MATH 120: Quiz 1 - 9/03/2014

No reference materials permitted except calculator.

(I) *Consumer Reports* published a report recently in which they evaluated washing machines. They studied 39 models, and reported the brand, cost, size (in ft$^3$), type (top or front loading), estimated energy costs per year, and an overall rating. Identify the “Who” and the “What” for this dataset. Classify the type of each variable (categorical or quantitative).

(II) The 2-way table shows the rank attained by male and female officers in the New York City Police Department (NYPD):

<table>
<thead>
<tr>
<th>Rank</th>
<th>Officer</th>
<th>Lieutenant</th>
<th>Captain or higher</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>4,281</td>
<td>89</td>
<td>22</td>
<td>4,392</td>
</tr>
<tr>
<td>Male</td>
<td>21,900</td>
<td>1,333</td>
<td>577</td>
<td>23,810</td>
</tr>
<tr>
<td>Total</td>
<td>26,181</td>
<td>1,422</td>
<td>599</td>
<td>28,202</td>
</tr>
</tbody>
</table>

(a) Find the percent of females whose rank is Lieutenant or higher.
(b) Determine, using statistically valid methods, whether these data indicate an association between rank and gender in the NYPD. Write a short paragraph summarizing your analysis. [You may omit graphing.]

Remember to show steps – Answers alone will receive no credit.

**Solution**

(I) Who = A sample of 39 models of washing machines.

What = The following 6 variables, with the type indicated in parentheses:

1. brand (categorical)
2. cost (quantitative)
3. size (quantitative)
4. type (categorical)
5. estimated energy costs (quantitative)
6. overall rating (could be quantitative or categorical)

Since “overall rating” could be a numerical score, or a letter grade or symbol, there isn’t enough information to tell whether it is quantitative or categorical.

(II) (a) There are 4,392 females in this dataset, of whom 89+22 have rank of Lieutenant or higher.

Percent of females w/ rank Lieutenant or higher = \[
\frac{89 + 22}{4,392} \times 100 = 2.53\%
\]

(b) The table below shows the conditional distribution of sex for each of the 3 ranks. In other words, percentages are computed column-wise. It also shows the marginal distribution of sex.
The table shows that the conditional distribution of sex changes significantly, depending upon rank of officers in the NYPD. We see that the proportion of women, which is highest among “Officers” (16.4%), drops steadily with increasing rank. There are only 3.7% women among those whose rank is Captain or higher. Conversely, the proportion of men increases as the ranks get higher. The table also shows that the conditional distributions differ appreciably from the marginal distribution, which is another indication that there is an association between gender and rank in these data.

<table>
<thead>
<tr>
<th></th>
<th>Officer</th>
<th>Lieutenant</th>
<th>Captain or higher</th>
<th>Cond. distr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>(\frac{4,281}{26,181} = 16.4%)</td>
<td>(\frac{89}{1,422} = 6.3%)</td>
<td>(\frac{22}{599} = 3.7%)</td>
<td>(\frac{4,392}{28,202} = 15.6%)</td>
</tr>
<tr>
<td>Male</td>
<td>(\frac{21,900}{26,181} = 83.6%)</td>
<td>(\frac{1,322}{1,422} = 93.7%)</td>
<td>(\frac{977}{599} = 96.3%)</td>
<td>(\frac{23,802}{28,202} = 84.4%)</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

**Grading:** Total points possible = 10 + 1 bonus point.

1 pt - Any reasonable attempt.

4 pt for (I): 1pt = correct “who.”

3pt = correct “What” with correct type.

6 pt for (II): (a)=1pt (for correct computation)

(b)=5pt:

1pt = attempt to compute conditional distribution (of any kind)

2pt = correctly compute a complete set of conditional distributions.

2pt = reasonable statement summarizing findings