Wald tests

Recap

General Wald test

Class activity, Part I

https://sta711-s23.github.io/class_activities/ca_lecture_18.html

Class activity

```
betahat <- m1$coefficients[4:5]
V <- vcov(m1)[4:5, 4:5]
test_stat <- t(betahat) %*% solve(V) %*% betahat
test_stat
```

```
##           [,1]
## [1,] 85.60437
```

Class activity

```
betahat <- m1$coefficients[4:5]
V <- vcov(m1)[4:5, 4:5]
test_stat <- t(betahat) %*% solve(V) %*% betahat
test_stat
```

```
##          [,1]
## [1,] 85.60437
```

```
# rejection region for alpha = 0.05
qchisq(0.05, df=2, lower.tail=F)
```

```
## [1] 5.991465
```

```
# p-value
pchisq(test_stat, df=2, lower.tail=F)
```

```
##              [,1]
## [1,] 2.577787e-19
```

A different question

We have the model

$$Y_i \sim Bernoulli(p_i)$$

$$\log\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 Sex_i + \beta_2 Age_i + \beta_3 SecondClass_i + \beta_4 ThirdClass_i$$

We want to test whether there is a difference in the chance of survival for second and third class passengers, holding age and sex fixed.

> What hypotheses should we test?

Contrasts

Class activity, Part II

https://sta711-s23.github.io/class_activities/ca_lecture_18.html

Class activity

```
a <- c(0, 0, 0, -1, 1)
test_stat <- (t(a) %*% coef(m1))/sqrt(t(a) %*% vcov(m1) %*% a)
test_stat
```

```
##           [,1]
## [1,] -5.207289
```

Class activity

```
a <- c(0, 0, 0, -1, 1)
test_stat <- (t(a) %*% coef(m1))/sqrt(t(a) %*% vcov(m1) %*% a)
test_stat
```

```
##           [,1]
## [1,] -5.207289
```

```
# rejection region for alpha = 0.05
qnorm(0.025, lower.tail=F)
```

```
## [1] 1.959964
```

```
# p-value
2*pnorm(abs(test_stat), lower.tail=F)
```

```
##               [,1]
## [1,] 1.916191e-07
```

A two-sample test for a difference in means