

# Modeling of decision support system for tourism resources evaluation based on UML

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**Abstract.** Using the relevant data of nine cities in Fujian province from 2000 to 2015, this paper uses the panel threshold regression model to study the relationship between tourism development and poverty alleviation. The results show that the tourism development in Fujian province has “double threshold effect” on poverty alleviation. (1) Tourism development can significantly reduce poverty alleviation in underdeveloped areas; In the middle region of economic development, tourism development has significant negative effect on poverty alleviation. In the developed regions, tourism development contributes to poverty alleviation, but the role is not significant. (2) With the tourism resources endowment as threshold variable, tourism development has a significant positive effect on poverty alleviation and shows a gradual upward trend. In the poor region, the coefficient is 0.0279 %; In the medium region of tourism resources, the coefficient of action is 0.0610 %, and the tourism resources area, the coefficient of action rises to 0 %.

**Key words.** Tourism development, Poverty reduction effect, Threshold.

## 1. Introduction

Tourism has the advantages of long industrial chain, low employment threshold and strong driving capability etc. Developing tourism is an important means to develop ecological civilization construction and implement poverty alleviation strategy. As the first ecological civilization pilot site of China, tourism of Fujian Province is developed rapidly. Tourist income of the whole province increased from RMB 30.5 billion in 2000 to RMB 314.4 billion in 2015, and proportion of tourist income in GDP increased from 8.1% in 2010 to 12.1% in 2015 with rise of 4 percent points. As a province of China with relatively good economic development, Fujian Province has made great achievements in poverty reduction since the reform and opening-

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up. Seen from poverty data published by Poverty Relief and Development Office of Fujian Agricultural Department, from 1986 to 2015, nearly 4 million impoverished people decreased accumulatively according to poverty relief standards of different periods. During “the 12th Five-year Plan”, poverty relief and development objects of Fujian Province decreased from 1.4 million to 0.452 million in 2015, and incidence of impoverished people at rural area decreased from 5.42% in 2010 to 1.65% in 2015, which was closely concerned with a series of poverty relief policies implemented by central government and local government of Fujian Province. Special Plan for Poverty Relief and Development in “the 13th Five-year Plan” of Fujian Province proposes that tourism poverty relief shall be developed, and promoting tourism development and promoting poverty relief and development become one of main tasks for development of current and future economic society of Fujian Province. Based on it, this paper tries to verify whether tourism development can promote poverty reduction obviously and whether poverty reduction effect of tourism is characterized by heterogeneity at areas with different economic development levels in the same province by taking 9 cities of Fujian Province between 2000-2015 as research objects, which is of great significance for each city of Fujian Province to develop policy on tourism poverty relief and promote poverty reduction.

## 2. Model setting and data sources

### 2.1. Model setting

To verify relationship between tourism development poverty reduction, following panel data model shall be constructed firstly:

$$POV_{it} = \mu_i + \beta_1 TOUR_{it} + \gamma X_{it} + \varepsilon_{it}, \quad (1)$$

Where, POV is poverty level; TOUR is tourism developmental level; X is other control variable affecting poverty reduction; i and t respectively represent area and time;  $\mu_i$  represents area effect not observed;  $\varepsilon_{it} \sim iid(0, \sigma^2)$  represents random disturbance term.

According to the above content, poverty reduction effect of tourism is complex, under different conditions, based on difference of action mechanism and poverty reduction effect, non-linear relationship may exist between tourism development and poverty reduction, and economic development and tourism resource will affect tourism development greatly, and they will affect poverty reduction effect of tourism under certain conditions, thus making poverty reduction effect present non-linear characteristics. The research respectively extends panel data model as multiple threshold panel regression models taking economic development level (PGDP) and tourism resource endowment level (RES) as threshold variables according to construction idea of threshold regression model proposed by Hasen (1999):

$$POV_{it} = \beta_1 TOUR_{it} I(PGDP \leq \eta_1) + \beta_2 TOUR_{it} I(\eta_1 < PGDP \leq \eta_2) + \dots + \beta_{n+1} TOUR_{it} I(PGDP > \eta_n) + \gamma_j X_{itj} + \mu_i + \varepsilon_{it} \quad (2)$$

$$POV_{it} = \beta_1 TOUR_{it} I(RES \leq \eta_1) + \beta_2 TOUR_{it} I(\eta_1 < RES \leq \eta_2) + \dots + \beta_{n+1} TOUR_{it} I(RES > \eta_n) + \gamma_j X_{itj} + \mu_i + \varepsilon_{it} \quad (3)$$

Where,  $\eta_1, \eta_2 \dots \eta_n$  respectively represent the 1st, 2nd,  $\dots$  and the Nth threshold values;  $I(PGDP \leq \eta_1)$  and  $I(RES \leq \eta_1)$  etc. represent different sections of economic development level and tourism resource endowment level, and if threshold variable meets the condition, then value of indicator function is 1 and otherwise it is 0; POV is used to measure strength of poverty reduction; TOUR represents tourism development level; PGDP represents threshold variable for economic development level; RES represents threshold variable for tourism resource endowment level; X is other control variable affecting poverty reduction; i and t respectively represent area and year;  $\mu_i$  represents area effect not observed;  $\varepsilon_{it} \sim iid(0, \sigma_2)$  represents random disturbance term. Control variable specifically contains urbanization level (CITY), industrial structure (INS), trade openness (FDI), educational level (EDU) and financial support strength (GOV) etc.

## 2.2. Selection of variable

(1) Explained variable. Most existing research achievements use index calculated based on poverty threshold as proxy variable to measure poverty level, such as poverty incidence, FGT index and sen index etc., which is weakly applicable to each city of Fujian Province. The reason is that Fujian Province belongs to province of China with good economic development, and its poverty incidence is relatively low; because there is no uniform standard for demarcation of poverty threshold, difference of poverty threshold at different periods is relatively great, and above index value will change greatly because of difference on selection of poverty threshold. The research obtains value of POV index to measure poverty level by referring to methods of Guo Xibao and Luo Zhi (2008)[17], Yang Xia and Liu Xiaoying (2013) [18], and  $POV = \text{rural per capita net income} * \text{rural population proportion} + \text{urban per capita total incomes} * \text{urban population proportion}$ .

(2) Core explaining variable. This research adopts tourism development level (TOUR) as proxy variable measuring tourism development, adopting ratio between international tourism income and GDP as tourism development level.

(3) Threshold variable. Seen from relevant research literature, tourism development is affected and restricted by numerous factors, of which economic development level and tourism resource endowment size are main influence factors. Economic development level decides tourism supply capability and demand level of the area.

(4) Control variable. Urbanization level (CITY), industrial structure (INS), trade openness (TRA), educational level (EDU) and financial support strength (GOV) are selected as control variables, of which urbanization level (CITY) is represented by proportion of urban population in total population; educational level (EDU) is measured by the number of senior high school student attending school in 10000 people; industrial structure (INS) is represented by proportion of added value of tertiary industry in GDP.

### 2.3. Data sources and processing

Sample selected in this research is data information of 9 cities of Fujian Province between 2000-2015. Description on data acquisition and processing is as follows: (1) total export-import volume is converted according to exchange rate at that year; (2) to eliminate effect of price factor in statistical data, absolute index value (poverty level and per capita GDP) is converted by CPI index (year of 2000 is taken as base period); (3) relevant statistical data used in this paper is sourced from Fujian Statistical Yearbook between 2001-2016, statistical yearbook of each city and national economy and social statistical bulletin of each city; (4) natural logarithm of absolute index value shall be obtained to avoid effect of dimension and heteroscedasticity. (See table 1)

Table 1. Descriptive statistics on variable

Variables	Definition	Mean value	Standard deviation	The mini-mum value	The maxi-mum value	Sample size
POV	ln (rural per capita net income* rural population proportion+ urban per capita disposable income * urban population proportion)	9.028448	0.485066	8.097941	10.31941	144
TOUR	International tourism income of each area/GDP	1.138772	1.214288	0.008691	4.935331	144
CITY	Urban population / the total number of population	0.342106	0.150936	0.11298	0.81395	144
EDU	Senior high school student attending school in 10000 people	188.4631	41.16413	78.22	283.56	144
INS	Added value of tertiary industry /GDP	0.379487	0.055765	0.269143	0.55707	144
GOV	Financial expenditure /GDP	0.093966	0.034145	0.021961	0.187872	144
TRA	Total export-import volume /GDP	0.378995	0.565689	0.015747	2.324687	144
PGDP	Ln (per capita GDP)	10.00734	0.626977	8.78966	11.1963	144

## 3. Empirical result and analysis

### 3.1. Verification of threshold effect

Economic development level and tourism resource endowment level are taken as threshold variables firstly, and aimed at null hypothesis of multiple thresholds, model (2)-(3) are estimated, to obtain F-statistics and p value, which is as shown in table 2. Result shows that when economic development level is taken as threshold variable, single threshold effect and double threshold effect of tourism development are

obvious under 1% significance level; when tourism resource endowment level is taken as threshold variable, single threshold effect for poverty reduction of tourism development is unobvious and double threshold effect is obvious under 1% significance level.

Table 2. Verification result of threshold effect

Model	Threshold variables	
	Economic development level (PGDP)	Tourism resource endowment level (RES)
Single threshold	34.010***(0.005)	15.852(0.160)
Double threshold	22.544***(0.000)	95.495***(0.000)

Note: numerical values within table are F-statistics corresponding to threshold verification, and what is within bracket is p value, being result obtained after 200 repeated sampling with bootstrap method; \*\*\* represents significance under 1% significance level.

Threshold values of economic development level and tourism resource endowment level are respectively recognized. Table 3 reports estimated value of threshold and its corresponding 95% confidence interval. Through likelihood ratio function graph in Fig.1, threshold value estimation and confidence interval construction process can be understood in clearer way. Imaginary line in the Fig. is critical value of LR value under 10% significance level; area below imaginary line constitutes 90% confidence interval of threshold value. As shown in Fig.1, when economic development level is taken as threshold variable, LR statistical magnitude approaches to 0 within 90% incrementally effective confidence interval [9.531,9.605] and [10.425,10.613]. It is impossible for verification result to refuse that estimated value of threshold is null hypothesis of its true value with the same estimator. Therefore it can be concluded that double threshold effect exists in model estimation and 2 estimated values of threshold respectively are 9.584 and 10.529. Similarly, when tourism resource endowment level is taken as threshold variable, it can be concluded that double threshold effect also exists in model estimation and 2 estimated values of threshold respectively are 0.282 and 2.479.

Table 3. Estimated values of threshold and its confidence interval

Index	Economic development level (PGDP)		Tourism resource endowment level (RES)	
	Estimated value of threshold	95% confidence interval	Estimated value of threshold	95% confidence interval
The first threshold	9.584	[9.531,9.605]	0.282	[0.248,0.511]
The second threshold	10.529	[10.425,10.613]	2.479	[2.352,2.606]

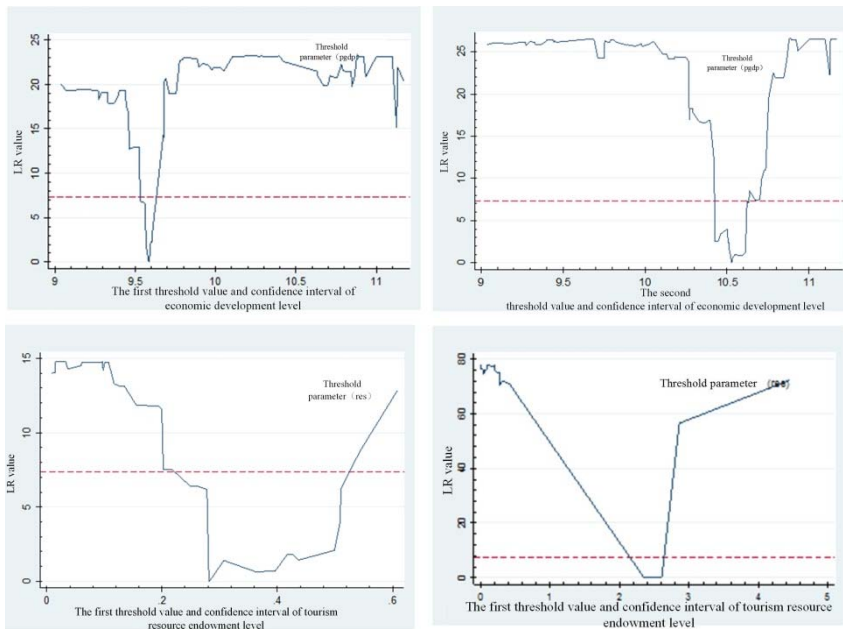


Fig. 1. Estimated values of threshold and its confidence interval

### 3.2. Analysis to estimated result of threshold

In conclusion, threshold effect verification results of tourism poverty reduction on economic development level and tourism resource endowment level refuse null hypothesis of linear relation, and threshold effect of tourism poverty reduction under double threshold model passes significance testing. Therefore it can be judged that under effect of 2 threshold variables, i.e. economic development level and tourism resource endowment level, poverty reduction effect of Fujian Province for tourism development has non-linear characteristic. According to threshold effect verification results and estimated result of threshold of 2 threshold variables, i.e. economic development level and tourism resource endowment level, relationship between tourism development and poverty reduction is respectively surveyed within different zone systems, and result is as shown in table 4. In addition, to compare poverty reduction effect of tourism development in overall level and within different zone systems, table 4 reports estimation result of linear individual fixed effect model simultaneously. Result shows that effect of tourism development on poverty reduction in model (1) passes significance testing and its estimated value of coefficient is negative obviously, which shows that tourism development of Fujian Province is not beneficial to poverty reduction, and seen from threshold estimation model (2) and (3), tourism development has non-linear characteristic to poverty reduction, and therefore, once measurement model is set as linear model (1) by mistake, unpredictable deviation may appear in measurement result. For example, effect of tourism development on poverty reduction is  $-0.353002$  in linear model (1), while coefficient value can be

positive or negative in non-linear model (2) with non-linear characteristics.

Table 4. Estimated results of fixed effect model and threshold estimation model

Variables	Fixed effect model		Threshold estimation model	
	(1)	(2)	(3)	(3)
CITY	1.38235***(13.34)	1.207***(12.05)	0.651***(6.26)	
EDU	0.0005808***(3.9)	0.00106***(6.83)	0.000933***(5.58)	
TRA	-0.0601451(-1.24)	-0.349***(-11.1)	0.157***(2.85)	
GOV	3.464168***(8.55)	3.664***(8.53)	2.654***(6.66)	
INS	1.033761***(4.88)	0.337***(2.03)	0.900***(3.69)	
PGDP	0.4740716***(22.68)	0.462***(20.76)	0.536***(25.22)	
TOUR	-0.0353002***(-2.75)			
TOUR1(PGDP≤9.584)		0.0341***(2.81)		
TOUR2(9.584<PGDP≤10.529)		-0.0328**(-2.43)		
TOUR3(PGDP>10.529)		0.0113(0.59)		
TOUR1(RES≤0.282)			0.0454***(4.56)	
TOUR2(0.282<RES≤2.479)			0.0808***(5.85)	
TOUR3(RES>2.479)			0.178***(10.37)	
Constant term	3.047089***(14.78)	3.461***(16.14)	2.524***(11.36)	

Note: what is within bracket is t value, and \*, \*\* and \*\*\* respectively represent significance under 10%, 5% and 1% significance level.

Table 5. Distribution table on economic development level and tourism resource endowment level of 9 cities of Fujian

Cities	<i>PGDP</i> ≤ 8.584	9.584 < <i>PGDP</i> ≤ 10.529	<i>PGDP</i> >10.529	<i>RES</i> ≤ 0.282	0.282 < <i>RES</i> ≤ 2.479	<i>RES</i> >2.479
Fuzhou		2000-2010	2011-2015	2000-2008	2009-2015	
Xiamen		2000-2002	2003-2015	2000-2001	2002-2008	2009-2015
Quanzhou	2000-2001	2002-2009	2010-2015	2000-2008	2009-2015	
Zhangzhou	2000-2006	2007-2013	2014-2015	2000-2010	2011-2015	
Putian	2000-2005	2006-2013	2014-2015	2000-2012	2013-2015	
Sanming	2000-2005	2006-2011	2012-2015	2000-2014	2015	
Longyan	2000-2005	2006-2011	2012-2015	2000-2015		
Nanping	2000-2007	2008-2015		2000-2015		
Ningde	2000-2007	2008-2015		2000-2013	2014-2015	

Result of model estimation of tourism development poverty reduction effect taking economic development level as threshold variable shows that effect of tourism development of Fujian Province on poverty reduction presents staged response double threshold characteristics based on economic development level. Specific performance of the characteristic is that when economic development level value of an

area is lower than threshold value 9.584, tourism development has obvious positive promotion effect on poverty reduction with 0.0341 influence coefficient; when economic development level value is between threshold value 9.584 and 10.529, effect of tourism development on poverty reduction is obvious negative effect with -0.0328 influence coefficient; when economic development level value exceeds threshold value 10.529, effect of tourism development on poverty reduction turns to be unobvious. In a word, tourism development poverty reduction effect is relatively obvious at area with relatively low economic development level, and developing tourism will be quite beneficial to poverty reduction; tourism development has obvious negative effect on poverty reduction at area with intermediate economic development level; tourism development has no obvious effect on poverty reduction at economically developed area. The reason lies in that tourism is the result when market economy is developed into a certain stage, and it has outstanding comprehensive driving effect; threshold for employees to tourism is relatively low, and at economically undeveloped area, once tourism is developed, local residents can be employed locally, thus driving income growth of individual and the family; but when economy is developed into a certain stage, original tourism employees will be saturated gradually, and when tourism is developed further, it will depend on other industries multiply, which will become important factor restricting tourism development poverty reduction effect, and therefore, tourism development is not beneficial to poverty reduction at area with intermediate economic development level; but at economically developed area, tertiary industry is developed rapidly, drive effect of other service industries excluding tourism on income is manifested increasingly, and tourism development has positive effect on poverty reduction but the effect is not obvious.

## 4. Research conclusion and policy suggestions

### 4.1. *Research conclusion*

Based on panel data of 9 cities of Fujian Province between 2000-2015, using panel threshold regression model proposed by Hansen (1999), and respectively taking economic development level and tourism resource endowment level as threshold variables, this paper verifies non-linear relationship between tourism development and poverty reduction. Research finds that under the effect of above 2 threshold variables, tourism poverty reduction effect of Fujian Province has obvious threshold characteristics. Specific performance is: (1) tourism development promotes poverty reduction obviously at economically undeveloped area; tourism development has obvious negative effect on poverty reduction at area with intermediate economic development level; tourism development is beneficial to poverty reduction at economically developed area but the effect is not obvious. (2) Tourism resource endowment has obvious positive effect on poverty reduction and the more developed the tourism is at an area, the more obvious the poverty reduction effect will be. The coefficient is 0.0279 at area with primary tourism resource endowment; effect coefficient is 0.0610 at area with medium tourism resource and effect coefficient increases to 0.156 at area with advanced tourism resource endowment, which means that tourism development



presents ladder-form continuous increase characteristic to poverty reduction.

#### 4.2. Policy suggestions

To promote tourism development better and promote poverty reduction, following policy suggestions are proposed by combining with research results of this paper:

Scientifically understand dynamic relationship between tourism development and poverty reduction. Poverty reduction effect based on tourism development has double threshold characteristics, and at initial economic development stage, tourism development can promote poverty reduction obviously; but when economy is developed into a certain stage, with appearance of tourism enclave and tourism leakage, tourism development has obvious negative effect on poverty reduction; but at stage when economy is relatively developed, tourism poverty reduction is not obvious. Therefore each area shall develop tourism development plan scientifically according to physical truth of local economic development, and reasonably promote and dynamically adjust tourism poverty alleviation policy. At present, 9 cities of Fujian Province mostly are at the third stage of economic development, tourism development has certain positive effect on poverty reduction but the effect is not obvious, and policy intervention shall be implemented to tourism development trend and accurate poverty alleviation policy shall be taken to ensure tourism poverty alleviation effect.

Reasonably develop tourism resource and promote tourism poverty alleviation. Result of this research shows that the richer the tourism resource is at an area, the stronger the tourism poverty reduction effect will be with ladder-form increase trend. Fujian is located at south-east coastal areas, and is one of important forest zones of the south with 65.95% forest coverage rate, occupying the first place in China, and it has superior natural conditions and rich forest resources and tourism resource. In 2015, Fujian Province introduced Scheme for Implementation of Rural Tourism Poverty Alleviation Project of Fujian Province (2016-2020), taking total image brand of "fresh Fujian" as core, being devoted to give play to comprehensive driving effect of tourism, and strengthening endogenous power for development of poor areas. Each area can reasonably plan and develop tourism resource by combining with local physical truth, so as to make tourism become important approach to develop regional economy and realize poverty reduction.

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