Chapter 4

Model Life Tables

The objective in this chapter is to construct model life tables for the 14 provinces in Southern Thailand. In Section 4.1 we use multiple logistic regressions to fit the model to the data from all 14 provinces using province and age group as joint categorical determinants separated by gender. In Section 4.2 we fit models to subgroups of six and eight provinces for male and female.

4.1 Models of all 14 provinces for male and female

We first fitted the logistic regression model described by Equation (2.5) to the data from all 14 provinces in the Southern Region with provinces and age groups as determinants. Chumporn is a referent group for province and age 0-4 is a referent category for age group. The separate models for the two sexes are shown in Tables 4.1 and 4.2.

Determinant	coefficient	St.Error	p-value
Constant	-6.1305	0.0451	0.0000
Province:			0.0000
Chumphon	0.0000		
Krabi	-0.0835	0.0453	0.0653
NakhonSiThammarat	-0.2048	0.0320	0.0000
Narathiwat	0.1697	0.0356	0.0000
Pattani	0.0970	0.0364	0.0077
Phang-nga	-0.1664	0.0495	0.0008
Phatthalung	-0.2561	0.0401	0.0000
Phuket	0.1626	0.0465	0.0005
Ranong	-0.3384	0.0633	0.0000
Satun	-0.0280	0.0486	0.5644
Songkhla	0.0445	0.0320	0.1650
Suratthani	-0.0454	0.0344	0.1867
Thang	-0.0986	0.0378	0.0091
Yala	0.0106	0.0413	0.7980
Age group:			0.0000
0-4	0.0000		
5-9	-1.3211	0.0764	0.0000
10-14	-1.3434	0.0769	0.0000
15-19	-0.4153	0.0563	0.0000
20-24	0.0951	0.0505	0.0600
25-29	0.7306	0.0447	0.0000
30-34	0.8222	0.0441	0.0000
35-39	0.6760	0.0457	0.0000
40-44	0.6046	0.0480	0.0000
45-49	0.8596	0.0477	0.0000
50-54	1.0531	0.0487	0.0000
55-59	1.4615	0.0464	0.0000
60-64	1.8523	0.0442	0.0000
65-69	2.3385	0.0430	0.0000
70-74	2.7286	0.0425	0.0000
75-79	3.2410	0.0433	0.0000
80-84	3.7326	0.0443	0.0000
85+	4.2692	0.0435	0.0000

Table 4.1: Model life table for all 14 provinces for males

Determinant	coefficient	St.Error	p-value
Constant	-6.5141	0.0539	0.0000
Province:			0.0000
Chumphon	0.0000		
Krabi	0.2134	0.0563	0.0002
NakhonSiThammarat	-0.1538	0.0408	0.0002
Narathiwat	0.5395	0.0445	0.0000
Pattani	0.4515	0.0445	0.0000
Phang-nga	0.0808	0.0613	0.1873
Phatthalung	-0.1390	0.0491	0.0047
Phuket	0.3901	0.0587	0.0000
Ranong	-0.1361	0.0813	0.0941
Satun	0.3045	0.0599	0.0000
Songkhla	0.1978	0.0409	0.0000
Suratthani	0.0489	0.0439	0.2649
Trang	-0.0945	0.0487	0.0523
Yala	0.3208	0.0519	0.0000
Age group:			0.0000
0-4	0.0000		
5-9	-1.4877	0.0923	0.0000
10-14	-1.5976	0.0959	0.0000
15-19	-1.1970	0.0820	0.0000
20-24	-0.7001	0.0712	0.0000
25-29	-0.2252	0.0611	0.0002
30-34	-0.2045	0.0611	0.0008
35-39	-0.0883	0.0604	0.1434
40-44	-0.0966	0.0635	0.1280
45-49	0.3063	0.0605	0.0000
50-54	0.7028	0.0587	0.0000
55-59	0.9454	0.0580	0.0000
60-64	1.4542	0.0523	0.0000
65-69	2.0380	0.0496	0.0000
70-74	2.5252	0.0482	0.0000
75-79	3.1091	0.0482	0.0000
80-84	3.7041	0.0477	0.0000
85+	4.4327	0.0453	0.0000

Table 4.2: Model life table for all 14 provinces for females

The number of parameters in this model (m) is 31 corresponding to the constant plus 17 age group parameters and 13 province parameters and the number of cells (n_g) is 252 corresponding to the product of 18 age groups and 14 provinces, so the number of degrees of freedom for assessing the goodness-of-fit of the model is 221.

The residual deviances based on these grouped data are 553.78 for the males and 474.00 for the females, indicating a poor fit in each case, as the plots of Pearson residuals against normal scores in Figure 4.1 show.

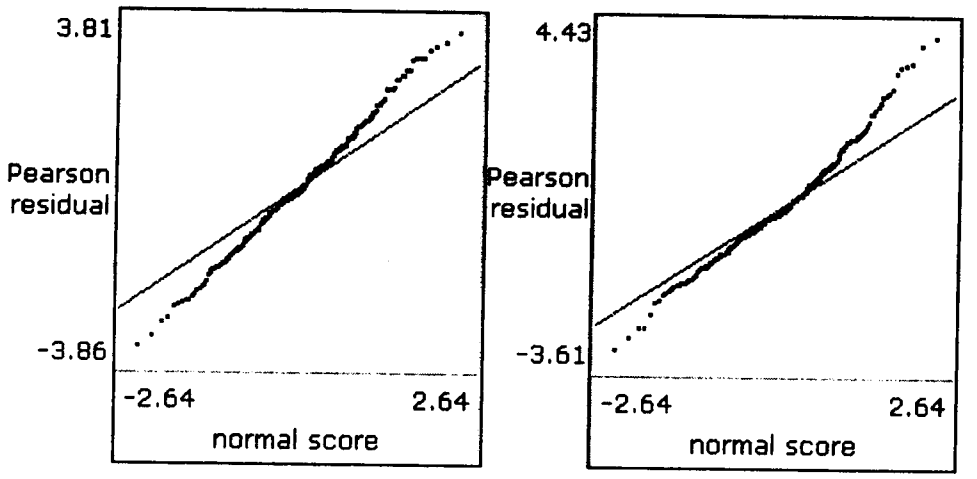


Figure 4.1: Plots of Pearson residuals from logistic regression models fitted to all 14 Southern Thai provinces for males (left) and females (right)

4.2 Models of subgroups of six and eight provinces for male and female

Next we looked for more homogeneous subgroups of provinces, and found that six provinces (the four southernmost – Narathiwat, Yala, Pattani and Satun – together with Krabi and Phuket) could be fitted reasonably well with common models for males and for females, and the remaining eight could also be grouped together in this way. We label these models as "lower south" and "upper south", respectively. Tables 4.3-4.6 show coefficients for provinces and age groups with the corresponding standard errors and p-values.

Determinant	coefficient	St.Error	p-value
Constant	-6.0016	0.0622	0.0000
Province:			0.0000
Krabi	0.0000		
Narathiwat	0.2440	0.0427	0.0000
Pattani	0.1610	0.0433	0.0002
Phuket	0.2714	0.0521	0.0000
Satun	0.0489	0.0540	0.3653
Yala	0.0868	0.0475	0.0677
Age group:			0.0000
0-4	0.0000		
5-9	-1.4396	0.1160	0.0000
10-14	-1.4468	0.1181	0.0000
15-19	-0.7233	0.0927	0.0000
20-24	-0.4035	0.0861	0.0000
25-29	0.2501	0.0726	0.0006
30-34	0.3955	0.0708	0.0000
35-39	0.3653	0.0727	0.0000
40-44	0.3850	0.0764	0.0000
45-49	0.4885	0.0785	0.0000
50-54	0.8292	0.0776	0.0000
55-59	1.2528	0.0733	0.0000
60-64	1.6373	0.0687	0.0000
65-69	2.2667	0.0655	0.0000
70-74	2.6885	0.0641	0.0000
75-79	3.1747	0.0669	0.0000
80-84	3.6032	0.0691	0.0000
85+	4.1594	0.0683	0.0000

Table 4.3: Model life table for six provinces for males

Determinant	coefficient	St.Error	p-value
Constant	-6.2705	0.0727	0.0000
Province:			0.0000
Krabi	0.0000		
Narathiwat	0.3217	0.0510	0.0000
Pattani	0.2256	0.0512	0.0000
Phuket	0.1941	0.0639	0.0024
Satun	0.0849	0.0649	0.1908
Yala	0.1076	0.0576	0.0618
Age group:			0.0000
0-4	0.0000		
5-9	-1.6271	0.1443	0.0000
10-14	-1.5841	0.1423	0.0000
15-19	-1.2566	0.1275	0.0000
20-24	-1.0208	0.1198	0.0000
25-29	-0.7113	0.1074	0.0000
30-34	-0.5387	0.1032	0.0000
35-39	-0.2550	0.0970	0.0086
40-44	-0.2085	0.1027	0.0423
45-49	0.3387	0.0930	0.0003
50-54	0.6076	0.0940	0.0000
55-59	0.8531	0.0929	0.0000
60-64	1.4665	0.0795	0.0000
65-69	2.1803	0.0746	0.0000
70-74	2.7027	0.0721	0.0000
75-79	3.1905	0.0745	0.0000
80-84	3.7084	0.0742	0.0000
85+	4.3162	0.0709	0.0000

Table 4.4: Model life table for six provinces for females

Determinant	coefficient	St.Error	p-value
Constant	-6.2918	0.0568	0.0000
Province:			0.0000
Chumphon	0.0000		
NakhonSiThammarat	-0.2001	0.0319	0.0000
Phang-nga	-0.1659	0.0495	0.0008
Phatthalung	-0.2515	0.0401	0.0000
Ranong	-0.3464	0.0633	0.0000
Songkhla	0.0439	0.0320	0.1700
Suratthani	-0.0482	0.0343	0.1606
Trang	-0.0981	0.0378	0.0094
Age group:			0.0000
0-4	0.0000		
5-9	-1.2191	0.1018	0.0000
10-14	-1.2479	0.1018	0.0000
15-19	-0.2038	0.0725	0.0049
20-24	0.3856	0.0650	0.0000
25-29	1.0128	0.0589	0.0000
30-34	1.0807	0.0585	0.0000
35-39	0.8847	0.0604	0.0000
40-44	0.7709	0.0631	0.0000
45-49	1.0923	0.0623	0.0000
50-54	1.2219	0.0640	0.0000
55-59	1.6232	0.0614	0.0000
60-64	2.0172	0.0590	0.0000
65-69	2.4369	0.0578	0.0000
70-74	2.8089	0.0575	0.0000
75-79	3.3421	0.0580	0.0000
80-84	3.8597	0.0591	0.0000
85+	4.3915	0.0580	0.0000

Table 4.5: Model life table for eight provinces for males

Determinant	coefficient	St.Error	p-value
Constant	-6.5352	0.0657	0.0000
Province:			0.0000
Chumphon	0.0000		
NakhonSiThammarat	-0.1520	0.0408	0.0002
Phang-nga	0.0782	0.0613	0.2020
Phatthalung	-0.1383	0.0491	0.0049
Ranong	-0.1468	0.0813	0.0709
Songkhla	0.1952	0.0409	0.0000
Suratthani	0.0447	0.0439	0.3081
Trang	-0.0965	0.0487	0.0476
Age group:			0.0000
0-4	0.0000		
5-9	-1.3829	0.1205	0.0000
10-14	-1.6064	0.1298	0.0000
15-19	-1.1519	0.1075	0.0000
20-24	-0.5069	0.0900	0.0000
25-29	0.0249	0.0770	0.7462
30-34	-0.0218	0.0778	0.7796
35-39	0.0135	0.0782	0.8628
40-44	-0.0281	0.0818	0.7311
45-49	0.2922	0.0801	0.0003
50-54	0.7615	0.0761	0.0000
55-59	1.0022	0.0753	0.0000
60-64	1.4532	0.0697	0.0000
65-69	1.9631	0.0667	0.0000
70-74	2.4317	0.0649	0.0000
75-79	3.0823	0.0641	0.0000
80-84	3.7130	0.0633	0.0000
85+	4.4877	0.0604	0.0000

Table 4.6: Model life table for eight provinces for females

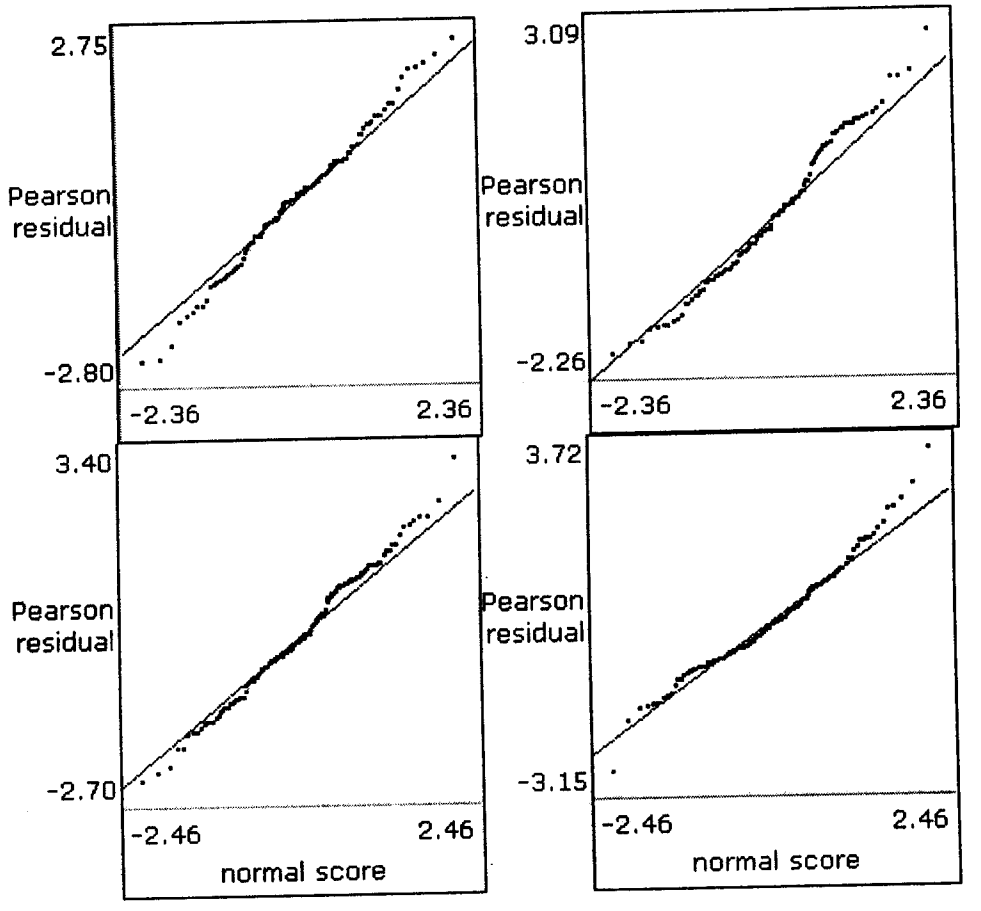


Figure 4.2: Plots of Pearson residuals from logistic models fitted to groups of six (upper) and eight (lower) Southern Thai provinces for males (left) and females (right)

Figure 4.2 shows the corresponding plots of Pearson residuals. The normal scores plots show an acceptable fit. Figure 4.3 shows plots of the mortality curves based on the four fitted model life tables. As expected, the male mortality is higher than that for females at all ages (although the curves must converge at age 85 because the mortality at this age encompasses all higher ages). The main difference between the "upper south" and "lower south" mortality curves is that for each gender the curve for the "lower south" model is smoother than that for the corresponding "upper south" model. The "upper south" curves show peaks at age 25 years whereas the "lower south" curves increase monotonically.

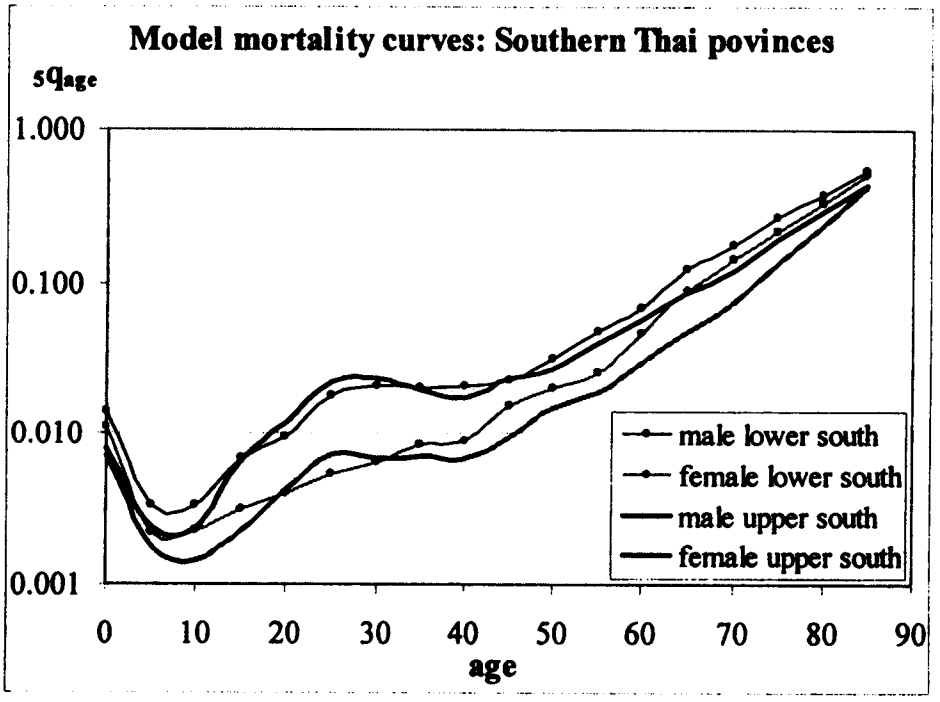
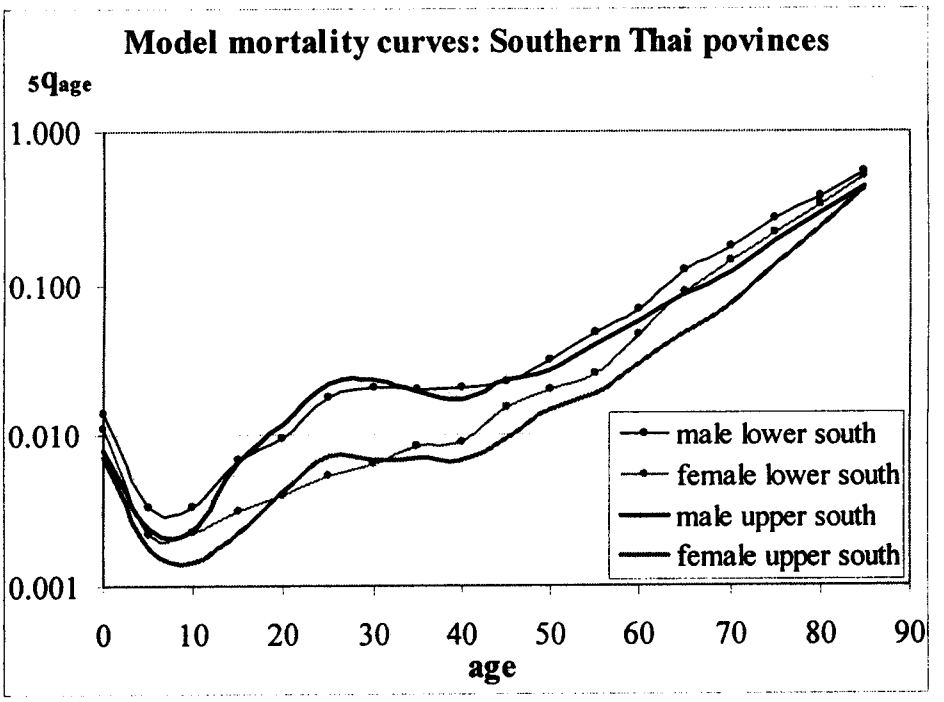


Figure 4.3: Age-specific mortality curves based on fitted logistic models

Figure 4.4 shows locally smoothed age-specific mortality curves for each group of provinces together with the corresponding model curve for the group. Allowing for statistical fluctuations in the data, the model curves fit reasonably well.

Figure 4.5 shows scatter plots of the province-specific parameters (b_j) for the two groups of provinces. Note that these are centered so that their average is 0 within each of the "upper south" and "lower south" groups of provinces. From this plot it is clear that Songkla and Narathiwat have relatively high mortality, whereas Ranong and Krabi have lower than average mortality levels.



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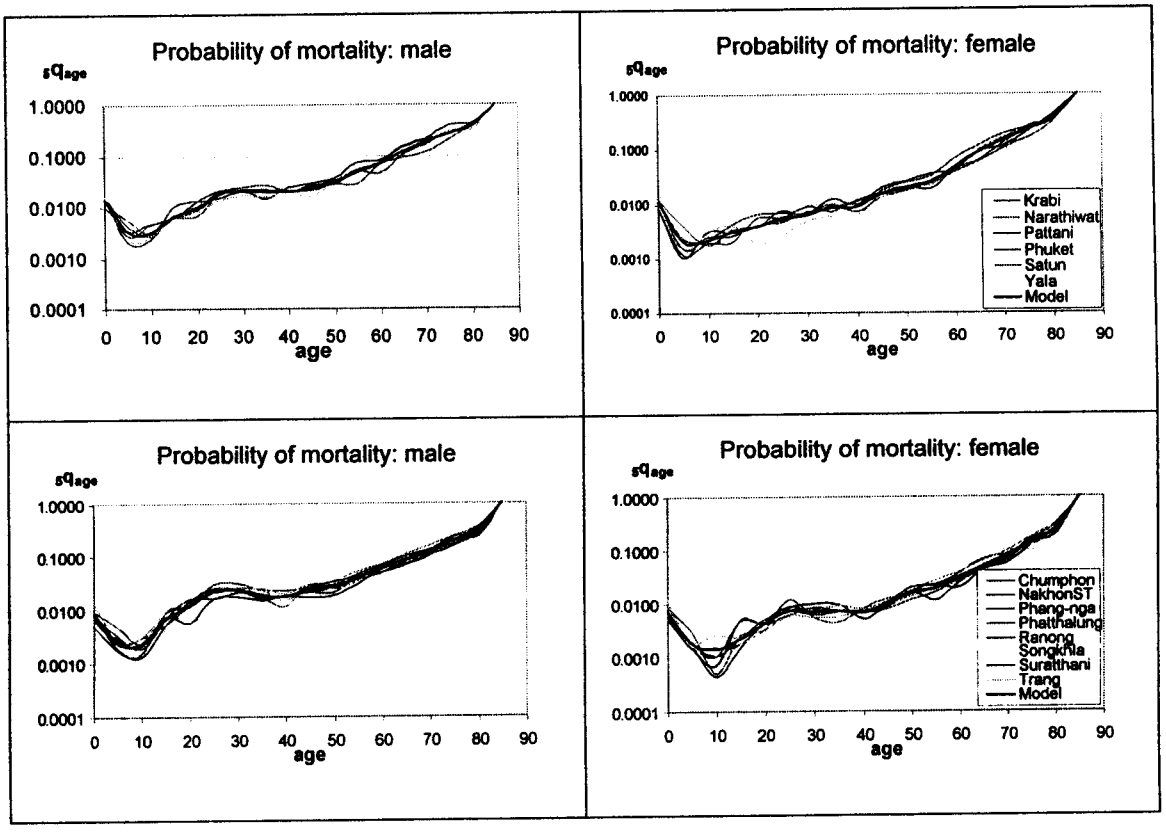

Figure 4.4: Age-specific mortality curves with the corresponding model curves

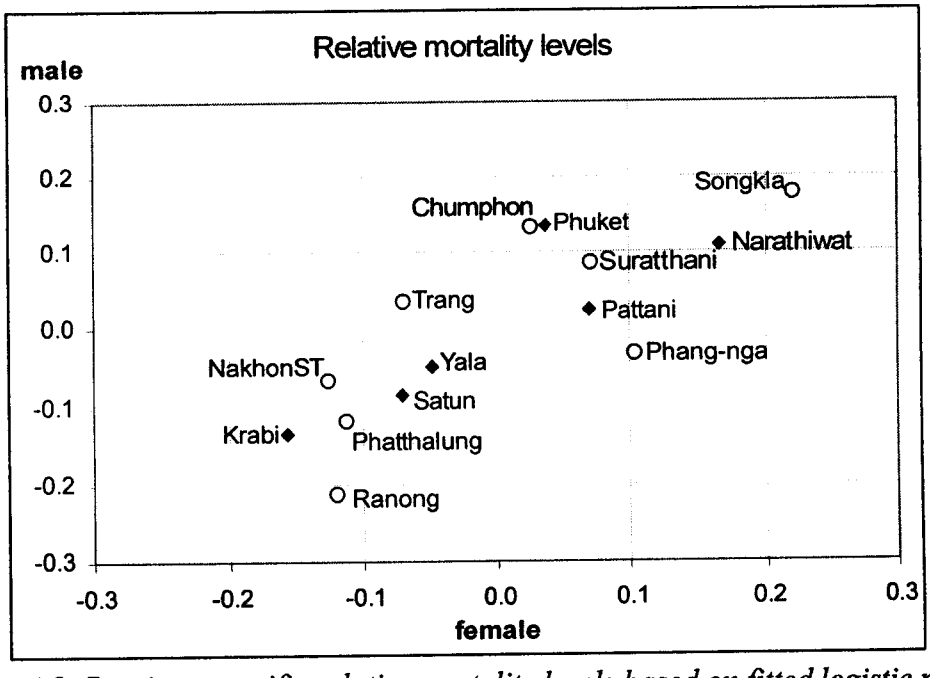

Figure 4.5: Province-specific relative mortality levels based on fitted logistic models