```sas
options ls=78 ps=60;

Data lcancer;
    infile
"\\mysbfiles.campus.stonybrook.edu\~\teaching\AMS588\data_chap7_colon.
txt"  firstobs=2;
    input days cens trt sex age nodes obstruct perfor adhere;
label days="(censored) survival time in days"
cens="censoring indicator"
trt="treatment:0-Lev(amisole), 1-Lev+5-FU"
sex="sex: 1-male"
age="age: in years"
nodes="number of lymph nodes with detectable cancer"
obstruct="obstruction of colon by tumour"
perfor="perforation of colon"
adhere="adherence to nearby organs"
run;

data lcancer1; set lcancer;
if sex = . or age = . or nodes = . or obstruct = . or perfor = . or
adhere = . then delete;
run;

/* Program #1 */
title "Program #1: Univariate analysis of treatment effect";
proc phreg data=lcancer;
model days*cens(0) = trt;
run;

/* Program #2 */
title "Program #2: Analysis of treatment effect adjusting for sex age
nodes obstruct perfor adhere";
proc phreg data=lcancer;
model days*cens(0) = trt sex age nodes obstruct perfor adhere;
run;

/* Program #3 */
title "Program #3: Model without treatment";
proc phreg data=lcancer;
model days*cens(0) = sex age nodes obstruct perfor adhere;
run;

/* Program #4 */
title "Program #4: Univariate analysis of treatment effect using
subsample";
proc phreg data=lcancer1;
model days*cens(0) = trt;
run;
```

```
/* Program #5 */
title "Program #5: Score test for treatment effect adjusting for other
covariates";
proc phreg data=lcancer1;
model days*cens(0) = sex age nodes obstruct perfor adhere trt
/ selection=forward include=6 details slentry=1.0;
run;

/* Program #6: look at the correlation among covariates in the whole
sample and the subsample*/
title "Program #6: Correlation of covariates using whole sample";
proc corr data=lcancer;
var sex age nodes obstruct perfor adhere;
run;
title "Program #6: Correlation of covariates using subsample";
proc corr data=lcancer1;
var sex age nodes obstruct perfor adhere;
run;
```

Program #1: Univariate analysis of treatment effect

The PHREG Procedure

Model Information		
Data Set	WORK.LCANCER	
Dependent Variable	days	(censored) survival time in days
Censoring Variable	cens	censoring indicator
Censoring Value(s)	0	
Ties Handling	BRESLOW	

Number of Observations Read	1228
Number of Observations Used	1228

Summary of the Number of Event and Censored Values			
Total	Event	Censored	Percent Censored
1228	575	653	53.18

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

Model Fit Statistics		
Criterion	Without Covariates	With Covariates
-2 LOG L	7808.200	7783.381
AIC	7808.200	7785.381
SBC	7808.200	7789.736

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	24.8188	1	<.0001
Score	24.8086	1	<.0001
Wald	24.4521	1	<.0001

Analysis of Maximum Likelihood Estimates							
Parameter	DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio	Label
trt	1	-0.41803	0.08454	24.4521	<.0001	0.658	treatment:0-Lev(amisole), 1-Lev+5-FU

Program #2: Analysis of treatment effect adjusting for sex age nodes obstruct perfor adhere

The PHREG Procedure

Model Information		
Data Set	WORK.LCANCER	
Dependent Variable	days	(censored) survival time in days
Censoring Variable	cens	censoring indicator
Censoring Value(s)	0	
Ties Handling	BRESLOW	

Number of Observations Read	1228
Number of Observations Used	1198

Summary of the Number of Event and Censored Values			
Total	Event	Censored	Percent Censored
1198	555	643	53.67

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

Model Fit Statistics		
Criterion	Without Covariates	With Covariates
-2 LOG L	7511.287	7401.384
AIC	7511.287	7415.384
SBC	7511.287	7445.617

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	109.9027	7	<.0001
Score	141.2217	7	<.0001
Wald	139.4522	7	<.0001

Analysis of Maximum Likelihood Estimates							
Parameter	DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio	Label
trt	1	-0.38539	0.08671	19.7525	<.0001	0.680	treatment:0-Lev(amisole), 1-Lev+5-FU
sex	1	-0.13032	0.08575	2.3097	0.1286	0.878	sex: 1-male
age	1	-0.0009174	0.00370	0.0616	0.8040	0.999	age: in years
nodes	1	0.07983	0.00813	96.4526	<.0001	1.083	number of lymph nodes with detectable cancer
obstruct	1	0.32703	0.10689	9.3609	0.0022	1.387	obstruction of colon by tumour
perfor	1	-0.07211	0.24579	0.0861	0.7692	0.930	perforation of colon
adhere	1	0.31956	0.11352	7.9250	0.0049	1.377	adherence to nearby organs run

Program #3: Model without treatment

The PHREG Procedure

Model Information		
Data Set	WORK.LCANCER	
Dependent Variable	days	(censored) survival time in days
Censoring Variable	cens	censoring indicator
Censoring Value(s)	0	
Ties Handling	BRESLOW	

Number of Observations Read	1228
Number of Observations Used	1198

Summary of the Number of Event and Censored Values			
Total	Event	Censored	Percent Censored
1198	555	643	53.67

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

Model Fit Statistics		
Criterion	Without Covariates	With Covariates
-2 LOG L	7511.287	7421.421
AIC	7511.287	7433.421
SBC	7511.287	7459.335

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	89.8653	6	<.0001
Score	121.1338	6	<.0001
Wald	118.4983	6	<.0001

Analysis of Maximum Likelihood Estimates							
Parameter	DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio	Label
sex	1	-0.10152	0.08551	1.4095	0.2351	0.903	sex: 1-male
age	1	-0.00123	0.00368	0.1122	0.7376	0.999	age: in years
nodes	1	0.08188	0.00821	99.4259	<.0001	1.085	number of lymph nodes with detectable cancer
obstruct	1	0.33932	0.10694	10.0674	0.0015	1.404	obstruction of colon by tumour
perfor	1	-0.08467	0.24660	0.1179	0.7313	0.919	perforation of colon

Program #3: Model without treatment

The PHREG Procedure

Analysis of Maximum Likelihood Estimates							
Parameter	DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio	Label
adhere	1	0.35503	0.11370	9.7504	0.0018	1.426	adherence to nearby organs run

Program #4: Univariate analysis of treatment effect using subsample

The PHREG Procedure

Model Information		
Data Set	WORK.LCANCER1	
Dependent Variable	days	(censored) survival time in days
Censoring Variable	cens	censoring indicator
Censoring Value(s)	0	
Ties Handling	BRESLOW	

Number of Observations Read	1198
Number of Observations Used	1198

Summary of the Number of Event and Censored Values			
Total	Event	Censored	Percent Censored
1198	555	643	53.67

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

Model Fit Statistics		
Criterion	Without Covariates	With Covariates
-2 LOG L	7511.287	7487.124
AIC	7511.287	7489.124
SBC	7511.287	7493.443

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	24.1628	1	<.0001
Score	24.1359	1	<.0001
Wald	23.7856	1	<.0001

Analysis of Maximum Likelihood Estimates							
Parameter	DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio	Label
trt	1	-0.42002	0.08612	23.7856	<.0001	0.657	treatment:0-Lev(amisole), 1-Lev+5-FU

Program #5: Score test for treatment effect adjusting for other covariates

The PHREG Procedure

Model Information		
Data Set	WORK.LCANCER1	
Dependent Variable	days	(censored) survival time in days
Censoring Variable	cens	censoring indicator
Censoring Value(s)	0	
Ties Handling	BRESLOW	

Number of Observations Read	1198
Number of Observations Used	1198

Summary of the Number of Event and Censored Values			
Total	Event	Censored	Percent Censored
1198	555	643	53.67

The following effects are included in each model:

sex age nodes obstruct perfor adhere

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

Model Fit Statistics		
Criterion	Without Covariates	With Covariates
-2 LOG L	7511.287	7421.421
AIC	7511.287	7433.421
SBC	7511.287	7459.335

Testing Global Null Hypothesis: BETA=0			
Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	89.8653	6	<.0001
Score	121.1338	6	<.0001
Wald	118.4983	6	<.0001

Analysis of Maximum Likelihood Estimates							
Parameter	DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio	Label
sex	1	-0.10152	0.08551	1.4095	0.2351	0.903	sex: 1-male
age	1	-0.00123	0.00368	0.1122	0.7376	0.999	age: in years
nodes	1	0.08188	0.00821	99.4259	<.0001	1.085	number of lymph nodes with detectable cancer

Program #5: Score test for treatment effect adjusting for other covariates

The PHREG Procedure

sex age nodes obstruct perfor adhere

		Parameter	Standard			Hazard	
Parameter	**DF**	**Estimate**	**Error**	**Chi-Square**	**Pr > ChiSq**	**Ratio**	**Label**
obstruct	1	0.33932	0.10694	10.0674	0.0015	1.404	obstruction of colon by tumour
perfor	1	-0.08467	0.24660	0.1179	0.7313	0.919	perforation of colon
adhere	1	0.35503	0.11370	9.7504	0.0018	1.426	adherence to nearby organs run

Analysis of Maximum Likelihood Estimates

		Score		Effect
Effect	**DF**	**Chi-Square**	**Pr > ChiSq**	**Label**
trt	1	19.9880	<.0001	treatment:0-Lev(amisole), 1-Lev+5-FU

Analysis of Effects Eligible for Entry

Chi-Square	DF	Pr > ChiSq
19.9880	1	<.0001

Residual Chi-Square Test

Step 1. Effect trt is entered. The model contains the following effects:

sex age nodes obstruct perfor adhere trt

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

	Without	With
Criterion	**Covariates**	**Covariates**
-2 LOG L	7511.287	7401.384
AIC	7511.287	7415.384
SBC	7511.287	7445.617

Model Fit Statistics

Test	Chi-Square	DF	Pr > ChiSq
Likelihood Ratio	109.9027	7	<.0001
Score	141.2217	7	<.0001
Wald	139.4522	7	<.0001

Testing Global Null Hypothesis: BETA=0

Program #5: Score test for treatment effect adjusting for other covariates

The PHREG Procedure

sex age nodes obstruct perfor adhere trt

		Analysis of Maximum Likelihood Estimates					
Parameter	DF	Parameter Estimate	Standard Error	Chi-Square	Pr > ChiSq	Hazard Ratio	Label
sex	1	-0.13032	0.08575	2.3097	0.1286	0.878	sex: 1-male
age	1	-0.0009174	0.00370	0.0616	0.8040	0.999	age: in years
nodes	1	0.07983	0.00813	96.4526	<.0001	1.083	number of lymph nodes with detectable cancer
obstruct	1	0.32703	0.10689	9.3609	0.0022	1.387	obstruction of colon by tumour
perfor	1	-0.07211	0.24579	0.0861	0.7692	0.930	perforation of colon
adhere	1	0.31956	0.11352	7.9250	0.0049	1.377	adherence to nearby organs run
trt	1	-0.38539	0.08671	19.7525	<.0001	0.680	treatment:0-Lev(amisole), 1-Lev+5-FU

Note: All effects have been entered into the model.

	Summary of Forward Selection					
Step	Effect Entered	DF	Number In	Score Chi-Square	Pr > ChiSq	Effect Label
1	trt	1	7	19.9880	<.0001	treatment:0-Lev(amisole), 1-Lev+5-FU

Program #6: Correlation of covariates using whole sample

The CORR Procedure

6 Variables: sex   age   nodes   obstruct perfor   adhere

Simple Statistics							
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
sex	1228	0.51792	0.49988	636.00000	0	1.00000	sex: 1-male
age	1228	59.90879	11.93823	73568	26.00000	83.00000	age: in years
nodes	1198	3.59432	3.48871	4306	0	33.00000	number of lymph nodes with detectable cancer
obstruct	1228	0.19055	0.39290	234.00000	0	1.00000	obstruction of colon by tumour
perfor	1228	0.02932	0.16876	36.00000	0	1.00000	perforation of colon
adhere	1228	0.14332	0.35054	176.00000	0	1.00000	adherence to nearby organs run

Pearson Correlation Coefficients Prob > |r| under H0: Rho=0 Number of Observations						
	sex	age	nodes	obstruct	perfor	adhere
sex	1.00000	0.01475	-0.04104	-0.03814	-0.00623	-0.01466
		0.6056	0.1557	0.1816	0.8273	0.6077
sex: 1-male	1228	1228	1198	1228	1228	1228
age	0.01475	1.00000	-0.14872	-0.09220	-0.00110	0.04441
	0.6056		<.0001	0.0012	0.9693	0.1198
age: in years	1228	1228	1198	1228	1228	1228
nodes	-0.04104	-0.14872	1.00000	-0.07239	0.01206	-0.03364
number of lymph nodes with detectable cancer	0.1557	<.0001		0.0122	0.6766	0.2447
	1198	1198	1198	1198	1198	1198
obstruct	-0.03814	-0.09220	-0.07239	1.00000	0.08776	-0.03277
	0.1816	0.0012	0.0122		0.0021	0.2512
obstruction of colon by tumour	1228	1228	1198	1228	1228	1228
perfor	-0.00623	-0.00110	0.01206	0.08776	1.00000	0.12179
	0.8273	0.9693	0.6766	0.0021		<.0001
perforation of colon	1228	1228	1198	1228	1228	1228
adhere	-0.01466	0.04441	-0.03364	-0.03277	0.12179	1.00000
	0.6077	0.1198	0.2447	0.2512	<.0001	
adherence to nearby organs run	1228	1228	1198	1228	1228	1228

Program #6: Correlation of covariates using subsample

The CORR Procedure

6 Variables: sex   age   nodes   obstruct perfor adhere

Simple Statistics						
Variable	N	Mean	Std Dev	Sum	Minimum	Maximum	Label
sex	1198	0.51920	0.49984	622.00000	0	1.00000	sex: 1-male
age	1198	59.95826	11.82227	71830	27.00000	83.00000	age: in years
nodes	1198	3.59432	3.48871	4306	0	33.00000	number of lymph nodes with detectable cancer
obstruct	1198	0.18865	0.39139	226.00000	0	1.00000	obstruction of colon by tumour
perfor	1198	0.03005	0.17080	36.00000	0	1.00000	perforation of colon
adhere	1198	0.14190	0.34910	170.00000	0	1.00000	adherence to nearby organs run

Pearson Correlation Coefficients, N = 1198 Prob > |r| under H0: Rho=0						
	sex	age	nodes	obstruct	perfor	adhere
sex	1.00000	0.01215	-0.04104	-0.03988	-0.00676	-0.02041
sex: 1-male		0.6743	0.1557	0.1678	0.8151	0.4803
age	0.01215	1.00000	-0.14872	-0.09290	-0.00186	0.05609
age: in years	0.6743		<.0001	0.0013	0.9487	0.0523
nodes	-0.04104	-0.14872	1.00000	-0.07239	0.01206	-0.03364
number of lymph nodes with detectable cancer	0.1557	<.0001		0.0122	0.6766	0.2447
obstruct	-0.03988	-0.09290	-0.07239	1.00000	0.09009	-0.02489
obstruction of colon by tumour	0.1678	0.0013	0.0122		0.0018	0.3895
perfor	-0.00676	-0.00186	0.01206	0.09009	1.00000	0.12458
perforation of colon	0.8151	0.9487	0.6766	0.0018		<.0001
adhere	-0.02041	0.05609	-0.03364	-0.02489	0.12458	1.00000
adherence to nearby organs run	0.4803	0.0523	0.2447	0.3895	<.0001	