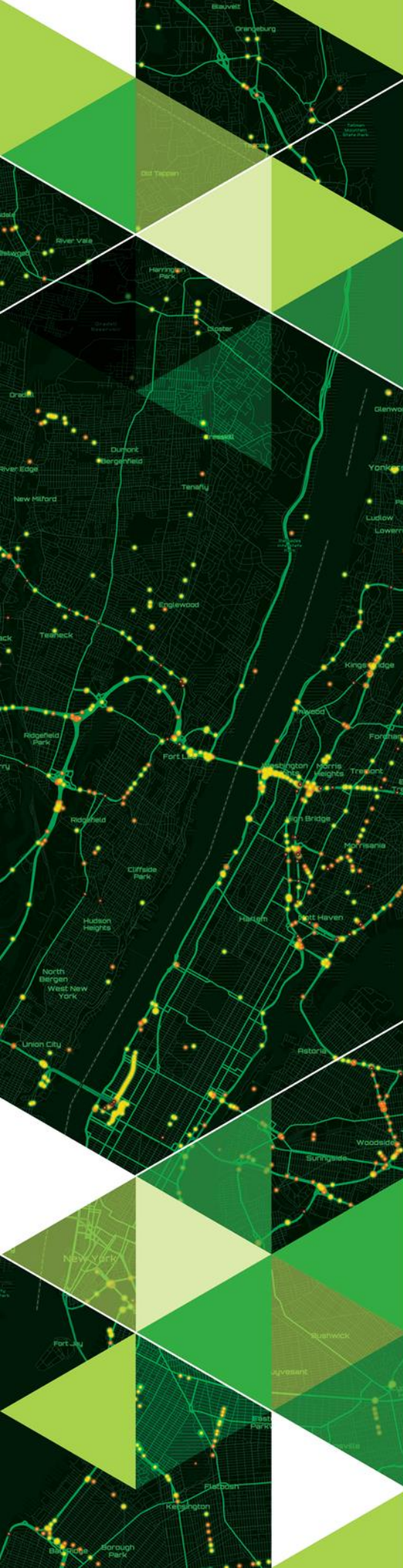




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Methodology statement: 2022/2027 Esri Updated Demographics

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Methodology statement: 2022/2027 Esri Updated Demographics

Data vintage and variables

Esri's 2022/2027 demographic updates mark the transition to a new decennial census base. This transition includes a once-a-decade update to Census 2020 geographic boundaries. Select Esri demographic update universes including population, housing, race, and ethnicity have now been rebased using the P.L.94-171 redistricting counts from the initial release of Census 2020 data. Converting to the new 2020 base required innovated solutions by Esri to adapt to new challenges from differentially privatized Census 2020 data as well as leveraging source data not in current Census 2020 geography. The demographic updates are point estimates representing July 1 of the current and forecast years. The following table summarizes the updated demographic variables. Also included are select averages, medians, aggregates, and per capita values.

		2022	2027
Totals	TOTAL POPULATION	✓	✓
	DAYTIME POPULATION	✓	
	TIME SERIES	✓	
	HOUSEHOLDS	✓	✓
	HOUSEHOLD POPULATION	✓	✓
	FAMILY POPULATION	✓	✓
	FAMILY HOUSEHOLDS	✓	✓
	GROUP QUARTERS POPULATION	✓	✓
	HOUSING UNITS	✓	✓
	OWNER-OCCUPIED HOUSING UNITS	✓	✓
	RENTER-OCCUPIED HOUSING UNITS	✓	✓
	VACANT HOUSING UNITS	✓	✓
Population Characteristics	POPULATION BY FIVE-YEAR AGE AND SEX	✓	✓
	POPULATION BY SINGLE-YEAR AGE AND SEX	✓	✓
	POPULATION BY AGE, SEX, AND RACE	✓	✓
	POPULATION BY AGE, SEX, AND HISPANIC ORIGIN	✓	✓
	EMPLOYED & UNEMPLOYED POPULATION 16+	✓	
	EMPLOYED & UNEMPLOYED 16+ BY AGE GROUP	✓	
	EMPLOYED POPULATION 16+ BY INDUSTRY	✓	
	EMPLOYED POPULATION 16+ BY OCCUPATION	✓	
	POPULATION 25+ BY EDUCATIONAL ATTAINMENT	✓	
	POPULATION 15+ BY MARITAL STATUS	✓	
Housing Characteristics	POPULATION BY GENERATION	✓	✓
	HOUSEHOLDS BY INCOME	✓	✓
	HOUSEHOLDS BY INCOME AND AGE OF HOUSEHOLDER	✓	✓
	HOUSEHOLDS BY DISPOSABLE INCOME	✓	
	HOUSEHOLDS BY DISPOSABLE INCOME AND AGE OF HOUSEHOLDER	✓	
	HOUSEHOLDS BY NET WORTH	✓	
	HOUSEHOLDS BY NET WORTH AND AGE OF HOUSEHOLDER	✓	
	OWNER-OCCUPIED HOUSING UNITS BY HOME VALUE	✓	✓
Indexes and Measures	DIVERSITY INDEX	✓	✓
	HOUSING AFFORDABILITY INDEX	✓	
	PERCENT OF INCOME FOR MORTGAGE	✓	
	WEALTH INDEX	✓	
	AGE DEPENDENCY RATIO	✓	✓
	CHILD DEPENDENCY RATIO	✓	✓
	SENIOR DEPENDENCY RATIO	✓	✓
	ECONOMIC DEPENDENCY RATIO	✓	
	CHILD ECONOMIC DEPENDENCY RATIO	✓	
	WORKING-AGE ECONOMIC DEPENDENCY RATIO	✓	
	SENIOR ECONOMIC DEPENDENCY RATIO	✓	

Census 2020 The U.S. Census Bureau released Census 2020 Redistricting Data (P.L. 94-171) on August 12, 2021. These files are available down to the block level and include tables covering race, ethnicity, population above and below 18 years of age, housing, and group quarters. This information and the updated Census 2020 geographies were processed, realigned where needed¹, and built into models for the 2022/2027 Updated Demographics release². However, key information from the decennial census has not yet been released. The Demographic and Housing Characteristics (DHC) and Detailed DHC files, which take the place of the SF1 files from Census 2010, are planned to be released on a future date. This means that critical information on topics such as age, household type, and tenure is not available to serve as a base in modeling efforts.

The U.S. population increased by 7.4 percent from 2010 to 2020, a growth of 2.3 million people annually. This is the lowest rate of population growth since the 1930s and the second lowest in the nation's history. The slow growth is, in part, a reflection of declining fertility rates, an aging population, and policies unfavorable to immigration. Unlike the trends seen from 2000 to 2010, household (occupied housing unit) growth outpaced total housing unit growth from 2010 to 2020. Housing units grew by 6.7 percent (approximately 879,000 annually) while households increased by 8.7 percent (1 million annually). Following the Great Recession, the housing market experienced a slow and steady recovery, resulting in an occupancy rate increase from 88.6 percent in 2010 to 90.3 percent in 2020 and a decline of more than 130,000 vacant units annually. The growth rate increase for households exceeds the population rate of growth due to the overall decline in the average persons per household, which fell from 2.58 in 2010 to 2.55 in 2020. This is an acceleration of the declining trend from the previous decade that saw average persons per household drop from 2.59 in 2000. Factors contributing to this trend in recent decades include delayed childbearing and increases in the share of both individuals living alone and single-parent households. Regionally, the South saw the largest increases in totals with population and households growing by 10.2 percent and 11.5 percent, respectively. However, the occupancy rate increase in the West marginally outpaced the South with a change from 89.8 percent in 2010 to 91.8 percent in 2020. While average persons per household declined in each region, the Midwest experienced the largest decrease from 2.49 in 2010 to 2.44 in 2020.

Summary totals Forecasting change in the size and distribution of the household population begins at the county level with several sources of data. Esri incorporates a full-time series of intercensal and vintage-based county estimates from the U.S. Census Bureau. Because testing has revealed improvement in accuracy by using a variety of sources to track county population trends, Esri also employs a time series of county-to-county migration data from the Internal Revenue Service, building permits and housing starts, plus residential postal delivery counts. Beginning with this decade, Esri has modeled housing demolitions using data from the American Housing Survey (AHS). The end result balances the measures of growth or decline from a variety of data series.

¹ <https://www.esri.com/arcgis-blog/products/esri-demographics/state-government/census-2020-realignment-by-esri/>

² For more information on the Census 2020 data products and Esri's value added, refer to <https://storymaps.arcgis.com/stories/822e39c59bed4b4a9c6fbaf307945c2>.

Measuring change in population or households at the county level is facilitated by the array of data reported for counties. Unfortunately, there is no current data reported specifically for block groups. Past trends can be calculated from previous census counts; the American Community Survey (ACS) provides five-year averages. However, these sources are not recent. To measure current population change by block group, Esri models the change in households from multiple sources: Experian; the U.S. Postal Service (USPS); Zonda, a Hanley Wood company; and RealPage, in addition to several ancillary sources.

The U.S. Postal Service publishes monthly counts of residential deliveries for every U.S. postal carrier route. This represents the most comprehensive and current information available for small, subcounty geographic areas. Carrier routes are a fluid geographic construct that is redefined continuously to incorporate real changes in the housing inventory and occupancy plus administrative changes in staffing and budgets of local post offices.

Converting delivery statistics from postal carrier routes to census block groups is a complex challenge. Carrier routes are defined to deliver the mail, while block groups are constructed to collect and report census data. Comparing two areas that are defined for wholly different purposes provides one significant conversion issue. Carrier routes commonly overlap multiple block groups. In many cases, a carrier route encompasses disjointed areas that can be distant from each other, but block groups are rarely divided into multiple polygons. These overlaps require an effective method of allocating the postal delivery counts across multiple block groups.

Esri has developed a technique to link carrier routes to the correct block groups—using the actual locations of mail deliveries. Its proprietary Address Based Allocation (ABA) methodology was developed in 2005 to solve the complex challenge of converting delivery counts from carrier routes to block groups. This allocation method assigns carrier routes using household addresses that are geocoded at the block level to serve as the foundation for the conversion. The approach is unbounded by geographic borders or arbitrary assumptions about the distribution of households or postal deliveries. ABA results have been tested extensively against Census 2010 counts, including an independent evaluation that involved data from four other vendors. This test confirmed the accuracy of Esri's ABA allocation method.³

For over a decade, Esri has licensed data from Zonda to track new residential construction in the top U.S. housing markets. This database identifies the location and characteristics of individual construction projects, including total units planned, under construction, and closed by type of housing. This data is especially critical in tracking growth in previously unpopulated areas. Beginning with the 2016 updates, Esri has used an additional database from Zonda that more than doubles Esri's geographic coverage and the number of units planned and completed. The addition of this database gives the household and housing unit update a finer level of granularity and insight into smaller housing markets across the nation.

RealPage housing data is incorporated to capture the growing multifamily rental market. Similar to Zonda that covers new residential-owned dwellings such as single-family homes and condominiums, RealPage collects and maintains data on planned,

³ esri.com/~media/Files/Pdfs/library/brochures/pdfs/vendor-accuracy-study.pdf

new, and existing rental properties of multifamily and student apartments nationwide. This data source provides a wealth of property-level characteristics, such as the total number of units or beds, building type, number of stories, and occupancy, as well as asking rent.

The best techniques are derived from a combination of models and data sources. Discrepant trends are checked extensively against independent sources and premium imagery data from Esri's ArcGIS Living Atlas of the World. Finally, totals for block groups are controlled to the county totals. Despite the appeal of microforecasting, there is more information available to track population change by county than by household. Ignoring the advantage of county-level data would be throwing away information.

Five-year projections

Projections are necessarily derived from current events and past trends. The past and present are known; the future must be extrapolated from this knowledge base. Even though projections represent the unknown, they are not uninformed. Guidelines for the development of projections also inform the use of those projections.

- The recent past provides a reasonable clue to the course of future events, especially if that information is tempered with a historical perspective.
- A stable rate of growth is easier to anticipate than rapid growth or decline.
- The damaging effects of natural disasters cannot be anticipated. Esri makes every effort to assess the impact of sudden, catastrophic events like strong storms, flooding, or wildfires.
- The risk inherent in forecasting is inversely related to the size of an area: the smaller the area, the greater the risk.
- The risk increases with the length of the projection interval. Any deviation of the projected trends from actual events is amplified over time.

Esri revises its forecasts annually to draw on the latest data. Future construction projects, as well as developments currently under construction, give Esri a unique view of the future landscape. Projections can be enhanced with personal knowledge of an area to provide the qualitative, anecdotal detail that is not captured in a national database. It is incumbent on the data user and the producers to incorporate as much information as possible when assessing local trends, especially for areas that are subject to boom-bust cycles or natural disasters.

Population and household characteristics

Esri incorporates a variety of data sources to update small areas like block groups, beginning with the latest base and then adding a mixture of administrative records and private sources to capture change to the base. Shifting the base every year to the latest release of ACS data incorporates real change with sampling error. To establish a more stable base, Esri has built estimate bases for key variables like income, labor force, and home value. The estimate bases combine the best data from ACS with other sources and enable better measures of change than are possible with ACS data alone. Periodic changes to the estimate bases are necessary to collect current change. Base changes impact comparability of the annual data but provide more reliable estimates. Demographic updates must incorporate both traditional and new data sources to remain current.

The population by age and sex is projected via a cohort survival model that separately calculates the components of population change by age and sex. Applying survival rates specific to the cohort carries a 2015 population base forward. Changes in the population by age and sex diverge at the household level. For example, an area that is losing population can age more rapidly with the loss of population in prime migrant ages, 20–34 years—unless there is a college nearby. Neighborhoods near colleges sustain high turnover from student populations but retain their youthful age distributions.

To capture these variations, Esri's model first separates the group quarters population⁴ from the household population and, second, keys the calculations to the size and characteristics of the population. This stratification identifies several patterns of change by age and sex that can be applied in a cohort survival model.

The changing profile of the U.S. population requires measuring population change by race and Hispanic origin. The American identity is shaped by diversity. Tracking the changing patterns of race and ethnicity provides a current portrait of our society. Historical trends in race and ethnicity combined with the most current data sources by race and Hispanic origin, including population estimates by county and state from the Census Bureau and survey data from the ACS, are analyzed to establish county population by race and Hispanic origin. Forecasts by block group combine local changes in the distributions by race and projected change for counties. The last step controls block group distributions to county totals by race and Hispanic origin.

The changing face of our nation is evident in Esri's Diversity Index, which summarizes racial and ethnic diversity in an area. Esri's definition of diversity is two-dimensional and combines racial diversity with ethnic diversity. This measure shows the likelihood that two persons, chosen at random from the same area, belong to different races or ethnic groups. In theory, the index ranges from 0 (no diversity) to 100 (complete diversity). An area's diversity index tends toward 100 when the population is more evenly divided across race and ethnic groups. If an area's entire population is divided evenly into two race groups and one ethnic group, the diversity

⁴ For the 2022 update cycle, group quarters estimates were kept constant at 2020 values. For most geographic areas the 2020 and 2022 vintages of this variable will contain the same value. However, for geographic areas such as user-defined polygons (for example, rings or drive times), ZIP Codes, places, CSDs, and Congressional Districts, 2020 and 2022 group quarters are independently created using geographic correspondence files from the base block group data layer. As a result, the apportioned values for both may differ for select areas. This is an artifact from the creation of (and application of) geographic correspondence files when creating data for these geographic layers or custom trade areas.

index equals 50. As more race groups are evenly represented in the population, the diversity index increases. Race and Hispanic origin data are reported by the Census Bureau and other agencies as grouped summary data; therefore, in practice, the diversity index will not reach the maximum value of 100. Nationally, Esri's Diversity Index has risen from 71 in 2020 to 71.6 in 2022, with a forecast to 72.9 in five years.

Diversity also describes the composition of American households. Esri uses the Census Bureau's definition of families and family households. Families include a householder and one or more people living in the same household who are related to the householder by birth, marriage, or adoption; therefore, family households are equal to the number of families. Family households can also include unrelated nonfamily members. Family households are modeled from Census 2010, Current Population Survey (CPS), and ACS data. Average family size has remained constant at 3.14 from 2010 to 2022.

The attendant change in average household size has shown a decline from 2.58 in 2010 to 2.55 in 2020 and remains at 2.55 for 2022. Average household size is used when forecasting the change in household population from the change in households. Average household size is traditionally one of the most predictable components of the forecasts and serves as a link between the population and household universes. Household forecasts are predicated on local patterns of change, which are controlled to the more constant trends for states and counties.

Few block groups represent a cross-section of U.S. households. For example, in areas that gain population from immigration, the trend in average household size is an increase. To distinguish local variation, Esri's model is keyed to the characteristics of households at the block group level. This stratification identifies several patterns of change by household type that are applied to forecast trends in the characteristics of households—both family composition and tenure. Local change is emphasized in the 2022/2027 forecasts of households for counties and block groups. National and state trends are monitored with sources such as the CPS and ACS from the Census Bureau and then applied as controls.

A mixed source model approach is used to forecast 2022 educational attainment and marital status, combining higher-level and timelier single-year ACS data with five-year lower-level ACS data as well as national statistics from the CPS. Adjustments are factored for changes to the base population's characteristics. Forecasted distributions are applied to Esri's 2022 population aged 15 years and older to update marital status. Similarly, educational attainment is updated for the population aged 25 years and older.

Housing data

Esri's housing updates include total housing units, occupancy, tenure, and home value. Total housing unit updates are created from recorded changes in the housing inventory and estimated changes in occupancy rates since April 2020, applied to Census 2020 base data. Recorded change in the housing inventory is culled from several data sources, including multiple construction data inputs from Zonda and RealPage, data for new manufactured homes placed by state from the Census Bureau, and building permits for permit-issuing places and counties. Numerous independent sources are leveraged to obtain detailed information on housing development data where no building permits exist. Independent estimates of change in occupancy are calculated from USPS residential lists, the ACS, and various state and local data sources. Additionally, data from the CPS and the Housing Vacancy Survey (HVS) from the Census Bureau is used to model trends in occupancy.

Data for tenure represents owner- and renter-occupied housing units. Together, the two components sum to total households or total occupied housing units. The delayed release of Census 2020 tenure data required the creation of an updated tenure base represented in the new Census 2020 geographic summary areas. A blend of source data was used, but it was primarily derived from geographically converted 2019 ACS five-year period estimates. Moreover, a time series model based on data from the HVS, combined with changes in the CPS, the ACS, and intercensal data, guides tenure forecasts. With a blend of top-down and bottom-up techniques, the forecasts take advantage of the latest information from survey data at higher levels of geography while employing local characteristics at the lower levels. The small-area models leverage more geographically granular trends from ACS as well as integrate the Zonda and RealPage housing data to update an area's tenure profile. ACS tenure time series data used in the models was smoothed to further reduce survey noise by tempering outlying data points. Data from lower levels of geography is controlled to higher levels to produce the tenure updates. Changes in owner versus renter occupancy are forecasted independently and then controlled to total households.

Esri reports home value for all owner-occupied housing units. A total of 13 home value intervals are reported.⁵ Summary measures of home value include medians and averages that are calculated from the distributions of home value. Medians represent the middle of the distribution or the point that splits the distribution equally.⁶ Medians are calculated using linear interpolation unless the median falls in the highest (>\$2,000,000) interval. Following the Census Bureau's convention, this median is reported as \$2,000,001 because housing value in the upper interval is top-coded to \$2,000,000. Due to limited data availability for these high-valued homes, Esri top-codes average home value to \$2,250,000.

Esri tracks the change in home value using several sources, including annual estimates from the ACS, the Home Price Expectations Survey from Pulsenomics, and the House Price Index (HPI) from the Federal Housing Finance Agency (FHFA). The Home Price Expectations Survey relies on a survey of more than 100 industry experts to forecast growth in the housing market. This forward-looking source is a key input to Esri's forecasts. The HPI is designed to monitor changes in average

⁵ For a table layout, refer to downloads.esri.com/esri_content_doc/dbl/us/Var_List_Updated-Demographics_June2022.pdf.

⁶ For more information on medians, refer to downloads.esri.com/esri_content_doc/dbl/us/Understanding_Medians.pdf.

home prices based on repeat sales or refinancing of the same properties. The index is derived from mortgage loans purchased or securitized by the Federal National Mortgage Association (Fannie Mae) or the Federal Home Loan Mortgage Corporation (Freddie Mac).

Esri's 2022 home value estimates incorporate the extraordinary shift in the housing market following the initial shock of the COVID-19 pandemic. Two years ago, with large swaths of the economy at a standstill, households faced unemployment, pay cuts, and uncertainty. Fueled by low mortgage rates and positive consumer sentiment, the real estate market has experienced unprecedented demand coupled with limited supply. Housing prices have soared in the last year, but growing inventories and rising mortgage rates suggests a slowdown is imminent. Esri forecasts a 7.3 percent appreciation in median home value between 2021 and 2022 and projects 3.4 percent annual change between 2022 and 2027.

Esri's model emphasizes the importance of a stable forecast base. Employing both the ACS's historical five-year estimates and household survey data, Esri's 2022 estimates begin with an updated forecast base that leverages the growing stability of ACS data. Once every few years and particularly during real estate market cycles, it is prudent to reset the base to capture the current housing landscape. Though this does preclude comparisons to past updates, especially for small areas, the base provides a strong foundation to measure change. Local estimates of home value change incorporate supply-demand characteristics, the socioeconomic traits of householders in the area, and trends assessed for larger markets.

Esri leverages current housing and income data to provide a snapshot of affordability. Esri's approach to measuring housing affordability uses an index to quantify the ability of a typical resident to purchase an existing home in an area.⁷ Employing information from a variety of sources to estimate the national average contract mortgage rate, an interest rate of 5.2 percent is estimated for Esri's 2022 Housing Affordability Index model. A 30-year mortgage is assumed, with a down payment of 20 percent of the home price. Regional property tax rates are determined from the latest round of the ACS, and Esri's model follows the Federal Housing Administration's guidelines for debt service ratios. Additionally, the 2022 Percent of Income for Mortgage (POIFM) quantifies the percentage of median household income dedicated to mortgage payments on a home priced at the median value.

⁷ <https://esri.maps.arcgis.com/apps/Cascade/index.html?appid=1419fe7ee70c4267a7258eb59a9a824c>

Labor force data Esri forecasts the 2022 employed and unemployed population aged 16 and older who are either working or actively looking for work, also known as the civilian labor force. The rebound in GDP from a large drop in Q2 2020 continued through 2021. However, a downturn occurred in Q1 2022 with GDP declining at an annual rate of 1.5 percent due in part to an increased trade deficit. Similar to the corresponding economic growth since the pandemic, the unemployment rate has continued on a general downward trend. Job growth raised the total workforce to more than 162 million people.

The civilian labor force does not include active-duty military, institutionalized individuals, and those not actively looking for work. The employed population 16 and older is further broken down by industry and occupation. Esri also provides additional labor market detail with the release of employment and unemployment estimates by four age groups: 16 to 24, 25 to 54, 55 to 64, and 65 and older. These variables are modeled using one- and five-year ACS employment and work status tables, CPS tables, and Local Area Unemployment Statistics (LAUS) trends.

Estimates of the civilian labor force integrate recent change in the supply and demand for labor from the LAUS, Occupational Employment Statistics (OES), and Current Employment Statistics (CES) programs of the Bureau of Labor Statistics (BLS), as well as the ACS and CPS from the U.S. Census Bureau. Federal statistical surveys are the principal sources for labor force trends. The 2022 employment and unemployment estimates are developed from a block group base constructed from one- and five-year ACS labor force tables and current sources. Esri's updated employment by industry and occupation captures temporal change from multiple federal statistical sources: the ACS and CPS from the Census Bureau and the CES and OES programs from the BLS. In 2022, the ACS-derived base at higher levels of geography was modified to better reflect the more current information available from the BLS. Due to this change and the shift to Census 2020 geographies, comparisons to Esri's labor force estimates prior to 2022 are not advised.

Household income Esri's 2022 household income estimates are reported for households as of July 1, 2022. Beginning with 2022, Esri's household income and related estimates reflect the current calendar year (and no longer the previous calendar year). Similarly, forecast year 2027 estimates are reported for forecasted households as of July 1, 2027, and represent household income for 2027. Current year estimates account for both post-pandemic recovery and the high inflationary environment of today. Esri estimates 5.8 percent per year change in median household income between 2020 and 2022. The five-year household income estimates forecast 3.1 percent annual growth in median household income, assuming historical post-recession income recovery rates.

Household income distributions are estimated for areas with 10 or more households only. Esri implements the definition of money income used by the Census Bureau. For each person 15 years of age or older, money income received in the preceding calendar year is summed from earnings, unemployment compensation, Social Security, Supplemental Security Income, public assistance, veterans' payments, survivor benefits, disability benefits, pension or retirement income, interest, dividends, rent, royalties, estates and trusts, educational assistance, alimony, child support, financial assistance from outside the household, and other income.

There are substantial differences between the Bureau of Economic Analysis (BEA) and the Census Bureau in estimates of per capita income. Care should be taken when comparing money estimates with other data sources since many income estimates are based solely on BEA data. Different definitions, methods of data collection, reference area, and population coverage generate different counts and measures of income.⁸ BEA calculates personal income as part of its mission to produce national income accounting estimates such as the gross national product. The Census Bureau collects money income statistics to satisfy its objective to enumerate and describe the population of the United States.

Data for consumer income collected by the Census Bureau covers money income received (exclusive of certain money receipts such as capital gains) before payments for personal income taxes, Social Security, union dues, Medicare deductions, and so on.

Early in the decade, extensive testing concluded that collapsing the ACS's 16 household income intervals into fewer intervals significantly improves statistical reliability. Esri's model estimates household income by nine income intervals.⁹

Estimates for household income are in nominal dollars. In other words, the growth of income attributed to inflation is included in the estimate. Esri models nominal household income directly. With inflation estimates only available at the national and regional levels and selected major cities, and a lack of local area inflation data, estimating local real household income is imprudent. Esri tracks national inflation rates to guide both current-year and forecast-year estimates. Expected national inflation is based on trends from 5- and 10-year break-even rates. These rates are

⁸ <https://www.census.gov/topics/income-poverty/income/guidance/data-sources/cps-vs-other.html>

⁹ For a table layout, refer to downloads.esri.com/esri_content_doc/dbl/us/Var_List_Updated-Demographics_June2022.pdf.

computed from the spread between nominal and inflation-adjusted Treasury securities as of the end of 2020. Break-even rates represent an estimate of the average expected inflation premium that market participants are pricing into these securities over the two time horizons. The annual inflation factor is forecasted at 1.2 percent.

To estimate income for households, Esri evaluates an extensive list of sources for household income trends that include both federal and proprietary sources. The review of national surveys includes the ACS (both one-year and five-year estimates), the BEA's local personal income series, the CPS, and the BLS's Consumer Price Index.

Esri's 2022 income estimates build on a annually updated forecast base. The forecast base capitalizes on historical ACS five-year estimates and household surveys. In any sample-based data source, both sampling and non-sampling errors contribute to the instability of time series data for small areas. Esri has designed parameters to quantify and normalize instability in its sources, producing a robust base on which to measure income change.

After forecasting the state income distributions, household income is estimated for block groups. Esri's income forecasts are uniquely designed to distinguish local variation, changes in income inequality, and urbanicity as differentiators of income growth. The model correlates the characteristics of households at the block group level with changes in income. This stratification identifies several patterns of change by household type that are applied to forecast trends in income. Modeling links the current income change to all households with similar socioeconomic characteristics. Areas with small household bases or missing base data, where the model is unable to capture the local variation, are forecast with another level of modeling to capture the change in income by strata (a group of areas classified by their sociodemographic characteristics). Separate forecasts of the change in income by strata are aggregated to compose the income distributions.

Summary measures of household income include medians and averages that are calculated from the distributions of income. A median represents the middle of the income distribution or the point that splits the distribution equally. A median is calculated from the income intervals of the distribution using Pareto interpolation, unless the median falls in the lowest (<\$15,000) or highest (>\$200,000) interval. For the lowest interval, linear interpolation is used. When the median falls in the upper interval, it is reported as \$200,001 because households in the upper interval are top-coded to \$200,000.

Averages are computed from estimates of aggregate income. Esri's process employs unique sociodemographic methods to model distributions and aggregates simultaneously. This top-down, bottom-up approach not only provides well-grounded small-area estimates but also places emphasis on the relationship between medians and averages.

Household income by age of householder

Household income is reported for seven age of householder groups. The income distribution for these age groups is based on the same nine intervals as household income. Methods for median and average calculations follow those used for household income.

Household income reported by age of householder is updated to be consistent with the 2022 distributions of household income and age of householder. To update the age distribution of householders, lacking age data from Census 2020, Esri must rely on the ratio of householders by age to the population by age from Census 2010 applied to current age distributions. This method does however take into account the change in group quarters population from 2010 to 2020. After the targets are set, the base distributions of household income by age of householder at the block group level are fitted to current distributions of households by income and age of householder. Independent estimates of age by income are key inputs to the model.

Disposable income

Similar to household income, disposable income is estimated in nominal dollars for nine intervals. Disposable income is also reported for the seven age of householder groups. Methods for median and average calculations follow those used for household income.

Disposable income represents money income after taxes—an estimate of a household's purchasing power. The proportion of household income left after taxes is estimated from special studies conducted by the Census Bureau to simulate household taxes. Esri's 2022 disposable income incorporates data from the 2020 Annual Social and Economic Supplement of the Current Population Survey (ASEC).

Four types of taxes are deducted: federal individual income taxes, state individual income taxes, FICA (Social Security) and federal retirement payroll taxes. Property taxes for owner-occupied housing are no longer available in the ASEC and therefore dropped from Esri's model. Internal Revenue Service tax rates are used as guidelines for model testing. Esri then applies the proportions of after-tax earnings to income intervals that are cross-tabulated by age of householder for each state. State-specific proportions account for the variation in taxes by state. The proportions, or multipliers, are then applied to the age by income forecasts for block groups and counties to calculate disposable income.

Net worth

The 2022 update of net worth builds upon the 2019 Survey of Consumer Finances (SCF) and incorporates extraordinary fluctuations on Wall Street and in the real estate sector following the COVID-19 pandemic. Esri's current median net worth estimate is \$155,942 and builds in an 8.6 percent annualized growth in the three years since the last SCF data point.

Beginning in 2019, Esri's total net worth is reported for 12 intervals to include an upper interval of greater than \$2 million. Net worth is also reported for the seven age of householder groups, by 10 net worth intervals. Summary measures of net worth include medians and averages, which are calculated from the distributions of net worth. Similar to household income methods, a median is calculated from the net worth intervals of the distribution using Pareto interpolation, unless the median falls in the lowest (<\$15,000) or highest interval. For the lowest interval, linear interpolation is used. When the median falls in the upper interval, it is reported as \$1,000,001 for net worth by age of householder and \$2,000,001 for total net worth.

Current income is only one component of a household's financial security. Householders' net worth or accumulated wealth reflects their ability to stay afloat

during a financial shock as well as save for future retirement. Net worth is estimated from data on household wealth that is collected from the Surveys of Consumer Finance (SCF) from the Federal Reserve Board from 1992 through 2019. These triennial surveys feature enhanced representation of wealthy households through the comprehensive measurement of net worth components. By definition, net worth equals total household assets less any debts, secured or unsecured. Assets include ownership of homes, rental properties, businesses, individual retirement accounts (IRAs) and Keogh accounts, pension plans, stocks, mutual funds, and motor vehicles. Examples of secured debt include home mortgages and vehicle loans; unsecured debt includes credit cards and other bills or certain bank loans.

Introduced in 2019, Esri's Wealth Index is compiled from a number of indicators of affluence including average household income and average net worth. The concept of wealth is defined by more than above-average household income. Wealth also includes the value of material possessions and resources. Esri captures both income and the accumulation of substantial wealth or the abundance of possessions and resources in its identification of the wealthiest areas in the country. The index represents the wealth of the area relative to the national level. Values exceeding 100 represent above-average wealth.

2022 geography

Current-year estimates and forecasts are prepared initially for counties and block groups. County data is aggregated to Core-Based Statistical Areas (CBSAs), states, or higher levels. Block group data is either aggregated directly or used with a correspondence file to produce data for census tracts, places, county subdivisions, ZIP Codes, congressional districts, and designated market areas (DMAs). For user-defined sites, circles, or polygons, block weights are applied to block group data.

Changes in the geographic areas for which data is tabulated and reported are critical to the analysis of trends. Esri reports data for political and statistical areas that include states, counties, census tracts, block groups, places, county subdivisions, CBSAs, and congressional districts, plus special use areas like ZIP Codes and DMAs. Of course, the provision of small-area data in Esri software allows users to define their own areas of interest too.¹⁰

Data is reported in 2020 geography for most of the standard political and statistical areas. Statistical areas, such as block groups and census tracts, are defined by the Census Bureau (with help from local officials) to collect and report data for neighborhoods. Historically, these areas change every 10 years with each new census. Political areas, such as counties, cities, or townships, are subject to change by local governments.

¹⁰ For more information on Esri's geographic layers, see <https://storymaps.arcgis.com/stories/953b3c417b154eaa9f9648529e2fa842>. To learn more about the method used to estimate data for any user-defined polygons, refer to <https://developers.arcgis.com/rest/geoenrichment/api-reference/data-apportionment.htm>.

The 2022/2027 updates reflect the metropolitan and micropolitan statistical areas released by the Office of Management and Budget (OMB) in March 2020. There are 384 metropolitan and 543 micropolitan areas. Congressional districts represent the 116th Congress. The place inventory is from TIGER 2021 and contains 31,617 areas.

ZIP Codes, which are defined solely by the U.S. Postal Service to expedite mail delivery, can change monthly or whenever the U.S. Postal Service revises delivery routes. ZIP Codes do not represent standard census geographic areas for data reporting. ZIP Code boundaries are not contiguous with census geographic areas or stable over time. Data estimated for ZIP Codes is also subject to change. Residential ZIP Code data is estimated from block group data, using a correspondence created by assigning Census 2020 block points to ZIP Code boundaries from HERE. The vintage of the ZIP Code boundaries is third quarter 2021; the total number of residential ZIP Codes in this release is 32,073.

The integration of demographic and spatial analysis has not only enabled the development of more accurate block group totals, but it has also provided the opportunity to update block totals. Blocks are the lowest common denominator in the geographic hierarchy and progress to block groups, tracts, counties, and states. Blocks are most useful in the estimation of data for polygons, which can be any area outside the geographic hierarchy, from retail trade areas to user-defined polygons (including circles and drive-time polygons). For most areas, the application provides a good estimate for the polygon. If the relationship between the underlying blocks and the parent block groups has changed significantly since 2020, the estimate cannot incorporate that change unless both blocks and block groups are updated.

Esri's data development team

Led by chief demographer Kyle R. Cassal, Esri's data development team has more than 40 years of experience in market intelligence. The team's economists, statisticians, demographers, geographers, and analysts produce independent small-area demographic and socioeconomic estimates and forecasts for the United States. The team develops exclusive demographic models and methodologies to create market-proven datasets, many of which are now industry benchmarks, such as Tapestry™ Segmentation, Consumer Spending, Market Potential, and annual Updated Demographics. Esri® demographics power ArcGIS® through dynamic web maps, data enrichment, reports, and infographics.



Esri, the global market leader in geographic information system (GIS) software, offers the most powerful mapping and spatial analytics technology available.

Since 1969, Esri has helped customers unlock the full potential of data to improve operational and business results. Today, Esri software is deployed in more than 350,000 organizations including the world's largest cities, most national governments, 75 percent of Fortune 500 companies, and more than 7,000 colleges and universities. Esri engineers the most advanced solutions for digital transformation, the Internet of Things (IoT), and location analytics to inform the most authoritative maps in the world.

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