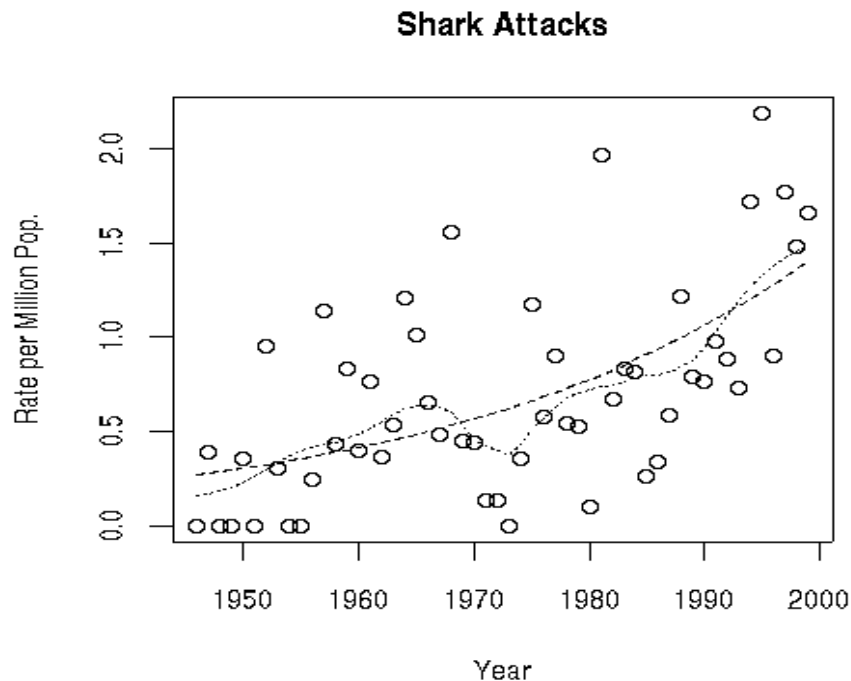


Modelling the trend in Shark Attacks



The Fitted Model

Call:

```
glm(formula = attacks ~ offset(log(population)) + year, family = poisson)
```

Deviance Residuals:

Min	1Q	Median	3Q	Max
-3.1470	-1.2001	-0.3177	0.7281	3.4856

Coefficients:

	Estimate	Std. Error	z value	Pr(> z)
(Intercept)	-75.792269	8.658221	-8.754	< 2e-16 ***
year	0.031174	0.004361	7.148	8.8e-13 ***

Signif. codes: 0 0.001 0.01 0.05 0.1 1

(Dispersion parameter for poisson family taken to be 1)

Null deviance: 176.93 on 53 degrees of freedom
 Residual deviance: 119.11 on 52 degrees of freedom
 AIC: 288.76

Number of Fisher Scoring iterations: 5

Confidence Intervals

Estimates with confidence intervals

	Estimate	Std. Error	Pr(> z)	2.5 %	97.5 %
(Intercept)	-75.79226904	8.658220532	2.062996e-18	-92.76206945	-58.82246862
year	0.03117395	0.004361182	8.801855e-13	0.02262619	0.03972171

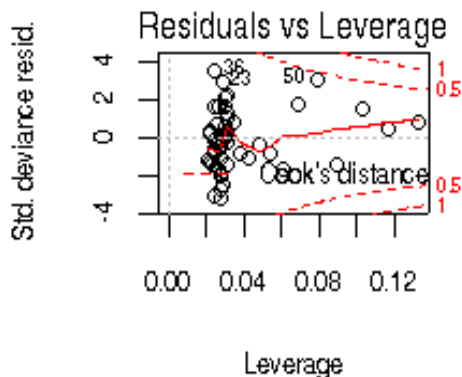
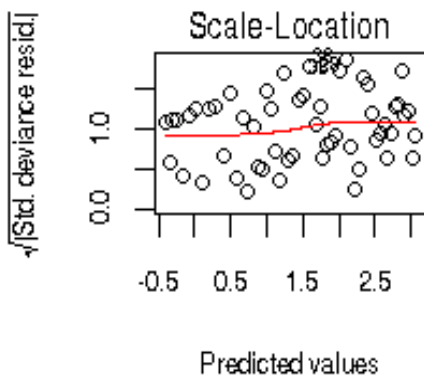
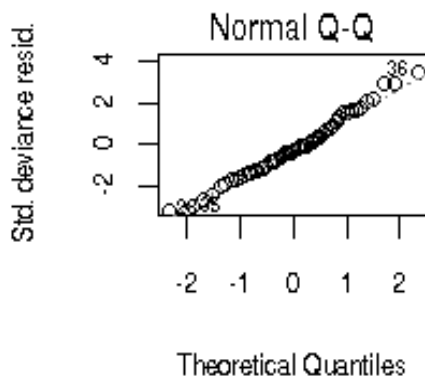
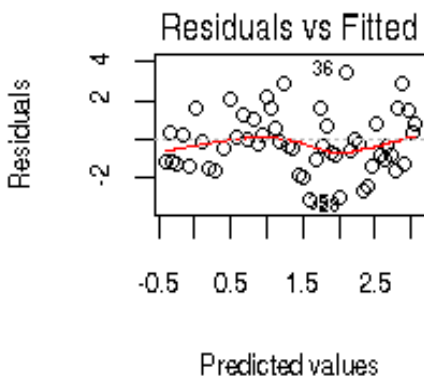
Back-transformed estimates with confidence intervals

	Estimate	Std. Error	Pr(> z)	2.5 %	97.5 %
(Intercept)	1.212930e-33	8.658220532	2.062996e-18	5.175414e-41	2.842670e-26
year	1.031665e+00	0.004361182	8.801855e-13	1.022884e+00	1.040521e+00

Back-transformed estimates with profile Confidence Intervals

	Estimate	Std. Error	Pr(> z)	2.5 %	97.5 %
(Intercept)	1.212930e-33	8.658220532	2.062996e-18	3.775357e-41	2.113763e-26
year	1.031665e+00	0.004361182	8.801855e-13	1.023034e+00	1.040684e+00

Examining Assumptions



Allowing for Non-(log)-linearity

```
glm(formula = attacks ~ offset(log(population)) + poly(year, 3),
     family = poisson)
```

Deviance Residuals:

Min	1Q	Median	3Q	Max
-3.2177	-1.0113	-0.4306	0.6417	4.0344

Coefficients:

	Estimate	Std. Error	z value	Pr(> z)	
(Intercept)	-14.29554	0.08459	-169.003	< 2e-16	***
poly(year, 3)1	3.41623	0.75973	4.497	6.9e-06	***
poly(year, 3)2	-0.34797	0.71522	-0.487	0.62660	
poly(year, 3)3	1.38863	0.50108	2.771	0.00558	**

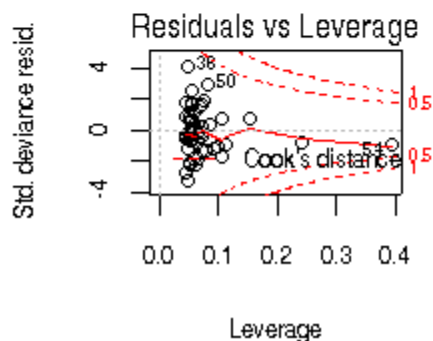
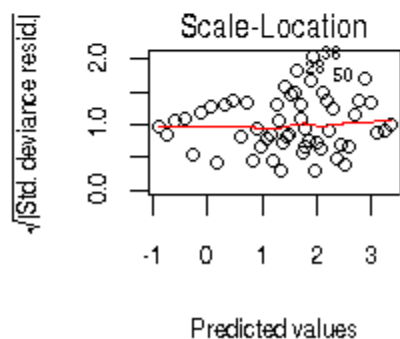
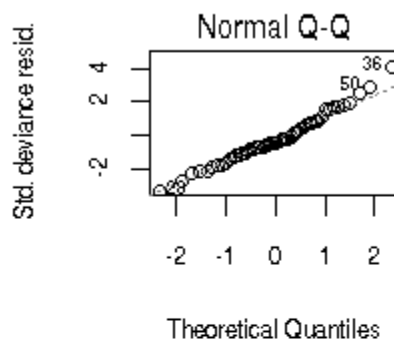
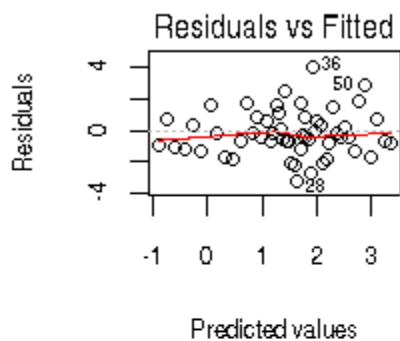
Signif. codes: 0 0.001 0.01 0.05 0.1 1

(Dispersion parameter for poisson family taken to be 1)

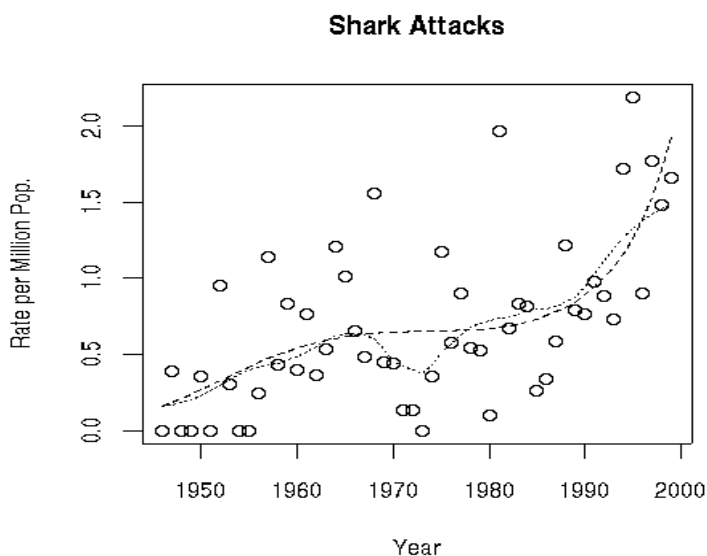
Null deviance: 176.93 on 53 degrees of freedom
 Residual deviance: 107.18 on 50 degrees of freedom
 AIC: 280.83

Number of Fisher Scoring iterations: 5

Re-examining Assumptions



The Improved Fit



A Segmented Regression Fit

```
upTo1985 <- (year <= 1985) * year
after1985 <- (year > 1985) * year
```

```
coefTable(glm( attacks ~ offset(log(population)) + (year > 1985) + upTo1985 +
after1985, family=poisson))
```

	Estimate	Std. Error	Pr(> z)	2.5 %	97.5 %
(Intercept)	-51.01906	15.903410	1.336e-03	-8.219e+01	-19.84895
year > 1985	-123.19614	38.380376	1.328e-03	-1.984e+02	-47.97198
upTo1985	0.01862	0.008063	2.096e-02	2.812e-03	0.03442
after1985	0.08054	0.017517	4.267e-06	4.621e-02	0.11488

This fit allows for different trends up to and after 1985. This is somewhat post hoc, but it does allow us to give a quantitative interpretation of the implications of non-linearity (log scale).

