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! Check whether a sports team can end the season with more
wins than any other team, and thus win the pennant ;
! We maximize Z = excess wins of team Kchk over every other team.
If we solve this model as an LP and Z <= 0, then clearly team Kchk
cannot win the pennant outright;
! Ref: Robinson, L. (1991), "Baseball playoff eliminations: An application
of linear programming," Operations Research Letters, North Holland, vol 10, pp. 67-74;
! Wayne, K, (2001), "A New Property and a Faster Algorithm for Baseball Elimination,"
SIAM J. Discrete Math., vol 14 no 2, pp 223-229;
! Keywords: Baseball, Elimination, LINGO, MLB, Pennant, Playoff, Robinson, Sports, Wayne;
SETS:
TEAM: WINS, WFin;
TxT( TEAM, TEAM) : NRem, W ;
ENDSETS

DATA:
MAKINT = 0 ; ! 1: wins must be an integer, 0: can be fractional;
! The teams;
!Case01 TEAM = CARDS CUBS CINCY METS;
! Wins so far, each team;
!Case01 WINS = 79 79 81 81;
!Case01 KChk = 1; ! Check whether the CARDS can win most games;
! Games remaining for each i and j;
!Case01
NREM = 0 3 0 0
3 0 0 0
0 0 0 3
0 0 3 0 ;
! The CARDS could finish with 79 + 3 = 82 wins.
This would beat CINCY if CINCY lost all remaining games.
Could CARDS have a better record than every other team?;

! The teams;
!Case02; TEAM = ATLANTA PHILLY NEWYORK MONTREAL;
! Wins so far, each team;
!Case02; WINS = 83 79 78 76;
!Case02; KChk = 4; ! Check whether the Montreal can win most games;
! Games remaining for each i and j. Matrix must be symmetric;
!Case02;
NREM = 0 1 6 1
1 0 0 3
6 0 0 1
1 3 1 0 ;
ENDDATA

SUBMODEL StillPoss:
! Is it still possible for team KChk to win more games than any other
team by the end of the regular season;
! Parameters:
WINS( j) = wins so far by team j,
LOSS( j) = losses so far by team j,
NRem( i, j) = number remaining games between i and j,
NTot = total games in season played by each team,
KChk = index of the team we wish to check,
Variables:
W( i, j) = number times team i wins against team j
in remaining games,
WFin( j) = final number of wins for team j
Z = number games by which team KChk has more wins than any other team;

@FOR( TxT( i, j) | i #LT# j:
! Each pair plays each other the requisite number remaining games;
[PLAY] W( i, j) + W( j, i) = NREM( i, j);
);

@FOR( TxT( i, j) | MAKINT #AND# i #LT# j:
@GIN( W( i, j)); ! W should be a general integer;
);

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! Compute final wins for each team;
@FOR( TEAM( i):
  [FINAL] WFin( i) = WINS( i) + @SUM( TxT( i, j) | i #NE# j: W( i, j));
  );
@FREE( Z); ! It could be negative;
! Z <= difference for every other team j;
! Difference in final wins of team KChk - team i;
@FOR( TEAM( j) | j #NE# KChk:
  [BEAT] Z <= WFin( KChk) - WFin( j);
  );
  MAX = Z;
ENDSUBMODEL

CALC:
@SET( 'TERSEO',2); ! Output level (0:verb, 1:terse, 2:only errors, 3:none);
@SET( 'PRBLVL', 1);! Integer probing level (0:LINGO, 1:none, 7:high);
! @GEN( Stillposs);
@SOLVE( StillPoss);
@WRITE( ' Best possible excess wins for team ', TEAM( KChk), ' is ', Z, @NEWLINE( 1));
@IFC( Z #LE# 0:
  @WRITE( TEAM ( KChk), ' cannot win the pennant.', @NEWLINE( 1));
  );
ENDCALC

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