# Question 1

a) Influence Diagram:

Return on Investment (ROI)

Turnover (T)

Earnings (E)

Sales (S)

Sales (S)

Cost of Sales (CS)

Sales (S)

Total Investment (TI)

Current Assets (CA)

Fixed Assets (FA)

Inventories (I)

Cash (C)

Variable Production Costs (VPC)

Accounts Receivables (AR)

Selling Expenses (SE)

Freight and Delivery (FD)

Administrative Costs (AC)

b) Symbols and mathematical model:

ROI = return on investment

T = turnover

E = earnings

S = sales

TI = total Investment

CA = current assets

FA = fixed assets

I = inventories

AR = accounts receivable

C = cash

CS = cost of sales

VPC = variable production costs

SE = selling expenses

FD = freight and delivery

AC = administrative costs

So, ROI = T \*(E/S)

Also, T = S/TI

Therefore, ROI = (S/TI) \* (E/S)

= E/TI ………. (i)

Again, TI = CA + FA

Also, CA = I + AR + C

So, TI = I + AR + C + FA …………. (ii)

Again, E = S - CS

Also, CS = VPC + SE + FD + AC

So, E = S – (VPC + SE + FD + AC) …………. (iii)

Finally, replacing E and TI in (i), ROI = (S – (VPC + SE + FD + AC)) / (I + AR + C + FA)

# Question 2

I selected the whole “Retirement Portfolio” dataset and added a pivot table on the same sheet. Then I selected “Type” as Rows and “Total Value” for Values for the pivot table.

Graphical user interface, application

Description automatically generatedThe number format of “Sum of Total Value” was changed to “Currency”.

Graphical user interface, application

Description automatically generated

Then I selected the whole pivot table and inserted a 2-D pie chart. I then added data labels with the below options selected from more options:

Graphical user interface, application

Description automatically generatedAnd finally, the graph looks like this:

# Question 3

Graphical user interface, diagram, application

Description automatically generatedFor this dataset, I went to insert tab and selected Line under Sparkline from the top ribbon.

Graphical user interface, text, application, email

Description automatically generatedThen I filled out the wizard as follows:

As a result of which I got the following:

Table

Description automatically generated

Graphical user interface, diagram

Description automatically generatedNext, I selected “Column” from Sparklines

Then I filled out the wizard as follows:

Graphical user interface, text, application, email

Description automatically generated

As a result of which I got the following:

Chart

Description automatically generated with medium confidence

After that I create a column named “Change” with this formula

=F5-F4

Table

Description automatically generated

And then I dragged that cell all across the column so that the formula gets applied to all the following cells. Below is the screenshot for the new column:

Table

Description automatically generated

Finally, I selected “Win/Loss” from the Sparklines and filled out the wizard for the new “Change” column.

Graphical user interface, application

Description automatically generated Graphical user interface, text, application, email

Description automatically generated

Below is the final output:

Chart

Description automatically generated

# Question 4

For this dataset, I selected the whole column G – “Unit Sold” and clicked “Conditional Formatting” from the “Home” ribbon. I went to “Icon Sets” on the drop down and selected “More Rules…”. Then I filled out the wizard as follows:

Graphical user interface, application

Description automatically generated

Below is a snippet of the final output:

Table

Description automatically generated

Thus, it is ascertained that the store where units sold tend to be less than 10 is reflected with “black” traffic icon, if the unit sold is at least ten however less than 20 then it is reflected in “red” icon. If the store is selling at least 20 units, however less than 30 units then it is reflected with “yellow” icon and the store that sells at least 30 units is reflected in “green” icon.

# Question 5

|  |  |  |  |
| --- | --- | --- | --- |
| **Inhouse** | | **Outsourced** | |
| Quantity | 1,500 | Quantity | 1,500 |
| Logistics Fixed cost | 6,000 | Unit cost | 17 |
| Unit cost | 15 |  |  |
| **Total cost of servicing** | 28500 | **Total cost of servicing** | 25500 |
| Formula | Logistics Fixed + (Unit cost \* Quantity) | Formula | Unit cost \* Quantity |
|  |  |  |  |
| **a) better decision:** | Outsource |  |  |
| As inhouse total cost of servicing is greater than outsourced total cost of servicing for given number of units. | | | |
| **b) Breakeven volume** |  |  |  |
| Difference in variable cost (unit cost) = | 2 |  |  |
| Fixed cost = | 6,000 |  |  |
| **Breakeven quantity =** | 3000 | (Fixed cost/ difference in variable cost) |  |

So, till 3,000 units outsourcing option will be a better option. After this limit, the firm should hire the team from logistics department.

# Question 6

For this problem, I calculated the minimum and maximum age using MIN() and MAX() functions. Then I used FLOOR() function to get the nearest multiple of 5 lower than minimum age and MROUND() function to get the nearest multiple of 5 greater than maximum age. Then I created a list of upper age limits for bins manually.

Application, table

Description automatically generated

Then I went to “Data Analysis” under “Data” tab from the top ribbon and selected ‘Histogram”. I selected the column for Age as input range, the list of “Upper Age Limit” as bin range, checked “Labels”, selected a random cell from the existing worksheet, and finally checked both “Cumulative Percentage” & “Chart Output” and hit “OK”.

Graphical user interface

Description automatically generated

Below is the output:

Chart, histogram

Description automatically generated

# Question 7

a) First, I created a list of Item Descriptions for which I want total quantity:

Graphical user interface, text, application, email

Description automatically generated

Then I used the following formula to get the sum of quantities for those items:

=SUMIF($D$4:$D$97,M5,$F$4:$F$97)

And I used the following formula to get the counts of order for those items:

=COUNTIF($D$4:$D$97,M5)

Here, column D has item descriptions, M5 holds the item description, which is our criteria for match, and column F has quantities per order.

And then I dragged the cell down so that the formula gets applied to following cells. Below is the result:

|  |  |  |
| --- | --- | --- |
| **Item Description** | **Total Quantity** | **Order count** |
| O-Ring | 16200 | 12 |
| Electrical Connector | 41925 | 8 |
| Shielded Cable/ft. | 224100 | 11 |

b) I used this formula to calculate total quantities of electrical connectors sold by Hulkey Fasteners:

=SUMIFS(F4:F97,D4:D97,N12,A4:A97,M12)

And I used below formula to get counts of separate orders:

=COUNTIFS(D4:D97,N12,A4:A97,M12)

Here,

column F has the quantities,

column D has the item descriptions,

N12 holds the value “Electrical Connector”,

Column A has the suppliers &

M12 holds the value “Hulkey Fasteners”

Below is the result:

|  |  |  |  |
| --- | --- | --- | --- |
| **Supplier** | **Item Description** | **Total Quantity** | **Order count** |
| Hulkey Fasteners | Electrical Connector | 22175 | 4 |

c) I Selected A3 cell, clicked on "Sort & Filter" and hit "Sort A to Z". This will sort the dataset according to supplier names. Then I selected A3:A97 and hit "Subtotal" on "Data" tab.

Graphical user interface, application

Description automatically generated

I hit 'OK' on the popup above and it will group the dataset by supplier names. Below is a snippet:

A screenshot of a computer

Description automatically generated with medium confidence

By clicking on ‘+’ on the left side pane, we can expand each supplier group and see separate purchase orders.

# Question 8

a) I used MIN() and MAX function on “Purchase Cost” & “Selling Price” columns to get the smallest and largest amounts. Below is the result:

|  |  |
| --- | --- |
| Smallest purchase cost | $15.00 |
| Largest purchase cost | $490.50 |
| Smallest selling price | $25.50 |
| Largest selling price | $649.95 |

b) I used the below function to count unique suppliers in this dataset:

=SUM(1/COUNTIF(F4:F27, F4:F27))

Alternate function: =COUNTA(UNIQUE(F4:F27))

Here, column F has the supplier names. Below is the result:

|  |  |
| --- | --- |
| Unique suppliers count | 5 |

c) First, I copied ‘Supplier’ column over to a blank sheet and got unique values by selecting “Remove Duplicates” from “Data” tab. Then I copied the unique values over to my current sheet and pasted from K11 cell.

I used the below formula to get total quantities by suppliers:

=SUMIF($F$4:$F$27,K12,$G$4:$G$27)

And I used the below formula to get the total order counts by supplier:

=COUNTIF($F$4:$F$27,K12)

Here, column F has supplier names, K12 will hold the supplier name for match, column G has quantities on hand. I dragged the formulas down so that they would be applied to following cells. Below is the result:

|  |  |  |
| --- | --- | --- |
| **Supplier** | **Total Quantity** | **Order Count** |
| Simpson's Bike Supply | 20 | 6 |
| The Bike Path | 13 | 4 |
| Bicyclist's Choice | 23 | 4 |
| Bike-One | 17 | 4 |
| Run-Up Bikes | 33 | 6 |

d) I used the below formula to get unique product counts for “Children” category:

=SUM(--(LEN(UNIQUE(FILTER(C4:C27,B4:B27=K20,"")))>0))

Here, column C has all product names, column B has all product categories, K20 holds the values “Children” for matching against column B.  
At the core, this formula uses the FILTER function to apply criteria, and the UNIQUE function to extract the unique values that remain. Working from the inside out, the FILTER function is used to apply criteria and extract only names that are associated with the " Children " category.

The if\_empty argument in FILTER is set to an empty string (""), which is important due to the way we count final results. Next, the UNIQUE function is used to remove duplicates. At this point, we have a unique list of names associated with Omega, and we just need to count them. The LEN function gets the length of each item in the list and returns an array of lengths. Next, we check if lengths are greater than zero and use a double negative to coerce the TRUE and FALSE values to 1s and 0s. Finally, we add up the results with the SUM function.

Alternative formula:

=COUNTA(UNIQUE(FILTER(C4:C27,B4:B27=K20)))

Here, column C has product names, column B has product category, K20 holds the value ‘Children’.

Below is the result:

|  |  |
| --- | --- |
| **Product Category** | **Count of Unique Products** |
| Children | 4 |

e) I used the following formula to filter out the list of suppliers that sells Hybrid products for more than $200:

=FILTER(F4:F27,(B4:B27="Hybrid")\*(E4:E27>200))

Here, column F has supplier names, column B has product categories, column E has selling prices.

Below is the result:

|  |
| --- |
| **Supplier** |
| Bike-One |
| Run-Up Bikes |
| Simpson's Bike Supply |

# Question 9

For this problem I used to VLOOKUP formulas to get item descriptions and cost per order for those 3 order numbers:

=VLOOKUP(L4,$B$3:$G$97,3,FALSE)

=VLOOKUP(L4,$B$3:$G$97,6,FALSE)

Here, L4 is the lookup value which holds order number, column B through G was selected as table array, this way column 3 will be item description and column 6 will be cost per order. I used exact matching for both VLOOKUPs.

Below is the result:

|  |  |  |
| --- | --- | --- |
| **Order number** | **Item Description** | **Cost per order** |
| Aug11008 | Pressure Gauge | 9000 |
| Sep11023 | Gasket | 7425 |
| Oct11020 | Airframe fasteners | 72250 |

# Question 10

a) I selected “Descriptive analysis” from “Data Analysis” under “Data” tab and filled out the wizard as follows:

Graphical user interface, application

Description automatically generated

After hitting “OK” I got the following report:

|  |  |
| --- | --- |
| *Times (sec.)* | |
|  |  |
| Mean | 126.2783251 |
| Standard Error | 3.691220698 |
| Median | 88 |
| Mode | 83 |
| Standard Deviation | 105.1835991 |
| Sample Variance | 11063.58952 |
| Kurtosis | 8.70752635 |
| Skewness | 2.413577454 |
| Range | 867 |
| Minimum | 9 |
| Maximum | 876 |
| Sum | 102538 |
| Count | 812 |

b) I used the following formula to get the 90th percentile:

=PERCENTILE.INC(A4:A815,0.9)

Here, column A has the Service Times at an Airport Ticketing Counter. Below is the result:

|  |  |
| --- | --- |
| 90th percentile | 260.9 |
|  |  |

c) The company can use these results by informing customers that they can expect their service to take up to ~261 seconds. Most of the service times will be much less than 261 seconds since the times are very positively skewed.

# Question 11

a) I divided results of sum function on a column by the result of count function on the same column to get the mean:

=SUM(A4:A45)/COUNT(A4:A45)

Here column A has the variable I want to get average on. I dragged the formula towards right to get mean of the other variables as well. Below is the result:

|  |  |  |
| --- | --- | --- |
| **House Age Mean** | **Square Feet Mean** | **Market Value Mean** |
| 29.83333333 | 1695.261905 | 92069.04762 |

Using AVERAGE() functions for mean, the results are as follows:

|  |  |  |
| --- | --- | --- |
| **House Age Mean** | **Square Feet Mean** | **Market Value Mean** |
| 29.83333333 | 1695.261905 | 92069.04762 |

Then I calculated the difference of observations from mean for all 3 variables. After that I got square values of all the differences. After that I used the following formula to get variance:

=SUM(I4:I45)/(COUNT(I4:I45)-1)

As, Variance = sum((x-mean) ^2)/n-1 where n= sample size

Here, column I would have the squared differences of observations from mean. I dragged the formula towards right to get variances of other variables as well. I used the following formula to get the standard deviations:

=SQRT(I49)

As, standard deviation is square root of variance.

Here, I49 will hold the variance of a particular variable. I dragged the formula towards right to get variances of other standard deviation as well. Below is the result:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **House Age** | **Square Feet** | **Market Value** |
| **Variance** | 5.898373984 | 48513.02729 | 111367555.2 |
| **Standard Deviation** | 2.428656827 | 220.2567304 | 10553.08273 |

Using VAR.S() for variances & STDDEV.S() for standard deviation, the results are as follows:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **House Age** | **Square Feet** | **Market Value** |
| **Variance** | 5.898373984 | 48513.02729 | 111367555.2 |
| **Standard Deviation** | 2.428656827 | 220.2567304 | 10553.08273 |

So, the numbers match between manual calculations and functions.

b) I divided the standard deviation by mean for every variable to get the coefficient of variation. Below is the output:

|  |  |  |  |
| --- | --- | --- | --- |
|  | **House Age** | **Square Feet** | **Market Value** |
| **Coefficient of variation** | 0.081407491 | 0.129924898 | 0.114621396 |

Comparing the coefficients of variation, it is evident that House Age has the least relative dispersion. Square Feet has the greatest relative dispersion.

# Question 12

Here,

|  |  |
| --- | --- |
| **Specialization** | **Count** |
| Finance | 67 |
| Marketing | 45 |
| Operation And Supply Chain Management | 51 |
| Information System | 18 |

So total number of occurrence/ outcomes = 67 + 45+ 51 + 18 = 181

So, the probability that a student is from either finance or marketing is = (67 + 45)/181

= 112/181

= 0.61878

For event to be mutual exclusive it is assumed that student cannot have multiple specialization. Since no information is given so, it can be assumed that no student has multiple specialization, to make the event mutual exclusive event.

# Question 13

An allergist wishes to test the hypothesis that at least 30% of the public is allergic to some cheese products.

So, null hypothesis would be less than 30% of the public is allergic to some cheese products,

H0: p < 0.30

And alternative hypothesis would be H1: p >= 0.30

a) The allergist can commit type 1 error if he rejects H0 even though H0 is true or p < 0.30 (less than 30% of the public is allergic to some cheese products).

b) The allergist can commit type 2 error if he accepts H0 even though H1 is true or p >= 0.30 (at least 30% of the public is allergic to some cheese products).