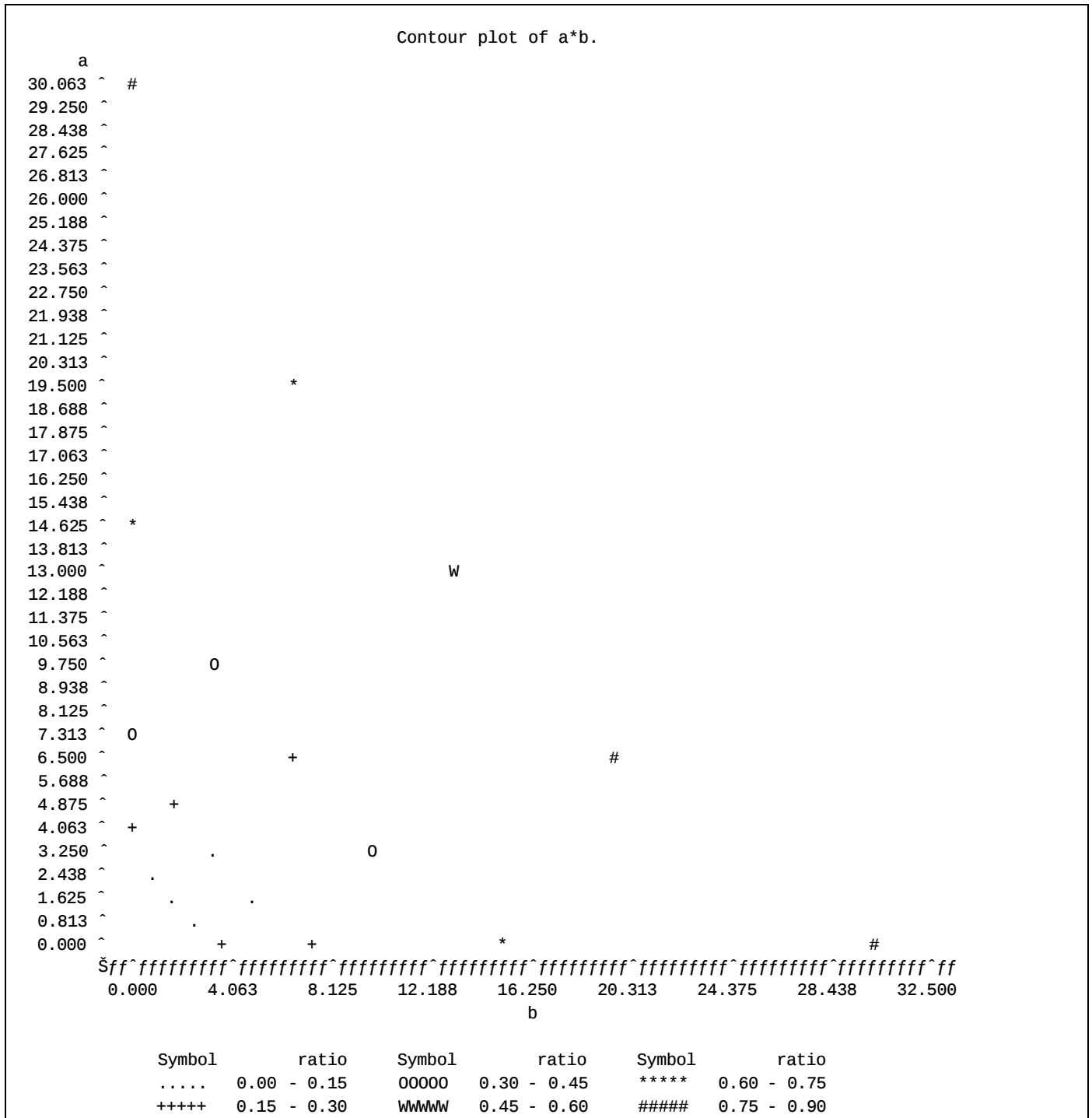



```
proc plot; plot a*b=ratio/contour=6; run;
```



First NLMixed

```
proc nlmixed data=one;
  parms th2=10 th3=2 th4=1 th5=0;
  z=a+th4*b+th5*sqrt(th4*a*b);
  t=(z/th2)**th3; den=1+t; p=t/den;
  model y~binomial(n,p);
  predict p out=new; run;
```

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	20
Observations Not Used	0
Total Observations	20
Parameters	4

Parameters

th2	th3	th4	th5	NegLogLike
10	2	1	0	86.8862593

Iteration History

Iter	Calls	NegLogLike	Diff	MaxGrad	Slope
1	2	57.2011464	29.68511	70.8134	-700.878
2	4	42.8172327	14.38391	22.34383	-117.117
3	6	41.9717029	0.84553	24.57818	-5.34539
4	7	40.5851739	1.386529	8.437119	-2.89579
5	8	40.3437374	0.241436	1.656384	-0.40785
6	10	40.3265499	0.017188	0.339897	-0.02958
7	12	40.3226692	0.003881	0.517251	-0.00175
8	14	40.3133207	0.009349	0.191415	-0.00459
9	16	40.3131256	0.000195	0.041871	-0.00049
10	18	40.3131167	8.899E-6	0.000223	-0.00002
11	20	40.3131167	1.492E-9	8.136E-6	-3.08E-9

NOTE: GCONV convergence criterion satisfied.

Fit Statistics

-2 Log Likelihood	80.6
AIC (smaller is better)	88.6
AICC (smaller is better)	91.3
BIC (smaller is better)	92.6

Parameter Estimates

Parameter	Estimate	Standard Error	DF	t Value	Pr > t	Alpha	Lower	Upper	Gradient
th2	9.9531	1.0590	20	9.40	<.0001	0.05	7.7441	12.1621	-1.2E-6
th3	1.8018	0.1612	20	11.18	<.0001	0.05	1.4655	2.1381	5.001E-7
th4	0.9002	0.1170	20	7.69	<.0001	0.05	0.6562	1.1442	-8.14E-6
th5	-1.0349	0.1390	20	-7.44	<.0001	0.05	-1.3248	-0.7449	-6.88E-7

```
proc print data=new;
  title 'predicted and actual probabilities from First NLMixed'; run;
```

Obs	a	b	y	n	ratio	dd	ray	Pred	Pred
1	0.0000	30.0000	26	30	0.86667	30.00	2	0.85796	0.031199
2	0.0000	15.0000	19	30	0.63333	15.00	2	0.63403	0.047534
3	0.0000	7.5000	7	30	0.23333	7.50	2	0.33196	0.046178
4	0.0000	3.7500	5	30	0.16667	3.75	2	0.12474	0.028830
5	6.5000	19.5000	23	30	0.76667	26.00	3	0.61802	0.045936
6	3.2500	9.7500	11	30	0.36667	13.00	3	0.31696	0.036347
7	1.6250	4.8750	3	30	0.10000	6.50	3	0.11746	0.021616
8	0.8125	2.4375	0	30	0.00000	3.25	3	0.03677	0.010250
9	13.0000	13.0000	15	30	0.50000	26.00	4	0.58120	0.047197
10	6.5000	6.5000	5	30	0.16667	13.00	4	0.28471	0.034228

11	3.2500	3.2500	4	29	0.13793	6.50	4	0.10247	0.019263
12	1.6250	1.6250	0	29	0.00000	3.25	4	0.03171	0.008922
13	19.5000	6.5000	20	30	0.66667	26.00	5	0.65759	0.043372
14	9.7500	3.2500	13	30	0.43333	13.00	5	0.35518	0.036958
15	4.8750	1.6250	6	29	0.20690	6.50	5	0.13643	0.023548
16	2.4375	0.8125	0	30	0.00000	3.25	5	0.04335	0.011643
17	30.0000	0.0000	23	30	0.76667	30.00	1	0.87952	0.027418
18	15.0000	0.0000	21	30	0.70000	15.00	1	0.67678	0.044072
19	7.5000	0.0000	13	30	0.43333	7.50	1	0.37522	0.046414
20	3.7500	0.0000	5	30	0.16667	3.75	1	0.14694	0.031407

Second NLMixed

```
proc nlmixed data=one;
  parms th2=10 th3=2 th4=1; th5=0;
  z=a+th4*b+th5*sqrt(th4*a*b);
  t=(z/th2)**th3; den=1+t; p=t/den;
  model y~binomial(n,p);
run;
```

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					20				
Observations Not Used					0				
Total Observations					20				
Parameters					3				
Parameters									
		th2	th3	th4	NegLogLike				
		10	2	1	86.8862593				
Iteration History									
Iter	Calls	NegLogLike		Diff	MaxGrad	Slope			
1	2	66.2515021		20.63476	38.25528	-444.143			
2	4	63.525803		2.725699	4.339629	-19.9969			
3	6	61.236808		2.288995	9.897762	-1.80098			
4	8	55.9123447		5.324463	3.150354	-2.94697			
5	9	55.5509208		0.361424	1.501651	-0.5263			
6	11	55.4603133		0.090608	0.471316	-0.15801			
7	13	55.4561936		0.00412	0.358576	-0.0069			
8	15	55.4557906		0.000403	0.045583	-0.00042			
9	17	55.4557518		0.000039	0.000282	-0.00007			
10	19	55.4557518		4.785E-9	7.472E-6	-9.62E-9			
NOTE: GCONV convergence criterion satisfied.									
Fit Statistics									
-2 Log Likelihood					110.9				
AIC (smaller is better)					116.9				
AICC (smaller is better)					118.4				
BIC (smaller is better)					119.9				
Parameter Estimates									
Standard									
Parameter	Estimate	Error	DF	t Value	Pr > t	Alpha	Lower	Upper	Gradient

th2	14.4553	1.3289	20	10.88	<.0001	0.05	11.6833	17.2272	-1.57E-7
th3	1.7352	0.1522	20	11.40	<.0001	0.05	1.4177	2.0527	-7.47E-6
th4	0.8962	0.1291	20	6.94	<.0001	0.05	0.6268	1.1656	7.273E-7

Third NLMixed

```
proc nlmixed data=one;
  parms th21=10 th22=15 k3=1 k4=1 k5=1 th31=2 th32=2 th33=2 th34=2 th35=2;
  c3=3; th23=(1+c3)*k3*th21*th22/(th22+c3*th21);
  c4=1; th24=(1+c4)*k4*th21*th22/(th22+c4*th21);
  c5=1/3; th25=(1+c5)*k5*th21*th22/(th22+c5*th21);
  th2=th21*(ray=1)+th22*(ray=2)+th23*(ray=3)+th24*(ray=4)+th25*(ray=5);
  th3=th31*(ray=1)+th32*(ray=2)+th33*(ray=3)+th34*(ray=4)+th35*(ray=5);
  t=(dd/th2)**th3; den=1+t; p=t/den;
  model y~binomial(n,p);
run;
```

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					20			
Observations Not Used					0			
Total Observations					20			
Parameters					10			
Parameters								
th21	th22	k3	k4	k5	th31	th32	th33	th34
10	15	1	1	1	2	2	2	2
Parameters								
th35		NegLogLike						
2		67.4244854						
Iteration History								
Iter	Calls	NegLogLike	Diff	MaxGrad	Slope			
1	2	45.4869634	21.93752	14.20285	-376.503			
2	3	39.0901268	6.396837	5.721319	-10.7579			
3	5	38.7434953	0.346632	4.759981	-1.72803			
4	7	37.8295565	0.913939	1.645019	-2.02159			
5	9	37.2467142	0.582842	1.256344	-0.55732			
6	10	36.6421193	0.604595	1.72693	-0.24723			
7	12	36.3768342	0.265285	1.526689	-0.46214			
8	13	36.291693	0.085141	2.411515	-0.43419			
9	15	36.0342946	0.257398	1.117181	-0.54607			
10	17	35.8872434	0.147051	1.018163	-0.1782			
11	18	35.6568203	0.230423	0.856666	-0.15784			
12	20	35.5653594	0.091461	0.571445	-0.15768			
13	22	35.5315885	0.033771	0.356684	-0.07712			
14	24	35.5221138	0.009475	0.04798	-0.01623			
15	26	35.5215239	0.00059	0.034754	-0.001			
16	27	35.5208411	0.000683	0.088181	-0.00022			
17	28	35.5199594	0.000882	0.036862	-0.00065			
18	30	35.5195965	0.000363	0.01602	-0.00049			
19	32	35.5195815	0.000015	0.003219	-0.00003			
20	34	35.5195813	2.233E-7	0.000226	-3.81E-7			
21	36	35.5195812	4.087E-9	0.000032	-5.88E-9			

NOTE: GCONV convergence criterion satisfied.

Fit Statistics

-2 Log Likelihood	71.0
AIC (smaller is better)	91.0
AICC (smaller is better)	115.5
BIC (smaller is better)	101.0

Parameter Estimates

Parameter	Estimate	Standard Error	DF	t Value	Pr > t	Alpha	Lower	Upper	Gradient
th21	9.9693	1.5017	20	6.64	<.0001	0.05	6.8369	13.1017	2.82E-6
th22	11.5012	1.4087	20	8.16	<.0001	0.05	8.5628	14.4397	-6.43E-6
k3	1.4615	0.2055	20	7.11	<.0001	0.05	1.0328	1.8903	-9.87E-6
k4	2.5140	0.5527	20	4.55	0.0002	0.05	1.3611	3.6670	-0.00002
k5	1.5726	0.2806	20	5.60	<.0001	0.05	0.9872	2.1580	0.000011
th31	1.3699	0.2907	20	4.71	0.0001	0.05	0.7634	1.9764	6.803E-6
th32	1.8056	0.3320	20	5.44	<.0001	0.05	1.1131	2.4981	-0.00002
th33	2.6407	0.4850	20	5.44	<.0001	0.05	1.6289	3.6525	-0.00002
th34	1.7617	0.4330	20	4.07	0.0006	0.05	0.8584	2.6649	-0.00001
th35	1.8748	0.3688	20	5.08	<.0001	0.05	1.1056	2.6440	-0.00003

Fourth NLMixed

```
proc nlmixed data=one;
  parms th21=10 th22=15 k3=1 k4=1 k5=1 th3=2;
  c3=3; th23=(1+c3)*k3*th21*th22/(th22+c3*th21);
  c4=1; th24=(1+c4)*k4*th21*th22/(th22+c4*th21);
  c5=1/3; th25=(1+c5)*k5*th21*th22/(th22+c5*th21);
  th2=th21*(ray=1)+th22*(ray=2)+th23*(ray=3)
    +th24*(ray=4)+th25*(ray=5);
  t=(dd/th2)**th3; den=1+t; p=t/den;
  model y~binomial(n,p);
  estimate 'LD50 on ray3' th23;
  estimate 'LD50 on ray4' th24;
  estimate 'LD50 on ray5' th25;
run;
```

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	20
Observations Not Used	0
Total Observations	20
Parameters	6

Parameters

th21	th22	k3	k4	k5	th3	NegLogLike
10	15	1	1	1	2	67.4244854

Iteration History

Iter	Calls	NegLogLike	Diff	MaxGrad	Slope
1	2	45.6947996	21.72969	14.10177	-382.073
2	3	44.0771523	1.617647	11.96029	-4.98185
3	4	41.3130264	2.764126	5.141138	-7.75267

4	6	40.7164548	0.596572	2.342934	-2.82639
5	7	40.2356303	0.480824	1.246948	-0.81194
6	9	40.0200483	0.215582	1.176147	-0.42058
7	10	39.672129	0.347919	1.542333	-0.30941
8	12	38.9337948	0.738334	2.521652	-0.46417
9	14	38.4833947	0.4504	0.929979	-0.38833
10	16	38.4002882	0.083107	0.512247	-0.1789
11	18	38.3894574	0.010831	0.113125	-0.02041
12	20	38.3871916	0.002266	0.125944	-0.00203
13	21	38.3834505	0.003741	0.164857	-0.00207
14	22	38.3812996	0.002151	0.116549	-0.00412
15	24	38.3802487	0.001051	0.006962	-0.00205
16	26	38.380244	4.76E-6	0.000337	-8.22E-6
17	28	38.380244	5.597E-9	0.00002	-1.13E-8

NOTE: GCONV convergence criterion satisfied.

Fit Statistics

-2 Log Likelihood	76.8
AIC (smaller is better)	88.8
AICC (smaller is better)	95.2
BIC (smaller is better)	94.7

Parameter Estimates

Parameter	Estimate	Standard Error	DF	t Value	Pr > t	Alpha	Lower	Upper	Gradient
th21	10.0510	1.2227	20	8.22	<.0001	0.05	7.5005	12.6015	-1.31E-6
th22	11.4984	1.3996	20	8.22	<.0001	0.05	8.5790	14.4178	-1.73E-7
k3	1.5678	0.2515	20	6.23	<.0001	0.05	1.0433	2.0924	3.203E-6
k4	2.4615	0.4222	20	5.83	<.0001	0.05	1.5808	3.3423	8.256E-6
k5	1.5739	0.2549	20	6.17	<.0001	0.05	1.0422	2.1056	-0.00002
th3	1.8192	0.1619	20	11.24	<.0001	0.05	1.4816	2.1569	-5.92E-6

Additional Estimates

Label	Estimate	Standard Error	DF	t Value	Pr > t	Alpha	Lower	Upper
LD50 on ray3	17.4012	2.2629	20	7.69	<.0001	0.05	12.6808	22.1216
LD50 on ray4	26.4023	3.9178	20	6.74	<.0001	0.05	18.2299	34.5747
LD50 on ray5	16.3335	2.1021	20	7.77	<.0001	0.05	11.9485	20.7185