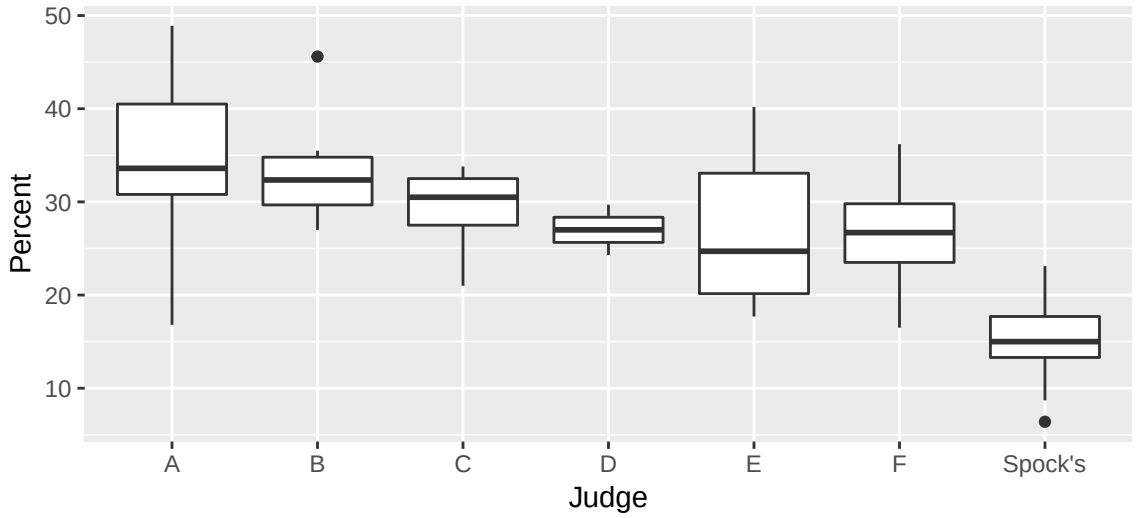
F tests for ANOVA, More Submodels

(Sleuth3 Sections 5.3 and 5.4)

Spock Trials Example

```
## # A tibble: 6 x 2
##   Percent Judge
##     <dbl> <chr>
## 1     6.4 Spock's
## 2     8.7 Spock's
## 3    13.3 Spock's
## 4    13.6 Spock's
## 5    15   Spock's
## 6    15.2 Spock's
```



All means equal?

$H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6 = \mu_7$

H_A : At least one mean is not equal to the others.

```
spock_fit_full <- lm(Percent ~ Judge, data = juries)
anova(spock_fit_full)
```

```
## Analysis of Variance Table
##
## Response: Percent
##           Df Sum Sq Mean Sq F value    Pr(>F)
## Judge      6 1927.1  321.18  6.7184 6.096e-05 ***
## Residuals 39 1864.5   47.81
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Note: Reduced model has only one mean for all 7 (H_0 is true).

What is the conclusion?

Means for other 6 judges equal?

$H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5 = \mu_6$

H_A : At least one mean for a judge other than Spock is not equal to the others.

Note: these hypotheses involve judges A through F; Spock's judge is not involved in these hypothesis statements.

```
juries <- juries %>%
  mutate(
    judge_spocks = ifelse(Judge %in% c("A", "B", "C", "D", "E", "F"), "Not Spock's", "Spock's")
  )
head(juries, 20)
```

```
## # A tibble: 20 x 3
##    Percent Judge   judge_spocks
##      <dbl> <chr>   <chr>
##  1     6.4 Spock's Spock's
##  2     8.7 Spock's Spock's
##  3    13.3 Spock's Spock's
##  4    13.6 Spock's Spock's
##  5    15   Spock's Spock's
##  6    15.2 Spock's Spock's
##  7    17.7 Spock's Spock's
##  8    18.6 Spock's Spock's
##  9    23.1 Spock's Spock's
## 10    16.8 A       Not Spock's
## 11    30.8 A       Not Spock's
## 12    33.6 A       Not Spock's
## 13    40.5 A       Not Spock's
## 14    48.9 A       Not Spock's
## 15    27   B       Not Spock's
## 16    28.9 B       Not Spock's
## 17    32   B       Not Spock's
## 18    32.7 B       Not Spock's
## 19    35.5 B       Not Spock's
## 20    45.6 B       Not Spock's
```

```
spock_fit_reduced <- lm(Percent ~ judge_spocks, data = juries)
anova(spock_fit_reduced, spock_fit_full)
```

```
## Analysis of Variance Table
##
## Model 1: Percent ~ judge_spocks
## Model 2: Percent ~ Judge
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1     44 2190.9
## 2     39 1864.5  5    326.46 1.3658 0.2582
```

What is the conclusion?