migraines

Chris Parrish

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reference:
- Cannon, et al., Stat2, chapter 09, example 9.6, 9.17

Import the data.

```
data <- read.csv("TMS.csv", header=TRUE)
head(data)
```

```
##     Group Yes No Trials
## 1     TMS  39 61    100
## 2 Placebo  22 78    100
```

```
dim(data)
```

```
## [1] 2 4
```

Odds ratio.

```
odds.painfree.TMS <- 39 / 61
odds.painfree.placebo <- 22 / 78
odds.ratio <- odds.painfree.TMS / odds.painfree.placebo
odds.ratio
```

```
## [1] 2.266766
```

Logistic regresssion using `glm`

```
TMS.data <- as.table(matrix(c(39, 22, 61, 78), nrow=2))
dimnames(TMS.data) <- list(treatment=c("TMS", "placebo"),
                           painfree=c("yes", "no"))
TMS.data               # success and failure in cols 1 and 2
```

```
##          painfree
## treatment yes no
##   TMS      39 61
##   placebo  22 78
```

```
Treatment <- c(1, 0)   # first row is first group
TMS.glm <- glm(TMS.data ~ Treatment, family=binomial)
options(show.signif.stars=FALSE)
summary(TMS.glm)
```

```
##
## Call:
## glm(formula = TMS.data ~ Treatment, family = binomial)
##
## Deviance Residuals:
## [1]  0  0
##
## Coefficients:
##             Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -1.2657     0.2414  -5.243 1.58e-07
## Treatment     0.8184     0.3167   2.584  0.00977
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 6.8854e+00  on 1  degrees of freedom
## Residual deviance: 3.7970e-14  on 0  degrees of freedom
## AIC: 13.701
##
## Number of Fisher Scoring iterations: 3
```

Alternate way of organizing the data.

```
TMS.data <- cbind(c(39, 22), c(61, 78))
dimnames(TMS.data) <- list(treatment=c("TMS", "placebo"),
                           painfree=c("yes", "no"))
TMS.data               # success and failure in cols 1 and 2
```

```
##          painfree
## treatment yes no
##   TMS      39 61
##   placebo  22 78
```

```
Treatment <- c(1, 0)   # first row is first group
TMS.glm <- glm(TMS.data ~ Treatment, family=binomial)
summary(TMS.glm)
```

```
##
## Call:
## glm(formula = TMS.data ~ Treatment, family = binomial)
##
## Deviance Residuals:
## [1]  0  0
##
## Coefficients:
##             Estimate Std. Error z value Pr(>|z|)
## (Intercept)  -1.2657     0.2414  -5.243 1.58e-07
## Treatment     0.8184     0.3167   2.584  0.00977
##
## (Dispersion parameter for binomial family taken to be 1)
##
##     Null deviance: 6.8854e+00  on 1  degrees of freedom
## Residual deviance: 3.7970e-14  on 0  degrees of freedom
```

```
## AIC: 13.701
##
## Number of Fisher Scoring iterations: 3
```

LRT (= Likelihood ratio test) for utility of a simple logistic regression model

$H_0 : \beta_1 = 0$

$H_a : \beta_1 \neq 0$

```
null.deviance <- 6.8854
residual.deviance <- .7970e-14
G <- null.deviance - residual.deviance   # test statistic
df <- 1 - 0
p.value <- 1 - pchisq(G, df=df)
p.value
```

```
## [1] 0.008690262
```

CI.

```
beta1 <- coef(TMS.glm)
beta1                    # beta1 = log(odds ratio)
```

```
## (Intercept)   Treatment
##  -1.2656664   0.8183542
```

```
exp(beta1)               # exp(beta1) = odds ratio
```

```
## (Intercept)   Treatment
##   0.2820513   2.2667660
```

```
confint(TMS.glm)         # CI for log(odds ratio)
```

```
## Waiting for profiling to be done...

##                  2.5 %     97.5 %
## (Intercept) -1.7622552 -0.8111003
## Treatment    0.2053259  1.4509009
```

```
exp(confint(TMS.glm))    # CI for odds ratio
```

```
## Waiting for profiling to be done...

##                 2.5 %    97.5 %
## (Intercept) 0.1716573 0.4443689
## Treatment   1.2279252 4.2669569
```

Probabilities of success for each group.

$$P(Success \mid Treatment = TMS)$$

```r
library(boot)
beta0 <- coef(TMS.glm)[1]
beta1 <- coef(TMS.glm)[2]
pi.TMS <- inv.logit(beta0 + beta1 * 1)
pi.TMS
```

```
## (Intercept)
##        0.39
```

$$P(Success \mid Treatment = placebo)$$

```r
pi.placebo <- inv.logit(beta0 + beta1 * 0)
pi.placebo
```

```
## (Intercept)
##        0.22
```