

# DEVELOPMENT OF THE METHOD OF ESTIMATING THE NUMBER OF **PEOPLE AT EVACUATION CENTER** IN CASE OF URBAN EARTHQUAKE DISASTER

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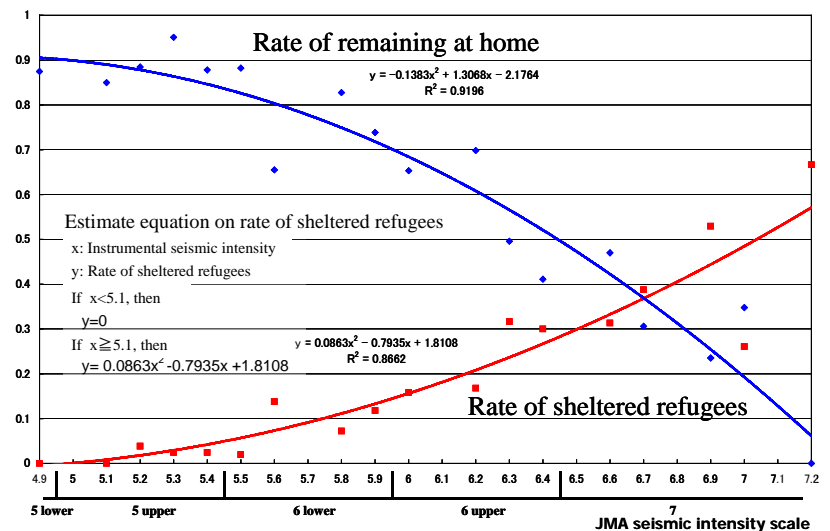
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## ■ Estimation of rate of sheltered refugees in 10 hours

(using the result of the random sampled social survey we conducted in impacted area of **Hanshin-Awaji Earthquake** in 2003)



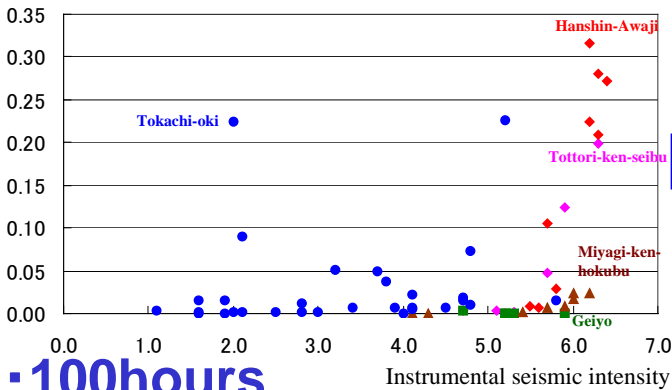
## ■ Six earthquakes with significant damage that occurred after the Great Hanshin-Awaji Earthquake.

1. Great Hanshin-Awaji Earthquake (Jan. 17, 1995 )  
M 7.3, Maximum JMA seismic intensity scale of 7
2. Tottori-ken-seibu Earthquake (Oct. 6, 2000)  
M 7.3, Maximum JMA seismic intensity scale of 6 upper
3. Heisei Geiyo Earthquake (Mar. 24, 2001)  
M6.7, Maximum JMA seismic intensity scale of 6 lower
4. Miyagi-ken-oki Earthquake (May 26, 2003)  
M7.1, Maximum JMA seismic intensity scale of 6 lower
5. Miyagi-ken-hokubu Earthquake (Jul. 26, 2003)  
M6.4, Maximum JMA seismic intensity scale of 6 upper
6. Tokachi-oki Earthquake (Sep. 26, 2003)  
M8.0 Maximum JMA seismic intensity scale of 6 lower

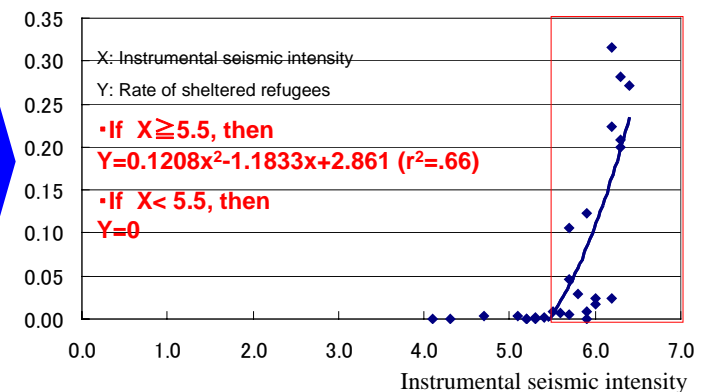
# Relationship between the refugee rate and instrumental seismic intensity in 10/100 hours

## - 10hours

Rate of sheltered refugees

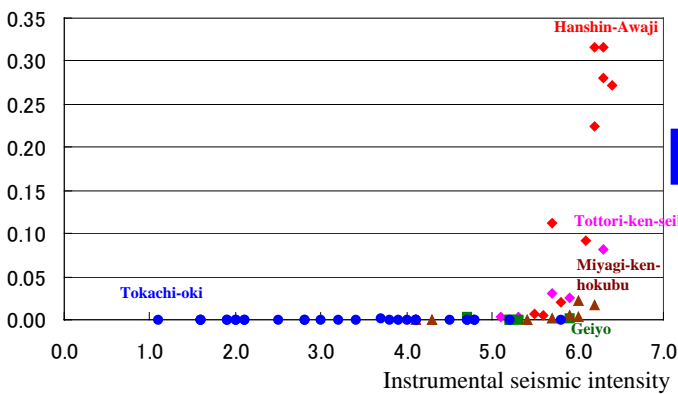


Rate of sheltered refugees

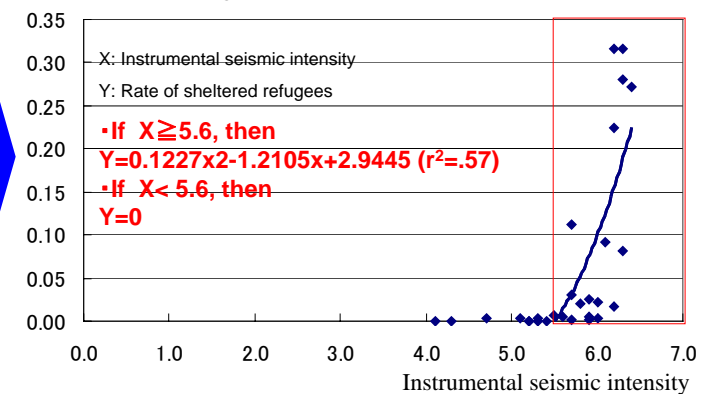


## - 100hours

Rate of sheltered refugees



Rate of sheltered refugees



- 1) People began to evacuate when the seismic intensity got stronger than **6 lower**.
- 2) Rate of sheltered refugees was higher when instrumental seismic intensity was larger.
- 3) Rate of sheltered refugees in 10 hours after the seismic disaster was higher than in 100 hours. It was especially revealed that 1) and 2) had the same trend as that of the social survey data.

At 100 hours after the seismic disaster, the correlation was relatively high, but this high correlation could be interpreted due to the fact that the refugee rate of the Great Hanshin-Awaji Earthquake has a large proportion in the overall trend. As to other three earthquakes, factors other than instrumental seismic intensity might be influencing behavior to evacuate to shelters. Therefore, **we further formulated an estimate equation using analysis results of the social survey for 100 hours after the seismic disaster.**

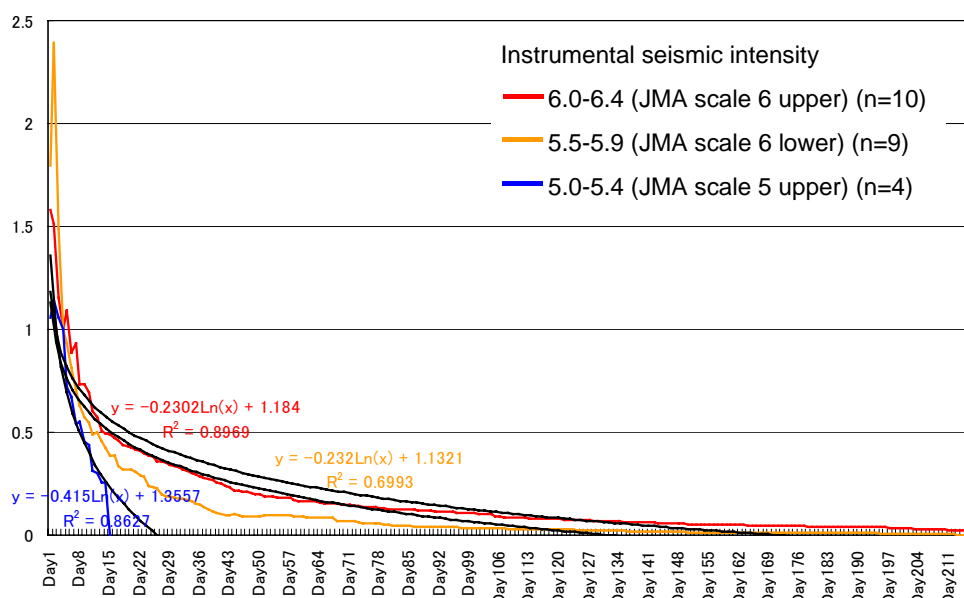
## Variables used for the generalized linear model

**Personal attributes** (sex, age, number of family members, family member structure, profession, type of the dwelling, house structure, total income per household), **External force** (instrumental seismic intensity), **Damage** (personal damage, damage to buildings and furniture, ratio of total damage, lifeline damage)

## Three variables are effective for the estimate of sheltered refugees in 100 hours

$$Y(100\text{hours}) = 0.774 \times \text{the number of refugees in 10 hours} + 0.159 \times \text{the number of inhabitants in completely collapsed buildings} + 0.101 \times \text{the number of inhabitants in completely destroyed buildings}$$

## Estimate equations for time point other than 10 and 100 hours after the seismic disaster

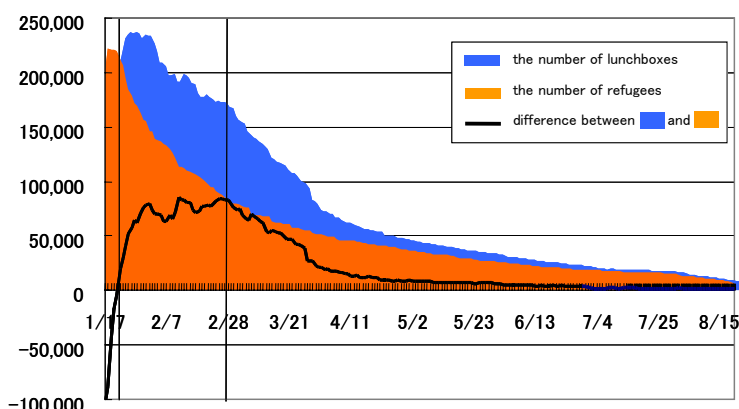


## Estimation of the volume of necessary food

Number of refugees who stayed in shelters and the number of lunchboxes distributed in Kobe City

Food Coefficient

The number of people



Day	FC	Day	FC	Day	FC	Day	FC	Day	FC	Day	FC
1	1.00	41	1.96	81	1.36	121	1.23	161	1.22	201	1.07
2	1.00	42	1.98	82	1.35	122	1.25	162	1.19	202	1.08
3	1.00	43	2.00	83	1.35	123	1.24	163	1.19	203	1.08
4	1.00	44	1.99	84	1.33	124	1.24	164	1.20	204	1.08
5	1.00	45	1.95	85	1.30	125	1.24	165	1.20	205	1.09
6	1.10	46	1.93	86	1.29	126	1.25	166	1.13	206	1.15
7	1.14	47	1.96	87	1.31	127	1.22	167	1.11	207	1.11
8	1.21	48	1.88	88	1.28	128	1.23	168	1.08	208	1.11
9	1.28	49	1.87	89	1.28	129	1.26	169	1.07	209	1.11
10	1.32	50	1.86	90	1.28	130	1.25	170	1.07	210	1.12
11	1.37	51	2.01	91	1.31	131	1.25	171	1.08	211	1.11
12	1.37	52	1.98	92	1.28	132	1.25	172	1.11	212	1.12
13	1.44	53	1.94	93	1.28	133	1.25	173	1.12	213	1.16
14	1.49	54	1.92	94	1.30	134	1.24	174	1.12	214	1.16
15	1.50	55	1.90	95	1.23	135	1.24	175	1.12	215	1.18
16	1.55	56	1.79	96	1.23	136	1.26	176	1.11		
17	1.56	57	1.78	97	1.23	137	1.21	177	1.11		
18	1.50	58	1.87	98	1.24	138	1.21	178	1.13		
19	1.51	59	1.87	99	1.21	139	1.21	179	1.13		
20	1.50	60	1.85	100	1.21	140	1.21	180	1.13		
21	1.47	61	1.84	101	1.25	141	1.19	181	1.12		
22	1.47	62	1.83	102	1.23	142	1.18	182	1.13		
23	1.53	63	1.77	103	1.24	143	1.20	183	1.11		
24	1.52	64	1.77	104	1.23	144	1.19	184	1.11		
25	1.59	65	1.82	105	1.25	145	1.19	185	1.12		
26	1.75	66	1.73	106	1.23	146	1.19	186	1.12		
27	1.73	67	1.74	107	1.23	147	1.21	187	1.12		
28	1.74	68	1.74	108	1.26	148	1.19	188	1.12		
29	1.73	69	1.69	109	1.24	149	1.19	189	1.12		
30	1.74	70	1.50	110	1.24	150	1.22	190	1.11		
31	1.69	71	1.49	111	1.24	151	1.20	191	1.11		
32	1.68	72	1.50	112	1.24	152	1.20	192	1.11		
33	1.70	73	1.43	113	1.23	153	1.20	193	1.11		
34	1.75	74	1.41	114	1.23	154	1.22	194	1.11		
35	1.77	75	1.41	115	1.24	155	1.19	195	1.11		
36	1.82	76	1.39	116	1.21	156	1.20	196	1.10		
37	1.81	77	1.40	117	1.21	157	1.23	197	1.17		
38	1.84	78	1.36	118	1.21	158	1.22	198	1.14		
39	1.89	79	1.35	119	1.24	159	1.21	199	1.12		
40	1.94	80	1.39	120	1.22	160	1.21	200	1.07		