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# 9 Risk Level

## 9.1 Pot Odds

The pot odds are the ratio of the amount to bet (call) to the amount to win (pot size).

If the pot would be P and the amount to call C, then the pot odds would be P:C[1].
To get percentages, the size of the call amount within the pot has to be calculated.[2]

$$O = {}^{C}/_{(P+C)}$$

If a player has a win percentage of W, a call is justified as long as the odds do not exceed this level.

$$O \leq W$$

Note: This does not take in count other strategies besides pure math like bluffing (where lower win percentages are played to steal the pot when the opponent folds) or disguising (where the action is slightly randomized to hide the own strategy).

Note 2: Implied pot odds increase the pot by guessing how many of the remaining players would call as well, which gives a larger number of hands that can be played.

$$O = {}^{C}/_{(P+C+X)}$$

## 9.2 Call vs Raise

When calculating the limit below which a call is profitable, a player has to take in count the actual pot P and the amount to call C. Whatever money was paid to the pot by him in previous rounds, is of no interest (the choice is either to stay in the game or to loose what was already paid).

$$O_C = {}^{C}/_{(P+C)}$$

When calculating the limit R for a raise, the situation is different. The money previously paid M is not lost if no raise is chosen.
(1) The player should look that the overall game remains in a profitable range, thus not betting any money (including what was paid before) above this limit.
(2) If a player raises, at least one player must raise, too.

$$O_R = {}^{(M+C+R)}\Big/_{(P+C+2R)}$$

Note: As on the call calculation, implied pot odds can increase the pot by guessing how many of the remaining players (in addition to the one that is required to call the raise) will call as well.

$$O_R = {}^{(M+C+R)}\Big/_{(P+C+2R+X)}$$

[1] a pot of 90€ and a call of 10€ would give a ratio of 90:10 or 9:1
[2] a pot of 90€ would be of size 100€ after a call of 10€, which gives a percentage of 10/100 = 10%

## 9.3 Examples

(1)
The pot contains 800€ from which 160€ (20%) are paid by the player. In 1000 games this would add up to 160.000€.
With a winning chance of 20%, 200 of these games would be won returning 800€ on each of them, thus winning 200*800=160.000€ in total.
→ the game is equaled, as $O_{20} = W_{20}$

(2)
If the player would have paid 180€ within these 800€ (22.5%),1000 games would add up to 180.00€, thus 20.000€ less than the winning sum (on 20% winning chance).
→ the game is unfavorable, as $O_{22.5} > W_{20}$

(3)
The pot contains 700€ from which 120€ (17%) are paid by the player. 100€ are required to call (12.5%) with a winning chance of 15%.
In 1000 games, 100.000€ must be invested to call, where 150 games would be won with a return of 800€ each (120.000€ in total).
→ the game is favorable, as $O_{12.5} < W_{15}$

(4)
The pot contains 800€ from which 120€ (15%) are paid by the player (including the call). The winning chance is 20%.
The overall paid money 120€+R should not be above 20% of the overall pot 800€+2R (after one opponent called the raise).

$$120 + R = (800 + 2R) \cdot 20\%$$
$$120 + R = 160 + 0.4R$$
$$0.6R = 40$$
$$0.6 = 66.66$$

→ the game is favorable as long as less than 66.66€ are raised