



$n$  )

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BCC

CCR  
BCC

[ ]

$s$   $x_m \dots x_2 x_1$   $n$   $m$   
BCC  $y_s \dots y_2 y_1$   
( $DMU_0$ )  
( )

$$\max E_0 = \sum_{r=1}^s u_r y_{r0} + u_0$$

st.

$$\sum_{i=1}^m v_i x_{i0} = 1,$$

$$\sum_{r=1}^s u_r y_{rj} - \sum_{i=1}^m v_i x_{ij} + u_0 \leq 0, \quad j=1,2,\dots,n,$$

$$u_r, v_i \geq 0, \quad r=1,2,\dots,s, i=1,2,\dots,m$$

w free.

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( )  $y_{rj}$   $x_{ij}$   
 $j$

$u_r$   $v_i$

$y_{rj}$   $x_{i0}$

CCR

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$$\max E_k = \frac{\sum_{r=1}^s u_r y_{rk}}{\sum_{i=1}^m v_i X_{ik}}$$

st.

$$\frac{\sum_{r=1}^s u_r y_{rk}}{\sum_{i=1}^m v_i X_{ik}} \leq 1 \quad k = 1,2,\dots,n,$$

$$u_r \geq 0 \quad r = 1,2,\dots,s$$

$$v_i \geq 0 \quad i = 1,2,\dots,m$$

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$$M^* = \min M \quad (1)$$

s.t.

$$M - d_j \geq 0 \quad j=1,2,\dots,n$$

$$\sum_{i=1}^m w_i x_{ij} \leq 1 \quad j=1,2,\dots,n$$

$$\sum_{r=1}^s u_r y_{rj} - \sum_{i=1}^m w_i x_{ij} + d_j - \beta_j = 0 \quad j=1,2,\dots,n$$

$$\sum_{j=1}^n d_j = n-1$$

$$0 \leq \beta_j \leq 1, d_j \in \{0,1\} \quad j=1,2,\dots,n$$

$$w_i \geq \varepsilon^* \quad i=1,2,\dots,m$$

$$u_r \geq \varepsilon^* \quad r=1,2,\dots,s$$

(2)

$$\pi_o^* = \max \sum_{r=1}^s Y_{ro}$$

s.t.

$$\sum_{r=1}^s Y_{rj} - \sum_{i=1}^m X_{ij} \leq 0$$

$$\sum_{i=1}^m X_{io} = 1$$

$$X_{ij} \in \tilde{D}_i^-$$

$$Y_{rj} \in \tilde{D}_r^+$$

$$X_{ij} \geq 0 \quad \forall i$$

$$Y_{rj} \geq 0 \quad \forall r$$

(3)

$$r \quad x_{ij} \quad y_{rj}$$

$$s. \quad j \quad i$$

m

n

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$$u_r \quad :$$

$$i \quad w_i \quad r$$

$$d_j \quad j$$

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M

d\_j

\beta\_j

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$$u_r \quad w_i$$

\varepsilon^\*

$$( \quad n \quad )$$

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n

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[ ]

\varepsilon^\*

[ ]

$$\begin{aligned}
 & M^* = \min M \\
 & \text{st.} \\
 & M - d_j \geq 0 \quad j=1,2,\dots,n \\
 & \sum_{i=1}^m w_i x_{ij} \leq 1 \quad j=1,2,\dots,n \\
 & \sum_{r=1}^s u_r y_{rj} - u_0 - \sum_{i=1}^m w_i x_{ij} + d_j - \beta_j = 0 \quad j=1,2,\dots,n \quad (1) \\
 & \sum_{j=1}^n d_j = n-1 \\
 & 0 \leq \beta_j \leq 1, d_j \in \{0,1\} \quad j=1,2,\dots,n \\
 & M, u_0 \text{ free} \\
 & w_i \geq \varepsilon^* \quad i=1,2,\dots,m \\
 & u_r \geq \varepsilon^* \quad r=1,2,\dots,s
 \end{aligned}$$
  

$$\begin{aligned}
 & \varepsilon^* = \max \varepsilon \\
 & \text{st.} \\
 & \sum_{i=1}^m w_i x_{ij} \leq 1 \quad j=1,2,\dots,n \\
 & \sum_{r=1}^s u_r y_{rj} - \sum_{i=1}^m w_i x_{ij} \leq 0 \quad j=1,2,\dots,n \quad (2) \\
 & w_i - \varepsilon \geq 0 \quad i=1,2,\dots,m \\
 & u_r - \varepsilon \geq 0 \quad r=1,2,\dots,s
 \end{aligned}$$
  

$$\begin{aligned}
 & \varepsilon^* = \max \varepsilon \\
 & \text{st.} \\
 & \sum_{i=1}^m w_i x_{ij} \leq 1 \quad j=1,2,\dots,n \\
 & \sum_{r=1}^s u_r y_{rj} - u_0 - \sum_{i=1}^m w_i x_{ij} \leq 0 \quad j=1,2,\dots,n \\
 & w_i - \varepsilon \geq 0 \quad i=1,2,\dots,m \\
 & u_r - \varepsilon \geq 0 \quad r=1,2,\dots,s
 \end{aligned}$$
  

$$\begin{aligned}
 & d_j \\
 & \sum_{j=1}^n d_j = n-1
 \end{aligned}$$
  

$$\begin{aligned}
 & u_0
 \end{aligned}$$

$$M^* = \min M$$

st.

$$M - d_j \geq 0 \quad j=1,2,\dots,n \quad ( )$$

$$\sum_{i=1}^m w_i x_{ij} \leq 1 \quad j=1,2,\dots,n$$

$$\sum_{r=1}^s u_r y_{rj} - \sum_{i=1}^m w_i x_{ij} + d_j - \beta_j = 0 \quad j=1,2,\dots,n$$

$$\sum_{j=1}^n d_j = n-1 \quad ( ) \quad \underline{y}_{rj} \leq y_{rj} \leq \bar{y}_{rj} \quad \text{and} \quad \underline{x}_{ij} \leq x_{ij} \leq \bar{x}_{ij} \quad ( )$$

$$0 \leq \beta_j \leq 1, d_j \in \{0,1\} \quad j=1,2,\dots,n$$

$$(x_{ij}) \in \mathcal{Q}_i$$

$$(y_{rj}) \in \mathcal{Q}_r$$

$$w_i \geq \varepsilon \quad i=1,2,\dots,m$$

$$u_r \geq \varepsilon \quad r=1,2,\dots,s$$

$$(y_{rj}) \in \Theta_r^+ \quad (x_{ij}) \in \Theta_i^- \quad ( ) ( )$$

$$s \cdot \quad j \quad x_{ij} \quad y_{rj} \quad i \quad m$$

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$$X_{ij} = w_i x_{ij} \quad \forall i, j$$

$$Y_{rj} = u_r y_{rj} \quad \forall r, j$$

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$$y_{rj} \leq y_{rk} \quad \text{and} \quad x_{ij} \leq x_{ik} \quad \text{for } j \neq k, r \in \text{DO}, i \in \text{DI}$$

$$y_{r1} \leq y_{r2} \leq \dots \leq y_{rk} \leq \dots \leq y_{rn} \quad (r \in \text{DO}), \quad ( )$$

$$x_{i1} \leq x_{i2} \leq \dots \leq x_{ik} \leq \dots \leq x_{in} \quad (i \in \text{DI}), \quad ( )$$

DI DO

( ) ( )

$$y_{r1} < y_{r2} < \dots < y_{rk} < \dots < y_{rn} \quad (r \in \text{SO}), \quad ( )$$

$$x_{i1} < x_{i2} < \dots < x_{ik} < \dots < x_{in} \quad (i \in \text{SI}), \quad ( )$$

SI SO

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	( )
	:
	( )
$d_1^* = 1$	/
$d_2^* = 1$	/
$d_3^* = 1$	/
$d_4^* = 0$	
$d_5^* = 1$	/
$d_6^* = 1$	
$d_7^* = 1$	/
$d_8^* = 1$	
$d_9^* = 1$	
$d_{10}^* = 1$	/
$d_{11}^* = 1$	
$d_{12}^* = 1$	/
$d_{13}^* = 1$	/
$d_{14}^* = 1$	
$d_{15}^* = 1$	/
$d_{16}^* = 1$	/
$d_{17}^* = 1$	
$d_{18}^* = 1$	/

$$\Theta_2^- = \{x_{218} \geq x_{216} \geq \dots \geq x_{217}\}$$

:( ) •

$$\Theta_1^+ = \left\{ \begin{array}{l} 50 \leq y_{11} \leq 65, 60 \leq y_{12} \leq 70, \\ 40 \leq y_{13} \leq 50, \dots, 90 \leq y_{118} \leq 150 \end{array} \right\}$$

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:

$$\tilde{D}_1^- = \left\{ \begin{array}{l} X_{11} = 253w_1; X_{12} = 268w_1; X_{13} = 259w_1 \\ \dots, X_{118} = 216w_1 \end{array} \right\}$$

$$\tilde{D}_2^- = \{X_{218} \geq X_{216} \geq \dots \geq X_{217}\}$$

$$\tilde{D}_1^+ = \left\{ \begin{array}{l} 50\mu_1 \leq Y_{11} \leq 65\mu_1; 60\mu_1 \leq Y_{12} \leq 70\mu_1 \\ 40\mu_1 \leq Y_{13} \leq 50\mu_1; \dots; 90\mu_1 \leq Y_{118} \leq 150\mu_1 \end{array} \right\}$$

$\varepsilon^*$  ( )

( ) WinQSB

$\varepsilon^*$  /

( )

(  $d_4^* = 0, d_{j \neq 4}^* = 1$  ) ( )

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- 1- Data Envelopment Analysis (DEA)
- 2- Imprecise Data
- 3- Interval Data
- 4- Ordinal Data
- 5- Supplier Selection
- 6- Input Oriented
- 7- Ratio Scale
- 8- Imprecise Data
- 9- Imprecise Data Envelopment Analysis (IDEA)
- 10- Stochastic Models
- 11- Strong Ordinal Data
- 12- Supply Chain Management (SCM)
- 13- Total Cost of Shipments (TC)
- 14- Supply Chain Management (SCM)
- 15- Number of bills received without errors (NB)