Math 150: Final Fall 2012
Sample Solutions

1 The Problems

1) Consider the following arguments. Draw a carefully labeled diagram for each one to test the validity of each argument. *State whether the argument is valid or invalid.*

a) Premises: All horses are mammals. No mammal is a plant. All trees are plants.
Conclusion: No horses are trees. (6 pt.)

b) Premises: All meat products contain protein. Chicken contains protein.
Conclusion: Chicken is a meat product. (5 pt.)

2) a) You decide to take a 1,264-mile cross-country trip to Cooper City, Florida. Suppose your car averages 30 miles per gallon during the trip and that the cost of gasoline is $3.89 per gallon. How much will you spend on gasoline during the trip? Round your answer to the nearest dollar. (5 pt.)

b) The Smith family's living room lighting uses a total of 180 watts of power. The family uses the lighting in that room for 22 hours a week. How many kilowatt-hours of energy does the lighting use in one year? (6 pt.)

3) The base elevation of a mountain is 1,600 feet. A hiker gains elevation at a constant rate of 700 vertical feet per hour.

a) Write an equation that relates the elevation (E), in feet, of the climber to the time (t), in hours, since the hiker began climbing. (3 pt.)

b) What will the hiker's elevation be after 2.5 hours? (4 pt.)

c) The summit of the mountain is 4,400 feet. How long will it take the hiker to reach the summit? (4 pt.)

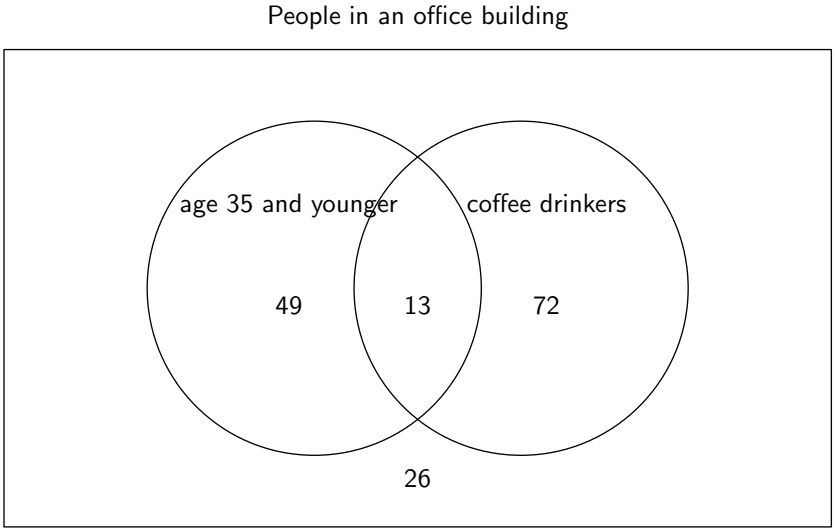
4) Use the Venn diagram below to answer questions about people in an office building:

a) How many coffee drinkers are there in the office building? (3 pt.)

b) How many in the office building are over 35 years old? (3 pt.)

c) How many in the office building are over 35 years old but don't drink coffee? (3 pt.)

d) How many total people are there in the office building? (2 pt.)



5) a) You purchase a television with a retail price of \$700. The local sales tax rate is 7.9%. What is the final cost? (6 pt.)

b) The final cost, including tax, of your new shoes is \$90. The local sales tax rate is 7.9%. What was the retail (pre-tax) price? Round to the nearest cent. (5 pt.)

6) With a reference value of 1982, the CPI in 1992 was 140.3 and the CPI in 2007 was 207.3. Use this information to answer the following questions:

a) If Bob made \$36,000 a year in 1992, what salary did he need to make in 2007, to the nearest dollar, to maintain the same standard of living? (6 pt.)

b) If a new car cost \$20,000 in 2007, use the CPI for both years to estimate its cost, to the nearest dollar in 1992. (5 pt.)

7) Identify at least one potential source of bias in each of the following studies. Explain your answers clearly.

a) To predict who will win a senate race, a newspaper randomly selects people at an airport and asks who they will be voting for in the upcoming election. (6 pt.)

b) A casino conducts a study to determine whether the public supports legalizing gambling. (5 pt.)

8) a) In July of 1999, Denver's population was 499,775 and its yearly growth rate was approximately 11%. If the growth rate had stayed constant, what would the estimate of the population have been in 2009? Its population in July of 2009 was 610,345, so what can we conclude about its growth rate in the years following 1999? (6 pt.)

b) If the price of platinum decreases at a monthly rate of 2%, by what percentage does it decrease in a year? Write your answer so that it's correct to 2 decimal places. (5 pt.)

9) A survey at a movie theatre asks what movie viewers just watched. The results are given in the frequency table below:

Movie	Number of viewers
Breaking Dawn	30
Skyfall	25
Lincoln	17
Life of Pi	15

a) Complete the frequency table by making columns for relative frequency and cumulative frequency. (7 pt.)

b) Draw a bar graph with the movies as categories and the vertical axis showing the relative frequencies as calculated in your table. Label the graph appropriately and completely. (4 pt.)

10) a)How much would it cost to carpet a 12 foot by 14 foot room with carpeting that costs $35 per square yard? Round your answer to the nearest dollar. (6 pt.)

b) Suppose 1.5 million cubic kilometers of water are spread out over Earth's 340 million square kilometers of ocean surface. How much would the sea level rise? (5 pt.)

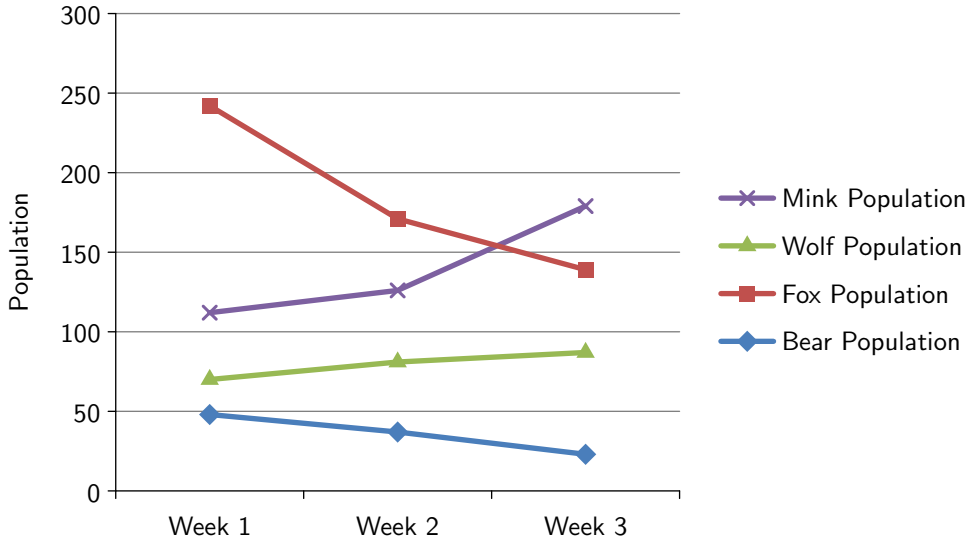
11) The scores of thirteen students on a chemistry exam are given below:

78 61 86 12 75 80 68 72 71 82 100 62 70

a) Find the five number summary of the grades and show a box-plot of the data. (7 pt.)

b) The teacher decides that the lowest and highest score are outliers. What are the mean and median if the outliers are removed? (4 pt.)

12) The population of certain mammal species is counted in a protected wildlife area. The graph below shows the population counts over the course of three weeks in the summer.



a) Which population rose the most over the course of the three weeks? Estimate the relative change in population from week 1 to week 3 for that species. Show the numbers you use in your calculations. (5 pt.)

b) Which population had the greatest decline in *relative* change from week 1 to week 3? Show which estimates and calculations you use to determine this. (6 pt.)

13) The label on Crunchy Pops cereal boxes claims that the box contains 10 ounces. The actual weight of the cereal in the boxes is normally distributed with a mean of 10 ounces and a standard deviation of 0.45 ounces.

a) What percent of the boxes contain more than 9.5 ounces?

b) What percent of the boxes contain between 9.55 and 10.9 ounces?

c) In a carton of 600 boxes, how many of the boxes would you expect to contain less than 10.09 ounces?

2 Percentiles Table & Formulas

In addition to the problems stated above, the following table and formulas were given to the students on the final.

Standard scores and percentiles for normal distributions:

z-score	Percentile	z-score	Percentile	z-score	Percentile	z-score	Percentile
−3.5	0.02	−1.0	15.87	0.0	50.00	1.1	86.43
−3.0	0.13	−0.95	17.11	0.05	51.99	1.2	88.49
−2.9	0.19	−0.90	18.41	0.10	53.98	1.3	90.32
−2.8	0.26	−0.85	19.77	0.15	55.96	1.4	91.92
−2.7	0.35	−0.80	21.19	0.20	57.93	1.5	93.32
−2.6	0.47	−0.75	22.66	0.25	59.87	1.6	94.52
−2.5	0.62	−0.70	24.20	0.30	61.79	1.7	95.54
−2.4	0.82	−0.65	25.78	0.35	63.68	1.8	96.41
−2.3	1.07	−0.60	27.43	0.40	65.54	1.9	97.13
−2.2	1.39	−0.55	29.12	0.45	67.36	2.0	97.72
−2.1	1.79	−0.50	30.85	0.50	69.15	2.1	98.21
−2.0	2.28	−0.45	32.64	0.55	70.88	2.2	98.61
−1.9	2.87	−0.40	34.46	0.60	72.57	2.3	98.93
−1.8	3.59	−0.35	36.32	0.65	74.22	2.4	99.18
−1.7	4.46	−0.30	38.21	0.70	75.80	2.5	99.38
−1.6	5.48	−0.25	40.13	0.75	77.34	2.6	99.53
−1.5	6.68	−0.20	42.07	0.80	78.81	2.7	99.65
−1.4	8.08	−0.15	44.04	0.85	80.23	2.8	99.74
−1.3	9.68	−0.10	46.02	0.90	81.59	2.9	99.81
−1.2	11.51	−0.05	48.01	0.95	82.89	3.0	99.87
−1.1	13.57	0.0	50.00	1.0	84.13	3.5	99.98

Formulas:

Exponential Growth:	Exponential Decay:
$T_{\text{double}} \approx \dfrac{70}{P}$ (for $P < 15$)	$T_{\text{half}} \approx \dfrac{70}{P}$ (for $P < 15$)
$Q = Q_0 \cdot 2^{t/T_{\text{double}}}$	$Q = Q_0 \cdot 0.5^{t/T_{\text{half}}}$
$Q = Q_0(1+r)^t$ with $r > 0$	$Q = Q_0(1+r)^t$ with $r < 0$

Standard Score (z-score): $z = \dfrac{x - \bar{x}}{s}$

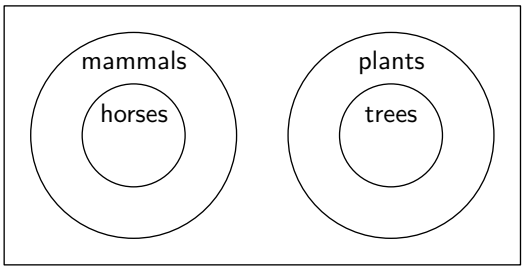
3 Solutions

3.1 Problem #1

Section to review: 1D

1a) The premises are about horses, mammals, plants, and trees. We draw a Venn diagram, where each of these four sets is represented by a circle.

The premise *all horses are mammals* means that the "horses" circle must lie inside the "mammals" circle. The premise *no mammal is a plant* means that the "mammal" and the "plant" circle must be disjoint. And the premise *all trees are plants* means that the "tree" circle must lie inside the "plants" circle. So we arrive at a diagram like the following:

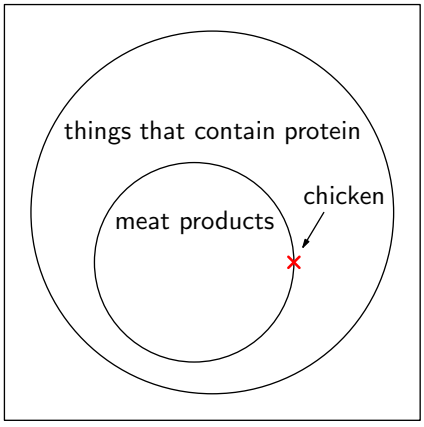


The conclusion *no horses are trees* is now equivalent to the claim that the "horses" and the "tree" circle are disjoint. According to the diagram, this is indeed the case. So the conclusion follows from the premises.

Answer: The argument is valid.

1b) The premises are about meat products, things that contain protein, and chicken (as food). We draw a Venn diagram, where each of the sets "meat products" and "things that contain protein" is represented by a circle, and the single object "chicken" is represented by an X.

The premise *all meat products contain protein* means that the "meat products" circle must lie inside the "contains protein" circle. The premise *chicken contains protein* means that also the "chicken" X must lie inside the "contains protein" circle. Since we have no further information about the relation between the "meat products" circle and the "chicken" X, we place the X on the boundary of that circle. So we arrive at a diagram like the following:



The conclusion *chicken is a meat product* is now equivalent to the claim that the "chicken" X lies inside the "meat product" circle. According to the

diagram, this is *not* the case. So the conclusion does *not* follow from the premises.

Answer: The argument is invalid.

3.2 Problem #2

Sections to review: 2A, 2B

2a) In order to figure out how much we will spend on gasoline, we first have to find the amount of gasoline needed.

Let x denote the amount of gasoline we will need for the trip. Then the given information about the average fuel consumption of the car means that $\frac{1264\,\mathrm{mi}}{x} = 30\,\frac{\mathrm{mi}}{\mathrm{gal}}$. Solving for x gives

$$x = 1264\,\mathrm{mi} \div 30\,\frac{\mathrm{mi}}{\mathrm{gal}} = 1264\,\mathrm{mi} \times \frac{1}{30}\,\frac{\mathrm{gal}}{\mathrm{mi}} = \frac{1264}{30}\,\mathrm{gal}.$$

Multiplying the amount (or: volume) of gasoline with the cost per volume gives now the total cost of the gasoline:

$$\frac{1264}{30}\,\mathrm{gal} \times \frac{\$3.89}{1\,\mathrm{gal}} = \frac{1264}{30} \times \$3.89 = \$163.89\ldots$$

Answer: We will spend about \$164 on gasoline during the trip.

2b) We first calculate the amount of energy used in one *week*:

$$\text{energy} = \text{power} \times \text{time} = 180\,\mathrm{W} \times 22\,\mathrm{h} = 3960\,\mathrm{Wh} = 3.96\,\mathrm{kWh}$$

Since there are 52 weeks in a year,[1] we have to multiply this amount by 52 to get the amount of energy used in one *year*:

$$3.96\,\mathrm{kWh} \times 52 = 205.92\,\mathrm{kWh}$$

Answer: The lighting uses about 210 kilowatt-hours of energy in one year.

3.3 Problem #3

Section to review: 9B

3a) Since the rate of change is constant, we use a linear model, i. e., we describe the situation by a linear function. The general equation for such a function is

$$\text{dependent variable} = \text{initial value} + \text{rate of change} \times \text{independent variable}.$$

[1] The precise factor is $\frac{365}{7} = 52.14\ldots$ for a common year and $\frac{366}{7} = 52.28\ldots$ for a leap year. But since the given data has also only two significant figures, it is appropriate to use this approximation (and also to round the final answer to two significant figures).

In this problem the dependent variable is the elevation E (in feet), and the independent variable is the time t (in hours). Since at the beginning ($t = 0$) the hiker is at the base of the mountain, i. e., at 1600 feet, the initial value for the elevation is 1600. The rate of change is given as 700 (in feet per hour).

Answer: $$E = 1600 + 700t$$

3b) Plugging $t = 2.5$ into the answer to part a) gives

$$E = 1600 + 700 \times 2.5 = 1600 + 1750 = 3350.$$

Answer: The hiker's elevation after 2.5 hours will be 3350 feet.

3c) Plugging $E = 4400$ into the answer to part a) and solving for t gives

$$\begin{aligned} 1600 + 700t &= 4400 \\ 700t &= 4400 - 1600 = 2800 \\ t &= \frac{2800}{700} = 4. \end{aligned}$$

Answer: It will take the hiker 4 hours to reach the summit.

3.4 Problem #4

Section to review: 1C

4a) In the Venn diagram, the total number of people inside the circle "coffee drinkers" is $13 + 72 = 85$.

Answer: There are 85 coffee drinkers in the office building.

4b) Being over 35 years old is the same as *not* having the property "being age 35 and younger". In the Venn diagram, the total number of people *outside* the corresponding circle "age 35 and younger" is $26 + 72 = 98$.

Answer: 98 people in the office building are over 35 years old.

4c) Of the $26 + 72$ people outside the circle "age 35 and younger", exactly 26 are also outside the circle "coffee drinkers".

Answer: 26 people in the office building are over 35 years old but don't drink coffee.

4d) The total number of people inside the rectangle "People in an office building" is $49 + 13 + 72 + 26 = 160$.

Answer: There are 160 people total in the office building.

3.5 Problem #5

Section to review: 3A

5a) We make a chart with the given data and the unknown:

	Retail Price	Sales Tax	Final Cost
Amounts:	\$700		x
Percents:	100%	+ 7.9% =	107.9%

Using this chart we can set up the proportion $\frac{x}{\$700} = \frac{107.9\%}{100\%} = 1.079$. Solving for x yields

$$x = 1.079 \times \$700 = \$755.3.$$

Answer: The final cost is \$755.30.

5b) We again make a chart with the given data and the unknown:

	Retail Price	Sales Tax	Final Cost
Amounts:	x		\$90
Percents:	100%	+ 7.9% =	107.9%

Using this chart we can set up the proportion $\frac{x}{\$90} = \frac{100\%}{107.9\%} = \frac{1}{1.079}$. Solving for x yields

$$x = \frac{1}{1.079} \times \$90 = \$90 \div 1.079 = \$83.4105\ldots$$

Answer: The retail price was \$83.41.

3.6 Problem #6

Section to review: 3D

6a) Like in the solution to problem #5, we first make a chart with the given data and the unknown:

	(1982) [2]	1992	2007
CPI:	(100)	140.3	207.3
Bob's Salary:		\$36,000	x

[2] The column for 1982 is actually not needed and can be omitted.

Using this chart we can set up the proportion $\frac{x}{\$36{,}000} = \frac{207.3}{140.3}$. Solving for x yields

$$x = \frac{207.3}{140.3} \times \$36{,}000 = \$53{,}191.73\ldots$$

Answer: In 2007 Bob needed to make a salary of \$53,192.

6b) We can reuse the chart from the solution to part a), changing only the last row:

	(1982)	1992	2007
CPI:	(100)	140.3	207.3
Cost of Car:		x	\$20,000

Using this chart we can set up the proportion $\frac{x}{\$20{,}000} = \frac{140.3}{207.3}$. Solving for x yields

$$x = \frac{140.3}{207.3} \times \$20{,}000 = \$13{,}535.93\ldots$$

Answer: In 1992 the cost of the car was about \$13,536.

3.7 Problem #7

Section to review: 5B

7a) If only people at an airport are randomly selected and asked, there is selection bias, as that sample is unrepresentative for the whole population, and (even more important) also unrepresentative for that part of the population that is going to vote in the upcoming election.

For instance, passengers (and also employees) at an airport tend to be more wealthy, less concerned regarding the negative ecological impacts of aviation and less likely unemployed than the average (voting) population. All these differences may affect their political preferences.

7b) Casinos have clearly a financial interest in having a broad public support for legalizing gambling. Because the study is conducted by the casino itself, there may be bias due to possible pressure on the researchers to produce in their study the result desired by the casino.

In addition, the fact that the casino conducts the study itself may also result in selection bias, as the casino may conduct the study only (or preferably) among its own customers.

3.8 Problem #8

Sections to review: 8A, 9C, 3A

8a) Since the growth rate in percentage, i. e., the *relative* rate of change, is assumed to be constant, we use an exponential model, i. e., we describe the situation by an exponential function. The general equation for such a function is

$$Q = Q_0(1 + r)^t,$$

where Q is the dependent variable, Q_0 is the initial value (the value of Q for $t = 0$), r is the relative rate of change, and t is the independent variable.

In this problem the dependent variable is Denver's population, and the independent variable is the time, measured in years after 1999. The initial value is given as 499,775, and the relative rate of change per year (the yearly growth rate) is given as $11\% = \frac{11}{100}$. In order to estimate Denver's population in 2009, we have to calculate Q for $t = 2009 - 1999 = 10$:

$$Q = 499{,}775 \times (1 + \tfrac{11}{100})^t = 499{,}775 \times (1.11)^{10} = 1{,}419{,}071.62\ldots$$

Since the given yearly growth rate had only two significant figures, it is appropriate to round this result also to two significant figures, i. e., to 1,400,000.

Comparing this estimate for Denver's population in July 2009 with Denver's real population of 610,345 at that time, we see that our estimate is much to high. We conclude that after 1999 the yearly growth rate was in fact much lower than 11%.[3]

Answer: In 2009 the estimate of the population would have been about 1.4 million. Since the real population at that time was much smaller, Denver's growth rate in the years following 1999 was much smaller than 11%.

8b) Since also in this problem the relative rate of change is assumed to be constant, we again use the equation $Q = Q_0(1 + r)^t$. Here the dependent variable Q is the price of platinum, and the independent variable t is the time, now measured in months. The initial value Q_0 is not specified, but the relative rate r of change per month (the negative of the monthly rate of decrease) is given as $-2\% = -\frac{2}{100}$.[4] In order to find the price of platinum after one year (12 months), we have to calculate Q for $t = 12$:

$$Q = Q_0 \cdot (1 - \tfrac{2}{100})^t = Q_0 \cdot (0.98)^{12} = Q_0 \cdot 0.784716\ldots \approx 0.7847 \cdot Q_0$$

So after one year only 78.47% *of* the value of platinum remains, i. e., the new value is $100\% - 78.47\% = 21.53\%$ *less than* the value one year ago.

[3] Strictly speaking we can only conclude that there was at least one year between 1999 and 2009 with a growth rate much lower than 11%. But since the growth rate of a city usually does not vary too much from year to year, it seems save to say that for most of the years between 1999 and 2009 the yearly growth rate was much lower than 11%.

[4] The relative rate of change is negative, because the price of platinum *decreases*.

Answer: In one year the price of platinum decreases by 21.53 percent.[5]

3.9 Problem #9

Section to review: 5C

9a) For the cumulative frequencies we successively add up the given frequencies:

$$\mathbf{30}, \quad 30 + 25 = \mathbf{55}, \quad 55 + 17 = \mathbf{72}, \quad 72 + 15 = \mathbf{87}$$

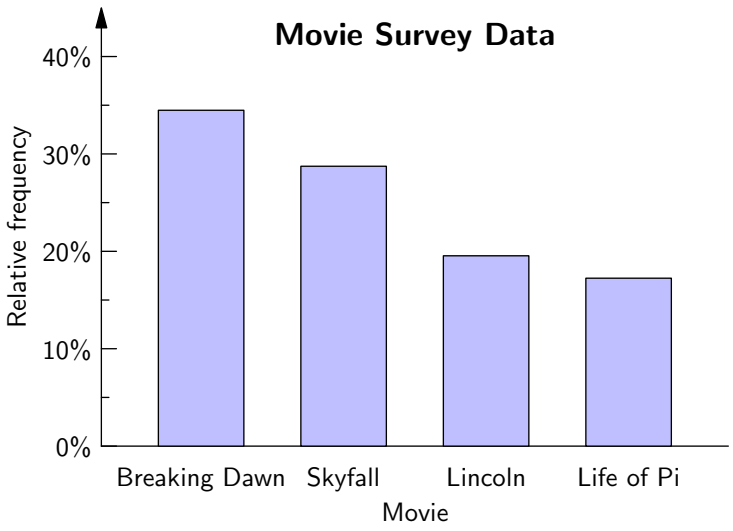
The last of these cumulative frequencies is the total number of viewers. For the relative frequencies we divide each given frequency by that total:

$$\frac{30}{87} = 0.3448\ldots, \quad \frac{25}{87} = 0.2873\ldots, \quad \frac{17}{87} = 0.1954\ldots, \quad \frac{15}{87} = 0.1724\ldots$$

Answer:

Movie	Number of Viewers	Relative Frequency	Cumulative Frequency
Breaking Dawn	30	34.5%	30
Skyfall	25	28.7%	55
Lincoln	17	19.5%	72
Life of Pi	15	17.2%	87

9b)



[5]Note that this amount of decrease is distinctly less than $12 \times 2\% = 24\%$, which would have been the answer if we had (wrongly) used a linear model for this problem instead of an exponential one.

3.10 Problem #10

Sections to review: 2A, 3B

10a) The area of the room is $12\,\text{ft} \times 14\,\text{ft} = 168\,\text{ft}^2$. To convert the resulting unit *square feet* to square yards, we recall that $1\,\text{yd} = 3\,\text{ft}$, so $1\,\text{yd}^2 = 9\,\text{ft}^2$ or $\frac{1\,\text{yd}^2}{9\,\text{ft}^2} = 1$. Hence

$$\text{area} = 168\,\text{ft}^2 = 168\,\text{ft}^2 \times \frac{1\,\text{yd}^2}{9\,\text{ft}^2} = \frac{168}{9}\,\text{yd}^2.$$

Multiplying the area with the cost per area gives now the total cost of the carpet:

$$\frac{168}{9}\,\text{yd}^2 \times \frac{\$35}{1\,\text{yd}^2} = \frac{168}{9} \times \$35 = \$653.33\ldots$$

Answer: It would cost about \$653 to carpet the room.[6]

10b) Since volume = area × height, we know that

$$1.5 \times 10^6\,\text{km}^3 = (340 \times 10^6\,\text{km}^2) \times \text{height}.$$

Solving for the height gives

$$\begin{aligned}\text{height} &= \frac{1.5 \times 10^6\,\text{km}^3}{340 \times 10^6\,\text{km}^2} = \frac{1.5}{340}\,\text{km} \\ &= 0.004411\ldots\ \text{km} \approx 0.0044\,\text{km} = 4.4\,\text{m}.\end{aligned}$$

Answer: The sea level would rise by about 4.4 meters.

3.11 Problem #11

Sections to review: 6A, 6B

11a) We first arrange the 13 data values in ascending order:

12 61 62 68 70 71 **72** 75 78 80 82 86 **100**

As we can see from this list, the lowest score is 12, the highest score is 100. Since the number of data values is odd, the median is the single data value in the middle of the list, which is 72.

To find the quartiles, we consider the lower and the upper half of the data set separately:

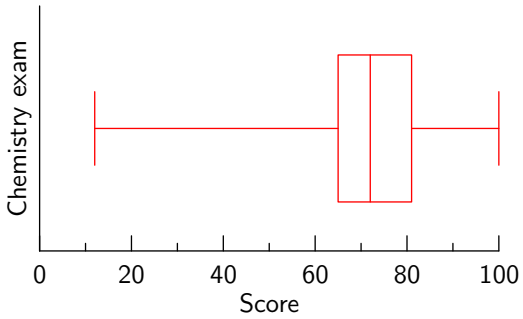
[6] If one takes into account that stores usually don't sell carpet in fractions of square yards, one first has to round the precise area of $\frac{168}{9}\,\text{yd}^2 \approx 18.67\,\text{yd}^2$ up to $19\,\text{yd}^2$, which then gives $19 \times \$35 = \$665$ as the total cost of the carpet. (To be save and to have some spare material left, I would actually spend \$700 to buy 20 square yards.)

12 61 **62** **68** 70 71 75 78 **80** **82** 86 100

Since the number of data values in each half is even, the median of each half (i. e., the corresponding quartile) is the mean of the two data values in the middle of that half. So the lower quartile is $\frac{62+68}{2} = \frac{130}{2} = 65$, and the upper quartile is $\frac{80+82}{2} = \frac{162}{2} = 81$.

Answer: The five-number summary of the grades and a boxplot of the data are given below:

low value = 12
lower quartile = 65
media = 72
upper quartile = 81
high value = 100



11b) If we remove the lowest and the highest data value, the median does not change, as the following list indicates:

~~12~~ 61 62 68 70 71 **72** 75 78 80 82 86 ~~100~~

For the mean we divide the sum of the remaining $13 - 2 = 11$ values by their total number:

$$\frac{61 + 62 + 68 + 70 + 71 + 72 + 75 + 78 + 80 + 82 + 86}{11} = \frac{805}{11} = 73.\overline{18}$$

Answer: If the outliers are removed, the mean is $73.\overline{18}$, and the median is still 72.

3.12 Problem #12

Sections to review: 5C, 3A

12a) The provided line chart shows that only the *mink* and the *wolf* population rose, while the fox and the bear population declined. So we have to compare only the former two populations.

From the line chart we estimate that from week 1 to week 3 the mink population grew from 112 to 179, while the wolf population grew from 70 to 87.[7] So the absolute changes in the mink and the wolf population were

$$179 - 112 = 67 \text{ (minks)} \quad \text{resp.} \quad 87 - 70 = 17 \text{ (wolves)}.$$

[7] Your estimates for these numbers may differ, but should not differ from the stated values by more than 5.

Since 67 is larger than 17, the mink population rose the most. The relative change for the mink population was $\frac{67}{112} = 0.5982\ldots$

Answer: Over the course of the three weeks the mink population rose the most. The relative change in the mink population during that time was about 60%.

12b) Since only the *fox* and the *bear* population declined, we have to compare only these two populations. From the line chart we estimate that from week 1 to week 3 the fox population shrank from 242 to 139, while the bear population shrank from 48 to 23.[8] So the relative changes in the fox and the bear population were

$$\frac{139 - 242}{242} = \frac{-103}{242} = -0.4256\ldots \approx -43\% \text{ (foxes)}$$

resp.

$$\frac{23 - 48}{48} = \frac{-25}{48} = -0.5208\ldots \approx -52\% \text{ (bears)}.$$

Since 52% is larger than 43%, in relative change the bear population declined the most.

Answer: From week 1 to week 3 the bear population had the greatest decline in relative change.

3.13 Problem #13

Section to review: 6C

13a) Given the mean $\bar{x} = 10\,\text{oz}$ and the standard deviation $s = 0.45\,\text{oz}$, we calculate the standard score (or: z-score) for the data value $x = 9.5\,\text{oz}$ as

$$z = \frac{x - \bar{x}}{s} = \frac{9.5\,\text{oz} - 10\,\text{oz}}{0.45\,\text{oz}} = \frac{-0.5\,\text{oz}}{0.45\,\text{oz}} = -\frac{0.5}{0.45} = -1.111\ldots$$

According to the provided standard score table this z-score corresponds to about the 13th percentile. This means that about 13% of the boxes contain less than or exactly 9.5 ounces, i. e., about $100\% - 13\% = 87\%$ of the boxes contain more than this amount.

Answer: About 87 percent of the boxes contain more than 9.5 ounces.

13b) Similarly to part a) we calculate the standard scores for the data values $x_1 = 9.55\,\text{oz}$ and $x_2 = 10.9\,\text{oz}$ as

$$z_1 = \frac{9.55\,\text{oz} - 10\,\text{oz}}{0.45\,\text{oz}} = \frac{-0.45\,\text{oz}}{0.45\,\text{oz}} = -1$$

[8] See previous footnote.

resp.

$$z_2 = \frac{10.9\,\text{oz} - 10\,\text{oz}}{0.45\,\text{oz}} = \frac{0.9\,\text{oz}}{0.45\,\text{oz}} = 2.$$

According to the provided standard score table these z-scores correspond to the 15.87th resp. the 97.72nd percentile. This means that 15.87% of the boxes contain less than or exactly 9.55 ounces, and 97.72% of the boxes contain less than or exactly 10.9 ounces. Therefore $97.72\% - 15.87\% = 81.85\%$ of the boxes have a content with weight *between* these two values.

Answer: 81.85 percent of the boxes contain between 9.55 and 10.9 ounces.

13c) Similarly to part a) we calculate the standard score for the data value $x = 10.09\,\text{oz}$ as

$$z = \frac{10.09\,\text{oz} - 10\,\text{oz}}{0.45\,\text{oz}} = \frac{0.09\,\text{oz}}{0.45\,\text{oz}} = \frac{0.09}{0.45} = 0.2.$$

According to the provided standard score table this z-score corresponds to the 57.93rd percentile. This means that about 57.93% of the boxes contain less than or exactly[9] 10.09 ounces. Out of 600 boxes, these are

$$57.93\% \times 600 = 0.5793 \times 600 = 347.58 \approx 348 \text{ boxes.}$$

Answer: We would expect about 348 of the 600 boxes to contain less than 10.09 ounces.

[9] Of course in practice a box will never contain *exactly* 10.09 oz, so we do not have to worry about this possibility.