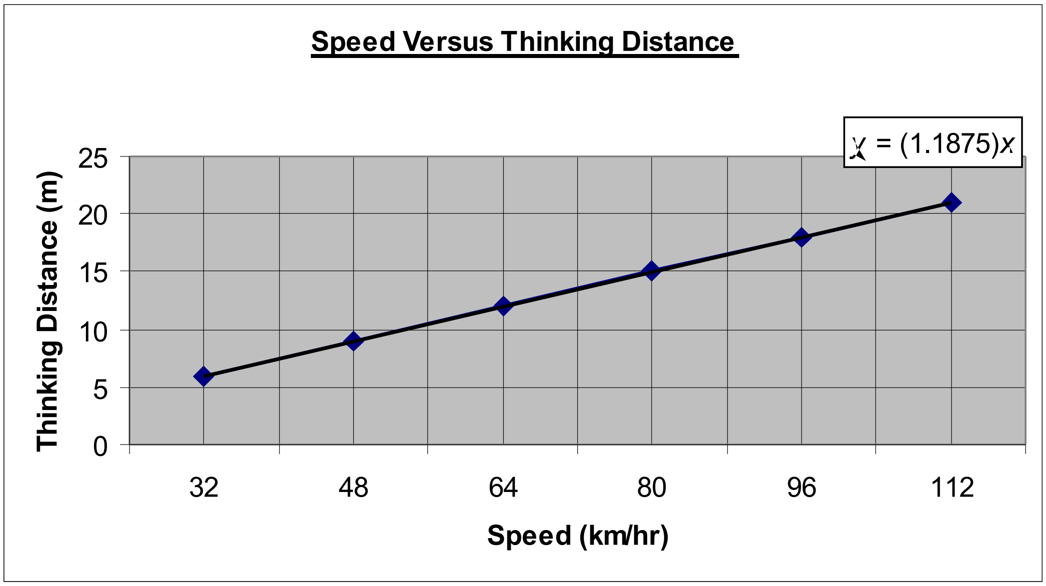
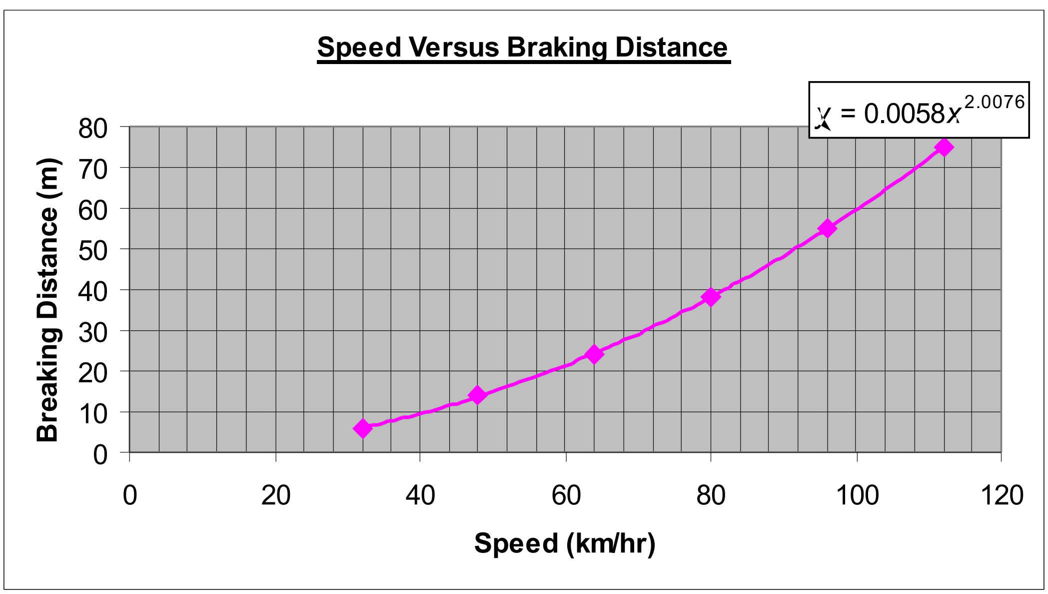
5 Stopping distances

Method

1. Through the use Chart Wizard on Microsoft Excel, I have generated the following graphs:





Already, we see that thinking distance is a **linear** function. From 32km/hr onwards, every time speed increases by 16km/hr, the distance travelled by the woman before braking increases by a constant 3m.

The additional braking distance however, shares a nonlinear relationship with speed. With increasing speed, the braking distance travelled appears to increase at an even faster rate. The gradient of the curve becomes steeper and steeper, in contrast to the first line, where the constant slope gives it its linearity.

Logically speaking, the data makes sense. If you are driving at 112km/hr, you will obviously travel much further before actually pushing the brakes than someone driving at 32km/hr, simply due to the sheer velocity of the car. The actual momentum of the car is what makes braking a lengthier task at higher speeds than at slower speeds (as momentum is mass x velocity), accounting for the increasing rates of braking distance with rising velocity.

2. (a) Since the function for speed versus thinking distance is linear, we can use the form $y = mx + c$ to determine an equation for the line:
1) $y = mx + c$
2) By using the coordinates (32,6) and (48,9) from the first graph, we can find the gradient or the m value of the equation.
$x_1 = 32$
$x_2 = 48$
$y_1 = 6$
$y_2 = 9$
Gradient = $\frac{y_2 - y_1}{x_2 - x_1}$

$= \frac{(9-6)}{(48-32)}$

$= \frac{3}{16}$ (or 0.1875)

3) So far, we have $y = 0.1875x + c$. To find the constant, we can plug in the coordinate (48,9) for x and y.
$9 = (0.1875)(48) + c$
$9 = 9 + c$
$c = 0$
4) The final function for **speed versus thinking distance** looks like this:
$\mathbf{f(x) = (3/16)x + 0}$
When graphing the linear function and finding its equation through the "trendline" option on Excel, I initially obtained $\boldsymbol{y = 3x + 3}$. The computer seems to have assumed that 16km/hr was equivalent to one unit of x.
What the computer did before:

Speed (km/hr)	Thinking Distance (m)
1	6
2	9
3	12
4	15
5	18
6	21

The gradient of the line consequently becomes 3 instead of 0.1875 and the constant seems to have been easily calculated by finding the difference between each *y* value (3). Excel considers the *x*-axis as ordinal instead of numerical. It ignores the fact that when speed is 0km/hr, thinking distance is naturally 0m (the line should pass through the origin but it does not).

Of course, this mistake could have been easily avoided on my part. Had I chosen a “scatter” instead of “line” graph, the numbers on the *x*-axis would have progressed by their true value of 16km/hr instead of 1km/hr. The instant “chart type” was changed to “scatter”, the trendline showed the correct equation of $y = 0.1875x$.