

# Resource Inventory Notes

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3-P RANDOM NUMBERS

and a

HANDHELD PROGRAMMABLE CALCULATOR

by

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ABSTRACT: The application of 3-P sampling requires a random number list tailored to certain characteristics of the sampled population. A handheld programmable calculator can be used in place of a main frame computer to generate 3-P random number lists.

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## INTRODUCTION

To select 3-P samples, a list of random numbers from 1 to KZ is required. Numbers greater than K will not result in samples and are termed "nulls" (Wiant 1976). Assuming that the entire population is subject to sampling, a biased sample is unlikely if:  $(Z/K)^2 > (4/ESN - 4M)$ , (Grosenbaugh 1964).

K = Pre-estimate of the quantity of the largest unit in the population.

$$KZ = \frac{\sum kpi}{ESN}$$

$\sum kpi$  = Pre-estimate of the total quantity of the population.

ESN = Desired number of samples.

$$Z = KZ - K$$

M = Number of units in the population.

Refer to 3-P literature, (Lund 1975) for theory and application of 3-P sampling techniques.

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Denver Service Center, Denver Federal Center, Bldg. 50  
Denver, Colorado, 80225**

Any device that generates uniformly distributed random numbers from one to KZ will produce the approximate ESN estimated to satisfy sampling requirements. A handheld programmable calculator is such a device.

Several types of programs are available to generate random numbers. One example generates uniformly distributed numbers greater than 0 and less than one (Hewlett Packard Company 1974). The random numbers are decimals carried to seven places. Another example generates uniformly distributed numbers from a given lower limit to a given upper limit (Texas Instruments Incorporated 1977). Both of the programs can be modified to generate random numbers that will satisfy 3-P sampling requirements.

#### PROCEDURE

A program that generates uniformly distributed numbers greater than 0 and less than one can be modified by taking the following steps:

1. Multiply each generated random number times KZ to produce a random number between one and KZ.
2. Round the transformed random number to the nearest whole number.
3. Insert a test to determine if the transformed random number is larger than K.
4. Display the random number if equal to or less than K.
5. Substitute and display a zero (null) for random numbers greater than K.

A program that generates uniformly distributed numbers between a given lower limit and a given upper limit can be modified by taking the following steps:

1. Set the lower limit at 1.
2. Set the upper limit at KZ.
3. Round the generated random number to the nearest whole number.
4. Insert a test to determine if the random number is larger than K.
5. Display the random number if equal to or less than K.
6. Substitute and display a zero (null) for random numbers greater than K.

Modified random number programs to select 3-P samples are available for the Hewlett Packard\* (HP) 55 and 25C and Texas Instruments\* (TI) 58 and 59. If you are interested in obtaining one of these programs contact Dave Estola (D-340), Bureau of Land Management, Denver Federal Center, Bldg. 50, Denver, Colorado, 80225 (Telephone, 303-234-2317).

\* The use of the trade names does not constitute an endorsement by the Bureau of Land Management.

### Field Application

Handheld programmable calculators can be used for 3-P sampling in the field in several ways. However, a different special calculator feature is necessary for each way.

The first possibility is to generate a printed list of random numbers. The use of a printed list is an integral part of the present conventional method of selecting 3-P samples. This type of application requires that the calculator be equipped with a printer.

The second possibility is to use the calculator's LED (light emitting diode) display. This method would involve taking the calculator to the field. A random number would be generated for each population unit and viewed on the LED display. When not being used, the calculator must be turned off to conserve the battery. This type of application requires that the calculator must be capable of retaining the contents of program and memory registers while turned off.

Some handheld programmable calculators are equipped with both the capability of retaining the contents of program and memory registers and a printing device.

### Literature Cited

Wiant 1976. Elementary 3-P sampling. W. Va. University Agri. & Forest Exp. Sta. Bul. 650 T.

Grosenbaugh, L. R. 1964. Some suggestions for better sample - tree - measurement. Soc. Am. For. Proc. 1963: p. 36-42.

Lund, H. G. 1975. 3-P sampling: an annotated bibliography. USDA Forest Service, State and Private Forestry, Upper Darby, Pa.

Hewlett Packard Co. 1974. HP-55 Statistical Programs, 19310 Pruneridge Avenue, Cupertino, CA 95014.

Texas Instruments Incorporated. 1977. TI Programmable 58/59, Master Library, Texas Instruments Incorporated, P.O. Box 53, Lubbock, TX 79408.

Current Literature

Please order publications directly from addresses given below:

General

Agri. Handbook No. 475 "Vegetation and Environmental Features of Forest and Range Ecosystems". Available from the Superintendent of Documents. Price is unknown. Stock number 001-000-03306-9. G.P.O., Washington, D.C. 20406.

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The Consultant, vol. 23 (1) 1978 contains "An Illustration of Sampling with Equal and Unequal Probabilities" by Wiant and Maxey. For availability of reprints of the article, write Dr. Harry Wiant, College of Forestry, West Virginia University, Morgantown, WV 26506.

*Order*  
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Drop us a line (Attention D-360) for a copy of Tech. Note 310 "Ecological Characteristics of Pinon-Juniper Woodlands on the Colorado Plateau - A Literature Survey" by Mark Zarn.

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Reprint. "Assessment of Plantation Performance" by Al Stage and "Mosaic - A System for Displaying a Proposed Modification Before its Impact on the Environment" are available from Intermountain For. & Range Exp. Sta., 507 - 25th St., Ogden, UT 84401.

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ISES Occasional Paper #2 "How to Make and Evaluate Population Projections" price \$3.50 from Institute for Social and Environmental Studies, Univ. of Kansas, Lawrence, KS 66044.

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"Input-output Analysis for Land Management Planning" describes the development and use of an input-output model to forecast economic impacts generated by different land management alternatives - for the Sierra National Forest. Limited copies are available from the Forest Supervisor, 1130 "O" Street, Fresno, CA 93721.

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Project Record ED&T 2551 "Evaluation of the Wayfinder 360 System" and Project Record ED&T 2402 "Equipment for Orthographic Projection in Timber Sale Layout" from USDA Forest Service, Equipment Development Center, Missoula, MT 59801.

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Gen. Tech. Report PSW-21 "1976 Inter-University Symposium on Renewable Resource Assessment and Programming: Executive Summary". Order from PSW Forest & Range Exp. Sta., USDA Forest Service, P.O. Box 245, Berkeley, CA 94701.

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2 copies

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Its hot off the presses! - "Proceedings of the workshop on Integrated Inventories of Renewable Natural Resources". This 482 paged publication is a must for any inventory designer and multi-resource manager. Contact the USDA Forest Service, Rocky Mountain Forest & Range Exp. Sta., 240 West Prospect, Fort Collins, CO 80521 and ask for a copy of General Tech. Report RM-55. Supplies of this monumental publication are limited.

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Res. Note PNW-289 "Computer Plotting of Graphs for Reports" from Pacific Northwest Forest & Range Exp., P.O. Box 3141, Portland, OR 97208.

FORESTRY

Reprints. "Einfaches Verfahren Zur Bestandesmassenermittlung durch die Deckpunkthohensumme" (in Japanese with German summary), "A New Method of the Estimation of Stand Volume" (in Japanese with English summary), "Eine Methode Zur Bestandesmassenermittlung mit dem vertikalen Kritischen Winkel" (in Japanese) and "Einfaches Verfahren Zur Bestandesmassenermittlung durch die Deckpunkthohensumme" (in German) all by Masami Kitamura are all available from Dr. Masami Kitamura, Dep't. of Forestry, Yamagata University, 1-23 Wakaba-Machi, 997 Tsuruoka, Japan.

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Management Notes No. 2 "The Illinois Forest Inventory Data Processing System" by Pelz and Thom. Check with the Illinois Division of Forestry, Dep't. of Conservation, R.R.5, Conservation Area, Springfield, IL 62706 for availability.

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Drop us a line for a copy of Tech. Note 309 "An Economic Analysis Series for Screening Proposed Timber Management Projects - Report No. 1 - Analytical Considerations" by Fran Horak.

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The December 1977 issue of Forest Science contains the article "Precision and the Probability of Misclassification in Site Index Estimation" by Lloyd and Hafley. Check your local conservation library for copies.

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"STX - A Computer System for Processing Timber Inventory Data" by John C. Rennie. Write the Dep't. of Forestry, Wildlife & Fisheries, P.O. Box 1071, Knoxville, TN 37901 for a copy.

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Bulletin 659 T "Tables and Procedures for Estimating Weights of Some Appalachian Hardwoods" from Agricultural Experiment Station, West Virginia University, Morgantown, WV 26506.

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Copies of Miscellaneous Publication No. 1336, "Trees and Shrubs of the United States: A Bibliography for Identification", are available from USDA Forest Service, Information Center, Room 904A, 1720 Peachtree Road, N.W., Atlanta, GA 30309.

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"Forest Land Grading Procedures Handbook" contact the State Dep't. of Natural Resources, Technical Services Division, Olympia, WA 98504 for availability.

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AFRI Research Report No. 36 "An Evaluation as to Voluntary Compliance with the Timber Harvesting Guidelines in the Adirondacks" and No. 37 "Annotated Bibliography of Forest Practices in Relation to Water Quality" are available from the Applied Forestry Research Institute, State University of New York, Syracuse, NY 13210.

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Res. Paper FPL-281 "Measurements of Heat Release Rates on Wood Products and an Assembly" from Forest Products Laboratory, N. Walnut St., Box 5130, Madison, WI 53705.

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RECREATION & WILDLIFE

Tech. Note 307 "Inventory Techniques for Sampling Avian Populations" by Kay Franzreb. Drop us a line (Attention D-360) and we'll send you a copy.

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Gen. Tech. Rept. PSW-20 "State-of-the-Art Methods for Research, Planning and Determining the Benefits of Outdoor Recreation" and Res. Paper PSW-123 "Evaluating Stream Trout Habitat on Large-Scale Aerial Color Photographs" from Pacific S.W. Forest & Range Exp. Sta., P.O. Box 245, Berkeley, CA 94701.

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"Quadrat Sampling of a Nesting Population of Bald Eagles" by J.W. Grier in Journal of Wildlife Management, 41 (3), 1977, p. 438-443.

"Scenic Assessment, An Overview" by L.M. Arthur, T.C. Daniel and R.S. Boster in Landscape Planning, vol. 4, 1977, p. 109-129.

"A Rapid Statistical Method of Habitat Classification Using Structural and Physiognomic Characteristics" by Moll et al. in S. African Journal of Wildlife Res. vol. 6 (1): p. 45-50.

"Mapping the Scenic Beauty of Forest Landscapes" by T.C. Daniel, Leisure Sciences, vol. 1 (1), 1977, p. 35-52. Check at your local conservation library for availability.

Res. Paper INT-192 "Rationing Wilderness Use, Methods, Problems and Guidelines" from Intermountain Forest & Range Exp. Sta., 507 - 25th St., Ogden, UT 84401.

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#### REMOTE SENSING

An oldie but goodie - reprints of "Factors for Computing Photo Coverage" by H. Gyde Lund are available from our office. Factors and procedures for determining number of aerial photos required to cover a given area are presented.

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Kodak Publication M-76 "Photo Interpretation for Land Managers" may be purchased for \$1.50 from Professional, Commercial and Industrial Markets Division, Eastman Kodak Co., Rochester, NY 14650.

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IAFHE RSL Res. Reports 77-8 "Habitat Analysis of the Copper River Delta Game Management Area (East Side), Alaska"; 77-9 "Detection of Dutch Elm Disease Using Oblique 35 mm Aerial Photography", and 77-10 "A Wetlands Survey of the Twin Cities 7-County Metropolitan Area - West Half", are available from IAFHE Remote Sensing Lab, Univ. of Minn., College of Forestry, 1530 North Cleveland Ave., St. Paul, MN 55108.

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Brochure 200 "An Introduction to Computer-Assisted Image Processing and Analysis" and subscriptions to the Optronics Journal are free upon request from Optronics International, Inc., 7 Stuart Road, Chelmsford, MA 01824. The February '78 issue of the journal contains an interesting article on "Digital Image Processing for Printed Wire Photo Works".

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SOILS & WATERSHED

"How Much Rain Does a Rain Gage Gage?" by Karl L. Neff in Journal of Hydrology, 35 (1977) 213-220. Contact your local library for a copy.

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Paper "The Use of Color Infrared and Color Aerial Photography for River Studies" by Skinner and CE Research No. CER 71-72 MMS-32 "The Use of Remote Sensing to Obtain Data for Describing the Large River - Interim Report" are available from Dep't. of Civil Engineering, Colorado State University, Ft. Collins, CO 80521.

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USDA Agriculture Handbook 436 "Soil Taxonomy" is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The price is \$17.50. Stock No. 001-060-02597-0.

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Meetings and Workshops

I.U.F.R.O. active this summer:

"Inventories on Successive Occasions" to be held June 18-24, 1978 in Bucharest Romania, in conjunction with IUFRO Subject Groups S4.02, S4.03 and S4.04. Contact Dr. Paul Schmid-Haas, Swiss Forest Research Institute, CH-8903 Birmensdorf, ZH, Switzerland.

"National Forest Inventory: Why Is It Needed and How Best Conduct It" also to be held in Bucharest June 18-24. Contact Dr. George Bumbu, Institutul de Cercetari si Amenajeri Silvice, Sos. Stefanesti Nr. 128, Sector 2-COD R. 72904, Bucharest, Romania for details.



"International Symposium on Remote Sensing for Observation and Inventory of Earth Resources and the Endangered Environment". July 2-8, 1978 in Freiburg, Federal Republic of Germany. Write Dr. G. Hildebrandt, Erbprinzenstr. 17a, D-7800 Freiburg i. Br. Federal Republic of Germany for more information.

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A busy schedule at Ft. Collins:

Public Involvement in Decision Making July 17-21, 1978. \$300.

Least-Squares Modeling in Design and Analysis. July 24-28, 1978. \$300.

Fifth North American Forest Soils Conference. August 6-9, 1978. \$60.

Forest Resource Management: A Systems Approach. August 7-18, 1978. \$495.

Contact Office of Conferences and Institutes, Rockwell Hall, Colorado State University, Fort Collins, CO 80523 for details. All look excellent.

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The 11th Annual Forestry & Wildlife Resource Institute will be held at Virginia Tech. June 25-July 1 for interested high school students. The cost is \$100 and enrollment will be limited to 75. The deadline for applying is May 1. For additional information contact William A. McElfresh, Cheatham Hall, Virginia Tech., Blacksburg, VA 24061.

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The Midwestern Mensurationist will hold an informal meeting at Pingree Park in Colorado-August 14-17, 1978. Participants will be charged \$70 (including room and board). Space will be limited. For further details contact Ed Frayer, Forest and Wood Sciences, Colorado State University, Ft. Collins, CO 80523. Pingree is the summer camp for the forestry school.

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Miscellaneous

WANTED!! Lead articles, current literature and meeting announcements for publishing in Resource Inventory Notes. Send in your contributions and suggestions. If you have a meeting to announce please allow for at least a four month time lag.

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