ANOVA *F* TEST

ANOVA (Analysis of Variance) is a statistical technique for comparing several means and to determine if the differences between the means are statistically significant.

To examine how pet dogs affect people in stressful situations, researchers recruited 45 women who owned a pet dog. Fifteen of the women were randomly assigned to each of three groups to do a stressful task alone, with a good friend present or with their pet dog present.

The stressful task was to count backwards by 13s or 17s. During the task, the subject's mean heart rate (in beats per minute) was recorded:

Alone	Good Friend	Pet Dog
80.369	99.692	69.169
87.446	83.400	70.169
90.015	102.154	75.985
99.046	80.277	86.446
87.231	91.354	68.862
91.754	100.877	64.169
87.785	101.062	97.538
77.800	97.046	85.000
84.738	88.015	58.692
84.877	81.600	79.662
73.277	86.985	69.231
84.523	92.492	69.538
70.877	89.815	70.077
75.477	98.200	72.262
62.646	76.908	65.446

Do the mean heart rates for the groups provide convincing evidence that the presence of a pet or friend affects heart rate during a stressful task?

1. **PUT DATA INTO SEPARATE LISTS; CHECK DISTRIBUTIONS/REMOVE ANY OUTLIERS.**

   Alone: *Moderately skewed; no outliers*

   Good Friend: *Symmetric; no outliers*

   Pet Dog: *Outlier (97.53)* → *Remove from list; Moderately skewed; No Outlier*

2. **PERFORM 1-VARIABLE STATS:**

GROUP	MEAN	STANDARD DEVIATION
Alone (L_1)	82.52	9.24
Good Friend (L_2)	91.33	8.34
Pet Dog (L_3)	71.76	7.70

P) **STATE PARAMATER(S)**

μ_1 = Mean heart rate when performing stressful task alone

μ_2 = Mean heart rate when performing stressful task with a close friend

μ_3 = Mean heart rate when performing stressful task with pet dog

H) **STATE HYPOTHESES**

H_0: $\mu_1 = \mu_2 = \mu_3$

H_a: $\mu_1 \neq \mu_2 \neq \mu_3$

A) **CHECK THAT ANOVA CAN BE SAFELY USED (TO COMPARE MEANS):**

a) Independent random samples

Subjects were randomly assigned to the three treatment groups yielding independent groups; hear rates were independent of each other

b) Population has normal distribution **or** $n \geq 30$ (Central Limit Theorem) **or** evidence of normality ($n < 30$)

Data reasonably safe to use (after outlier removed)

c) All standard deviations are the *same* [2(smallest) ≤ largest]

2(7.70) = 15.4 < 9.24

T) **PERFORM TEST**

TESTS → ANOVA (L$_1$, L$_2$, L$_3$) →F = 19.33 (df = 2), P-value = .000001

S) **STATE CONCLUSION**

At α = .01, we reject H$_0$ and conclude the experiment gives strong evidence that the average heart rates of subjects differ when performing a stressful task alone, with a close friend present or a pet dog present.

From the descriptive data analysis, stress levels appear to be highest when a friend is present and lowest when a pet dog is present.