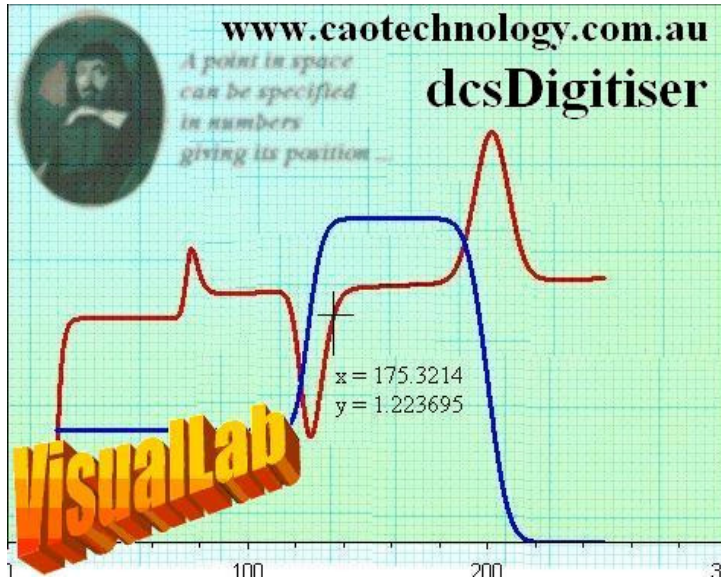


Smartest calculator — VisualLab



“VisualLab” is a format-free (syntax-free) math software that makes **computations of maths easier than ever!** Type your equations as in a notebook; **VisualLab** knows how to compute. No training is needed – it is visual. **Making one more able and more efficient.** VisualLab covers most math needs in science, engineering and statistics: e.g.

Matrices and linear eqns; Complex numbers;
Probability and Statistics; Equation solving;
Differentiation; Differential equations;
Equation plotting; Transcendental eqns;
Curve fitting; Curve digitization;
and more and more ...

Write eqns as in a notebook; VisualLab does all.

Format-free, syntax-free, VisualLab is smart.

VisualLab calculates simultaneous nonlinear eqns. VisualLab calculates linear eqns, sum of seq's.

These two figures show how to eqn computation, and how to show plots of the equations.

VisualLab - dcsDigitiser ... Points Generation by Equation and Editing

Eqns:

$$y = 0.15x^2 + 0.35x + 1$$

$$y = \sin(2\pi x + \delta) + 2 \cos(\pi / 2 x - \delta)$$

$$\delta = \pi / 6$$

$$y = 3 - x$$

1) Type eqns here

Range:

From x1 = $-\pi$ To x2 = π

No. of intervals: 300 Step increment: 1

Option for histogram: Column No.: No. of classes: 6

3) Numerical results are shown here

Pt No.	x =	y =	y =	y =
1	-3.141593	6.141593	1.380883	0.999497
2	-3.120649	6.120649	1.36854	1.076066
3	-3.099705	6.099705	1.356329	1.155236
4	-3.078761	6.078761	1.344249	1.234821
5	-3.057817	6.057817	1.332301	1.312604
6	-3.036873	6.036873	1.320484	1.386378
7	-3.015929	6.015929	1.308799	1.453987
8	-2.994985	5.994985	1.297246	1.513361
9	-2.974041	5.974041	1.285824	1.562553
10	-2.953097	5.953097	1.274533	1.599778
11	-2.932153	5.932153	1.263375	1.623438
12	-2.911209	5.911209	1.252348	1.632157
13	-2.890265	5.890265	1.241452	1.624802
14	-2.869321	5.869321	1.230688	1.600504
15	-2.848377	5.848377	1.220056	1.558677
16	-2.827433	5.827434	1.209555	1.499025
17	-2.806489	5.806489	1.199186	1.421553

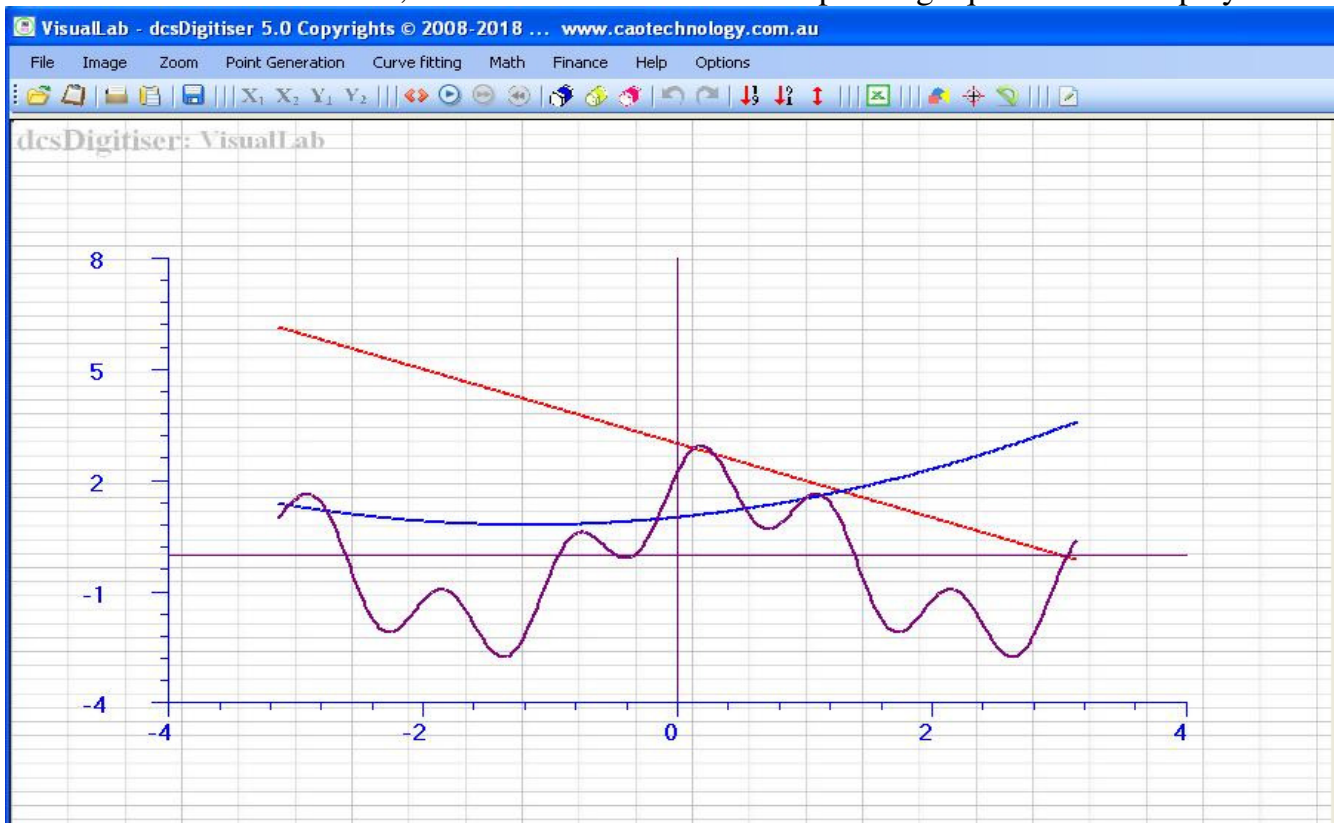
How to type your equations:

- In a form of $y = f(x)$, or $x = f(y)$, e.g:
 $y1 = \sin(2n \omega x + 1) + 3b \cos(2n \omega x + 2)$
 $y2 = 2x^2 + 3x - 3$
 $\omega = 2.5$
 $b = 2.13$
- $n = 3.14159265358979$ has been built in for this Point Generation application; no need for declaration.
- Up to 4 equations can be defined to obtain 4 curves.
- Pts no. will be used as x if there is only one column of data.
- To select data, hold and move left mouse button;
 Ctrl + C to copy selection to clipboard;
 Click btn 'Paste clipb'd'
 Click btn 'Delete sel'n'

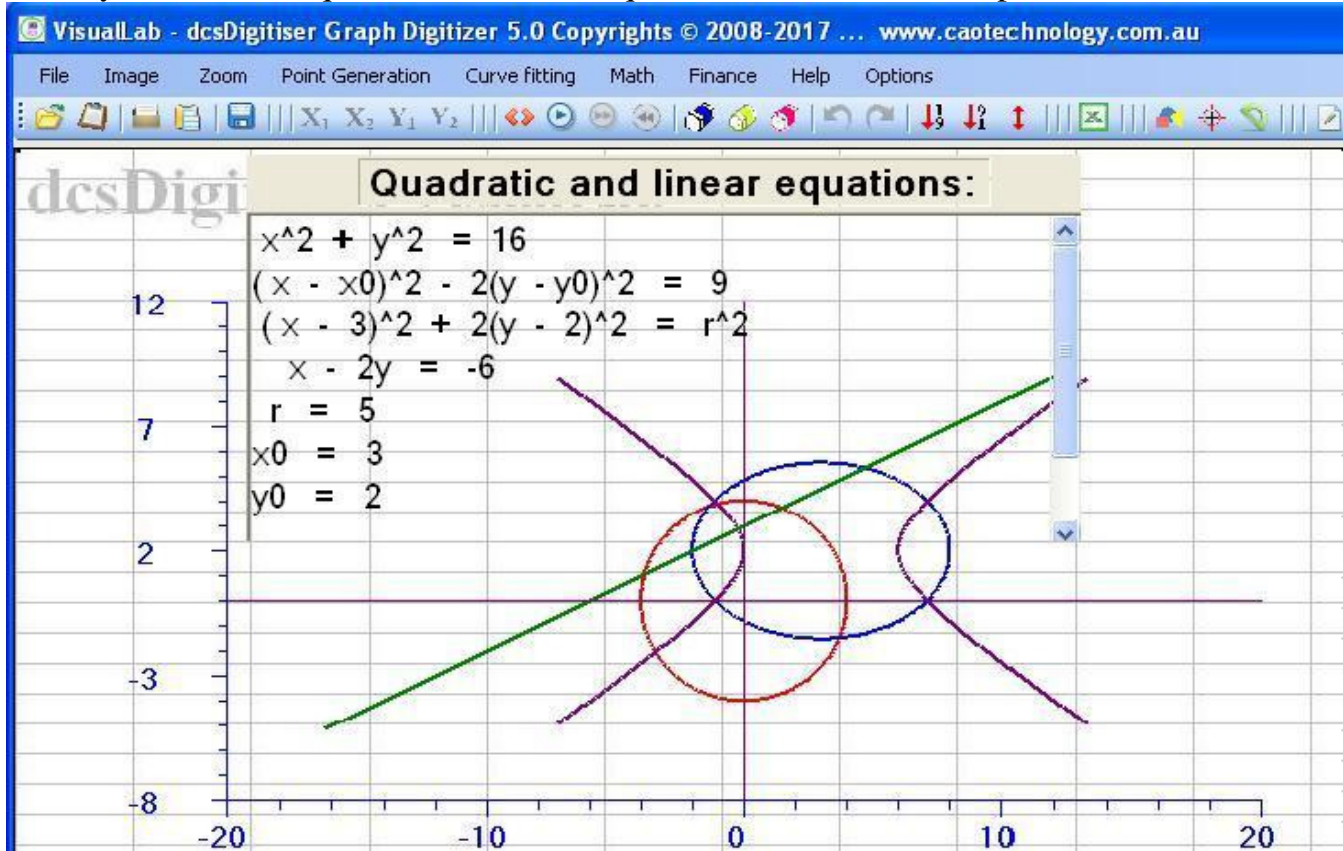
2) Click btn "Calculate" here

4) Click btn "Plot" to see graphs below

When btn "Plot" is clicked, three curves for three corresponding equations are displayed.



Freely write several quadratic and linear equations; a click to see the plots.



VisualLab makes matrix computations and solve linear equations, easy and straightforward.

VisualLab - dcsDigitiser ... Matrices and Linear equations

Save

Example

A =

1	1	1	3	3	3
1	4	1	2	5	2
1.2	1.1	1	2	3	3
1	2	4	3	2	4
3	2	4	1	6	1
1	2	3	5	2	1

B =

3	2	0.5	2	1	1
3	4	1	2	1	3
1	2	1	3	2	5
1	2	3	4	5	6
5	3	2	3	1	3
3	2	1	4	5	3

How to type your equation ?

Matrix operators: + - * ^ ^T ^-1 det()

Examples: C = B^T + 23.3 * B^4 * 3 A
C = A^-1
C = det(A + B)
C = 2 (A + B) + AB

Tips for equation formats:

A * B Number of columns of Matrix A and number of rows of Matrix B must be equal

A ^ n n - integer >= 1, except A^-1 for inverse matrices

Ax = B For linear equations to calculate x

Equation: **C = A^-1 * B + (A B)^3 * (A - B)**

Equation

Solution

C =

-159685	-470876	12011000	-2396120	6593290	-134231
-186896	-551107	140547	-2801010	7717190	-157039
-145754	-4297990	10962600	-2186570	601840	-122508
-20510700	-604791	154284	-307819	846726	-172437
-19532200	-5758740	14687500	-292482	806079	-164108
-184254	-5432730	13859600	-276452	7604820	-15490500

Calculation

Clear answer

Exit

VisualLab - dcsDigitiser ... Matrices and Linear equations

A =

1	1	1	3	3	3
1	4	1	2	5	2
1.2	1.1	1	2	3	3
1	2	4	3	2	4
3	2	4	1	6	1
1	2	3	5	2	1

B =

3	2	0.5	2	1	1
3	4	1	2	1	3
1	2	1	3	2	5
1	2	3	4	5	6
5	3	2	3	1	3
3	2	1	4	5	3

How to type your equation ?

Matrix operators: + - * ^ ^T ^-1 det()

Examples: C = B^T + 23.3 * B^4 * 3 A
C = A^-1
C = det(A + B)
C = 2 (A + B) + AB

Equation: **Ax = B**

Linear equation

Answer

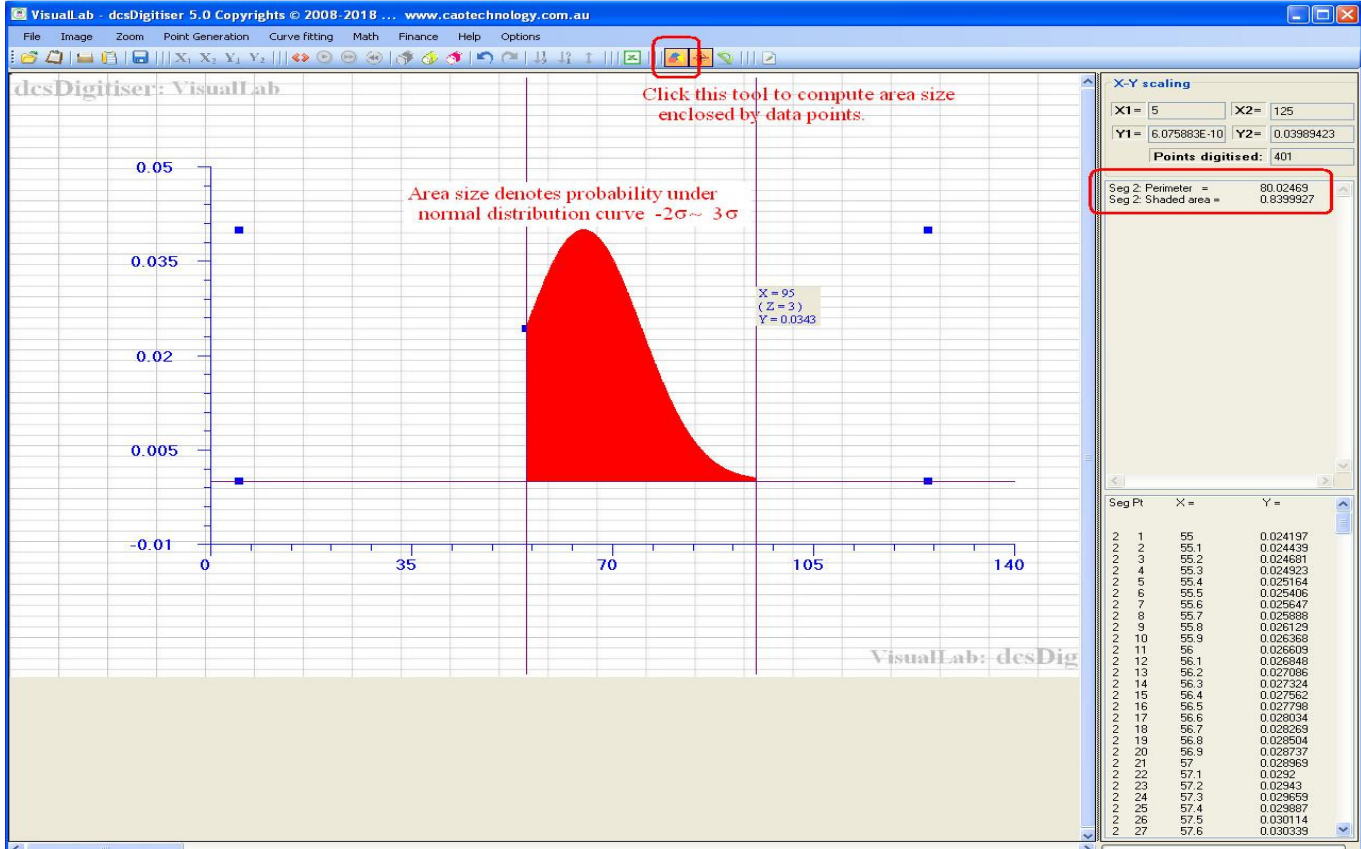
x =

-6.05762
-2.54054
1.68485
0.534421
3.64202
-0.872004

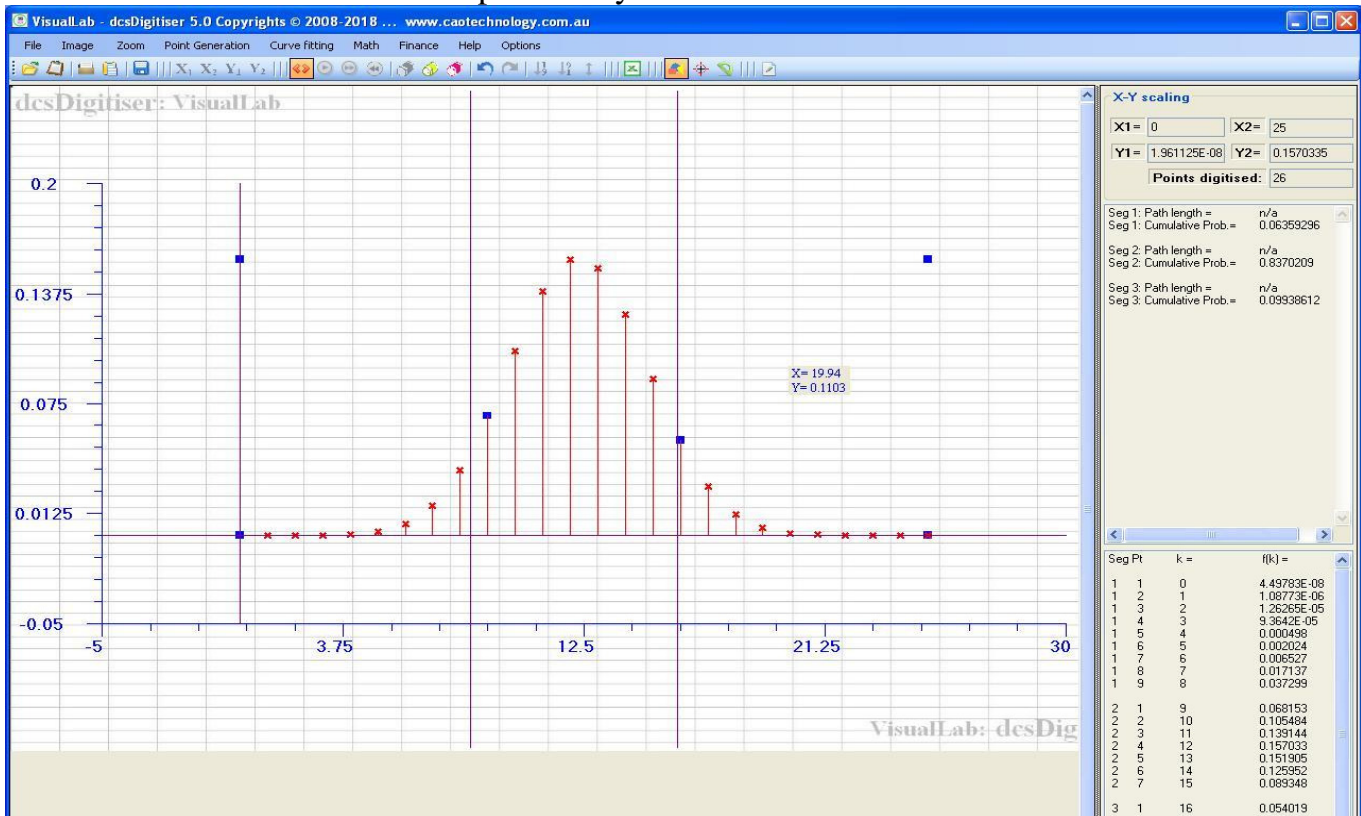
C =

(answer)

VisualLab integrates area size to compute probability value for the Gaussian distribution curve.



VisualLab calculate cumulative probability value for a binominal distribution model.



An example how VisualLab solves a second order ordinary differential equation.

VisualLab - dcsDigitiser ... Ordinary Differential Equation Solver

Differential eqns:

$$m \frac{d^2x}{dt^2} + k \frac{dx}{dt} + c x = t \sin(2t)$$

$m = 2$
 $k = 0.1$
 $c = 3$

Initial values:

$$x(0) = 1$$

$$\frac{dx}{dt}(0) = 0$$

Time span: 20

Delta increment:
☒ Coarse (fast)
☐ Medium
☐ Fine (slow)

How to type your equations:

- In a form of $\frac{dy}{dx} = f(x, y)$; $\frac{dz}{dt} = f(t, z)$; $\frac{d^2y}{dt^2} = f(t, y, \frac{dy}{dt})$ etc. e.g.
 $\frac{d^2y}{dx^2} = \frac{dy}{dx} + 2y + x^2 + \sin(3x)$
 $\frac{dz}{dt} = a \sin(2\pi t)$
- Initial value is given in
- For ODEs with third or to first or second order ODEs, e.g.
 $\frac{d^2y}{dt^2} = a * (\frac{dy}{dt})^2 - g$
 $\frac{d^2z}{dt^2} = a * z^2 - g$
 $\frac{dy}{dt} = z$
- Variables are case sensitive, e.g. $b \neq B$, $z1 \neq Z1$;
- Computational instability may occur if the span is too large. Narrow the span if necessary.

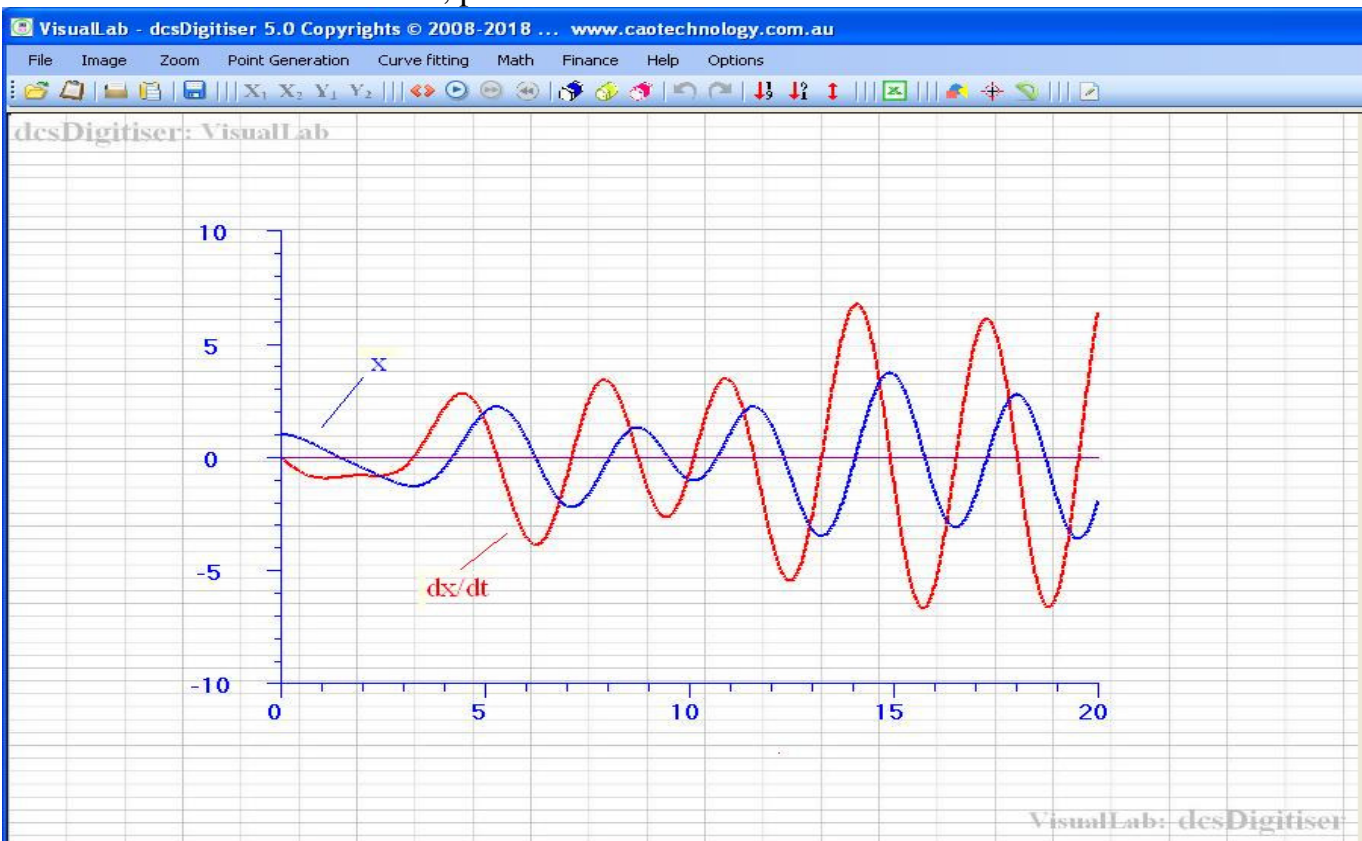
3) Analytical and numerical solutions are shown here.

2) Click "Solve" btn

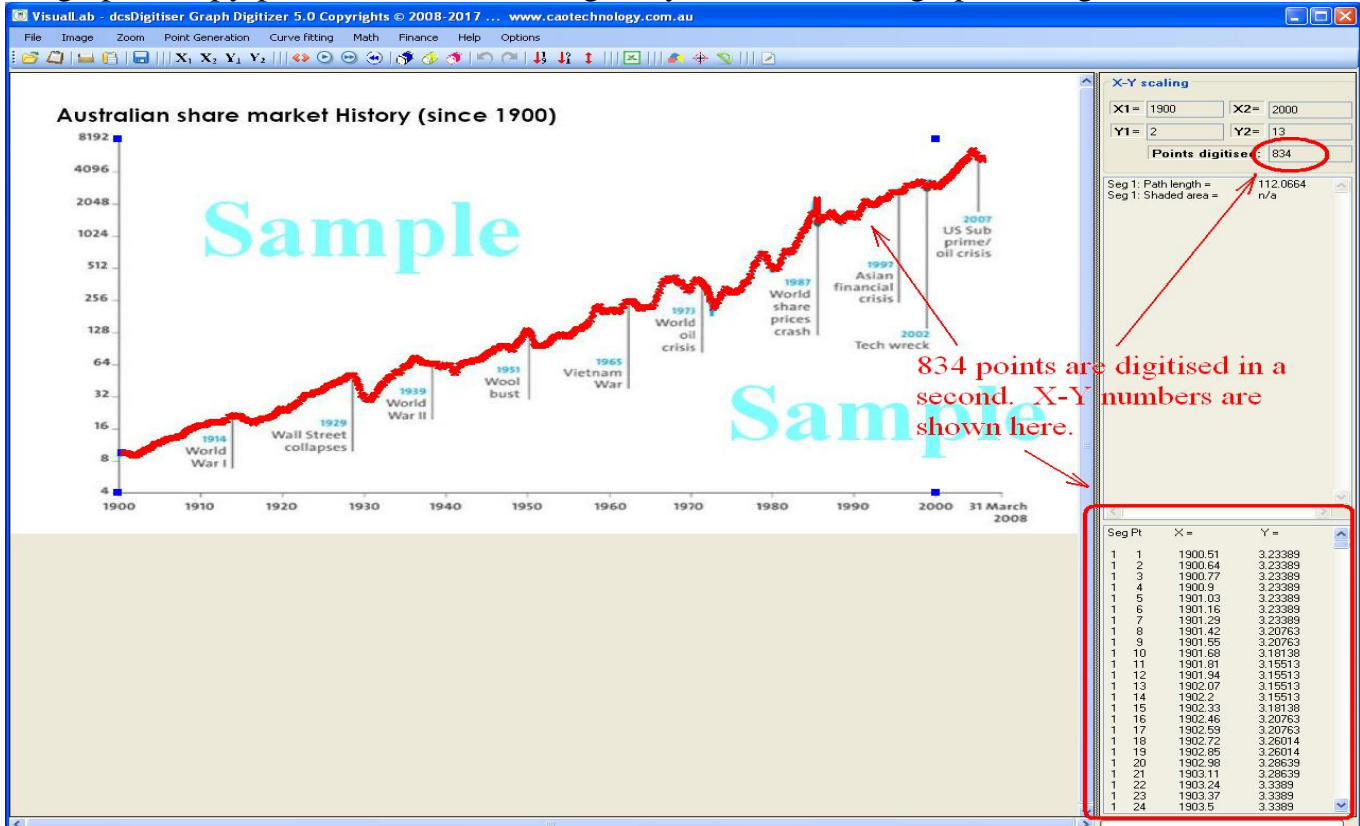
4) Click "Plot" btn to see the plots.

Pt No.	t =	dx/dt =	x =
1	0	0	1
2	0.02	-0.02998234	0.9994003
3	0.04	-0.05990075	0.9982023
4	0.06	-0.08972143	0.9964079
5	0.08	-0.1194108	0.9940196
6	0.1	-0.1489354	0.9910409
7	0.12	-0.1782623	0.9874756
8	0.14	-0.2073589	0.9833285
9	0.16	-0.2361931	0.9786046
10	0.18	-0.2647333	0.9733099
11	0.2	-0.2929484	0.9674509
12	0.22	-0.3208082	0.9610348
13	0.24	-0.3482831	0.9540691
14	0.26	-0.3753442	0.9465622
15	0.28	-0.4019638	0.9385229
16	0.3	-0.4281147	0.9299606
17	0.32	-0.4537709	0.9208852
18	0.34	-0.4789074	0.911307
19	0.36	-0.5035003	0.901237
20	0.38	-0.5275267	0.8906865
21	0.4	-0.5509649	0.8796672
22	0.42	-0.5737945	0.8681913

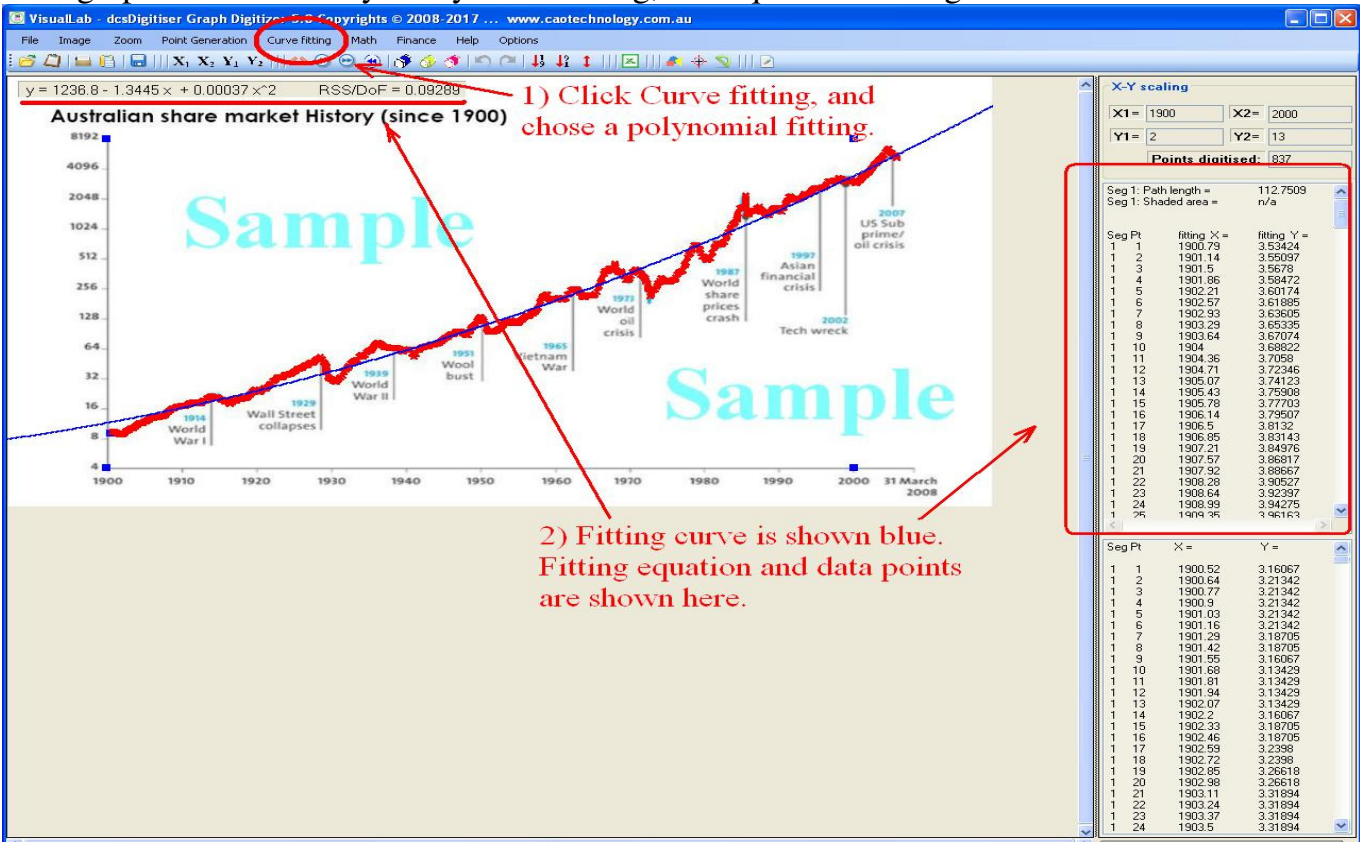
When the btn "Plot" is clicked, plots of x and dx.dt vs time t are shown.



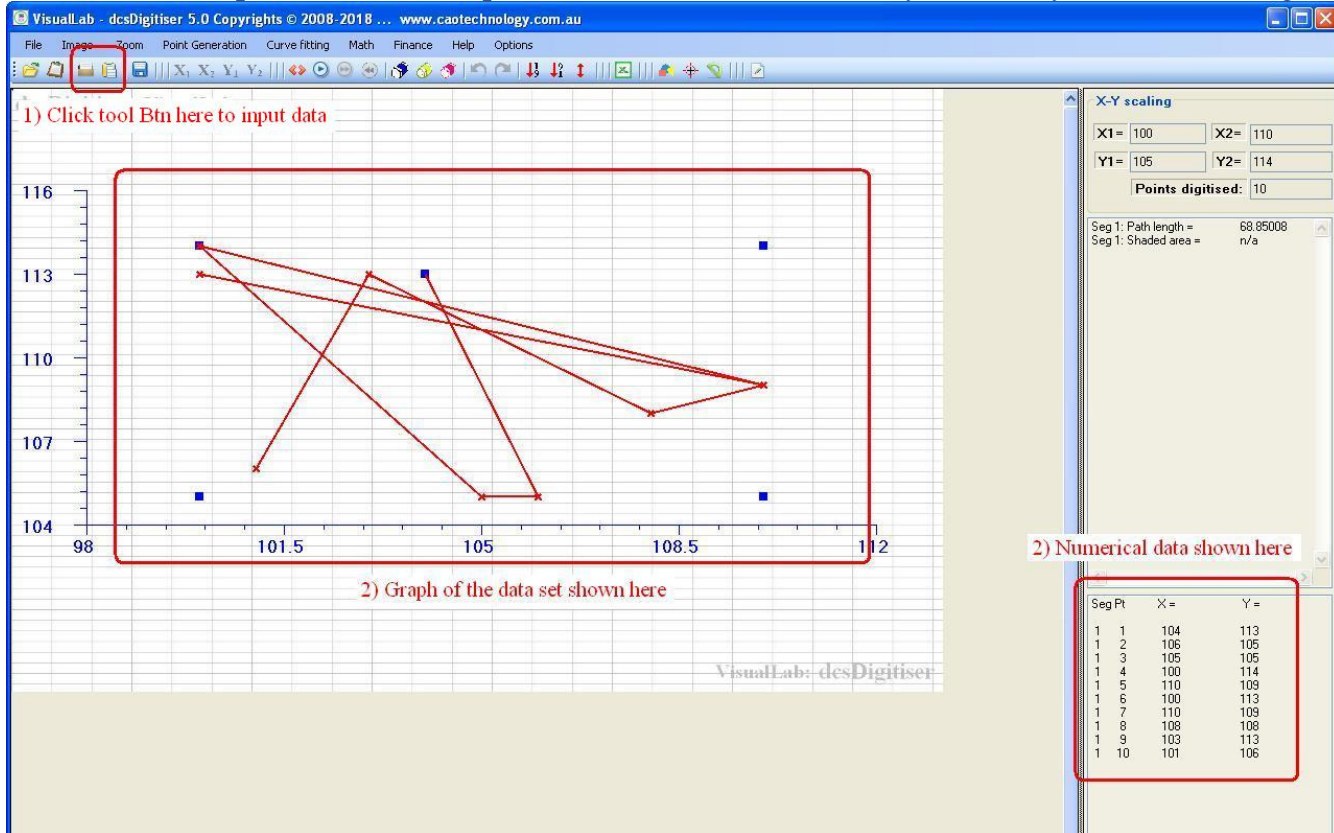
A graph is copy-pasted from a PDF image; x-y numbers of the graph are digitised in a second.



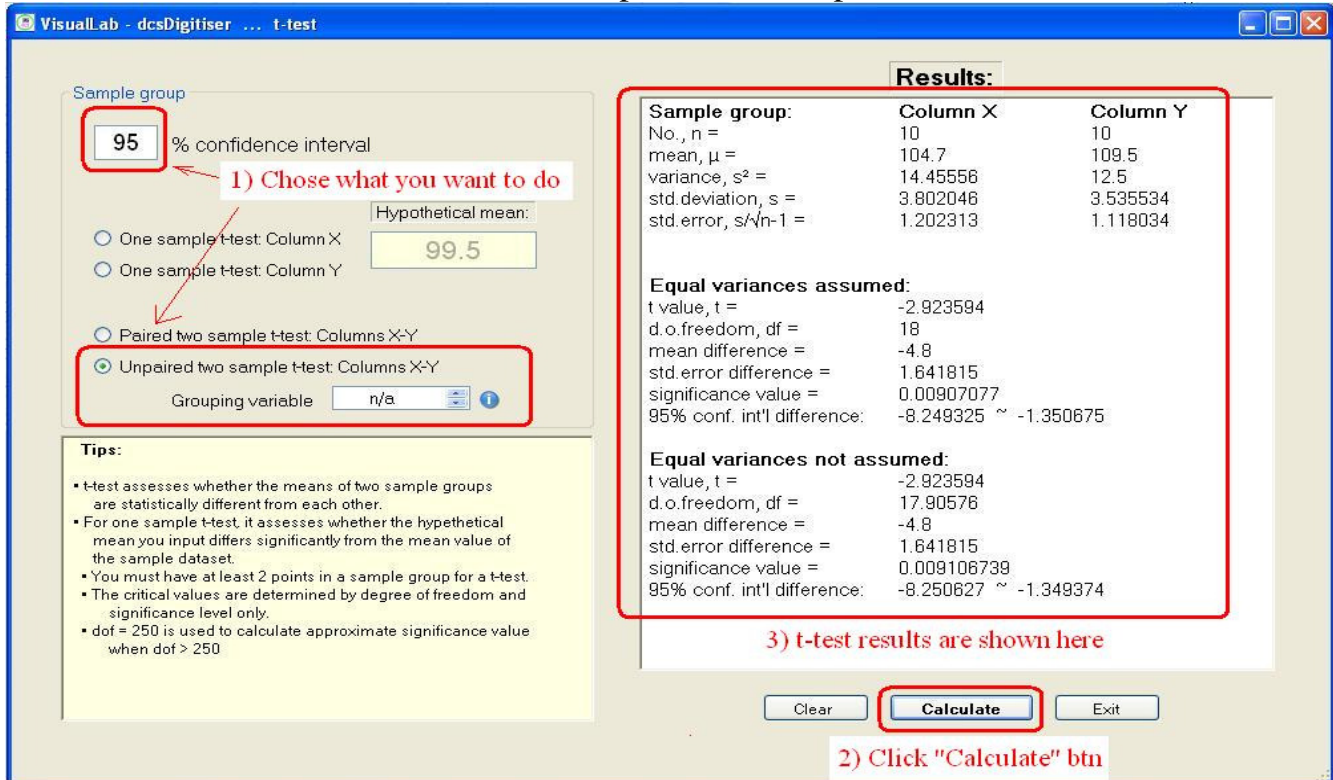
The graph is further analysed by curve fitting, and eqn of the fitting curve is obtained.



Statistical analysis can be carried out for any data set shown on the screen. For example, one has 10 data points in a file, input the data set to VisualLab; you'll see your data looking like:



Go to menu Maths > t- test..., and chose unpaired two sample test; results are shown as follows:



Maths > chi-square test enables one to perform chi-square test. An example is shown below:

VisualLab - dcsDigitiser ... chiSquareTest

Raw data for chi-square test:

No.	Group A	Group B	Group C	Group D	Group E	Group F	Group G	Group H
1	2	3	4					
2	3	3	2					
3	3	4	5					
4								
5								
6								
7								
8								
9								
10								
11								

Obs:

1) Input data here

Exp:

(user input)

Results:

$\chi^2 = 0.9346275$

d.o.f. = 4

Crit'l value (P=0.1) = 7.779

Crit'l value (P=0.05) = 9.488

Crit'l value (P=0.01) = 13.277

Crit'l value (P=0.001) = 18.467

2) Click "Run" btn here

3) Results are shown here

Tips for chi-square test:

- $\chi^2 = \sum (\text{Obs'd} - \text{Vexp'd})^2 / \text{Vexp'd}$
- Input observed raw data only into the data grid box;
- Expected values are values of null hypothesis H_0 ; if known, tick check-box and input its values;
- If chi-square value is less than the critical value, null hypothesis is accepted; otherwise is rejected.
- To select data, hold & move left mouse btn Ctrl + C to copy selection to clipboard; Click btn 'Paste clipb'd' below to paste data in clipboard; Click btn 'Delete sel'n' to delete selected

Clear data Paste Save **Run**

Clear res't Delete selection Exit

Maths > ANOVA ... An example showing how two way ANOVA is carried out in VisualLab.

VisualLab - dcsDigitiser ... ANOVA (Analysis of Variance)

Data and commands More data grids for 2nd factor More data grids for 2nd factor

Data for ANOVA:

No.	Group A	Group B	Group C	Group D	Group E	Group F
1	2	3	5			
2	3	4	5			
3	4	3	6			
4	2	3	3			
5	2	4	4			
6						
7						
8						
9						
10						
11						

1:

1) Input data here

No.	Group A	Group B	Group C	Group D	Group E	Group F
1	3	1	4			
2	3	2	5			
3	3	3	6			
4	3	4	3			
5	3	5	2			
6						
7						
8						
9						
10						
11						

2:

2) Click "Run" btn here

3) Results are shown here

ANOVA results:

	SS	dof	MS	F value
Between groups:	12.07	2	6.033	4.892
Between 2nd factor:	0.3	1	0.3	0.2432
Cross factors:	1.4	2	0.7	0.5676
Error (within groups):	29.6	24	1.233	
Total:	43.37	29	1.495	

Tips for ANOVA (analysis of variance):

- There must be at least two groups of data;
- If no checkbox for 2nd factor is ticked, one-way ANOVA for data in DataGrid No. 1 is computed;
- Two-way ANOVA will be robust if number of data points of each group and number of the 2nd factor groups are all equal;
- Empty cell in each DataGrid is regarded the end of data;
- SS - Sum of Square, MS - Mean Square;
- F value, aka F ratio, is the ratio of a given MS over MS of Error (within groups).
- To select data, hold & move left mouse button; Ctrl + C to copy selection to clipboard; Click btn 'Paste clipb'd' below to paste data in clipboard; Click btn 'Delete sel'n' to delete selected data

Clear data Paste to 1: Save data **Run**

Clear result Paste to 2: