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THE ARTIFICE OF CARIBBEAN ISLAND'S OVERPOPULATION

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Abstract

Scientists and intellectuals, government officials, journalists, and the general media have asserted that almost every single Caribbean island is overpopulated. Most of these claims are based on the relatively high population density of these islands in comparison to the rest of the countries of the Americas. This article investigates if population density is an appropriate indicator of overpopulation in the specific context of the insular Caribbean. The main sources of empirical information used in this article are: (1) national and regional population densities; (2) the human development index produced by the United Nations Development Program; and (3) a population projection of a "standing room-only island." The article concludes that assertions of Caribbean island overpopulation, based on high population density, are methodological and statistical artifices or mathematical miscalculations. These artifices are the result of poor methodological choices: (1) the selection of geographic methodological scales; and (2) the selection of an inappropriate mean as a measure of central tendency. Moreover, statistical analysis demonstrates that overpopulation (as measured by population density) is not directly related to human poverty in the Caribbean region. There is insufficient statistical basis to conclude that Caribbean islands are overpopulated.

Keywords: Overpopulation, weighted population density, geographical scale, statistical artifice, Caribbean, Barbados, French Caribbean, heterogeneity

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Introduction

In 1965 a group of geographers promoted a collaborative study on population pressure over resources in the Third World (Zelinsky, Kosinsky and Prothero, 1970), using the terms "equilibrium between population and resources," "imbalance between human numbers and needs," "maladjustment between resources and the population," and the more vigorous term, "overpopulation" (p. 14-15). One of the editors of the volume, the prominent American cultural geographer Wilbur Zelinsky, asserted that even if scholars unanimously agree at the conceptual level what is overpopulation, there still remains the question of how to measure it operationally. After 40 years, this question has yet to elicit a satisfactory answer.

In the Caribbean region there is a historical tradition of operationalizing overpopulation by equating it with a measurement of high population density (Briggs, 2002). From Clark's *Porto Rico and its Problems* (1930) and Pedreira's *Insularismo* (1934) to the recent claims of the National Geographic Society 2006 *Eye in the Sky* series on overpopulation, Caribbean islands' high population density and overpopulation are practically synonymous. In the context of the Caribbean, I do not know of any systematic study that supports the claim that population density offers indisputable evidence of overpopulation. Back in 1965, Zelinksky warned geographers about scientists who use statistics as a surrogate of reality and at times impute to statistics relevance not inherent in them (Zelinsky, Kosinsky & Prothero, 1970). Following this warning, this article scrutinizes the relevance of population density as a measure of Caribbean island overpopulation. Building up on the dialectical mode of inquiry in statistical research advocated by an earlier essay (Aviles, 2008), the scrutiny of population density will focus on the implicit theoretical assumptions of this indicator and its ability (or inability) to capture the heterogeneity at different levels of analysis.

I. A methodological artifice: The choice of geographic scales

Overpopulation usually refers to an excess of population in relation to a specific resource, which is operationalized by the ratio between the specific resource under consideration and the size of the population. Population density (or crude density), the ratio of population to the area it occupies measured in inhabitants per square kilometre, is the most common numerical indicator in assertions of Caribbean overpopulation. While population density was criticized as a meaningless indicator for overpopulation (Ehrlich & Ehrlich, 1991), it is still widely used as a numerical justification for such assertions.

The North American region (see map 1A) reveals a low population density, similar to that of the South American region (see map 1C), where the only exception is Ecuador, a country whose population density is one notch up in relation to its neighbors. The map of Central America (see map 1B) presents a different pattern since these countries have higher population densities than the previous two regions. The Caribbean region (see map 1D), composed of an archipelago of smaller islands (with the exception of Cuba), exhibits a sharp contrast with its continental counterparts. Caribbean islands hold the highest population density of the Americas, occupying the highest three levels of the population density gradient of the maps.

The concept of geographical scales, largely ignored in discussion on Caribbean overpopulation, becomes a key factor in the explanation of the numerical artifice of high population density. *Geographical scales* refer to the unit that organizes the spatial differentiation into regions (Johnston, Gregory, Pratt, & Watts, 2000), and allows the observer to focus on the global scale (the planet as a single region), the multiple regions of the national scale within the planet, or the multiple regions of the sub-national scale within a nation. The *cartographic scale* of a map refers to the correspondence between the distance on a map to the distance "on the ground" (Marston, 2000). The constructions of maps 1A-1D used different cartographic scales in order to map regions of different sizes into a standard piece of paper. If the cartographic scale is presented in the map, there is no basis for confusion regarding the size of a place. *Methodological scales*, which refers to the level of resolution or detail that the researcher selects in the analysis of a specific phenomenon (Johnston, Gregory, Pratt, & Watts, 2000), may lead the observer to wrong conclusions through maps 1A-1D.

Since the Caribbean archipelago comprises island nations and island-provinces or island-departments of European nations, maps of the insular Caribbean use different methodological scales. Caribbean island-nations and island-departments exhibit the highest population density in the Americas, such as Barbados (654 hab./km^2) and Puerto Rico (446 hab./km^2) . Similarly, the French department of Saint Martin and Saint Barthélemy (479 hab./km^2) exhibits a population density far greater than that of many nations. The Caribbean map (see map 1D) includes both the scale of the nation-state and the scale of sub-national divisions, disregarding the incorporation of islands (or portions of islands) into larger nations-states. The scale of the nation-state, while extremely relevant for geopolitical purposes, is misleading when dealing with population density. Geographers agree that there is no natural, optimum, pre-determined geographical scale to be used in social research (Marston, 2000). The use of different methodological scales (nations and departments) makes it methodologically inappropriate to compare the crude density of continental France (an area with 21 departments), which occupies an area of 675,000 km^2, with that of its overseas regions, which do not occupy more than 1,500 km^2 each.

If the principle of heterogeneity is acknowledged (Harvey, 1997; Lewontin and Levins, 2007), a different map of population density in the Americas will be constructed.

Heterogeneity forces a researcher to bear in mind that objects are internally heterogeneous at every level, an assumption that is at odds with traditional habits of statistical classification which makes the researcher to consider all elements of the same class as homogeneous or equals. As Map 2 reveals, areas of equal population density as that of the Caribbean are spotted through Northern, Central, and South America, making the Caribbean region to appear as no longer exceptional. When maps are sensitive to such variations, it is possible to assert that there is a numerical artifice based on the choice of the geographical methodological scale of the analysis.

II. A Statistical Artifice: The Well-Chosen Average

Assertions of overpopulation in the French Caribbean overseas departments are presumably based on the differential population density of continental France and its island departments. Recently, a French demographer affirmed that: "[S]ince 1954, the emigration of large numbers of people from the islands of Martinique and Guadeloupe is judged as an indispensable solution to the overpopulation of these departments" (Condon, 2004: p. 368, author's translation from French original). Meanwhile, a popular cyber-encyclopedia asserts that "… France has continued its attempts to improve the economic life of Martinique, which is plagued by overpopulation and a lack of development" ("Martinique", 2009).

Understanding the bias involved in the use of crude densities deserves particular attention, which this section attempts to do with a methodological and empirical analysis of the crude and regional density of continental France. The crude density of continental France conceals the heterogeneity of this large territory in relation to the French Caribbean islands since their islandness facilitates relatively easy access to different regions through its shores, and the small territorial extension leaves little or no room for a scarcely populated hinterland. The crude density of larger nation-states is an average that includes vast areas with little or no population, therefore introducing a bias that produces a methodological artifact. The crude population density is blind to the heterogeneity of sub-national population densities. When there is a territory with scarcely populated vast national areas (usually forests, desserts, rugged terrain, or inhospitable low temperature zones) and a handful of cities with millions of inhabitants, crude averages favor scarcely populated areas due to their larger territorial extension.

The national crude density constitutes a version of the case presented more than fifty years ago by Darrel Huff in the chapter, *The Well-Chosen Average*, of his renowned book, *How to Lie with Statistics*. Huff stated that "you have in reality the case that sounds like a joke or a figure of speech: Nearly everybody is below average" (1954, p. 31). In the case of national crude density of large territories, the immense majority of the regions are well below the national population density.

A plot of the population density of each of the twenty one regions of continental France (see Figure 1A, grey columns) demonstrates that population density are highly skewed in this territory, which means that the vast majority of the regions have little density and a few regions are extraordinary dense. A basic principle of statistics advises against the use of an arithmetic mean as a summary measure of such skewed distributions. This situation is aggravated when it is considered that crude densities are area weighted densities (Craig, 1984), which means that regions with larger areas have more influence on the national crude density than regions with smaller areas. Figure 1A shows the proportion of the national weight of each region's area vis-à-vis its population density. Under such situation, it is not appropriate to use crude density, since it has a built-in bias that magnifies the influence of larger regions. To remove this statistical bias, Craig (1984) suggests the use of a population weighted mean. Figure 1B demonstrates that the equivalent weight of the relative contribution of the population is quite similar to the regions' population density. A population weighted mean reduces the built-in bias of the crude population density. A population weighted density provides the methodological advantage of a simple interpretation: it represents the density at which people live (Craig, 1984; Lewontin and Levins, 2007).

The above explanation lead Craig to promote an alternative to the national crude population density, which is the geometric mean of the population weighted density (D_{GM}), equivalent to:

$$D_{GM} = \prod_{i=1}^{n} \left[\left(\frac{population_i}{area_i} \right)^{\frac{population_i}{total\ population}} \right]$$

where the national area is divided in *n* regions and $population_i$ and $area_i$ are the corresponding measures for the i^{th} region of the national area.

The Caribbean overseas departments of France offer a good opportunity to utilize the above formula to demonstrate the built-in bias of the crude density. France is divided in 28 regions and 100 departments. As Table 1 presents, the crude density of France is 96 persons per km^2, a dramatic difference in relation to the crude densities of their overseas departments of Guadeloupe (259 hab./km^2), Martinique (338 hab./km^2), and Saint Martin and Saint

Barthélemy (479 hab./km^2) (see Figure 2). However, when weighted population densities are used, the Île the France department (formerly known as *Region Parisiene*) has the extraordinary density of 4,384 hab./km^2. The apparently high Caribbean islands' population density is the product of a statistical artifice that results from the misuse of the arithmetic mean as a measure of central tendency to describe a highly skewed distribution of sub-national population densities (see Figure 3). Assertions of Caribbean overpopulation that rest on a statistical artifice become statistical fallacies with no empirical basis. These fallacies have motivated the imagination of researchers to forecast an astonishing demographic future.

III. The "*standing-room only*" Island

Since the 19th century Barbados has been described as an overpopulated society. The alleged overpopulation of Barbados led G. W. Roberts, a historical demographer with ample research in the British Caribbean, to conclude that it could eventually become a standing-room only island. In his 1963 speech before a United States House of Representatives Committee, this demographer asserted that:

> "[I]f we assume that the growth continues at the rate of 1.3 per cent per annum, this island of 166 square miles will within a span of 190 years – that is, within somewhat less than six generations – attain a level of standing room only. I define the term 'standing room' to mean literally three square yards per person" (quoted in Cummins et al., 1965: p. 1600).

This Barbados population projection is based on the mathematical method of extrapolation that produces an estimate of a value of a variable beyond the range of observed conditions. Since extrapolations are based on the assumption that the behavior of such variable will continue the established observed trend, it requires judicious and circumspect considerations. Roberts' calculation is based on the assumption that the established observed trend of the growth rate of Barbadians would remain the same for 190 years, from 1963 to 2153. If Roberts was correct, not even the situation of having one Barbadian for every 4 square yards in year 2143 will make them change their reproductive behavior for the following 7 years (see Table 2). The untenable assumption that nothing would make Barbadians to slow-down their growth rate during two centuries compromises the reliability of this extrapolation.

The actual mathematical calculations of this population projection are problematic. Using the formula for exponential growth (see Table 2), it becomes evident that it is not possible to achieve the population of about 171,823,903 (one person per 3 square yards in Barbados) in about 190 years having the annual rate of 1.3%. To achieve that population size it is required to have an annual rate of 3.47%, which in terms of population growth is an outstanding difference. While Roberts reports a population doubling time of 53 years, it is required to have a population doubling time of 20 years, in order to achieve his forecasted population. That Roberts' mathematical miscalculation and extreme forecast had the approval of the peer review process of the rigorous *American Journal of Public Health* suggests that, in the context of Caribbean islands, bold numerical assertions of overpopulation are not suspicious statements.

The idea that overpopulation conducive to 'standing-room only' places was not new in the 1960s, since the book *Standing Room Only?* (Ross, 1927) was already published three decades earlier. Its author, Edward Ross, a United States sociologist who wanted to be known as the 20th century Malthus, was not a natural born alarmist, but an empirical researcher who attempted a synthesis of sociology and ecology (Gross, 2002). This economist-turned-sociologist made his famous prediction of a standing room only world based on a population doubling time of 60.15 years, provided that manna should fall from the atmosphere. This whimsical explicit assumption will produce by the year 2755 a situation equally comic: the possibility of "hanging out in our planet the sign, STANDING ROOM ONLY" (Ross, 1927, p.104, emphasis in original). The fantastic assumptions used by Ross hyperbolic example and the question mark of the book title, makes it clear that the *standing room only* image is not meant to be taken literally. If Barbados was to become a standing-room only island, manna should fall from the atmosphere too. Unfortunately, bad statistics sometimes take on lives of their own (Best, 2001) and the statistical fiction that they produce becomes real in terms of island representations and their political consequences.

IV. Barbados as Counterexample of Overpopulation

Beyond statistical artifices and mathematical miscalculations of assertions of overpopulation, the Caribbean offers an additional statistical evidence to test the arguments presented so far. The theoretical strength of population density as an indicator of overpopulation can be observed in its relation to the well-being of Caribbean nation-states, since overpopulated countries should host a myriad of deleterious social and economic consequences. As a measurement of well-being this analysis uses the human poverty index, a composite measure of life expectancy, literacy rate, unemployment, and income distribution. This index assigns a high ranking to states with higher level of social deprivation and a low ranking to states with good standard of living (UNDP, 2008). As shown in Table 3 and Figure 4, Barbados, the most densely populated country in the Western hemisphere (627 hab./km^2), provides the best standard of living in the Caribbean. Barbados enjoys the hemisphere's third lowest index of human poverty, only preceded by Canada and the United States. This analysis excludes the islands of Bermuda and the Bahamas since they are not usually considered part of the insular Caribbean (Gaztambide, 2008).

As Figure 4 demonstrates, the data from Barbados is distant from the main cluster of observations, which makes statisticians muse over the possibility that they are facing the case of a statistical outlier. The use of statistical formulas to detect an outlier, and possibly delete this observation from the statistical analysis, is always a matter of a researcher's subjective decisions. In this case, there are no substantive reasons to consider Barbados as an outlier that should be deleted from the statistical analysis. Barbados data is, in Abelson's (1995) terms, the empirical counterexample that challenges a positive universal. This is, its departure from the main cluster of observations by its high population density and its low human poverty index, provides a paramount example that clearly contests the claim that high population density is an indicator of overpopulation. Barbados is an embarrassment for those who claim that population density is an indicator of overpopulation.

Moreover, statistical analysis demonstrates that the strength of the association of the index of human poverty with population density is quite weak. The nonparametric statistical analysis of ranking correlation known as Kendall Tau (τ) is the analysis of choice due to: (1) its small number of observations ($n=12$) is not suitable for parametric statistics; (2) the most common form of the human poverty index is a ranking of countries, which is the basis for Kendall Tau; and, (3) its correlation coefficient is easy to interpret. As presented in Table 3, Kendall's correlation coefficient equals 0.35 ($\tau=0.35$), which suggests a somewhat weak association. The Caribbean region demonstrates that high population density has little to do with human poverty.

V. Conclusion

In her 1963 reflection on writing, Flannery O'Connor asserted that

> "[t]here is a certain embarrassment about being a storyteller in these times when stories are considered not quite as satisfying as statements and statements not quite as satisfying as statistics; but in the long run, a people is known, not by its statements or statistics, but by the stories it tells." (1995, p.192)

In a similar way, Abelson affirms that research always tells a story and statistical analysis serves the narrative function of sharpening that story. Accordingly, studies of Caribbean island overpopulation should be read as stories. But these stories have a specific peculiarity; their statistics do not provide numerical evidence, they are just ornamental elements.

This article has demonstrated that tales of a Caribbean island with an impending overpopulated future of lack of space is based on mathematical miscalculations and ridiculous unrealistic assumptions. Similarly, the evidence presented in this article demonstrates that assertions of Caribbean island overpopulation, based on high population density, are methodological and statistical artifices. From a geographical point of view, claims of overpopulation involve the use of poor methodological choices related to the use of geographic scales. From a statistical point of view, the selection of an inappropriate mean as a measure of central tendency produces biased estimates of population density, on which overpopulation assertions are based. Assertions of overpopulation are based on other criteria but statistical rigor.

The multiple stories of Caribbean islands' overpopulation end up providing credibility to numerical formulations and not the other way around. It would be illusory to hold expectations that methodological, statistical, or mathematical critiques may easily discredit such stories of overpopulation. No statistician should feel demoralized. This situation should motivate an even more forceful denunciation of the statistical artifices used by the storytellers of overpopulation, whether they are scientists and intellectuals, government officials, journalists, or the general media.

TABLES

Table 1: Comparison of Crude Population Densities and Weighted Population French Caribbean (persons/km^2)

Region and Departments	Population	Area	Crude population density	Departmentally weighted population density (geometric mean)
France	64,473,140	674,843	96	
St Martin & St Barthélemy				479
St Martin & St Barthélemy	35,930	75	479	
Guadeloupe				259
Guadeloupe	372,458	1,436	259	
Martinique				338
Martinique	381,427	1,128	338	
Ile de France	10,842,037	12011	903	4,384
Paris	2,168,000	105	20,648	
Hauts-de-Siene	1,532,000	176	8,705	
Siene-Saint-Denis	1,485,000	236	6,292	
Val-de-Marne	1,293,000	245	5,278	
Val-d’Oise	1,153,500	1246	926	
Essonne	1,193,500	1804	662	
Yvelines	1,398,500	2284	612	
Siene-et-Marne	1,267,500	5915	214	

Notes:

Data from Wikipedia (Entries: France, Saint Martin and Saint Barthélemy, Guadeloupe, Martinique, and Ile de France: Retrieved December 2008)

Table 2: Calculation of Overpopulation in Barbados

Growth rate	Doubling time	Population in 2143	Population in 2150	Population in 2468
1.3 %	53 years		2,746,673 (one person for every 188 $yards^2$)	171,466,958 (one person for every 3 $yards^2$)
3.47 %	20 years	128,867,927 (one person for every 4 $yards^2$)	169,591,157 (one person for every 3 $yards^2$)	

Background information:

1) Area of Barbados = 431 km^2 (166 square miles)

2) "Three square yards per person" means and island population of 171,823,903.

3) Baseline population (1960) = 232,327

4) Formula used:

$$r * t = \ln\left({(population\ time\ t)}\middle/{(population\ time\ 0)} \right)$$

- r = annual growth rate
- t = time interval in years
- ln = natural logarithm
- population time 0 = baseline population
- population time t = population after t years

Table 3: Population densities and ranking of Human Poverty Index (Low ranking equals less human poverty)

	Country	Population Density (inhabitants/km2) [1]	Ranking of Human Poverty Index [2]
1	Barbados	627	31
2	Haiti	307	146
3	St. Vincent &Grenadines	307	93
4	St. Lucia	298	72
5	Grenada	260	82
6	Trinidad & Tobago	254	59
7	Jamaica	241	101
8	Dominican Republic	192	79
9	Antigua & Barbuda	184	57
10	St. Kitts & Nevis	164	54
11	Dominica	105	71
12	Cuba	102	51

Source:

1. Calculations made by the author with data from CIA World Fact Book. Available at: https://www.cia.gov/library/publications/the-world-factbook/ . Retrieved, December 20, 2008.

2. Human Poverty Index: Data comes from 2007/2008 Human Development Report. Available at: http://hdrstats.undp.org/indicators/18.html. Retrieved, December 20, 2008.

Kendall Tau Rank Correlation Statistic

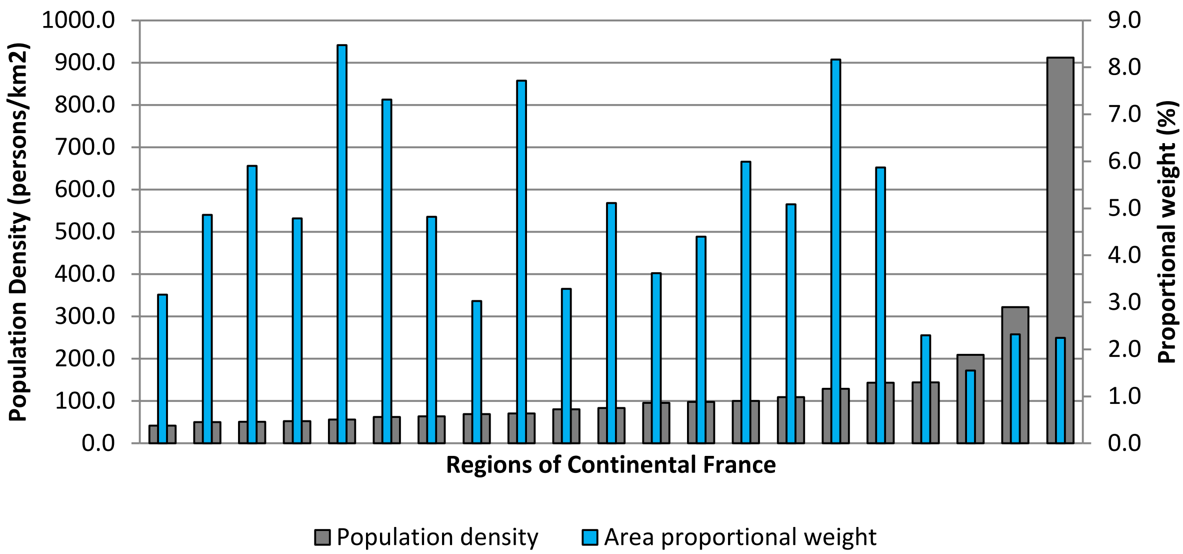
Kendall Tau = 0.35

The Kendall Tau rank correlation statistic was calculated using the open source software Free Statistics and Forecasting Software, available at:

http://www.wessa.net/rwasp_kendall.wasp . Retrieved on December 20, 2008.

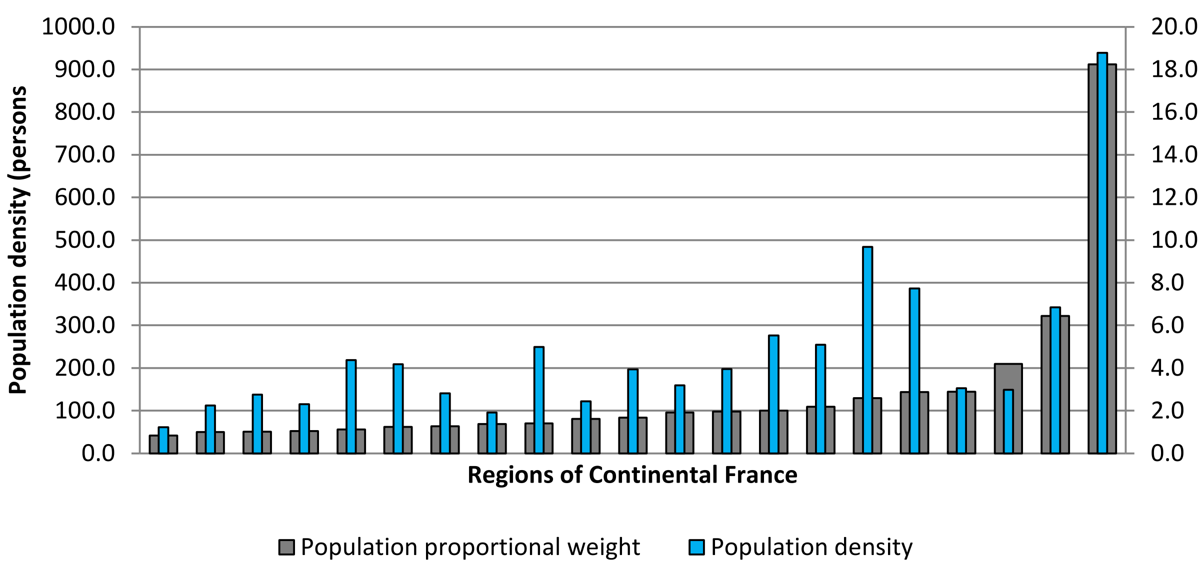
FIGURES

Figure 1A: Population density and area proportional weight by Regions of Continental France



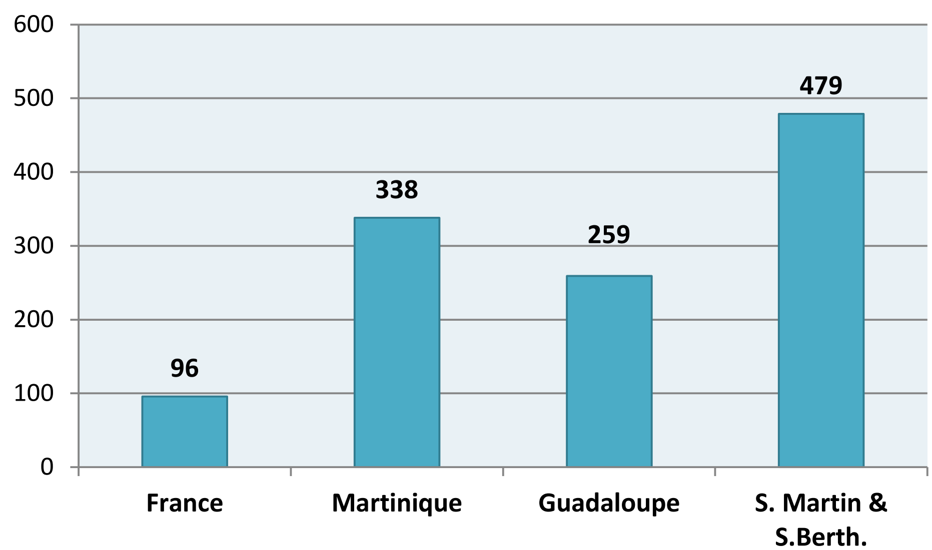
Source: Wikipedia "Regions of France". Accessed: August 15, 2009.

Figure 1B: Population density and population proportional weight by Regions of Continental France



Source: Wikipedia "Regions of France". Accessed: August 15, 2009.

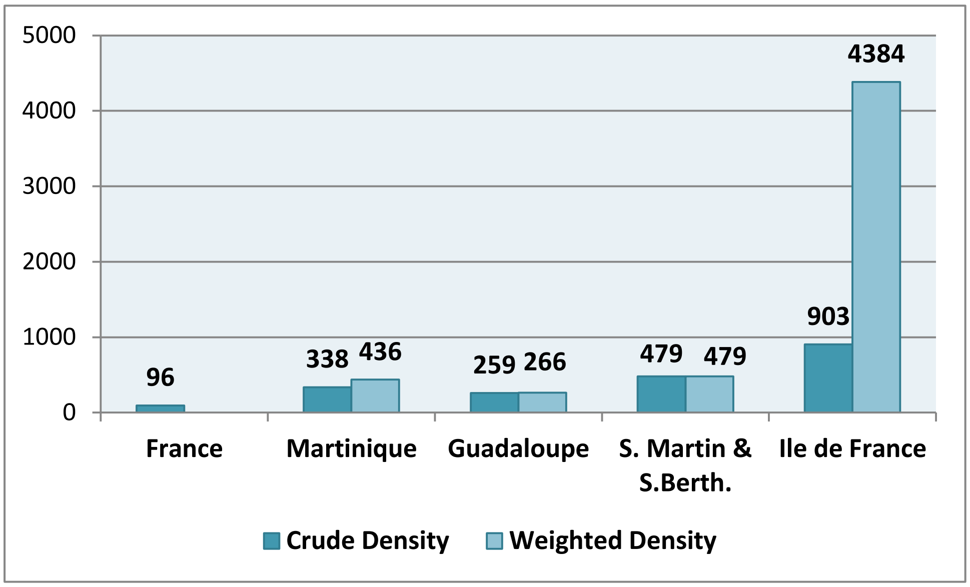
Figure 2: Crude Density (persons/km^2) France and French Caribbean Overseas Departments



Source

Wikipedia: "Regions of France". Accessed: August 15, 2009.

Figure 3: Crude and Weighted Density (persons/km^2) France, French Caribbean Overseas Departments, and the Paris Region

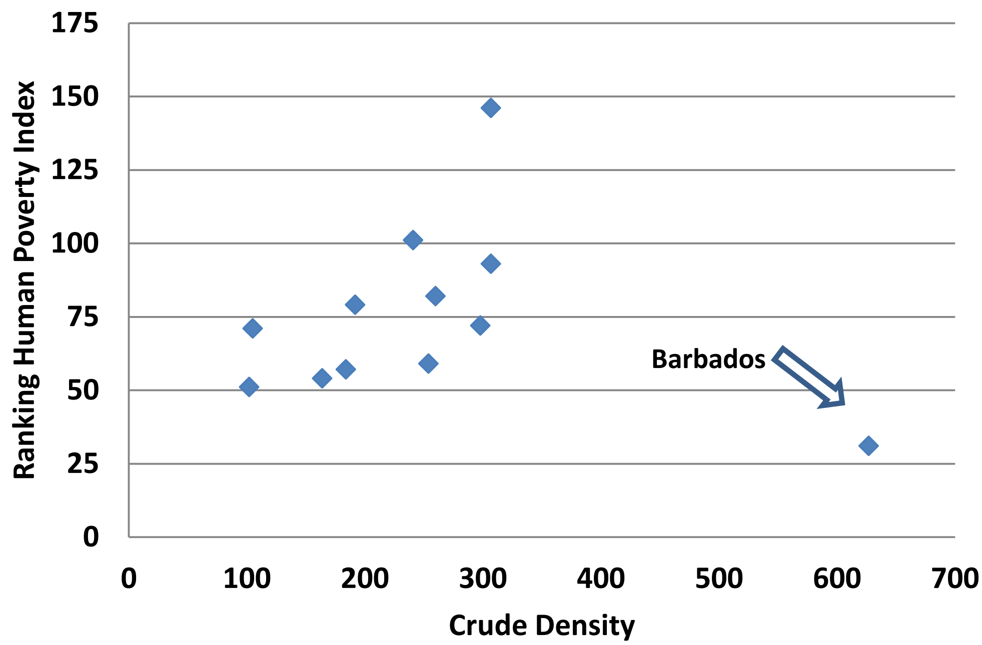


Source

Wikipedia: “Regions of France”. Accessed: August 15, 2009.

Figure 4: Relation of Ranking of Human Poverty Index with Crude Density (persons/km2)

Caribbean Nation States



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