Quick Guide to HAZUS-MH MR1

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ESRI 380 New York St., Redlands, CA 92373-8100, USA • TEL 909-793-2853 • FAX 909-793-5953 • E-MAIL info@esri.com • WEB www.esri.com

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Loss Estimation Software for Earthquakes, Hurricane Winds, and Floods

Hazards U.S. Multi-Hazard (HAZUS-MH) is a powerful risk assessment software program for analyzing potential losses from floods, hurricane winds, and earthquakes. HAZUS-MH uses ESRI® software to run its calculations and is an extension for ArcGIS® Desktop. HAZUS-MH was developed by the Federal Emergency Management Agency (FEMA) under contract with the National Institute of Building Sciences. It started in 1992 as a project related to the National Earthquake Hazards Reduction Program.

The latest scientific knowledge and open source national data are used to implement the methodologies and calculate the physical damage and economic losses caused by these natural disasters and social impacts to populations. Physical damage analysis defines the hazard and calculates damage to residential and commercial buildings, schools, critical facilities, and infrastructure. Economic loss analysis calculates the lost jobs, business interruptions, and repair and reconstruction costs. And the social impact analysis identifies casualties, shelter requirements, and medical aid using data from the physical damage analysis.

There are three levels of HAZUS-MH usage. Level 1 uses the default data that is embedded in HAZUS-MH and does a basic analysis. In Level 2, additional, detailed local data can be imported to the HAZUS-MH environment, and the analysis could run using this higher-quality data. Experts and engineers can change some of the values that HAZUS-MH suggests and use HAZUS-MH in Level 3 with higher accuracy for their specific study region.

HAZUS-MH has been used for disaster mitigation purposes in many government agencies, especially after the Disaster Mitigation Act of 2000 where agencies are required to estimate hazard losses. Agencies involved in economic development, homeland security, urban planning, and so forth, are some examples. Not only government agencies but also the private sector use HAZUS-MH. Examples include telecommunications, health and human services, defense and intelligence, transportation, engineering, and utilities industries. In the defense and intelligence industry, HAZUS-MH is used for monitoring critical infrastructure and high-risk targets (nuclear and military installations) and in emergency operations centers (EOCs) for emergency and disaster response analysis. For health and human services, HAZUS-MH can be applied to social impact assessments such as casualties, shelter requirements, and hospital capabilities. Another good example of HAZUS-MH usage is in the transportation industry. Assessing the damage to roads, highways, and bridges would help sort out the logistical problems that can be encountered in a disaster. With these results, evacuation routes can be planned and their design improved.

With a wide range of users, HAZUS-MH will continue to be in demand.

Software Requirements

Currently, HAZUS-MH Maintenance Release 1 (MR1) runs with ArcGIS 9 Service Pack (SP) 1. The new MR2 will work with ArcGIS 9.1. MR2 was released in mid-2006.

The table below identifies software requirements (and recommendations) for HAZUS-MH MR1.

Computer Speed	Minimal	Moderate	Preferred
	Pentium® III, 1 GHz core speed 512 MB RAM	Pentium 4, 2 GHz core speed 512 MB RAM	Pentium 4, 2.6 GHz (or better) core speed and 800 MHz system bus 1 GB RAM
	Note: **Allows moderately fast analysis for small communities only**	**Note:** **Allows fast analysis for medium-sized communities and real-time analysis for small communities**	**Note:** **Allows fast analysis for large urban areas and real-time analysis for all communities**
Computer Storage: Free Hard Disk Space	10 GB Allows installation of HAZUS-MH and storage of three scenarios for a medium-sized community	40 GB Allows installation for HAZUS-MH and storage of three scenarios for large urban areas	80 GB Allows installation for HAZUS-MH and storage of 25 or more scenarios for large urban areas
Hardware Accessories	DVD-ROM reader with 12x minimum read speed		
	Graphics card with 800 x 600 minimum resolution		
	Mouse, keyboard, and 19" monitor		
Supporting Software	**Microsoft® Windows® 2000 SP2, SP3, and SP4**		
	Microsoft Windows XP SP1		
	ArcGIS 9 SP1		
	ArcGIS Spatial Analyst extension required for Flood Model		

HAZUS-MH Supplied Data

Data that comes with HAZUS-MH is open source and collected for the nation. It is extensively updated with each upgrade and it has more than 200 data layers. Inventory data is divided into two types:

- Common to All Hazards
  - General building types and occupancies
  - Lifelines
  - Replacement costs
  - Demographics
- Hazard Specific
  - Specific building types
  - Elevation
  - Building configurations

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HAZUS-MH Models

Flood Model

The Flood Model is used to assess both riverine and coastal flooding. This model estimates potential damage to all classes of buildings (wood, concrete, unreinforced masonry, etc.), essential facilities (medical facilities, emergency operations centers, and schools), transportation and utility lifelines, vehicles, and agricultural crops. Casualties can be estimated from census information. The model addresses building debris generation and shelter requirements. Direct losses are estimated based on physical damage to structures and their contents and interiors.

Hurricane Winds Model

The Hurricane Winds Model can run analysis for 22 states including Hawaii. Loss estimations are done for commercial, residential, and industrial buildings. The analysis can take up to four hours for large study regions with Census 2000 tracts. It also estimates direct economic loss, poststorm shelter needs, and building and tree debris quantities. The hurricane scenarios can now also be downloaded from the National Weather Service Web site.

Earthquake Model

With the Earthquake Model, damage and loss estimations to buildings, essential facilities, transportation and utility lifelines, and population, based on scenario or probabilistic earthquakes, can be mapped and reports can be created. It estimates the debris resulting from quake fire damage, casualties, and shelter requirements. Direct economic losses are estimated based on physical damage to structures and their contents and interiors.

Outputs of Data Models

The map and report outputs of HAZUS-MH differ for each hazard model. The Earthquake Model has the most comprehensive output list. This model estimates the damage to buildings, facilities, and systems; damage from fires following an earthquake; hazardous materials release; and lastly, debris generation. Additionally, direct losses such as repair costs, income loss, casualties, and shelter needs are included. Indirectly calculated losses are supply shortages, sales decline, opportunity costs, and economic loss.

The Flood Model estimates direct damage to buildings, essential facilities, and transportation and utility systems and induced damage estimations only for debris generation. Direct losses include the cost of repairs, income loss from crop damage, and shelter needs. Casualties are estimated by a general output. Indirect losses include supply shortages, sales decline, opportunity costs, and economic losses.

The Hurricane Winds Model estimates direct damage to buildings, essential facilities, and high-potential-loss facilities. Induced damage estimations include hazardous materials release and debris generation. Direct losses include the cost of repairs, income loss, and shelter needs. There is no output for indirect losses.

Industries That Can Benefit from HAZUS-MH

Many industries can benefit from this extension to ArcGIS. HAZUS-MH provides a unique tool that can be implemented in all phases of disaster management. Although it is used for disaster mitigation purposes, HAZUS-MH can be used during a disaster to estimate damage and loss and also during the recovery stage. Its capabilities have earned international attention, and many other countries are expected to create their own versions in the future. Below is a short summary of how different industries can leverage this tool.

- Business
  - Business continuity planning—In times of disaster, businesses are interrupted and sometimes demolished. To prevent these losses, HAZUS-MH can provide important inputs for business analysis concerning indirect losses such as supply shortages, sales decline, opportunities costs, and economic loss.
  - Risk management—Information and data need to be secure in times of disaster to prevent loss of important and confidential information.
  - Insurance, real estate—Real estate values heavily depend on the hazard zones that they are in; thus, this sector can leverage the physical damage estimations in their work.
  - Financial services—Customers' purchasing habits and need for additional products can be analyzed through the outputs of the indirect loss estimations from HAZUS-MH.
- Communications
  - Location based—It is important to know that a communication tower's location is safe from hazards. HAZUS-MH physical damage estimation will help determine a tower's location and its suitability for use.
  - Media/Press—The public will need to be informed of the disaster and the type of hazard. HAZUS-MH can produce estimation reports and maps.
- Conservation
  - Cultural landmarks and protected natural lands that are in high-risk areas would face greater economic loss. Hazards not only affect human beings but also protected habitats and cultural lands. HAZUS-MH provides important location information that would be useful for those regions.
  - Archaeological sites—Archaeological sites should also be protected from the dangers of a disaster.
- Defense and Intelligence
  - Emergency operations centers—Site selection for EOCs during the disaster or in the mitigation phase would be a crucial part of their operations. This could be done by HAZUS-MH.
  - Emergency and disaster response teams—For the search and rescue teams, knowing the estimated number of casualties and their locations would be vital.
  - Nuclear and military installations locations—In particular, nuclear plant installations have to make sure that they are in secure locations. If a feasibility study is going to be implemented, HAZUS-MH can provide the general values.

- Education
  - Libraries and museums—Libraries and museums protect our historical assets, and HAZUS-MH can determine if they are at risk or not. Nonstructural mitigation acts can be applied for libraries and museums.
- Engineering
  - Building code analysis—Structural engineers and earthquake engineers can do statistical analysis on building fragility curves and also be able to estimate the economic and social impacts of earthquake damage using HAZUS-MH.
- Government
  - Urban planning—Future developments and the current stage of preparedness can be assessed using HAZUS-MH.
  - Department of Homeland Security—For such a government agency, it is important to know the location of hazards and how to dispatch law enforcement to the region, as crime often increases during disasters.
  - Economic development—To create a sustainable economy through appropriate investments, hazards should be taken into account.
- Health and Human Services
  - For this sector, the number of casualties, internally displaced people, hospital capacities, mass casualty transportation, and so forth, can be analyzed via HAZUS-MH.
- Natural Resources
  - Pipeline damage—Damage to pipelines would create an environmental hazard; therefore, their proximity to essential facilities, population, and so forth, is very important to know. This link could be analyzed with HAZUS-MH and a GIS.
  - Potable water sources—The injured would need potable water; therefore, it would be important to settle them where potable water is plentiful following a disaster.
  - Chemical spill during disasters—The location of chemical spills, their environmental effects, and proximity to populated areas would be important data that can be analyzed through HAZUS-MH.
  - Agriculture—Damage to agriculture affects the short- and long-term economy. HAZUS-MH has the ability to address the economic loss calculations with agriculture, too.
- Transportation
  - Highway and bridge damage—HAZUS-MH can calculate damage to these systems, which are the critical parts of the response stage.

- Utilities
  - Electric, gas, water, wastewater—These can create the secondary hazards such as fires and explosions; therefore, they are also considered vital inputs for analysis. HAZUS-MH can create damage results for these systems.

How to Order HAZUS-MH

Contact

FEMA Distribution Center
P.O. Box 2012
Jessup, MD 20794-2012
Phone: 1-800-480-2520
Fax: 301-362-5335

In addition, an order form is available at
http://www.fema.gov/plan/prevent/hazus/hz_orderform.shtm.

Helpful Hints

- Be sure to have the required software and service packs.
- Running the entire inventory for the analysis will take several hours.
- Before you install the software, make sure you have copied the HAZUS-MH study region data onto your machine.
- Each scenario occupies 300 MB of disk space, so making room in the directory is important.
- To run the analysis, the limitation is 2 GB or, in other words, Census 2000 tracts that could be used.
- The Flood Model uses a maximum of four counties or 9,000 census blocks in a riverine analysis. Coastal flood modeling can run a maximum of one county.
- If the earthquake scenario is taken from Shakemap (only for California, from United States Geological Survey [USGS], CalTech, California Geological Survey, the California Integrated Seismic Network Web site) and the magnitude used is less than 5, the loss estimates are amplified.
- If the user-defined scenario in earthquake modeling is used, the soil maps are not used in the analysis run.
- With regard to HAZUS-MH compatibility, if you have ArcReader™ 9.1 and ArcGIS 9 with HAZUS-MH MR1, it will prevent the HAZUS-MH program from running smoothly. In this case, you would need to uninstall ArcReader 9.1.
- The Hurricane and Flood models do not have casualty layers.
- Census data refers to the general reports from the Census Bureau.
- Earthquakes have detailed casualty output maps and reports.

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Additional Information on HAZUS-MH

The following provide more information on HAZUS-MH.

- Free HAZUS-MH Web seminar on the Virtual Campus Web site at www.esri.com; http://www.esri.com/news/releases/06_1qtr/arcgis_fema.html
- User groups
  - Central HAZUS-MH user group; http://www.hazus.org
  - Southern California HAZUS-MH user group; http://www.hazus.org/SoCalHUG/SoCalHUG%20Virtual%20Meeting%20Room.htm
  - http://www.hazus.org/BAHUG/BAHUG.htm
- http://earthquake.usgs.gov/shakemap/sc/shake/archive/scenario.html
- http://www.fema.gov/plan/prevent/hazus/hz_manuals.shtm
- http://hazus.org/DATA_STANDARDIZATION/DATA_STANDARDIZATION.htm
- http://www.fema.gov/plan/prevent/hazus/hz_users.shtm

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1. http://www.fema.gov/plan/prevent/hazus/hz_models.shtm
2. K. Miller, 2006, Basic HAZUS Multihazards Course Handouts, E313

ESRI
380 New York Street
Redlands, California
92373-8100 USA

Phone: 909-793-2853
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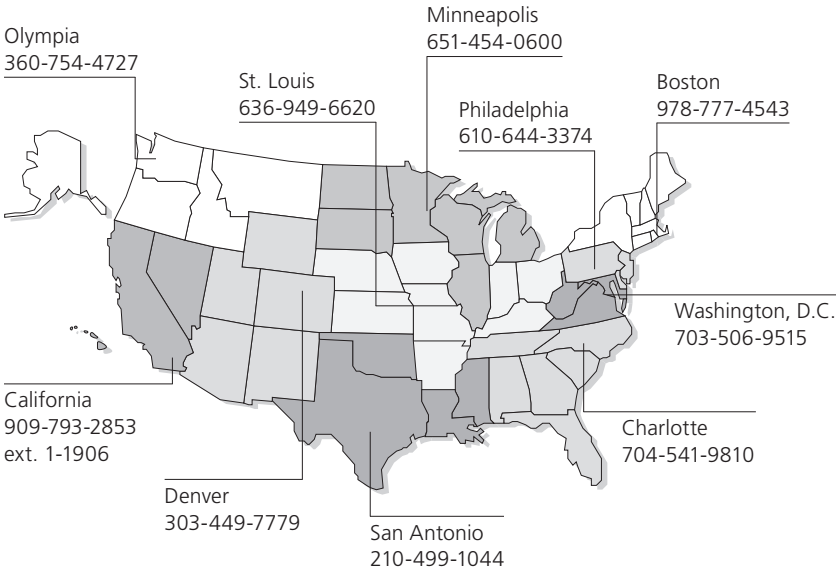

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