Elementary Statistics: Homework

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Contents

Chapter 1

The Language and Terminology

1.1 The Language and Terminology

1. Consider the following is data on the 9-month salary of mathematics faculty members (to the nearest thousand dollars) in the year 1999-00:

$$\begin{array}{cccccccccc} 61 & 63 & 72 & 80 & 70 & 76 & 97 & 60 & 57 & 65 \\ 67 & 73 & 66 & 75 & 61 & 54 & 61 & 65 & 70 & 68 \\ 53 & 50 & 50 & 40 & 51 & 44 & 62 & 57 & 51 & 52 \\ 50 & 57 & 52 & 52 & 56 & 46 & & & & \end{array} \tag{1.1}$$

   Use class width = 10K. Complete the following frequency table:

Class	39.5 − 49.5	49.5 − 59.5	59.5 − 69.5	69.5 − 79.5	79.5 − 89.5	89.5 − 99.5
Freq						

2. Following is the grand total (out of 400) of scores obtained by students in a class.

$$\begin{array}{cccccccccc} 386 & 343 & 287 & 394 & 303 & 280 & 333 & 389 & 376 & 350 \\ 388 & 380 & 320 & 391 & 371 & 354 & 366 & 354 & 284 & 298 \\ 327 & 386 & 380 & 370 & 363 & 382 & 362 & 384 & 343 & 352 \\ 350 & 391 & 345 & 385 & 310 & 380 & 381 & 362 & 326 & 82 \\ 391 & 328 & 345 & 376 & & & & & & \end{array} \tag{1.2}$$

We use class width = 50. Complete the frequency table of the date data in (1.2):

Class	*Frequency*
51 – 100	
101 – 150	
151 – 200	
201 – 250	
251 – 300	
301 – 350	
351 – 400	

If a data value falls on the boundary, count it on the left interval.

3. The following is data on the weight (in ounces), at birth, of some babies.

74	105	124	110	119	137	96	110	120	115	140
65	135	123	129	72	121	117	96	107	80	91
74	123	124	124	134	78	138	106	130	97	145
93	133	128	96	126	124	125	127	62	127	92
95	118	126	94	127	121	117	124	93	135	156
143	125	120	147	138	72	119	89	81	113	91
133	127	138	122	110	113	100	115	110	135	141
97	127	120	110	107	111	126	132	120	108	148
143	103	92	124	150	86	121	98	74	85	99

(1.3)

Complete the frequency table of the weight distribution data in (1.3):

Class	*Frequency*
60.5 – 70.5	
[70.5 – 80.5	
80.5 – 90.5	
90.5 – 100.5	
100.5 – 110.5	
110.5 – 120.5	
120.5 – 130.5	
130.5 – 140.5	
140.5 – 150.5	
150.5 – 160.5	

Chapter 2

Measures of Central Tendency and Measures of Dispersion

2.1 Mean and Median

1. The following is the price (in dollars) of a stock (say, CISCO SYSTEMS) checked by a trader several times on a particular day.

   139 143 128 138 149 131 143 133

   (a) Find the mean price (in dollars) observed by the trader.

   (b) Find the median price observed by the trader (in dollars).

2. The following figures refer to the GPA of six students:

   3.0 3.3 3.1 3.0 3.1 3.1

   (a) Find the median of the GPA.

   (b) Find the mean of the GPA.

3. The following data give the lifetime (in days) of certain light bulbs.

   138 952 980 967 992 197 215 157

(a) Find the mean for the lifetime of these light bulbs.

(b) Find the median for the lifetime of the bulbs.

4. An athlete ran an event 32 times. The following frequency table gives the time taken (in seconds) by the athlete to complete the events.

Time (*in seconds*)	**Frequency**
11.6	4
11.7	5
11.8	6
11.9	7
12.0	6
12.1	4
Total	32

(a) Compute the mean time taken by the athlete. (Write up to 4 significant digits.)

(b) Find the median time taken by the athlete

5. The following are the weights (in ounces), at birth, of 30 babies born in Lawrence Memorial Hospital in May 2000.

94	105	124	110	119	137	96	110	120	115
104	135	123	129	72	121	117	96	107	80
96	123	124	124	134	78	138	106	130	97

(a) Compute the mean weight, at birth, of the babies.

(b) Using the previous table, compute the median weight, at birth, of the babies.

6. Following is a frequency table for the hourly wages (paid only in whole dollars) of 99 employees in an industry.

Hourly Wages	7	8	9	10	11	12	13	14	15	16	17	18	19
Frequency	1	4	10	4	9	8	6	5	17	19	3	1	2

(a) Compute the mean hourly wage.

(b) Using the previous frequency table, compute the median hourly wage.

7. The following is the frequency table on the number of typos found in a sample of 30 books published by a publisher.

Number of Typos	156	158	159	160	162
Frequency	6	4	5	6	9

   (a) Compute the mean number of typos in a book.

   (b) Using the previous frequency table, compute the median number of typos found in a book.

8. The following are the lengths (in inches), at birth, of 14 babies born in Lawrence Memorial Hospital in May 2000.

Length	17	18.5	19	20	21.5
Frequency	2	3	4	3	2

   (a) Compute the mean length, at birth, of these babies.

   (b) Using the previous table, compute the median length, at birth, of these babies.

2.2 Variance and Standard Deviations

1. The following is the price (in dollars) of a stock (say, CISCO SYSTEMS) checked by a trader several times on a particular day.

   138 142 127 137 148 130 142 133

   (a) Find the variance of the price (to four decimal places).

   (b) Find the standard deviation of the price (to four decimal places).

2. The following figures refer to the GPA of six students:

   3.0 3.3 3.1 3.0 3.1 3.1

   (a) Find the variance of the GPA (to four decimal places).

   (b) Find the standard deviation of the GPA (to four decimal places).

3. The following data give the life time (in days) of certain light bulbs.

938 952 980 967 992 997 915 957

   (a) Find the variance for the life time of these bulbs (to four decimal places).

   (b) Find the standard deviation for these bulbs (to four decimal places).

4. An athlete ran an event 32 times. The following frequency table gives the time taken (in seconds) by the athlete to complete the events.

Time (*in seconds*)	**Frequency**
11.6	4
11.7	5
11.8	6
11.9	7
12.0	6
12.1	4
Total	32

   (a) Compute the variance for the times taken by the athlete (to four decimal places).

   (b) Find the standard deviation for the times taken by the athlete (to four decimal places).

5. The following are the weights (in ounces), at birth, of 30 babies born in Lawrence Memorial Hospital in May 2000.

94	105	124	110	119	137	96	110	120	115
104	135	123	129	72	121	117	96	107	80
96	123	124	124	134	78	138	106	130	97

   (a) Compute the variance of the weight, at birth, of the babies.

   (b) Compute the standard deviation of the weight, at birth, of the babies.

6. Following is a frequency table for the hourly wages (paid only in whole dollars) of 99 employees in an industry.

Hourly Wages	7	8	9	10	11	12	13	14	15	16	17	18	19
Frequency	11	4	10	4	9	8	6	5	17	19	3	1	2

(a) Compute the variance of the hourly wage.

(b) Compute the standard deviation of the hourly wage.

7. The following is a frequency table on the number of typos found in a sample of 30 books published by a publisher.

Number of Typos	156	158	159	160	162
Frequency	6	4	5	6	9

(a) Compute the variance of the number of typos in a book.

(b) Compute the standard deviation of the number of typos in a book.

8. The following are the lengths (in inches), at birth, of 14 babies born in Lawrence Memorial Hospital in May 2000.

Length	17	18.5	19	20	21.5
Frequency	2	3	4	3	2

(a) Compute the variance of the length, at birth, of these babies.

(b) Compute the standard deviation of the length, at birth, of these babies.

Chapter 3

Probability

3.1 Basic Concept of Probability

No Homework

3.2 Probability Table and Equally likely

1. The following table gives the probability distribution of a loaded die.

Face	1	2	3	4	5	6
Probability	0.20	0.15	0.15	0.10	0.05	0.35

   Find the probability that an even number face will show up when you roll the die.

2. A die is rolled twice. What is the probability that the two numbers are unequal?

3. A student wants to pick a school based on the recent grade distribution of the school. Following is the grade distribution of the previous year in a school:

Grades	A	B	C	D	F
Percentage of Students	19	33	31	14	3

What is the probability that a student will receive a C-grade or higher in this school?

4. A container has 11 red balls, 15 green balls, 10 white balls, and 8 yellow balls. A child picks up a ball from the container. Find the probability that the ball is red.

5. A die is rolled twice. What is the probability that the product of the two numbers is 11?

6. A magician asks you to pick a card from a deck of 52 cards. What is the probability that you will pick a heart?

7. You toss a coin 4 times. What is the total number of outcomes?

8. The sex of 4 unborn children is to be determined in a lab today. What is the probability that there will be at least 2 girls?

3.3 Laws of Probabability

1. Suppose E and F are two events. It is given that P(E)=.22, P(not F)=.65, and P(E and F)=.13. Determine the probability that either E or F occur.

2. Suppose E and F are two events. It is given that P(not E)=.33, P(not F)=.54, and P(E or F)=.68. Determine the probability that both E and F occur.

3. Use the information in Question 2. Determine the probability that neither E nor F occur.

4. The proportion of students who own a vehicle is 0.55, and the proportion of students who live in a dorm is 0.41. If the proportion of students who either own a vehicle or live in a dorm is 0.83, find the proportion of students who live in a dorm and own a vehicle.

5. The probability that it does not rain in Arizona in June is 0.22. Find the probability that it rains at least once in the month of June in Arizona.

6. The probabilities that a particular office phone rings 0, 1, 2, 3 times in half hour are respectively: .05, .15, .21, .42. Find the probability that the phone rings at least 4 times between 3:30-4:00 pm.

7. The probability of a student going to a bar on Wednesday is $3/5$. The probability of the student going to class on Thursday is $4/5$. If the probability that the student either goes to the bar or goes to class the next day is $9/10$, what is the probability that the student will do the both?

8. The probability that a student will major in mathematics is .13 and the probability that a student will have a major in engineering is .31. The probability that a student will double major in mathematics and engineering is .07. What is the probability that a student will major in mathematics or engineering?

3.4 Counting Techniques and Probability

1. Compute ${}_8C_2$.

2. Suppose 2 scholarships, \$1000 each, is to be given to 2 students. There are 9 applicants. How many choices of 2 awardees are possible?

3. Suppose 2 scholarships, one for \$2000 and another for \$1000, will be given to 2 students. There are 9 applicants. How many choices of 2 awardees are possible?

4. In an annual sports meet, 9 students compete in 2 events (the 100 meter and 1000 meter race). How many ways can two winners can be picked?

5. A coin is tossed 6 times. What is the total number of possible outcomes?

6. The sex of 8 unborn children is to be determined today in a lab. What is the probability that 2 particular children (say the child of Elizabeth and the child of Maria) will be boys?

7. A committee of 8 is to be formed from a group of 7 mothers, 6 fathers, and 8 children. What is the probability that the committee will have exactly 4 fathers?

8. The 6 seats in the first row are to be assigned to a class of 17 women and 20 men. What is the probability that all the seats will be assigned to women.

3.5 Conditional Probability and Independence

1. For two events, E and F, it is given that the probabilities $P(E) = 0.6$, $P(F|E) = 0.3$, and $P(F) = 0.7$. What is the probability that E and F occur simultaneously?

2. For two events, E and F, it is given that the probabilities $P(E) = 0.5$, $P(F \text{ and } E) = 0.3$, and $P(F) = 0.9$. What is the conditional probability that F occurred, given that E has occurred?

3. Following are some data from a hospital emergency room:

   (a) The probability that a patient in the emergency room will have health insurance is 0.8.

   (b) The probability that a patient in the emergency room will survive the treatment 0.9.

   (c) The probability that a patient in the emergency room will have health insurance and will also survive is 0.6.

   What is the conditional probability that a patient in the emergency room will survive, given that he/she has health insurance.

4. Following are some observations on the stock market:

   (a) The probability that the Dow Jones Industrial Average (DJIA) will go up today is 0.75.

   (b) The probability that the value of your portfolio will go up today is 0.80.

(c) The probability that both the DJIA will go up and the value of your portfolio will go up today is 0.6.

What is the conditional probability that the value of your portfolio went up today, given that the DJIA went up today?

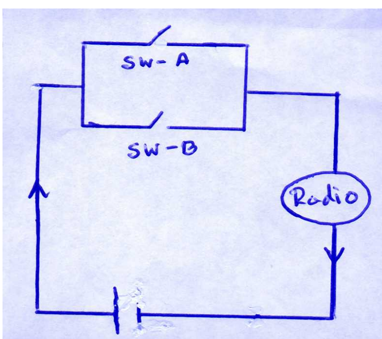
5. Following are some data on allergy treatment:

(a) The probability that a person will get the allergy in a season is 0.55.

(b) The probability that a person has taken an allergy treatment and gets an allergy in the season is 0.15.

(c) The probability that a person has taken the treatment is 0.6.

What is the conditional probability that a person will get an allergy, given that she/he has taken the allergy treatment?

6. 

Consider the following circuit with the radio: It is given that the probability that switch A is closed is 0.35 and the probability that switch B is closed is 0.40. It is also known that the 2 switches function independently. What is the probability that the radio is playing?

7. An airplane has 2 engines and the engines function independently. The probability that the first engine fails during a flight is 0.1 and the probability that the second engine fails is 0.1. What is the probability that both will fail during a flight?

8. The probability that you will receive a wrong number call this week is 0.2. The probability that you will receive a sales call this week is 0.5. The probability that you will receive a survey call this week is 0.3.

What is the probability that you will receive one of each this week? (Assume independence.)

9. The probability that you will receive a wrong number call this week is 0.1. The probability that you will receive a sales call this week is 0.6. What is the probability that you will receive either a wrong number call or a sales call this week? (Assume independence.)

10. During your trip to Florida, the probability that the weather in Florida will be good is 0.9 and the probability that it will be cold in Lawrence is 0.3. What is the probability that, during your trip, you will have good weather in Florida and it will be cold in Lawrence? (Assume independence.)

Chapter 4

Random Variables

4.1 Random Variables

None

4.2 Probability Distribution

1. The following table gives the probability distribution of the starting salary X earned by new graduates from some university (to the nearest \$10K).

$X = x$	0	1	2	3	4	5	6	7
$p(x)$	0.05	0.15	0.22	0.22	0.17	0.10	.05	.04

   What is the expected starting salary of a new graduate?

2. For the starting salary X in Question 1, what is the standard deviation of the staring salary?

3. Maria is a plumber who works for 3 different employers. Employer A pays her \$120 a day, employer B pays her \$70 dollars a day, and employer C pays her \$180 a day. She works for whoever calls her first.

The probability that employer A calls her first is 0.4, the probability that employer B calls first is .2, and the probability that employer C calls her first is 0.3 (the probability that no one calls is .1). What is the expected income of Maria per day?

4. Maria is the plumber in Question 3. What is the standard deviation of the daily income of Maria?

5. The number X of typos in a website has the following probability distribution.

$X = x$	0	1	2	3	4	5
$p(x)$	.14	0.27	0.27	0.18	0.09	0.05

What is the expected number of typos in a website?

6. Let X be the number of typos, as in Question 5. What is the standard deviation of X?

7. Let X be the number of typos, as in Question 5. What is the probability that there would be at least 3 typos is a book?

8. Let X represents the number of students in a class, in a school district. The following is the distribution of X:

$X = x$	11	12	13	14	15	16	17	18	19	20	21
$p(x)$	.08	.09	.11	.13	.14	.13	.10	.09	.06	.05	.02

What is the expected number of students in a class?

9. Refer to Question 8. Compute the standard deviation σ.

10. A Gambling house has a loaded die. One pays \$3 to play each time. One gets back number of dollards equal to the face that turns up. The following is the probability distribution of the loaded die, together with the win X.

$Face$	1	2	3	4	5	6
$p(x)$	.3	.2	.2	.1	.1	.1
$Win\ X = x$	-2	-1	0	1	2	3

Compute the expected win $E(X)$?

4.3 The Bernoulli and Binomial Experiments

1. The statistics of campus interviews show that for every 10 interviews 4 job offers are made. Out of 66 interviews, what is the probability that at least 30 offers would be made? (Use TI-84, Silver Edition.)

2. Refer to Question 1. What would be the expected number of job offers made?

3. Refer to Question 1. What would be the standard deviation σ of the number of job offers made?

4. Assume that 20 percent of the babies get fever after immunization shoots. If 130 babies are immunized in a clinic, what is the probability that at most 30 will get fever?

5. Refer to Question 4. What is the expected number of babies that would get fever?

6. Refer to Question 4. What would be the standard deviation σ ?

7. It is assumed by the coach that a swimmer can finish an event within target time 45 percent times during practice. Suppose the swimmer swims 80 times. What is the probability that he/she will finish within the target time at least 40 times?

8. Refer to Question 8. What is the expected number $E(X)$ of times that he/she will finish within target time?

9. Refer to Question 8. What is the standard deviation σ of the number of times X that he/she will finish within target time?

10. It was reported, that 20 percent of the population in a region were infected by AIDS-HIV. A sample of 200 people from this region were examined for AIDS-HIV. What was the expected number of infected people?

Chapter 5

Continuous Random Variables

5.1 Probability Density Function (pdf)

None

5.2 The Normal Random Variable

1. Suppose Z is the standard normal random variable. Find the probability $P(-1.23 \leq Z)$.
2. Suppose Z is the standard normal random variable. Find the probability $P(-1.18 \leq Z \leq 1.87)$.
3. Suppose X is a normal random variable with mean $\mu = 11.5$ and standard deviation $\sigma = 2.3$. Find the probability $P(X \leq 14)$.
4. Monthly consumption of electricity X (in KWH, in a winter month) by the households in a county has a normal distribution with mean 875 KWH and standard deviation 155 KWH. What proportions of households consumes less than 1000 KWH?
5. The monthly cell phone minutes used by an individual in a city has normal distribution with mean 2700 minutes and standard deviation

325 minutes. What proportion of calls would last more than 3000 minutes?

6. The amount of time a student spends to take a test has normal distributions with mean 45 minutes and standard deviation 13 minutes. What proportion of students would finish in 60 minutes?

7. The annual rainfall X in a region is normally distributed with mean $\mu = 62$ cm and standard deviation $\sigma = 9$ cm. What is the probability that rainfall will be between 55 cm and 70 cm?

8. The birth weight X of babies is normally distributed with mean $\mu = 113$ ounces and standard deviation $\sigma = 19$ ounces. What proportion of babies will have birth weight below 150 ounces?

9. The length X of babies at birth is normally distributed with mean $\mu = 18.5$ inches and standard deviation $\sigma = 2.3$ inch. What proportion of babies are smaller than 21 inches ?

10. The weight X of salmon caught in a river is normally distributed with mean $\mu = 24$ pounds and standard deviation $\sigma = 7$ pounds. You can keep only those above 15 pounds. What proportion of the salmon caught can be kept?

5.2.1 Inverse Normal

1. Suppose Z is the standard normal random variable. It is given that $P(Z \leq c) = 0.2300$. What is the value of c?

2. Suppose Z is the standard normal random variable. It is given that $P(d \leq Z) = 0.9500$. What is the value of d?

3. Suppose X is a normal random variable with mean $\mu = 3.5$ pounds and standard deviation $\sigma = 1.2$ pounds. Given that the probability $P(c \leq X) = 0.2550$, what is the value of c?

4. The weight X of babies (of a fixed age) is normally distributed with mean $\mu = 212$ ounces and standard deviation $\sigma = 25$ ounces. Doctors would be concerned (not necessarily alarmed) if a baby is among the

lower 5 percent in weight. Find the cut-off weight l, below which the doctors will be concerned.

5. The weight X of babies (of a fixed age) is normally distributed with mean $\mu = 212$ ounces and standard deviation $\sigma = 25$ ounces. Doctors would also be concerned (not necessarily alarmed) if a baby is among the upper 10 percent in weight. Find the cut-off weight u, above which the doctors will be concerned.

6. The weight X of salmon caught in a river is normally distributed with mean $\mu = 24$ pounds and standard deviation $\sigma = 6$ pounds. You can keep those that are among that upper 66 percent in weight. What is the cut-off weight l, above which you can keep the fish?

7. The height of an adult male in a region is known to be normally distributed with mean of $\mu = 69$ inches and a standard deviation $\sigma = 2.5$ inches. How high should a doorway be so that 92 percent of adult males can pass through it without having to bend?

8. The hourly wages X in an industry has a normal distribution with mean \$40 and standard deviation \$17. What is the 97 percentile of the hourly wage?

9. The mean monthly water consumption X by the households in a subdivision has a normal distribution with mean 4500 gallons and standard deviation 3000 gallons. A surcharge would be imposed to the top 20 percent users. What is the cut-off number of gallons?

10. The time X needed for a student to arrive at the class from his/her residence has a normal distribution with mean 30 minutes and with standard deviation 7 minutes. How much time before the class he/she should start so that he/she would be late only for 7 percent of the first period?

5.3 Normal Approximation to Binomial

1. A Lawrence bank knows from past experience that 40 percent of the customers visit the drive through window. If 600 customers visit the

bank, what is the probability that more than 220 will visit the drive through window? (More than 220 means greater or equal to 221.)

2. It is known that 42 percent of the population have blood group A. Suppose 800 persons are examined every day in a lab. What is the probability that at most 360 will have blood group A?

3. The hiring statistics of a corporation (say Sprint) indicate that for every 10 interviews it gives, it makes 2 job offers. Suppose it plans to interview 400 candidates next month. What is the probability that it will make less than 74 job offers? (Less than 74 means less or equal to 73.)

4. It is reported that 20 percent of the population in a region are infected by AIDS-HIV. A sample of 256 were examined for AIDS-HIV. What is the approximate probability that more than 60 were infected?

5. The probability that a light bulb produced in a factory is defective is .15. If you have a sample of 60 bulbs, what is the approximate probability that the number of defective bulbs will be at most 10?

6. The campaign committee of a candidate claims that sixty percent of the voters are in favor of the candidate. You interview 150 voters. Assuming the claim is accurate, what is the approximate probability that less than 80 will favor the candidate?

7. It is claimed that 55 percent of the population supports government action on poverty. A sample of 780 are interviewed. What is the approximate probability that more than 450 would support the same?

8. A producer of a drug claims that only 22 percent of the patients may suffer some side effects. The drug was prescribed to 600 patients. What is the probability that more than 130 would suffer from some side effect?

9. It is known that 73 percent of population took a flu shot. In a medical facility, 400 patients visit in a week. What is the probability that less than 300 would have taken the flu shot?

10. In a used car sell website 25 percent of the cars are sold by the first owner. Currently there are 220 car sell ads in the website. what is the probability that less than 50 are sold by the first owner?

Chapter 6

Sampling Distribution

6.1 Sampling Distribution

None

6.2 Central Limit Theorem

1. It is known that the tuition paid per semester by students in a university has a distribution with mean \$1,550 and standard deviation \$416. Assume 64 students are interviewed. Use CLT to compute the approximate probability that the sample mean tuition $\overline{X}$ paid will be above \$1,600.

2. The mean weight of tomatoes is 225 grams and standard deviation 45 grams. What is the (approximate) probability that the mean $\overline{X}$ of a sample of 68 tomatoes would be less than 230 grams? (Use CLT.)

3. The birth weight of babies in a region has mean $\mu = 114$ pounds and standard deviation $\sigma = 18$ pound. If 100 babies are sampled, what is the (approximate) probability that the mean weight $\overline{X}$ will be less than 116 pounds? (Use CLT.)

4. The time to drive to the campus is normally distributed with mean $\mu = 33$ minutes and standard deviation $\sigma = 12$ minutes. What is the (approximate) probability that the mean time $\overline{X}$ taken by a sample of 35 will be less than 36 minutes? (Use CLT.)

5. The mean time car salespersons spend with a client is 48 minutes and standard deviation 19 minutes. In a week 77 clients visit a dealer. What is the (approximate) probability that mean time $\overline{X}$ spent with these clients would exceed 50 minutes? (Use CLT.)

6. The members of a family share cell phone time. The mean length of the calls is mean 28 minutes and standard deviation is 18 minutes. The family made 98 calls. What is the (approximate) probability that the **total** time used would be less 3000 minutes?

7. The weight X of salmon caught in a river is has mean $\mu = 24$ pounds and standard deviation $\sigma = 8$ pounds. If you catch 36 fish, what is the approximate probability that the **total** weight of fish caught will exceed 900 pounds? (Use CLT.)

8. During the rainy season, in a region, the mean weekly rainfall is 10 inches and standard deviation 4.4 inches. What is the probability that **total** rainfall during the remaining 12 weeks of the season would exceed 130 inches? (Use CLT.)

9. The mean time a real-estate agent spend showing a house is 55 minutes and standard deviation is 22 minutes. An agent showed 33 houses in a week. What is the (approximate) probability that the agent would have spent less than a **total** of 1800 minutes (30 hours) showing houses?

10. The mean time taken by a school student to complete a homework problem is 220 seconds and standard deviation 100 seconds. A homework assignment has 30 problems. What (approximate) proportion of students would spend more than a **total** of 6000 seconds (100 minutes)?

6.3 Distribution of the Sample Proportion

1. It is speculated that the proportion p of students who paid more than \$5000 tuition this year is $p = .58$. A sample of 680 students was

collected. Assuming that this speculation is correct, what is the probability that more than 400 would have paid more than \$5000 in tuition (i.e. sample mean would be more than 400/680)? (Use CLT.)

2. A gross estimate of a fisherman is that that 65 percent of the salmon in a river exceed thirty pounds in weight. A fisherman catches 480 salmon. Assuming his/her gross estimate, what is the probability that less than 300 would be above thirty pounds (i.e. sample mean would be less than 300/480)? (Use CLT.)

3. It is assumed that proportion of tomatoes above 225 grams is $p = .72$. What is the probability that a sample of 200 tomatoes would have less than 150 tomatoes above 225 grams (i.e. sample mean would be less than 150/200)? (Use CLT.)

4. It is assumed that 52 percent of the population take less than thirty minutes to commute to work. In a sample 720, what is the probability that more than 370 commute less than thirty minutes (i.e. sample mean would be more than 370/720)? (Use CLT.)

5. It is speculated that in a rainy season, in a region, probability that it will rain at least one inch is $p = .80$. What is the probability that for more than 100 days it will rain more than an inch, in a season of 120 days (i.e. sample mean would be more than 100/120)? (Use CLT.)

6. The campaign committee of a candidate claims that 43 percent of the voters are in favor of the candidate. You interview 250 voters. Assuming the claim is accurate, what is the approximate probability that less than 100 will favor the candidate (i.e. sample mean would be less than 100/250)? (Use CLT.)

7. A gas station knows from past experience that 25 percent of the customers pay outside by credit card. If 800 customers visit the Gas station, what is the probability that less than 215 will pay outside by credit card (i.e. sample mean would be less than 215/800)? (Use CLT.)

8. The probability that a light bulb produced in a factory is defective is .15. What is the approximate probability that a sample 700 would have less than 100 defective lamps (i.e. sample mean would be less than 100/700)? (use CLT.)

Chapter 7

Estimation

7.1 Point and Interval Estimation

7.1.1 Confidence Interval of μ

1. A stock broker knows that the end-of-year balance X (percent of the January 1 balance) in the client's account has a distribution with mean μ percent and standard deviation $\sigma = 10$. The broker collected a sample of 49 clients and the sample mean $\overline{x}$ was found to be 100 percent. Compute a 99 percent confidence interval for the mean balance μ. Give the Margin of Error E, Left end point and Right end point, of the mean balance μ:

   $MOE = E =$ $\qquad$ $LEP =$ $\qquad$ $REP =$

2. The length of a certain species of animal has a distribution with mean μ and standard deviation $\sigma = 13.5$. To estimate the mean μ of a herd, you have collected a sample of size 87 and the sample mean $\overline{x}$ was found to be 68 inches. Compute a 96 percent confidence interval for the mean length μ of the herd. Give the Margin of Error E, Left end point and Right end point, of the mean balance μ:

   $MOE = E =$ $\qquad$ $LEP =$ $\qquad$ $REP =$

3. The time X taken for a KU student to drive to the campus has distribution with mean μ minutes and and standard deviation $\sigma = 7.5$ minutes. To estimate the mean time μ, a sample of size 116 was collected and the sample mean $\overline{x}$ was found to be 22 minutes. Compute a 98 percent confidence interval for the mean time μ. Give the Margin of Error E, Left end point and Right end point, of the mean time μ:

   $MOE = E =$ $LEP =$ $REP =$

4. The time taken for an athlete to run an event has a distribution with mean μseconds and known standard deviation $\sigma = 3.5$ seconds. To estimate the mean run time μ, the athlete runs the event 30 times and the sample mean run time $\overline{x}$ was found to be 25 seconds. Compute a 95 percent confidence interval for the mean time μ. Give the Margin of Error E, Left end point and Right end point, of the mean time μ:

   $MOE = E =$ $LEP =$ $REP =$

5. It is known that the tuition paid per semester by students in a university has a distribution with mean $\mu$and known standard deviation $\sigma = \$1278$. To estimate the mean μ a sample of 180 students were interviewed. The sample mean $\overline{x}$ is found to be \$4200. Compute a 92 percent confidence interval for the mean tuition μ. Give the Margin of Error E, Left end point and Right end point, of μ:

   $MOE = E =$ $LEP =$ $REP =$

6. The weight of salmon caught in a river has mean μ pounds. We know from previous experience that the standard deviation of the weight is $\sigma = 6$ pounds. Suppose you catch 56 fish and the mean weight of the fish is$\overline{x} = 21.1$ pounds. Compute a 90 percent confidence interval for the mean weight μ. Give the Margin of Error E, Left end point and Right end point, of μ:

   $MOE = E =$ $LEP =$ $REP =$

7.1.2 The Required Sample Size

1. Suppose you want to estimate the mean μ housing price in Lawrence. From past experience it is known that the standard deviation of the

housing price is $\sigma = 45$ K. How large a sample you will need to take so that, at 99 percent level of confidence, the sample mean $\overline{X}$ of the housing price will differ by at most 5 K from μ. (Round upward only.)

2. The time taken by a swimmer to complete an event has a distribution with mean μ seconds and known standard deviation $\sigma = 20$ seconds. To estimate the mean time μ within 2 second from the sample mean $\overline{X}$ time, with 98 percent confidence, how many times does he/she have to swim the event? (Round upward only.)

3. Suppose you want to estimate the mean μ starting salary for the new KU graduates. From past experience it is known that the standard deviation of the starting salary is $\sigma = 13$ K. How large a sample will you need to take so that, at 96 percent level of confidence, the sample mean $\overline{X}$ of the starting salary will differ by at most 1 K from μ. (Round upward only.)

4. The gas prices at various gas stations has a mean μ and known standard deviation $\sigma = 87$ cents. To estimate the mean μ within 5 cents from the sample mean $\overline{X}$, with 94 percent confidence, how large a sample do you have to draw? (Round upward only.)

5. The time X taken for a KU student to drive to the campus has distribution with mean μ minutes and standard deviation $\sigma = 540$ seconds. The mean time μ is to be estimated within 100 seconds from the actual value of μ with a 97 percent confidence. How large a sample needs to be drawn?

6. The weight of salmon caught in a river has mean μ pounds. We know from previous experience that the standard deviation of the weight is $\sigma = 1.5$ kilograms. To determine the probability of a business proposition the mean weight μ is to be estimated within .5 kilograms from the actual value with 80 percent confidence. How many fish do you need to catch to do that?

7.2 Confidence interval for μ when σ is Unknown

1. The height X of adults has normal distribution with mean μ and standard deviation σ. To estimate the height of a group of people, a sample of $n = 22$ individuals was collected and the sample mean was found to be $\overline{x} = 155.1$ and the sample standard deviation $s = 14.9$. Compute a 95 percent confidence interval for mean height μ. Give the Margin of Error E, Left end point and Right end point, of μ:

   $MOE = E =$ $LEP =$ $REP =$

2. The time X spent, per month, on a cell phone by an individual has normal distribution with mean μ. To estimate $n = 250$ people was collected. It was found that the sample mean $\overline{x} = 129.1$ minutes and the sample standard deviation of s = 11.95 minutes. Construct a 99 percent confidence interval for mean time μ. Give the Margin of Error E, Left end point and Right end point, of μ:

   $MOE = E =$ $LEP =$ $REP =$

3. The temperature X of water in some kind of heating equipment has a normal distribution with mean μ. To estimate the mean temperature μ, a sample of 131 reading was collected. It was found that the sample mean $\overline{x} = 101.6$ degrees and the standard deviation $s = 11.1$ degrees. Compute a 96 percent confidence interval for mean temperature μ. Give the Margin of Error E, Left end point and Right end point, of μ:

   $MOE = E =$ $LEP =$ $REP =$

4. It is assumed that the lifetime (in hours) of light bulbs produced in a factory is normally distributed with mean μ and standard deviation σ. To estimate μ the following data was collected on the life time of bulbs:

2530	7811	5140	4598	3099	8414	1541	4123	7892
1783	3560	6544	2377	3214	2223	4548	1574	3641

   Compute a 95 percent confidence interval for μ. Give the Margin of Error E, Left end point and Right end point, of μ:

   $MOE = E =$ $LEP =$ $REP =$

5. To estimate the mean time taken to complete a three mile-drive by a race car, the race car did several time trials, and the following sample of times taken to complete the laps was collected:

50.1	48.7	49.7	46.5	54.4
53.9	52.0	51.3	47.6	56.0
52.7	51.3	51.9	53.8	50.4
49.2	48.7	54.6	53.6	

   Compute a 95 percent confidence interval for the mean μ. Give the Margin of Error E, Left end point and Right end point, of μ:

   $MOE = E =$ $\qquad$ $LEP =$ $\qquad$ $REP =$

6. To estimate the mean height μ, in feet, of toddlers at age two, the following data was recorded:

1.55	1.50	1.15	1.30	1.45	1.60	1.70	1.65	1.20	1.65
1.35	1.60	1.75	1.60	1.25	1.20	1.25	1.60	1.55	

   Compute a 99 percent confidence interval for the mean μ. Give the Margin of Error E, Left end point and Right end point, of μ:

   $MOE = E =$ $\qquad$ $LEP =$ $\qquad$ $REP =$

7.3 About the Population Proportion

1. To estimate the proportion p of defective light bulbs produced in a factory, a sample of 180 bulbs were tested. In this sample 27 were defective. Compute a 95 percent confidence interval for p. Compute the margin of error e in estimating p at 95 percent level of confidence. Give the Margin of Error e, Left end point, Right end point, and the Conservative Margin of Error E:

   $MOE = e =$ $\qquad$ $LEP =$ $\qquad$ $REP =$ $\qquad$ $C - MOE = E =$

2. In certain areas AIDS-HIV epidemic may a concern. A sample of 176 people were examined for AIDS-HIV and 44 were found to be infected

by AIDS-HIV. We will compute a 99 percent confidence interval for the proportion p of people who were infected by AIDS-HIV. Compute the margin of error e in estimating p at 99 percent level of confidence. Give the Margin of Error e, Left end point, Right end point, and the Conservative Margin of Error E:

$MOE = e =$ $LEP =$ $REP =$ $C - MOE = E =$

3. You want to estimate the proportion p of defective light bulbs produced in a factory. Suppose you want to estimate p within .01 from the sample proportion $\overline{X}$ of defective items at 95 percent level of confidence. How large a sample would you take? (Round upward only.)

   Required Sample Size $n =$

4. You want to estimate the proportion p of people who oppose capital punishment. To estimate p within .02 from the sample proportion $\overline{X}$ with 99 percent level of confidence, how large a sample will you have to take? (Round upward only.)

   Required Sample Size $n =$

7.4 Confidence Interval of the Variance σ^2

1. The following is data on the 9-monthly salaries of mathematics faculty members (to the nearest thousand dollars) in the year 1999-00:

72	80	70	76	97	60	57	65
66	75	61	54	61	65	70	68
50	40	51	44	62	57	51	52
52	52	56	46				

   It is assumed that the salary is normally distributed. Compute a 95 percent confidence interval for variance σ^2 of the salary, which measures the variability in the salary structure. Give the left end point and the right end point:

   $LEP =$ $REP =$

2. The tuition X paid per semester by students is normally distributed. To estimate the variance σ^2 of the tuition paid, a sample of size 16 was drawn and the sample variance of the tuition was found to be $s^2 = \$313$. Compute a 99 percent confidence interval for variance σ^2 of the tuition paid. Give the left end point and the right end point:

$$LEP = \qquad\qquad REP =$$

3. The following is data on the height (in feet) of some African elephants.

10.9	11.7	9.3	9.9	11.5
8.8	12.9	11.7	9.1	11.1
9.1	8.7	10.5	11.3	12.3
13.1	12.9	9.5	10.7	11.3

It is known that the height of these elephants is normally distributed with mean μ and standard deviation σ. Compute a 90 percent confidence interval for variance σ^2 of the height of the elephant population. Give the left end point and the right end point:

$$LEP = \qquad\qquad REP =$$

Chapter 8

Comparing Two Populations

8.1 Confidence Interval of $\mu_1 - \mu_2$

1. To compare the annual salaries of professors in a university over the last two years, some data was collected. Last year, the mean salary of 36 professors was \$60.6 K. This year, the mean salary of 34 professors was \$63.7 K. Last year's standard deviation of the salary was known to be $\sigma_1 = \$11$ K and this years standard deviation of the salary is known to be $\sigma_2 = \$13$ K. Compute a 99 percent confidence interval for the difference $\mu_1 - \mu_2$ of mean salary of professors all over the university, where μ_1 is the last years mean salary and μ_2. is this years mean salary. Give the Margin of Error E, Left end point and Right end point, of $\mu_1 - \mu_2$:

   $MOE = E =$ $\qquad$ $LEP =$ $\qquad$ $REP =$

2. To compare gas prices in California and Kansas, data was collected. The standard deviation of gas prices in California is known to be $\sigma_1 =$ 20 cents per gallon. Gas prices in 40 gas stations in California were sampled and the mean price was found to be 375 cents per gallon. The standard deviation of gas prices in Kansas is known to be $\sigma_2 = 10$ cents per gallon. Gas prices in 36 gas stations in Kansas were sampled and the mean price was found to be 365 cents per gallon. Compute a at 95

percent confidence interval for the the difference $\mu_1 - \mu_2$ of mean gas prices, where μ_1 is the mean gas price in California, and μ_2 mean gas price in Kansas. Give the Margin of Error E, Left end point and Right end point, of $\mu_1 - \mu_2$:

$MOE = E =$ $LEP =$ $REP =$

3. The African elephants and the Indian elephants are different in height, weight, and the length of ear and tusk. The mean height and standard deviation of the African elephants are μ_1, σ_1, respectively. The mean height and standard deviation of the Indian elephants are μ_2, σ_2, respectively. It is known that $\sigma_1 = 1.5$ feet and $\sigma_2 = 1$ foot. A sample of size 18 African elephants were collected and the sample mean height was found to be $\overline{x} = 11.2$ feet. A sample of size 32 Indian elephants was collected and the sample mean height was found to be $\overline{y} = 9.2$ feet. Compute a 98 percent confidence interval for the difference $\mu_1 - \mu_2$ of mean height. Give the Margin of Error E, Left end point and Right end point, of $\mu_1 - \mu_2$:

   $MOE = E =$ $LEP =$ $REP =$

4. The weight of salmon in two different rivers are normally distributed with mean μ_1, μ_2 and standard deviation σ_1, σ_2, respectively. It is known that the $\sigma_1 = 2.3$ pounds and $\sigma_2 = 2.9$ pounds. A sample of size $m = 21$ fish from the first river was collected and the sample mean weight was found to be $\overline{x} = 19.9$ pounds. A sample of size $n = 48$ fish from the second river was collected and the sample mean weight was found to be $\overline{y} = 17.4$ pounds.

   Compute a 97 percent confidence interval for the difference$\mu_1 - \mu_2$. Give the Margin of Error E, Left end point and Right end point, of $\mu_1 - \mu_2$:

   $MOE = E =$ $LEP =$ $REP =$

8.2 When σ_1 and σ_2 are unknown

1. Qn 0 The African elephants and Indian elephants are different in height, weight, and the length of ear and tusk. It is natural to assume that

all these are normally distributed. Assume that height of African and Indian elephants have an equal standard deviation σ. The mean heights the African elephants and Indian elephants are μ_1, μ_2, respectively. The following data were collected on the height of elephants from the two continents (these are not real data):

10.9	11.7	9.3	9.9	11.5
8.8	12.9	11.7	9.1	11.1
9.1	8.7	10.5	11.3	12.3
13.1	12.9	9.5	10.7	11.3

7.1	8.3	8.2	9.1	10.3
9.3	9.7	8.9	8.8	9.1
7.9	9.9	9.2	8.8	8.1
8.7	8.8	9.3	10.1	9.9
9.9				

Compute a 97 percent confidence interval for the difference $\mu_1 - \mu_2$. Give the pulled estimate S_p for σ, the Margin of Error E, Left end point and Right end point

$S_p =$ $\qquad$ $MOE = E =$ $\qquad$ $LEP =$ $\qquad$ $REP =$

2. The weight of salmon in two different rivers are normally distributed with mean μ_1, μ_2, respectively, and equal standard deviation σ. A sample of size $m = 13$ fish from the first river was collected and the sample mean weight was found to be $\overline{x} = 19.9$ pounds and the sample standard deviation $s_1 = 1.8$ pounds. A sample of size $n = 12$ fish from the second river was collected and the sample mean weight was found to be $\overline{y} = 17.4$ pounds and the sample standard deviation $s_2 = 2.2$ pounds. Compute a 98 percent confidence interval for the difference $\mu_1 - \mu_2$. Give the pulled estimate S_p for σ, the Margin of Error E, Left end point and Right end point

   $S_p =$ $\qquad$ $MOE = E =$ $\qquad$ $LEP =$ $\qquad$ $REP =$

3. To compare gas prices in California and Kansas, data was collected. It is assumed that the gas prices in these two states are normally distributed and have same standard deviation σ. Gas prices in 14 gas stations in California were sampled and the mean price was found to be $\overline{x} = \$3.75$ per gallon and the sample standard deviation $s_1 = \$0.22$. Gas prices in 11 gas stations in Kansas were sampled and the mean price was found to be $\overline{y} = \$3.65$ per gallon and the sample standard deviation $s_2 = \$0.18$. Compute a 95 percent confidence interval for the

difference $\mu_1 - \mu_2$ of mean gas prices, where μ_1 is the mean gas price in California and μ_2 is the mean gas price in Kansas. Give the pulled estimate S_p for σ, the Margin of Error E, Left end point and Right end point

$S_p =$ $MOE = E =$ $LEP =$ $REP =$

8.3 Comparing Two Population Proportions

1. To compare the proportions p_1, p_2 of men and women, respectively, who watch football data was collected. In a sample of 227 men, 106 said that they watch football, and in a sample of 156 women, 48 said they watch football. (These are not real data.) Compute a 97 percent confidence interval for the difference $p_1 - p_2$ of proportions. Give the Margin of Error E, Left end point and Right end point

   $MOE = E =$ $LEP =$ $REP =$

2. To compare the proportion p_1 of working men who make more than \$50 K annually and the proportion p_2 of working women who make more than \$50 K annually, data was collected. In a sample of 210 men, it was found that 97 made more than \$50 K last year. In a sample of 270 women, it was found that 88 made more than \$50 K last year. Compute a 99 percent confidence interval for for the difference $p_1 - p_2$ of proportions. Give the Margin of Error E, Left end point and Right end point

   $MOE = E =$ $LEP =$ $REP =$

3. To compare the proportion p_1 of defective light bulbs from Brand-A and the proportion p_2 of defective bulbs from Brand-B, data was collected. In a sample of 270 bulbs from Brand-A, 37 were found to be defective. In a sample of 220 bulbs from Brand-B, 27 were found to be defective. Compute a 95 percent confidence interval for the difference $p_1 - p_2$ of proportions. Give the Margin of Error E, Left end point and Right end point

   $MOE = E =$ $LEP =$ $REP =$

Chapter 9

Testing Hypotheses

9.1 A Significance Test for mean μ when σ is known

These are also called Z-Test (informally).

1. It is believed that the mean μ starting salary for the new KU graduates has increased from last year's mean of $\mu = 51$ K annually. It is known that the standard deviation of the starting salary is $\sigma = 5$ K. To test what you believe, you collect a sample of 15 new graduates and find that the sample mean salary is $\overline{X} = 54$ K. Do a significance test to determine whether the mean starting salary has increased, as follows

   (a) Formulate the Null and alternate hypothesis, and compute z-value and p-value:

   $$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$z\ value =$	$p - value =$

   The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At five percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that the mean starting salary of KU graduates has increased?

Lowest Percent Level of Acceptance of H_A:

2. The mean weight μ of babies at birth in the United States is believed to be higher than the mean birth weight of 112 ounce, throughout the world. The standard deviation of the birth weight in US is known to be 17 ounce. Data on 96 babies in the US was collected and the mean weight was found to be 115 ounces. Do a significance test to determine whether the mean birth weight in the US is higher than the mean birth weight for the world as a whole.

   (a) Formulate the Null and alternate hypothesis, and compute z-value and p-value:

   $$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$z\ value =$	$p - value =$

   The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

   (b) At 7 percent level of significance would you accept of reject the Null Hypothesis?
   Answer: Yes/No

   (c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that the mean birth weight of US babies is higher?

   Lowest Percent Level of Acceptance of H_A:

3. The time taken by an athlete to run an event has a distribution with mean μ seconds and known standard deviation $\sigma = 3$ seconds. The coach believes that the mean time μ of the athlete has improved from last year's mean of 25 seconds. To test the belief of the coach, the

athlete ran the event 29 times and the sample mean run time was found to be 23.9 seconds. Do a significance test to determine if the athlete has improved.

(a) Formulate the Null and alternate hypothesis, and compute z-value and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

z value =	$p -$ value =

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 6 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that his/her mean time has improved?

Lowest Percent Level of Acceptance of H_A:

9.2 A Significance Test for mean μ when σ is unknown

These are also called T-Test (informally).

1. It is believed that, due to pollution, the mean weight μ of salmon in a river is lower than last year's mean of 23 pounds. To test this concern about pollution, 46 fish were caught. The mean weight of the fish was found to be $\overline{X} = 21.1$ pounds and standard deviation $s = 6$. Do a significance test that the mean weight has reduced.

   (a) Formulate the Null and alternate hypothesis, and compute t-value and p-value:

   $$\begin{cases} H_0 : \\ H_A : \end{cases}$$

T value =	$p -$ value =

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 6 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that the mean weight has reduced?

Lowest Percent Level of Acceptance of H_A:

2. Due to favorable weather conditions, it is believed that the mean diameter μ of the pumpkins in the market is higher than last years mean of 34 cm. To test, a sample of 26 pumpkins were examined. The sample mean was found to be 37 cm and the sample standard deviation was $s = 11$ cm. Do a significance test that mean diameter is higher.

(a) Formulate the Null and alternate hypothesis, and compute t-value and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$T\ value =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 4 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that the mean diameter is higher?

Lowest Percent Level of Acceptance of H_A:

3. The mean time μ taken to by a student to drive to the work is believed to be higher than 20 minutes. A sample of 31 such driving time was collected. The sample mean and standard deviation was found to be $\overline{X} = 24$ minutes, $s = 8$ minutes. Do a significance test that mean

(a) Formulate the Null and alternate hypothesis, and compute t-value and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

T $value =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 1 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that mean driving time is higher than 20 inches?

Lowest Percent Level of Acceptance of H_A:

4. The mean length μ of telephone calls in a corporation is believed higher than 10 minutes. To test this, the following data on the length of calls was collected:

24	11	28	16	18	3	26	9	13	19	2
11	18	19	5	6	25	22	11	2	12	17

Perform a significance test.

(a) Formulate the Null and alternate hypothesis, and compute degrees of freedom (df), t-value and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$df =$	T $value =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 4 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that mean length of calls is higher than 10 minutes

Lowest Percent Level of Acceptance of H_A:

5. A car manufacturer claims that the new model of the car will give more mileage per gallon than the old model. The old model gives a mean mileage of 33 miles per gallon. To test the claim, 19 cars of the new model were tested and the sample mean was found to be $\overline{X} = 35$ miles and the standard deviation $s = 5.6$ miles. Perform a significance test on the claim of the manufacturer.

   (a) Formulate the Null and alternate hypothesis, and compute degrees of freedom (*df*), t-value and *p*-value:

   $$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$df =$	$T\ value =$	$p - value =$

   The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

   (b) At 4 percent level of significance would you accept of reject the Null Hypothesis?
   Answer: Yes/No

   (c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that this model would give better mileage per gallon than the old model

   Lowest Percent Level of Acceptance of H_A:

6. The instructor claims that the mean time taken to complete an online homework assignment is less than that of traditional homework, which is 45 minutes. A sample of 27 homework times is collected. The sample mean time taken to complete homework is $\overline{X} = 42$ minutes and standard deviation $s = 7.5$ minutes. Perform a significance test for this claim.

   (a) Formulate the Null and alternate hypothesis, and compute, degrees of freedom (*df*), t-value and *p*-value:

   $$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$df =$	$T\ value =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 4 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that the mean time has reduced?

Lowest Percent Level of Acceptance of H_A:

9.3 Population Proportion

1. It is claimed that, in a border town, the immigrant population rose above 50 percent. In a sample of 211 individuals, 119 were immigrant. Perform a significant test.

   (a) Formulate the Null and alternate hypothesis, and compute z-value and p-value:

   $$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$Z\ value =$	$p - value =$

   The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

   (b) At 4 percent level of significance would you accept of reject the Null Hypothesis?
   Answer: Yes/No

   (c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that the immigrant population rose above 50 percent?

   Lowest Percent Level of Acceptance of H_A:

2. In a certain region, it is believed that the proportion of the population infected with AIDS-HIV has exceeded 20 percent. A sample of 276

people from were examined for AIDS-HIV and 64 were found to be infected by AIDS-HIV. Perform a significant test.

(a) Formulate the Null and alternate hypothesis, and compute z-value and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$Z\ value =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 4 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that the proportion of the population infected with AIDS-HIV has exceeded 20 percent?

Lowest Percent Level of Acceptance of H_A:

3. About 13 percent of items produced by an old machine are defective. You thinking whether to replace it by a new one. You took a sample of 721 items produced by a new machine, and 76 were defective. Perform a significant test that the new machine is better.

(a) Formulate the Null and alternate hypothesis, and compute z-value and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$Z\ value =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 4 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that the new machine would be better?

Lowest Percent Level of Acceptance of H_A:

9.4 Testing Hypotheses on Variance σ^2

1. It is believed that the variance $\sigma^2$of birth weight of babies in a certain region is higher than 196 ounces. Data on 27 babies in the region was collected and the sample variance was $s^2 = 324$ ounces. Perform a significance test.

   (a) Formulate the Null and alternate hypothesis, and compute Stat-value (Y) and p-value:

   $$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$Y =$	$p - value =$

   The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

   (b) At 5 percent level of significance would you accept of reject the Null Hypothesis?
   Answer: Yes/No

   (c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that the variance $\sigma^2$of birth weight of babies is higher than 196

   Lowest Percent Level of Acceptance of H_A:

2. A political leader complained that in the recent past the variability of annual income in the country has increased. It is known that the variance of annual income in used to be \$5 K. Data on 26 individuals was collected, and the sample variance was found to be s^2 =8.8 K. Perform a significance test that the variance σ^2 of annual income has increased.

(a) Formulate the Null and alternate hypothesis, and compute Stat-value (Y) and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$Y =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 4 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that the variance σ^2 of annual income in the country has increased above $ 5 K

Lowest Percent Level of Acceptance of H_A:

3. Qn 7 The variance σ^2 of monthly electricity consumption is believed to be higher than 20000 KWH-square. A sample of 19 households had a sample variance was $s^2 = 32500$ KWH-square. Perform a significance test.

(a) Formulate the Null and alternate hypothesis, and compute Stat-value (Y) and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$Y =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 4 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would accept that the variance σ^2 of monthly electricity consumption is believed to be higher than 20000?

Lowest Percent Level of Acceptance of H_A:

9.5 A Significance Test to Compare Two Populations

1. It has been reported that gas prices in California are higher than that in Kansas. The standard deviation of gas prices in California is known to be $\sigma_1 = 20$ cents per gallon and the standard deviation of gas prices in Kansas is known to be $\sigma_2 = 10$ cents per gallon. To verify the report, data was collected. A sample of 40 gas stations in California had a mean price 375 cents per gallon. Another sample 36 gas stations in Kansas, and the mean price was found to be 369 cents per gallon. It is speculated that the mean gas price μ_1 in California is higher than the mean gas price μ_2 in Kansas. Perform a significance test.

   (a) Formulate the Null and alternate hypothesis, and compute t-value and p-value:

   $$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$t\ value =$	$p-value =$

   The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

   (b) At 4 percent level of significance would you accept of reject the Null Hypothesis?
   Answer: Yes/No

   (c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would Reject the null hypothesis?

   Lowest Percent Level of Acceptance of H_A:

2. It is believed that computer professionals are better paid than statisticians. The standard deviation of the annual salary of computer professionals is $\sigma_1 = \$11$ K, and the standard deviation of the annual salary of statisticians is $\sigma_2 = \$8$ K. In a sample of 37 computer professionals the mean annual salary was found to be \$81 K and in a sample of 41 statisticians the mean annual salary was found to be \$76 K. Perform a significance test that the mean annual salary μ_1 of computer professionals is higher than the mean annual salary μ_2 of statisticians?

(a) Formulate the Null and alternate hypothesis, and compute z-value and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

z $value =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 5 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would Reject the null hypothesis?

Lowest Percent Level of Acceptance of H_A:

3. The weight of a particular type of Salmon in two rivers would be compared. The standard deviation weight of Salmon in River-I is $\sigma_1 = 1.4$ pounds. The standard deviation weight of Salmon in River-II is $\sigma_2 = 1.2$ pounds. It is speculated that the mean weight μ_1 of Salmon in River-I is higher than the mean weight μ_2 of Salmon in River-II. A sample of size 18 Salmon from River-I was collected and the sample mean weight was found to be $\overline{X} = 11.4$ pounds. A sample of size 32 Salmon from River-II was collected and the sample mean weight was found to be $\overline{Y} = 10.8$ pounds. Perform a significance test that mean weight μ_1 of Salmon in River-I higher than the mean weight μ_2 of Salmon in River-II.

(a) Formulate the Null and alternate hypothesis, and compute z-value and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

z $value =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 7 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would Reject the null hypothesis?

Lowest Percent Level of Acceptance of H_A:

9.6 Compare Means of Two Populations: σ_1, σ_2 Unknown

1. It is speculated that the mean waiting time μ_1 for the bus while coming is longer than the mean waiting time μ_2 for the bus while returning. The waiting time X while coming and Y while returning have equal standard deviation σ. The following data on waiting time, in minutes, was collected:

8.2	7.5	5.8	9.1	5.7
6.5	4.9	7.1	8.5	7.5
7.6	7.3	7.7	8.3	8.4
9.5	9.3	8.2	7.2	4.6
6.6	9.3	8.2	7.2	4.6

6.3	5.2	8.3	5.9	5.5
7.1	8.1	7.9	6.3	6.9
9.1	8.1	7.0	4.9	5.3
6.3	7.1	6.3	6.1	5.8
5.7	6.8	8.3	7.7	

Perform a significance test that μ_1 is longer than μ_2.

(a) Formulate the Null and alternate hypothesis, and compute degrees of freedom (df) t-value and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$df =$	$t\ value =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 7 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would Reject the null hypothesis?

Lowest Percent Level of Acceptance of H_A:

2. The instruxtor claims that the mean time μ_1 taken to complete online homework assignment is less than the mean time μ_2 taken to complete traditional homework. To verify this claim, you collect data. A sample of 13 online homework had sample mean time of 59 minutes and standard deviation of 9 minutes. A sample of 12 traditional homework have a sample mean of 65 minutes and standard deviation of 11 minutes. Perform a significance test that μ_1 is less than μ_2.

   (a) Formulate the Null and alternate hypothesis, and compute degrees of freedom (df) t-value and p-value:

   $$\begin{cases} H_0: \\ H_A: \end{cases}$$

$df =$	$t\ value =$	$p - value =$

   The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

   (b) At 7 percent level of significance would you accept of reject the Null Hypothesis?
   Answer: Yes/No

   (c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would Reject the null hypothesis?

   Lowest Percent Level of Acceptance of H_A:

3. The weight of salmon in two different rivers are normally distributed with mean μ_1, μ_2, respectively, and equal standard deviation σ. A sample of size $m = 15$ fish from the first river was collected and the sample mean weight was found to be $\overline{X} = 17.4$ pounds and the sample standard deviation $s_1 = 1.8$ pounds. A sample of size $n = 14$ fish from the second river was collected and the sample mean weight was found to be $\overline{Y} = 18.7$ pounds and the sample standard deviation $s_2 = 2.2$ pounds. Perform a significance test that the mean weight μ_1 of salmon in the first river is less than the mean weight μ_2 of salmons in the second river.

(a) Formulate the Null and alternate hypothesis, and compute degrees of freedom (*df*) t-value and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

df =	*t value* =	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At4 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would Reject the null hypothesis?

Lowest Percent Level of Acceptance of H_A:

9.7 Comparing Proportions of Two Populations p_1, p_2

1. It is believed that the proportion $p_1$of immigrants is higher in California is than that p_2 in Kansas. To verify this, data was collected. Among 327 people interviewed in California, 46 were immigrants. Among 273 people interviewed in Kansas, 26 were immigrants. Perform a significance test that the proportion of immigrants is higher in California than in Kansas.

   (a) Formulate the Null and alternate hypothesis, and compute z-value and p-value:

   $$\begin{cases} H_0 : \\ H_A : \end{cases}$$

z value =	$p - value =$

   The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 7 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would Reject the null hypothesis?

Lowest Percent Level of Acceptance of H_A:

2. It is believed that the proportion $p_1$of working men who make more that \$ 50 K annually is higher than the proportion p_2 of working women who make more that \$ 50 K annually. To verify this, 112 working men were interviewed, and it was found that 57 of them make more that \$ 50 K annually. Also, 238 working women were interviewed, and it was found that 101 of them make more that \$ 50 K annually. Based on this data, would you conclude that the proportion of working men who make more than \$ 50 K is higher than the proportion of women who make more than \$ 50 K?

(a) Formulate the Null and alternate hypothesis, and compute z-value and p-value:

$$\begin{cases} H_0 : \\ H_A : \end{cases}$$

$z\ value =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 3 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would Reject the null hypothesis?

Lowest Percent Level of Acceptance of H_A:

3. Items produced by an old machine were inspected and out of 155 items, 21 were defective. Items produced by a new machine were inspected,

and out of 255 items, 22 were defective. It is expected the proportion $p_1$of defective items produced by the old machine would be higher than the proportion p_2 of defective items produced by the new machine. Perform a significance test.

(a) Formulate the Null and alternate hypothesis, and compute z-value and p-value:

$$\begin{cases} H_0: \\ H_A: \end{cases}$$

z $value =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 5 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would Reject the null hypothesis?

Lowest Percent Level of Acceptance of H_A:

4. A new vaccine was tested on 377 individuals, and it was found that 37 of them got the virus. Also, 411 individuals were given a placebo, and it was found that 58 of them got the virus. The producer of the vaccine claims that the proportion p_1 of the infected people in the vaccinated population is lower than the proportion p_2 of the infected people in the un-vaccinated population. Perform a significance test.

(a) Formulate the Null and alternate hypothesis, and compute z-value and p-value:

$$\begin{cases} H_0: \\ H_A: \end{cases}$$

z $value =$	$p - value =$

The latter would depend on whether it is a Two Tail, Left Tail or Right Tail Test.

(b) At 1 percent level of significance would you accept of reject the Null Hypothesis?
Answer: Yes/No

(c) What would be the lowest level of significance, percent among .1, .5, 1 , 2, 3, 4, 5, 6, 7, 8, 9, 10 percent, at which you would Reject the null hypothesis?

Lowest Percent Level of Acceptance of H_A: