rfstime"],status=gbsgdata[rownames(data),"sta

colnames(dataBrestCancerTest) <-str_replace_all(colnames(dataBrestCancerTest),":","_")
colnames(dataBrestCancerTest) <-str_replace_all(colnames(dataBrestCancerTest)," ","")
colnames(dataBrestCancerTest) <-str_replace_all(colnames(dataBrestCancerTest),"\\.","_")
colnames(dataBrestCancerTest) <-str_replace_all(colnames(dataBrestCancerTest),"-","_")
colnames(dataBrestCancerTest) <-str_replace_all(colnames(dataBrestCancerTest),">","_")
dataBrestCancerTest$time <- dataBrestCancerTest$time/365

pander::pander(table(odata[rownames(data),"status"]), caption="gbsg")
```

Table 2: gbsg

0	1
499	183

1.3 Cox Modeling

```
ml <- BSWiMS.model(Surv(time,status)~.,data=dataBrestCancerTrain,loops=1,NumberofRepeats = 5)
```

——.

```
sm <- summary(ml)
pander::pander(sm$coefficients)
```

Table 3: Table continues below

	Estimate	lower	HR	upper	u.Accuracy	r.Accuracy
age_nodes	0.000716	1.001	1.001	1.001	0.626	0.600
size_grade	0.005649	1.005	1.006	1.006	0.598	0.623
nodes	0.086582	1.082	1.090	1.099	0.637	0.642
size	0.006888	1.005	1.007	1.009	0.595	0.641
size_nodes	-0.000378	1.000	1.000	1.000	0.624	0.643

	Estimate	lower	HR	upper	u.Accuracy	r.Accuracy
age_size	-0.000149	1.000	1.000	1.000	0.567	0.627
grade	0.204934	1.146	1.227	1.314	0.565	0.637
age	-0.003113	0.996	0.997	0.998	0.513	0.628
grade_nodes	-0.013784	0.981	0.986	0.992	0.635	0.645

Table 4: Table continues below

	full.Accuracy	u.AUC	r.AUC	full.AUC	IDI	NRI
age_nodes	0.632	0.630	0.601	0.634	0.03040	0.4594
size_grade	0.632	0.599	0.626	0.634	0.01868	0.3914
nodes	0.643	0.640	0.643	0.644	0.00745	0.0564
size	0.643	0.595	0.642	0.644	0.01447	0.3587
size_nodes	0.643	0.629	0.644	0.644	0.00346	0.3430
age_size	0.632	0.568	0.630	0.634	0.00635	0.1935
grade	0.643	0.561	0.638	0.644	0.00926	0.2069
age	0.643	0.513	0.628	0.644	0.00416	0.0917
grade_nodes	0.643	0.639	0.646	0.644	0.00207	-0.0910

	z.IDI	z.NRI	Delta.AUC	Frequency
age_nodes	12.81	14.37	0.033056	1
size_grade	9.82	11.29	0.007947	1
nodes	8.33	1.66	0.000148	1
size	8.05	9.97	0.001322	1
size_nodes	7.25	9.57	-0.000377	1
age_size	5.95	5.36	0.004078	1
grade	5.88	6.31	0.005344	1
age	5.27	2.51	0.015465	1
grade_nodes	5.03	-2.55	-0.002609	1

1.4 Cox Model Performance

Here we evaluate the model using the RRPlot() function.

1.4.1 The evaluation of the raw Cox model with RRPlot()

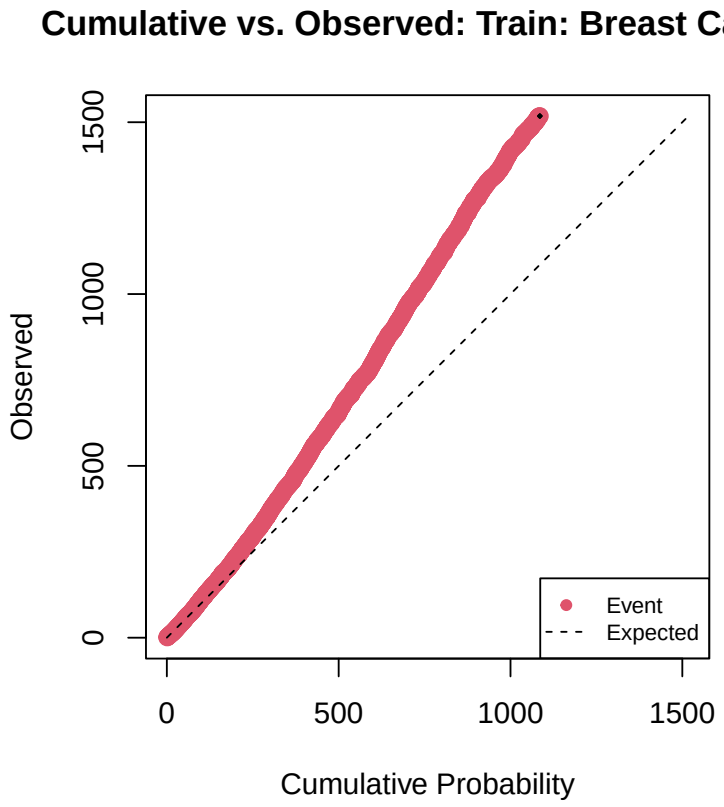
Here we will use the predicted event probability assuming a baseline hazard for events withing 5 years

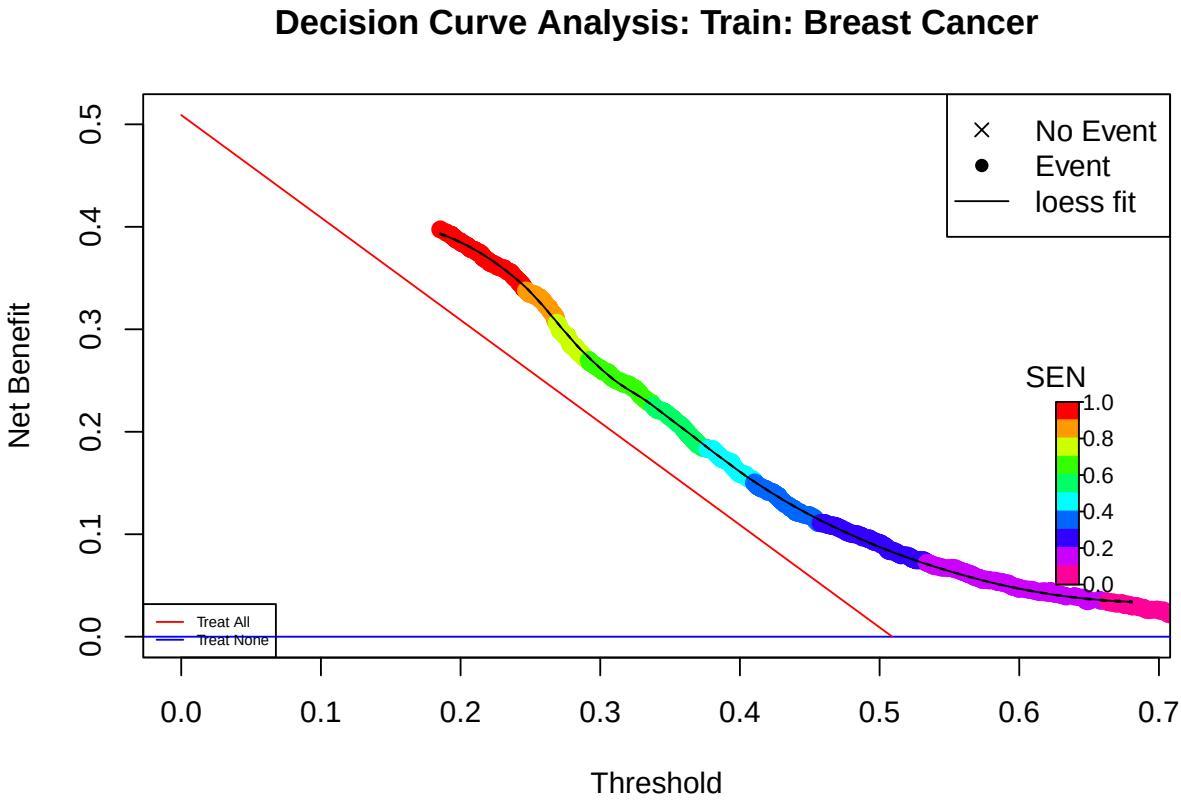
```
timeinterval <- 5 # Five years

h0 <- sum(dataBrestCancerTrain$status & dataBrestCancerTrain$time <= timeinterval)
h0 <- h0/sum((dataBrestCancerTrain$time > timeinterval) | (dataBrestCancerTrain$status==1))

pander::pander(t(c(h0=h0,timeinterval=timeinterval)),caption="Initial Parameters")
```

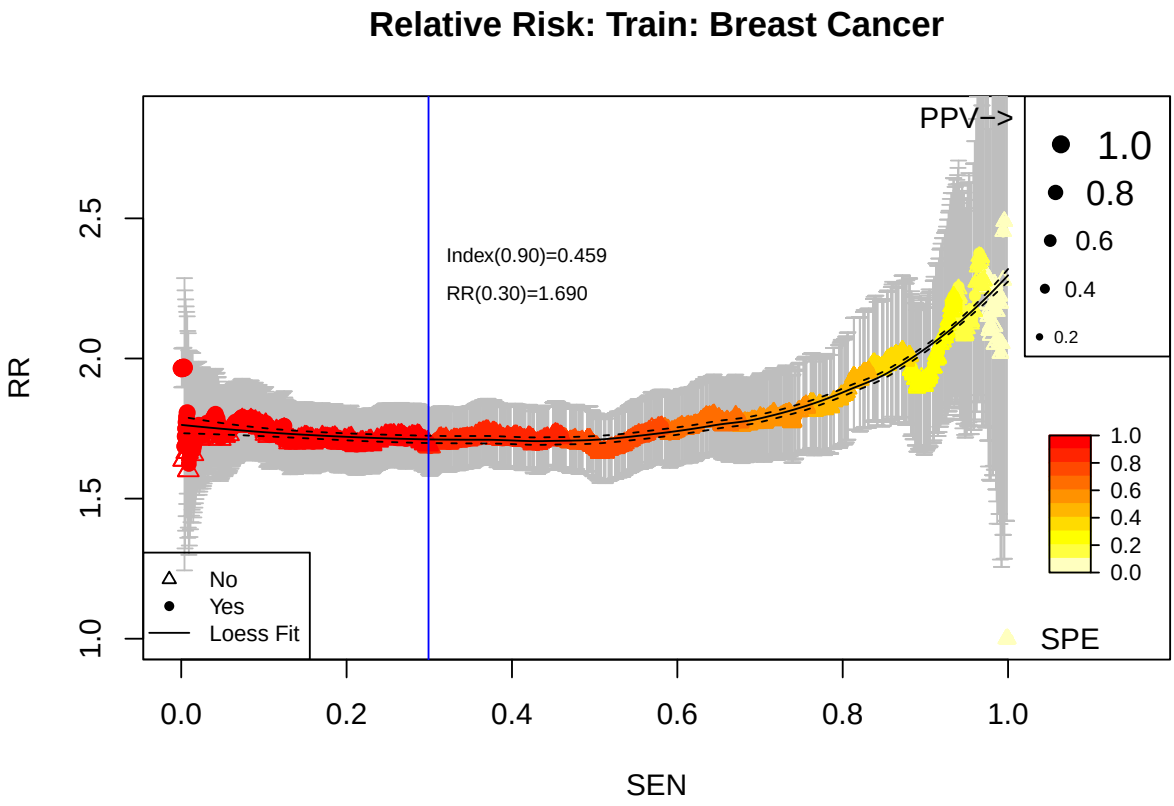
Table 6: Initial Parameters

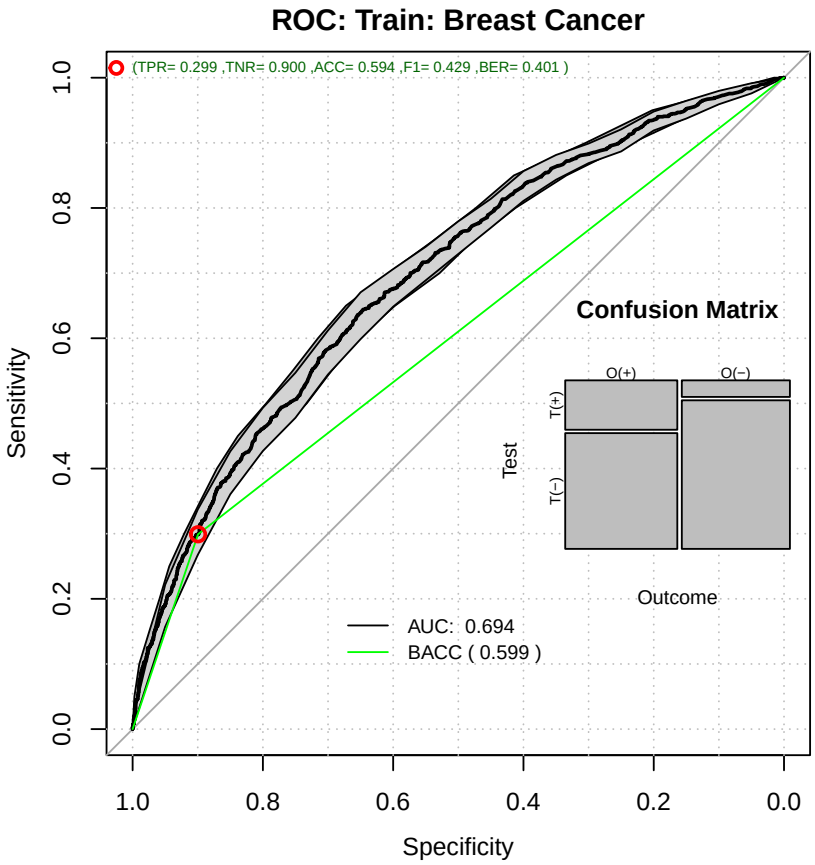
h0	timeinterval
0.429	5

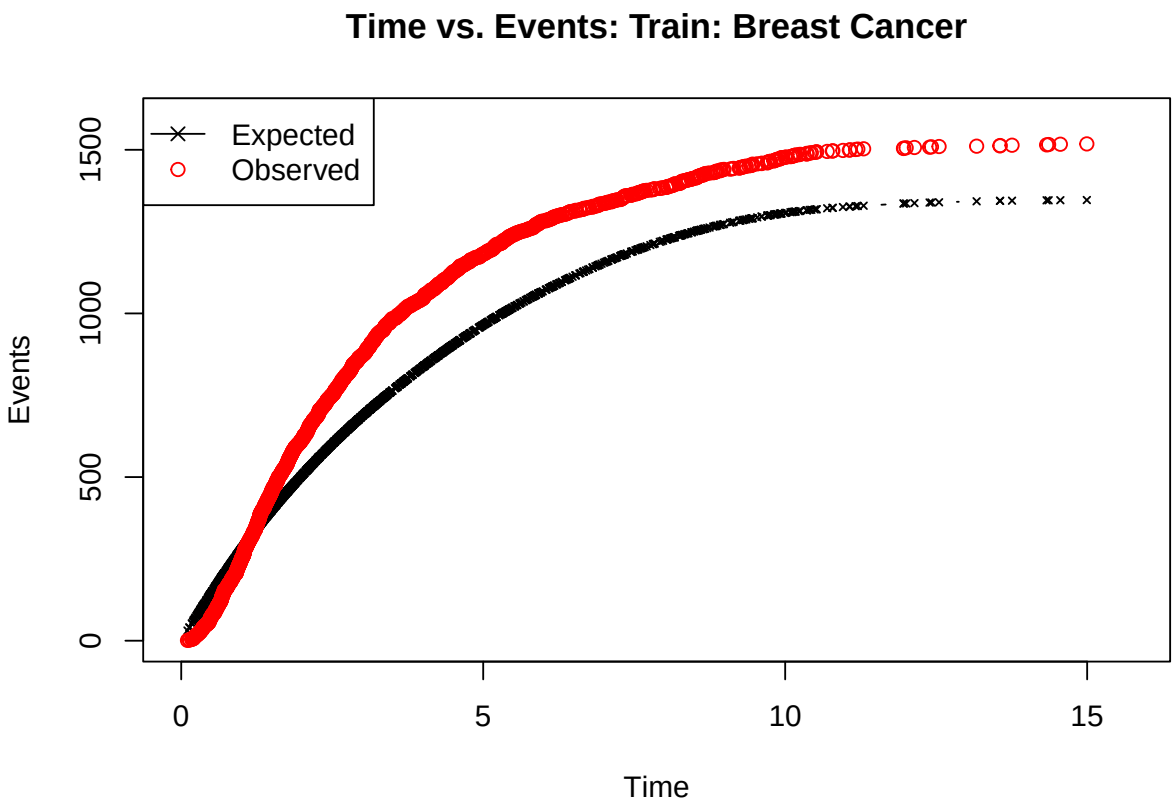
```
index <- predict(ml,dataBrestCancerTrain)
rdata <- cbind(dataBrestCancerTrain$status,ppoisGzero(index,h0))

rrAnalysisTrain <- RRPlot(rdata,atProb=c(0.90,0.80),
                      timetoEvent=dataBrestCancerTrain$time,
                      title="Train: Breast Cancer",
                      ysurvlim=c(0.00,1.0),
                      riskTimeInterval=timeinterval)
```

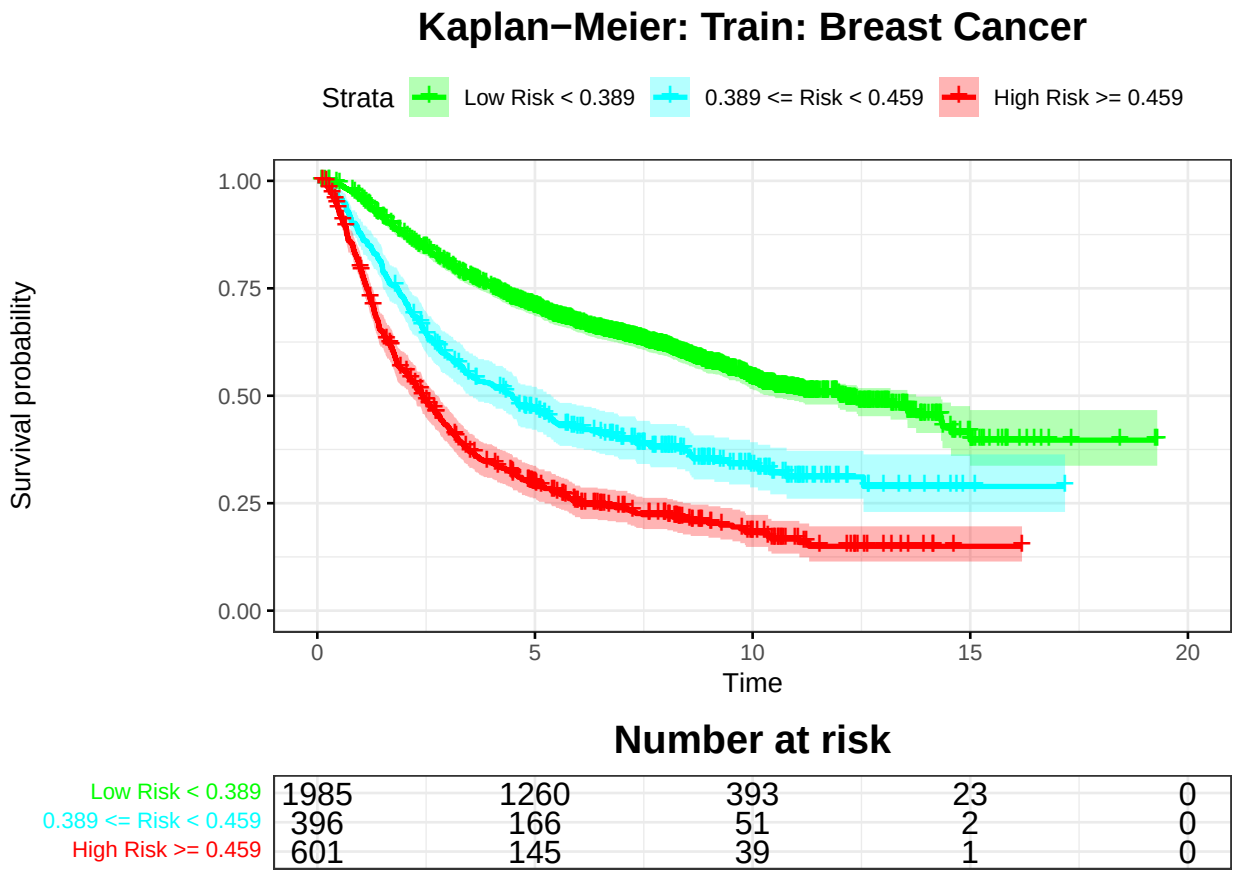



Decision Curve Analysis: Train: Breast Cancer
No Event
Event
loess fit
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None
Net Benefit
0.0
0.1
0.2
0.3
0.4
0.5
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Threshold


Relative Risk: Train: Breast Cancer
PPV–>
1.0
0.8
0.6
0.4
0.2
Index(0.90)=0.459
RR(0.30)=1.690
1.0
0.8
0.6
0.4
0.2
0.0
No
Yes
Loess Fit
SPE
RR
2.5
2.0
1.5
1.0
0.0
0.2
0.4
0.6
0.8
1.0
SEN


ROC: Train: Breast Cancer
(TPR= 0.299 ,TNR= 0.900 ,ACC= 0.594 ,F1= 0.429 ,BER= 0.401)
Sensitivity
Specificity
1.0
0.8
0.6
0.4
0.2
0.0
Confusion Matrix
O(+)
O(−)
T(+)
T(−)
Test
Outcome
AUC: 0.694
BACC (0.599)


Time vs. Events: Train: Breast Cancer
Expected
Observed
Events
0
500
1000
1500
0
5
10
15
Time



As we can see the Observed probability as well as the Time vs. Events are not calibrated.

1.4.2 Uncalibrated Performance Report

```
pander::pander(t(rrAnalysisTrain$keyPoints),caption="Threshold values")
```

Table 7: Threshold values

	@:0.9	@:0.8	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.459	0.389	0.320	0.214	0.18549	0.500
RR	1.690	1.713	1.799	2.376	1.00000	1.725
SEN	0.299	0.462	0.644	0.965	1.00000	0.246
SPE	0.900	0.798	0.646	0.125	0.00137	0.931
BACC	0.599	0.630	0.645	0.545	0.50068	0.589

```
pander::pander(t(rrAnalysisTrain$OERatio$estimate),caption="O/E Ratio")
```

Table 8: O/E Ratio

O/E	Low	Upper	p.value
1.13	1.07	1.19	4.66e-06

```
pander::pander(t(rrAnalysisTrain$OE95ci),caption="O/E Mean")
```

Table 9: O/E Mean

mean	50%	2.5%	97.5%
1.16	1.16	1.15	1.17

```
pander::pander(t(rrAnalysisTrain$OAcum95ci),caption="O/Acum Mean")
```

Table 10: O/Acum Mean

mean	50%	2.5%	97.5%
1.35	1.35	1.35	1.35

```
pander::pander(rrAnalysisTrain$c.index$cstatCI,caption="C. Index")
```

mean.C Index	median	lower	upper
0.676	0.677	0.664	0.69

```
pander::pander(t(rrAnalysisTrain$ROCAnalysis$aucs),caption="ROC AUC")
```

Table 12: ROC AUC

est	lower	upper
0.694	0.675	0.713

```
pander::pander((rrAnalysisTrain$ROCAnalysis$sensitivity),caption="Sensitivity")
```

Table 13: Sensitivity

est	lower	upper
0.299	0.276	0.323

```
pander::pander((rrAnalysisTrain$ROCAnalysis$specificity),caption="Specificity")
```

Table 14: Specificity

est	lower	upper
0.9	0.883	0.915

```
pander::pander(t(rrAnalysisTrain$thr_atP),caption="Probability Thresholds")
```

Table 15: Probability Thresholds

90%	80%
0.459	0.389

```
pander::pander(t(rrAnalysisTrain$RR_atP),caption="Risk Ratio")
```

Table 16: Risk Ratio

est	lower	upper
1.69	1.59	1.8

```
pander::pander(rrAnalysisTrain$surdif,caption="Logrank test")
```

Table 17: Logrank test Chisq = 465.079317 on 2 degrees of freedom, p = 0.000000

	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	1985	816	1144	93.9	385.7
class=1	396	248	177	28.0	31.8
class=2	601	454	197	336.3	391.3

1.4.3 Cox Calibration

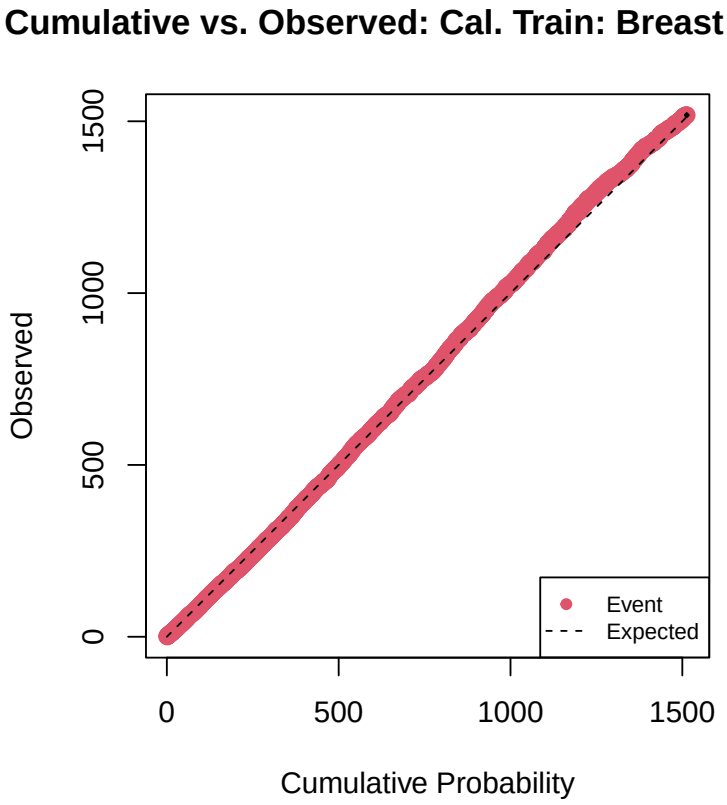
```
op <- par(no.readonly = TRUE)


calprob <- CoxRiskCalibration(ml,dataBrestCancerTrain,"status","time")


pander::pander(c(h0=calprob$h0,
                 Gain=calprob$hazardGain,
                 DeltaTime=calprob$timeInterval),
               caption="Cox Calibration Parameters")
```

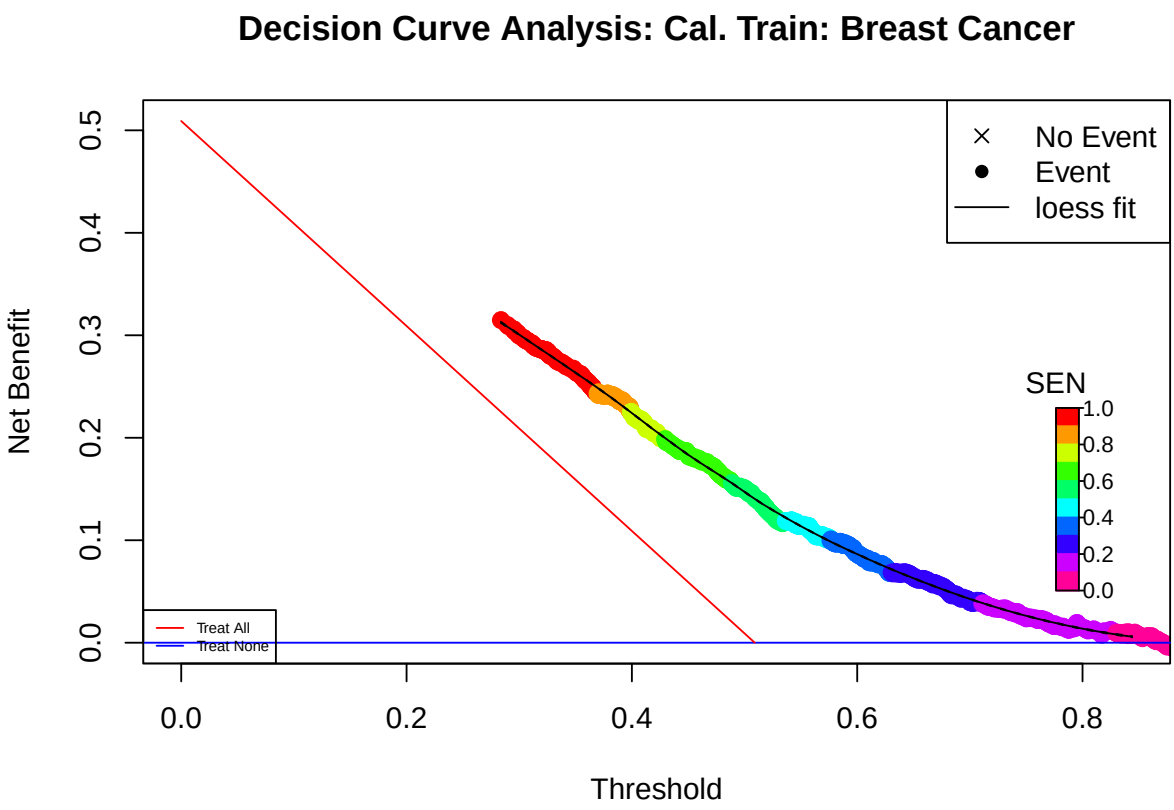
h0	Gain	DeltaTime
0.698	1.35	6.97

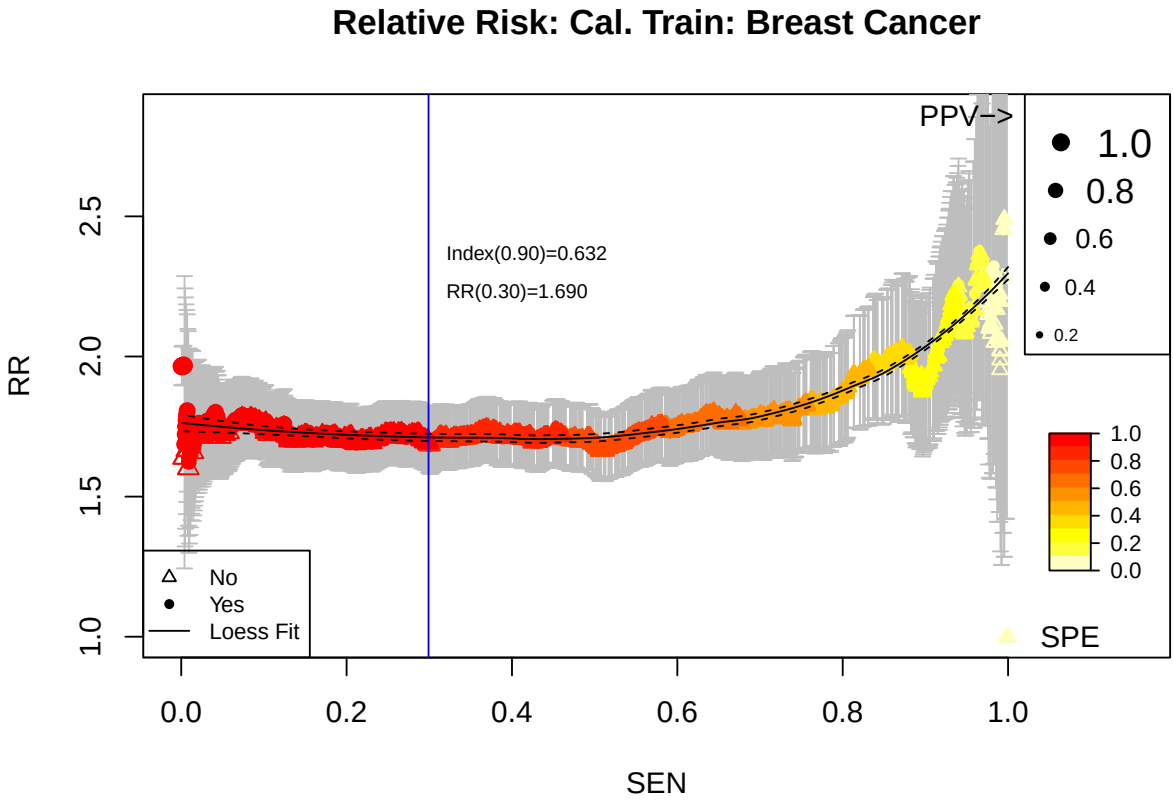
1.4.4 The RRplot() of the calibrated model

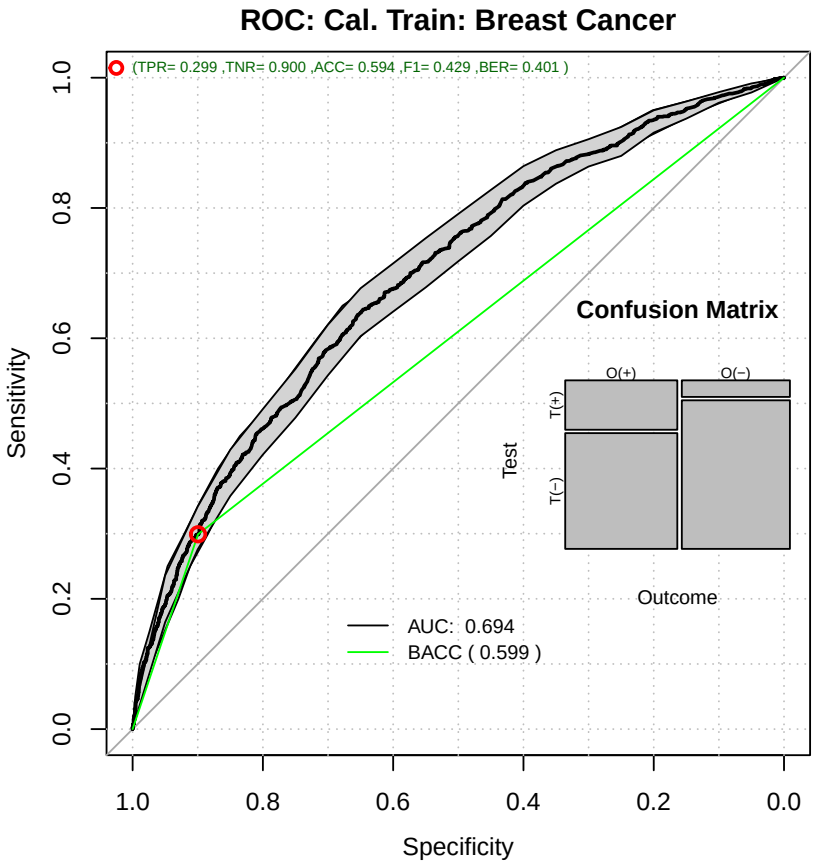
```
h0 <- calprob$h0
timeinterval <- calprob$timeInterval;

rdata <- cbind(dataBrestCancerTrain$status,calprob$prob)


rrAnalysisTrain <- RRPlot(rdata,atProb=c(0.90,0.80),
                      timetoEvent=dataBrestCancerTrain$time,
```

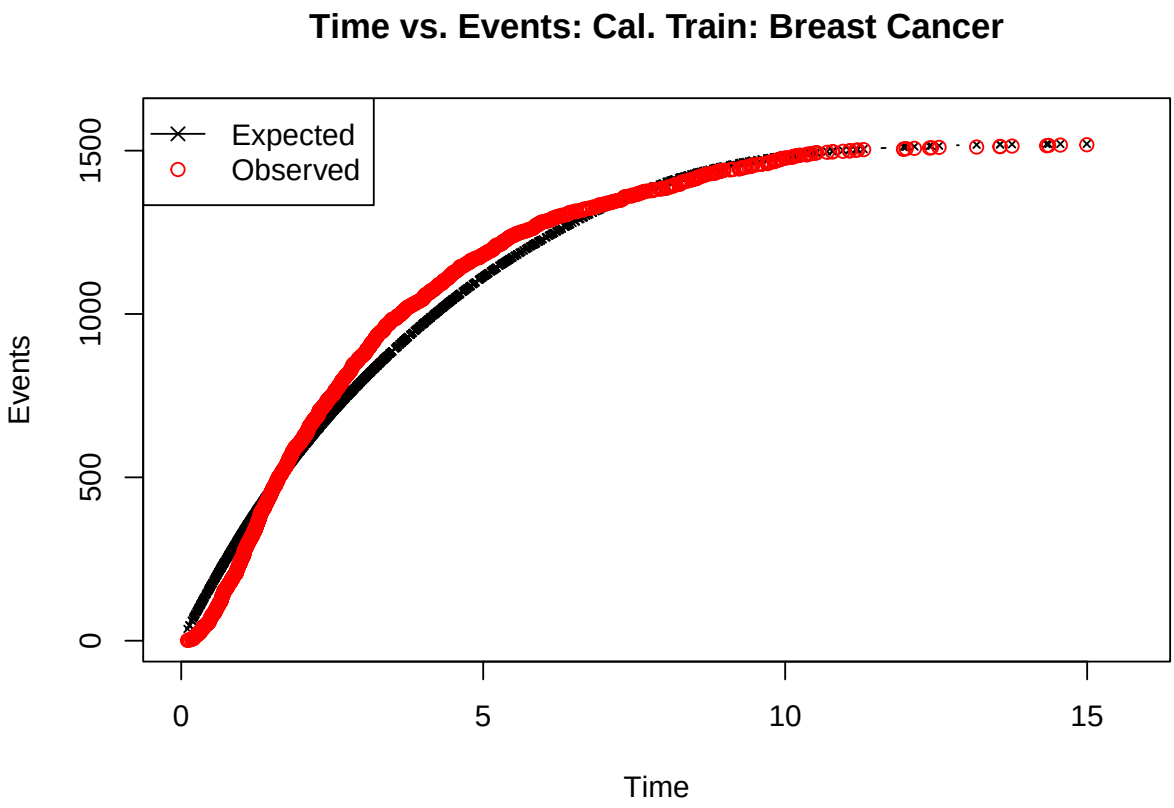
```
                    title="Cal. Train: Breast Cancer",
                    ysurvlim=c(0.00,1.0),
                    riskTimeInterval=timeinterval)
```

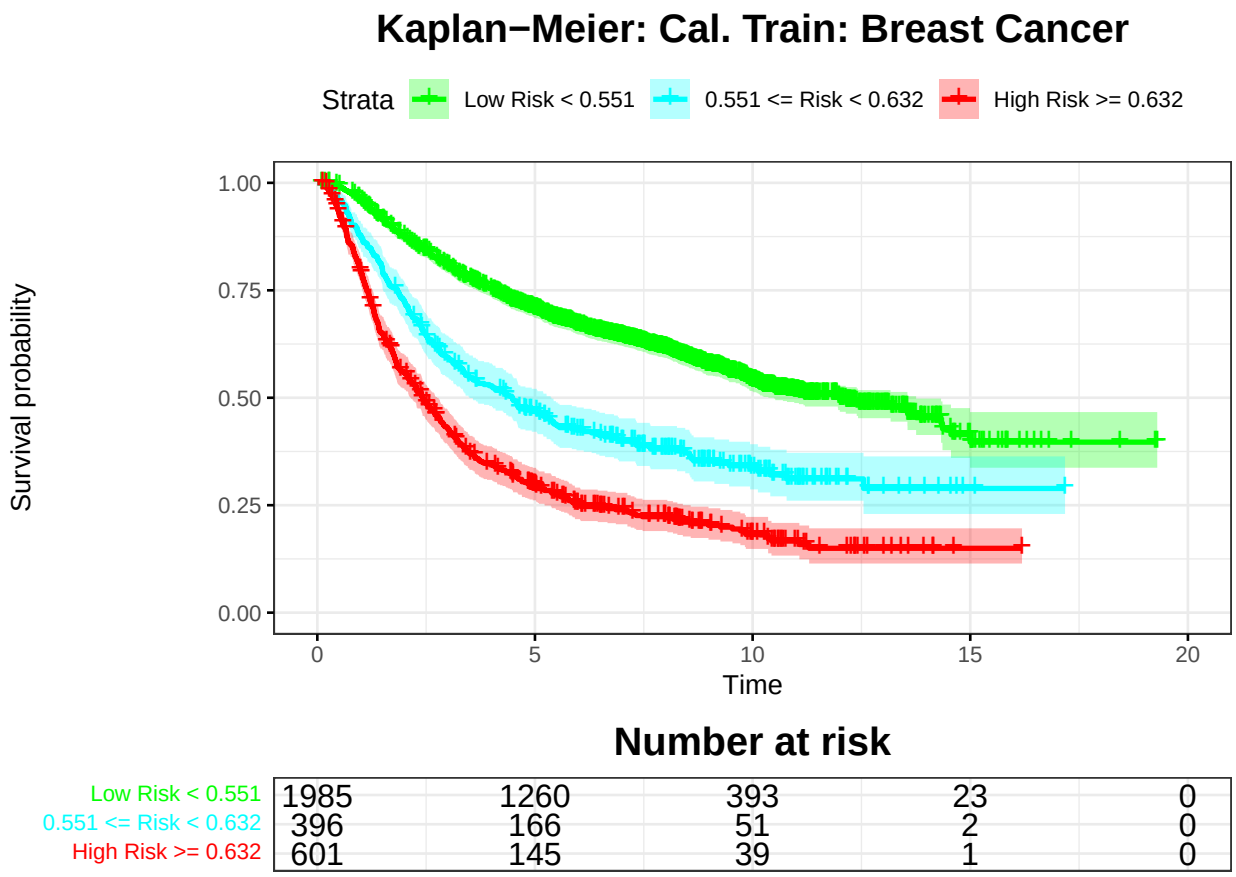



Decision Curve Analysis: Cal. Train: Breast Cancer
Net Benefit
0.0
0.1
0.2
0.3
0.4
0.5
Threshold
0.0
0.2
0.4
0.6
0.8
No Event
Event
loess fit
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None


Relative Risk: Cal. Train: Breast Cancer
PPV–>
1.0
0.8
0.6
0.4
0.2
Index(0.90)=0.632
RR(0.30)=1.690
1.0
0.8
0.6
0.4
0.2
0.0
No
Yes
Loess Fit
SPE
RR
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0
SEN


ROC: Cal. Train: Breast Cancer
(TPR= 0.299 ,TNR= 0.900 ,ACC= 0.594 ,F1= 0.429 ,BER= 0.401)
Sensitivity
Specificity
1.0
0.8
0.6
0.4
0.2
0.0
Confusion Matrix
O(+)
O(−)
T(+)
T(−)
Test
Outcome
AUC: 0.694
BACC (0.599)


Time vs. Events: Cal. Train: Breast Cancer
Expected
Observed
Events
0
500
1000
1500
0
5
10
15
Time



1.4.5 Calibrated Train Performance

```
pander::pander(t(rrAnalysisTrain$keyPoints),caption="Threshold values")
```

Table 19: Threshold values

	@:0.9	@:0.8	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.632	0.551	0.466	0.324	0.28381	0.500
RR	1.690	1.713	1.799	2.376	1.00000	1.758
SEN	0.299	0.462	0.644	0.965	1.00000	0.580
SPE	0.900	0.798	0.646	0.125	0.00137	0.706
BACC	0.599	0.630	0.645	0.545	0.50068	0.643

```
pander::pander(t(rrAnalysisTrain$OERatio$estimate),caption="O/E Ratio")
```

Table 20: O/E Ratio

O/E	Low	Upper	p.value
0.998	0.949	1.05	0.959

```
pander::pander(t(rrAnalysisTrain$OE95ci),caption="O/E Mean")
```

Table 21: O/E Mean

mean	50%	2.5%	97.5%
1	1	0.996	1.01

```
pander::pander(t(rrAnalysisTrain$OAcum95ci),caption="O/Acum Mean")
```

Table 22: O/Acum Mean

mean	50%	2.5%	97.5%
1.01	1.01	1.01	1.01

```
pander::pander(rrAnalysisTrain$c.index$cstatCI,caption="C. Index")
```

mean.C Index	median	lower	upper
0.676	0.676	0.662	0.691

```
pander::pander(t(rrAnalysisTrain$ROCAnalysis$aucs),caption="ROC AUC")
```

Table 24: ROC AUC

est	lower	upper
0.694	0.675	0.713

```
pander::pander((rrAnalysisTrain$ROCAnalysis$sensitivity),caption="Sensitivity")
```

Table 25: Sensitivity

est	lower	upper
0.299	0.276	0.323

```
pander::pander((rrAnalysisTrain$ROCAnalysis$specificity),caption="Specificity")
```

Table 26: Specificity

est	lower	upper
0.9	0.883	0.915

```
pander::pander(t(rrAnalysisTrain$thr_atP),caption="Probability Thresholds")
```

Table 27: Probability Thresholds

90%	80%
0.632	0.551

```
pander::pander(t(rrAnalysisTrain$RR_atP),caption="Risk Ratio")
```

Table 28: Risk Ratio

est	lower	upper
1.69	1.59	1.8

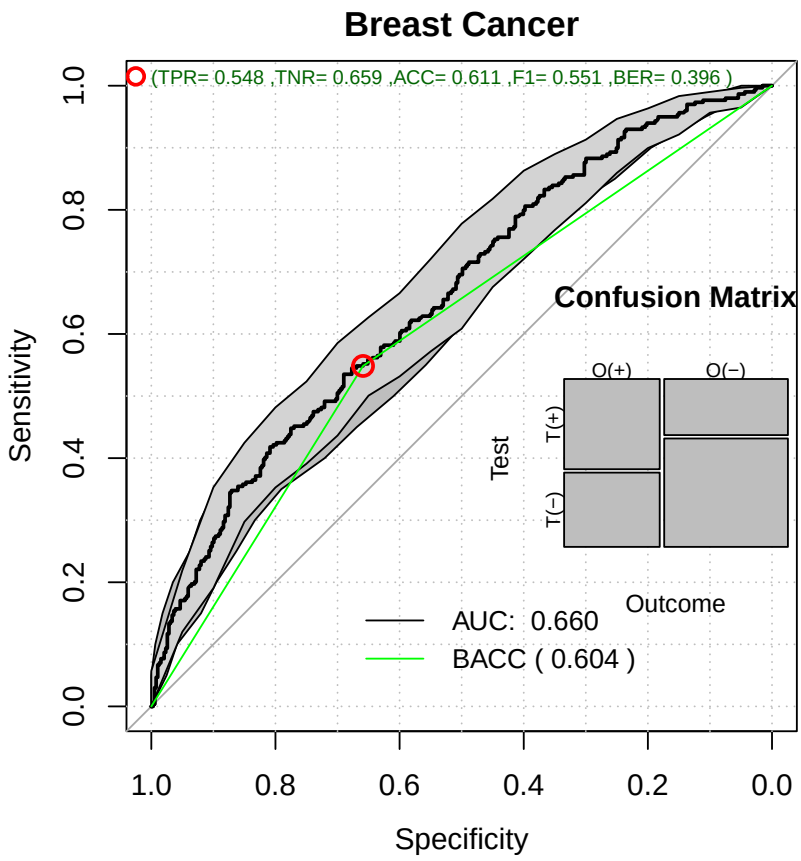
```
pander::pander(rrAnalysisTrain$surdif,caption="Logrank test")
```

Table 29: Logrank test Chisq = 465.079317 on 2 degrees of freedom, p = 0.000000

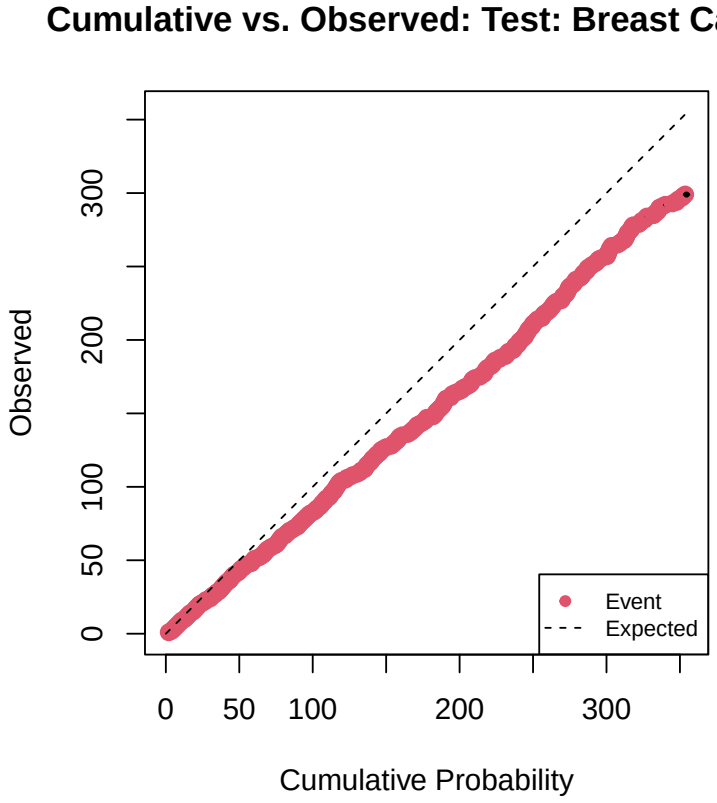
	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	1985	816	1144	93.9	385.7
class=1	396	248	177	28.0	31.8
class=2	601	454	197	336.3	391.3

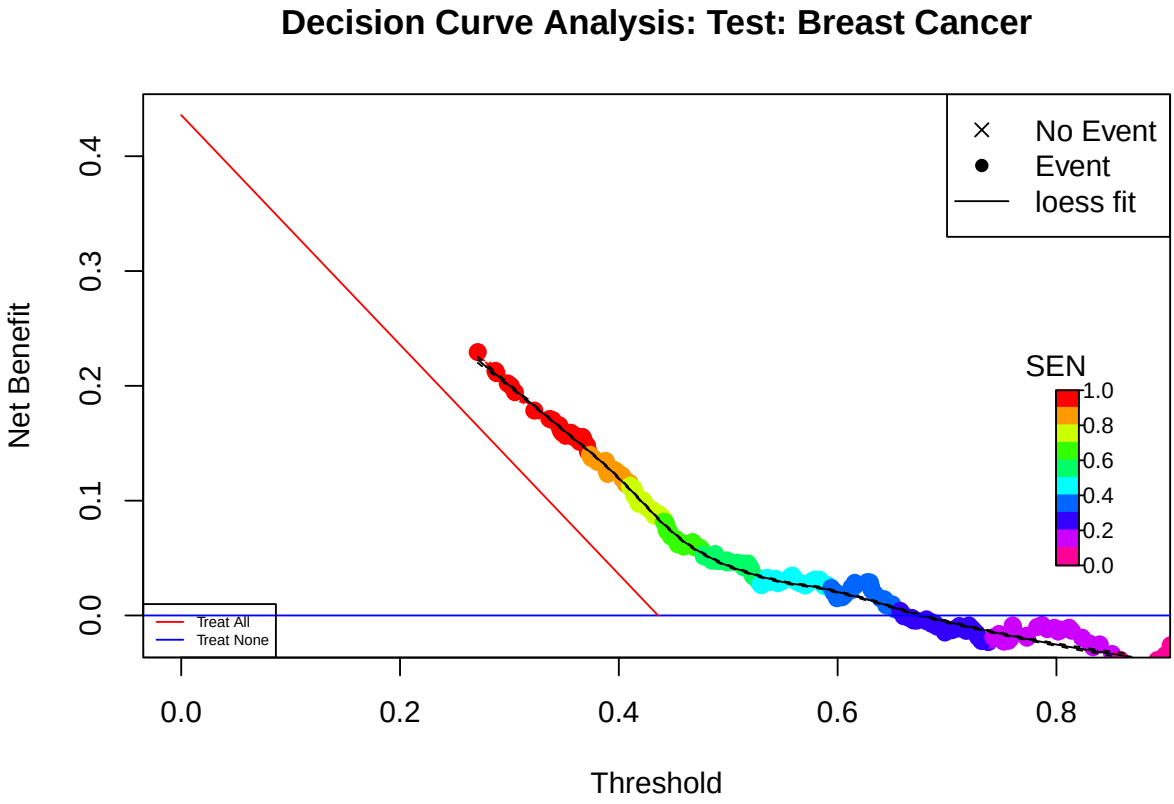
1.5 Performance on the external data set

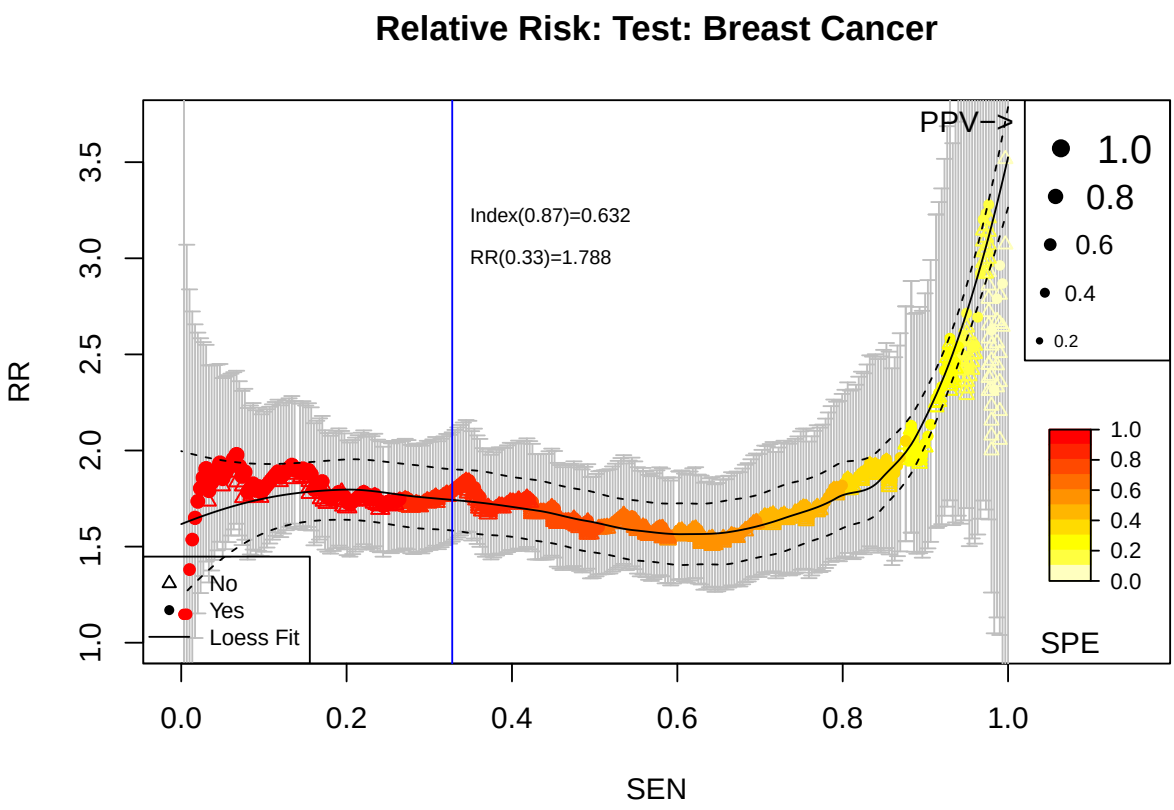
```
index <- predict(ml,dataBrestCancerTest)
pp <- predictionStats_binary(cbind(dataBrestCancerTest$status,index),plotname="Breast Cancer")
```

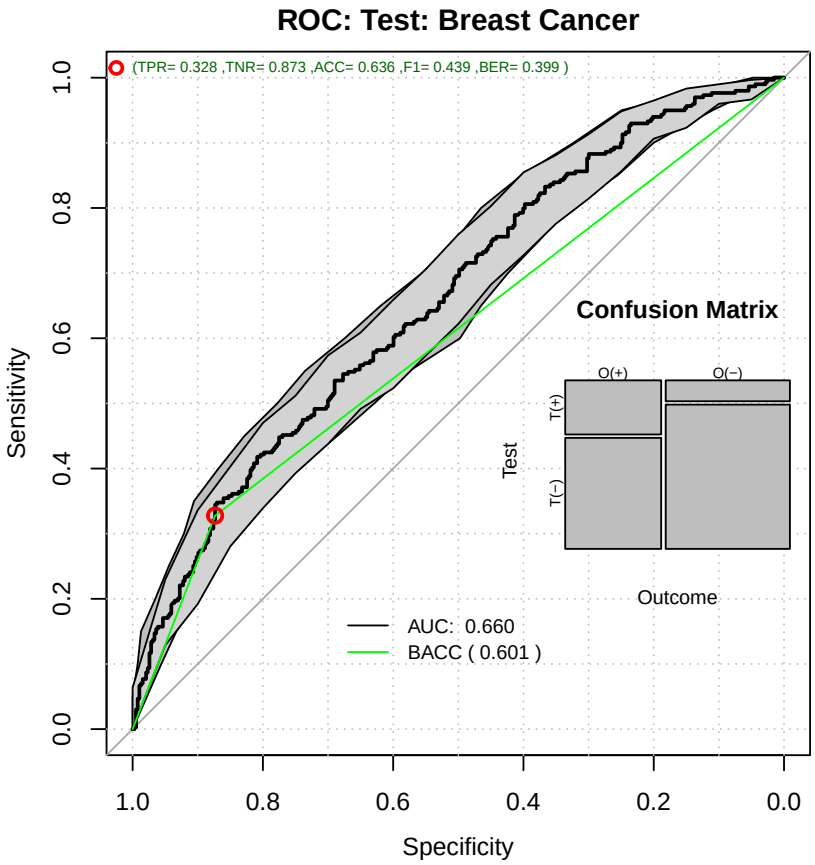


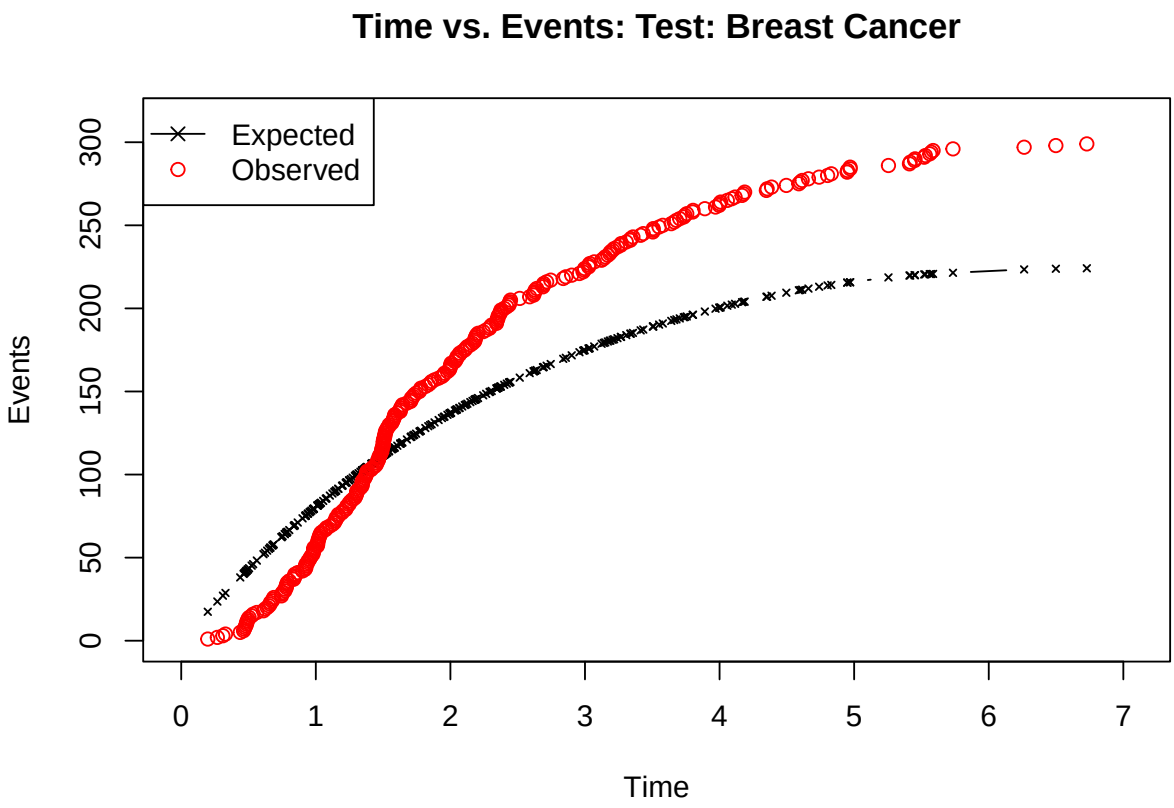

```
par(op)


prob <- ppoisGzero(index,h0)
rdata <- cbind(dataBrestCancerTest$status,prob)
rrCoxTestAnalysis <- RRPlot(rdata,atThr=rrAnalysisTrain$thr_atP,
                      timetoEvent=dataBrestCancerTest$time,
                      title="Test: Breast Cancer",
                      ysurvlim=c(0.00,1.0),
                      riskTimeInterval=timeinterval)
```

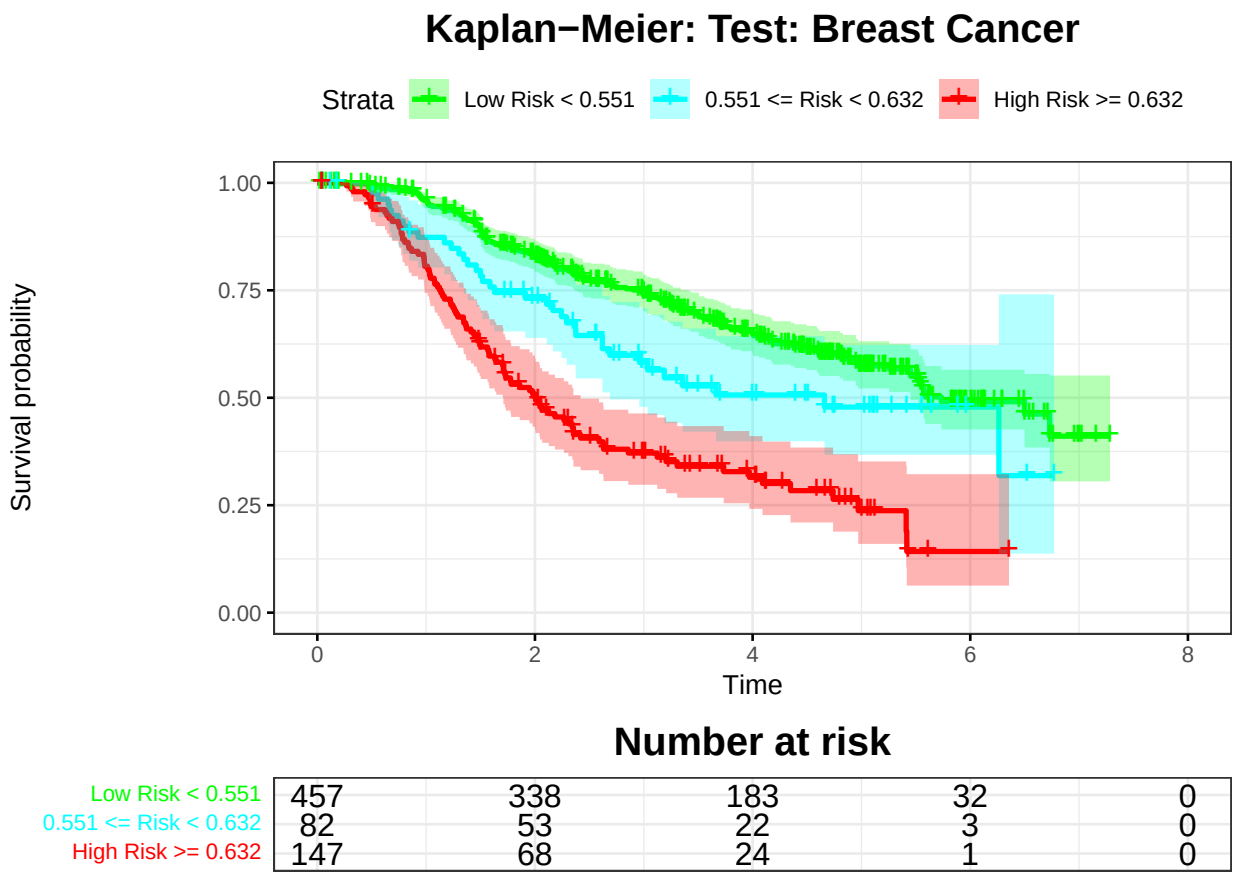

Cumulative vs. Observed: Test: Breast Cancer
Observed
0
50
100
200
300
Event
Expected
0
50
100
200
300
Cumulative Probability


Decision Curve Analysis: Test: Breast Cancer
No Event
Event
loess fit
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None
Net Benefit
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8
Threshold


Relative Risk: Test: Breast Cancer
PPV–>
Index(0.87)=0.632
RR(0.33)=1.788
1.0
0.8
0.6
0.4
0.2
1.0
0.8
0.6
0.4
0.2
0.0
SPE
No
Yes
Loess Fit
RR
SEN
1.0
1.5
2.0
2.5
3.0
3.5
0.0
0.2
0.4
0.6
0.8
1.0


ROC: Test: Breast Cancer
(TPR= 0.328 ,TNR= 0.873 ,ACC= 0.636 ,F1= 0.439 ,BER= 0.399)
Sensitivity
Specificity
1.0
0.8
0.6
0.4
0.2
0.0
Confusion Matrix
O(+)
O(−)
T(+)
T(−)
Test
Outcome
AUC: 0.660
BACC (0.601)


Time vs. Events: Test: Breast Cancer
Expected
Observed
Events
0
50
100
150
200
250
300
0
1
2
3
4
5
6
7
Time




```
par(op)
```

1.5.1 External Data Report

```
pander::pander(t(rrCoxTestAnalysis$keyPoints),caption="Threshold values")
```

Table 30: Threshold values

	@:0.63	@:0.55	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.631	0.552	0.583	0.337	0.2710	0.500
RR	1.799	1.643	1.758	3.279	26.3824	1.594
SEN	0.331	0.452	0.418	0.977	1.0000	0.552
SPE	0.873	0.757	0.809	0.111	0.0155	0.654
BACC	0.602	0.604	0.613	0.544	0.5078	0.603

```
pander::pander(t(rrCoxTestAnalysis$OERatio$estimate),caption="O/E Ratio")
```

Table 31: O/E Ratio

O/E	Low	Upper	p.value
1.33	1.19	1.49	1.74e-06

```
pander::pander(rrCoxTestAnalysis$c.index,caption="C. Index")
```

- **C Index**: *0.664*
- **Dxy**: *0.328*
- **S.D.**: *0.0311*
- **n**: *686*
- **missing**: *0*
- **uncensored**: *299*
- **Relevant Pairs**: *266144*
- **Concordant**: *176737*
- **Uncertain**: *203702*
- **cstatCI**:

mean.C Index	median	lower	upper
0.664	0.665	0.635	0.694

```
pander::pander(t(rrCoxTestAnalysis$ROCAnalysis$aucs),caption="ROC AUC")
```

Table 33: ROC AUC

est	lower	upper
0.66	0.619	0.7

```
pander::pander((rrCoxTestAnalysis$ROCAnalysis$sensitivity),caption="Sensitivity")
```

Table 34: Sensitivity

est	lower	upper
0.328	0.275	0.384

```
pander::pander((rrCoxTestAnalysis$ROCAnalysis$specificity),caption="Specificity")
```

Table 35: Specificity

est	lower	upper
0.873	0.836	0.905

```
pander::pander(t(rrCoxTestAnalysis$thr_atP),caption="Probability Thresholds")
```

Table 36: Probability Thresholds

90%	80%
0.632	0.551

```
pander::pander(t(rrCoxTestAnalysis$RR_atP),caption="Risk Ratio")
```

Table 37: Risk Ratio

est	lower	upper
1.79	1.53	2.09

```
pander::pander(rrCoxTestAnalysis$surdif,caption="Logrank test")
```

Table 38: Logrank test Chisq = 81.471750 on 2 degrees of freedom, p = 0.000000

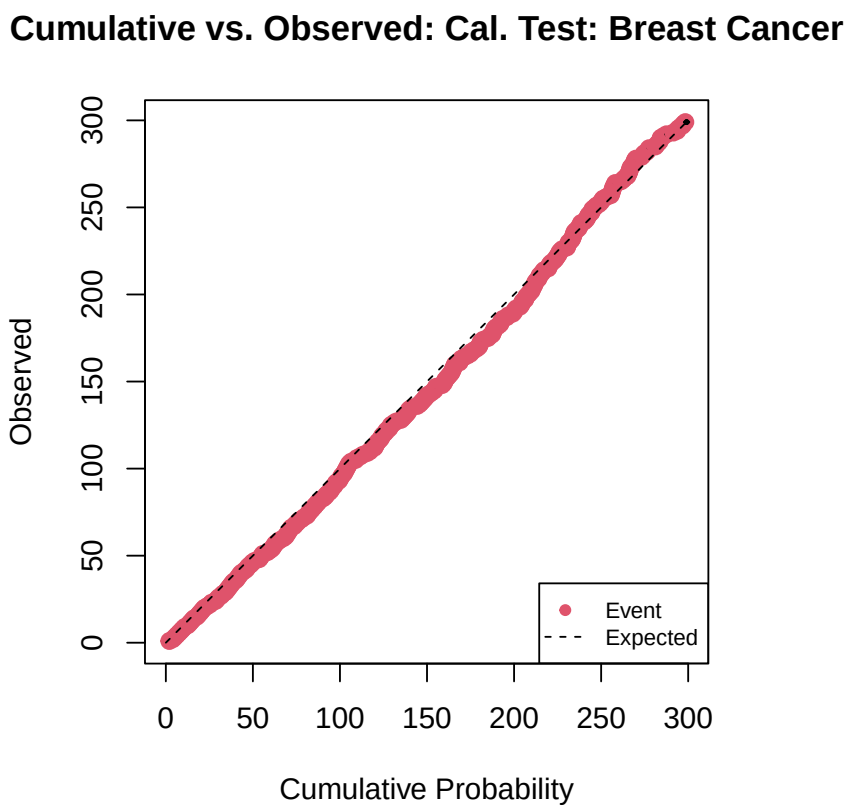
	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	457	164	221.4	14.888	58.181
class=1	82	37	33.2	0.438	0.494
class=2	147	98	44.4	64.710	77.254

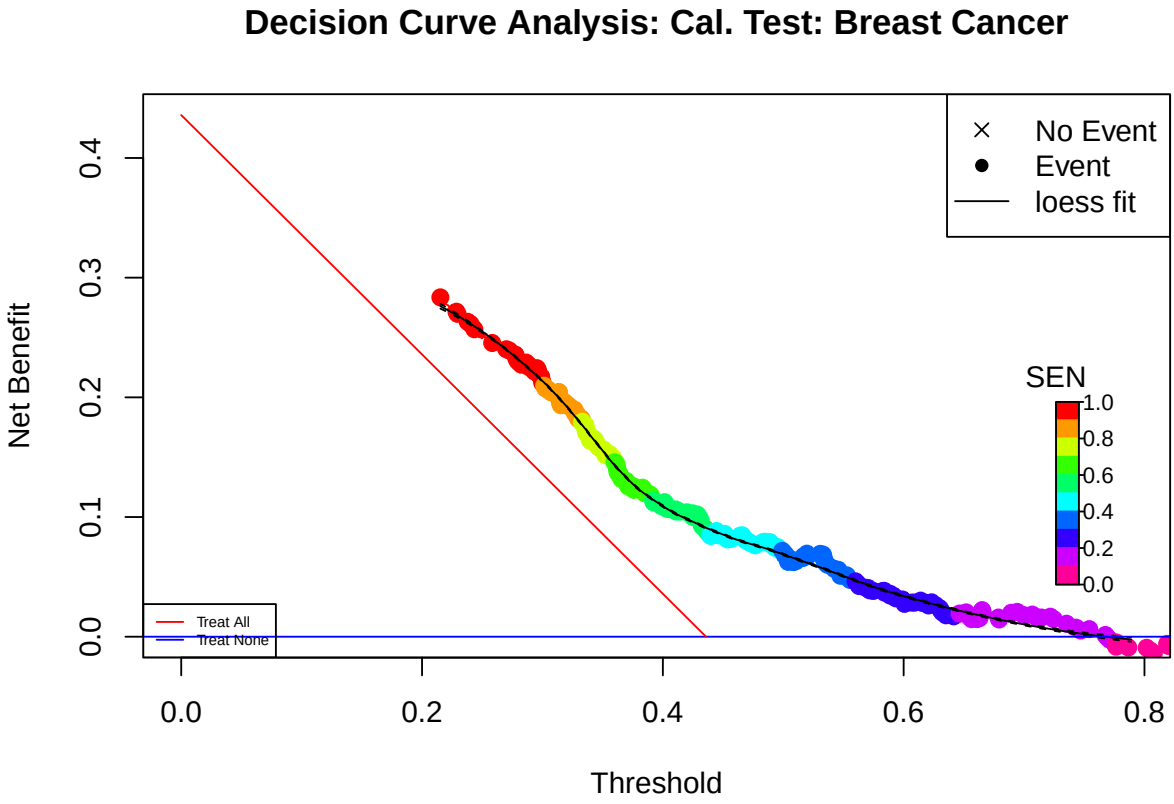
1.5.2 Calibrating the index on the test data

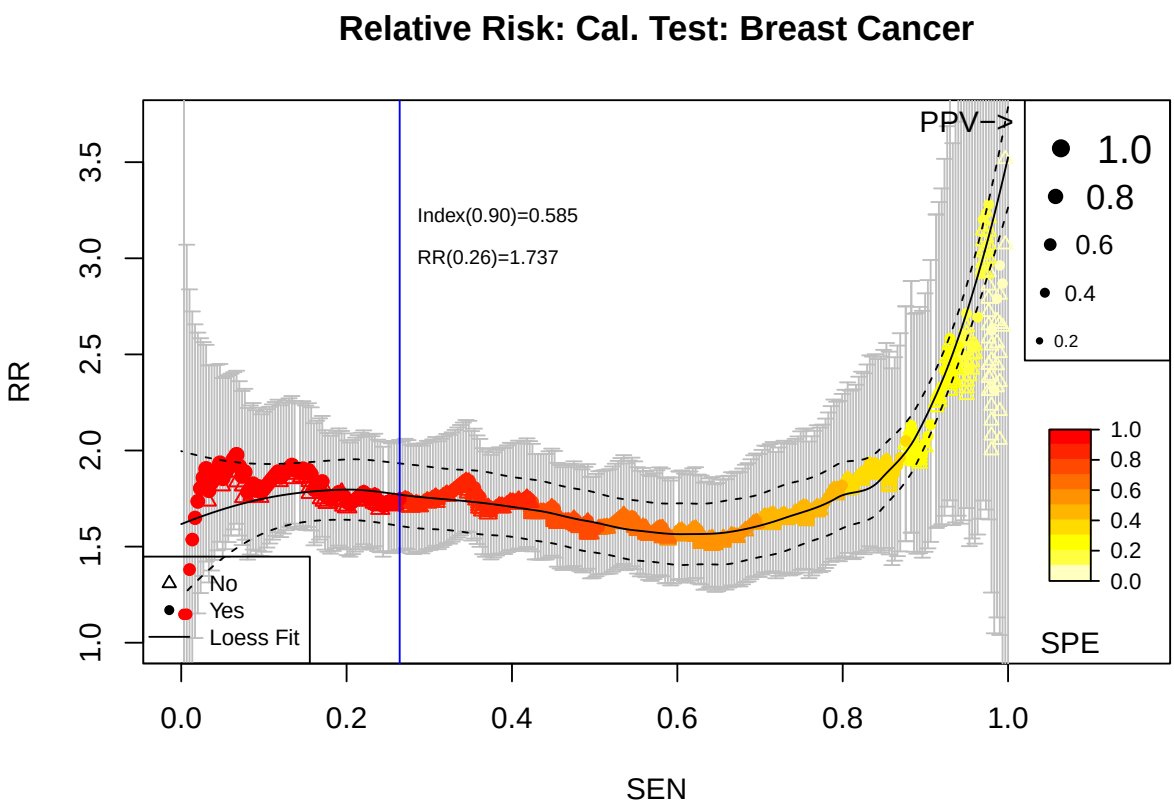
```
calprob <- CoxRiskCalibration(ml,dataBrestCancerTest,"status","time")

pander::pander(c(h0=calprob$h0,
                 Gain=calprob$hazardGain,
                 DeltaTime=calprob$timeInterval),
               caption="Cox Calibration Parameters")
```

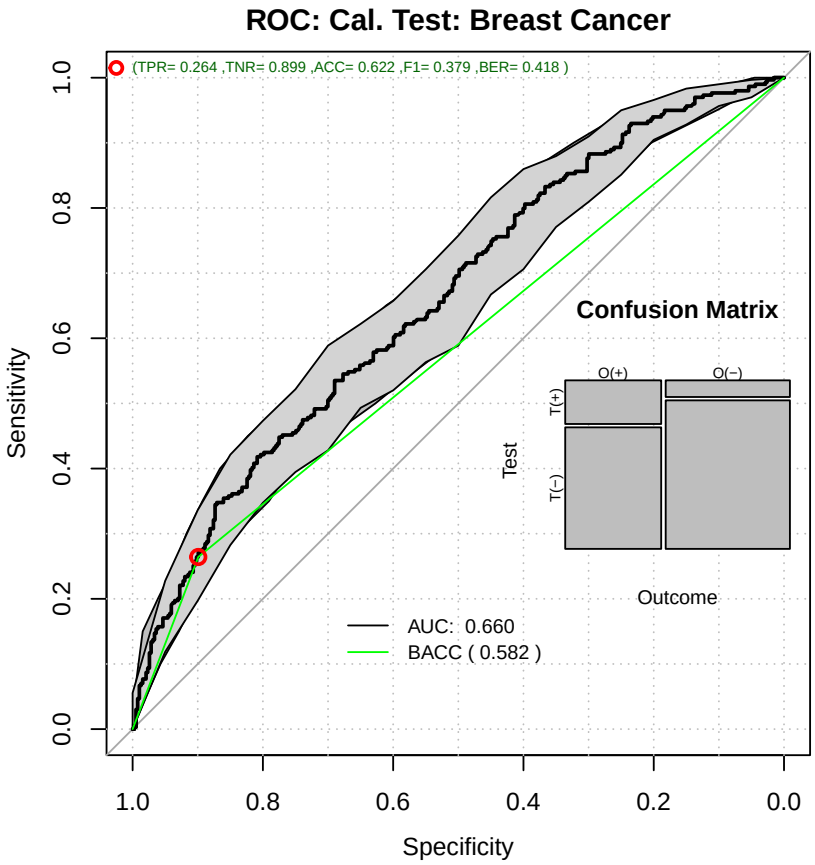
h0	Gain	DeltaTime
0.535	0.925	4.87

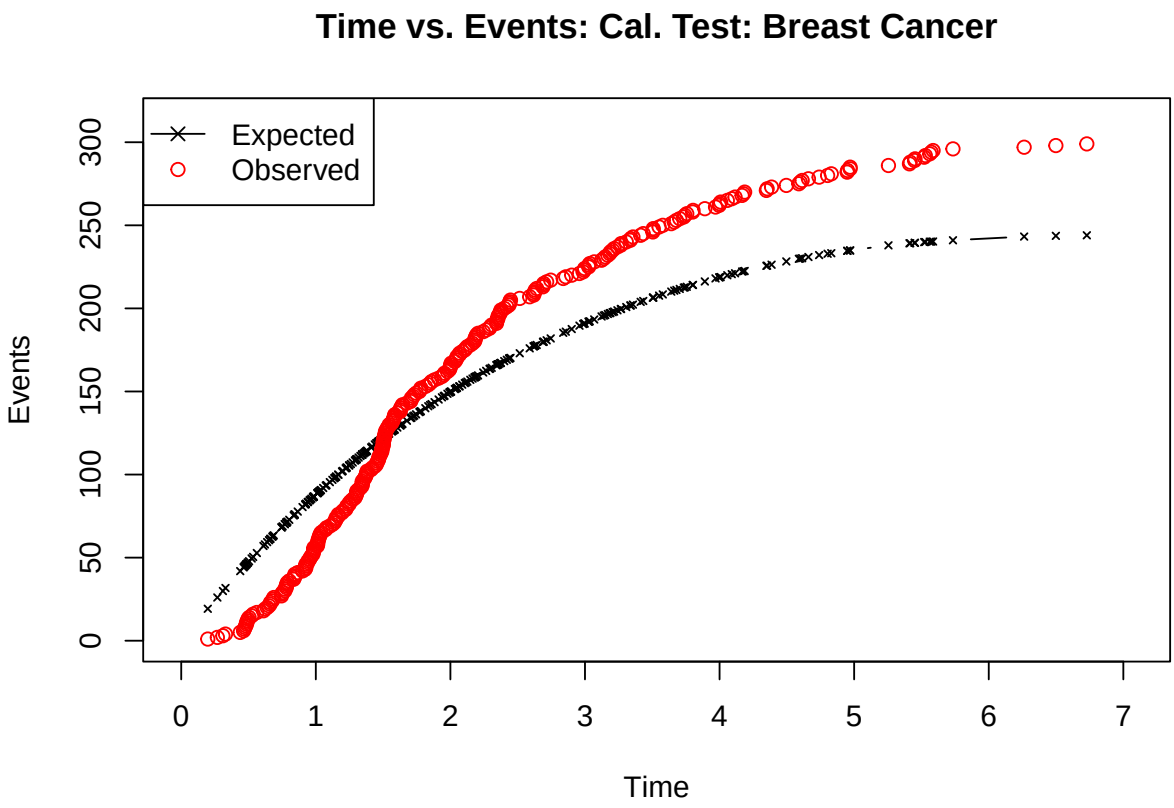
```
rdata <- cbind(dataBrestCancerTest$status,calprob$prob)

rrAnalysis <- RRPlot(rdata,atProb=c(0.90,0.80),
                     timetoEvent=dataBrestCancerTest$time,
                     title="Cal. Test: Breast Cancer",
                     ysurvlim=c(0.00,1.0),
                     riskTimeInterval=calprob$timeInterval)
```

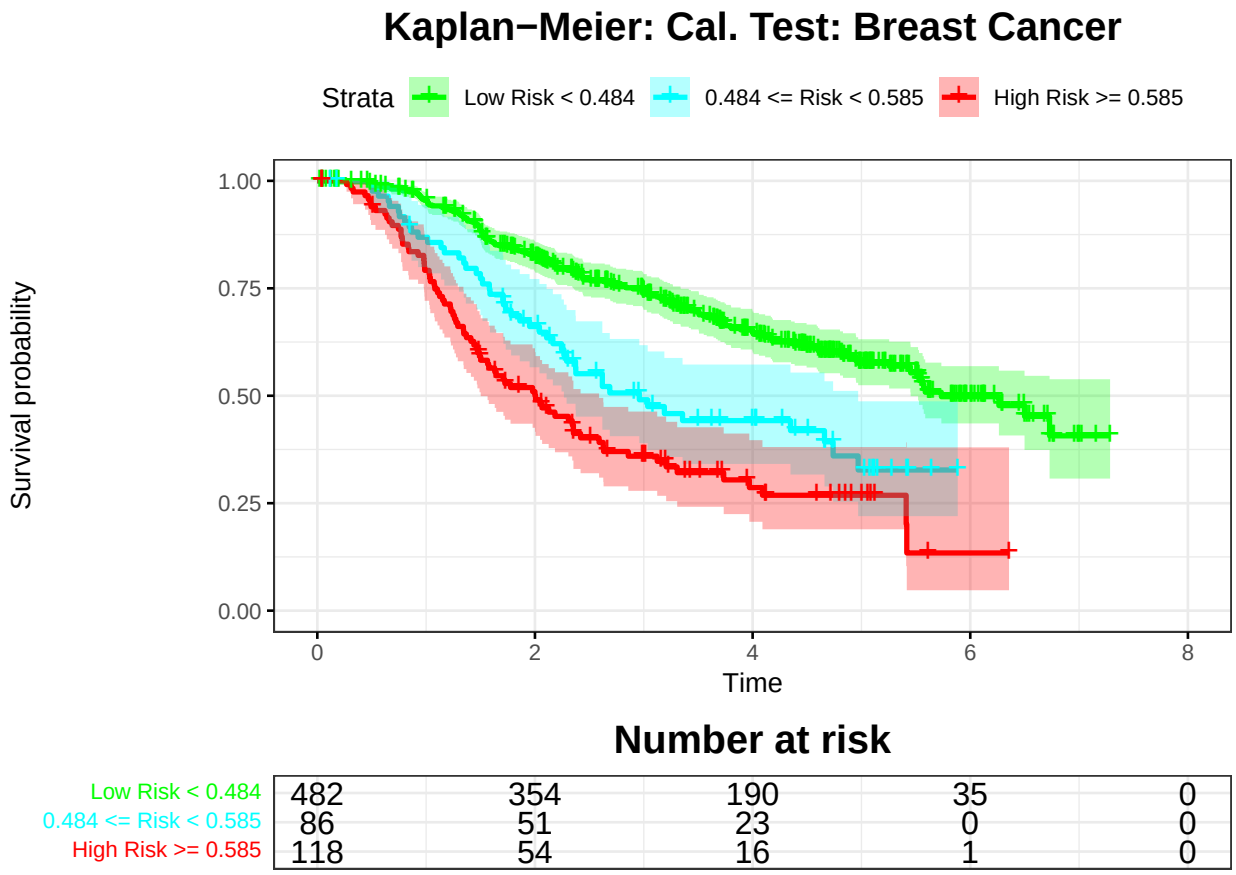

Cumulative vs. Observed: Cal. Test: Breast Cancer
Observed
0
50
100
150
200
250
300
Event
Expected
Cumulative Probability


Decision Curve Analysis: Cal. Test: Breast Cancer
No Event
Event
loess fit
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None
Net Benefit
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8
Threshold


Relative Risk: Cal. Test: Breast Cancer
PPV–>
Index(0.90)=0.585
RR(0.26)=1.737
1.0
0.8
0.6
0.4
0.2
1.0
0.8
0.6
0.4
0.2
0.0
SPE
No
Yes
Loess Fit
RR
1.0
1.5
2.0
2.5
3.0
3.5
0.0
0.2
0.4
0.6
0.8
1.0
SEN


ROC: Cal. Test: Breast Cancer
(TPR= 0.264 ,TNR= 0.899 ,ACC= 0.622 ,F1= 0.379 ,BER= 0.418)
Sensitivity
1.0
0.8
0.6
0.4
0.2
0.0
Specificity
1.0
0.8
0.6
0.4
0.2
0.0
Confusion Matrix
O(+)
O(−)
T(+)
T(−)
Test
Outcome
AUC: 0.660
BACC (0.582)


Time vs. Events: Cal. Test: Breast Cancer
Expected
Observed
Events
0
50
100
150
200
250
300
0
1
2
3
4
5
6
7
Time



1.5.3 After Calibration Report

```
pander::pander(t(rrAnalysis$keyPoints),caption="Threshold values")
```

Table 40: Threshold values

	@:0.9	@:0.8	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.584	0.484	0.489	0.270	0.2152	0.499
RR	1.741	1.721	1.758	3.279	26.3824	1.738
SEN	0.268	0.421	0.418	0.977	1.0000	0.398
SPE	0.899	0.798	0.809	0.111	0.0155	0.819
BACC	0.583	0.610	0.613	0.544	0.5078	0.609

```
pander::pander(t(rrAnalysis$OERatio$estimate),caption="O/E Ratio")
```

Table 41: O/E Ratio

O/E	Low	Upper	p.value
1.23	1.09	1.37	0.00061

```
pander::pander(rrAnalysis$c.index,caption="C. Index")
```

- **C Index**: *0.664*
- **Dxy**: *0.328*
- **S.D.**: *0.0311*
- **n**: *686*
- **missing**: *0*
- **uncensored**: *299*
- **Relevant Pairs**: *266144*
- **Concordant**: *176737*
- **Uncertain**: *203702*
- **cstatCI**:

mean.C Index	median	lower	upper
0.664	0.664	0.633	0.692

```
pander::pander(t(rrAnalysis$ROCAnalysis$aucs),caption="ROC AUC")
```

Table 43: ROC AUC

est	lower	upper
0.66	0.619	0.7

```
pander::pander((rrAnalysis$ROCAnalysis$sensitivity),caption="Sensitivity")
```

Table 44: Sensitivity

est	lower	upper
0.264	0.215	0.318

```
pander::pander((rrAnalysis$ROCAnalysis$specificity),caption="Specificity")
```

Table 45: Specificity

est	lower	upper
0.899	0.865	0.927

```
pander::pander(t(rrAnalysis$thr_atP),caption="Probability Thresholds")
```

Table 46: Probability Thresholds

90%	80%
0.585	0.484

```
pander::pander(t(rrAnalysis$RR_atP),caption="Risk Ratio")
```

Table 47: Risk Ratio

est	lower	upper
1.74	1.48	2.05

```
pander::pander(rrAnalysis$surdif,caption="Logrank test")
```

Table 48: Logrank test Chisq = 80.835092 on 2 degrees of freedom, p = 0.000000

	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	482	173	232.4	15.20	69.5
class=1	86	47	32.0	7.02	7.9
class=2	118	79	34.6	57.14	65.4

1.6 Logistic Model

Here we train a logistic model on the same data set

```
## Only label subjects that present event withing five years

dataBrestCancerR <- subset(dataBrestCancerTrain, time>=5 | status==1)
dataBrestCancerR$status <- dataBrestCancerR$status * (dataBrestCancerR$time < 5)
dataBrestCancerR$time <- NULL

#ml <- BSWiMS.model(status~1,data=dataBrestCancerR,loops=20,NumberofRepeats = 5)
mlog <- BSWiMS.model(status~1,data=dataBrestCancerR,loops=1,NumberofRepeats = 5)
```

——..

```
sm <- summary(mlog)
pander::pander(sm$coefficients)
```

Table 49: Table continues below

	Estimate	lower	OR	upper	u.Accuracy	r.Accuracy
size_nodes	1.05e-03	1.001	1.001	1.001	0.669	0.571
nodes	4.33e-02	1.040	1.044	1.048	0.676	0.634
grade_nodes	1.50e-02	1.014	1.015	1.016	0.682	0.637
age_nodes	1.06e-03	1.001	1.001	1.001	0.678	0.653
size_grade	1.75e-03	1.001	1.002	1.002	0.632	0.682
age_size	8.73e-05	1.000	1.000	1.000	0.608	0.682
grade	2.27e-01	1.168	1.254	1.347	0.571	0.683
age_meno	-6.04e-03	0.992	0.994	0.996	0.571	0.676
age_pgr	-5.42e-06	1.000	1.000	1.000	0.571	0.686
age_grade	-1.65e-03	0.997	0.998	0.999	0.574	0.690
meno_grade	1.02e-01	1.045	1.107	1.173	0.571	0.683
nodes_hormon	-1.38e-02	0.979	0.986	0.994	0.587	0.688
size	3.94e-03	1.002	1.004	1.006	0.611	0.693
meno_pgr	3.19e-04	1.000	1.000	1.001	0.571	0.687

	Estimate	lower	OR	upper	u.Accuracy	r.Accuracy
pgr	-1.07e-04	1.000	1.000	1.000	0.571	0.689
meno_nodes	-2.60e-02	0.955	0.974	0.994	0.640	0.686
grade_pgr	-3.51e-05	1.000	1.000	1.000	0.571	0.669
meno_size	2.34e-03	1.000	1.002	1.004	0.604	0.691

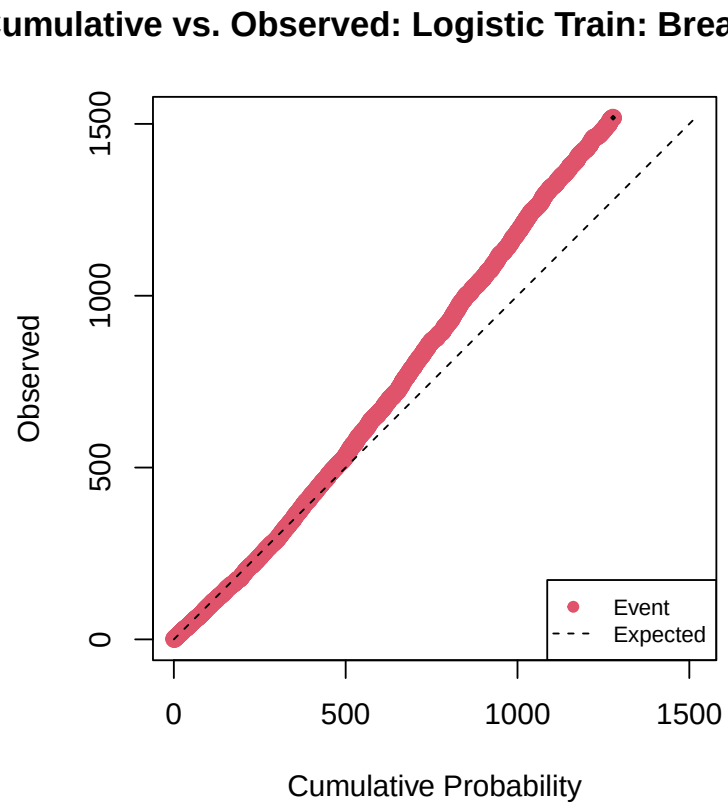
Table 50: Table continues below

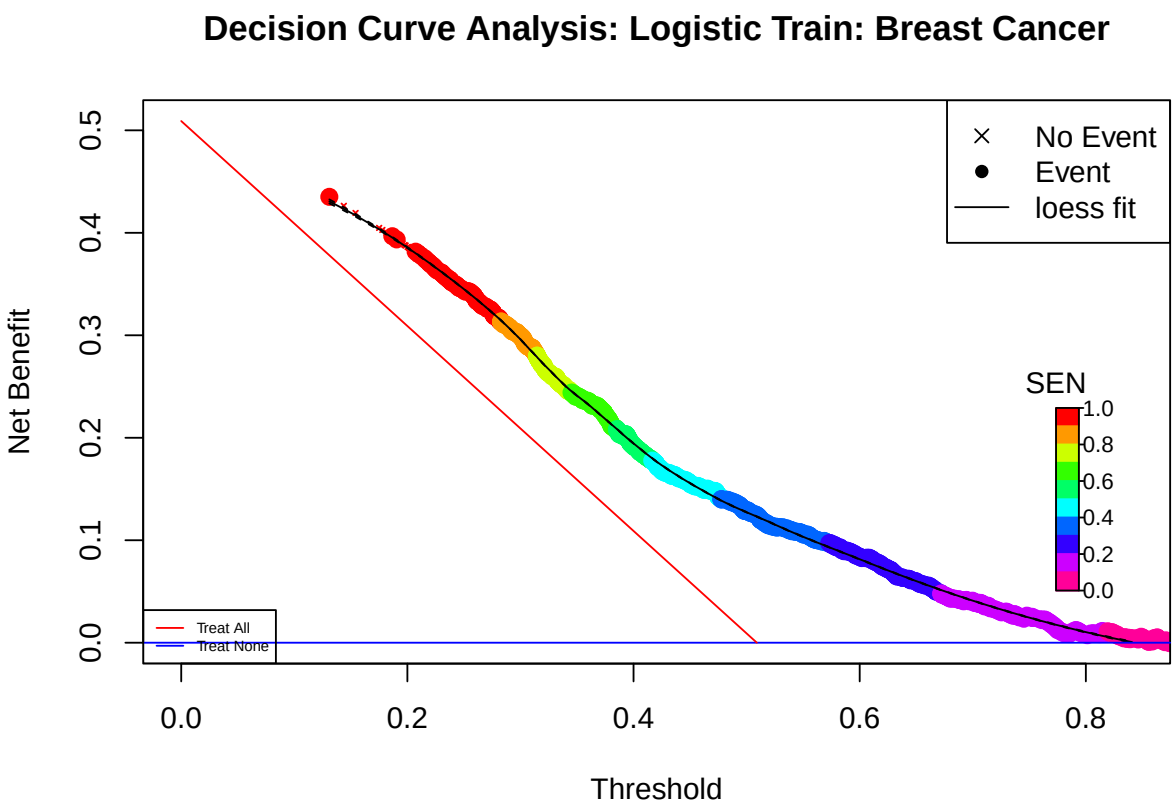
	full.Accuracy	u.AUC	r.AUC	full.AUC	IDI
size_nodes	0.668	0.627	0.500	0.628	0.11233
nodes	0.690	0.639	0.621	0.662	0.07110
grade_nodes	0.686	0.649	0.624	0.655	0.06580
age_nodes	0.686	0.642	0.621	0.657	0.03346
size_grade	0.686	0.626	0.646	0.655	0.01787
age_size	0.686	0.577	0.649	0.657	0.01534
grade	0.690	0.500	0.653	0.662	0.01340
age_meno	0.686	0.500	0.645	0.657	0.00782
age_pgr	0.686	0.500	0.656	0.657	0.00512
age_grade	0.690	0.507	0.661	0.662	0.00454
meno_grade	0.686	0.500	0.652	0.657	0.00425
nodes_hormon	0.686	0.526	0.658	0.655	0.00280
size	0.690	0.618	0.663	0.662	0.00507
meno_pgr	0.686	0.500	0.657	0.657	0.00316
pgr	0.686	0.500	0.659	0.655	0.00257
meno_nodes	0.686	0.595	0.656	0.657	0.00264
grade_pgr	0.668	0.500	0.627	0.628	0.00241
meno_size	0.690	0.578	0.663	0.662	0.00185

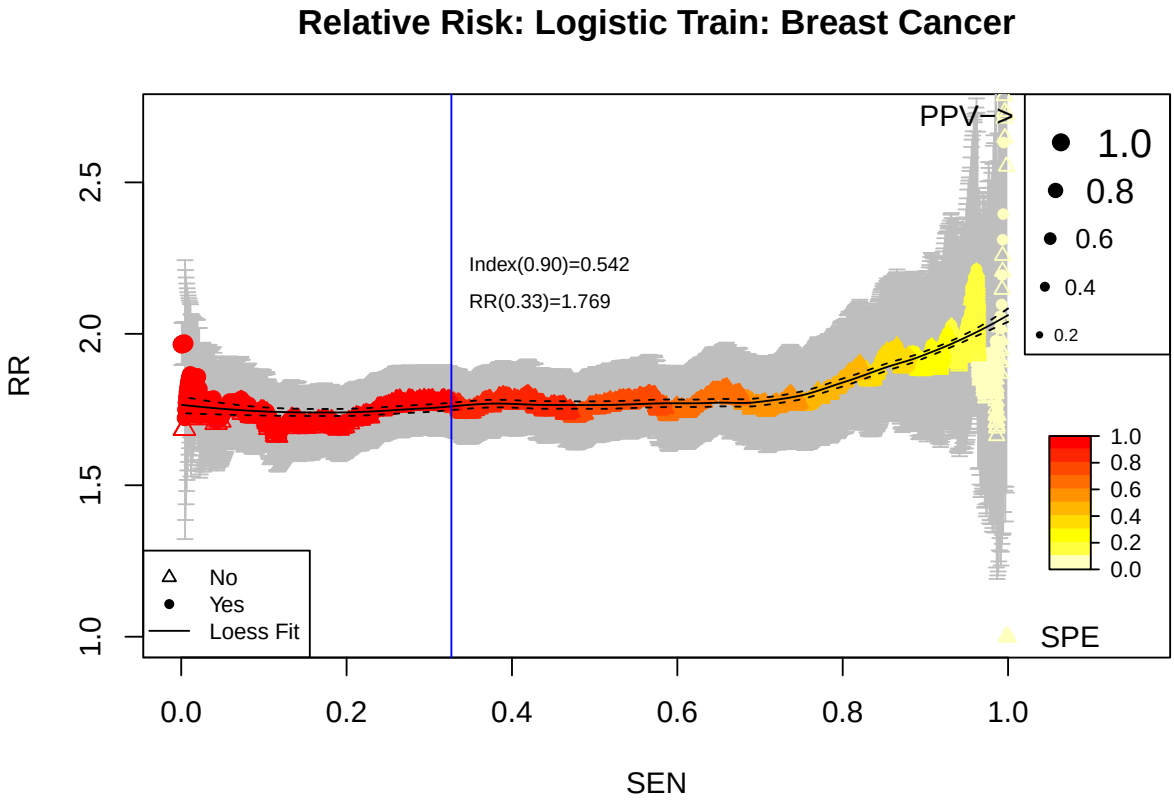
	NRI	z.IDI	z.NRI	Delta.AUC	Frequency
size_nodes	0.63654	17.86	18.870	0.128490	1
nodes	0.57106	14.13	16.179	0.040494	1
grade_nodes	0.54866	13.66	15.650	0.031087	1
age_nodes	0.21312	9.39	5.710	0.035896	1
size_grade	0.29411	6.74	7.728	0.008648	1
age_size	0.29152	6.41	7.652	0.007600	1
grade	0.19036	6.20	4.983	0.008461	1
age_meno	0.08057	4.76	2.337	0.012065	1
age_pgr	0.00745	4.11	0.194	0.000417	1
age_grade	0.11372	3.60	2.960	0.000315	1
meno_grade	0.20428	3.47	5.343	0.004441	1
nodes_hormon	0.45522	3.44	12.150	-0.002853	1
size	0.21050	3.42	5.600	-0.001075	1
meno_pgr	0.05977	3.35	1.558	-0.000429	1
pgr	0.19759	2.64	5.745	-0.004123	1
meno_nodes	-0.06329	2.59	-1.645	0.000631	1
grade_pgr	0.17471	2.55	5.058	0.001252	1
meno_size	0.10227	2.43	2.662	-0.001378	1

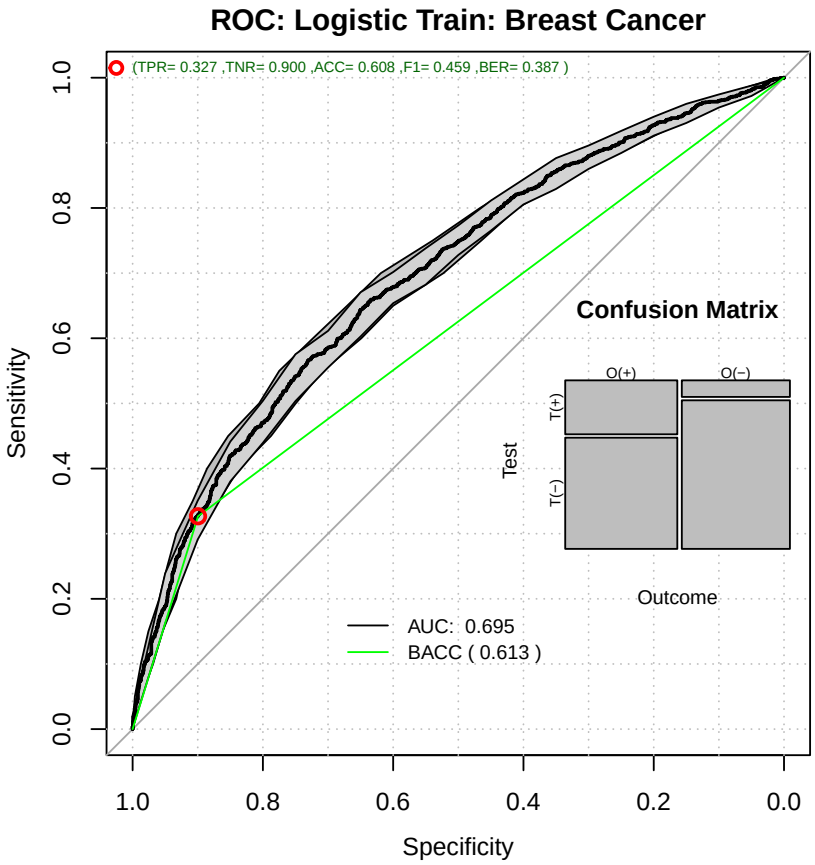
1.7 Logistic Model Performance

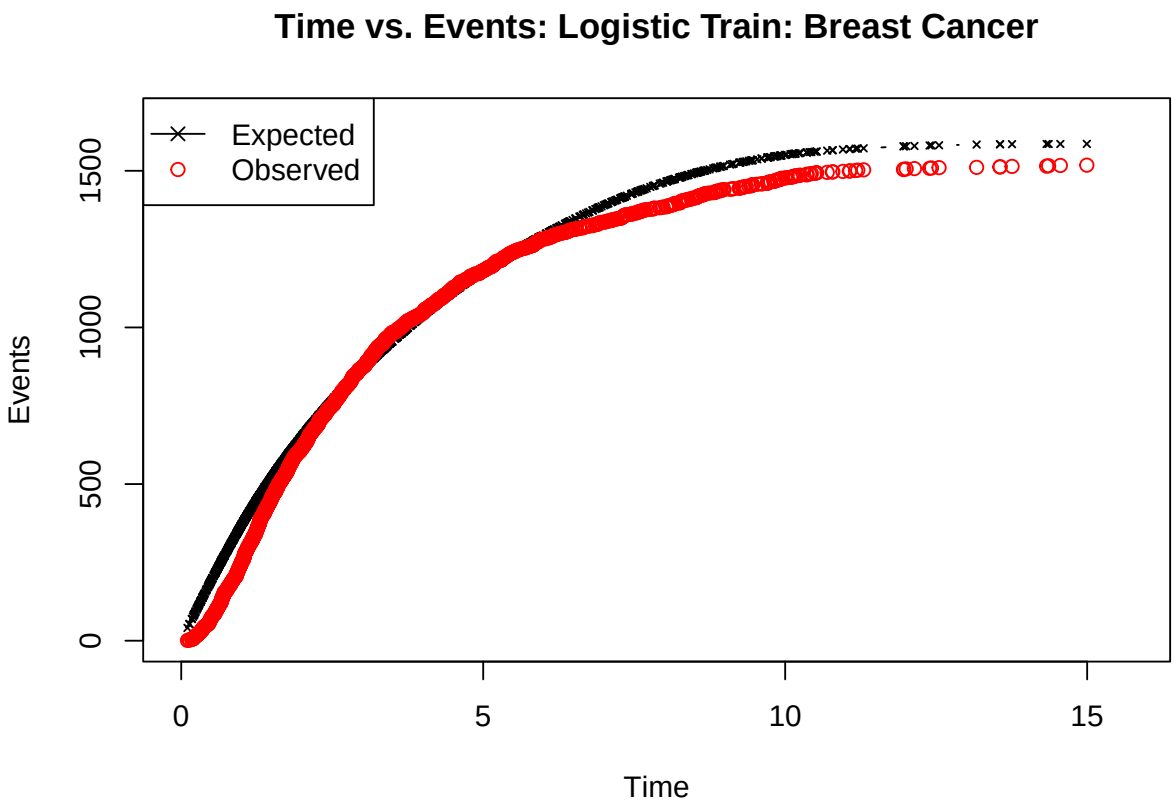
```
op <- par(no.readonly = TRUE)


cprob <- predict(mlog,dataBrestCancerTrain)

rdata <- cbind(dataBrestCancerTrain$status,cprob)
rrAnalysisTrain <- RRPlot(rdata,atProb=c(0.90,0.80),
                      timetoEvent=dataBrestCancerTrain$time,
                      title="Logistic Train: Breast Cancer",
                      ysurvlim=c(0.00,1.0),
                      riskTimeInterval=5.0)
```

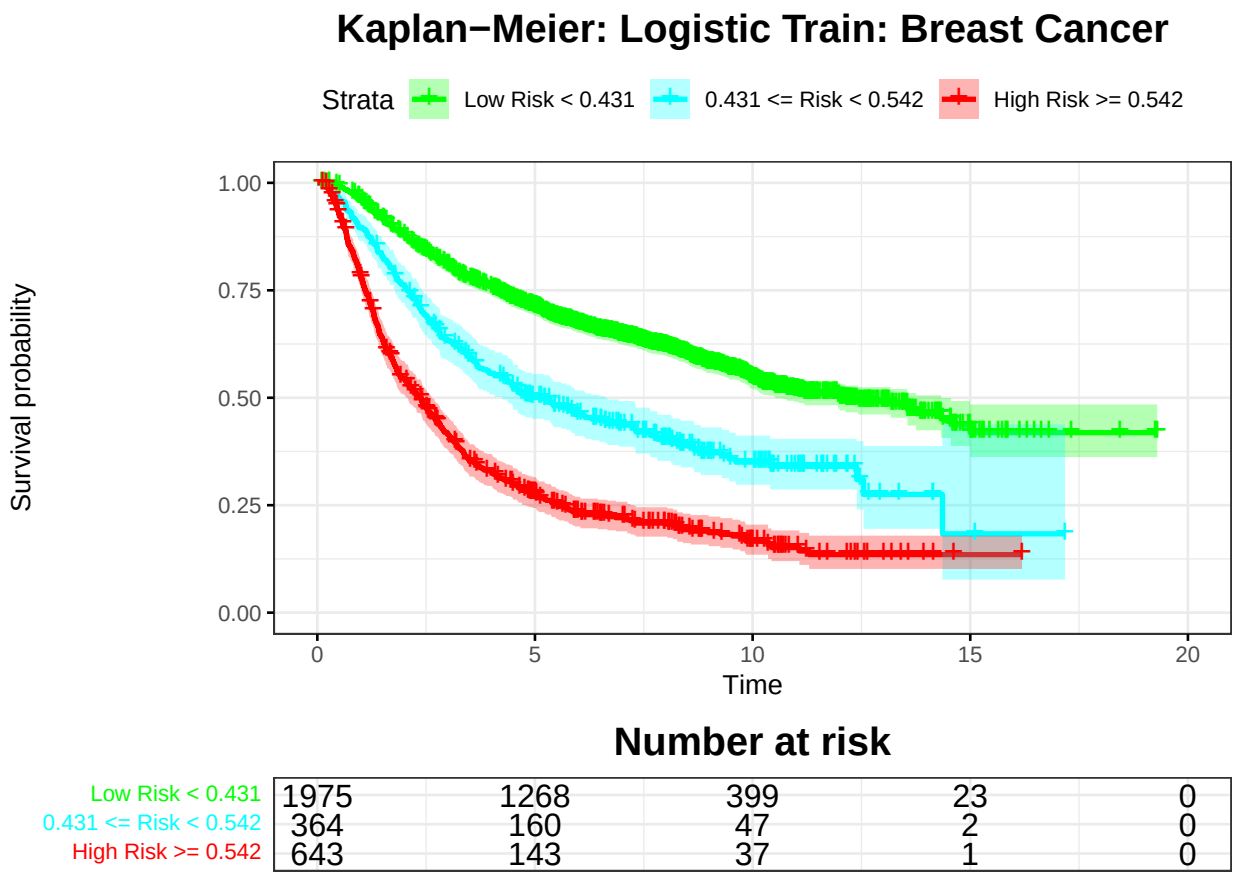



Decision Curve Analysis: Logistic Train: Breast Cancer
Net Benefit
0.0
0.1
0.2
0.3
0.4
0.5
0.0
0.2
0.4
0.6
0.8
Threshold
No Event
Event
loess fit
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None


Relative Risk: Logistic Train: Breast Cancer
PPV–>
1.0
0.8
0.6
0.4
0.2
Index(0.90)=0.542
RR(0.33)=1.769
1.0
0.8
0.6
0.4
0.2
0.0
No
Yes
Loess Fit
SPE
RR
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0
SEN


ROC: Logistic Train: Breast Cancer
(TPR= 0.327 ,TNR= 0.900 ,ACC= 0.608 ,F1= 0.459 ,BER= 0.387)
Sensitivity
Specificity
1.0
0.8
0.6
0.4
0.2
0.0
Confusion Matrix
O(+)
O(−)
T(+)
T(−)
Test
Outcome
AUC: 0.695
BACC (0.613)


Time vs. Events: Logistic Train: Breast Cancer
Expected
Observed
Events
0
500
1000
1500
0
5
10
15
Time




```
par(op)
```

1.7.1 Training Report

```
pander::pander(t(rrAnalysisTrain$keyPoints),caption="Threshold values")
```

Table 52: Threshold values

	@:0.9	@:0.8	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.542	0.431	0.394	0.255	0.130969	0.500
RR	1.765	1.739	1.799	2.213	1.000000	1.773
SEN	0.327	0.470	0.566	0.962	1.000000	0.374
SPE	0.900	0.799	0.731	0.125	0.000683	0.874
BACC	0.613	0.635	0.648	0.543	0.500342	0.624

```
pander::pander(t(rrAnalysisTrain$OERatio$estimate),caption="O/E Ratio")
```

Table 53: O/E Ratio

O/E	Low	Upper	p.value
0.957	0.91	1.01	0.0901

```
pander::pander(rrAnalysisTrain$c.index,caption="C. Index")
```

- **C Index**: *0.68*
- **Dxy**: *0.36*
- **S.D.**: *0.014*
- **n**: *2982*
- **missing**: *0*
- **uncensored**: *1518*
- **Relevant Pairs**: *6184528*
- **Concordant**: *4206582*
- **Uncertain**: *2703838*
- **cstatCI**:

mean.C Index	median	lower	upper
0.68	0.68	0.666	0.695

```
pander::pander(t(rrAnalysisTrain$ROCAnalysis$aucs),caption="ROC AUC")
```

Table 55: ROC AUC

est	lower	upper
0.695	0.677	0.714

```
pander::pander((rrAnalysisTrain$ROCAnalysis$sensitivity),caption="Sensitivity")
```

Table 56: Sensitivity

est	lower	upper
0.327	0.303	0.351

```
pander::pander((rrAnalysisTrain$ROCAnalysis$specificity),caption="Specificity")
```

Table 57: Specificity

est	lower	upper
0.9	0.883	0.915

```
pander::pander(t(rrAnalysisTrain$thr_atP),caption="Probability Thresholds")
```

Table 58: Probability Thresholds

90%	80%
0.542	0.431

```
pander::pander(t(rrAnalysisTrain$RR_atP),caption="Risk Ratio")
```

Table 59: Risk Ratio

est	lower	upper
1.77	1.66	1.88

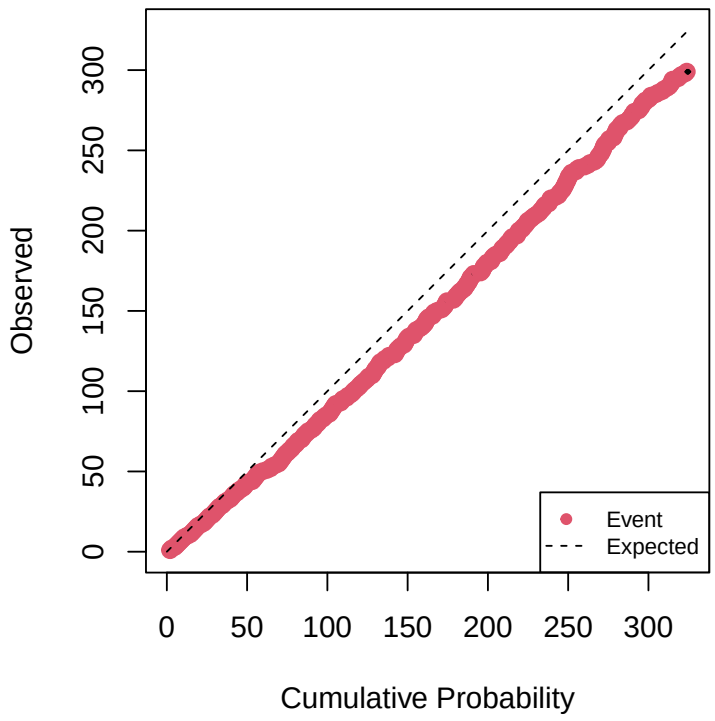
```
pander::pander(rrAnalysisTrain$surdif,caption="Logrank test")
```

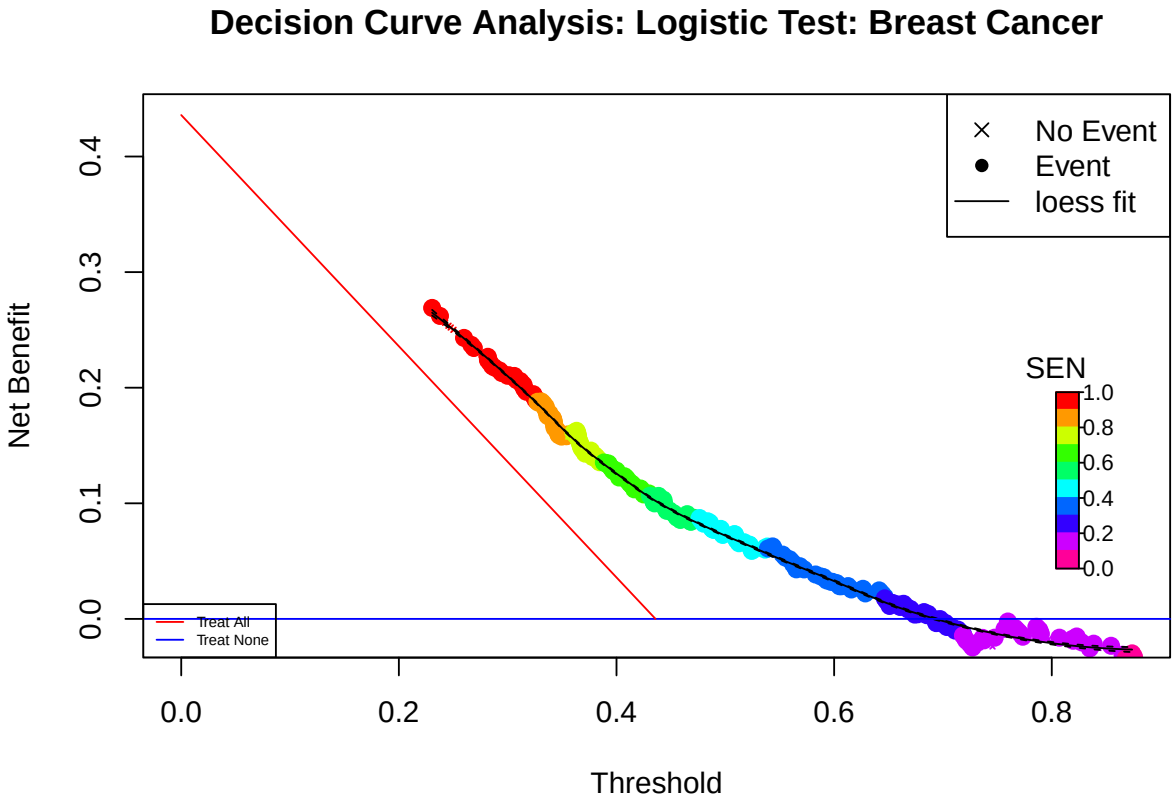
Table 60: Logrank test Chisq = 543.347175 on 2 degrees of freedom, p = 0.000000

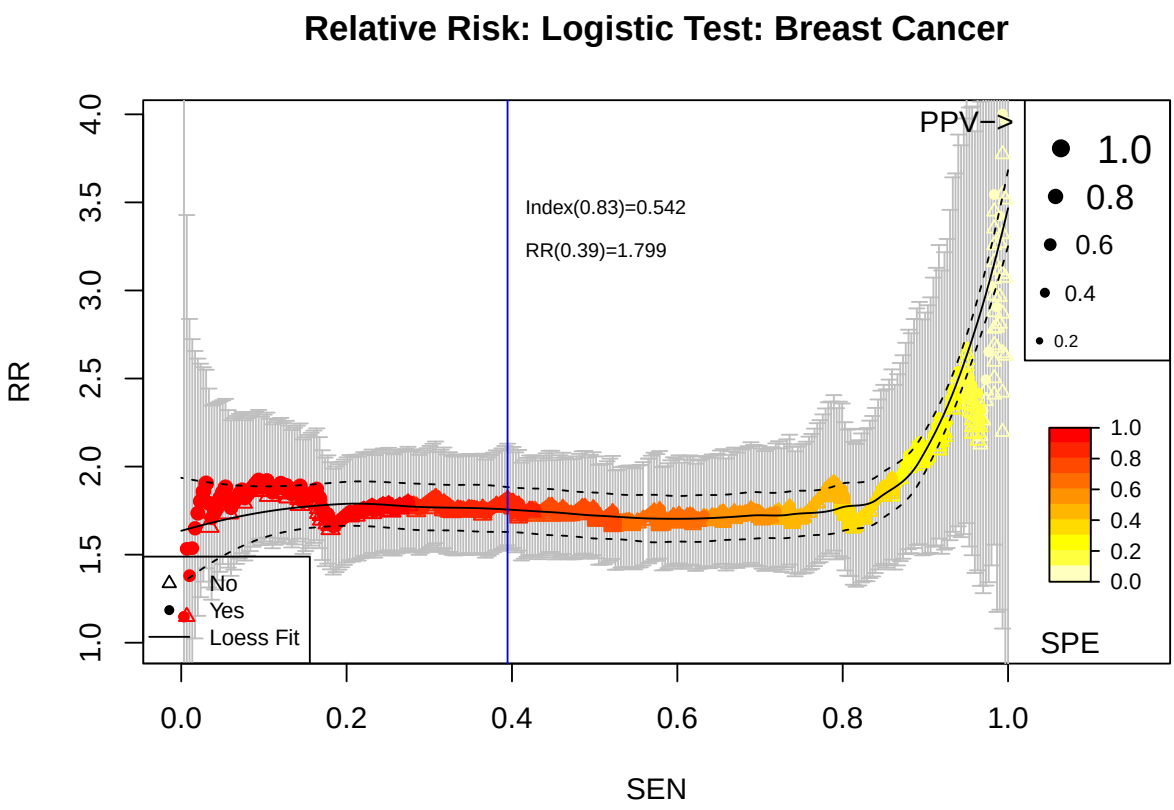
	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	1975	804	1145	101.5	418.9
class=1	364	218	169	14.1	15.9
class=2	643	496	204	418.2	490.7

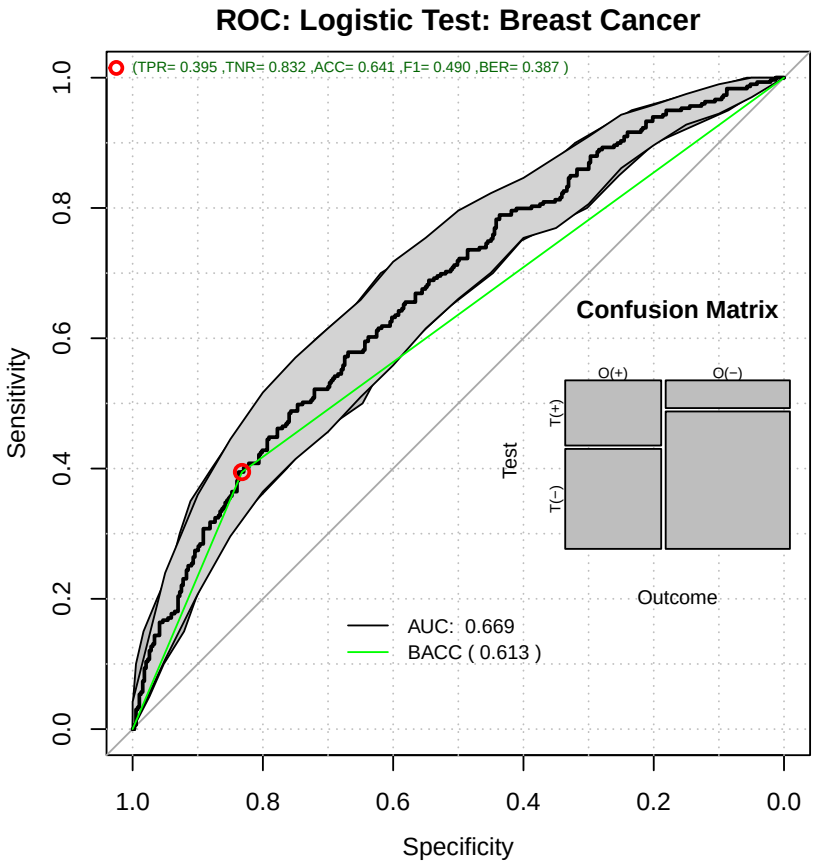
1.7.2 Results on the validation set using Logistic model

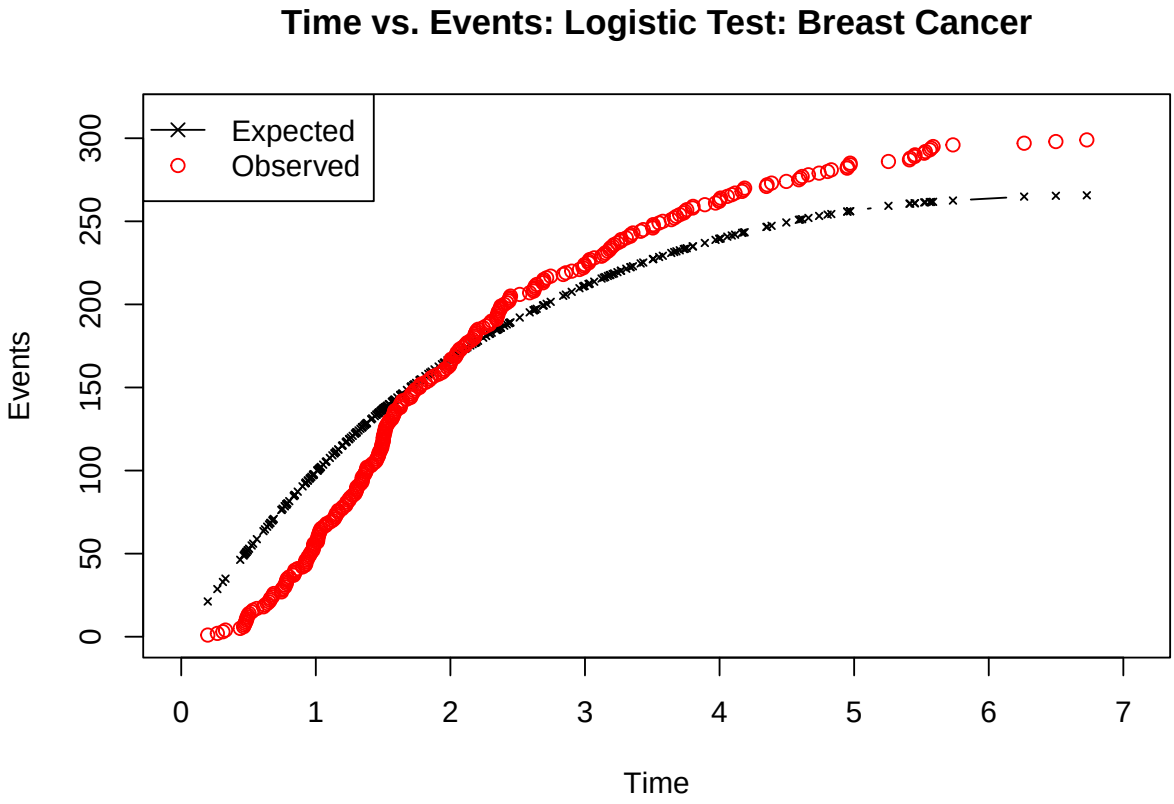
```
pre <- predict(mlog,dataBrestCancerTest)
rdata <- cbind(dataBrestCancerTest$status,pre)

rrAnalysis <- RRPlot(rdata,atThr=rrAnalysisTrain$thr_atP,
                     timetoEvent=dataBrestCancerTest$time,
                     title="Logistic Test: Breast Cancer",
                     ysurvlim=c(0.00,1.0),
                     riskTimeInterval=5)
```

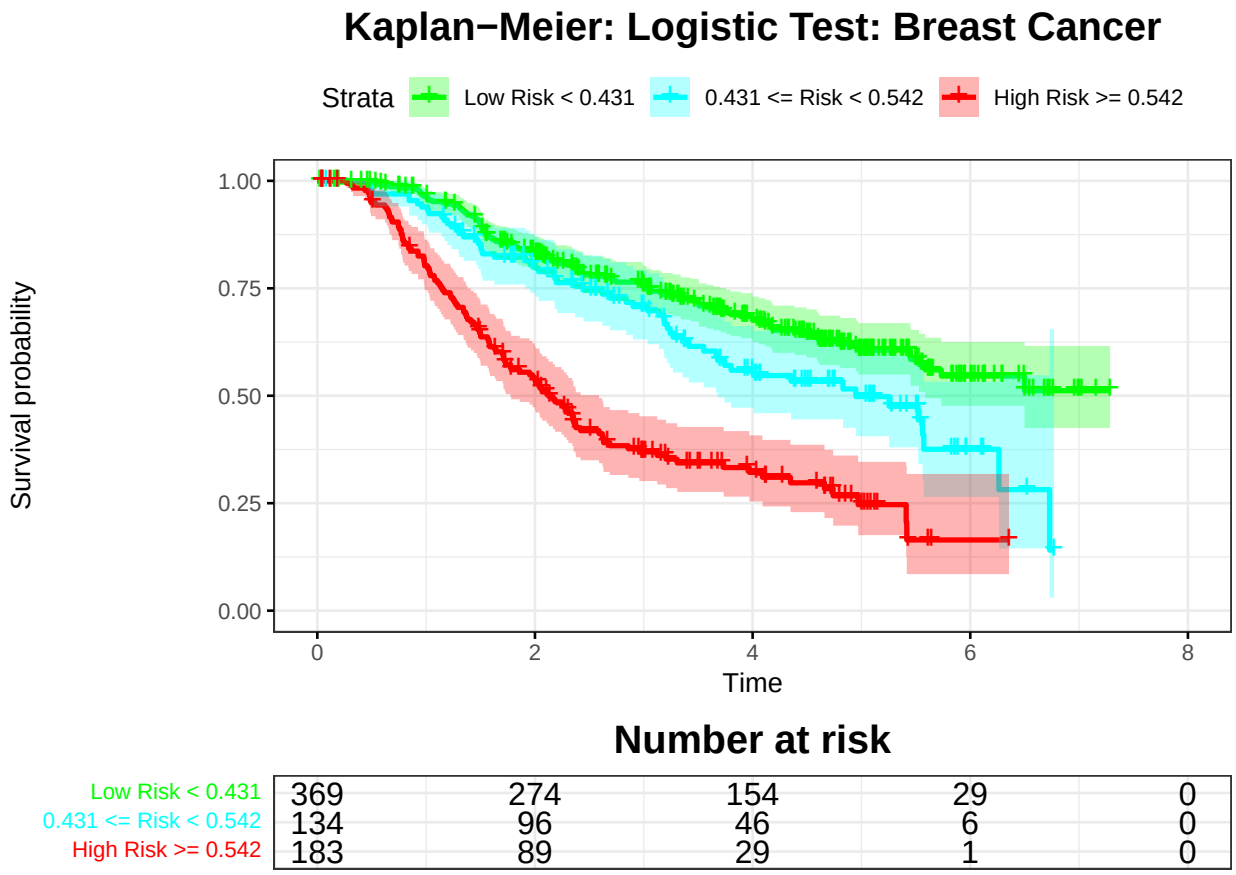

Cumulative vs. Observed: Logistic Test: Breast Cancer
Observed
0
50
100
150
200
250
300
Event
Expected
0
50
100
150
200
250
300
Cumulative Probability


Decision Curve Analysis: Logistic Test: Breast Cancer
No Event
Event
loess fit
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None
Net Benefit
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8
Threshold


Relative Risk: Logistic Test: Breast Cancer
RR
SEN
PPV–>
Index(0.83)=0.542
RR(0.39)=1.799
1.0
0.8
0.6
0.4
0.2
SPE
No
Yes
Loess Fit
1.0
2.0
3.0
4.0
0.0
0.2
0.4
0.6
0.8
1.0


ROC: Logistic Test: Breast Cancer
(TPR= 0.395 ,TNR= 0.832 ,ACC= 0.641 ,F1= 0.490 ,BER= 0.387)
Sensitivity
Specificity
1.0
0.8
0.6
0.4
0.2
0.0
Confusion Matrix
O(+)
O(−)
T(+)
T(−)
Test
Outcome
AUC: 0.669
BACC (0.613)


Time vs. Events: Logistic Test: Breast Cancer
Expected
Observed
Events
0
50
100
150
200
250
300
0
1
2
3
4
5
6
7
Time




```
par(op)
```

1.7.3 Validation Report

```
pander::pander(t(rrAnalysis$keyPoints),caption="Threshold values")
```

Table 61: Threshold values

	@:0.54	@:0.43	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.542	0.431	0.439	0.306	0.2306	0.500
RR	1.792	1.702	1.756	2.678	21.9530	1.732
SEN	0.395	0.595	0.579	0.950	1.0000	0.448
SPE	0.832	0.638	0.669	0.181	0.0129	0.780
BACC	0.613	0.617	0.624	0.565	0.5065	0.614

```
pander::pander(t(rrAnalysis$OERatio$estimate),caption="O/E Ratio")
```

Table 62: O/E Ratio

O/E	Low	Upper	p.value
1.13	1	1.26	0.0428

```
pander::pander(rrAnalysis$c.index,caption="C. Index")
```

- **C Index**: *0.669*
- **Dxy**: *0.338*
- **S.D.**: *0.0309*
- **n**: *686*
- **missing**: *0*
- **uncensored**: *299*
- **Relevant Pairs**: *266144*
- **Concordant**: *178115*
- **Uncertain**: *203702*
- **cstatCI**:

mean.C Index	median	lower	upper
0.669	0.67	0.639	0.699

```
pander::pander(t(rrAnalysis$ROCAnalysis$aucs),caption="ROC AUC")
```

Table 64: ROC AUC

est	lower	upper
0.669	0.628	0.709

```
pander::pander((rrAnalysis$ROCAnalysis$sensitivity),caption="Sensitivity")
```

Table 65: Sensitivity

est	lower	upper
0.395	0.339	0.453

```
pander::pander((rrAnalysis$ROCAnalysis$specificity),caption="Specificity")
```

Table 66: Specificity

est	lower	upper
0.832	0.791	0.868

```
pander::pander(t(rrAnalysis$thr_atP),caption="Probability Thresholds")
```

Table 67: Probability Thresholds

90%	80%
0.542	0.431

```
pander::pander(t(rrAnalysis$RR_atP),caption="Risk Ratio")
```

Table 68: Risk Ratio

est	lower	upper
1.8	1.54	2.11

```
pander::pander(rrAnalysis$surdif,caption="Logrank test")
```

Table 69: Logrank test Chisq = 92.507991 on 2 degrees of freedom, p = 0.000000

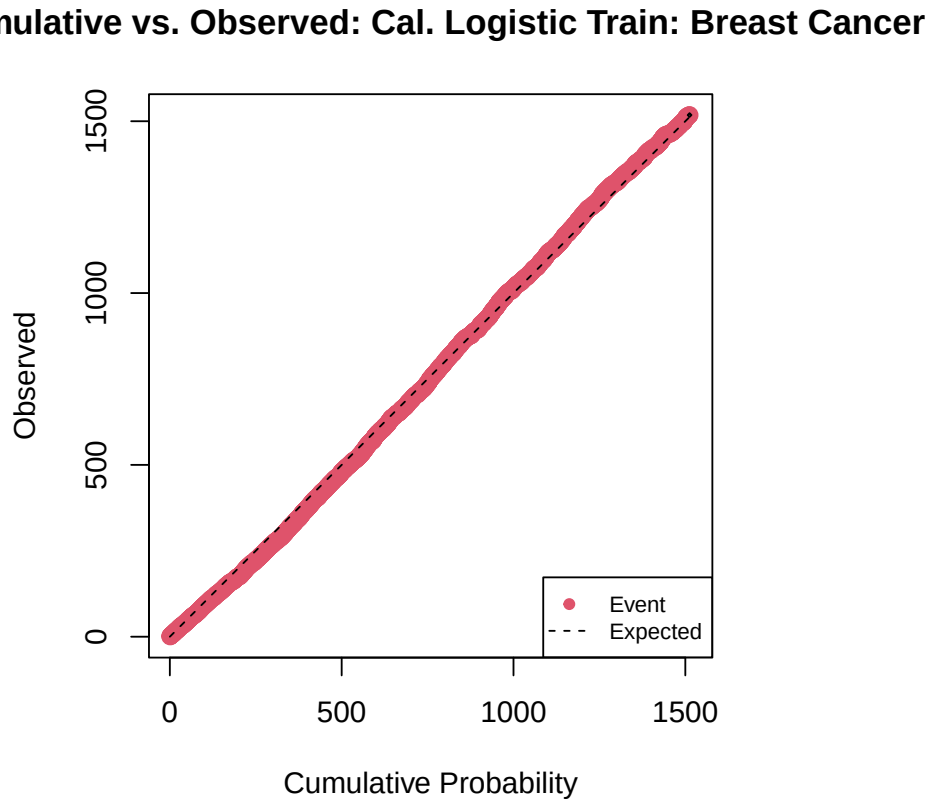
	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	369	121	181.7	20.2997	52.3868
class=1	134	60	61.7	0.0479	0.0604
class=2	183	118	55.5	70.2342	88.0195

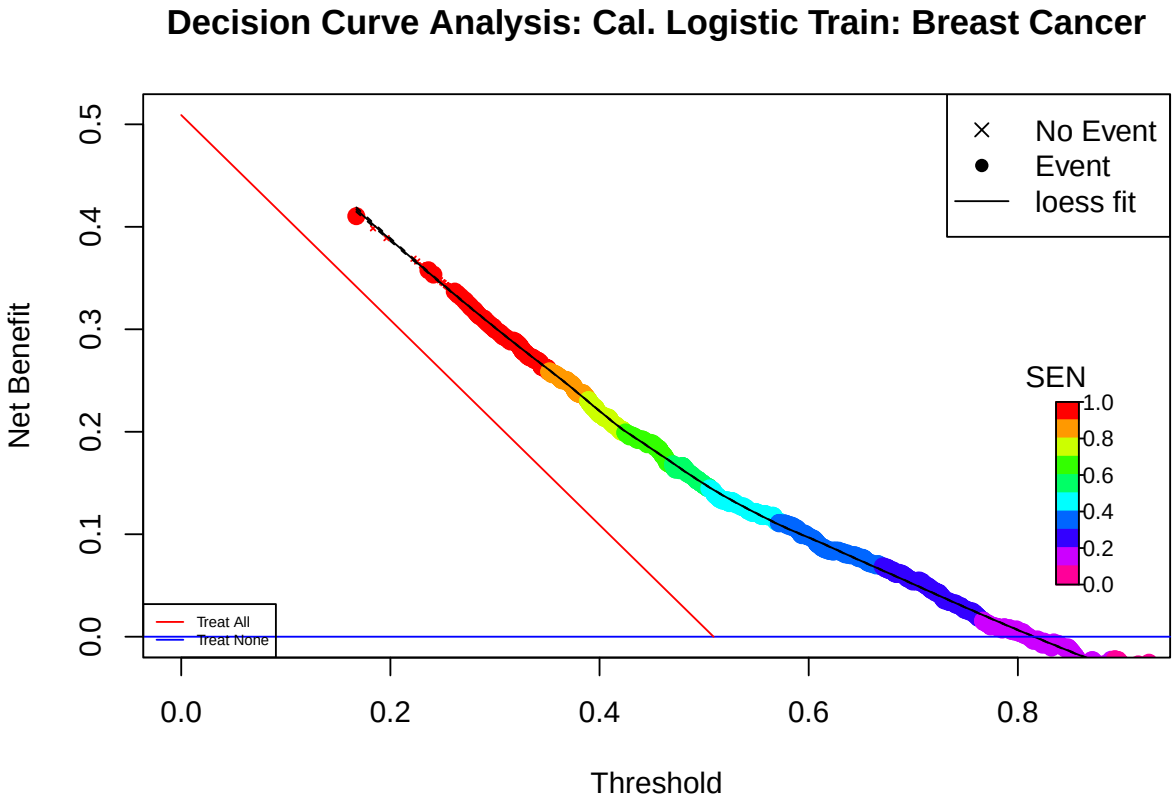
1.8 Logistic Model Poisson Calibration

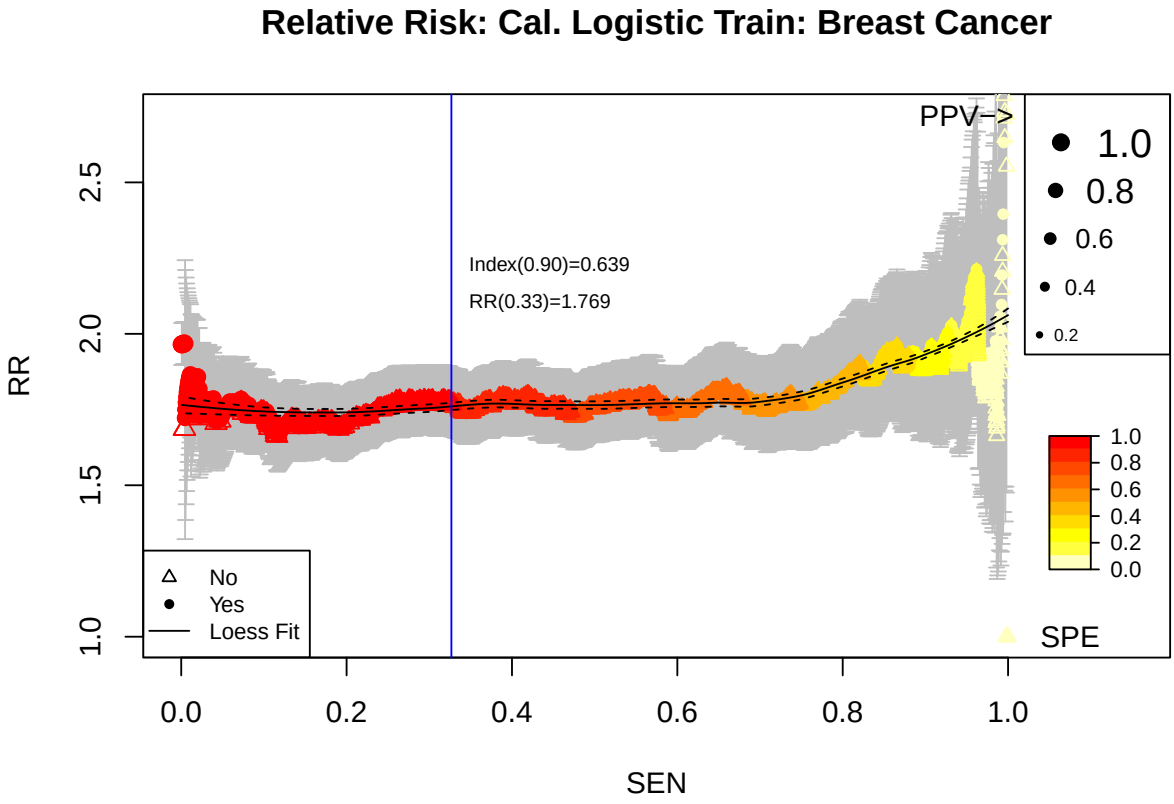
```
riskdata <- cbind(dataBrestCancerTrain$status,predict(mlog,dataBrestCancerTrain,type="prob"),dataBrestCa
calprob <- CalibrationProbPoissonRisk(riskdata)

pander::pander(c(h0=calprob$h0,
                 Gain=calprob$hazardGain,
                 DeltaTime=calprob$timeInterval),
               caption="Logistic Calibration Parameters")
```

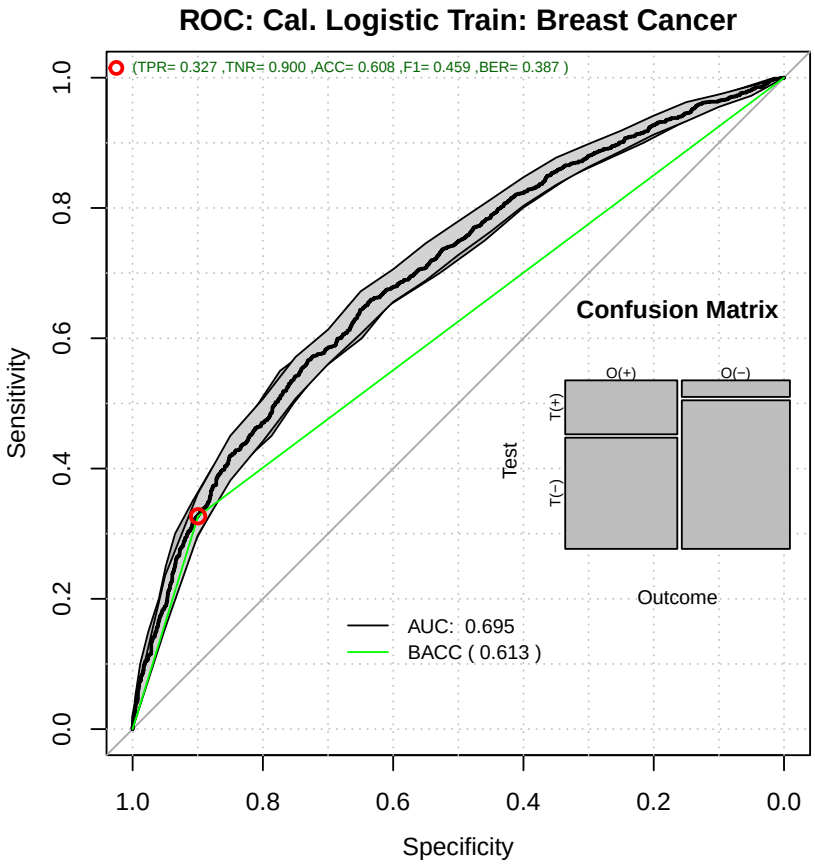
h0	Gain	DeltaTime
0.676	1.31	7.14

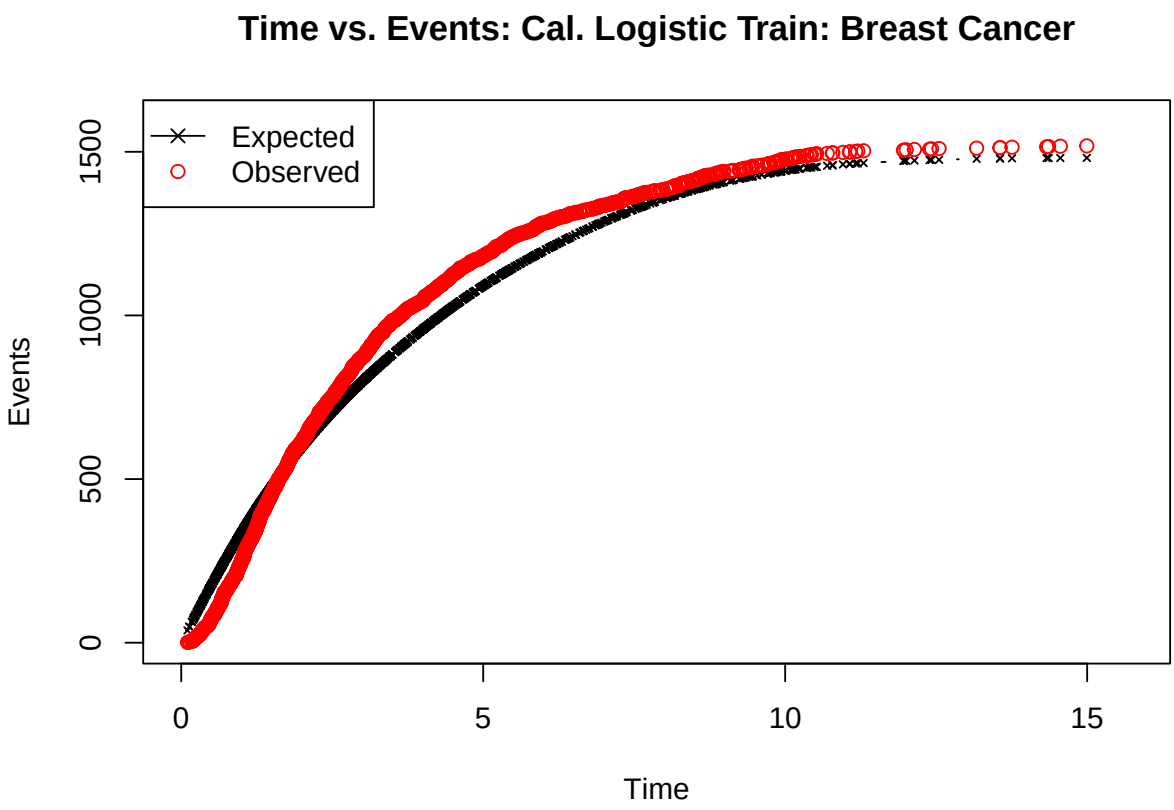
```
timeinterval <- calprob$timeInterval;
gain <- calprob$hazardGain

rdata <- cbind(dataBrestCancerTrain$status,calprob$prob)


rrAnalysisTrain <- RRPlot(rdata,atProb=c(0.90,0.80),
                      timetoEvent=dataBrestCancerTrain$time,
                      title="Cal. Logistic Train: Breast Cancer",
                      ysurvlim=c(0.00,1.0),
                      riskTimeInterval=timeinterval)
```

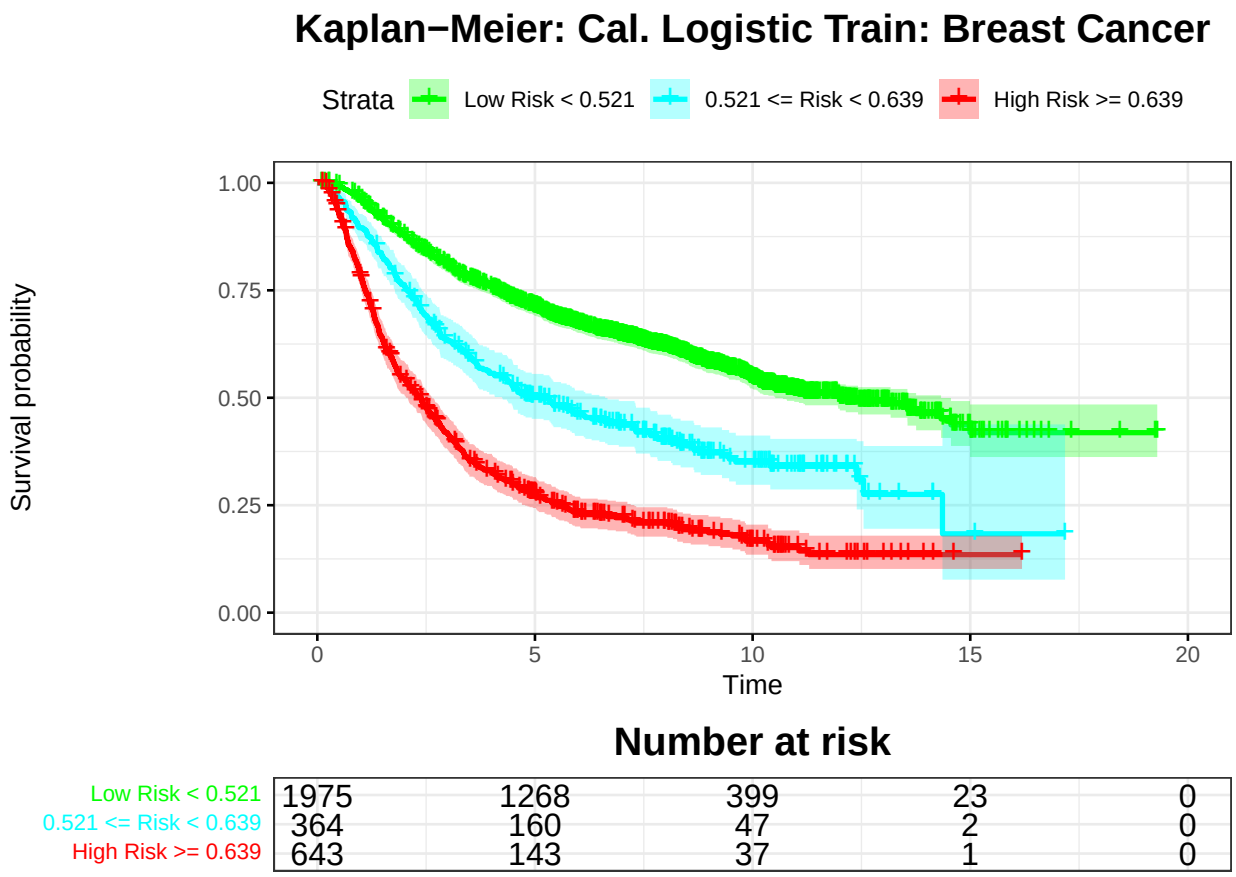

Cumulative vs. Observed: Cal. Logistic Train: Breast Cancer
Observed
0
500
1000
1500
Cumulative Probability
0
500
1000
1500
Event
Expected


Decision Curve Analysis: Cal. Logistic Train: Breast Cancer
Net Benefit
0.0
0.1
0.2
0.3
0.4
0.5
0.0
0.2
0.4
0.6
0.8
Threshold
No Event
Event
loess fit
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None


Relative Risk: Cal. Logistic Train: Breast Cancer
PPV–>
1.0
0.8
0.6
0.4
0.2
Index(0.90)=0.639
RR(0.33)=1.769
1.0
0.8
0.6
0.4
0.2
0.0
No
Yes
Loess Fit
SPE
RR
2.5
2.0
1.5
1.0
0.0
0.2
0.4
0.6
0.8
1.0
SEN


ROC: Cal. Logistic Train: Breast Cancer
(TPR= 0.327 ,TNR= 0.900 ,ACC= 0.608 ,F1= 0.459 ,BER= 0.387)
Sensitivity
Specificity
1.0
0.8
0.6
0.4
0.2
0.0
Confusion Matrix
O(+)
O(−)
T(+)
T(−)
Test
Outcome
AUC: 0.695
BACC (0.613)


Time vs. Events: Cal. Logistic Train: Breast Cancer
Expected
Observed
Events
0
500
1000
1500
0
5
10
15
Time




```
par(op)
```

1.8.1 Report of the calibrated logistic: training

```
pander::pander(t(rrAnalysisTrain$keyPoints),caption="Threshold values")
```

Table 71: Threshold values

	@:0.9	@:0.8	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.639	0.521	0.480	0.319	0.167426	0.500
RR	1.765	1.739	1.799	2.213	1.000000	1.759
SEN	0.327	0.470	0.566	0.962	1.000000	0.507
SPE	0.900	0.799	0.731	0.125	0.000683	0.774
BACC	0.613	0.635	0.648	0.543	0.500342	0.641

```
pander::pander(t(rrAnalysisTrain$OERatio$estimate),caption="O/E Ratio")
```

Table 72: O/E Ratio

O/E	Low	Upper	p.value
1.02	0.974	1.08	0.343

```
pander::pander(rrAnalysisTrain$c.index,caption="C. Index")
```

- **C Index**: *0.68*
- **Dxy**: *0.36*
- **S.D.**: *0.014*
- **n**: *2982*
- **missing**: *0*
- **uncensored**: *1518*
- **Relevant Pairs**: *6184528*
- **Concordant**: *4206590*
- **Uncertain**: *2703838*
- **cstatCI**:

mean.C Index	median	lower	upper
0.68	0.68	0.666	0.693

```
pander::pander(t(rrAnalysisTrain$ROCAnalysis$aucs),caption="ROC AUC")
```

Table 74: ROC AUC

est	lower	upper
0.695	0.677	0.714

```
pander::pander((rrAnalysisTrain$ROCAnalysis$sensitivity),caption="Sensitivity")
```

Table 75: Sensitivity

est	lower	upper
0.327	0.303	0.351

```
pander::pander((rrAnalysisTrain$ROCAnalysis$specificity),caption="Specificity")
```

Table 76: Specificity

est	lower	upper
0.9	0.883	0.915

```
pander::pander(t(rrAnalysisTrain$thr_atP),caption="Probability Thresholds")
```

Table 77: Probability Thresholds

90%	80%
0.639	0.521

```
pander::pander(t(rrAnalysisTrain$RR_atP),caption="Risk Ratio")
```

Table 78: Risk Ratio

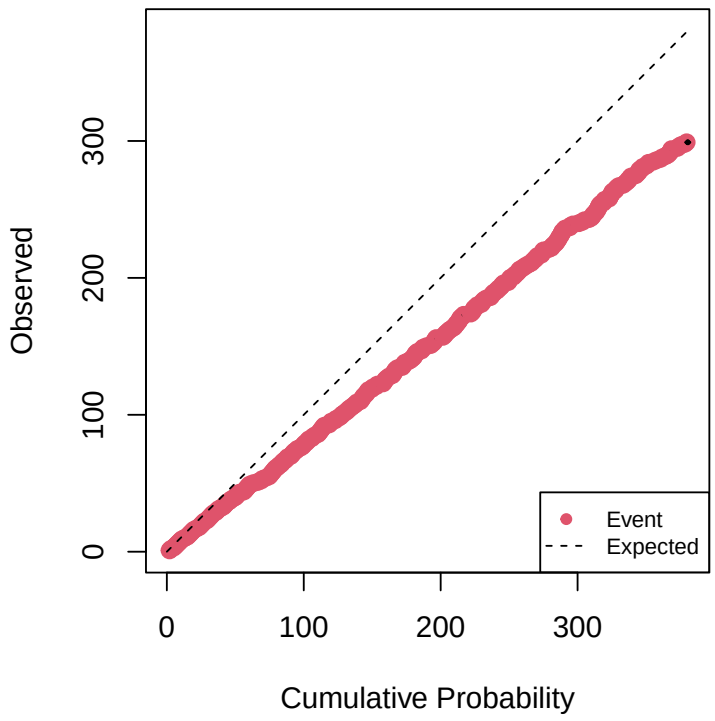
est	lower	upper
1.77	1.66	1.88

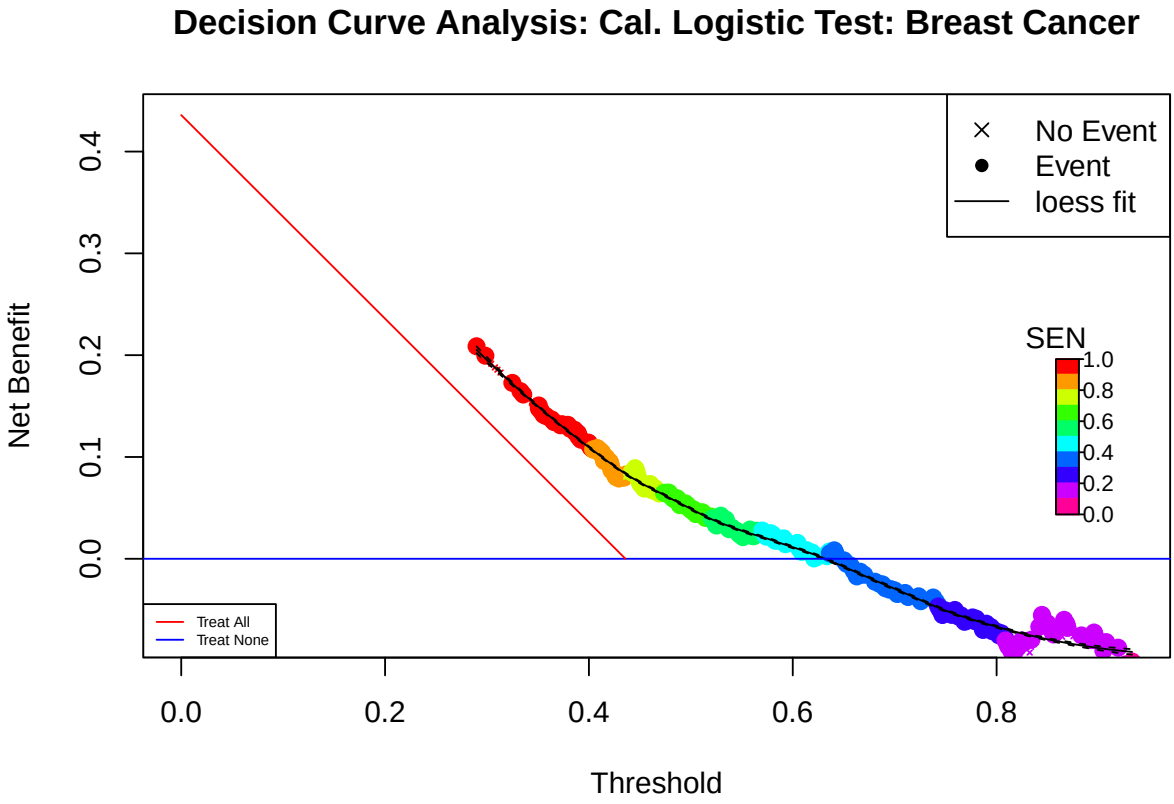
```
pander::pander(rrAnalysisTrain$surdif,caption="Logrank test")
```

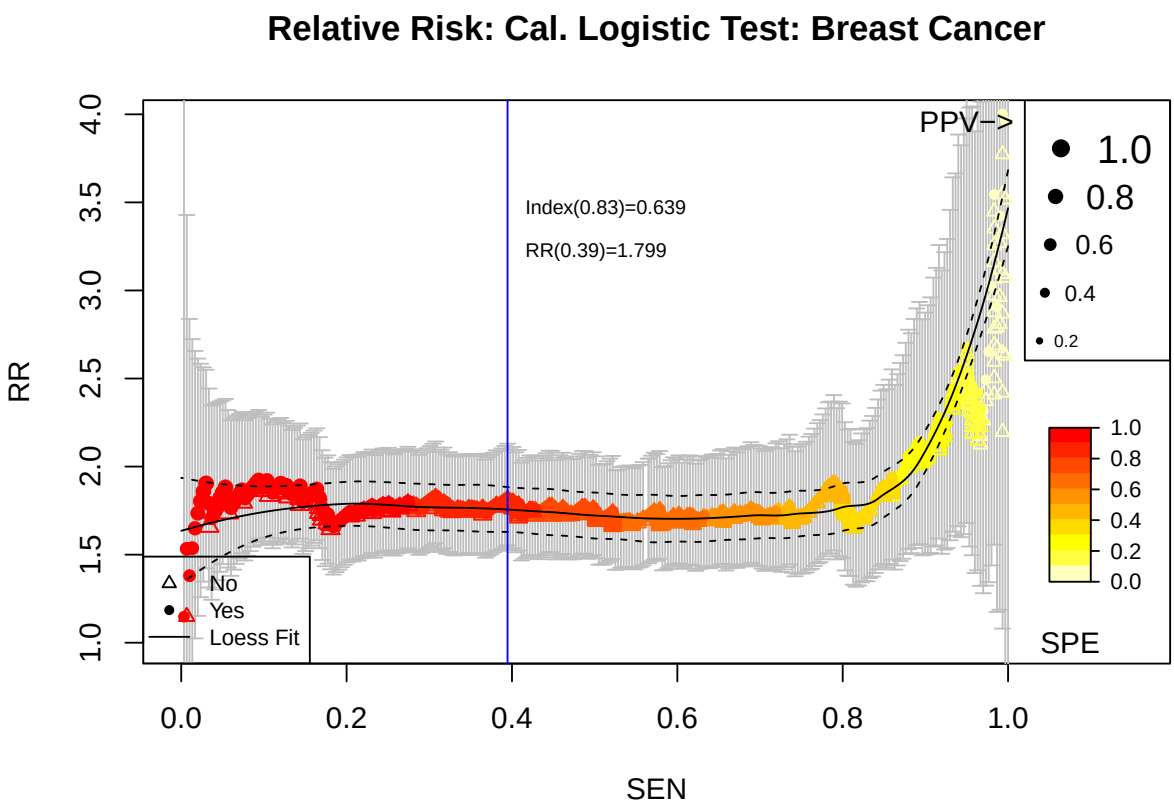
Table 79: Logrank test Chisq = 543.347175 on 2 degrees of freedom, p = 0.000000

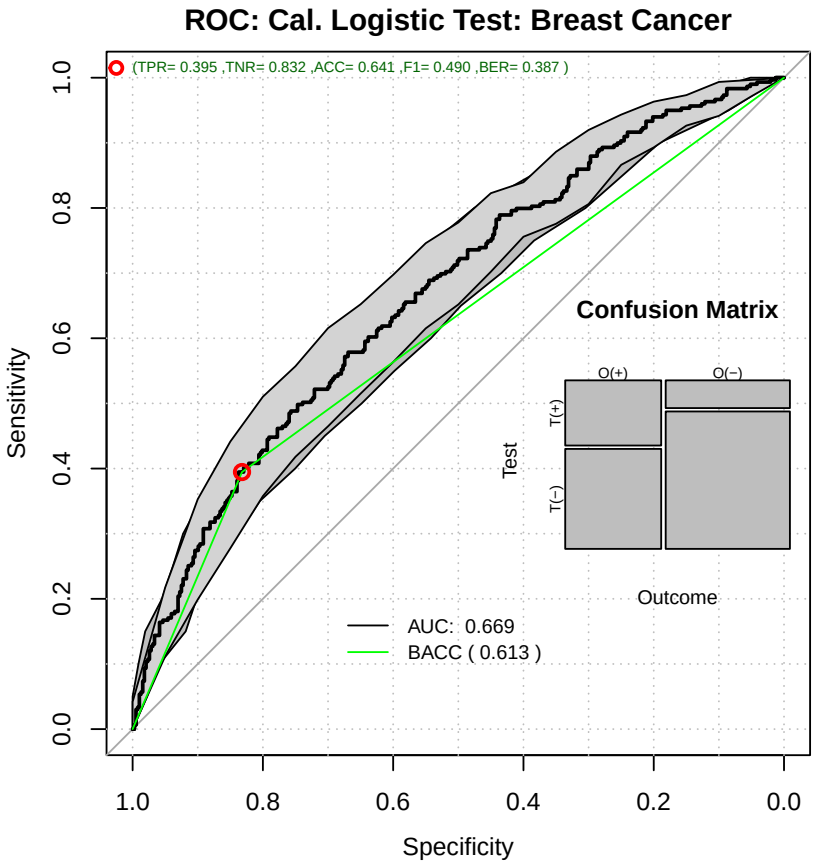
	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	1975	804	1145	101.5	418.9
class=1	364	218	169	14.1	15.9
class=2	643	496	204	418.2	490.7

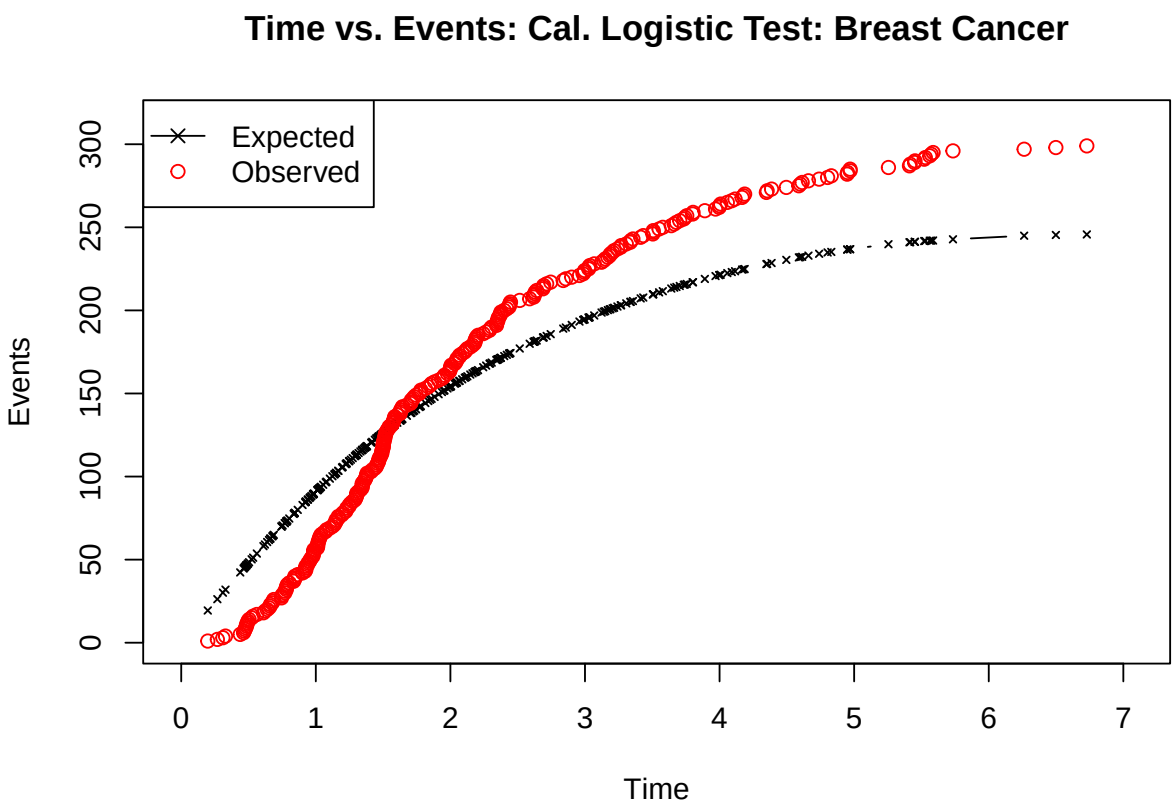
```
probLog <- predict(mlog,dataBrestCancerTest)
aprob <- adjustProb(probLog,gain)

rdata <- cbind(dataBrestCancerTest$status,aprob)
rrAnalysisTestLogistic <- RRPlot(rdata,atThr=rrAnalysisTrain$thr_atP,
                     timetoEvent=dataBrestCancerTest$time,
                     title="Cal. Logistic Test: Breast Cancer",
                     ysurvlim=c(0.00,1.0),
                     riskTimeInterval=timeinterval)
```

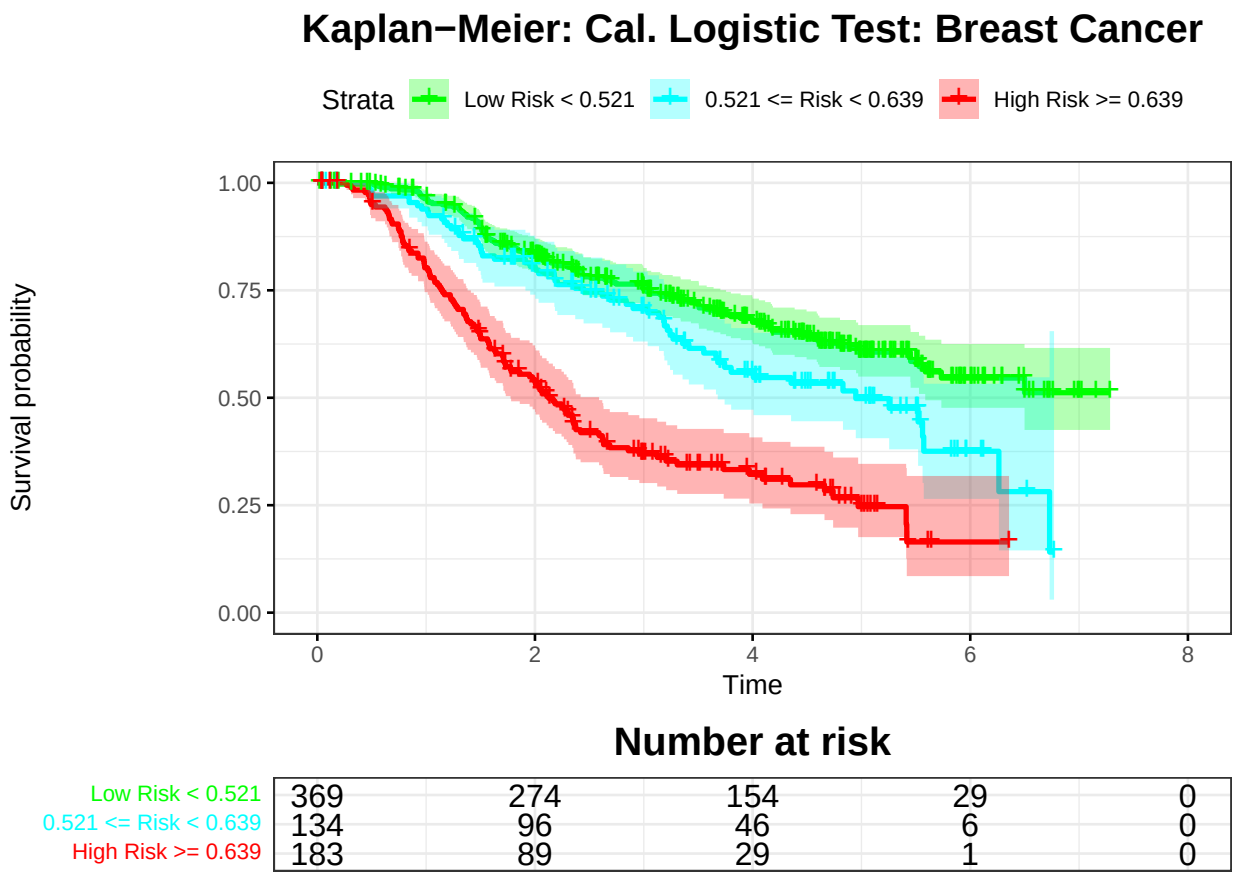

Cumulative vs. Observed: Cal. Logistic Test: Breast Cancer
Observed
0
100
200
300
0
100
200
300
Cumulative Probability
Event
Expected


Decision Curve Analysis: Cal. Logistic Test: Breast Cancer
No Event
Event
loess fit
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None
Net Benefit
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8
Threshold


Relative Risk: Cal. Logistic Test: Breast Cancer
RR
SEN
PPV–>
Index(0.83)=0.639
RR(0.39)=1.799
No
Yes
Loess Fit
SPE
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
3.0
3.5
4.0
0.0
0.2
0.4
0.6
0.8
1.0


ROC: Cal. Logistic Test: Breast Cancer
(TPR= 0.395 ,TNR= 0.832 ,ACC= 0.641 ,F1= 0.490 ,BER= 0.387)
Sensitivity
Specificity
1.0
0.8
0.6
0.4
0.2
0.0
Confusion Matrix
O(+)
O(−)
T(+)
T(−)
Test
Outcome
AUC: 0.669
BACC (0.613)


Time vs. Events: Cal. Logistic Test: Breast Cancer
Expected
Observed
Events
0
50
100
150
200
250
300
0
1
2
3
4
5
6
7
Time




```
par(op)
```

1.8.2 Report of the calibrated validation

```
pander::pander(t(rrAnalysisTestLogistic$keyPoints),caption="Threshold values")
```

Table 80: Threshold values

	@:0.64	@:0.52	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.639	0.521	0.529	0.379	0.2897	0.500
RR	1.792	1.702	1.756	2.678	21.9530	1.703
SEN	0.395	0.595	0.579	0.950	1.0000	0.642
SPE	0.832	0.638	0.669	0.181	0.0129	0.587
BACC	0.613	0.617	0.624	0.565	0.5065	0.614

```
pander::pander(t(rrAnalysisTestLogistic$OERatio$estimate),caption="O/E Ratio")
```

Table 81: O/E Ratio

O/E	Low	Upper	p.value
1.22	1.08	1.36	0.00101

```
pander::pander(rrAnalysisTestLogistic$c.index,caption="C. Index")
```

- **C Index**: *0.669*
- **Dxy**: *0.338*
- **S.D.**: *0.0309*
- **n**: *686*
- **missing**: *0*
- **uncensored**: *299*
- **Relevant Pairs**: *266144*
- **Concordant**: *178115*
- **Uncertain**: *203702*
- **cstatCI**:

mean.C Index	median	lower	upper
0.669	0.67	0.64	0.698

```
pander::pander(t(rrAnalysisTestLogistic$ROCAnalysis$aucs),caption="ROC AUC")
```

Table 83: ROC AUC

est	lower	upper
0.669	0.628	0.709

```
pander::pander((rrAnalysisTestLogistic$ROCAnalysis$sensitivity),caption="Sensitivity")
```

Table 84: Sensitivity

est	lower	upper
0.395	0.339	0.453

```
pander::pander((rrAnalysisTestLogistic$ROCAnalysis$specificity),caption="Specificity")
```

Table 85: Specificity

est	lower	upper
0.832	0.791	0.868

```
pander::pander(t(rrAnalysisTestLogistic$thr_atP),caption="Probability Thresholds")
```

Table 86: Probability Thresholds

90%	80%
0.639	0.521

```
pander::pander(t(rrAnalysisTestLogistic$RR_atP),caption="Risk Ratio")
```

Table 87: Risk Ratio

est	lower	upper
1.8	1.54	2.11

```
pander::pander(rrAnalysisTestLogistic$surdif,caption="Logrank test")
```

Table 88: Logrank test Chisq = 92.507991 on 2 degrees of freedom, p = 0.000000

	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	369	121	181.7	20.2997	52.3868
class=1	134	60	61.7	0.0479	0.0604
class=2	183	118	55.5	70.2342	88.0195

1.9 Comparing the COX and Logistic Models on the Independent Data

```
pander::pander(t(rrCoxTestAnalysis$OAcum95ci))
```

mean	50%	2.5%	97.5%
0.841	0.841	0.84	0.842

```
pander::pander(t(rrAnalysisTestLogistic$OAcum95ci))
```

mean	50%	2.5%	97.5%
0.791	0.791	0.791	0.792

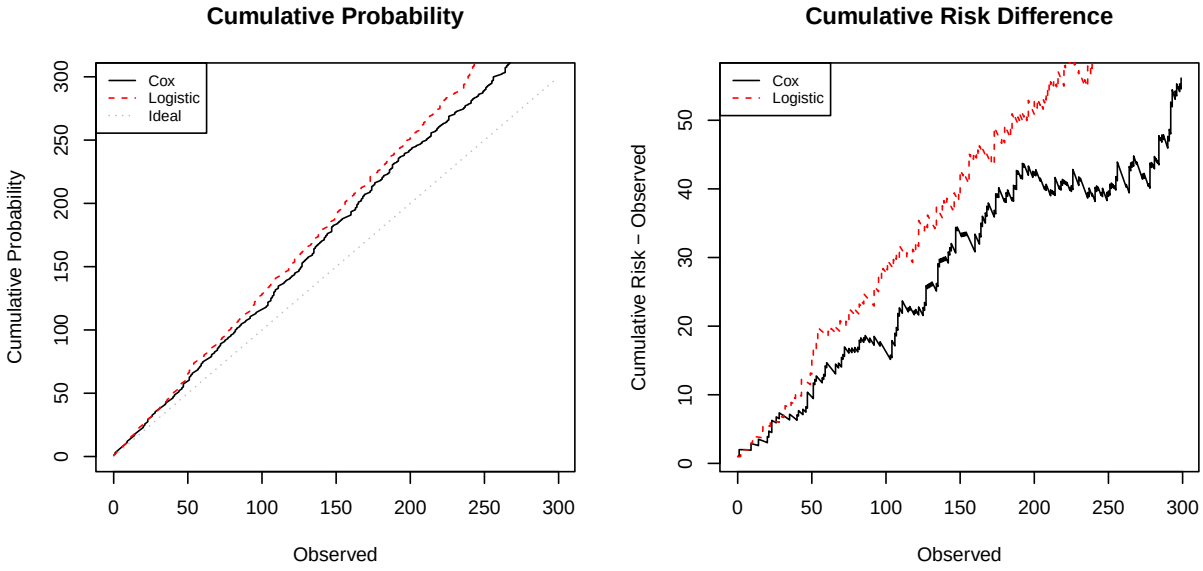
```
pander::pander(t(rrCoxTestAnalysis$OE95ci))
```

mean	50%	2.5%	97.5%
1.11	1.11	1.08	1.14

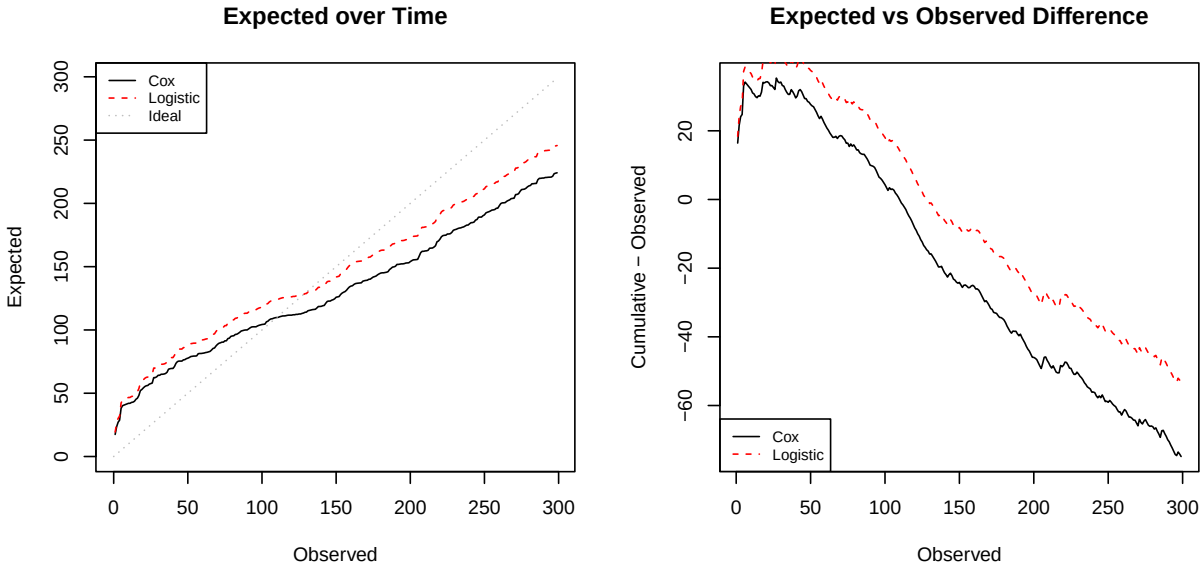
```
pander::pander(t(rrAnalysisTestLogistic$OE95ci))
```

mean	50%	2.5%	97.5%
0.989	0.989	0.961	1.02

```
maxobs <- sum(dataBrestCancerTest$status)

par(mfrow=c(1,2),cex=0.75)

plot(rrCoxTestAnalysis$CumulativeOvs[,1:2],type="l",lty=1,
     main="Cumulative Probability",
     xlab="Observed",
     ylab="Cumulative Probability",
     ylim=c(0,maxobs),
     xlim=c(0,maxobs))
lines(rrAnalysisTestLogistic$CumulativeOvs[,1:2],lty=2,col="red")
lines(x=c(0,maxobs),y=c(0,maxobs),lty=3,col="gray")
legend("topleft",legend = c("Cox","Logistic","Ideal"),
       col=c("black","red","gray"),
       lty=c(1,2,3),
       cex=0.75
)


plot(rrCoxTestAnalysis$CumulativeOvs$Observed,
     rrCoxTestAnalysis$CumulativeOvs$Cumulative-
       rrCoxTestAnalysis$CumulativeOvs$Observed,
     main="Cumulative Risk Difference",
     xlab="Observed",
     ylab="Cumulative Risk - Observed",
     type="l",
     lty=1)
lines(rrAnalysisTestLogistic$CumulativeOvs$Observed,
     rrAnalysisTestLogistic$CumulativeOvs$Cumulative-
       rrAnalysisTestLogistic$CumulativeOvs$Observed,
     lty=2,
     col="red")
legend("topleft",legend = c("Cox","Logistic"),
       col=c("black","red"),
       lty=c(1,2),
       cex=0.75
)
```




```
plot(rrCoxTestAnalysis$OEData[,2:3],type="l",lty=1,
     main="Expected over Time",
     xlab="Observed",
     ylab="Expected",
     ylim=c(0,maxobs),
     xlim=c(0,maxobs))
lines(rrAnalysisTestLogistic$OEData[,2:3],lty=2,col="red")
lines(x=c(0,maxobs),y=c(0,maxobs),lty=3,col="gray")
legend("topleft",legend = c("Cox","Logistic","Ideal"),
       col=c("black","red","gray"),
       lty=c(1,2,3),
       cex=0.75
)

plot(rrCoxTestAnalysis$OEData$Observed,
     rrCoxTestAnalysis$OEData$Expected-
       rrCoxTestAnalysis$OEData$Observed,
     main="Expected vs Observed Difference",
     xlab="Observed",
     ylab="Cumulative - Observed",
     type="l",
     lty=1)
lines(rrAnalysisTestLogistic$OEData$Observed,
     rrAnalysisTestLogistic$OEData$Expected-
       rrAnalysisTestLogistic$OEData$Observed,
     lty=2,col="red")

legend("bottomleft",legend = c("Cox","Logistic"),
       col=c("black","red"),
       lty=c(1,2),
       cex=0.75
)
```


Expected over Time
Cox
Logistic
Ideal
Expected
Observed
0
50
100
150
200
250
300
Expected vs Observed Difference
Cumulative – Observed
Cox
Logistic
Observed
−60
−40
−20
0
20

```
par(op)
```