



**APPENDIX AVAILABLE ON REQUEST**

**Special Report**

**Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality**

**Part II: Sensitivity Analyses**

**Appendix G. Values of the Ecologic Covariates**

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**Re-analysis of the Harvard Six-Cities Study  
and the American Cancer Society Study  
of Air Pollution and Mortality,  
Phase II: Sensitivity Analysis**

**Appendix A, B, C, D, E, F, G, H, and I**

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## APPENDIX G – VALUES OF THE ECOLOGIC COVARIATES

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### INTRODUCTION

In this appendix, the actual values of the ecologic covariates used in the reanalysis are listed for each of the 154 metropolitan areas in the ACS Study. These data were derived from many sources as outlined in Table E.1. Most of the socioeconomic data comes from the US Census Bureau. The climate data were obtained from the US National Oceans and Atmospheric Administration from their database of reporting sites.

Data from these sources was then aggregated to the appropriate geographic area, as defined by the ZIP codes used by ACS in assigning CPS-II respondents to cities. The counties comprising these cities are outlined in Table F.1. For several reasons, it was not possible to obtain a full set of ecologic covariates for all of the cities. The NOAA only archives data for a very specific set of meteorological stations in the United States. Not all of the ACS cities are NOAA reporting stations. Because not all of the ACS cities are defined as metropolitan areas by the Census Bureau, some of the data were not available for these sites. The values for the hardness of water were taken from a previous report. Not all of the ACS cities were included in this other study. Moreover, some of the MAs in New England are defined in terms of towns not counties. Not all of the data available for counties is available at the town level. For example the number of physicians was not available for towns and therefore, these MAs are missing a value for this variable.

The following tables list the values which were used for the ecologic covariates for each of the metropolitan areas defined in Appendix F.

### DESCRIPTIVE STATISTICS AND CORRELATION MATRICES FOR THE ECOLOGIC COVARIATES

As noted in Table G.1 to G.6, it was not possible to obtain data on all of the ecologic covariates of interest for each city in the ACS Study. Although the socioeconomic, race and demographic data were available for almost all cities, data on the physical environment, climate and gaseous copollutants was readily available only for certain cities. The variables with the most missing values are relative humidity and NO<sub>2</sub>, which were available from a reliable national source for only 95 and 74 out of 151 cities respectively in the sulfate cohort.

All confidence intervals were calculated over the range of the data for the respective cohorts (sulfate particles or fine particles). Only 47 cities in the fine particles cohort (comprised of 50 cities) are also in the sulfate cohort. In some cases, the inclusion of the three additional cities in the fine particle cohort had a noticeable effect on the range of certain ecologic covariates. For example, the range in mean 1979 income is actually larger in the smaller fine particles cohort than in the sulfate cohort.

For the sulfate cohort, descriptive statistics are provided for both the raw and filtered data. Four

variables were found to exhibit no spatial autocorrelation in their raw form (mean income, number of doctors per 100,000, poverty index, and ozone), and were therefore not filtered. Of the spatially autocorrelated variables, it was not possible to eliminate their spatial autocorrelation in mean maximum temperature, carbon monoxide and NO<sub>2</sub> through filtering, therefore precluding their use in the filtered analyses. In most cases, filtering the data results in only minor changes to the range of the ecologic covariate and to its correlation with sulfate air pollution. However, for two ecologic covariates, population change and mean relative humidity, filtering has an appreciable impact on the range and correlation with sulfate.

Pearson correlation coefficients between the raw variables are shown in the upper right half of Table G.7 and the correlations between the filtered variables in the lower left. Correlations between the raw and filtered versions of the same variable are shown on the diagonal of this matrix. For the most part, the raw variables are highly correlated with their filtered counterpart, with coefficients of 80% or more. However, raw population change and raw mean relative humidity are weakly correlated with their filtered counterparts (7% and 6% respectively). This is because the two variables in raw form demonstrated a high degree of spatial autocorrelation which is removed by filtering. Filtering also changes the correlation between these two variables and other variables. For example, the correlation between population change and raw sulfate is -40% before filtering and 2% after filtering. Similarly the correlation between mean relative humidity and sulfate is 59% before filtering and -12% after filtering. In general, the magnitude of correlations between filtered variables are lower than those between unfiltered variables, since the spatial filtering process removes the correlation between ecologic variables attributable to spatial coincidence.

Pearson correlation coefficients between ecologic covariates in the fine particles cohort are shown in Table G.8. Since the data in this cohort was too sparse to be filtered only correlations between raw variables are shown. Although the correlations in fine particle cohort are generally similar in magnitude and direction to those in the sulfate cohort some differences are apparent. For example, correlation between the Gini coefficient and the percentage of adults in the MA with a high school education is -27% in the sulfate cohort and -44% in the fine particles cohort. The correlation between education and hospital beds is -12% correlated in the sulfate cohort and -3% correlated in the fine particles cohort. These differences are attributable to the smaller number of data points in the fine particle cohort.

**Table G.1 Demographic and Race Data**

MA Code	Metropolitan Area	State	Total Population (1980)	Percent Population Change ('80-'86)	Percent White	Percent African American
1000	Birmingham	AL	883993	3.1	72.06	27.17
3440	Huntsville	AL	196966	18.6	79.20	19.80
5160	Mobile	AL	443536	6.0	70.34	28.64
4400	Little Rock-North Little Rock	AR	474464	6.6	79.17	19.12
6200	Phoenix	AZ	1509227	25.9	93.84	3.17
8520	Tucson	AZ	602400	13.4	92.67	2.70
360	Anaheim	CA	2166800	12.1	90.10	1.27
2840	Fresno	CA	587600	14.2	89.24	5.00
4480	Los Angeles-Long Beach	CA	8295900	10.9	78.88	12.61
6780	Riverside-San Bernardino	CA	1558215	28.4	90.60	5.06
6920	Sacramento	CA	1099814	17.4	87.38	5.60
7320	San Diego	CA	2201300	18.2	86.31	5.61
7360	San Francisco	CA	1488895	6.7	73.45	8.56
7400	San Jose	CA	1401600	8.2	83.94	3.31
1720	Colorado Springs	CO	380400	22.9	90.41	6.18
2080	Denver	CO	1428836	14.3	91.96	5.30
2670	Fort Collins-Loveland	CO	174600	17.0	97.68	0.39
3060	Greeley	CO	123438	9.4	98.00	0.49
6560	Pueblo	CO	125972	0.9	97.18	1.93
1160	Bridgeport-Milford	CT	383836		75.36	12.65
3280	Hartford	CT	527006		85.13	12.09
5480	New Haven-Meriden	CT	421782		85.92	13.35
8840	Washington	DC	2655167	5.3	63.27	26.78
9160	Wilmington	DE	523221	5.3	84.03	13.99
2680	Fort Lauderdale-Hollywood-Pompano Beach	FL	2643766	10.1	81.96	14.93
3600	Jacksonville	FL	722252	18.1	77.25	21.57
5960	Orlando	FL	699906	28.4	85.98	12.92
8280	Tampa-St. Petersburg-Clearwater	FL	1964296	19.1	90.55	8.75
520	Atlanta	GA	2138143	19.7	74.91	24.58
1800	Columbus	GA	239196	4.8	61.69	34.99
1360	Cedar Rapids	IA	251492	1.0	97.21	1.65
2120	Des Moines	IA	367561	3.8	93.93	3.81
2200	Dubuque	IA	93745	-2.9	99.20	0.33
8920	Waterloo-Cedar Falls	IA	162781	-6.9	93.41	5.38
1080	Boise City	ID	173125	12.0	97.56	0.33
1600	Chicago	IL	7171437	2.9	76.91	19.90
1020	Bloomington	IN	98785	2.9	95.76	2.67
2440	Evansville-Henderson	IN	276252	1.8	93.67	5.63
2960	Gary-Hammond	IN	642733	-4.3	78.69	19.66
3480	Indianapolis	IN	1305911	3.0	85.93	12.79
7800	South Bend-Mishawaka	IN	378947	2.3	91.53	7.26
8320	Terre Haute	IN	137247	-2.2	94.72	4.50
8440	Topeka	KS	154916	3.8	89.92	7.66
9040	Wichita	KS	411870	6.6	88.47	7.78

**Table G.1 Demographic and Race Data**

MA Code	Metropolitan Area	State	Total Population (1980)	Percent Population Change ('80-'86)	Percent White	Percent African American
4280	Lexington-Fayette	KY	317548	4.3	77.31	10.91
760	Baton Rouge	LA	494151	10.4	70.83	27.85
5560	New Orleans	LA	1256668	6.2	64.65	34.51
7680	Shreveport	LA	333158	9.4	65.83	33.15
1120	Boston	MA	2428005		90.53	6.55
5400	New Bedford	MA	108007		90.61	2.54
8000	Springfield	MA	400451		88.59	6.93
9240	Worcester	MA	261069		95.97	2.06
720	Baltimore	MD	1543882	4.3	66.67	25.44
730	Bangor	ME	82561		98.74	0.24
4240	Lewiston-Auburn	ME	78075		99.23	0.36
6400	Portland	ME	94436		99.13	0.27
2162	Detroit-Ann Arbor	MI	4752764	-3.2	78.61	19.35
2640	Flint	MI	450499	-3.5	80.14	17.47
4040	Lansing-East Lansing	MI	419750	1.2	92.23	5.55
6960	Saginaw-Bay City-Midland	MI	421518	-4.3	89.29	8.85
2240	Duluth	MN	266650	-8.7	97.65	0.34
5120	Minneapolis-St Paul	MN	2137133	7.4	94.68	2.31
3760	Kansas City	MO	1433464	5.9	85.98	12.52
7040	St. Louis	MO	2376971	2.6	81.80	17.13
3560	Jackson	MS	362038	8.3	57.33	46.59
880	Billings	MT	108035	11.2	96.75	0.19
3040	Great Falls	MT	80696	-1.6	94.27	1.19
1520	Charlotte-Gastonia-Rock Hill	NC	885552	9.9	77.87	20.00
3120	Greensboro-Winston-Salem-High Point	NC	950763	5.4	79.96	19.01
6640	Raleigh-Durham	NC	560775	16.0	72.84	26.15
1010	Bismarck	ND	79988	7.4	97.36	0.08
2520	Fargo-Moorhead	ND	137574	5.6	98.45	0.16
2985	Grand Forks	ND	66100	5.0	95.62	1.62
4360	Lincoln	NE	192884	6.8	96.03	1.70
5920	Omaha	NE	585122	5.0	90.43	7.51
4760	Manchester	NH	100706	7.0	98.85	1.18
6450	Portsmouth-Dover-Rochester	NH	159749		98.16	0.94
3640	Jersey City	NJ	556972	-0.7	82.31	12.52
5640	Newark	NJ	1879147	0.5	74.99	21.75
875	Paterson	NJ	1292970	0.4	89.27	7.13
8480	Trenton	NJ	307863	4.2	78.86	17.98
200	Albuquerque	NM	420262	12.9	92.74	2.14
4120	Las Vegas	NV	463087	23.0	86.08	9.99
6720	Reno	NV	193623	16.0	93.33	1.92
160	Albany-Schenectady-Troy	NY	835880	0.9	95.29	3.65
1280	Buffalo	NY	1015472	-5.0	88.04	10.20
2335	Elmira	NY	97656	-7.3	95.23	4.05

**Table G.1 Demographic and Race Data**

MA Code	Metropolitan Area	State	Total Population (1980)	Percent Population Change ('80-'86)	Percent White	Percent African American
5380	Nassau-Suffolk	NY	2605813	1.1	91.56	6.22
5600	New York	NY	8274961	2.4	70.30	23.09
6460	Poughkeepsie	NY	245055	4.8	90.85	6.94
6840	Rochester	NY	971230	0.9	90.30	8.02
8160	Syracuse	NY	642971	1.0	93.49	4.82
8680	Utica-Rome	NY	320180	-1.5	96.88	2.39
80	Akron	OH	660328	-2.4	89.79	9.14
1320	Canton	OH	404421	-1.0	92.98	6.03
1640	Cincinnati	OH	1401471	1.2	86.50	2.03
1680	Cleveland	OH	2173734	-2.4	81.43	16.80
1840	Columbus	OH	1243827	4.5	87.58	11.36
2000	Dayton-Springfield	OH	942083	-0.9	86.03	12.59
3200	Hamilton-Middletown	OH	258787	4.9	94.34	4.76
4800	Mansfield	OH	131205	-1.8	92.26	7.10
8080	Steubenville-Weirton	OH	163734	-5.5	95.51	3.89
8400	Toledo	OH	616864	-0.9	88.00	10.62
9320	Youngstown-Warren	OH	531350	-4.0	88.35	10.49
5880	Oklahoma City	OK	860969	14.2	86.11	9.13
6440	Portland	OR	1105750	4.3	92.64	2.91
240	Allentown-Bethlehem	PA	635481	3.4	97.55	1.41
280	Altoona	PA	136621	-3.0	98.77	0.76
2360	Erie	PA	279780	-0.2	94.64	4.34
3240	Harrisburg-Lebanon-Carlisle	PA	556242	3.8	92.55	6.10
3680	Johnstown	PA	264506	-3.9	98.44	1.35
4000	Lancaster	PA	362346	8.6	96.59	1.92
6160	Philadelphia	PA	4716559	2.3	79.16	18.73
6280	Pittsburgh	PA	2423311	-4.4	91.51	7.49
6680	Reading	PA	312509	2.7	96.46	2.46
42069	Scranton (Lackawanna)	PA	227908	-2.2	98.87	0.47
7610	Sharon	PA	128299	-3.7	95.25	4.30
8050	State College	PA	112760	1.6	97.07	1.51
9140	Williamsport	PA	118416	-1.8	98.07	1.44
9280	York	PA	381255	4.3	96.50	2.64
6480	Providence	RI	487781		92.84	4.83
1440	Charleston	SC	430346	12.8	68.36	31.05
1760	Columbia	SC	409955	8.5	69.73	28.68
3160	Greenville-Spartanburg	SC	747100	6.2	82.11	17.06
1560	Chatanooga	TN	426540	-0.2	84.42	14.01
3840	Knoxville	TN	565970	4.5	92.94	6.04
4920	Memphis	TN	913472	5.0	57.95	39.84
5360	Nashville	TN	933847	9.4	83.25	16.24
840	Beaumont-Port Arthur	TX	373210	0.7	75.89	21.77
1880	Corpus Christi	TX	326228	11.4	95.17	3.94
1920	Dallas	TX	2877238	23.4	83.83	14.48
2320	El Paso	TX	479899	17.0	94.82	3.83
2920	Galveston-Texas City	TX	365325	10.4	85.25	13.56

**Table G.1 Demographic and Race Data**

MA Code	Metropolitan Area	State	Total Population (1980)	Percent Population Change ('80-'86)	Percent White	Percent African American
3360	Houston	TX	2734595	18.1	77.89	18.78
4600	Lubbock	TX	211651	6.2	91.34	7.25
7200	San Angelo	TX	84784	15.8	95.00	4.02
7240	San Antonio	TX	1072125	19.1	91.83	6.75
8800	Waco	TX	170755	9.9	83.13	15.95
9080	Wichita Falls	TX	121082	5.0	87.99	8.94
7160	Salt Lake City-Ogden	UT	910222	14.4	96.07	0.98
1950	Danville	VA	283677	0.3	72.80	26.26
5720	Norfolk-Virginia Beach-Newport News	VA	1160347	12.8	69.36	28.11
6760	Richmond-Petersburg	VA	787044	6.3	64.45	29.09
6800	Roanoke	VA	220393	2.0	87.30	11.73
7600	Seattle	WA	1607618	8.9	89.46	3.60
7840	Spokane	WA	341835	4.4	95.63	1.29
8200	Tacoma	WA	632819	11.0	88.81	5.19
2290	Eau Claire	WI	130932	4.4	98.54	0.14
3800	Kenosha	WI	123137	-2.5	96.36	2.54
4720	Madison	WI	462965	4.3	95.87	2.24
5080	Milwaukee	WI	1497955	-1.0	87.86	10.09
6600	Racine	WI	173132	-0.5	90.65	7.99
1480	Charleston	WV	311341	-1.0	94.93	4.44
3400	Huntington-Ashland	WV	388888	-1.6	97.67	1.86



**Table G.2 Health Services and Socio-economic Data**

MA Code	Metropolitan Area	State	Percent Finishing High School	Mean Income (1979) (\$)	Poverty Rate Individuals (%)	Unemploy-ment Rate (%)	Gini Coefficient
1000	Birmingham	AL	61.7	6824	15.3	8.2	0.426
3440	Huntsville	AL	70.1	7068	13.8	7.2	0.406
5160	Mobile	AL	61.4	6066	18.3	10.7	0.423
4400	Little Rock-North Little Rock	AR	68.2	6844	12.8	6.9	0.404
6200	Phoenix	AZ	75.0	7744	10.5	5.6	0.395
8520	Tucson	AZ	74.6	7181	13.0	5.7	0.409
360	Anaheim	CA	80.4	9612	7.3	4.0	0.380
2840	Fresno	CA	63.7	7010	14.5	12.3	0.420
4480	Los Angeles-Long	CA	69.8	8365	13.4	6.7	0.430
6780	Riverside-San Bernardino	CA	70.1	7316	11.2	6.4	0.403
6920	Sacramento	CA	77.7	7958	11.2	6.2	0.401
7320	San Diego	CA	78.0	7992	11.3	5.0	0.410
7360	San Francisco	CA	79.2	10360	9.7	4.6	0.421
7400	San Jose	CA	79.5	9576	7.1	5.8	0.369
1720	Colorado Springs	CO	82.7	7061	10.3	7.3	0.391
2080	Denver	CO	80.5	8891	8.2	7.2	0.388
2670	Fort Collins-Loveland	CO	82.7	7489	11.0	6.6	0.389
3060	Greeley	CO	68.8	6542	14.1	8.4	0.400
6560	Pueblo	CO	66.5	6744	13.7	12.1	0.411
1160	Bridgeport-Milford	CT	62.3	7055	10.1	3.7	0.395
3280	Hartford	CT	70.6	8417	9.2	4.2	0.396
5480	New Haven-Meriden	CT	68.7	7055	10.3	6.1	0.395
8840	Washington	DC	79.2	10131	9.2	3.8	0.383
9160	Wilmington	DE	69.6	7785	10.9	5.0	0.392
2680	Fort Lauderdale-Hollywood-Pompano Beach	FL	66.6	8100	12.7	5.8	0.435
3600	Jacksonville	FL	67.0	6828	15.1	5.4	0.415
5960	Orlando	FL	71.3	7126	15.0	4.7	0.425
8280	Tampa-St. Petersburg-Clearwater	FL	66.5	7230	11.4	5.0	0.414
520	Atlanta	GA	66.7	7746	12.5	4.6	0.408
1800	Columbus	GA	58.3	5734	18.8	7.6	0.430
1360	Cedar Rapids	IA	80.0	7977	9.4	4.8	0.382
2120	Des Moines	IA	78.5	8175	8.1	5.7	0.380
2200	Dubuque	IA	68.6	7155	8.3	7.7	0.384
8920	Waterloo-Cedar Falls	IA	73.5	7684	9.0	12.2	0.377
1080	Boise City	ID	81.7	7805	8.5	5.8	0.389
1600	Chicago	IL	67.6	8614	11.2	7.2	0.401
1020	Bloomington	IN	74.7	6322	15.0	3.9	0.430
2440	Evansville-Henderson	IN	64.2	7426	9.7	6.8	0.398
2960	Gary-Hammond	IN	65.4	7897	9.9	11.7	0.370
3480	Indianapolis	IN	68.8	7765	9.4	5.2	0.387

**Table G.2 Health Services and Socio-economic Data**

MA Code	Metropolitan Area	State	Percent Finishing High School	Mean Income (1979) (\$)	Poverty Rate Individuals (%)	Unemployment Rate (%)	Gini Coefficient
7800	South Bend-Mishawaka	IN	66.9	7331	8.7	5.5	0.379
8320	Terre Haute	IN	67.7	6668	10.7	7.0	0.393
8440	Topeka	KS	78.3	7970	7.8	5.1	0.378
9040	Wichita	KS	76.2	8135	8.9	6.0	0.384
4280	Lexington-Fayette	KY	66.3	7000	14.1	5.3	0.415
760	Baton Rouge	LA	68.2	7160	14.9	11.0	0.419
5560	New Orleans	LA	62.7	6999	17.5	10.9	0.439
7680	Shreveport	LA	63.4	7071	15.8	12.0	0.432
1120	Boston	MA	77.3	7950	9.8	4.7	0.411
5400	New Bedford	MA	41.8	5752	15.1	8.9	0.415
8000	Springfield	MA	66.1	6701	12.5	6.1	0.407
9240	Worcester	MA	64.8	6648	11.1	5.2	0.399
720	Baltimore	MD	62.0	7747	5.7	5.6	0.396
730	Bangor	ME	76.0	6042	11.3	7.3	0.405
4240	Lewiston-Auburn	ME	56.5	5700	12.6	6.5	0.391
6400	Portland	ME	75.6	6937	7.7	5.3	0.392
2162	Detroit-Ann Arbor	MI	67.7	8513	10.1	7.9	0.394
2640	Flint	MI	67.8	7983	10.6	10.6	0.377
4040	Lansing-East Lansing	MI	77.3	7644	10.7	7.0	0.376
6960	Saginaw-Bay City-Midland	MI	67.3	7423	10.4	10.0	0.385
2240	Duluth	MN	71.0	6966	9.3	9.5	0.385
5120	Minneapolis-St Paul	MN	79.7	8679	6.8	4.2	0.380
3760	Kansas City	MO	73.6	8116	9.0	4.7	0.390
7040	St. Louis	MO	64.1	7704	10.4	7.0	0.394
3560	Jackson	MS	67.9	6536	18.8	8.0	0.440
880	Billings	MT	76.6	7639	9.3	7.8	0.396
3040	Great Falls	MT	75.2	7006	10.3	2.7	0.391
1520	Charlotte-Gastonia-Rock Hill	NC	57.6	7005	10.6	4.6	0.408
3120	Greensboro-Winston-Salem-High Point	NC	57.0	6980	11.0	4.6	0.397
6640	Raleigh-Durham	NC	69.0	7278	12.3	3.3	0.401
1010	Bismarck	ND	71.5	7344	8.8	7.1	0.340
2520	Fargo-Moorhead	ND	76.5	7302	9.8	7.8	0.337
2985	Grand Forks	ND	76.2	6561	11.0	3.8	0.357
4360	Lincoln	NE	81.5	7739	8.6	3.1	0.381
5920	Omaha	NE	76.6	7570	9.1	5.3	0.385
4760	Manchester	NH	61.9	6822	9.7	5.2	0.340
6450	Portsmouth-Dover-Rochester	NH	73.5	6626	8.8	5.0	0.369
3640	Jersey City	NJ	51.5	6504	16.9	8.0	0.419
5640	Newark	NJ	68.9	8514	11.2	5.3	0.414
875	Paterson	NJ	68.6	9200	7.1	4.6	0.397
8480	Trenton	NJ	67.8	8178	9.4	4.3	0.398

**Table G.2 Health Services and Socio-economic Data**

MA Code	Metropolitan Area	State	Percent Finishing High School	Mean Income (1979) (\$)	Poverty Rate Individuals (%)	Unemployment Rate (%)	Gini Coefficient
200	Albuquerque	NM	76.5	7154	13.2	6.5	0.408
4120	Las Vegas	NV	74.0	8284	9.1	6.2	0.393
6720	Reno	NV	80.1	9524	7.0	5.1	0.387
160	Albany-Schenectady-Troy	NY	69.7	7094	9.8	5.2	0.386
1280	Buffalo	NY	65.4	7147	10.6	7.2	0.394
2335	Elmira	NY	69.5	6393	11.0	6.8	0.382
5380	Nassau-Suffolk	NY	75.8	8866	5.7	4.4	0.381
5600	New York	NY	62.4	7739	18.1	6.7	0.455
6460	Poughkeepsie	NY	70.6	7834	7.3	3.8	0.372
6840	Rochester	NY	70.4	7911	8.8	5.7	0.380
8160	Syracuse	NY	70.7	6942	10.4	7.4	0.385
8680	Utica-Rome	NY	64.5	6140	11.4	7.1	0.384
80	Akron	OH	69.5	7549	9.4	8.0	0.384
1320	Canton	OH	67.1	7273	8.6	10.2	0.370
1640	Cincinnati	OH	63.2	7542	10.3	6.5	0.398
1680	Cleveland	OH	68.2	8062	9.8	7.8	0.395
1840	Columbus	OH	71.8	7497	11.1	6.1	0.389
2000	Dayton-Springfield	OH	69.4	7492	10.3	6.6	0.386
3200	Hamilton-Middletown	OH	64.7	7384	9.8	7.7	0.373
4800	Mansfield	OH	66.1	6907	9.4	9.2	0.369
8080	Steubenville-Weirton	OH	62.3	7374	9.3	8.7	0.380
8400	Toledo	OH	68.2	7533	11.0	8.4	0.418
9320	Youngstown-Warren	OH	66.7	7259	9.7	10.6	0.382
5880	Oklahoma City	OK	73.0	7700	10.6	6.8	0.406
6440	Portland	OR	78.7	8454	9.0	7.2	0.396
240	Allentown-Bethlehem	PA	63.2	7565	7.4	7.4	0.372
280	Altoona	PA	65.4	6105	10.9	9.2	0.379
2360	Erie	PA	69.9	6692	10.0	8.5	0.376
3240	Harrisburg-Lebanon-Carlisle	PA	68.3	7478	8.0	4.7	0.365
3680	Johnstown	PA	60.1	6292	10.3	10.7	0.387
4000	Lancaster	PA	59.6	7151	8.5	3.4	0.364
6160	Philadelphia	PA	66.0	7522	11.9	5.2	0.406
6280	Pittsburgh	PA	67.3	7624	9.2	8.3	0.395
6680	Reading	PA	58.5	7404	8.2	6.4	0.374
42069	Scranton (Lackawanna)	PA	63.8	6162	9.8	7.6	0.391
7610	Sharon	PA	66.8	6811	9.1	8.4	0.374
8050	State College	PA	75.8	5967	16.7	6.0	0.408
9140	Williamsport	PA	65.6	6217	10.8	7.1	0.376
9280	York	PA	61.3	7189	7.2	5.3	0.363
6480	Providence	RI	61.4	6985	11.1	7.3	0.384
1440	Charleston	SC	63.3	6144	16.5	4.6	0.405
1760	Columbia	SC	66.3	6729	13.3	3.8	0.394
3160	Greenville-Spartanburg	SC	51.9	6461	12.4	5.7	0.399
1560	Chatanooga	TN	58.3	6481	13.7	7.1	0.410

**Table G.2 Health Services and Socio-economic Data**

MA Code	Metropolitan Area	State	Percent Finishing High School	Mean Income (1979) (\$)	Poverty Rate Individuals (%)	Unemployment Rate (%)	Gini Coefficient
3840	Knoxville	TN	59.8	6584	15.0	7.8	0.420
4920	Memphis	TN	63.8	6540	20.0	6.8	0.434
5360	Nashville	TN	63.7	7158	11.7	5.2	0.404
840	Beaumont-Port Arthur	TX	62.5	7460	12.4	14.5	0.396
1880	Corpus Christi	TX	57.7	6548	17.0	12.2	0.417
1920	Dallas	TX	69.6	8304	10.0	6.5	0.401
2320	El Paso	TX	59.5	5322	21.7	11.5	0.421
2920	Galveston-Texas City	TX	65.2	8099	9.5	11.2	0.373
3360	Houston	TX	69.9	8987	10.3	10.3	0.394
4600	Lubbock	TX	66.4	6970	14.3	6.8	0.416
7200	San Angelo	TX	59.8	6886	12.5	7.0	0.425
7240	San Antonio	TX	62.7	6200	18.1	7.2	0.417
8800	Waco	TX	58.5	6298	17.2	7.8	0.431
9080	Wichita Falls	TX	65.4	7148	12.3	8.3	0.415
7160	Salt Lake City-Ogden	UT	80.7	6853	8.4	5.3	0.373
1950	Danville	VA	46.7	6181	13.4	7.8	0.400
5720	Norfolk-Virginia Beach- Newport News	VA	66.2	6802	14.0	4.9	0.396
6760	Richmond-Petersburg	VA	62.3	7640	11.3	4.5	0.391
6800	Roanoke	VA	62.0	7380	11.0	4.8	0.401
7600	Seattle	WA	81.7	9368	7.7	6.5	0.385
7840	Spokane	WA	78.2	7244	11.5	8.2	0.401
8200	Tacoma	WA	77.1	7565	10.0	7.8	0.388
2290	Eau Claire	WI	70.3	6264	11.8	6.6	0.389
3800	Kenosha	WI	64.8	7818	7.0	12.4	0.361
4720	Madison	WI	79.9	7934	8.9	5.6	0.381
5080	Milwaukee	WI	71.4	8279	7.9	6.1	0.378
6600	Racine	WI	67.7	8063	7.0	8.5	0.363
1480	Charleston	WV	63.3	7208	11.2	10.2	0.398
3400	Huntington-Ashland	WV	54.6	6128	16.8	11.8	0.420

**Table G.3 Climate Data**

MA Code	Metropolitan Area	State	Mean Maximum Temperature (F)	Variation in Max. Temperature	Mean Relative Humidity (%)	Variation in Relative Humidity
1000	Birmingham	AL	73.483	67.127	46.020	237.971
3440	Huntsville	AL	71.065	77.473	48.543	223.498
5160	Mobile	AL	77.052	49.448	50.281	254.294
4400	Little Rock-North Little Rock	AR	71.181	84.096		
6200	Phoenix	AZ	86.992	45.758	19.766	83.220
8520	Tucson	AZ	83.256	49.208	19.269	90.692
360	Anaheim	CA				
2840	Fresno	CA	76.901	54.597		
4480	Los Angeles-Long Beach	CA	76.304	47.884		
6780	Riverside-San Bernardino	CA	78.156	64.513		
6920	Sacramento	CA	73.455	51.751		
7320	San Diego	CA	71.494	23.846		
7360	San Francisco	CA	66.081	32.754		
7400	San Jose	CA	71.400	39.008		
1720	Colorado Springs	CO	61.971	124.504	29.698	262.457
2080	Denver	CO	64.172	125.832	30.424	247.582
2670	Fort Collins-Loveland	CO	63.044	104.388		
3060	Greeley	CO	64.388	116.908		
6560	Pueblo	CO	68.892	132.146	29.873	265.449
1160	Bridgeport-Milford	CT	59.597	56.018	51.392	301.323
3280	Hartford	CT	60.310	79.545	45.254	258.808
5480	New Haven-Meriden	CT				
8840	Washington	DC	65.809	83.727	47.206	238.952
9160	Wilmington	DE	63.919	71.426	49.176	218.970
2680	Fort Lauderdale-Hollywood-Pompano Beach	FL	83.600	14.002		
3600	Jacksonville	FL	79.308	47.381		
5960	Orlando	FL	82.737	32.827		
8280	Tampa-St. Petersburg-Clearwater	FL	81.664	27.609		
520	Atlanta	GA	72.094	66.377	45.104	253.867
1800	Columbus	GA	76.196	58.475	43.475	250.563
1360	Cedar Rapids	IA	58.802	98.163		
2120	Des Moines	IA	60.720	106.249		
2200	Dubuque	IA				
8920	Waterloo-Cedar Falls	IA	58.179	98.537		
1080	Boise City	ID				

**Table G.3 Climate Data**

MA Code	Metropolitan Area	State	Mean Maximum Temperature (F)	Variation in Max. Temperature	Mean Relative Humidity (%)	Variation in Relative Humidity
1600	Chicago	IL				
1020	Bloomington	IN	63.451	93.315		
2440	Evansville-Henderson	IN	66.596	90.466	49.832	193.010
2960	Gary-Hammond	IN				
3480	Indianapolis	IN	62.363	87.774	52.142	188.180
7800	South Bend-Mishawaka	IN	59.079	87.935	51.898	180.824
8320	Terre Haute	IN				
8440	Topeka	KS	65.694	106.189	48.159	203.090
9040	Wichita	KS	67.677	106.284	45.517	222.171
4280	Lexington-Fayette	KY	64.885	91.810	50.428	204.753
760	Baton Rouge	LA	77.556	56.000	50.735	212.940
5560	New Orleans	LA	77.679	50.525	54.455	187.249
7680	Shreveport	LA	76.204	75.250	47.530	224.358
1120	Boston	MA	58.955	80.378	49.990	312.554
5400	New Bedford	MA	58.860	60.350		
8000	Springfield	MA				
9240	Worcester	MA	56.282	79.600	50.363	267.508
720	Baltimore	MD	65.025	78.552	46.635	217.851
730	Bangor	ME	53.971	75.735	50.327	294.875
4240	Lewiston-Auburn	ME	56.062	74.030		
6400	Portland	ME	55.468	69.520	49.602	293.792
2162	Detroit-Ann Arbor	MI	58.236	81.009	51.276	167.709
2640	Flint	MI	56.843	82.282	53.430	180.633
4040	Lansing-East Lansing	MI	56.986	84.858	54.082	183.235
6960	Saginaw-Bay City-Midland	MI	55.339	80.263		
2240	Duluth	MN	49.343	87.054	53.069	233.956
5120	Minneapolis-St Paul	MN	55.624	95.108	49.641	166.658
3760	Kansas City	MO	66.347	102.239		
7040	St. Louis	MO	65.749	102.366	47.598	214.043
3560	Jackson	MS	76.273	72.740	48.247	241.288
880	Billings	MT	60.242	144.673	34.795	207.900
3040	Great Falls	MT	58.208	137.738	37.511	217.616
1520	Charlotte-Gastonia-Rock Hill	NC	70.583	69.045	44.062	237.446
3120	Greensboro-Winston-Salem-High Point	NC	68.306	76.258		
6640	Raleigh-Durham	NC	70.189	77.629	46.202	242.704
1010	Bismarck	ND	55.897	120.976	46.434	187.583
2520	Fargo-Moorhead	ND	53.816	106.375	51.526	174.358
2985	Grand Forks	ND	53.252	106.479		
4360	Lincoln	NE	64.250	118.318		

**Table G.3 Climate Data**

MA Code	Metropolitan Area	State	Mean Maximum Temperature (F)	Variation in Max. Temperature	Mean Relative Humidity (%)	Variation in Relative Humidity
5920	Omaha	NE	61.199	113.366	47.655	197.081
4760	Manchester	NH				
6450	Portsmouth-Dover-Rochester	NH				
3640	Jersey City	NJ	58.783	68.450		
5640	Newark	NJ	63.308	74.438	45.266	234.839
875	Paterson	NJ				
8480	Trenton	NJ				
200	Albuquerque	NM	70.483	58.571	25.002	123.587
4120	Las Vegas	NV	79.883	53.780	17.008	76.295
6720	Reno	NV	66.896	75.51	25.769	103.634
160	Albany-Schenectady-Troy	NY	57.754	81.985	50.566	216.129
1280	Buffalo	NY	56.363	89.134	52.500	198.676
2335	Elmira	NY	58.591	86.239		
5380	Nassau-Suffolk	NY	61.657	67.600	48.600	215.178
5600	New York	NY	61.222	56.896	50.301	274.772
6460	Poughkeepsie	NY	59.550	76.607		
6840	Rochester	NY	57.024	90.520	52.630	188.310
8160	Syracuse	NY	57.36	89.319	53.146	198.225
8680	Utica-Rome	NY	55.204	89.550		
80	Akron	OH	59.260	91.836	53.277	195.646
1320	Canton	OH				
1640	Cincinnati	OH	64.694	89.749		
1680	Cleveland	OH	58.937	97.021	52.297	171.211
1840	Columbus	OH	61.774	91.119	49.059	176.035
2000	Dayton-Springfield	OH	61.290	93.068	50.735	176.128
3200	Hamilton-Middletown	OH				
4800	Mansfield	OH	58.650	90.931	56.376	230.089
8080	Steubenville-Weirton	OH	61.634	92.367		
8400	Toledo	OH	58.819	89.532	53.140	201.258
9320	Youngstown-Warren	OH	58.462	95.962	53.329	207.117
5880	Oklahoma City	OK	70.894	102.006	44.364	228.225
6440	Portland	OR	62.958	52.558	52.228	191.552
240	Allentown-Bethlehem	PA	61.168	73.526	47.959	221.242
280	Altoona	PA	57.564	89.178		
2360	Erie	PA	57.116	89.345	54.118	178.944
3240	Harrisburg-Lebanon-Carlisle	PA	61.506	75.293	47.688	225.686
3680	Johnstown	PA	62.913	93.445		
4000	Lancaster	PA	63.369	70.260		
6160	Philadelphia	PA	63.963	72.352	47.773	207.258

**Table G.3 Climate Data**

MA Code	Metropolitan Area	State	Mean Maximum Temperature (F)	Variation in Max. Temperature	Mean Relative Humidity (%)	Variation in Relative Humidity
6280	Pittsburgh	PA	60.263	95.953	48.840	186.769
6680	Reading	PA	62.560	77.216		
42069	Scranton (Lackawanna)	PA	58.386	80.435	49.675	208.780
7610	Sharon	PA				
8050	State College	PA	58.861	87.629		
9140	Williamsport	PA	59.912	74.326	47.772	216.125
9280	York	PA				
6480	Providence	RI	60.145	72.594	48.250	302.517
1440	Charleston	SC	75.579	57.336	49.417	232.415
1760	Columbia	SC	75.036	67.391	42.807	242.471
3160	Greenville-Spartanburg	SC	70.653	64.357	46.034	280.725
1560	Chatanooga	TN	70.740	69.210	46.849	228.600
3840	Knoxville	TN	69.530	73.763	48.510	212.604
4920	Memphis	TN	72.094	80.693	48.842	217.506
5360	Nashville	TN	70.104	86.491	46.794	225.746
840	Beaumont-Port Arthur	TX				
1880	Corpus Christi	TX	80.843	56.036	52.820	193.358
1920	Dallas	TX	76.136	89.332	42.965	215.114
2320	El Paso	TX				
2920	Galveston-Texas City	TX	74.607	35.248		
3360	Houston	TX	79.135	60.976	48.950	212.918
4600	Lubbock	TX	73.547	112.154	34.961	302.436
7200	San Angelo	TX	77.379	91.667	36.826	230.562
7240	San Antonio	TX	79.860	65.191	42.169	227.163
8800	Waco	TX	78.117	84.392	44.866	221.071
9080	Wichita Falls	TX	75.349	108.539	40.283	204.141
7160	Salt Lake City-Ogden	UT	63.636	73.673	36.106	119.894
1950	Danville	VA	70.040	84.886		
5720	Norfolk-Virginia Beach- Newport News	VA	68.494	81.635	49.332	214.962
6760	Richmond-Petersburg	VA	68.862	85.025	46.052	246.058
6800	Roanoke	VA	66.731	84.061	45.192	247.912
7600	Seattle	WA	59.591	41.190	54.953	192.37
7840	Spokane	WA	57.418	70.130	47.427	163.122
8200	Tacoma	WA				
2290	Eau Claire	WI	55.378	96.021	49.005	174.490
3800	Kenosha	WI	54.608	86.345		
4720	Madison	WI	56.537	89.688	52.390	193.574
5080	Milwaukee	WI	55.355	90.259	54.514	196.334
6600	Racine	WI	54.375	82.694		
1480	Charleston	WV	66.121	100.641	46.770	222.191
3400	Huntington-Ashland	WV	65.501	98.222	47.839	223.487



**Table G.4 Health Services and Physical Environment Data**

MA Code	Metropolitan Area	State	Doctors per 100,000	Hospital Beds per 100,000	Water Hardness (ppm)	Altitude (m)
1000	Birmingham	AL	248	663	59	183
3440	Huntsville	AL	153	452		195
5160	Mobile	AL	182	628	20	2
4400	Little Rock-North Little Rock	AR	270	904	18	
6200	Phoenix	AZ	194	425	244	332
8520	Tucson	AZ	269	433		727
360	Anaheim	CA	239	379		49
2840	Fresno	CA	182	368	119	90
4480	Los Angeles-Long Beach	CA	261	479	125	101
6780	Riverside-San Bernardino	CA	157	367		262
6920	Sacramento	CA	213	259	21	8
7320	San Diego	CA	229	350	207	13
7360	San Francisco	CA	442	555	58	19
7400	San Jose	CA	257	354	194	27
1720	Colorado Springs	CO	127	435		1831
2080	Denver	CO	250	447	116	1609
2670	Fort Collins-Loveland	CO	148	222		1525
3060	Greeley	CO	123	254		1422
6560	Pueblo	CO	189	990		1421
1160	Bridgeport-Milford	CT			29	
3280	Hartford	CT			12	
5480	New Haven-Meriden	CT			43	
8840	Washington	DC	342	594	102	15
9160	Wilmington	DE	183	693	48	37
2680	Fort Lauderdale-Hollywood- ompano Beach	FL	256	591		3
3600	Jacksonville	FL	175	454	274	
5960	Orlando	FL	156	428	123	32
8280	Tampa-St. Petersburg- Clearwater	FL	177	568	81	17
520	Atlanta	GA	192	453	20	320
1800	Columbus	GA	132	740	25	76
1360	Cedar Rapids	IA	512	965	99	223
2120	Des Moines	IA	153	647	78	245
2200	Dubuque	IA	149	657	282	198
8920	Waterloo-Cedar Falls	IA	137	558	241	264
1080	Boise City	ID	164	463	85	831
1600	Chicago	IL	243	564	133	182
1020	Bloomington	IN	146	253	111	
2440	Evansville-Henderson	IN	176	813	100	120
2960	Gary-Hammond	IN	129	525	136	185
3480	Indianapolis	IN	234	544	241	219

**Table G.4 Health Services and Physical Environment Data**

MA Code	Metropolitan Area	State	Doctors per 100,000	Hospital Beds per 100,000	Water Hardness (ppm)	Altitude (m)
7800	South Bend-Mishawaka	IN	133	459	203	
8320	Terre Haute	IN	134	561	208	155
8440	Topeka	KS	229	1424	100	290
9040	Wichita	KS	209	529	86	398
4280	Lexington-Fayette	KY	354	1056		300
760	Baton Rouge	LA	143	369	38	6
5560	New Orleans	LA	286	659	74	
7680	Shreveport	LA	261	821	68	
1120	Boston	MA			12	6
5400	New Bedford	MA			15	15
8000	Springfield	MA			12	21
9240	Worcester	MA			9	146
720	Baltimore	MD	388	790	50	10
730	Bangor	ME				48
4240	Lewiston-Auburn	ME				37
6400	Portland	ME			14	21
2162	Detroit-Ann Arbor	MI	221	532	98	
2640	Flint	MI	156	408	86	
4040	Lansing-East Lansing	MI	165	398	86	
6960	Saginaw-Bay City-Midland	MI	130	572		
2240	Duluth	MN	156	655	44	189
5120	Minneapolis-St Paul	MN	225	448	68	256
3760	Kansas City	MO	209	649	276	244
7040	St. Louis	MO	224	649	182	143
3560	Jackson	MS	283	1231	47	90
880	Billings	MT	189	440	148	952
3040	Great Falls	MT	189	763	151	1016
1520	Charlotte-Gastonia-Rock Hill	NC	133	450	22	213
3120	Greensboro-Winston-Salem-High Point	NC	192	404	40	
6640	Raleigh-Durham	NC	490	736	30	
1010	Bismarck	ND	210	801		512
2520	Fargo-Moorhead	ND	233	760		274
2985	Grand Forks	ND	253	870		254
4360	Lincoln	NE	169	710	206	358
5920	Omaha	NE	252	833	236	313
4760	Manchester	NH		912		69
6450	Portsmouth-Dover-Rochester	NH				6
3640	Jersey City	NJ	175	630	36	3
5640	Newark	NJ	265	677	26	45
875	Paterson	NJ	272	425		30

**Table G.4 Health Services and Physical Environment Data**

MA Code	Metropolitan Area	State	Doctors per 100,000	Hospital Beds per 100,000	Water Hardness (ppm)	Altitude (m)
8480	Trenton	NJ	255	739		15
200	Albuquerque	NM	269	549	112	1511
4120	Las Vegas	NV	133	378		616
6720	Reno	NV	249	689	40	1371
160	Albany-Schenectady-Troy	NY	235	563	54	46
1280	Buffalo	NY	259	806	124	183
2335	Elmira	NY	182	814		266
5380	Nassau-Suffolk	NY	299	643		18
5600	New York	NY	355	641	61	9
6460	Poughkeepsie	NY	180	1156		64
6840	Rochester	NY	257	627	82	157
8160	Syracuse	NY	237	443	109	124
8680	Utica-Rome	NY	141	1065	16	129
80	Akron	OH	187	551	106	
1320	Canton	OH	145	608	413	
1640	Cincinnati	OH	241	575	115	208
1680	Cleveland	OH	269	620	128	
1840	Columbus	OH	202	467	90	
2000	Dayton-Springfield	OH	170	720	358	
3200	Hamilton-Middletown	OH	100	390		
4800	Mansfield	OH	120	516	229	
8080	Steubenville-Weirton	OH	97	369	111	
8400	Toledo	OH	227	692	170	
9320	Youngstown-Warren	OH	156	551	86	262
5880	Oklahoma City	OK	213	554	90	379
6440	Portland	OR	257	449	9	
240	Allentown-Bethlehem	PA	164	517	157	111
280	Altoona	PA	149	679		357
2360	Erie	PA	154	636	129	227
3240	Harrisburg-Lebanon-Carlisle	PA	204	709	13	110
3680	Johnstown	PA	139	722		360
4000	Lancaster	PA	125	348		116
6160	Philadelphia	PA	276	615	75	14
6280	Pittsburgh	PA	242	721		232
6680	Reading	PA	173	604	88	79
42069	Scranton (Lackawanna)	PA	179	951	26	230
7610	Sharon	PA	102	570		304
8050	State College	PA	129	363		352
9140	Williamsport	PA	174	648		161
9280	York	PA	115	278		122

**Table G.4 Health Services and Physical Environment Data**

MA Code	Metropolitan Area	State	Doctors per 100,000	Hospital Beds per 100,000	Water Hardness (ppm)	Altitude (m)
6480	Providence	RI			24	7
1440	Charleston	SC	239	514		36
1760	Columbia	SC	221	1066	29	
3160	Greenville-Spartanburg	SC	158	410		
1560	Chatanooga	TN	213	582	59	209
3840	Knoxville	TN	181	665	116	271
4920	Memphis	TN	237	742	38	80
5360	Nashville	TN	237	766	90	134
840	Beaumont-Port Arthur	TX	126	568	66	
1880	Corpus Christi	TX	153	495		
1920	Dallas	TX	172	450	66	141
2320	El Paso	TX	132	433	146	1147
2920	Galveston-Texas City	TX	256	541	115	
3360	Houston	TX	219	527	73	
4600	Lubbock	TX	260	696	422	
7200	San Angelo	TX	157	814		563
7240	San Antonio	TX	195	654	223	
8800	Waco	TX	149	885	156	
9080	Wichita Falls	TX	180	1044	67	291
7160	Salt Lake City-Ogden	UT	214	346	186	1298
1950	Danville	VA	134	379		
5720	Norfolk-Virginia Beach- Newport News	VA	177	570	74	
6760	Richmond-Petersburg	VA	272	757		
6800	Roanoke	VA	248	1161		
7600	Seattle	WA	274	347	18	
7840	Spokane	WA	219	621	156	
8200	Tacoma	WA	135	535	21	
2290	Eau Claire	WI	162	697	54	243
3800	Kenosha	WI	108	352	132	186
4720	Madison	WI	329	684	345	263
5080	Milwaukee	WI	227	646		193
6600	Racine	WI	119	328	130	191
1480	Charleston	WV	190	616	32	189
3400	Huntington-Ashland	WV	151	544		173

**Table G.5 Gaseous Co-pollutant Data**

MA Code	Metropolitan Area	State	Fine Part ( $\mu\text{g}/\text{m}^3$ )	Sulfates ( $\mu\text{g}/\text{m}^3$ )	CO (ppb)	NO2 (ppb)	O3 (ppb)	SO2 (ppb)
1000	Birmingham	AL	24.51	13.1	1497.74		24.28	
3440	Huntsville	AL		12.0	833.53	23.39	27.45	
5160	Mobile	AL	20.89	12.6				
4400	Little Rock-North Little Rock	AR	17.84	5.9			28.23	
6200	Phoenix	AZ	15.24	4.3	1950.43	7.75	21.83	5.595
8520	Tucson	AZ		4.4	2260.24	30.32	27.90	0.827
360	Anaheim	CA		11.5	3178.48	43.49	21.42	7.461
2840	Fresno	CA	10.32	5.8	1240.98	32.27	29.90	2.732
4480	Los Angeles-Long Beach	CA	21.81	14.0	3050.16	51.06	27.96	7.381
6780	Riverside-San Bernardino	CA		14.6	2008.63	37.14	41.14	4.083
6920	Sacramento	CA		5.8	1116.45	22.39	25.47	1.620
7320	San Diego	CA		11.2	1165.04	27.57	34.48	5.794
7360	San Francisco	CA	12.16	6.6	1514.50	26.06	10.93	0.605
7400	San Jose	CA	12.44	6.2	1735.14	35.04	19.15	
1720	Colorado Springs	CO		6.1	1828.34	27.34	26.45	
2080	Denver	CO	16.09	6.2	2371.84	43.64	23.86	12.814
2670	Fort Collins-Loveland	CO		5.2	1819.44		26.71	
3060	Greeley	CO		4.7	1316.97		23.41	
6560	Pueblo	CO		6.7	1106.83			
1160	Bridgeport-Milford	CT		9.9	3017.08	27.72	35.63	11.669
3280	Hartford	CT	14.77	9.4	2134.18	29.08	26.23	10.983
5480	New Haven-Meriden	CT		8.5	939.98		28.50	8.372
8840	Washington	DC	22.51	14.9	1010.07	24.54	21.96	11.841
9160	Wilmington	DE		19.4	1109.56	31.38	23.00	6.526
2680	Fort Lauderdale-Hollywood-ompano Beach	FL		6.9	1827.10		20.83	2.164
3600	Jacksonville	FL		11.2	1214.68	14.59	31.60	6.688
5960	Orlando	FL		7.9	1247.29		22.54	3.240
8280	Tampa-St. Petersburg-learwater	FL	11.42	10.3	996.82	15.88	21.27	5.545
520	Atlanta	GA	20.29	12.0	1620.18	32.10	21.84	9.170
1800	Columbus	GA		9.4			18.68	
1360	Cedar Rapids	IA		10.6	928.47		19.08	10.414
2120	Des Moines	IA		10.6	2893.02		36.68	7.192
2200	Dubuque	IA		8.9	2292.66			3.577
8920	Waterloo-Cedar Falls	IA		9.1				3.245
1080	Boise City	ID	12.12		2915.17			3.011
1600	Chicago	IL	21.04		1847.58	34.75	18.47	12.327
1020	Bloomington	IN		13.7				

**Table G.5 Gaseous Co-pollutant Data**

MA Code	Metropolitan Area	State	Fine Part ( $\mu\text{g}/\text{m}^3$ )	Sulfates ( $\mu\text{g}/\text{m}^3$ )	CO (ppb)	NO2 (ppb)	O3 (ppb)	SO2 (ppb)
2440	Evansville-Henderson	IN		14.2	548.86	19.57	16.80	10.911
2960	Gary-Hammond	IN	25.24	19.1	1253.95		18.20	14.936
3480	Indianapolis	IN	21.09	12.6	2288.52	36.06	22.37	14.753
7800	South Bend-Mishawaka	IN		11.7			17.23	11.691
8320	Terre Haute	IN		13.2				15.177
8440	Topeka	KS	10.33	6.8				
9040	Wichita	KS	13.59	4.9	1236.13		24.04	
4280	Lexington-Fayette	KY		14.3	1280.73	18.09	23.88	7.219
760	Baton Rouge	LA		11.2			20.38	11.369
5560	New Orleans	LA		14.6		20.98	14.02	2.725
7680	Shreveport	LA		10.1				
1120	Boston	MA		11.0	1992.48	32.38	27.96	10.445
5400	New Bedford	MA		11.8				11.547
8000	Springfield	MA		12.8	3952.27		28.04	13.188
9240	Worcester	MA		10.7			31.24	12.683
720	Baltimore	MD		13.0	1831.54	26.06	21.37	10.796
730	Bangor	ME		10.2	1137.05			8.633
4240	Lewiston-Auburn	ME		10.7	1368.48			18.238
6400	Portland	ME		11.3			38.79	9.234
2162	Detroit-Ann Arbor	MI		14.7	1171.14	25.58	18.30	7.579
2640	Flint	MI		9.5			17.86	5.138
4040	Lansing-East Lansing	MI		13.1		30.96	25.98	12.503
6960	Saginaw-Bay City-Midland	MI		11.3	1069.98	25.21		5.797
2240	Duluth	MN		7.0	2489.58		22.88	5.916
5120	Minneapolis-St Paul	MN	13.68	8.4	1862.99	23.12	23.91	9.601
3760	Kansas City	MO		10.2	2273.33		28.04	.181
7040	St. Louis	MO		13.5	1225.57	24.84	23.28	.788
3560	Jackson	MS	15.71	8.8		14.43	27.43	
880	Billings	MT		7.1	1166.99	13.76	16.74	13.097
3040	Great Falls	MT		3.6	840.74	9.55		1.687
4360	Lincoln	NB		6.6	1519.71		24.81	
5920	Omaha	NB	13.07	8.7	955.85		18.53	6.508
1520	Charlotte-Gastonia-Rock Hill	NC	22.60	11.5	1783.98		21.18	8.789
3120	Greensboro-Winston-Salem-High Point	NC		12.9	1314.84		26.06	
6640	Raleigh-Durham	NC	16.79	11.9	2489.21			
1010	Bismarck	ND		5.3				
2520	Fargo-Moorhead	ND		6.3				

**Table G.5 Gaseous Co-pollutant Data**

MA Code	Metropolitan Area	State	Fine Part ( $\mu\text{g}/\text{m}^3$ )	Sulfates ( $\mu\text{g}/\text{m}^3$ )	CO (ppb)	NO2 (ppb)	O3 (ppb)	SO2 (ppb)
2985	Grand Forks	ND		4.8				
4760	Manchester	NH		11.1	1973.59		25.46	8.853
6450	Portsmouth-Dover- Rochester	NH		8.7				
3640	Jersey City	NJ	17.34	13.8	2060.34	30.33	22.08	14.136
5640	Newark	NJ		11.4	2711.83	33.43	21.84	11.972
875	Paterson	NJ		12.8		31.00	25.19	10.317
8480	Trenton	NJ		12.1	1349.85		26.57	9.004
200	Albuquerque	NM	8.95	4.5	1608.82	19.61	25.69	1.861
4120	Las Vegas	NV		4.2	2587.61	35.14	21.82	
6720	Reno	NV	11.82	4.1	2481.17	48.57	23.30	
160	Albany-Schenectady-Troy	NY		10.5	627.75		19.70	15.152
1280	Buffalo	NY	23.53	11.7	919.92	23.29	25.30	13.423
2335	Elmira	NY		6.6	573.72		22.82	7.800
5380	Nassau-Suffolk	NY		8.4	1307.35	27.48	23.92	7.823
5600	New York	NY		10.7	2194.97	34.71	21.06	18.785
6460	Poughkeepsie	NY		8.1	1036.04		14.13	11.968
6840	Rochester	NY		9.9	1096.44		21.09	19.627
8160	Syracuse	NY		10.2	862.77	21.08	20.36	10.123
8680	Utica-Rome	NY		8.6				9.336
80	Akron	OH	24.60	14.1	877.59		28.00	
1320	Canton	OH		13.6	1094.5	28.86	25.09	26.065
1640	Cincinnati	OH	23.12	14.3	1438.41	24.96	20.28	11.949
1680	Cleveland	OH	24.58	13.7	2269.14		20.61	13.757
1840	Columbus	OH		11.8	1448.75	19.30	17.07	9.079
2000	Dayton-Springfield	OH	18.80	13.5	1258.96	21.99	21.16	
3200	Hamilton-Middletown	OH		13.2	835.82	15.28	22.32	12.337
4800	Mansfield	OH		13.1				7.913
8080	Steubenville-Weirton	OH	23.09	23.5	2311.68	22.68	19.18	29.317
8400	Toledo	OH		10.8	864.06		25.11	8.572
9320	Youngstown-Warren	OH	20.23	15.7		40.71	19.00	10.688
5880	Oklahoma City	OK	15.86	6.3	535.01	19.80	22.66	0.025
6440	Portland	OR	14.66	7.7	2174.62	27.27	10.41	6.004
240	Allentown-Bethlehem	PA	17.88	14.5	1798.81	24.91	23.68	11.088
280	Altoona	PA		14.2				
2360	Erie	PA		12.1		17.14	29.43	13.225
3240	Harrisburg-Lebanon- Carlisle	PA		11.9	1924.60	22.01	22.58	9.730
3680	Johnstown	PA		17.2	751.59	23.92	22.46	21.627
4000	Lancaster	PA		12.5				

**Table G.5 Gaseous Co-pollutant Data**

MA Code	Metropolitan Area	State	Fine Part ( $\mu\text{g}/\text{m}^3$ )	Sulfates ( $\mu\text{g}/\text{m}^3$ )	CO (ppb)	NO2 (ppb)	O3 (ppb)	SO2 (ppb)
6160	Philadelphia	PA	21.40	11.5	1403.37	33.71	24.82	15.125
6280	Pittsburgh	PA		15.8	2325.69	25.48	22.92	20.649
6680	Reading	PA		12.1		25.47	20.22	14.279
42069	Scranton (Lackawanna)	PA		11.7				
7610	Sharon	PA		12.4				
8050	State College	PA		15.3				
9140	Williamsport	PA		12.4			21.48	7.115
9280	York	PA		13.2	1382.53	25.89	24.67	12.381
6480	Providence	RI	12.89	8.7	1718.62	35.39	22.69	13.839
1440	Charleston	SC		13.8				5.609
1760	Columbia	SC		16	1083.87		25.82	3.353
3160	Greenville-Spartanburg	SC		11	1857.83			2.116
1560	Chatanooga	TN	16.64	13.9				
3840	Knoxville	TN		13.9	3168.89		19.94	7.597
4920	Memphis	TN		12.8	1820.59	15.66	26.90	10.426
5360	Nashville	TN	20.45	8.7	2166.50		17.42	9.321
840	Beaumont-Port Arthur	TX		14.4	347.83	13.31	27.71	0.297
1880	Corpus Christi	TX		8.8	537.37		25.06	45.270
1920	Dallas	TX	16.48	10.0	746.09	18.14	24.90	1.577
2320	El Paso	TX	15.74		1635.98	24.81	21.69	13.643
2920	Galveston-Texas City	TX		9.0	194.20	16.94	25.09	4.806
3360	Houston	TX	13.37	10.5	771.74	25.79	22.22	4.398
4600	Lubbock	TX		4.5				
7200	San Angelo	TX		4.4				
7240	San Antonio	TX		6.6	671.40	15.55	21.86	0.847
8800	Waco	TX		10.0				
9080	Wichita Falls	TX		6.9				
7160	Salt Lake City-Ogden	UT	15.39	4.8	1770.17	27.29	25.27	16.537
1950	Danville	VA		13.6				
5720	Norfolk-Virginia Beach- Newport News	VA	16.91	14.8	1159.63		35.17	11.569
6760	Richmond-Petersburg	VA		11.0	1409.57	30.57	32.32	12.103
6800	Roanoke	VA		12.4			21.61	6.413
7600	Seattle	WA	11.87	7.5	2360.00		14.56	5.086
7840	Spokane	WA	9.38	5.6	2579.79		15.06	9.984
8200	Tacoma	WA		6.8	2718.32		15.06	5.104
2290	Eau Claire	WI		8.3				
3800	Kenosha	WI		10.8		12.70	29.05	5.445
4720	Madison	WI		9.8			27.12	6.693



**Table G.5 Gaseous Co-pollutant Data**

MA Code	Metropolitan Area	State	Fine Part ( $\mu\text{g}/\text{m}^3$ )	Sulfates ( $\mu\text{g}/\text{m}^3$ )	CO (ppb)	NO2 (ppb)	O3 (ppb)	SO2 (ppb)
5080	Milwaukee	WI		11.6	969.92	18.42	22.62	6.938
6600	Racine	WI		11.1	616.33		23.35	6.613
1480	Charleston	WV	20.10	17.8	971.63	18.88	15.68	15.001
3400	Huntington-Ashland	WV	33.35	15.3	1049.67	11.78	20.84	9.337

Table G-6. Descriptive statistics for the ecologic covariates used in the re-analysis of both the sulfate and fine particle cohorts

Ecologic Covariate	Sulfate Cohort										Fine Particles Cohort				
	Raw					Filtered					Raw				
	N	min	max	mean	cor	min	max	mean	cor	N	min	max	mean	cor	
Pollution Measure	151	3.6	23.5	10.6	10	3.6	19.0	9.7	100	50	8.95	33.35	17.48	100	
Demographic Data															
Population Change	139	-9.7	28.4	5.7	-40	-2126.1	90.9	-9.8	3	48	-5.5	25.9	7.3	-52	
Race Data															
Whites %	151	57.3	99.2	87.4	-22	63.3	106.7	88.0	-19	50	57.3	97.7	85.1	-23	
African Americans %	151	0.1	46.6	10.1	28	0.1	28.4	8.7	27	50	0.3	46.6	11.8	34	
Health Services Data															
Doctors per 100000	138	97	512	206	-13	Not necessary to filter <sup>1</sup>	Not necessary to filter <sup>1</sup>	Not necessary to filter <sup>1</sup>	-12	48	97	490	224	-20	
Hospital Beds per 10000	139	222	1424	609	-5	222	1233	592	-3	48	346	1424	587	-4	
Socio-Economic Data															
High School Educated %	151	41.8	82.7	68.4	-44	42.6	83.6	69.7	-30	50	51.6	81.7	69.4	-57	
1979 Income mean	151	5700	10360	7363	-13	Not necessary to filter <sup>1</sup>	Not necessary to filter <sup>1</sup>	Not necessary to filter <sup>1</sup>	-6	50	5322	10360	7683	-25	
Poverty Rate	151	5.69	20.02	11.12	8	Not necessary to filter <sup>1</sup>	Not necessary to filter <sup>1</sup>	Not necessary to filter <sup>1</sup>	11	50	6.8	21.7	11.2	22	
Income Inequality	151	0.34	0.45	0.39	2	0.34	0.46	0.39	11	50	0.37	0.44	0.40	11	
Unemployment Rate	151	2.7	14.5	6.9	16	2.7	15.2	6.8	13	50	3.3	12.3	7.0	28	

Ecologic Covariate	Sulfate Cohort						Fine Particles Cohort							
	Raw			Filtered			Raw			Filtered				
	N	min	max	mean	cor	min	max	mean	cor	N	min	max	mean	cor
<b>Climate Data</b>														
Maximum Temperature mean	135	49.3	87.0	65.4	-13	Not possible to filter <sup>2</sup>	Not possible to filter <sup>2</sup>	87.0	55.6	46	55.6	87.0	67.1	-13
Variation in Max. Temp.	135	14.0	144.7	80.1	-6	14.0	144.7	79.3	-6	46	27.6	125.8	76.7	31
Relative Humidity mean	95	17.0	56.4	46.3	59	31.4	98.5	46.9	-12	37	19.8	55.0	45.6	33
Variation in Relative Humidity	95	76.3	312.6	213.0	23	31.4	98.5	46.9	29	37	83.2	302.5	205.9	28
<b>Physical Environment Data</b>														
Water Hardness	109	9.0	422.0	106.2	-9	14.0	422.0	101.2	-4	49	9	358	98	4
Elevation	110	2	1831	279.9	-49	3	1831	351.4	-43	38	2	1609	343	-33
<b>Gaseous Co-pollutants</b>														
Carbon Monoxide	107	194.2	3952.3	1561.3	-7	Not possible to filter <sup>2</sup>	Not possible to filter <sup>2</sup>	1677.8	-4	44	535.0	3050.2	1677.8	-16
Nitrogen Dioxide	74	7.8	51.1	25.5	-1	Not possible to filter <sup>2</sup>	Not possible to filter <sup>2</sup>	27.4	-8	33	7.8	51.1	27.4	-8
Ozone	117	10.4	41.1	23.5	2	Not necessary to filter <sup>1</sup>	Not necessary to filter <sup>1</sup>	22.1	4	45	10.4	35.2	22.1	4
Sulfur Dioxide	113	0.02	29.32	9.27	48	0.02	22.5	7.93	24	38	0.02	29.32	9.85	50

1. These variables did not exhibit spatial autocorrelation, and were thus not filtered.

2. These variables did exhibit spatial autocorrelation, but a suitable distance could not be found at which the spatial autocorrelation could be removed.

**Table G.7** Pearson correlations (%) between ecologic covariates in the sulfate cohort. Correlations between raw variables in upper triangle and between filtered variables in lower triangle.

		raw data																						
		Pop. Change	White	Black	Doctors	Hospital Beds	High School	Income	Poverty	Gini	Unemployment	Temperature	Var. in Temp.	R. Humidity	Var. in R.H.	H2O Hardness	Altitude	Sulfates	CO	NO2	O3	SO2		
filtered data	Pop. Change	7	-17	11	8	-26	25	14	20	28	-28	70	-36	-60	-15	-6	27	-40	10	10	27	-43		
	White	-7	90	-96	-35	-12	24	-12	-45	-51	3	-46	35	-13	-22	27	28	-22	-3	-4	-3	12		
	Black	10	-90	80	24	17	-32	-2	50	49	4	46	27	17	23	-24	-29	28	-7	-7	4	4	-6	
	Doctors <sup>1</sup>	-12	-41	29	100	32	26	41	-2	20	-36	4	-15	5	5	-12	-13	-13	12	21	21	-14	-7	
	Hospital Beds	-6	-12	10	32	97	-12	-19	10	5	-9	-7	26	7	26	-9	-14	-5	-12	-20	-8	7	7	
	High School	-9	7	-18	31	-13	92	55	-44	-27	-31	-19	17	-23	-35	18	38	-44	15	22	22	-0	-22	
	Income <sup>11</sup>	-4	-25	22	41	-18	50	100	-58	-20	-22	-2	-10	-7	-26	5	1	-13	17	42	42	-20	-12	
	Poverty <sup>1</sup>	8	-26	23	-2	9	-34	-58	100	76	25	50	-25	-1	22	-15	-6	8	-7	-22	6	6	-17	
	Gini	8	-38	35	20	4	-21	-18	74	99	9	60	-36	-12	27	-22	-8	2	10	-1	1	1	-22	
	Unemployment	2	26	-15	-37	-6	-40	-28	18	5	89	4	4	15	-4	5	9	16	-27	-23	-13	3	3	
	Temperature <sup>2</sup>																							
	Var. in Temp.	-1	26	-19	-18	23	5	-18	-9	-22	19		88	-6	10	23	47	-6	-12	-16	-1	34	34	
	R. Humidity	-0	14	-21	3	-19	26	5	-10	-15	5		-13	6	32	-16	-73	59	-21	-9	-8	25	25	
	Var. in R.H.	-6	-16	13	2	17	-24	-22	17	17	3		22	-22	96	-27	-31	23	-8	8	28	12	12	
	H2O Hardness	-19	12	-7	-3	-8	6	0	-1	-6	1		5	7	-8	91	20	-9	-17	-16	3	4	4	
	Altitude	0	37	-36	-19	-7	30	-11	-4	-12	11		46	35	-21	13	94	-49	6	7	7	7	-8	
	Sulfates	3	-19	27	-12	-3	-30	-6	11	11	13		-6	-12	29	-4	-43	88	-7	-1	2	48	48	
	CO <sup>21</sup>																							
	NO <sub>2</sub> <sup>2</sup>																							
	O3 <sup>1</sup>	-9	-5	3	-14	-7	-5	-20	6	2	-11		9	3	29	7	9	9	9	100	-6	-6	-6	
	SO <sub>2</sub>	2	3	2	-9	4	-11	-11	-13	-19	8		33	25	7	18	9	24	24	-4	94	-4	94	

1. These variables did not exhibit spatial autocorrelation, and were thus not filtered.

2. These variables did exhibit spatial autocorrelation, but a suitable distance could not be found at which the spatial autocorrelation could be removed.

