



## Appendix II (Governing Equations)

Variables	Equations
Airline Food Deliveries per Day	Total No. of Airline Landings per Day*Airline Food Delivery Percentage
Airline Food Support Rate	Airline Food Deliveries per Day*Airline Packages per Delivery
Airline Team Delivery per Day	"Total No. of Airline Landings per Day"*Airline Team Delivery Percentage
Average Broadcast Coverage of the Disaster	Destruction Percentage*STEP(1,1095)*Time Effect Function(Time)
Burying Rate	Unburied Corps/Burying Time(Time)
Construction Rate	0.65-STEP(0.65, 1095 )
Contact Between Infected and Uninfected people	Susceptible Contacts*Probability of Contact with Infected People
Corps buried	Burying Rate
Death rate due to Debris	MIN(Rate of Finding Corps, Total Population)
Debris Death Percentage	1-Living Percentage Function(Time)
Debris Removal Rate A	MIN(Total Debris Removal Ability of the City*Class A Percentage, Debrised New Buildings Class A)
Debris Removal Rate B	MIN(Total Debris Removal Ability of the City*Class B Percentage, Debrised Old Building Class B)
Debrised New Buildings Class A	Integral (Destruction Rate Due to Earthquake-Debris Removal Rate A)
Debrised Old	Integral(Destruction Rate Due to Earthquake-Debris Removal Rate B)

Building Class B	
Destruction Rate Due to Earthquake	$0.5 * \text{New Buildings Class A} * \text{PULSE}(1095, 1)$
Destruction Rate Due to Earthquake(old buildings)	$\text{Old Buildings Class B} * \text{PULSE}(1095, 1)$
Disease Death	$\text{MIN}(\text{Disease Death Rate}, \text{Total Population})$
Disease Death Rate	$\text{Disease Death Percentage} * \text{People Infected with Deadly Diseases}$
Environment Population Infection Rate	$\text{MIN}(\text{Population Susceptible to deadly Diseases}, \text{Pollution Infection Percentage} * \text{Population Susceptible to deadly Diseases})$
Food Consumption Rate	$\text{MIN}(\text{Food Reservoir} (\text{Total Population} * \text{Food Packages per Person per Day}))$
Food Increase Rate	$\text{Airline Food Support Rate} + \text{"Non-Airline Food Support Rate"}$
Food Reservoir	$\text{Integral}(\text{Food Increase Rate} - \text{Food Consumption Rate})$
"Humanitarian Teams (Percentage of Total Pop.)"	$\text{"Total No. of Rescue Teams in the Zone"} * \text{Humanarian Teams Percentage}$
Infection Rate	$\text{Contact Between Infected and Uninfected people} * \text{Infectivity} * \text{STEP}(1, 1095)$
Injured People	$\text{Integral}(\text{Rate of Finding Injured People} - \text{Injured People Death Rate} - \text{Injury Recovery Rate})$
Injured People Death Rate	$\text{Injured People} * \text{Injury Death Percentage}$
Injury Death Percentage	$\text{"Med-Inj Function"} (\text{"No. of Medical Team per Person"} / \text{"Ideal No. of Medical Team per Person"})$
Injury Recovery	$\text{Injured People} / \text{Time for Injury Recovery}$

Rate	
"Max. No. of Landings per Lane per Day"	Time in 1 Day/Time Needed per Landing
"Max. Possible Landings per Day"	"Max. No. of Landings per Lane per Day"*"No. of Airport Lanes"
"Max. Possible Caravans Per Day"	"No. of Ground Roads"*"Max. Capacity of Each Road per Day(Caravans per Day)"
Migration Rate	Total Population*"Attractiveness Coeff."
Natural Destruction Rate A	New Buildings Class A/Natural Destruction Time A
Natural Destruction Rate B	Natural Destruction Rate B
New Buildings Class A	Integral (Construction Rate-Destruction Rate Due to Earthquake-Natural Destruction Rate A)
"No. of Dead People"	Unburied Corps +Corps buried
"No. of Ground Roads"	Integral(Road Construction Rate-Road Destruction Rate)
"No. of Medical Team per Person"	"Total No. of Medical Teams in the Zone"/Total Population
"No. of People per Building"	Average Area of a Building*People per Area
"Non-Airline Food Deliveries per Day"	"Total No. of Caravans per Day"*"Non-Airline Food Delivery Percentage"
"Non-Airline Food Support Rate"	"Non-Airline Food Deliveries per Day"*"Non-Airline Packages per Delivery"
"Non-Airline Team	"Non-Airline Team Delivery Percentage"*"Total No. of Caravans per

Delivery per Day"	Day"
Old Buildings Class B	Integral(-Destruction Rate Due to Earthquake-Natural Destruction Rate B)
People Conception of the Disaster	DELAYII(Broad Average Effect Function(Average Broadcast Coverage of the Disaster), Time to Form the Conception, 0 )
People Found per Day due to Debris Removal	Total Debris Removal Ability of the City*"No. of People per Building"
People Infected with Deadly Diseases	Integral (Environment Population Infection Rate+ Infection Rate-Disease Death Rate-Recovery Rate)
People per Area	"Total Population (initial)"/"Total Area of Buildings (Initial)"
Percentage of Caravans	Conception Percentage Function(People Conception of the Disaster)
Percentage of Landings	Conception Percentage Function(People Conception of the Disaster)
Pollution Infection Percentage	Infection Function(Burying Time)
Population Increase Rate	Total Population*"Population Increase Coeff."
Population Susceptible to deadly Diseases	Integral(-Environment Population Infection Rate-Infection Rate)
Probability of Contact with Infected People	People Infected with Deadly Diseases/Total Population
"Professional & NGO Teams Sent to Disaster site"	"Total No. of Rescue Teams in the Zone"*"NGO & Prof. Teams Percentage"
Rate of Finding	MIN(Debris Death Percentage*People Found per Day due to Debris

Corps	Removal, Trapped People )
Rate of Finding Injured People	$\text{MIN}(\text{Trapped People, Living Percentage Function}(\text{Time}) * \text{People Found per Day due to Debris Removal})$
Rate of Trapped People	"No. of People per Building" * Total Destruction Rate due to Earthquake
Recovery Rate	People Infected with Deadly Diseases/Time for Recovery
Road Destruction Rate	"No. of Ground Roads"/"Destruction Time (Road Life)"
Susceptible Contacts	Population Susceptible to deadly Diseases * Contact Frequency
Teams Decrease Rate	Teams Present in the Zone/Time to Stay in the Zone
Teams Increase Rate	$\text{STEP}(1, 1095) * (\text{"Non-Airline Team Delivery per Day"} + \text{Airline Team Delivery per Day})$
Teams People Arrival Rate	$(\text{Teams Increase Rate} - \text{Teams Decrease Rate}) * \text{"Average No. of People Per Team"}$
Teams Present in the Zone	$\text{Integral}(\text{Teams Increase Rate} - \text{Teams Decrease Rate})$
Time for Injury Recovery	"Food-Medic-Time Function" (Food per Person per Day * "No. of Medical Team per Person")
"Total Debris Removal Ability of Fire-Stations (Building per day)"	"No. Fire-Stations" * "Debris Removal Ability per Fire-Station (Building per day)"
"Total Debris Removal Ability of Prof. & NGO Teams (Building per day)"	"Debris Removal Ability per Prof. & NGO Team (Building Per Day)" * "Professional & NGO Teams Sent to Disaster site"
"Total Debris	Debris Removal Ability per Humanitarian Teams * "Humanitarian

Removal Ability of Humanitarian Teams (Buildings per Day)"	Teams (Percentage of Total Pop.)"
Total Debris Removal Ability of the City	"Total Debris Removal Ability of Fire-Stations (Building per day)"+ "Total Debris Removal Ability of Prof.& NGO Teams (Building per day)"+ "Total Debris Removal Ability of Humanitarian Teams (Buildings per Day)"
Total Destruction Rate due to Earthquake	Destruction Rate Due to Earthquake+ Destruction Rate Due to Earthquake
"Total No. of Airline Landings per Day"	"Max. Possible Landings per Day"*Percentage of Landings
"Total No. of Caravans per Day"	"Max. Possible Caravans Per Day"*Percentage of Caravans
"Total No. of Medical Teams in the Zone"	Teams Present in the Zone-"Total No. of Rescue Teams in the Zone"
"Total No. of Rescue Teams in the Zone"	Teams Present in the Zone*Rescue Team Percentage
Total Population	Integral(Migration Rate+ Population Increase Rate+ Teams People Arrival Rate-Death rate due to Debris-Disease Death-Injury Death Rate)
Trapped People	Integral(Rate of Trapped People-Rate of Finding Corps-Rate of Finding Injured People)
Unburied Corps	Integral(Injured People Death Rate+ Rate of Finding Corps-Burying Rate)