Chapter 2

TESTING DATA FOR NORMALITY

Exercise 1:

The following data represent a samples of week 1 quiz score.
Calculate the skewness and kurtosis.

90	72	90
64	95	89
74	88	100
77	57	35
100	64	95
65	80	84
90	100	76

	data	$x_i - \bar{x}$	$(x_i - \bar{x})^2$	$\left(\frac{x_i-\bar{x}}{s}\right)^3$	$\left(\frac{x_i-\bar{x}}{s}\right)^4$
1	90	9.761905	95.29478	0.202561	0.118962
2	64	-16.2381	263.6757	-0.9323	0.91077
3	74	-6.2381	38.91383	-0.05286	0.019837
⋮	⋮	⋮	⋮	⋮	⋮
19	95	14.7619	217.9138	0.700452	0.622068
20	84	3.761905	14.15193	0.011592	0.002624
21	76	-4.2381	17.96145	-0.01658	0.004226
Total	1685		5525.81	-18.4149	69.01972

$$\bar{x} = \frac{\sum x}{n} = \frac{1685}{21} = 80.2381$$

$$S = \sqrt{\frac{\sum (x_i - \bar{x})^2}{n-1}} = \sqrt{\frac{5525.80}{20}} = 6.62199$$

$$\sum \left(\frac{x_i - \bar{x}}{S}\right)^3 = -18.4149$$

$$\sum \left(\frac{x_i - \bar{x}}{S}\right)^4 = 69.01972$$

$$S_k = \frac{n}{(n-1)(n-2)} \sum \left(\frac{x_i - \bar{x}}{S}\right)^3$$

$$= \frac{21}{(21-1)(21-2)} \times -18.4149 = -1.01766$$

$$SE_{S_k} = \sqrt{\frac{6n(n-1)}{(n-2)(n+1)(n+3)}} = \sqrt{\frac{6 \times 21(21-1)}{(21-2)(21+1)(21+3)}} = 0.50119$$

$$Z_{S_k} = \frac{S_k - 0}{SE_{S_k}}$$

$$= \frac{-1.01766 - 0}{0.50119} = -2.032$$

$$Z_{S_k} \notin (-1.96, 1.96)$$

$$K = \left[\frac{n(n+1)}{(n-1)(n-2)(n-3)} \sum \left(\frac{x_i - \bar{x}}{S}\right)^4\right] - \frac{3(n-1)^2}{(n-2)(n-3)}$$

$$= \left[\frac{21(21+1)}{(21-1)(21-2)(21-3)} \times 69.02\right] - \frac{3(21-1)^2}{(21-2)(21-3)} = 1.153$$

$$SE_K = \sqrt{\frac{24n(n-1)^2}{(n-2)(n-3)(n+5)(n+3)}}$$

$$= \sqrt{\frac{24 \times 21(21-1)^2}{(21-2)(21-3)(21+5)(21+3)}} = 0.971941$$

$$Z_k = \frac{K - 0}{SE_K}$$

$$= \frac{1.153 - 0}{0.971941} = 1.186$$

$$Z_k \in (-1.96, 1.96)$$

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```r
install.packages("e1071")
library(e1071)
# Data :
scores <- c(90, 72, 90, 64, 95, 89, 74, 88, 100, 77, 57, 35, 100, 64, 95, 65, 80, 84, 90, 100, 76)
#Sample Skewness + Sample Kurtosis :
#  type = 2 أو type = 3 اعتماداً على تعريف البرنامج (type = 2 يعطي صيغة مشابهة لـ SPSS و Excel)
sample_skew <- skewness(scores, type = 2)
sample_skew
sample_kur <- kurtosis(scores, type = 2)
sample_kur
#sample size (n ):
n=length(scores)
n
#Standard Error (SE) for Skewness and Sample Kurtosis :
SE_skew <- sqrt((6*n*(n-1)) / ((n-2)*(n+1)*(n+3)))
SE_skew
SE_kur <- sqrt((24*n*(n-1)^2) / ((n-2)*(n-3)*(n+5)*(n+3)))
SE_kur
#Z score:
Z_skew<- sample_skew /SE_skew
Z_skew
Z_kur<- sample_kur /SE_kur
Z_kur
#Z_table  qnorm( 1- alpha/2 ) , alpha=0.05
Z_table <- qnorm(1- 0.05/2)
Z_table

```

4:99 (Top Level) R Script

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Values

n	21L
sample_kur	1.15308609036369
sample_skew	-1.01766455132858
SE_kur	0.971941029961179
SE_skew	0.501194744833586
x	num [1:21] 90 64 74 77 100 65…
Z_kur	1.18637453797968
Z_skew	-2.03047729813383
Z_table	1.95996398454005

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Exercise 2:

A department store has decided to evaluate customer satisfaction. The store provides customers with a survey to rate employee friendliness. The survey uses a scale of 1–10. The survey results are:

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

Calculate the skewness and kurtosis.

RStudio

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```r
installed.packages('e1071')
library(e1071)
x=c(7,4,5,5,6,3,4,5,5,8,3,4,8,5,6,6,5,9,7,2)
#Sample Skewness + Sample Kurtosis :
#  type = 2 أو type = 3 اعتماداً على تعريف البرنامج (type = 2 لـ يعطي صيغة مشابهة لـ SPSS و Excel)
sample_skew <- skewness(x, type = 2)
sample_skew
sample_kur <- kurtosis(x, type = 2)
sample_kur
#sample size (n ):
n=length(x)
n
#Standard Error (SE) for Skewness and Sample Kurtosis :
SE_skew <- sqrt((6*n*(n-1)) / ((n-2)*(n+1)*(n+3)))
SE_skew
SE_kur <- sqrt((24*n*(n-1)^2) / ((n-2)*(n-3)*(n+5)*(n+3)))
SE_kur
#Z score:
Z_skew<- sample_skew /SE_skew
Z_skew
Z_kur<- sample_kur /SE_kur
Z_kur
#Z_table  qnorm( 1- alpha/2 ) , alpha=0.05
Z_table <- qnorm(1- 0.05/2)
```

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Values

n	20L
sample_kur	-0.283332275262219
sample_skew	0.239518211492532
SE_kur	0.992383612541845
SE_skew	0.512103336707757
x	num [1:20] 7 4 5 5 6 3 4 5 5 …
Z_kur	-0.285506805716496
Z_skew	0.467714608212401
Z_table	1.95996398454005

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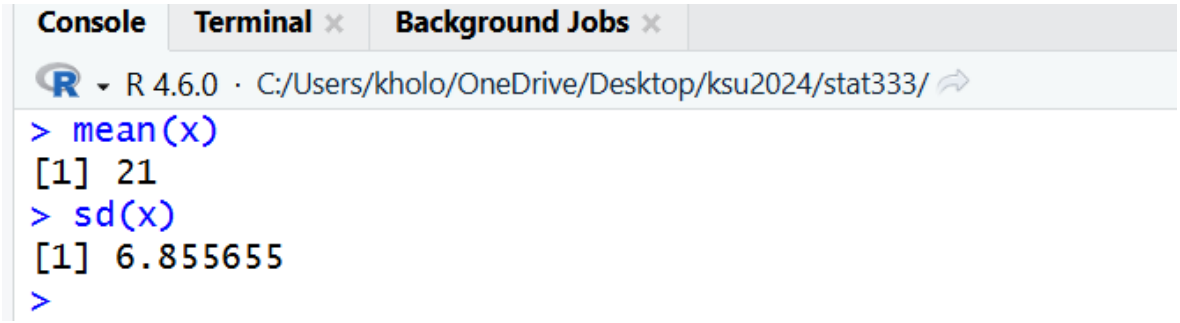
Exercise 3:

Calculate the skewness and kurtosis for the following data.

	data	$x_i - \bar{x}$	$(x_i - \bar{x})^2$	$\left(\frac{x_i-\bar{x}}{s}\right)^3$	$\left(\frac{x_i-\bar{x}}{s}\right)^4$
1	25				
2	30				
3	12				
4	18				
5	20				
Total					



Untitled5* | stat333_chapter2.R* | Untitled3*

Source on Save | Run | Source

```r
installed.packages('e1071')
library(e1071)
x=c(25,30,12,18,20)
#Sample Skewness + Sample Kurtosis :
#  type = 2 أو type = 3 اعتماداً على تعريف البرنامج (type = 2 لـ يعطي صيغة مشابهة لـ SPSS و Excel)
sample_skew <- skewness(x, type = 2)
sample_skew
sample_kur <- kurtosis(x, type = 2)
sample_kur
#sample size (n ):
n=length(x)
n
#Standard Error (SE) for Skewness and Sample Kurtosis :
SE_skew <- sqrt((6*n*(n-1)) / ((n-2)*(n+1)*(n+3)))
SE_skew
SE_kur <- sqrt((24*n*(n-1)^2) / ((n-2)*(n-3)*(n+5)*(n+3)))
SE_kur
#Z score:
Z_skew<- sample_skew /SE_skew
Z_skew
Z_kur<- sample_kur /SE_kur
Z_kur
#Z_table  qnorm( 1- alpha/2 ) , alpha=0.05
Z_table <- qnorm(1- 0.05/2)

```

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Values

n	5L
sample_kur	-0.383431416930738
sample_skew	0.0465526568610302
SE_kur	2
SE_skew	0.912870929175277
x	num [1:5] 25 30 12 18 20
Z_kur	-0.191715708465369
Z_skew	0.0509958805491677
Z_table	1.95996398454005

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