Example 17
Wilcoxon paired samples
Comparing paired samples
Nonparametric
Setup

Observations by researchers have led them to believe that fluid in the pericardium can influence blood flow. To confirm this observation in a total of 16 dogs, the left coronary flow (ml/min) was measured during an initial control period and then measured after injecting saline solution into the pericardium. Does fluid in the pericardium influence blood flow?

Dog	Control	After
1	125	109
2	52	82
3	91	37
4	97	58
5	82	70
6	53	43
7	71	66
8	128	112
9	71	84
10	63	47
11	66	47
12	107	98
13	144	135
14	106	93
15	117	108
16	98	79

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Solution

1. State your question: Does the presence of fluid in the pericardium influence blood flow?
    a. Is it a good scientific question? Definable, measurable, and controllable.
    b. Identify your population: Coronary blood flow in dogs
    c. Identify your dependent variable: Blood flow
    d. Identify your independent variable: Presence or absence of fluid in pericardium.
2. State your hypothesis set
    a. Verbal hypothesis: The presence of fluid in the pericardium significantly influences blood flow.
    b. Statistical hypothesis (H_O, H_A).
        H_0: The presence of fluid in the pericardium will not influence blood flow.
        H_A: The presence of fluid in the pericardium will influence blood flow.
    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: Interval
        i. Dependent variable: Interval
            - Converted: Interval → Ordinal
        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? Paired
    e. What aspect of the variable do you want to compare?
        ~~i. Central tendency -- means~~
        ii. Central tendency – medians
    ~~f. State the test to be used: t-test (paired-sample)~~
        - ~~Random sample – Assumed~~
        - ~~The differences in the means are normally distributed. – Tested , Failed~~

Shapiro-Wilk normality test

data: Difference
W = 0.884, p-value = 0.04484

g. State the test to be used: Wilcoxon paired-sample
   i. Are the assumptions of the test met?
      - Random sample
      - Symmetrical distribution of the differences – Graphed

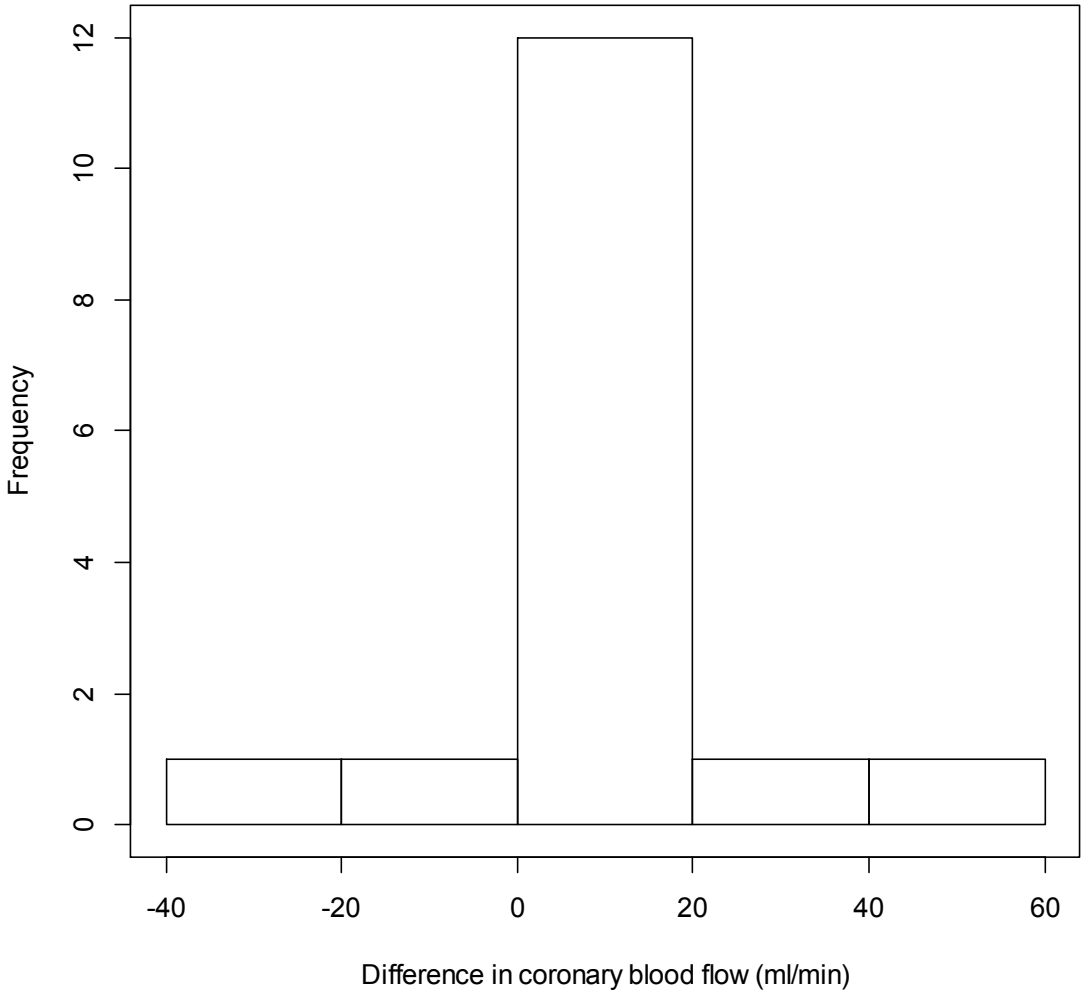
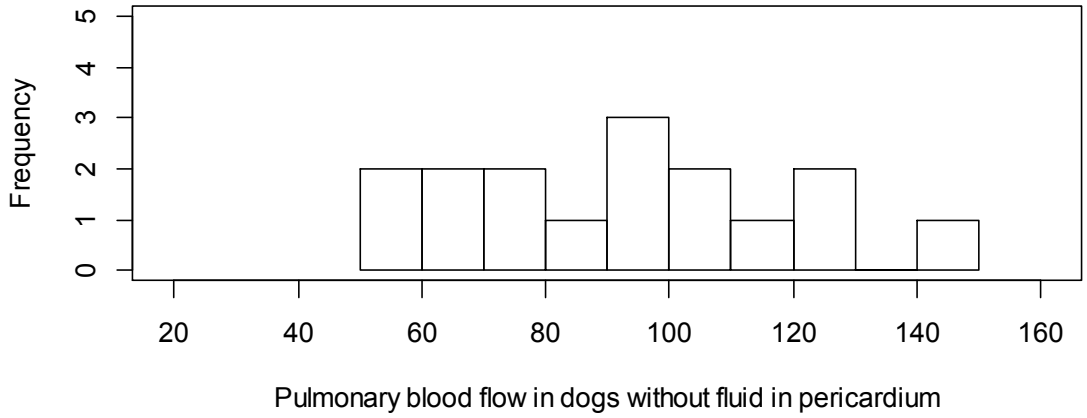


Figure 1. Assessing symmetry of difference in coronary blood flow (ml/min)

5. Conduct your sampling
   In a total of 16 dogs, the left coronary flow was measured during an initial control period and then measured after injecting saline solution into the pericardium.
6. Graph the data



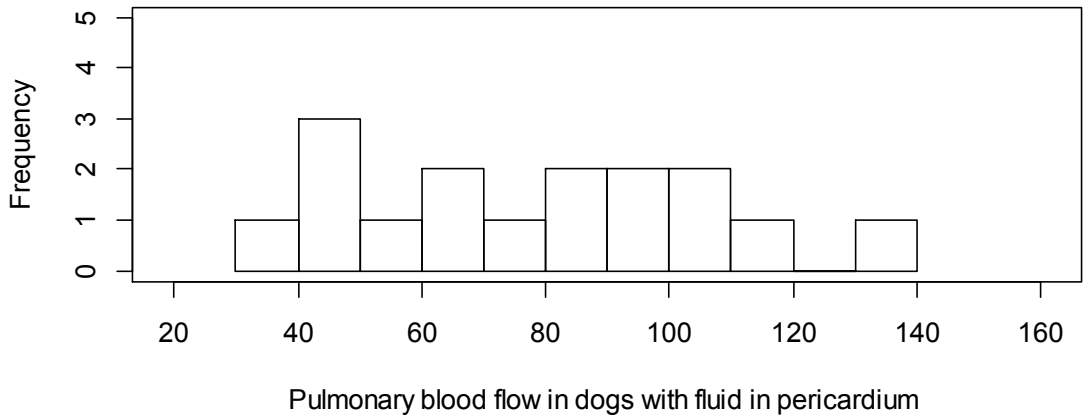


Figure 2. Pulmonary blood flow (ml/min) in dogs with and without saline in the pericardium.

7. Summarize the data
   n=16

8. Calculate your test statistic.

Wilcoxon signed rank test with continuity correction

data: Dogs$Control and Dogs$After
V = 114.5, p-value = 0.01719
alternative hypothesis: true location shift is not equal to 0

Warning message:
In wilcox.test.default(Dogs$Control, Dogs$After, paired = T) :
cannot compute exact p-value with ties

9. Retain or reject your null hypothesis based on your test statistic.
Since the calculated p-value (0.017) is less than the significance level (0.05), we would reject our null hypothesis and retain our alternate hypothesis.
10. Interpret the results in biological terms.
The presence of fluid in the pericardium does significantly influence blood flow (V = 114.5, n=16, p=0.017)