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Dirty Recycling: Auto Salvage and Its Potential Impacts on Marginalized Populations

Ethan B. Dively
Gettysburg College

Nicholas C. Ferreri
Gettysburg College

Cole D. Rossiter
Gettysburg College

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Abstract
The salvage yard represents the final waypoint in the cradle-to-grave cycle of the automobile. Residual amounts of petroleum hydrocarbons, heavy metals, and acids used in automobiles can be extremely harmful to human health and the environment if not managed correctly. The purpose of this study was to assess the extent to which minority populations were exposed to the hazards of the auto salvage industry. Census data for population, income, race/ethnicity, sex, and age were organized using ArcGIS software. Population demographics were analyzed in the areas surrounding 98 auto salvage yards found in Philadelphia and Adams Counties, Pennsylvania. In Philadelphia County, the results showed that low-income minorities, females, and 65+ individuals are over represented groups near auto salvage yards. Conversely, Adams County showed few spatial relationships in demographic distribution. Our findings suggest that in urban counties, such as Philadelphia, depressed property values have resulted in a large percentage of below average income minorities inhabiting areas in close proximity to auto salvage yards. On the other hand, auto salvage yards in rural areas, such as Adams County, do not appear to have the same effect because population density and racial diversity are much lower.

Keywords
auto salvage, environmental justice, car, automobile, science, recycle, ArcGIS

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Comments
Environmental Studies Thesis

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Ethan Dively, Nick Ferreri, and Cole Rossiter

Department of Environmental Studies
Gettysburg College
Gettysburg, PA

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Abstract

The salvage yard represents the final waypoint in the cradle-to-grave cycle of the automobile. Residual amounts of petroleum hydrocarbons, heavy metals, and acids used in automobiles can be extremely harmful to human health and the environment if not managed correctly. The purpose of this study was to assess the extent to which minority populations were exposed to the hazards of the auto salvage industry. Census data for population, income, race/ethnicity, sex, and age were organized using ArcGIS software. Population demographics were analyzed in the areas surrounding 98 auto salvage yards found in Philadelphia and Adams Counties, Pennsylvania. In Philadelphia County, the results showed that low-income minorities, females, and 65+ individuals are over represented groups near auto salvage yards. Conversely, Adams County showed few spatial relationships in demographic distribution. Our findings suggest that in urban counties, such as Philadelphia, depressed property values have resulted in a large percentage of below average income minorities inhabiting areas in close proximity to auto salvage yards. On the other hand, auto salvage yards in rural areas, such as Adams County, do not appear to have the same effect because population density and racial diversity are much lower.

Introduction

With the perfection of the assembly line in 1913, Henry Ford transformed the American perspective of the automobile from a luxury of the rich to a reality for moderate-income middle-class families. Today, many people view the automobile as more than a means of transportation, but as an extension of their social status in society. The car evokes a sense of personal freedom, power, prestige, individualism, and privacy (Lucas 1973, Blank 1992). It allows people to liberate themselves mentally while also moving themselves geographically (Goode 2002). But, most of all, the automobile is a reflection of the restless spirit of America. As such, the car has attained a high stature in a society that has come to all but depend on it for mobility (Lewis 1997). In fact, this blind

necessity has created a disconnect between humanity and the environment, isolating the benefits of the automobile from the negative environmental and social impacts (Kunstler 1993).

In both the United States and around the world, used or inoperable automobiles tend to end up in auto salvage yards, with a large percentage of those eventually consolidated and sold as scrap metal for recovery (Loucks 1999). On one hand auto salvage yards act as the recyclers of functional second hand auto parts and remove some of the pressure on manufacturers to produce new parts for automobile owners who need replacements. But, they also represent expansive eyesores that damage property values and have the potential to contribute to public health issues and environmental degradation by polluting nearby soils, groundwater, and streams (Environmental 2010).

Since auto salvage yards are undesirable to live near, there is a corresponding devaluation of all nearby properties (Zeiss and Atwater 1989). This devaluation may result in a legacy of lower property values in the surrounding area or, in the case of an emergent auto salvage yard, may negatively impact a location's current residents by damaging the real value of their equity investment in a home. As a result, low-income families tend to comprise the majority of property owners in these areas. Given the potential for health hazards which result from environmental contaminants it follows logically that the majority of those people who may be at risk of harm due to the presence of auto salvage yards will be disproportionately low-income families who are more often than not racial minorities (Bryant 1995).

Background:

With the revolution of the assembly line in 1913, Ford was able to produce a new Model T every 93 minutes (Snow 2013). That year global production was estimated to be slightly more than 600,000 vehicles. Fast-forward to 1950 and that figure increased to about 10.5 million. Today, the estimate for global annual automobile production has reached 84 million vehicles (Wards 2007 and

Production 2013). Global automobile production has exploded in the last century and, at least in aggregate production, shows no sign of slowing down anytime soon. This high rate of production has resulted in a correspondingly high rate of automobile disposal as well. In 2009, approximately 14.8 million cars were disposed of in the United States alone. The enormity of this number necessitates the question, where are all of these cars ending up and how are they being disposed (U.S. 2010)?

Of the 14.8 million cars that Americans disposed of in 2009, dealers in the secondary market for scrap metals purchased the majority (U.S. 2010). Firms in the business of salvaging valuable materials tear apart cars, sort them into pieces based on type of metal, and then send them away to smelting facilities where the metals are reclaimed. The cars that are not sent to such facilities have ended up abandoned in rural yards, empty urban lots, and, in many cases, in the car lots owned by auto salvagers who allow the public to have their pick of used parts (U.S. 2010).

Human Health and the Environment

Large-scale salvage operations are tightly regulated by the EPA and state level agencies, and there are strict standards concerning the proper collection and disposal of potentially harmful materials found in automobiles. Small car lots may be expected to adhere to the same levels of hazardous material handling but are not likely subjected to the same rigorous level of scrutiny due to their small size and the sheer volume of small scale operations. Automobiles contain petroleum hydrocarbons, heavy metals, acids, and other chemicals that pose potential threats to the environment and human health (Environmental 2010, U.S. 2010, Vehicle 2011).

Petroleum hydrocarbons are found in gasoline, motor oil, and other fluids contained within an automobile. These fluids are a mixture of aromatic and aliphatic hydrocarbons. These chemicals have the potential to cause substantial environmental disturbances, potentially resulting in the toxification of water resources. They are also known carcinogens. Benzene, one of the most common

hydrocarbons found in these mixtures, has been linked to leukemia and other similar blood disorders (Rinsky et al. 1987).

Heavy metals found in automobiles include lead, cadmium, chromium, arsenic, zinc, copper, aluminum, mercury, and nickel. These metals have a wide array of impacts in humans should they be ingested through the skin, lungs, or contaminated water (Singh 2005). Lead poisoning, even at very low levels may result in severe impairment of brain development in children and at high levels may cause loss of brain function and nervous system responses (Byers and Lord 1943, Centers 1985). Cadmium poisoning has frequently been linked to renal damage and osteoporosis, particularly in women (Friberg 1950). Chromium ingestion can result in the rapid deterioration of the liver, kidneys, and blood cells. In large doses arsenic causes failure of the lungs, liver, and kidneys resulting in coma and death (Dayan and Paine 2001). In smaller doses arsenic exposure has been linked to an increased risk of heart disease, cancer, stroke, chronic respiratory diseases, and diabetes (Hughes 2002). Zinc and copper have not been found to present serious health threats when not ingested in exceptionally large quantities. Aluminum ingestion has the potential to impair nervous system responses such as voluntary and involuntary muscle control (Yokel 2000). Mercury poisoning presents a serious risk of fatality due to severe damage to the brain, kidneys, and lungs (Curley et al. 1971). Nickel is only toxic in large quantities but ongoing research has discovered a linkage between some forms of cancer and the oral or nasal inhalation of nickel (Singh 2005).

Acids contained within the batteries of automobiles can cause changes in soil chemistry that kill soil organisms and prevent the growth of vegetation (Sparks 2003). Ethylene glycol is a chemical similar to alcohol found in radiator coolant, brake fluid, power steering fluid, and transmission fluid that is toxic to humans and animals. Animals are the most common fatalities due to the attractive sweet taste and scent of this chemical (Harte 1991, Leth and Gregrsen 2005).

The level of automobile waste that is generated coupled with the toxicity of many chemicals and metals found in decaying cars suggests that auto salvage yards may pose a substantial risk to

both humans and the environment. The extensive list of health complications resulting from exposure to automobile waste puts those living near salvages yards at a greater risk of health problems than those people living further away.

Environmental Justice

Environmental justice is defined by the Environmental Protection Agency as, "the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The EPA has this goal for all communities and persons across the United States. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and has equal access to the decision-making process to have a healthy environment in which to live, learn, and work" (Environmental 2014). By this definition, no person should be exposed to a higher than normal level of environmental or health risk factors simply because he or she is poor or a minority.

People of low socioeconomic status and of a racial or an ethnic minority are frequently the demographics that are most severely affected by such health hazards. One reason for this is a general lack of education and political representation. These affected demographics frequently lack the education necessary to be aware of the health risks associated with living near any of the aforementioned areas (Bryant 1995). If they are unaware of the risk, it is certain that they will not seek out a solution to an unknown problem. Money represents another significant barrier. Unless a population can be mobilized through a grassroots effort the financial barrier to environmental justice issues is enough to ensure that they will go unaddressed (Bryant 1995, Newton 1996).

Incoming development projects such as landfills or power plants tend to crop up in areas of previously depressed property values that are oftentimes inhabited by impoverished or minority populations. The insertion of hazardous development projects is generally the result of the lack of

representation by such groups (Newton 1996). When determining the location of an unwanted land use project, it is often the case that affluent and educated individuals will be the most successful at preventing the entry of the project. The result is then that the project gets shuffled around until it ends up in an area that provides the least amount of resistance (Bryant 1995). As explained above a lack of education and financial assistance prevents minority demographics from fighting the establishment of undesirable land use projects.

In the 1996 case of *Chester Residents Concerned for Quality Living V. Seif,* residents of Chester, Pennsylvania, filed a discrimination suit on the grounds that waste handling facilities were discriminatorily located nearby minority residents of the Philadelphia area. Their argument was that sixty percent of the region's waste facilities were located in an area containing only eight percent of the region's population. Furthermore the population affected was over seventy percent African American. The case was filed specifically to fight the construction of a soil reclamation facility. During the course of the case the Pennsylvania Department of Environmental Protection denied the projects permit, and when the case eventually made it to the Supreme Court in 1998, the court ruled it moot as there was no longer a decision to be made. Despite the lack of victory in court this case opened the door for environmental justice litigation under section 601 of Title VI of the Civil Rights Act of 1964. This section prevents discrimination based on race, color, or national origin by any government agency that receives federal assistance. The establishment of this precedent in 1998 has enabled the recognition of many cases of discrimination containing an environmental justice component to be heard since that time (Chester 1996, Hurwitz and Sullivan 2001).

The severity of the potential hazards associated with auto salvage yards begs the question of what demographic groups are most likely to be influenced by any spillover effects of the auto salvage industry? Based on information that suggests a depression in property value surrounding junkyards, this study seeks to assess variations in demographics with specific regard to distance from auto salvage yards. An answer to this inquiry would help to give a better understanding of the extent at

which particular demographic groups have been overexposed to potential hazards. This study has particular relevance given that the people found to be negatively impacted may not have the resources necessary to conduct such research on their own.

Methods

Two counties were selected as case studies for our research. The first, Adams County, is primarily rural compared to the much more urban Philadelphia County. Both are located in the state of Pennsylvania, giving the project local significance. Internet research using White Pages, Yellow Pages, Google Maps, and other sources was conducted to locate auto salvage yards across both counties. Additionally, the majority of each county was scanned using a combination of Google Maps and Google Earth Pro to locate any other auto salvage yards. A total of 11 auto salvage yards were located in Adams County and 87 in Philadelphia County (Figure 1). Although it is likely that we did not document every auto salvage yard, we are confident those that were observed are a more than satisfactory representation of auto salvage yards located across both counties. For each, name (if known), latitude/longitude, and lot size were determined using Google Maps and Google Earth Pro and recorded in an Excel file.

In order to model the distribution of population, census datas were collected from American Fact Finder, a government run website that hosts archived census datas. Aggregate income (applying to citizens 15 years of age and older) and the total population from the year 1999 were available at the census block group level of resolution. Race/ethnicity, age, and sex from the year 2010 were available at the census block level of resolution. Shapefiles containing the census block and block groups for both Adams and Philadelphia counties were obtained from the official census website. Care was taken to ensure that there were no omission errors due to changing block groups between 1999 and the present. Shapefiles for the block groups represent the regions as they were mapped in 1999 and there were no data matching errors.

Census blocks are the smallest geographic areas over which demographic data such as sex, age, and race/ethnicity are collected by the United States Census Bureau. Blocks are "bounded by visible features such as roads, streams, and railroad tracks, and by non-visible boundaries such as property lines, city, township, school district, county limits and short line-of-sight extensions of roads" (US Census Bureau 2014). Blocks are created by an automated computer process that references all visible and nonvisible features compiled in a geographic database. Each time a polygon is completed, a block is created. Population is not taken into account when census blocks are created so it is possible to have census blocks with a population of zero (US Census Bureau 2014).

Census block groups are the intermediary unit of statistical division between census blocks and census tracts. Each census block group is made up of a cluster of census blocks and in turn a group of census block groups make up a census tract. A block group usually contains between 600 and 3,000 individuals. They are used to present data and control block numbering. Additionally, block groups typically make up a contiguous area and never cross state, county, or census tract boundaries (US Census Bureau 2014) (Figure 2).

All of the GIS work was completed using ESRI's ArcGIS software package. While similar research pertaining to auto salvage yards has not been done, GIS has been used effectively to model other issues of environmental justice (Jerrett et al. 2001, Maantay 2007). County shapefiles were converted to geodatabases to calculate the area of each block group and the county as a whole in square kilometers. The raw census datas were joined to the aforementioned geodatabases by the census BLOCKID that corresponded to each unique census block or block group.

After assembling the list of auto salvage yards, the latitude and longitude coordinates of each were recorded in decimal degrees and converted into a point layer in ArcGIS (Figures 3 and 4). Around each of these points buffers were created with radii of 0.125, 0.25, 0.5, 1, and 2 km. These buffers were merged with the Union geoprocessing tool and then each distance was separated into

discrete layers resulting in five ranges that showed data from 0-0.125, 0.125-0.25, 0.25-0.5, 0.5-1, and 1-2 km. It should be noted that due to the larger size of block groups and blocks in Adams County, the 0-0.125 km range was omitted from the study because there was no significant difference between this range and the 0.125-0.25 km range. This was done so that each of these discrete regions could be compared to one another without having to give attention to the data that had already been considered within a smaller buffer zone.

Census blocks in each country were then selected for analysis if the geometric center of a given block was contained within the range being considered. For Philadelphia County the same process was performed for the income data, as the census block groups were small enough to allow meaningful results without modifying the process. However, in Adams County the census block groups were very large, and using a geometric center selection method would have yielded no results. Instead we selected all block groups that intersected with the buffer zones. This method, while not ideal, did yield unique results at each buffer distance.

After the datas were selected for each range they were exported to Excel where results were calculated by range and by county. Population density was calculated by dividing the total population by area. Since the aggregate income data only included individuals 15 years or older, all individuals younger than 15 were removed from the total population to calculate per capita income. Totals for each race/ethnicity, age, and sex were added and percent composition was calculated.

In the United States Census there are seven accepted race identifiers: Caucasian, African American, American Indian/Alaska Native (AI/AN), Asian-American, Native Hawaiian Islander/Pacific Islander (NHI/PI), Other, or Plus 2, which are people who identify as two or more of these categories. Gender is defined as either male or female. Age is broken down into 23 categories which we reorganized into 6 categories: 0-17, 18-24, 25-39, 40-54, 55-64, and 65 years and older.

Results

Philadelphia County

According to the 2010 census, the population density of Philadelphia County was 4,130 individuals km^{-2}. Within the 0-0.125 km range population density was 2,400 km^{-2} increasing logarithmically to 4,690 km^{-2} at 2 km with an R^2 value of 0.98 (Figure 5). In 1999, per capita income in Philadelphia County was $20,500. Between 0.125 and 2 km away from auto salvage yards per capita income increased from $15,200 to $16,500 following a linear regression with an R^2 value of 0.84 (Figure 6).

Regressions were not performed on the race/ethnicity, gender, and age parameters because they would not only clutter our figures but would be near mirror images for significant results. The racial composition of Philadelphia County is primarily made up of Caucasians and African Americans. At all points within 2 km of auto salvage yards, African Americans make up the greatest proportion of individuals, decreasing linearly from 0.125-1 km before increasing slightly to 2 km. In an opposite trend, the proportion of Caucasians increases steadily from 0.125-1 km before decreasing slightly to 2 km. For individuals who identify as Other, Asian American, Plus 2, AI/AN, or NHI/PI there were no apparent trends (Figure 7). The population of Philadelphia County was 53% female and 47% male. Within 0.125 km of auto salvage yards 57.5% of individuals identified as female and 42.5% identified as male. The percent composition decreased sharply to the county average for females and increased sharply to the county average for males at 1 km before leveling out (Figure 8). Within two kilometers of auto salvage yards the highest proportion of individuals were in the 0-17 age range, making up roughly a quarter of the population. The only age group that showed a significant trend were those individuals in the 65+ age bracket. At an eighth of a kilometer 21.5 percent of the population was 65 years or older. As the distance increased to one kilometer the

proportion of these individuals decreased to 9 percent before increasing to 14 percent two kilometers away (Figure 9).

Adams County

According to the 2010 census, the population density of Adams County was 75 individuals km^{-2}. Within the 0-0.25 range population density was 62 km^{-2} increasing following a reverse quadratic to 144 km^{-2} before decreasing to 74 km^{-2} at 2 km with an R^2 value of 0.99 (Figure 5). In 1999, per capita income in Adams County was $22,900. Between 0.125 and 2 km away from auto salvage yards per capita income decreased from $23,800 to $23,300 following a logarithmic regression with an R^2 value of 0.96 (Figure 6).

Regressions were not performed on the race/ethnicity, gender, and age parameters because they would not only clutter our figures but would be near mirror images for significant results. In 2010, the population of Adams County was 93.5% Caucasian. Within the 2 km range surrounding all 11 auto salvage yards across the county there was little to no variation in percent composition as a function of distance (Figure 7). The population of Adams County was 51% female and 49% male. Auto salvage yards did not appear to have effect on the proportion of males or females living near them compared to the rest of the county (Figure 8). Within 2 km of auto salvage yards the highest proportion of individuals were in the 0-17 age range, making up roughly a quarter of the population, and the lowest proportion of individuals were 18-24 years old, making up less than 10% of the population. No age bracket showed a significant trend as a function of distance from auto salvage yards (Figure 9).

Discussion

While for the majority of Philadelphia County the blocks and block groups are very small, those same units for Adams County are in some cases very large. As a result it is very difficult to

capture data about the desired buffer distances in Adams County. In some cases the blocks or block groups contained data within their extent that was many kilometers away from the auto salvage yard to which it was being related. This methodology may have had the impact of misrepresenting the composition of populations that live in close proximity to auto salvage yards.

Conspicuously missing from the data set is any information about Hispanic/Latino populations. This is an unfortunate result of the data that are available from the Census Bureau. When collecting census data on race/ethnicity, Hispanics are addressed as a subset of each race/ethnicity that has been reported. Because of the structure of the census data it was not possible to manage the volume of data that was being used to extract the population that identified as Hispanic/Latino. Had this been done, additional error may have been introduced in the form of double counting individuals as multiple races. Adams County is known for having a large Hispanic population and this population may have self-identified as "Plus 2" or "Other".

In Philadelphia County some of the buffers intersected the edges of the county line. To maintain consistency with respect to only surveying Philadelphia County, any data that would have lied outside of the county were not included in this analysis. This decision obviously creates errors of omission that may have minimized the extent to which some of the larger buffers differed from the smaller ones that existed entirely within the county.

The income data that were available is nearly fifteen years old. In that time the United States has experienced two periods of economic downturn, the most serious of which being the recession of 2008-2009. It is likely that the results would be different with current data; however, how much change and in what demographic groups cannot be said.

Population Density and Per Capita Income

In Philadelphia County, 98% of the population density around auto salvage yards was explained by an increasing logarithmic function of distance. The steepest growth was seen closer to

auto salvage yards, leveling out as the distance increased. This observation is logical because auto salvage yards are undesirable to live near and are frequently found in areas that are zoned as commercial or industrial where populations are near zero. Adams County, on the other hand, shows a surprising trend of low population density increasing initially and then decreasing to near initial levels 2 km away. A reverse quadratic regression explains 99% of population density around auto salvage yards in Adams County. A possible explanation for this population shift could be related to the rural nature of the county. We expect a low population increasing as distance from auto salvage yards increases. The decrease in population density to two kilometers may be the result of the inclusion of large amounts of farmland that exist outside of communities where the salvage yards are located.

In Philadelphia County, per capita income increases with distance from an auto salvage yard. This is the expected result as individuals with higher incomes would not generally elect to live close to an auto salvage yard. Even so the per capita income is $4,000-$5,300 lower within the 2 km buffer than over the entire county as a whole. Conversely, in Adams County, the trend suggests that income decreases with increased distance. It seems likely that this trend is the result of the large census block groups and the rural nature of Adams County. Additionally, the range of per capita income figures varies by less than eight hundred dollars, which is not a significant amount.

Race, Sex, and Age

In Philadelphia County it is evident that racial bias exists in the regions immediately surrounding auto salvage yards. Almost three-quarters of the population living within 0.125 km of auto salvage yards is African American compared to a mere 13% Caucasian. This difference reaches a minimum 1 km away from the source. In Adams County, there is very little racial diversity. It is not surprising therefore that there is a fairly consistent and high percentage of Caucasians living at each distance from auto salvage yards.

In Adams County the results with regards to sex do not show any trends that are likely to be indicative of any sort of bias against women. However, in Philadelphia County it does appear that within 0.125 km of an auto salvage yard there is a higher proportion of women. While not likely being the direct result of gender discrimination it could be postulated that lower wages for working women result in their having to select less desirable housing that comes at a lower cost.

With respect to age, neither county's populations change dramatically except for the case of 65+ individuals in Philadelphia. The elderly population decreases sharply with increased distance from auto salvage yards. This may very well be the result of poverty within aging populations. Pensions and social security have failed to keep up with inflation and for individuals who may have retired twenty years ago, their monthly cash flows are very small and while they could have sustained them at the time that they retired, are no longer sufficient to afford such individuals the opportunity to be selective with regards to their housing (Engelhardt and Gruber 2004).

There are interactions between race, age and sex that may be responsible for some of the trends that we have seen. Women and minority women in particular are the group of people most likely to be living in poverty (Cawthorne 2008). Of impoverished women, greater than 25% of them are single parents. This relation to single parents ties the female population to the large percentage of young children that live nearby auto salvage yards. Information collected about women suggests that what is being seen in our trends is likely a higher concentration of impoverished, single, mothers (Cawthorne 2008, Poverty 2014).

Conclusion

These collective results have a variety of implications as they relate to the question of what minorities are potentially impacted and to what extent. In Adams County the results fail to show any overarching trends that suggest that minorities are being over exposed to potential hazards of auto salvage yards. Philadelphia County, however, does show some trends that may indicate the presence

of potential environmental justice issues similar to those found in the case of Chester, Pennsylvania (Chester 1996).

Adams County lacks diversity and as it is very rural auto salvage yards seem to be farther away from all people rather than a few select minority populations. In Philadelphia County the data results suggest that in general African Americans, women, the young, and the elderly make up the majority of people living in the areas closest to auto salvage yards. The results also suggest that the groups of people living there also have a lower income per capita. This result makes a strong argument for a locally developed case of environmental injustice (Environmental 2014).

Considering the health concerns associated with many of the materials found in auto salvage yards these populations may be at an increased risk of health related problems due to their composition. The large population of very young people is concerning when considering the probable presence of heavy metals in the area. Lead and other heavy metals have been proven to adversely affect brain development in young people (Byers and Lord 1943, Centers 1985). The large population of old people on the other hand have weaker immune systems and are more likely to have pre-existing organ system complications (Chandra 1997). Heavy metals also are responsible for organ damage. In a case where an individual may already be living with impaired kidney or liver function any additional stressor on such organ systems present a very real threat to health and safety.

The large population of women is also of concern as many of the metals and chemicals present at salvage yards can have strongly adverse effects on fetal development during pregnancy. There is a risk of developmental problems that could severely impair a child's ability to achieve a relatively normal quality of life (Glinianaia et al. 2004).

Racism continues to plague the United States and despite many efforts to ensure equality, they are not always successful. As in the case of the people of Chester, Pennsylvania, racial minorities frequently find themselves disproportionately exposed to undesirable and unhealthy living conditions (Chester 1996). This seems to be the case with respect to auto salvage yards in

Philadelphia County. The large percentage of African American individuals living near salvage yards could have several reasons. One explanation is that there could be a linkage between low incomes and membership in a minority population (Poverty 2014) . This is a national trend that may have manifested itself in this case by concentrating low-income African American households in an area where property values are lower and they can more easily afford housing. Lower property values and an increasing minority population may have caused what some call "white flight" where the Caucasian population responds to an increase in the presence of minorities by seeking new housing in a more homogeneously Caucasian community (Suarez 1999). As the age of these auto salvage yards is not known, it is also possible that they have been placed into these minority communities after the communities were already established. This placement would suggest that developers or businessmen might have abused the lack of education and representation that these communities have in order to secure a location for new development. There is a third possibility, which is that members of these minority communities have established some of these auto salvage yards themselves. Scrap consolidation is a field of work that does not require the pursuit of an expensive college education. It is possible that these communities have created employment opportunities for themselves; however, there is no way to approach such an idea from this method of study.

Based on our results it seems reasonable to suggest that minority populations in Philadelphia County are being exposed to the potential hazards of auto salvage yards at a higher rate than non-minorities. With regards to Adams County, the rural nature of the area combined with the general lack of minority populations prevents any trends similar to those seen in Philadelphia County from being observed. Future studies may choose to consider more widely the demographic composition of rural areas compared to suburban or urban areas and potentially make a statement about the relative risk of environmental justice issues as a function of level of development.

Works Cited

Blank, H. (Director). (1992). *Wild wheels* : Zoom In Productions.

Bryant, B. I. (1995). *Environmental justice: issues, policies, and solutions*. Washington, D.C.: Island Press.

Byers, R. K., & Lord, E. E. (1943). Late effects of lead poisoning on mental development. *Archives of Pediatrics & Adolescent Medicine*, *66*(5), 471.

Cawthorne, A. (2008, October 8). The Straight Facts on Women in Poverty. *Center for American Progress*. http://www.americanprogress.org/issues/women/report/2008/10/08/5103/the-straight-facts-on-women-in-poverty/

Centers for Disease Control (CDC. (1985). Preventing lead poisoning in young children--United States. *MMWR. Morbidity and mortality weekly report*, *34*(5), 66.

Chandra, R. K. (1997). Nutrition and the immune system: an introduction. The American journal of clinical nutrition, 66(2), 460S-463S.

Chester Residents for Quality Living v. Seif, 944 F. Supp. 413 (E.D. Pa. 1996).

Curley, A., Sedlak, V. A., Girling, E. F., Hawk, R. E., Barthel, W. F., Pierce, P. E., & Likosky, W. H. (1971). Organic mercury identified as the cause of poisoning in humans and hogs. *Science*, *172*(3978), 65-67.

Dayan, A. D., & Paine, A. J. (2001). Mechanisms of chromium toxicity, carcinogenicity and allergenicity: review of the literature from 1985 to 2000.*Human & Experimental Toxicology*, *20*(9), 439-451.

Engelhardt, G. V., & Gruber, J. (2004). *Social security and the evolution of elderly poverty* (No. w10466). National Bureau of Economic Research.

Environmental Concerns at Auto Salvage Yards. (2010). New Hampshire Department of Environmental Sciences.

Environmental Justice. (2014, March 10). *EPA*. Retrieved , from http://www.epa.gov/compliance/environmentaljustice/.

Frequently Asked Questions. (2014). *U.S. Census Bureau: FAQs*. Retrieved April 25, 2014, from https://ask.census.gov/faq.php?id=5000&faqId=6391.

Friberg, L. (1950). Health Hazards in the Manufacture of Alkaline Accumulators with special reference to Chronic Cadmium Poisoning. A Clinical and Experimental Study. *Acta medica scandinavica*, *138*(Suppl. 240).

Glinianaia, S. V., Rankin, J., Bell, R., Pless-Mulloli, T., & Howel, D. (2004). Particulate air pollution and fetal health: a systematic review of the epidemiologic evidence. *Epidemiology*, *15*(1), 36-45.

Goode, J. (2002). *Drive: women's true stories from the open road*. New York: Seal Press.

Harte, J. (1991). *Toxics A to Z: a guide to everyday pollution hazards*. Berkeley: University of California Press.

Heiman, M. K. (1996). Race, waste, and class: new perspectives on environmental justice. *Antipode*, *28*(2), 111-121.

Hughes, M. F. (2002). Arsenic toxicity and potential mechanisms of action.*Toxicology letters*, *133*(1), 1-16.

Hurwitz, J. H., & Sullivan, E. Q. (2001). Using Civil Rights Laws to Challenge Environmental Racism-From Bean to Guardians to Chester to Sandoval. *JL Soc'y*, *2*, 5.

Jerrett, M., Burnett, R. T., Kanaroglou, P., Eyles, J., Finkelstein, N., Giovis, C., & Brook, J. R. (2001). A GIS-environmental justice analysis of particulate air pollution in Hamilton, Canada. *Environment and Planning A*, *33*(6), 955-974.

Kunstler, J.H. 1993. *The Geography of Nowhere.* New York, New York: Simon & Schuster, Inc.

Leth, P. M., & Gregersen, M. (2005). Ethylene glycol poisoning. *Forensic science international*, *155*(2), 179-184.

Lewis, T. (1997). *Divided Highways: Building the Interstate Highways, Transforming American Life.* New York, New York: Viking Penguin.

Loucks, O. L. (1999). *Sustainability perspectives for resources and business*. Boca Raton: Lewis Publishers.

Lucas, G. (Director). (1973). *American Graffiti* : Universal City.

Maantay, J. (2002). Zoning law, health, and environmental justice: what's the connection?. *The Journal of Law, Medicine & Ethics*, *30*(4), 572-593.

Newton, D. E. (1996). *Environmental justice a reference handbook*. Santa Barbara, Calif.: ABC-CLIO.

Poverty in the United States: a snapshot. (2014). *National Center for Law and Economic Justice.* Retrieved, from http://www.nclej.org/poverty-in-the-us.php

Production Statistics | OICA. (2013). *OICA.* Retrieved , from http://www.oica.net/category/production-statistics/

Rinsky, R. A., Smith, A. B., Hornung, R., Filloon, T. G., Young, R. J., Okun, A. H., & Landrigan, P. J. (1987). Benzene and leukemia. *New England journal of medicine*, *316*(17), 1044-1050.

Suarez, R. (1999). *The old neighborhood: what we lost in the great suburban migration, 1966-1999*. New York: Free Press.

Singh, V. P. (2005). *Metal toxicity and tolerance in plants and animals*. New Delhi: Sarup.

Snow, R. (2013). *I invented the modern age: the rise of Henry Ford*. : Simon and Schuster.

Sparks, D. L. (2003). *Environmental soil chemistry*. Academic press.

U.S. Scrappage Rate Grows as More Cars Junked, Fewer Sold. (2010).*WardsAuto Home Page*. Retrieved from http://wardsauto.com/news-amp-analysis/us-scrappage-rate-grows-more-cars-junked-fewer-
sold

Vehicle Recycling Manual. (2011). Washington State Department of Ecology

Ward's world motor vehicle data 2007 ([2007 ed.). (2007). Southfield, MI: Ward's Automotive Group.

What are census blocks?. (2014). *Random Samplings*. Retrieved April 25, 2014, from http://blogs.census.gov/2011/07/20/what-are-census-blocks/

Yokel, R. A. (2000). The toxicology of aluminum in the brain: a review.*Neurotoxicology*, *21*(5), 813.

Zeiss, C., & Atwater, J. (1989). Waste facility impacts on residential property values. *Journal of Urban Planning and Development*, *115*(2), 64-80.

Appendix

Figure 1. Google earth imagery of auto salvage yards in Philadelphia County (Top) and Adams (Bottom) County, Pennsylvania.

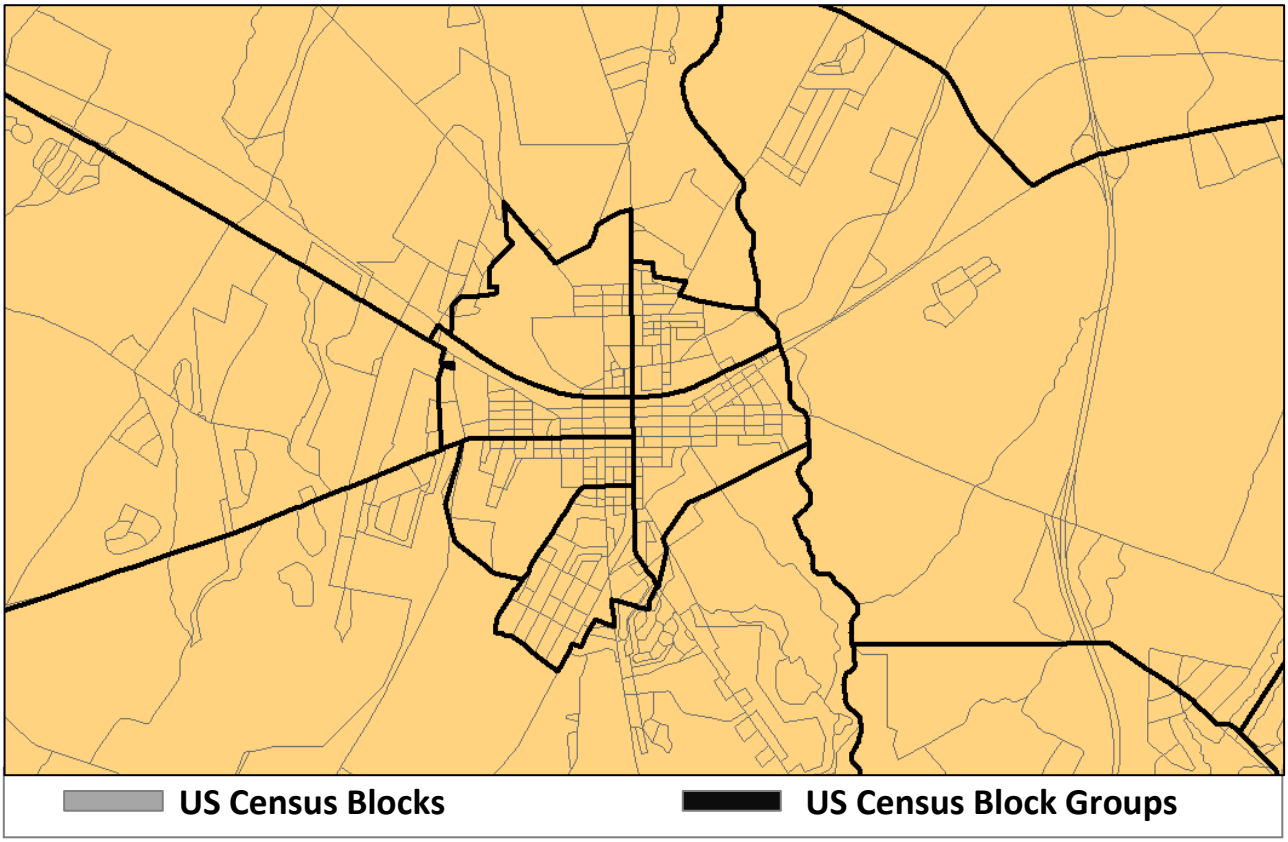

Figure 2. Map of the Gettysburg Borough in Adams County, Pennsylvania that shows the difference in size between US Census blocks and US Census block groups.

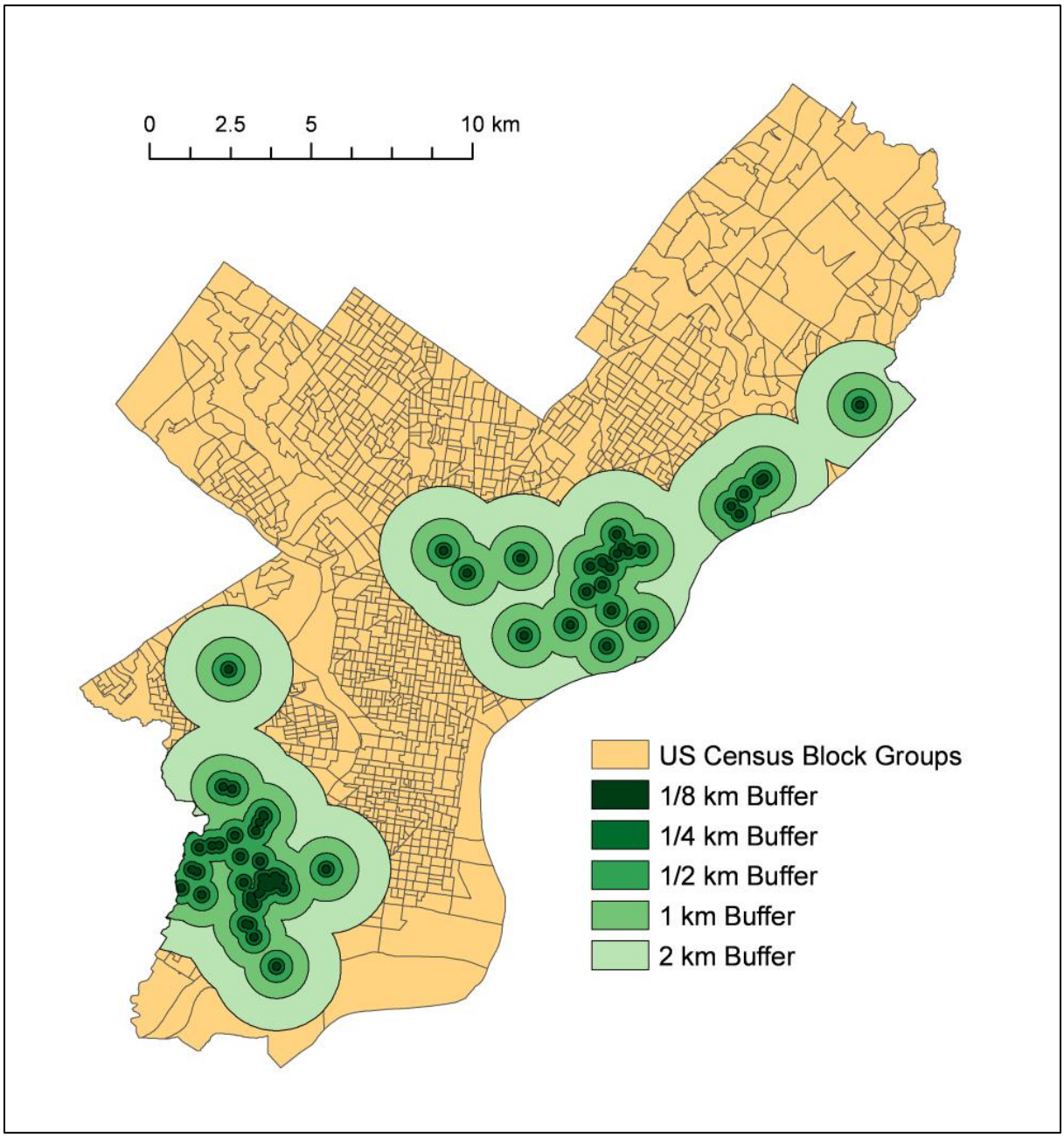

Figure 3. Map of 5 separate ranges representing distance from auto salvage yards in Philadelphia County, Pennsylvania. The ranges are 0-0.125 km, 0.125-0.25 km, 0.25-0.5 km, 0.5-1 km, and 1-2 km.

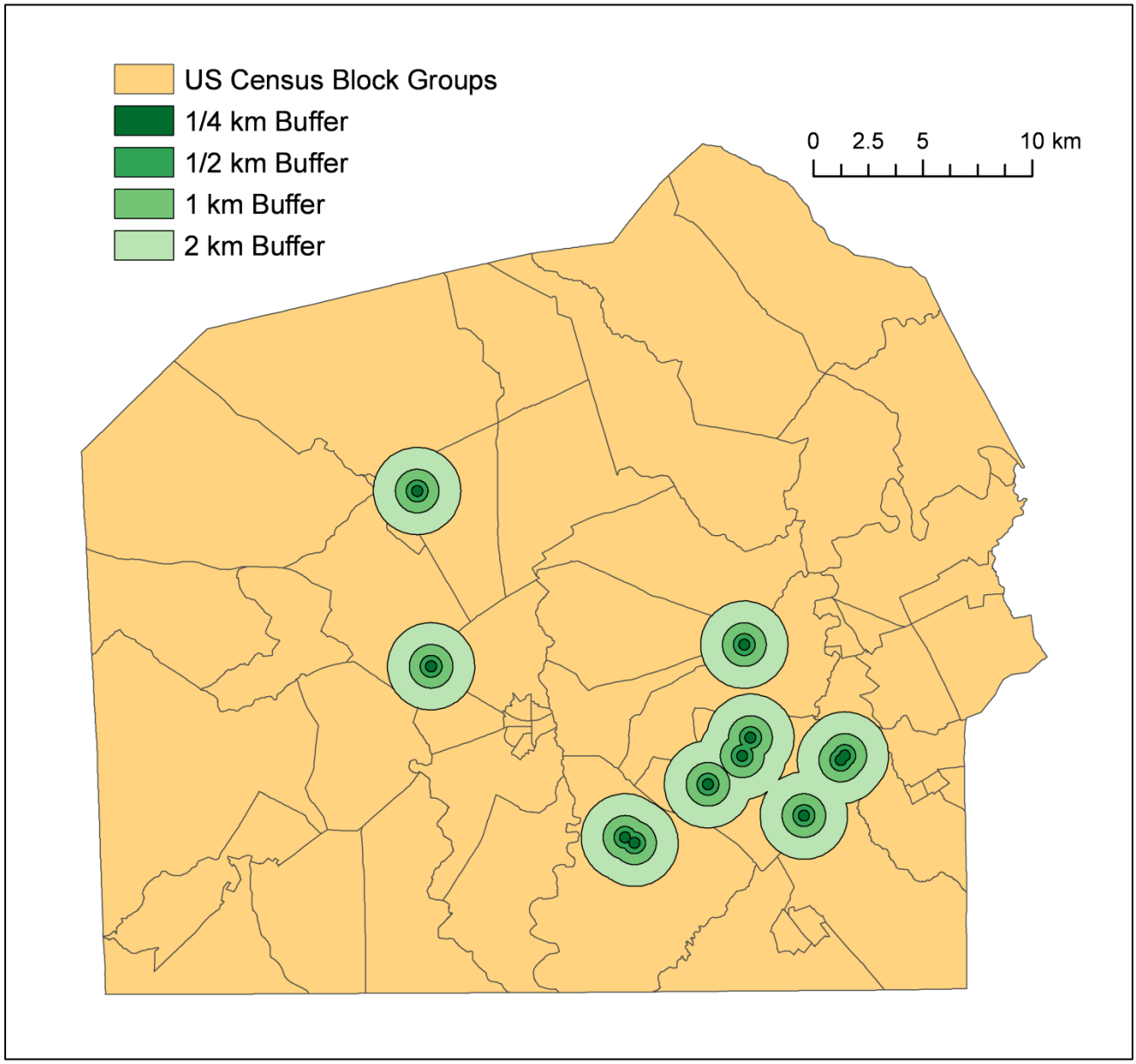

Figure 4. Map of 4 separate ranges representing distance from auto salvage yards in Philadelphia County, Pennsylvania. The ranges are 0-0.25 km, 0.25-0.5 km, 0.5-1 km, and 1-2 km.

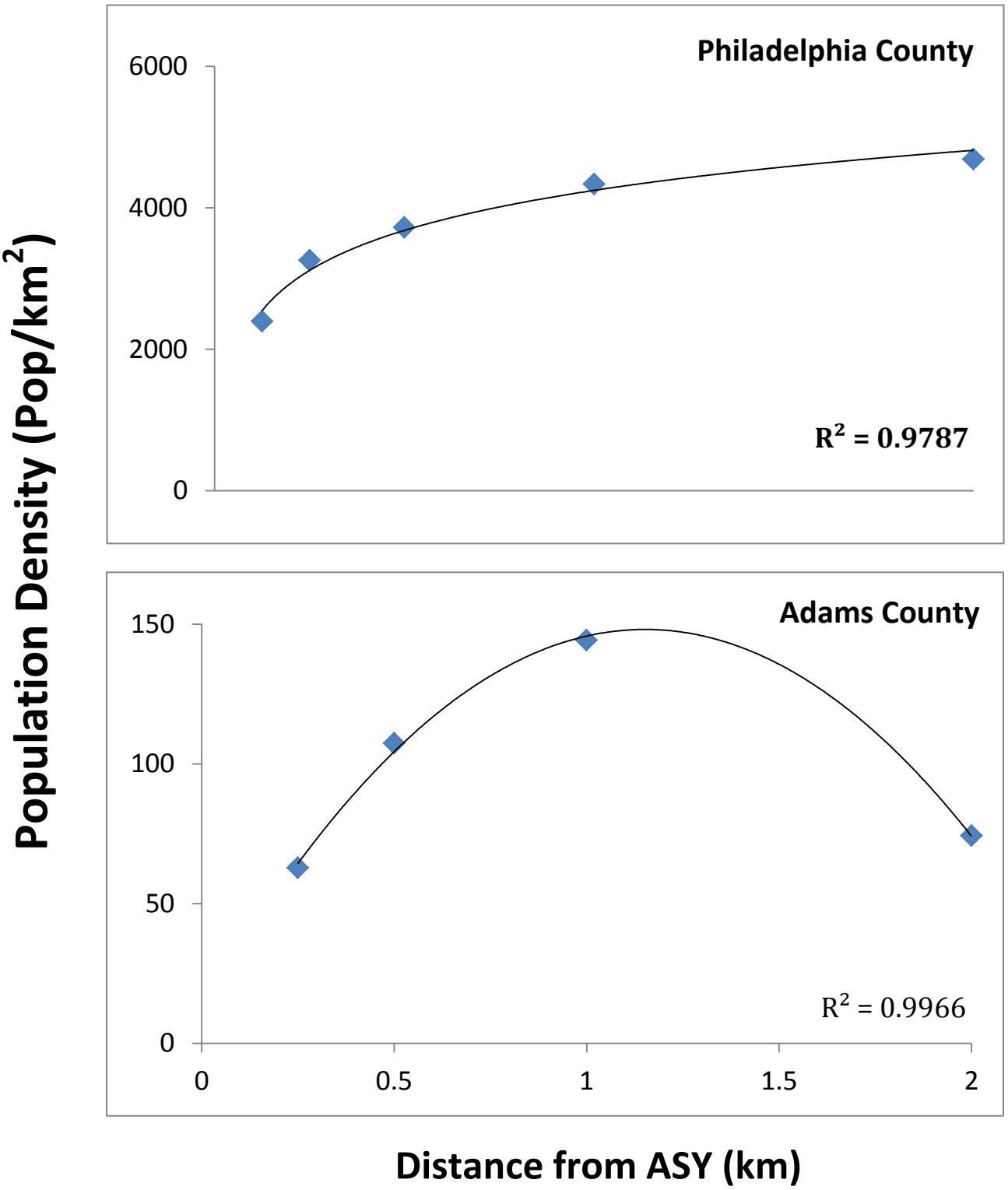

Figure 5. Regression curves representing population density as a function of distance from auto salvage yards in Philadelphia and Adams County, Pennsylvania.

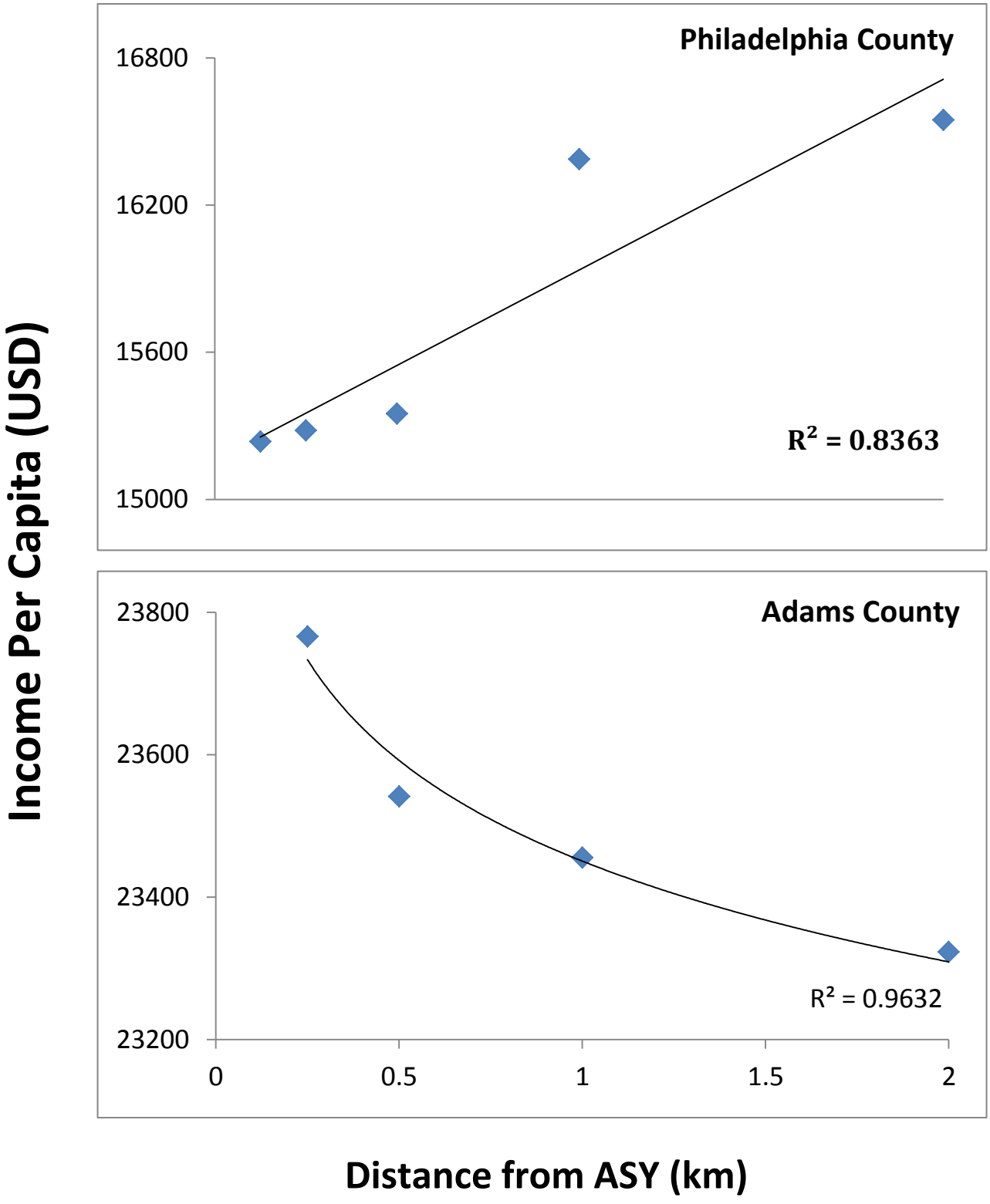

Figure 6. Regression curves representing income per capita as a function of distance from auto salvage yards in Philadelphia and Adams County, Pennsylvania.

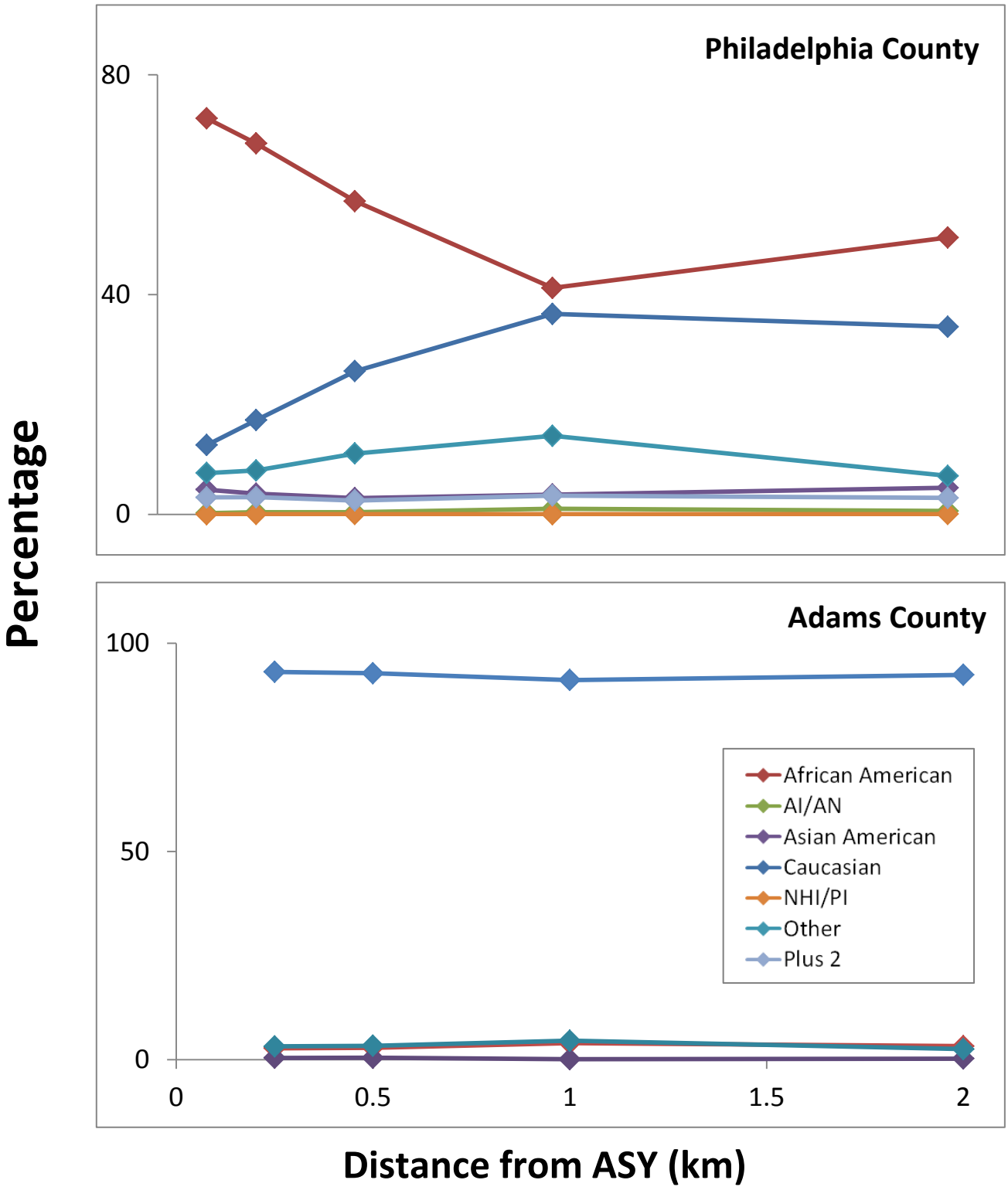

Figure 7. Line graphs representing racial composition as a function of distance from auto salvage yards in both Philadelphia and Adams County, Pennsylvania.

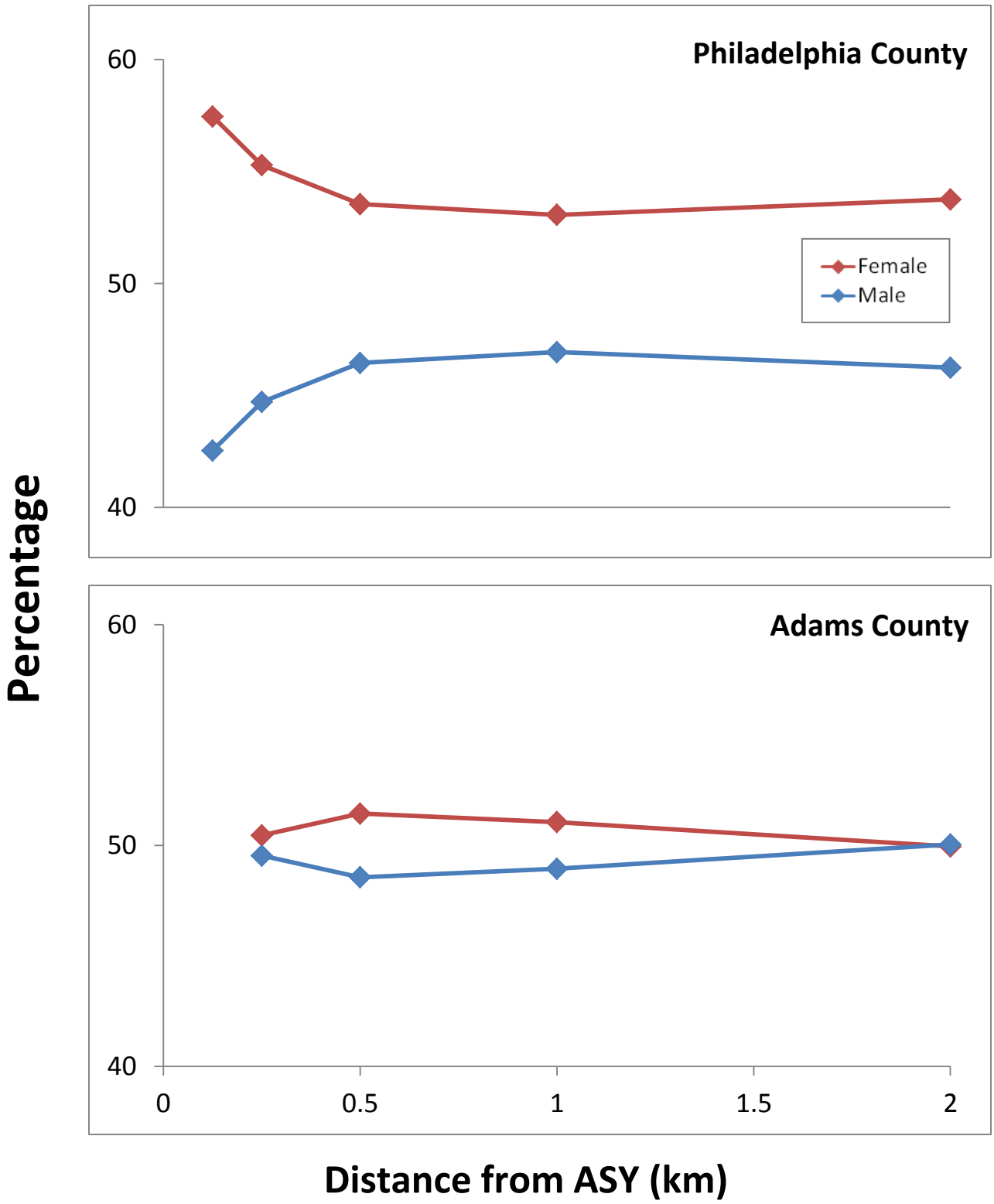

Figure 8. Line graphs representing gender as a function of distance from auto salvage yards in both Philadelphia and Adams County, Pennsylvania.

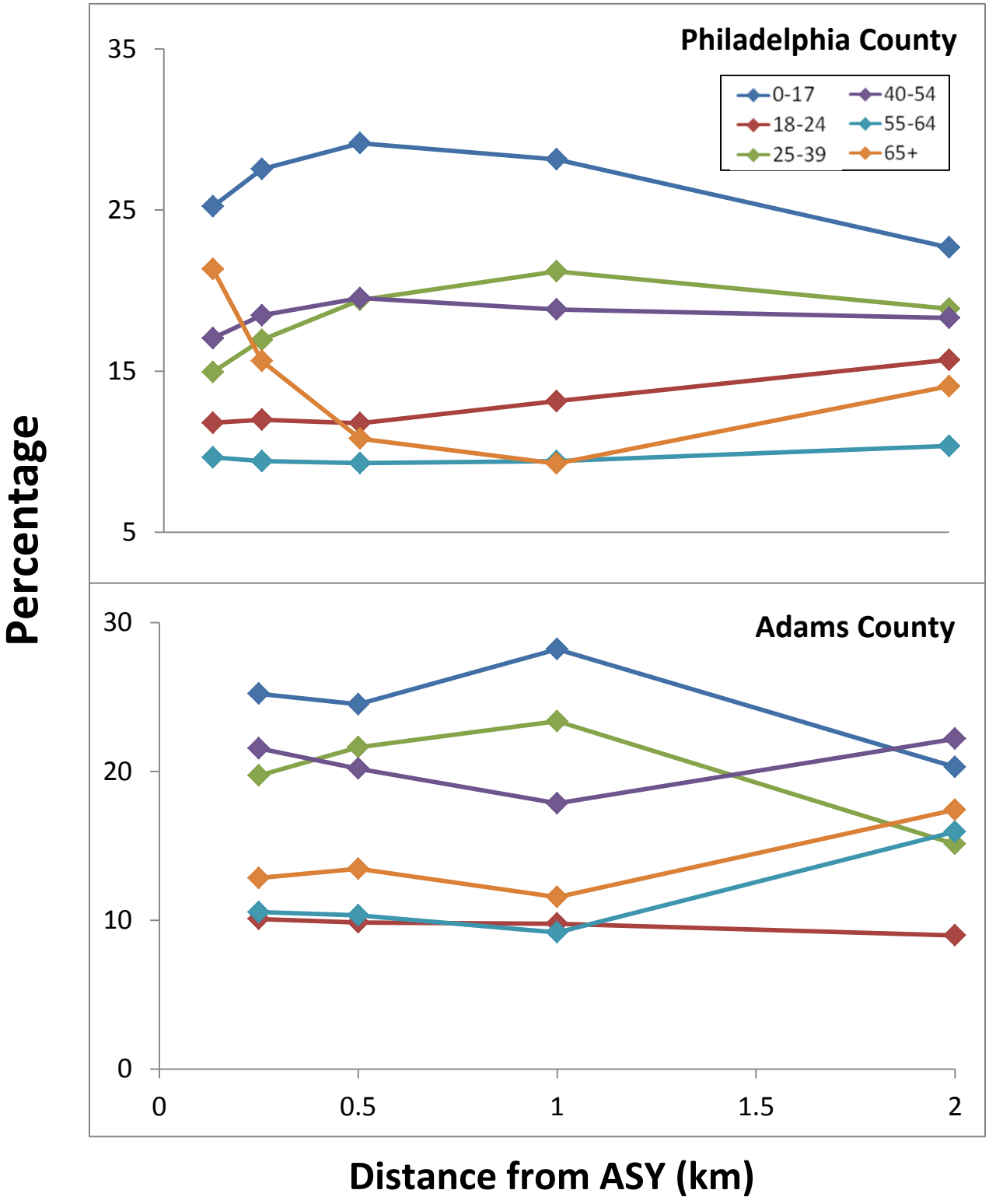

Figure 9. Line graphs representing age as a function of distance from auto salvage yards in both Philadelphia and Adams County, Pennsylvania.