Learn By Doing Activity

Scenario: Critical Flicker Frequency (CFF) and Eye Color

The purpose of this activity is to give you guided practice in carrying out the ANOVA F-test.

Background: Critical Flicker Frequency (CFF) and Eye Color

There is various flickering light in our environment; for instance, light from computer screens and fluorescent bulbs. If the frequency of the flicker is below a certain threshold, the flicker can be detected by the eye. Different people have slightly different flicker "threshold" frequencies (known as the *critical flicker frequency*, or CFF). Knowing the critical threshold frequency below which flicker is detected can be important for product manufacturing as well as tests for ocular disease. Do people with different eye color have different threshold flicker sensitivity? A 1973 study ("The Effect of Iris Color on Critical Flicker Frequency," *Journal of General Psychology* [1973], 91–95) obtained the following data from a random sample of 19 subjects.

Eye Color	Threshold Frequency (CFF)
Brown	26.8
Brown	27.9
Brown	23.7
Brown	25
Brown	26.3
Brown	24.8
Brown	25.7
Brown	24.5
Green	26.4
Green	24.2
Green	28
Green	26.9
Green	29.1
Blue	25.7
Blue	27.2
Blue	29.9
Blue	28.5
Blue	29.4
Blue	28.3

Do these data suggest that people with different eye color have different threshold sensitivity to flickering light? In other words, do the data suggest that threshold sensitivity to flickering light is related to eye color?

Comment: We recommend that before starting, you create for yourself a figure that summarizes this problem, similar to the figures that we presented for the examples that we used in this part.

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What is the explanatory variable (X) and how many values does it take? What are those values? What is the response variable (Y)?

Your Answer:

X = color of the eye. It takes 3 values, Brown, Green, or Blue.
Y = Threshold Frequency (CFF)

Our Answer:
We want to check whether CFF is related to eye color, therefore, the explanatory variable is eye color, which takes three values: Brown, Green and Blue, and the response variable is CFF.

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Learn By Doing (1/1 point)

What are the hypotheses that are being tested here? Be sure that you define clearly the parameters that you are using.

Your Answer:

Ho: them mu's are the same
Ha: they are not the same

Our Answer:
The hypotheses that being tested here are: Ho: $\mu 1 = \mu 2 = \mu 3$ Ha: not all the μ's are equal Where: $\mu 1$ = mean CFF of people that have brown eyes. $\mu 2$ = mean CFF of people that have green eyes. $\mu 3$ = mean CFF of people that have blue eyes.

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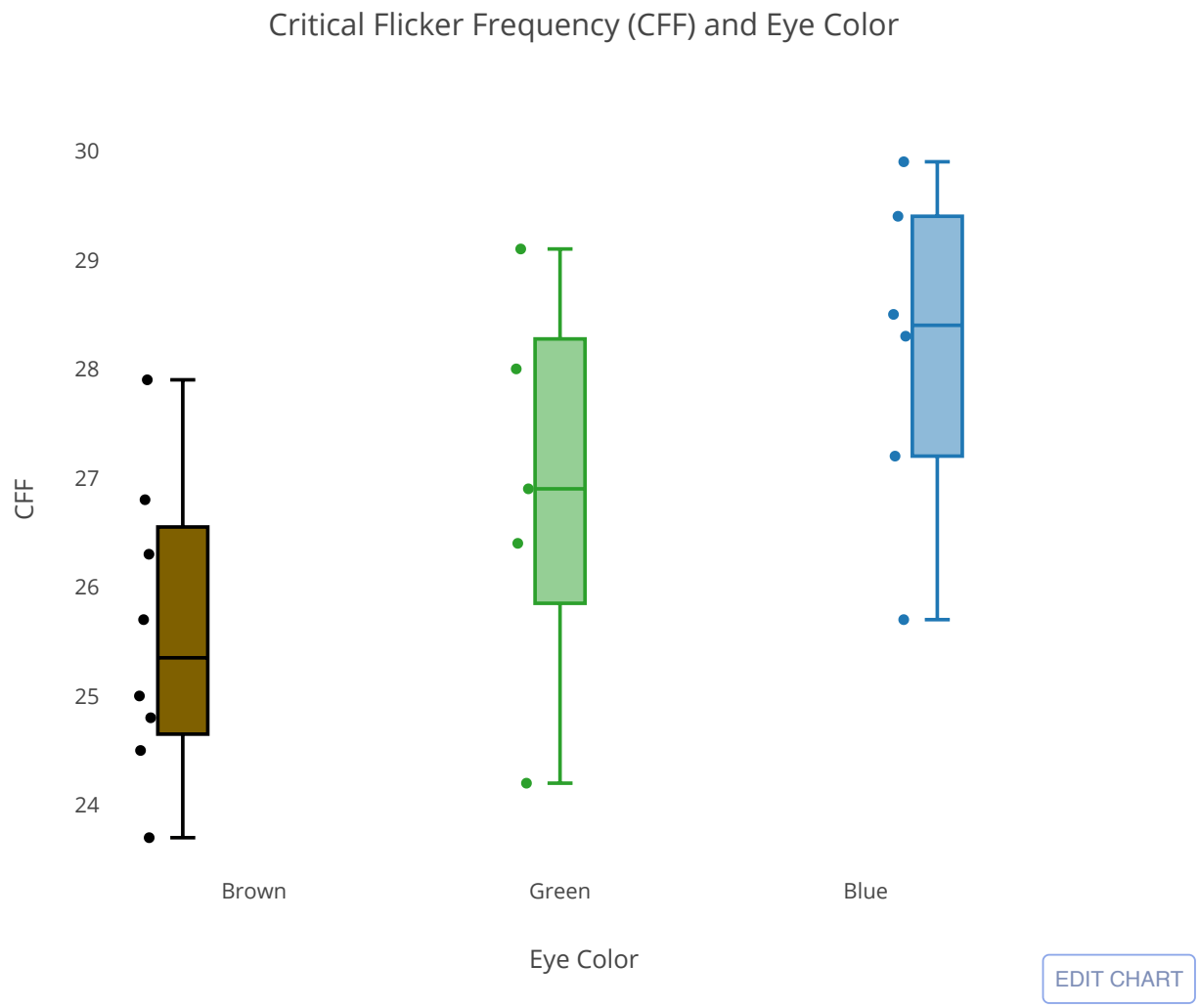
Below are boxplots that show how the CFF values compare for the three different eye colors.



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The standard deviations for the various eye colors are: Brown: 1.365, Green: 1.843, and Blue: 1.527. Are the conditions that allow us to safely use the ANOVA F-test met?

Your Answer:

a.) yes independently randomly sampled
b.) no outliers, seem normally enough distributed
c.) standard deviations are probably the same

Our Answer:

Let's check the conditions: (i) We are told that the sample was chosen at random, so the three eye-color samples are independent. (ii) The sample sizes are quite low, but the boxplots do not display any extreme violation of the normality assumption in the form of extreme skewness or outliers. (iii) We can

assume that the equal population standard deviation condition is met, since the rule of thumb is satisfied (1.843 / 1.365 is less than 2).In summary, we can safely proceed with the ANOVA F-test.

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Based on the boxplots, summarize what the data suggest about how CFF is related to eye color. Do you think that the data provide enough evidence against the null hypothesis? (There is no right or wrong answer here, just your feelings from looking at the data.)

Your Answer:

There's some overlap, so Ho might not be rejected?

Edit: Okay so I guess it should be considered as not that overlap -- this means that there is reasonable evidence against Ho.

Our Answer:

The data suggest that the CFF of the people with brown eyes is the lowest (on average), followed by green-eyed people, and people with blue eyes have the highest CFF (on average). It seems like that there is a reasonable amount of evidence in the data against H0. The three boxplots do not overlap much, and it really doesn't seem very likely that the three populations from which these three samples were chosen all share the same mean.

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Learn By Doing (1/1 point)

Here is the ANOVA F-test output. Interpret the p-value and draw your conclusion in context.

Your Answer:

No figure :(but i'd just check p-values: if they're <0.05, that means there's no relation.

Our Answer:

The test statistic F is 4.8 (which is quite large), and the p-value is 0.023, indicating that it is unlikely (probability of 0.023) to get data like those observed assuming that CFF is not related to eye color (as the null hypothesis claims). Since the p-value is small (in particular, smaller than 0.05), we have enough evidence in the data to reject H0 and conclude that the mean CFFs in the three eye-color populations are not all the same. In other words, we can conclude that CFF is related to eye color.

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