

Breeder Mortality Calculator FAQs

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Published by:

Meat & Livestock Australia Limited

ABN: 39 081 678 364

May 2013

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Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this report.

1. Q: Why can't we just directly count the dead animals to produce an estimate of mortalities?

In smaller, more intensively managed beef properties (in the south-east of Australia), it may be possible to maintain close supervision of cattle and to know whenever an animal dies because animals can be directly observed every day. Under these circumstances it would be possible to produce accurate and direct counts of deaths.

In extensive beef properties, cattle may only be mustered once or twice and occasionally more often in any one year. Cattle are not under close observation and deaths may be unobserved. In addition, it may be very difficult to achieve a complete muster every time that cattle are yarded and cattle may be missed on any given muster but still be alive. This has led to difficulties in estimating mortality rates on extensive beef properties.

The approach outlined in this mortality calculator is an attempt to use data that are available (mustering counts) coupled with some relatively simple assumptions, to produce estimates of mortality that will be reasonable given the limitations.

2. Q: How good is the calculator at estimating a count of the number of deaths in animals?

The numerator, or count of deaths, is based on the difference between two estimates of closing counts of animals: one derived from a prediction based on opening counts minus sales plus purchases and plus new additions (branded animals), and the other based on counts derived from mustering rounds conducted through the year. This difference may be considered as an estimate of missing animals, with possible explanations for missing animals including mortality, losses through rations and those animals that are still alive but not mustered (moved to adjacent property or paddock).

The calculator incorporates adjustment for rations so that rations are not counted as mortalities for the purpose of estimating a mortality rate.

If mustering efficiency is reasonably good and if the property uses several years of data and not just one year, then the potential bias from poor mustering efficiency at any one muster should be minimised and the estimates of deaths will be most reasonable. However, it is important to accept that this calculator produces an estimate of deaths that will be reasonably close to the true value but may be a little bit above or below the true value depending on possible explanations for missing animals on any given property.

3. Q: Why do we need to enter multiple years of data?

The Mortality Calculator is designed to use multiple years of data (up to 10 years of data for *Breeder Mortality Calculator 1.0 Simple* and 5 years of data for *Breeder Mortality Calculator 2.0 Advanced*). Data are entered using an annual cycle and using opening and closing counts of animals derived from mustering periods through the year.

The data are aggregated in calculations. This means that if several years of data are entered, the resulting mortality rates may be considered to represent an average over all years of data. The reason that this approach has been used is that in any one year there may be good or bad musters (fewer or more missing animals) and there may be individual years with either very low mortalities or very high mortalities. The Mortality Calculator is considered to offer the best value when multiple years of data are entered and the results interpreted as a long-term or average estimate of mortality. Users can then assess their performance to see if there may be value in investing in strategies to either understand mortalities in more detail or to implement strategies designed to reduce mortalities.

It is possible to enter just one year of data and determine an estimated mortality rate for one year. The accuracy of this sort of limited estimate will depend on the quality of the data and a single year estimate is probably likely to be most valid when it is estimated using the more detailed *Breeder Mortality Calculator 2.0 Advanced*.

It is also possible to add additional data each year to the existing *Breeder Mortality Calculator* that already has data entered from previous years.

4. Q: Why does the *Breeder Mortality Calculator* need to produce an adjusted count of animals at risk to produce an estimate of mortality rate?

A mortality rate is based on two figures – the numerator or count of deaths, and the denominator or total number of animals at risk of dying. The denominator is referred to as the At-risk count.

There are a number of difficulties in estimating mortality rates and it is important to get both counts as accurate as possible or the mortality rate estimates may be misleading. The above section explains some of the issues relating to the numerator. This section explains some of the issues relating to the denominator and their effects on mortality rate estimates. The best way to explain these is through examples.

Example 1

Imagine a closed herd that starts the year with 1,000 females. No female cattle are purchased, none are sold and no calves are weaned and branded to add to the herd. This sort of example is called a closed herd because there are no movements into or out of the herd.

If we follow the herd for 12 months and 70 females die during that time then the mortality rate can be estimated as the numerator (number of deaths = 70) divided by the denominator (number of animals at risk of dying at the start of the period = 1,000), which produces an estimate of 0.07. We can express this number as a percentage by multiplying it by 100 = 7%.

We can then say that the mortality rate is 7% per year or 7 deaths per 100 animals per year. This sort of calculation of mortality rate is called a cumulative incidence rate. This is because it has a denominator that is based on the number of animals at risk of dying at the start of the period and a numerator based on the number of new deaths that occurred during the time period (on year).

Example 2

Imagine the same property starts the year with 1,000 females. After 6 months, 600 of the females are sold and trucked off the property to the buyer's property. They are lost to follow up – all we know is that they were all alive at the time they left the original property and arrived at the buyer's property. The remaining 400 females stayed at the original property and were followed for the rest of the year. There were 35 animals that died in the first 6 months of the year and 14 animals died in the second 6 months, producing a total of 49 animals that died over the whole year.

If we used the same cumulative incidence approach as described in *Example 1*, we could divide 49 by 1,000 to produce an estimate of 4.9% mortality rate.

In fact this estimate is wrong and represents an under-estimate of the true mortality rate, because of the 600 animals that were trucked off the property after 6 months. We should not count these animals as contributing time at risk to the denominator after they have left the property. A better way to estimate the denominator is to think in terms of animal time at risk.

There were 400 animals that were followed on the property all year (either died on the property or survived to the end of the year). Each animal contributed one year and so these

animals altogether contributed 400 animal-years to the denominator. The other 600 animals were only present on the property for half of the year so they each contributed 0.5 animal-years to the denominator. Multiplying 0.5 by 600 produces 300. Having 600 animals on the property for half a year is the same as saying that these animals contributed 300 animal-years to the total time at risk.

Adding the two component contributions (400+300), we get a total of 700 animal years at risk for the denominator.

Then we can divide the total deaths (n=49) by the new denominator (700 animal years) and we get a mortality rate of 0.07 or 7%. The fact is that the mortality rate is identical to the first example. The reason we have fewer total deaths is because 600 animals left the property after 6 months and were no longer available to die on the property. If we did not adjust the denominator appropriately we could produce a mortality rate estimate that is misleading.

Example 3

Imagine the same starting property that starts the 12 month period with 1000 females. After 6 months, an additional 3000 animals are bought onto the property. In the first 6 months of the year, a total of 35 animals died. In the second half of the year a total of 145 animals died, producing a total count of deaths through the year of 175.

If we used the same cumulative incidence approach as described in *Example 1*, we could divide 175 by 1,000 to produce an estimate of 17.5% mortality rate.

In fact this estimate is wrong and represents an over-estimate of the true mortality rate, because of the 3000 animals that were trucked onto the property after 6 months. We need to add additional animals to the denominator to account for the fact that there were 4,000 animals on the property and available to die in the second half of the year. A better way to estimate the denominator is to think in terms of animal time at risk.

There were 1,000 animals that were followed on the property all year (either died on the place or survived to the end of the year). Each animal contributed one year and so these animals altogether contributed 1000 animal-years to the denominator. The other 3,000 animals were only present on the property for half of the year so they each contributed 0.5 animal-years to the denominator. Multiplying 0.5 by 3,000 produces 1,500. Having 3000 animals on the property for half a year is the same as saying that these animals contributed 1,500 animal-years to the total time at risk.

Adding the two component contributions (1,000 + 1,500), we get a total of 2,500 animal years at risk.

Then we divide the total deaths (175) by the correct denominator of animal time at risk (2500 animal years) and we get a mortality rate of 0.07 or 7% mortality per year.

The point of these three examples is that in situations where the population can be described as dynamic (where animals can either leave or enter the population at risk at any time through the study period), using the starting count of animals as a denominator for estimating mortality rate can be wrong and can produce estimates that may be higher or lower than they should be. The most appropriate way to deal with this is to adjust the denominator by estimating contributions of different groups to the total animal time at risk. Each animal can only be counted in the denominator if it is actually on the property of interest and it should not be counted either before it arrives or after it leaves.

5. Q: How do we adjust a denominator if we don't know when animals may have arrived or departed?

Often we know that animals may have left or arrived during the year but we don't know exactly when. If we can assume that animals were able to arrive (or depart) at any time and that the likelihood of animals either departing or arriving was likely to be equally distributed across the period of interest, then the most appropriate way to adjust for this is to assume that the animals arrived (or departed) at the half way point.

It turns out that if we don't know exactly when movements occurred but we are confident that movements occurred fairly equally throughout the year, then the best way to treat the contribution to animal time at risk is to multiply the total by 0.5. Mathematically this is the same as saying that half the movements occurred in the first half of the year and half occurred in the second half of the year and they were evenly distributed across the time period.

This is why in *Breeder Mortality Calculator 1.0 Simple*, we use an adjustment of 0.5 for sales and purchases and branded animals in producing the total animal time at risk (the denominator).

6. Q: How good is this adjustment process?

The examples described above clearly indicate that in an open herd situation (where animals may arrive or depart through the period of interest), estimation of rates is likely to be wrong unless some form of adjustment of the denominator takes place.

If we can assume that animal movements do take place through the year or even just that they are equally likely to occur in the first half of the year as in the second half, then the simple assumption that all movements occur at the half-way point is a great way of producing a reasonably accurate estimate of the denominator. However, if animal movements may occur mostly in one half of the year then this simple adjustment process is also likely to produce the wrong estimate.

Consider adjustments for sales.

Adjusting for sales involves making the denominator smaller to account for the fact that the sold animals are no longer contributing to the animal-time at risk once they have gone.

If we assume sales occurred at the half-way point and in fact most of the sales occurred near the end of the year, then we will be making the denominator smaller than it should be and the resulting mortality estimate will be larger than it should be. This effect is because the adjustment assumed they were gone by mid-year when in fact they were still on the property until near the end of the year.

If we assume sales occurred at the half-way point and in fact nearly all of the sales occurred at the start of the year then we will be making the denominator larger than it should be and the resulting mortality estimate will be smaller than it should be.

The effect for purchases will be in the opposite directions because purchased animals contribute nothing to the animal-time at risk until they arrive.

Adjusting for purchases involves making the denominator larger to account for the fact that the purchased animals need to be counted as contributing to the animal-time at risk once they have arrived.

If we assume all purchases occurred at the half-way point and in fact they nearly all occurred near the end of the year, then the denominator will be larger than it should be and the mortality estimate smaller. This effect is because we assumed they arrived at mid-year when in fact they did not arrive until near the end of the year.

Conversely if nearly all the purchases occurred near the start of the year and we adjust assuming they occurred at the half-way point, then the denominator will be smaller than it should be and the mortality estimate higher.

The point of this is that an adjustment of the denominator based on assuming movements occurred at the half-way point, is dependent on movements occurring roughly equally in the first half of the year and in the second half of the year. If this is not true then the estimates may be wrong and the error can be in either direction.

7. Q: Why does the calculator provide two estimates – one with an estimate of the animal-time at risk (denominator) that is not adjusted for sales and one where the denominator is adjusted for sales?

When we began using the livestock scheduling approach with adjusted denominators to account for animal movements during the year, we took interim figures back to producers to validate the findings. Adjustment of the denominators for purchases and incoming branded animals (animals that were branded during any one year) appeared to be producing output that was consistent with what producers were experiencing on their own properties. However, when movement of animals off the property (sales) were incorporated into the adjustment calculations, estimates of mortality occasionally became unrealistic, typically by being much higher than producers thought was possible. A possible explanation for this is if the movements were not evenly distributed across the entire year. This effect was explained in the previous FAQ.

Our response to this was to produce an estimate of adjusted animal-time at risk (denominator) that was adjusted for purchases and incoming branded animals but was not adjusted for sales.

The resulting mortality estimate will be most valid when any sales that did occur actually took place in the second half of the year. If sales resulted in movement of relatively large numbers of animals off the property in the first half of the year then this approach will produce mortality estimates that are likely to be lower than they really are. Discussion of interim results suggests that removing sales movements from the denominator adjustments resulted in output that was considered consistent with producers' own records of cattle numbers and mortalities.

The *Breeder Mortality Calculator* does produce a second set of estimates that are adjusted for sales. It is useful for users to compare these two estimates. If a user knows that sales have occurred in both halves of the year, then this estimate is likely to be the most valid estimate for that user. If most sales occurred in the first half of the year, then the estimate that does incorporate adjustment for sales will still be better than the estimate that is not adjusted for sales but both will be under-estimating true mortality rate.

If the two estimates are very different, then this may suggest that animal sales resulted in large scale changes to animal-time at risk on the property and more detailed information to better estimate animal-time at risk may be needed. See the following FAQ for more information.

8. Q: Is there a way of adjusting for the actual time when movements occurred?

If producers are able to provide information on the month when movements occurred and the associated count of animals moving on or off (sales, purchases and brandings), then this detailed knowledge can be used to adjust the denominator more precisely for each movement. This is the approach taken in the *Breeder Mortality Calculator 2.0 Advanced*.

If users have detailed knowledge of the month of year when movements occurred (including sales, purchases and brandings), then using *Breeder Mortality Calculator 2.0 Advanced* should produce the most accurate estimates of mortality rates.

9. Q: I have used the *Breeder Mortality Calculator 1.0 Simple* and I think the results are not what I expected. What can I do to check this or get better results?

Sometimes the *Breeder Mortality Calculator* will produce a negative estimate for mortality. This is saying that there were more live animals recorded as being on the property at the end of the year than there were at the start of the year (including adjustments for movements onto and off the property). Negative mortality figures cannot be right so when this happens it means that somewhere in the data entry tables, the numbers do not make sense. Occasionally the *Breeder Mortality Calculator* may produce estimates of mortality that may be either higher than expected or lower than expected.

It is possible that either the numerator or the denominator counts may be wrong. The numerator counts are the estimates of dead animals. If you are confident that your mustering efficiency is pretty good and you keep accurate records, then the numerator counts are likely to be as good as you can get them. The next problem is the denominator counts. It is our view that denominator counts are a more difficult problem and may be contributing to mortality estimates that are not quite right. The most likely reasons for this are because of animal movements that have not been counted, either at all or in the most appropriate way. Reading the earlier FAQ answers will provide explanations for why denominator counts are problematic.

It is important to note that the *Breeder Mortality Calculator 1.0 Simple* has some simple assumptions for handling data and particularly timing of moves (on or off the property) and that these may sometimes not be right (see FAQs 4, 5 and 6).

If you use the *Breeder Mortality Calculator 1.0 Simple* and get results that do not make sense or that are not what you expect, then please consider using the *Breeder Mortality Calculator 2.0 Advanced*. The Advanced version 2.0 requires more detailed data inputs, particularly with respect to month of year when movements occur (sales and purchases) and month of the year when brandings occur. Recording this data in more detail will produce more accurate denominator counts and will result in a more accurate estimate of mortality.

Acknowledgements

- The Breeder Mortality Calculator I was developed by Alastair Henderson (Mirroong Pty Ltd), Nigel Perkins (AusVet Animal Health Services Pty Ltd) and Steve Banney (Steve Banney Agribusiness) as part of MLA project [B.NBP.0664 Determining property-level rates of breeder cow mortality in northern Australia](#).
- A link to the recording of the Breeder Mortality Project webinar can be found [here](#).
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