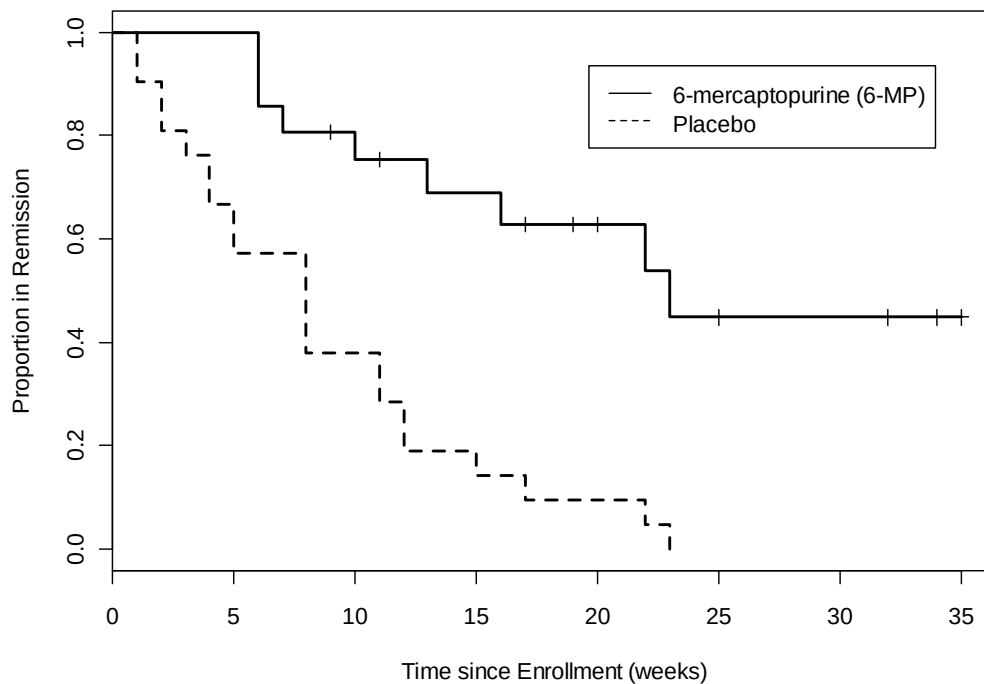


A. Leukemia Data VGSM Biostatistics p.55 (KM Survival Curves in R)

```

WeeksinRemission <- c(1,1,2,2,3,4,4,5,5,8,8,8,8,11,11,12,12,15,17,22,23,
6,6,6,6,7,9,10,10,11,13,16,17,19,20,22,23,25,32,32,34,35)
treatment <- c(rep("Placebo",21),rep("6-MP",21))
status <- c(rep(0,24),1,0,1,0,1,1,0,0,1,1,1,0,0,rep(1,5))
status <- 1-status
leuk <- data.frame(cbind(WeeksinRemission,status), fac=treatment)

fit <- survfit(Surv(WeeksinRemission,status) ~ treatment, data=leuk)
plot(fit,lty = 1:4,lwd=2,xlab="Time since Enrollment (weeks)", ylab="Proportion in Remission")
legend(locator(1), legend=c("6-mercaptopurine (6-MP)","Placebo"), lty = 1:4)

```

Leukemia Analysis in Minitab**Nonparametric Survival Plot for time****Distribution Analysis: time by treatment**

Variable: time

treatment = 6-MP

Censoring Information	Count
Uncensored value	9
Right censored value	12

Censoring value: cens = 0

Nonparametric Estimates**Characteristics of Variable**

	Standard	95.0% Normal CI	
Mean(MTTF)	Error	Lower	Upper
23.2874	2.98041	17.4459	29.1289

Median = 23

IQR = * Q1 = 13 Q3 = *

Kaplan-Meier Estimates

Time	Number at Risk	Number Failed	Survival Probability	Standard Error	95.0% Normal CI	
					Lower	Upper
6	21	3	0.857143	0.076360	0.707479	1.00000
7	17	1	0.806723	0.086935	0.636333	0.97711
10	15	1	0.752941	0.096350	0.564099	0.94178
13	12	1	0.690196	0.106815	0.480843	0.89955
16	11	1	0.627451	0.114054	0.403910	0.85099
22	7	1	0.537815	0.128234	0.286482	0.78915
23	6	1	0.448179	0.134591	0.184385	0.71197

Distribution Analysis: time by treatment

Variable: time

treatment = Placebo

Censoring Information Count
 Uncensored value 21

Censoring value: cens = 0

Nonparametric Estimates**Characteristics of Variable**

	Standard	95.0% Normal CI	
Mean(MTTF)	Error	Lower	Upper
8.66667	1.41140	5.90036	11.4330

Median = 8

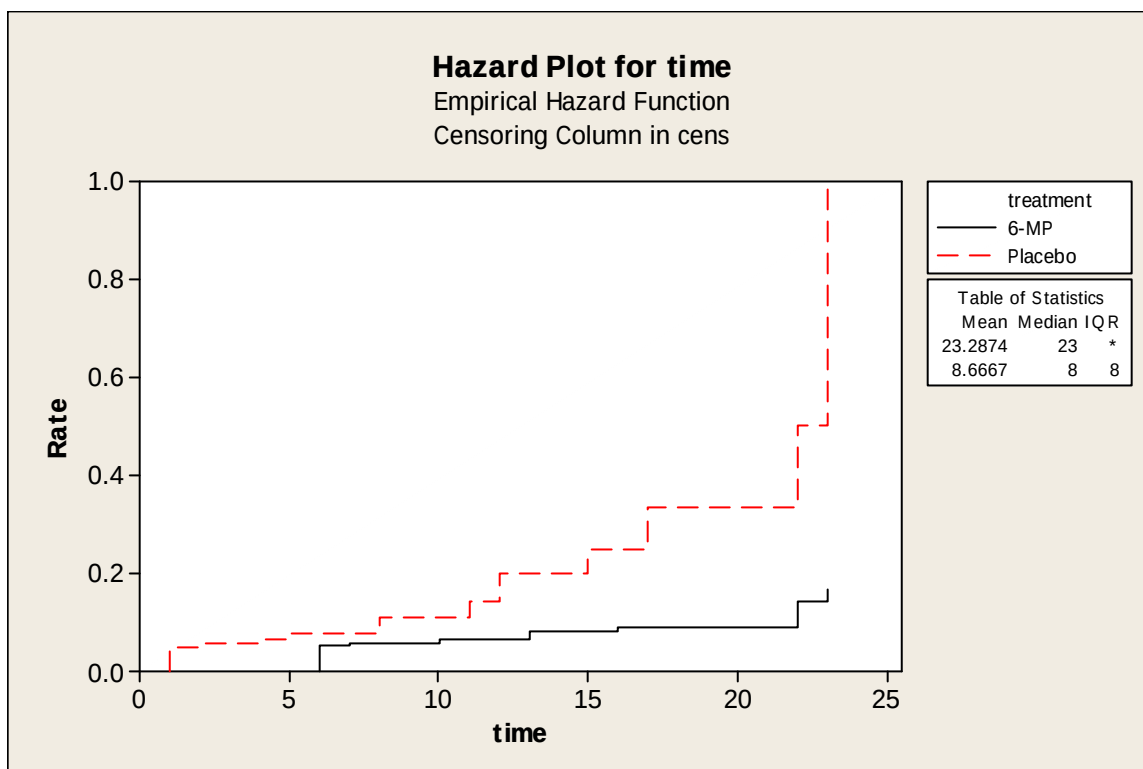
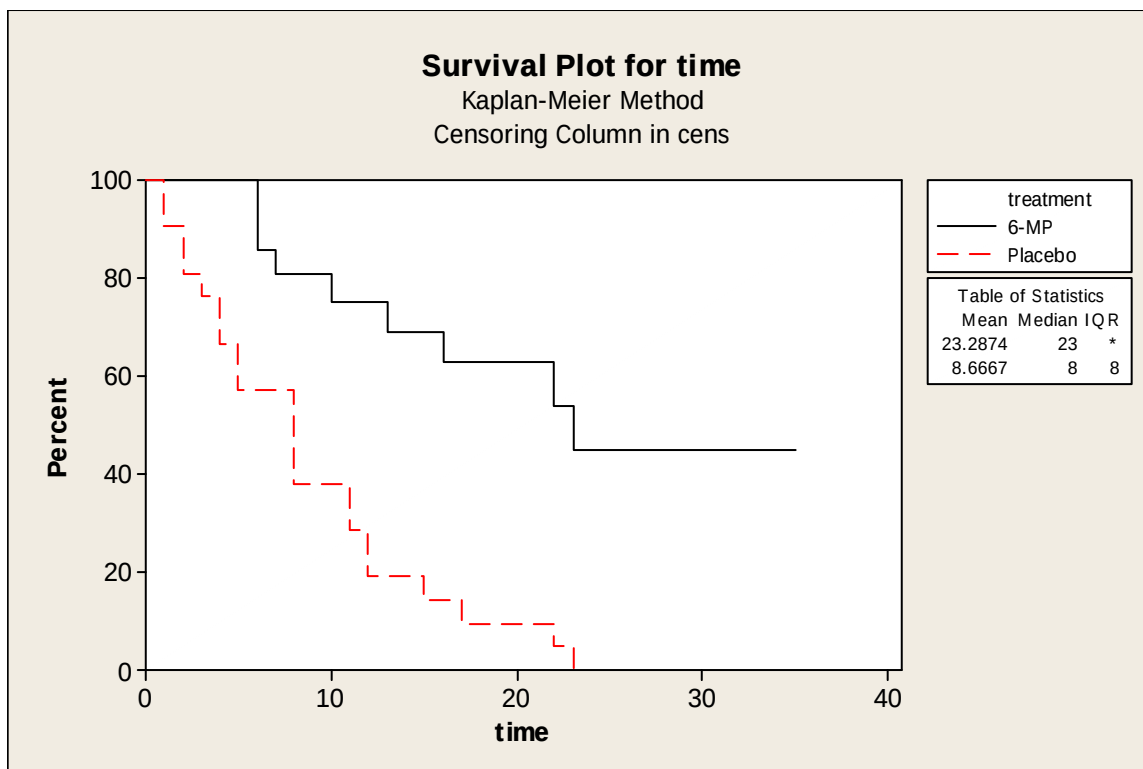
IQR = 8 Q1 = 4 Q3 = 12

Kaplan-Meier Estimates

Time	Number at Risk	Number Failed	Survival Probability	Standard Error	95.0% Normal CI	
					Lower	Upper
1	21	2	0.904762	0.064056	0.779214	1.00000
2	19	2	0.809524	0.085689	0.641576	0.97747
3	17	1	0.761905	0.092943	0.579740	0.94407
4	16	2	0.666667	0.102869	0.465047	0.86829
5	14	2	0.571429	0.107990	0.359772	0.78308
8	12	4	0.380952	0.105971	0.173253	0.58865
11	8	2	0.285714	0.098581	0.092499	0.47893
12	6	2	0.190476	0.085689	0.022529	0.35842
15	4	1	0.142857	0.076360	0.000000	0.29252
17	3	1	0.095238	0.064056	0.000000	0.22079
22	2	1	0.047619	0.046471	0.000000	0.13870
23	1	1	0.000000	0.000000	0.000000	0.00000

Distribution Analysis: time by treatment**Comparison of Survival Curves****Test Statistics**

Method	Chi-Square	DF	P-Value
Log-Rank	16.7929	1	0.000
Wilcoxon	13.4579	1	0.000

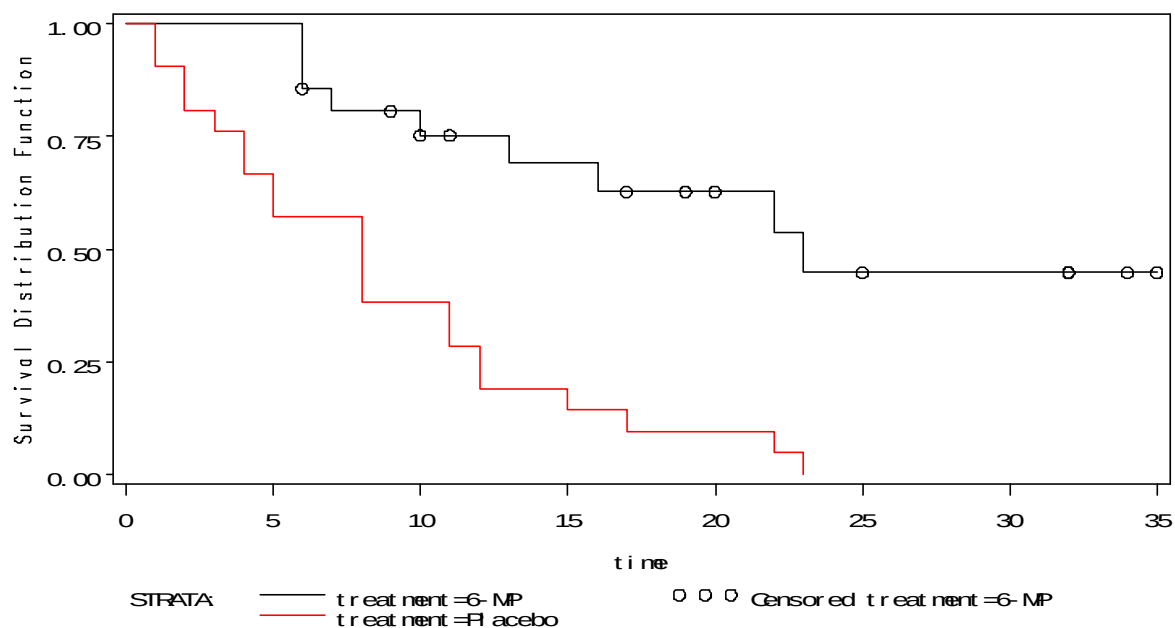


Leukemia Analysis in SASProgram:

```

data one;
  do treatment='6-MP' , 'Placebo';
    do pt=1 to 21;
      input time uncensored @@; drop pt; output;
    end; end;
datalines;
6 1 6 1 6 1 7 1 10 1 13 1 16 1 22 1 23 1 6 0 9 0
10 0 11 0 17 0 19 0 20 0 25 0 32 0 32 0 34 0 35 0
1 1 1 1 2 1 2 1 3 1 4 1 4 1 5 1 5 1 8 1 8 1
8 1 11 1 11 1 12 1 12 1 15 1 17 1 22 1 23 1
;
proc lifetest plots=(s);
  time time*uncensored(0);
  strata treatment;
run;

```

Output:

The LIFETEST Procedure

Stratum 1: treatment = 6-MP

Product-Limit Survival Estimates

time	Survival	Failure	Survival Standard Error	Number Failed	Number Left
------	----------	---------	-------------------------------	------------------	----------------

0.0000	1.0000	0	0	0	21
6.0000	.	.	.	1	20
6.0000	.	.	.	2	19
6.0000	0.8571	0.1429	0.0764	3	18
6.0000*	.	.	.	3	17
7.0000	0.8067	0.1933	0.0869	4	16
9.0000*	.	.	.	4	15
10.0000	0.7529	0.2471	0.0963	5	14
10.0000*	.	.	.	5	13
11.0000*	.	.	.	5	12
13.0000	0.6902	0.3098	0.1068	6	11
16.0000	0.6275	0.3725	0.1141	7	10
17.0000*	.	.	.	7	9
19.0000*	.	.	.	7	8
20.0000*	.	.	.	7	7
22.0000	0.5378	0.4622	0.1282	8	6
23.0000	0.4482	0.5518	0.1346	9	5
25.0000*	.	.	.	9	4
32.0000*	.	.	.	9	3
32.0000*	.	.	.	9	2
34.0000*	.	.	.	9	1
35.0000*	.	.	.	9	0

NOTE: The marked survival times are censored observations.

Summary Statistics for Time Variable time

Quartile Estimates

Percent	Point Estimate	95% Confidence Interval	
		[Lower	Upper)
75	.	23.0000	.
50	23.0000	13.0000	.
25	13.0000	6.0000	23.0000

Mean	Standard Error
17.9092	1.6474

NOTE: The mean survival time and its standard error were underestimated because the largest observation was censored and the estimation was restricted to the largest event time.

Stratum 2: treatment = Placebo

Product-Limit Survival Estimates

time	Survival	Failure	Survival Standard Error	Number Failed	Number Left
0.0000	1.0000	0	0	0	21
1.0000	.	.	.	1	20
1.0000	0.9048	0.0952	0.0641	2	19
2.0000	.	.	.	3	18
2.0000	0.8095	0.1905	0.0857	4	17
3.0000	0.7619	0.2381	0.0929	5	16
4.0000	.	.	.	6	15
4.0000	0.6667	0.3333	0.1029	7	14
5.0000	.	.	.	8	13
5.0000	0.5714	0.4286	0.1080	9	12
8.0000	.	.	.	10	11
8.0000	.	.	.	11	10
8.0000	.	.	.	12	9

8.0000	0.3810	0.6190	0.1060	13	8
11.0000	.	.	.	14	7
11.0000	0.2857	0.7143	0.0986	15	6
12.0000	.	.	.	16	5
12.0000	0.1905	0.8095	0.0857	17	4
15.0000	0.1429	0.8571	0.0764	18	3
17.0000	0.0952	0.9048	0.0641	19	2
22.0000	0.0476	0.9524	0.0465	20	1
23.0000	0	1.0000	0	21	0

Summary Statistics for Time Variable time

Quartile Estimates

Percent	Point Estimate	95% Confidence Interval	
		[Lower	Upper)
75	12.0000	8.0000	17.0000
50	8.0000	4.0000	11.0000
25	4.0000	2.0000	8.0000

Mean	Standard Error
8.6667	1.4114

Summary of the Number of Censored and Uncensored Values

Stratum	treatment	Total	Failed	Censored	Percent Censored
1	6-MP	21	9	12	57.14
2	Placebo	21	21	0	0.00

Total		42	30	12	28.57

Testing Homogeneity of Survival Curves for time over Strata

Rank Statistics

treatment	Log-Rank	Wilcoxon
6-MP	-10.251	-271.00
Placebo	10.251	271.00

Covariance Matrix for the Log-Rank Statistics

treatment	6-MP	Placebo
6-MP	6.25696	-6.25696
Placebo	-6.25696	6.25696

Covariance Matrix for the Wilcoxon Statistics

treatment	6-MP	Placebo
6-MP	5457.11	-5457.11
Placebo	-5457.11	5457.11

Test of Equality over Strata

Test	Chi-Square	DF	Pr > Chi-Square
Log-Rank	16.7929	1	<.0001
Wilcoxon	13.4579	1	0.0002
-2Log(LR)	16.4852	1	<.0001

B. PBC Data (p.218) and CPH Model fit (in SAS):

```

data one;
  input number status rx sex asictes hepatom spiders edema
        bilirubin cholest albumin copper alkphos sgot trigli
        platel prothrom histol age years logbili logalbu logprot;
datalines;
  [ Data omitted ]

data two;
  set one;
  hist1=(histol=1); hist2=(histol=2); hist3=(histol=3); hist4=(histol=4);
  albumindiff=albumin-3; age5=0.2*age;
  rxhepatom=rx*hepatom;

proc phreg;
  *model years*status(0)=rx hepatom rxhepatom;
  *model years*status(0)=age5;
  *model years*status(0)=albumin; ** p.250 Exercise 7.3;
  *model years*status(0)=hist2 hist3 hist4;
  *test -hist2+hist3+3*hist4;
  *model years*status(0)=histol;
  *model years*status(0)=rx logbili;
  model years*status(0)=rx bilirubin;
run;

```

The PHREG Procedure

Model Information

Data Set	WORK.TWO
Dependent Variable	years
Censoring Variable	status
Censoring Value(s)	0
Ties Handling	BRESLOW

Number of Observations Read	312
Number of Observations Used	312

Summary of the Number of Event and Censored Values

Total	Event	Censored	Percent Censored
312	125	187	59.94

Convergence Status

Convergence criterion (GCONV=1E-8) satisfied.

Model Fit Statistics

Criterion	Without Covariates	With Covariates
-2 LOG L	1279.960	1194.168
AIC	1279.960	1198.168
SBC	1279.960	1203.825

Testing Global Null Hypothesis: BETA=0						
Test		Chi-Square	DF	Pr > ChiSq		
Likelihood Ratio		85.7915	2	<.0001		
Score		190.9773	2	<.0001		
Wald		130.8341	2	<.0001		
Analysis of Maximum Likelihood Estimates						
Variable	DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio
rx	1	-0.20069	0.18341	1.1974	0.2738	0.818
bilirubin	1	0.15140	0.01329	129.8730	<.0001	1.163

C. ACTG Data VGSM Biostatistics p.212 and Problem 7.6 on pp.250-1

CPH Model fit with interaction (in SAS):

```
data one;
  input days cens rx cd4 @@;
  rxcd4=rx*cd4;
datalines;
  [ Data omitted ]

proc phreg;
  model days*cens(0)=rx cd4 rxcd4;
run;
```

The PHREG Procedure				
Model Information				
Data Set		WORK.ONE		
Dependent Variable		days		
Censoring Variable		cens		
Censoring Value(s)		0		
Ties Handling		BRESLOW		
Number of Observations Read		880		
Number of Observations Used		880		
Summary of the Number of Event and Censored Values				
Total	Event	Censored	Percent Censored	
880	55	825	93.75	
Convergence Status				
Convergence criterion (GCONV=1E-8) satisfied.				
Model Fit Statistics				
Criterion	Without Covariates	With Covariates		
-2 LOG L	662.808	623.775		
AIC	662.808	629.775		

SBC		662.808	635.797			
Testing Global Null Hypothesis: BETA=0						
Test	Chi-Square	DF	Pr > ChiSq			
Likelihood Ratio	39.0336	3	<.0001			
Score	35.4522	3	<.0001			
Wald	30.3169	3	<.0001			
Analysis of Maximum Likelihood Estimates						
Variable	DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio
rx	1	0.60735	0.70067	0.7514	0.3860	1.836
cd4	1	-0.00484	0.00148	10.7120	0.0011	0.995
rxcd4	1	-0.00593	0.00285	4.3186	0.0377	0.994

"rx" = 0 for Placebo and = 1 for ZD

"cd4" ranges from 30 to 704

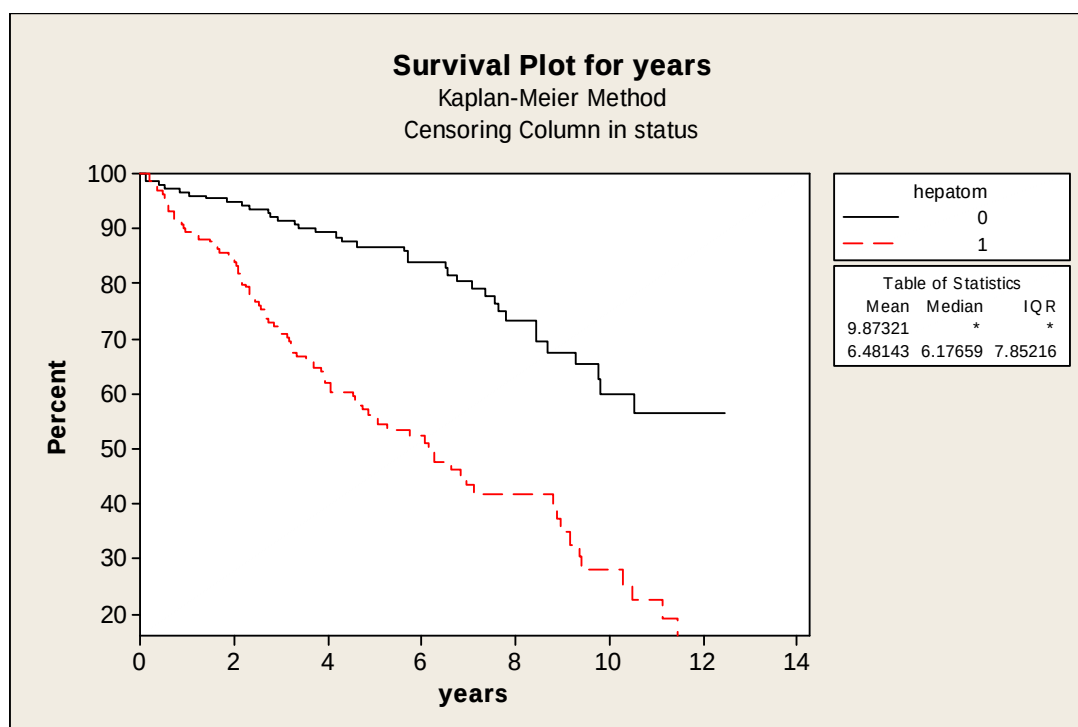
D. Return to PBC analysis for Problem 7.9 on p.251

Distribution Analysis: years by hepatom

Comparison of Survival Curves

Test Statistics

Method	Chi-Square	DF	P-Value
Log-Rank	40.1846	1	0.000
Wilcoxon	36.1594	1	0.000



```
proc lifetest plots=(lls);  
  time years*status(0);  
  strata hepatom;  
run;
```

