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# The Relative Accuracy of One-Day and Three-Day Weights of Range Cows

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# The Relative Accuracy of One-Day and Three-Day Weights of Range Cows

By

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This is to certify that, in accordance with the requirements of South Dakota State College for the Master of Science Degree, Leroy H. Holt has presented to this committee three bound copies of an acceptable thesis, done in the major field; and has satisfactorily passed a two-hour oral examination on the thesis, the major field, Animal Husbandry, and the minor field, Agronomy.

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INTRODUCTION

The weight of an animal is usually the most important measurement in assessing the results of livestock experiments. This is especially true with meat animals such as cattle, sheep, and hogs. The weight as measured by individual weighings is a variable that is influenced by many factors.

In most experiments the weight desired is the average body weight under conditions being imposed by the experimental treatment. This weight can be measured only approximately, the error depending upon the precision of the scales, the care and accuracy of the weigher and the care and fill of the animals. The general conclusion has been that three-day weights aid considerably in reducing such errors to a minimum.

Weights that represent the average body weight of range cows in experiments are very necessary as the differences between experimental treatments are often relatively small, and the numbers of animals are few. To get three consecutive weights with the cattle being held under normal conditions is almost impossible because the cattle are often wild, the time between waterings is difficult to control, and the distance the cattle are driven from the pasture to the scales varies with the location of the cattle at weighing time.

Studies on cattle in the feed lot indicate that one-day weights are about as accurate as three-day weights for determining the effect of the treatment being studied. This may or may not be true with range cows since it is probably more difficult to control factors affecting the cows' weight under range conditions. If, however, one-day weights were as accurate or nearly as accurate, experimenters could save much time and effort in their work. Further, weighing on only one day would give the added advantage of managing the cattle more nearly as they are treated under production conditions.

The initiation of new beef cattle breeding work throughout the United States further increases the need of accurate measurements of the weights of cows on range and pasture. Any improvement in determining this true weight, therefore, will have widespread benefits.

## REVIEW OF LITERATURE

There are no published records to date on the relative accuracy of one-day and three-day weights on beef cows maintained on western ranges. There have been several studies reported, however, on dairy cattle kept in barns and on pasture, and upon steers, swine, and sheep in the feed lot.

Lush and Black (1926) compared one and three-day weights of steers at the beginning and end of feeding experiments. They concluded that the increased accuracy of extra weighings justified the expense of making the three-day weights, although one-day weights were not inaccurate enough to be useless for experimental purposes.

Lush, Christensen, Wilson, and Black (1928) presented a more detailed report on cattle weights, in which they showed the theoretical statistical advantage of three-day weights over one-day weights.

Hale and Godbey (1935) studied swine data and found that the standard error of weights of hogs varied according to the size of hogs. They concluded that a larger t value would allow correct interpretation of the significance of the t value from single-day weights.

Hazel (1938) investigated weights of fattening pigs and concluded that the practical value of weighing more than once is negligible for usual feeding trials because the standard deviation due to inaccuracy is relatively small.

Hodgson and Knott (1942) published a report upon the accuracy of live weights of dairy cows on pasture. Their data were from a grazing experiment where the cows were weighed three days consecutively at the beginning and at the end of the grazing period. In their study the average experimental error was 14.0 pounds with a range of 7.0 pounds to 28.3 pounds. The standard error in the weights of 1200 pound cows averaged 2.2 pounds. They concluded that the method of weighing in that experiment gave an accurate measure of the cows' live weights. No comparison of one versus three-day weights was made in their report.

Bean (1946) studied hog weights and concluded that his analysis failed to show any advantage of three-day average weights over single-day weights. In fact, his first-day weights were slightly more accurate as judged by the standard error than the three day average weights.

Baker, Phillips, and Black (1947) compared one-day and three-day weaning weights of calves. They stated that there was no advantage in taking weights on three consecutive days as compared to taking a single weight, when the calves were maintained under uniform conditions.

Patterson (1947) studied steer data and proved that it was possible to reduce the size of the standard error of the mean by using a three-day average weight instead of a one-day weight. However, in all three sets of his data, 11 animals with single-day weights gave more information, as judged by a smaller standard of error for animals, than 10 animals with three-day weights.

Bean (1948) investigated data on single versus three-day average weights for sheep. He showed that the three-day average weight did not consistently produce a smaller standard error than was obtained from first-day weights. He concluded that there was no justification for continuing the practice of weighing sheep three consecutive days to obtain a value to represent the initial or final weight of a lamb on a feeding trial.

## SOURCE OF DATA

The data used in this study were the actual three-day starting and three-day final weights on a herd of range cows on range experiments, at the South Dakota Range Experimental Station, Cottonwood, South Dakota. The range on which the cows were grazed was a mixture of about 33 per cent tall grasses and 67 per cent short grasses. The rainfall in this area averages approximately 16.3 inches per year. The carrying capacity of the range is about one animal unit per 2.43 acres per month. In general the area is typical of much of the North Great Plains range area.

The weights were taken in early May and early December--at the beginning and end of summer grazing trials. In the fall of 1942, the calves were weaned early in November and the cows were weighed on three consecutive days at that time. These weights were also included. The cows were mostly high grade Herefords of medium type. All weights were taken under as nearly similar conditions as was possible under normal range management. The work was started in the fall of 1941 and extended to the spring of 1947. A total of 578 three-day weights were studied.

In the fall of 1941 when the cows were first put on experiment, they were very wild and nervous. The following spring they also showed some wildness. Furthermore, the last two weighings of the 1942 spring period were made during very rainy weather. In the spring of 1946 the cows were accidentally held off feed and water for 24 hours after the first-day's weights were taken. In this case the second and third weights were taken on the third and fourth days respectively. All of the weights taken were studied in this investigation, but in portions of this study the above-noted weights were omitted as it was felt they were not representative of good range management.

During the first five years from 1941 to 1946, a herd of 48 cows was maintained annually in the experiment. In 1947 the size of the herd was increased to 60 head. Some replacements were made in the herd each year to eliminate aged cows and cows that had contracted cancer eyes. In no year did the number of replacements exceed six head.

In some of the summer pastures, the cows were driven from one to two miles for weighing. This was the approximate distance the cows had to travel daily for water.

A Fairbanks livestock scale was used for all weighings. Weight were read to the nearest two pounds.

## ANALYSIS OF DATA AND RESULTS

### Similarity of weights.

Inspection of the data showed considerable variation in the three consecutive weights of the cows. This was true for both the spring and fall weights. Table I shows some of the actual variation encountered in the weights of individual cows. The cows listed in table I were selected at random by drawing two cows from each of the 12 weigh periods studied. The greatest range in three-day weights of any cow shown in this sample was 86 pounds. In the entire population, the greatest range was 120 pounds.

It is evident that the variation shown in these figures would greatly affect the total gains or losses of cattle on experiment if they all tended to move up or down together.

Table 2 shows the deviation of the three-day average weight from the first day weight for spring weights, fall weights, and all weights, respectively. The distribution appears practically normal with a slightly longer tail on the loss side. The tendency for large losses was greater with spring weights than with fall weights. This difference, however, was not large.

The degree of similarity of the three-day weights and the likeness of the first-day weight to the average of the three-day weights is shown by the correlation coefficients in table 3. These correlations are all highly significant. Also they are very large and very similar. The relationship between fall weights was, in general, slightly higher than between spring weights. These differences, however, were all very small.

TABLE 1. THREE-DAY AND AVERAGE THREE-DAY WEIGHTS OF A RANDOM SAMPLE OF RANGE COWS

| Cow No. | 1st DAY | 2nd DAY | 3rd DAY | 3-DAY AVERAGE |
|---|---|---|---|---|
| 24 | 1190 | 1188 | 1104 | 1161 |
| 41 | 1024 | 1016 | 970 | 1003 |
| 4 | 1182 | 1176 | 1114 | 1157 |
| 29 | 704 | 646 | 654 | 668 |
| 6 | 920 | 920 | 958 | 933 |
| 20 | 1080 | 1060 | 1064 | 1068 |
| 46 | 696 | 704 | 764 | 721 |
| 40 | 1182 | 1138 | 1186 | 1169 |
| 15 | 850 | 900 | 904 | 885 |
| 27 | 10[illegible]4 | 1070 | 1028 | 1047 |
| 6 | 952 | 964 | 934 | 950 |
| 29 | 800 | 780 | 780 | 787 |
| 21 | 852 | 864 | 926 | 881 |
| 43 | 938 | 926 | 954 | 939 |
| 39 | 882 | 896 | 890 | 889 |
| 14 | 760 | 782 | 760 | 767 |
| 14 | 842 | 860 | 880 | 861 |
| 9 | 838 | 860 | 880 | 861 |
| 42 | 1034 | 1050 | 1023 | 1036 |
| 12 | 876 | 875 | 860 | 870 |
| 35 | 1085 | 1065 | 1088 | 1079 |
| 33 | 1092 | 1101 | 1091 | 1095 |
| 19 | 1115 | 1095 | 1120 | 1110 |
| 86 | 900 | 910 | 880 | 897 |
| Average | 951.6 | 950.8 | 949.2 | 950.5 |
| Standard Deviation | 148.93 | 146.59 | 135.30 | 142.42 |
| Standard Error | 30.40 | 29.92 | 27.62 | 29.07 |

| Deviation in Pounds | Spring weights: Number of cows | Spring weights: Per cent of total | Fall Weights: Number of cows | Fall Weights: Per cent of total | Total Weights: Number of cows | Total Weights: Per cent of total |
|---|---|---|---|---|---|---|
| 46 to 55 | 3 | .0126 | | | 3 | .0052 |
| 36 to 45 | 4 | .0168 | 5 | .0147 | 9 | .0156 |
| 26 to 35 | 16 | .0669 | 10 | .0295 | 26 | .0450 |
| 16 to 25 | 32 | .1339 | 30 | .0885 | 62 | .1073 |
| 6 to 15 | 45 | .1883 | 53 | .1563 | 98 | .1696 |
| 5 to - 5 | 59 | .2469 | 92 | .2714 | 151 | .2612 |
| - 6 to -15 | 29 | .1213 | 72 | .2124 | 101 | .1747 |
| -16 to -25 | 13 | .0544 | 46 | .1357 | 59 | .1021 |
| -26 to -35 | 13 | .0544 | 19 | .0560 | 32 | .0554 |
| -36 to -45 | 11 | .0460 | 8 | .0236 | 19 | .0329 |
| -46 to -55 | 4 | .0168 | 2 | .0059 | 6 | .0104 |
| -56 to -65 | 5 | .0209 | 1 | .0029 | 6 | .0104 |
| -66 to -75 | 4 | .0168 | 1 | .0029 | 5 | .0086 |
| -76 to -85 | | | | | | |
| -86 to -95 | 1 | .0042 | | | 1 | .0017 |
| Total | 239 | 1.0002 | 339 | .9998 | 578 | 1.0001 |

TABLE 5. CORRELATIONS BETWEEN WEIGHTS OF RANGE COWS TAKEN OVER A THREE-DAY PERIOD.

| YEAR | SEASON | N | r<br>1st to Av. | r<br>1st to 2d | r<br>1st to 3rd | r<br>2d to 3rd |
|---|---|---|---|---|---|---|
| 1941 | Fall | 48 | .9815 | .9700 | .9351 | .9702 |
| 1942 | Spring | 43 | .9786 | .9275 | .9518 | .9591 |
| *1942 | Fall | 48 | .9894 | .9760 | .9696 | .9871 |
| 1942 | Fall | 51 | .9885 | .9648 | .9689 | .9697 |
| 1943 | Spring | 48 | .9937 | .9769 | .9828 | .9861 |
| 1943 | Fall | 48 | .9904 | .9678 | .9712 | .9651 |
| 1944 | Spring | 48 | .9867 | .9796 | .9379 | .9574 |
| 1944 | Fall | 48 | .9956 | .9900 | .9884 | .9698 |
| 1945 | Spring | 42 | .9892 | .9790 | .9661 | .9880 |
| 1945 | Fall | 48 | .9953 | .9810 | .9900 | .9853 |
| **1946 | Spring | 48 | .9820 | .9685 | .9519 | .9823 |
| 1946 | Fall | 48 | .9964 | .9847 | .9838 | .9690 |
| 1947 | Spring | 58 | .9826 | .9564 | .9552 | .9760 |
| Total | Fall | 339 | .9920 | .9777 | .9753 | .9752 |
| Total | Spring | 239 | .9858 | .9634 | .9580 | .9728 |
| Total | | 578 | .9896 | .9721 | .9685 | .9767 |

* --Weights taken at time calves were weaned.

** --Weights taken on 1st, 3rd and 4th days.

Accuracy of single and three-day weights.

Table 4 shows the mean weights and standard errors for the cows for each weigh period studied. Spring and fall weights are again summarized separately.

There was a slight tendency for the cows to lose weight during the three-day weigh period. This loss is similar to that reported by Baker, Phillips, and Black (1947) for calves. The total decline for all data studied was 5.4 pounds. The average three-day weight was 2.7 pounds smaller than the first day weight. This difference in mean is quite small compared to the loss or gain usually studied, and it tended to affect all lots alike.

The accuracy of the first, second, third and three-day average weights was very similar, as judged by the standard error. For example, the means and standard errors for the first, second, third and three-day average weights in the spring of 1947 were 971.9 ± 14.4, 970.9 ± 14.5, 967.2 ± 15.1 and 969.9 ± 14.5, respectively. Furthermore the accuracy appeared to be about as great in the fall of 1941 when the cows were very wild as during later weigh periods when they were easily managed. The means and standard errors for the three consecutive days and the three-day average for that first weighing were 1062.5 ± 12.3, 1044.3 ± 12.9, 1012.0 ± 13.3 and 1039.6 ± 12.6. The great reduction in mean weight at this weigh period was undoubtedly due to nervousness and lack of fill on the cows.

| Year Season | n | 1st Day Weights | Standard error of mean | 2nd Day Weights | Standard error of mean | 3rd Day Weights | Standard error of mean | Average Weights | Standard error of mean |
|---|---|---|---|---|---|---|---|---|---|
| 1941 Fall | 48 | 1062.5 | 12.3 | 1044.3 | 12.9 | 1012.0 | 13.3 | 1039.6 | 12.6 |
| 1942 Spring | 43 | 937.3 | 16.6 | 889.3 | 15.5 | 881.5 | 15.4 | 902.7 | 15.5 |
| *1942 Fall | 48 | 992.7 | 15.5 | 991.2 | 15.3 | 990.1 | 15.4 | 991.4 | 15.3 |
| 1942 Fall | 48 | 957.1 | 14.4 | 966.4 | 14.8 | 986.2 | 14.9 | 969.9 | 14.5 |
| 1943 Spring | 48 | 921.8 | 15.7 | 933.5 | 16.3 | 928.0 | 14.8 | 927.9 | 15.5 |
| 1943 Fall | 48 | 992.8 | 14.3 | 989.5 | 14.4 | 967.3 | 13.3 | 983.2 | 13.8 |
| 1944 Spring | 48 | 915.4 | 14.4 | 917.7 | 14.8 | 948.4 | 13.9 | 927.2 | 14.2 |
| 1944 Fall | 48 | 872.5 | 16.9 | 884.3 | 17.3 | 870.3 | 16.9 | 875.7 | 17.0 |
| 1945 Spring | 42 | 858.4 | 16.6 | 861.0 | 16.6 | 884.3 | 16.1 | 867.9 | 16.3 |
| 1945 Fall | 48 | 945.2 | 18.7 | 941.8 | 18.6 | 939.4 | 18.1 | 942.1 | 18.4 |
| **1946 Spring | 48 | 904.3 | 19.6 | 867.3 | 19.4 | 869.8 | 19.4 | 880.5 | 19.3 |
| 1946 Fall | 48 | 1032.0 | 19.0 | 1027.9 | 18.7 | 1015.7 | 18.1 | 1026.1 | 18.5 |
| 1947 Spring | 58 | 971.9 | 14.4 | 970.9 | 14.5 | 967.2 | 15.1 | 969.9 | 14.5 |
| Total Fall | 339 | 979.0 | 6.0 | 977.8 | 6.0 | 968.9 | 5.9 | 975.4 | 5.9 |
| Total Spring | 239 | 924.3 | 6.9 | 918.7 | 6.9 | 925.6 | 6.7 | 922.9 | 6.7 |
| Total | 578 | 956.4 | 4.5 | 953.4 | 4.5 | 951.0 | 4.4 | 953.7 | 4.5 |

*Weights taken at time calves were weaned.

**Weights taken on 1st, 3rd, and 4th days.

Baker, Phillips, and Black (1947) reported the first-day weights were actually more accurate than second or third-day weights. They divided their data into weight groups on the basis of first-day weights, however, and then calculated standard errors for first, second and third weighings. Since they used the first day's weights for dividing the data, they automatically reduced the variance within the class since the range was fixed for these weights. The accuracy of the first, second and third day weights was investigated in this study, but the weight groups were divided on the basis of three-day average weights. Table 5 contains these data.

The findings of this comparison again show the first, second and third day weights to be practically similar in accuracy. The variance of the three-day average weights is less than any single-day weights, but this has in part occurred because the average weight was the basis for grouping the cattle into weight groups. Thus it does not indicate that the three-day weights excell the others in accuracy.

By analysis of variance, an estimate of the increased accuracy resulting from three daily weighings instead of one can be calculated. The procedure is well explained by Snedecor (1946) and was used by Patterson (1947) in his study of "The Comparative Efficiency of Single Versus Three-Day Weights of Steers." Table 6 contains the analysis of variance of weights of all cows studied.

The analyses were run on spring, fall, and all weights. In general, workers are more interested in gains and losses of animals on experiment, but such data were not a part of this study.

| GROUP | n | 1st Day Weights | Standard error of mean | 2nd Day Weights | Standard error of Mean | 3rd Day Weights | Standard error of mean | Average Weights | Standard error of means |
|---|---|---|---|---|---|---|---|---|---|
| SPRING | | | | | | | | | |
| 600 | 3 | 638.7 | 36.0 | 626.0 | 13.6 | 644.0 | 11.0 | 636.3 | 19.4 |
| 700 | 21 | 756.0 | 20.4 | 755.0 | 16.8 | 770.0 | 21.7 | 760.3 | 15.4 |
| 800 | 82 | 855.5 | 4.3 | 847.1 | 3.9 | 855.8 | 4.0 | 852.8 | 3.3 |
| 900 | 77 | 954.2 | 4.4 | 947.7 | 4.2 | 954.8 | 4.1 | 952.2 | 3.3 |
| 1000 | 41 | 1049.9 | 5.3 | 1048.0 | 5.4 | 1048.7 | 5.8 | 1048.9 | 4.7 |
| 1100 | 13 | 1130.5 | 8.5 | 1128.0 | 10.2 | 1120.0 | 6.7 | 1126.1 | 6.4 |
| Total Spring | 239 | 924.3 | 2.4 | 918.7 | 2.3 | 925.6 | 2.3 | 922.9 | 1.9 |
| FALL | | | | | | | | | |
| 600 | 2 | 664.0 | 20.0 | 681.0 | 19.0 | 663.0 | 7.0 | 669.5 | 15.5 |
| 700 | 25 | 755.5 | 6.0 | 756.7 | 5.9 | 753.7 | 5.2 | 755.3 | 5.2 |
| 800 | 65 | 857.4 | 3.8 | 857.9 | 3.4 | 856.2 | 4.0 | 857.2 | 3.3 |
| 900 | 101 | 958.1 | 3.4 | 958.9 | 3.0 | 947.8 | 3.1 | 955.5 | 2.7 |
| 1000 | 96 | 1047.9 | 3.5 | 1044.2 | 3.2 | 1035.4 | 3.5 | 1042.9 | 3.0 |
| 1100 | 43 | 1156.6 | 5.1 | 1150.9 | 5.1 | 1134.6 | 5.9 | 1147.3 | 4.2 |
| 1200 | 6 | 1233.3 | 11.4 | 1235.2 | 11.0 | 1214.5 | 17.0 | 1227.7 | 12.5 |
| Total Fall | 339 | 979.0 | 1.8 | 977.8 | 1.6 | 968.9 | 1.8 | 975.4 | 1.5 |

COMPARISON OF WEIGHTS OF COWS OBTAINED ON THREE DAYS WITH THE THREE-DAY AVERAGE WEIGHTS, THE DATA BEING GROUPED BY 100 POUND INTERVALS ACCORDING TO THE AVERAGE WEIGHT, SEPARATELY BY SEASONS.

| GROUP | n | 1st Day Weights | Standard error of mean | 2nd Day Weights | Standard error of mean | 3rd Day Weights | Standard error of mean | Average Weights | Standard error of means |
|---|---|---|---|---|---|---|---|---|---|
| SPRING & FALL | | | | | | | | | |
| 600 | 5 | 648.8 | 20.7 | 648.0 | 9.6 | 651.6 | 6.4 | 649.6 | 11.7 |
| 700 | 46 | 755.7 | 4.4 | 756.0 | 4.0 | 761.1 | 4.2 | 757.6 | 3.6 |
| 800 | 147 | 856.3 | 2.9 | 851.9 | 2.6 | 856.0 | 2.8 | 854.7 | 2.4 |
| 900 | 178 | 956.4 | 2.7 | 954.0 | 2.5 | 950.8 | 2.5 | 953.8 | 2.1 |
| 1000 | 137 | 1048.5 | 2.9 | 1045.3 | 2.8 | 1039.4 | 3.0 | 1044.7 | 2.5 |
| 1100 | 56 | 1150.5 | 4.3 | 1145.6 | 4.5 | 1131.0 | 4.8 | 1142.0 | 3.5 |
| Total Spring and Fall | 578 | 956.4 | 1.4 | 953.4 | 1.3 | 951.0 | 1.4 | 953.7 | 1.2 |

Analysis of weights is often needed in breeding experiments to determine the effects of treatments on size, condition, etc., and the problem of weighing upon one or more days is always encountered.

The variance that should be used for testing the significance of differences between groups of cattle such as those investigated in this study is that found between animals. The mean square for differences between animals where three final weights are taken includes one part of the residual mean square plus three parts of a component due to animals. Thus, the size of the residual or weighing errors is considred in the significance test. It is possible to calculate the size of the two components of variance and their relative importance to each other.

The mean square for animals in table 6 is represented by the equation, $3\sigma a^2 + \sigma r^2$ where $\sigma a^2$ is a component of "pure" variance due to differences between animals and $\sigma r^2$ is a component due to residual variance. This equation divided by three gives the variance between animals based on the average of three-day weights and can then be compared to the variance between animals based on one-day weights. The equation for the variance between animals based on one-day weights is $\sigma a^2 + \sigma r^2$. Thus, one-day weights include three times as much residual variation as three-day weights.

The variance for average three-day weights would be more reliable than that for one-day weights if there were no significant difference between the variance for the different days.

TABLE 6. ANIMAL AND RESIDUAL VARIANCE OF RANGE COW WEIGHTS

| Source of data | Source of variation | D/f | Mean Square | Estimate of ($\sigma$) Pure Variance |
|---|---|---|---|---|
| Spring | Animal | 238 | 32 575 | $\sigma a^2 =$ 10 066 |
| | Residual | 476 | 2 378 | $\sigma r^2 =$ 2 378 |
| Fall | Animal | 338 | 44 255 | $\sigma a^2 =$ 14 718 |
| | Residual | 676 | 102 | $\sigma r^2 =$ 102 |
| Total | Animal | 577 | 41 359 | $\sigma a^2 =$ 13 438 |
| | Residual | 1 154 | 1 046 | $\sigma r^2 =$ 1 046 |

Spring $\sigma a^2 + \frac{\sigma r^2}{3} =$ 10 859 Reduction of 1 585 over one-day value or 12.74 per cent.

Fall $\sigma a^2 + \frac{\sigma r^2}{3} =$ 14 752 Reduction of 68 over one-day value or 0.46 per cent.

Total $\sigma a^2 + \frac{\sigma r^2}{3} =$ 13 787 Reduction of 697 over one-day value or 4.81 per cent.

Bean (1946) found the first-day weights to be more reliable than the second and third-days' weights or the three-day average weight in pig weights. Baker, et al., reported a similar finding with calves, but their data were sorted into classes on the basis of first-day weights. In the data of this study there was no difference in reliability of the three consecutive weights. Patterson found the same to be true for steers in the feed lot and on grazing tests.

Estimated values of the $\sigma a^2$ and $\sigma r^2$ were calculated as stated above and are shown in table 6. These values were calculated as follows: The estimate of the parameter $\sigma r^2$ is 2378. The equation $3\sigma a^2 + \sigma r^2$ equals 32575. Solving for $a^2$ gives a value of 10066. As stated above, $\sigma a^2 + \sigma r^2$ is the equation for the variance of animals based upon single-day weights. Thus, 12444 is the variance for one-day weights. A comparable value for three-day weights is $\sigma a^2 + \frac{\sigma r^2}{3}$ or 10859. Therefore, the mean square for animals is reduced 1585 or 12.74 per cent. In other words, one would need 12.74 per cent more animals when studying weights of cattle and weighing only one day to get the same accuracy that results when weighing three days and using the average weight. For fall and for all weights, the increased accuracy was only 0.46 per cent and 4.81 per cent, respectively.

## DISCUSSION AND RESULTS

There was a very high degree of repeatability in the three-day weights of the cows studied in this experiment. The correlations varied from a low of .935 to a high of .996. Also, these correlations were calculated on a within season basis.

The repeatability of weights was not perfect, however. The range of three-day weights on individual cows varied from 0 pounds to 120 pounds. This variation appeared, however, to have little effect on the means. Also, the use of three-day weights had little effect on the accuracy of the mean as judged by the standard error of each mean. For instance, in total weights the standard error of the mean for the first-day weights and for the three-day average weights is the same, 4.5 pounds. For all fall weights the three-day average weight has a standard error of 0.1 pounds less than that for the first-day weights. If one were studying 10 cows per lot, the standard error of the mean would be 35.0 and 34.4 for one-day and three-day weights, respectively.

The use of analysis of variance technique on beginning and final weights also show that very little is gained by weighing the cows three consecutive days. Thus, it appears that one-day weights are satisfactory for beginning and final weights of range cows on experiment trials.

This was true on the accuracy of means even when the range cows were very wild. Also, weighing wild range cows in this experiment resulted in large shrinks on each consecutive day at certain weigh periods which definitely introduced a bias into the total gains.

Increasing the number of cows rather than weighing two or more times seems to be the most practical way of improving the reliability of feeding tests with cows on range experiments. This technique avoids much extra labor and the experimental hazards due to non-controllable conditions. It would seem, however, that if one is taking only one-day weights that every precaution should be made to get accurate weights and to weigh on days when the cows have an opportunity to get a normal fill. Such procedure is undoubtedly much more conducive to accuracy than weighing every 28 days regardless of other conditions.

Although both fall and spring weights were very similar in accuracy, the fall weights were slightly superior of the two studied. This was undoubtedly due to the fact that the spring weights were taken during the calving and nursing period. It appears that some special procedure could probably be developed to improve the accuracy of weights taken at this period.

## SUMMARY AND CONCLUSIONS

The purpose of this investigation was to determine the value of weighing range cows from one to three times when on summer grazing and wintering experiments. A total of 578 three-days weights on mature cows were included in the study. These weights were taken on approximately May 1 and December 1 over a seven year consecutive period.

The three consecutive daily weights were highly similar to each other and to the three-day average weight. The correlation coefficient for the first-day weight and three-day average weight was .9896. The standard error of the means of all the data for the first, second, third, and three-day average weights was 4.5, 4.5, 4.4, and 4.5 pounds, respectively. An analysis of variance of the spring, fall, and all weights showed three weighings reduced the residual variance 12.74 per cent, 0.46 per cent and 4.81 per cent, respectively.

The cows lost some weight during the three consecutive weighings, the respective daily weights being 956.4, 953.4, and 951.9 pounds.

The data indicate that although some increased accuracy results from weighing three days instead of one, the increase does not justify more than one-day weights for range cows on experimental tests.

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