Advanced Biometry Midterm Exam  (2012)

Due 9:30 a.m. Monday, 2 April

You may use any and all books, computer programs, and whatever else helps, except do not communicate with anyone (except me) about the exam.

Be complete. Do appropriate diagnostics and remedies. Tell me what you did and why. And be sure to state your conclusions. If you’re unsure what I’m after, please ask.

Do not put your name on your answers. Instead identify your answers by your ID number from the list Matt will email to the class.

Put the answers to the two questions on separate pages.

(1)  50 points

This question will use the CRAMP data analyzed in Discussion # 1 (18 Jan.), but to answer a different question. A major aim of the CRAMP project is determine and monitor negative human impacts on coral reefs. One way to address this would be to compare reefs that are near centers of human population, and therefore more subject to exploitation, pollution, etc., to reefs farther from large populations; the latter might be expected to have “healthier” coral populations, with higher coral cover (and perhaps higher coral diversity, though for this question you will focus on coral cover). A complication is that sites near population centers also may differ in ways that affect corals but are not part of human impacts; for instance, they might be more or less wave exposed, more or less subject to freshwater effects, etc., than sites farther from human population centers.

The data:

The data are the same as for Discussion # 1, except do NOT use the variables site, coral diversity, and rugosity. I will distribute a new version of the data set with these variables excluded. There are 150 observations; the first two and last two observations are:

<table>
<thead>
<tr>
<th>coral</th>
<th>pop5km</th>
<th>fishmass</th>
<th>depth</th>
<th>mnwave</th>
<th>wshdarea</th>
<th>strmdist</th>
<th>rain</th>
<th>mAlg</th>
<th>cAlg</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>185094</td>
<td>3.74</td>
<td>0.91</td>
<td>4.2</td>
<td>4099.44</td>
<td>653.27</td>
<td>600</td>
<td>7.2</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>82671</td>
<td>1800.76</td>
<td>12.12</td>
<td>4.2</td>
<td>3824.64</td>
<td>5896.96</td>
<td>600</td>
<td>16.8</td>
<td>0</td>
</tr>
</tbody>
</table>

...85.8 662 14171.17 19.09 2.9 8749.41 1904.74 600 0 0.4

88.4 68 3377.8 13 5.1 19.85 21023.3 400 0 0

The question:

Do sites near larger human populations have lower coral cover than sites near smaller human populations, all else being equal?
This question is an extension of the analysis of silversword population dynamics from Discussion # 0 (11 January). In that Discussion it was seen that the proportion of live plants in a population generally increased with increasing elevation, but also that there was a great deal of variability among the lowest populations, some of which had proportions of live plants similar to those of the highest populations. Note that, as described in Discussion # 0, a separate analysis had shown a positive correlation between the proportion of live plants and the long-term population growth rate.

In hopes of better understanding the factors determining population dynamics, Paul K. and his colleagues measured or determined several additional variables for each of the silversword populations:

- mean annual precipitation, in mm (from the Hawaii Rainfall Atlas; Giambelluca et al. 2011)
- % cover of non-silversword vegetation (from point intercept transects)
- silversword population size (including dead and live plants)
- soil age, in years (from estimates of ages of different lava flows; Sherrod et al. 2008)
- date of the silversword census, as days since the first census

(The different populations were censused at different times spanning nearly half a year, during a dry year in which there was considerably mortality of silverswords. This variable is included to account for the possibility that populations censused later in the study might have suffered some mortality, and thus have lower proportions of live plants, during the time since the first populations were censused.)

The data:

Only 26 of the 31 populations will be used for this analysis. The five highest-elevation populations will be excluded: they were on the outer slopes of the summit of Haleakala on much older soils than the other populations, all of which were inside the “crater.” (These observations already will be excluded from the data set that will be distributed; do not exclude any additional observations.)

The first two and last two observations are:

<table>
<thead>
<tr>
<th>% alive</th>
<th>Elev</th>
<th>Precip</th>
<th>veg cover</th>
<th>Pop size</th>
<th>Soil age</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>38.09</td>
<td>2185</td>
<td>1395</td>
<td>2.2</td>
<td>3788</td>
<td>2250</td>
<td>0</td>
</tr>
<tr>
<td>53.05</td>
<td>2205</td>
<td>1221</td>
<td>2.6</td>
<td>673</td>
<td>2250</td>
<td>9</td>
</tr>
</tbody>
</table>

... 36.62 2402 1117 0.6 325 21500 171
40.95 2366 1110 0.6 315 21500 171

The question:

How is the proportion of live plants in a population related to the environmental variables?
That is, which of these factors appear to affect silversword population dynamics (as represented by the proportion of live plants), and how?