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Study on Analysis of Environmental Parameters and Ecological Prediction of Flowers Based on Machine Learning

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Abstract: This paper uses machine learning and related technologies to process, analyze and study the ecological environment parameters of flowers, and makes ecological predictions on them. Taking orchids as an example, data collection and processing were conducted to analyze and study the correlation and distribution density of environmental parameters such as temperature, moisture, conductivity, pH value, nitrogen, phosphorus, potassium, and fertility, as well as their impact on leaf color parameters. And our research team gradually improve the data collection method to increase the accuracy of the original data. According to the obtained statistical data, a regression model is established for modeling analysis and ecological prediction. Further this paper improved the coefficients, reduced errors, and enhanced the actual performance of the data model. The research methods, content, and predictive information presented in this paper provide valuable practical applications for the technological development and intelligent management in the field of flowers.

1. Introduction

With the dynamic changes and continuous development of information technology and Machine Learning technology, people's research on flower ecology has gradually deepened and strengthened. In this paper, Python and machine learning technology are used to study the parameter change, parameter correlation and flower health status of flower ecology, and a regression model is established to predict the ecological health status.[1-2]

2. Data Collection and Arrangement

In this paper, orchids, known as "gentlemen in flowers", are selected as an example to collect, analyze and study the environmental parameters of flowers. There are many kinds of orchids, so this paper will first study their specific species, establish an environmental parameter model, carry out correlation research, ecological evaluation and prediction; According to the information that has been studied, the environmental parameters are weighted and increased to further expand the research on orchid species; Gradually and deeply study the ecological situation of more kinds of flowers.[3-5]

The general environmental state of the collected data is: northern area (Tai 'an, Shandong), with temperature of 15~25℃ and humidity of 40%~60% (comfortable). Oncidium in potted flowers was selected as the research object, and the parameters (temperature, moisture, conductivity, pH, nitrogen, phosphorus, potassium, fertility, etc.) were detected and collected by professional equipment.

Firstly, the RGB mode of color is used to identify the data. Select the leaves of orchids for color detection (i.e., leaf color), take three values in the range of 2mm*2mm for each group, and keep two data with relatively small color difference: (136, 140), (136, 139), (101, 112), (116, 108), (114, 108), (131, 130), (94, 122), (131, 126), (135, 134) and (143, 157). Average each group of data, and the results are as follows: 138.0, 137.5, 106.5, 112.0, 111.0, 130.5, 108.0, 128.5, 134.5 and 150.0.

Then the HSV (hue, saturation, brightness) method is used to identify the data, and the collected data are as follows: (74.58, 0.82, 0.51), (78.70 ,0.81, 0.59), (78.46 ,0.62, 0.49), (75.50, 0.88, 0.54), (78.10, 0.90, 0.50), (80.38, 0.98, 0.42), (77.25, 0.84, 0.37), (81.60, 0.71, 0.55), (77.96, 0.93, 0.58) and (73.84, 0.47, 0.53).

Through the comparison, research and analysis of the data, the second way (HSV) can better reflect the change of leaf color. In this paper, HSV is chosen to identify the color data of leaves, and it is regarded as one of the data dimensions that reflect the ecological health of leaves.

The relevant values of the above groups of data (temperature, moisture, conductivity, pH, nitrogen, phosphorus, potassium, fertility and leaf color) are shown in Table 1.

Table 1: Data table a.

No.	Temperature (°C)	moisture (%)	Conductivity (us/cm)	pH	Nitrogen (mg/kg)	Phosphorus (mg/kg)	Potassium (mg/kg)	Fertility (mg/kg)	Leaf color (H value)
1	18.0	9.8	74.0	7.0	3	5	11	40	74.58
2	16.0	28.7	443.0	6.9	22	31	70	243	78.70
3	17.1	12.9	214.0	6.9	10	14	34	117	78.46
4	17.3	18.5	252.0	7.1	12	17	40	138	75.50
5	20.0	21.6	145.0	6.4	7	10	23	79	78.10
6	20.2	20.1	123.0	6.2	6	8	19	67	80.38
7	19.2	19.4	240.0	6.5	12	16	38	132	77.25
8	12.4	13.0	98.0	6.9	4	6	15	53	81.60
9	16.4	12.3	56.0	7.0	2	3	8	30	77.96
10	16.9	12.2	131.0	7.0	6	9	20	72	73.84

3. Data Research and Statistics

According to the collected and sorted data of flower environmental parameters, a data file in CSV format is formed, and the data types of parameters are set, so as to prepare for further data analysis.[6-7]

Using Python platform, combined with the related functions of Pandas module, data analysis is carried out. Firstly, the descriptive information such as mean, std, min, 25%, 50%, 75% and max of the statistical data is shown in Table 2.

The quantitative data of the above statistics can reflect the distribution and change of various environmental parameters of flowers, which provides a data basis for the subsequent correlation analysis.

Table 2: Descriptive statistics table.

Category	Temperature (℃)	Moisture (%)	Conductivity (us/cm)	pH	Nitrogen (mg/kg)	Phosphorus (mg/kg)	Potassium (mg/kg)	Fertility (mg/kg)	Leaf color (H value)
mean	17.350	16.850	177.600	6.790	8.400	11.900	27.800	97.100	77.637
std	2.273	5.824	115.115	0.307	5.930	8.171	18.474	63.373	2.446
min	12.400	9.800	56.000	6.200	2.000	3.000	8.000	30.000	73.840
25%	16.525	12.450	104.250	6.600	4.500	6.500	16.000	56.500	75.938
50%	17.200	15.750	138.000	6.900	6.500	9.500	21.500	75.500	78.030
75%	18.900	19.925	233.500	7.000	11.500	15.500	37.000	128.250	78.640
max	20.200	28.700	443.000	7.100	22.000	31.000	70.000	243.000	81.600

In order to display the level value of leaf color more intuitively, the leaf color data is expanded and adjusted in proportion here, and the leaf color distribution picture A as shown in Figure 1 is obtained.

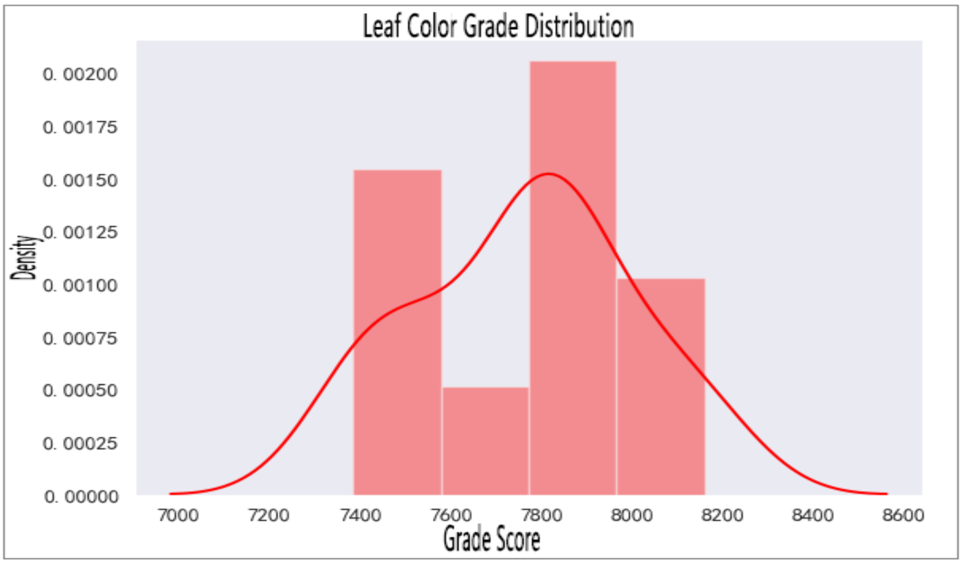

Figure 1: Leaf color level distribution diagram a.

Leaf color data are concentrated in (7400, 7600) and (7800, 8000), with more in (8000, 8200) and less in (7600, 7800).

4. Correlation Analysis of Data

The quantitative data of correlation of various parameters of flowers are shown in Table 3.

Table 3: Correlation quantification table a.

Category	Temperature	moisture	Conductivity	pH	nitrogen	phosphorus	potassium	fertility	Leaf color
Temperature	1.000	0.272	-0.015	-0.660	0.021	-0.004	-0.009	-0.013	-0.268
moisture	0.272	1.000	0.789	-0.433	0.807	0.795	0.790	0.788	0.300
Conductivity	-0.015	0.789	1.000	0.054	0.999	0.999	0.999	0.999	0.041
pH	-0.660	-0.433	0.054	1.000	0.015	0.053	0.049	0.054	-0.455
nitrogen	0.021	0.807	0.999	0.015	1.000	0.999	0.999	0.999	0.043
phosphorus	-0.004	0.795	0.999	0.053	0.999	1.000	0.999	0.999	0.021
potassium	-0.009	0.790	0.999	0.049	0.999	0.999	1.000	0.999	0.043
fertility	-0.013	0.788	0.999	0.054	0.999	0.999	0.999	1.000	0.038
Leaf color	-0.268	0.300	0.041	-0.455	0.043	0.021	0.043	0.038	1.000

According to the data in the correlation quantification table, leaf color grade is positively correlated with water, conductivity, nitrogen, phosphorus, potassium and fertility, among which water, nitrogen and potassium content have relatively great positive effects on leaf color grade; Leaf color grade is negatively correlated with temperature and pH value, among which pH value has a relatively great negative influence on leaf color grade. The correlation of other parameters, nitrogen, phosphorus, potassium and fertility, has a great positive correlation with each other; There is a negative correlation between conductivity and temperature. PH value has negative correlation with temperature and moisture.[8-10]

5. Data Enhancement and Optimization

In order to enhance the correlation of data, relevant parameter data are further collected; And improved the data collection method, using two devices to collect at the same time, taking the average value of the data. Ten groups of data are added on the basis of Table 1, as shown in Table 4. Parameter data with serial numbers of 11~20 have been added here.

Table 4: Data table b.

No.	Temperature (℃)	Moisture (%)	Conductivity (us/cm)	pH	nitrogen (mg/kg)	Phosphorus (mg/kg)	potassium (mg/kg)	fertility (mg/kg)	Leaf color (Hvalu)
11	13.9	28.7	353	6.9	17	24	56	194	83.22
12	18.3	13.3	103	6.9	5	7	16	56	76.31
13	18.7	12.8	111	6.7	5	7	17	61	75.79
14	18.9	29.3	250	4.0	12	17	40	137	71.11
15	19.7	18.8	183	6.8	9	12	29	100	75.73
16	18.8	17.7	105	6.9	5	7	16	57	69.70
17	20.6	11.7	87	7.0	4	6	13	47	68.00
18	20.0	58.2	1144	6.5	57	80	183	629	79.64
19	19.9	42.7	912	6.4	45	63	145	501	77.69
20	16.4	18.2	303	6.9	15	21	48	166	73.08

For the above 20 groups of data, the data distribution of each parameter is shown in Figure 2. The abscissa represents the numerical value of the parameter data, and the ordinate represents the distribution density of the parameter data. The distribution of each parameter can be visually seen through the distribution chart.

After adding data, the parameter correlation quantification data obtained is shown in Table 5.

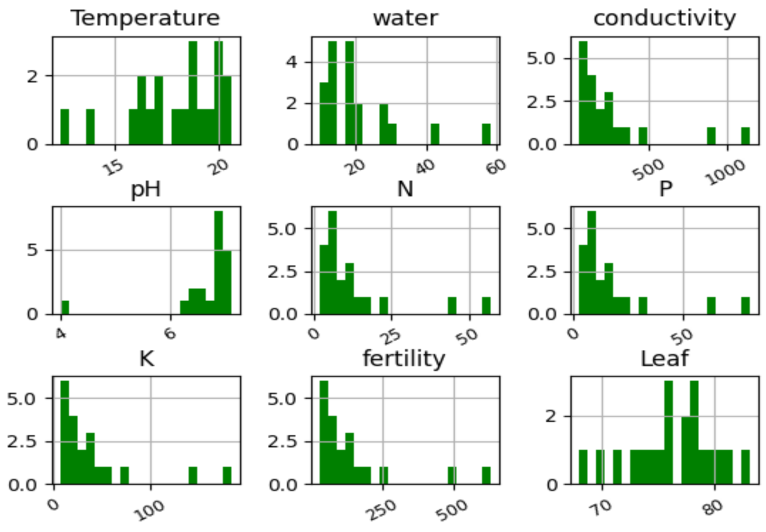

Figure 2: Parameter frequency distribution diagram.

Table 5: Correlation quantification table b.

Category	Temperature	moisture	Conductivity	pH	nitrogen	phosphorus	potassium	fertility	Leaf color
Temperature	1.0000	0.2378	0.1895	-0.2957	0.1993	0.1929	0.1903	0.1895	-0.4328
moisture	0.2378	1.0000	0.9470	-0.3378	0.9486	0.9476	0.9480	0.9471	0.2986
Conductivity	0.1895	0.9470	1.0000	-0.1363	0.9998	0.9998	0.9999	0.9999	0.2897
pH	-0.2957	-0.3378	-0.1363	1.0000	-0.1376	-0.1354	-0.1394	-0.1365	0.1619
nitrogen	0.1993	0.9486	0.9998	-0.1376	1.0000	0.9998	0.9998	0.9998	0.2853
phosphorus	0.1929	0.9476	0.9998	-0.1354	0.9998	1.0000	0.9998	0.9998	0.2827
potassium	0.1903	0.9480	0.9999	-0.1394	0.9998	0.9998	1.0000	0.9999	0.2902
fertility	0.1895	0.9471	0.9999	-0.1365	0.9998	0.9998	0.9999	1.0000	0.2899
Leaf color	-0.4328	0.2986	0.2897	0.1619	0.2853	0.2827	0.2902	0.2899	1.0000

From the quantitative table above, it can be seen that there is a strong positive correlation between leaf color grade and moisture, potassium content, electrical conductivity, nitrogen content, and phosphorus content, and a negative correlation with temperature. The correlation between other parameters, such as conductivity and pH, has a negative correlation.

6. Modeling Aanalysis and Ecological Prediction

Based on the improvement of data collection methods and the increase of data, the leaf color level distribution as shown in Figure 3 was obtained.

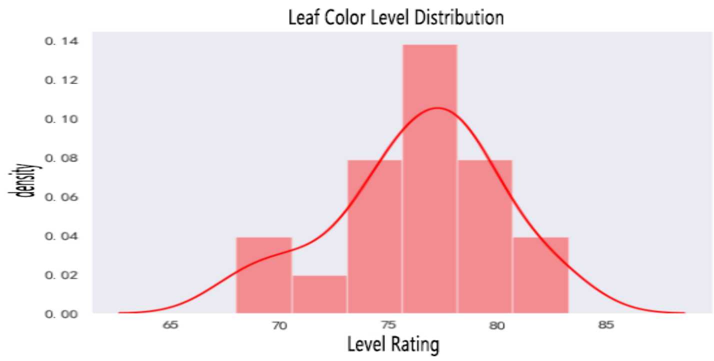

Figure 3: Leaf color level distribution diagram b

Our research team standardize the ecological data of flowers, establish regression models, write and run Python programs, and obtain relevant data as shown in Figure 4.

	coef	std err	t	P>|t|	[0.025	0.975]
Intercept	76.3320	0.727	105.031	0.000	74.732	77.932
Temperature	-1.5609	0.974	-1.603	0.137	-3.704	0.582
Moisture	5.4048	3.347	1.615	0.135	-1.962	12.772
Conductivity	-93.4670	453.460	-0.206	0.840	-1091.525	904.591
pH	1.8090	1.140	1.587	0.141	-0.699	4.317
Nitrogen	9.0755	58.048	0.156	0.879	-118.687	136.838
Phosphorus	-98.0045	51.961	-1.886	0.086	-212.371	16.362
Potassium	55.1224	133.328	0.413	0.687	-238.331	348.576
Fertility	123.8049	434.413	0.285	0.781	-832.332	1079.942

Omnibus:	1.827	Durbin-Watson:	1.198
Prob(Omnibus):	0.401	Jarque-Bera (JB):	0.560
Skew:	-0.315	Prob(JB):	0.756
Kurtosis:	3.524	Cond. No.	2.04e+03

Figure 4: Leaf color level distribution diagram b

Based on the above relevant data and adding adjustment coefficients Ki to each item, our research team establish a model as shown in formula 1:

$$\text{Leaf Color Level} = -1.5609 * \text{Temperature} * K1 + 5.4048 * \text{Moisture} * K2 - 93.4670 * \text{Conductivity} * K3 + 1.8090 * pH * K4 + 9.0755 * \text{Nitrogen} * K5 - 98.0045 * \text{Phosphorus} * K6 + 55.1224 * \text{potassium} * K7 + 123.8049 * \text{Fertility} * K8 + 76.3320 * K9 \quad (1)$$

Through fertilization, watering, temperature control and other ways to change the value of some environmental parameters of flowers, so that the flower ecology grows in a better direction. After waiting for the environmental parameters to stabilize for a period of time, relevant parameter data are collected again to predict the ecological value of leaf color. Select the relevant data, adjust the value of Ki, and conduct the program test. The data of group A (temperature, moisture, conductivity, pH, nitrogen, phosphorus, potassium and fertility) are 31.0℃, 25.4%, 129.0us/cm, 7.8, 6mg/kg, 9mg/kg, 20mg/kg and 70mg/kg), when K3 is 0.7488 and other coefficients are 1, a good prediction data is obtained, the leaf color prediction data is 92.076, the actual detection data is 91.82, and the error is 0.279%. Group B data (temperature, moisture, conductivity, pH, nitrogen, phosphorus, potassium, fertility, respectively: 23.3℃, 15.4%, 141.0us/cm, 7.9, 7mg/kg, 9mg/kg, 22mg/kg, 77mg/kg), when K3 is 0.7584 and other coefficients are 1, a good prediction data is obtained, the leaf color prediction data is 69.809, the actual detection data is 69.68, and the error is 0.185%.

According to the above data, the influence of electrical conductivity on ecological prediction fluctuates greatly. The parameter changes of electrical conductivity will be studied step by step, and a reasonable method will be found to solve the influence of each parameter on ecological prediction.

In the future, the following methods are proposed to optimize the original data and improve the prediction effect: (1) our team gradually correct the parameters to improve the accuracy of the data; (2) our team study other related methods and models, make in-depth analysis and comparison of parameters, and obtain a better data model; (3) our team enhance and optimize the data collection method to increase the accuracy of the original data; (4) our team enhance the training database, and combine the related technologies such as neural network and deep learning to improve the research effect.

7. Conclusion

Taking orchids as an example, this paper uses machine learning and Python technology to make statistics, processing, analysis, research and ecological prediction on the environmental parameters of flower ecology. The correlation and distribution density of environmental parameters such as temperature, moisture, conductivity, pH value, nitrogen, phosphorus, potassium and fertility, and their effects on leaf color parameters were analyzed. The data acquisition method is improved and the accuracy of the original data is increased. According to the statistical data studied, a model is established for data analysis and ecological prediction. And our research team adjust the coefficient to reduce the error and enhance the actual effect of the data model. The research methods, research contents and forecast information in this paper provide good practical application value for scientific and technological development and intelligent management in the field of flowers. The methods and techniques will be further improved to enhance the accuracy of data and enhance the actual prediction effect.

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