An Updated GIS-Based Methodology for Exporting the HAZUS Earthquake Model for Global Applications: HAZ EM (Extended Mediterranean) Loss Estimation

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We have updated and enhanced the methodology first described by Hansen and Bausch (2006) <u>http://www.hazus.org/HAZUSorg_DOCUMENTS/BAUSCH_EXPORTING_HAZUS_nonUS.p</u> <u>df</u> for a Sicily study region. This new application reaches across 21 Countries that participate in the joint UNESCO/USGS Reduction of Earthquake Loss in the Extended Mediterranean Region (RELEMR) <u>http://portal.unesco.org/science/en/ev.php-</u>



Enhancement include the development of 3 layers of resolution, including grid sizes of 100 km, 10 km, and 1 km, based on a population threshold of 100K. A new treatment for "urban" or high population density grids (1 km) where we assign the majority of non-residential building

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occupancy types was developed. Additional ShakeMap scenarios covering the area of interest have been developed by the USGS and we have formatted and developed a "500 year" Probabilistic Hazard map from the Global Seismic Hazard Map <u>http://www.seismo.ethz.ch/gshap/</u> to use for loss estimates

Background: The HAZUS-MH earthquake model

The HAZUS-MH earthquake model uses Geographic Information System (GIS) software and scientifically developed algorithms to calculate, map, and display earthquake loss data for communities throughout the U.S. (United States). Once the ground motions are provided or modeled by the HAZUS software, the program uses a series of mathematical formulas, calculates the violence of ground shaking, the amount of damage, the number of casualties, the number of people displaced by damaged structures, and the disruption and economic losses caused by the earthquake. These formulas describe the relationship between earthquake magnitude, violence of ground shaking, building and utility system damage, cost of repair, and indirect economic impact.

Concept: An International Application

In general we export a U.S. building stock to other areas of the world based on a user defined grid. We select a U.S. building stock that best fits the population and the built environment for the application, but the intent is that the user would replace the building stock information with their own local data. In this example we export the U.S. proxy data from the Puerto Rico building stock to the RELEMR region, which includes the Middle Eastern and Mediterranean countries of Algeria, Cyprus, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Malta, Morocco, Oman, Saudi Arabia, Spain, Sudan, Syria, Tunisia, Turkey, United Arab Emirates, West Bank (Palestinian Authority) and Yemen. This method allows the user to benefit from an existing methodology and to concentrate resources on developing good building inventory information to replace the U.S. proxy data are in a format that can be followed by the user.

This concept requires the use of the USGS (United States Geological Survey) ShakeMaps Earthquake Hazards Program <u>http://earthquake.usgs.gov/earthquakes/shakemap/</u> as a source of ground motion and shaking intensity algorithms, the USGS PAGER (Prompt Assessment of Global Earthquakes for Response) <u>http://earthquake.usgs.gov/eqcenter/pager/</u> as a source for ground motion data based on scenario earthquakes and LandScan 2008TM as a source for a high resolution (1km) population grid. It is possible to develop ground motion and population data from other sources, but these three provide global capabilities that are already available in a useable GIS format. In the case of ShakeMaps and PAGER, hazus.zip files are provided that includes the necessary HAZUS ground motion inputs (PGA, PGV, SA 0.3 and SA 1.0).

The LandScan 2008TM Global Population Database, 2008 is produced by the Oak Ridge National

Laboratory, <u>http://www.ornl.gov/gist/</u> and requires a license agreement to utilize and has some access constraints.

For more information on PAGER and/or ShakeMaps, please contact: Dr. David Wald, <u>wald@usgs.gov</u>

For more information on LandScanTM, please contact: Dr. Budhendra Bhaduri, <u>bhaduribl@ornl.gov</u>

Steps: 3 Basic Steps

Three basic steps are required to implement and run an analysis of losses for an international study region using HAZUS.

- 1) Create and Populate a User Defined Grid
- 2) Develop and Incorporate Ground Motion and Hazard Information
- 3) Run Analysis

These basic steps are described in more detail below, however, the user of these proposed methods should understand the technical methodology of the HAZUS loss estimation program (see HAZUS-MH Earthquake Technical and User Manuals;

http://www.fema.gov/hazus/hz_manuals.shtm) Step 1 requires the skills of an advanced GIS person knowledgeable in working with ArcGIS Geodatabases, as well as the ArcInfo-level software license available from ESRI www.esri.com. The user of this method is required to replace U.S. proxy building stock data with that developed locally and to apply or modify the loss functions that best represent their local building stock. A number of resources can help facilitate this, including EERI's World Housing Encyclopedia http://www.world-

housing.net/index.asp, but developing building stock inventories can be a significant effort. We will describe options that allow the user to import more limit portfolios of buildings that may be available through a survey of essential facilities, such as schools or hospitals, using the HAZUS Advanced Engineering Building Module (AEBM) <u>http://www.fema.gov/hazus/dl_aebm.shtm</u> or the HAZUS Comprehensive Data Management System (CDMS)

http://www.fema.gov/plan/prevent/hazus/index.shtm#2. As noted above, a diverse set of GIS and engineering skills are required to successfully implement this method. In addition, the user community typically includes emergency managers and public policy makers. Therefore, success in utilizing HAZUS internationally, as well as in the U.S., requires a group of users. In the U.S. we have developed HAZUS User Groups across the Country to help implement the program. www.hazus.org and www.usehazus.com.

Step 1 – Create and Populate a User-Defined Grid

Step-by-Step Instructions

The following instructions are divided into numbered tasks that are then followed by the detailed steps required to complete each task. Many steps are also followed by italicized comments that provide additional helpful information.

NOTE: The following steps are associated with the creation and population of a user-defined grid for the RELEMR region to be used with FEMA's HAZUS loss estimation software. The concepts presented here are adaptable to any global study area.

Set the Working Environment

Creating and populating a user-defined grid will take many steps. During this process we will need to create numerous temporary datasets and it is important to keep these organized. To keep our datasets in order we will first set up our working environment.

NOTE: Because HAZUS-MH was developed for use within the United States and Puerto Rico, you must replace the Geodatabases in an existing State folder with your new regional data. For this exercise we will be replacing the Puerto Rico folder.

1. In the working directory of your choice, create the following folders:

FinalData - Contains the final Geodatabases that will replace the Puerto Rico folder.

OrigData – Contains the original Geodatabases that will be used to import attribute table structures.

IntData – Contains the intermediate Geodatabases that will be loaded into the FinalData folder.

syBoundary – Contains the syBoundary.mdb Geodatabase to be edited.

Working – Will be used as a working directory and store any intermediate datasets.

- 2. Copy the **syBoundary.mdb** Geodatabase from any of the **HAZUS data DVDs** into the **syBoundary** folder.
- 3. Copy the following Geodatabases from the original **PR1** (Puerto Rico) folder into the **FinalData** and **OrigData** folders:

FinalData Folder	OrigData Folder
FinalData FinalData bndrygbs.mdb F.mdb F.mdb F.mdb F.mdb F.mdb F.mdb F.mdb F.mdb F.mdb F.mdb F.mdb F.mdb	 → → OrigData → → → Dondrygbs.mdb → → → EF.mdb → → → HPLF.mdb → → → TRN.mdb → → → UTIL.mdb

The original PR1 folder is located on Data DVD #4.

- 4. In ArcCatalog, delete the existing feature classes and tables in each Geodatabase in the FinalData folder.
- 5. Replace the deleted feature classes and tables in the FinalData folder with new empty datasets:
 - ➢ In ArcCatalog, Right-Click on the bndrygbs.mdb Geodatabase and select New→Feature Class...



In the New Feature Class Window, enter hzTract as the Name of the new feature class.

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Name:	hzTract	
Alias:		
-1100.	1	
Туре		
line, p	;ature class will store ESHI simple features (e.g., point, olygon).	
C This fe	ature class will store annotation features, network	
feature	 dimension features, or custom objects. 	
Select feature	the type of custom objects that you will store in this e class.	
1		

- Click Next.
- Leave the default settings in the Database Storage Configuration window. Click Next.
- > In the Field Definition window click the **Import...** button.
- Browse to the hzTract feature class in the OrigData folder and click the Add button.
- > Click on the **Shape** field and set the following **Field Properties**:
 - Geometry Type Polygon
 - Spatial Reference GCS_North_American_1983
- Click Finish.
- Repeat the previous steps for the following feature classes and tables in the FinalData folder. Be sure to specify Geometry Type for each new feature class as there are polygon, polyline, and point feature classes.

bndryGBS.mdb	EF.mdb	HPLF.mdb	TRN.mdb	UTIL.mdb
 indrygbs.mdb eqTractAttribs hzBldgCountOccupT hzDemographicsT hzExposureContentOccupT hzExposureOccupT hzMeansCountyLocationFactor hzSqFootageOccupT hzTract 	Fr.mdb eqCareFlty eqEmergencyCtr eqFireStation eqFireStation eqSchool hzCareFlty hzEmergencyCtr hzFireStation hzPoliceStation hzSchool	 HPLF.mdb eqDams eqHazmat eqMiltary eqMiltary eqMiltary hzDams hzHazmat hzHazmat hzHuclearFity hzNuclearFity 	TRN.mdb III eqAirportFlty III eqAirportFlty III eqFerryFlty III eqHighwayBridge III eqHighwayBridge III eqHighwaySegment III eqLightRailBridge III eqLightRailBridge III eqLightRailBridge III eqLightRailBridge III eqLightRailFlty III eqLightRailFlty III eqLightRailFlty III eqLightRailFlty III eqLightRailFlty III eqRailwayBridge III eqRailwaySegment III eqRailFlty III hzlightRailFlty IIII hzlightRailFlty <td>UIL.mdb eqCommunicationFlty eqElectricPowerFlty eqNaturalGasDL eqNaturalGasFlty eqOilFly eqOilFly eqOilFly eqOtableWaterDL eqPotableWaterPl eqWasteWaterPl eqWasteWaterPl eqWasteWaterPl eqWasteWaterPl eqWasteWaterPl eqWasteWaterPl hzCommunicationFlty hzNaturalGasFlty hzNaturalGasFlty hzNaturalGasPl hzNaturalGasPl</td>	UIL.mdb eqCommunicationFlty eqElectricPowerFlty eqNaturalGasDL eqNaturalGasFlty eqOilFly eqOilFly eqOilFly eqOtableWaterDL eqPotableWaterPl eqWasteWaterPl eqWasteWaterPl eqWasteWaterPl eqWasteWaterPl eqWasteWaterPl eqWasteWaterPl hzCommunicationFlty hzNaturalGasFlty hzNaturalGasFlty hzNaturalGasPl

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- 6. Copy the new set of earthquake Geodatabases from the **FinalData** folder into the **IntData** folder.
- 7. Add the Population Ratio field to the necessary tables in the **bndrygbs.mdb** Geodatabase in the **IntData** folder.
 - In ArcCatalog, Right-Click on the hzBldgCountOccupT table and select Properties...

Name	Туре
III eqTractAttribs	Personal Geodatabase Table
III hzBldgCountOccupT	Personal Geodatabase Table
ArcensusBlock	Personal Geodatabase Feature Class
La hzCounty	Personal Geodatabase Feature Class
III hzDemographicsT	Personal Geodatabase Table
III hzExposureContenti Rename F2	Personal Geodatabase Table
III hzExposureOccupT Export	Personal Geodatabase Table
III hzMeansCountyLoca	Personal Geodatabase Table
III hzSqFootageOccup1 Create Feature Class	Personal Geodatabase Table
D hzTract	Personal Geodatabase Feature Class
Load >	
Properties	

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Scroll to the bottom of the Fields tab and add a new field named POP_RATIO as Type Double.

Field	IName	Data Type	
REL1I		Short Integer	
GOV1I		Short Integer	-
GOV2I		Short Integer	-
EDU1I		Short Integer	-
EDU2I		Short Integer	-
_POP_RATIO		Double	1
			-
Domain			
Default Value	100		
Domain			
Precision	0		
Scale	0		
		Import	
To add a new field, type t click in the Data Type col Properties	ne name into an er umn to choose the	npty row in the Field Name colu data type, then edit the Field	mn,

- ≻ Click **OK**.
- Repeat these steps to create another field called U_POP_RATIO as Type Double (This will represent the Urban Population Ratio).
- Repeat these steps for the hzExposureContentOccupT, hzExposureOccupT, and the hzSqFootageOccupT tables.

The POP_RATIO (Population Ratio) field will be used to distribute the General Building Stock throughout the study region.

The U_POP_RATIO (Urban Population Ratio) field will be used to distribute the General Building Stock throughout the designated urban areas within the study region.

8. Perform any necessary geographic transformations to preliminary datasets (Landscan Grid, Study Region Boundary). The HAZUS software uses the **Geographic Coordinate System North American Datum 1983**.

Develop the Landscan Grid

Now that you have set up the working environment you are ready to develop the polygonal grid that will be used to define your study area. The following example will create a grid for the RELEMR region using the Landscan 2008 data. This methodology is one of many that could be used to create an International study region.

1. **Open** a new ArcMap session and **Add** the **lspop2008** Landscan Grid.



- 2. Set the Spatial Analyst Working Environment:
 - > On the Spatial Analyst drop-down menu, select **Options...**

Spatial <u>A</u> nalyst 💌 Layer: europe
Distance
D <u>e</u> nsity
Interpolate to Raster
Surface Analysis
Cell S <u>t</u> atistics
Neighborhood Statistics
Zonal Statistics
<u>R</u> eclassify
Raster Calculator
<u>⊂</u> onvert ►
Options

Set the Working Directory as your Working folder that was created in a previous step.

The working directory will store any grids created with the Raster Calculator.

 (Optional) Set the Analysis Mask to a shapefile that represents your study region with a 100km buffer, the buffer will ensure that LandScan data will not be omitted along the boundaries of your study region.

The analysis mask will limit the extent of any newly created grids to the extent of the mask. Any polygonal or raster dataset can act as a mask and should be used to reduce file size and processing time.

Options	? 🗙
General Extent Cell Size	
Working directory: ily_Working\Working\Raster	B
Analysis mask: Region_Mask	2
 Analysis Coordinate System Analysis output will be saved in the same coordinate system as the input (or first raster input if there are multiple inputs). Analysis output will be saved in the same coordinate system as the active data frame. 	e
Display warning message if raster inputs have to be projected during analysis operation.	
OK Ca	incel

3. Aggregate three manageable grids to represent urban areas, urban/rural interface areas and rural areas. The LandScan data has a resolution of 1km grid cells and an aggregation based on a multiplier can be used to create different grid cell sizes to represent the population distribution differently throughout the study region.



Expression: AGGREGATE(INGRID1, 3, MAX, EXPAND, DATA)

> On the Spatial Analyst drop-down menu select **Raster Calculator...**



Create the rural (100km) grid. Enter the following expression (the output will be a raster so it is important to remember to keep the name limited to 13 characters: rgn_grd_sum00 = Aggregate ([lspop2008], 100, SUM, #, #).

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# Raster Calculator						(?×
Layers:							
Ispop2008	×	7	8	9	=	\diamond	And
	1	4	5	6	>	>=	Or
	•	1	2	3	<	<=	Xor
	+	()		()	Not
rgn_grd_sum00 = Aggr	egate ([ls	spop20	08], 100), SUM	, #, #)		^
1							<u>×</u>
About Building Expressio	ns		Evalua	te	Canc	el	>>

Click Evaluate.

This will create a new grid in the specified working directory called rgn_grd_sum00 that is one hundred times the size of the original and represents the sum of the input cells.

- > On the Spatial Analyst drop-down menu select **Raster Calculator...**
- Create the urban/rural interface (10km) grid. Enter the following expression: rgn_grd_sum10 = Aggregate ([lspop2008], 10, SUM, #, #).

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# Raster Calculator						[? 🗙
Layers:							
Ispop2008	×	7	8	9	=	\diamond	And
	1	4	5	6	>	>=	Or
	•	1	2	3	<	<=	Xor
	+	()		()	Not
rgn_grd_sum10 = Aggr	egate ([l:	pop20	08], 10,	SUM,	#, #)		<u>^</u>
							~
About Building Expressio	ns		Evalua	te	Cano	el	>>

Click Evaluate.

This will create a new grid in the specified working directory called rgn_grd_sum10 that is 10 times the size of the original and represents the sum of the input cells.

- > On the Spatial Analyst drop-down menu select **Raster Calculator...**
- Create the urban (1km) grid. Enter the following expression: rgn_grd_sum10 = Aggregate ([lspop2008], 1, SUM, #, #).

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# Raster Calculator						(? 🗙
Layers:							
lspop2008	×	7	8	9	=	\diamond	And
	1	4	5	6	>	>=	Or
	·	1	2	3	<	<=	Xor
	+	(()	Not
rgn_grd_sum1 = Aggre	egate ([lsp	op2008	8], 1, SI	UM, #,	#)		~
							~
About Building Expressio	ns		Evalua	te	Canc	el	>>

Click Evaluate.

This will create a new grid in the specified working directory called rgn_grd_sum1 that is 1 times the size of the original and represents the sum of the input cells

- 4. Convert the aggregated grids to features.
 - > On the Spatial Analyst drop-down menu select Convert \rightarrow Raster to Features...

Spatial <u>A</u> nalyst 👻 Layer: euro	pe04
Distance 🕨	× 🗠 🗠 🔶 1:2,249,0
Density	🕞 📑 100% 🔽 🔳 🗎
Surface Analysis	× @
Cell Statistics	
Neighborhood Statistics	XX
Zonal Statistics	- 23
<u>R</u> eclassify	- 160.6667
Raster Calculator	41
<u>⊂</u> onvert ►	Eeatures to Raster
Options	Raster to Features

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- Set the Input raster to **rgn_grd_sum1**.
- > Set the Output geometry type to **Point**.
- Set the **Output features** to **rgn_grd_sum1_pnts** in the working directory.

Raster to Features	? 🛛
Input raster:	rgn_grd_sum1 💽 💕
Field:	<value></value>
Output geometry type:	Polygon
🔽 Generalize lines	
Output features:	emp\rgn_grd_sum1_pnts.shb
	OK Cancel

- Repeat steps 1 4 for rgn_grd_sum10 saving the feature dataset as rgn_grd_sum10_pnts.
- Repeat steps 1 4 for rgn_grd_sum00 saving the feature dataset as rgn_grd_sum00_pnts.
- 5. Create Thiessen Polygons.

You must have an ArcInfo License to create Create Thiessen Polygons in ArcMap.



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Type in the word(s) to search	for:
Create Thiessen	•
	Search
Tool	Toolbox
Create Thiessen Polygons	Analysis Tools

Open ArcToolbox, click the Search tab and type "Create Thiessen" in the search box.

> Open the "Create Thiessen Polygons" tool.

Be sure that "ALL" is selected in the Output Fields (optional) dialog.

Create Thiessen Polygons						X
Input Features					_	^
rgn_grd_sum1_pnts				•	E	
Output Feature Class						
C:\rgn_grd_sum1_poly.shp					Ĕ	
Output Fields (optional)					_	
ALL					•	
	OK	Cancel	Environments	Show	Help >:	>
						_

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- Repeat steps 1 3 for rgn_grd_sum10_pnts and save the output dataset as rgn_grd_sum10_poly.
- Repeat steps 1 3 for rgn_grd_sum00_pnts and save the output dataset as rgn_grd_sum00_poly.
- You should now have three polygonal grids (1km, 10km and 100km) that can be combined to make your regional grid dataset.

Depending on the size of the study region a shapefile size limit can be reached when converting the 1km grid to a point and polygon shapefile. If this happens it is best to split the study region up into multiple regions for processing the 1km grid. These separate 1km point and polygon files can be merged together later in the process when they are combined with the 10km and 100km grid point and polygon files.

- 6. Combine urban (1km), urban/rural interface (10km) grids and rural (100km) grids.
 - Start an Editing Session in ArcMap by selecting Start Editing from the Editor Toolbar drop-down menu. The data location of the files that will be edited may need to be selected in the dialog box.



> From the Selection drop-down menu select Select By Attributes...

<u>S</u> ele	ction <u>T</u> ools <u>W</u> indow <u>H</u> elp
5	Select By <u>A</u> ttributes
S	Select By Location
4	Select By Graphics
	Zoom To Selected Features
Σ	Statistics
	Se <u>t</u> Selectable Layers
	⊆lear Selected Features
	Interactive Selection Method
	Options

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- Set the Layer to **rgn_grd_sum00_poly**.
- Set the Method to "Create a New Selection".
- Set the Population threshold. Enter "GRID_CODE" > 100000 into the Query Text Box.

The population threshold will determine where to use the finer resolution grids. This is a variable number and can be modified to match the needs of your study area. The lower the threshold the higher number of grid cells.

Select By A	ttributes	?×
Layer: Method: "FID" "POINTID" I"GRID_COD	rgn_grd_sum00_poly □ Only show selectable layers in this list Create a new selection DE"	
= <> > > = < <= _ % () Is SELECT * FR "GRID_COD	Like And Or Not Get Unique Values Go To: COM grd_rgn_1_points WHERE: E'' > 100000	
Clear	Verify Help Load	Save
	OK Apply	Close

- > Click Apply.
- > Open the attribute table of the selected shapefile: **rgn_grd_sum00_poly**.
- > **Delete** the selected grid cells.
- > From the Selection drop-down menu select **Select By Location...**

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Create the following query: I want to: select features from the following layer(s): rgn_grd_sum10_poly that: have their centroid in the features in this layer: rgn_grd_sum00_poly.

Select By Location
Lets you select features from one or more layers based on where they are located in relation to the features in another layer. I want to:
select features from 📃 💌
the following layer(s):
 ✓ rgn_grd_sum10_poly ☐ rgn_grd_sum00_poly
Only show selectable layers in this list that:
have their centroid in 📃 💌
the features in this layer:
♦ rgn_grd_sum00_poly
Use selected features (0 features selected)
Apply a buffer to the features in rgn_grd_sum00_poly
of: 0,000000 Decimal Degrees
Help OK Apply Close

- > Click Apply.
- > Open the attribute table of the selected shapefile: **rgn_grd_sum10_poly**.

- > **Delete** the selected grid cells.
- > From the Selection drop-down menu select Select By Attributes...



- Set the Layer to **rgn_grd_sum10_poly**.
- Set the Method to "Create a New Selection".
- Set the Population threshold. Enter "GRID_CODE" > 100000 into the Query Text Box.

Select By A	ttributes	?×
Layer:	rgn_grd_sum10_poly Only show selectable layers in this list	•
Method:	Create a new selection	•
"FID" "POINTID" "GRID_COU "Input_FID"	DE''	I
= <:	> Like	
\rightarrow	= And	
< <	= Or	
_ % ()) Not	
ls	Get Unique Values Go To:	
SELECT * FF	ROM rgn_grd_10_polygons WHERE:	
"GRID_COD	PE'' > 100000	<
Clear	Verify Help Load Sa	ve
	OK Apply CI	ose

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- Click Apply.
- > Open the attribute table of the selected shapefile: **rgn_grd_sum10_poly**.
- > **Delete** the selected grid cells.
- > From the Selection drop-down menu select Select By Location...



Create the following query: I want to: select features from the following layer(s): rgn_grd_sum1_poly that: have their centroid in the features in this layer: rgn_grd_sum10_poly.

Select By Location
Lets you select features from one or more layers based on where they are located in relation to the features in another layer. I want to:
select features from 📃
the following layer(s):
 ✓ rgn_grd_sum1_poly ☐ rgn_grd_sum10_poly
Only show selectable layers in this list that:
have their centroid in 📃 💌
the features in this layer:
🔗 rgn_grd_sum10_poly 🔽
Use selected features (O features selected)
Apply a buffer to the features in rgn_grd_sum10_poly
of: 0,000000 Decimal Degrees
Help OK Apply Close

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- Click Apply.
- > Open the attribute table of the selected shapefile: **rgn_grd_sum1_poly**.
- > **Delete** the selected grid cells
- Stop the Editing session and Save your edits.
- ➤ Right-click **rgn_grd_sum00_poly** and select **Data→Export data...**

✓ rgn_grd_sv		Copy Remove								
gn_grd_si	<u> </u>	Joins and Relates	•					D		<
europe04 Value High : !	œ	Zoom To Layer Visible Scale Range	*							
Low : C		Use Symbol Levels	-							
		Label Features Convert Labels to Annotation Convert Features to Graphics								
		Data 🕨		Set Da	ta Source					
		Save As Layer File Make Permanent	9	Export	Data v/Rematch	Add	lress	es.,,	,	
	r	Properties								

- Save the exported dataset as **Region_Grid_Append** in your working directory.
- > Open the ArcToolbox Window.
- ➢ Double-click the Append Tool under Data Management Tools→General to open the Append Tool Window.



Select **rgn_grd_sum1_poly** and **rgn_grd_sum10_poly** as your **Input Features**.

🎤 Append						×
Input Datasets						^
				•	2	
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Taurah Dabarah						
Decise Crid Appand				-	اچي	
(append				-		
TEST					•	
Field Map (optional)					_	
					+	¥
	ОК	Cancel	Environments	Show H	Help >>	>

> Select **Region_Grid_Append** as your **Output Features**.

- Click OK.
- You should now have one combined polygonal grid that can be clipped to finalize the regional grid dataset.
- 7. Clip the Grid dataset by your regional boundary.
 - > Open the ArcToolbox Window by pressing the ArcToolbox button.



➢ Double-Click the Clip tool under Analysis Tools→Extract to open the Clip Tool Window.



- > Select **Region_Grid_Append** as your **Input Features**.
- Select Region_Bnd (or whatever dataset defines your study area) as your Clip Features.

Navigate to your working directory and set the Output Feature Class to Region_Grid.

This will create a new feature dataset named Region_Grid which will represent census tracts in the HAZUS bndrygbs.mdb geodatabase.

P	Clip						$\mathbf{ imes}$
	Input Features						^
	Region_Grid_Append				•	2	
	Clip Features						
	Region_Bnd				•	2	
	Output Feature Class						
	C:\Region_Grid.shp					2	
	XY Tolerance (optional)						
				Decima	al degrees	•	
							_
							×
		ОК	Cancel	Environmen	ts Show	Help >:	>

- Click **OK**.
- > You should now have your regional grid dataset.



RELEMR Region

FEMA (Federal Emergency Management Agency) Region VIII Mitigation GIS



RELEMR Region – Zoomed into an area of Egypt to show the 1km, 10km and100km grids side-by-side.

- 8. Calculate the Population Ratio.
 - > Right-Click Region_Grid and select **Open Attribute Table**.



> In the Attribute Table, Click the **Options** button and select **Add Field**.

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- > Enter **POP_RATIO** into the **Name** field.
- > Set **Type** as **Double**.

Ad	d Field			? 🛛
N	ame:	POP_RATIO		
Ъ	pe:	Double		•
	Field Prope	erties		
	Precision		0	
	Scale		0	
			OK	Cancel

≻ Click **OK**.

A new field is created in the Region_Grid attribute table.

In the Attribute Table, Right-Click on the GRID_CODE field name and select Statistics.

	GRID_CODE
1	Sort Ascending
F	Sort Descending
	Summarize
	Calculate Values
Σ	Statistics
	Freeze/Unfreeze Column
	Delete Field

Write down the Sum: 461330544

The sum of 461,330,544 represents the total population for our study area. You will use this number to calculate the Population Ratio.

Statistics of Region_Grid	? 🛛
Field	
GRID_CODE	Frequency Distribution
Statistics: Count: 142993	150,000
Minimum: 0 Maximum: 99704 Sum: 461330544	100,000 -
mean: 3226.240048 Standard Deviation: 8010.044597	8.000
	0 14796 29592 44388 59184 73960 85776
	7398 22194 36990 51786 66582 81378 96174

> Right-Click on the **POP_RATIO** field name select **Calculate Values...**



Enter the following expression: [GRID_CODE]/461330544 in the Field Calculator.



Click OK.

0.000032
0.000022
0
0.000019
0
0.000004
0.000051

- > Repeat steps for **U_POP_RATIO** (Urban Population Ratio).
- Select out the urban (1km) grids from your Region_Grid shapefile.
- Calculate the urban population from the selected tracts in the same way that the population for the region was calculated.
- Distribute the urban population through the selected urban (1km) grids in the same way that the population was distributed throughout the region.

The U_POP_RATIO should only be distributed to the urban (1km) tracts and the POP_RATIO should be distributed to all tracts in the region. The POP_RATIO (Population Ratio) and U_POP_RATIO (Urban Population Ratio) fields will be used to distribute the General Building Stock throughout the study region.

9. Calculate the Census Tract ID and County Identifier.

HAZUS uses Federal Information Processing Standards (FIPS) Codes as unique identifiers for each Census Tract. This is an eleven digit number of which the first two digits identify the State, the next three digits identify the County, and the final six digits identify the Census Tract.

Because you will be replacing the data for Puerto Rico you will use the Puerto Rico State identifier (72) and an existing County identifier (001) to represent the first five digits of the Census Tract ID. The remaining six digits will be calculated using a simple numbering expression.

It is important to note that because HAZUS is designed for use within the U.S. and Puerto Rico you must maintain an existing State and County identifier in order for HAZUS to work. To go even further, you must maintain the State and County identifiers of the State data you will be replacing.

- In the Region_Grid Attribute Table, Click the Options button and select Add Field.
- > Enter **Tract** into the **Name** field.

- Set **Type** as **Text**.
- Set Length as 11.

Add Field	J		? 🛛
<u>N</u> ame:	Tract		
Tupe:	Tevt		-
1990.	TOAL		<u> </u>
Field Pro	perties		
Alias			
Allow N	JULL Values	Yes	
Default	Value		
Domain			
Length		11	
		OK	Cancel

- ➢ Click OK.
- > Right-Click on the **Tract** field name select **Calculate Values...**
- Check the Advanced checkbox and enter the following Expression into the Pre-Logic VBA Script Code text box:

Dim TractNum As Long Dim TractStr As String TractNum = [OBJECTID] + 1000000 TractStr = "72001" + Right(Cstr(TractNum), 6)

The number "72001" is the State and County identifier for Adjuntas County in Puerto Rico. Please see the notes above for a discussion on the use of this number.

Enter TractStr into the lower text box.

Pre-Logic VBA Script Code	Advanced	+ - =
Dim TractNum As Long Dim TractStr As String	<u>^</u>	<u>L</u> oad
TractNum = [OBJECTID] + 1000000 TractStr = ''72001'' + Right(Cstr(TractNum), 6)		<u>S</u> ave
······································		<u>H</u> elp
	~	
Tract =		OK
TractStr		Cancel

Click **OK**.

Tract*
72001000001
72001000002
72001000003
72001000004
72001000005
72001000006

- In the Region_Grid Attribute Table, Click the Options button and select Add Field.
- > Enter **Tract6** into the **Name** field.
- Set **Type** as **Text**.
- Set Length as 6.

Add Field	l	? 🛛
<u>N</u> ame:	Tract6	
<u>T</u> ype:	Text	•
Field Pro	operties	
Alias		
Allow I	NULL Values	Yes
Default	Value	
Domain	1	
Length		6
	Г	
		OK Cancel

- Click OK.
- > Right-Click on the **Tract6** field name select **Calculate Values...**
- > Enter the expression **Right**([**Tract**], 6) in the Field Calculator.

Tract6 represents the last six digits of the Census Tract ID.

Tract6 =	🗌 <u>A</u> dvanced	+ - =
Right([Tract], 6]		<u>L</u> oad
		<u>S</u> ave
		<u>H</u> elp
		OK
		Cancel

Click **OK**.

Tract6
000001
000002
000003
000004
000005
000006

- In the Region_Grid Attribute Table, Click the Options button and select Add Field.
- > Enter **CountyFips** into the **Name** field.
- Set **Type** as **Text**.
- Set Length as 5.

Add F	ield				?	Z
Name:		CountyF	ïps			
<u>Type:</u>		Text			-	
Field Properties		ties				
Allo	w NUL	L Values		Yes		
Det	Default Value					
Dor	nain					
Ler	igth			5		
				OK	Cancel	

- Click **OK**.
- > Right-Click on the CountyFips field name select Calculate Values...
- > Enter the expression "72001" in the Field Calculator.

The number "72001" is the State and County identifier for Adjuntas County in Puerto Rico. Please see the notes above for a discussion on the use of this number.

CountyFips =	☐ <u>A</u> dvanced	+ · =
"72001"		<u>L</u> oad
		<u>S</u> ave
		<u>H</u> elp
		0K
		Cancel

Click OK.

CountyFips 72001 72001 72001 72001 72001 72001 72001	-		
72001 72001 72001 72001 72001 72001 72001	Ľ	CountyFips	
72001 72001 72001 72001 72001 72001	E	72001	
72001 72001 72001 72001	F	72001	
72001 72001 72001	ľ	72001	
72001 72001	F	72001	
72001		72001	
	ľ	72001	

- 10. Calculate the Area, Latitude, and Longitude.
 - > In the Region_Grid Attribute Table, Add the following three fields:

Name:	Type:
TractArea	Float
CenLat	Double
CenLongit	Double

- > Calculate the **TractArea** field.
- Open the Attribute Table of the Region_Grid shapefile, right-click the TractArea column and select "Calculate Geometry".
- > Select Area in the "Property:" field and Square Kilometers in the "Units:" field.

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Calculate Geo	metry		? 🗙
Property:	Area		•
Coordinate Sys	tem		
🖲 Use coordin	ate system of the data source:	:	
PCS: Worl	d Cylindrical Equal Area		
C Use coordin	ate system of the data frame:		
	Sausea Vilemetars [sa km]		
onics.	pquare kilometers [sq kin]		
🔲 Calculate sel	ected records only		
Help		ОК	Cancel

Because HAZUS uses GCS NAD83 a projected coordinate system, the feature class must also be in a projected coordinate system to make an accurate area calculation. If Area in the "Property:" field appears as "Area – Disabled" it means that the Region_Grid shapefile is not in a projected coordinate system and needs to be reprojected. This can be done through the Project tool in ArcToolbox.

- Calculate the **CenLat** field.
- Open the Attribute Table of the Region_Grid shapefile, right-click the CenLat column and select "Calculate Geometry".
- Select Y Coordinate of Centroid in the "Property:" field and Decimal Degrees in the "Units:" field

Calculate Geom	etry		? X		
Property:	Y Coordinate of Centroid		•		
_ Coordinate Syst	em				
Ose coordina	te system of the data source:				
GCS: WGS 1	984				
C Use coordina	te system of the data frame:				
GCS: WGS	1984				
Uniter	Desimal Degrees				
Offics.	Decimal Degrees				
Calculate selected records only					
Help		ок са	ancel		

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- Calculate the CenLongit field.
- Open the Attribute Table of the Region_Grid shapefile, right-click the CenLongit column and select "Calculate Geometry".
- Select X Coordinate of Centroid in the "Property:" field and Decimal Degrees in the "Units:" field

Calculate G	Geometry 🤶 💽	
Property:	X Coordinate of Centroid	•
_ Coordinate	System	
Use cool	ordinate system of the data source:	
GCS: V	WG5 1984	
C Use coo	ordinate system of the data frame: WGS 1984	_
Units:	Decimal Degrees	•
Calculate	e selected records only OK Cancel	

TractArea	CenLat	CenLongit
3.05815	38.804540	15.223618
5.6935	38.708050	13.179209
0.075133	38.709134	13.200977
1.62109	38.788769	15.195019
8.0521	38.788175	15.216953
2.59057	38.695957	13.171031

- 11. Calculate remaining Census Tract fields.
 - > In the Region_Grid Attribute Table, Add the following two fields:

Name:	Type:
NumAggrBocks	Long Integer
BldgSchemesId	Text (length 5)

Calculate the NumAggrBocks field to equal 1.

The NumAggrBocks field contains the number of census blocks in each census tract. Because the earthquake only operates at the census tract level this number is irrelevant; however, the field does not allow for null values.

Calculate the **BldgSchemesId** field to equal "**PR2**".

The BldgSchemesId field identifies the default Building Scheme for Puerto Rico. This value was taken from the original Puerto Rico Tract feature class and will be applied to the RELEMR region. After completing your study region you will be able to alter these building schemes to better reflect local conditions. If you are using any State other than Puerto Rico as your surrogate you will need to alter this value accordingly.

NumAggrBocks	BidgSchemesid
1	PR2

Populate the Geodatabases

This next section will take you through the steps of populating the Intermediate Geodatabases and loading the Final Data. We will use the population ratio to distribute the General Building Stock throughout the study area. This methodology is one of many that could be used for distributing the GBS.

- 1. Load the data into the Intermediate Geodatabases in the IntData folder.
 - In ArcCatalog, Right-Click on hzTract in the IntData folder and select Load→Load Data...

S I	nzTra	ct			Personal Geod	
		⊆ору	Ctrl+C			
	×	Delete				
		Rena <u>m</u> e	F2			
		Create La <u>v</u> er				
		<u>E</u> xport	I	•		
		Surveying,				
		Load			Load Data	
	2	<u>R</u> eview/Rematch	Addresses		🔄 Load XML Recordset Document	
	r	Properties				

- > Click **Next** in the first screen of the **Simple Data Loader**.
- Navigate to the Region_Grid feature class in your Working folder and Click the Add button.

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Simple Data Loader	X
Enter the source data that you will be loading from. Click Add to add it to the list of source data to be loaded. You can load from multiple data sets in the same operation if they share the same schema. Input data	
List of source data to load	
Add Remove	
< <u>Back</u> <u>Next></u> Canc	el

- > Click **Next** twice to get to the Field Matching Window.
- > Set each Matching Source field to match the Target field.

Each field will automatically find its counterpart if there is an identical match. There should be a match for every Target Field except Length.

Sim	iple Data Loader		
F	for each target field, select the sou	rce field that should be loaded into it.	
[Target Field	Matching Source Field	~
	Tract [string]	Tract [string]	
	CountyFips [string]	CountyFips [string]	
	BldgSchemesld [string]	BldgSchemesld [string]	
	Tract6 [string]	Tract6 [string]	
	TractArea [float]	TractArea [float]	
	NumAggrBocks [int]	NumAggrBocks [int]	
	CenLat [double]	CenLat [double]	
	CenLongit [double]	CenLongit [double]	
	Length [float]	<none></none>	
]		Reset	
		< <u>B</u> ack <u>N</u> ext > Ca	ancel

- Click Next.
- Make sure the "Load all of the source data" radio button is selected and Click Next.
There is a limit to the number of records you can load with the Simple Data Loader. When loading tens of thousands of records you may need to load the data in two or more batches. This can be done with the "Load only the features that satisfy a query" radio button.

Simple Data Loader	
You can load all of the features from your source data into the target feature class or you can limit what is loaded by defining an attribute query.	
Load all of the source data	
\bigcirc Load only the features that satisfy a query	
Query Builder	
< <u>B</u> ack <u>N</u> ext > Cancel	

- > Review the Summary window and Click **Finish**.
- The process for loading data into feature classes and tables is the same. Repeat these steps by loading the Region_Grid feature class into the following tables:

hzBldgCountOccupT hzExposureContentOccupT hzExposureOccupT hzSqFootageOccupT hzDemographicsT

The only matching fields should be **Tract** and **POP_RATIO**. The rest of the fields will be calculated in the following steps.

Target Field	Matching Source Field	4
Tract [string]	Tract [string]	
RES1I [short int]	<none></none>	_
RES2I [short int]	<none></none>	
RES3AI [short int]	<none></none>	_
GUV2"(shortint)"	<none></none>	
EDU1I [short int]	<none></none>	
EDU2I [short int]	<none></none>	
POP_RATIO [double]	POP_RATIO [double]	
	Reset	

Load the Region_Bnd (or whatever dataset defines your study area) dataset into the hzCounty feature class.

You may not have any matching fields; however, the geographic feature will still be loaded. We will calculate any remaining fields in the following step.

Sim	ple Data Loader		×
F	or each target field, select the source fie	eld that should be loaded into it.	
Γ	Target Field	Matching Source Field	^
	CountyFips [string]	<none></none>	
	CountyFips3 [string]	<none></none>	
	CountyName [string]	<none></none>	
	State [string]	<none></none>	
	StateFips [string]	<none></none>	
	NumAggrTracts [int]	<none></none>	
			~
		Reset	
		< <u>B</u> ack <u>N</u> ext > Cance	el

- 2. Calculate any remaining fields in the hzCounty feature class.
 - > In ArcMap, add the **hzCounty** feature class from the FinalData folder.
 - > Open the Attribute Table.
 - Calculate the following values for each field:

CountyFip CountyFip CountyNan State = "PI StateFips = NumAggrT	s = "72001" s3 = "001" me = "Sicily R" = "72" Fract = 679	' State Cour ?' Nam State State Tota	e + Co nty Ide e of St e Abbr e Ident l # of (unty Iden entifier tudy Area eviation f ifier Census Tr	tifier or Puerto Rico racts
CountyFips	CountyFips3	CountyName	State	StateFips	NumAggrTracts
72001	001	Sicily	PR	72	679

- 3. Calculate the General Building Stock and Demographics distribution.
 - (Optional) Create a summary table containing total values for each of the HAZUS GBS attribute tables. This will provide a quick reference when calculating the General Building Stock distribution and Demographics distribution.

General Building Stock Totals by Occupancy				
Occupancy	hzBldgCountOccupT	hzExposureOccupT	hzExposureContent	hzSqFootageOccupT
RES1I	1022374	111670824	55845945	1635083.97
RES2I	4602	184469	95071	5972.07
RES3AI	13528	2787205	1401364	48191.79
RES3BI	7672	1865429	940337	29673.86
RES3CI	3391	3916231	1962727	36245.81
RES3DI	1842	2770523	1387808	28577.17
RES3EI	160	1235579	619254	13197.69
RES3FI	420	3258578	1630950	35700.17
RES4I	17	290182	145103	3224.90
RES5I	801	2231679	1116156	21839.70
RES6I	10	35394	17707	393.40
COM1I	267	1989179	1989179	32330.93
COM2I	1133	1860408	1860408	34942.30
COM3I	546	419320	419320	5616.57
COM4I	260	1973705	1973705	23191.11
COM5I	488	264789	264789	1999.70
COM6I	51	381602	572411	3068.60
COM71	473	391781	587733	3509.29
COM8I	999	592851	592851	5031.01
COM9I	12	14453	14453	164.20
COM10I	0	0	0	0.00
IND1I	308	598589	897916	9428.70
IND2I	548	894148	1341265	16793.69
IND3I	325	1523691	2285571	14825.00
IND4I	14	76981	115482	748.99
IND51	8	41792	62691	406.60
IND61	189	341771	341771	6419.19
AGR1I	107	184621	184621	3467.51
REL1I	140	243019	243019	2477.03
GOV1	383	329978	329978	4249.09
GOV2I	14	17076	25616	145.90
EDU1I	13	246271	246271	3085.75
EDU2I	45	243149	364735	2465.40

To accommodate the large difference between the population of Puerto Rico and The RELEMR Region a multiplier was used to correct for the population differences, the multiplier was applied to all General Building Stock and Demographic data in the RELEMR study region. The multiplier was applied to the Puerto Rico data and logged in a table similar to the one pictured above. The values established with the multiplier were then distributed as described below.

- Distribution of General Building Stock and Demographics data through the use of the POP_RATIO and U_POP_RATIO.
 - 1. POP_RATIO is applied to all Residential Building Types through the use of the field calculator, for example: RES1 = 1022374 * [POP_RATIO]. See example below.
 - 2. POP_RATIO is applied to all Demographic Data through the use of the field calculator, for example: Population = 461330544 * [POP_RATIO]. See example below.
 - POP_RATIO and U_POP_RATIO are applied to all Commercial, Industrial, Religious, Agricultural and Educational Building Types through the use of the field calculator, for example: COM1 = (27 * [POP_RATIO]) + (240 * [U_POP_RATIO]). See example below.

In this example the total number of COM1locations would be 267, we took 10% of that number (27) and distributed those locations throughout the entire region though the use of the POP_RATIO which is applied to all grids in the study region. The remaining 90% (240) COM1 locations were distributed throughout the urban areas through the use of the U_POP_RATIO which is applied to only the urban grids in the area.

Field Calculator		? 🔀
Fields: IND11 IND21 IND31 IND41 IND51 IND61 AGR11 GOV11 GOV21 EDU11 EDU21 RES11 = 1022374 * [POP_RATIO]	Type: Number String Date Advanced	Functions: Abs () Atn () Cos () Exp () Fix () Int () Sin () Sar () * / & + - = Load Save Help
Calculate selected records only	V	OK Cancel

Field Calculator		? 🛛
Fields: OBJECTID Tract Population Households GroupQuarters MaleLess16 MaleOver65 FemaleLess16 Female16to65 Female16to65 FemaleOver65 MalePopulation Population = 461330544 * [POP_RATIO]	Type: Number String Date	Functions: Abs () Atn () Cos () Exp () Fix () Int () Log () Sin () Sin () Sin () * / & + - = Load Save
Calculate selected records only	×	OK Cancel

Field Calculator		? 🗙
Fields: OBJECTID Tract RE51I RE52I RE53AI RE53BI RE53DI RE53FI RE54I RE55I COM11 = ([POP_RATIO * 27) + ([U_POP_RATIO] * 240)]	Type: Number String Date	Functions: Abs () Atn () Cos () Exp () Fix () Int () Log () Sin () Sqr () * / & + - = Load Save Help
Calculate selected records only	~	OK Cancel

- In ArcMap, add the hzBldgCountOccupT, hzExposureContentOccupT, hzExposureOccupT, hzSqFootageOccupT and hzDemographicsT tables.
- > Open the attribute table of hzBldgCountOccupT.
- > Right-Click the field name **RES1I** and select **Calculate Values.**
- Apply the methodology outlined above to properly distribute General Building Stock and Demographics Data throughout the region using POP_RATIO and U_POP_RATIO.
- Repeat these steps for the hzExposureContentOccupT, hzExposureOccupT, hzSqFootageOccupT and hzDemographicsT tables.
- 4. Load the data into the Final Geodatabases in the FinalData folder:
 - In ArcCatalog, use the Simple Data Loader to load data from the Intermediate Geodatabases in the IntData folder to the Final Geodatabases in the FinalData folder. Do this for the following feature classes and tables:
 - hzTract hzCounty hzBldgCountOccupT hzExposureContentOccupT hzExposureOccupT hzSqFootageOccupT hzDemographicsT
- 5. Copy the Geodatabases in the **FinalData** folder to the **PR1** data aggregation folder. The five newly created Geodatabases should replace five of the existing Geodatabases. Your final PR1 folder should look like this:.
 - PRI

 Image: Constraint of the second secon
- 6. Edit the syBoundary.mdb Geodatabase.

Numerous fields in the syBoundary.mdb Geodatabase contain indexes. These indexes may need to be removed in order to delete features in ArcMap.

In ArcMap, add the syState, syCounty, and syTract feature classes from the syBoundary folder.

Start an Editing Session and delete all features for Puerto Rico in each feature class. Use the following queries for each dataset to select the appropriate features:

syState - SELECT * FROM syState WHERE StateFips = '72'
syCounty - SELECT * FROM syCounty WHERE CountyFips LIKE '72*'
syTract - SELECT * FROM syTract WHERE Tract LIKE '72*'

- > Stop the Editing Session and Save your edits.
- 7. Load data into the syBoundary.mdb Geodatabase.
 - In ArcCatalog, use the Simple Data Loader to load the hzTract feature class from the FinalData folder into the syTract feature class in the syBoundary folder.

All Target fields and Matching Source fields should automatically match.

Target Field	Matching Source Field
Tract [string]	Tract [string]
CountyFips [string]	CountyFips [string]
Tract6 [string]	Tract6 [string]
TractArea [float]	TractArea [float]
CenLongit [double]	CenLongit [double]
CenLat [double]	CenLat [double]
	Reset

Load the hzCounty feature class from the FinalData folder into the syCounty feature class in the syBoundary folder.

All Target fields and Match Source fields should automatically match except **NumTracts**. You should manually select the Matching Source field as **NumAggrTracts**.

mple Data Loader	en field that charded he handed into it	(
Target Field	Matching Source Field	
CountyFips [string]	CountyFips [string]	_8
CountyFips3 [string]	CountyFips3 [string]	_
CountyName [string]	CountyName [string]	
State [string]	State [string]	
StateFips [string]	StateFips [string]	
NumTracts [int]	<none></none>	-
	<none> CountyFips [string] CountyFips3 [string] CountyName [string] State [string] StateFips [string] NumAggrTracts [int]</none>	
	< <u>B</u> ack <u>N</u> ext > Ca	ncel

Load the hzCounty feature class from the FinalData folder into the syState feature class in the syBoundary folder.

You will not have matching fields for StateName, Region, NumCounties, and HUState. We will calculate these remaining fields in the following step.

Sim	ple Data Loader		
F	or each target field, select the sourc	e field that should be loaded into it.	
Г	Target Field	Matching Source Field	~
	StateFips [string]	StateFips [string]	
	State [string]	State [string]	_
	StateName [string]	<none></none>	
	Region [short int]	<none></none>	
	NumCounties [short int]	<none></none>	
	HUState [short int]	<none></none>	
			~
		Reset	
		< <u>B</u> ack <u>N</u> ext > Ca	ncel

- 8. Calculate any remaining fields in the **syState** feature class.
 - > In ArcMap, add the **syState** feature class from the syBoundary folder.
 - > Open the Attribute Table.
 - Calculate the following values for each field:

StateName = "RELEMR"	Broad Name of Study Area
Region = 0	Identifies PR as an Eastern State
NumCounties = 1	Total # of Counties
HUState = 0	Identifies Ineligibility for the Hurricane Model

- 9. Copy the new syBoundary.mdb Geodatabase in the syBoundary folder to the HAZUS data aggregation folder and replace the existing Geodatabase.
- 10. (Optional) Replace any indices for large feature classes (e.g. syTract, hzTract, hzBldgCountOccupT. Although this step is not required, it may improve processing time while building your study region.

NOTE: As discussed these steps provide users outside the United States with a sophisticated earthquake loss estimation tool. One of the critical next steps will be to adjust the U.S. building type information to better represent the building stock of the local Country. We start with the Puerto Rico building types as the best proxy mainly because a relatively low percentage is assigned to the wood frame categories so prevalent elsewhere in the U.S:

Parameters for PR2. Right-click cell for context menu. □ccupancy Wood % Concrete % Steel % Masony % Manu. Housing % Total RES1 5 45 0 50 0 100 RES3A 5 55 0 40 0 100 RES3B 5 55 0 40 0 100 RES3C 5 55 0 40 0 100 RES3C 5 55 0 40 0 100 RES3C 5 55 0 40 0 100 RES3F 5 55 0 40 0 100 RES3 5 55 0 40 0 100 COM1 5 60 15 20 0 100 COM2 5 60 15 20 0 100 COM3 5 60 15 20 0 100	🗖 View Mapping Scheme 📃 🗖 🔀							
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Yellow= default building type distribution. Green= user-defined building type distribution. Print OK Cancel	EDU2	5	60	15	20	0	100	-
Yellow= default building type distribution. Green= user-defined building type distribution. Print OK Cancel	•							
Print OK Cancel	Yellow= default	building type distr	ibution. Green= u:	ser-defined buil	ding type distrib	ution.		
					<u>P</u> rint	: ОК	Cancel	

FEMA (Federal Emergency Management Agency) Region VIII Mitigation GIS

Build the Study Region

This section involves the creation of a study region in Sicily, Italy for which you will model the impact of a user-defined scenario and simulation in this course.

- 1. Create a New Study Region
 - Start HAZUS-MH and choose **Create a New Region**.
 - > Click **Next** to open the Create New Region window.
 - > Enter **RELEMR** for the study region name.

Create New Region	X
Study Region Name Each study region needs to identified with a unique name.	
Enter below a name which uniquely identifies your region. The name can b characters long.	e up to 50
RELEMR	
Region description (optional):	
Study Region Creation Example	~
< Back Next >	Cancel

- > Click **Next** to move to the Hazard Type window.
- > Verify that <u>ONLY</u> the **Earthquake** option is checked,

Create New Region
Hazard Type The hazard type controls the type and amount of data that will be aggregated. The hazard type selected affects the analysis options that will be available.
Your study region can include one or more of the following hazards. Check below the hazard(s) you are interested in.
< <u>B</u> ack <u>N</u> ext > Cancel

- Click Next to move to the Aggregation Level window.
- > Choose **Census Tract** as the aggregation level.

Create New Region	×
Aggregation Level The aggregation level defines the procedure by which the study is defined.	ł
You can define your study region at one of four geographic levels. We call this the aggregation level. Please select below the aggregation level you want to use.	
C <u>S</u> tate	
C County	
Census tract	
🔿 Census bloc <u>k</u>	
< <u>B</u> ack <u>N</u> ext > Cancel	

- > Click the **Next** button to move to the State Selection window.
- Choose **RELEMR** (**PR**) for the state to include in your study region.

Create New Region	×
State Selection The state selection narrows down the locati specific state(s).	on of the region to be created to
Please select the state(s) for the study regions States (1 selected): New York (NY) North Carolina (NC) North Dakota (ND) Ohio (OH) Oklahoma (OK) Oregon (OR) Pennsylvania (PA) RELEMR (PR) Rhode Island (RI) South Carolina (SC) South Dakota (SD) Tennessee (TN) Texas (TX)	n you want to create. Show map
	< Back Next > Cancel

- > Click the **Next** button to move to the County Selection window.
- > Choose **RELEMR** for the county to include in your study region.

Create New Region		\mathbf{X}			
County Selection The county selection defines the county or counties within previously selected state(s), to include in the study region.					
Please select the county or counties for the study region you want to create.					
States:	Counties (1 selected):				
RELEMR (PR)	RELEMR	Select all counties Deselect all counties Show map			
	Total: 1	Auto select all			
	< Back N	lext > Cancel			

> Click the **Next** button to move to the Census Tract Selection window.

Create New Region		×		
Census Tract Selection The census tract selection defines the census tract(s) within previously selected counties, to include in the study region.				
Please select the census tract(s	s) for the study region you	want to create.		
RELEMR, PR	72001000000	Select all tracts		
72001 72001 72001 72001 72001 72001	72001000001 72001000002 72001000003 72001000004 72001000004	Deselect all tracts		
	72001000003 72001000006 72001000007 72001000008 72001000009 72001000009	Show map		
Sort by state	Total: 0	Auto select all		
	< Back	Next > Cancel		

There are two ways to select Counties or Tracts. The first is by selecting the County Names (as we did above) or the Tract numbers. The second is by selecting the Counties or Tracts from the Map View. We will use the second method in the following step.

> Click the **Show Map** button to move to the Map Selection window.

IMPORTANT NOTE: Because of the large number (140K) of grid cells in the RELEMR Region the Map View will take about **5 minutes** to display in window on a typical machine



> Use the **Select Features** button to select tracts of interest.

The Map View provides simple tools such as pan, zoom, info and add data to enable you to navigate through and select the data. Data can be added to the dialog box to make selections easier, data such as county boundaries, administrative boundaries or jurisdiction boundaries can be added.

For this example, we will use the Add Data button to add a Country boundaries layer for guidance in selecting a study region incorporating Amman, Jordan. Navigate to the folder containing a Country boundary file. For this example, it is at \\RELEMR\WorldData\data\cntry06.





To set the Country boundaries layer so that fill does not display, click on the Layer
 Control tool

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Layer Control	X
Layers cntry06 RegionSelection	Feature Layer Properties
	Visibility Range 1: 0 (Max Scale)
	I: 0 (Min Scale) Symbology
	Fill Symbol Solid
Auto Select Boundary Features	Fill Color Hollow Horizontal Vertical
Up Down Top Bottom	Backward Diagonal

> Change the **Fill Symbol** to **Hollow** as shown above.



> It also helps to change the **Outline Color** to something brighter as shown above.



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> Use **Zoom Tool** (1) to zoom into your area of interest.



> Use Select Key 1 to select the grid cells you wish to analyze.

Hint: Hold the shift key to highlight areas for selection or de selection.

NOTE: When using the free version of SQL Express that ships with HAZUS, try to keep the area of analysis to **fewer than 4,000 grids**. Otherwise the 4GB SQL limitation may be exceeded and some of the analyses results will be excluded.

Click on Selection Done button

Create New Region		X			
Census Tract Selection The census tract selection defines the census tract(s) within previously selected counties, to include in the study region.					
Please select the census tract(s) for the study region you <u>I</u> racts (0 selected):	want to create.			
RELEMR, PR	72001000000	Select <u>all tracts</u>			
	72001000002 72001000003	Deselect all tracts			
	72001000004 72001000005 72001000006 72001000007 72001000008 72001000009 72001000009	Show <u>m</u> ap			
Sort by state	Total: 1038	☐ <u>A</u> uto select all			
	< <u>B</u> ack	<u>N</u> ext > Cancel			

After selecting it will take a few minutes to process and return back to the Census Tract Selection window.

NOTE: At this point it is a good idea to confirm that the **Total** number of tracts (grids) selected is **less than 4,000** depending on the user's license restrictions with SQL Server.

Click the Next button to move to the final screen of the Study Region Creation wizard.



> Click **Finish** to complete the new region creation process.

When the region creation has completed, the HAZUS-MH startup screen will appear.

HAZUS-MH
Region aggregation successful. Please use "Open a region" option to open the region.
ОК



- 2. Open the study region
 - > Open the **RELEMR** region.

Open Region				
Select Region The study region selection sets the region that will be opened.				
Select the study region you v so far.	want to open from the list of study regions you l	nave created		
Hegion Haiti Version 4 - Haiti Bui Big Island Flood Region Hilo Bay Flood Region Richfield Import Yuma County, AZ Yuma Region Salt Lake Segment Sce RELEMR_test RELEMR Region Test	Description	2/5/2010 11: 2/27/2010 1: 2/27/2010 2: 3/24/2010 1: 4/4/2010 5:1 4/4/2010 5:2 4/13/2010 9: 6/10/2010 8: 6/11/2010 5:		
	< <u>B</u> ack <u>N</u> ext >	Cancel		

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Adding Base Map Layers

- While not required for an earthquake loss estimation analysis, the view can benefit from base layers added to the ArcMap Table of Contents
- For this example, we will use the Add Data button to add a Country boundaries layer from <u>\\RELEMR\WorldData\data\cntry06</u>
- Double click on the symbol beneath the Country layer in the Table of Contents to change the symbology to hollow and increase the line width:

s	ymbol Select	or	? 🛛
	Category: A	.11	Preview
	Green	Blue	
			Options
			Eill Color:
	Sun	Hollow	Outline <u>W</u> idth:
			Outline Color:
	Lake	Rose	
			Properties
			More Symbols +
	Beige	Yellow	<u>S</u> ave <u>R</u> eset
			OK Cancel

 We will use the Add Data button to add a hillshade located here \\RELEMR\WorldData\shaded_relief\SRTM Shaded Relief (Central North).lyr that will illustrate the important role topographic relief will play later when we utilize ground motion maps.

Add Data							
Look in: 📋	shaded_relief 💽 🕒 📑 🎬 🗄						
🕸 GTOPO30 Shaded Relief (Central North).lyr							
GTOPO30 Sł	haded Relief (Central South).lyr						
gtopo30_n_i	relief_c.jp2						
gtopo30_s_r	relief_c.jp2						
SRTM Shade	ed Relief (Central North).lyr						
SRTM Shade	ed Relief (Central South).lyr						
srtm_n_relie	ef_c.jp2						
srtm_s_relie	:f_c.jp2						
1							
Name:	SRTM Shaded Relief (Central North).lyr	Add					
Show of type:	Datasets and Layers (*.lyr)	Cancel					



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Another extremely useful way to add base data is to use ArcGIS Online Services, such as those available from ESRI.

10 uut	l these s	ervices, us	e the Add L	Data butto	n 🔽	and sele	ect GIS	Serv
Add	Data							
Look	.in: 间	GIS Servers		▼ 1	L 🛐			品
AC	d ArcGIS :	5erver						
Ac 🖾	d ArcIMS	5erver						
	id WCS Se Hituma a-	rver						
He AC	JO WIND DE	rver						
Name	9:						Add	1
Name	e: v of type:	Datasets and	II suere (* lur)			_	Ado	l

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> Select Add ArcGIS Server and select the radio button for Use GIS Services:

Add ArcGIS Server	? 🗵
	This wizard guides you through the process of making a connection to an ArcGIS Server. You can either create a user connection to use GIS services, or an administrative connection to manage GIS services. What would you like to do?
	< <u>B</u> ack <u>N</u> ext > Cancel
General	? 🛛
Choose the type of ArcGIS	Server connection
Internet	
Server URL:	http://services.arcgisonline.com/v92
<i>c</i>	http://www.myserver.com/arcgis/services
Host Name	
rioscivenio.	
Authentication (Optional))
User Name:	arcgis_beta
Password:	****
	✓ Save Username/Password
	< <u>B</u> ack Finish Cancel

- This service is provided streaming over the internet using: <u>http://services.arcgisonline.com/v92</u>
- > User Name: arcgis_beta and Password: beta

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Add Data						
Look in: 🝺	GIS Servers	•	۵ 😒		8-8- 8-8- 8-8-	88
원 Add ArcGIS 원 Add ArcIMS 원 Add WCS Se 원 Add WMS Se 아 v92 on servi	Server Server erver erver ices.arcgisonline.com					
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Select the new ArcGIS Server and add World Imagery and/or other layers to your base map:

Add Data					
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📄 Demographi	cs 🛛 🖾 I3_Imagery_Prime_World_2D 🛛 🖾 World_Topo_Map				
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🚞 Specialty	🖾 USA_Topo_Maps				
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Step 2 – Developing and Incorporating Ground Motions and Hazard Information

In the U.S., there are many options available for a HAZUS earthquake model user to define a scenario or utilize ground motions from a real event. These options include selecting from a database of historical earthquakes, from a set of fault sources used in the development of the USGS National Hazard Map, selecting a probabilistic or annualized loss ground motions based on USGS probabilistic mapping, and inputting user defined ground motions from a network of ground motion monitoring instruments such as ShakeMap <u>www.shakemap.org</u> or developed by users outside the HAZUS program. The user supplied ground motions are required to be in a geodatabase format and include layers of ground motion: peak ground acceleration, peak ground velocity (in/sec), and spectral accelerations at 0.3 and 1.0 seconds to represent short and long period ground motions, respectively.

For this application, we recently created an M 7.0 Dead Sea scenario that is both credible and will impact our Amman area study region



http://earthquake.usgs.gov/earthquakes/shakemap/list.php?s=1&n=global&y=2010

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PERCEIVED SHAKING	Notfelt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	11-111	IV	V	VI	VII	VIII	IX	X+

The ground motions above are based on modeling a M 7.0 rupture along the Dead Sea rift and are further constrained by using soil amplification parameters based on topography as described by Wald and others: <u>http://earthquake.usgs.gov/hazards/apps/vs30/</u>.

Step-by-Step Instructions

The following instructions are divided into numbered tasks that are then followed by the detailed steps required to complete each task. Many steps are also followed by italicized comments that provide additional helpful information. Be sure to ask your instructor for clarification or assistance whenever you are unclear about a step in the exercise.

NOTE: Completion of the exercise requires internet access.

1. Select the "**Downloads**" section of the ShakeMap scenario. <u>http://earthquake.usgs.gov/earthquakes/shakemap/global/shake/Dead_Sea_Rift7.0_se/#download</u>



Ask your instructor if you need assistance with this task.

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2. Scroll down to the "GIS Files" and select the HAZUS Zip File - hazus.zip.

Also note the .kml file format that works with the free GoogleEarth viewer. First download and install GoogleEarth <u>www.googleearth.com</u> then simply double click on the .kml file and "fly into" Jordan while overlaying the semi-transparent event intensity map. Note that you can also sign up for the automatic service and have these delivered and opened automatically on your desktop <u>http://earthquake.usgs.gov/eqcenter/shakemap/rss_info.php</u>



3. **Save** into a data folder:

File Download	l		×	
Do you want	to open or save t	his file?		
I N I	ame: hazus,zip Type: Compressed (; From: earthquake,us	zipped) Folder, 105KB sgs.gov		
⊡ Al <u>w</u> ays ask t	<u>Open</u> before opening this ty	<u>Save</u> Cancel		
While harm y save t	files from the Internet our computer. If you his file. <u>What's the ris</u>	can be useful, some files can potent do not trust the source, do not open <u>k?</u>	ially or	
Save As				? 🗙
Save jn:	🗀 ShakeMaps	~	G 🕫 🖻	۶ 🛄 -
My Recent Documents Desktop	Chula_M7			
My Documents				
	File <u>n</u> ame:	hazus		<u>Open</u>
My Computer	Save as <u>t</u> ype:	Compressed (zipped) Folder	1	Cancel

4. **UnZip** and **Extract** the .shp files to a data folder.

Note these include ground motion layers for the four inputs required by HAZUS (PGA, PGV, SA 0.3 and SA 1.0). However, they are in the older ESRI shape file format and need to be converted to a geodatabase as outlined in the following steps to work with the new 9.x version of the software.

Extraction Wizard	
Select a Destination Files inside the ZIP a choose.	rchive will be extracted to the location you
	Select a folder to extract files to. Files will be extracted to this <u>directory:</u> C:\RELEMR\ShakeMaps\DeadSea_M7\hazus Browse Password Extracting
	< <u>B</u> ack <u>N</u> ext≻ Cancel

5. To use these ground motion files in HAZUS the user needs to define the projection of these files. We have already created the four necessary projection files (.prj) that can be directly copied to the folder containing the ground motion .shp files. This will automatically provide the correct NAD '83 Geographic projection required by HAZUS when the ShakeMap.exe utility creates the geodatabase in the next step.

e <u>E</u> dit <u>V</u> iew F <u>a</u> vorites <u>T</u> o	iols <u>H</u> elp				
🕽 Back 🔹 🔘 🕤 🏂 🍃	Search 📂 Folders 🛄 🔹				
dress 🛅 C:\RELEMR\ShakeMaps	3				× 🖻
	Name 🔺	Size	Туре	Date Modified	
File and Folder Tasks	Chula_M7		File Folder	6/13/2010 2:31 PM	
Ca Make a new Folder	DeadSea_M7		File Folder	6/13/2010 2:32 PM	
	🔁 Tehran_M7		File Folder	6/13/2010 2:31 PM	
Web	🖬 pga.prj	1 KB	PRJ File	5/14/2009 3:33 PM	
Share this folder	pgv.prj	1 KB	PRJ File	5/14/2009 3:33 PM	
	psa03.prj	1 KB	PRJ File	5/14/2009 3:33 PM	
	📼 psa10.prj	1 KB	PRJ File	5/14/2009 3:33 PM	
Other Places	5 ShakeMap	164 KB	Application	8/21/2007 7:53 PM	
~					
RELEMR					
My Documents					
🧕 My Computer					
Ny Network Places					
Details					

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6. To convert the ShakeMap shape files to the correct geodatabase format, double click on the **ShakeMap.exe** utility.

Note that this utility is provided free with the HAZUS-MH program and is located in the ShakeMap Utility folder on the Setup DVD. These do not automatically move to the local machine during a typical program installation, therefore, the user will have to manually copy the file or run it from the Setup DVD. More detailed instructions on using this utility are provided in the ShakeMap Instructions.doc.

Choose the S	hakeMap PGA shapefile	
Look in:	hazus 🗾 🖻 🗊 🖭 📰	
Name: Show of type:	pga.shp Browses for shapefiles.	Open Cancel

7. Select the folder icon to browse to and upload the 4 shape files as shown.

Be extra careful not to enter a file on the wrong line, for example if pgv.shp is loaded in pga.shp the loss calculation results will be erroneous. Note that it will automatically create and name the geodatabase we need to utilize for the loss estimation. An error may occur at this utility looks for a specific filename that includes "_data", however, the global ShakeMap product may be named slightly differently. Please see solution below.

😵 Shake Map Shapefile to Geodatabase Conversion Utility	X					
Input USGS shapefiles PGA: C:\RELEMR\ShakeMaps\DeadSea_M7\hazus\pga.shp						
PGV: C:\RELEMR\ShakeMaps\DeadSea_M7\hazus\pgv.shp						
SA U.3: JU:\HELEMR\ShakeMaps\DeadSea_M7\hazus\psaU3.shp						
Output geodatabase Folder path: C:\RELEMR\ShakeMaps\DeadSea_M7\hazus\ Geodatabase name: ShakeMap	×					
OK Cano	el					
Processing Successful ShakeMap shapefile to HAZUS geodatabase conversion complete. Processing time: Hours: 0, Mins:00, Secs:02 OK						

Note: There are two processes that will now need to be completed in the HAZUS program. These include pointing the program to the ShakeMap geodatabase and then selecting the ShakeMap scenario as the user-supplied earthquake scenario.

8. Open your HAZUS study region and from the **Hazard** menu choose **DataMaps** to open the Data Maps Dialog:

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Data Maps Dia	log						
ld	Name	МарТуре	IsCurrent	Database	Database	Table Name	Table Ti 🔺
							-
•							
Add map	to list	Remove m	an from list	Sor	F 1		
	(0 list	Tenove m	ap nom ilst	<u></u> 0i		Cju	

Select the Add map to list... button on the bottom left corner. Browse to and open the ShakeMap.mdb geodatabase that we created above. In this case it is located at \\RELEMR\ShakeMaps\DeadSea_M7\hazus\

Open	? 🛛
Look jn: 🔎	hazus 💌 🗲 🗈 📸 📰 🕶
ShakeMap	
File <u>n</u> ame:	ShakeMap Dpen
Files of type:	Microsoft Access Databases Files (*.mdb) 🔽 Cancel

The program needs to be pointed to each of the 4 data tables to define the ground motions used by HAZUS. The Data Map Attributes dialog will automatically open when the ShakeMap.mdb file is opened. The Map name (typed by the user), Map type (selected using the combo box and scroll arrows) and Table name (scroll toward bottom of list and do not select the Shape_Index files) need to be defined as shown below. This process needs to be completed until all four map table names are defined.

Note: This dialog is also the interface for adding hazard maps such as landslide, liquefaction, tsunami and dam inundation if available for your study region.

Data Map Attr	ributes 🛛 🔀
<u>M</u> ap name:	1.0 sec
Ma <u>p</u> type	User-defined at period = 1.0 secs
Table <u>n</u> ame :	pga_Shape_Index pgv pgv_Shape_Index psa03 psa03_Shape_Index psa10
	OK Cancel

Data Maps Dialog									
	ld		Name	MapType	IsCurrent	Database Name	Database Path		Table Name
1	10000	1.0 sec		User-defined	Г	ShakeMap.mdb	C:\RELEMR\ShakeMaps\DeadSea_M7\hazus\	psa10	
2		0.3 sec		User-defined		ShakeMap.mdb	C:\RELEMR\ShakeMaps\DeadSea_M7\hazus\	psa03	
3		PGA		User-defined		ShakeMap.mdb	C:\RELEMR\ShakeMaps\DeadSea_M7\hazus\	pga	
4		PGV		User-defined		ShakeMap.mdb	C:\RELEMR\ShakeMaps\DeadSea_M7\hazus\	pgv	
1									
									•
4)
			Add map to list			Remove map from list	Sort		Close

- 9. Review the Data Maps Dialog box to confirm no layers were entered into the wrong ground motion types. Make certain the **Table Names** and the user entered **Name** fields match for each ground motion type.
- 10. From the **Hazard** menu choose **Scenario** to define the earthquake scenario for this analysis:
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Select the **Next** button.

Scenario Wizard	×
Earthquake Hazard Scenario Selection This wizard helps in defining a new scenario, Activating an old scenario, deleting an existing scenario or define hazard maps.	
Scenario event: Define a new scenario Use an already pre-defined scenario Delete an existing scenario Define hazard maps 	
< <u>B</u> ack <u>N</u> ext >	Cancel

> Use the radio button to **Define a new scenario**.

Scenario Wizard				×
Seismic Hazard Type Selection Defines the type of seismic hazard				
Seismic hazard type: Deterministic hazard: Historical gpicenter event Source event Arbitrary event Probabilistic hazard User-supplied hazard				
	< <u>B</u> ack	<	<u>N</u> ext >	Cancel

> For Seismic Hazard Type select the User-supplied hazard...

Scenari	io Wizard		X
User [r- defined Hazard Option Define other parameters for the User-defin	ed Event option	
Grou	ind Shaking Maps Liquefaction Maps	Landslide Maps Surface F	ault Ruptu
	PGA countour map: PGA		•
	PG⊻ countour map: PGV		-
	Spectral Response Maps:		
	At 0.3 seconds: 0.3 sec		-
	At 1.0 seconds: 1.0 sec		•
<u>M</u> ag	nitude generating the event: 7.0	_	
		< <u>B</u> ack <u>N</u> ext >	Cancel

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Point each combo box to the ground motion tables we named earlier in the exercise and indicate the magnitude generating the event.

Scenario Wizard	×
Hazard Scenario Event Name Define the name of the scenario event	1
Enter a name for the scenario event (40 characters max.) M 7.0 Dead Sea Earthquake Scenario	
< <u>B</u> ack <u>N</u> ext> C	ancel

Clearly name the event being careful not to make typographical errors as each results page will include the event name then press Next.

Scenario Wizard	×
Completing the Scenario Definition Wizard	
You have successfully completed the Scenario Definition.	
You specified the following settings:	
Hazard Type = User Supplied Magnitude = 7.400000 Ground Shaking Maps PGAMap = PGA PGVMap = PGV Spectral 0.3 sec = 0.3 sec Spectral 1.0 sec = 1.0 sec	
< <u>B</u> ack [Finish] Cance	*

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Step 3 – Run Analysis

Under the **Analysis** drop down menu-select **Run** and the **Analysis Options** screen will pop up:

Analysis Options	
Inventory View	<u>S</u> elect All Deselect All
	OK Cancel
Number of modules selected = 0	
Blue text indicates modules which need to be (re-) analyzed s current vis-a-vis the hazard scenario and/or the analysis para	ince they are not meters.

Choose the Select All button and answer Yes to skipping the creation of ground motion contour maps since you are providing these:

Save User Selections option	
You have selected all options including generation option. Contour Maps are g viewing only and are not used by the a the generation of Contour Maps increa: analysis runtime, we recommend skippi wish to skip generation of Contour Map) Contour Map jenerated for nalysis. Since ses your ng it. Do you is?
(Yes	No

> Then select **Okay** and **Yes** to running the analysis:

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HAZUS-MH		\mathbf{X}
Run analysis with th	ne options selec	ted?
Yes	No	

Processing Status
Running analysis
Analyzing damage state probabilities by building type
Cancel



- > For this scenario the analysis completed in 6 minutes and 37 seconds.
- A broad range of results including tables, thematic maps and reports are now available under the **Results** drop down menu.