Recent Developments in Survival Analysis with SAS® Software

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About Marc

- Masters in Quantitative Psychology from the University of North Carolina at Chapel Hill
- Biostatistician at Duke University Medical Center and UNC-Chapel Hill for 14 years
- Senior Analytical Training Consultant at SAS
- Develop and teach courses in survival analysis … and other stuff.
- At SAS since 2004

SAS Procedures for Performing Survival Analysis

LIFETEST

computes the Kaplan-Meier estimate of a survivor function and provides the log-rank test to compare the underlying hazards of two or more samples of right-censored data. You can also use this procedure to study the association between the failure time and a number of concomitant variables.

ICLIFETEST

computes nonparametric estimates of survivor functions for interval-censored data. You can use this procedure to compare the underlying survival distributions of two or more samples of interval-censored data.

SAS Procedures for Performing Survival Analysis

PHREG

fits the Cox proportional hazards model and its extensions.

ICPHREG

fits proportional hazards regression models to interval-censored data. You can select a piecewise constant function as the baseline hazard function, or you can model the cumulative baseline hazard function by cubic splines.

SURVEYPHREG

is a Cox modeling procedure similar to PROC PHREG, appropriate for analyzing data that are collected from a survey sample.

SAS Procedures for Performing Survival Analysis

PHSELECT

fits the Cox proportional hazards model and its extensions. The PHSELECT procedure is specifically designed to operate in SAS Viya and performs computations in multiple threads.

RMSTREG

performs data analysis that is based on the restricted mean survival time (RMST) when the proportional hazards assumption is violated.

SAS Procedures for Performing Survival Analysis

LIFEREG

fits parametric models to failure time data that can be left-censored, right-censored, or interval-censored. The log of the survival time is modeled as a linear effect of covariates and a random disturbance term, the distribution of which includes the Weibull, log-normal, and log-logistic distributions.

QUANTLIFE

performs quantile regression for survival data by modeling the quantiles of the lifetime variable as a function of the covariates.

SAS Procedures for Performing Survival Analysis

LOGISTIC

can perform discrete time survival analysis, provided the data is expanded appropriately (one observation per person, per unit time, for all time up to event or censoring).

SEVERITY

procedure in SAS/ETS software can be used to model survival data.

RELIABILITY

Procedure in SAS/QC suite that provides tools for reliability and survival data analysis and for recurrent events data analysis.

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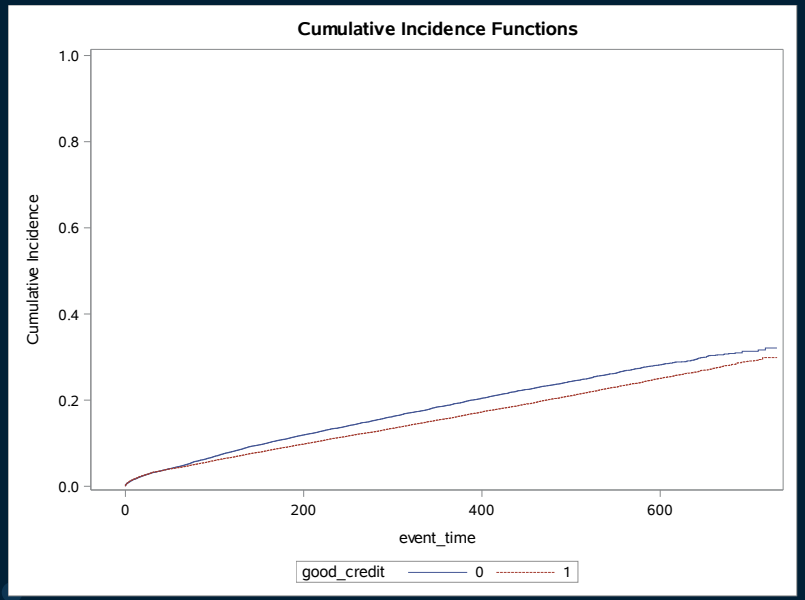
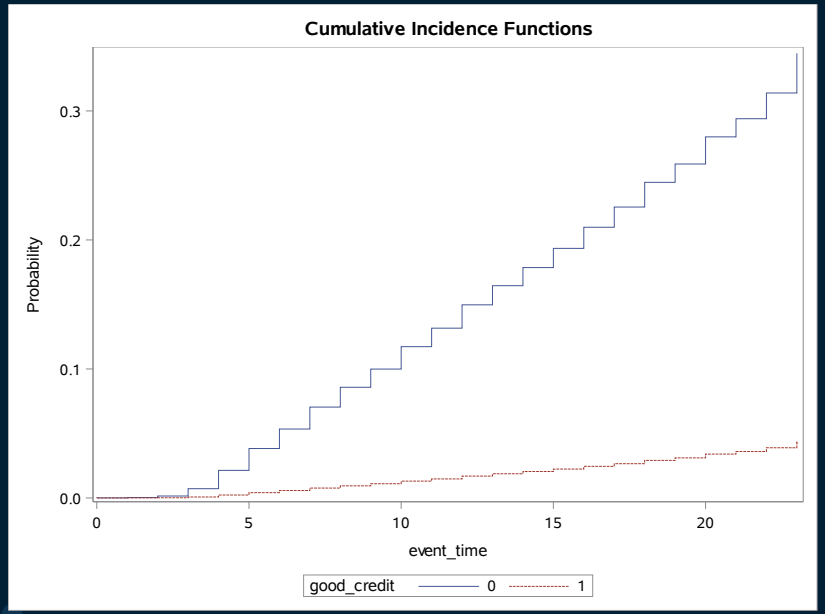
Some Features You Might Not Know About – LIFETEST Fine and Gray's Competing Risks



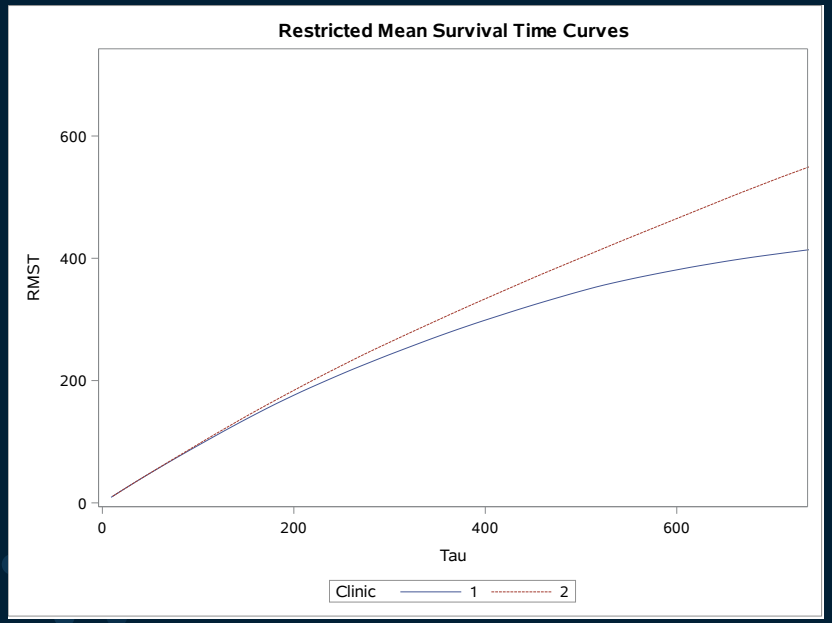

```
proc lifetest data=Wireless plots=cif;
        time event_time*event_type(0)
                / eventcode=(1 2);
        strata good_credit;
run;
```

Some Features You Might Not Know About – PHREG Fine and Gray's Competing Risks



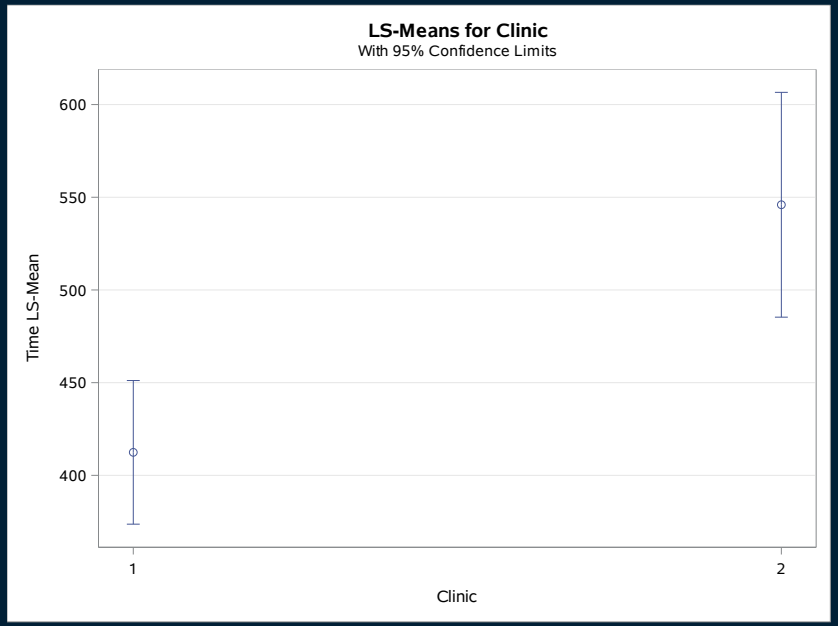

```
proc phreg data=wirelessmonthly
          plots(overlay=stratum)=(cif);
   model event_time*event_type(0)
          = good_credit dealer_type
            rate_plan / eventcode=2;
   baseline covariates=cif /
            rowid=good_credit;
run;
```

Some Features You Might Not Know About – PROC LIFETEST Restricted Mean Survival Time



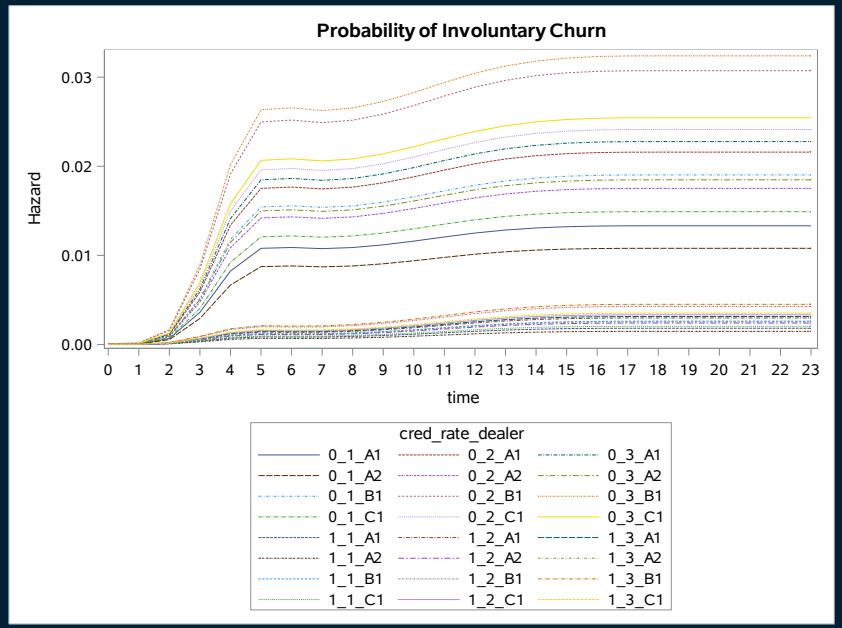

```
proc lifetest data=methadone
        rmst(tau=730) rmtl(tau=730);
    Time Time*Status(0);
    Strata Clinic;
run;
```

Some Features You Might Not Know About – PROC RMSTREG




```
proc rmstreg data=methadone
                tau=730;
     class Clinic Prison;
     model Time*Status(0) = Clinic
           / link=linear method=pv;
run;
```

Some Features You Might Not Know About – Discrete Time Logistic Model



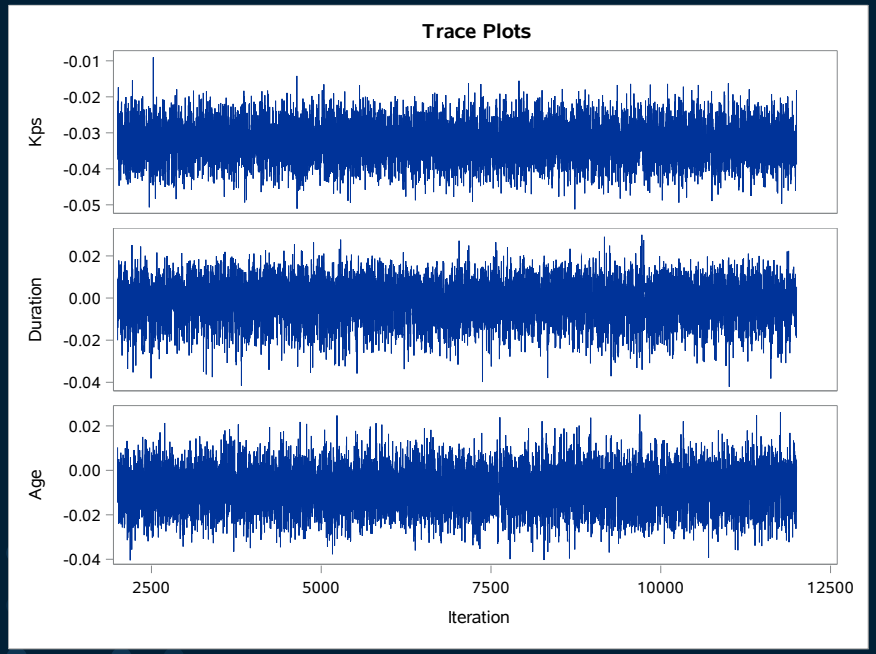

```
proc logistic data=Expand_Wireless;
   class dealer_type rate_plan;
   model category(event='1') =
            gc gc*spl1 gc*spl2 gc*spl3
            gc*spl4 spl1-spl4;
   code file="model1.txt";
run;
```

Some Features You Might Not Know About – Frailty Model in PROC LOGISTIC

Type 3 Tests					
Effect	Wald Chi-Square	DF	Pr > ChiSq	Adjusted DF	Adjusted Pr > ChiSq
Treat	4.8961	1	0.0269	0.9587	0.0252
Type	2.6395	1	0.1042	0.6795	0.0629
Treat*Type	7.1349	1	0.0076	0.9644	0.0071
ID	110.3922	.	.	74.2788	0.0042

```
proc phreg data=Blind;
  class ID Treat Type;
  model Time*Status(0)=Treat|Type;
  random ID;
run;
```

Some Features You Might Not Know About – BAYES Statement in PROC LOGISTIC




```
proc phreg data=VALung;
   class Prior Cell Therapy;
   model Time*Status(0)=Kps
      Duration Age Prior Cell Therapy;
   bayes seed=1
      coeffprior=normal(input=Prior)
      statistics=(summary interval)
      diagnostics=(autocorr ess)
      plots=trace;
run;
```