DIRECTIONS:

- Important! Before starting, see STATS HOMEWORK tips in the STATS GUIDE on Notebook page 1!

- Your decision to Carefully Read and Follow that advice (or not) can be fateful for your semester’s performance and course grade!

- Refer back to Topic 1 and Topic 2 Examples as “prototypes problems.”

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**Topic 1 Problems**

**Problem 1 (Truth in advertising)**

*Wal-Mart, Inc.* advertises that almost all of the products it sells are manufactured in the United States, and *Made In The U.S.A.* signs can be found throughout every *Wal-Mart* store in the U.S. Recently, a consumer watchdog group named *Consumers for Truth in Advertising* accused *Wal-Mart* of false advertising. The consumer group claims that, in fact, more than half of all *Wal-Mart* stores in the U.S. generate at least 20% of sales revenue from foreign-made goods. *Wal-Mart* denies the claim, asserting instead that no more than 10% of its U.S. stores generate at least 20% of sales revenue from foreign-made goods.

Suppose that there are 6400 *Wal-Mart* stores in the U.S., and that an independent auditing company randomly selects 40 of these. The auditing company carefully audits each of these 40 stores and records for each a “Yes” or “No” answer to whether or not the store generates at least 20% of sales revenue from foreign-made goods. Suppose that the auditor finds that 13 out of the 40 stores audited generate at least 20% of sales revenue from foreign-made goods.

(a) Apply the Six Steps of Inference. (But before Step 1 also express the question *non-numerically.* )

(b) Does *Wal-Mart* appear to be correct in its claim? Does the consumer group appear to be correct in its claim? Explain, based on the auditor’s results.
Problem 2 (Gas versus diesel)
The American Automobile Association (AAA) is a national organization that also has 50 state chapters. Members of the Iowa chapter of the AAA would like to compare prices of regular gasoline to prices of diesel fuel within the state of Iowa.

In particular, suppose that the Iowa chapter would like to test the theory that diesel is more expensive on average than regular gasoline at Iowa service stations that sell both fuels, on Sept. 30, 2018.

The AAA national organization provides the Iowa chapter with a database of prices, shown in the table below. The database is developed as follows:

- Five zip codes are randomly selected from all zip codes in the state of Minnesota, and five zip codes are randomly selected from all zip codes in the state of Iowa.
- In each selected zip code, a service station that sells both fuels is randomly chosen from all such service stations in that zip code. The prices for both diesel and regular gas on Sept. 30, 2018 at the chosen station are recorded in the database.

<table>
<thead>
<tr>
<th>Zip Code</th>
<th>City</th>
<th>State</th>
<th>Price (dollars/gallon) for Regular Gas</th>
<th>Price (dollars/gallon) for Diesel Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>50005</td>
<td>Minerva</td>
<td>Iowa</td>
<td>3.66</td>
<td>3.73</td>
</tr>
<tr>
<td>50021</td>
<td>Ankeny</td>
<td>Iowa</td>
<td>3.63</td>
<td>3.60</td>
</tr>
<tr>
<td>55005</td>
<td>Bethel</td>
<td>Minnesota</td>
<td>3.81</td>
<td>3.88</td>
</tr>
<tr>
<td>56258</td>
<td>Marshall</td>
<td>Minnesota</td>
<td>3.86</td>
<td>3.92</td>
</tr>
<tr>
<td>50101</td>
<td>Galt</td>
<td>Iowa</td>
<td>3.72</td>
<td>3.80</td>
</tr>
<tr>
<td>56678</td>
<td>Becida</td>
<td>Minnesota</td>
<td>3.83</td>
<td>3.88</td>
</tr>
<tr>
<td>55732</td>
<td>Pike</td>
<td>Minnesota</td>
<td>3.93</td>
<td>3.98</td>
</tr>
<tr>
<td>50438</td>
<td>Miller</td>
<td>Iowa</td>
<td>3.60</td>
<td>3.67</td>
</tr>
<tr>
<td>52050</td>
<td>Greeley</td>
<td>Iowa</td>
<td>3.58</td>
<td>3.64</td>
</tr>
<tr>
<td>55383</td>
<td>Norwood</td>
<td>Minnesota</td>
<td>3.84</td>
<td>3.87</td>
</tr>
</tbody>
</table>

(a) Complete Step 2 of the Six Steps: Identify the statistical population or populations. (Choose the single best answer from the five choices (A1)–(A5) below.)

(A1) All service stations in Iowa that serve both diesel and regular gas
(A2) All automobile users in the state of Iowa
(A3) There are two populations:
  - Pop 1 = All service stations in Iowa that serve both diesel and regular gas
  - Pop 2 = All service stations in Minnesota that serve both diesel and regular gas

(A4) There are two populations:
  - Pop 1 = All automobile users in the state of Iowa
  - Pop 2 = All automobile users in the state of Minnesota

(A5) There are two populations:
  - Pop 1 = All zip codes in the state of Iowa
  - Pop 2 = All zip codes in the state of Minnesota

(continued)
(b) Complete Step 3: Identify the sample or samples.
(Choose the single best answer.)

(A1) Five service stations in Iowa whose prices for diesel and regular gas are recorded in the database

(A2) Five automobile users in the state of Iowa who purchase fuel on Sept. 30, 2018

(A3) There are two samples:
- Sample 1 = Five service stations in Iowa whose prices for diesel and regular gas are recorded in the database
- Sample 2 = Five service stations in Minnesota whose prices for diesel and regular gas are recorded in the database

(A4) There are two samples:
- Sample 1 = Five automobile users in the state of Iowa who purchase fuel on Sept. 30, 2018
- Sample 2 = Five automobile users in the state of Minnesota who purchase fuel on Sept. 30, 2018

(A5) There are two samples:
- Sample 1 = Five zip codes in the state of Iowa from which a single service station is chosen
- Sample 2 = Five zip codes in the state of Minnesota from which a single service station is chosen

(A6) There are two samples:
- Sample 1 = Five service stations in Iowa whose price for diesel only is recorded in the database.
- Sample 2 = Five service stations in Iowa whose price for regular gas only is recorded in the database.

(c) Complete Step 4: Identify the variable or variables measured on the sample or samples.
(Write out the answer.)

(d) Does the theory appear to be correct? (Choose the single best answer.)

(A1) Yes, since 3.797 > 3.746
(A2) No, since 3.797 > 3.746
(A3) Yes, since 3.688 > 3.638
(A4) No, since 3.688 > 3.638

(continued)
Problem 3  (Gas versus diesel, revisited)
The American Automobile Association (AAA) is a national organization that also has 50 state chapters. Members of the Iowa chapter of the AAA would like to compare prices of regular gasoline to prices of diesel fuel within the state of Iowa.

In particular, suppose that the Iowa chapter would like to test the theory that diesel is more expensive on average than regular gasoline at Iowa service stations that sell both fuels, on Sept. 30, 2018.

The AAA national organization provides the Iowa chapter with a database of prices, shown in the table below. The database is developed as follows:

- Ten zip codes are randomly selected from all zip codes in the state of Minnesota, and ten zip codes are randomly selected from all zip codes in the state of Iowa.

- In each selected zip code, a service station that sells both fuels is randomly chosen from all such service stations in that zip code. The price for either diesel or regular gas (but not both) on Sept. 30, 2018 at the chosen station is recorded in the database.

<table>
<thead>
<tr>
<th>Zip Code</th>
<th>City</th>
<th>State</th>
<th>Price (dollars/gallon) for Regular Gas</th>
<th>Price (dollars/gallon) for Diesel Fuel</th>
</tr>
</thead>
<tbody>
<tr>
<td>50005</td>
<td>Minerva</td>
<td>Iowa</td>
<td>3.66</td>
<td>—</td>
</tr>
<tr>
<td>50021</td>
<td>Ankeny</td>
<td>Iowa</td>
<td>3.63</td>
<td>—</td>
</tr>
<tr>
<td>50066</td>
<td>Dawson</td>
<td>Iowa</td>
<td>3.58</td>
<td>—</td>
</tr>
<tr>
<td>51591</td>
<td>Red Oak</td>
<td>Iowa</td>
<td>3.60</td>
<td>—</td>
</tr>
<tr>
<td>52146</td>
<td>Egan</td>
<td>Iowa</td>
<td>3.72</td>
<td>—</td>
</tr>
<tr>
<td>50101</td>
<td>Galt</td>
<td>Iowa</td>
<td>—</td>
<td>3.80</td>
</tr>
<tr>
<td>51249</td>
<td>Cloverdale</td>
<td>Iowa</td>
<td>—</td>
<td>3.73</td>
</tr>
<tr>
<td>50613</td>
<td>Cedar Falls</td>
<td>Iowa</td>
<td>—</td>
<td>3.60</td>
</tr>
<tr>
<td>50438</td>
<td>Miller</td>
<td>Iowa</td>
<td>—</td>
<td>3.67</td>
</tr>
<tr>
<td>52050</td>
<td>Greeley</td>
<td>Iowa</td>
<td>—</td>
<td>3.64</td>
</tr>
<tr>
<td>55373</td>
<td>Rockford</td>
<td>Minnesota</td>
<td>3.81</td>
<td>—</td>
</tr>
<tr>
<td>55380</td>
<td>Silver Creek</td>
<td>Minnesota</td>
<td>3.84</td>
<td>—</td>
</tr>
<tr>
<td>56006</td>
<td>Mankato</td>
<td>Minnesota</td>
<td>3.86</td>
<td>—</td>
</tr>
<tr>
<td>56280</td>
<td>Porter</td>
<td>Minnesota</td>
<td>3.83</td>
<td>—</td>
</tr>
<tr>
<td>55072</td>
<td>Danforth</td>
<td>Minnesota</td>
<td>3.93</td>
<td>—</td>
</tr>
<tr>
<td>55005</td>
<td>Bethel</td>
<td>Minnesota</td>
<td>—</td>
<td>3.88</td>
</tr>
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<td>Marshall</td>
<td>Minnesota</td>
<td>—</td>
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<td>Minnesota</td>
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</tr>
<tr>
<td>55383</td>
<td>Norwood</td>
<td>Minnesota</td>
<td>—</td>
<td>3.87</td>
</tr>
</tbody>
</table>

(questions for Problem 3 on next page)
(a) Complete Step 2. (Choose the single best answer.)

(A1) All service stations in Iowa that serve both diesel and regular gas

(A2) All automobile users in the state of Iowa

(A3) There are two populations:
   - Pop 1 = All service stations in Iowa that serve both diesel and regular gas
   - Pop 2 = All service stations in Minnesota that serve both diesel and regular gas

(A4) There are two populations:
   - Pop 1 = All automobile users in the state of Iowa
   - Pop 2 = All automobile users in the state of Minnesota

(A5) There are two populations:
   - Pop 1 = All zip codes in the state of Iowa
   - Pop 2 = All zip codes in the state of Minnesota

(b) Complete Step 3. (Choose the single best answer.)

(A1) Ten automobile users in the state of Iowa who purchase fuel on Sept. 30, 2018

(A2) There are two samples:
   - Sample 1 = Ten service stations in Iowa whose prices for diesel and regular gas are recorded in the database
   - Sample 2 = Ten service stations in Minnesota whose prices for diesel and regular gas are recorded in the database

(A3) There are two samples:
   - Sample 1 = Ten automobile users in the state of Iowa who purchase fuel on Sept. 30, 2018
   - Sample 2 = Ten automobile users in the state of Minnesota who purchase fuel on Sept. 30, 2018

(A4) There are two samples:
   - Sample 1 = Ten zip codes in the state of Iowa from which a single service station is chosen
   - Sample 2 = Ten zip codes in the state of Minnesota from which a single service station is chosen

(A5) There are two samples:
   - Sample 1 = Five service stations in Iowa whose price for diesel only is recorded in the database.
   - Sample 2 = Five service stations in Iowa whose price for regular gas only is recorded in the database.

(c) Write out the answer to Step 5.

(d) Write out the answer to Step 6.
Topic 2 Problems

1. Often an easy way to remember a Stats idea or concept (such as standard deviation) is to keep a simple example in mind. We’ll try this by comparing variability in a really simple example!

Compare the lengths of brown squirrels to black squirrels in southeastern Texas. Suppose three squirrels of each type are caught, with the following length measurements, in centimeters:

<table>
<thead>
<tr>
<th>Brown Squirrels</th>
<th>Black Squirrels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen</td>
<td>Length</td>
</tr>
<tr>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
</tr>
</tbody>
</table>

Grab the long-hand formula for sample variance $s^2$ from page 59 in the Notebook:

$$ s^2 = \frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n - 1} $$

(a) Find $s^2_{Brown}$ and $s_{Brown}$ by filling in all blanks in the table below, similar to the table used for the sample of daily Hotspot use on Notebook page 59:

Brown Squirrels

<table>
<thead>
<tr>
<th>$i$</th>
<th>$x_i$</th>
<th>$\bar{x}$</th>
<th>$x_i - \bar{x}$</th>
<th>$(x_i - \bar{x})^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$x_1 = \text{______}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$x_2 = \text{______}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$x_3 = \text{______}$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$s^2_{Brown} = \text{_____} \quad s_{Brown} = \text{_____}$

(b) Now repeat for $s^2_{Black}$ and $s_{Black}$:

Black Squirrels

<table>
<thead>
<tr>
<th>$i$</th>
<th>$x_i$</th>
<th>$\bar{x}$</th>
<th>$x_i - \bar{x}$</th>
<th>$(x_i - \bar{x})^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$x_1 = \text{______}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>$x_2 = \text{______}$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>$x_3 = \text{______}$</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$s^2_{Black} = \text{_____} \quad s_{Black} = \text{_____}$
(c) The simple graph below shows lengths of both samples of squirrels. Which type of squirrel appears to be more variable in length, based on the graph?

(d) Consider variability a second way — numerically instead of graphically. Provide numerical evidence that supports your graphical conclusion in (c).

(e) Assume that biologists know that both brown squirrels and black squirrels are bell-shaped in their lengths. What are the minimum and maximum lengths between which approximately 95% of all brown squirrels will measure?

(f) What are the minimum and maximum lengths between which approximately 95% of all black squirrels will measure?

(g) Consider variability yet another (third) way — in bell curves. Which type of squirrel shows greater variability in length based on answers (e) and (f) alone? Be specific in your answer. (Cite numbers other than standard deviation or variance.)

2. Twenty students who took Business Stats last semester were interviewed for the number of midterm exams (out of two exams) for which the student was personally satisfied with his/her performance.

1  2  1  0  2
2  1  1  0  0
2  2  1  1  0
0  1  2  1  1

(a) Construct a histogram for these data.
(b) What’s the proportion of students in the sample who are satisfied with more than one exam?
(c) What’s the proportion of students in the sample who are satisfied with less than two exams?
(d) If a student is selected at random from the sample, what’s the probability that he or she is satisfied with two exams?

(continued)
3. The number of home loan applications granted during January, 2019 for a sample of 50 commercial banks follows:

```
2 4 2 32 9 9 2 6 3 1
14 9 16 7 8 19 6 4 4 2
4 18 0 6 13 7 2 8 0 1
14 1 2 2 18 8 24 1 8 5
1 3 11 18 26 3 12 23 5 4
```

(a) Construct a histogram for these data.
(b) What fraction of these 50 commercial banks granted 10 or fewer home loans in January, 2019?

4. Consider the following data:

```
652  648  658  662
653  654  670  671
674  666  679  679
653  652  667  671
655  677  646  678
682  678  669  650
```

(a) What’s the appropriate choice for the stem in a stem-and-leaf plot? What’s the choice for the leaf?
(b) Make the stem plot.

5. A group of school children in a physical education class is measured according to the number of consecutive skips without error while skipping rope.

```
24  9 13  98 17 41 23 22 29 25 20 22 21 18 15 62 22 13 41 18
13 16 75 11 32 9 16 9 16 6 54 16 6 20 10 37 9 4  8 22
21 31  1 16 19
```

(a) Construct a stem-and-leaf plot.
(b) Does the Bell Curve Rule provide a good description for the population of all such school children? Why or why not?
(c) What’s the best estimate of the minimum number of skips without error by the 40% of children who do the best??

6. Given \( n = 10 \) measurements: 3, 5, 4, 6, 10, 5, 6, 2, 8, find \( \bar{x} \) and \( m \).

(continued)
7. Often consumers can save considerable cash by purchasing computers directly from the manufacturer—an average of $900 by some estimates. The direct-sale satisfaction ratings (on a scale of 1 to 9) for seven such companies, based on a survey of 4000 buyers, are shown below.

<table>
<thead>
<tr>
<th>Company</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sony</td>
<td>7.5</td>
</tr>
<tr>
<td>Dell</td>
<td>7.9</td>
</tr>
<tr>
<td>Lenovo</td>
<td>7.4</td>
</tr>
<tr>
<td>Gateway</td>
<td>8.2</td>
</tr>
<tr>
<td>Hewlett Packard</td>
<td>7.8</td>
</tr>
<tr>
<td>Zotac</td>
<td>7.7</td>
</tr>
<tr>
<td>Apple</td>
<td>8.0</td>
</tr>
</tbody>
</table>

(a) Find the average satisfaction rating for these seven companies.
(b) Find the typical satisfaction rating.
(c) If you were shopping for a computer, would you be interested in the average satisfaction rating? If not, what measure would you be interested in, and why?

8. Given \( n = 5 \) measurements: 2, 4, 0, 3, 1, find the sample mean \( \bar{x} \) and sample standard deviation \( s \). (Don’t use the long-hand formula for \( s^2 \). Input numbers into your calculator instead!) (Calculate \( s \) correctly to 3 decimal places accuracy.)

9. Bob is a cashier at the New Pioneer Food Co-op in Coralville. Times (in seconds) for Bob to check customers out are recorded as 15, 62, 53, 11, 38, 75, 112, 40, 22, 57.

(a) Calculate \( \bar{x} \) and \( s \). (Calculate to 2 decimal places accuracy.)
(b) Apply the Bell Curve Rule to describe the relevant population.
(c) Explain why applying the Bell Curve Rule to Bob’s checkout times seems to have been a mistake.

10. The inflation rate is the percentage increase in general price levels from one year to the next. Inflation has long been a problem in a particular South American country. The data below show annual inflation rates for that country over the past 25 years. (Tip: What do negative numbers mean?)

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0</td>
<td>6.0</td>
<td>7.5</td>
<td>15.0</td>
<td>12.0</td>
</tr>
<tr>
<td>6.5</td>
<td>8.0</td>
<td>4.0</td>
<td>5.5</td>
<td>6.0</td>
</tr>
<tr>
<td>5.0</td>
<td>12.0</td>
<td>-1.0</td>
<td>-3.5</td>
<td>3.0</td>
</tr>
<tr>
<td>7.5</td>
<td>5.0</td>
<td>10.0</td>
<td>8.0</td>
<td>3.5</td>
</tr>
<tr>
<td>9.0</td>
<td>12.0</td>
<td>6.5</td>
<td>1.0</td>
<td>5.0</td>
</tr>
</tbody>
</table>

(a) Calculate \( \bar{x} \) and \( s \).
(b) Apply the Bell Curve Rule to describe the relevant population.

11. Television commercials on the Fox Business Network average 75 seconds, with standard deviation 20 seconds. Assuming that times for commercials on FBN are bell-shaped,

(a) Approximately what percentage of commercials last less than 35 seconds?
(b) Approximately what percentage of commercials last longer than 55 seconds?

(end of assignment)