Hypothesis Testing

Math 122

Hypothesis Testing Outline

- Define your parameters
- State the claim being tested in symbols.
- State the Alternative Hypothesis H_1. ($\neq$, $<$, or $>$)
- State the Null Hypothesis H_0. ($=$)
- Decide on a test/distribution
- Find a P-value (technology)
- Conclude

P-value and formal conclusion

- If $\mathbf{P} \leq \boldsymbol{\alpha}$ then H_0 is not consistent with the observations.
- Reject H_0 and support H_1.

P-value and formal conclusion

- If **P > α** then H_0 is consistent with the observations.
- Do not reject H_0 and do not support H_1.

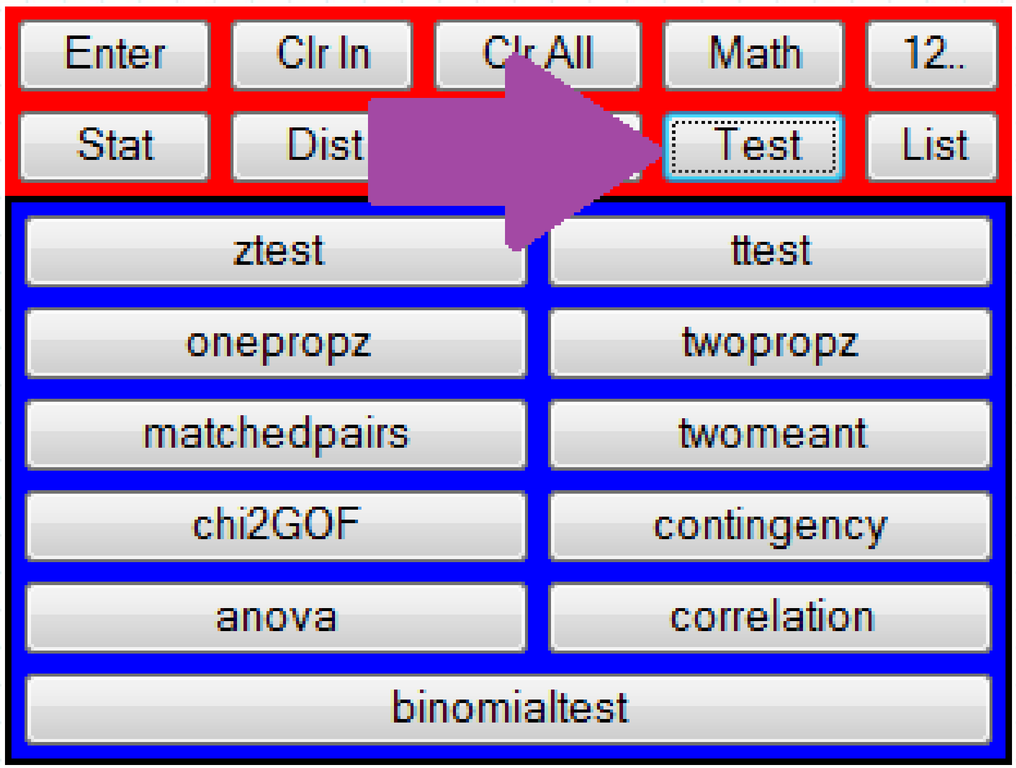
Final Conclusion

- If your **claim is H_0** then your conclusion will be
  - There is enough sample evidence to **reject** the claim.
  - There is **not** enough sample evidence to **reject** the claim.
- If your **claim is H_1** then your conclusion will be
  - The evidence **supports** the claim.
  - The sample evidence does not **support** the claim.

Types of Claims We Will Test

(A whirlwind overview of the next 3 weeks)

All depend on some variant of the Central Limit Theorem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contingency
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correlation
binomialtest

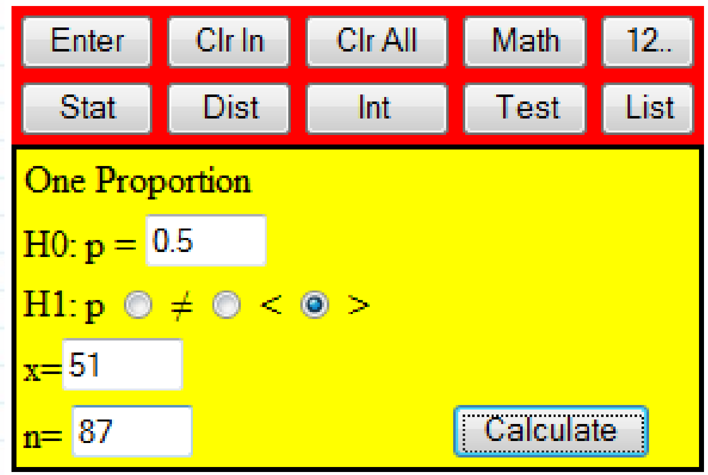
One Proportion

- Use onepropz

- **Example**: In a random sample of 87 Grey Forest Glow Worms, 51 were striped. Use this data to test the claim that **most Grey Forest Glow Worms are striped.**

onepropz

1. p = proportion of GFGW which are striped
2. Claim: $p>0.5$
3. H_1: $p>0.5$
4. H_0: $P=0.5$
5. P-value: 0.0539



6. Do not reject H_0. Do not support H_1.
7. There is not enough sample evidence to support the claim.

Two Proportions

- Use twopropz

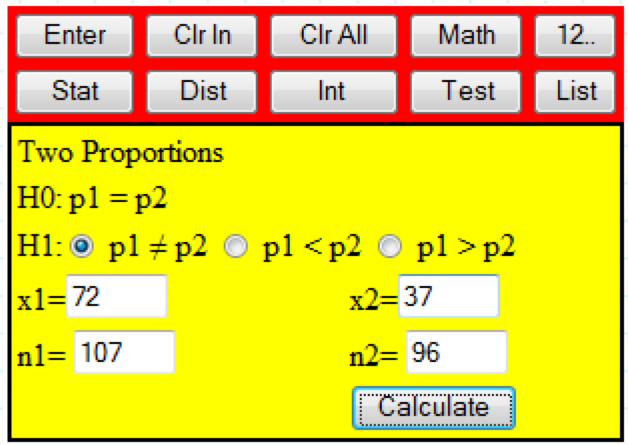
- **Example**: Among 107 male Grey Forest Glow Worms, 72 were striped. Among 96 female GFGWs, 37 were striped. Use this data to test the claim that **the proportion of male GFGWs which are striped is greater than the proportion of female GFGWs which are striped**.

twopropz

1. p_1=proportion of male GFGW with stripes

p_2=proportion of female GFGW with stripes

2. Claim: $p_1>p_2$



3. H_1: $p_1>p_2$

4. H_0: $p_1=p_2$

5. P-value=0.0000

6. Reject H_0. Support H_1.

7. The sample evidence supports the claim.

One Mean

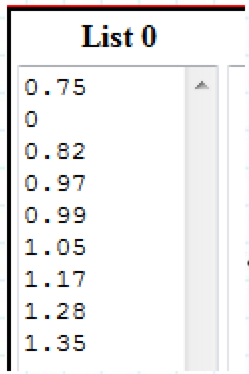
- Use ttest

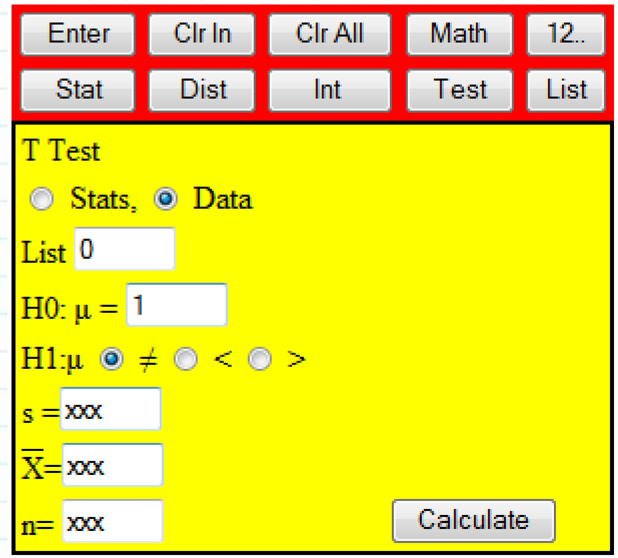
- **Example**: A sample of adult GFGWs had the lengths listed below (in inches). Use this data to test the claim that the mean length of an adult GFGW is not 1 inch.

- 0.75, 0,.82, 0.97, 0.99, 1.05, 1.17, 1.28, 1.35

ttest

1. μ =mean length of an adult GFGW
2. Claim: $\mu \neq 1$
3. H_1: $\mu \neq 1$
4. H_0: $\mu = 1$
5. P-value=0.62





6. Do not reject H_0. Do not support H_1.
7. The sample evidence does not support the claim.

Two Independent Means

- Use twomeant

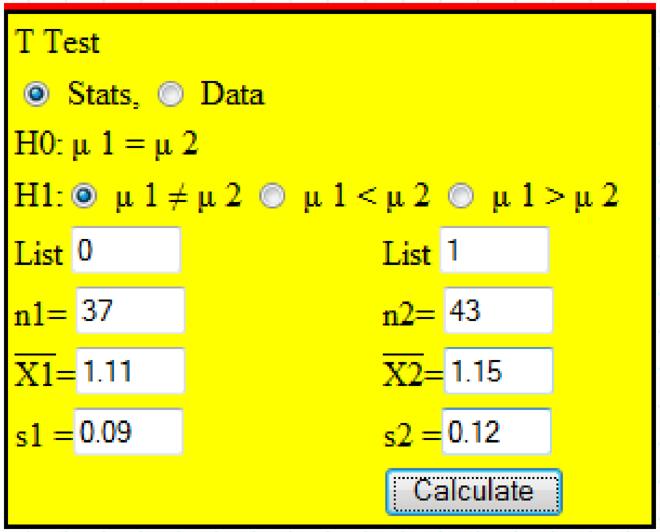
- **Example**: A random sample of 37 GFGWs had an average length of 1.11in with a standard deviation 0.09in. A random sample of 43 blue glow worms had an average length of 1.15in with a standard deviation of 0.12in. Test the claim that **these two types of worms have the same average length**.

twomeant

1. μ_1 =mean length of GFGW

μ_2 =mean length of blue worms

2. Claim: $\mu_1 = \mu_2$
3. H_1: $\mu_1 \neq \mu_2$
4. H_0: $\mu_1 = \mu_2$
5. P-value: 0.09
6. Do not reject H_0. Do not support H_1.
7. There is not enough sample evidence to reject the claim.



Matched Pairs

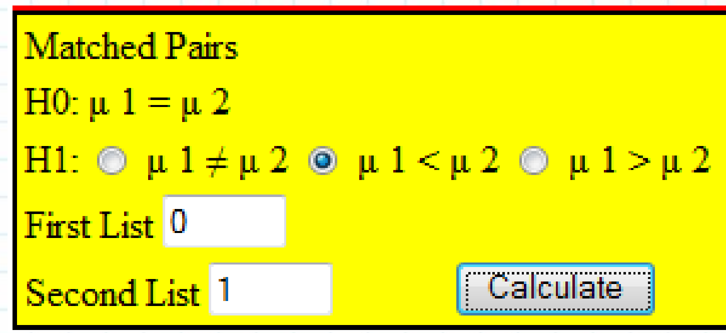
- Use matchedpairs
- **Example**: Below are listed the weights of several GFGWs (in oz) along with the weight of food eaten in one day by the same worm. Test the claim that a GFGW on average eats more than its body weight in a day.

Weight	0.09	0.09	0.11	0.12	0.15	0.15	0.16
Eaten	0.07	0.10	0.12	0.13	0.16	0.17	0.16

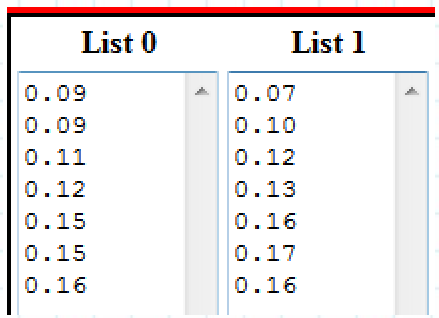
matchedpairs

1. μ_1 =mean weight of GFGW

μ_2 =mean weight of food eaten



2. Claim: $\mu_1 < \mu_2$



3. H_1: $\mu_1 < \mu_2$

4. H_0: $\mu_1 = \mu_2$

5. P-value: 0.14

6. Do not reject H_0. Do not support H_1.

7. The sample evidence does not support the claim.

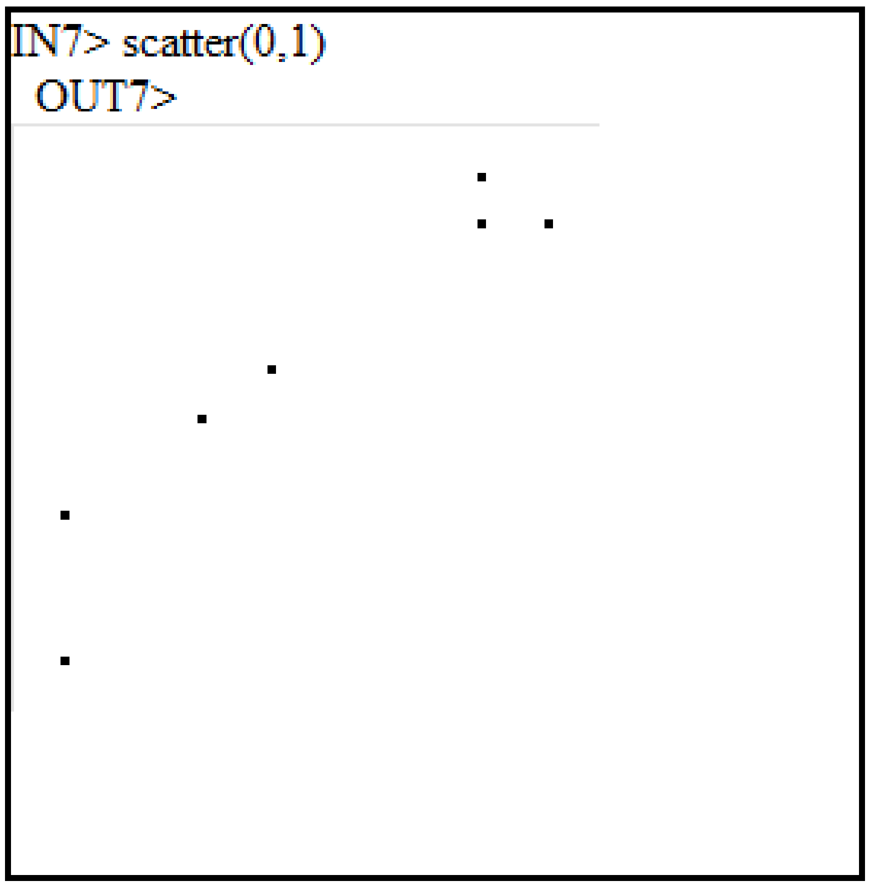
Linear Correlation

- Use correlation
- H_0 is always that there is no linear correlation.
- H_1 is always that there is linear correlation.
- **Example**: Below are listed the weights of several GFGWs (in oz) along with the weight of food eaten in one day by the same worm. Test the claim that **there is a linear correlation between a GFGW's weight and how much the worm eats in a day.**

Weight	0.09	0.09	0.11	0.12	0.15	0.15	0.16
Eaten	0.07	0.10	0.12	0.13	0.16	0.17	0.16

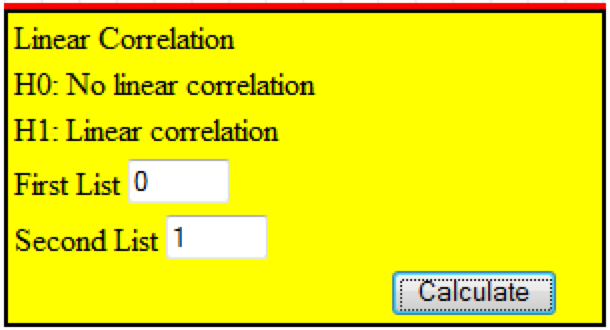
scatter

scatter(0,1) will give:



correlation

1. Claim: there is a linear correlation between weight and the amount of food the worm eats.
2. H_0: there is no linear correlation.
3. H_1: there is linear correlation.
4. P-value: 0.001
5. Reject H_0. Support H_1.
6. The sample evidence supports the claim that there is linear correlation.



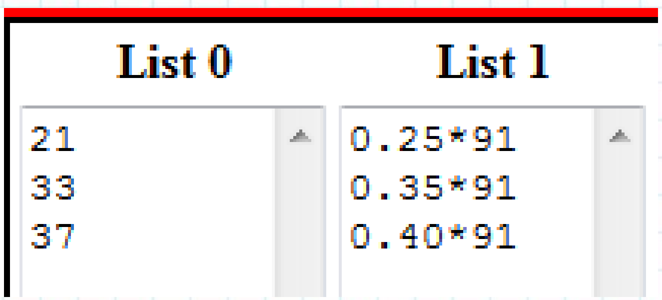
χ^2 Goodness of Fit

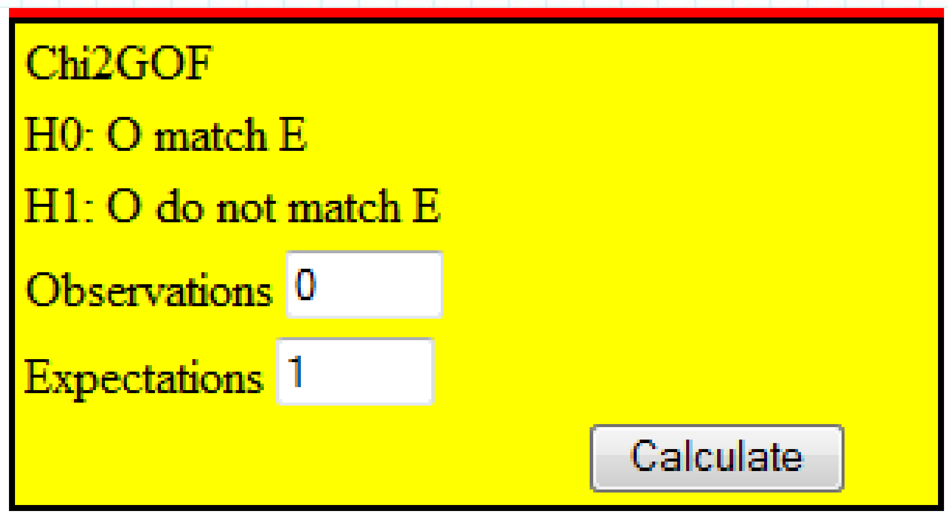
- Use chi2GOF
- H_0 is always that the observed frequencies match the expected values.
- H_1 is always that the observed frequencies do not match the expected values.
- **Example**: A candy company claims that 25% of its candy is brown, 35% is red, and 40% is blue. A bag of candy contained the numbers of each color in the table below. **Test the claim that the actual frequencies of colors match the claimed distribution.**
-

Brown	Red	Blue
21	33	37

chi2GOF

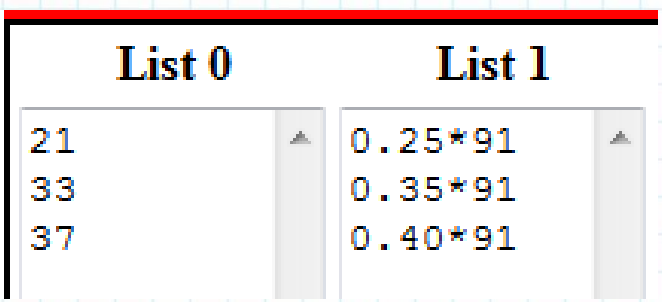
1. Claim: The actual frequencies match the claimed distribution.
2. H_0: Observations match claim
3. H_1: Observations do not match claim

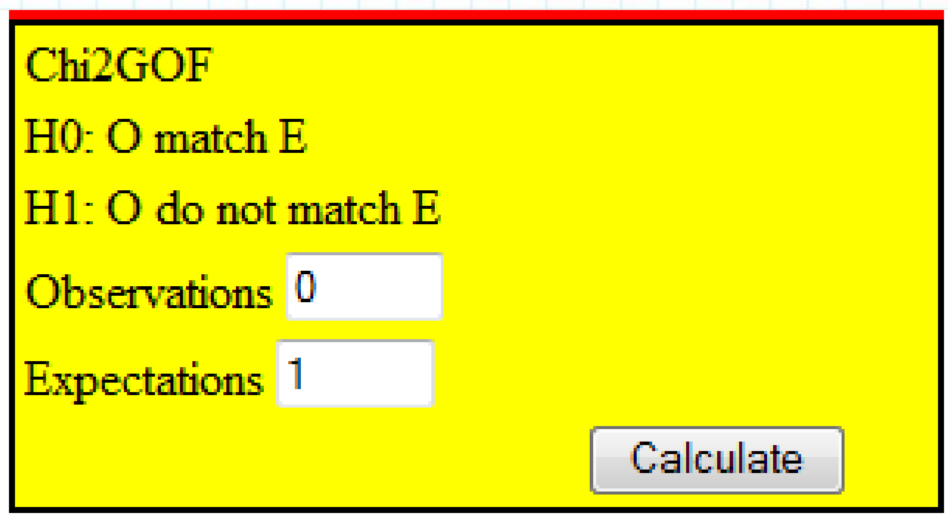




chi2GOF

4. P-value: 0.91
5. Do not reject H_0. Do not support H_1.
6. There is not enough sample evidence to reject the claim.





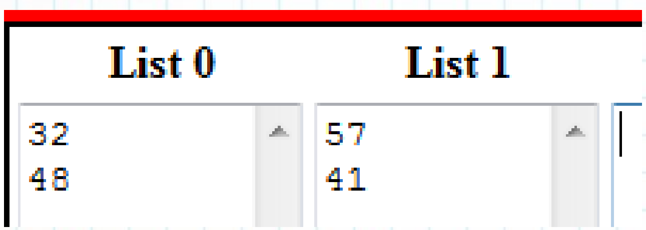
Contingency Table

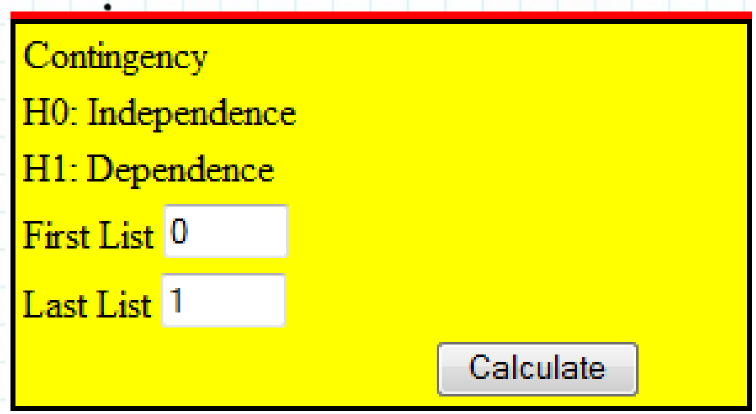
- Use contingency
- H_0 is always that the rows and columns are independent.
- H_1 is always that the rows and columns are dependent.
- **Example**: The genders and dietary preferences of a sample of GFGWs were observed with the results below. Test the claim that **dietary preference is dependent on gender.**
-

	Male	Female
Leaves	32	57
Bark	48	41

contingency

1. Claim: Dietary preference depends on gender
2. H_0: rows and columns are independent
3. H_1: rows and columns are dependent





4. P-value: 0.0159
5. Reject H_0. Support H_1.

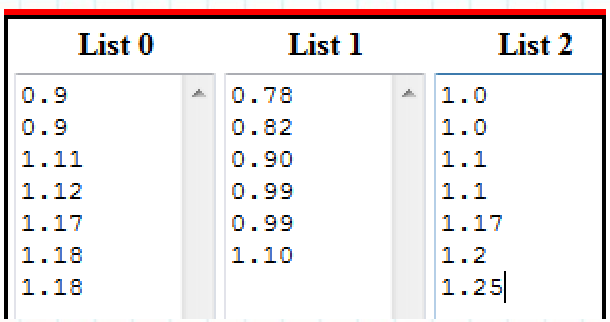
ANOVA

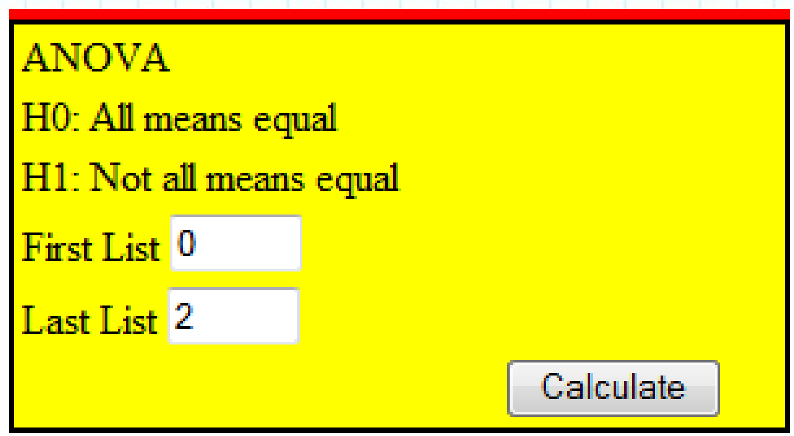
- Use anova
- H_0 is always that the samples come from populations with equal means.
- H_1 is always that the samples do not come from populations with equal means.
- **Example**: The table below lists the lengths of samples of three colors of glow worms. Test the claim that **all three colors have the same mean length.**
-

Grey	0.9	0.9	1.11	1.12	1.17	1.18	1.18
Blue	0.78	0.82	0.90	0.99	0.99	1.10	
Green	1.0	1.0	1.1	1.1	1.17	1.2	1.25

anova

1. Claim: The means are all the same.
2. H_0: The means are all equal.
3. H_1: The means are not all equal.





4. P-value:0.023
5. Reject H_0. Support H_1.