

Kuwait University
College of Science
Department of Statistics and Operations Research

Stat 101
Homework Booklet

Summer 2010

Student's Name: _____

Student's Number: _____

Student's Lab Section: _____

Homework # 1

Problem 1

For each of the following cases, indicate whether the variable is qualitative or quantitative (specifying in the second case whether it is discrete or continuous).

- a. High school grade point average of those who applied for admission to Kuwait University in Spring 2010
- b. Entry level salary of students who graduated from Kuwait University in Fall 2010
- c. Age of applicants for a computer technician position (advertised in December 2009) within the College of Science of Kuwait University
- d. Gender of students enrolled in all sections of Stat 101 during Spring 2010
- e. Educational institution where the teaching staff working currently within the Statistics and Operations Research department earned their PhD degrees
- f. Color of the cars driven by the 2010 players of the handball national team of Kuwait

Problem 2

Indicate whether each of the following constitutes a population or a sample.

- a. One hundred students admitted to Kuwait University in Spring 2010
- b. All non-technical support staff currently working for Kuwait University
- c. All female students graduating from Kuwait University in spring 2010
- d. One thousand applicants for jobs advertised by Microsoft in December 2009
- e. All students enrolled in all courses offered by the College of Science of Kuwait University in Fall 2009
- f. All students who were enrolled in Stat 101 during Fall 2009

Problem 3

Indicate for each of the following the population, the sample, the variable, and its type. Provide an example of a possible observation for each case.

- a. Income of ten physicians practicing in Kuwait City in January 2010
- b. Number of accidents that occurred along the 4th ring road on fifteen random days of summer 2009
- c. Blood type of twenty Kuwait University students enrolled in Stat 101 of Summer 2009
- d. Number of courses already completed by ten male students newly enrolled in the Statistics and Operations Research Department in Spring 2010
- e. Weight of fifteen male athletes from Al-Ahli sport club of Kuwait on the day of their medical exam in February 2010.

Problem 4

A study of the records of 600 students from the college of Social Sciences revealed that thirty person of the sampled students were originally admitted to a different college. The University is interested in predicting the proportion of students that might transfer to the college of Social Sciences next academic year. Describe the

- population
- sample
- variable of interest and its type
- descriptive statistics
- inference of interest.

Problem 5

Indicate whether each of the following studies involves descriptive or inferential statistics.

- a. The number of Americans that voted for President Obama during the past election.
- b. The number of Americans that may vote for President Obama during the next election.
- c. The number of personal computers per household according to the last national census undertaken in Kuwait.
- d. The number of cell phones to be used in Kuwait by the end of year 2010.

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Homework # 2

Problem 1

Thirty adults were asked which of the following conveniences they find essential for their lives: television (T), refrigerator (R), air conditioning (A), public transportation (P), or microwave (M). Their responses are listed below.

R	A	R	P	P	T	R	M	P	A
A	R	R	T	P	P	T	R	A	A
R	P	A	T	R	P	R	A	P	R

1. Prepare a frequency distribution table.
2. Calculate the relative frequencies and percentages for all categories.
3. What percentage of these adults named refrigerator or air conditioning as the convenience that is essential for them?
4. Draw a bar graph for the relative frequency distribution.
5. Draw a pie chart for this data.

Problem 2

Nixon Corporation manufactures computer terminals. The following data are the numbers of computer terminals produced at the company for a sample of 30 days.

24	32	27	23	33	33	29	25	23	28
21	26	31	22	27	33	27	23	28	29
31	35	34	22	26	28	23	35	31	21

1. Construct a frequency distribution table using classes 21-23, 24-26, 27-29, 30-32, and 33-35.
2. Calculate the relative frequencies and percentages for all classes.
3. Construct a histogram for the percentage distribution.
4. For what percentage of the days is the number of computer terminals produced in the interval 27-29?
5. Construct a dot plot.
6. Prepare a box and whisker plot. Comment on the skewness of these data.

Problem 3

The following data give the time (in minutes) that each of 20 students waited in line at their bookstore to pay for their textbooks in the beginning of Spring 2003.

15	8	23	21	5	17	31	22	34	6
5	10	14	17	16	25	30	3	31	19

1. Construct a stem and leaf plot for these data.
2. Construct a dot plot.
3. Comment on the skewness of the data.
4. Find the mean, median, and mode.
5. Compute the range, variance, and standard deviation.

Problem 4

These data give the time (in hours) that 8 students spent at the library.

8	5	6	5	10	14	17	16
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1. Find the mean, median, and mode.
2. Compute the range, variance, and standard deviation.

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Homework # 3

Problem 1

A box contains computer parts; few of which are defective. Two parts are selected at random from this box and inspected to determine if they are good (G) or defective (D).

1. Draw a tree diagram for this experiment.
2. How many total outcomes are possible? Write these outcomes in a sample space S.
3. List the outcomes included in each of the following events:
 - a. At least one part is good.
 - b. Exactly one part is defective.
 - c. The first part is good and the second is defective.
 - d. At most one part is good.

Problem 2

1. Which of the following can't be probabilities of events?

1/5 0.97 -0.55 1.56 5/3 0.0 -2/7 1.0

Problem 3

A hat contains 40 marbles: 18 are red and 22 green. If one marble is randomly selected out of this hat,

1. what is the probability that this marble is
 - a. red?
 - b. green?
2. Do these probabilities add to 1.0?

Problem 4

In a statistics class of 64 students, 25 have volunteered for community service in the past. If one student is randomly selected from this group,

1. what is the probability that he
 - a. has volunteered for community service in the past?
 - b. has never volunteered for community service in the past?
2. Do these probabilities add to 1.0?

Problem 5

Let A be the event that a number less than 3 is obtained when we roll a dice once.

1. What is the probability of A?
2. What is the complementary event of A?
3. What is the probability of the complementary event of A?

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Homework # 4

Problem 1

- Given that A, B, and C are three independent events, find the joint probability for the following.
 - $P(A) = 0.20$, $P(B) = 0.46$, and $P(C) = 0.25$
 - $P(A) = 0.44$, $P(B) = 0.27$, and $P(C) = 0.43$
- Given that $P(A) = 0.30$, and $P(A \text{ and } B) = 0.24$, find $P(B|A)$.
- Given that $P(A|B) = 0.40$, and $P(A \text{ and } B) = 0.36$, find $P(B)$.
- Find $P(A \text{ or } B)$ for the following.
 - $P(A) = 0.58$, $P(B) = 0.66$, and $P(A \text{ and } B) = 0.57$
 - $P(A) = 0.72$, $P(B) = 0.42$, and $P(A \text{ and } B) = 0.39$
- Given that A and B are mutually exclusive events, find $P(A \text{ or } B)$ for the following.
 - $P(A) = 0.47$, and $P(B) = 0.27$
 - $P(A) = 0.16$, and $P(B) = 0.59$

Problem 2

A sample of 2000 adults were asked whether or not they have ever shopped on the Internet. The following table gives a two-way classification of the responses.

	Have Shopped	Have Never Shopped
Male	300	900
Female	200	600

- If one adult is selected at random from these 2000 adults, find the probability that this adult
 - Has never shopped on the Internet
 - Is a male
 - Has shopped on the Internet given that this adult is a female
 - Is a male given that this adult has never shopped in the Internet
- Are the event "male" and "female" mutually exclusive? Why or why not?
- Are the event "Have shopped" and "male" mutually exclusive? Why or why not?
- Are the event "Have shopped" and "female" independent? Why or why not?
- If one adult is selected at random from these 2000 adults, find the probability that this adult
 - Has never shopped on the Internet and is a male
 - Has shopped on the Internet and is a female
 - Has never shopped on the Internet or is a female
 - Has shopped on the Internet or is a male
 - Has shopped on the Internet or has never shopped on the Internet

Problem 3

- The probability that any given person is allergic to a certain drug is .03. What is the probability that none of three randomly selected persons is allergic to this drug. Assume that all three persons are independent.
- The probability of a student getting an A grade in an economics class is .24 and that of getting a B grade is .28. What is the probability that a randomly selected student from this class will get an A or a B in this class?

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Homework # 5

Problem 1

Each of the following tables lists certain values of x and their probabilities. Verify whether or not each represents a valid probability distribution.

a.

x	$P(x)$
0	.10
1	.50
2	.45
3	.40

b.

x	$P(x)$
2	.35
3	.28
4	.20
5	.14

c.

x	$P(x)$
7	-.25
8	.85
9	.40

Problem 2

The following table gives the probability distribution function of a discrete random variable x .

x	0	1	2	3	4	5	6
$P(x)$.11	.19	.28	.15	.12	.09	.06

Find the following probabilities.

- $P(x = 3)$
- $P(x \leq 2)$
- $P(x \geq 4)$
- $P(1 \leq x \leq 4)$
- Probability that x assumes a value less than 4
- Probability that x assumes a value greater than 4
- Probability that x assumes a value in the interval 2 to 5 inclusive

Problem 3

A sporting shop sells exercise machines as well as other sporting goods. On different days, it sells different numbers of these machines. The following table lists the probability distribution function of the number of machines sold per day at this shop.

Machines sold per day	4	5	6	7	8	9	10
Probability	.08	.11	.14	.19	.20	.16	.12

- Graph the probability distribution.
- Determine the probability that the number of exercise machines sold by this shop on a given day is
 - Exactly 6
 - More than 8
 - 5 to 8 inclusive
 - At most 6
- Calculate the mean and standard deviation for this probability distribution.

Problem 4

According to a survey of adults, 64% of adults owned cell phones. Assume that this result holds true for the current population of all adults. Suppose that two adults are selected at random. Let x denote the number of adults who own a cell phone in this sample.

1. Construct the probability distribution table of x .
2. Draw a tree diagram for this table.

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Homework # 6

Problem 1

1. An environmental agency will randomly select 4 houses from a block containing 25 houses for a random check. How many total selections are possible?
2. An English department at a university has 16 faculty members. Three faculty members will be randomly selected to represent the department on a committee. In how many ways can the department select three faculty members from 16?
3. In how many ways can a sample (without replacement) of 9 items be selected from a population of 20 items?

Problem 2

Let x be a discrete random variable that possesses a binomial distribution. Using the binomial formula, find the following probabilities. Verify your answers using the binomial tables **and** Minitab.

- a. $P(x=0)$ for $n = 5$ and $p=.052$
- b. $P(x=4)$ for $n = 7$ and $p=.90$
- c. $P(x=7)$ for $n = 10$ and $p=.60$
- d. $P(2 \leq x \leq 4)$ for $n = 6$ and $p=.30$
- e. $P(x \leq 3)$ for $n = 4$ and $p=.40$
- f. $P(x \geq 5)$ for $n = 8$ and $p=.70$
- g. $P(1 \leq x \leq 4)$ for $n = 12$ and $p=.30$
- h. $P(x < 3)$ for $n = 9$ and $p=.05$
- i. $P(x > 5)$ for $n = 6$ and $p=.70$
- j. $P(3 < x < 7)$ for $n = 15$ and $p=.80$
- k. $P(x=0)$ for $n = 8$ and $p=.70$

Problem 3

In a survey of adults in December 2001, 80% of the respondents said they feel stress "frequently" or "sometimes" in their daily lives. Assume that this percentage is true for the current population of all adults. Find the probability that the number of adults in a random sample of 15 who feel stress frequently or sometimes is

- a. At most 9
- b. At least 11

- c. 10 to 12
- d. None
- e. Exactly 10

Problem 4

Suppose that 10% of Americans say that they had gained a lot of weight in the past five years. Find the probability that the number of Americans who say that they had gained a lot of weight in the past five years is

- a. At most 2
- b. At least 4
- c. 1 to 4
- d. None
- e. Exactly 4

Problem 5

Based on a survey it conducted, a fast food chain believes that 70% of all people like its new hamburger. On a certain day, eight customers bought it for the first time. Let x denote the number of customers in this sample who will like this hamburger.

- a. Obtain the probability distribution of x .
- b. Draw a graph of the probability distribution of x .
- c. Determine the mean and standard deviation of x .
- d. Find the probability that exactly three of the eight customers will like the new hamburger.

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Homework # 7

Problem 1

1. For a standard normal distribution, find the area within 1.5 standard deviation of the mean –that is, the area between $\mu - 1.5\sigma$ and $\mu + 1.5\sigma$.
2. Let X be a continuous random variable that has a normal distribution with a mean of 40 and a standard deviation of 4. Find the probability that X assumes a value
 - a. Between 29 and 35
 - b. Between 34 and 51
3. Let X be a continuous random variable that is normally distributed with a mean of 65 and a standard deviation of 15. Find the probability that X assumes a value
 - a. Greater than 56
 - b. Greater than 74
 - c. Less than 43
 - d. Less than 71
4. Find the value of z so that the area under the standard normal curve
 - a. From 0 to z is 0.1965 and z is positive
 - b. Between 0 and z is (approximately) 0.2740 and z is negative
 - c. In the left tail is (approximately) 0.2050
 - d. In the right tail is (approximately) 0.1053
5. Let X be a continuous random variable that follows a normal distribution with a mean of 550 and a standard deviation of 75.
 - a. Find the value of x so that the area under the normal curve to the left of x is approximately 0.9600.
 - b. Find the value of x so that the area under the normal curve to the right of x is approximately 0.0275.
 - c. Find the value of x so that the area under the normal curve to the right of x is 0.0250.
 - d. Find the value of x so that the area under the normal curve to the left of x is 0.9345.
 - e. Find the value of x so that the area under the normal curve between μ and x is 0.4700 and the value of x is less than μ .
 - f. Find the value of x so that the area under the normal curve between μ and x is 0.4100 and the value of x is greater than μ .
6. For a binomial probability distribution, $n = 25$ and $p = 0.40$.
 - a. Find the probability $P(8 \leq X \leq 13)$ using the table of binomial probabilities.
 - b. Find the probability $P(8 \leq X \leq 13)$ by using the normal distribution as an approximation to the binomial distribution. What is the difference between this approximation and the exact probability calculated in part a?

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Homework # 8

1. For a binomial probability distribution, $n = 120$ and $p = 0.60$. Let X be the number of successes in 120 trials.
 - a. Find the mean and standard deviation of this binomial distribution.
 - b. Find $P(X \leq 72)$ using the normal approximation to the binomial distribution.
 - c. Find $P(67 \leq X \leq 73)$ using the normal approximation.

Problem 2

1. A bank issues credit cards. It is estimated that the average balances on all credit cards issued by the bank have a mean of \$845 and a standard deviation of \$270. Assume that the balances on these credit cards follow a normal distribution.
 - a. What is the probability that a randomly selected credit card issued by this bank has a balance between \$1000 and \$1400?
 - b. What is the percentage of the credit cards issued by this bank that have a balance of \$750 or more?
2. Fast auto service guarantees that the maximum waiting time for its customers is 20 minutes for oil and lube service on their cars. It also guarantees that any customer who has to wait longer than 20 minutes for this service will receive a 50% discount on the charges. It is estimated that the mean time taken for oil and lube service at this garage is 15 minutes per car and the standard deviation is 2.4 minutes. Suppose the time taken for oil and lube service on a car follows a normal distribution.
 - a. What is the probability that a car takes longer than 25 minutes for oil and lube service?
 - b. What percentage of the customers will receive the 50% discount on their charges?
 - c. The company wants to limit this discount to at most 5% of the customers. What should the maximum guaranteed waiting time be?
3. According to a survey, 45.3% of ninth graders watch three or more hours of television on a typical school day. Assume that this percentage is true for all current ninth graders. Find an approximation to the probability that in a random sample of 250 ninth graders, 104 to 120 watch three or more hours of television on a typical school day.
4. 5% of the calculators manufactured by a company malfunction within a two-year period. The company recently mailed 500 such calculators to its customers.
 - a. Approximate the probability that exactly 29 of the 500 calculators will be returned for refund or replacement within a two-year period.
 - b. Approximate the probability that 27 or more of the 500 calculators will be returned for refund or replacement within a two-year period.
 - c. Approximate the probability that 15 to 22 of the 500 calculators will be returned for refund or replacement within a two-year period.

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Homework # 9

Problem 1

1. According to a survey, the mean charges for a hotel room in the USA were \$84.58 per day in 2001. Assume that the current hotel room rates have a normal distribution with a mean of \$84.58 per day and a standard deviation of \$12. Let \bar{x} denote the mean charge for hotel rooms for a sample of 90 rooms. Find the mean and standard deviation of \bar{x} and describe the shape of its sampling distribution.
2. A bank issues credit cards. It is estimated that the average balances on all credit cards issued by the bank have a mean of \$845 and a standard deviation of \$270. Assume that the balances on these credit cards follow a normal distribution. Let \bar{x} denote the mean balance of a sample of 64 credit cards. Find the mean and standard deviation of \bar{x} and describe the shape of its sampling distribution.

Problem 2

According to the US Bureau of Labor Statistics estimates, the average earnings of construction workers were \$18.96 per hour in August 2002. Assume that the current earnings of all construction workers are normally distributed with a mean of \$18.96 per hour and a standard deviation of \$3.60 per hour. Find the probability that the mean hourly earnings of a random sample of 25 construction workers is

1. between \$18 and \$20 per hour
2. within \$1 of the population mean
3. greater than the population mean by \$1.50 or more
4. less than the population mean by \$0.75 or more per hour

Problem 3

According to CardWeb.com, the average credit card debt per household was \$8367 in 2001. Assume that the probability distribution of all such current debts is skewed to the right with a mean of \$8367 and a standard deviation of \$2400. Find the probability that the mean of a random sample of 225 such debts is

1. between \$8100 and \$8500
2. within \$200 of the population mean
3. greater than the population mean by \$300 or more
4. less than \$8218

Problem 4

1. In a population of 5000 subjects, 600 have green eyes. A sample of 120 subjects selected from this population contains 18 subjects whose eyes are green. What are the values of the population and sample proportions?
2. In a population of 9500 subjects, 75% possess a certain characteristic. In a sample of 400 subjects selected from this population, 78% possess the same characteristic. How many subjects in the population and sample respectively possess this characteristic?
3. Consider a large population with $p=0.63$. Find the mean and standard deviation of the sample proportion \hat{p} for a sample size of
 - d. 100
 - e. 900

Problem 5

A survey of all medium and large sized corporations showed that 64% of them offer retirement plans to their employees. Let \hat{p} be the proportion in a random sample of 50 such corporations that offer retirement plans to their employees. Find the probability that the value of \hat{p} will be

1. between 0.54 and 0.61
2. greater than 0.71

Problem 6

A company makes deliveries of a large number of products to its customers. It is known that 85% of all the orders it receives from its customers are delivered on time. Let \hat{p} be the proportion of orders in a random sample of 100 that are delivered on time. Find the probability that the value of \hat{p} will be

1. between 0.81 and 0.88
2. less than 0.87

Problem 7

A city is planning to build a hydroelectric power plant. A local newspaper found that 53% of the voters in this city favor the construction of this plant. Assume that this result holds true for the population of all voters in this city. What is the probability that more than 50% of the voters in a random sample of 200 voters selected from this city will favor the construction of this plant?

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Homework # 10

N.B.: Solve questions 1-5 manually and using Minitab.

- For a data set obtained from a sample, $n=64$, $\bar{x}=24.5$, and $s=3.1$.
 - What is the point estimate of μ ?
 - Make a 99% confidence interval for μ .
 - What is the maximum error of estimate for part b?
- According to a survey, mothers with children under age 18 spent an average of 16.87 hours per week online. Suppose that this mean is based on a random sample of 1000 such mothers and that the standard deviation for this sample is 3.2 hours per week. Construct a 95% confidence interval for the corresponding population mean.
- A sample of 12 observations taken from a normally distributed population produced the following data: 13 15 9 11 8 19 17 9 10 14 16 12
 - What is the point estimate of μ ?
 - Make a 95% confidence interval for μ .
 - What is the maximum error of estimate for part b?
- Suppose that a random sample of 25 theaters in the United States yielded a mean movie ticket price of \$5.70 with a standard deviation of \$1.05. Assuming that movie ticket prices are normally distributed, find a 95% confidence interval for the mean price of movie tickets for all theaters in the United States.
- In a poll of 617 workers, 25% said they have observed their co-workers stealing products or cash from their employers.
 - What is the point estimate of the corresponding population proportion?
 - Find a 95% confidence interval for proportion of all such workers who have observed their co-workers stealing products or cash from their employers.
 - What is the maximum error of estimate for part b?
- A department store manager wants to estimate at a 90% confidence level the mean amount spent by all customers at this store. From an earlier study, the manager knows that the standard deviation of amounts spent by customers at this store is \$31. What sample size should he choose so that the estimate is within \$3 of the population mean?
- A preliminary study has shown that 93% of all Tony's pizzas are delivered within 30 minutes. How large should the sample size be so that the 99% confidence interval for the proportion of all Tony's pizzas delivered within 30 minutes has a maximum error of 0.02?

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Homework # 11

N.B.: Solve all questions manually and using Minitab.

1. The manufacturer of a certain brand of auto batteries claims that the mean life of these batteries is 45 months. A consumer protection agency that wants to check this claim took a random sample of 36 such batteries and found that the mean life for this sample is 43.75 months with a standard deviation of 4.5 months. Find the P-value for the hypothesis test with the alternative hypothesis that the mean life of these batteries is less than 45 months. Will you reject the null hypothesis at $\alpha=.025$?
2. A machine is set to fill 32-ounce milk cartons. However, the amount it puts into the cartons varies slightly from carton to carton. It is known that the standard deviation of the milk in all such cartons is always equal to 0.15 ounce. A sample of 35 such cartons produced a mean net weight of 31.90 ounce. Calculate the P-value for this hypothesis test. Will you reject the null hypothesis at $\alpha=.01$? at $\alpha=.05$?
3. According to existing data, the average compensation of CEOs in the United States was \$2.4 million in 2001. Suppose that a recent random sample of 32 CEOs showed a mean annual cash compensation of \$2.6 million with a standard deviation of \$0.5 million. Does the sample information support the alternative hypothesis that the current mean annual cash compensation for CEOs exceeds \$2.4 million at the 2.5% significance level?
4. According to a survey, the mean cost of a visit to a doctor's office in the United States was \$60 in 2002. Suppose that a recent sample of 25 visits to doctors gave a mean of \$63.50 and a standard deviation of \$2.00. Using the 5% significance level, can you conclude that the current mean cost of a visit to a doctor's office exceeds \$60? Assume that such costs for all visits to doctors are normally distributed.
5. According to a 2002 survey, 47% of Americans dream of owning a business. Assume that this result was true for the population of Americans in 2002. A recent random sample of 1000 Americans found that 430 of them dream of owning a business. Test at the 5% significance level if the current percentage of Americans who dream of owning a business is different from 47%.
6. According to a 2002 report, women held 49% of management and professional jobs in 2000. Suppose that a recent random sample of 200 such jobs found that 52% of these jobs are held by women. Can you conclude that the percentage of such jobs that are held by women currently exceeds 49%? Use $\alpha=.025$.

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Homework # 12

N.B.: Solve all questions manually and using Minitab.

Problem 1

An auto manufacturing company wanted to investigate how the price of one of its car models depreciates with age. The research department at the company took a sample of eight cars of this model and collected the following information on the ages (in years) and prices (in hundreds of dollars) of these cars.

Age	8	3	6	9	2	5	6	3
Price	19	94	50	21	145	42	36	99

1. Construct a scatter diagram for these data. Does the scatter diagram exhibit a linear relationship between ages and prices of cars?
2. Find the regression line with price as a dependent variable and age as an independent variable.
3. Give a brief interpretation of the values of the intercept and slope calculated in part 2.
4. Plot the regression line on the scatter diagram of part 1 and show the errors by drawing vertical lines between scatter points and the regression line.
5. Predict the price of a 7-year old car of this model.
6. Estimate the price of an 18-year old car of this model.
7. Compute the coefficient of determination and give a brief interpretation of it.
8. Do you expect the ages and prices of cars to be positively or negatively related? Explain.
9. Compute the linear correlation coefficient.

Problem 2

The following table gives information on ages (years) and cholesterol levels for a random sample of 10 men.

Age	58	69	43	39	63	52	47	31	74	36
Cholesterol level	189	235	193	177	154	191	213	165	198	181

1. Construct a scatter diagram for these data taking age as an independent variable and cholesterol level as a dependent variable. Does the scatter diagram exhibit a linear relationship between age and cholesterol level?
2. Find the regression line of cholesterol level on age.
3. Give a brief interpretation of the values of the intercept and slope calculated in part 2.

4. Plot the regression line on the scatter diagram of part 1 and show the errors by drawing vertical lines between scatter points and the regression line.
5. Predict the cholesterol level of a 60-year old man.
6. Compute the coefficient of determination and give a brief interpretation of it.
7. Compute the linear correlation coefficient and explain its meaning.