Survival Analysis of Post-Myocardial Infarction Patients

Alvein, Orr, Pham

5/22/2020

Abstract

Background

The rates of myocardial infarction is becoming an increasing common occurence in the United States. As medical knowledge and techniques improve to meet need of infarction episode, so does the need to understand the survivbility of patients who have survived such episodes.

Objectives

Our goal is to provide detailed survival statistics of post-myocardial infarction patients as well as provide an accurate regression model to best prediction of survival outcomes of a single year following an infarction episode.

Methods

Data from 133 post-myocardial infarction patients measure the time in months until death in a one year monitoring period of follow-up. We use a combination of nonparametric (Kaplan-Meier) and parametric methods (Weibull/Cox PH) to determine estimates of survival among gender and myocardial strata (contraction depth, muscular activity,). We consider a slew of statistical and graphical results before determining the most appropriate method of modeling.

Results

Out of all of our methods, we have determined that [] is the most appropriate model for prediction of patient survival. We have AIC values of. We have BIC values. Thus, this model is the best.

Conclusion

summary statistics [review of our model + specific surval rates]

Introduction

Heart disease has become the leader cause of death among the US population among a majority of all racial and ethnic groups (Heron 2019). Myocardial infarctions are becoming largely common among U.S. populations. The number of myocardial infarctions are remarkedly increased from [start date] to [end date] by [x] amount (add citation). In 2015, approximately 23% of all fatalities in the United States was related to some degree of heart disease (cdc. cite please). Unsurprisingly, clinical studies have shown harmful symptoms in post-infarction survival patients. Our obtained dataset to examine the tangible difference in survability rates from the course of year following an infarction episode.

By applying survival analysis techniques to this data set, we seek to achieve improved understanding of the characteristics exhibited by patients in a one year post-infarction interval.We also propose a model to better predict the probability of a survival of patients based on these variable characteristics.

Dataset

We have obtained our data set from Kaggle. The data set contains 133 total patient observations and records 8 variables. Two of the patients as survival times were not given; thus, we elected to remove those values to develop the most accurate portrayal of survival times.

Below is a table summary of each table header variable label and a definition of that variable.

Variable	Label	Definition
Survival	Survival	The number of months the patints survived, post-myocardial infarction.
Status	Status	Censorship status. 0 denotes that a patient is a censored while 1 denotes that a patient is uncensored.
Alive at the end of Survival Period	Alive.E	Binary variable. 0 denotes that patient is alive at the end of the survival period while 1 indicates that a patient is still alive.
Patient Age	Age	The age in years when a myocardial infarction occurs.
Age Group	Age.Strata	0 denotes 49 or younger. 1 denotes 50 or older. 2 denotes 65 or older.
Pericardial Effusion	P.Effusion	Binary variable. Pericardial effusion is excess fluid surrounding the heart. Though excess is not harmful, it is sometimes indicates a porly functioning heart. 0 denotes that pericardial effusion is absent while 1 denotes that fluid is present.
Fractional Shortening	F.Shortening	Fractional shortening is a measure of contractility around the heart. Generally, lower numbers are considered to be abnormal.
E-Point Septal Separation	EPSS	E-point septal separation is an addition measure of heart contractivity. Larger numbers are considered to be abnormal.
Left Ventricular End-Diastolic Dimension	LVDD	Left ventricular end-diastolic dimension is the measure of the heart at the end of disatole. The larger this value is indicates a larger heart. Larger hearts are generally in poor health.
Wall Motion Score	WMS	Wall motion score is a measure of how the segments of the left ventricle are moving during systol.
Wall Motion Index	WMI	Wall motion index is the wall motion score divided by the number of segments that are moving. Normally, 12-13 segments can be seen in an echocardiogram.
Wall Motion Strata	WMI.S	Binary Variable. 0 denotes that WMI is less than or equal to 1.28. 1 denotes that WMI is greater than or equal to 1.28.

Since the time of infartion varies, some patients were followed for less than a year. This provides a clear

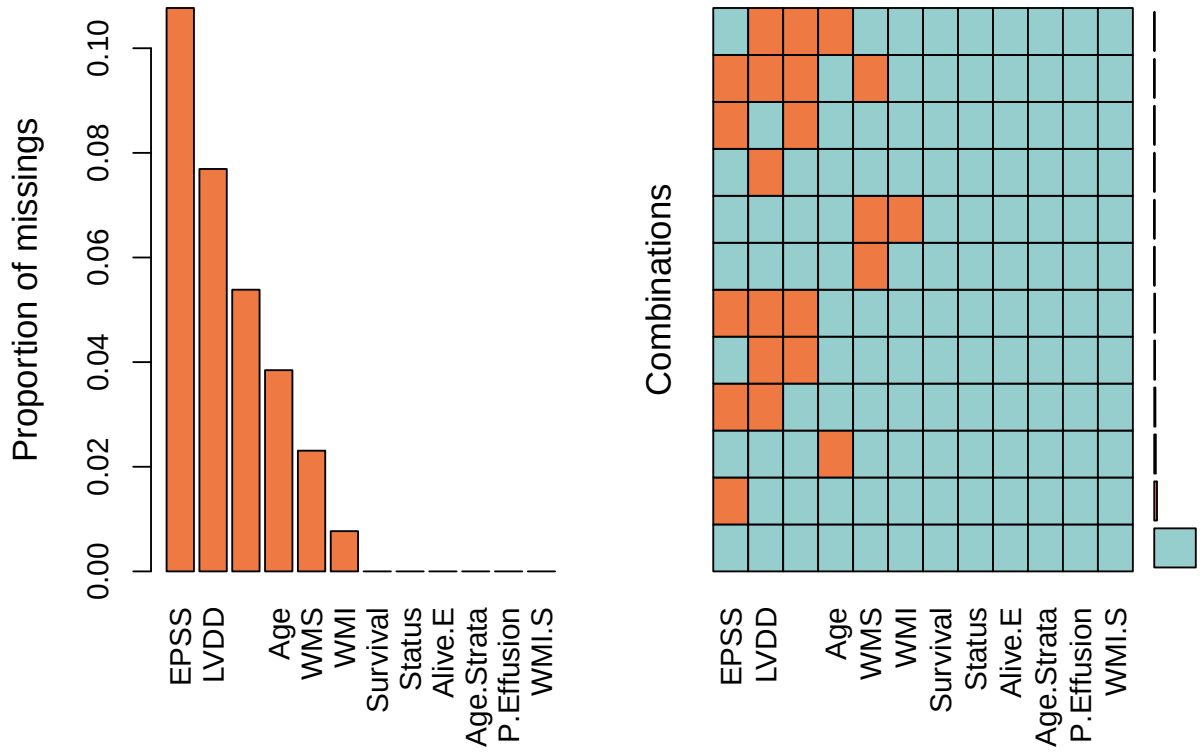
censoring and truncation provide. We will address this concern in detail in the later in this section. It should be noted that we have a slew of missing values. Since a single patient has shown as missing, we have opted to impute the values for this data row. With this in mind, our predictive and summary models will have less than ideal accuracy.

The full dataset is available in the appendix of this paper.

Methodology

Imputation

In addition to the two rows that we removed, we further modified the dataset. The provided data contains 40 missing values that we chose to impute using the random forest algorithm methods in the missForest R package. Below is a summary of the missing data:




```
##
##  Variables sorted by number of missings:
##      Variable       Count
##          EPSS 0.107692308
##          LVDD 0.076923077
##  F.Shortening 0.053846154
##           Age 0.038461538
##           WMS 0.023076923
##           WMI 0.007692308
##      Survival 0.000000000
##        Status 0.000000000
##       Alive.E 0.000000000
##    Age.Strata 0.000000000
##    P.Effusion 0.000000000
```

```
##         WMI.S 0.000000000
```

The algorithmic process used here uses a modified k-nearest neighbot (KNN) approach. sing a training data set, the routines of the missForest algorithm predicts the missing values trained on the observed parts of the dataset (Stekhoven 2012). Refer to Stekhoven, et. al 2012 for more detail.

Following imputation, we verify the imputation accuracy using the normalized root mean squared error as an indicator of accuracy (NRMSE, Oba et al. (2003)). Our calculated NRMSE is as follows:

```
##     Survival Status Alive.E   Age Age.Strata P.Effusion F.Shortening   EPSS
## 1      11.00      1       0 71.00          2          0        0.260  9.000
## 2      19.00      1       0 72.00          2          0        0.380  6.000
## 3      16.00      1       0 55.00          1          0        0.260  4.000
## 4      57.00      1       0 60.00          1          0        0.253 12.062
## 5      19.00      0       1 57.00          1          0        0.160 22.000
## 6      26.00      1       0 68.00          2          0        0.260  5.000
## 7      13.00      1       0 62.00          1          0        0.230 31.000
## 8      50.00      1       0 60.00          1          0        0.330  8.000
## 9      19.00      1       0 46.00          0          0        0.340  0.000
## 10     25.00      1       0 54.00          1          0        0.140 13.000
## 11     10.00      0       1 77.00          2          0        0.130 16.000
## 12     52.00      1       0 62.00          1          1        0.450  9.000
## 13     52.00      1       0 73.00          2          0        0.330  6.000
## 14     44.00      1       0 60.00          1          0        0.150 10.000
## 15      0.50      0       1 62.00          1          0        0.120 23.000
## 16     24.00      1       0 55.00          1          1        0.250 12.063
## 17      0.50      0       1 69.00          2          1        0.260 11.000
## 18      0.50      0       1 62.53          1          1        0.070 20.000
## 19     22.00      0       1 66.00          2          0        0.090 17.000
## 20      1.00      0       1 66.00          2          1        0.220 15.000
## 21      0.75      0       1 69.00          2          0        0.150 12.000
## 22      0.75      0       1 85.00          2          1        0.180 19.000
## 23      0.50      0       1 73.00          2          0        0.230 12.733
## 24      5.00      0       1 71.00          2          0        0.170  0.000
## 25     48.00      1       0 64.00          1          0        0.190  5.900
## 26     29.00      1       0 54.00          1          0        0.300  7.000
## 27     29.00      1       0 35.00          0          0        0.300  5.000
## 28     29.00      1       0 55.00          1          0           NA  7.000
## 29      0.25      0       1 75.00          2          0           NA     NA
## 30     36.00      1       0 55.00          1          1        0.210  4.200
## 31      1.00      0       1 65.00          2          0        0.150     NA
## 32      1.00      0       1 52.00          1          1        0.170 17.200
## 33      3.00      0       1    NA          2          0           NA 12.000
## 34     27.00      1       0 47.00          0          0        0.400  5.120
## 35     35.00      1       0 63.00          1          0           NA 10.000
## 36     26.00      1       0 61.00          1          0        0.610 13.100
## 37     16.00      1       0 63.00          1          1           NA     NA
## 38      1.00      0       1 65.00          2          0        0.060 23.600
## 39     19.00      1       0 68.00          2          0        0.510     NA
## 40     31.00      1       0 80.00          2          0        0.410  5.400
## 41     32.00      1       0 54.00          1          0        0.350  9.300
## 42     16.00      1       0 70.00          2          1        0.270  4.700
## 43     40.00      1       0 79.00          2          0        0.150 17.500
## 44     46.00      1       0 56.00          1          0        0.330     NA
## 45      2.00      0       1 67.00          2          1        0.440  9.000
```

```
## 46   37.00    1    0 64.00    1    0    0.090     NA
## 47   19.50    0    1 81.00    2    0    0.120     NA
## 48   20.00    0    1 59.00    1    0    0.030 21.300
## 49    0.25    0    1 63.00    1    1       NA     NA
## 50    2.00    0    1 56.00    1    1    0.040 14.000
## 51    7.00    0    1 61.00    1    1    0.270     NA
## 52   10.00    1    0 57.00    1    0    0.240 14.800
## 53   12.00    1    0 58.00    1    0    0.300  9.400
## 54    1.00    0    1 60.00    1    0    0.010 24.600
## 55   10.00    1    0 66.00    2    0    0.290 15.600
## 56   45.00    1    0 63.00    1    0    0.150 13.000
## 57   22.00    1    0 57.00    1    0    0.130 18.600
## 58   53.00    1    0 70.00    2    0    0.100  9.800
## 59   38.00    1    0 68.00    2    0    0.290     NA
## 60   26.00    1    0 79.00    2    0    0.170 11.900
## 61    9.00    1    0 73.00    2    0    0.120     NA
## 62   26.00    1    0 72.00    2    0    0.187 12.000
## 63    0.50    0    1 59.00    1    0    0.130 16.400
## 64   12.00    1    0 67.00    2    1    0.110 10.300
## 65   49.00    1    0 51.00    1    0    0.160 13.200
## 66    0.75    0    1 50.00    1    0    0.140 11.400
## 67   49.00    1    0 70.00    2    1    0.250  9.700
## 68   47.00    1    0 65.00    2    0    0.360  8.800
## 69   41.00    1    0 78.00    2    0    0.060 16.100
## 70    0.25    0    1 86.00    2    0    0.225 12.200
## 71   33.00    1    0 56.00    1    0    0.250 11.000
## 72   29.00    1    0 60.00    1    0    0.120 10.200
## 73   41.00    1    0 59.00    1    0    0.290  7.500
## 74   26.00    1    0 50.00    1    0    0.060 30.100
## 75   15.00    1    0 54.00    1    0    0.217 17.900
## 76    0.25    0    1 68.00    2    0    0.220 21.700
## 77    0.03    0    1    NA    2    0    0.260 19.400
## 78   12.00    1    0 64.00    1    0    0.200  7.100
## 79   32.00    1    0 63.00    1    0    0.200  5.000
## 80   32.00    1    0 65.00    2    0    0.060 23.600
## 81   27.00    1    0 54.00    1    1    0.070 16.800
## 82   23.00    1    0 62.00    1    0    0.250  6.000
## 83    0.75    0    1 78.00    2    0    0.050 10.000
## 84    0.75    0    1 61.00    1    0       NA     NA
## 85   34.00    1    0 52.00    1    0    0.140 25.000
## 86    1.00    0    1 73.00    2    0    0.050 14.800
## 87   21.00    0    1 70.00    2    1    0.160 19.200
## 88   55.00    1    0 55.00    1    0    0.280  5.500
## 89   15.00    0    1 60.00    1    0    0.180  8.700
## 90    0.50    0    1 67.00    2    0    0.155 11.300
## 91   35.00    1    0 64.00    1    0    0.300  6.600
## 92   53.00    1    0 59.00    1    0    0.344  9.100
## 93   33.00    1    0 46.00    0    0    0.272 16.500
## 94   33.00    1    0 63.00    1    0    0.250  5.600
## 95   40.00    0    1 74.00    2    0    0.200  4.800
## 96   33.00    1    0 59.00    1    0    0.500  9.100
## 97    5.00    0    1 65.00    2    1    0.160  8.500
## 98    4.00    0    1 58.00    1    0    0.170 28.900
## 99   31.00    1    0 53.00    1    0    0.170     NA
```

```
## 100    33.00      1       0 66.00          2          0        0.200     NA
## 101    22.00      1       0 70.00          2          0        0.380  0.000
## 102    25.00      1       0 62.00          1          0        0.258 11.800
## 103     1.25      0       1 63.00          1          0        0.300  6.900
## 104    24.00      1       0 59.00          1          0        0.170 14.300
## 105    25.00      1       0 57.00          1          0        0.228  9.700
## 106    24.00      1       0 57.00          1          0        0.036  7.000
## 107     0.75      0       1 78.00          2          0        0.230 40.000
## 108     3.00      0       1 62.00          1          0        0.260  7.600
## 109    27.00      1       0 62.00          1          0        0.220 12.100
## 110    13.00      1       0 66.00          2          0        0.240 13.600
## 111    36.00      1       0 61.00          1          0        0.270  9.000
## 112    25.00      1       0 59.00          1          1        0.400  9.200
## 113    27.00      1       0 57.00          1          0        0.290  9.400
## 114    34.00      1       0 62.00          1          1        0.190 28.900
## 115    37.00      1       0    NA          2          0        0.260  0.000
## 116    34.00      1       0 54.00          1          0        0.430  9.300
## 117    28.00      0       1 62.00          1          1        0.240 28.600
## 118    28.00      1       0    NA          2          0        0.230 19.100
## 119    17.00      1       0 64.00          1          0        0.150  6.600
## 120    38.00      1       0 57.00          1          1        0.120  0.000
## 121    31.00      1       0 61.00          1          0        0.180  0.000
## 122    12.00      1       0 61.00          1          1        0.190 13.200
## 123    36.00      1       0 48.00          0          0        0.150 12.000
## 124    17.00      1       0    NA          2          0        0.090  6.800
## 125    21.00      1       0 61.00          1          0        0.140 25.500
## 126     7.50      0       1 64.00          1          0        0.240 12.900
## 127    41.00      1       0 64.00          1          0        0.280  5.400
## 128    36.00      1       0 69.00          2          0        0.200  7.000
## 129    22.00      1       0 57.00          1          0        0.140 16.100
## 130    20.00      1       0 62.00          1          0        0.150  0.000
##      LVDD   WMS   WMI WMI.S
## 1   4.600 14.00 1.000     0
## 2   4.100 14.00 1.700     1
## 3   3.420 14.00 1.000     0
## 4   4.603 16.00 1.450     1
## 5   5.750 18.00 2.250     1
## 6   4.310 12.00 1.000     0
## 7   5.430 22.50 1.875     1
## 8   5.250 14.00 1.000     0
## 9   5.090 16.00 1.140     0
## 10  4.490 15.50 1.190     0
## 11  4.230 18.00 1.800     1
## 12  3.600 16.00 1.140     0
## 13  4.000 14.00 1.000     0
## 14  3.730 14.00 1.000     0
## 15  5.800 11.67 2.330     1
## 16  4.290 14.00 1.000     0
## 17  4.650 18.00 1.640     1
## 18  5.200 24.00 2.000     1
## 19  5.819  8.00 1.333     1
## 20  5.400 27.00 2.250     1
## 21  5.390 19.50 1.625     1
## 22  5.460 13.83 1.380     1
```

```
## 23  6.060  7.50 1.500     1
## 24  4.650  8.00 1.000     0
## 25  3.480 10.00 1.110     0
## 26  3.850 10.00 1.667     1
## 27  4.170 14.00 1.000     0
## 28     NA  2.00 1.000     0
## 29     NA    NA 1.000     0
## 30  4.160 14.00 1.560     1
## 31  5.050 10.00 1.000     0
## 32  5.320 14.00 1.170     0
## 33     NA  6.00 3.000     1
## 34  3.100 12.00 1.000     0
## 35     NA 14.00 1.170     0
## 36  4.070 13.00 1.625     1
## 37  5.310  5.00 1.000     0
## 38     NA 21.50 2.150     1
## 39  3.880 15.00 1.670     1
## 40  4.360    NA 1.000     0
## 41  3.630 11.00 1.222     0
## 42  4.490 22.00 2.000     1
## 43  4.270 13.00 1.300     1
## 44  3.590 14.00 1.000     0
## 45  3.960 17.50 1.450     1
## 46     NA 12.00 2.000     1
## 47     NA  9.00 1.250     0
## 48  6.290 17.00 1.310     1
## 49     NA 23.00 2.300     1
## 50  5.000    NA    NA     1
## 51     NA  9.00 1.500     1
## 52  5.260 18.00 1.380     1
## 53  3.490 14.00 1.000     0
## 54  5.650 39.00 3.000     1
## 55  6.150 14.00 1.000     0
## 56  4.570 13.00 1.080     0
## 57  4.370 12.33 1.370     1
## 58  5.300 23.00 2.300     1
## 59  4.410 14.00 1.167     0
## 60  5.150 10.50 1.050     0
## 61  6.780 16.67 1.390     1
## 62  5.020 13.00 1.180     0
## 63  4.960 17.83 1.370     1
## 64  4.680 11.00 1.000     0
## 65  5.260 11.00 1.000     0
## 66  4.750 10.00 2.500     1
## 67  5.570  5.50 1.100     0
## 68  5.780 12.00 1.000     0
## 69  5.620 13.67 1.367     1
## 70  5.200 24.00 2.180     1
## 71  4.720 11.00 1.000     0
## 72  4.310 15.00 1.670     1
## 73  4.750 13.00 1.080     0
## 74  5.950 21.50 2.390     1
## 75  4.540 16.50 1.180     0
## 76  4.850 15.00 1.150     0
```

```
## 77  4.770 21.00 2.100     1
## 78  4.580 14.00 1.000     0
## 79  5.200  8.00 1.000     0
## 80  6.740 12.00 1.090     0
## 81  4.160 18.00 1.500     1
## 82  4.480 11.00 1.000     0
## 83  4.440 15.00 1.360     1
## 84     NA 28.00 2.330     1
## 85  6.210 11.50 1.150     0
## 86  4.140 15.50 1.410     1
## 87  5.250 11.00 1.000     0
## 88  4.480 22.00 1.830     1
## 89  4.560 13.50 1.040     0
## 90  5.160 13.00 1.000     0
## 91  4.360 14.00 1.270     0
## 92  4.040  9.00 1.000     0
## 93  5.360 12.67 1.060     0
## 94  3.870 18.00 1.500     1
## 95  4.560 12.50 1.040     0
## 96  3.420 18.00 1.500     1
## 97  5.470 16.00 1.450     1
## 98  6.730 26.08 2.010     1
## 99  4.690 10.00 1.000     0
## 100 4.230 12.00 1.000     0
## 101 4.550 10.00 1.000     0
## 102 4.870 11.00 1.000     0
## 103 3.520 18.16 1.510     1
## 104 5.490 13.50 1.500     1
## 105 4.290 11.00 1.000     0
## 106 4.120 13.50 1.230     0
## 107 6.230 14.00 1.400     1
## 108 4.420 14.00 1.000     0
## 109 3.920 11.00 1.000     0
## 110 4.380 22.00 2.200     1
## 111 4.060 12.00 1.000     0
## 112 5.360 12.00 1.000     0
## 113 4.770  9.00 1.000     0
## 114 6.630 19.50 1.950     1
## 115 4.380  9.00 1.000     0
## 116 4.790 10.00 1.000     0
## 117 5.860 21.50 1.950     1
## 118 5.490 12.00 1.200     0
## 119 4.170 14.00 1.270     0
## 120 2.320 16.50 1.375     1
## 121 4.480 11.00 1.375     1
## 122 5.040 19.00 1.730     1
## 123 3.660 10.00 1.000     0
## 124 4.960 13.00 1.080     0
## 125 5.160 14.00 1.270     0
## 126 4.720 12.00 1.000     0
## 127 5.470 11.00 1.100     0
## 128 5.050 14.50 1.210     0
## 129 4.360 15.00 1.360     1
## 130 4.510 15.50 1.409     1
```

```
##     Survival          Status          Alive.E            Age
##  Min.   : 0.030   Min.   :0.0000   Min.   :0.0000   Min.   :35.00
##  1st Qu.: 8.625   1st Qu.:0.0000   1st Qu.:0.0000   1st Qu.:57.00
##  Median :24.000   Median :1.0000   Median :0.0000   Median :63.00
##  Mean   :22.602   Mean   :0.6752   Mean   :0.3097   Mean   :63.07
##  3rd Qu.:34.000   3rd Qu.:1.0000   3rd Qu.:1.0000   3rd Qu.:68.00
##  Max.   :57.000   Max.   :1.0000   Max.   :1.0000   Max.   :86.00
##  NA's   :10       NA's   :13       NA's   :17       NA's   :23
##    Age.Strata      P.Effusion      F.Shortening         EPSS
##  Min.   :0.000   Min.   :0.0000   Min.   :0.0100   Min.   : 0.00
##  1st Qu.:1.000   1st Qu.:0.0000   1st Qu.:0.1500   1st Qu.: 7.05
##  Median :1.000   Median :0.0000   Median :0.2100   Median :11.80
##  Mean   :1.363   Mean   :0.1949   Mean   :0.2185   Mean   :12.41
##  3rd Qu.:2.000   3rd Qu.:0.0000   3rd Qu.:0.2700   3rd Qu.:16.25
##  Max.   :2.000   Max.   :1.0000   Max.   :0.6100   Max.   :40.00
##  NA's   :6       NA's   :12       NA's   :19       NA's   :31
##       LVDD            WMS             WMI            WMI.S
##  Min.   :3.100   Min.   : 2.00   Min.   :1.000   Min.   :0.0000
##  1st Qu.:4.270   1st Qu.:11.63   1st Qu.:1.000   1st Qu.:0.0000
##  Median :4.650   Median :14.00   Median :1.230   Median :0.0000
##  Mean   :4.763   Mean   :14.28   Mean   :1.387   Mean   :0.4561
##  3rd Qu.:5.260   3rd Qu.:16.50   3rd Qu.:1.535   3rd Qu.:1.0000
##  Max.   :6.780   Max.   :27.00   Max.   :3.000   Max.   :1.0000
##  NA's   :17      NA's   :14      NA's   :11      NA's   :16
```

```
##   missForest iteration 1 in progress...
```

```
## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?
```

```
## done!
##   missForest iteration 2 in progress...
```

```
## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
```

```
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## done!
##   missForest iteration 3 in progress...

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## done!
##   missForest iteration 4 in progress...

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?

## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?
```

```
## Warning in randomForest.default(x = obsX, y = obsY, ntree = ntree, mtry =
## mtry, : The response has five or fewer unique values. Are you sure you want to
## do regression?
```

```
## done!
```

```
##      Survival        Status      Alive.E      Age Age.Strata P.Effusion
## 1   11.000000  1.000000e+00  0.00000e+00 71.00000       2.00    0.00000
## 2   19.000000  1.000000e+00  0.00000e+00 72.00000       2.00    0.00000
## 3   16.000000  1.000000e+00 -4.32987e-17 55.00000       1.00    0.00000
## 4   57.000000  1.000000e+00  0.00000e+00 60.00000       1.00    0.00000
## 5    2.162500  0.000000e+00  1.00000e+00 57.00000       1.00    0.00000
## 6   26.000000  1.000000e+00  0.00000e+00 68.00000       2.00    0.00000
## 7   13.000000  9.000000e-01  0.00000e+00 62.00000       1.00    0.00000
## 8   50.000000  1.000000e+00  0.00000e+00 60.00000       1.00    0.00000
## 9   19.000000  1.000000e+00  0.00000e+00 46.00000       0.91    0.24000
## 10  25.000000  1.000000e+00  0.00000e+00 54.00000       1.00    0.00000
## 11  10.000000  0.000000e+00  1.00000e+00 77.00000       2.00    0.00000
## 12  52.000000  1.000000e+00  0.00000e+00 62.00000       1.00    1.00000
## 13  52.000000  1.000000e+00  0.00000e+00 73.00000       2.00    0.00000
## 14  44.000000  9.700000e-01  3.00000e-02 60.00000       1.00    0.00000
## 15   0.500000 -4.773959e-17  9.40000e-01 60.09500       1.00    0.00000
## 16  32.420595  1.000000e+00  0.00000e+00 55.00000       1.00    0.00125
## 17   0.500000  0.000000e+00  1.00000e+00 69.00000       2.00    1.00000
## 18   0.500000  1.000000e-02  1.00000e+00 64.67000       1.00    1.00000
## 19   8.297083  0.000000e+00  1.00000e+00 66.00000       2.00    0.35000
## 20   1.000000  0.000000e+00  1.00000e+00 66.00000       2.00    1.00000
## 21   0.750000  0.000000e+00  9.90000e-01 69.00000       2.00    0.00000
## 22   0.750000  0.000000e+00  1.00000e+00 85.00000       2.00    1.00000
## 23   0.500000  0.000000e+00  1.00000e+00 73.00000       2.00    0.00000
## 24   5.000000  0.000000e+00  1.00000e+00 71.00000       2.00    0.00000
## 25  48.000000  1.000000e+00  0.00000e+00 64.00000       1.00    0.00000
## 26  33.309773  1.000000e+00  0.00000e+00 54.00000       0.94    0.13000
## 27  29.000000  1.000000e+00  0.00000e+00 35.00000       0.00    0.00000
## 28  29.000000  1.000000e+00  0.00000e+00 55.00000       1.00    0.00000
## 29   0.250000  0.000000e+00  1.00000e+00 75.00000       2.00    0.00000
## 30  36.000000  1.000000e+00  0.00000e+00 55.00000       1.00    1.00000
## 31   1.000000  0.000000e+00  1.00000e+00 65.00000       2.00    0.00000
## 32  10.584000  0.000000e+00  1.00000e+00 52.00000       1.00    1.00000
## 33   3.000000  0.000000e+00  1.00000e+00 68.79000       2.00    0.00000
## 34  32.818667  1.000000e+00  0.00000e+00 47.00000       0.00    0.00000
## 35  35.000000  1.000000e+00  0.00000e+00 63.00000       1.00    0.00000
## 36  26.000000  1.000000e+00  0.00000e+00 61.00000       1.00    0.16500
## 37  16.000000  1.000000e+00  0.00000e+00 63.00000       1.00    1.00000
## 38   1.000000  0.000000e+00  1.00000e+00 70.77500       2.00    0.00000
## 39  19.000000  1.000000e+00  0.00000e+00 69.52333       2.00    0.00000
## 40  31.000000  1.000000e+00  0.00000e+00 80.00000       2.00    0.00000
## 41  32.000000  1.000000e+00  0.00000e+00 54.00000       1.00    0.00000
## 42  16.000000  1.000000e+00  0.00000e+00 70.00000       2.00    1.00000
## 43  40.000000  1.000000e+00  0.00000e+00 79.00000       2.00    0.00000
## 44  46.000000  1.000000e+00  0.00000e+00 60.12383       1.00    0.00000
## 45   2.000000  0.000000e+00  1.00000e+00 67.00000       2.00    1.00000
## 46  37.000000  1.000000e+00  0.00000e+00 64.00000       1.00    0.00000
## 47  19.500000  0.000000e+00  1.00000e+00 81.00000       2.00    0.00000
## 48  20.000000  0.000000e+00  6.20000e-01 59.00000       1.00    0.00000
```

```
## 49   0.250000  1.000000e-02  9.80000e-01 63.00000       1.00    1.00000
## 50   2.000000  0.000000e+00  1.00000e+00 56.00000       1.00    1.00000
## 51   7.000000  0.000000e+00  1.00000e+00 61.00000       1.07    1.00000
## 52  10.000000  1.000000e+00  2.50000e-01 57.00000       1.00    0.00000
## 53  12.000000  1.000000e+00  0.00000e+00 58.00000       1.00    0.00000
## 54   1.000000  0.000000e+00  9.60000e-01 60.00000       1.00    0.00000
## 55  10.000000  1.000000e+00  0.00000e+00 66.00000       2.00    0.00000
## 56  45.000000  1.000000e+00  0.00000e+00 63.00000       1.00    0.00000
## 57  22.000000  1.000000e+00  0.00000e+00 57.22600       1.00    0.00000
## 58  53.000000  1.000000e+00  0.00000e+00 70.00000       2.00    0.00000
## 59  38.000000  1.000000e+00  1.00000e-02 68.00000       1.87    0.02000
## 60  26.000000  1.000000e+00  1.80000e-01 79.00000       2.00    0.00000
## 61   9.000000  1.000000e+00  4.20000e-01 73.00000       2.00    0.00000
## 62  26.000000  1.000000e+00  0.00000e+00 72.00000       2.00    0.00000
## 63   0.500000  0.000000e+00  1.00000e+00 59.00000       1.00    0.00000
## 64  12.000000  1.000000e+00  0.00000e+00 70.16000       2.00    1.00000
## 65  49.000000  1.000000e+00  0.00000e+00 51.00000       1.00    0.00000
## 66   0.750000  0.000000e+00  9.30000e-01 50.00000       1.00    0.00000
## 67  49.000000  1.000000e+00  9.00000e-02 70.00000       2.00    1.00000
## 68  47.000000  1.000000e+00  0.00000e+00 65.00000       2.00    0.00000
## 69  41.000000  1.000000e+00  0.00000e+00 78.00000       2.00    0.12000
## 70   0.250000  0.000000e+00  1.00000e+00 86.00000       2.00    0.00000
## 71  33.000000  1.000000e+00  0.00000e+00 58.38825       1.00    0.00000
## 72  29.000000  9.900000e-01  0.00000e+00 60.00000       1.00    0.00000
## 73  41.000000  1.000000e+00  0.00000e+00 59.00000       1.00    0.00000
## 74  26.000000  1.000000e+00  0.00000e+00 50.00000       1.00    0.00000
## 75  15.000000  1.000000e+00  0.00000e+00 58.41792       1.00    0.00000
## 76   0.250000  0.000000e+00  1.00000e+00 68.00000       2.00    0.43000
## 77   0.030000  0.000000e+00  1.00000e+00 74.67583       2.00    0.00000
## 78  12.000000  1.000000e+00  0.00000e+00 64.00000       1.00    0.00000
## 79  32.000000  1.000000e+00  0.00000e+00 63.00000       1.00    0.00000
## 80  32.000000  9.500000e-01  0.00000e+00 65.00000       2.00    0.00000
## 81  27.000000  9.500000e-01  9.00000e-02 54.00000       1.00    1.00000
## 82  23.000000  1.000000e+00  0.00000e+00 59.14256       1.00    0.00000
## 83   0.750000  0.000000e+00  1.00000e+00 78.00000       2.00    0.00000
## 84   0.750000  0.000000e+00  1.00000e+00 61.00000       1.00    0.00000
## 85  34.000000  1.000000e+00  0.00000e+00 52.00000       1.00    0.00000
## 86   6.911667  8.000000e-02  1.00000e+00 60.98400       1.10    0.00000
## 87  21.000000  0.000000e+00  1.00000e+00 69.84500       2.00    1.00000
## 88  55.000000  1.000000e+00  0.00000e+00 55.00000       1.00    0.00000
## 89  15.000000  0.000000e+00  1.00000e+00 60.00000       1.00    0.00000
## 90   7.320000  0.000000e+00  1.00000e+00 67.00000       2.00    0.00000
## 91  35.000000  1.000000e+00  0.00000e+00 64.00000       1.00    0.00000
## 92  53.000000  1.000000e+00  0.00000e+00 59.00000       1.00    0.00000
## 93  33.000000  1.000000e+00  2.00000e-02 46.00000       0.86    0.00000
## 94  33.000000  1.000000e+00  0.00000e+00 63.00000       1.00    0.00000
## 95  40.000000  0.000000e+00  1.00000e+00 74.00000       2.00    0.09000
## 96  33.000000  1.000000e+00  0.00000e+00 59.37000       1.00    0.00000
## 97   5.000000  0.000000e+00  9.50000e-01 65.00000       2.00    1.00000
## 98   4.000000  0.000000e+00  1.00000e+00 62.96500       1.00    0.00000
## 99  31.000000  1.000000e+00  0.00000e+00 58.99633       1.00    0.00000
## 100 33.000000  1.000000e+00  0.00000e+00 66.00000       2.00    0.00000
## 101 22.000000  1.000000e+00  0.00000e+00 70.00000       2.00    0.00000
## 102 25.000000  1.000000e+00  0.00000e+00 62.00000       1.00    0.00000
```

```
## 103  1.250000  0.000000e+00  1.00000e+00 63.00000       1.00    0.00000
## 104 24.000000  1.000000e+00  0.00000e+00 59.01000       1.00    0.00000
## 105 25.000000  1.000000e+00  0.00000e+00 57.00000       1.00    0.00000
## 106 24.000000  1.000000e+00  0.00000e+00 57.00000       1.00    0.00000
## 107  0.750000  0.000000e+00  1.00000e+00 78.00000       2.00    0.00000
## 108  3.000000  0.000000e+00  1.00000e+00 62.00000       1.00    0.00000
## 109 27.000000  9.900000e-01  0.00000e+00 62.00000       1.00    0.00000
## 110 13.000000  1.000000e+00  0.00000e+00 66.00000       2.00    0.00000
## 111 36.000000  1.000000e+00  0.00000e+00 61.00000       1.00    0.00000
## 112 25.000000  1.000000e+00  0.00000e+00 59.00000       1.00    1.00000
## 113 27.000000  1.000000e+00  0.00000e+00 57.00000       1.00    0.00000
## 114 34.000000  1.000000e+00  0.00000e+00 62.00000       1.00    1.00000
## 115 37.000000  1.000000e+00  0.00000e+00 68.95500       2.00    0.00000
## 116 34.000000  1.000000e+00  0.00000e+00 54.00000       1.00    0.00000
## 117  3.967100  0.000000e+00  1.00000e+00 62.00000       1.00    1.00000
## 118 28.000000  1.000000e+00  0.00000e+00 67.85000       2.00    0.00000
## 119 17.000000  1.000000e+00  0.00000e+00 64.00000       1.00    0.01000
## 120 38.000000  1.000000e+00  0.00000e+00 57.00000       1.00    1.00000
## 121 31.000000  1.000000e+00  0.00000e+00 59.06000       1.00    0.00000
## 122 12.000000  9.400000e-01  0.00000e+00 61.00000       1.00    1.00000
## 123 36.000000  1.000000e+00  0.00000e+00 48.00000       0.00    0.01000
## 124 17.000000  1.000000e+00  0.00000e+00 70.02833       2.00    0.00000
## 125 21.000000  1.000000e+00  0.00000e+00 61.00000       1.00    0.00000
## 126  7.500000  0.000000e+00  1.00000e+00 64.00000       1.00    0.00000
## 127 41.000000  1.000000e+00  0.00000e+00 64.00000       1.00    0.24000
## 128 36.000000  1.000000e+00  4.00000e-02 69.00000       2.00    0.00000
## 129 22.000000  1.000000e+00  0.00000e+00 57.00000       1.00    0.00000
## 130 35.182857  1.000000e+00  0.00000e+00 59.01833       1.00    0.00000
##     F.Shortening      EPSS     LVDD      WMS      WMI         WMI.S
## 1      0.2600000  9.000000 4.600000 14.00000 1.000000  0.000000e+00
## 2      0.3800000 10.098287 4.100000 14.00000 1.700000  1.000000e+00
## 3      0.2600000  4.000000 3.420000 14.00000 1.000000  0.000000e+00
## 4      0.2530000 12.062000 4.603000 16.00000 1.450000  1.000000e+00
## 5      0.1600000 21.185320 5.750000 18.00000 1.854610  1.000000e+00
## 6      0.2600000  5.000000 4.310000 12.00000 1.000000  0.000000e+00
## 7      0.2300000 31.000000 5.430000 22.50000 1.875000  1.000000e+00
## 8      0.3300000  8.000000 5.250000 14.00000 1.084821  0.000000e+00
## 9      0.3400000  9.371613 5.090000 16.00000 1.140000  0.000000e+00
## 10     0.1400000 13.000000 4.490000 15.50000 1.190000  0.000000e+00
## 11     0.1300000 16.000000 4.230000 18.00000 1.800000  1.000000e+00
## 12     0.4500000  9.000000 3.600000 16.00000 1.140000  0.000000e+00
## 13     0.3300000  6.000000 4.000000 14.00000 1.000000  0.000000e+00
## 14     0.1500000 11.546000 3.730000 14.00000 1.000000  0.000000e+00
## 15     0.1200000 20.206320 5.800000 11.67000 2.330000  1.000000e+00
## 16     0.2500000 12.063000 4.290000 10.71578 1.000000  0.000000e+00
## 17     0.1968300 11.000000 4.650000 18.00000 1.640000  1.000000e+00
## 18     0.0700000 20.000000 5.200000 24.00000 2.000000  1.000000e+00
## 19     0.0900000 17.000000 5.819000  8.00000 1.333000  1.000000e+00
## 20     0.2200000 15.000000 5.400000 27.00000 2.250000  1.000000e+00
## 21     0.1500000 12.000000 5.390000 19.50000 1.625000  1.000000e+00
## 22     0.1800000 19.000000 5.460000 13.83000 1.380000  1.000000e+00
## 23     0.2300000 12.733000 6.060000 17.21186 1.500000  1.000000e+00
## 24     0.1700000  0.000000 4.650000  8.00000 1.000000  0.000000e+00
## 25     0.1900000  5.900000 3.480000 10.00000 1.110000  0.000000e+00
```

```
## 26     0.3000000  7.000000 3.850000 10.00000 1.667000  1.000000e+00
## 27     0.3000000  5.000000 4.170000 14.00000 1.000000  0.000000e+00
## 28     0.2437842  7.000000 4.500882  2.00000 1.000000  0.000000e+00
## 29     0.1940167 13.269650 5.215593 11.55830 1.000000  0.000000e+00
## 30     0.2100000  4.200000 4.160000 15.16242 1.560000  1.000000e+00
## 31     0.1500000 10.063913 5.050000 10.00000 1.000000  2.000000e-01
## 32     0.1700000 17.200000 5.320000 14.00000 1.222295  0.000000e+00
## 33     0.1426383 12.000000 5.145472  6.00000 3.000000  1.000000e+00
## 34     0.4000000  5.120000 3.100000 12.00000 1.000000  0.000000e+00
## 35     0.2246757 10.000000 4.447437 14.00000 1.170000  0.000000e+00
## 36     0.6100000 13.100000 4.070000 13.00000 1.625000  1.000000e+00
## 37     0.1992533  9.943083 5.310000  5.00000 1.000000 -6.661338e-17
## 38     0.0600000 23.600000 5.736560 21.50000 2.150000  9.300000e-01
## 39     0.5100000  9.854287 3.880000 15.00000 1.670000  1.000000e+00
## 40     0.4100000  8.427017 4.360000 11.57542 1.000000  0.000000e+00
## 41     0.3500000  9.300000 3.630000 11.00000 1.222000  0.000000e+00
## 42     0.2700000 13.640500 4.490000 22.00000 2.000000  1.000000e+00
## 43     0.1500000 17.500000 4.270000 13.00000 1.300000  1.000000e+00
## 44     0.3207420  8.097467 3.590000 14.00000 1.000000  0.000000e+00
## 45     0.4400000  9.000000 4.682775 17.50000 1.450000  9.300000e-01
## 46     0.0900000 12.679573 4.802063 12.00000 2.000000  1.000000e+00
## 47     0.1200000 13.037000 5.098410  9.00000 1.236220  3.000000e-01
## 48     0.0300000 21.300000 5.495555 17.00000 1.310000  1.000000e+00
## 49     0.1609250 20.386000 5.165800 23.00000 2.300000  1.000000e+00
## 50     0.0400000 14.000000 5.000000 16.99240 1.685540  1.000000e+00
## 51     0.1362500 14.055330 4.988545 16.44801 1.500000  1.000000e+00
## 52     0.2400000 14.800000 5.260000 18.00000 1.380000  9.400000e-01
## 53     0.3000000  9.400000 3.490000 14.00000 1.096555  0.000000e+00
## 54     0.0100000 24.600000 5.650000 16.51002 3.000000  9.500000e-01
## 55     0.2900000 15.600000 6.150000 14.00000 1.000000  2.200000e-01
## 56     0.2123700 13.000000 4.570000 13.00000 1.080000  0.000000e+00
## 57     0.1300000 18.600000 4.370000 12.33000 1.370000  8.400000e-01
## 58     0.1986900 15.816240 5.300000 23.00000 2.300000  1.000000e+00
## 59     0.2900000  6.246870 4.410000 14.00000 1.167000  0.000000e+00
## 60     0.1700000 11.174000 5.150000 10.50000 1.050000  0.000000e+00
## 61     0.1200000 20.575230 6.780000 16.67000 1.390000  1.000000e+00
## 62     0.1870000 12.000000 5.020000 13.00000 1.180000  7.000000e-02
## 63     0.1300000 16.400000 4.960000 17.83000 1.370000  1.000000e+00
## 64     0.1100000  9.329583 4.680000 10.59750 1.000000  0.000000e+00
## 65     0.1600000 13.200000 5.260000 11.00000 1.000000  0.000000e+00
## 66     0.1400000 11.400000 4.750000 10.00000 2.500000  1.000000e+00
## 67     0.2500000 11.967480 5.570000  5.50000 1.100000  0.000000e+00
## 68     0.3600000  8.800000 4.108068 12.00000 1.000000  0.000000e+00
## 69     0.0600000 16.100000 5.620000 13.67000 1.367000  1.000000e+00
## 70     0.2250000 18.922000 5.200000 24.00000 2.180000  1.000000e+00
## 71     0.2500000 11.000000 4.720000 11.00000 1.000000  0.000000e+00
## 72     0.1200000 10.200000 4.433316 15.00000 1.670000  1.000000e+00
## 73     0.2900000  9.230220 4.750000 13.00000 1.080000  0.000000e+00
## 74     0.1754900 24.265997 5.950000 21.50000 2.390000  1.000000e+00
## 75     0.2170000 17.900000 4.540000 16.50000 1.180000  0.000000e+00
## 76     0.2200000 21.700000 5.617510 15.00000 1.150000  0.000000e+00
## 77     0.2600000 19.400000 4.770000 21.00000 2.100000  1.000000e+00
## 78     0.2000000  7.100000 4.580000 14.00000 1.088695  1.000000e-02
## 79     0.2000000  5.000000 5.200000  8.00000 1.000000 -7.771561e-17
```

```
## 80     0.0600000 23.600000 6.740000 12.00000 1.090000  0.000000e+00
## 81     0.0700000 16.800000 4.160000 18.00000 1.500000  1.000000e+00
## 82     0.2500000  6.000000 4.480000 11.26952 1.000000  0.000000e+00
## 83     0.0500000 10.000000 4.440000 15.00000 1.360000  1.000000e+00
## 84     0.1508250 16.454330 5.094810 19.22205 2.330000  1.000000e+00
## 85     0.1400000 25.000000 6.210000 11.50000 1.220398  0.000000e+00
## 86     0.0500000 14.800000 4.140000 15.50000 1.410000  1.000000e+00
## 87     0.1801333 19.200000 5.250000 11.00000 1.000000  0.000000e+00
## 88     0.2800000  5.500000 4.480000 22.00000 1.830000  1.000000e+00
## 89     0.1800000 10.565500 4.560000 13.50000 1.040000  0.000000e+00
## 90     0.1550000 11.300000 5.160000 10.82500 1.000000  0.000000e+00
## 91     0.3000000  6.600000 4.360000 14.00000 1.270000  0.000000e+00
## 92     0.3440000  9.100000 4.040000  9.00000 1.074627  0.000000e+00
## 93     0.2298733 16.500000 5.360000 12.67000 1.060000  0.000000e+00
## 94     0.2500000  5.600000 3.870000 18.00000 1.500000  1.000000e+00
## 95     0.2000000  4.800000 4.560000 12.50000 1.040000  0.000000e+00
## 96     0.5000000  9.100000 3.420000 18.00000 1.500000  1.000000e+00
## 97     0.1600000  8.500000 5.470000 16.00000 1.450000  1.000000e+00
## 98     0.1700000 28.900000 6.730000 26.08000 2.010000  1.000000e+00
## 99     0.1700000  8.488130 4.690000 10.00000 1.000000  0.000000e+00
## 100    0.2000000  7.686713 4.230000 12.00000 1.000000  0.000000e+00
## 101    0.2168800  0.000000 4.550000 10.00000 1.000000  0.000000e+00
## 102    0.2264969 11.800000 4.870000 11.00000 1.000000  0.000000e+00
## 103    0.3000000  6.900000 3.520000 18.16000 1.510000  1.000000e+00
## 104    0.1700000 14.300000 5.490000 13.50000 1.500000  1.000000e+00
## 105    0.2280000  9.700000 4.290000 11.40161 1.000000  0.000000e+00
## 106    0.3089233  9.065010 4.120000 13.50000 1.230000 -9.381385e-17
## 107    0.2300000 40.000000 6.230000 14.00000 1.400000  1.000000e+00
## 108    0.2600000  7.600000 4.420000 14.00000 1.000000  0.000000e+00
## 109    0.2200000 12.100000 3.920000 11.00000 1.000000  0.000000e+00
## 110    0.2400000 13.600000 4.380000 22.00000 2.200000  1.000000e+00
## 111    0.2700000  9.000000 4.060000 12.00000 1.000000  0.000000e+00
## 112    0.4000000  9.200000 5.360000 12.00000 1.000000  0.000000e+00
## 113    0.2900000  9.400000 4.770000  9.00000 1.000000  0.000000e+00
## 114    0.1900000 28.900000 5.510467 19.50000 1.950000  1.000000e+00
## 115    0.2600000  0.000000 4.380000  9.00000 1.000000  0.000000e+00
## 116    0.4300000  9.300000 4.790000 10.00000 1.000000  0.000000e+00
## 117    0.2400000 28.600000 5.860000 21.50000 1.950000  1.000000e+00
## 118    0.2300000 19.100000 5.490000 12.00000 1.200000  0.000000e+00
## 119    0.1500000  6.600000 4.170000 14.00000 1.270000  0.000000e+00
## 120    0.1200000  0.000000 4.525807 16.50000 1.375000  9.600000e-01
## 121    0.1800000  0.000000 4.480000 11.00000 1.375000  1.000000e+00
## 122    0.1900000 13.200000 5.040000 15.40650 1.566499  1.000000e+00
## 123    0.1500000 12.000000 3.660000 10.00000 1.000000  0.000000e+00
## 124    0.0900000  6.800000 4.960000 13.00000 1.109170  0.000000e+00
## 125    0.1400000 25.500000 5.160000 14.00000 1.270000  0.000000e+00
## 126    0.2400000 12.900000 4.720000 12.00000 1.000000  0.000000e+00
## 127    0.2800000  5.400000 5.470000 11.00000 1.100000  5.000000e-02
## 128    0.2000000  9.642907 5.050000 14.50000 1.210000  0.000000e+00
## 129    0.1400000 16.100000 4.360000 15.00000 1.360000  8.900000e-01
## 130    0.2130900  0.000000 4.510000 15.50000 1.409000  1.000000e+00
```

	x
NRMSE	0.2454194

Censoring

Fixed study start time and fixed study end time.

Patients can start late.

Left censored: Some values, we are unsure how long ago was their myocardial infarction episode. We only have recorded data from the moment patients entered the study and when the study ends.

Right censored: Additionally, some patients live far beyond the scope of the study.

Summary statistics

Over the course of the study, there is a ## Kaplan-Meier We conduct nonparametric Kaplan-Meier fit on our data over multiple strata. We first conduct a fit over all patients in regards to censoring. Then we work on gender groups, age, and general ventriculular condition. A survival function can be defined as:

[insert latex equation for survival function, with censored values]

Weibull Fits (+Cox PH)

Log-Normal

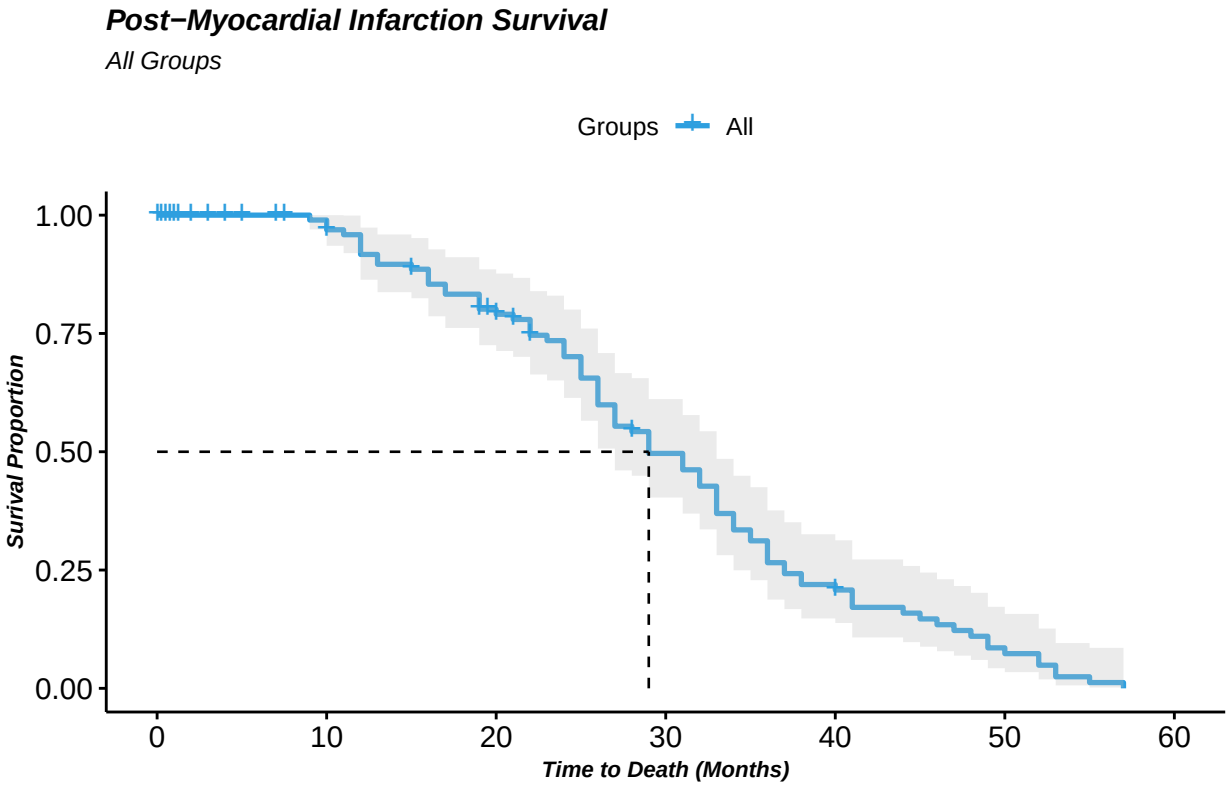
Results

Table of Summary Statistics

KM Curve & Hazard

Survival Curves

KM Overall



Here is the survival curve for all groups within our dataset. We see that a majority of our censored values have very short survival times. This is very intuitive given to our limited interval study time of a single year. We clearly see a median survival time of approximately 29 weeks.

records	n.max	n.start	events	*rmean	*se(rmean)	median	0.95LCL	0.95UCL
130	130	130	88	30.53008	1.249886	29	27	33

Hazard Plots

Weibull Curve

Cox Proportional Hazard

Model Diagnostics

AIC, BIC, and Confidence Intervals

Residual Analysis/QQ Plot

Discussion

References

Heron, M. Deaths: Leading causes for 2017 pdf icon[PDF – 3 M]. National Vital Statistics Reports;68(6). Accessed November 19, 2019.

Daniel J. Stekhoven, Peter Bühlmann, MissForest—non-parametric missing value imputation for mixed-type data, Bioinformatics, Volume 28, Issue 1, 1 January 2012, Pages 112–118,

Salzberg, S. (1988). Exemplar-based learning: Theory and implementation (Technical Report TR-10-88). Harvard University, Center for Research in Computing Technology, Aiken Computation Laboratory (33

Oxford Street; Cambridge, MA 02138).

Kan, G., Visser, C., Kooler, J., & Dunning, A. (1986). Short and long term predictive value of wall motion score in acute myocardial infarction. British Heart Journal, 56, 422-427.

Fryar CD, Chen T-C, Li X. Prevalence of uncontrolled risk factors for cardiovascular disease: United States, 1999–2010 pdf icon[PDF-494K]. NCHS data brief, no. 103. Hyattsville, MD: National Center for Health Statistics; 2012. Accessed May 9, 2019.

Appendix

Dataset

R Code

Table 1: Dataset

Survival	Status	Alive.E	Age	Age.Strata	P.Effusion	F.Shortening	EPSS	LVDD	WMS	WMI	WMI.S
11.00	1	0	71.00	2	0	0.260	9.000	4.600	14.00	1.000	0
19.00	1	0	72.00	2	0	0.380	6.000	4.100	14.00	1.700	1
16.00	1	0	55.00	1	0	0.260	4.000	3.420	14.00	1.000	0
57.00	1	0	60.00	1	0	0.253	12.062	4.603	16.00	1.450	1
19.00	0	1	57.00	1	0	0.160	22.000	5.750	18.00	2.250	1
26.00	1	0	68.00	2	0	0.260	5.000	4.310	12.00	1.000	0
13.00	1	0	62.00	1	0	0.230	31.000	5.430	22.50	1.875	1
50.00	1	0	60.00	1	0	0.330	8.000	5.250	14.00	1.000	0
19.00	1	0	46.00	0	0	0.340	0.000	5.090	16.00	1.140	0
25.00	1	0	54.00	1	0	0.140	13.000	4.490	15.50	1.190	0
10.00	0	1	77.00	2	0	0.130	16.000	4.230	18.00	1.800	1
52.00	1	0	62.00	1	1	0.450	9.000	3.600	16.00	1.140	0
52.00	1	0	73.00	2	0	0.330	6.000	4.000	14.00	1.000	0
44.00	1	0	60.00	1	0	0.150	10.000	3.730	14.00	1.000	0
0.50	0	1	62.00	1	0	0.120	23.000	5.800	11.67	2.330	1
24.00	1	0	55.00	1	1	0.250	12.063	4.290	14.00	1.000	0
0.50	0	1	69.00	2	1	0.260	11.000	4.650	18.00	1.640	1
0.50	0	1	62.53	1	1	0.070	20.000	5.200	24.00	2.000	1
22.00	0	1	66.00	2	0	0.090	17.000	5.819	8.00	1.333	1
1.00	0	1	66.00	2	1	0.220	15.000	5.400	27.00	2.250	1
0.75	0	1	69.00	2	0	0.150	12.000	5.390	19.50	1.625	1
0.75	0	1	85.00	2	1	0.180	19.000	5.460	13.83	1.380	1
0.50	0	1	73.00	2	0	0.230	12.733	6.060	7.50	1.500	1
5.00	0	1	71.00	2	0	0.170	0.000	4.650	8.00	1.000	0
48.00	1	0	64.00	1	0	0.190	5.900	3.480	10.00	1.110	0
29.00	1	0	54.00	1	0	0.300	7.000	3.850	10.00	1.667	1
29.00	1	0	35.00	0	0	0.300	5.000	4.170	14.00	1.000	0
29.00	1	0	55.00	1	0	NA	7.000	NA	2.00	1.000	0
0.25	0	1	75.00	2	0	NA	NA	NA	NA	1.000	0
36.00	1	0	55.00	1	1	0.210	4.200	4.160	14.00	1.560	1
1.00	0	1	65.00	2	0	0.150	NA	5.050	10.00	1.000	0
1.00	0	1	52.00	1	1	0.170	17.200	5.320	14.00	1.170	0
3.00	0	1	NA	2	0	NA	12.000	NA	6.00	3.000	1
27.00	1	0	47.00	0	0	0.400	5.120	3.100	12.00	1.000	0
35.00	1	0	63.00	1	0	NA	10.000	NA	14.00	1.170	0
26.00	1	0	61.00	1	0	0.610	13.100	4.070	13.00	1.625	1
16.00	1	0	63.00	1	1	NA	NA	5.310	5.00	1.000	0
1.00	0	1	65.00	2	0	0.060	23.600	NA	21.50	2.150	1
19.00	1	0	68.00	2	0	0.510	NA	3.880	15.00	1.670	1
31.00	1	0	80.00	2	0	0.410	5.400	4.360	NA	1.000	0
32.00	1	0	54.00	1	0	0.350	9.300	3.630	11.00	1.222	0
16.00	1	0	70.00	2	1	0.270	4.700	4.490	22.00	2.000	1
40.00	1	0	79.00	2	0	0.150	17.500	4.270	13.00	1.300	1
46.00	1	0	56.00	1	0	0.330	NA	3.590	14.00	1.000	0
2.00	0	1	67.00	2	1	0.440	9.000	3.960	17.50	1.450	1
37.00	1	0	64.00	1	0	0.090	NA	NA	12.00	2.000	1
19.50	0	1	81.00	2	0	0.120	NA	NA	9.00	1.250	0
20.00	0	1	59.00	1	0	0.030	21.300	6.290	17.00	1.310	1
0.25	0	1	63.00	1	1	NA	NA	NA	23.00	2.300	1
2.00	0	1	56.00	1	1	0.040	14.000	5.000	NA	NA	1
7.00	0	1	61.00	1	1	0.270	NA	NA	9.00	1.500	1
10.00	1	0	57.00	1	0	0.240	14.800	5.260	18.00	1.380	1
12.00	1	0	58.00	1	0	0.300	9.400	3.490	14.00	1.000	0
1.00	0	1	60.00	1	0	0.010	24.600	5.650	39.00	3.000	1
10.00	1	0	66.00	2	0	0.290	15.600	6.150	14.00	1.000	0