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A POPULATION GEOGRAPHER'S POPULATION PYRAMID

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Usual population profiles are as Figure 1A for the population of Thailand in 1980; a display created by grouping numbers by sex and age and then standardizing these by re- expression as percentages of the total number of males and of females. Such structures commonly are interpreted as showing average conditions, though nothing is implied about the distribution of age-sex values from place to place within the designated area. For a population geographer, concerned with spatial differentiation, the orthodox population profile holds little value. What is wanted is a display of the variation of age-sex values from place to place; a display such as Figure 1B which was created by first ranking the percentages of total male and total female populations in each age group in each of the 698 districts comprising Thailand in 1980, and then providing a resistant summary of each distribution by locating the median, the first and third quartiles, and the lowest and highest values. Architecturally, the display comprises a pile of modified box- and-whisker plots (the box-and-whisker plot being a device used in formal exploratory analysis); one plot for each age group by sex. The box is formed by two short vertical lines at the first and the third quartiles which are joined by two paralle horizontal lines; the whiskers are single horizontal lines from the quartile sides of the box to the lowest and the highest values except when an end-value is extraordinary (more than 2.5 percentage points from the nearest value) and so shown as an outlier by an x. Within the box, between the quartiles, a vertical line represents the median. Such a graphic display proffers a deal of information about age-sex structure because the shape of the distribution of values is presented for each age group from place to place within the designated area. Stimulated, thereby, is a curiosity about the geography of the variation in age-sex structure: are there observable spatial regularities from place to place?

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There are two principal ways to answer this question. Both are infrequently used, though one is more common than the other. The more common way is to map the distribution of values for each age-sex group. So, the range of district values in each age-sex group might be quartered as on Figure 1B and depicted in a series of thirty-two charts. The worth of such a display is its wealth of analytical detail. The shortcoming of such a display is that it is difficult to comprehend the age-sex structure of the population of even one place and, consequently, virtually impossible to discern the geography of structural differentials. To comprehend differences from place to place, whole age-sex structures must be classified and mapped. This is the less common (and, by-the-bye, more arduous) way to answer the question posed, but it is the way to a direct response.

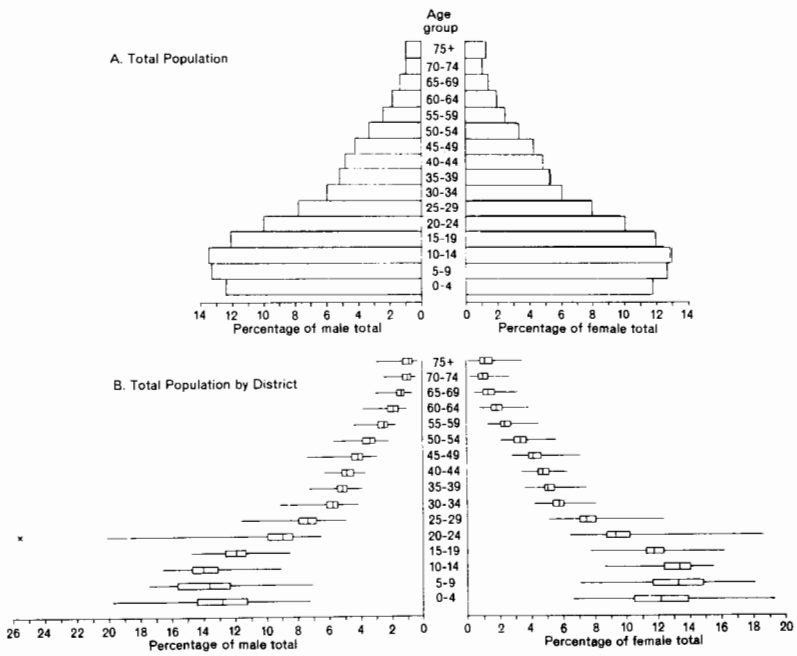

Figure 1. Thailand : 1980 age-sex structure.

Classification of age-sex structures begins with the calculation of successive differences between adjacent age-sex groups because it is the direction and the magnitude of these differences which give to an age-sex structure its distinctive profile. In this particular instance, the differences sought are between percentages of total male and of total female populations in each of sixteen age groups taken in sequential pairs from (0- 4) minus (5-9) through (70-74) minus (75+) in each district. Figure 2 provides a graphic description of such differences for males in each of the 593 rural districts of Thailand-districts outside the Bangkok metropolitan area which do not include a municipal area.

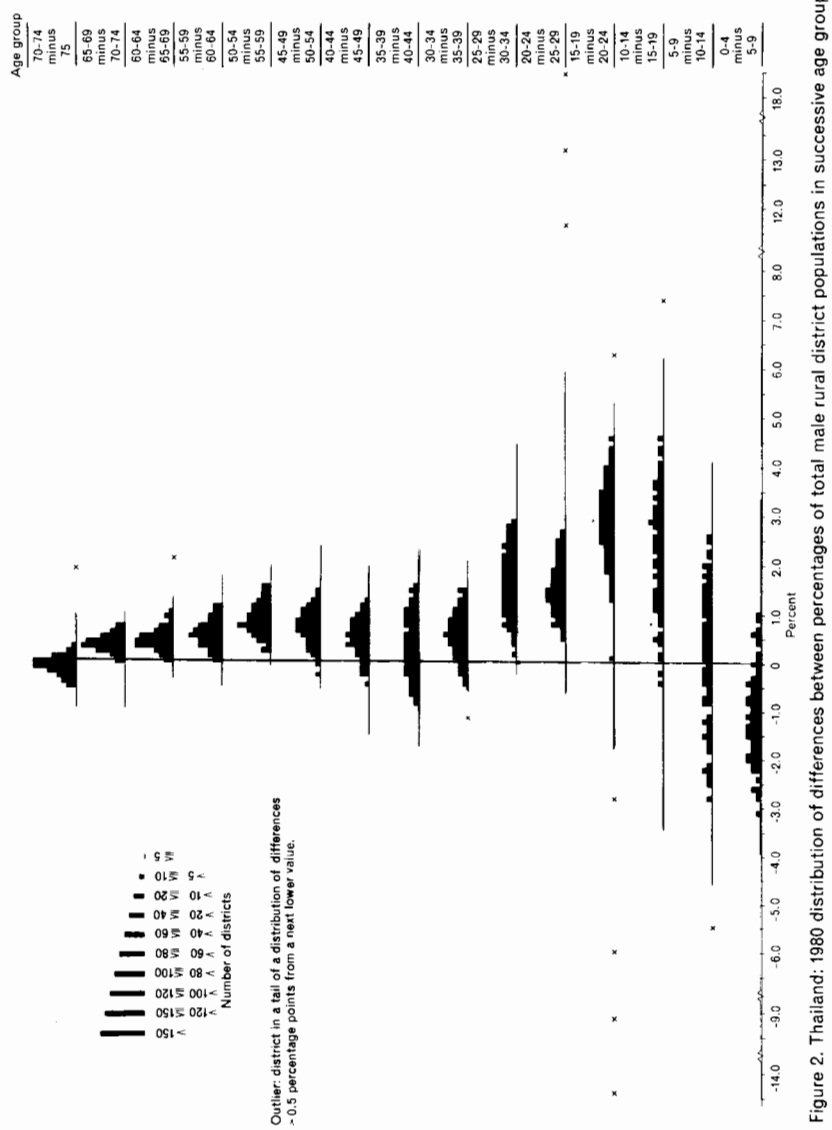

Figure 2. Thailand: 1980 distribution of differences between percentages of total male rural district populations in successive age groups.

Three features of Figure 2 merit highlighting. First, differences between successive age groups range widely among young age group pairs. Second, differences between successive age groups are apt to range over plus and minus values. Third, there is substantial overlap of values throughout the profile of differences between successive age group pairs. Taken together, these three features raise the possibility of a considerable number of different district population structures. How considerable a number depends on what is judged to be a significant difference between successive age group population. If a difference of sign in significant - because the profile is indented or protruded thereat - are all differences of sign equally significant? Is a difference of, say, plus or minus 0.1 of a percentage point the same as a difference of plus or minus 1.0 percentage point? To decide this vital matter it is necessary first to determine the number of different district age structures which are generated by different discriminative rules. In practice, this involves the application of a succession of increasingly wider definitions of what constitutes *no difference* between successive age groups. For our example, the number of different age structures at different levels of significance is shown by Table 1.

Perhaps most notable of several remakable features of Table 1 is the large number of different population profiles at the least rigorous significance level; which large number increases sharply as the significance level rises to 0.5, at which point there are 413 different profiles for the 593 rural districts. Thereafter, the number of different profiles declines, but gradually, and moderate numbers are reached only when the difference between successive age groups must be large to be significant. The large number of different population profiles largely reflects the preponderance of unique profiles - those which characterize a lone district - or, at most, the relatively large number of profiles which separately characterize no more than several districts. In fact, unique and near-unique population profiles account for the great majority of districts at significance levels as high as 1.0 ; and only at very high levels of significance do such profiles account for less than a tenth of the districts. Conversely, population profiles which individually account for even a tenth of all districts are established only when the significance level is high; and such profiles, together, account for half or more of all districts only when the level of significance is extremely high. The development of

profiles which separately comprise a tenth or more of all districts coincides with the development of what might be called a *uniform population profile*, that is one which shows no significant difference between any of the sixteen age groups taken in successive pairs. Eventually, of course, all districts will be in the terminal uniform population profile pile, though each district will have reached this terminus by a unique route as it joins with different districts in a succession of profiles along the way. At the highest significance level on Table 1, the uniform profile is, in fact, pre-eminent, accounting for fully 30 percent of all districts. Indeed, discontinuing Table 1 at significance level 3.0 was prompted by the extensiveness of the uniform population profile and the rapidly increasing spill of districts into this terminal pile.

At what level of significance, then, is description of the distribution of different population profiles warranted; at what point in Table 1 is it proper to depict the spatial differentiation of age structure? If by proper is meant that real explanations might be found for all profiles in the working of mortality, fertility and migration, then it can be argued that the first appearance of the uniform population profile surely marks a place in the succession of significance levels at which an explanation cannot be found. In Table 1, this significance level is 1.7. The proper point for depiction, therefore, is at a significance level of 1.6 or less. At such levels of significance, however, the large number of different profiles and the small number of districts with the same profile makes depiction impractical. Indeed, whatever foursquare stance is adopted with respect to what is proper, portrayal of the distribution of different population profiles is precluded by its being impracticable.

Table 1. Thailand 1980 : number of male rural district population profiles at successive significance levels

Significance level*	Number of different profiles	Number of districts with same population Profile								
		1	2	3-4	5-9	10-24	25-59	60-99	100-149	150-183
		Number of occurrences								
+ or -	191	136	25	9	11	5	4	1	0	0
0.1	245	187	22	18	10	6	1	0	1	0
0.2	270	203	32	16	9	8	1	1	0	0
0.3	319	237	37	22	15	6	2	0	0	0
0.4	390	287	62	30	8	3	0	0	0	0
0.5	413	324	48	32	8	1	0	0	0	0
0.6	393	295	55	25	18	0	0	0	0	0
0.7	373	266	52	41	13	1	0	0	0	0
0.8	357	259	45	29	22	2	0	0	0	0
0.9	331	244	36	30	16	5	0	0	0	0
1.0	280	204	22	27	19	7	1	0	0	0
1.1	237	161	29	20	15	9	3	0	0	0
1.2	196	119	36	19	6	13	3	0	0	0
1.3	166	104	24	12	6	16	4	0	0	0
1.4	146	90	19	11	6	15	5	0	0	0
1.5	125	71	18	9	11	10	6	0	0	0
1.6	108	49	16	17	11	9	5	1	0	0
1.7	95	39	15	14	13	8	4	2	0	0
1.8	90	39	10	14	16	4	5	1	1	0
1.9	82	34	12	9	16	6	3	1	1	0
2.0	69	24	11	10	10	9	4	0	1	0
2.1	61	22	7	12	11	8	2	1	1	0
2.2	57	18	10	9	8	8	2	1	0	1
2.3	57	23	5	11	5	8	3	0	1	1
2.4	51	18	9	8	4	6	4	0	2	0
2.5	45	17	6	7	5	5	3	0	1	1
2.6	40	15	4	8	3	6	0	2	1	1
2.7	34	11	5	6	3	5	0	2	1	1
2.8	31	11	3	5	5	3	0	2	1	1
2.9	30	14	2	5	2	3	0	1	1	2
3.0	26	11	4	3	1	3	1	0	1	2

Note : *A "significance level" refers to the difference between percentages of total male populations in successive age groups from the youngest (0-4 minus 5-9) through the oldest (70-74 minus 75+) in each rural district. So, for-means all differences of sign are significant; 0.1 means only differences of sign greater than 0.1 and less than -0.1 are significant; and so on. The higher the significance level, the lower is the difference between successive age groups ; as used here, a significance level simply distinguishes three categories of difference: positive, negative and nil.

Well, why not amalgamate certain of the sixteen age groups which comprise the population profile or make use of a wide geographical grid at the outset of exploratory analysis? Surely a population profile which comprised only several age groups or a geographical grid comprised of seventy-odd provinces instead of some six hundred districts would reduce the multitude of different configurations to a mappable few? Barring some a *priori* re-grouping of the available data (a procedure deprecated by the exploratory analyst, though routinely practiced by researchers who suffer from an "embarrassment of riches") such generalizations of the data can come only from manifest regularities in the data. There are no manifest regularities in the data.

The aforesaid gives good reason for attempting a geography of particular parts of the age structure; in truth, to portray the spatial differentiation of this particular population structure is possible only through subdivision of the profile into its indicant facets. Most obvious aspect of the population profile comes from the relatively recent downturn in fertility which shows up as indentations at the base of age-sex structures. Had these basal indentations involved only differences between age groups 0-4 and 5-9, mapping the distribution of manifest fertility decline would be easy; instead, basal indentations can comprise several successive age groups, which circumstance dramatically increases the number of different configurations, even when differences between successive age groups are only three: positive, negative and nil. The five population profile types displayed by Figure 3 come from a judicious sorting and arraying of the ins-and-outs among basal age groups. Figure 3 is a geography of fertility decline throughout the rural districts of Thailand. That this geography is coherent suggests a nice diffusion of the innovation of restricted fertility; which finding gives promise of a nice description of the process of fertility decline throughout the kingdom in near future.

Although demographic processes shape the geographic population profile, the working of demographic processes cannot be elucidated by an examination of the geographic population profile. What an exploratory analysis of the geographic population profile is concerned to proffer is guidance to enquiry into the geographic aspects of the working of demographic processes.

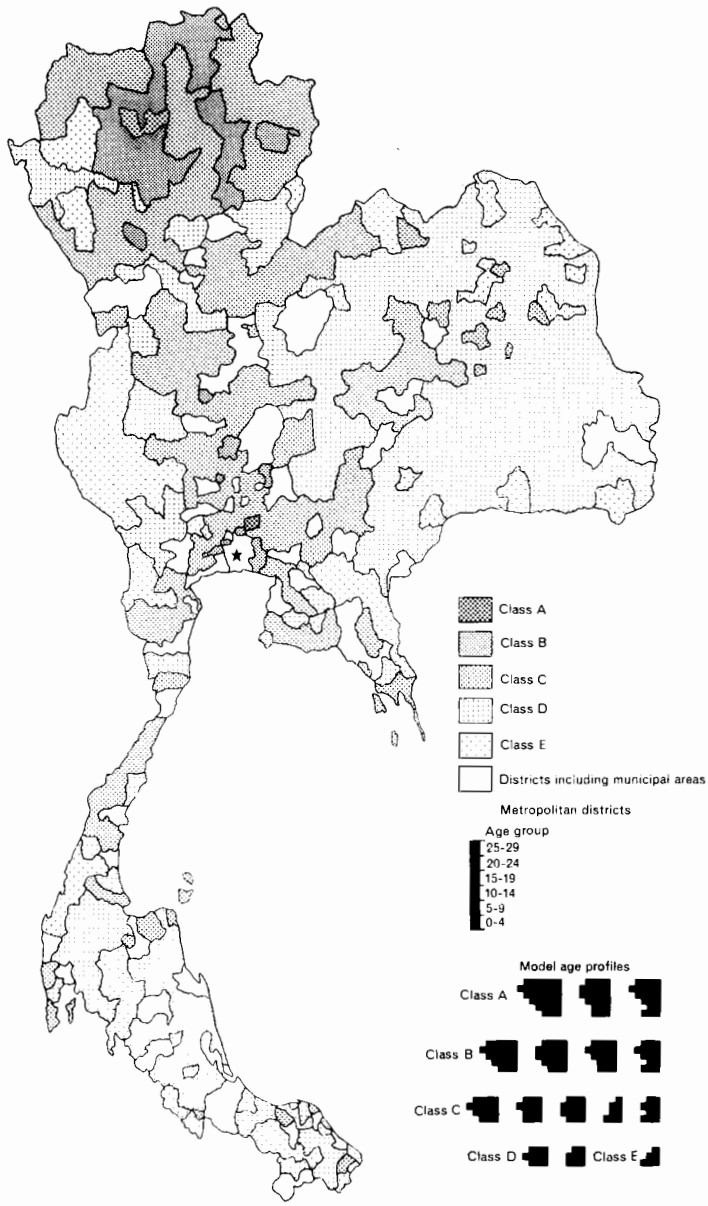

Figure 3. Thailand: 1980 differential decline of fertility as manifested in the distribution of differences between percentages of total male rural district populations in successive basal age groups.