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A Computerized Performance Record Keeping System for Beef Cattle in Utah

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A COMPUTERIZED PERFORMANCE RECORD KEEPING SYSTEM FOR BEEF CATTLE IN UTAH

by

John J. Pierce

A thesis submitted in partial fulfillment
of the requirements for the degree

of

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in

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John J. Pierce

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ABSTRACT

A Computerized Performance Record Keeping System

for Beef Cattle in Utah

by

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Utah State University, 1973

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A computer program was developed at Utah State University (USU) to aid in obtaining a more complete individual performance record keeping system for beef cattle in Utah. Some computer programs for beef cattle records presently exist but a program was needed that was readily available to the USU animal science extension and resident staff.

The program was written in FORTRAN for use on the Burrough 6700 computer located at the Utah State University Computer Center. It was designed to read input data for individual animals, perform various calculations (i.e. days of age, adjusted weaning weight and weaning weight ratio), print out the input data and results of the calculations for each animal as well as the average adjusted weight for each sex group (heifer, bull, steer). The computer program will manipulate weights in either the English or metric system and will convert weights from the English to metric system if desired. A unique feature of the program is the ranking of animals from highest to lowest based on the weaning weight ratio with accompanying animal number. The records

can be evaluated to identify potential animals to use as replacements and those to be culled.

The input data are collected on the ranch by a cooperative arrangement between the ranch operator and the USU Extension Staff. The ranch operator collects the preliminary data such as: birth date, tag number, tattoo number, dam, age of dam, and sire, and records it on the beef cattle performance input record. The extension specialist weights, gives a conformation score and records the information for each calf on the input record. The beef cattle performance input record is arranged in the same order as the data card is key punched thus facilitating the punching of the data cards.

The staff can change from using the desk calculator to the use of the computer to improve efficiency and flexibility output as well as having more time available to spend with the public teaching that maintaining accurate records can help improve their herds for production and for inventory control. This can help the beef cattle industry to improve quality and type of beef animal produced in Utah and should improve the potential efficiency and profit. The rancher can transfer his records, with minor modifications, to one of the existing national computer programming organizations if desired.

This computer program with or without modification has application for current research and university teaching. The computer program

was designed for use with beef cattle, but could be modified to use for any class of livestock.

This program is not an end in itself but is a foundation from which to build an improved record keeping system in Utah which could improve the production and quality of the beef cattle industry.

(43 pages)

INTRODUCTION

Few ranchers maintain individual performance records of their cattle. Records can provide a basis for the most intelligent selection of replacement heifers, feeder steers and animals to be culled.

Record keeping is important to different people for different reasons. For the purebred producer, records are an essential part of being able to identify the sire and dam to determine the genetic potential of the calf and for breed registration purposes. The commercial producer also has use for records. The identity of the sire may not be as important to the commercial operator, but selection for replacements and identifying culls is still important. It is also possible to use commercial cattle to test purebred bulls. Feedlot performance and carcass data are of great concern to the commercial man and having performance records of the cattle would be an aid in determining the type of animal wanted for future use. These are some reasons why records are essential to compete in the beef cattle business of today.

Inventory control is another important phase of record keeping that is not always considered. A prelisting of all the animal tag numbers could be printed on a computer output sheet prior to the animals actually being handled. As the animals are examined, the data collected could be recorded for each individual and if there is some discrepency as to the correct number of the animal it could be corrected at this time. Also,

if some of the data for an animal are blank after all the animals have been examined, it is then possible to record what happened to that animal, if known, or try to find what has happened to the animal.

The Utah State University staff could teach the value and use of records. With the records readily available, the university staff would be able to suggest improvements to educate the rancher to use such records to make his management decisions. After the rancher has been convinced that using records can improve his herd quality, he may wish to transfer them to one of the national organizations that have extensive computer programs for beef cattle records. He could do this to establish the reputation of his cattle within such an organization. The rancher will actively participate if he feels the program will be profitable to him. Therefore, there is a need for this educational proposal.

At present, the extension staff processes records by using a desk calculator. This consumes long hours that could be used for educational programs. The Animal Science extension and research staff could improve efficiency and deal with more complicated calculations if a computer was used. Summaries and statistical analysis could be greatly enhanced by using a computer. Presently, essential data may be delayed from being calculated and summarized due to the time involved in handling the records. Evaluating the summaries (field and research records) quickly could aid in helping to determine the needs of the people

of Utah and developing appropriate departmental programs. The need for computerized records is most commonly recognized as a management tool for cattle production, but such record systems could be applied to any class of livestock.

With the present trend toward computer work in all fields, students with animal science majors or minors could benefit from some background training in computer work as related to animal science. New employment possibilities could arise within organizations using computer systems, as such organizations will need personnel familiar with animal science problems on their staff.

Objectives

1. To develop a computerized beef cattle performance record system.

   a. To emphasize a simple record keeping system for beef cattle to be used efficiently and profitably by ranchers.

   b. To make it possible to build upon the initial record keeping system or transfer it to one of the complex national computer record systems.

2. Investigate the potential of computer usage for student training and the use of the computer for individual records on experimental animals.

REVIEW OF LITERATURE

Performance records for beef cattle are only about thirty years old as compared with the Dairy Herd Improvement Program that is about sixty years old. According to Baker (1966), if the beef performance program parallels growth of the dairy performance program, 10% of the nation's beef cows will be enrolled in performance programs by 1981. In 1965 there were 1.5% of the nation's beef cattle enrolled in such performance programs.

Currently there are a number of organizations that have computer programs for beef cattle records. At least one organization will handle all breeds concerning performance data on individual animals. The American Angus Association is an example of a breed organization that deals with commercial and purebred cattle. Their primary use of the computer is maintaining ancestral records of the Angus breed and updating the present ownership of these cattle (Angus Breed Improvement 1972), varying degrees of performance data processing is also available for Angus cattle. Most of the other breed associations also use a computer system to process records for their specific breed of cattle.

The Beef Improvement Federation is not in the record processing business, it was organized from a cross section of the cattle industry in an attempt to improve the total industry by establishing guidelines for the beef cattle industry. Their objectives are to outline procedures for measuring and recording beef cattle performance data and offering

suggestions to achieve greater uniformity of terminology and methods of measuring performance traits (BIF 1972).

Past research has studied various genetic and environmental factors and their effects on cattle production. For example, it is known that weaning weight can be affected by such factors as sire, dam, age of dam, and sex of calf. Cundiff, et. al. (1966) made a study to investigate effects of certain factors and their two-way interactions on weaning weight in beef cattle. The purpose of the test was to acquire the knowledge of the effects needed in developing and evaluating beef cattle breeding programs designed to improve weaning weight. In their study each calf was classified by age of dam, sex, breed, type of pasture, area of state, month of birth and type of management. The data were collected in Oklahoma. Their results indicated age of dam, sex, area, month of birth and type of management had significant influences on weaning weight, each accounting for more than 5% of the total variance. Estimates for age of dam indicated weaning weight increased 22kg. between 2-4 years suggesting this group might be classified into three to five month increments rather than by yearly age. Results of the interaction analysis indicated that the effect of age of dam was essentially the same regardless of sex, breed, type of pasture, season of birth or type of management. Sex by type of management, month of birth by type of pasture, and month of birth by type of management appeared important enough to be taken into account in adjusting weaning weights.

METHOD OF PROCEDURE

Prior to developing a computer program, a study was conducted to identify which data were essential and how the data were collected and calculated. A specific case was selected as being representative of the data collected and processed by the USU extension service. The specific case was used to review the procedures for collecting and calculating individual records on beef cattle in Utah. The rancher had previously recorded the ear tag number, birth weight (if known), birth date, sire, dam and age of dam. The extension specialist brought the scales to the ranch, did the actual weighing, recorded the weight and corresponding ear tag number and gave the conformation score as the calves were weighed. These weights were taken at the weaning and yearling ages. The data were recorded on the beef cattle performance input record (Appendix A) which is an aid to the rancher in maintaining complete input data records.

This input record was used by the extension specialist to calculate the final performance data from the raw data. The data were calculated by using the following formulas (BIF 1972).

$$\text{Unadjusted 205 day weight} = \left(\frac{\text{Actual weight - birth weight}}{\text{age in days}} \times 205\right) + \text{birth}^{*}\ \text{weight.}$$

---

*If birth weight is not known a constant of 70 pounds or (70 x 0.4536 kilograms) is widely accepted as the assumed birth weight for beef cattle.

To adjust for age of dam, the following adjustment factors were used:

- 2 year olds - multiply unadjusted 205 day weight by 1.15
- 3 year olds - multiply unadjusted 205 day weight by 1.10
- 4 year old - multiply unadjusted 205 day weight by 1.05
- 5 through 10 year old - no adjustment
- 11 year olds and up - multiply unadjusted 205 day weight by 1.05

Once the adjusted weaning weight is computed each animal is compared with the average of its sex group to give it a weaning weight ratio with the average being 100. Each calf's conformation score, which is given by the extension specialist, is listed and the conformation ratio within each sex group again with the average being 100 is calculated and listed. The weight per day of age (WPD) is from birth to weaning. This is calculated by the formula:

$$WPD = \frac{\text{actual weaning weight}}{\text{days in age}}$$

The yearling data are also recorded on each animal. This data consists of the actual yearling weight, the yearling adjusted weight, the yearling conformation score, the yearling conformation ratio, the days in age at yearling weight and days between weaning and yearling weight. These data are handled in much the same manner as the weaning data. The yearling adjusted weight is adjusted to the 365 day age using the following formula (BIF 1972):

$$\text{Adjusted 365 day weight} = \left(\frac{\text{actual yearling weight-actual weaning weight}}{\text{number of days between weights}} \times 160\right) + \text{weaning weight (205 days) adjusted for age of dam.}$$

Also figured with the yearling data are the total weight gained from weaning to yearling age, weight per day of age and average daily gain. The total weight gained is calculated by actual yearling weight minus actual weaning weight. Yearling weight per day of age is the actual yearling weight divided by days in age. Average daily gain (ADG) is shown in the following formula.

$$\text{ADG} = \frac{\text{actual yearling weight - actual weaning weight}}{\text{number of days between weights}}$$

The calculated data are then used for making management decisions concerning the animals examined.

RESULTS AND DISCUSSION

The major contribution of this study was to develop a computer program for beef cattle records at Utah State University (Appendix B). It was written to be used as an educational tool for use by the Extension Service and Animal Science Department to teach the importance of performance records on individual animals in today's beef industry. Computerized records will facilitate handling the data to be calculated as well as adding flexibility in examining and evaluating the records.

Program aspects

The rancher's name and the adjusted weaning and yearling weight average for each sex group (heifer, bull, steer) is found on the first page of the computer printout (Appendix C). This enables the manager or specialist to see the average weights of each sex group for the herd. If one animal's record (card) was missed when being punched this figure can be used to estimate the weaning weight ratio for this one animal without going back to the computer. Also, the difference can be noted between the different sex groups. The second page of output contains the rancher's name and the weaning data for the entire herd with all the weaning data for each animal being on one line. It is common to report scientific data in the metric system, but most data collected and reported on ranches are in the English system. Therefore, part of the program has been designed to calculate weights in either kilograms or pounds

and can convert pounds to kilograms if desired. A special feature of the program is illustrated at the right side of the page. The last two columns give the ranking of the weaning weight ratio from highest to lowest with the corresponding ear tag number that readily identifies each individual weaning weight ratio (Appendix C - weaning data). The ratio is a way of comparing animals within the herd to determine their rank in relation to the rest of the herd. This is particularly useful in selecting the animals to use as replacement heifers, feeder steers, and those to be culled. With this ranking, the most outstanding and least valuable animals are easily identified without having to scan the entire list to make that determination. Other ranking possibilities are available with minor modifications, which does add potential flexibility to the program. A ranking could be made of the actual weaning weight, the age at weaning and/or the weight per day of age. These are additions that could be used to perform a more detailed selection system.

In order to compare calves on an equal basis, each animal's weight was adjusted to 205 days, which is commonly used as the adjusted weaning age. Each animal was considered only with other animals of the same sex (heifer, bull, steer). By having all the weaning data for each animal on the same line various columns can easily be compared such as the conformation ratio can be compared with the weaning weight ratio to determine if the animals look the same as the performance records indicate.

Part of the program is designed to calculate the days in age of each animal. This is important from birth to weaning and also from weaning to 365 day or yearling age. In order to calculate the days in age the birth date, weaning date and yearling date are needed. The dates are entered in the computer as month, day and year, e. g. 041069 = fourth month, tenth day of 1969. Such a system does not require transposing dates from the conventional calendar system to a coded numbering system based on total numbers of days in the year. In addition, this portion of the program tests for a leap year or between two years and makes the necessary adjustments as required. This age is then stored for later use in calculations and in the final printout.

The weight per day (WPD) can also be seen to decide how many pounds or kilograms per day the animal gained. There are two school's of thought on how this value should be calculated. The sample WPD output (Appendix C - weaning data) is the actual weaning weight divided by the days in age. The other method uses the actual weaning weight minus the birth weight with the remaining value being divided by days in age. This may cause a difference in the final value for WPD but for these purposes it was felt that not subtracting a constant birth weight gave a preferred value of actual gains to weaning age. If the actual birth weight is known, there is more justification for calculating WPD on the basis of weight change between birth and weaning. Caution must be used in comparing WPD, as WPD on total weaning weight is not a valid comparison to WPD on weaning weight minus birth weight.

The column identified as "problems" provides a numerical code indicating if an animal is sick, dead, sold or has some other abnormal conditions that should be recorded (Appendix C - weaning data).

On the third output sheet the yearling data are printed if available. The yearling weight per day of age is based on the same reasoning as the weaning weight per day of age. The average daily gain and yearling weight per day of age can be compared to note the animal's gains from weaning to yearling age with gains to yearling age. A legend explaining the heading abbreviations is printed on the last output page (Appendix D).

The calculations that are used in this computer program are based on the guidelines of the Beef Improvement Federation (BIF 1972). Another system could have been used such as not adjusting for age in days or age of dam; also more measurements could have been taken, but this program was designed to meet the present and short range future demands of the personnel involved. The program is, thus, the groundwork from which to build and modify as the needs arise. The calculations used here are common and are widely accepted in the field. The output (Appendix C) indicates that variations do exist among animals within herds and studying such results are necessary for the most useful interpretations to be used in animal selection.

Importance of record keeping

The present outlook indicates that there are sound economic and management bases for keeping individual animal records and eventually

the rancher will have to keep more complete records. The computer program is designed to keep a record of the rate of gain at different times in the animal's life so that comparisons between pre and post weaning can be made to determine if the animal is performing in the expected manner. Then, the individual can be compared with the herd to see where it ranks within the herd. In the future, it would be possible to summarize all records obtained in Utah, on a total basis or within breeds, so that an individual rancher could compare his results to the average of all comparable cattle. This illustrates the flexibility available with computerized records. Record keeping is also important for inventory control. The program does give inventory control between weaning and yearling age by use of the problems column, as previously explained. Further modification of the program to have a prelisting of all the tag numbers before the animals are actually handled is possible, and could be expanded to include the entire herd.

Animal records may lead to some complications. For instance, each animal must be identified in some way for individual records to be kept. There are several methods of identifying cattle. Some of the more common types are: an individual number branded on each animal, ear tags of various types, and ear tattoos. With branding there is a tendency for the hair to grow over the brand thus making it difficult to read. Ear tags are sometimes lost. Ear tattoos must be put in so they can be easily read. Some of these problems of positive identification

can be overcome by such methods as using two ear tags, a combination of an ear tag and tattoo, or an ear tag and a brand number. Once the animals are identified, a major step toward improved record keeping has been accomplished.

Production aspects

Valuable information for various phases of animal science can be taken from the program. Nutritional and breeding aspects can be evaluated by comparing records of various years. With this information, the operator will be able to determine which cows are consistent producers and which have missed calving, are poor calf producers, or have other production problems.

The sire may also be evaluated, if he is known. If his calves are ranked high in the weaning weight ratio, it would appear that he is a benefit to the herd and it may be advisable to use him in the future. If, on the other hand, his progeny are below the herd average it may indicate that a replacement is needed. Future matings may be planned based on the performance of the progeny of the various bulls and cows.

Educational aspects

The educational aspects of this program are numerous. The extension personnel can benefit from the program by using it as an aid in teaching through personal contact with the rancher, to a group as part of a livestock extension class, and by demonstration of actual results that have

been obtained using the system (Appendix C). The program is also an aid to the extension staff in performing a wider range of calculations more efficiently and quickly. From the results obtained, the specialist is able to interpret and summarize the information and make suggestions for improvement based on the summary.

The farmer and rancher learn most by actually working with the Extension Livestock Specialist using the computer program to upgrade their herd. A leading rancher has said, "Ranchers need not keep records on their cattle, but they are going to have to compete with the ranchers that do." Records, if kept and evaluated correctly, are an aid to the rancher in making management decisions toward improving his herd. Once the rancher has learned the value and proper use of records he could then transfer to one of the national associations that provide computer record keeping on performance and may also provide breed registration for his animals.

The undergraduate and graduate students interested in livestock can use this computer program to learn and analyze the basic principles of using animal records. It enables a class to have the opportunity to work with real data, have it read into the computer and get the needed output rapidly without having a detailed background in computer operations. Graduate students can use this program as the basis to expand or modify to meet their particular demands. An economic analysis may even be considered to determine the value the program has as an aid in actual

practice. The computer program could also be considered background training for the student when he gets on the job either in his own operation or while helping others plan improvements for their livestock operations.

The animal science staff, in addition to using this program as a teaching aid, could use it to keep data on the experimental animals that are on research projects. The program could be used as is, modified or expanded, to meet the demands of the situation. This would allow more efficiency and flexibility of calculations as well as giving a summary and provide data for statistical analyses.

SUMMARY AND CONCLUSION

A computer program was developed in an attempt to improve the performance record keeping system for beef cattle in Utah. It is recognized that some computer programs for beef cattle records already exist but a program was needed that was readily available to the extension and animal science staff at Utah State University (U. S. U.).

The program was written in FORTRAN for use on the Burroughs 6700 computer located at the Utah State University Computer Center. This program was designed to read the input data for individual animals, perform various calculations (i. e. days in age, adjusted weaning weight and weaning weight ratio), print an output sheet containing the average adjusted weaning and yearling weight for each sex group (heifer, bull, steer), then print the input data for each individual animal plus the results of the various calculations. The program will manipulate weights in either the English or metric system and will convert weights from the English to metric system if so desired. A helpful aid, built into the program, is the ranking of animals from highest to lowest based on the weaning weight ratio with accompanying animal number. This enables the manager to quickly see which are the best and poorest performing animals in the herd. These records and the actual animal can then be examined more closely to determine which animals to use as replacements and which should be culled.

The input data are collected on the ranch by a cooperative arrangement between the ranch operator and the USU Extension Staff. The ranch

operator collects the preliminary data such as: birth date, tag number, tattoo number, dam, age of dam, and sire, and records it on the beef cattle performance input record. The extension specialist weighs, gives a conformation score and records the information for each calf on the input record. The beef cattle performance input record is arranged in the same order as the data card is key punched thus facilitating the punching of the data cards.

The staff can change from using the desk calculator to the use of the computer to improve efficiency and flexibility output as well as having more time available to spend with the public teaching that maintaining accurate records can help improve their herds for production and for inventory control. This can help the beef cattle industry to improve quality and type of beef animal produced in Utah and should improve the potential efficiency and profit. The program is designed for the rancher to transfer his records, with minor modifications, to one of the various national computer programming organizations if desired.

This computer program with or without modification has application for current research and university teaching. A modified program could summarize research records on experimental animals. The teaching staff could use applicable computer programs for class assignments. The computer program was designed for use with beef cattle but could be modified to use for any class of livestock.

In conclusion, it is realized that this computer program is not an end in itself but is a foundation from which to build an improved record keeping system in Utah, which could improve the production and quality of the beef cattle industry.

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APPENDIXES

Appendix A: Beef cattle performance input record

Name _____

Address _____

Tag No.	Tatto No.	Breed	Sex	Birth Month	Date Day	Year	Birth Weight	Wean Month	Date Day	Year	Actual Weaning Weight	Wean Conf. Score	Dam No.	Dam Age	Sire No.	Problems	Year Month	Date Day	Year	Actual Year Weight	Year Conf. Score
Col. 1-4	Col. 5-9	Col. 10-11	Col. 12	Col. 13-14	Col. 15-16	Col. 17-18	Col. 19-21	Col. 22-23	Col. 24-25	Col. 26-27	Col. 28-30	Col. 31-33	Col. 34-37	Col. 38-39	Col. 40-43	Col. 44	Col. 45-46	Col. 47-48	Col. 49-50	Col. 51-54	Col. 55-57

Appendix B: Computer program developed for performance record keeping of beef cattle in Utah in this study

```
FILE  5=PIERCE/DATAIN
      INTEGER BIRTHD,WEANDA,YEARDA
      DIMENSION ICUM(11),NAME(12),IAGE(3),IM(520,3),ID(520,3),
     1IYR(520,3),IWAWST(520),ITAG(520),ITATT(520),IBR(520),IS(520),
     1IBWT(520),IAWW(520),IWS(520),IDAND(520),IDA(520),ISIRE(520),
     1IADW(520),IWW(520),ICR(520),IFYWT(520),IYAW(520),NADY(520),
     1IYW(520),NYS(520),NCR(520),NDBW(520),
     1LGA(520),ADG(520),WDA(520),
     1WPD(520),WORD(13),IP(520),LTAG(520),LWW(520)
      DATA ICUM/31,59,90,120,151,181,212,243,273,304,334/,
     1     NAME/ 1, 2, 3, 4, 5, 6, 7, 8, 9,10,11,12/
      EQUIVALENCE (IAGE(1),BIRTHD),(IAGE(2),WEANDA),(IAGE(3),YEARDA)
  111 FORMAT(I4,I5,I2,I1,I2,I2,I2,I3,I2,I2,I2,I3,I3,I4,I2,I4,I1,I2,I2,
     1I2,I4,I3)
  221 FORMAT(' ',103X,'RANK')
  222 FORMAT('0',9X, 'TAGN TATTO BR S BIRTHD BWT WEANDA AWW IWS DAND DA
     1SIRE WAW ADW IWW ICR    WPD PR           LTAG    LWW')
  232 FORMAT('0',9X,I4,X,I5,X,I2,X,I1,X,I2,I2,I2,X,I3,X,I2,I2,I2,X,I3,X,
     1I3,X,I4,X,I2,X,I4,X,I3,X,I3,X,I3,X,I3,X,F6.3,2X,I1,10X,I4,4X,I3)
  233 FORMAT('0',9X,I4,X,I2,I2,I2,X,I4,X,I4,X,I3,X,I3,X,I3,X,I3,X,I3,5X,
     1I4,6X,F6.3,6X,F6.3)
  244 FORMAT('0',9X,  'TAGN YEARDA FYWT IYAW ADY IYW NYS NCR DBW WEIGHT
     1GAIN      ADG        WT/DAY')
  432 FORMAT('0',9X,'  CWAW      BWAW      SWAW')
  433 FORMAT('0',9X,F6.2,3X,F6.2,3X,F6.2)
  444 FORMAT('0',9X,'  CYAW      BYAW      SYAW')
  445 FORMAT('0',9X,F6.2,3X,F6.2,3X,F6.2)
  470 FORMAT('1','          HEADING LEGEND:',/,10X,
     *'CWAW=COW WEAN ADJUSTED WEIGHT AVERAGE',/,10X,
     *'RWAW=BULL WEAN ADJUSTED WEIGHT AVERAGE',/,10X,
     *'SWAW=STEER WEAN ADJUSTED WEIGHT AVERAGE',/,10X,
     *'CYAW=COW YEAR ADJUSTED WEIGHT AVERAGE',/,10X,
     *'RYAW=BULL YEAR ADJUSTED WEIGHT AVERAGE',/,10X,
```

```
     *'SYAW=STEER YEAR ADJUSTED WEIGHT AVERAGE',//,10X,
     *'TAGN=TAG NO',/,10X,
     *'TATTO=TATTOO',/,10X,'BR=BREED',/,15X,'1=HEREFORD',/,15X,
     *'2=ANGUS',/,15X,'3=CHAROLAIS',/,15X,'4=SIMMENTAL',/,15X,
     *'5=HEREFORD X ANGUS',/,15X,'6=HEREFORD X CHAROLAIS',/,15X,
     *'7=HEREFORD X ANGUS X CHAROLAIS',/,15X,'8=LIMOUSIN X CHAROLAIS',
     */,10X,'S=SEX:',/,15X,'1=COW 2=BULL 3=STEER',/,10X,
     *'BIRTHD=BIRTH DATE',/,10X,'BWT=BIRTH WEIGHT',/,10X,
     *'WEANDA=WEANING DATE',/,10X,
     *'AWW=ACTUAL WEANING WEIGHT',/,10X,'IWS=WEAN CONFORMATION SCORE',/,
     *15X,'1=- 2=MIDDLE 3=+',/,10X,'DANO=DAM NO',/,10X,'DA=DAM AGE',/,
     *10X,'SIRE=SIRE NO',/,10X,'WAW=ADJUSTED WEAN WEIGHT',/,10X,
     *'ADW=AGE IN DAYS AT WEANING',/,10X,'IWW=WEAN WEIGHT RATIO',/,10X,
     *'ICR=WEAN CONFORMATION RATIO',/,10X,'WPD=WEIGHT PER DAY OF AGE W',
     */,10X,'PR=PROBLEMS:',/,15X,'1=SICK 2=DIED 3=SOLD',/,10X,
     *'LTAG=ASSOCIATED TAG',/,10X,'LWW=WEAN WEIGHT RATIO RANKING',//,
     *10X,'TAGN=TAG NO',/,10X,'FYWT=ACTUAL YEAR WEIGHT',/,10X,
     *'YEARDA=YEARING DATE WEIGHED',/,10X,'IAW=YEAR ADJUSTED WEIGHT',/,
     *10X,'ADY=AGE IN DAYS AT YEARING WEIGHTS',/,10X,
     *'IYW=YEAR WEIGHT RATIO',/,10X,'NYS=YEAR CONFORMATION SCORE:',/,
     *15X,'1=- 2=MIDDLE 3=+',/,10X,'NCR=YEAR CONFORMATION RATIO',/,10X,
     *'DBW=DAYS BETWEEN WEAN AND YEAR WEIGHTS',/,10X,

     *'WEIGHT GAIN=WEIGHT GAIN BETWEEN WEAN AND YEAR AGE',/,10X,
     *'ADG=AVERAGE DAILY GAIN',/,10X,
     *'WT/DAY=WEIGHT PER DAY OF AGE YR')
1332 FORMAT(I1,13A6)
1333 FORMAT('1',2X,I1,10X,13A6)
     READ(5,1332)KM,(WORD(I),I=1,13)
```

```
      WRITE(6,1333)KM,(WORD(I),I=1,13)

      NCARD=0
      ICOW=0
      IBULL=0
      ISTEER=0
      ITC=0
      ITB=0
      ITS=0
      ICC=0
      ICB=0
      ICS=0
      IYC=0
      IYB=0
      IYS=0
      NCOW=0
      NBULL=0
      NSTEER=0
      NCC=0
      NCB=0
      NCS=0
    5 NCARD=NCARD+1
      READ(5,111,END=6)ITAG(NCARD),ITATT(NCARD),IBR(NCARD),IS(NCARD),
     1IM(NCARD,1),ID(NCARD,1),IYR(NCARD,1),IBWT(NCARD),IM(NCARD,2),
     1ID(NCARD,2),IYR(NCARD,2),IAWW(NCARD),IWS(NCARD),IDAND(NCARD),
     1IDA(NCARD),ISIRE(NCARD),IP(NCARD),IM(NCARD,3),ID(NCARD,3),
     1IYR(NCARD,3),IFYWT(NCARD),NYS(NCARD)
C       USE ONLY IN CONVERTING FROM ENGLISH TO METRIC SYSTEM
      IF(KM.LT.1)GO TO 98
      BWT=(FLOAT(IBWT(NCARD))*0.4536)
      IBWT(NCARD)=BWT
      AWW=(FLOAT(IAWW(NCARD))*0.4536)
      IAWW(NCARD)=AWW
```

```
      FYWT=(FLOAT(IFYWT(NCARD))*0.4536)
      IFYWT(NCARD)=FYWT
   98 IWAw=0
      DO 11 NTIME=1,3
      ILEAP=0
      IAGE(NTIME)=0
      ALEAP=FLOAT(IYR(NCARD,NTIME))/4.
      BLEAP=IYR(NCARD,NTIME)/4
      IF(ALEAP.EQ.BLEAP)ILEAP=1
      DO 10 I=1,12
      IF(IM(NCARD,NTIME).NE.NAME(I))GO TO 10
      IF(I.EQ.1)GO TO 8
      IF(I.GE.3.AND.ILEAP.EQ.1)IAGE(NTIME)=1
      IAGE(NTIME)=ICUM(I-1)+ID(NCARD,NTIME)+IAGE(NTIME)
      GO TO 11
    8 IAGE(NTIME)=ID(NCARD,NTIME)
      GO TO 11
   10 CONTINUE
   11 CONTINUE
      IADW(NCARD)=WEANDA-BIRTHD
      WPD(NCARD)=FLOAT(IAWW(NCARD))/FLOAT(IADW(NCARD))
      U=(FLOAT(IAWW(NCARD)-IBWT(NCARD))/FLOAT(IADW(NCARD)))*205.+(FLOAT
     1(IBWT(NCARD)))
      IF(IDA(NCARD).LE.2)GO TO 12
      IF(IDA(NCARD).EQ.3)GO TO 13
      IF(IDA(NCARD).EQ.4)GO TO 14
      IF(IDA(NCARD).GE.5.AND.IDA(NCARD).LE.10)GO TO 15
      IF(IDA(NCARD).GE.11)GO TO 14
```

```
12 IWAW=U*1.15
   GO TO 16
13 IWAW=U*1.10
   GO TO 16
14 IWAW=U*1.05
   GO TO 16
15 IWAW=U
   GO TO 16
16 IF(IS(NCARD)-2)21,22,23
21 ITC=ITC+1
   IWAWST(NCARD)=IWAW
   ICOW=ICOW+IWAW
   ICC=ICC+IWS(NCARD)
   GO TO 35
22 ITB=ITB+1
   IWAWST(NCARD)=IWAW
   IBULL=IBULL+IWAW
   ICB=ICB+IWS(NCARD)
   GO TO 35
23 ITS=ITS+1
   IWAWST(NCARD)=IWAW
   ISTEER=ISTEER+IWAW
   ICS=ICS+IWS(NCARD)
   GO TO 35
35 IF(IFYWT(NCARD).EQ.0)GO TO 5
   IF(IYR(NCARD,1).NE.IYR(NCARD,3))GO TO 60
60 NADY(NCARD)=(365-BIRTHD)+YEARDA
   NDBW(NCARD)=NADY(NCARD)-IADW(NCARD)
   WDA(NCARD)=FLOAT(IFYWT(NCARD))/FLOAT(NADY(NCARD))
   LGA(NCARD)=IFYWT(NCARD)-IAWW(NCARD)
   ADG(NCARD)=FLOAT(LGA(NCARD))/FLOAT(NDBW(NCARD))
   Y=ADG(NCARD)*160+IWAWST(NCARD)
   IY=Y
```

```
      GO TO 50
   50 IF(IS(NCARD)-2)501,502,503
  501 IYC=IYC+1
      IYAw(NCARD)=IY
      NCOw=NCOW+IY
      NCC=NCC+NYS(NCARD)
      GO TO 5
  502 IYB=IYB+1
      IYAw(NCARD)=IY
      NBULL=NBULL+IY
      NCB=NCB+NYS(NCARD)
      GO TO 5
  503 IYS=IYS+1
      IYAw(NCARD)=IY
      NSTEER=NSTEER+IY
      NCS=NCS+NYS(NCARD)
      GO TO 5
    6 IF(ITC.EQ.0)GO TO 41
      CWAw=FLOAT(ICOW)/FLOAT(ITC)
      CAWS=FLOAT(ICC)/FLOAT(ITC)
   41 IF(ITB.EQ.0)GO TO 42
      BWAw=FLOAT(IBULL)/FLOAT(ITB)
      BAWS=FLOAT(ICB)/FLOAT(ITB)
   42 IF(ITS.EQ.0)GO TO 48
      SWAw=FLOAT(ISTEER)/FLOAT(ITS)
      SAWS=FLOAT(ICS)/FLOAT(ITS)
   48 WRITE(6,432)
      WRITE(6,433)CWAW,BWAW,SWAW
```

```
      IF(IYC.EQ.0)GO TO 51
      CYAW=FLOAT(NCOW)/FLOAT(IYC)
      CAYS=FLOAT(NCC)/FLOAT(IYC)
   51 IF(IYB.EQ.0)GO TO 52
      BYAW=FLOAT(NBULL)/FLOAT(IYB)
      BAYS=FLOAT(NCB)/FLOAT(IYB)
   52 IF(IYS.EQ.0)GO TO 43
      SYAW=FLOAT(NSTEER)/FLOAT(IYS)
      SAYS=FLOAT(NCS)/FLOAT(IYS)
   43 WRITE(6,444)
      WRITE(6,445)CYAW,BYAW,SYAW
      WRITE(6,1333)KM,(WORD(I),I=1,13)
      WRITE(6,221)
      WRITE(6,222)
      NC=NCARD-1
      DO 700 KK=1,NC
      IF(IS(KK)-2)701,702,703
  701 CWW=FLOAT(IWAWST(KK))/CWAW
      IWW(KK)=CWW*100.
      CCR=FLOAT(IWS(KK))/CAWS
      ICR(KK)=CCR*100.
      GO TO 800
  702 BWW=FLOAT(IWAWST(KK))/BWAW
      IWW(KK)=BWW*100.
      BCR=FLOAT(IWS(KK))/BAWS
      ICR(KK)=BCR*100.
      GO TO 800
  703 SWW=FLOAT(IWAWST(KK))/SWAW
      IWW(KK)=SWW*100.
      SCR=FLOAT(IWS(KK))/SAWS
      ICR(KK)=SCR*100.
      GO TO 800
  800 IF(IFYWT(KK).EQ.0)GO TO 850
```

```
      IF(IS(KK)-2)801,802,803
  801 CYW=FLOAT(IYAW(KK))/CYAW
      IYW(KK)=CYW*100.
      YCR=FLOAT(NYS(KK))/CAYS
      NCR(KK)=YCR*100.
      GO TO 850
  802 BYW=FLOAT(IYAW(KK))/BYAW
      IYW(KK)=BYW*100.
      YBR=FLOAT(NYS(KK))/BAYS
      NCR(KK)=YBR*100.
      GO TO 850
  803 SYW=FLOAT(IYAW(KK))/SYAW
      IYW(KK)=SYW*100.
      YSR=FLOAT(NYS(KK))/SAYS
      NCR(KK)=YSR*100.
      GO TO 850
  850 GO TO 700
  700 CONTINUE
      DO 89 M=1,NC
      LWW(M)=IWW(M)
      LTAG(M)=ITAG(M)
   89 CONTINUE
      DO 90 I=1,NC
      DO 90 J=I+1,NCARD
      IF(LWW(I).GE.LWW(J))GO TO 90
      L=LWW(I)
      LWW(I)=LWW(J)
      LWW(J)=L
```

```
      L=LTAG(I)
      LTAG(I)=LTAG(J)
      LTAG(J)=L
   90 CONTINUE
      DO 96 KK=1,NC
      WRITE(6,232)ITAG(KK),ITATT(KK),IBR(KK),IS(KK),IM(KK,1),ID(KK,1),
     1IYR(KK,1),IBWT(KK),IM(KK,2),ID(KK,2),IYR(KK,2),IAWW(KK),IWS(KK),
     1IDAND(KK),IDA(KK),ISIRE(KK),IWAWST(KK),IADW(KK),IWW(KK),ICR(KK),
     1WPD(KK),IP(KK),LTAG(KK),LWW(KK)
   96 CONTINUE
      WRITE(6,1333)KM,(WORD(I),I=1,13)
      WRITE(6,244)
      DO 950 JJ=1,NC
      IF(IFYWT(JJ).EQ.0)GO TO 950
      WRITE(6,233)ITAG(JJ),IM(JJ,3),ID(JJ,3),IYR(JJ,3),IFYWT(JJ),
     1IYAW(JJ),NADY(JJ),IYW(JJ),NYS(JJ),NCR(JJ),NDBW(JJ),LGA(JJ),ADG(JJ)
     1,WDA(JJ)
  950 CONTINUE
      WRITE(6,470)
      STOP
      END
```

Appendix C: Sample output sheets of the computer program containing the results of the various calculations, output weights in kilograms. First page of output. Adjusted weaning and yearling weight averages for each sex group.

1 RANCHER X

CWAW[a]	BWAW	SWAW
171.00	202.75	184.33
CYAW	BYAW	SYAW
252.50	340.25	0.00

a) See Appendix D for explanation of abbreviations.

1 RANCHER X

TAGN	TATTO	BR	S	BIRTHD	BWT	WEANDA	AWW	WS	DANO	DA	SIRE	WAW	ADW	IWW	ICR	WPD	PR	RANK[a] LTAG	RANK[a] LWW
1	1	1	1	3 669	31	102969	199	132	405	5	36	176	237	102	95	0.840	3	4	109
2	2	1	2	3 769	31	102769	226	141	178	10	149	201	234	99	99	0.966	0	248	109
3	3	1	1	31069	31	102969	158	142	369	2	666	164	233	95	102	0.678	0	1	102
4	4	1	2	31069	31	102769	235	143	14	14	60	222	231	109	101	1.017	0	6	101
6	6	1	1	31469	31	102969	181	141	560	4	36	173	229	101	101	0.790	0	132	100
8	8	1	2	31569	31	102769	195	141	656	3	666	197	226	97	99	0.863	0	2	99
15	15	1	2	31869	31	102769	206	141	226	7	58	191	223	94	99	0.924	0	8	97
132	0	5	3	41069	31	10 972	147	132	32	2	0	185	183	100	100	0.803	2	3	95
248	0	1	3	4 869	31	10 972	185	142	248	10	0	201	185	109	107	1.000	3	15	94
808	0	1	3	51569	31	10 972	124	122	808	4	0	167	148	90	92	0.838	3	808	90

a) The last two columns with the ranking data are independent of the other data on the rows, but can be cross referenced by tag number (LTAG = TAGN and LWW = IWW; see Appendix D).

1 RANCHER X

TAGN	YEARDA	FYWT	IYAW	ADY	IYW	NYS	NCR	DBW	WEIGHT GAIN	ADG	WT/DAY
2	4 170	362	340	390	99	132	92	156	136	0.872	0.928
3	4 770	240	246	393	97	142	96	160	82	0.513	0.611
4	4 170	394	385	387	113	153	107	156	159	1.019	1.018
6	4 770	267	259	389	102	152	103	160	86	0.538	0.686
8	4 170	319	324	382	95	142	100	156	124	0.795	0.835
15	4 170	324	312	379	91	141	99	156	118	0.756	0.855

Appendix D: Legend describing the heading abbreviations on the output sheets

```
HEADING LEGEND:
 CWAW=COW WEAN ADJUSTED WEIGHT AVERAGE
 BWAW=BULL WEAN ADJUSTED WEIGHT AVERAGE
 SWAW=STEER WEAN ADJUSTED WEIGHT AVERAGE
 CYAW=COW YEAR ADJUSTED WEIGHT AVERAGE
 BYAW=BULL YEAR ADJUSTED WEIGHT AVERAGE
 SYAW=STEER YEAR ADJUSTED WEIGHT AVERAGE

 TAGN=TAG NO
 TATTO=TATTOO
 BR=BREED
       1=HEREFORD
       2=ANGUS
       3=CHAROLAIS
       4=SIMMENTAL
       5=HEREFORD X ANGUS
       6=HEREFORD X CHAROLAIS
       7=HEREFORD X ANGUS X CHAROLAIS
       8=LIMOUSIN X CHAROLAIS
 S=SEX:
       1=COW 2=BULL 3=STEER
 BIRTHD=BIRTH DATE
 BWT=BIRTH WEIGHT
 WEANDA=WEANING DATE
 AWW=ACTUAL WEANING WEIGHT
 IWS=WEAN CONFORMATION SCORE
      1=- 2=MIDDLE 3=+
 DANO=DAM NO
 DA=DAM AGE
 SIRE=SIRE NO
 WAW=ADJUSTED WEAN WEIGHT
 ADW=AGE IN DAYS AT WEANING
 IWW=WEAN WEIGHT RATIO
 ICR=WEAN CONFORMATION RATIO
 WPD=WEIGHT PER DAY OF AGE W
 PR=PROBLEMS:
      1=SICK 2=DIED 3=SOLD
 LTAG=ASSOCIATED TAG
 LWW=WEAN WEIGHT RATIO RANKING

 TAGN=TAG NO
 FYWT=ACTUAL YEAR WEIGHT
 YEARDA=YEARING DATE WEIGHED
 IAW=YEAR ADJUSTED WEIGHT
 ADY=AGE IN DAYS AT YEARING WEIGHTS
 IYW=YEAR WEIGHT RATIO
 NYS=YEAR CONFORMATION SCORE:
      1=- 2=MIDDLE 3=+
 NCR=YEAR CONFORMATION RATIO
 DBW=DAYS BETWEEN WEAN AND YEAR WEIGHTS
 WEIGHT GAIN=WEIGHT GAIN BETWEEN WEAN AND YEAR AGE
 ADG=AVERAGE DAILY GAIN
 WT/DAY=WEIGHT PER DAY OF AGE YR
```

VITA

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