

Example 10
t-test - One sample
Comparing sample and population means
Setup

A researcher wants to know if a deficiency of vitamin E affects rats ability to store vitamin A. She has 83 rats that have a vitamin E deficiency and she has measured their ability to store vitamin A (data provided, IU). Long term studies of rats have determined the population mean of 3400 I.U. for vitamin A storage.

Vitamin A Storage in vitamin E deficient rats (IU)

2879	3085	2754	3540
3612	3466	3397	3371
4521	4100	4059	2896
4008	3299	4515	2694
3762	3987	3532	3095
3282	3411	3729	3886
4132	3228	2700	3017
1977	2870	3542	3713
3357	3422	3048	3565
2593	2808	3665	3062
2750	3444	3881	2959
4299	2830	2931	4533
3202	2958	3859	3663
3155	2659	3667	3167
3664	2862	4041	3405
2689	2824	3745	3804
3605	3642	3956	3450
2574	3613	2913	3237
3120	3061	3262	2700
2597	4163	3254	3217
2783	3239	3796	

Example 10

t-test - One Sample Comparing sample and population means Solution

1. State your question: Does vitamin A storage in rats with vitamin E deficiency differ from rats in general
 - a. Is it a good scientific question? Definable, measurable, and controllable.
 - b. Identify your population: Vitamin A storage in rats
 - c. Identify your dependent variable: Vitamin A storage
 - d. Identify your independent variable: Vitamin E deficiency
2. State your hypothesis set
 - a. Verbal hypothesis: Vitamin A storage in rats with vitamin E deficiency will differ from that in rats in general.
 - b. Statistical hypothesis (H_0 , H_A).
 H_0 : $x = \mu$ $x = 3400$ Vitamin A storage in rats with vitamin E deficiency will not differ from that in rats in general.
 H_A : $x \neq \mu$ $x \neq 3400$ Vitamin A storage in rats with vitamin E deficiency will differ from that in rats in general.
 - c. Is your hypothesis set exhaustive? Yes
 - d. Is your hypothesis set exclusive? Yes
3. State your significance level: $\alpha = 0.05$
4. Select the appropriate test
 - a. Variable scale
 - i. Dependent variable: Ratio
 - o Converted or transformed? No
 - ii. Independent variable: Nominal
 - o Converted or transformed? No
 - b. What information is given or available?
 - i. Sample data
 - ii. Parameters? Population mean
 - c. Number of samples: 1
 - d. Are the data paired or unpaired? Not applicable
 - e. What aspect of the variable do you want to compare: Central Tendency -- Means
 - f. State the test to be used: t-test - One sample
 - i. Are the assumptions of the test met? Yes
 - o Random sample
 - o Independent samples
 - o Data comes from a normal distribution. Tested

Shapiro-Wilk normality test

data: SampleData
W = 0.9844, p-value = 0.4163

5. Conduct your sampling
We obtained of sample of 83 Vitamin E deficient rats and measured the Vitamin A stored in each of the rats.
6. Graph the data

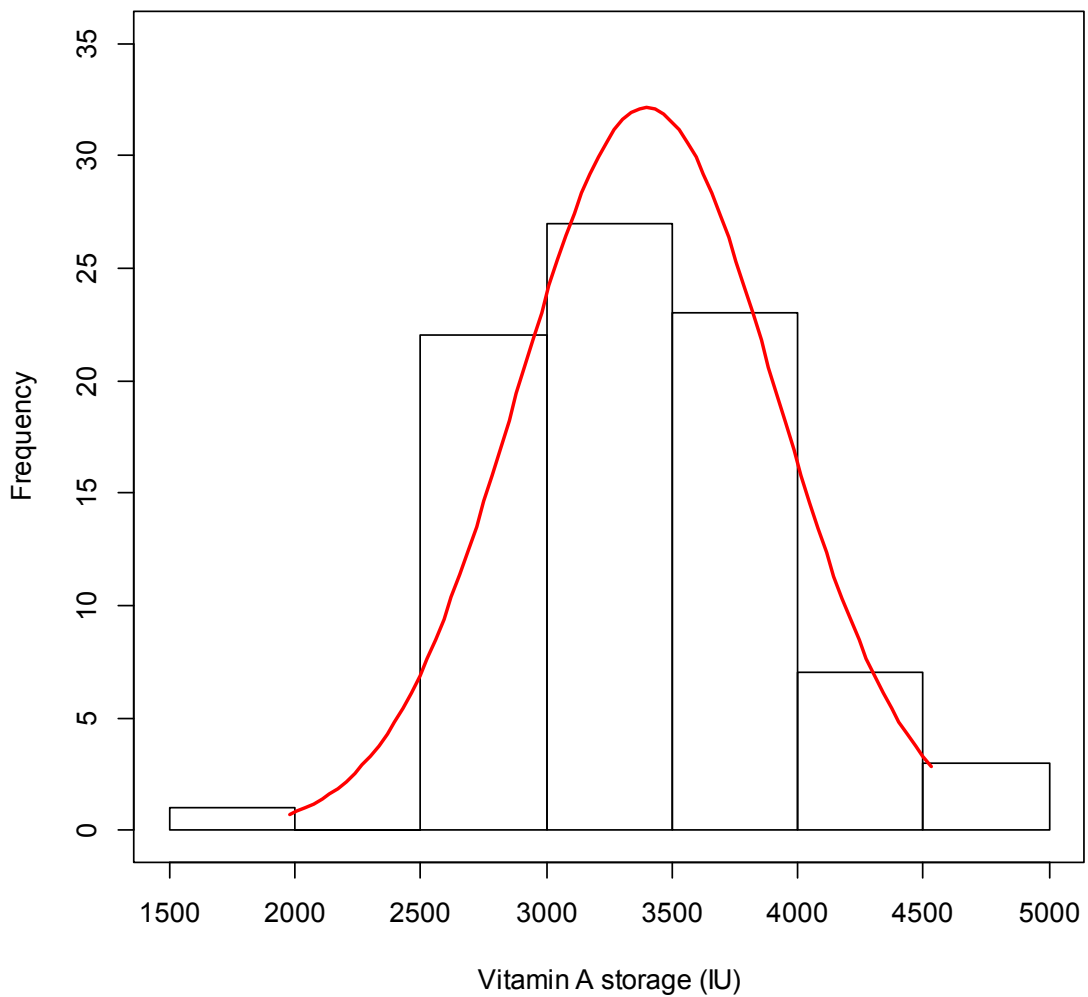


Figure 1. Vitamin A storage for 83 rats with Vitamin E deficiency. The red line represents the expected normal distribution of vitamin A storage for rats in general ($\mu=3400$, $s=515$).

7. Summarize the data.

Population parameters (Obtained from many years of research)

$$\mu = 3400 \text{ I.U.}$$

Sample description

$$n = 83$$

$$\bar{x} = 3358 \text{ I.U.}$$

$$s = 515 \text{ I.U.}$$

8. Calculate your test statistic.

One Sample t-test

data: SampleData

t = -0.7347, df = 82, p-value = 0.4646

alternative hypothesis: true mean is not equal to 3400

95 percent confidence interval:

3245.979 3470.936

sample estimates:

mean of x

3358.458

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

The calculated p-value (0.4646) is greater than the significance level, therefore we would retain our null hypothesis and reject our alternate hypothesis.

10. Interpret the results in biological terms.

Vitamin E deficiency does not influence vitamin A storage in rats (t=0.735, df=82, p=0.465).