Cohort Analysis: A unique method to conduct analyses of subgroups and trends in dairy herd performance

S.C. Smith

DHI-Provo; a division of DHI Computing Service, Inc.
1525 West 820 North
Provo, Utah, 84601 USA

Abstract

Traditional milk recording or dairy herd improvement (DHI) herd summary reports generated by dairy records processing centers provide valuable insight into the performance and status of dairy herds. The summary reports are generally based on the whole herd and/or lactation groups. Monitoring the herd summary statistics over time enables the detection of trends and changes in animal performance. However, it often takes time for the results of herd and feed management changes to be reflected in the herd summary statistics. For example, if a dairy producer changes the feeding and management of the dry cows and newly fresh cows, it could significantly impact these cows and thus the herd. However, it will take a number of months to see a significant change in herd summary statistics such as test day and annual rolling herd average milk production. In cohort analysis reports, the herd is divided into cohort groups, such as month of calving, and the statistics are calculated for each cohort group. By analysing the performance of the smaller cohort groups, it is possible to more succinctly evaluate the impact of herd and feed management changes within a herd.

Keywords: Dairy herd improvement, Cohort analysis

Introduction

Over the years, there has been a tremendous increase in the size of dairy operations. In 1974, the average size of herds processed by DHI-Provo was 197 cows. In 2011, the average herd size was 1,021 cows. In addition to the size of dairies increasing, the dairy producers are utilizing more outside professional expertise such as feed nutritionists, veterinarians and herd management consultants to assist them in making herd and feeding management decisions. As new herd management techniques, technologies and feed products are implemented on the dairies, the dairy producers and consultants want to be able to measure the effectiveness of their management and feed changes.

More than 30 years ago, DHI-Provo introduced the Trend Analysis report. This report segments the cows into lactation groups of: lactation 1, lactation 2 and above, and the whole herd. The cows are also divided into groups based on the month they calved. The Trend Analysis report shows average milk production of the cows at various stages of the lactation. It also includes several reproduction statistics. This report has been very helpful for medium and large sized dairies as they evaluate their herd performance in more detail. The Trend Analysis report was the precursor to the more advanced and much more flexible Cohort Analysis program that is now part of the DHI-Plus® herd management software used by many dairy producers and consultants.

Cohorts

One of the first uses of the word “cohort” was to describe an ancient Roman military unit, comprising six centuries, equal to one tenth of a legion. The word cohort is also used to define a group of people with a common statistical characteristic. In education a cohort group may refer to a class of students. Cohort groups are also used in medical research.

In the DHI-Plus Cohort Analysis report, the initial cohort grouping is based on the month the cows calved. All of the cows that calved in a month, such as October, are put into one cohort group; the cows that calved in November are put into another group, and so forth. Then a number of statistics are calculated for those cohort groups of animals including: milk production, reproduction and health traits. This enables the dairy producers and consultants to see the performance of the cows that calved in a given month as compared to the animals that calved in other months.

The sample report in Figure 1 shows a portion of a Cohort Analysis report for a herd with 1,074 cows. In November 2011, there were 114 cows that calved. In December 2011, there were 84 cows that calved. Milk weights, which are generally recorded monthly, are separated into 30 days in milk (DIM) groups. For the 108 cows that calved in September 2011, there were 103 recorded milk weights during the first 30 DIM. The average milk weight was 95.4 pounds. During the 31 to 60 DIM range there were 107 recorded milk weights with an average of 96.7 pounds.

By looking down a column of values you can see how well the cows that calved in a given month did throughout their lactation. By looking across a row you can see how well each cohort group did during each DIM range.

In Figure 1, the cows that calved in September 2011 averaged 95.4 pounds during their first 30 DIM. The cows that calved October 2011 averaged 98.6 and the cows that calved in November 2011 averaged 105.0 during their first 30 DIM. The statistics shown are for the whole herd. The statistics are also calculated for lactation groups 1, 2 and 3+.

DIM	Data	Apr 12	Mar 12	Feb 12	Jan 12	Dec 11	Nov 11	Oct 11	Sep 11
Lact. All									
Transition	# Calved	35	86	101	101	84	114	94	108
1-30	# of Weights	0	76	79	87	71	86	69	103
	Milk		102.9	93.6	101.2	87.5	105.0	98.6	95.4
31-60	# of Weights		13	97	74	82	114	82	107
	Milk		106.0	103.6	107.6	99.3	107.0	104.4	96.7
61-90	# of Weights			13	112	67	117	87	84
	Milk			101.6	105.2	100.4	101.7	97.7	99.6
91-120	# of Weights				14	77	94	89	103
	Milk				100.1	95.4	97.8	91.0	89.7

Figure 1 Month of calving cohort groups with milk production in days in milk groups.

Graphs

Many of the statistics in the Cohort Analysis reports can also be displayed in several different graphical forms. The importance of graphs in understanding data was explained by John M. Chambers et al. (1983), an expert on the subject of graphical methods for data analysis. He said, “There is no statistical tool that is as powerful as a well-chosen graph. Our eye-brain system is the most sophisticated information processor ever developed, and through graphical displays we can put this system to good use to obtain deep insight into the structure of data. An enormous amount of quantitative information can be conveyed by the graphs; our eye-brain system can summarize vast information quickly and extract salient features, but it is also capable of focusing on detail.”

Lactation curve line graphs

Each line on the graph in Figure 2 is a lactation curve for a specific month-of-calving cohort group. Herd-management consultants have found their clients understand and relate very well to the graphs. This graph illustrates that if cows start out with low milk production, the cows will most likely have low production throughout their lactation. This can then lead to a discussion on the importance of good management practices of cows during the dry period, at time of calving and at the very beginning of the lactation.

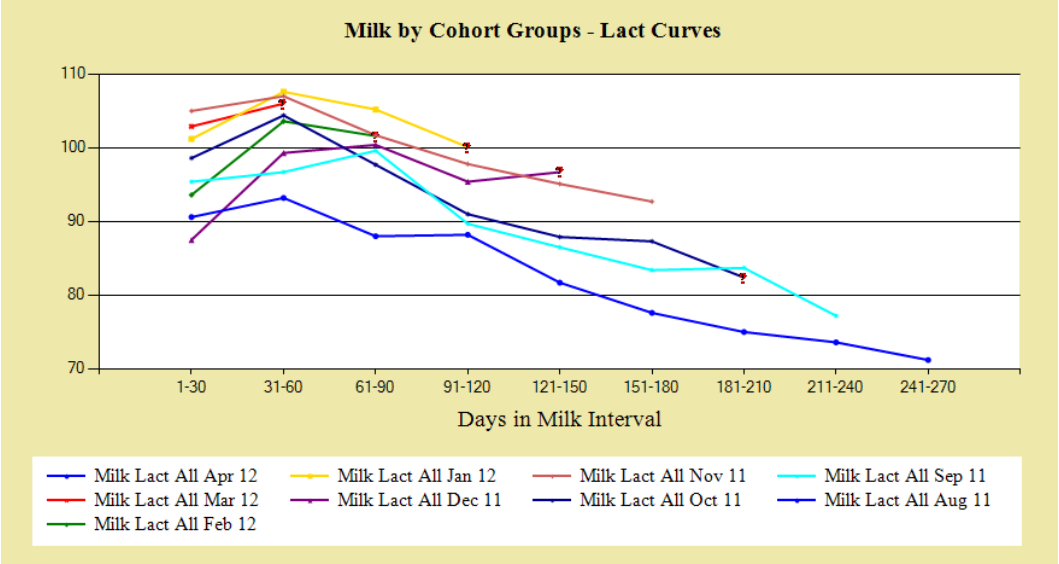

Figure 2 Milk production lactation curves of month of calving cohort groups.

Other types of graphs such as bar graphs, box plots and histograms can be used effectively to display the Cohort Analysis report statistics.

Periods of time within the cohort groups

The size of the herd can influence the use of the Cohort Analysis program. If a herd is relatively small, there may not be enough animals calving each month to effectively calculate statistics for each cohort group. Within the Cohort Analysis program, the user can select the periods of time to be used within the cohort groups. The cohort groups can be based on the quarter, month, or week of calving.

If the herd is small, quarterly cohort groups may be the best option for grouping cows. If the herd is large, there may be enough animals calving in the herd to group the cows into week of calving cohort groups and still have enough cows within each cohort group to calculate useable statistical values. Using the weekly cohort groups makes the report more sensitive to management changes.

Transition cow management discussion tool

The Cohort Analysis report in Figure 3 includes the following transition related items: percent of calves born that were male or female, percent of cows that had milk fever, retained placenta (RP), or displaced abomasum (DA). The user can select from many transition data items available within the program. For example, the user could include the days dry, the days in the close-up pen, and dystocia or calving-ease data items on the report.

By including other potentially related data items on the report and grouping the cows into week of calving cohort groups, this report becomes a very effective tool to monitor and evaluate the transition cows and the dairy personnel who are caring for the cows. It may be easier for dairy personnel to remember unusual events that occurred during specific weeks rather than trying to remember and relate to multiple changes or events that occurred over the period of a month. Perhaps one of the dairy personnel was gone on vacation during a specific week and the replacement person was not as proficient. Or, perhaps there was an unusual weather event during a specific week that had an impact on the cows' performance.

DIM	Data	Feb 26	Feb 19	Feb 12	Feb 05	Jan 29	Jan 22	Jan 15	Jan 08	Jan 01	Dec 25
Lact. All											
Transition	# Calved	101	119	115	120	122	114	110	122	115	113
	# w DOA's	9	10	7	7	6	9	13	17	9	10
	% DOA's	8.9	8.4	6.1	5.8	4.9	7.9	11.8	13.9	7.8	8.8
	% Male / M+F	45	45	43	44	50	38	49	43	45	43
	% Female / M+F	55	55	57	56	50	62	51	57	55	57
	% Milk Fever		3.4	2.6	3.3	4.9	4.4	5.5	0.8	4.3	0.9
	% RP	5.0	8.4	7.8	5.8	4.9	6.1	5.5	5.7	4.3	0.9
	% DA		1.7	0.9	1.7	1.6	3.5	0.9	1.6	1.7	

Figure 3 Weekly calving cohort groups with transition events.

Other Cohort Groupings

Grouping cows based on their time period of calving for analysis is a powerful tool. Other cohort groupings have also been developed to compare groups of cows based on other data items. Some of the other cohort groupings are based on the cows having a specific health event such as: mastitis, milk fever, retained placenta, metritis, ketosis, pneumonia or laminitis. Other cohort groupings include: days dry, days in the close-up pen, level of somatic cell counts, age at first lactation calving, calf sex, reasons for leaving the herd, and the protein to fat ratio. A user can also create a custom or user-defined cohort grouping. These other cohort groupings and analysis can be very enlightening. They help the producers identify the level of impact of events and conditions within their herd. With this knowledge, the producers can more effectively identify areas of opportunities to improve and to set priorities.

Mastitis health events during the first 60 days in milk

One cohort grouping option separates cows into two groups based on mastitis: those that had a clinical case of mastitis in the first 60 DIM and those that did not. In Figure 4, there were a total 1244 cows in the report. Of those cows, 106 had mastitis in their first 60 DIM which is 9 percent of the cows. The average 305 day mature equivalent milk for cows with mastitis was 1,753 pounds lower than the other cows that did not have mastitis.

DIM	Data	MAST 60DIM	Other	Totals
Lact. All				
Transition	# of Cows	106 (9%)	1138 (91%)	1244
	Days Since Fresh	175	172	174
	305 ME Milk	26,320	28,073	27,197

Figure 4 Mastitis in the first 60 days in milk.

This report enables the dairy producers to measure the impact of mastitis on their own cows. Other statistics can be added to the reports for additional analysis. When reproduction items were added to this report, it showed a difference in the reproductive performance of the cows as well. Of the cows that did not have mastitis in their first 60 DIM, 53 percent became pregnant by the time they were 150 DIM. Of the cows that had mastitis, only 46 percent were pregnant by 150 DIM. Both production and reproduction were significantly affected by the cases of mastitis.

Heifers

Another important management area within a dairy herd is the heifer raising operation. Cohort analysis can also be performed on the management of the heifers. For example, the heifers can be grouped by month of birth. Statistics related to dead loss, health and reproduction can be monitored. Some of the health statistics analysed are the rate of: pneumonia, laminitis and scours. Some of the reproduction statistics analysed are: age at breeding, conception rates and age at calving.

Conclusion

As herd sizes increase, separating the animals in the herd into cohort groups, such as month of calving or month of birth, can be a very effective tool to evaluate the performance of the herd, the effectiveness of the personnel caring for the animals and the impact of management and feed changes. Analysis of cohort groups enables dairy producers and consultants to succinctly evaluate the impact of herd and feed management changes within a herd. Responses to management changes can be evaluated sooner with a cohort analysis report than with traditional milk recording and DHI herd summary reports.

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