Evolution Chi square practice


A structurally magnificent protein signal molecule acting as a neurotransmitter stimulates the most complex and sophisticated region of the frontal cortex known to facilitate the recitation of the symphonically elegant FSU Warchant cheer. A mutated version triggers cells in the most primitive part of the brain stem, often referred to as the reptilian brain, initiating autonomic nervous system functions including audible mouth-breathing, uncontrolled drooling, and reflexive guttural grunts resembling the words to the Neanderthal-era cult incantation titled “We Are the Boys of Old Florida”. While the Warchant gene is clearly dominant to the mutant Old Florida gene, unfortunate heterozygous hybrids can be recognized by the epigenetic marker “House Divided” bumper sticker on their car. Population samplings taken in the past revealed the following data:

<table>
<thead>
<tr>
<th></th>
<th>Warchanters</th>
<th>Old Floridians</th>
<th>Hybrids</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>622</td>
<td>218</td>
<td>720</td>
</tr>
<tr>
<td>2015</td>
<td>919</td>
<td>112</td>
<td>361</td>
</tr>
</tbody>
</table>

Determine if evolution has occurred in the population in the 10 years documented. See solution below.

If it is determined that the population has evolved, select the most likely mechanism from below and justify your selection.

a) In 2006, Walmart begins offering Buy One Get One Free birth control products
b) A tech start-up opened a new operations center nearby, and many high IQ employees re-located to the area.
c) A 2006 hurricane blows a substantial amount of fungal spores into the area. Inhaled spores germinate in lung tissue, resulting in an infection that thickens the vocal cords.

First, determine gene frequencies for 2005. 

\[ q = \frac{1156}{3120} = .37 \quad p = .63 \]

For the 2015 population, a total of 1392 in the sampling would have the following distribution if evolution has not occurred (null hypothesis) and gene frequencies remained at the 2005 values of \( q = .37 \) and \( p = .63 \)

Total 2015 population = 1392. Expected values are calculated like this:

\[
\begin{align*}
\text{# of Warchanters} & = 1392 \times .40 \text{ (p squared)} = 552 \\
\text{# of Old Floridians} & = 1392 \times .14 \text{ (q squared)} = 191 \\
\text{# of Hybrids} & = 1392 \times .47 \text{ (2pq)} = 649
\end{align*}
\]

A Chi Square analysis comparing these expected values (null hypothesis) to the observed ones gives chi2 values of:

\[
\begin{align*}
\text{Warchanters} & - 244 \quad + \quad \text{Old Floridians} - .42 \quad + \quad \text{Hybrids} - 232 \quad = \quad 476.42
\end{align*}
\]

\[ 476.42 > 5.99 \text{ (chi square value at } p = .05 \text{ and two degrees of freedom)} \]

Difference is significant, null hypothesis is not supported/rejected, evolution has occurred.