Example 12
F-test
Comparing sample variances
Setup

A new brand of light trap (Brand B) was recently purchased and we need to determine if the variability of the data collected from the new light traps is significantly different than the variability of the data collected from an older brand of light traps (Brand A). Light traps were placed in similar habitats and the captures are attached below.

Brand	Moths
A	43
A	53
A	48
A	55
A	49
A	44
A	46
A	47
A	40
A	42
B	50
B	46
B	48
B	47
B	51
B	39
B	54
B	43

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Solution

1. State your question: Does the variation in the number of moths captured in light traps differ by the type of trap.
    a. Is it a good scientific question? Definable, measurable, controllable.
    b. Identify your population: Captures of moths for different brands of traps
    c. Identify your dependent variable: Number of moths captured
    d. Identify your independent variable: Type of light trap
2. State your hypothesis set
    a. Verbal hypothesis: The type of light trap influences the variance of the number of moths caught.
    b. Statistical hypothesis (H_O, H_A).
        H_O: $s^2_A = s^2_B$ The variance of the number of moths captured at the different types of traps are the same.
        H_A: $s^2_A \neq s^2_B$ The variance of the number of moths captured at the different types of traps are not the same.
    c. Is your hypothesis set exhaustive? Yes
    d. Is your hypothesis set exclusive? Yes
3. State your significance level: α=0.05
4. Select the appropriate test
    a. Variable scale
        i. Dependent variable: Ratio
            - Converted or transformed? No
        ii. Independent variable: Nominal
            - Converted or transformed? No
    b. What information is given or available?
        i. Sample data
    c. Number of samples: 2
    d. Are the data paired or unpaired? Unpaired
    e. What aspect of the variable do you want to compare?
        i. Variability – variances
    f. State the test to be used: F-test
        i. Are the assumptions of the test met?
            - Random samples – Assumed
            - Independent samples – Assumed
            - Normally distributed populations – Tested

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        Shapiro-Wilk normality test

data:  MothsA$Moths
W = 0.966, p-value = 0.852

        Shapiro-Wilk normality test

data:  MothsB$Moths
    W = 0.983, p-value = 0.976
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5. Conduct your sampling
6. Graph the data

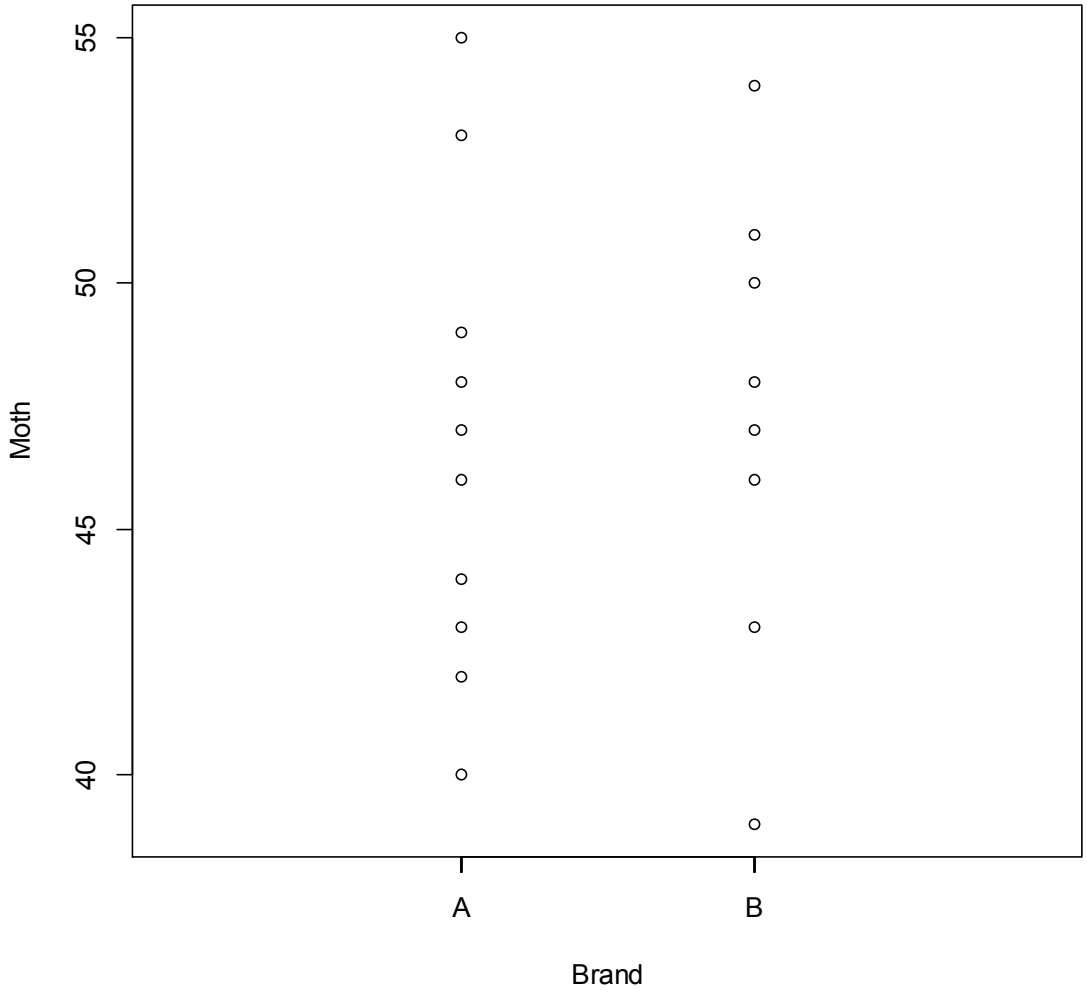

Figure1. Variation the number of moths captured in light traps of brands A and B.

7. Summarize the data.

Sample A

$n_A = 10$

$\bar{x} = 46.7$ moths

$s^2_A = 22.7$ moths^2

Sample B

$n_B = 8$

$\bar{x} = 47.3$ moths

$s^2_B = 22.2$ moths^2

8. Calculate your test statistic.

F test to compare two variances

data: Moths$Moths by Moths$Brand
F = 1.0209, num df = 9, denom df = 7, p-value = 0.9983
alternative hypothesis: true ratio of variances is not equal to 1
95 percent confidence interval:
0.2116564 4.2846163
sample estimates:
ratio of variances
1.020865

9. Retain or reject your null hypothesis based on your test statistic.

The calculated p-value (0.998) is greater than the significance level (0.05), therefore we would retain our null hypothesis and reject our alternate hypothesis.

10. Interpret the results in biological terms.

The type of light trap utilized does not influence the variance of the number of moths captured ($F = 1.02$, $df = 9, 7$, $p = 0.998$).