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/*****
Do body iron stores increase the risk of cancer in men?
This question was answered using data from NHANES I and its epidemiologic
follow-up. In NHANES I, a dietary questionnaire and medical exam provided
information on transferrin saturation (expressed as a percentage) as an
indicator of body iron stores: (serum iron / total iron-binding capacity) *
100.

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During the epidemiologic follow-up, researchers recorded the incidence of cancer and time to cancer (in days) since the initial exam. Censoring occurs at time of follow-up interview if cancer had not occurred by that time.

The data for this example consist of 3,290 men who:

- 1) had their total iron-binding capacity measured in NHANES I
- 2) had their cancer status determined in the follow-up survey
- 3) were alive and cancer-free for at least 4 years after the initial exam.

The explanatory variable of interest is a binary indicator for high transferrin saturation vs. normal levels. We wish to determine whether high transferrin saturation is significantly associated with time to cancer in days (DAYFOLL), after adjustment for age at initial examination and smoking status. In this analysis, people who did not develop cancer (CANCER1=0) by the follow-up interview are censored at that time.

We use the SURVIVAL procedure to fit the Cox proportional hazards model. We also show how to use the EFFECTS statement for obtaining contrasts.

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*****
/
libname in ".";
options ps=60 ls=78;

PROC SURVIVAL data=in.ironstud filetype=sas DESIGN=WR;
  NEST Q_STRATA PSU1;
  WEIGHT B_WTIRON;

  SUBGROUP SMOKE;
  LEVELS 4;

  EVENT CANCER1;
  MODEL DAYFOLL=AGEXAM SMOKE TRFSAT/TIES=EFRON;
  EFFECTS SMOKE=(1 -1 0 0) / NAME = "Current vs. Former Smoker";
  EFFECTS SMOKE=(1 0 -1 0) / NAME = "Current vs. Never Smoker";
  EFFECTS AGEXAM SMOKE / NAME="Combined Effect: Age and Smoking";
  TEST ADJWALDF;

  SETENV COLSPCE=1 LABWIDTH=15 COLWIDTH=8 DECWIDTH=4 ;

  PRINT BETA="BETA" SEBETA="S.E." LOWBETA="LOW 95% LIM" UPBETA="UP 95% LIM"
        T_BETA="T:BETA=0" P_BETA="P-VALUE" HR LOWHR UPHR
        DF="DF" ADJWALDF="ADJUSTED WALD F" ADJWALDP="P-VALUE"
        /SEBETAFMT=F8.5 DFFMT=F4.0 T_BETAFMT=F8.2 DEFTFMT=F6.2
        HRFMT=F7.2 LOWHRFMT=F6.2 UPHRFMT=F6.2 ADJWALDFMT=F8.2 ;
  RTITLE "Relationship Between Body Iron Stores and Time to Cancer"
        " " "Adjusted for Age and Smoking Status" " ";
RUN;

```

S U D A A N  
Software for the Statistical Analysis of Correlated Data  
Copyright Research Triangle Institute November 2005  
Release 9.0.2

NOTE: Using a default start time of -1000000000 for all records

Number of observations read : 3290 Weighted count: 40570323  
Observations used in the analysis : 3290 Weighted count: 40570323  
Denominator degrees of freedom : 35

Maximum number of estimable parameters for the model is 5

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Summary of Event Values  
by: CANCER1.

CANCER1	Frequency	Weighted Sum
Censored	3058.000	38824628.000
Non-Censored	232.000	1745695.000

SURVIVAL has converged to a solution in 6 iterations.

-2 \* Normalized Log-Likelihood with Beta(s) = 0 : 4806.15  
-2 \* Normalized Log-Likelihood Full Model : 4611.38  
Approximate Chi-Square (-2 \* Log-L Ratio) : 194.77  
Degrees of Freedom : 5  
Approximate P-Value : 0.00

Note: The approximate Chi-Square is not adjusted for clustering.  
Refer to hypothesis test table for adjusted test.

Variance Estimation Method: Taylor Series (WR)  
 Dependent Variable: DAYFOLL  
 Censoring Variable: CANCER1  
 Ties Handling: EFRON  
 Relationship Between Body Iron Stores and Time to Cancer

Adjusted for Age and Smoking Status

by: Independent Variables and Effects.

Independent Variables and Effects	BETA	S.E.	LOW 95% LIM	UP 95% LIM	T:BETA=0	P-VALUE
-----						
SMOKE						
1	-0.6410	0.26283	-1.1745	-0.1074	-2.44	0.0200
2	-0.9924	0.27338	-1.5474	-0.4374	-3.63	0.0009
3	-0.3404	0.27457	-0.8978	0.2170	-1.24	0.2233
4	0.0000	0.00000	0.0000	0.0000	.	.
AGEXAM	0.0957	0.01006	0.0753	0.1161	9.51	0.0000
TRFSAT	0.1654	0.19684	-0.2342	0.5650	0.84	0.4065
-----						

Variance Estimation Method: Taylor Series (WR)  
 Dependent Variable: DAYFOLL  
 Censoring Variable: CANCER1  
 Ties Handling: EFRON  
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by: Contrast.

Contrast	DF	ADJUSTED WALD F	P-VALUE
-----			
OVERALL MODEL	5	26.18	0.0000
SMOKE	3	4.81	0.0069
AGEXAM	1	90.43	0.0000
TRFSAT	1	0.71	0.4065
Current vs. Former Smoker	1	2.41	0.1299
Current vs. Never Smoker	1	1.30	0.2626
Combined Effect: Age and Smoking	4	33.77	0.0000
-----			

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The SURVIVAL Procedure

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Variance Estimation Method: Taylor Series (WR)  
Dependent Variable: DAYFOLL  
Censoring Variable: CANCER1  
Ties Handling: EFRON  
Relationship Between Body Iron Stores and Time to Cancer

Adjusted for Age and Smoking Status

by: Independent Variables and Effects.

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Independent			
Variables and	Lower	Upper	
Effects	Hazards	95%	95%
	Ratio	Limit	Limit
-----			
SMOKE			
1	0.53	0.31	0.90
2	0.37	0.21	0.65
3	0.71	0.41	1.24
4	1.00	1.00	1.00
AGEXAM	1.10	1.08	1.12
TRFSAT	1.18	0.79	1.76
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