

PROBLEMS ON CHAPTER 2 AND SELECTED SOLVED PROBLEMS

1. Damages at a factory manufacturing chairs are categorized according to the material wasted.

plastic	75
iron	31
cloth	22
spares	8

Draw a Pareto chart.

2. Losses at an oil refinery (in millions of dollars) due to excess heat can be divided according to the reason behind the generation of excessive heat.

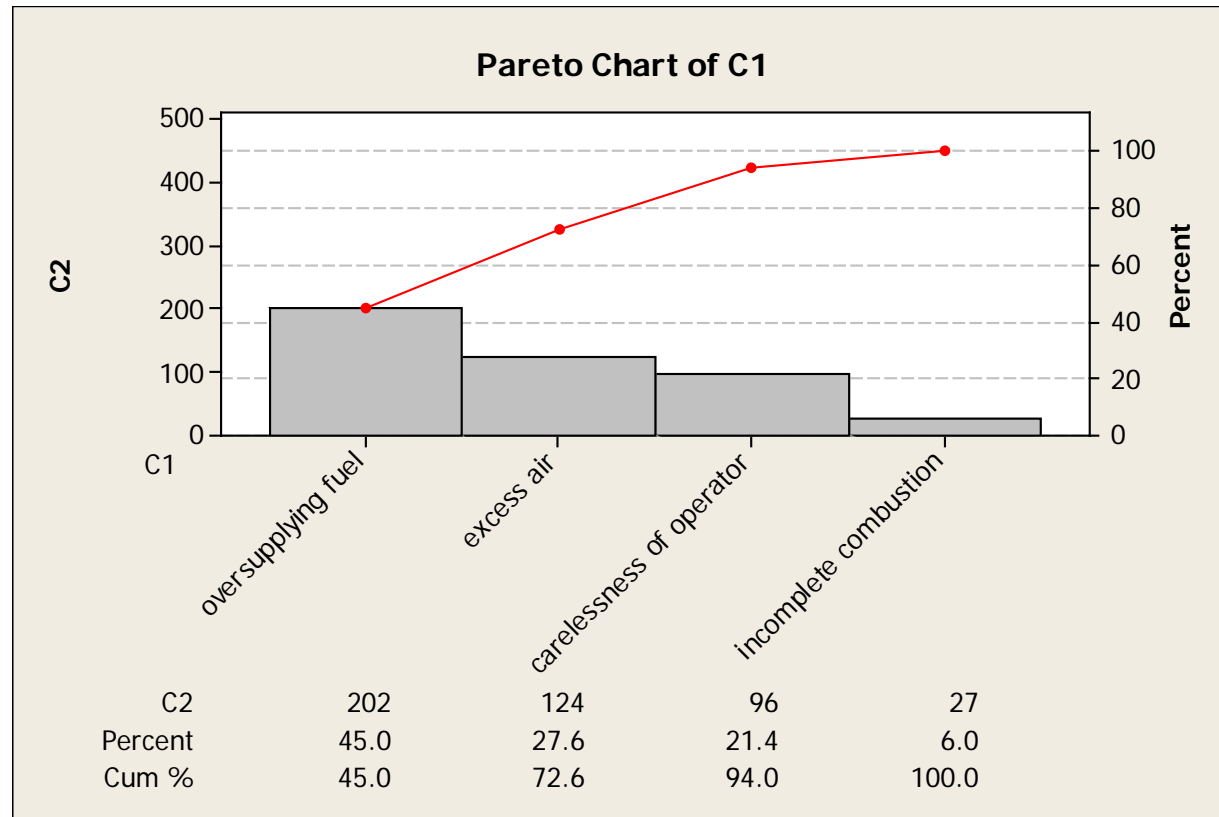
oversupplying fuel	202
excess air	124
carelessness of operator	96
incomplete combustion	27

- (a) Draw a Pareto chart.
- (b) What percent of the loss occurs due to
 - (1) excess air?
 - (2) excess air and oversupplying fuel?

Solution:

Total 449

a)



b)

(1) excess air = 27.6%

(2) excess air and oversupplying fuel = 72.6%

3. Tests were conducted to measure the running temperature for engines (in °F). A sample of 15 tests yielded the temperature values:

182 184 184 186 180 198 195 194
 197 200 188 188 194 197 184

Construct a dot diagram.

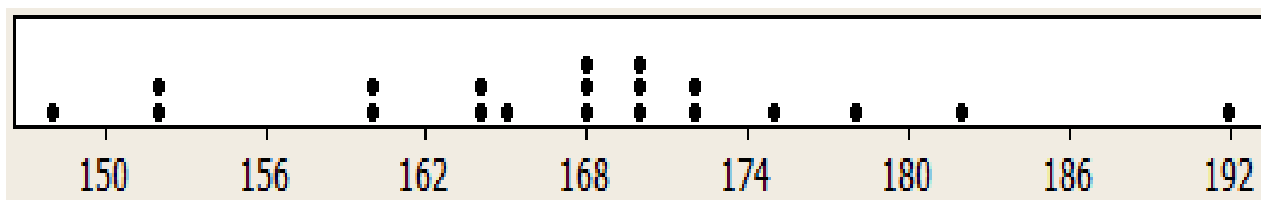
4. To determine the strengths of various detergents, the following are 20 measurements of the total dissolved salts (parts per million) in water:

168 170 148 160 168 164 175 178
 165 168 152 170 172 192 182 164
 152 160 170 172

Construct a dot diagram.

Solution:

148	152	160	164	165	168	170	172	175	178	182	192
	152	160	164		168	170	172				
					168	170					



5. To continually increase the speed of computers, electrical engineers are working on ever-decreasing scales. The size of devices currently undergoing development is measured in nanometers (nm), meters. Engineers fabricating a new transmission-type electron multiplier² created an array of silicon Nano-pillars on a flat silicon membrane. Subsequently, they measured the diameters (nm) of 50 pillars:

62	68	69	80	68	79	83	70	74	73
74	75	80	77	80	83	73	79	100	93
92	101	87	96	99	94	102	95	90	98
86	93	91	90	95	97	87	89	100	93
92	98	101	97	102	91	87	110	106	118

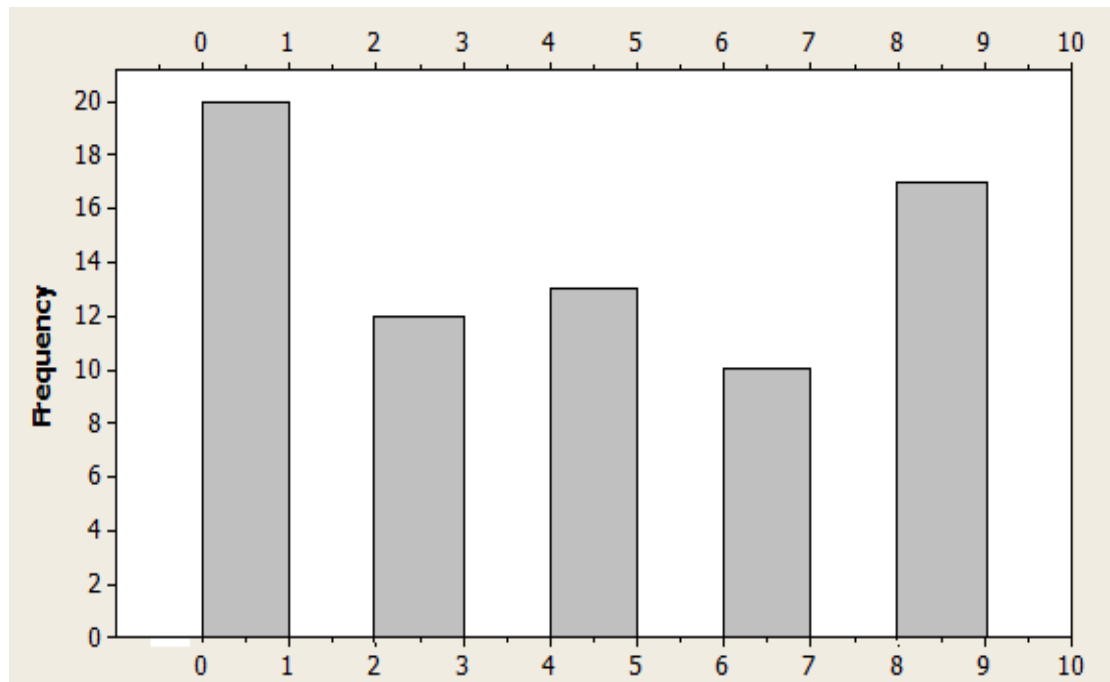
Group these measurements into a frequency distribution and construct a histogram using $(60,70]$, $(70, 80]$, $(80,90]$, $(90,100]$, $(100, 110]$, $(110,120]$, where the right-hand endpoint is included but the left-hand endpoint is not.

6. The following are the number of transistors failing a quality check per hour during 72 observed hours of production:

2	4	6	8	1	2	1	8	5	4	6	1
0	1	8	2	3	4	1	2	5	1	1	8
2	1	9	1	4	2	5	6	8	1	7	1
4	9	1	8	2	4	1	1	8	5	5	3
0	9	1	9	7	1	8	8	7	7	7	2
7	1	2	7	3	5	8	8	5	9	9	0

Group these data into a frequency distribution showing how often each of the values occurs and draw a bar chart.

Class (failing a quality per hour)	Frequency
0-1	20
2-3	12
4-5	13
6-7	10
8-9	17
Total	72



7. A contract for the maintenance of a leading manufacturer's computers was given to a team of specialists. After six months, the supervisor of the team felt that computer performance could be improved by modifying the existing IC board. To document the current status, the team collected data on the number of IC board failures. Use the data below to:

(a) calculate the sample mean \bar{x} ,

(b) calculate the sample standard deviation s .

Number of IC board failures:

12	3	8	6	19	1	2	5
1	11	14	3	13	2	9	8
2	1	4	13	3	11	9	15
14	5	12	7	6	16	10	0

Solution:

$$\bar{x} = \frac{\sum_{i=1}^n x_i}{n}$$

$$\bar{x} = \frac{245}{32} = 7.66$$

$$s^2 = \frac{\sum_{i=1}^n x_i^2 - \left(\sum_{i=1}^n x_i \right)^2 / n}{n - 1}$$

$$s^2 = \frac{2721 - (245)^2 / 32}{32 - 1} = 27.27$$

$$s = 5.22$$

8. Meat products are regularly monitored for freshness. A trained inspector selects a sample of the product and assigns an offensive smell score between 1 and 7 where 1 is very fresh. The resulting offensive smell scores, for each of 16 samples, are:

3.2	3.9	1.7	5	1.9	2.6	2.4	5.3
1	2.7	3.8	5.2	1	6.3	3.3	4.3

- (a) Find the mean \bar{x} ,
- (b) Find the median.
- (c) Find Standard Deviation s .

9. Use the distribution obtained previously to calculate the mean, variance, and standard deviation:

Solution:

class	x_i	f_i	$x_i f_i$	$x_i^2 f_i$
(66,67]	66.5	1	66.5	4422.25
(67,68]	67.5	3	202.5	13668.75
(68,69]	68.5	6	411	28153.5
(69,70]	69.5	13	903.5	62793.25
(70,71]	70.5	11	775.5	54672.75
(71,72]	71.5	11	786.5	56234.75
(72,73]	72.5	7	507.5	36793.75
(73,74]	73.5	3	220.5	16206.75
(74,75]	74.5	2	149	11100.5
(75,76]	75.5	1	75.5	5700.25
Total		58	4098	289746.5

Class	Frequency
(66,67]	1
(67,68]	3
(68,69]	6
(69,70]	13
(70,71]	11
(71,72]	11
(72,73]	7
(73,74]	3
(74,75]	2
(75,76]	1
Total	58

$$\bar{x} = \frac{\sum_{i=1}^k x_i f_i}{n}$$

$$\bar{x} = \frac{4098}{58} = 70.66$$

$$s^2 = \frac{289746.5 - (4098)^2/58}{57} = 3.54$$

$$s = 1.88$$

$$s^2 = \frac{\sum_{i=1}^k x_i^2 f_i - \left(\sum_{i=1}^k x_i f_i \right)^2 / n}{n - 1}$$

10. For each of the following distributions, find the mean, the median, variance and standard deviation.

Grade	Frequency
40–49	5
50–59	18
60–69	27
70–79	15
80–89	6