LOG FILE
April 17, 2016

```
. do "C:\Prog_Stata\fedora160416.do"
. * 16 April 2016
. * EQ DCE Competition
. * Fedora Predictions
. * Benjamin M. Craig
. *
. * This code demonstrates my approach to modeling EQ-5D-5L valuation data
. * and how I produced the predictions for the DCE competition.
. *
. * To use this code, you will need access to STATA software and either
. * internet access or downloads of 2 comma-separated values (CSV) files:
. *    Prediction_file.csv
. *    Exploratory_Data.csv
. *
. * Specifically, this code estimates 1 model, Fedora, which includes a 20-
. * parameter regression (one for each health problem in the EQ-5D-5L) and
. * 2 ancillary parameters (i.e., 22 parameters).
. *
. * Most model assumes constant proportionality:
. *
. *   Value = Lifespan - Problems * Duration
. *
. *  Fedora assumes:
. *
. *   Value = Lifespan^alpha - Problems * Duration^beta
. *
. * NOTE: if alpha and beta are 1, the model is constant proportional.
. *
. * The code is divided into 3 sections:
. *  (1) Import and recode responses into analytical data
. *  (2) Estimate Fedora using analytical data
. *  (3) Predict probabilities and estimate chi-square for Fedora
. *
. * For additional information, please email: benjamin.craig@iahpr.org
. * SECTION 1: Import and recode responses into analytical data
. local folder="http://iahpr.org/wordpress/wp-content/uploads/2016/03/"
. * Exploratory data
. import delimited using "`folder'/Exploratory_Data.csv", clear case(preserve)
(7 vars, 81,480 obs)
. save exploratory, replace
file exploratory.dta saved
. * Prediction file
. import delimited using "`folder'/Prediction_file.csv", clear case(preserve)
(5 vars, 3,200 obs)
. save predict, replace
file predict.dta saved
. * Recode the exploratory data
. use exploratory, clear
. * Switch A and B in each pair to be identical [left/right]
. gen switch=(H_A>H_B)
. replace choice=1-choice if switch==1
(40,931 real changes made)
. qui for X in any T H: gen D=X_A \ replace X_A=X_B if switch==1 \ /*
> */ replace X_B=D if switch==1 \ drop D
. * Calculate pair probabilities
. bysort p_id: egen C=mean(choice) /* pair probabilities */
. bysort p_id: gen N=_N            /* pair sample sizes */
. bysort p_id: keep if _n==1
(79,920 observations deleted)
. drop r_id choice switch
. save pairs, replace
file pairs.dta saved
. * Combine the blank prediction file with the pairs data
. use predict, clear
. gen switch=(H_A>H_B)
. qui for X in any T H: gen D=X_A \ replace X_A=X_B if switch==1 \ /*
> */ replace X_B=D if switch==1 \ drop D
. joinby p_id using pairs, unmatched(master)
. gen analysis=_merge==3
. drop switch _merge
. * Recode lifespans into years
. qui for X in any A B: gen X_time=substr(T_X,1,strpos(T_X," ")-1) \ /*
> */ destring X_time, replace force \ /*
> */ replace X_time=X_time/365.25 if strpos(T_X,"day")>0 \ /*
> */ replace X_time=X_time*7/365.25 if strpos(T_X,"week")>0 \ /*
> */ replace X_time=X_time/12 if strpos(T_X,"month")>0 \ /*
> */ replace X_time=0 if X_time==.
. * Separate the 5 domains of the EQ-5D-5L
. qui for X in any A B: tostring H_X, replace \ /*
> */ gen X_MO=substr(H_X,1,1) \ gen X_SC=substr(H_X,2,1) \ /*
> */ gen X_UA=substr(H_X,3,1) \ gen X_PD=substr(H_X,4,1) \ /*
> */ gen X_AD=substr(H_X,5,1) \ destring X_MO-X_AD, replace
. * Incorporate the 5 attributes using their additive differences in value
. gen dif_time=A_time-B_time
. qui for X in any MO SC UA PD AD: /*
> */ gen X1=(B_X>1)-(A_X>1) \ /*
> */ gen X2=(B_X>2)-(A_X>2) \ /*
> */ gen X3=(B_X>3)-(A_X>3) \ /*
> */ gen X4=(B_X>4)-(A_X>4)
. * Separate the disadvantages of A from the disadvantages of B
. qui for X in varlist MO1-AD4: gen A_X = X*(X>0)
. qui for X in varlist MO1-AD4: gen B_X = -X*(X<0)
. qui for X in any MO SC UA PD AD: /*
> */ gen a_X1=(A_X>1) \ /*
> */ gen a_X2=(A_X>2) \ /*
> */ gen a_X3=(A_X>3) \ /*
> */ gen a_X4=(A_X>4)
. qui for X in any MO SC UA PD AD: /*
> */ gen b_X1=(B_X>1) \ /*
> */ gen b_X2=(B_X>2) \ /*
> */ gen b_X3=(B_X>3) \ /*
> */ gen b_X4=(B_X>4)
. save analysis, replace
file analysis.dta saved
. * SECTION 2: Estimate Fedora using analytical data
. use analysis, clear
. * Constrain parameters of the 4 equations (A,B,a,b) to be equal
. qui for Y in numlist 1/20 \ /*
> */ X_A in varlist A_MO1-A_AD4 \ /*
> */ X_B in varlist B_MO1-B_AD4 : /*
> */ constraint Y [eq1a]X_A=[eq1b]X_B
. qui for Y in numlist 21/40 \ /*
> */ X_A in varlist a_MO1-a_AD4 \ /*
> */ X_B in varlist b_MO1-b_AD4 : /*
> */ constraint Y [eq2a]X_A=[eq2b]X_B
. qui for Y in numlist 41/60 \ /*
> */ X_A in varlist A_MO1-A_AD4 \ /*
> */ X_a in varlist a_MO1-a_AD4 : /*
> */ constraint Y [eq1a]X_A=[eq2a]X_a
. * Estimate Fedora with Constant Proportionality Assumption
. capture program drop wls_fedora1
. program wls_fedora1
  1. args lnf xb1 xb2 zb1 zb2
  2. tempvar P A_V B_V w
  3.
. * Disadvantages of B
. qui gen double `A_V'=`xb1'*$ML_y4+($ML_y3-$ML_y4) if ($ML_y3>$ML_y4)
  4. qui replace    `A_V'=`xb1'*$ML_y3+`zb2'*($ML_y4-$ML_y3)  if ($ML_y4>=$ML_y3)
  5. qui replace    `A_V'=`zb2'*$ML_y4 if ($ML_y3==0)
  6. qui replace    `A_V'=$ML_y3 if ($ML_y4==0)
  7.
. * Disadvantages of A
. qui gen double `B_V'=`xb2'*$ML_y3+($ML_y4-$ML_y3) if ($ML_y4>$ML_y3)
  8. qui replace    `B_V'=`xb2'*$ML_y4+`zb1'*($ML_y3-$ML_y4)  if ($ML_y3>=$ML_y4)
  9. qui replace    `B_V'=`zb1'*$ML_y3 if ($ML_y4==0)
 10. qui replace    `B_V'=$ML_y4 if ($ML_y3==0)
 11.
. qui gen double `P'=`A_V'/(`A_V'+`B_V')
 12.
. * Construct theoretical weights for Weighted Least Squares Estimation
. qui gen double `w'=(1/(`P'*(1-`P')))    /* Uncertainty Weight */
 13. qui replace `w'=(4*($ML_y2^2)/(2*$ML_y2-1)) if (`P'<=0)+(`P'>=1)
/* Berkson Weight if w==. */
 14. qui replace `lnf' =-(($ML_y1-`P')^2 )*`w'
 15. end
. mat m0=J(1,80,0.1)
. ml model lf wls_fedora1 /*
> */ (eq1a:C= A_MO1-A_AD4 , nocons)  /*
> */ (eq1b:N= B_MO1-B_AD4 , nocons)  /*
> */ (eq2a:A_time= a_MO1-a_AD4 , nocons)  /*
> */ (eq2b:B_time= b_MO1-b_AD4 , nocons)  /*
> */ [fweight=N] if analysis==1,  /*
> */ tech(nr) init(m0, copy) maximize missing  /*
> */ nopreserve search(off) iterate(50) /*
> */ difficult constraint(1/60) collinear
Iteration 0:   log likelihood = -7965.5838
Iteration 1:   log likelihood = -5940.9886
Iteration 2:   log likelihood = -5243.6017
Iteration 3:   log likelihood = -5174.1328
Iteration 4:   log likelihood = -5173.9628
Iteration 5:   log likelihood = -5173.9628
. ml display
                                                Number of obs     =     81,480
                                                Wald chi2(0)      =          .
Log likelihood = -5173.9628                     Prob > chi2       =          .
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
eq1a         |
       A_MO1 |   .0700658   .0037549    18.66   0.000     .0627064    .0774252
       A_MO2 |   .0400127   .0042777     9.35   0.000     .0316286    .0483968
       A_MO3 |   .1783307   .0086707    20.57   0.000     .1613364     .195325
       A_MO4 |   .1269834   .0101185    12.55   0.000     .1071516    .1468153
       A_SC1 |   .0243234   .0041759     5.82   0.000     .0161387    .0325081
       A_SC2 |   .0447697   .0038815    11.53   0.000     .0371621    .0523773
       A_SC3 |   .1746956   .0103272    16.92   0.000     .1544546    .1949366
       A_SC4 |   .1875099   .0127832    14.67   0.000     .1624553    .2125646
       A_UA1 |   .0727943   .0043238    16.84   0.000     .0643197    .0812689
       A_UA2 |    .018828   .0059603     3.16   0.002      .007146    .0305101
       A_UA3 |   .1223404   .0078527    15.58   0.000     .1069493    .1377315
       A_UA4 |   .0560833   .0094131     5.96   0.000     .0376339    .0745327
       A_PD1 |   .0608278   .0044962    13.53   0.000     .0520155    .0696401
       A_PD2 |    .051347   .0052237     9.83   0.000     .0411088    .0615853
       A_PD3 |   .5138365   .0106968    48.04   0.000     .4928712    .5348018
       A_PD4 |   .1104702     .01351     8.18   0.000     .0839911    .1369493
       A_AD1 |   .0904724   .0036101    25.06   0.000     .0833967    .0975481
       A_AD2 |   .0686826   .0078742     8.72   0.000     .0532495    .0841158
       A_AD3 |   .3122867    .010156    30.75   0.000     .2923813    .3321921
       A_AD4 |   .0724193   .0062982    11.50   0.000     .0600751    .0847635
-------------+----------------------------------------------------------------
eq1b         |
       B_MO1 |   .0700658   .0037549    18.66   0.000     .0627064    .0774252
       B_MO2 |   .0400127   .0042777     9.35   0.000     .0316286    .0483968
       B_MO3 |   .1783307   .0086707    20.57   0.000     .1613364     .195325
       B_MO4 |   .1269834   .0101185    12.55   0.000     .1071516    .1468153
       B_SC1 |   .0243234   .0041759     5.82   0.000     .0161387    .0325081
       B_SC2 |   .0447697   .0038815    11.53   0.000     .0371621    .0523773
       B_SC3 |   .1746956   .0103272    16.92   0.000     .1544546    .1949366
       B_SC4 |   .1875099   .0127832    14.67   0.000     .1624553    .2125646
       B_UA1 |   .0727943   .0043238    16.84   0.000     .0643197    .0812689
       B_UA2 |    .018828   .0059603     3.16   0.002      .007146    .0305101
       B_UA3 |   .1223404   .0078527    15.58   0.000     .1069493    .1377315
       B_UA4 |   .0560833   .0094131     5.96   0.000     .0376339    .0745327
       B_PD1 |   .0608278   .0044962    13.53   0.000     .0520155    .0696401
       B_PD2 |    .051347   .0052237     9.83   0.000     .0411088    .0615853
       B_PD3 |   .5138365   .0106968    48.04   0.000     .4928712    .5348018
       B_PD4 |   .1104702     .01351     8.18   0.000     .0839911    .1369493
       B_AD1 |   .0904724   .0036101    25.06   0.000     .0833967    .0975481
       B_AD2 |   .0686826   .0078742     8.72   0.000     .0532495    .0841158
       B_AD3 |   .3122867    .010156    30.75   0.000     .2923813    .3321921
       B_AD4 |   .0724193   .0062982    11.50   0.000     .0600751    .0847635
-------------+----------------------------------------------------------------
eq2a         |
       a_MO1 |   .0700658   .0037549    18.66   0.000     .0627064    .0774252
       a_MO2 |   .0400127   .0042777     9.35   0.000     .0316286    .0483968
       a_MO3 |   .1783307   .0086707    20.57   0.000     .1613364     .195325
       a_MO4 |   .1269834   .0101185    12.55   0.000     .1071516    .1468153
       a_SC1 |   .0243234   .0041759     5.82   0.000     .0161387    .0325081
       a_SC2 |   .0447697   .0038815    11.53   0.000     .0371621    .0523773
       a_SC3 |   .1746956   .0103272    16.92   0.000     .1544546    .1949366
       a_SC4 |   .1875099   .0127832    14.67   0.000     .1624553    .2125646
       a_UA1 |   .0727943   .0043238    16.84   0.000     .0643197    .0812689
       a_UA2 |    .018828   .0059603     3.16   0.002      .007146    .0305101
       a_UA3 |   .1223404   .0078527    15.58   0.000     .1069493    .1377315
       a_UA4 |   .0560833   .0094131     5.96   0.000     .0376339    .0745327
       a_PD1 |   .0608278   .0044962    13.53   0.000     .0520155    .0696401
       a_PD2 |    .051347   .0052237     9.83   0.000     .0411088    .0615853
       a_PD3 |   .5138365   .0106968    48.04   0.000     .4928712    .5348018
       a_PD4 |   .1104702     .01351     8.18   0.000     .0839911    .1369493
       a_AD1 |   .0904724   .0036101    25.06   0.000     .0833967    .0975481
       a_AD2 |   .0686826   .0078742     8.72   0.000     .0532495    .0841158
       a_AD3 |   .3122867    .010156    30.75   0.000     .2923813    .3321921
       a_AD4 |   .0724193   .0062982    11.50   0.000     .0600751    .0847635
-------------+----------------------------------------------------------------
eq2b         |
       b_MO1 |   .0700658   .0037549    18.66   0.000     .0627064    .0774252
       b_MO2 |   .0400127   .0042777     9.35   0.000     .0316286    .0483968
       b_MO3 |   .1783307   .0086707    20.57   0.000     .1613364     .195325
       b_MO4 |   .1269834   .0101185    12.55   0.000     .1071516    .1468153
       b_SC1 |   .0243234   .0041759     5.82   0.000     .0161387    .0325081
       b_SC2 |   .0447697   .0038815    11.53   0.000     .0371621    .0523773
       b_SC3 |   .1746956   .0103272    16.92   0.000     .1544546    .1949366
       b_SC4 |   .1875099   .0127832    14.67   0.000     .1624553    .2125646
       b_UA1 |   .0727943   .0043238    16.84   0.000     .0643197    .0812689
       b_UA2 |    .018828   .0059603     3.16   0.002      .007146    .0305101
       b_UA3 |   .1223404   .0078527    15.58   0.000     .1069493    .1377315
       b_UA4 |   .0560833   .0094131     5.96   0.000     .0376339    .0745327
       b_PD1 |   .0608278   .0044962    13.53   0.000     .0520155    .0696401
       b_PD2 |    .051347   .0052237     9.83   0.000     .0411088    .0615853
       b_PD3 |   .5138365   .0106968    48.04   0.000     .4928712    .5348018
       b_PD4 |   .1104702     .01351     8.18   0.000     .0839911    .1369493
       b_AD1 |   .0904724   .0036101    25.06   0.000     .0833967    .0975481
       b_AD2 |   .0686826   .0078742     8.72   0.000     .0532495    .0841158
       b_AD3 |   .3122867    .010156    30.75   0.000     .2923813    .3321921
       b_AD4 |   .0724193   .0062982    11.50   0.000     .0600751    .0847635
------------------------------------------------------------------------------
. mat b_fedora0=e(b)
. * NOTE: This is identical to the the Bradley-Terry WLS model
. * in the Exploratory Analysis, except that it uses the theoretical weights.
. * Estimate Fedora with theta, alpha and beta
. capture program drop wls_fedora1
. program wls_fedora1
  1. args lnf xb1 xb2 zb1 zb2 alpha beta
  2. tempvar P A_V B_V T_A T_B D_A D_B w
  3. qui gen double `T_A'=`alpha'*ln($ML_y3)  /* Alpha is the effect of lifespan */
  4. qui gen double `T_B'=`alpha'*ln($ML_y4)
  5. qui gen double `D_A'=`beta'*ln($ML_y3)   /* Beta is the effect of duration */
  6. qui gen double `D_B'=`beta'*ln($ML_y4)
  7.
. * Disadvantages of B
. qui gen double `A_V'=`xb1'*exp(`D_B')+(exp(`T_A')-exp(`T_B')) if ($ML_y3>$ML_y4)
  8. qui replace    `A_V'=`xb1'*exp(`D_A')+`zb2'*(exp(`D_B')-exp(`D_A'))  if
($ML_y4>=$ML_y3)
  9. qui replace    `A_V'=`zb2'*exp(`D_B') if ($ML_y3==0)
 10. qui replace    `A_V'=exp(`T_A') if ($ML_y4==0)
 11.
. * Disadvantages of A
. qui gen double `B_V'=`xb2'*exp(`D_A')+(exp(`T_B')-exp(`T_A')) if ($ML_y4>$ML_y3)
 12. qui replace    `B_V'=`xb2'*exp(`D_B')+`zb1'*(exp(`D_A')-exp(`D_B'))  if
($ML_y3>=$ML_y4)
 13. qui replace    `B_V'=`zb1'*exp(`D_A') if ($ML_y4==0)
 14. qui replace    `B_V'=exp(`T_B') if ($ML_y3==0)
 15.
. qui gen double `P'=`A_V'/(`A_V'+`B_V')
 16.
. * Construct theoretical weights for Weighted Least Squares Estimation
. qui gen double `w'=(1/(`P'*(1-`P')))    /* Uncertainty Weight */
 17. qui replace `w'=(4*($ML_y2^2)/(2*$ML_y2-1)) if (`P'<=0)+(`P'>=1)
/* Berkson Weight if w==. */
 18. qui replace `lnf' =-(($ML_y1-`P')^2 )*`w'
 19. end
. mat m1=b_fedora0,0.5,0.5
. ml model lf wls_fedora1 /*
> */ (eq1a:C= A_MO1-A_AD4 , nocons)  /*
> */ (eq1b:N= B_MO1-B_AD4 , nocons)  /*
> */ (eq2a:A_time= a_MO1-a_AD4 , nocons)  /*
> */ (eq2b:B_time= b_MO1-b_AD4 , nocons)  /*
> */ /alpha /beta [fweight=N] if analysis==1,  /*
> */ tech(nr) init(m1, copy) maximize missing  /*
> */ nopreserve search(off) iterate(50) /*
> */ difficult constraint(1/60) collinear
Iteration 0:   log likelihood = -5722.8212
Iteration 1:   log likelihood = -5273.0728  (not concave)
Iteration 2:   log likelihood = -3588.8411  (not concave)
Iteration 3:   log likelihood = -3438.9318  (not concave)
Iteration 4:   log likelihood = -3409.5025  (not concave)
Iteration 5:   log likelihood = -3179.2126  (not concave)
Iteration 6:   log likelihood = -2946.6595
Iteration 7:   log likelihood = -2932.1761
Iteration 8:   log likelihood = -2677.0851
Iteration 9:   log likelihood = -2655.6007
Iteration 10:  log likelihood = -2654.5209
Iteration 11:  log likelihood = -2654.5183
Iteration 12:  log likelihood = -2654.5183
. ml display
                                                Number of obs     =     81,480
                                                Wald chi2(0)      =          .
Log likelihood = -2654.5183                     Prob > chi2       =          .
------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
eq1a         |
       A_MO1 |   .0162336   .0011303    14.36   0.000     .0140183    .0184489
       A_MO2 |   .0294416   .0023703    12.42   0.000      .024796    .0340873
       A_MO3 |   .1309349   .0049108    26.66   0.000       .12131    .1405599
       A_MO4 |   .0842535   .0049709    16.95   0.000     .0745107    .0939962
       A_SC1 |   .0177395   .0014686    12.08   0.000     .0148611    .0206179
       A_SC2 |   .0310703   .0020234    15.36   0.000     .0271044    .0350362
       A_SC3 |   .1391488   .0057685    24.12   0.000     .1278428    .1504547
       A_SC4 |   .0937537    .006057    15.48   0.000     .0818823    .1056252
       A_UA1 |   .0140187   .0012422    11.29   0.000      .011584    .0164533
       A_UA2 |   .0146191    .002391     6.11   0.000     .0099327    .0193054
       A_UA3 |   .1136766    .004555    24.96   0.000      .104749    .1226042
       A_UA4 |   .0368734   .0053118     6.94   0.000     .0264624    .0472845
       A_PD1 |    .014749   .0015129     9.75   0.000     .0117838    .0177143
       A_PD2 |   .0260796    .001882    13.86   0.000     .0223909    .0297683
       A_PD3 |   .2686381   .0068625    39.15   0.000     .2551878    .2820883
       A_PD4 |    .099022   .0065762    15.06   0.000      .086133    .1119111
       A_AD1 |   .0357312   .0013896    25.71   0.000     .0330077    .0384547
       A_AD2 |   .0536931   .0040137    13.38   0.000     .0458263    .0615599
       A_AD3 |   .1484151   .0054766    27.10   0.000     .1376811    .1591491
       A_AD4 |   .0468012   .0035243    13.28   0.000     .0398938    .0537086
-------------+----------------------------------------------------------------
eq1b         |
       B_MO1 |   .0162336   .0011303    14.36   0.000     .0140183    .0184489
       B_MO2 |   .0294416   .0023703    12.42   0.000      .024796    .0340873
       B_MO3 |   .1309349   .0049108    26.66   0.000       .12131    .1405599
       B_MO4 |   .0842535   .0049709    16.95   0.000     .0745107    .0939962
       B_SC1 |   .0177395   .0014686    12.08   0.000     .0148611    .0206179
       B_SC2 |   .0310703   .0020234    15.36   0.000     .0271044    .0350362
       B_SC3 |   .1391488   .0057685    24.12   0.000     .1278428    .1504547
       B_SC4 |   .0937537    .006057    15.48   0.000     .0818823    .1056252
       B_UA1 |   .0140187   .0012422    11.29   0.000      .011584    .0164533
       B_UA2 |   .0146191    .002391     6.11   0.000     .0099327    .0193054
       B_UA3 |   .1136766    .004555    24.96   0.000      .104749    .1226042
       B_UA4 |   .0368734   .0053118     6.94   0.000     .0264624    .0472845
       B_PD1 |    .014749   .0015129     9.75   0.000     .0117838    .0177143
       B_PD2 |   .0260796    .001882    13.86   0.000     .0223909    .0297683
       B_PD3 |   .2686381   .0068625    39.15   0.000     .2551878    .2820883
       B_PD4 |    .099022   .0065762    15.06   0.000      .086133    .1119111
       B_AD1 |   .0357312   .0013896    25.71   0.000     .0330077    .0384547
       B_AD2 |   .0536931   .0040137    13.38   0.000     .0458263    .0615599
       B_AD3 |   .1484151   .0054766    27.10   0.000     .1376811    .1591491
       B_AD4 |   .0468012   .0035243    13.28   0.000     .0398938    .0537086
-------------+----------------------------------------------------------------
eq2a         |
       a_MO1 |   .0162336   .0011303    14.36   0.000     .0140183    .0184489
       a_MO2 |   .0294416   .0023703    12.42   0.000      .024796    .0340873
       a_MO3 |   .1309349   .0049108    26.66   0.000       .12131    .1405599
       a_MO4 |   .0842535   .0049709    16.95   0.000     .0745107    .0939962
       a_SC1 |   .0177395   .0014686    12.08   0.000     .0148611    .0206179
       a_SC2 |   .0310703   .0020234    15.36   0.000     .0271044    .0350362
       a_SC3 |   .1391488   .0057685    24.12   0.000     .1278428    .1504547
       a_SC4 |   .0937537    .006057    15.48   0.000     .0818823    .1056252
       a_UA1 |   .0140187   .0012422    11.29   0.000      .011584    .0164533
       a_UA2 |   .0146191    .002391     6.11   0.000     .0099327    .0193054
       a_UA3 |   .1136766    .004555    24.96   0.000      .104749    .1226042
       a_UA4 |   .0368734   .0053118     6.94   0.000     .0264624    .0472845
       a_PD1 |    .014749   .0015129     9.75   0.000     .0117838    .0177143
       a_PD2 |   .0260796    .001882    13.86   0.000     .0223909    .0297683
       a_PD3 |   .2686381   .0068625    39.15   0.000     .2551878    .2820883
       a_PD4 |    .099022   .0065762    15.06   0.000      .086133    .1119111
       a_AD1 |   .0357312   .0013896    25.71   0.000     .0330077    .0384547
       a_AD2 |   .0536931   .0040137    13.38   0.000     .0458263    .0615599
       a_AD3 |   .1484151   .0054766    27.10   0.000     .1376811    .1591491
       a_AD4 |   .0468012   .0035243    13.28   0.000     .0398938    .0537086
-------------+----------------------------------------------------------------
eq2b         |
       b_MO1 |   .0162336   .0011303    14.36   0.000     .0140183    .0184489
       b_MO2 |   .0294416   .0023703    12.42   0.000      .024796    .0340873
       b_MO3 |   .1309349   .0049108    26.66   0.000       .12131    .1405599
       b_MO4 |   .0842535   .0049709    16.95   0.000     .0745107    .0939962
       b_SC1 |   .0177395   .0014686    12.08   0.000     .0148611    .0206179
       b_SC2 |   .0310703   .0020234    15.36   0.000     .0271044    .0350362
       b_SC3 |   .1391488   .0057685    24.12   0.000     .1278428    .1504547
       b_SC4 |   .0937537    .006057    15.48   0.000     .0818823    .1056252
       b_UA1 |   .0140187   .0012422    11.29   0.000      .011584    .0164533
       b_UA2 |   .0146191    .002391     6.11   0.000     .0099327    .0193054
       b_UA3 |   .1136766    .004555    24.96   0.000      .104749    .1226042
       b_UA4 |   .0368734   .0053118     6.94   0.000     .0264624    .0472845
       b_PD1 |    .014749   .0015129     9.75   0.000     .0117838    .0177143
       b_PD2 |   .0260796    .001882    13.86   0.000     .0223909    .0297683
       b_PD3 |   .2686381   .0068625    39.15   0.000     .2551878    .2820883
       b_PD4 |    .099022   .0065762    15.06   0.000      .086133    .1119111
       b_AD1 |   .0357312   .0013896    25.71   0.000     .0330077    .0384547
       b_AD2 |   .0536931   .0040137    13.38   0.000     .0458263    .0615599
       b_AD3 |   .1484151   .0054766    27.10   0.000     .1376811    .1591491
       b_AD4 |   .0468012   .0035243    13.28   0.000     .0398938    .0537086
-------------+----------------------------------------------------------------
alpha        |
       _cons |   .2747722   .0066482    41.33   0.000      .261742    .2878024
-------------+----------------------------------------------------------------
beta         |
       _cons |   .1483939   .0064667    22.95   0.000     .1357194    .1610684
------------------------------------------------------------------------------
. mat b_fedora1=e(b)
. * Review the parameters of the two models
. mat results=(b_fedora0[1,1..20],1,1)',(b_fedora1[1,1..20],b_fedora1[1,81..82])'
. mat colnames results = CP Fedora
. mat list results
results[22,2]
                   CP     Fedora
eq1a:A_MO1  .07006582  .01623361
eq1a:A_MO2  .04001268  .02944163
eq1a:A_MO3  .17833074  .13093495
eq1a:A_MO4  .12698344  .08425349
eq1a:A_SC1  .02432339   .0177395
eq1a:A_SC2   .0447697  .03107029
eq1a:A_SC3  .17469562  .13914878
eq1a:A_SC4  .18750992  .09375374
eq1a:A_UA1  .07279431  .01401866
eq1a:A_UA2  .01882804  .01461905
eq1a:A_UA3  .12234042  .11367658
eq1a:A_UA4   .0560833  .03687342
eq1a:A_PD1  .06082777  .01474902
eq1a:A_PD2  .05134702  .02607958
eq1a:A_PD3  .51383655  .26863808
eq1a:A_PD4  .11047017    .099022
```

```
eq1a:A_AD1  .09047241  .03573116
eq1a:A_AD2  .06868265  .05369309
eq1a:A_AD3   .3122867  .14841512
eq1a:A_AD4  .07241929  .04680122
       r21          1  .27477218
       r22          1  .14839392
. * NOTE: The inclusion of 2 parameters (alpha and beta) relax the constant
. * proportionality assumption and reduce the chi square by over half (3166).
. * SECTION 3: Predict probabilities and estimate chi-square for Fedora
. use analysis, clear
. * Predict the probabilities for the Fedora model (theta, alpha, beta)
. gen A_f1=0
. qui for X in varlist A_MO1-A_AD4 \ Y in numlist 1/20: /*
> */ replace A_f1=A_f1+X*b_fedora1[1,Y]
. gen B_f1=0
. qui for X in varlist B_MO1-B_AD4  \ Y in numlist 1/20: /*
> */ replace B_f1=B_f1+X*b_fedora1[1,Y]
. gen a_f1=0
. qui for X in varlist a_MO1-a_AD4 \ Y in numlist 1/20: /*
> */ replace a_f1=a_f1+X*b_fedora1[1,Y]
. gen b_f1=0
. qui for X in varlist b_MO1-b_AD4  \ Y in numlist 1/20: /*
> */ replace b_f1=b_f1+X*b_fedora1[1,Y]
. qui gen double t_A=A_time^b_fedora1[1,81] /* Alpha is the effect of lifespan */
. qui gen double t_B=B_time^b_fedora1[1,81]
. qui gen double D_A=A_time^b_fedora1[1,82] /* Beta is the effect of duration */
. qui gen double D_B=B_time^b_fedora1[1,82]
. * Disadvantages of B
. qui gen double A_V=A_f1*D_B+(t_A-t_B) if (A_time>B_time)
. qui replace    A_V=A_f1*D_A+b_f1*(D_B-D_A)  if (B_time>=A_time)
. qui replace    A_V=b_f1*D_B if (A_time==0)
. qui replace    A_V=t_A if (B_time==0)
. * Disadvantages of A
. qui gen double B_V=B_f1*D_A+(t_B-t_A) if (B_time>A_time)
. qui replace    B_V=B_f1*D_B+a_f1*(D_A-D_B)  if (A_time>=B_time)
. qui replace    B_V=a_f1*D_A if (B_time==0)
. qui replace    B_V=t_B if (A_time==0)
. qui gen double P_f1=A_V/(A_V+B_V)
. replace P_f1=round(P_f1*1000)/1000
(3,200 real changes made)
. replace P_f1=0 if P_f1<0  /* If the prediction is less than 0 */
(0 real changes made)
. replace P_f1=1 if P_f1>1  /* If the prediction is greater than 1 */
(0 real changes made)
. rename P_f1 P_fedora
. save prediction, replace
file prediction.dta saved
. * Audit predictions and compute chi square
. use prediction, clear
. keep if analysis==1
(1,640 observations deleted)
. drop A_MO-b_AD4
. gen success=round(N*C,1)
. gen pv=0
. local i=1
. qui while `i'<=_N {
. replace pv=. if analysis==0
(0 real changes made)
. gen reject=(pv<0.01)*(analysis==1)
. tab reject
     reject |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |      1,495       95.83       95.83
          1 |         65        4.17      100.00
------------+-----------------------------------
      Total |      1,560      100.00
. twoway (scatter C P_fedora if reject==0) /*
> */     (scatter C P_fedora if reject==1), legend(off)
. * NOTE: It appears that 65 out of the 1560 predictions (4%; red) are rejected
. * at a p-value 0.01, which is acceptable for this competition. There is
. * certainly room for improvement; however, this would likely require
. * additional parameters beyond theta, alpha and beta.
.  * Construct empirical weights for Weighted Least Squares Estimation
. gen double w=(1/(C*(1-C)))                      /* Uncertainty Weight */
(2 missing values generated)
. replace w=(4*(N^2)/(2*N-1)) if w==.             /* Berkson Weight if w==. */
(2 real changes made)
. gen fedora_sq=N*(C-P_fedora)^2*w
. tabstat fedora_sq, s(sum)
    variable |       sum
-------------+----------
   fedora_sq |  3567.711
------------------------
. * NOTE: The Bradley-Terry model (shown in the Exploratory Analysis code)
. * achieved a chi square of 8243, which was much lower than its closest
. * competitor, logit WLS (21521). By adding just 2 parameters, Fedora
. * reduces the chi square to 3568. Additional parameters may improve its
. * fit further; however, these predictions seem sufficient for my entry.
. * All are welcome to build from this code with proper citation.
. * Export Prediction File for Fedora
. use prediction, clear
. export delimited p_id T_A T_B H_A H_B P_fedora /*
> */ using "C:\data\crhe16\csv\Fedora_Predictions.csv", replace
file C:\data\crhe16\csv\Fedora_Predictions.csv saved
```