How to Calculate Asian Handicap Odds

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Note! This is a guide for determining the right Asian Handicap odds - not an introduction to Asian Hadicap betting. To make good use of the information provided here, the reader needs estimated probabilities (1X2) for the matches and being familiar with Asian Handicap betting is an advantage. (Mathematical proofs are also presented at the end of the paper, altough understanding them is not required to be able to use the formulas.)

1.1 Preface

Quarter ball is Asian Handicap's very own and unique curiosity. In addition to normal half ball lines Asian Handicaps also contain the possibility to win or lose half of the stake. The purpose of this is to make the odds as close to each other as possible for both teams. Calculating the right odds for quarter ball handicaps is a little trickier than for other handicaps. But fortunately the mathematical formulas are very simple and easy to use even with a pocket calculator.

1.2 Formulas and Examples

At first let's take a look at the simpler situations where the handicap is half a goal or zero goals (=no advatage for either team).

Handicaps marked as 0:0 are identical to moneyline bets (which is a term used in America for this type of bet). In moneyline you bet on which team will win the game. And if the game ends with a draw the stakes will (usually) be fully refunded. And because the result from refunded stake is exactly the same as if the bet was never placed, the possibility of draw can be excluded from the set.

The true odds (in decimal presentation) for moneyline can be derived from the probabilities of home win, draw and away win in the following way:

Home Odds = $(1 - p_0) / p_1$
Away Odds = $(1 - p_0) / p_2$,

where p_1 is the probability for home win (a value between 0 and 1), p_0 the probability for draw (0..1) and p_2 the probability for away win (0..1).

Numerical example:

If 1X2-probabilities for a game are 45% (= 0.45), 30% (= 0.30) and 25% (=0.25), moneyline odds would be:

Home Odds = (1 - 0.30) / 0.45 = **1.56**
Away Odds = (1 - 0.30) / 0.25 = **2.80**

Half ball handicaps are usually marked with 0:½ which means that the visiting team is getting a head start of half a goal (or ½:0 if home team is getting the half ball advantage). So, if the game ends with a draw the visiting team is considered to have won by half a goal and all bets placed for the visitor are winners. If home team wins, it will be considered as a winner because even the half goal advantage for the visiting team can't turn that result around. There's no push (stake refund) in half ball handicaps.

The odds for visiting team getting half ball advantage:

Home Odds = 1 / p_1
Away Odds = 1 / (1 – p_1)

An example using the same values for probabilities as before (45-30-25):

Home Odds = 1 / 0.45 = **2.22**
Away Odds = 1 / (1 - 0.45) = **1.82**

And then, the quarter ball handicaps (which are usually marked with 0: ¼ if the quarter ball is given to the visiting team). Quarter balls actually mean that the stake of the bet will be divided in two separate bets where one is with 0:0 handicap and the other with 0:½ handicap. Now, if you bet on the home team you will win your bet if the home team wins and lose your bet if the visiting team wins. Similiarly betting on the visiting team is a winning bet if the visitor wins and a losing bet if the visitor loses. But the draw is what makes it different for the two teams here. If you bet on the home team and the game ends with a draw you lose half of your stake and get the other half back (refunded). But if you had bet on the visitor and the game ends with a draw you would get one half of your stake back (as refund) and the other half of the stake would be a winner with the given odds.

Now, if that didn't sound confusing try to figure out how to derive the right odds for that kind of bet. Here's how it's done:

Home Odds = (1 – p_0 / 2) / p_1
Away Odds = (1 – p_0 / 2) / (p_2 + p_0 / 2)

Our example probabilities (45-30-25) would make the odds like this:

Home Odds = (1 – 0.30 / 2) / 0.45 = **1.89**
Away Odds = (1 – 0.30 / 2) / (0.25 + 0.30 / 2) = **2.13**

But that's not the end of Asian Handicaps. We still have ¾, 1, 1¼, 1½ etc handicaps left. Fortunately these go pretty much the same way as the previous handicaps. Only difference is that we can no longer derive the odds from the 1X2-probabilities only. We also need the probabilities for one team winning exactly by one goal, two goals and so on.

If the handicap is one full goal (marked with 0:1) the bet is like a moneyline bet except that the push situation happens when home team wins precisely by one goal. So, in order to win a bet placed for the home team it must win at least by two goals. And to win with a bet placed for the visitor it must at least tie the game. Now, because the push situation is home team's one goal victory, you need the probability of that event in order to determine the odds for this kind of handicap. The formulas for calculating the odds when the probabilities are known are:

Home Odds = $(1 - p_{h1}) / (p_1 - p_{h1})$
Away Odds = $(1 - p_{h1}) / (1 - p_1)$,

Where p_1, p_0 and p_2 are the same as before and p_{h1} is the probability for home team winning by one goal. The value for p_{h1} can't be derived straight from the values of p_1, p_0 and p_2 but the future paper ´How To Calculate the Odds for Correct Score Betting' will show methods to do that. As a rule of thumb, it's best to use the value 0.2 for p_{h1} regardless of how big favourite the home team is. And this actually works quite accurately as long as the home team is a favourite and not an underdog.

If we have for example the value of 0.20 for p_{h1} (and take the other values from our previous examples) we get the following odds:

Home Odds = (1 – 0.20) / (0.45 – 0.20) = **3.20**
Away Odds = (1 – 0.20) / (1 – 0.45) = **1.45**

Handicaps marked with 0: ¾ mean that the stake is divided into two 0:½ and 0:1 bets. Therefore betting the home team is a winning bet if home team wins at least with 2 goals and betting for away team is a winner if away team manages to get at least a draw. And if home team wins precisely by one goal bets placed for home team are winners by half of the stake and the other half is refunded. Bets placed for visiting team when home team wins by one goal are half losers and the other half is refunded.

The odds are determined like this:

Home Odds = $(1 - p_{h1} / 2) / (p_1 - p_{h1} / 2)$
Away Odds = $(1 - p_{h1} / 2) / (1 - p_1)$

Example with the same numerical values as before:

Home Odds = (1 – 0.20 / 2) / (0.45 – 0.20 / 2) = **2.57**
Away Odds = (1 – 0.20 / 2) / (1 – 0.45) = **1.64**

All the rest handicaps are similar to those already described. In the following formulas p_{h2} is the probability for home team winning precisely by two goals:

Home Odds (0:1¼) = $(1 - p_{h1} / 2) / (p_1 - p_{h1})$
Away Odds (0:1¼) = $(1 - p_{h1} / 2) / (1 - p_1 + p_{h1} / 2)$

Home Odds (0:1½) = $1 / (p_1 - p_{h1})$
Away Odds (0:1½) = $1 / (1 - p_1 + p_{h1})$

Home Odds (0:1¾) = $(1 - p_{h2} / 2) / (p_1 - p_{h1} - p_{h2} / 2)$
Away Odds (0:1¾) = $(1 - p_{h2} / 2) / (1 - p_1 + p_{h1})$

Home Odds (0:2) = $(1 - p_{h2}) / (p_1 - p_{h1} - p_{h2})$
Away Odds (0:2) = $(1 - p_{h2}) / (1 - p_1 + p_{h1})$

And until we publish ´How To Calculate the Odds for Correct Score Betting' we can only show some practical approximations for p_{h2}. If the game is evenly matched (meaning that there is no clear favourite), value 0.1 can be used for p_{h2}. If the probability for home win is around 0.5, a value of 0.15 for p_{h2} is better. And if the home team is a big favourite with probability of 0.65 to win the game, 0.2 is a good value for p_{h2}.

1.3 Mathematical Presentation

Let the sample space be $\Omega = \{w_{ij} \mid i, j \in \mathbf{N}\}$, where w_{ij} denotes such an outcome of a soccer game that home team scores i goals and visiting team scores j goals.

Draw, home win and away win are events that can be presented as:

$$A_0 = \{w_{ij} \mid i = j, i \in \mathbf{N}, j \in \mathbf{N}\}$$
$$A_1 = \{w_{ij} \mid i > j, i \in \mathbf{N}, j \in \mathbf{N}\}$$
$$A_2 = \{w_{ij} \mid i < j, i \in \mathbf{N}, j \in \mathbf{N}\}$$

And let's use the notation p_i for the probabilities $P(A_i) \in [0,1]$:

$$p_i = P(A_i),\ \ i \in \{0, 1, 2\}$$

0:0 Handicaps (Moneyline):

If b_1 denotes the amount to bet on the home team and b_2 is the bet amount for the visiting team, win amounts for these bets will be

$$r_1 = \begin{cases} b_1, & \text{if } A_0 \text{ occurs} \\ o_1 b_1, & \text{if } A_1 \text{ occurs} \\ 0, & \text{if } A_2 \text{ occurs,} \end{cases}$$

and

$$r_2 = \begin{cases} b_2, & \text{if } A_0 \text{ occurs} \\ 0, & \text{if } A_1 \text{ occurs} \\ o_2 b_2, & \text{if } A_2 \text{ occurs,} \end{cases}$$

where o_1 and o_2 are the moneyline odds for the home team and the visiting team.

The expected win amounts are

$$E(r_1) = p_0 b_1 + p_1 o_1 b_1 = b_1 (p_0 + p_1 o_1),$$

and

$$E(r_2) = p_0 b_2 + p_2 o_2 b_2 = b_2 (p_0 + p_2 o_2).$$

To derive the true odds (without the house edge) we set the expected win amounts to be equal to the bet amounts:

$$E(r_1) = b_1 (p_0 + p_1 o_1) = b_1$$
$$p_0 + p_1 o_1 = 1$$
$$o_1 = \frac{1 - p_0}{p_1}$$

$$E(r_2) = b_2 (p_0 + p_2 o_2) = b_2$$
$$p_0 + p_2 o_2 = 1$$
$$o_2 = \frac{1 - p_0}{p_2}$$

And as we can see, moneyline odds are inverses of the conditional probabilities for home and away win with the condition that the game result is not a draw.

Half Ball-Handicaps:

Let's look at the situation where home team is getting half a goal advantage. Again b_1 and b_2 are the amounts to bet for the home and visiting teams, and the win amounts for the bets are now

$$r_1 = \begin{cases} o_1 b_1, & \text{if } A_0 \text{ occurs} \\ o_1 b_1, & \text{if } A_1 \text{ occurs} \\ 0, & \text{if } A_2 \text{ occurs,} \end{cases}$$

and

$$r_2 = \begin{cases} 0, & \text{if } A_0 \text{ occurs} \\ 0, & \text{if } A_1 \text{ occurs} \\ o_2 b_2, & \text{if } A_2 \text{ occurs,} \end{cases}$$

where o_1 and o_2 are the ½:0-handicap odds.

The expected win amounts are

$$E(r_1) = p_0 o_1 b_1 + p_1 o_1 b_1 = b_1 o_1 (p_0 + p_1),$$

and

$$E(r_2) = p_2 o_2 b_2.$$

And then we set the expected win amounts to be equal to the bet amounts:

$$\begin{aligned} E(r_1) = b_1 o_1 (p_0 + p_1) &= b_1 \\ o_1 (p_0 + p_1) &= 1 \\ o_1 &= \frac{1}{p_0 + p_1} \end{aligned}$$

$$\begin{aligned} E(r_2) = p_2 o_2 b_2 &= b_2 \\ p_2 o_2 &= 1 \\ o_2 &= \frac{1}{p_2} \end{aligned}$$

Similiarly you could derive odds for 0:½-handicaps.

Quarter Ball-Handicaps:

When the home team is getting a quarter goal advantage, the win amounts are

$$r_1 = \begin{cases} \frac{o_1 + 1}{2} b_1, & \text{if } A_0 \text{ occurs} \\ o_1 b_1, & \text{if } A_1 \text{ occurs} \\ 0, & \text{if } A_2 \text{ occurs,} \end{cases}$$

and

$$r_2 = \begin{cases} \frac{1}{2} b_2, & \text{if } A_0 \text{ occurs} \\ 0, & \text{if } A_1 \text{ occurs} \\ o_2 b_2, & \text{if } A_2 \text{ occurs.} \end{cases}$$

The expected win amounts are

$$E(r_1) = p_0 \frac{o_1 + 1}{2} b_1 + p_1 o_1 b_1 = b_1 \left(p_0 \frac{o_1 + 1}{2} + p_1 o_1 \right),$$

and

$$E(r_2) = \tfrac{1}{2} p_0 b_2 + p_2 o_2 b_2 = b_2 \left(\tfrac{1}{2} p_0 + p_2 o_2 \right).$$

Derive the odds:

$$E(r_1) = b_1 \left(p_0 \frac{o_1 + 1}{2} + p_1 o_1 \right) = b_1$$
$$o_1 \left(\tfrac{1}{2} p_0 + p_1 \right) + \tfrac{1}{2} p_0 = 1$$
$$o_1 = \frac{1 - \frac{1}{2} p_0}{\frac{1}{2} p_0 + p_1}$$

$$E(r_2) = b_2 \left(\tfrac{1}{2} p_0 + p_2 o_2 \right) = b_2$$
$$\tfrac{1}{2} p_0 + p_2 o_2 = 1$$
$$o_2 = \frac{1 - \frac{1}{2} p_0}{p_2}$$

Other Handicaps:

Full Goal-handicaps like 1:0 and 2:0 are identical to 0:0 handicaps except that events A_i must be replaced with the following events B_i:

$B_0 = \{w_{ij} \mid i = j-k, i \in \mathbf{N}, j \in \mathbf{N}, k \in \mathbf{N}\}$ (push)
$B_1 = \{w_{ij} \mid i > j-k, i \in \mathbf{N}, j \in \mathbf{N}, k \in \mathbf{N}\}$ (home win against the line)
$B_2 = \{w_{ij} \mid i < j-k, i \in \mathbf{N}, j \in \mathbf{N}, k \in \mathbf{N}\}$ (away win against the line)

where k is the number of goals home team is getting in advance.

Also the rest of the handicaps (like ¾:0, 1¼:0, 1½:0 and 2½:0) are derived using the formulas shown before. Just the A_i events must be replaced with new events that represent results against the line.