|  |  |  |
| --- | --- | --- |
| Assignment 4 – Part 2 | September 3  15338673 | |
| PW Janse van Rensburg | | Survival Analysis |

# Question 4

H0: hroutine(t) = hchlorh(t) vs H1: hroutine(t) ≠ hchlorh(t)

Stratifying the sample, for each subset, we test the above hypothesis. We should keep in mind the log-rank test uniformly weights all time points. We first consider the 0-29% surface burned area and retrieve the following results with the log-rank test:

|  |  |  |  |
| --- | --- | --- | --- |
| Test of Equality over Strata | | | |
| Test | **Chi-Square** | **DF** | **Pr > Chi-Square** |
| Log-Rank | 2.7319 | 1 | 0.0984 |

For this particular subset, the p-value is higher than when considering the entire population at once, telling us that for this subset particularly, there is also not a difference between the routine bathing treatment and the body cleansing treatment. As the log-rank test uniformly weights all time points, with this p-value and ꭓ2 test statistic being higher than the overall population test, implies TODO: FINISH THIS

Next we consider the 30-50% surface burned area and again implementing the log-rank test obtain the following results:

|  |  |  |  |
| --- | --- | --- | --- |
| Test of Equality over Strata | | | |
| Test | **Chi-Square** | **DF** | **Pr > Chi-Square** |
| Log-Rank | 0.4165 | 1 | 0.5187 |

We observe an even higher p-value of 0.5187. We can therefore not reject the null hypothesis and conclude that for this subset of 30-50% surface burned area there is not a difference between the routine bathing treatment and the body cleansing treatment.

Lastly we consider the 51-100% surface burned area patients and implementing the log-rank test, we obtain the following results:

|  |  |  |  |
| --- | --- | --- | --- |
| Test of Equality over Strata | | | |
| Test | **Chi-Square** | **DF** | **Pr > Chi-Square** |
| Log-Rank | 1.2003 | 1 | 0.2733 |

We observe an even higher p-value than that of the 0-29% group of 0.2733. We can therefore not reject the null hypothesis and conclude that for this subset of 51-100% surface burned area patients there is not a difference between the routine bathing treatment and the body cleansing treatment.

# Question 5

H0: htreated(t) = hcontrol(t) vs H1: htreated(t) ≠ hcontrol(t)

Under

We define D1 = 1 if T1 < T2 (or T1 = T2 and the treated rat experiences tumorigenesis but the control rat does not) and the treated rat experiences tumorigenesis (i.e. not censored) and D2 = 1 if T1 > T2 (or T1 = T2 and the control rat experiences tumorigenesis but the treated rat does not) and the control rat experiences tumorigenesis.

Using the above defined formula for Z, we derive the following results using the log-rank test:

|  |  |  |
| --- | --- | --- |
| Test of Equality over Strata | | |
| Test | **Z-score** | **Pr >Z** |
| Log-Rank | 3.900067 | 0.000199 |

With the Z-score of 3.9 and a p-value of 0.000199 we can comfortably reject H0 at even a 0.01 level of significance and conclude that there is indeed a difference in the times to tumor between the treated and control rats.

# Appendix A

Code used

**data** burn\_data;

label TimeFollowed='Time (in days) until infection'

Treatment='Treatment Group';

\*infile 'H:\Werk\Survival Analysis\survival\_analysis\assignment\_4\section1\_6.dat';

/\*

Z1 Treatment: 0-routine bathing 1-Body cleansing

Z2 Gender (0=male 1=female)

Z3 Race: 0=nonwhite 1=white

Z4 Percentage of total surface area burned

Z5 Burn site indicator: head 1=yes, 0=no

Z6 Burn site indicator: buttock 1=yes, 0=no

Z7 Burn site indicator: trunk 1=yes, 0=no

Z8 Burn site indicator: upper leg 1=yes, 0=no

Z9 Burn site indicator: lower leg 1=yes, 0=no

Z10 Burn site indicator: respiratory tract 1=yes, 0=no

Z11 Type of burn: 1=chemical, 2=scald, 3=electric, 4=flame

T1 Time to excision or on study time

D1 Excision indicator: 1=yes 0=no

T2 Time to prophylactic antibiotic treatment or on study time

D2 Prophylactic antibiotic treatment: 1=yes 0=no

T3 Time to straphylocous aureaus infection or on study time

D3 Straphylocous aureaus infection: 1=yes 0=no

\*/

input Patient\_ID Treatment Gender Race Perc\_Area\_Burned BSI\_Head BSI\_Butt BSI\_Trunk BSI\_Upper BSI\_Lower BSI\_Resp TOB TTE Excision\_Ind TTPAT PAT TTSAI SAI @@;

cards;

1 0 0 0 15 0 0 1 1 0 0 2 12 0 12 0 12 0

2 0 0 1 20 0 0 1 0 0 0 4 9 0 9 0 9 0

3 0 0 1 15 0 0 0 1 1 0 2 13 0 13 0 7 1

4 0 0 0 20 1 0 1 0 0 0 2 11 1 29 0 29 0

5 0 0 1 70 1 1 1 1 0 0 2 28 1 31 0 4 1

6 0 0 1 20 1 0 1 0 0 0 4 11 0 11 0 8 1

7 0 0 1 5 0 0 0 0 0 1 4 12 0 12 0 11 1

8 0 0 1 30 1 0 1 1 0 0 4 8 1 34 0 4 1

9 0 0 1 25 0 1 0 1 1 0 4 10 1 53 0 4 1

10 0 0 1 20 0 1 0 1 0 0 4 7 0 1 1 7 0

11 0 0 1 30 1 0 1 0 0 1 4 7 1 21 1 44 1

12 0 0 0 20 0 0 1 0 0 1 4 20 0 1 1 20 0

13 0 0 1 25 0 0 1 1 1 0 4 12 1 32 0 32 0

14 0 0 1 70 0 0 0 0 0 1 4 16 0 16 0 16 0

15 0 0 1 20 1 0 1 0 0 0 4 39 0 39 0 39 0

16 0 0 0 10 1 0 1 0 0 1 4 23 1 34 0 34 0

17 0 0 1 10 1 0 0 0 0 0 4 8 0 8 0 8 0

18 0 0 1 15 0 0 0 0 0 0 4 15 0 15 0 6 1

19 0 0 1 10 0 0 0 0 0 1 4 8 0 8 0 8 0

20 0 0 1 15 0 0 0 0 1 0 4 24 1 32 0 32 0

21 0 0 1 16 0 0 1 0 0 0 4 25 1 22 1 43 0

22 0 1 1 55 1 0 1 1 0 0 4 14 1 3 1 56 0

23 0 0 1 20 1 0 1 1 0 0 4 24 1 47 0 11 1

24 0 0 0 30 0 0 0 1 1 0 4 6 1 43 0 43 0

25 0 0 1 40 0 1 0 1 1 0 1 25 0 3 1 25 0

26 0 0 1 15 1 0 1 1 0 0 4 12 0 12 0 12 0

27 0 1 1 50 0 0 1 0 0 1 4 15 1 53 0 32 1

28 0 0 1 40 1 0 1 1 0 0 4 18 1 52 0 51 1

29 0 1 1 45 0 1 1 1 1 0 4 13 1 11 1 21 0

30 0 1 0 40 0 1 1 1 1 0 2 29 0 2 1 29 0

31 0 0 1 28 0 0 1 0 0 0 2 7 0 7 0 3 1

32 0 0 1 19 1 0 1 0 0 0 3 16 0 16 0 16 0

33 0 0 1 15 0 0 1 0 0 0 2 10 0 10 0 3 1

34 0 0 1 5 0 0 1 0 1 0 3 6 0 6 0 4 1

35 0 1 1 35 0 0 1 0 0 0 4 8 1 43 0 7 1

36 0 0 1 2 1 0 1 0 0 0 1 1 1 27 0 27 0

37 0 1 1 5 0 0 1 0 0 0 2 18 0 18 0 18 0

38 0 0 1 55 1 0 1 0 0 1 4 6 1 5 1 47 1

39 0 0 0 10 0 0 0 1 0 0 2 19 1 29 0 29 0

40 0 0 1 15 0 0 1 0 0 0 4 5 0 5 0 5 0

41 0 1 1 20 1 0 1 0 0 1 4 1 1 4 1 97 0

42 0 1 0 30 1 0 1 1 0 1 4 15 1 28 0 28 0

43 0 0 1 25 1 1 1 1 0 1 4 14 1 4 1 7 1

44 0 0 1 95 1 1 1 1 1 1 4 9 0 9 0 3 1

45 0 1 1 30 0 0 0 0 1 0 4 1 1 39 0 39 0

46 0 0 1 15 1 0 1 0 0 0 4 10 0 10 0 10 0

47 0 0 1 20 0 1 1 1 0 0 4 6 1 5 1 46 0

48 0 1 1 6 0 0 1 0 0 0 2 13 1 28 0 28 0

49 0 0 1 15 0 0 1 0 0 1 4 11 1 21 0 21 0

50 0 0 1 7 0 0 1 1 0 0 1 8 1 17 1 38 0

51 0 0 1 13 0 0 1 1 1 0 4 10 0 10 0 10 0

52 0 0 1 25 1 0 1 0 0 1 4 6 1 40 0 5 1

53 0 0 1 25 1 0 1 0 1 1 4 18 1 22 0 9 1

54 0 1 1 20 1 0 1 0 0 1 4 16 1 16 1 21 1

55 0 1 1 25 0 0 1 1 0 0 4 7 1 26 0 26 0

56 0 0 1 95 1 0 1 1 1 1 4 14 0 14 0 14 0

57 0 0 1 17 1 0 1 0 0 0 4 16 0 16 0 16 0

58 0 0 1 3 0 0 1 0 1 0 3 4 0 4 0 1 1

59 0 0 1 15 1 0 1 0 0 0 4 19 0 6 1 19 0

60 0 0 1 65 1 1 1 1 1 1 4 21 1 8 1 10 1

61 0 1 1 15 1 0 1 1 1 1 4 18 0 18 0 18 0

62 0 0 1 40 1 0 1 0 0 0 3 31 0 31 0 13 1

63 0 0 1 45 1 0 1 1 0 1 4 11 1 24 1 40 0

64 0 1 0 35 0 0 1 1 0 0 4 4 1 5 1 47 0

65 0 0 1 85 1 1 1 1 0 1 4 12 1 8 1 9 1

66 0 1 1 15 0 1 0 1 0 1 4 11 1 35 0 19 1

67 0 0 1 70 0 1 1 1 1 0 2 23 1 8 1 60 0

68 0 0 1 6 1 0 0 0 0 1 4 7 0 7 0 7 0

69 0 0 1 20 0 0 1 0 0 0 4 19 1 26 0 6 1

70 0 1 1 36 1 0 1 0 1 1 4 16 1 20 1 23 1

71 1 1 1 50 1 1 1 0 1 0 4 15 0 1 1 15 0

72 1 0 1 21 1 0 1 0 0 0 4 6 1 13 1 23 0

73 1 0 1 16 1 0 1 0 0 0 4 2 1 9 0 9 0

74 1 1 1 3 0 0 1 0 0 0 4 6 1 14 0 14 0

75 1 0 1 5 1 0 1 0 0 0 3 8 0 8 0 2 1

76 1 0 1 32 0 1 1 1 0 1 4 18 1 51 0 18 1

77 1 0 1 38 0 1 1 1 0 0 4 12 1 22 0 22 0

78 1 0 1 16 1 0 1 0 0 0 4 7 1 16 0 16 0

79 1 1 1 9 0 1 0 1 0 0 4 6 1 2 1 2 1

80 1 0 1 17 0 1 1 0 0 0 2 10 1 10 1 22 0

81 1 0 1 22 1 0 1 0 0 0 4 12 1 20 0 5 1

82 1 0 1 10 0 0 1 0 0 0 4 5 1 5 1 14 0

83 1 0 1 12 1 0 1 0 0 0 4 12 0 12 0 12 0

84 1 0 1 80 1 1 1 1 1 1 4 6 1 4 1 41 0

85 1 1 1 15 0 0 1 1 0 0 4 9 1 9 1 21 0

86 1 0 1 50 1 0 1 0 0 1 4 18 1 7 1 56 0

87 1 0 1 50 1 1 1 1 1 1 4 7 1 42 1 67 0

88 1 0 1 15 1 0 1 0 0 0 3 11 0 11 0 11 0

89 1 0 1 8 1 0 1 0 0 0 4 9 1 17 0 17 0

90 1 1 1 45 1 1 1 1 0 0 1 11 1 11 1 18 1

91 1 0 1 20 0 1 1 1 0 1 4 6 1 6 1 14 1

92 1 0 1 5 0 0 1 0 1 0 3 4 1 8 0 5 1

93 1 0 1 25 0 0 1 0 0 0 2 5 1 10 0 5 1

94 1 0 1 40 0 1 1 1 0 0 4 11 1 8 1 31 0

95 1 0 1 4 0 0 1 0 1 0 3 9 1 7 1 23 0

96 1 0 1 25 0 0 1 1 0 1 4 4 1 14 1 46 0

97 1 1 1 20 0 0 1 0 1 0 4 5 1 1 1 38 0

98 1 1 1 26 0 0 1 0 0 1 4 8 1 3 1 35 0

99 1 0 1 10 0 1 1 1 0 0 4 13 1 21 0 21 0

100 1 1 1 85 1 1 1 1 0 1 4 11 0 3 1 11 0

101 1 0 1 75 1 0 1 1 1 0 4 29 1 49 0 16 1

102 1 0 0 5 0 0 1 0 1 0 1 13 0 13 0 13 0

103 1 0 1 20 1 0 1 0 0 0 4 1 1 12 0 12 0

104 1 1 1 8 0 1 0 1 1 0 4 6 1 6 1 13 0

105 1 1 1 10 0 0 1 0 0 1 4 6 1 23 0 23 0

106 1 0 1 10 0 0 0 0 1 1 4 3 1 31 0 31 0

107 1 1 0 2 0 0 1 0 0 0 1 2 1 2 1 10 0

108 1 0 0 5 0 0 0 0 1 0 2 4 1 4 1 17 0

109 1 0 1 10 1 0 0 0 1 0 4 5 1 18 0 18 0

110 1 0 1 18 0 0 1 1 1 0 4 6 1 5 1 33 0

111 1 0 1 20 1 0 1 1 0 0 4 9 1 8 1 17 0

112 1 0 1 80 1 1 1 1 1 1 4 4 1 11 1 13 0

113 1 0 0 17 1 0 1 1 1 1 4 5 1 4 1 35 0

114 1 0 0 35 1 0 1 0 0 0 4 7 1 7 1 71 0

115 1 0 1 50 1 0 1 0 1 1 4 11 0 11 0 3 1

116 1 0 0 20 0 0 1 0 0 0 4 6 1 31 1 42 1

117 1 0 1 25 0 1 1 1 0 0 3 8 0 8 0 5 1

118 1 0 1 20 0 0 0 1 0 1 1 3 1 2 1 30 0

119 1 0 1 20 0 0 1 1 0 0 4 6 1 38 0 38 0

120 1 0 1 10 1 0 1 0 0 0 4 16 0 16 0 16 0

121 1 0 0 15 1 0 1 0 0 0 2 20 0 20 0 20 0

122 1 0 1 15 0 0 1 0 1 0 4 30 0 2 1 30 0

123 1 0 1 15 0 0 1 0 0 0 4 2 1 7 0 7 0

124 1 0 1 20 0 0 1 1 0 0 2 8 1 6 1 22 0

125 1 0 1 13 1 0 1 0 0 0 4 13 0 4 1 5 1

126 1 0 1 25 1 0 1 0 0 1 4 13 1 1 1 31 0

127 1 0 1 25 0 0 1 1 0 1 4 17 0 17 0 10 1

128 1 0 1 8 1 0 1 0 0 0 4 14 0 14 0 14 0

129 1 1 1 30 1 0 1 0 0 1 4 13 0 5 1 13 0

130 1 0 1 40 0 1 1 1 1 0 4 24 0 7 1 17 1

131 1 1 1 12 0 1 1 1 1 0 1 14 1 21 0 21 0

132 1 0 1 15 0 0 1 0 0 0 4 8 1 19 1 25 0

133 1 0 1 25 1 0 1 0 0 0 4 23 0 23 0 8 1

134 1 0 1 15 0 0 1 0 0 0 4 17 1 17 0 11 1

135 1 0 0 20 0 0 1 1 1 0 4 19 1 31 0 31 0

136 1 0 1 22 0 1 1 0 0 0 4 14 1 20 0 20 0

137 1 0 1 15 1 0 1 0 1 0 4 15 1 22 0 22 0

138 1 0 1 7 1 0 1 0 0 0 3 13 0 3 1 13 0

139 1 0 1 30 0 1 1 1 1 0 2 49 0 49 0 4 1

140 1 0 1 20 1 0 1 0 0 1 4 14 0 10 1 14 0

141 1 1 1 35 1 0 1 0 0 1 4 6 1 5 1 49 0

142 1 0 0 10 0 0 1 0 0 0 4 12 0 12 0 12 0

143 1 0 1 8 0 0 1 0 1 0 3 14 0 1 1 14 0

144 1 0 1 13 0 0 0 0 1 0 4 32 1 38 0 38 0

145 1 1 0 10 0 1 1 1 0 0 2 12 1 13 1 41 0

146 1 0 1 8 0 0 0 1 1 0 4 10 1 18 0 18 0

147 1 0 1 7 1 0 1 0 0 0 4 8 0 8 0 8 0

148 1 0 1 52 1 0 1 1 1 1 4 15 1 39 1 76 0

149 1 1 1 14 0 1 1 1 1 0 4 8 1 62 0 62 0

150 1 1 1 7 0 0 1 0 0 0 1 5 1 17 0 17 0

151 1 1 1 20 1 0 1 0 0 0 4 7 1 6 1 17 1

152 1 0 1 15 0 0 0 1 1 1 4 19 1 3 1 42 0

153 1 0 1 10 0 0 1 0 0 0 4 10 0 10 0 2 1

154 1 0 1 35 1 1 1 0 0 0 4 10 1 27 0 27 0

;

**run**;

**proc** **print** data=burn\_data;

**run**;

**data** burn\_data\_029 burn\_data\_3050 burn\_data\_51100;

set burn\_data ;

if Perc\_Area\_Burned < **30** then output burn\_data\_029;

else if Perc\_Area\_Burned > **30** & Perc\_Area\_Burned < **51** then output burn\_data\_3050;

else if Perc\_Area\_Burned > **50** then output burn\_data\_51100;

**run**;

**proc** **print** data=burn\_data\_029;

**run**;

**proc** **lifetest** data=burn\_data\_029;

time TTSAI\*SAI(**0**);

strata Treatment;

**run**;

**proc** **print** data=burn\_data\_3050;

**run**;

**proc** **lifetest** data=burn\_data\_3050;

time TTSAI\*SAI(**0**);

strata Treatment;

**run**;

**proc** **print** data=burn\_data\_51100;

**run**;

**proc** **lifetest** data=burn\_data\_51100;

time TTSAI\*SAI(**0**);

strata Treatment;

**run**;

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Group | Treated Rat | Censored | Control Rat | Censored |  | D1 | D2 |
| 1 | 101 | 1 | 104 | 1 |  | 0 | 0 |
| 2 | 104 | 1 | 104 | 1 |  | 0 | 0 |
| 3 | 104 | 1 | 104 | 1 |  | 0 | 0 |
| 4 | 77 | 1 | 97 | 1 |  | 0 | 0 |
| 5 | 89 | 1 | 104 | 1 |  | 0 | 0 |
| 6 | 88 | 0 | 104 | 1 |  | 1 | 0 |
| 7 | 104 | 0 | 94 | 1 |  | 0 | 0 |
| 8 | 96 | 0 | 104 | 1 |  | 1 | 0 |
| 9 | 82 | 1 | 104 | 1 |  | 0 | 0 |
| 10 | 70 | 0 | 104 | 1 |  | 1 | 0 |
| 11 | 89 | 0 | 91 | 1 |  | 1 | 0 |
| 12 | 91 | 1 | 92 | 1 |  | 0 | 0 |
| 13 | 39 | 0 | 50 | 0 |  | 1 | 0 |
| 14 | 103 | 0 | 91 | 1 |  | 0 | 0 |
| 15 | 93 | 1 | 104 | 1 |  | 0 | 0 |
| 16 | 85 | 1 | 104 | 1 |  | 0 | 0 |
| 17 | 104 | 1 | 104 | 1 |  | 0 | 0 |
| 18 | 104 | 1 | 104 | 1 |  | 0 | 0 |
| 19 | 81 | 1 | 104 | 1 |  | 0 | 0 |
| 20 | 67 | 0 | 104 | 1 |  | 1 | 0 |
| 21 | 104 | 1 | 104 | 1 |  | 0 | 0 |
| 22 | 104 | 1 | 104 | 1 |  | 0 | 0 |
| 23 | 104 | 1 | 87 | 1 |  | 0 | 0 |
| 24 | 87 | 1 | 104 | 1 |  | 0 | 0 |
| 25 | 104 | 1 | 104 | 1 |  | 0 | 0 |
| 26 | 89 | 1 | 104 | 1 |  | 0 | 0 |
| 27 | 78 | 1 | 81 | 0 |  | 0 | 0 |
| 28 | 104 | 1 | 94 | 1 |  | 0 | 0 |
| 29 | 86 | 0 | 104 | 1 |  | 1 | 0 |
| 30 | 34 | 0 | 87 | 1 |  | 1 | 0 |
| 31 | 76 | 1 | 84 | 0 |  | 0 | 0 |
| 32 | 103 | 0 | 104 | 1 |  | 1 | 0 |
| 33 | 102 | 0 | 104 | 1 |  | 1 | 0 |
| 34 | 80 | 0 | 104 | 1 |  | 1 | 0 |
| 35 | 45 | 0 | 104 | 1 |  | 1 | 0 |
| 36 | 94 | 0 | 104 | 1 |  | 1 | 0 |
| 37 | 104 | 1 | 104 | 1 |  | 0 | 0 |
| 38 | 104 | 1 | 101 | 0 |  | 0 | 1 |
| 39 | 76 | 1 | 84 | 0 |  | 0 | 0 |
| 40 | 80 | 0 | 80 | 1 |  | 0 | 0 |
| 41 | 72 | 0 | 104 | 1 |  | 1 | 0 |
| 42 | 73 | 0 | 104 | 1 |  | 1 | 0 |
| 43 | 92 | 0 | 104 | 1 |  | 1 | 0 |
| 44 | 104 | 1 | 98 | 1 |  | 0 | 0 |
| 45 | 55 | 1 | 104 | 1 |  | 0 | 0 |
| 46 | 49 | 1 | 83 | 1 |  | 0 | 0 |
| 47 | 89 | 0 | 104 | 1 |  | 1 | 0 |
| 48 | 88 | 1 | 99 | 1 |  | 0 | 0 |
| 49 | 103 | 0 | 104 | 1 |  | 1 | 0 |
| 50 | 104 | 1 | 104 | 1 |  | 0 | 0 |
|  |  |  |  |  |  | 18 | 1 |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  | Z | 3.900067 |  |
|  |  |  |  |  |  |  |  |
|  |  |  |  |  | p-value | 0.000199 |  |