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Appendix A

Additional Regression Results

Table 6.1.2 Results of Regression Analysis
(including variables: [1]API91 and [2]ABER92)

Dependent variable: ΔLogAPI92

Variables	Coefficient	Standard error	Sig T
Constant	4.545	3.252	0.1679
API91	-0.170	0.013	0.0000
ABER91	-0.157	0.039	0.0002
ABER92	-0.167	0.040	0.0001
NEXP	-0.001	5.505E-04	0.0166
DOCT	7.644E-04	1.132E-04	0.5024
NURS	-9.248E-04	6.302E-04	0.1480
HBED	-0.002	0.001	0.2191
AVIN	2.555E-04	8.491E-05	0.0040
GPP	1.807E-06	6.340E-06	0.7768
EDUC	-1.152	0.341	0.0014
FARM	0.028	0.022	0.1933
PDEN	-2.174E-04	5.891E-04	0.7137
FSIZ	-1.026	0.722	0.1607
FRST	0.039	0.014	0.0093
TEMP	0.011	0.024	0.3703
RAIN	-3.580E-04	3.595E-04	0.6624
TELE	-0.009	0.006	0.1291
CAR	0.010	0.002	0.0000
R Square	0.92	Observations: 45	
Adjusted R Square	0.89		

Note: (1) Lagged Annual Parasite Incidence Rate(1991)
(2) Annual Blood Examination Rate, 1992

Table 6.1.3 Results of Regression Analysis
(excluding variables: [1]API91 and [2]ABER91)

Dependent variable: ΔLogAPI92

Variables	Coefficient	Standard error	Sig T
Constant	2.107	1.266	0.7379
ABER92	-0.144	0.023	0.0563
NEXP	-0.001	0.001	0.2745
DOCT	1.279E-04	2.237E-04	0.5698
NURS	-0.001	0.001	0.1352
HBED	-0.003	0.002	0.2273
AVIN	1.218E-04	1.656E-04	0.4648
GPP	-9.096E-06	1.248E-05	0.4693
EDUC	-0.454	0.615	0.0641
FARM	0.041	0.043	0.3382
PDEN	-5.185E-06	0.001	0.9965
FSIZ	0.607	1.409	0.6681
FRST	0.082	0.026	0.0023
TEMP	0.124	0.045	0.5634
RAIN	-0.003	7.213E-04	0.1584
TELE	0.124	0.045	0.3152
CAR	0.019	0.004	0.0762

R Square	0.67	Observations: 45
Adjusted R Square	0.58	

Note: (1) lagged Annual Parasite Incidence Rate(1991)
(2) lagged Annual Blood Examination Rate(1991)

Table 6.1.4 Correlation Matrix

	ABER91	ABER92	NEXP	DOCT	NURS	HBED
ABER91	1.0000	.9742	.1943	.0009	-.0743	-.0913
ABER92	.9742	1.0000	.1790	-.0158	-.0822	-.0972
NEXP	.1943	.1790	1.0000	-.0153	-.1062	-.1310
DOCT	.0009	-.0158	-.0153	1.0000	.8094	.8906
NURS	-.0743	-.0822	-.1062	.8094	1.0000	.8285
HBED	-.0913	-.0972	-.1310	.8906	.8285	1.0000
AVIN	-.2303	-.1979	-.0774	-.6793	-.5110	-.4840
GPP	-.1374	-.1167	-.0644	-.3704	-.2372	-.1465
EDUC	-.1925	-.1104	-.0330	-.4722	-.3710	-.2832
FARM	.0957	.0885	.0064	.6968	.6122	.5947
PDEN	-.1984	-.1803	-.0429	-.2406	-.1690	-.1332
FSIZ	-.0185	-.0081	.0320	.5455	.3204	.5186
FRST	.6305	.5862	.0788	.0359	.0499	-.0652
RAIN	.4499	.4469	.0541	.0555	-.0381	-.0178
TEMP	.2817	.2670	-.0788	.1279	.0981	.0773
TELE	.0654	.0260	-.0011	.8124	.6792	.7158
CAR	.2862	.2646	.0102	.7482	.5871	.6981
API91	.6942	.7337	.1028	-.0921	-.1177	-.1421

	AVIN	GPP	EDUC	FARM	PDEN	FSIZ
ABER91	-.2303	-.1374	-.1925	.0957	-.1984	-.0185
ABER92	-.1979	-.1167	-.1104	.0885	-.1803	-.0081
NEXP	-.0774	-.0644	-.0330	.0064	-.0429	.0320
DOCT	-.6793	-.3704	-.4722	.6968	-.2406	.5455
NURS	-.5110	-.2372	-.3710	.6122	-.1690	.3204
HBED	-.4840	-.1465	-.2832	.5947	-.1332	.5186
AVIN	1.0000	.7412	.7636	-.8432	.6380	-.4790
GPP	.7412	1.0000	.5919	-.6557	.5808	-.3540
EDUC	.7636	.5919	1.0000	-.5279	.5513	-.2023
FARM	-.8432	-.6557	-.5279	1.0000	-.4949	.5534
PDEN	.6380	.5808	.5513	-.4949	1.0000	-.2405
FSIZ	-.4790	-.3540	-.2023	.5534	-.2405	1.0000
FRST	-.2883	-.2334	-.3219	.1524	-.2660	-.0904
RAIN	-.1124	-.0889	.0221	.1012	-.0813	.1951
TEMP	-.1773	-.1410	-.0418	.2186	-.0751	.1353
TELE	-.7088	-.4472	-.4507	.7341	-.2528*	.5007
CAR	-.6592	-.3708	-.3535	.6854	-.2095	.5512
API91	.0034	-.0197	.0172	-.0789	-.0889	-.1017

	FRST	RAIN	TEMP	TELE	CAR	API91
ABER91	.6305	.4499	.2817	.0654	.2862	.6942
ABER92	.5862	.4469	.2670	.0260	.2646	.7337
NEXP	.0788	.0541	-.0788	-.0011	.0102	.1028
DOCT	.0359	.0555	.1279	.8124	.7482	-.0921
NURS	.0499	-.0381	.0981	.6792	.5871	-.1177
HBED	-.0652	-.0178	.0773	.7158	.6981	-.1421
AVIN	-.2883	-.1124	-.1773	-.7088	-.6592	.0034
GPP	-.2334	-.0889	-.1410	-.4472	-.3708	-.0197
EDUC	-.3219	.0221	-.0418	-.4507	-.3535	.0172
FARM	.1524	.1012	.2186	.7341	.6854	-.0789
PDEN	-.2660	-.0813	-.0751	-.2528	-.2095	-.0889
FSIZ	-.0904	.1951	.1353	.5007	.5512	-.1017
FRST	1.0000	.2826	.2871	.0770	.1065	.2799
RAIN	.2826	1.0000	.7448	.0685	.0909	.5042
TEMP	.2871	.7448	1.0000	.1443	.1478	.1557
TELE	.0770	.0685	.1443	1.0000	.7715	-.0496
CAR	.1065	.0909	.1478	.7715	1.0000	-.0135
API91	.2799	.5042	.1557	-.0496	-.0135	1.0000

Appendix B

Interfacing economic/health/disease data to formulate the combined database for analysis

1. The need of database interfacing

Since the economic, health and disease data are coming from different sources, the characteristic of these data are different in terms of the level(e.g. economic data: household record; health data: provincial level; malaria data: by region, zone and sector) and timeframe(e.g. economic: once two years; malaria: every month). In order to make analysis of interactions among the factors of socioeconomic, health and disease, interfacing these data are the basic steps.

2. Methods of interfacing economic, health and disease databases

The structure of Regional System records includes a core portion and a "program" portion for more extensive information about particular kind of cases (e.g. malaria). The system will have a standard Regional system record format, customized country input and reporting formats, but with as much standardization as possible to promote efficiency and allow communication of data between countries. This standard format database will be monthly and provincially based for Thailand. The methods of interfacing economic/health/disease databases are as follows:

2.1 Convert two-year economic data to standard format

steps:

1. generate province records through average of household data
2. create summary economic databases for 1986, 1988,1990, 1992 from household databases in these years
3. estimate economic data in the years between surveys (e.g. 1987,1989) using average, e.g. income, 1987 - average the income of 1986 and 1988.
4. covert yearly data to monthly data by using methods of:
   - 4.1. repetition - all monthly data are simply equal to that year average
   - 4.2. the equal step method

   e.g. income(1986): 20,000 Baht,
   income(1987): 26,000 Baht,
   different between 1986 and 1987: 6,000Baht
   step Δ = 6,000 Baht / 12 Months = 500 Baht

The estimation of income for each month in 1986:

Jan. 1986: 20,000
Feb. 1986: 20,500
Mar. 1986: 21,000
Apr. 1986: 21,500
May 1986: 22,000
June 1986: 22,500
July 1986: 23,000
Aug. 1986: 23,500
Sep. 1986: 24,000
Oct. 1986: 24,500
Nov. 1986: 25,000
Dec. 1986: 25,500

4.3. linear growth method

Historical data are provided from time period Y_1 to Y_n, this period of sampling will be used to build a forecasting model and forecast the values which are out-of-sample.

e.g. using trend forecasting method for estimating the average income in Jan. 1993. The data sample are from Jan. 1988 to Dec. 1992.

Estimating a time trend line by specifying a bivariate regression model of the form

$$Y_t = \alpha + \beta t + \varepsilon$$

where

Y_t = actual value of the time-series variable

t = time = 1,2,3,...,n;

ε = random error in time period t.

The forecast values for $Y_t\hat{}$ are determined by estimating the regression coefficients for a and b and then solving the equation for each value of t:

$$Y_t\hat{} = a + bt$$

if we got from regression analysis:

$$Yt\hat{} = 16,000 + 200t$$

then for the time 1993.01, t = 61

estimated income will be: $Y_{1993.01}$ = 28,200 Baht

2.2 Convert health care data to standard format

Steps:

1. create province records by summary health care units data
2. create data base for each year
   - repetition
   assume health indicators are constant in these years
   - linear growth
   assume these health factors increase with a constant rate
3. create health database by month by province
   - repetition
   assume health factors are constant within one year

2.3 Convert malaria data to standard format

Steps:

1. classify the malaria sectors to each of province
   e.g. Tak Province includes malaria sectors 3 and 7.
2. create malaria database by province by month by summary the malaria case in involved sectors

2.4 create integrated economic-health-disease database

Based on the above conversions, the integrated database will be generated by merging these three converted database by province.

3. Selected Indicators of integrated economic-health-disease database:

Socioeconomic indicators:

1. Population structure
2. consumption expenditure
3. Income
4. Source of income
5. Occupation
6. Level of education(head of household)
7. Size of household
8. Composition of household
9. Gender of each member
10. Sector of production
11. Land/residence ownership
12. Province
13. Region
14. Community..city/village
15. Number of TV, radio, refrigerator

Health indicators:

1. Mortality rate (age specific)
2. Life expectancy
3. Infant mortality rate
4. Maternal mortality rate
5. Number/distribution of health personnel
6. Number/distribution of health facilities
7. Nutrition status
8. Sanitation (Latrines/household)

Disease: Malaria

Other indicators:

1. Water supply
2. Area
3. Distance
4. Number of telephone
5. Number of private telephone
6. Electricity
7. GPP (by sector of production)

Environment indices:

1. Rainfall
2. Humidity
3. Temperature
4. Forest area

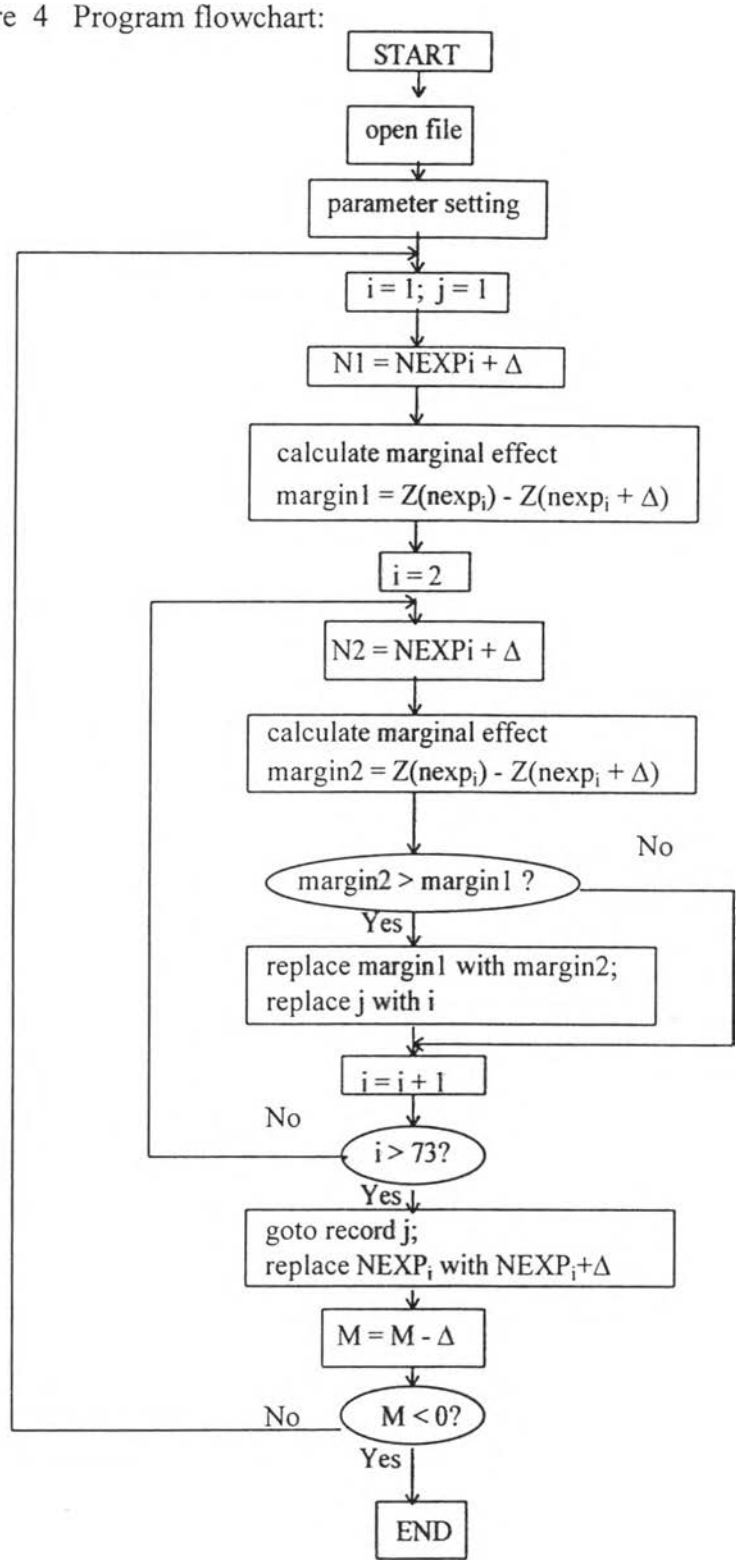
Appendix C
Computer program to calculate the efficient level of health resource distribution

$Z = \sum CASE_{92i}$

Minimize $Z = (1+g) \bullet \sum CASE_{91i} \bullet e^{a+b \bullet NEXPi}$

subject to: $M = \sum NEXP_i, \quad \forall i$

Figure 4 Program flowchart:



```
**** Dbase Program for searching the efficient level of  health resource ****
**** distribution among provinces, Thailand *****
**** Program Name:  efficent.prg ****
**** Database Name: efficent.dbf ****
******************** 73 records (provinces) in the database *****
*** the lines starting with '*' are notes, will not excuted *****

clear all
set talk off

use efficent

*** initial parameter setting ***
replace all nexp with 0
Delta=1000000
M=22729437658
b=-0.000003212

*** Start searching and updating ***
do while M-Deltor>=0
*** give the start value of marginal effect ***
go top
i=1
j=1
n1=nexp+Delta
M=M-Delta

temp1_1=a+b*n1/popu
temp1_2=a+b*nexp/popu

z1_1=case91*exp(temp1_1)
z1_2=case91*exp(temp1_2)

*** condition for number of cases greater or equal zero ***
margin1=z1_2-z1_1
if z1_1<0
  replace mark with 1
endif

i=2

*** select the province which the unit budget allocated ***
*** will have the greatest marginal output(cases reduced) *

do while i<74
go i
if mark=1
```

```
  i=i+1
  loop
endif

n2=nexp+Delta
temp2_1=a+b*n2/popu
temp2_2=a+b*nexp/popu

z2_1=case91*exp(temp2_1)
z2_2=case91*exp(temp2_2)

margin2=z2_2-z2_1

if margin2>margin1
  store margin2 to margin1
  store i to j
 if z2_1<0
  replace mark with 1
 endif
endif

i=i+1
enddo

*** add the unit budget to the province which the marginal ***
*** output is the greatest, continue to test another unit ***
*** budget allocation ***

goto j
replace nexp with nexp+Delta

enddo
*** finish searching and updating when all budget distributed ***

*** estimate the number of case, when the budget allocated ***
*** most efficiently ***

go top
do while .not.eof()
temp3=a+b*nexp/popu
replace y92_eff with case91*exp(temp3)
replace api92_eff with y92_eff*1000/popu
skip
enddo

*** end the program ***
RETURN
```

Biography

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