AB Final Exercise B: Data from Goldin *et al* (1955)

```
options ls=95 ps=48;
data one;
  input amet sixm y @@; n=8; rat=y/n; datalines;
 38    0.0 0  50    0.0 0  67    0.0 1  90    0.0 0 120    0.0 1 160    0.0 1
213    0.0 6 284    0.0 5 379    0.0 7 506    0.0 8 675    0.0 8 900    0.0 8
  0   90.0 0   0  120.0 0   0  160.0 0   0  213.0 0   0  284.0 0   0  379.0 2
  0  506.0 3   0  675.0 2   0  900.0 6   0 1200.0 8   0 1600.0 8
 38    5.1 0  50    6.7 0  67    9.0 0  90   12.0 1 120   16.0 2 160   21.0 2
213   28.0 5 284   38.0 6 379   50.0 7 506   67.0 8 675   90.0 8 900  120.0 8
 28   28.0 1  38   38.0 1  50   50.0 2  67   67.0 0  90   90.0 0 120  120.0 4
160  160.0 5 213  213.0 7 284  284.0 8 379  379.0 8 506  506.0 8 675  675.0 8
  9   67.0 0  12   90.0 0  16  120.0 0  21  160.0 1  28  213.0 4  38  284.0 7
 50  379.0 7  67  506.0 7  90  675.0 8 120  900.0 8 160 1200.0 8
;
data one; set one;
  if amet=0 then amet=0.00000000000000000000001;
  if sixm=0 then sixm=0.00000000000000000000001;
data onea; set one; if amet le 1; drug='sixm'; x=sixm; drop amet sixm;   ** amet is zero here **;
data oneb; set one; if sixm le 1; drug='amet'; x=amet; drop amet sixm;   ** sixm is zero here **;
data oneab; set onea oneb;                                               ** no combined doses here **;
   dumsixm=(drug='sixm'); dumamet=(drug='amet');
proc print; run;
```

Obs	y	n	rat	drug	x	dumsixm	dumamet
1	0	8	0.000	sixm	90	1	0
2	0	8	0.000	sixm	120	1	0
3	0	8	0.000	sixm	160	1	0
4	0	8	0.000	sixm	213	1	0
5	0	8	0.000	sixm	284	1	0
6	2	8	0.250	sixm	379	1	0
7	3	8	0.375	sixm	506	1	0
8	2	8	0.250	sixm	675	1	0
9	6	8	0.750	sixm	900	1	0
10	8	8	1.000	sixm	1200	1	0
11	8	8	1.000	sixm	1600	1	0
12	0	8	0.000	amet	38	0	1
13	0	8	0.000	amet	50	0	1
14	1	8	0.125	amet	67	0	1
15	0	8	0.000	amet	90	0	1
16	1	8	0.125	amet	120	0	1
17	1	8	0.125	amet	160	0	1
18	6	8	0.750	amet	213	0	1
19	5	8	0.625	amet	284	0	1
20	7	8	0.875	amet	379	0	1
21	8	8	1.000	amet	506	0	1
22	8	8	1.000	amet	675	0	1
23	8	8	1.000	amet	900	0	1

First NLMixed

```
proc nlmixed data=oneab;
  parms th2a=200 th2b=200 th3a=3 th3b=3;
  th2=th2a*dumamet+th2b*dumsixm; th3=th3a*dumamet+th3b*dumsixm;
  t=(x/th2)**th3; den=1+t; p=t/den;
  model y~binomial(n,p);
run;
```

```
                                The NLMIXED Procedure
                                     Specifications

                Data Set                                    WORK.ONEAB
                Dependent Variable                          y
                Distribution for Dependent Variable         Binomial
                Optimization Technique                      Dual Quasi-Newton
                Integration Method                          None

                                       Dimensions

                           Observations Used                      23
                           Observations Not Used                   0
                           Total Observations                     23
                           Parameters                              4

                                       Parameters

                      th2a        th2b        th3a        th3b    NegLogLike
                       200         200           3           3    77.3596775

                                    Iteration History
                        NOTE: GCONV convergence criterion satisfied.

                                       Fit Statistics

                           -2 Log Likelihood                   36.9
                           AIC (smaller is better)             44.9
                           AICC (smaller is better)            47.1
                           BIC (smaller is better)             49.4

                                    Parameter Estimates

                          Standard
 Parameter   Estimate        Error     DF   t Value   Pr > |t|    Alpha     Lower     Upper   Gradient
 th2a          205.71      20.8739     23      9.85     <.0001     0.05    162.53    248.89   1.088E-7
 th2b          653.36      62.8619     23     10.39     <.0001     0.05    523.32    783.40    -8.1E-8
 th3a          3.5098       0.7154     23      4.91     <.0001     0.05    2.0300    4.9896   -0.00001
 th3b          3.9593       0.8878     23      4.46     0.0002     0.05    2.1228    5.7959   -1.69E-6
```

Second NLMixed

```
proc nlmixed data=oneab;
  parms th2a=200 th2b=2000 th3=3;
  th2=th2a*dumamet+th2b*dumsixm;
  t=(x/th2)**th3; den=1+t; p=t/den;
  model y~binomial(n,p);
run;
```

```
                                The NLMIXED Procedure
                                     Specifications

                Data Set                                    WORK.ONEAB
                Dependent Variable                          y
                Distribution for Dependent Variable         Binomial
                Optimization Technique                      Dual Quasi-Newton
                Integration Method                          None

                                       Dimensions

                           Observations Used                      23
                           Observations Not Used                   0
                           Total Observations                     23
                           Parameters                              3
```

```
                                  Parameters
                          th2a        th2b         th3    NegLogLike
                           200        2000           3    63.3193512

                                Iteration History
                        NOTE: GCONV convergence criterion satisfied.

                                Fit Statistics
                          -2 Log Likelihood                  37.0
                          AIC (smaller is better)            43.0
                          AICC (smaller is better)           44.3
                          BIC (smaller is better)            46.4

                                Parameter Estimates
                          Standard
 Parameter  Estimate        Error    DF  t Value  Pr > |t|   Alpha     Lower     Upper  Gradient
 th2a         205.68     20.3013    23    10.13     <.0001    0.05    163.68    247.68  -1.54E-9
 th2b         654.35     65.2392    23    10.03     <.0001    0.05    519.39    789.30  -6.61E-9
 th3          3.7038      0.5598    23     6.62     <.0001    0.05    2.5457    4.8618  -5.36E-7
```

Third NLMixed

```
proc nlmixed data=oneab;
  parms th2a=200 th3=2 th8=1;
  th2b=th8*th2a;  th2=th2a*dumamet+th2b*dumsixm;
  t=(x/th2)**th3; den=1+t; p=t/den;
  model y~binomial(n,p);
run;
```

```
                              The NLMIXED Procedure
                                  Specifications
            Data Set                                    WORK.ONEAB
            Dependent Variable                          y
            Distribution for Dependent Variable         Binomial
            Optimization Technique                      Dual Quasi-Newton
            Integration Method                          None

                                  Dimensions
                        Observations Used                    23
                        Observations Not Used                 0
                        Total Observations                   23
                        Parameters                            3

                                  Parameters
                          th2a         th3         th8    NegLogLike
                           200           2           1    64.4536807

                                Iteration History
                        NOTE: GCONV convergence criterion satisfied.

                                Fit Statistics
                          -2 Log Likelihood                  37.0
                          AIC (smaller is better)            43.0
                          AICC (smaller is better)           44.3
                          BIC (smaller is better)            46.4
```

```
                                Parameter Estimates
                     Standard
 Parameter  Estimate     Error    DF  t Value  Pr > |t|   Alpha     Lower     Upper  Gradient
 th2a         205.68   20.3014    23    10.13    <.0001    0.05    163.68    247.68  -2.59E-8
 th3          3.7038    0.5598    23     6.62    <.0001    0.05    2.5457    4.8618  -4.53E-7
 th8          3.1814    0.4463    23     7.13    <.0001    0.05    2.2581    4.1046  -8.43E-7
```

Fourth NLMixed

```
proc sort data=one; by amet sixm; run;
proc nlmixed data=one;
  parms th2=300 th3=4 th4=1 th5=0;
  z=amet+th4*sixm+th5*sqrt(th4*amet*sixm);
  t=(z/th2)**th3; den=1+t; p=t/den;
  model y~binomial(n,p);
  predict p out=new1;
run;
data new1; set new1; preda=pred; keep amet sixm rat preda;
```

```
                                The NLMIXED Procedure
                                    Specifications
                Data Set                                        WORK.ONE
                Dependent Variable                              y
                Distribution for Dependent Variable             Binomial
                Optimization Technique                          Dual Quasi-Newton
                Integration Method                              None

                                        Dimensions
                            Observations Used                       58
                            Observations Not Used                    0
                            Total Observations                      58
                            Parameters                               4

                                        Parameters
                        th2         th3         th4         th5    NegLogLike
                        300           4           1           0    102.950997

                                    Iteration History
                      NOTE: GCONV convergence criterion satisfied.

                                    Fit Statistics
                          -2 Log Likelihood                     110.3
                          AIC (smaller is better)               118.3
                          AICC (smaller is better)              119.0
                          BIC (smaller is better)               126.5

                                Parameter Estimates
                     Standard
 Parameter  Estimate     Error    DF  t Value  Pr > |t|   Alpha     Lower     Upper  Gradient
 th2          230.85   20.3974    58    11.32    <.0001    0.05    190.02    271.68  -9.72E-7
 th3          3.3420    0.3050    58    10.96    <.0001    0.05    2.7315    3.9525  0.000013
 th4          0.3776   0.04950    58     7.63    <.0001    0.05    0.2786    0.4767   8.16E-6
 th5          1.3703    0.3742    58     3.66    0.0005    0.05    0.6213    2.1194  -0.00005
```

Fifth NLMixed

```
proc nlmixed data=one;
  parms th2=300 th3=4 th4=1 th5=0 th6=0.1;
  z=amet+th4*sixm+th5*sqrt(th4*amet*sixm);
  zt=(1/th6)*(z**th6-1); th2t=(1/th6)*(th2**th6-1);
  ex=exp(th3*(zt-th2t)); den=1+ex; p=ex/den;
  model y~binomial(n,p);
  predict p out=new2;
run;
data new2; set new2; predb=pred; keep amet sixm predb;
```

The NLMIXED Procedure

Specifications

Data Set	WORK.ONE
Dependent Variable	y
Distribution for Dependent Variable	Binomial
Optimization Technique	Dual Quasi-Newton
Integration Method	None

Dimensions

Observations Used	58
Observations Not Used	0
Total Observations	58
Parameters	5

Parameters

th2	th3	th4	th5	th6	NegLogLike
300	4	1	0	0.1	171.939582

Iteration History

NOTE: GCONV convergence criterion satisfied.

Fit Statistics

-2 Log Likelihood	107.6
AIC (smaller is better)	117.6
AICC (smaller is better)	118.7
BIC (smaller is better)	127.9

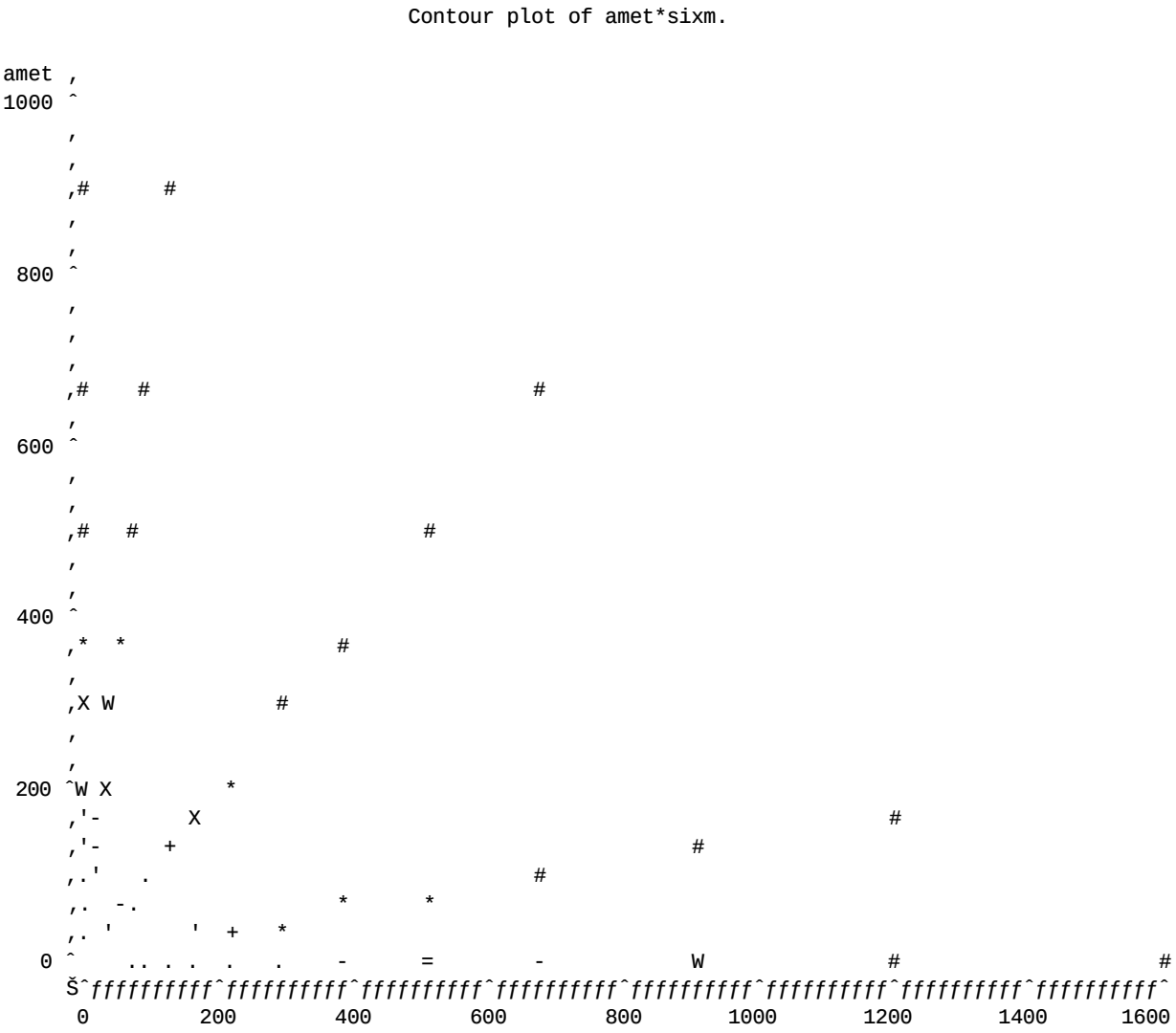
Parameter Estimates

Parameter	Estimate	Standard Error	DF	t Value	Pr > |t|	Alpha	Lower	Upper	Gradient
th2	243.66	22.6661	58	10.75	<.0001	0.05	198.28	289.03	1.621E-7
th3	0.3362	0.4928	58	0.68	0.4979	0.05	-0.6503	1.3226	-0.0003
th4	0.3872	0.04938	58	7.84	<.0001	0.05	0.2884	0.4861	-0.00004
th5	1.3005	0.3611	58	3.60	0.0007	0.05	0.5777	2.0233	-4.6E-7
th6	0.4267	0.2711	58	1.57	0.1209	0.05	-0.1159	0.9693	-0.00058

```
data new; merge new1 new2; by amet sixm; run;
proc print; run;
```

Obs	amet	sixm	y	n	rat	Pred	StdErr Pred	DF	tValue	Probt	Alpha	Lower	Upper	predb
1	0	90.0	0	8	0.000	0.00165	0.001113	58	1.486	0.14263	0.05	-0.00057	0.00388	0.00961
2	0	120.0	0	8	0.000	0.00432	0.002583	58	1.671	0.10011	0.05	-0.00085	0.00949	0.01526
3	0	160.0	0	8	0.000	0.01121	0.005903	58	1.899	0.06257	0.05	-0.00061	0.02303	0.02563
4	0	213.0	0	8	0.000	0.02865	0.013107	58	2.186	0.03287	0.05	0.00241	0.05489	0.04553
5	0	284.0	0	8	0.000	0.07162	0.027811	58	2.575	0.01259	0.05	0.01595	0.12729	0.08577
6	0	379.0	2	8	0.250	0.16830	0.053010	58	3.175	0.00240	0.05	0.06219	0.27441	0.16808
7	0	506.0	3	8	0.375	0.34709	0.080875	58	4.292	0.00007	0.05	0.18520	0.50898	0.32513
8	0	675.0	2	8	0.250	0.58206	0.086632	58	6.719	0.00000	0.05	0.40865	0.75547	0.56213
9	0	900.0	6	8	0.750	0.78460	0.063616	58	12.333	0.00000	0.05	0.65726	0.91194	0.79513
10	0	1200.0	8	8	1.000	0.90501	0.035650	58	25.386	0.00000	0.05	0.83364	0.97637	0.93131
11	0	1600.0	8	8	1.000	0.96142	0.017305	58	55.557	0.00000	0.05	0.92678	0.99606	0.98239
12	9	67.0	0	8	0.000	0.00820	0.004069	58	2.016	0.04847	0.05	0.00006	0.01635	0.02041
13	12	90.0	0	8	0.000	0.02151	0.008927	58	2.409	0.01918	0.05	0.00364	0.03938	0.03582
14	16	120.0	0	8	0.000	0.05436	0.018276	58	2.975	0.00427	0.05	0.01778	0.09095	0.06604
15	21	160.0	1	8	0.125	0.12863	0.033384	58	3.853	0.00029	0.05	0.06181	0.19546	0.12610
16	28	28.0	1	8	0.125	0.01230	0.005655	58	2.176	0.03366	0.05	0.00098	0.02363	0.02528
17	28	213.0	4	8	0.500	0.27786	0.051446	58	5.401	0.00000	0.05	0.17488	0.38085	0.24635
18	38	0.0	0	8	0.000	0.00240	0.001491	58	1.610	0.11278	0.05	-0.00058	0.00538	0.01098
19	38	5.1	0	8	0.000	0.00667	0.003314	58	2.012	0.04893	0.05	0.00003	0.01330	0.01808
20	38	38.0	1	8	0.125	0.03341	0.012512	58	2.671	0.00981	0.05	0.00837	0.05846	0.04670
21	38	284.0	7	8	0.875	0.50677	0.060274	58	8.408	0.00000	0.05	0.38612	0.62742	0.45769
22	50	0.0	0	8	0.000	0.00598	0.003274	58	1.828	0.07267	0.05	-0.00057	0.01254	0.01732
23	50	6.7	0	8	0.000	0.01650	0.006901	58	2.391	0.02007	0.05	0.00269	0.03032	0.03018
24	50	50.0	2	8	0.250	0.07961	0.023761	58	3.351	0.00142	0.05	0.03205	0.12718	0.08551
25	50	379.0	7	8	0.875	0.72610	0.051042	58	14.225	0.00000	0.05	0.62393	0.82827	0.70401
26	67	0.0	1	8	0.125	0.01576	0.007405	58	2.128	0.03757	0.05	0.00094	0.03058	0.02983
27	67	9.0	0	8	0.000	0.04277	0.014291	58	2.993	0.00406	0.05	0.01416	0.07137	0.05535
28	67	67.0	0	8	0.000	0.18702	0.040990	58	4.563	0.00003	0.05	0.10497	0.26907	0.16919
29	67	506.0	7	8	0.875	0.87491	0.032719	58	26.740	0.00000	0.05	0.80941	0.94040	0.88742
30	90	0.0	0	8	0.000	0.04117	0.016201	58	2.541	0.01375	0.05	0.00874	0.07360	0.05488
31	90	12.0	1	8	0.125	0.10662	0.026734	58	3.988	0.00019	0.05	0.05310	0.16013	0.10741
32	90	90.0	0	8	0.000	0.38150	0.055875	58	6.828	0.00000	0.05	0.26965	0.49334	0.33143
33	90	675.0	8	8	1.000	0.94865	0.017472	58	54.296	0.00000	0.05	0.91367	0.98362	0.96840
34	120	0.0	1	8	0.125	0.10096	0.032236	58	3.132	0.00272	0.05	0.03643	0.16548	0.10488
35	120	16.0	2	8	0.250	0.23788	0.041407	58	5.745	0.00000	0.05	0.15499	0.32077	0.21077
36	120	120.0	4	8	0.500	0.61733	0.055645	58	11.094	0.00000	0.05	0.50595	0.72872	0.56962
37	120	900.0	8	8	1.000	0.97972	0.008497	58	115.306	0.00000	0.05	0.96271	0.99673	0.99292
38	160	0.0	1	8	0.125	0.22702	0.055272	58	4.107	0.00013	0.05	0.11638	0.33766	0.20578
39	160	21.0	2	8	0.250	0.44750	0.050075	58	8.937	0.00000	0.05	0.34726	0.54774	0.39490
40	160	160.0	5	8	0.625	0.80841	0.041063	58	19.687	0.00000	0.05	0.72621	0.89060	0.80070
41	160	1200.0	8	8	1.000	0.99215	0.003915	58	253.416	0.00000	0.05	0.98431	0.99999	0.99872
42	213	0.0	6	8	0.750	0.43315	0.072708	58	5.957	0.00000	0.05	0.28761	0.57870	0.38737
43	213	28.0	5	8	0.625	0.67835	0.046294	58	14.653	0.00000	0.05	0.58569	0.77102	0.64249
44	213	213	7	8	0.875	0.91651	0.024230	58	37.825	1.42727E-42	0.05	0.86801	0.96502	0.93331
45	284	0	5	8	0.625	0.66651	0.067223	58	9.915	4.25694E-14	0.05	0.53195	0.80107	0.63540
46	284	38	6	8	0.750	0.84768	0.032816	58	25.831	1.66308E-33	0.05	0.78199	0.91337	0.85165
47	284	284	8	8	1.000	0.96634	0.012418	58	77.817	2.27664E-60	0.05	0.94149	0.99120	0.98300
48	379	0	7	8	0.875	0.83981	0.044764	58	18.761	2.62831E-26	0.05	0.75021	0.92942	0.84624
49	379	50	7	8	0.875	0.93546	0.019031	58	49.156	5.65797E-49	0.05	0.89737	0.97356	0.95451
50	379	379	8	8	1.000	0.98690	0.005882	58	167.780	1.25126E-79	0.05	0.97512	0.99867	0.99655
51	506	0	8	8	1.000	0.93231	0.024076	58	38.724	3.84391E-43	0.05	0.88411	0.98050	0.95294
52	506	67	8	8	1.000	0.97446	0.009639	58	101.090	6.52362E-67	0.05	0.95516	0.99375	0.98928
53	506	506	8	8	1.000	0.99497	0.002665	58	373.394	9.2666E-100	0.05	0.98964	1.00031	0.99944
54	675	0	8	8	1.000	0.97303	0.011609	58	83.821	3.17413E-62	0.05	0.94980	0.99627	0.98877
55	675	90	8	8	1.000	0.99013	0.004544	58	217.902	3.33845E-86	0.05	0.98103	0.99922	0.99797
56	675	675	8	8	1.000	0.99807	0.001178	58	847.398	2.1267E-120	0.05	0.99572	1.00043	0.99993
57	900	0	8	8	1.000	0.98951	0.005303	58	186.601	2.65561E-82	0.05	0.97890	1.00013	0.99784
58	900	120	8	8	1.000	0.99620	0.002063	58	482.911	3.093E-106	0.05	0.99207	1.00033	0.99969

```
proc plot data=one; plot amet*sixm=rat/contour; run;
```



NOTE: 7 obs hidden.