

MATH 523: EXAMPLES - POISSON DATA SETS

RESULTS

EXAMPLE: Scottish Lip Cancer data

```
1 > anova(glm0.off, glm1.off, glm2.off, glm3.off)
2 Analysis of Deviance Table
3
4 Model 1: Y ~ 1 + offset(log(E))
5 Model 2: Y ~ AFF + offset(log(E))
6 Model 3: Y ~ AFF + LAT + offset(log(E))
7 Model 4: Y ~ AFF + LAT + LONG + offset(log(E))
8   Resid. Df Resid. Dev Df Deviance
9 1          55      380.73
10 2          54      238.62 1   142.106
11 3          53      159.71 1    78.908
12 4          52      159.44 1     0.276
13 >
14 > summary(glm2.off)
15
16 Call:
17 glm(formula = Y ~ AFF + LAT + offset(log(E)), family = poisson,
18     data = ScottishLip)
19
20 Deviance Residuals:
21     Min       1Q   Median       3Q      Max
22 -3.3979  -1.0943   0.2294   1.3201   3.0078
23
24 Coefficients:
25             Estimate Std. Error z value Pr(>|z|)
26 (Intercept) -24.586752   2.537728  -9.688  < 2e-16 ***
27 AFF          0.054241   0.006707   8.087  6.1e-16 ***
28 LAT          0.429060   0.045241   9.484  < 2e-16 ***
29 ---
30 Signif. codes:  0  ***  0.001  **  0.01  *  0.05  .  0.1    1
31
32 (Dispersion parameter for poisson family taken to be 1)
33
34 Null deviance: 380.73  on 55  degrees of freedom
35 Residual deviance: 159.71  on 53  degrees of freedom
36 AIC: 373.69
37
38 Number of Fisher Scoring iterations: 5
39
40 >
41 > anova(glm0.off, glm1.off, glm2.off, glm4.off)
42 Analysis of Deviance Table
43
44 Model 1: Y ~ 1 + offset(log(E))
45 Model 2: Y ~ AFF + offset(log(E))
46 Model 3: Y ~ AFF + LAT + offset(log(E))
47 Model 4: Y ~ AFF + LAT + AFF:LAT + offset(log(E))
48
49   Resid. Df Resid. Dev Df Deviance
50 1          55      380.73
51 2          54      238.62 1   142.106
52 3          53      159.71 1    78.908
53 4          52      152.86 1     6.848
54
55
56
```

```

57 > summary(glm4.off)
58
59 Call:
60 glm(formula = Y ~ AFF + LAT + AFF:LAT + offset(log(E)), family = poisson,
61      data = ScottishLip)
62
63 Deviance Residuals:
64      Min       1Q   Median       3Q      Max
65 -3.6309  -1.1398   0.1526   1.3215   3.2172
66
67 Coefficients:
68             Estimate Std. Error z value Pr(>|z|)
69 (Intercept) -34.594815    4.433805  -7.803 6.07e-15 ***
70 AFF          0.907269    0.333043   2.724 0.00645 **
71 LAT          0.606971    0.078845   7.698 1.38e-14 ***
72 AFF:LAT     -0.015117    0.005906  -2.560 0.01048 *
73 ---
74 Signif. codes:  0  ***  0.001  **  0.01  *  0.05  .  0.1  1
75
76 (Dispersion parameter for poisson family taken to be 1)
77
78 Null deviance: 380.73  on 55  degrees of freedom
79 Residual deviance: 152.86  on 52  degrees of freedom
80 AIC: 368.84
81
82 Number of Fisher Scoring iterations: 5
83
84
85 > glm5.off<-glm(Y~AFF+LAT+AFF:LAT+offset(log(E)),family=quasipoisson,data=ScottishLip)
86 > summary(glm5.off)
87
88 Call:
89 glm(formula = Y ~ AFF + LAT + AFF:LAT + offset(log(E)), family = quasipoisson,
90      data = ScottishLip)
91
92 Deviance Residuals:
93      Min       1Q   Median       3Q      Max
94 -3.6309  -1.1398   0.1526   1.3215   3.2172
95
96 Coefficients:
97             Estimate Std. Error t value Pr(>|t|)
98 (Intercept) -34.59482    7.62767  -4.535 3.42e-05 ***
99 AFF          0.90727    0.57295   1.584 0.119
100 LAT          0.60697    0.13564   4.475 4.19e-05 ***
101 AFF:LAT     -0.01512    0.01016  -1.488 0.143
102 ---
103 Signif. codes:  0  ***  0.001  **  0.01  *  0.05  .  0.1  1
104
105 (Dispersion parameter for quasipoisson family taken to be 2.959582)
106
107 Null deviance: 380.73  on 55  degrees of freedom
108 Residual deviance: 152.86  on 52  degrees of freedom
109 AIC: NA
110
111 Number of Fisher Scoring iterations: 5

```

EXAMPLE: Political Affiliations of College Students:

```
1 > anova(glm3.aff,glm4.aff)
2 Analysis of Deviance Table
3
4 Model 1: Y ~ A + C
5 Model 2: Y ~ A * C
6   Resid. Df Resid. Dev Df Deviance
7 1          6      16.39
8 2          0       0.00  6      16.39
9
10 > qchisq(0.95,6)
11 [1] 12.59159
12
13 > anova(glm2.aff,glm3.aff)
14 Analysis of Deviance Table
15
16 Model 1: Y ~ A
17 Model 2: Y ~ A + C
18   Resid. Df Resid. Dev Df Deviance
19 1          9      36.175
20 2          6      16.390  3      19.785
21 > anova(glm1.aff,glm3.aff)
22 Analysis of Deviance Table
23
24 Model 1: Y ~ C
25 Model 2: Y ~ A + C
26   Resid. Df Resid. Dev Df Deviance
27 1          8      49.822
28 2          6      16.390  2      33.432
29
30 > summary(glm4.aff)
31
32 Call:
33 glm(formula = Y ~ A * C, family = poisson, data = Affil)
34
35
36           Estimate Std. Error z value Pr(>|z|)
37 (Intercept)  3.52636    0.17150  20.562 < 2e-16 ***
38 A2           0.58451    0.21402   2.731  0.00631 **
39 A3          -0.75377    0.30317  -2.486  0.01291 *
40 C2          -0.09237    0.24833  -0.372  0.70991
41 C3          -0.58192    0.28643  -2.032  0.04219 *
42 C4          -0.39087    0.26998  -1.448  0.14769
43 A2:C2        -1.07406    0.36152  -2.971  0.00297 **
44 A3:C2         0.15300    0.42778   0.358  0.72060
45 A2:C3        -0.39346    0.37672  -1.044  0.29628
46 A3:C3         0.58192    0.45502   1.279  0.20094
47 A2:C4        -0.05645    0.33901  -0.167  0.86776
48 A3:C4         0.10318    0.46768   0.221  0.82538
49 ---
50 Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
51 (Dispersion parameter for poisson family taken to be 1)
52
53 Null deviance:  6.9607e+01 on 11 degrees of freedom
54 Residual deviance: -2.2204e-15 on  0 degrees of freedom
55 AIC: 83.906          Number of Fisher Scoring iterations: 3
56
57 > fitted(glm4.aff)
58 1  2  3  4  5  6  7  8  9 10 11 12
59 34 61 16 31 19 17 19 23 16 23 39 12
```

EXAMPLE: Classroom behaviour data:

```
1 >
2 > anova(glm7.Behav)
3 Analysis of Deviance Table
4
5 Model: poisson, link: log
6
7 Response: Y
8
9 Terms added sequentially (first to last)
10
11
12              Df Deviance Resid. Df Resid. Dev
13 NULL                      11      100.718
14 Deviant                   1    44.430
15 AtRisk                    1     2.329
16 Adversity                 2    37.540
17 Deviant:AtRisk            1     1.442
18 Deviant:Adversity         2     3.656
19 AtRisk:Adversity          2    10.378
20 Deviant:AtRisk:Adversity  2     0.943
21 >
22 > glm6.Behav<-update(glm7.Behav,~.-Deviant:AtRisk:Adversity)
23 > summary(glm6.Behav)
24
25 Call:
26 glm(formula = Y ~ Deviant + AtRisk + Adversity + Deviant:AtRisk +
27     Deviant:Adversity + AtRisk:Adversity, family = poisson, data = Behaviour)
28
29 Deviance Residuals:
30      1      2      3      4      5      6      7      8
31  0.02682 -0.04026 -0.18240  0.12394  0.28502 -0.33107 -0.10345  0.11113  0.45288
32  -0.24649 -0.51762
33      12
34  0.37972
35 Coefficients:
36             Estimate Std. Error z value Pr(>|z|)
37 (Intercept)    0.4766    0.6576   0.725   0.4686
38 DeviantND      1.0026    0.7046   1.423   0.1548
39 AtRiskY        0.3945    0.7150   0.552   0.5811
40 AdversityLow   -0.3749    0.9530  -0.393   0.6940
41 AdversityMed    0.3487    0.7357   0.474   0.6355
42 DeviantND:AtRiskY -0.5899    0.6151  -0.959   0.3375
43 DeviantND:AdversityLow  1.6615    0.9666   1.719   0.0856 .
44 DeviantND:AdversityMed  0.9269    0.7169   1.293   0.1961
45 AtRiskY:AdversityLow  -0.6094    0.7388  -0.825   0.4094
46 AtRiskY:AdversityMed   0.9456    0.6576   1.438   0.1504
47 ---
48 Signif. codes:  0  ***  0.001  **  0.01  *  0.05  .  0.1  1
49
50 (Dispersion parameter for poisson family taken to be 1)
51
52 Null deviance: 100.71803  on 11  degrees of freedom
53 Residual deviance:  0.94285  on  2  degrees of freedom
54 AIC: 61.692
55
56 Number of Fisher Scoring iterations: 4
57
58 >
```

```

59 > glm5.Behav<-update(glm6.Behav,~.-AtRisk:Adversity)
60 > summary(glm5.Behav)
61
62 Call:
63 glm(formula = Y ~ Deviant + AtRisk + Adversity + Deviant:AtRisk +
64     Deviant:Adversity, family = poisson, data = Behaviour)
65
66 Deviance Residuals:
67     1      2      3      4      5      6      7      8
68  1.62458 -1.73653 -1.59441  1.30447  0.69645 -0.70855  0.48757 -0.36585 -0.13245
69  0.08402 -0.16704
70
71 12
72 0.10395
73
74 Coefficients:
75             Estimate Std. Error z value Pr(>|z|)
76 (Intercept)      0.1625    0.6254   0.260   0.7950
77 DeviantND         1.1184    0.7290   1.534   0.1250
78 AtRiskY           0.8755    0.5323   1.645   0.1000
79 AdversityLow      -0.6931    0.8660  -0.800   0.4235
80 AdversityMed       1.0116    0.5839   1.733   0.0832 .
81 DeviantND:AtRiskY  -0.6748    0.5778  -1.168   0.2428
82 DeviantND:AdversityLow  1.7492    0.9584   1.825   0.0680 .
83 DeviantND:AdversityMed  0.8008    0.6974   1.148   0.2508
84 ---
85 Signif. codes:  0  ***  0.001  **  0.01  *  0.05  .  0.1  1
86
87 (Dispersion parameter for poisson family taken to be 1)
88
89 Null deviance: 100.718  on 11  degrees of freedom
90 Residual deviance: 11.321  on 4  degrees of freedom
91 AIC: 68.07
92
93 Number of Fisher Scoring iterations: 4
94
95 >
96 > anova(glm5.Behav,glm6.Behav,glm7.Behav)
97 Analysis of Deviance Table
98
99 Model 1: Y ~ Deviant + AtRisk + Adversity + Deviant:AtRisk + Deviant:Adversity
100 Model 2: Y ~ Deviant + AtRisk + Adversity + Deviant:AtRisk + Deviant:Adversity +
101     AtRisk:Adversity
102 Model 3: Y ~ Deviant * AtRisk * Adversity
103
104 Resid. Df Resid. Dev Df Deviance
105 1      4      11.3206
106 2      2       0.9428 2   10.3777
107 3      0       0.0000 2    0.9428

```