Gun-running and Numerical Methods

For finding the roots of an equation, we can use:
Bisection
Linear Interpolation
The Newton-Raphson Method
Each subsequent method requires more information and more calculation, but generally yields better results more quickly.
They may be compared to a gun-runner trying to slip over the US-Mexico border:

Bisection – go halfway between the two points

What we need: Two x values either side of the root, and $f(x)$ **What we calculate:** The sign (positive/negative) of $f(x)$ for each x value The halfway point of the two x values	*Thanks to some careless tweeting on the part of our gun-runner, we know that he was **in the US at 12 noon**, and that **by 8pm he was in Mexico**.* *With no other information, our best guess for when he crossed the border would be the halfway point, **4pm**.*

Linear Interpolation – assume constant gradient between two points

What we need: Two x values either side of the root, and $f(x)$ **What we calculate:** The value of $f(x)$ for each x value The equation of the straight line connecting these two coordinates The point at which this line crosses the x-axis	*The use of a credit card at a drive-thru tells us our gun-runner stopped for coffee in San Antonio, **200 miles north of the border** at **11am**, and was sighted in a cafe in Monterrey, **100 miles south of the border**, at **5pm**.* *Assuming a constant speed, our best guess for when he crossed the border would be **3pm**.*

The Newton-Raphson Method – extrapolate from gradient at given point

What we need: A single x value, $f(x)$ and $f'(x)$ **What we calculate:** The values of $f(x)$ and $f'(x)$ The equation of the straight line passing through $(x, f(x))$ with gradient $f'(x)$. The point at which this line crosses the x-axis	*Our gun-runner's vehicle was sighted by the Feds going **60mph** on I-35, **25 miles north of the border** at **2:50pm**.* *Assuming his speed remains the same, our best guess for when he crossed the border would be **3:15pm**.*

Note: Formulae are readily derivable for each of these methods, but it is important to become familiar with the concepts first and foremost, and learn not to depend on formulae alone for solving problems.