Inference for Distributions

Use a separate sheet of paper. You must show all work and all steps must be clearly labeled. Submitting just answers will result in a grade of 0! All unexplained numbers will be ignored and final answers must be written in complete sentences.

1. André is a waiter in San Francisco. The Internal Revenue Service is doing an audit on his tax return this year. In particular, the IRS wants to know the average amount André gets for a tip. Tips in San Francisco are fairly normally distributed. In an effort to satisfy the IRS, André took a random sample of eight credit card receipts, each of which indicated his tip. The sample mean is $12.35 with a standard deviation of $2.25. *(solution for a & b worked out on chp 11 powerpoint)*
    a. Find a 90% confidence interval for the population mean of tips received by André.
    b. Test the IRS claim that André makes more than $10 per tip.
    c. Suppose we specify a 1% significance level for the IRS test of significance in part b, does this change the conclusion?

2. *Consumer Reports* gave the following information about annual premiums (in dollars) for 18 renewable life insurance policies with similar benefits:

300	345	328	426	660	388	410	563	303
395	278	455	577	470	455	373	365	360

   Find a 90% confidence interval for the population of all annual premiums for such life insurance policies.

3. The P/E ratio is the price of a share of stock divided by the company's total earnings per share. If a company is fundamentally sound, then a low P/E ratio may indicate a bargain stock, whereas a high P/E ratio could indicate that the stock is overpriced. A random sample of 10 energy stocks listed in the *Wall Street Journal* gave the following P/E ratios:

14.1	12.2	19.3	15.4	10.0	13.2	22.4	16.3	15.1	17.2

    a. Find a 95% confidence interval for the mean P/E ratio of all energy stocks.
    b. Suppose a broker considers any stock under a P/E ratio of 18 to be a bargain. What would his assessment of energy stocks be?

4. A study was conducted to evaluate the effectiveness of a new mosquito repellent designed by the U.S. Army to be applied as camouflage face paint (*Journal of Mosquito Control Association*, June 1995). The repellent was applied to the forearms of five volunteers and then the arms were exposed to 15 active mosquitoes for a ten-hour period. Based on the number and location of the mosquito bites, the percentage of the forearm surface area protects from bites (called percent repellency) was calculated for each of the five volunteers. For one color of paint (loam), the average percent repellency for 83% with a sample standard deviation of 15%.

    a. **Review**: if a type II error is considered more serious, would they use $\alpha = .05$ or $\alpha = .10$?
    b. The new repellent is considered effective if it provides a percent repellency of at least 95. Conduct a test to determine whether the mean repellency percentage of the new mosquito repellent is less than 95. Use the α–level identified in part a.
    c. Although we don't have the data, what situation would cause use to question the accuracy of our findings in part b?

5. *Consumer Reports* gave a report about the life (hours) of size AA batteries in toys. A total of 16 random toys were tested which gave a mean life of 3.58 hours with sample standard deviation of 1.85 hours.

    a. The packaging for the batteries claims that the AA batteries last around 5 hours in toys. Does the sample differ from the claim? $\alpha = .02$
    b. Would your answer change if $\alpha = .005$? Explain.

6. A major car manufacturer wants to test a new engine to determine whether it meets new air-pollution standards. The mean emission of all engines of this type must be less than 20 parts per million of carbon. Ten engines are manufactured for testing purposes, and the emission level of each is determined. The data (in parts per million) are listed:

   15.6 16.2 22.5 20.5 16.4 19.4 16.6 17.9 12.7 13.9

   Do the data supply sufficient evidence to allow the manufacturer to conclude that this type of engine meets the pollution standard? $\alpha = .01$

7. In a recent year, you take a random survey of 20 students from Austin and record the ACT score for each student. The scores are listed below.

   26 22 23 12 19 25 23 21 25 10 17 26 23 24 20 14 21 23 20 22

   a. Build a 60% confidence interval for the true mean ACT score.
   b. What conclusions can you make about the mean ACT scores for students living in other Texas cities? Explain.

8. A newly renovated kitchen store at the mall claims the average price of their two-slice toasters is $50. It has been observed that the prices for two-slice toasters are approximately normal. A random sample of 12 two-slice toasters was taken to find the mean price of $61.12 with a standard deviation of $24.62.
   a. Is there sufficient proof to think the store's claim is too low? $\alpha = .01$
   b. Build a 90% confidence interval. Explain how you could use the confidence interval to support your decision in part a.

9. *Environmentalists, government officials, and vehicle manufacturers are all interested in studying the auto exhaust emissions produced by motor vehicles. The major pollutants in auto exhaust from gasoline engines are hydrocarbons, monoxide, and nitrogen oxides (NOX). The NOX levels (in grams per mile) for a random sample of light-duty engines of the same type are given below.

1.28	1.17	1.16	1.08	0.60	1.32	1.24	0.71	0.49	1.38	1.20	0.78
0.95	2.20	1.78	1.83	1.26	1.73	1.31	1.80	1.15	0.97	1.12	0.72
1.31	1.45	1.22	1.32	1.47	1.44	0.51	1.49	1.33	0.86	0.57	1.79
2.27	1.87	2.94	1.16	1.45	1.51	1.47	1.06	2.01	1.39		

   Construct and interpret a 95% confidence interval for the mean amount of NOX emitted by light-duty engines of this type.

10. *Computers in some vehicles calculate various quantities related to performance. One of these is fuel efficiency, or gas mileage, usually expressed as miles per gallon (mpg). For one vehicle equipped in this way, the mpg was recorded each time the gas tank was filled and the computer was then reset. Here are the mpg values for a random sample of 20 of these records.

15.80	13.60	15.60	19.10	22.40	15.60	22.50	17.20	19.40	22.60
19.40	18.00	14.60	18.70	21.00	14.80	22.60	21.50	14.30	20.90

   a. Describe the distribution using graphical methods and summarize the results in a few sentences.
   b. Is it appropriate to use methods based on Normal distributions to analyze these data? Explain why or why not.
   c. Find and report the mean, standard deviation, standard error, and the margin of error for 95% confidence.
   d. Construct and interpret a 95% confidence interval for μ, the mean mpg for this vehicle based on these data.
   e. Do you think that this interval would apply to other similar vehicles? Explain why or why not.

*Yates, Moore, & Starnes. *The Practice of Statistics, 3rd Edition.*