

**BEGINNERS' AUTOGRAPH WEBINAR**, delivered in four 1½-hour sessions in June 2020  
by Douglas Butler (iCT Training Centre, Oundle) and Rob Smith (La Salle Education)

## SESSION 1: Geometry and Measures

(p.2)

- 1a. Introduction
- 1b. A collection of points
- 1c. Reflection
- 1d. Rotation and animation
- 1f. Angle Measurement
- 1g. Enlargement Area
- 1h. Vectors and Translation
- 1i. Multiple Transformations

### Extension Topics

- 1J. Regular Polygons
- 1k. Vectors: Addition and Subtraction
- 1l. Bearings
- 1m. Triangle Properties
- 1n. 3D Shapes

## SESSION 2: ALGEBRA and GRAPHING (i)

(p.5)

- 2a.  $y = mx + c$ , using the constant controller
- 2b. Simultaneous Linear Equations
- 2c. Quadratic Functions
- 2d. Cubic, Reciprocal, and Exponential Fns

### Extension Topics

- 2e. Graphs of Inverse Functions
- 2f. Trig Graphs:  $\sin x$ ,  $\cos x$ ,  $\tan x$
- 2g. Estimate of Gradient

## SESSION 3: ALGEBRA and GRAPHING (ii)

(p.7)

- 3a. Solving Quadratics
- 3b. Fitting to a parabolic image
- 3c. Equation of Circle
- 3d. Solving Linear Inequalities

### Extension Topics

- 3e. Distance – Speed – Acceleration
- 3f. Reflections and Translations of Graphs
- 3g. Solving by Iteration

## SESSION 4: Statistics/data handling

(p.9)

BIVARIATE DATA  
SINGLE VARIABLE DATA

- 4a. Data set: BabyData.xls
- 4a. Scatter Diagram (small)/(large)
- 4b Entering Raw Data Manually
- 4c. Discrete Raw Data
- 4d. Grouped Data
- 4e. Cumulative Data and Histogram

### Contact:

Douglas Butler

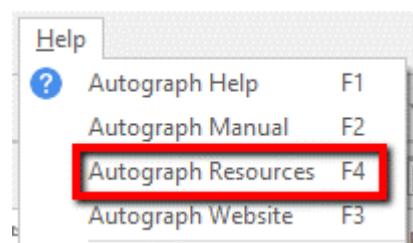
Email: [debutler@argonet.co.uk](mailto:debutler@argonet.co.uk)

Autograph Resources: Press F4 ->

[www.tsm-resources.com](http://www.tsm-resources.com)

Complete Mathematics Webinar Documentation and .agg files:

<https://completemaths.com/autograph/webinar-materials>

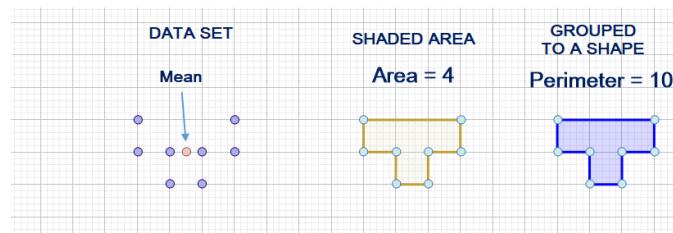


## SESSION 1: GEOMETRY and MEASURES

### 1a. INTRODUCTION

Standard Level, editing the axes to create a grid for Geometry work  
 Snap settings, equal aspect

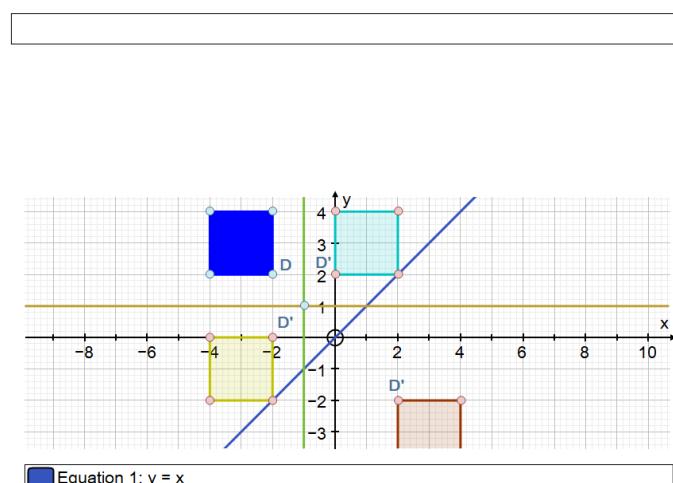
Autograph file: 1a.blank.agg



### 1b. A COLLECTION OF POINTS

Creating Data, Shaded Area or a Shape

Autograph file: 1b.data-shape



### 1c. REFLECTION

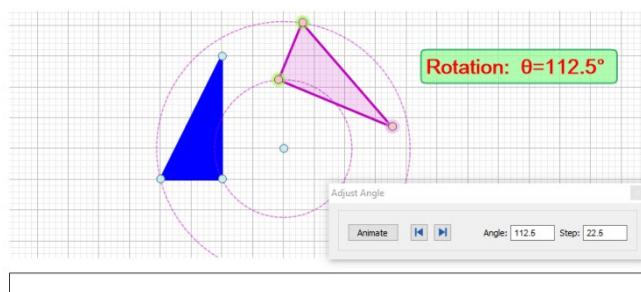
Creating a square and a triangle  
 Reflections in x-, y-axes,  
 horizontal, vertical lines,  $y=x$   
 Edit draw options (transparency)  
 Editing point label

Autograph file: 1c.reflection

### 1d. ROTATION AND ANIMATION

Show constructions  
 Clockwise/anti-clockwise  
 Animation controller  
 Constant controller  
 Text box

Autograph file: 1e.rotation.agg



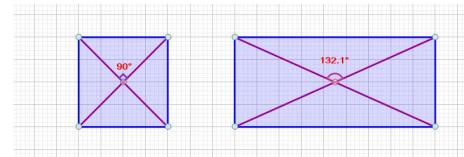
## 1f. ANGLE MEASUREMENT

A SQUARE AND RECTANGLE ('Group to shape')

Draw diagonals (segment tool)

Identify intersection points and angle measurement

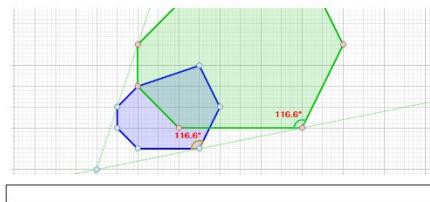
Autograph file: 1f.square-rectangle



HEPTAGON ENLARGEMENT

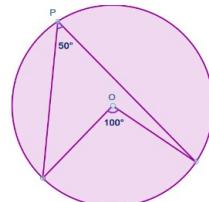
Angle measurement; parallel line test.

Autograph file: 1f.enlargement



CIRCLE AND ANGLE MEASUREMENT

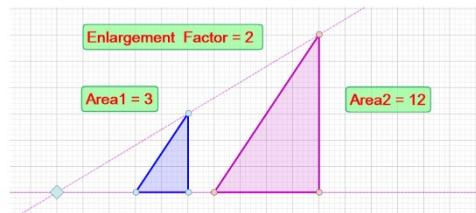
Autograph file: 1f.circle



## 1g. ENLARGEMENT AREA

Using calculator to measure area and area ratio

Autograph file: 1g.enlargement.agg

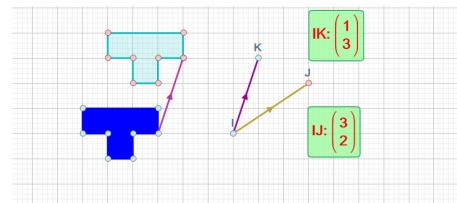


## 1h. VECTORS AND TRANSLATION

Two types of vector, based on one or two points

Advanced users: associate a constant with an attribute  
Eg direction of a vector

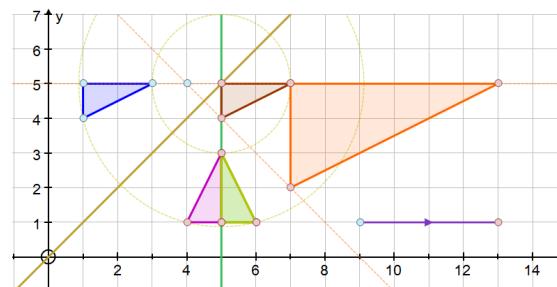
Autograph file: 1h.translation.agg



## 1i. MULTIPLE TRANSFORMATIONS

Invariance

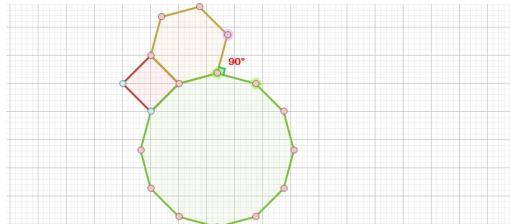
Autograph file: 1i.transformations.agg



## Geometry and Measures: EXTENSION TOPICS

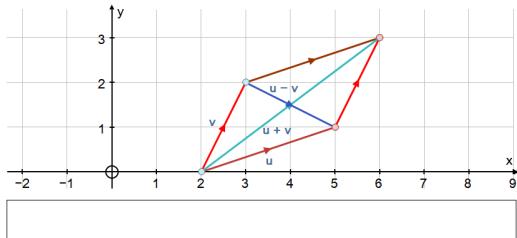
### 1J. REGULAR POLYGONS

Autograph file: 1j.polygons.agg



### 1k. VECTORS ADDITION AND SUBTRACTION

Autograph file: 1k.vectors.agg



### I.I BEARINGS

Pasting in an image from Google Earth

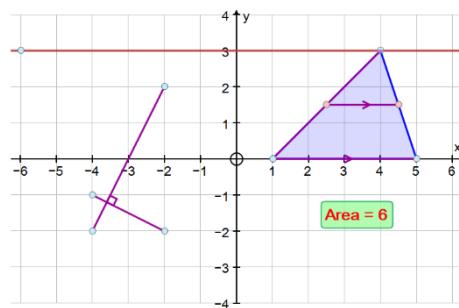
Autograph file: 1k.bearings.agg



### 1m. TRIANGLE PROPERTIES

Creating a shaded area; mid-point  
Parallel test; equality test  
Closest point  
Calculator to display area

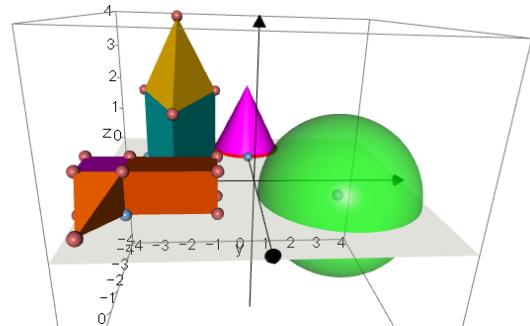
Autograph file: 1m.triangle.agg



### 1n. 3D SHAPES

Cube, cuboid, prisms, cylinders, pyramids, cones, spheres

Autograph file: 1.3Dshapes.agg

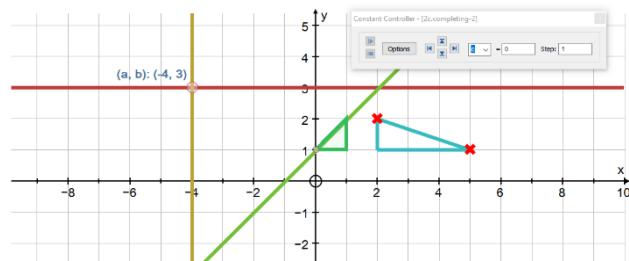


## SESSION 2: ALGEBRA and GRAPHING (i)

### 2a. $y = mx + c$ using the constant controller

m and c both start = 1

Autograph file: 2a.mx+c.agg



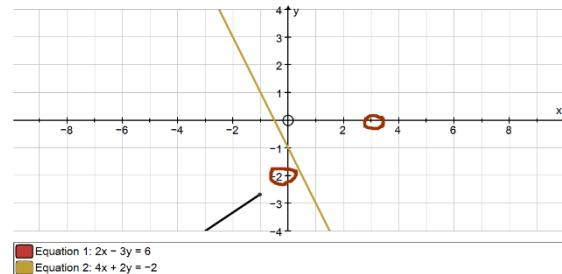
### 2b. SIMULTANEOUS LINEAR EQUATIONS

Implicit form of the straight line

$$\text{Slow plot } 2x - 3y = 6$$

$$4x + 2y = -2$$

Autograph file: 2b.simultaneous.agg



### 2c. QUADRATIC FUNCTIONS

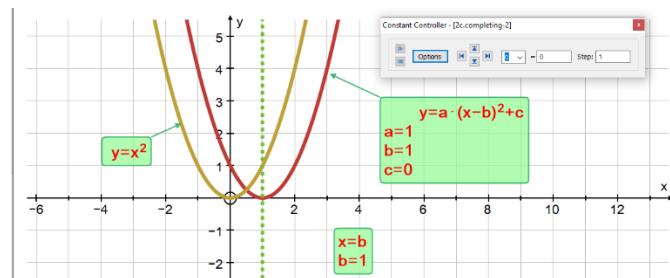
Intercepts, turning points.

Transformations:  $y = ax^2$ ,  $(x - a)^2$

Completing the square:  $y = a(x - b)^2 + c$

Autograph file: 2c.completing-1.agg

Autograph file: 2c.completing-2.agg

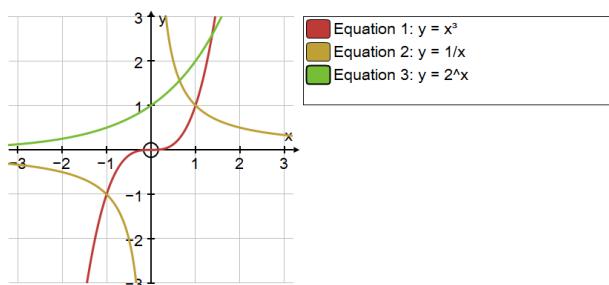


### 2d. CUBIC, RECIPROCAL and EXPONENTIAL FUNCTIONS

$y = x^3$ ,  $1/x$  and  $2^x$

Slow plot!

Autograph file: 2d.cubics.agg



## Algebra and Graphing (i): EXTENSION TOPICS

### 2e. GRAPHS OF INVERSE FUNCTIONS

Use of XY attribute point

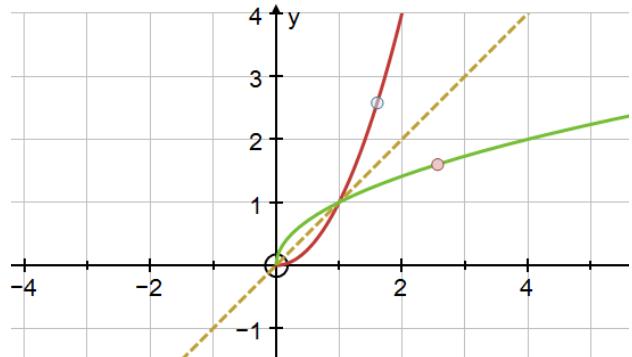
Check that a reflection in  $y=x$  is indeed an inverse

$$y = 3x \text{ and } x = 3y$$

$$y = x^2$$

Autograph file: 2e.inverse-1.agg

Autograph file: 2e.inverse-2.agg



### 2f. TRIG GRAPHS: sinx, cosx, tanx

Standard level is DEGREES by default

Equation entry takes most trig forms,  
 $\sin x$ ,  $\cos x$ ,  $\tan x$ ,  $a \sin x$ ,  $\sin(x - b)$ ,  $\sin x + c$

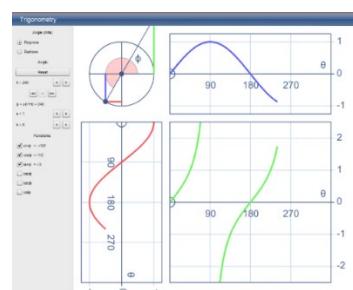
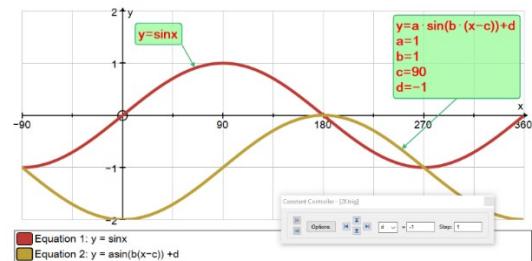
Slow plot useful here

Vertical asymptotes using  $x = k$

constant controller: family values  
 comma-separated  $k = -90, 90, 270$

Autograph file: 2f.trig.agg

File -> New Extras Page -> Trigonometry



### 2g. ESTIMATE OF GRADIENT

Paste an image of skier from the web

Place a point ON the graph.

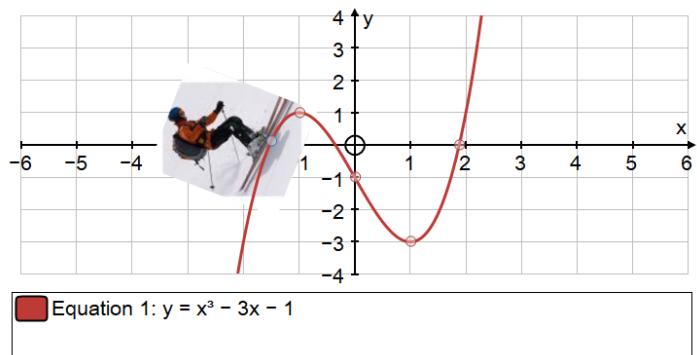
Select the skier and the point

"attach to point"

Move the skier to be parallel to the curve

Move, or animate the point along the curve

Autograph file: 2g.gradient.agg



## SESSION 3: ALGEBRA and GRAPHING (ii)

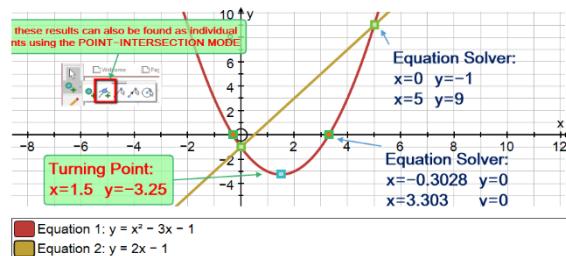
### 3a. SOLVING QUADRATICS

Select line and curve: 'Point' -> Solve Intersection

Select curve: 'Point' -> Solve  $f(x) = 0$

Select curve: 'Point' -> Turning Points

Autograph file: 3a.solve.agg



### 3b. FITTING TO A PARABOLIC IMAGE

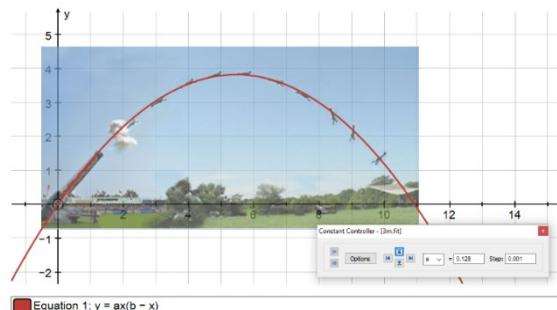
Choose scales and move image to place the origin

$y = ax(b - x)$

use constant controller to optimise 'b' and 'a'



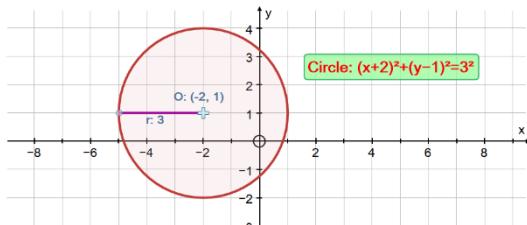
3b.fit-McDonald.agg, 3b.fit-basketball.agg



Autograph files: 3b.fit-cannon.agg

### 3c. EQUATION OF CIRCLE

Autograph file: 3c.circle.agg



### 3d. SOLVING LINEAR INEQUALITIES

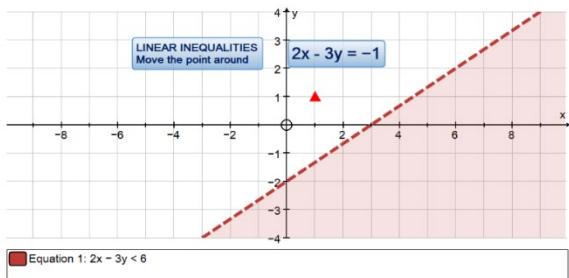
Implicit form for straight line (slow plot!)

Use of calculator to show value of

$2x - 3y$  as you drag the point.

Shading of reject reading  
(see view -> preferences)

Autograph file: 3d.inequalities.agg



## Algebra and Graphing (ii): EXTENSION TOPICS

### 3e. DISTANCE – SPEED – ACCELERATION

Edit Axes -> variables 'v' and 't'

Select the 4 points Create -> shaded area

Create shaded area



Autograph file: 3e.velocity-1.agg

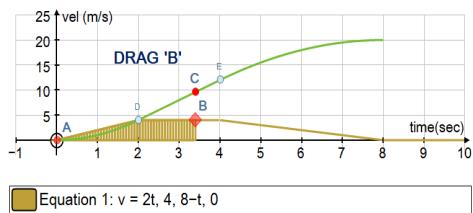
For more advanced students, use a piecewise entry

Illustrated:  $v = 2t, 4, 8 - t, 0$

Boundaries at 0, 2, 4, 8, 10

Area A-B then XY point (time, area)

-> locus -> distance travelled



Autograph file: 3e.velocity-2.agg

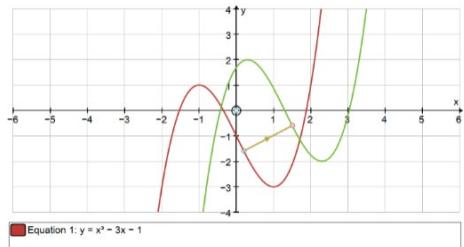
### 3f. REFLECTIONS and TRANSLATIONS OF GRAPHS

Place a point on the curve,

and create the desired transformation for that point.

Select the point and the transformed point,

then 'Create' -> 'Locus'



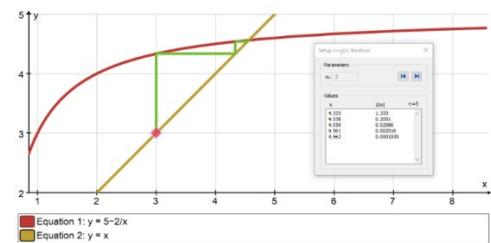
Autograph file: 3f.translate.agg

### 3g. SOLVING BY ITERATION

$$y = 5 - \frac{2}{x} \text{ and } y = x$$

select a point on the curve and  $y = x$

'Create' ->  $x = g(x)$  iteration



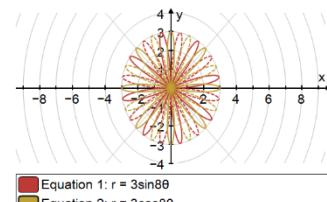
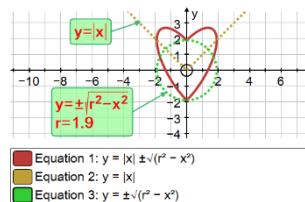
Autograph file: 3g.iteration.agg

### 3h. INTERESTING CREATIONS

Valentine's Day heart + animation!

Autograph file: 3h-pattern-1

Autograph file: 3h-pattern-2



## SESSION 4: STATISTICS AND DATA HANDLING

### 4a. DATA SET: BabyData.xls

Data for 1174 births in Berkeley University, California  
 Data should ideally show its source.

Select one column or two adjacent columns to study  
 It is necessary to hide any intervening columns.

Excel files: BabyData(50).xls, BabyData(1174).xls

O	P	Q	R	S	T	U	V	W
Vt (kg)	Mother Smoked?	Random						
58.1	1	0.0009						

SOURCE: BERKELEY UNIVERSITY OF CALIFORNIA, San Francisco  
[www.stat.berkeley.edu/~stallabs/data/babies.data](http://www.stat.berkeley.edu/~stallabs/data/babies.data)  
[www.stat.berkeley.edu/~stallabs/labs.html](http://www.stat.berkeley.edu/~stallabs/labs.html)

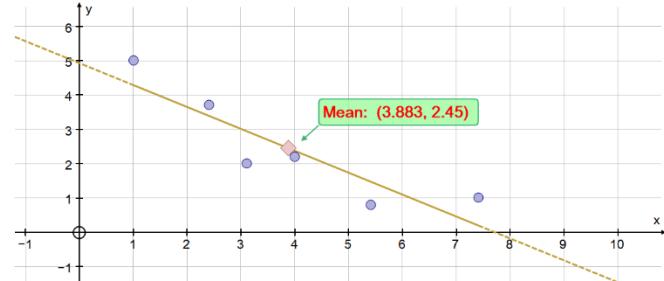
Ib	oz	Birth Weight (lb)	Birth Weight (kg)	Gestation (days)	Mother's Age (yrs)	ft	in	Mother's Ht (in)
7	3	7.19	3.26	281	28	5	1	61
6	7	6.44	2.92	292	28	5	2	62
10	3	10.19	4.62	298	37	5	1	61
8	2	8.13	3.69	289	23	5	6	66
8	2	8.13	3.69	294	32	5	3	63
5	8	5.50	2.49	273	20	5	6	66
7	5	7.31	3.32	298	22	5	4	64

### BIVARIATE DATA

#### 4a1. SCATTER DIAGRAM (small)

Line of best fit with just a few data points  
 Extrapolation shown dotted.  
 Select all points 'Point' -> 'Mean'

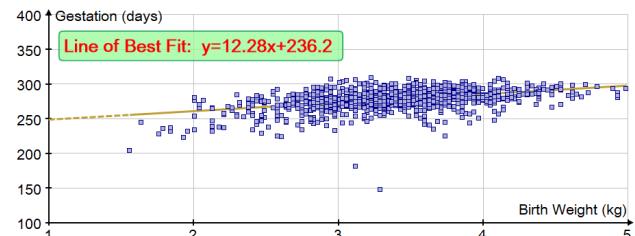
Autograph file: 4a1.scatter(6).agg



#### 4a3. SCATTER DIAGRAM (large)

Select two adjacent columns in Excel.  
 In Autograph: Enter XY data  
 Select the data (click on any one point)  
 'Line' -> 'Line of best fit'

Autograph file: 4a3.scatter(1174).agg

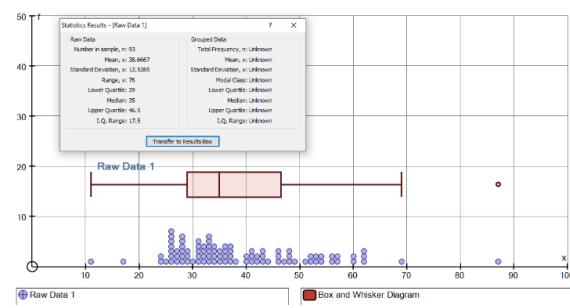


### SINGLE VARIABLE DATA

#### 4b ENTERING RAW DATA MANUALLY

Using the point mode: create a data set  
 View Statistics Box  
 Plot a box plot: outliers are  $1.5 \times \text{IQR}$

Autograph file: 4b.single-data.agg

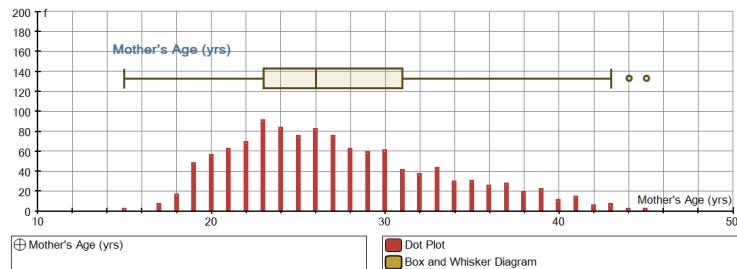


## 4c. DISCRETE RAW DATA

Dot Plot - Box Plot

Outliers

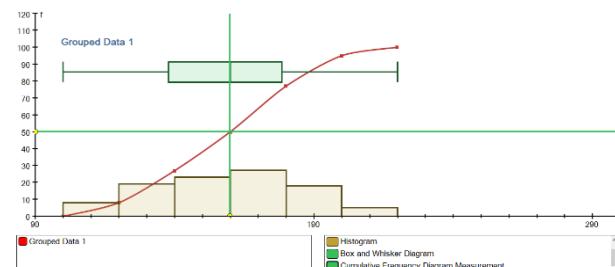
Autograph file: 4c.dot-box.agg



## 4d. GROUPED DATA

Entering group boundaries and frequencies

Autograph file: 4d.grouped-data.agg



## 4e. CUMULATIVE DATA

Box Plot (from grouped data)

Cumulative Frequency Diagram

Autograph file: 4e.cumulative.agg



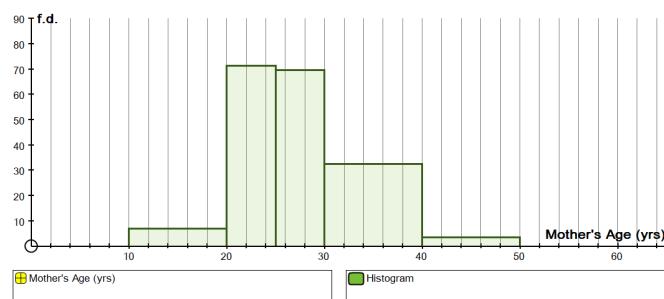
## 4f. HISTOGRAM

Bar Chart (from raw data)

Unequal classes

Frequency Density

Autograph file: 4f.histogram.agg



Contact:

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Autograph Resources: Press F4 ->

[www.tsm-resources.com](http://www.tsm-resources.com)

Complete Mathematics Webinar Documentation and .agg files:

<https://completemaths.com/autograph/webinar-materials>

