<u>Effect of some common operations on the dispersion of a data set</u>

To create a dynamic worksheet for students to explore the effect of the following two operations on the dispersion of a data set:

> (1) Adding a common constant to each item of the set of data; and
>
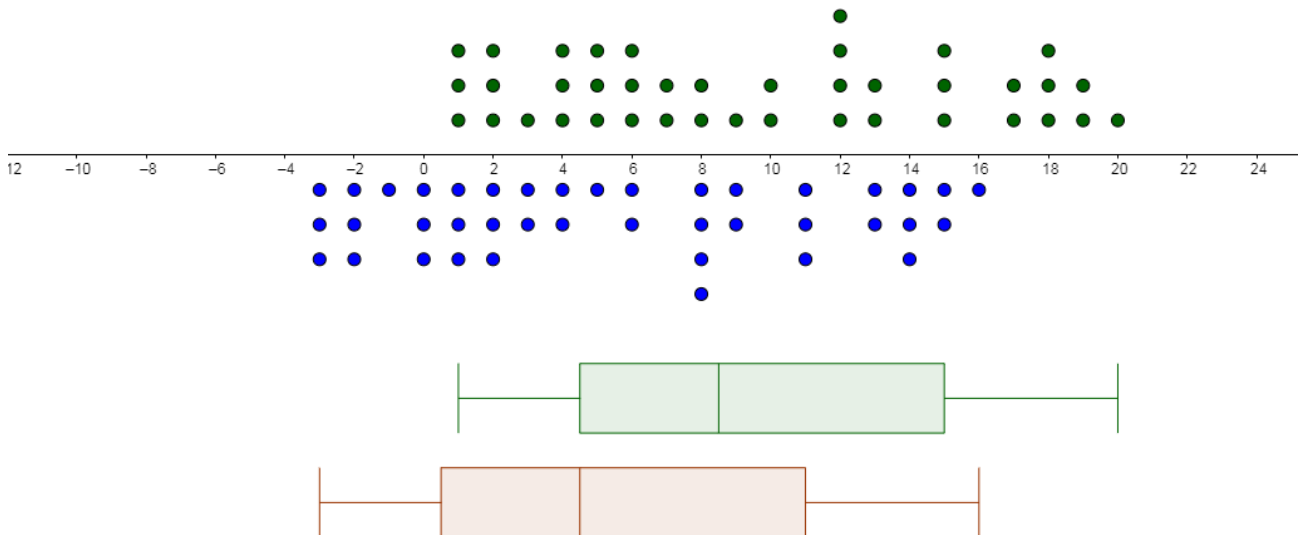> (2) Multiplying each item of the set of data by a common constant.

Create objects on the Spreadsheet window and graphic window as follows:

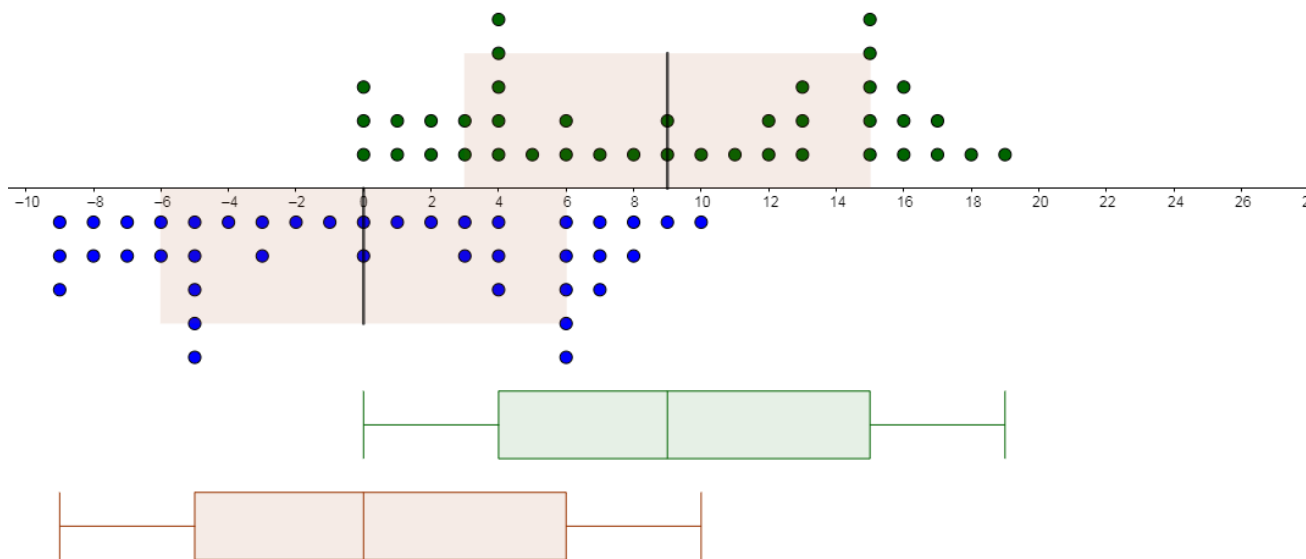| Steps	Objects to be created	Action
1.	A set of randomly generated data	◆ Select "Spreadsheet" in "View" menu over the tool bar ◆ In a cell of the spreadsheet, e.g. cell A1, type "=randombetween(0,20)" and copy this cell to 10 cells vertically (e.g. A1 to A40)
2.	The measures of dispersion and the graphs of representation of the data	◆ In a cell below the data set, say A42, type "=SD[A1:A40]" to calculate the standard deviation of the data set ◆ In another cell, say A43, type "=Q3[A1:A40] - Q1[A1:A40]" to calculate the interquartile range of the data set ◆ In another cell, say A44, type "=DotPlot[A1:A40,false,1]" to output the dot plot of the data set ◆ In another cell, say A45, type "=BoxPlot[-7, 1, A1:A10]" to output the box-and-whisker diagram of the data set

Steps	Objects to be created	Action
3.	The new data sets and the measures of dispersion under the operations	◆ Create a slider in the graphic window and rename it as p, setting its interval from -15 to 15 ◆ Create another slider and rename it as q, setting its interval from 0 to 5 ◆ In cell B1, type "=A1+p" ◆ In cell C1, type "=A1*q" ◆ Copy B1 and C1 to cells from B1 to B40 and C1 to C40 ◆ Copy cells between A42 and A45 to respective cells in column B and column C ◆ In cells B44 and C44, change the last parameter in the bracket of the function DotPlot to –1. i.e. "DotPlot[B1:B40,false,-1]", "DotPlot[C1:C40,false,-1]" ◆ In cells B45 and C45, change the first parameter in the bracket of the function BoxPlot to –10. i.e. "=BoxPlot[-10, 4, B1:B40]", "=BoxPlot[-10, 4, C1:C40]"
4.	Check boxes to show/hide individual effects	◆ Create text boxes to show the measures of dispersion on each set of the data ◆ Create check boxes "a" and "b" to show/hide the information of the two data sets of column B and C with toggle. ◆ Right Click checkbox a, in "Settings", go to "On Update" menu ◆ Type "If(a==true,SetValue(b,false))" and press OK ◆ Right Click checkbox b, in "Settings", go to "On Update" menu ◆ Type "If(b==true,SetValue(a,false))" and press OK
5.	Button to refresh the data set	◆ Select ⬜OK "Button" and type "Update data set" ◆ In "Object Properties", go to "On click" under "Scripting" menu ◆ Type "UpdateConstruction[]" and press OK

Extension

Show data set x is by 1 times (data set z)

Show data set x is added with -9 (data set y) $\sigma_x = 6.02, \sigma_y = 6.02, \text{Inter} - \text{QuartileRange} = 11$ [Update data set x]

Show $\bar{x} \pm \sigma_x$ and $\bar{y} \pm \sigma_y$ or $\bar{x} \pm \sigma_x$ and $\bar{z} \pm \sigma_z$ $\bar{x} = 9$ $\bar{y} = 0$

1. Add region of $\bar{x} \pm \sigma_x$, $\bar{y} \pm \sigma_y$ and $\bar{z} \pm \sigma_z$

Steps	Objects to be created	Action
1.	Checkbox and text of "$\bar{x} \pm \sigma_x$, $\bar{y} \pm \sigma_y$ and $\bar{z} \pm \sigma_z$",	◆ Create a Checkbox "c" with no Caption ◆ Create a Text Object [ABC] ◆ In "Settings" of the Text Object, go to "Text" and select "LaTex formula" and enter "\text{Show }\bar{x}±\sigma{_x}\text{ and } \bar{y}±\sigma{_y}\text{ or }\bar{x}±\sigma{_x} \text{and } \bar{z}±\sigma{_z}" ◆ Change Text Object showing "Standard Deviation and IQR" with $\sigma_x = 6.02, \sigma_y = 6.02, \text{Inter} - \text{QuartileRange} = 11$ by going to "Settings", "Text" then select "LaTex formula" and enter \sigma{_x}= [A42] ,\sigma{_y}= [B42] , Inter-Quartile Range= [B43] ◆ Change similar cases as well.
2.	Mean and Polygon showing the area of "$\bar{x} \pm \sigma_x$, $\bar{y} \pm \sigma_y$ and	◆ Select "Algebra" View ◆ Type "barx = mean(A1:A40) to create mean for data set x.

Steps	Objects to be created	Action
	$\bar{z} \pm \sigma_z$"	• Create 4 points A, B, C, D by typing "A=(barx - A42,0)", "B=(barx + A42,0)", "C=(barx - A42,4)"and "D=(barx + A42,4)" • Select "Polygon" tool and points A,B, C and D. • Hide A, B, C, D and segments created by "Polygon" tool. • Repeat with Data Set y and z. (e.g. create bary, barz, H,I,J,K and P,Q,R,S. Show $\bar{x}$, $\bar{y}$ and $\bar{z}$" • Create Text Objects with "LaTex Formula" e.g. \bar{x}= barx • Set Show/Hide condition accordingly
3.	Hide/Show polygons upon selection	• Select the polygon of $\bar{x} \pm \sigma_x$, in "Settings", go to "Advanced" in "Condition to Show Object", type "c" • Select the polygon of $\bar{y} \pm \sigma_y$, in "Settings", go to "Advanced" in "Condition to Show Object", type "a && c" • Select the Polygon of $\bar{z} \pm \sigma_z$, in "Settings", go to "Advanced" in "Condition to Show Object", type "b && c"

2. Show segment of $\bar{x}$, $\bar{y}$ and $\bar{z}$

Steps	Objects to be created	Action
1.	Segment of "$\bar{x}$, $\bar{y}$ and $\bar{z}$"	• Select "Algebra" View • Type "segment((barx,0),(barx,4))", "segment((bary0),(bary,-4))","segment((barz,0),(barz,4))"
2.	Hide/Show polygons upon selection	• Select segment of $\bar{x}$, $\bar{y}$ and $\bar{z}$ and set appropriate "Condition to Show Object" under "Advanced" in respective "Settings". • e.g. Select segment of $\bar{y}$, in "Settings", go to "Advanced" in "Condition to Show Object", type "a && c"