A STUDY ON SURVIVAL TEST IN HAZARDS MODEL
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Abstract

In general mathematical models for survival analysis is based on hazard functions i.e. on conditional failure rates, which identifies the specific linear model form, to estimate and interpret the survivor and hazard functions, and to assess the relationship between the explanatory variables to survival time T, a survival test was conducted under certain conditions on 20 asthmatic children, and the reliability factors and the number of survivors without asthma are identified in the interval of time t.

Key Words: Survival Time, Hazard functions, Reliability, Survivor function, Asthmatic patients

Introduction

Symptoms on asthma are shortness of breath or you hear a whistling or wheezy sound in your chest when you breathe, a chronic condition that causes inflammation and narrowing of the bronchial tubes, and the passageways that allow air to enter and leave the lungs. If people with asthma are exposed to a substance to which they are sensitive or a situation that changes their regular breathing patterns, the symptoms can become more severe. Asthma symptoms affect an estimated 26 million Americans, 19 million adults and 7 million children and are one of the leading causes of absences from work and school. Asthma often runs in families according to the World Health Organization, about half the cases are due to genetic susceptibility and half result from environmental factors. Although there is no cure for asthma, effective treatments are available. Asthma can be best managed by seeing an allergist. There are two types of asthma: allergic (caused by exposure to an allergen) and no allergic (caused by stress, exercise, illnesses like a cold or the flu, or exposure to extreme weather, irritants in the air or some medications). Asthma Symptoms: coughing, shortness of breath, chest tightness, wheezing (a whistling or squeaky sound in your chest when you breathe, especially when exhaling). A model
may be organic giving shape to an abstraction involving mathematical relationships or statement underlying the various aspects of the phenomenon under observation. It may be dynamic changing with time or static. This project had a survey from 20 asthmatic children. Their parents replied that the following factors make wheezing curd, guava, lemon, tap water, dust, brown colored powder. They advised to avoid the factors. This project followed those 6 months. From that data this project gives the following survival test.

**The Hazard Rate**

For survival analysis, we need methods that directly account for the sequential nature of the data, and are able to handle censoring and incorporate time-varying covariates. The solution is to model survival times indirectly, via the so-called hazard rate, which is a concept related to chances of making a transition out of the current state at each instant (or time period) conditional on survival up to that point.

The survivor function is \( S(t) = 1 - F(t) \), \( t \) is the elapsed time since entry to the state at time 0.

The failure function \( \Pr(T \leq t) = F(t) \). Implies the survivor function

\[
\Pr(T > t) = 1 - F(t) = S(t)
\]

The continuous time hazard rate, \( h(t) \), is defined as

\[
h(t) = \frac{f(t)}{1-F(t)} = \frac{f(t)}{S(t)}
\]

Thus \( h(t)\Delta(t) \), for small \( t \), is akin to the conditional probability of having a spell length of exactly \( t \), conditional on survival up to time \( t \). It should be stressed, however, that the hazard rate is not a probability, as it refers to the exact time \( t \) and not the tiny interval thereafter. The only restriction on the hazard rate is that \( h(t) \geq 0 \).

**Hazards Models**

Assume a function for the hazard rate \( Z(t) \). This will be a hazard model. There are two types in hazard model.

1. **Constant Hazard**
2. **Linearly increasing hazard**

Here consider the linearly increasing hazard model that we can consider in this category is one in which the hazard increase linearly with time. This is shown in the figure .1

**Material and Methods:** A test conducted under certain conditions on 20 asthmatic children. The total duration of the test was 6 months. The number of children who survive without asthma during each monthly interval is noted. The
Results obtained are tabulated below. Thus table lists the total number of survived children without asthma at the end of 1 months, 2 months, 6months. The number of survivors without asthma during the interval is represented by s, and the cumulative survivors without asthma to end of the interval by S. The number of children survived without asthma during a particular interval only is noted at the end of the interval or at the beginning of the next interval the values of S are entered between two values of t as shown in column 2 of the table. Column 4 gives the number of survivors with asthma at the end of each time interval. During the first month there are was nobody survive without asthma in this test. Leaving behind 20 asthmatic children. Between the first and second month 1 child survives without asthma leaving 19 failures. The test of the history is listed in the table in this manner. The cumulative survivors without asthma from the beginning of the test till a particular time are given in column 3. From the table, the total number of children survived without asthma is 0 till the end of the first and second month, 1 till the end of the third month and so on. From this table get survivor rate, reliability, survivor density, and unreliability.

**Survivor without Asthma Density (S, D)**

Total number of children at the very beginning of the test. function f (t) is estimated as the Probability Density Function (or Density Function)Like any other continuous random variable, the survival time T has a probability density function defined as the limit of the probability that an individual fails in the short interval t to ∆t, t per unit width ∆t, or simply the probability of failure in a small interval per unit time. It can be expressed as...

\[
f(t) = \lim_{\Delta t \to 0} \frac{P(t \leq T < t + \Delta t)}{\Delta t}
\]

**Density function Properties**

- f (t) is a nonnegative function f (t) ≥ 0 for all t ≥ 0
- The area between the density curve and the t axis is equal to 1.

**Results and Discussions**

A small sample of 20 asthmatic children are taken, a survival test was conducted for the period of 6 months the number of children who survive without asthma during each monthly interval is noted. During the first month, the number of children without asthma is 0.

\[S_d = 0/20 = 0\]

During the first month, the number of children without asthma is 1.
Similarly during the six month, the number of children without asthma is 20.

\[ S\ d = \frac{6}{20} = 0.30 \]  Her some of \( s \ d \) is 1.

**Table: 1. Estimation of Survivors without Asthma**

<table>
<thead>
<tr>
<th>Time in month (t)</th>
<th>No. of survivors without asthma (s)</th>
<th>Cumulative survivors without asthma (S)</th>
<th>No. of survivors with asthma (f)</th>
<th>survivors without asthma density (s,d)</th>
<th>survivors without asthma rate (Z)</th>
<th>Reliability (R)</th>
<th>Unreliability (UR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>0</td>
<td>20</td>
<td>0.05</td>
<td>0.05</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>1</td>
<td>19</td>
<td>0.15</td>
<td>0.17</td>
<td>0.05</td>
<td>0.95</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
<td>4</td>
<td>16</td>
<td>0.25</td>
<td>0.37</td>
<td>0.2</td>
<td>0.8</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>9</td>
<td>11</td>
<td>0.25</td>
<td>0.59</td>
<td>0.45</td>
<td>0.55</td>
</tr>
<tr>
<td>5</td>
<td>6</td>
<td>14</td>
<td>6</td>
<td>0.3</td>
<td>2</td>
<td>0.7</td>
<td>0.3</td>
</tr>
<tr>
<td>6</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Here sum of \( s\ d \) is 1.
Survivor With Out Asthma Rate ($Z$)

This is ratio of the number of survivors without during a particular month to the average population during that interval

\[ Z(1) = \frac{0}{(20+20)/2} \]
\[ Z(2) = \frac{1}{(20+19)/2} \]
\[ Z(3) = \frac{3}{(19+16)/2} \] and so on.

Reliability ($R$)

This is ratio of the survivors without asthma at any given time to the total in initial population

\[ R(1) = \frac{0}{20} = 0 \]
\[ R(2) = \frac{1}{20} = 0.05. \]

Unreliability ($UR$)

This is ratio of the survivors with asthma at any given time to the initial population.

\[ UR(1) = \frac{20}{20} = 1 \]
\[ UR(2) = \frac{19}{20} = 0.95. \] And so on.

Conclusion

From the table we can see that the sum of reliability and unreliability is one. Also survival complementary events. Therefore if the reliability factor for the $t$ is $R(t)$, the for the same period is $1 - R(t)$. From this test, we conclude that avoiding the allergy factors is one of the treatments for asthma.

Reference

1. Adapted from Stephen P. Jenkins, Notes on Survival Analysis, July 2005.
5. American college of Allergy, Asthma and Immunology (ACAAI).