Package 'hazus'

Title Damage functions from FEMA's HAZUS software for use in modeling financial losses from natural disasters

Description Damage Functions (DFs), also known as Vulnerability Functions, associate the physical damage to a building or a structure (and also its contents and inventory) from natural disasters to financial damage. The Federal Emergency Management Agency (FEMA) in USA developed several thousand DFs and these serve as a benchmark in natural catastrophe modeling, both in academia and industry. However, these DFs and their documentation are buried within the HAZUS software are not easily accessible for analysis and visualization. This package provides more than 1300 raw DFs used by FEMA's HAZUS software and also functionality to extract and visualize DFs specific to the flood hazard. The vignette included with this package demonstrates its use.

Version 0.1

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Depends R (>= 3.0.2)

Imports reshape2

VignetteBuilder knitr

Suggests ggplot2, knitr

License GPL (>= 2)

LazyData true

Collate 'data.r' 'extract_hazus_functions.r'

NeedsCompilation no

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R **topics documented:**

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extract_hazus_functions

Extract HAZUS damage functions for specified function type

Description

Extract HAZUS damage functions for specified function type

Usage

```
extract_hazus_functions(func_type = "depth",
  long_format = TRUE)
```

Arguments

func_type   Flood damage or depreciation function type. Choose one of depth (depth-damage
                 functions), velocity (velocity-depth-damage functions), ag (damage functions
                 for agriculture, based on duration of flooding), bridge (damage function for
                 bridges based on the severity of the flood) or deprec (depreciation with age).

long_format   Logical flag to indicate whether raw data is desired or in a format suited for
                 plotting using ggplot2. Damage function data from HAZUS are typically in the
                 wide format.

Value

data frame, the number of rows and columns depend on the first argument of the function.

Author(s)

Gopi Goteti

Examples

```
# depth-damage functions
fl_dept <- extract_hazus_functions()
# depth-damage functions, raw data only
fl_dept <- extract_hazus_functions(long_format = FALSE)
# velocity-depth-damage functions
fl_velo <- extract_hazus_functions(func_type = "velocity")
# agriculture damage functions
fl_agri <- extract_hazus_functions(func_type = "ag")
# bridge damage functions
fl_bridge <- extract_hazus_functions(func_type = "bridge")
# depreciation functions
fl_depr <- extract_hazus_functions(func_type = "deprec")
# columns names of all flood damage functions
lapply(ls(pattern = "fl_"), FUN = function(x) colnames(get(x)))
# flood occupancy types and description
data(haz_fl_occ)
head(haz_fl_occ)
```

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hazus	*Damage functions and other utilities from FEMA's HAZUS software for use in modeling financial risk from natural disasters.*

Description

Damage functions and other utilities from FEMA's HAZUS software for use in modeling financial risk from natural disasters.

Details

Damage functions are useful in modeling financial risk from natural disasters. **hazus** provides the damage functions used by FEMA's HAZUS software. **hazus** currently provides functionality to extract and visualize damage functions specific to flood hazard. Hurricane and earthquake damage functions would be included in the future.

Author(s)

Gopi Goteti

References

HAZUS, The Federal Emergency Management Agency's (FEMA's) Methodology for Estimating Potential Losses from Disasters, http://www.fema.gov/hazus

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| `haz_fl_agri` | *Agriculture damage functions from HAZUS, specific to flood* |

Description

Table D.31 (pg. D-27 of the User Manual) describes the attributes of these damage functions. Data was obtained from the table flAgDmgFn in the MS Access Database flDmRsFn found in the HAZUS software package.

Format

Data frame with 6 columns and 7300 rows

Details

Variables:

- Crop - Name or type of the crop (currently 20 possibilities)

- FunctionSource - Source of the data (either HAZUS default or from USACE)

- JulianDay - Day of year (1 to 365)

- PctCropLoss - Maximum potential percentage crop damage

- PctLossDuration0_d - 0-Day flood duration damage modifier

- PctLossDuration3_d - 3-Day flood duration damage modifier

- PctLossDuration7_days - 7-Day flood duration damage modifier

- PctLossDuration14_days - 14-Day flood duration damage modifier

Author(s)

Gopi Goteti

References

HAZUS-MH MR4 Flood Model User Manual and Technical Manual, August 2009, http://www.fema.gov/protecting-our-communities/hazus/hazus-user-technical-manuals

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`haz_fl_bridge`	*Damage functions from HAZUS for highway, railway and light rail bridges, specific to flood*

Description

Table D.29 (pg. D-24 of the User Manual) describes the attributes of the table. Data was obtained from the table flBridgeDmgFn in the MS Access Database flDmRsFn found in the HAZUS software package.

Format

Data frame with 45 columns and 8 rows

Details

Variables:

- BridgeDmgFnId - Identifier used by HAZUS
- Occupancy - Bridge-specific occupancy
- Source - Source of the data (currently only HAZUS default)
- Description - Single span or continuous span
- RP - Percent damage for return period in years

Author(s)

Gopi Goteti

References

HAZUS-MH MR4 Flood Model User Manual and Technical Manual, August 2009, http://www.fema.gov/protecting-our-communities/hazus/hazus-user-technical-manuals

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`haz_fl_depr`	*Depreciation functions from HAZUS, specfic to flood*

Description

Table D.5 (pg. D-9 of the User Manual) describes the attributes of the table. Data was obtained from the table flDepFunction in the MS Access Database flDmRsFn found in the HAZUS software package.

Format

Data frame with 36 columns and 101 rows

Details

Variables:

- Age - Average age of the structure in years (0 to 100 years)
- Next 35 columns - Depreciation by age for 35 occupancy classes, where occupancy is defined by `haz_fl_occ`

Author(s)

Gopi Goteti

References

HAZUS-MH MR4 Flood Model User Manual and Technical Manual, August 2009, `http://www.fema.gov/protecting-our-communities/hazus/hazus-user-technical-manuals`

`haz_fl_dept`	*Depth-damage functions from HAZUS, specific to flood*

Description

Tables D.28, D.30, D.32 (pg. D-22, D-26 and D-28 of the User Manual) describe the attributes of these tables. Data was obtained from the tables flBldgStructDmgFn, flBldgContDmgFn, flBldgInvDmgFn, flEssntStructDmgFn, flEssntContDmgFn, flUtilFltyDmgFn, flVehicleDmgFn, in the MS Access Database flDmRsFn found in the HAZUS software package. Data from the above tables was combined into a single data frame.

Format

Data frame with 51 columns and 1260 rows

Details

Variables:

- Occupancy - Subclasses within each Occupy_Class (`haz_fl_occ`)
- DmgFnId - Identifier used by HAZUS
- Source - Source identified by HAZUS
- Description - Description from HAZUS
- Comment - Comments from HAZUS, usually blank
- Columns beginning with ft - Percent damage at specified flood depth
- Source_Table - HAZUS table name from which the data was obtained
- Occupy_Class - Generalized occupancy class (`haz_fl_occ`), e.g., RES1 and RES2 occupanices were assigned to the RES class. One of - AGR, AUTO, COM, EDU, GOV, IND, Other_Occupy, REL and RES
- Cover_Class - Coverage class, one of building (Bldg), contents (Cont), inventory (Inv), or other (Other_Cover)

Author(s)

Gopi Goteti

References

HAZUS-MH MR4 Flood Model User Manual and Technical Manual, August 2009, `http://www.fema.gov/protecting-our-communities/hazus/hazus-user-technical-manuals`.

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haz_fl_occ   *Building occupancy classes, specific to flood.*

Description

Modified from Table 3.1 from HAZUS-MH MR4 Flood Model Technical Manual.

Format

Data frame with 5 columns and 33 rows

Details

Variables:

- Occupy_Class - Generalized occupancy class, e.g., RES1 and RES2 occupanices were assigned to the RES class. One of - AGR, AUTO, COM, EDU, GOV, IND, Other_Occupy, REL and RES

- Occupancy - Subclasses within each Occupy_Class

- Occ_Desc1 - Description of Occupy_Class

- Occ_Desc2 - Description of Occupancy provided by HAZUS

- SIC_code - SIC (Standard Industrial Classification) code specified by HAZUS

Author(s)

Gopi Goteti

References

HAZUS-MH MR4 Flood Model User Manual and Technical Manual, August 2009, `http://www.fema.gov/protecting-our-communities/hazus/hazus-user-technical-manuals`.

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haz_fl_velo	*Velocity-depth-damage functions from HAZUS, specific to flood*

Description

These functions are specified in HAZUS as empirical equations and indicate whether or not the structure will collapse under a given combination of flood velocity and flood depth. The empirical equations have the form specified below, where the coefficients and exponents are dependent on the velocity and depth thresholds for a given structure type

$$coef1 * V^{expo1} + coef2 * V + coef3$$

Format

Data frame with 8 columns and 12 rows

Details

Variables:

- num_story - Number of stories (1, 2 or 3)
- struc_type - Structure type (wood, masonry, concrete or steel)
- thresh_d - Depth threshold (ft) used in the above equation
- thresh_v - Velocity threshold (ft/s) used in the above equation
- coef1 - Coefficient in the above equation
- coef2 - Similar to coef1
- coef3 - Similar to coef1
- expo1 - Exponent in the above equation

Author(s)

Gopi Goteti

References

Obtained from Tables 5.5, 5.6 and 5.7 of the HAZUS-MH MR4 Flood Model Technical Manual, August 2009, http://www.fema.gov/protecting-our-communities/hazus/hazus-user-technical-manuals

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