Efficiency Evaluation of Armed Policy Mobile Division

Xiangchao Sun, Fang Wang, Dihua Ouyang, Zhizheng Wu

Engineering University of CAPF, Shanxi, Xi'an, 710086, China

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Abstract. In this paper, I establish the operational effectiveness evaluation model of large scale incident across the land disposal in armed police forces based on the unascertained measure theory, First of all, I establish unascertained measurement function of each influencing factor; according to the actual situation, I use both the qualitative analysis and qualitative analysis; also the entropy weight theory is used to calculate the index weight of each influencing factor, in accordance with the confidence level recognition criteria for the degree. Finally some troop's cross-regional operational effectiveness evaluation results are obtained. The calculation results are more objective and accord well with the actual situation, so this method is scientific and reasonable. The results are also helpful for improving the combat effectiveness of troops and the aid decision and can be applied in practice.

Introduction

The mass unexpected incidents occur frequently because China is in the special period of switch to a market economy now. The scale of these incidents are becoming bigger and bigger and the influence is becoming worse and worse. When we are dealing with the large scale incidents according to the current situation of forces' distribution, we may meet with the cross regional operation, but there is no reliable evaluation of cross regional operation among every troop. Meng Zhancun [1] and other scholars use the fuzzy comprehensive evaluation method to assess the effectiveness of equipment support system, but the reliability of design and reasoning algorithm of synthesis credibility have some shortcomings, for example, it doesn't meet the three criteria of measurement, especially the subjective factors when we use the expert evaluating method to confirm the weight [2-3] . The application of analytic hierarchy process is the most popular and mature method, but its subjectivity is very strong and its judgment standard is lack of the scientific basis [4]. In this paper, I establish the operation effectiveness evaluation model to assess the across regional operation effectiveness when the armed police deals with the big scale cross regional incidents, and this method will be significant for improving the operation effectiveness of settling the across regional mass unexpected incidents.

The Unascertained Measurement Theory

Suppose there are n evaluating objects, $R_1, R_2, \cdots R_n$,as for every evaluating object $R_i\left(i=1,2,\cdots,n\right)$, I need measure m indexes and the index space of $X_1, X_2, \cdots X_m$ can be signed as X .So the R_i stands for the m dimensional vector, that is $R_i=\left(X_{i1}, X_{i2}, \cdots X_{im}\right)$,in this equation, X_{ij} stands for the measurement that the research object R_i related to the evaluation index X_j . As for every sub-item $X_{ij}\left(i=1,2,\cdots,n;\ j=1,2,\cdots,m\right)$, suppose there are p evaluation grades and the space of evaluation grades are signed as. $U=\left(C_1, C_2, \cdots, C_P\right)$

The Single Index Unascertained Measurement

Suppose $\mu_{ijk}=\mu\left(X_{ij}\in C_k\right)$ stands for the measured value X_{ij} belong to the degree of estimation scale C_k , it must meet the following conditions:

$$0\le\mu\left(X_{ij}\in C_k\right)\le 1 \tag{1}$$

$$\mu\left(X_{ij} \in U\right) = 1 \tag{2}$$

$$\mu\left(X_{ij} \in \bigcup_{l=1}^{k} C_l\right) = \sum_{l=1}^{k} \mu(X_{ij} \in C_l) \tag{3}$$

$$\mu\left(\lambda X_{ij} \in \bigcup_{l=1}^{k} C_l\right) = \lambda \sum_{l=1}^{k} \mu(X_{ij} \in C_l) \tag{4}$$

Among them, $i = 1, 2, \cdots, n; j = 1, 2, \cdots, m; k = 1, 2, \cdots, p$ .The equation (2) named as meeting the polarity of "evaluation space" U, the equation (3) named as meeting the additivity of "evaluation space" U, and named things that meets the equation (1),(2),(3),(4)as the unascertained measurement . Also named the matrix:

$$(\mu_{ijk})_{m \times p} = \begin{bmatrix} \mu_{i11} & \mu_{i12} & \cdots & \mu_{i1p} \\ \mu_{i21} & \mu_{i22} & \cdots & \mu_{i2p} \\ \vdots & \vdots & \vdots & \vdots \\ \mu_{im1} & \mu_{im2} & \cdots & \mu_{imp} \end{bmatrix} \tag{5}$$

As the single index evaluation matrix [6].

The Determination of Index Weight

I use w_j to stand for the measurement index X_j 's relative importance compared with other indexes. It should meet $0 \le w_j \le 1$:

$$\sum_{j=1}^{m} w_j = 1$$

I name the w_j as the weight of X_j , and name $w = (w_1, w_2, \cdots w_m)$ as index weight vector. I use the entropy theory to define the weight, that is

$$v_{ij} = 1 + \frac{1}{\log p} \sum_{i=1}^{p} \mu_{ijk} \lg \mu_{ijk} \tag{6}$$

$$w_j = v_{ij} \Big/ \sum_{i=1}^{n} v_{ij} \tag{7}$$

So w_j can show the importance of X_j and w_j can be considered as the weight of. X_j

Multi-Index Synthetic Measurement Evaluation Vectors

Suppose $\mu_{ik} = \mu\left(R_i \in C_k\right)$ stands for the evaluation sample R_i belong to the degree of evaluation k , so

$$\mu_{ik} = \sum_{j=1}^{m} w_j \mu_{ijk}$$

$$i = 1, 2, \cdots, n; k = 1, 2, \cdots, p \tag{8}$$

Because of $0 \le \mu_{ik} \le 1$, and, the equation (8) can be named as the unascertained measure and $\left(\mu_{i1}, \mu_{i2}, \cdots, \mu_{ip}\right)$ can be named as multi-index

$$\sum_{i=1}^{p} \mu_{ik} = 1$$

Synthetic measurement evaluation vectors [7].

Credible Degree Recognition Criterion

In order to make the final evaluation of the evaluating objects, I use the credible degree recognition criterion: suppose the credible degree $\left(\lambda \ge 0.5\right)$,

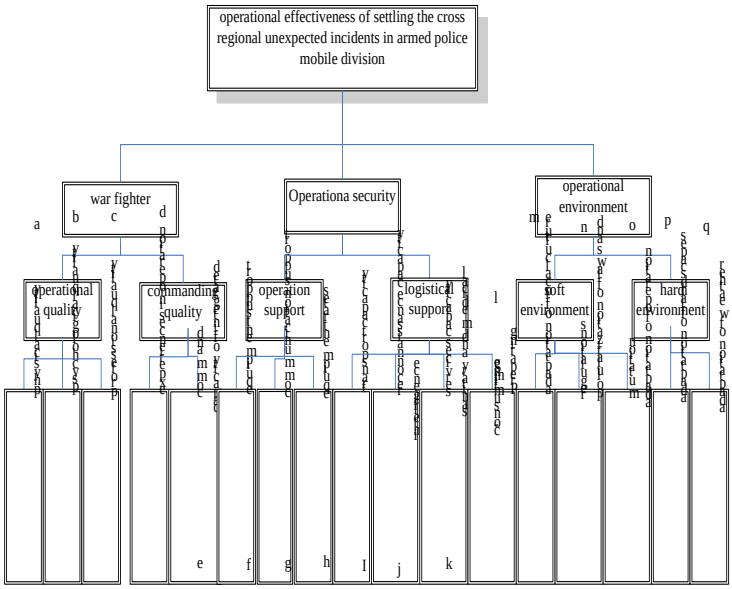
If $C_1 > C_2 > \cdots > C_P$, and

$$k_0 = \min\left\{k : \sum_{l=1}^{k} \mu_{il} \ge \lambda, (k = 1, 2, \cdots, p)\right\}$$

So I consider the evaluation sample R_i as the k_0 evaluation C_{k_0} .

Establishment of Evaluation Index System

We can't use the single index to determine the operation effectiveness evaluation, by contrary; we should follow the following principles to construct the evaluation index system: scientificalness, feasibility, the combination of qualitative analysis and qualitative analysis and the combination of activity and inertia. The relativity among the indexes should be as small as possible. This paper assesses the operational effectiveness of settling the cross regional unexpected incidents in armed police from the perspective of war fighter, operational security operational environment and other 17 factors. The construction of index system should take the cross region, unexpected incidents and other features into consideration; we not only meet the basic operational index, but also combine the commanding ability, the adaptation of local conditions, landscapes and weather and other indexes. This shows the special request of operational environment and forms the following three levels of index system:



Among them, the equipment rates and preparing time-consuming are quantitative indexes, and its grading standards and assignments are listed in table 1. While other factors are qualitative indexes and the grades and value of every evaluation index are listed in table 2. The evaluation congregation is $\{C_1, C_2, C_3, C_4\}$, that is to say there are four grades: 1, 2, 3, 4 every grade respectively is excellent, good, ordinary and unqualified.

Table 1 the grades of quantitative indexes and value standards

evaluation grade / evaluation index	excellent (C_1)	good (C_2)	ordinary (C_3)	unqualified (C_4)
Equipment rates (%)	>90%	85%~90%	80%~85%	<80%
Preparing time-consuming (min)	30~40	40~50	50~60	<60

Table 2 qualitative index grades and value standards

evaluation grade / evaluation index	excellent (C_1)	good (C_2)	ordinary (C_3)	unqualified (C_4)
Qualitative index (centesimal)	>90	80~90	60~80	<60

Certain Mobile Division's Evaluation of Operation effectiveness

Construct the Single Index Measurement Function

I use the questionnaire to give the value of the evaluation indexes above and then I will take the mean value as the result, see table 3:

Table 3 certain mobile division's result statistics of every index

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q
certain mobile division	92	84	81	70	83	95	93	82	92	82	86	57	75	90	80	81	90

According to the definition of single index measurement function and figure 1, figure 2, I can get the measurement value of every evaluation index. Among them, the equipment rates and the Certain Mobile Division's Evaluation of Operation effectiveness measurement function of preparing time-consuming are shown in figure 1 and figure 2, while other qualitative single index measurement functions are shown in figure 3.

According to the value of table 3 and the single index measurement functions above, I can get the matrix of single evaluation of certain mobile division:

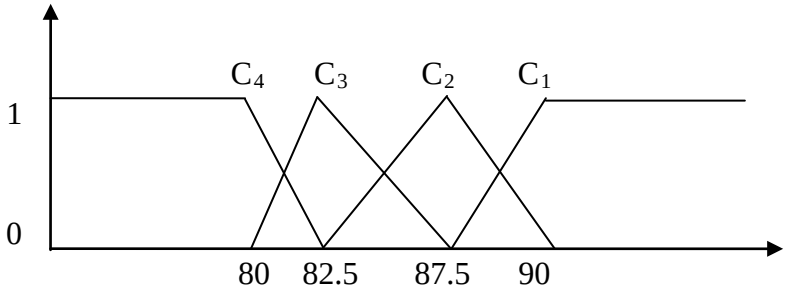


Figure.1 single index measurement function of equipment rates

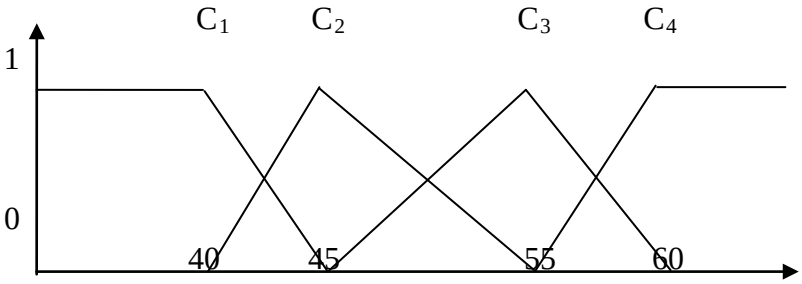


Figure.2 single index measure function of preparing time-consuming

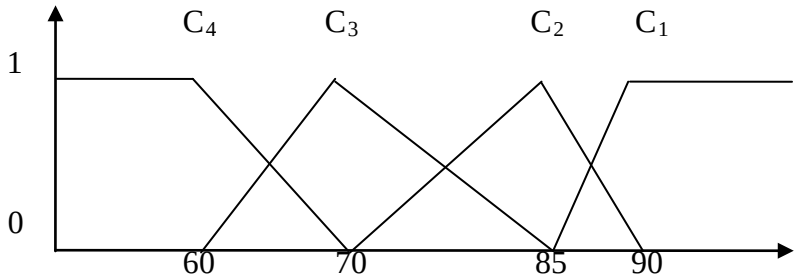


Figure.3 qualitative single index measurement function

The Calculation of Multi-index Measurement Evaluation Matrix

According to the (6) and (7), I can use the MATLAB to calculate the weight of every index, so the result is $\left(w_a, w_b, \cdots, w_q\right)$ = (0.0764, 0.0629, 0.0444, 0.0764, 0.0547, 0.0764, 0.0764, 0.0393, 0.0764, 0.0488, 0.0488, 0.0393, 0.0413, 0.0764, 0.0413, 0.0444, 0.0764; According to the formula of single

index measurement matrix, I can get the result of multi-index measurement vector: $\mu = w_i \cdot u_{ijk}$ = (0.4680, 0.2907, 0.2019, and 0.0393).

The Recognition of Credible Degree Principle

Suppose the credible degree $\lambda = 0.5$, according to the multi-index measurement evaluation vector (8) and the credible degree evaluation formula (9), from left to right, k0=0.7587>0.5, so the result is grade II, that is to say, its operational effectiveness is good; from right to left, the result is grade II, so I can say that the evaluating object's operational effectiveness is good and it is accordance with the accomplishment of operation task.

$$U_{ijk} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0.933 & 0.067 & 0 \\ 0 & 0.733 & 0.267 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0.867 & 0.133 & 0 \\ 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0.2 & 0.8 \\ 1 & 0 & 0 & 0 \\ 0 & 0.8 & 0.2 & 0 \\ 0.2 & 0.8 & 0 & 0 \\ 0 & 0 & 0.6 & 0.4 \\ 0 & 0.333 & 0.667 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0.667 & 0.333 & 0 \\ 0 & 0.733 & 0.267 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

Conclusions

Factors that affects the troop's cross regional operational effectiveness are various and complicated, it includes internal factors and external factors and use the unascertained measure evaluation model to make a judgment. I construct the affecting factors and grading standards according to the features of cross regional operation and apply the unascertained measure theory to construct the unascertained measure function of operational effectiveness' evaluation index; I use the entropy weight theory to calculate the weight of every index and evaluate the operational effectiveness according to the cognition principle of credible degree, because the result is very scientific, adequate and reliable. We cannot only use this method to assess the operational effectiveness, but also draw up a pointed training in order to improve the capacity of task accomplishment and supply a scientific, effective training to the evaluation of troop's operational effectiveness.

Unascertained measure theory in the evaluation of operational effectiveness research is just a preliminary attempt, from now on, the selection of evaluation index and the determining method of index weight require further study in order to strengthen its general applicability.

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