Prediction of Waste Mobile Phone Quantity in Shanxi Province Based on "Estimation" Model

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Abstract

This paper analyzes the possible environmental problems and utilization value of waste mobile phones. Taking Shanxi Province as an example, taking smart phones as the main prediction object, according to the total population of Shanxi Province in 2019, the popularity rate of mobile phones, the average service life of mobile phones, etc., and the "estimation" model is used to predict the production of waste mobile phones in various regions of Shanxi Province in 2021.

Keywords

Waste Mobile Phone; Waste Prediction; "Estimation" Model.

1. Introduction

With the rapid development of science and technology and the rapid improvement of people's social living standard, smart phone has become one of the most frequently used electronic products in people's daily life and work. At present, China has become the largest production base of mobile communication industry in the world, and the number of mobile phone users ranks first in the world. With the further improvement of people's requirements for the function and appearance of mobile phones, the mobile phone manufacturers are innovating technology faster and faster, and the replacement cycle of mobile phones is also constantly shortened. According to the data of the Ministry of Industry and Information Technology, the total number of waste mobile phones in China reached 1.83 billion from 2014 to 2019, and 499 million in 2019. With the popularization of 5G network, more mobile phones will be washed out [1].

Waste mobile phones contain a variety of scarce metals, such as gold, silver, palladium and copper, as well as glass, plastic and other materials, which have a very large potential resource recycling value. If mobile phones are directly buried without harmless treatment, they will pollute soil and groundwater resources, enter the food chain and endanger human health and survival. Experts and scholars call the waste mobile phone as the urban mine for recycling precious metals. Relevant studies show that the amount of gold extracted from one ton wasted mobile phone is about 30 times that extracted from the same weight of gold ore [2]. The correct recycling of waste mobile phones is not only conducive to the reuse of resources, saving the limited resources on the earth, but also can bring considerable economic benefits, and meet the requirements of sustainable development of China's economic development. Therefore, it is of great significance to accurately predict the quantity of waste mobile phone and recycling for reasonably planning the layout and scale of recycling enterprises and formulating the access conditions of relevant industries.

2. Prediction Method of Electronic Waste

There are various methods to predict the amount of Electronic waste. Simon et al. summarized the following seven main estimation models [3], which are used to estimate the amount of electronic waste, as shown in Table 1 below.

Table 1. Prediction Method of Electronic Waste

Method	Data requirements	Formula
Market Supply Model	Sales volume of electronic products, Average service life of electronic products	$Q_w = U_t$
Market Supply A Model	Sales volume of electronic products, Service life distribution of electronic products	$Q_w = \sum_i S_i P_i$
Stanford Model	Sales volume of electronic products, Service life distribution of electronic products (changing with time)	$Q_w = \sum_i S_i P_i$
"Estimate" Model	The social ownership of electronic products, Average life of electronic products	$Q_w = P_n/n$
Time Gradient Model	Sales volume of electronic products, Social ownership and historical waste data of electronic products	$Q_t = \sum_{n=t_1}^{t} S_n - \sum_{n=t_1}^{t-1} P_n - (H_t - H_{t_1})$
Carnegie-Mellon Model	Sales volume of electronic products, Proportion of different disposal methods of electronic products	There is no specific formula
ICER Model	Product replacement rate	There is no specific formula

3. Prediction of Waste Mobile Phones Quantity in Shanxi Province Based on "Estimation" Mode

3.1 Prediction Model

Due to the lack of the sales data of electronic products in Shanxi Province over the years, and the market supply model, market supply A model, Stanford model, time gradient model, Carnegie-Mellon model and so on all need to be based on the sales data of mobile phones, so it is difficult to directly use these models to predict the production amount of waste mobile phones. In addition, the current economic development level of Shanxi Province is low, and the number of completely abandoned mobile phones is limited. Most mobile phones enter the secondary market or are left idle after simple treatment and maintenance, so it is more suitable to adopt the "estimation" model [4]. Combined with the actual situation of Shanxi Province, this paper adopts the "estimation" model method to forecast the production amount of waste mobile phones in Shanxi Province, aiming to provide data support and reasonable suggestions for the development of waste mobile phone treatment in Shanxi Province. The "estimation" model is mainly calculated based on the combination of social inventory and average service life. The estimation expression is as follows:

$$Q_w = \frac{P_n}{n}$$

Q_w is the amount of used mobile phones in a certain year, P_n is the social ownership of used mobile phones in a certain year, and n is the average service life of the mobile phone.

3.2 Model Parameters

According to the relevant data of Shanxi Statistical Yearbook, the number of permanent residents in Shanxi Province in 2019 is obtained [5]. According to the data of the Ministry of Industry and Information Technology, the penetration rate of mobile phones in China in 2019 is 106.9%. The mobile phone ownership of each region can be calculated from "mobile phone ownership = total population * mobile phone penetration rate", as shown in Table 2.

3.3 Average Service Life of Mobile Phones

Data released by Qianzhan Industry Research Institute in the Analysis Report on Market Demand Forecast and Investment Strategy Planning of China's Smartphone Industry from 2016 to 2021 shows that the replacement cycle of users has shortened from 18 months to 15 months, so the average service life of used mobile phones is 1.25 years [6].

Table 2. Mobile Phone Ownership in Shanxi Province in 2019

Area	Total resident population	Mobile phone users
Datong	3455996	4726500
Shuozhou	1781219	3694500
Xinzhou	3171991	1512000
Yangquan	1414360	3707500
Taiyuan	4421458	2504800
Lvliang	3885602	1904100
Jinzhong	3381576	3614900
Changzhi	3468210	5729500
Linfeng	4500264	3390900
Jincheng	2343106	4810800
Yuncheng	5359652	4153700
Total	37183400	39749100

3.4 Forecast Results

Based on the above social ownership and the average service life of mobile phones in Shanxi Province, the "estimated" model is used to calculate the amount of waste mobile phones in Shanxi Province in 2021, as shown in Table 3 below.

Table 3. Amount of waste mobile phones in Shanxi Province in 2021

Area	Total resident population	Mobile phone users	Quantity of waste mobile phones
Datong	3455996	4726500	3781200
Shuozhou	1781219	3694500	2955600
Xinzhou	3171991	1512000	1209600
Yangquan	1414360	3707500	2966000
Taiyuan	4421458	2504800	2003800
Lvliang	3885602	1904100	1523300
Jinzhong	3381576	3614900	2891900
Changzhi	3468210	5729500	4583600
Linfeng	4500264	3390900	2712700
Jincheng	2343106	4810800	3848600
Yuncheng	5359652	4153700	3323000
Total	37183400	39749100	31799300

4. Analysis and Discussion of Prediction Results

In this paper, the "estimation" model is used to forecast the amount of waste mobile phones in Shanxi Province in 2021. The results show that the amount of waste mobile phones in Shanxi Province in 2021 is expected to reach 31799300. There are still some uncertainties in the above estimation of the amount of waste mobile phones. This is because in the estimation model of the production volume of waste mobile phones, changes in the average service life of mobile phones caused by technological progress and other factors are not taken into account, which affects the accuracy of the estimation results to a certain extent.

References

[1] Information on:https://it.chinairn.com/news/20191229/141814557.html

[2] Juntao Li, Dulin Li, Mengmeng Lu. Design of C2B waste mobile phone reverse logistics recovey network based on carbon emission. Manufactur Automation.Vol.40(2018)NO.9.p.95-101.

[3] Simon Wilkinson, Noel Duffy, Matt Crowe. Waste from electric and electronic equipment in Ireland. Environmental Protection Agency of Ireland, p.2001:68-81.

[4] Kailun He, Chuangye Cheng, Huilong Sun, et, al. Research on the prediction of major electronic waste production in Chongqing based on "estimation" model. Green Science and Technology. (2015) NO.3.p. 227-228,229.

[5] Information on: http://tjj.shanxi.gov.cn/tjsj/tjnj/

[6] Information on: http://inews.ifeng.com/mip/47001902/news.shtml