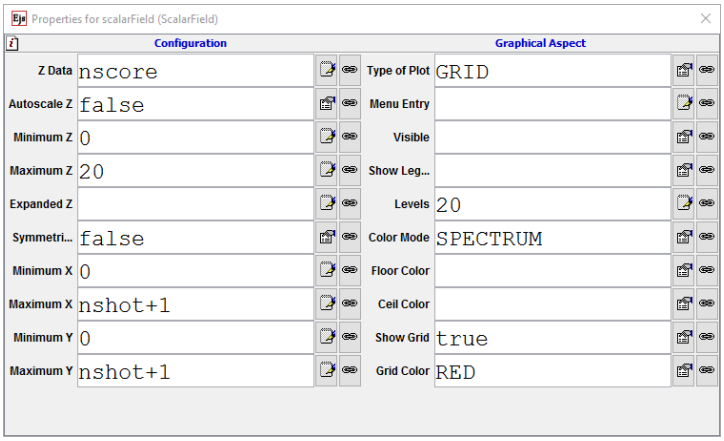
Scoring from centre-ice

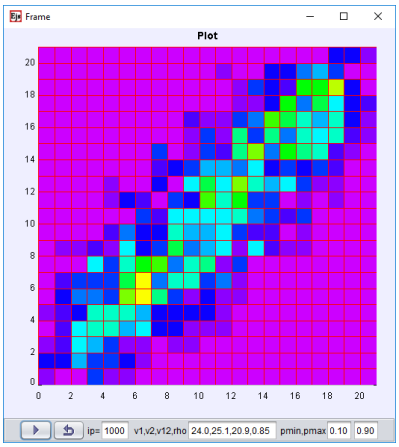
For this lab, you develop an EJS simulation of ice hockey players attempting to shoot pucks into open nets from centre ice. There are two nets, one on each side of the ice, and the players are given 20 attempts to score into each net (a total of 40 attempts).

Assume that each attempt is independent so that you can model a player's total score into each net as an outcome of a binomial random variable, with $N_{\text{shot}} = 20$ and scoring probability p. Some players are more skilled at this than others, which means that some players have a larger scoring probability than others do.

With EJS, construct a simulation of this setup and show the distribution of the pairs of total scores for the players. To do this, define a 2D array of type double (do not use type int), `nscore[nshot+1][nshot+1]`, and initialize the 21^2 elements to be zero. Visualize this with a grid, using a "Scaler Field" (look in 3rd tab within 2D drawables). Set the properties as shown in the left figure below.

For each step in the evolution, simulate the two sets of attempts for a single player. First assign a scoring probability for the player by assuming it is uniformly distributed between p_{min} and p_{max}. Simulate `nshot` attempts at each net and increment by one the array element `nscore[score1][score2]` (where `score1` and `score2` are the total scores into each net for the player). The right figure shows the result of a simulation of 1000 players, with $p_{\text{min}} = 0.1$ and $p_{\text{max}} = 0.9$. Grid elements with brighter colors have more entries. Magenta corresponds to 0 entries.





To speed up the visualization, change SPD to 100 in the evolution. Calculate the sample variances, covariance, and correlation coefficient after each new player is included. Do the following:

1. For $p_{\text{min}} = p_{\text{max}} = 0.5$, all players have the same skill. Analytically calculate the variances and covariance for this situation. Compare to the sample variances and sample covariance from the simulation.

(continued)

2. With $p_{\min} = 0.1$ and $p_{\max} = 0.9$, there is a wide range of player skill. Report the sample variances and covariance for this situation. Explain why the sample variances are larger and the sample correlation is positive.
3. The expected score for a player is $N_{shot}\ p$. Using a uniform distribution for p from $p_{\min}$ to $p_{\max}$, find the variance of the expected scores. Compare this calculation to the sample covariances for several choices of $p_{\min}$ and $p_{\max}$.

Answer the questions on the description page of the EJS simulation.

As usual, submit your work as *yourname_lab05.ejs* to the course website for grading.