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"Post-Census 2000 Population Estimates for the Municipios of Puerto Rico: The Traditional Demographic Formula in the Context of a Regression Estimation Technique."

ABSTRACT

In this presentation, I describe a new method being investigated by the U.S. Census Bureau for producing the official estimates of total population for the municipios of Puerto Rico and present preliminary results from its application to data for the 1990s. This method consists of a demographic-component estimation technique couched in a regression framework. As such, the components of population change (births, deaths, and migration) are treated as parameters to be estimated, with particular emphasis on estimating the level of migration. The resulting component estimates are then combined into a set of total population estimates for the 1990s and confidence intervals are calculated for these estimates. Finally, these test estimates are evaluated in light of the results from Census 2000.

BACKGROUND

During the 1990s, the Puerto Rico municipio total population estimates were produced using a ratio-correlation method. An evaluation of these estimates in light of Census 2000 showed that this method performed modestly well.[1] However, further investigation revealed year-to-year fluctuations in the estimates produced with this method that were likely to be unrealistic. Therefore, research was begun in search of a new method for the Puerto Rico municipio total population estimates for the post Census 2000 period.

This paper describes the method currently being recommended for use in the production of the Puerto Rico municipio total population estimates. It also presents some results of the application of this method to data from the 1990s and evaluates them in the light of Census 2000. Finally, it discusses some of the limitations of this method for the production of population estimates.

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[1]Christenson, Matthew. (forthcoming). "An Evaluation of the Population Estimates for the Commonwealth and Municipios of Puerto Rico during the 1990s." (*Population Division Working Paper*) U.S. Census Bureau: Washington, D.C.

THE METHOD

The method currently being recommended for use in the production of the Puerto Rico municipio total population estimates is a demographic-component estimation technique couched in a regression framework. It can be summarized as follows:

1) The method starts with the component method of population estimation in which the post-censal population change for the municipios is modeled as an additive function of births, deaths (-), and net migration.
2) Estimates of the annual rate of net migration between the two previous censuses are computed.
3) Multiple regression analysis is used to estimate the relationship of theoretically appropriate covariates with these estimates of the annual rate of net migration.
4) The prediction algorithm that results from the regression analysis is used with actualized data on the covariates in order to produce new estimates of net migration for the post-censal period. In addition, estimates of net-migration based on the upper and lower bounds of the 95% confidence intervals of the algorithm are also produced.
5) These estimates of net migration and estimates of births and deaths from vital registration are used in the component technique to produce the final estimates of population for the municipios of Puerto Rico.

A more detailed description of each of these steps follows.

STEP 1: THE BASIC COMPONENT METHOD OF POPULATION ESTIMATION:

The component method of population estimation follows the population according to its exposure to mortality, fertility, and migration as in the following formula:

(1) $$POP_Y = POP_{Base} + BIR_P - DTH_P + NM_P$$

where

POP_Y = The estimated population
POP_{Base} = The base population
BIR_P = Births during the estimation period
DTH_P = Deaths during the estimation period
NM_P = Net migration during the estimation period

Starting with a base population, fertility is estimated to arrive at the number of births every year. These are then added to the population. Similarly, the population is exposed to the

chance of dying as determined by estimated mortality. Once deaths are estimated, they are subtracted from the population. Finally, the component method takes into account net migration, or the difference between the number of in-migrants who are incorporated into the population and the number of out-migrants who leave the population. The whole procedure is repeated for each year of the estimation period, resulting in the estimated population.

For this analysis, the following data were used to in the estimation of the population for April 1, 2000.

The Base Population: After the last two censuses, the Secretary of Commerce made the decision that the unadjusted censuses were to be used for all official non-redistricting purposes. This included the production of the official estimates for Puerto Rico. Therefore, the unadjusted data as released by the Census Bureau for the 1990 Census for Puerto Rico was used as the base population for intercensal estimates for the 1990s.

Fertility: Births for calendar years 1990-2000 were taken from vital registration as received from the Puerto Rico Planning Board. These data are assumed to be accurate and complete. They were converted to estimate-year births (July 1 – June 30) by summing ½ of the births for year Y and ½ the births for year Y+1. Similarly, births for the period April 1 – June 30 1990 were estimated by taking ¼ of the births for calendar year 1990, whereas births for the period June 30, 1999 – April 1, 2000 were calculated by taking ½ of the births for calendar year 1999 and ¼ of the births for calendar year 2000. By definition, these births sum to the total number of births in the Commonwealth for each estimate year.

Mortality: Deaths for calendar years 1990-2000 were taken from vital registration as received from the Puerto Rico Planning Board. These data were assumed to be accurate and complete. They were converted to estimate year deaths (July 1 – June 30) by summing ½ of the deaths for year Y and ½ the deaths for year Y+1. Similarly, deaths for the period April 1 – June 30, 1990 were estimated by taking ¼ of the deaths for calendar year 1990, whereas deaths for the period June 30, 1999 – April 1, 2000 were calculated by taking ½ of the deaths for calendar year 1999 and ¼ of the deaths for calendar year 2000. By definition, these deaths sum to the total number of deaths in the Commonwealth for each estimate year.

STEP 2: THE ESTIMATION OF INTERCENSAL NET MIGRATION RATES

The dependent variable to be estimated in the regression analysis was the annual net migration rate for the 1980 to 1990 period. It was calculated using a survival-residual technique as follows.

1) The total population in each municipio from the 1980 census is survived to the year 1990 under the assumption of no net migration:

(3) $$POP_{E1990} = POP_{C1980} + BIR_{1980-1990} - DTH_{1980-1990}$$

where

POP_{E1990} = Estimated population on 4/1/1990
POP_{C1980} = Census population on 4/1/1980
$BIR_{1980-1990}$ = Births between 4/1/1980 and 3/31/1990
$DTH_{1980-1990}$ = Deaths between 4/1/1980 and 3/31/1990

2) Next, the net migration for the 1980-1990 period is calculated by subtracting the enumerated population for each municipio from the 1990 census from the estimated 4/1/1990 population for each municipio.

(4) $$NM_{1980-1990} = POP_{E1990} - POP_{C1990}$$

where

$NM_{1980-1990}$ = Net migration between 4/1/1980 and 3/31/1990
POP_{E1990} = Estimated population on 4/1/1990
POP_{C1990} = Census population on 4/1/1990

3) Finally, the annual net migration rate for the 1980-1990 period is calculated by dividing the net migration by the number of years in the period (10) and then dividing this by an estimate of the population at the midpoint of the period[2].

(5) $$NMR_{1980-1990} = (NM_{1980-1990} / 10) / POP_{C1980}$$

where

$NMR_{1980-1990}$ = Net migration rate for the period 4/1/1980 to 3/31/1990
$NM_{1980-1990}$ = Net migration between 4/1/1980 and 3/31/1990
POP_{C1980} = Census population on 4/1/1980

[2] Ideally, the net migration rate would be calculated using the population at the midpoint between 4/1/1990 and 4/1/2000. However, since we are assuming no knowledge of migration during the intercensal period, this is not possible. Hence, the 1990 census population is used as a proxy.

STEP 3: MULTIVARIATE ANALYSIS OF THE INTERCENSAL NET MIGRATION RATES

in regression methods of estimation, hypotheses are made about factors that may explain differences in the parameter of interest across time and/or space (i.e., geographic units). Data are then collected that provide an indication of differences in the parameter of interest and in each of the factors hypothesized to explain these differences. These data are then processed using a multivariate technique to determine which of the indicators or combination of indicators best predicts the differences in the parameter of interest.

One result of the multivariate analysis is a prediction algorithm by which future values of the value of interest may be estimated. The prediction algorithm takes the following form:

(2) $$Y = a + \beta_1 X_1 + \beta_2 X_2 \ldots + \beta_n X_n + e$$

where

Y	= Value of the parameter to be estimated
a	= Constant
$\beta_{1\ldots n}$	= Coefficients (weighting factors)
$X_{1\ldots n}$	= Values of the explanatory variable

The prediction algorithm is typically applied in a context where data on the parameter of interest are not available but data on the associated indicators are available. The result is a set of estimates of the parameter of interest.

For this exploratory multivariate analysis, data on potential covariates of the annual intercensal net-migration rate were available primarily from the 1980 census and the vital registration system in Puerto Rico. Where necessary, these indicators were transformed into rates so as to parallel the form of the dependent variable. Then, the prediction algorithm was derived in the following manner:

a. The estimate of the annual net migration rate for the 1980 to 1990 period was regressed on multiple indicators representing each hypothesis using Ordinary Least Squares regression. Thousands of different specifications of the model, including interaction terms between different indicators, were tested using a Data Mining technique. The models in which all parameters were significant at the .05 level are chosen for further consideration.

b. In order to avoid overspecification of the model due to the use of the Data Mining technique, the best models from the 1980 analysis as determined by the Adjusted R-squared statistic were tested by regressing the estimate of the annual net migration rate

for the 1990 to 2000 period on updated variables. The first model in which all parameters were significant at the .05 level was chosen.

STEP 4: ESTIMATION OF THE FINAL NET MIGRATION RATE.

The final estimates of net migration for the municipios of Puerto Rico for each year were calculated by taking updated data for the indicators in the final model from the 1990 Census and/or as received from the Puerto Rico Planning Board and using them in the final prediction algorithm from the analysis of the multivariate analysis of the data from the 1980s. This resulted in estimates of the annual net migration rate for each municipio in each calendar year.

STEP 5: THE ESTIMATES OF TOTAL POPULATION FOR THE MUNICIPIOS OF PUERTO RICO

The final estimates of total population for the municipios of Puerto Rico for each estimate year was calculated by combining the components described above with the standard demographic formula. The estimates were produced cumulatively, with the estimated population of the previous year serving as the population base for the estimation of each subsequent year as shown in equation 6.

(6) $$POP_Y = POP_{Y-1} + BIR_{P(Y-1,Y)} - DTH_{P(Y-1,Y)} + NM_{P(Y-1,Y)}$$

where

POP_Y = The estimated population as of 7/1 of year Y
POP_{Y-1} = The estimated population as of 7/1 of the previous year
$BIR_{P(Y-1,Y)}$ = Births between 7/1/ of the previous year and 6/30 of Year Y
$DTH_{P(Y-1,Y)}$ = Deaths between 7/1/ of the previous year and 6/30 of Year Y
$NM_{P(Y-1,Y)}$ = The net migration between 7/1/ of the previous year and 6/30 of Year Y

Note that the estimate of net migration for each year is dependent upon the cumulative estimate series. Hence, it was calculated using the net migration rate and the population of the previous year. In addition, it was controlled to the net international migration produced for the official Puerto Rico Commonwealth Estimates[3]:

$$NM_{P(Y-1,Y)} = NIM_{Commonwealth} * (NMR_{P(Y-1,Y)} * POP_{Y-1}) / \Sigma (NMR_{P(Y-1,Y)} * POP_{Y-1})$$

[3] It is possible to control to just net international migration from the Commonwealth estimates because, by definition, net internal migration at the Commonwealth level is zero.

where

$NM_{P(Y-1,Y)}$ = The net migration between 7/1/ of the previous year and 6/30 of Year Y

$NIM_{Commonwealth}$ = Net international migration produced for the official Puerto Rico Commonwealth Estimates.

$NMR_{P(Y-1,Y)}$ = The net migration rate associated with the period from 7/1 of the previous year and 6/30 of Year Y.

POP_{Y-1} = The estimated population as of 7/1 of the previous year

Finally, note that it was not necessary to control the municipio estimates to the Commonwealth total from the official Puerto Rico Commonwealth Estimates since each component was controlled independently.

RESULTS

For the purposes of this presentation, two sets of results will be discussed: the final prediction algorithm used to create the estimates of the intercensal net-migration rate for the 1980-1990 period, and the final population estimates for April 1, 2000 and their accuracy.

1) The final prediction algorithm from the multiple regression analysis of the intercensal net-migration rate for the 1980-1990 period explained approximately 39 percent of the variance (Adjusted R^2 statistic) and consisted of the following indicators, associated coefficients and standard errors:

Indicator	Coefficient	Standard Error
Constant	-2.80	3.47
1. Median Age of Population in 1980	0.16*	0.06
2. Housing stock built 1970-1980	-0.10	0.06
3. Median Housing Value 1980[4]	-0.02*	0.01
4. Percent Home Ownership 1980	-0.06	0.03
5. Rate of natural increase 1980-1989	7.35*	3.42
6. Interaction term: 2 X 4	0.002*	0.001

*Significant at the .05 level. Note that base variables of an interaction term (variables 2 and 4) need not be significant if the interaction term itself is significant.

[4] Coefficient and Standard Error multiplied by 1000 for presentation purposes.

These effects support the following hypotheses:

Variable 1: The higher the median age of the population of a municipio, the higher the annual net migration rate of that municipio.

Variable 2: See variable 6 (interaction term).

Variable 3: The higher the median housing value in a municipio, the lower annual net migration rate of that municipio.

Variable 4: See variable 6 (interaction term).

Variable 5: The higher the rate of natural increase in a municipio, the higher the annual net migration rate of that municipio

Variable 6 (Interaction of variables 3 and 5): Large increases in housing stock in the previous decade in areas with low rates of housing ownership leads to higher annual net migration rates.

2) The estimates of total population for the municipios of Puerto Rico with comparisons to Census 2000.

The final estimates can be found in Appendix A. The mean algebraic error of the percent differences between the estimates and Census 2000 (MALPE) is -3.5 percent, indicating a tendency in the estimates to understate the size of the municipio. The mean absolute error of the percent differences between the estimates and Census 2000 (MAPE) is 6.2 percent. This compares modestly well to the accuracy of both the official estimates for Puerto Rico during the 1990s[5] as well as the official estimates for the counties of the United States during the 1990s[6]. However, the estimates based on the upper and lower confidence intervals (Appendix B) show that these estimates are subject to large amounts of error. Nonetheless, the simple fact that we are able to begin to quantify this error is a large step forward.

[5] Christenson, Matthew. (forthcoming). "An Evaluation of the Population Estimates for the Commonwealth and Municipios of Puerto Rico during the 1990s." (*Population Division Working Paper*) U.S. Census Bureau: Washington, D.C.

[6] Blumerman, Lisa, and Carrie Simon. (forthcoming). "Population Estimates of the 1990s: Close to the Mark?" (*Population Division Working Paper*) U.S. Census Bureau: Washington, D.C.

LIMITATIONS

The major limitation the Puerto Rico municipio estimates is the absence of reliable information about net migration. The assumption that the migration in the intercensal period between 1990 and 2000 followed the same pattern as that during the 1980s may be untenable. At this point, however, no other technique has been found that can shed more light on the internal or international migration for Puerto Rico.

In addition, net migration as conceptualized in our method may not be suitable for prediction since it is actually made up of at least two components that may be explained by different factors (in-migration and out-migration). In addition, migration within Puerto Rico may be explained by different factors than migration between Puerto Rico and the rest of the world.

A further limitation to this method is that net migration between 1990 and 2000 as calculated with the residual technique also includes any differential coverage in the two censuses. To the degree that there are large differences in the coverage of the 1990 Census and Census 2000 in Puerto Rico, the estimated net migration rates will be inaccurate.

A final potential limitation these estimates is the quality of the birth and death data. For the purposes of these estimates, it is assumed that these as received from the Department of Health in Puerto Rico are complete and accurate. However, there is no direct measure of the completeness of coverage of these measures.

Appendix A: Population Estimates of the Municipios of Puerto Rico for April 1, 2000 Compared with Values from Census 2000.

Municipio	Census 2000	Estimate 2000	Difference (estimate minus census) Number	Percent
Adjuntas	19,143	19,797	654	3.4
Aguada	42,042	39,094	-2,948	-7.0
Aguadilla	64,685	61,305	-3,380	-5.2
Aguas Buenas	29,032	27,324	-1,708	-5.9
Aibonito	26,493	27,007	514	1.9
Añasco	28,348	26,439	-1,909	-6.7
Arecibo	100,131	97,262	-2,869	-2.9
Arroyo	19,117	19,232	115	0.6
Barceloneta	22,322	22,027	-295	-1.3
Barranquitas	28,909	28,833	-76	-0.3
Bayamón	224,044	241,904	17,860	8.0
Cabo Rojo	46,911	41,783	-5,128	-10.9
Caguas	140,502	145,508	5,006	3.6
Camuy	35,244	31,423	-3,821	-10.8
Canóvanas	43,335	41,991	-1,344	-3.1
Carolina	186,076	191,876	5,800	3.1
Cataño	30,071	38,255	8,184	27.2
Cayey	47,370	48,838	1,468	3.1
Ceiba	18,004	18,983	979	5.4
Ciales	19,811	19,773	-38	-0.2
Cidra	42,753	39,116	-3,637	-8.5
Coámo	37,597	36,109	-1,488	-4.0
Comerio	20,002	20,792	790	3.9
Corozal	36,867	35,535	-1,332	-3.6
Culebra	1,868	1,924	56	3.0
Dorado	34,017	32,771	-1,246	-3.7
Fajardo	40,712	39,074	-1,638	-4.0
Florida	12,367	9,626	-2,741	-22.2
Guanica	21,888	19,362	-2,526	-11.5
Guayama	44,301	42,876	-1,425	-3.2
Guayanilla	23,072	21,321	-1,751	-7.6
Guaynabo	100,053	110,294	10,241	10.2
Gurabo	36,743	32,622	-4,121	-11.2
Hatillo	38,925	34,652	-4,273	-11.0

Municipio	Census 2000	Estimate 2000	Difference (estimate minus census) Number	Percent
Hormigueros	16,614	16,182	-432	-2.6
Humacao	59,035	58,184	-851	-1.4
Isabela	44,444	40,484	-3,960	-8.9
Jayuya	17,318	16,419	-899	-5.2
Juana Díaz	50,531	46,746	-3,785	-7.5
Juncos	36,452	33,027	-3,425	-9.4
Lajas	26,261	24,387	-1,874	-7.1
Lares	34,415	31,071	-3,344	-9.7
Las Marias	11,061	9,799	-1,262	-11.4
Las Piedras	34,485	30,762	-3,723	-10.8
Loiza	32,537	32,316	-221	-0.7
Luquillo	19,817	19,225	-592	-3.0
Manatí	45,409	42,685	-2,724	-6.0
Maricao	6,449	6,489	40	0.6
Maunabo	12,741	12,436	-305	-2.4
Mayaguez	98,434	103,601	5,167	5.2
Moca	39,697	35,362	-4,335	-10.9
Morovis	29,965	28,537	-1,428	-4.8
Naguabo	23,753	22,940	-813	-3.4
Naranjito	29,709	31,013	1,304	4.4
Orocovis	23,844	22,990	-854	-3.6
Patillas	20,152	20,073	-79	-0.4
Peñuelas	26,719	24,095	-2,624	-9.8
Ponce	186,475	195,035	8,560	4.6
Quebradillas	25,450	22,852	-2,598	-10.2
Rincón	14,767	13,126	-1,641	-11.1
Rio Grande	52,362	51,096	-1,266	-2.4
Sabana Grande	25,935	24,158	-1,777	-6.9
Salinas	31,113	30,204	-909	-2.9
San German	37,105	36,042	-1,063	-2.9
San Juan	434,374	500,564	66,190	15.2
San Lorenzo	40,997	36,859	-4,138	-10.1
San Sebastian	44,204	40,818	-3,386	-7.7
Santa Isabel	21,665	20,022	-1,643	-7.6
Toa Alta	63,929	52,904	-11,025	-17.2
Toa Baja	94,085	95,668	1,583	1.7
Trujillo Alto	75,728	67,332	-8,396	-11.1

Municipio	Census 2000	Estimate 2000	Difference (estimate minus census) Number	Percent
Utuado	35,336	35,183	-153	-0.4
Vega Alta	37,910	37,720	-190	-0.5
Vega Baja	61,929	60,184	-1,745	-2.8
Vieques	9,106	9,070	-36	-0.4
Villalba	27,913	25,927	-1,986	-7.1
Yabucoa	39,246	37,205	-2,041	-5.2
Yauco	46,384	43,090	-3,294	-7.1
Puerto Rico	3,808,610	3,808,610	0	
Mean Algebraic Percent Error (MALPE)				-3.5
Mean Absolute Percent Error (MAPE)				6.2

Appendix B: Population Estimates for the Municipios of Puerto Rico on April 1, 2000 Based on the Upper and Lower Bounds of the Confidence Intervals of the Net Migration Estimate and Compared with Values from Census 2000.

Municipio	Census 2000	Upper Bound	Difference (estimate – census) Number	Percent	Lower Bound	Difference (estimate – census) Number	Percent
Adjuntas	19,143	19,291	148	0.8	20,145	1,002	5.2
Aguada	42,042	47,245	5,203	12.4	29,138	-12,904	-30.7
Aguadilla	64,685	58,109	-6,576	-10.2	64,834	149	0.2
Aguas Buenas	29,032	30,286	1,254	4.3	23,156	-5,876	-20.2
Aibonito	26,493	29,319	2,826	10.7	23,584	-2,909	-11.0
Añasco	28,348	29,504	1,156	4.1	22,174	-6,174	-21.8
Arecibo	100,131	98,197	-1,934	-1.9	94,180	-5,951	-5.9
Arroyo	19,117	19,705	588	3.1	18,240	-877	-4.6
Barceloneta	22,322	22,655	333	1.5	20,784	-1,538	-6.9
Barranquitas	28,909	30,801	1,892	6.5	25,799	-3,110	-10.8
Bayamón	224,044	231,327	7,283	3.3	252,719	28,675	12.8
Cabo Rojo	46,911	45,833	-1,078	-2.3	35,910	-11,001	-23.5
Caguas	140,502	144,014	3,512	2.5	144,920	4,418	3.1
Camuy	35,244	34,919	-325	-0.9	26,530	-8,714	-24.7
Canóvanas	43,335	45,756	2,421	5.6	36,510	-6,825	-15.7
Carolina	186,076	172,507	-13,569	-7.3	218,063	31,987	17.2
Cataño	30,071	39,881	9,810	32.6	35,405	5,334	17.7
Cayey	47,370	48,812	1,442	3.0	47,974	604	1.3
Ceiba	18,004	17,915	-89	-0.5	20,192	2,188	12.2
Ciales	19,811	22,327	2,516	12.7	16,311	-3,500	-17.7
Cidra	42,753	45,932	3,179	7.4	30,450	-12,303	-28.8
Coámo	37,597	38,947	1,350	3.6	31,828	-5,769	-15.3
Comerio	20,002	20,967	965	4.8	20,174	172	0.9
Corozal	36,867	38,060	1,193	3.2	31,654	-5,213	-14.1
Culebra	1,868	2,334	466	24.9	1,422	-446	-23.9
Dorado	34,017	34,437	420	1.2	29,991	-4,026	-11.8
Fajardo	40,712	36,183	-4,529	-11.1	42,656	1,944	4.8
Florida	12,367	10,511	-1,856	-15.0	8,340	-4,027	-32.6
Guanica	21,888	19,091	-2,797	-12.8	19,380	-2,508	-11.5
Guayama	44,301	41,792	-2,509	-5.7	43,623	-678	-1.5
Guayanilla	23,072	21,583	-1,489	-6.5	20,569	-2,503	-10.8
Guaynabo	100,053	116,510	16,457	16.4	100,192	139	0.1
Gurabo	36,743	37,974	1,231	3.4	25,740	-11,003	-29.9

Municipio	Census 2000	Upper Bound	Difference (estimate – census) Number	Percent	Lower Bound	Difference (estimate – census) Number	Percent
Hatillo	38,925	39,209	284	0.7	28,471	-10,454	-26.9
Hormigueros	16,614	16,358	-256	-1.5	15,641	-973	-5.9
Humacao	59,035	59,300	265	0.4	55,605	-3,430	-5.8
Isabela	44,444	43,461	-983	-2.2	35,902	-8,542	-19.2
Jayuya	17,318	17,305	-13	-0.1	14,971	-2,347	-13.6
Juana Díaz	50,531	49,513	-1,018	-2.0	42,309	-8,222	-16.3
Juncos	36,452	35,581	-871	-2.4	29,157	-7,295	-20.0
Lajas	26,261	26,448	187	0.7	21,313	-4,948	-18.8
Lares	34,415	34,427	12	0.0	26,335	-8,080	-23.5
Las Marias	11,061	10,595	-466	-4.2	8,608	-2,453	-22.2
Las Piedras	34,485	33,788	-697	-2.0	26,424	-8,061	-23.4
Loiza	32,537	40,352	7,815	24.0	22,904	-9,633	-29.6
Luquillo	19,817	18,508	-1,309	-6.6	19,895	78	0.4
Manatí	45,409	42,712	-2,697	-5.9	41,872	-3,537	-7.8
Maricao	6,449	6,707	258	4.0	6,084	-365	-5.7
Maunabo	12,741	13,070	329	2.6	11,373	-1,368	-10.7
Mayaguez	98,434	91,608	-6,826	-6.9	120,440	22,006	22.4
Moca	39,697	41,443	1,746	4.4	27,627	-12,070	-30.4
Morovis	29,965	32,570	2,605	8.7	23,218	-6,747	-22.5
Naguabo	23,753	22,704	-1,049	-4.4	22,842	-911	-3.8
Naranjito	29,709	35,647	5,938	20.0	24,929	-4,780	-16.1
Orocovis	23,844	25,410	1,566	6.6	19,578	-4,266	-17.9
Patillas	20,152	21,453	1,301	6.5	17,923	-2,229	-11.1
Peñuelas	26,719	27,695	976	3.7	19,380	-7,339	-27.5
Ponce	186,475	178,671	-7,804	-4.2	216,094	29,619	15.9
Quebradillas	25,450	24,603	-847	-3.3	20,201	-5,249	-20.6
Rincón	14,767	14,273	-494	-3.3	11,435	-3,332	-22.6
Rio Grande	52,362	57,848	5,486	10.5	41,986	-10,376	-19.8
Sabana Grande	25,935	25,933	-2	0.0	21,433	-4,502	-17.4
Salinas	31,113	32,682	1,569	5.0	26,505	-4,608	-14.8
San German	37,105	37,422	317	0.9	33,534	-3,571	-9.6
San Juan	434,374	400,493	-33,881	-7.8	663,530	229,156	52.8
San Lorenzo	40,997	40,711	-286	-0.7	31,378	-9,619	-23.5
San Sebastian	44,204	45,360	1,156	2.6	34,423	-9,781	-22.1
Santa Isabel	21,665	19,083	-2,582	-11.9	21,014	-651	-3.0
Toa Alta	63,929	64,206	277	0.4	39,355	-24,574	-38.4

Municipio	Census 2000	Upper Bound	Difference (estimate – census) Number	Percent	Lower Bound	Difference (estimate – census) Number	Percent
Toa Baja	94,085	98,844	4,759	5.1	89,684	-4,401	-4.7
Trujillo Alto	75,728	65,870	-9,858	-13.0	68,157	-7,571	-10.0
Utuado	35,336	34,481	-855	-2.4	35,523	187	0.5
Vega Alta	37,910	43,035	5,125	13.5	30,636	-7,274	-19.2
Vega Baja	61,929	61,987	58	0.1	56,678	-5,251	-8.5
Vieques	9,106	9,540	434	4.8	8,287	-819	-9.0
Villalba	27,913	29,718	1,805	6.5	20,958	-6,955	-24.9
Yabucoa	39,246	40,377	1,131	2.9	32,494	-6,752	-17.2
Yauco	46,384	44,885	-1,499	-3.2	39,917	-6,467	-13.9
Puerto Rico	3,808,610	3,808,610	0		3,808,610	0	
Mean Algebraic Percent Error (MALPE)				1.8			-11.3
Mean Absolute Percent Error (MAPE)				6.0			15.6