A Game of Screens

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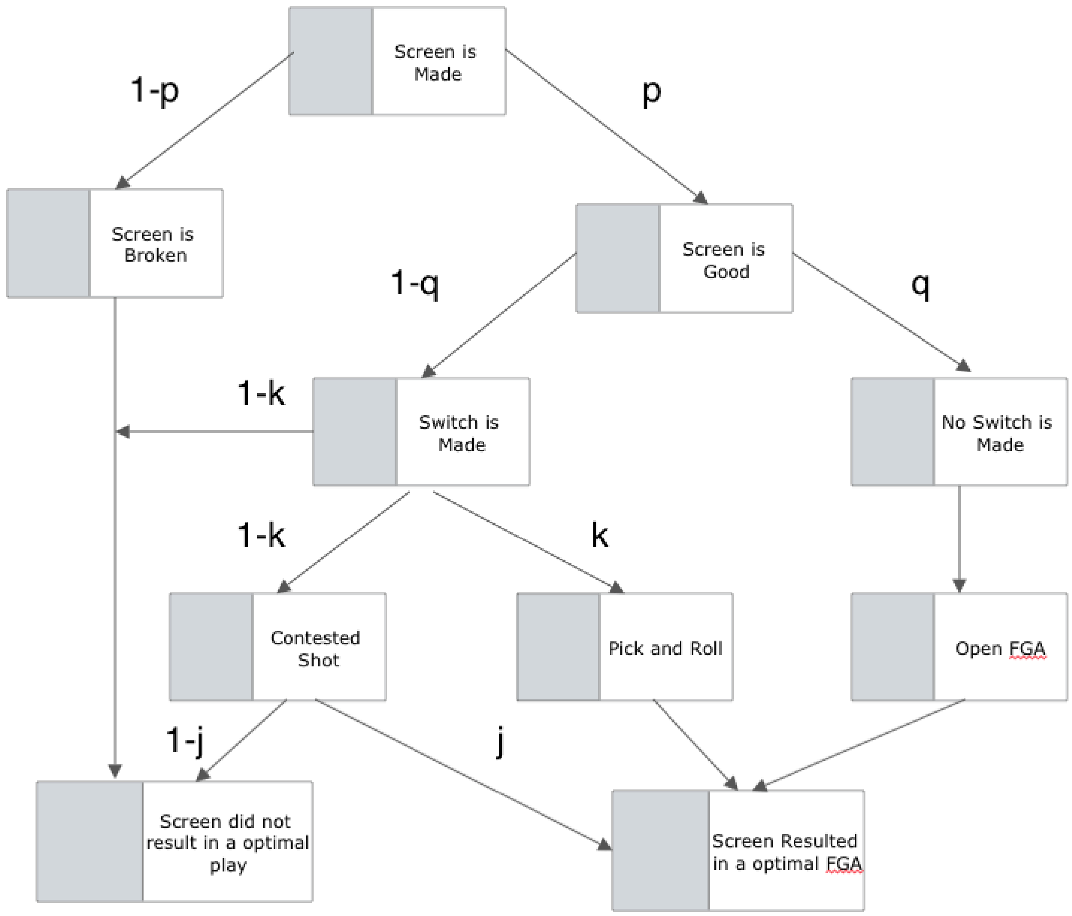
A screen is when an offensive player legally blocks the path of a defender to open up another offensive player for a shot or to receive a pass. Screens are useful to help create spacing for players to cut, drive or shoot. Essentially the end goal of a screen is to give a teammate a more optimal FGA. Screens are one of those things in the game that isn't measurable or calculable and doesn't even have a statistic to measure it. This why I had a large debate with myself over my decision to record, what Coach Ken said looked like a child's drawing, the screens and screen results of the game McMaster university played against Waterloo university. Now there was a large possibility that non of this would work and it was useless data but if we look a little closer, we can figure out what actually happens and how we can turn this into a formula to help us make coaching decisions. Let's begin by looking at this logistically. Now when player A goes to set a screen against the opposition (we'll call him player B) several things can occur. Player B can break the screen or player A can hold the screen. If Player A can hold the screen then we have another set of events that can occur. The player the screen is set for can get a guarded shot (assuming if you are open you take the shot) , or a switch can occur and the player will get a contested play. This play can either be a pick and roll, a contested shot, or a "failed play" which results in passing the ball of to someone else or simply dribbling around or driving to the basket while guarded (ie. not optimal plays).
Before we examine the following flow chart, we must acknowledge some assumptions and probablities:

- p = the probability that the screen worked (logically the probability the screen was broken is 1-p).
- q = the probability that the defence is prepared and they make the switch (1-q indicates they didn't).
- k = the probability that after a switch is made that player setting the pick is open for the pick (while 1-k could mean that the center is not open, it could also mean that there was no correct play and regardless the play broke down into a non-optimal result).
- j = the probability that the the contested shot or drive off the screen was perhaps effective whether it be through favourable switch or to an excellent shooter.



Now it is very simple to simply try to find each end result simply as a conditional probability but what if we tried to be more accurate and include more intuitive approaches in our thinking. If a coach notices through out the game that certain tactics are working stronger that others, he is more likely to keep running that play and try to take advantage of it. We will use that assumption in our model. The more effective the screen is, the rate at which the coach runs a play will increase. Lets denote β to be a screen being ran. We can say since these are 'rates' we are dealing with that they can technically be classified as a differential equation. We present the following equation:

$$\frac{d\beta}{dt} = pq\beta + p(1-q)k\beta + p(1-q)(1-k)j\beta$$

By creating this equation we know a lot of things. We are able to show that there are only 3 correct scenario's when setting a screen and that there is a probability to decide whether to even run the screen. What I mean by this is, if we were to solve for the stability and equilibrium of the model, we would find that the probabilities of each respective state directly tell us the perceived out come. If we take the Jacobian ($\alpha = \beta'$) of our model we can find the stability of our model and see how often we should really be running the play.

$$\alpha = p(q + k - qk + 2j - jq - jk + jkq)$$

By doing this we have found the true probability determining whether the screen should be set. What this essentially does is set values around 1 and tells us almost like a likelihood probability of the occurrences. Typically there is a high percentage of he screen holding up, lets assume roughly 90%. This is now where we decide based on other factors. If we know the opposition has a good defence, they will have a high defensive efficiency and a high switch rate on screens therefor earning them a low q value (60%). If they have a low efficiency rating we can presume that giving them a high q value is appropriate (80%). Similarly we look at the k parameter and decide what is the true probability of our player actually getting the pick and roll opportunity off of the screen (typically this number is rather low ie.20% - 30%). Same thing goes for our j parameter, it is relatively small (20%). So now we can tell from entering our values into our formula that if our value is above 1, the team should be running multiple screens and the higher the value above 1, the more screens the team should run. If the value is below 1, the team should not run screens as often because the other team is clearly going to be able to counter them. Lets look at an example of this. If you are up against a team with a high defensive efficiency, you can assume they will be switching often giving a $q = 50\%$. This also affects the j value as it will be lower, lets say 17%. Finally our k value will be average because this is more of a match-up dependant probability so it depends how good your center is. For this example, we will stick with 20%. This gives us a final α value of 0.7542 which tells us well in advance that the screen plays may not be the ideal method to generate offence. If we are facing a team with bad defence we can say that there will be the following values: $q = 80\%$ $k = 20\%$ $j = .25$, which results in an α value of 1.017.

This equation can help coaches decide how many times to play screen plays based on knowing how effective they will be before the game even begins. This allows the coach to properly set plays and have a well optimized offence.