MULTINOMIAL LOGIT AND ORDERED LOGIT
WITH NON-LINEARITY AND STATISTICAL INTERACTION

What explains **how people think about the Bible**? Using GSS 2000 we build a model predicting if people take the Bible as the Word of God, Inspired Word or just a Book of Fables.

We will look at the effect of the respondents
 -- gender 0 is male and 1 is female(**sex**),
 -- **age**,
 -- education (**educ**),
 -- personal income (**rincom98**),
 -- political views scaled on a 1-9 scale where 1 is extremely liberal and 9 is extremely conservative (**polviews**),
 -- the intensity of one's religious affiliation where 1 is most intense and 4 is no religion so religious intensity weakens as the values of the variable increases and it really should be thought of as lack of religious commitment (**reliten**),
 -- and finally one's confidence that God exists where 1 is convinced that there is no God and 6 is convinced of the opposite (**god**).

What explains **how much confidence people have in science**?
We will look at the same set of variables.

HERE IS HOW I PREPARED THE DATA FOR ANALYSIS

```
--> reset$
--> read; nrec=2817; nvar=9; file=c:\science.dat; format=(9f8.2);
    names(x1=confsci, x2=educ, x3=bible, x4=age, x5=polviews, x6=reliten, x7=...
    blanks $
--> open; output=outfile$
--> skip$
--> reject; educ>90$
--> reject;  reliten>4$
--> reject; god>6$
--> reject; bible>4$
--> reject; rincom98>23$
--> reject; age>97$
--> reject; bible=4$
--> reject; bible=0$
--> create; nbible=3-bible$
--> create; bible=bible-1$
--> create; sex=sex-1$
--> create; educ2=educ*educ$
--> create; agexpol=age*polviews$

--> dstat; rhs=confsci, educ, bible, age, polviews, reliten, rincom98, sex, g...
                        Descriptive Statistics
             All results based on nonmissing observations.
Variable        Mean         Std.Dev.        Minimum         Maximum      Cases
------------------------------------------------------------------------------
CONFSCI    1.38162879      .625829193      .000000000      2.00000000       1056
EDUC       13.3221440      2.84078449      .000000000      20.0000000       1847
BIBLE      .825121819      .693771371      .000000000      2.00000000       1847
AGE        45.9599350      17.6041251      18.0000000      89.0000000       1847
POLVIEWS   4.31727125      1.66020255      1.00000000      9.00000000       1847
RELITEN    2.03681646      1.04074534      1.00000000      4.00000000       1847
RINCOM98   9.39361126      7.65553230      .000000000      23.0000000       1847
SEX        .570113698      .495193734      .000000000      1.00000000       1847
GOD        1.80671359      2.60655860      .000000000      6.00000000       1847
NBIBLE     1.17487818      .693771371      .000000000      2.00000000       1847
```

```
--> Title; The base-line model  (Restricted Log-Likelihood)$

--> logit; lhs=nbible; rhs=one$

Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Multinomial Logit Model                     |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 05, 2011 at 05:52:53PM.|
| Dependent variable               NBIBLE     |
| Weighting variable                 None     |
| Number of observations             1847     |
| Iterations completed                  1     |
| Log likelihood function       -1878.437     |
| Number of parameters                  2     |
| Info. Criterion: AIC =          2.03621     |
|   Finite Sample: AIC =          2.03621     |
| Info. Criterion: BIC =          2.04219     |
| Info. Criterion:HQIC =          2.03841     |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Characteristics in numerator of Prob[Y = 1]
 Constant|    1.06482161       .06575775    16.193   .0000
---------+Characteristics in numerator of Prob[Y = 2]
 Constant|     .71225604       .06922948    10.288   .0000

+--------------------------------------------------------------------+
| Information Statistics for Discrete Choice Model.                  |
|                          M=Model MC=Constants Only   M0=No Model   |
| Criterion F (log L)    -1878.43738       -1878.43738   -2029.13690 |
| LR Statistic vs. MC        .00000            .00000        .00000 |
| Entropy for probs.      1878.43738        1878.43738    2029.13690 |
| Normalized Entropy          .92573            .92573       1.00000 |
| Entropy Ratio Stat.      301.39904         301.39904        .00000 |
| Bayes Info Criterion       2.03404           2.03404       2.19722 |
| BIC(no model) - BIC         .16318            .16318        .00000 |
| Pseudo R-squared            .00000            .00000        .00000 |
| Pct. Correct Pred.        48.83595            .00000      33.33333 |
| Means:       y=0    y=1    y=2    y=3    y=4    y=5     y=6   y>=7 |
| Outcome     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000 |
| Pred.Pr     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000 |
| Notes: Entropy computed as Sum(i)Sum(j)Pfit(i,j)*logPfit(i,j).     |
|        Normalized entropy is computed against M0.                  |
|        Entropy ratio statistic is computed against M0.             |
|        BIC = 2*criterion - log(N)*degrees of freedom.              |
|        If the model has only constants or if it has no constants,  |
|        the statistics reported here are not useable.               |
+--------------------------------------------------------------------+
Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted
------  --------------  +  -----
Actual       0    1    2  |  Total
------  --------------  +  -----
  0          0  311    0  |    311
  1          0  902    0  |    902
  2          0  634    0  |    634
------  --------------  +  -----
Total        0 1847    0  |   1847
```

```
--> logit; lhs=nbible; rhs=one, sex, age, educ, rincom98, polviews, reliten, ...
    rst:b0,0,0,0,0,0,0,0,b8,0,0,0,0,0,0,0$
Normal exit from iterations. Exit status=0.
+---------------------------------------------+
| Multinomial Logit Model                     |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 05, 2011 at 05:52:53PM.|
| Dependent variable               NBIBLE     |
| Weighting variable                 None     |
| Number of observations             1847     |
| Iterations completed                  1     |
| Log likelihood function       -1878.437     |
| Number of parameters                  2     |
| Info. Criterion: AIC =          2.03621     |
|   Finite Sample: AIC =          2.03621     |
| Info. Criterion: BIC =          2.04219     |
| Info. Criterion:HQIC =          2.03841     |
| Restricted log likelihood     -1878.437     |
| McFadden Pseudo R-squared      .0000000     |
| Chi squared                   .3683454E-10  |
| Degrees of freedom                  14      |
| Prob[ChiSqd > value] =         1.000000     |
+---------------------------------------------+
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Characteristics in numerator of Prob[Y = 1]
 Constant|    1.06482161       .06575775    16.193   .0000
 SEX     |       .000000    .....(Fixed Parameter).......
 AGE     |       .000000    .....(Fixed Parameter).......
 EDUC    |       .000000    .....(Fixed Parameter).......
 RINCOM98|       .000000    .....(Fixed Parameter).......
 POLVIEWS|       .000000    .....(Fixed Parameter).......
 RELITEN |       .000000    .....(Fixed Parameter).......
 GOD     |       .000000    .....(Fixed Parameter).......
---------+Characteristics in numerator of Prob[Y = 2]
 Constant|     .71225604       .06922948    10.288   .0000
 SEX     |       .000000    .....(Fixed Parameter).......
 AGE     |       .000000    .....(Fixed Parameter).......
 EDUC    |       .000000    .....(Fixed Parameter).......
 RINCOM98|       .000000    .....(Fixed Parameter).......
 POLVIEWS|       .000000    .....(Fixed Parameter).......
 RELITEN |       .000000    .....(Fixed Parameter).......
 GOD     |       .000000    .....(Fixed Parameter).......
+-----------------------------------------------------------------------+
| Information Statistics for Discrete Choice Model.                     |
|                          M=Model MC=Constants Only   M0=No Model      |
| Criterion F (log L)    -1878.43738       -1878.43738   -2029.13690    |
| LR Statistic vs. MC        .00000            .00000        .00000     |
| Degrees of Freedom       14.00000            .00000        .00000     |
| Prob. Value for LR         .00000            .00000        .00000     |
| Entropy for probs.      1878.43738        1878.43738    2029.13690    |
| Normalized Entropy          .92573            .92573       1.00000    |
| Entropy Ratio Stat.      301.39904         301.39904        .00000     |
| Bayes Info Criterion       2.09105           2.09105       2.25424    |
| BIC(no model) - BIC         .16318            .16318        .00000     |
| Pseudo R-squared            .00000            .00000        .00000     |
| Pct. Correct Pred.        48.83595            .00000      33.33333     |
| Means:       y=0    y=1    y=2    y=3    y=4    y=5     y=6   y>=7     |
| Outcome     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000     |
| Pred.Pr     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000     |
| Notes: Entropy computed as Sum(i)Sum(j)Pfit(i,j)*logPfit(i,j).         |
|        Normalized entropy is computed against M0.                     |
|        Entropy ratio statistic is computed against M0.                |
|        BIC = 2*criterion - log(N)*degrees of freedom.                 |
|        If the model has only constants or if it has no constants,     |
|        the statistics reported here are not useable.                  |
+-----------------------------------------------------------------------+
Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted
```

Actual	0	1	2	Total
0	0	311	0	311
1	0	902	0	902
2	0	634	0	634
Total	0	1847	0	1847

```
--> Title; ORIGINAL MODEL Logit NBIBLE 2=word of God 1=Inspired Word, 0=Book of
Fables$

--> logit; lhs=nbible; rhs=one, sex, age, educ, rincom98, polviews, reliten, ...

Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Multinomial Logit Model                     |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 05, 2011 at 05:57:46PM.|
| Dependent variable                NBIBLE    |
| Weighting variable                  None    |
| Number of observations              1847    |
| Iterations completed                   6    |
| Log likelihood function       -1632.816     |
| Number of parameters                  16    |
| Info. Criterion: AIC =           1.78540    |
|   Finite Sample: AIC =           1.78556    |
| Info. Criterion: BIC =           1.83323    |
| Info. Criterion:HQIC =           1.80303    |
| Restricted log likelihood     -1878.437     |
| McFadden Pseudo R-squared      .1307585     |   Here is McFadden
| Chi squared                   491.2434      |
| Degrees of freedom                 14       |   You have 14 df b/c you have 2*7 slopes
| Prob[ChiSqd > value] =         .0000000     |
+---------------------------------------------+
THIS IS A CONTRAST BETWEEN BOOK OF FABLES (0) AND INSPIRED WORDS (1)
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Characteristics in numerator of Prob[Y = 1]
 Constant|    3.58635583       .55010463     6.519   .0000
 SEX     |     .30799638       .14829870     2.077   .0378    .57011370
 AGE     |    -.00400444       .00446875     -.896   .3702   45.9599350
 EDUC    |    -.11496748       .02768320    -4.153   .0000   13.3221440
 RINCOM98|     .02098482       .01029330     2.039   .0415   9.39361126
 POLVIEWS|     .12922948       .04579281     2.822   .0048   4.31727125
 RELITEN |    -.71291731       .06637084   -10.741   .0000   2.03681646
 GOD     |     .07145073       .03015337     2.370   .0178   1.80671359

THIS IS A CONTRAST BETWEEN BOOK OF FABLES (0) AND WORD OF GOD (2)

---------+Characteristics in numerator of Prob[Y = 2]
 Constant|    5.52256228       .61807759     8.935   .0000
 SEX     |     .57163413       .16720286     3.419   .0006    .57011370
 AGE     |    -.00350846       .00487915     -.719   .4721   45.9599350
 EDUC    |    -.28418987       .03197531    -8.888   .0000   13.3221440
 RINCOM98|     .00662968       .01171286      .566   .5714   9.39361126
 POLVIEWS|     .27308250       .05076926     5.379   .0000   4.31727125
 RELITEN |   -1.15768152       .08203908   -14.111   .0000   2.03681646
 GOD     |     .08544004       .03262193     2.619   .0088   1.80671359

+---------------------------------------------------------------------+
| Information Statistics for Discrete Choice Model.                   |
|                          M=Model MC=Constants Only   M0=No Model    |
| Criterion F (log L)    -1632.81570       -1878.43738   -2029.13690  |
| LR Statistic vs. MC      491.24335             .00000        .00000  |
| Degrees of Freedom        14.00000             .00000        .00000  |
| Prob. Value for LR          .00000             .00000        .00000  |
| Entropy for probs.      1632.81570        1878.43738    2029.13690  |
| Normalized Entropy          .80468             .92573       1.00000  |
| Entropy Ratio Stat.      792.64239          301.39904        .00000  |
| Bayes Info Criterion       1.82508            2.09105       2.25424  |
| BIC(no model) - BIC         .42915             .16318        .00000  |
| Pseudo R-squared            .13076             .00000        .00000  |
| Pct. Correct Pred.        59.55604             .00000      33.33333  |
| Means:       y=0    y=1    y=2    y=3    y=4    y=5     y=6   y>=7   |
| Outcome     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000   |
| Pred.Pr     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000   |
| Notes: Entropy computed as Sum(i)Sum(j)Pfit(i,j)*logPfit(i,j).       |
|        Normalized entropy is computed against M0.                   |
```

```
|        Entropy ratio statistic is computed against M0.              |
|        BIC = 2*criterion - log(N)*degrees of freedom.               |
|        If the model has only constants or if it has no constants,   |
|        the statistics reported here are not useable.                |
+---------------------------------------------------------------------+
Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted
------  --------------  +  -----
Actual       0    1    2  |  Total
------  --------------  +  -----
  0        115  166   30  |    311
  1         47  691  164  |    902
  2         10  330  294  |    634
------  --------------  +  -----
Total      172 1187  488  |   1847
```

You don't have to worry about the Information Statistics. In the box you will find several of the statistics that are listed earlier including the Log likelihood, Chi Squared (now named LR - or Likelihood Ratio -- Statistics vs. MC or Constant only Model) McFadden etc.

--> Title; **The difference the order of the categories in multinomial logit analysis makes$**

```
--> Title; Logit BIBLE 0=word of God 1=Inspired Word, 2=Book of Fables$
--> logit; lhs=bible; rhs=one, sex, age, educ, rincom98, polviews, reliten, god$

Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Multinomial Logit Model                     |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 05, 2011 at 06:32:43PM.|
| Dependent variable                BIBLE     |
| Weighting variable                 None     |
| Number of observations             1847     |    NOTE: NOTHING CHANGES HERE
| Iterations completed                  6     |
| Log likelihood function       -1632.816     |
| Number of parameters                 16     |
| Info. Criterion: AIC =          1.78540     |
|   Finite Sample: AIC =          1.78556     |
| Info. Criterion: BIC =          1.83323     |
| Info. Criterion:HQIC =          1.80303     |
| Restricted log likelihood     -1878.437     |
| McFadden Pseudo R-squared      .1307585     |
| Chi squared                   491.2434     |
| Degrees of freedom                   14     |
| Prob[ChiSqd > value] =         .0000000     |
+---------------------------------------------+
```

THIS IS A CONTRAST BETWEEN BOOK OF WORD OF GOD (0) AND INSPIRED WORDS (1)
NOTICE: WE DID NOT HAVE THIS CONTRAST IN THE PREVIOUS RUN BUT IT IS IMPLICIT.YOU CAN GET THESE COEFFICIENTS BY SUBTRACTION FROM THE PREVIOUS MODEL.
TAKE THE CONSTANT OF THE FIRST AND SECOND CONTRAST IN THE PREVIOUS MODEL AND SUBTRACT ONE FROM THE OTHER. YOU WILL GET THE CONSTANT BELOW
3.58635583- 5.52256228= -1.93620645
YOU CAN DO THE SAME THING WITH EACH SLOPE, E.G. FOR SEX
.30799638-.57163413= -.26363775 ETC.

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
Characteristics in numerator of Prob[Y = 1]					
Constant	-1.93620645	.42246868	-4.583	.0000	
SEX	-.26363775	.11748428	-2.244	.0248	.57011370
AGE	-.00049598	.00327744	-.151	.8797	45.9599350
EDUC	.16922240	.02251313	7.517	.0000	13.3221440
RINCOM98	.01435515	.00838766	1.711	.0870	9.39361126
POLVIEWS	-.14385302	.03408224	-4.221	.0000	4.31727125
RELITEN	.44476421	.06446059	6.900	.0000	2.03681646
GOD	-.01398931	.02040696	-.686	.4930	1.80671359

THIS IS A CONTRAST BETWEEN BOOK OF WORD OF GOD (0) AND BOOK OF FABLES(2)
NOTICE: WE DID HAVE THIS CONTRAST IN THE PREVIOUS RUN BUT IN REVERSE. HERE YOU HAVE THE EXACT SAME COEFFICIENTS WITH REVERSE SIGNS.

Characteristics in numerator of Prob[Y = 2]					
Constant	-5.52256228	.61807759	-8.935	.0000	
SEX	-.57163413	.16720286	-3.419	.0006	.57011370
AGE	.00350846	.00487915	.719	.4721	45.9599350
EDUC	.28418987	.03197531	8.888	.0000	13.3221440
RINCOM98	-.00662968	.01171286	-.566	.5714	9.39361126
POLVIEWS	-.27308250	.05076926	-5.379	.0000	4.31727125
RELITEN	1.15768152	.08203908	14.111	.0000	2.03681646
GOD	-.08544004	.03262193	-2.619	.0088	1.80671359

```
+---------------------------------------------------------------------+
| Information Statistics for Discrete Choice Model.                   |
|                          M=Model MC=Constants Only   M0=No Model    |
| Criterion F (log L)    -1632.81570       -1878.43738   -2029.13690  |
| LR Statistic vs. MC      491.24335            .00000        .00000  |
| Degrees of Freedom       14.00000            .00000        .00000  |
| Prob. Value for LR         .00000            .00000        .00000  |
| Entropy for probs.      1632.81570        1878.43738    2029.13690  |
| Normalized Entropy          .80468            .92573       1.00000  |
```

Entropy Ratio Stat.	792.64239	301.39904	.00000
Bayes Info Criterion	1.82508	2.09105	2.25424
BIC(no model) - BIC	.42915	.16318	.00000
Pseudo R-squared	.13076	.00000	.00000
Pct. Correct Pred.	59.55604	.00000	33.33333

Means:	y=0	y=1	y=2	y=3	y=4	y=5	y=6	y>=7
Outcome	.3433	.4884	.1684	.0000	.0000	.0000	.0000	.0000
Pred.Pr	.3433	.4884	.1684	.0000	.0000	.0000	.0000	.0000

Notes: Entropy computed as Sum(i)Sum(j)Pfit(i,j)*logPfit(i,j).
Normalized entropy is computed against M0.
Entropy ratio statistic is computed against M0.
BIC = 2*criterion - log(N)*degrees of freedom.
If the model has only constants or if it has no constants,
the statistics reported here are not useable.

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

	Predicted			
Actual	0	1	2	Total
0	294	330	10	634
1	164	691	47	902
2	30	166	115	311
Total	488	1187	172	1847

```
--> Title; Logit NBIBLE testing non-linearity for Education$

--> logit; lhs=nbible; rhs=one, sex, age, educ, educ2, rincom98, polviews, re...

Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Multinomial Logit Model                     |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 05, 2011 at 06:49:04PM.|
| Dependent variable               NBIBLE     |
| Weighting variable                 None     |
| Number of observations             1847     |
| Iterations completed                  6     |
| Log likelihood function       -1629.358     |
| Number of parameters                 18     |
| Info. Criterion: AIC =          1.78382     |
|   Finite Sample: AIC =          1.78402     |
| Info. Criterion: BIC =          1.83763     |
| Info. Criterion:HQIC =          1.80366     |
| Restricted log likelihood     -1878.437     |
| McFadden Pseudo R-squared      .1325990     |
| Chi squared                   498.1578      |  Compare to 491.2434
| Degrees of freedom                16        |  Compare to 14
| Prob[ChiSqd > value] =         .0000000     |  Adding EDUC2 raised ChiSqd by 6.9144
+---------------------------------------------+   with 2 df sig.at .05 but not .01
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Characteristics in numerator of Prob[Y = 1]
 Constant|      .58853435      1.21823552      .483   .6290
 SEX     |      .27062473       .14927340     1.813   .0698    .57011370
 AGE     |     -.00252952       .00451923     -.560   .5757   45.9599350
 EDUC    |      .32421578       .16401163     1.977   .0481   13.3221440
 EDUC2   |     -.01550818       .00577831    -2.684   .0073   185.545208
 RINCOM98|      .02028058       .01033645     1.962   .0498   9.39361126
 POLVIEWS|      .12631495       .04578495     2.759   .0058   4.31727125
 RELITEN |     -.71854306       .06674936   -10.765   .0000   2.03681646
 GOD     |      .06898454       .03023247     2.282   .0225   1.80671359
---------+Characteristics in numerator of Prob[Y = 2]
 Constant|     2.73631486      1.22673873     2.231   .0257
 SEX     |      .53560454       .16784051     3.191   .0014    .57011370
 AGE     |     -.00211483       .00492329     -.430   .6675   45.9599350
 EDUC    |      .12789382       .16753002      .763   .4452   13.3221440
 EDUC2   |     -.01470942       .00616942    -2.384   .0171   185.545208
 RINCOM98|      .00609138       .01174619      .519   .6041   9.39361126
 POLVIEWS|      .27012431       .05064428     5.334   .0000   4.31727125
 RELITEN |    -1.16158977       .08219672   -14.132   .0000   2.03681646
 GOD     |      .08290632       .03267628     2.537   .0112   1.80671359

+---------------------------------------------------------------------+
| Information Statistics for Discrete Choice Model.                   |
|                          M=Model MC=Constants Only   M0=No Model    |
| Criterion F (log L)    -1629.35846       -1878.43738   -2029.13690  |
| LR Statistic vs. MC      498.15784           .00000        .00000   |
| Degrees of Freedom        16.00000           .00000        .00000   |
| Prob. Value for LR          .00000           .00000        .00000   |
| Entropy for probs.      1629.35846        1878.43738    2029.13690  |
| Normalized Entropy          .80298           .92573       1.00000  |
| Entropy Ratio Stat.      799.55688         301.39904        .00000   |
| Bayes Info Criterion       1.82948           2.09920       2.26238  |
| BIC(no model) - BIC         .43289           .16318        .00000   |
| Pseudo R-squared            .13260           .00000        .00000   |
| Pct. Correct Pred.        59.71846           .00000      33.33333   |
| Means:       y=0    y=1    y=2    y=3    y=4    y=5     y=6   y>=7  |
| Outcome     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000  |
| Pred.Pr     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000  |
| Notes: Entropy computed as Sum(i)Sum(j)Pfit(i,j)*logPfit(i,j).       |
|        Normalized entropy is computed against M0.                   |
|        Entropy ratio statistic is computed against M0.              |
|        BIC = 2*criterion - log(N)*degrees of freedom.               |
|        If the model has only constants or if it has no constants,   |
```

```
|        the statistics reported here are not useable.                |
+---------------------------------------------------------------------+
Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

             Predicted
------  ---------------  +  -----
Actual       0    1    2  |  Total
------  ---------------  +  -----
  0        112  168   31  |    311
  1         42  696  164  |    902
  2         10  329  295  |    634
------  ---------------  +  -----
Total      164 1193  490  |   1847
```

```
--> Title; Logit NBIBLE testing interaction between Age and Political Views$

--> logit; lhs=nbible; rhs=one, sex, age, agexpol, educ, rincom98, polviews, ...

Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Multinomial Logit Model                     |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 05, 2011 at 06:58:06PM.|
| Dependent variable               NBIBLE     |
| Weighting variable                 None     |
| Number of observations             1847     |
| Iterations completed                  6     |
| Log likelihood function       -1630.366     |
| Number of parameters                 18     |
| Info. Criterion: AIC =          1.78491     |
|   Finite Sample: AIC =          1.78511     |
| Info. Criterion: BIC =          1.83872     |
| Info. Criterion:HQIC =          1.80475     |
| Restricted log likelihood     -1878.437     |
| McFadden Pseudo R-squared      .1320625     |
| Chi squared                   496.1424      |   Compare to 491.2434
| Degrees of freedom                16        |   Compare to 14
| Prob[ChiSqd > value] =         .0000000     | Adding AGEXPOL raised ChiSqd by 4.899
+---------------------------------------------+   with 2 df not sig. at .05 overall
+--------+--------------+----------------+--------+--------+----------+
|Variable| Coefficient  | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+--------------+----------------+--------+--------+----------+
---------+Characteristics in numerator of Prob[Y = 1]
 Constant|    2.76112167       .71179224     3.879   .0001
 SEX     |     .29866669       .14854707     2.011   .0444    .57011370
 AGE     |     .01560437       .01174768     1.328   .1841   45.9599350
 EDUC    |    -.11457049       .02767934    -4.139   .0000   13.3221440
 AGEXPOL |    -.00496163       .00270687    -1.833   .0668  200.874932
 RINCOM98|     .01927285       .01035418     1.861   .0627   9.39361126
 POLVIEWS|     .34992469       .13039308     2.684   .0073   4.31727125
 RELITEN |    -.72017958       .06668369   -10.800   .0000   2.03681646
 GOD     |     .07229928       .03024109     2.391   .0168   1.80671359
---------+Characteristics in numerator of Prob[Y = 2]
 Constant|    4.36616312       .80971977     5.392   .0000
 SEX     |     .56166794       .16746091     3.354   .0008    .57011370
 AGE     |     .02317548       .01311220     1.767   .0771   45.9599350
 EDUC    |    -.28356136       .03195840    -8.873   .0000   13.3221440
 AGEXPOL |    -.00650429       .00293177    -2.219   .0265  200.874932
 RINCOM98|     .00472648       .01177196      .402   .6880   9.39361126
 POLVIEWS|     .56733038       .14389636     3.943   .0001   4.31727125
 RELITEN |   -1.16711152       .08239789   -14.164   .0000   2.03681646
 GOD     |     .08582147       .03271474     2.623   .0087   1.80671359

+-----------------------------------------------------------------------+
| Information Statistics for Discrete Choice Model.                     |
|                          M=Model MC=Constants Only   M0=No Model      |
| Criterion F (log L)    -1630.36619       -1878.43738   -2029.13690    |
| LR Statistic vs. MC      496.14239            .00000        .00000    |
| Degrees of Freedom        16.00000            .00000        .00000    |
| Prob. Value for LR          .00000            .00000        .00000    |
| Entropy for probs.      1630.36619        1878.43738    2029.13690    |
| Normalized Entropy          .80348            .92573       1.00000    |
| Entropy Ratio Stat.      797.54142         301.39904        .00000    |
| Bayes Info Criterion       1.83058           2.09920       2.26238    |
| BIC(no model) - BIC         .43180            .16318        .00000    |
| Pseudo R-squared            .13206            .00000        .00000    |
| Pct. Correct Pred.        59.23119            .00000      33.33333    |
| Means:       y=0    y=1    y=2    y=3    y=4    y=5     y=6   y>=7    |
| Outcome     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000    |
| Pred.Pr     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000    |
| Notes: Entropy computed as Sum(i)Sum(j)Pfit(i,j)*logPfit(i,j).        |
|        Normalized entropy is computed against M0.                     |
|        Entropy ratio statistic is computed against M0.                |
|        BIC = 2*criterion - log(N)*degrees of freedom.                 |
|        If the model has only constants or if it has no constants,     |
```

```
|       the statistics reported here are not useable.               |
+-------------------------------------------------------------------+
Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted
------  --------------  +  -----
Actual      0    1    2  |  Total
------  --------------  +  -----
  0       111  172   28  |    311
  1        48  687  167  |    902
  2        10  328  296  |    634
------  --------------  +  -----
Total     169 1187  491  |   1847
--> Title; Imposing model restrictions$

--> Title; Test of the equality of the effect of Education and Age$

--> logit; lhs=nbible; rhs=one, sex, age, educ, rincom98, polviews, reliten, ...
    rst:b0,b1,b2,b2,b4,b5,b6,b7,b8,b9,b10,b10,b12,b13,b14,b15$
Normal exit from iterations. Exit status=0.

+-----------------------------------------------+
| Multinomial Logit Model                       |
| Maximum Likelihood Estimates                  |
| Model estimated: Feb 05, 2011 at 07:06:13PM.  |
| Dependent variable                  NBIBLE    |
| Weighting variable                    None    |
| Number of observations                1847    |
| Iterations completed                     6    |
| Log likelihood function          -1681.397    |
| Number of parameters                    14    |
| Info. Criterion: AIC =             1.83584    |
|   Finite Sample: AIC =             1.83596    |
| Info. Criterion: BIC =             1.87769    |
| Info. Criterion:HQIC =             1.85127    |
| Restricted log likelihood        -1878.437    |
| McFadden Pseudo R-squared         .1048956    |
| Chi squared                      394.0798     |
| Degrees of freedom                      14    |
| Prob[ChiSqd > value] =            .0000000    |
+-----------------------------------------------+
```

*This is wrong. It should be **12** (14-2) We estimate only 12 parameters because we estimate only 1 parameter for each pair of AGE and EDUC.*

Compare to 491.2434 in the orginal model

491.2434-394.0798= 97.1636 Change in ChiSqd is 97.1636 with 14-12=2 df. It is highly significant

GETTING ONE YEAR OLDER (AGE) DOES NOT HAVE THE SAME EFFECT AS GETTING ONE YEAR MORE EDUCATION (EDUC)

```
+--------+-------------+----------------+--------+--------+----------+
|Variable| Coefficient | Standard Error |b/St.Er.|P[|Z|>z]| Mean of X|
+--------+-------------+----------------+--------+--------+----------+
---------+Characteristics in numerator of Prob[Y = 1]
 Constant|    2.31386070       .43299218     5.344   .0000
 SEX     |     .29630100       .14673592     2.019   .0435    .57011370
 AGE     |    -.00779646       .00432888    -1.801   .0717   45.9599350
 EDUC    |    -.00779646       .00432888    -1.801   .0717   13.3221440
 RINCOM98|     .00750617       .00972582      .772   .4402   9.39361126
 POLVIEWS|     .14983492       .04497644     3.331   .0009   4.31727125
 RELITEN |    -.71275598       .06598437   -10.802   .0000   2.03681646
 GOD     |     .07400205       .02984445     2.480   .0132   1.80671359
---------+Characteristics in numerator of Prob[Y = 2]
 Constant|    2.24481041       .47232390     4.753   .0000
 SEX     |     .47782257       .16246950     2.941   .0033    .57011370
 AGE     |    -.00916887       .00467765    -1.960   .0500   45.9599350
 EDUC    |    -.00916887       .00467765    -1.960   .0500   13.3221440
 RINCOM98|    -.03024750       .01079725    -2.801   .0051   9.39361126
 POLVIEWS|     .31692920       .04921161     6.440   .0000   4.31727125
 RELITEN |   -1.12168678       .07950501   -14.108   .0000   2.03681646
 GOD     |     .08848465       .03193100     2.771   .0056   1.80671359

+-------------------------------------------------------------------+
| Information Statistics for Discrete Choice Model.                 |
|                          M=Model MC=Constants Only   M0=No Model  |
| Criterion F (log L)   -1681.39748      -1878.43738   -2029.13690  |
| LR Statistic vs. MC     394.07981            .00000        .00000 |
```

```
| Degrees of Freedom        14.00000            .00000        .00000 |
| Prob. Value for LR          .00000            .00000        .00000 |
| Entropy for probs.      1681.39748        1878.43738    2029.13690 |
| Normalized Entropy          .82863            .92573       1.00000 |
| Entropy Ratio Stat.       695.47884         301.39904        .00000 |
| Bayes Info Criterion        1.87769           2.09105       2.25424 |
| BIC(no model) - BIC          .37655            .16318        .00000 |
| Pseudo R-squared            .10490            .00000        .00000 |
| Pct. Correct Pred.        57.06551            .00000      33.33333 |
| Means:       y=0    y=1    y=2    y=3    y=4    y=5     y=6   y>=7 |
| Outcome     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000 |
| Pred.Pr     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000 |
| Notes: Entropy computed as Sum(i)Sum(j)Pfit(i,j)*logPfit(i,j).     |
|        Normalized entropy is computed against M0.                  |
|        Entropy ratio statistic is computed against M0.             |
|        BIC = 2*criterion - log(N)*degrees of freedom.              |
|        If the model has only constants or if it has no constants,  |
|        the statistics reported here are not useable.               |
+--------------------------------------------------------------------+
Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted
------  ---------------  +  -----
Actual      0    1    2  |  Total
------  ---------------  +  -----
  0       107  178   26  |    311
  1        51  692  159  |    902
  2        13  366  255  |    634
------  ---------------  +  -----
Total     171 1236  440  |   1847
```

```
--> Title; Test of the equality of the coefficient for GOD across
alternatives$

--> Title; Test of the equality of the coefficient for GOD across alternatives$
--> logit; lhs=nbible; rhs=one, sex, age, educ, rincom98, polviews, reliten, ...
    rst:b0,b1,b2,b3,b4,b5,b6,b7,b8,b9,b10,b11,b12,b13,b14,b7$
Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Multinomial Logit Model                     |
| Maximum Likelihood Estimates                |
| Model estimated: Mar 05, 2011 at 06:34:46PM.|
| Dependent variable               NBIBLE     |
| Weighting variable                 None     |
| Number of observations             1847     |
| Iterations completed                  6     |
| Log likelihood function       -1633.050     |
| Number of parameters                 15     |
| Info. Criterion: AIC =          1.78457     |
|   Finite Sample: AIC =          1.78471     |
| Info. Criterion: BIC =          1.82941     |
| Info. Criterion:HQIC =          1.80110     |
| Restricted log likelihood     -1878.437     |
| McFadden Pseudo R-squared      .1306335     |
| Chi squared                   490.7739      |
| Degrees of freedom                14        |
| Prob[ChiSqd > value] =         .0000000     |
+---------------------------------------------+
```

Compare to 491.2434 in the orginal model

This is wrong. It should be 13 (14-1)

491.2434-490.7739= 0.4695

Change in ChiSqd is 0.4695 with 14-13=1 df. It is NOT significant.

GOD DOES HAVE THE SAME EFFECT IN THE TWO CONTRASTS.

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
Characteristics in numerator of Prob[Y = 1]					
Constant	3.57459439	.55003605	6.499	.0000	
SEX	.30766591	.14833013	2.074	.0381	.57011370
AGE	-.00401821	.00447000	-.899	.3687	45.9599350
EDUC	-.11474329	.02769033	-4.144	.0000	13.3221440
RINCOM98	.02099821	.01029574	2.040	.0414	9.39361126
POLVIEWS	.12886783	.04580006	2.814	.0049	4.31727125
RELITEN	-.71177799	.06637145	-10.724	.0000	2.03681646
GOD	.07580876	.02944756	2.574	.0100	1.80671359
Characteristics in numerator of Prob[Y = 2]					
Constant	5.53898579	.61759961	8.969	.0000	
SEX	.57198786	.16713930	3.422	.0006	.57011370
AGE	-.00347233	.00487690	-.712	.4765	45.9599350
EDUC	-.28398746	.03196489	-8.884	.0000	13.3221440
RINCOM98	.00664041	.01170839	.567	.5706	9.39361126
POLVIEWS	.27283535	.05075187	5.376	.0000	4.31727125
RELITEN	-1.15867341	.08200804	-14.129	.0000	2.03681646
GOD	.07580876	.02944756	2.574	.0100	1.80671359

```
+---------------------------------------------------------------------+
| Information Statistics for Discrete Choice Model.                   |
|                          M=Model MC=Constants Only   M0=No Model    |
| Criterion F (log L)    -1633.05044       -1878.43738   -2029.13690  |
| LR Statistic vs. MC      490.77388           .00000        .00000   |
| Degrees of Freedom        14.00000           .00000        .00000   |
| Prob. Value for LR          .00000           .00000        .00000   |
| Entropy for probs.      1633.05044        1878.43738    2029.13690  |
| Normalized Entropy          .80480           .92573       1.00000  |
| Entropy Ratio Stat.      792.17291         301.39904        .00000  |
| Bayes Info Criterion       1.82534           2.09105       2.25424  |
| BIC(no model) - BIC         .42890           .16318        .00000   |
| Pseudo R-squared            .13063           .00000        .00000   |
| Pct. Correct Pred.        59.61018           .00000      33.33333   |
| Means:       y=0    y=1    y=2    y=3    y=4    y=5     y=6   y>=7  |
| Outcome     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000  |
| Pred.Pr     .1684  .4884  .3433  .0000  .0000  .0000  .0000  .0000  |
| Notes: Entropy computed as Sum(i)Sum(j)Pfit(i,j)*logPfit(i,j).       |
|        Normalized entropy is computed against M0.                   |
```

```
|        Entropy ratio statistic is computed against M0.              |
|        BIC = 2*criterion - log(N)*degrees of freedom.               |
|        If the model has only constants or if it has no constants,   |
|        the statistics reported here are not useable.                |
+---------------------------------------------------------------------+
Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

            Predicted
------  --------------  +  -----
Actual       0    1    2  |  Total
------  --------------  +  -----
  0        116  164   31  |    311
  1         47  690  165  |    902
  2         10  329  295  |    634
------  --------------  +  -----
Total      173 1183  491  |   1847


--> Title; Test of the irrelevant alternatives$

--> logit; lhs=nbible; rhs=one, sex, age, educ, rincom98, polviews, reliten, ...
    rst:b0,b1,b2,b3,b4,b5,b6,b7,b8,b1,b2,b3,b4,b5,b6,b7$

Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Multinomial Logit Model                     |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 05, 2011 at 11:15:10PM.|
| Dependent variable               NBIBLE     |
| Weighting variable                 None     |
| Number of observations             1847     |
| Iterations completed                  6     |
| Log likelihood function       -1725.011     |
| Number of parameters                  9     |
| Info. Criterion: AIC =           1.87765    |
|   Finite Sample: AIC =           1.87770    |
| Info. Criterion: BIC =           1.90456    |
| Info. Criterion:HQIC =           1.88757    |
| Restricted log likelihood     -1878.437     |
| McFadden Pseudo R-squared      .0816775     |
| Chi squared                   306.8521      |
| Degrees of freedom                 14       |
| Prob[ChiSqd > value] =         .0000000     |
+---------------------------------------------+
```

Compare to 491.2434 in the orginal model

This is wrong. It should be 7.

491.2434-306.8521=184.3913

Change in ChiSqd is 184.3913 with 14-7=7 df. It is highly significant

THERE IS A DIFFERENCE BETWEEN BELIEVING THAT THE BIBLE IS A BOOK OF FABLES AND A BOOK OF INSPIRED WORDS.

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
Characteristics in numerator of Prob[Y = 1]					
Constant	4.22742224	.53474627	7.905	.0000	
SEX	.37991391	.14482659	2.623	.0087	.57011370
AGE	-.00312567	.00433353	-.721	.4707	45.9599350
EDUC	-.16317584	.02683647	-6.080	.0000	13.3221440
RINCOM98	.01655306	.01007249	1.643	.1003	9.39361126
POLVIEWS	.17070677	.04452187	3.834	.0001	4.31727125
RELITEN	-.83827253	.06458999	-12.978	.0000	2.03681646
GOD	.07485256	.02947129	2.540	.0111	1.80671359
Characteristics in numerator of Prob[Y = 2]					
Constant	3.87485667	.53518428	7.240	.0000	
SEX	.37991391	.14482659	2.623	.0087	.57011370
AGE	-.00312567	.00433353	-.721	.4707	45.9599350
EDUC	-.16317584	.02683647	-6.080	.0000	13.3221440
RINCOM98	.01655306	.01007249	1.643	.1003	9.39361126
POLVIEWS	.17070677	.04452187	3.834	.0001	4.31727125
RELITEN	-.83827253	.06458999	-12.978	.0000	2.03681646
GOD	.07485256	.02947129	2.540	.0111	1.80671359

The constants are not equal!

Information Statistics for Discrete Choice Model.

	M=Model	MC=Constants Only	M0=No Model
Criterion F (log L)	-1725.01133	-1878.43738	-2029.13690
LR Statistic vs. MC	306.85210	.00000	.00000
Degrees of Freedom	14.00000	.00000	.00000
Prob. Value for LR	.00000	.00000	.00000
Entropy for probs.	1725.01133	1878.43738	2029.13690
Normalized Entropy	.85012	.92573	1.00000
Entropy Ratio Stat.	608.25113	301.39904	.00000
Bayes Info Criterion	1.92492	2.09105	2.25424
BIC(no model) - BIC	.32932	.16318	.00000
Pseudo R-squared	.08168	.00000	.00000
Pct. Correct Pred.	51.70547	.00000	33.33333

Means:	y=0	y=1	y=2	y=3	y=4	y=5	y=6	y>=7
Outcome	.1684	.4884	.3433	.0000	.0000	.0000	.0000	.0000
Pred.Pr	.1684	.4884	.3433	.0000	.0000	.0000	.0000	.0000

Notes: Entropy computed as Sum(i)Sum(j)Pfit(i,j)*logPfit(i,j).
Normalized entropy is computed against M0.
Entropy ratio statistic is computed against M0.
BIC = 2*criterion - log(N)*degrees of freedom.
If the model has only constants or if it has no constants, the statistics reported here are not useable.

Frequencies of actual & predicted outcomes
Predicted outcome has maximum probability.

Actual	Predicted 0	1	2	Total
0	138	173	0	311
1	85	817	0	902
2	16	618	0	634
Total	239	1608	0	1847

```
--> Title; Ordered logit NBIBLE 2=word of God 1=Inspired Word, 0=Book of Fables$

--> ordered; lhs=nbible; rhs=one, sex, age, educ, rincom98, polviews, reliten...
Normal exit from iterations. Exit status=0.
+---------------------------------------------+
| Ordered Probability Model                   |
| Maximum Likelihood Estimates                |
| Model estimated: Feb 05, 2011 at 11:38:15PM.|
| Dependent variable               NBIBLE     |
| Weighting variable                 None     |
| Number of observations             1847     |
| Iterations completed                 15     |
| Log likelihood function       -1636.842     |
| Number of parameters                  9      |
| Info. Criterion: AIC =          1.78218      |
|   Finite Sample: AIC =          1.78223      |
| Info. Criterion: BIC =          1.80908      |
| Info. Criterion:HQIC =          1.79210      |
| Restricted log likelihood     -1878.437      |
| McFadden Pseudo R-squared      .1286150      |
| Chi squared                   483.1903      |
| Degrees of freedom                 7        |
| Prob[ChiSqd > value] =         .0000000     |
| Underlying probabilities based on Logistic  |
+---------------------------------------------+
```

Compare to 491.2434 in the orginal model
Compare to df. 14
491.2434-483.1903= 8.0531
Change in ChiSqd is 8.0531 with 14-7=7 df. It is NOT significant

THE CATEGORIES ARE ORDERED. THERE IS NO SIGNFICANT DIFFERENCE BETWEEN THE MODEL THAT ASSUMES THAT THE CATEGORIES ARE UNORDERED AND ONE THAT ASSUMES THAT THEY ARE.

```
+---------------------------------------------+
| Ordered Probability Model                   |
| Cell frequencies for outcomes               |
|  Y Count Freq  Y Count Freq  Y Count Freq   |
|  0   311 .168  1   902 .488  2   634 .343   |
+---------------------------------------------+
```

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
Index function for probability					
Constant	4.93416736	.37101407	13.299	.0000	
SEX	.36260713	.09810893	3.696	.0002	.57011370
AGE	-.00075459	.00280797	-.269	.7881	45.9599350
EDUC	-.18713870	.01852006	-10.105	.0000	13.3221440
RINCOM98	.00018820	.00692665	.027	.9783	9.39361126
POLVIEWS	.17460937	.02948371	5.922	.0000	4.31727125
RELITEN	-.73708164	.04940047	-14.921	.0000	2.03681646
GOD	.03939569	.01780367	2.213	.0269	1.80671359
Threshold parameters for index					
Mu(1)	2.76397117	.08497123	32.528	.0000	

Cross tabulation of predictions. Row is actual, column is predicted.
Model = Logistic . Prediction is number of the most probable cell.

Actual	Row Sum	0	1	2	3	4	5	6	7	8	9
0	311	89	196	26							
1	902	37	696	169							
2	634	6	328	300							
Col Sum	1847	132	1220	495	0	0	0	0	0	0	0

General Ordered Logistic/Ordinal Logit Model
(J Ordered Outcomes)

$$\Pr(Y=0) = L[\mu_0 - \sum \beta x] = L[-\sum \beta x]$$

Since $\mu_0=0$

$$\Pr(Y=1) = L[\mu_1 - \sum \beta x] - L[-\sum \beta x]$$

$$\Pr(Y=2) = L[\mu_2 - \sum \beta x] - L[\mu_1 - \sum \beta x]$$

$$\Pr(Y=3) = L[\mu_3 - \sum \beta x] - L[\mu_2 - \sum \beta x]$$

$$\Pr(Y=4) = L[\mu_4 - \sum \beta x] - L[\mu_3 - \sum \beta x]$$

……..

$$\Pr(Y=J) = 1 - L[\mu_{j-1} - \sum \beta x]$$

Three ordered outcomes

$$\Pr(Y=0) = L[-\sum \beta x]$$

$$\Pr(Y=1) = L[\mu_1 - \sum \beta x] - L[-\sum \beta x]$$

$$\Pr(Y=2) = 1 - L[\mu_1 - \sum \beta x]$$

Prose:

You start with a predicted value $\Sigma\beta X$. Σ stands for: sum! β for each slope, X for the value of the independent variable.

You calculate the *cumulative logodds* by subtracting this prediction from μ for each category except for the last one.

The μs are given in the output except for the first category, μ_0, which is always 0.(If you have C ordered categories, you will get C-2 μs.)

You have to turn the cumulative logodds into cumulative probabilities. This is what L stands for: take this logodds, turn it into odds and then into probabilities!

Finally, you have to turn the cumulative probabilities into simple probabilities.

Y=0 Book of fables Y=1 Inspired Word Y=2 Word of God

Suppose we take a person who is a **FEMALE** (SEX=1), 45 years old (AGE=45), has two years of college (EDUC=14), has an income just above the average (RINCOM98=10), politically right in the center (POLVIEWS=5), somewhat religious (RELITEN=2) and tends to believe there is a a little more than the average (GOD=2).

What are the probabilities?

Pr(Y=0)=L[-Σβx]

Σβx = 4.934167363 + .3626071277 *SEX- .0007545942856*AGE- .1871387001*EDUC
+.0001882013823*RINCOM98+ .1746093736*POLVIEWS- .7370816406*RELITEN +.03939569289*GOD
Σβx = 4.934167363 +.3626071277 *1-.0007545942856*45 -.1871387001*14
+.0001882013823*10 +.1746093736*5 -.7370816406*2
+.03939569289*2 = 2.122433
L[-Σβx]=L[-2.122433] L is an operator that says: whatever follows me is a logodds, turn it into a probability.

Logodds= -2.122433 → odds= $e^{-2.122433}$=.1197 → CumProb=.1197/(1+.1197)=.1069
Pr(Y=0)= .1069 ≈ 11%

Pr(Y=1)=L[μ_1-Σβx]- L[-Σβx]

=L[2.763971174-2.122433]-L[-2.122433]= L[0.641538174]-L[-2.122433]

Logodds= 0.641538174 → odds=$e^{0.641538174}$ =1.8994 →CumProb=1.8994 /(1+1.8994)=.6551
Pr(Y=1) =.6551-.1069=.5482 ≈ 55%

Pr(Y=2)=1- L[μ_1-Σβx]

Pr(Y=2) =1-.6551=.3449 ≈ 34%

Suppose we take the same person but now he is a **MALE** (SEX=0)

What are the probabilities?

Pr(Y=0)=L[-Σβx]

Σβx = 4.934167363 +.3626071277 ***0**-.0007545942856*45 -.1871387001*14
+.0001882013823*10 +.1746093736*5 -.7370816406*2
+.03939569289*2 = 1.759826
L[-1.759826]
Logodds= **-**1.759826 → $e^{-1.759826}$ =.1721 → CumProb= .1721/(1+.1721)=.1468
Pr(Y=0)= .1468 ≈ 15%

Pr(Y=1)=L[μ_1-Σβx]- L[-Σβx]

=L[2.763971174-1.759826]-L[-1.759826]= L[1.004145174]-L[-1.759826] =.7318-.1468=.5850
Pr(Y=1) = .585≈ 59%

Pr(Y=2)=1- L[μ_1-Σβx]

Pr(Y=2)=1-.7318=.2682 ≈ 27%

	Female	Male
Book of Fables	**11%**	**15%**
Inspired Word	**55%**	**59%**
Word of God	**34%**	**27%**
Total	**100%**	**101%** (rounding error)

```
--> Title; Confidence in Science$

--> Title; Logit Confidence in science$
--> logit; lhs=confsci; rhs=one, sex, age, educ, rincom98, polviews, reliten,...

Normal exit from iterations. Exit status=0.

            +--------------------------------------------+
            | Multinomial Logit Model                    |
            | Maximum Likelihood Estimates               |
            | Dependent variable              CONFSCI    |
            | Weighting variable                  ONE    |
            | Number of observations             1056    |
            | Iterations completed                  6    |
            | Log likelihood function       -925.8770    |
            | Restricted log likelihood     -963.4007    |
            | Chi-squared                    75.04722    |
            | Degrees of freedom                   14    |
            | Significance level             .0000000    |
            +--------------------------------------------+
+---------+-------------+----------------+--------+---------+----------+
|Variable | Coefficient | Standard Error |b/St.Er.|P[|Z|>z] | Mean of X|
+---------+-------------+----------------+--------+---------+----------+
         Characteristics in numerator of Prob[Y = 1]
 Constant  .8336465967      .88922026         .938   .3485
 SEX       .2391257147      .25345772         .943   .3454  .55492424
 AGE       .5221962573E-02  .72619260E-02     .719   .4721  44.642992
 EDUC      .1027760285      .46811377E-01    2.196   .0281  13.584280
 RINCOM98  .2882301836E-01  .18313069E-01    1.574   .1155  9.8892045
 POLVIEWS -.1744255829      .70303548E-01   -2.481   .0131  4.3096591
 RELITEN  -.1152077280      .12454771        -.925   .3550  2.0577652
 GOD       .3772148522E-01  .50699414E-01     .744   .4569  1.4820076
         Characteristics in numerator of Prob[Y = 2]
 Constant -1.075032024      .90706898       -1.185   .2359
 SEX       .1424398810      .25661690         .555   .5788  .55492424
 AGE       .4710251504E-02  .73989491E-02     .637   .5244  44.642992
 EDUC      .2259745576      .48069713E-01    4.701   .0000  13.584280
 RINCOM98  .2458170598E-01  .18434450E-01    1.333   .1824  9.8892045
 POLVIEWS -.1976505294      .71747885E-01   -2.755   .0059  4.3096591
 RELITEN   .1024213267      .12428037         .824   .4099  2.0577652
 GOD       .2635197659E-01  .51536589E-01     .511   .6091  1.4820076


            Predicted
------  --------------  +  -----
Actual      0    1    2  |  Total
------  --------------  +  -----
  0         1   56   25  |     82
  1         0  310  179  |    489
  2         0  213  272  |    485
------  --------------  +  -----
Total       1  579  476  |   1056
```

```
--> Title; Ordered Logit Confidence in science$

--> ordered; lhs=confsci; rhs=one, sex, age, educ, rincom98, polviews, relite...

Normal exit from iterations. Exit status=0.

+---------------------------------------------+
| Ordered Probit Model                        |
| Maximum Likelihood Estimates                |
| Dependent variable              CONFSCI     |
| Weighting variable                  ONE     |
| Number of observations             1056     |
| Iterations completed                 13     |
| Log likelihood function         -931.7901   |
| Restricted log likelihood       -963.4007   |
| Chi-squared                      63.22104   |
| Degrees of freedom                      7   |
| Significance level              .0000000    |
|    Cell frequencies for outcomes            |
|  Y Count Freq  Y Count Freq  Y Count Freq   |
|  0    82 .077  1   489 .463  2   485 .459   |
| Logistic Probability Model                  |
+---------------------------------------------+
```

Compare with 75.04722

Compare with 14.

Variable	Coefficient	Standard Error	b/St.Er.	P[|Z|>z]	Mean of X
	Index function for probability				
Constant	.5552447674	.45352059	1.224	.2208	
SEX	-.2240893868E-01	.12771061	-.175	.8607	.55492424
AGE	.8788514607E-03	.37422102E-02	.235	.8143	44.642992
EDUC	.1407969548	.22912506E-01	6.145	.0000	13.584280
RINCOM98	.3951597129E-02	.88880075E-02	.445	.6566	9.8892045
POLVIEWS	-.7227514916E-01	.37727604E-01	-1.916	.0554	4.3096591
RELITEN	.1681205504	.59331424E-01	2.834	.0046	2.0577652
GOD	.8659613764E-03	.24887553E-01	.035	.9722	1.4820076
	Threshold parameters for index				
Mu(1)	2.744624139	.12122241	22.641	.0000	

	Predicted			
Actual	0	1	2	Total
0	0	65	17	82
1	0	308	181	489
2	0	216	269	485
Total	0	589	467	1056

Y=0 Little Y=1 Some Y=2 A lot

Suppose we take a person who is a female (SEX=1), 45 years old (AGE=45), has **TWO YEARS OF COLLEGE** (EDUC=14), has an income just above the average (RINCOM98=10), politically right in the center (POLVIEWS=5), somewhat religious (RELITEN=2) and tends to believe there is a a little more than the average (GOD=2).

What are the probabilities?

Pr(Y=0)=L[-Σβx]

Σβx = 2.559655

L[-Σβx]=L[-2.559655]

Logodds= -2.559655→ odds= $e^{-2.559655}$=.0773 → CumProb=.0773/(1+.0773)=.-0718

Pr(Y=0)= .0718 ≈ 7%

Pr(Y=1)=L[μ_1-Σβx]- L[-Σβx]

=L[2.744624139 -2.559655]-L[-2.559655]= L[0.184969]-L[-2.122433]

Logodds= 0.184969 → odds=e 0.184969=1.2032 →CumProb=1.2032 /(1+1.2032)=.5461

Pr(Y=1) =.5461-.0718=.4743 ≈ 47%

Pr(Y=2)=1- L[μ_1-Σβx]
Pr(Y=2) =1-.5446=.4554 ≈ 46%

Suppose we take the same person but now she has **A MASTERS DEGREE** (EDUC=16)
What are the probabilities?

Pr(Y=0)=L[-Σβx]
Σβx = 3.122843
L[-3.122843]
Logodds= -3.122843 → $e^{-3.122843}$ =.0440 → CumProb= .0440/(1+.0440)=.0422
Pr(Y=0)= .0422 ≈ 4%

Pr(Y=1)=L[μ_1-Σβx]- L[-Σβx]
=L[2.744624139 -3.122843]-L[-3.122843]= L[-0.3782189]-L[-3.122843] =.4066-.0422=.3644
Pr(Y=1) = .3644≈ 36%

Pr(Y=2)=1- L[μ_1-Σβx]
Pr(Y=2)=1-.4066=.5934 ≈ 59%

	2 year college	Masters
Little	**7%**	**4%**
Some	**47%**	**36%**
A lot	**46%**	**59%**
Total	**100%**	**99% (rounding error)**