INSTITUTO POLITECNICO NACIONAL
ESCUELA SUPERIOR DE CÓMPUTO
METODOS CUANTITATIVOS PARA LA TOMA DE DECISIONES

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Multiplicadores LaGrange

2.-

$f(x,y,z) = x^2+y^2+z^2$ → Máximizar

s.a

$$x+y+z=1 \quad (1)$$
$$x+2y+3z=6 \quad (2)$$

$$L(x,y,z,\lambda_1,\lambda_2) = x^2+y^2+z^2-\lambda_1(x+y+z-1)-\lambda_2(x+2y+3z-6)$$
$$= x^2+y^2+z^2-\lambda_1 x-\lambda_1 y-\lambda_1 z+\lambda_1-\lambda_2 x+2\lambda_2 y-3\lambda_2 z+6\lambda_2$$

$$\frac{\partial L}{\partial x} = 2x-\lambda_1-\lambda_2=0$$

$$\frac{\partial L}{\partial y} = 2y-\lambda_1-2\lambda_2=0$$

$$\frac{\partial L}{\partial z} = 2z-\lambda_1-3\lambda_2=0$$

$$\frac{\partial L}{\partial \lambda_1} = -x-y-z+1=0$$

$$\frac{\partial L}{\partial \lambda_2} = -x-2y-3z+6=0$$

$$x=\frac{\lambda_1+\lambda_2}{2}$$

$$y=\frac{\lambda_1+2\lambda_2}{2}$$

$$z=\frac{\lambda_1+3\lambda_2}{2}$$

$$x+y+z=1$$

$$x+2y+3z=6$$

$$\frac{\lambda_1+\lambda_2}{2}+\frac{\lambda_1+2\lambda_2}{2}+\frac{\lambda_1+3\lambda_2}{2}=1$$

$$\frac{\lambda_1+\lambda_2}{2}+2\left(\frac{\lambda_1+2\lambda_2}{2}\right)+3\left(\frac{\lambda_1+3\lambda_2}{2}\right)=6$$

$$\frac{3\lambda_1+6\lambda_2}{2}=1$$

$$\frac{6\lambda_1+14\lambda_2}{2}=6$$

$$3\lambda_1+6\lambda_2=2$$
$$6\lambda_1+14\lambda_2=12$$

$$3\lambda_1+6\lambda_2=2$$
$$-3\lambda_1-7\lambda_2=-6$$
$$-\lambda_2=-4$$

$$\lambda_2=4$$

$$3\lambda_1+6(4)=2$$
$$3\lambda_1=2-24$$
$$\lambda_1=-\frac{22}{3}$$

$$x=-\frac{5}{3} \quad y=\frac{1}{3} \quad z=\frac{7}{3}$$

$$f(x,y,z)=\left(-\frac{5}{3}\right)^2+\left(\frac{1}{3}\right)^2+\left(\frac{7}{3}\right)^2=\frac{25}{3}$$

x	y	z	f(x,y,z)	
$-\frac{5}{3}$	0	0	$\frac{25}{9}$	N.S.
0	$\frac{1}{3}$	0	$\frac{1}{9}$	N.S.
0	0	$\frac{7}{3}$	$\frac{49}{9}$	N.S.
$-\frac{2}{3}$	$\frac{1}{3}$	$\frac{7}{3}$	6	
$-\frac{5}{3}$	$\frac{1}{3}$	$\frac{10}{3}$	10	
$-\frac{5}{3}$	$\frac{4}{3}$	$\frac{7}{3}$	14	
$-\frac{5}{3}$	$\frac{1}{3}$	$\frac{10}{3}$	$\frac{25}{3}$	
$-\frac{8}{3}$	$\frac{4}{3}$	$\frac{7}{3}$	$\frac{38}{3}$	
$-\frac{5}{3}$	$\frac{4}{3}$	$\frac{10}{3}$	$\frac{35}{3}$	
$-\frac{8}{3}$	$\frac{4}{3}$	$\frac{10}{3}$	$\frac{14}{3}$	

Máx $f(x,y,z)=14$

$x=-\frac{5}{3}$

$y=\frac{1}{3}$

$z=\frac{10}{3}$

3.-

$f(x,y) = -2x^2 - y^2 + xy + 8x + 3y$ Máx

s.a

$3{,}000x + 1{,}000y = 100{,}000 \rightarrow 1{,}000(3x+y) = (100)1{,}000 \rightarrow 3x+y = 100$

$L(x,y,\lambda_1) = -2x^2 - y^2 + xy + 8x + 3y - \lambda_1(3x + y - 100)$

$= -2x^2 - y^2 + xy + 8x + 3y - 3\lambda_1 x - \lambda_1 y + \lambda_1 100$

$\frac{\partial L}{\partial x} = -4x + y + 8 - 3\lambda_1 = 0$

$\frac{\partial L}{\partial y} = -2y + x + 3 - \lambda_1 = 0$

$\frac{\partial L}{\partial \lambda_1} = -3x - y + 100 = 0$

$+3\lambda_1 = -4x + y + 8$

$\lambda_1 = \frac{-4x + y + 8}{3}$

$\lambda_1 = x - 2y + 3$

$x - 2y + 3 = \frac{-4x + y + 8}{3}$

$3x - 6y + 9 = -4x + y + 8$

$7x - 7y = -1$

$3x + y = 100$

$y = 100 - 3x$

$7x - 7(100 - 3x) = -1$

$7x - 700 + 21x = -1$

$28x = -1 + 700$

$x = \frac{699}{28} \quad y = \frac{703}{28}$

$f(x,y) = -2\left(\frac{699}{28}\right)^2 - \left(\frac{703}{28}\right)^2 + \left(\frac{699}{28}\right)\left(\frac{703}{28}\right) + 8\left(\frac{699}{28}\right) + 3\left(\frac{703}{28}\right)$

$= -974.982 \rightarrow -974,982$

X	Y	f(x,y)
0	100	-9700000
25	25	-975000
33	1	-1879000
1	97	-9015000
15	55	-2545000
20	40	-1320000
5	85	-6555000
10	70	-4110000
30	10	-1,350,000