**Conduct Backward Selection in Multivariable Competing Risk Analysis by Cause Specific Hazard Model**

**Macro:** %Cause\_Specific\_SEL

**Created Date/Author:** Feb 23, 2019/Chao Zhang, Yuan Liu, and Yaqi Jia

**Current Version**: V1

**Working Environment:** SAS 9.4 English version

**Purpose:** To conduct multivariate backward selection Cause-Specific Hazard model on competing risk survival data. For a particular cause of interest, we treat all the competing events as censored observations in the analysis. The risk set at each time includes only those subjects who have not failed from competing events or are truly censored.

**Reference**:

1 SAS Institute Inc, 2017 SAS/STAT® 14.3 User’s Guide. Cary, NC: SAS Institute Inc. User’s Guide the Phreg Procedure.

2 Changbin Guo and Ying So (2018), Cause-Specific Analysis of Competing Risks Using the Phreg Procedure. SAS2159-2018 SAS Institute Inc.

3 PHREG\_SEL V23 created by Dana Nickleach

**Parameters:**

|  |  |  |
| --- | --- | --- |
| **Parameters** | **Description** | **Required** |
| DSN | The name of the data set to be analyzed. | Yes |
| EVENT | Name of time to event outcome variable. | Yes |
| CENSOR | Name of censoring indicator variable. | Yes |
| CENSORED\_VALUE | The value in CENSOR that were specified the Values of Censored. For example, 0 = Censored, 1= Relapse, 2= Death, if relapse is the event of interest, type 0 and type 2 were specified censored in Cause-Specified Hazard Model. | Yes |
| VAR | The list of variables on interest in the initial model that would be eliminated during the backward selection procedure separated by spaces. The order of variables in this list will be preserved in the final report. | Yes |
| CVAR | The list of categorical variables that are in VAR. If need to change the reference group, you can follow each variable name by (DESC) where needed and separate terms by \*. See code example. | Yes |
| INC | Number of variables to include in the model. The first n variables in the var parameter will be included in every model. The default value is 0. | Optional |
| slstay | The significance level for removing variables from the model (optional). The default value is .2. | Optional |
| ID | Variable to be used in the ID statement in PHREG (optional). Refer to SAS Help and Documentation for proper use of this option. ID and COVSAGG will be used together in the model to compute the robust sandwich covariance matrix estimate for cluster data. The ID statement identifies the variable that represents the clusters. If observations have more than one record in the data file, the number of observations reported in the table footer will be the number of records, not unique observations. | Optional |
| ORIENTATION | Orientation of the output Word table. Default is portrait, can be changed to landscape. | Optional |
| FILENAME | File name for output table. This is necessary if report=T. | Yes |
| OUTPATH | File path for output table to be stored. This is necessary if report=T. | Yes |
| DEBUG | Set to T if running in debug mode (optional). Work datasets will not be deleted in debug mode. This is useful if you are editing the code or want to further manipulate the resulting data sets. The default value is F. | Optional |

**Usage Example:**

**data** Bmt;

input Disease T Status @@;

datalines;

1 2081 0 1 1602 0 1 1496 0 1 1462 0 1 1433 0

1 1377 0 1 1330 0 1 996 0 1 226 0 1 1199 0

1 1111 0 1 530 0 1 1182 0 1 1167 0 1 418 2

1 383 1 1 276 2 1 104 1 1 609 1 1 172 2

1 487 2 1 662 1 1 194 2 1 230 1 1 526 2

1 122 2 1 129 1 1 74 1 1 122 1 1 86 2

1 466 2 1 192 1 1 109 1 1 55 1 1 1 2

1 107 2 1 110 1 1 332 2 2 2569 0 2 2506 0

2 2409 0 2 2218 0 2 1857 0 2 1829 0 2 1562 0

2 1470 0 2 1363 0 2 1030 0 2 860 0 2 1258 0

2 2246 0 2 1870 0 2 1799 0 2 1709 0 2 1674 0

2 1568 0 2 1527 0 2 1324 0 2 957 0 2 932 0

2 847 0 2 848 0 2 1850 0 2 1843 0 2 1535 0

2 1447 0 2 1384 0 2 414 2 2 2204 2 2 1063 2

2 481 2 2 105 2 2 641 2 2 390 2 2 288 2

2 421 1 2 79 2 2 748 1 2 486 1 2 48 2

2 272 1 2 1074 2 2 381 1 2 10 2 2 53 2

2 80 2 2 35 2 2 248 1 2 704 2 2 211 1

2 219 1 2 606 1 3 2640 0 3 2430 0 3 2252 0

3 2140 0 3 2133 0 3 1238 0 3 1631 0 3 2024 0

3 1345 0 3 1136 0 3 845 0 3 422 1 3 162 2

3 84 1 3 100 1 3 2 2 3 47 1 3 242 1

3 456 1 3 268 1 3 318 2 3 32 1 3 467 1

3 47 1 3 390 1 3 183 2 3 105 2 3 115 1

3 164 2 3 93 1 3 120 1 3 80 2 3 677 2

3 64 1 3 168 2 3 74 2 3 16 2 3 157 1

3 625 1 3 48 1 3 273 1 3 63 2 3 76 1

3 113 1 3 363 2

;

%let dir = C:\;

**proc** **format**;

value DiseaseGroup **1**='ALL' **2**='AML-Low Risk' **3**='AML-High Risk';

value sex **0**= 'F' **1**='M';

**run**;

**data** bmt; set bmt; call streaminit(**123**); u = rand("Uniform");output;**run**;

**data** bmt; set bmt; if u>=**0.7** then sex=**1**; else if u<**0.5** then sex=**0**;

if u>=**0.4** then race='white'; else race='AA';

label sex = 'gender' group = 'patient group'

label T = ' disease-free survival time (days)';

format Group DiseaseGroup. SEX SEX.;

**run**;

title 'table 1 Multivariate Cause-Specific Hazard Regression for Relapse';

%***CauseSpecific\_sel***(dsn=bmt,

event=t, censor=status, censored\_value=**0** **2**,

var=Group logWaitTime sex,

cvar=Group sex,

inc=**0**,

slstay=**.3**,

ORIENTATION = portrait,

outpath= &dir.\,

filename=aaa,

debug=F);

title '';

**Summary Table Example:**

Table 1 Multivariate Cause-Specific Hazard Regression for Relapse

|  | | | **disease-free survival time (days)** | | |
| --- | --- | --- | --- | --- | --- |
|  | | | **----------------------------------------** | | |
| **Covariate** | **Level** | **N** | **Hazard Ratio** | **HR P-value** | **Global P-value** |
| Group | ALL | 34 | 0.61 (0.27-1.35) | 0.221 | **0.013** |
| AML-Low Risk | 44 | 0.28 (0.12-0.66) | **0.003** | - |
| AML-High Risk | 36 | - | - | - |
|  | | | | | |
| logWaittime |  | 114 | 0.80 (0.53-1.21) | 0.290 | 0.290 |
|  | | | | | |
| \*Number of observations in the original data set = 137. Number of observations used = 114. \*Backward selection with an alpha level of removal of .3 was used. The following variables were removed from the model: gender. \*Cause-Specific Hazard Model:  Type of Censored= 0 2;  Type of Interest= 1. | | | | | |

title 'table 2 Multivariate Cause-Specific Hazard Regression for Death';

%***CauseSpecific\_sel***(dsn=bmt,

event=t, censor=status, censored\_value=**0** **2**,

var=Group logWaitTime sex,

cvar=Group sex,

inc=**0**,

slstay=**.3**,

ORIENTATION = portrait,

outpath= &dir.\,

filename=aaa,

debug=F);

title '';

Table 2 Multivariate Cause-Specific Hazard Regression for Death

|  | | | **disease-free survival time (days)** | | |
| --- | --- | --- | --- | --- | --- |
|  | | | **----------------------------------------** | | |
| **Covariate** | **Level** | **N** | **Hazard Ratio** | **HR P-value** | **Global P-value** |
| Group | ALL | 34 | 0.99 (0.42-2.33) | 0.978 | 0.112 |
| AML-Low Risk | 44 | 0.43 (0.17-1.06) | 0.067 | - |
| AML-High Risk | 36 | - | - | - |
|  | | | | | |
| sex | F | 59 | 0.36 (0.17-0.78) | **0.009** | **0.009** |
| M | 55 | - | - | - |
|  | | | | | |
| \*Number of observations in the original data set = 137. Number of observations used = 114. \*Backward selection with an alpha level of removal of .3 was used. The following variables were removed from the model: logWaittime. \*Cause-Specific Hazard Model:  Type of Censored= 0 1;  Type of Interest= 2. | | | | | |

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