

Data Nugget: Do insects prefer local or foreign foods? 2012 Data Worksheet

Species #	<i>native</i> ₁ species prop leaf herbivory damage	<i>exotic</i> ₂ species prop leaf herbivory damage	<i>invasive</i> ₃ species prop leaf herbivory damage	Native Squared Difference (<i>native</i> _{<i>i</i>} - \bar{x}_1) ²	Exotic Squared Difference (<i>exotic</i> _{<i>i</i>} - \bar{x}_2) ²	Invasive Squared Difference (<i>invasive</i> _{<i>i</i>} - \bar{x}_3) ²
1	0.042	0.000	0.000	(0.042-0.037) ² = 0.000025	(0.000-0.063) ² = 0.003969	(0.000-0.089) ² = 0.007921
2	0.016	0.000	0.000	(0.016-0.037) ² = 0.000441	(0.000-0.063) ² = 0.003969	(0.000-0.089) ² = 0.007921
3	0.074	0.010	0.170	(0.074-0.037) ² = 0.001369	(0.010-0.063) ² = 0.002809	(0.170-0.089) ² = 0.006561
4	0.067	0.028	0.183	(0.067-0.037) ² = 0.0009	(0.028-0.063) ² = 0.001225	(0.183-0.089) ² = 0.008836
5	0.003	0.002	0.029	(0.003-0.037) ² = 0.001156	(0.002-0.063) ² = 0.003721	(0.029-0.089) ² = 0.0036
6	0.032	0.027	0.050	(0.032-0.037) ² = 0.000025	(0.027-0.063) ² = 0.001296	(0.050-0.089) ² = 0.001521
7	0.071	0.025	0.216	(0.071-0.037) ² = 0.001156	(0.025-0.063) ² = 0.001444	(0.216-0.089) ² = 0.016129
8	0.012	0.000	0.091	(0.012-0.037) ² = 0.000625	(0.000-0.063) ² = 0.003969	(0.091-0.089) ² = 0.000004
9	0.149	0.016	0.065	(0.149-0.037) ² = 0.012544	(0.016-0.063) ² = 0.002209	(0.065-0.089) ² = 0.000576
10	0.008	0.293	0.088	(0.008-0.037) ² = 0.000841	(0.293-0.063) ² = 0.0529	(0.088-0.089) ² = 0.000001
11	0.000	0.016		(0.000-0.037) ² = 0.001369	(0.016-0.063) ² = 0.002909	
12	0.167	0.006		(0.167-0.037) ² =0.0169	(0.006-0.063) ² = 0.003249	
13	0.000	0.000		(0.000-0.037) ² = 0.001369	(0.000-0.063) ² = 0.003969	
14	0.004	0.100		(0.004-0.037) ² = 0.001089	(0.100-0.063) ² = 0.001369	
15	0.012	0.241		(0.012-0.037) ² =0.00625	(0.241-0.063) ² = 0.00151321	
16	0.006	0.242		(0.006-0.037) ² = 0.000961	(0.242-0.063) ² = 0.00150544	
17	0.000			(0.000-0.037) ² = 0.001369		
18	0.000			(0.000-0.037) ² = 0.001369		
19	0.046			(0.046-0.037) ² = 0.000081		
20						
21						
22						
23						
24						
Sample Size (n)	19	16	10			
Mean (\bar{x})	$\bar{x}_1 = 0.037$	$\bar{x}_2 = 0.063$	$\bar{x}_3 = 0.089$			
Sum of Squares (SS) = $\sum (x_i - \bar{x}_1)^2$				SS1 = 0.04421	SS2 = 0.09133	SS3 = 0.05307
Variance (s^2) = $\frac{\sum(x_i - \bar{x})^2}{(n - 1)}$				$s_1^2 = 0.00246$	$s_2^2 = 0.00609$	$s_3^2 = 0.00590$
Standard deviation $s = \sqrt{\frac{\sum(x_i - \bar{x})^2}{(n - 1)}}$				$s_1 = 0.04956$	$s_2 = 0.07803$	$s_3 = 0.07679$
Standard error of the mean $SE_{\bar{x}} = \frac{s}{\sqrt{n}}$				$SE_{\bar{x}} = 0.01137$	$SE_{\bar{x}} = 0.01951$	$SE_{\bar{x}} = 0.02428$
95% CI = $\frac{2s}{\sqrt{n}}$				95% CI = 0.02274	95% CI = 0.03901	95% CI = 0.04857

Teacher Note – Statistics Extension: This Data Worksheet allows your students to work with raw data from one year (2012) of this experiment. In this activity, students are guided through the calculation of the mean, sum of squares, variance, standard deviation, standard error of the mean, and 95% confidence intervals for hypothesis testing.

A note to help interpret the data provided in the Data Worksheet – The data presented in this Data Nugget represents the **mean** proportion leaf area eaten by herbivores for native, exotic, and invasive plants, which was calculated in three steps. First, Elizabeth measured 10 leaves per plant, and calculated a mean proportion herbivory for each individual plant (*individual mean*). Second, she took these means for the 10 individuals representing each species and calculated a mean for each species (*species mean*; these values can be found on the Data Worksheet). Finally, she took the species means and averaged them to calculate the mean for each species type (*species type mean*; these values can be found in the table within the Data Nugget). Elizabeth’s analysis is called a mixed model, and the statistical replication for her study is challenging to understand. The unit of replication (or sample size [n]) for this study is the number of species of each plant type (25 native, 25 exotic, 11 invasive), not the number of individuals per species or the number of leaves measured. Elizabeth had multiple individuals per species and measured multiple leaves per individual to get a more accurate estimate of damage levels experienced by a species. The number of leaves measured per plant and the number of individuals included for each species did not impact the statistical power for hypothesis testing.

Additional note – Your students may notice that the Data Worksheet only shows data for 45 species in 2012 (instead of 61 mentioned in the Data Nugget). This is because there were two different experiments combined in this dataset; one study ran in 2011, and the other study ran from 2012-2013. Some of the species were different in the first and second study.

- Data Nugget: Do insects prefer local or foreign foods?
 - <http://datanuggets.org/2014/01/do-insects-prefer-local-or-foreign-foods/>
- Data Worksheet - Teacher Guide
 - http://datanuggets.org/wp-content/uploads/2014/01/Local-or-Foreign-Statistics_Teacher.pdf
- Data Worksheet - Student Activity
 - http://datanuggets.org/wp-content/uploads/2014/01/Local-or-Foreign-Statistics_Student.pdf