DairyCo Breeding+

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Reliability of genetic indices explained

What and Why

Reliability indicates how reliable, or accurate, an estimate of genetic merit is, and is published as a percentage in the general range 20% up to 99%.

Q: How reliable are genetic indexes?
The reliability of genetic indexes varies widely depending on the amount and source of information used in their calculation. For example, a production trait pedigree index based on parent average typically has a reliability of around 30-40%. But a widespread proof for a bull based on the performance of daughters in several hundred herds could have a reliability of up to 99%.

Q: Why the need for a reliability figure?
The lower the reliability of the proof, the more likely it is to change as more information are added - such as more daughter information. So it is important to use bulls with limited reliabilities with caution.

Q: What about herd and daughter numbers?
When bull proofs are published, the number of daughters contributing to the figures and the number of herds in which they are found is generally also specified. Where the daughter proportion is high in just one or two herds, there are again greater chances of instability and so it is important to be cautious in the use of such bulls.

Q: What else affects the reliability?
There are two further principles that are worth bearing in mind:

Firstly, when the proofs of foreign bulls are converted to UK-equivalent figures their reliability figure is reduced as part of the conversion process. Thus, a 99% reliable foreign bull will never reach 99% reliability on his UK-equivalent proof initially. However, once the bull receives information from UK milking progeny, this reliability will rise again.

Secondly, when a trait has a lower heritability more information is needed to reach the same reliability as more highly heritable traits. The degree to which the genes that control a trait is passed down the generations is referred to as its heritability. Some traits are more heritable than others. Examples of highly heritable traits include fat or protein percentage of milk and cow stature. These traits will reach a higher reliability quicker, compared to the reliability of a Fertility Index, for example, due to the lower heritability of this trait.

As rule of thumb, the more heritable a trait, the easier it is to improve the trait through breeding.

Although the quickest progress can be made through breeding for highly heritable traits, traits of low heritability can still be improved through breeding.

Table 1: Typical production index reliabilities for bulls

Reliability	Comment	Information contributing
10-29%	Extremely low	Some Pedigree Indexes involving estimates from relatives
30-40%	Very low	Most Pedigree Indexes involving estimates from parents with reasonable reliabilities
41-55%	Low	Some Pedigree Indexes. Usually the sire is well proven and the dam has very high reliability
56-65%	Low to moderate	Bulls with officially published PTAs (minimum 50%)
66-75%	Moderate	Bulls with early progeny test data and typically foreign bulls
76-90%	Moderate to high	Proven bulls with a first crop proof
91-98%	High	Proven bulls with a large number of daughters from a wide cross section of herds
99%	Very high	Widely proven and used AI bulls

Q: Confidence *vs.* Reliability
As the reliability of a proof increases, the confidence on that proof typically increases by the same amount. However, this relationship is not entirely linear. In fact, the confidence in proofs starts to increase substantially more at higher levels of reliability – above about 75%.

We generally measure the confidence by the so called 95% confidence intervals. When we talk about this interval, we mean that there is a 95% probability that the true genetic merit of that animal lies within the given interval boundaries.

The confidence interval (CI) is determined by the estimated reliability of the genetic index at the time. So for example the CI of Milk at 35% reliability is +/- 590 kgs, whereas at 90% reliability this has been reduced to +/- 231 kgs (see table 2).

Table 2: Examples of 95% confidence intervals (+/-) at various reliability levels for a number of traits.

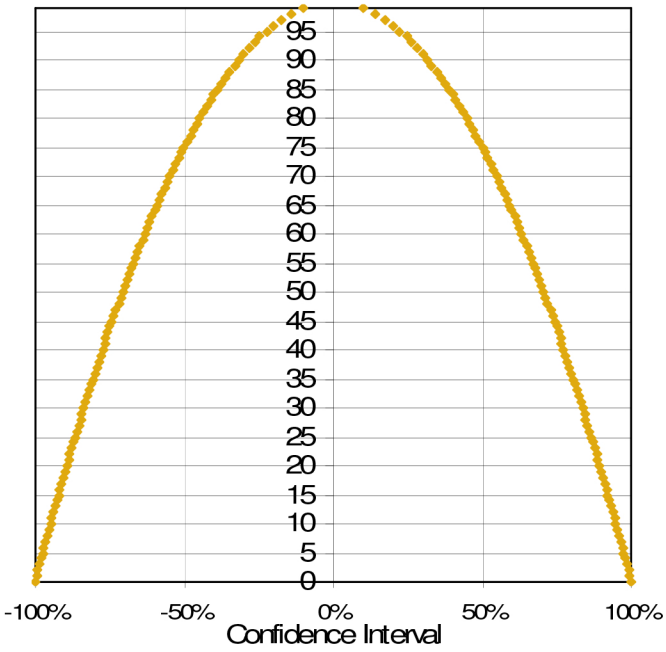
	Milk	Fat	Prt	SCC	LS	FI	Legs	Udder
35	590	20.1	17.1	18	0.5	12.3	1.9	1.7
50	517	17.7	15.0	16	0.4	10.8	1.6	1.5
65	433	14.8	12.5	13	0.3	9.0	1.4	1.3
75	366	12.5	10.6	11	0.3	7.6	1.2	1.1
85	283	9.7	8.2	9	0.2	5.9	0.9	0.8
90	231	7.9	6.7	7	0.2	4.8	0.7	0.7
95	164	5.6	4.7	5	0.1	3.4	0.5	0.5
99	73	2.5	2.1	2	0.1	1.5	0.2	0.2

* SCC = Somatic Cell Count; LS = Lifespan FI = Fertility Index;

Figure 1 further illustrates how the confidence of proofs increases with increased reliability. From this it is clearly visible that as reliability reaches above 75% the confidence starts to improve markedly and gets significantly better above 90%.

However, it is also important to note that even at 99% reliability, the bull proof can still change slightly as we are not able to assess the genetic merit at 100% accuracy - but any changes at that stage are expected to be very small.

Figure 1: Confidence interval (+/- 100%) at increasing reliability levels between 1 and 99% reliability.

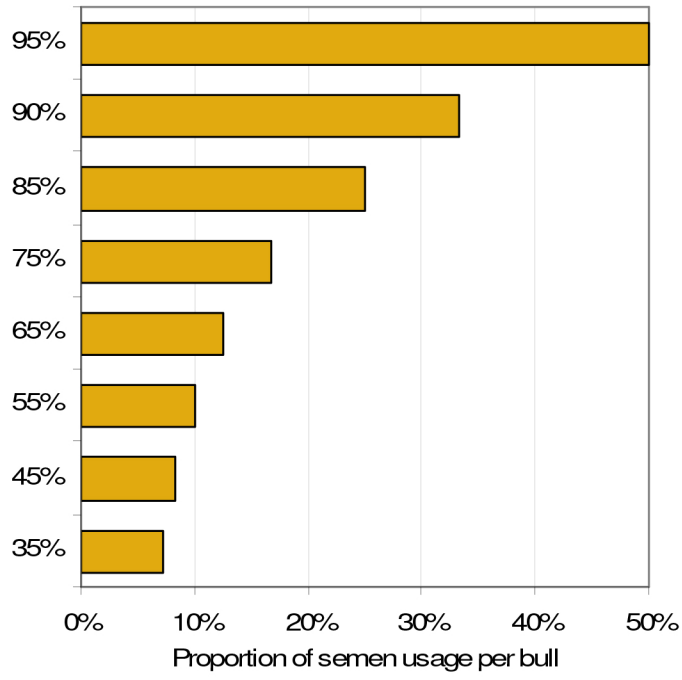


Q: What about using a team of bulls?
Most producers already use more than one bull in a breeding season to avoid the risk of disappointments. The level of reliability does not change this, but as a rule the lower the reliability of a bull's PTA, the lower the confidence that the figures are a true reflection of the bulls potential, and therefore the fewer doses of semen you should use per bull. Therefore, when using low reliability bulls, it is advisable to use a variety of such bulls.

However, it is not true that team reliabilities are higher than the reliabilities of the individual bull in that team.

Figure 2 gives a rough guide to the recommended levels of usage of semen from individual bulls at different levels of reliability. For example – for a bull with a 35% reliability it is recommended to breed no more than about 7% of the herd to the bull, whereas at 95% reliability up to 50% of the herd can normally safely be bred to a single bull.

Figure 2: Guide to proportion of semen usage for single bull at several levels of reliability (35%, 45%, …, 95%).



More information on the principles of genetic indices can be found on the DairyCo ***breeding+*** website in 'Breeding Briefs: a quick guide to genetic indexes in dairy cattle'

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