Risk-Evaluation: Breast Cancer Royston-Altman

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Contents

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
```

```
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)
```

	Estimate	lower	HR	upper	u.Accuracy	r.Accuracy	full.Accuracy	u.AUC	r.AUC	full.AUC	IDI	NRI	z.IDI	z.NRI	Delta.AUC	Frequency
age_nodes	0.000716	1.001	1.001	1.001	0.626	0.600	0.632	0.630	0.601	0.634	0.0304	0.4594	12.81	14.37	0.033056	1
size_grade	0.005649	1.005	1.006	1.006	0.598	0.623	0.632	0.599	0.626	0.634	0.01866	0.3914	9.82	11.29	0.007947	1
nodes	0.086581	1.082	1.090	1.099	0.637	0.642	0.643	0.640	0.643	0.644	0.00746	0.0564	8.33	1.66	0.000148	1
size	0.006888	1.005	1.007	1.009	0.595	0.641	0.643	0.595	0.642	0.644	0.01447	0.3587	8.05	9.97	0.001322	1
size_nodes	-0.000378	1.000	1.000	1.000	0.624	0.643	0.643	0.629	0.644	0.644	0.00346	0.3430	7.25	9.57	-0.000377	1
age_size	-0.000149	1.000	1.000	1.000	0.567	0.627	0.632	0.568	0.630	0.634	0.00635	0.1935	5.95	5.36	0.004078	1
grade	0.204934	1.146	1.227	1.314	0.565	0.637	0.643	0.561	0.638	0.644	0.00926	0.2069	5.88	6.31	0.005344	1

	Estimate	lower	HR	upper	u.Accuracy	r.Accuracy	full.Accuracy	u.AUC	r.AUC	full.AUC	IDI	NRI	z.IDI	z.NRI	Delta.AUC	Frequency
age	-0.003113	0.996	0.997	0.998	0.513	0.628	0.643	0.513	0.628	0.644	0.00416	0.0917	5.27	2.51	0.0154	651
grade_nodes	-0.013784	0.981	0.986	0.992	0.635	0.645	0.643	0.639	0.646	0.644	0.00207	-0.0910	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()

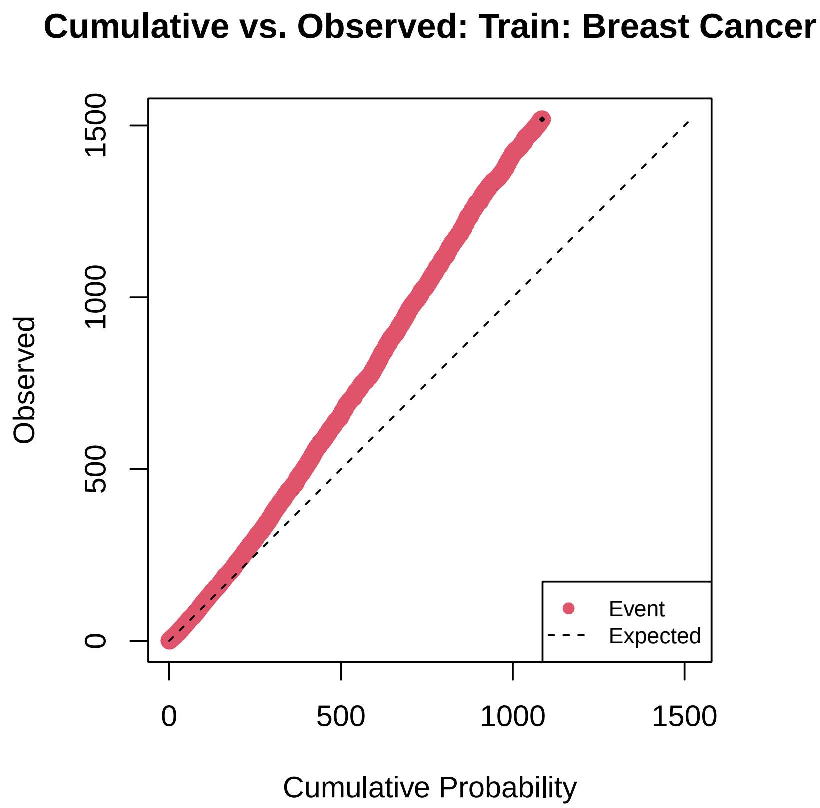
Here we will use the predicted event probability assuming a baseline hazard for events withing 5 years

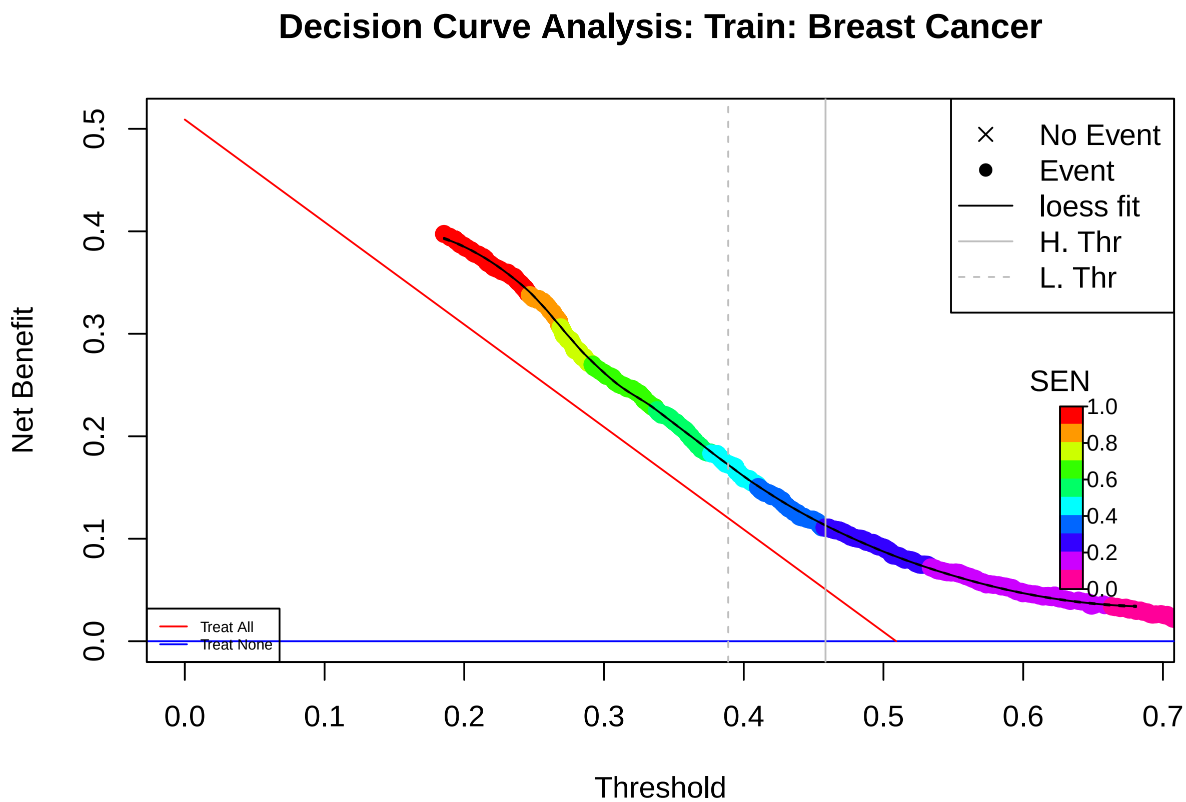
```
timeinterval <- 5 # Five years

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 4: Initial Parameters

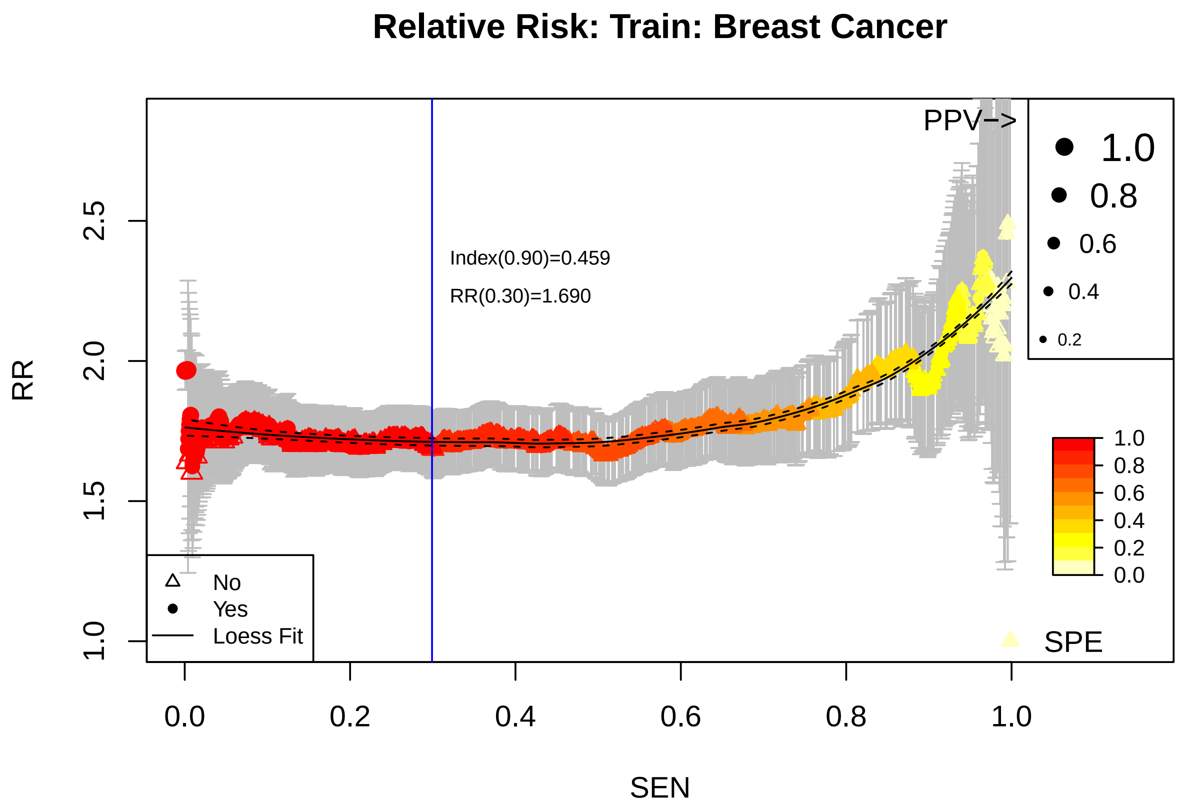
h0	timeinterval
0.429	5

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

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

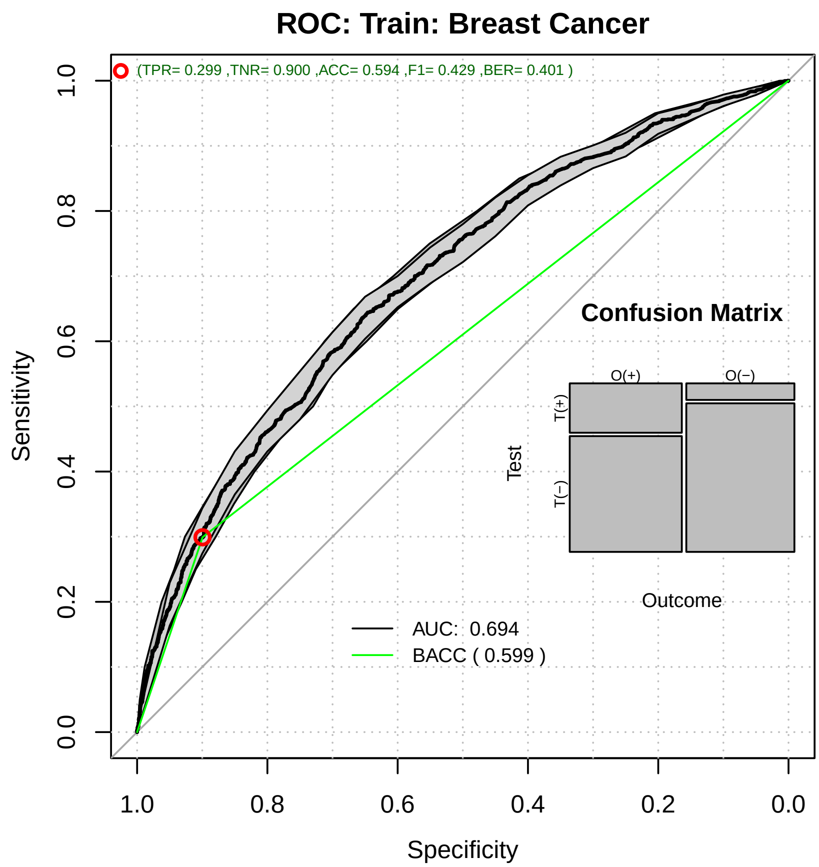

Cumulative vs. Observed: Train: Breast Cancer
Observed
0
500
1000
1500
Cumulative Probability
0
500
1000
1500
Event
Expected

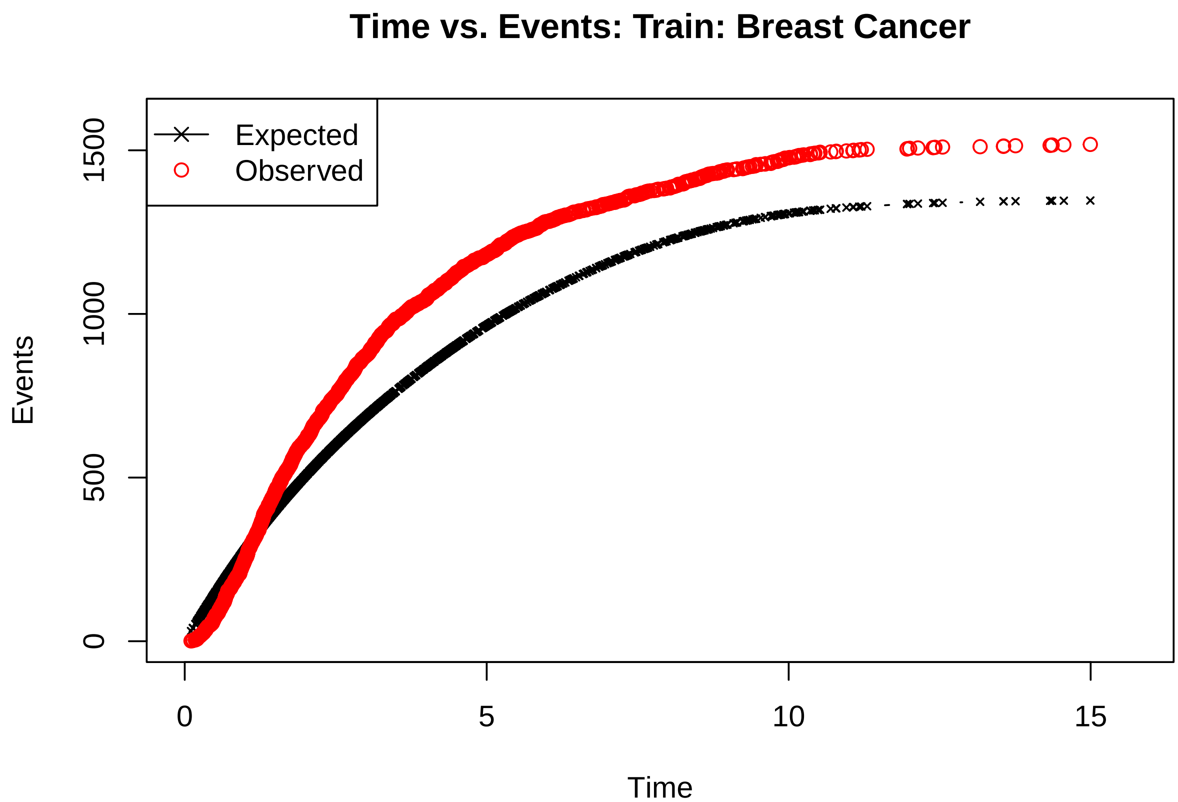


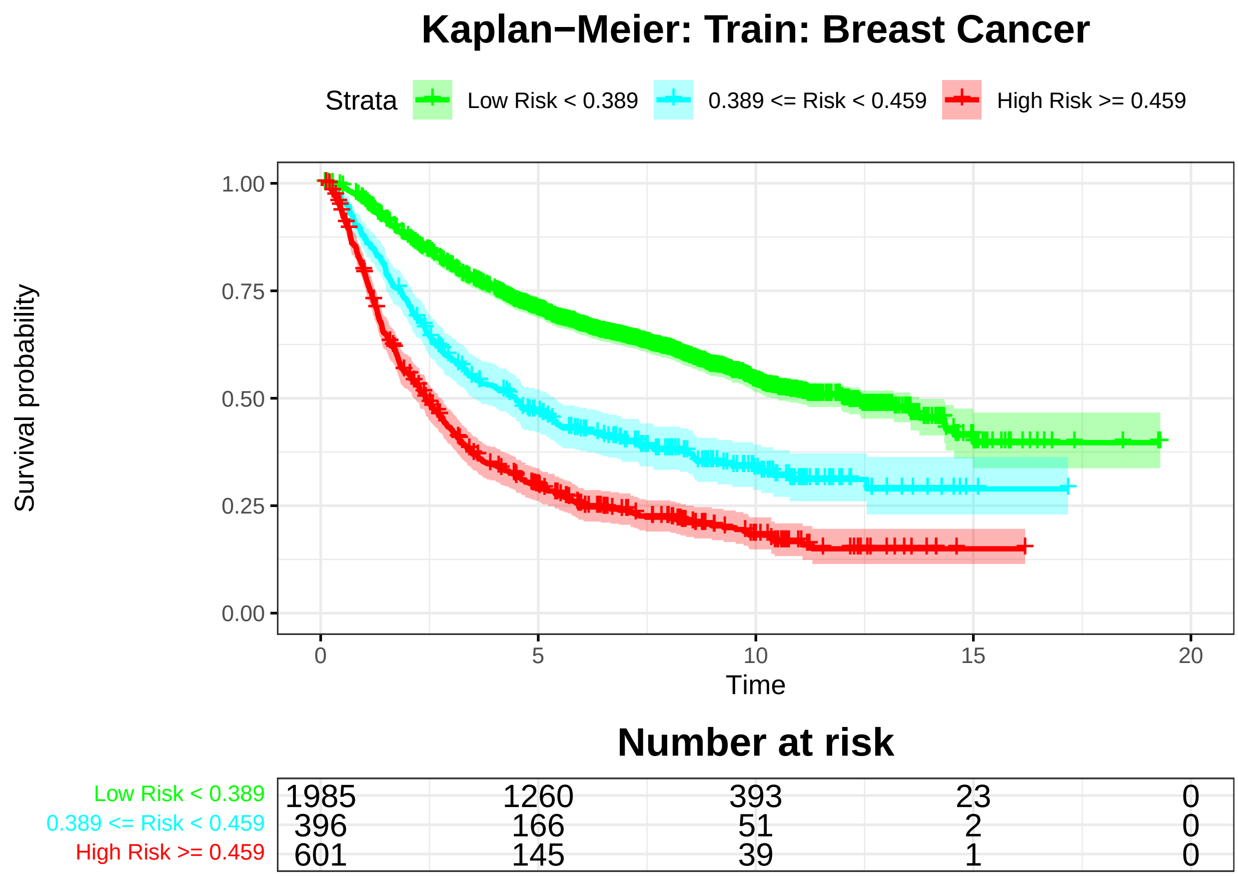
Decision Curve Analysis: Train: Breast Cancer
Net Benefit
Threshold
No Event
Event
loess fit
H. Thr
L. Thr
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7



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

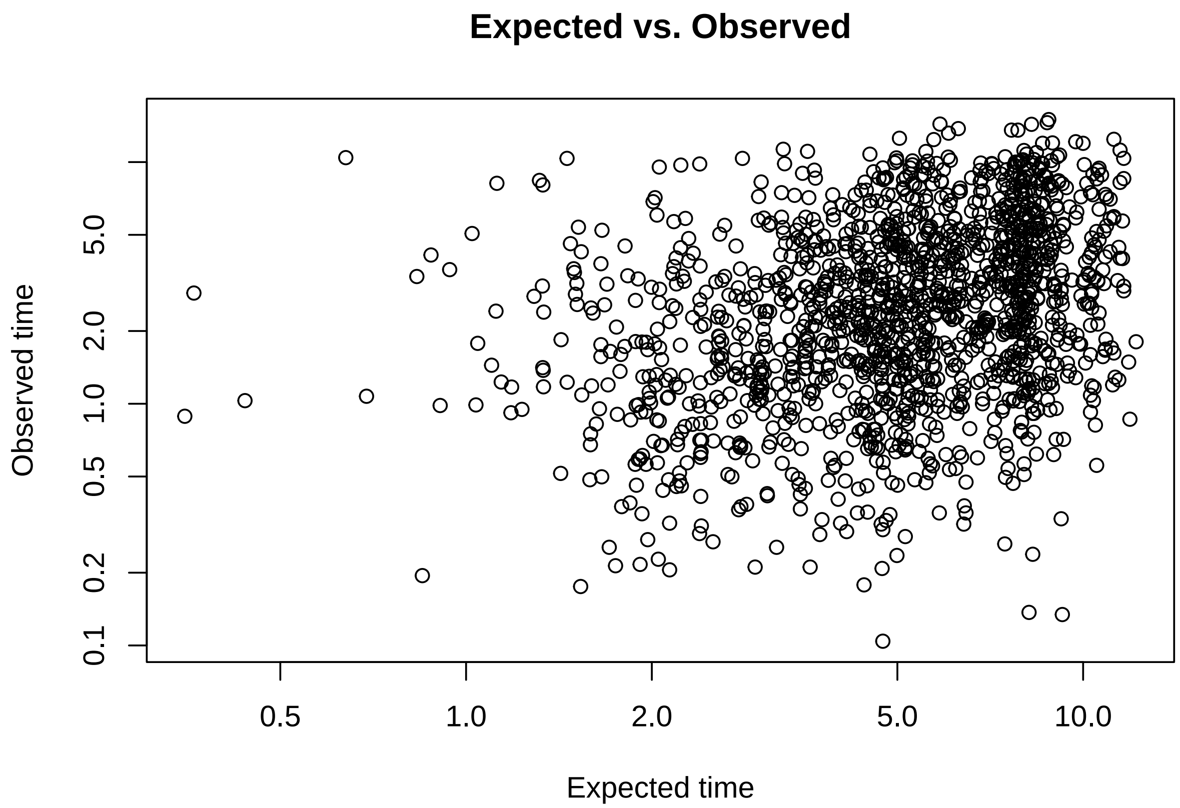

ROC: Train: Breast Cancer
(TPR= 0.299 ,TNR= 0.900 ,ACC= 0.594 ,F1= 0.429 ,BER= 0.401)
Sensitivity
Specificity
1.0
0.8
0.6
0.4
0.2
0.0
Confusion Matrix
O(+)
O(−)
T(+)
T(−)
Test
Outcome
AUC: 0.694
BACC (0.599)


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



1.4.2 Time to event

```
timetoEvent <- meanTimeToEvent(rdata[rdata[,1]==1,2],timeinterval)
obstime <- dataBrestCancerTrain[rdata[,1]==1,"time"]

plot(timetoEvent,obstime,xlab="Expected time",ylab="Observed time",main="Expected vs. Observed",log="xy
```




```r
pander::pander(cor.test(timetoEvent,obstime,method="spearman"))
```

Table 5: Spearman's rank correlation rho: `timetoEvent` and `obstime`

Test statistic	P value	Alternative hypothesis	rho
3.95e+08	5.22e-38 * * *	two.sided	0.322

```r
MADerror <- mean(abs(timetoEvent-obstime))
pander::pander(MADerror)
```

3.12

The Time vs. Events are not calibrated. Lets do the calibration

1.4.3 Uncalibrated Performance Report

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

Table 6: 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	0.4996
RR	1.690	1.713	1.799	2.376	1.00000	1.7255

	@:0.9	@:0.8	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
RR_LCI	1.586	1.603	1.666	1.869	0.00000	1.6196
RR_UCI	1.802	1.830	1.942	3.019	0.00000	1.8383
SEN	0.299	0.462	0.644	0.965	1.00000	0.2464
SPE	0.900	0.798	0.646	0.125	0.00137	0.9310
BACC	0.599	0.630	0.645	0.545	0.50068	0.5887
NetBenefit	0.110	0.172	0.246	0.374	0.39742	0.0916

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

Table 7: 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 8: 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 9: 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	0.663	0.69

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

Table 11: ROC AUC

est	lower	upper
0.694	0.675	0.713

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

Table 12: Sensitivity

est	lower	upper
0.299	0.276	0.323

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

Table 13: Specificity

est	lower	upper
0.9	0.883	0.915

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

Table 14: Probability Thresholds

90%	80%
0.459	0.389

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

Table 15: 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

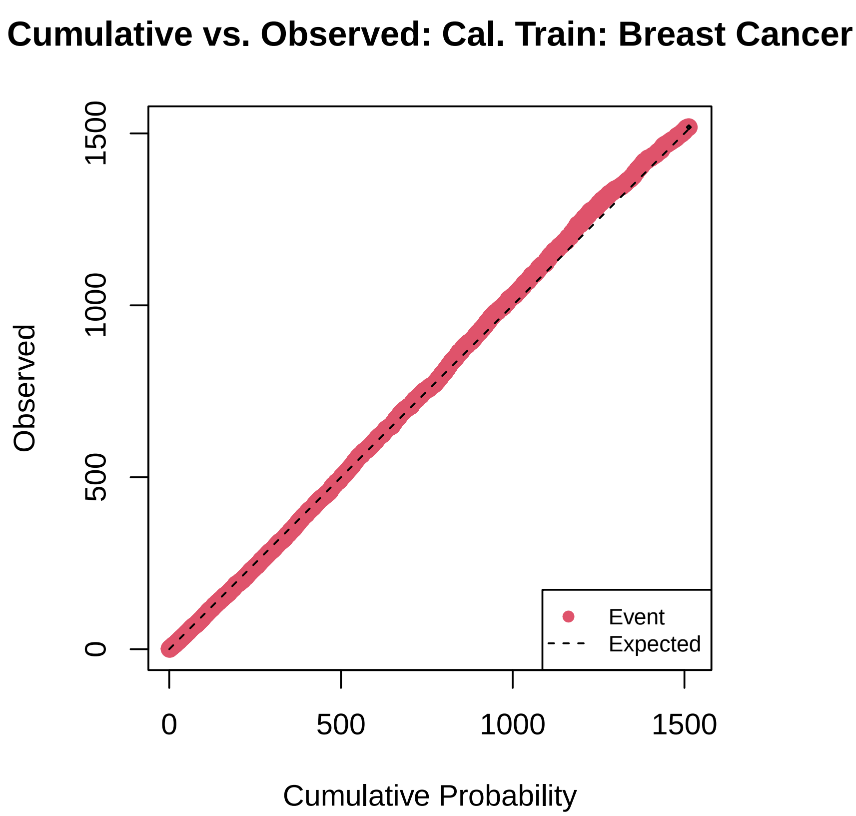
1.4.4 Cox Calibration

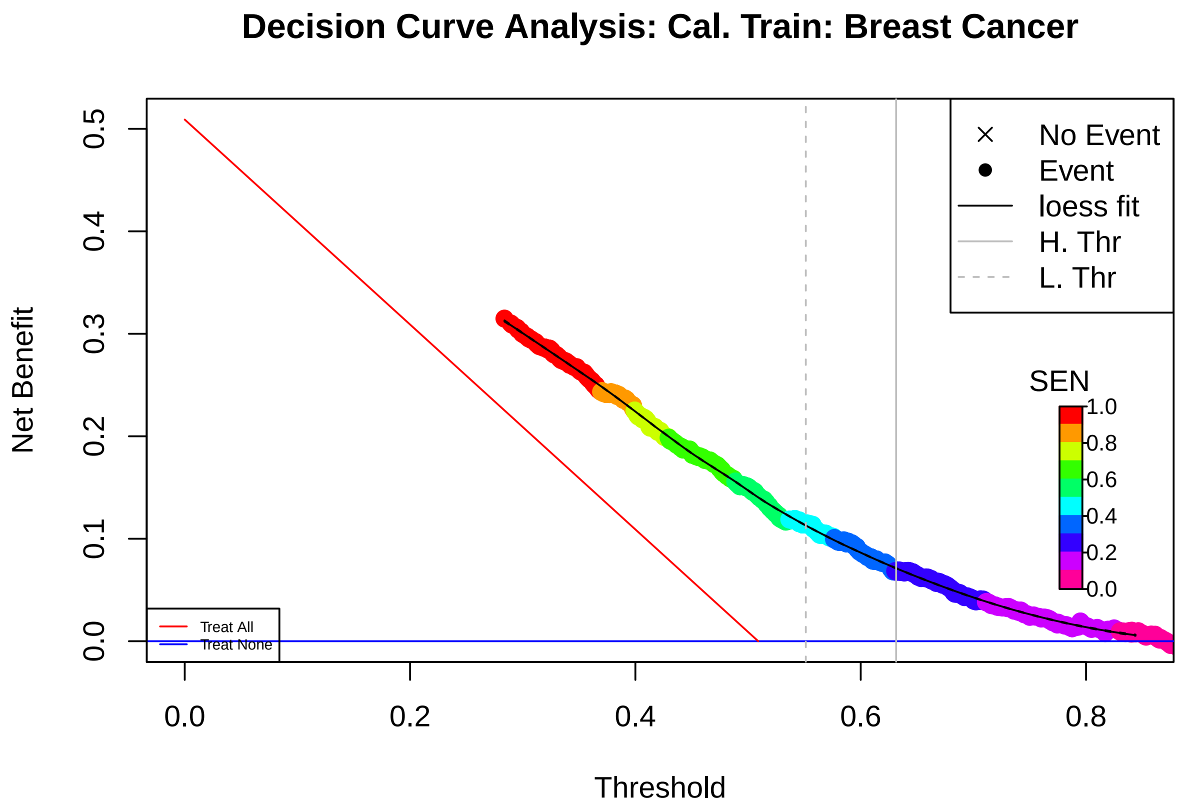
```
op <- par(no.readonly = TRUE)


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


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

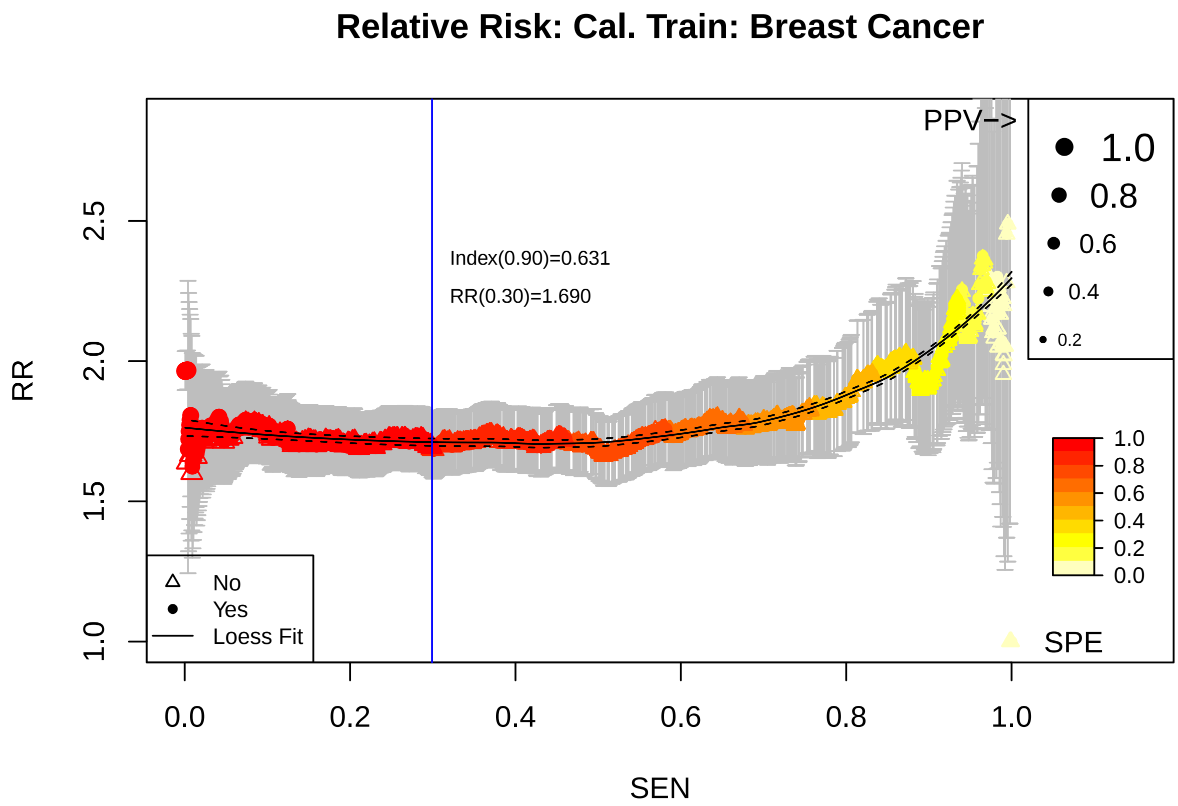
h0	Gain	DeltaTime
0.698	1.35	6.97

1.4.5 The RRplot() of the calibrated model

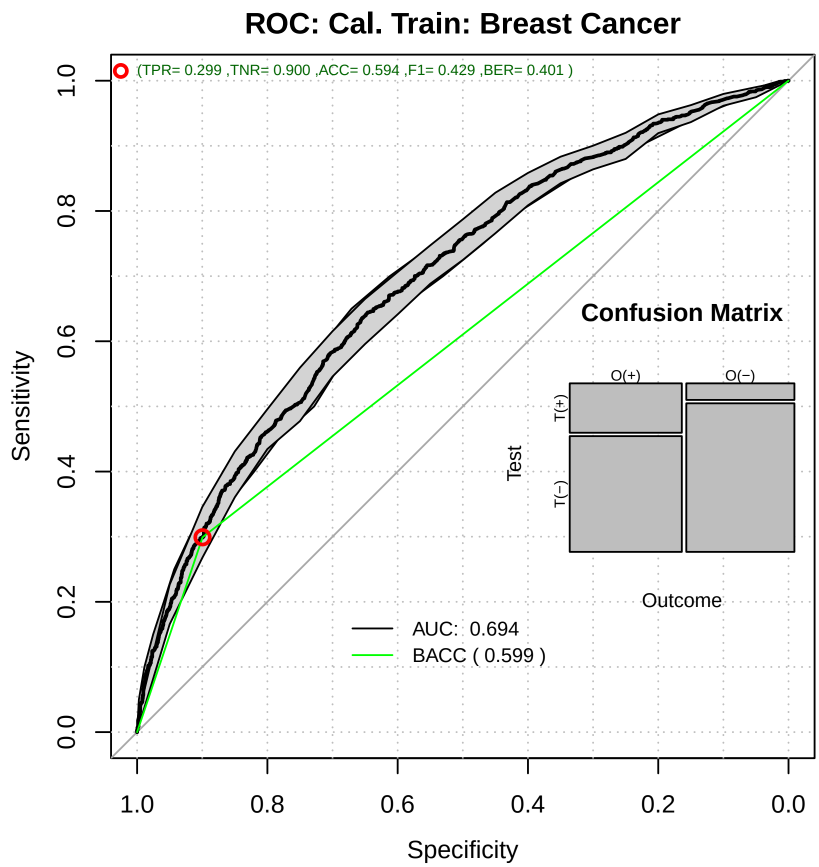
```r
h0 <- calprob$h0
timeinterval <- calprob$timeInterval;

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


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

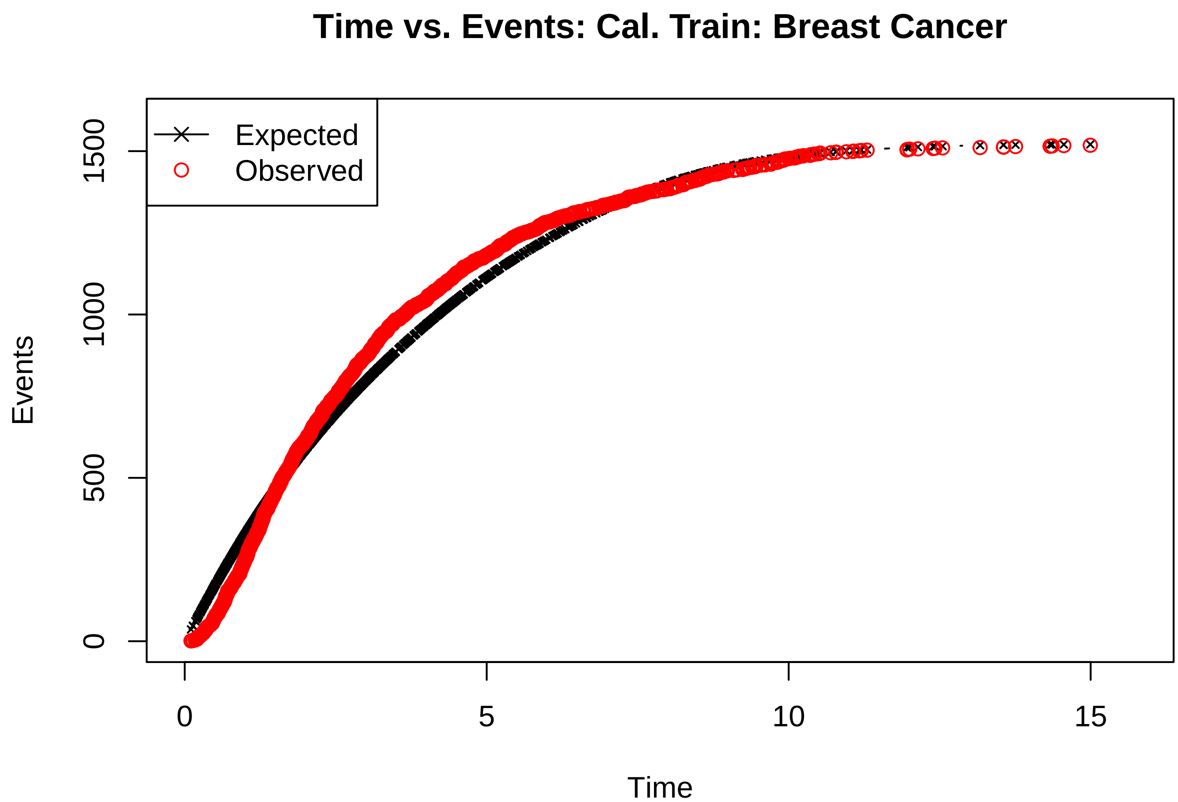


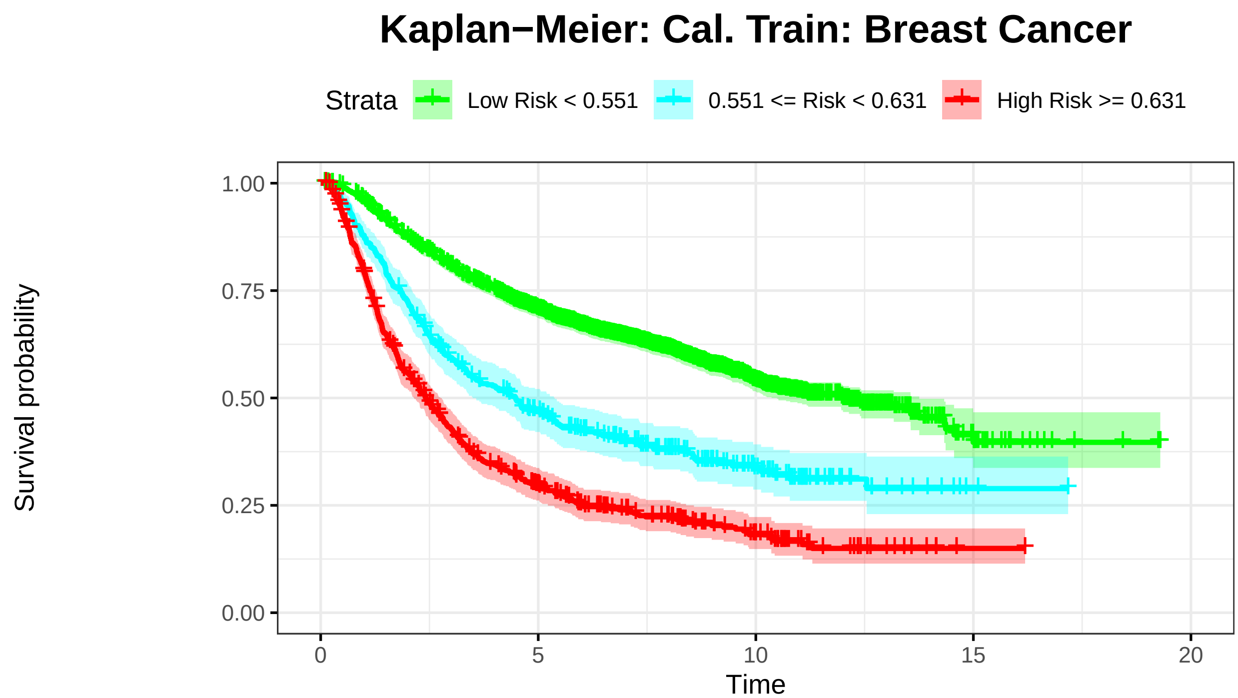

Decision Curve Analysis: Cal. Train: Breast Cancer
Net Benefit
Threshold
0.0
0.1
0.2
0.3
0.4
0.5
0.0
0.2
0.4
0.6
0.8
No Event
Event
loess fit
H. Thr
L. Thr
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None



Relative Risk: Cal. Train: Breast Cancer
PPV–>
1.0
0.8
0.6
0.4
0.2
Index(0.90)=0.631
RR(0.30)=1.690
RR
2.5
2.0
1.5
1.0
No
Yes
Loess Fit
1.0
0.8
0.6
0.4
0.2
0.0
SPE
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)
Confusion Matrix
O(+)
O(−)
T(+)
T(−)
Test
Outcome
AUC: 0.694
BACC (0.599)
Sensitivity
Specificity
1.0
0.8
0.6
0.4
0.2
0.0


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

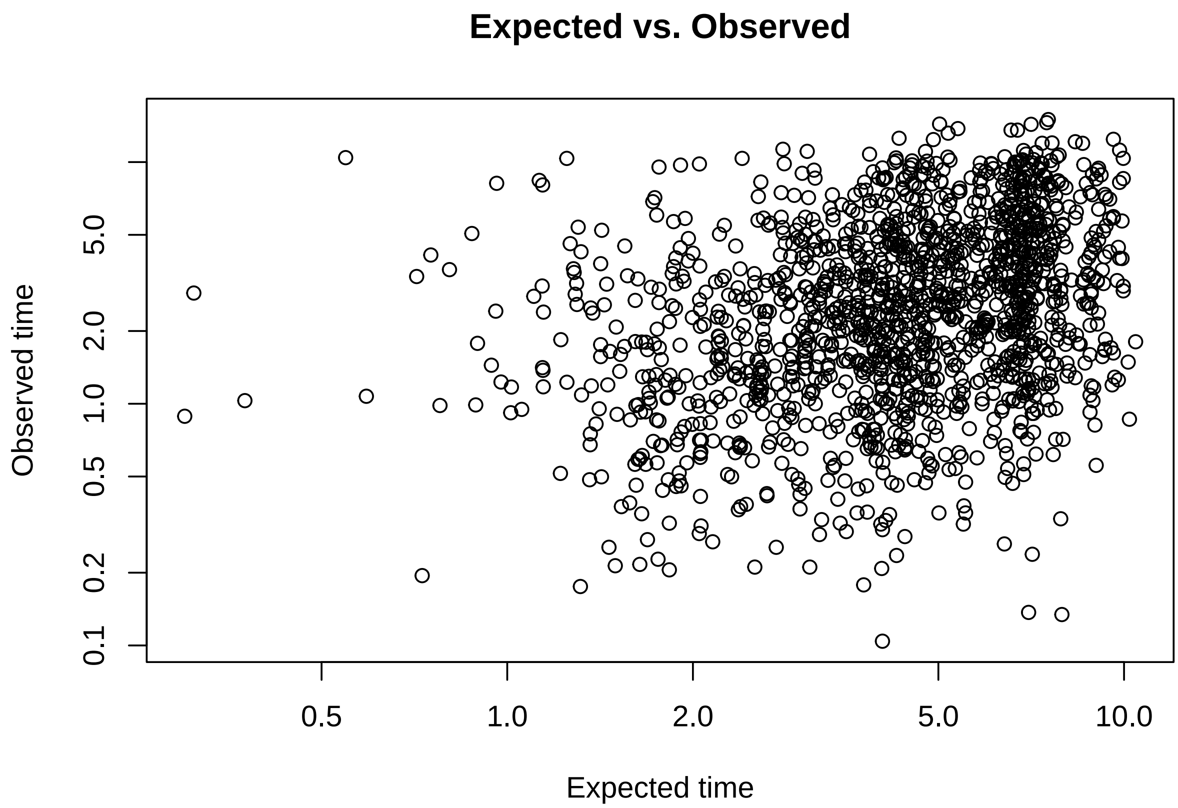


Number at risk

	0	5	10	15	20
Low Risk < 0.551	1985	1260	393	23	0
0.551 <= Risk < 0.631	396	166	51	2	0
High Risk >= 0.631	601	145	39	1	0

1.4.6 Time to event after calibration

```
timetoEvent <- meanTimeToEvent(rdata[rdata[,1]==1,2],timeinterval)
obstime <- dataBrestCancerTrain[rdata[,1]==1,"time"]

plot(timetoEvent,obstime,xlab="Expected time",ylab="Observed time",main="Expected vs. Observed",log="xy
```




```r
pander::pander(cor.test(timetoEvent,obstime,method="spearman"))
```

Table 17: Spearman's rank correlation rho: `timetoEvent` and `obstime`

Test statistic	P value	Alternative hypothesis	rho
3.95e+08	5.22e-38 * * *	two.sided	0.322

```r
MADerror <- mean(abs(timetoEvent-obstime))
pander::pander(MADerror)
```

2.63

1.4.7 Calibrated Train Performance

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

Table 18: Threshold values

	@:0.9	@:0.8	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.6318	0.551	0.466	0.324	0.28381	0.500
RR	1.6904	1.713	1.799	2.376	1.00000	1.758
RR_LCI	1.5860	1.603	1.666	1.869	0.00000	1.636

	@:0.9	@:0.8	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
RR_UCI	1.8018	1.830	1.942	3.019	0.00000	1.889
SEN	0.2991	0.462	0.644	0.965	1.00000	0.580
SPE	0.8996	0.798	0.646	0.125	0.00137	0.706
BACC	0.5993	0.630	0.645	0.545	0.50068	0.643
NetBenefit	0.0677	0.114	0.176	0.286	0.31480	0.150

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

Table 19: 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 20: 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 21: 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	0.69

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

Table 23: ROC AUC

est	lower	upper
0.694	0.675	0.713

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

Table 24: Sensitivity

est	lower	upper
0.299	0.276	0.323

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

Table 25: Specificity

est	lower	upper
0.9	0.883	0.915

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

Table 26: Probability Thresholds

90%	80%
0.631	0.551

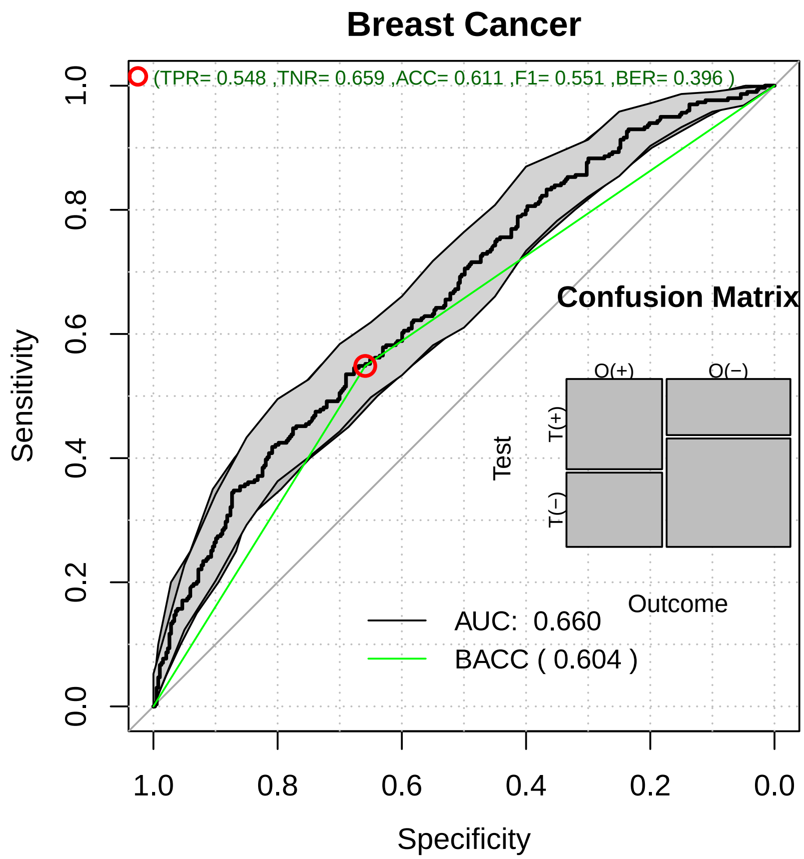
```
pander::pander(rrAnalysisTrain$surdif,caption="Logrank test")
```

Table 27: Logrank test Chisq = 465.079317 on 2 degrees of freedom, p = 0.000000

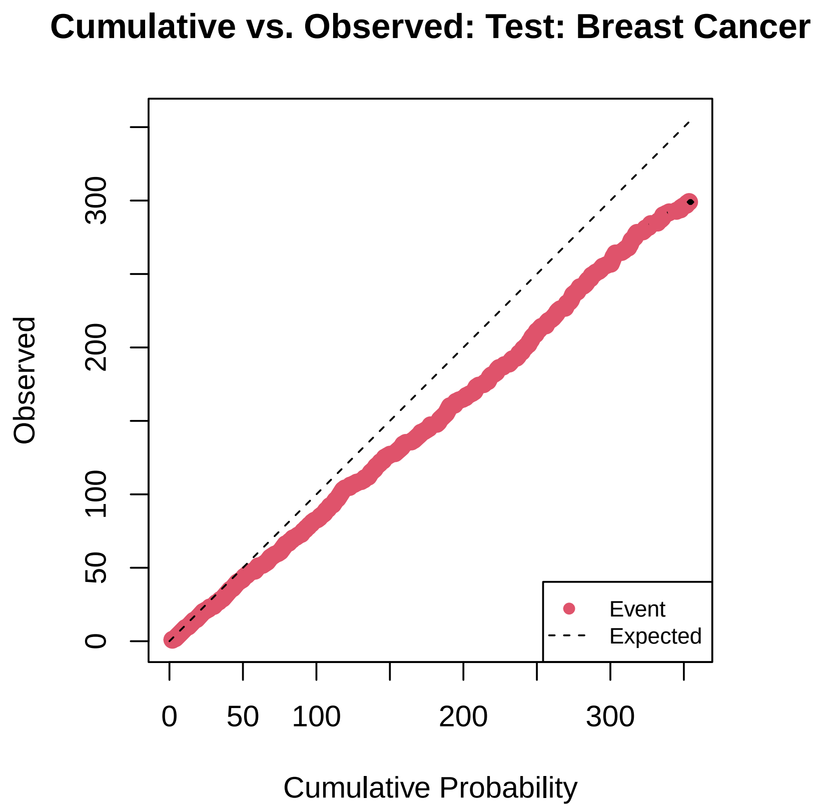
	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	1985	816	1144	93.9	385.7
class=1	396	248	177	28.0	31.8
class=2	601	454	197	336.3	391.3

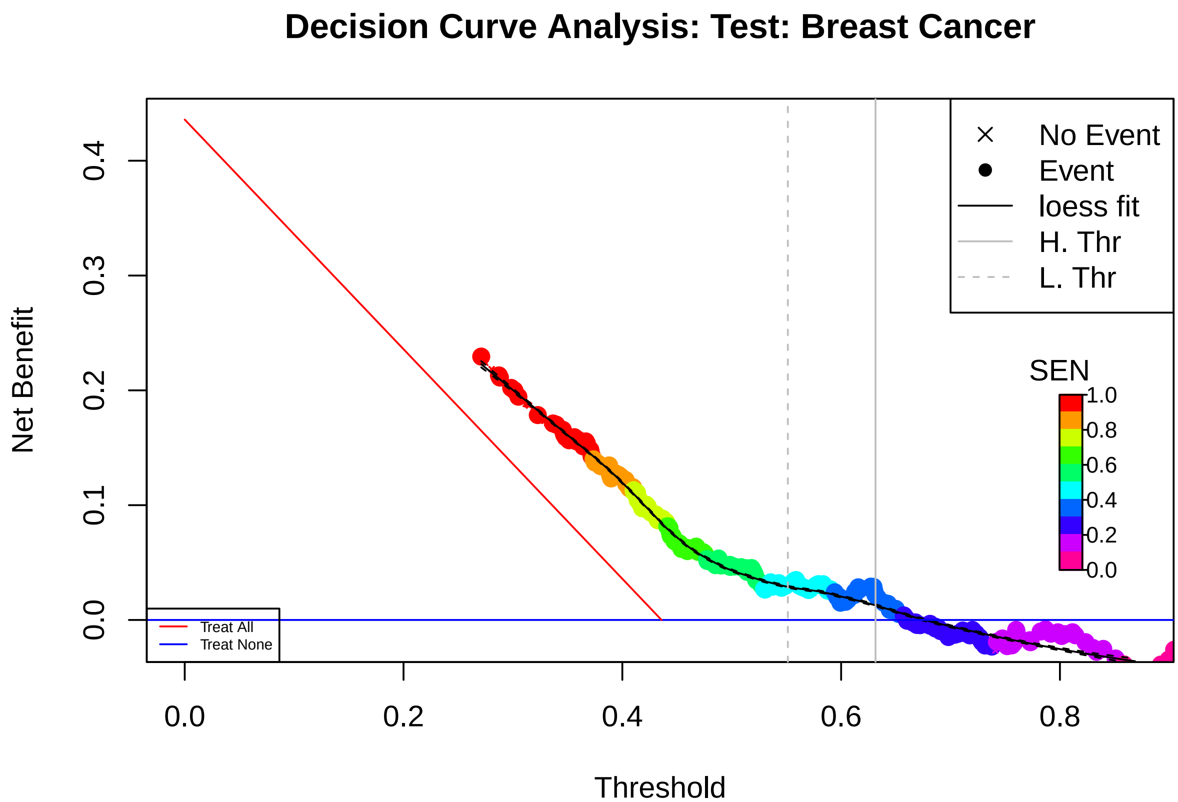
1.5 Performance on the external data set

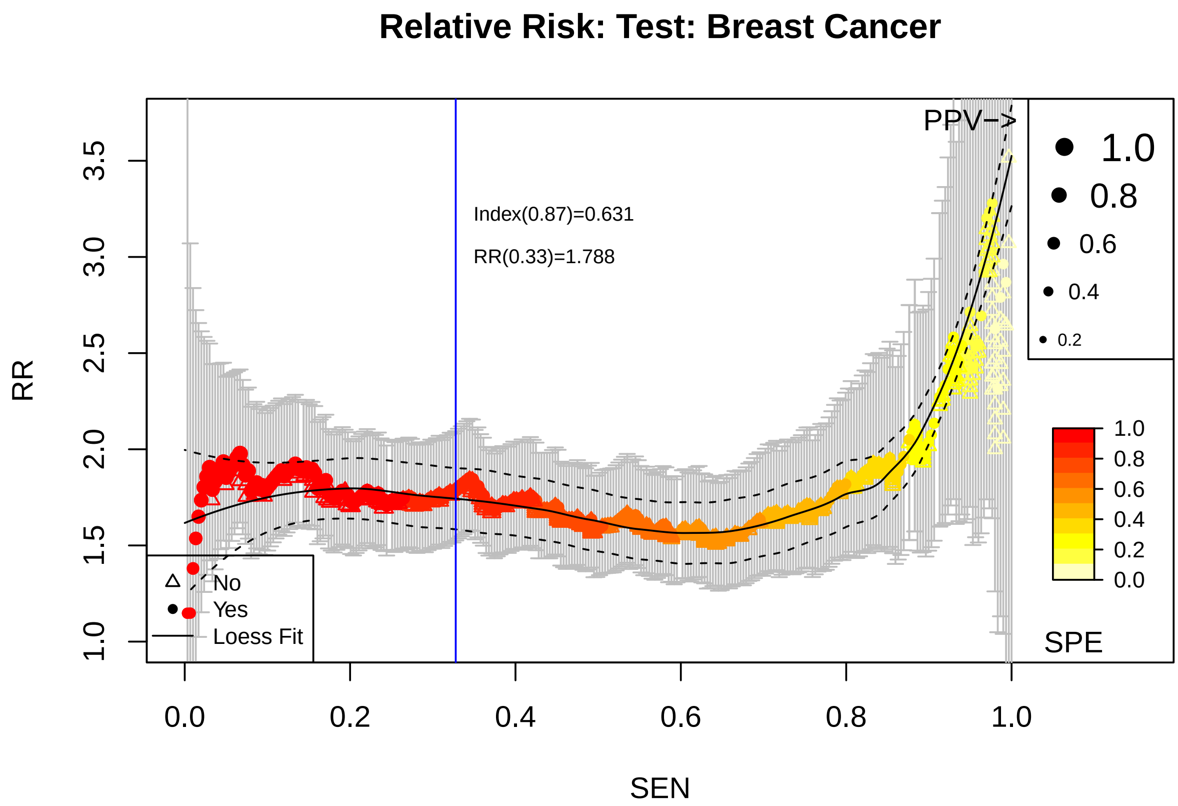
```
index <- predict(ml,dataBrestCancerTest)
pp <- predictionStats_binary(cbind(dataBrestCancerTest$status,index),plotname="Breast Cancer")
```



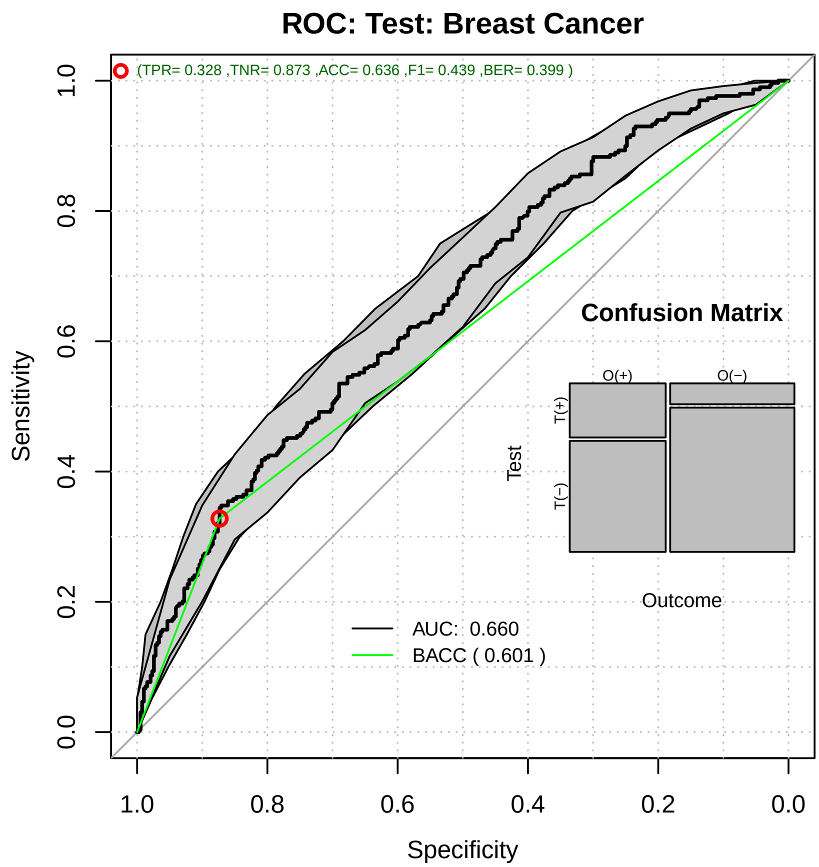

```
par(op)


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)
```

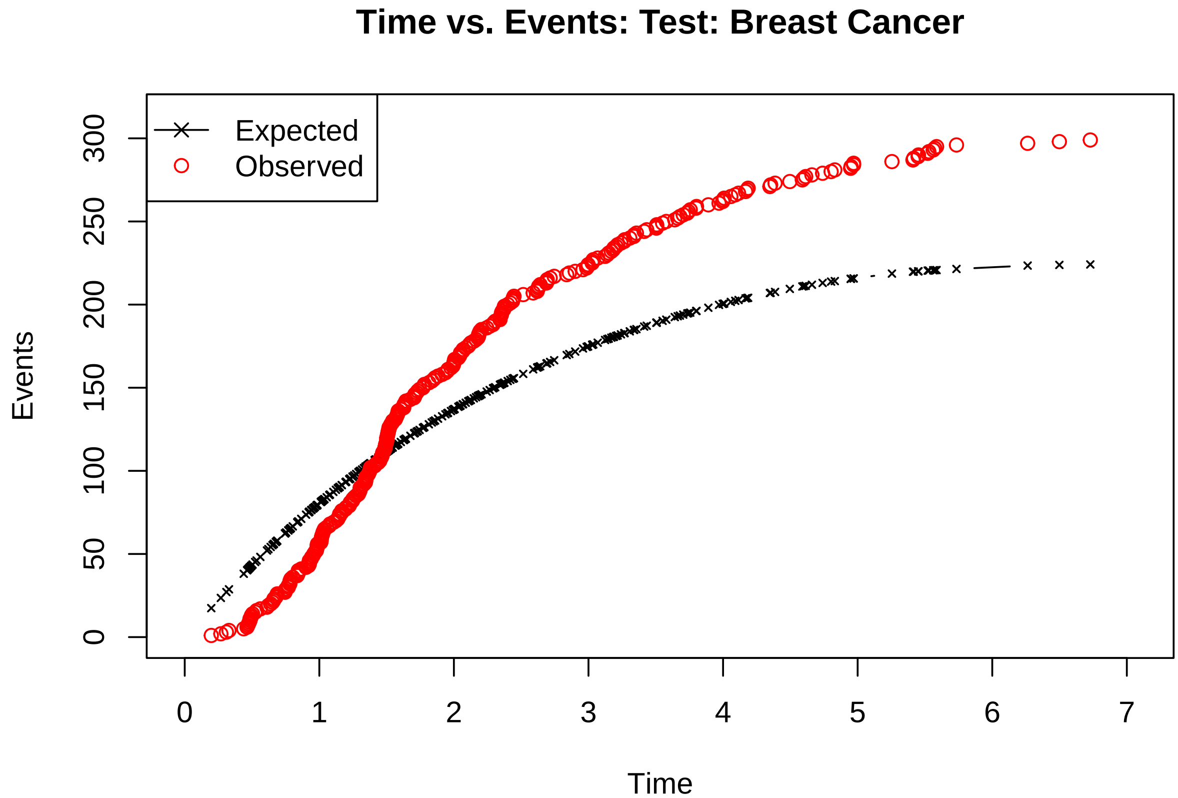

Cumulative vs. Observed: Test: Breast Cancer
Observed
0
50
100
200
300
Cumulative Probability
0
50
100
200
300
Event
Expected

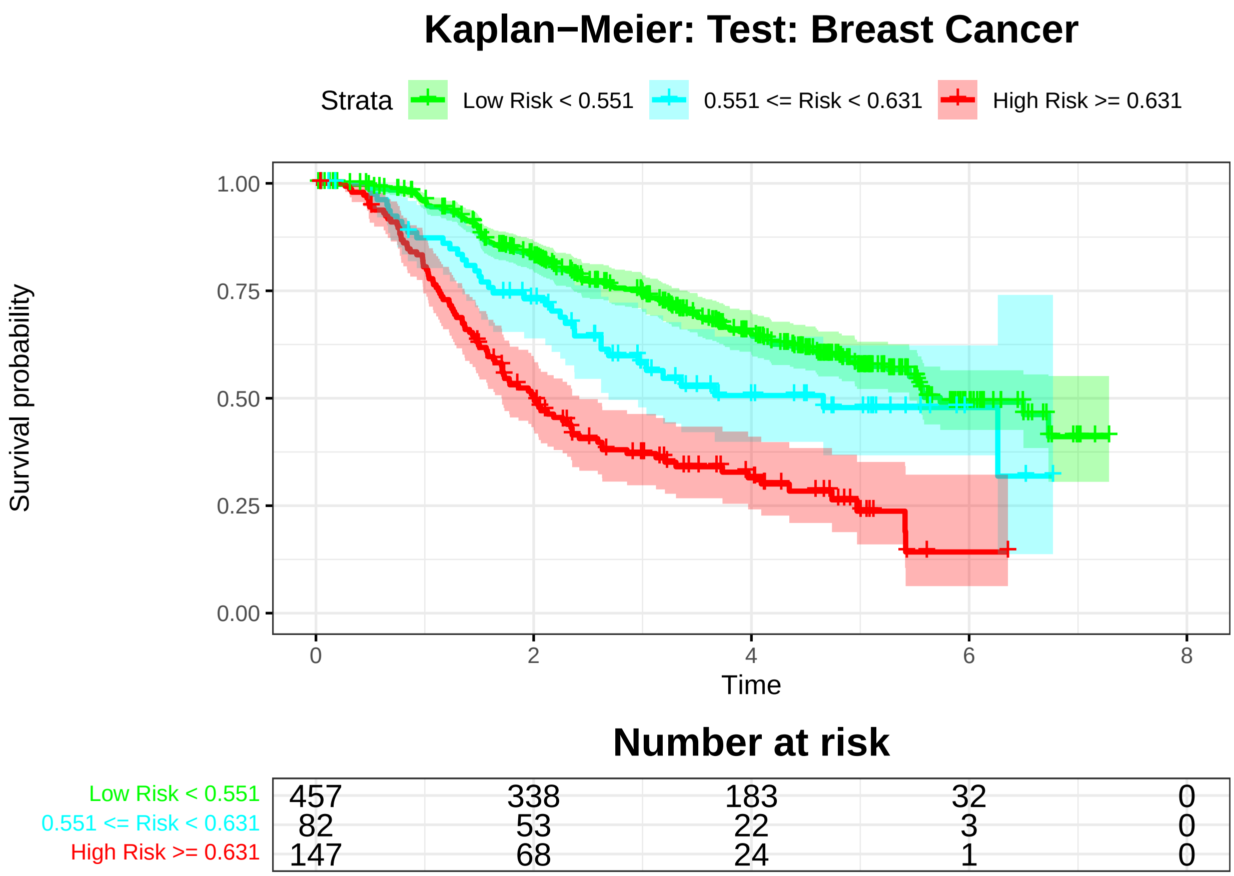

Decision Curve Analysis: Test: Breast Cancer
No Event
Event
loess fit
H. Thr
L. Thr
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None
Net Benefit
Threshold
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8



Relative Risk: Test: Breast Cancer
RR
SEN
PPV->
Index(0.87)=0.631
RR(0.33)=1.788
No
Yes
Loess Fit
SPE
1.0
0.8
0.6
0.4
0.2
0.0
3.5
3.0
2.5
2.0
1.5
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
Time
0
1
2
3
4
5
6
7




```
par(op)
```

1.5.1 External Data Report

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

Table 28: Threshold values

	@:0.631	@:0.551	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.6312	0.5516	0.5834	0.337	2.71e-01	0.4996
RR	1.7994	1.6427	1.7581	3.279	2.64e+01	1.5937
RR_LCI	1.5366	1.3951	1.4980	1.641	5.65e-02	1.3435
RR_UCI	2.1071	1.9343	2.0632	6.552	1.23e+04	1.8906
SEN	0.3311	0.4515	0.4181	0.977	1.00e+00	0.5518
SPE	0.8734	0.7571	0.8088	0.111	1.55e-02	0.6537
BACC	0.6022	0.6043	0.6134	0.544	5.08e-01	0.6028
NetBenefit	0.0221	0.0283	0.0312	0.171	2.29e-01	0.0455

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

Table 29: 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	0.663	0.632	0.692

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

Table 31: ROC AUC

est	lower	upper
0.66	0.619	0.7

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

Table 32: Sensitivity

est	lower	upper
0.328	0.275	0.384

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

Table 33: Specificity

est	lower	upper
0.873	0.836	0.905

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

Table 34: Probability Thresholds

90%	80%
0.631	0.551

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

Table 35: Logrank test Chisq = 81.471750 on 2 degrees of freedom, p = 0.000000

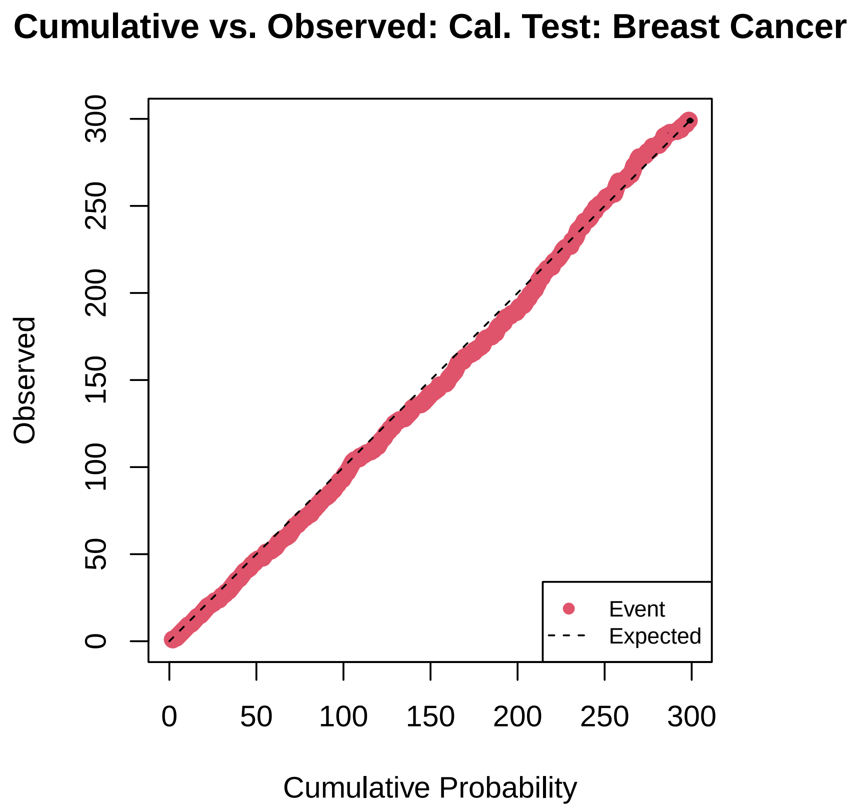
	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	457	164	221.4	14.888	58.181
class=1	82	37	33.2	0.438	0.494
class=2	147	98	44.4	64.710	77.254

1.5.2 Calibrating the index on the test data

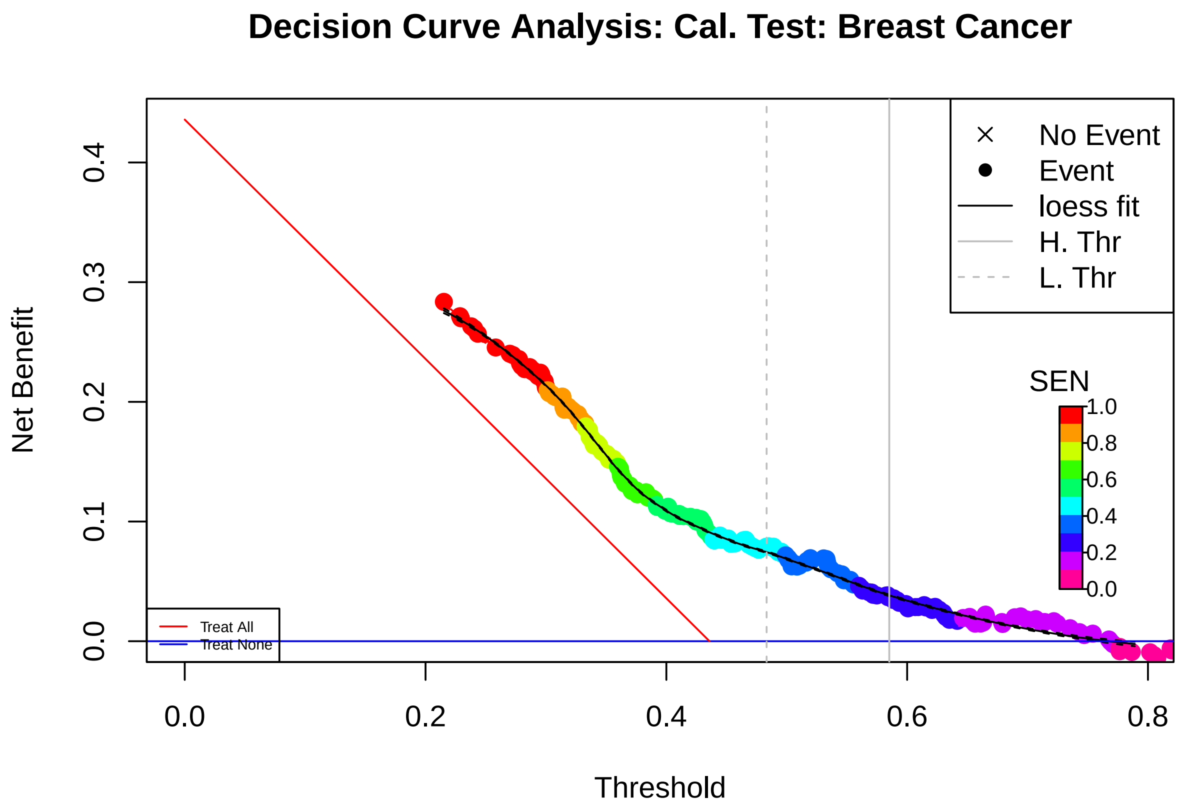
```
calprob <- CoxRiskCalibration(ml,dataBrestCancerTest,"status","time")

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

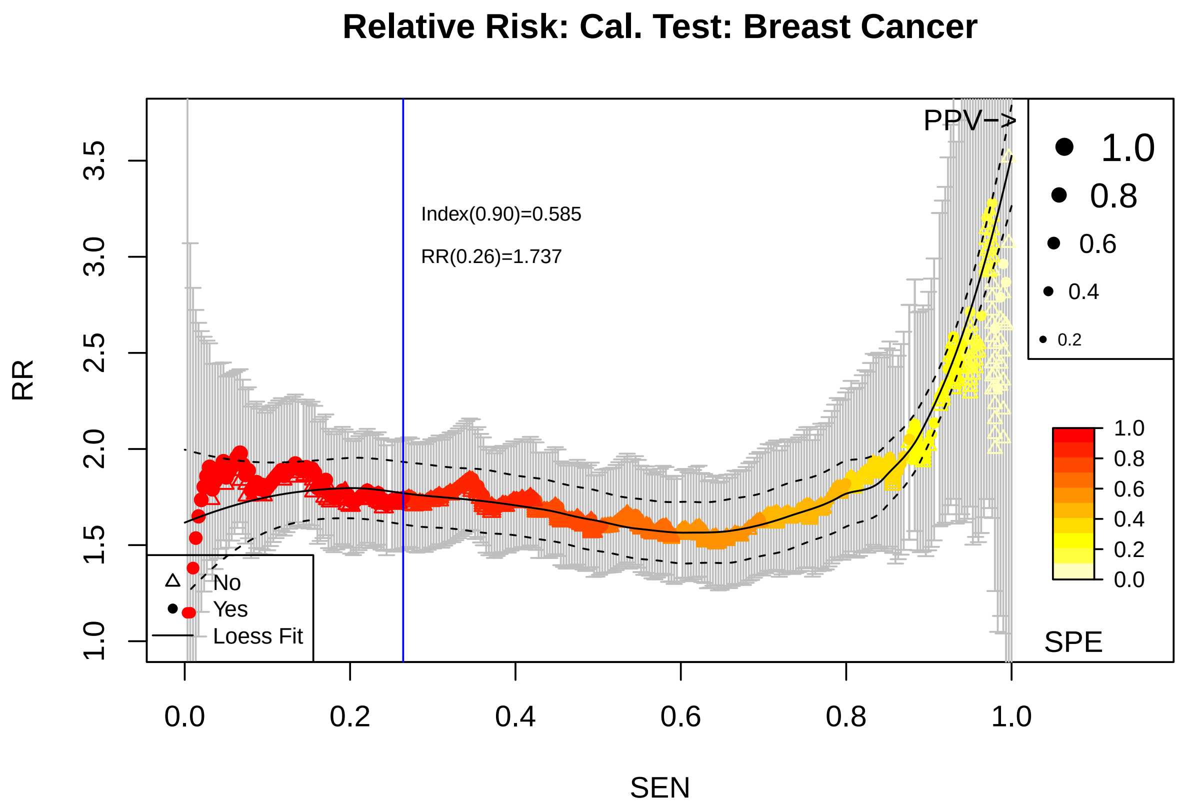
```
rdata <- cbind(dataBrestCancerTest$status,calprob$prob)

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

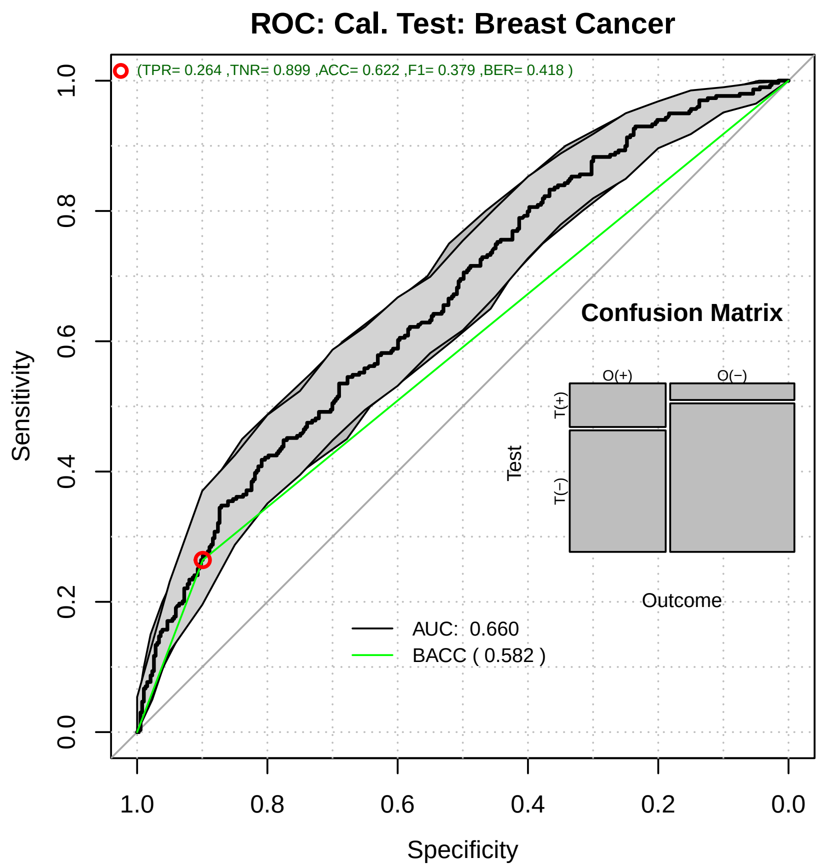


Cumulative vs. Observed: Cal. Test: Breast Cancer
Observed
0
50
100
150
200
250
300
Cumulative Probability
Event
Expected

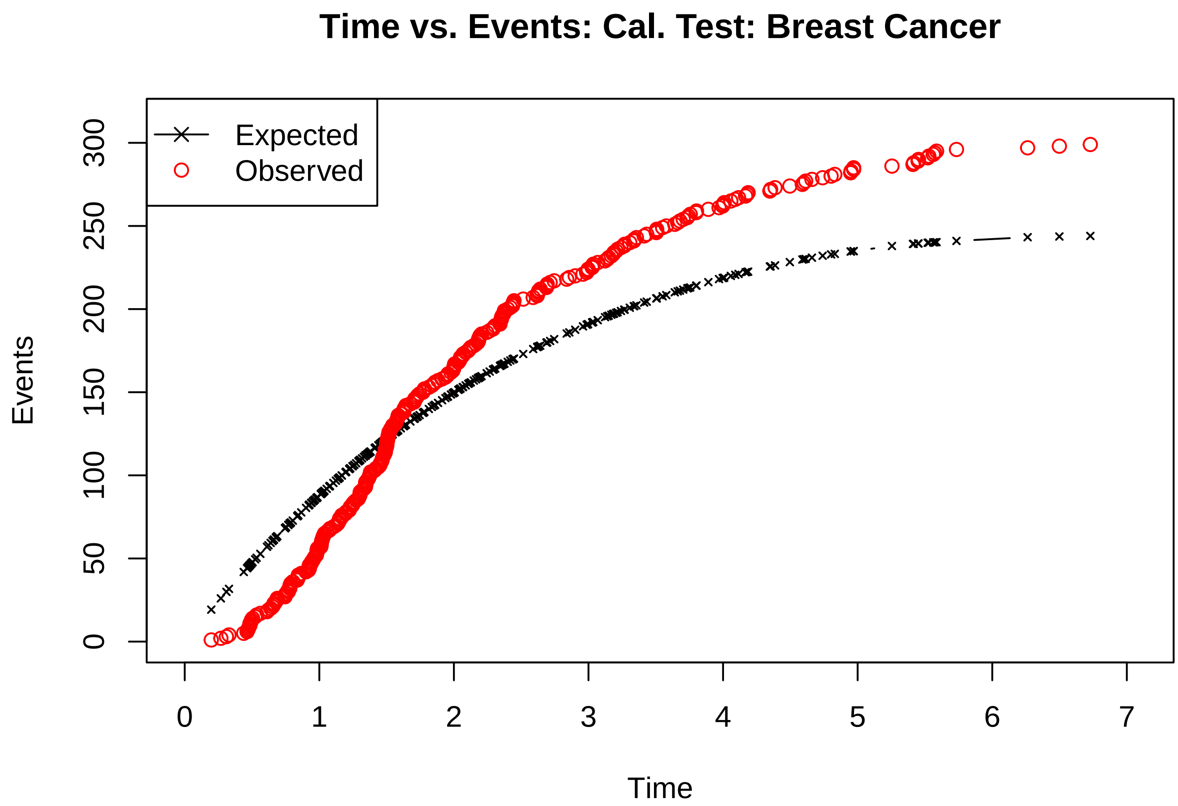


Decision Curve Analysis: Cal. Test: Breast Cancer
No Event
Event
loess fit
H. Thr
L. Thr
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None
Net Benefit
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8
Threshold

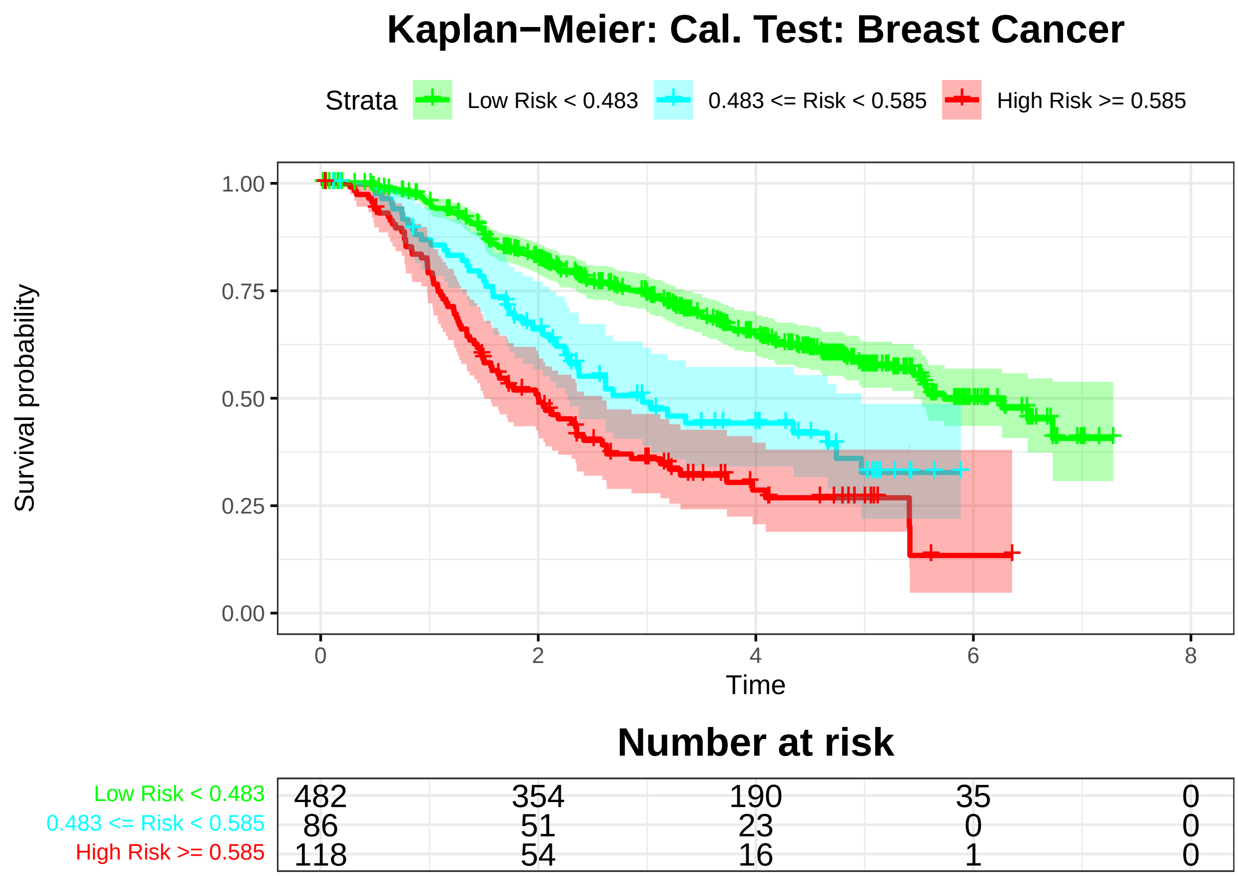

Relative Risk: Cal. Test: Breast Cancer
Index(0.90)=0.585
RR(0.26)=1.737
PPV−>
1.0
0.8
0.6
0.4
0.2
SPE
No
Yes
Loess Fit
RR
SEN
1.0
1.5
2.0
2.5
3.0
3.5
0.0
0.2
0.4
0.6
0.8
1.0



ROC: Cal. Test: Breast Cancer
(TPR= 0.264 ,TNR= 0.899 ,ACC= 0.622 ,F1= 0.379 ,BER= 0.418)
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 (0.582)



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



1.5.3 After Calibration Report

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

Table 37: Threshold values

	@:0.9	@:0.8	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.5843	0.483	0.489	0.270	2.15e-01	0.4991
RR	1.7405	1.732	1.758	3.279	2.64e+01	1.7385
RR_LCI	1.4790	1.475	1.498	1.641	5.65e-02	1.4816
RR_UCI	2.0483	2.035	2.063	6.552	1.23e+04	2.0399
SEN	0.2676	0.425	0.418	0.977	1.00e+00	0.3980
SPE	0.8992	0.798	0.809	0.111	1.55e-02	0.8191
BACC	0.5834	0.612	0.613	0.544	5.08e-01	0.6086
NetBenefit	0.0367	0.079	0.079	0.240	2.84e-01	0.0718

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

Table 38: O/E Ratio

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

```r
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	0.663	0.634	0.694

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

Table 40: ROC AUC

est	lower	upper
0.66	0.619	0.7

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

Table 41: Sensitivity

est	lower	upper
0.264	0.215	0.318

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

Table 42: Specificity

est	lower	upper
0.899	0.865	0.927

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

Table 43: Probability Thresholds

90%	80%
0.585	0.483

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

Table 44: 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

```r
## 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)
```

—..

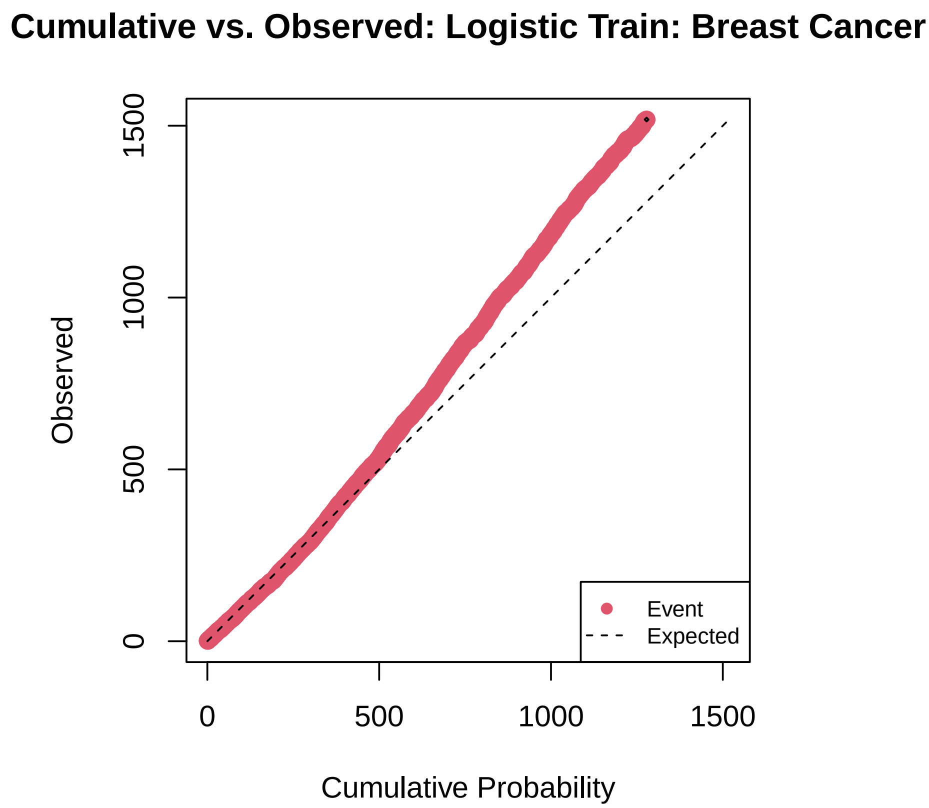
```r
sm <- summary(mlog)
pander::pander(sm$coefficients)
```

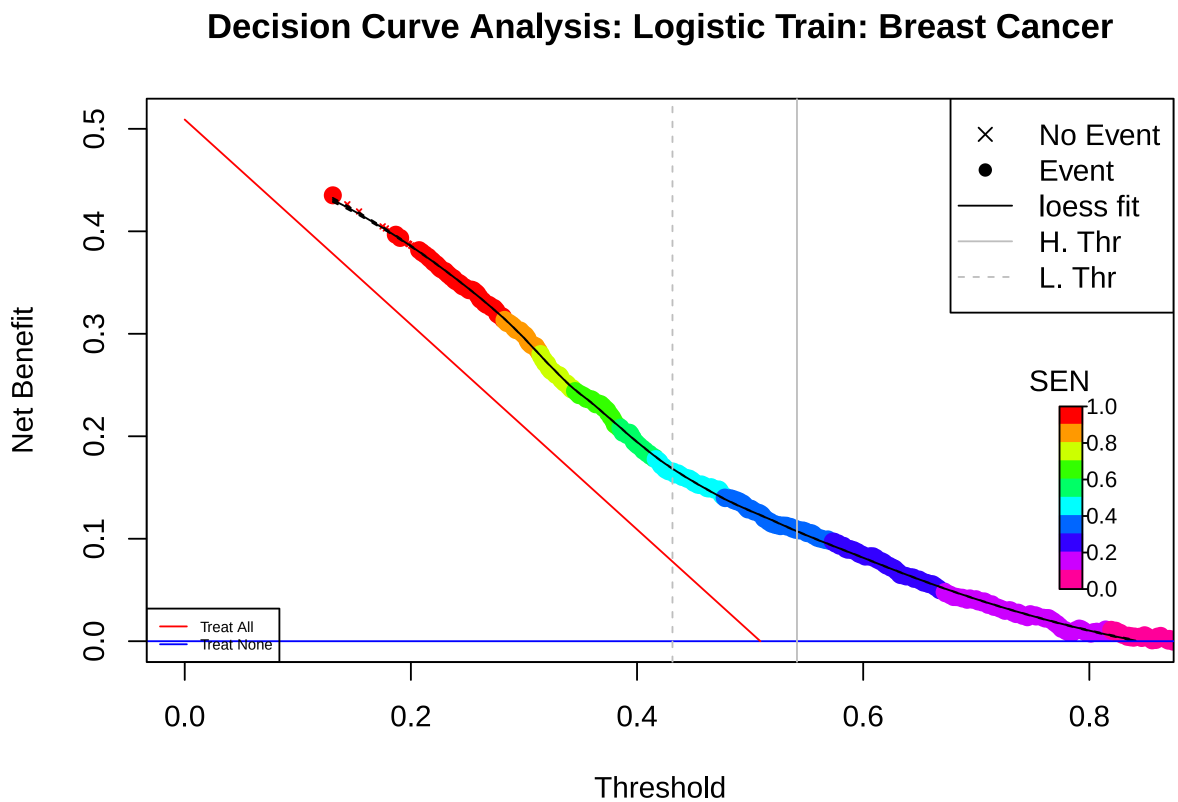
	Estimate	lower	OR	upper	u.Accuracy	r.Accuracy	full.Accuracy	u.AUC	r.AUC	full.AUC	IDI	NRI	z.IDI	z.NRI	Delta.AUC	Frequency
size_nodes	[illegible].05e-03	1.001	1.001	1.001	0.669	0.571	0.668	0.627	0.500	0.628	0.1123	0.6365	17.86	18.870	0.128490	1
nodes	4.33e-02	1.040	1.044	1.048	0.676	0.634	0.690	0.639	0.621	0.662	0.0711	0.5710	14.13	16.179	0.040494	1
grade_nodes	1.50e-02	1.014	1.015	1.016	0.682	0.637	0.686	0.649	0.624	0.655	0.0658	0.5486	13.66	15.650	0.031087	1
age_nodes	1.96e-03	1.001	1.001	1.001	0.678	0.653	0.686	0.642	0.621	0.657	0.0334	0.2131	9.39	5.710	0.035896	1
size_grade	1.75e-03	1.001	1.002	1.002	0.632	0.682	0.686	0.626	0.646	0.655	0.0178	0.2941	6.74	7.728	0.008648	1
age_size	8.73e-05	1.000	1.000	1.000	0.608	0.682	0.686	0.577	0.649	0.657	0.0153	0.2915	6.41	7.652	0.007600	1
grade	2.27e-01	1.168	1.254	1.347	0.571	0.683	0.690	0.500	0.653	0.662	0.0134	0.1903	6.20	4.983	0.008461	1
age_meno	-6.04e-03	0.992	0.994	0.996	0.571	0.676	0.686	0.500	0.645	0.657	0.0078	0.0805	4.76	2.337	0.012065	1

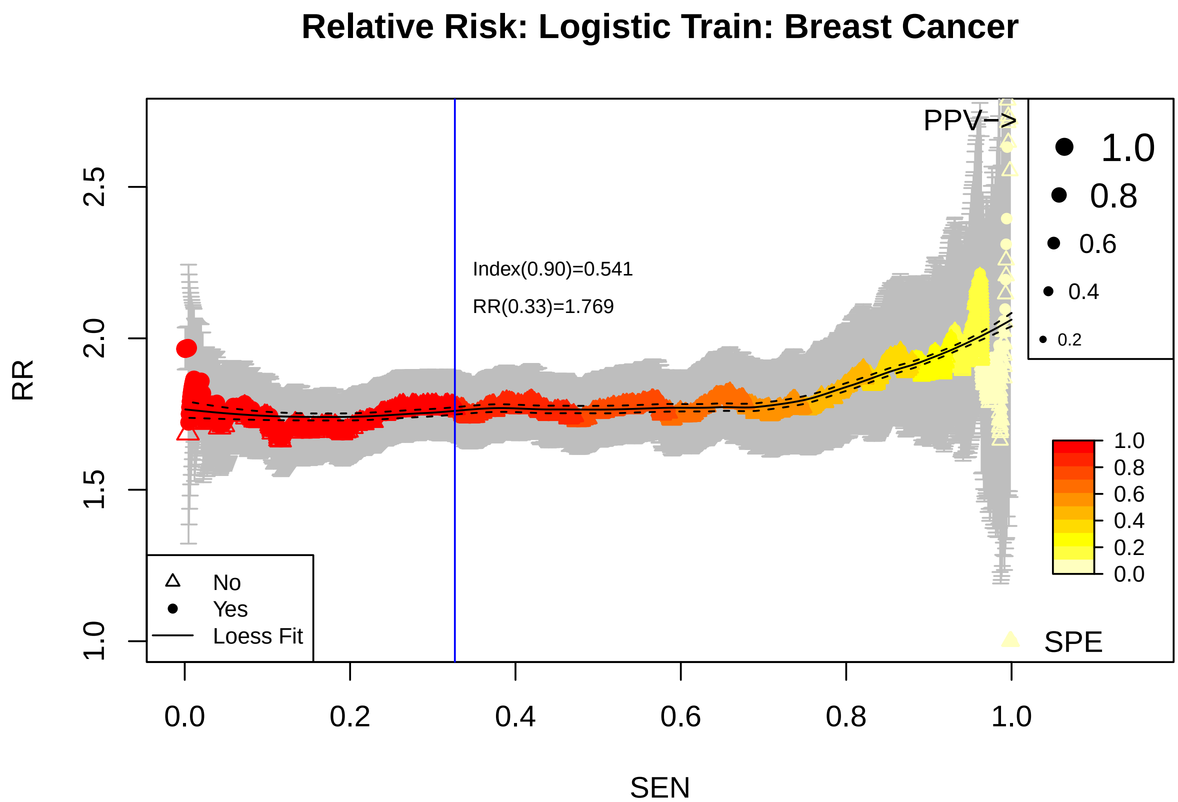
	Estimate	lower	OR	upper	u.Accuracy	r.Accuracy	full.Accuracy	u.AUC	r.AUC	full.AUC	IDI	NRI	z.IDI	z.NRI	Delta.AUC	Frequency
age_pgr	-5.42e-06	1.000	1.000	1.000	0.571	0.686	0.686	0.500	0.656	0.657	0.00512	0.00745	4.11	0.194	0.000417	1
age_grade	1.65e-03	0.997	0.998	0.999	0.574	0.690	0.690	0.507	0.661	0.662	0.00450	0.11372	3.60	2.960	0.000315	1
meno_grade	1.02e-01	1.045	1.107	1.173	0.571	0.683	0.686	0.500	0.652	0.657	0.00425	0.20428	3.47	5.343	0.004441	1
nodes_hormon	-1.38e-02	0.979	0.986	0.994	0.587	0.688	0.686	0.526	0.658	0.655	0.00280	0.45522	3.44	12.150	-0.002853	1
size	3.94e-03	1.002	1.004	1.006	0.611	0.693	0.690	0.618	0.663	0.662	0.00507	0.21053	3.42	5.600	-0.001075	1
meno_pgr	3.19e-04	1.000	1.000	1.001	0.571	0.687	0.686	0.500	0.657	0.657	0.00316	0.05977	3.35	1.558	-0.000429	1
pgr	-1.07e-04	1.000	1.000	1.000	0.571	0.689	0.686	0.500	0.659	0.655	0.00257	0.19759	2.64	5.745	-0.004123	1
meno_nodes	-2.60e-02	0.955	0.974	0.994	0.640	0.686	0.686	0.595	0.656	0.657	0.00264	-0.06329	2.59	-1.645	0.000631	1
grade_pgr	-3.51e-05	1.000	1.000	1.000	0.571	0.669	0.668	0.500	0.627	0.628	0.00240	0.17471	2.55	5.058	0.001252	1
meno_size	2.34e-03	1.000	1.002	1.004	0.604	0.691	0.690	0.578	0.663	0.662	0.00185	0.10227	2.43	2.662	-0.001378	1

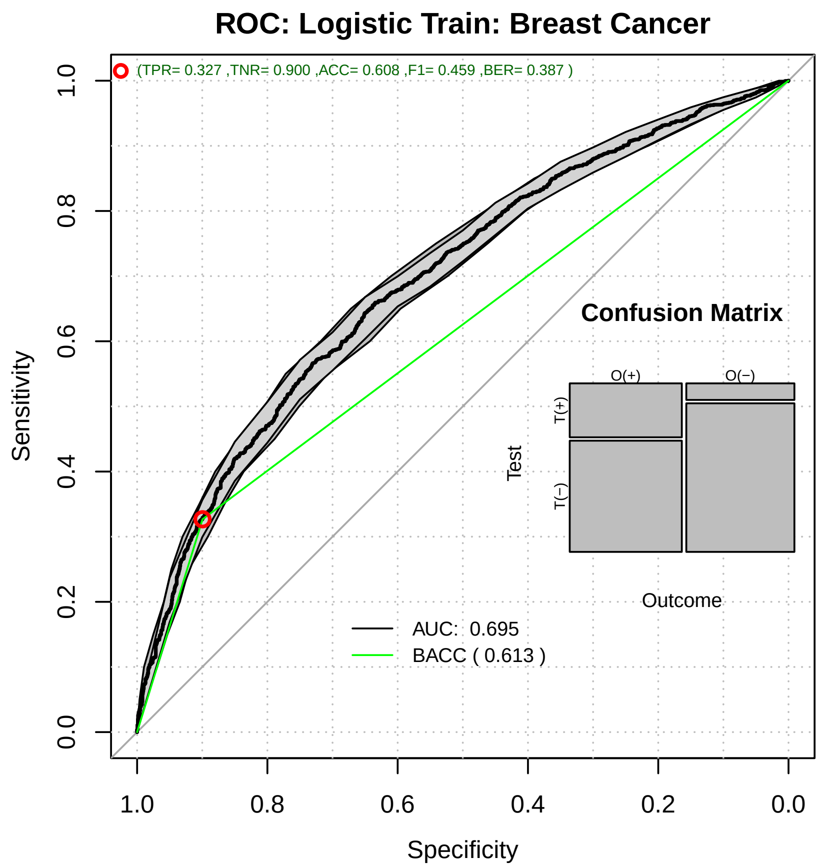
1.7 Logistic Model Performance

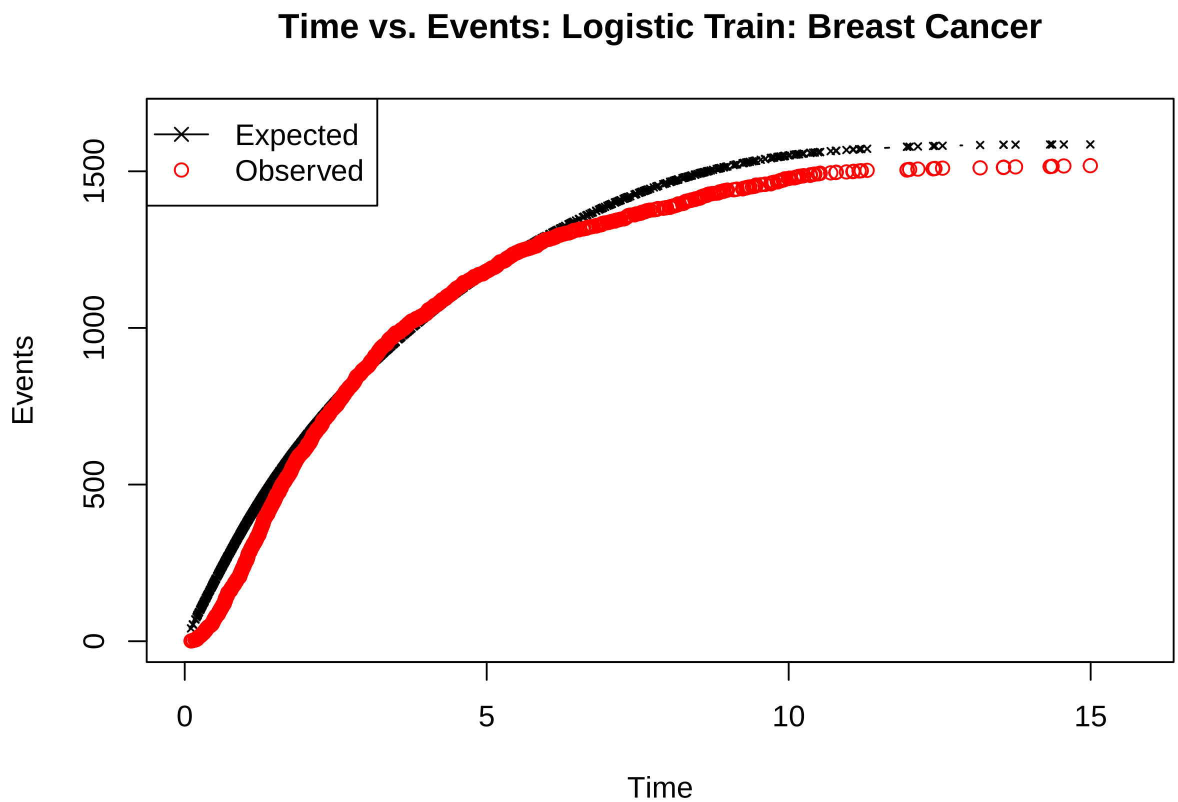
```
op <- par(no.readonly = TRUE)


cprob <- predict(mlog,dataBrestCancerTrain)

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

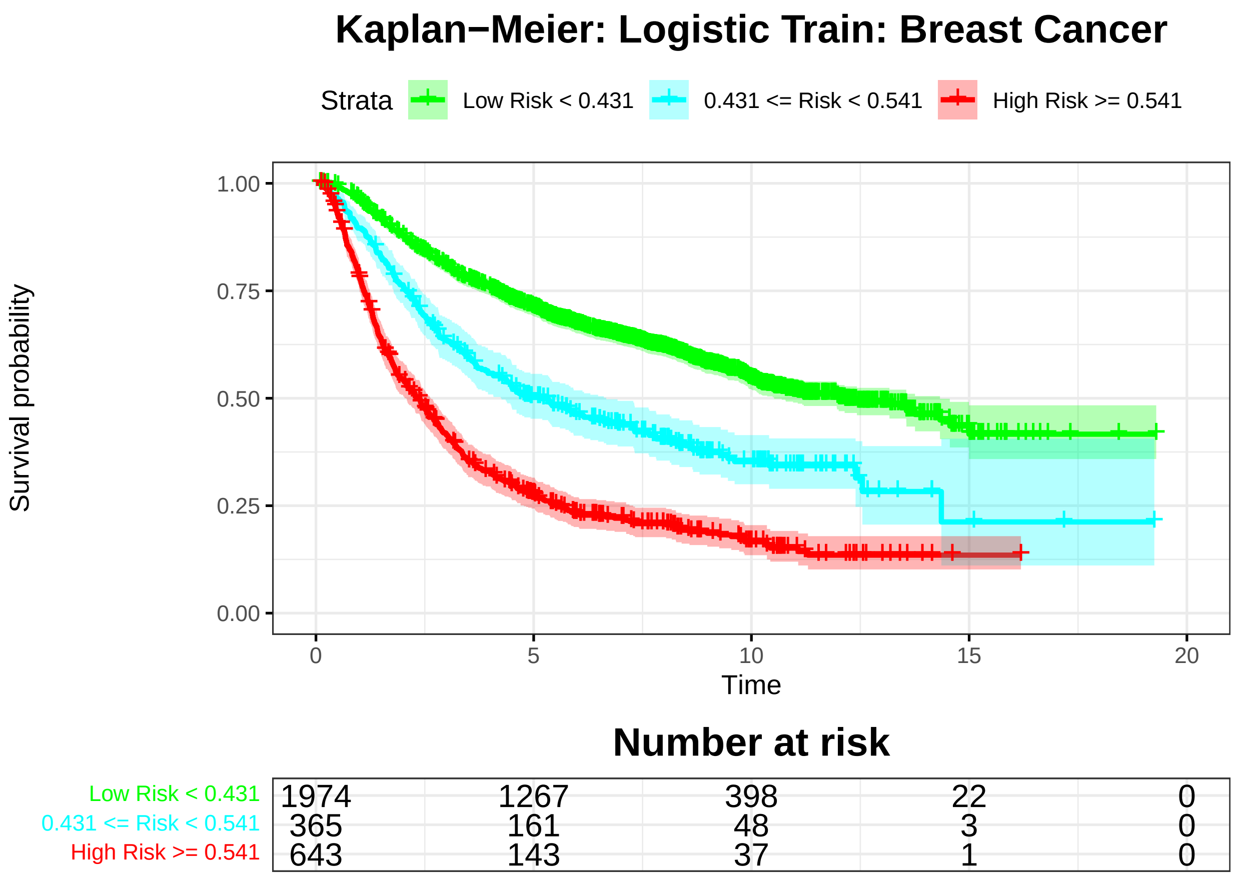

Cumulative vs. Observed: Logistic Train: Breast Cancer
Observed
0
500
1000
1500
Event
Expected
0
500
1000
1500
Cumulative Probability


Decision Curve Analysis: Logistic Train: Breast Cancer
Net Benefit
Threshold
0.0
0.1
0.2
0.3
0.4
0.5
0.0
0.2
0.4
0.6
0.8
No Event
Event
loess fit
H. Thr
L. Thr
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)=0.541
RR(0.33)=1.769
2.5
2.0
1.5
1.0
RR
1.0
0.8
0.6
0.4
0.2
0.0
No
Yes
Loess Fit
SPE
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
Time
0
500
1000
1500
0
5
10
15




```
par(op)
```

1.7.1 Training Report

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

Table 46: 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
RR_LCI	1.659	1.627	1.676	1.764	0.000000	1.665
RR_UCI	1.879	1.858	1.931	2.777	0.000000	1.888
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
NetBenefit	0.108	0.165	0.202	0.342	0.435125	0.129

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

Table 47: 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**: *4206584*
- **Uncertain**: *2703838*
- **cstatCI**:

mean.C Index	median	lower	upper
0.68	0.681	0.667	0.695

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

Table 49: ROC AUC

est	lower	upper
0.695	0.677	0.714

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

Table 50: Sensitivity

est	lower	upper
0.327	0.303	0.351

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

Table 51: Specificity

est	lower	upper
0.9	0.883	0.915

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

Table 52: Probability Thresholds

90%	80%
0.541	0.431

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

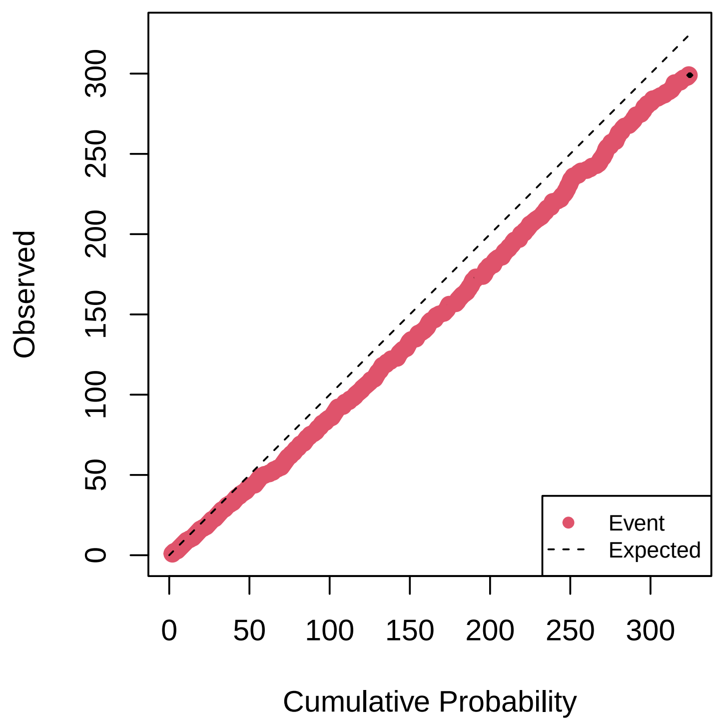
Table 53: Logrank test Chisq = 541.976716 on 2 degrees of freedom, p = 0.000000

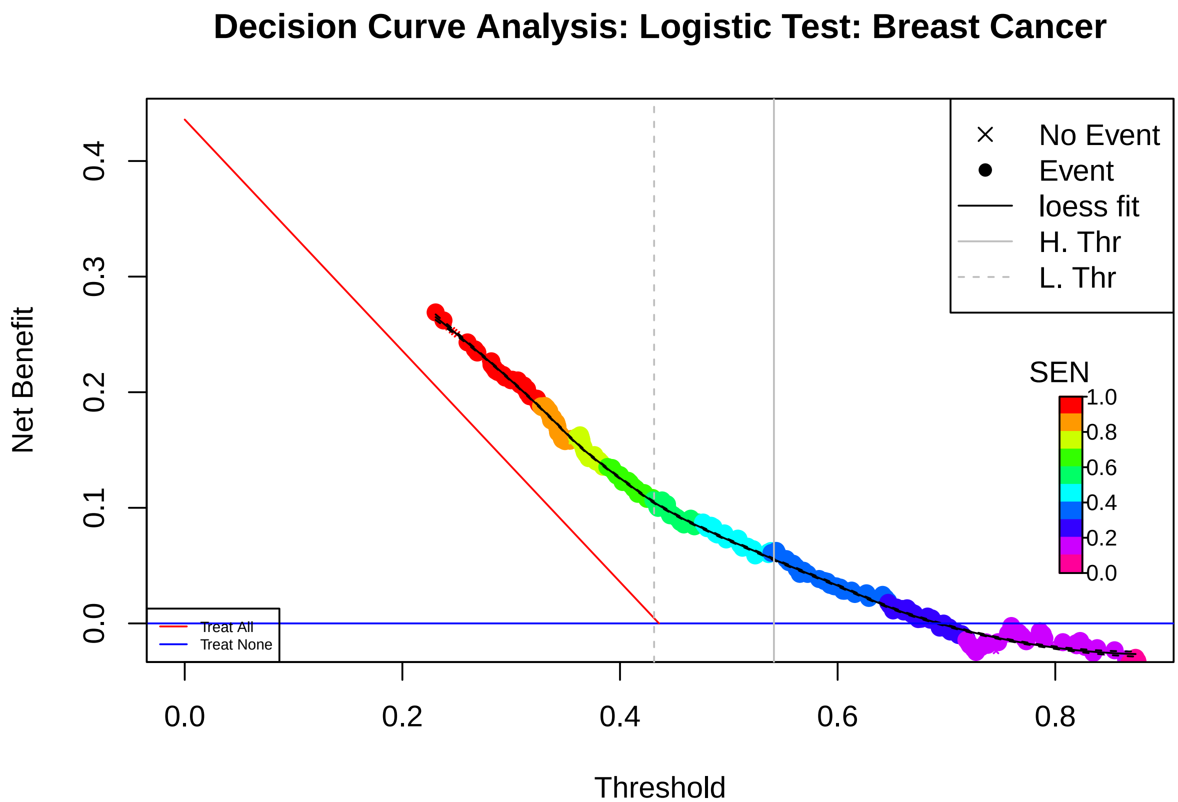
	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	1974	804	1144	100.9	415.3
class=1	365	218	170	13.4	15.1
class=2	643	496	204	418.2	490.7

1.7.2 Results on the validation set using Logistic model

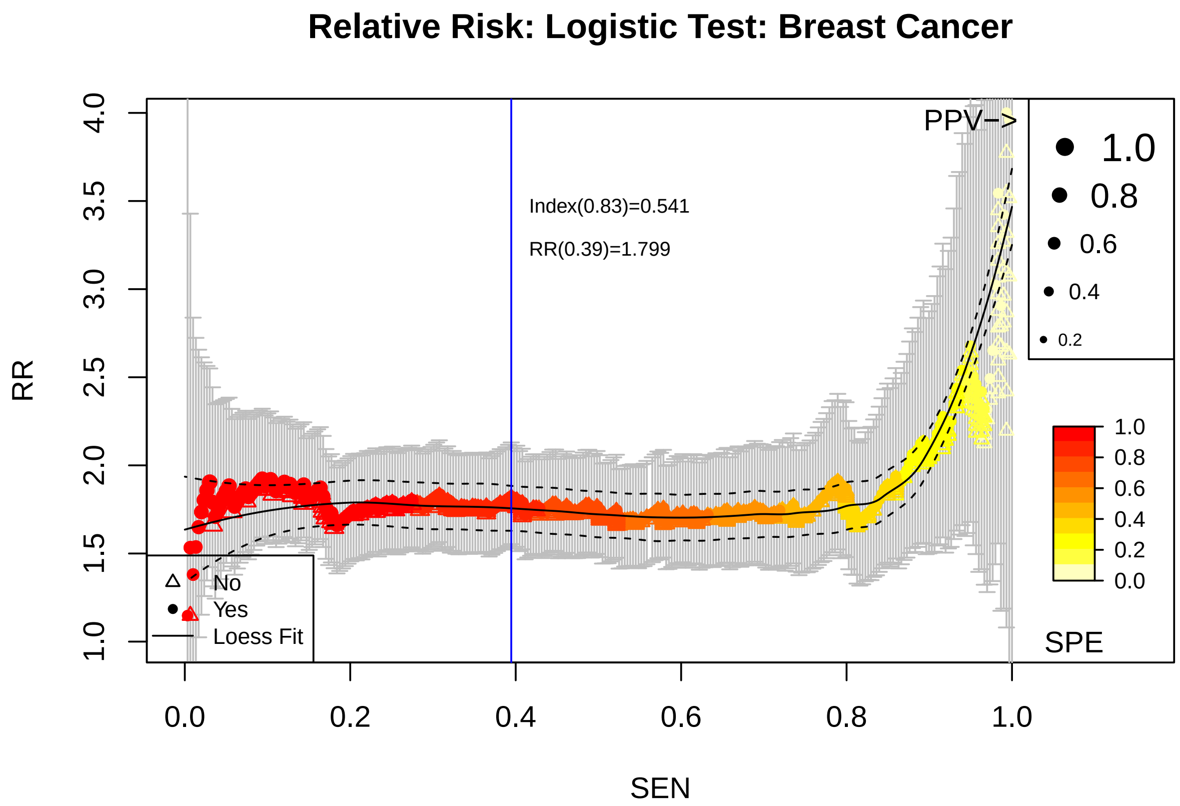
```
pre <- predict(mlog,dataBrestCancerTest)
rdata <- cbind(dataBrestCancerTest$status,pre)

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

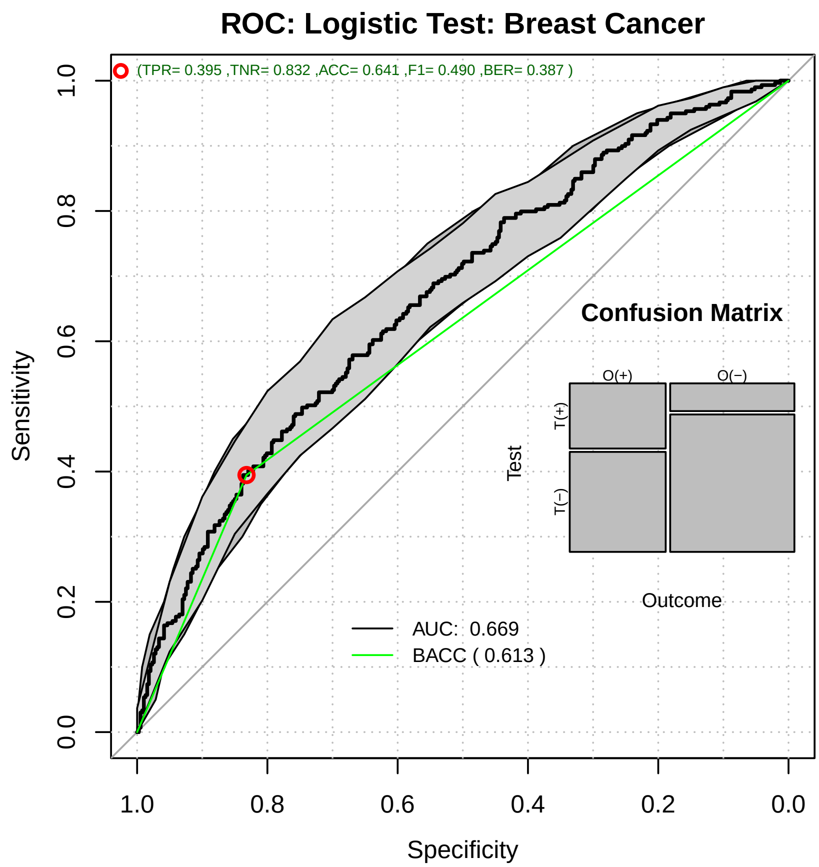




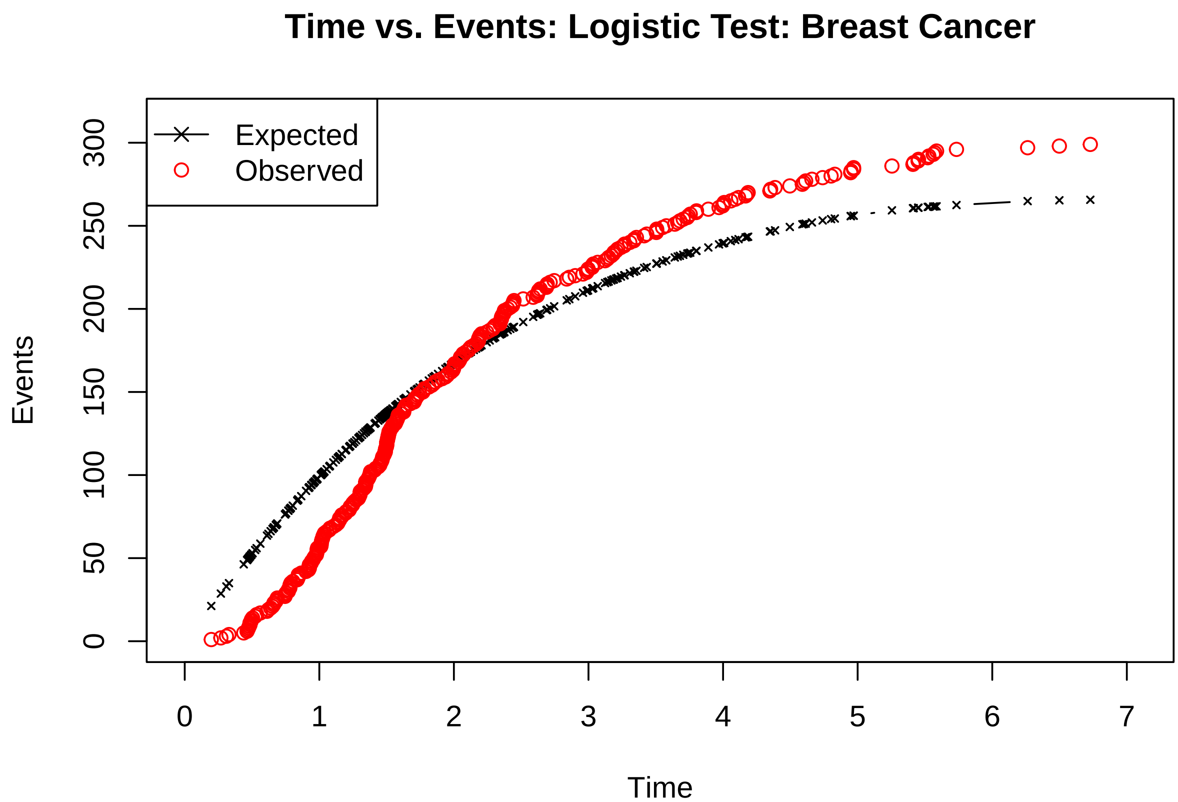
Decision Curve Analysis: Logistic Test: Breast Cancer
Net Benefit
Threshold
No Event
Event
loess fit
H. Thr
L. Thr
SEN
Treat All
Treat None

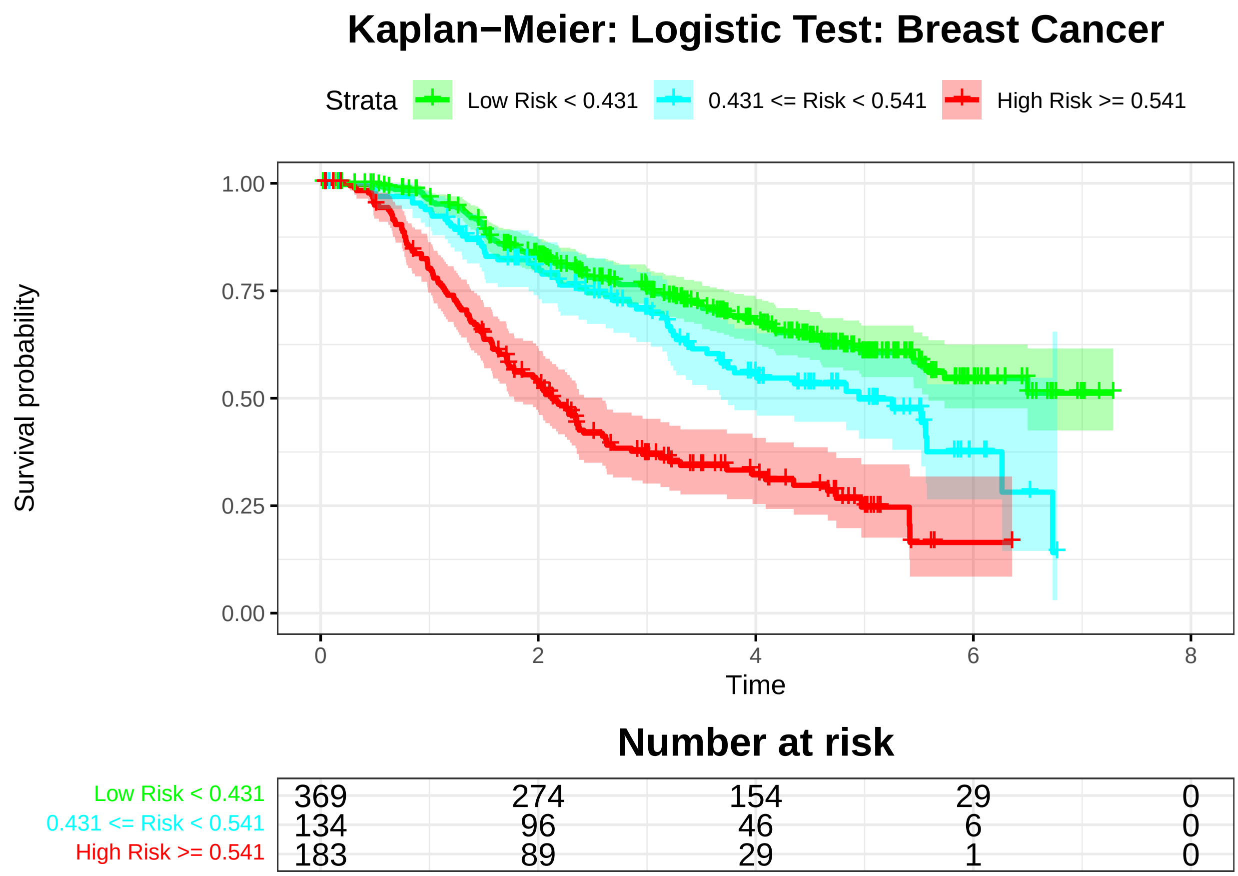


Relative Risk: Logistic Test: Breast Cancer
RR
SEN
Index(0.83)=0.541
RR(0.39)=1.799
PPV->
1.0
0.8
0.6
0.4
0.2
SPE
No
Yes
Loess Fit
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
3.0
3.5
4.0



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
Time
0
50
100
150
200
250
300
0
1
2
3
4
5
6
7




```
par(op)
```

1.7.3 Validation Report

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

Table 54: Threshold values

	@:0.541	@:0.431	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.542	0.431	0.439	0.306	2.31e-01	0.4996
RR	1.792	1.702	1.756	2.678	2.20e+01	1.7318
RR_LCI	1.529	1.428	1.477	1.679	4.75e-02	1.4731
RR_UCI	2.100	2.029	2.088	4.271	1.02e+04	2.0360
SEN	0.395	0.595	0.579	0.950	1.00e+00	0.4482
SPE	0.832	0.638	0.669	0.181	1.29e-02	0.7804
BACC	0.613	0.617	0.624	0.565	5.06e-01	0.6143
NetBenefit	0.060	0.105	0.106	0.210	2.69e-01	0.0717

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

Table 55: 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	0.64	0.7

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

Table 57: ROC AUC

est	lower	upper
0.669	0.628	0.709

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

Table 58: Sensitivity

est	lower	upper
0.395	0.339	0.453

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

Table 59: Specificity

est	lower	upper
0.832	0.791	0.868

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

Table 60: Probability Thresholds

90%	80%
0.541	0.431

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

Table 61: Logrank test Chisq = 92.507991 on 2 degrees of freedom, p = 0.000000

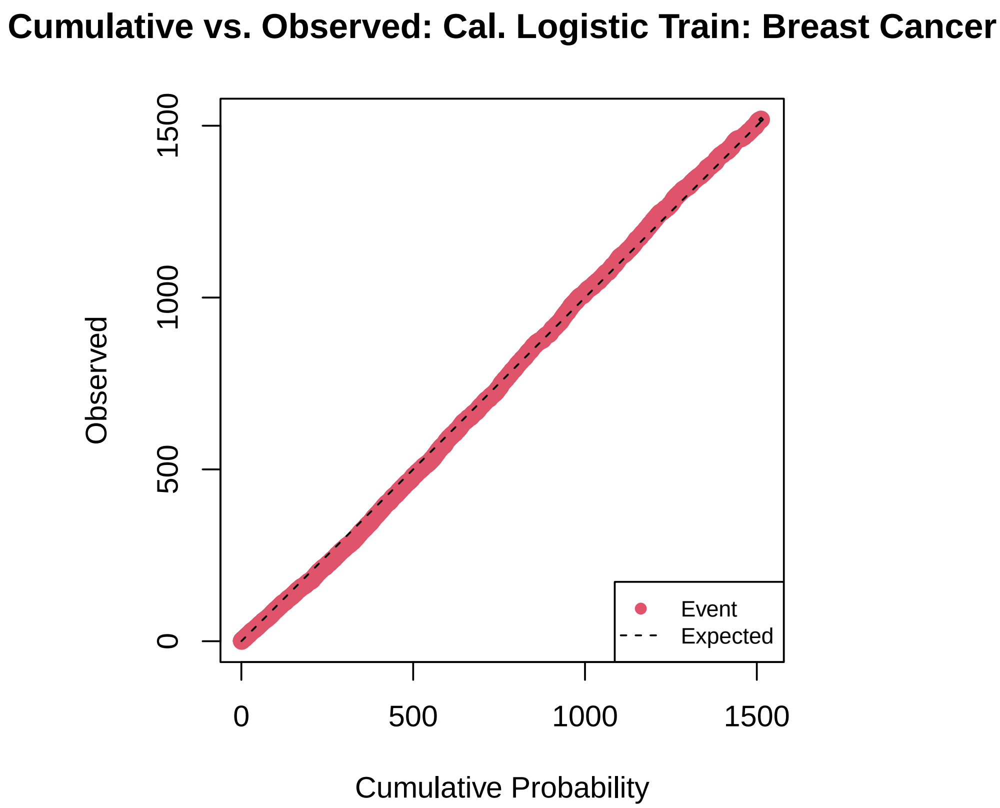
	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	369	121	181.7	20.2997	52.3868
class=1	134	60	61.7	0.0479	0.0604
class=2	183	118	55.5	70.2342	88.0195

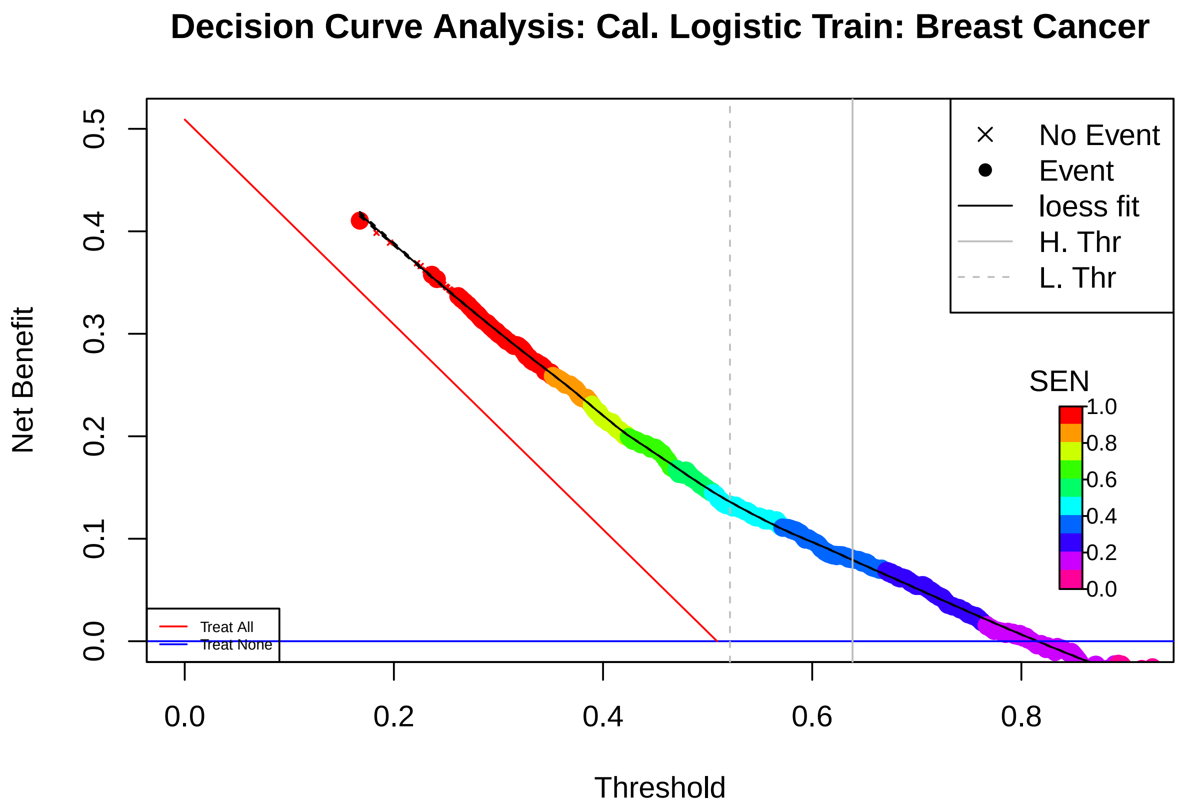
1.8 Logistic Model Poisson Calibration

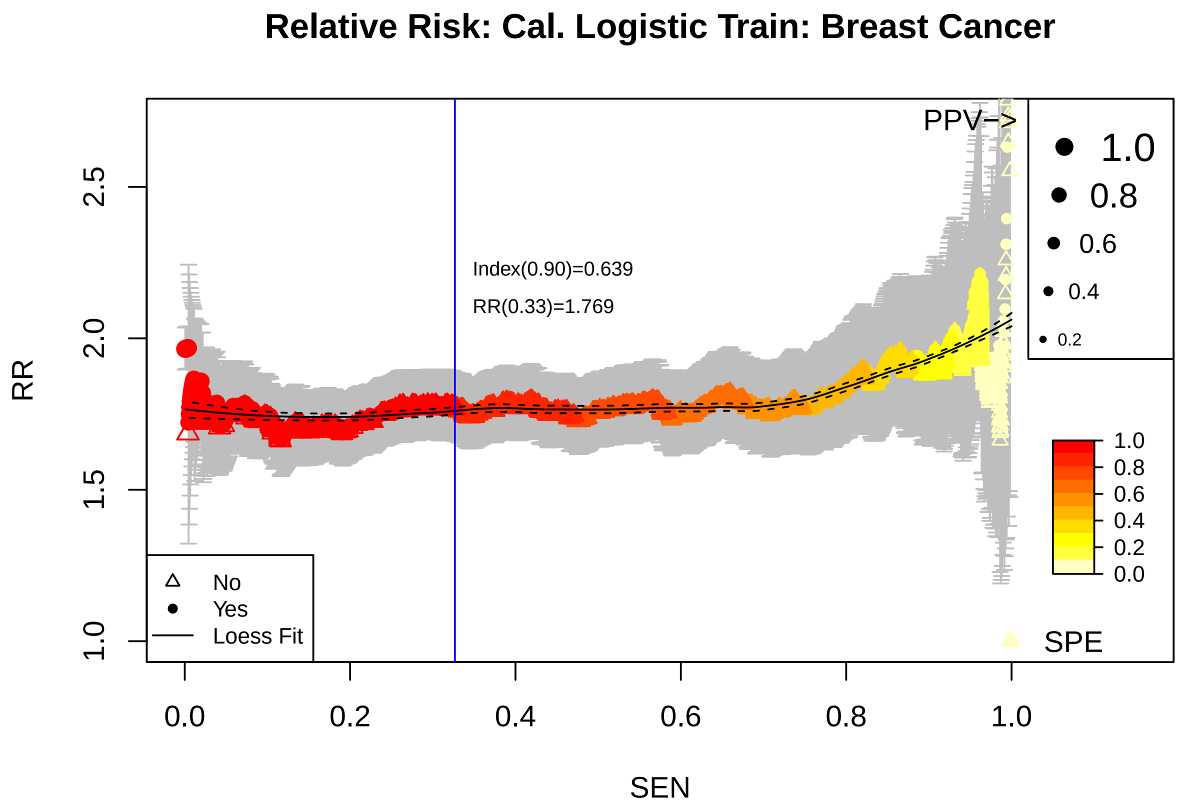
```
riskdata <- cbind(dataBrestCancerTrain$status,predict(mlog,dataBrestCancerTrain,type="prob"),dataBrestCa
calprob <- CalibrationProbPoissonRisk(riskdata)

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

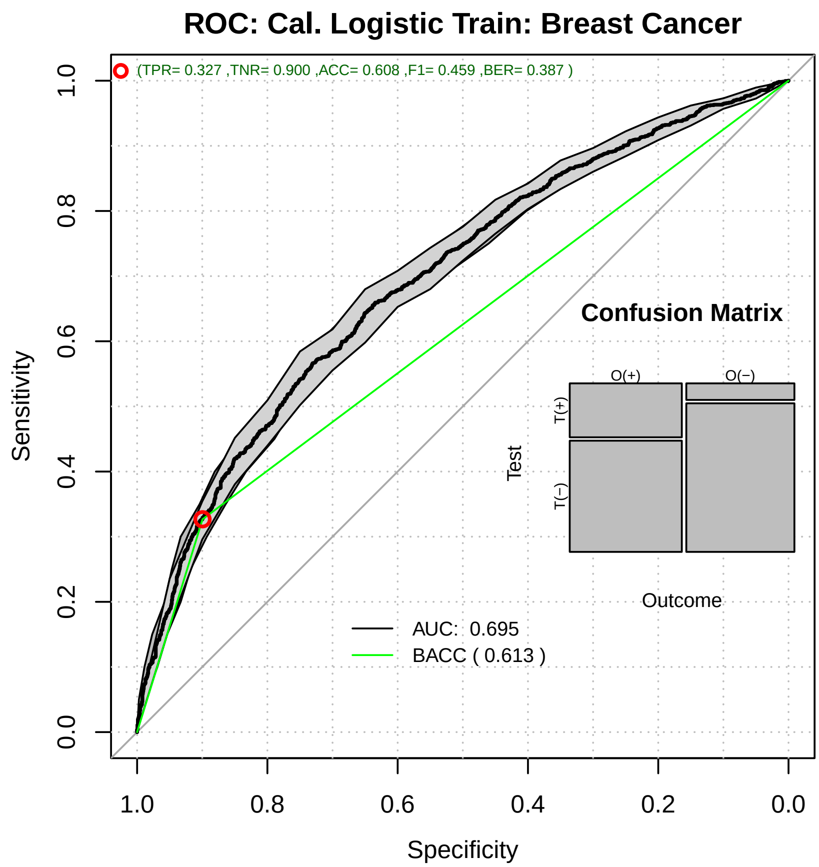
```
timeinterval <- calprob$timeInterval;
gain <- calprob$hazardGain

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


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

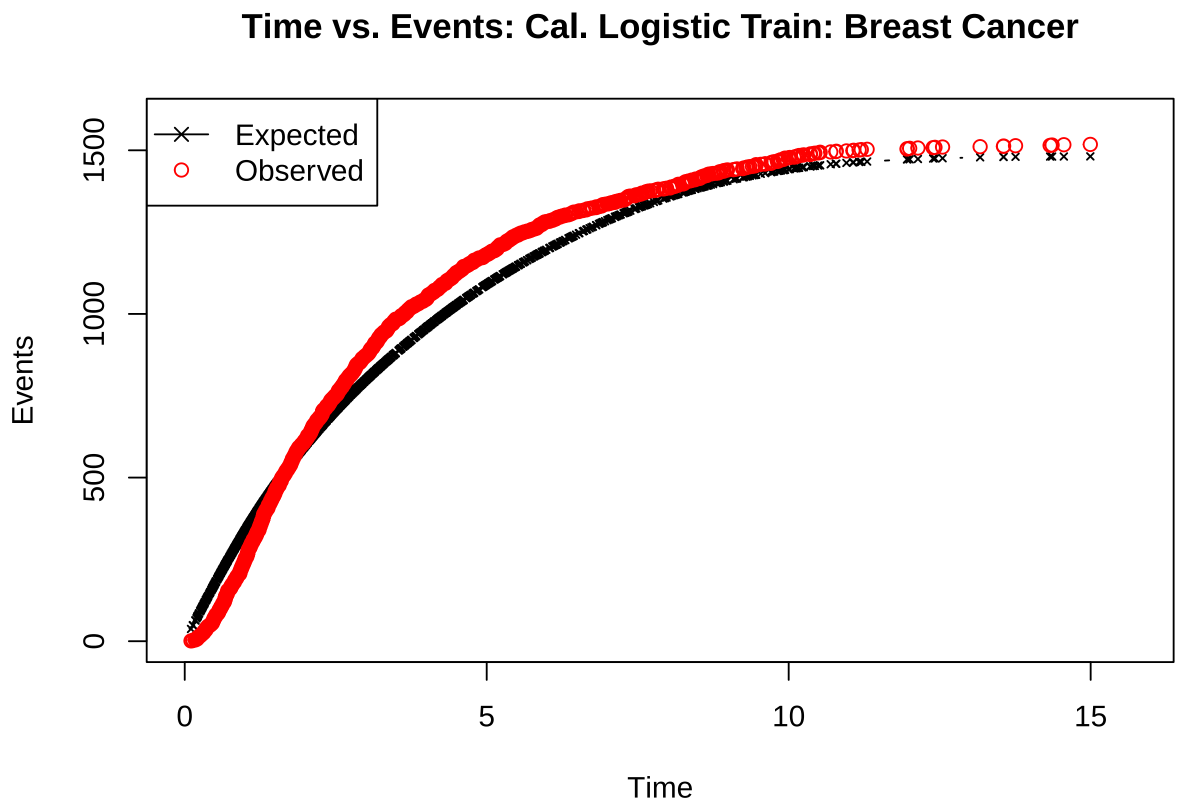

Cumulative vs. Observed: Cal. Logistic Train: Breast Cancer
Observed
0
500
1000
1500
Event
Expected
0
500
1000
1500
Cumulative Probability


Decision Curve Analysis: Cal. Logistic 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
H. Thr
L. Thr
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None

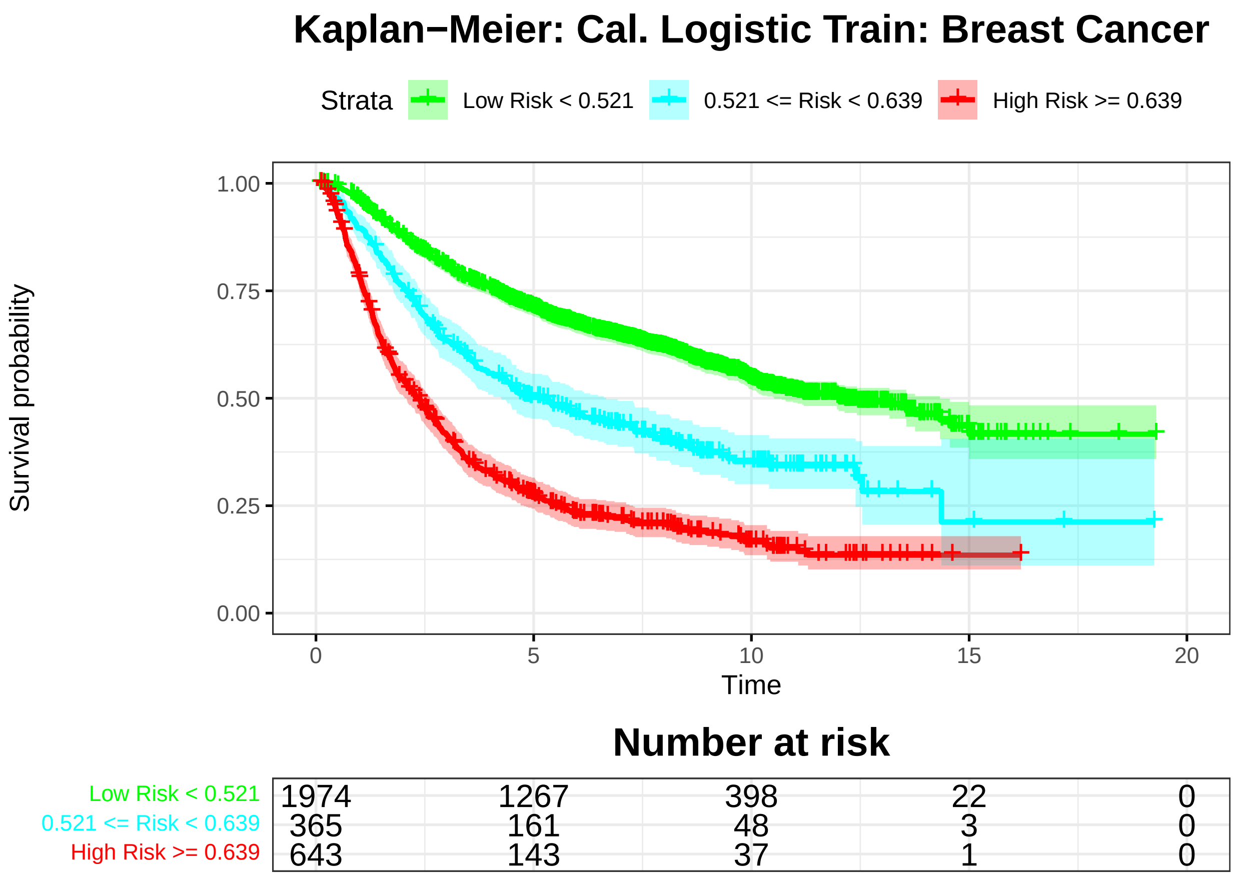


Relative Risk: Cal. Logistic Train: Breast Cancer
RR
SEN
Index(0.90)=0.639
RR(0.33)=1.769
PPV->
SPE
No
Yes
Loess Fit


ROC: Cal. Logistic Train: Breast Cancer
(TPR= 0.327 ,TNR= 0.900 ,ACC= 0.608 ,F1= 0.459 ,BER= 0.387)
Sensitivity
Specificity
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 63: Threshold values

	@:0.9	@:0.8	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.6395	0.521	0.480	0.319	0.167426	0.500
RR	1.7654	1.739	1.799	2.213	1.000000	1.759
RR_LCI	1.6587	1.627	1.676	1.764	0.000000	1.643
RR_UCI	1.8790	1.858	1.931	2.777	0.000000	1.882
SEN	0.3267	0.470	0.566	0.962	1.000000	0.507
SPE	0.8996	0.799	0.731	0.125	0.000683	0.774
BACC	0.6132	0.635	0.648	0.543	0.500342	0.641
NetBenefit	0.0789	0.132	0.166	0.288	0.410407	0.147

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

Table 64: 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	0.667	0.693

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

Table 66: ROC AUC

est	lower	upper
0.695	0.677	0.714

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

Table 67: Sensitivity

est	lower	upper
0.327	0.303	0.351

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

Table 68: Specificity

est	lower	upper
0.9	0.883	0.915

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

Table 69: Probability Thresholds

90%	80%
0.639	0.521

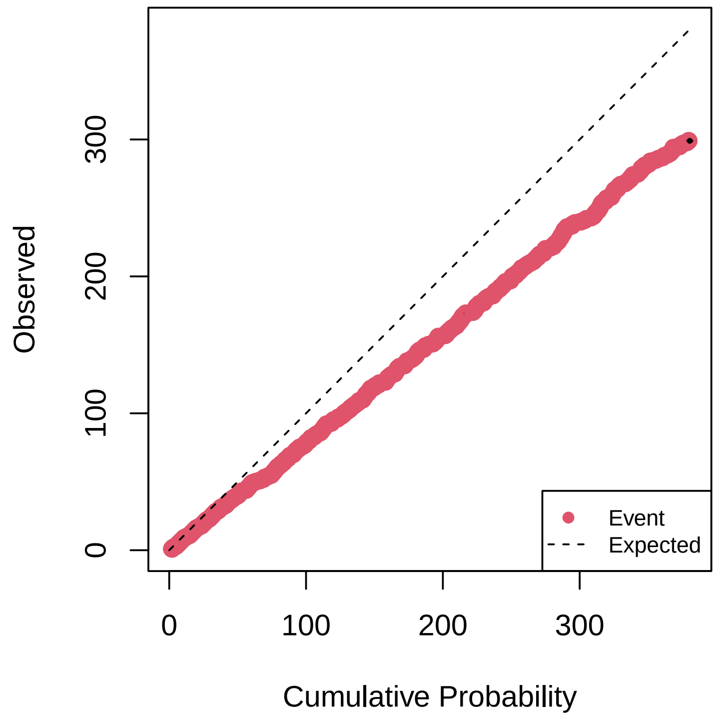
```
pander::pander(rrAnalysisTrain$surdif,caption="Logrank test")
```

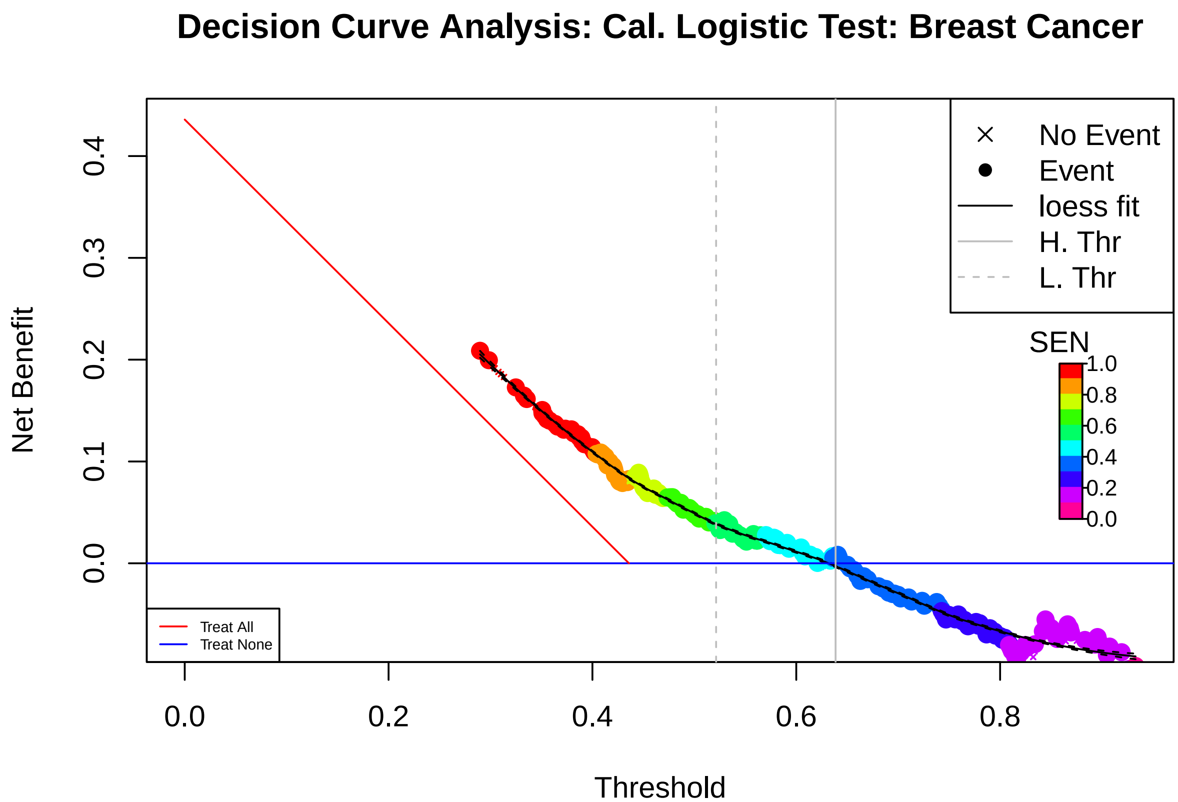
Table 70: Logrank test Chisq = 541.976716 on 2 degrees of freedom, p = 0.000000

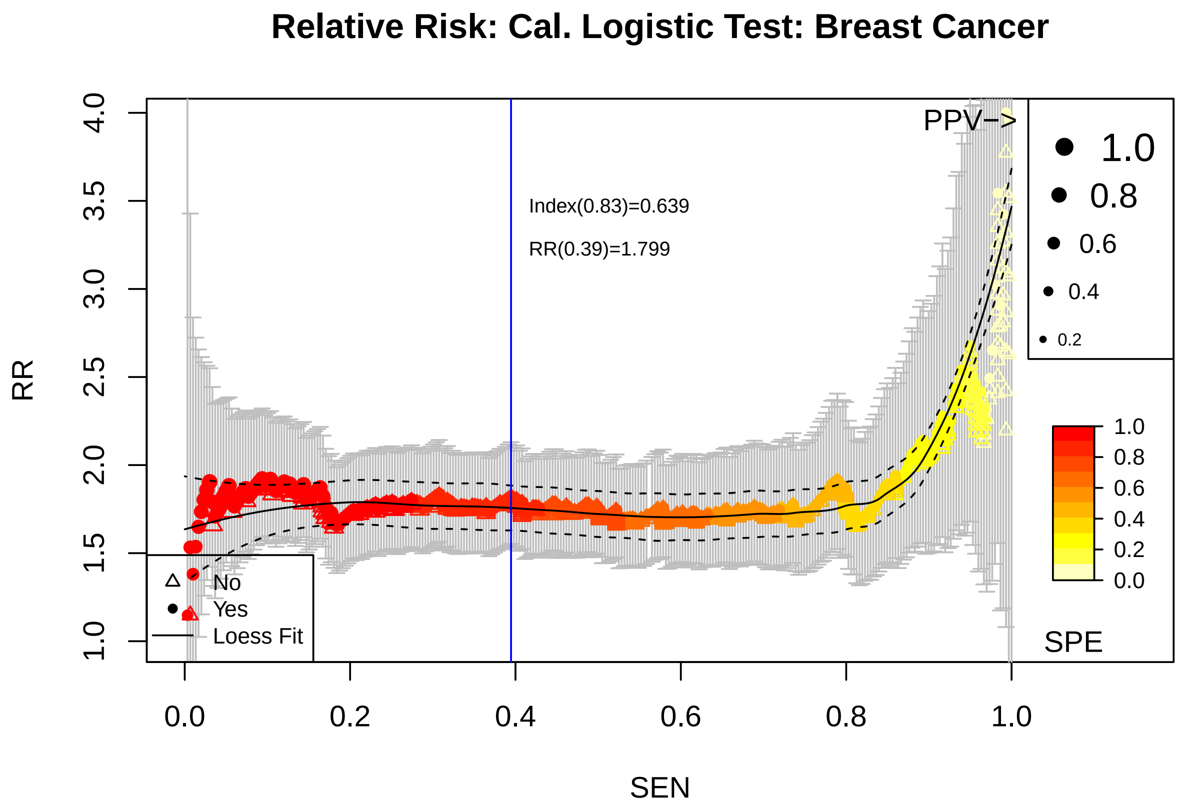
	N	Observed	Expected	(O-E)^2/E	(O-E)^2/V
class=0	1974	804	1144	100.9	415.3
class=1	365	218	170	13.4	15.1
class=2	643	496	204	418.2	490.7

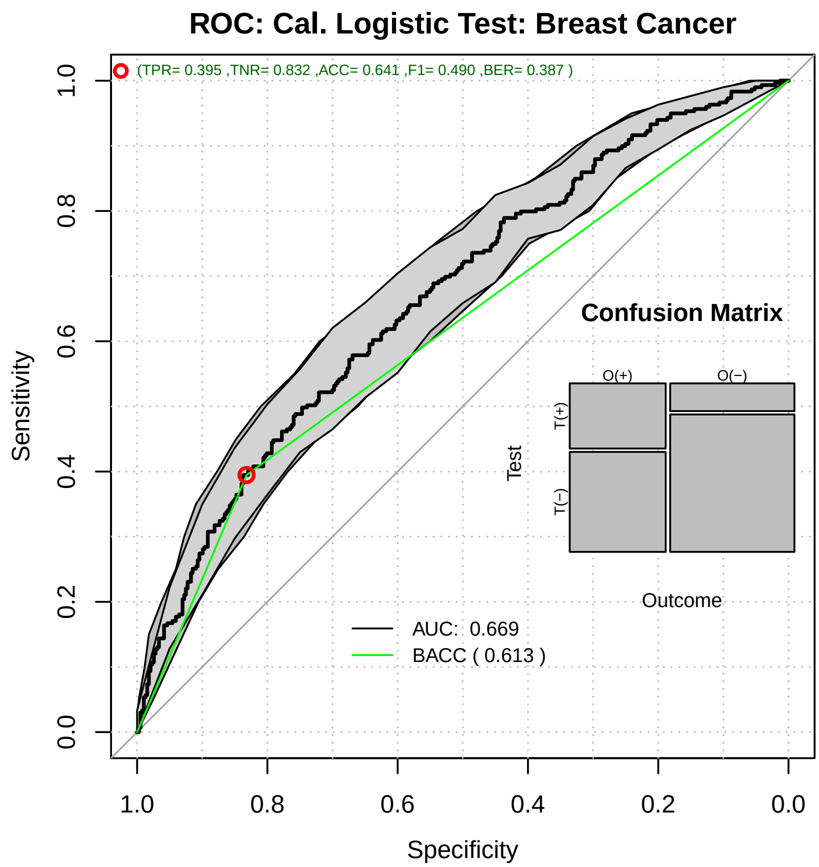
```
probLog <- predict(mlog,dataBrestCancerTest)
aprob <- adjustProb(probLog,gain)

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

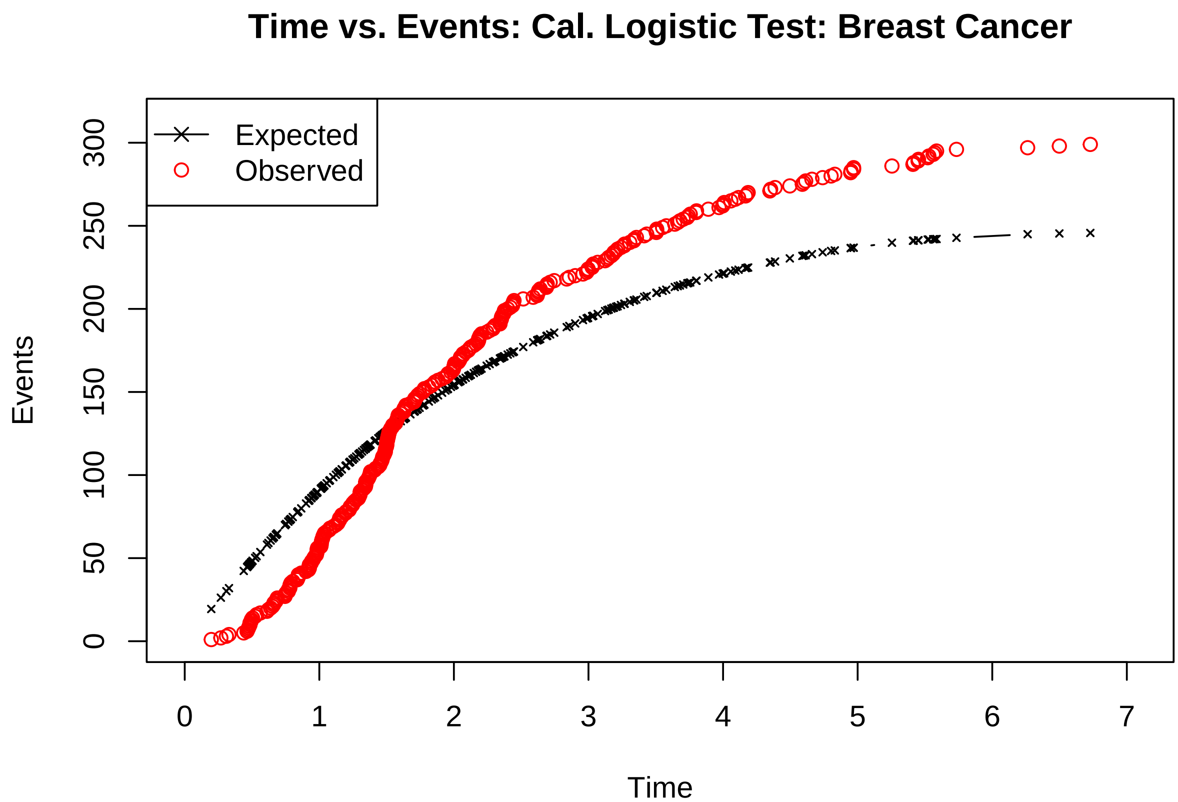



Decision Curve Analysis: Cal. Logistic Test: Breast Cancer
Net Benefit
Threshold
0.0
0.1
0.2
0.3
0.4
0.0
0.2
0.4
0.6
0.8
No Event
Event
loess fit
H. Thr
L. Thr
SEN
1.0
0.8
0.6
0.4
0.2
0.0
Treat All
Treat None

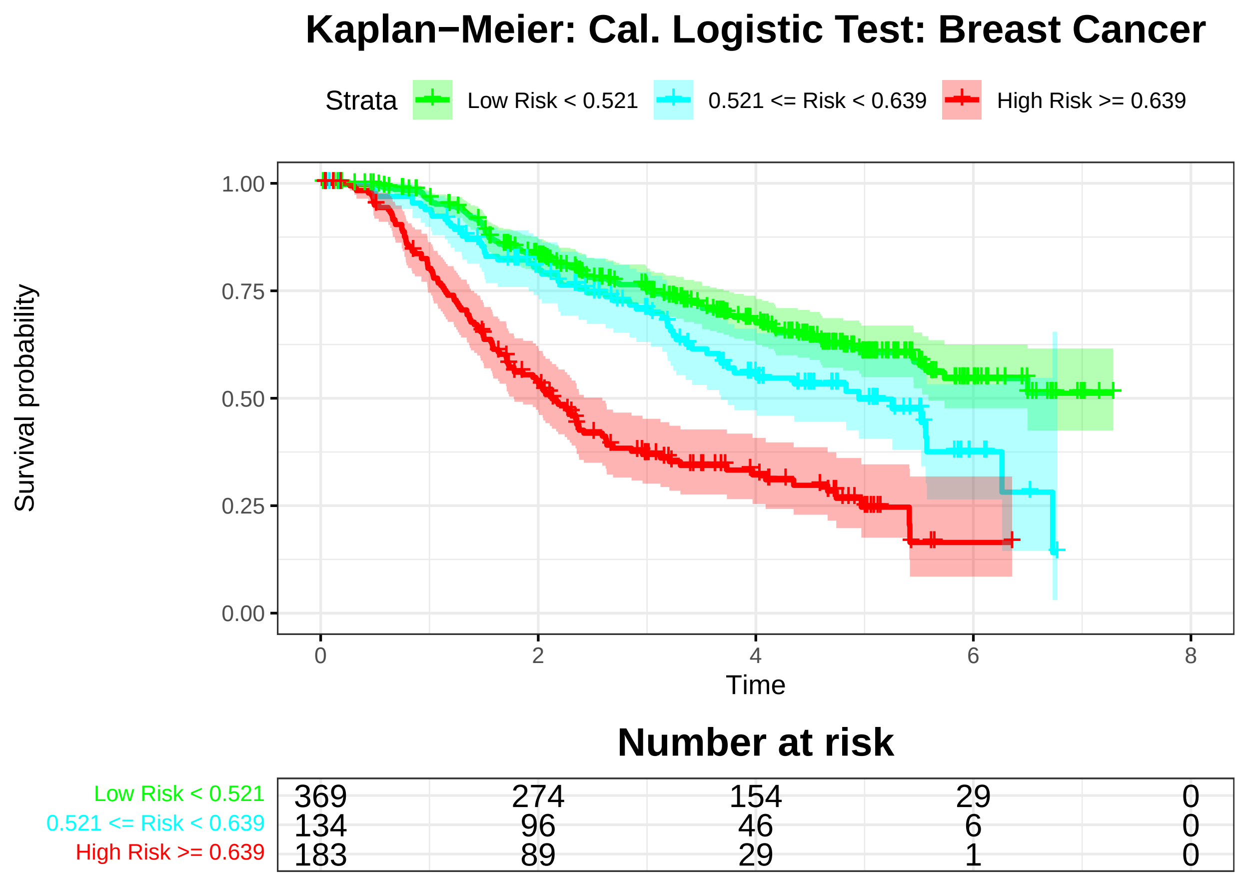

Relative Risk: Cal. Logistic Test: Breast Cancer
RR
SEN
SPE
PPV−>
Index(0.83)=0.639
RR(0.39)=1.799
No
Yes
Loess Fit
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.0
0.2
0.4
0.6
0.8
1.0
0.8
0.6
0.4
0.2



ROC: Cal. Logistic Test: Breast Cancer
(TPR= 0.395 ,TNR= 0.832 ,ACC= 0.641 ,F1= 0.490 ,BER= 0.387)
Sensitivity
Specificity
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
Time
0
50
100
150
200
250
300
0
1
2
3
4
5
6
7




```
par(op)
```

1.8.2 Report of the calibrated validation

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

Table 71: Threshold values

	@:0.639	@:0.521	@MAX_BACC	@MAX_RR	@SPE100	p(0.5)
Thr	0.63882	0.5212	0.5294	0.379	2.90e-01	0.5001
RR	1.79193	1.7024	1.7562	2.678	2.20e+01	1.7026
RR_LCI	1.52914	1.4283	1.4771	1.679	4.75e-02	1.4179
RR_UCI	2.09988	2.0290	2.0880	4.271	1.02e+04	2.0446
SEN	0.39465	0.5953	0.5786	0.950	1.00e+00	0.6421
SPE	0.83204	0.6382	0.6693	0.181	1.29e-02	0.5866
BACC	0.61335	0.6168	0.6239	0.565	5.06e-01	0.6144
NetBenefit	0.00447	0.0374	0.0423	0.132	2.09e-01	0.0466

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

Table 72: 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	0.638	0.699

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

Table 74: ROC AUC

est	lower	upper
0.669	0.628	0.709

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

Table 75: Sensitivity

est	lower	upper
0.395	0.339	0.453

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

Table 76: Specificity

est	lower	upper
0.832	0.791	0.868

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

Table 77: Probability Thresholds

90%	80%
0.639	0.521

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

Table 78: 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	0.843

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

mean	50%	2.5%	97.5%
0.791	0.791	0.791	0.792

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

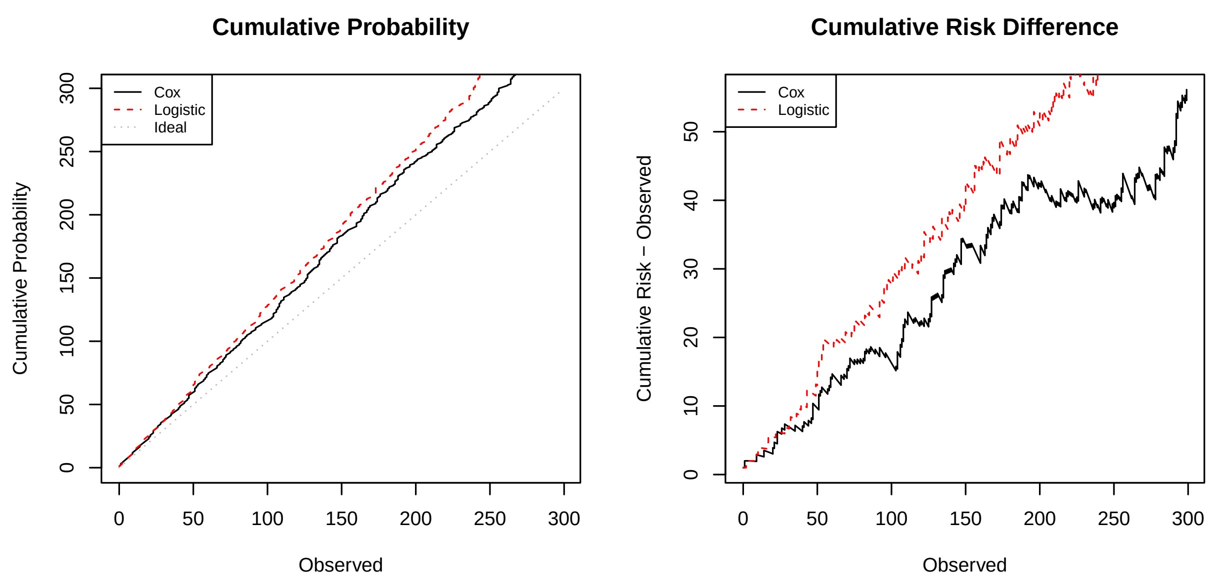
mean	50%	2.5%	97.5%
1.11	1.11	1.08	1.13

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

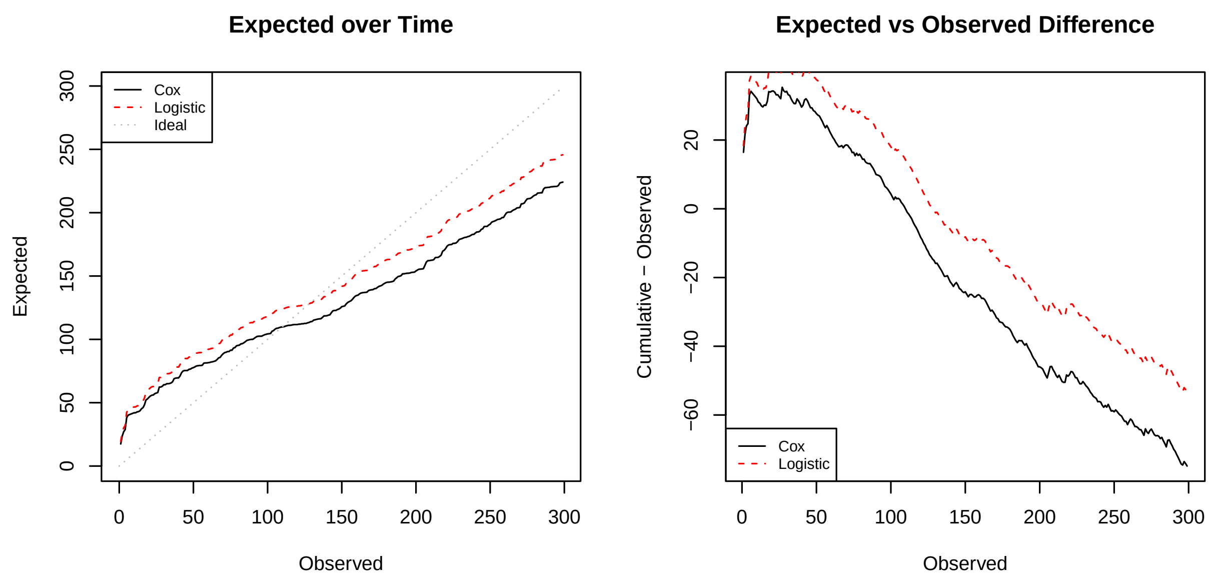
mean	50%	2.5%	97.5%
0.989	0.989	0.962	1.01

```
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
)
```



```
par(op)
```