Package 'z22'

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Type Package

Title Official Gridded Data from the German Census 2022

Version 1.0.0

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Description Provides fast and easy access to German census grid data from the 2011 and 2022 censuses <https://www.zensus2022.de/>, including a wide range of socio-economic indicators at multiple spatial resolutions (100m, 1km, 10km). Enables efficient download, processing, and analysis of large census datasets covering population, households, families, dwellings, and buildings. Harmonized data structures allow direct comparison with the 2011 census, supporting temporal and spatial analyses. Facilitates conversion of data into common formats for spatial analysis and mapping ('terra', 'sf', 'ggplot2').

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URL https://github.com/jslth/z22/, https://jslth.github.io/z22/

BugReports https://github.com/jslth/z22/issues

Encoding UTF-8

Depends R (>= 3.3.0)

Imports utils, stats, cli, httr2, dplyr, arrow

Suggests terra, sf, ggplot2, sinew, knitr, rmarkdown, testthat (>= 3.0.0)

RoxygenNote 7.3.2

VignetteBuilder knitr

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Contents

`categories` *Feature categories*

Description

While some features contain total counts or averages, others contain figures classified by certain categories. You can access these tables programmatically using `z22_categories`.

For further clarification of terms used in the category labels, see the glossary.

Usage

```
z22_categories(feature)
```

Arguments

`feature`	A grid feature. See `z22_features` for a list of available features. If a feature is provided that does not have categories, generates a table based on the feature description.

Value

A tibble containing the category code (`code`) as well as German and English labels (`german` and `english`). Each row relates to a category of a feature.

Categories

code	german	english
1	Deutschland	Germany
20	Ausland	Foreign
21	EU27-Land	EU27 country
22	Europa	Europe
23	Welt	World
24	Sonstige	Other

`birth_country`

code	german	english
1	Männlich	Male
2	Weiblich	Female

`sex`

code	german	english
1	Römisch-katholische Kirche	Roman Catholic Church
2	Evangelische Kirche	Evangelical Church
3	Sonstige, keine, ohne Angabe	Other, none, no information

`religion`

code	german	english
1	Deutschland	Germany
2	Ausland	Foreign

`citizenship`

code	german	english
1	Deutschland	Germany
20	Ausland	Foreign
21	EU27-Land	EU27 Country
22	Sonstiges Europa	Other Europe
23	Sonstige Welt	Other World
24	Sonstige	Other

`citizenship_group`

code	german	english
1	Deutschland	Germany
2	Bosnien und Herzegowina	Bosnia and Herzegovina
3	Griechenland	Greece
4	Italien	Italy
5	Kasachstan	Kazakhstan
6	Kroatien	Croatia
7	Niederlande	Netherlands
8	Österreich	Austria
9	Polen	Poland
10	Rumänien	Romania
11	Russische Föderation	Russian Federation
12	Türkei	Turkey
13	Ukraine	Ukraine
14	Sonstige	Other

`citizenship_origin`

code	german	english
1	Eine Staatsangehörigkeit	One citizenship
2	Mehrere, deutsch und ...	Several, German and ...
3	Mehrere, nur ausländische	Several, only foreign
4	Nicht bekannt	Unknown

`citizenship_total`

code	german	english
1	Unter 18	Under 18
2	18 - 29	18 to 29
3	30 - 49	30 to 49
4	50 - 64	50 to 64
5	65 und älter	65 and older

`age_short`

code	german	english
1	Unter 10	Under 10
2	10 - 19	10 to 19
3	20 - 29	20 to 29
4	30 - 39	30 to 39
5	40 - 49	40 to 49
6	50 - 59	50 to 59
7	60 - 69	60 to 69
8	70 - 79	70 to 79
9	80 und älter	80 and older

`age_long`

code	german	english
1	Ledig	Single
2	Verheiratet	Married
3	Verwitwet	Widowed
4	Geschieden	Divorced
5	Eingetr. Lebenspartnerschaft	Registered partnership
6	Eingetr. Lebenspartner/-in verstorben	Registered partner deceased
7	Eingetr. Lebenspartnerschaft aufgehoben	Registered partnership annulled
8	Ohne Angabe	No information

`marital_status`

code	german	english
1	Ehepaare ohne Kind	Couples without child
2	Ehepaare, mind. 1 Kind < 18	Couples, at least 1 child < 18
3	Ehepaare alle Kinder >= 18	Couples all children >= 18
4	Eingetr. Lebenspartnerschaften ohne Kind	Registered civil partnerships without child

5	Eingetr. Lebenspartnerschaften mind. 1 Kind < 18	Registered civil partnerships, at least 1 child < 18
6	Eingetr. Lebenspartnerschaften alle Kinder >= 18	Registered civil partnerships all children >= 18
7	Nichteheliche Lebensgem. ohne Kind	Non-marital partnerships without child
8	Nichteheliche Lebensgem. mind. 1 Kind < 18	Non-marital partnerships, at least 1 child < 18
9	Nichteheliche Lebensgem. alle Kinder >= 18	Non-marital partnerships all children >= 18
10	Alleinerziehende Väter mind. 1 Kind < 18	Single fathers, at least 1 child < 18
11	Alleinerziehende Väter alle Kinder >= 18	Single fathers all children >= 18
12	Alleinerziehende Mütter mind. 1 Kind < 18	Single mothers, at least 1 child < 18
13	Alleinerziehende Mütter alle Kinder >= 18	Single mothers all children >= 18

`family_type`

code	german	english
1	2 Personen	2 Persons
2	3 Personen	3 Persons
3	4 Personen	4 Persons
4	5 Personen	5 Persons
5	6 und mehr Personen	6 and more Persons

`family_size`

code	german	english
1	Einpersonenhaushalte (Singlehaushalte)	One-person households (Single households)
2	Paare ohne Kind(er)	Couples without child(ren)
3	Paare mit Kind(ern)	Couples with child(ren)
4	Alleinerziehende Elternteile	Single parents
5	Mehrpersonenhaushalte ohne Kernfamilie	Multi-person households without core family

`household_family`

code	german	english
1	Einpersonenhaushalte (Singlehaushalte)	One-person households (Single households)
2	Ehepaare	Married couples
3	Eingetr. Lebenspartnerschaften	Registered civil partnerships
4	Nichteheliche Lebensgemeinschaften	Non-marital partnerships
5	Alleinerziehende Mütter	Single mothers
6	Alleinerziehende Väter	Single fathers
7	Mehrpersonenhaushalte ohne Kernfamilie	Multi-person households without core family

`household_lifestyle`

code	german	english
1	Haushalte mit ausschließlich Senioren/-innen	Households with only seniors
2	Haushalte mit Senioren/-innen und Jüngeren	Households with seniors and younger people
3	Haushalte ohne Senioren/-innen	Households without seniors

`household_senior`

code	german	english
1	1 Person	1 Person
2	2 Personen	2 Persons
3	3 Personen	3 Persons
4	4 Personen	4 Persons
5	5 Personen	5 Persons
6	6 und mehr Personen	6 and more Persons

`household_size_group`

code	german	english
1	Von Eigentümer/-in bewohnt	Occupied by owner
11	Eigentum: mit aktuell geführtem Haushalt	Ownership: with currently managed household
12	Eigentum: ohne aktuell geführtem Haushalt	Ownership: without currently managed household
2	Zu Wohnzwecken vermietet	Rented for residential purposes
21	Vermietet: mit aktuell geführtem Haushalt	Rented: with currently managed household
22	Vermietet: ohne aktuell geführtem Haushalt	Rented: without currently managed household
3	Ferien- und Freizeitwohnung	Holiday and leisure home
4	Leer stehend	Vacant
5	Diplomaten-/Streitkräftewohnung	Diplomatic/Military housing
99	Gewerbl. Nutzung	Commercial use

`dwelling_occupancy`

code	german	english
1	Privatperson/-en	Private person(s)
2	Privatwirtschaftliche Unternehmen (jur. Personen)	Private sector companies (legal persons)
3	Öffentliche Unternehmen, Kirchen o.ä.	Public companies, churches or similar
4	Wohnungsgenossenschaft	Housing cooperative
99	Trifft nicht zu (da keine Eigentumswohnung)	Does not apply (no condominium)

`dwelling_ownership_home`

code	german	english
1	Gemeinschaft von Wohnungseigentümern/-innen	Homeowner association
2	Privatperson/-en	Private person(s)
3	Wohnungsgenossenschaft	Housing cooperative
4	Kommune oder Kommunales Wohnungsunternehmen	Municipality or municipal housing company
5	Privatwirtschaftliches Wohnungsunternehmen	Private sector housing company
6	Anderes privatwirtschaftliches Unternehmen	Other private sector company
7	Bund oder Land	Federal or state government
8	Organisation ohne Erwerbszweck (z.B. Kirche)	Non-profit organization (e.g. church)

`dwelling_ownership_property`

code	german	english
1	Unter 30	Under 30

2	30 - 39	30 - 39
3	40 - 49	40 - 49
4	50 - 59	50 - 59
5	60 - 69	60 - 69
6	70 - 79	70 - 79
7	80 - 89	80 - 89
8	90 - 99	90 - 99
9	100 - 109	100 - 109
10	110 - 119	110 - 119
11	120 - 129	120 - 129
12	130 - 139	130 - 139
13	140 - 149	140 - 149
14	150 - 159	150 - 159
15	160 - 169	160 - 169
16	170 - 179	170 - 179
17	180 und mehr	180 and more
99	t.n.z., gewerblich	n.a., commercial

`floor_space`

code	german	english
1	1 Raum	1 Room
2	2 Räume	2 Rooms
3	3 Räume	3 Rooms
4	4 Räume	4 Rooms
5	5 Räume	5 Rooms
6	6 Räume	6 Rooms
7	7 und mehr Räume	7 and more Rooms
99	t.n.z., gewerblich	n.a., commercial

`dwelling_rooms`

code	german	english
1	Vor 1919	Before 1919
2	1919 - 1948	1919 - 1948
3	1949 - 1978	1949 - 1978
4	1979 - 1986	1979 - 1986
5	1987 - 1990	1987 - 1990
6	1991 - 1995	1991 - 1995
7	1996 - 2000	1996 - 2000
8	2001 - 2004	2001 - 2004
9	2005 - 2008	2005 - 2008
10	2009 und später	2009 and later

`dwelling_constr_year`

code	german	english

1	Gebäude mit Wohnraum	Building with living space
11	Wohngebäude	Residential building
111	Wohngebäude (ohne Wohnheime)	Residential building (excluding dormitories)
112	Wohnheim	Dormitory
12	Sonstiges Gebäude mit Wohnraum	Other building with living space

`dwelling_building_type`

code	german	english
1	Freistehendes Haus	Detached house
2	Doppelhaus Hälfte	Semi-detached house
3	Gereihtes Haus	Terraced house
4	Anderer Gebäudetyp	Other building type

`dwelling_building_design`

code	german	english
1	Freistehendes Einfamilienhaus	Detached single-family house
2	Einfamilienhaus: Doppelhaushälfte	Single-family house: semi-detached
3	Einfamilienhaus: Reihenhaus	Single-family house: terraced
4	Freistehendes Zweifamilienhaus	Detached two-family house
5	Zweifamilienhaus: Doppelhaushälfte	Two-family house: semi-detached
6	Zweifamilienhaus: Reihenhaus	Two-family house: terraced
7	Mehrfamilienhaus: 3-6 Wohnungen	Multi-family house: 3-6 apartments
8	Mehrfamilienhaus: 7-12 Wohnungen	Multi-family house: 7-12 apartments
9	Mehrfamilienhaus: 13 und mehr Wohnungen	Multi-family house: 13 and more apartments
10	Anderer Gebäudetyp	Other building type

`dwelling_building_size`

code	german	english
1	Fernheizung (Fernwärme)	District heating (long-distance heating)
2	Etagenheizung	Self-contained central heating
3	Blockheizung	Block heating
4	Zentralheizung	Central heating
5	Einzel-/Mehrraumöfen (auch Nachtspeicherheizung)	Individual/multi-room stoves (including night storage heating)
6	Keine Heizung im Gebäude oder in den Wohnungen	No heating in the building or in the apartments

`dwelling_heat_type`

code	german	english
1	Gas	Gas
2	Heizöl	Heating oil
3	Holz(pellets)	Wood (pellets)
4	Biomasse (ohne Holz), Biogas	Biomass (no wood), biogas
5	Solar-/Geothermie, Wärmepumpen	Solar, geothermal, heat pumps
6	Strom (ohne Wärmepumpen)	Electric heating (no heat pumps)

7	Kohle	Coal
8	Fernwärme	District heating
9	Kein Energieträger	No heating

`dwelling_heat_src`

code	german	english
1	Gemeinschaft von Wohnungseigentümern/-innen	Homeowner association
2	Privatperson/-en	Private person(s)
3	Wohnungsgenossenschaft	Housing cooperative
4	Kommune oder Kommunales Wohnungsunternehmen	Municipality or municipal housing company
5	Privatwirtschaftliches Wohnungsunternehmen	Private sector housing company
6	Anderes privatwirtschaftliches Unternehmen	Other private sector company
7	Bund oder Land	Federal or state government
8	Organisation ohne Erwerbszweck (z.B. Kirche)	Non-profit organization (e.g. church)

`building_ownership_property`

code	german	english
1	Vor 1919	Before 1919
2	1919 - 1948	1919 - 1948
3	1949 - 1978	1949 - 1978
4	1979 - 1986	1979 - 1986
5	1987 - 1990	1987 - 1990
6	1991 - 1995	1991 - 1995
7	1996 - 2000	1996 - 2000
8	2001 - 2004	2001 - 2004
9	2005 - 2008	2005 - 2008
10	2009 und später	2009 and later

`building_constr_year`

code	german	english
1	1 Wohnung	1 Apartment
2	2 Wohnungen	2 Apartments
3	3 - 6 Wohnungen	3 - 6 Apartments
4	7 - 12 Wohnungen	7 - 12 Apartments
5	13 und mehr Wohnungen	13 and more Apartments

`building_dwellings`

code	german	english
1	Freistehendes Einfamilienhaus	Detached single-family house
2	Einfamilienhaus: Doppelhaushälfte	Single-family house: semi-detached
3	Einfamilienhaus: Reihenhaus	Single-family house: terraced
4	Freistehendes Zweifamilienhaus	Detached two-family house
5	Zweifamilienhaus: Doppelhaushälfte	Two-family house: semi-detached

6	Zweifamilienhaus: Reihenhaus	Two-family house: terraced
7	Mehrfamilienhaus: 3-6 Wohnungen	Multi-family house: 3-6 apartments
8	Mehrfamilienhaus: 7-12 Wohnungen	Multi-family house: 7-12 apartments
9	Mehrfamilienhaus: 13 und mehr Wohnungen	Multi-family house: 13 and more apartments
10	Anderer Gebäudetyp	Other building type

`building_size`

code	german	english
1	Gebäude mit Wohnraum	Building with living space
11	Wohngebäude	Residential building
111	Wohngebäude (ohne Wohnheime)	Residential building (excluding dormitories)
112	Wohnheim	Dormitory
12	Sonstiges Gebäude mit Wohnraum	Other building with living space

`building_type`

code	german	english
1	Freistehendes Haus	Detached house
2	Doppelhaus Hälfte	Semi-detached house
3	Gereihtes Haus	Terraced house
4	Anderer Gebäudetyp	Other building type

`building_design`

code	german	english
1	Fernheizung (Fernwärme)	District heating (long-distance heating)
2	Etagenheizung	Self-contained central heating
3	Blockheizung	Block heating
4	Zentralheizung	Central heating
5	Einzel-/Mehrraumöfen (auch Nachtspeicherheizung)	Individual/multi-room stoves (including night storage heating)
6	Keine Heizung im Gebäude oder in den Wohnungen	No heating in the building or in the apartments

`building_heat_type`

code	german	english
1	Gas	Gas
2	Heizöl	Heating oil
3	Holz(pellets)	Wood (pellets)
4	Biomasse (ohne Holz), Biogas	Biomass (no wood), biogas
5	Solar-/Geothermie, Wärmepumpen	Solar, geothermal, heat pumps
6	Strom (ohne Wärmepumpen)	Electric heating (no heat pumps)
7	Kohle	Coal
8	Fernwärme	District heating
9	Kein Energieträger	No heating

`building_heat_src`

Examples

```
z22_categories("sex")

# Features without categories are given code 0
z22_categories("families")
```

`glossary` *Definitions and explanations for common Census terms*

Description

First off, this package uses a couple of semi-official terms to make it easier to unequivocally identify certain parts of an aspect. When we are talking about a

- **feature**, we talk about an indicator aggregated to grid cells, e.g., age or the number of dwellings.
- **category**, we talk about the discrete classifications of features, e.g., ages 10 to 19, 20 to 29, 30 to 39, etc.
- Both feature and category have to be provided to uniquely identify a **dataset**.

This documentation is a collection of definitions as they are provided by the Federal Statistical Office of Germany.

Building year

This characteristic indicates the **year of construction** of a building with living space in microcensus classes on the respective census reference date. The year of construction refers to the year in which the building was completed. In the case of conversions, extensions and additions to the house, the original year of construction of the building applies. In the case of completely destroyed and rebuilt buildings, the year of reconstruction is taken as the year of construction.

Building classifications

The census distinguishes three types of building classifications. Because they are very close terminologically, they need clarification:

Building size Originally called "building type size" (Gebäudetyp-Größe), this classification provides information on the building type in relation to its size. Categories range from detached single-family buildings to multi-story multi-unit buildings.

Building type Originally called "building type" (Gebäudeart), this classification provides information about the residential use of residential buildings. It distinguishes buildings based on how much space is used for residential purposes. Categories include:

- **Buildings with living space**: Permanent buildings which are either fully or partially reserved for residential use by households. This also includes buildings used for administrative or commercial purposes if they contain at least one dwelling used for residential purposes. Buildings with living space are divided into residential buildings and other buildings with living space.

- **Residential buildings**: Buildings in which at least half of the total usable floor space is used for residential purposes. Residential buildings also include dormitories (where residents run their own household).
- **Dormitories**: Dormitories are residential buildings that primarily serve the housing needs of certain groups of the population (e.g. student residences, retirement homes). Dormitories have common rooms. Residents of dormitories run their own households.
- **Other buildings with living space**: Buildings in which less than half of the total floor space is used for residential purposes, e.g. because the building is predominantly occupied by stores or offices.

Building design Originally called "building type construction design" (Gebäudetyp-Bauweise), this classification specifies the morphological design of a building, i.e. whether it is detached, semi-detached, terraced or something else.

Citizens / Citizenship

Persons with German citizenship are counted as German **citizens**. When assigning citizenship, a distinction is made between persons with German and non-German citizenship. Persons with a German citizenship are considered to be German, regardless of the existence of other citizenships.

Members of the German Armed Forces, police authorities and the Foreign Service working abroad and their families residing there are not included in this analysis, as they cannot be assigned regionally at grid cell level in Germany.

Core family

This characteristic indicates the type of **core family** according to national typification, i.e. according to the reference person principle, taking into account secondary residents. A core family consists of two or more persons belonging to the same private household and is made up of the reference person of the private household - a central person of the private household defined by age, marital status and gender - and at least one other person, e.g. the partner or a child of the reference person. This family concept restricts relationships between ancestors and descendants to direct relationships (first degree), i.e. relationships between parents and children. Only one core family can exist in a household. Other persons living in the household are not assigned to a core family. A household without a core family is possible.

The type of core family depends on the type of couple relationship or the gender of the single parent, and on the presence and age (under or over 18) of children. The term marriage is not differentiated according to the gender of the married persons. Persons in shared accommodation are not included here, only persons who have their own household.

A range of terms relate to core families:

- A **couple** comprises of married couples, couples in a registered civil partnership and couples in a non-marital partnership who live together in a private household.
- A **married couple** is a couple married according to the legal marital status on the reference date and living in a private household.
- A **registered civil partnership** (ELP) is a legally recognized same-sex couple in a private household according to the legal marital status on the reference date.
- A **non-marital partnership** (NELG) is a mixed-sex couple in a private household who were not married to each other according to their legal marital status on the reference date.

- A **single mother** or a **single father** is a parent without a partner with at least one child within a private household.
- A **child** is a biological son, stepson or adopted son or a biological daughter, stepdaughter or adopted daughter (regardless of age) whose usual place of residence is in the private household of at least one parent and one parent is the caregiver and/or partner of the caregiver.
- A **senior** is defined as a person who has reached the age of 65 on the census date.

Dwelling

A **dwelling** is defined as rooms that are closed off from the outside, intended for residential purposes, usually located together, which enable the management of a separate household and are not used entirely for commercial purposes.

A dwelling does not necessarily have to contain a kitchen or kitchenette. Apartments have their own entrance directly from the outside, from a stairwell or a vestibule. However, a dwelling may also include basement or floor rooms (e.g. attics) that are developed for residential purposes outside the actual end of the dwelling.

Floor space

To determine the **floor space**, the following areas are taken into account:

- **full**: floor areas of rooms or parts of rooms with a clear height of at least 2 meters.
- **half**: floor areas of rooms or parts of rooms with a clear height of at least 1 meter but less than 2 meters; unheatable observatories, swimming pools, and similar rooms closed on all sides.
- **generally a quarter, but no more than half**: areas of balconies, loggias, roof gardens, terraces.

Foreigners

Persons with a non-German nationality are counted as **foreigners**. When assigning nationality, a distinction is made between persons with German and non-German nationality. Persons with German citizenship are considered German, regardless of the existence of other citizenships.

Household

A private **household** consists of at least one person. This is based on the "concept of communal living": all persons who live together in dwelling, regardless of their residential status (sole residence, main or secondary residence), are considered members of the same private household, meaning that there is one private household per occupied dwelling. There is a maximum of one core family in a household. Other persons living in the household are not assigned to a core family.

Heating type

The characteristic reflects the **type of heating** in the building. This evaluation is carried out for dwellings. The predominant type of heating in the building is broken down according to which spatial unit (district, building block, building, dwelling, room) is heated by the heating system. In passive houses, systems for heat recovery/controlled ventilation systems are considered "heating" and are assigned accordingly (usually: central heating).

District heating Here, entire residential districts are supplied with heat from a central district heating plant (so-called district heating).

Self-contained central heating Self-contained central heating refers to a central heating system for all rooms in a self-contained dwelling, whereby the heating source (for example, gas boiler) is usually located within this dwelling.

Block heating Block heating is when a block of entire houses is heated by a central heating system and the heating source is located in or on one of the buildings or in its immediate vicinity (so-called local heating).

Central heating With central heating, all the residential units in a building are heated from a central heating point located within the building (usually in the basement). This also includes heat pumps.

Single or multi-room stoves Individual stoves (such as coal or night storage stoves) only heat the room in which they are located at any one time. They are usually permanently installed. A multi-room stove (e.g. tiled stove) heats several rooms at the same time (also through air ducts). No heating in the building or in the dwellings

Marital status

The **marital status** indicates a person's marital status under personal law. The marital status under personal law is determined in accordance with the Personenstandsgesetz (PStG) and the Lebenspartnerschaftsgesetz (LPartG).

The introduction of the right to marriage for persons of the same sex (Eheöffnungsgesetz) has allowed same-sex couples to marry since October 1, 2017. The establishment of new registered civil partnerships under the Lebenspartnerschaftsgesetz (LPartG) has no longer been possible since October 1, 2017. Unless existing civil partnerships are converted into a marriage, registered civil partnerships remain in place.

Net rent

The average **net rent** per square meter is the ratio between the total rent per square meter of the dwellings and the total number of dwellings. The calculation is made for rented dwellings in residential buildings (excluding dormitories). Dwellings not rented out are excluded from the calculation.

Ownership

Ownership is divided into **home ownership** and **property ownership**. Home ownership determines who is entitled to ownership of a dwelling in a building divided according to the Wohneigentumsgesetz (WEG) while property ownership determines who is entitled to ownership in a building. Owners can be private individuals or legal entities.

The **ownership rate** represents the share of owner-occupied dwellings in all occupied dwellings. Not taken into account: Vacant dwellings, vacation and leisure dwellings and commercially used dwellings. The calculation is made for dwellings in residential buildings (excluding halls of residence).

Place of birth

Persons born up to August 2, 1945 in former German eastern territories within the borders of Germany in 1937 are not counted as born abroad, but are assigned the German state code. If the **place of birth** is not within these borders, the current state code is assigned. Places of birth in countries that have merged into other countries, such as the Soviet Union or Yugoslavia, are assigned to the countries that exist today wherever possible.

EU27 Comprises the member states of the European Union as of 15 May 2022, previously last amended by the UK's withdrawal in 2020. Persons born in Czechoslovakia are also included in "EU27 country (as of 2020)" with the current country codes. Croatia is also included here following its accession to the EU on July 1, 2013.

Other Europe Includes the Russian Federation and Turkey as well as other current country codes of the former Soviet Union and the former Yugoslavia. Great Britain is assigned here following its withdrawal from the EU.

Other World Includes all other countries. This category includes other current country codes of the former Soviet Union that were not assigned to "Other Europe".

Other Includes "Not specified".

Residents

Each **resident** is assigned to an **address** and thus to a grid cell with a side length of 100 m, 1 km or 10 km. Members of the German Armed Forces, police authorities and the Foreign Service working abroad and their families living there are not included in this analysis, as they cannot be assigned regionally at grid cell level in Germany.

Room

A **room** is either a living room, dining room, bedroom or other separate room (e.g. habitable cellar or floor rooms) of at least 6 square meters in size as well as self-contained kitchens, regardless of their size. Bathrooms, toilets, hallways and utility rooms are generally not counted. A living room with a dining area, sleeping alcove or kitchenette is to be counted as one room. Accordingly, dwellings in which there is no structural separation of the individual living areas (e.g. so-called "loft dwellings") consist of only one room.

Source of heating

The characteristic shows the energy **source of the heating** in the building. This evaluation is carried out for dwellings. Energy source used to heat the building. If there are several energy sources in the building, it is the one that heats the largest part of the living space. In passive houses, the residual heat requirement is covered by an additional source, which is specified here.

- **Gas**
- **Heating oil**
- **Wood, wood pellets**
- **Biomass (excluding wood), biogas**: All organic substances produced by plants or animals from which energy can be obtained by burning. Energy can be obtained through combustion. This includes straw, organic waste or liquid manure (excluding wood). Biogas is produced during the fermentation of biomass and is also classified here.

- **Solar/geothermal energy, environmental heat, exhaust air heat**: Solar energy as well as energy from water, air and earth is obtained here with the help of collectors, heat pumps and heat exchangers. This also includes heat obtained from the exhaust air of buildings (so-called exhaust air heat).
- **Electricity (without heat pumps)**
- **Coal**
- **District heating (various heating sources)**
- **No energy source (no heating)**

Vacancy

The **vacancy rate** (dwellings) represents the ratio of vacant dwellings to all occupied and vacant dwellings. The market-active vacancy rate represents the proportion of vacant dwellings that are available again within three months as a percentage of all dwellings in residential buildings. Not taken into account: Vacation and leisure dwellings as well as commercially used dwellings. The calculation is made for dwellings in residential buildings (excluding halls of residence).

Source

Translated and slightly edited version of the dataset descriptions of the Zensus 2022 and Zensus 2011 gridded datasets by the Federal Statistical Office of Germany.

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inspire *Generate INSPIRE IDs*

Description

Given pairs of coordinates, generates their INSPIRE grid representation. Given INSPIRE identifiers, can also extract the X and Y coordinates.

An INSPIRE ID contains information about the CRS, cell size and the ETRS89-LAEA coordinates of the south-west corner of the grid cell in its format. Only the relevant first digits are used in place of the full coordinates. In case of `res = "100km"`, these are the first two digits, for `res = "100m"` the first five digits.

```
CRS3035{cellsize}mN{y}E{x} # new format
{cellsize}N{y}E{x}         # legacy format
```

The legacy format always uses meters while the legacy formats aggregates cell sizes greater or equal to 1000m to km.

Usage

```
z22_inspire_generate(coords, res = NULL, legacy = FALSE)

z22_inspire_extract(inspire, as_sf = FALSE)
```

Arguments

coords	A list, matrix, or dataframe where the X and Y coordinates are either in the columns "x" and "y" or in the first and second column position, respectively. Column names are converted to lowercase. Can also be a sf/sfc object in which case the coordinates are extracted using st_coordinates.
res	Resolution of the grid. Can be "100m", "250m", "1km", "5km", "10km", or "100km". If NULL, tries to guess the resolution from the provided coordinates.
legacy	If TRUE, generates legacy INSPIRE ID. Defaults to FALSE.
inspire	A vector of INSPIRE IDs. Can be either legacy or non-legacy.
as_sf	Whether to return an object of class sfc or a tibble.

Details

To remain fast even for huge grid datasets, the function is just a very simple sprintf wrapper that performs no input checks. To produce valid INSPIRE identifiers, make sure to transform your data to ETRS89-LAEA (e.g. using st_transform(..., 3035)). You should also make sure that the coordinates are the south-west corner of existing INSPIRE grid cells.

Value

z22_inspire_generate returns a character vector containing the INSPIRE identifiers. z22_inspire_extract returns a dataframe or sfc object containing the points extracted from the INSPIRE identifiers. Note that the returned coordinates are always the centers of the grid cells as opposed to the south-west corners.

Examples

```
library(dplyr, warn.conflicts = FALSE)

# Generate IDs from a dataframe
coords <- tibble(x = c(4334150, 4334250), y = c(2684050, 2684050))
identical(z22_inspire_extract(z22_inspire_generate(coords)), coords)

# Extract coordinates from legacy ID strings
z22_inspire_extract("100mN34000E44000")

# Generate IDs from an sf dataframe
if (requireNamespace("sf", quietly = TRUE)) {
  coords <- sf::st_as_sf(coords, coords = c("x", "y"))
  z22_inspire_generate(coords)
}
```

`z22_data` *Get Census 2022 grid dataset*

Description

Retrieve the values and coordinates of gridded features from the censuses 2011 and 2022.

When we are talking about a

- **feature**, we talk about an indicator aggregated to grid cells, e.g., age or the number of dwellings.
- **category**, we talk about the discrete classifications of features, e.g., ages 10 to 19, 20 to 20, 30 to 39, etc.
- Both feature and category have to be provided to uniquely identify a **dataset**.

Usage

```
z22_data(
  feature,
  categories = NULL,
  year = 2022,
  res = "1km",
  all_cells = FALSE,
  normalize = FALSE,
  rasterize = FALSE,
  as_sf = FALSE,
  update_cache = FALSE
)
```

Arguments

`feature`	A grid feature. See `z22_features` for a list of available features. You can pass both English names and legacy names (i.e., variable names from the 2011 census).
`categories`	One or multiple feature categories. See `z22_categories` for a list of available categories. If `NULL`, retrieves all categories for a given feature. Generally, the more categories are selected, the longer the download.
`year`	Census year. Currently, only 2011 and 2022 are available. Defaults to 2022.
`res`	Resolution of the grid dataset. Can be `"100m"`, `"1km"`, or `"10km"`. If `year` is 2011, `"10km"` is not available and some features are only available at certain resolutions.
`all_cells`	If `TRUE`, joins the retrieved attribute with the complete grid from `z22_grid`. Otherwise, the attribute grid will contain only those grid cells with one or more recorded units. Defaults to `FALSE`, because loading the grid and joining with it is computationally expensive.

normalize — If TRUE and feature is a counted feature, computes shares by dividing the counts by the total number of units in the grid cell. The type of unit depends on the theme of the feature, e.g., if the feature is in theme "Buildings", the feature counts are divided by the total number of buildings. Note that this operation requires an additional download (the total number of units). Also note that sometimes (possibly due to the key-cell method), shares of over 1 are computed. Defaults to FALSE.

rasterize — If TRUE and the terra package is installed, converts the attribute coordinates to a SpatRaster.

as_sf — If TRUE and the sf package is installed, converts the attribute coordinates to an sf tibble.

update_cache — By default, both functions cache attribute files for the remainder of the R session. They are downloaded to a temporary directory and - if the file to download already exists - are recovered from the cache. In other words, when rerunning the same request multiple times, the subsequent calls should be much faster. If TRUE, disables caching for this call and overwrites the currently cached attribute file (if any) with a fresh one. Defaults to FALSE, i.e. always cache.

Details

Half of the grids cell width is added to each coordinate in the dataset internally. According to the INSPIRE guidelines, coordinates always represent the South-west of the grid cells. Centroids represent the geographic location of grid cells better which is why they are used.

By default, data are downloaded from the z22data data repository which stores all pre-processed data. You can download this repository and use it offline or use an entirely different repository by setting `options(z22.data_repo = "path/to/z22data")`.

Value

A tibble, SpatRasterDataset or sf tibble depending on the rasterize and as_sf arguments.

If a tibble is returned each category in categories is stored in a column. If a SpatRasterDataset is returned, each category is a named layer.

Examples

```
# Get gridded population
pop <- z22_data("population", res = "10km", rasterize = TRUE)
terra::plot(pop$cat_0)

# Get data about the number of people born in a EU27 country
z22_data("birth_country", categories = 21, res = "1km")
```

z22_decode *Decode and translate features and categories*

Description

Replace category codes with their labels.

Usage

```
z22_decode(codes, feature, lang = c("english", "german"))
```

Arguments

codes	A vector of character codes, possibly prefixed with "cat_".
feature	A grid feature that the category codes belong to.
lang	Specifies the language of the output description. Can be either "english" (default) or "german". Note that the English descriptions are only ad-hoc translations based off the German originals.

Value

.data with category codes decoded to labels.

Examples

```
# retrieves a the translation of cat codes directly
z22_decode(1, "marital_status")

# recycles codes
z22_decode(c(1, 1, 1), "marital_status")

# undefined codes are returned as NA
z22_decode(c(1, 2, 3), feature = "sex")

# special case: cat_* strings
z22_decode("cat_2", feature = "sex")
```

z22_features *Features*

Description

Get a list of available features. To get a list of all categories, see z22_categories.

For further clarification of terms used in the feature labels, see the glossary.

Usage

```
z22_features(theme = NULL, year = NULL, res = NULL, legacy_names = FALSE)
```

Arguments

theme	Theme of the feature. Available themes are "population", "families", "households", "dwellings", and "buildings". If NULL, returns features for all themes.
year	Census year. Can be 2011 or 2022. If NULL, returns features for both years.
res	Resolution of the feature grid. Can be "100m", "1km", or "10km". For Census 2011, only 100m and 1km are available and not all features are available for both resolutions. For Census 2022, all features are available at all resolutions. If NULL, returns features for all resolutions.
legacy_names	If TRUE, uses legacy (german) feature names from the Census 2011 where possible. Defaults to FALSE.

Value

A tibble containing the following columns:

- theme: Theme of the feature
- feature: Feature name
- desc: Human-readable english description
- z22: Whether the feature is available in the Census 2022
- z11_100m: Whether the feature is available in the Census 2011 at a 100m resolution
- z11_1km: Whether the feature is available in the Census 2011 at a 1km resolution
- has_cat: Whether the feature is is further divided into categories.

Examples

```
# return all features related to dwellings
z22_features("dwellings")

# return all features available in the Census 2011
z22_features(year = 2011)

# return all features available in 2011 at a 1km resolution
z22_features(year = 2011, res = "1km")
```

z22_grid *Get INSPIRE grid*

Description

Retrieve the entire INSPIRE grid.

Unlike the feature grids retrieved from z22_data, the INSPIRE grid encompasses the entire area of Germany. You can thus use it to join with the incomplete feature grids from z22_data to create a complete dataset.

Usage

```
z22_grid(
  res,
  year = 2019,
  rasterize = FALSE,
  as_sf = FALSE,
  update_cache = FALSE
)
```

Arguments

res	Resolution of the grid. Can be "100m", "250m", "1km", "5km", "10km", or "100km".
year	Version of the grid. Can be 2015, 2017, 2018 and 2019. Defaults to the latest version.
rasterize	If TRUE and the terra package is installed, converts the attribute coordinates to a SpatRaster.
as_sf	If TRUE and the sf package is installed, converts the attribute coordinates to an sf tibble.
update_cache	By default, both functions cache attribute files for the remainder of the R session. They are downloaded to a temporary directory and - if the file to download already exists - are recovered from the cache. In other words, when rerunning the same request multiple times, the subsequent calls should be much faster. If TRUE, disables caching for this call and overwrites the currently cached attribute file (if any) with a fresh one. Defaults to FALSE, i.e. always cache.

Details

Note the uncompressed object sizes of the output (2019 version):

- 100 m: 38 million cells, 291 MB
- 250 m: 6 million cells, 47 MB
- 1 km: 384 thousand cells, 3 MB
- 5 km: 16 thousand cells, 0.12 MB
- 10 km: 4 thousand cells, 0.03 MB

Value

A tibble, SpatRasterDataset or sf tibble depending on the rasterize and as_sf arguments.

If a tibble is returned each category in categories is stored in a column. If a SpatRasterDataset is returned, each category is a named layer.

Examples

```
# Get high-res grid as tibble
z22_grid("100m")

# Get low-res grid as raster
z22_grid("1km", rasterize = TRUE)
```

---

z22_pivot_longer *Cast feature grid to a long table*

Description

Helper function to convert the output of z22_data to a long table. This can be useful for plotting or other data wrangling tasks.

Note that pivoting can quickly become expensive for larger 100m grids.

Usage

```
z22_pivot_longer(.data, feature, lang = c("english", "german"))
```

Arguments

.data	Output of z22_data.
feature	A grid feature that is represented by .data.
lang	Specifies the language of the output description. Can be either "english" (default) or "german". Note that the English descriptions are only ad-hoc translations based off the German originals.

Details

Note that all columns starting with "cat_*" are automatically used for pivoting.

Value

A dataframe containing the columns category, value, x and y. All non-category columns are preserved.

Examples

```
# get feature grid
age <- z22_data("age_short", res = "10km")

# pivot to a long table
z22_pivot_longer(age, feature = "age_short")
```

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