Bilkent University

IE 400 - Principles of Engineering Management

Project

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Contents

1 Integer Programming Model

Let $x_{ij}^{(t)}$ be the indicator of whether a link exists between node i and j at time t.

Let $y_{ij}^{(t)}$ be the indicator of whether node i and j are connected at time t.

Let c_{ij} be the cost of the link between node i and node j.

Let $r_{ij}^{(t)}$ be the revenue gained by the connectivity of node i and node j.

Let

$S = \{(1,2),(1,3),(1,4),(1,5),(1,6),(1,7),$
$(2,3),(2,4),(2,5),(2,6),(2,7),$
$(3,4),(3,5),(3,6),$
$(4,5),(4,6),(4,7),$
$(5,6),(5,7),$
$(6,7)\}$

maximize	$\sum_{i=2}^{7}\sum_{j=i}^{7} y_{ij}^{(t)}(r_{ij}-c_{ij})$	
subject to		
A link continues its existence:		
$x_{ij}^{(1)} \leq x_{ij}^{(2)}$,	$(i,j) \in S$	$t \in \{1,2\}$
All nodes must be connected:		
$y_{ij}^{(2)} = 1$	$(i,j) \in S$	
Ring network at end of first year:		
$2 - \sum_{\forall(i,j)} 20(1-y_{ij}^{(1)}) \leq 0$	$(i,j) \in S$	$t \in \{1,2\}$
$\sum_{\forall(i,j)} 20y_{ij}^{(1)} \leq 0$	$(i,j) \in S$	$t \in \{1,2\}$
Defining connectivity:		
$x_{ij}^{(t)} \leq y_{ij}^{(t)}$	$(i,j) \in S$	$t \in \{1,2\}$
$y_{ij}^{(t)} + y_{jk}^{(t)} - 1 \leq y_{ik}^{(t)}$	$t \in \{1,2\}$	$(i,j) \in S$; $(j,k) \in S$; $(i,k) \in S$
IP constraints:		
$x_{ij}^{t} \in \{0,1\}$	$(i,j) \in S$	$t \in \{1,2\}$
$y_{ij}^{(t)} \in \{0,1\}$	$(i,j) \in S$	$t \in \{1,2\}$