

$$\mathcal{L} = f(\xi) - \lambda (c - g(\xi))$$

MAX

$\{\xi\}$

$f(\xi)$

s. t. $-g(\xi) = c$

$$\text{MAX} \quad -Z \cdot W$$

$$W \cdot z = \sum W_i z_i$$

$$\{z\} \quad \text{s.t.} \quad q = f(z)$$

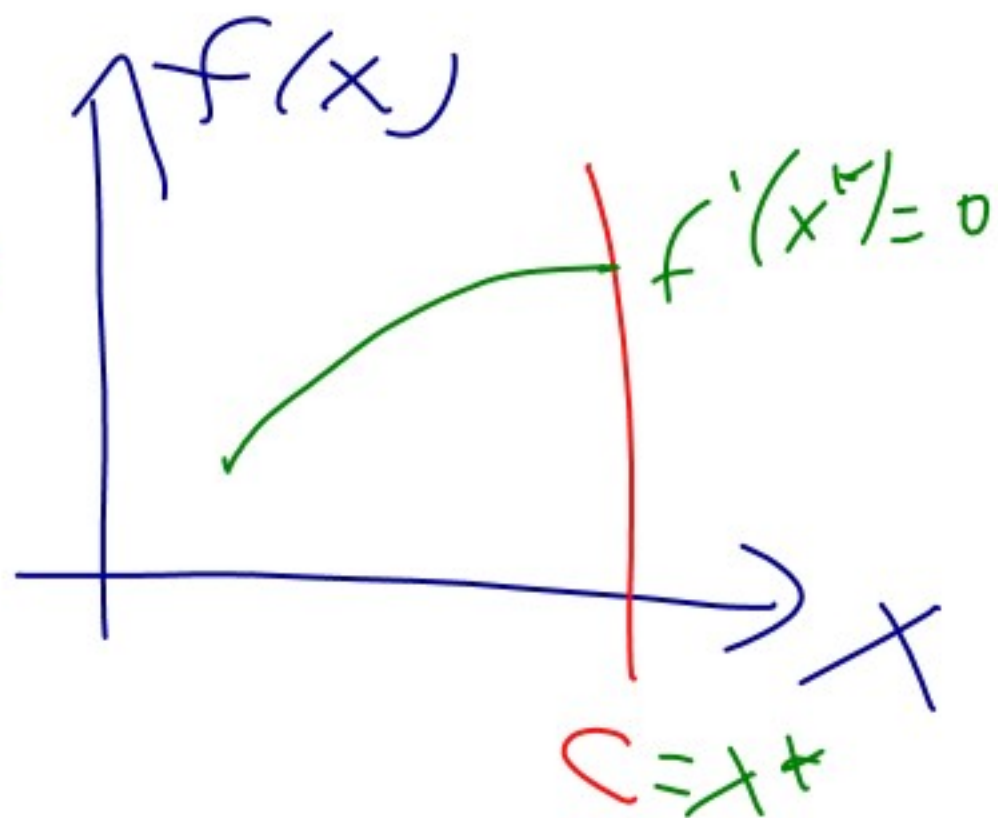
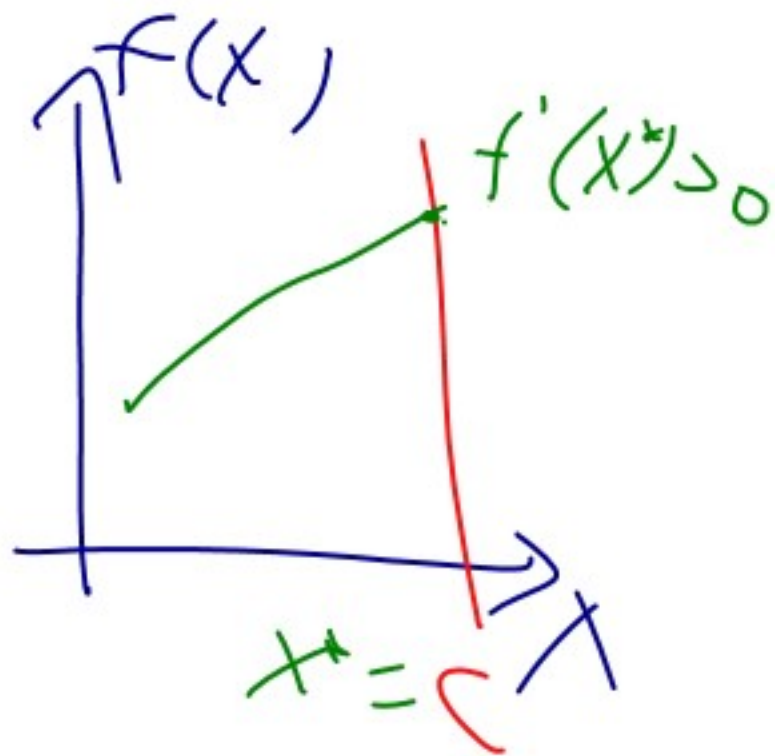
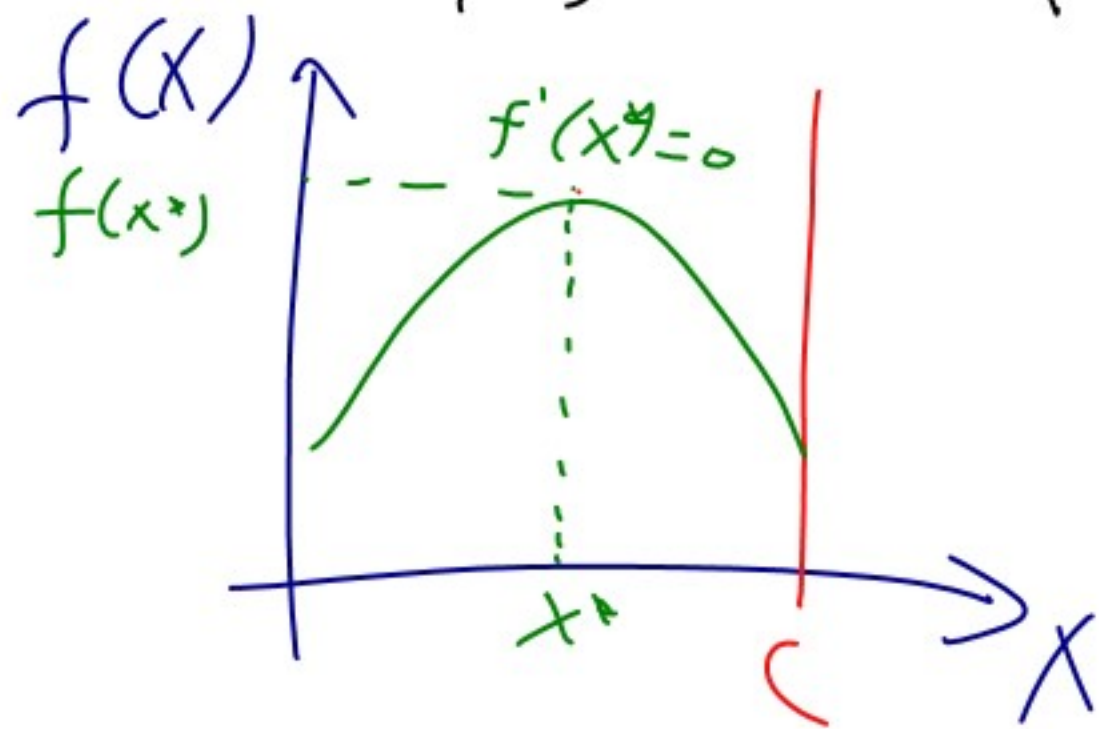
$$\mathcal{L} = -Z \cdot W + \lambda (f(z) - q)$$

$$\lambda = C M_f$$

KHUVN TUCKER

$$\begin{array}{ll} \text{MAX} & f(x) \\ \text{s.t.} & x \leq c \end{array}$$

$$f'(x^*)(c - x^*) = 0$$



$$\text{MAX } f(x)$$

$$\{x\}$$

s.t.

$$g_h(x) = c_h \quad h = 1, 2, \dots, K$$

$$h_l(x) \leq d_l$$

$$f: \mathbb{R}^n \rightarrow \mathbb{R}$$

$$x \rightarrow f(x)$$

$$l = 1, 2, \dots, L$$

COND. K-T

$$\textcircled{1} \quad \frac{\partial f(x^*)}{\partial x_i} = \sum_{k=1}^K \lambda_k \frac{\partial g_k(x^*)}{\partial x_i} + \sum_{l=1}^L \gamma_l \frac{\partial h_l(x^*)}{\partial x_i}$$

$i = 1, 2, \dots, n$

$$\textcircled{2} \quad \lambda_k \in \mathbb{R} \quad k = 1, 2, \dots, K$$
$$\gamma_l \in \mathbb{R}_+ \quad l = 1, 2, \dots, L$$

$$\gamma_l (h_l(x^*) - d_l) = 0$$

① CVA S, LINEALLES: $u(x, y) = x + y^\alpha$

$$0 < \alpha < 1$$

$$\text{MAX } x + y^\alpha$$

$$\{x, y\}$$

s. t.

$$p_x x + p_y y = I$$

$$-x \leq 0$$

$$-y \leq 0$$

$$\textcircled{1} \quad \frac{\partial (x+y^T)}{\partial x} = \frac{\partial \lambda(-p_x x - p_y y + I)}{\partial x} + \gamma_1 \frac{\partial (-x)}{\partial x} + \gamma_2 \frac{\partial (-y)}{\partial x}$$

$$\frac{\partial (x+y^T)}{\partial \textcolor{red}{x}} = \frac{\partial \lambda(-p_x x - p_y y + I)}{\partial \textcolor{red}{x}} + \gamma_1 \frac{\partial (-x)}{\partial \textcolor{red}{x}} + \gamma_2 \frac{\partial (-y)}{\partial \textcolor{red}{y}}$$

$$\textcircled{2} \quad \begin{array}{ll} \gamma_1 \geq 0 & \gamma_1(-x-0)=0 \\ \gamma_2 \geq 0 & \gamma_2(-y-0)=0 \end{array}$$

$$\textcircled{1} \quad 1 = -\lambda(p_x) - \gamma_1 \quad \gamma_1 x = 0 \quad \gamma_1 \geq 0$$

$$\alpha y^{\alpha-1} = -\lambda p_y - \gamma_2 \quad \gamma_2 y = 0 \quad \gamma_2 \geq 0$$

$$\textcircled{A} \quad \gamma_1 > 0, \gamma_2 > 0 \quad \begin{array}{l} x^* = 0 \\ y^* = 0 \end{array}$$

$$\textcircled{B} \quad \gamma_1 > 0, \gamma_2 = 0 \quad \begin{array}{l} x^* = 0 \\ y^* > 0 \end{array}$$

$$\textcircled{C} \quad \gamma_1 = 0, \gamma_2 = 0$$

$$\textcircled{C} \quad \gamma_1 = 0, \gamma_2 > 0 \quad \begin{array}{l} x^* > 0 \\ y^* = 0 \end{array}$$

$$\alpha(0)^{\alpha-1} = -\lambda p_y \Rightarrow \lambda =$$

$$\begin{aligned} 1 &= -\lambda p_x - \gamma_1 \\ \alpha y^{\alpha-1} &= -\lambda p_y \\ I &= p_y y^* \Rightarrow y^* = \frac{I}{p_y} \end{aligned}$$

$$\begin{aligned} \gamma_1 &= -1 - \lambda p_x \\ \lambda &= -\alpha \left(\frac{I}{p_y} \right)^{\alpha-1} \frac{1}{p_y} \end{aligned}$$

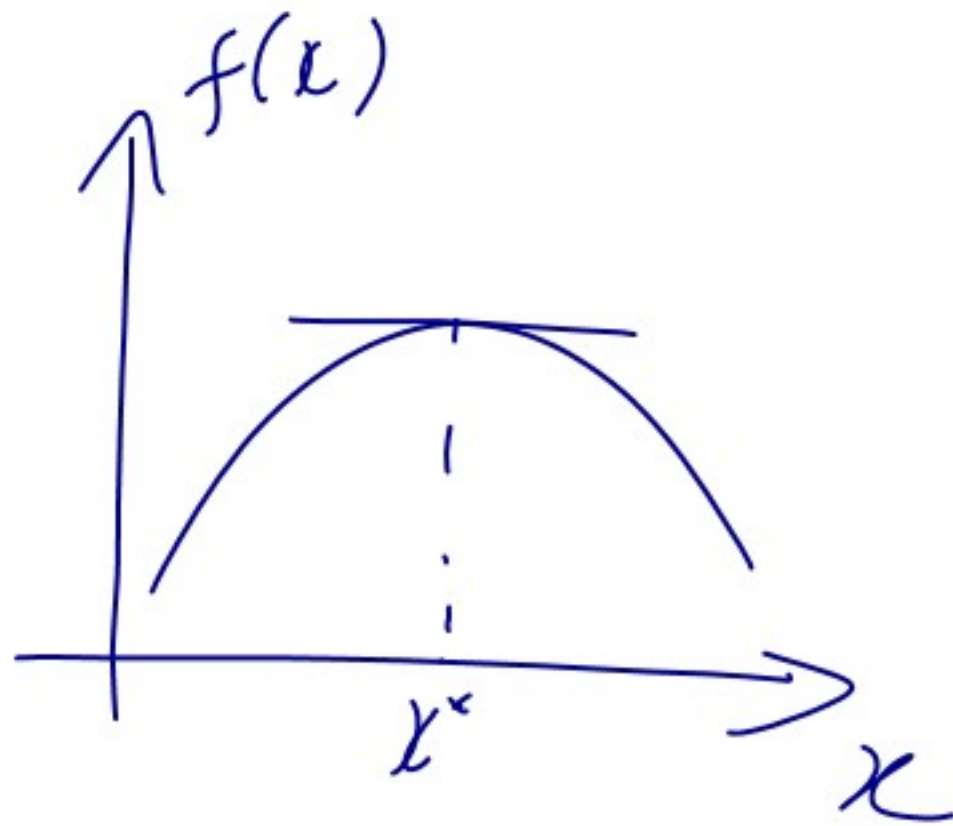
$$\gamma_1 = -1 + \alpha \frac{p_x}{p_y} \left(\frac{I}{p_y} \right)^{\alpha-1} > 0$$

$$\gamma_i = -1 + \alpha \frac{p_x}{p_y} \left(\frac{I}{p_y} \right)^{\alpha-1} > 0$$

$$\frac{\alpha p_x}{p_y p_y^{\alpha-1}} > I^{1-\alpha}$$

$$\frac{\alpha p_x}{p_y} \left(\frac{I}{p_y} \right)^{\alpha-1} > 1$$

$$\left(\frac{\alpha p_x}{p_y^\alpha} \right)^{\frac{1}{1-\alpha}} > I$$



C.I.O $f'(x^*) = 0$ ✓

~~$f'(x) = 0$~~