Harmonics Example

FILE: XYScat2.cln

Introduction

This is a novel example of using dynamic input devices together with the XY Scatter Graph. It displays the wave form for 1 cycle of the primary wave, given the amplitude of it and ten of its harmonics.

When you open this file, select Scale to Fit on the Scale dialogue and switch on Automatic recalculation.

The amplitude of each harmonic is provided by Tumbler Objects.

The calculation is performed by a Computer Object (although you can design a similar sheet using tables and a simple Calculator object).

The finished graph is displayed on an XY Scatter Graph object.

The Computer Program

The program inside the Computer Object needs a little explaining but is not complex. Click on each line to have it explained.

```
main{
    result:={a,b,c,d,e,f,g,h,i,j,k};
    if (l_wave=null) {
          harmonics:={1,2,3,4,5,6,1.5,2.5,3.5,4.5,5.5};
          for (i:=0@; i<11@; i+=1@;) {
                for (x:=0@; x<100@; x+=1@;) {
                      l_wave[i][x] := sin(x/50*pi*harmonics[i]);
                };
          };
          l_xs:=ariseries{100,0,10};
    };
    wave:=null;
    for (i:=0; i<11; i+=1;) {
          wave+=result[i]*l_wave[i];
    };
    return {l_xs,wave};
}
```

This line assembles the inputs a to k into a single array. Doing this allows us to use a FOR loop to go through each harmonic in-tern.

This tests is the variable l_wave has been initialised yet, this variable is used to hold the wave forms for each of the harmonics, since it is faster to pre-calculate them like this than to calculate them each time the program is run.

Notice that this section of code will never execute on your computer. Because it is assigned to a variable beginning with the characters l_ , the variable will be saved with the sheet. This means that once it has run (on the development computer) and been saved, there is no need to recalculate these wave tables again - the waveforms are saved with the program.

See Variables and their Scope

This line initialises the variable harmonic to contain an array of the frequencies of each harmonic.

This line steps through the 11 harmonics.

This line steps along the X axis, for which the corresponding Y value is calculated.

This lines calculates the Y value for the harmonic and stores it in the l_wave variable. We are using l_wave as a two dimensional array, the columns are the 11 harmonics, the rows are the Y values for each of those harmonic waves.

Here we construct an array of x's 0 to 99, using the AriSeries function.

Assigns Null to the Wave variable, this is not strictly necessary since Wave is an automatic variable it has a Null value anyway, but it recommended as it makes the code easier to alter later.

This loop steps through the 11 harmonics

This line first scales the harmonics by the amplitude for that harmonic.

- result[i] contains the harmonics amplitude, for example it might contains 2.
- l_wave[i] contains is an array representing the wave form for the harmonic, for example it might contain {0,0.08,0.17,0.26....}
- result[i]*l_wave[i] multiplies each element of the l_wave array by the value result[i]
- The resulting array is added to the wave total (adding two 1 dimensional arrays together adds their corresponding values).

This line returns a two element array of l_xs - the array of x values, and wave - the resulting wave array. This is the form required by an XY Scatter graph.