

Final answers should have accuracy to 6 decimal places (or 4 decimal places for table-derived answers). Show some work how the mean and standard deviation are computed. *Giving only the answer will bring you few points.*

$$\begin{aligned} \text{midrange} &= \frac{\text{lowest value} + \text{highest value}}{2} & \text{range} &= \text{highest value} - \text{lowest value} \\ \bar{x} &= \frac{x_1 + x_2 + \dots + x_n}{n} = \frac{\sum_i x_i}{n} = \frac{\sum_i x_i f_i}{n} & Z &= \frac{X - \bar{x}}{s} & \text{margin of error} &= \frac{1}{\sqrt{n}} \times 100\% \\ s &= \sqrt{\frac{(x_1 - \bar{x})^2 + (x_2 - \bar{x})^2 + \dots + (x_n - \bar{x})^2}{n-1}} = \sqrt{\frac{\sum_i (x_i - \bar{x})^2}{n-1}} = \sqrt{\frac{\sum_i f_i (x_i - \bar{x})^2}{n-1}} \end{aligned}$$

1. (8pts) A downtown beautification project is proposed for Murray's downtown, paid for by taxpayer money. To gauge support for the idea, city officials decide to do a survey of the city's population. Answer whether each of the following methods (only one answer per method) will produce a good, bad or questionable random sample of voters and **comment why**. Remember you are trying to decide whether every voter has an equal chance of being selected for the sample.

- a  good    Surveying passers-by on the court square.  
 bad    *The typical passer-by would come downtown of ten so*  
 iffy    *would be inclined more to support project; also: mostly captures people who work downtown*
- b  good    Surveying people attending a basketball game at the CFSB center.  
 bad    *Probably surveys a lot of out-of-towners as well*  
 iffy
- c  good    Surveying random people from the city's property tax records.  
 bad    *Best among options, but it would miss people who*  
 iffy    *rent their dwelling*
- d  good    Surveying patrons of Murray's Dairy Queen.  
 bad    *Likely a pretty good cross-section of town's population,*  
 iffy    *but possibly captures mostly younger people*

2. (9pts) The scores on an exam of a College Algebra class are shown below.

- a) Construct a grouped frequency distribution whose first class is 50-59.  
 b) Are there more students in the second from top or the second from bottom class?  
 c) Which class has the most students?

91, 109, 83, 92, 68, 75, 74, 86, 84, 69, 83,  
 65, 92, 69, 76, 100, 89, 74, 53, 64, 78, 67,  
 73, 101, 78, 72, 58, 74, 96, 59, 102, 71, 85,  
 64, 77, 96, 107

Class	Frequency
50-59	3
60-69	7
70-79	11
80-89	6
90-100	5
100-109	5

*→ b) More in 2nd from bottom*  
*c) The class 70-79*

3. (18pts) Over the course of a week, a curious observer counts the number of people sitting at the computers in the main hall of Murray State's library at 4PM. She gets the numbers below.

- a) Find the midrange.  
 b) Find the median.  
 c) Find the mean.  
 d) Find the range.  
 e) Find the standard deviation.

14, 23, 32, 21, 11, 8, 11

8, 11, 11, 14, 21, 23, 32

d) range = 32 - 8 = 24

a)  $\frac{8+32}{2} = 20$

e)  $(8-7)^2 + 2 \cdot (11-7)^2 + \dots + (23-7)^2 + (32-7)^2 = 438.8$

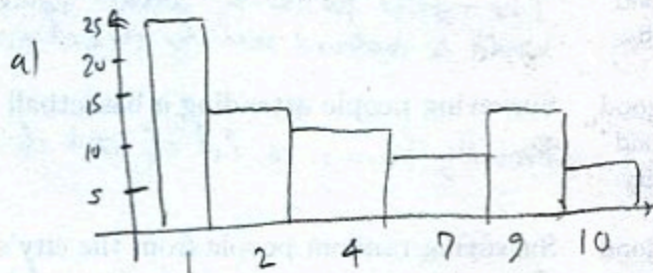
b) middle number is 4th: 14

$s = \sqrt{\frac{438.8}{6}} = 8.552360$

c)  $\frac{14+23+32+21+11+8+11}{7} = \frac{120}{7} = 17.142857$

4. (25pts) A thrift store has a selection of cheaply priced items. The table below indicates the prices that appear in the store and how many items have them.

- a) Draw a histogram for the data.  
 b) Find the mode price.  
 c) Find the median price.  
 d) Find the mean price.  
 e) Find the standard deviation.



Price	Frequency
\$1	25
\$2	13
\$4	11
\$7	8
\$9	12
\$10	7
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b) mode = \$1

c)  $76/2 = 38$  need 38th and 39th  $\frac{2+4}{2} = 3$

1, 1, 2, 2, 4, 4, 7, 7, 9, 9, 10, 10  
 ↑            ↑            ↑            ↑  
 25th        38th 39th 49th

d)  $\frac{25 \cdot 1 + 13 \cdot 2 + 11 \cdot 4 + 8 \cdot 7 + 12 \cdot 9 + 7 \cdot 10}{25 + 13 + 11 + 8 + 12 + 7} = \frac{329}{76} = 4.328947$

e)  $25(1-x)^2 + 13(2-x)^2 + \dots + 7(10-x)^2 = 892.7$

$s = \sqrt{\frac{892.7}{75}} = 3.450172$

5. (5pts) Men Henry from the US and Hans from Germany weigh 205 lb and 186 lb, respectively. The weights of men for their age group are normally distributed with mean 200 lb and standard deviation 13 lb for the US, and mean 182 lb and standard deviation 11 lb for Germany. Use z-scores to determine who is heavier relative to other men in their age group in their respective countries.

$$\text{Henry: } z = \frac{205 - 200}{13} = \frac{5}{13} = 0.384615 \leftarrow \begin{array}{l} \text{more stand. dev. above} \\ \text{mean so heavier} \end{array}$$

$$\text{Hans: } z = \frac{186 - 182}{11} = \frac{4}{11} = 0.363636$$

6. (5pts) A survey of 508 adults found that 44% of them have never owned a cat. Find the margin of error of this survey and explain what it means.

$$\frac{1}{\sqrt{508}} \times 100\% = 4.436783 \quad 44 \pm 4.436 = 48.44$$

$$44 - 4.436 = 39.56$$

With 95% probability, the actual percentage of people who have never owned a cat is between 39.56 and 48.44

7. (13pts) The retirement age for NFL players is normally distributed with a mean of 33 years and a standard deviation of 2 years. Use the 68-95-99.7 rule (draw a picture) to find the percentage of NFL players who retire

a) between ages 31 and 35

68%

b) before age 27

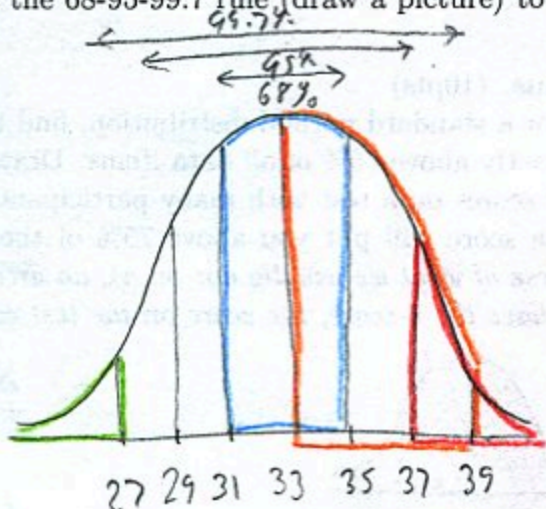
$$50 - \frac{99.7}{2} = 0.15\%$$

c) after age 37

$$50 - \frac{95}{2} = 2.5\%$$

d) between ages 33 and 39

$$\frac{99.7}{2} = 49.85\%$$



8. (17pts) The annual salaries at a certain company are normally distributed with mean \$58 K and standard deviation \$12 K. Draw a picture showing which area you are computing as you answer:

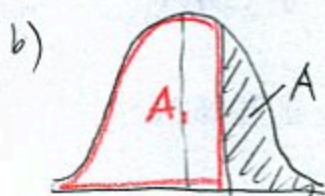
- a) What percentage of employees is paid less than \$75 K?  
 b) What percentage of employees is paid above \$63 K?  
 c) What percentage of employees is paid between \$35 K and \$55 K?



$$z = \frac{75 - 58}{12} = \frac{17}{12} = 1.42$$

$$P(Z \leq 1.42) = 0.9222$$

92.22%



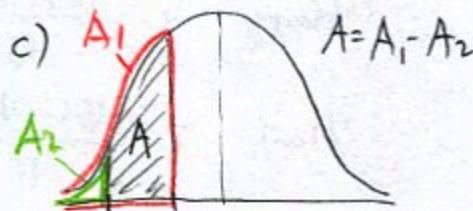
$$z = \frac{63 - 58}{12} = \frac{5}{12} = 0.42$$

$$P(Z \geq 0.42) = 1 - P(Z \leq 0.42)$$

$$= 1 - 0.6628$$

$$= 0.3372$$

33.72%



$$z_1 = \frac{55 - 58}{12} = -\frac{3}{12} = -0.25$$

$$z_2 = \frac{35 - 58}{12} = -\frac{23}{12} = -1.92$$

$$P(-1.92 \leq Z \leq -0.25)$$

$$= P(Z \leq -0.25) - P(Z \leq -1.92)$$

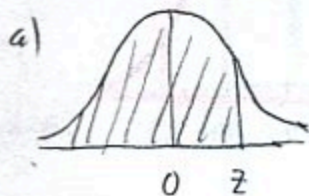
$$= 0.4013 - 0.0274$$

$$= 0.3739$$

37.39%

**Bonus.** (10pts)

- a) For a standard normal distribution, find the 75-th percentile, that is, the data item that is exactly above 75% of all data items. Draw a picture.  
 b) If scores on a test with many participants had a mean of 81 with standard deviation 9, which score will put you above 75% of the other test-takers? (Hint: this problem is the inverse of what we usually do: on a), an area is given and we have to find the z-score. Once you have the z-score, the score on the test can easily be found in b.)



$A = 0.75$ , need  $z$   
 look for number in table  
 closest to 0.75: 0.7486  
 corresponding to  $z = 0.67$

b)  $\frac{x - 81}{9} = 0.67$

$$x - 81 = 9 \cdot 0.67$$

$$x = 81 + 9 \cdot 0.67$$

$$= 87.03$$

Need to get 87.03 to be above 75% of test takers.

Score has to be 0.67 standard deviations above the mean.