**Component ordering optimal decision based on simulation of single product**

**Abstract:** The problem of the optimal component ordering of dealers who sell only one product is studied.In the case of market demand for product uncertainty,this paper presents a discrete stochastic optimization model for the order size of single product component based on the best expectations of the dealer's profit ,proves the existence and uniqueness of the optimal solution using the marginal analysis method,gives the formula and method of optimal order quantity.The article uses the market demand satisfaction rate as a stochastic constraint on the model,discusses the optimal component ordering of the dealer in the case of random constraints and the absence of random constraints.Finally, the conclusion of this paper is proved by experimental simulation.

**Key Words:** Component ordering decision,Simulation,Marginal analysis

[[1]](#footnote-0)

1. Introduction

With the current market environment increasingly complex, dynamic and uncertain, the product life cycle is generally shortened.Some products that seem to have a long life cycle (such as mobile phones, computers, and other electronic products in durable consumer goods) have become short-lived products because of their characteristics such as fashion.Short life cycle products often have the following characteristics: high demand for product uncertainty, short product life cycle, rapid decline in value, strong product substitution effects [1].Needless to say, this situation will continue into the 21st century, so that dealers facing the market environment is more severe.This requires dealers who produce these products to respond more quickly and accurately to uncertain market demand.The operating mode of these resellers is what order a number of components from the component manufacturer, and then assemble into a product to profit.For the dealer, the order cost of the product component is high, but when the product has passed the sales period, the remaining components can only be processed according to their salvage.So scientificly and [reasonably](https://translate.google.cn/" \l "en/zh-CN/javascript:void(0)) ordering components, not only can improve the dealer's profit expectations and help enterprises meet timely customer needs, but also lay a good foundation for the long-term development of enterprises[2].Optimal component ordering decision for the product attracts more and more scholars and experts.Many scholars use the newsboy model to solve the problem of optimal order quantity[3,4].The newsboy model is mainly to solve the problem of optimal order quantity under the stochastic demand to maximize the expected profit,but they are in the pursuit of profit maximization process, did not take into account the market demand to meet the rate.In this paper, the use of newsboy model to solve the problem of dealer product component ordering, while the market demand satisfaction rate as a constraint.

The products produced by the dealer in the article are considered to be composed of general components and feature components.In the case of market demand for product uncertainty,this paper presents a discrete stochastic optimization model for the order size of single product component based on the best expectations of the dealer's profit,uses the market demand satisfaction rate as a stochastic constraint on the model,discusses the optimal component ordering of the dealer in the case of random constraints and the absence of random constraints.On the basis of analyzing the nature of the problem, we design the algorithm and use the simulation software to get the result, and put forward some suggestions on the management of the dealer.Since the market demand for the product is random,after the dealer assembled the product, the most ideal situation is that the two components are no surplus and the product just meet the needs of the market

1. Problem description and mathematical model

In the face of random market demand, dealers will assembled the components ordered into products to sell, from which to obtain revenue.in general, the dealer assembled components into product will encounter the following two cases: 1,the product can meet the market demand, but the components are left, 2, the components are not left, but the product can not meet the market demand.When the components are left, for the remaining part of the component, the dealer handles them according to their salvage.As the salvage value much smaller than the cost of ordering, too many ordering components will bring losses to the dealer.The assembly volume of the product can not meet the needs of the market, which will cause the product out of stock, will reduce the dealer's service level, will damage the corporate brand image.Taking into account the above two cases, when ordering components,the dealer will set the minimum satisfaction rate to ensure that the image of the enterprise.

We describe the above product model.For simplifying the following description,we use  and as the subscript of notation,Letdenote specific compoment and denote substitution component.The product model can be represented by the following symbol.

：order cost of per unit component  of product

 ：demand for product is a random variable.it satisfies the distribution rule that is,,and .

： salvage value of per unit component of product

 ： selling price of product

： order quantity of component  of product (Decision variables)

Firstly,we give some assumptions about system parameters.

Assumption 1..It means that the cost of the component is greater than the salvage value of the component.

Assumption 2..It means that the dealer sells the product is profitable

field . And the middle of the ring will produce magnetic beam. the metal body in ring can produce eddy current and emit Joule heat to melt metals.In the practice of industrial production, liquid steel production equipment, such as steel converter or vacuum treatment equipment connected with the measurement equipment is very bad environment ,so 9 environmental impact factors is analyzed in Table 2.

Table 2: Environmental Impact Factors

**influence factors of environment**   **[description](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);)**

Temperature Due to temperature changes can cause nonlinear distortion of the spectrum in optical signal

(The outside and inside of the furnace) transmission system,detector and signal conversion and transmission devices

chen Jinzhong et al.[10] study the Radiation characteristics in their Paper,the result show that

electromagnetic radiation that The radiation intensity of the plasma is enhanced with the increase of the magnetic field

field intensity

Electromagnetic stirring The flow velocity and direction of molten iron will affect the accuracy and real-time of the

measurement.

Vibration Influence on the focusing of the lens and The accuracy of the measurement

Evaporation effect between alloys The presence of the medium can cause reflection,Refraction and attenuation of light.

Type of gas Under different atmosphere conditions (argon, nitrogen or oxygen etc), the measured signal

is affected by the influence of the masking effect etc

pressure Gas pressure will influence plasma expansion.Low pressures increase energy losses and

uniformity of the plasma energy distribution

Distance of laser to liquid no

3  Rough set theory and the feature extraction

method

Information System Table. Information system table is a two dimensional table (column and row). The row shows definite number of objects, whereas the column shows the attribute value and class label of the objects [6]. It can be presented as where is finite set of objects,is set of attribute, andis decision.

Indistinguishable RelationIt is an equivalence relation ,indistinguishable relation is defined as： .usually also called 

Upper approximation of a setincludes all objects of information system table which possibly belongs to the class. Lower approximation of setis the set of objects of the information system table which certainly belongstothe class.Te set of all objects that belong to lower approximation is referred to as positive region.The difference between upper approximation set and lower approximation set is referred to as boundary region. Equations show mathematical formula for (,,,)







Dependency of attributes. we can measure dependence on each other betweenandwith rough membership function,which is defined as:



In the above equation, card（· ）represents the cardinal of the set.

Redundant attribution. Forandsubset of attributes letif is true,is redundant in thesubset of attributes,otherwiseis indispensable in thesubset of attributes

3.1 the feature extraction of basic ideas

According to the attribute dependency of thought, when processing [feature](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) [extraction](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);),is calculated in the decision system table which is [degree](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) [of](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) [dependence](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) of [decision](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) [attributes](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) relative to each condition attribute set  in condition attributes. Because of card（· ）fixed in the same,The value ofis determined by. We only need calculate Positive region ofand then sort according to the size of them.Meanwhile, in order to ensure that classification ability of the selected feature setnot changed relative to [decision](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) [attributes](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);), positive region could be calculated preferentially. So when processing feature [extraction](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);),(is environmental impact factors of metal smelting and represents decision attributes ) is computed and determine whether it is equal to 

**2.3 Algorithm description**

1. decision information system table ；
2. calculating ;
3. calculating positive region ofand then sort according to the size of them .the result of sorting called and the size of the positive domain of each attribute is also required.
4. let={ };
5. Select the attribute of the current maximum positive domain from  if   go to (7); else Go to(6);
6. if exist,C` and  if exit one or many calculate  and chooseof the maximum   ,; go to (5); else , go to (5);
7. Output 

**3 Data processing and result analysis**

*Data collection*. For this study data sets have been selected from previous literature . Principles collected by data are follows: 1,parameters of LIBS system possibly is same; 2, data collected possibly is from  identical experiment. Based on the above two principles , six environmental factors of LIBS are selected ,which are distance form sample to focus, pressure, type of gas,electromagnetic radiation, temperature and angle of incidence. The energy parameters related with laser material interaction are influence and irradiance (energy per unit area and time,W/cm2). The effect of changes in the laser energy is related to laser wavelength and pulse time. Difference of physical characteristics of the material itself and elements selected will cause the difference in concentration. energy parameters, physical characteristics and type of elements are chosen . So a decision table is constructed by 25 samples with 9 conditional attributes and a decision attribute(Spectral intensity as decision attribute) . There are missing values in decision table. A show of the decision table is given in Table 3.

*Handling Missing Value*. Handling of missing values is a data preprocessing technique to obtain a smooth data set. Te common methods include ignoring the tuple that holds missing value, imputing with the mean, or imputing with the most frequent value [7] In this study, missing value is handled as follows. If the percentage of missing value in a tuple is greater than or equal to 25%, then reject that tuple from the data set or else impute it by the most frequent value of the attribute in the class that belongs to the tuple. Te same applies to attributes too.

|  |
| --- |
|  |

Figure.3 Flow Diagram Algorith

Table 3: Environmental Influencing Factors Of LIBS As A Decision Table

No.   [energy](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) distance form physical pressure type electromagnetic angle temperature type of Spectral

to focus characteristics of gas radiation elements intensity

/mm /MPa /T /℃

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 0.2 | 0 | soil | 0.1 | air | 无 | vertical |  | Al | 11 |
| 2 | 0.2 | 0 | soil | 0.1 | air | 0.3 | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Al | 13 |
| 3 | 0.2 | 0 | soil | 0.1 | air | 0.5 | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Al | 17 |
| 4 | 0.2 | 0 | soil | 0.1 | air | no | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Fe | 10 |
| 5 | 0.2 | 0 | soil | 0.1 | air | 0.3 | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Fe | 14 |
| 6 | 0.2 | 0 | soil | 0.1 | air | 0.5 | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Fe | 15 |
| 7 | 10 | 0 | metal | 0.5 | Ar | no | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Cu | 900- 950 |
| 8 | 0.2 | 0 | soil | 0.1 | Ar | no | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Al | 16- 18 |
| 9 | 6 | 0 | metal | 0.1 | air | no | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Mn | 80- 100 |
| 10 | 6 | 0 | metal | 0.1 | air | no | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Fe | 70- 80 |
| 11 | 6 | 0 | metal | 0.1 | N2 | no | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Fe | 80- 100 |
| 12 | 6 | 0 | metal | 0.1 | N2 | no | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Mn | 100- 120 |
| 13 | 6 | 0 | metal | 0.1 | Ar | no | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Fe | 300- 320 |
| 14 | 6 | 0 | soil | 0.6 | Ar | no | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Si | 550- 600 |
| 15 | 6 | 0 | soil | 0.6 | Ar | no | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Fe | 400- 450 |
| 16 |  | 0 | soil | 0.8 | Ar | no | vertical | [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) | Cu | 970- 1050 |
| 17 | 0.2 | 6 | soil | 0.1 | air | no | vertical | 200 | Fe | 23 |
| 18 | 0.2 | 6 | soil | 0.1 | air | no | vertical | 200 | Al | 16 |
| 19 | 0.2 | 6 | soil | 0.1 | air | no | vertical | 200 | Mg | 19- 20 |
| 20 | 0.2 | 6 | soil | 0.1 | air | no | vertical | 250 | Fe | 25 |
| 21 | 0.2 | 6 | soil | 0.1 | air | no | vertical | 250 | Al | 17- 18 |
| 22 | 0.2 | 6 | soil | 0.1 | air | no | vertical | 250 | Mg | 21- 22 |
| 23 | 0.2 | 6 | soil | 0.1 | air | no | vertical | 300 | Fe | 25- 26 |
| 24 | 0.2 | 6 | soil | 0.1 | air | no | vertical | 300 | Al | 19 |
| 25 | 0.2 | 6 | soil | 0.1 | air | no | vertical | 300 | Mg | 23- 24 |

|  |
| --- |
| [energy](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);)： 6J-10J(including terminal): 1;200mj: 2  distance form  focus to sample 0: 1;6mm: 2  physical  characteristics： soil: 1;metal: 2  pressure： 0.1: 1;0.5MPa-0.8MPa(including terminal): 2  electromagnetic  radiation： no: 1; 0.3T: 2;0.5T: 3  type of gas： air: 1;Ar: 2;N2: 3  angle： vertical: 1  temperature： [normal](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);): 1;200: 2; 250: 3;300: 4  type of elements： AL: 1;Fe: 2;Cu: 3;Mn: 4;Mg: 5  spectral intensity：0-20: 1; 20-50: 2;50-500: 3;500-1500; 4 |

*discretization of data.* Since the Pawlak’s rough set model is more suitable for data containing discrete attributes, continuous attributes should be discretized as a preprocessing step in rough sets ,in the Table1,Attribute values of 2,3,5,7,11 column are nonuniform distribution but are gathered in intervals,continuous attributes are discretized by close together between attribute values. concrete operation is followed as Table 4 .And Table 5 shows decision table of discretized, where a,b,c,d,e,f,g,h and i respectively indicate [energy](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);), distance form to focus ,physical characteristics ,pressure ,type of gas ,electromagnetic radiation, angle ,temperature, type of elements, spectral intensity. D is spectral intensity.

*reduction and Result analysis.* Attribute reduction in rough set theory is also called feature selection; it aims to remove unnecessary attributes while retaining the discernibility of objects under the original attributes. In this paper, algorithm of blind attribute reduction is applied , A program about algorithm is programmed in vs2010. Flow diagram of algorithm is given in Figure.3 .reduction result is shown in Table 6

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| N. | a | b | c | d | e | f | g | h | i | D |
| 1 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 2 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 |
| 3 | 2 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 1 |
| 4 | 2 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 |
| 5 | 2 | 1 | 1 | 1 | 1 | 2 | 1 | 1 | 2 | 1 |
| 6 | 2 | 1 | 1 | 1 | 1 | 3 | 1 | 1 | 2 | 1 |
| 7 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 1 | 3 | 4 |
| 8 | 2 | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 |
| 9 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 4 | 3 |
| 10 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 3 |
| 11 | 1 | 1 | 2 | 1 | 3 | 1 | 1 | 1 | 2 | 3 |
| 12 | 1 | 1 | 2 | 1 | 3 | 1 | 1 | 1 | 4 | 3 |
| 13 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 2 | 3 |
| 14 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 | 4 | 3 |
| 15 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 3 |
| 16 | 1 | 1 | 1 | 2 | 2 | 1 | 1 | 1 | 3 | 4 |
| 17 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 |
| 18 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 1 |
| 19 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 2 | 5 | 1 |
| 20 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 2 | 2 |
| 21 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 1 | 1 |
| 22 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 3 | 5 | 2 |
| 23 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 4 | 2 | 2 |
| 24 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 4 | 1 | 1 |
| 25 | 2 | 2 | 1 | 1 | 1 | 1 | 1 | 4 | 5 | 2 |

Table 5: Discretized Decision Tables

Table 4: Principle Of Discretization

Table 6: Table Of Reduction Result

information system Result of attribute reduction

physical characteristics

The main factors affecting type of gas

the spectral intensity temperature

type of elements

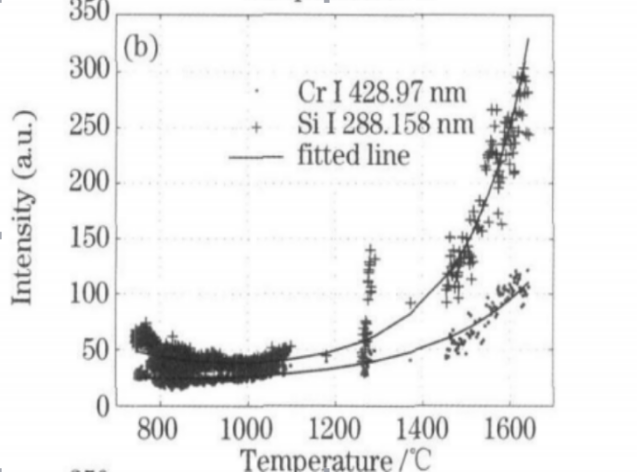


Figure4

In the table 5,Angle,electromagnetic radiation,distance form focus to sample,[energy](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);),pressure are unnecessary attributes but physical characteristics, type of elements, temperature,type of gas are retained as the key environment factors. Given the physical characteristics and the type of elements not belong to environment factors of LIBS, Final results are type of gas and temperature. Sun lanxiang[8]in their laboratory room uses LIBS [technology](D:/youdao/Dict/6.3.69.8341/resultui/frame/javascript:void(0);) to on-line monitoring Cr, Si, and Mn element mass fraction. The studying result showed that the liquid steel temperature strong affected plasma emission intensity,and the spectral line's intensity of different elements varies in terms of temperature,which is consistent with the temperature as a necessary attribute. Figure 4 shows the relationship between temperature and intensity in literature[9], On the other hand, Under different atmosphere conditions (argon, nitrogen or oxygen etc), the measured signal is affected by the influence of the masking effect etc.

4 Conclusions

This paper begins with a brief explanation of principles of LIBS measurement and high frequency Induction and describes LIBS system influence factors . Especially in the aspect of molten alloy working environment, a detailed environmental influence is analyzed. Rough set theory and the feature extraction method is then followed. Finally, feature selection of rough set theory is combined to deal with the gathered data from the literature. The analysis from the literature [8]shows that it is identical that temperature and atmosphere have much influence on the spectral line. So we can get some advice from this conclusion for the quantitative analysis of steel smelting with LIBS.In terms of LIBS metal detection , The method of rough set has not been used in known literature to do a comprehensive analysis of the interference of environmental factors.

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1. [↑](#footnote-ref-0)