Archie, a method of evaluating systems

By Steve Tilley

(reproduced and amended with permission)

One of the problems we encounter frequently is deciding how good a system is. We have all seen the advertisements for tipsters telling of £10000 returned to level stakes, eleven months out of twelve in profit etc. Sadly I cannot give you a way of separating the wheat from the chaff for them but I can give you a method you can apply to your own systems and betting.

Below is a table showing the results from five tipsters

Table 1

Tipster	Runners	Winners	%age Winners	Level Stake Profit
A	154	57	37%	13%
B	91	31	34%	55%
C	281	50	18%	42%
D	152	16	10.5%	58%
E	34	24	71%	88%

Now imagine you were asked to buy these systems. Which of these systems would be the best one to pick? In fact put them in the order that you would choose them.

The first step is to calculate a quantity called the expected number of winners. Let us consider say 100 bets at 4/1 how many winners would we expect? When a bookmaker offers you odds what he is doing is telling you the chance he gives that horse of winning. For example if he offers a horse at 4/1 then he is giving it a 0.2, or 20% chance of winning. I can already here some people wondering how we get this. How does 4/1 end up as 20%? If you are happy with this then skip the next paragraph.

To convert odds into a chance of winning do the following write the odds as A to B, if its odds on then remember to write them the right way round. 2/1 ON becomes 1 to 2. The chance of winning is B divided by A+B. So 4/1 becomes 1 divided by 4+1 = 1/5 =0.2. (0.2 is of course 20%). So 9/4 gives 4 divided by 13 = 0.308. If you are betting on the tote then merely take the tote return and divide it into 1. A tote return of 2.50 gives a chance of winning of 1 divided by 2.5 =0.4 (Tables for this type of calculation for odds and tote can often be found in racing and betting texts.)

For us to make money betting the real chance of a horse winning must be greater than the chance the bookmaker gives it. If you divide the real chance of you winning the bet by the chance offered by the bookmaker then if this is

greater than one you will make a profit in the long run. The name given to the real chance divided by the chance offered by the bookmaker is the advantage.

The expected number of winners over a series of bets is the sum of all the chances the bookmaker offers. So if you had three bets at 4/1 the expected number of winners is 0.2+0.2+0.2=0.6 if you had 20 bets at 9/4 the expected number of winners is 20 times 0.308=6.16. If you had one bet at 9/4 and one at 4/1 the expected number of winners would be 0.2+0.308=0.508. So to calculate the expected number of winners for a series of bets convert them all into chances to win and then add them all together.

This has been done for our five tipsters above and it is given in the table below.

Table 2

Tipster	Runners	Winners	Expected Winners	Average Odds	Average advantage
A	154	57	53.42	0.347	1.067 *(57 / 53.42)*
B	91	31	20.82	0.229	1.489 *(31 / 20.82)*
C	281	50	32.53	0.116	1.537
D	152	16	10.05	0.066	1.592
E	34	24	14.60	0.429	1.644

Thus for tipster A, the expected number of winners is 53.42 for B 20.82 etc.

We can take the expected winners and divided it by the number of runners giving the chance that the Tipster selected. For example tipster A gives a chance of 0.347 this can be converted back to the more familiar odds giving about 15/8 whereas D had an average chance of 0.066 which is about 15/1

The average advantage is number of winners divided by the sum of odds. So punter E bets at an advantage of 1.644 or 64.4% whereas punter A has an advantage of 1.067 or 6.7%.

Now imagine that again you were asked to buy these systems. Put them in the order that you would choose them. Is it different to the first order you put?

There is a relatively simple statistical test that we can apply to assess these systems. The test we can use is called the Chi-Squared test and is described at length in numerous statistical textbooks. Rather than go into it in great depth I will give a simple way of calculating it and using it. As we are using if for assessing racing I will call it Racing CHI or "Archie". In the most basic terms the higher Archie is the better the system is and the more likely it is to give bets that have an advantage to the punter.

Before we go further there is one important point. *You can only use the*

Archie test if the expected number of winners is greater than five. **This is** for good statistical reasons.

The formula for Archie is

$$\text{Archie} = \frac{\text{runners} \times (\text{winners} - \text{expected\_winners})^2}{\text{expected\_winners} \times (\text{runners} - \text{expected\_winners})}$$

Do not panic. This is easier than it looks (honestly).

For Tipster A we get

$$\text{Archie} = \frac{154 \times (57 - 53.42)^2}{53.42 \times (154 - 53.42)}$$

Giving 0.367

For Tipster B

$$\text{Archie} = \frac{91 \times (31 - 20.82)^2}{20.82 \times (91 - 20.82)}$$

Giving an answer of 6.454

Doing this for all the tipsters gives.

Table 3

Tipster	Archie score
A	0.367
B	6.454
C	10.61
D	3.772
E	10.607

What the Archie score means needs a little explanation. It is a measure of the probability that the system we are looking at, over a large number of bets, has an average advantage per bet of less than one. It is the chance that if you follow this system in the long term you will find the actual number of winners is less than the expected number of winners. (If anyone wants the mathematics behind this contact me via the editor or e-mail.)

It is undoubtedly possible for a system that has a average advantage per bet of less than one to produce a profit over a series of bets due to for, want of a better word, luck. For example picking horses with two word names both starting with the same letter has produced short term profits but in the long term it's a failure (but fun!).

Archie is based on Chi-Squared, luckily for us there are tables that give the chance of any Chi-Squared or Archie score occurring due to chance.

Table 4

Archie	Archie Probability
0.3	0.5839
0.5	0.4795
1.0	0.3173
1.5	0.2207
2.0	0.1573
2.5	0.1138
3.0	0.0833
3.5	0.0614
4.0	0.0455
4.5	0.0339
5.0	0.0253
5.5	0.0190
6.0	0.0143
6.5	0.0108
7.0	0.0082
7.5	0.0062
8.0	0.0047
8.5	0.0036
9.0	0.0027
9.5	0.0021
10.0	0.0016
10.5	0.0012
11.0	0.0009
11.5	0.0007
12.0	0.0005

Using this table we can build the following table

Table 5

Punter	Archie score	Archie Probability (approx.)
A	0.367	0.3
B	6.454	0.0108
C	10.61	0.0012
D	3.772	0.05
E	10.607	0.0012

From this we can see the chance of tipster E's getting results like this due to chance rather than skill is about 1 in a thousand whereas tipster A's results have about a 30% chance of being due to luck rather than skill.

From this we can see that tipsters E and C looks the safest to follow then B, D and A.

The underlying mathematics for all this is quite complex but by using the Archie score we can quickly evaluate and compare systems. By doing this we can get discriminate between genuine effects and those just due to chance.

For example, if you are following your own bets and calculating your Archie score then a high Archie score should give you some confidence that you are doing well. Whereas a low one might indicate that any profits you had made were due to luck and the inevitable reversal of form could come at any time.

As a further example let's consider the following results perhaps from our own betting

Table 6

Runners	Winners	Expected winners
57	20	12.068

This gives an Archie score of

$$\text{Archie} = \frac{57 \times (20 - 12.068)^2}{12.068 \times (57 - 12.068)} = 6.616$$

The first column in table 4 is the Archie score; the second is the chance of getting a score that high due to chance. Here our score of 6.61 would occur less than 0.0108 of the time by pure chance thus we can be safe to say that our betting is getting results better than the starting prices would suggest.

Now we all know what happens when we follow a tipster or a system. It starts to make losses. Then just after we give it up in disgust it promptly produces a number of long priced winners. Why does this happen?

First the tipster or system may have been having a purple patch when we noticed it and then has returned to its normal performance after we join in. By using Archie as described above we can reduce the chances of this. If we have a good Archie score and hence a low probability of it getting that good a result by chance then we can have reasonable hopes there is a good chance of similar performance in the future.

Systems and tipsters may have bad runs due to chance as we all know. However there is also the chance that the system or tipster has "gone off". There are many reasons to account for this; the public or bookmakers may

become wise to the system and force prices down. Changes in courses, handicappers, race fixtures, training methods etc may all cause the number of winners picked to drop sharply even if the odds are still the same.

Archie helps us to differentiate between these. It is important to do so. If you leave a system when it has just hit a bad patch then when it recovers you will miss out on the winnings. Conversely failing to get out of a collapsing system can be expensive!

Further problems arise if it is your own system or you are your own tipster. You have a bad patch. You start to get concerned and start changing your selection rules. If you do this and it was just a bad patch you hit due to pure bad luck then you'll miss out on winners you would have had if you'd stuck to your original methods. Of course if your system had been overtaken by events and was now useless then sticking with it is not a good move.

Let us assume that we decide to follow the system we can use the Archie score to help us evaluate the bets.

First we find the average advantage per bet.

$$average\_advantage = \frac{number\_of\_winners}{sum\_of\_odds} = \frac{20}{12.068} = 1.657$$

This means that on average this system produces a 65.7% advantage over the starting price. This is a good start!

We now start to bet following our system and record our bets. We can now employ Archie again.

$$Archie = \frac{runners \times (winners - expected\_winners)^2}{expected\_winners \times (runners - expected\_winners)}$$

Now we can apply a little trick. In Archie originally the expected winners was merely the sum of all the odds. This means that I was expecting our system to be no better at finding winners than the odds would suggest. The Archie score and probability suggest otherwise i.e. it is better at finding winners than the bare odds. In other words he has an advantage over the odds.

Its average advantage as we found before was 1.657. So if the sum of odds over a series of bets were 10 then I would expect it to have 10 times 1.657, say 16 or 17 winners.

Let us say after following him for a while I had the following hypothetical results. The profit is the level stake profit or loss up to then.

Runners	Winners	Expected winners	Profit
20	4	4.2	-12.60

The corrected expected number of winners is 4.20 times 1.657 = 6.959. I've only got 4, should I be worried?

$$\text{Archie} = \frac{20 \times (4 - 56.959)^2}{6.959 \times (20 - 6.959)} = 1.93$$

This gives a probability from table 2 of about 0.16. So the chance of getting results as bad as this are about 0.16. No need to panic yet.

After 20 more bets

Runners	Winners	Expected winners	Profit
40	10	9.6	42.20

Now our corrected expected number of winners is 9.6 times 1.657 =15.907. I'm still making a profit but I've got nearly six less winners than I would expect if the system was running as before.

The Archie score is 3.642 as calculated with our formula. This means I would only get a difference this great about 5% of the time. I would certainly be getting concerned here. I have a good profit but things might be heading for a down turn. There's only a 1 in 20 chance my system is working as it did before.

After 20 more bets

Runners	Winners	Expected winners	Profit
60	17	13	54.40

This gives a corrected expected number of winners of 13 times 1.657 = 21.54

This in turn gives an Archie score of 1.493. This could occur about 22% of the time so the system is probably working as before.

It is important to note that the profit after tax on a level stake is a poor measure of how the system was performing. After 20 runners nursing a 12.60 loss you might have been tempted to bail out missing what came later.

Using Archie this way only compares it with what you expect your system or tipster to do and it tells you the chance of the results you get coming from the system if it performed as before. As a rule of thumb Archie score of 4 or more should worry you. Scores of 6 or more suggest that something has changed and you should review things.

Notice the two different ways we use the Archie score. When we're evaluating a system we want a *high* Archie score that tells us it is doing better than chance. When we're betting on a system using the corrected expected winners method we want a *low* Archie score as that means the system was

running as before.

Using Archie does not guarantee you a profit. Nor does it tell you how to get out of a system the instant it "goes wrong" thus maximising your profits. What it does do is provide a rational test to warn you if your system is performing as well as you can reasonably expect

Thanks to all those in [Smartsig](#) who commented and helped with this when it originally appeared in their magazine.