20181018c Profit maximisation

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### Principles

Profit(q) = TR(q) - TC(q)  
We need to express Profit interms of q, then find the critical points, then the maxima

### Example

TC(q) = 1000 + 2*q + 0.06*q^2  
q + 10\*p = 500 (Demand curve)

library(Ryacas)  
library(mosaic)

p = Sym('p'); q = Sym('q')  
Solve(q + 10\*p == 500,p) # p in demand curve, in terms of q

## expression(list(p == -((q - 500)/10)))

TR = -((q - 500)/10) \* q  
TR = Simplify(TR)  
TR

## expression((500 \* q - q^2)/10)

TC = 1000 + 2\*q + 0.06\*q^2  
Profit = TR - TC  
Profit = Simplify(Profit)  
Profit

## expression(-1.6 \* q^2/10 + 48 \* q - 1000)

dProfit = deriv(Profit,q)  
ddProfit = deriv(dProfit,q)  
Solve(dProfit==0,q)

## expression(list(q == 480/3.2))

Eval(Profit,list(q=c(480/3.2)))

## [1] 2600

Eval(ddProfit,list(q=c(480/3.2)))

## [1] -0.32

So the maxima is at q == (480/3.2, 2600)

# The break-even point (when profit first reaches +ve)  
Solve(Profit==0,q)

## expression(list(q == -(10 \* (root(16640/10, 2) - 48)/3.2), q ==   
## -(-10 \* (root(16640/10, 2) + 48)/3.2)))

N('%')

## expression(list(q == 22.5245121601, q == 277.4754878398))

Eval(dProfit, list(q=c(22.5245121601, 277.4754878398)))

## [1] 40.79216 -40.79216

So the breakeven point would be q == 22.525, when profit first reaches +ve

# verified with graphs  
plotFun(-1.6 \* q^2/10 + 48 \* q - 1000 ~ q)

