MATH201
Summer College 2003

Quiz 1

Name: Key /50

Instructions:

1. Do not start until instructed to do so.
2. You may use a calculator and one 3” x 5” card (front and back) with notes, but nothing else.
3. The work you turn in must be your own.
4. SHOW ALL WORK.
Questions 1-5: The following descriptive statistics and histogram are based on the final course grades in MATH202 last semester. Use this information to answer the following questions.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>course</td>
<td>252</td>
<td>75.67</td>
<td>16.20</td>
<td>4.83</td>
<td>98.42</td>
</tr>
</tbody>
</table>

1. **2 points** Which of the following is closest to the median for these data?
   A. 50  B. 60  **C. 80**  D. 90  E. 55

2. **4 points** If the highest course average were changed to a 100, what effect would the change have on the median? What effect would the change have on the standard deviation?
   The median would remain the same.  
The standard deviation would increase (more spread).

3. **3 points** About what proportion of the class failed (below 60 is failing)? Shade in the portion of the histogram that corresponds to this proportion.
   About 10%

4. **4 points** Steve, who took MATH202 last semester, earned a 90 course average. His friend Ruth, who took a very similar course at another university where the mean was 60.0 and the standard deviation was 5.5, earned a 71.6 course average. Compare Steve and Ruth on the basis of their performance in the course relative to their classmates.

   \[
   \text{Steve: } Z = \frac{90 - 75.67}{16.20} = 0.88
   \]

   \[
   \text{Ruth: } Z = \frac{71.6 - 60.0}{5.5} = 2.11
   \]

   Ruth's score was more than 2 standard deviations above the mean for her class while Steve's wasn't even one standard deviation above the mean. Ruth did better relative to her classmates.
Questions 5-9 (2 points each): The United States Supreme Court ruled on Monday that minority applicants can be given an edge when applying to colleges and universities, but only a very narrow edge. The latest Gallup Poll finds Americans generally divided on affirmative action programs for minorities, but substantially opposed to any program that may give minorities a clear edge in college admissions -- perhaps even the slight edge that the Supreme Court would grant. One question asked was, "Which comes closer to your view about evaluating students for admission into a college or university -- applicants should be admitted solely on the basis of merit, even if that results in few minority students being admitted (or) an applicant's racial and ethnic background should be considered to help promote diversity on college campuses, even if that means admitting some minority students who otherwise would not be admitted?" Overall, 69% of those surveyed said that admission should be based solely on merit while 27% said race/ethnic background should be considered. (4% had no opinion). These results are based on telephone interviews with 1,385 national adults, aged 18+, conducted June 12-18, 2003, including blacks and Hispanics, whose responses are weighted to reflect their proportions in the general population.

5. Describe the population of interest.

   *All American adults, aged 18+ (with telephones).*

6. What is the variable of interest? Is it quantitative or qualitative?

   "Which is closer to your view: only merit, race considered, or no opinion?"

7. What is the parameter of interest?

   Either the proportion of all Americans who feel "only merit" or "race should be considered.

8. Give the numeric value of the statistic that estimates the parameter you gave above.

   Either 69% or 27%.

9. Is this problem descriptive or inferential in nature?

Questions 10, 11: A soft-drink bottler fills bottles with soda. For quality assurance purposes, filled bottles are sampled to ensure that they contain close to the content indicated on the label. A sample of 30 bottles of soda contain the amounts, in milliliters, shown in the following table. The data have been ordered from lowest to highest. The mean and standard deviation are 993 and 29, respectively.

<table>
<thead>
<tr>
<th>914</th>
<th>946</th>
<th>957</th>
<th>959</th>
<th>964</th>
<th>974</th>
<th>975</th>
<th>977</th>
<th>977</th>
<th>984</th>
</tr>
</thead>
<tbody>
<tr>
<td>986</td>
<td>987</td>
<td>988</td>
<td>989</td>
<td>990</td>
<td>991</td>
<td>995</td>
<td>996</td>
<td>997</td>
<td>999</td>
</tr>
<tr>
<td>1001</td>
<td>1010</td>
<td>1014</td>
<td>1017</td>
<td>1018</td>
<td>1025</td>
<td>1028</td>
<td>1030</td>
<td>1031</td>
<td>1060</td>
</tr>
</tbody>
</table>
10. **2 points** Which of the following would be an appropriate way to summarize these data graphically? Circle all that apply.
   A. pie chart  
   B. histogram  
   C. dotplot  
   D. bar chart  
   E. x,y scatterplot

11. **5 points** Compute the 1-standard deviation interval around the mean. Give the actual percentage of the data values that fall in it and the percentage predicted by the Empirical Rule. Does the Empirical Rule model "fit" the data? Explain. (You do not need to check the other two intervals. Make your assessment based on only the 1-standard deviation interval you found.)

\[
\bar{x} \pm s = 993 \pm 29 \rightarrow (964, 1022) \quad 2 \frac{1}{3} \sigma = 70\% \quad \text{vs.} \quad 68\%
\]

For this interval, the data seem to fit the normal curve model (Empirical Rule) fairly well.

Questions 12-13: When a person completes their federal income tax return for a given year, the "bottom line" is a dollar amount indicating either how much the person owes the government in taxes (if too little tax was withheld during the year) or how much the government owes the person as a refund (if too much tax was withheld during the year). According to the Internal Revenue Service, income tax returns one year averaged $1,332 in refunds for taxpayers. One explanation for this figure is that taxpayers would rather have the government keep back too much money during the year than to owe it money at the end of the year. Suppose the average refund at the end of last year was $1,332 with a standard deviation of $666, for all taxpayers. Assume these amounts were bell-shaped.

12. **4 points** What proportion of all taxpayers got a refund last year? i.e. refunds > 0

\[
\begin{align*}
\frac{2.5\%}{97.5\%} \times 2 \times 666 &= 1332, \quad \text{so} \quad 0 \quad \text{is} \quad 2 \text{ standard deviations below the mean} \\
\bar{x} &= 1332 \\
97.5\% &\text{ get a refund}
\end{align*}
\]

13. **4 points** Give the refund amount that is at the 84th percentile of the distribution.

\[
\begin{align*}
16\% + 68\% &= 84\% \\
? &= 1332 + 666 = $1998
\end{align*}
\]
**Questions 14-15:** In the paper “The Relation of Sex and Sense of Direction to Spatial Orientation in an Unfamiliar Environment” (Journal of Environmental Psychology, 2000, Vol. 20, pp. 17-28), Sholl et al. published the results of examining the sense of direction of male and female students. After being taken to an unfamiliar wooded park, the students were given some spatial orientation tests, including pointing to south, which tested their absolute frame of reference. The students pointed by moving a pointer attached to a 360° protractor. The following data are the absolute pointing errors, in degrees, of the participants.

<table>
<thead>
<tr>
<th></th>
<th>13</th>
<th>130</th>
<th>39</th>
<th>33</th>
<th>10</th>
<th>13</th>
<th>68</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>14</td>
<td>8</td>
<td>20</td>
<td>5</td>
<td>138</td>
<td>122</td>
<td>78</td>
</tr>
</tbody>
</table>

14. **2 points** Construct two dotplots of the data, one for each group. Use the scales below to help you.

![Male Dotplot](image)

![Female Dotplot](image)

15. **3 points** Comment on the relationship between gender and sense of direction.

*There doesn’t appear to be a clear relationship between gender and sense of direction in these data.*
Questions 16, 17: The US Bureau of the Census compiles census data on educational attainment of Americans. From the document 1990 Census of Population, the distribution of educational attainment for all US adults 25 years old and older is shown on the left below. On the right is the distribution of a sample of US adults (25 years old and older) taken this year.

<table>
<thead>
<tr>
<th>Highest Level</th>
<th>Percentage</th>
<th>Highest Level</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not HS graduate</td>
<td>24.8</td>
<td>Not HS graduate</td>
<td>86</td>
<td>17.2%</td>
</tr>
<tr>
<td>HS graduate</td>
<td>30.0</td>
<td>HS graduate</td>
<td>169</td>
<td>33.5%</td>
</tr>
<tr>
<td>Some college</td>
<td>18.7</td>
<td>Some college</td>
<td>86</td>
<td>17.2%</td>
</tr>
<tr>
<td>Associate’s degree</td>
<td>6.2</td>
<td>Associate’s degree</td>
<td>37</td>
<td>7.4%</td>
</tr>
<tr>
<td>Bachelor’s degree</td>
<td>13.1</td>
<td>Bachelor’s degree</td>
<td>82</td>
<td>16.4%</td>
</tr>
<tr>
<td>Advanced degree</td>
<td>7.2</td>
<td>Advanced degree</td>
<td>40</td>
<td>8.0%</td>
</tr>
</tbody>
</table>

16. 2 points What proportion of all US adults 25 years old and older had educational experiences beyond high school in 1990?

\[
18.7 + 6.2 + 13.1 + 7.2 = 45.2\%
\]

17. 2 points Is there evidence that the distribution of educational attainment in the US population of adults aged 25 and over has changed since 1990? Explain.

There is some evidence in the sample that the distribution has changed, especially in the “Not HS grad” category. Whether this is due to the fact that we only have partial information in the sample or to a real change in the population is a question that needs to be answered.

18. 3 points Consider the following sample of baby weights (in pounds) from recent hospital records:

7.5, 8.2, 8.3, 7.9, 8.1 \hspace{1cm} \bar{x} = 8

What is the standard deviation of these weights? (Show me that you know how to use the formula.)

\[
\sigma = \sqrt{\frac{1}{n-1} \sum_{i=1}^{n} (x_i - \bar{x})^2} = \sqrt{\frac{(7.5-8)^2 + (8.2-8)^2 + (8.3-8)^2 + (7.9-8)^2 + (8.1-8)^2}{5-1}}
\]

\[
= \sqrt{\frac{4}{4}} = \sqrt{1} = 1 \hspace{1cm} \approx 1.3162
\]