Online Supporting Information for the article: "Suicide and Drought in NSW, Australia, 1970-2007". Unabridged

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Contents

1 Introduction

This document accompanies the R code at this website `https://github.com/ivanhanigan/SuicideAndDroughtInNSW` to calculate the Hutchinson Drought Index and fit the regression models for the paper 'Suicide and Drought in New South Wales (NSW), Australia, 1970-2007'.

The calculation of the Drought Index is demonstrated using free data from the Australian Bureau of Meteorology. The suicide mortality data are not publicly available due to confidentiality restrictions. The R code we ran the regressions with is included but the original data are only available for authorised users approved by the Australian Bureau of Statistics and the NSW Registrar of Births Deaths and Marriages.

2 Drought Index

The R code includes a demonstration of the Hutchinson Drought Index [1]. This climatic drought index is shown graphically for a location in the 'Central West' SD of NSW in Figure 1.

Instructions for using R to download and analyse the spatial data from the Australian Bureau of Statistics (`http://www.abs.gov.au`) and the weather data from the Australian Bureau of Meteorology (`http://www.bom.gov.au`) websites are included.

```
[1] "STATE_CODE_2006" "SD_CODE_2006"    "SD_NAME_2006"
```

```
[1] "STATE_CODE_2006" "SD_CODE_2006"    "SD_NAME_2006"
```

```
Object of class SpatialPointsDataFrame
Coordinates:
             min    max
coords.x1 113.67 153.47
coords.x2 -42.93 -11.65
Is projected: FALSE
proj4string :
[+proj=longlat +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +no_defs]
Number of points: 307
Data attributes:
       V1              V2               V3              V4
 Min.   : 2014   Min.   :-42.93   Min.   :113.7   Min.   :   3.0
 1st Qu.:12040   1st Qu.:-34.25   1st Qu.:122.6   1st Qu.:  63.0
 Median :26026   Median :-31.48   Median :140.2   Median : 195.0
 Mean   :35472   Mean   :-30.03   Mean   :136.8   Mean   : 220.5
 3rd Qu.:52511   3rd Qu.:-26.71   3rd Qu.:147.1   3rd Qu.: 310.0
 Max.   :99005   Max.   :-11.65   Max.   :153.5   Max.   :1270.0
```

```
                     V5
 ABERDEEN (MAIN RD)   :  1
 ALCOOTA              :  1
 ALICE SPRINGS AIRPORT:  1
 ANNA CREEK           :  1
 ANNA PLAINS          :  1
 ANNEAN               :  1
 (Other)              :301
```

```
       V1     V2     V3  V4                            V5
223 50004 -33.11 147.80 240       BOGAN GATE POST OFFICE
224 50018 -32.29 147.67 210            DANDALOO (KELVIN)
225 50028 -32.90 147.52 264       TRUNDLE  (MURRUMBOGIE)
226 50031 -32.73 148.19 285        PEAK HILL POST OFFICE
227 50052 -33.07 147.23 195   CONDOBOLIN AG RESEARCH STN
229 51049 -31.99 147.95 215 TRANGIE RESEARCH STATION AWS
```

```
       V1     V2     V3  V4                             V5
223 50004 -33.11 147.80 240        BOGAN GATE POST OFFICE
224 50018 -32.29 147.67 210             DANDALOO (KELVIN)
225 50028 -32.90 147.52 264        TRUNDLE  (MURRUMBOGIE)
226 50031 -32.73 148.19 285         PEAK HILL POST OFFICE
227 50052 -33.07 147.23 195    CONDOBOLIN AG RESEARCH STN
229 51049 -31.99 147.95 215  TRANGIE RESEARCH STATION AWS
251 63005 -33.43 149.56 713 BATHURST AGRICULTURAL STATION
253 65022 -33.16 148.59 530          MANILDRA (HAZELDALE)
262 73038 -34.41 147.52 270                 TEMORA A.R.S.
```

```
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```

2.1 Calculate the Drought Index

The Drought index is shown in Figure 1 for the SD of 'Central West NSW' during a period which includes a strong drought (1979-83). The raw monthly rainfall totals are integrated to rolling

6-monthly totals (both shown in first panel) which are then ranked into percentiles by month and this is rescaled to range between -4 and +4 in keeping with the range of the Palmer Index [2] (second panel). Mild drought is below -1 in the Palmer index and so consecutive months below this threshold are counted. In the original method 5 or more consecutive months was defined as the beginning of a drought, which continued until the rescaled percentiles exceed -1 again (third panel). The enhanced method imposes a more conservative threshold of zero (the median) to break a drought (fourth panel).

There was also an alternative method devised by Hutchinson where the rescaled percentile values are integrated using conditional cumulative sums. That method is included in the R code however we decided not to use it in this study because the counting method is simpler and gives similar results.

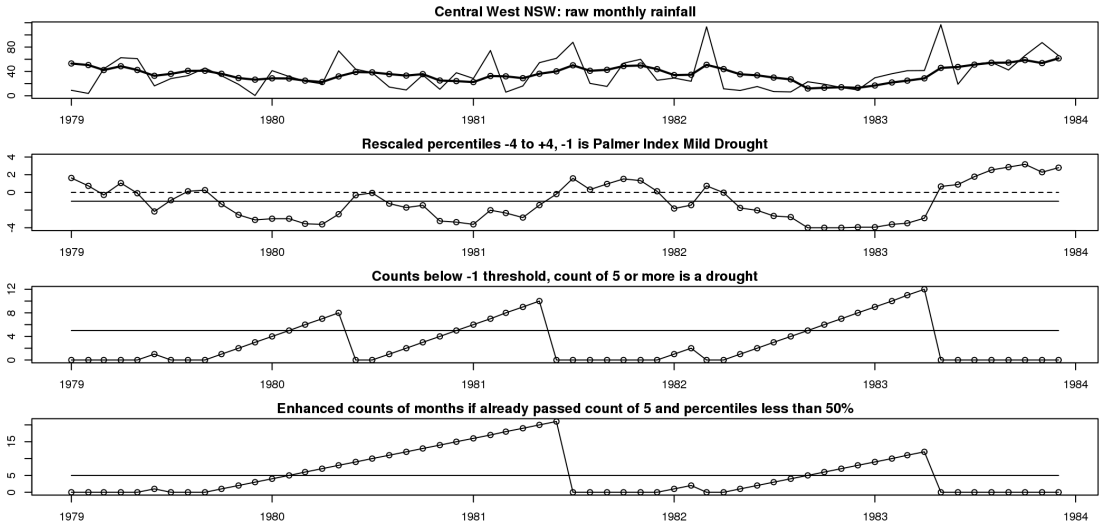

Figure 1: The Drought index in Central West NSW with the enhanced method shown in the fourth panel.

```
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Object of class SpatialPointsDataFrame

Coordinates:

             min    max

coords.x1 113.67 153.47

coords.x2 -42.93 -11.65

Is projected: FALSE

proj4string :
```

```
[+proj=longlat +ellps=GRS80 +towgs84=0,0,0,0,0,0,0 +no_defs]
Number of points: 307
Data attributes:
       V1              V2              V3              V4
 Min.   : 2014   Min.   :-42.93   Min.   :113.7   Min.   :   3.0
 1st Qu.:12040   1st Qu.:-34.25   1st Qu.:122.6   1st Qu.:  63.0
 Median :26026   Median :-31.48   Median :140.2   Median : 195.0
 Mean   :35472   Mean   :-30.03   Mean   :136.8   Mean   : 220.5
 3rd Qu.:52511   3rd Qu.:-26.71   3rd Qu.:147.1   3rd Qu.: 310.0
 Max.   :99005   Max.   :-11.65   Max.   :153.5   Max.   :1270.0


                     V5
 ABERDEEN (MAIN RD)   :  1
 ALCOOTA              :  1
 ALICE SPRINGS AIRPORT:  1
 ANNA CREEK           :  1
 ANNA PLAINS          :  1
 ANNEAN               :  1
 (Other)              :301
      V1     V2     V3  V4                         V5
264 74128 -35.55 144.95  93    DENILIQUIN POST OFFICE
279 80065 -35.88 145.55 115                YARROWEYAH
280 82001 -36.37 146.71 580      BEECHWORTH COMPOSITE
282 83032 -36.85 146.32 816 WHITLANDS (BURDER'S LANE)
285 85046 -38.05 145.80  60               LABERTOUCHE
287 86117 -37.48 145.15 244               TOOROURRONG
      V1     V2     V3  V4                         V5
264 74128 -35.55 144.95  93    DENILIQUIN POST OFFICE
279 80065 -35.88 145.55 115                YARROWEYAH
280 82001 -36.37 146.71 580      BEECHWORTH COMPOSITE
282 83032 -36.85 146.32 816 WHITLANDS (BURDER'S LANE)
285 85046 -38.05 145.80  60               LABERTOUCHE
287 86117 -37.48 145.15 244               TOOROURRONG
```

```
288 86131 -37.56 145.13 198                    YAN YEAN
292 88060 -37.45 145.21 520         WALLABY CREEK WEIR

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  2

pdf
  2
```

2.2 The Summation Method

When the index is calculated using the sum of each consecutive month's rainfall deficiency score the resulting measure addresses the question of how intense the drought is, rather than just the duration which is provided by the counting method. This version of the index is shown in Figure 2.

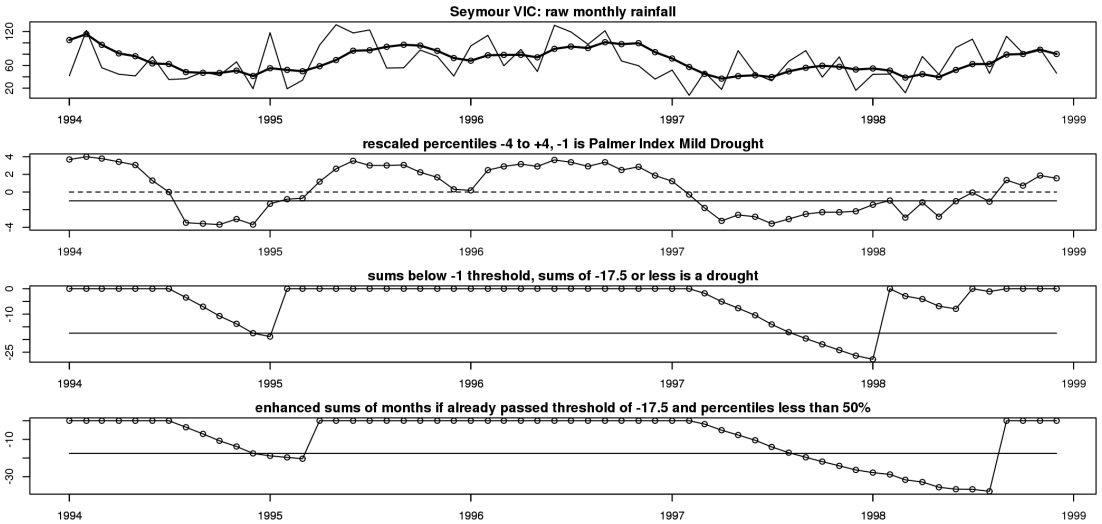

Figure 2: SeymourDrought9499enhanced.png

```
          date year month      rain sixmnthtot       index indexBelowThreshold
1709 1998-05-01 1998     5  44.18750   237.2457 -2.79738562           -2.797386
1710 1998-06-01 1998     6  91.80000   313.0207 -1.03896104           -1.038961
1711 1998-07-01 1998     7 106.46250   375.0082 -0.05194805            0.000000
1712 1998-08-01 1998     8  46.17500   376.3582 -1.09090909           -1.090909
1770 2003-06-01 2003     6  80.13179   315.1445 -0.98701299            0.000000
1818 2007-06-01 2007     6  71.66050   320.7478 -0.72727273            0.000000
     count count2      sums     sums2
```

```
1709     3     15 -6.875817 -35.64248
1710     4     16 -7.914778 -36.68144
1711     0     17  0.000000 -36.73338
1712     1     18 -1.090909 -37.82429
1770     0     12  0.000000 -33.10245
1818     0     13  0.000000 -35.44351

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  2
```

3 Suicide and Drought Modeling

```
'data.frame':        69916 obs. of  19 variables:
 $ time           : num  0 0 0 0 0 0 0 0 0 0 ...
 $ sd_group       : Factor w/ 11 levels "Central West",..: 1 1 1 1 1 1 1 1 1 1 ...
 $ sex            : int  1 1 1 2 2 1 2 2 1 2 ...
 $ agegp          : Factor w/ 7 levels "10_19","20_29",..: 1 4 6 4 5 7 6 7 2 1 ...
 $ dthyy          : int  1970 1970 1970 1970 1970 1970 1970 1970 1970 1970 ...
 $ dthmm          : Factor w/ 12 levels "1","2","3","4",..: 1 1 1 1 1 1 1 1 1 1 ...
 $ deaths         : num  0 1 0 0 0 0 0 0 0 0 ...
 $ sui_und        : num  0 1 0 0 0 0 0 0 0 0 ...
 $ pop            : num  15432 9128 5237 8488 7436 ...
 $ avrain         : num  76.3 76.3 76.3 76.3 76.3 ...
 $ avcount        : num  0.0221 0.0221 0.0221 0.0221 0.0221 ...
 $ tmax_anomaly   : num  -2.16 -2.16 -2.16 -2.16 -2.16 ...
 $ tmax           : num  28.7 28.7 28.7 28.7 28.7 ...
 $ avsums         : num  -1.31 -1.31 -1.31 -1.31 -1.31 ...
 $ avcount2       : num  0.0221 0.0221 0.0221 0.0221 0.0221 ...
 $ avsums2        : num  -1.31 -1.31 -1.31 -1.31 -1.31 ...
 $ logDroughtCount: num  0.0218 0.0218 0.0218 0.0218 0.0218 ...
 $ mm             : num  1 1 1 1 1 1 1 1 1 1 ...
 $ timevar        : num  0.0833 0.0833 0.0833 0.0833 0.0833 ...
```

3.1 Descriptive Statistics of Drought and Suicide

Descriptive statistics for the Drought Index are shown in Table 1. Summary statistics for Suicide rates are shown in Table 2.

```
'data.frame':        4994 obs. of  20 variables:
 $ time           : Date, format: "1970-01-01" "1970-02-01" ...
 $ sd_group       : Factor w/ 11 levels "Central West",..: 1 1 1 1 1 1 1 1 1 1 ...
 $ sex            : int  1 1 1 1 1 1 1 1 1 1 ...
 $ agegp          : Factor w/ 7 levels "10_19","20_29",..: 1 1 1 1 1 1 1 1 1 1 ...
 $ dthyy          : int  1970 1970 1970 1970 1970 1970 1970 1970 1970 1970 ...
 $ dthmm          : Factor w/ 12 levels "1","2","3","4",..: 1 2 3 4 5 6 7 8 9 10 ...
 $ deaths         : num  0 0 0 0 0 0 0 0 0 0 ...
 $ sui_und        : num  0 0 0 0 0 0 0 0 0 0 ...
 $ pop            : num  15432 15432 15432 15432 15432 ...
 $ avrain         : num  76.3 32.2 52.4 62.2 41 ...
 $ avcount        : num  0.0221 0.0441 0 0 0.1103 ...
 $ tmax_anomaly   : num  -2.157 0.547 -1.864 -0.451 -2.251 ...
 $ tmax           : num  28.7 30.5 25.3 22.2 15.5 ...
 $ avsums         : num  -1.31 -1.88 0 0 -1.48 ...
 $ avcount2       : num  0.0221 0.0441 0 0 0.1103 ...
 $ avsums2        : num  -1.31 -1.88 0 0 -1.48 ...
 $ logDroughtCount: num  0.0218 0.0432 0 0 0.1046 ...
 $ mm             : num  1 2 3 4 5 6 7 8 9 10 ...
 $ timevar        : num  0.0833 0.1667 0.25 0.3333 0.4167 ...
 $ drought        : num  0 0 0 0 0 0 0 0 0 0 ...
```

	time	sd_group	sex	agegp	dthyy	dthmm	deaths	sui_und	pop
19765	1980-09-01	Central West	1	10_19	1980	9	0	0	15090
19867	1980-10-01	Central West	1	10_19	1980	10	0	0	15090
20120	1980-11-01	Central West	1	10_19	1980	11	0	0	15090
20214	1980-12-01	Central West	1	10_19	1980	12	1	1	15090
20331	1981-01-01	Central West	1	10_19	1981	1	0	0	14977
20547	1981-02-01	Central West	1	10_19	1981	2	0	0	14977
20681	1981-03-01	Central West	1	10_19	1981	3	2	2	14977

```
20793 1981-04-01 Central West   1 10_19  1981     4      1       1 14977
        avrain  avcount tmax_anomaly     tmax    avsums avcount2   avsums2
19765 13.79706 5.272059    2.0988534 20.50662 -17.51445 13.19118 -28.22017
19867 39.35147 6.073529    2.4887044 24.77794 -16.68169 14.19118 -29.84662
20120 10.69853 7.073529    2.9252282 28.84559 -17.60253 15.19118 -32.97533
20214 46.90882 8.029412    1.5389452 30.73676 -20.85849 16.19118 -36.00951
20331 35.57647 9.029412    3.1375374 33.94706 -23.81067 17.19118 -39.26844
20547 89.97353 8.382353    0.8280783 30.82279 -28.09290 18.19118 -40.69177
20681  9.68750 8.911765   -0.1268819 27.08309 -28.02559 19.19118 -42.36396
20793 31.86471 8.830882    1.4207627 24.04706 -28.87741 20.19118 -44.18900
      logDroughtCount mm  timevar drought
19765        1.836105  9 10.75000       3
19867        1.956360 10 10.83333       3
20120        2.088591 11 10.91667       3
20214        2.200487 12 11.00000       3
20331        2.305522  1 11.08333       3
20547        2.238831  2 11.16667       3
20681        2.293722  3 11.25000       3
20793        2.285529  4 11.33333       3
      sd_group drought max(avcount) min(dthyy) max(dthyy)
1 Central West       1     5.779412       1972       1972
2 Central West       2     7.948529       1980       1980
3 Central West       3     9.029412       1980       1981
4 Central West       4    11.264706       1982       1983
5 Central West       5     5.955882       1985       1985
6 Central West       6     6.948529       1994       1994
7 Central West       7     7.661765       2002       2003
8 Central West       8     5.794118       2004       2004
9 Central West       9    11.566176       2006       2007
               sd_group numberOfDroughts avgDuration maxDuration
1          Central West                9    7.994281    11.56618
2                Hunter               11    7.375160    14.77465
3             Illawarra                7    8.920000    16.48000
```

```
4        Mid-North Coast                8    8.420635    14.69841
5                Murray                 7    7.732348    11.01724
6           Murrumbidgee               10    7.010448    11.02239
7  North and Far Western                8    7.197887    11.53284
8               Northern                5    8.465896    10.99422
9         Richmond-Tweed               13    8.230769    16.95238
10         South Eastern                8    7.906818    11.02727
11                Sydney                9    8.764706    20.00000
```

```
                sd_group avgMonthlyDeaths     avgPop     rate
1           Central West        1.5198238  138202.17 13.19653
2                 Hunter        4.5308370  430402.66 12.63237
3             Illawarra        3.0462555  280036.88 13.05366
4        Mid-North Coast        1.9074890  183520.63 12.47264
5                Murray        0.9735683   86220.51 13.54993
6           Murrumbidgee        1.3303965  118778.27 13.44081
7  North and Far Western        1.5462555  114460.50 16.21089
8               Northern        1.7268722  146464.55 14.14845
9         Richmond-Tweed        1.6629956  139356.23 14.32010
10         South Eastern        1.5748899  135091.01 13.98959
11                Sydney       34.0044053 3040952.32 13.41859
```

```
    sd_group dthyy dthmm summary     pop
1     Sydney  1970     1      38 2408289
2     Sydney  1970    10      38 2408289
3     Sydney  1970    11      33 2408289
4     Sydney  1970    12      38 2408289
5     Sydney  1970     2      29 2408289
6     Sydney  1970     3      42 2408289
7     Sydney  1970     4      27 2408289
8     Sydney  1970     5      23 2408289
9     Sydney  1970     6      44 2408289
10    Sydney  1970     7      36 2408289
11    Sydney  1970     8      29 2408289
12    Sydney  1970     9      43 2408289
```

13	Sydney	1971	1	47	2425781
14	Sydney	1971	10	34	2425781
15	Sydney	1971	11	43	2425781
16	Sydney	1971	12	39	2425781
17	Sydney	1971	2	31	2425781
18	Sydney	1971	3	28	2425781
19	Sydney	1971	4	31	2425781
20	Sydney	1971	5	42	2425781
21	Sydney	1971	6	47	2425781
22	Sydney	1971	7	33	2425781
23	Sydney	1971	8	33	2425781
24	Sydney	1971	9	36	2425781
25	Sydney	1972	1	35	2443263
26	Sydney	1972	10	38	2443263
27	Sydney	1972	11	38	2443263
28	Sydney	1972	12	33	2443263
29	Sydney	1972	2	35	2443263
30	Sydney	1972	3	39	2443263
31	Sydney	1972	4	35	2443263
32	Sydney	1972	5	49	2443263
33	Sydney	1972	6	35	2443263
34	Sydney	1972	7	27	2443263
35	Sydney	1972	8	35	2443263
36	Sydney	1972	9	41	2443263
37	Sydney	1973	1	37	2460750
38	Sydney	1973	10	44	2460750
39	Sydney	1973	11	29	2460750
40	Sydney	1973	12	37	2460750
41	Sydney	1973	2	28	2460750
42	Sydney	1973	3	42	2460750
43	Sydney	1973	4	44	2460750
44	Sydney	1973	5	37	2460750
45	Sydney	1973	6	39	2460750

46	Sydney	1973	7	36	2460750
47	Sydney	1973	8	26	2460750
48	Sydney	1973	9	28	2460750
49	Sydney	1974	1	32	2478238
50	Sydney	1974	10	32	2478238
51	Sydney	1974	11	34	2478238
52	Sydney	1974	12	29	2478238
53	Sydney	1974	2	24	2478238
54	Sydney	1974	3	37	2478238
55	Sydney	1974	4	33	2478238
56	Sydney	1974	5	37	2478238
57	Sydney	1974	6	37	2478238
58	Sydney	1974	7	39	2478238
59	Sydney	1974	8	27	2478238
60	Sydney	1974	9	25	2478238
61	Sydney	1975	1	38	2495725
62	Sydney	1975	10	43	2495725
63	Sydney	1975	11	46	2495725
64	Sydney	1975	12	27	2495725
65	Sydney	1975	2	23	2495725
66	Sydney	1975	3	27	2495725
67	Sydney	1975	4	39	2495725
68	Sydney	1975	5	34	2495725
69	Sydney	1975	6	38	2495725
70	Sydney	1975	7	41	2495725
71	Sydney	1975	8	43	2495725
72	Sydney	1975	9	30	2495725
73	Sydney	1976	1	40	2513217
74	Sydney	1976	10	30	2513217
75	Sydney	1976	11	32	2513217
76	Sydney	1976	12	25	2513217
77	Sydney	1976	2	27	2513217
78	Sydney	1976	3	28	2513217

79	Sydney	1976	4	24	2513217
80	Sydney	1976	5	39	2513217
81	Sydney	1976	6	32	2513217
82	Sydney	1976	7	37	2513217
83	Sydney	1976	8	36	2513217
84	Sydney	1976	9	29	2513217
85	Sydney	1977	1	30	2552783
86	Sydney	1977	10	26	2552783
87	Sydney	1977	11	31	2552783
88	Sydney	1977	12	23	2552783
89	Sydney	1977	2	28	2552783
90	Sydney	1977	3	30	2552783
91	Sydney	1977	4	21	2552783
92	Sydney	1977	5	29	2552783
93	Sydney	1977	6	39	2552783
94	Sydney	1977	7	33	2552783
95	Sydney	1977	8	37	2552783
96	Sydney	1977	9	24	2552783
97	Sydney	1978	1	35	2592354
98	Sydney	1978	10	48	2592354
99	Sydney	1978	11	33	2592354
100	Sydney	1978	12	25	2592354
101	Sydney	1978	2	33	2592354
102	Sydney	1978	3	37	2592354
103	Sydney	1978	4	21	2592354
104	Sydney	1978	5	22	2592354
105	Sydney	1978	6	26	2592354
106	Sydney	1978	7	41	2592354
107	Sydney	1978	8	33	2592354
108	Sydney	1978	9	41	2592354
109	Sydney	1979	1	21	2631924
110	Sydney	1979	10	34	2631924
111	Sydney	1979	11	31	2631924

112	Sydney	1979	12	30	2631924
113	Sydney	1979	2	25	2631924
114	Sydney	1979	3	34	2631924
115	Sydney	1979	4	25	2631924
116	Sydney	1979	5	31	2631924
117	Sydney	1979	6	37	2631924
118	Sydney	1979	7	34	2631924
119	Sydney	1979	8	35	2631924
120	Sydney	1979	9	32	2631924
121	Sydney	1980	1	37	2671495
122	Sydney	1980	10	29	2671495
123	Sydney	1980	11	26	2671495
124	Sydney	1980	12	23	2671495
125	Sydney	1980	2	36	2671495
126	Sydney	1980	3	37	2671495
127	Sydney	1980	4	28	2671495
128	Sydney	1980	5	31	2671495
129	Sydney	1980	6	23	2671495
130	Sydney	1980	7	26	2671495
131	Sydney	1980	8	23	2671495
132	Sydney	1980	9	31	2671495
133	Sydney	1981	1	32	2711070
134	Sydney	1981	10	36	2711070
135	Sydney	1981	11	29	2711070
136	Sydney	1981	12	31	2711070
137	Sydney	1981	2	25	2711070
138	Sydney	1981	3	26	2711070
139	Sydney	1981	4	29	2711070
140	Sydney	1981	5	24	2711070
141	Sydney	1981	6	22	2711070
142	Sydney	1981	7	29	2711070
143	Sydney	1981	8	33	2711070
144	Sydney	1981	9	38	2711070

145	Sydney	1982	1	27	2744594
146	Sydney	1982	10	35	2744594
147	Sydney	1982	11	38	2744594
148	Sydney	1982	12	40	2744594
149	Sydney	1982	2	23	2744594
150	Sydney	1982	3	40	2744594
151	Sydney	1982	4	25	2744594
152	Sydney	1982	5	33	2744594
153	Sydney	1982	6	24	2744594
154	Sydney	1982	7	34	2744594
155	Sydney	1982	8	26	2744594
156	Sydney	1982	9	30	2744594
157	Sydney	1983	1	36	2778125
158	Sydney	1983	10	23	2778125
159	Sydney	1983	11	27	2778125
160	Sydney	1983	12	30	2778125
161	Sydney	1983	2	31	2778125
162	Sydney	1983	3	32	2778125
163	Sydney	1983	4	25	2778125
164	Sydney	1983	5	28	2778125
165	Sydney	1983	6	37	2778125
166	Sydney	1983	7	37	2778125
167	Sydney	1983	8	25	2778125
168	Sydney	1983	9	25	2778125
169	Sydney	1984	1	24	2811656
170	Sydney	1984	10	32	2811656
171	Sydney	1984	11	34	2811656
172	Sydney	1984	12	40	2811656
173	Sydney	1984	2	24	2811656
174	Sydney	1984	3	23	2811656
175	Sydney	1984	4	26	2811656
176	Sydney	1984	5	22	2811656
177	Sydney	1984	6	33	2811656

178	Sydney	1984	7	38	2811656
179	Sydney	1984	8	21	2811656
180	Sydney	1984	9	34	2811656
181	Sydney	1985	1	29	2845187
182	Sydney	1985	10	28	2845187
183	Sydney	1985	11	34	2845187
184	Sydney	1985	12	26	2845187
185	Sydney	1985	2	25	2845187
186	Sydney	1985	3	31	2845187
187	Sydney	1985	4	36	2845187
188	Sydney	1985	5	35	2845187
189	Sydney	1985	6	24	2845187
190	Sydney	1985	7	37	2845187
191	Sydney	1985	8	39	2845187
192	Sydney	1985	9	33	2845187
193	Sydney	1986	1	32	2878723
194	Sydney	1986	10	36	2878723
195	Sydney	1986	11	36	2878723
196	Sydney	1986	12	34	2878723
197	Sydney	1986	2	32	2878723
198	Sydney	1986	3	50	2878723
199	Sydney	1986	4	36	2878723
200	Sydney	1986	5	35	2878723
201	Sydney	1986	6	21	2878723
202	Sydney	1986	7	27	2878723
203	Sydney	1986	8	38	2878723
204	Sydney	1986	9	26	2878723
205	Sydney	1987	1	31	2936629
206	Sydney	1987	10	42	2936629
207	Sydney	1987	11	50	2936629
208	Sydney	1987	12	46	2936629
209	Sydney	1987	2	32	2936629
210	Sydney	1987	3	30	2936629

211	Sydney	1987	4	26	2936629
212	Sydney	1987	5	31	2936629
213	Sydney	1987	6	31	2936629
214	Sydney	1987	7	39	2936629
215	Sydney	1987	8	35	2936629
216	Sydney	1987	9	43	2936629
217	Sydney	1988	1	42	2994539
218	Sydney	1988	10	41	2994539
219	Sydney	1988	11	28	2994539
220	Sydney	1988	12	33	2994539
221	Sydney	1988	2	32	2994539
222	Sydney	1988	3	39	2994539
223	Sydney	1988	4	23	2994539
224	Sydney	1988	5	36	2994539
225	Sydney	1988	6	32	2994539
226	Sydney	1988	7	43	2994539
227	Sydney	1988	8	31	2994539
228	Sydney	1988	9	26	2994539
229	Sydney	1989	1	35	3052453
230	Sydney	1989	10	28	3052453
231	Sydney	1989	11	28	3052453
232	Sydney	1989	12	32	3052453
233	Sydney	1989	2	39	3052453
234	Sydney	1989	3	42	3052453
235	Sydney	1989	4	36	3052453
236	Sydney	1989	5	44	3052453
237	Sydney	1989	6	37	3052453
238	Sydney	1989	7	46	3052453
239	Sydney	1989	8	32	3052453
240	Sydney	1989	9	39	3052453
241	Sydney	1990	1	34	3110363
242	Sydney	1990	10	41	3110363
243	Sydney	1990	11	27	3110363

244	Sydney	1990	12	47	3110363
245	Sydney	1990	2	33	3110363
246	Sydney	1990	3	37	3110363
247	Sydney	1990	4	26	3110363
248	Sydney	1990	5	32	3110363
249	Sydney	1990	6	28	3110363
250	Sydney	1990	7	44	3110363
251	Sydney	1990	8	46	3110363
252	Sydney	1990	9	31	3110363
253	Sydney	1991	1	35	3168281
254	Sydney	1991	10	34	3168281
255	Sydney	1991	11	33	3168281
256	Sydney	1991	12	31	3168281
257	Sydney	1991	2	28	3168281
258	Sydney	1991	3	45	3168281
259	Sydney	1991	4	27	3168281
260	Sydney	1991	5	52	3168281
261	Sydney	1991	6	43	3168281
262	Sydney	1991	7	45	3168281
263	Sydney	1991	8	40	3168281
264	Sydney	1991	9	38	3168281
265	Sydney	1992	1	29	3205280
266	Sydney	1992	10	47	3205280
267	Sydney	1992	11	45	3205280
268	Sydney	1992	12	48	3205280
269	Sydney	1992	2	27	3205280
270	Sydney	1992	3	32	3205280
271	Sydney	1992	4	38	3205280
272	Sydney	1992	5	37	3205280
273	Sydney	1992	6	38	3205280
274	Sydney	1992	7	38	3205280
275	Sydney	1992	8	30	3205280
276	Sydney	1992	9	43	3205280

277	Sydney	1993	1	28	3242281
278	Sydney	1993	10	27	3242281
279	Sydney	1993	11	29	3242281
280	Sydney	1993	12	41	3242281
281	Sydney	1993	2	31	3242281
282	Sydney	1993	3	35	3242281
283	Sydney	1993	4	36	3242281
284	Sydney	1993	5	30	3242281
285	Sydney	1993	6	30	3242281
286	Sydney	1993	7	39	3242281
287	Sydney	1993	8	33	3242281
288	Sydney	1993	9	32	3242281
289	Sydney	1994	1	42	3279284
290	Sydney	1994	10	32	3279284
291	Sydney	1994	11	49	3279284
292	Sydney	1994	12	53	3279284
293	Sydney	1994	2	29	3279284
294	Sydney	1994	3	49	3279284
295	Sydney	1994	4	35	3279284
296	Sydney	1994	5	42	3279284
297	Sydney	1994	6	50	3279284
298	Sydney	1994	7	44	3279284
299	Sydney	1994	8	31	3279284
300	Sydney	1994	9	38	3279284
301	Sydney	1995	1	43	3316285
302	Sydney	1995	10	41	3316285
303	Sydney	1995	11	37	3316285
304	Sydney	1995	12	40	3316285
305	Sydney	1995	2	34	3316285
306	Sydney	1995	3	37	3316285
307	Sydney	1995	4	26	3316285
308	Sydney	1995	5	45	3316285
309	Sydney	1995	6	49	3316285

310	Sydney	1995	7	31	3316285
311	Sydney	1995	8	41	3316285
312	Sydney	1995	9	40	3316285
313	Sydney	1996	1	44	3353295
314	Sydney	1996	10	32	3353295
315	Sydney	1996	11	45	3353295
316	Sydney	1996	12	42	3353295
317	Sydney	1996	2	43	3353295
318	Sydney	1996	3	34	3353295
319	Sydney	1996	4	36	3353295
320	Sydney	1996	5	42	3353295
321	Sydney	1996	6	38	3353295
322	Sydney	1996	7	32	3353295
323	Sydney	1996	8	32	3353295
324	Sydney	1996	9	32	3353295
325	Sydney	1997	1	37	3398466
326	Sydney	1997	10	51	3398466
327	Sydney	1997	11	59	3398466
328	Sydney	1997	12	66	3398466
329	Sydney	1997	2	46	3398466
330	Sydney	1997	3	39	3398466
331	Sydney	1997	4	40	3398466
332	Sydney	1997	5	42	3398466
333	Sydney	1997	6	41	3398466
334	Sydney	1997	7	34	3398466
335	Sydney	1997	8	38	3398466
336	Sydney	1997	9	52	3398466
337	Sydney	1998	1	47	3443640
338	Sydney	1998	10	32	3443640
339	Sydney	1998	11	36	3443640
340	Sydney	1998	12	35	3443640
341	Sydney	1998	2	40	3443640
342	Sydney	1998	3	51	3443640

343	Sydney	1998	4	40	3443640
344	Sydney	1998	5	41	3443640
345	Sydney	1998	6	37	3443640
346	Sydney	1998	7	34	3443640
347	Sydney	1998	8	44	3443640
348	Sydney	1998	9	37	3443640
349	Sydney	1999	1	41	3488815
350	Sydney	1999	10	42	3488815
351	Sydney	1999	11	39	3488815
352	Sydney	1999	12	35	3488815
353	Sydney	1999	2	39	3488815
354	Sydney	1999	3	47	3488815
355	Sydney	1999	4	44	3488815
356	Sydney	1999	5	37	3488815
357	Sydney	1999	6	34	3488815
358	Sydney	1999	7	41	3488815
359	Sydney	1999	8	48	3488815
360	Sydney	1999	9	48	3488815
361	Sydney	2000	1	45	3533989
362	Sydney	2000	10	23	3533989
363	Sydney	2000	11	36	3533989
364	Sydney	2000	12	35	3533989
365	Sydney	2000	2	36	3533989
366	Sydney	2000	3	43	3533989
367	Sydney	2000	4	41	3533989
368	Sydney	2000	5	37	3533989
369	Sydney	2000	6	31	3533989
370	Sydney	2000	7	29	3533989
371	Sydney	2000	8	22	3533989
372	Sydney	2000	9	27	3533989
373	Sydney	2001	1	33	3579170
374	Sydney	2001	10	40	3579170
375	Sydney	2001	11	37	3579170

376	Sydney	2001	12	34	3579170
377	Sydney	2001	2	34	3579170
378	Sydney	2001	3	29	3579170
379	Sydney	2001	4	32	3579170
380	Sydney	2001	5	32	3579170
381	Sydney	2001	6	42	3579170
382	Sydney	2001	7	35	3579170
383	Sydney	2001	8	41	3579170
384	Sydney	2001	9	35	3579170
385	Sydney	2002	1	35	3610412
386	Sydney	2002	10	30	3610412
387	Sydney	2002	11	32	3610412
388	Sydney	2002	12	37	3610412
389	Sydney	2002	2	30	3610412
390	Sydney	2002	3	35	3610412
391	Sydney	2002	4	37	3610412
392	Sydney	2002	5	20	3610412
393	Sydney	2002	6	24	3610412
394	Sydney	2002	7	42	3610412
395	Sydney	2002	8	32	3610412
396	Sydney	2002	9	33	3610412
397	Sydney	2003	1	49	3641661
398	Sydney	2003	10	23	3641661
399	Sydney	2003	11	17	3641661
400	Sydney	2003	12	28	3641661
401	Sydney	2003	2	35	3641661
402	Sydney	2003	3	28	3641661
403	Sydney	2003	4	25	3641661
404	Sydney	2003	5	35	3641661
405	Sydney	2003	6	32	3641661
406	Sydney	2003	7	37	3641661
407	Sydney	2003	8	26	3641661
408	Sydney	2003	9	35	3641661

409	Sydney	2004	1	34	3672906
410	Sydney	2004	10	28	3672906
411	Sydney	2004	11	31	3672906
412	Sydney	2004	12	22	3672906
413	Sydney	2004	2	27	3672906
414	Sydney	2004	3	34	3672906
415	Sydney	2004	4	32	3672906
416	Sydney	2004	5	25	3672906
417	Sydney	2004	6	29	3672906
418	Sydney	2004	7	36	3672906
419	Sydney	2004	8	31	3672906
420	Sydney	2004	9	26	3672906
421	Sydney	2005	1	28	3704155
422	Sydney	2005	10	33	3704155
423	Sydney	2005	11	35	3704155
424	Sydney	2005	12	22	3704155
425	Sydney	2005	2	24	3704155
426	Sydney	2005	3	29	3704155
427	Sydney	2005	4	39	3704155
428	Sydney	2005	5	26	3704155
429	Sydney	2005	6	29	3704155
430	Sydney	2005	7	27	3704155
431	Sydney	2005	8	22	3704155
432	Sydney	2005	9	28	3704155
433	Sydney	2006	1	38	3735409
434	Sydney	2006	10	24	3735409
435	Sydney	2006	11	34	3735409
436	Sydney	2006	12	23	3735409
437	Sydney	2006	2	23	3735409
438	Sydney	2006	3	29	3735409
439	Sydney	2006	4	29	3735409
440	Sydney	2006	5	24	3735409
441	Sydney	2006	6	28	3735409

442	Sydney	2006	7	20	3735409
443	Sydney	2006	8	26	3735409
444	Sydney	2006	9	19	3735409
445	Sydney	2007	1	36	3766651
446	Sydney	2007	10	33	3766651
447	Sydney	2007	2	27	3766651
448	Sydney	2007	3	24	3766651
449	Sydney	2007	4	24	3766651
450	Sydney	2007	5	31	3766651
451	Sydney	2007	6	36	3766651
452	Sydney	2007	7	36	3766651
453	Sydney	2007	8	34	3766651
454	Sydney	2007	9	27	3766651

Table 1: Descriptive statistics for the drought index

SD group	N droughts	Avg Duration	Max Duration
1 Central West	9	8	12
2 Hunter	11	7	15
3 Illawarra	7	9	16
4 Mid-North Coast	8	8	15
5 Murray	7	8	11
6 Murrumbidgee	10	7	11
7 North and Far Western	8	7	12
8 Northern	5	8	11
9 Richmond-Tweed	13	8	17
10 South Eastern	8	8	11
11 Sydney	9	9	20

Table 2: Descriptive statistics for suicide (PYL = Person Years Lived)

SD group	Avg Death/Month	Avg Pop	Rate/100000 PYL
1 Central West	2	138202	13
2 Hunter	5	430403	13
3 Illawarra	3	280037	13
4 Mid-North Coast	2	183521	12
5 Murray	1	86221	14
6 Murrumbidgee	1	118778	13
7 North and Far Western	2	114460	16
8 Northern	2	146465	14
9 Richmond-Tweed	2	139356	14
10 South Eastern	2	135091	14
11 Sydney	34	3040952	13

3.2 Correlation between Temperature and Drought

We found that monthly maximum temperature variables are not strongly correlated with the drought index in our dataset. Correlation coefficients for the variables are shown in Table 3.

Table 3: Correlations

Variables	Correlation
cor(logDroughtCount,tmax)	0.05
cor(tmax,tmaxanomaly)	0.23
cor(logDroughtCount,tmaxanomaly)	0.35

3.3 Core Model Diagnostics and Variable Selection

We initially fitted age stratified time series Poisson Generalized Linear Models (GLMs). We identified a Core Model that included age, sex, region, season and long term trend. We assessed standard model diagnostics for this. Then we used Generalized Additive Models (GAMs) with the automatic estimation of the optimal amount of smoothing on the drought index using penalised regression splines from the R package: mgcv [3]. These estimated smooths were then explored in GLMs. Many models were fitted to test different combinations of variables. The models are ranked by their Bayesian Information Criterion (BIC) scores in Table 4 (AIC is shown for interest).

Diagnostic plots of the core model are shown in Figure 3.

```
Single term deletions


Model:
deaths ~ sin(timevar * 2 * pi) + cos(timevar * 2 * pi) + sd_group +
    agegp * sex * ns(time, 3) + offset(log(pop))
                     Df Deviance   AIC    LRT  Pr(>Chi)
<none>                     38654 69814
sin(timevar * 2 * pi)  1    38661 69809  6.908 0.0085794 **
cos(timevar * 2 * pi)  1    38670 69818 15.640 7.662e-05 ***
sd_group              10    38698 69745 43.418 4.187e-06 ***
agegp:sex:ns(time, 3) 18    38703 69662 48.849 0.0001125 ***
---
Signif. codes:  0 âĂŸ***âĂŹ 0.001 âĂŸ**âĂŹ 0.01 âĂŸ*âĂŹ 0.05 âĂŸ.âĂŹ 0.1 âĂŸ âĂŹ 1
```

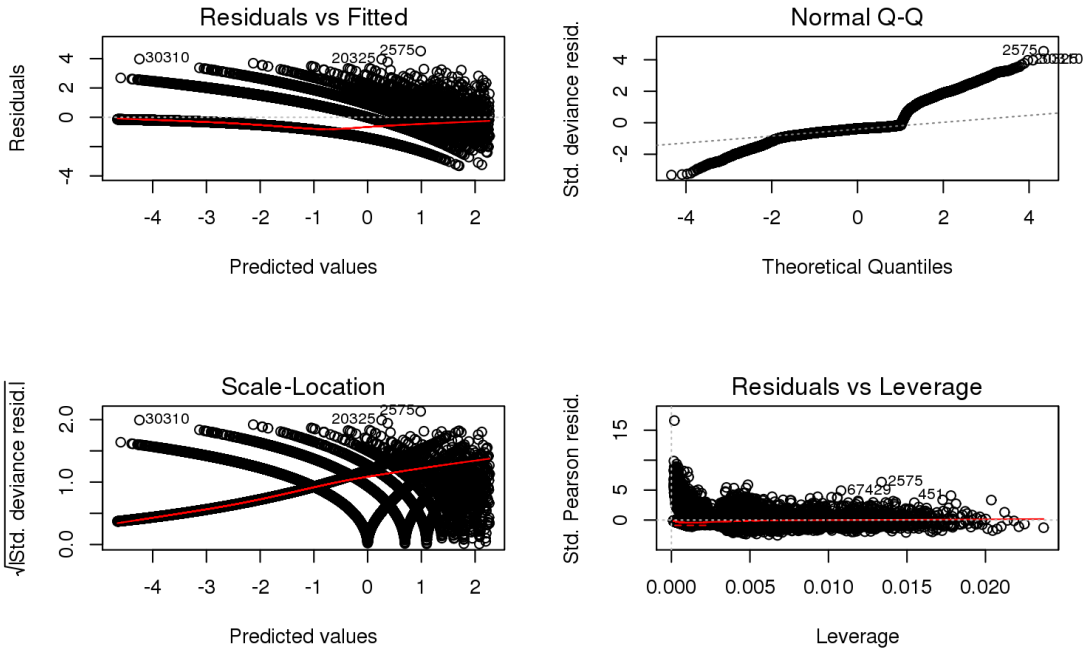

Figure 3: coreModelDiagnosticPlot.png

```
pdf
  2

Call:
glm(formula = deaths ~ sin(timevar * 2 * pi) + cos(timevar *
    2 * pi) + sd_group + agegp * sex * ns(time, 3) + offset(log(pop)),
    family = quasipoisson, data = data)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-3.3136  -0.5555  -0.3750  -0.2603   4.5152

Coefficients:
                              Estimate Std. Error t value Pr(>|t|)
(Intercept)                 -12.032410   0.314846 -38.217  < 2e-16 ***
sin(timevar * 2 * pi)        -0.023747   0.008771  -2.707 0.006784 **
cos(timevar * 2 * pi)         0.035846   0.008800   4.073 4.64e-05 ***
sd_groupHunter               -0.051679   0.042713  -1.210 0.226318
```

```
sd_groupIllawarra              -0.011850   0.045256  -0.262 0.793438
sd_groupMid-North Coast        -0.049794   0.049570  -1.005 0.315130
sd_groupMurray                  0.020954   0.059147   0.354 0.723130
sd_groupMurrumbidgee            0.021933   0.054096   0.405 0.685154
sd_groupNorth and Far Western   0.189563   0.052044   3.642 0.000270 ***
sd_groupNorthern                0.075051   0.050676   1.481 0.138614
sd_groupRichmond-Tweed          0.093430   0.051156   1.826 0.067797 .
sd_groupSouth Eastern           0.047643   0.051815   0.919 0.357844
sd_groupSydney                  0.002005   0.037784   0.053 0.957688
agegp20_29                      1.644248   0.349193   4.709 2.50e-06 ***
agegp30_39                      1.733754   0.353111   4.910 9.13e-07 ***
agegp40_49                      1.971013   0.344237   5.726 1.03e-08 ***
agegp50_59                      1.914973   0.349739   5.475 4.38e-08 ***
agegp60_69                      2.304978   0.369740   6.234 4.57e-10 ***
agegp70plus                     2.771488   0.389821   7.110 1.17e-12 ***
sex                            -0.529196   0.226636  -2.335 0.019546 *
ns(time, 3)1                    1.663505   0.349557   4.759 1.95e-06 ***
ns(time, 3)2                    1.634941   0.783576   2.087 0.036936 *
ns(time, 3)3                   -1.101448   0.319517  -3.447 0.000567 ***
agegp20_29:sex                 -0.092501   0.253569  -0.365 0.715266
agegp30_39:sex                  0.011911   0.255105   0.047 0.962760
agegp40_49:sex                  0.062950   0.248133   0.254 0.799734
agegp50_59:sex                  0.127925   0.250718   0.510 0.609889
agegp60_69:sex                 -0.267726   0.266730  -1.004 0.315511
agegp70plus:sex                -0.655146   0.280701  -2.334 0.019600 *
agegp20_29:ns(time, 3)1         0.177973   0.393660   0.452 0.651199
agegp30_39:ns(time, 3)1        -0.368994   0.393097  -0.939 0.347896
agegp40_49:ns(time, 3)1        -0.878825   0.395656  -2.221 0.026342 *
agegp50_59:ns(time, 3)1        -0.941833   0.409045  -2.303 0.021309 *
agegp60_69:ns(time, 3)1        -0.897216   0.428994  -2.091 0.036492 *
agegp70plus:ns(time, 3)1       -1.114998   0.426582  -2.614 0.008956 **
agegp20_29:ns(time, 3)2         0.146763   0.877317   0.167 0.867145
agegp30_39:ns(time, 3)2        -0.463293   0.883382  -0.524 0.599965
```

```
agegp40_49:ns(time, 3)2        -1.103259   0.868271  -1.271 0.203861
agegp50_59:ns(time, 3)2        -1.795455   0.883603  -2.032 0.042161 *
agegp60_69:ns(time, 3)2        -2.272281   0.931814  -2.439 0.014749 *
agegp70plus:ns(time, 3)2       -2.066445   0.968902  -2.133 0.032947 *
agegp20_29:ns(time, 3)3         0.860112   0.364637   2.359 0.018336 *
agegp30_39:ns(time, 3)3         1.732837   0.356072   4.867 1.14e-06 ***
agegp40_49:ns(time, 3)3         1.533726   0.356512   4.302 1.69e-05 ***
agegp50_59:ns(time, 3)3         0.873315   0.368233   2.372 0.017712 *
agegp60_69:ns(time, 3)3         0.649004   0.388460   1.671 0.094783 .
agegp70plus:ns(time, 3)3        0.681943   0.383660   1.777 0.075496 .
sex:ns(time, 3)1               -0.661840   0.269927  -2.452 0.014212 *
sex:ns(time, 3)2               -1.331060   0.576645  -2.308 0.020986 *
sex:ns(time, 3)3                0.619020   0.234437   2.640 0.008281 **
agegp20_29:sex:ns(time, 3)1    -0.267845   0.306426  -0.874 0.382070
agegp30_39:sex:ns(time, 3)1     0.027449   0.303414   0.090 0.927916
agegp40_49:sex:ns(time, 3)1    -0.031321   0.304750  -0.103 0.918141
agegp50_59:sex:ns(time, 3)1    -0.080661   0.312566  -0.258 0.796360
agegp60_69:sex:ns(time, 3)1    -0.088821   0.328832  -0.270 0.787076
agegp70plus:sex:ns(time, 3)1    0.331360   0.324803   1.020 0.307644
agegp20_29:sex:ns(time, 3)2    -0.400812   0.648523  -0.618 0.536552
agegp30_39:sex:ns(time, 3)2    -0.270145   0.649315  -0.416 0.677378
agegp40_49:sex:ns(time, 3)2    -0.067988   0.636593  -0.107 0.914949
agegp50_59:sex:ns(time, 3)2     0.317770   0.643469   0.494 0.621422
agegp60_69:sex:ns(time, 3)2     0.863718   0.681788   1.267 0.205216
agegp70plus:sex:ns(time, 3)2    0.997710   0.707429   1.410 0.158446
agegp20_29:sex:ns(time, 3)3    -0.856757   0.273391  -3.134 0.001726 **
agegp30_39:sex:ns(time, 3)3    -1.215554   0.265223  -4.583 4.59e-06 ***
agegp40_49:sex:ns(time, 3)3    -1.271706   0.264904  -4.801 1.58e-06 ***
agegp50_59:sex:ns(time, 3)3    -1.003265   0.271174  -3.700 0.000216 ***
agegp60_69:sex:ns(time, 3)3    -0.797518   0.287447  -2.774 0.005530 **
agegp70plus:sex:ns(time, 3)3   -0.872378   0.283996  -3.072 0.002129 **
---
Signif. codes:  0 âĂŸ***âĂŹ 0.001 âĂŸ**âĂŹ 0.01 âĂŸ*âĂŹ 0.05 âĂŸ.âĂŹ 0.1 âĂŸ âĂŹ 1
```

```
(Dispersion parameter for quasipoisson family taken to be 0.9424658)

    Null deviance: 51106  on 69915  degrees of freedom
Residual deviance: 38654  on 69848  degrees of freedom
AIC: NA

Number of Fisher Scoring iterations: 6
```

The effect estimates for initial models of climate are shown in Figure 4. The drought effect was found to be complicated by the countervailing effects in men and women during subsequent modelling.

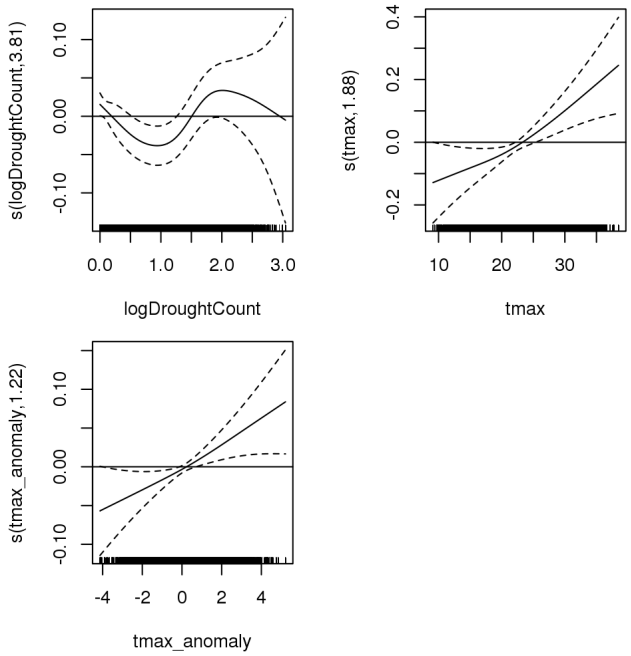

Figure 4: droughtTmaxAnomGAMS.png

```
pdf
  2
```

	model	param	aic
estats	sd_group*sex	78	69000.724261418
estats.1	age*sex*ns(time,df=3)	68	69190.9940743366
estats.2	tmaxanomModel	69	69184.2292611656
estats.3	tmax_anomaly*sex	70	69186.1069405509
estats.4	tmaxModel	71	69179.6061480822
estats.5	ns(tmax,3)*sex	74	69153.7168874518
estats.6	ageSexTrendSineXtra	70	69194.1865008069
estats.7	droughtModel	73	69186.0550358559
estats.8	tmax_anomaly*ns(time,3)	72	69187.7436924085
estats.9	sd_group*ns(time,3)	98	68961.9666698443
estats.10	ns(tmax,3)*tmax_anomaly	75	69186.919932702
estats.11	tmax_anomaly*agegp	75	69190.7857471075
estats.12	ns(logDroughtCount,5)*tmax_anomaly	79	69179.0007307755
estats.13	ns(logDroughtCount,5)*sex	78	69189.2500666982
estats.14	tmax_anomaly*sd_group	79	69180.5151463649
estats.15	ns(tmax,3)*ns(time,3)	80	69176.2429803571
estats.16	ns(logDroughtCount,5)*ns(time,3)	88	69193.7860016232
estats.17	ns(logDroughtCount,5)*ns(tmax,3)	91	69171.0663574609
estats.18	ns(tmax,3)*agegp	89	69196.830666324
estats.19	sd_group*sex*ns(time,3)	138	68811.5937008125
estats.20	ns(logDroughtCount,5)*agegp	103	69200.9627012294
estats.21	ns(tmax,3)*sd_group	101	69192.4898214451
estats.22	ns(logDroughtCount,5)*sd_group	123	69224.748071169
estats.23	agegp*sd_group	128	69175.4649453144
estats.24	sd_group*age*sex*ns(time,df=3)	618	69143.3206231067

	bic	percentChDev
estats	69714.8181458535	24.7768091375964
estats.1	69813.5374607675	24.3653745244352
estats.2	69815.927697397	24.3825246206206
estats.3	69826.9604265827	24.3827639651755

```
estats.4  69829.6146839145 24.3993974524668
estats.5  69831.1905726855 24.4617951187288
estats.6  69835.0399868388 24.3669547022941
estats.7  69845.2186214886 24.3906923207374
estats.8  69846.9072780413 24.3873881291093
estats.9  69859.1615502889 24.9309139935094
estats.10 69873.5486677362 24.4007401690249
estats.11 69877.4144821416 24.3931759360408
estats.12 69883.9395654106  24.424062452741
estats.13 69885.0338515328 24.4000941963524
estats.14 69903.7640806009  24.428925991859
estats.15 69908.6469643935 24.4411987292496
estats.16 69962.8101848614  24.422525914505
estats.17 69967.5556901005  24.478721597195
estats.18 70011.6300985645 24.4361354081766
estats.19 70074.9905732753 25.3816844207085
estats.20 70079.8474820731 24.4554440400007
estats.21  70117.149851291 24.4915898949028
estats.22   70250.11364882 24.4715175937565
estats.23 70347.3113197726  24.630564158636
estats.24 74801.1413997879  26.611025366504
```

Table 4: Models ranked by Bayesian Information Criterion (BIC).

Model	Parameters	BIC	AIC
sd_group*sex	78	69715	69001
age*sex*ns(time,df=3)	68	69814	69191
tmaxanomModel	69	69816	69184
tmax_anomaly*sex	70	69827	69186
tmaxModel	71	69830	69180
ns(tmax,3)*sex	74	69831	69154
ageSexTrendSineXtra	70	69835	69194
droughtModel	73	69845	69186
tmax_anomaly*ns(time,3)	72	69847	69188
sd_group*ns(time,3)	98	69859	68962
ns(tmax,3)*tmax_anomaly	75	69874	69187
tmax_anomaly*agegp	75	69877	69191
ns(logDroughtCount,5)*tmax_anomaly	79	69884	69179
ns(logDroughtCount,5)*sex	78	69885	69189
tmax_anomaly*sd_group	79	69904	69181
ns(tmax,3)*ns(time,3)	80	69909	69176
ns(logDroughtCount,5)*ns(time,3)	88	69963	69194
ns(logDroughtCount,5)*ns(tmax,3)	91	69968	69171
ns(tmax,3)*agegp	89	70012	69197
sd_group*sex*ns(time,3)	138	70075	68812
ns(logDroughtCount,5)*agegp	103	70080	69201
ns(tmax,3)*sd_group	101	70117	69192
ns(logDroughtCount,5)*sd_group	123	70250	69225
agegp*sd_group	128	70347	69175
sd_group*age*sex*ns(time,df=3)	618	74801	69143

3.4 Suicide and Drought Model by Age, Sex and Region

Our final GAM estimated curved response functions for drought and suicide by age, sex and region are shown in Figure 5. This model is labelled 'interactionDrtAgeSexRuralModel2' in Table 4. It included drought effects for each age/sex/region subgroup:

$$
\begin{aligned}
log(O_{ijk}) \quad = \quad & s(Drought \times Sex \times AgeGroupBy20years \times RuralOrUrbanRegion) \\
& + AgeGroupBy10years_i \times Sex_j \times s(Time, df = 3, basis = NaturalCubicSpline) \\
& + StatisticalDivision_k \\
& + s(Month, df = 4, basis = CyclicCubicSpline) \\
& + s(tmaxAnomaly) \\
& + offset(log(Pop_{ijk}))
\end{aligned}
$$

Where:

O_{ijk} = monthly suicide counts by AgeGroupBy10years$_i$, Sex$_j$ and StatisticalDivision$_k$

s(Drought × Sex × AgeGroupBy20years × RuralOrUrbanRegion) are interaction effects

Time = the month number in the sequence from Jan-1970 until Oct-2007

Month = the months of the year ranked from 1 to 12

s( ) = penalized regression splines, degrees of freedom (df) may be specified

tmaxAnomaly = monthly averaged temperature maxima anomalies from long term averages

Pop_{ijk} = interpolated population by month in each group

The eleven regions were classified as rural or urban based on the locations of the three major cities of NSW: Sydney, Newcastle and Wollongong. All other regions were classed as rural.

```
data$DrtMales10_29urban <- ifelse(data$agegp2 == 10_29 & data$sex == 1 & data$rural == 0, data$lo
data$DrtMales30_49urban <- ifelse(data$agegp2 == 30_49 & data$sex == 1 & data$rural == 0, data$lo
data$DrtMales50plusurban <- ifelse(data$agegp2 == 50plus & data$sex == 1 & data$rural == 0, data$

data$DrtMales10_29rural <- ifelse(data$agegp2 == 10_29 & data$sex == 1 & data$rural == 1, data$lo
data$DrtMales30_49rural <- ifelse(data$agegp2 == 30_49 & data$sex == 1 & data$rural == 1, data$lo
data$DrtMales50plusrural <- ifelse(data$agegp2 == 50plus & data$sex == 1 & data$rural == 1, data$
```

```
data$DrtFemales10_29urban <- ifelse(data$agegp2 == 10_29 & data$sex == 2 & data$rural == 0, data$
data$DrtFemales30_49urban <- ifelse(data$agegp2 == 30_49 & data$sex == 2 & data$rural == 0, data$
data$DrtFemales50plusurban <- ifelse(data$agegp2 == 50plus & data$sex == 2 & data$rural == 0, dat

data$DrtFemales10_29rural <- ifelse(data$agegp2 == 10_29 & data$sex == 2 & data$rural == 1, data$
data$DrtFemales30_49rural <- ifelse(data$agegp2 == 30_49 & data$sex == 2 & data$rural == 1, data$
data$DrtFemales50plusrural <- ifelse(data$agegp2 == 50plus & data$sex == 2 & data$rural == 1, dat

Time difference of 18.75566 mins

pseudo.Rsquared
      0.6747133

Time difference of 1.158233 mins

Call:
glm(formula = deaths ~ sin(timevar * 2 * pi) + cos(timevar *
    2 * pi) + DrtMales10_29rural + DrtMales30_49rural + DrtMales50plusrural +
    DrtFemales10_29rural + DrtFemales30_49rural + ns(DrtFemales50plusrural,
    df = 5) + ns(DrtMales10_29urban, df = 6) + DrtMales30_49urban +
    ns(DrtMales50plusurban, df = 4) + DrtFemales10_29urban +
    ns(DrtFemales30_49urban, df = 3) + DrtFemales50plusurban +
    tmax_anomaly + agegp2 + rural + sd_group + sex + agegp +
    agegp * sex * ns(time, 3) + offset(log(pop)), family = poisson,
    data = data)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-3.2777  -0.5583  -0.3657  -0.2420   4.4990

Coefficients: (17 not defined because of singularities)
                                  Estimate Std. Error z value Pr(>|z|)
(Intercept)                     -12.804520   0.372817 -34.345  < 2e-16 ***
sin(timevar * 2 * pi)            -0.024895   0.009093  -2.738 0.006185 **
cos(timevar * 2 * pi)             0.036617   0.009077   4.034 5.49e-05 ***
DrtMales10_29rural                0.094124   0.034488   2.729 0.006349 **
```

DrtMales30_49rural	0.124349	0.028181	4.413	1.02e-05	***
DrtMales50plusrural	-0.020010	0.031372	-0.638	0.523581	
DrtFemales10_29rural	-0.041776	0.075984	-0.550	0.582451	
DrtFemales30_49rural	-0.116702	0.058770	-1.986	0.047063	*
ns(DrtFemales50plusrural, df = 5)1	NA	NA	NA	NA	
ns(DrtFemales50plusrural, df = 5)2	0.994347	0.199104	4.994	5.91e-07	***
ns(DrtFemales50plusrural, df = 5)3	NA	NA	NA	NA	
ns(DrtFemales50plusrural, df = 5)4	NA	NA	NA	NA	
ns(DrtFemales50plusrural, df = 5)5	NA	NA	NA	NA	
ns(DrtMales10_29urban, df = 6)1	NA	NA	NA	NA	
ns(DrtMales10_29urban, df = 6)2	NA	NA	NA	NA	
ns(DrtMales10_29urban, df = 6)3	0.082090	0.069906	1.174	0.240280	
ns(DrtMales10_29urban, df = 6)4	NA	NA	NA	NA	
ns(DrtMales10_29urban, df = 6)5	NA	NA	NA	NA	
ns(DrtMales10_29urban, df = 6)6	NA	NA	NA	NA	
DrtMales30_49urban	-0.030154	0.018166	-1.660	0.096934	.
ns(DrtMales50plusurban, df = 4)1	0.122997	0.066174	1.859	0.063070	.
ns(DrtMales50plusurban, df = 4)2	NA	NA	NA	NA	
ns(DrtMales50plusurban, df = 4)3	NA	NA	NA	NA	
ns(DrtMales50plusurban, df = 4)4	NA	NA	NA	NA	
DrtFemales10_29urban	0.039441	0.040135	0.983	0.325749	
ns(DrtFemales30_49urban, df = 3)1	-0.092972	0.225054	-0.413	0.679527	
ns(DrtFemales30_49urban, df = 3)2	NA	NA	NA	NA	
ns(DrtFemales30_49urban, df = 3)3	NA	NA	NA	NA	
DrtFemales50plusurban	-0.011791	0.029629	-0.398	0.690655	
tmax_anomaly	0.017101	0.005301	3.226	0.001256	**
agegp230_49	1.960199	0.356029	5.506	3.68e-08	***
agegp250plus	2.771552	0.402857	6.880	6.00e-12	***
rural	-0.025243	0.040861	-0.618	0.536733	
sd_groupHunter	-0.056708	0.023494	-2.414	0.015791	*
sd_groupIllawarra	-0.014606	0.028087	-0.520	0.603054	
sd_groupMid-North Coast	-0.051399	0.051121	-1.005	0.314686	
sd_groupMurray	0.019829	0.060928	0.325	0.744836	

sd_groupMurrumbidgee	0.020024	0.055724	0.359	0.719347	
sd_groupNorth and Far Western	0.187027	0.053629	3.487	0.000488	***
sd_groupNorthern	0.073939	0.052203	1.416	0.156661	
sd_groupRichmond-Tweed	0.087991	0.052768	1.667	0.095417	.
sd_groupSouth Eastern	0.046142	0.053384	0.864	0.387400	
sd_groupSydney	NA	NA	NA	NA	
sex	-0.536378	0.234220	-2.290	0.022018	*
agegp20_29	1.650884	0.359818	4.588	4.47e-06	***
agegp30_39	-0.239459	0.224669	-1.066	0.286499	
agegp40_49	NA	NA	NA	NA	
agegp50_59	-0.860949	0.289032	-2.979	0.002894	**
agegp60_69	-0.469606	0.314352	-1.494	0.135206	
agegp70plus	NA	NA	NA	NA	
ns(time, 3)1	1.665084	0.359982	4.625	3.74e-06	***
ns(time, 3)2	1.603827	0.808198	1.984	0.047206	*
ns(time, 3)3	-1.124896	0.330435	-3.404	0.000663	***
sex:agegp20_29	-0.097433	0.261216	-0.373	0.709151	
sex:agegp30_39	0.025172	0.263895	0.095	0.924009	
sex:agegp40_49	0.074650	0.256738	0.291	0.771234	
sex:agegp50_59	0.147160	0.259337	0.567	0.570412	
sex:agegp60_69	-0.249028	0.275778	-0.903	0.366526	
sex:agegp70plus	-0.639387	0.290154	-2.204	0.027552	*
agegp20_29:ns(time, 3)1	0.180015	0.405286	0.444	0.656921	
agegp30_39:ns(time, 3)1	-0.370431	0.404870	-0.915	0.360224	
agegp40_49:ns(time, 3)1	-0.879169	0.407503	-2.157	0.030970	*
agegp50_59:ns(time, 3)1	-0.947184	0.421396	-2.248	0.024594	*
agegp60_69:ns(time, 3)1	-0.902334	0.441980	-2.042	0.041194	*
agegp70plus:ns(time, 3)1	-1.122060	0.439461	-2.553	0.010672	*
agegp20_29:ns(time, 3)2	0.157326	0.903823	0.174	0.861813	
agegp30_39:ns(time, 3)2	-0.481038	0.911420	-0.528	0.597645	
agegp40_49:ns(time, 3)2	-1.140874	0.895864	-1.273	0.202844	
agegp50_59:ns(time, 3)2	-1.802382	0.912024	-1.976	0.048127	*
agegp60_69:ns(time, 3)2	-2.289795	0.961609	-2.381	0.017256	*

```
agegp70plus:ns(time, 3)2           -2.084793   0.999615  -2.086 0.037015 *
agegp20_29:ns(time, 3)3             0.880390   0.375797   2.343 0.019143 *
agegp30_39:ns(time, 3)3             1.730928   0.368591   4.696 2.65e-06 ***
agegp40_49:ns(time, 3)3             1.512589   0.369043   4.099 4.16e-05 ***
agegp50_59:ns(time, 3)3             0.867469   0.381063   2.276 0.022819 *
agegp60_69:ns(time, 3)3             0.635607   0.401809   1.582 0.113681
agegp70plus:ns(time, 3)3            0.667298   0.396897   1.681 0.092707 .
sex:ns(time, 3)1                   -0.658662   0.277883  -2.370 0.017774 *
sex:ns(time, 3)2                   -1.339703   0.594572  -2.253 0.024245 *
sex:ns(time, 3)3                    0.614396   0.242536   2.533 0.011302 *
sex:agegp20_29:ns(time, 3)1        -0.268550   0.315363  -0.852 0.394459
sex:agegp30_39:ns(time, 3)1         0.027399   0.312412   0.088 0.930115
sex:agegp40_49:ns(time, 3)1        -0.032419   0.313783  -0.103 0.917711
sex:agegp50_59:ns(time, 3)1        -0.080014   0.321919  -0.249 0.803705
sex:agegp60_69:ns(time, 3)1        -0.087884   0.338715  -0.259 0.795279
sex:agegp70plus:ns(time, 3)1        0.334230   0.334535   0.999 0.317753
sex:agegp20_29:ns(time, 3)2        -0.407945   0.667788  -0.611 0.541273
sex:agegp30_39:ns(time, 3)2        -0.250953   0.669793  -0.375 0.707904
sex:agegp40_49:ns(time, 3)2        -0.035435   0.656674  -0.054 0.956966
sex:agegp50_59:ns(time, 3)2         0.355181   0.664044   0.535 0.592736
sex:agegp60_69:ns(time, 3)2         0.910105   0.703491   1.294 0.195770
sex:agegp70plus:ns(time, 3)2        1.044673   0.729753   1.432 0.152275
sex:agegp20_29:ns(time, 3)3        -0.870108   0.281792  -3.088 0.002017 **
sex:agegp30_39:ns(time, 3)3        -1.208394   0.274666  -4.399 1.09e-05 ***
sex:agegp40_49:ns(time, 3)3        -1.251666   0.274327  -4.563 5.05e-06 ***
sex:agegp50_59:ns(time, 3)3        -0.975801   0.280716  -3.476 0.000509 ***
sex:agegp60_69:ns(time, 3)3        -0.762613   0.297392  -2.564 0.010337 *
sex:agegp70plus:ns(time, 3)3       -0.836479   0.293878  -2.846 0.004422 **
---
Signif. codes:  0 âĂŸ***âĂŹ 0.001 âĂŸ**âĂŹ 0.01 âĂŸ*âĂŹ 0.05 âĂŸ.âĂŹ 0.1 âĂŸ âĂŹ 1

(Dispersion parameter for poisson family taken to be 1)
```

```
    Null deviance: 51106  on 69915  degrees of freedom
Residual deviance: 38565  on 69835  degrees of freedom
AIC: 69127

Number of Fisher Scoring iterations: 6

pseudo.Rsquared
      0.6742745

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  2
```

The estimated degrees of freedom from the GAM were then used with parametric splines in a GLM to estimate the effect sizes. A key drought effect reported in the paper was for rural males aged 30-49 where an Interquartile Range (IQR) rise in drought index gave a Relative Risk (RR) of 1.15 (95CI 1.08 to 1.22). The IQR for the drought index is about 2 months. For the temperature anomaly term there was a RR of 1.03 (95CI 1.01 to 1.05) per IQR rise (1.6 degrees C).

```
Time difference of 1.158547 mins

Call:
glm(formula = deaths ~ sin(timevar * 2 * pi) + cos(timevar *
    2 * pi) + tmax_anomaly + DrtMales10_29rural + DrtMales30_49rural +
    DrtMales50plusrural + DrtFemales10_29rural + DrtFemales30_49rural +
    ns(DrtFemales50plusrural, df = 5) + ns(DrtMales10_29urban,
```

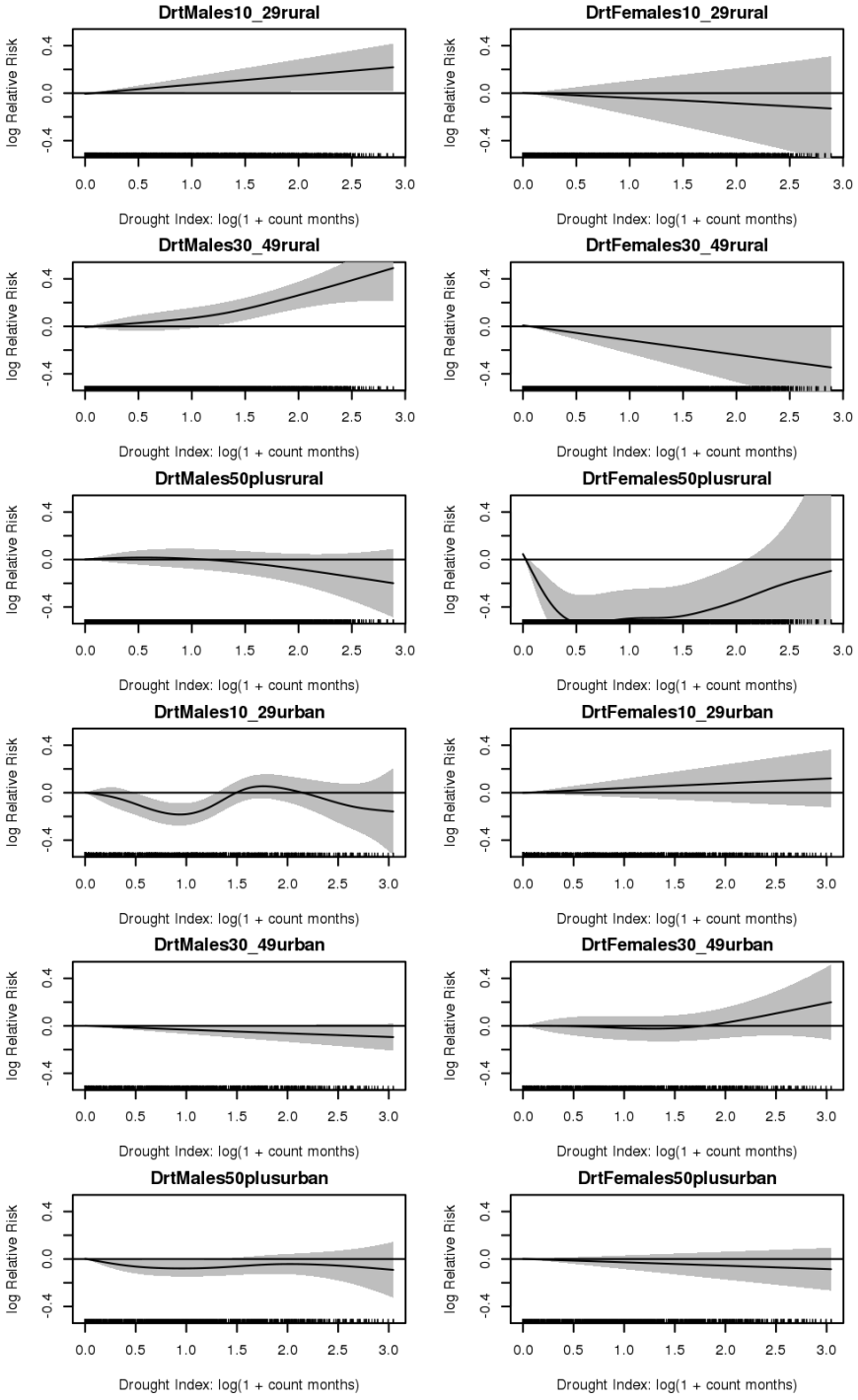

Figure 5: Estimated response functions for suicide and drought in each of the subgroups.

```
df = 6) + DrtMales30_49urban + ns(DrtMales50plusurban, df = 4) +
DrtFemales10_29urban + ns(DrtFemales30_49urban, df = 3) +
DrtFemales50plusurban + agegp2 + rural + sd_group + sex +
agegp + agegp * sex * ns(time, 3) + offset(log(pop)), family = poisson,
```

```
    data = data)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-3.2777  -0.5583  -0.3657  -0.2420   4.4990

Coefficients: (17 not defined because of singularities)
                                    Estimate Std. Error z value Pr(>|z|)
(Intercept)                      -12.804520   0.372817 -34.345  < 2e-16 ***
sin(timevar * 2 * pi)             -0.024895   0.009093  -2.738 0.006185 **
cos(timevar * 2 * pi)              0.036617   0.009077   4.034 5.49e-05 ***
tmax_anomaly                       0.017101   0.005301   3.226 0.001256 **
DrtMales10_29rural                 0.094124   0.034488   2.729 0.006349 **
DrtMales30_49rural                 0.124349   0.028181   4.413 1.02e-05 ***
DrtMales50plusrural               -0.020010   0.031372  -0.638 0.523581
DrtFemales10_29rural              -0.041776   0.075984  -0.550 0.582451
DrtFemales30_49rural              -0.116702   0.058770  -1.986 0.047063 *
ns(DrtFemales50plusrural, df = 5)1        NA         NA      NA       NA
ns(DrtFemales50plusrural, df = 5)2 0.994347   0.199104   4.994 5.91e-07 ***
ns(DrtFemales50plusrural, df = 5)3        NA         NA      NA       NA
ns(DrtFemales50plusrural, df = 5)4        NA         NA      NA       NA
ns(DrtFemales50plusrural, df = 5)5        NA         NA      NA       NA
ns(DrtMales10_29urban, df = 6)1           NA         NA      NA       NA
ns(DrtMales10_29urban, df = 6)2           NA         NA      NA       NA
ns(DrtMales10_29urban, df = 6)3    0.082090   0.069906   1.174 0.240280
ns(DrtMales10_29urban, df = 6)4           NA         NA      NA       NA
ns(DrtMales10_29urban, df = 6)5           NA         NA      NA       NA
ns(DrtMales10_29urban, df = 6)6           NA         NA      NA       NA
DrtMales30_49urban                -0.030154   0.018166  -1.660 0.096934 .
ns(DrtMales50plusurban, df = 4)1   0.122997   0.066174   1.859 0.063070 .
ns(DrtMales50plusurban, df = 4)2          NA         NA      NA       NA
ns(DrtMales50plusurban, df = 4)3          NA         NA      NA       NA
ns(DrtMales50plusurban, df = 4)4          NA         NA      NA       NA
```

DrtFemales10_29urban	0.039441	0.040135	0.983	0.325749	
ns(DrtFemales30_49urban, df = 3)1	-0.092972	0.225054	-0.413	0.679527	
ns(DrtFemales30_49urban, df = 3)2	NA	NA	NA	NA	
ns(DrtFemales30_49urban, df = 3)3	NA	NA	NA	NA	
DrtFemales50plusurban	-0.011791	0.029629	-0.398	0.690655	
agegp230_49	1.960199	0.356029	5.506	3.68e-08	***
agegp250plus	2.771552	0.402857	6.880	6.00e-12	***
rural	-0.025243	0.040861	-0.618	0.536733	
sd_groupHunter	-0.056708	0.023494	-2.414	0.015791	*
sd_groupIllawarra	-0.014606	0.028087	-0.520	0.603054	
sd_groupMid-North Coast	-0.051399	0.051121	-1.005	0.314686	
sd_groupMurray	0.019829	0.060928	0.325	0.744836	
sd_groupMurrumbidgee	0.020024	0.055724	0.359	0.719347	
sd_groupNorth and Far Western	0.187027	0.053629	3.487	0.000488	***
sd_groupNorthern	0.073939	0.052203	1.416	0.156661	
sd_groupRichmond-Tweed	0.087991	0.052768	1.667	0.095417	.
sd_groupSouth Eastern	0.046142	0.053384	0.864	0.387400	
sd_groupSydney	NA	NA	NA	NA	
sex	-0.536378	0.234220	-2.290	0.022018	*
agegp20_29	1.650884	0.359818	4.588	4.47e-06	***
agegp30_39	-0.239459	0.224669	-1.066	0.286499	
agegp40_49	NA	NA	NA	NA	
agegp50_59	-0.860949	0.289032	-2.979	0.002894	**
agegp60_69	-0.469606	0.314352	-1.494	0.135206	
agegp70plus	NA	NA	NA	NA	
ns(time, 3)1	1.665084	0.359982	4.625	3.74e-06	***
ns(time, 3)2	1.603827	0.808198	1.984	0.047206	*
ns(time, 3)3	-1.124896	0.330435	-3.404	0.000663	***
sex:agegp20_29	-0.097433	0.261216	-0.373	0.709151	
sex:agegp30_39	0.025172	0.263895	0.095	0.924009	
sex:agegp40_49	0.074650	0.256738	0.291	0.771234	
sex:agegp50_59	0.147160	0.259337	0.567	0.570412	
sex:agegp60_69	-0.249028	0.275778	-0.903	0.366526	

```
sex:agegp70plus                   -0.639387   0.290154  -2.204 0.027552 *
agegp20_29:ns(time, 3)1            0.180015   0.405286   0.444 0.656921
agegp30_39:ns(time, 3)1           -0.370431   0.404870  -0.915 0.360224
agegp40_49:ns(time, 3)1           -0.879169   0.407503  -2.157 0.030970 *
agegp50_59:ns(time, 3)1           -0.947184   0.421396  -2.248 0.024594 *
agegp60_69:ns(time, 3)1           -0.902334   0.441980  -2.042 0.041194 *
agegp70plus:ns(time, 3)1          -1.122060   0.439461  -2.553 0.010672 *
agegp20_29:ns(time, 3)2            0.157326   0.903823   0.174 0.861813
agegp30_39:ns(time, 3)2           -0.481038   0.911420  -0.528 0.597645
agegp40_49:ns(time, 3)2           -1.140874   0.895864  -1.273 0.202844
agegp50_59:ns(time, 3)2           -1.802382   0.912024  -1.976 0.048127 *
agegp60_69:ns(time, 3)2           -2.289795   0.961609  -2.381 0.017256 *
agegp70plus:ns(time, 3)2          -2.084793   0.999615  -2.086 0.037015 *
agegp20_29:ns(time, 3)3            0.880390   0.375797   2.343 0.019143 *
agegp30_39:ns(time, 3)3            1.730928   0.368591   4.696 2.65e-06 ***
agegp40_49:ns(time, 3)3            1.512589   0.369043   4.099 4.16e-05 ***
agegp50_59:ns(time, 3)3            0.867469   0.381063   2.276 0.022819 *
agegp60_69:ns(time, 3)3            0.635607   0.401809   1.582 0.113681
agegp70plus:ns(time, 3)3           0.667298   0.396897   1.681 0.092707 .
sex:ns(time, 3)1                  -0.658662   0.277883  -2.370 0.017774 *
sex:ns(time, 3)2                  -1.339703   0.594572  -2.253 0.024245 *
sex:ns(time, 3)3                   0.614396   0.242536   2.533 0.011302 *
sex:agegp20_29:ns(time, 3)1       -0.268550   0.315363  -0.852 0.394459
sex:agegp30_39:ns(time, 3)1        0.027399   0.312412   0.088 0.930115
sex:agegp40_49:ns(time, 3)1       -0.032419   0.313783  -0.103 0.917711
sex:agegp50_59:ns(time, 3)1       -0.080014   0.321919  -0.249 0.803705
sex:agegp60_69:ns(time, 3)1       -0.087884   0.338715  -0.259 0.795279
sex:agegp70plus:ns(time, 3)1       0.334230   0.334535   0.999 0.317753
sex:agegp20_29:ns(time, 3)2       -0.407945   0.667788  -0.611 0.541273
sex:agegp30_39:ns(time, 3)2       -0.250953   0.669793  -0.375 0.707904
sex:agegp40_49:ns(time, 3)2       -0.035435   0.656674  -0.054 0.956966
sex:agegp50_59:ns(time, 3)2        0.355181   0.664044   0.535 0.592736
sex:agegp60_69:ns(time, 3)2        0.910105   0.703491   1.294 0.195770
```

```
sex:agegp70plus:ns(time, 3)2         1.044673   0.729753   1.432 0.152275
sex:agegp20_29:ns(time, 3)3         -0.870108   0.281792  -3.088 0.002017 **
sex:agegp30_39:ns(time, 3)3         -1.208394   0.274666  -4.399 1.09e-05 ***
sex:agegp40_49:ns(time, 3)3         -1.251666   0.274327  -4.563 5.05e-06 ***
sex:agegp50_59:ns(time, 3)3         -0.975801   0.280716  -3.476 0.000509 ***
sex:agegp60_69:ns(time, 3)3         -0.762613   0.297392  -2.564 0.010337 *
sex:agegp70plus:ns(time, 3)3        -0.836479   0.293878  -2.846 0.004422 **
---
Signif. codes:  0 âĂŸ***âĂŹ 0.001 âĂŸ**âĂŹ 0.01 âĂŸ*âĂŹ 0.05 âĂŸ.âĂŹ 0.1 âĂŸ âĂŹ 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 51106  on 69915  degrees of freedom
Residual deviance: 38565  on 69835  degrees of freedom
AIC: 69127

Number of Fisher Scoring iterations: 6

pseudo.Rsquared
      0.6742745

[1] 1.122753

[1] 2.073303

[1] 1.149829

[1] 1.080688

[1] 1.223392

Single term deletions

Model:
deaths ~ sin(timevar * 2 * pi) + cos(timevar * 2 * pi) + tmax_anomaly +
    DrtMales10_29rural + DrtMales30_49rural + DrtMales50plusrural +
    DrtFemales10_29rural + DrtFemales30_49rural + ns(DrtFemales50plusrural,
```

```
    df = 5) + ns(DrtMales10_29urban, df = 6) + DrtMales30_49urban +
    ns(DrtMales50plusurban, df = 4) + DrtFemales10_29urban +
    ns(DrtFemales30_49urban, df = 3) + DrtFemales50plusurban +
    agegp2 + rural + sd_group + sex + agegp + agegp * sex * ns(time,
    3) + offset(log(pop))
```

	Df	Deviance	AIC	LRT	Pr(>Chi)	
<none>		38565	69127			
sin(timevar * 2 * pi)	1	38572	69133	7.496	0.0061829	**
cos(timevar * 2 * pi)	1	38581	69142	16.275	5.478e-05	***
tmax_anomaly	1	38575	69136	10.388	0.0012687	**
DrtMales10_29rural	1	38572	69132	7.191	0.0073256	**
DrtMales30_49rural	1	38583	69144	18.677	1.548e-05	***
DrtMales50plusrural	1	38565	69126	0.410	0.5221160	
DrtFemales10_29rural	1	38565	69126	0.308	0.5790212	
DrtFemales30_49rural	1	38569	69129	4.144	0.0417870	*
ns(DrtFemales50plusrural, df = 5)	1	38593	69154	28.533	9.210e-08	***
ns(DrtMales10_29urban, df = 6)	1	38566	69127	1.388	0.2386939	
DrtMales30_49urban	1	38567	69128	2.776	0.0956671	.
ns(DrtMales50plusurban, df = 4)	1	38568	69129	3.490	0.0617570	.
DrtFemales10_29urban	1	38565	69126	0.955	0.3284023	
ns(DrtFemales30_49urban, df = 3)	1	38565	69125	0.170	0.6800571	
DrtFemales50plusurban	1	38565	69125	0.159	0.6901503	
agegp2	0	38565	69127	0.000		
rural	0	38565	69127	0.000		
sd_group	9	38596	69141	31.883	0.0002086	***
sex:agegp:ns(time, 3)	18	38613	69140	48.602	0.0001225	***

```
---
Signif. codes:  0 âĂŸ***âĂŹ 0.001 âĂŸ**âĂŹ 0.01 âĂŸ*âĂŹ 0.05 âĂŸ.âĂŹ 0.1 âĂŸ âĂŹ 1
```

3.5 Attributable Number of Deaths

The predicted number of rural male suicides aged 30-49 per annum associated with droughts over our study period was 4.01 (95%CI 2.14 to 6.05, p = 0.000015), accounting for 9% of the total in 38 years.

However this effect only applies in the months that were in drought, and to a greater extent depending on the intensity of the drought. As drought is a rare and episodic event this estimate is obviously an underestimate of the real impact in terms of numbers of deaths during droughts and potential years of life lost.

```
[1] "sd_group','sex','agegp','dthyy','dthmm','deaths','sui_und','pop','logDroughtCount"
```

```
      sd_group rural sex  agegp agegp2 dthyy dthmm deaths   pop logDroughtCount
1 Central West     1   1  10_19  10_29  1970     1      0 15432      0.02181905
2 Central West     1   1  40_49  30_49  1970     1      1  9128      0.02181905
3 Central West     1   1  60_69 50plus  1970     1      0  5237      0.02181905
4 Central West     1   2  40_49  30_49  1970     1      0  8488      0.02181905
5 Central West     1   2  50_59 50plus  1970     1      0  7436      0.02181905
6 Central West     1   1 70plus 50plus  1970     1      0  3353      0.02181905
```

```
 [1] "time"                  "sd_group"              "sex"
 [4] "agegp"                 "dthyy"                 "dthmm"
 [7] "deaths"                "sui_und"               "pop"
[10] "avrain"                "avcount"               "tmax_anomaly"
[13] "tmax"                  "avsums"                "avcount2"
[16] "avsums2"               "logDroughtCount"       "mm"
[19] "timevar"               "rural"                 "agegp2"
[22] "DrtMales10_29urban"    "DrtMales30_49urban"    "DrtMales50plusurban"
[25] "DrtMales10_29rural"    "DrtMales30_49rural"    "DrtMales50plusrural"
[28] "DrtFemales10_29urban"  "DrtFemales30_49urban"  "DrtFemales50plusurban"
[31] "DrtFemales10_29rural"  "DrtFemales30_49rural"  "DrtFemales50plusrural"
```

```
      sd_group sex agegp avgMonthlyDeaths    avgPop      avgRate
1 Central West   1 10_19        0.1057269 14565.220 7.258858e-06
2 Central West   1 20_29        0.2599119 11640.225 2.232877e-05
3 Central West   1 30_39        0.2312775 11523.846 2.006947e-05
```

```
4 Central West   1 40_49        0.2048458 10639.692 1.925298e-05
5 Central West   1 50_59        0.1806167  8938.379 2.020688e-05
6 Central West   1 60_69        0.1189427  6731.930 1.766845e-05
```

	sd_group	sex	agegp	avgMonthlyDeaths	avgPop	avgRate
1	Central West	1	10_19	0.10572687	14565.220	7.258858e-06
2	Central West	1	20_29	0.25991189	11640.225	2.232877e-05
3	Central West	1	30_39	0.23127753	11523.846	2.006947e-05
4	Central West	1	40_49	0.20484581	10639.692	1.925298e-05
5	Central West	1	50_59	0.18061674	8938.379	2.020688e-05
6	Central West	1	60_69	0.11894273	6731.930	1.766845e-05
7	Central West	1	70plus	0.12555066	5339.344	2.351425e-05
8	Central West	2	10_19	0.01982379	13704.617	1.446504e-06
9	Central West	2	20_29	0.05726872	11026.568	5.193703e-06
10	Central West	2	30_39	0.06828194	11114.850	6.143307e-06
11	Central West	2	40_49	0.04625551	10023.815	4.614561e-06
12	Central West	2	50_59	0.04845815	8534.661	5.677806e-06
13	Central West	2	60_69	0.03303965	6897.189	4.790306e-06
14	Central West	2	70plus	0.01982379	7521.837	2.635498e-06
15	Hunter	1	10_19	0.23568282	40563.498	5.810219e-06
16	Hunter	1	20_29	0.75550661	37565.392	2.011177e-05
17	Hunter	1	30_39	0.77312775	35575.727	2.173189e-05
18	Hunter	1	40_49	0.69603524	32485.344	2.142613e-05
19	Hunter	1	50_59	0.43171806	27655.278	1.561069e-05
20	Hunter	1	60_69	0.34361233	21938.938	1.566221e-05
21	Hunter	1	70plus	0.41850220	17866.123	2.342434e-05
22	Hunter	2	10_19	0.03083700	38518.357	8.005794e-07
23	Hunter	2	20_29	0.14317181	35609.533	4.020603e-06
24	Hunter	2	30_39	0.15638767	34917.326	4.478798e-06
25	Hunter	2	40_49	0.18942731	31770.912	5.962288e-06
26	Hunter	2	50_59	0.14096916	27452.987	5.134930e-06
27	Hunter	2	60_69	0.11233480	23226.225	4.836550e-06
28	Hunter	2	70plus	0.10352423	25257.018	4.098830e-06
29	Illawarra	1	10_19	0.14977974	27128.877	5.521045e-06

```
30    Illawarra   1  20_29       0.55066079 24321.881 2.264055e-05
31    Illawarra   1  30_39       0.49779736 23603.176 2.109027e-05
32    Illawarra   1  40_49       0.44273128 21569.819 2.052550e-05
33    Illawarra   1  50_59       0.28414097 17923.987 1.585255e-05
34    Illawarra   1  60_69       0.23348018 14400.520 1.621332e-05
35    Illawarra   1 70plus       0.24008811 11162.366 2.150871e-05
36    Illawarra   2  10_19       0.02202643 25456.159 8.652693e-07
37    Illawarra   2  20_29       0.07488987 22969.824 3.260359e-06
38    Illawarra   2  30_39       0.11233480 23346.053 4.811726e-06
39    Illawarra   2  40_49       0.14757709 20922.137 7.053634e-06
40    Illawarra   2  50_59       0.14977974 17703.181 8.460612e-06
```

	sd_group	sum(avgMonthlyDeaths)	sum(avgPop)
1	Central West	1.5198238	138202.17
2	Hunter	4.5308370	430402.66
3	Illawarra	3.0462555	280036.88
4	Mid-North Coast	1.9074890	183520.63
5	Murray	0.9735683	86220.51
6	Murrumbidgee	1.3303965	118778.27
7	North and Far Western	1.5462555	114460.50
8	Northern	1.7268722	146464.55
9	Richmond-Tweed	1.6629956	139356.23
10	South Eastern	1.5748899	135091.01
11	Sydney	34.0044053	3040952.32

```
    sd_group sex  agegp avgMonthlyDeaths   avgPop      avgRate
141   Sydney   1  10_19        1.1916300 269031.3 4.429336e-06
142   Sydney   1  20_29        5.9317181 292341.6 2.029037e-05
143   Sydney   1  30_39        5.1828194 276223.6 1.876313e-05
144   Sydney   1  40_49        4.4735683 236838.1 1.888872e-05
145   Sydney   1  50_59        3.2819383 188307.1 1.742865e-05
146   Sydney   1  60_69        2.4493392 129867.6 1.886027e-05
147   Sydney   1 70plus        2.3392070 102487.3 2.282437e-05
148   Sydney   2  10_19        0.4339207 257540.7 1.684863e-06
149   Sydney   2  20_29        1.5550661 292093.0 5.323873e-06
```

```
150   Sydney   2  30_39        1.7048458 273605.7 6.231033e-06
151   Sydney   2  40_49        1.6894273 232950.9 7.252289e-06
152   Sydney   2  50_59        1.5704846 186502.3 8.420726e-06
153   Sydney   2  60_69        1.0242291 142361.8 7.194550e-06
154   Sydney   2 70plus        1.1762115 160801.5 7.314681e-06
```

```
       sd_group sex  agegp avgMonthlyDeaths    avgPop      avgRate
1  Central West   1  10_19       0.10572687 14565.220 7.258858e-06
2  Central West   1  20_29       0.25991189 11640.225 2.232877e-05
3  Central West   1  30_39       0.23127753 11523.846 2.006947e-05
4  Central West   1  40_49       0.20484581 10639.692 1.925298e-05
5  Central West   1  50_59       0.18061674  8938.379 2.020688e-05
6  Central West   1  60_69       0.11894273  6731.930 1.766845e-05
7  Central West   1 70plus       0.12555066  5339.344 2.351425e-05
8  Central West   2  10_19       0.01982379 13704.617 1.446504e-06
9  Central West   2  20_29       0.05726872 11026.568 5.193703e-06
10 Central West   2  30_39       0.06828194 11114.850 6.143307e-06
11 Central West   2  40_49       0.04625551 10023.815 4.614561e-06
12 Central West   2  50_59       0.04845815  8534.661 5.677806e-06
13 Central West   2  60_69       0.03303965  6897.189 4.790306e-06
14 Central West   2 70plus       0.01982379  7521.837 2.635498e-06
```

```
      sd_group sex agegp rural agegp2 dthyy dthmm deaths   pop logDroughtCount
1 Central West   1 10_19     1  10_29  1970     1      0 15432      0.02181905
2 Central West   1 10_19     1  10_29  1977     2      0 15432      0.00000000
3 Central West   1 10_19     1  10_29  2005     7      0 13694      0.97622307
4 Central West   1 10_19     1  10_29  1974     2      0 15508      0.00000000
5 Central West   1 10_19     1  10_29  1984     1      0 14776      0.00000000
6 Central West   1 10_19     1  10_29  1984    10      0 14776      0.01459880
  avgMonthlyDeaths   avgPop      avgRate
1        0.1057269 14565.22 7.258858e-06
2        0.1057269 14565.22 7.258858e-06
3        0.1057269 14565.22 7.258858e-06
4        0.1057269 14565.22 7.258858e-06
5        0.1057269 14565.22 7.258858e-06
```

```
6        0.1057269 14565.22 7.258858e-06
```

```
         Central West                Hunter             Illawarra
                  908                     0                     0
      Mid-North Coast                Murray          Murrumbidgee
                  908                   908                   908
North and Far Western              Northern        Richmond-Tweed
                  908                   908                   908
        South Eastern                Sydney
                  908                     0
```

```
        sd_group sex agegp rural agegp2 dthyy dthmm deaths   pop
909 Central West   1 30_39     1  30_49  1978     5      0 10601
910 Central West   1 30_39     1  30_49  1973    11      1  9625
911 Central West   1 30_39     1  30_49  1995     6      0 12719
912 Central West   1 30_39     1  30_49  2005     4      0 11485
913 Central West   1 30_39     1  30_49  1985     1      1 11870
914 Central West   1 30_39     1  30_49  1986    11      1 11980
    logDroughtCount avgMonthlyDeaths   avgPop      avgRate deathsAttributable
909      0.00000000        0.2312775 11523.85 2.006947e-05        0.000000000
910      0.00000000        0.2312775 11523.85 2.006947e-05        0.000000000
911      0.05715841        0.2312775 11523.85 2.006947e-05        0.001820768
912      0.72925219        0.2312775 11523.85 2.006947e-05        0.021878924
913      0.44393139        0.2312775 11523.85 2.006947e-05        0.013520287
914      0.00000000        0.2312775 11523.85 2.006947e-05        0.000000000
    deathsAttributableLower deathsAttributableUpper
909             0.000000000             0.000000000
910             0.000000000             0.000000000
911             0.001010401             0.002633697
912             0.011915218             0.032252159
913             0.007422476             0.019769467
914             0.000000000             0.000000000
```

```
   dthyy deathsAttributable deaths     pop logDroughtCount
1   1970          2.4653205     26 1461300               1
```

2	1971	1.5649079	28	1472340	0
3	1972	2.8457617	36	1483212	1
4	1973	1.6568028	35	1494180	0
5	1974	0.5198329	36	1505136	0
6	1975	2.4070181	23	1516104	1
7	1976	1.1402979	31	1527144	0
8	1977	2.0880939	24	1571340	0
9	1978	2.4468371	24	1615632	1
10	1979	2.6854265	25	1659876	1
11	1980	7.4951577	40	1704168	1
12	1981	3.7687632	22	1748532	1
13	1982	5.3215368	28	1791048	1
14	1983	3.5201086	35	1833600	1
15	1984	0.1263017	25	1876164	0
16	1985	3.4662494	33	1918716	1
17	1986	4.8652618	36	1961376	1
18	1987	1.9104383	51	2028264	0
19	1988	0.9463116	50	2095212	0
20	1989	0.7664546	35	2162196	0
21	1990	1.7828060	50	2229144	0
22	1991	8.5090255	73	2296188	1
23	1992	4.7500627	59	2323500	1
24	1993	6.4081406	65	2350884	1
25	1994	7.9437583	71	2378280	1
26	1995	4.1391121	62	2405664	1
27	1996	0.5710331	59	2433132	0
28	1997	4.7635099	68	2432088	1
29	1998	5.1368548	79	2431068	1
30	1999	1.4771274	65	2430084	0
31	2000	4.1397594	80	2429064	0
32	2001	3.6205015	67	2428152	1
33	2002	12.1173317	52	2417748	1
34	2003	11.1516601	72	2407392	1

```
35  2004          6.7551563     53 2397072              1
36  2005          3.3710618     40 2386716              0
37  2006          5.9728904     30 2376456              1
38  2007          7.7310444     31 1971710              1
```

```
[1] 152.3477
```

```
[1] 38
```

```
[1] 4.009151
```

```
[1] 2.136019
```

```
[1] 6.046266
```

```
      [,1] [,2]
 [1,] -1825   36
 [2,] 15612  121
 [3,] 15612  129
 [4,] -1825  153
 [5,] -1825  186
 [6,] 15612  299
 [7,] 15612  395
 [8,] -1825  417
 [9,] -1825  441
[10,] 15612   36
[11,] 15612  121
[12,] -1825  129
[13,] -1825  153
[14,] 15612  186
[15,] 15612  299
[16,] -1825  395
[17,] -1825  417
[18,] 15612  441
[19,] 15612   36
[20,] -1825  126
[21,] -1825  136
```

```
[22,] 15612  160
[23,] 15612  187
[24,] -1825  300
[25,] -1825  402
[26,] 15612  417
[27,] 15612  448
[28,] -1825   36
[29,] -1825  126
[30,] 15612  136
[31,] 15612  160
[32,] -1825  187
[33,] -1825  300
[34,] 15612  402
[35,] 15612  417
[36,] -1825  448
```

```
pdf
  2
```

```
[1] 3
```

```
[1] 7.894737
```

```
         Central West                Hunter             Illawarra
                  908                     0                     0
      Mid-North Coast                Murray          Murrumbidgee
                  908                   908                   908
North and Far Western              Northern        Richmond-Tweed
                  908                   908                   908
        South Eastern                Sydney
                  908                     0
```

```
        sd_group sex agegp rural agegp2 dthyy dthmm deaths   pop
932 Central West   1 30_39     1  30_49  1983     4      0 11651
949 Central West   1 30_39     1  30_49  1982     9      0 11542
951 Central West   1 30_39     1  30_49  1980    10      1 11155
```

```
953 Central West   1 30_39     1  30_49  1980     5      0 11155
956 Central West   1 30_39     1  30_49  1980    11      0 11155
982 Central West   1 30_39     1  30_49  1981     3      0 11433
    logDroughtCount avgMonthlyDeaths   avgPop      avgRate deathsAttributable
932        2.483680        0.2312775 11523.85 2.006947e-05         0.08461065
949        1.834932        0.2312775 11523.85 2.006947e-05         0.05936994
951        1.956360        0.2312775 11523.85 2.006947e-05         0.06165828
953        2.189021        0.2312775 11523.85 2.006947e-05         0.07003974
956        2.088591        0.2312775 11523.85 2.006947e-05         0.06639205
982        2.293722        0.2312775 11523.85 2.006947e-05         0.07573286
    deathsAttributableLower deathsAttributableUpper logDroughtCountDeclared
932              0.04378946              0.13143419                2.483680
949              0.03132083              0.09041093                1.834932
951              0.03241251              0.09424137                1.956360
953              0.03656698              0.10781452                2.189021
956              0.03476547              0.10188592                2.088591
982              0.03941690              0.11695395                2.293722

   dthyy deathsAttributable deaths     pop logDroughtCountDeclared
1   1970         0.50266888     26 1461300                     0.1
2   1971         0.00000000     28 1472340                     0.0
3   1972         0.68434507     36 1483212                     0.2
4   1973         0.25607449     35 1494180                     0.1
5   1974         0.00000000     36 1505136                     0.0
6   1975         0.00000000     23 1516104                     0.0
7   1976         0.00000000     31 1527144                     0.0
8   1977         0.05794209     24 1571340                     0.0
9   1978         0.54601179     24 1615632                     0.1
10  1979         0.20245274     25 1659876                     0.0
11  1980         3.94306323     40 1704168                     0.7
12  1981         2.27810344     22 1748532                     0.4
13  1982         2.06845481     28 1791048                     0.4
14  1983         2.86378052     35 1833600                     0.5
15  1984         0.00000000     25 1876164                     0.0
```

```
16  1985         0.60873299     33 1918716                    0.1
17  1986         1.22963945     36 1961376                    0.2
18  1987         0.14301429     51 2028264                    0.0
19  1988         0.00000000     50 2095212                    0.0
20  1989         0.00000000     35 2162196                    0.0
21  1990         0.00000000     50 2229144                    0.0
22  1991         3.54113149     73 2296188                    0.4
23  1992         0.30032308     59 2323500                    0.0
24  1993         4.11377232     65 2350884                    0.4
25  1994         3.45735108     71 2378280                    0.4
26  1995         0.66099467     62 2405664                    0.1
27  1996         0.00000000     59 2433132                    0.0
28  1997         0.11963073     68 2432088                    0.0
29  1998         0.70348266     79 2431068                    0.1
30  1999         0.00000000     65 2430084                    0.0
31  2000         1.34440422     80 2429064                    0.1
32  2001         0.25600125     67 2428152                    0.0
33  2002         8.05803307     52 2417748                    0.9
34  2003         7.40377088     72 2407392                    1.0
35  2004         1.62276055     53 2397072                    0.2
36  2005         0.00000000     40 2386716                    0.0
37  2006         1.95250493     30 2376456                    0.3
38  2007         4.27803326     31 1971710                    0.8

[1] 53.19648

[1] 17.73216

[1] 9.260883

[1] 27.28826

      sd_group rural sex  agegp agegp2 dthyy dthmm deaths   pop logDroughtCount
1 Central West     1   1  10_19  10_29  1970     1      0 15432      0.02181905
2 Central West     1   1  40_49  30_49  1970     1      1  9128      0.02181905
3 Central West     1   1  60_69 50plus  1970     1      0  5237      0.02181905
```

```
4 Central West     1   2  40_49  30_49  1970     1      0  8488      0.02181905
5 Central West     1   2  50_59 50plus  1970     1      0  7436      0.02181905
6 Central West     1   1 70plus 50plus  1970     1      0  3353      0.02181905
```

```
 [1] "time"                 "sd_group"             "sex"
 [4] "agegp"                "dthyy"                "dthmm"
 [7] "deaths"               "sui_und"              "pop"
[10] "avrain"               "avcount"              "tmax_anomaly"
[13] "tmax"                 "avsums"               "avcount2"
[16] "avsums2"              "logDroughtCount"      "mm"
[19] "timevar"              "rural"                "agegp2"
[22] "DrtMales10_29urban"   "DrtMales30_49urban"   "DrtMales50plusurban"
[25] "DrtMales10_29rural"   "DrtMales30_49rural"   "DrtMales50plusrural"
[28] "DrtFemales10_29urban" "DrtFemales30_49urban" "DrtFemales50plusurban"
[31] "DrtFemales10_29rural" "DrtFemales30_49rural" "DrtFemales50plusrural"
```

```
      sd_group sex agegp avgMonthlyDeaths    avgPop      avgRate
1 Central West   1 10_19        0.1057269 14565.220 7.258858e-06
2 Central West   1 20_29        0.2599119 11640.225 2.232877e-05
3 Central West   1 30_39        0.2312775 11523.846 2.006947e-05
4 Central West   1 40_49        0.2048458 10639.692 1.925298e-05
5 Central West   1 50_59        0.1806167  8938.379 2.020688e-05
6 Central West   1 60_69        0.1189427  6731.930 1.766845e-05
```

```
       sd_group sex  agegp avgMonthlyDeaths    avgPop      avgRate
1  Central West   1  10_19       0.10572687 14565.220 7.258858e-06
2  Central West   1  20_29       0.25991189 11640.225 2.232877e-05
3  Central West   1  30_39       0.23127753 11523.846 2.006947e-05
4  Central West   1  40_49       0.20484581 10639.692 1.925298e-05
5  Central West   1  50_59       0.18061674  8938.379 2.020688e-05
6  Central West   1  60_69       0.11894273  6731.930 1.766845e-05
7  Central West   1 70plus       0.12555066  5339.344 2.351425e-05
8  Central West   2  10_19       0.01982379 13704.617 1.446504e-06
9  Central West   2  20_29       0.05726872 11026.568 5.193703e-06
10 Central West   2  30_39       0.06828194 11114.850 6.143307e-06
```

```
11 Central West   2  40_49       0.04625551 10023.815 4.614561e-06
12 Central West   2  50_59       0.04845815  8534.661 5.677806e-06
13 Central West   2  60_69       0.03303965  6897.189 4.790306e-06
14 Central West   2 70plus       0.01982379  7521.837 2.635498e-06
15       Hunter   1  10_19       0.23568282 40563.498 5.810219e-06
16       Hunter   1  20_29       0.75550661 37565.392 2.011177e-05
17       Hunter   1  30_39       0.77312775 35575.727 2.173189e-05
18       Hunter   1  40_49       0.69603524 32485.344 2.142613e-05
19       Hunter   1  50_59       0.43171806 27655.278 1.561069e-05
20       Hunter   1  60_69       0.34361233 21938.938 1.566221e-05
21       Hunter   1 70plus       0.41850220 17866.123 2.342434e-05
22       Hunter   2  10_19       0.03083700 38518.357 8.005794e-07
23       Hunter   2  20_29       0.14317181 35609.533 4.020603e-06
24       Hunter   2  30_39       0.15638767 34917.326 4.478798e-06
25       Hunter   2  40_49       0.18942731 31770.912 5.962288e-06
26       Hunter   2  50_59       0.14096916 27452.987 5.134930e-06
27       Hunter   2  60_69       0.11233480 23226.225 4.836550e-06
28       Hunter   2 70plus       0.10352423 25257.018 4.098830e-06
29    Illawarra   1  10_19       0.14977974 27128.877 5.521045e-06
30    Illawarra   1  20_29       0.55066079 24321.881 2.264055e-05
31    Illawarra   1  30_39       0.49779736 23603.176 2.109027e-05
32    Illawarra   1  40_49       0.44273128 21569.819 2.052550e-05
33    Illawarra   1  50_59       0.28414097 17923.987 1.585255e-05
34    Illawarra   1  60_69       0.23348018 14400.520 1.621332e-05
35    Illawarra   1 70plus       0.24008811 11162.366 2.150871e-05
36    Illawarra   2  10_19       0.02202643 25456.159 8.652693e-07
37    Illawarra   2  20_29       0.07488987 22969.824 3.260359e-06
38    Illawarra   2  30_39       0.11233480 23346.053 4.811726e-06
39    Illawarra   2  40_49       0.14757709 20922.137 7.053634e-06
40    Illawarra   2  50_59       0.14977974 17703.181 8.460612e-06

               sd_group sum(avgMonthlyDeaths) sum(avgPop)
1          Central West             1.5198238   138202.17
2                Hunter             4.5308370   430402.66
```

```
3              Illawarra             3.0462555   280036.88
4        Mid-North Coast             1.9074890   183520.63
5                Murray              0.9735683    86220.51
6           Murrumbidgee             1.3303965   118778.27
7  North and Far Western             1.5462555   114460.50
8               Northern             1.7268722   146464.55
9         Richmond-Tweed             1.6629956   139356.23
10         South Eastern             1.5748899   135091.01
11                Sydney            34.0044053  3040952.32
```

```
    sd_group sex  agegp avgMonthlyDeaths   avgPop      avgRate
141   Sydney   1  10_19        1.1916300 269031.3 4.429336e-06
142   Sydney   1  20_29        5.9317181 292341.6 2.029037e-05
143   Sydney   1  30_39        5.1828194 276223.6 1.876313e-05
144   Sydney   1  40_49        4.4735683 236838.1 1.888872e-05
145   Sydney   1  50_59        3.2819383 188307.1 1.742865e-05
146   Sydney   1  60_69        2.4493392 129867.6 1.886027e-05
147   Sydney   1 70plus        2.3392070 102487.3 2.282437e-05
148   Sydney   2  10_19        0.4339207 257540.7 1.684863e-06
149   Sydney   2  20_29        1.5550661 292093.0 5.323873e-06
150   Sydney   2  30_39        1.7048458 273605.7 6.231033e-06
151   Sydney   2  40_49        1.6894273 232950.9 7.252289e-06
152   Sydney   2  50_59        1.5704846 186502.3 8.420726e-06
153   Sydney   2  60_69        1.0242291 142361.8 7.194550e-06
154   Sydney   2 70plus        1.1762115 160801.5 7.314681e-06
```

```
       sd_group sex  agegp avgMonthlyDeaths    avgPop      avgRate
1  Central West   1  10_19       0.10572687 14565.220 7.258858e-06
2  Central West   1  20_29       0.25991189 11640.225 2.232877e-05
3  Central West   1  30_39       0.23127753 11523.846 2.006947e-05
4  Central West   1  40_49       0.20484581 10639.692 1.925298e-05
5  Central West   1  50_59       0.18061674  8938.379 2.020688e-05
6  Central West   1  60_69       0.11894273  6731.930 1.766845e-05
7  Central West   1 70plus       0.12555066  5339.344 2.351425e-05
8  Central West   2  10_19       0.01982379 13704.617 1.446504e-06
```

```
9  Central West   2  20_29       0.05726872 11026.568 5.193703e-06
10 Central West   2  30_39       0.06828194 11114.850 6.143307e-06
11 Central West   2  40_49       0.04625551 10023.815 4.614561e-06
12 Central West   2  50_59       0.04845815  8534.661 5.677806e-06
13 Central West   2  60_69       0.03303965  6897.189 4.790306e-06
14 Central West   2 70plus       0.01982379  7521.837 2.635498e-06
```

```
      sd_group sex agegp rural agegp2 dthyy dthmm deaths   pop logDroughtCount
1 Central West   1 10_19     1  10_29  1970     1      0 15432      0.02181905
2 Central West   1 10_19     1  10_29  1977     2      0 15432      0.00000000
3 Central West   1 10_19     1  10_29  2005     7      0 13694      0.97622307
4 Central West   1 10_19     1  10_29  1974     2      0 15508      0.00000000
5 Central West   1 10_19     1  10_29  1984     1      0 14776      0.00000000
6 Central West   1 10_19     1  10_29  1984    10      0 14776      0.01459880
  avgMonthlyDeaths   avgPop      avgRate
1        0.1057269 14565.22 7.258858e-06
2        0.1057269 14565.22 7.258858e-06
3        0.1057269 14565.22 7.258858e-06
4        0.1057269 14565.22 7.258858e-06
5        0.1057269 14565.22 7.258858e-06
6        0.1057269 14565.22 7.258858e-06
```

```
         Central West                Hunter             Illawarra
                  908                     0                     0
      Mid-North Coast                Murray          Murrumbidgee
                  908                   908                   908
North and Far Western              Northern        Richmond-Tweed
                  908                   908                   908
        South Eastern                Sydney
                  908                     0
```

```
      sd_group sex agegp rural agegp2 dthyy dthmm deaths   pop logDroughtCount
1 Central West   1 10_19     1  10_29  1970     1      0 15432      0.02181905
2 Central West   1 10_19     1  10_29  1977     2      0 15432      0.00000000
3 Central West   1 10_19     1  10_29  2005     7      0 13694      0.97622307
```

```
4 Central West   1 10_19     1  10_29  1974     2       0 15508       0.00000000
5 Central West   1 10_19     1  10_29  1984     1       0 14776       0.00000000
6 Central West   1 10_19     1  10_29  1984    10       0 14776       0.01459880
  avgMonthlyDeaths   avgPop      avgRate deathsAttributable
1        0.1057269 14565.22 7.258858e-06       0.0002302894
2        0.1057269 14565.22 7.258858e-06       0.0000000000
3        0.1057269 14565.22 7.258858e-06       0.0095665393
4        0.1057269 14565.22 7.258858e-06       0.0000000000
5        0.1057269 14565.22 7.258858e-06       0.0000000000
6        0.1057269 14565.22 7.258858e-06       0.0001474831
  deathsAttributableLower deathsAttributableUpper
1            6.485518e-05            0.0003959677
2            0.000000e+00            0.0000000000
3            2.607809e-03            0.0169999643
4            0.000000e+00            0.0000000000
5            0.000000e+00            0.0000000000
6            4.154503e-05            0.0002535258

   dthyy deathsAttributable deaths     pop logDroughtCount
1   1970         1.63722697     20 2078736               1
2   1971         1.06014388     15 2105040               0
3   1972         2.07627616     22 2131224               1
4   1973         1.15590250     11 2157480               0
5   1974         0.38449382     23 2183712               0
6   1975         1.63806960     18 2209968               1
7   1976         0.86054449     18 2236272               0
8   1977         1.51017367     20 2265312               0
9   1978         1.67348785     29 2294424               1
10  1979         1.87494430     25 2323560               1
11  1980         5.15318618     27 2352672               1
12  1981         2.56183741     36 2381856               1
13  1982         3.69884074     31 2378976               1
14  1983         2.39790832     29 2376168               1
15  1984         0.08597138     32 2373324               0
```

```
16  1985        2.30888670    40 2370516          1
17  1986        2.74146267    48 2367756          1
18  1987        1.02054459    49 2366136          0
19  1988        0.56320097    47 2364648          0
20  1989        0.45029052    53 2363160          0
21  1990        0.99635270    47 2361672          0
22  1991        4.03599733    36 2360232          1
23  1992        2.38881487    44 2344416          1
24  1993        2.62388149    38 2328672          1
25  1994        3.53839404    49 2312952          1
26  1995        1.87885198    34 2297208          1
27  1996        0.27609580    57 2281512          0
28  1997        2.23570167    69 2281044          1
29  1998        2.17970956    51 2280648          1
30  1999        0.71169131    44 2280240          0
31  2000        1.56398250    25 2279844          0
32  2001        1.56706840    34 2279532          1
33  2002        5.05160372    42 2280432          1
34  2003        4.82395392    22 2281428          1
35  2004        3.00120794    20 2282424          1
36  2005        1.53841601    22 2283420          0
37  2006        2.80890725    22 2284488          1
38  2007        3.57316259    15 1904490          1

[1] 79.64719

[1] 2.095979

[1] 0.5618928

[1] 3.791449
```

The predicted number of rural female suicides aged 30-49 per annum associated with droughts are estimated for comparison with the figure for males. The decreased number of rural female suicides aged 30-49 per annum associated with droughts over our study period was -0.72 (95%CI -1.32 to -0.01, p = 0.041787).

```
[1] "sd_group','sex','agegp','dthyy','dthmm','deaths','sui_und','pop','logDroughtCount"
```

```
      sd_group rural sex  agegp agegp2 dthyy dthmm deaths   pop logDroughtCount
1 Central West     1   1  10_19  10_29  1970     1      0 15432      0.02181905
2 Central West     1   1  40_49  30_49  1970     1      1  9128      0.02181905
3 Central West     1   1  60_69 50plus  1970     1      0  5237      0.02181905
4 Central West     1   2  40_49  30_49  1970     1      0  8488      0.02181905
5 Central West     1   2  50_59 50plus  1970     1      0  7436      0.02181905
6 Central West     1   1 70plus 50plus  1970     1      0  3353      0.02181905
```

```
 [1] "time"                 "sd_group"             "sex"
 [4] "agegp"                "dthyy"                "dthmm"
 [7] "deaths"               "sui_und"              "pop"
[10] "avrain"               "avcount"              "tmax_anomaly"
[13] "tmax"                 "avsums"               "avcount2"
[16] "avsums2"              "logDroughtCount"      "mm"
[19] "timevar"              "rural"                "agegp2"
[22] "DrtMales10_29urban"   "DrtMales30_49urban"   "DrtMales50plusurban"
[25] "DrtMales10_29rural"   "DrtMales30_49rural"   "DrtMales50plusrural"
[28] "DrtFemales10_29urban" "DrtFemales30_49urban" "DrtFemales50plusurban"
[31] "DrtFemales10_29rural" "DrtFemales30_49rural" "DrtFemales50plusrural"
```

```
      sd_group sex agegp avgMonthlyDeaths    avgPop      avgRate
1 Central West   1 10_19        0.1057269 14565.220 7.258858e-06
2 Central West   1 20_29        0.2599119 11640.225 2.232877e-05
3 Central West   1 30_39        0.2312775 11523.846 2.006947e-05
4 Central West   1 40_49        0.2048458 10639.692 1.925298e-05
5 Central West   1 50_59        0.1806167  8938.379 2.020688e-05
6 Central West   1 60_69        0.1189427  6731.930 1.766845e-05
```

```
       sd_group sex  agegp avgMonthlyDeaths    avgPop      avgRate
1  Central West   1  10_19       0.10572687 14565.220 7.258858e-06
2  Central West   1  20_29       0.25991189 11640.225 2.232877e-05
3  Central West   1  30_39       0.23127753 11523.846 2.006947e-05
4  Central West   1  40_49       0.20484581 10639.692 1.925298e-05
5  Central West   1  50_59       0.18061674  8938.379 2.020688e-05
```

6	Central West	1	60_69	0.11894273	6731.930	1.766845e-05
7	Central West	1	70plus	0.12555066	5339.344	2.351425e-05
8	Central West	2	10_19	0.01982379	13704.617	1.446504e-06
9	Central West	2	20_29	0.05726872	11026.568	5.193703e-06
10	Central West	2	30_39	0.06828194	11114.850	6.143307e-06
11	Central West	2	40_49	0.04625551	10023.815	4.614561e-06
12	Central West	2	50_59	0.04845815	8534.661	5.677806e-06
13	Central West	2	60_69	0.03303965	6897.189	4.790306e-06
14	Central West	2	70plus	0.01982379	7521.837	2.635498e-06
15	Hunter	1	10_19	0.23568282	40563.498	5.810219e-06
16	Hunter	1	20_29	0.75550661	37565.392	2.011177e-05
17	Hunter	1	30_39	0.77312775	35575.727	2.173189e-05
18	Hunter	1	40_49	0.69603524	32485.344	2.142613e-05
19	Hunter	1	50_59	0.43171806	27655.278	1.561069e-05
20	Hunter	1	60_69	0.34361233	21938.938	1.566221e-05
21	Hunter	1	70plus	0.41850220	17866.123	2.342434e-05
22	Hunter	2	10_19	0.03083700	38518.357	8.005794e-07
23	Hunter	2	20_29	0.14317181	35609.533	4.020603e-06
24	Hunter	2	30_39	0.15638767	34917.326	4.478798e-06
25	Hunter	2	40_49	0.18942731	31770.912	5.962288e-06
26	Hunter	2	50_59	0.14096916	27452.987	5.134930e-06
27	Hunter	2	60_69	0.11233480	23226.225	4.836550e-06
28	Hunter	2	70plus	0.10352423	25257.018	4.098830e-06
29	Illawarra	1	10_19	0.14977974	27128.877	5.521045e-06
30	Illawarra	1	20_29	0.55066079	24321.881	2.264055e-05
31	Illawarra	1	30_39	0.49779736	23603.176	2.109027e-05
32	Illawarra	1	40_49	0.44273128	21569.819	2.052550e-05
33	Illawarra	1	50_59	0.28414097	17923.987	1.585255e-05
34	Illawarra	1	60_69	0.23348018	14400.520	1.621332e-05
35	Illawarra	1	70plus	0.24008811	11162.366	2.150871e-05
36	Illawarra	2	10_19	0.02202643	25456.159	8.652693e-07
37	Illawarra	2	20_29	0.07488987	22969.824	3.260359e-06
38	Illawarra	2	30_39	0.11233480	23346.053	4.811726e-06

```
39    Illawarra   2  40_49       0.14757709 20922.137 7.053634e-06
40    Illawarra   2  50_59       0.14977974 17703.181 8.460612e-06
```

```
                sd_group sum(avgMonthlyDeaths) sum(avgPop)
1           Central West             1.5198238   138202.17
2                 Hunter             4.5308370   430402.66
3              Illawarra             3.0462555   280036.88
4        Mid-North Coast             1.9074890   183520.63
5                 Murray             0.9735683    86220.51
6           Murrumbidgee             1.3303965   118778.27
7  North and Far Western             1.5462555   114460.50
8               Northern             1.7268722   146464.55
9         Richmond-Tweed             1.6629956   139356.23
10         South Eastern             1.5748899   135091.01
11                Sydney            34.0044053  3040952.32
```

```
    sd_group sex  agegp avgMonthlyDeaths   avgPop      avgRate
141   Sydney   1  10_19        1.1916300 269031.3 4.429336e-06
142   Sydney   1  20_29        5.9317181 292341.6 2.029037e-05
143   Sydney   1  30_39        5.1828194 276223.6 1.876313e-05
144   Sydney   1  40_49        4.4735683 236838.1 1.888872e-05
145   Sydney   1  50_59        3.2819383 188307.1 1.742865e-05
146   Sydney   1  60_69        2.4493392 129867.6 1.886027e-05
147   Sydney   1 70plus        2.3392070 102487.3 2.282437e-05
148   Sydney   2  10_19        0.4339207 257540.7 1.684863e-06
149   Sydney   2  20_29        1.5550661 292093.0 5.323873e-06
150   Sydney   2  30_39        1.7048458 273605.7 6.231033e-06
151   Sydney   2  40_49        1.6894273 232950.9 7.252289e-06
152   Sydney   2  50_59        1.5704846 186502.3 8.420726e-06
153   Sydney   2  60_69        1.0242291 142361.8 7.194550e-06
154   Sydney   2 70plus        1.1762115 160801.5 7.314681e-06
```

```
       sd_group sex  agegp avgMonthlyDeaths    avgPop      avgRate
1  Central West   1  10_19       0.10572687 14565.220 7.258858e-06
2  Central West   1  20_29       0.25991189 11640.225 2.232877e-05
```

```
3  Central West   1  30_39       0.23127753 11523.846 2.006947e-05
4  Central West   1  40_49       0.20484581 10639.692 1.925298e-05
5  Central West   1  50_59       0.18061674  8938.379 2.020688e-05
6  Central West   1  60_69       0.11894273  6731.930 1.766845e-05
7  Central West   1 70plus       0.12555066  5339.344 2.351425e-05
8  Central West   2  10_19       0.01982379 13704.617 1.446504e-06
9  Central West   2  20_29       0.05726872 11026.568 5.193703e-06
10 Central West   2  30_39       0.06828194 11114.850 6.143307e-06
11 Central West   2  40_49       0.04625551 10023.815 4.614561e-06
12 Central West   2  50_59       0.04845815  8534.661 5.677806e-06
13 Central West   2  60_69       0.03303965  6897.189 4.790306e-06
14 Central West   2 70plus       0.01982379  7521.837 2.635498e-06
```

```
      sd_group sex agegp rural agegp2 dthyy dthmm deaths   pop logDroughtCount
1 Central West   1 10_19     1  10_29  1970     1      0 15432      0.02181905
2 Central West   1 10_19     1  10_29  1977     2      0 15432      0.00000000
3 Central West   1 10_19     1  10_29  2005     7      0 13694      0.97622307
4 Central West   1 10_19     1  10_29  1974     2      0 15508      0.00000000
5 Central West   1 10_19     1  10_29  1984     1      0 14776      0.00000000
6 Central West   1 10_19     1  10_29  1984    10      0 14776      0.01459880
  avgMonthlyDeaths   avgPop      avgRate
1        0.1057269 14565.22 7.258858e-06
2        0.1057269 14565.22 7.258858e-06
3        0.1057269 14565.22 7.258858e-06
4        0.1057269 14565.22 7.258858e-06
5        0.1057269 14565.22 7.258858e-06
6        0.1057269 14565.22 7.258858e-06
```

```
[1] 1.122753
```

```
[1] 0.8771938
```

```
[1] 0.7707765
```

```
[1] 0.9983036
```

```
         Central West                Hunter             Illawarra
                  908                     0                     0
```

```
      Mid-North Coast                 Murray          Murrumbidgee
                  908                    908                   908
North and Far Western               Northern        Richmond-Tweed
                  908                    908                   908
        South Eastern                 Sydney
                  908                      0
```

```
         sd_group sex agegp rural agegp2 dthyy dthmm deaths   pop
4087 Central West   2 30_39     1  30_49  1997     2      0 12345
4088 Central West   2 30_39     1  30_49  1984    12      0 11263
4089 Central West   2 30_39     1  30_49  1990     9      0 12124
4090 Central West   2 30_39     1  30_49  1999     8      0 12153
4091 Central West   2 30_39     1  30_49  1970    12      0  8576
4092 Central West   2 30_39     1  30_49  1987     4      0 11670
     logDroughtCount avgMonthlyDeaths   avgPop      avgRate deathsAttributable
4087      0.00732604       0.06828194 11114.85 6.143307e-06      -6.481191e-05
4088      0.00000000       0.06828194 11114.85 6.143307e-06       0.000000e+00
4089      0.00000000       0.06828194 11114.85 6.143307e-06       0.000000e+00
4090      0.36545977       0.06828194 11114.85 6.143307e-06      -3.117272e-03
4091      0.00000000       0.06828194 11114.85 6.143307e-06       0.000000e+00
4092      0.05715841       0.06828194 11114.85 6.143307e-06      -4.766322e-04
     deathsAttributableLower deathsAttributableUpper
4087           -0.0001287297           -8.401947e-07
4088            0.0000000000            0.000000e+00
4089            0.0000000000            0.000000e+00
4090           -0.0060664906           -4.125010e-05
4091            0.0000000000            0.000000e+00
4092           -0.0009439806           -6.196610e-06
```

```
   dthyy deathsAttributable deaths     pop logDroughtCount
1   1970        -0.44761392      6 1352916               1
2   1971        -0.28372594     10 1365960               0
3   1972        -0.47315370      5 1378836               1
4   1973        -0.27526310      8 1391808               0
5   1974        -0.09513828      7 1404768               0
```

6	1975	-0.42138006	8	1417740	1
7	1976	-0.19420653	6	1430784	0
8	1977	-0.37763565	9	1474680	0
9	1978	-0.42266244	5	1518648	1
10	1979	-0.47742077	6	1562616	1
11	1980	-1.23212695	6	1606584	1
12	1981	-0.62747899	9	1650648	1
13	1982	-0.89295101	5	1696272	1
14	1983	-0.56061194	5	1741980	1
15	1984	-0.02468488	6	1787652	0
16	1985	-0.60050787	11	1833360	1
17	1986	-0.87703153	8	1879128	1
18	1987	-0.33800723	5	1948968	0
19	1988	-0.16425048	13	2018880	0
20	1989	-0.15368815	7	2088816	0
21	1990	-0.33476771	13	2158728	0
22	1991	-1.51028103	11	2228712	1
23	1992	-0.86526537	10	2263320	1
24	1993	-1.14948309	18	2297976	1
25	1994	-1.36343794	10	2332680	1
26	1995	-0.80755410	12	2367336	1
27	1996	-0.11445042	16	2402112	0
28	1997	-0.88881596	19	2411388	1
29	1998	-0.93455336	16	2420736	1
30	1999	-0.28791068	26	2430072	0
31	2000	-0.81366598	9	2439420	0
32	2001	-0.70779796	17	2448852	1
33	2002	-2.17149123	13	2443776	1
34	2003	-1.96685752	8	2438832	1
35	2004	-1.28527338	17	2433864	1
36	2005	-0.68875988	15	2428920	0
37	2006	-1.06121092	6	2424012	1
38	2007	-1.40764692	7	2015780	1

```
[1] -27.29876

[1] 38

[1] -0.7183885

[1] -1.318613

[1] -0.01011795
```

3.6 Test the Sex Stratification

To find out if the inclusion of a seperate term for Rural Males and Rural Females aged 30-49 is warranted we performed a likelihood ratio test with an alternative model where the drought effect was not stratified by sex. The model was significantly better when including the Rural 30-49 sex stratification (likelihood ratio test p = 0.000077).

```
Time difference of 1.23547 mins

Likelihood ratio test


Model 1: deaths ~ sin(timevar * 2 * pi) + cos(timevar * 2 * pi) + tmax_anomaly +
    DrtMales10_29rural + DrtMales30_49rural + DrtMales50plusrural +
    DrtFemales10_29rural + DrtFemales30_49rural + ns(DrtFemales50plusrural,
    df = 5) + ns(DrtMales10_29urban, df = 6) + DrtMales30_49urban +
    ns(DrtMales50plusurban, df = 4) + DrtFemales10_29urban +
    ns(DrtFemales30_49urban, df = 3) + DrtFemales50plusurban +
    agegp2 + rural + sd_group + sex + agegp + agegp * sex * ns(time,
    3) + offset(log(pop))
Model 2: deaths ~ Drt30_49rural + sin(timevar * 2 * pi) + cos(timevar *
    2 * pi) + DrtMales10_29rural + DrtMales50plusrural + DrtFemales10_29rural +
    ns(DrtFemales50plusrural, df = 5) + ns(DrtMales10_29urban,
    df = 6) + DrtMales30_49urban + ns(DrtMales50plusurban, df = 4) +
    DrtFemales10_29urban + ns(DrtFemales30_49urban, df = 3) +
    DrtFemales50plusurban + tmax_anomaly + agegp2 + rural + sd_group +
    sex + agegp + agegp * sex * ns(time, 3) + offset(log(pop))
  #Df LogLik Df Chisq Pr(>Chisq)
1  81 -34483
```

```
2  80 -34490 -1 15.64   7.66e-05 ***
---
Signif. codes:  0 âĂŸ***âĂŹ 0.001 âĂŸ**âĂŹ 0.01 âĂŸ*âĂŹ 0.05 âĂŸ.âĂŹ 0.1 âĂŸ âĂŹ 1

     [,1]
[1,] factor,26
[2,] factor,26
[3,] factor,26
[4,] factor,26
[5,] factor,26

     [,1]
[1,] factor,26
[2,] factor,26
[3,] factor,26
[4,] factor,26
[5,] factor,26
```

4 Sensitivity Analyses

4.1 Enhanced Drought Index

We conducted sensitivity analyses for the drought exposure variable. The drought index was enhanced with the threshold needed to end a drought made more stringent. For example in Figure 1 the drought in 1980 would not have ended in the middle of that year given the new threshold but would have continued into 1981 (the fourth panel).

The drought effects estimated were similar to those from our previous modeling.

The key effect estimates are shown for the enhanced drought index in Figure 6.

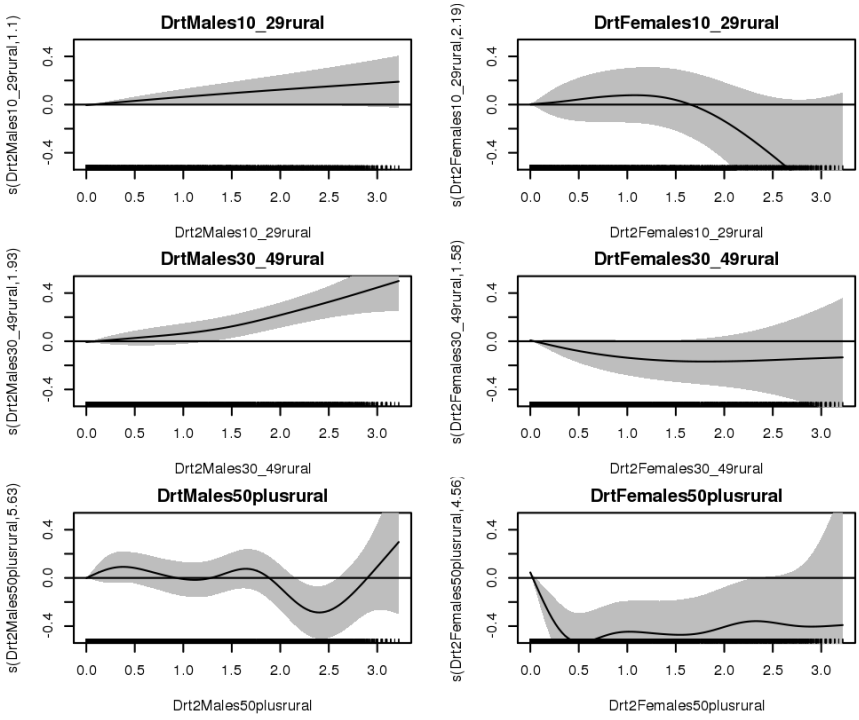

Figure 6: interactionDrtAgeSexRuralModel2enhanced.png

```
Time difference of 14.46496 mins

pseudo.Rsquared
       0.674864

pdf
  2
```

4.2 Self-harm Coded as Undetermined

A sensitivity analysis was conducted that combined the suicide deaths with deaths coded as 'Self inflicted injury, undetermined if intentional'. This analysis agreed with our previous modelling.

The key effect estimates for the drought index effect on Suicides Plus Undetermined are shown in Figure 7.

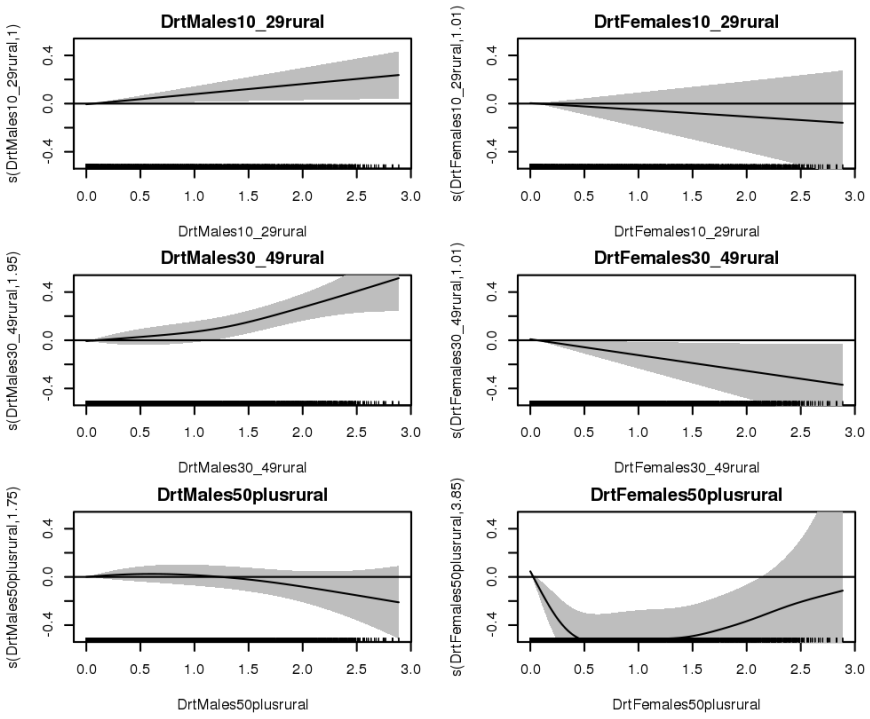

Figure 7: interactionDrtAgeSexRuralModel2SuicidePlusUndetermined.png

```
pdf
  2
```

```
Time difference of 10.45511 mins
```

```
pseudo.Rsquared
      0.6887485
```

```
pdf
  2
```

4.3 Drop High Leverage Points

A sensitivity analysis was finally conducted that dropped any observations identified as having high leverage. Dropping these observations from the final model produced effect estimates that also agreed with our prior modeling results

```
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
0.0001246 0.0003591 0.0005495 0.0011590 0.0008562 0.0273500
```

```
    Min.  1st Qu.   Median     Mean  3rd Qu.     Max.
-2.55300 -0.39680 -0.25990 -0.00661 -0.17250 17.11000
```

```
pdf
  2
```

```
pdf
  2
```

```
     Min.   1st Qu.    Median      Mean   3rd Qu.      Max.
0.0001245 0.0003596 0.0005505 0.0011590 0.0008575 0.0259000
```

```
[1] 1.150108
```

```
[1] 1.080953
```

```
[1] 1.223687
```

```
Single term deletions
```

```
Model:
```

```
deaths ~ sin(timevar * 2 * pi) + cos(timevar * 2 * pi) + tmax_anomaly +
    DrtMales10_29rural + DrtMales30_49rural + DrtMales50plusrural +
    DrtFemales10_29rural + DrtFemales30_49rural + ns(DrtFemales50plusrural,
    df = 5) + ns(DrtMales10_29urban, df = 6) + DrtMales30_49urban +
    ns(DrtMales50plusurban, df = 4) + DrtFemales10_29urban +
    ns(DrtFemales30_49urban, df = 3) + DrtFemales50plusurban +
    agegp2 + rural + sd_group + sex + agegp + agegp * sex * ns(time,
    3) + offset(log(pop))
```

	Df	Deviance	AIC	LRT	Pr(>Chi)	
<none>		38549	69085			
sin(timevar * 2 * pi)	1	38556	69090	7.123	0.0076095	**
cos(timevar * 2 * pi)	1	38565	69100	16.445	5.008e-05	***
tmax_anomaly	1	38559	69094	10.476	0.0012093	**
DrtMales10_29rural	1	38556	69091	7.224	0.0071951	**
DrtMales30_49rural	1	38567	69102	18.742	1.496e-05	***
DrtMales50plusrural	1	38549	69084	0.401	0.5267085	
DrtFemales10_29rural	1	38549	69084	0.391	0.5320226	
DrtFemales30_49rural	1	38553	69088	4.215	0.0400698	*
ns(DrtFemales50plusrural, df = 5)	1	38577	69112	28.353	1.011e-07	***
ns(DrtMales10_29urban, df = 6)	1	38550	69085	1.394	0.2377683	
DrtMales30_49urban	1	38551	69086	2.785	0.0951707	.
ns(DrtMales50plusurban, df = 4)	1	38552	69087	3.500	0.0613767	.
DrtFemales10_29urban	1	38549	69083	0.178	0.6727412	
ns(DrtFemales30_49urban, df = 3)	1	38549	69083	0.151	0.6974145	
DrtFemales50plusurban	1	38549	69083	0.099	0.7533711	
agegp2	0	38549	69085	0.000		
rural	0	38549	69085	0.000		
sd_group	9	38580	69099	31.862	0.0002103	***
sex:agegp:ns(time, 3)	18	38594	69095	45.948	0.0003019	***

```
---
Signif. codes:  0 âĂŸ***âĂŹ 0.001 âĂŸ**âĂŹ 0.01 âĂŸ*âĂŹ 0.05 âĂŸ.âĂŹ 0.1 âĂŸ âĂŹ 1
```

A diagnostic plot of the leverage and residuals is shown in Figure 8. Dropping observations with high leverage produced effect estimates that also agreed with our prior modeling results

(Figure 9).

4.4 plot check

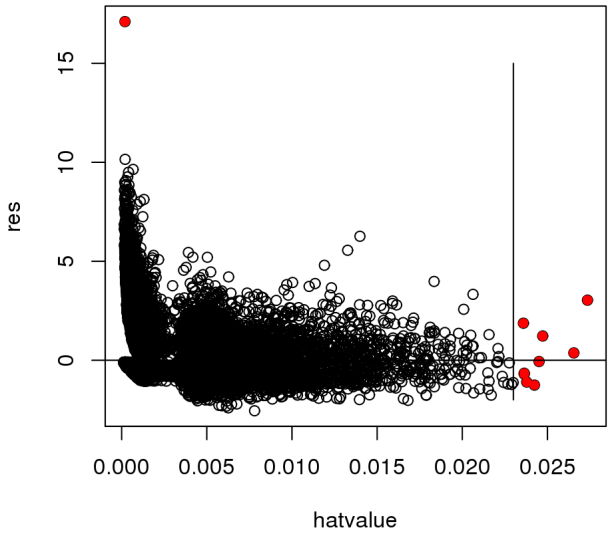

Figure 8: interactionDrtAgeSexRuralModel3checkLeverage.png

4.5 plot do

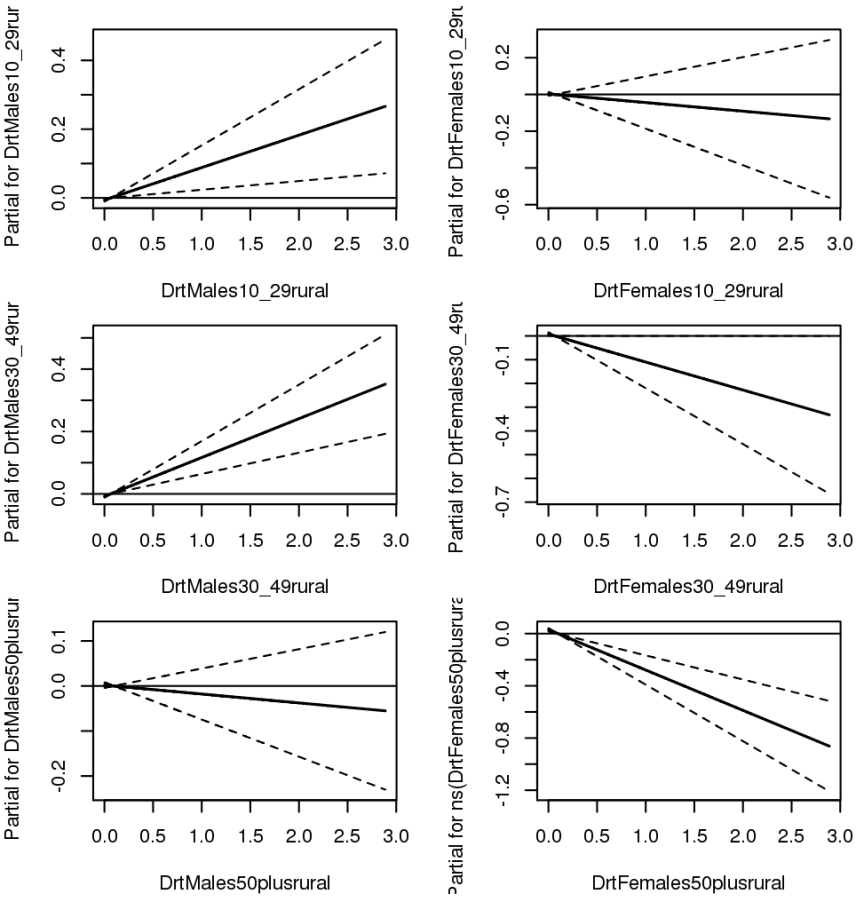

Figure 9: interactionDrtAgeSexRuralModel3noLeverage.png

References

[1] Smith, D. I, Hutchinson, M. F, & McArthur, R. J. (1992) *Climatic and Agricultural Drought: Payments and Policy.* (Centre for Resource and Environmental Studies, Australian National University, Canberra, Australia).

[2] Palmer, W. (1965) *Meteorological drought. Research paper No. 45.* (U.S. Department of Commerce Weather Bureau, Washington, D.C.).

[3] Wood, S. (2008) Fast stable direct fitting and smoothness selection for generalized additive models. *Journal of the Royal Statistical Society: Series B (Statistical Methodology)* **70**, 495–518.

5 Code for Figures 1 and 2

The R codes to fit the model and display the exposure-response relationships for the drought index on rural suicides (Figures 1 and 2 of the paper) are shown below using Sweave.

```
> ######################
> #do,  show model fig1 and 2
> ######################
>
>
> # first fit the model
>         interactionDrtAgeSexRuralModel2 <- gam(deaths ~  s(mm, k=3, fx=T, bs = 'cp')
+         + s(DrtMales10_29rural)
+         + s(DrtMales30_49rural)
+         + s(DrtMales50plusrural)
+         + s(DrtFemales10_29rural)
+         + s(DrtFemales30_49rural)
+         + s(DrtFemales50plusrural)
+         + s(DrtMales10_29urban)
+         + s(DrtMales30_49urban)
+         + s(DrtMales50plusurban)
+         + s(DrtFemales10_29urban)
+         + s(DrtFemales30_49urban)
+         + s(DrtFemales50plusurban)
+         + s(tmax_anomaly)
+         + agegp2
+         + rural
+         + sd_group
+         + sex
+         + agegp
+         + agegp*sex*ns(time,df = 3)
+         + offset(log(pop)), data=data,family=poisson)
>
```

The code to create this graph is shown next:

```
> ########################
> #do,  show plot fig 1 and 2
> ########################
>
>
>
>         # now make a plot of each group effects
>
>         png('RuralMales20.png',res=200,width = 600, height = 1000)
>         layout(matrix(c(1:4),ncol=1),heights=c(1,1,1,0.2))
>         par(mfrow=c(4,1), mar=c(0.1,4,1.5,0.5), cex=.7)
>         plot(interactionDrtAgeSexRuralModel2,select=2,se=T, ylim = c(-0.8,0.8), shade=TRUE,shad
>         abline(0,0)
>         title('Rural Males aged 10-29', cex=.5, font.main = 1)
>         plot(interactionDrtAgeSexRuralModel2,select=3,se=T, ylim = c(-0.8,0.8), shade=TRUE,shad
>         abline(0,0)
>         title('Rural Males aged 30-49', cex=.5, font.main = 1)
>         plot(interactionDrtAgeSexRuralModel2,select=4,rug=F,se=T, ylim = c(-0.8,0.8), shade=TRU
>         abline(0,0)
>         title('Rural Males aged 50 plus', cex=.5, font.main = 1)
>         par(mar=c(1,4,6,0.5))
>         plot(1,1,type = 'n', xaxt = 'n', yaxt='n',ylab='',xlab='', axes = F)
>         title(main = 'Drought Index: log(1 + count months)',  font.main = 1,cex.main=.9)
>         dev.off()
>         png('RuralFemales20.png',res=200,width = 600, height = 1000)
>         layout(matrix(c(1:4),ncol=1),heights=c(1,1,1,0.2))
>         par(mfrow=c(4,1), mar=c(0.1,4,1.5,0.5), cex=.7)
>         plot(interactionDrtAgeSexRuralModel2,select=5,se=T, ylim = c(-0.8,0.8), shade=TRUE,shad
>         abline(0,0)
>         title('Rural Females aged 10-29', cex=.5, font.main = 1)
>         plot(interactionDrtAgeSexRuralModel2,select=6,se=T, ylim = c(-0.8,0.8), shade=TRUE,shad
>         abline(0,0)
>         title('Rural Females aged 30-49', cex=.5, font.main = 1)
>         plot(interactionDrtAgeSexRuralModel2,select=7,rug=F,se=T, ylim = c(-0.8,0.8), shade=TRU
>         abline(0,0)
>         title('Rural Females aged 50 plus', cex=.5, font.main = 1)
>         par(mar=c(1,4,6,0.5))
>         plot(1,1,type = 'n', xaxt = 'n', yaxt='n',ylab='',xlab='', axes = F)
>         title(main = 'Drought Index: log(1 + count months)',  font.main = 1,cex.main=.9)
>         dev.off()
>
>
```

5.1 The software packages and operating system

```
> sessionInfo()

R version 3.2.2 (2015-08-14)
Platform: x86_64-redhat-linux-gnu (64-bit)
Running under: Red Hat Enterprise Linux Server release 6.7 (Santiago)

locale:
 [1] LC_CTYPE=en_US.UTF-8       LC_NUMERIC=C
 [3] LC_TIME=en_US.UTF-8        LC_COLLATE=en_US.UTF-8
```

```
 [5] LC_MONETARY=en_US.UTF-8    LC_MESSAGES=en_US.UTF-8
 [7] LC_PAPER=en_US.UTF-8       LC_NAME=C
 [9] LC_ADDRESS=C               LC_TELEPHONE=C
[11] LC_MEASUREMENT=en_US.UTF-8 LC_IDENTIFICATION=C

attached base packages:
[1] tcltk     splines   stats     graphics  grDevices utils     datasets
[8] methods   base

other attached packages:
 [1] lmtest_0.9-31         zoo_1.7-10            xtable_1.7-1
 [4] sqldf_0.4-6.4         RSQLite.extfuns_0.0.1 RSQLite_0.11.4
 [7] chron_2.3-43          gsubfn_0.6-5          proto_0.3-10
[10] mgcv_1.8-7            nlme_3.1-121          RPostgreSQL_0.4
[13] DBI_0.2-7             plyr_1.8              geosphere_1.2-28
[16] rgdal_0.9-2           sp_1.1-0

loaded via a namespace (and not attached):
[1] lattice_0.20-33 grid_3.2.2      Matrix_1.2-2    tools_3.2.2
```

5.2 Warnings

```
> warnings()

NULL
```