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Hands-on Working Procedure in RADIUS

Scenario

- Estimate the damaged by an Earthquake in a sample area is shown in the following picture.
- Assumption in that area
 - Total population : 7815
 - Total buildings : 1915
 - Mesh spacing : 0.05 km/mesh
 - Local road : 5 km
 - Bridge : 1
 - Road electric poles : 500
 - Water distribution line : 30 km
 - Gasoline stations : 1

★ Reference point to measure the epicenter distance



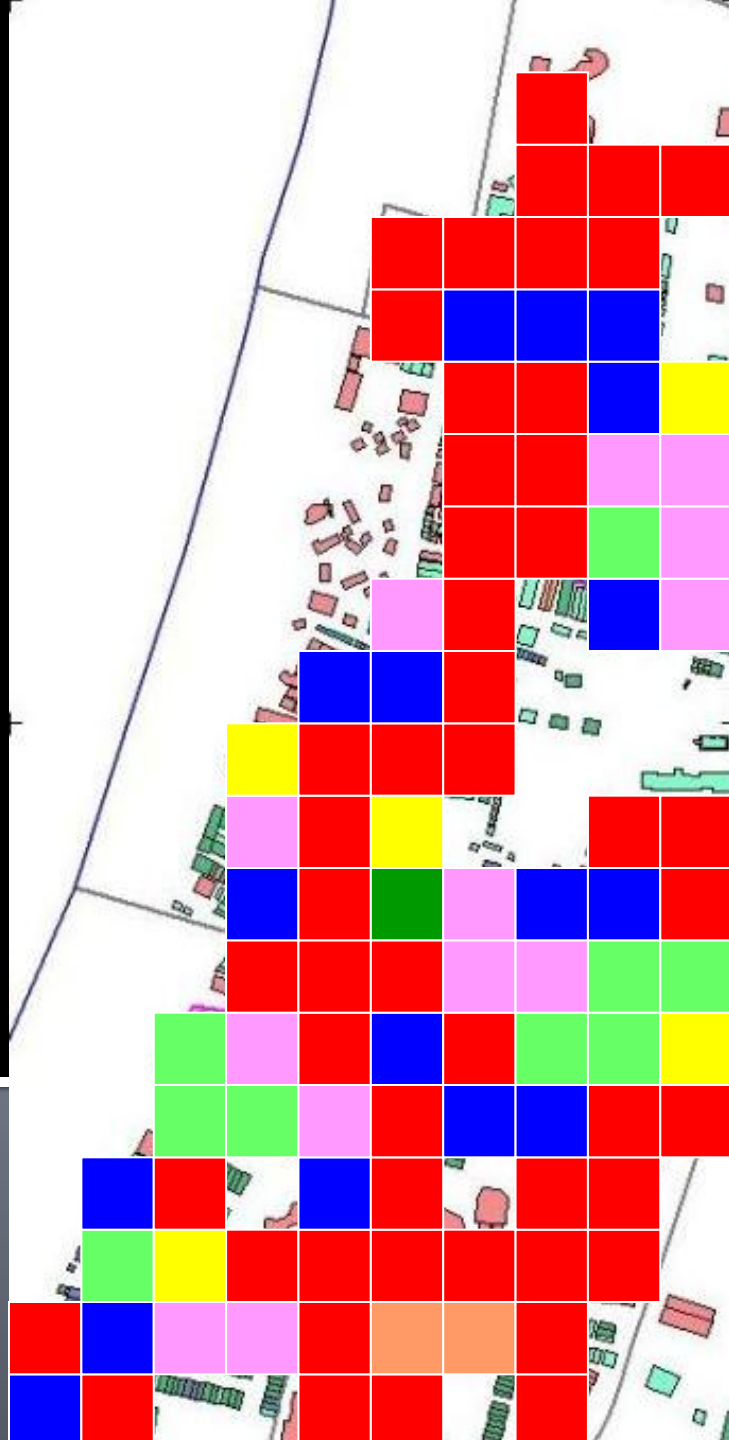
Scenario

- The earthquake data are as follows:
 - Magnitude : 9
 - Depth : 33 km
 - Occurrence Time : 8 a.m.
 - Direction : South – West
 - Attenuation Equation : Joyner & Boore, 1981
 - Epicentral Distance : 200 km
 - Reference point to measure the distance from hypocenter can be seen in the previous picture.

Scenario

- Composition of buildings per mesh at the sample area can be grouped as follows:
 - Non-Engineered Buildings:
 - 100% masonry buildings with height up to 2 stories
 - Engineered Buildings:
 - 100% engineered buildings with height from 2 stories above
 - Mostly Non-Engineered:
 - 80% Non-Engineered and 20% Engineered
 - Mostly Engineered:
 - 20% Non-Engineered and 80% Engineered
 - Average:
 - 50% Non-Engineered and 50% Engineered
 - Hospital:
 - 100% high rise hospital
 - Clinics:
 - 10% clinics and 90% non-engineered buildings

- Non-Engineered
- Engineered
- Mostly Non-Engineered
- Mostly Engineered
- Average
- Hospital
- Clinics



Scenario

- The importance factor will be decided considering local factors (e.g. population density).
- Local soil type for all areas is average stiff soil.

- Identified:
 - Target Area or City Name, Total Population Count at Night, Total Building Count
 - Top Left Corner or Mesh Area, Bottom Right Corner or Mesh Area, Mesh spacing (in km)
- Defines the meshes on the RADIUS Program interface
 - Number the meshes using integers, alphabets or a combination of the two

The screenshot shows the RADIUS99 program interface in Microsoft Excel. The title bar reads "Microsoft Excel - RADIUS99". The menu bar includes File, Edit, View, Insert, Format, Tools, Data, Window, and Help. The toolbar shows various icons for file operations and formatting. The main window displays a spreadsheet with the following content:

RADIUS Program Menu & Mesh Area

Outline of Procedure

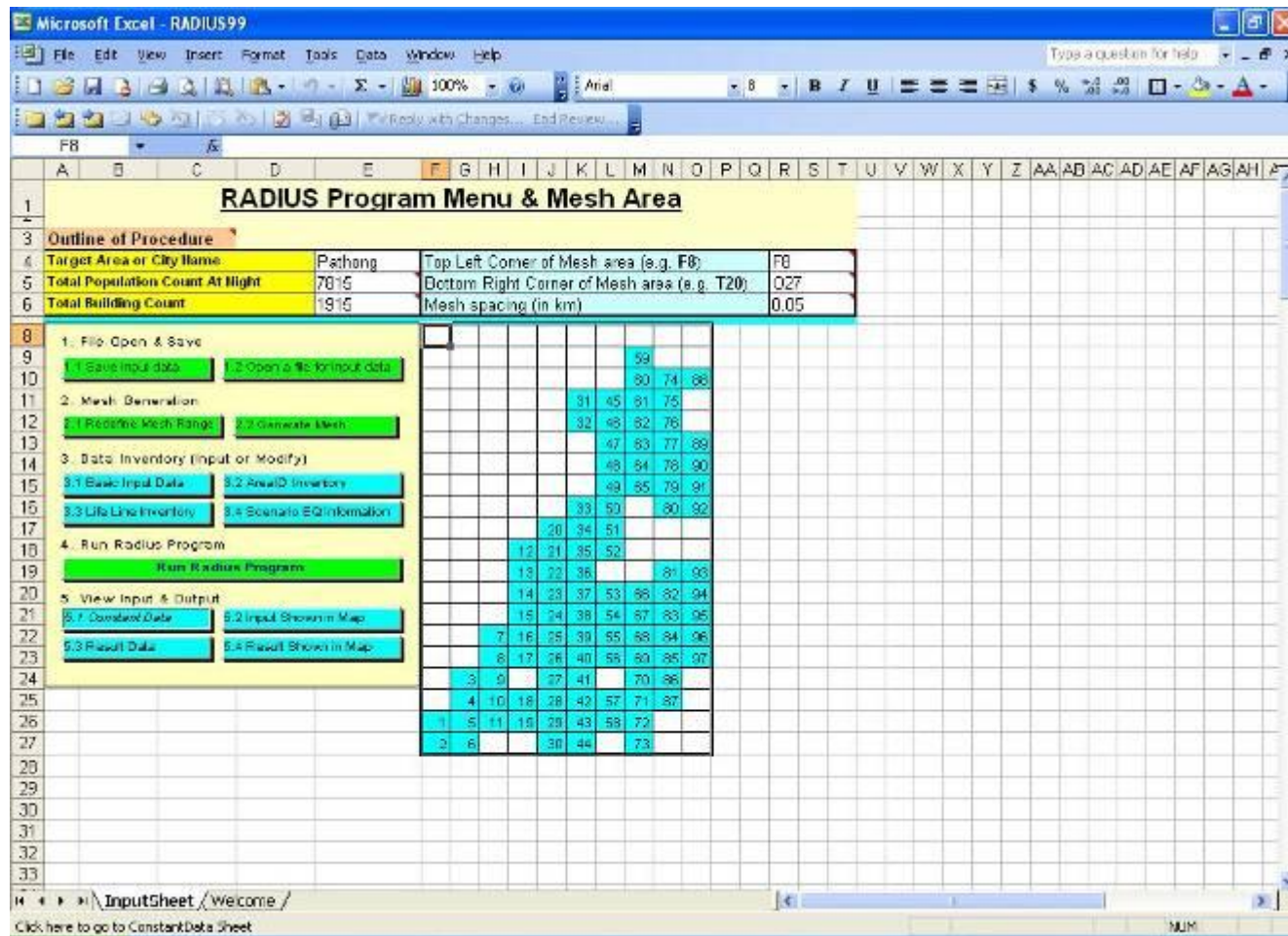
Target Area or City Name	Pathong	Top Left Corner of Mesh area (e.g. F8)	F8
Total Population Count At Night	7815	Bottom Right Corner of Mesh area (e.g. T20)	T20
Total Building Count	1915	Mesh spacing (in km)	0.05

The interface is divided into five main sections:

- File Open & Save**
 - 1.1 Save input data
 - 1.2 Open a file for input data
- Mesh Generation**
 - 2.1 Redefine Mesh Range
 - 2.2 Generate Mesh
- Data Inventory (Input or Modify)**
 - 3.1 Basic Input Data
 - 3.2 ArealD Inventory
 - 3.3 Life Line Inventory
 - 3.4 Scenario EQ Information
- Run Radius Program**
 - Run Radius Program
- View Input & Output**
 - 5.1 Constant Data
 - 5.2 Input Shown in Map
 - 5.3 Result Data
 - 5.4 Result Shown in Map

The mesh grid is a 10x10 grid of 'x' marks, with the top-left corner at cell F8 and the bottom-right corner at cell T20. The grid is bounded by a red border. The status bar at the bottom shows "InputSheet Welcome / NUM".

- Generate Mesh → The RADIUS Program automatically assigns MeshID values to meshes from left to right and top to bottom, after the user input is complete.



- Input or modify the data that will be used by click **3.1. Basic Input Data** button.
- Fill the Area ID, Area name, Mass Weight, and Local Soil Type for each mesh.
- The input data can be viewed in map by click down the box opposite to **Mesh Map arranged**, and choose the option you want to see.
- Click **Return Main Menu** button to go back to main menu.

Microsoft Excel - RADIUS99-1

File Edit View Insert Format Tools Data Window Help

100%

Basic Input Data

MeshMap arranged by Area D

Clear Input Data Auto Check Return Main Menu

Mesh ID	Area ID	Area Name	Mesh Weight	Local Soil Type
1	1	NE	2	2
2	3	MNEng	2	2
3	3	MNEng	2	2
4	2	Eng	2	2
5	3	MNEng	2	2
6	1	NE	2	2
7	2	Eng	2	2
8	2	Eng	2	2
9	1	NE	2	2
10	4	MEng	2	2
11	5	Average	2	2
12	4	MEng	2	2
13	5	Average	2	2
14	3	MNEng	2	2
15	1	NE	2	2
16	5	Average	2	2
17	2	Eng	2	2
18	1	NE	2	2
19	5	Average	2	2
20	3	MNEng	2	2
21	1	NE	2	2
22	1	NE	2	2
23	1	NE	2	2
24	1	NE	2	2
25	1	NE	2	2
26	5	Average	2	2
27	3	MNEng	2	2
28	1	NE	2	2

Target Region or City Name Pathing

Total Population Counts 7816

Total Building Counts 1916

Update Mesh Map

Click here to go to the Basic Input Sheet

- Define the buildings that consist in each area by click **3.2. AreaID Inventory** button.
 - Building classes explanation included in this form.
 - Fill the blank area for each area name from left to right.
 - Remember, the Sum for each area must be 100 %, if not the program will display warning.
- After the data is completed, return to main menu by click **Return Main Menu**.

The screenshot shows a Microsoft Excel spreadsheet titled 'RADIUS99'. The main window displays a table titled 'Inventory by Area' with columns for Area ID, Area Name, and various building class percentages (RES1-RES4, EDU1-EDU2, MED1-MED2, COM, IND, and a Sum column). A red box highlights the data entry area. To the right, a sidebar titled 'Building Classes Explanation' provides detailed descriptions for each building class code.

Area ID	Area Name	RES1 (%)	RES2 (%)	RES3 (%)	RES4 (%)	EDU1 (%)	EDU2 (%)	MED1 (%)	MED2 (%)	COM (%)	IND (%)	Sum (%)
1	NE	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
2	Eng	0.00	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
3	MNEng	0.00	80.00	0.00	20.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
4	MEng	0.00	20.00	0.00	80.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
5	Average	0.00	50.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
7	Hospita	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00	0.00	0.00	100.00
8	Clinics	0.00	90.00	0.00	0.00	0.00	0.00	10.00	0.00	0.00	0.00	100.00

Building Classes Explanation

- RES1**--- Internal construction - mainly slums, row-housing etc. made from unfired bricks, mud mortar, loosely tied walls and roofs.
- RES2**--- URM-RC composite construction - sub-standard construction, not complying with the local code provisions. Height up to 3 stories.
URM is Un-Reinforced Masonry and RC is Reinforced Concrete building
- RES3**--- URM-RC composite construction - old, deteriorated construction, not complying with the latest code provisions. Height 4 - 6 stories.
- RES4**--- Engineered RC construction - newly constructed multi-storied buildings, for residential and commercial purposes.
- EDU1**--- School buildings, up to 2 stories; usually percentage should be very small
- EDU2**--- School buildings, greater than 2 stories; usually percentage should be very small
- MED1**--- Low to medium rise hospitals; usually percentage should be very small
- MED2**--- High rise hospitals; usually percentage should be very small
- COM**--- Shopping Centers
- IND**--- Industrial facilities, both low and high rise

- The RADIUS Program could be used for earthquake damage estimation of many lifelines, but not for some other essential facilities like railways or telecommunications, and damage to contents and business interruption.
 - Click **3.3. Life Line Inventory** button.
 - Fill the blank box at **Total Count** column for each lifeline. If there is no lifeline, leave the box or fill 0.
 - The definition of each lifelines are included in this form.
- After the data is completed, return to main menu by click **Return Main Menu**.

The screenshot shows a Microsoft Excel spreadsheet titled 'RADIUS99'. The main content is a 'LifeLine Inventory' form. At the top, there are buttons for 'Read Me First', 'Data Clear', 'Return Main Menu' (highlighted with a red box), and 'Auto Check'. Below these is a table with the following data:

LifeLine	Total Count	Unit	Definition
Road1	5	km	Length of Local Roads (in km), for the concerned city or target region.
Road2	0	km	Length of major roads such as Freeways/Highways (in km).
Bridge	1	Count	Number of major Transportation Bridges (road and railway).
Tunnels	0	Count	Number of major Transportation Tunnels, for the concerned city or target region.
Electric1	500	Count	Number of major Electrical & Telecommunication transmission towers.
Electric2	0	Site	Number of Electrical & Telecommunication sub-stations.
Water1	20	km	Length of major Water & Sewage trunk and distribution lines (km).
Water2	0	Site	Number of Water & Sewage pumping stations.
Water3	0	Site	Number of Water & Sewage treatment plants.
Reservoir1	0	Count	Number of Storage Reservoirs or Dams.
Reservoir2	0	Count	Number of Terminal Reservoirs or Elevated Storage Tanks.
Gasoline	1	Count	Number of Gasoline stations.

The 'Return Main Menu' button and the 'Total Count' column are highlighted with red boxes. The 'Definition' column has a red arrow pointing to the word 'Definition'.

- The last data required is earthquake motion that will be used to estimate the damage.
- Click the **3.4. Scenario EQ Information** button.
 - The form below will be displayed. Choose **User Defined Earthquake** button
 - Fill the data required : **Scenario Earthquake, EQ Magnitude, EQ Depth, EQ Occurance Time, Reference MeshID, and EQ Epicentral**.
 - Drop down the box opposite to **EQ Direction** to choose the EQ Direction.
 - Drop down the box below **Choose Attenuation Equation** to choose the attenuation equation.
 - Click **OK & Return** button to go back to main menu.

The screenshot shows a Microsoft Excel spreadsheet titled "RADIUS99" with a form titled "Scenario Earthquake Information". The form is divided into several sections:

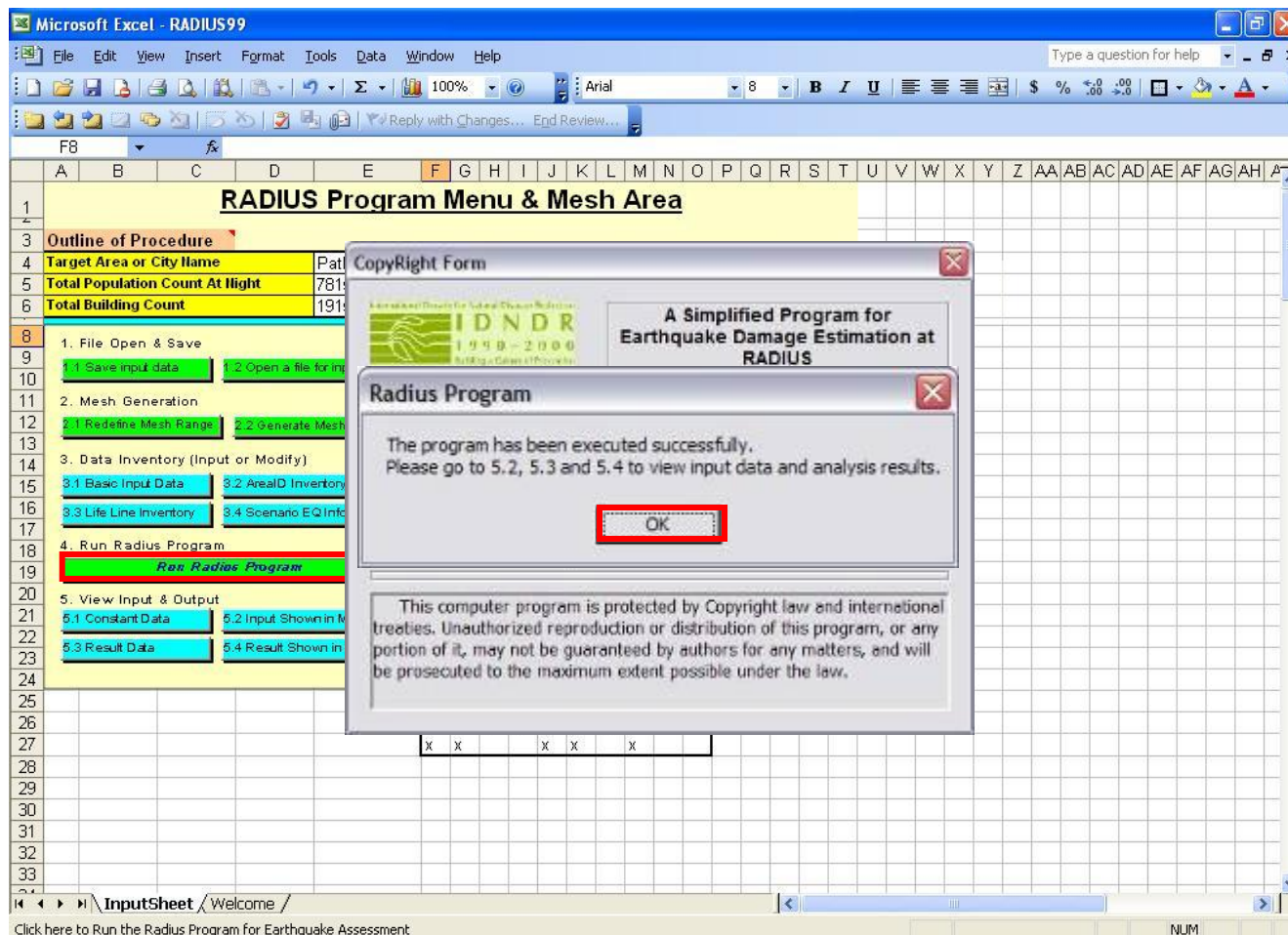
- Scenario:** Radio buttons for "Historical Earthquake" and "User Defined Earthquake". The "User Defined Earthquake" option is selected.
- Earthquake Information:**
 - Choose Scenario Earthquake: Sundun Earthquake
 - Earthquake Magnitude: 0
 - Earthquake Depth (m): 33
 - EQ Occurance Time (hr): 8
- Attenuation Equation:**
 - Choose Attenuation Equation: Joyner & Boore - 1981
- Reference:**
 - Enter Reference MeshID No: 80
 - Earthquake Epicentral distance (m): 200
 - Choose EQ Direction relative from Ref. Mesh: South West

At the bottom right of the form is a button labeled "OK & Return". To the right of the form is a table with 8 rows and 2 columns:

ID	Earthquake
1	Tangshan Ear
2	El Asnam Ear
3	Spitak earthqu
4	Luzon Earthqu
5	Manjil Earthqu
6	Northridge Ear
7	Kobe Earthqu
8	Kocaeli Earth
8	ChiChi Earthq

The Excel window title bar shows "Microsoft Excel - RADIUS99" and the status bar at the bottom shows "Click here to go to the Earthquake Parameter Sheet" and "NUM".

- Click **Run Radius Program** button to analyze the scenario and obtain the result.
 - The box below will appear, click the **GO** button.
 - Wait for a moment.
 - After the program finished, the box below will appear, click the **OK** button.



- Review the result by click **5.3. Result Data** button.
 - There are six tables represent the result:
 - Table 1: Main Results
 - Table 2: Lifeline Inventory and Damage
 - Table 3: Building Inventory Partitioned to Meshes
 - Table 4: Building Damage Ratio (%)
 - Table 5: Number of Buildings Damaged by Earthquake
 - Table 6: Population and Casualty Distribution
 - Click the **Return to Main Menu** button that always on the top of each tables to go back to main menu.

Microsoft Excel - RADIUS99

File Edit View Insert Format Tools Data Window Help

Type a question for help

100% Arial

Return to Main Menu

Table 6 --- Population And Casualty Distribution

Total population is 7815 Total deaths are 0 Total Severe injuries are 0 Total Moderate Injuries are 0

Total	Mesh ID	Area ID	Mesh Weight	Area Name	Population (Day)	Population (Night)	Death Ratio (%)	Deaths Count	Injury Ratio (%)	Severe Injury Count	Moderate Injury Count	Injury/Moderate/Severe Count
0	1	1	2	NE	13	25	0.0	0	0.0	0	0	0
0	2	3	2	MNEng	35	70	0.0	0	0.0	0	0	0
0	3	3	2	MNEng	35	70	0.0	0	0.0	0	0	0
0	4	2	2	Eng	125	251	0.0	0	0.0	0	0	0
0	5	3	2	MNEng	35	70	0.0	0	0.0	0	0	0
0	6	1	2	NE	13	25	0.0	0	0.0	0	0	0
0	7	2	2	Eng	125	251	0.0	0	0.0	0	0	0
0	8	2	2	Eng	125	251	0.0	0	0.0	0	0	0
0	9	1	2	NE	13	25	0.0	0	0.0	0	0	0
0	10	4	2	MEng	109	209	0.0	0	0.0	0	0	0
0	11	5	2	Average	69	136	0.0	0	0.0	0	0	0
0	12	4	2	MEng	109	209	0.0	0	0.0	0	0	0
0	13	5	2	Average	69	136	0.0	0	0.0	0	0	0
0	14	3	2	MNEng	35	70	0.0	0	0.0	0	0	0
0	15	1	2	NE	13	25	0.0	0	0.0	0	0	0
0	16	5	2	Average	69	136	0.0	0	0.0	0	0	0
0	17	2	2	Eng	125	251	0.0	0	0.0	0	0	0
0	18	1	2	NE	13	25	0.0	0	0.0	0	0	0
0	19	5	2	Average	69	136	0.0	0	0.0	0	0	0
0	20	3	2	MNEng	35	70	0.0	0	0.0	0	0	0
0	21	1	2	NE	13	25	0.0	0	0.0	0	0	0

Welcome ResultsSheet

Click here to go to the Calculated ResultsData Sheet

MJM

- The results in map format can be viewed by click **5.4. Result Shown in Map** button.
 - Choose one of the following result options in the **Result Data Dialogue**
 - MMI
 - Damaged Building
 - Damaged Building Ratio
 - Casualties (Death)
 - Casualties (Injury)
 - Click **Exit** button to return to main menu.

The screenshot shows a Microsoft Excel spreadsheet with the following content:

Casualties (Injury) Distribution

Region (City) Name : Pathong	Earthquake Name : Sumatra Earthquake
Total Population Counts : 7815	Occurrence Date :
Total Building Count : 1815	Occurrence Time : 8
Total Mesh : 97	EQ Magnitude : 9
Spacing of Mesh(km) : 0.05	EQ Direction relative from Ref.Mesh : South West
Reference Mesh : 60	EQ Distance(km) to Ref.Mesh : 200
Used Attenuation Equation : Joyner & Boore - 1981	

Color ID Legend:

Color ID	Automatic Range		Manual Range	
	From	To	From	To
0	0	0	0	0
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0

Population & Casualty Summary

The total population counts are 7815 and 0% injured

AreaID	Area Name	Day Pop	Night Pop Counts	Death	Injury
1	NE	839	1278	0	0
2	Enc	1127	2265	0	0
3	MNEng	561	1122	0	0
4	WEng	514	1027	0	0
5	Average	898	1791	0	0
7	Hospital	902	301	0	0
8	Clinics	39	41	0	0
Summary Information		4878	7815	0	0

Map Using Automatic Range (Cell characters show ColorID)

The map shows a grid of cells representing the distribution of casualties. The cells are colored based on the ColorID legend. The map shows a concentration of casualties in the central and right-hand side of the grid, with a few cells showing a ColorID of 3 (red) in the bottom right corner.