1 Malaria control with bednets

See the 2018 Lancet article *Efficacy of Olyset Duo, a bednet containing pyriproxyfen and permethrin, versus a permethrin-only net against clinical malaria in an area with highly pyrethroid-resistant vectors in rural Burkina Faso: a cluster-randomised controlled trial* (`Bednets.pdf` in `A9` folder of my-Courses) by Tiono et. al. Reproduce the Rate ratio (95% CI) in Table 2. Calculate the rate difference and 95% CI comparing PPF-treated to Standard long-lasting insecticidal nets. Check the goodness of fit.

```
##
## Call:
## glm(formula = cases ~ exposure + offset(log(years)), family = poisson(link = log),
##     data = df)
##
## Deviance Residuals:
##     Min       1Q   Median       3Q      Max
## -16.682   -4.732    1.497    3.984   12.024
##
## Coefficients:
##             Estimate Std. Error z value Pr(>|z|)
## (Intercept)  0.68314    0.02432  28.092  < 2e-16 ***
## exposure    -0.26687    0.03286  -8.121 4.62e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## (Dispersion parameter for poisson family taken to be 1)
##
##     Null deviance: 1381.2  on 23  degrees of freedom
## Residual deviance: 1316.0  on 22  degrees of freedom
## AIC: 1476.7
##
## Number of Fisher Scoring iterations: 5
```

2 Population mortality rates in Denmark

We can fit the following simple (multiplicative) rate ratio model to the patterns of mortality rates for 1980-1984 and 2000-2004. The reference cell is females 70-74, 1980-84. R = rate. M = multiplier.

Year	Age	Female (F)			Male (M)			
1980-1984	70-74	R_F			R_F		$\times M_M$	
	75-79	R_F	$\times M_{75}$		R_F	$\times M_{75}$	$\times M_M$	
	80-84	R_F	$\times M_{80}$		R_F	$\times M_{80}$	$\times M_M$	
	85-89	R_F	$\times M_{85}$		R_F	$\times M_{85}$	$\times M_M$	
2000-2004	70-74	R_F		$\times M_{20y}$	R_F		$\times M_M$	$\times M_{20y}$
	75-79	R_F	$\times M_{75}$	$\times M_{20y}$	R_F	$\times M_{75}$	$\times M_M$	$\times M_{20y}$
	80-84	R_F	$\times M_{80}$	$\times M_{20y}$	R_F	$\times M_{80}$	$\times M_M$	$\times M_{20y}$
	85-89	R_F	$\times M_{85}$	$\times M_{20y}$	R_F	$\times M_{85}$	$\times M_M$	$\times M_{20y}$

Year	Age	Female_deaths	Female_PT	Female_rate	Male_deaths	Male_PT	Male_rate
1980-1984	70-74	15989	586882.8	0.0272439	23810	456908.21	0.0521111
1980-1984	75-79	20838	454142.7	0.0458843	24707	300318.92	0.0822692
1980-1984	80-84	24073	297678.6	0.0808691	20319	167303.51	0.1214499
1980-1984	85-89	20216	147771.7	0.1368057	13524	74295.83	0.1820291
2000-2004	70-74	13912	521561.9	0.0266737	17360	436994.92	0.0397259
2000-2004	75-79	19731	471945.5	0.0418078	22477	341362.82	0.0658449
2000-2004	80-84	25541	369989.9	0.0690316	22992	217929.72	0.1055019
2000-2004	85-89	27135	226798.1	0.1196439	17444	104009.58	0.1677153
2005-2009	70-74	12179	540568.6	0.0225300	15782	472012.84	0.0334355
2005-2009	75-79	17273	444474.2	0.0388616	19547	344351.34	0.0567647
2005-2009	80-84	23513	363534.1	0.0646789	21781	230530.24	0.0944822
2005-2009	85-89	26842	237877.3	0.1128397	17811	114485.04	0.1555749

Rate =	______	×______	×______	×______	×______	×______
		if	if	if	if	if
		75-79	80-84	85-89	male	2000-04
$\log[Rate]$ =	______	+______	+______	+______	+______	+______
		if	if	if	if	if
		75-79	80-84	85-89	male	2000-04
$\log[Rate]$ =	______	+______	+______	+______	+______	+______
		×	×	×	×	×
		I_{75-79}	I_{80-84}	I_{85-89}	I_{male}	$I_{2000-04}$

where each 'I' is a (0/1) indicator of the category in question. By using both the 0 and 1 values of each I, this 6-parameter equation produces a fitted value for each of the $4 \times 2 \times 2 = 16$ cells.