

ANOVA F TEST

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

To determine which colors best attract insects, experimenters randomly placed 6 sticky boards of each of 4 colors in a field of oats and measured the number of beetles trapped:

BOARD COLOR	INSECTS TRAPPED					
Blue	16	11	20	21	14	7
Green	37	32	20	29	37	32
White	21	12	14	17	13	20
Yellow	45	59	48	46	38	47

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

Only the number of insects trapped on yellow boards appear to have any outliers (38 and 59)... removed from list

NOTE: This makes the sample size for yellow boards very small ($n = 3$)

2. PERFORM 1-VARIABLE STATS:

COLOR	MEAN (\bar{x})	STANDARD DEVIATION (s)
Blue (L_1)	14.83	5.345
Green (L_2)	31.17	6.306
White (L_3)	16.17	3.764
Yellow (L_4)	46.5	1.291

3. CHECK THAT ANOVA CAN BE SAFELY USED (TO COMPARE MEANS):

- Independent SRSs from each population... *unknown; however, the sample was "random"*
- Population has normal distribution **or** $n \geq 40$ (Central Limit Theorem) **or** normal probability plot is relatively linear after removing outliers ($n < 40$)... *np's appear relatively linear*

c) All standard deviations are the *same* [$s_{\text{largest}} \leq 2(s_{\text{smallest}})$]

$$\frac{\text{largest}}{\text{smallest}} = \frac{6.306}{1.291} = 4.88 > 2 \dots \text{though ANOVA is robust, the results may be invalid}$$

4. STATE HYPOTHESES:

μ_1 = mean number of insects trapped by blue boards

μ_2 = mean number of insects trapped by green boards

μ_3 = mean number of insects trapped by white boards

μ_4 = mean number of insects trapped by yellow boards

$$H_0: \mu_1 = \mu_2 = \mu_3 = \mu_4$$

$$H_a: \mu_1, \mu_2, \mu_3, \mu_4 \text{ are not all equal}$$

5. PERFORM TEST (TI-84/89 CAN ONLY BE USED FOR COMPARING ≤ 6 MEANS):

a. USING CALCULATOR:

STAT \rightarrow TESTS \rightarrow F:ANOVA (L_1, L_2, L_3, L_4) \rightarrow ENTER:

$$F \text{ Statistic} = 45.439, P\text{-value} = 1.33 \times 10^{-8} < .001$$

b. USING TABLE D:

Where degrees of freedom in the numerator = 3 and degrees of freedom in the denominator = 18:

$$I = \# \text{ groups} = 4 \quad N = \# \text{ observations} = 22 \text{ (after removing outliers)}$$

$$\text{numerator df} = I - 1 = 4 - 1 = 3 \quad \text{denominator df} = N - I = 22 - 4 = 18$$

$$P\text{-value} < .001$$

6. STATE CONCLUSION

Despite the (very) small samples, the experiment provides strong evidence ($p < .001$) of differences among the colors. Yellow boards appear to be the best at attracting beetles.