Questions 1, 2 and 3 refer to the following table which lists the weekly wage for employees at a small manufacturing plant.

<table>
<thead>
<tr>
<th>Weekly Wage</th>
<th>Number of Employees</th>
</tr>
</thead>
<tbody>
<tr>
<td>$308</td>
<td>3</td>
</tr>
<tr>
<td>$312</td>
<td>6</td>
</tr>
<tr>
<td>$316</td>
<td>5</td>
</tr>
<tr>
<td>$320</td>
<td>5</td>
</tr>
<tr>
<td>$324</td>
<td>4</td>
</tr>
<tr>
<td>$328</td>
<td>2</td>
</tr>
</tbody>
</table>

1. What is the median wage at this plant?
   There are 25 employees \((3 + 6 + 5 + 5 + 4 + 2 = 25)\). If we list them in order by wages, the first 3 get $308, the next six get $312 and the next five get $316. In that group of five is the thirteenth employee; the “middle” one. His/her wage is the median: $316.
   a) 312  
   b) 316 ← CORRECT ANSWER  
   c) 317  
   d) 318  
   e) 320

2. What is the mean wage at this plant?
   The mean wage is the average wage. We add up all the wages and divide by 25, the number of employees. The sum of all the wages is
   \[3 \times 308 + 6 \times 312 + 5 \times 316 + 5 \times 320 + 4 \times 324 + 2 \times 328 = 7928.\]
   The mean wage is \(\frac{7928}{25} = 317.12\), which we may round off to 317.
   a) 312  
   b) 316 ← CORRECT ANSWER  
   c) 317 ← CORRECT ANSWER  
   d) 318  
   e) 320

3. What is the mode of this data set?
   The mode is the “most popular” wage, which is $312 since six employees make that much, more than make any other wage.
   a) 312 ← CORRECT ANSWER  
   b) 316  
   c) 317  
   d) 318  
   e) 320
4. Jodie has the following coins in her purse: 6 pennies, 5 nickels, 3 dimes and 4 quarters. One of the coins falls out. What is the probability that the coin is a quarter?

Jodie has 18 coins \((6 + 5 + 3 + 4 = 18)\). There are 18 possible coins to fall out. There are 4 of these which we’re interested in, so the probability is \(4/18 = 2/9\).

a) 1/4  
b) 2/9 ←CORRECT ANSWER  
c) 3/4  
d) 0  
e) 1

5. According to the Mathematical Sciences Department, student complaints about my grading for the last seven years are as follows:

<table>
<thead>
<tr>
<th>Academic Year</th>
<th>Number of Complaints</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994-1995</td>
<td>15,719</td>
</tr>
<tr>
<td>1995-1996</td>
<td>17,077</td>
</tr>
<tr>
<td>1996-1997</td>
<td>19,264</td>
</tr>
<tr>
<td>1997-1998</td>
<td>19,887</td>
</tr>
<tr>
<td>1998-1999</td>
<td>19,571</td>
</tr>
<tr>
<td>1999-2000</td>
<td>17,401</td>
</tr>
<tr>
<td>2000-2001</td>
<td>15,065</td>
</tr>
</tbody>
</table>

Which period had the largest change in the number of complaints?

The change from ‘94–95 to ‘95–96 is \(|15,719 − 17,077| = 1,358\). The other changes are, in order: \(|17,077 − 19,264| = 2,187\), \(|19,264 − 19,887| = 623\), \(|19,887 − 19,571| = 316\), \(|19,571 − 17,401| = 2,170\), and \(|17,401 − 15,065| = 2,336\). The last one is largest. Aren’t you glad that I’m getting few complaints lately?

e) 1999-2000 to 2000-2001 ←CORRECT ANSWER

6. If gasoline costs $1.40 per gallon and you drive 12,000 miles per year, how much would you save in one year by increasing gas mileage from 25 miles per gallon to 30 miles per gallon?

Driving 12,000 miles at 25 miles per gallon, you’ll use \(12,000 \times \frac{1}{25} = 480\) gallons of gasoline, costing \(1.4 \times 480 = 672\) dollars. At 30 miles per gallon, you’ll use \(12,000 \times \frac{1}{30} = 400\) gallons, costing \(1.4 \times 400 = 560\) dollars. This is a savings of \(672 − 560 = 112\) dollars over the 25 mile per gallon scenario.

a) $672  
b) $80  
c) $35  
d) $560  
e) $112 ←CORRECT ANSWER
7. A very large (tens of thousands) number of gas stations are polled nationwide concerning the price per gallon of unleaded gasoline. The mean price is $1.40 per gallon with a standard deviation of 15 cents per gallon. If you were to look at a large number of samples of size 50 in the survey, computed the mean of each sample and listed the numbers in a table, what would be the standard deviation of the numbers in your table?

According to the formula on page 63 (using “infinite population”), the \textit{standard error of the mean}, which is what we’re after, is \( \frac{15}{\sqrt{50}} = 2.12\ldots \), which we may round off to 2.1 cents per gallon.

a) 15 cents per gallon  

b) 2.1 cents per gallon \(<\)CORRECT ANSWER  
c) $7.5 per gallon  
d) 2.8 cents per gallon  
e) none of the above

8. A game biologist captures and tags 340 bass one afternoon at Lake Shabonna. The biologist returns one week later and captures 250 bass, 20 of which have tags. What estimate would the biologist give for the total number of bass in Lake Shabonna?

On the second go around, \( \frac{20}{250} \times 100 = 8 \) percent of the bass are seen to be tagged. Assuming that 8% of all the bass in the lake are tagged, we need to answer the question: “340 is 8% of what?”

One way to figure this out is to use

\[
\frac{\text{is}}{\text{of}} = \frac{\text{percent}}{100}.
\]

Here “is” = 340, “percent” = 8, and we want to find “of.” Using just a wee bit of algebra, the answer is

\[
\frac{340 \times 100}{8} = 4,250
\]

a) 20/250  
b) 6,800  
c) 5,000  
d) 27  
e) 4,250 \(<\)CORRECT ANSWER

9. If two dice are rolled simultaneously, what is the probability that the roll is a 7 or 11?

We actually did this exact problem in class. There are 36 ways to roll two dice. Six rolls will give a 7 and 2 rolls will give an 11. So 8 out of the 36 rolls will give us what we want, and the probability is \( \frac{8}{36} = \frac{2}{9} \).

a) 1/6  
b) 2/3  
c) .23  
d) 2/9 \(<\)CORRECT ANSWER  
e) .33
10. Below is a pie chart showing how I earned money last year. If my total income was $270,000, how much did I make from bribes?

   The pie chart says that 30% of my income was from bribes. We need to figure out what 30% of $270,000 is. The same old “is over of equals percent over 100” works. Here “of” equals $270,000, “percent” equals 30, and we want to find “is.” Using algebra (“Again? Do we have to?”) I get

   \[
   \frac{270,000 \times 30}{100} = 81,000.
   \]

   By the way, in case you were wondering, I don’t make nearly that much money from bribes in real life.

   a) $81,000 ← CORRECT ANSWER  
   b) $30,000  
   c) $90,000  
   d) $9,000  
   e) none of the above

11. Loafers of America bought 100 loaves of bread from five different bakeries, weighed them, then computed the mean weight and standard deviation. Their findings are listed below.

<table>
<thead>
<tr>
<th>Bakery</th>
<th>Mean Weight</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canker Crust</td>
<td>16.5 oz.</td>
<td>.9 oz.</td>
</tr>
<tr>
<td>Big Buns</td>
<td>16.0 oz.</td>
<td>1.1 oz.</td>
</tr>
<tr>
<td>Luscious Loaves</td>
<td>15.5 oz.</td>
<td>.9 oz.</td>
</tr>
<tr>
<td>D’Oh! Boys</td>
<td>17.5 oz.</td>
<td>1.2 oz.</td>
</tr>
<tr>
<td>Lard Lad</td>
<td>19.5 oz.</td>
<td>1.3 oz.</td>
</tr>
</tbody>
</table>

   Which bakery produced the most consistent sized loaf?

   As discussed at the end of section 1.2 of the textbook, we want the bakery with the smallest ratio of standard deviation to mean, \( \frac{\sigma}{\mu} \). Those ratios are, in order, \( \frac{.9}{16.5} = .0545\ldots \), \( \frac{1.1}{16} = .06875 \), \( \frac{.9}{15.5} = .058\ldots \), \( \frac{1.2}{17.5} = .0685\ldots \), and \( \frac{1.3}{19.5} = .066 \). So despite its name, Canker Crust makes the most consistent sized loaf. Too bad, I was really rooting for D’Oh! Boys.

   The correct answer was a).
12. A jet flies from Chicago to Denver and back again, a total of 1,800 miles. The trip to Denver is against some strong winds in the upper atmosphere and the jet flies an average of 500 miles per hour. On the return trip, with the winds at its back, the jet averages 600 miles per hour. What is the jet’s average speed over the entire trip?

The jet flies 900 miles at 500 miles per hour, which takes \( \frac{900}{500} = \frac{9}{5} \) hours. (This is one hour and 48 minutes, but we don’t need to use that.) The jet flies back 900 miles at 600 miles per hour, taking \( \frac{900}{600} = \frac{3}{2} \) hours. The total flight time is \( \frac{9}{5} + \frac{3}{2} = \frac{33}{10} \) hours. The average speed is the distance travelled divided by the time taken: \( \frac{1,800}{\frac{33}{10}} = 545.45 \), which we round off to 545.5 miles per hour.

a) 545.5 miles per hour ←CORRECT ANSWER
b) 550 miles per hour
c) 1,100 miles per hour
d) none of the above

e) all of the above

13. If approximately 65% of all numbers in a normally distributed data set are between 10 and 20, what are the mean and standard deviation of the data set?

We did one just like this in class. One possibility is a mean of 15 and a standard deviation of 5, but that’s only if I’d written 68% like I was supposed to. D’Oh! Oh well... The idea, if you recall from class, is that there are many ways to fit 65% (or 68%) under part of a graph. It doesn’t have to be under the middle; it can be more on one side or the other. The correct answer, regardless of the percentages, is that this is not enough information to determine the mean and standard deviation.

a) \( \mu = 15 \) \( \sigma = 5 \)
b) \( \mu = 5 \) \( \sigma = 15 \)
c) \( \mu = 10 \) \( \sigma = 10 \)
d) \( \mu = 15 \) \( \sigma = 10 \)
e) Not enough information is given to say for sure. ↑ CORRECT ANSWER

14. What changes to the graph below would make the “peaks and valleys” more pronounced?

You may read right there on pages 15 and 16 how to do this. Elongating the horizontal scale and/or condensing the vertical scale will do just the opposite of what you want: make the graph look “flatter.” I don’t think red ink makes a bit of difference, and moving the graph up/down or right/left (what “removing the zero line” would accomplish) doesn’t do much to change our perception of the peaks and valleys either. Elongating the vertical scale and/or condensing the horizontal scale will do what we want.

a) Elongate the horizontal scale and condense the vertical scale.
b) Remove the zero line.
c) Elongate the vertical scale. ←CORRECT ANSWER
d) Use red ink instead of black.
e) Elongate the horizontal scale.
15. A student pays $6,776 in tuition and fees, which amounts to 44% of her total yearly expenses. If room and board is $5,390, what percent of her yearly expenses is that?

We first must answer the question: “$6,776 is 44% of what?” Again with the “is over of” thing... Here “is” equals 6,776, “percent” equals 44, and we want to find “of.” It’s

\[
\frac{100 \times 6,776}{44} = 15,400.
\]

So $15,400 is her total yearly expenses. $5,390 is what percent of that? Now “is” equals 5,390, “of” equals 15,400, and we want to find “percent.” It’s

\[
\frac{100 \times 5,390}{15,400} = 35.
\]

a) 35% ←CORRECT ANSWER
d) 6%
b) 79.5%
e) none of the above
c) 50.3%

16. IQ scores are normally distributed with a mean of 100 and a standard deviation of 15. An IQ over 140 is officially “genius” level. What is the probability that a person chosen at random will be a “genius?”

We need to 40 beyond the mean. First, how much standard deviation is that? It’s \(\frac{40}{15} = 2.5\), which we should round off to 2.7. According to the table, going 2.7 times the standard deviation gets 49.7% of the population. Of course, getting up to the mean to start with gets 50% of the population. So 50 + 49.7 = 99.7 percent of the population have IQs no more than 140, leaving the remaining 100 − 99.7 = .3 percent who are geniuses. Translating into probabilities, that means .003 probability of being a genius.

a) .497
d) .006
b) .003 ←CORRECT ANSWER
e) .99
c) .997

d) .006 ←CORRECT ANSWER

c) .997

17. A (very large) mathematics party has 40% geeks, 35% dweebs and 25% doofuses. Assume these categories are mutually exclusive and a sample of 70 is chosen to see just how badly they dress. Which of the following gives the most representative sample?

We need to figure out percentages of 70: 40% of 70 is \(.4 \times 70 = 28\), 35% of 70 is \(.35 \times 70 = 24.5\), and 25% of 70 is \(.25 \times 70 = 17.5\). Of course, we can’t take .5 dweebs or doofuses; we have to take close whole numbers. So a good representative sample will use around 28 geeks, 24.5 dweebs and 17.5 doofuses.

a) 40 geeks, 35 dweebs and 25 doofuses
d) 28 geeks, 24 dweebs and 18 doofuses
b) 35 geeks, 25 dweebs and 10 doofuses ←CORRECT ANSWER
c) 30 geeks, 25 dweebs and 15 doofuses
e) 24 geeks, 23 dweebs and 23 doofuses
18. Which of the following statements is false?

a) Two normally distributed data sets with the same mean have identical graphs.
b) Two normally distributed data sets with the same median may not have identical graphs.
c) Two normally distributed data sets with the same median and mode may not have identical graphs.
d) Adding 5 to all numbers in a normally distributed data set will not change the standard deviation.
e) Standard deviants don’t generally distribute graphs.

Only a) is false.

19. If a student comes to me complaining about their grade, the probability that I yell at them is .7, the probability that I kick them out of my office is .55, and the probability that I yell at them and kick them out of my office is .35. If you come to me complaining about your grade, what is the probability that I will yell at you but not kick you out of my office?

Think of it this way, if 100 students come to complain, 70 of them will be yelled at. (Sorry about ending that sentence with a preposition.) Of those 70, 35 will also be kicked out of my office. So the remaining 35 apparently didn’t get kicked out of my office. Thus (how’s that for a good math word?), 35 out of 100 students will be yelled at but not kicked out of my office. Whence (Ooo! That one’s even better!) the probability is \( \frac{35}{100} = .35 \).

a) .245
d) .35 ← CORRECT ANSWER
b) .385
e) .25
c) .19

20. The heights of trees in a grove of larch are normally distributed with a mean height of 20 feet and a standard deviation of 1 foot. What percentage of the trees are less than 18 feet high?

Two feet is two standard deviations. According to the table, that gets 47.7 percent. Of course, 50% of the trees are higher than the mean, leaving the lowly 100 – (50 + 47.7) = 100 – 97.7 = 2.3 percent which are less than 18 feet high.

a) 3.3%
d) 2.3% ← CORRECT ANSWER
b) 47.7%
e) 3%
c) 3.7%

As an “exercise for the reader,” you may want to find the assigned homework problems which (often very) closely match these exam questions.