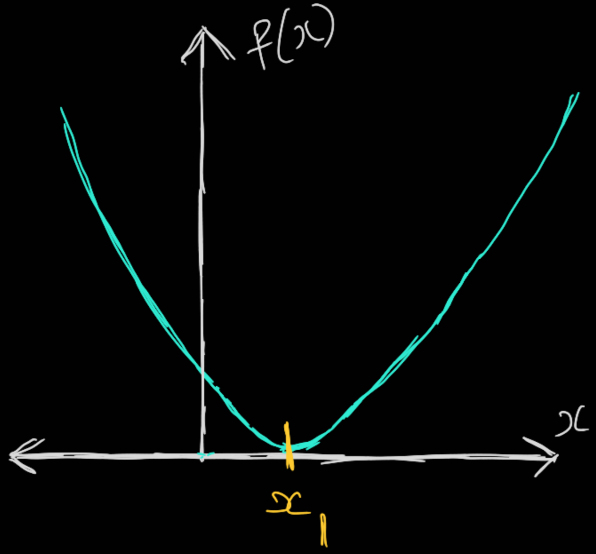
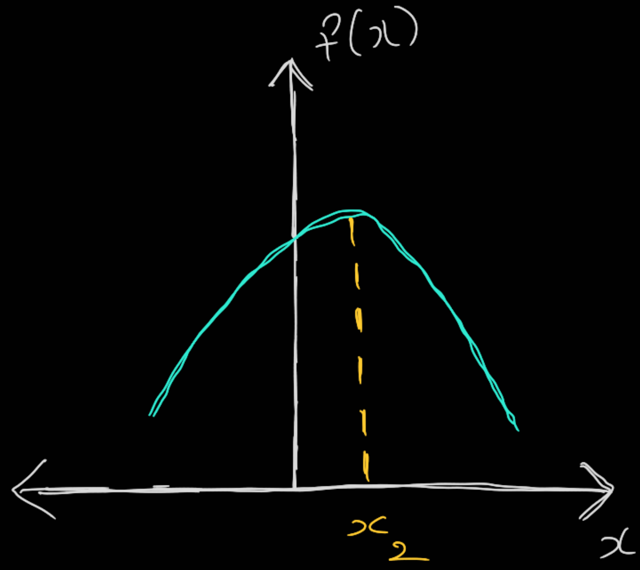
Maxima and Minina

All the calculus we have covered till now is to find minima and maxima, going back to our problem of predicting incomes we are trying to minimize the error i.e $(y-\hat{y})^2$



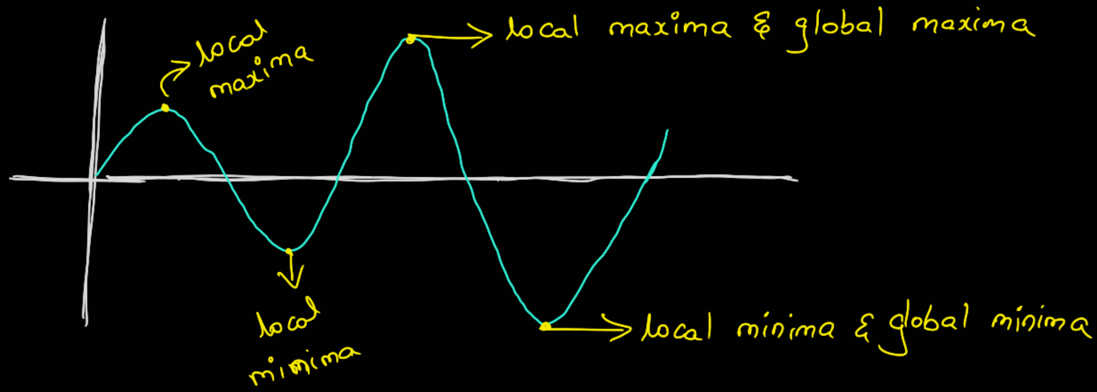
minima @ x_1



maxima @ x_2

Point to be noted is functions can have both minima and maxima or one of minima and maxima or neither of them

lets look a slightly more complex looking example



Global minima = min (all local minimas)

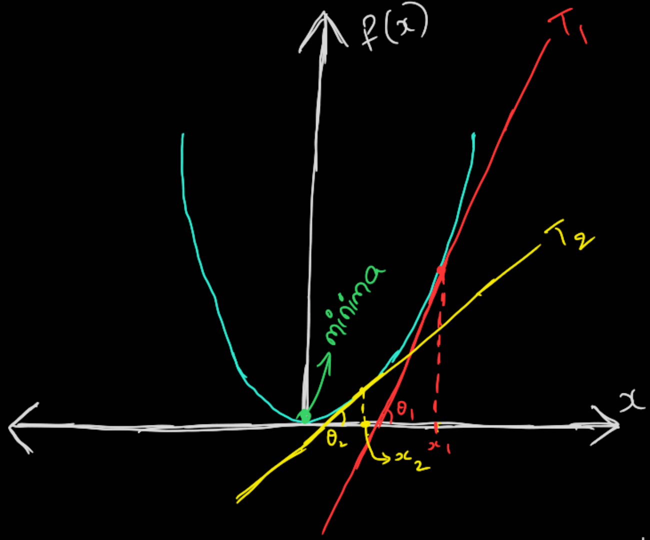
Global maxima = max (all local maximas)

Regardless of minima and maxima, all these points are called optimas.

local minimas & maximas $\Rightarrow$ local optimas

Global minima & maxima $\Rightarrow$ Global optima

How to find them?



In our example

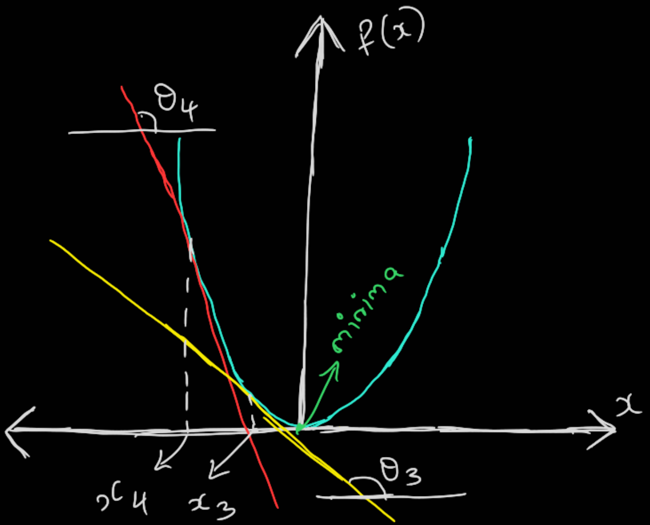
$0^\circ < \theta_2 < \theta_1 < 90^\circ$ → Both are +ve

$0 < \tan(\theta_2) < \tan(\theta_1) < \infty$

↓ at origin

slope @ x_2 < slope @ x_1

which means slope is ↓ while travelling towards origin from +ve side



Here $180^\circ > \theta_3 > \theta_4 > 90^\circ$

$\Rightarrow \left.\begin{array}{l}\tan(\theta_3) < 0 \\ \tan(\theta_4) < 0\end{array}\right\}$ → Both are −ve

$\tan(\theta_3) > \tan(\theta_4)$

Key observations Here are

→ At minima slope = 0

→ Right side of minma slope is +ve

→ Left side of minima slope is −ve

→ Around minima slope is increasing

→ At minima $\frac{d}{dx}\left(\frac{d f(x)}{dx}\right) > 0$

lly for maxima →

→ At maxima slope = 0

→ Right side of maxima slope is −ve

→ left side of maxima slope is +ve

→ Around maxima slope is decreasing

→ At maxima $\frac{d}{dx}\left(\frac{df(x)}{dx}\right) < 0$