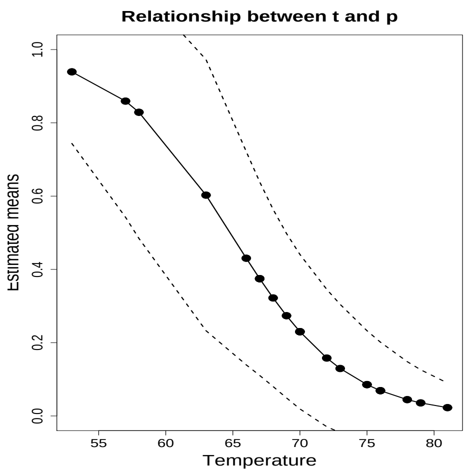
1. Use data set of pre-Challenger space shuttle flights.

(a)
```
> summary(shuttle.out)
Call:
glm(formula = indicate ~ temp, family = binomial)

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  15.0429     7.3719   2.041   0.0413 *
temp         -0.2322     0.1081  -2.147   0.0318 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 28.267  on 22  degrees of freedom
Residual deviance: 20.315  on 21  degrees of freedom
AIC: 24.315

Number of Fisher Scoring iterations: 4
```

There is evidence that the coefficient of the temperature covariate is non zero (p-value=0.03). The test $H_0 : \beta_1 < 0$ has a p-value of 0.015. I would say that this data set suggests that their claim was not correct.

(b)
```
shuttle.fits <- predict.glm(shuttle.out,type="response",se.fit=TRUE)
ind <- order(temp)
plot(temp[ind],shuttle.fits$fit[ind],type="b",ylim=c(0,1),
  xlab="Temperature",ylab="Estimated means",main="Relationship between t and p")
lines(temp[ind],shuttle.fits$fit[ind]-2*shuttle.fits$se.fit[ind],lty=2)
lines(temp[ind],shuttle.fits$fit[ind]+2*shuttle.fits$se.fit[ind],lty=2)
```




The temperature 31$^o$F is outside the range of temperature values used to fit the model. However, assuming that the relationship of temperature and O-ring incidents remains the same at lower temperature values, the model suggests that there is a very high probability of having an O-ring incident on a lauch at 31$^o$F.

```
> predict.glm(shuttle.out,data.frame(temp=31),se.fit=TRUE,type="response")
$fit
[1] 0.9996088
$se.fit
[1] 0.001578722
```

2. Use data set gathered in a project aimed at reducing jams on a large collating machine.

   (a) It appears that there are statistically detectable Air Pressure and Bar Tightness effects in these data since the coefficients for the levels of these two variables are significant. If one wants small number of jams, one wants level 2 of Air Pressure and level 2 of Bar Tightness.

```
> summary(collator.out)

Call:
glm(formula = y ~ AA + BB, family = poisson, offset = log(k))

Deviance Residuals:
      1        2        3        4        5        6
-0.5040   0.1693   0.3442   0.7453  -0.3004  -0.5532

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  -3.2159     0.1068 -30.099  < 2e-16 ***
AA1           0.2420     0.1313   1.844  0.06520 .
AA2          -0.4856     0.1472  -3.299  0.00097 ***
BB1           0.6781     0.1045   6.491 8.54e-11 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

    Null deviance: 59.201  on 5  degrees of freedom
Residual deviance:  1.353  on 2  degrees of freedom
AIC: 37.188

Number of Fisher Scoring iterations: 3
```

   (b)
```
mu <- collator.out$coefficients[1]
alpha1 <- collator.out$coefficients[2] ; alpha2 <- collator.out$coefficients[3]
alpha3 <- -(alpha1+alpha2)
beta1 <- collator.out$coefficients[4] ; beta2 <- -beta1
> exp(c(mu+alpha1+beta1,mu+alpha2+beta1,mu+alpha3+beta1,
        mu+alpha1+beta2,mu+alpha2+beta2,mu+alpha3+beta2))
 0.10069307  0.04863886  0.10084992  0.02593996  0.01253006  0.02598037
```

   (c) `collator.fits$fit` = $k*$(answer in 4(b)).

```
> collator.fits$fit
[1] 29.704457 20.233767 31.061776 12.295543  6.766233 12.938224
```

   (d)
```
> lcollator.fits$fit
       1        2        3        4        5        6
3.391297 3.007353 3.435978 2.509237 1.911944 2.560186
```

3. See Prof. Vardeman's solutions posted on the 2003 Stat 511 Web page.