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A PUNCH-CARD SYSTEM SUITABLE FOR USE WITH SMALL SAMPLES IN WILDLIFE MANAGEMENT AND RESEARCH

by

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A PUNCH-CARD SYSTEM SUITABLE FOR USE WITH SMALL SAMPLES IN WILDLIFE MANAGEMENT AND RESEARCH 1/

By Lowell Adams
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With the increased use of quantitative refinements in wildlife research and management, there is need for techniques to speed the handling of masses of statistical data. One such technique is the punch-card system for compiling and analyzing data. This system has not been commonly used in wildlife work because it is designed for use with large collections of data than usually are at hand. Also, machinery for its use is prohibitive because of the cost. However, a relatively new kind of punch-card system is available which is inexpensive and suitable for use with small collections of data. This is the Notch-card System, which, to my knowledge, has not been used in wildlife work but which is remarkably well suited for that purpose. The system is here described and compared with the better-known Hollerith punch-card systems. (Cottam and Curtis, 1948).

Punch-card systems are techniques for compiling and analyzing data quickly and accurately by mechanical means. The compiling and analysis of data, whether done by punch-cards or manually, is essentially a process of sorting into categories and tallying the frequencies of observations in the respective categories. For example, in analyzing hunter-return data, a wildlife manager may wish to sort the returns according to county of residence, species of game hunted, where hunted, hours spent in hunting, and the like. He will then have information as to the total number of hunters from each county, how many hunted each species of game, how many hunted in each locality, etc. The punch-card system can speed this analysis of data to an amazing degree.

Essentially, the punch-card systems consist of coding the data so as to express them in terms of holes in a piece of cardboard instead of numbers or symbols on a piece of paper. With the data thus portrayed, various categories can be selected from the mass of data by mechanical or electrical machines which select according to the position of the holes in the cardboards.

The more elaborate systems, such as the Hollerith punch-cards, have become familiar to the public through their use as financial forms such as the United States postal notes, which are printed on stiff paper and have rectangular holes punched in them.

1/ The use of the Notch-card system was originally suggested by Mr. Clarence Chase, Forest Economist, Lake States Forest Experiment Station, where the system has been in use by Mr. Chase for several years.

The Notch-card System

The simpler system, which is frequently better adapted to use with wildlife data is the notch-card system. This is less commonly used but may be familiar to World War II veterans who remember their personnel forms with holes and notches around the margins. With this system, cards of any size or shape may be used. The card has a series of holes punched around all sides just inside the edges. Data are coded so that each hole represents a specific bit of information. Then each hole which is positive for its respective information is notched out so that it is no longer a hole but a notch in the side of the card. Holes negative for their respective bits of information are left intact. To return to the example of the hunter returns, there may be a bank or group of holes, each one representing a county in a state. The hole representing the county in which the hunter resided is notched out. Other county-holes are not notched. Selection or sorting from a deck of cards so notched is done with a long steel needle. All the cards are smoothly aligned so that the corresponding holes are in alignment. Then the needle is inserted in a hole to be sorted and lifted up. All cards notched at that point fall away as the deck is lifted. In the above example, all those cards falling away would be those of all the hunters from a given county. These fallen cards may then be further sorted in the same manner to determine, for example, what areas were hunted, what kinds of guns were used, what game was killed, or any other information that had been previously notched into the cards.

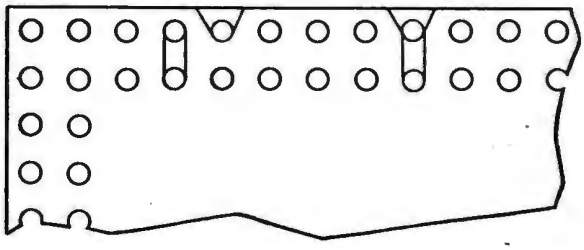
Comparison of the Two Systems

It will be noted that with the notch-card system, pre-punched holes are notched out, while with the Hollerith system, the card is not pre-punched but data in the form of holes are punched into the card. Either method is readily usable and the difference is not significant in evaluating them.

Both the Hollerith and the Notch-card systems have a place in wildlife research and management. The choice of systems is based largely on the size of job to be done and the financial resources available. The Hollerith system is geared to handle huge masses of data with amazing speed, but its machines are costly and cannot be economically owned unless there is need for their continuous operation. Most wildlife research and management operations cannot afford to maintain a Hollerith plant. Rental services are available, however, and occasional big punch-card jobs should take advantage of such service. The Fish and Wildlife Service's migratory bird banding records are handled this way.

The Notch-card system can be operated with a minimum investment of only $2.50 to $5.00, plus cards. While it does not have the capacity for handling data or the speed for sorting of the Hollerith system, it does greatly speed up the analysis of data over non-carded methods and for most wildlife data its capacity is adequate. The capacity of a card is determined by the number of positions available for punching a hole or a notch. The Hollerith card can be punched in positions ranging all over the body of the card, but the card of the notch-card system can be

notched only around the edges. Thus, a notch-card the size of a standard Hollerith card has 78 notch positions while the Hollerith card has several hundred hole positions. Notch positions can be added to the notch-card by increasing the size of the card. Occasionally it may be advantageous to add notch positions by using a double or triple row of holes along the edge of the card. This requires a special punch for the



secondary rows. Punching the second or third row allows the cards to drop only a little way from the deck, but this is sufficient to permit them to be pulled out the rest of the way by hand.

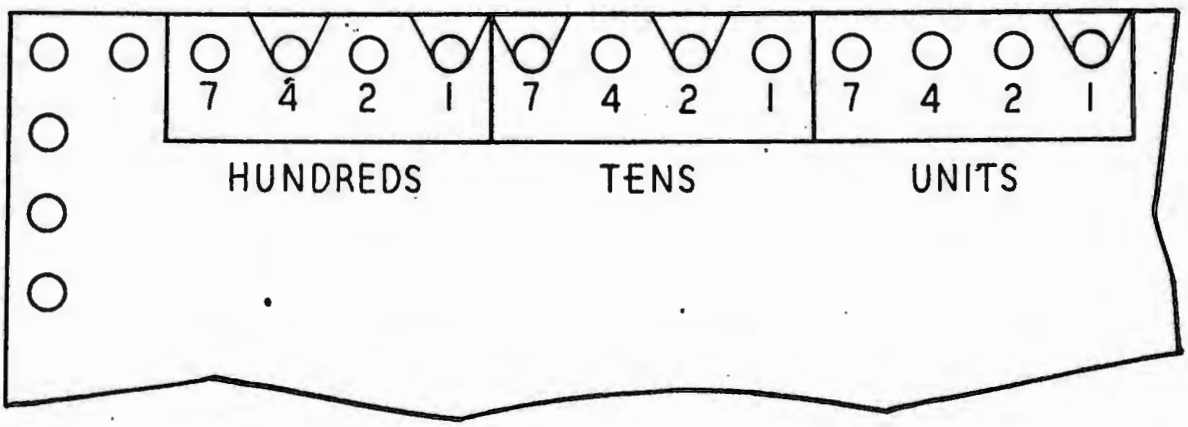
Uses

The Notch-card system can be used for office records such as personnel, payroll, accounting, inventory, etc. It may be used for analyses and record files for hunter returns, creel censuses, research data, and bibliographies. It can be put to use almost anywhere that collections of repetitive data are subject to analysis. In the case of bibliographies, a collection of seven or eight cross-referenced indexes may be maintained on but one set of cards.

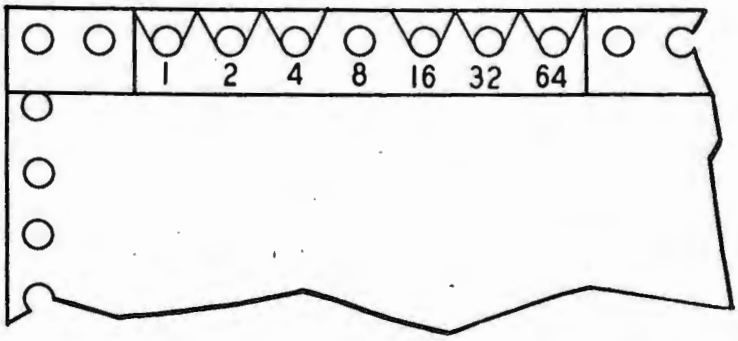
Coding

The most important aspect of the use of any punch-card system is the coding of information. To be accomplished most effectively, coding should be done at the beginning of a project--before the data are collected. This has two advantages. It assures the collecting of data in a form which can be readily coded, and, second, it frequently allows the punching of data directly on cards in the field. If the data cannot be punched directly in the field, at least they can be recorded on forms which have the code indicated, so that punch operators will have to use a minimum of subjective judgment. Unless data are pre-coded, they usually must be subjected to two operations before they are in punch-card form. First, they must be transferred to code-sheets. Then they must be punched into cards. These extra steps take time and allow errors to be introduced. With regard to the errors, all data should be carefully verified each time they pass through a coding or punching process. Once an error is allowed to be established on the punched cards, it may be there permanently, because it is not ordinarily subjected to personal scrutiny in the sorting and tallying processes.

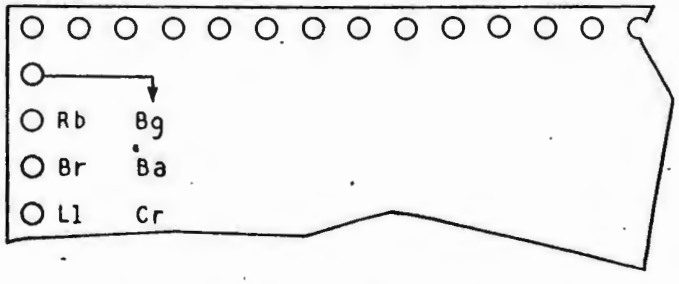
Coding may be done in either one of two ways - by direct coding or by numerical coding. In direct coding a notch-position stands for a descriptive term. For example, in a research project on deer, there may be need for information as to the sex. Two notch-positions may be used for this, one for "male" and one for "female." Or one hole might be used, notched for male and un-notched for female. Similarly sorting may be required according to species of big game. In this case, a series of notch-positions may be designated elk, moose, mule deer, etc., respectively. Numerical coding is used when the categories are numerous or represent large numbers. Notch-positions may be numbered consecutively from 1 to 10, 12, or 20, etc. This is simply a numerical form of direct coding. But if numbers from, say, 85 to 260 are used as in dressed weights of deer, it will be desirable to use combinations of notch-positions. For this purpose, notch-positions are set off in groups of 4. The positions in each group are numbered 1, 2, 4 and 7 consecutively. These numbers are used in combinations to form numbers from 1 to 10. The number 1 position is notched for 1, the number 2 position for 2. The combination of 1 and 2 is used for 3. The number 4 position alone is 4. Positions 4 and 1 are 5. Four and 2 positions are 6, and position 7 alone stands for 7. Combinations are continued to 10. A series of such banks of positions could be used to record digits, tens, hundred, etc. Using this system, a dressed deer weight of 195 pounds would have the following positions notched: In the "hundreds" bank the number one position, in the "tens" bank two and seven positions (equal to nine) and in the digits bank four and one positions (equal to five). Thus, with a combination of 12 positions, 3 banks of 4 each, any weight from zero to 1,000 pounds can be recorded. Notches for the number 195 are indicated.



A more efficient modification of the number code may be used with the holes numbered by geometric progression - 1, 2, 4, 8, 16, 32, etc. In this case the decimal system is not used. Instead there is just one bank of holes and it includes as many holes as are needed to reach the desired capacity. The number 119 is notched in the following illustration using the geometric progression system. (Simply notch holes such that the sum of their code numbers equals the desired number. In this case the numbers 64, 32, 16, 4, 2 and 1 add up to 119.) Note that only 7 holes are needed to reach a capacity of 119 in this case. With the decimal system, 12 holes would be needed for the same capacity.



There are many modifications possible in coding with combinations of notch-positions. Occasionally data which at first appear impossible to code within the scope of the notch-card system are finally found to be capable of coding when the right combinations are used. Combinations may also be used with some forms of direct coding. For example, in a set of data containing information on several species of cold-water fish, and also on several warm-water species, the same holes can be used for either cold-water or warm-water fish, provided the two categories will never appear simultaneously. Thus, if data from high mountain lakes are used in conjunction with data from farm ponds stocked with warm-water fish, and it is determined that the two classes of fish will not appear simultaneously, an arrangement such as the one shown may be used. The trout are represented by three notch positions. The warm-water



Rb - Rainbow
Br - Eastern Brook
Ll - Loch Leven
Bg - Bluegill
Ba - Bass
Cr - Crappie

fish are represented by the same three positions plus a fourth position. The fourth position serves as a "key-shift." If it is punched, the code is for warm-water fish. If it is not punched, the code is for trout. In sorting, one needles first the "key-shift" position to separate trout from warm-water fish, then sorts according to species as desired.

Coding symbols may be printed directly on cards, or blank cards may be used with a "key" card showing the code. It is more convenient, safer, and costs little more to have all cards printed with the code symbols.

The body of the card is available for recording any desired data. For example, a bibliography card file may have such items as subject, journal, date, author, species and file number coded in the notch positions, with the complete bibliographic citation, including notes or abstracts written on the body of the card. For a research project, the code may cover species, locality, date, observer, etc., with blanks in the body for writing in observations such as weights, frequencies of activities, and the like.

Aside from a few general principles such as those described, coding is largely a matter of imagination and personal resourcefulness in devising code systems. The punch-card companies and their distributors offer free counseling services to help with refinements of all phases of the technique.

Limits of the Punch-card Systems

The question may arise as to the advisability of using a punch-card system for a particular job. It is difficult to generalize about this, but it may be pointed out that there are, perhaps, limits beyond which these systems should not be used. If the data are few, it may be just as quick to work them up manually. It is hard to say where the minimum limit is. Five hundred cards are probably near the minimum for the notch-card system. However, Cottam and Curtis (1948) used only 100 cards with the Hollerith system which is generally considered to have a much higher minimum efficiency number than the notch-card system. There is hardly any limit to the maximum number of cards used. With the Hollerith system, the more cards there are the more efficiently they can be sorted. This is not so true of the notch-card system. But at just what point of numbers the Hollerith system becomes more efficient than the notch-cards cannot be stated since it would vary under different conditions. In addition to number of cards, efficiency is determined in part by card code capacity and number of times they are to be sorted. A little experimenting with the punch-card systems will help to determine individual limitations.

Supplementary Equipment

Both systems have supplementary machinery to suit various purposes. Several thousands of dollars are needed to buy a complete outfit of Hollerith machines. These machines will perform unbelievably complex operations such as mathematical computations and transforming coded material into printed reports. The notch-card system supplementary

equipment is for more modest uses. It is also less expensive. A keyboard punch may be used instead of the simple conductor's punch to speed up the punching operation. A gang punch is available for punching a number of cards (up to 200) at a time. Alignment blocks, file boxes, and multiple-needle sorting racks are also available. Most of this supplementary equipment is developed to speed up punching and sorting, and is more useful and efficient for larger jobs.

Literature Cited

Cottam, Grant, and J. T. Curtis. 1948
The use of the punched card method in phytosociological research. Ecology 29(4): 516-519