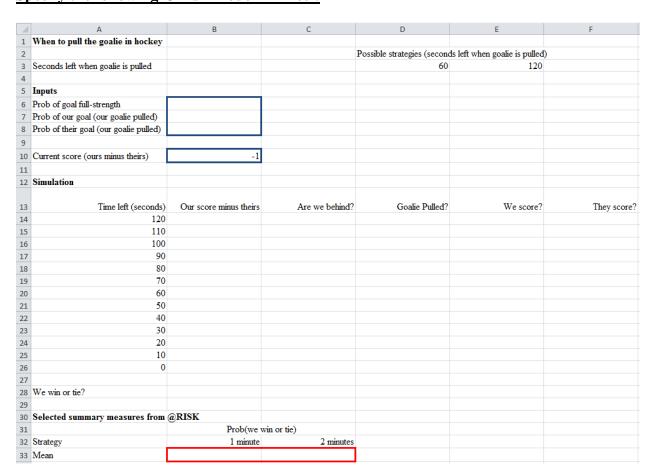# Example: When to pull the goalie in hockey

When his team is behind late in the game, a hockey coach usually waits until there is one minute left before pulling the goalie out of the game. Using simulation, it is possible to show that coaches should pull their goalies sooner. Suppose that if both teams are at full strength, each team scores an average of 0.05 goal per minute. Also, suppose that if you pull your goalie you score an average of 0.08 goal per minute and your opponent scores an average of 0.12 goal per minute. Suppose you are one goal behind. Compare the following two strategies:
- Pull your goalie if you are behind at any point in the last minute of the game; put him back in if you tie the score.
- Pull your goalie if you are behind at any point in the last two minutes of the game; put him back in if you tie the score.

Simulate the game using 10-second increments of time. Use the RISKBINOMIAL function to determine whether a team scores a goal in a given 10-second segment. This is reasonable because the probability of scoring two or more goals in a 10-second period is near zero.

Which strategy provides a higher probability of winning or tying the game?

Specify the following @Risk Model in Excel:

	A	B	C	D	E	F
1	When to pull the goalie in hockey					
2				Possible strategies (seconds left when goalie is pulled)		
3	Seconds left when goalie is pulled			60	120	
4						
5	Inputs					
6	Prob of goal full-strength					
7	Prob of our goal (our goalie pulled)					
8	Prob of their goal (our goalie pulled)					
9						
10	Current score (ours minus theirs)	-1				
11						
12	Simulation					
13	Time left (seconds)	Our score minus theirs	Are we behind?	Goalie Pulled?	We score?	They score?
14	120					
15	110					
16	100					
17	90					
18	80					
19	70					
20	60					
21	50					
22	40					
23	30					
24	20					
25	10					
26	0					
27						
28	We win or tie?					
29						
30	Selected summary measures from @RISK					
31		Prob(we win or tie)				
32	Strategy	1 minute	2 minutes			
33	Mean					

Results:

	A	B	C	D	E	F	G
1	**When to pull the goalie in hockey**						
2				Possible strategies (seconds left when goalie is pulled)			
3	Seconds left when goalie is pulled	60		60	120		
4							
5	**Inputs**						
6	Prob of goal full-strength	0.0083					
7	Prob of our goal (our goalie pulled)	0.0133					
8	Prob of their goal (our goalie pulled)	0.02					
9							
10	Current score (ours minus theirs)	-1					
11							
12	**Simulation**						
13		Time left (seconds)	Our score minus theirs	Are we behind?	Goalie Pulled?	We score?	They score?
14		120	-1	1	0	0	0
15		110	-1	1	0	0	0
16		100	-1	1	0	0	0
17		90	-1	1	0	0	0
18		80	-1	1	0	0	0
19		70	-1	1	0	0	0
20		60	-1	1	1	0	0
21		50	-1	1	1	0	0
22		40	-1	1	1	0	0
23		30	-1	1	1	0	0
24		20	-1	1	1	0	1
25		10	-2	1	1	0	0
26		0	-2	1	1	0	0
27							
28	We win or tie?	0					
29							
30	**Selected summary measures from @RISK**						
31		Prob(we win or tie)					
32	Strategy	1 minute	2 minutes				
33	Mean	0.112	0.132				

Which strategy provides a higher probability of winning or tying the game?