1. *(5 points)* **Drosophila Melanogaster** Choose a common fruit fly Drosophila melanogaster at random. Call the length of the thorax (where the wings and legs attach) Y. The random variable Y has the Normal distribution with mean $\mu = 0.800$ millimeter (mm) and standard deviation $\sigma = 0.078$ mm. The probability $P(Y > 1)$ that the fly you choose has a thorax more than 1 mm long is about

   A. 0.005.

   B. 0.5.

   C. 0.995.

2. *(5 points)* The National Assessment of Educational Progress (NAEP) includes a mathematics test for high school seniors. Scores on the test range from 0 to 300. Suppose that you give the NAEP test to an SRS of 900 12th-graders from a large population in which the scores have mean $\mu = 150$ and standard deviation $\sigma = 35$. The mean $\bar{x}$ will vary if you take repeated samples.

Suppose that an SRS of 900 12th-graders has $\bar{x} = 148$. Based on this sample, a 95% confidence interval for μ is

   A. 2.29.

   B. 150 ± 2.29.

   C. 148 ± 2.29.

3. *(5 points)* You read in a book on poker that the probability of being dealt two pairs in a five-card poker hand is 1/20. This means that

   A. if you deal thousands of poker hands, the fraction of them that contain two pairs will be very close to 1/20.

   B. if you deal 20 poker hands, exactly 1 of them will contain two pairs.

   C. if you deal 10,000 poker hands, exactly 500 of them will contain two pairs.

4. *(5 points)* You are testing $H_0 : \mu = 0$ against $H_a : \mu \neq 0$ based on an SRS of 20 observations from a Normal population. What values of the z statistic are statistically significant at the $\alpha = 0.005$ level?

   A. All values for which $z > 2.807$

   B. All values for which $|z| > 2.807$

   C. All values for which $z > 2.576$

5. (*20 points*) Choose a new car or light truck at random and note its color. Here are the probabilities of the most popular colors for vehicles sold globally in 2010

Color	Silver	Black	White	Gray	Red	Blue	Beige, Brown
Probability	0.26	0.24	0.16	0.16	0.06	0.05	0.03

(a) What is the probability that the vehicle you choose has any color other than those listed?

(b) What is the probability that a randomly chosen vehicle is neither silver nor white?

6. (*20 points*) Breast-feeding mothers secrete calcium into their milk. Some of the calcium may come from their bones, so mothers may lose bone mineral. Researchers measured the percent change in mineral content of the spines of 47 mothers during three months of breast-feeding. Here are the data:

$$
\begin{array}{cccccccccc}
-4.7 & 2.2 & -6.5 & -4.0 & 0.3 & -2.5 & -4.9 & -7.8 & -3.1 & -1.0 \\
-3.0 & -4.9 & -4.7 & -2.3 & 0.4 & -2.7 & -1.0 & -3.6 & -3.8 & -5.3 \\
-0.8 & -6.5 & -5.2 & -5.9 & 0.2 & -5.3 & -1.8 & -2.0 & -2.5 & -2.2 \\
-8.3 & -5.2 & -2.1 & -0.3 & -5.1 & -2.1 & -6.8 & -4.3 & -5.7 & -7.0 \\
-2.2 & -5.6 & -4.4 & -3.3 & -6.2 & -6.8 & 1.7 & & &
\end{array}
$$

(a) The researchers are willing to consider these 47 women as an SRS from the population of all nursing mothers. Suppose that the percent change in this population has standard deviation $\sigma = 2.5\%$. Make a stemplot of the data to verify that the data follow a Normal distribution quite closely. (Don't forget that you need both a 0 and a -0 stem because there are both positive and negative values.)

(b) Use a 99% confidence interval to estimate the mean percent change in the population.

7. Samples versus experiments. (*20 points*) Give an example of a question about college students, their behavior, or their opinions that would best be answered by

(a) a sample survey.

(b) an experiment.

8. (*20 points*) Young men in North America and Europe (but not in Asia) tend to think they need more muscle to be attractive. One study presented 200 young American men with 100 images of men with various levels of muscle. Researchers measure level of muscle in kilograms per square meter (kg/m^2) of fat-free body mass. Typical young men have about $20 \ kg/m^2$. Each subject chose two images, one that represented his own level of body muscle and one that he thought represented "what women prefer." The mean gap between self-image and "what women prefer" was $2.35 \ kg/m^2$. Suppose that the "muscle gap" in the population of all young men has a Normal distribution with standard deviation $2.5 \ kg/m^2$. We suspect (before seeing the data) that young men think women prefer more muscle than they themselves have.

(a) State null and alternative hypotheses for testing this suspicion.

(b) What is the value of the test statistic z?

(c) You can tell just from the value of z that the evidence in favor of the alternative is very strong (that is, the *p*-value is very small). Explain why this is true.