# APPENDIX 03 - GLIM 3.77 Programs

The GLIM 3.77 program listings perform survival analysis, using the GLIM macros described in APPENDIX 04, unless NOT required.
GLIM program 1 gives an example of the logit link.
Data is from F77 Program 8

GLIM programs 2-6 use the macros WEIBULL and RESPLOT
- Program 2 uses Gehan's Data
- Program 3 uses my data from F77 Program 21
- Program 4 uses my data from F77 Program 22
- Program 5 uses my data from F77 Program 23
- Program 6 uses the data from Technometrics (SH), 1979, Vol 21, p419

GLIM program 7 gives an example of logistic regression.

Descriptions of the GLIM Macros WEIBULL and RESPLOT can be found in APPENDIX 04.
NB: 'REA?' tells you that GLIM hasn't got enough data units it requires. Don't worry about it.

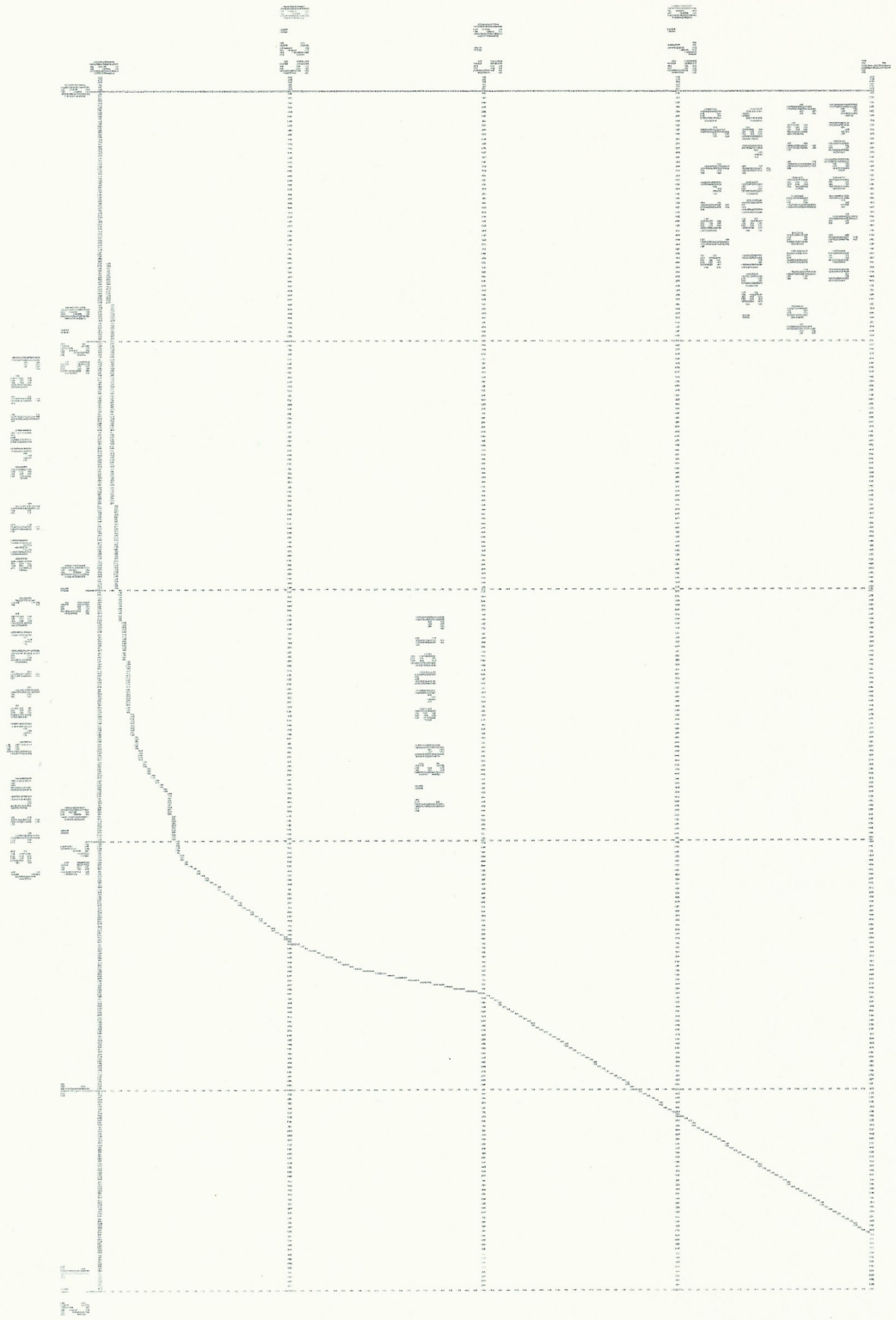
## GLIM Program 1

Data: As in section 1.7.4, but excluding censoring

```
$units 39$
$! This data is for RC2 model, excluding censoring$
$calc d=1$
$! x=Failure time, r=No. of trials in view$
$data x r$
$read 0.172 69 0.184 66 0.194 64 0.233 61 0.244 59 0.249 57
REA? 0.328 52 0.329 51 0.341 50 0.390 48 0.413 47 0.415 46
REA? 0.461 44 0.467 42 0.488 41 0.489 40 0.495 39 0.502 37
REA? 0.509 36 0.524 34 0.537 31 0.547 30 0.569 27 0.571 26
REA? 0.598 25 0.612 24 0.630 22 0.636 21 0.663 18 0.673 17
REA? 0.674 16 0.679 15 0.706 11 0.742 10 0.770 9 0.852 4
$!Calculate the proportion failed out of r trials$
$calc prop=d/r$
$!Look at the actual data for RC2, excluding censoring$
$look x r d prop$
$yvar d$
$!Define Binomial error$
$error b r$
$fit$
$fit x$
$disp e$
$!Plot graph of proportion failed against time$
$plot prop x$
$stop$
```

Output from GLIM Program 1

```
Fitting constant only gave:
     scaled deviance = 27.261 at cycle  4
                  df = 38

Fitting x gave:
     scaled deviance = 6.4630 at cycle  4
                  df = 37

             estimate        s.e.      parameter
               -5.583      0.5521      1
                4.478       1.001      X
         scale parameter taken as 1.000
```



## Interpretation of Output from GLIM Program 1

The graph in Figure A3.1 is a sigmoid curve. There are many sigmoid curves.
If we fit $b_0$ only we get deviance=27.261 on 38 df
If we fit $b_0$ and $b_1$ we get deviance= 6.463 on 37 df
If we leave out x, we find that the deviance is increased by
27.261-6.463 = 20.798
We can test $H_0$: $b_1=0$ as a likelihood ratio test.
2 ln (lambda) = reduction in deviance due to $b_1$.
= 20.798 on chi-square 1 df
This is far greater than 3.841. We reject the null hypothesis.
We conclude that the slope is not zero and the failure time can be used to predict the product limit estimator.
Alternatively, we can use a t-test.
The logit equation is (eta)=-5.573+4.478x. SE($b_1$)=1.001.
$t=b_1/se(b_1)=4.478/1.001=4.474$
This is > $t_{0.025,38}$= 2.025 (approx.). Reject the null hypothesis. The conclusion is as before.

GLIM Program 2

This program was taken from PACKAGE\GLIM\MACLIB.DOC, 'GLIM Macro library Release 1.0', January 1985.

Data: Gehan's data from Biometrika,1965,Vol. 52,p213, JRSS B 1978,P. 217 and Analysis of survival data, Cox and Oakes,1984,Table 1.2
(Those highlighted in italics are censored)

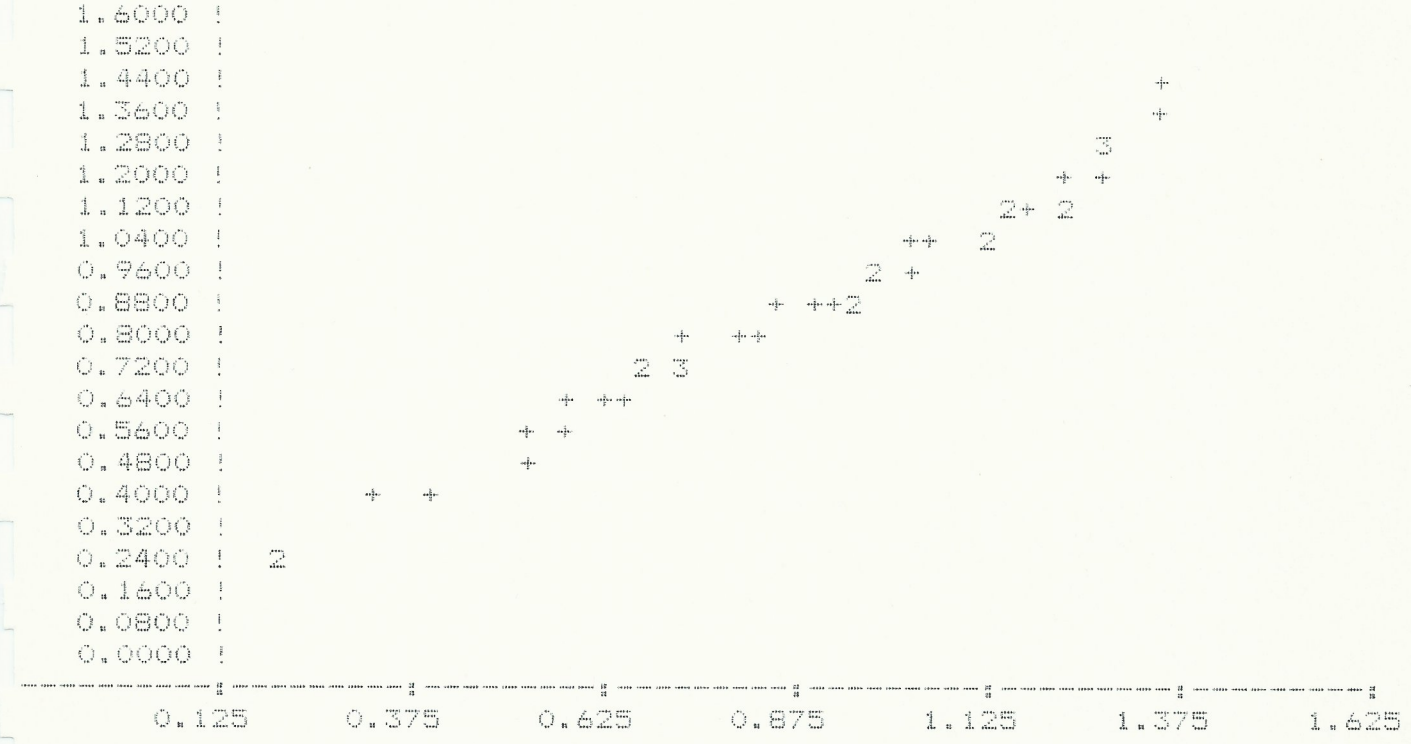
Control: 1 1 2 2 3 4 4 5 5 8 8 8 11 11 12 12 15 17 22 23
6-MP : 6 6 6 6 7 9 10 *10* *11* 13 16 *17* *19* *20* 22 23 25 32 32 *34* *35*

```
$units 42$
$C Gehan's Data...JRSS B 1978,P.217 and Biometrika,1965,52,p213$
$data t $read
REA? 1 1 2 2 3 4 4 5 5   8 8 8 8 11 11 12 12 15 17 22 23
REA? 6 6 6 6 7 9 10 10  11 13 16 17 19 20 22 23 25 32 32 34 35
$data c $read
REA? 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
REA? 1 1 1 0 1 0 1 0 0 1 1 0 0 0 1 1 0 0 0 0 0 0
$ca g=%gl(2,21)$
! Variables:
!   T remission times in weeks
!   C censor variate (1=uncensored, 0=censored)
!   G group treatment (1=placebo,2=6-mercaptopurine(6-mp))
!
$m model g $e
$input %plc 80 weib$
$ca %A=%W=0$use weib t c$
$use resp c$
$stop$
```

Output from GLIM Program 2

```
                                        -- Model is g
Exponential fit

  Deviance    shape        df        scaled
              parameter              deviance
    217.05    1.0000       40         38.017 at cycle 4 on 40 df
Weibull fit
    213.22    1.3156       39         50.649 at cycle 5 on 40 df
    213.16    1.3546       39         52.343 at cycle 5 on 40 df
    213.16    1.3632       39         52.719 at cycle 5 on 40 df
    213.16    1.3652       39         52.805 at cycle 5 on 40 df

---Standard errors of estimates given below are underestimated
                 estimate          s.e.       parameter
                   -1.339        0.5491       1
                   -1.731        0.3983       G
           scale parameter taken as 1.000

Residual plot
     3.200 !                                                  +
     3.040 !
     2.880 !
     2.720 !                                              +
     2.560 !
     2.400 !
     2.240 !
     2.080 !                                 +
     1.920 !
     1.760 !                          +
     1.600 !
     1.440 !                    +
     1.280 !                    +
     1.120 !                 2
     0.960 !              22
     0.800 !           3
     0.640 !        2+ +
     0.480 !     42
     0.320 !   32
     0.160 !53
     0.000 !4
-----------:----------:----------:----------:----------:----------:----------:
          0.000      0.800      1.600      2.400      3.200      4.000      4.800
```

Variance stabilised residual plot



## GLIM Program 3

As GLIM Program 2, but for the uncensored data

### Data

The data sets below represent the failure times. They are obtained by simulating the Weibull distribution with :-
k=3 and p=1.25 for the control group (call this Group 1) and
k=3 and p=2.50 for the treated group (call this Group 2).

Group 1: 1.431 0.536 0.589 0.803 0.639 0.485 0.444 0.829 0.761 0.538
0.624 0.703 0.333 0.678 0.769 1.312 0.745 1.162 0.798 0.812
0.347 0.655 0.807 0.662 0.981 1.258 1.070 1.010 0.623 0.875
0.353 0.259 0.684 0.618 1.030 0.822 0.806 0.960 1.007 0.286
0.797 0.617 0.604 1.407 0.730 0.519 0.396 0.764 0.457 0.443
1.088 0.961 0.594 0.902 0.702 0.394 0.631 0.664 0.274 0.732
1.215 0.668 1.064 0.977 0.512 1.052 0.658 0.537 0.620 0.713
0.802 1.107 1.027 0.749 0.993 0.310 0.541 0.419 0.940 0.814
0.846 1.305 0.578 1.186 0.561 0.384 0.510 0.614 0.733 0.619
0.761 1.110 0.723 0.590 0.822 0.627 0.690 0.712 0.366 0.810
0.601 0.532 0.634 0.880 0.985 0.790 0.558 0.481 0.877 0.420
0.504 0.918 0.869 0.368 0.521 0.804 1.011 0.474 0.959 0.846
0.869 0.300 0.867 0.663 0.452 0.793 0.688 0.995 0.495 0.963
0.775 0.892 0.815 0.733 0.437 0.353 1.031 0.561 0.812 0.879
0.855 0.258 0.900 0.850 0.362 0.865 0.432 0.589 0.500 0.592
0.965 0.505 0.857 0.536 0.426 0.624 0.195 0.734 0.820 0.574
0.678 0.536 0.508 0.878 0.562 0.205 0.941 0.475 0.563 0.725
0.622 0.657 0.913 1.406 0.812

Group 2: 0.478 0.355 0.297 0.417 0.468 0.491 0.241 0.420 0.364 0.344
0.219 0.263 0.373 0.378 0.113 0.304 0.378 0.301 0.357 0.408
0.547 0.237 0.037 0.265 0.396 0.575 0.318 0.280 0.474 0.119
0.430 0.402 0.229 0.270 0.413 0.370 0.262 0.288 0.597 0.388
0.194 0.357 0.351 0.479 0.320 0.535 0.230 0.266 0.232 0.365
0.408 0.533 0.355 0.326 0.388 0.294 0.296 0.395 0.440 0.449
0.387 0.411 0.344 0.186 0.575 0.408 0.233 0.395 0.247 0.366
0.660 0.432 0.527 0.411 0.249 0.369 0.511 0.258 0.236 0.544
0.366 0.438 0.417 0.276 0.366 0.511 0.417 0.184 0.361 0.285
0.420 0.362 0.476 0.340 0.278 0.434 0.369 0.492 0.241 0.377
0.232 0.255 0.363 0.250 0.542 0.513 0.336 0.285 0.582 0.325
0.758 0.199 0.116 0.326 0.269 0.395 0.260 0.292 0.391 0.407
0.417 0.446 0.255 0.216 0.417 0.481 0.425 0.428 0.293 0.390
0.451 0.322 0.192 0.246 0.155 0.209 0.215 0.426 0.138 0.293
0.178 0.323 0.454 0.340 0.684 0.409 0.474 0.197 0.286 0.396
0.612 0.584 0.273 0.282 0.168 0.362 0.505 0.272 0.347 0.179
0.398 0.284 0.401 0.354 0.324 0.310 0.273 0.297 0.364 0.270
0.373 0.234 0.234 0.271 0.507

```
$units 350$
$! Failure times are obtained by simulating the Weibull
$! distribution with index=3, rate=1.25 in the control group
$! and index=3, rate=2.5 in the treated group.
$! This is for the no censoring model.
$data t $read
$REA? 1.431 0.536 0.589 0.803 0.639 0.485 0.444 0.829 0.761 0.538
```

```
$REA? 0.624 0.703 0.333 0.678 0.769 1.312 0.745 1.162 0.798 0.812
$REA? 0.347 0.655 0.807 0.662 0.981 1.258 1.070 1.010 0.623 0.875
$REA? 0.353 0.259 0.684 0.618 1.030 0.822 0.806 0.960 1.007 0.286
$REA? 0.797 0.617 0.604 1.407 0.730 0.519 0.396 0.764 0.457 0.443
$REA? 1.088 0.961 0.594 0.902 0.702 0.394 0.631 0.664 0.274 0.732
$REA? 1.215 0.668 1.064 0.977 0.512 1.052 0.658 0.537 0.620 0.713
$REA? 0.802 1.107 1.027 0.749 0.993 0.310 0.541 0.419 0.940 0.814
$REA? 0.846 1.305 0.578 1.186 0.561 0.384 0.510 0.614 0.733 0.619
$REA? 0.761 1.110 0.723 0.590 0.822 0.627 0.690 0.712 0.366 0.810
$REA? 0.601 0.532 0.634 0.880 0.985 0.790 0.558 0.481 0.877 0.420
$REA? 0.504 0.918 0.869 0.368 0.521 0.804 1.011 0.474 0.959 0.846
$REA? 0.869 0.300 0.867 0.663 0.452 0.793 0.688 0.995 0.495 0.963
$REA? 0.775 0.892 0.815 0.733 0.437 0.353 1.031 0.561 0.812 0.879
$REA? 0.855 0.258 0.900 0.850 0.362 0.865 0.432 0.589 0.500 0.592
$REA? 0.965 0.505 0.857 0.536 0.426 0.624 0.195 0.734 0.820 0.574
$REA? 0.678 0.536 0.508 0.878 0.562 0.205 0.941 0.475 0.563 0.725
$REA? 0.622 0.657 0.913 1.406 0.812 0.478 0.355 0.297 0.417 0.468
$REA? 0.491 0.241 0.420 0.364 0.344 0.219 0.263 0.373 0.378 0.113
$REA? 0.304 0.378 0.301 0.357 0.408 0.547 0.237 0.037 0.265 0.396
$REA? 0.575 0.318 0.280 0.474 0.119 0.430 0.402 0.229 0.270 0.413
$REA? 0.370 0.262 0.288 0.597 0.388 0.194 0.357 0.351 0.479 0.320
$REA? 0.535 0.230 0.266 0.232 0.365 0.408 0.533 0.355 0.326 0.388
$REA? 0.294 0.296 0.395 0.440 0.449 0.387 0.411 0.344 0.186 0.575
$REA? 0.408 0.233 0.395 0.247 0.366 0.660 0.432 0.527 0.411 0.249
$REA? 0.369 0.511 0.258 0.236 0.544 0.366 0.438 0.417 0.276 0.366
$REA? 0.511 0.417 0.184 0.361 0.285 0.420 0.362 0.476 0.340 0.278
$REA? 0.434 0.369 0.492 0.241 0.377 0.232 0.255 0.363 0.250 0.542
$REA? 0.513 0.336 0.285 0.582 0.325 0.758 0.199 0.116 0.326 0.269
$REA? 0.395 0.260 0.292 0.391 0.407 0.417 0.446 0.255 0.216 0.417
$REA? 0.481 0.425 0.428 0.293 0.390 0.451 0.322 0.192 0.246 0.155
$REA? 0.209 0.215 0.426 0.138 0.293 0.178 0.323 0.454 0.340 0.684
$REA? 0.409 0.474 0.197 0.286 0.396 0.612 0.584 0.273 0.282 0.168
$REA? 0.362 0.505 0.272 0.347 0.179 0.398 0.284 0.401 0.354 0.324
$REA? 0.310 0.273 0.297 0.364 0.270 0.373 0.234 0.234 0.271 0.507
$calc c=1$ ! Calculates c=1, for all units
$calc g=%gl(2,175)$
$! Variables:
$! t is the failure time in arbitary units
$! c is the censor variate (1=uncensored, 0=censored)
$! g is the group treatment (1=control,2=treated(drug))
$!
$m model g $e
$input %plc 80 weib$
$calc %a=%w=0$use weib t c$
$use resp c$
$stop$
```

Output from GLIM Program 3

-- Model is g

Exponential fit

| Deviance | shape parameter | df | scaled deviance |
|---|---|---|---|
| 219.94 | 1.0000 | 348 | 45.229 at cycle 4 on 348 df |

Weibull fit

| | | | |
|---|---|---|---|
| -142.97 | 4.5574 | 347 | 744.0 at cycle 5 on 348 df |
| -238.63 | 3.4878 | 347 | 461.15 at cycle 5 on 348 df |
| -244.74 | 3.2122 | 347 | 397.42 at cycle 5 on 348 df |
| -244.90 | 3.1681 | 347 | 387.58 at cycle 5 on 348 df |
| -244.90 | 3.1624 | 347 | 386.33 at cycle 5 on 348 df |

---Standard errors of estimates given below are underestimated

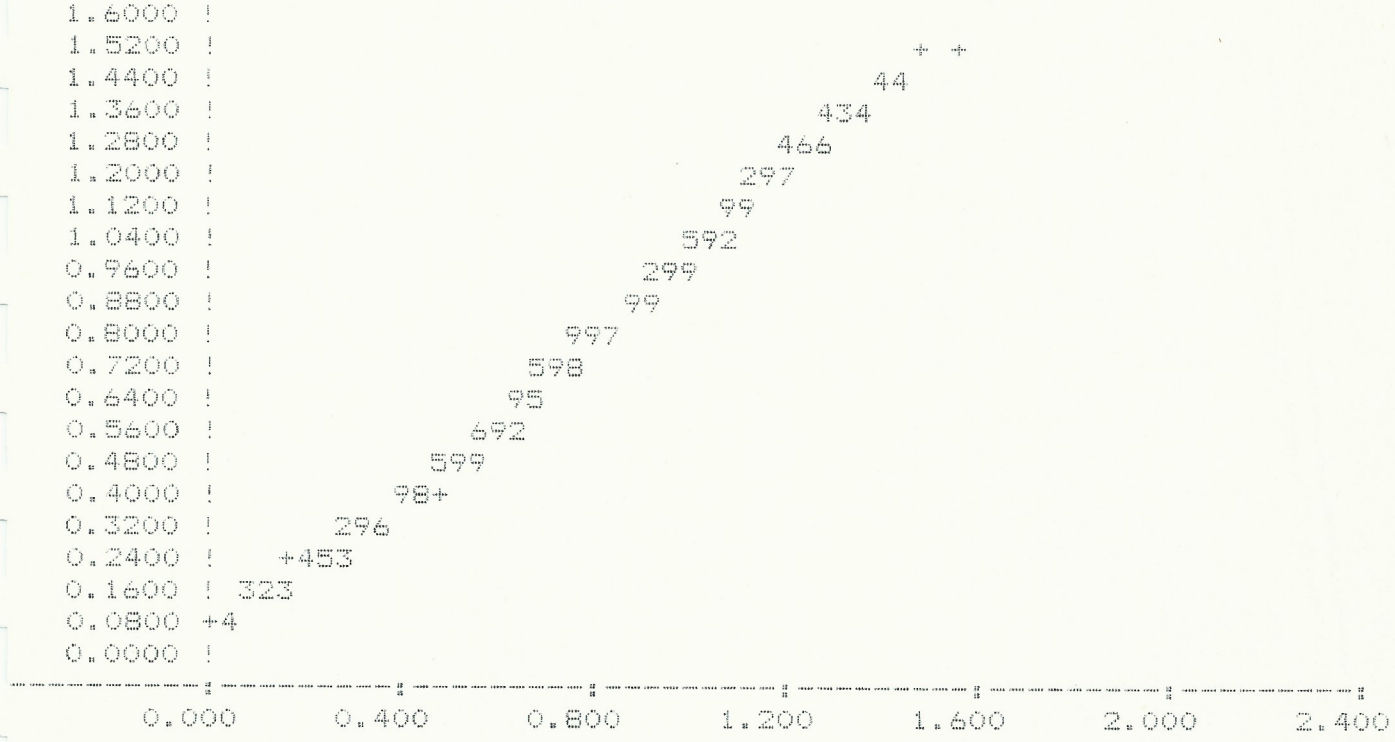
| estimate | s.e. | parameter |
|---|---|---|
| -1.560 | 0.1690 | 1 |
| 2.254 | 0.1069 | 6 |

scale parameter taken as 1.000

Residual plot

```
    6.000 !                                                      +
    5.700 !
    5.400 !
    5.100 !                                                  +
    4.800 !                                                +
    4.500 !                                                +
    4.200 !                                             +    +
    3.900 !                                          ++
    3.600 !                                    + ++
    3.300 !                                  +2+
    3.000 !                              ++ +2
    2.700 !                            43
    2.400 !                         63
    2.100 !                      652
    1.800 !                   2592
    1.500 !                  97
    1.200 !              692
    0.900 !           99
    0.600 !         999
    0.300 !        996
    0.000       99
          ---------:---------:---------:---------:---------:---------:---------:
                0.00      1.60      3.20      4.80      6.40      8.00      9.60
```

Variance stabilised residual plot



## GLIM Program 4

As GLIM Program 3, but for the Type I censoring data

## Data

The data sets below represent the failure times obtained by taking the minimum of the censor times and the remission times. The remission times are obtained by simulating the Weibull distribution with :-

k=3, p=1.25 for the control group (call this Group 1) and
k=3, p=2.50 for the treated group (call this Group 2).

This is for the constant censoring model.
Minimum time for censoring to occur is 0.875
(Failure times in italics are censored)

Group 1: *0.875* 0.536 0.589 0.803 0.639 0.485 0.444 0.839 0.761 0.538
0.624 0.703 0.333 0.678 0.769 *0.875* 0.745 *0.875* 0.798 0.812
0.347 0.655 0.807 0.622 *0.875* *0.875* *0.875* *0.875* 0.623 0.875
0.353 0.259 0.684 0.618 *0.875* 0.822 0.806 *0.875* *0.875* 0.286
0.797 0.617 0.604 *0.875* 0.730 0.519 0.396 0.764 0.457 0.443
*0.875* *0.875* 0.594 *0.875* *0.875* 0.594 *0.875* 0.702 0.394 0.631
0.664 0.274 0.732 *0.875* 0.668 *0.875* *0.875* 0.512 *0.875* *0.875*
0.512 *0.875* 0.658 0.537 0.620 0.713 0.802 *0.875* *0.875* 0.749
*0.875* 0.310 0.541 0.419 *0.875* 0.578 *0.875* 0.561 0.384 0.510
0.614 0.733 0.619 0.761 *0.875* 0.723 0.590 0.822 0.627 0.690
0.712 0.366 0.810 0.601 0.532 0.634 *0.875* *0.875* 0.790 0.558
0.481 *0.875* 0.420 0.504 *0.875* 0.869 0.368 0.521 0.804 *0.875*
0.474 *0.875* 0.846 0.869 0.300 0.867 0.663 0.452 0.793 0.688
*0.875* 0.495 *0.875* *0.815* 0.733 *0.437* *0.353* *0.875* 0.561 0.812
*0.875* 0.855 0.258 *0.875* 0.850 0.362 0.865 0.432 0.589 0.500
0.592 *0.875* 0.505 0.857 0.536 0.426 0.624 0.195 0.734 0.820
0.574 0.638 0.536 0.508 *0.875* 0.562 0.205 *0.875* 0.475 0.563
0.725 0.622 0.657 *0.875* *0.875*

Group 2: 0.478 0.355 0.297 0.417 0.468 0.491 0.241 0.420 0.364 0.344
0.219 0.263 0.373 0.378 0.113 0.304 0.378 0.301 0.357 0.408
0.547 0.237 0.037 0.265 0.396 0.575 0.318 0.280 0.474 0.119
0.430 0.402 0.229 0.270 0.413 0.370 0.262 0.288 0.597 0.388
0.194 0.357 0.351 0.479 0.320 0.535 0.230 0.266 0.232 0.365
0.408 0.533 0.355 0.326 0.388 0.294 0.296 0.395 0.440 0.449
0.387 0.411 0.344 0.186 0.575 0.408 0.233 0.395 0.247 0.366
0.660 0.432 0.527 0.411 0.249 0.369 0.511 0.258 0.236 0.544
0.366 0.438 0.417 0.276 0.366 0.511 0.417 0.184 0.361 0.285
0.420 0.362 0.476 0.340 0.278 0.434 0.369 0.492 0.241 0.377
0.232 0.255 0.363 0.250 0.542 0.513 0.336 0.285 0.582 0.325
0.758 0.199 0.116 0.326 0.269 0.395 0.260 0.292 0.391 0.407
0.417 0.446 0.255 0.216 0.417 0.481 0.425 0.428 0.293 0.390
0.451 0.322 0.192 0.246 0.155 0.209 0.215 0.426 0.138 0.293
0.178 0.323 0.454 0.340 0.684 0.409 0.474 0.197 0.286 0.396
0.612 0.584 0.273 0.282 0.168 0.362 0.505 0.272 0.347 0.179
0.398 0.284 0.401 0.354 0.324 0.310 0.273 0.297 0.364 0.270
0.373 0.234 0.234 0.271 0.507

```
$units 350$
$! Failure times are obtained by taking the minimum of the
$! censor times and the remission times. The remission times
```

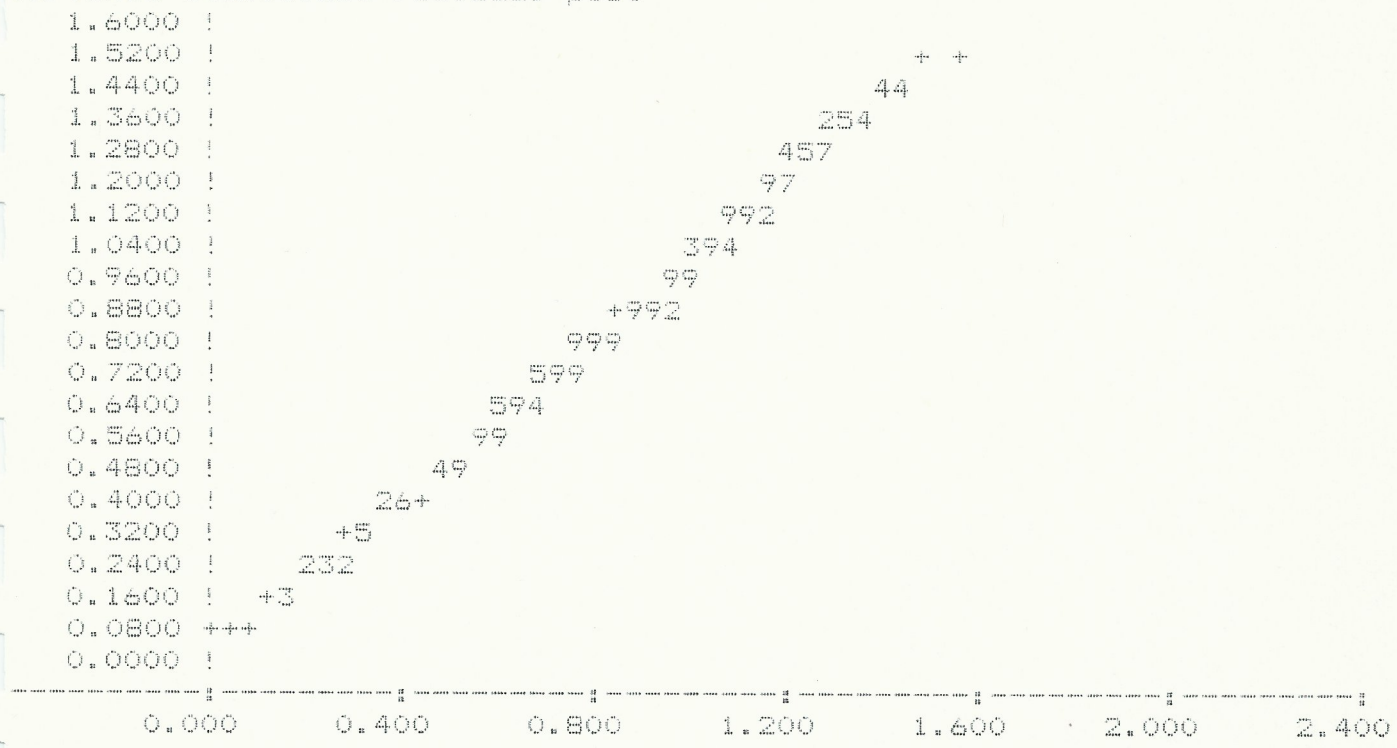
```
$! are obtained by simulating the Weibull distribution with
$! index=3 (for both groups) and rate=1.25 for the control
$! group, 2.5 otherwise.
$! This is for the constant censoring model.
$! Minimum time for censoring to occur is 0.875
$data x c $read
REA? 0.875 0 0.536 1 0.589 1 0.803 1 0.639 1 0.485 1 0.444 1
REA? 0.839 1 0.761 1 0.538 1 0.624 1 0.703 1 0.333 1 0.678 1
REA? 0.769 1 0.875 0 0.745 1 0.875 0 0.798 1 0.812 1 0.347 1
REA? 0.655 1 0.807 1 0.622 1 0.875 0 0.875 0 0.875 0 0.875 0
REA? 0.623 1 0.875 0 0.353 1 0.259 1 0.684 1 0.618 1 0.875 0
REA? 0.822 1 0.806 1 0.875 0 0.875 0 0.286 1 0.797 1 0.617 1
REA? 0.604 1 0.875 0 0.730 1 0.519 1 0.396 1 0.764 1 0.457 1
REA? 0.443 1 0.875 0 0.875 0 0.594 1 0.875 0 0.875 0 0.594 1
REA? 0.875 0 0.702 1 0.394 1 0.631 1 0.664 1 0.274 1 0.732 1
REA? 0.875 0 0.668 1 0.875 0 0.875 0 0.512 1 0.875 0 0.875 0
REA? 0.512 1 0.875 0 0.658 1 0.537 1 0.620 1 0.713 1 0.802 1
REA? 0.875 0 0.875 0 0.749 1 0.875 0 0.310 1 0.541 1 0.419 1
REA? 0.875 0 0.578 1 0.875 0 0.561 1 0.384 1 0.510 1 0.614 1
REA? 0.733 1 0.619 1 0.761 1 0.875 0 0.723 1 0.590 1 0.822 1
REA? 0.627 1 0.690 1 0.712 1 0.366 1 0.810 1 0.601 1 0.532 1
REA? 0.634 1 0.875 0 0.875 0 0.790 1 0.558 1 0.481 1 0.875 0
REA? 0.420 1 0.504 1 0.875 0 0.869 1 0.368 1 0.521 1 0.804 1
REA? 0.875 0 0.474 1 0.875 0 0.846 1 0.869 1 0.300 1 0.867 1
REA? 0.663 1 0.452 1 0.793 1 0.688 1 0.875 0 0.495 1 0.875 0
REA? 0.815 1 0.733 1 0.437 1 0.353 1 0.875 0 0.561 1 0.812 1
REA? 0.875 0 0.855 1 0.258 1 0.875 0 0.850 1 0.362 1 0.865 1
REA? 0.432 1 0.589 1 0.500 1 0.592 1 0.875 0 0.505 1 0.857 1
REA? 0.536 1 0.426 1 0.624 1 0.195 1 0.734 1 0.820 1 0.574 1
REA? 0.638 1 0.536 1 0.508 1 0.875 0 0.562 1 0.205 1 0.875 0
REA? 0.475 1 0.563 1 0.725 1 0.622 1 0.657 1 0.875 0 0.875 0
REA? 0.478 1 0.355 1 0.297 1 0.417 1 0.468 1 0.491 1 0.241 1
REA? 0.420 1 0.364 1 0.344 1 0.219 1 0.263 1 0.373 1 0.378 1
REA? 0.113 1 0.304 1 0.378 1 0.301 1 0.357 1 0.408 1 0.547 1
REA? 0.237 1 0.037 1 0.265 1 0.396 1 0.575 1 0.318 1 0.280 1
REA? 0.474 1 0.119 1 0.430 1 0.402 1 0.229 1 0.270 1 0.413 1
REA? 0.370 1 0.262 1 0.288 1 0.597 1 0.388 1 0.194 1 0.357 1
REA? 0.351 1 0.479 1 0.320 1 0.535 1 0.230 1 0.266 1 0.232 1
REA? 0.365 1 0.408 1 0.533 1 0.358 1 0.326 1 0.388 1 0.294 1
REA? 0.296 1 0.395 1 0.440 1 0.449 1 0.387 1 0.411 1 0.344 1
REA? 0.186 1 0.575 1 0.408 1 0.233 1 0.395 1 0.247 1 0.366 1
REA? 0.660 1 0.432 1 0.527 1 0.411 1 0.249 1 0.369 1 0.511 1
REA? 0.258 1 0.236 1 0.544 1 0.366 1 0.438 1 0.417 1 0.276 1
REA? 0.366 1 0.511 1 0.417 1 0.184 1 0.361 1 0.285 1 0.420 1
REA? 0.362 1 0.476 1 0.340 1 0.278 1 0.434 1 0.369 1 0.492 1
REA? 0.241 1 0.377 1 0.232 1 0.255 1 0.363 1 0.250 1 0.542 1
REA? 0.513 1 0.336 1 0.285 1 0.582 1 0.325 1 0.758 1 0.199 1
REA? 0.116 1 0.326 1 0.269 1 0.395 1 0.260 1 0.292 1 0.391 1
REA? 0.407 1 0.417 1 0.446 1 0.255 1 0.216 1 0.417 1 0.481 1
REA? 0.425 1 0.428 1 0.293 1 0.390 1 0.451 1 0.322 1 0.192 1
REA? 0.246 1 0.155 1 0.209 1 0.215 1 0.426 1 0.138 1 0.293 1
REA? 0.178 1 0.323 1 0.454 1 0.340 1 0.684 1 0.409 1 0.474 1
REA? 0.197 1 0.286 1 0.396 1 0.612 1 0.584 1 0.273 1 0.282 1
REA? 0.168 1 0.362 1 0.505 1 0.272 1 0.347 1 0.179 1 0.398 1
REA? 0.284 1 0.401 1 0.354 1 0.324 1 0.310 1 0.273 1 0.297 1
REA? 0.364 1 0.270 1 0.373 1 0.234 1 0.234 1 0.271 1 0.507 1
```

```
$calc g=%gl(2,175)$
$! Variables:
$!   x is the failure time in arbitary units
$!   c is the censor variate (1=uncensored, 0=censored)
$!   g is the group treatment (1=control, 2=treated (drug))
$!
$m model g $e
$input %plc 80 weib$
$calc %a=%w=0$use weib x c$
$use reap c$
$stop$
```

Output from GLIM Program 4

```
                                        -- Model is g
Exponential fit

  Deviance    shape        df        scaled
              parameter              deviance
    220.79    1.0000      348          137.80 at cycle 4 on 348 df
Weibull fit
   -161.94    3.8053      347          572.94 at cycle 5 on 348 df
   -174.58    3.3802      347          487.80 at cycle 5 on 348 df
   -175.39    3.2731      347          467.28 at cycle 5 on 348 df
   -175.42    3.2497      347          462.86 at cycle 5 on 348 df
   -175.43    3.2449      347          461.95 at cycle 5 on 348 df
```

```
---Standard errors of estimates given below are underestimated
                estimate          s.e.       parameter
                  -1.488        0.1904               1
                   2.251        0.1155               6
          scale parameter taken as 1.000

Residual plot
     6.000 !
     5.700 !                                                    +
     5.400 !
     5.100 !                                          +
     4.800 !
     4.500 !                                  +
     4.200 !
     3.900 !                          +
     3.600 !                      ++
     3.300 !                    2+
     3.000 !                 +
     2.700 !               22
     2.400 !             3+
     2.100 !          +22
     1.800 !        +6
     1.500 !      372
     1.200 !    89
     0.900 !   99
     0.600 ! 999
     0.300 !99
     0.000 99
-----------:---------:---------:---------:---------:---------:---------:
          0.00       2.00       4.00       6.00       8.00      10.00      12.00
```


Variance stabilised residual plot
1.6000
1.5200
1.4400
1.3600
1.2800
1.2000
1.1200
1.0400
0.9600
0.8800
0.8000
0.7200
0.6400
0.5600
0.4800
0.4000
0.3200
0.2400
0.1600
0.0800
0.0000
0.000
0.400
0.800
1.200
1.600
2.000
2.400

## GLIM Program 5

As for GLIM Program 3, but for the Type II censoring data (RC I model)

### Data

Group 1: *1.400* 0.536 0.589 0.803 0.639 0.485 0.444 0.839 0.761 0.538
0.624 0.703 0.333 0.678 0.769 1.312 0.745 1.162 0.798 0.812
0.347 0.655 0.807 0.622 0.981 *1.256* 1.070 1.010 0.623 0.875
0.353 0.259 0.684 0.618 1.030 0.822 0.806 0.960 1.007 0.286
0.797 0.617 0.604 *1.153* 0.730 0.519 0.396 0.764 0.457 0.443
1.088 0.961 0.594 0.902 0.702 0.394 0.631 0.664 0.274 0.732
*1.055* 0.668 *1.044* 0.977 0.512 *1.026* 0.658 0.537 0.620 0.713
0.802 *0.992* *0.986* 0.749 *0.975* 0.310 0.541 0.419 0.940 0.814
0.846 *0.934* 0.578 *0.923* 0.561 0.384 0.510 0.614 0.733 0.619
0.761 *0.877* 0.723 0.590 0.822 0.627 0.690 0.712 0.366 0.810
0.601 0.532 0.634 *0.808* *0.802* 0.790 0.558 0.481 *0.779* 0.420
0.504 *0.762* *0.756* 0.368 0.521 *0.739* *0.733* 0.474 *0.722* *0.716*
*0.710* 0.300 0.669 0.663 0.452 *0.682* *0.676* *0.670* 0.495 *0.659*
*0.653* *0.647* *0.641* *0.636* 0.437 0.353 *0.618* 0.561 *0.607* *0.601*
*0.595* *0.590* 0.258 *0.578* *0.572* 0.362 *0.561* 0.432 *0.549* 0.500
*0.538* *0.532* 0.505 *0.521* *0.515* 0.426 *0.503* 0.195 *0.492* *0.486*
*0.480* *0.475* *0.469* *0.463* *0.457* *0.452* 0.205 *0.440* *0.434* *0.429*
*0.423* *0.417* *0.411* *0.406* *0.400*

Group 2: 0.478 0.355 0.297 0.417 0.468 0.491 0.241 0.420 0.364 0.344
0.219 0.263 0.373 0.378 0.113 0.304 0.378 0.301 0.357 0.408
0.547 0.237 0.037 0.265 0.396 0.575 0.318 0.280 0.474 0.119
0.430 0.402 0.229 0.270 0.413 0.370 0.262 0.288 0.597 0.388
0.194 0.357 0.351 0.479 0.320 0.535 0.230 0.266 0.232 0.365
0.408 0.533 0.355 0.326 0.388 0.294 0.296 0.395 0.440 0.449
0.387 0.411 0.344 0.186 0.575 0.408 0.233 0.395 0.247 0.366
0.660 0.432 0.527 0.411 0.249 0.369 0.511 0.258 0.236 0.544
0.366 0.438 0.417 0.276 0.366 0.511 0.417 0.184 0.361 0.285
0.420 0.362 0.476 0.340 0.278 0.434 0.369 0.492 0.241 0.377
0.232 0.255 0.363 0.250 0.542 0.513 0.336 0.285 0.582 0.325
0.758 0.199 0.116 0.326 0.269 0.395 0.260 0.292 0.391 0.407
0.417 0.446 0.255 0.216 0.417 0.481 0.425 0.428 0.293 0.390
0.451 0.322 0.192 0.246 0.155 0.209 0.215 0.426 0.138 0.293
0.178 0.323 0.454 0.340 *0.572* 0.409 0.474 0.197 0.286 0.396
*0.538* *0.532* *0.273* *0.282* *0.168* *0.362* *0.503* 0.272 0.347 0.179
0.398 0.284 0.401 0.354 0.324 0.310 0.273 0.297 0.364 0.270
0.373 0.234 0.234 0.271 *0.400*

```
$units 350$
$! Failure times are obtained by taking the minimum of the
$! censor times and the remission times. The remission times
$! are obtained by simulating the Weibull distribution with
$! index=3 (for both groups) and rate=1.25 for the control
$! group, 2.5 otherwise. This is for the realistic case I
$! model, where the censor time at i=n is 0.400.
$data x c $read
REA? 1.400 0 0.536 1 0.589 1 0.803 1 0.639 1 0.485 1 0.444 1
REA? 0.839 1 0.761 1 0.538 1 0.624 1 0.703 1 0.333 1 0.678 1
REA? 0.769 1 1.312 1 0.745 1 1.162 1 0.798 1 0.812 1 0.347 1
REA? 0.655 1 0.807 1 0.622 1 0.981 1 1.256 0 1.070 1 1.010 1
REA? 0.623 1 0.875 1 0.353 1 0.259 1 0.684 1 0.618 1 1.030 0
REA? 0.822 1 0.806 1 0.960 1 1.007 1 0.286 1 0.797 1 0.617 1
REA? 0.604 1 1.153 0 0.730 1 0.519 1 0.396 1 0.764 1 0.457 1
REA? 0.443 1 1.088 1 0.961 1 0.594 1 0.902 1 0.702 1 0.394 1
REA? 0.631 1 0.664 1 0.274 1 0.732 1 1.055 0 0.668 1 1.044 0
REA? 0.977 1 0.512 1 1.026 0 0.658 1 0.537 1 0.620 1 0.713 1
REA? 0.802 1 0.992 0 0.986 0 0.749 1 0.975 0 0.310 1 0.541 1
REA? 0.419 1 0.940 1 0.814 1 0.846 1 0.934 0 0.578 1 0.923 0
REA? 0.561 1 0.384 1 0.510 1 0.614 1 0.733 1 0.619 1 0.761 1
REA? 0.877 0 0.723 1 0.590 1 0.822 1 0.627 1 0.690 1 0.712 1
REA? 0.366 1 0.810 1 0.601 1 0.532 1 0.634 1 0.808 0 0.802 0
REA? 0.790 1 0.558 1 0.481 1 0.779 0 0.420 1 0.504 1 0.762 0
REA? 0.756 0 0.368 1 0.521 1 0.739 0 0.733 0 0.474 1 0.722 0
REA? 0.716 0 0.710 0 0.300 1 0.699 0 0.663 1 0.452 1 0.682 0
REA? 0.676 0 0.670 0 0.495 1 0.659 0 0.653 0 0.647 0 0.641 0
REA? 0.636 0 0.437 1 0.353 1 0.618 0 0.561 1 0.607 0 0.601 0
REA? 0.595 0 0.590 0 0.258 1 0.578 0 0.572 0 0.362 1 0.561 0
REA? 0.432 1 0.549 0 0.500 1 0.538 0 0.532 0 0.505 1 0.521 0
REA? 0.515 0 0.426 1 0.503 0 0.195 1 0.492 0 0.486 0 0.480 0
REA? 0.475 0 0.469 0 0.463 0 0.457 0 0.452 0 0.205 1 0.440 0
REA? 0.434 0 0.429 0 0.423 0 0.417 0 0.411 0 0.406 0 0.400 0
REA? 0.478 1 0.355 1 0.297 1 0.417 1 0.468 1 0.491 1 0.241 1
REA? 0.420 1 0.364 1 0.344 1 0.219 1 0.263 1 0.373 1 0.378 1
REA? 0.113 1 0.304 1 0.378 1 0.301 1 0.357 1 0.408 1 0.547 1
REA? 0.237 1 0.037 1 0.265 1 0.396 1 0.575 1 0.318 1 0.280 1
REA? 0.474 1 0.119 1 0.430 1 0.402 1 0.229 1 0.270 1 0.413 1
REA? 0.370 1 0.262 1 0.288 1 0.597 1 0.388 1 0.194 1 0.357 1
REA? 0.351 1 0.479 1 0.320 1 0.535 1 0.230 1 0.266 1 0.232 1
REA? 0.365 1 0.408 1 0.533 1 0.355 1 0.326 1 0.388 1 0.294 1
REA? 0.296 1 0.395 1 0.440 1 0.449 1 0.387 1 0.411 1 0.344 1
REA? 0.186 1 0.575 1 0.408 1 0.233 1 0.395 1 0.247 1 0.366 1
REA? 0.660 1 0.432 1 0.527 1 0.411 1 0.249 1 0.369 1 0.511 1
REA? 0.258 1 0.236 1 0.544 1 0.366 1 0.438 1 0.417 1 0.276 1
REA? 0.366 1 0.511 1 0.417 1 0.184 1 0.361 1 0.285 1 0.420 1
REA? 0.362 1 0.476 1 0.340 1 0.278 1 0.434 1 0.369 1 0.492 1
REA? 0.241 1 0.377 1 0.232 1 0.255 1 0.363 1 0.250 1 0.542 1
REA? 0.513 1 0.336 1 0.285 1 0.582 1 0.325 1 0.758 1 0.199 1
REA? 0.116 1 0.326 1 0.269 1 0.395 1 0.260 1 0.292 1 0.391 1
REA? 0.407 1 0.417 1 0.446 1 0.255 1 0.216 1 0.417 1 0.481 1
REA? 0.425 1 0.428 1 0.293 1 0.390 1 0.451 1 0.322 1 0.192 1
REA? 0.246 1 0.155 1 0.209 1 0.215 1 0.426 1 0.138 1 0.293 1
REA? 0.178 1 0.323 1 0.454 1 0.340 1 0.572 0 0.409 1 0.474 1
REA? 0.197 1 0.286 1 0.396 1 0.538 0 0.532 0 0.273 1 0.282 1
REA? 0.168 1 0.362 1 0.503 0 0.272 1 0.347 1 0.179 1 0.398 1
```

```
REA? 0.284 1 0.401 1 0.354 1 0.324 1 0.310 1 0.273 1 0.297 1
REA? 0.364 1 0.270 1 0.373 1 0.234 1 0.234 1 0.271 1 0.400 0
$calc g=%gl(2,175)$
$! Variables:
$!   x is the failure time in arbitary units
$!   c is the censor variate (1=uncensored, 0=censored)
$!   g is the group treatment (1=control, 2=treated (drug))
$!
$m model g $e
$input %plc 80 weib$
$calc %a=%w=0$use weib x c$
$use resp c$
$stop$
```

Output from GLIM Program 5

-- Model is g

Exponential fit

| Deviance | shape parameter | df | scaled deviance | |
|---|---|---|---|---|
| 221.07 | 1.0000 | 348 | 152.69 | at cycle 4 on 348 df |

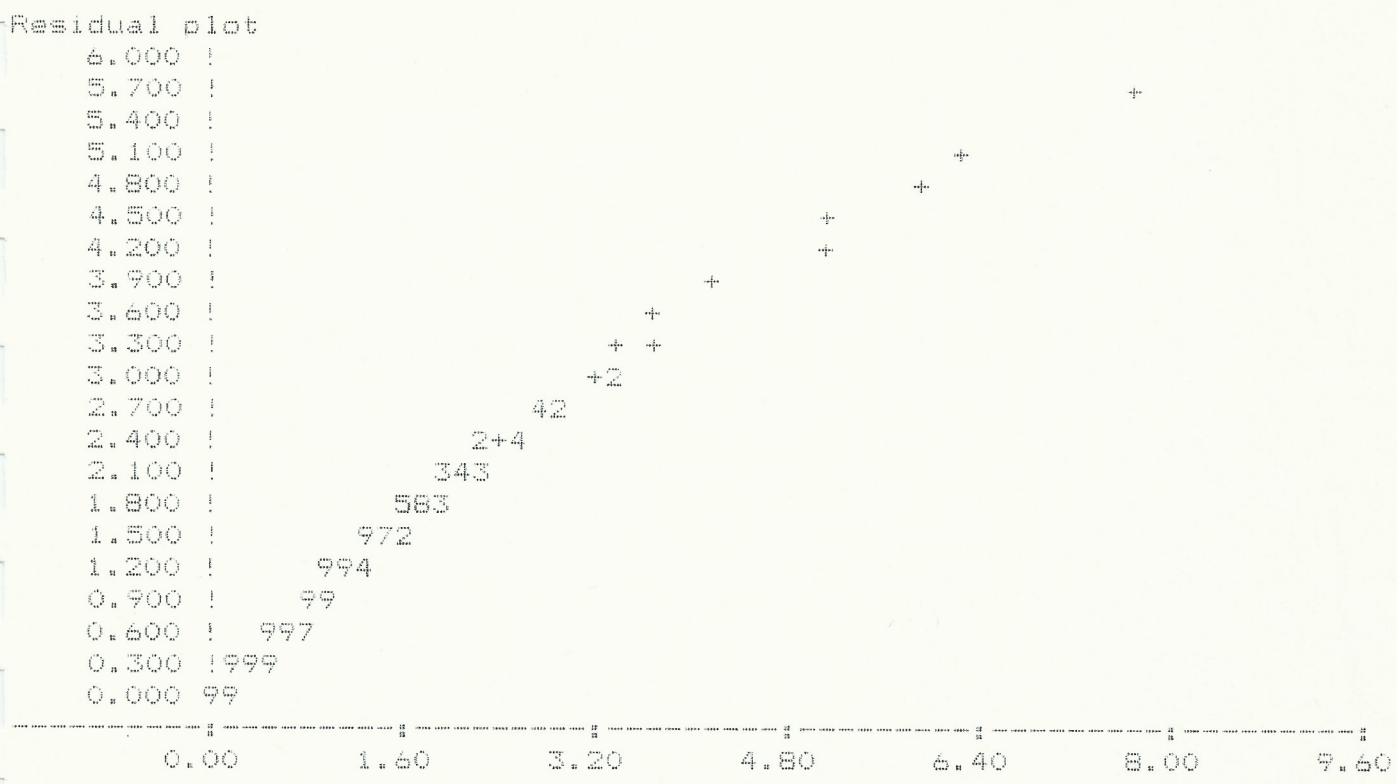
Weibull fit

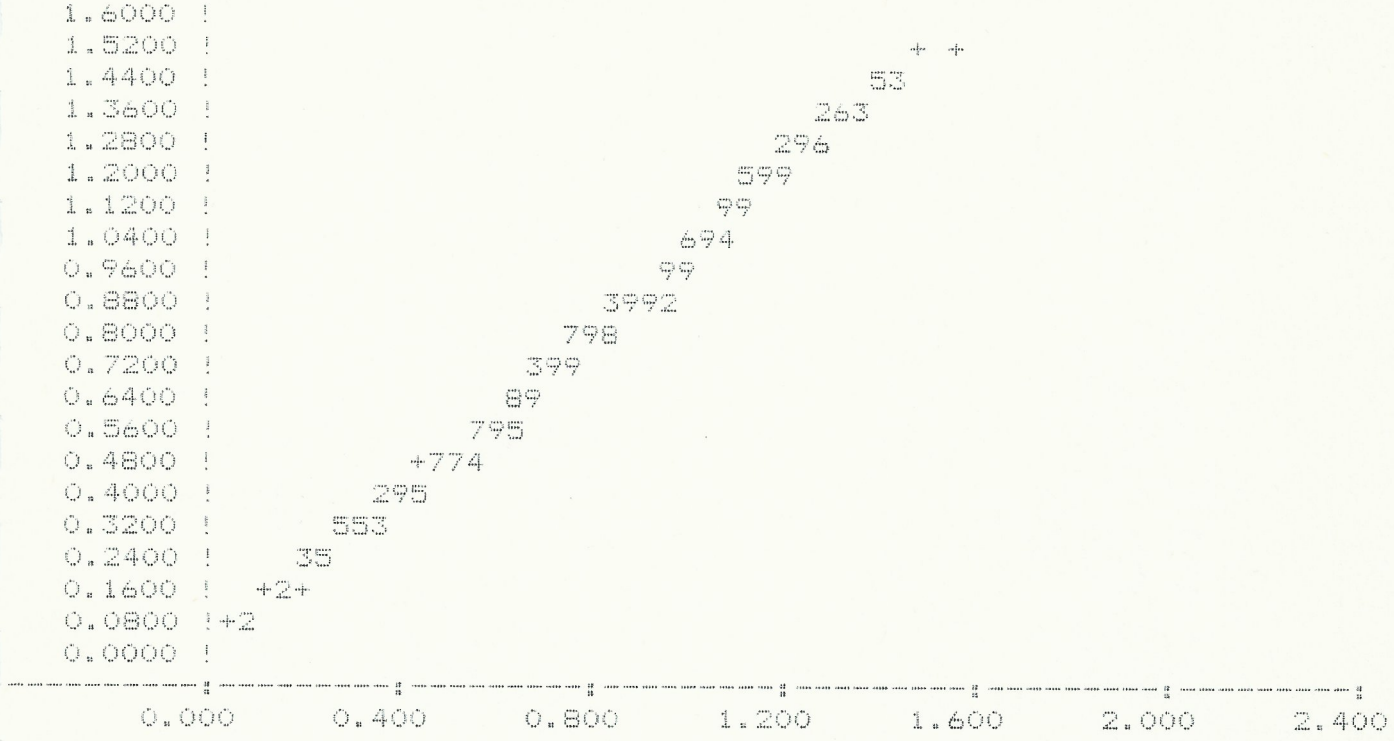
| | | | | |
|---|---|---|---|---|
| -91.643 | 4.2079 | 347 | 656.2 | at cycle 5 on 348 df |
| -142.40 | 3.3529 | 347 | 476.39 | at cycle 5 on 348 df |
| -145.14 | 3.1510 | 347 | 438.39 | at cycle 5 on 348 df |
| -145.20 | 3.1191 | 347 | 432.66 | at cycle 5 on 348 df |
| -145.20 | 3.1156 | 347 | 431.91 | at cycle 5 on 348 df |

---Standard errors of estimates given below are underestimated

| estimate | s.e. | parameter |
|---|---|---|
| -1.745 | 0.2024 | 1 |
| 2.330 | 0.1210 | G |

scale parameter taken as 1.000


Residual plot
6.000
5.700
5.400
5.100
4.800
4.500
4.200
3.900
3.600
3.300
3.000
2.700
2.400
2.100
1.800
1.500
1.200
0.900
0.600
0.300
0.000
0.00
1.60
3.20
4.80
6.40
8.00
9.60


Variance stabilised residual plot
1.6000
1.5200
1.4400
1.3600
1.2800
1.2000
1.1200
1.0400
0.9600
0.8800
0.8000
0.7200
0.6400
0.5600
0.4800
0.4000
0.3200
0.2400
0.1600
0.0800
0.0000
0.000
0.400
0.800
1.200
1.600
2.000
2.400

GLIM Program 6

This program was taken from GLIM documentation in filenames EXMACLIB.GLM/EXMACLIB.LOG on our PCs.

Data: Schmee and Hahn, Technometrics, 1979, Vol. 21, Page 419
(Those highlighted in Italics are censored)

Temp. in deg. C

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 150 | *8064* | *8064* | *8064* | *8064* | *8064* | *8064* | *8064* | *8064* | *8064* | *8064* |
| 170 | 1764 | 2772 | 3444 | 3542 | 3780 | 4860 | 5196 | 5448 | 5448 | 5448 |
| 190 | 408 | 408 | 1344 | 1344 | 1440 | *1680* | *1680* | *1680* | *1680* | *1680* |
| 220 | 408 | 408 | 504 | 504 | 504 | 528 | 528 | 528 | 528 | 528 |

```
$!
$! Temperature accelerated life tests on electrical
$! insulation in 40 motorettes
$! reported by schmee and hahn, technometrics, 1979, 21, p419
$!
$units 40
$data time c $read
$REA? 8064 0 8064 0 8064 0 8064 0 8064 0
$REA? 8064 0 8064 0 8064 0 8064 0 8064 0
$REA? 1764 1 2772 1 3444 1 3542 1 3780 0
$REA? 4860 1 5196 1 5448 0 5448 0 5448 0
$REA?  408 1  408 1 1344 1 1344 1 1440 1
$REA? 1680 0 1680 0 1680 0 1680 0 1680 0
$REA?  408 1  408 1  504 1  504 1  504 1
$REA?  528 0  528 0  528 0  528 0  528 0
$ca temp=%gl(4,10)$ca temp=130+20*%eq(temp,4)*10$
$! Variables
$!  time - life time of motorette insulation in hours
$!  c    - censoring variate (0=censored, 1=uncensored)
$!  temp - temperature in degrees centigrade
$tra$input %plc 80 weibull$tra o i h f w$
$m model temp $e
$ca %a=%w=0$use weib time c$
$m conv 0.00001 $e
$m disp et $e
$ca %a=1.1 : %w=12 : %b=1$
$use weib * * %b$
$use resplot c$
$stop$
```

Output from GLIM Program 6

Using the default convergence criteria (0.001) we have:-

-- Model is temp

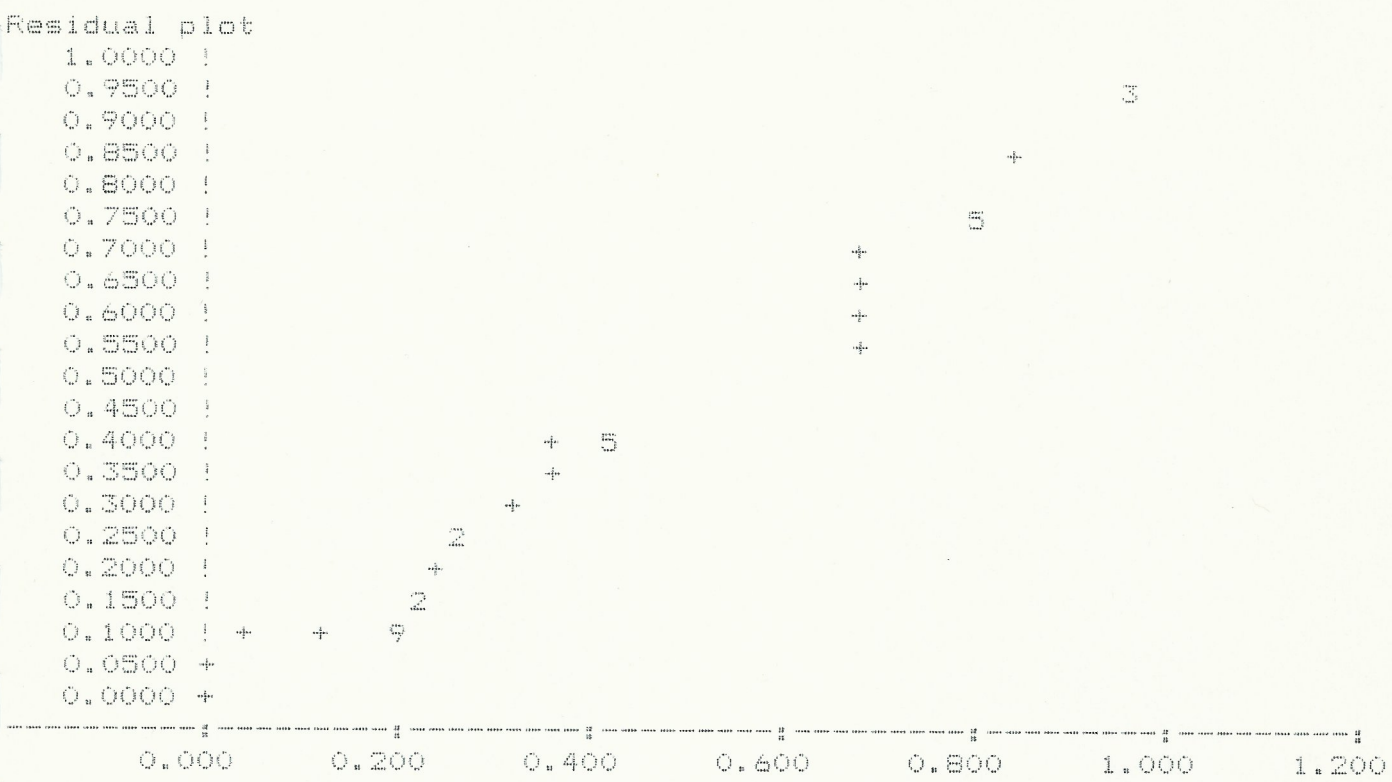
Exponential fit

| Deviance | shape parameter | df | scaled deviance |
|---|---|---|---|
| 311.70 | 1.0000 | 38 | 34.916 at cycle 4 on 38 df |

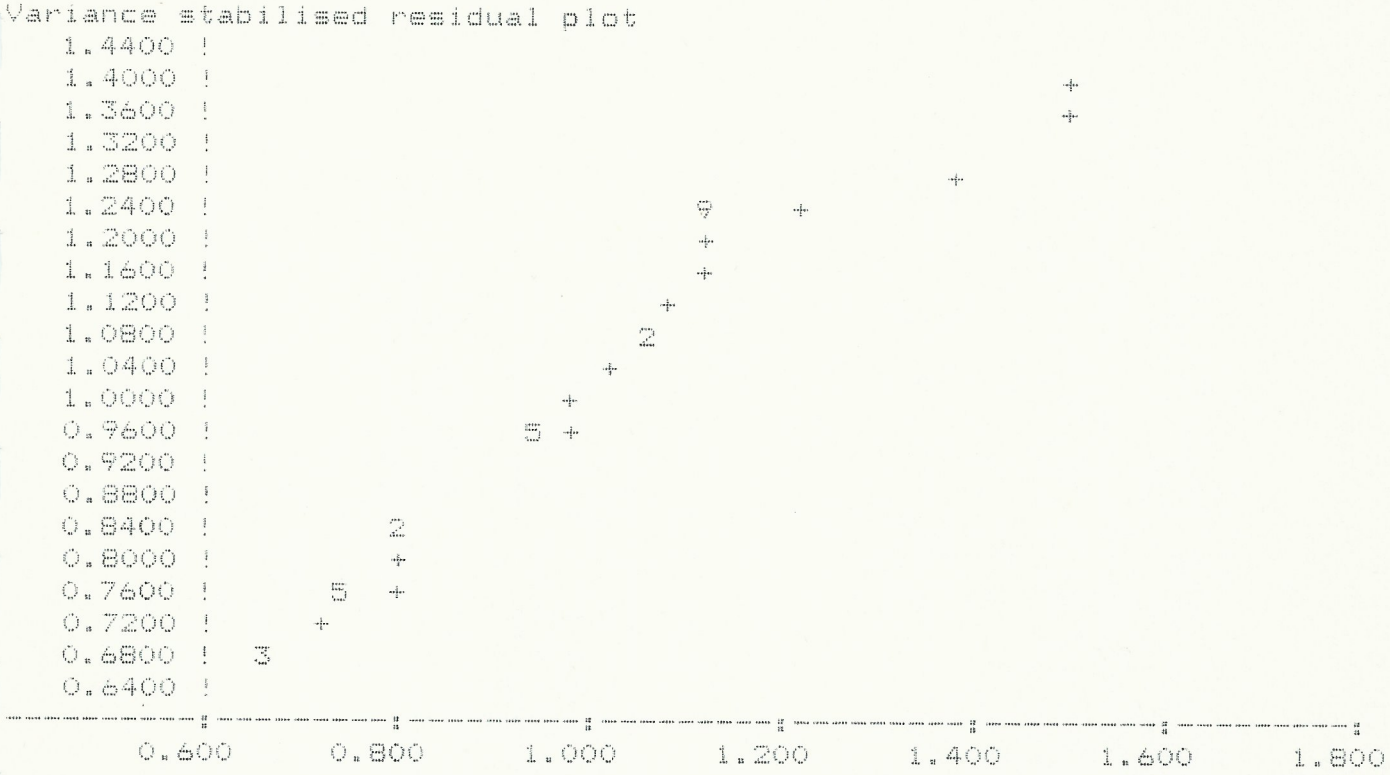
Weibull fit

| | | | |
|---|---|---|---|
| 295.53 | 2.4455 | 37 | 49.152 at cycle 5 on 38 df |

```
   294.82    2.8002        37          53.044 at cycle 5 on 38 df
   294.74    2.9226        37          54.419 at cycle 5 on 38 df
   294.73    2.9664        37          54.914 at cycle 5 on 38 df
   294.73    2.9821        37          55.093 at cycle 5 on 38 df
   294.73    2.9878        37          55.158 at cycle 5 on 38 df
   294.73    2.9899        37          55.181 at cycle 5 on 38 df

---Standard errors of estimates given below are underestimated
                estimate         s.e.      parameter
                  -48.79        1.795      1
                  0.1355    0.009332      TEMP
          scale parameter taken as 1.000

Using a convergence criteria of 0.00001 we have:-

                                -- Model is temp

Weibull fit

 Deviance    shape        df        scaled
            parameter              deviance
   309.35    1.1000        37          35.799 at cycle 5 on 38 df
   295.51    2.4541        37          49.245 at cycle 5 on 38 df
   294.82    2.8031        37          53.076 at cycle 5 on 38 df
   294.74    2.9237        37          54.431 at cycle 5 on 38 df
   294.73    2.9667        37          54.918 at cycle 5 on 38 df
   294.73    2.9822        37          55.094 at cycle 5 on 38 df
   294.73    2.9879        37          55.158 at cycle 5 on 38 df
   294.73    2.9899        37          55.181 at cycle 5 on 38 df
   294.73    2.9906        37          55.190 at cycle 5 on 38 df
   294.73    2.9909        37          55.193 at cycle 5 on 38 df
   294.73    2.9910        37          55.194 at cycle 5 on 38 df
   294.73    2.9910        37          55.194 at cycle 5 on 38 df

---Standard errors of estimates given below are underestimated
                estimate         s.e.      parameter
                  -48.81        1.795      1
                  0.1355    0.009332      TEMP
          scale parameter taken as 1.000

Working matrix
  1       -3.222
  2      0.01660  -8.709e-05
  3       -48.81       0.1355      379.2
             1            2          3
```


Residual plot
1.0000
0.9500
0.9000
0.8500
0.8000
0.7500
0.7000
0.6500
0.6000
0.5500
0.5000
0.4500
0.4000
0.3500
0.3000
0.2500
0.2000
0.1500
0.1000
0.0500
0.0000
0.000
0.200
0.400
0.600
0.800
1.000
1.200

Variance stabilised residual plot



## GLIM Program 7

Description of data:-

The data below is my training programme under sunny conditions, between 24th March 1991 and 13th April 1991.

| | | | | | | |
|---|---|---|---|---|---|---|
| No. of miles | : | 5 | 7 | 12 | 13 | 11 | 15 |
| Weight loss (lbs) | : | 1 | 1 | 3 | 3 | 6 | 5 |
| Time of run (hrs) | : | 34/60 | 53/60 | 87/60 | 92/60 | 107/60 | 137/60 |

Although the no. of miles is NOT an explanatory variable, it is a vector that GLIM requires for Binomial errors.
The weight loss is an explanatory variable.

```
$units 6$
$! This data is my training programme under sunny conditions$
$! n is the no. of miles I have been running$
$! wtl is the weight loss in pounds$
$! t is the time taken for this run in hours$
$data n wtl t$
$read 5 1 34 7 1 53 12 3 87 13 3 92 11 6 107 15 5 137$
$! Convert the times in hours$
$calc t=t/60$
$yvar t$
$err b n$
$fit wtl$
$stop$
```

## Output from GLIM Program 7

If we fit the weight loss, we get deviance=0.038185 on 4 df.
The equation is (eta)=-2.166+(0.08296x)
The standard error of $b_1$=0.2188.
We can test $H_0$: $b_1$=0 as a t-test.
t=0.08296/0.2188=0.379. This is < $t_{0.025,4}$= 2.776.
Reject the null hypothesis and conclude that with 95% confidence, the weight loss has no effect on how long the training run lasts.

In Appendix 05, I will calculate relative risks.