

Example 22
Pearson Correlation
Setup

An ornithologist has noted that within a species of birds that it appears as though individuals with longer wings also have longer tails. The ornithologist has collected wing and tail measurements for 12 individuals. Do birds with long wings also have long tails?

Wing length(cm)	Tail length (cm)
10.4	7.4
10.8	7.6
11.1	7.9
10.2	7.2
10.3	7.4
10.2	7.1
10.7	7.4
10.5	7.2
10.8	7.8
11.2	7.7
10.6	7.8
11.4	8.3

Example 22
Pearson Correlation
Solution

1. State your question: Do the lengths of wings and tails co-vary within a species of bird?
 - a. Is it a good scientific question? Definable, measurable, and controllable
 - b. Identify your population: Wing and tail lengths of birds of the same species
 - c. Identify your variables: Wing and tail lengths
2. State your hypothesis set
 - a. Verbal hypothesis: Wing and tail length within a species of birds tends to co-vary.
 - b. Statistical hypothesis (H_0 , H_A).
 - H_0 : Wing and tail length within a species of birds do not tend to co-vary.
 - H_A : Wing and tail length within a species of birds tend to co-vary.
3. State your significance level: $\alpha=0.05$
4. Select the appropriate test.
 - a. Variable scales
 - i. Variable 1: Ratio
 - Converted or transformed? No
 - ii. Variable 2: Ratio
 - Converted or transformed? No
 - b. What information is given or available?
 - i. Sample data
 - c. Number of samples: Many (12)
 - d. Are the data paired or unpaired? Unpaired
 - e. What aspect of the variable do you want to compare?
 - i. Correlation
 - f. State the test to be used: Pearson correlation
 - i. Are the assumptions of the test met? Yes
 - Random sample - Assumed
 - Independent sample - Assumed
 - Bivariate Normal Distribution - Tested pass
 - The relationship between the two variables is linear. - Assessed visually (see step 6)

Shapiro-Wilk normality test

data: Z

W = 0.946, p-value = 0.5787

5. Conduct your sampling
12 birds were captured and their wings and tails were measured.

Wing length(cm)	Tail length (cm)
10.4	7.4
10.8	7.6
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10.3	7.4
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11.2	7.7
10.6	7.8
11.4	8.3

6. Graph the data

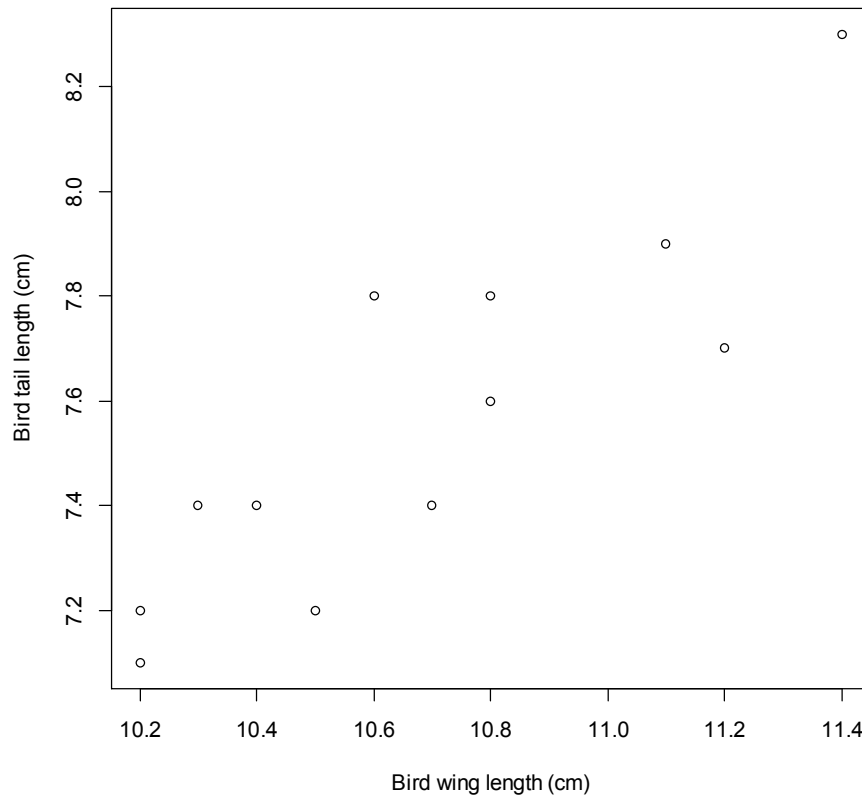


Figure 1. Bird wing length (cm) graphed against bird tail length.

7. Summarize the data

$$X_{\text{Tail}} = 7.6 \text{ cm}$$

$$X_{\text{Wing}} = 10.7 \text{ cm}$$

8. Calculate your test statistic.

Pearson's product-moment correlation

data: Birds\$Wing and Birds\$Tail

t = 5.5893, df = 10, p-value = 0.0002311

alternative hypothesis: true correlation is not equal to 0

95 percent confidence interval:

0.5923111 0.9631599

sample estimates:

cor

0.8703546

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

The calculated p-value (0.0002311) is less than the significance level (0.05), so we would reject our null hypothesis and retain our alternate hypothesis.

10. Interpret the results in biological terms.

The lengths of wings and tails within a species of bird do co-vary ($r=0.870$, $t=5.589$, $df=10$, $p<0.001$).