Survival Analysis of Post-Myocardial Infarction Patients

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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 age, 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

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. We examine records of several patient variables

[Insert more kaggle context]

```
##      speed           dist
##  Min.   : 4.0   Min.   :  2.00
##  1st Qu.:12.0   1st Qu.: 26.00
##  Median :15.0   Median : 36.00
##  Mean   :15.4   Mean   : 42.98
##  3rd Qu.:19.0   3rd Qu.: 56.00
##  Max.   :25.0   Max.   :120.00
```

We have obtained a data set examining the the length and survival of post-myocardial patients over the course of one year.

Dataset

We have obtained our data set from Kaggle. The data set contains 133 of observations and records 9 variables. Please refer to the data set below for more details.

Survival is the the number of months patient survived (has survived, if patient is still alive). Because all the patients had their heart attacks at different times, it is possible that some patients have survived less than one year but they are still alive. Check the second variable to confirm this. Such patients cannot be used for the prediction task mentioned above.

Alive.end is a binary variable if a patient is alive by the end of the survival variable, 0 means the patient has died at the end of the time period while 1 means that patient is still alive.

p.age is a patient's age at the time of the infarction.

If pericardial-effusion is present around the heart, it is recorded as a 1. If the effusion is not present around the heart, it is recorded as a 0.

Fractional shortening, the measure of contracility around the heart, is recorded as continuous numbers. Lower numbers can be concidered as increasingly abnormal.

E-point septal separation (epss), another measure of contractility, is also recorded with continuous numbers. Larger numbers are increasingly abnormal.

Left ventricular end-diastolic dimension is a measure of the size of the heart at end-diastole. Large hearts tend to be sick hearts.

Wall-motion-index is a wall-motion-score divided by number of segments seen. Usually 12-13 segments are seen in an echocardiogram.

Alive-at-1: 0 means patient was either dead after 1 year or had been followed for less than 1 year. 1 means patient was alive at 1 year.

[add table summarizing the headers]

```
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##  Max.   :25.0   Max.   :120.00
```

[add the data set??]

```
##      speed           dist
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```

```
##  3rd Qu.:19.0   3rd Qu.: 56.00
##  Max.   :25.0   Max.   :120.00
```

[add details from kaggle]

Mathematical Definitions

Censoring

Left Censored: Because all the patients had their heart attacks at different times, it is possible that some patients have survived less than one year but they are still alive. Check the second variable to confirm this. Such patients cannot be used for the prediction task mentioned above.

Curves

equations

[latex]

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.

Methodology

Summary statistics

Kaplan-Meier

Weibull Fits

Cox PH

Results

Table of Summary Statistics

```
##      speed           dist       
##  Min.   : 4.0   Min.   :  2.00  
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##  Max.   :25.0   Max.   :120.00
```

KM Curve

```
##      speed           dist       
##  Min.   : 4.0   Min.   :  2.00  
##  1st Qu.:12.0   1st Qu.: 26.00  
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```

Weibull Curve

```
##      speed           dist
##  Min.   : 4.0   Min.   :  2.00
##  1st Qu.:12.0   1st Qu.: 26.00
##  Median :15.0   Median : 36.00
##  Mean   :15.4   Mean   : 42.98
##  3rd Qu.:19.0   3rd Qu.: 56.00
##  Max.   :25.0   Max.   :120.00
```

Cox Proportional Hazard

```
##      speed           dist
##  Min.   : 4.0   Min.   :  2.00
##  1st Qu.:12.0   1st Qu.: 26.00
##  Median :15.0   Median : 36.00
##  Mean   :15.4   Mean   : 42.98
##  3rd Qu.:19.0   3rd Qu.: 56.00
##  Max.   :25.0   Max.   :120.00
```

Model Diagnostics

AIC, BIC, and Confidence Intervals

```
##      speed           dist
##  Min.   : 4.0   Min.   :  2.00
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##  Mean   :15.4   Mean   : 42.98
##  3rd Qu.:19.0   3rd Qu.: 56.00
##  Max.   :25.0   Max.   :120.00
```

Residual Analysis/QQ Plot

```
##      speed           dist
##  Min.   : 4.0   Min.   :  2.00
##  1st Qu.:12.0   1st Qu.: 26.00
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##  Mean   :15.4   Mean   : 42.98
##  3rd Qu.:19.0   3rd Qu.: 56.00
##  Max.   :25.0   Max.   :120.00
```

```
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##  Max.   :25.0   Max.   :120.00
```

Discussion

References

[https://www.cdc.gov/heartdisease/facts.htm]

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

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.