PRACTICAL JOURNAL

RESEARCH IN COMPUTING
&
DATA SCIENCE

SUBMITTED BY
NAME
SEATNO

IN PARTIAL FULFILLMENT OF
M.Sc. (IT) Part-I (Sem-1)

UNIVERSITY OF MUMBAI
DEPARTMENT OF COMPUTER SCIENCE & IT
S.K.SOMAIYA COLLEGE OF ARTS, SCIENCE & COMMERCE
Vidyavihar (E), Mumbai-400077
2019-2020

RESEARCH IN COMPUTING [PSIT1P1]

S K SOMAIYA COLLEGE OF ARTS, SCIENCE & COMMERCE
"Aurobindo"
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CERTIFICATE

This is to Certify that, Mr./Ms. _____
Student of **M.Sc. I.T Part-I (Sem-I)** with seat no _____ and college enrolled roll no _____ has satisfactorily completed the practical in Information Technology Laboratory for the course **(PSIT101) Research in Computing** in the program of **INFORMATION TECHNOLOGY** from the **UNIVERSITY OF MUMBAI** for the academic year 2019-2020.

(Subject In-Charge) **(HOD)**

(Examiners)

_____

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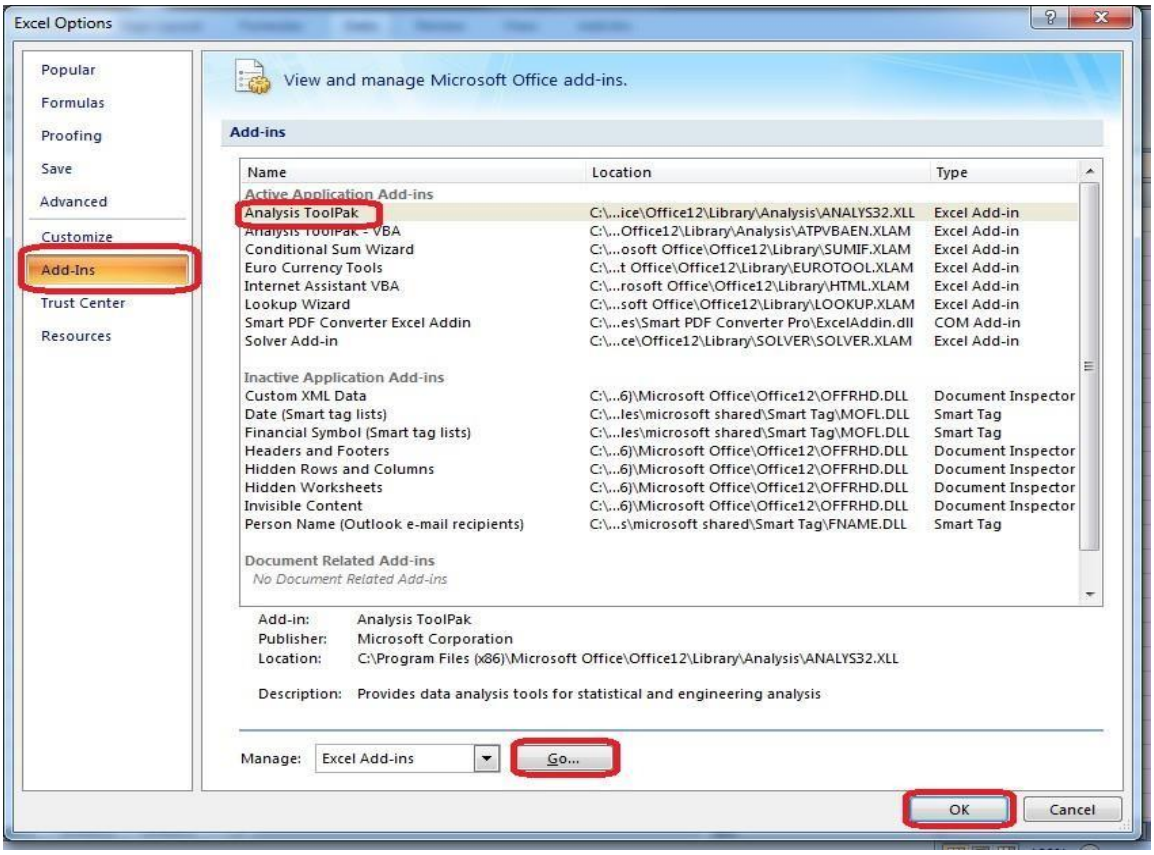
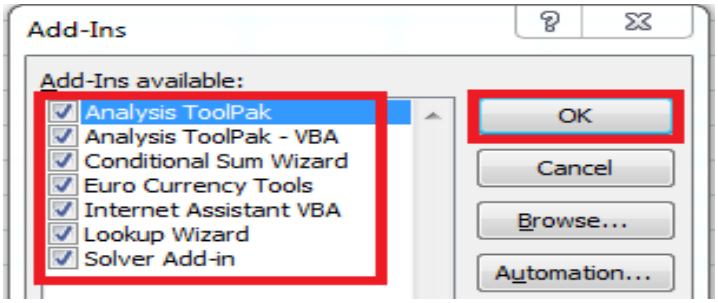
Practical 1:

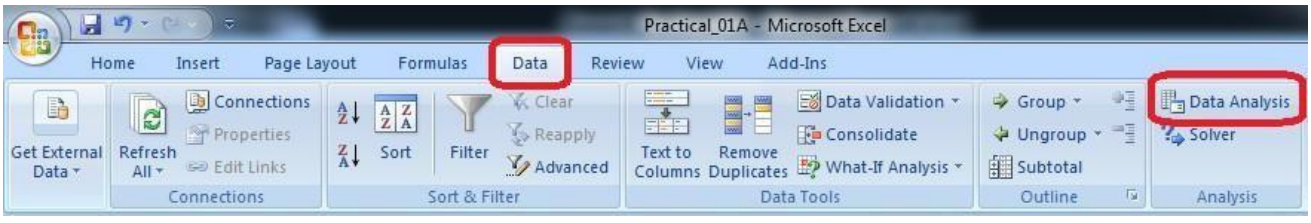
Aim: 1A. Write a program for obtaining descriptive statistics of data.

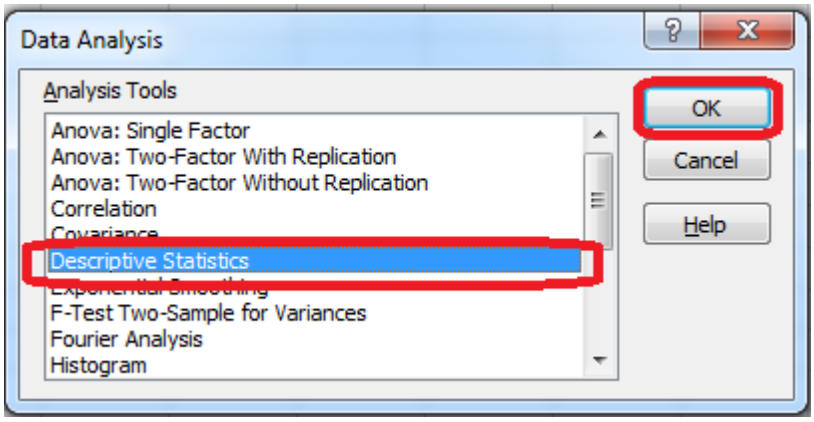
Using Excel:

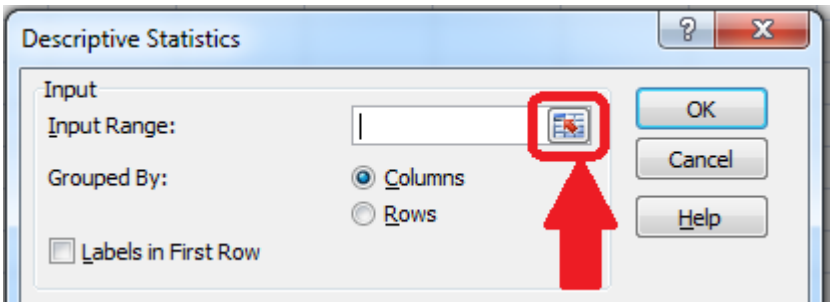
Go to File Menu → Options → Add-Ins→ Select Analysis ToolPak→ Press OK



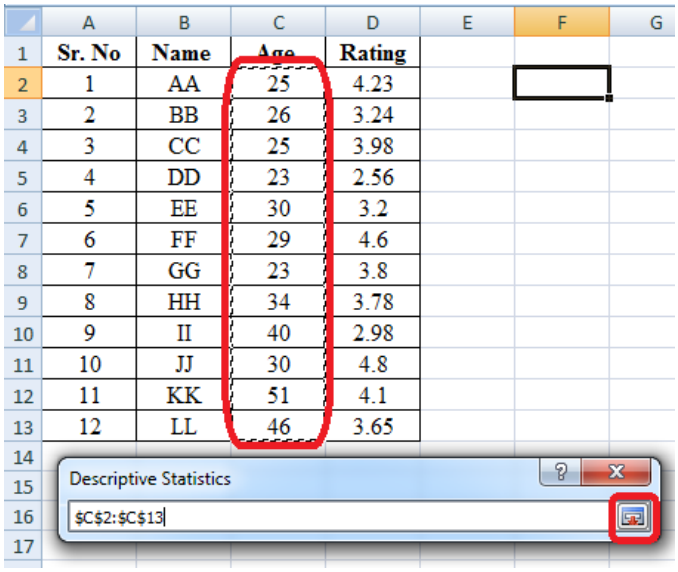




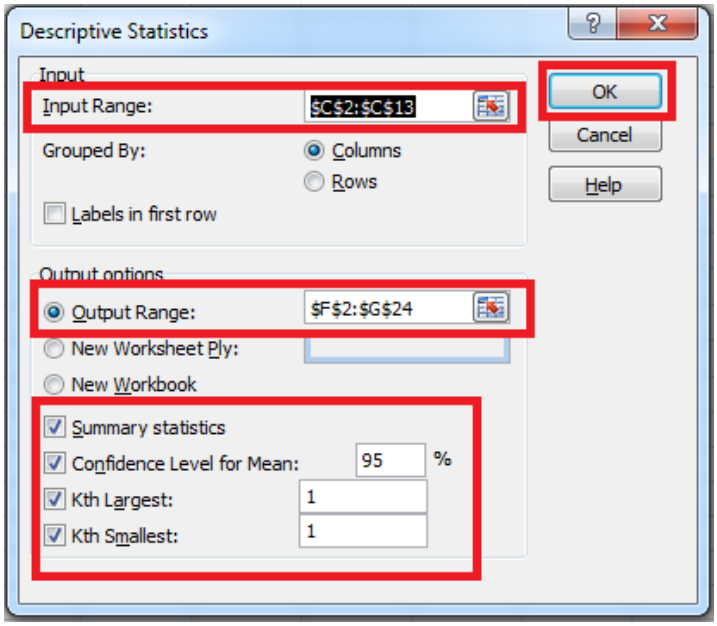




Select the data range from the excel worksheet.



	A	B	C	D	E	F	G
1	Sr. No	Name	Age	Rating			
2	1	AA	25	4.23			
3	2	BB	26	3.24			
4	3	CC	25	3.98			
5	4	DD	23	2.56			
6	5	EE	30	3.2			
7	6	FF	29	4.6			
8	7	GG	23	3.8			
9	8	HH	34	3.78			
10	9	II	40	2.98			
11	10	JJ	30	4.8			
12	11	KK	51	4.1			
13	12	LL	46	3.65			
14							
15							
16							
17							

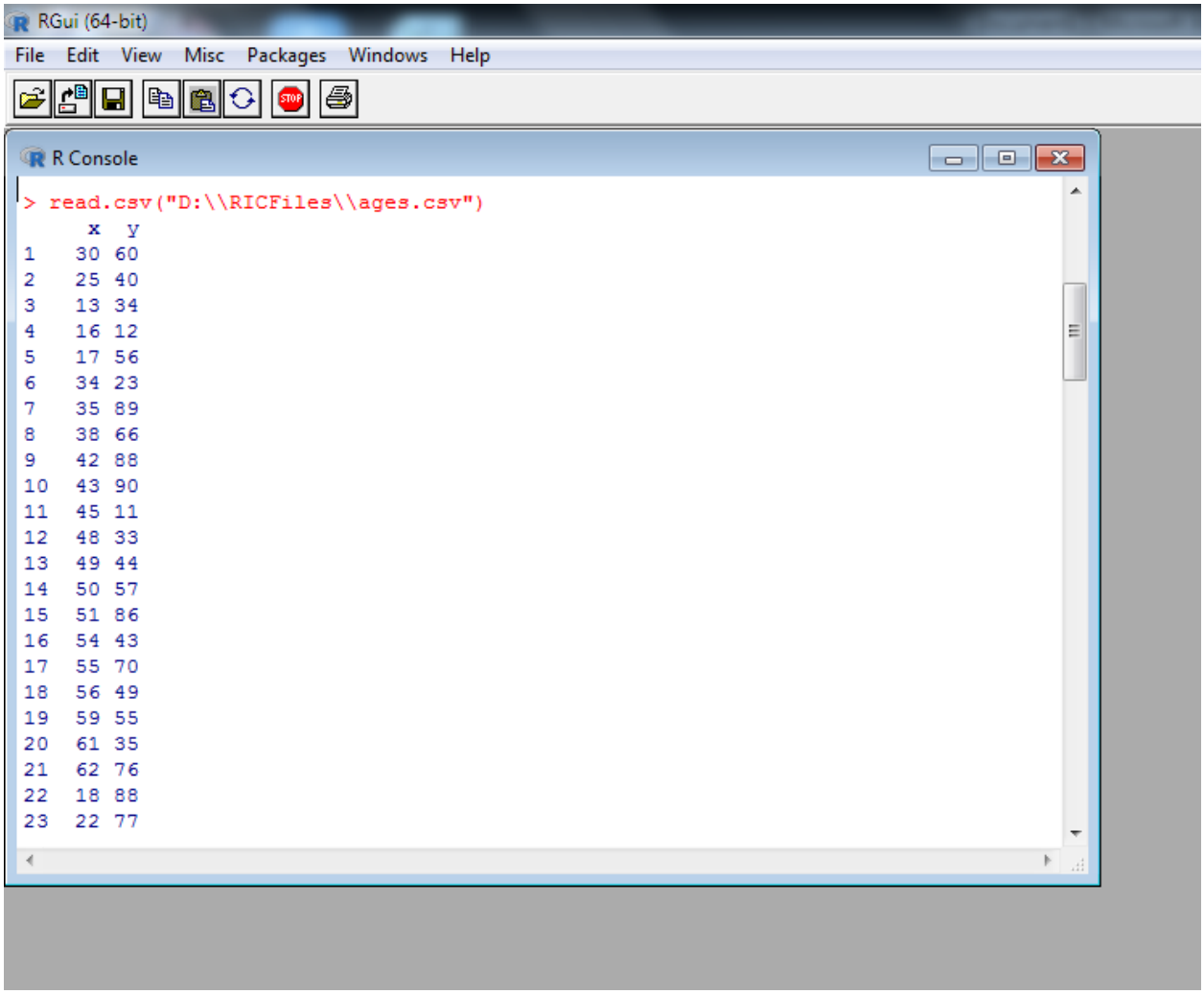


Output:

	A	B	C	D	E	F	G
1	**Sr. No**	**Name**	**Age**	**Rating**			
2	1	AA	25	4.23		*Column1*	
3	2	BB	26	3.24			
4	3	CC	25	3.98		Mean	31.83333
5	4	DD	23	2.56		Standard Error	2.665246
6	5	EE	30	3.2		Median	29.5
7	6	FF	29	4.6		Mode	25
8	7	GG	23	3.8		Standard Deviation	9.232682
9	8	HH	34	3.78		Sample Variance	85.24242
10	9	II	40	2.98		Kurtosis	0.24931
11	10	JJ	30	4.8		Skewness	1.135089
12	11	KK	51	4.1		Range	28
13	12	LL	46	3.65		Minimum	23
14						Maximum	51
15						Sum	382
16						Count	12
17						Largest(1)	51
18						Smallest(1)	23
19						Confidence Level(95.0%)	5.866167

Aim: 1B. Import data from different data sources (from Excel, csv, mysql, sql server, oracle to R/Python/Excel)

Using R:



Practical 2

Aim: 2A. Design a survey form for a given case study, collect the primary data and analyse it.

Case 1:

A researcher wants to conduct a Survey in colleges on Use of ICT in higher education from Mumbai, Thane and Navi Mumbai. The survey focuses on access to and use of ICT in teaching and learning, as well as on attitudes towards the use of ICT in teaching and learning.
Design questionnaire addressed to teachers seeks information about the target class, his experience using ICT for teaching, access to ICT infrastructure, support available, ICT based activities and material used, obstacles to the use of ICT in teaching, learning activities with the target class, your skills and attitudes to ICT, and some personal background information.

Arrange question in following groups:

1. Information about the target class you teach
2. Experience with ICT for teaching
3. ICT access for teaching
4. Support to teachers for ICT use
5. ICT based activities and material used for teaching
6. Obstacles to using ICT in teaching and learning
7. Learning activities with the target class
8. Teacher skills
9. Teacher opinions and attitudes
10. Personal background information

Case 2:

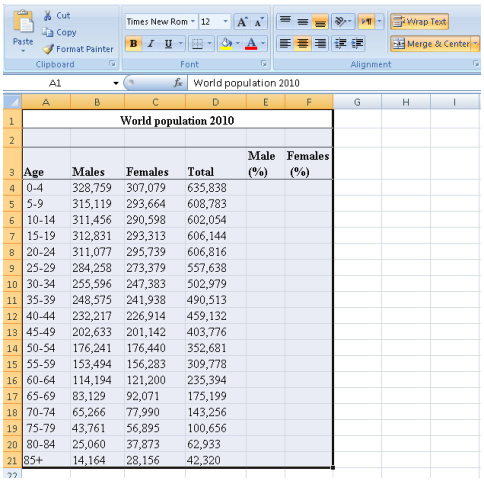
A research agency wants to study the perception about App based taxi service in Mumbai, Thane and Navi Mumbai. The survey focuses on customers attitude towards app base taxi service as well as on attitudes towards regular taxi cab.
Design questionnaire seeks information about the target taxi service, his experience using taxi services, access, support available, obstacles and some personal background information, with the following objectives:

1. To find out the customer satisfaction towards the App based-taxi services.
2. To find the level of convenience and comfort with App based -taxi services.
3. To know their opinion about the tariff system and promptness of service.
4. To ascertain the customer view towards the driver behaviour and courtesy.
5. To provide inputs to enhance the services to delight the customers.
6. To examine relationship between service quality factors and taxi passenger satisfaction.
7. To suggest better regulations for transportation authorities regarding customer protection and effective monitoring of taxi services.

Aim: 2B. Perform analysis of given secondary data.

a. **Determine your research question** – Knowing exactly what you are looking for.
b. **Locating data**– Knowing what is out there and whether you can gain access to it. A quick Internet search, possibly with the help of a librarian, will reveal a wealth of options.
c. **Evaluating relevance of the data** – Considering things like the data's original purpose, when it was collected, population, sampling strategy/sample, data collection protocols, operationalization of concepts, questions asked, and form/shape of the data.
d. **Assessing credibility of the data** – Establishing the credentials of the original researchers, searching for full explication of methods including any problems encountered, determining how consistent the data is with data from other sources, and discovering whether the data has been used in any credible published research.
e. **Analysis –** This will generally involve a range of statistical processes.

Example: Analyze the given Population Census Data for Planning and Decision Making by using the size and composition of populations.

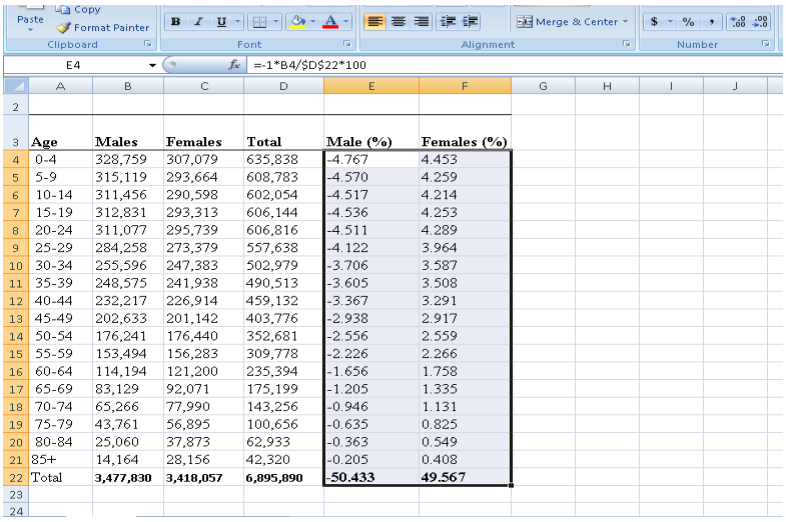


World population 2010

Age	Males	Females	Total	Male (%)	Females (%)
0-4	328,759	307,079	635,838		
5-9	315,119	293,664	608,783		
10-14	311,456	290,598	602,054		
15-19	312,831	293,313	606,144		
20-24	311,077	295,739	606,816		
25-29	284,258	273,379	557,638		
30-34	255,596	247,383	502,979		
35-39	248,575	241,938	490,513		
40-44	232,217	226,914	459,132		
45-49	202,633	201,142	403,776		
50-54	176,241	176,440	352,681		
55-59	153,494	156,283	309,778		
60-64	114,194	121,200	235,394		
65-69	83,129	92,071	175,199		
70-74	65,266	77,990	143,256		
75-79	43,761	56,895	100,656		
80-84	25,060	37,873	62,933		
85+	14,164	28,156	42,320		

Put the cursor in cell **B22** and click on the **AutoSum** and then click **Enter**. This will calculate the total population. Then copy the formula in cell **D22** across the row **22.**To calculate the percent of males in cell **E4**, enter the formula **=-1*100*B4/$D$22** . And copy the formula in cell **E4** down to cell **E21.**

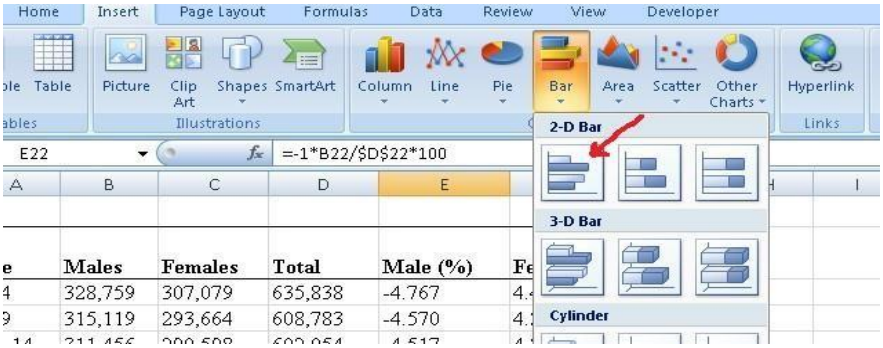
To calculate the percent of females in cell **F4**, enter the formula =**100*C4/$D$22**. Copy the formula in cell **F4** down to cell **F21.**



Age	Males	Females	Total	Male (%)	Females (%)
0-4	328,759	307,079	635,838	-4.767	4.453
5-9	315,119	293,664	608,783	-4.570	4.259
10-14	311,456	290,598	602,054	-4.517	4.214
15-19	312,831	293,313	606,144	-4.536	4.253
20-24	311,077	295,739	606,816	-4.511	4.289
25-29	284,258	273,379	557,638	-4.122	3.964
30-34	255,596	247,383	502,979	-3.706	3.587
35-39	248,575	241,938	490,513	-3.605	3.508
40-44	232,217	226,914	459,132	-3.367	3.291
45-49	202,633	201,142	403,776	-2.938	2.917
50-54	176,241	176,440	352,681	-2.556	2.559
55-59	153,494	156,283	309,778	-2.226	2.266
60-64	114,194	121,200	235,394	-1.656	1.758
65-69	83,129	92,071	175,199	-1.205	1.335
70-74	65,266	77,990	143,256	-0.946	1.131
75-79	43,761	56,895	100,656	-0.635	0.825
80-84	25,060	37,873	62,933	-0.363	0.549
85+	14,164	28,156	42,320	-0.205	0.408
Total	**3,477,830**	**3,418,057**	**6,895,890**	**-50.433**	**49.567**

To build the population pyramid, we need to choose a horizontal bar chart with two series of data (% male and % female) and the age labels in column A as the **Category X-axis** labels. Highlight the range **A3:A21**, hold down the CTRL key and highlight the range **E3:F21**

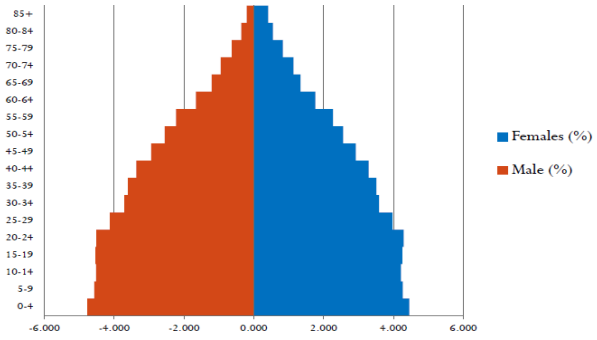
Under **inset** tab, under horizontal bar charts select **clustered bar chart**



Put the tip of your mouse arrow on the **Y-axis** (vertical axis) so it says “Category Axis”, right click and chose **Format Axis**

Choose **Axis options** tab and set the major and minor tick mark type to **None**, Axis labels to **Low**, and click **OK**.

Click on any of the bars in your pyramid, click right and select “format data series”. Set the **Overlap** to **100** and **Gap Width** to **0**. Click **OK**.

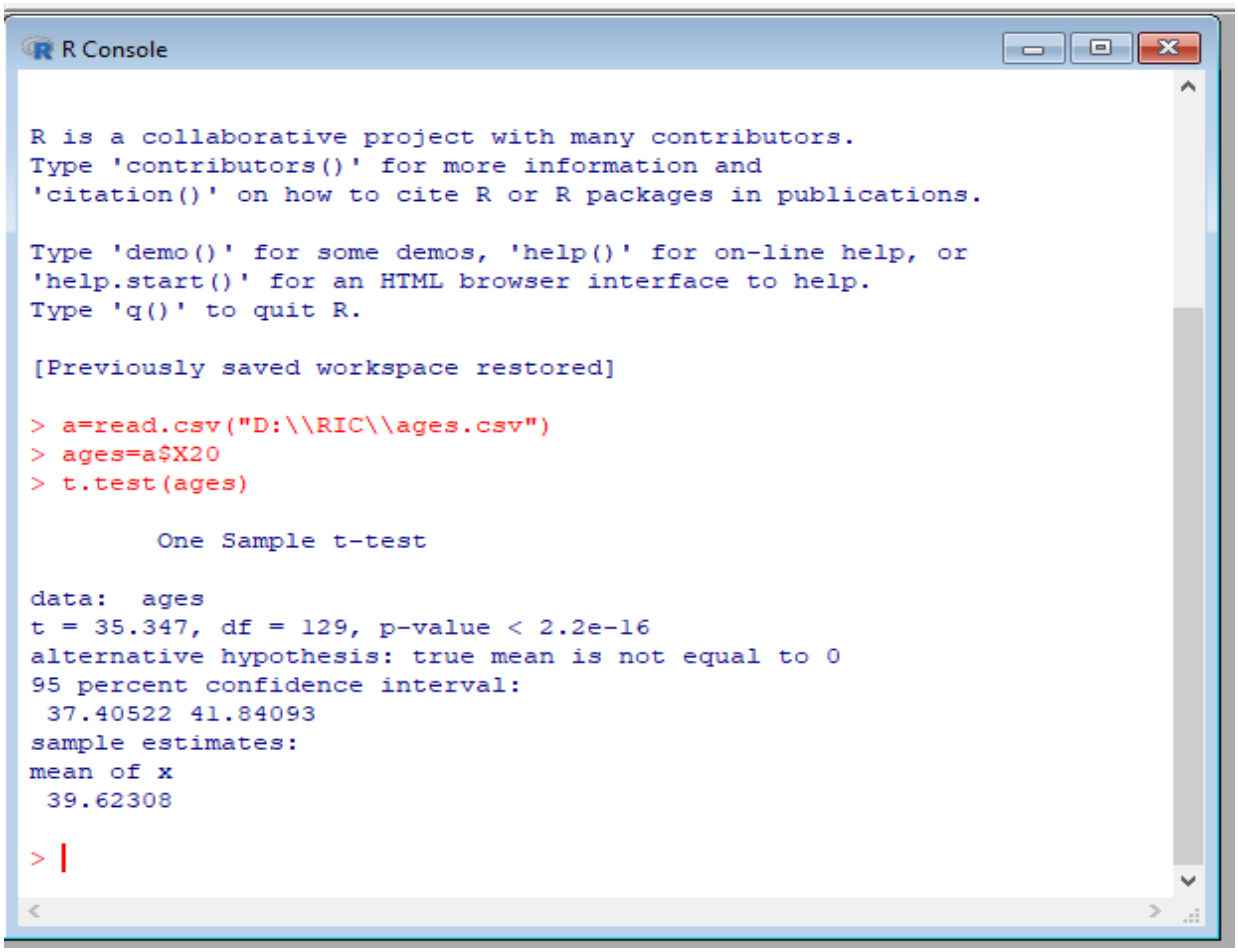


Practical 3:

Aim: 3A. Perform testing of hypothesis using one sample t-test.

One sample t-test: The One Sample T Test determines whether the sample mean is statistically different from a known or hypothesised population mean. The One Sample T Test is a parametric test.

Using R:



Aim: 3B. Write a program for t-test comparing two means for independent samples.

The T distribution provides a good way to perform one sample tests on the mean when the population variance is not known provided the population is normal or the sample is sufficiently large so that the Central Limit Theorem applies.

Two Sample t Test

Example: A college Princiapal informed classroom teachers that some of their students showed unusual potential for intellectual gains. One month's later the students identified to teachers as having potentional for unusual intellectual gains showed significiantly greater gains performance on a test said to measure IQ than did students who were not so identified. Below are the data for the students:

Experimental	Comparison	
35	2	
40	27	
12	38	
15	31	
21	1	
14	19	
46	1	
10	34	
28	3	
48	1	
16	2	
30	3	
32	2	
48	1	
31	2	
22	1	
12	3	
39	29	
19	37	
25	2	
27.15	11.95	Mean
12.51	14.61	Sd

Experimental Data

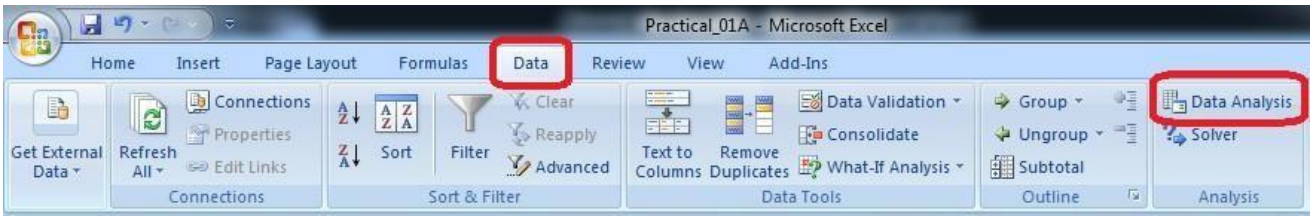
To calculate Standard Mean go to cell A22 and type =SUM(A2:A21)/20

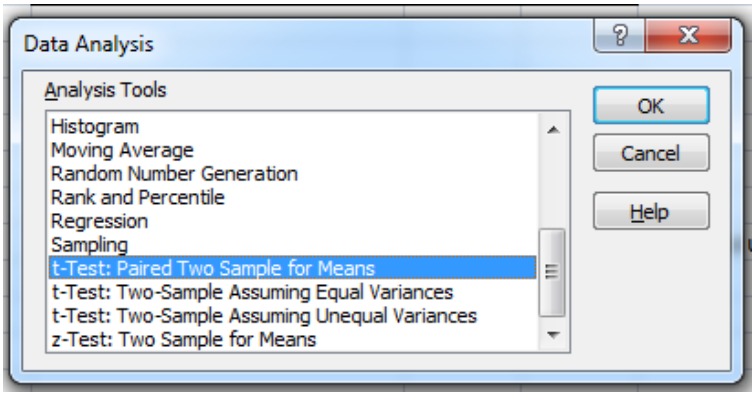
To calculate Standard Deviation go to cell A23 and type =STDEV(A2:A21)

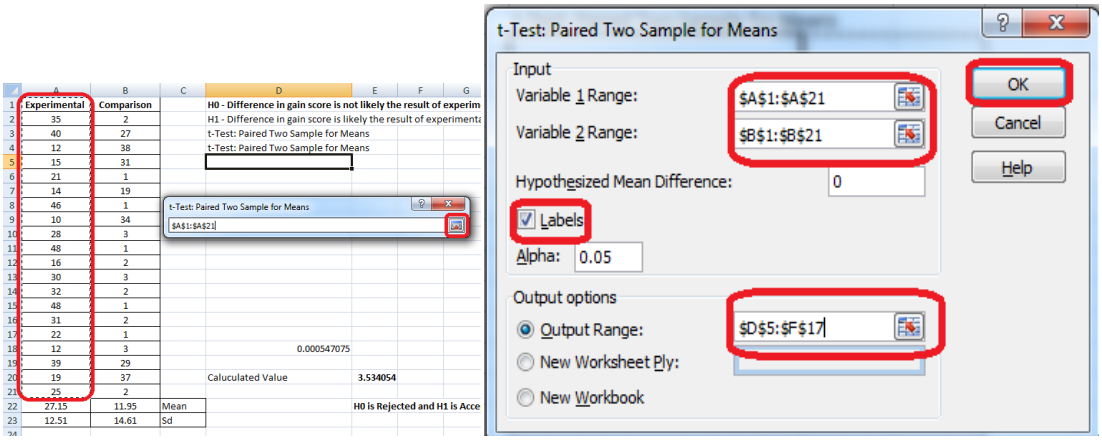
Comparison Data

To calculate Standard Mean go to cell B22 and type =SUM(B2:B21)/20

To calculate Standard Deviation go to cell B23 and type =STDEV(B2:B21) To find T-Test Statistics go to data →Data Analysis







To caluculate the T-Test square value go to cell E20 and type

=(A22-B22)/SQRT((A23*A23)/COUNT(A2:A21)+(B23*B23)/COUNT(A2:A21))

Now go to cell E20 and type

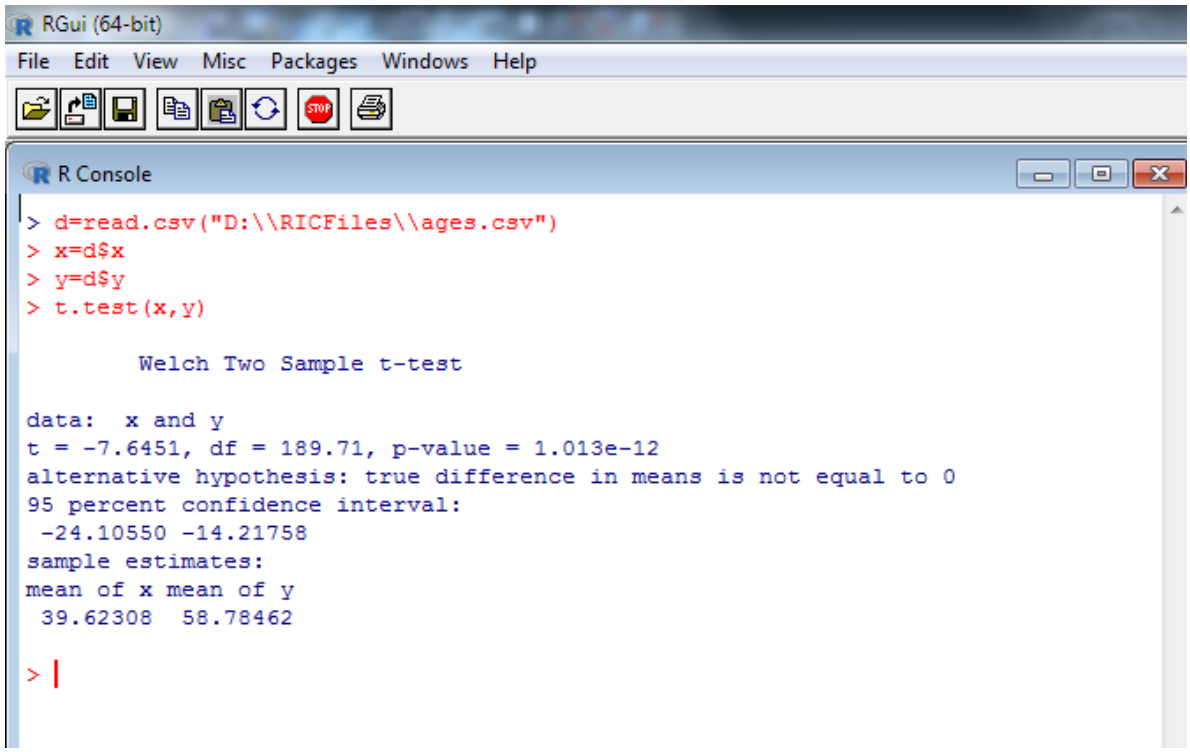
=IF(E20<E12,"H0 is Accepted", "H0 is Rejected and H1 is Accepted")

Our calculated value is larger than the tabled value at alpha = .01, so we reject the null hypothesisand accept the alternative hypothesis, namely, that the difference in gain scores is likely the resultof the experimental treatment and not the result of chance variation.

Output:

	A	B	C	D	E	F	G	H	I	J	K
1	**Experimental**	**Comparison**		**H0 - Difference in gain score is not likely the result of experimental treatment.**							
2	35	2		H1 - Difference in gain score is likely the result of experimental treatment and not the result of change variation.							
3	40	27		t-Test: Paired Two Sample for Means							
4	12	38		t-Test: Paired Two Sample for Means							
5	15	31		t-Test: Paired Two Sample for Means							
6	21	1									
7	14	19			*Experimental*	*Comparison*					
8	46	1		Mean	27.15	11.95					
9	10	34		Variance	156.45	213.5236842					
10	28	3		Observations	20	20					
11	48	1		Pearson Correlation	-0.395904927						
12	16	2		Hypothesized Mean Difference	0						
13	30	3		df	19						
14	32	2		t Stat	2.996289153						
15	48	1		P(T<=t) one-tail	0.003711226						
16	31	2		t Critical one-tail	1.729132792						
17	22	1		P(T<=t) two-tail	0.007422452						
18	12	3		t Critical two-tail	2.09302405						
19	39	29									
20	19	37		Caluculated Value	**3.534053898**						
21	25	2									
22	27.15	11.95	Mean		**H0 is Rejected and H1 is Accepted**						
23	12.51	14.61	Sd								

Using R:



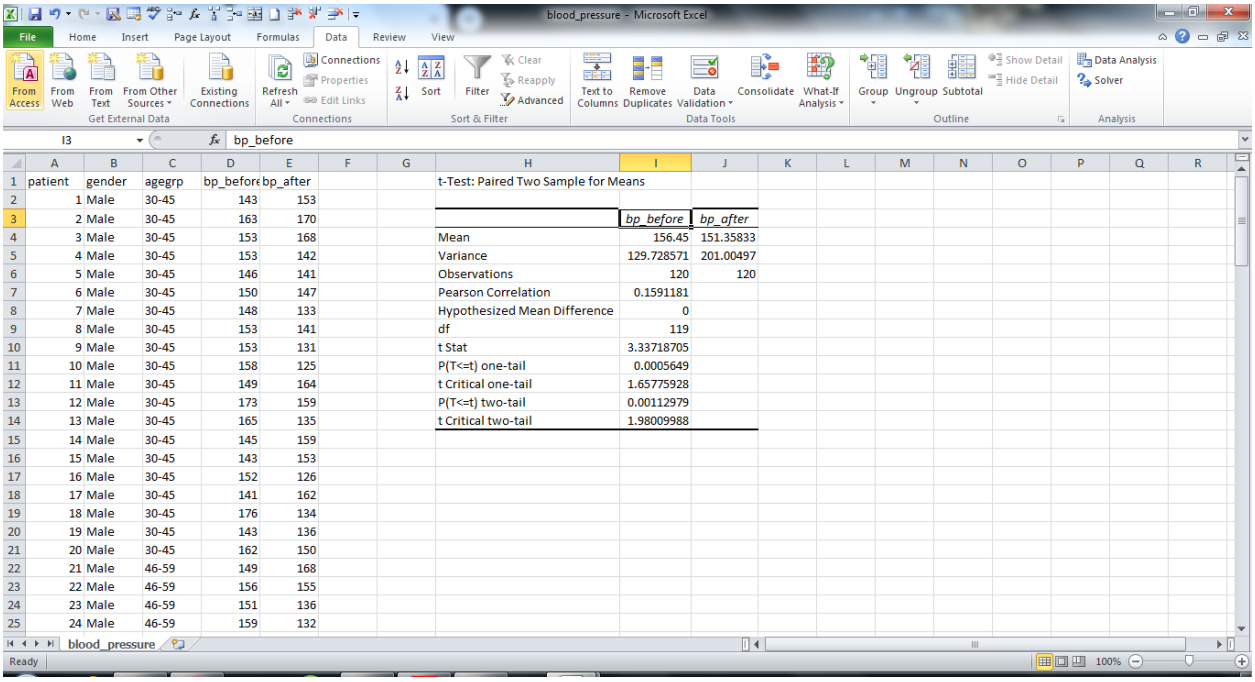
Aim: 3C. Perform testing of hypothesis using paired t-test.

The paired sample t-test is also called dependent sample t-test. It's an univariate test that tests for a significant difference between 2 related variables. An example of this is if you where to collect the blood pressure for an individual before and after some treatment, condition, or time point. The data set contains blood pressure readings before and after an intervention. These are variables "bp_before" and "bp_after".

The hypothesis being test is:

- **H_0** - The mean difference between sample 1 and sample 2 is equal to 0.
- **H_0** - The mean difference between sample 1 and sample 2 is not equal to 0

Output:



patient	gender	agegrp	bp_before	bp_after
1	Male	30-45	143	153
2	Male	30-45	163	170
3	Male	30-45	153	168
4	Male	30-45	153	142
5	Male	30-45	146	141
6	Male	30-45	150	147
7	Male	30-45	148	133
8	Male	30-45	153	141
9	Male	30-45	153	131
10	Male	30-45	158	125
11	Male	30-45	149	164
12	Male	30-45	173	159
13	Male	30-45	165	135
14	Male	30-45	145	159
15	Male	30-45	143	153
16	Male	30-45	152	126
17	Male	30-45	141	162
18	Male	30-45	176	134
19	Male	30-45	143	136
20	Male	30-45	162	150
21	Male	46-59	149	168
22	Male	46-59	156	155
23	Male	46-59	151	136
24	Male	46-59	159	132

t-Test: Paired Two Sample for Means

	bp_before	bp_after
Mean	156.45	151.35833
Variance	129.728571	201.00497
Observations	120	120
Pearson Correlation	0.1591181	
Hypothesized Mean Difference	0	
df	119	
t Stat	3.33718705	
P(T<=t) one-tail	0.0005649	
t Critical one-tail	1.65775928	
P(T<=t) two-tail	0.00112979	
t Critical two-tail	1.98009988	

A paired sample t-test was used to analyze the blood pressure before and after the intervention to test if the intervention had a significant affect on the blood pressure. The blood pressure before the intervention was higher (156.45 ± 11.39 units) compared to the blood pressure post intervention (151.36 ± 14.18 units); there was a statistically significant decrease in blood pressure (t(119)=3.34, p= 0.0011) of 5.09 units.

Practical 4

Aim: 4A. Perform testing of hypothesis using chi-squared goodness-of-fit test.

Problem:

Ansystem administrator needs to upgrade the computers for his division. He wants to know what sort of computer system his workers prefer. He gives three choices: Windows, Mac, or Linux. Test the hypothesis or theory that an equal percentage of the population prefers each type of computer system .

System	O	Ei	$\sum \frac{(O_i - E_i)^2}{Ei}$
Windows	20	33.33%	
Mac	60	33.33%	
Linux	20	33.33%	

H0 : The population distribution of the variable is the same as the proposed distribution

HA : The distributions are different

To calculate the Chi –Squred value for Windows go to cell D2 and type =((B2-C2)*(B2-C2))/C2

To calculate the Chi –Squred value for Mac go to cell D3 and type =((B3-C3)*(B3-C3))/C3

To calculate the Chi –Squred value for Mac go to cell D3 and type =((B4-C4)*(B4-C4))/C4

Go to Cell D5 for $\sum \frac{(O_i - E_i)^2}{Ei}$ and type=SUM(D2:D4)

To get the table value for Chi-Square for α = 0.05 and dof = 2, go to cell D7 and type =CHIINV(0.05,2)

At cell D8 type =IF(D5>D7, "H0 Accepted","H0 Rejected")

Output:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	System	O	Ei	$\sum \frac{(O_i - E_i)^2}{Ei}$										
2	Windows	20	33.33	5.333333		H0 : The population distribution of the variable is the same as the proposed distribution								
3	Mac	60	33.33	21.33333		H1 - : The distributions are different								
4	Linux	20	33.33	5.333333										
5	Total	100	100	32										
6														
7			Table Value	5.991465										
8			H0 Accepted											

Aim: 4B. Perform testing of hypothesis using chi-squared test of independence.

In a study to understatnd the permormacne of M. Sc. IT Part -1 class, a college selects a random sample of 100 students. Each student was asked his grade obtained in B. Sc. IT. The sampleis as given below

Sr. No	Roll No	Student's Name	Gen	Grade
1	1	Gaborone	m	O
2	2	Francistown	m	O
3	5	Niamey	m	O
4	13	Maxixe	m	O
5	16	Tema	m	O
6	17	Kumasi	m	O
7	34	Blida	m	O
8	35	Oran	m	O
9	38	Saefda	m	O
10	42	Constantine	m	O
11	43	Annaba	m	O
12	45	Bejaefa	m	O
13	48	Medea	m	O
14	49	Djelfa	m	O
15	50	Tipaza	m	O
16	51	Bechar	m	O
17	54	Mostaganem	m	O
18	55	Tiaret	m	O
19	56	Bouira	m	O
20	59	Tebessa	m	O
21	61	El Harrach	m	O
22	62	Mila	m	O
23	65	Fouka	m	O
24	66	El Eulma	m	O
25	68	SidiBel Abbes	m	O
26	69	Jijel	m	O
27	70	Guelma	m	O
28	85	Khemis El Khechna	m	O
29	87	Bordj El Kiffan	m	O
30	88	Lakhdaria	m	O
31	6	Maputo	m	D
32	12	Lichinga	m	D
33	15	Ressano Garcia	m	D
34	19	Accra	m	D
35	27	Wa	m	D
36	28	Navrongo	m	D
37	37	Mascara	m	D
38	44	Batna	m	D
39	57	El Biar	m	D
40	60	Boufarik	m	D
41	63	OuedRhiou	m	D
42	64	Souk Ahras	m	D
43	71	Dar El Befda	m	D
44	86	Birtouta	m	D
45	18	Takoradi	m	C
46	22	Cape Coast	m	C
47	29	Kwabeng	m	C
48	30	Algiers	m	C

49	31	Laghouat	m	C
50	39	Relizane	m	C
51	52	Setif	m	C
52	53	Biskra	m	C
53	67	Kolea	m	C
54	100	AefnFakroun	m	C
55	26	Nima	m	B
56	32	TiziOuzou	m	B
57	33	Chlef	m	B
58	89	M'sila	m	A
59	96	Heliopolis	m	A
60	97	Berrouaghia	m	A
61	98	Sougueur	m	A

Null Hypothesis - H0 : The performance of girls students is same as boys students. **Alternate Hypothesis - H1 :** The performance of boys and girls students are different. Open Excel Workbook

	O	**A**	**B**	**C**	**D**	**Total**	$\sum \frac{(O_i - E_i)^2}{Ei}$
Girls	11	7	5	5	11	**39**	6.075
Boys	30	4	3	10	14	**61**	6.075
Total	41	11	8	15	25	**100**	**12.150**
Ei	**20.5**	**5.5**	**4**	**7.5**	**12.5**	**50**	

Prepare a contingency table as shown above. To
calculate Girls Students with ‘O’ Grade
Go to Cell N6 and type =COUNTIF($J$2:$K$40,"O")

To calculate Girls Students with ‘A’ Grade
Go to Cell O6 and type =COUNTIF($J$2:$K$40,"A")

To calculate Girls Students with ‘B’ Grade
Go to Cell P6 and type =COUNTIF($J$2:$K$40,"B")

To calculate Girls Students with ‘C’ Grade
Go to Cell Q6 and type =COUNTIF($J$2:$K$40,"C")

To calculate Girls Students with ‘D’ Grade
Go to Cell R6 and type =COUNTIF($J$2:$K$40,"D")

To calculate Boys Students with ‘O’ Grade
Go to Cell N7 and type =COUNTIF($D$2:$E$62,"O") To
calculate Boys Students with ‘A’ Grade
Go to Cell O7 and type =COUNTIF($D$2:$E$62,"A") To
calculate Boys Students with ‘B’ Grade
Go to Cell P7 and type =COUNTIF($D$2:$E$62,"B") To
calculate Boys Students with ‘C’ Grade
Go to Cell Q7 and type =COUNTIF($D$2:$E$62,"C") To
calculate Boys Students with ‘D’ Grade

Go to Cell R7 and type =COUNTIF($D$2:$E$62,"D")

To calculated the expected value Ei

Go to Cell N9 and type =N8/2 Go to Cell O9 and type =O8/2 Go to Cell P9 and type =P8/2 Go to Cell Q9 and type =Q8/2 Go to Cell R9 and type =R8/2

Go to Cell S6 and calculate total girl students = SUM(N6:R6) Go to Cell S7 and calculate total girl students = SUM(N7:R7)

Now Calculate $\sum \frac{(O_i - E_i)^2}{Ei}$

Go to cell **T6** and type =SUM((N6-$N$9)^2/$N$9,(O6-$O$9)^2/$O$9,(P6-$P$9)^2/$P$9,(Q6-Q$9)^2/$Q$9, (R6-$R$9)^2/$R$9)

Go to cell **T7** and type =SUM((N7-$N$9)^2/$N$9,(O7-$O$9)^2/$O$9,(P7-$P$9)^2/$P$9,(Q7-Q$9)^2/$Q$9, (R7-$R$9)^2/$R$9)

To get the table value go to cell T11 and type **=CHIINV(0.05,4)**

Go to cell O13 and type =IF(T8>=T11," H0 is Accepted", "H0 is Rejected")

M	N	O	P	Q	R	S	T
H0 : Performance of boys and girls are equal							
Frequency Table							$(O_i - E_i)^2$
	O	**A**	**B**	**C**	**D**	**Total**	**Ei**
Girls	11	7	5	5	11	**39**	6.075
Boys	30	4	3	10	14	**61**	6.075
Total	41	11	8	15	25	**100**	**12.150**
Ei	**20.5**	**5.5**	**4**	**7.5**	**12.5**	**50**	
Critcal Value of α =0.05 for df = (2-1) * (5-1)							9.487729
Decesion		**H0 is Accepted**					

Practical 5

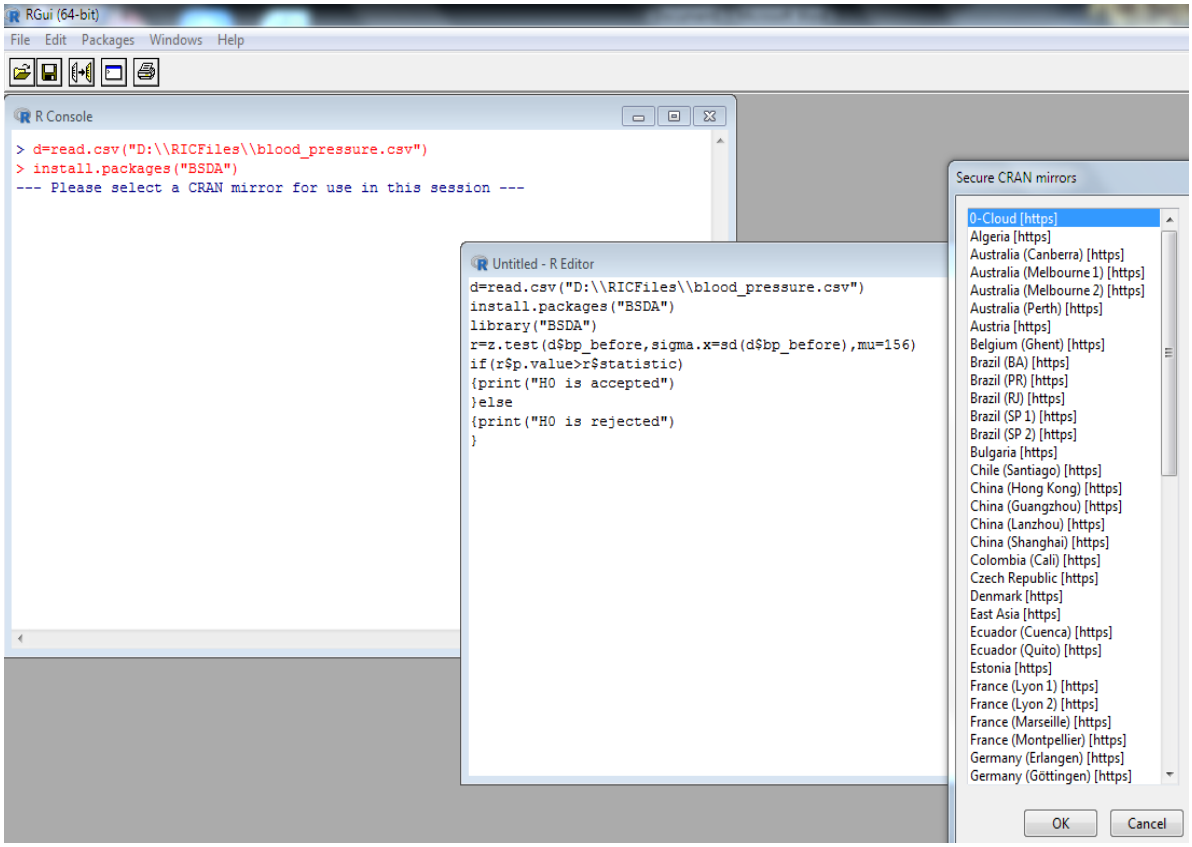
Aim: Perform testing of hypothesis using Z-test.

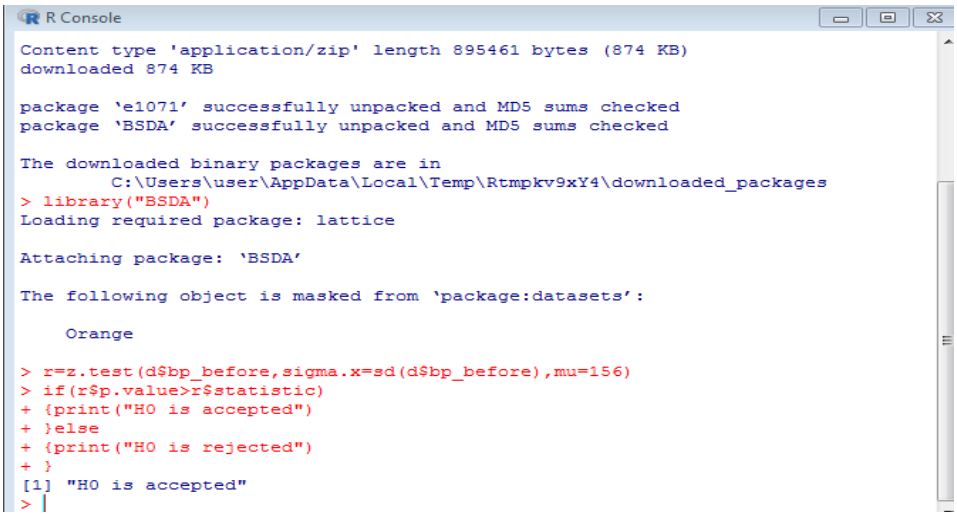
Use a Z test if:

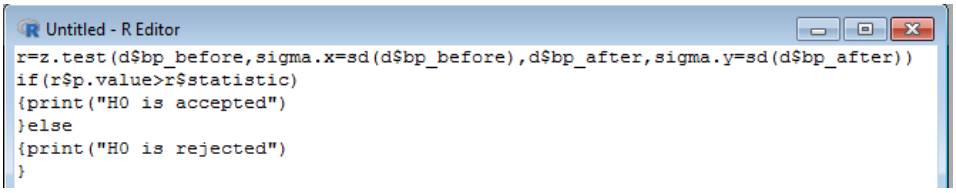
- Your sample size is greater than 30. Otherwise, use a t test.
- Data points should be independent from each other. In other words, one data point isn't related or doesn't affect another data point.
- Your data should be normally distributed. However, for large sample sizes (over 30) this doesn't always matter.
- Your data should be randomly selected from a population, where each item has an equal chance of being selected.
- Sample sizes should be equal if at all possible.

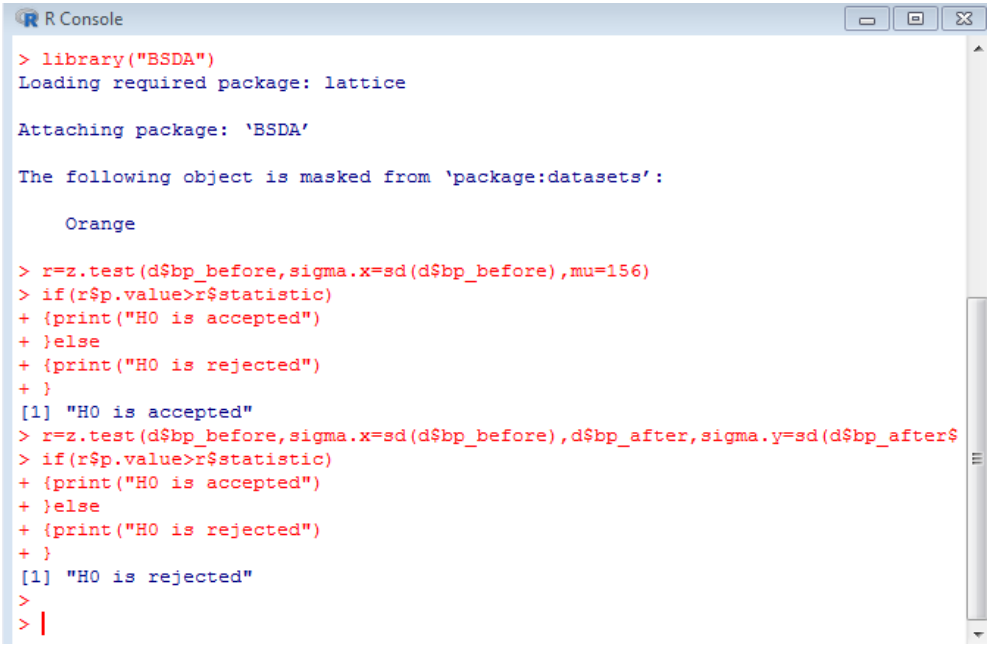
Ho - Blood pressure has a mean of 156 units

```
Untitled - R Editor
d=read.csv("D:\\RICFiles\\blood_pressure.csv")
install.packages("BSDA")
library("BSDA")
r=z.test(d$bp_before,sigma.x=sd(d$bp_before),mu=156)
if(r$p.value>r$statistic)
{print("H0 is accepted")
}else
{print("H0 is rejected")
}
```









Two-sample Z test- In two sample z-test , similar to t-test here we are checking two independent data groups and deciding whether sample mean of two group is equal or not.

H0 : mean of two group is 0

H1 : mean of two group is not 0

Practical 6

Aim: 6A. Perform testing of hypothesis using One-way ANOVA.

ANOVA ASSUMPTIONS

- The dependent variable (SAT scores in our example) should be continuous.
- The independent variables (districts in our example) should be two or more categorical groups.
- There must be different participants in each group with no participant being in more than one group. In our case, each school cannot be in more than one district.
- The dependent variable should be approximately normally distributed for each category.
- Variances of each group are approximately equal.

From our data exploration, we can see that the average SAT scores are quite different for each district. Since we have five different groups, we cannot use the t-test, use the 1-way ANOVA test anyway just to understand the concepts.

H0 - There are no significant differences between the groups' mean SAT scores.

$$\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$$

H1 - There is a significant difference between the groups' mean SAT scores.

If there is at least one group with a significant difference with another group, the null hypothesis will be rejected.

Using Excel:

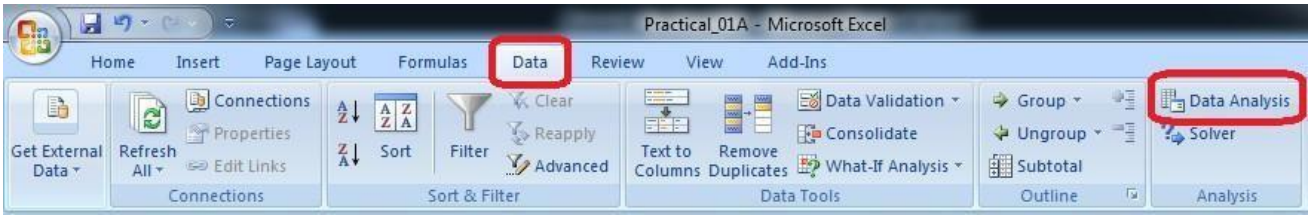
H0 - There are no significant differences between the Subject's mean SAT scores.

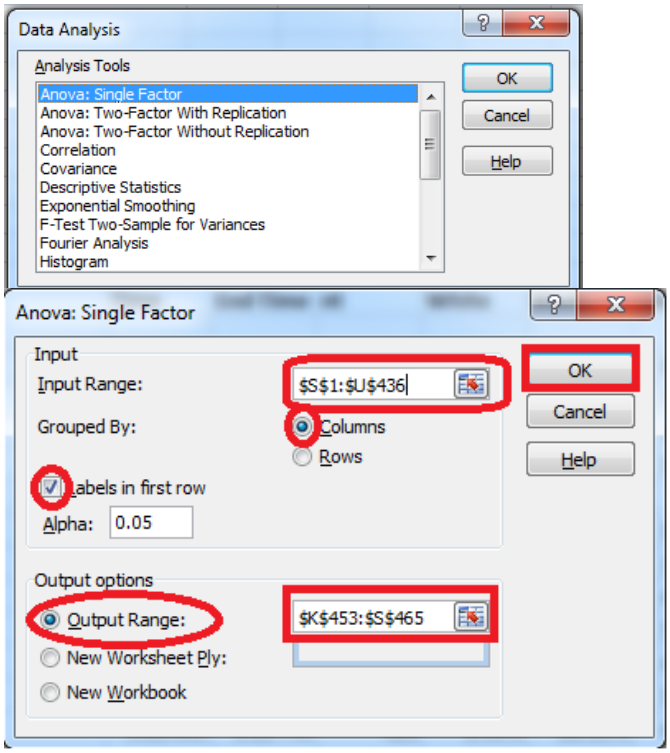
$$\mu_1 = \mu_2 = \mu_3 = \mu_4 = \mu_5$$

H1 - There is a significant difference between the Subject's mean SAT scores.

If there is at least one group with a significant difference with another group, the null hypothesis will be rejected.

To perform ANOVA go to data →Data Analysis





Input Range: $S$1:$U$436*(Select columns to be analyzed in group)*

Output Range: $K$453:$S$465*(Can be any Range)*

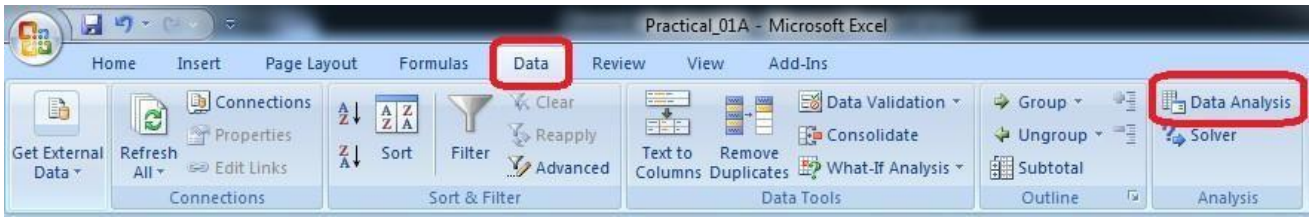
Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
Average Score (SAT Math)	375	162354	432.944	5177.144		
Average Score (SAT Reading)	375	159189	424.504	3829.267		
Average Score (SAT Writing)	375	156922	418.4587	4166.522		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	39700.57	2	19850.28	4.520698	0.01108	3.003745
Within Groups	4926677	1122	4390.977			
Total	4966377	1124				

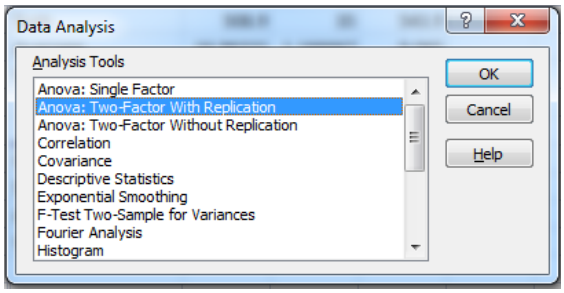
Since the resulting p-value is less than 0.05. The null hypothesis(H0) is rejected and conclude that there is a significant difference between the SAT scores for each subject.

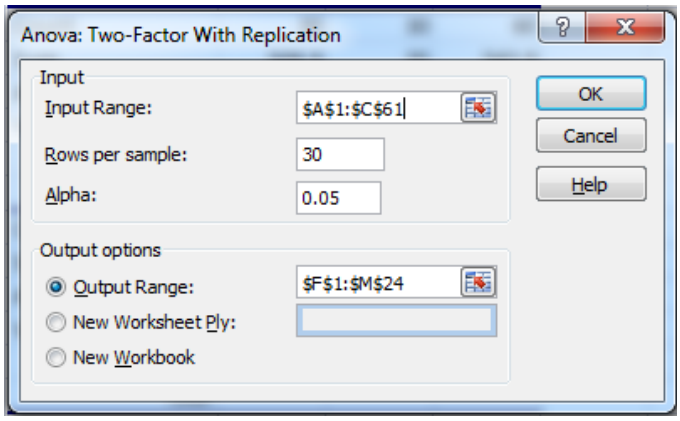
Aim: 6B. Perform testing of hypothesis using Two-way ANOVA.

Using Excel:

Go to Data tab → Data Analysis







Input Range - $A$1:$C$61
Rows Per Sample – 30 (Beacause 30 Patients are given each dose) Alpha – 0.05
Output Range - $F$1:$M$24

Output:

Anova: Two-Factor With Replication						
SUMMARY	len	dose	Total			
1						
Count	30	30	60			
Sum	508.9	35	543.9			
Average	16.96333	1.166667	9.065			
Variance	68.32723	0.402299	97.22333			
31						
Count	30	30	60			
Sum	619.9	35	654.9			
Average	20.66333	1.166667	10.915			
Variance	43.63344	0.402299	118.2854			
Total						
Count	60	60				
Sum	1128.8	70				
Average	18.81333	1.166667				
Variance	58.51202	0.39548				
ANOVA						

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Sample	102.675	1	102.675	3.642079	0.058808	3.922879
Columns	9342.145	1	9342.145	331.3838	8.55E-36	3.922879
Interaction	102.675	1	102.675	3.642079	0.058808	3.922879
Within	3270.193	116	28.19132			
Total	12817.69	119				

P-value = 0.0588079 column in the ANOVA Source of Variation table at the bottom of the output. Because the p-values for both medicin dose and interaction are less than our significance level, these factors are statistically significant. On the other hand, the interaction effect is not significant because its p-value (0.0588) is greater than our significance level. Because the interaction effect is not significant, we can focus on only the main effects and not consider the interaction effect of the dose.

Aim: 6C. Perform testing of hypothesis using MANOVA.

Using Excel:

Go to http://www.real-statistics.com/free-download/

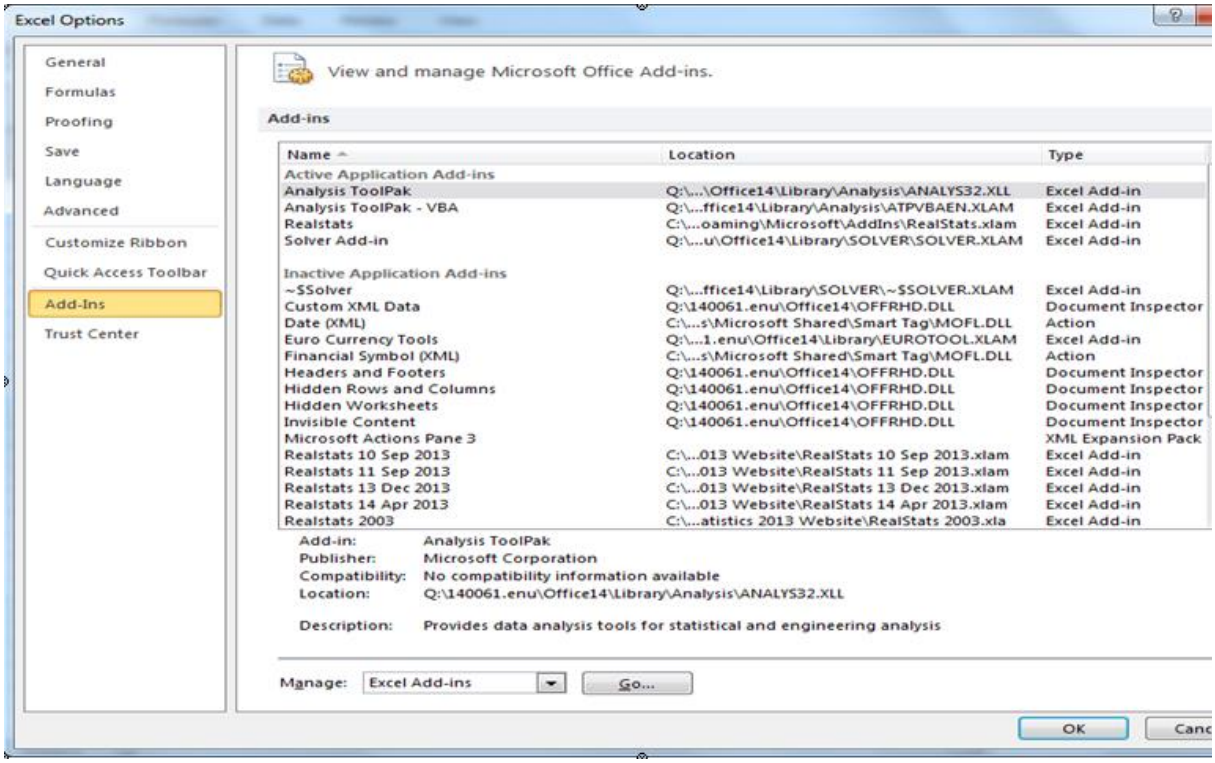
1. Download Real Statistics Resource Pack

Or

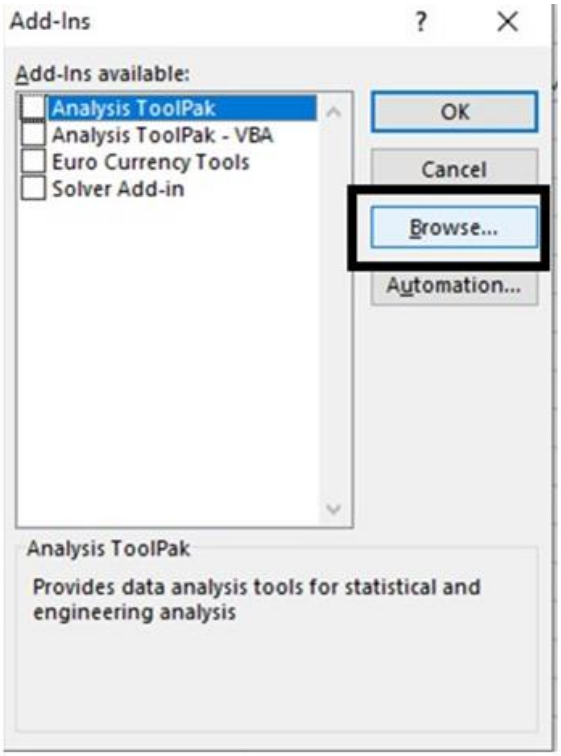
http://www.real-statistics.com/wp-content/uploads/2019/11/XRealStats.xlam

Install Add-in in excel. Select File > Help|Options > Add-Ins and click on the Go button at the bottom of the window (see Figure 1).

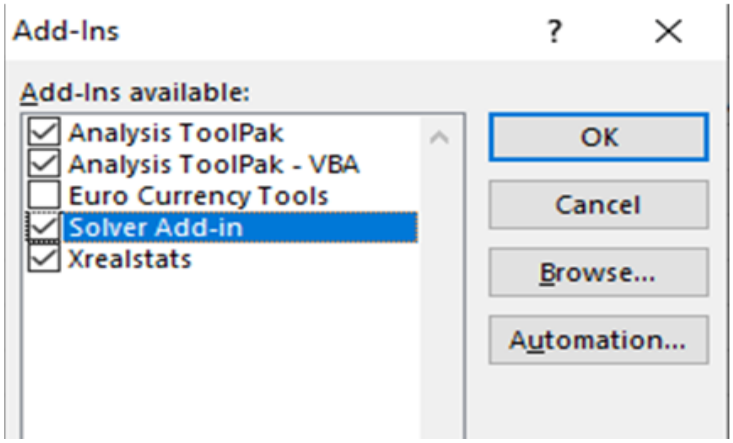
Add-ins -> Analysis Pack -> Go



Click on browse and select XrealStats file (previously downloaded).



.

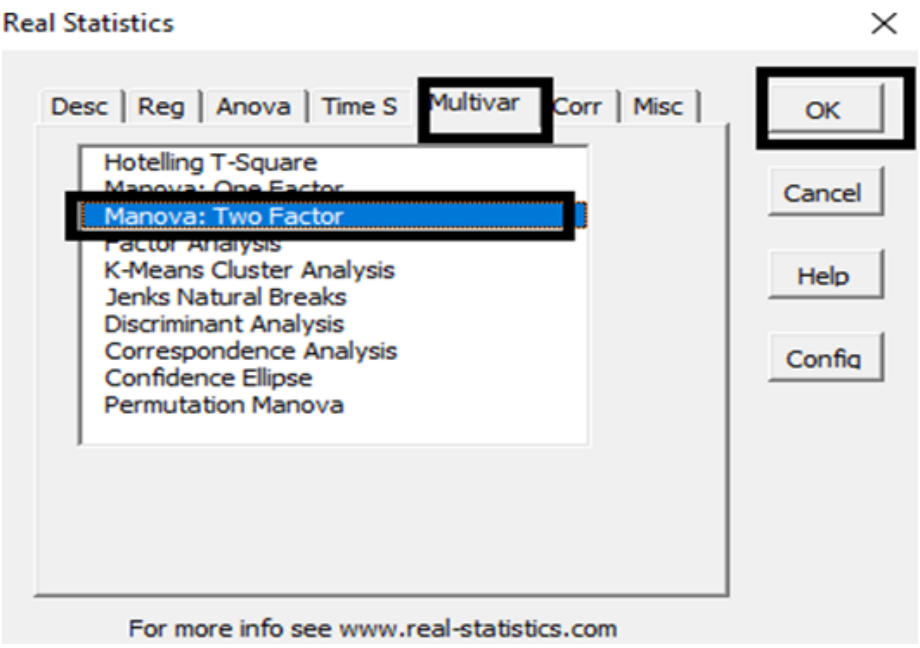


Now create an excel sheet with following data.

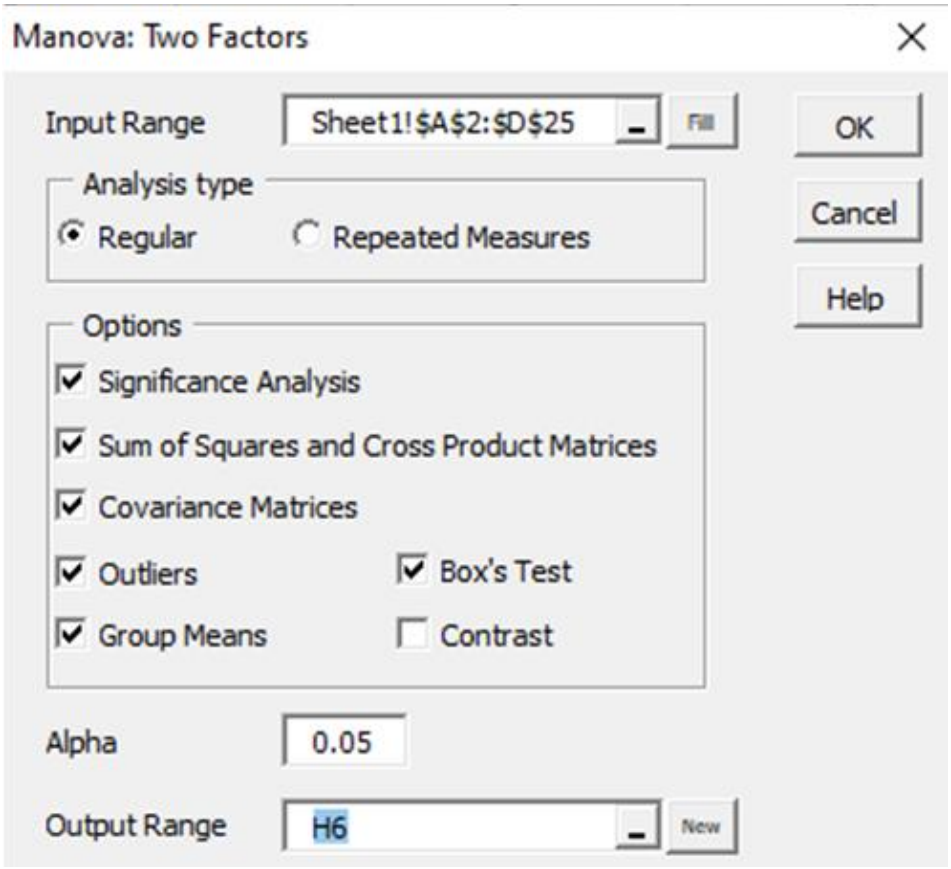
A study was conducted to see the impact of social-economic class (rich, middle, poor) and gender (male, female) on kindness and optimism using on a sample of 24 people based on the data in Figure 1.

	A	B	C	D
3	gender	economic	kindness	optimism
4	male	wealthy	5	3
5	male	wealthy	4	6
6	male	wealthy	3	4
7	male	wealthy	2	4
8	male	middle	4	6
9	male	middle	3	6
10	male	middle	5	4
11	male	middle	5	5
12	male	poor	7	5
13	male	poor	4	3
14	male	poor	3	1
15	male	poor	7	2
16	female	wealthy	2	3
17	female	wealthy	3	5
18	female	wealthy	5	3
19	female	wealthy	4	2
20	female	middle	9	8
21	female	middle	6	5
22	female	middle	7	6
23	female	middle	8	9
24	female	poor	8	9
25	female	poor	9	8
26	female	poor	3	7
27	female	poor	5	7

Press ctrl-m to open Real Statistics menu.



Select the data excluding column names. Select a cell for output.



Output:

Two-Way MANOVA

fact A	*stat*	*df1*	*df2*	*F*	*p-value*	*part eta-sq*
Pillai Trac	0.190764	2	16	1.885866	0.183909	0.190764
Wilk's Lan	0.809236	2	16	1.885866	0.183909	0.190764
Hotelling	0.235733	2	16	1.885866	0.183909	0.190764
Roy's Lg R	0.235733					

fact B	*stat*	*df1*	*df2*	*F*	*p-value*	*part eta-sq*
Pillai Trac	0.340249	4	34	1.742501	0.163458	0.170125
Wilk's Lan	0.8181	4	32	1.778757	0.157443	0.1819
Hotelling	0.479878	4	30	1.799541	0.155008	0.193509
Roy's Lg R	0.448078					

SSCP Matrices

Tot

104.9565	59.86957
59.86957	110.6087

Row (A)

12.5247	15.41502
15.41502	18.97233

Column (B)

31.15295	22.95885
22.95885	19.37655

Practical 7

A. Perform the Random sampling for the given data and analyse it.

Example 1: From a population of 10 women and 10 men as given in the table in Figure 1 on the left below, create a random sample of 6 people for Group 1 and a periodic sample consisting of every 3rd woman for Group 2.

You need to run the sampling data analysis tool twice, once to create Group 1 and again to create Group 2. For Group 1 you select all 20 population cells as the Input Range and Random as the Sampling Method with 6 for the Random Number of Samples. For Group 2 you select the 10 cells in the Women column as Input Range and Periodic with Period 3.

Open existing excel sheet with population data

Sample Sheet looks as given below:

	A	B	C	D	E	F	G	H	I	J	K
1	Sr. No	Roll No	Student's Name	Gender	Grade		Sr. No	Roll No	Student's Name	Gender	Grade
2	1	1	Gaborone	m	O		62	3	Maun	f	O
3	2	2	Francistown	m	O		63	7	Tete	f	O
4	3	5	Niamey	m	O		64	9	Chimoio	f	O
5	4	13	Maxixe	m	O		65	11	Pemba	f	O
6	5	16	Tema	m	O		66	14	Chibuto	f	O
7	6	17	Kumasi	m	O		67	25	Mampong	f	O
8	7	34	Blida	m	O		68	36	Tlemcen	f	O
9	8	35	Oran	m	O		69	40	Adrar	f	O
10	9	38	Saefda	m	O		70	41	Tindouf	f	O
11	10	42	Constantine	m	O		71	46	Skikda	f	O
12	11	43	Annaba	m	O		72	47	Ouargla	f	O
13	12	45	Bejaefa	m	O		73	10	Matola	f	D
14	13	48	Medea	m	O		74	20	Legon	f	D
15	14	49	Djelfa	m	O		75	21	Sunyani	f	D
16	15	50	Tipaza	m	O		76	72	Teenas	f	D
17	16	51	Bechar	m	O		77	73	Kouba	f	D
18	17	54	Mostaganem	m	O		78	75	Hussen Dey	f	D
19	18	55	Tiaret	m	O		79	77	Khenchela	f	D
20	19	56	Bouira	m	O		80	82	Hassi Bahbah	f	D
21	20	59	Tebessa	m	O		81	84	Baraki	f	D
22	21	61	El Harrach	m	O		82	91	Boudouaou	f	D
23	22	62	Mila	m	O		83	95	Tadjenanet	f	D
24	23	65	Fouka	m	O		84	4	Molepolole	f	C

Output:

O	P
Male	Female
A	A
A	A
A	A
B	A
C	B
C	C
D	C
D	C
D	C
D	C
D	D
D	A
D	B
D	B
O	D
O	D

B. Perform the Stratified sampling for the given data and analyse it.

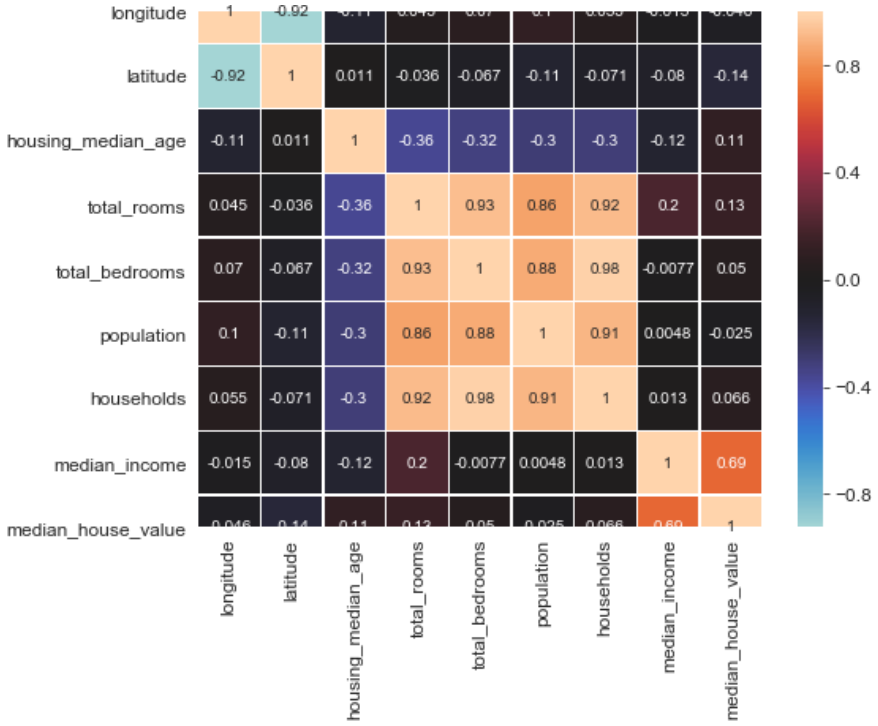
We are to carry out a **hypothetical** housing quality survey across Lagos state, Nigeria. And we looking at a total of 5000 houses (hypothetically). We don't just go to one local government and select 5000 houses, rather we ensure that the 5000 houses are a representative of the whole 20 local government areas Lagos state is comprised of. This is called stratified sampling. The population is divided into homogenous strata and the right number of instances is sampled from each stratum to guarantee that the test-set (which in this case is the 5000 houses) is a representative of the overall population. If we used random sampling, there would be a significant chance of having bias in the survey results.

Program Code:

```
import pandas as pd
importnumpy as np

importmatplotlib
importmatplotlib.pyplot as plt

plt.rcParams['axes.labelsize'] = 14
plt.rcParams['xtick.labelsize'] = 12
plt.rcParams['ytick.labelsize'] = 12

importseaborn as sns
color = sns.color_palette()
sns.set_style('darkgrid')

importsklearn
fromsklearn.model_selection import train_test_split

housing =pd.read_csv('housing.csv')
print(housing.head())
print(housing.info())

 #creating a heatmap of the attributes in the dataset
correlation_matrix = housing.corr()
plt.subplots(figsize=(8,6))
sns.heatmap(correlation_matrix, center=0, annot=True, linewidths=.3)


corr =housing.corr()
print(corr['median_house_value'].sort_values(ascending=False))

sns.distplot(housing.median_income)
plt.show()
```

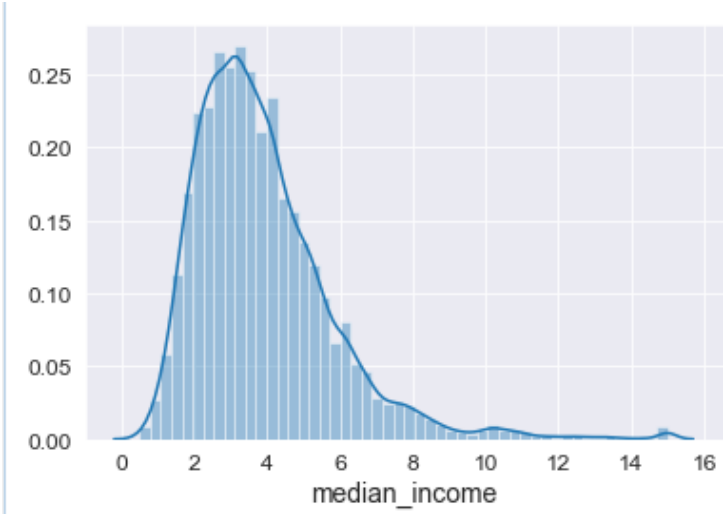
Output:

```
In [28]: runfile('J:/Research In Computing/Practical Material/Programs/Practical_05/
Stratified_Sample.py', wdir='J:/Research In Computing/Practical Material/Programs/Practical_05')
   longitude  latitude  ...  median_house_value  ocean_proximity
0    -122.23     37.88  ...            452600.0         NEAR BAY
1    -122.22     37.86  ...            358500.0         NEAR BAY
2    -122.24     37.85  ...            352100.0         NEAR BAY
3    -122.25     37.85  ...            341300.0         NEAR BAY
4    -122.25     37.85  ...            342200.0         NEAR BAY

[5 rows x 10 columns]
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 20640 entries, 0 to 20639
Data columns (total 10 columns):
longitude             20640 non-null float64
latitude              20640 non-null float64
housing_median_age    20640 non-null float64
total_rooms           20640 non-null float64
total_bedrooms        20433 non-null float64
population            20640 non-null float64
households            20640 non-null float64
median_income         20640 non-null float64
median_house_value    20640 non-null float64
ocean_proximity       20640 non-null object
dtypes: float64(9), object(1)
memory usage: 1.6+ MB
None
median_house_value    1.000000
median_income         0.688075
total_rooms           0.134153
housing_median_age    0.105623
households            0.065843
total_bedrooms        0.049686
population           -0.024650
longitude            -0.045967
latitude             -0.144160
Name: median_house_value, dtype: float64
```



There's a ton of information we can mine from the heatmap above, a couple of strongly positively correlated features and a couple of negatively correlated features. Take a look at the small bright box right in the middle of the heatmap from total_rooms on the left 'y-axis' till

also note that median_income is the most correlated feature to the target which is



median_house_value.

From the image above, we can see that most median incomes are clustered between $20,000 and $50,000 with some outliers going far beyond $60,000 making the distribution skew to the right.

Practical 8

Write a program for computing different correlation.

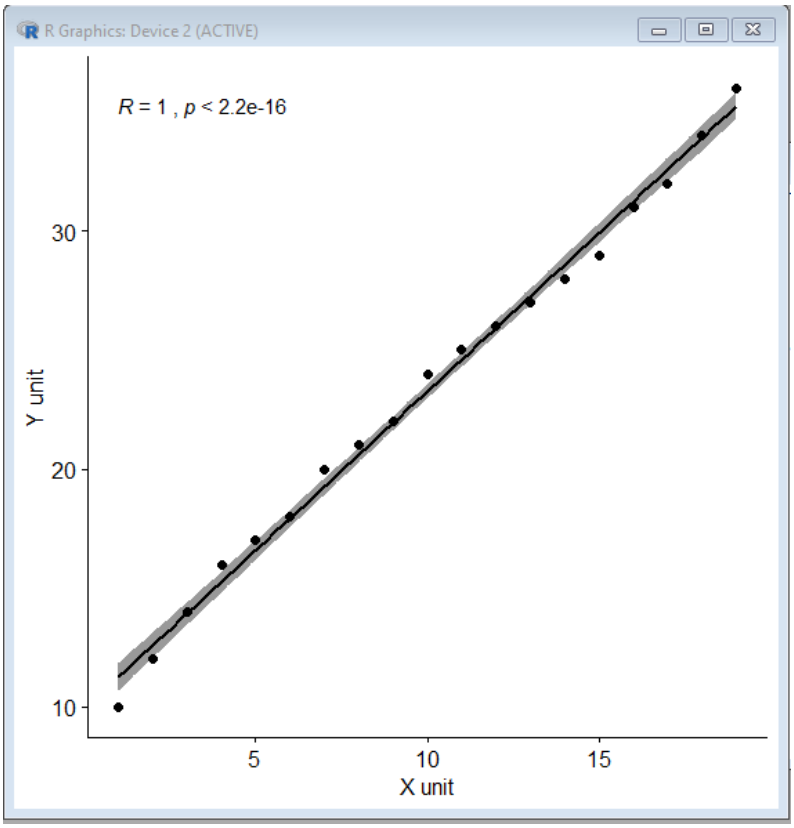
Positive Correlation:

A positive correlation, when the correlation coefficient is greater than 0, signifies that both variables move in the same direction or are correlated. When ρ is +1, it signifies that the two variables being compared have a perfect positive relationship; when one variable moves higher or lower, the other variable moves in the same direction with the same magnitude.

	A	B
1	x	y
2	1	10
3	2	12
4	3	14
5	4	16
6	5	17
7	6	18
8	7	20
9	8	21
10	9	22
11	10	24
12	11	25
13	12	26
14	13	27
15	14	28
16	15	29
17	16	31
18	17	32
19	18	34
20	19	36

```
a=read.csv("D:/Research Paper/jornal/Book.csv")
x=a$x
y=a$y
s=cor(x,y,method="pearson")
install.packages(“ggpubr”)
ggscatter(a, x = "x",y = "y",
          add = "reg.line", conf.int = TRUE,
          cor.coef = TRUE, cor.method = "pearson",
          xlab = "X unit", ylab = "Y unit")
```

Output:



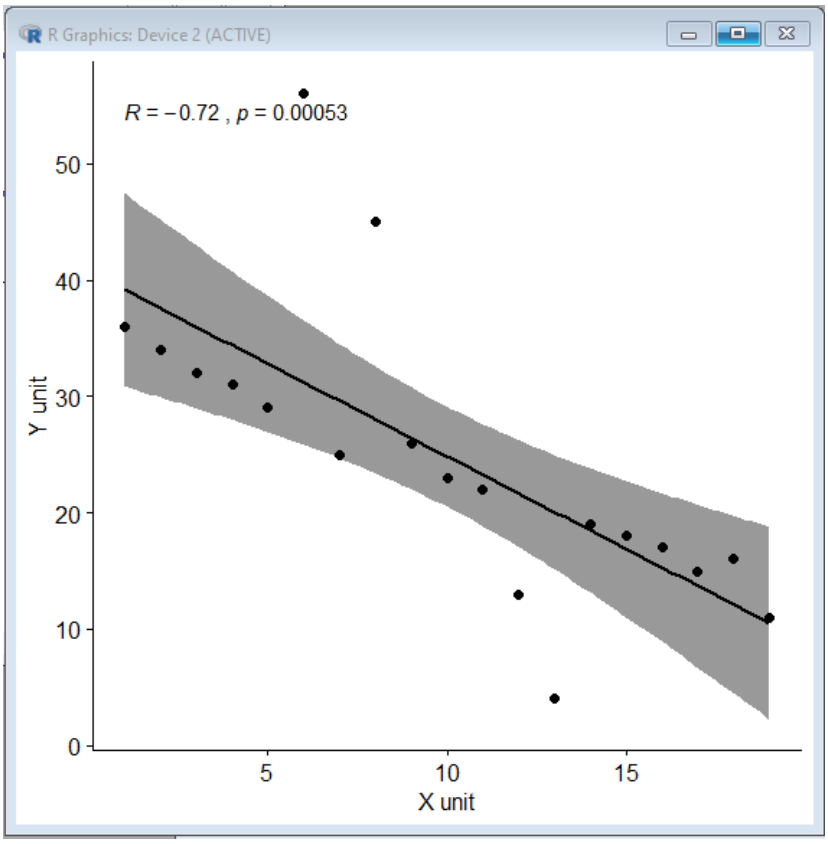
Negative Correlation:

A negative (inverse) correlation occurs when the correlation coefficient is less than 0 and indicates that both variables move in the opposite direction. In short, any reading between 0 and -1 means that the two securities move in opposite directions. When ρ is -1, the relationship is said to be perfectly negative correlated; in short, if one variable increases, the other variable decreases with the same magnitude, and vice versa. However, the degree to which two securities are negatively correlated might vary over time and are almost never exactly correlated, all the time.

	A	B
1	x	y
2	1	36
3	2	34
4	3	32
5	4	31
6	5	29
7	6	56
8	7	25
9	8	45
10	9	26
11	10	23
12	11	22
13	12	13
14	13	4
15	14	19
16	15	18
17	16	17
18	17	15
19	18	16
20	19	11

```
a=read.csv("D:/Research Paper/jornal/Book.csv")
x=a$x
y=a$y
s=cor(x,y,method="pearson")
install.packages(“ggpubr”)
ggscatter(a, x = "x",y = "y",
          add = "reg.line", conf.int = TRUE,
          cor.coef = TRUE, cor.method = "pearson",
          xlab = "X unit", ylab = "Y unit")
```

Output:


R Graphics: Device 2 (ACTIVE)
R = −0.72 , p = 0.00053
Y unit
X unit
0
10
20
30
40
50
5
10
15

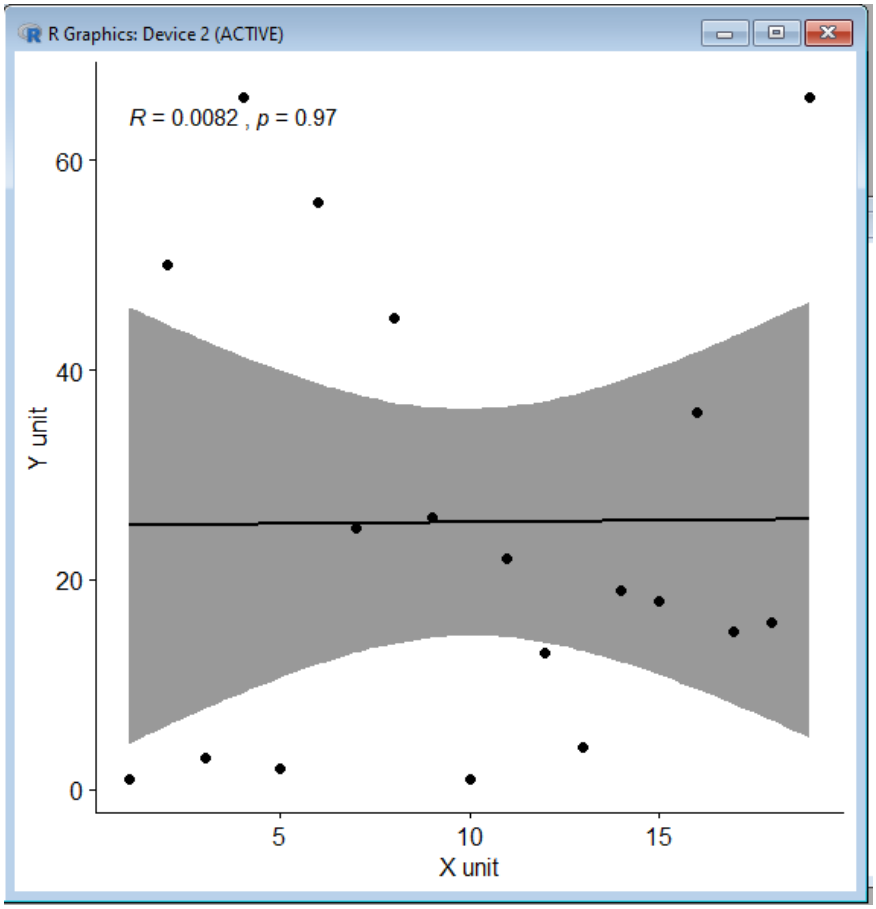
No Correlation:

When there is no clear relationship between the two variables, we say there is no correlation between the two variables.

	A	B
1	x	y
2	1	1
3	2	50
4	3	3
5	4	66
6	5	2
7	6	56
8	7	25
9	8	45
10	9	26
11	10	1
12	11	22
13	12	13
14	13	4
15	14	19
16	15	18
17	16	36
18	17	15
19	18	16
20	19	66

```
a=read.csv("D:/Research Paper/jornal/Book12.csv")
x=a$x
y=a$y
s=cor(x,y,method="pearson")

ggscatter(a, x = "x",y = "y",
          add = "reg.line", conf.int = TRUE,
        cor.coef = TRUE, cor.method = "pearson",
        xlab = "X unit", ylab = "Y unit")
```

Output:


R Graphics: Device 2 (ACTIVE)
R = 0.0082 , p = 0.97
60
40
20
0
Y unit
5
10
15
X unit

Practical 9:

Aim: 9A. Write a program to Perform linear regression for prediction.

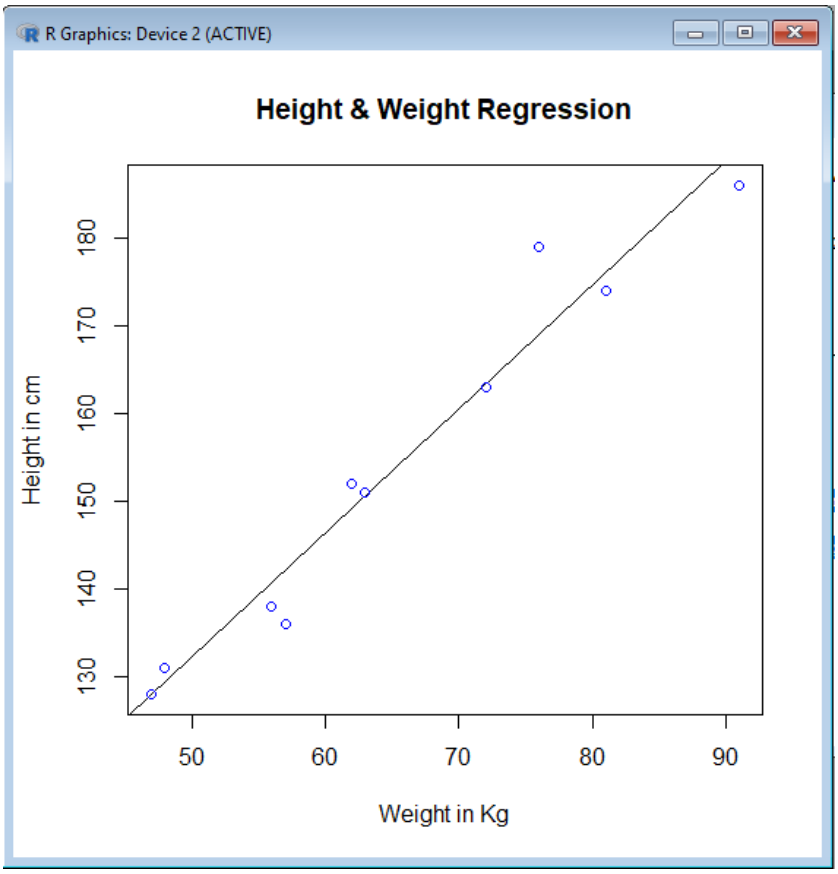
Linear Regression:

Linear regression is used to predict the value of an outcome variable Y based on one or more input predictor variables X. The aim is to establish a linear relationship (a mathematical formula) between the predictor variable(s) and the response variable, so that, we can use this formula to estimate the value of the response Y, when only the predictors (Xs) values are known.

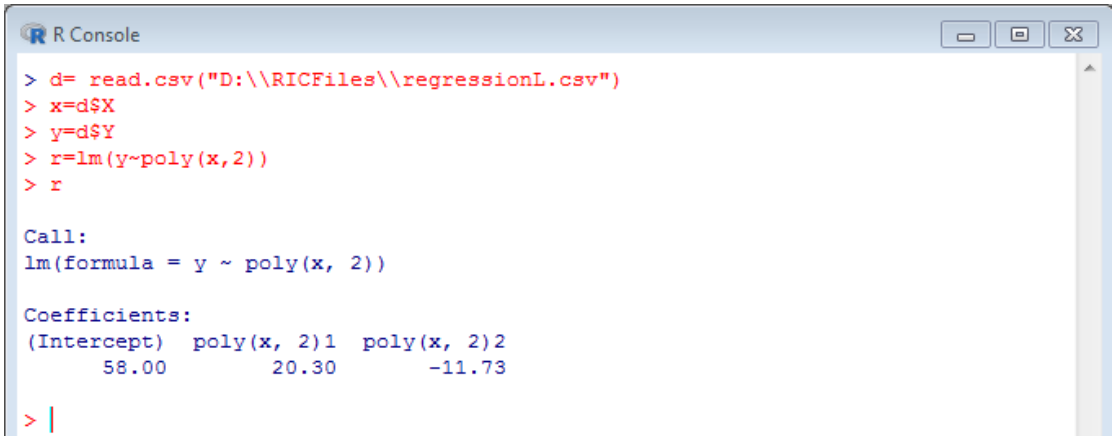
```
# The predictor vector.
x = c(151, 174, 138, 186, 128, 136, 179, 163, 152, 131)

# The resposne vector.
y = c(63, 81, 56, 91, 47, 57, 76, 72, 62, 48)

# Apply the lm() function.
relation = lm(y~x)

# Find weight of a person with height 170.
a = data.frame(x = 170)0
result = predict(relation,a)
print(result)
```

```
> # The predictor vector.
> x = c(151, 174, 138, 186, 128, 136, 179, 163, 152, 131)
>
> # The resposne vector.
> y = c(63, 81, 56, 91, 47, 57, 76, 72, 62, 48)
>
> # Apply the lm() function.
> relation = lm(y~x)
>
> # Find weight of a person with height 170.
> a = data.frame(x = 170)
> result =  predict(relation,a)
> print(result)
       1
76.22869
```

```
plot(y,x,col = "blue",
        main = "Height & Weight Regression",
        abline(lm(x~y)),
        xlab = "Weight in Kg",ylab = "Height in cm")
```



Aim: 9B. Perform polynomial regression for prediction.



Practical 10:

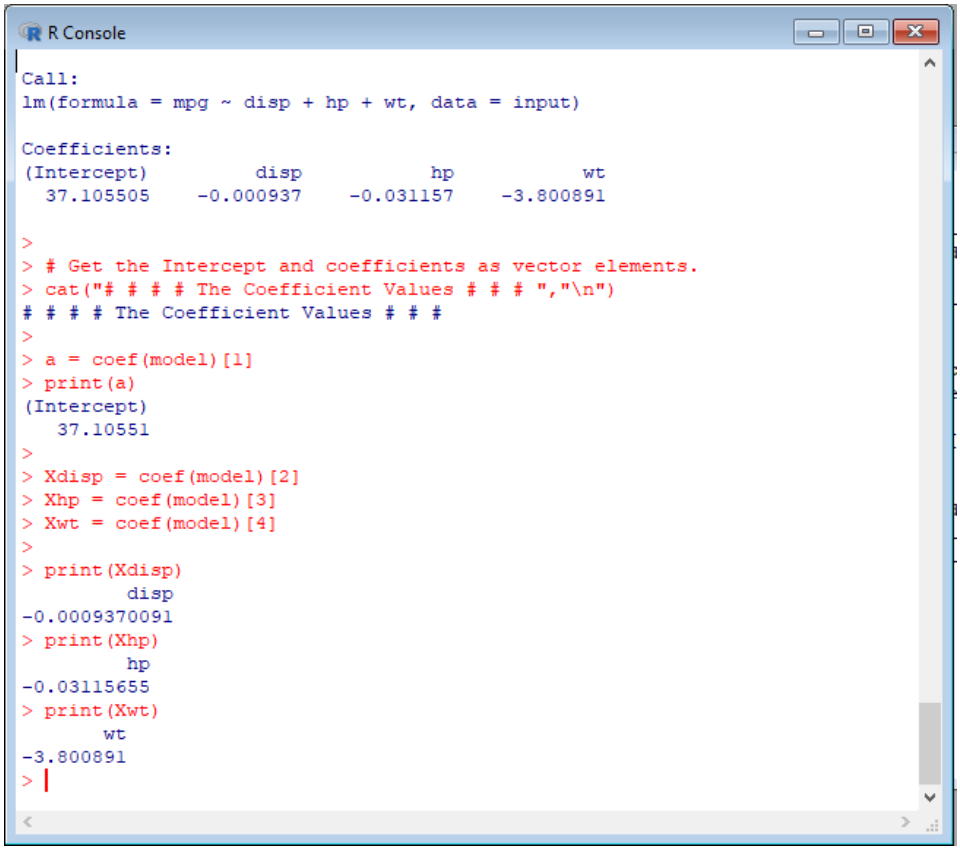
Aim: 10A. Write a program for multiple linear regression analysis.

Multiple Regression:

Multiple regression is an extension of linear regression into relationship between more than two variables. In simple linear relation we have one predictor and one response variable, but in multiple regression we have more than one predictor variable and one response variable.

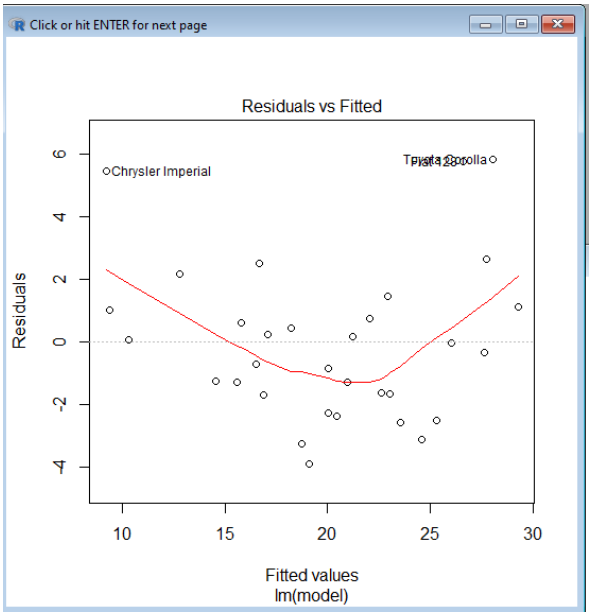
We create the regression model using the lm() function in R. The model determines the value of the coefficients using the input data. Next we can predict the value of the response variable for a given set of predictor variables using these coefficients.

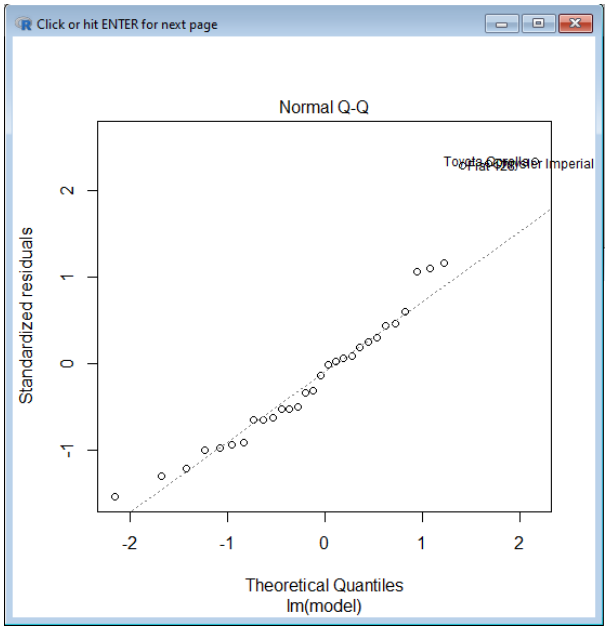
Using R:

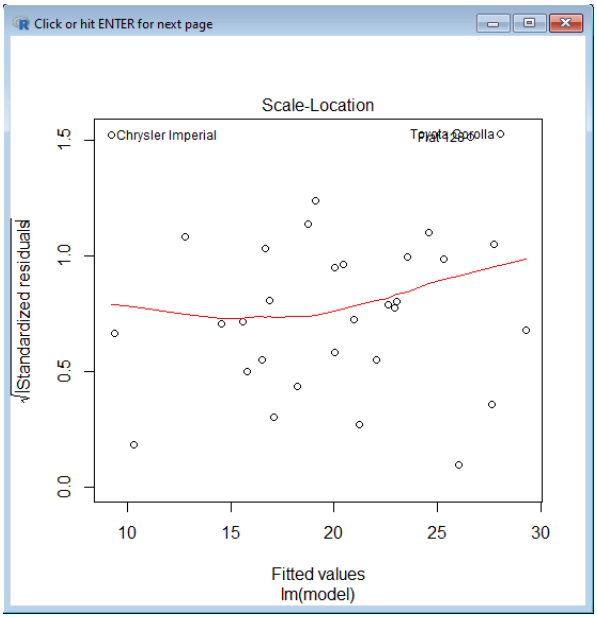


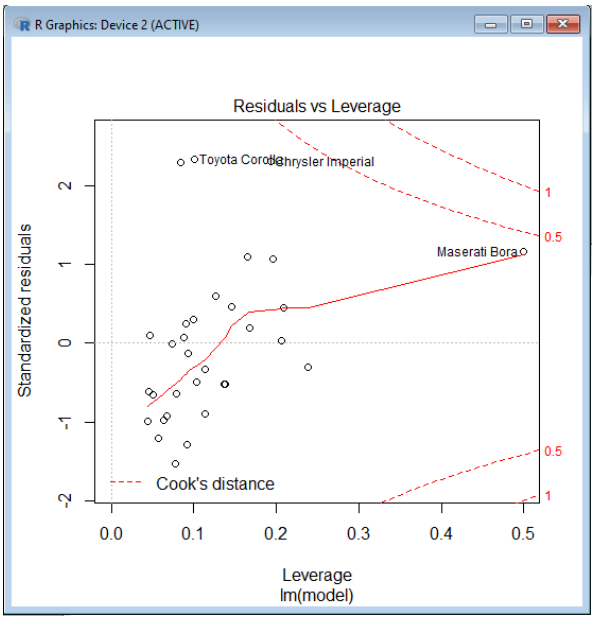

```
input = mtcars[,c("mpg","disp","hp","wt")]
        # Create the relationship model.
model = lm(mpg~disp+hp+wt, data = input)
        # Show the model.
print(model)
        # Get the Intercept and coefficients as vector elements.
cat("# # # # The Coefficient Values # # # ","\n")
```

```
a = coef(model)[1]
print(a)


Xdisp = coef(model)[2]
Xhp = coef(model)[3]
Xwt = coef(model)[4]
print(Xdisp)
print(Xhp)
print(Xwt)
fit=lm(model,input)
plot(fit)
```









Aim: 10B. Perform logistic regression analysis.

Logistic Regression:

It is a classification method built on the same concept as linear regression.
With linear regression, we take linear combination of explanatory variables plus an intercept term to arrive at a prediction.

The Logistic Regression is a regression model in which the response variable (dependent variable) has categorical values such as True/False or 0/1. It actually measures the probability of a binary response as the value of response variable based on the mathematical equation relating it with the predictor variables.

```
input = mtcars[,c("am","cyl","hp","wt")]
data = glm(formula = am ~ cyl + hp + wt, data = input, family = binomial)
print(summary(data))
```

```
Call:
glm(formula = am ~ cyl + hp + wt, family = binomial, data = input)

Deviance Residuals:
     Min        1Q    Median        3Q       Max
-2.17272  -0.14907  -0.01464   0.14116   1.27641

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept) 19.70288    8.11637   2.428   0.0152 *
cyl          0.48760    1.07162   0.455   0.6491
hp           0.03259    0.01886   1.728   0.0840 .
wt          -9.14947    4.15332  -2.203   0.0276 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 43.2297  on 31  degrees of freedom
Residual deviance:  9.8415  on 28  degrees of freedom
AIC: 17.841

Number of Fisher Scoring iterations: 8
```

```
newdata = data.frame(wt = 2.1, hp = 180, cyl = 1)
predict(data , newdata, type="response")
```

```
> newdata = data.frame(wt = 2.1, hp = 180, cyl = 1)
> predict(data , newdata, type="response")
        1
0.9989343
>
```

DATA SCIENCE [PSIT1P2]

S K SOMAIYA COLLEGE OF ARTS, SCIENCE & COMMERCE
"Aurobindo"
Vidyavihar(East) Mumbai 400077

CERTIFICATE

This is to Certify that, Mr./Ms._____
Student of **M.Sc. I.T Part-I (Sem-I)** with seat no _____ and college enrolled roll no _____ has satisfactorily completed the practical in Information Technology Laboratory for the course **(PSIT102) Data Science** in the program of **INFORMATION TECHNOLOGY** from the **UNIVERSITY OF MUMBAI** for the academic year 2019-2020.

(**Subject In-Charge)** **(HOD)**

(Examiners)

_____

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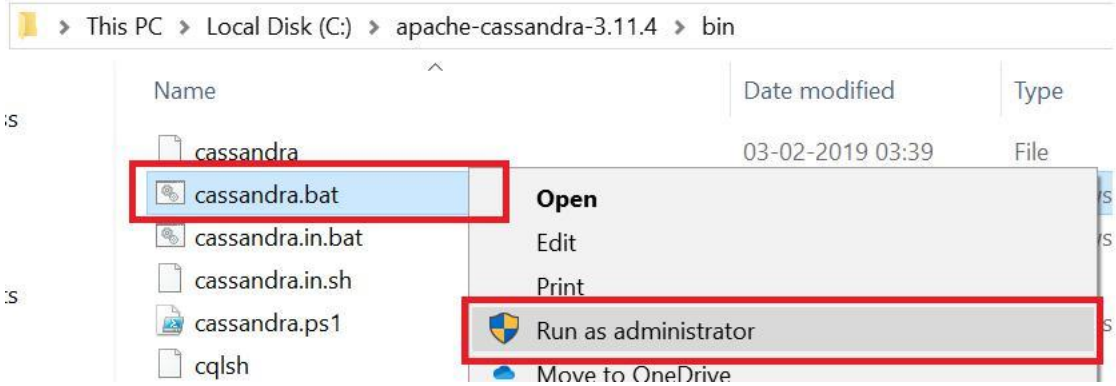
Practical 1:

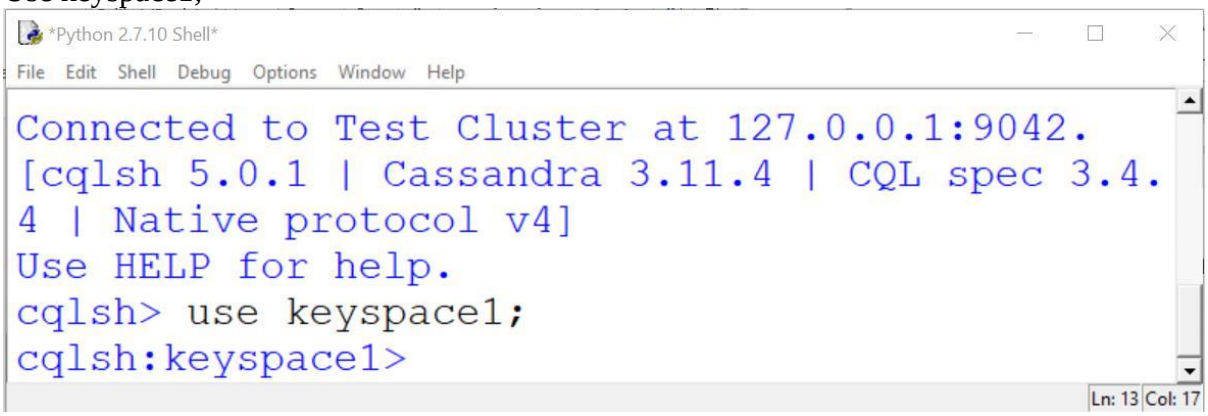
Creating Data Model using Cassandra.

Go to Cassandra directory
C:\apache-cassandra-3.11.4\bin



Run Cassandra.bat file
Open C:\apache-cassandra-3.11.4\bin\cqlsh.py with python 2.7 and run

Creating a Keyspace using Cqlsh
Create keyspace keyspace1 with replication =
{'class':'SimpleStratergy', 'replication_factor': 3};
Use keyspace1;



Create table dept (dept_id int PRIMARY KEY, dept_name text, dept_loc text);
Create table emp (emp_id int PRIMARY KEY, emp_name text, dept_id int, email text, phone text);

Insert into dept (dept_id, dept_name, dept_loc) values (1001, 'Accounts', 'Mumbai');
Insert into dept (dept_id, dept_name, dept_loc) values (1002, 'Marketing', 'Delhi');
Insert into dept (dept_id, dept_name, dept_loc) values (1003, 'HR', 'Chennai');

Insert into emp (emp_id, emp_name, dept_id, email, phone) values (1001, 'ABCD', 1001, 'abcd@company.com', '1122334455');
Insert into emp (emp_id, emp_name, dept_id, email, phone) values (1002, 'DEFG', 1001, 'defg@company.com', '2233445566');
Insert into emp (emp_id, emp_name, dept_id, email, phone) values (1003, 'GHIJ', 1002, 'ghij@company.com', '3344556677');
Insert into emp (emp_id, emp_name, dept_id, email, phone) values (1004, 'JKLM', 1002, 'jklm@company.com', '4455667788');

Insert into emp (emp_id, emp_name, dept_id, email, phone) values (1005, 'MNOP', 1003, 'mnop@company.com', '5566778899');
Insert into emp (emp_id, emp_name, dept_id, email, phone) values (1006, 'MNOP', 1003, 'mnop@company.com', '5566778844');

```
cqlsh:keyspace1> select * from emp;

 emp_id | dept_id | email              | emp_name | phone
--------+---------+--------------------+----------+------------
   1006 |    1003 | mnop@company.com |     MNOP | 5566778844
   1004 |    1002 | jklm@company.com |     JKLM | 4455667788
   1005 |    1003 | mnop@company.com |     MNOP | 5566778899
   1001 |    1001 | abcd@company.com |     ABCD | 1122334455
   1003 |    1002 | ghij@company.com |     GHIJ | 3344556677
   1002 |    1001 | defg@company.com |     DEFG | 2233445566

(6 rows)
```

```
cqlsh:keyspace1> select * from dept;

 dept_id | dept_loc | dept_name
---------+----------+-----------
    1001 |   Mumbai |  Accounts
    1003 |  Chennai |        HR
    1002 |    Delhi | Marketing

(3 rows)
```

update dept set dept_name='Human Resource' where dept_id=1003;

```
cqlsh:keyspace1> select * from dept;

 dept_id | dept_loc | dept_name
---------+----------+----------------
    1001 |   Mumbai |       Accounts
    1003 |  Chennai | Human Resource
    1002 |    Delhi |      Marketing

(3 rows)
```

```
cqlsh:keyspace1> delete from emp where emp_id=1006;
cqlsh:keyspace1> select * from emp;

 emp_id | dept_id | email              | emp_name | phone
--------+---------+--------------------+----------+------------
   1004 |    1002 | jklm@company.com |     JKLM | 4455667788
   1005 |    1003 | mnop@company.com |     MNOP | 5566778899
   1001 |    1001 | abcd@company.com |     ABCD | 1122334455
   1003 |    1002 | ghij@company.com |     GHIJ | 3344556677
   1002 |    1001 | defg@company.com |     DEFG | 2233445566

(5 rows)
```

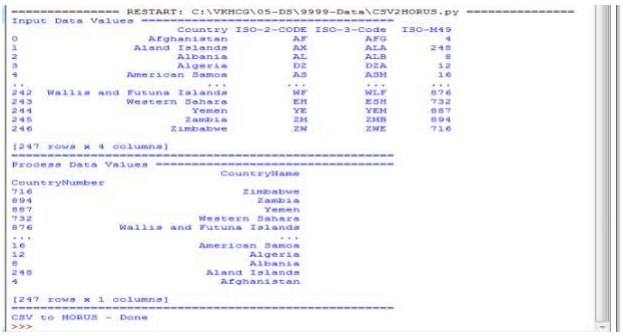
Practical 2:

Write Python / R Program to convert from the following formats to HORUS format:

A. Text delimited CSVto HORUS format. Code:

```
# Utility Start CSV to HORUS ================================
# Standard Tools
import pandas as pd
# Input Agreement ===========================================
sInputFileName='C:/VKHCG/05-DS/9999-Data/Country_Code.csv'
InputData=pd.read_csv(sInputFileName,encoding="latin-1") print('Input
Data Values ===================================')
print(InputData)
print('=================================================')
# Processing Rules ==========================================
ProcessData=InputData
# Remove columns ISO-2-Code and ISO-3-CODE


# Rename Country and ISO-M49 ProcessData.rename(columns={'Country':
'CountryName'}, inplace=True) ProcessData.rename(columns={'ISO-M49':
'CountryNumber'}, inplace=True)
# Set new Index
ProcessData.set_index('CountryNumber', inplace=True)
# Sort data by CurrencyNumber
ProcessData.sort_values('CountryName', axis=0, ascending=False, inplace=True)
print('Process Data Values ===================================')
print(ProcessData)
print('=================================================')
# Output Agreement ==========================================
OutputData=ProcessData sOutputFileName='C:/VKHCG/05-DS/9999-
Data/HORUS-CSV-Country.csv' OutputData.to_csv(sOutputFileName, index
= False)
print('CSV to HORUS - Done')
# Utility done ==============================================
```

Output:



B. XML to HORUS Format

Code:

```
# Utility Start XML to HORUS ================================
# Standard Tools
import pandas as pd
import xml.etree.ElementTree as ET
def df2xml(data):
    header = data.columns
    root = ET.Element('root')
    for row in range(data.shape[0]):
        entry = ET.SubElement(root,'entry')
        for index in range(data.shape[1]):
            schild=str(header[index])
            child = ET.SubElement(entry, schild)
            if str(data[schild][row]) != 'nan':
                child.text = str(data[schild][row])
            else:
                child.text = 'n/a'
            entry.append(child)
    result = ET.tostring(root)
    return result
def xml2df(xml_data):
    root = ET.XML(xml_data)
    all_records = []
    for i, child in enumerate(root):
        record = {}
        for subchild in child:
            record[subchild.tag] = subchild.text
        all_records.append(record)
    return pd.DataFrame(all_records)

sInputFileName='C:/VKHCG/05-DS/9999-Data/Country_Code.xml'

InputData = open(sInputFileName).read()
print('================================================')
print('Input Data Values ==============================')
print('================================================')
print(InputData)
print('================================================')
#================================================================
=
# Processing Rules ========================================
#================================================================
=
ProcessDataXML=InputData
# XML to Data Frame

# Remove columns ISO-2-Code and ISO-3-CODE
ProcessData.drop('ISO-2-CODE', axis=1,inplace=True)
ProcessData.drop('ISO-3-Code', axis=1,inplace=True)
# Rename Country and ISO-M49
```

```
ProcessData.rename(columns={'Country': 'CountryName'}, inplace=True)
ProcessData.rename(columns={'ISO-M49': 'CountryNumber'}, inplace=True)
# Set new Index
ProcessData.set_index('CountryNumber', inplace=True)
# Sort data by CurrencyNumber
ProcessData.sort_values('CountryName', axis=0, ascending=False, inplace=True)
print('====================================================')
print('Process Data Values ================================')
print('====================================================')
print(ProcessData)
print('====================================================')
OutputData=ProcessData
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-XML-Country.csv'
OutputData.to_csv(sOutputFileName, index = False)
print('====================================================')
print('XML to HORUS - Done')
print('====================================================')
# Utility done ===================================================
```

Output:

```
=============== RESTART: C:\VKHCG\05-DS\9999-Data\XML2HORUS.py ===============
====================================================
Input Data Values ==================================
====================================================
Squeezed text (385 lines).
====================================================
====================================================
Process Data Values ================================
====================================================
                             CountryName
CountryNumber
716                             Zimbabwe
894                               Zambia
887                                Yemen
732                       Western Sahara
876           Wallis and Futuna Islands
...                                 ...
16                        American Samoa
12                               Algeria
8                                Albania
248                       Aland Islands
4                           Afghanistan

[247 rows x 1 columns]
====================================================
====================================================
XML to HORUS - Done
====================================================
>>>
```

C. JSON to HORUS Format

Code:

```
# Utility Start JSON to HORUS ====================================
# Standard Tools
#============================================================
=
import pandas as pd
# Input Agreement ============================================
sInputFileName='C:/VKHCG/05-DS/9999-Data/Country_Code.json'
InputData=pd.read_json(sInputFileName, orient='index', encoding="latin-1")
print('Input Data Values ==================================')
print(InputData)
```

```
print('====================================================')
# Processing Rules ==========================================
ProcessData=InputData
# Remove columns ISO-2-Code and ISO-3-CODE


# Rename Country and ISO-M49 ProcessData.rename(columns={'Country':
'CountryName'}, inplace=True) ProcessData.rename(columns={'ISO-M49':
'CountryNumber'}, inplace=True)
# Set new Index
ProcessData.set_index('CountryNumber', inplace=True)
# Sort data by CurrencyNumber
ProcessData.sort_values('CountryName', axis=0, ascending=False, inplace=True)
print('Process Data Values ================================')
print(ProcessData)
print('====================================================')
# Output Agreement ==========================================
OutputData=ProcessData sOutputFileName='c:/VKHCG/05-DS/9999-
Data/HORUS-JSON-Country.csv' OutputData.to_csv(sOutputFileName,
index = False)
print('JSON to HORUS - Done')
# Utility done ==============================================
```

Output:

```
>>>
============== RESTART: C:\VKHCG\05-DS\9999-Data\JSON2HORUS.py ==============
Input Data Values ===================================
                          Country ISO-2-CODE ISO-3-Code  ISO-M49
0                     Afghanistan         AF         AFG        4
1                   Aland Islands         AX         ALA      248
10                      Argentina         AR         ARG       32
100                       Hungary         HU         HUN      348
101                       Iceland         IS         ISL      352
..                            ...        ...         ...      ...
95                         Guyana         GY         GUY      328
96                          Haiti         HT         HTI      332
97      Heard and Mcdonald Islands         HM         HMD      334
98   Holy Seeÿ(Vatican City State)         VA         VAT      336
99                       Honduras         HN         HND      340

[247 rows x 4 columns]
====================================================
Process Data Values ================================
                            CountryName
CountryNumber
716                            Zimbabwe
894                              Zambia
887                               Yemen
732                      Western Sahara
876           Wallis and Futuna Islands
...                                 ...
16                      American Samoa
12                             Algeria
8                              Albania
248                      Aland Islands
4                          Afghanistan

[247 rows x 1 columns]
====================================================
JSON to HORUS - Done
>>>
```

D. MySql Database to HORUS Format

Code:

```
# Utility Start Database to HORUS ===================================
# Standard Tools
#============================================================
=
import pandas as pd
import sqlite3 as sq
# Input Agreement ===========================================
```

```
sInputFileName='C:/VKHCG/05-DS/9999-Data/utility.db'
sInputTable='Country_Code'
conn = sq.connect(sInputFileName)
sSQL='select * FROM ' + sInputTable + ';'
InputData=pd.read_sql_query(sSQL, conn)
print('Input Data Values ===================================')
print(InputData)
print('=====================================================')
# Processing Rules ============================================
ProcessData=InputData
# Remove columns ISO-2-Code and ISO-3-CODE


# Rename Country and ISO-M49 ProcessData.rename(columns={'Country':
'CountryName'}, inplace=True) ProcessData.rename(columns={'ISO-M49':
'CountryNumber'}, inplace=True)
# Set new Index
ProcessData.set_index('CountryNumber', inplace=True)
# Sort data by CurrencyNumber
ProcessData.sort_values('CountryName', axis=0, ascending=False, inplace=True)
print('Process Data Values ================================')
print(ProcessData)
print('=====================================================')
# Output Agreement ============================================
OutputData=ProcessData sOutputFileName='C:/VKHCG/05-DS/9999-
Data/HORUS-CSV-Country.csv' OutputData.to_csv(sOutputFileName, index
= False)
print('Database to HORUS - Done')
# Utility done ================================================
```

Output:

```
>>>
========== RESTART: C:\VKHCG\05-DS\9999-Data\DATABASE2HORUS.py ==========
Input Data Values ===================================
     index                    Country ISO-2-CODE ISO-3-Code  ISO-M49
0        0                Afghanistan         AF        AFG        4
1        1              Aland Islands         AX        ALA      248
2        2                    Albania         AL        ALB        8
3        3                    Algeria         DZ        DZA       12
4        4             American Samoa         AS        ASM       16
..     ...                        ...        ...        ...      ...
242    242  Wallis and Futuna Islands         WF        WLF      876
243    243             Western Sahara         EH        ESH      732
244    244                      Yemen         YE        YEM      887
245    245                     Zambia         ZM        ZMB      894
246    246                   Zimbabwe         ZW        ZWE      716

[247 rows x 5 columns]
=====================================================
Process Data Values ================================
                index                CountryName
CountryNumber
716               246                   Zimbabwe
894               245                     Zambia
887               244                      Yemen
732               243             Western Sahara
876               242  Wallis and Futuna Islands
```

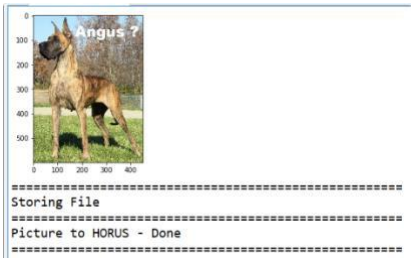
E. Picture (JPEG) to HORUS

Format Code:

```
# Utility Start Picture to HORUS ==================================
# Standard Tools
#=============================================================
=
from scipy.misc import imread
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
# Input Agreement ============================================
```

```
sInputFileName='C:/VKHCG/05-DS/9999-Data/Angus.jpg' InputData
= imread(sInputFileName, flatten=False, mode='RGBA')

print('Input Data Values ===================================')
print('X: ',InputData.shape[0])
print('Y: ',InputData.shape[1])
print('RGBA: ', InputData.shape[2])
print('=====================================================')
# Processing Rules ============================================
ProcessRawData=InputData.flatten() y=InputData.shape[2] + 2
x=int(ProcessRawData.shape[0]/y)
ProcessData=pd.DataFrame(np.reshape(ProcessRawData, (x,
y))) sColumns= ['XAxis','YAxis','Red', 'Green', 'Blue','Alpha']
ProcessData.columns=sColumns ProcessData.index.names
=['ID']

print('Rows: ',ProcessData.shape[0]) print('Columns :',ProcessData.shape[1])
print('=====================================================')
print('Process Data Values ================================')
print('=====================================================')
plt.imshow(InputData)
plt.show()
print('=====================================================')
# Output Agreement ============================================
OutputData=ProcessData print('Storing File') sOutputFileName='C:/VKHCG/05-
DS/9999-Data/HORUS-Picture.csv' OutputData.to_csv(sOutputFileName, index =
False)
print('=====================================================')
print('Picture to HORUS - Done')
print('=====================================================')
```

Output:



F. Video to HORUS

Format Code:

Movie to Frames

```
# Utility Start Movie to HORUS (Part 1) ======================
# Standard Tools
#=============================================================
import os
```

```
import shutil
import cv2
#============================================================
sInputFileName='C:/VKHCG/05-DS/9999-Data/dog.mp4'
sDataBaseDir='C:/VKHCG/05-DS/9999-Data/temp'
if os.path.exists(sDataBaseDir):
shutil.rmtree(sDataBaseDir)
if not os.path.exists(sDataBaseDir):
os.makedirs(sDataBaseDir)
print('=====================================================')
print('Start Movie to Frames')
print('=====================================================')
vidcap = cv2.VideoCapture(sInputFileName)
success,image = vidcap.read()
count = 0
while success:
success,image = vidcap.read()
sFrame=sDataBaseDir + str('/dog-frame-' + str(format(count, '04d'))+ '.jpg')
print('Extracted: ', sFrame)
cv2.imwrite(sFrame, image)
if os.path.getsize(sFrame) == 0:
count += -1
os.remove(sFrame)
print('Removed: ', sFrame)
if cv2.waitKey(10) == 27: # exit if Escape is hit
break
        count += 1
print('=====================================================')
print('Generated : ', count, ' Frames')
print('=====================================================')
print('Movie to Frames HORUS - Done')
print('=====================================================')
# Utility done ================================================
```

```
>>>
========== RESTART: C:\VKHCG\05-DS\9999-Data\MOVIE2HORUSFrame.py ==========
=================================================
Start Movie to Frames
=================================================
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0000.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0001.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0002.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0003.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0004.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0005.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0006.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0007.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0008.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0009.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0010.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0099.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0100.jpg
Extracted:  C:/VKHCG/05-DS/9999-Data/temp/dog-frame-0101.jpg
=====================================================
Generated :  101  Frames
=================================================
Movie to Frames HORUS - Done
=================================================
>>>
```

Now frames are created and need to load them into HORUS.

Frames to Horus

```
# Utility Start Movie to HORUS (Part 2) ======================
# Standard Tools
#============================================================
```

```
from scipy.misc import imread
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import os
# Input Agreement ========================================
sDataBaseDir='C:/VKHCG/05-DS/9999-
Data/temp' f=0
for file in os.listdir(sDataBaseDir):
if file.endswith(".jpg"):
f += 1
sInputFileName=os.path.join(sDataBaseDir, file)
print('Process : ', sInputFileName)
InputData = imread(sInputFileName, flatten=False, mode='RGBA')
print('Input Data Values ===================================')
print('X: ',InputData.shape[0])
print('Y: ',InputData.shape[1])
print('RGBA: ', InputData.shape[2])
        print('=====================================================')
# Processing Rules ========================================
ProcessRawData=InputData.flatten() y=InputData.shape[2] + 2
x=int(ProcessRawData.shape[0]/y)
ProcessFrameData=pd.DataFrame(np.reshape(ProcessRawData, (x, y)))
ProcessFrameData['Frame']=file
print('=====================================================')
print('Process Data Values ===================================')
print('=====================================================')
plt.imshow(InputData)
plt.show() if f == 1: ProcessData=ProcessFrameData
else:
ProcessData=ProcessData.append(ProcessFrameData) if
f > 0:
sColumns= ['XAxis','YAxis','Red', 'Green', 'Blue','Alpha','FrameName']
ProcessData.columns=sColumns
print('=====================================================')
ProcessFrameData.index.names =['ID']
print('Rows: ',ProcessData.shape[0]) print('Columns :',ProcessData.shape[1])
print('=====================================================')
# Output Agreement ========================================
OutputData=ProcessData
print('Storing File')
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-Movie-Frame.csv'
OutputData.to_csv(sOutputFileName, index = False)
print('=====================================================')
print('Processed ; ', f,' frames')
print('=====================================================')
```

```
print('Movie to HORUS - Done')
print('=====================================================')
```

Output:

```
=====================================================
Rows:  15667200
Columns : 7
=====================================================
Storing File
=====================================================
Processed ;  102  frames
=====================================================
Movie to HORUS - Done
=====================================================
```

dog-frame-0000.jpeg

dog-frame-0001.jpeg

dog-frame-0100.jpeg

dog-frame-0101.jpeg

Check the files from C:\VKHCG\05-DS\9999-Data\temp
The movie clip is converted into 102 picture frames and then to HORUS format.

G. Audio to HORUS Format

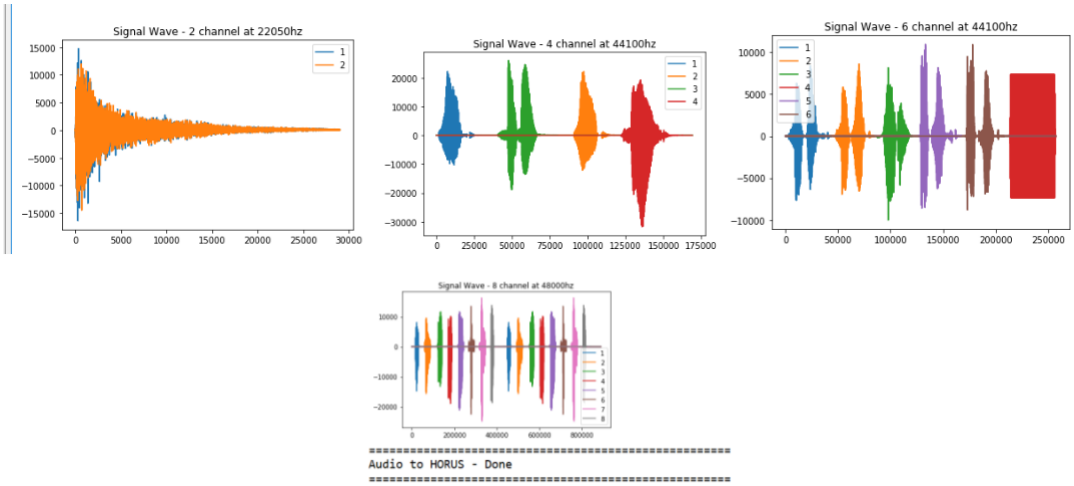
Code:

```
# Utility Start Audio to HORUS ================================
# Standard Tools
#=============================================================
=
from scipy.io import wavfile
import pandas as pd
import matplotlib.pyplot as plt
```

```
import numpy as np
#============================================================
=
def show_info(aname, a,r):
    print ('----------------')
    print ("Audio:", aname)
    print ('----------------')
    print ("Rate:", r)
    print ('----------------')
    print ("shape:", a.shape)
    print ("dtype:", a.dtype)
    print ("min, max:", a.min(), a.max())
    print ('----------------')
    plot_info(aname, a,r)
#============================================================
=
def plot_info(aname, a,r):
    sTitle= 'Signal Wave - '+ aname + ' at ' + str(r) + 'hz'
    plt.title(sTitle)
    sLegend=[]
    for c in range(a.shape[1]):
        sLabel = 'Ch' + str(c+1)
        sLegend=sLegend+[str(c+1)]
        plt.plot(a[:,c], label=sLabel)
    plt.legend(sLegend)
    plt.show()
#============================================================
=
sInputFileName='C:/VKHCG/05-DS/9999-Data/2ch-sound.wav'
print('=====================================================')
print('Processing : ', sInputFileName)
print('=====================================================')
InputRate, InputData = wavfile.read(sInputFileName)
show_info("2 channel", InputData,InputRate)
ProcessData=pd.DataFrame(InputData)
sColumns= ['Ch1','Ch2']
ProcessData.columns=sColumns
OutputData=ProcessData
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-Audio-2ch.csv'
OutputData.to_csv(sOutputFileName, index = False)
#============================================================
=
sInputFileName='C:/VKHCG/05-DS/9999-Data/4ch-sound.wav'
print('=====================================================')
print('Processing : ', sInputFileName)
print('=====================================================')
InputRate, InputData = wavfile.read(sInputFileName)
show_info("4 channel", InputData,InputRate)
ProcessData=pd.DataFrame(InputData)
sColumns= ['Ch1','Ch2','Ch3', 'Ch4']
```

```
ProcessData.columns=sColumns
OutputData=ProcessData
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-Audio-4ch.csv'
OutputData.to_csv(sOutputFileName, index = False)
#=============================================================
=
sInputFileName='C:/VKHCG/05-DS/9999-Data/6ch-sound.wav'
print('=====================================================')
print('Processing : ', sInputFileName)
print('=====================================================')
InputRate, InputData = wavfile.read(sInputFileName)
show_info("6 channel", InputData,InputRate)
ProcessData=pd.DataFrame(InputData)
sColumns= ['Ch1','Ch2','Ch3', 'Ch4', 'Ch5','Ch6']
ProcessData.columns=sColumns
OutputData=ProcessData
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-Audio-6ch.csv'
OutputData.to_csv(sOutputFileName, index = False)
#=============================================================
=
sInputFileName='C:/VKHCG/05-DS/9999-Data/8ch-sound.wav'
print('=====================================================')
print('Processing : ', sInputFileName)
print('=====================================================')
InputRate, InputData = wavfile.read(sInputFileName)
show_info("8 channel", InputData,InputRate)
ProcessData=pd.DataFrame(InputData)
sColumns= ['Ch1','Ch2','Ch3', 'Ch4', 'Ch5','Ch6','Ch7','Ch8']
ProcessData.columns=sColumns
OutputData=ProcessData
sOutputFileName='C:/VKHCG/05-DS/9999-Data/HORUS-Audio-8ch.csv'
OutputData.to_csv(sOutputFileName, index = False)
print('=====================================================')
print('Audio to HORUS - Done')
```

Output:



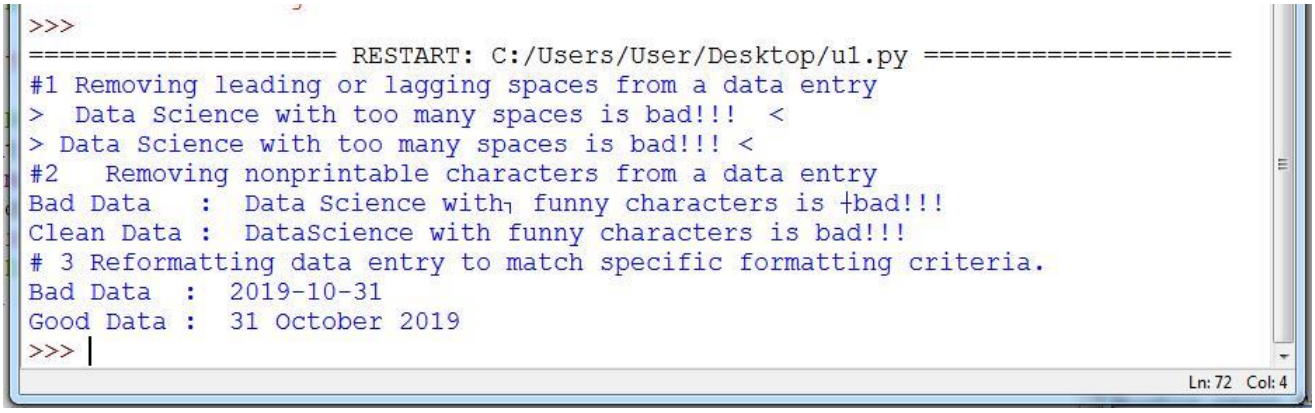
Practical 3: Utilities and Auditing

A. Fixers Utilities:

Fixers enable your solution to take your existing data and fix a specific quality issue.

```
#---------------------------- Program to Demonstrate Fixers utilities -------------------
import string
import datetime as dt
# 1 Removing leading or lagging spaces from a data entry
print('#1 Removing leading or lagging spaces from a data
entry'); baddata = "  Data Science with too many spaces is bad!!!
" print('>',baddata,'<')
cleandata=baddata.strip()
print('>',cleandata,'<')

# 2 Removing nonprintable characters from a data entry
print('#2   Removing nonprintable characters from a data entry')
printable = set(string.printable)
baddata = "Data\x00Science with\x02 funny characters is \x10bad!!!"
cleandata=''.join(filter(lambda x: x in string.printable,baddata))
print('Bad Data   : ',baddata);
print('Clean Data : ',cleandata)

# 3 Reformatting data entry to match specific formatting criteria.
#   Convert YYYY/MM/DD to DD Month YYYY
print('# 3 Reformatting data entry to match specific formatting criteria.')
baddate = dt.date(2019, 10, 31)
baddata=format(baddate,'%Y-%m-%d')
gooddate = dt.datetime.strptime(baddata,'%Y-%m-%d')
gooddata=format(gooddate,'%d %B %Y')
print('Bad Data : ',baddata)
print('Good Data : ',gooddata)
```

Output:



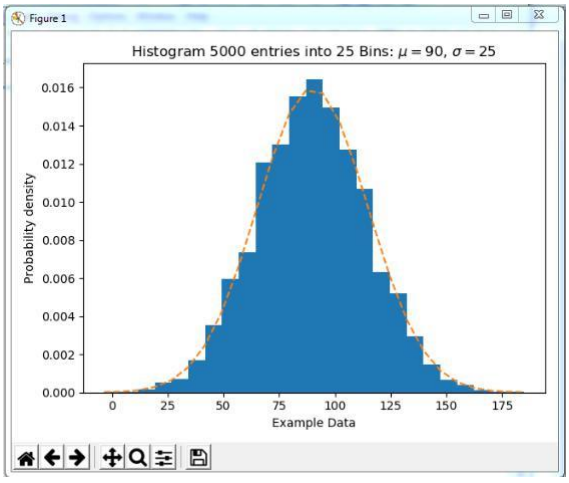
B. Data Binning or Bucketing

Binning is a data preprocessing technique used to reduce the effects of minor observation errors. Statistical data binning is a way to group a number of more or less continuous values into a smaller number of “bins.”

Code :

```
import numpy as np
import matplotlib.mlab as mlab
import matplotlib.pyplot as plt
import scipy.stats as stats
np.random.seed(0)
# example data
mu = 90 # mean of distribution
sigma = 25 # standard deviation of distribution
x = mu + sigma * np.random.randn(5000)
num_bins = 25
fig, ax = plt.subplots()
# the histogram of the data
n, bins, patches = ax.hist(x, num_bins, density=1)
# add a 'best fit' line
y = stats.norm.pdf(bins, mu, sigma)
# mlab.normpdf(bins, mu, sigma)
ax.plot(bins, y, '--')
ax.set_xlabel('Example Data')
ax.set_ylabel('Probability density')
sTitle=r'Histogram ' + str(len(x)) + ' entries into ' + str(num_bins) + ' Bins: $\mu=' +
str(mu) + '$, $\sigma=' + str(sigma) + '$'
ax.set_title(sTitle)
fig.tight_layout()
sPathFig='C:/VKHCG/05-DS/4000-UL/0200-DU/DU-
Histogram.png' fig.savefig(sPathFig)
plt.show()
```

Output:



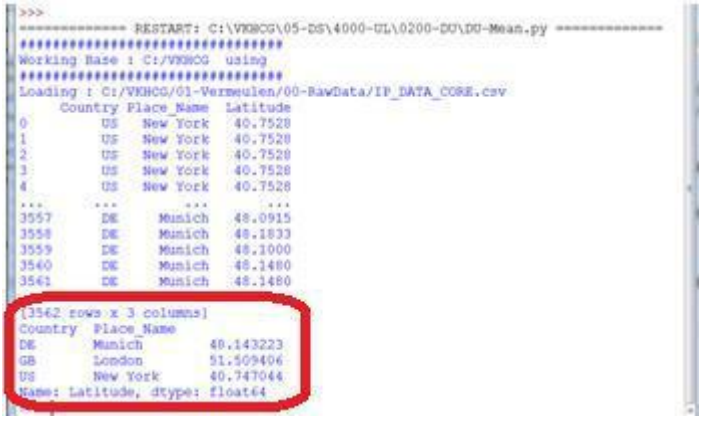
C. Averaging of Data

The use of averaging of features value enables the reduction of data volumes in a control fashion to improve effective data processing. C:\VKHCG\05-DS\4000-UL\0200-DU\DU-Mean.py

Code:

```
import pandas as pd
##################################################################
InputFileName='IP_DATA_CORE.csv'
OutputFileName='Retrieve_Router_Location.csv'
Base='C:/VKHCG'
print('#################################')
print('Working Base :',Base, ' using ')
print('#################################')
sFileName=Base + '/01-Vermeulen/00-RawData/' + InputFileName
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
  usecols=['Country','Place Name','Latitude','Longitude'], encoding="latin-1")
IP_DATA_ALL.rename(columns={'Place Name': 'Place_Name'}, inplace=True)
AllData=IP_DATA_ALL[['Country', 'Place_Name','Latitude']] print(AllData)

MeanData=AllData.groupby(['Country', 'Place_Name'])['Latitude'].mean()
print(MeanData)
##################################################################
```

Output:



Outlier Detection

Outliers are data that is so different from the rest of the data in the data set that it may be caused by an error in the data source. There is a technique called outlier detection that, with good data science, will identify these outliers.

C:\VKHCG\05-DS\4000-UL\0200-DU\DU-Outliers.py

Code:

```
##################################################################
# -*- coding: utf-8 -*-
##################################################################
import pandas as pd
##################################################################
InputFileName='IP_DATA_CORE.csv'
OutputFileName='Retrieve_Router_Location.csv'
Base='C:/VKHCG'
print('#################################')
```

```
print('Working Base :',Base)
print('################################')
#################################################################
sFileName=Base + '/01-Vermeulen/00-RawData/' + InputFileName
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
  usecols=['Country','Place Name','Latitude','Longitude'], encoding="latin-1")
IP_DATA_ALL.rename(columns={'Place Name': 'Place_Name'}, inplace=True)
LondonData=IP_DATA_ALL.loc[IP_DATA_ALL['Place_Name']=='London']
AllData=LondonData[['Country', 'Place_Name','Latitude']]
print('All Data')
print(AllData)
MeanData=AllData.groupby(['Country', 'Place_Name'])['Latitude'].mean()
StdData=AllData.groupby(['Country', 'Place_Name'])['Latitude'].std()
print('Outliers')
UpperBound=float(MeanData+StdData)
print('Higher than ', UpperBound)
OutliersHigher=AllData[AllData.Latitude>UpperBound]
print(OutliersHigher)
LowerBound=float(MeanData-StdData)
print('Lower than ', LowerBound)
OutliersLower=AllData[AllData.Latitude<LowerBound]
print(OutliersLower)
print('Not Outliers')
OutliersNot=AllData[(AllData.Latitude>=LowerBound) &
(AllData.Latitude<=UpperBound)]
print(OutliersNot)
#################################################################
```

Output:

```
========== RESTART: C:\VKHCG\05-DS\4000-UL\0200-DU\DU-Outliers.py
==========
################################
Working Base : C:/VKHCG
################################
Loading : C:/VKHCG/01-Vermeulen/00-RawData/IP_DATA_CORE.csv
All Data
     Country Place_Name  Latitude
1910      GB     London   51.5130
1911      GB     London   51.5508
1912      GB     London   51.5649
1913      GB     London   51.5895
1914      GB     London   51.5232
.....             .....

[1502 rows x 3 columns]
Outliers
 Higher than 51.51263550786781
     Country Place_Name  Latitude
1910      GB     London   51.5130
```

```
1911    GB    London   51.5508
1912    GB    London   51.5649
1913    GB    London   51.5895
1914    GB    London   51.5232
1916    GB    London   51.5491
1919    GB    London   51.5161
1920    GB    London   51.5198
1921    GB    London   51.5198
1923    GB    London   51.5237
1924    GB    London   51.5237
 Lower than 51.50617687562166
    Country Place_Name  Latitude
1915    GB    London   51.4739
Not Outliers
    Country Place_Name  Latitude
```

D. Logging

Write a Python / R program for basic logging in data science.

C:\VKHCG\77-Yoke\Yoke_Logging.py

Code:

```
import sys
import os
import logging
import uuid
import shutil
import time
################################################################
   Base='C:/VKHCG'
################################################################
sCompanies=['01-Vermeulen','02-Krennwallner','03-Hillman','04-Clark']
sLayers=['01-Retrieve','02-Assess','03-Process','04-Transform','05-Organise','06-
Report']
sLevels=['debug','info','warning','error']

for sCompany in sCompanies:
   sFileDir=Base + '/' + sCompany
   if not os.path.exists(sFileDir):
      os.makedirs(sFileDir)
   for sLayer in sLayers:
      log = logging.getLogger() # root logger
      for hdlr in log.handlers[:]: # remove all old handlers
         log.removeHandler(hdlr)
      #-----------------------------------------------------------------------------
      sFileDir=Base + '/' + sCompany + '/' + sLayer + '/Logging'
      if os.path.exists(sFileDir):
         shutil.rmtree(sFileDir)
      time.sleep(2)
      if not os.path.exists(sFileDir):
         os.makedirs(sFileDir)
      skey=str(uuid.uuid4())
```

```
        sLogFile=Base + '/' + sCompany + '/' + sLayer +
'/Logging/Logging_'+skey+'.log'
        print('Set up:',sLogFile)
        # set up logging to file - see previous section for more details
        logging.basicConfig(level=logging.DEBUG,
                            format='%(asctime)s %(name)-12s %(levelname)-8s
                            %(message)s', datefmt='%m-%d %H:%M',
                            filename=sLogFile,
                            filemode='w')
        # define a Handler which writes INFO messages or higher to the
        sys.stderr console = logging.StreamHandler()
        console.setLevel(logging.INFO)
        # set a format which is simpler for console use
        formatter = logging.Formatter('%(name)-12s: %(levelname)-8s %(message)s')
        # tell the handler to use this format
        console.setFormatter(formatter)
        # add the handler to the root logger
        logging.getLogger('').addHandler(console)
         # Now, we can log to the root logger, or any other logger. First the root...
        logging.info('Practical Data Science is fun!.')

        for sLevel in sLevels:
           sApp='Apllication-'+ sCompany + '-' + sLayer + '-' + sLevel
           logger = logging.getLogger(sApp) if sLevel == 'debug':

              logger.debug('Practical Data Science logged a debugging message.')
            if sLevel == 'info':
              logger.info('Practical Data Science logged information message.')
           if sLevel == 'warning':
              logger.warning('Practical Data Science logged a warning message.')
           if sLevel == 'error':
              logger.error('Practical Data Science logged an error message.')
#-------------------------------------------------------------------------------
```

Output:

```
>>>
================= RESTART: C:\VKHCG\77-Yoke\Yoke_Logging.py =================
Set up: C:/VKHCG/01-Vermeulen/01-Retrieve/Logging/Logging_61705603-bb6e-47f0-b5a
9-23d42e267311.log
root        : INFO     Practical Data Science is fun!.
Apllication-01-Vermeulen-01-Retrieve-info: INFO     Practical Data Science logge
d information message.
Apllication-01-Vermeulen-01-Retrieve-warning: WARNING  Practical Data Science lo
gged a warning message.
Apllication-01-Vermeulen-01-Retrieve-error: ERROR    Practical Data Science logg
ed an error message.
Set up: C:/VKHCG/01-Vermeulen/02-Assess/Logging/Logging_a7fecb9b-4d40-474e-bc2d-
994958d85194.log
```

Practical 4

A. Perform the following data processing using R.

Use R-Studio for the following:

```
>library(readr)
Warning message:package 'readr' was built under R version 3.4.4
```

Load a table named IP_DATA_ALL.csv.

```
>IP_DATA_ALL <- read_csv("C:/VKHCG/01-Vermeulen/00-
RawData/IP_DATA_ALL.csv")
Parsed with column specification:
cols(
  ID = col_double(),
  Country = col_character(),
  `Place Name` = col_character(),
  `Post Code` = col_double(),
  Latitude = col_double(),
  Longitude = col_double(),
  `First IP Number` = col_double(),
  `Last IP Number` = col_double()
)

>View(IP_DATA_ALL)
>spec(IP_DATA_ALL)
cols(
  ID = col_double(),
  Country = col_character(),
  `Place Name` = col_character(),
  `Post Code` = col_double(),
  Latitude = col_double(),
  Longitude = col_double(),
  `First IP Number` = col_double(),
  `Last IP Number` = col_double()
)
```

This informs you that you have the following eight columns:

- ID of type integer
- Place name of type character
- Post code of type character
- Latitude of type numeric double
- Longitude of type numeric double
- First IP number of type integer
- Last IP number of type integer

```
>library(tibble)
>set_tidy_names(IP_DATA_ALL, syntactic = TRUE, quiet = FALSE)
New names:
Place Name -> Place.Name
Post Code -> Post.Code
```

First IP Number -> First.IP.Number
Last IP Number -> Last.IP.Number
This informs you that four of the field names are not valid and suggests new field names that are valid.You can fix any detected invalid column names by executing
IP_DATA_ALL_FIX=set_tidy_names(IP_DATA_ALL, syntactic = TRUE, quiet = TRUE)
By using command View(IP_DATA_ALL_FIX), you can check that you have fixed the columns. The new table IP_DATA_ALL_FIX.csv will fix the invalid column names with valid names.

```
>sapply(IP_DATA_ALL_FIX, typeof)
          ID      Country   Place.Name    Post.Code     Latitude
    "double"  "character"  "character"     "double"     "double"
   Longitude First.IP.Number  Last.IP.Number
    "double"     "double"     "double"
>library(data.table)
>hist_country=data.table(Country=unique(IP_DATA_ALL_FIX[is.na(IP_DATA_ALL_FIX
['Country']) == 0, ]$Country))
>setorder(hist_country,'Country')
>hist_country_with_id=rowid_to_column(hist_country, var = "RowIDCountry")
>View(hist_country_fix)
>IP_DATA_COUNTRY_FREQ=data.table(with(IP_DATA_ALL_FIX, table(Country)))
>View(IP_DATA_COUNTRY_FREQ)
```

IP_DATA_COUNTRY_FREQ

Filter

	Country	N
2	GB	1502
3	US	1383
1	DE	677

- The two biggest subset volumes are from the US and GB.
- The US has just over four times the data as GB.

```
hist_latitude
=data.table(Latitude=unique(IP_DATA_ALL_FIX
[is.na(IP_DATA_ALL_with_ID ['Latitude']) == 0, ]$Latitude))
setkeyv(hist_latitude, 'Latitude') setorder(hist_latitude)
hist_latitude_with_id=rowid_to_column(hist_latitude, var = "RowID")
View(hist_latitude_with_id)
IP_DATA_Latitude_FREQ=data.table(with(IP_DATA_ALL_FIX,table(Latitude)))
View(IP_DATA_Latitude_FREQ)
```

	Latitude	N
133	51.5092	1478
1	40.6888	130
107	48.15	114
9	40.7143	113

- The two biggest data volumes are from latitudes 51.5092 and 40.6888.
- The spread appears to be nearly equal between the top-two

latitudes. >sapply(IP_DATA_ALL_FIX[,'Latitude'], min, na.rm=TRUE)

Latitude 40.6888
What does this tell you?
Fact: The range of latitude for the Northern Hemisphere is from 0 to 90. So, if you do not have any latitudes farther south than 40.6888, you can improve your retrieve routine.
>sapply(IP_DATA_ALL_FIX[,'Country'], min, na.rm=TRUE) Country "DE"

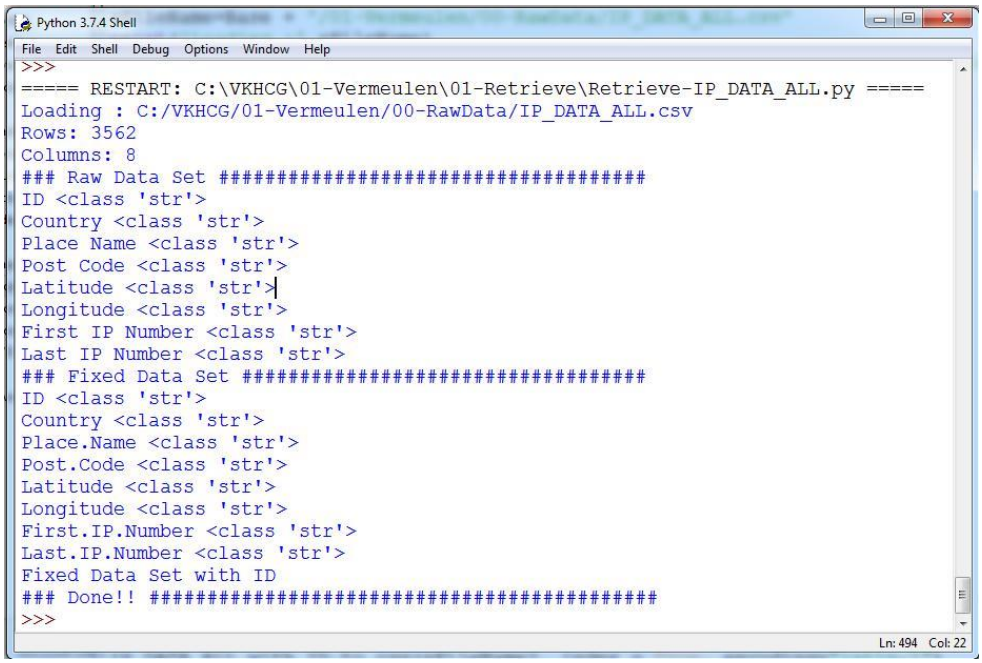
Minimum business frequency is from DE – Denmark.
>sapply(IP_DATA_ALL_FIX[,'Latitude'], max, na.rm=TRUE)
Latitude
51.5895
>sapply(IP_DATA_ALL_FIX[,'Country'], max, na.rm=TRUE)
Country
"US"
The result is 51.5895. What does this tell you?
Fact: The range in latitude for the Northern Hemisphere is from 0 to 90. So, if you do not have any latitudes more northerly than 51.5895, you can improve your retrieve routine.
>sapply(IP_DATA_ALL_FIX [,'Latitude'], mean, na.rm=TRUE) Latitude

46.69097
>sapply(IP_DATA_ALL_FIX [,'Latitude'], median, na.rm=TRUE)
Latitude
48.15
>sapply(IP_DATA_ALL_FIX [,'Latitude'], range, na.rm=TRUE)
Latitude
[1,] 40.6888
[2,] 51.5895
>sapply(IP_DATA_ALL_FIX [,'Latitude'], quantile, na.rm=TRUE)
Latitude
0% 40.6888
25% 40.7588
50% 48.1500
75% 51.5092
100% 51.5895
>sapply(IP_DATA_ALL_FIX [,'Latitude'], sd, na.rm=TRUE)
Latitude
4.890387
>sapply(IP_DATA_ALL_FIX [,'Longitude'], sd, na.rm=TRUE)
Longitude
38.01702

B. Program to retrieve different attributes of data.

```
##### C:\ VKHCG\01-Vermeulen\01-Retrieve\Retrive_IP_DATA_ALL.py###
import sys
import os
import pandas as pd
################################################################
Base='C:/VKHCG'
################################################################
sFileName=Base + '/01-Vermeulen/00-
RawData/IP_DATA_ALL.csv' print('Loading :',sFileName)
```

```
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin-1")
########################################################################
sFileDir=Base + '/01-Vermeulen/01-Retrieve/01-EDS/02-
Python' if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
print('Rows:', IP_DATA_ALL.shape[0])
print('Columns:', IP_DATA_ALL.shape[1])
print('### Raw Data Set #####################################')
for i in range(0,len(IP_DATA_ALL.columns)):
    print(IP_DATA_ALL.columns[i],type(IP_DATA_ALL.columns[i]))
print('### Fixed Data Set ###################################')
IP_DATA_ALL_FIX=IP_DATA_ALL
for i in range(0,len(IP_DATA_ALL.columns)):
    cNameOld=IP_DATA_ALL_FIX.columns[i] + '    '
    cNameNew=cNameOld.strip().replace(" ", ".")
    IP_DATA_ALL_FIX.columns.values[i] = cNameNew
    print(IP_DATA_ALL.columns[i],type(IP_DATA_ALL.columns[i]))
########################################################################
#print(IP_DATA_ALL_FIX.head())
########################################################################
print('Fixed Data Set with ID')
IP_DATA_ALL_with_ID=IP_DATA_ALL_FIX
IP_DATA_ALL_with_ID.index.names =
['RowID'] #print(IP_DATA_ALL_with_ID.head())
sFileName2=sFileDir + '/Retrieve_IP_DATA.csv'
IP_DATA_ALL_with_ID.to_csv(sFileName2, index = True, encoding="latin-1")
########################################################################
print('### Done!! ############################################')
########################################################################
```



C. Data Pattern

To determine a pattern of the data values, Replace all alphabet values with an uppercase case *A*, all numbers with an uppercase *N*, and replace any spaces with a lowercase letter *b* and all other unknown characters with a lowercase *u*. As a result, "Good Book 101" becomes "AAAAbAAAAbNNNu."This pattern creation is beneficial for designing any specific assess rules. This pattern view of data is a quick way to identify common patterns or determine standard layouts.

```
library(readr)
library(data.table)
FileName=paste0('c:/VKHCG/01-Vermeulen/00-RawData/IP_DATA_ALL.csv')
IP_DATA_ALL <- read_csv(FileName)
hist_country=data.table(Country=unique(IP_DATA_ALL$Country))
pattern_country=data.table(Country=hist_country$Country,
                           PatternCountry=hist_country$Country)
oldchar=c(letters,LETTERS)
newchar=replicate(length(oldchar),"A")
for (r in seq(nrow(pattern_country))){
  s=pattern_country[r,]$PatternCountry;
  for (c in seq(length(oldchar))){
    s=chartr(oldchar[c],newchar[c],s)
  };
  for (n in seq(0,9,1)){
    s=chartr(as.character(n),"N",s)
  };
  s=chartr(" ","b",s)
  s=chartr(".","u",s)
  pattern_country[r,]$PatternCountry=s;
};
View(pattern_country)
```

Filter

	Country	PatternCountry
1	US	AA
2	DE	AA
3	GB	AA

Example 2: This is a common use of patterns to separate common standards and structures. Pattern can be loaded in separate retrieve procedures. If the same two patterns, NNNNuNNuNN and uuNNuNNuNN, are found, you can send NNNNuNNuNN directly to be converted into a date, while uuNNuNNuNN goes through a quality-improvement process to then route back to the same queue as NNNNuNNuNN, once it complies.

```
library(readr)
library(data.table)
Base='C:/VKHCG'
FileName=paste0(Base,'/01-Vermeulen/00-RawData/IP_DATA_ALL.csv')
IP_DATA_ALL <- read_csv(FileName)
hist_latitude=data.table(Latitude=unique(IP_DATA_ALL$Latitude))
```

```
pattern_latitude=data.table(latitude=hist_latitude$Latitude,
                            Patternlatitude=as.character(hist_latitude$Latitude))
oldchar=c(letters,LETTERS)
newchar=replicate(length(oldchar),"A")
for (r in seq(nrow(pattern_latitude))){
  s=pattern_latitude[r,]$Patternlatitude;
  for (c in seq(length(oldchar))){
    s=chartr(oldchar[c],newchar[c],s)
  };
  for (n in seq(0,9,1)){
    s=chartr(as.character(n),"N",s)
  };
  s=chartr(" ","b",s)
  s=chartr("+","u",s)
  s=chartr("-","u",s)
  s=chartr(".","u",s)
  pattern_latitude[r,]$Patternlatitude=s;
};
setorder(pattern_latitude,latitude)
View(pattern_latitude[1:3])
```

Filter

	latitude	Patternlatitude
1	40.6888	NNuNNNN
2	40.7038	NNuNNNN
3	40.7055	NNuNNNN

D. Loading IP_DATA_ALL:

This data set contains all the IP address allocations in the world. It will help you to locateyour customers when interacting with them online.

Create a new Python script file and save it as Retrieve-IP_DATA_ALL.py in directory C:\VKHCG\01-Vermeulen\01-Retrieve.

```
##############Retrieve-IP_DATA_ALL.py#########################
# -*- coding: utf-8 -*-
################################################################
import sys
import os
import pandas as pd
################################################################
Base='C:/VKHCG'
################################################################
sFileName=Base + '/01-Vermeulen/00-
RawData/IP_DATA_ALL.csv' print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
################################################################
sFileDir=Base + '/01-Vermeulen/01-Retrieve/01-EDS/02-
Python' if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
```

```
print('Rows:', IP_DATA_ALL.shape[0])
print('Columns:', IP_DATA_ALL.shape[1])
print('### Raw Data Set #####################################')
for i in range(0,len(IP_DATA_ALL.columns)):
    print(IP_DATA_ALL.columns[i],type(IP_DATA_ALL.columns[i]))
print('### Fixed Data Set ###################################')
IP_DATA_ALL_FIX=IP_DATA_ALL
for i in range(0,len(IP_DATA_ALL.columns)):
    cNameOld=IP_DATA_ALL_FIX.columns[i] + '    '
    cNameNew=cNameOld.strip().replace(" ", ".")
    IP_DATA_ALL_FIX.columns.values[i] = cNameNew
    print(IP_DATA_ALL.columns[i],type(IP_DATA_ALL.columns[i]))
#print(IP_DATA_ALL_FIX.head())
print('Fixed Data Set with ID')
IP_DATA_ALL_with_ID=IP_DATA_ALL_FIX
IP_DATA_ALL_with_ID.index.names =
['RowID'] #print(IP_DATA_ALL_with_ID.head())

sFileName2=sFileDir + '/Retrieve_IP_DATA.csv'
IP_DATA_ALL_with_ID.to_csv(sFileName2, index = True, encoding="latin-1")
######################################################################
print('### Done!! ############################################')
######################################################################
```

```
>>>
===== RESTART: C:\VKHCG\01-Vermeulen\01-Retrieve\Retrieve-IP_DATA_ALL.py =====
Loading : C:/VKHCG/01-Vermeulen/00-RawData/IP_DATA_ALL.csv
Rows: 3562
Columns: 8
### Raw Data Set #####################################
ID <class 'str'>
Country <class 'str'>
Place Name <class 'str'>
Post Code <class 'str'>
Latitude <class 'str'>
Longitude <class 'str'>
First IP Number <class 'str'>
Last IP Number <class 'str'>
### Fixed Data Set ###################################
ID <class 'str'>
Country <class 'str'>
Place.Name <class 'str'>
Post.Code <class 'str'>
Latitude <class 'str'>
Longitude <class 'str'>
First.IP.Number <class 'str'>
Last.IP.Number <class 'str'>
Fixed Data Set with ID
### Done!! ############################################
>>>
```

Start your Python editor and create a text file named Retrieve-IP_Routing.py in directory. C:\VKHCG\01-Vermeulen\01-Retrieve.

```
######################################################################
# -*- coding: utf-8 -*-
######################################################################
import sys
import os
import pandas as pd
from math import radians, cos, sin, asin, sqrt
######################################################################
def haversine(lon1, lat1, lon2, lat2,stype):
```

```
    """
    Calculate the great circle distance between two
    points on the earth (specified in decimal degrees) """

    # convert decimal degrees to radians
    lon1, lat1, lon2, lat2 = map(radians, [lon1, lat1, lon2, lat2])
    # haversine formula
    dlon = lon2 - lon1
    dlat = lat2 - lat1
    a = sin(dlat/2)**2 + cos(lat1) * cos(lat2) * sin(dlon/2)**2
    c = 2 * asin(sqrt(a))
    if stype == 'km':
        r = 6371 # Radius of earth in
    kilometers else:
        r = 3956 # Radius of earth in
    miles d=round(c * r,3)
    return d
#####################################################################
Base='C:/VKHCG'
#####################################################################
sFileName=Base + '/01-Vermeulen/00-RawData/IP_DATA_CORE.csv'
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
  usecols=['Country','Place Name','Latitude','Longitude'], encoding="latin-1")
#####################################################################
sFileDir=Base + '/01-Vermeulen/01-Retrieve/01-EDS/02-
Python' if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
#####################################################################
IP_DATA = IP_DATA_ALL.drop_duplicates(subset=None, keep='first', inplace=False)
IP_DATA.rename(columns={'Place Name': 'Place_Name'}, inplace=True)
IP_DATA1 = IP_DATA
IP_DATA1.insert(0, 'K', 1)
IP_DATA2 = IP_DATA1
#####################################################################
print(IP_DATA1.shape)
#####################################################################
IP_CROSS=pd.merge(right=IP_DATA1,left=IP_DATA2,on='K')
IP_CROSS.drop('K', axis=1, inplace=True)
IP_CROSS.rename(columns={'Longitude_x': 'Longitude_from', 'Longitude_y':
'Longitude_to'}, inplace=True)
IP_CROSS.rename(columns={'Latitude_x': 'Latitude_from', 'Latitude_y':
'Latitude_to'}, inplace=True)
IP_CROSS.rename(columns={'Place_Name_x': 'Place_Name_from', 'Place_Name_y':
'Place_Name_to'}, inplace=True)
IP_CROSS.rename(columns={'Country_x': 'Country_from', 'Country_y': 'Country_to'},
inplace=True)
#####################################################################
IP_CROSS['DistanceBetweenKilometers'] = IP_CROSS.apply(lambda row:
    haversine(
```

```
        row['Longitude_from'],
        row['Latitude_from'],
        row['Longitude_to'],
        row['Latitude_to'],
        'km')
        ,axis=1)
#####################################################################
IP_CROSS['DistanceBetweenMiles'] = IP_CROSS.apply(lambda row:
   haversine(
        row['Longitude_from'],
        row['Latitude_from'],
        row['Longitude_to'],
        row['Latitude_to'],
        'miles')
        ,axis=1)
print(IP_CROSS.shape)
sFileName2=sFileDir + '/Retrieve_IP_Routing.csv'
IP_CROSS.to_csv(sFileName2, index = False, encoding="latin-1")
#####################################################################
print('### Done!! ################################################')
#####################################################################
```

Output:

See the file named Retrieve_IP_Routing.csv in C:\VKHCG\01-Vermeulen\01-Retrieve\01-EDS\02-Python.

	Country_from	Place_Name_from	Latitude_from	Longitude_from	Country_to	Place_Name_to	Latitude_to	Longitude_to	DistanceBetweenKilometers	DistanceBetweenMiles
2	US	New York	40.7528	-73.9725	US	New York	40.7528	-73.9725	0	0
3	US	New York	40.7528	-73.9725	US	New York	40.7214	-74.0052	4.448	2.762
4	US	New York	40.7528	-73.9725	US	New York	40.7662	-73.9862	1.885	1.17
5	US	New York	40.7528	-73.9725	US	New York	40.7449	-73.9782	1.001	0.622
6	US	New York	40.7528	-73.9725	US	New York	40.7605	-73.9933	1.95	1.211
7	US	New York	40.7528	-73.9725	US	New York	40.7588	-73.968	0.767	0.476
8	US	New York	40.7528	-73.9725	US	New York	40.7637	-73.9727	1.212	0.753
9	US	New York	40.7528	-73.9725	US	New York	40.7553	-73.9924	1.699	1.055
10	US	New York	40.7528	-73.9725	US	New York	40.7308	-73.9975	3.228	2.004
11	US	New York	40.7528	-73.9725	US	New York	40.7694	-73.9609	2.088	1.297

Total Records: 22501

So, the distance between a router in New York (40.7528, -73.9725) to anoher router in New York (40.7214, -74.0052) is 4.448 kilometers, or 2.762 miles. Building a Diagram for the Scheduling of Jobs

Start your Python editor and create a text file named Retrieve-Router-Location.py in directory.
C:\VKHCG\01-Vermeulen\01-Retrieve.

```
###################    Retrieve-Router-Location.py    ######################
# -*- coding: utf-8 -*-
#####################################################################
import sys
import os
import pandas as pd
#####################################################################
InputFileName='IP_DATA_CORE.csv'
OutputFileName='Retrieve_Router_Location.csv'
#####################################################################
Base='C:/VKHCG'
```

```
#####################################################################
sFileName=Base + '/01-Vermeulen/00-RawData/' + InputFileName
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
  usecols=['Country','Place Name','Latitude','Longitude'], encoding="latin-1")
#####################################################################
IP_DATA_ALL.rename(columns={'Place Name': 'Place_Name'}, inplace=True)
#####################################################################
sFileDir=Base + '/01-Vermeulen/01-Retrieve/01-EDS/02-
Python' if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)

ROUTERLOC = IP_DATA_ALL.drop_duplicates(subset=None, keep='first', inplace=False)

print('Rows :',ROUTERLOC.shape[0])
print('Columns :',ROUTERLOC.shape[1])

sFileName2=sFileDir + '/' + OutputFileName
ROUTERLOC.to_csv(sFileName2, index = False, encoding="latin-1")
#####################################################################
print('### Done!! ############################################')
#####################################################################
```

Output:

```
>>>
=== RESTART: C:\VKHCG\01-Vermeulen\01-Retrieve\Retrieve-Router-Location.py ===
Loading : C:/VKHCG/01-Vermeulen/00-RawData/IP_DATA_CORE.csv
Rows : 150
Columns : 4
### Done!! ############################################
```

See the file named Retrieve_Router_Location.csv in C:\VKHCG\01-Vermeulen\01-Retrieve\01-EDS\02-Python.

1	Country	Place_Name	Latitude	Longitude
2	US	New York	40.7528	-73.9725
3	US	New York	40.7214	-74.0052
4	US	New York	40.7662	-73.9862
5	US	New York	40.7449	-73.9782
6	US	New York	40.7605	-73.9933
7	US	New York	40.7588	-73.968
8	US	New York	40.7637	-73.9727
9	US	New York	40.7553	-73.9924
10	US	New York	40.7308	-73.9975

Krennwallner AG

The company has two main jobs in need of your attention:

- *Picking content for billboards*: I will guide you through the data science required to pick advertisements for each billboard in the company.
- *Understanding your online visitor data*: I will guide you through the evaluation of the web traffic to the billboard's online web servers.

Picking Content for Billboards
Start your Python editor and create a text file named Retrieve-DE-Billboard-Locations.py in directory.
C:\VKHCG\02-Krennwallner\01-Retrieve.

```
################# Retrieve-DE-Billboard-Locations.py  ##############
# -*- coding: utf-8 -*-
#################################################################
import sys
import os
import pandas as pd
#################################################################
InputFileName='DE_Billboard_Locations.csv'
OutputFileName='Retrieve_DE_Billboard_Locations.csv'
Company='02-Krennwallner'
#################################################################
Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
#################################################################
Base='C:/VKHCG'
sFileName=Base + '/' + Company + '/00-RawData/' + InputFileName
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
  usecols=['Country','PlaceName','Latitude','Longitude'])

IP_DATA_ALL.rename(columns={'PlaceName': 'Place_Name'}, inplace=True)
#################################################################
sFileDir=Base + '/' + Company + '/01-Retrieve/01-EDS/02-Python'
if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)

ROUTERLOC = IP_DATA_ALL.drop_duplicates(subset=None, keep='first', inplace=False)

print('Rows :',ROUTERLOC.shape[0])
print('Columns :',ROUTERLOC.shape[1])

sFileName2=sFileDir + '/' + OutputFileName
ROUTERLOC.to_csv(sFileName2, index = False)

#################################################################
print('### Done!! ############################################')
#################################################################
```

```
>>>
 RESTART: C:\VKHCG\02-Krennwallner\01-Retrieve\Retrieve-DE-Billboard-Locations.py
################################
Working Base : C:/VKHCG  using  win32
################################
Loading : C:/VKHCG/02-Krennwallner/00-RawData/DE_Billboard_Locations.csv
Rows : 8873
Columns : 4
### Done!! ############################################
```

See the file named Retrieve_Router_Location.csv in C:\VKHCG\02-Krennwallner\01-Retrieve\01-EDS\02-Python.

1	Country	Place_Name	Latitude	Longitude
2	US	New York	40.7528	-73.9725
3	US	New York	40.7214	-74.0052
4	US	New York	40.7662	-73.9862
5	US	New York	40.7449	-73.9782
6	US	New York	40.7605	-73.9933
7	US	New York	40.7588	-73.968
8	US	New York	40.7637	-73.9727
9	US	New York	40.7553	-73.9924
10	US	New York	40.7308	-73.9975

Understanding Your Online Visitor Data

Let's retrieve the visitor data for the billboard we have in Germany.

Several times it was found that common and important information is buried somewhere in the company's various data sources. Investigating any direct suppliers or consumers' upstream or downstream data sources attached to the specific business process is necessary. That is part of your skills that you are applying to data science. Numerous insightful fragments of information was found in the data sources surrounding a customer's business processes.

Start your Python editor and create a file named Retrieve-Online-Visitor.py in directory C:\VKHCG\02-Krennwallner\01-Retrieve.

```
##################################################################
# -*- coding: utf-8 -*-
##################################################################
import sys
import os
import pandas as pd
import gzip as gz
##################################################################
InputFileName='IP_DATA_ALL.csv'
OutputFileName='Retrieve_Online_Visitor'
CompanyIn= '01-Vermeulen' CompanyOut=
'02-Krennwallner'
##################################################################
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
##################################################################
Base='C:/VKHCG'
sFileName=Base + '/' + CompanyIn + '/00-RawData/' + InputFileName
```

```
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False,
  usecols=['Country','Place Name','Latitude','Longitude','First IP Number','Last IP Number'])

IP_DATA_ALL.rename(columns={'Place Name': 'Place_Name'}, inplace=True)
IP_DATA_ALL.rename(columns={'First IP Number': 'First_IP_Number'}, inplace=True)
IP_DATA_ALL.rename(columns={'Last IP Number': 'Last_IP_Number'}, inplace=True)
#####################################################################
sFileDir=Base + '/' + CompanyOut + '/01-Retrieve/01-EDS/02-Python'
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)

visitordata = IP_DATA_ALL.drop_duplicates(subset=None, keep='first', inplace=False)
visitordata10=visitordata.head(10)

print('Rows :',visitordata.shape[0])
print('Columns :',visitordata.shape[1])

print('Export CSV')
sFileName2=sFileDir + '/' + OutputFileName +
'.csv' visitordata.to_csv(sFileName2, index = False)
print('Store All:',sFileName2)

sFileName3=sFileDir + '/' + OutputFileName +
'_10.csv' visitordata10.to_csv(sFileName3, index =
False) print('Store 10:',sFileName3)

for z in ['gzip', 'bz2', 'xz']:
   if z == 'gzip':
      sFileName4=sFileName2 + '.gz'
   else:
      sFileName4=sFileName2 + '.' + z
   visitordata.to_csv(sFileName4, index = False, compression=z)
   print('Store :',sFileName4)
#####################################################################
print('Export JSON')
for sOrient in ['split','records','index', 'columns','values','table']:
   sFileName2=sFileDir + '/' + OutputFileName + '_' + sOrient + '.json'
   visitordata.to_json(sFileName2,orient=sOrient,force_ascii=True)
   print('Store All:',sFileName2)

   sFileName3=sFileDir + '/' + OutputFileName + '_10_' + sOrient + '.json'
   visitordata10.to_json(sFileName3,orient=sOrient,force_ascii=True)
   print('Store 10:',sFileName3)

   sFileName4=sFileName2 + '.gz'
   file_in = open(sFileName2, 'rb')
   file_out = gz.open(sFileName4, 'wb')
   file_out.writelines(file_in)
   file_in.close()
```

```
    file_out.close()
    print('Store GZIP All:',sFileName4)

    sFileName5=sFileDir + '/' + OutputFileName + '_' + sOrient + '_UnGZip.json'
    file_in = gz.open(sFileName4, 'rb')
    file_out = open(sFileName5, 'wb')
    file_out.writelines(file_in)
    file_in.close()
    file_out.close()
    print('Store UnGZIP All:',sFileName5)
########################################################################
print('### Done!! ############################################')
########################################################################
```

Output:

```
== RESTART: C:\VKHCG\02-Krennwallner\01-Retrieve\Retrieve-Online-Visitor.py ==
##############################
Working Base : C:/VKHCG  using  win32
##############################
Loading : C:/VKHCG/01-Vermeulen/00-RawData/IP_DATA_ALL.csv
Rows : 3562
Columns : 6
Export CSV
Store All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor.csv
Store 10: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_10.csv
Store : C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor.csv.gz
Store : C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor.csv.bz2
Store : C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor.csv.xz
Export JSON
Store All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_split.json
Store 10: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_10_split.json
Store GZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_split.json.gz
Store UnGZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_split_UnGZip.json
Store All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_records.json
Store 10: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_10_records.json
Store GZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_records.json.gz
Store UnGZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_records_UnGZip.json
Store All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_index.json
Store 10: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_10_index.json
Store GZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_index.json.gz
Store UnGZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_index_UnGZip.json
Store All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_columns.json
Store 10: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_10_columns.json
Store GZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_columns.json.gz
Store UnGZIP All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_columns_UnGZip.json
Store All: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor_values.json
```

See the file named Retrieve_Online_Visitor.csv in C:\VKHCG\02-Krennwallner\01-Retrieve\01-EDS\02-Python.

	A	B	C	D	E	F
1	Country	Place_Name	Latitude	Longitude	First_IP_Number	Last_IP_Number
2	US	New York	40.6888	-74.0203	400887248	400887263
3	US	New York	40.6888	-74.0203	400904512	400904543
4	US	New York	40.6888	-74.0203	401402080	401402095
5	US	New York	40.6888	-74.0203	402261072	402261087
6	US	New York	40.6888	-74.0203	402288032	402288047
7	US	New York	40.6888	-74.0203	641892352	641900543
8	US	New York	40.6888	-74.0203	644464896	644465151
9	US	New York	40.6888	-74.0203	758770912	758770927
10	US	New York	40.6888	-74.0203	1075972352	1075975167

You can also see the following JSON files of only ten records.

XML processing.
Start Python editor and create a file named Retrieve-Online-Visitor-XML.py indirectory C:\VKHCG\02-Krennwallner\01-Retrieve.

```
########################################################################
# -*- coding: utf-8 -*-
########################################################################
import sys
```

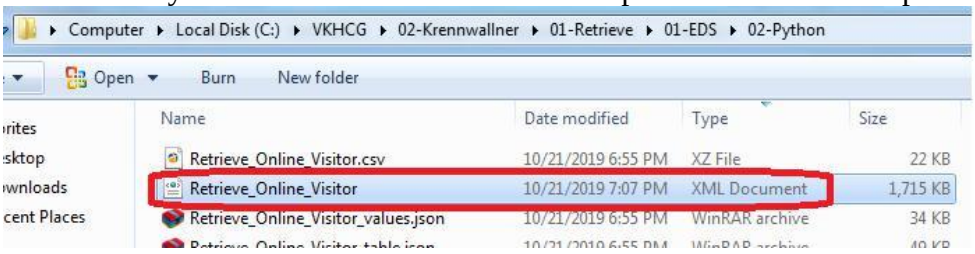
```
import os
import pandas as pd
import xml.etree.ElementTree as ET
#####################################################################
def df2xml(data):
    header = data.columns
    root = ET.Element('root')
    for row in range(data.shape[0]):
        entry = ET.SubElement(root,'entry')
        for index in range(data.shape[1]):
            schild=str(header[index])
            child = ET.SubElement(entry, schild)
            if str(data[schild][row]) != 'nan':
                child.text = str(data[schild][row])
            else:
                child.text = 'n/a'
            entry.append(child)
    result = ET.tostring(root)
    return result
#####################################################################
def xml2df(xml_data):
    root = ET.XML(xml_data)
    all_records = []
    for i, child in enumerate(root):
        record = {}
        for subchild in child:
            record[subchild.tag] = subchild.text
        all_records.append(record)
    return pd.DataFrame(all_records)
#####################################################################
InputFileName='IP_DATA_ALL.csv'
OutputFileName='Retrieve_Online_Visitor.xml'
CompanyIn= '01-Vermeulen'
CompanyOut= '02-Krennwallner'
#####################################################################
if sys.platform == 'linux':
    Base=os.path.expanduser('~') + '/VKHCG'
else:
    Base='C:/VKHCG'
#####################################################################
print('#################################')
print('Working Base :',Base, ' using ', sys.platform)
print('#################################')
#####################################################################
sFileName=Base + '/' + CompanyIn + '/00-RawData/' + InputFileName
print('Loading :',sFileName)
IP_DATA_ALL=pd.read_csv(sFileName,header=0,low_memory=False)

IP_DATA_ALL.rename(columns={'Place Name': 'Place_Name'}, inplace=True)
IP_DATA_ALL.rename(columns={'First IP Number': 'First_IP_Number'}, inplace=True)
```

```
IP_DATA_ALL.rename(columns={'Last IP Number': 'Last_IP_Number'}, inplace=True)
IP_DATA_ALL.rename(columns={'Post Code': 'Post_Code'}, inplace=True)
#################################################################
sFileDir=Base + '/' + CompanyOut + '/01-Retrieve/01-EDS/02-Python'
if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)

visitordata = IP_DATA_ALL.head(10000)

print('Original Subset Data Frame')
print('Rows :',visitordata.shape[0])
print('Columns :',visitordata.shape[1])
print(visitordata)

print('Export XML')
sXML=df2xml(visitordata)

sFileName=sFileDir + '/' + OutputFileName
file_out = open(sFileName, 'wb')
file_out.write(sXML)
file_out.close()
print('Store XML:',sFileName)
xml_data = open(sFileName).read()
unxmlrawdata=xml2df(xml_data)
print('Raw XML Data Frame')
print('Rows :',unxmlrawdata.shape[0])
print('Columns :',unxmlrawdata.shape[1])
print(unxmlrawdata)
unxmldata = unxmlrawdata.drop_duplicates(subset=None, keep='first', inplace=False)
print('Deduplicated XML Data Frame')
print('Rows :',unxmldata.shape[0])
print('Columns :',unxmldata.shape[1])
print(unxmldata)
#print('### Done!! ################################################')
```

Output:

See a file named Retrieve_Online_Visitor.xml in C:\VKHCG\02-Krennwallner\01-Retrieve\01-EDS\02-Python.

This enables you to deliver XML format data as part of the retrieve step.



```
Working Base : C:/VKHCG  using  win32
################################
Loading : C:/VKHCG/01-Vermeulen/00-RawData/IP_DATA_ALL.csv
Original Subset Data Frame
Rows : 3562
Columns : 8
      ID Country Place_Name  ... Longitude  First_IP_Number  Last_IP_Number
0      1      US   New York  ...  -73.9725        204276480       204276735
1      2      US   New York  ...  -73.9725        301984864       301985791
2      3      US   New York  ...  -73.9725        404678736       404679039
3      4      US   New York  ...  -73.9725        411592704       411592959
4      5      US   New York  ...  -73.9725        416784384       416784639
...  ...     ...        ...  ...       ...              ...             ...
3557  3558     DE     Munich  ...   11.5392       1591269504      1591269631
3558  3559     DE     Munich  ...   11.7500       1558374784      1558374911
3559  3560     DE     Munich  ...   11.4667       1480845312      1480845439
3560  3561     DE     Munich  ...   11.7434       1480596992      1480597503
3561  3562     DE     Munich  ...   11.7434       1558418432      1558418943

[3562 rows x 8 columns]
Export XML
Store XML: C:/VKHCG/02-Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor.xml
Raw XML Data Frame
Rows : 3562
Columns : 8
      ID Country Place_Name  ... Longitude First_IP_Number Last_IP_Number
0      1      US   New York  ...  -73.9725        204276480       204276735
1      2      US   New York  ...  -73.9725        301984864       301985791
2      3      US   New York  ...  -73.9725        404678736       404679039
3      4      US   New York  ...  -73.9725        411592704       411592959
4      5      US   New York  ...  -73.9725        416784384       416784639
...  ...     ...        ...  ...       ...              ...             ...
3557  3558     DE     Munich  ...   11.5392       1591269504      1591269631
3558  3559     DE     Munich  ...     11.75       1558374784      1558374911
3559  3560     DE     Munich  ...   11.4667       1480845312      1480845439
3560  3561     DE     Munich  ...   11.7434       1480596992      1480597503
3561  3562     DE     Munich  ...   11.7434       1558418432      1558418943

[3562 rows x 8 columns]
Deduplicated XML Data Frame
Rows : 3562
Columns : 8
      ID Country Place_Name  ... Longitude First_IP_Number Last_IP_Number
0      1      US   New York  ...  -73.9725        204276480       204276735
1      2      US   New York  ...  -73.9725        301984864       301985791
2      3      US   New York  ...  -73.9725        404678736       404679039
3      4      US   New York  ...  -73.9725        411592704       411592959
4      5      US   New York  ...  -73.9725        416784384       416784639
...  ...     ...        ...  ...       ...              ...             ...
3557  3558     DE     Munich  ...   11.5392       1591269504      1591269631
3558  3559     DE     Munich  ...     11.75       1558374784      1558374911
3559  3560     DE     Munich  ...   11.4667       1480845312      1480845439
3560  3561     DE     Munich  ...   11.7434       1480596992      1480597503
3561  3562     DE     Munich  ...   11.7434       1558418432      1558418943

[3562 rows x 8 columns]
>>>
```

C:\VKHCG\02-Krennwallner\01-Retrieve\01-EDS\...

```
- <root>
  - <entry>
      <ID>1</ID>
      <ID>1</ID>
      <Country>US</Country>
      <Country>US</Country>
      <Place_Name>New York</Place_Name>
      <Place_Name>New York</Place_Name>
      <Post_Code>10017</Post_Code>
      <Post_Code>10017</Post_Code>
      <Latitude>40.7528</Latitude>
      <Latitude>40.7528</Latitude>
      <Longitude>-73.9725</Longitude>
      <Longitude>-73.9725</Longitude>
      <First_IP_Number>204276480</First_IP_Number>
      <First_IP_Number>204276480</First_IP_Number>
      <Last_IP_Number>204276735</Last_IP_Number>
      <Last_IP_Number>204276735</Last_IP_Number>
    </entry>
```

Hillman Ltd

Start yourPython editor and create a file named Retrieve-Incoterm-EXW.py in directory C:\VKHCG\03-Hillman\01-Retrieve.

import os

```
import sys
import pandas as pd
IncoTerm='EXW'
InputFileName='Incoterm_2010.csv'
OutputFileName='Retrieve_Incoterm_' + IncoTerm + '_RuleSet.csv'
Company='03-Hillman'
#######################################################################
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
sFileDir=Base + '/' + Company + '/01-Retrieve/01-EDS/02-Python'
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#######################################################################
### Import Incoterms
#######################################################################
sFileName=Base + '/' + Company + '/00-RawData/' + InputFileName
print('############')
print('Loading :',sFileName)
IncotermGrid=pd.read_csv(sFileName,header=0,low_memory=False)
IncotermRule=IncotermGrid[IncotermGrid.Shipping_Term ==
IncoTerm] print('Rows :',IncotermRule.shape[0])
print('Columns :',IncotermRule.shape[1])
print('############') print(IncotermRule)
sFileName=sFileDir + '/' + OutputFileName
IncotermRule.to_csv(sFileName, index =
False)
print('### Done!! ################################################')
```

Output

See the file named Retrieve_Incoterm_EXW.csv in C:\VKHCG\03-Hillman\01-Retrieve\01-EDS\02-Python. Open this file,

```
>>>
===== RESTART: C:\VKHCG\03-Hillman\01-Retrieve\Retrieve-Incoterm-EXW.py =====
################################
Working Base : C:/VKHCG  using  win32
################################
############
Loading : C:/VKHCG/03-Hillman/00-RawData/Incoterm_2010.csv
Rows : 1
Columns : 9
############
  Shipping_Term  Seller Carrier Port_From  ... Port_To Terminal Named_Place  Buyer
0           EXW  Seller   Buyer     Buyer  ...   Buyer    Buyer       Buyer  Buyer

[1 rows x 9 columns]
### Done!! ############################################
```

FCA—Free Carrier (Named Place of Delivery)

```
import os
import sys
import pandas as pd
#####################################################################
IncoTerm='FCA'
InputFileName='Incoterm_2010.csv'
OutputFileName='Retrieve_Incoterm_' + IncoTerm + '_RuleSet.csv'
Company='03-Hillman'
#####################################################################
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
#####################################################################
sFileDir=Base + '/' + Company + '/01-Retrieve/01-EDS/02-Python'
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#####################################################################
### Import Incoterms
#####################################################################
sFileName=Base + '/' + Company + '/00-RawData/' + InputFileName
print('############')
print('Loading :',sFileName)
IncotermGrid=pd.read_csv(sFileName,header=0,low_memory=False)
IncotermRule=IncotermGrid[IncotermGrid.Shipping_Term ==
IncoTerm] print('Rows :',IncotermRule.shape[0])
print('Columns :',IncotermRule.shape[1])
print('############') print(IncotermRule)
sFileName=sFileDir + '/' + OutputFileName
IncotermRule.to_csv(sFileName, index =
False)
print('### Done!! ############################################')
```

Output:

```
>>>
===== RESTART: C:\VKHCG\03-Hillman\01-Retrieve\Retrieve-Incoterm-FCA.py =====
################################
Working Base : C:/VKHCG  using  win32
################################
############
Loading : C:/VKHCG/03-Hillman/00-RawData/Incoterm_2010.csv
Rows : 1
Columns : 9
############
  Shipping_Term  Seller Carrier Port_From  ... Port_To Terminal Named_Place  Buyer
1           FCA  Seller  Seller     Buyer  ...   Buyer    Buyer       Buyer  Buyer

[1 rows x 9 columns]
### Done!! ############################################
```

CPT—Carriage Paid To (Named Place of Destination)

C:\VKHCG\03-Hillman\01-Retrieve.

CIP—Carriage and Insurance Paid To (Named Place of Destination)

DAT—Delivered at Terminal (Named Terminal at Port or Place of Destination)
DAP—Delivered at Place (Named Place of Destination)

DDP—Delivered Duty Paid (Named Place of Destination)
By this term, the seller is responsible for delivering the goods to the named place in the country of the buyer and pays all costs in bringing the goods to the destination, including import duties and taxes. The seller is not responsible for unloading. This term places the maximum obligations on the seller and minimum obligations on the buyer. No risk or responsibility is transferred to the buyer until delivery of the goods at the named place of destination.

Possible Shipping Routes
There are numerous potential shipping routes available to the company. The retrieve step can generate the potential set, by using a route combination generator. This will give you a set of routes, but it is highly unlikely that you will ship along all of them. It is simply a population of routes that can be used by the data science to find the optimum solution.
Start your Python editor and create a file named Retrieve-Warehouse-Incoterm-Chains.py in directory C:\VKHCG\03-Hillman\01-Retrieve.

Adopt New Shipping Containers
Adopting the best packing option for shipping in containers will require that I introduce a new concept. Shipping of containers is based on a concept reducing the packaging you use down to an optimum set of sizes having the following requirements:

- The product must fit within the box formed by the four sides of a cube.
- The product can be secured using packing foam, which will fill any void volume in the packaging.
- Packaging must fit in shipping containers with zero space gaps.
- Containers can only hold product that is shipped to a single warehouse, shop, or customer.

Start your Python editor and create a text file named Retrieve-Container-Plan.py in directory . C:\VKHCG\03-Hillman\01-Retrieve.
***** Replace pd.DataFrame.from_items with pd.DataFrame.from_dict**

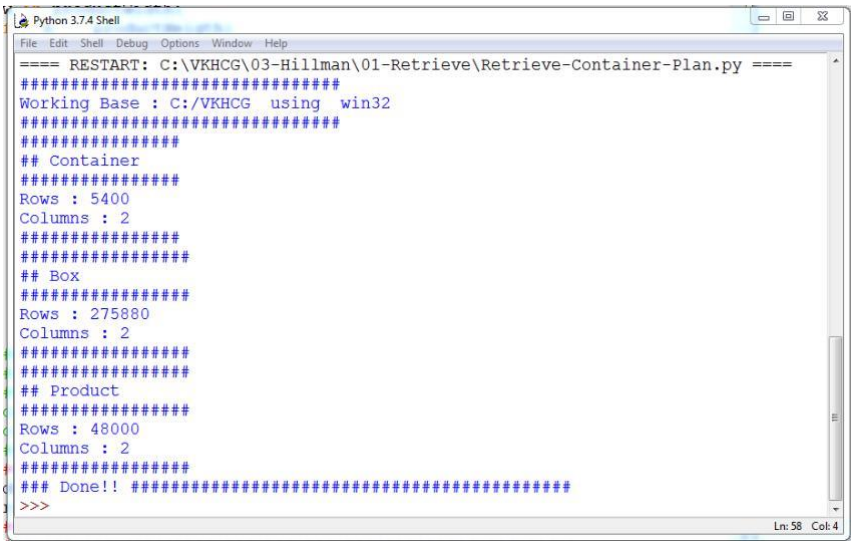
```
import sys
import os
import pandas as pd
################################################################
ContainerFileName='Retrieve_Container.csv'
BoxFileName='Retrieve_Box.csv'
ProductFileName='Retrieve_Product.csv'
Company='03-Hillman'
################################################################
Base='C:/VKHCG'
################################################################
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
################################################################
sFileDir=Base + '/' + Company + '/01-Retrieve/01-EDS/02-Python'
if not os.path.exists(sFileDir):
```

```
   os.makedirs(sFileDir)
#####################################################################
### Create the Containers
#####################################################################
containerLength=range(1,21)
containerWidth=range(1,10)
containerHeigth=range(1,6)
containerStep=1
c=0
for l in containerLength: for
   w in containerWidth:
      for h in containerHeigth:
         containerVolume=(l/containerStep)*(w/containerStep)*(h/containerStep)
         c=c+1
         ContainerLine=[('ShipType', ['Container']), ('UnitNumber',
                  ('C'+format(c,"06d"))), ('Length',(format(round(l,3),".4f"))),
                  ('Width',(format(round(w,3),".4f"))),
                  ('Height',(format(round(h,3),".4f"))),
                  ('ContainerVolume',(format(round(containerVolume,6),".6f")))]
         if c==1:
           ContainerFrame =
         pd.DataFrame.from_dict(ContainerLine) else:
            ContainerRow = pd.DataFrame.from_dict(ContainerLine)
            ContainerFrame = ContainerFrame.append(ContainerRow)
         ContainerFrame.index.name = 'IDNumber'

print('#################')
print('## Container')
print('#################')
print('Rows :',ContainerFrame.shape[0])
print('Columns :',ContainerFrame.shape[1])
print('#################')
#####################################################################
sFileContainerName=sFileDir + '/' + ContainerFileName
ContainerFrame.to_csv(sFileContainerName, index = False)
#####################################################################
## Create valid Boxes with packing foam
#####################################################################
boxLength=range(1,21)
boxWidth=range(1,21)
boxHeigth=range(1,21)
packThick=range(0,6)
boxStep=10
b=0
for l in boxLength: for
   w in boxWidth:
      for h in boxHeigth:
         for t in packThick:
            boxVolume=round((l/boxStep)*(w/boxStep)*(h/boxStep),6)
```

```
            productVolume=round(((l-t)/boxStep)*((w-t)/boxStep)*((h-t)/boxStep),6)
            if productVolume > 0:
               b=b+1
               BoxLine=[('ShipType', ['Box']), ('UnitNumber',
                 ('B'+format(b,"06d"))),
                 ('Length',(format(round(l/10,6),".6f"))),
                 ('Width',(format(round(w/10,6),".6f"))),
                 ('Height',(format(round(h/10,6),".6f"))),
                 ('Thickness',(format(round(t/5,6),".6f"))),
                 ('BoxVolume',(format(round(boxVolume,9),".9f"))),
                 ('ProductVolume',(format(round(productVolume,9),".9f")))]
               if b==1:
                 BoxFrame = pd.DataFrame.from_dict(BoxLine)
               else:
                  BoxRow = pd.DataFrame.from_dict(BoxLine)
                  BoxFrame = BoxFrame.append(BoxRow)
               BoxFrame.index.name = 'IDNumber'
print('#################')
print('## Box')
print('#################')
print('Rows :',BoxFrame.shape[0])
print('Columns :',BoxFrame.shape[1])
print('#################')
#####################################################################
sFileBoxName=sFileDir + '/' + BoxFileName
BoxFrame.to_csv(sFileBoxName, index = False)
#####################################################################
## Create valid Product
#####################################################################
productLength=range(1,21)
productWidth=range(1,21)
productHeigth=range(1,21)
productStep=10
p=0
for l in productLength: for
   w in productWidth:
      for h in productHeigth:
         productVolume=round((l/productStep)*(w/productStep)*(h/productStep),6) if
         productVolume > 0:
            p=p+1
            ProductLine=[('ShipType', ['Product']), ('UnitNumber',
              ('P'+format(p,"06d"))),
              ('Length',(format(round(l/10,6),".6f"))),
              ('Width',(format(round(w/10,6),".6f"))),
              ('Height',(format(round(h/10,6),".6f"))),
              ('ProductVolume',(format(round(productVolume,9),".9f")))]
            if p==1:
              ProductFrame =
            pd.DataFrame.from_dict(ProductLine) else:
               ProductRow = pd.DataFrame.from_dict(ProductLine)
```

```
            ProductFrame = ProductFrame.append(ProductRow)
        BoxFrame.index.name = 'IDNumber'
print('##################')
print('## Product')
print('##################')
print('Rows :',ProductFrame.shape[0])
print('Columns :',ProductFrame.shape[1])
print('##################')
#####################################################################
sFileProductName=sFileDir + '/' + ProductFileName
ProductFrame.to_csv(sFileProductName, index = False)
#####################################################################
#####################################################################
print('### Done!! ############################################')
#####################################################################
```

Output:



Your second simulation is the cardboard boxes for the packing of the products. The requirement is for boxes having a dimension of 100 centimeters × 100 centimeters × 100 centimeters to 2.1 meters × 2.1 meters × 2.1 meters. You can also use between zero and 600 centimeters of packing foam to secure any product in the box.

See the container data file Retrieve_Container.csv and Retrieve_Box.csv in C:\VKHCG\03-Hillman\01-Retrieve\01-EDS\02-Python.

Create a Delivery Route
The model enables you to generate a complex routing plan for the shipping routes of the company. Start your Python editor and create a text file named Retrieve-Route-Plan.py in directory .
C:\VKHCG\03-Hillman\01-Retrieve.

```
import os
import sys
import pandas as pd
from geopy.distance import vincenty
```

```
######################################################################
InputFileName='GB_Postcode_Warehouse.csv'
OutputFileName='Retrieve_GB_Warehouse.csv'
Company='03-Hillman'
######################################################################
Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
######################################################################
sFileDir=Base + '/' + Company + '/01-Retrieve/01-EDS/02-Python'
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
######################################################################
sFileName=Base + '/' + Company + '/00-RawData/' + InputFileName
print('############')
print('Loading :',sFileName)
Warehouse=pd.read_csv(sFileName,header=0,low_memory=False)
WarehouseClean=Warehouse[Warehouse.latitude != 0]
WarehouseGood=WarehouseClean[WarehouseClean.longitude != 0]
WarehouseGood.drop_duplicates(subset='postcode', keep='first', inplace=True)
WarehouseGood.sort_values(by='postcode', ascending=1)
######################################################################
sFileName=sFileDir + '/' + OutputFileName
WarehouseGood.to_csv(sFileName, index = False)

WarehouseLoop = WarehouseGood.head(20)

for i in range(0,WarehouseLoop.shape[0]):
   print('Run :',i,' ========>>>>>>>>>>>',WarehouseLoop['postcode'][i])
   WarehouseHold = WarehouseGood.head(10000)
   WarehouseHold['Transaction']=WarehouseHold.apply(lambda row:
            'WH-to-WH'
            ,axis=1)
   OutputLoopName='Retrieve_Route_' + 'WH-' + WarehouseLoop['postcode'][i] +
'_Route.csv'

   WarehouseHold['Seller']=WarehouseHold.apply(lambda row:
            'WH-' + WarehouseLoop['postcode'][i]
            ,axis=1)

   WarehouseHold['Seller_Latitude']=WarehouseHold.apply(lambda row:
            WarehouseHold['latitude'][i],axis=1)
   WarehouseHold['Seller_Longitude']=WarehouseHold.apply(lambda row:
            WarehouseLoop['longitude'][i],axis=1)

   WarehouseHold['Buyer']=WarehouseHold.apply(lambda row:
            'WH-' + row['postcode'],axis=1)

   WarehouseHold['Buyer_Latitude']=WarehouseHold.apply(lambda row:
```

```
            row['latitude'],axis=1)
    WarehouseHold['Buyer_Longitude']=WarehouseHold.apply(lambda row:
            row['longitude'],axis=1)

    WarehouseHold['Distance']=WarehouseHold.apply(lambda row: round(
        vincenty((WarehouseLoop['latitude'][i],WarehouseLoop['longitude'][i]),
            (row['latitude'],row['longitude'])).miles,6),axis=1)

    WarehouseHold.drop('id', axis=1, inplace=True)
    WarehouseHold.drop('postcode', axis=1, inplace=True)
    WarehouseHold.drop('latitude', axis=1, inplace=True)
    WarehouseHold.drop('longitude', axis=1, inplace=True)
    ######################################################################
    sFileLoopName=sFileDir + '/' + OutputLoopName
    WarehouseHold.to_csv(sFileLoopName, index = False)
######################################################################
print('### Done!! ############################################')
######################################################################
```

Output:

```
====== RESTART: C:\VKHCG\03-Hillman\01-Retrieve\Retrieve-Route-Plan.py ======
################################
Working Base : C:/VKHCG using win32
################################
###########
Loading : C:/VKHCG/03-Hillman/00-RawData/GB_Postcode_Warehouse.csv
Run : 0 =======>>>>>>>>>> AB10
Run : 1 =======>>>>>>>>>> AB11
Run : 2 =======>>>>>>>>>> AB12
Run : 3 =======>>>>>>>>>> AB13
Run : 4 =======>>>>>>>>>> AB14
Run : 5 =======>>>>>>>>>> AB15
Run : 6 =======>>>>>>>>>> AB16
Run : 7 =======>>>>>>>>>> AB21
Run : 8 =======>>>>>>>>>> AB22
Run : 9 =======>>>>>>>>>> AB23
Run : 10 =======>>>>>>>>>> AB24
Run : 19 =======>>>>>>>>>> AB37
### Done!! ############################################
>>>
```

See the collection of files similar in format to Retrieve_Route_WH-AB11_Route.csv in C:\VKHCG\03-Hillman\01-Retrieve\01-EDS\02-Python.

	Transaction	Seller	Seller_Latitude	Seller_Longitude	Buyer	Buyer_Latitude	Buyer_Longitude	Distance
2	WH-to-WH	WH-AB11	57.13875	-2.09089	WH-AB10	57.13514	-2.11731	1.024915
3	WH-to-WH	WH-AB11	57.13875	-2.09089	WH-AB11	57.13875	-2.09089	0
4	WH-to-WH	WH-AB11	57.13875	-2.09089	WH-AB12	57.101	-2.1106	2.715503
5	WH-to-WH	WH-AB11	57.13875	-2.09089	WH-AB13	57.10801	-2.23776	5.922893

Global Post Codes

Open RStudio and use R to process the following R script:

Retrieve-Postcode-Global.r.

```
library(readr)
All_Countries <- read_delim("C:/VKHCG/03-Hillman/00-RawData/All_Countries.txt",
                    "\t", col_names = FALSE,
                    col_types = cols(
                      X12 = col_skip(),
                      X6 = col_skip(),
                      X7 = col_skip(),
                      X8 = col_skip(),
                      X9 = col_skip()),
                    na = "null", trim_ws = TRUE)
write.csv(All_Countries,
        file = "C:/VKHCG/03-Hillman/01-Retrieve/01-EDS/01-
R/Retrieve_All_Countries.csv")
```

Output:

The program will successfully uploaded a new file named Retrieve_All_Countries.csv, after removing column No. 6, 7, 8, 9 and 12 from All_Countries.txt

	A	B	C	D	E	F	G	H
1		X1	X2	X3	X4	X5	X10	X11
2	1	x1	x2	x3	x4	x5	x10	x11
3	2	AD	AD100	Canillo			42.5833	1.6667
4	3	AD	AD200	Encamp			42.5333	1.6333
5	4	AD	AD300	Ordino			42.6	1.55
6	5	AD	AD400	La Massana			42.5667	1.4833
7	6	AD	AD500	Andorra la Vella			42.5	1.5
8	7	AD	AD600	Sant Juli<c3> de Lòria			42.4667	1.5
9	8	AD	AD700	Escaldes-Engordany			42.5	1.5667
10	9	AR	3636	POZO CERCADO (EL CHORRO (F), DPTO. RIVADAVIA (S))	Salta	A	-23.4933	-61.9267
11	10	AR	4123	LAS SALADAS	Salta	A	-25.7833	-64.5

Clark Ltd

Clark is the financial powerhouse of the group. It must process all the money-related data sources.

Forex-The first financial duty of the company is to perform any foreign exchange trading.

Forex Base Data-Previously, you found a single data source (Euro_ExchangeRates.csv) for forex rates in Clark. Earlier in the chapter, I helped you to create the load, as part of your R processing.

The relevant file is Retrieve_Retrieve_Euro_ExchangeRates.csv in directory C:\ VKHCG\04-Clark\01-Retrieve\01-EDS\01-R. So, that data is ready.

Financials - Clark generates the financial statements for all the group's companies.

Financial Base Data - You found a single data source (Profit_And_Loss.csv) in Clark for financials and, as mentioned previously, a single data source (Euro_ExchangeRates.csv) for forex rates. The file relevant file is Retrieve_Profit_And_Loss.csv in directory C:\VKHCG\04-Clark\01-Retrieve\ 01-EDS\01-R.

Person Base Data

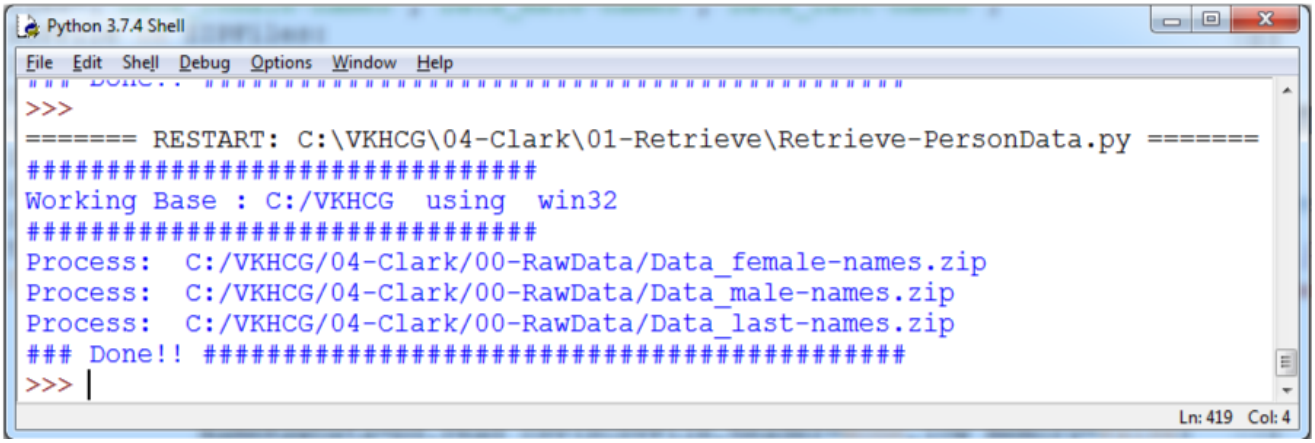
Start Python editor and create a file named Retrieve-PersonData.py in directory . C:\VKHCG\04-Clark\01-Retrieve.

```
################################################################
# -*- coding: utf-8 -*-
```

```
import sys
import os
import shutil
import zipfile
import pandas as pd
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
Company='04-Clark'
ZIPFiles=['Data_female-names','Data_male-names','Data_last-names']
for ZIPFile in ZIPFiles:
    InputZIPFile=Base+'/'+Company+'/00-RawData/' + ZIPFile + '.zip'
    OutputDir=Base+'/'+Company+'/01-Retrieve/01-EDS/02-Python/' + ZIPFile
    OutputFile=Base+'/'+Company+'/01-Retrieve/01-EDS/02-Python/Retrieve-'+ZIPFile+'.csv'
    zip_file = zipfile.ZipFile(InputZIPFile, 'r')
    zip_file.extractall(OutputDir)
    zip_file.close()
    t=0
    for dirname, dirnames, filenames in os.walk(OutputDir):
        for filename in filenames:
            sCSVFile = dirname + '/' + filename
            t=t+1
            if t==1:
                NameRawData=pd.read_csv(sCSVFile,header=None,low_memory=False)
                NameData=NameRawData
            else:
                NameRawData=pd.read_csv(sCSVFile,header=None,low_memory=False)
                NameData=NameData.append(NameRawData)
    NameData.rename(columns={0 : 'NameValues'},inplace=True)
    NameData.to_csv(OutputFile, index = False)
    shutil.rmtree(OutputDir)
    print('Process: ',InputZIPFile)
print('### Done!! ############################################')
```

This generates three files named

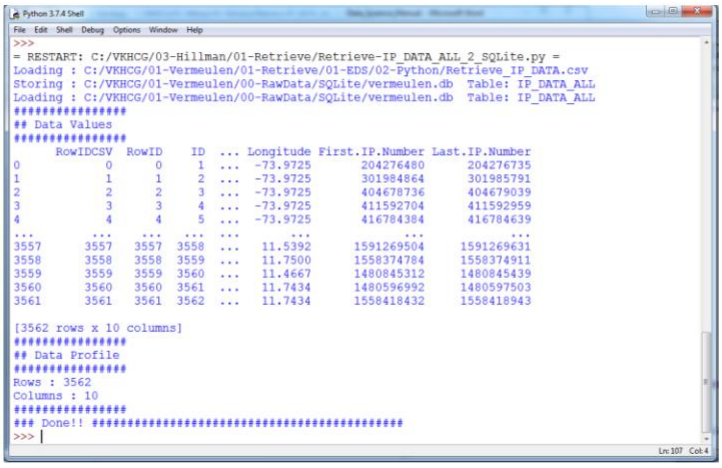
Retrieve-Data_female-names.csv
Retrieve-Data_male-names.csv
Retrieve-Data_last-names.csv



Connecting to other Data Sources

A. Program to connect to different data sources. SQLite:

```
# -*- coding: utf-8 -*-
import sqlite3 as sq
import pandas as pd
Base='C:/VKHCG'
sDatabaseName=Base + '/01-Vermeulen/00-RawData/SQLite/vermeulen.db'
conn = sq.connect(sDatabaseName)
sFileName='C:/VKHCG/01-Vermeulen/01-Retrieve/01-EDS/02-
Python/Retrieve_IP_DATA.csv'
print('Loading :',sFileName)
IP_DATA_ALL_FIX=pd.read_csv(sFileName,header=0,low_memory=False)
IP_DATA_ALL_FIX.index.names = ['RowIDCSV']
sTable='IP_DATA_ALL'
print('Storing :',sDatabaseName,' Table:',sTable)
IP_DATA_ALL_FIX.to_sql(sTable, conn, if_exists="replace")
print('Loading :',sDatabaseName,' Table:',sTable)
TestData=pd.read_sql_query("select * from IP_DATA_ALL;", conn)
print('#################')
print('## Data Values')
print('#################')
print(TestData)
print('#################')
print('## Data Profile')
print('#################')
print('Rows :',TestData.shape[0])
print('Columns :',TestData.shape[1])
print('#################')
print('### Done!! ############################################')
```



MySQL:

Open MySql

Create a database “DataScience”

Create a python file and add the following code:

```
################# Connection With MySQL ######################
import mysql.connector

conn = mysql.connector.connect(host='localhost',
                               database='DataScience',
                               user='root',
                               password='root')
conn.connect
if(conn.is_connected):
   print('###### Connection With MySql Established Successfullly ##### ')
else:
   print('Not Connected -- Check Connection Properites')
```

```
>>>
 RESTART: C:/Users/User/AppData/Local/Programs/Python/Python37-32/mysqlconnection.py
###### Connection With MySql Established Successfullly #####
>>>
```

Microsoft Excel

```
##################Retrieve-Country-Currency.py
#######################################################################
# -*- coding: utf-8 -*-
#######################################################################
import os
import pandas as pd
#######################################################################
Base='C:/VKHCG'
#######################################################################
sFileDir=Base + '/01-Vermeulen/01-Retrieve/01-EDS/02-
Python' #if not os.path.exists(sFileDir):
#os.makedirs(sFileDir)
#######################################################################
CurrencyRawData = pd.read_excel('C:/VKHCG/01-Vermeulen/00-
RawData/Country_Currency.xlsx')
```

```
sColumns = ['Country or territory', 'Currency', 'ISO-4217']
CurrencyData = CurrencyRawData[sColumns]
CurrencyData.rename(columns={'Country or territory': 'Country', 'ISO-4217':
'CurrencyCode'}, inplace=True)
CurrencyData.dropna(subset=['Currency'],inplace=True)
CurrencyData['Country'] = CurrencyData['Country'].map(lambda x: x.strip())
CurrencyData['Currency'] = CurrencyData['Currency'].map(lambda x:
x.strip())
CurrencyData['CurrencyCode'] = CurrencyData['CurrencyCode'].map(lambda x:
x.strip())
print(CurrencyData)
print('~~~~~~~ Data from Excel Sheet Retrived Successfully ~~~~~~~ ')
########################################################################
sFileName=sFileDir + '/Retrieve-Country-Currency.csv'
CurrencyData.to_csv(sFileName, index = False)
########################################################################
```

OUTPUT:

```
                    Country              Currency CurrencyCode
1               Afghanistan         Afghan afghani          AFN
2    Akrotiri and Dhekelia (UK)          European euro          EUR
3       Aland Islands (Finland)          European euro          EUR
4                       Albania           Albanian lek          ALL
5                       Algeria         Algerian dinar          DZD
..                          ...                   ...          ...
271          Wake Island (USA)  United States dollar          USD
272  Wallis and Futuna (France)              CFP franc          XPF
274                       Yemen          Yemeni rial          YER
276                      Zambia        Zambian kwacha          ZMW
277                    Zimbabwe  United States dollar          USD

[253 rows x 3 columns]
~~~~~~~ Data from Excel Sheet Retrived Successfully ~~~~~~~
>>>
```

Practical 5:
Assessing Data

Assess Superstep

Data quality refers to the condition of a set of qualitative or quantitative variables. Dataquality is a multidimensional measurement of the acceptability of specific data sets. Inbusiness, data quality is measured to determine whether data can be used as a basis forreliable intelligence extraction for supporting organizational decisions. Data profiling involves observing in your data sources all the viewpoints that theinformation offers. The main goal is to determine if individual viewpoints are accurateand complete. The Assess superstep determines what additional processing to apply tothe entries that are noncompliant.

Errors

Typically, one of four things can be done with an error to the data.

1. Accept the Error
2. Reject the Error
3. Correct the Error
4. Create a Default Value

A. Perform error management on the given data using pandas package.

Python pandas package enables several automatic error-management features.

File Location: C:\VKHCG\01-Vermeulen\02-Assess

Missing Values in Pandas:

i. Drop the Columns Where All Elements Are Missing Values

	A	B	C	D	E	F	G	H
1	ID	FieldA	FieldB	FieldC	FieldD	FieldE	FieldF	FieldG
2	1	Good	Better	Best	1024		10241	1
3	2	Good		Best	512		5121	2
4	3	Good	Better		256		256	3
5	4	Good	Better	Best			211	4
6	5	Good	Better		64		6411	5
7	6	Good		Best	32		32	6
8	7		Better	Best	16		1611	7
9	8			Best	8		8111	8
10	9				4		41	9
11	10	A	B	C	2		21111	10
12								11
13	10	Good	Better	Best	1024		102411	12
14	10	Good		Best	512		512	13
15	10	Good	Better		256		1256	14
16	10	Good	Better	Best				15
17	10	Good	Better		64		164	16
18	10	Good		Best	32		322	17
19	10		Better	Best	16		163	18
20	10			Best	8		844	19
21	10				4		4555	20
22	10	A	B	C	2		111	21

Code :

```
##################### Assess-Good-Bad-01.py#########################
# -*- coding: utf-8 -*-
#####################################################################
import sys
import os
import pandas as pd
#####################################################################
Base='C:/VKHCG'
#####################################################################
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
#####################################################################
sInputFileName='Good-or-Bad.csv'
sOutputFileName='Good-or-Bad-01.csv'
```

```
Company='01-Vermeulen'
##################################################################
Base='C:/VKHCG'
##################################################################
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-Python'
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
##################################################################
### Import Warehouse
##################################################################
sFileName=Base + '/' + Company + '/00-RawData/' +
sInputFileName print('Loading :',sFileName)
RawData=pd.read_csv(sFileName,header=0)
print('##################################')
print('## Raw Data Values')
print('##################################')
print(RawData)
print('##################################')
print('## Data Profile')
print('##################################')
print('Rows :',RawData.shape[0])
print('Columns :',RawData.shape[1])
print('##################################')
##################################################################
sFileName=sFileDir + '/' + sInputFileName
RawData.to_csv(sFileName, index = False)
##################################################################
TestData=RawData.dropna(axis=1, how='all')
##################################################################
print('##################################')
print('## Test Data Values')
print('##################################')
print(TestData)
print('##################################')
print('## Data Profile')
print('##################################')
print('Rows :',TestData.shape[0])
print('Columns :',TestData.shape[1])
print('##################################')
##################################################################
sFileName=sFileDir + '/' + sOutputFileName
TestData.to_csv(sFileName, index = False)
##################################################################
print('##################################')
print('### Done!! ####################')
print('##################################')
##################################################################
```

Output:

```
>>>
```

```
======= RESTART: C:\VKHCG\01-Vermeulen\02-Assess\Assess-Good-Bad-01.py
=======
################################
Working Base : C:/VKHCG using win32
################################
Loading : C:/VKHCG/01-Vermeulen/00-RawData/Good-or-Bad.csv
################################
## Raw Data Values
################################
    ID FieldA  FieldB FieldC  FieldD FieldE   FieldF FieldG
 0 1.0   Good Better    Best 1024.0     NaN   10241.0      1
 1 2.0   Good    NaN    Best  512.0     NaN    5121.0      2
 2 3.0   Good Better     NaN  256.0     NaN     256.0      3
 3 4.0   Good Better    Best    NaN     NaN     211.0      4
 4 5.0   Good Better     NaN   64.0     NaN    6411.0      5
 5 6.0   Good    NaN    Best   32.0     NaN      32.0      6
 6 7.0    NaN  Better   Best   16.0     NaN    1611.0      7
 7 8.0    NaN    NaN    Best    8.0     NaN    8111.0      8
 8 9.0    NaN    NaN     NaN    4.0     NaN      41.0      9
9   10.0    A      B       C      2.0    NaN   21111.0       10
10   NaN   NaN     NaN    NaN     NaN     NaN          NaN11
11   10.0 Good  Better   Best 1024.0     NaN 102411.0       12
12   10.0 Good    NaN    Best  512.0     NaN     512.0      13
13   10.0 Good  Better    NaN  256.0     NaN    1256.0      14
14   10.0 Good  Better   Best    NaN     NaN       NaN      15
15   10.0 Good  Better    NaN   64.0     NaN     164.0      16
16   10.0 Good    NaN    Best   32.0     NaN     322.0      17
17   10.0  NaN  Better   Best   16.0     NaN     163.0      18
18   10.0  NaN    NaN    Best    8.0     NaN     844.0      19
19   10.0  NaN    NaN     NaN    4.0     NaN    4555.0      20
20   10.0    A      B       C  2.0      NaN     111.0       21
```

All of column E has been deleted, owing to the fact that all values in that column were missing values/errors.

ii. Drop the Columns Where Any of the Elements Is Missing Values

```
################### Assess-Good-Bad-02.py############################
import sys
import os
import pandas as pd Base='C:/VKHCG'
sInputFileName='Good-or-Bad.csv'
sOutputFileName='Good-or-Bad-02.csv'
Company='01-Vermeulen'

################################################################
Base='C:/VKHCG'
################################################################
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
```

```
    sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-Python'
    if not os.path.exists(sFileDir):
       os.makedirs(sFileDir)
    ########################################################################
    ### Import Warehouse
    ########################################################################
    sFileName=Base + '/' + Company + '/00-RawData/' +
    sInputFileName print('Loading :',sFileName)
    RawData=pd.read_csv(sFileName,header=0)
    print('#################################')
    print('## Raw Data Values')
    print('#################################')
    print(RawData)
    print('#################################')
    print('## Data Profile')
    print('#################################')
    print('Rows :',RawData.shape[0])
    print('Columns :',RawData.shape[1])
    print('#################################')
    ########################################################################
    sFileName=sFileDir + '/' + sInputFileName
    RawData.to_csv(sFileName, index = False)
    ########################################################################
    TestData=RawData.dropna(axis=1, how='any')
    ########################################################################
    print('#################################')
    print('## Test Data Values')
    print('#################################')
    print(TestData)
    print('#################################')
    print('## Data Profile')
    print('#################################')
    print('Rows :',TestData.shape[0])
    print('Columns :',TestData.shape[1])
    print('#################################')
    ########################################################################
    sFileName=sFileDir + '/' + sOutputFileName
    TestData.to_csv(sFileName, index = False)
    ########################################################################
    print('#################################')
    print('### Done!! ####################')
    print('#################################')
    ########################################################################
>>>
======= RESTART: C:\VKHCG\01-Vermeulen\02-Assess\Assess-Good-Bad-02.py
=======
################################
Working Base : C:/VKHCG using win32
################################
Loading : C:/VKHCG/01-Vermeulen/00-RawData/Good-or-Bad.csv
```

```
################################
## Raw Data Values
################################
    ID FieldA  FieldB FieldC  FieldD FieldE     FieldF FieldG
 0  1.0   Good Better      Best 1024.0   NaN    10241.0      1
 1  2.0   Good    NaN   Best    512.0   NaN     5121.0      2
################################
## Data Profile
################################
Rows : 21
Columns : 8
################################
################################
## Test Data Values
################################
   FieldG
0       1
1       2
################################
## Data Profile
################################
Rows : 21
Columns : 1
################################
################################
### Done!! ####################
################################
>>>
```

iii. Keep Only the Rows That Contain a Maximum of Two Missing Values

```
#####################   Assess-Good-Bad-03.py ################
# -*- coding: utf-8 -*-
#########################################################################
import sys
import os
import pandas as pd
#########################################################################
sInputFileName='Good-or-Bad.csv'
sOutputFileName='Good-or-Bad-03.csv'
Company='01-Vermeulen'
Base='C:/VKHCG'
#########################################################################
print('#################################')
print('Working Base :',Base, ' using Windows ~~~~')
print('#################################')
#########################################################################
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-Python'
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#########################################################################
### Import Warehouse
#########################################################################
sFileName=Base + '/' + Company + '/00-RawData/' +
sInputFileName print('Loading :',sFileName)
RawData=pd.read_csv(sFileName,header=0)
print('#################################')
print('## Raw Data Values')
print('#################################')
print(RawData)
print('#################################')
print('## Data Profile')
print('#################################')
print('Rows :',RawData.shape[0])
print('Columns :',RawData.shape[1])
print('#################################')
#########################################################################
sFileName=sFileDir + '/' + sInputFileName
RawData.to_csv(sFileName, index = False)
#########################################################################
TestData=RawData.dropna(thresh=2)
print('#################################')
print('## Test Data Values')
print('#################################')
print(TestData)
print('#################################')
print('## Data Profile')
print('#################################')
print('Rows :',TestData.shape[0])
print('Columns :',TestData.shape[1])
```

```
print('#################################')
sFileName=sFileDir + '/' + sOutputFileName
TestData.to_csv(sFileName, index = False)
#########################################################################
print('#################################')
print('### Done!! ######################')
print('#################################')
#########################################################################
```

	A	B	C	D	E	F	G	H
1	ID	FieldA	FieldB	FieldC	FieldD	FieldE	FieldF	FieldG
2	1	Good	Better	Best	1024		10241	1
3	2	Good		Best	512		5121	2
4	3	Good	Better		256		256	3
5	4	Good	Better	Best			211	4
6	5	Good	Better		64		6411	5
7	6	Good		Best	32		32	6
8	7		Better	Best	16		1611	7
9	8			Best	8		8111	8
10	9				4		41	9
11	10	A	B	C	2		21111	10

Before After

	A	B	C	D	E	F	G	H
1	ID	FieldA	FieldB	FieldC	FieldD	FieldE	FieldF	FieldG
2	1	Good	Better	Best	1024		10241	1
3	2	Good		Best	512		5121	2
4	3	Good	Better		256		256	3
5	4	Good	Better	Best			211	4
6	5	Good	Better		64		6411	5
7	6	Good		Best	32		32	6
8	7		Better	Best	16		1611	7
9	8			Best	8		8111	8
10	9				4		41	9
11	10	A	B	C	2		21111	10

Row with more than two missing values got deleted.

The next step along the route is to generate a full network routing solution for the company, to resolve the data issues in the retrieve data.

B. Write Python / R program to create the network routing diagram from the given data onrouters.

```
########## Assess-Network-Routing-Company.py ####################
import sys
import os
import pandas as pd
#########################################################################
pd.options.mode.chained_assignment = None
#########################################################################
Base='C:/VKHCG'
#########################################################################
print('#################################')
print('Working Base :',Base, ' using Windows')
print('#################################')
#########################################################################
sInputFileName1='01-Retrieve/01-EDS/01-R/Retrieve_Country_Code.csv'
sInputFileName2='01-Retrieve/01-EDS/02-Python/Retrieve_Router_Location.csv'
sInputFileName3='01-Retrieve/01-EDS/01-R/Retrieve_IP_DATA.csv'
#########################################################################
sOutputFileName='Assess-Network-Routing-Company.csv'
Company='01-Vermeulen'
#########################################################################
#########################################################################
### Import Country Data
#########################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName1
```

```
print('################################')
print('Loading :',sFileName)
print('################################')
CountryData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
print('Loaded Country:',CountryData.columns.values)
print('################################')
#####################################################################
## Assess Country Data
#####################################################################
print('################################') print('Changed
:',CountryData.columns.values) CountryData.rename(columns={'Country':
'Country_Name'}, inplace=True) CountryData.rename(columns={'ISO-2-
CODE': 'Country_Code'}, inplace=True) CountryData.drop('ISO-M49', axis=1,
inplace=True) CountryData.drop('ISO-3-Code', axis=1, inplace=True)
CountryData.drop('RowID', axis=1, inplace=True)

print('To :',CountryData.columns.values)
print('################################')
#####################################################################
#####################################################################
### Import Company Data
#####################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName2
print('################################')
print('Loading :',sFileName)
print('################################')
CompanyData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-
1")
print('Loaded Company :',CompanyData.columns.values)
print('################################')
#####################################################################
## Assess Company Data
#####################################################################
print('################################') print('Changed
:',CompanyData.columns.values)
CompanyData.rename(columns={'Country': 'Country_Code'},
inplace=True) print('To :',CompanyData.columns.values)
print('################################')
### Import Customer Data
#####################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName3
print('################################') print('Loading :',sFileName)
print('################################')
CustomerRawData=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin-1") print('################################')

print('Loaded Customer :',CustomerRawData.columns.values)
print('################################')
#####################################################################
```

```
CustomerData=CustomerRawData.dropna(axis=0, how='any')
print('#################################')
print('Remove Blank Country Code')
print('Reduce Rows from', CustomerRawData.shape[0],' to ', CustomerData.shape[0])
print('#################################')
#####################################################################
print('#################################')
print('Changed :',CustomerData.columns.values)
CustomerData.rename(columns={'Country': 'Country_Code'}, inplace=True)
print('To :',CustomerData.columns.values)
print('#################################')
#####################################################################
print('#################################')
print('Merge Company and Country Data')
print('#################################')
CompanyNetworkData=pd.merge(
      CompanyData,
      CountryData,
      how='inner',
      on='Country_Code'
      )
#####################################################################
print('#################################')
print('Change ',CompanyNetworkData.columns.values)
for i in CompanyNetworkData.columns.values:
   j='Company_'+i
   CompanyNetworkData.rename(columns={i: j}, inplace=True)
print('To ', CompanyNetworkData.columns.values)
print('#################################')
#####################################################################
#####################################################################
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-Python'
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#####################################################################
sFileName=sFileDir + '/' + sOutputFileName
print('#################################')
print('Storing :', sFileName)
print('#################################')
CompanyNetworkData.to_csv(sFileName, index = False, encoding="latin-1")
#####################################################################
#####################################################################
print('#################################')
print('### Done!! ####################')
print('#################################')
#####################################################################
```

Output:
Go to C:\VKHCG\01-Vermeulen\02-Assess\01-EDS\02-Python folder and open Assess-Network-Routing-Company.csv

	A	B	C	D	E
1	ny_Countr	Company_Place_Name	Company_Latitude	Company_Longitude	Company_Country_Name
2	US	New York	40.7528	-73.9725	United States of America
3	US	New York	40.7214	-74.0052	United States of America
4	US	New York	40.7662	-73.9862	United States of America
5	US	New York	40.7449	-73.9782	United States of America
6	US	New York	40.7605	-73.9933	United States of America
7	US	New York	40.7588	-73.968	United States of America
8	US	New York	40.7637	-73.9727	United States of America
9	US	New York	40.7553	-73.9924	United States of America

Next, Access the the customers location using network router location.

```
####################Assess-Network-Routing-Customer.py ######################
import sys
import os
import pandas as pd
#####################################################################
pd.options.mode.chained_assignment = None
#####################################################################
Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
#####################################################################
sInputFileName=Base+'/01-Vermeulen/02-Assess/01-EDS/02-Python/Assess-Network-
Routing-Customer.csv'
#####################################################################
sOutputFileName='Assess-Network-Routing-
Customer.gml' Company='01-Vermeulen'
#####################################################################
### Import Country Data
#####################################################################
sFileName=sInputFileName
print('##################################')
print('Loading :',sFileName)
print('##################################')
CustomerData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-
1") print('Loaded Country:',CustomerData.columns.values)
print('##################################')
print(CustomerData.head())
print('##################################')
print('### Done!! ####################')
print('##################################')
#####################################################################
```

Output

Assess-Network-Routing-Customer.csv

	A	B	C	D	E
1	ıer_Countr	tomer_Place_Na	Customer_Latitude	Customer_Longitude	Customer_Country_Name
2	BW	Gaborone	-24.6464	25.9119	Botswana
3	BW	Francistown	-21.1667	27.5167	Botswana
4	BW	Maun	-19.9833	23.4167	Botswana
5	BW	Molepolole	-24.4167	25.5333	Botswana
6	NE	Niamey	13.5167	2.1167	Niger
7	MZ	Maputo	-25.9653	32.5892	Mozambique
8	MZ	Tete	-16.1564	33.5867	Mozambique
9	MZ	Quelimane	-17.8786	36.8883	Mozambique
10	MZ	Chimoio	-19.1164	33.4833	Mozambique
11	MZ	Matola	-25.9622	32.4589	Mozambique
12	MZ	Pemba	-12.9608	40.5078	Mozambique
13	MZ	Lichinga	-13.3128	35.2406	Mozambique
14	MZ	Maxixe	-23.8597	35.3472	Mozambique
15	MZ	Chibuto	-24.6867	33.5306	Mozambique
16	MZ	Ressano Garcia	-25.4428	31.9953	Mozambique
17	GH	Tema	5.6167	-0.0167	Ghana
18	GH	Kumasi	6.6833	-1.6167	Ghana
19	GH	Takoradi	4.8833	-1.75	Ghana
20	GH	Accra	5.55	-0.2167	Ghana

Assess-Network-Routing-Node.py

```
#####################################################################
import sys
import os
import pandas as pd
#####################################################################
pd.options.mode.chained_assignment = None
#####################################################################
Base='C:/VKHCG'
#####################################################################
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
#####################################################################
sInputFileName='01-Retrieve/01-EDS/02-Python/Retrieve_IP_DATA.csv'
#####################################################################
sOutputFileName='Assess-Network-Routing-Node.csv'
Company='01-Vermeulen'
#####################################################################
### Import IP Data
#####################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName
print('##################################')
print('Loading :',sFileName)
print('##################################')
IPData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-
1") print('Loaded IP :', IPData.columns.values)
print('##################################')
#####################################################################
print('##################################') print('Changed
:',IPData.columns.values) IPData.drop('RowID', axis=1, inplace=True)
IPData.drop('ID', axis=1, inplace=True)
IPData.rename(columns={'Country': 'Country_Code'}, inplace=True)
IPData.rename(columns={'Place.Name': 'Place_Name'}, inplace=True)
IPData.rename(columns={'Post.Code': 'Post_Code'}, inplace=True)
```

```
IPData.rename(columns={'First.IP.Number': 'First_IP_Number'}, inplace=True)
IPData.rename(columns={'Last.IP.Number': 'Last_IP_Number'}, inplace=True)
print('To :',IPData.columns.values)
print('#################################')
#####################################################################
print('#################################')
print('Change ',IPData.columns.values)
for i in IPData.columns.values:
    j='Node_'+i
    IPData.rename(columns={i: j}, inplace=True)
print('To ', IPData.columns.values)
print('#################################')
#####################################################################
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-Python'
if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
#####################################################################
sFileName=sFileDir + '/' + sOutputFileName
print('#################################')
print('Storing :', sFileName)
print('#################################')
IPData.to_csv(sFileName, index = False, encoding="latin-1")
#####################################################################
print('#################################')
print('### Done!! ####################')
print('#################################')
#####################################################################
```

Output:
C:/VKHCG/01-Vermeulen/02-Assess/01-EDS/02-Python/Assess-Network-Routing-Node.csv

	A	B	C	D	E	F	G
1	Node_Country_Code	Node_Place_Name	Node_Post_Code	Node_Latitude	Node_Longitude	ode_First_IP_Numb	Node_Last_IP_Number
2	BW	Gaborone		-24.6464	25.9119	692781056	692781567
3	BW	Gaborone		-24.6464	25.9119	692781824	692783103
4	BW	Gaborone		-24.6464	25.9119	692909056	692909311
5	BW	Gaborone		-24.6464	25.9119	692909568	692910079
6	BW	Gaborone		-24.6464	25.9119	693051392	693052415
7	BW	Gaborone		-24.6464	25.9119	693078272	693078527
8	BW	Gaborone		-24.6464	25.9119	693608448	693616639
9	BW	Gaborone		-24.6464	25.9119	696929792	696930047
10	BW	Gaborone		-24.6464	25.9119	700438784	700439039
11	BW	Gaborone		-24.6464	25.9119	702075904	702076927
12	BW	Gaborone		-24.6464	25.9119	702498816	702499839
13	BW	Gaborone		-24.6464	25.9119	702516224	702517247
14	BW	Gaborone		-24.6464	25.9119	774162663	774162667
15	BW	Gaborone		-24.6464	25.9119	1401887232	1401887743
16	BW	Gaborone		-24.6464	25.9119	1754209024	1754209279
17	NE	Niamey		13.5167	2.1167	696918528	696919039
18	NE	Niamey		13.5167	2.1167	696922112	696924159
19	NE	Niamey		13.5167	2.1167	701203456	701203711
20	NE	Niamey		13.5167	2.1167	758886912	758887167
21	NE	Niamey		13.5167	2.1167	1347294153	1347294160
22	NE	Niamey		13.5167	2.1167	1755108096	1755108351
23	NE	Niamey		13.5167	2.1167	1755828480	1755828735
24	MZ	Maputo		-25.9653	32.5892	692883456	692883967
25	MZ	Maputo		-25.9653	32.5892	692944896	692946943

Directed Acyclic Graph (DAG)
A directed acyclic graph is a specific graph that only has one path through the graph.

C. Write a Python / R program to build directed acyclic graph.

Open your python editor and create a file named Assess-DAG-Location.py in directory C:\VKHCG\01-Vermeulen\02-Assess

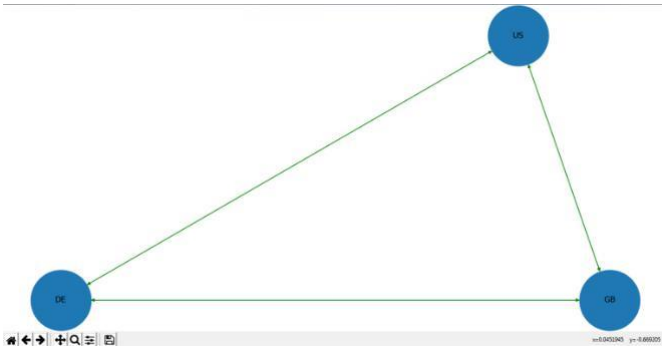
```
################################################################
import networkx as nx
import matplotlib.pyplot as plt
import sys
import os
import pandas as pd
################################################################
Base='C:/VKHCG'
################################################################
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
################################################################
sInputFileName='01-Retrieve/01-EDS/02-Python/Retrieve_Router_Location.csv'
sOutputFileName1='Assess-DAG-Company-Country.png'
sOutputFileName2='Assess-DAG-Company-Country-Place.png'
Company='01-Vermeulen'
################################################################
### Import Company Data
################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName
print('##################################')
print('Loading :',sFileName)
print('##################################')
CompanyData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-
1") print('Loaded Company :',CompanyData.columns.values)
print('##################################')
################################################################
print(CompanyData)
print('##################################')
print('Rows : ',CompanyData.shape[0])
print('##################################')
################################################################
G1=nx.DiGraph()
G2=nx.DiGraph()
################################################################
for i in range(CompanyData.shape[0]):
   G1.add_node(CompanyData['Country'][i])
   sPlaceName= CompanyData['Place_Name'][i] + '-' + CompanyData['Country'][i]
   G2.add_node(sPlaceName)

print('##################################')
for n1 in G1.nodes():
```

```
    for n2 in G1.nodes():
        if n1 != n2:
            print('Link :',n1,' to ', n2)
            G1.add_edge(n1,n2)
print('#################################')

print('#################################')
print("Nodes of graph: ")
print(G1.nodes())
print("Edges of graph: ")
print(G1.edges())
print('#################################')
#####################################################################
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-Python'
if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
#####################################################################
sFileName=sFileDir + '/' + sOutputFileName1
print('#################################')
print('Storing :', sFileName)
print('#################################')
nx.draw(G1,pos=nx.spectral_layout(G1),
        nodecolor='r',edge_color='g',
        with_labels=True,node_size=8000,
        font_size=12)
plt.savefig(sFileName) # save as png
plt.show() # display
#####################################################################
print('#################################')
for n1 in G2.nodes():
    for n2 in G2.nodes():
        if n1 != n2:
            print('Link :',n1,' to ', n2)
            G2.add_edge(n1,n2)
print('#################################')

print('#################################')
print("Nodes of graph: ")
print(G2.nodes())
print("Edges of graph: ")
print(G2.edges())
print('#################################')
#####################################################################
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-Python'
if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
#####################################################################
sFileName=sFileDir + '/' + sOutputFileName2
print('#################################')
print('Storing :', sFileName)
```

```
print('################################')
nx.draw(G2,pos=nx.spectral_layout(G2),
        nodecolor='r',edge_color='b',
        with_labels=True,node_size=8000,
        font_size=12)
plt.savefig(sFileName) # save as png
plt.show() # display
#####################################################################
```

Output:

################################
Rows : 150
################################
################################
Link : US to DE
Link : US to GB
Link : DE to US
Link : DE to GB
Link : GB to US
Link : GB to DE
################################
################################
Nodes of graph:
['US', 'DE', 'GB']
Edges of graph:
[('US', 'DE'), ('US', 'GB'), ('DE', 'US'), ('DE', 'GB'), ('GB', 'US'), ('GB', 'DE')] ################################



Customer Location DAG

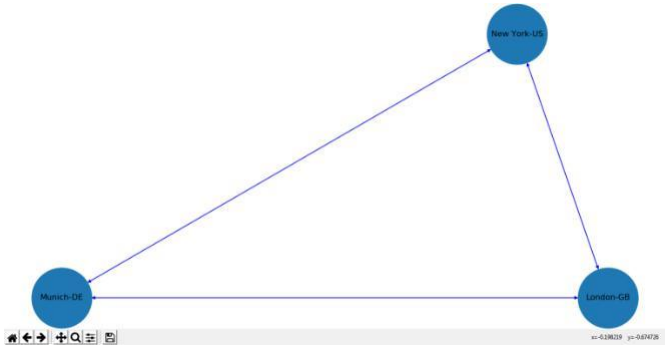
```
################### Assess-DAG-Location.py###################
import networkx as nx
import matplotlib.pyplot as plt
import sys
import os
import pandas as pd
#####################################################################
Base='C:/VKHCG'
#####################################################################
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
#####################################################################
sInputFileName='01-Retrieve/01-EDS/02-Python/Retrieve_Router_Location.csv'
sOutputFileName1='Assess-DAG-Company-Country.png'
sOutputFileName2='Assess-DAG-Company-Country-Place.png'
Company='01-Vermeulen'
#####################################################################
### Import Company Data
#####################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName
print('##################################')
print('Loading :',sFileName)
print('##################################')
CompanyData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-
1") print('Loaded Company :',CompanyData.columns.values)
print('##################################')
#####################################################################
print(CompanyData)
print('##################################')
print('Rows : ',CompanyData.shape[0])
print('##################################')
#####################################################################
G1=nx.DiGraph()
G2=nx.DiGraph()
#####################################################################
for i in range(CompanyData.shape[0]):
    G1.add_node(CompanyData['Country'][i])
    sPlaceName= CompanyData['Place_Name'][i] + '-' + CompanyData['Country'][i]
    G2.add_node(sPlaceName)

print('##################################')
for n1 in G1.nodes():
    for n2 in G1.nodes():
        if n1 != n2:
            print('Link :',n1,' to ', n2)
            G1.add_edge(n1,n2)
print('##################################')
```

```
print('################################')
print("Nodes of graph: ")
print(G1.nodes())
print("Edges of graph: ")
print(G1.edges())
print('################################')
#####################################################################
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-Python'
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#####################################################################
sFileName=sFileDir + '/' + sOutputFileName1
print('################################')
print('Storing :', sFileName)
print('################################')
nx.draw(G1,pos=nx.spectral_layout(G1),
        nodecolor='r',edge_color='g',
        with_labels=True,node_size=8000,
        font_size=12)
plt.savefig(sFileName) # save as png
plt.show() # display
#####################################################################
print('################################')
for n1 in G2.nodes():
   for n2 in G2.nodes():
      if n1 != n2:
         print('Link :',n1,' to ', n2)
         G2.add_edge(n1,n2)
print('################################')

print('################################')
print("Nodes of graph: ")
print(G2.nodes())
print("Edges of graph: ")
print(G2.edges())
print('################################')
#####################################################################
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-Python'
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#####################################################################
sFileName=sFileDir + '/' + sOutputFileName2
print('################################')
print('Storing :', sFileName)
print('################################')
nx.draw(G2,pos=nx.spectral_layout(G2),
        nodecolor='r',edge_color='b',
        with_labels=True,node_size=8000,
        font_size=12)
plt.savefig(sFileName) # save as png
```

```
plt.show() # display
#####################################################################
```

Output:

```
#################################
Link : New York-US to Munich-DE
Link : New York-US to  London-GB
Link : Munich-DE to New York-US
Link : Munich-DE to  London-GB
Link : London-GB to New York-US
Link : London-GB to Munich-DE
#################################
#################################
Nodes of graph:
['New York-US', 'Munich-DE', 'London-GB']
Edges of graph:
[('New York-US', 'Munich-DE'), ('New York-US', 'London-GB'), ('Munich-DE', 'New York-US'), ('Munich-DE', 'London-GB'), ('London-GB', 'New York-US'), ('London-GB', 'Munich-DE')]
```



Open your Python editor and create a file named Assess-DAG-GPS.py in directory C:\VKHCG\01-Vermeulen\02-Assess.

```
import networkx as nx
import matplotlib.pyplot as plt
import sys
import os
import pandas as pd
Base='C:/VKHCG'
print('#################################')
print('Working Base :',Base, ' using ', sys.platform)
print('#################################')
sInputFileName='01-Retrieve/01-EDS/02-Python/Retrieve_Router_Location.csv'
sOutputFileName='Assess-DAG-Company-GPS.png'
Company='01-Vermeulen'
### Import Company Data
sFileName=Base + '/' + Company + '/' + sInputFileName
print('#################################')
print('Loading :',sFileName)
print('#################################')
CompanyData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
```

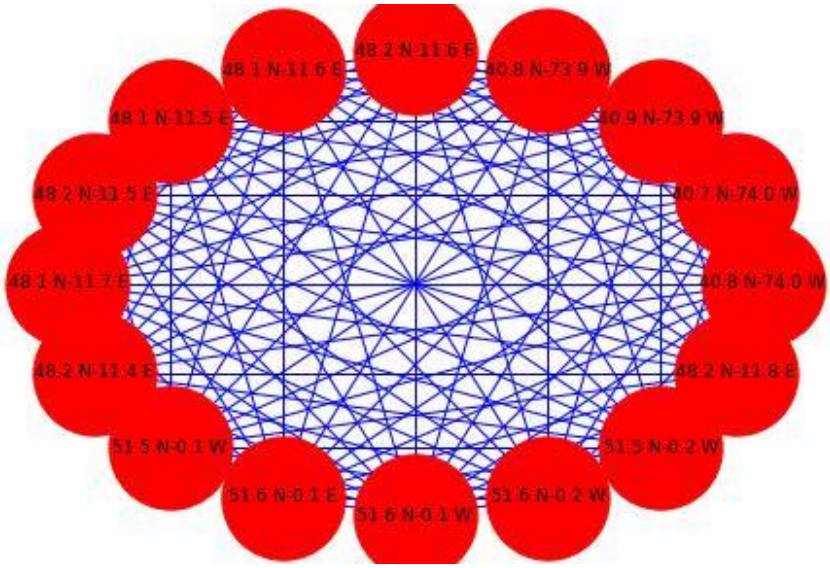
```
print('Loaded Company :',CompanyData.columns.values)
print('################################')
print(CompanyData)
print('################################')
print('Rows : ',CompanyData.shape[0])
print('################################')
G=nx.Graph()
for i in range(CompanyData.shape[0]):
    nLatitude=round(CompanyData['Latitude'][i],2)
    nLongitude=round(CompanyData['Longitude'][i],2)

    if nLatitude < 0:
        sLatitude = str(nLatitude*-1) + ' S'
    else:
        sLatitude = str(nLatitude) + ' N'

    if nLongitude < 0:
        sLongitude = str(nLongitude*-1) + ' W'
    else:
        sLongitude = str(nLongitude) + ' E'

    sGPS= sLatitude + '-' + sLongitude
    G.add_node(sGPS)

print('################################')
for n1 in G.nodes():
    for n2 in G.nodes():
        if n1 != n2:
            print('Link :',n1,' to ', n2)
            G.add_edge(n1,n2)
print('################################')

print('################################')
print("Nodes of graph: ")
print(G.number_of_nodes())
print("Edges of graph: ")
print(G.number_of_edges())
print('################################')
```

Output:

```
=== RESTART: C:\VKHCG\01-Vermeulen\02-Assess\Assess-DAG-GPS-unsmoothed.py
===
################################
Working Base : C:/VKHCG using win32
################################
Loading : C:/VKHCG/01-Vermeulen/01-Retrieve/01-EDS/02-
Python/Retrieve_Router_Location.csv
################################
Loaded Company : ['Country' 'Place_Name' 'Latitude' 'Longitude']
################################
```

	Country	Place_Name	Latitude	Longitude
0	US	New York	40.7528	-73.9725
1	US	New York	40.7214	-74.0052

-
-



D. Write a Python / R program to pick the content for Bill Boards from the given data.

Picking Content for Billboards

The basic process required is to combine two sets of data and then calculate the number of visitors per day from the range of IP addresses that access the billboards in Germany.

Bill Board Location: Rows - 8873

Access Visitors: Rows - 75999

Access Location Record: Rows – 1,81,235

Open Python editor and create a file named **Assess-DE-Billboard.py** in directory C:\VKHCG\02-Krennwallner\02-Assess

```
################## Assess-DE-Billboard.py######################
import sys
import os
import sqlite3 as sq
import pandas as pd
######################################################################
Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
######################################################################
sInputFileName1='01-Retrieve/01-EDS/02-
Python/Retrieve_DE_Billboard_Locations.csv' sInputFileName2='01-Retrieve/01-
EDS/02-Python/Retrieve_Online_Visitor.csv' sOutputFileName='Assess-DE-Billboard-
Visitor.csv' Company='02-Krennwallner'
######################################################################
sDataBaseDir=Base + '/' + Company + '/02-Assess/SQLite'
if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
```

```
#####################################################################
sDatabaseName=sDataBaseDir + '/krennwallner.db'
conn = sq.connect(sDatabaseName)
#####################################################################
### Import Billboard Data
#####################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName1
print('#################################')
print('Loading :',sFileName)
print('#################################')
BillboardRawData=pd.read_csv(sFileName,header=0,low_memory=False,
encoding="latin-1")
BillboardRawData.drop_duplicates(subset=None, keep='first',
inplace=True) BillboardData=BillboardRawData
print('Loaded Company :',BillboardData.columns.values)
print('#################################')
#####################################################################
print('################')
sTable='Assess_BillboardData' print('Storing
:',sDatabaseName,' Table:',sTable)
BillboardData.to_sql(sTable, conn,
if_exists="replace") print('################')
#####################################################################
print(BillboardData.head())
print('#################################')
print('Rows : ',BillboardData.shape[0])
print('#################################')
#####################################################################
### Import Billboard Data
#####################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName2
print('#################################')
print('Loading :',sFileName)
print('#################################')
VisitorRawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-
1") VisitorRawData.drop_duplicates(subset=None, keep='first', inplace=True)
VisitorData=VisitorRawData[VisitorRawData.Country=='DE']
print('Loaded Company :',VisitorData.columns.values)
print('#################################')
#####################################################################
print('################')
sTable='Assess_VisitorData'
print('Storing :',sDatabaseName,' Table:',sTable)
VisitorData.to_sql(sTable, conn,
if_exists="replace") print('################')
#####################################################################
print(VisitorData.head())
print('#################################')
print('Rows : ',VisitorData.shape[0])
print('#################################')
```

```
#####################################################################
print('################')
sTable='Assess_BillboardVisitorData'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="select distinct"
sSQL=sSQL+ " A.Country AS BillboardCountry,"
sSQL=sSQL+ " A.Place_Name AS BillboardPlaceName,"
sSQL=sSQL+ " A.Latitude AS BillboardLatitude, "
sSQL=sSQL+ " A.Longitude AS BillboardLongitude,"
sSQL=sSQL+ " B.Country AS VisitorCountry,"
sSQL=sSQL+ " B.Place_Name AS VisitorPlaceName,"
sSQL=sSQL+ " B.Latitude AS VisitorLatitude, "
sSQL=sSQL+ " B.Longitude AS VisitorLongitude,"
sSQL=sSQL+ " (B.Last_IP_Number - B.First_IP_Number) * 365.25 * 24 * 12 AS
VisitorYearRate"
sSQL=sSQL+ " from"
sSQL=sSQL+ " Assess_BillboardData as A"
sSQL=sSQL+ " JOIN "
sSQL=sSQL+ " Assess_VisitorData as B"
sSQL=sSQL+ " ON "
sSQL=sSQL+ " A.Country = B.Country"
sSQL=sSQL+ " AND "
sSQL=sSQL+ " A.Place_Name = B.Place_Name;"
BillboardVistorsData=pd.read_sql_query(sSQL,
conn) print('################')
#####################################################################
print('################')
sTable='Assess_BillboardVistorsData'
print('Storing :',sDatabaseName,' Table:',sTable)
BillboardVistorsData.to_sql(sTable, conn, if_exists="replace")
print('################')
#####################################################################
print(BillboardVistorsData.head())
print('################################')
print('Rows : ',BillboardVistorsData.shape[0])
print('################################')
#####################################################################
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-Python'
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#####################################################################
print('################################')
print('Storing :', sFileName)
print('################################')
sFileName=sFileDir + '/' + sOutputFileName
BillboardVistorsData.to_csv(sFileName, index =
False) print('################################')
#####################################################################
print('### Done!! ############################################')
#####################################################################
```

Output:
C:\VKHCG\02-Krennwallner\01-Retrieve\01-EDS\02-Python\Retrieve_Online_Visitor.csv containing, 10,48,576**(Ten lack Forty Eight Thousand Five Hundred and Seventy Six)**rows.

	A	B	C	D	E	F
1	Country	Place_Name	Latitude	Longitude	First_IP_Number	Last_IP_Number
2	BW	Gaborone	-24.6464	25.9119	692781056	692781567
3	BW	Gaborone	-24.6464	25.9119	692781824	692783103
4	BW	Gaborone	-24.6464	25.9119	692909056	692909311
1048556	NL	Amsterdam	52.3556	4.9136	385939968	385940479
1048557	NL	Amsterdam	52.3556	4.9136	385942528	385943551
1048558	NL	Amsterdam	52.3556	4.9136	385957888	385961983
1048559	NL	Amsterdam	52.3556	4.9136	386003200	386003967
1048560	NL	Amsterdam	52.3556	4.9136	386012160	386012671
1048561	NL	Amsterdam	52.3556	4.9136	386013184	386013695
1048562	NL	Amsterdam	52.3556	4.9136	386015232	386015487
1048563	NL	Amsterdam	52.3556	4.9136	386020352	386021375
1048564	NL	Amsterdam	52.3556	4.9136	386035712	386039807
1048565	NL	Amsterdam	52.3556	4.9136	386060288	386068479
1048566	NL	Amsterdam	52.3556	4.9136	386073344	386073599
1048567	NL	Amsterdam	52.3556	4.9136	386074112	386074623
1048568	NL	Amsterdam	52.3556	4.9136	386076416	386076671
1048569	NL	Amsterdam	52.3556	4.9136	386088960	386089983
1048570	NL	Amsterdam	52.3556	4.9136	386095616	386096127
1048571	NL	Amsterdam	52.3556	4.9136	386109440	386113535
1048572	NL	Amsterdam	52.3556	4.9136	386191360	386195455
1048573	NL	Amsterdam	52.3556	4.9136	386201600	386203135
1048574	NL	Amsterdam	52.3556	4.9136	386215936	386220031
1048575	NL	Amsterdam	52.3556	4.9136	386228224	386232319
1048576	NL	Amsterdam	52.3556	4.9136	386244608	386244863

Retrieve_Online_Visitor

SQLite Visitor's Database
C:/VKHCG/02-Krennwallner/02-Assess/SQLite/krennwallner.db Table:

	BillboardCountry	BillboardPlaceName	...	VisitorLongitude	VisitorYearRate
0	DE	Lake	...	8.5667	26823960.0
1	DE	Horb	...	8.6833	26823960.0
2	DE	Horb	...	8.6833	53753112.0
3	DE	Horb	...	8.6833	107611416.0
4	DE	Horb	...	8.6833	13359384.0

	A	B	C	D	E	F	G	H	I
1	illboardCountr	BillboardPlaceName	oardLatit	oardLongi	sitorCount	VisitorPlaceName	sitorLatitu	itorLongitu	VisitorYearRate
2	DE	Lake	51.7833	8.5667	DE	Lake	51.7833	8.5667	26823960
3	DE	Horb	48.4333	8.6833	DE	Horb	48.4333	8.6833	26823960
4	DE	Horb	48.4333	8.6833	DE	Horb	48.4333	8.6833	53753112
5	DE	Horb	48.4333	8.6833	DE	Horb	48.4333	8.6833	107611416
6	DE	Horb	48.4333	8.6833	DE	Horb	48.4333	8.6833	13359384
7	DE	Horb	48.4333	8.6833	DE	Horb	48.4889	8.6734	26823960
8	DE	Horb	48.4333	8.6833	DE	Horb	48.4889	8.6734	53753112
9	DE	Hardenberg	51.1	7.7333	DE	Hardenberg	51.1	7.7333	26823960
181221	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1167	8.6833	1157112
181222	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1167	8.6833	24299352
181223	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1167	8.6833	807769368
181224	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1172	8.7281	53753112
181225	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1172	8.7281	26823960
181226	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1172	8.7281	107611416
181227	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1172	8.7281	1577880
181228	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1184	8.6095	15042456
181229	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1184	8.6095	10834776
181230	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1319	8.6838	736344
181231	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1319	8.6838	0
181232	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1327	8.7668	736344
181233	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1492	8.7097	1723360536
181234	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1492	8.7097	430761240
181235	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1528	8.745	26823960
181236	DE	Frankfurt	50.1327	8.7668	DE	Frankfurt	50.1878	8.6632	1577880

Assess-DE-Billboard-Visitor

E. Write a Python / R program to generate GML file from the given csv file. Understanding Your Online Visitor Data

Online visitors have to be mapped to their closest billboard, to ensure we understand where and what they can access.

Open your Python editor and create a file called Assess-Billboard_2_Visitor.py in directory
C:\VKHCG\ 02-Krennwallner\02-Assess.

```
import networkx as nx
import sys
import os
import sqlite3 as sq
import pandas as pd
from geopy.distance import vincenty
################################################################
Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
################################################################
Company='02-Krennwallner'
sTable='Assess_BillboardVisitorData'
sOutputFileName='Assess-DE-Billboard-Visitor.gml'
################################################################
sDataBaseDir=Base + '/' + Company + '/02-Assess/SQLite'
if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
################################################################
sDatabaseName=sDataBaseDir + '/krennwallner.db'
conn = sq.connect(sDatabaseName)
################################################################
print('#################')
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="select "
sSQL=sSQL+ " A.BillboardCountry,"
sSQL=sSQL+ " A.BillboardPlaceName,"
sSQL=sSQL+ " ROUND(A.BillboardLatitude,3) AS BillboardLatitude, "
sSQL=sSQL+ " ROUND(A.BillboardLongitude,3) AS BillboardLongitude,"
sSQL=sSQL+ " (CASE WHEN A.BillboardLatitude < 0 THEN "
sSQL=sSQL+ " 'S' || ROUND(ABS(A.BillboardLatitude),3)"
sSQL=sSQL+ " ELSE "
sSQL=sSQL+ " 'N' || ROUND(ABS(A.BillboardLatitude),3)"
sSQL=sSQL+ " END ) AS sBillboardLatitude,"
sSQL=sSQL+ " (CASE WHEN A.BillboardLongitude < 0 THEN "
sSQL=sSQL+ " 'W' || ROUND(ABS(A.BillboardLongitude),3)"
sSQL=sSQL+ " ELSE "
sSQL=sSQL+ " 'E' || ROUND(ABS(A.BillboardLongitude),3)"
sSQL=sSQL+ " END ) AS sBillboardLongitude,"
sSQL=sSQL+ " A.VisitorCountry,"
sSQL=sSQL+ " A.VisitorPlaceName,"
```

```
sSQL=sSQL+ " ROUND(A.VisitorLatitude,3) AS VisitorLatitude, "
sSQL=sSQL+ " ROUND(A.VisitorLongitude,3) AS VisitorLongitude,"
sSQL=sSQL+ " (CASE WHEN A.VisitorLatitude < 0 THEN "
sSQL=sSQL+ " 'S' || ROUND(ABS(A.VisitorLatitude),3)"
sSQL=sSQL+ " ELSE "
sSQL=sSQL+ " 'N' ||ROUND(ABS(A.VisitorLatitude),3)"
sSQL=sSQL+ " END ) AS sVisitorLatitude,"
sSQL=sSQL+ " (CASE WHEN A.VisitorLongitude < 0 THEN "
sSQL=sSQL+ " 'W' || ROUND(ABS(A.VisitorLongitude),3)"
sSQL=sSQL+ " ELSE "
sSQL=sSQL+ " 'E' || ROUND(ABS(A.VisitorLongitude),3)"
sSQL=sSQL+ " END ) AS sVisitorLongitude,"
sSQL=sSQL+ " A.VisitorYearRate"
sSQL=sSQL+ " from"
sSQL=sSQL+ " Assess_BillboardVistorsData AS A;"
BillboardVistorsData=pd.read_sql_query(sSQL,
conn) print('################')
#####################################################################
BillboardVistorsData['Distance']=BillboardVistorsData.apply(lambda row:
   round(
   vincenty((row['BillboardLatitude'],row['BillboardLongitude']),
            (row['VisitorLatitude'],row['VisitorLongitude'])).miles ,4)

     ,axis=1)
#####################################################################
G=nx.Graph()
#####################################################################
for i in range(BillboardVistorsData.shape[0]): sNode0='MediaHub-' +
   BillboardVistorsData['BillboardCountry'][i] sNode1='B-'+
   BillboardVistorsData['sBillboardLatitude'][i] + '-' sNode1=sNode1
   + BillboardVistorsData['sBillboardLongitude'][i]
   G.add_node(sNode1,
           Nodetype='Billboard',
           Country=BillboardVistorsData['BillboardCountry'][i],
           PlaceName=BillboardVistorsData['BillboardPlaceName'][i],
           Latitude=round(BillboardVistorsData['BillboardLatitude'][i],3),
           Longitude=round(BillboardVistorsData['BillboardLongitude'][i],3))

   sNode2='M-'+ BillboardVistorsData['sVisitorLatitude'][i] + '-'
   sNode2=sNode2 + BillboardVistorsData['sVisitorLongitude'][i]
   G.add_node(sNode2,
           Nodetype='Mobile',
           Country=BillboardVistorsData['VisitorCountry'][i],
           PlaceName=BillboardVistorsData['VisitorPlaceName'][i],
           Latitude=round(BillboardVistorsData['VisitorLatitude'][i],3),
           Longitude=round(BillboardVistorsData['VisitorLongitude'][i],3))

   print('Link Media Hub :',sNode0,' to Billboard : ', sNode1)
   G.add_edge(sNode0,sNode1)
   print('Link Post Code :',sNode1,' to GPS : ', sNode2)
```

```
    G.add_edge(sNode1,sNode2,distance=round(BillboardVistorsData['Distance'][i]))
###########################################################
print('#################################')
print("Nodes of graph: ",nx.number_of_nodes(G))
print("Edges of graph: ",nx.number_of_edges(G))
print('#################################')
###########################################################
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-Python'
if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
###########################################################
sFileName=sFileDir + '/' + sOutputFileName
print('#################################')
print('Storing :', sFileName)
print('#################################')
nx.write_gml(G,sFileName)
sFileName=sFileName +'.gz'
nx.write_gml(G,sFileName)
###########################################################
###########################################################
print('### Done!! ############################################')
###########################################################
```

Output:

This will produce a set of demonstrated values onscreen, plus a graph data file named Assess-DE-Billboard-Visitor.gml.

(It takes a long time to complete the process, after completion the gml file can be viewed in text editor)

Hence, we have applied formulae to extract features, such as the distance between the billboard and the visitor.

Planning an Event for Top-Ten Customers

Open Python editor and create a file named Assess-Visitors.py in directory C:\VKHCG\02-Krennwallner\02-Assess

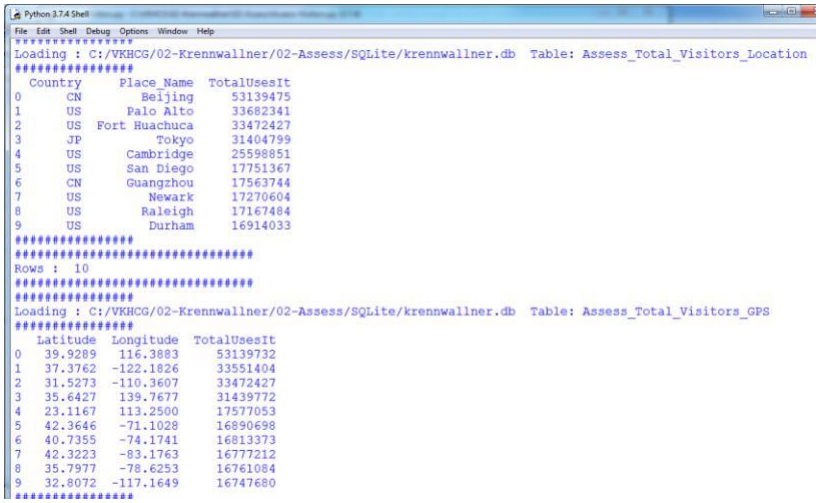
```
###########################################################
import sys
import os
import sqlite3 as sq
import pandas as pd
from pandas.io import sql
###########################################################
Base='C:/VKHCG'
print('#################################')
print('Working Base :',Base, ' using ', sys.platform)
print('#################################')
###########################################################
Company='02-Krennwallner'
sInputFileName='01-Retrieve/01-EDS/02-Python/Retrieve_Online_Visitor.csv'
###########################################################
sDataBaseDir=Base + '/' + Company + '/02-Assess/SQLite'
```

```
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
#####################################################################
sDatabaseName=sDataBaseDir + '/krennwallner.db'
conn = sq.connect(sDatabaseName)
#####################################################################
### Import Country Data
#####################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName
print('################################')
print('Loading :',sFileName)
print('################################')
VisitorRawData=pd.read_csv(sFileName,
                    header=0,
                    low_memory=False,
                    encoding="latin-1",
                    skip_blank_lines=True)
VisitorRawData.drop_duplicates(subset=None, keep='first',
inplace=True) VisitorData=VisitorRawData
print('Loaded Company :',VisitorData.columns.values)
print('################################')
#####################################################################
print('################')
sTable='Assess_Visitor'
print('Storing :',sDatabaseName,' Table:',sTable)
VisitorData.to_sql(sTable, conn,
if_exists="replace") print('################')
#####################################################################
print(VisitorData.head())
print('################################')
print('Rows : ',VisitorData.shape[0])
print('################################')
#####################################################################
print('################')
sView='Assess_Visitor_UseIt' print('Creating
:',sDatabaseName,' View:',sView) sSQL="DROP
VIEW IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)
sSQL="CREATE VIEW " + sView + "
AS" sSQL=sSQL+ " SELECT"
sSQL=sSQL+ " A.Country," sSQL=sSQL+
" A.Place_Name," sSQL=sSQL+ "
A.Latitude," sSQL=sSQL+ " A.Longitude,"

sSQL=sSQL+ " (A.Last_IP_Number - A.First_IP_Number) AS UsesIt"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " Assess_Visitor as A"
sSQL=sSQL+ " WHERE"
sSQL=sSQL+ " Country is not null"
sSQL=sSQL+ " AND"
```

```
sSQL=sSQL+ " Place_Name is not null;"
sql.execute(sSQL,conn)
######################################################################
print('################')
sView='Assess_Total_Visitors_Location'
print('Creating :',sDatabaseName,' View:',sView)
sSQL="DROP VIEW IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT"
sSQL=sSQL+ " Country,"
sSQL=sSQL+ " Place_Name,"
sSQL=sSQL+ " SUM(UsesIt) AS TotalUsesIt"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " Assess_Visitor_UseIt"
sSQL=sSQL+ " GROUP BY"
sSQL=sSQL+ " Country,"
sSQL=sSQL+ " Place_Name"
sSQL=sSQL+ " ORDER BY"
sSQL=sSQL+ " TotalUsesIt DESC"
sSQL=sSQL+ " LIMIT 10;"
sql.execute(sSQL,conn)
######################################################################
print('################')
sView='Assess_Total_Visitors_GPS'
print('Creating :',sDatabaseName,' View:',sView)
sSQL="DROP VIEW IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT"
sSQL=sSQL+ " Latitude,"
sSQL=sSQL+ " Longitude,"
sSQL=sSQL+ " SUM(UsesIt) AS TotalUsesIt"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " Assess_Visitor_UseIt"
sSQL=sSQL+ " GROUP BY"
sSQL=sSQL+ " Latitude,"
sSQL=sSQL+ " Longitude"
sSQL=sSQL+ " ORDER BY"
sSQL=sSQL+ " TotalUsesIt DESC"
sSQL=sSQL+ " LIMIT 10;"
sql.execute(sSQL,conn)
######################################################################
sTables=['Assess_Total_Visitors_Location', 'Assess_Total_Visitors_GPS']
for sTable in sTables:
    print('################')
    print('Loading :',sDatabaseName,' Table:',sTable)
    sSQL=" SELECT "
```

```
    sSQL=sSQL+ " *"
    sSQL=sSQL+ " FROM"
    sSQL=sSQL+ " " + sTable + ";"
    TopData=pd.read_sql_query(sSQL, conn)
    print('#################')
    print(TopData)
    print('#################')
    print('#################################')
    print('Rows : ',TopData.shape[0])
    print('#################################')
#########################################################################
print('### Done!! ############################################')
#########################################################################
```

Output:



```
Python 3.7.4 Shell
File  Edit  Shell  Debug  Options  Window  Help
#################
Loading : C:/VKHCG/02-Krennwallner/02-Assess/SQLite/krennwallner.db  Table: Assess_Total_Visitors_Location
################
  Country     Place_Name  TotalUsesIt
0      CN        Beijing     53139475
1      US      Palo Alto     33682341
2      US  Fort Huachuca     33472427
3      JP          Tokyo     31404799
4      US      Cambridge     25598851
5      US      San Diego     17751367
6      CN      Guangzhou     17563744
7      US         Newark     17270604
8      US        Raleigh     17167484
9      US         Durham     16914033
################
################################
Rows :  10
################################
################
Loading : C:/VKHCG/02-Krennwallner/02-Assess/SQLite/krennwallner.db  Table: Assess_Total_Visitors_GPS
################
   Latitude  Longitude  TotalUsesIt
0   39.9289   116.3883     53139732
1   37.3762  -122.1826     33551404
2   31.5273  -110.3607     33472427
3   35.6427   139.7677     31439772
4   23.1167   113.2500     17577053
5   42.3646   -71.1028     16890698
6   40.7355   -74.1741     16813373
7   42.3223   -83.1763     16777212
8   35.7977   -78.6253     16761084
9   32.8072  -117.1649     16747680
################
```

F. Write a Python / R program to plan the locations of the warehouses from the given data.

Planning the Locations of the Warehouses

Planning the location of the warehouses requires the assessment of the GPS locations of these warehouses against the requirements for Hillman's logistics needs.

Open your editor and create a file named Assess-Warehouse-Address.py in directory C:\VKHCG\03-Hillman\02-Assess.

```
################### Assess-Warehouse-Address.py ###################
import os
import pandas as pd
from geopy.geocoders import Nominatim
geolocator = Nominatim()
#################################################################
InputDir='01-Retrieve/01-EDS/01-R'
InputFileName='Retrieve_GB_Postcode_Warehouse.csv'
EDSDir='02-Assess/01-EDS'
OutputDir=EDSDir + '/02-Python'
OutputFileName='Assess_GB_Warehouse_Address.csv'
Company='03-Hillman'
#################################################################
Base='C:/VKHCG'
print('################################')
```

```
print('Working Base :',Base, ' using Windows')
print('##################################')
#################################################################
sFileDir=Base + '/' + Company + '/' + EDSDir
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#################################################################
sFileDir=Base + '/' + Company + '/' + OutputDir
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#################################################################
sFileName=Base + '/' + Company + '/' + InputDir + '/' + InputFileName
print('############')
print('Loading :',sFileName)
Warehouse=pd.read_csv(sFileName,header=0,low_memory=False)
Warehouse.sort_values(by='postcode', ascending=1)
#################################################################
## Limited to 10 due to service limit on Address Service.
#################################################################
WarehouseGoodHead=Warehouse[Warehouse.latitude != 0].head(5)
WarehouseGoodTail=Warehouse[Warehouse.latitude != 0].tail(5)
#################################################################
WarehouseGoodHead['Warehouse_Point']=WarehouseGoodHead.apply(lambda
        row: (str(row['latitude'])+','+str(row['longitude']))
        ,axis=1)
WarehouseGoodHead['Warehouse_Address']=WarehouseGoodHead.apply(lambda row:
        geolocator.reverse(row['Warehouse_Point']).address ,axis=1)

WarehouseGoodHead.drop('Warehouse_Point', axis=1,
inplace=True) WarehouseGoodHead.drop('id', axis=1, inplace=True)
WarehouseGoodHead.drop('postcode', axis=1, inplace=True)
#################################################################
WarehouseGoodTail['Warehouse_Point']=WarehouseGoodTail.apply(lambda row:
        (str(row['latitude'])+','+str(row['longitude']))
        ,axis=1)
WarehouseGoodTail['Warehouse_Address']=WarehouseGoodTail.apply(lambda row:
        geolocator.reverse(row['Warehouse_Point']).address ,axis=1)

WarehouseGoodTail.drop('Warehouse_Point', axis=1,
inplace=True) WarehouseGoodTail.drop('id', axis=1, inplace=True)
WarehouseGoodTail.drop('postcode', axis=1, inplace=True)
#################################################################
WarehouseGood=WarehouseGoodHead.append(WarehouseGoodTail,
ignore_index=True) print(WarehouseGood)
#################################################################
sFileName=sFileDir + '/' + OutputFileName
WarehouseGood.to_csv(sFileName, index = False)
#################################################################
print('### Done!! ############################################')
#################################################################
```

Output:

```
################################
Working Base : C:/VKHCG  using Windows
################################
###########
Loading : C:/VKHCG/03-Hillman/01-Retrieve/01-EDS/01-R/Retrieve_GB_Postcode_Warehouse.csv
    latitude  longitude                                  Warehouse_Address
0  57.135140  -2.117310  35, Broomhill Road, Broomhill, Aberdeen, Aberd...
1  57.138750  -2.090890  South Esplanade West, Torry, Aberdeen, Aberdee...
2  57.101000  -2.110600  A92, Cove and Altens, Aberdeen, Aberdeen City,...
3  57.108010  -2.237760  Colthill Circle, Milltimber, Countesswells, Ab...
4  57.100760  -2.270730  Johnston Gardens East, Peterculter, South Last...
5  53.837717  -1.780013  HM Revenue and Customs, Riverside Estate, Temp...
6  53.794470  -1.766539  Listerhills Road Norcroft Street, Listerhills ...
7  51.518556  -0.714794  Sorting Office, Stafferton Way, Fishery, Maide...
8  54.890923  -2.943847  Royal Mail (Delivery Office), Junction Street,...
9  57.481338  -4.223951  Inverness Sorting & Delivery Office, Strothers...
### Done!! ############################################
>>>
```

G. Write a Python / R program using data science via clustering to determine new warehouses using the given data.

Global New Warehouse: Hillman wants to add extra global warehouses, and you are required to assess wherethey should be located. We only have to collect the possible locations for warehouses.

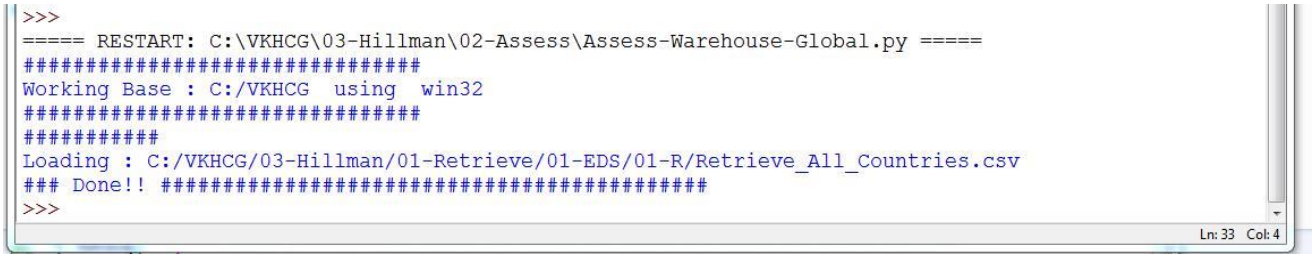
The following example will show you how to modify the data columns you read in that are totally ambiguous. Open Python editor and create a file named Assess-Warehouse-Global.py in directory
C:\VKHCG\03-Hillman\02-Assess

```
#################        Assess-Warehouse-Global.py##############
import sys
import os
import pandas as pd
#################################################################
Base='C:/VKHCG'
#################################################################
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
#################################################################
Company='03-Hillman'
InputDir='01-Retrieve/01-EDS/01-R'
InputFileName='Retrieve_All_Countries.csv'
EDSDir='02-Assess/01-EDS'
OutputDir=EDSDir + '/02-Python'
OutputFileName='Assess_All_Warehouse.csv'
#################################################################
sFileDir=Base + '/' + Company + '/' + EDSDir
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#################################################################
sFileDir=Base + '/' + Company + '/' + OutputDir
```

```
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#################################################################
sFileName=Base + '/' + Company + '/' + InputDir + '/' + InputFileName
print('############')
print('Loading :',sFileName)
Warehouse=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
#################################################################
sColumns={'X1' : 'Country',
        'X2' : 'PostCode',
        'X3' : 'PlaceName',
        'X4' : 'AreaName',
        'X5' : 'AreaCode',
        'X10' : 'Latitude',
        'X11' : 'Longitude'}
Warehouse.rename(columns=sColumns,inplace=True)
WarehouseGood=Warehouse
#################################################################
sFileName=sFileDir + '/' + OutputFileName
WarehouseGood.to_csv(sFileName, index = False)
#################################################################
print('### Done!! ############################################')
#################################################################
```

This will produce a set of demonstrated values onscreen, plus a graph data file named Assess_All_Warehouse.csv.

Output:



Open Assess0_All_Warehose.csv from C:\VKHCG\03-Hillman\02-Assess\01-EDS\02-Python

	A	B	C	D	E	F	G	H
1	Unnamed: 0	Country	PostCode	PlaceName	AreaName	AreaCode	Latitude	Longitude
2	1	AD	AD100	Canillo			42.5833	1.6667
3	2	AD	AD200	Encamp			42.5333	1.6333
4	3	AD	AD300	Ordino			42.6	1.55
5	4	AD	AD400	La Massana			42.5667	1.4833
6	5	AD	AD500	Andorra la Vella			42.5	1.5
31621	31620	AT	4925	Gumpling	OberÃ¶sterreich	4	48.1555	13.4802
31622	31621	AT	4925	Windischhub	OberÃ¶sterreich	4	48.1555	13.4802
31623	31622	AT	4926	Obereselbach	OberÃ¶sterreich	4	48.1917	13.5784
31624	31623	AT	4926	Jetzing	OberÃ¶sterreich	4	48.1555	13.4802
31625	31624	AT	4926	Pilgersham	OberÃ¶sterreich	4	48.1772	13.5855
31626	31625	AT	4926	Grausgrub	OberÃ¶sterreich	4	48.1555	13.4802
31627	31626	AT	4926	Marienkirchen am Hi	OberÃ¶sterreich	4	48.1828	13.577
31628	31627	AT	4926	Stocket	OberÃ¶sterreich	4	48.1555	13.4802
31629	31628	AT	4926	Baching	OberÃ¶sterreich	4	48.1555	13.4802
31630	31629	AT	4926	Kern	OberÃ¶sterreich	4	48.1555	13.4802
31631	31630	AT	4926	Manaberg	OberÃ¶sterreich	4	48.1555	13.4802
31632	31631	AT	4926	Untereselbach	OberÃ¶sterreich	4	48.1555	13.4802
31633	31632	AT	4926	Hatting	OberÃ¶sterreich	4	48.1555	13.4802
31634	31633	AT	4926	Unering	OberÃ¶sterreich	4	48.1555	13.4802
31635	31634	AT	4926	Kleinbach	OberÃ¶sterreich	4	48.1555	13.4802
31636	31635	AT	4926	Lehen	OberÃ¶sterreich	4	48.1555	13.4802
31637	31636	AT	4926	Hof	OberÃ¶sterreich	4	48.1555	13.4802
31638	31637	AT	4931	GroÃŸweiffendorf	OberÃ¶sterreich	4	48.15	13.3333
31639	31638	AT	4931	Neulendt	OberÃ¶sterreich	4	48.1697	13.3531

Assess All Warehouse

H. Using the given data, write a Python / R program to plan the shipping routes for best-fit international logistics.

Hillman requires an international logistics solution to support all the required shippingroutes.

Open Python editor and create a file named Assess-Best-Fit-Logistics.py in directory C:\VKHCG\03-Hillman\02-Assess

```
import sys
import os
import pandas as pd
import networkx as nx
from geopy.distance import vincenty
import sqlite3 as sq
from pandas.io import sql
################################################################
if sys.platform == 'linux':
    Base=os.path.expanduser('~') + '/VKHCG'
else:
    Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
Company='03-Hillman'
InputDir='01-Retrieve/01-EDS/01-R'
InputFileName='Retrieve_All_Countries.csv'
EDSDir='02-Assess/01-EDS'
OutputDir=EDSDir + '/02-Python'
OutputFileName='Assess_Best_Logistics.gml'
################################################################
sFileDir=Base + '/' + Company + '/' + EDSDir
if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
```

```
#####################################################################
sFileDir=Base + '/' + Company + '/' + OutputDir
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#####################################################################
sDataBaseDir=Base + '/' + Company + '/02-Assess/SQLite'
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
#####################################################################
sDatabaseName=sDataBaseDir + '/Hillman.db'
conn = sq.connect(sDatabaseName)
#####################################################################
sFileName=Base + '/' + Company + '/' + InputDir + '/' + InputFileName
print('###########')
print('Loading :',sFileName)
Warehouse=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
#####################################################################
sColumns={'X1' : 'Country',
        'X2' : 'PostCode',
        'X3' : 'PlaceName',
        'X4' : 'AreaName',
        'X5' : 'AreaCode',
        'X10' : 'Latitude',
        'X11' : 'Longitude'}
Warehouse.rename(columns=sColumns,inplace=True)
WarehouseGood=Warehouse
#print(WarehouseGood.head())
#####################################################################
RoutePointsCountry=pd.DataFrame(WarehouseGood.groupby(['Country'])[['Latitude','Longitude']].mean())
#print(RoutePointsCountry.head())
print('#################')
sTable='Assess_RoutePointsCountry'
print('Storing :',sDatabaseName,' Table:',sTable)
RoutePointsCountry.to_sql(sTable, conn, if_exists="replace")
print('#################')
#####################################################################
RoutePointsPostCode=pd.DataFrame(WarehouseGood.groupby(['Country',
'PostCode'])[['Latitude','Longitude']].mean())
#print(RoutePointsPostCode.head())
print('#################')
sTable='Assess_RoutePointsPostCode'
print('Storing :',sDatabaseName,' Table:',sTable)
RoutePointsPostCode.to_sql(sTable, conn, if_exists="replace")
print('#################')
#####################################################################
RoutePointsPlaceName=pd.DataFrame(WarehouseGood.groupby(['Country',
'PostCode','PlaceName'])[['Latitude','Longitude']].mean())
#print(RoutePointsPlaceName.head())
print('#################')
sTable='Assess_RoutePointsPlaceName'
print('Storing :',sDatabaseName,' Table:',sTable)
RoutePointsPlaceName.to_sql(sTable, conn, if_exists="replace")
print('#################')
#####################################################################
### Fit Country to Country
#####################################################################
print('#################')
sView='Assess_RouteCountries' print('Creating
:',sDatabaseName,' View:',sView) sSQL="DROP
VIEW IF EXISTS " + sView + ";"
```

```
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT DISTINCT"
sSQL=sSQL+ "   S.Country AS SourceCountry,"
sSQL=sSQL+ "   S.Latitude AS SourceLatitude,"
sSQL=sSQL+ "   S.Longitude AS SourceLongitude,"
sSQL=sSQL+ "   T.Country AS TargetCountry,"
sSQL=sSQL+ "   T.Latitude AS TargetLatitude,"
sSQL=sSQL+ "   T.Longitude AS TargetLongitude"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ "   Assess_RoutePointsCountry AS S"
sSQL=sSQL+ "   ,"
sSQL=sSQL+ "   Assess_RoutePointsCountry AS T"
sSQL=sSQL+ " WHERE S.Country <> T.Country"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " S.Country in ('GB','DE','BE','AU','US','IN')"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " T.Country in ('GB','DE','BE','AU','US','IN');"
sql.execute(sSQL,conn)

print('################')
print('Loading :',sDatabaseName,' Table:',sView)
sSQL=" SELECT "
sSQL=sSQL+ " *"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " " + sView + ";"
RouteCountries=pd.read_sql_query(sSQL, conn)

RouteCountries['Distance']=RouteCountries.apply(lambda row:
   round(
   vincenty((row['SourceLatitude'],row['SourceLongitude']),
            (row['TargetLatitude'],row['TargetLongitude'])).miles,4),axis=1)

print(RouteCountries.head(5))
#####################################################################
### Fit Country to Post Code
#####################################################################
print('################')
sView='Assess_RoutePostCode' print('Creating
:',sDatabaseName,' View:',sView) sSQL="DROP
VIEW IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT DISTINCT"
sSQL=sSQL+ "   S.Country AS SourceCountry,"
sSQL=sSQL+ "   S.Latitude AS SourceLatitude,"
sSQL=sSQL+ "   S.Longitude AS SourceLongitude,"
sSQL=sSQL+ "   T.Country AS TargetCountry,"
sSQL=sSQL+ "   T.PostCode AS TargetPostCode,"
sSQL=sSQL+ "   T.Latitude AS TargetLatitude,"
sSQL=sSQL+ "   T.Longitude AS TargetLongitude"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ "   Assess_RoutePointsCountry AS S"
sSQL=sSQL+ "   ,"
sSQL=sSQL+ "   Assess_RoutePointsPostCode AS T"
sSQL=sSQL+ " WHERE S.Country = T.Country"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " S.Country in ('GB','DE','BE','AU','US','IN')"
```

```
sSQL=sSQL+ " AND"
sSQL=sSQL+ " T.Country in ('GB','DE','BE','AU','US','IN');"
sql.execute(sSQL,conn)

print('################')
print('Loading :',sDatabaseName,' Table:',sView)
sSQL=" SELECT "
sSQL=sSQL+ " *"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " " + sView + ";"
RoutePostCode=pd.read_sql_query(sSQL, conn)

RoutePostCode['Distance']=RoutePostCode.apply(lambda row:
   round(
   vincenty((row['SourceLatitude'],row['SourceLongitude']),
            (row['TargetLatitude'],row['TargetLongitude'])).miles
         ,4)
     ,axis=1)

print(RoutePostCode.head(5))
#####################################################################
### Fit Post Code to Place Name
#####################################################################
print('################')
sView='Assess_RoutePlaceName' print('Creating
:',sDatabaseName,' View:',sView) sSQL="DROP
VIEW IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT DISTINCT"
sSQL=sSQL+ "   S.Country AS SourceCountry,"
sSQL=sSQL+ "   S.PostCode AS SourcePostCode,"
sSQL=sSQL+ "   S.Latitude AS SourceLatitude,"
sSQL=sSQL+ "   S.Longitude AS SourceLongitude,"
sSQL=sSQL+ "   T.Country AS TargetCountry,"
sSQL=sSQL+ "   T.PostCode AS TargetPostCode,"
sSQL=sSQL+ "   T.PlaceName AS TargetPlaceName,"
sSQL=sSQL+ "   T.Latitude AS TargetLatitude,"
sSQL=sSQL+ "   T.Longitude AS TargetLongitude"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ "   Assess_RoutePointsPostCode AS S"
sSQL=sSQL+ "   ,"
sSQL=sSQL+ "   Assess_RoutePointsPLaceName AS T"
sSQL=sSQL+ " WHERE"
sSQL=sSQL+ " S.Country = T.Country"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " S.PostCode = T.PostCode"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " S.Country in ('GB','DE','BE','AU','US','IN')"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " T.Country in ('GB','DE','BE','AU','US','IN');"
sql.execute(sSQL,conn)

print('################')
print('Loading :',sDatabaseName,' Table:',sView)
sSQL=" SELECT "
sSQL=sSQL+ " *"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " " + sView + ";"
```

```
RoutePlaceName=pd.read_sql_query(sSQL, conn)

RoutePlaceName['Distance']=RoutePlaceName.apply(lambda row:
   round(
   vincenty((row['SourceLatitude'],row['SourceLongitude']),
            (row['TargetLatitude'],row['TargetLongitude'])).miles
          ,4)
     ,axis=1)

print(RoutePlaceName.head(5))
#####################################################################
G=nx.Graph()
#####################################################################
print('Countries:',RouteCountries.shape)
for i in range(RouteCountries.shape[0]):
   sNode0='C-' + RouteCountries['SourceCountry'][i]
   G.add_node(sNode0,
            Nodetype='Country',
            Country=RouteCountries['SourceCountry'][i],
            Latitude=round(RouteCountries['SourceLatitude'][i],4),
            Longitude=round(RouteCountries['SourceLongitude'][i],4))

   sNode1='C-' + RouteCountries['TargetCountry'][i]
   G.add_node(sNode1,
            Nodetype='Country',
            Country=RouteCountries['TargetCountry'][i],
            Latitude=round(RouteCountries['TargetLatitude'][i],4),
            Longitude=round(RouteCountries['TargetLongitude'][i],4))
   G.add_edge(sNode0,sNode1,distance=round(RouteCountries['Distance'][i],3))
   #print(sNode0,sNode1)
#####################################################################
print('Post Code:',RoutePostCode.shape)
for i in range(RoutePostCode.shape[0]):
   sNode0='C-' + RoutePostCode['SourceCountry'][i]
   G.add_node(sNode0,
            Nodetype='Country',
            Country=RoutePostCode['SourceCountry'][i],
            Latitude=round(RoutePostCode['SourceLatitude'][i],4),
            Longitude=round(RoutePostCode['SourceLongitude'][i],4))

   sNode1='P-' + RoutePostCode['TargetPostCode'][i] + '-' + RoutePostCode['TargetCountry'][i]
   G.add_node(sNode1,
            Nodetype='PostCode',
            Country=RoutePostCode['TargetCountry'][i],
            PostCode=RoutePostCode['TargetPostCode'][i],
            Latitude=round(RoutePostCode['TargetLatitude'][i],4),
            Longitude=round(RoutePostCode['TargetLongitude'][i],4))
   G.add_edge(sNode0,sNode1,distance=round(RoutePostCode['Distance'][i],3))
   #print(sNode0,sNode1)
#####################################################################
print('Place Name:',RoutePlaceName.shape)
for i in range(RoutePlaceName.shape[0]):
   sNode0='P-' + RoutePlaceName['TargetPostCode'][i]  + '-'
   sNode0=sNode0 + RoutePlaceName['TargetCountry'][i]
   G.add_node(sNode0,
            Nodetype='PostCode',
            Country=RoutePlaceName['SourceCountry'][i],
            PostCode=RoutePlaceName['TargetPostCode'][i],
            Latitude=round(RoutePlaceName['SourceLatitude'][i],4),
            Longitude=round(RoutePlaceName['SourceLongitude'][i],4))
```

```
    sNode1='L-' + RoutePlaceName['TargetPlaceName'][i] + '-'
    sNode1=sNode1 + RoutePlaceName['TargetPostCode'][i] + '-'
    sNode1=sNode1 + RoutePlaceName['TargetCountry'][i]
    G.add_node(sNode1,
            Nodetype='PlaceName',
            Country=RoutePlaceName['TargetCountry'][i],
            PostCode=RoutePlaceName['TargetPostCode'][i],
            PlaceName=RoutePlaceName['TargetPlaceName'][i],
            Latitude=round(RoutePlaceName['TargetLatitude'][i],4),
            Longitude=round(RoutePlaceName['TargetLongitude'][i],4))
    G.add_edge(sNode0,sNode1,distance=round(RoutePlaceName['Distance'][i],3))
    #print(sNode0,sNode1)
###################################################################
sFileName=sFileDir + '/' + OutputFileName
print('################################')
print('Storing :', sFileName)
print('################################')
nx.write_gml(G,sFileName)
sFileName=sFileName +'.gz'
nx.write_gml(G,sFileName)
###################################################################
print('################################')
print('Path:', nx.shortest_path(G,source='P-SW1-GB',target='P-01001-US',weight='distance'))
print('Path length:', nx.shortest_path_length(G,source='P-SW1-GB',target='P-01001-US',weight='distance'))
print('Path length (1):', nx.shortest_path_length(G,source='P-SW1-GB',target='C-GB',weight='distance'))
print('Path length (2):', nx.shortest_path_length(G,source='C-GB',target='C-US',weight='distance'))
print('Path length (3):', nx.shortest_path_length(G,source='C-US',target='P-01001-US',weight='distance'))
print('################################')
print('Routes from P-SW1-GB < 2: ', nx.single_source_shortest_path(G,source='P-SW1-GB' ,cutoff=1))
print('Routes from P-01001-US < 2: ', nx.single_source_shortest_path(G,source='P-01001-US' ,cutoff=1))
print('################################')
###################################################################
print('################')
print('Vacuum Database')
sSQL="VACUUM;"
sql.execute(sSQL,conn)
print('################')
###################################################################
print('### Done!! ############################################')
###################################################################
```

Output:

You can now query features out of a graph, such as shortage pathsbetween locations and paths from a given location, using Assess_Best_Logistics.gml with appropirate application.

I. Write a Python / R program to decide the best packing option to ship in container from the given data.

Hillman wants to introduce new shipping containers into its logistics strategy. This program will through a process of assessing the possible container sizes.This example introduces features with ranges or tolerances.

Open Python editor and create a file named Assess-Shipping-Containers.py in directory C:\VKHCG\03-Hillman\02-Assess

```
import sys
import os
import pandas as pd
import sqlite3 as sq
from pandas.io import sql
```

```
#####################################################################
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
#####################################################################
Company='03-Hillman'
InputDir='01-Retrieve/01-EDS/02-Python'
InputFileName1='Retrieve_Product.csv'
InputFileName2='Retrieve_Box.csv'
InputFileName3='Retrieve_Container.csv'
EDSDir='02-Assess/01-EDS'
OutputDir=EDSDir + '/02-Python'
OutputFileName='Assess_Shipping_Containers.csv'
#####################################################################
sFileDir=Base + '/' + Company + '/' + EDSDir
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#####################################################################
sFileDir=Base + '/' + Company + '/' + OutputDir
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
#####################################################################
sDataBaseDir=Base + '/' + Company + '/02-Assess/SQLite'
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
#####################################################################
sDatabaseName=sDataBaseDir + '/hillman.db'
conn = sq.connect(sDatabaseName)
#####################################################################
#####################################################################
### Import Product Data
#####################################################################
sFileName=Base + '/' + Company + '/' + InputDir + '/' +
InputFileName1 print('###########')
print('Loading :',sFileName)
ProductRawData=pd.read_csv(sFileName,
                header=0,
                low_memory=False,
                encoding="latin-1"
                )
ProductRawData.drop_duplicates(subset=None, keep='first',
inplace=True) ProductRawData.index.name = 'IDNumber'
ProductData=ProductRawData[ProductRawData.Length <= 0.5].head(10)
print('Loaded Product :',ProductData.columns.values)
print('################################')
#####################################################################
print('################')
sTable='Assess_Product'
print('Storing :',sDatabaseName,' Table:',sTable)
ProductData.to_sql(sTable, conn,
if_exists="replace") print('################')
#####################################################################
print(ProductData.head())
print('################################')
print('Rows : ',ProductData.shape[0])
print('################################')
#####################################################################
#####################################################################
### Import Box Data
```

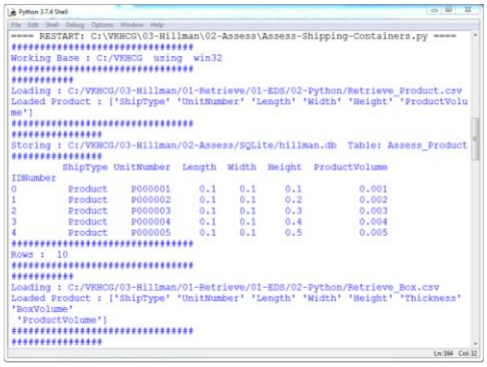
```
#####################################################################
sFileName=Base + '/' + Company + '/' + InputDir + '/' + InputFileName2
print('###########')
print('Loading :',sFileName)
BoxRawData=pd.read_csv(sFileName,
                header=0,
                low_memory=False,
                encoding="latin-1"
                )
BoxRawData.drop_duplicates(subset=None, keep='first', inplace=True)
BoxRawData.index.name = 'IDNumber'
BoxData=BoxRawData[BoxRawData.Length <= 1].head(1000)
print('Loaded Product :',BoxData.columns.values)
print('################################')
#####################################################################
print('################')
sTable='Assess_Box'
print('Storing :',sDatabaseName,' Table:',sTable)
BoxData.to_sql(sTable, conn, if_exists="replace")
print('################')
#####################################################################
print(BoxData.head())
print('################################')
print('Rows : ',BoxData.shape[0])
print('################################')
#####################################################################
#####################################################################
### Import Container Data
#####################################################################
sFileName=Base + '/' + Company + '/' + InputDir + '/' +
InputFileName3 print('###########')
print('Loading :',sFileName)
ContainerRawData=pd.read_csv(sFileName,
                header=0,
                low_memory=False,
                encoding="latin-1"
                )
ContainerRawData.drop_duplicates(subset=None, keep='first', inplace=True)
ContainerRawData.index.name = 'IDNumber'
ContainerData=ContainerRawData[ContainerRawData.Length <=
2].head(10) print('Loaded Product :',ContainerData.columns.values)
print('################################')
#####################################################################
print('################')
sTable='Assess_Container'
print('Storing :',sDatabaseName,' Table:',sTable)
BoxData.to_sql(sTable, conn, if_exists="replace")
print('################')
#####################################################################
print(ContainerData.head())
print('################################')
print('Rows : ',ContainerData.shape[0])
print('################################')
#####################################################################
#####################################################################
### Fit Product in Box
#####################################################################
print('################')
sView='Assess_Product_in_Box' print('Creating
:',sDatabaseName,' View:',sView)
```

```
sSQL="DROP VIEW IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT"
sSQL=sSQL+ " P.UnitNumber AS ProductNumber,"
sSQL=sSQL+ " B.UnitNumber AS BoxNumber,"
sSQL=sSQL+ " (B.Thickness * 1000) AS PackSafeCode,"
sSQL=sSQL+ " (B.BoxVolume - P.ProductVolume) AS PackFoamVolume,"
sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) * (B.Height*10)) * 167 AS Air_Dimensional_Weight,"
sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) * (B.Height*10)) * 333 AS Road_Dimensional_Weight,"
sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) * (B.Height*10)) * 1000 AS Sea_Dimensional_Weight,"
sSQL=sSQL+ " P.Length AS Product_Length,"
sSQL=sSQL+ " P.Width AS Product_Width,"
sSQL=sSQL+ " P.Height AS Product_Height,"
sSQL=sSQL+ " P.ProductVolume AS Product_cm_Volume,"
sSQL=sSQL+ " ((P.Length*10) * (P.Width*10) * (P.Height*10)) AS Product_ccm_Volume,"
sSQL=sSQL+ " (B.Thickness * 0.95) AS Minimum_Pack_Foam,"
sSQL=sSQL+ " (B.Thickness * 1.05) AS Maximum_Pack_Foam,"
sSQL=sSQL+ " B.Length - (B.Thickness * 1.10) AS Minimum_Product_Box_Length,"
sSQL=sSQL+ " B.Length - (B.Thickness * 0.95) AS Maximum_Product_Box_Length,"
sSQL=sSQL+ " B.Width - (B.Thickness * 1.10) AS Minimum_Product_Box_Width,"
sSQL=sSQL+ " B.Width - (B.Thickness * 0.95) AS Maximum_Product_Box_Width,"
sSQL=sSQL+ " B.Height - (B.Thickness * 1.10) AS Minimum_Product_Box_Height,"
sSQL=sSQL+ " B.Height - (B.Thickness * 0.95) AS Maximum_Product_Box_Height,"
sSQL=sSQL+ " B.Length AS Box_Length,"
sSQL=sSQL+ " B.Width AS Box_Width,"
sSQL=sSQL+ " B.Height AS Box_Height,"
sSQL=sSQL+ " B.BoxVolume AS Box_cm_Volume,"
sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) * (B.Height*10)) AS Box_ccm_Volume,"
sSQL=sSQL+ " (2 * B.Length * B.Width) + (2 * B.Length * B.Height) + (2 * B.Width * B.Height)
AS Box_sqm_Area,"
sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) * (B.Height*10)) * 3.5 AS Box_A_Max_Kg_Weight,"
sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) * (B.Height*10)) * 7.7 AS Box_B_Max_Kg_Weight,"
sSQL=sSQL+ " ((B.Length*10) * (B.Width*10) * (B.Height*10)) * 10.0 AS Box_C_Max_Kg_Weight"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " Assess_Product as P"
sSQL=sSQL+ " ,"
sSQL=sSQL+ " Assess_Box as B"
sSQL=sSQL+ " WHERE"
sSQL=sSQL+ " P.Length >= (B.Length - (B.Thickness * 1.10))"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " P.Width >= (B.Width - (B.Thickness * 1.10))"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " P.Height >= (B.Height - (B.Thickness * 1.10))"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " P.Length <= (B.Length - (B.Thickness * 0.95))"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " P.Width <= (B.Width - (B.Thickness * 0.95))"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " P.Height <= (B.Height - (B.Thickness * 0.95))"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " (B.Height - B.Thickness) >= 0"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " (B.Width - B.Thickness) >= 0"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " (B.Height - B.Thickness) >= 0"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " B.BoxVolume >= P.ProductVolume;"
sql.execute(sSQL,conn)
```

```
#####################################################################
### Fit Box in Pallet
#####################################################################
t=0
for l in range(2,8): for
   w in range(2,8):
      for h in range(4): t += 1

         PalletLine=[('IDNumber',[t]),

                  ('ShipType', ['Pallet']),
                  ('UnitNumber', ('L-'+format(t,"06d"))),
                  ('Box_per_Length',(format(2**l,"4d"))),
                  ('Box_per_Width',(format(2**w,"4d"))),
                  ('Box_per_Height',(format(2**h,"4d")))]
         if t==1:
           PalletFrame =
         pd.DataFrame.from_items(PalletLine) else:
            PalletRow = pd.DataFrame.from_items(PalletLine)
            PalletFrame = PalletFrame.append(PalletRow)
PalletFrame.set_index(['IDNumber'],inplace=True)
#####################################################################
PalletFrame.head()
print('################################')
print('Rows : ',PalletFrame.shape[0])
print('################################')
#####################################################################
### Fit Box on Pallet
#####################################################################
print('#################')
sView='Assess_Box_on_Pallet' print('Creating
:',sDatabaseName,' View:',sView) sSQL="DROP
VIEW IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT DISTINCT"
sSQL=sSQL+ " P.UnitNumber AS PalletNumber,"
sSQL=sSQL+ " B.UnitNumber AS BoxNumber,"
sSQL=sSQL+ " round(B.Length*P.Box_per_Length,3) AS Pallet_Length,"
sSQL=sSQL+ " round(B.Width*P.Box_per_Width,3) AS Pallet_Width,"
sSQL=sSQL+ " round(B.Height*P.Box_per_Height,3) AS Pallet_Height,"
sSQL=sSQL+ " P.Box_per_Length * P.Box_per_Width * P.Box_per_Height AS Pallet_Boxes"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " Assess_Box as B"
sSQL=sSQL+ " ,"
sSQL=sSQL+ " Assess_Pallet as P"
sSQL=sSQL+ " WHERE"
sSQL=sSQL+ " round(B.Length*P.Box_per_Length,3) <= 20"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " round(B.Width*P.Box_per_Width,3) <= 9"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " round(B.Height*P.Box_per_Height,3) <= 5;"
sql.execute(sSQL,conn)
#####################################################################
sTables=['Assess_Product_in_Box','Assess_Box_on_Pallet']
for sTable in sTables:
   print('################')
   print('Loading :',sDatabaseName,' Table:',sTable)
   sSQL=" SELECT "
   sSQL=sSQL+ " *"
```

```
    sSQL=sSQL+ " FROM"
    sSQL=sSQL+ " " + sTable + ";"
    SnapShotData=pd.read_sql_query(sSQL, conn)
    print('################')
    sTableOut=sTable + '_SnapShot'
    print('Storing :',sDatabaseName,' Table:',sTable)
    SnapShotData.to_sql(sTableOut, conn, if_exists="replace")
    print('################')
#####################################################################
### Fit Pallet in Container
#####################################################################
sTables=['Length','Width','Height']
for sTable in sTables:

    sView='Assess_Pallet_in_Container_' + sTable
    print('Creating :',sDatabaseName,' View:',sView)
    sSQL="DROP VIEW IF EXISTS " + sView + ";"
    sql.execute(sSQL,conn)

    sSQL="CREATE VIEW " + sView + " AS"
    sSQL=sSQL+ " SELECT DISTINCT"
    sSQL=sSQL+ " C.UnitNumber AS ContainerNumber,"
    sSQL=sSQL+ " P.PalletNumber,"
    sSQL=sSQL+ " P.BoxNumber,"
    sSQL=sSQL+ " round(C." + sTable + "/P.Pallet_" + sTable + ",0)"
    sSQL=sSQL+ " AS Pallet_per_" + sTable + ","
    sSQL=sSQL+ " round(C." + sTable + "/P.Pallet_" + sTable + ",0)"
    sSQL=sSQL+ " * P.Pallet_Boxes AS Pallet_" + sTable + "_Boxes,"
    sSQL=sSQL+ " P.Pallet_Boxes"
    sSQL=sSQL+ " FROM"
    sSQL=sSQL+ " Assess_Container as C"
    sSQL=sSQL+ " ,"
    sSQL=sSQL+ " Assess_Box_on_Pallet_SnapShot as P"
    sSQL=sSQL+ " WHERE"
    sSQL=sSQL+ " round(C.Length/P.Pallet_Length,0) > 0"
    sSQL=sSQL+ " AND"
    sSQL=sSQL+ " round(C.Width/P.Pallet_Width,0) > 0"
    sSQL=sSQL+ " AND"
    sSQL=sSQL+ " round(C.Height/P.Pallet_Height,0) > 0;"
    sql.execute(sSQL,conn)

    print('################')
    print('Loading :',sDatabaseName,' Table:',sView)
    sSQL=" SELECT "
    sSQL=sSQL+ " *"
    sSQL=sSQL+ " FROM"
    sSQL=sSQL+ " " + sView + ";"
    SnapShotData=pd.read_sql_query(sSQL, conn)
    print('################')
    sTableOut= sView + '_SnapShot'
    print('Storing :',sDatabaseName,' Table:',sTableOut)
    SnapShotData.to_sql(sTableOut, conn, if_exists="replace")
    print('################')
#####################################################################
print('################')
sView='Assess_Pallet_in_Container'
print('Creating :',sDatabaseName,' View:',sView)
sSQL="DROP VIEW IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)
```

```
sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT"
sSQL=sSQL+ " CL.ContainerNumber,"
sSQL=sSQL+ " CL.PalletNumber,"
sSQL=sSQL+ " CL.BoxNumber,"
sSQL=sSQL+ " CL.Pallet_Boxes AS Boxes_per_Pallet,"
sSQL=sSQL+ " CL.Pallet_per_Length,"
sSQL=sSQL+ " CW.Pallet_per_Width,"
sSQL=sSQL+ " CH.Pallet_per_Height,"
sSQL=sSQL+ " CL.Pallet_Length_Boxes * CW.Pallet_Width_Boxes * CH.Pallet_Height_Boxes AS
Container_Boxes"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " Assess_Pallet_in_Container_Length_SnapShot as CL"
sSQL=sSQL+ " JOIN"
sSQL=sSQL+ " Assess_Pallet_in_Container_Width_SnapShot as CW"
sSQL=sSQL+ " ON"
sSQL=sSQL+ " CL.ContainerNumber = CW.ContainerNumber"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " CL.PalletNumber = CW.PalletNumber"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " CL.BoxNumber = CW.BoxNumber"
sSQL=sSQL+ " JOIN"
sSQL=sSQL+ " Assess_Pallet_in_Container_Height_SnapShot as CH"
sSQL=sSQL+ " ON"
sSQL=sSQL+ " CL.ContainerNumber = CH.ContainerNumber"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " CL.PalletNumber = CH.PalletNumber"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " CL.BoxNumber = CH.BoxNumber;"
sql.execute(sSQL,conn)
######################################################################
sTables=['Assess_Product_in_Box','Assess_Pallet_in_Container']
for sTable in sTables:
    print('################')
    print('Loading :',sDatabaseName,' Table:',sTable)
    sSQL=" SELECT "
    sSQL=sSQL+ " *"
    sSQL=sSQL+ " FROM"
    sSQL=sSQL+ " " + sTable + ";"
    PackData=pd.read_sql_query(sSQL, conn)
    print('################')
    print(PackData)
    print('################')
    print('################################')
    print('Rows : ',PackData.shape[0])
    print('################################')
    sFileName=sFileDir + '/' + sTable + '.csv'
    print(sFileName)
    PackData.to_csv(sFileName, index = False)
print('### Done!! ############################################')
######################################################################
```



J. Write a Python program to create a delivery route using the given data.

Creating a Delivery Route

Hillman requires the complete grid plan of the delivery routes for the company, to ensure the suppliers, warehouses, shops, and customers can be reached by its new strategy. This new plan will enable the optimum routes between suppliers, warehouses, shops, and customers.

Open Python editor and create a file named Assess-Shipping-Routes.py in directory C:\VKHCG\03-Hillman\02-Assess.

```
######################################################################
import sys
import os
import pandas as pd
import sqlite3 as sq
from pandas.io import sql
import networkx as nx
from geopy.distance import vincenty
######################################################################
nMax=3
nMaxPath=10
nSet=False
nVSet=False
######################################################################
Base='C:/VKHCG'
######################################################################
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
######################################################################
Company='03-Hillman'
InputDir1='01-Retrieve/01-EDS/01-R'
InputDir2='01-Retrieve/01-EDS/02-Python'
InputFileName1='Retrieve_GB_Postcode_Warehouse.csv'
InputFileName2='Retrieve_GB_Postcodes_Shops.csv'
EDSDir='02-Assess/01-EDS'
OutputDir=EDSDir + '/02-Python'
OutputFileName1='Assess_Shipping_Routes.gml'
OutputFileName2='Assess_Shipping_Routes.txt'
######################################################################
sFileDir=Base + '/' + Company + '/' + EDSDir
if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
######################################################################
sFileDir=Base + '/' + Company + '/' + OutputDir
if not os.path.exists(sFileDir):
    os.makedirs(sFileDir)
######################################################################
sDataBaseDir=Base + '/' + Company + '/02-Assess/SQLite'
```

```
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
#####################################################################
sDatabaseName=sDataBaseDir + '/hillman.db'
conn = sq.connect(sDatabaseName)
#####################################################################
#####################################################################
### Import Warehouse Data
#####################################################################
sFileName=Base + '/' + Company + '/' + InputDir1 + '/' +
InputFileName1 print('###########')
print('Loading :',sFileName)
WarehouseRawData=pd.read_csv(sFileName,
                header=0,
                low_memory=False,
                encoding="latin-1"
                )
WarehouseRawData.drop_duplicates(subset=None, keep='first', inplace=True)
WarehouseRawData.index.name = 'IDNumber' WarehouseData=WarehouseRawData.head(nMax)
WarehouseData=WarehouseData.append(WarehouseRawData.tail(nMax))
WarehouseData=WarehouseData.append(WarehouseRawData[WarehouseRawData.postcode=='KA13']) if
nSet==True:

WarehouseData=WarehouseData.append(WarehouseRawData[WarehouseRawData.postcode=='SW1W'])
WarehouseData.drop_duplicates(subset=None, keep='first', inplace=True)
print('Loaded Warehouses :',WarehouseData.columns.values)
print('#################################')
#####################################################################
print('################')
sTable='Assess_Warehouse_UK'
print('Storing :',sDatabaseName,' Table:',sTable)
WarehouseData.to_sql(sTable, conn, if_exists="replace")
print('################')
#####################################################################
print(WarehouseData.head())
print('#################################')
print('Rows : ',WarehouseData.shape[0])
print('#################################')
#####################################################################
### Import Shop Data
#####################################################################
sFileName=Base + '/' + Company + '/' + InputDir1 + '/' +
InputFileName2 print('###########')
print('Loading :',sFileName)
ShopRawData=pd.read_csv(sFileName,
                header=0,
                low_memory=False,
                encoding="latin-1"
                )
ShopRawData.drop_duplicates(subset=None, keep='first',
inplace=True) ShopRawData.index.name = 'IDNumber'
ShopData=ShopRawData
print('Loaded Shops :',ShopData.columns.values)
print('#################################')
#####################################################################
print('################')
sTable='Assess_Shop_UK'
print('Storing :',sDatabaseName,' Table:',sTable)
ShopData.to_sql(sTable, conn, if_exists="replace")
```

```
print('################')
#####################################################################
print(ShopData.head())
print('################################')
print('Rows : ',ShopData.shape[0])
print('################################')
#####################################################################
### Connect HQ
#####################################################################
print('################')
sView='Assess_HQ'
print('Creating :',sDatabaseName,' View:',sView)
sSQL="DROP VIEW IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT"
sSQL=sSQL+ " W.postcode AS HQ_PostCode,"
sSQL=sSQL+ " 'HQ-' || W.postcode AS HQ_Name,"
sSQL=sSQL+ " round(W.latitude,6) AS HQ_Latitude,"
sSQL=sSQL+ " round(W.longitude,6) AS HQ_Longitude"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " Assess_Warehouse_UK as W"
sSQL=sSQL+ " WHERE"
sSQL=sSQL+ " TRIM(W.postcode) in ('KA13','SW1W');"
sql.execute(sSQL,conn)
#####################################################################
### Connect Warehouses
#####################################################################
print('################')
sView='Assess_Warehouse'
print('Creating :',sDatabaseName,' View:',sView)
sSQL="DROP VIEW IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT"
sSQL=sSQL+ " W.postcode AS Warehouse_PostCode,"
sSQL=sSQL+ " 'WH-' || W.postcode AS Warehouse_Name,"
sSQL=sSQL+ " round(W.latitude,6) AS Warehouse_Latitude,"
sSQL=sSQL+ " round(W.longitude,6) AS Warehouse_Longitude"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " Assess_Warehouse_UK as W;"
sql.execute(sSQL,conn)
#####################################################################
### Connect Warehouse to Shops by PostCode
-#####################################################################
print('################')
sView='Assess_Shop'
print('Creating :',sDatabaseName,' View:',sView)
sSQL="DROP VIEW IF EXISTS " + sView + ";"
sql.execute(sSQL,conn)

sSQL="CREATE VIEW " + sView + " AS"
sSQL=sSQL+ " SELECT"
sSQL=sSQL+ " TRIM(S.postcode) AS Shop_PostCode,"
sSQL=sSQL+ " 'SP-' || TRIM(S.FirstCode) || '-' || TRIM(S.SecondCode) AS Shop_Name,"
sSQL=sSQL+ " TRIM(S.FirstCode) AS Warehouse_PostCode,"
sSQL=sSQL+ " round(S.latitude,6) AS Shop_Latitude,"
sSQL=sSQL+ " round(S.longitude,6) AS Shop_Longitude"
```

```
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " Assess_Warehouse_UK as W"
sSQL=sSQL+ " JOIN"
sSQL=sSQL+ " Assess_Shop_UK as S"
sSQL=sSQL+ " ON"
sSQL=sSQL+ " TRIM(W.postcode) = TRIM(S.FirstCode);"
sql.execute(sSQL,conn)
#####################################################################
#####################################################################
G=nx.Graph()
#####################################################################
print('################')
sTable = 'Assess_HQ'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL=" SELECT DISTINCT"
sSQL=sSQL+ " *"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " " + sTable + ";"
RouteData=pd.read_sql_query(sSQL, conn)
print('################')
#####################################################################
print(RouteData.head())
print('################################')
print('HQ Rows : ',RouteData.shape[0])
print('################################')
#####################################################################
for i in range(RouteData.shape[0]):
   sNode0=RouteData['HQ_Name'][i]
   G.add_node(sNode0,
            Nodetype='HQ',
            PostCode=RouteData['HQ_PostCode'][i],
            Latitude=round(RouteData['HQ_Latitude'][i],6),
            Longitude=round(RouteData['HQ_Longitude'][i],6))
#####################################################################
print('################')
sTable = 'Assess_Warehouse'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL=" SELECT DISTINCT"
sSQL=sSQL+ " *"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " " + sTable + ";"
RouteData=pd.read_sql_query(sSQL, conn)
print('################')
#####################################################################
print(RouteData.head())
print('################################')
print('Warehouse Rows : ',RouteData.shape[0])
print('################################')
for i in range(RouteData.shape[0]):
   sNode0=RouteData['Warehouse_Name'][i]
   G.add_node(sNode0,
            Nodetype='Warehouse',
            PostCode=RouteData['Warehouse_PostCode'][i],
            Latitude=round(RouteData['Warehouse_Latitude'][i],6),
            Longitude=round(RouteData['Warehouse_Longitude'][i],6))
print('################')
sTable = 'Assess_Shop'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL=" SELECT DISTINCT"
sSQL=sSQL+ " *"
```

```
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " " + sTable + ";"
RouteData=pd.read_sql_query(sSQL, conn)
print('################')
print(RouteData.head())
print('################################')
print('Shop Rows : ',RouteData.shape[0])
print('################################')
for i in range(RouteData.shape[0]):
   sNode0=RouteData['Shop_Name'][i]
   G.add_node(sNode0,
            Nodetype='Shop',
            PostCode=RouteData['Shop_PostCode'][i],
            WarehousePostCode=RouteData['Warehouse_PostCode'][i],
            Latitude=round(RouteData['Shop_Latitude'][i],6),
            Longitude=round(RouteData['Shop_Longitude'][i],6))
#####################################################################
## Create Edges
#####################################################################
print('################################')
print('Loading Edges')
print('################################')

for sNode0 in nx.nodes_iter(G):
   for sNode1 in nx.nodes_iter(G):
      if G.node[sNode0]['Nodetype']=='HQ' and \
         G.node[sNode1]['Nodetype']=='HQ' and \
         sNode0 != sNode1:
            distancemeters=round(\
                        vincenty(\
                              (\
                               G.node[sNode0]['Latitude'],\
                               G.node[sNode0]['Longitude']\
                               ),\
                               (\
                                G.node[sNode1]['Latitude']\
                                ,\
                                G.node[sNode1]['Longitude']\
                                )\
                                ).meters\
                        ,0)
            distancemiles=round(\
                        vincenty(\
                              (\
                               G.node[sNode0]['Latitude'],\
                               G.node[sNode0]['Longitude']\
                               ),\
                               (\
                                G.node[sNode1]['Latitude']\
                                ,\
                                G.node[sNode1]['Longitude']\
                                )\
                                ).miles\
                        ,3)

            if distancemiles >= 0.05:
               cost = round(150+(distancemiles * 2.5),6)
               vehicle='V001'
            else:
               cost = round(2+(distancemiles * 0.10),6)
```

```
            vehicle='ForkLift'

        G.add_edge(sNode0,sNode1,DistanceMeters=distancemeters, \
                DistanceMiles=distancemiles, \
                Cost=cost,Vehicle=vehicle)
        if nVSet==True:
            print('Edge-H-H:',sNode0,' to ', sNode1, \
              ' Distance:',distancemeters,'meters',\
              distancemiles,'miles','Cost', cost,'Vehicle',vehicle)

    if G.node[sNode0]['Nodetype']=='HQ' and \
       G.node[sNode1]['Nodetype']=='Warehouse' and \
       sNode0 != sNode1:
          distancemeters=round(\
                        vincenty(\
                              (\
                               G.node[sNode0]['Latitude'],\
                               G.node[sNode0]['Longitude']\
                               ),\
                               (\
                                G.node[sNode1]['Latitude']\
                                ,\
                                G.node[sNode1]['Longitude']\
                                )\
                                ).meters\
                       ,0)
          distancemiles=round(\
                        vincenty(\
                              (\
                               G.node[sNode0]['Latitude'],\
                               G.node[sNode0]['Longitude']\
                               ),\
                               (\
                                G.node[sNode1]['Latitude']\
                                ,\
                                G.node[sNode1]['Longitude']\
                                )\
                                ).miles\
                       ,3)
          if distancemiles >= 10:
             cost = round(50+(distancemiles * 2),6)
             vehicle='V002'
          else:
             cost = round(5+(distancemiles * 1.5),6)
             vehicle='V003'
          if distancemiles <= 50:
             G.add_edge(sNode0,sNode1,DistanceMeters=distancemeters, \
                     DistanceMiles=distancemiles, \
                     Cost=cost,Vehicle=vehicle)
             if nVSet==True:
                print('Edge-H-W:',sNode0,' to ', sNode1, \
                  ' Distance:',distancemeters,'meters',\
                  distancemiles,'miles','Cost', cost,'Vehicle',vehicle)

    if nSet==True and \
       G.node[sNode0]['Nodetype']=='Warehouse' and \
       G.node[sNode1]['Nodetype']=='Warehouse' and \
       sNode0 != sNode1:
          distancemeters=round(\
                        vincenty(\
```

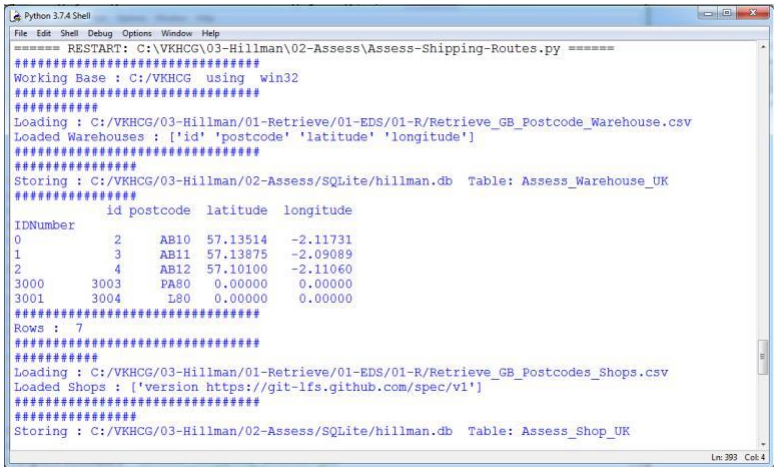
```
                                (\
                                 G.node[sNode0]['Latitude'],\
                                 G.node[sNode0]['Longitude']\
                                 ),\
                                 (\
                                  G.node[sNode1]['Latitude']\
                                  ,\
                                  G.node[sNode1]['Longitude']\
                                  )\
                                  ).meters\
                        ,0)
            distancemiles=round(\
                         vincenty(\
                                (\
                                 G.node[sNode0]['Latitude'],\
                                 G.node[sNode0]['Longitude']\
                                 ),\
                                 (\
                                  G.node[sNode1]['Latitude']\
                                  ,\
                                  G.node[sNode1]['Longitude']\
                                  )\
                                  ).miles\
                        ,3)
            if distancemiles >= 10:
               cost = round(50+(distancemiles * 1.10),6)
               vehicle='V004'
            else:
               cost = round(5+(distancemiles * 1.05),6)
               vehicle='V005'

            if distancemiles <= 20:
               G.add_edge(sNode0,sNode1,DistanceMeters=distancemeters, \
                        DistanceMiles=distancemiles, \
                        Cost=cost,Vehicle=vehicle)
               if nVSet==True:
                  print('Edge-W-W:',sNode0,' to ', sNode1, \
                    ' Distance:',distancemeters,'meters',\
                    distancemiles,'miles','Cost', cost,'Vehicle',vehicle)

      if G.node[sNode0]['Nodetype']=='Warehouse' and \
         G.node[sNode1]['Nodetype']=='Shop' and \
         G.node[sNode0]['PostCode']==G.node[sNode1]['WarehousePostCode'] and \
         sNode0 != sNode1:

            distancemeters=round(\
                         vincenty(\
                                (\
                                 G.node[sNode0]['Latitude'],\
                                 G.node[sNode0]['Longitude']\
                                 ),\
                                 (\
                                  G.node[sNode1]['Latitude']\
                                  ,\
                                  G.node[sNode1]['Longitude']\
                                  )\
                                  ).meters\
                        ,0)
            distancemiles=round(\
                         vincenty(\
```

```
                                (\
                                 G.node[sNode0]['Latitude'],\
                                 G.node[sNode0]['Longitude']\
                                 ),\
                                 (\
                                  G.node[sNode1]['Latitude']\
                                  ,\
                                  G.node[sNode1]['Longitude']\
                                  )\
                                  ).miles\
                        ,3)
        if distancemiles >= 10:
           cost = round(50+(distancemiles * 1.50),6)
           vehicle='V006'
        else:
           cost = round(5+(distancemiles * 0.75),6)
           vehicle='V007'
        if distancemiles <= 10:
           G.add_edge(sNode0,sNode1,DistanceMeters=distancemeters, \
                   DistanceMiles=distancemiles, \
                   Cost=cost,Vehicle=vehicle)
           if nVSet==True:
              print('Edge-W-S:',sNode0,' to ', sNode1, \
                ' Distance:',distancemeters,'meters',\
                distancemiles,'miles','Cost', cost,'Vehicle',vehicle)

if nSet==True and \
   G.node[sNode0]['Nodetype']=='Shop' and \
   G.node[sNode1]['Nodetype']=='Shop' and \
   G.node[sNode0]['WarehousePostCode']==G.node[sNode1]['WarehousePostCode'] and \
   sNode0 != sNode1:

      distancemeters=round(\
                      vincenty(\
                            (\
                             G.node[sNode0]['Latitude'],\
                             G.node[sNode0]['Longitude']\
                             ),\
                             (\
                              G.node[sNode1]['Latitude']\
                              ,\
                              G.node[sNode1]['Longitude']\
                              )\
                              ).meters\
                        ,0)
      distancemiles=round(\
                      vincenty(\
                            (\
                             G.node[sNode0]['Latitude'],\
                             G.node[sNode0]['Longitude']\
                             ),\
                             (\
                              G.node[sNode1]['Latitude']\
                              ,\
                              G.node[sNode1]['Longitude']\
                              )\
                              ).miles\
                        ,3)

      if distancemiles >= 0.05:
```

```
                cost = round(5+(distancemiles * 0.5),6)
                vehicle='V008'
            else:
                cost = round(1+(distancemiles * 0.1),6)
                vehicle='V009'

            if distancemiles <= 0.075:
                G.add_edge(sNode0,sNode1,DistanceMeters=distancemeters, \
                        DistanceMiles=distancemiles, \
                        Cost=cost,Vehicle=vehicle)
                if nVSet==True:
                    print('Edge-S-S:',sNode0,' to ', sNode1, \
                      ' Distance:',distancemeters,'meters',\
                      distancemiles,'miles','Cost', cost,'Vehicle',vehicle)

        if nSet==True and \
            G.node[sNode0]['Nodetype']=='Shop' and \
            G.node[sNode1]['Nodetype']=='Shop' and \
            G.node[sNode0]['WarehousePostCode']!=G.node[sNode1]['WarehousePostCode'] and \
            sNode0 != sNode1:

                distancemeters=round(\
                            vincenty(\
                                (\
                                 G.node[sNode0]['Latitude'],\
                                 G.node[sNode0]['Longitude']\
                                 ),\
                                 (\
                                  G.node[sNode1]['Latitude']\
                                  ,\
                                  G.node[sNode1]['Longitude']\
                                  )\
                                  ).meters\
                           ,0)
                distancemiles=round(\
                            vincenty(\
                                (\
                                 G.node[sNode0]['Latitude'],\
                                 G.node[sNode0]['Longitude']\
                                 ),\
                                 (\
                                  G.node[sNode1]['Latitude']\
                                  ,\
                                  G.node[sNode1]['Longitude']\
                                  )\
                                  ).miles\
                           ,3)

                cost = round(1+(distancemiles * 0.1),6)
                vehicle='V010'

                if distancemiles <= 0.025:
                    G.add_edge(sNode0,sNode1,DistanceMeters=distancemeters, \
                            DistanceMiles=distancemiles, \
                            Cost=cost,Vehicle=vehicle)
                    if nVSet==True:
                        print('Edge-S-S:',sNode0,' to ', sNode1, \
                          ' Distance:',distancemeters,'meters',\
                          distancemiles,'miles','Cost', cost,'Vehicle',vehicle)
    sFileName=sFileDir + '/' + OutputFileName1
```

```
print('################################')
print('Storing :', sFileName)
print('################################')
nx.write_gml(G,sFileName)
sFileName=sFileName +'.gz'
nx.write_gml(G,sFileName)
print('Nodes:',nx.number_of_nodes(G))
print('Edges:',nx.number_of_edges(G))
sFileName=sFileDir + '/' + OutputFileName2
print('################################')
print('Storing :', sFileName)
print('################################')
## Create Paths
print('################################')
print('Loading Paths')
print('################################') f
= open(sFileName,'w')
l=0
sline = 'ID|Cost|StartAt|EndAt|Path|Measure' if
nVSet==True: print ('0', sline) f.write(sline+
'\n')
for sNode0 in nx.nodes_iter(G): for
   sNode1 in nx.nodes_iter(G):
      if sNode0 != sNode1 and \
         nx.has_path(G, sNode0, sNode1)==True and
         \ nx.shortest_path_length(G, \
           source=sNode0, \ target=sNode1, \
           weight='DistanceMiles') <
           nMaxPath:
             l+=1
             sID='{:.0f}'.format(l)
             spath = ','.join(nx.shortest_path(G,
               \ source=sNode0, \
               target=sNode1, \
               weight='DistanceMiles'))
             slength= '{:.6f}'.format(\
               nx.shortest_path_length(G, \
               source=sNode0, \ target=sNode1, \
               weight='DistanceMiles'))
             sline = sID + '|''DistanceMiles''|''' + sNode0 + '''|''' \
             + sNode1 + '''|''' + spath + '''|' + slength
             if nVSet==True: print (sline)
             f.write(sline + '\n')
             l+=1
             sID='{:.0f}'.format(l)
             spath = ','.join(nx.shortest_path(G,
               \ source=sNode0, \
               target=sNode1, \
               weight='DistanceMeters'))
             slength= '{:.6f}'.format(\
               nx.shortest_path_length(G, \
               source=sNode0, \ target=sNode1, \
               weight='DistanceMeters'))
             sline = sID + '|''DistanceMeters''|''' + sNode0 + '''|''' \
             + sNode1 + '''|''' + spath + '''|' + slength
             if nVSet==True: print (sline)
             f.write(sline + '\n')
             l+=1
```

```
            sID='{:.0f}'.format(l)
            spath = ','.join(nx.shortest_path(G, \
              source=sNode0, \
              target=sNode1, \
              weight='Cost'))
            slength= '{:.6f}'.format(\
              nx.shortest_path_length(G, \
              source=sNode0, \
              target=sNode1, \
              weight='Cost'))
            sline = sID + '|"Cost"|"' + sNode0 + '"|"' \
            + sNode1 + '"|"' + spath + '"|' + slength
            if nVSet==True: print (sline)
            f.write(sline + '\n')
f.close()
print('Nodes:',nx.number_of_nodes(G))
print('Edges:',nx.number_of_edges(G))
print('Paths:',sID)
print('################')
print('Vacuum Database')
sSQL="VACUUM;"
sql.execute(sSQL,conn)
print('################')
print('### Done!! ############################################')
```



Clark Ltd

Clark Ltd is the accountancy company that handles everything related to the VKHCG's finances and personnel. Let's investigate Clark with new knowledge.

K. Write a Python program to create Simple forex trading planner from the given data.

Simple Forex Trading Planner

Clark requires the assessment of the group's forex data, for processing and data qualityissues. I will guide you through an example of a forex solution.

Open your Python editor and create a file named Assess-Forex.py in directory C:\VKHCG\04-Clark\02-Assess.

```
################################################################
import sys
import os
import sqlite3 as sq
import pandas as pd
################################################################
```

```
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
Company='04-Clark'
sInputFileName1='01-Vermeulen/01-Retrieve/01-EDS/02-Python/Retrieve-Country-Currency.csv'
sInputFileName2='04-Clark/01-Retrieve/01-EDS/01-R/Retrieve_Euro_EchangeRates.csv'
################################################################
sDataBaseDir=Base + '/' + Company + '/02-Assess/SQLite'
if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
################################################################
sDatabaseName=sDataBaseDir + '/clark.db'
conn = sq.connect(sDatabaseName)
################################################################
### Import Country Data
################################################################
sFileName1=Base + '/' + sInputFileName1
print('################################')
print('Loading :',sFileName1)
print('################################')
CountryRawData=pd.read_csv(sFileName1,header=0,low_memory=False, encoding="latin-1")
CountryRawData.drop_duplicates(subset=None, keep='first', inplace=True)
CountryData=CountryRawData
print('Loaded Company :',CountryData.columns.values)
print('################################')
################################################################
print('################')
sTable='Assess_Country'
print('Storing :',sDatabaseName,' Table:',sTable)
CountryData.to_sql(sTable, conn, if_exists="replace")
print('################')
################################################################
print(CountryData.head())
print('################################')
print('Rows : ',CountryData.shape[0])
print('################################')
################################################################
### Import Forex Data
################################################################
sFileName2=Base + '/' + sInputFileName2
print('################################')
print('Loading :',sFileName2)
print('################################')
ForexRawData=pd.read_csv(sFileName2,header=0,low_memory=False, encoding="latin-
1") ForexRawData.drop_duplicates(subset=None, keep='first', inplace=True)
ForexData=ForexRawData.head(5)
print('Loaded Company :',ForexData.columns.values)
print('################################')
################################################################
print('################')
sTable='Assess_Forex'
print('Storing :',sDatabaseName,' Table:',sTable)
ForexData.to_sql(sTable, conn,
if_exists="replace") print('################')
################################################################
print(ForexData.head())
print('################################')
print('Rows : ',ForexData.shape[0])
```

```
print('################################')
#################################################################
print('################')
sTable='Assess_Forex'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="select distinct"
sSQL=sSQL+ " A.CodeIn"
sSQL=sSQL+ " from"
sSQL=sSQL+ " Assess_Forex as A;"
CodeData=pd.read_sql_query(sSQL, conn)
print('################')
#################################################################

for c in range(CodeData.shape[0]):
   print('################')
   sTable='Assess_Forex & 2x Country > ' + CodeData['CodeIn'][c]
   print('Loading :',sDatabaseName,' Table:',sTable)
   sSQL="select distinct"
   sSQL=sSQL+ " A.Date,"
   sSQL=sSQL+ " A.CodeIn,"
   sSQL=sSQL+ " B.Country as CountryIn,"
   sSQL=sSQL+ " B.Currency as CurrencyNameIn,"
   sSQL=sSQL+ " A.CodeOut,"
   sSQL=sSQL+ " C.Country as CountryOut,"
   sSQL=sSQL+ " C.Currency as CurrencyNameOut,"
   sSQL=sSQL+ " A.Rate"
   sSQL=sSQL+ " from"
   sSQL=sSQL+ " Assess_Forex as A"
   sSQL=sSQL+ " JOIN"
   sSQL=sSQL+ " Assess_Country as B"
   sSQL=sSQL+ " ON A.CodeIn = B.CurrencyCode"
   sSQL=sSQL+ " JOIN"
   sSQL=sSQL+ " Assess_Country as C"
   sSQL=sSQL+ " ON A.CodeOut = C.CurrencyCode"
   sSQL=sSQL+ " WHERE"
   sSQL=sSQL+ " A.CodeIn ='" + CodeData['CodeIn'][c] + "';"
   ForexData=pd.read_sql_query(sSQL, conn).head(1000)
   print('################')
   print(ForexData)
   print('################')
   sTable='Assess_Forex_' + CodeData['CodeIn'][c]
   print('Storing :',sDatabaseName,' Table:',sTable)
   ForexData.to_sql(sTable, conn, if_exists="replace")
   print('################')
   print('################################')
   print('Rows : ',ForexData.shape[0])
   print('################################')
#################################################################
print('### Done!! ############################################')
#################################################################
```

Output:

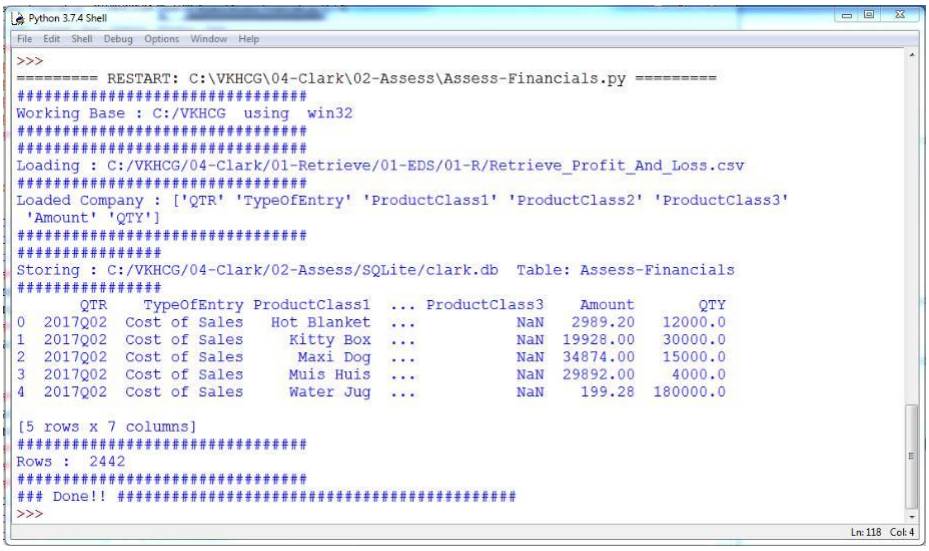
This will produce a set of demonstrated values onscreen by removing duplicate records and other related data processing.

L. Write a Python program to process the balance sheet to ensure that only good data is processing.

Financials
Clark requires you to process the balance sheet for the VKHCG group companies. Go through a sample balance sheet data assessment, to ensure that only the good data is processed.

Open Python editor and create a file named Assess-Financials.py in directory C:\VKHCG\04-Clark\02-Assess.

```
import sys
import os
import sqlite3 as sq
import pandas as pd
if sys.platform == 'linux':
    Base=os.path.expanduser('~') + '/VKHCG'
else:
    Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
Company='04-Clark'
sInputFileName='01-Retrieve/01-EDS/01-R/Retrieve_Profit_And_Loss.csv'
sDataBaseDir=Base + '/' + Company + '/02-Assess/SQLite'
if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
sDatabaseName=sDataBaseDir + '/clark.db'
conn = sq.connect(sDatabaseName)
### Import Financial Data
sFileName=Base + '/' + Company + '/' + sInputFileName
print('################################')
print('Loading :',sFileName)
print('################################')
FinancialRawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
FinancialData=FinancialRawData
print('Loaded Company :',FinancialData.columns.values)
print('################################')
print('#################')
sTable='Assess-Financials'
print('Storing :',sDatabaseName,' Table:',sTable)
FinancialData.to_sql(sTable, conn, if_exists="replace")
print('#################')
print(FinancialData.head())
print('################################')
print('Rows : ',FinancialData.shape[0])
print('################################')
print('### Done!! ############################################')
```



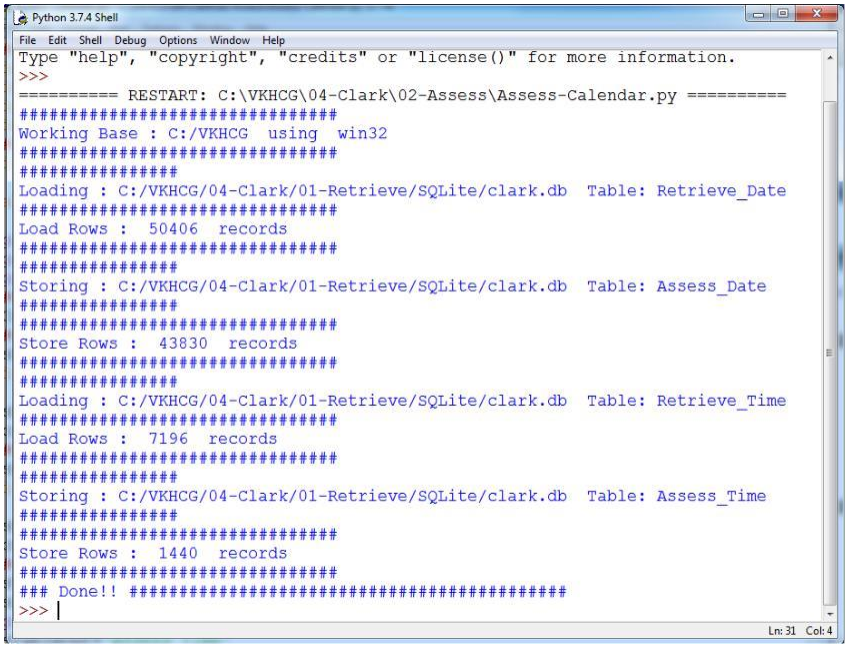
Write a Python program to store all master records for the financial calendar Financial Calendar

Clark stores all the master records for the financial calendar. So we import thecalendar from the retrieve step's data storage.

Open Python editor and create a file named Assess-Calendar.py in directory C:\VKHCG\04-Clark\02-Assess.

```
##################################################################
import sys
import os
import sqlite3 as sq
import pandas as pd
##################################################################
if sys.platform == 'linux':
   Base=os.path.expanduser('~') + '/VKHCG'
else:
   Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
##################################################################
Company='04-Clark'
##################################################################
sDataBaseDirIn=Base + '/' + Company + '/01-
Retrieve/SQLite' if not os.path.exists(sDataBaseDirIn):
   os.makedirs(sDataBaseDirIn)
sDatabaseNameIn=sDataBaseDirIn + '/clark.db'
connIn = sq.connect(sDatabaseNameIn)
##################################################################
sDataBaseDirOut=Base + '/' + Company + '/01-
Retrieve/SQLite' if not os.path.exists(sDataBaseDirOut):
   os.makedirs(sDataBaseDirOut)
sDatabaseNameOut=sDataBaseDirOut + '/clark.db'
connOut = sq.connect(sDatabaseNameOut)
##################################################################
sTableIn='Retrieve_Date'
sSQL='select * FROM ' + sTableIn + ';'
print('################')
sTableOut='Assess_Time'
print('Loading :',sDatabaseNameIn,' Table:',sTableIn)
dateRawData=pd.read_sql_query(sSQL, connIn)
dateData=dateRawData
##################################################################
print('################################')
print('Load Rows : ',dateRawData.shape[0], ' records')
print('################################')
dateData.drop_duplicates(subset='FinDate', keep='first', inplace=True)
##################################################################
print('################')
sTableOut='Assess_Date'
print('Storing :',sDatabaseNameOut,' Table:',sTableOut)
dateData.to_sql(sTableOut, connOut, if_exists="replace")
print('################')
##################################################################
print('################################')
print('Store Rows : ',dateData.shape[0], ' records')
print('################################')
##################################################################
##################################################################
sTableIn='Retrieve_Time'
```

```
sSQL='select * FROM ' + sTableIn + ';'
print('#################')
sTableOut='Assess_Time'
print('Loading :',sDatabaseNameIn,' Table:',sTableIn)
timeRawData=pd.read_sql_query(sSQL, connIn)
timeData=timeRawData
#####################################################################
print('#################################')
print('Load Rows : ',timeData.shape[0], ' records')
print('#################################')
timeData.drop_duplicates(subset=None, keep='first', inplace=True)
#####################################################################
print('#################')
sTableOut='Assess_Time'
print('Storing :',sDatabaseNameOut,' Table:',sTableOut)
timeData.to_sql(sTableOut, connOut, if_exists="replace")
print('#################')
#####################################################################
print('#################################')
print('Store Rows : ',timeData.shape[0], ' records')
print('#################################')
#####################################################################
print('### Done!! ############################################')
#####################################################################
```



M. Write a Python program to generate payroll from the given data.

People

Clark Ltd generates the payroll, so it holds all the staff records. Clark also handles all payments to suppliers and receives payments from customers' details on all companies.

Open Python editor and create a file named Assess-People.py in directory C:\VKHCG\04-Clark\02-Assess.

```
#####################################################################
import sys
import os
import sqlite3 as sq
import pandas as pd
#####################################################################
```

```
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
Company='04-Clark'
sInputFileName1='01-Retrieve/01-EDS/02-Python/Retrieve-Data_female-names.csv'
sInputFileName2='01-Retrieve/01-EDS/02-Python/Retrieve-Data_male-names.csv'
sInputFileName3='01-Retrieve/01-EDS/02-Python/Retrieve-Data_last-names.csv'
sOutputFileName1='Assess-Staff.csv'
sOutputFileName2='Assess-Customers.csv'
################################################################
sDataBaseDir=Base + '/' + Company + '/02-Assess/SQLite'
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
################################################################
sDatabaseName=sDataBaseDir + '/clark.db'
conn = sq.connect(sDatabaseName)
################################################################
### Import Female Data
################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName1
print('################################')
print('Loading :',sFileName)
print('################################')
print(sFileName)
FemaleRawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-
1") FemaleRawData.rename(columns={'NameValues' : 'FirstName'},inplace=True)
FemaleRawData.drop_duplicates(subset=None, keep='first', inplace=True)
FemaleData=FemaleRawData.sample(100) print('################################')

################################################################
print('################')
sTable='Assess_FemaleName'
print('Storing :',sDatabaseName,' Table:',sTable)
FemaleData.to_sql(sTable, conn,
if_exists="replace") print('################')
print('################################')
print('Rows : ',FemaleData.shape[0], ' records')
print('################################')
################################################################
### Import Male Data
sFileName=Base + '/' + Company + '/' + sInputFileName2
print('################################')
print('Loading :',sFileName)
print('################################')
MaleRawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
MaleRawData.rename(columns={'NameValues' : 'FirstName'},inplace=True)
MaleRawData.drop_duplicates(subset=None, keep='first', inplace=True)
MaleData=MaleRawData.sample(100)
print('################################')
sTable='Assess_MaleName'
print('Storing :',sDatabaseName,' Table:',sTable)
MaleData.to_sql(sTable, conn, if_exists="replace")
print('################')
################################################################
print('################################')
print('Rows : ',MaleData.shape[0], ' records')
print('################################')
################################################################
```

```
### Import Surname Data
sFileName=Base + '/' + Company + '/' + sInputFileName3
print('################################')
print('Loading :',sFileName)
print('################################')
SurnameRawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
SurnameRawData.rename(columns={'NameValues' : 'LastName'},inplace=True)
SurnameRawData.drop_duplicates(subset=None, keep='first', inplace=True)
SurnameData=SurnameRawData.sample(200)
print('################')
sTable='Assess_Surname'
print('Storing :',sDatabaseName,' Table:',sTable)
SurnameData.to_sql(sTable, conn, if_exists="replace")
print('################')
print('################################')
print('Rows : ',SurnameData.shape[0], ' records')
print('################################')
print('################')
sTable='Assess_FemaleName & Assess_MaleName'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="select distinct"
sSQL=sSQL+ " A.FirstName,"
sSQL=sSQL+ " 'Female' as Gender"
sSQL=sSQL+ " from"
sSQL=sSQL+ " Assess_FemaleName as A"
sSQL=sSQL+ " UNION"
sSQL=sSQL+ " select distinct"
sSQL=sSQL+ " A.FirstName,"
sSQL=sSQL+ " 'Male' as Gender"
sSQL=sSQL+ " from"
sSQL=sSQL+ " Assess_MaleName as A;"
FirstNameData=pd.read_sql_query(sSQL, conn)
print('################')
#####################################################################
#print('################')
sTable='Assess_FirstName'
print('Storing :',sDatabaseName,' Table:',sTable)
FirstNameData.to_sql(sTable, conn, if_exists="replace")
print('################')
#####################################################################
#####################################################################
print('################')
sTable='Assess_FirstName x2 & Assess_Surname'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="select distinct"
sSQL=sSQL+ " A.FirstName,"
sSQL=sSQL+ " B.FirstName AS SecondName,"
sSQL=sSQL+ " C.LastName,"
sSQL=sSQL+ " A.Gender"
sSQL=sSQL+ " from"
sSQL=sSQL+ " Assess_FirstName as A"
sSQL=sSQL+ " ,"
sSQL=sSQL+ " Assess_FirstName as B"
sSQL=sSQL+ " ,"
sSQL=sSQL+ " Assess_Surname as C"
sSQL=sSQL+ " WHERE"
sSQL=sSQL+ " A.Gender = B.Gender"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " A.FirstName <> B.FirstName;"
PeopleRawData=pd.read_sql_query(sSQL, conn)
```

```
People1Data=PeopleRawData.sample(10000)

sTable='Assess_FirstName & Assess_Surname'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="select distinct"
sSQL=sSQL+ " A.FirstName,"
sSQL=sSQL+ " " AS SecondName,"
sSQL=sSQL+ " B.LastName,"
sSQL=sSQL+ " A.Gender"
sSQL=sSQL+ " from"
sSQL=sSQL+ " Assess_FirstName as A"
sSQL=sSQL+ " ,"
sSQL=sSQL+ " Assess_Surname as B;"
PeopleRawData=pd.read_sql_query(sSQL, conn)
People2Data=PeopleRawData.sample(10000)
PeopleData=People1Data.append(People2Data)
print(PeopleData)
print('#################')
#print('#################')
sTable='Assess_People'
print('Storing :',sDatabaseName,' Table:',sTable)
PeopleData.to_sql(sTable, conn, if_exists="replace")
print('#################')
sFileDir=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python' if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
sOutputFileName = sTable+'.csv'
sFileName=sFileDir + '/' + sOutputFileName
print('################################')
print('Storing :', sFileName)
print('################################')
PeopleData.to_csv(sFileName, index = False)
print('################################')
#####################################################################
print('### Done!! ############################################')
#####################################################################
```

OUTPUT:

```
Python 3.7.4 Shell
File  Edit  Shell  Debug  Options  Window  Help
========== RESTART: C:\VKHCG\04-Clark\02-Assess\Assess-People.py ==========
Loading : C:/VKHCG/04-Clark/01-Retrieve/01-EDS/02-Python/Retrieve-Data_female-names.csv
C:/VKHCG/04-Clark/01-Retrieve/01-EDS/02-Python/Retrieve-Data_female-names.csv
Storing : C:/VKHCG/04-Clark/02-Assess/SQLite/clark.db  Table: Assess_FemaleName
Rows :  100  records
Loading : C:/VKHCG/04-Clark/01-Retrieve/01-EDS/02-Python/Retrieve-Data_male-names.csv
Storing : C:/VKHCG/04-Clark/02-Assess/SQLite/clark.db  Table: Assess_MaleName
Rows :  100  records
Loading : C:/VKHCG/04-Clark/01-Retrieve/01-EDS/02-Python/Retrieve-Data_last-names.csv
Storing : C:/VKHCG/04-Clark/02-Assess/SQLite/clark.db  Table: Assess_Surname
Rows :  200  records
Loading : C:/VKHCG/04-Clark/02-Assess/SQLite/clark.db  Table: Assess_FemaleName & Assess_MaleName
Storing : C:/VKHCG/04-Clark/02-Assess/SQLite/clark.db  Table: Assess_FirstName
Loading : C:/VKHCG/04-Clark/02-Assess/SQLite/clark.db  Table: Assess_FirstName x2 & Assess_Surname
Loading : C:/VKHCG/04-Clark/02-Assess/SQLite/clark.db  Table: Assess_FirstName & Assess_Surname
        FirstName SecondName  LastName  Gender
2471856    Miguel      Efren    Ortega    Male
3466902    Tommye    Coretta   Roberts  Female
3336496      Stan     Xavier     Costa    Male
1151796   Faviola       Gene     Heard  Female
893614     Dorene     Joelle   Mccloud  Female
...           ...        ...       ...     ...
31958    Santiago              Crook    Male
32635     Shaunte            Ferreira  Female
2436       Bernie              Dubose    Male
39951     Zoraida              Cherry  Female
7702       Dannie               Foret    Male

[20000 rows x 4 columns]
Storing : C:/VKHCG/04-Clark/02-Assess/SQLite/clark.db  Table: Assess_People
Storing : C:/VKHCG/04-Clark/02-Assess/01-EDS/02-Python/Assess_People.csv
################################
```

Practical 6:

Processing Data

A. Build the time hub, links, and satellites.

Open your Python editor and create a file named Process_Time.py. Save it into directory C:\VKHCG\01-Vermeulen\03-Process.

```
import sys
import os
from datetime import datetime
from datetime import timedelta
from pytz import timezone, all_timezones
import pandas as pd
import sqlite3 as sq
from pandas.io import sql
import uuid
pd.options.mode.chained_assignment = None
if sys.platform == 'linux':
   Base=os.path.expanduser('~') + '/VKHCG'
else:
   Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
Company='01-Vermeulen'
InputDir='00-RawData'
InputFileName='VehicleData.csv'
sDataBaseDir=Base + '/' + Company + '/03-Process/SQLite'
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
################################################################
sDatabaseName=sDataBaseDir + '/Hillman.db'
conn1 = sq.connect(sDatabaseName)
################################################################
sDataVaultDir=Base + '/88-DV'
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
sDatabaseName=sDataVaultDir + '/datavault.db'
conn2 = sq.connect(sDatabaseName)
base = datetime(2018,1,1,0,0,0)
numUnits=10*365*24
date_list = [base - timedelta(hours=x) for x in range(0,
numUnits)] t=0
for i in date_list:
   now_utc=i.replace(tzinfo=timezone('UTC'))
   sDateTime=now_utc.strftime("%Y-%m-%d %H:%M:%S")
   print(sDateTime)
   sDateTimeKey=sDateTime.replace(' ','-').replace(':','-')
   t+=1
   IDNumber=str(uuid.uuid4())
   TimeLine=[('ZoneBaseKey', ['UTC']),
         ('IDNumber', [IDNumber]),
         ('nDateTimeValue', [now_utc]),
         ('DateTimeValue', [sDateTime]),
         ('DateTimeKey', [sDateTimeKey])]
   if t==1:
     TimeFrame = pd.DataFrame.from_items(TimeLine)
   else:
      TimeRow = pd.DataFrame.from_items(TimeLine)
      TimeFrame = TimeFrame.append(TimeRow)
################################################################
```

```
TimeHub=TimeFrame[['IDNumber','ZoneBaseKey','DateTimeKey','DateTimeValue']]
TimeHubIndex=TimeHub.set_index(['IDNumber'],inplace=False)
TimeFrame.set_index(['IDNumber'],inplace=True) sTable = 'Process-Time'
print('Storing :',sDatabaseName,' Table:',sTable)
TimeHubIndex.to_sql(sTable, conn1, if_exists="replace")
sTable = 'Hub-Time'
print('Storing :',sDatabaseName,' Table:',sTable)
TimeHubIndex.to_sql(sTable, conn2, if_exists="replace")
active_timezones=all_timezones
z=0
for zone in active_timezones:
   t=0
   for j in range(TimeFrame.shape[0]):
      now_date=TimeFrame['nDateTimeValue'][j]
      DateTimeKey=TimeFrame['DateTimeKey'][j]
      now_utc=now_date.replace(tzinfo=timezone('UTC'))
      sDateTime=now_utc.strftime("%Y-%m-%d %H:%M:%S")
      now_zone = now_utc.astimezone(timezone(zone))
      sZoneDateTime=now_zone.strftime("%Y-%m-%d %H:%M:%S")
      print(sZoneDateTime)
      t+=1
      z+=1
      IDZoneNumber=str(uuid.uuid4())
      TimeZoneLine=[('ZoneBaseKey', ['UTC']),
                    ('IDZoneNumber', [IDZoneNumber]),
                    ('DateTimeKey', [DateTimeKey]),
                    ('UTCDateTimeValue', [sDateTime]),
                    ('Zone', [zone]),
                    ('DateTimeValue', [sZoneDateTime])]
      if t==1:
        TimeZoneFrame = pd.DataFrame.from_items(TimeZoneLine)
      else:
         TimeZoneRow = pd.DataFrame.from_items(TimeZoneLine)
         TimeZoneFrame = TimeZoneFrame.append(TimeZoneRow)

   TimeZoneFrameIndex=TimeZoneFrame.set_index(['IDZoneNumber'],inplace=False)
   sZone=zone.replace('/','-').replace(' ','')
   sTable = 'Process-Time-'+sZone
   print('Storing :',sDatabaseName,' Table:',sTable)
   TimeZoneFrameIndex.to_sql(sTable, conn1,
   if_exists="replace") sTable = 'Satellite-Time-'+sZone
   print('Storing :',sDatabaseName,' Table:',sTable)
   TimeZoneFrameIndex.to_sql(sTable, conn2, if_exists="replace")
print('#################')
print('Vacuum Databases')
sSQL="VACUUM;"
sql.execute(sSQL,conn1)
sql.execute(sSQL,conn2)
print('#################')
print('### Done!! ############################################')
```

You have built your first hub and satellites for time in the data vault.
The data vault has been built in directory ..\ VKHCG\88-DV\datavault.db. You can access it with your SQLite tools

Golden Nominal

A golden nominal record is a single person's record, with distinctive references for use by all systems. This gives the system a single view of the person. I use first name, other names, last name, and birth date as my golden nominal. The data we have in the assess directory requires a birth date to become a golden nominal. The proram will generate a golden nominal using our sample data set.
Open your Python editor and create a file called Process-People.py in the ..

```
C:\VKHCG\04-Clark\03-Process directory.
################################################################
import sys
import os
import sqlite3 as sq
import pandas as pd
from pandas.io import sql
from datetime import datetime, timedelta
from pytz import timezone, all_timezones
from random import randint
import uuid
if sys.platform == 'linux':
   Base=os.path.expanduser('~') + '/VKHCG'
else:
   Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
Company='04-Clark'
sInputFileName='02-Assess/01-EDS/02-Python/Assess_People.csv'
sDataBaseDir=Base + '/' + Company + '/03-Process/SQLite'
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
sDatabaseName=sDataBaseDir + '/clark.db'
conn1 = sq.connect(sDatabaseName)
sDataVaultDir=Base + '/88-DV'
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
sDatabaseName=sDataVaultDir + '/datavault.db'
conn2 = sq.connect(sDatabaseName)
### Import Female Data
sFileName=Base + '/' + Company + '/' + sInputFileName
print('################################')
print('Loading :',sFileName)
print('################################')
print(sFileName)
RawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
RawData.drop_duplicates(subset=None, keep='first', inplace=True)

start_date = datetime(1900,1,1,0,0,0)
start_date_utc=start_date.replace(tzinfo=timezone('UTC'))

HoursBirth=100*365*24
RawData['BirthDateUTC']=RawData.apply(lambda row:
        (start_date_utc + timedelta(hours=randint(0, HoursBirth)))
        ,axis=1)
zonemax=len(all_timezones)-1
RawData['TimeZone']=RawData.apply(lambda row:
        (all_timezones[randint(0, zonemax)])
        ,axis=1)
RawData['BirthDateISO']=RawData.apply(lambda row:

        row["BirthDateUTC"].astimezone(timezone(row['TimeZone'])) ,axis=1)

RawData['BirthDateKey']=RawData.apply(lambda row:
        row["BirthDateUTC"].strftime("%Y-%m-%d %H:%M:%S")
        ,axis=1)
RawData['BirthDate']=RawData.apply(lambda row:
        row["BirthDateISO"].strftime("%Y-%m-%d %H:%M:%S")
        ,axis=1)
RawData['PersonID']=RawData.apply(lambda row:
```

```
            str(uuid.uuid4())
            ,axis=1)
Data=RawData.copy()
Data.drop('BirthDateUTC', axis=1,inplace=True)
Data.drop('BirthDateISO', axis=1,inplace=True)
indexed_data = Data.set_index(['PersonID'])
print('#################################')
print('################')
sTable='Process_Person'
print('Storing :',sDatabaseName,' Table:',sTable)
indexed_data.to_sql(sTable, conn1, if_exists="replace")
print('################')
PersonHubRaw=Data[['PersonID','FirstName','SecondName','LastName','BirthDateKey']]
PersonHubRaw['PersonHubID']=RawData.apply(lambda row:
            str(uuid.uuid4())
            ,axis=1)
PersonHub=PersonHubRaw.drop_duplicates(subset=None, \
                                       keep='first',\
                                       inplace=False)
indexed_PersonHub = PersonHub.set_index(['PersonHubID'])
sTable = 'Hub-Person'
print('Storing :',sDatabaseName,' Table:',sTable)
indexed_PersonHub.to_sql(sTable, conn2, if_exists="replace")
PersonSatelliteGenderRaw=Data[['PersonID','FirstName','SecondName','LastName'\
                    ,'BirthDateKey','Gender']]
PersonSatelliteGenderRaw['PersonSatelliteID']=RawData.apply(lambda row:
            str(uuid.uuid4())
            ,axis=1)
PersonSatelliteGender=PersonSatelliteGenderRaw.drop_duplicates(subset=None, \
                                            keep='first', \
                                            inplace=False)
indexed_PersonSatelliteGender = PersonSatelliteGender.set_index(['PersonSatelliteID'])
sTable = 'Satellite-Person-Gender'
print('Storing :',sDatabaseName,' Table:',sTable)
indexed_PersonSatelliteGender.to_sql(sTable, conn2, if_exists="replace")
################################################################
PersonSatelliteBirthdayRaw=Data[['PersonID','FirstName','SecondName','LastName',\
                     'BirthDateKey','TimeZone','BirthDate']]
PersonSatelliteBirthdayRaw['PersonSatelliteID']=RawData.apply(lambda row:
            str(uuid.uuid4())
            ,axis=1)
PersonSatelliteBirthday=PersonSatelliteBirthdayRaw.drop_duplicates(subset=None, \
                                              keep='first',\
                                              inplace=False)
indexed_PersonSatelliteBirthday = PersonSatelliteBirthday.set_index(['PersonSatelliteID'])
sTable = 'Satellite-Person-Names'
print('Storing :',sDatabaseName,' Table:',sTable)
indexed_PersonSatelliteBirthday.to_sql(sTable, conn2, if_exists="replace")
sFileDir=Base + '/' + Company + '/03-Process/01-EDS/02-Python'
if not os.path.exists(sFileDir):
   os.makedirs(sFileDir)
sOutputFileName = sTable + '.csv'
sFileName=sFileDir + '/' + sOutputFileName
print('#################################')
print('Storing :', sFileName)
print('#################################')
RawData.to_csv(sFileName, index = False)
print('#################################')
print('################')
print('Vacuum Databases')
```

```
sSQL="VACUUM;"
sql.execute(sSQL,conn1)
sql.execute(sSQL,conn2)
print('################')
print('### Done!! ############################################')
```

Output :
It will apply golden nominal rules by assuming nobody born before January 1, 1900, droping to two ISO complex date time structures, as the code does not translate into SQLite's data types and saves your new golden nominal to a CSV file.

Load the person into the data vault

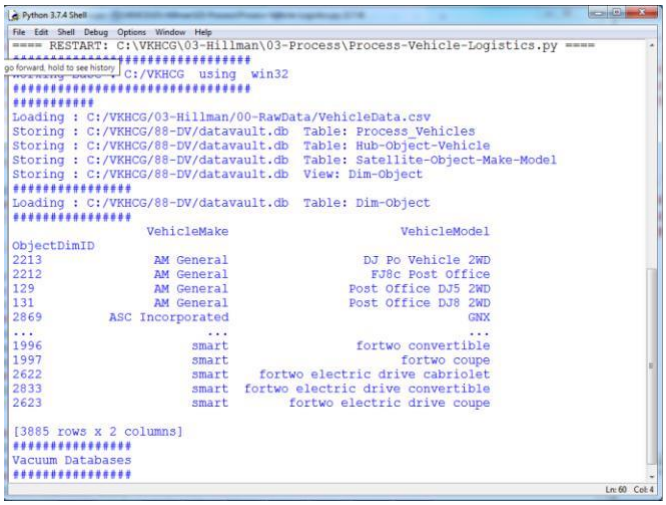
```
========== RESTART: C:\VKHCG\04-Clark\03-Process\Process-People.py ==========
Working Base : C:/VKHCG  using  win32
Loading : C:/VKHCG/04-Clark/02-Assess/01-EDS/02-Python/Assess_People.csv
C:/VKHCG/04-Clark/02-Assess/01-EDS/02-Python/Assess_People.csv Storing :
C:/VKHCG/88-DV/datavault.db Table: Process_Person Storing : C:/VKHCG/88-
DV/datavault.db Table: Satellite-Person-Gender
Storing : C:/VKHCG/88-DV/datavault.db  Table: Satellite-Person-Names
Storing : C:/VKHCG/04-Clark/03-Process/01-EDS/02-Python/Satellite-Person-Names.csv
Vacuum Databases
################
### Done!! ############################################
```

Vehicles
The international classification of vehicles is a complex process. There are standards, but these are not universally applied or similar between groups or countries.
Let's load the vehicle data for Hillman Ltd into the data vault, as we will need it later. Create a new file named Process-Vehicle-Logistics.py in the Python editor in directory ..\VKHCG\03-Hillman\03-Process.

```
# -*- coding: utf-8 -*-
import sys
import os
import pandas as pd
import sqlite3 as sq from
pandas.io import sql
import uuid

pd.options.mode.chained_assignment = None
if sys.platform == 'linux':
   Base=os.path.expanduser('~') + '/VKHCG'
else:
   Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
Company='03-Hillman'
InputDir='00-RawData'
InputFileName='VehicleData.csv'
sDataBaseDir=Base + '/' + Company + '/03-Process/SQLite'
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
sDatabaseName=sDataBaseDir + '/Hillman.db'
conn1 = sq.connect(sDatabaseName)
sDataVaultDir=Base + '/88-DV'
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
sDatabaseName=sDataVaultDir + '/datavault.db'
conn2 = sq.connect(sDatabaseName)
sFileName=Base + '/' + Company + '/' + InputDir + '/' +
InputFileName print('###########')
```

```
print('Loading :',sFileName)
VehicleRaw=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
sTable='Process_Vehicles'
print('Storing :',sDatabaseName,' Table:',sTable)
VehicleRaw.to_sql(sTable, conn1, if_exists="replace")
VehicleRawKey=VehicleRaw[['Make','Model']].copy()
VehicleKey=VehicleRawKey.drop_duplicates()
VehicleKey['ObjectKey']=VehicleKey.apply(lambda row:
    str('('+ str(row['Make']).strip().replace(' ', '-').replace('/', '-').lower()
     + ')-(' + (str(row['Model']).strip().replace(' ', '-').replace(' ', '-
     ').lower()) +')')
       ,axis=1)
VehicleKey['ObjectType']=VehicleKey.apply(lambda row:
   'vehicle'
       ,axis=1)
VehicleKey['ObjectUUID']=VehicleKey.apply(lambda row:
   str(uuid.uuid4())
       ,axis=1)
### Vehicle Hub
#
VehicleHub=VehicleKey[['ObjectType','ObjectKey','ObjectUUID']].copy()
VehicleHub.index.name='ObjectHubID' sTable =
'Hub-Object-Vehicle' print('Storing :',sDatabaseName,'
Table:',sTable) VehicleHub.to_sql(sTable, conn2,
if_exists="replace")
### Vehicle Satellite
#
VehicleSatellite=VehicleKey[['ObjectType','ObjectKey','ObjectUUID','Make','Model']].copy()
VehicleSatellite.index.name='ObjectSatelliteID'
sTable = 'Satellite-Object-Make-Model'
print('Storing :',sDatabaseName,' Table:',sTable)
VehicleSatellite.to_sql(sTable, conn2, if_exists="replace")


### Vehicle Dimension
sView='Dim-Object'
print('Storing :',sDatabaseName,' View:',sView)
sSQL="CREATE VIEW IF NOT EXISTS [" + sView + "]
AS" sSQL=sSQL+ " SELECT DISTINCT"
sSQL=sSQL+ "  H.ObjectType,"
sSQL=sSQL+ " H.ObjectKey AS VehicleKey,"
sSQL=sSQL+ " TRIM(S.Make) AS VehicleMake,"
sSQL=sSQL+ " TRIM(S.Model) AS VehicleModel"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " [Hub-Object-Vehicle] AS H"
sSQL=sSQL+ " JOIN"
sSQL=sSQL+ " [Satellite-Object-Make-Model] AS S"
sSQL=sSQL+ " ON"
sSQL=sSQL+ " H.ObjectType=S.ObjectType"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " H.ObjectUUID=S.ObjectUUID;"
sql.execute(sSQL,conn2)

print('#################')
print('Loading :',sDatabaseName,' Table:',sView)
sSQL=" SELECT DISTINCT"
sSQL=sSQL+ " VehicleMake,"
sSQL=sSQL+ " VehicleModel"
sSQL=sSQL+ " FROM"
sSQL=sSQL+ " [" + sView + "]"
```

```
sSQL=sSQL+ " ORDER BY"
sSQL=sSQL+ " VehicleMake"
sSQL=sSQL+ " AND"
sSQL=sSQL+ " VehicleMake;"
DimObjectData=pd.read_sql_query(sSQL, conn2)

DimObjectData.index.name='ObjectDimID'
DimObjectData.sort_values(['VehicleMake','VehicleModel'],inplace=True, ascending=True)
print('#################')
print(DimObjectData)
#########################################################################
print('#################')
print('Vacuum Databases')
sSQL="VACUUM;"
sql.execute(sSQL,conn1)
sql.execute(sSQL,conn2)
print('#################')
#########################################################################
conn1.close()
conn2.close()
#########################################################################
#print('### Done!! ############################################')
#########################################################################
```

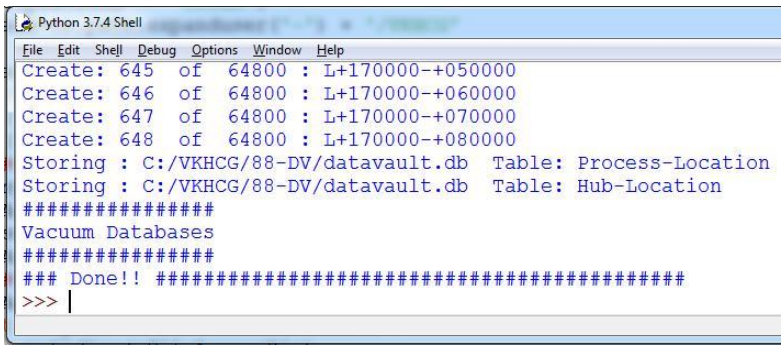


Human-Environment Interaction

In the Python editor, open a new file named Process_Location.py in directory ..\VKHCG\01-Vermeulen\03-Process.

```
import sys
import os
import pandas as pd
import sqlite3 as sq
from pandas.io import sql
import uuid
Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
Company='01-Vermeulen'
InputAssessGraphName='Assess_All_Animals.gml'
EDSAssessDir='02-Assess/01-EDS'
InputAssessDir=EDSAssessDir + '/02-Python'
sFileAssessDir=Base + '/' + Company + '/' + InputAssessDir
```

```
if not os.path.exists(sFileAssessDir):
   os.makedirs(sFileAssessDir)
sDataBaseDir=Base + '/' + Company + '/03-Process/SQLite'
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
sDatabaseName=sDataBaseDir + '/Vermeulen.db'
conn1 = sq.connect(sDatabaseName)
sDataVaultDir=Base + '/88-DV'
if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
sDatabaseName=sDataVaultDir + '/datavault.db'
conn2 = sq.connect(sDatabaseName)
t=0
tMax=360*180
for Longitude in range(-180,180,10):
   for Latitude in range(-90,90,10):
      t+=1
      IDNumber=str(uuid.uuid4())
      LocationName='L'+format(round(Longitude,3)*1000, '+07d') +\
                   '-'+format(round(Latitude,3)*1000, '+07d')
      print('Create:',t,' of ',tMax,':',LocationName)
      LocationLine=[('ObjectBaseKey', ['GPS']),
                    ('IDNumber', [IDNumber]),
                    ('LocationNumber', [str(t)]),
                    ('LocationName', [LocationName]),
                    ('Longitude', [Longitude]),
                    ('Latitude', [Latitude])]
      if t==1:
         LocationFrame = pd.DataFrame.from_items(LocationLine)
      else:
         LocationRow = pd.DataFrame.from_items(LocationLine)
         LocationFrame = LocationFrame.append(LocationRow)
LocationHubIndex=LocationFrame.set_index(['IDNumber'],inplace=False)
sTable = 'Process-Location'
print('Storing :',sDatabaseName,' Table:',sTable)
LocationHubIndex.to_sql(sTable, conn1, if_exists="replace")
sTable = 'Hub-Location'
print('Storing :',sDatabaseName,' Table:',sTable)
LocationHubIndex.to_sql(sTable, conn2, if_exists="replace")
print('#################')
print('Vacuum Databases')
sSQL="VACUUM;"
sql.execute(sSQL,conn1)
sql.execute(sSQL,conn2)
print('#################')
print('### Done!! ############################################')
```



Forecasting

Forecasting is the ability to project a possible future, by looking at historical data. The datavault enables these types of investigations, owing to the complete history it collects as itprocesses the source's systems data. A data scientist supply answers to such questions as the following:

- What should we buy?
- What should we sell?
- Where will our next business come from?

C: \VKHCG\04-Clark\03-Process. I will guide you through this process. You will require a library called quandl

type pip install quandl in cmd

```
################################################################
import sys
import os
import sqlite3 as sq
import quandl
import pandas as pd
################################################################
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
Company='04-Clark'
sInputFileName='00-RawData/VKHCG_Shares.csv'
sOutputFileName='Shares.csv'
################################################################
sDataBaseDir=Base + '/' + Company + '/03-Process/SQLite'
if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
################################################################
sFileDir1=Base + '/' + Company + '/01-Retrieve/01-EDS/02-
Python' if not os.path.exists(sFileDir1):
    os.makedirs(sFileDir1)
################################################################
sFileDir2=Base + '/' + Company + '/02-Assess/01-EDS/02-
Python' if not os.path.exists(sFileDir2):
    os.makedirs(sFileDir2)
################################################################
sFileDir3=Base + '/' + Company + '/03-Process/01-EDS/02-Python'
if not os.path.exists(sFileDir3):
    os.makedirs(sFileDir3)
################################################################
sDatabaseName=sDataBaseDir + '/clark.db'
conn = sq.connect(sDatabaseName)
################################################################
### Import Share Names Data
################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName
print('################################')
print('Loading :',sFileName)
print('################################')
RawData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
RawData.drop_duplicates(subset=None, keep='first', inplace=True)
print('Rows :',RawData.shape[0])
print('Columns:',RawData.shape[1])
print('################')
################################################################
```

```
sFileName=sFileDir1 + '/Retrieve_' + sOutputFileName
print('################################')
print('Storing :', sFileName)
print('################################')
RawData.to_csv(sFileName, index = False)
print('################################')
#####################################################################
sFileName=sFileDir2 + '/Assess_' + sOutputFileName
print('################################')
print('Storing :', sFileName)
print('################################')
RawData.to_csv(sFileName, index = False)
print('################################')
#####################################################################
sFileName=sFileDir3 + '/Process_' + sOutputFileName
print('################################')
print('Storing :', sFileName)
print('################################')
RawData.to_csv(sFileName, index = False)
print('################################')
#####################################################################
### Import Shares Data Details
nShares=RawData.shape[0]
#nShares=6
for sShare in range(nShares): sShareName=str(RawData['Shares'][sShare])
   ShareData = quandl.get(sShareName) UnitsOwn=RawData['Units'][sShare]
   ShareData['UnitsOwn']=ShareData.apply(lambda row:(UnitsOwn),axis=1)
   ShareData['ShareCode']=ShareData.apply(lambda
   row:(sShareName),axis=1) print('################')


   print('Share :',sShareName)
   print('Rows :',ShareData.shape[0])
   print('Columns:',ShareData.shape[1])
   print('################')
   #####################################################################
   print('################')
   sTable=str(RawData['sTable'][sShare])
   print('Storing :',sDatabaseName,' Table:',sTable)
   ShareData.to_sql(sTable, conn, if_exists="replace")
   print('################')
   #####################################################################
   sOutputFileName = sTable.replace("/","-") + '.csv'
   sFileName=sFileDir1 + '/Retrieve_' + sOutputFileName
   print('################################')
   print('Storing :', sFileName)
   print('################################')
   ShareData.to_csv(sFileName, index = False)
   print('################################')
   #####################################################################
   sOutputFileName = sTable.replace("/","-") + '.csv'
   sFileName=sFileDir2 + '/Assess_' + sOutputFileName
   print('################################')
   print('Storing :', sFileName)
   print('################################')
   ShareData.to_csv(sFileName, index = False)
   print('################################')
   #####################################################################
   sOutputFileName = sTable.replace("/","-") + '.csv'
   sFileName=sFileDir3 + '/Process_' + sOutputFileName
```

```
    print('################################')
    print('Storing :', sFileName)
    print('################################')
    ShareData.to_csv(sFileName, index = False)
    print('################################')
print('### Done!! ############################################')
#################################################################
```

Output:

```
======== RESTART: C:\VKHCG\04-Clark\03-Process\Process-Shares-Data.py ========
Working Base : C:/VKHCG  using  win32
Loading : C:/VKHCG/04-Clark/00-RawData/VKHCG_Shares.csv
Rows  : 10
Columns: 3
Storing : C:/VKHCG/04-Clark/01-Retrieve/01-EDS/02-Python/Retrieve_Shares.csv
Storing : C:/VKHCG/04-Clark/02-Assess/01-EDS/02-Python/Assess_Shares.csv
Storing : C:/VKHCG/04-Clark/03-Process/01-EDS/02-Python/Process_Shares.csv
Share  : WIKI/GOOGL
Rows  : 3424
Columns: 14
Storing : C:/VKHCG/04-Clark/03-Process/SQLite/clark.db  Table: WIKI_Google
Storing : C:/VKHCG/04-Clark/01-Retrieve/01-EDS/02-Python/Retrieve_WIKI_Google.csv
Storing : C:/VKHCG/04-Clark/02-Assess/01-EDS/02-Python/Assess_WIKI_Google.
```

Practical 7:
Transforming Data

Transform Superstep

C: \VKHCG\01-Vermeulen\04-Transform.

```
import sys
import os
from datetime import datetime
from pytz import timezone
import pandas as pd
import sqlite3 as sq
import uuid
pd.options.mode.chained_assignment = None
####################################################################
Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
####################################################################
Company='01-Vermeulen'
InputDir='00-RawData'
InputFileName='VehicleData.csv'
####################################################################
sDataBaseDir=Base + '/' + Company + '/04-
Transform/SQLite' if not os.path.exists(sDataBaseDir):
   os.makedirs(sDataBaseDir)
####################################################################
sDatabaseName=sDataBaseDir + '/Vermeulen.db'
conn1 = sq.connect(sDatabaseName)
####################################################################
sDataVaultDir=Base + '/88-DV'
if not os.path.exists(sDataVaultDir):
   os.makedirs(sDataVaultDir)
####################################################################
sDatabaseName=sDataVaultDir + '/datavault.db'
conn2 = sq.connect(sDatabaseName)
####################################################################
sDataWarehouseDir=Base + '/99-DW'
if not os.path.exists(sDataWarehouseDir):
   os.makedirs(sDataWarehouseDir)
####################################################################
sDatabaseName=sDataWarehouseDir + '/datawarehouse.db'
conn3 = sq.connect(sDatabaseName)
####################################################################
print('\n##################################')
print('Time Category')
print('UTC Time')
BirthDateUTC = datetime(1960,12,20,10,15,0)
BirthDateZoneUTC=BirthDateUTC.replace(tzinfo=timezone('UTC'))
BirthDateZoneStr=BirthDateZoneUTC.strftime("%Y-%m-%d %H:%M:%S")
BirthDateZoneUTCStr=BirthDateZoneUTC.strftime("%Y-%m-%d %H:%M:%S (%Z) (%z)")
print(BirthDateZoneUTCStr)
print('##################################')
print('Birth Date in Reykjavik :')
BirthZone = 'Atlantic/Reykjavik'
BirthDate = BirthDateZoneUTC.astimezone(timezone(BirthZone))
BirthDateStr=BirthDate.strftime("%Y-%m-%d %H:%M:%S (%Z) (%z)")
BirthDateLocal=BirthDate.strftime("%Y-%m-%d %H:%M:%S")
print(BirthDateStr)
```

```
print('################################')
#################################################################
IDZoneNumber=str(uuid.uuid4())
sDateTimeKey=BirthDateZoneStr.replace(' ','-').replace(':','-
') TimeLine=[('ZoneBaseKey', ['UTC']),
        ('IDNumber', [IDZoneNumber]),
        ('DateTimeKey', [sDateTimeKey]),
        ('UTCDateTimeValue', [BirthDateZoneUTC]),
        ('Zone', [BirthZone]),
        ('DateTimeValue', [BirthDateStr])]
TimeFrame = pd.DataFrame.from_items(TimeLine)
#################################################################
TimeHub=TimeFrame[['IDNumber','ZoneBaseKey','DateTimeKey','DateTimeValue']]
TimeHubIndex=TimeHub.set_index(['IDNumber'],inplace=False)
#################################################################
sTable = 'Hub-Time-Gunnarsson'
print('\n################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n################################')
TimeHubIndex.to_sql(sTable, conn2, if_exists="replace")
sTable = 'Dim-Time-Gunnarsson'
TimeHubIndex.to_sql(sTable, conn3, if_exists="replace")
#################################################################
TimeSatellite=TimeFrame[['IDNumber','DateTimeKey','Zone','DateTimeValue']]
TimeSatelliteIndex=TimeSatellite.set_index(['IDNumber'],inplace=False)
#################################################################
BirthZoneFix=BirthZone.replace(' ','-').replace('/','-') sTable =
'Satellite-Time-' + BirthZoneFix + '-Gunnarsson'
print('\n################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n################################')
TimeSatelliteIndex.to_sql(sTable, conn2, if_exists="replace")
sTable = 'Dim-Time-' + BirthZoneFix + '-Gunnarsson'
TimeSatelliteIndex.to_sql(sTable, conn3, if_exists="replace")
#################################################################
print('\n################################')
print('Person Category')
FirstName = 'Guðmundur'
LastName = 'Gunnarsson'
print('Name:',FirstName,LastName)
print('Birth Date:',BirthDateLocal)
print('Birth Zone:',BirthZone)
print('UTC Birth Date:',BirthDateZoneStr)
print('################################')
#################################################################
IDPersonNumber=str(uuid.uuid4())
PersonLine=[('IDNumber', [IDPersonNumber]),
        ('FirstName', [FirstName]),
        ('LastName', [LastName]),
        ('Zone', ['UTC']),
        ('DateTimeValue', [BirthDateZoneStr])]
PersonFrame = pd.DataFrame.from_items(PersonLine)
#################################################################
TimeHub=PersonFrame
TimeHubIndex=TimeHub.set_index(['IDNumber'],inplace=False)
#################################################################
sTable = 'Hub-Person-Gunnarsson'
print('\n################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n################################')
```

```
TimeHubIndex.to_sql(sTable, conn2, if_exists="replace")
sTable = 'Dim-Person-Gunnarsson'
TimeHubIndex.to_sql(sTable, conn3, if_exists="replace")
#####################################################################
```

Output : Guðmundur Gunnarsson was born on December 20, 1960, at 9:15 in Landspítali,Hringbraut 101, 101 Reykjavík, Iceland.

```
>>>
 RESTART: C:\VKHCG\01-Vermeulen\04-Transform\Transform-Gunnarsson_is_Born.py
Working Base : C:/VKHCG  using  win32
Time Category
UTC Time
1960-12-20 10:15:00 (UTC) (+0000)
##################################
Birth Date in Reykjavik :
1960-12-20 09:15:00 (-01) (-0100)
##################################
##################################
Storing : C:/VKHCG/99-DW/datawarehouse.db
 Table: Hub-Time-Gunnarsson
##################################
##################################
Storing : C:/VKHCG/99-DW/datawarehouse.db
 Table: Satellite-Time-Atlantic-Reykjavik-Gunnarsson
##################################
Person Category
Name: Guðmundur Gunnarsson
Birth Date: 1960-12-20 09:15:00
Birth Zone: Atlantic/Reykjavik
UTC Birth Date: 1960-12-20 10:15:00
##################################
Storing : C:/VKHCG/99-DW/datawarehouse.db
 Table: Hub-Person-Gunnarsson
##################################
```

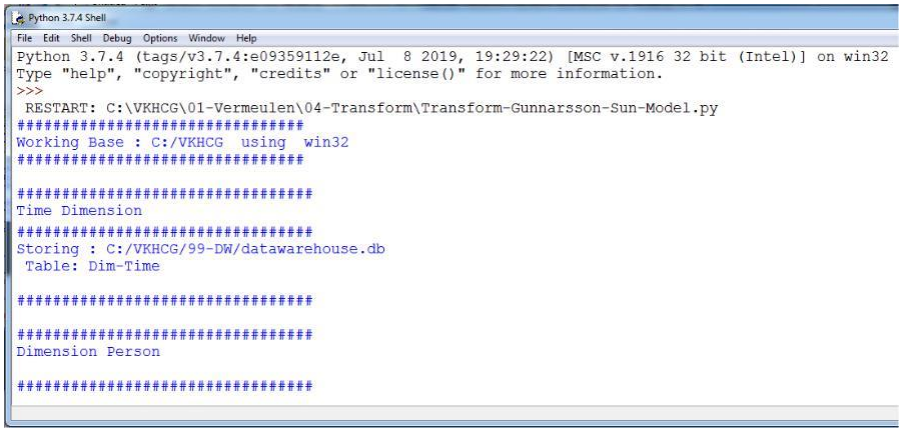
You must build three items: **dimension Person**, **dimension Time**, and **factPersonBornAtTime**.
Open your Python editor and create a file named Transform-Gunnarsson-Sun-Model.py in directory C:\VKHCG\01-Vermeulen\04-Transform.

```
#####################################################################
import sys
import os
from datetime import datetime
from pytz import timezone
import pandas as pd
import sqlite3 as sq
import uuid
pd.options.mode.chained_assignment = None
#####################################################################
if sys.platform == 'linux':
    Base=os.path.expanduser('~') + '/VKHCG'
else:
    Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
#####################################################################
Company='01-Vermeulen'
#####################################################################
sDataBaseDir=Base + '/' + Company + '/04-
Transform/SQLite' if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
#####################################################################
sDatabaseName=sDataBaseDir + '/Vermeulen.db'
conn1 = sq.connect(sDatabaseName)
#####################################################################
sDataWarehousetDir=Base + '/99-DW'
if not os.path.exists(sDataWarehousetDir):
    os.makedirs(sDataWarehousetDir)
```

```
#####################################################################
sDatabaseName=sDataWarehousetDir + '/datawarehouse.db'
conn2 = sq.connect(sDatabaseName)
#####################################################################
print('\n#################################')
print('Time Dimension')
BirthZone = 'Atlantic/Reykjavik'
BirthDateUTC = datetime(1960,12,20,10,15,0)
BirthDateZoneUTC=BirthDateUTC.replace(tzinfo=timezone('UTC'))
BirthDateZoneStr=BirthDateZoneUTC.strftime("%Y-%m-%d %H:%M:%S")
BirthDateZoneUTCStr=BirthDateZoneUTC.strftime("%Y-%m-%d %H:%M:%S (%Z) (%z)")
BirthDate = BirthDateZoneUTC.astimezone(timezone(BirthZone))
BirthDateStr=BirthDate.strftime("%Y-%m-%d %H:%M:%S (%Z) (%z)")
BirthDateLocal=BirthDate.strftime("%Y-%m-%d %H:%M:%S")
#####################################################################
IDTimeNumber=str(uuid.uuid4())
TimeLine=[('TimeID', [IDTimeNumber]),
        ('UTCDate', [BirthDateZoneStr]),
        ('LocalTime', [BirthDateLocal]),
        ('TimeZone', [BirthZone])]
TimeFrame = pd.DataFrame.from_items(TimeLine)
#####################################################################
DimTime=TimeFrame
DimTimeIndex=DimTime.set_index(['TimeID'],inplace=False)
#####################################################################
sTable = 'Dim-Time'
print('\n#################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n#################################')
DimTimeIndex.to_sql(sTable, conn1, if_exists="replace")
DimTimeIndex.to_sql(sTable, conn2, if_exists="replace")
#####################################################################
print('\n#################################')
print('Dimension Person')
print('\n#################################')
FirstName = 'Guðmundur'
LastName = 'Gunnarsson'
#####################################################################
IDPersonNumber=str(uuid.uuid4())
PersonLine=[('PersonID', [IDPersonNumber]),
          ('FirstName', [FirstName]),
          ('LastName', [LastName]),
          ('Zone', ['UTC']),
          ('DateTimeValue', [BirthDateZoneStr])]
PersonFrame = pd.DataFrame.from_items(PersonLine)
#####################################################################
DimPerson=PersonFrame
DimPersonIndex=DimPerson.set_index(['PersonID'],inplace=False)
#####################################################################
sTable = 'Dim-Person'
print('\n#################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n#################################')
DimPersonIndex.to_sql(sTable, conn1, if_exists="replace")
DimPersonIndex.to_sql(sTable, conn2, if_exists="replace")
#####################################################################
print('\n#################################')
print('Fact - Person - time')
print('\n#################################')
IDFactNumber=str(uuid.uuid4())
```

```
PersonTimeLine=[('IDNumber', [IDFactNumber]),
                ('IDPersonNumber', [IDPersonNumber]),
                ('IDTimeNumber', [IDTimeNumber])]
PersonTimeFrame = pd.DataFrame.from_items(PersonTimeLine)
#####################################################################
FctPersonTime=PersonTimeFrame
FctPersonTimeIndex=FctPersonTime.set_index(['IDNumber'],inplace=False)
#####################################################################
sTable = 'Fact-Person-Time'
print('\n#################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n#################################')
FctPersonTimeIndex.to_sql(sTable, conn1, if_exists="replace")
FctPersonTimeIndex.to_sql(sTable, conn2, if_exists="replace")
#####################################################################
```

Output:



Building a Data Warehouse

Open the Transform-Sun-Models.py file from directory C:\VKHCG\01-Vermeulen\04-Transform.

```
#########################################################################
import sys
import os
from datetime import datetime
from pytz import timezone
import pandas as pd
import sqlite3 as sq
import uuid
pd.options.mode.chained_assignment = None
#####################################################################
if sys.platform == 'linux':
    Base=os.path.expanduser('~') + '/VKHCG'
else:
    Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
#####################################################################
Company='01-Vermeulen'
#####################################################################
sDataBaseDir=Base + '/' + Company + '/04-
Transform/SQLite' if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
#####################################################################
```

```
sDatabaseName=sDataBaseDir + '/Vermeulen.db'
conn1 = sq.connect(sDatabaseName)
#################################################################
sDataVaultDir=Base + '/88-DV'
if not os.path.exists(sDataVaultDir):
   os.makedirs(sDataVaultDir)
#################################################################
sDatabaseName=sDataVaultDir + '/datavault.db'
conn2 = sq.connect(sDatabaseName)
#################################################################
sDataWarehouseDir=Base + '/99-DW'
if not os.path.exists(sDataWarehouseDir):
   os.makedirs(sDataWarehouseDir)
#################################################################
sDatabaseName=sDataWarehouseDir + '/datawarehouse.db'
conn3 = sq.connect(sDatabaseName)
#################################################################
sSQL=" SELECT DateTimeValue FROM [Hub-Time];"
DateDataRaw=pd.read_sql_query(sSQL, conn2)
DateData=DateDataRaw.head(1000)
print(DateData)
#################################################################
print('\n#################################')
print('Time Dimension')
print('\n#################################')
t=0
mt=DateData.shape[0]
for i in range(mt):
   BirthZone = ('Atlantic/Reykjavik','Europe/London','UCT')
   for j in range(len(BirthZone)):
      t+=1
      print(t,mt*3)
      BirthDateUTC = datetime.strptime(DateData['DateTimeValue'][i],"%Y-%m-%d %H:%M:%S")
      BirthDateZoneUTC=BirthDateUTC.replace(tzinfo=timezone('UTC'))
      BirthDateZoneStr=BirthDateZoneUTC.strftime("%Y-%m-%d %H:%M:%S")
      BirthDateZoneUTCStr=BirthDateZoneUTC.strftime("%Y-%m-%d %H:%M:%S (%Z) (%z)")
      BirthDate = BirthDateZoneUTC.astimezone(timezone(BirthZone[j]))
      BirthDateStr=BirthDate.strftime("%Y-%m-%d %H:%M:%S (%Z) (%z)")
      BirthDateLocal=BirthDate.strftime("%Y-%m-%d %H:%M:%S")
      ###################################################################
      IDTimeNumber=str(uuid.uuid4())
      TimeLine=[('TimeID', [str(IDTimeNumber)]),
            ('UTCDate', [str(BirthDateZoneStr)]),
            ('LocalTime', [str(BirthDateLocal)]),
            ('TimeZone', [str(BirthZone)])]
      if t==1:
         TimeFrame = pd.DataFrame.from_items(TimeLine)
      else:
         TimeRow = pd.DataFrame.from_items(TimeLine)
         TimeFrame=TimeFrame.append(TimeRow)
#################################################################
DimTime=TimeFrame
DimTimeIndex=DimTime.set_index(['TimeID'],inplace=False)
#################################################################
sTable = 'Dim-Time'
print('\n#################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n#################################')
DimTimeIndex.to_sql(sTable, conn1, if_exists="replace")
DimTimeIndex.to_sql(sTable, conn3, if_exists="replace")
```

```
#####################################################################
sSQL=" SELECT " + \
    " FirstName," + \
    " SecondName," + \
    " LastName," + \
    " BirthDateKey " + \
    " FROM [Hub-Person];"
PersonDataRaw=pd.read_sql_query(sSQL,
conn2) PersonData=PersonDataRaw.head(1000)
#####################################################################
print('\n#################################')
print('Dimension Person')
print('\n#################################')
t=0
mt=DateData.shape[0]
for i in range(mt):
   t+=1
   print(t,mt)
   FirstName = str(PersonData["FirstName"])
   SecondName = str(PersonData["SecondName"])
   if len(SecondName) > 0:
      SecondName=""
   LastName = str(PersonData["LastName"])
   BirthDateKey = str(PersonData["BirthDateKey"])
   ###################################################################
   IDPersonNumber=str(uuid.uuid4())
   PersonLine=[('PersonID', [str(IDPersonNumber)]),
               ('FirstName', [FirstName]),
               ('SecondName', [SecondName]),
               ('LastName', [LastName]),
               ('Zone', [str('UTC')]), ('BirthDate',
               [BirthDateKey])]
   if t==1:
      PersonFrame =
   pd.DataFrame.from_items(PersonLine) else:
      PersonRow = pd.DataFrame.from_items(PersonLine)
      PersonFrame = PersonFrame.append(PersonRow)
#####################################################################
DimPerson=PersonFrame
print(DimPerson)
DimPersonIndex=DimPerson.set_index(['PersonID'],inplace=False)
#####################################################################
sTable = 'Dim-Person'
print('\n#################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n#################################')
DimPersonIndex.to_sql(sTable, conn1, if_exists="replace")
DimPersonIndex.to_sql(sTable, conn3, if_exists="replace")
#####################################################################
```

Output:

You have successfully performed data vault to data warehouse transformation.

Simple Linear Regression

Linear regression is used if there is a relationship or significant association between the variables. This can be checked by scatterplots. If no linear association appears between the variables, fitting a linear regression model to the data will not provide a useful model. A linear regression line has equations in the following form: Y = a + bX,

Where, X = explanatory variable and

Y = dependent variable
b = slope of the line
a = intercept (the value of y when x = 0)

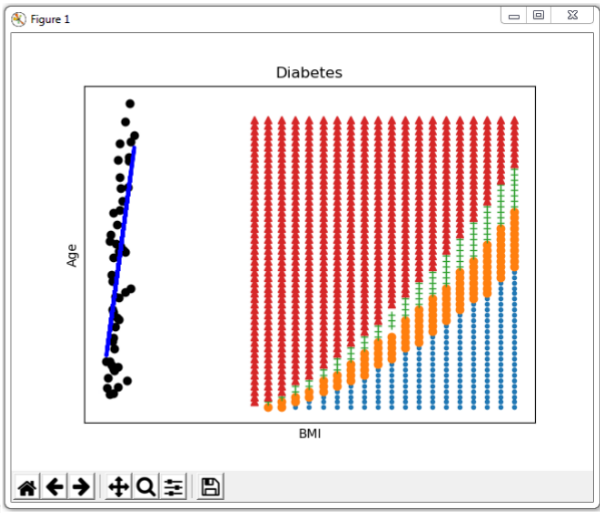
```
######################################################################
# -*- coding: utf-8 -*-
######################################################################
import sys
import os
import pandas as pd
import sqlite3 as sq
import matplotlib.pyplot as
plt import numpy as np

from sklearn import datasets, linear_model
from sklearn.metrics import mean_squared_error, r2_score
######################################################################
Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
######################################################################
######################################################################
Company='01-Vermeulen'
######################################################################
sDataBaseDir=Base + '/' + Company + '/04-
Transform/SQLite' if not os.path.exists(sDataBaseDir):
    os.makedirs(sDataBaseDir)
######################################################################
sDatabaseName=sDataBaseDir + '/Vermeulen.db'
conn1 = sq.connect(sDatabaseName)
######################################################################
sDataVaultDir=Base + '/88-DV'
if not os.path.exists(sDataVaultDir):
    os.makedirs(sDataVaultDir)
######################################################################
sDatabaseName=sDataVaultDir + '/datavault.db'
conn2 = sq.connect(sDatabaseName)
######################################################################
sDataWarehouseDir=Base + '/99-DW'
if not os.path.exists(sDataWarehouseDir):
    os.makedirs(sDataWarehouseDir)
######################################################################
sDatabaseName=sDataWarehouseDir + '/datawarehouse.db'
conn3 = sq.connect(sDatabaseName)
######################################################################
t=0
tMax=((300-100)/10)*((300-30)/5)
for heightSelect in range(100,300,10):
    for weightSelect in range(30,300,5):
        height = round(heightSelect/100,3)
        weight = int(weightSelect)
        bmi = weight/(height*height)
        if bmi <= 18.5:
            BMI_Result=1
        elif bmi > 18.5 and bmi < 25:
            BMI_Result=2
        elif bmi > 25 and bmi < 30:
            BMI_Result=3
        elif bmi > 30:
```

```
        BMI_Result=4
    else:
        BMI_Result=0
    PersonLine=[('PersonID', [str(t)]),
            ('Height', [height]),
            ('Weight', [weight]),
            ('bmi', [bmi]),
            ('Indicator', [BMI_Result])]
    t+=1
    print('Row:',t,'of',tMax)
    if t==1:
        PersonFrame = pd.DataFrame.from_items(PersonLine)
    else:
        PersonRow = pd.DataFrame.from_items(PersonLine)
        PersonFrame = PersonFrame.append(PersonRow)
#####################################################################
DimPerson=PersonFrame
DimPersonIndex=DimPerson.set_index(['PersonID'],inplace=False)
#####################################################################
sTable = 'Transform-BMI'
print('\n#################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n#################################')
DimPersonIndex.to_sql(sTable, conn1, if_exists="replace")
#####################################################################
#####################################################################
sTable = 'Person-Satellite-BMI'
print('\n#################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n#################################')
DimPersonIndex.to_sql(sTable, conn2, if_exists="replace")
#####################################################################
#####################################################################
sTable = 'Dim-BMI'
print('\n#################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n#################################')
DimPersonIndex.to_sql(sTable, conn3, if_exists="replace")
#####################################################################
fig = plt.figure()
PlotPerson=DimPerson[DimPerson['Indicator']==1]
x=PlotPerson['Height']
y=PlotPerson['Weight']
plt.plot(x, y, ".")
PlotPerson=DimPerson[DimPerson['Indicator']==2]
x=PlotPerson['Height']
y=PlotPerson['Weight']
plt.plot(x, y, "o")
PlotPerson=DimPerson[DimPerson['Indicator']==3]
x=PlotPerson['Height']
y=PlotPerson['Weight']
plt.plot(x, y, "+")
PlotPerson=DimPerson[DimPerson['Indicator']==4]
x=PlotPerson['Height']
y=PlotPerson['Weight']
plt.plot(x, y, "^")
plt.axis('tight')
plt.title("BMI Curve")
plt.xlabel("Height(meters)")
plt.ylabel("Weight(kg)")
```

```
plt.plot()


# Load the diabetes dataset diabetes
= datasets.load_diabetes()

# Use only one feature
diabetes_X = diabetes.data[:, np.newaxis, 2]
diabetes_X_train = diabetes_X[:-30]
diabetes_X_test = diabetes_X[-50:]
diabetes_y_train = diabetes.target[:-30]
diabetes_y_test = diabetes.target[-50:]
regr = linear_model.LinearRegression()
regr.fit(diabetes_X_train, diabetes_y_train)
diabetes_y_pred = regr.predict(diabetes_X_test)
print('Coefficients: \n', regr.coef_)
print("Mean squared error: %.2f"
    % mean_squared_error(diabetes_y_test, diabetes_y_pred))
print('Variance score: %.2f' % r2_score(diabetes_y_test, diabetes_y_pred))
plt.scatter(diabetes_X_test, diabetes_y_test, color='black')
plt.plot(diabetes_X_test, diabetes_y_pred, color='blue', linewidth=3)
plt.xticks(())
plt.yticks(())
plt.axis('tight')
plt.title("Diabetes")
plt.xlabel("BMI")
plt.ylabel("Age")
plt.show()
```

Output:

```
Row: 1077 of 1080.0
Row: 1078 of 1080.0
Row: 1079 of 1080.0
Row: 1080 of 1080.0

##################################
Storing : C:/VKHCG/99-DW/datawarehouse.db
 Table: Transform-BMI

##################################

##################################
Storing : C:/VKHCG/99-DW/datawarehouse.db
 Table: Person-Satellite-BMI

##################################

##################################
Storing : C:/VKHCG/99-DW/datawarehouse.db
 Table: Dim-BMI

##################################
>>>
```



Practical 8:

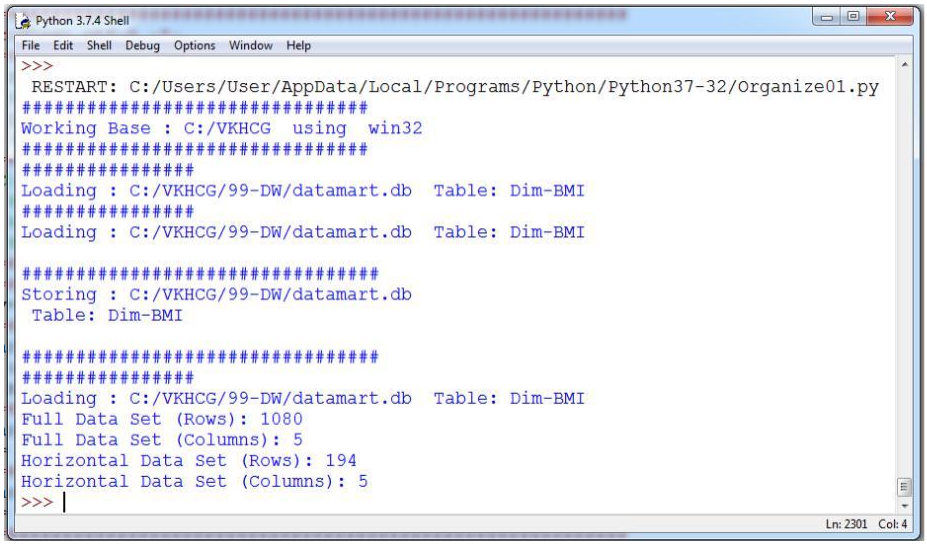
Organizing Data

C:\VKHCG\01-Vermeulen\05-Organise\ Organize-Horizontal.py

```
################################################################
import sys
import os
import pandas as pd
import sqlite3 as sq
################################################################
Base='C:/VKHCG'
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
################################################################
################################################################
Company='01-Vermeulen'
################################################################
sDataWarehouseDir=Base + '/99-DW'
if not os.path.exists(sDataWarehouseDir):
    os.makedirs(sDataWarehouseDir)
################################################################
sDatabaseName=sDataWarehouseDir + '/datawarehouse.db'
conn1 = sq.connect(sDatabaseName)
################################################################
sDatabaseName=sDataWarehouseDir + '/datamart.db'
conn2 = sq.connect(sDatabaseName)
################################################################
print('################')
sTable = 'Dim-BMI'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="SELECT * FROM [Dim-BMI];"
PersonFrame0=pd.read_sql_query(sSQL, conn1)
print('################')
sTable = 'Dim-BMI'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="SELECT PersonID,\
    Height,\
    Weight,\
    bmi,\
    Indicator\
    FROM [Dim-BMI]\
    WHERE \
    Height > 1.5 \
    and Indicator = 1\
    ORDER BY \
        Height,\
        Weight;"
PersonFrame1=pd.read_sql_query(sSQL, conn1)
################################################################
DimPerson=PersonFrame1
DimPersonIndex=DimPerson.set_index(['PersonID'],inplace=False)
################################################################
sTable = 'Dim-BMI'
print('\n##################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n##################################')
#DimPersonIndex.to_sql(sTable, conn2, if_exists="replace")
################################################################
print('################')
```

```
sTable = 'Dim-BMI'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="SELECT * FROM [Dim-BMI];"
PersonFrame2=pd.read_sql_query(sSQL, conn2)
print('Full Data Set (Rows):', PersonFrame0.shape[0])
print('Full Data Set (Columns):', PersonFrame0.shape[1])
print('Horizontal Data Set (Rows):', PersonFrame2.shape[0])
print('Horizontal Data Set (Columns):', PersonFrame2.shape[1])
```

Output:



Vertical Style

C:\VKHCG\01-Vermeulen\05-Organise\ Organize-Vertical.py

```
import sys
import os
import pandas as pd
import sqlite3 as sq
################################################################
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
################################################################
Company='01-Vermeulen'
################################################################
sDataWarehouseDir=Base + '/99-DW'
if not os.path.exists(sDataWarehouseDir):
    os.makedirs(sDataWarehouseDir)
################################################################
sDatabaseName=sDataWarehouseDir + '/datawarehouse.db'
conn1 = sq.connect(sDatabaseName)
################################################################
sDatabaseName=sDataWarehouseDir + '/datamart.db'
conn2 = sq.connect(sDatabaseName)
################################################################
print('################################')
sTable = 'Dim-BMI'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="SELECT * FROM [Dim-BMI];"
PersonFrame0=pd.read_sql_query(sSQL, conn1)
################################################################
```

```
print('################################')
sTable = 'Dim-BMI'
print('Loading :',sDatabaseName,' Table:',sTable)
print('################################')
sSQL="SELECT \
      Height,\
      Weight,\
      Indicator\
  FROM [Dim-BMI];"
PersonFrame1=pd.read_sql_query(sSQL, conn1)
#####################################################################
DimPerson=PersonFrame1
DimPersonIndex=DimPerson.set_index(['Indicator'],inplace=False)
#####################################################################
sTable = 'Dim-BMI-Vertical'
print('\n################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n################################')
DimPersonIndex.to_sql(sTable, conn2, if_exists="replace")
#####################################################################
print('#################')
sTable = 'Dim-BMI-Vertical'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="SELECT * FROM [Dim-BMI-Vertical];"
PersonFrame2=pd.read_sql_query(sSQL, conn2)
#####################################################################
print('################################')
print('Full Data Set (Rows):', PersonFrame0.shape[0])
print('Full Data Set (Columns):', PersonFrame0.shape[1])
print('################################')
print('Horizontal Data Set (Rows):', PersonFrame2.shape[0])
print('Horizontal Data Set (Columns):', PersonFrame2.shape[1])
print('################################')
#####################################################################
```

Output:

```
====== RESTART: C:\VKHCG\01-Vermeulen\05-Organise\Organize-Vertical.py ======
################################
Working Base : C:/VKHCG  using  win32
################################
################################
Loading : C:/VKHCG/99-DW/datamart.db  Table: Dim-BMI
################################
Loading : C:/VKHCG/99-DW/datamart.db  Table: Dim-BMI
################################

################################
Storing : C:/VKHCG/99-DW/datamart.db
 Table: Dim-BMI-Vertical

################################
#################
Loading : C:/VKHCG/99-DW/datamart.db  Table: Dim-BMI-Vertical
################################
Full Data Set (Rows): 1080
Full Data Set (Columns): 5
################################
Horizontal Data Set (Rows): 1080
Horizontal Data Set (Columns): 3
################################
```

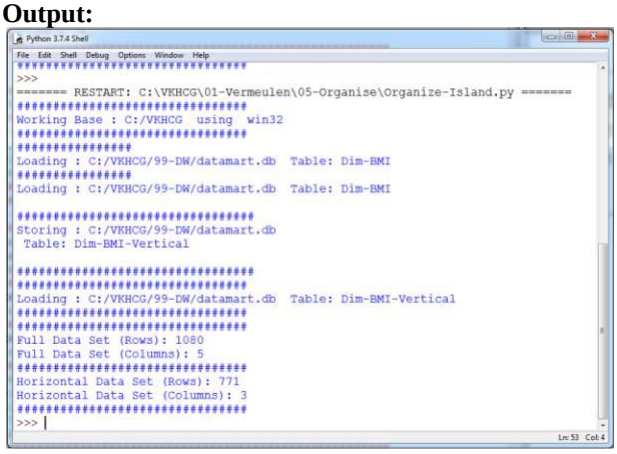
Island Style

C:\VKHCG\01-Vermeulen\05-Organise\ Organize-Island.py

```
import sys
import os
import pandas as pd
import sqlite3 as sq
#####################################################################
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
#####################################################################
#####################################################################
```

```
Company='01-Vermeulen'
##################################################################
sDataWarehouseDir=Base + '/99-DW'
if not os.path.exists(sDataWarehouseDir):
   os.makedirs(sDataWarehouseDir)
##################################################################
sDatabaseName=sDataWarehouseDir + '/datawarehouse.db'
conn1 = sq.connect(sDatabaseName)
##################################################################
sDatabaseName=sDataWarehouseDir + '/datamart.db'
conn2 = sq.connect(sDatabaseName)
##################################################################
print('################')
sTable = 'Dim-BMI'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="SELECT * FROM [Dim-BMI];"
PersonFrame0=pd.read_sql_query(sSQL, conn1)
##################################################################
print('################')
sTable = 'Dim-BMI'
print('Loading :',sDatabaseName,' Table:',sTable)

sSQL="SELECT \
      Height,\
      Weight,\
      Indicator\
  FROM [Dim-BMI]\
  WHERE Indicator > 2\
  ORDER BY  \
      Height,\
      Weight;"
PersonFrame1=pd.read_sql_query(sSQL, conn1)
##################################################################
DimPerson=PersonFrame1
DimPersonIndex=DimPerson.set_index(['Indicator'],inplace=False)
##################################################################
sTable = 'Dim-BMI-Vertical'
print('\n#################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n#################################')
DimPersonIndex.to_sql(sTable, conn2, if_exists="replace")
##################################################################
print('#################################')
sTable = 'Dim-BMI-Vertical'
print('Loading :',sDatabaseName,' Table:',sTable)
print('#################################')
sSQL="SELECT * FROM [Dim-BMI-Vertical];"
PersonFrame2=pd.read_sql_query(sSQL, conn2)
##################################################################
print('#################################')
print('Full Data Set (Rows):', PersonFrame0.shape[0])
print('Full Data Set (Columns):', PersonFrame0.shape[1])
print('#################################')
print('Horizontal Data Set (Rows):', PersonFrame2.shape[0])
print('Horizontal Data Set (Columns):', PersonFrame2.shape[1])
print('#################################')
##################################################################
```

Output:



Secure Vault Style

C:\VKHCG\01-Vermeulen\05-Organise\ Organize-Secure-Vault.py

```
import sys
import os
import pandas as pd
import sqlite3 as sq
################################################################
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
################################################################
Company='01-Vermeulen'
################################################################
sDataWarehouseDir=Base + '/99-DW'
if not os.path.exists(sDataWarehouseDir):
   os.makedirs(sDataWarehouseDir)
################################################################
sDatabaseName=sDataWarehouseDir + '/datawarehouse.db'
conn1 = sq.connect(sDatabaseName)
################################################################
sDatabaseName=sDataWarehouseDir + '/datamart.db'
conn2 = sq.connect(sDatabaseName)
################################################################
print('#################')
sTable = 'Dim-BMI'
print('Loading :',sDatabaseName,' Table:',sTable)
sSQL="SELECT * FROM [Dim-BMI];"
PersonFrame0=pd.read_sql_query(sSQL, conn1)
################################################################
print('#################')
sTable = 'Dim-BMI'
print('Loading :',sDatabaseName,' Table:',sTable)

sSQL="SELECT \
      Height,\
      Weight,\
      Indicator,\
      CASE Indicator\
      WHEN 1 THEN 'Pip'\
      WHEN 2 THEN 'Norman'\
      WHEN 3 THEN 'Grant'\
      ELSE 'Sam'\
```

```
    END AS Name\
 FROM [Dim-BMI]\
 WHERE Indicator > 2\
 ORDER BY  \
    Height,\
    Weight;"
PersonFrame1=pd.read_sql_query(sSQL, conn1)
#####################################################################
DimPerson=PersonFrame1
DimPersonIndex=DimPerson.set_index(['Indicator'],inplace=False)
#####################################################################
sTable = 'Dim-BMI-Secure'
print('\n#################################')
print('Storing :',sDatabaseName,'\n Table:',sTable)
print('\n#################################')
DimPersonIndex.to_sql(sTable, conn2, if_exists="replace")
#####################################################################
print('#################################')
sTable = 'Dim-BMI-Secure'
print('Loading :',sDatabaseName,' Table:',sTable)
print('#################################')
sSQL="SELECT * FROM [Dim-BMI-Secure] WHERE Name = 'Sam';"
PersonFrame2=pd.read_sql_query(sSQL, conn2)
#####################################################################
print('#################################')
print('Full Data Set (Rows):', PersonFrame0.shape[0])
print('Full Data Set (Columns):', PersonFrame0.shape[1])
print('#################################')
print('Horizontal Data Set (Rows):', PersonFrame2.shape[0])
print('Horizontal Data Set (Columns):', PersonFrame2.shape[1])
print('Only Sam Data')
print(PersonFrame2.head())
print('#################################')
#####################################################################
```

Output:

```
Python 3.7.4 Shell
File  Edit  Shell  Debug  Options  Window  Help
>>>
==== RESTART: C:\VKHCG\01-Vermeulen\05-Organise\Organize-Secure-Vault.py ====
################################
Working Base : C:/VKHCG  using  win32
################################
################
Loading : C:/VKHCG/99-DW/datamart.db  Table: Dim-BMI
################
Loading : C:/VKHCG/99-DW/datamart.db  Table: Dim-BMI

################################
Storing : C:/VKHCG/99-DW/datamart.db
 Table: Dim-BMI-Secure

################################
################################
Loading : C:/VKHCG/99-DW/datamart.db  Table: Dim-BMI-Secure
################################
################################
Full Data Set (Rows): 1080
Full Data Set (Columns): 5
################################
Horizontal Data Set (Rows): 692
Horizontal Data Set (Columns): 4
Only Sam Data
   Indicator  Height  Weight Name
0          4     1.0      35  Sam
1          4     1.0      40  Sam
2          4     1.0      45  Sam
3          4     1.0      50  Sam
4          4     1.0      55  Sam
################################
```

Association Rule Mining

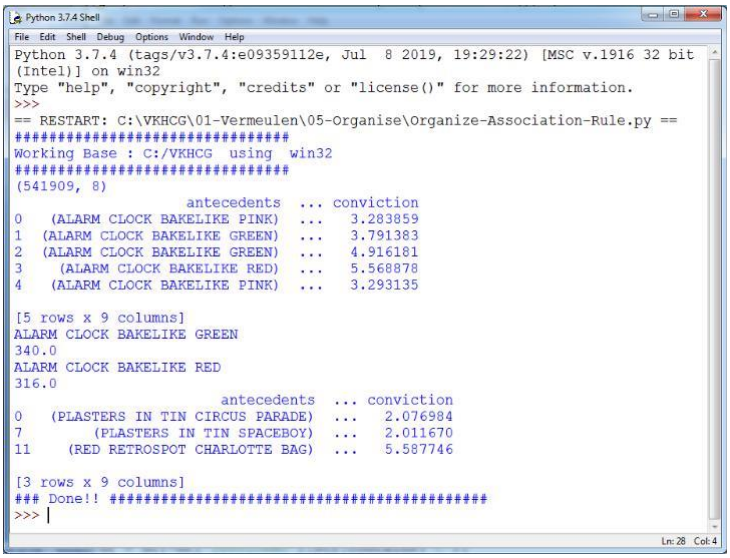
C:\VKHCG\01-Vermeulen\05-Organise\ Organize-Association-Rule.py

```
import sys
import os
import pandas as pd
from mlxtend.frequent_patterns import apriori
from mlxtend.frequent_patterns import association_rules
```

```
#####################################################################
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
#####################################################################
Company='01-Vermeulen'
InputFileName='Online-Retail-Billboard.xlsx'
EDSAssessDir='02-Assess/01-EDS'
InputAssessDir=EDSAssessDir + '/02-Python'
#####################################################################
sFileAssessDir=Base + '/' + Company + '/' + InputAssessDir
if not os.path.exists(sFileAssessDir):
   os.makedirs(sFileAssessDir)
#####################################################################
sFileName=Base+'/'+ Company + '/00-RawData/' + InputFileName
#####################################################################
df = pd.read_excel(sFileName)
print(df.shape)
#####################################################################
df['Description'] = df['Description'].str.strip()
df.dropna(axis=0, subset=['InvoiceNo'], inplace=True)
df['InvoiceNo'] = df['InvoiceNo'].astype('str')
df = df[~df['InvoiceNo'].str.contains('C')]

basket = (df[df['Country'] =="France"]
         .groupby(['InvoiceNo', 'Description'])['Quantity']
         .sum().unstack().reset_index().fillna(0)
         .set_index('InvoiceNo'))
#####################################################################
def encode_units(x):
   if x <= 0:
      return 0
   if x >= 1:
      return 1
#####################################################################
basket_sets = basket.applymap(encode_units)
basket_sets.drop('POSTAGE', inplace=True, axis=1)
frequent_itemsets = apriori(basket_sets, min_support=0.07, use_colnames=True)
rules = association_rules(frequent_itemsets, metric="lift", min_threshold=1)
print(rules.head())
rules[ (rules['lift'] >= 6) &
      (rules['confidence'] >= 0.8) ]
#####################################################################
sProduct1='ALARM CLOCK BAKELIKE GREEN'
print(sProduct1)
print(basket[sProduct1].sum())
sProduct2='ALARM CLOCK BAKELIKE RED'
print(sProduct2)
print(basket[sProduct2].sum())
#####################################################################
basket2 = (df[df['Country'] =="Germany"]
         .groupby(['InvoiceNo', 'Description'])['Quantity']
         .sum().unstack().reset_index().fillna(0)
         .set_index('InvoiceNo'))

basket_sets2 = basket2.applymap(encode_units)
basket_sets2.drop('POSTAGE', inplace=True, axis=1)
frequent_itemsets2 = apriori(basket_sets2, min_support=0.05, use_colnames=True)
rules2 = association_rules(frequent_itemsets2, metric="lift", min_threshold=1)
```

```
print(rules2[ (rules2['lift'] >= 4) &
       (rules2['confidence'] >= 0.5)])
#####################################################################
print('### Done!! ##############################################')
#####################################################################
```

Output:



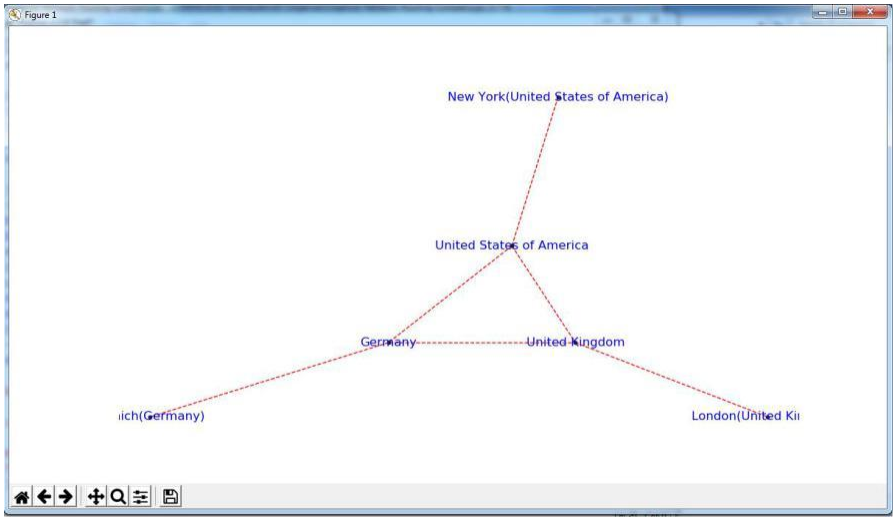
Create a Network Routing Diagram

I will guide you through a possible solution for the requirement, by constructing an island-style Organize superstep that uses a graph data model to reduce the records and the columns on the data set.

C:\VKHCG\01-Vermeulen\05-Organise\ Organise-Network-Routing-Company.py

```
import sys
import os
import pandas as pd
import networkx as nx
import matplotlib.pyplot as plt
#####################################################################
pd.options.mode.chained_assignment = None
#####################################################################
Base='C:/VKHCG'
#####################################################################
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
#####################################################################
sInputFileName='02-Assess/01-EDS/02-Python/Assess-Network-Routing-Company.csv'
#####################################################################
sOutputFileName1='05-Organise/01-EDS/02-Python/Organise-Network-Routing-Company.gml'
sOutputFileName2='05-Organise/01-EDS/02-Python/Organise-Network-Routing-Company.png'
Company='01-Vermeulen'
#####################################################################
#####################################################################
### Import Country Data
#####################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName
print('################################')
print('Loading :',sFileName)
```

```
print('################################')
CompanyData=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
print('################################')
print(CompanyData.head())
print(CompanyData.shape)
G=nx.Graph()
for i in range(CompanyData.shape[0]):
    for j in range(CompanyData.shape[0]):
        Node0=CompanyData['Company_Country_Name'][i]
        Node1=CompanyData['Company_Country_Name'][j]
        if Node0 != Node1:
            G.add_edge(Node0,Node1)

for i in range(CompanyData.shape[0]):
    Node0=CompanyData['Company_Country_Name'][i]
    Node1=CompanyData['Company_Place_Name'][i] + '('+ CompanyData['Company_Country_Name'][i] + ')'
    if Node0 != Node1:
        G.add_edge(Node0,Node1)

print('Nodes:', G.number_of_nodes())
print('Edges:', G.number_of_edges())
sFileName=Base + '/' + Company + '/' + sOutputFileName1
print('################################')
print('Storing :',sFileName)
print('################################')
nx.write_gml(G, sFileName)
sFileName=Base + '/' + Company + '/' + sOutputFileName2
print('################################')
print('Storing Graph Image:',sFileName)
print('################################')
plt.figure(figsize=(15, 15))
pos=nx.spectral_layout(G,dim=2)
nx.draw_networkx_nodes(G,pos, node_color='k', node_size=10, alpha=0.8)
nx.draw_networkx_edges(G, pos,edge_color='r', arrows=False, style='dashed')
nx.draw_networkx_labels(G,pos,font_size=12,font_family='sans-serif',font_color='b')
plt.axis('off')
plt.savefig(sFileName,dpi=600)
plt.show()
print('################################')
print('### Done!! ####################')
print('################################')
```



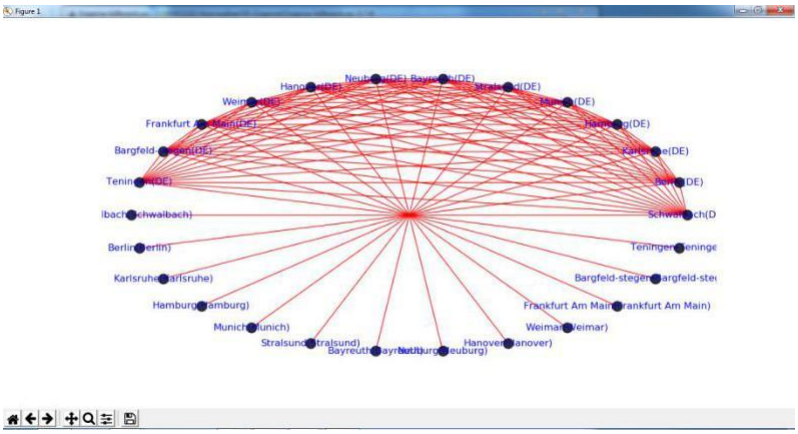
Picking Content for Billboards

C:\VKHCG\02-Krennwallner\05-Organise\ Organise-billboards.py

```
################################################################
import sys
import os
import pandas as pd
import networkx as nx
import matplotlib.pyplot as plt
import numpy as np
################################################################
pd.options.mode.chained_assignment = None
################################################################
Base='C:/VKHCG'
################################################################
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
sInputFileName='02-Assess/01-EDS/02-Python/Assess-DE-Billboard-Visitor.csv'
################################################################
sOutputFileName1='05-Organise/01-EDS/02-Python/Organise-Billboards.gml'
sOutputFileName2='05-Organise/01-EDS/02-Python/Organise-Billboards.png'
Company='02-Krennwallner'
################################################################
################################################################
### Import Company Data
################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName
print('################################')
print('Loading :',sFileName)
print('################################')
BillboardDataRaw=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
print('################################')
################################################################
print(BillboardDataRaw.head())
print(BillboardDataRaw.shape)
BillboardData=BillboardDataRaw
sSample=list(np.random.choice(BillboardData.shape[0],20))
################################################################
G=nx.Graph()
for i in sSample:
    for j in sSample:
        Node0=BillboardData['BillboardPlaceName'][i] + '('+ BillboardData['BillboardCountry'][i] +
        ')' Node1=BillboardData['BillboardPlaceName'][j] + '('+ BillboardData['BillboardCountry'][i]
        + ')' if Node0 != Node1:
            G.add_edge(Node0,Node1)

for i in sSample:
    Node0=BillboardData['BillboardPlaceName'][i] + '('+ BillboardData['VisitorPlaceName'][i] +
    ')' Node1=BillboardData['BillboardPlaceName'][i] + '('+ BillboardData['VisitorCountry'][i] + ')'
    if Node0 != Node1:
        G.add_edge(Node0,Node1)

print('Nodes:', G.number_of_nodes())
print('Edges:', G.number_of_edges())
################################################################
sFileName=Base + '/02-Krennwallner/' + sOutputFileName1
print('################################')
print('Storing :',sFileName)
```

```
print('#################################')
nx.write_gml(G, sFileName)
#####################################################################
sFileName=Base + '/02-Krennwallner/' + sOutputFileName2
print('#################################')
print('Storing Graph Image:',sFileName)
print('#################################')
plt.figure(figsize=(15, 15))
pos=nx.circular_layout(G,dim=2)
nx.draw_networkx_nodes(G,pos, node_color='k', node_size=150, alpha=0.8)
nx.draw_networkx_edges(G, pos,edge_color='r', arrows=False, style='solid')
nx.draw_networkx_labels(G,pos,font_size=12,font_family='sans-serif',font_color='b')
plt.axis('off')
plt.savefig(sFileName,dpi=600)
plt.show()
#####################################################################
print('#################################')
print('### Done!! ####################')
print('#################################')
#####################################################################
```

Output :



Create a Delivery Route C:\VKHCG\03-Hillman\05-Organise\Organise-Routes.py

```
import sys
import os
import pandas as pd
#####################################################################
Base='C:/VKHCG'
#####################################################################
print('#################################')
print('Working Base :',Base, ' using ', sys.platform)
print('#################################')
#####################################################################
sInputFileName='02-Assess/01-EDS/02-Python/Assess_Shipping_Routes.txt'
#####################################################################
sOutputFileName='05-Organise/01-EDS/02-Python/Organise-
Routes.csv' Company='03-Hillman'
#####################################################################
#####################################################################
### Import Routes Data
#####################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName
print('#################################')
```

```
print('Loading :',sFileName)
print('################################')
RouteDataRaw=pd.read_csv(sFileName,header=0,low_memory=False, sep='|', encoding="latin-1")
print('################################')
#####################################################################
RouteStart=RouteDataRaw[RouteDataRaw['StartAt']=='WH-KA13']
#####################################################################
RouteDistance=RouteStart[RouteStart['Cost']=='DistanceMiles']
RouteDistance=RouteDistance.sort_values(by=['Measure'], ascending=False)
#####################################################################
RouteMax=RouteStart["Measure"].max()
RouteMaxCost=round((((RouteMax/1000)*1.5*2)),2)
print('################################')
print('Maximum (£) per day:')
print(RouteMaxCost)
print('################################')
#####################################################################
RouteMean=RouteStart["Measure"].mean()
RouteMeanMonth=round((((RouteMean/1000)*2*30)),6)
print('################################')
print('Mean per Month (Miles):')
print(RouteMeanMonth)
print('################################')
```

Output:

Clark Ltd

Our financial services company has been tasked to investigate the options to convert1 million pounds sterling into extra income. Mr. Clark Junior suggests using the simplevariance in the daily rate between the British pound sterling and the US dollar, togenerate extra income from trading. Your chief financial officer wants to know if this isfeasible?

Simple Forex Trading Planner

Your challenge is to take 1 million US dollars or just over six hunderd thou sand pounds sterling and, by simply converting it between pounds sterling and US dollars, achieve a profit. Are you up to this challenge?

The Program will help you how to model this problem and achieve a positive outcome. The forex data has been collected on a daily basis by Clark's accounting department, from previous overseas transactions.

C:\VKHCG\04-Clark\05-Organise\Organise-Forex.py

```
import sys
import os
import pandas as pd
import sqlite3 as sq
import re
#####################################################################
Base='C:/VKHCG'
#####################################################################
```

```
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
#####################################################################
sInputFileName='03-Process/01-EDS/02-Python/Process_ExchangeRates.csv'
#####################################################################
sOutputFileName='05-Organise/01-EDS/02-Python/Organise-Forex.csv'
Company='04-Clark'
#####################################################################
sDatabaseName=Base + '/' + Company + '/05-Organise/SQLite/clark.db'
conn = sq.connect(sDatabaseName)
#conn = sq.connect(':memory:')
#####################################################################
#####################################################################
### Import Forex Data
#####################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName
print('################################')
print('Loading :',sFileName)
print('################################')
ForexDataRaw=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-
1") print('################################')
#####################################################################
ForexDataRaw.index.names =
['RowID'] sTable='Forex_All'
print('Storing :',sDatabaseName,' Table:',sTable)
ForexDataRaw.to_sql(sTable, conn, if_exists="replace")
#####################################################################
sSQL="SELECT 1 as Bag\
      , CAST(min(Date) AS VARCHAR(10)) as Date \
      ,CAST(1000000.0000000 as NUMERIC(12,4)) as Money \
      ,'USD' as Currency \
      FROM Forex_All \
      ;"
sSQL=re.sub("\s\s+", " ", sSQL)
nMoney=pd.read_sql_query(sSQL, conn)

#####################################################################
nMoney.index.names = ['RowID']
sTable='MoneyData'
print('Storing :',sDatabaseName,' Table:',sTable)
nMoney.to_sql(sTable, conn, if_exists="replace")
#####################################################################
sTable='TransactionData'
print('Storing :',sDatabaseName,' Table:',sTable)
nMoney.to_sql(sTable, conn, if_exists="replace")
#####################################################################
ForexDay=pd.read_sql_query("SELECT Date FROM Forex_All GROUP BY Date;",
conn) ##################################################################### t=0

for i in range(ForexDay.shape[0]):
   sDay1=ForexDay['Date'][i]
   sDay=str(sDay1)
   sSQL='\
   SELECT M.Bag as Bag, \
         F.Date as Date, \
         round(M.Money * F.Rate,6) AS Money, \
         F.CodeIn AS PCurrency, \
         F.CodeOut AS Currency \
   FROM MoneyData AS M \
```

```
    JOIN \
    ( \
        SELECT CodeIn, CodeOut, Date, Rate FROM Forex_All WHERE
       CodeIn = "USD" AND CodeOut = "GBP" \ UNION \

        SELECT CodeOut AS CodeIn, CodeIn AS CodeOut, Date, (1/Rate) AS Rate FROM \
        Forex_All WHERE CodeIn = "USD" AND CodeOut = "GBP" \
    )ASF\
    ON \
    M.Currency=F.CodeIn \
    AND \
    F.Date ='" +sDay + "';'
    sSQL=re.sub("\s\s+", " ", sSQL)

    ForexDayRate=pd.read_sql_query(sSQL, conn)
    for j in range(ForexDayRate.shape[0]):
        sBag=str(ForexDayRate['Bag'][j])
        nMoney=str(round(ForexDayRate['Money'][j],2))
        sCodeIn=ForexDayRate['PCurrency'][j]
        sCodeOut=ForexDayRate['Currency'][j]

    sSQL='UPDATE MoneyData SET Date= '" + sDay + "', '
    sSQL= sSQL + ' Money = ' + nMoney + ', Currency='" + sCodeOut + ""
    sSQL= sSQL + ' WHERE Bag=' + sBag + ' AND Currency='" + sCodeIn + "';'

    sSQL=re.sub("\s\s+", " ", sSQL)
    cur = conn.cursor()
    cur.execute(sSQL)
    conn.commit()
    t+=1
    print('Trade :', t, sDay, sCodeOut, nMoney)

    sSQL=' \
    INSERT INTO TransactionData ( \
                            RowID, \
                            Bag, \
                            Date, \
                            Money, \
                            Currency \
                        )  \
    SELECT ' + str(t) + ' AS RowID, \
       Bag, \
       Date, \
       Money, \
       Currency \
    FROM MoneyData  ;'
    sSQL=re.sub("\s\s+", " ", sSQL)
    cur = conn.cursor()
    cur.execute(sSQL)
    conn.commit()
####################################################################
sSQL="SELECT RowID, Bag, Date, Money, Currency FROM TransactionData ORDER BY RowID;"
sSQL=re.sub("\s\s+", " ", sSQL)
TransactionData=pd.read_sql_query(sSQL, conn)
OutputFile=Base + '/' + Company + '/' + sOutputFileName
TransactionData.to_csv(OutputFile, index = False)
####################################################################
```

Output:

Save the Assess-Forex.py file, then compile and execute with your Python compiler.
This will produce a set of demonstrated values onscreen.

Practical 9

Generating Data

Report Superstep

The Report superstep is the step in the ecosystem that enhances the data science findings with the art of storytelling and data visualization. You can perform the best data science, but if you cannot execute a respectable and trustworthy Report step by turning your data science into actionable business insights, you have achieved no advantage for your business.

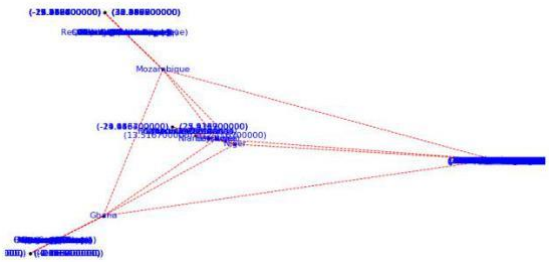
Vermeulen PLC

Vermeulen requires a map of all their customers' data links. Can you provide a report to deliver this? I will guide you through an example that delivers this requirement.

C:\VKHCG\01-Vermeulen\06-Report\Raport-Network-Routing-Customer.py

```
################################################################
import sys
import os
import pandas as pd
import networkx as nx
import matplotlib.pyplot as plt
################################################################
pd.options.mode.chained_assignment = None
################################################################
if sys.platform == 'linux':
   Base=os.path.expanduser('~') + 'VKHCG'
else:
   Base='C:/VKHCG'
################################################################
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
################################################################
sInputFileName='02-Assess/01-EDS/02-Python/Assess-Network-Routing-Customer.csv'
################################################################
sOutputFileName1='06-Report/01-EDS/02-Python/Report-Network-Routing-Customer.gml'
sOutputFileName2='06-Report/01-EDS/02-Python/Report-Network-Routing-Customer.png'
Company='01-Vermeulen'
################################################################
################################################################
### Import Country Data
################################################################
sFileName=Base + '/' + Company + '/' + sInputFileName
print('################################')
print('Loading :',sFileName)
print('################################')
CustomerDataRaw=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1")
CustomerData=CustomerDataRaw.head(100)
print('Loaded Country:',CustomerData.columns.values)
print('################################')
################################################################
print(CustomerData.head())
print(CustomerData.shape)
################################################################
G=nx.Graph()
for i in range(CustomerData.shape[0]): for
   j in range(CustomerData.shape[0]):
      Node0=CustomerData['Customer_Country_Name'][i]
      Node1=CustomerData['Customer_Country_Name'][j]  if
      Node0 != Node1:
```

```
        G.add_edge(Node0,Node1)

for i in range(CustomerData.shape[0]):
   Node0=CustomerData['Customer_Country_Name'][i]
   Node1=CustomerData['Customer_Place_Name'][i] + '('+ CustomerData['Customer_Country_Name'][i] + ')'
   Node2='('+ "{:.9f}".format(CustomerData['Customer_Latitude'][i]) + ')\
   ('+ "{:.9f}".format(CustomerData['Customer_Longitude'][i]) +
   ')' if Node0 != Node1:
      G.add_edge(Node0,Node1)
   if Node1 != Node2:
      G.add_edge(Node1,Node2)

print('Nodes:', G.number_of_nodes())
print('Edges:', G.number_of_edges())
#####################################################################
sFileName=Base + '/' + Company + '/' + sOutputFileName1
print('#################################')
print('Storing :',sFileName)
print('#################################')
nx.write_gml(G, sFileName)
#####################################################################
sFileName=Base + '/' + Company + '/' + sOutputFileName2
print('#################################')
print('Storing Graph Image:',sFileName)
print('#################################')

plt.figure(figsize=(25, 25))
pos=nx.spectral_layout(G,dim=2)
nx.draw_networkx_nodes(G,pos, node_color='k', node_size=10, alpha=0.8)
nx.draw_networkx_edges(G, pos,edge_color='r', arrows=False, style='dashed')
nx.draw_networkx_labels(G,pos,font_size=12,font_family='sans-serif',font_color='b')
plt.axis('off')
plt.savefig(sFileName,dpi=600)
plt.show()
print('#################################')
print('### Done!! ####################')
print('#################################')
```



Krennwallner AG

The Krennwallner marketing department wants to deploy the locations of the billboards onto the company web server. Can you prepare three versions of the locations' web pages?

- Locations clustered into bubbles when you zoom out
- Locations as pins
- Locations as heat map

Picking Content for Billboards

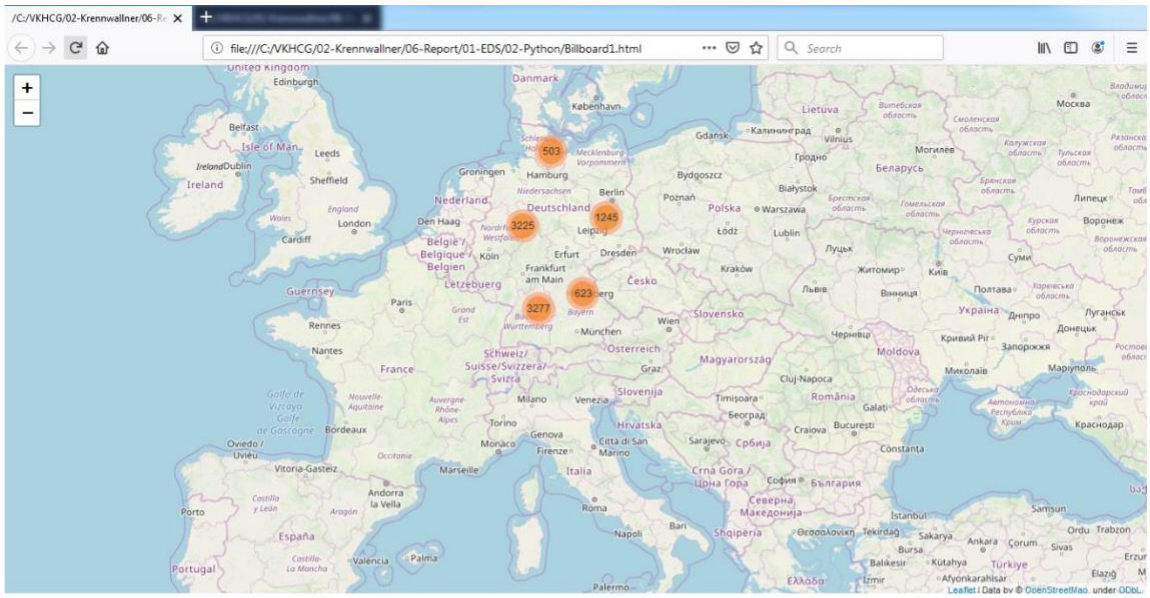
C:\VKHCG\02-Krennwallner\06-Report\Report_Billboard.py

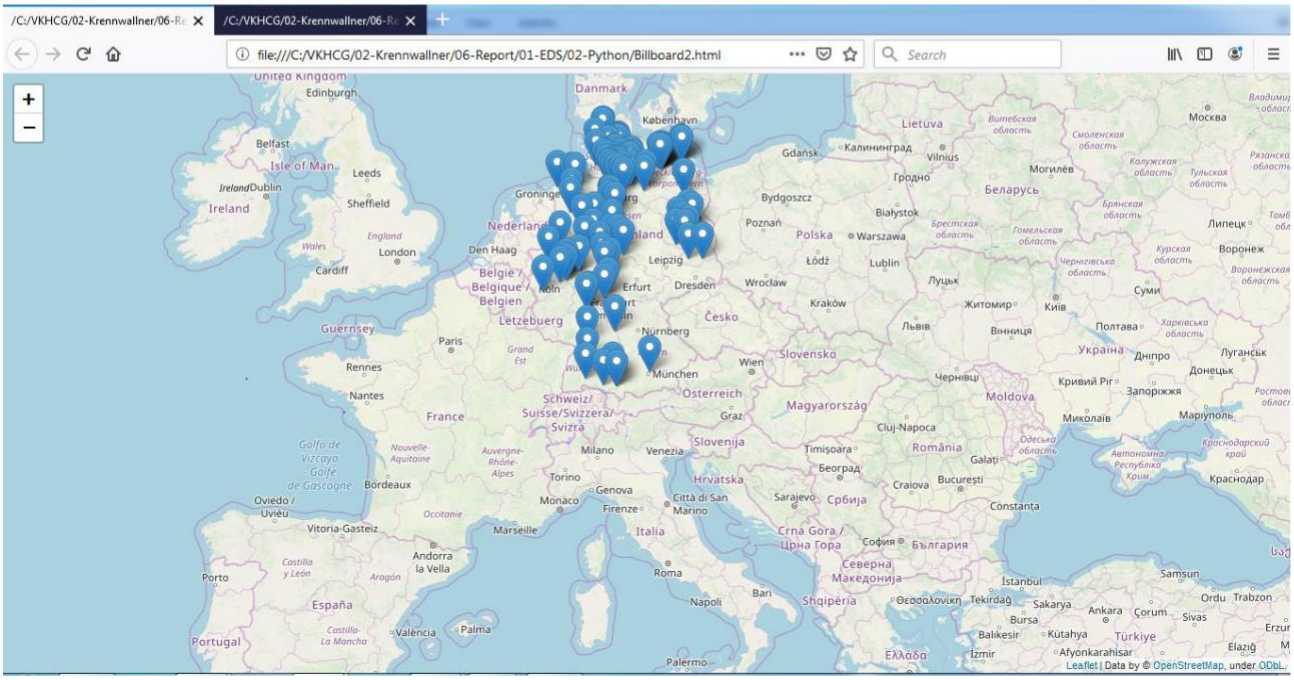
```
import sys
import os
import pandas as pd
```

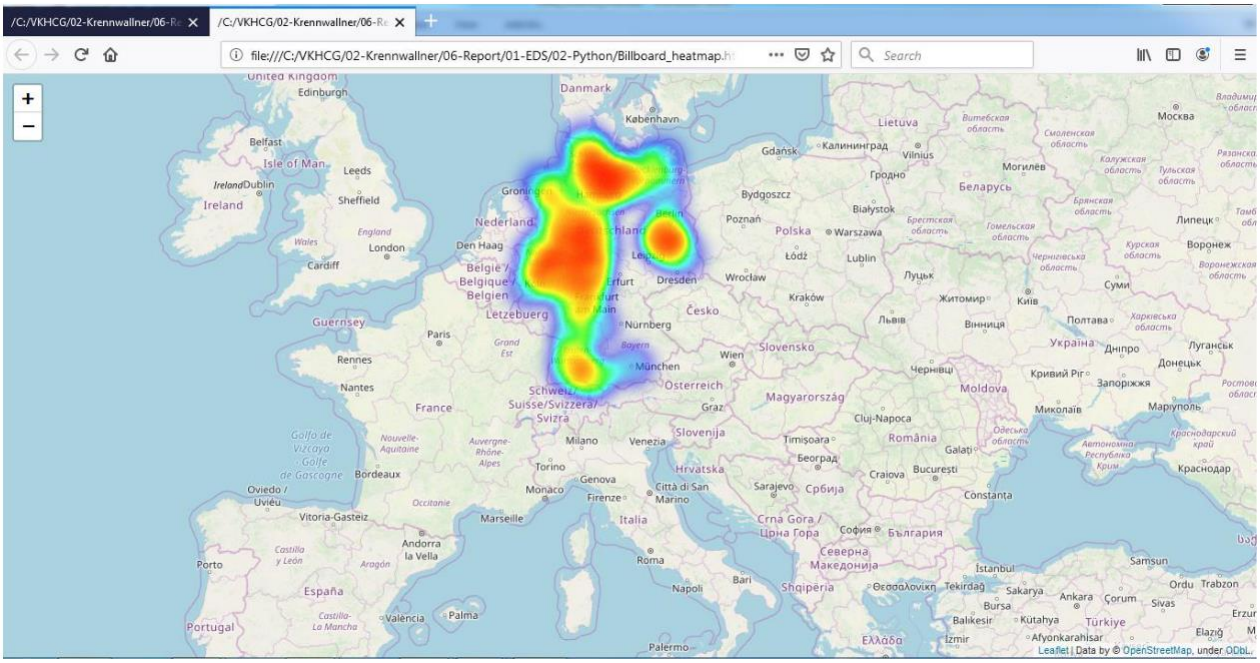
```
from folium.plugins import FastMarkerCluster, HeatMap
from folium import Marker, Map
import webbrowser
#####################################################################
Base='C:/VKHCG'
print('################################')
print('Working Base :',Base, ' using ', sys.platform)
print('################################')
##################################################################### sFileName=Base+'/02-
Krennwallner/01-Retrieve/01-EDS/02-Python/Retrieve_DE_Billboard_Locations.csv' df =
pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-1") df.fillna(value=0, inplace=True)

print(df.shape)
#####################################################################
t=0
for i in range(df.shape[0]):
   try:
      sLongitude=df["Longitude"][i]
      sLongitude=float(sLongitude)
   except Exception:
      sLongitude=float(0.0)
  try:
      sLatitude=df["Latitude"][i]
      sLatitude=float(sLatitude)
   except Exception:
      sLatitude=float(0.0)
try:
      sDescription=df["Place_Name"][i] + ' (' +
   df["Country"][i]+')' except Exception:
      sDescription='VKHCG'
   if sLongitude != 0.0 and sLatitude != 0.0:
      DataClusterList=list([sLatitude, sLongitude])
      DataPointList=list([sLatitude, sLongitude, sDescription])
      t+=1
      if t==1:
         DataCluster=[DataClusterList]
         DataPoint=[DataPointList]
      else:
         DataCluster.append(DataClusterList)
         DataPoint.append(DataPointList)
data=DataCluster
pins=pd.DataFrame(DataPoint)
pins.columns = [ 'Latitude','Longitude','Description']
#####################################################################
stops_map1 = Map(location=[48.1459806, 11.4985484], zoom_start=5) marker_cluster
= FastMarkerCluster(data).add_to(stops_map1) sFileNameHtml=Base+'/02-
Krennwallner/06-Report/01-EDS/02-Python/Billboard1.html'
stops_map1.save(sFileNameHtml)
webbrowser.open('file://' + os.path.realpath(sFileNameHtml))
#####################################################################
stops_map2 = Map(location=[48.1459806, 11.4985484], zoom_start=5)
for name, row in pins.iloc[:100].iterrows():
   Marker([row["Latitude"],row["Longitude"]],
popup=row["Description"]).add_to(stops_map2) sFileNameHtml=Base+'/02-Krennwallner/06-
Report/01-EDS/02-Python/Billboard2.html' stops_map2.save(sFileNameHtml)
webbrowser.open('file://' + os.path.realpath(sFileNameHtml))
#####################################################################
stops_heatmap = Map(location=[48.1459806, 11.4985484], zoom_start=5)
stops_heatmap.add_child(HeatMap([[row["Latitude"], row["Longitude"]] for name, row
in pins.iloc[:100].iterrows()]))
```

```
sFileNameHtml=Base+'/02-Krennwallner/06-Report/01-EDS/02-
Python/Billboard_heatmap.html' stops_heatmap.save(sFileNameHtml)
webbrowser.open('file://' + os.path.realpath(sFileNameHtml))
######################################################################
print('### Done!! ################################################')
######################################################################
```

Output:







Hillman Ltd

Dr. Hillman Sr. has just installed a camera system that enables the company to capture video and, therefore, indirectly, images of all containers that enter or leave the warehouse. Can you convert the number on the side of the containers into digits?

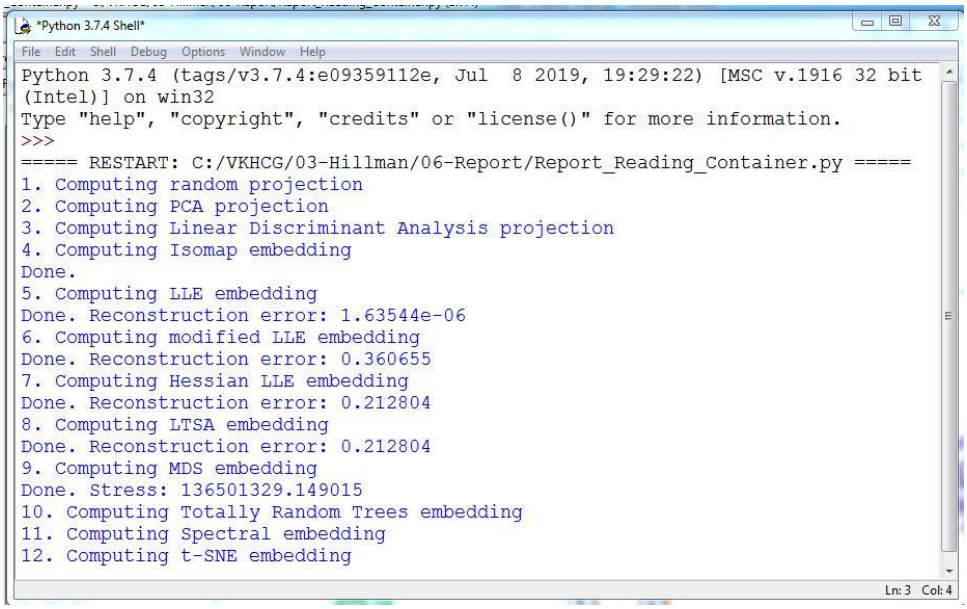
Reading the Containers

C:\VKHCG\03-Hillman\06-Report\ Report_Reading_Container.py

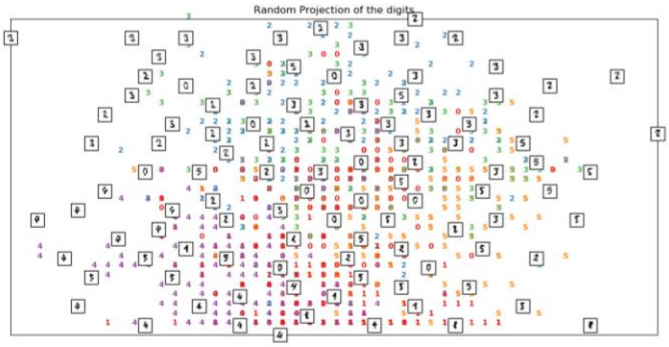
```
from time import time
import numpy as np
import matplotlib.pyplot as plt
from matplotlib import offsetbox
from sklearn import (manifold, datasets, decomposition, ensemble, discriminant_analysis, random_projection)
digits = datasets.load_digits(n_class=6)
X = digits.data
y = digits.target
n_samples, n_features = X.shape
n_neighbors = 30
def plot_embedding(X, title=None):
    x_min, x_max = np.min(X, 0), np.max(X, 0)
    X = (X - x_min) / (x_max -
    x_min) plt.figure(figsize=(10, 10))
    ax = plt.subplot(111)
    for i in range(X.shape[0]):
            plt.text(X[i, 0], X[i, 1], str(digits.target[i]),
                color=plt.cm.Set1(y[i] / 10.),
                fontdict={'weight': 'bold', 'size': 9})
    if hasattr(offsetbox, 'AnnotationBbox'):
        # only print thumbnails with matplotlib > 1.0
        shown_images = np.array([[1., 1.]]) # just something big
        for i in range(digits.data.shape[0]):
            dist = np.sum((X[i] - shown_images) ** 2, 1)
            if np.min(dist) < 4e-3:
                # don't show points that are too
                close continue
            shown_images = np.r_[shown_images, [X[i]]]
```

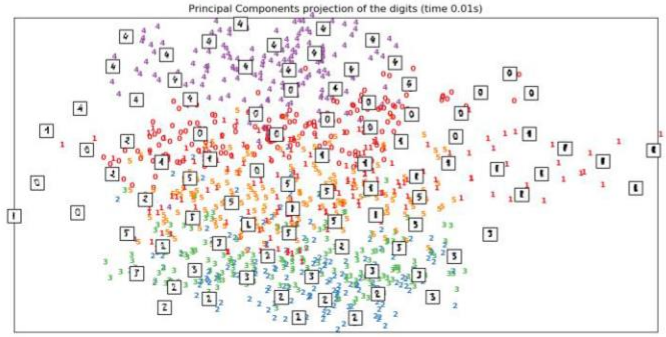
```
        imagebox = offsetbox.AnnotationBbox(offsetbox.OffsetImage(digits.images[i],
cmap=plt.cm.gray_r),X[i])
        ax.add_artist(imagebox)
    plt.xticks([]), plt.yticks([])
    if title is not None:
        plt.title(title)
n_img_per_row = 20
img = np.zeros((10 * n_img_per_row, 10 * n_img_per_row))
for i in range(n_img_per_row):
  ix = 10 * i + 1
  for j in range(n_img_per_row):
        iy = 10 * j + 1
        img[ix:ix + 8, iy:iy + 8] = X[i * n_img_per_row + j].reshape((8, 8))
plt.figure(figsize=(10, 10))
plt.imshow(img, cmap=plt.cm.binary)
plt.xticks([])
plt.yticks([])
plt.title('A selection from the 64-dimensional digits dataset')
print("Computing random projection")
rp = random_projection.SparseRandomProjection(n_components=2, random_state=42)
X_projected = rp.fit_transform(X)
plot_embedding(X_projected, "Random Projection of the digits")
print("Computing PCA projection")
t0 = time()
X_pca = decomposition.TruncatedSVD(n_components=2).fit_transform(X)
plot_embedding(X_pca,"Principal Components projection of the digits (time %.2fs)" %(time() - t0))
print("Computing Linear Discriminant Analysis projection")
X2 = X.copy()
X2.flat[::X.shape[1] + 1] += 0.01 # Make X invertible
t0 = time()
X_lda = discriminant_analysis.LinearDiscriminantAnalysis(n_components=2).fit_transform(X2, y)
plot_embedding(X_lda,"Linear Discriminant projection of the digits (time %.2fs)" %(time() - t0))
print("Computing Isomap embedding")
t0 = time()
X_iso = manifold.Isomap(n_neighbors, n_components=2).fit_transform(X)
print("Done.")
plot_embedding(X_iso,"Isomap projection of the digits (time %.2fs)" %(time() - t0))
print("Computing LLE embedding")
clf = manifold.LocallyLinearEmbedding(n_neighbors, n_components=2,method='standard')
t0 = time()
X_lle = clf.fit_transform(X)
print("Done. Reconstruction error: %g" % clf.reconstruction_error_)
plot_embedding(X_lle,"Locally Linear Embedding of the digits (time %.2fs)" %(time() - t0))
print("Computing modified LLE embedding")
clf = manifold.LocallyLinearEmbedding(n_neighbors, n_components=2,
method='modified')
t0 = time()
X_mlle = clf.fit_transform(X)
print("Done. Reconstruction error: %g" % clf.reconstruction_error_)
plot_embedding(X_mlle,"Modified Locally Linear Embedding of the digits (time %.2fs)" %(time() - t0))
print("Computing Hessian LLE embedding")
clf = manifold.LocallyLinearEmbedding(n_neighbors, n_components=2,method='hessian')
t0 = time()
X_hlle = clf.fit_transform(X)
print("Done. Reconstruction error: %g" % clf.reconstruction_error_)
plot_embedding(X_hlle,"Hessian Locally Linear Embedding of the digits (time %.2fs)" %(time() - t0))
print("Computing LTSA embedding")
clf = manifold.LocallyLinearEmbedding(n_neighbors, n_components=2,method='ltsa')
t0 = time()
X_ltsa = clf.fit_transform(X)
```

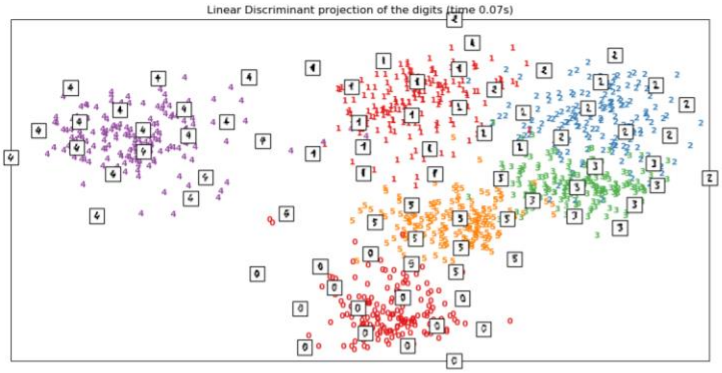
```
print("Done. Reconstruction error: %g" % clf.reconstruction_error_)
plot_embedding(X_ltsa,"Local Tangent Space Alignment of the digits (time %.2fs)" %(time() - t0))
print("Computing MDS embedding")
clf = manifold.MDS(n_components=2, n_init=1, max_iter=100)
t0 = time()
X_mds = clf.fit_transform(X)
print("Done. Stress: %f" % clf.stress_)
plot_embedding(X_mds,"MDS embedding of the digits (time %.2fs)" %(time() - t0))
print("Computing Totally Random Trees embedding")
hasher = ensemble.RandomTreesEmbedding(n_estimators=200,
random_state=0, max_depth=5)
t0 = time()
X_transformed = hasher.fit_transform(X)
pca = decomposition.TruncatedSVD(n_components=2)
X_reduced = pca.fit_transform(X_transformed)
plot_embedding(X_reduced,"Random forest embedding of the digits (time %.2fs)" %(time() - t0))
print("Computing Spectral embedding")
embedder = manifold.SpectralEmbedding(n_components=2, random_state=0,
eigen_solver="arpack")
t0 = time()
X_se = embedder.fit_transform(X)
plot_embedding(X_se,"Spectral embedding of the digits (time %.2fs)" %(time() - t0))
print("Computing t-SNE embedding")
tsne = manifold.TSNE(n_components=2, init='pca', random_state=0)
t0 = time()
X_tsne = tsne.fit_transform(X)
plot_embedding(X_tsne,"t-SNE embedding of the digits (time %.2fs)" %(time() - t0))
plt.show()
```

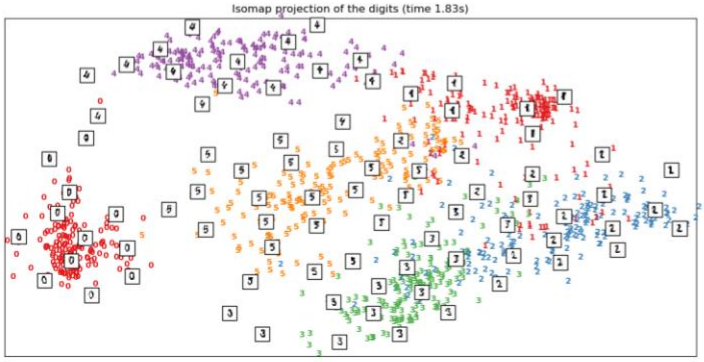


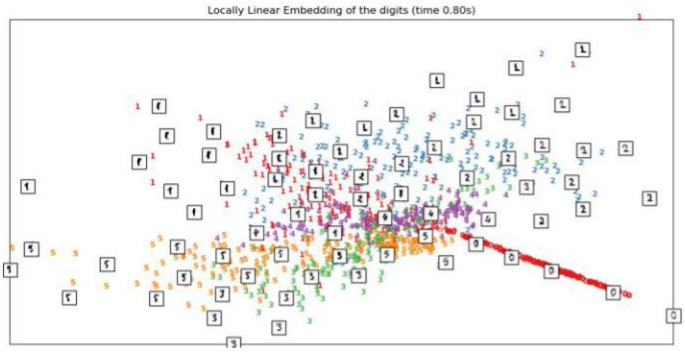

A selection from the 64-dimensional digits dataset

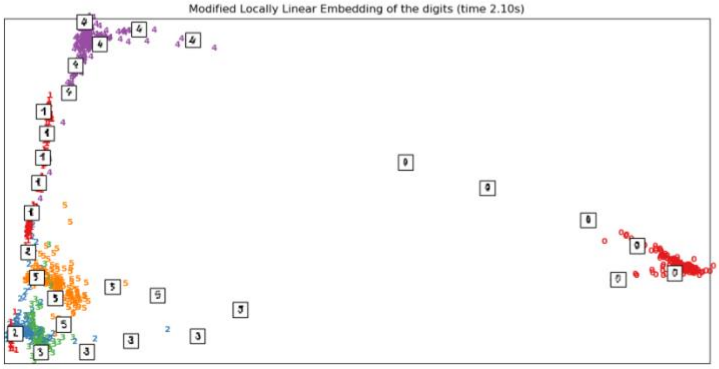

Random Projection of the digits

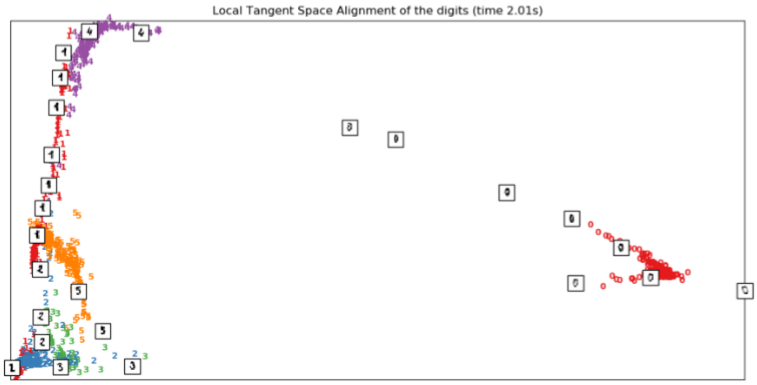

Principal Components projection of the digits (time 0.01s)


Linear Discriminant projection of the digits (time 0.07s)


Isomap projection of the digits (time 1.83s)


Locally Linear Embedding of the digits (time 0.80s)


Modified Locally Linear Embedding of the digits (time 2.10s)



Clark Ltd

The financial company in VKHCG is the Clark accounting firm that VKHCG owns with a 60% stake. The accountants are the financial advisers to the group and handle everything to do with the complex work of international accounting.

Financials

The VKHCG companies did well last year, and the teams at Clark must prepare a balance sheet for each company in the group. The companies require a balance sheet for each company, to be produced using the template (Balance-Sheet-Template.xlsx) that can be found in the example directory (..\VKHCG\04-Clark\00-RawData).

The Program will guide you through a process that will enable you to merge the data science with preformatted Microsoft Excel template, to produce a balance sheet for each of the VKHCG companies.

C:\VKHCG\04-Clark\06-Report\Report-Balance-Sheet.py

```
import sys
import os
import pandas as pd
import sqlite3 as sq
import re
from openpyxl import load_workbook
################################################################
Base='C:/VKHCG'
################################################################
print('##################################')
print('Working Base :',Base, ' using ', sys.platform)
print('##################################')
################################################################
sInputTemplateName='00-RawData/Balance-Sheet-Template.xlsx'
################################################################
sOutputFileName='06-Report/01-EDS/02-Python/Report-Balance-Sheet'
```

```
Company='04-Clark'
#####################################################################
sDatabaseName=Base + '/' + Company + '/06-
Report/SQLite/clark.db' conn = sq.connect(sDatabaseName) #conn =
sq.connect(':memory:')
#####################################################################
### Import Balance Sheet Data
#####################################################################
for y in range(1,13): sInputFileName='00-RawData/BalanceSheets' +
   str(y).zfill(2) + '.csv' sFileName=Base + '/' + Company + '/' +
   sInputFileName print('################################')

   print('Loading :',sFileName) print('################################')
   ForexDataRaw=pd.read_csv(sFileName,header=0,low_memory=False, encoding="latin-
   1") print('################################')

   #####################################################################
   ForexDataRaw.index.names =
   ['RowID'] sTable='BalanceSheets'
   print('Storing :',sDatabaseName,'
   Table:',sTable) if y == 1:
      print('Load Data')
      ForexDataRaw.to_sql(sTable, conn, if_exists="replace")
   else:
      print('Append Data')
      ForexDataRaw.to_sql(sTable, conn, if_exists="append")
#####################################################################
sSQL="SELECT \
         Year, \
         Quarter, \
         Country, \
         Company, \
         CAST(Year AS INT) || 'Q' || CAST(Quarter AS INT) AS sDate, \
         Company || ' (' || Country || ')' AS sCompanyName , \ CAST(Year
         AS INT) || 'Q' || CAST(Quarter AS INT) || '-' ||\ Company || '-' ||
         Country AS sCompanyFile \
      FROM BalanceSheets \
      GROUP BY \
         Year, \
         Quarter, \
         Country, \
         Company \
      HAVING Year is not null
     \ ;"
sSQL=re.sub("\s\s+", " ", sSQL)
sDatesRaw=pd.read_sql_query(sSQL,
conn) print(sDatesRaw.shape)
sDates=sDatesRaw.head(5)
#####################################################################
## Loop Dates
#####################################################################
for i in range(sDates.shape[0]):
   sFileName=Base + '/' + Company + '/' +
   sInputTemplateName wb = load_workbook(sFileName)
   ws=wb.get_sheet_by_name("Balance-Sheet")
   sYear=sDates['sDate'][i]
   sCompany=sDates['sCompanyName'][i]
   sCompanyFile=sDates['sCompanyFile'][i]
   sCompanyFile=re.sub("\s+", "", sCompanyFile)
```

```
ws['D3'] = sYear
ws['D5'] = sCompany

sFields = pd.DataFrame(
      [
      ['Cash','D16', 1],
      ['Accounts_Receivable','D17', 1],
      ['Doubtful_Accounts','D18', 1],
      ['Inventory','D19', 1],
      ['Temporary_Investment','D20', 1],
      ['Prepaid_Expenses','D21', 1],
      ['Long_Term_Investments','D24', 1],
      ['Land','D25', 1],
      ['Buildings','D26', 1],
      ['Depreciation_Buildings','D27', -1],
      ['Plant_Equipment','D28', 1],
      ['Depreciation_Plant_Equipment','D29', -1],
      ['Furniture_Fixtures','D30', 1],
      ['Depreciation_Furniture_Fixtures','D31', -1],
      ['Accounts_Payable','H16', 1],
      ['Short_Term_Notes','H17', 1],
      ['Current_Long_Term_Notes','H18', 1],
      ['Interest_Payable','H19', 1],
      ['Taxes_Payable','H20', 1],
      ['Accrued_Payroll','H21', 1],
      ['Mortgage','H24', 1],
      ['Other_Long_Term_Liabilities','H25', 1],
      ['Capital_Stock','H30', 1]
      ]
       )

nYear=str(int(sDates['Year'][i]))
nQuarter=str(int(sDates['Quarter'][i]))
sCountry=str(sDates['Country'][i])
sCompany=str(sDates['Company'][i])

sFileName=Base + '/' + Company + '/' + sOutputFileName +
\ '-' + sCompanyFile + '.xlsx'

print(sFileName)

for j in range(sFields.shape[0]):

   sSumField=sFields[0][j]
   sCellField=sFields[1][j]
   nSumSign=sFields[2][j]

   sSQL="SELECT  \
         Year, \
         Quarter, \
         Country, \
         Company, \
         SUM(" + sSumField + ") AS nSumTotal \
      FROM BalanceSheets \
      GROUP BY \
         Year, \
         Quarter, \
         Country, \
         Company \
      HAVING \
```

```
            Year=" + nYear + " \
        AND \
            Quarter=" + nQuarter + " \
        AND \
            Country='" + sCountry + "' \
        AND \
            Company='" + sCompany + "' \
        ;"
    sSQL=re.sub("\s\s+", " ", sSQL)
    sSumRaw=pd.read_sql_query(sSQL, conn)
    ws[sCellField] = sSumRaw["nSumTotal"][0] * nSumSign
    print('Set cell',sCellField,' to ', sSumField,'Total')
wb.save(sFileName)
```

Output:

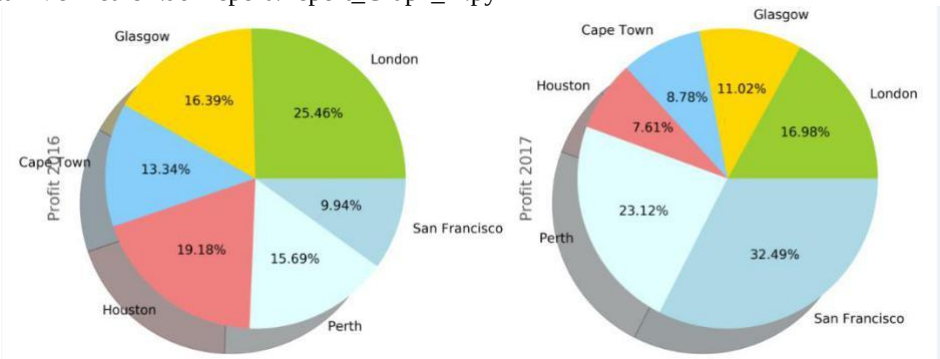
Graphics

This section will now guide you through a number of visualizations that particularly useful in presenting data to my customers.

Pie Graph

Double Pie

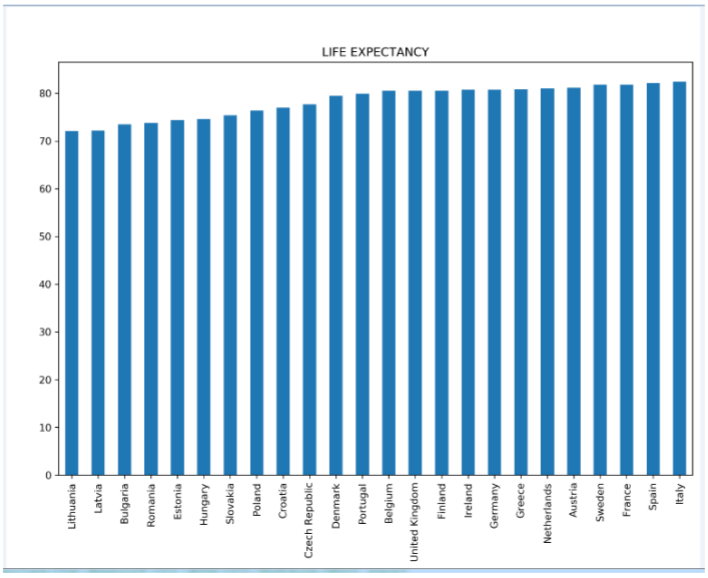
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_A.py



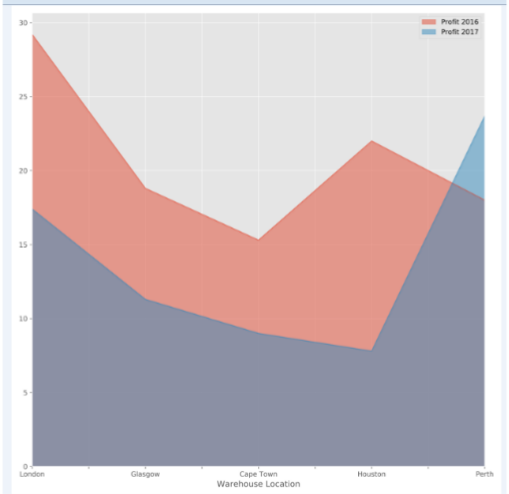
Line Graph

C:/VKHCG/01-Vermeulen/06-Report/Report_Graph_A.py

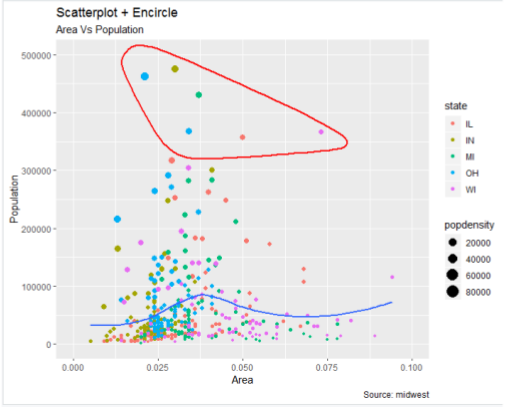
Bar Graph / Horizontal Bar Graph C:/VKHCG/01-Vermeulen/06-Report/Report_Graph_A.py



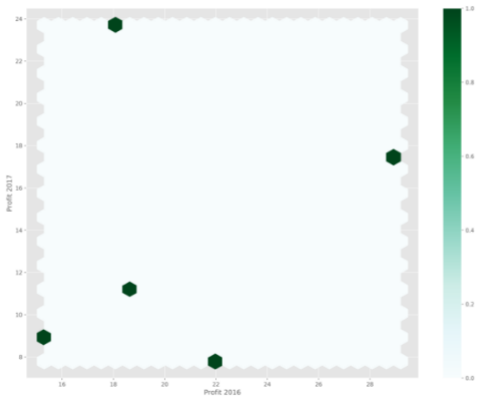
Area Graph
C:/VKHCG/01-Vermeulen/06-Report/Report_Graph_A.py



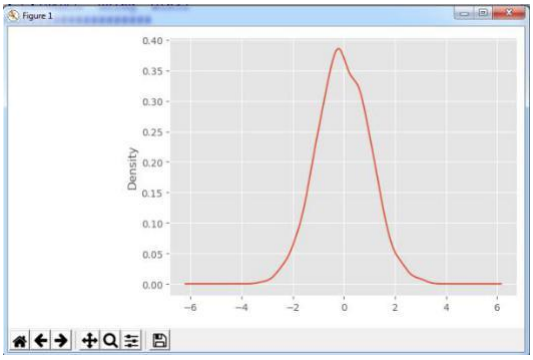
SCATTER GRAPH : VKHCG/03-HILLMAN/06-REPORT/REPORT-SCATTERPLOT-WITH-ENCIRCLING.R



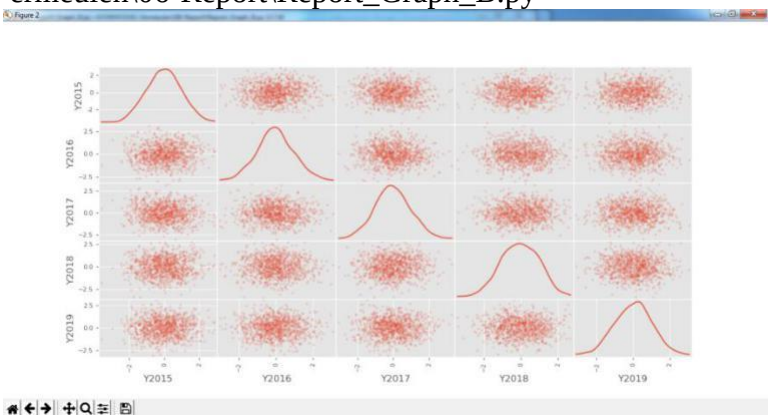
Hexbin:
Program : C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_A.py



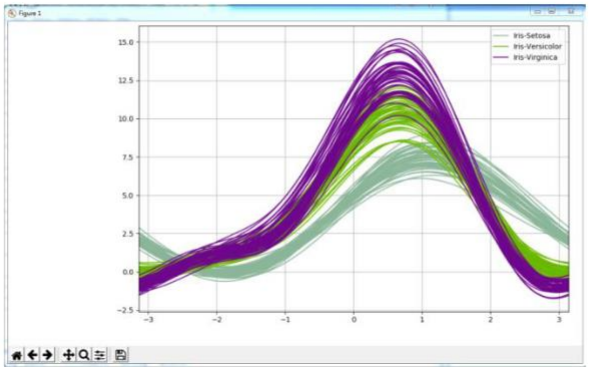
Kernel Density Estimation (KDE) Graph C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_B.py



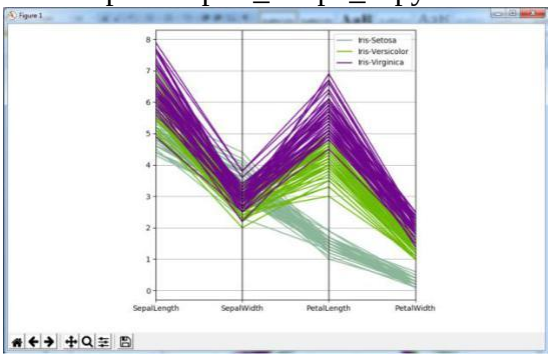
Scatter Matrix Graph
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_B.py



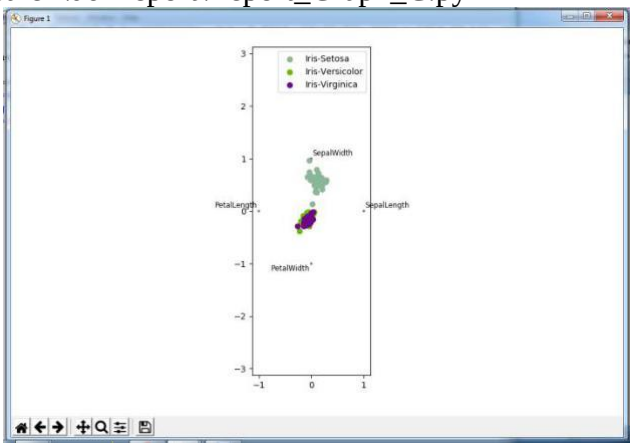
Andrews' Curves
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_C.py



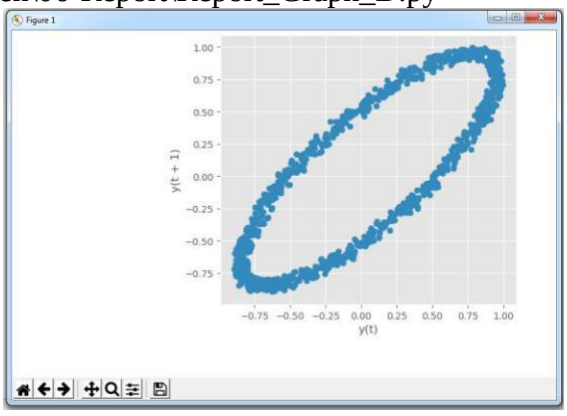
Parallel Coordinates
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_C.py



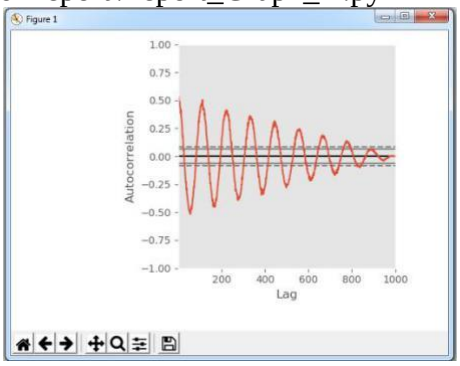
RADVIZ Method
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_C.py



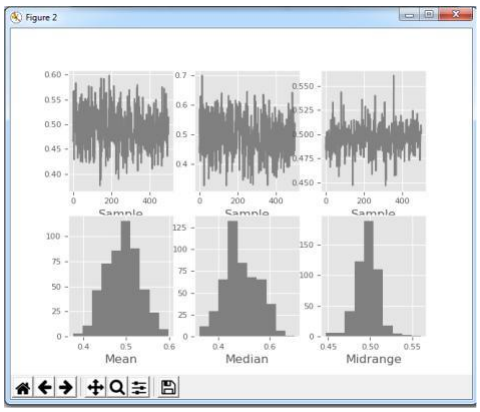
Lag Plot
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_D.py



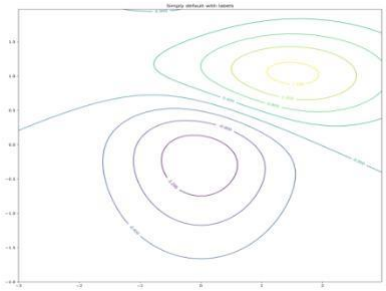
Autocorrelation Plot
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_D.py



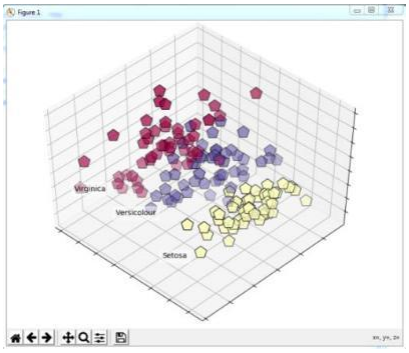
Bootstrap Plot
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_D.py



Contour Graphs
C:\VKHCG\01-Vermeulen\06-Report\Report_Graph_G.py



3D Graphs
C:\VKHCG\01-Vermeulen\06-Report\Report_PCA_IRIS.py



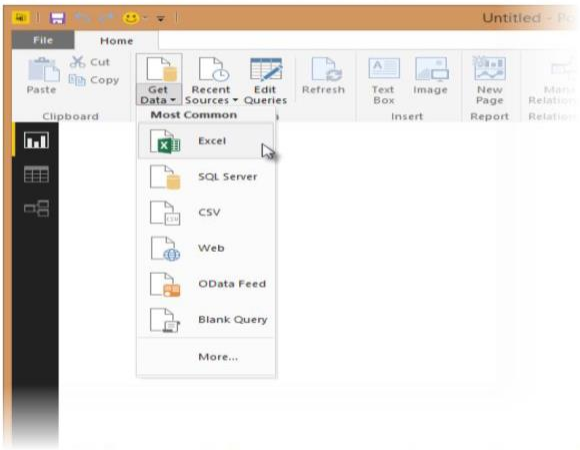
Practical 10

Data Visualization with Power BI

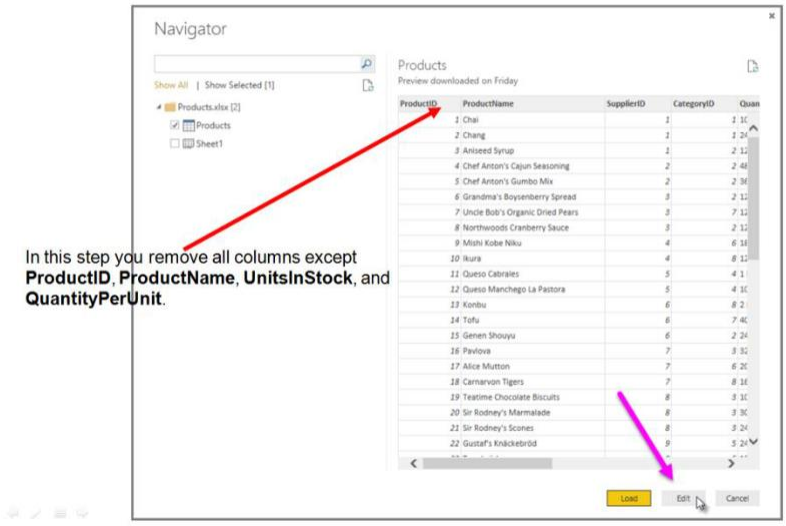
Case Study : Sales Data

Step 1: Connect to an Excel workbook

1. Launch Power BI Desktop.
2. From the Home ribbon, select **Get Data**. Excel is one of the **Most Common** data connections, so you can select it directly from the **Get Data** menu.

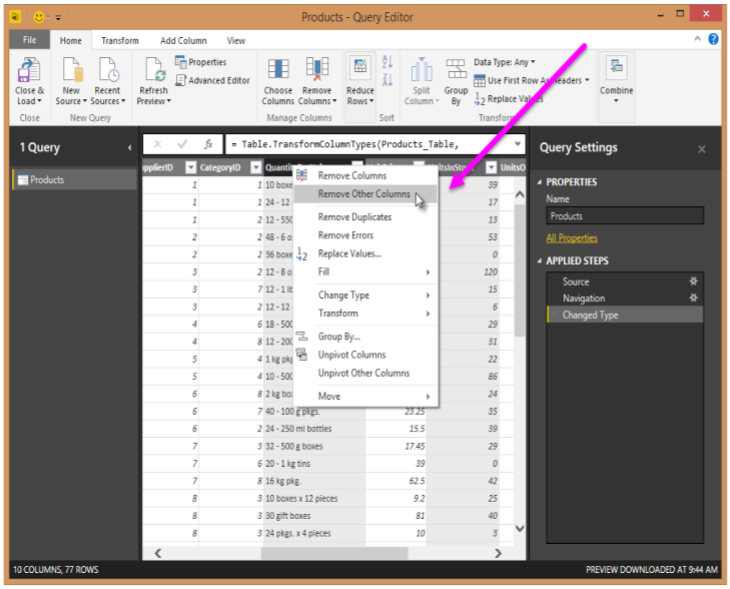


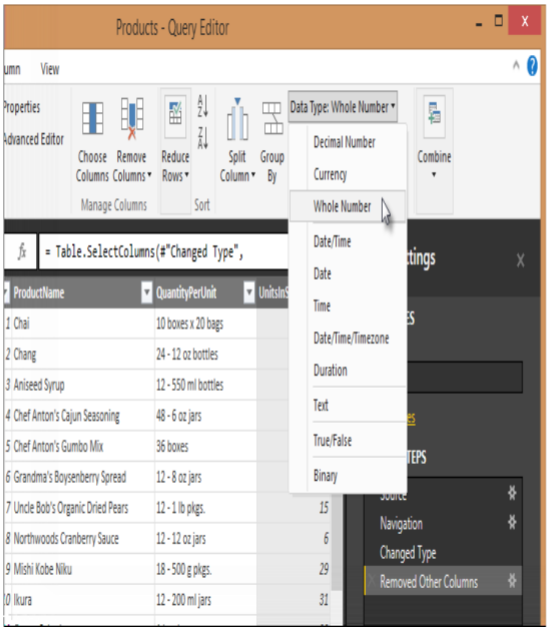
3. If you select the Get Data button directly, you can also select **File > Excel** and select **Connect**.
4. In the **Open File** dialog box, select the **Products.xlsx** file.



You can also open the Query Editor by selecting Edit Queries from the Home ribbon in Power BI Desktop. The following steps are performed in Query Editor.

1. In Query Editor, select the ProductID, ProductName, QuantityPerUnit, and UnitsInStock columns
   (use Ctrl+Click to select more than one column, or Shift+Click to select columns that are beside each other)
2. Select Remove Columns → Remove Other Columns from the ribbon, or right-click on a column header and click Remove Other Columns.





Step 3: Change the data type of the UnitsInStock column

For the Excel workbook, products in stock will always be a whole number, so in this step you confirm the UnitsInStock column's datatype is Whole Number.

1. Select the UnitsInStock column.
2. 2. Select the Data Type drop-down button in the Home ribbon.
3. If not already a Whole Number, select Whole Number for data type from the drop down *(the Data Type: button also displays the data type for the current selection).*

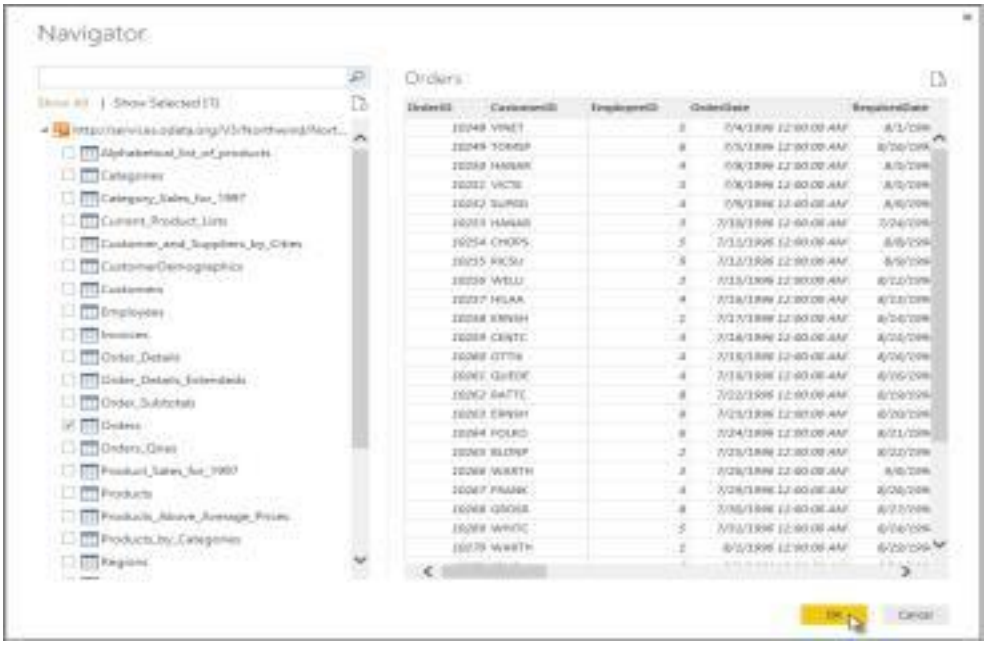
Task 2: Import order data from an OData feed

You import data into Power BI Desktop from the sample Northwind OData feed at the following URL, which you can copy (and then paste) in the steps below:
http://services.odata.org/V3/Northwind/Northwind.svc/

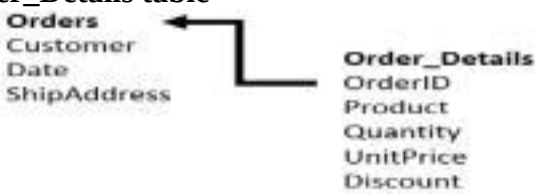
Step 1: Connect to an OData feed

1. From the **Home** ribbon tab in Query Editor, select **Get Data.**
2. Browse to the **OData Feed** data source.

3. In the **OData Feed** dialog box, paste the **URL** for the Northwind OData feed.
4. Select **OK**.



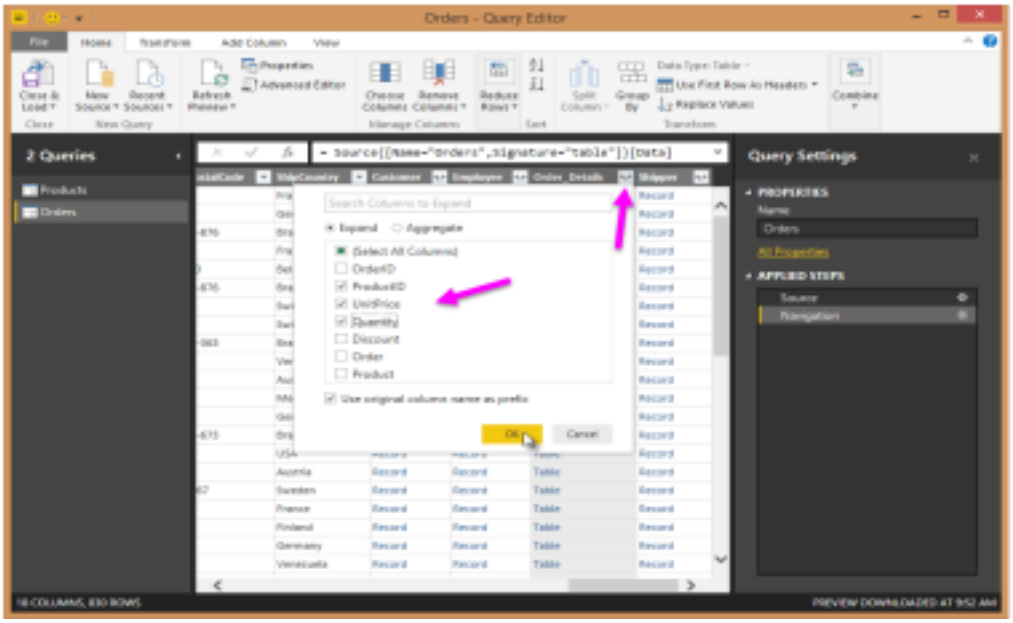
Step 2: Expand the Order_Details table



Expand the **Order_Details** table that is related to the **Orders** table, to combine the **ProductID**, **UnitPrice**, and **Quantity** columns from **Order_Details** into the **Orders** table. The **Expand** operation combines columns from a related table into a subject table. When the query runs, rows from the related table (**Order_Details**) are combined into rows from the subject table (**Orders**).

After you expand the **Order_Details** table, three new columns and additional rows are added to the **Orders** table, one for each row in the nested or related table.

1. In the **Query View**, scroll to the **Order_Details** column.
2. In the **Order_Details** column, select the expand icon ().
3. In the **Expand** drop-down: a. Select **(Select All Columns)** to clear all columns. Select **ProductID**, **UnitPrice**, and **Quantity**. click **OK**.



Step 3: Remove other columns to only display columns of interest
In this step you remove all columns except **OrderDate, ShipCity**, **ShipCountry**, **Order_Details.ProductID**, **Order_Details.UnitPrice**, and **Order_Details.Quantity** columns. In the previous task, you used **Remove Other Columns**. For this task, you remove selected columns.
In the **Query View**, select all columns by completing a.

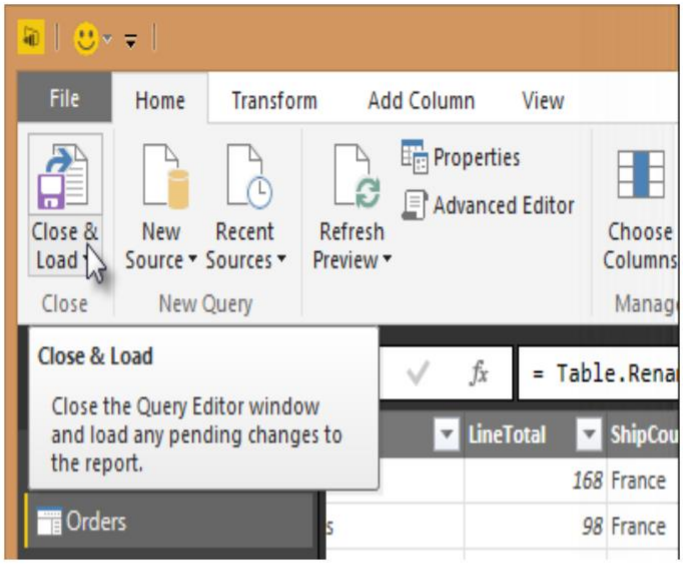
a. Click the first column (**OrderID**).
b. Shift+Click the last column (**Shipper**).
c. Now that all columns are selected, use Ctrl+Click to unselect the following columns: OrderDate, ShipCity, ShipCountry, Order_Details.ProductID, Order_Details.UnitPrice, and Order_Details.Quantity.

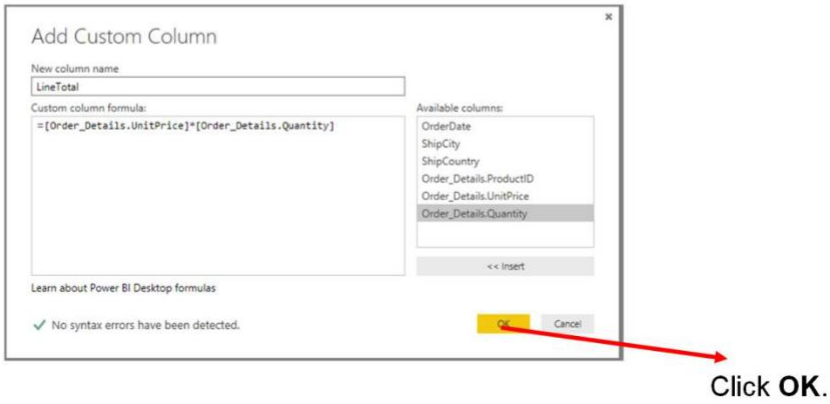
Now that only the columns we want to remove are selected, right-click on any selected column header and click Remove Columns.

Step 4: Calculate the line total for each Order_Details row
Power BI Desktop lets you to create calculations based on the columns you are importing, so you can enrich the data that you connect to. In this step, you create a **Custom Column** to calculate the line total for each **Order_Details** row. Calculate the line total for each **Order_Details** row:

1. In the **Add Column** ribbon tab, click **Add Custom Column**.

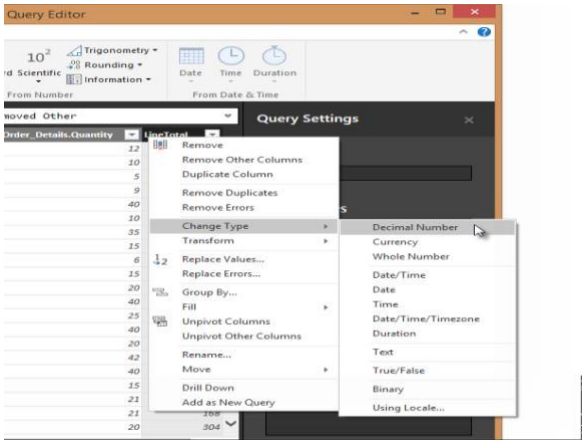
2. In the Add Custom Column dialog box, in the Custom Column Formula textbox, enter **[Order_Details.UnitPrice] * [Order_Details.Quantity].**
3. In the New column name textbox, enter LineTotal.





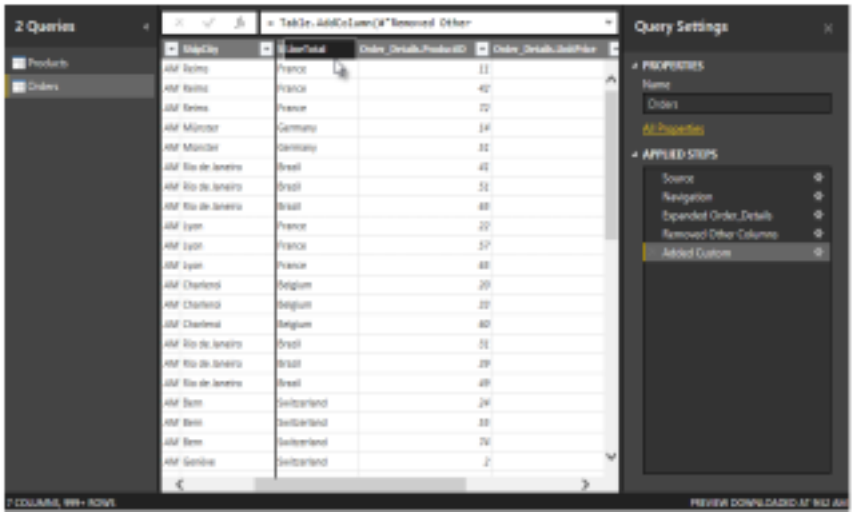
Step 5: Set the datatype of the LineTotal field

1. Right click the **LineTotal** column.
2. Select **Change Type** and choose **Decimal Number.**

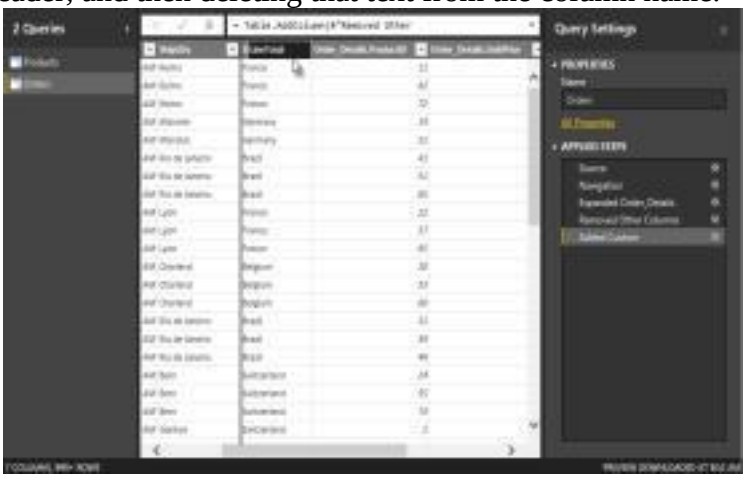


Step 6: Rename and reorder columns in the query

1. In **Query Editor**, drag the **LineTotal** column to the left, after **ShipCountry**.
2. Remove



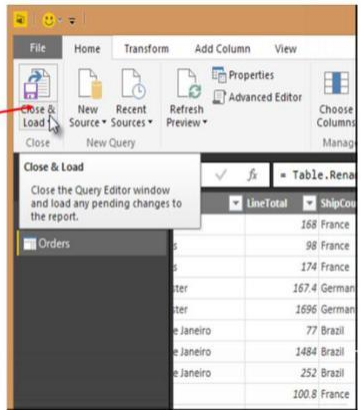
2. Remove the *Order_Details.* prefix from the **Order_Details.ProductID**, **Order_Details.UnitPrice** and **Order_Details.Quantity** columns, by double-clicking on each column header, and then deleting that text from the column name.



Task 3: Combine the Products and Total Sales queries

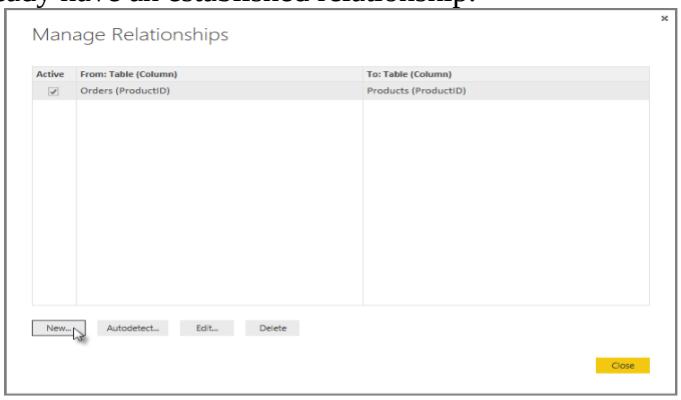
Step 1: Confirm the relationship between Products and Total Sales

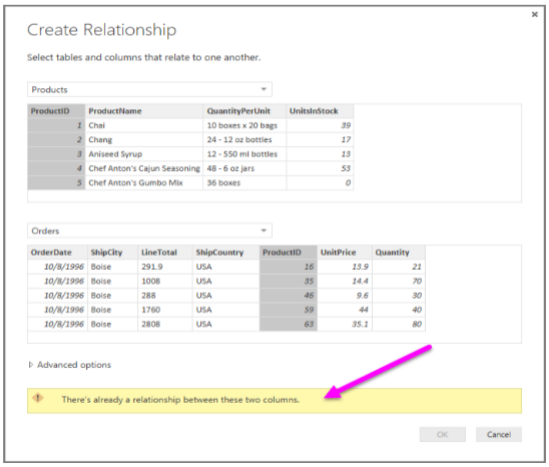
1. First, we need to load the model that we created in Query Editor into Power BI Desktop. From the **Home** ribbon of Query Editor, select **Close & Load**.



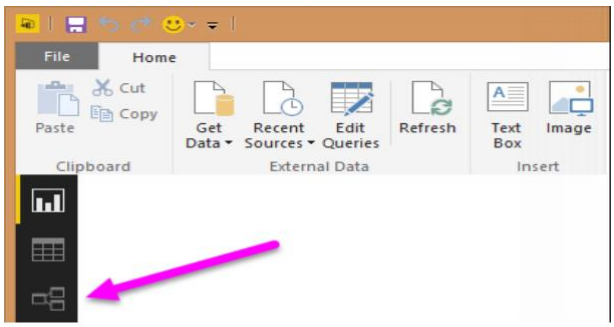
2. Power BI Desktop loads the data from the two queries
3. Once the data is loaded, select the Manage Relationships button Home ribbon
4. Select the New… button

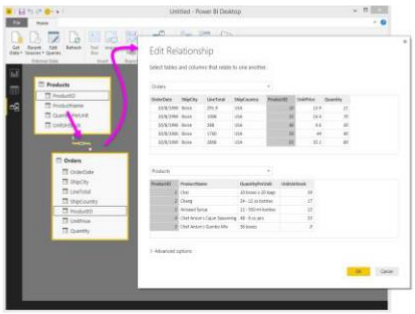
5. When we attempt to create the relationship, we see that one already exists! As shown in the Create Relationship dialog (by the shaded columns), the ProductsID fields in each query already have an established relationship.





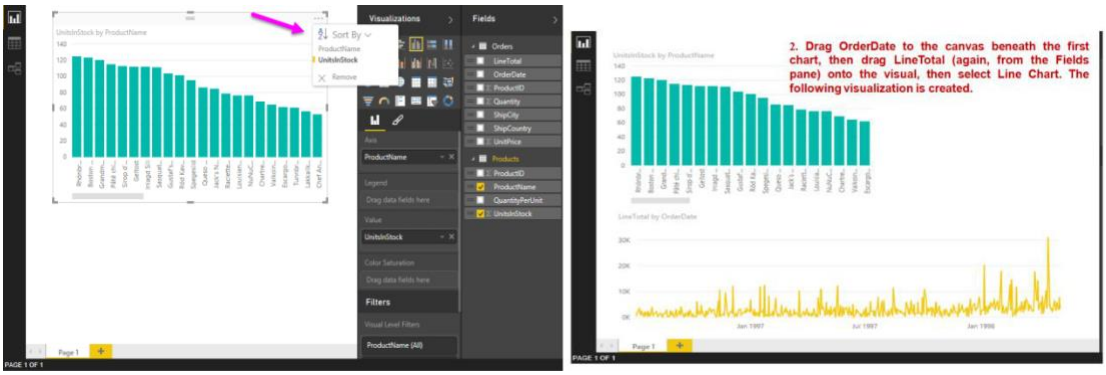
6. **Select Cancel, and then select Relationship view in Power BI Desktop.**



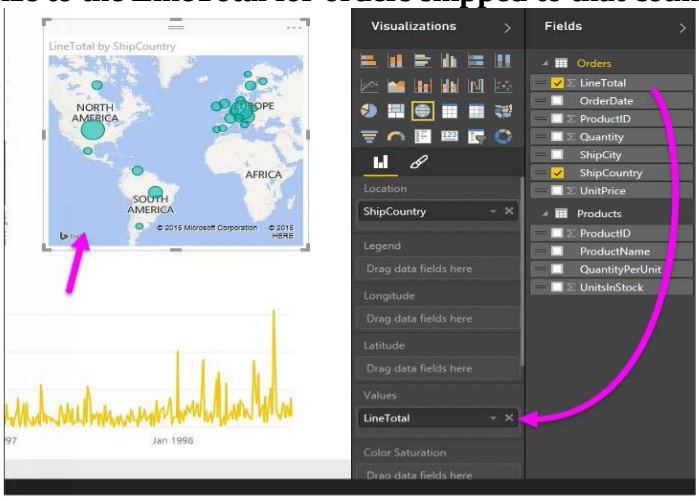


Task 4: Build visuals using your data

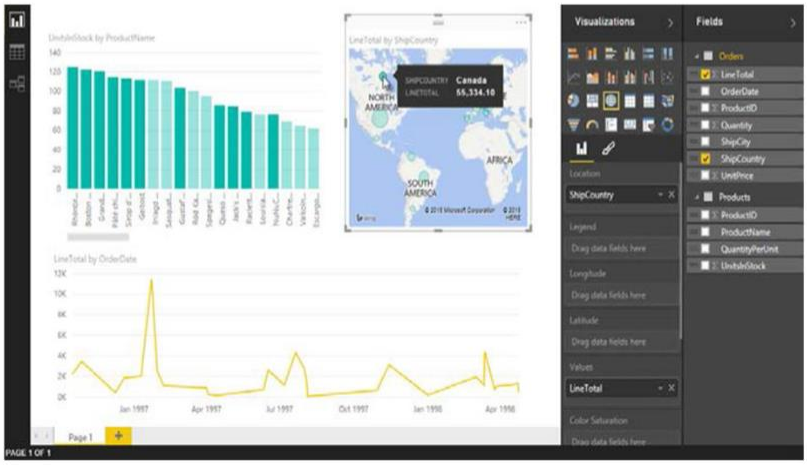
Step 1: Create charts showing Units in Stock by Product and Total Sales by Year



3. **Next, drag ShipCountry to a space on the canvas in the top right. Because you selected a geographic field, a map was created automatically. Now drag LineTotal to the Values field; the circles on the map for each country are now relative in size to the LineTotal for orders shipped to that country.**



Step 2: Interact with your report visuals to analyze further



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