Assignment 5

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1) A square piece of tin of side 18 cm is to be made into a box without top, by cutting a square from each corner and folding up the flaps to form the box. What should be the side of the square to be cut off so that the volume of the box is the maximum possible.
Solution: Let the given side of tin be a.

$$a = 18cm \tag{0.0.1}$$

Lets cut a square of side x from each corner then the box formed folding up the flaps has dimensions as

$$l = a - 2x,\ b = a - 2x,\ h = x \tag{0.0.2}$$

The length, breadth, height are positive. These give the constraints on x

$$a - 2x > 0,\ x > 0 \tag{0.0.3}$$

$$\implies 0 < x < \frac{a}{2} \tag{0.0.4}$$

Volume of the box is given by

$$V(x) = x(a - 2x)^2 \tag{0.0.5}$$

We now check the convexity of the function $V(x)$ under the constraints given by (0.0.4)

$$V'(x) = (a - 2x)(a - 6x) \tag{0.0.6}$$

$$V''(x) = 8(3x - a) \tag{0.0.7}$$

For $x > \frac{a}{3}$ the function $V(x)$ is convex, otherwise it is concave. The function convexity is changing under the constraints. So the given problem cannot be expressed as a Convex optimization problem.