

Chapter 6

Applications

In this chapter, we apply our method to analyze the cancer mortality data year 2001 in Taiwan area. Our objectives are to find out whether there are high occurrences in Taiwan and the characteristic of the largest cluster if it really exists

We first divide our data into six categories determined by three age groups (aged below 50, aged between 50 and 64, aged above 65) and two sexes (male and female). There are 350 districts or townships within our study regions. Hence, each region is likely to have unusually high occurrences with the p-value smaller than significance level. Here, we take 0.05 as our significance level. So, if the region's p-value is smaller than 0.05, it is inferred to have unusually high occurrences. Since the sum of regions with unusually high occurrences is assumed to be binomially distributed, when this sum is more than $350 \times 0.05 + \sqrt{350 \times 0.05 \times 0.95} \approx 22$, we then conclude that there are clustering in the cancer mortality data.

6.1 Test of clustering

From table 6.2, we can make a conclusion that there are clustering in the cancer mortality data over all six categories. The following diagrams may give a clear picture for the readers. In Figure 6.1.1 to 6.1.6, the highlighted regions are those with unusually high occurrences.

For the male group, significant clustering occurs in 81 townships within the category of ages below 50; in 61 townships within the category of ages between 50 and 64; in 73 townships within the category of ages 65 and beyond. For the female group, significant clustering occurs in 51 townships within the category of ages below 50; in 30 townships within the category of ages between 50 and 64; in 41 townships within the category of ages 65 and beyond. Tables of townships with clustering in all six categories are given in Appendix C.

Probabilities of Observed Numbers of Cancer Mortality for Male aged below 50 in 2001

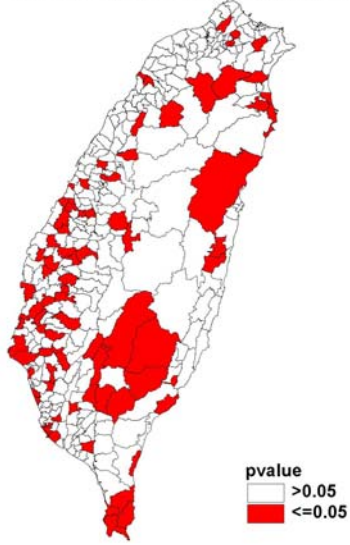


Figure 6.1.1

Probabilities of Observed Numbers of Cancer Mortality for Male aged between 50 and 64 in 2001

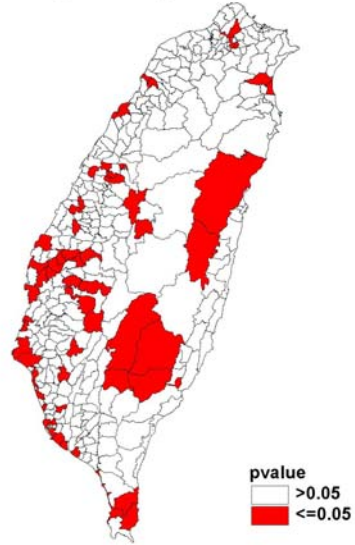


Figure 6.1.2

Probabilities of Observed Numbers of Cancer Mortality for Male Aged Above 65 in 2001

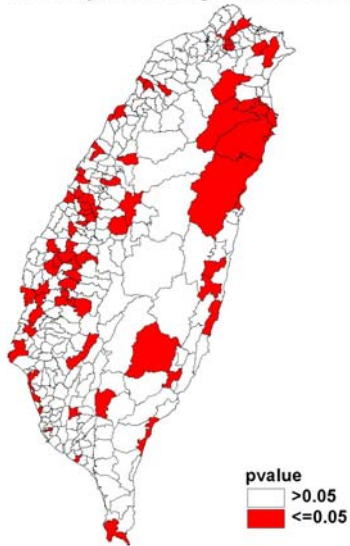


Figure 6.1.3

Probabilities of Observed Numbers of Cancer Mortality for Female aged below 50 in 2001

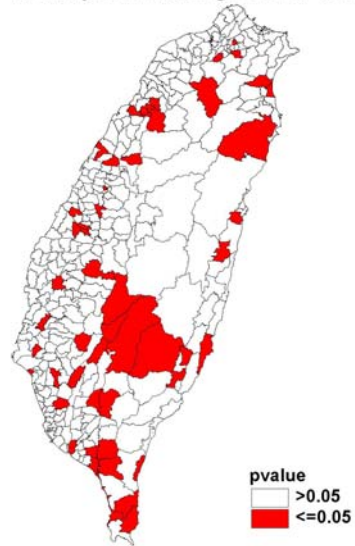


Figure 6.1.4

Probabilities of Observed Numbers of Cancer Mortality for Female aged between 50 and 64 in 2001

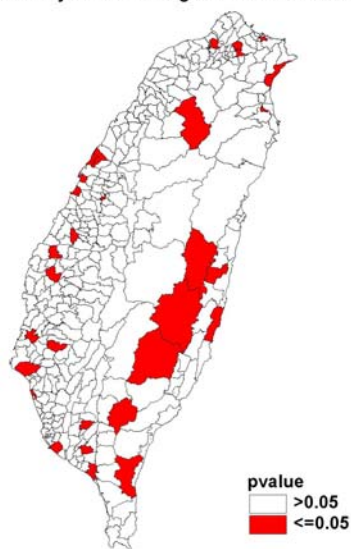


Figure 6.1.5

Probabilities of Observed Numbers of Cancer Mortality for Female Aged Above 65 in 2001

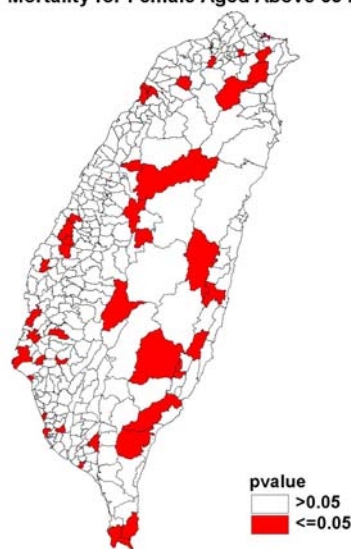


Figure 6.1.6

6.2 Detection of cluster

From the regions with unusually high occurrences found in section 6.1, we are interested in whether there is any cluster within these clustering regions. Based on the results by Monte Carlo simulations as mentioned in section 3.3, we conclude that there is an apparent cluster in the category of male ages 65 and beyond and the category of female category ages below 50. Figure 6.2.1 and 6.2.2 show the location of the cluster detected in the two categories respectively.

In category of male ages 65 and beyond, based on the maximum numbers of regions linked, an apparent cluster was found in the following townships: Douliu City, Dounan Township, Huwei Township, Siluo Township, Tuku Township, Lunbei Township, Yuanchang Township in Yunlin County; Dalin Township, Minsyong Township, Shueishang Township, Jhongpu Township in Chia-I County and West District in Chia-I City.

In category of female category ages below 50, based on the maximum numbers of regions linked, an apparent cluster was found in the following townships: Gukeng Township in Yunlin County; Alishan Township in Chia-I County; Jiasian Township, Taoyuan Township, Sanmin Township in Kaohsiung County; Luye

Township, Chihshang Township, Haiduan Township in Taitung County.

Category	Number of regions with unusually high occurrences	Maximum number of regions contained among the linked regions	Maximum size of the population at risk among the linked regions
Male, ages below 50	81**	9	601,566
Male, ages between 50 and 64	61**	9	890,079
Male, ages 65 and beyond	73**	12*	1,183,050
Female, ages below 50	51**	8*	259,664
Female, ages between 50 and 64	30**	4	365,500
Female, ages 65 and beyond	41**	4	206,555

Table 6.2: Results for Test of Clustering and Test for Detection of Cluster. Numbers Marked with “**” Indicate Significant Clustering Exists. Numbers Marked with “*” Indicate a Significant Cluster.

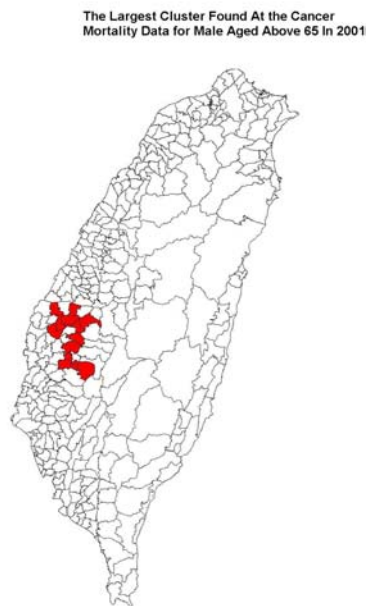


Figure 6.2.1

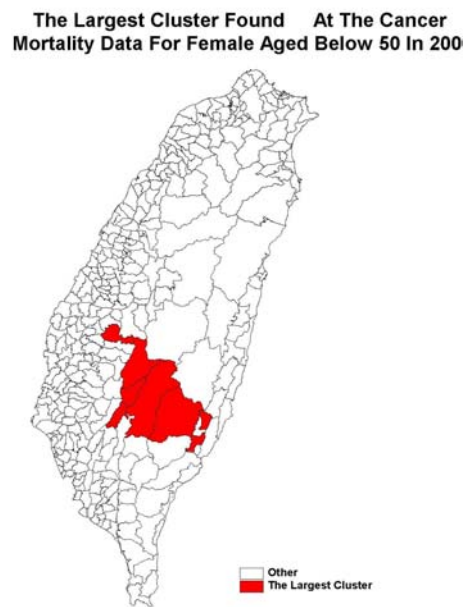


Figure 6.2.2

6.3 Discussions

From the results of test of clustering, Taiwan cancer mortality rate in the six categories above have a tendency of clustering. It is more obvious in some populous townships (e.g. townships in Yunlin County, Chia-I County) and mountain area (e.g. townships in Taitung County). These results give us a clear picture about the spatial pattern of the disease and the severity of the disease in the country. In Table 6.3, we show some statistics announced by Medical Association, Republic of China in the year 2001. Compare to Taipei City, the other three counties that possess high cancer mortality rate seems to have poor medical services. So, the authorities should take further investigation on these areas. Allocate more medical services in these areas is one of the essential steps to overcome the problems.

County/ City	Number of Medical Organizations	Number of Clinics	Number of Doctors/km ²	Population At Risk / Number of Doctors
Yunlin County	291	268	0.41	1410
Chia-I County	154	145	0.22	1344
Taitung County	103	94	0.06	1101
Taipei City	1184	1138	25.94	373

Table 6.3: Medical Allocation Information Announced by Medical Association, Republic of China in the Year 2001