Practical 3.3

- In this assignment the homework and the practical are presented as one integrated exercise.
- You must be able to do and understand all calculations with your **calculator and with Excel.**

Exercise 1
Answer the following Question.

The Energy Information Administration reported that the mean retail price per gallon of regular grade gasoline was $2.30. Suppose that the standard deviation was $0.1 and that the retail price per gallon has a bell-shaped distribution.

a. What percentage of regular gasoline sold between $2.20 and $2.40 per gallon?
b. What percentage of regular gasoline sold between $2.20 and $2.50 per gallon?
c. What percentage of regular gasoline sold more than $2.50 per gallon?

- Do the question on your own and THEN check the MEMO below.
- It helps to draw a graph!

MEMO:

a. $2.20 is one standard deviation below the mean and $2.40 is one standard deviation above the mean. The empirical rule says that approximately 68% of gasoline sales should be in the price range.

b. Part (a) shows that approximately 68% of the gasoline sales are between $2.20 and $2.40. Since the bell-shaped distribution is symmetric, approximately half of 68%, or 34%, of the gasoline sales should be between $2.20 and the mean price of $2.30. $2.50 is two standard deviations above the mean price of $2.30. The empirical rule says that approximately 95% of the gasoline sales should be within two standard deviations of the mean. Thus, approximately half of 95%, or 47.5%, of the gasoline sales should be between the mean price of $2.30 and $2.50. The percentage of gasoline sales between $2.20 and $2.50 should be approximately 34% + 47.5% = 81.5%.

c. $2.50 is two standard deviations above the mean and the empirical rule says that approximately 95% of the gasoline sales should be within two standard deviations of the mean. Thus, 1 - 95% = 5% of the gasoline should be more than two standard deviations from the mean. Since the bell-shaped distribution is symmetric, we expected half of 5%, or 2.5%, would be more than $2.50.

Exercise 2

- Answer questions (a) to (d) and THEN check the MEMO below.

Many families in California are using backyard structures for home offices, art studios, hobby areas as well as additional storage. Suppose that the mean price for a customized wooden, shingled backyard structure is $3100. Assume that the standard deviation is $1200.

a. What is the for a backyard structure costing $2300?
b. What is the z –score for a backyard structure costing $4900?
c. Interpret the z –scores in parts (a) and (b). Comment on whether either should be considered an outlier
d. If the cost of a backyard shed-office combination built in Albany, California, is $13000, should this structure be considered an outlier? Explain.

- Make sure that you also know how to calculate the z-scores in Excel 2010.

MEMO:

a.

$$z = \frac{x-\mu}{\sigma} = \frac{2300-3100}{1200} = -.67$$

b.

$$z = \frac{x-\mu}{\sigma} = \frac{4900-3100}{1200} = 1.50$$

c. $2300 is .67 standard deviations below the mean. $4900 is 1.50 standard deviations above the mean. Neither is an outlier.

d.

$$z = \frac{x-\mu}{\sigma} = \frac{13000-3100}{1200} = 8.25$$

$13,000 is 8.25 standard deviations above the mean. This cost is an outlier.

Exercise 3

A service station recorded the following frequency distribution for the number of gallons of gasoline sold per car in a sample of 680 cars.

Gasoline (gallons)	Frequency
0 – 4	74
5 – 9	192
10 – 14	280
15 – 19	105
20 – 24	23
25 – 29	6
Total	680

Compute the mean, variance and standard deviation for these grouped data. If the service station expects to service about 120 cars on a given day, estimate the total number of gallons of gasoline that will be sold.

- The solutions are shown in Excel in the steps below.
- Make sure that you also know how to calculate all the answers with your calculator.

1. Type the following information in an Excel spread sheet. (See Fig 5.6)

Figure 5.6

	A	B	C
1	**Gasoline**		
2	**(gallons)**	**Frequency**	**Midpoint**
3		***f***	***M***
4	0-4	74	2
5	5-9	192	7
6	10-14	280	
7	15-19	105	
8	20-24	23	
9	25-29	6	

2. After selecting cells C4:C5 in Fig 5.6 drag the *fill handle* down to cell C9. All midpoints are now copied into cells C6:C9. (See Fig 5.7)
3. Calculate the average

$$\bar{x} = \frac{\sum fM}{n}$$

by entering the formula: =B4*C4 into cell D4. (See Fig. 5.7)

Figure 5.7

	A	B	C	D
1	**Gasoline**			
2	**(gallons)**	**Frequency**	**Midpoint**	
3		***f***	***M***	***fM***
4	0-4	74	2	=B4*C4
5	5-9	192	7	
6	10-14	280	12	
7	15-19	105	17	
8	20-24	23	22	
9	25-29	6	27	

Select cell D4 and double click the *fill handle* or drag the *fill handle* down to cell D9.

4. Calculate the average in cell B12. (See Fig. 5.8)

Figure 5.8 Formula Sheet

	A	B	C	D
1	Gasoline			
2	(gallons)	Frequency	Midpoint	
3		*f*	*M*	*fM*
4	0-4	74	2	=B4*C4
5	5-9	192	7	=B5*C5
6	10-14	280	12	=B6*C6
7	15-19	105	17	=B7*C7
8	20-24	23	22	=B8*C8
9	25-29	6	27	=B9*C9
10		=SUM(B4:B9)		=SUM(D4:D9)
11				
12	Average	=D10/B10		

Figure 5.8 Value Sheet

	A	B	C	D
1	Gasoline			
2	(gallons)	Frequency	Midpoint	
3		*f*	*M*	*fM*
4	0-4	74	2	148
5	5-9	192	7	1344
6	10-14	280	12	3360
7	15-19	105	17	1785
8	20-24	23	22	506
9	25-29	6	27	162
10		680		7305
11				
12	Average	10.743		

5. After calculating the average, it is now possible to calculate the variance

$$s^2 = \frac{\sum f_i (M_i - \bar{x})^2}{n}$$

in columns E, F and G and in cell B13. (See Fig. 5.9 and let $\bar{x}$ = ***xbar***.)

Figure 5.9 Formula Sheet

	A	B	C	D	E	F	G
1	Gasoline						
2	(gallons)	Frequency	Midpoint				
3		*f*	*M*	*fM*	*(M - xbar)*	*(M - xbar)^2*	*f (M - xbar)^2*
4	0-4	74	2	148	=C4-B12	=E4*E4	=B4*F4
5	5-9	192	7	1344	=C5-B12	=E5*E5	=B5*F5
6	10-14	280	12	3360	=C6-B12	=E6*E6	=B6*F6
7	15-19	105	17	1785	=C7-B12	=E7*E7	=B7*F7
8	20-24	23	22	506	=C8-B12	=E8*E8	=B8*F8
9	25-29	6	27	162	=C9-B12	=E9*E9	=B9*F9
10		**680**		**7305**			**=SUM(G4:G9)**
11							
12	**Average**	10.743					
13	**Variance**	=G10/(B10-1)					

Figure 5.9 Value Sheet

	A	B	C	D	E	F	G
1	Gasoline						
2	(gallons)	Frequency	Midpoint				
3		*f*	*M*	*fM*	*(M - xbar)*	*(M - xbar)^2*	*f (M - xbar)^2*
4	0-4	74	2	148	-8.743	76.434	5656.107
5	5-9	192	7	1344	-3.743	14.007	2689.422
6	10-14	280	12	3360	1.257	1.581	442.662
7	15-19	105	17	1785	6.257	39.154	4111.219
8	20-24	23	22	506	11.257	126.728	2914.744
9	25-29	6	27	162	16.257	264.302	1585.809
10		**680**		**7305**			**17399.963**
11							
12	**Average**	10.743					
13	**Variance**	25.626					

6.The standard deviation is calculated in cell B14. (See Fig 5.10)

Figure 5.10 Formula Sheet

	A	B
12	**Average**	=D10/B10
13	**Variance**	=G10/(B10-1)
14	**Std.dev.**	=SQRT(B13)

Figure 5.10 Value Sheet

	A	B
12	**Average**	10.743
13	**Variance**	25.626
14	**Std.dev.**	5.062

Note:
If the service station expects to service 120 cars on a given day, then the estimate of total gallons sold would be: (10.743)(120) = 1289.16