**Previously in MA30087/50087:**

- duality: motivating example

$$\begin{array}{lrcl} \text{maximise} & z & = & 1x_1 + 2x_2 \\ \text{subject to} & 5x_1 + 20x_2 & \leq & 400 \\ & 10x_1 + 15x_2 & \leq & 450 \\ & x_1, x_2 & \geq & 0. \end{array}$$

- maximum is $z = 52$ obtained when $x_1 = 24$ and $x_2 = 14$

**Today in MA30087/50087:**

- consider linear combinations of the constraints, multipliers $y_1, y_2 \geq 0$ such that

$$\begin{array}{rcll} 5y_1 + 10y_2 & \geq & 1 & \quad (x_1 \text{ value in objective}) \\ 20y_1 + 15y_2 & \geq & 2 & \quad (x_2 \text{ value in objective}) \end{array}$$

  which make the upper bound, $400y_1 + 450y_2$, as small as possible

- primal problem (standard maximisation problem)

$$\text{(P)} \quad \begin{array}{lr} \text{maximise} & z = \mathbf{c}^T\mathbf{x} \\ \text{subject to} & \mathbf{A}\mathbf{x} \leq \mathbf{b} \\ & \mathbf{x} \geq \mathbf{0}_n \end{array}$$

- symmetric dual problem (is in standard minimisation form)

$$\text{(D)} \quad \begin{array}{lr} \text{minimise} & z' = \mathbf{b}^T\mathbf{y} \\ \text{subject to} & \mathbf{A}^T\mathbf{y} \geq \mathbf{c} \\ & \mathbf{y} \geq \mathbf{0}_m \end{array}$$

- dual of the dual is the primal
- asymmetric dual of the canonical maximisation problem: no constraints on the sign of the variables