

4. Patients with heart-attack symptoms arrive at an emergency room either by ambulance or self-transportation provided by themselves, family, or friends. When a patient arrives at the emergency room, the time of arrival is recorded. The time when the patient's diagnostic treatment begins is also recorded.

An administrator of a large hospital wanted to determine whether the mean wait time (time between arrival and diagnostic treatment) for patients with heart-attack symptoms differs according to the mode of transportation. A random sample of 150 patients with heart-attack symptoms who had reported to the emergency room was selected. For each patient, the mode of transportation and wait time were recorded. Summary statistics for each mode of transportation are shown in the table below.

Mode of Transportation	Sample Size	Mean Wait Time (in minutes)	Standard Deviation of Wait Times (in minutes)
Ambulance	77	6.04	4.30
Self	73	8.30	5.16

- (a) Use a 99 percent confidence interval to estimate the difference between the mean wait times for ambulance-transported patients and self-transported patients at this emergency room.
- (b) Based only on this confidence interval, do you think the difference in the mean wait times is statistically significant? Justify your answer.

Solution:

- (a) State: We wish to estimate, with 99% confidence, the true difference in mean wait times, $\mu_A - \mu_S$, for ambulance-transported (μ_A) and self-transported (μ_S) patients with heart-attack symptoms at this emergency room.

Plan: If conditions for inference are met, we will construct a 2-sample t interval for $\mu_A - \mu_S$.

Random: It is given that this is one random sample, not two. However, by splitting them into two groups based on transportation method, it is reasonable to consider these as two independent samples. (That is, no one individual is likely to be in both groups.)

10%: It is reasonable to assume that there are at least 770 ambulance-transported heart-attack patients and 730 self-transported heart attack patients at this emergency room.

Normal/Large Counts: Since we do not know the distributions of the two populations, we look at sample sizes. Both 77 and 73 are large enough sample sizes for t procedures to be reasonable.

Do: The 2-sample t interval is given by:

$$(\bar{x}_A - \bar{x}_S) \pm t_{df}^* \sqrt{\frac{s_A^2}{n_A} + \frac{s_S^2}{n_S}}$$

Where d.f. can be calculated using the conservative lesser of sample sizes – 1, or by the more complicated method the calculator uses.

(Choose one method and be consistent.)

Method 1: Calculator (recommended)

Use the calculator. Do Menu>Statistics>Confidence Intervals>2-sample t Interval>Stats and enter the summary data using ambulance data for sample 1 and self-driven data for sample 2. Be sure to scroll down and change the confidence level to 0.99 and select "Pooled NO". Note the resulting confidence interval, the estimate and margin of error, and the degrees of freedom. Then look up the t^* for that degrees of freedom using inverse t. The d.f. calculated by the calculator is 140.37. Then $\text{inv}t(.995,140.37)=2.61131$ (and yes, you can type the decimals in the degrees of freedom).

State that you are using the calculator method and show how you calculated t^* .

Then show this work:

$$(6.04 - 8.30) \pm 2.611 \sqrt{\frac{4.3^2}{77} + \frac{5.16^2}{73}}$$

$$-2.26 \pm 2.03089$$

$$(-4.29089, -0.229108)$$

Note that, with the exception of t^* , all of the above is given in the calculator confidence interval results. You do not have to actually type in the calculations.

Method 2: Manual method (not recommended, but just be careful about your calculator entries if you use it)

State that you are using the conservative calculation of degrees of freedom:
the lesser of $73-1$ and $77-1$, which is 72 .

Find t^* one of two ways:

Either: Using the table, look in the 99% confidence column, using the row for 60 d.f. (Because 72 is not a row in the table, use the largest degrees of freedom less than what you calculated.) This gives: $t^* = 2.660$

OR: Using the calculator inverse t function, find the t^* for 72 d.f.: $\text{inv}t(.995,72)=2.64585$
This gives: $t^* = 2.64585$

Then show this work:

$$\text{Either: } (6.04 - 8.30) \pm 2.660 \sqrt{\frac{4.3^2}{77} + \frac{5.16^2}{73}}$$

$$-2.26 \pm 2.660(0.77773)$$

$$-2.26 \pm 2.06876$$

$$(-4.32876, -0.191238)$$

$$\begin{aligned}\text{Or: } & (6.04 - 8.30) \pm 2.64585 \sqrt{\frac{4.3^2}{77} + \frac{5.16^2}{73}} \\ & -2.26 \pm 2.64585(0.77773) \\ & -2.26 \pm 2.05776 \\ & (-4.31776, -0.20224)\end{aligned}$$

Conclude: We are 99% confident that interval from -4.29089 to -0.229108 captures the true difference of mean wait-time for ambulance-transported and self-transported patients with heart-attack symptoms at this emergency room.

(Note: use your confidence limits according the method you used in the DO step.)

- (b) Because zero is NOT in the 99% confidence interval of plausible values for the true difference in means, a significance test of $H_0: \mu_A - \mu_S = 0$ vs. $H_a: \mu_A - \mu_S \neq 0$ would reject H_0 at the $\alpha = 1 - .99 = 0.01$ level of significance. Hence, at the 0.01 level of significance, there is evidence of a significant difference in wait time for heart attack patients who arrive by ambulance when compared with those who are self-transported to this emergency room.