Hurricane force   Student Notes

Introduction   Weather station information

The London Grid for Learning Networked Weather Station http://weather.lgfl.org.uk/ displays live weather data updated every minute from a number of weather stations in England and Wales. The default view shows a number of dials to read and interpret.

Information given on the weather station

Temperature in degrees Celsius and wind chill temperature

Barometric pressure in hectoPascals (equivalent to millibars)
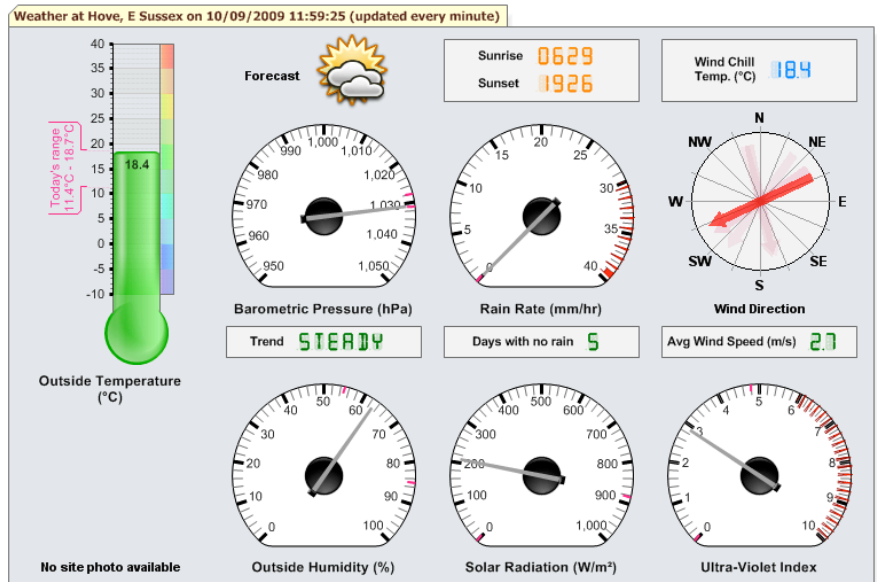
Rain rate in mm/hr

Days with no rain

Wind direction and average speed in metres per second

Outside **humidity** as a percentage

Solar radiation in Watts per square metre

Ultra violet index on a scale from 1 - 10

Wind speed activity using TI-Nspire

What do you know about wind speed?

The figures on the LGFL weather station are given in metres per second but sailors often use knots, what other units might be used? How are they usually given on weather forecasts? What about shipping forecasts? Which would mean the most to you? Would you recognise if it was going to be particularly windy?

How would you describe wind speeds to someone else so that they understood what the weather was going to be like? Which units would you use? How is it given on television forecasts?   Sometimes wind speeds could be in miles per hour, kilometres per hour, knots (nautical miles per hour) and also using the Beaufort scale (Force 1 to 12) or higher for hurricanes using the Torro scale.

The task

Your task is to set up TI-Nspire so that a weather forecaster could use it to quickly convert the wind speeds here in m/s into other units including the Beaufort scale?

You could use Spreadsheets and formulae, conversion graphs or conversion algorithms.

There is a weather data facts and figures sheet which gives you more information about the different units that can be used.

What instructions would you give to the weather forecasters so that they could use the TI-Nspire?

Getting started

1. Entering data into a spreadsheet

Wind speeds from a variety of locations could be entered into the first column of a 'Lists & Spreadsheet' page and then further columns set up to convert these into different units.

The example below has taken values for wind speeds in metres per second from the Beaufort scale. For example **Force 5** on the Beaufort scale (described as *fresh breeze*) varies **between 8.0 and 10.7 metres per second**. 8.0 is the lower speed in mps entered into column B and 10.7 is in column C
More information at http://www.metoffice.gov.uk/weather/marine/guide/beaufortscale.html

A beaufortscale	B lowermps	C uppermps	D terms
0	0	0.2	calm
1	0.3	1.5	lightair
2	1.6	3.3	lightbreeze
3	3.4	5.4	gentlebreeze
4	5.5	7.9	moderatebreeze
5	8.0	10.7	freshbreeze
6	10.8	13.8	strongbreeze
7	13.9	17.1	neargale
8	17.2	20.7	gale
9	20.8	24.4	severegale
10	24.5	28.4	storm
11	28.5	32.6	violentstorm
12	32.7		

(Note that TiNspire will only accept single words in spreadsheet cells. Hence violentstorm!)

2. Converting the wind speed data into other units

Could you set up a table or charts that others could use to convert this information into other units for example change metres per second into km per hour?
These are some possibilities:-

1. **You could insert a calculator page** and try out a calculation for one of the speeds shown in the table. Does the answer seem reasonable? Can you find an alternative method that you could use to check? Can you express this as a general rule?
2. **You could set up extra columns on the spreadsheet and put formulas into each column**. There are instructions for doing this in the introduction to this booklet. There is also an example for this below.
3. **You could set up conversion graphs to change from one unit to another**, or to convert a speed to the Beaufort scale. There are two examples for this below. One uses a '**Data & Statistics** 'page to obtain a graph and the other uses a '**Graphs**' page for the graph.

2.1 Conversion formulas Using a Lists & Spreadsheet page

> Open the tns file or set up one of your own by entering data into a 'Lists & Spreadsheet' page like the one shown earlier.
> Add names in the white cells at the top of extra columns for converting the data –such as
> > Kmperhr
> > Mph
> > Knots
> Enter a formula in the grey formula cell below the column title for example to convert the figures in column b to kilometres per hour you could type in **b[]*3600/100** Why does this work? Could it be written in a simpler way?
> What other columns and formulas could you add?

| A beaufortscale	B lowermps	C uppermps	D terms	E kmperhr
				=b[]*3600/1000
1	0	0	0.2	calm	0
2	1	0.3	1.5	lightair	1.1
3	2	1.6	3.3	lightbreeze	5.8
4	3	3.4	5.4	gentlebreeze	12.2
5	4	5.5	7.9	moderatebreeze	19.8
6	5	8.0	10.7	freshbreeze	28.8
7	6	10.8	13.8	strongbreeze	38.9
8	7	13.9	17.1	neargale	50.0
9	8	17.2	20.7	gale	61.9
10	9	20.8	24.4	severegale	74.9
11	10	24.5	28.4	storm	88.2
12	11	28.5	32.6	violentstorm	102.6
13	12	32.7			117.7
14					
15					
16					

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Type square brackets [] to indicate a column.

2,2   Conversion graphs – Beaufort scale   **Using a Data & Statistics page.**

One way to convert speeds to the Beaufort Scale is to use the data in the table.

➢ From the menu ('Insert' for software) select '5: Data & Statistics'

➢ Move to the x-axis, select 'enter variable' and choose Beaufortscale.

➢ Move to the y-axis and choose 'lowermps' then select ctrl menu (right click for software) and 'add y variable'. Then select 'uppermps'

➢ To convert a particular speed say 29mps to the scale select menu 4 and 'plot function' enter f(x) = 29. This is Force 11 on the Beaufort scale. How can you tell from the graph?

➢ If you have more columns on your table you could do this for other units.
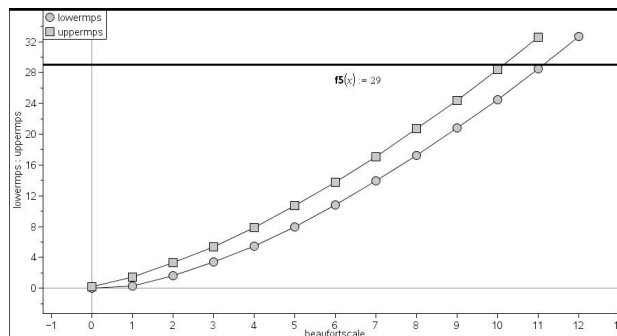
The data in the table could also be used to set up conversion graphs for other pairs of units, but if formulas have been used in the table then these could be used as functions in a 'Graphs page'.

2.3   Conversion graphs – Graphs of functions   **Using a Graphs page**

➢ Insert a 'Graphs ' page from the home screen on the handheld or 'Insert' on the software.

➢ From menu4 select 'window settings': Then set the window to the required size depending on the units to be converted. Use the arrow keys to move down the settings table. The example below is for converting from km per hour to knots.

➢ From menu1 select '6: Text' and label the x-axis as the value that you know and the y-axis as the value you want to find out.

➢ Next enter the formula you have worked out to convert from x to y. Your formula should contain an 'x'. In this case from km per hour(x) to knots(y). One possible formula for y would be y = $f(x) = x/1.86$ Why? Can you find other ways? Is this formula accurate enough?

➢ To use the conversion graph: from menu 5 select '2: point on', move to the graph line and put a point on the graph. Then using the hand tool (for software- select the pointer from menu 1), grab the point and drag it to an appropriate point on the graph to read off the figures. In the example shown 60 km per hour is approximately 32.3 knots.
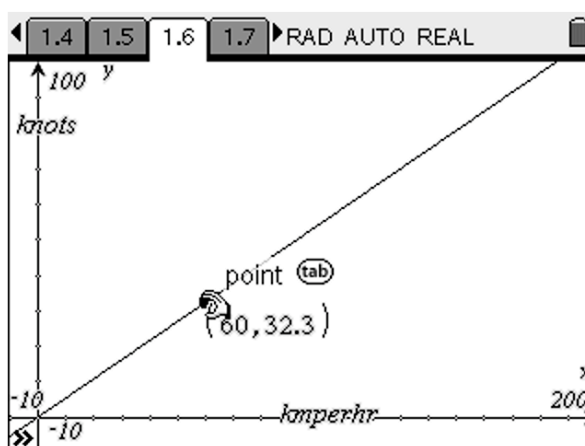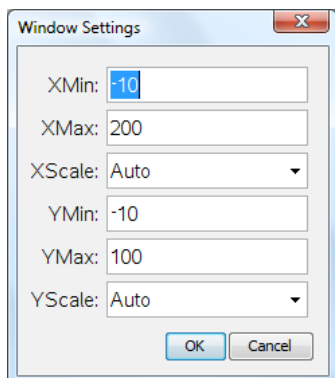
Extension activity   Hurricanes, tornadoes and fitting functions

You can find out more about the Beaufort scale at http://en.wikipedia.org/wiki/Beaufort_scale
The foot of this web page has links to hurricane scales such as the Saffir-Simpson hurricane scale and the Torro scale for classifying tornado wind speeds. These scales could be used to extend the Beaufort scale to higher numbers.

The task

If you use a 'Data & Statistics' page to plot the mean speeds (average of the lower and upper speeds) in metres per second for each point on the Beaufort scale, can you find a function that will fit this data?
Some possibilities are:-

➢ use the plot function option on menu 4 to try to find a function that will fit the Beaufort scale data.
➢ use one of the regression options to find a suitable function.
➢

The page on the Torro scale may give you some ideas to check out. You could try this for different units.