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ABSTRACT

To construct a descriptive analysis of national school system size categories suitable to facilitate cross-provincial comparisons in future research, data concerning the number of students, schools, teachers, and school and central office administrators as reported in 1986-87, excluding Quebec, were obtained from Statistics Canada. Enrollment and school data for Quebec were supplied for the 1987-88 school year by the Quebec Ministry of Education. To qualify as a school system, a board had either to operate more than one school, or to employ a board administrator; the final data contained 788 public school systems within Canada's 10 provinces and 2 territories. In addition to enrollment, school numbers, mean school enrollment, and three estimates of employee numbers were used as organizational size measures. An analysis of compiled data indicated high correlations between employee measures and enrollment, suggesting that while enrollment may represent a different theoretical measure of size, it can nonetheless be used as a reasonable proxy for employee number (although differences of scale remain). Further research involving school system size measures should be sensitive to the presence of exceptionally large or small systems during sampling and analysis. Five tables and four figures are included. (57 references and 5 footnotes) (KM)

Similarities and Singularities: A Comparative Analysis of the Organizational Size of Canadian School Systems

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Similarities and Singularities: A Comparative Analysis of the Organizational Size of Canadian School Systems

There has been a sustained research interest in school system size which has intensified in recent years. Some of this research has considered theory based relationships between size and selected aspects of organizational structure and administrative practice (e.g. Hickcox and Ducharme, 1972; Gill & Friesen, 1968; Holdaway, 1971; Moeller & Charters 1966; Peterson, 1984; Terrien and Mills, 1955). Most of the literature dealing with system size, however, deals in one way or another with the policy issue of what might constitute an optimum sized administrative unit (Educational Research Service, 1974). Such research has often been stimulated and supported by desires to increase economic and administrative efficiency and enhance educational opportunities through the amalgamation of smaller systems into larger, presumably more efficient and effective, organizations (Brown, 1968; Carpenter, 1948; Fox, 1981; Coleman & LaRocque, 1986; Sher & Tompkins, 1977). Virtually all North American provinces and states have implemented one or more district consolidation programs of this kind during the last fifty years, markedly reducing the number of systems within their boundaries and increasing their average size (Campbell, Cunningham, Nystrand & Usdan, 1985, p. 87; Bezeau, 1989, p. 132). Recent research has questioned both the rationale and results of such "big-is-better" policies through increased and more careful scrutiny of the relationships between system size and performance (Coleman, 1986a; 1986b; Coleman & LaRocque, 1986; Coleman, Walsh & LaRocque, 1988; Bidwell & Kasarda, 1975; Fowler, 1989;

Friedkin & Necochea, 1988; Guthrie, 1979; Monk, 1984; Walberg & Fowler, 1987). What Coleman and LaRocque (1986) have described as the myths about small systems have been called into question while Walberg and Fowler (1987, p. 13) have cautioned that policies promoting larger systems "may have been a move in the wrong direction."

But what constitutes a small, large, or even an average sized school system? There is no immediately apparent answer to this seemingly simple question. Nor is it as simple as it may at first appear. Size is inherently a relative property and although it may be easy to identify larger and smaller elements in a set, deciding where to draw dividing lines between small, medium and large groups in a continuous, finely gradated distribution is a hazardous matter. Moreover, in the case of school systems, the range and pattern of size distributions are likely to vary between jurisdictions such that what might be thought of as small in one province or state, could be regarded as medium or even large in some other setting. Yet without some common understanding of what might qualify as a small or large system, the translation of current and future research findings between jurisdictions is necessarily impeded, if not confounded.

This paper attempts to provide a basis for the development of such a common understanding within the Canadian context. We begin with a consideration of the problem of conceptualizing and measuring organizational and school system size together with a review of size categories presented in the literature. This is followed by a descriptive analysis of the range of school system sizes in Canada and each province together with a report of our attempts to devise a single system of size categories that could facilitate the co-ordination and comparison of Canadian research. We are acutely aware of shortcomings in the size classification which we propose and we offer it more in an attempt to stimulate interest and discussion in this problem rather than to prescribe an answer. The significance of the paper, we feel, lies more in the descriptive analysis which offers a previously unavailable account of the range and distribution of the size of Canadian school systems.

Conceptual and Measurement Concerns

Organizational Size

Many possible measures of organizational size present themselves. One could, for example, count the number of people in an organization or the number of different job titles; measure inputs, outputs or productive capacity; assess the value of physical assets, number of operational sites or total square footage of building space; spatial dispersion, the magnitude of the operating budget, or various combinations or ratios of such measures. Most such potential size indicators are subsumed under the four general measures suggested by Kimberly (1976): physical capacity, e.g. beds in a hospital, cells in a jail or "places"--or possibly classrooms--in a school or school system; personnel available to the organization; organizational inputs and outputs--typically such things as productivity, sales, number of clients; and discretionary resources available to the organization.

The most commonly used measure of organizational size, nevertheless, is a simple or adjusted count of employees, with 65 of the 80 studies considered in Kimberly's (1976) review using this approach. As discussed by Kimberly, this approach elides many difficult conceptual issues, not the least of which is the problem of comparability across different types of organizations. Can, for example, a school system with 300 students and 50 employees, be taken as the same "size" as a factory, or store, or government department with a similar number of employees? And what if in some of these organizations the 50 employees represent the full-time equivalent of, say, 100 or more individuals? Moreover, there is very little conceptual discussion or theoretical explanation offered in the literature for this approach except for the observation that it is people that are organized and administered.

Similarly, little, if any, theoretical justification is typically offered for the size categories used in various studies, nor has this issue attracted much conceptual discussion. Caplow's (1957) classic analysis based on interaction possibili ies is one notable exception. His analysis recognized small primary groups (c. 2-20 members), small non-primary groups (c. 3-100 members), medium sized groups (c. 50-1,000 members), large groups (c. 1,000-10,000 members), and giant groups with more than 10,000 members. In some cases such groups might not have the status of formal organizations by some definitions, but all formal organizations can be considered as groups as this term is used by Caplow. Note, however, that his analysis was based on "membership", rather than number of employees, and thus if applied to school systems an appropriate measure might be the sum of the number of students and employees and--where sensible--other non-employee members, such as regular volunteers, trustees and so forth.

Jaques (1976) has offered another particularly interesting analysis of organizational size groupings. In this case the conceptual base rests on his theory of depth-structure in bureaucratic organizations and his associated constructs of time-span and levels of abstraction in the management of progressively larger organizations. These constructs allow for a multi-dimensional measure of size, but his suggested scheme also includes a maximum number of employees for each size grouping. Thus, organizations at his Stratum I level would have only one employee, Stratum II organizations a maximum of 50 employees, Stratum III, a maximum of 350, Stratum IV, a maximum of 2,500; Stratum V, a maximum of 20,000 and Stratum VI a maximum of 150,000 employees (p. 153). He stipulates that these limits are appropriate for labour intensive organizations, which again raises the question of comparability across different organizational types, and there is no obvious way of accounting for situations--as in school systems--where the non-employee members considerably outnumber the employees.

The problems inherent in classification schemes can be at least partly avoided by using a continuous measure of organizational size, and counts of employees can obviously be used in this way. Apparent advantages of this approach are that it provides greater precision and allows for more sophisticated statistical analyses. Such data, however, are typically highly skewed with long, 'J'-like tails at the upper end of the distribution and as such do not satisfy the normality assumption that underlies most statistical analysis techniques. This is not uncommon with data based on counts which cannot take negative values, and logarithmic or other transformations have been recommended as appropriate in such circumstances (Chambers, Cleveland, Kleiner & Tukey, 1983;

Maguire, 1986; Simon, 1955). Kimberly (1976, p. 583) found this approach to be increasingly popular in studies of organizational size, but he also noted that opinion is divided on the theoretical desirability of this practice. Yet, while treating an operational measure of organizational size as a continuous variable may still be preferable for some analytical purposes, the issue of size classifications cannot be entirely avoided for, as Caplow (1957) pointed out, it is "unrealistic to discuss communities without making a general distinction between villages and great cities" (p. 486), and it is just as unrealistic to discuss organizations--or specifically school systems--without acknowledging the parallel between the larger and smaller instances.

School System Size

The measurement and classification of school system size faces all of the difficulties noted above but, just as in the broader literature, they are frequently bypassed in research. Monk (1984) has provided a recent discussion of the situation, in which he observed that "Although enrolment level is perhaps the most common measure of size, it is clear that the size of districts can vary along several dimensions" (p. 40). He took account of this in his study of internal resource allocation within New York State school districts by including six measures of system size: enrollment, geographical size, number of elementary schools, average enrollment of elementary schools, variation in elementary enrollment and a measure of population sparsity.[1] Medium to low correlations were found between these measures (r = -.27 to .53), except in the case of the relationship between enrollment and number of elementary schools (r = .89). Regression analyses found that whereas his alternate measures of size--particularly number of elementary schools and enrollment variation between elementary schools within a system--were associated with the internal allocation of resources, system enrollment was not (Monk, 1984, p. 53). Monk did not, however, use log transformations of his data, although other recent studies relying on system enrollment as a continuous measure of size have done so (e.g. Coleman, 1986; Friedkin & Necochea, 1988;). A few studies have also used measures of size not based on enrollment. A Manitoba study (MAST, 1971, cited by Coleman, 1972, p. 62), for example, used number of authorized teachers as the measure of size, while Peterson (1984) used number of schools.

These exceptions aside, by far the commonest indicator of school system size is student enrollment. When enrollment is not treated as a continuous variable, some sequential set of enrollment categories is used as the actual measure of size, but not all studies use the same classification system. This is a particular problem with Canadian research, as is illustrated in Table 1. The overlap between the size categories shown in the Table is a particular cause for concern. A system which fell into the smallest category (<5,000 students) in the two Ontario studies, for instance, could be classified as a medium-sized system using either of the two British Columbian categories. Similarly, a system with, say, 25,000 students would fall into the largest categories used by Coleman (1986), Coleman et al. (1988) and Fullan et al. (1987), but the "large-medium" categories used by Hickcox and Ducharme (1972) and Holdaway (1971).

These discrepancies can be explained and defended in terms of varying purposes and contexts. Holdaway (1971), for example, was investigating staffing ratios in larger urban systems, whereas the Coleman (1986) paper was concerned with small systems. Moreover, the categories used in the Coleman et al. and Hickcox and Ducharme studies were derived empirically by partitioning their systems into equally sized groupings. While this tactic facilitates analysis of the data at hand, it necessarily confounds comparison between studies as, of course, does the general problem of disparate categories.

The fundamental explanation for the use of non-standard size classifications in Canadian research, however, undoubtedly lies in provincial sovereignty over educational policy and geographical and demographic diversity between the provinces. Most Canadian educational research is set within a provincial context, and insofar as each province exhibits a different range and pattern of school system enrollments this will be reflected in the size categories adopted. But need this necessarily be so? There is far more commonality in the size categories used in research conducted in the United States, although the constituent es also determine their own schooling policies and there is also considerable diversity in geographic and settlement patterns. Indeed, national surveys in the United States have used exactly the same size classifications (Cunningham and Hentges, 1982; NASSP, 1984), and the National Centre for Educational Statistics (1982) employs a single--although different--classification system for its national summaries.

But even if a standard system of enrollment categories were to gain currency in Canada--or North America as a whole--this would still ignore the other dimensions of organizational size discussed by Kimberly and

Monk. Further, the previously noted problems of comparability between studies of school system and other organizations would still remain. for students are not employees. Furthermore, the uncertain organizational status of students (Allison, 1980) may also imply theoretical incompatibilities. Compulsory attendance laws allow students little choice regarding their "membership" in school organizations, and the location of their residence (and perhaps other factors, such as religion in some cases) pre-determines the school system of which they will be a part. Enrollment, therefore, may theoretically represent a measure of production--or more accurately production-in-process--rather than membership. Kimberly recognized measures of production as legitimate indicators of organizational size, but such measures clearly have a different theoretical status from those based on the number of personnel available to the organization.

Even so, a Foucaultian imperative generally ensures the regular and rigorous collection of enrollment statistics by state authorities. Hence, while student enrollment by itself may represent a theoretically--and in some ways an ideologically-- suspect indicator of system size, such data have the virtues of being both easily available and generally comprehensible. For such reasons alone enrollment will likely continue to be used as the dominant measure of system size.

The Study

Our main objective was to conduct a descriptive analysis of the organizational size of all Canadian school systems with a view to assessing the possibilities of constructing a system of national size categories that could be used to facilitate cross-provincial comparisons in future research. Even if an acceptable system of categories could not be devised, we reasoned that an appreciation of the full range of system size in Canada would be useful in designing future studies and interpreting research findings.

The data

Statistics Canada provided the initial database. These data included number of students, schools, teachers, school administrators and central office administrators as reported for all Canadian school boards in 1986-87, excluding Quebec. Enrollment and school data for Quebec boards were supplied directly by the Quebec Ministry of Education, but in this case these data were for the 1987-88 school year. This discrepancy was not seen as problematic and was disregarded in the analyses. A more serious limitation was that the Quebec data did not include the numbers of teachers or administrators employed by boards, and thus Quebec was excluded from detailed analyses which included numbers of teachers and administrators.

After inclusion of the Quebec boards, the database contained 865 school boards enrolling a grand total of 4,651,024 students in 13,902 schools. Some of these boards, however, do not readily conform to what is normally understood as a school system. Some, for example, were boards established to provide education to children in hospital or other special care facilities; others operated a single small school and did not appear to employ any administrative staff. These boards raised the difficult definitional question of what qualifies as a school system, and thus which boards, if any, should be eliminated from the database. We resolved this problem on the basis of the theoretical proposition that all systems necessarily contain sub-systems. The major structural sub-systems in school systems can be taken to be schools and administrative offices.[8] Consequently, we decided that to qualify as a "school system" a board must either operate more than one school or employ a board administrator.

All the boards listed as operating only a single school were therefore eliminated from the database unless there were reasonable grounds to believe that the board employed at least one individual in the capacity of a central office--as opposed to a school--administrator. Certain anomalies in the database complicated this screening process--one board with a single school and three teachers, for example, was listed as having 3 central office administrators! Where possible, therefore, independent corroboration was sought from entries in the CEA Handbook and provincial directories. The application of this decision rule removed 77 "non-systems" from the data set which together accounted for 6,894 students, representing 0.13 per cent of the national enrollment.[9]

The final data set therefore contained a total of 788 entries representing all public school systems in the ten provinces and the two territories. While we believe this database provides a reasonably accurate approximation of the current state of affairs, certain other limitations and characteristics deserve note. Some systems operate only elementary or secondary schools, but these distinctions were ignored in the analyses. In a few instances administrative conventions serve to fragment systems which may function as a single unit. Some of the secondary and elementary systems serving the same settlement areas in Saskatchewan, for instance, appear to share the same chief school officer and may thus operate as at least a partially integrated system, even though they appear as two separate systems in the data. Department of National Defense schools on military establishments are included. Private schools are not included, nor are Indian Affairs schools or Band operated schools. Schools in the Yukon are administered directly by the territorial government, and thus they appeared as a single "system" in the data. For this reason the Yukon was excluded from some of the analyses, as were the three systems in the Northwest Territories.

Measures

Table 2a lists the measures of system size that were considered together with the national means, standard deviations and Pearson correlations between the variables. In addition to enrollment, numbers of schools, mean school enrollment (enrollment divided by schools) and three estimates of the number of employees were used as measures of organizational size. These measures (none of which were available for Quebec) were total number of teachers (part-time + full-time), number of central office administrators, and an estimate of total employees gained by summing the previous two variables. As may be seen, there were very high correlations between these employee measures and enrollment, suggesting that while enrollment may represent a different theoretical measure of size, it can nonetheless be used as a reasonable proxy for number of employees, although, of course, differences of scale remain. Consequently--and because of its widespread use in other research--enrollment is used as the main indicator of size in most of the results reported in this paper. But despite the high correlations, some discrepancies between enrollment and the measure of total employees were detected in the detailed graphical analyses undertaken during the course of the study, the details of which will have to await future attention.

Table 2b lists the mean enrollment and number of schools for each province. Provincial correlations between the size measures were very similar to those obtained for the national distribution, except in the case of two relationships, the coefficients for which are also listed in Table 2b. A markedly weaker association between enrollment and number of central office staff is evident in Manitoba and Nova Scotia and a slightly weaker relationship in New Brunswick. The greatest departures from the correlations at the national level, however, occur in the relationship between system enrollment and mean school enrollment, with considerable fluctuation between the provincial relationships being evident. There is very little relationship between system enrollment and average school size in some provinces, but a reasonably strong positive association in some others.

Analysis

An initial appreciation of the overall range in the size of Canadian school systems can be obtained from Figure 1 which plots the actual values and the base 10 log values for system enrollment against the corresponding quantile scale for these data. Quantiles represent fractions, from 0.0--1.0, of a ranked data set, so that the median is represented by the .50 quantile [Q(.5)], and the interquartile range by Q(.25)--Q(.75) (Chambers, et al., 1983, pp. 11-16). As such quantiles are analogous to percentiles and may be interpreted as such without doing great violence to the concept[4]. The quantile enrollment scale for the total distribution has been used as a common axis in a number of the plots presented here in order to facil' a : comparison. Corresponding enrollment values for the quantiles from both national and provincial distributions are listed in Table 3, which is discussed below. It should be noted that the vertical axes in the quantile plots were erected at Q(-0.01) and Q(1.01) so as to display the tails of the distributions more clearly. All of these Figures were printed from a high resolution graphing program which plotted each of the 788 systems as a single point.[5] Solid lines in the displays are thus a consequence of overprinting caused by high densities in the distributions.

Figure 1 clearly shows the highly asymmetric nature of the enrollment distribution, with all the systems below the Q(.80) enrolling fewer than 7,500 students, but with enrollment values curving upwards to about the Q(.97) beyond which they rise very rapidly. Eight systems fall beyond the Q(.99), appearing as outliers from the distribution at the extreme right of the display. Enrollment in these "big eight" systems ranges from 61,632 -- 103,082 students, and together they account for almost 14 per cent of the national enrollment.

The upper trace in Figure 1 shows the effect of a log transformation of the enrollment data. As can be seen, the transformation serves to symmetrize the data so that it more closely approximates the normal distribution. This has the desirable effect of reducing the spread between the main body and the upper outliers while allowing the previously overwhelmed systems in the lower tail to be perceived, the four smallest systems being clearly evident. Such transformations would seem clearly desirable--if not essential--in research which employs enrollment as a continuous measure of size when the distribution of the systems under study is similar to that shown here. The highly skewed distribution of the non-log enrollment values would certainly seem to invalidate the use of statistical procedures based on the properties of the normal distribution, even such non-complicated measures as means and variance. On this point, note that the mean system enrollment of 6,101 students given in Table 2, equates to the Q(.75), and as such provides a grossly misleading impression of an "average" sized Canadian school system.

The casement display given in Figure 2 reproduces the log-enrollment distribution for the country as a whole in the upper left panel and plots the provincial distributions on the same scales in the remaining panels, thus showing how each provincial distribution contributes and compares to the national distribution. British Columbian systems appear throughout the main body of the distribution and into the upper tail, but none appear in positions which conform to the lower end of the national distribution. The Alberta systems, however, are spread evenly throughout the full range, including some of the smallest systems in the data set and two of the "big eight" systems. Further, there is a clustering of systems toward the lower end of both the Alberta and Saskatchewan distribution. Ontario and Quebec also span the full scale of the national distribution, the former accounting for five of the "big eight", the latter one. There is also a greater density of larger systems in Ontario, but the Quebec systems appear more closely packed throughout the mid-range. There is a marked absence of very large systems in the other provinces, but in each case the plots show a separation--and in some cases clusters--of systems at the extremes of the provincial range. Some provincial plots also show interesting gaps in the distributions which could form a basis for the development of empirically grounded size categories for those provinces.

The box plot displays in Figures 3 and 4 together with the numerical summaries in Table 3 facilitate more direct and detailed comparisons of the range and patterns of the distributions. The horizontal line within each of the box plots represents the median for the respective distribution. The top and bottom ends of the boxes mark the Q(.75) and Q(.25) values, each of the boxes thus encompassing the interquartile range of the distribution represented. The horizontal cross-bars and the end of the "Ts" extending from each box show Q(.90) and Q(.10), and dots beyond these cross-bars indicate systems falling outside this range in the tails of the distributions.

The upper panel of Figure 3 shows system enrollments for each province, the very squat shape of the plots graphically illustrating the relatively small size of the great majority of systems, with the interquartile range for each province falling below 20,000 students. Only in Ontario does the Q(.90) extend beyond this mark. This plot also clearly highlights the marked spread between the majority of the systems and the relatively few very large systems. The lower panel of Figure 3 offers an alternate view of the log transformations for each province, allowing a clearer visual comparison between medians of smaller systems. This plot highlights the smaller outliers in each province except Prince Edward Island, where the five systems are logically accommodated within the limits of the box plot. Nonetheless, there is a wide range between the smallest and next smallest systems in this province as is shown more clearly in Figure 2.

Figure 4 summarizes the enrollment distribution for all Canadian systems as plotted against the national quantile scale as used in the Figures 1 & 2. The plot on the extreme left of this array summarizes the national distribution, and thus the median bar and the box limits of the interquartile range correspond with the appropriate quantile values on the left axis scale. Table 3 provides the corresponding numeric values for the medians and other quantile values shown in the plots. Taken together, Figure 4 and Table 3 that show the median system enrollment for the national distribution is 2,569, with the median system enrollment for four of the provinces falling below this value, and that for the six others falling above. Ontario can be clearly seen as having the highest median system enrollment (7,461) with the Q(.75) for that province falling well above the Q(.75) for the country as a whole. The location of the median bar within the upper part of the box plot for Ontario further indicates that system enrollment in that province is skewed to toward the upper tail of the distribution, as is further indicated by the density of outside values above the Q(.90). In contrast the location of the median for the Manitoba systems, indicates a clustering of smaller systems toward the lower end of the interquartile range in that province. The median values for both Alberta and Saskatchewan can be seen to lie around the lower quarter of the national distribution, whereas the medians for Newfoundland and New Brunswick approximate the nation median.

As in the other Figures, perhaps the most notable feature of Figure 4 is the presence of systems falling beyond the Q(.90) and Q(.10) limits in each of the provinces except Prince Edward Island, where, as mentioned, the display is constrained by the small number of systems. Table 3 shows that these extreme values represent substantial departures from the medians of their respective provincial distributions. Thus while in each province the interquartile range encompasses a comparatively modest enrollment span, all except PEI also contain systems which have markedly larger and smaller enrollments. This is most evident in Alberta where the interquartile range--which by definition encompasses half of the systems--extends from 483 to 2,741 students, but the two largest systems--both members of the "big eight"--have enrollments of 69,220 and 84,535 students. In this case the largest system has more than thirty times as many students as the system at the top of the interquartile range, and sixty times as many students as the median system.

Yet the point being made is that all provinces contain systems that depart markedly from the middle range of their enrollment distribution. Thus, Ontario, with the highest median enrollment, also contains the system with the highest enrollment in the country, although in this case the distance between the median (7,461) and maximum enrollments (103,082) represents a more modest fourteenfold increase. Nevertheless, at the other end of the Ontario distribution the system with the smallest enrollment (238) is more than thirty times smaller than the median. Due to the highly skewed nature of the distributions, however, by far the most noticeable singularities appear as outliers in the upper enrollment range, and as such are more clearly portrayed by the box plots in Figure 3, but the numerical differences between the top of interquartile ranges and the maximum enrollments in Table 3 also help tell the tale.

Enrollment categories

It is clear from the Figures presented above and the values in Table 3 that any attempt to construct a single system of enrollment categories for Canadian school systems must allow for outliers and should ideally help convey the singular nature of these systems as compared to the majority of those crowded in the main body of the distribution. In essence, a representative categorization scheme should allow for and characterize both the singularities and the similarities in the distribution.

Table 4 places Canadian systems within the size categories frequently used, as discussed earlier, to classify systems in the United States. The distribution of systems in that country is also shown for comparative purposes. These categories do not seem unreasonable at first glance, although in comparison with the values given in Table 2 and the graphic displays, they can be seen to emphasize the lower end of the Canadian distribution. Further, the percentages of systems falling into each category show that they provide a far better summary of the distribution of systems in the USA than they do for those in Canada. Although category C accounts for slightly more than half of the systems in the two countries, a markedly higher proportion of Canadian systems fall into the two largest categories, and a far smaller proportion into the lowest category. In sum, this system does not appear to adequately recognize the higher proportion of larger systems in Canada and anticipates the presence of a greater number of very small systems. Moreover, these categories disguise the presence of the relatively very large outliers noted in the Canadian distribution. Nevertheless the comparison between the two national distributions given in Table 4 is not without interest.

Table 5 offers an alternative based on our analysis of the distributions of the Canadian systems. The classification categories presented were derived through studying the shape of the distributions and ranked listings of the systems. In addition to quantile plots of enrollment such as those in Figures 1 and 2, actual and transformed enrollment values were also plotted against numbers of schools, teachers and administrators for both the complete range and selected sectors of the distributions. Cluster analyses were also performed and the results considered when interpreting the plots and deciding on the final size categories. The partitions of the distribution offered here, nevertheless, inevitably contain arbitrary elements and reflect our particular perceptions and values. Even so, the boundaries of the larger categories seem to us to provide a reasonable reflection of the patterning in the data, although we are tempted to further sub-divide the LSS category. We are less happy with the boundaries of the smaller categories, the determination of which relied more heavily on intuition and compromise and the placing of which neglects certain complicating factors discussed later.

The suggested classification scheme as presented in Table 5 contains six categories ranging from Very Small School Systems [VSSS] with less than 300 students, to Very Large School Systems [VLSS], which enrol more than 60,000 pupils, a category which contains only the "big eight" systems mentioned previously and clearly evident in the plots. These two extreme categories account for 2.4 and 1.0 per cent of Canadian systems respectively and capture the extreme outliers in the national distribution. Two thirds (N=526, 66.8%) of the systems fall into the Medium [MSS] size category with enrollments ranging from 1,000--10,000 students. This classification embodies the main body of the distribution, the end points corresponding to .18 to .85 quantiles on the scale used in the Figures. The Small School System [SSS] category, from 300--1,000 students, accounts for the 125 (15.9%) systems which lie along the convex curve at the lower end of the log enrollment plot. The Large [LSS] category, from 10,000--60,000 students, contains the remaining 110 (14%) systems.

As can be seen, this arrangement places the majority of Canadian systems in the middle [MSS] category and allows for a roughly proportional but decreasing spread through the two adjoining categories to the outlier classifications. As such it groups the systems into a rough analogue of the shape of the widely known normal curve. Thus, while the skewed nature of the distribution is captured by the exponential-like increase in the category boundaries, the distribution of systems across these categories matches intuitive expectations. This, we feel, provides a sensible empirically grounded system for partitioning the national distribution.

Table 5 also applies these categories to the provincial distributions. Every province except Nova Scotia is represented in each of the three middle categories, although Nova Scotia has a single system falling in the VSSS classification. Moreover, in each case the majority of the provincial systems fall into the central MSS category--although it is a close run thing in the case of Ontario. Even so, this accurately reflects the differences between the provincial distributions illustrated in Figures 2 and 3. For these reasons we believe the proposed scheme can have utility for comparative research both within and between provinces. Its major weakness is that in some provinces, notably Manitoba, Quebec and Newfoundland, what may appear as an unreasonable proportion of systems fall into the MSS category. Whether this would actually constitute a problem would depend on the nature of the research. Nonetheless, in studies where finer differentiation is desirable, this could be achieved by further partitioning within the MSS category, and in some instances--in studies of economies of scale for example--this might also be desirable in provinces which have a wider spread across the major categories. Yet even when further partitioning of the MSS category appears desirable, the other categories provide a way to identify and control for systems that fall outside the middle range, and especially the singular outliers. The main point, however, is that the scheme offered here provides an empirically rooted set of size classes that can facilitate comparative research between provinces. Further, the two extreme categories can easily be collapsed into their adjoining categories in provinces which do not contain very small or large systems. When such systems are part of the population under study, however, we feel that they should placed in their appropriate class as shown.

Discussion

The seemingly simple notion of organizational size carries with it many complexities. As noted in the literature review, the immediate problem for any would-be analysts is that of choosing an appropriate measure. This is further complicated in the consideration of school system (or school) size by the uncertain organizational status of students.

The analysis reported here, nevertheless, relied on enrollment data and did not directly address the alternative measures of system size included in the data set. This was partly justified above on the grounds of the high correlations between enrollment and the other measures, and was also partly forced by the limitations of a single paper, but some comment on the relationship between enrollment and number of schools in smaller systems is required.

Some of the systems which fall into our SSS category contain but a single high school with, for example, 991 students and 53 teachers. Others, however, include 10 or more schools (the largest number is 18), with fewer students but similar numbers of professional staff. Which is larger? Surely systems with fewer students but many more schools must be regarded as more administratively complex than those which include but a single school? Moreover, this problem extends in the MSS size category defined above, with the "largest" single-school system enrolling more than 1500 students. These kind of discrepancies gradually disappear as student enrollments increase, but at the lower end of the distribution they present acute problems. Nevertheless, the way in which these anomalies are disguised when enrollment is used as the sole measure of size illustrates precisely the kind of problem that needs to be resolved in a sound theory of school system size

Conclusion

Comparative studies of school system size hold significance for the practical, theoretical and policy realms of educational administration.

But as reviewed and illustrated in this paper, the notion of school system size brings with it difficult definitional and measurement problems. The intuitively simple problem of classifying systems as small, medium or large turns out to be less than straight forward or simple. Yet a reliable and defensible means of doing this is necessary if size related differences are to be sensibly studied, and research findings and policy outcomes are to be compared. Indeed, it seems clear that no progress can be made in studying relationships between system size and other factors unless a standard system of categories comes into common use. The classification system presented in this paper will hopefully contribute to this end, but is by no means completely satisfactory. Regardless, from the description presented here it would appear that research involving measures of school system size should be sensitive to the presence of exceptionally large or small systems when samples are being drawn and during analysis. Finally, there is also much work to be done in developing alternate measures of size which better represent the organizational nature and administrative complexities of school systems.

TABLE 1

SELECTED SIZE GROUPINGS FROM THE LITERATURE

STUDY	SETTING	MEASURE	CATEGORIES
Coleman et al. (1988)	B.C.	students	< 2,100 2,101 - 5,560 5,561 - 51,000
Fullan et al. (1987)	Ontario	students	< 5,000 5,000 - 20,000 > 20,000 (county) > 20,000 (urban)
Coleman and LaRocque (1986)	B.C.	students	< 1,500 1,501 - 3,000 3,001 - 4,500 4,501 - 6,000 6,001 - 10,000 10,001 - 15,000 15,001 - 20,000 > 20,000
Hickcox and Ducharme (1972)	Ont.	students	< 4,999 5,000 - 12,999 13,000 - 19,999 20,000 - 39,999 < 40,000
Holdaway (1971)	7 Metro areas in W. Canada	students	3,034 - 7,016 8,024 - 15,853 19,208 - 48,106 72,950 - 75,502

TABLE 2a

UNIVARIATE STATISTICS AND PEARSON
CORRELATIONS FOR MAIN VARIABLES

Variable	N	Mean	SD	Correlations				
				2	3	4	5	6
1 STUDENTS (System enrolment)	788	6,101	11,241	.997	.913	.975	.376	.414
2 TT (Total of full and part time teachers)	594[1]	308.7	567.4	-	.913	.974	.369	.414
3 HQAD (Number of central office administrators)	594	14.8	34.6		-	.922	.297	.311
4 TEM (Total employees [2+3])	594	323.6	599.2			-	.366	.410
5 MISCENROL (Mean school enrolment)	788	273.2	127.7				-	.251
6 SCHOOLS (in system)	788	17.5	24.7					

[1] Excludes Quebec

TABLE 2b

UNVARIATE STATISTICS AND PEARSON CORRELATIONS, BY PROVINCE

	N	Mean enrollment	Mean schools	r Student & HQAD	MSE
B.C.	75	6,483	20.5	.867	.653
ALTA	130	3,465	11.6	.936	.208
SASK	101	1,992	8.9	.941	.132
MAN	49	4,061	12.0	.480	.535
ONT	132	13,550	36.9	.928	.638
QUE	194	5,292	13.2	n.a.	.262
N.B.	41	3,401	10.5	.791	.523
N.S.	22	7,767	24.6	.519	.505
P.E.I.	5	4,898	13.2	.986	-.085
NFLD	35	3,982	17.0	.887	.565

TABLE 3

QUANTILE POINTS FOR CANADA AND THE PROVINCES

	Q (1.0) Maximum	Q (.75)	Q (.5) Median	Q(.25)	Q (0) Minimum
CANADA	103,082	6,128	2,569	1,287	44
B.C.	50,742	7,491	3,583	1,392	440
ALTA	84,535	2,741	1,375	483	44
SASK	23,986	1,790	1,282	833	213
MAN	35,215	5,273	1,857	1,413	828
ONT	103,082	16,460	7,461	2,208	238
QUE	90,591	6,273	3,405	1,805	192
N.B.	16,211	3,363	2,267	1,578	252
N.S.	28,607	11,060	4,847	3,274	262
P.E.I.	10,747	5,028	4,852	3,395	465
NFLD	19,957	4,362	2,787	2,075	305

TABLE 4
CANADIAN AND AMERICAN SYSTEMS
CLASSIFIED BY COMMON AMERICAN CATEGORIES

Group	Enrollment	Canada N (%)	U.S.A. N (%)
A	> 25,000	28 (3.6)	189 (.01)
B	3,000 to 24,999	321 (40.7)	3,360 (4.1)
C	300 to 2,999	420 (53.3)	8,040 (56.4)
D	< 300	19 (2.4)	2,671 (18.7)
TOTALS		788 (100)	14,260 (99.21)

TABLE 5
DEVISED CLASSIFICATION SYSTEM

	VSS	SSS	MSS	LSS	VLSS		
		300-	1,000-	10,000-			
	<300	1,000	10,000	60,000	60,000+	TOTAL	
	19	125	526	110	8	788	number
CANADA	2.4	15.9	66.8	14.0	1.0	100.0	row %
	100.0	100.0	100.0	100.0	100.0	100.0	col. %
		9	52	14	0	75	
B.C.	0.0	12.0	69.3	18.7	0.0	100.0	
	0.0	7.2	9.9	12.7	0.0	9.5	
	10	47	67	4	2	130	
ALBERTA	7.7	36.2	51.5	3.1	1.5	100.0	
	52.6	37.6	12.7	3.6	25.0	16.5	
	5	28	65	3	0	101	
SASK.	5.0	27.7	64.4	3.0	0.0	100.0	
	26.3	22.4	12.4	2.7	0.0	12.8	
	0	2	44	3	0	49	
MANITOBA	0.0	4.1	89.8	6.1	0.0	100.0	
	0.0	1.6	8.4	2.7	0.0	6.2	
	1	14	60	52	5	132	
ONTARIO	0.8	10.6	45.5	39.4	3.8	100.0	
	5.3	11.2	11.4	47.3	62.5	16.8	
	1	13	159	20	1	194	
QUEBEC	0.5	6.7	82.0	10.3	0.5	100.0	
	5.3	10.4	30.2	18.2	12.5	24.6	
	1	7	30	3	0	41	
N.B.	2.4	17.1	73.2	7.3	0.0	100.0	
	5.3	5.6	5.7	2.7	0.0	5.2	
	1	0	14	7	0	22	
N.S.	4.5	0.0	634.6	31.8	0.0	100.0	
	5.3	0.0	2.7	6.4	0.02.8		
	0	1	3	1	0	5	
P.E.I.	0.0	20.0	60.0	20.0	0.0	100.0	
	0.0	0.8	0.6	0.9	0.0	0.6	
	0	3	30	2	0	35	
NFLD.	0.0	8.6	85.7	5.7	0.0	100.0	
	0.0	2.4	5.7	1.8	0.0	4.4	

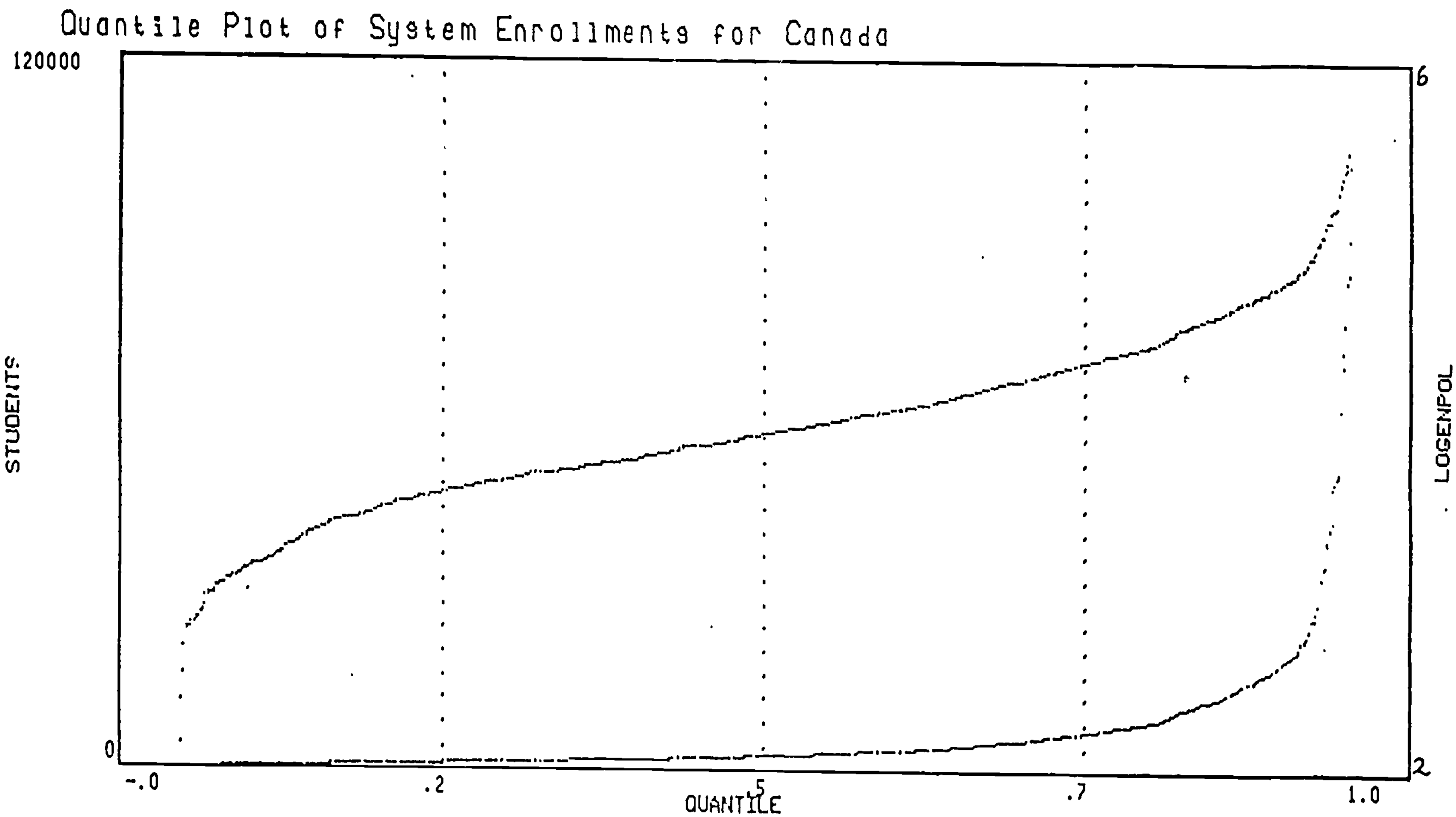


FIGURE 1
QUANTILE PLOT OF ENROLLMENTS

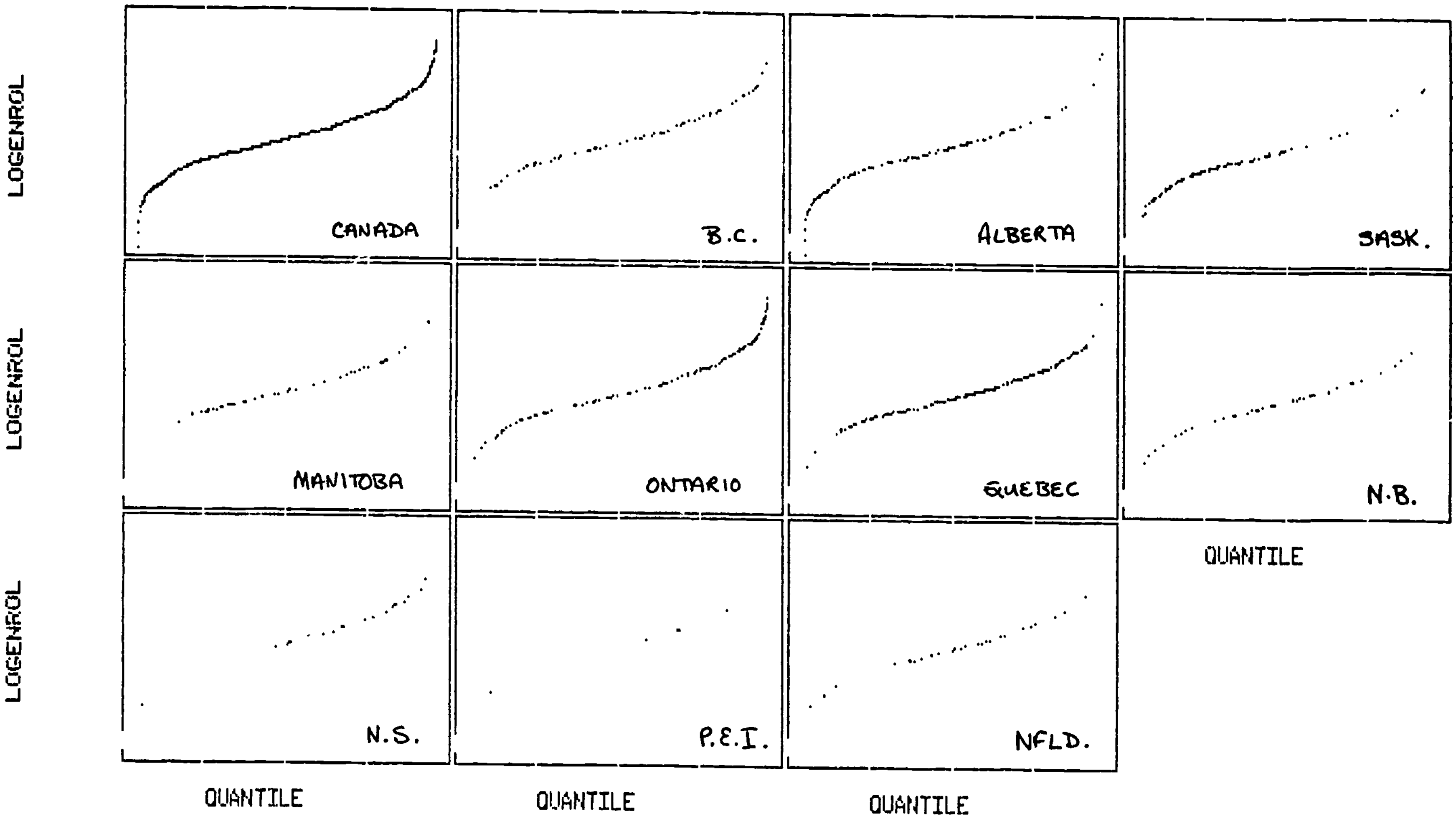
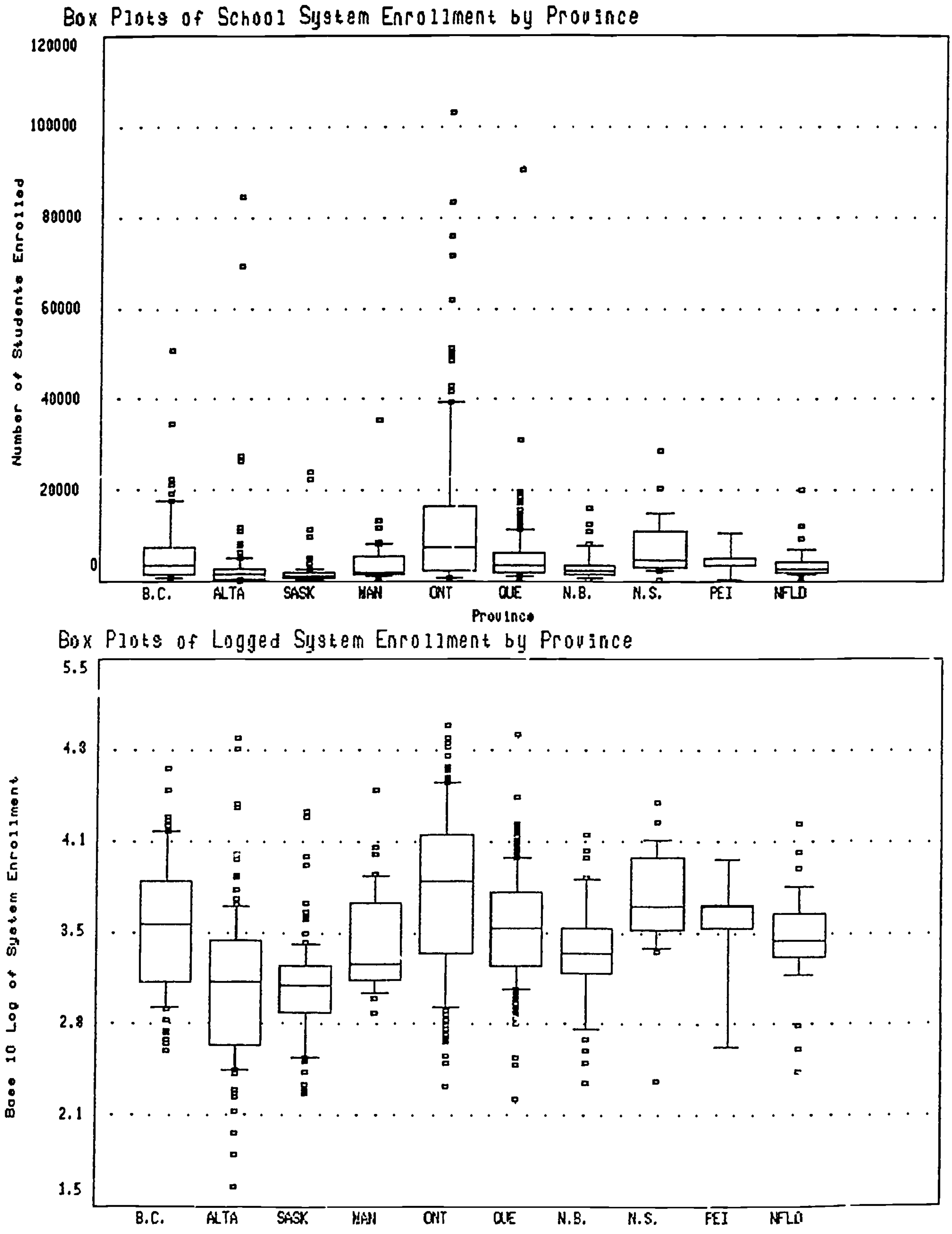


FIGURE 2
CASEMENT DISPLAY OF NATIONAL AND PROVINCIAL LOG ENROLLMENTS

FIGURE 3
BOX PLOTS OF PROVINCIAL ENROLLMENTS



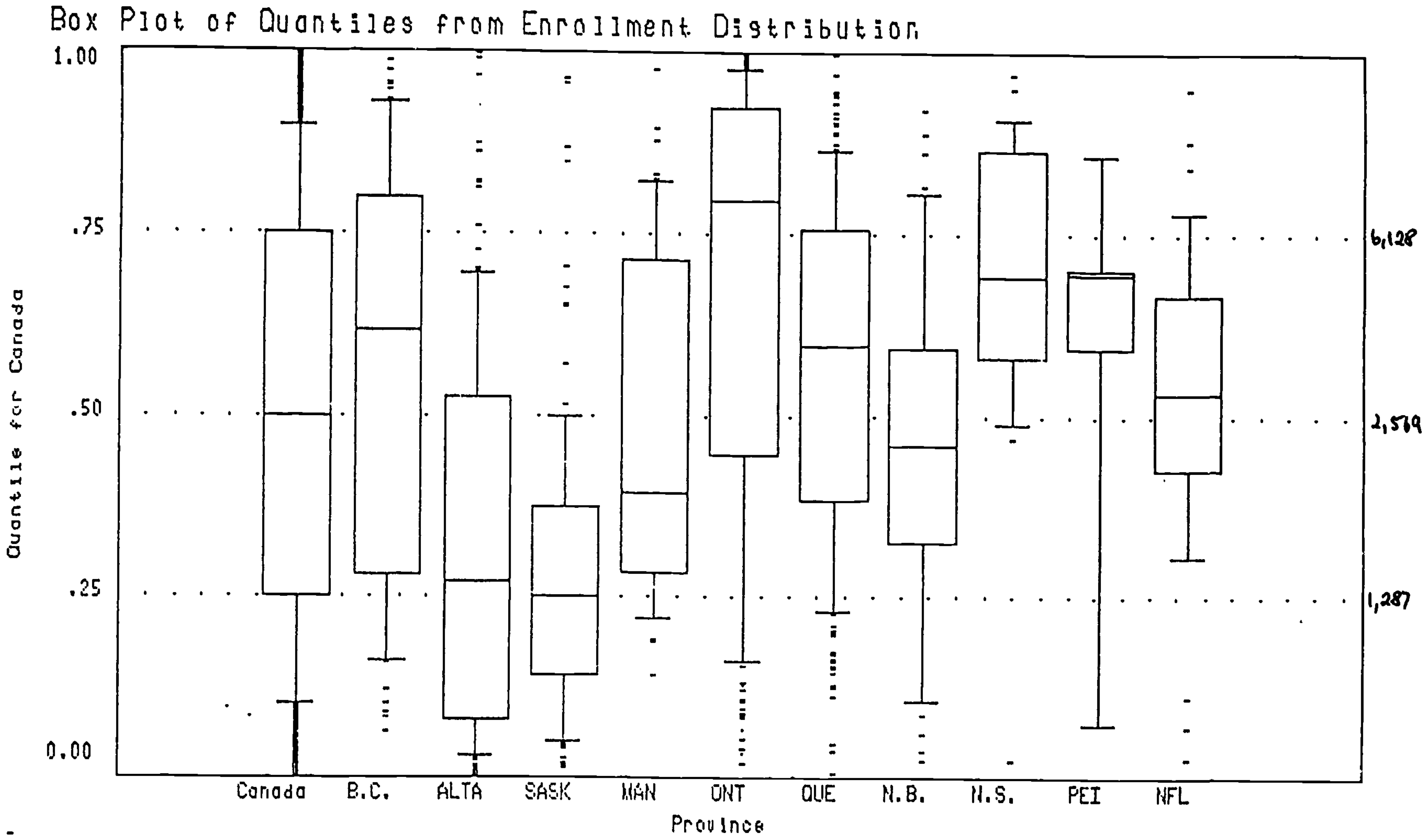


FIGURE 4
BOX PLOT OF ENROLLMENT QUANTILES

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Footnotes

1. The product of a district's K-12 enrollment and geographical size. He noted that pupils per square mile was also used as a substitute measure of sparsity, but that the use of this alternate measure "made no substantive difference in the results" (Monk, 1984, p. 52).

2. Classes--defined as either classrooms per se or groups formed for instructional purposes--also qualify as major structural units in schooling organizations, and clearly other kinds of sub-systems can also be defined and recognized, but this is not the place for a theoretical discussion of school and school system structure. Moreover, we lacked data on number and type of classes or classrooms in the systems under study--although such measures could well constitute important measures of school system size and complexity.

3. We are not entirely sure the game was worth the candle, and were sorely tempted at times to simply ignore the problem. Nonetheless, the issue of what does qualify as a school system strikes us as a crucial issue in studies of this kind, as well as other descriptive survey work, especially when special attention is being given to small schools and "systems". We also suspect that we incorrectly eliminated a number of "true" system due to a lack of accurate information on actual administrative arrangements. On this point the question of how very small single-school boards actually provide for the administration of their affairs seems a worthy subject for study.

4. But data quantiles are not, strictly speaking, percentiles, nor does the display presented in Figure 1 fully respect the conventions presented by Chambers et al. (1983). They prefer to label the horizontal axis of a quantile plot "Fraction of Data", so as to preserve the identity of any given quantile as the particular value in the sorted data set that represents the corresponding fraction in question.

5. All of the analyses and plots reported here were conducted on a Zenith microcomputer using <u>Solo</u> statistical software as distributed by BMPD Inc.