

Complete the following tasks. You need to show work for full credit, and you may use a calculator such as RStudio to finish the calculations. In particular, for integrals, you may use resources like *Wolfram Alpha* to check your answers, but you need to show your work during Math 32 homework and exams. Some answers have been provided. Assemble your work into one PDF document and upload the PDF back into our CatCourses page.

From the class data taken collected in the Demographics Survey,

- Men's heights are normally distributed with  $\mu = 71.2499$  inches and  $\sigma = 14.8530$  inches
- Men's weights are normally distributed with  $\mu = 168.5468$  pounds and  $\sigma = 40.0461$  pounds
- Women's heights are normally distributed with  $\mu = 63.7975$  inches and  $\sigma = 9.6149$  inches
- Women's weights are normally distributed with  $\mu = 135.7459$  pounds and  $\sigma = 30.9147$  pounds

For tasks involving the normal distribution, practice writing answers in terms of the cumulative distribution function for the standard normal distribution  $\Phi(z)$ :

$$\Phi(z) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^z e^{-t^2/2} dt, \quad F(x) = \Phi\left(\frac{x - \mu}{\sigma}\right), \quad z = \frac{x - \mu}{\sigma}$$

For example, the answer to the first task (besides converting to a percentage) would be:

$$\Phi\left(\frac{78 - 63.7975}{9.6149}\right) - \Phi\left(\frac{62 - 63.7975}{9.6149}\right)$$

1. **Navy Pilots** The US Navy requires that fighter pilots have heights between 62 inches and 78 inches.
  - (a) Find the percentage of women meeting the height requirement.
  - (b) Find the percentage of men meeting the height requirement.
  - (c) If the height requirements are changed to exclude the tallest 10% of men and the shortest 10% of women, what are the new height requirements?
2. **Commerce** The weight distribution of parcels sent in a certain manner is normal with mean value 12 pounds and standard deviation 3.5 pounds. The parcel service wishes to establish a weight value  $c$  beyond which there will be a surcharge. What value of  $c$  is such that 99% of all parcels are under the surcharge weight?

3. **Earthquakes** Assume that Richter scale magnitudes of earthquakes are normally distributed with a mean of 1.184 and a standard deviation of 0.587.
- (a) Earthquakes with magnitudes less than 2.000 are considered “micro-earthquakes” that are not felt. What percentage of earthquakes fall into this category?
  - (b) Earthquakes above 4.0 will cause indoor items to shake. What percentage of earthquakes fall into this category?
  - (c) Find the 95th percentile. Will all earthquakes above the 95th percentile cause indoor items to shake?
4. **Physiology** Suppose that blood chloride concentration (nmol/L) has a normal distribution with mean 104 and standard deviation 5.00.<sup>1</sup>
- (a) What is the probability that the chloride concentration is less than 105?
  - (b) What is the probability that the chloride concentration differs from the mean by more than one standard deviation?
  - (c) How would you characterize the most extreme 0.1% of chloride concentration values?
5. **Materials Science** A machine that produces ball bearings has initially been set so that the true average diameter of the bearings it produces is 0.500 inches. A bearing is acceptable if its diameter is within 0.004 inches of this target value. Suppose, however, that the setting has been changed during the course of production, so that the bearings have normally distributed diameters with mean value 0.499 inches and standard deviation 0.002 inches. What percentage of the bearings produced will not be acceptable?

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<sup>1</sup>“Mathematical Model of Chloride Concentration in Human Blood”, Journal of Medicinal Engineering and Technology, 2006: 25-30

6. At Bobcat Jensen's grocery store, there has been a pandemic-induced rush on certain goods, such as

- $T$ : packages of toilet paper
- $W$ : packages of disinfectant wipes

The following joint distribution shows how many packages of toilet paper and disinfectant wipes a shopper can obtain per visit. Compute the requested probabilities for one shopping visit.<sup>2</sup>

		<b>T</b>			
		<b>0</b>	<b>1</b>	<b>2</b>	<b>3</b>
<b>W</b>	<b>0</b>	0.31	0.22	0.09	0.04
	<b>1</b>	0.15	0.05	0.04	0.01
	<b>2</b>	0.04	0.03	0.01	0.01

- probability that zero packages of toilet paper or zero packages of disinfectant wipes are purchased
- expected number of packages of toilet paper purchased
- standard deviation of packages of disinfectant wipes purchased given that exactly one case of toilet paper was obtained

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<sup>2</sup>This was an exam question during the Spring 2020 semester.

Here are some of answers. Note that numbers may slightly vary depending on when and where the rounding took place.

1. (a) 50.4330%  
(b) 40.8531%  
(c) 51.4755 inches to 90.2848 inches
2. 20.1422 pounds
3. (a) 91.7754%  
(b)  $8.0420 \times 10^{-5}$  percent  
(c) 2.1495 on the Richter scale will not cause items to shake
4. (a) 0.5793  
(b) 0.3173  
(c) below 87.5474 or above 120.4526
5. 0.0730
6. (a) 0.85  
(b) 0.73 packages of toilet paper  
(c) 0.6574 packages of disinfectant wipes