

Supplementary Material

Supplementary Table 1. Missing Values for Features in the Final Data Set, Prior to Imputation.

Variable	Overall N = 5,420 ¹	Alive N = 3,379 ¹	Dead N = 2,041 ¹
Age (years old)	60.0 (54.0, 66.0)	59.0 (53.0, 64.0)	61.0 (55.0, 69.0)
Marital status			
<i>Unmarried</i>	1,955 (36.1)	1,160 (34.3)	795 (39.0)
<i>Married</i>	3,465 (63.9)	2,219 (65.7)	1,246 (61.0)
Gender			
<i>Female</i>	1,386 (25.6)	890 (26.3)	496 (24.3)
<i>Male</i>	4,034 (74.4)	2,489 (73.7)	1,545 (75.7)
Race			
<i>Black</i>	587 (10.9)	321 (9.6)	266 (13.1)
<i>White</i>	3,387 (62.9)	2,185 (65.2)	1,202 (59.0)
<i>Other</i>	1,413 (26.2)	843 (25.2)	570 (28.0)
<i>Missing</i>	33	30	3
PRCDA			
<i>Not PRCDA</i>	4,014 (74.1)	2,496 (73.9)	1,518 (74.4)
<i>PRCDA</i>	1,406 (25.9)	883 (26.1)	523 (25.6)
Grade			
<i>I</i>	1,095 (24.6)	828 (30.6)	267 (15.4)
<i>II</i>	2,369 (53.3)	1,475 (54.4)	894 (51.5)
<i>III</i>	899 (20.2)	381 (14.1)	518 (29.9)
<i>IV</i>	82 (1.8)	26 (1.0)	56 (3.2)
<i>Missing</i>	975	669	306
Summary Stage			
<i>Localized</i>	4,163 (78.5)	2,830 (84.9)	1,333 (67.7)
<i>Regional</i>	989 (18.7)	479 (14.4)	510 (25.9)
<i>Distant</i>	149 (2.8)	24 (0.7)	125 (6.4)
<i>Missing</i>	119	46	73
T Stage			
<i>T1</i>	2,815 (52.7)	2,030 (60.8)	785 (39.2)
<i>T2</i>	1,712 (32.0)	1,107 (33.1)	605 (30.2)
<i>T3</i>	661 (12.4)	175 (5.2)	486 (24.3)
<i>T4</i>	156 (2.9)	29 (0.9)	127 (6.3)
<i>Missing</i>	76	38	38
M Stage			
<i>M0</i>	5,234 (97.8)	3,327 (99.4)	1,907 (95.1)
<i>M1</i>	117 (2.2)	19 (0.6)	98 (4.9)
<i>Missing</i>	69	33	36
N Stage			
<i>N0</i>	5,169 (98.2)	3,282 (99.3)	1,887 (96.4)
<i>N1</i>	95 (1.8)	24 (0.7)	71 (3.6)
<i>Missing</i>	156	73	83
Tumor size (mm)	38.0 (24.0, 65.0)	30.0 (20.0, 50.0)	55.0 (35.0, 97.0)
<i>Missing</i>	149	77	72
Surgery			
<i>Wedge/segmental resection</i>	1,855 (34.23)	936 (27.70)	919 (45.03)
<i>Lobectomy</i>	1,407 (25.96)	626 (18.53)	781 (38.27)
<i>Hepatectomy or transplant</i>	2,158 (39.82)	1,817 (53.77)	341 (16.71)
Chemotherapy			
<i>Not</i>	3,853 (71.09)	2,350 (69.55)	1,503 (73.64)
<i>Yes</i>	1,567 (28.91)	1,029 (30.45)	538 (26.36)
Laterality			
<i>Not a paired site</i>	5,312 (98.01)	3,312 (98.02)	2,000 (97.99)
<i>Right</i>	75 (1.38)	46 (1.36)	29 (1.42)
<i>Left</i>	28 (0.52)	16 (0.47)	12 (0.59)

Variable	Overall N = 5,420 ¹	Alive N = 3,379 ¹	Dead N = 2,041 ¹
<i>Paired site</i>	5 (0.09)	5 (0.15)	0 (0)
AFP			
<i>Not</i>	2,626 (63.06)	1,543 (58.94)	1,083 (70.05)
<i>Yes</i>	1,538 (36.94)	1,075 (41.06)	463 (29.95)
<i>Missing</i>	1,256	761	495
Lymph Node Surgery			
<i>None</i>	4,275 (80.09)	2,632 (78.83)	1,643 (82.19)
<i>1 to 3 regional lymph nodes removed</i>	923 (17.29)	619 (18.54)	304 (15.21)
<i>4 or more regional lymph nodes removed</i>	140 (2.62)	88 (2.64)	52 (2.60)
<i>Missing</i>	82	40	42
Survival Months (m)	56.0 (32.0, 100.0)	82.0 (52.0, 121.0)	23.0 (10.0, 44.0)

¹Median (IQR); n (%)

²Wilcoxon rank sum test; Pearson's Chi-squared test; Fisher's exact test

Supplementary Table 2. Optimal Hyperparameters, DeepSurv and N-MTLR Models.

Parameter	DeepSurv Model	N-MTLR Model
Neural Network Structure (Layer: activation; nodes)	1: BentIdentity; 124 2: Softplus; 22	1: Swish; 68 2: Softplus; 31 3: ReLU; 29
Init method	orthogonal	orthogonal
optimizer	rmsprop	rmsprop
Learning Rate	0.0008863275587276226	0.00022910284957333943
Number of Epochs	1677	1685
Dropout	0.42409086451709327	0.36927381787496294
L2 Regularization	0.00033356593933829597	1.001117107297981e-06
Batch Normalization	False	False
L2 Smoothing Regularization		0.00014937725872625422
Bins		100

Supplementary Table 3. Optimal Hyperparameters, Random Survival Forest

Parameter	Random Survival Forest Model
Trees	246
Max Features	0.2
Max Depth	53
Min Node Size	7
Sample Size Percent	0.6705819632657677
Importance Mode	normalized_permutation