# Contents



## 0.1 Inequality constraints

### 0.1.1 Lagrangians with inequality constraints

We can add constraints to an optimisation problem. These constraints can be equality constraints or inequality constraints. We can write constrained optimisation problem as:

Minimise $f(x)$ subject to

$g_i(x) \leq 0$ for $i = 1, \ldots, m$

$h_i(x) = 0$ for $i = 1, \ldots, p$

We write the Lagrangian as:

$\mathcal{L}(x, \lambda, \nu) = f(x) + \sum_{i=1}^{m} \lambda_i g_i(x) + \sum_{i=1}^{p} \nu_i h_i(x)$

If we try and solve this like a standard Lagrangian, then all of the inequality constraints will instead by equality constraints.

### 0.1.2 Affinity of the Lagrangian

The Lagrangian function is affine with respect to $\lambda$ and $\nu$.

$\mathcal{L}(x, \lambda, \nu) = f(x) + \sum_{i=1}^{m} \lambda_i g_i(x) + \sum_{i=1}^{p} \nu_i h_i(x)$

$\mathcal{L}_{\lambda_i}(x, \lambda, \nu) = g_i(x)$

$\mathcal{L}_{\nu_i}(x, \lambda, \nu) = h_i(x)$

As the partial differential is constant, the partial differential is an affine function.