USF UNIVERSITY OF SOUTH FLORIDA

Statistical and Econometric Methods

Assignment #8
(Duration Models)

You are given 204 observations from a travel survey conducted in the spring of 1988, in the Seattle area (this is the same data that was used for assignment #2). 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, Weibull, Weibull model with gamma heterogeneity and log-logistic hazard models. Please note that LIMDEP actually estimates the parameter vector $-\beta$ instead of just β so that the effect of the covariates on the hazard is:

$$EXP(-\beta X)$$

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.

2. Show and discuss the shape of the hazard function of your best specifications.

2. 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 *tobit.dat*)

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)

```
|-> sample;1-204$
|-> read;nvar=21;nobs=204;file=U:\00Work-Purdue\new_laptop\CE697N-
disk\tobit.dat$
Reading data file as space delimited format.
|-> reject;x3=0$
|-> dstat;rhs=x3$
```

Variable	Mean	Standard Deviation	Minimum	Maximum	Cases	Missing Values
X3	51.29167	37.46716	4.0	240.0	96	0

```
Descriptive Statistics for   1 variables
DSTAT results are matrix LASTDSTA in current project.
|-> create;if(x6=1)car=1$
|-> create;if(x9>6)old=1$
|-> dstat;rhs=car$
```

Variable	Mean	Standard Deviation	Minimum	Maximum	Cases	Missing Values
CAR	.71875	.451969	0.0	1.0	96	0

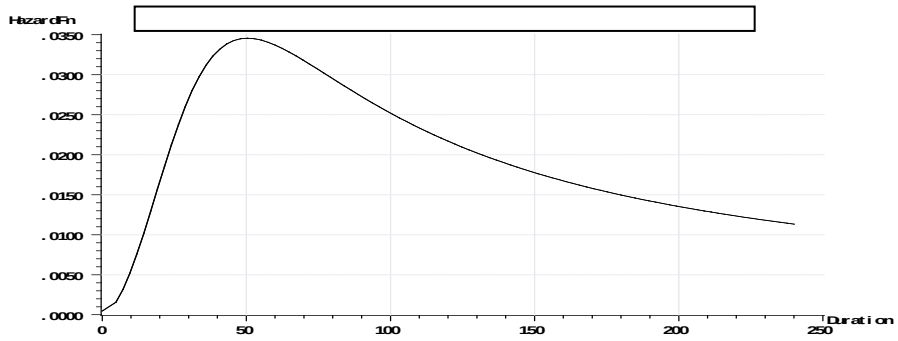
```
Descriptive Statistics for   1 variables
DSTAT results are matrix LASTDSTA in current project.
|-> create;ltime=log(x3)$
|-> survival;lhs=ltime;rhs=one,x15,x17,x12;model=weibull;plot$
Iterative procedure has converged
Normal exit:  11 iterations. Status=0, F=    .9628262D+02

------------------------------------------------------------------------------
Loglinear Survival Model: WEIBULL
Dependent variable                LTIME
Log likelihood function       -96.28262
Estimation based on N =     96, K =   5
Inf.Cr.AIC  =    202.6 AIC/N =    2.110
```

LTIME	Coefficient	Standard Error	z	Prob. |z|>Z*	95% Confidence Interval	
RHS of hazard model.....						
Constant	1.73227***	.65863	2.63	.0085	.44138	3.02316
X15	.03274*	.01940	1.69	.0916	-.00529	.07077
X17	1.05542***	.27857	3.79	.0002	.50943	1.60140
X12	-.03866	.05781	-.67	.5037	-.15196	.07464
Ancillary parameters for survival.....						
Sigma	.58725***	.05501	10.68	.0000	.47944	.69507

```
***, **, * ==>  Significance at 1%, 5%, 10% level.
Model was estimated on Nov 04, 2015 at 02:42:22 PM
------------------------------------------------------------------------------
------------------------------------------------------------
Parameters of underlying density at data means
Parameter   Estimate   Std. Error        Confidence Interval
------------------------------------------------------------
Lambda       .01793       .00121       .0156 to       .0203
P           1.70284       .15951      1.3902 to      2.0155
Median     44.96713      3.03851     39.0116 to     50.9226
------------------------------------------------------------
Percentiles  of  survival  distribution
Survival         .25          .50          .75           .95
Time           67.56        44.97        26.83          9.75
------------------------------------------------------------
```

```
|-> survival;lhs=ltime;rhs=one,x15,x17,x12;model=weibull;heterogeneity;plot$
Iterative procedure has converged
Normal exit:  16 iterations. Status=0, F=    .9388402D+02

------------------------------------------------------------------------------
Loglinear Survival Model: WEIBULL
Dependent variable                LTIME
Log likelihood function       -93.88402
Estimation based on N =     96, K =   6
Inf.Cr.AIC  =    199.8 AIC/N =    2.081
Weibull Model with Gamma Heterogeneity
--------+---------------------------------------------------------------------
        |                 Standard            Prob.      95% Confidence
   LTIME|  Coefficient       Error       z    |z|>Z*         Interval
--------+---------------------------------------------------------------------
        |RHS of hazard model.....................................................
Constant|    1.87039***      .58870     3.18  .0015      .71655   3.02422
     X15|     .03375*        .01784     1.89  .0585     -.00122    .06872
     X17|     .85791***      .25730     3.33  .0009      .35361   1.36222
     X12|    -.01045         .05761     -.18  .8561     -.12336    .10246
        |Ancillary parameters for survival.....................................
   Theta|     .61415         .39136     1.57  .1166     -.15290   1.38120
   Sigma|     .42125***      .07172     5.87  .0000      .28068    .56182
--------+---------------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
Model was estimated on Nov 04, 2015 at 02:42:22 PM
------------------------------------------------------------------------------

------------------------------------------------------------
Parameters of underlying density at data means
Parameter   Estimate   Std. Error        Confidence Interval
------------------------------------------------------------
Lambda        .02230       .00226       .0179 to       .0267
P            2.37390       .40417      1.5817 to      3.1661
Median      42.16025      4.27718     33.7770 to     50.5435
------------------------------------------------------------
Percentiles  of  survival  distribution
Survival         .25          .50         .75           .95
Time           62.34        42.16       27.55         12.92
------------------------------------------------------------

|-> survival;lhs=ltime;rhs=one,x15,x17,x12;model=logistic;plot$
Iterative procedure has converged
Normal exit:   9 iterations. Status=0, F=    .9428102D+02

------------------------------------------------------------------------------
Loglinear Survival Model: LOGISTIC
Dependent variable                LTIME
Log likelihood function       -94.28102
Estimation based on N =     96, K =   5
Inf.Cr.AIC  =    198.6 AIC/N =    2.068
--------+---------------------------------------------------------------------
        |                 Standard            Prob.      95% Confidence
   LTIME|  Coefficient       Error       z    |z|>Z*         Interval
--------+---------------------------------------------------------------------
        |RHS of hazard model.....................................................
Constant|    1.85926***      .56578     3.29  .0010      .75036   2.96817
     X15|     .03537**       .01696     2.08  .0371      .00212    .06862
     X17|     .81174***      .24762     3.28  .0010      .32642   1.29706
     X12|    -.00640         .05582     -.11  .9087     -.11581    .10301
        |Ancillary parameters for survival.....................................
   Sigma|     .36482***      .03478    10.49  .0000      .29665    .43300
--------+---------------------------------------------------------------------
***, **, * ==>  Significance at 1%, 5%, 10% level.
Model was estimated on Nov 04, 2015 at 02:42:22 PM
------------------------------------------------------------------------------
```

```
------------------------------------------------------------
Parameters of underlying density at data means
Parameter   Estimate   Std. Error        Confidence Interval
------------------------------------------------------------
Lambda        .02430       .00157       .0212 to       .0274
P            2.74104       .26134      2.2288 to      3.2533
Median      41.14903      2.65177     35.9516 to     46.3465
------------------------------------------------------------
Percentiles  of  survival  distribution
Survival         .25          .50         .75           .95
Time           61.44        41.15       27.56         14.06
------------------------------------------------------------
```




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

Iterative procedure has converged
Normal exit:  30 iterations. Status=0, F=    .8963885D+02

------------------------------------------------------------------------------
Random Coefficients  WiblSurv Model
Dependent variable                LTIME
Log likelihood function       -89.63885
Estimation based on N =     96, K =   9
Inf.Cr.AIC  =    197.3 AIC/N =    2.055
Sample is  1 pds and     96 individuals
Simulation  based on   200 Halton draws
Weibull duration model
--------+---------------------------------------------------------------------
        |                  Standard            Prob.      95% Confidence
   LTIME|  Coefficient       Error       z    |z|>Z*         Interval
--------+---------------------------------------------------------------------
        |Nonrandom parameters.....................................................
Constant|    2.02163***      .29488     6.86  .0000     1.44368   2.59958
     X15|     .03309***      .00868     3.81  .0001      .01609    .05010
        |Means for random parameters..............................................
     X10|    -.15849**       .07436    -2.13  .0331     -.30424   -.01274
     X17|     .72438***      .13635     5.31  .0000      .45714    .99163
     X18| .12011D-04***   .3918D-05     3.07  .0022  .43310D-05  .19690D-04
        |Scale parameters for dists. of random parameters.........................
     X10|     .03558         .04173      .85  .3938     -.04620    .11736
     X17|     .22761***      .01809    12.59  .0000      .19216    .26305
     X18| .18610D-05      .1226D-05     1.52  .1291 -.54225D-06  .42642D-05
        |Scale parameter for survival distribution................................
ScalParm|     .33519***      .02688    12.47  .0000      .28251    .38788
--------+---------------------------------------------------------------------
```