U.S. Fire Administration
National Fire Data Center

Data Sources and National Estimates Methodology Overview for the U.S. Fire Administration's Topical Fire Report Series (Volume 22)

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FEMA

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U.S. Fire Administration

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Background

The topical reports produced as part of the U.S. Fire Administration's (USFA's) Topical Fire Report Series explore facets of the fire problem in the U.S. as depicted through data collected in the USFA's National Fire Incident Reporting System (NFIRS) from incidents reported by local response agencies. Each topical report briefly addresses the nature of the specific fire or fire-related topic, highlights important findings from the data, and may suggest other resources to consider for further information. The national estimates presented in the topical reports are based on data from the NFIRS and the National Fire Protection Association's (NFPA's) annual Survey of Fire Departments for U.S. Fire Experience.

This document addresses national estimates, as well as the data sources used to derive the estimates, with an emphasis on the specific NFIRS data elements analyzed in the topical reports. NFIRS data quality, including "unknown" data entries and missing data values, is also discussed. Because the majority of the USFA's topical reports address fires and losses in buildings, this overview focuses on buildings.

Data sources

National Fire Incident Reporting System

The NFIRS is the world's largest collection of data for incidents to which fire departments respond. These fire departments reported nearly 27 million runs or responses to all incidents including nearly 1.1 million fire runs in 2020.[1] In 2020, the most recent year for available data, 20,436 fire departments reported fire incidents to the NFIRS.[2] In 2020, 69% of U.S. fire departments reported fire incidents to the NFIRS.[3] With at least two-thirds of all fire departments nationwide reporting fire incidents to the NFIRS, the reporting departments represent a very large data set that enables the USFA to develop reasonable estimates of various aspects of the fire problem. Although some states do require their departments to participate in the state system, participation in the NFIRS is voluntary. Furthermore, if a fire department is a recipient of a Fire Act Grant, participation is required.[4] For the years 2018 to 2020, NFIRS data were submitted by all 50 states, the District of Columbia and Native American Tribal Authorities. It is important to note that not all fire departments within participating states report to the NFIRS.

[1]NFIRS Public Data Release (PDR) file, 2020. The terminology "runs or responses" does not reflect single incidents but can include mutual aid responses to the same incident.
[2]The 20,436 fire departments reflect only those departments submitting responses that were included in the 2020 NFIRS PDR file. Only NFIRS valid and released incidents are included in the PDR. Mutual and automatic aid runs were excluded from this count to avoid counting the same incident more than once.
[3]For 2020, the NFPA published that there were 29,452 fire departments in the U.S. Source: NFPA, U.S. Fire Department Profile 2020, September 2022 (https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/Emergency-responders/osfdprofile.pdf).
[4]From the fiscal year (FY) 2020 Assistance to Firefighters Grant (AFG) Notice of Funding Opportunity (NOFO) — while NFIRS reporting is strongly encouraged, NFIRS reporting is not a requirement to apply for or be awarded a grant within the AFG Program. However, fire departments that receive funding under this program must agree to provide information to the NFIRS for the period covered by the assistance. If a recipient does not currently participate in the NFIRS and does not have the capacity to report at the time of the award, that recipient must agree to provide information to the system for a 12-month period commencing as soon as possible after it develops the capacity to report. Capacity to report to the NFIRS must be established prior to the termination of the 2-year performance period. To be compliant and close out the grant, the grantee may be asked by the Federal Emergency Management Agency to provide proof of compliance in reporting to the NFIRS. Any grantee that stops reporting to the NFIRS during the grant's period of performance is subject to having the award(s) modified or withdrawn. See the FY 2020 AFG NOFO at https://www.fema.gov/sites/default/files/documents/fema_fy-2020_afg_notice-of-funding-opportunity.pdf.

Because the NFIRS incident reports are submitted voluntarily, the data do not represent a statistically selected sample. Additionally, NFIRS data are not stand-alone. Therefore, the USFA currently scales up raw NFIRS data or percentages to the NFPA's annual national survey estimates. This approach is discussed further in the National Estimates Overview section.

National Fire Protection Association survey estimates

The NFPA's Survey of Fire Departments for U.S. Fire Experience is based on a stratified random sample of U.S. fire departments.[5] The sample of departments is stratified by size of community protected, and ratio estimation methodology is used to develop national-level summary estimates on fire-loss statistics (the total numbers of reported fires, fire deaths, fire injuries and direct dollar loss), as well as summary estimates of fires and losses by major incident types (i.e., structure, vehicle, outside and other).

The 2018 to 2020 NFPA estimates of residential structure fires and losses used to develop the USFA's national estimates of residential building fires are presented in Table 1. From 2018 to 2020, the NFPA survey produced an annual average estimate of 376,000 residential structure fires, resulting in 2,775 civilian fire deaths, 12,075 civilian fire injuries and $8.3 billion in property damage each year.[6] Of these NFPA residential structure fire and loss estimates, 67% of fires, 55% of deaths, 51% of injuries and 55% of dollar losses were reported to the NFIRS during this 3-year period.

Table 1. NFPA estimates of residential structure fires and losses (2018-2020)

Year	Residential structure fires	Residential structure fire deaths	Residential structure fire injuries	Residential structure fire dollar loss (in millions)
2018	387,000	2,820	11,600	8,286
2019	361,500	2,870	12,700	7,976
2020	379,500	2,630	11,900	8,703

Source: NFPA, "Fire Loss in the United States," 2018 to 2020.

The 2018 to 2020 NFPA estimates of nonresidential structure fires and losses used to develop the USFA's national estimates of nonresidential building fires are presented in Table 2. From 2018 to 2020, the NFPA survey produced an annual average estimate of 114,300 nonresidential structure fires, resulting in 100 civilian fire deaths, 1,125 civilian fire injuries and $3.5 billion in property damage.[7] Of these NFPA nonresidential structure fire and loss estimates, 69% of fires, 76% of deaths, 58% of injuries and 79% of dollar losses were reported to the NFIRS during this 3-year period.

[5]For detailed information regarding the NFPA's survey methodology, see the NFPA's "Methodology used in calculating national estimates from NFPA's 2021 fire experience survey," September 2022, https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/US-Fire-Problem/Methodsfirelossandothers.ashx.

[6]Fires are rounded to the nearest 100, deaths to the nearest 5, injuries to the nearest 25 and dollar loss to the nearest $100 million.

[7]Fires are rounded to the nearest 100, deaths to the nearest 5, injuries to the nearest 25 and dollar loss to the nearest $100 million.

Table 2. NFPA estimates of nonresidential structure fires and losses (2018-2020)

Year	Nonresidential structure fires	Nonresidential structure fire deaths	Nonresidential structure fire injuries	Nonresidential structure fire dollar loss (in millions)
2018	112,000	90	1,100	2,780
2019	120,000	110	1,200	4,311
2020	111,000	100	1,100	3,404

Source: NFPA, "Fire Loss in the United States," 2018 to 2020.

National estimates overview

National estimates presented in the USFA's Topical Fire Report Series (Volume 22) are based on NFIRS data from 2018 to 2020, the NFPA's annual surveys of structure fire-loss estimates from 2018 to 2020, and the USFA's building fire-loss estimates from 2018 to 2020.

Overall estimates of the fire problem come from the NFPA's annual Survey of Fire Departments for U.S. Fire Experience.[8] As previously noted, this survey produces national-level summary estimates on fire-loss statistics (the total numbers of reported fires, fire deaths, fire injuries and direct dollar loss), as well as summary estimates of fires and losses by major incident types (i.e., structure, vehicle, outside and other). The summary estimates by major incident type are further broken down to the next tier (e.g., residential structures, highway vehicles and the like). The raw NFPA survey data are not available to the public, the USFA or various other national fire data analysts.

All nationally based estimates on subsets of fire data are derived by scaling up the raw NFIRS data. These estimates are based on a method of apportioning the NFPA estimates for total fires and structure, vehicle, outside and other fires.[9] Generally, these national estimates are derived by computing a percentage of fires, deaths, injuries or dollar loss in a particular NFIRS category and multiplying it by the corresponding total estimate from the NFPA annual survey.[10] This methodology is the accepted practice of national fire data analysts.

One problem with this approach is that the proportions of fires and fire losses differ between the large NFIRS data set and the NFPA survey sample.[11] Nonetheless, to be

[8]For detailed information regarding the NFPA's survey methodology, see the NFPA's "Methodology used in calculating national estimates from NFPA's 2021 fire experience survey," September 2022, https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/US-Fire-Problem/Methodsfirelossandothers.ashx.

[9]The foundation of computing national estimates is based on "The National Estimates Approach to U.S. Fire Statistics" by Hall, J. R. and Harwood, B., https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/NFPA-estimates-and-methodology/NationalEstimatesApproach.pdf.

[10]The NFPA summary estimates are used for the overall U.S. fire losses; fire losses from structure, vehicle, outside and other fires; and as the basis for the USFA's estimates of residential and nonresidential building fires and losses. The alternative approach for these summary numbers is to use the relative percentage of fires (or other loss measures) from the NFIRS and scale up (multiply by) to the NFPA estimate of total fires.

[11]For additional information regarding the differences in proportions of fires and losses between NFIRS data and the NFPA survey, see the section titled "Differences between the National Fire Incident Reporting System data and the National Fire Protection Association survey data" in USFA's "Fire in the United States 2008-2017," 20th edition, November 2019, https://www.usfa.fema.gov/downloads/pdf/publications/fius20th.pdf.

consistent with approaches being used by other fire data analysts, the NFPA estimates of fires, deaths, injuries and dollar loss are used as a starting point. The details of the fire problem below this level are based on proportions from the NFIRS. Because the proportions of fires and fire losses differ between the NFIRS and the NFPA estimates, from time to time, this approach leads to inconsistencies. These inconsistencies will remain until all estimates can be derived directly from NFIRS data.

Ideally, one would like to have the data come from one consistent data source: the NFIRS. One of the critical pieces of data necessary to do so is missing: the overall population protected by all reporting fire departments. This "residential population protected" is not reported to the NFIRS, nor is the data easy to come by, especially where a county or other jurisdiction is served by several fire departments that each report their fires independently.

Other issues (such as full reporting because of reporting deadlines, data access and budgetary considerations) add a layer of complexity to using the NFIRS data to create estimates. Nonetheless, with such a large wealth of fire-incident data, the USFA believes it is possible to harness NFIRS data to produce national estimates of the U.S. fire problem.

Through the years, several ad hoc studies have been undertaken to identify NFIRS representativeness — none of which have identified major reporting issues. Most NFIRS data exhibit stability from one year to the next without radical changes. Results based on the full data set are generally similar to those based on part of the data, another indication of data reliability. In short, the NFIRS data are a very large and reasonably stable data set that is used as input to develop national estimates.

Structures versus buildings in the National Fire Incident Reporting System

The NFIRS allows for the differentiation between buildings and nonbuildings. In the NFIRS, a structure is a built object and can include nonbuildings, such as platforms, tents, connective structures (e.g., bridges, fences, telephone poles) and various other structures, in addition to buildings. Analyses of 2018 to 2020 NFIRS structure fire data show that, by and large, the majority (97%) of structure fires occurred in buildings.

The distinction between buildings and nonbuildings is particularly important when determining the effectiveness of nonbehavior-based fire safety mechanisms, such as smoke alarms and residential sprinklers. These important components of early fire detection apply to buildings and not necessarily to these other types of structures. To facilitate analysis of these components and to acknowledge that prevention efforts are generally centered on buildings, the USFA separates buildings from other structures. For these reasons, the USFA focuses on producing building fire and loss estimates separately for residential and nonresidential buildings.

Residential buildings

Table 3 shows the raw numbers of residential building fires and losses reported to the NFIRS from 2018 to 2020.

Table 3. Residential building fires and losses reported to the NFIRS (2018-2020)

Year	Residential building fires	Residential building fire deaths	Residential building fire injuries	Residential building fire dollar loss (in millions)
2018	260,527	1,610	6,674	4,765
2019	256,114	1,594	6,635	4,626
2020	222,194	1,347	4,873	4,172

Source: USFA, 2018 to 2020 NFIRS.

Table 4 shows the raw numbers of residential structure fires and losses reported to the NFIRS from 2018 to 2020. On average, from 2018 to 2020, 98% of residential structure fires, 99% of associated deaths, 99% of injuries and 99% of dollar losses reported to the NFIRS occurred in residential buildings.

Table 4. Residential structure fires and losses reported to the NFIRS (2018-2020)

Year	Residential structure fires	Residential structure fire deaths	Residential structure fire injuries	Residential structure fire dollar loss (in millions)
2018	265,572	1,627	6,714	4,818
2019	261,211	1,617	6,681	4,690
2020	226,686	1,356	4,908	4,220

Source: USFA, 2018 to 2020 NFIRS.

Nonresidential buildings

Table 5 shows the raw numbers of nonresidential building fires and losses reported to the NFIRS from 2018 to 2020.

Table 5. Nonresidential building fires and losses reported to the NFIRS (2018-2020)

Year	Nonresidential building fires	Nonresidential building fire deaths	Nonresidential building fire injuries	Nonresidential building fire dollar loss (in millions)
2018	73,454	69	665	2,434
2019	75,714	79	704	2,335
2020	69,044	63	465	2,166

Source: USFA, 2018 to 2020 NFIRS.

Table 6 shows the raw numbers of nonresidential structure fires and losses reported to the NFIRS from 2018 to 2020. On average, 93% of nonresidential structure fires, 93% of deaths, 93% of injuries and 84% of dollar losses reported to the NFIRS from 2018 to 2020 occurred in nonresidential buildings.

Table 6. Nonresidential structure fires and losses reported to the NFIRS (2018-2020)

Year	Nonresidential structure fires	Nonresidential structure fire deaths	Nonresidential structure fire injuries	Nonresidential structure fire dollar loss (in millions)
2018	79,380	74	710	2,547
2019	81,891	86	752	3,507
2020	74,110	68	500	2,241

Source: USFA, 2018 to 2020 NFIRS.

National estimates of building fires and losses

Based on the raw numbers of building fires and structure fires reported to the NFIRS, along with the NFPA survey estimates of structure fires, the USFA developed a methodology for computing national estimates of residential and nonresidential building fires and losses.[12] The USFA uses these national building fire estimates in the Topical Fire Report Series, Fire Estimate Summary Series and various other fire data reports.[13] Tables 7 and 8 present the USFA's national estimates of fires and losses for residential and nonresidential buildings, respectively.

Table 7. USFA's national estimates of residential building fires and losses (2018-2020)

Year	Residential building fires	Residential building fire deaths	Residential building fire injuries	Residential building fire dollar loss — adjusted to 2020 dollars (in millions)
2018	379,600	2,790	11,525	8,446
2019	354,400	2,830	12,625	7,964
2020	372,000	2,615	11,825	8,604

Source: USFA, Fire Estimate Summary Series (2011 to 2020).

[12]The USFA's methodology for computing national estimates of residential and nonresidential building fires and losses is detailed in the USFA's "National Estimates Methodology for Building Fires and Losses," August 2012, https://www.usfa.fema.gov/downloads/pdf/statistics/national_estimate_methodology.pdf.
[13]The USFA's Fire Estimate Summary Series, as well as 2003 to 2020 national estimates of residential and nonresidential building fires and losses, are published at https://www.usfa.fema.gov/statistics/. The USFA's Topical Fire Report Series and various other fire data reports are available at https://www.usfa.fema.gov/statistics/reports/.

Table 8. USFA's national estimates of nonresidential building fires and losses (2018-2020)

Year	Nonresidential building fires	Nonresidential building fire deaths	Nonresidential building fire injuries	Nonresidential building fire dollar loss — adjusted to 2020 dollars (in millions)
2018	103,600	85	1,025	2,738
2019	110,900	100	1,125	2,905
2020	103,400	95	1,025	3,290

Source: USFA, Fire Estimate Summary Series (2011 to 2020).

National Fire Incident Reporting System data used in U.S. Fire Administration analyses

Although the NFIRS contains hundreds of data elements, only a few are used in producing the USFA's topical reports. Most of these data elements are required to be completed for each fire incident type; however, for small, confined fires (i.e., Incident Types 113 to 118); outside rubbish fires with no value (i.e., Incident Types 150 to 155); and other unclassified fires, certain data elements are not required to be completed.

A complete list of NFIRS data elements is documented in the "National Fire Incident Reporting System Complete Reference Guide."[14] Table 9 identifies NFIRS data elements that are used most often in fire data analyses in the topical reports produced by the USFA.

Table 9. NFIRS data elements used in USFA analyses

Data element	Description	Required data element for all fires
Incident type	The actual situation found on scene when emergency personnel arrived.	Yes
Property use	The actual use of the property where the incident occurred, not the overall use of mixed-use properties of which the property is a part.	Yes
Incident date	The month, day and year of the incident.	Yes

[14]"National Fire Incident Reporting System Complete Reference Guide," USFA, January 2015, https://www.usfa.fema.gov/downloads/pdf/nfirs/NFIRS_Complete_Reference_Guide_2015.pdf.

Table 9. NFIRS data elements used in USFA analyses — continued

Data element	Description	Required data element for all fires
Alarm time	The actual month, day, year and time of day (hour, minute and second) when the alarm was received by the fire department.	Yes
Death	A civilian fire death resulting from the incident or occurring during the mitigation of the incident (includes emergency personnel who are not part of the fire department, such as police officers or utility workers).	Yes
Injury	A civilian fire injury resulting from the incident or occurring during the mitigation of the incident (includes emergency personnel who are not part of the fire department, such as police officers or utility workers).	Yes
Dollar loss	The sum of the total property and contents dollar losses.	Yes
Fire spread[15]	The extent of fire spread in terms of how far the flame damage extended.	No
Area of fire origin	The primary use of the area where the fire started within the property.	No
Heat source	The source of heat that ignited the "item first ignited" to cause the fire.	No
Item first ignited	The use or configuration of the item or material first ignited by the heat source. The item that had sufficient volume or heat intensity to extend to uncontrolled or self-perpetuating fire.	No
Factors contributing to ignition	The contributing factors that allowed the heat source and combustible material to combine to ignite the fire.	No
Presence of detectors	The existence of fire-detection equipment within its designed range of the fire.	No
Presence of automatic extinguishing system (AES)	The existence of an AES within the AES's designed range of a fire.	No

Source: "National Fire Incident Reporting System Complete Reference Guide," USFA, January 2015.

[15]Fire spread is not a required data element for all fires. Although not required for confined fires (i.e., Incident Types 113 to 118), the confined fire incident types were designed to reflect small, low-loss fires, typically with a fire spread that is limited to the object of fire origin. In addition, fire spread is only a required element in the fire module when the Structure Type is coded as an enclosed building or fixed portable or mobile structure. Therefore, when analyzing NFIRS building fire data only, fire spread is either required or could be inferred for confined fires, and essentially it contains no missing data values.

In addition to the data elements presented in Table 9, "fire cause" is a data characteristic included in almost every USFA topical report analysis; however, it is not directly collected in the NFIRS. Fire cause is determined for all structure fires based on an algorithm using cause-related data elements from the NFIRS, such as the heat source, item first ignited, cause of ignition, factors contributing to ignition and equipment involved in ignition. Fire causes are often a complex chain of events. To make it easier to grasp the "big picture," 16 midlevel categories of fire causes, such as heating, cooking and electrical malfunction, are used by the USFA to define structure fire causes.

Structure fires are assigned to 1 of the 16 midlevel cause groupings using a hierarchy of definitions. A fire is included in the highest category into which it fits on the list. If it does not fit the top category, then the second one is considered; and if not that one, the third; and so on. Once a match is found, the cause is assigned, and no further checking of subsequent categories is done in the matrix. If no match is found, the incident is assigned a fire cause of "unknown."[16]

Data quality

Data quality is an area of great importance. The following criteria are used in monitoring data in the NFIRS during the year: the data are complete, the data are accurate and the data are current. These criteria are monitored by creating reports from the database that show the number of reporting fire departments, the number of incidents by state, the number of invalid incidents and the number of unreleased incidents. The USFA provides the reports to the state NFIRS program managers and works with them to resolve any data issues. Technical assistance (e.g., telephone support or site visits) is provided to states to help address any data quality and data reporting needs.

Audits of the data are performed during the year to identify any inconsistencies. The audits focus on the following criteria: gaps in reporting, critical errors in the data and outliers in the data. In particular, the USFA works closely with states to monitor the quality of data coming from third-party vendor software. The USFA assists states in monitoring vendor data quality issues or contacts vendors directly to discuss an issue at a state's request. Other data quality issues are questionable, high dollar-loss incidents and questionable, high numbers of fire deaths. Quarterly, USFA staff query the database for questionable values (i.e., outliers) and verify the values with state- and local-level NFIRS program managers. The data quality steps are important to ensure that the data meet the USFA's criteria before the data are released in the NFIRS PDR format.

The USFA published the report "Review and Assessment of Data Quality in the National Fire Incident Reporting System" (May 2017). This document covers a review of the system, the many robust data quality checks and mechanisms which are an integral part of the NFIRS, and an assessment of the data quality both at the state level and at the data element level. The data element assessment focuses on the most common data elements used in NFIRS data analyses. NFIRS data were reviewed from the most recent years available at the time of the report's development (2009 to 2011). Additionally, the report includes a section drawn from published NFPA documents covering the NFPA survey methodology.[17]

[16]The USFA's detailed structure fire cause methodology and definitions are available in the document "National Fire Incident Reporting System Version 5.0 Fire Data Analysis Guidelines and Issues," July 2011, https://www.usfa.fema.gov/downloads/pdf/nfirs/nfirs_data_analysis_guidelines_issues.pdf.

[17]The "Review and Assessment of Data Quality in the National Fire Incident Reporting System" document is available at https://www.usfa.fema.gov/downloads/pdf/publications/nfirs_data_quality_report.pdf.

Unknown entries, incomplete loss reporting and unreported fires are also important considerations when assessing NFIRS data quality. These topics are discussed in more detail in the sections that follow.

Unknown data entries and missing values

On a fraction of the incident reports or casualty reports submitted to the NFIRS, the desired information for many data elements is either reported as "unknown" or is not reported at all. The total number of unknown entries or missing (i.e., blank or null) values is often larger than some of the important subcategories. For example, 51% of fatal fires in residential buildings reported from 2018 to 2020 did not have sufficient data recorded in the NFIRS to determine fire cause. The lack of data, especially for these residential fatal fires, masks the true picture of the fire problem.

Many prevention and public education programs use the NFIRS data to target at-risk groups or to address critical problems. Fire officials use the data in decision-making that affects the allocation of firefighting resources. Consumer groups and litigators use the data to assess product fire incidence. When the unknowns are large, the credibility of the data suffers. In some cases, even after the best attempts by fire investigators, the information is truly unknown. In other cases, the information reported as "unknown" in the initial NFIRS report is not updated after the fire investigation is completed. Reporting fire departments need to be more aware of the effect of incomplete data reporting and the need to update the initial NFIRS report if additional information is available after investigation. Efforts have been undertaken at the national level to encourage fire departments to close the loop on fires after investigations are completed.

In analyses, the unknown and missing data values should not be ignored. The approach taken by the USFA in presenting the data is to provide not only the "raw" percentages of each category, but also the "adjusted" percentages computed using only those incidents for which data were provided. This calculation, in effect, distributes the fires for which the data are unknown in the same proportion as the fires for which the data are known, which may or may not be approximately right. Both the reported data and the adjusted data (if unknowns are present) are plotted on bar charts in the USFA reports.

The following example illustrates distributing the fires for which the data are unknown using the cause of residential building fires: Cooking was determined as the fire cause for 41.4% of reported residential building fires from 2018 to 2020; another 18.7% of reported fires had unknown causes. Thus, the percent of fires that had their cause reported was 100 minus 18.7, which equals 81.3%. With the unknown causes apportioned like the known causes, the adjusted percent of cooking fires in residential buildings can then be computed as 41.4 divided by 81.3, which equals 50.9%.

It is important to note that null and blank values are considered unreported data and differ in meaning and substance from "unknown" data. In data elements where information is required, a null or blank value may invalidate the record and cause it to be excluded from analyses. In addition, many fire data elements are not required for NFIRS confined fires (i.e., Incident Types 113 to 118) and, thus, contain missing or null values. Therefore, the USFA excludes confined fires from the analyses of these nonrequired data elements for building fires.

The following section focuses on data elements where information is required for nonconfined fires (i.e., Incident Types 111 and 120 to 123); however, the data entries for these elements may contain valid unknown values. Tables 10 and 11 show the percentages of unknown data values for NFIRS data elements that are required for only nonconfined residential and nonresidential building fires (i.e., the percentages do not reflect confined fires), respectively, with the exception of "fire cause." Although the USFA's fire cause, as previously discussed, is not a collected NFIRS data element, but rather assigned based on an algorithm using several cause-related data elements from the NFIRS, it is included in these tables for ease of presentation. It is important to note that percentages of unknown data values for "fire cause," unlike the rest of the required data elements for nonconfined fires presented in the tables, reflect both confined and nonconfined fires. For 2018 to 2020, the percentages of unknown values for each data element in Tables 10 and 11 are relatively consistent from one year to the next, except for the factors contributing to ignition data element, which reflects a larger increase in unknown values from 2018 to 2020. In addition, for nonresidential building fires, the percentages of unknown values for fire cause show a large increase over the 3-year period.

Table 10. Percent of unknown values by specific data element for residential building fires reported to the NFIRS (2018-2020)

Data element	2018 Percent unknown	2019 Percent unknown	2020 Percent unknown
Area of fire origin	14.8	15.1	14.7
Heat source	39.9	40.3	39.6
Item first ignited	41.3	41.8	41.2
Factors contributing to ignition	32.9	34.4	35.5
Presence of detectors	31.1	30.1	29.2
Presence of AES	9.6	9.5	9.2
Fire cause	18.5	18.8	18.6

Source: NFIRS.

Table 11. Percent of unknown values by specific data element for nonresidential building fires reported to the NFIRS (2018-2020)

Data element	2018 Percent unknown	2019 Percent unknown	2020 Percent unknown
Area of fire origin	19.0	20.0	20.8
Heat source	43.6	44.3	45.4
Item first ignited	45.8	47.2	48.0
Factors contributing to ignition	34.8	36.3	39.0
Presence of detectors	20.9	20.1	20.0
Presence of AES	11.4	10.9	10.9
Fire cause	36.4	36.9	41.5

Source: NFIRS.

Incomplete loss reporting

Although it is troublesome that insufficient data for the various NFIRS data elements can mask the true picture of the fire problem and impact the credibility of the data, the apparent nonreporting of injuries and property loss associated with many fire incidents is equally challenging. For example, there are many reported fires where the flame spread indicates damage, but property loss is not reported. It is notoriously difficult to estimate dollar loss, but an approximation is more useful than leaving the data element blank. Analysts need to be aware that this apparent lack of property-loss data affects the understanding of those fires that cause substantial loss.

Identifying large outliers

If the incident record clearly contains outliers, it is generally recommended to exclude the record from the analysis. However, before excluding such records, a quick internet search is completed to see if some unusual fire did occur. Additionally, if time permits, the USFA follows up with the fire department that submitted the incident record for data verification.

National Fire Incident Reporting System analytic resources

Several resources that provide more detailed documentation on using the NFIRS and NFIRS data are available. The "National Fire Incident Reporting System Complete Reference Guide" provides instructions for reporting data to the NFIRS and an understanding of the data elements collected by the system. It also serves as a reference for coding the data.

The document "National Fire Incident Reporting System Version 5.0 Fire Data Analysis Guidelines and Issues" discusses analytic considerations and methods of analyzing fire-incident data using NFIRS data. Topics include the NFIRS 5.0 data structure, general quality assurance issues, and definitions and parameters of common fire analyses (e.g., residential building fires or casualties), including the methodology for determining structure fire causes. The methods, techniques and considerations discussed are those used by the USFA analysts, and they do not necessarily reflect methods, techniques and considerations used by fire data analysts from other agencies and organizations. NFIRS data partners may (and do) employ their own methods for analyzing the data and may make differing assumptions when encountering data issues.

The "Review and Assessment of Data Quality in the National Fire Incident Reporting System" covers a review of the system, the many robust data quality checks and mechanisms which are an integral part of the NFIRS, and an assessment of the data quality both at the state level and at the data element level. The data element assessment focuses on the most common data elements used in NFIRS data analyses.

"The National Estimates Approach to U.S. Fire Statistics" is the original methodology for creating estimates of the U.S. fire problem using the NFPA's annual Survey of Fire Departments for U.S. Fire Experience and NFIRS data. The authors present a detailed consensus procedure for such calculations, as well as the supporting rationale. "National Estimates Methodology for Building Fires and Losses" is the USFA's application of the national estimates approach to building fires and fire losses. It details the USFA's current fire data estimation methodology for all building fires (i.e., residential and nonresidential) and associated losses.

The USFA's "Fire in the United States 2008-2017" is a statistical portrait of the national fire problem and provides an in-depth discussion of the data sources and the methodologies used to incorporate these data into fire analyses. Lastly, the "Fire Data Analysis Handbook" is a resource for those unfamiliar with basic data analysis techniques and their applicability to fire-data based analyses.

Resources

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