Linear Decision Rule Approach

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1 Original Problem

$$\begin{aligned} \max \quad & \mathbb{E}_{\xi}\left(\sum_{t=1}^{T} \mathbf{v}^{T} \mathbf{x_t}\left(\xi^{t}\right)\right) \\ s.t. \quad & \sum_{t=1}^{T} A \mathbf{x_t}\left(\xi^{t}\right) \leq \mathbf{c} \\ & x_t(\xi^{t}) \leq p_t(\xi) \\ & \forall \xi \in \Xi, t=1, \ldots, T \end{aligned} \tag{1}$$

2 Linear Decision Rule Approach

2.1 Primal Problem

$$\begin{aligned} \max \quad & \mathbb{E}_{\xi}\left(\sum_{t=1}^{T} \mathbf{v}^{T} X_t P_t \xi\right) \\ s.t. \quad & \sum_{t=1}^{T} A X_t P_t \xi \leq \mathbf{c} \\ & X_t P_t \xi \leq p_t^{T} \xi \\ & \forall \xi \in \Xi = \left\{\xi : W\xi \leq h\right\}, t=1, \ldots, T \end{aligned} \tag{2}$$

time complexity

2.2 Duality

Firstly we transform equation(1) into a tighter formulation.

$$\begin{aligned} \max \quad & \mathbb{E}_{\xi}\left(\sum_{t=1}^{T} \mathbf{v}^{T} \mathbf{x_t}\left(\xi^{t}\right)\right) \\ s.t. \quad & \sum_{t=1}^{T} \tilde{A} \mathbf{x_t}\left(\xi^{t}\right) \leq \tilde{\mathbf{c}}_t\left(\xi\right) \\ & \mathbf{x_t}\left(\xi^{t}\right) \geq 0 \\ & \forall \xi \in \Xi, t=1, \ldots, T \end{aligned} \tag{3}$$

Then it has a duality.

$$
\begin{array}{ll}
\min & \mathbb{E}_{\xi}\left(\sum_{t=1}^{T}\tilde{\mathbf{c}}_t\left(\xi\right)\mathbf{y_t}\left(\xi^t\right)\right) \\
s.t. & \sum_{t=1}^{T}\tilde{A}^T\mathbf{y_t}\left(\xi^t\right)\geq\mathbf{v}^T \\
 & \mathbf{y_t}\left(\xi^t\right)\geq 0 \\
 & \forall\xi\in\Xi, t=1,\ldots,T
\end{array}
\tag{4}
$$

3 Numerical Results

3.1 First Case in Re-solve

3.2 Second Case in Re-solve

3.3 Some Tricks