Solving optimization by Hand

Our final Model is in the form of

$$Sales = 6.75 + 0.0191 \times TV + 0.02886 \times Radio + 0.001086 \times TV \times Radio \quad \longrightarrow (1)$$

↳ Interaction term

Given $TV + Radio = 300$

Sub $Radio = 300 - TV$ in eq (1)

$$Sales = 6.75 + 0.0191 \times TV + 0.02886 \times (300 - TV) + 0.001086 \times TV \times (300 - TV)$$

$$Sales = 6.75 + 0.0191 \times TV + 8.658 - 0.02886 TV + 0.3258 TV - 0.001086 (TV)^2$$

$f(x) =$ $$Sales = 15.408 + 0.3161 \times TV - 0.001086 (TV)^2 \quad \longrightarrow (3)$$

Solving First order condition

$f'(x) = 0$

$$0.3161 - 2 \times 0.001086 \times TV = 0$$

$$0.3161 - 0.002172 \times TV = 0 \quad \longrightarrow (2)$$

$$\frac{0.3161}{0.002172} = TV$$

$$TV = 145.534 \text{ units}$$

Radio = 300 − 145.534

Radio = 154.465 units

~~More~~ dd

After Solving eq ② (2nd order diff)

$f''(x) = -0.002172$ which is < 0

∴ T.V, Radio are maximum points

TV budget must be $145,534 dollars and Radio budget must be $154,465 dollars to maximize the sales

Sub TV value in ③

$$\text{Sales} = 15.408 + 0.3151 \times 145.534 - 0.001086 \times (145.534)^2$$

Sales = 38.4 units of sales

This prediction is high compared to existing sales value.

- The maximum sales value for the existing data is 27 units.