1. A random sample of seven 2009 sports cars is taken and their “in the city” miles per gallon is recorded. The results are as follows: 20 19 20 19 16 18 22
Assuming the population distribution is normal, calculate a 95% confidence interval for \( \mu \), the population mean “in the city” mpg for 2009 sports cars.

2. According to a Gallup Poll conducted in March of 2009, 38% of American adults polled believe that global warming will pose a serious threat to them or their way of life in their lifetime. Assuming a sample size of 1000, find the margin of error for a 95% confidence interval for estimating the population proportion of all American adults who believe that global warming will pose a serious threat to them or their way of life in their lifetime.

3. In 2008, Monitoring the Future reported that 20% of 12th graders had smoked cigarettes during the previous 30 days. If we assume that the sample size is 300, calculate a 90% confidence interval for the population proportion of all 12th graders who have smoked cigarettes during the previous 30 days.

4. Using the results of a Newsweek poll conducted in March of 2009, a 90% confidence interval on the proportion of adult Americans who have a favorable opinion of Barack Obama is given by (0.699, 0.741). If everything else is the same, but the confidence level increases, what happens to the width of the confidence interval?

5. A quality control engineer is concerned that the mean fill amount of a certain bottle-filling machine has changed. He randomly selects 20 bottles and measures their mean fill amount to be 2.05 liters. Assuming the distribution of fill amounts is normally distributed with a standard deviation of 0.04 liters, calculate a 90% confidence interval for \( \mu \).

6. Suppose we are estimating \( p \) and we have no prior estimate of \( p \). Find the required sample size for a confidence level of 90% and a margin of error of 0.02.

7. Suppose we would like to estimate \( p \) with 95% confidence and a margin of error of 0.03. From a previous study we have an estimate of \( p \), \( \hat{p} = 0.37 \). Find the required sample size under these conditions.

8. A brokerage firm would like to estimate the mean daily trading volume of Google stock to within 0.25 million shares. What is the minimum sample size required if a 90% confidence level is desired and the population standard deviation is assumed to be 1.048 million shares?
9. A quality control engineer would like to estimate the mean fill amount of a certain bottle-filling machine to within 0.05 liter. If we assume that the population standard deviation is 0.17 liters, how large of a sample is needed to estimate \( \mu \) with 95% confidence?

10. A few years ago, noon-time pedestrian traffic past a store had a mean of \( \mu = 225 \). To see if any change in traffic has occurred, counts were taken for a sample of 31 weekdays. It was found that \( \bar{x} = 240 \) and \( s = 20 \).

(a) Obtain a 95% confidence interval for \( \mu \).
(b) Obtain a 99% confidence interval for \( \mu \).

11. Over the past several decades, communication platforms have changed from telephones (land lines), to cell phones, to text messaging, to Internet based Web-pages. A researcher estimates the percentage of high school students who have a Web-page on myspace.com by surveying a random sample of 50 students. Thirty-four students said yes, they have a myspace page and 16 said no, they do not have one. Find

(a) 95% confidence interval
(b) 99% confidence interval for the proportion of high school students who do have a myspace web-page.

16. It is very time consuming to find rattlesnakes and nerve racking to measure them. A scientist randomly finds 12 snakes from the Central Pennsylvania area and measures their length. The following twelve measurements in inches are obtained:

<table>
<thead>
<tr>
<th>40.2</th>
<th>43.1</th>
<th>45.5</th>
<th>44.5</th>
<th>39.5</th>
<th>38.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>40.2</td>
<td>41.0</td>
<td>41.6</td>
<td>43.1</td>
<td>44.9</td>
<td>42.8</td>
</tr>
</tbody>
</table>

Using the above data, find a 90% confidence interval for the mean length of rattlesnakes in the Central Pennsylvania area.

17. The National Assessment of Educational Progress (NAEP) administers exams to a nationwide sampling of students to assess the quality of education in America. Suppose NAEP would like to estimate the population proportion of American schoolchildren who would answer a given question correctly.

a) They would like the estimate to be within 0.05 with 99% confidence. How large a sample size do they need?

b) Find a sample size that which would give a margin of error of 0.03 with 99% confidence.

18. A random sample of the heart rates of 15 women is observed. The sample mean was 75.6 beats per minute, with standard deviation of 6.65 beats per minute. Assume that the plot does not contradict the normality assumption, and construct and interpret a 90% confidence interval for the population mean heart rate of all women.
19. A random sample of 81 day-counts of wolves from Isle Royale in the middle of Lake Superior resulted in a mean of 57 wolves and a standard deviation of 10 wolves. Construct and interpret a 90% confidence interval for the population mean day-count of wolves in the Isle Royale.

20. A random sample of 49 colleges yielded a mean cost of college education of $30,500 per year. Assume that the population standard deviation is $3,000.
   a. Compute and interpret the margin of error for a confidence interval with 90% confidence.
   b. Construct and interpret a 90% confidence interval for the population mean cost of college education.

21. A biotechnician would like to estimate the mean number of genes that she will have to analyze in her research. Assume that the standard deviation is 120 genes.
   a. How many genes does she have to sample if she would like the estimate to be accurate to within 10 genes with 95% confidence?
   b. How many genes does she have to sample if she would like the estimate to be accurate to within 5 genes with 95% confidence?

22. A researcher wanted to determine the mean number of hours per week the typical person watches television. Results from the Sullivan Statistics Survey indicate that $\sigma = 7.5$
   How many people are needed to estimate the number of hours people watch television per week within 2 hours with 90% confidence?

23. In a Gallup poll is going to conduct a survey to answer the question. “Do you feel that the laws covering the sale of firearms should be made more strict?” suppose the margin of error in the poll is 3.5% and confidence level is 95%. At least how many people should be in the sample?

24. The mean price for a gallon of milk in New York City in 2007 was $3.18. A mean price for a gallon of milk sampled from 25 different grocery stores in New York City in 2008 was $4.31. Assume that the population standard deviation is known to be $0.50 and we have a normally distributed population. Using p-value method test if the mean price for a gallon of milk has increased from the 2007 prices. Use $\alpha = 0.10$.

25. The mean life span of an African savanna elephant in the wild used to be 60 years. A recent sample of 15 deceased elephants in the wild yielded a mean life span of 62 years. Assume that $\sigma = 6$ years and normally distributed population. Test if the population mean life span of African savanna elephants has increased, using $\alpha = 0.05$.

26. According to a Nielsen report, the average age of an audience watching American Idol Season 7 was 42 years with $\sigma = 4$ years. A random sample of 100 audiences for the Season 8 show yielded a mean age of 36.4 years. Test if the population mean age of audience for American Idol has changed, using $\alpha = 0.05$. 
27. A sample of 20 adult female rats is drawn at random from a large number of rats in an animal house. Among other measurements the uterine weight (in milligrams) is recorded at postmortem for each rat. The sample yields a mean uterine weight of 21 mg. Assume $\sigma = 1.6$ mg and normally distributed population. Using the critical value, test whether the population mean uterine weight is less than 21.5 mg, using a level of significance $\alpha = 0.10$.

28. A potential buyer wants to determine if the amount of an active ingredient in a medicine is less than .024 ounces. A random sample of 38 bottles yields a mean content of .021 ounces with a standard deviation of .005. Test the appropriate hypothesis with $\alpha = .05$.

29. According to the Energy Information Administration (official energy statistics from the U.S. government), the mean price for one gallon of unleaded regular gasoline in U.S. cities for August, 2011 was $3.64. A random sample of 30 pumps in cities in the state of Georgia yielded an average price of $3.16 per gallon for unleaded gasoline. Assume that $\sigma = .90$. Test whether the population mean price for unleaded gasoline is lower in Georgia than the general population, using a significance level of $\alpha = 0.01$.

30. The distribution of claim size for a car insurance company in 2009 was normally distributed with a mean of $1200 and a standard deviation of $240. A random sample of 50 claims made in the year 2010 yielded a mean of $1150. Test whether the population mean claim has decreased using $\alpha = 0.05$.

31. According to a report by the CDC, 32.6% of adults consumed fruit two or more times per day. A random sample of 500 individuals showed that 186 adults consumed fruits two or more times per day. If appropriate, test whether the population proportion of fruit consumed two or more times a day has increased, using a level of significance of $\alpha = 0.05$.

32. According to a global Nielson report, 66% of North Americans pay more attention to the nutritional information on a package than they did two years ago. A random sample of 400 individuals from North America showed that 300 people stated that they did pay more attention to the nutritional information on a package than they did two years ago. We are interested in testing to see if the proportion has increased.

33. A sample of 20 adult female rats is drawn at random from a large number of rats in an animal house. Among other measurements the uterine weight (in milligrams) is recorded at postmortem for each rat. The following values are obtained. We are interested in testing whether the population mean uterine weight is less than 21.5 mg, using a level of significance $\alpha = 0.10$. 
15. Nine hybrid cars were randomly selected and their mileages per gallon on highway were noted as given below. We are interested in testing whether the population mean highway mileage for these hybrid cars is greater than 35 mpg. Assume the population is normally distributed and use $\alpha = 0.10$.

<table>
<thead>
<tr>
<th>Car</th>
<th>Mileage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toyota Prius II</td>
<td>48</td>
</tr>
<tr>
<td>Honda Civic Hybrid Manual</td>
<td>48</td>
</tr>
<tr>
<td>Toyota Camry Hybrid</td>
<td>37</td>
</tr>
<tr>
<td>Ford Escape Hybrid</td>
<td>32</td>
</tr>
<tr>
<td>Nissan Altima Hybrid</td>
<td>35</td>
</tr>
<tr>
<td>Toyota Highlander Hybrid</td>
<td>27</td>
</tr>
<tr>
<td>Lexus RX400h</td>
<td>25</td>
</tr>
<tr>
<td>Honda Insight Manual</td>
<td>65</td>
</tr>
<tr>
<td>Mercury Mariner</td>
<td>30</td>
</tr>
</tbody>
</table>

17. Suppose that a recent article stated that the average time spent in jail by a first–time convicted burglar is 2.5 years. A study was then done to see if the average time has increased in the new century. A random sample of 26 first–time convicted burglars in a recent year was picked. The average length of time in jail from the survey was 3 years with a standard deviation of 1.8 years. Suppose that it is somehow known that the population is normal. Conduct a hypothesis test to determine if the average length of jail time has increased.

18. A large number of meteorites composed of iron, chondrite, or achondrite fall onto the Earth every day. However, most are very small when they hit the surface and are unreported. In a random sample of 45 meteorite falls and finds, the mean weight was 106.14 kg. Assume $\sigma = 35$ kg. Find a 95% confidence interval for the mean weight of all meteorite finds.

19. Due to a decrease in state funding, rising health care costs, and the cost of technology the tuition at state colleges and universities has risen rapidly over the last decade. According to the College Board, the mean tuition and fees at state colleges for the 2008-2009 academic year was $6585. Suppose a random sample of 12 New Jersey state colleges was obtained and the mean tuition and fees for 2008-2009 was $6353. Assume the tuition distribution is normal and $\sigma = 225$.

   a. Find a 99% confidence interval for the true mean tuition and fees at New Jersey state colleges and universities.

   b. Suppose the governor of New Jersey believes that the majority of New Jersey residents cannot afford to attend a state college or university if the tuition is greater than $6200. Is there any evidence to suggest that the true mean tuition and fees for New Jersey state colleges is greater than $6200?
20. In many areas, newspaper carriers deliver morning papers using their automobiles because the routes are too long to walk. In a random sample of 28 carriers who use their automobiles, the sample mean route length was \( \bar{x} = 16.7 \) miles with \( s = 3.4 \). The distribution of route lengths is normal.

a. Find a 95% confidence interval for the true mean route length of newspaper carriers who use their automobiles.

b. If the mean length of the route is over 20 miles, the circulation department becomes concerned that papers will not be delivered by 7:00 AM. Is there any evidence to suggest that the true mean route length is over 20 miles?

21. A computer supply store sells a wide variety of generic replacement ink cartridges for printers. A consumer group is concerned that the cartridges may not contain the specified amount of ink (30 ml). A random sample of 17 black replacement cartridges was obtained, and the amount of ink (in ml) in each is given below.

30.27  29.70  29.35  29.08  29.74  29.26  29.50  29.12  29.68  28.54  30.01  29.87  30.61  29.33  29.21  28.84

Assume the underlying distribution of ink amount is normal.

a. Find a 95% confidence interval for the true mean amount of ink in each black cartridge.

b. Is there any evidence to suggest that the cartridges are under-filled?

22. Good vision is very important for effective learning, especially for children in elementary school. Some optometrists argue that as many as 25% of all elementary school children may have impaired vision. A random sample of 256 elementary school children was obtained, and each was given a vision test. Fifty were found to have some form of impaired vision.

a. Find a 95% confidence interval for the true proportion of elementary school children with impaired vision.

b. Is there any evidence to suggest the claim \( p \neq 0.25 \)? Justify your answer.

23. Many dairy farms have experienced bankruptcy over the past decade due to the wild fluctuations in conventional milk prices. However, organic farms, those that do not treat cows with antibiotics or hormones and that use feed grown without chemicals, have remained solvent and even expanded. In a random sample of 1400 New England dairy farms 90 are certified as organic.

a. Find a 99% confidence interval for the true proportion of New England dairy farms certified as organic.

b. Five years ago, an extensive census reported that 3% of all New England dairy farms were organic. Is there any evidence to suggest that this proportion has changed?

24. The mean daily energy requirement for eight-year-old boys is 2200 calories. An education researcher believes that many students in this group do poorly in school due to an inadequate diet and not having enough energy. A random sample of academically at-
35. Residential mailboxes in Des Moines, Iowa, should be installed such that the bottom of the mailbox is 42 inches above the ground. This rule is designed for safety and accommodate short mail carriers. A random sample of 75 mailboxes in large city was selected. The height of each was carefully measured, and sample mean was 43.22 inches. Assume $\sigma = 7.6$ inches and use $\alpha = 0.05$. Is there any evidence to suggest that the true mean height of mailboxes in Des Moines is different from 42 inches?

36. During a routine commercial airline flight, some of the time in the aircraft is spent waiting to take off and taxiing to an arrival gate. However, airlines also keep careful records of the actual airborne time of each flight. A random sample of the airborne times (in minutes) of United Airlines flights from Boston to Denver during 2005 was obtained and the data are given below.

- 235
- 250
- 247
- 241
- 240
- 246
- 231
- 233
- 230
- 255
- 228
- 246
- 247
- 238
- 223

Is there any evidence to suggest that the true mean airborne time is less than this 245 minutes? Assume the underlying distribution is normal and use $\alpha = 0.025$.

37. Coalbed methane is an important source of natural gas in the United States. The Powder River coalfield has approximately 2500 wells, each producing 159,350 cubic feet of gas per day. In order to maintain sufficient storage facilities, the mean well output is carefully monitored. A random sample of 50 well was obtained and the daily methane output for each was recorded. The sample mean was 163288 cubic feet and standard deviation was 8792 cubic feet. Is there any evidence to suggest that the mean methane output per well per day has increased? Use $\alpha = 0.01$

38. During the 2007-2008 school year, approximately 64% of principals in Florida public schools were females. This year school year survey shows that 231 of 328 randomly selected principals in Florida public schools were female. Is there any evidence to suggest that the proportion of female principals in Florida public school has changed? Use $\alpha = 0.05$

39. A certain puzzle task is designed to measure spatial reasoning performance. 45% of all people attempting the puzzle complete the task within the allotted time. A researcher decided to test the theory that classical music increases brain activity and improves the ability to perform such tasks. A random sample of 400 people was obtained, and each listened to 15 minutes of classical music, then attempted the task. 211 completed the task within the allotted time. Use p value method to test whether the proportion of people who complete the puzzle within allotted time has increased. Use $\alpha = 0.001$

As you see there are similar problems, you may look at those and try as many as until you are comfortable with all of these. Knowing how to answer all of these questions may prepare you for the exam.

--- Dr. Manage