

Some Sampling Techniques

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Example "A"

OWN	T	R	S	SUB	PLT	SIZE	CRUISER	TYPE
COND	SP	DBH	HT 32L	TOT HT	AGE C	FREQ. # TREES	S.I. GROWTH 10 YR IN.	LOG F.C.

Data card is 7½" long and is hole punched in center folding area for loose leaf notebook.

4. STATISTICAL ANALYSIS OF THE SAMPLE

It is first necessary to understand the relationship between the sample and the population. In cruising merchantable timber the population is composed of all trees of merchantable size on the area to be cruised. The sample is any portion of that population taken in the form of plots or strips for the purpose of estimating the magnitude of that population.

The statistical values of the sample which are the arithmetic mean, the standard deviation, and the coefficient of variation are in estimation of the corresponding parameters of the population. The only time that these population parameters are known exactly is after a 100% cruise has been made. Obviously any errors that influence the determination of the sample parameters will be magnified in the estimation of the population parameters.

It is customary to use Greek Letters to refer to the population parameters and Roman letters for the corresponding sample parameters.

b. The Arithmetic Mean:

μ (mu) is the population mean and can only be determined by a 100% sample. \bar{X} is the sample mean used as an estimate of the population mean. x is the value of an observation. (A plot in this case). N is the total number of possible observations. n is the number of observations in the sample. Σ is the Greek letter, sigma, meaning "summation of."

$$\mu = \frac{\Sigma X}{N} \quad \text{and} \quad \bar{X} = \frac{\Sigma X}{n}$$

c. The Variance and Standard Deviation:

σ^2 (small sigma) is the population variance. Sx^2 is the sample variance used in estimation of the population variance. Variance is the average squared deviation from the mean.

The quantity $(X - \mu)$ is called an error since it is an exact statement of the variation of an observation from the mean of the population. The quantity $(X - \bar{X})$ is called a residual because it is a statement of the variation existing be-

FLIGHT	PHOTO	SLOPE	ASPECT	DATE
GRADE AND VOLUME				VOLUME DEC. C
1½	2	2½	3	C. F.
				B. A.
				C. D.

tween an observation and the sample mean and is only an estimation of the quantity. $(X - \bar{X})$.

It will be noticed that in the formula for the sample variance, $n - 1$ was used as a divisor instead of n . Using the factor $(n - 1)$ makes the variance of the sample larger than if n were used; this is done for the following reasons:

1. The population mean (μ) is generally unknown because 100% cruises are seldom made. Therefore, it is necessary to estimate the variance of the population mean from the variance of the sample mean which, in turn is based on the sample mean. Once the mean of a sample is determined there are only $n - 1$ independent comparisons. For example, in the hypothetical array of three (3) observations with the values, 4, 5 and 6 the arithmetic mean is 5. Thus, if the mean, 5, and one other observation, say 4, is taken then the value of the third observation is automatically fixed at 6.

2. In addition the variance of the sample mean, mean square of residuals, is always less than the variance of the population mean, mean square of errors, whenever the sample mean varies from the population mean. This is true regardless of whether the sample mean is larger or smaller than the population mean.

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Therefore, one observation is sacrificed which increases the variance thereby compensating for this fact. The factor of $(n - 1)$ is extremely important whenever the sample is comprised of less than thirty (30) observations. This point will be discussed further.

d. Coefficient of Variation

Reference to Tables IB, IC, and ID will illustrate the effect of this statistic. The coefficient of variation is equal to the standard deviation divided by the arithmetic mean with this result multiplied by 100%. The formula is:

$$C.V. = \frac{S_x}{\bar{X}} (100)$$

Variability of groups of data such as cruises of different stands of timber can be compared by means of this coefficient which is stated as a percentage. Very often the magnitudes of two sets of data are so different that the absolute values of the standard deviation of each set are not directly comparable. Then comparison of variability can be made by relating the standard deviation to the arithmetic mean.

e. Standard Error of the Mean

In computing this parameter the standard deviation of the population is estimated from the standard deviation of the sample by correcting the sample parameter for its tendency to be less than that of the corresponding population parameter.

$$\text{Estimated } \sigma = S_x \sqrt{\frac{n}{n-1}}$$

SE_M (Standard error of the mean) =

$$\frac{\text{Estimated } \sigma}{\sqrt{n}}$$

when n is the number of observations.

The confidence which can be placed in any statistical measure computed from a sample depends upon how closely that measure comes to the corresponding parameter for the population. The standard error of the mean provides a means of estimating how closely the arithmetic mean of the sample comes to the population mean without taking repeated samples in the population. It is therefore one of the main considerations in determining the reliability of an average. It is necessary to consider probability when discussing reliability. In stating an average it is proper to state the number of standard errors used and the number of observations in the sample on which the average is based. An average volume/acre in board feet Scribner based on 100 observations and

1 standard error would be stated as follows:

$$\text{Average volume/acre} = 50,000 \text{ BFS} \pm 1,000 \text{ (100 cases).}$$

The statement can then be made that the true mean lies between 49,000 and 51,000 BFS and that statement will be wrong one time out of three on the average.

If the statement is made that the true mean lies between 48,000 and 52,000 BFS, **average of two standard errors** from the observed mean, the statement will be wrong one time out of 20 on the average. A range of two standard errors is most commonly used in forestry.

If the statement is made that the true mean lies between 47,000 and 53,000 BFS, a range of **three standard errors** from the observed mean, the statement would be wrong one time out of 370 on the average.

The above probability statements are based on samples of over 30 observations. As the number of observations decreases from 30 the probability also decreases. For a sample of two observations the statement would be wrong one time out of two on the average for one standard error instead of as stated above. In stating an average to two standard errors for a sample of over 30 cases the result of the standard error formula is simply multiplied by two in order to get the amount that the true mean may vary from the sample mean. In stating an average to two standard errors for a sample of less than 30 cases it is necessary to get the correct multiplier from a table of "t" which may be found in any standard text on statistics. Thus for a sample of 10 observations the factor would be 2.262 instead of two and for a sample of 2 observations the factor would be 12.706 instead of two. It is essential to know the number of observations in a sample as well as the number of standard errors used whenever the reliability of an average is being considered.

f. Sampling Error

Sampling error is zero when a 100% cruise is made. Since it is generally impractical to make a 100% cruise it is necessary to decide upon an allowable sampling error and then compute the sample so that this allowable error will not be exceeded. This is done by using the formula previously given for computing the required number of plots.

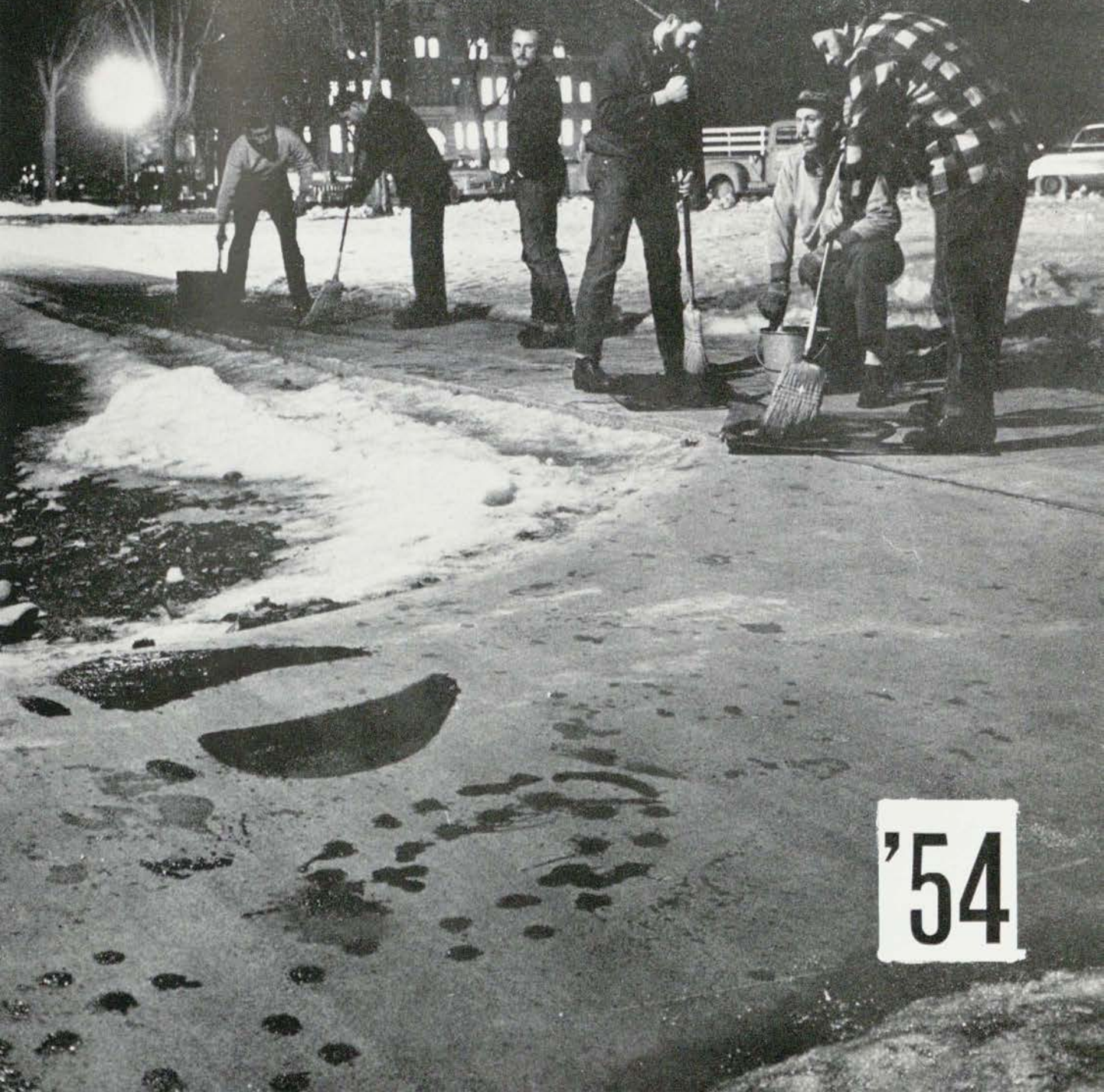
Since the coefficient of variation is usually estimated before beginning the survey, it is necessary to compute the final sampling error achieved after the survey is over by the following formula:

$$a = \sqrt{\frac{T^2 C^2 (N - n)}{nN}}$$

This formula is derived from the formula for the required number of plots.

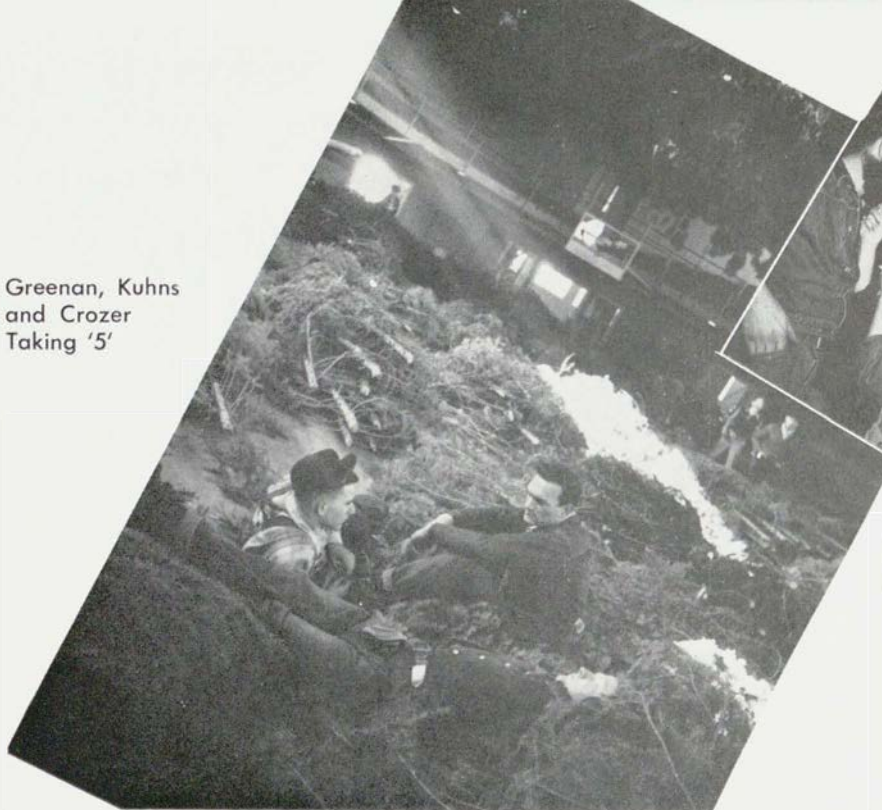
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FORESTERS BALL



'54

Greenan, Kuhns
and Crozer
Taking '5'



Queens judging the
beards —
Chamberlin took
top honors

Can-Can girls at
intermission time

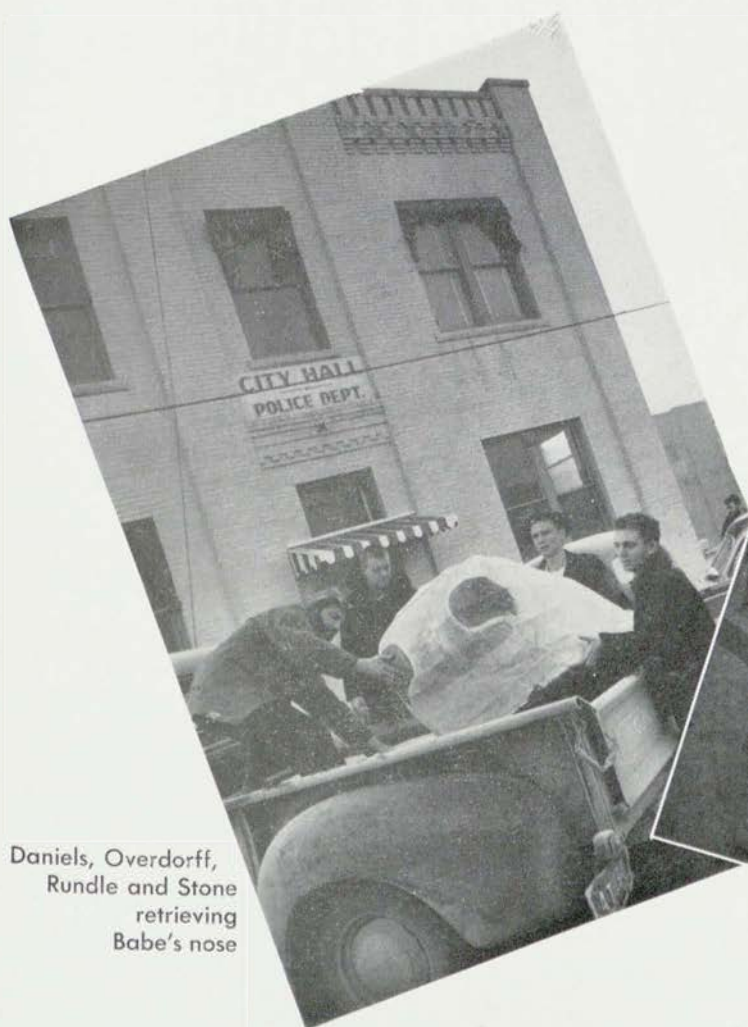


Dick Johnson and
Claudia Hooper
"Let her in Dick,
you can't keep a
gal waiting
forever!"





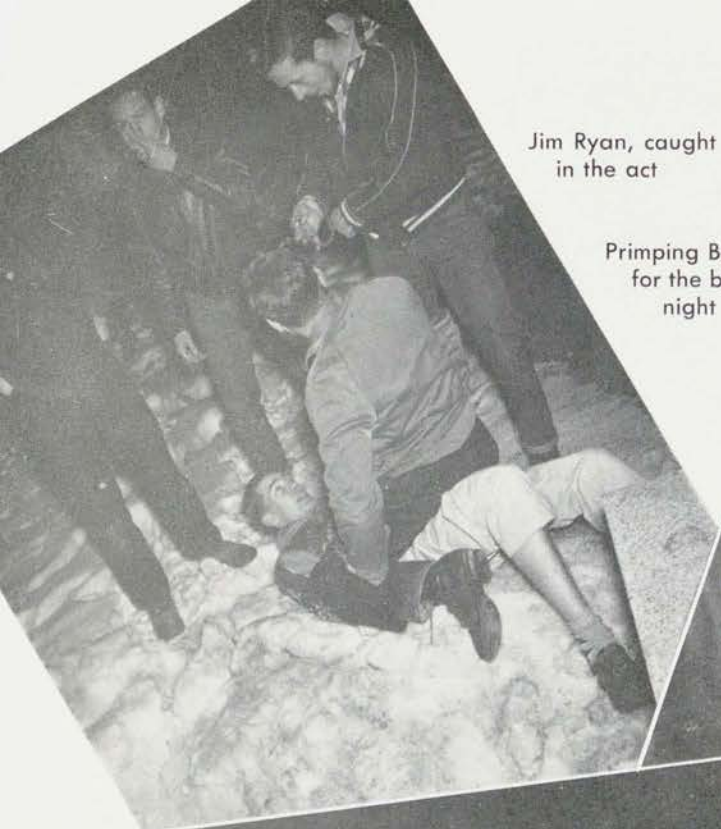
The boys with the peach fuzz:
John Holden, Al Crozer, Frank Kirsten,
John Lowell, Pat Ryan, Jim Zeltinger,
Dan Daniels, Jack Chamberlin and
Jim Eakland



Daniels, Overdorff,
Rundle and Stone
retrieving
Babe's nose

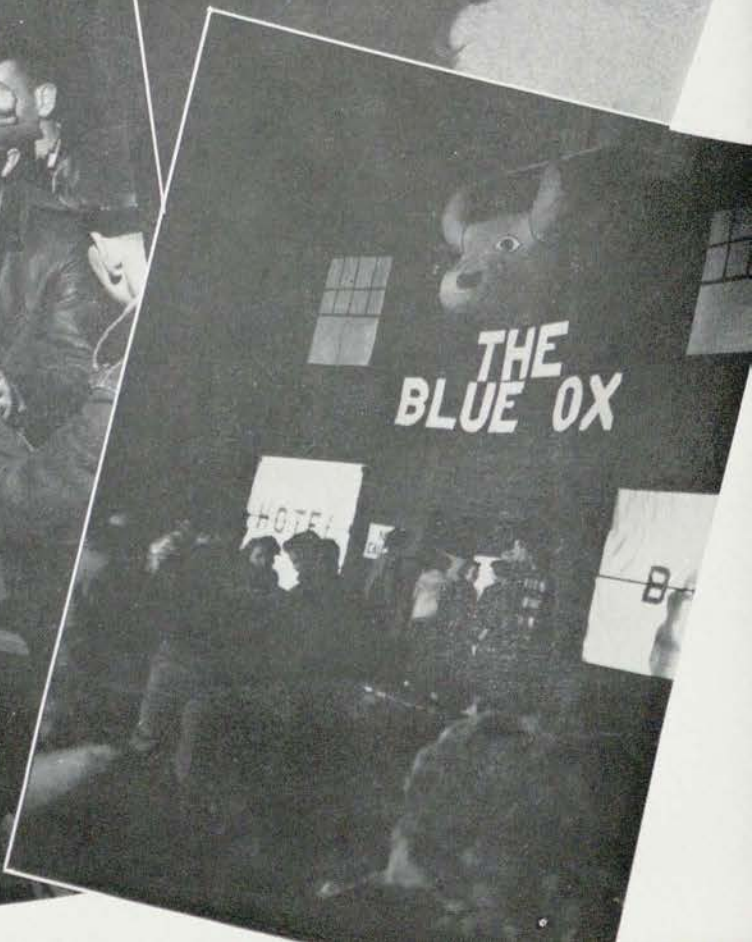


"Bertha, how you've changed"



Jim Ryan, caught
in the act

Priming Bertha
for the big
night



... The foresters, believe it or not, worked 3,625 man hours to produce this year's ball. Without a doubt, this year's dance was one of the best Paul and Babe have seen at MSU in a long time.

The fellow's work paid off, not only in a good gate return, but also in some national advertising — and a warped gym floor. The ball was photographed from beginning to end by LIFE and received a three-page spread. The pictures in this section are some of the many that they took.

Water, from the melting snow brought into the gym on the trees, resulted in too much stress on the wooden floor — it warped! Foresters helped the Physical Education Department refinish the floor.

A new angle in the beard contest was tried and went over with much success. The "Queens" on the campus, acting as judges, determined who was to receive a prize for the best whisker rub. Dan Daniels was proclaimed the whisker rubbing champ, while Jack Chamberlin had to settle for first prize — an electric razor.

The Bunny Hop!



IN MEMORIAM

DAVID W. SALTSMAN

Born August 21, 1931, Canton, Ohio

Died October 26, 1954, Whitefish, Montana

Graduated from the School of Forestry, Montana State University, in 1953. Former president of the Montana Druids, and Photography editor of the Forestry Kaimin.

A WOODSMAN'S PRAYER

Let me breathe the clean pure air
That blows only in the wilder places
Send me far from the tainted cities
Packed tight with mongrel races.

Let me quench my thirst
In pure crystalline springs
That bubble from the living rock
Shadowed only by an eagle's wings.

Let me follow the untrod trail
Roaming freely till the end of my days
And watch the dusty red sun
Set the heavens and mountains ablaze.

Let me, alone, eager and forever,
Follow and fight the naked wild
And when I die, mark me down
For what I am — Nature's Child.

— Silas R. Thompson

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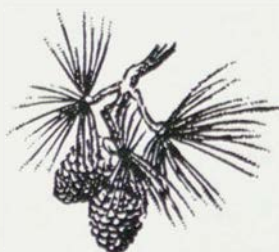
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The allowable sampling error ("a") derived from this formula is the maximum error which will result from the fact that a 100% cruise was not made. This statement is based on the assumption that bias has been eliminated from the sample and that the sample is representative.

The "a" of the above formula is often referred to as "accuracy." This is misleading because it is only a statement of maximum expected sampling error at a specified probability and does not include the technique errors which affect the accuracy of a cruise. Thus all errors due to inaccurate estimates or measurements of DBH, height, form class, defect and breakage and misuse of volume tables, inaccurate area determinations, and computation errors are in addition to the possible sampling error. Technique errors can be either compensating or compounding in their effect on sampling error.

5. SUMMARY

The need for better planimetric maps and forest inventory information in management planning is becoming increasingly important. Utilization trends dictate a finer economy and reliable information at less cost is necessary to maintain the profit in growing and harvesting trees. Management is rightfully entitled to maps and information with a specified degree of certainty. While the foregoing is a tried and workable method and is generally applicable to most other problems of inventory, modification of this procedure may be necessary for specific problems.

Table IA

Effect of Area

t = 2, a is 10%, c = 50%

Area	Plots	% Cruise
10	17	85%
40	45	56
80	62	39
160	77	24
640	93	7.3
2000	98	2.5
10000	100	0.5
20000	100	0.25
40000	100	0.125

Table IB

Effect of CV (c)

a is 10%, t is 2, and c is 40%

Area	Plots	% Cruise
10	16	80%
40	36	45
80	46	29
160	54	17
640	62	7.6
2000	62	4.8
10000	62	0.31

Table IC

Effect of CV

t = 2, c is 30%, a = 10%

Area	Plots	% Cruise
10	13	65%
40	25	31
80	30	19
160	33	10.3
640	35	2.7
2000	36	0.9
10000	36	0.18

Table ID

Effect of CV

t = 2, c is 20%, a = 10%

Area	Plots	% Cruise
10	6	30%
40	7	8.8
80	8	5
160	8	2.5
640	8	0.2
2000	8	0.04

Table IE

Effect of the error (SE)

t is 2, CV is 50%, a is 20%

Area	Plots	% Cruise
10	12	60%
40	20	25
80	22	14
160	23	7.2
640	25	1.95
2000	25	0.625
10000	25	0.125

Table IF

Effect of Size of Plot

a = 10%, c = 50%, t = 2,

Plot 1/5 Ac

Area	Plots	% Cruise
10	33	66%
40	67	33.3
80	80	20
160	89	11.1
640	97	3.0
2000	99	0.99
10000	100	0.2

Note: Tables IA, IB, IC, ID, and IE based upon 1/2 acre sample size.

Referring to formula shown for computing the required number of samples:

EXAMPLE

$N = 10,000 \times 2 = 20,000$ 1/2 acre samples possible

$t = 2$ standard deviations or 95% probability

$c =$ Coefficient of variation (decimal figure)

$a =$ Accuracy (decimal figure)

$n =$ Required number of samples

$$n = \frac{[20,000] \times [(2)^2 (.50)^2]}{(20,000) (.10)^2 + [(2)^2 (.50)^2]}$$

$$n = \frac{(20,000) (1.00)}{(200) (1.00)}$$

$n = 100$ samples required

If this same formula were applied to a stand basis the same procedure would be taken to determine the sample required, but the coefficient of variation would certainly be less than 50% due to finer stratification of the stand variation. The coefficient of variation if not known can be estimated and a quick analysis made of variance of the first few samples obtained to determine a better estimate of the "c" value. The first computation of the required number of samples can then be increased or decreased to correspond to the change by recomputing "n" with the new value of "c".

BIBLIOGRAPHY

- Sampling Methods in Forestry and Range Management, Schumacher, F. X., and Chapman, R. A.
- Methods of Correlation Analysis, Ezekiel, M.
- An Outline of Statistical Methods, Arkin and Colton.
- Statistical Methods, Snedecor, George W.





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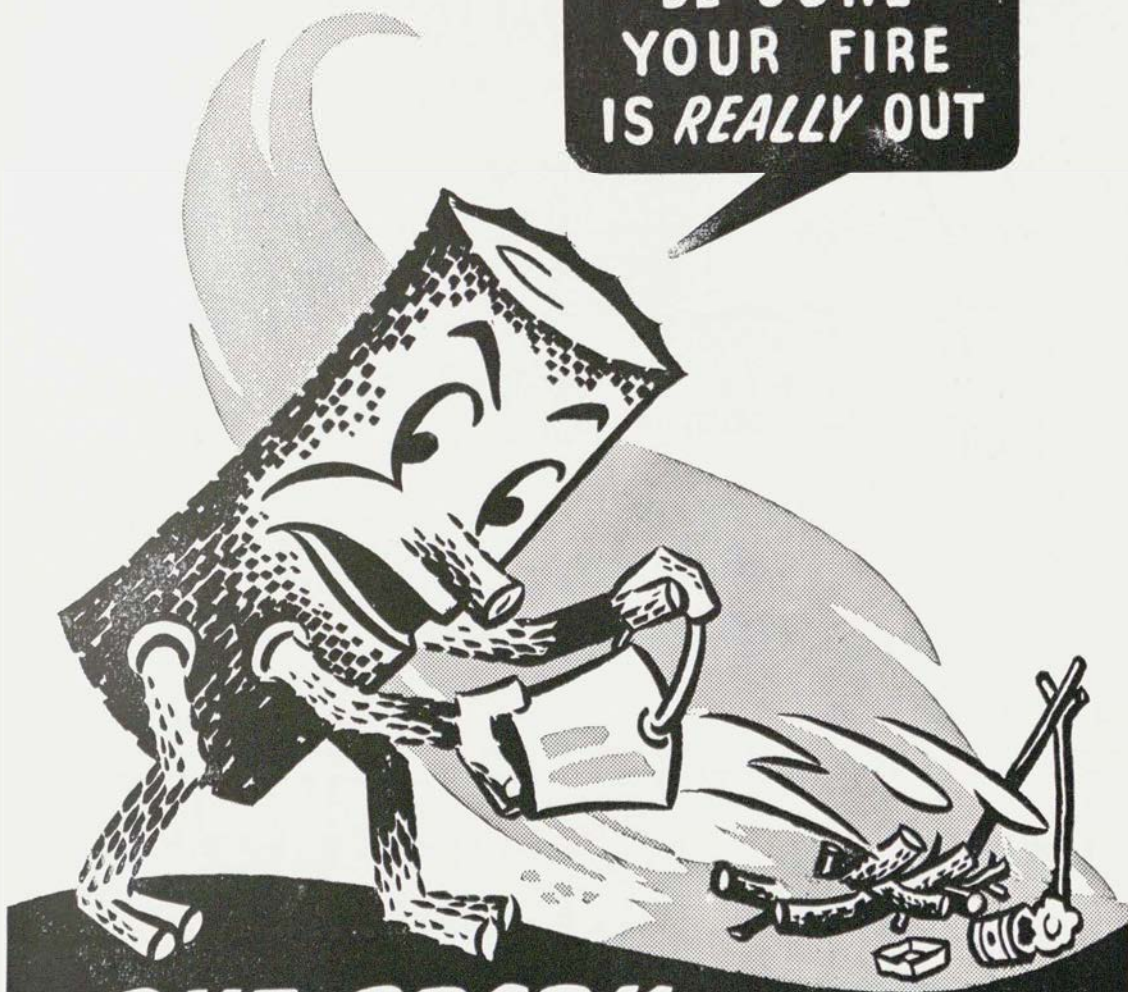
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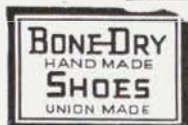
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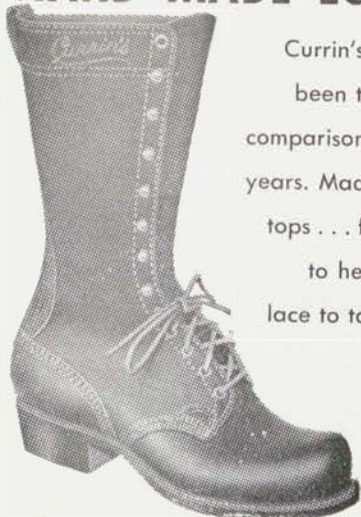
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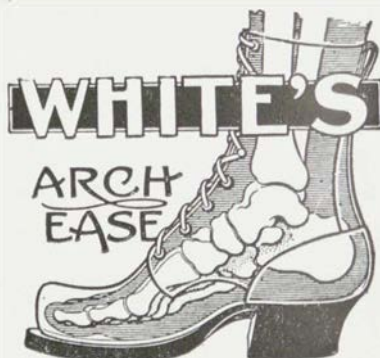
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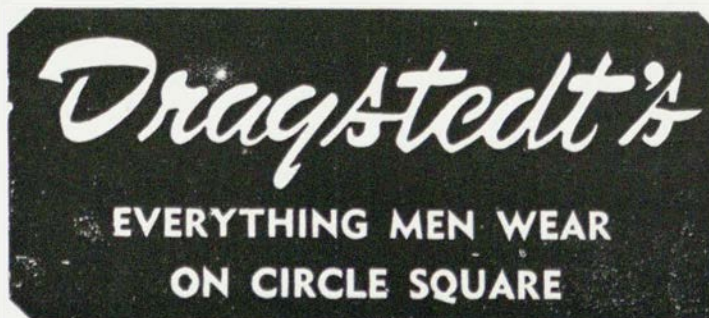
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