(1) (Moore and McCabe, 1998) The one-sample t statistic from a sample of n = 30 observations for the two-sided test of:

\[ H_0 : \mu = 64 \]
\[ H_a : \mu \neq 64 \]
has the value \( t_{obs} = 1.12 \).

(a) What are the degrees of freedom for \( t \)?

(b) Locate two critical values \( t^* \) from the t-table that bracket \( t_{obs} \). What are the right-tail probabilities \( p \) for these two values? (c) Relying on your answer to the previous section, how would you report the \( P \)-value for this test? (d) Is the value \( t = 1.12 \) statistically significant at the 10% level? At the 5% level? (e) Find the exact \( P \)-value using R.

(2) (Moore and McCabe, 1998) A study examined the effect of exercise on how students perform on their final exam in statistics. The \( P \)-value was given as 0.87.

(a) State null and alternative hypotheses that could have been used for this study. (Note there is more than one correct answer to this question.)

(b) Do you reject the null hypothesis?

(c) What is your conclusion?

(d) What other facts about the study would you like to know for a proper interpretation of the result?

(3) (Moore and McCabe, 1998) Crop researchers plant 15 plots with a new variety of corn. The yields in bushels per acre are:

138.0 139.1 113.0 132.5 140.7 109.7 118.9 134.8
109.6 127.3 115.6 130.4 130.2 111.7 105.5

Assume that the population of yields is normal.

(a) Find the 90% confidence interval for the mean yield \( \mu \) for this variety of corn.

(b) Find the 95% confidence interval.

(c) Find the 99% confidence interval.
(d) How do margin of error in (a), (b), and (c) change as confidence level increases?

(4) (Moore and McCabe, 1998) Every user of statistics should understand the distinction between statistical significance and practical importance. A sufficiently large sample will declare very small effects statistically significant. Let us suppose that SAT mathematics (SAT-M) scores in the absence of coaching vary normally with $\mu = 475$ and $\sigma = 100$. Suppose further that coaching may change but does not change $\sigma$. An increase in the SAT-M score from 475 to 478 is of no importance in seeking admission to college, but this unimportant change can be statistically very significant. To see this, calculate the $P-$value for the test of:

$H_0 : \mu = 475$

$H_a : \mu > 475$

In each of the following situations:

(a) A coaching service coaches 100 students; their SAT-M scores average $\bar{x} = 478$. Also assume $s = 100$.

(b) By the next year, the service has coached 1000 students; their SAT-M scores average $\bar{x} = 478$ with $s = 100$.

(c) An advertising campaign brings the number of students coached to 10,000; their average score is still $\bar{x} = 478$ with $s = 100$.

(d) Give a 99% confidence interval for the mean SAT-M score $\mu$ coaching in each part of the previous exercise. Interpret the results.

(5) (Moore and McCabe, 1998) The table below gives the pretest and posttest scores on MLA listening test in Spanish for 20 high school Spanish teachers who attended an intensive summer course in Spanish.
(a) We hope to show that attending the institute improves listening skills. State an appropriate \( H_0 \) and \( H_a \). Be sure to identify the parameters appearing in the hypothesis.

(b) Make a graphical check for outliers or strong skewness in the data that you will use in your statistical test, and report your conclusions on the validity of the test.

(c) Carry out a test. Can you reject the null hypothesis at the 5% significance level? At the 1% significance level?

(d) Give a 90% confidence interval for the mean increase in listening score due to attending the summer institute.

(6) It is claimed that 55% of all Chicago residential phones are unlisted. A telemarketing firm in LA uses a device that dials 450 residential telephone numbers in that city at random.

(a) What is the sampling distribution of \( \hat{p} \) - the sample proportion of unlisted phone numbers?

(b) How likely is the sample proportion of unlisted numbers (\( \hat{p} \)) to be between .54 and .62?

(c) What is the probability that the majority of the sampled telephone numbers were listed?

(d) What is the probability that more than 450 of the sampled phone numbers were unlisted?
(7) (Moore and McCabe, 1998) College financial aid offices expect students to use summer earnings to help pay for college. But how large are these earnings? One college studied this question by asking a sample of students how much they earned. Omitting students who were not employed, 1296 responses were received. Here are the data in summary form:

<table>
<thead>
<tr>
<th>Group</th>
<th>n</th>
<th>$x$</th>
<th>s</th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td>675</td>
<td>$1884.52$</td>
<td>$1368.37$</td>
</tr>
<tr>
<td>Females</td>
<td>621</td>
<td>$1360.39$</td>
<td>$1037.46$</td>
</tr>
</tbody>
</table>

(a) Use the two-sample $t$-procedures to give a 90% confidence interval for the difference between the mean summer earnings of male and female students.

(b) The distribution of earnings is strongly skewed to the right. Nevertheless, use of $t$-procedure is justified. Why?

(c) Once the sample size was decided, the sample was chosen by taking every $k$-th name from an alphabetical list of undergraduates. Is it reasonable to consider the samples as Simple Random Sample (SRS) chosen from the male and the female undergraduate populations?

(d) What other information about the study would you request before accepting the results as describing all undergraduates?

(8) (Moore and McCabe, 1998) Does increasing the amount of calcium in our diet reduce blood pressure? A randomized comparative experiment gave one group of 10 black men a calcium supplement for 12 weeks. The control group of 11 black men received a placebo that appeared identical. The experiment was double-blinded. Table below gives the seated systolic (heart contracted) blood pressure for all subjects at the beginning and at the end of the 12-week period, in millimeters ($mm$) of mercury. Because the researchers were interested in decreasing blood pressure, table below also shows the decrease for each subject. An increase appears as a
(a) Take group 1 to be the calcium and group 2 to be the placebo group. The evidence that calcium lowers blood pressure more than a placebo is assessed by testing:

\[ H_0 : \mu_1 = \mu_2 \]

\[ H_a : \mu_1 > \mu_2 \]

Carry out the test at 0.10 and 0.05 significant levels.

(9) The number of pages of books in the university library has an average of 400 pages with a standard deviation of 50 pages. Suppose we pick 60 books from the library, what is the probability that the average of these 60 books exceed 375 pages?

(10) For a particular brand of cars, the gas consumption on travelling between Bakersfield and Los Angeles is 5 gallons. The gas consumption has a distribution with standard deviation of 0.4 gallons. There are 30 cars of this particular brand that travel together from Bakersfield to Los Angeles. What is the probability that these 30 cars consume less than 145 gallons together?

(11) According to Statistics Canada, 7% of the Canadians used marijuana in 1994. If 200 Canadians were drawn randomly, what is the probability that more than 9% in this sample used marijuana?
(12) The recent California Recall showed that 55% of the votes cast chose to recall the governor (that is, the “Yes” vote). If before the election, 150 registered voters were randomly chosen for a poll, what is the probability that the proportion of “Yes” vote turns up less than 50%, giving a false prediction of the outcome?

(13) A manufacturer claims that the average weight of a pack of pastilles is 140 grams with standard deviation of 3 grams. A random sample of 80 packages showed an average of 139 grams. Does this cast a doubt on the manufacturer’s claim that the average weight is 140 grams? Explain.

(14) According to the American Red Cross, 4% of the US population has a blood type of AB. If 500 residents were chosen, what is the probability that the proportion of the residents having blood type AB lies between 3% and 6%?