

ISYE 4133 March Madness IP

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Objective

Maximize expected number of points awarded based off a team's win probability.

Decision Variables

Note: round $k = 0$ refers to round 1 and team $i = 0$ refers to team 1

$$x_{ik} = \begin{cases} 1 & \text{if team } i \text{ wins round } k, \\ 0 & \text{o/w} \end{cases}$$

p_{ik} = probability that team i wins round k , $\forall i \in [0, 63]$, $k \in [0, 5]$

Integer Program

$$\max \sum_{k=0}^5 (2^k \sum_{i=0}^{63} p_{ik} x_{ik})$$

s.t.

$$\sum_{k=n}^5 x_{ik} = (6 - n)x_{i,n-1} \quad \forall i \in [0, 63], n \in [1, 5] \quad \text{cannot win future rounds if loss in previous round}$$

$$\sum_{a=0}^1 x_{2p+a, 0} = 1 \quad \forall p \in [0, 31] \quad \text{only one winner per matchup in round 1}$$

$$\sum_{a=0}^3 x_{2p+a, 1} = 1 \quad \forall p \in [0, 31] \quad \text{only one winner per matchup in round 2}$$

$$\sum_{a=0}^7 x_{2p+a, 2} = 1 \quad \forall p \in [0, 31] \quad \text{only one winner per matchup in round 3}$$

$$\sum_{a=0}^{15} x_{2p+a, 3} = 1 \quad \forall p \in [0, 31] \quad \text{only one winner per matchup in round 4}$$

$$\sum_{a=0}^{31} x_{2p+a, 4} = 1 \quad \forall p \in [0, 31] \text{ only one winner per matchup in round 5}$$

$$\sum_{a=0}^{63} x_{2p+a, 5} = 1 \quad \forall p \in [0, 31] \text{ only one winner per matchup in round 6}$$

The following constraint is added for part e

$$\sum_{i=0}^{63} x_{ik} = 62 \quad \forall k \in [0, 5]$$

The following constraints are added for part h

Upset constraints

$$x_{5, 0} + x_{21, 0} + x_{37, 0} + x_{53, 0} \geq 1$$

$$x_{9, 0} + x_{25, 0} + x_{41, 0} + x_{57, 0} \geq 1$$

$$x_{13, 0} + x_{29, 0} + x_{45, 0} + x_{61, 0} \geq 1$$

$$x_{3, 0} + x_{19, 0} + x_{35, 0} + x_{51, 0} \geq 2$$

Upper seed limit

$$x_{0, 3} + x_{16, 3} + x_{32, 3} + x_{48, 3} \leq 3$$