MagicMetric History

The MagicMetric was a basketball player rating system invented by Dick Mays and Jeff Gantner in the late 1990s. It was an acronym for the MAys and Gantner Index of Contribution, (i.e. MAGIC). The formula has been quoted in various reference sources as:

MM = (1.8 FG2made) + (0.9 FreeThrowmade) + (3 FG3made) + (0.65 Rebounds) + (0.9 Assists) + (0.8 Blocks) + Steals - (0.65 MissedFieldGoals) - (0.5 MissedFreeThows) – Turnovers

On a per minute basis, the MagicMetric per minute statistic is sometimes abbreviated MM/m or mmm.

For four years the website www.magicmetric.com, tracked and recorded NBA player statistics on a daily basis. The site also recorded season ending statistics for 4000+ NCAA players each season during this time. The rating gathered a small following on the Internet and was picked up and quoted in Sports Ticker ranking of college players.

MagicMetric Variations

The value placed on the coefficients was determined by solving a set of linear equations; however, these equations rely heavily on one single factor which may vary based on the skill level of the players. The single most important factor which affects the values of the coefficients is the average points per possession. In a league of young players, the average points scored per possession might be quite low. If the above formula was used in a league of eight year olds, it would not provide sufficient valuation for scoring, and would overstate the value of rebounds and steals.

The Magic Metric formula listed above was based on an average of slightly about 1 point per possession, which is a compromise for NBA, high school and college level play.

Derivation of the Magic Metric

Eleven statistics are commonly available from box scores. These statistics do not measure all of the contributions of various players, for instance, taking a charge is not generally counted the same as stealing the ball, but it has the same net contribution. The statistics kept can be broken into 7 contributing factors, and 3 demerit or negative factors. Fouls are not considered in the Magic Metric as they could be positive, negative, or neutral depending on why the foul was incurred.

Contributing Factors:
FG2 = 2 point FG made.
FG3 = 3 point FG made
FT1= Free Throws Made
REB = Rebounds
AST = Assists
STL = Steals
BLK = Blocks

Negative Factors
FGM = Field Goals Missed
FTM = Free Throw Missed
TOV = Turnovers

The total contribution a player makes that is measurable is some linearly weighted sum of the positive factors, minus a similarly weighted negative factors. The problem is to determine the value of the coefficients of the following equation:

Total Contribution = C1*FG2 + C2*FG3 + C3*FT1 *C4REB +C5*AST+C6*STL+C7*BLK – D1*FGM – D2*FTM –D3*TOV.

TENDEX is a formula, created by David Heeren, in which the value of these coefficients are subjectively determined. The MagicMetric provides some stronger mathematical reasoning to derive the value of the coefficients. The core formulas are:

Formula 1: C4 = D1 *miss a shot and grab a rebound, results in zero contribution*.

Formula2: C6 = D3 *steal a ball and turn it over results in zero contribution*

Formula3: C2*2 –D1*4 = C1*3 –D1*3 *relates three point scoring to two point scoring*

Formula 3 is the biggest difference from TENDEX, because it recognizes a stronger contribution for three point shots. If I take six three pointers and hit two, it has the same contribution as taking six 2 point shots and hitting 3 of them.

These first three formulas are hard to argue, and any linear weighting formula that doesn't yield these identities is not following the same logic used by the MagicMetric.

Now we begin to get into formulas that are in part derived from statistical inferences based on observation data.

Formula 4: D3 = .65*D1 *relates missed shots to turnovers*

This is based on watching real games more than just using game statistics. Technically, a tip in should count as a rebound plus a field goal made, but sometimes the rebound is not given to the player making the tip in. Watching many NBA games it appears that the offensive team gets the ball on a missed shot 35% of the time. Or roughly 2 out of 3 rebounds are recovered by the defensive team. This appears to be approximately the same ratio in church league and high school games. It might not hold true as the competition level decreases, but is probably a pretty good approximation for a wide variety of skill levels.

Formula 5:

C5 = .5*C1 *makes an assist worth ½ a FG2.*

In the NBA, the average FG% was 46% for the first season we collected stats. We monitored about ten games, to determine the likelihood that an assist will contribute to a FG made. In the NBA, over ½ of the made shots have an assist attributed to them, but less than ½ of the shots taken are "assist eligible." This is a guess as we have to predict whether an assist would have been given on a shot that was missed, had the player made the shot. It appears that assist eligible shots are over 20% more likely to be made than shots in which an assist would not be given. This is a huge increase in the prospects for making the shot, and thus it seems fair to award half as much credit to the person making the assist.

Formula 6
C7 = (C6 + C4)/2 *a block is worth less than a steal but more than a rebound.*

This formula says a blocked shot is worth between a rebound and a steal. Cleary a block should be worth at least as much as causing a missed shot, (thus the same as a rebound). However, not every block results in a change of possession, so it is not worth as much as a steal. However, it does appear to be worth more than simply causing a missed shot as there is an additional intimidation factor which may affect other shots. So it appears reasonable to just split the difference.

Formula 7:
2*C3 = C1 ; *Two free throws should be worth as much as a two point Field goal.*

Same net result.

Formula 8
2*D2 = . *D3 *missing a free throw is half as bad as a turnover*

When you miss two free throws, you have almost the same result as turning the ball over, as the defending team gets possession of the ball over 80% of the time. You could make this formula 2D2 = .8*D3, except that it does not account for how bad it is to miss the front end of a 1 and 1. It is actually much worse to miss the front end of a one-and-one than the second shot, as it is eighty percent as bad as a turnover, however no one keeps stats on whether it is a one-n-one situation or which shot was missed, so we just err on the side of caution and say two free throws missed is equal to a turnover.

The preceding 8 equations construct much of the relative value for solving our Total Contribution formula. However, the formula has ten unknowns, and to solve for it we need ten equations. We need two more formulas.

How much is a steal worth relative to a three point goal? This depends on the level of play of a league. If the average points per possession is 1 point, then it seems that a three point goal provides three times more contribution than stealing the ball. If the league is a bunch of eight year olds, then a three point goal should be worth a good deal more relative to a steal.

To be more precise, we need to introduce a the concept of APP, average points per possession. But for our first derivation of the MagicMetric, we just assumed it to be about one, which yielded formula 9.

Formula 9:
C2 = 3*C6. *a three point goal provides three times the contribution of a steal.*

*More precisely we would state C2 = 3*C6/APP*

We wanted a simple formula, to make keeping track of things easier, and we wanted the Total Contribution to approximately equal the total points scored. We had a full season of statistics available to us, so we could plug in the values and solve for the coefficients. We actually did this exercise, and the value for C2 was so close to 3 as to be statistically insignificant.

So Formula 10 is simply C2 = 3.

Making this simplification, and plugging back into the formula with our season stats, we more closely approximated the actually points scored by making a block worth .8 rather than .82. So we making these simplifications we have ten formulas and ten unknowns and can rewrite the equations using average points per possession as follows:

MM = C1*FG2 + C2*FG3 + C3*FT1 *C4REB +C5*AST+C6*STL+C7*BLK – D1*FGM – D2*FTM –D3*TOV.

D3 = C6 = APP
C4 = D1 = APP *.65
C7 = APP *.8
D2 = APP*.5
C2 = 3
C1*3 –D1*3 =C2*2 –D1*4 so **C1 = (6 - .65*APP)/3**
C3 = C5 = (6 - .65*APP)/6

APP	FG2	FG3	FT	REB	AST	STL	BLK	FGm	FTm	TOV
1.2	1.74	3	0.87	0.78	0.87	1.2	0.96	-0.78	-0.6	-1.2
1	1.78	3	0.89	0.65	0.89	1	0.8	-0.65	-0.5	-1
0.8	1.82	3	0.91	0.52	0.91	0.8	0.64	-0.52	-0.4	-0.8
0.6	1.87	3	0.93	0.39	0.93	0.6	0.48	-0.39	-0.3	-0.6
0.4	1.91	3	0.95	0.26	0.95	0.4	0.32	-0.26	-0.2	-0.4

Thanks to Jose Antonio Martinez Garcia for soliciting this information, and helping to keep the MagicMetric alive.