

## Build a Frequency Exercise Key

### Smith Farms – Hay Enterprise

Martin and Peg Smith have expanded the herd (in anticipation of excellent cattle prices) to 50 cows. Typically they pasture the cattle in the summer, but need to feed hay in the fall and winter. The herd's average hay use is about 1.80 tons of hay per cow per year, with some variability. In fact, careful record keeping indicates the herd's alfalfa hay requirements depend on the severity of the winter and the quality of summer pasture. The herd's hay needs during the last 24 years are summarized in Table 1. For instance, the Smiths used 1.9 tons per cow during four of the last 24 years.

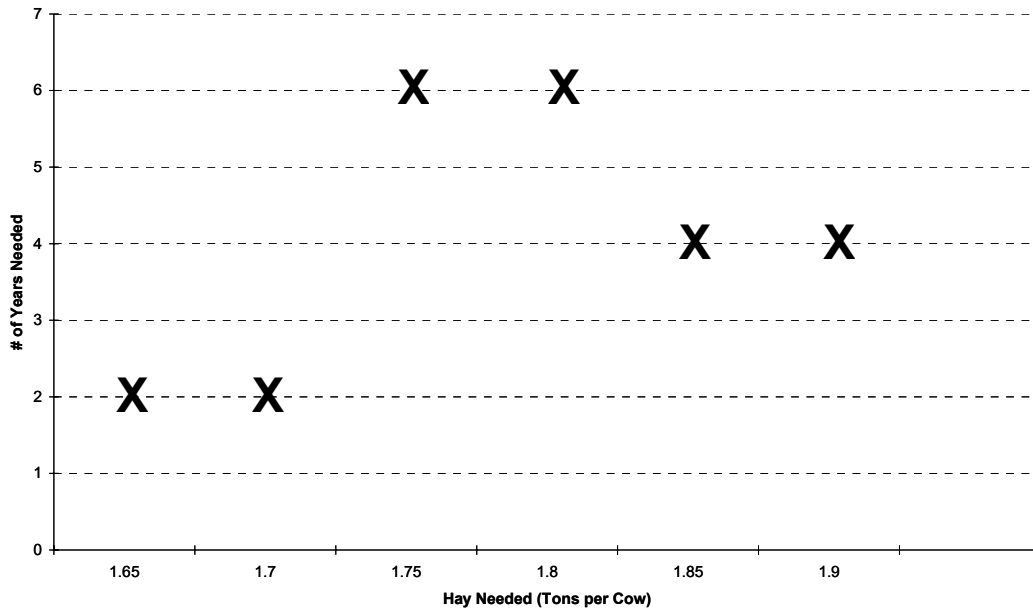
**Table 1. Martin and Peg Smith's Beef Enterprise – Hay Needs Summary**

Hay Need Category	Hay Needed per Cow	Number of Years <sup>1</sup>
1 (Low)	1.65 tons per cow	2
2	1.70 tons per cow	2
3	1.75 tons per cow	6
4	1.80 tons per cow	6
5	1.85 tons per cow	4
6 (High)	1.90 tons per cow	4

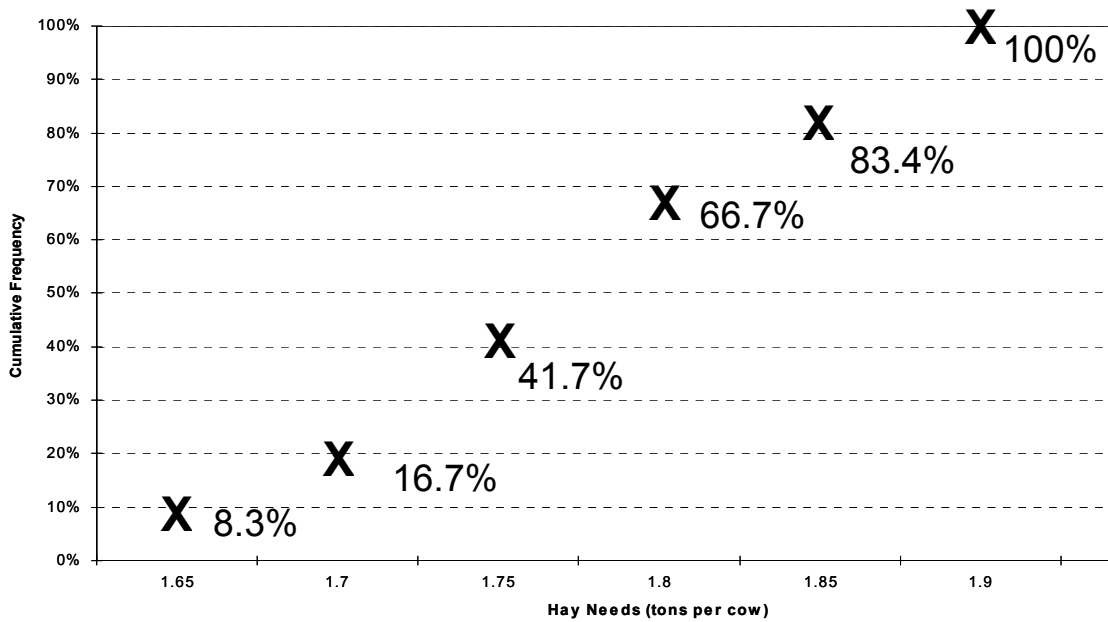
Use the information in Table 1 to construct both an historical frequency and an historical cumulative frequency on the next page.

<sup>1</sup> Number of years in the last 24 that the Smiths needed x.xx tons of hay.

Probability Frequency: Smith Farms Hay Needs  
24 Year History



Cumulative Frequency - Smith Farms Hay Needs  
24 Year History



The cumulative frequency is calculated by first dividing the years 1.65 tons/cow was needed (2) by the total years (24). Other percentages are added to this, in order of increasing hay need, until 100% is reached.

1. Using the historical frequency, are we as likely to need the 1.65 tons of hay per cow as 1.85 tons of hay? What else can we learn from looking at the frequency?

No, the need for 1.65 tons/cow only occurred twice in 24 years, while 1.85 tons/cow occurred four times.

We learn that it is very likely that the Smiths will need 1.75 and 1.8 tons/cow since these occurred most often.

2. Using the cumulative frequency, what is the probability that the Smiths will need less than 1.75 tons of hay per cow? What's the probability the Smiths will need more than 1.75 tons of hay per cow?

The probability of needing less than 1.75 tons/cow is 41.7% (the cumulative percentage to that point). The need for more than 1.75 tons/cow is  $1 - .417$ , or 58.3% of the time.

3. Smith Farms harvested 192 tons of hay, some of which they can sell to horse owners for a substantial margin. Of course, they don't want to sell too much hay or else they will have to buy some in the early spring. If the Smiths want to keep enough hay around so that they won't run out of it about 80 percent of the time, how much should they sell? (Hint: Use the cumulative frequency and remember the Smiths intend to keep all 50 cows.)

At about 80% of the time the Smiths need 1.85 tons/cow. 1.85 tons/cow times 50 cows is 92.5 tons. Producing 192 and setting back 92.5 leaves 99.5 tons to sell.

The previous example was pretty straightforward. The only uncertain variable was the amount of hay needed. In reality, the Smiths would need to gauge (at least) the price of hay that horse owners are willing to pay today, the expected production of hay if it hasn't been harvested, and a forecast of what hay prices are likely to be in the future.