Statistical and Econometric Methods for Transportation Data Analysis

Chapter 16 – Random Parameter Models

Example 16.3
Random Parameters Duration Models

You are given 204 observations from a travel survey conducted in the spring of 1988, in the Seattle area. While the purpose of the survey was to study the number of times (per week) commuters' changed their departure time on their work-to-home trip to avoid traffic congestion, we also have information on the length of time that they delay their trips to avoid congestion. The length of time commuters' delay is ideally suited to duration models.

Your task is to estimate a random paramters Weibull duration model. Please not that the software package actually estimates the parameter vector -$\boldsymbol{\beta}$ instead of just $\boldsymbol{\beta}$ so that the effect of the covariates on the hazard is:

$$EXP(-\boldsymbol{\beta}\mathbf{X})$$

This means that a negative parameter increases the hazard and thus decreases the duration. So the negative sign gives the effect on duration instead of on the hazard.

Following the same procedure used for random-paramter count models (assignment #9), random parameters are introduced into duration models by adding a randomly distributed term ($\boldsymbol{\omega}_n$) is introduced so that $\boldsymbol{\beta}_n = \boldsymbol{\beta} + \boldsymbol{\omega}_n$ and explanatory variables now act on the hazard as $EXP(\boldsymbol{\beta}_n\mathbf{X}_n)$, where $\boldsymbol{\beta}$ now varies across n observations. As with the two random parameter models presented previously (logit and count modles), a simulation-based maximum likelihood method is again used (with Halton draws again being an efficient alternative to random draws).

This means that a negative parameter in LIMDEP increases the hazard and thus decreases the duration. So the negative sign gives the effect on duration instead of on the hazard.

In your analysis include:

1. The results of your best model specification.

3. A discussion of the logical process that led you to the selection of your final specification. (e.g. Discuss the theory behind the inclusion of your selected variables). Include *t*-statistics and justify the sign of your variables.

Variables available for your specification are (file Ex16-3.txt)

Variable Number	Explanation
x1	Household number
x2	Do you ever delay work-to-home departure to avoid traffic congestion? 1-yes, 0-no
x3	If sometimes delay, on average how many minutes do you delay?
x4	If sometimes delay, do you 1-perform additional work, 2-engage in non-work activities, or 3-do both?
x5	If sometimes delay, how many times have you delayed in the past week?
x6	Mode of transportation used work-to-home: 1-car SOV, 2-carpool, 3-vanpool, 4-bus, 5 other.
x7	Primary route (work-to-home): 1-I90, 2-I5, 3-SR520, 4-I405, 5-other
x8	Do you generally encounter traffic congestion on you work-to-home trip? 1-yes, 2-no
x9	Age in years: 1-(<25), 2-(26-30), 3-(31-35), 4-(36-40), 5-(41-45), 6-(46-50), 7-(>50)
x10	Gender: 1-male, 0-female
x11	Number of cars in household
x12	Number of children in household
x13	Annual income: 1 - less than 20000, 2 - 20000 to 29999, 3 - 30000 to 39999, 4 - 40000 to 49999, 5 - 50000 to 59999, 6 - >60000
x14	Do you have flexible work hours? 1-yes, 0-no
x15	Distance from work to home (in miles)
x16	Face LOS D or worse? 1-yes, 0-no
x17	Ratio of actual travel time to free-flow travel time
x18	Population of work zone
x19	Retail employment in work zone
x20	Service employment in work zone
x21	Size of work zone (in acres)

```
--> RESET
--> sample;1-204$
--> read;nvar=21;nobs=204;file=D:Ex16-3.dat$
--> reject;x3=0$
--> dstat;rhs=x3$
Descriptive Statistics
All results based on nonmissing observations.
===============================================================================
Variable        Mean         Std.Dev.        Minimum         Maximum      Cases
===============================================================================
-------------------------------------------------------------------------------
All observations in current sample
-------------------------------------------------------------------------------
X3        51.2916667     37.4671552      4.00000000      240.000000          96

--> create;if(x6=1)car=1$
--> create;if(x9>6)old=1$
--> dstat;rhs=car$
Descriptive Statistics
All results based on nonmissing observations.
===============================================================================
Variable        Mean         Std.Dev.        Minimum         Maximum      Cases
===============================================================================
-------------------------------------------------------------------------------
All observations in current sample
-------------------------------------------------------------------------------
CAR       .718750000     .451969375      .000000000      1.00000000          96

--> create;ltime=log(x3)$
--> survival;lhs=ltime;rhs=one,x10,x15,x17,x18;model=weibull
    ;rpm;pts=200;halton
    ;fcn=x10(n),x17(n),x18(n)$

+---------------------------------------------------+
| OLS Starting values for random parameters model   |
| Ordinary    least squares regression              |
| Model was estimated Sep 14, 2010 at 11:30:07AM    |
| LHS=LTIME    Mean                 =   3.706844    |
|              Standard deviation   =   .6997312    |
| WTS=none     Number of observs.   =         96    |
| Model size   Parameters           =          5    |
|              Degrees of freedom   =         91    |
| Residuals    Sum of squares       =   38.11339    |
|              Standard error of e  =   .6471696    |
| Fit          R-squared            =   .1806085    |
|              Adjusted R-squared   =   .1445913    |
| Model test   F[  4,    91] (prob) =   5.01 (.0011)|
| Diagnostic   Log likelihood       =  -91.87654    |
|              Restricted(b=0)      =  -101.4378    |
|              Chi-sq [  4]  (prob) =  19.12 (.0007)|
| Info criter. LogAmemiya Prd. Crt. =  -.8195216    |
|              Akaike Info. Criter. =  -.8196159    |
+---------------------------------------------------+
+---------+-------------+---------------+--------+---------+----------+
|Variable | Coefficient | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+---------------+--------+---------+----------+
 Constant      1.66327149      .54200556     3.069   .0021
 X15            .04135661      .01539192     2.687   .0072    7.70833333
 X10          -.13791020       .14468253     -.953   .3405     .69791667
 X17            .75173041      .24918005     3.017   .0026    1.95937500
 X18          .132663D-04    .699274D-05     1.897   .0578    26240.2500
```

```
Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Random Coefficients  WiblSurv Model         |
| Maximum Likelihood Estimates                |
| Model estimated: Sep 14, 2010 at 11:30:52AM.|
| Dependent variable                LTIME     |
| Weighting variable                 None     |
| Number of observations               96     |
| Iterations completed                 41     |
| Log likelihood function       -88.62897     |
| Sample is  1 pds and      96 individuals.   |
| Weibull duration model                      |
| Simulation based on 200 Halton draws        |
+---------------------------------------------+
+---------+--------------+----------------+--------+---------+----------+
|Variable | Coefficient  | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+--------------+----------------+--------+---------+----------+
         Nonrandom parameters
 Constant      1.95225484      .10752597    18.156   .0000
 X15            .03470521      .00317378    10.935   .0000    7.70833333
         Means for random parameters
 X10          -.16418077      .02963436    -5.540   .0000     .69791667
 X17            .71765963      .05002343    14.346   .0000    1.95937500
 X18          .119067D-04    .146496D-05     8.128   .0000    26240.2500
         Diagonal elements of Cholesky matrix
 X10            .13877946      .02933724     4.730   .0000
 X17            .28136693      .02301737    12.224   .0000
 X18          .392888D-05    .490941D-06     8.003   .0000
         Below diagonal elements of Cholesky matrix
 lX17_X10       .19535399      .02396657     8.151   .0000
 lX18_X10     .463581D-06    .155596D-05      .298   .7658
 lX18_X17     .346417D-05    .163352D-05     2.121   .0339
         Scale parameter for survival distribution
 ScalParm       .19057105      .01031871    18.468   .0000

Implied covariance matrix of random parameters

Matrix Var_Beta has  3 rows and  3 columns.
               1             2             3
        +----------------------------------------
       1|     .01926       .02711    .6433550D-07
       2|     .02711       .11733    .1065267D-05
       3|  .6433550D-07  .1065267D-05  .2765149D-10

Implied standard deviations of random parameters

Matrix S.D_Beta has  3 rows and  1 columns.
               1

        +--------------
       1|     .13878
       2|     .34254
       3|  .5258469D-05

Implied correlation matrix of random parameters

Matrix Cor_Beta has  3 rows and  3 columns.
               1             2             3
        +----------------------------------------
       1|    1.00000       .57032       .08816
       2|     .57032      1.00000       .59142
       3|     .08816       .59142      1.00000
```