**What is the “True” AEI of a Stallion?**

**Summary Version**

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 DIAGRAM 1: Observed AEIs of a Stallion from Mares Stratified

 by the CIs to Which the Stallion Was Bred

 Stallion 45 ° LEGEND

**AEI** **45 ° angle line**—Stallion

produces runners with same AEI as whatever

 **.16 slope** mare it is bred to.

 1.66

**Line with slope of .16.** Typical 1990s

1.5 -relationship between observed AEI and CI of

 mares to which a stallion is bred (determined

by a statistical study).

 The intersection of the **45 °** line with the

 observed relationship between AEI and

 CI (**.16 sloped line) is an estimate of the**

 Stallion’s true (adjusted) AEI

.

 1.0 2.0 .

**Mare CI (AEI’s of mares’ other foals)🡪**

Using data from the late 1990s, this study estimated that the average relationship between AEI and CI of mares bred was as reported in the diagram above. The .16 slope line represents a plot of that average stallion’s relationship between the stallion’s AEIs and CIs for subgroups of his mares, where their CIs for ten deciles, from lowest to highest mare CIs, where plotted against the stallion AEIs for those subgroups.. See the last page of this summary for data from an example using Dynaformer data. After sorting the CIs of mares bred to each of 66 stallions into ten deciles, calculating the average CI for each decile for each stallion, then investigating the relationship between AEIs and CIs for each stallion by decile, I observed that an increase of 1.0 in the CI of the mares to which the average stallion was bred was associated with an increase in the observed AEI of the stallion of approximately .16.[[1]](#footnote-1)

As represented in the diagram above, a stallion bred to 1.0 CI mares that exhibits an AEI of 1.5 will normally exhibit an AEI that is .16 higher (than 1.5 in this example) if he is bred to mares with an average CI of 2.0: So, AEI = 1.5 + .16 = 1.66 if bred to mares with an average CI of 2.0

Using this relationship, it is possible to work backward from observed AEI numbers a stallion reports to arrive at an “adjusted AEI” that reflects the stallion’s “**True AEI**.” For instance, it would be interesting to know the true ability to generate AEI of the representative stallion from the diagram above. This stallion produced an AEI of 1.5 when bred to mares with a CI of 1.0. He produced an AEI of 1.66 when bred to mares with a CI of 2.0. A pedigree analyst would say that he “moved up” the 1.0 CI mares by generating an AEI of 1.5, but “moved down” the 2.0 CI mares by generating an AEI of 1.66 when bred to 2.0 CI mares. It seems that this stallion’s true AEI is somewhere between 1.5 and 1.66, but where?

The question is, “What level of mares would the stallion neither ‘move up’ nor ‘move down’?” This can be defined as his “True AEI.” The answer can be determined graphically (see the diagram above), or algebraically. Graphically, if the line representing the relationship between observed AEI and CI is plotted (as it is above), there is a point where the observed AEI equals the CI of the mares to which the stallion is bred. This occurs where the plotted AEI/CI line intersects the 45% angle line. In the case above, eyeballing the line suggests that AEI and CI are equal at about 1.58 to 1.6. This point can be determined more precisely by using algebra.

Using the case where he generated an AEI of 1.66 when bred to 2.0 CI mares, his observed AEI is overstated when considering the 2.0 mares to which he was bred. More precisely, if the slope of the AEI/CI plotted line is .16, then his true AEI is overstated by .16 times the increment in mare CIs that exceeds his true AEI. So:

Observed AEI (1.66) = his true AEI + .16 x (difference between the CIs of mares to which he was bred and **mares with a CI equal to his true AEI**). But, since his true AEI equals the CI of mares when he produces foals with CIs equal to his AEI, we can substitute “True AEI” for “mares with a CI equal to his true AEI. So:

Observed AEI = True AEI + .16 x (2.0 – True AEI), and we have

1.66 = True AEI + .16 x (2.0 – True AEI), thus

1.66 = True AEI + .32 - .16 True AEI, and

1.34 = .84 True AEI, and

True AEI = 1.34/.84 = 1.59.

As you can see, this answer is consistent with the answer one would estimate by using the eye-balled graphical approach.

**2016 State of Affairs**

**Between now and the late 1990s when the data for this study was collected, AEIs and CIs of stallions and mares have dropped significantly. This is due in large part to two changes in industry practices:**

**1) Almost all trainers now give their runners a longer period between races, especially their top runners. Top runners run (and win) fewer times each year, and their AEIs are lower as a result.**

**2) Mid-level, and even moreso elite stallions, breed many more mares each year now than they did 15-20 years ago. Necessarily, that means that top stallions have moved down the mare quality chain, causing them to generate lower average earnings (and thus lower AEIs).**

**The combination of these two changes tends to compress AEIs and CIs, especially for mid-level and elite stallions. I guesstimate that as a result the slope of the AEI/CI line has decreased to approximately .12 from its late-1990s estimate of .16. This means that the formula for estimating the “True AEI” is now approximately as follows:**

**Observed AEI = his true AEI + .12 x (difference between the CIs of mares to which he was bred and mares with a CI equal to his true AEI). So, using a 2016 example, Into Mischief has a reported AEI of 2.59 and a reported CI of 1.45 in March 2016. What is his “True AEI?” Using the formula, it is**

**2.59 = True AEI + .12 x (1.45 – True AEI \*), or**

**2.59 = True AEI + .145 - .12 x True AEI, or**

**2.59 = .88 x True AEI + .145, or**

**2.59 – .145 = .9 x True AEI, or**

**2.445 = .88 x True AEI, or**

**2.445/.88 = True AEI, or**

**2.78 = True AEI**

**The algebraic estimate of Into Mischief’s True AEI is almost .20 points higher than his reported AEI.**

\*Recall that at the point where a stallion neither moves up nor moves down his mares, his AEI should equal the CI of mares bred to him.

**An example of the data for an individual stallion appears on the following page.**

This example reports CIs and AEIs by decile for Dynaformer when his seventh crop were two-year olds. There is a substantial degree of randomness in the data, in part because of the relatively small sample size (average crop size of 53) from the first seven crops. The AEI/CI relationship would be expected to be become slightly less variable for Dynaformer each succeeding year.

 TABLE 1: AEI/CI Relationships for DYNAFORMER in 1999

|  |  |  |
| --- | --- | --- |
| DECILE | **AEI** | **CI** |
| Decile | CI | AEI |
| Lowest CI | .20 | 1.06 |
| Decile 2 | .47 | 1.59 |
| Decile 3 |  .66 | 1.28 |
| Decile 4 |  .85 | 1.20 |
| Decile 5 | 1.00 |  .91 |
| Decile 6 | 1.26 | 1.20 |
| Decile 7 | 1.49 | 2.62 |
| Decile 8 | 1.86 | 1.98 |
| Decile 9 | 2.29 | 2.31 |
| Highest CI | 4.52 | 3.58 |
| No CI | Not used  | Not used  |
| 10 Decile Mean | 1.46 | 1.77 |

1. The plotted slope of the AEI/CI line varies from stallion to stallion, but results tended to cluster around the .16 slope for stallions with both high and low AEIs. Though it is arguable that a particular stallion might legitimately have an AEI/CI slope that is different from .16, it seems more reasonable to this author to attribute most, if not all the differences in observed slopes for individual stallion AEI/CI lines to randomness in the data. [↑](#footnote-ref-1)