Study on Meteorological Service Model Optimization

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• I . Improvement of efficiency evaluation model

• II. Contingent valuation method

 Meteorological service is a kind of service offered by meteorologists to the society. World meteorological organization convened a special technology seminar themed meteorological and hydrological socio-economic benefit in Geneva in March 1990.125 scholars from 67 countries discussed four themes, one of which is assessment method of socio-economic benefit in meteorology and hydrology.

- In September 1994, a second meeting was convened in Geneva; it pointed out benefit evaluation was important and valuable, was also a difficult subject.
- Experts and scholars analyzed and evaluated socio-economic benefit from different perspectives, but because of the difficulty to define its ownership and various factors affecting its ultimate benefit, there have not been a commonly-recognized evaluation method or model.

• At present, there are two main methods:

measuring increased benefit and reduced loss by practical investigations and analyses

calculating benefits by theoretical analyses and using mathematical models I.Theoretical basis and method of public meteorological service benefit assessment

1.Theoretical basis-WTP

On the basis of "cost –benefit analysis" theory and utility theory in microeconomics (WTP) is adequate to be used to measure the values of goods (service)), and. Consumer's degree of satisfaction depends on the number of consumed goods (service)

so satisfaction (U) can be expressed:

• utility function must meet

 $\frac{\partial W}{\partial a} = 0$

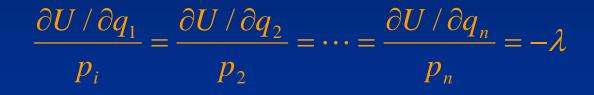
$$L = \sum_{i=1}^{n} p_i \cdot q_i$$

• The main conditions for the existence of Lagrange extreme value are:

 $\frac{\partial U}{\partial q_i} = -\lambda p_i$

 $W = U + \lambda L$

that rations of the marginal utility of all items to their prices are equal



expressed as:

$$U_i = \int_{p_i}^q \cdot dq_i$$

2. Three main methods of quantitative assessment

• (1) Paying voluntarily

$$\mathbf{W} = P \bullet \sum_{i=1}^{t} \frac{M_i}{N_i} \sum_{j=1}^{n} C_j \bullet B_{ij}$$

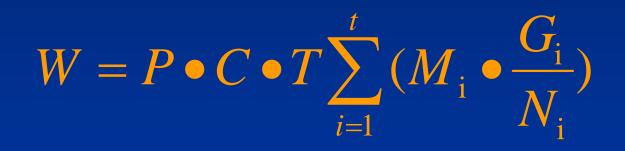
- W- is the benefits of meteorological services
- P- is correction coefficient, usually defined as national television coverage
- Mi- is the population over 15years old of ith investigation area
- Ni- is the population of ith valid questionnaires
- Cj- is median of jth payment grade
- Bij- is the number of people who will pay the jth payment grade in ith area.

(2) Cost saving





• (3) Shadow price



II. Amendment of public meteorological service benefit evaluation model

1.Amendment of correction coefficient P P=0.9658

2.Adjustment of shadow price C

3.Redefinition of G_i

forecast									
Options	Once	Once	Once	Twice	Three	Others			
	per	every	per day	per day	times				
	week	three			per				
		days			day				
Number	7515	13999	98352	38503	14003	2069			
Proportion	4.31%	8.03%	56.38%	22.07%	8.03%	1.19%			

Table1. The number of public listening to (watching) weather forecast

From table1, we know that 88% of the public listen to (watch) weather forecast over one time per day.

$$\frac{7515 \times \frac{1}{7} + 13999 \times \frac{1}{3} + 98352 \times 1 + 38503 \times 2 + 14003 \times 3 + 2069 \times 4}{7515 + 13999 + 98352 + 38503 + 14003 + 2069} \approx 1.33$$

So the new frequency is 1.33, multiplying the population of ith area, we will get a new value of Gi.

III. Empirical analysis-calculation of paying voluntarily

 According to data from China statistics Yearbook 2008, we know P=0.9658, M=1328.02 million, N=44828. With data from questionnaires, formula can be expressed as:

W = P •
$$\sum_{i=1}^{t} \frac{M_i}{N_i} \sum_{j=1}^{n} C_j \cdot B_{ij} = 68.15$$
亿元/年

IV. Contingent valuation method

 There are four design patterns which are bidding game (BG), open-ended (OE), payment card (PC) and dichotomous choice (DC), in this paper, we use DC to infer average WTP.

V. Dichotomy logistic model

Suppose that indirect utility function is

• their corresponding utility functions are $U_{0} = V(q_{0}, y, s) + \varepsilon_{0}$ $U_{1} = V(q_{1}, y, s) + \varepsilon_{1}$

• So its probability is $P(\text{accept}) = P[V(q_1, y - BID, s) + \varepsilon_1 \ge V(q_0, y, s) + \varepsilon_0]$

 Take the highest bidding as integral upper limitation, and lowest bidding as lower limit of integration, we can get

$$WTP_{mean} = \int_{BID_{max}}^{BID_{max}} \frac{e^{\alpha' + \beta' S + \lambda BID}}{1 + e^{\alpha' + \beta' S + \lambda BID}} dBID = \frac{1}{\lambda} \ln \frac{1 + e^{\alpha' + \beta' S + \lambda BID_{max}}}{1 + e^{\alpha' + \beta' S + \lambda BID_{min}}}$$

VI. Calculation of the value of public meteorological service

- In this paper, we uses dichotomy design pattern, and calculate the value of public meteorological service with WTP.
- Survey results show that public WTP has relation with socio-economic conditions and the status of meteorological service, such as: age, sex, family average monthly earnings, education level and degree of satisfaction of metrological service.

 Table2.
 Descriptions and values of variables

VariablesDescription and valuesYDependent variable, whether respondents will to pay 40Yuan to keep present meteorological service level, 1=accept, 0=refuseSex1=male, 0=femaleAge1= respondents from 13 years old to 17years old 2= respondents from 18 years old to 23 years old 3= respondents from 24 years old to 29 years old 4= respondents from 30 years old to 39 years old 5= respondents from 40 years old to 49 years old 6= respondents from 50 years old to 59 years old 6= respondents from 50 years old to 59 years old 6= respondents mith a primary education 1= respondents with a technical secondary school education 4= respondents with a technical secondary school education 4= respondents with a junior college education 6= respondents with a postgraduate education 7= respondents with a doctoral educationProfessionThe trade of respondents 1=worker 2=peasant 3=administrator in institutions4=worker 2=peasant 3=administrator in institutions
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Profession The trade of respondents
1-worker 2-neasant 3-administrator in institutions A-student 5-teacher 6-cadre
7=police/soldier 8=medical staff 9=businessman 10=individual household
11=civil servant 12=retired people 13=others
Income Average monthly earnings
1=less than 1000 Yuan 2=1001-2000 Yuan 3=2001-5000 Yuan
4=5001-10000 Yuan 5=more than 10000 Yuan
Address Residence of respondents 1=urban 2=rural
Bid1 Will to pay 40 Yuan More than 100 Yuan
80 Yuan 60 Yuan 50 Yuan 40 Yuan
Bid2 Refuse to pay 40 Yuan
0 Yuan 1-10 Yuan 11-20 Yuan 21-30 Yuan 31-39 Yuan

		В	S.E.	Wald	df	Sig.	Exp(B)
Step 1(a)	sex	077	.126	.373	1	.541	.926
	age	.469	.057	66.728	1	.000	1.598
	edu	.117	.053	4.844	1	.028	1.124
	address	.185	.134	1.917	1	.166	1.203
	income	.086	.068	1.581	1	.209	1.089
	profession	.027	.029	.918	1	.338	1.028
	Bid1	018	.004	24.295	1	.000	.983
	Bid2	057	.007	61.189	1	.000	.944
	Constant	958	.468	4.188	1	.041	.384

Table3. Results of backward regression

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Step 2(a)	age	.470	.057	67.255	1	.000	1.600		
	edu	.113	.053	4.595	1	.032	1.119		
	address	.198	.132	2.262	1	.133	1.220		
	income	.086	.068	1.595	1	.207	1.090		
	profession	.027	.029	.871	1	.351	1.027		
	Bid1	017	.004	23.973	1	.000	.983		
	Bid2	057	.007	61.550	1	.000	.944		
	Constant	-1.077	.426	6.390	1	.011	.341		

Table3. Results of backward regression

Step 3(a)	age	.474	.057	68.723	1	.000	1.607
	edu	.114	.053	4.732	1	.030	1.121
	address	.189	.131	2.068	1	.150	1.208
	income	.087	.068	1.622	1	.203	1.090
	Bid1	017	.004	23.961	1	.000	.983
	Bid2	057	.007	61.657	1	.000	.944
	Constant	966	.409	5.577	1	.018	.380

 $WTP_{mean} = \frac{1}{\lambda} \ln \frac{1 + e^{\alpha' + \beta' S + \lambda BID_{max}}}{1 + e^{\alpha' + \beta' S + \lambda BID_{min}}}$ = $\frac{1}{-0.017} \ln \frac{1 + e^{-0.966 + 0.474 age + 0.114 egu + 0.189 address + 0.087 income - 0.057 bid 2 - 0.017 bid 1_{max}}}{1 + e^{-0.966 + 0.474 age + 0.114 egu + 0.189 address 0.087 income - 0.057 bid 2 - 0.017 bid 1_{min}}}$

WI. Conclusion

- The use of CVM to assess benefits of public meteorological services in china is still at the exploratory stage. There will be differences by using different CVM investigation models.
- We should choose and adjust investigation models by doing a large number of comparative studies while referring to the real situations of China.

 In my opinion, assessment models should be amended according to different questionnaire models. The revised model will have a more objective evaluation on the effectiveness of national meteorological service.

Thank you !