บทความวิจัย

การสร้างตัวแบบความเสี่ยงจากการก่อการร้ายในจังหวัดชายแดนภาคใต้ของประเทศไทยระหว่างปี พ.ศ. 2547- 2548

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บทคัดย่อ

วัตถุประสงค์ของการศึกษาเพื่ออธิบายอัตราเสี่ยงการก่อการร้ายในจังหวัดภาคใต้ตอนล่างของประเทศไทยว่าเกิดได้อย่างไร ตามลักษณะของพื้นที่และเวลาของการเกิดเหตุการณ์ โดยใช้ข้อมูลที่เกิดขึ้นจริงจากการบันทึกของสำนักงานตำรวจแห่งชาติ (ส่วนหน้า) ภาค 9 ระหว่างปี 2004 ถึง 2005 ตัวแปรตามนิยามเป็นเหตุการณ์ที่เกิดจากการก่อการร้ายที่เกิดขึ้นในพื้นใด ๆ ครอบคลุมทุกอำเภอในจังหวัด นราธิวาส ปัตตานี ยะลา และอำเภอทางทิศตะวันตกของจังหวัดสงขลา ข้อมูลที่เกี่ยวของได้ถูกบันทึกเป็น เวลา วันที่ เดือน ปี ประเภทของเหตุการณ์ และสถานที่เกิดเหตุการณ์ ความรุนแรงของเหตุการณ์กำหนดเป็นจำนวนเต็มจาก 1 ถึง 9 อัตราเสี่ยงของเหตุการณ์สำหรับแต่ละตำบลในเฉพาะช่วงเวลา หาได้จากจำนวนเหตุการณ์ทั้งหมดที่บันทึกไว้ในแต่ละตำบลตามช่วงเวลา หารด้วยจำนวนประชากรที่อาศัย

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รับต้นฉบับ 25 กันยายน 2550 ปรับปรุง-แก้ไขตามข้อเสนอแนะของผู้ทรงคุณวุฒิ 10 ตุลาคม 2551
รับลงตีพิมพ์ 28 กันยายน 2552

อยู่ในตำบลต่อประชากร 1000 คน ซึ่งจำนวนประชากรดังกล่าวได้จากการสำมะโนประชากรของประเทศไทย ปี 2543 แผนที่และโมเดลทางสถิติวิเคราะห์ใช้ตัวแบบทวินามวิเศษ

ผลการศึกษา พบว่า ช่วงเวลาของการเกิดความรุนแรงบ่อยๆ จะเป็นเวลากลางคืนระหว่าง 2 และ 3 ทุ่ม และมักจะเป็น วันพุธและวันพฤหัสบดี อิทธิพลของช่วงเวลาชี้ให้เห็นว่าอัตราเสี่ยงมีแนวโน้มเพิ่มขึ้นจากระหว่าง ปี 2004 ถึง 2005 และอิทธิพลของสถานที่เกิดเหตุการณ์ก่อการร้ายมีการขยายตัวไปยังจังหวัดสงขลา กล่าวโดยสรุป การก่อการร้ายได้ขยายตัวและแผ่กว้างไปยังอำเภอใกล้เคียงและจะมีความรุนแรงมากขึ้น ดังนั้น กลยุทธ์การป้องเพื่อลดเหตุก่อการร้ายจะต้องทำโดยเร่งด่วนและกระทำไปพร้อมๆ กับการให้ความช่วยเหลือเยียวยาแก่ครอบครัวผู้ประสบเหตุในพื้นที่

คำสำคัญ: ความรุนแรง, จังหวัดชายแดนภาคใต้ตอนล่าง, เหตุการณ์ก่อการร้าย, อัตราเสี่ยง

RESEARCH ARTICLE

Terrorism Risk Modeling in Southern Border Provinces of Thailand during 2004 to 2005

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Abstract

This study aimed to describe how the risk rate of a terrorist event occurring in the population in southernmost provinces of Thailand depends on specific place and time, using actual data obtained from the Police Region 9 in 2004 and 2005. The outcome is defined as the terrorism incidents at any location in the provinces of Narathiwat, Pattani and Yala, together with the four westernmost districts of Songkla Province. The time, date, month, year and subdistrict where the event took place were recorded. The severity of the consequence of violence was coded as an integer from 1 to 9. The risk rate of events for each subdistrict in a specified period of time was constructed by dividing the total number of events recorded in the subdistrict over the period by the corresponding population resident in the subdistrict in 1000s according to the year 2000 Population Census of Thailand. Grid maps and statistical models were used to investigate the terrorist event rate distributed by location and time. The analytical method called "negative binomial regression" was employed.

The finding revealed that the most frequent violent periods were between 8 and 9 pm and the most likely days were Wednesdays and Thursdays. The period effects show a steadily increasing trend in the rate during 2004 stabilizing in 2005. The district effects revealed that terrorism incidents have expanded to the adjacent districts in Songkla. It is suggested that a suitable preventive strategy for reducing the incidence of terrorist events must be implemented in concert with a healing strategy for the victims' families in this region.

Keywords: terrorism incident, risk rate, severity, southernmost Thai provinces

Introduction

The southernmost provinces of Thailand comprise Pattani, Yala and Narathiwat. The region borders the Gulf of Thailand to the north and north-east, Malaysia to the east and south, and Songkla province of Thailand to the west. The total area of the three provinces is 1,962 square kilometers and 80 percent of the population is Muslim, with the remainder almost entirely Buddhist. The ethnicities of the population in this region are mixed. Thailand is a plural society comprising of widely different religious beliefs, diverse social traditions and culture. In southern Thailand, which comprises much of the upper part of the Malay Peninsula, several ethnic groups live together in a multicultural society, and a similar situation exists in western Malaysia, which comprises the southern part of the Malay Peninsula (Kounchart 2000). Pattani Kingdom was established during the conversion of the southern Malay Peninsula and the Indonesian Archipelago to Islam around the 11th century (Syukri 2005). Before they were conquered by Bangkok in 1786 and incorporated into the Kingdom of Thailand in 1902, the three southernmost provinces of Thailand had formed the independent sultanate of Pattani. For most of the 20th century the region was relatively peaceful, with Malay, Thai, Chinese, Muslims, Buddhists, and persons of other faiths including Christians able to practice their religion and live, attend school and work together in villages, towns and cities (Office of the National Security Council 1994).

However, just as scholars such as Rahimmula (2004) concluded that the Thai Government had pacified political tension in the south, the situation changed with a raid on a military base in Narathiwat by insurgents who stole a large quantity of weapons in early January 2004. Four soldiers were killed in this raid and twenty schools were set on fire around the same time. Since then, the insurgency has increased in strength and continued unabated, claiming more than 2000 lives.

The causes of the insurgency are complicated but to some extent understandable. The official language of the region is Thai, and the governmental structures are strongly influenced by upper South and Northern parts of Thailand. Such influences can alienate people in a predominantly Muslim region of the Kingdom. Some Muslims feel that they do not have an important place and status in their society (Stephen 1994). Muslims in Southern Thailand are faced with conflicting expectations and become uncertain of what they should do. They have experienced a situation where no clear rules are adopted. Some academics assume that Malay Muslims in this region can become easily influenced and unpredictable in their behaviour (Ua-amnoey 2005). Stronger identification with religion can then provide economic, social and political sustenance, as well as security.

The basic traditional culture and religion in the southernmost provinces are different from those common to the rest of Thailand. The terrorist activity in southern Thailand might be explained both by geography and what might be called an alienation factor. It is believed that the terrorists' enemy can be regarded as the Thai government and its representatives; for instance, government offices, the army, police force, public schools and their teachers, and the Buddhist temples and their monks. Actions against ordinary citizens are also usually seen as actions against the Thai government, because the government is responsible for security. These insurgent actions in turn prompt the government to act more strongly to ensure safety of life and property (Southern Border Peace Building Command 2005). In this way violent conflict escalates.

The situation that has developed in Southern Thailand has parallels in many other regions of the world that have experienced terrorist violence and insurgency in recent years, and much has been written in the press and in scholarly articles about the roots causes of these problems. Areas that have suffered similar conflicts in the past include Burundi, Canada, Cyprus, East Timor, Eritrea, India, Lebanon, Nigeria, Northern Ireland, Pakistan, South Africa, and Sri Lanka. Since 9/11 and the consequent invasion of Afghanistan and Iraq by the United States, the scope and intensity of terrorism has escalated all over the world (Moaward 2005).

Possibly the closest parallel case to the situation is Southern Thailand is provided by the conflict between the Tamil tigers and the government of Sri Lanka. This conflict has been going on for more than 25 years and shows no signs of reaching a satisfactory conclusion. An analysis of the causes of the violence was provided nearly 10 years ago by Stavenhagen (1998). Like the Muslims in Southern Thailand, the Tamils are a minority in Sri Lanka as a whole but comprise the majority ethnic-religious group in the north-east, where they settled more than 2000 years ago. The Tamils have their own language but this language is not recognized as an official language by the central government and is not used at all in public schools where Buddhism is the official religion and Buddhist culture prevails.

If the government is to be successful in providing safety and security for the people of southern Thailand it needs clear knowledge of patterns and trends in terrorist events. The aim of our study is to describe how the risk rate of terrorism incidents depends on the place and time, using actual data for 2004-2005. It is expected that use of this model will be a tool to assist the Thai government to find solutions of the violence in Southern Thailand.

This study aims to describe how the risk rate of terrorism incidents varied with respect to location and time in the population in the southernmost provinces of Thailand. The research objective is thus to develop a statistically valid model that identifies the locations where and the periods when the risk of such incidents is either substantially higher or lower than average, which in turn can provide the basis for studies aimed at developing strategies for preventing such incidents from occurring in the future.

Methodology

Data Acquisition

The terrorism incidents at targeted locations in the region in 4 provinces (all districts in the provinces of Narathiwat, Pattani and Yala, together with the four westernmost districts of Songkla Province) were obtained from Police Region 9 from the beginning of January 2004 to the end of December 2005. The hour of the day, date, and subdistrict where the incident took place were recorded. There are 37 districts and 290 subdistricts in this region. The outcome is the terrorism incidence by location and period in the region.

Statistical methods

In our study the outcome is defined as the terrorism incidents at any location in the region during the period from the beginning of January 2004 to the end of December 2005. The severity of the outcome was coded as an integer from 1 to 9 as given in Table 1.

Table 1 Classification of events by severity

Type of terrorist event	Severity
minor property damage	1
major property damage	2
psychological threat	3
vehicle trap or armed robbery	5
gun robbery/arrest of terrorist	6
serious fire or bombing injury	7
murder by shooting or road nail trap	8
murder by bombing or beheading	9

The region comprises all districts in the provinces of Narathiwat, Pattani and Yala, together with the four westernmost districts of Songkla Province. The hour of the day, date, and subdistrict where the event took place were recorded. There are 37 districts and 290 subdistricts in this region.

We computed the risk rate of events for each subdistrict in a specified period of time by dividing the total number of events recorded in the subdistrict over the period by the corresponding population resident in the subdistrict in 1000s according to the 2000 Population Census of Thailand. The average population of the 290 subdistricts was 6694, but these populations varied substantially. Six subdistricts had populations greater than 20,000 (Sateng, SatengNok and Betong in Yala Province with 73,077, 24,745 and 23,531 residents, respectively, BangNak and SungaiKolok in Narathiwat Province with 42,010 and 37,671 residents, respectively, and Sabarang in Pattani Province with 23,702 residents). At the other extreme, nine subdistricts had fewer than 2000 residents, the smallest being Tachi in Yala Province with 1288 residents.

Since the research question involves studying how the risk of a terrorist event depends on various factors including the time of day, the day of the week, the month of the year and the district or subdistrict in the region, we focused on the rate of occurrence of such events with respect to an appropriate denominator reflecting the corresponding population at risk.

As a preliminary analysis, we used MapInfo Version 6.5 (MapInfo Corporation 2001) to create thematic range maps based on event rates per year in subdistricts. The maps were coloured using five bands with graduated 0-255 scaled (red, green, blue) amounts, namely, (1) less than 0.5 events per 1000 per year (255 red, 208 green, 232 blue), (2) 0.5 to 0.5 (255, 144, 200), (3) 0.5 to 1 (255, 64, 160), (4) 1 to 1.5 (255, 0, 0) and (5) 1.5 or more (80, 0, 0). Since such thematic maps show fluctuations due to unpredictable random variations, we then created grid thematic maps based on smoothing the range maps with IDW (inverse density weighted) interpolator (cell size, exponent, search radius) settings (0.25 miles, 4, 20 miles), creating contours using the same colour bands centered at (0.25, 0.65, 1, 1.5 and 2) events per 1000 per year. We also considered event rate increases from 2004 to 2005, starting with a range map based on four specified bands, namely (1) less than -0.2 events per 1000 per year (255 red, 255 green, 208 blue), (2) -0.2 to 0.2 (0, 255, 0), (3) 0.2 to 0.75 (255, 0, 0) and (4) 0.75 or more (80, 0, 0), and finishing with a grid map using the same IDW interpolator settings centered at increases of (-0.5, 0, 0.5 and 1) events per year.

The statistical methods comprise of comparison of proportions including Pearson's chi-squared test, and generalized linear models for analyzing risks including Poisson and negative binomial regression (Venables and Ripley 1999). If we assume that the event occurrences are described by a Poisson or negative binomial process with mean l_{it}, where i denotes place (district, say) and t denotes period, the model takes the form

$$\ln(\lambda_{it}) = \ln(P_i/1000) + \mu + \alpha_i + \beta_t \qquad (1)$$

where P_i is the population of place i. For the Poisson distribution the variance is the same as the mean, whereas the negative binomial distribution is relatively over dispersed, having variance $l_{it}(1+l_{it}/q)$. The negative binomial model is thus the special case of the Poisson model arising in the limit as q tends to infinity.

The overall goodness-of-fit of the model may be assessed by using Pearson's chi-squared test to compare the residual deviance (defined as -2 times the difference in the log-likelihood between the fitted model and a saturated model that fits the data perfectly) with the number of degrees of freedom (defined as the sample size minus the number of fitted parameters). A more detailed analysis of the goodness-of-fit that highlights individual anomalies involves graphing 'deviance residuals' against corresponding quantiles from a standardized normal distribution. We used the R statistical system (Venables and Smith, 2004) for statistical model fitting, plotting confidence intervals and assessing goodness-of-fit.

Results

Preliminary Analysis

Table 2 shows the numbers of events recorded in the region by severity in each of the two years. Overall, there was an increase of approximately 50% from 2004 to 2005. Over 50% of the events (56% in 2004 and 53% in 2005) resulted in at least one fatality.

The daily incidence of events varied substantially over the two-year period, with a maximum of 126 events recorded on 26 October 2005. Relatively high incidences of events were recorded as well on 9 June 2005 (96 events), 22 April 2004 (76 events) and 31 August 2005 (67 events). No events were recorded on 47 days. Figure 1 shows the maximum and minimum numbers of events for each week (Monday to Sunday). The curve in this graph plots the average numbers of events in successive weeks.

Table 2 Classification of events by severity in each year

	Event severity								
year	**1**	**2**	**3**	**5**	**6**	**7**	**8**	**9**	**Total**
2004	54	36	2	62	34	458	700	125	1471
2005	72	130	35	166	162	483	906	260	2214
Total	**126**	**166**	**37**	**228**	**196**	**941**	**1606**	**385**	**3685**

Table 3 shows the incidences of events by month for each year. Over the two-year period, the proportions of events were higher in the March-June and October-November periods. However, this seasonal effect is not the same for the two years, with lower proportions in March, April and December in 2005 than in 2004, and correspondingly higher proportions in May and June. To confirm the analyses, Pearson's independence test is employed for the association between month and year gives a chi-squared statistic of 243.2 with 11 degrees of freedom, $p < 0.0001$.

Tables 4 and 5 show the distributions of events by hour of day and by day of the week. The most frequent periods were between 8 and 9 pm (13.7% and 11.8%, of the total, respectively, compared with an average of 4.5% for other hours of the day). The most likely days were Wednesdays and Thursdays (18.3% and 20.0% of events, respectively, compared with 12.3% events on average for other days). These differences revealed such highly statistical significance, all giving p-values less than 0.0001 when assessed using Pearson chi-squared test for uniformity.

Figure 2 shows grid maps of the regional distributions of event rates for 2004 and 2005, whereas Figure 3 shows the corresponding grid maps for the average event rate over the two years 2004-2005 (left panel), and for the increase in this rate from 2004 to 2005 (right panel). The distributions of the event rates in the bands used to create the thematic range maps underlying these grid maps are given in Table 6.

Table 3 Event incidence by month for each year

	Month of Year												
Year	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Total**
2004	56	81	181	221	87	91	88	106	82	152	174	152	1471
2005	117	137	157	154	254	300	161	195	136	270	261	72	2214
Total	173	218	338	375	341	391	249	301	218	422	435	224	3685
Percen	4.7	5.9	9.2	10.2	9.2	10.6	6.8	8.2	5.9	11.4	11.8	6.1	100.0

Table 4 Events by hour of day reported (1 = 12-1 etc; time unavailable for 151 events)

Hour	1	2	3	4	5	6	7	8	9	10	11	12	Total
am	78	90	67	85	88	76	172	210	188	129	105	105	1393
pm	88	76	75	81	118	128	176	485	416	230	149	119	2141
Total	166	166	142	166	206	204	348	695	604	359	254	224	3534

Table 5 Events by day of week reported

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Total
479	443	676	739	511	395	442	3685
(13.0)	(12.0)	(18.3)	(20.0)	(13.9)	(10.7)	(12.0)	(100.0)

Table 6 Distributions of event rates in 2004 and 2005

Range	2004	2005	Average 2004-05	Range	Increase 2004-05
0 to 0.25	50	50	50		
0.25 to 0.50	62	40	62	-1.27 to -0.20	69
0.50 to 1.00	59	69	93	-0.20 to 0.20	63
1.00 to 1.50	64	44	39	0.20 to 0.75	81
1.50 or more	55	87	46	0.75 or more	77
Maximum	4.29	5.73	5.01	Maximum	4.33

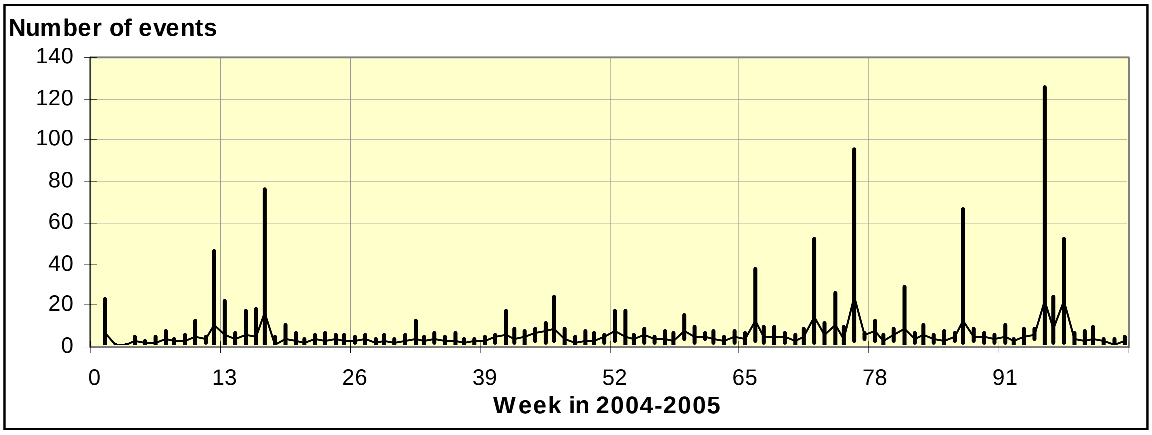

Figure 1 Minimum and maximum numbers of events by week

These maps show that the 50% increase rate of the incidence from 2004 to 2005 was not uniformly distributed over the region, but concentrated in the already high incidence area in 2004. The subdistricts in Songkla Province and those bordering Malaysia appear to have decreased terrorism event rates from 2004 to 2005. At the other extreme, there were two focal points from which the event rate grew substantially from 2004 to 2005, one in the northeastern wing of Yala Province bordering both Pattani Province to the north and Narathiwat Province to the south, and the other in central Narathiwat Province. Each of these focal points expanded to form large clusters of subdistricts with event rates above 1.75 per 1000 per year, centered at northeastern Yala and in central Narathiwat. Smaller clusters of increased growth occurred in subdistricts along the Pattani River in central Yala and southern Pattani.

Statistical Modeling

The preliminary analysis shows large variations in the numbers of events occurring in successive time periods. The daily incidences were highly volatile, and aggregating the data by month fails to smooth out these fluctuations. However, the spatial variations appear to be more regular. The objective in the statistical modeling is to combine these temporal and spatial effects and thus arrive at a formula that can be used to describe, at least approximately, the rate at which events occur in a specified place over a

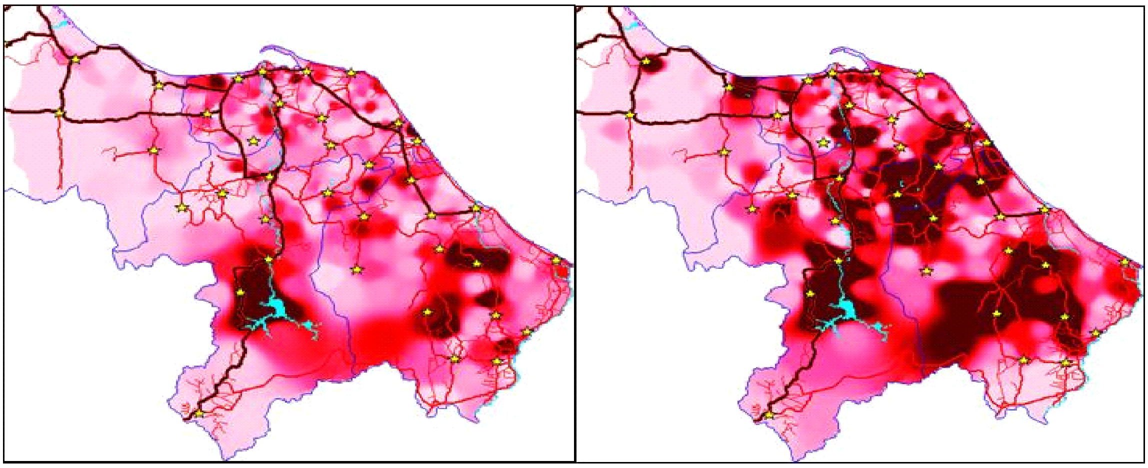

Figure 2 Grid maps for overall event rates per 1000 population in subdistricts in 2004 (left panel) and 2005 (right panel), with major roads and towns shown.

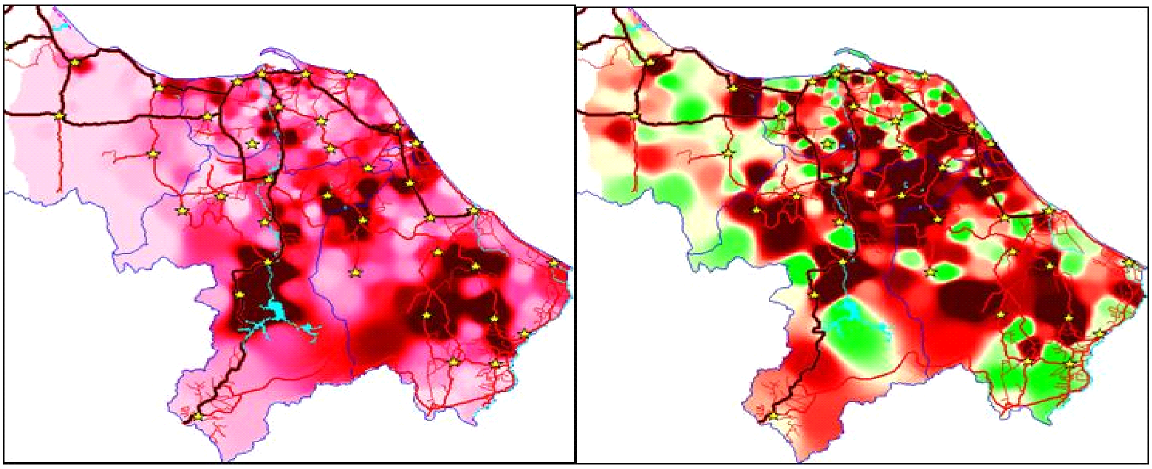

Figure 3 Grid maps for event rates based on subdistricts for 2004-2005 (left panel) and for the increase from 2004 to 2005 (right panel)

specified period of time. This model thus involves parameters associated with these spatial and time effects, and these parameters should be geared to reflect the corresponding variation in event occurrences.

Given the relative variations in these event occurrences shown in Table 3 and Figures 2 and 3, the model we consider in this section (specified in Equation 1) uses two-month periods as the time periods and districts to describe the spatial location.

The residual deviance obtained after fitting the Poisson model is 914.0 with 396 degrees of freedom, indicating substantial overdispersion. The negative binomial model with q estimated as 7.81 (standard error 1.16) gives the much reduced residual deviance of 494.1, and thus provides a better fit to the data.

Figure 4 shows various plots based on fitting the negative binomial model to the observed event rates for 2-month periods in districts for 2004-2005. The top left plot shows observed counts vs model-

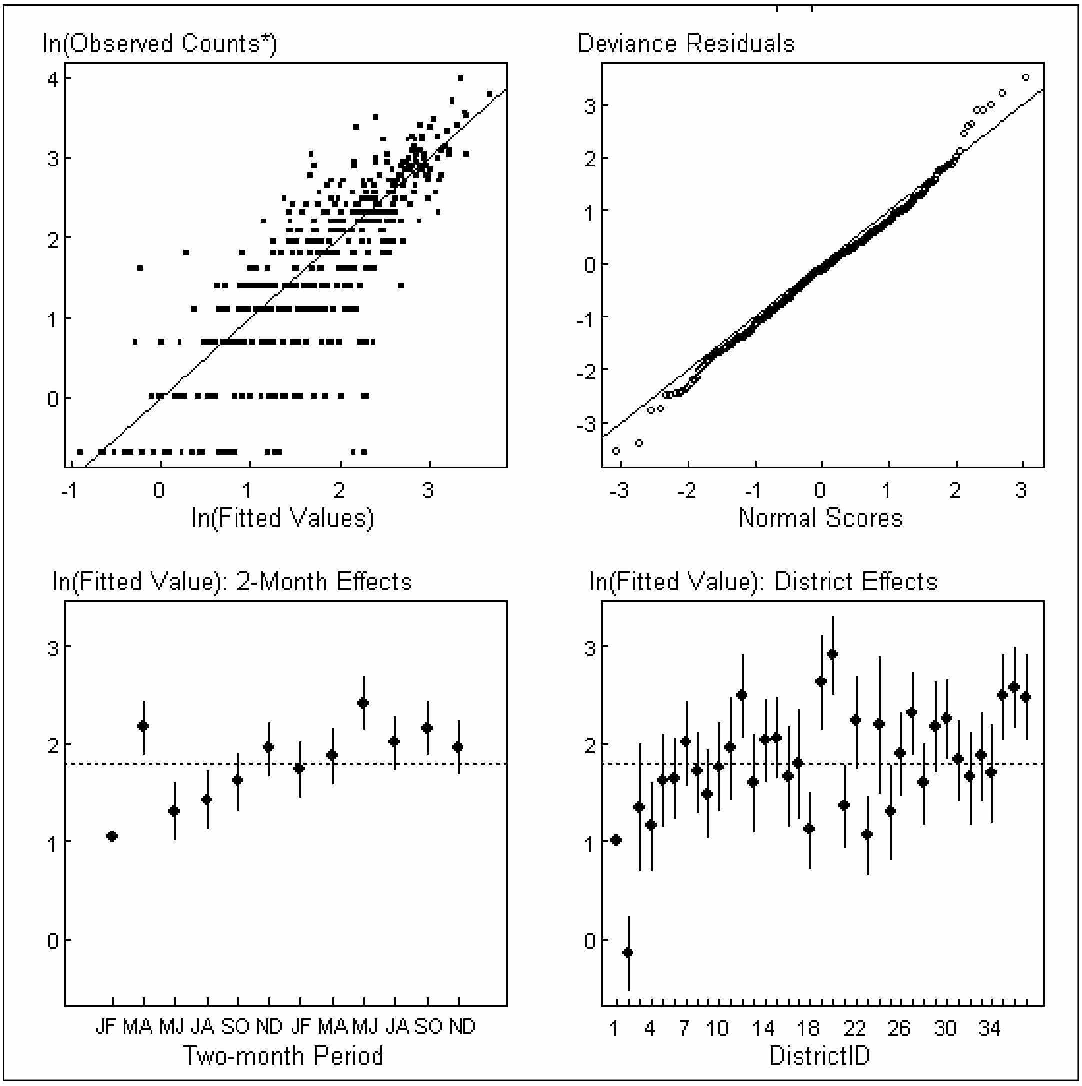

Figure 4 Results from fitting negative binomial model to event rates in districts in 2- month periods (* Zero counts are replaced by 0.5 to avoid logarithms of 0)

fitted counts, both expressed as logarithms. The top right plot shows deviance residuals vs normal scores. The lower plots show 95% confidence intervals for the period effects and the district effects, each expressed on a log scale as differences from the baseline values (Jan-Feb 2004 and District 3 in Songkla, respectively). The overall mean is shown as a dotted line in these plots.

The residual plot shows some departure from the straight line indicating a perfect fit, due to a small number of high outliers. These correspond to the clustering of events already identified in Figure 1. The period effects show a steadily increasing trend in the rate during 2004 stabilizing in 2005, with the exception of a high peak in March-April 2004 and a less pronounced peak in May-June 2005. The district effects confirm the pattern seen in the left panel of Figure 3. District 4 in Songkla has a comparatively low value as expected, given that on 14 events were reported in this district during the 2-year period: the next highest is District 3 in Songkla with 74 reported events.

Discussion and Conclusion

The daily incidence of events varied substantially over the two-year period, with a maximum of 126 events recorded on 26 October 2005. Relatively high incidences of events were recorded as well on 9 June 2005, 22 April 2004 and 31 August 2005. The most frequent periods were between 8 and 9 pm, and the most likely days that incidents occurred were Wednesdays and Thursdays. The period effects show a steadily increasing trend in the rate during 2004 stabilizing in 2005, with the exception of a high peak in March-April 2004 and a less pronounced peak in May-June 2005. The terrorist event occurrences had expanded to the adjacent districts in Songkla. A suitable method for prevention and solving of the terrorist events must be implemented urgently together with healing the victim's families in this region.

While this study provides an answer to the question of where and when the risk of terrorist incidents was high during the two-year study period, further data are now available for three more years, and it would be interesting to see to what extend the patterns have continued in more recent years. It is also important to recognize that this study only answers the questions of where and when increased terrorism incidence has occurred, and does not address the question as to why these rates vary with respect to place and time. Further studies are needed to correlation our results with social indicators such as unemployment, varying educational completion, school non-attendance, and demographic disparities in these indicators.

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