Abstract:

The COVID-19 outbreak at the end of 2019 has once again aroused wide concern from all sectors of society about the potential risks of wildlife trade and consumption, and also highlights the standardization of regulating wildlife trade practices. In this paper, we should prohibit the use of visualization, correlation analysis model and comparative analysis for a long time, and use Python to solve the problem.

In this paper, we use CITES trade database data to screen, divide, count, and then be visualized by Python to clearly show the main groups, species and main purpose uses of wildlife and non-wildlife trade. A correlation analysis model was introduced to demonstrate the correlation between the SARS epidemic in 2003 and the new coronavirus epidemic in 2020 combined with CITES trade data, which reflected the strong correlation between wildlife trade and major epidemics.

Finally, combined with the above analysis conclusions and relevant authoritative literature, wildlife trade should be banned for a long time from three different aspects of economy, society and ecology. Then summarize and put forward suggestions in the form of letters.

Key word: wildlife, major epidemic, correlation analysis, SARS epidemic, COVID-19, economy, society, ecology, visualization.

Contents

1 Brief introduction

1.1 Background of the problem

With the novel coronavirus raging, the public health problems arising in the wildlife trade have once again attracted wide attention, with experimental results showing that the SARS virus in 2003, the Ebola virus in Africa and the current novel coronavirus are both suspected to be related to the wildlife market. There is no doubt that wildlife trade has many negative effects, and the three most important ones are the sudden decline or even extinction of populations, the invasion of alien species and the spread of diseases. Accordingly, some researchers hope to kill the trade entirely, but it will expose some people to unemployment and cost the country's economy so much. So whether the wildlife trade should be banned for a long time has become a controversial topic.

1.2 Problem restatement

Now we use the CITES trade database as our data source, based on the above background and data information, we need to build a mathematical model to solve the following problems:

- Information was extracted from wildlife trade data to analyze which groups and species were the most traded.
- The main purposes of analyzing these wildlife and non-wildlife trades.
- Changes in wildlife import and export trade over the past two decades, 2003-2022.
- Is the wildlife trade related to outbreaks of major infectious diseases.
- Whether a long ban on wildlife trade is feasible, what is the economic and social impact, and explain why.
- Analyze the results of the above issues, and write a letter to the relevant U. S. government departments, explaining our views and making policy recommendations.

2 Analysis of problems

2.1 Analysis of question 1

For problem 1: Extract information from wildlife trade data, then from four angles (Order, Family, Genus, Taxon) to classify wildlife volume, analyze which groups and species are traded the most, and then use horizontal bar statistics for visual modeling, to clearly show which groups and species are traded the most times.

2.2 Analysis of question 2

For question 2: Start from the two major aspects of (wild animals and non-wild animals), make statistics, and then analyze the relatively high part, make statistics on which species are mainly in this part, and analyze the main purpose of these wild animals and non-wildlife trade.

2.3 Analysis of question 3

For question 3: Statistics the animal trade data of the past two decades (2003-2022), and analyze the changes in wildlife import and export trade in connection with the major outbreaks in the world at that time.

2.4 Analysis of question 4

For question 4:Whether wildlife trade is related to outbreaks of major infectious diseases. The correlation analysis of the two major epidemics of SARS and COVID-19 was mainly conducted to explore the correlation between the major epidemics and wildlife trade, establish the correlation analysis model, and then answer the questions according to the statistical results.

2.5 Analysis of question 5

For question 5: Combined with the relevant authoritative literature and accurate data, from the economic, social, and ecological three aspects of the demonstration, whether it is feasible to ban the wildlife trade for a long time, what will have an impact on the economy and society, and explain the reasons.

2.6 Analysis of question 6

For question 6: Analyze the results of the above issues, and write a letter to the relevant departments of the US government, explaining our views and making policy suggestions. Summarize the analysis results in the present paper, and write a simple letter to explain the views and some suggestions of the paper.

3 Model establishment and solution

3.1 Visual analysis model establishment and solution

3.1.1 The hypothesis of the model

For CITES trade database data, Source is divided into field captured (W) and unknown (U) two kinds, the title requires selecting Source=W data, for Source= blank part and Source=U two parts, the default is not field captured data. This model is used to solve problems one, two, three.

3.1.2 The establishment and solution of the first question visual model

- Wildlife data was filtered out, sorted according to Order, and their data were visualized:

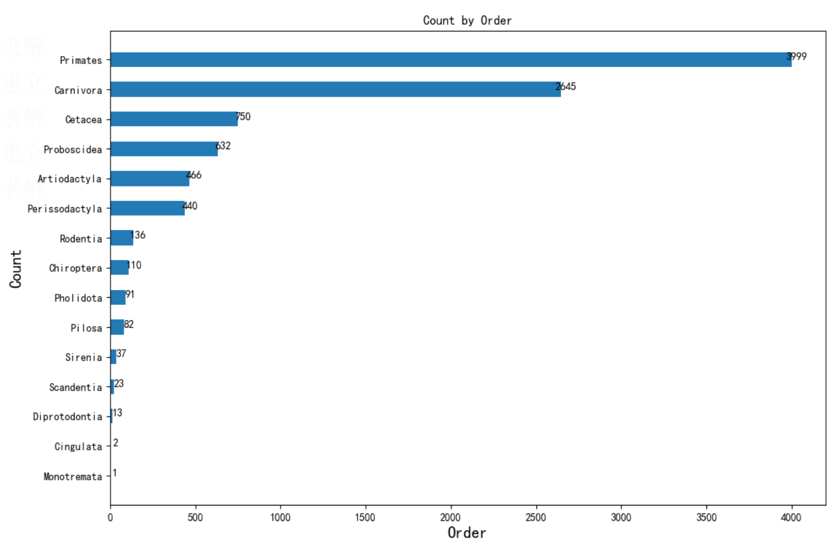


Figure 1:

- Wildlife data were filtered out, classified according to Family, and the top 20 data were visualized:

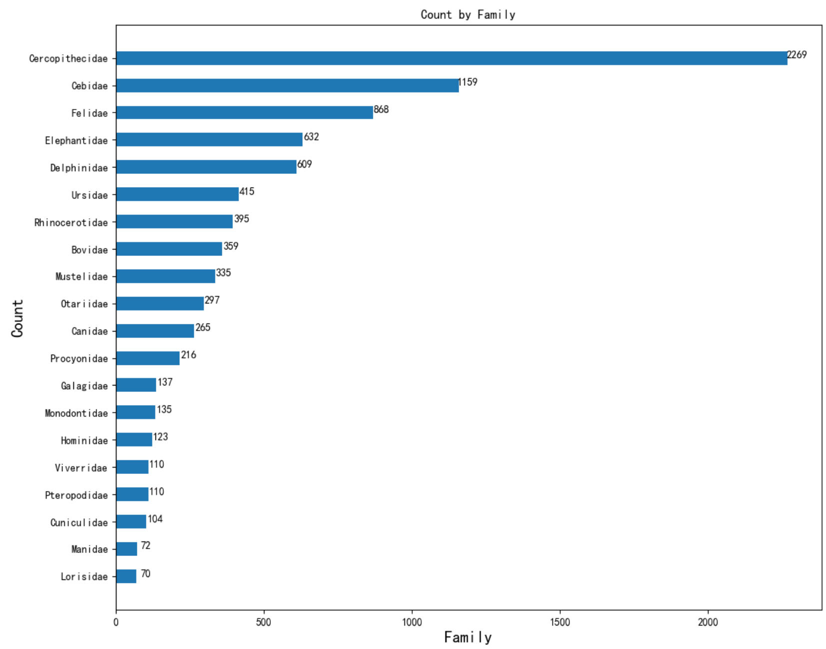


Figure 2:

- The wildlife data were filtered and sorted according to Genus, and the top 20 data were visualized:

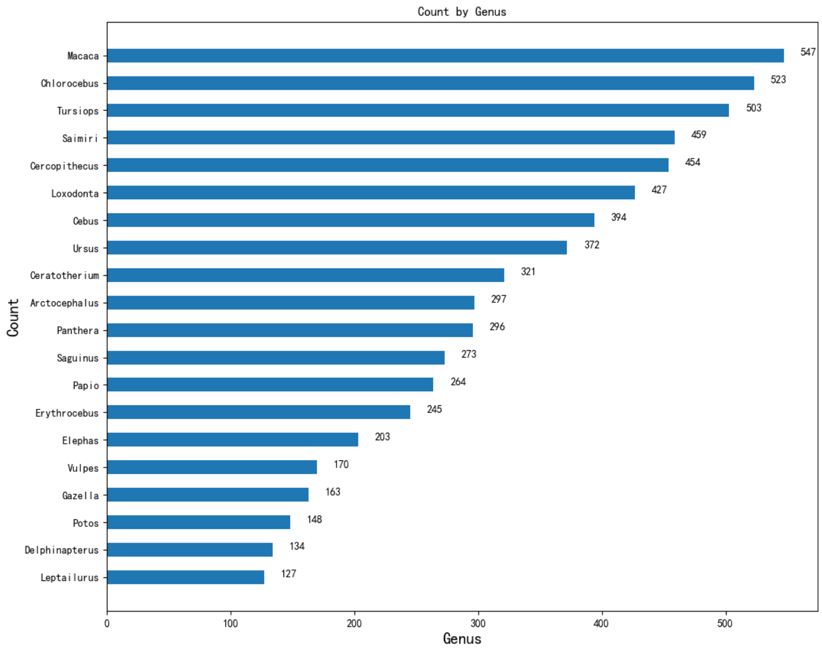

Count by Genus
Macaca 547
Chlorocebus 523
Tursiops 503
Saimiri 459
Cercopithecus 454
Loxodonta 427
Cebus 394
Ursus 372
Ceratotherium 321
Arctocephalus 297
Panthera 296
Saguinus 273
Papio 264
Erythrocebus 245
Elephas 203
Vulpes 170
Gazella 163
Potos 148
Delphinapterus 134
Leptailurus 127
Count
Genus
0 100 200 300 400 500

Figure 3:

- The wild animals were filtered and sorted according to Taxon, and the top 20 data were visualized:

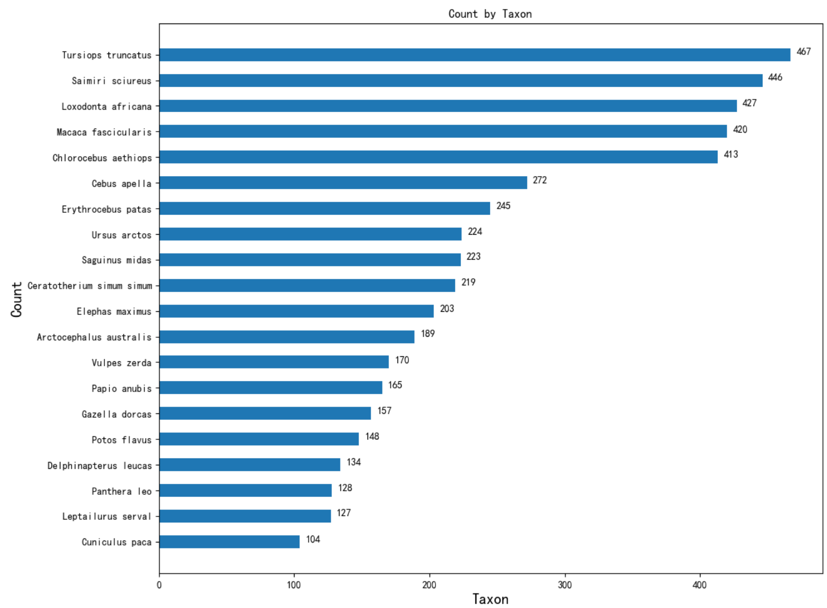


Figure 4:

3.1.3 Solving the problem

- Figure 1:According to the Order classification, Primates are the group with the most.

- Figure 2:According to Family classification, Cebidae is the most frequent in Genus classification.

- Figure 3: According to Genus classification, the trade frequency of Chlorocebus is the highest according to Taxon classification.

- Figure 4: According to the Taxon classification, the Saimiri Sciureus category has the highest number of trades.

3.2 The second question is about model building

In the case of the first asked wildlife data screening out, as indicated in CITES trade database

"If all these details reported by the exporter / re-exporter and importer are the same, the transaction will appear on the same line of the form. It should be noted that the details of specific transactions reported by exporters / reexporters and importers often do not show perfect correlation and therefore do not appear in the same line of the comparison table"

Therefore, further data is needed to deweight the data of the CITES trade database, and then statistics the main purpose of wildlife and non-wildlife trade, and display it using bar statistics and pie charts.

- For wildlife, the data were statistical analyzed by using a visual model as follows:

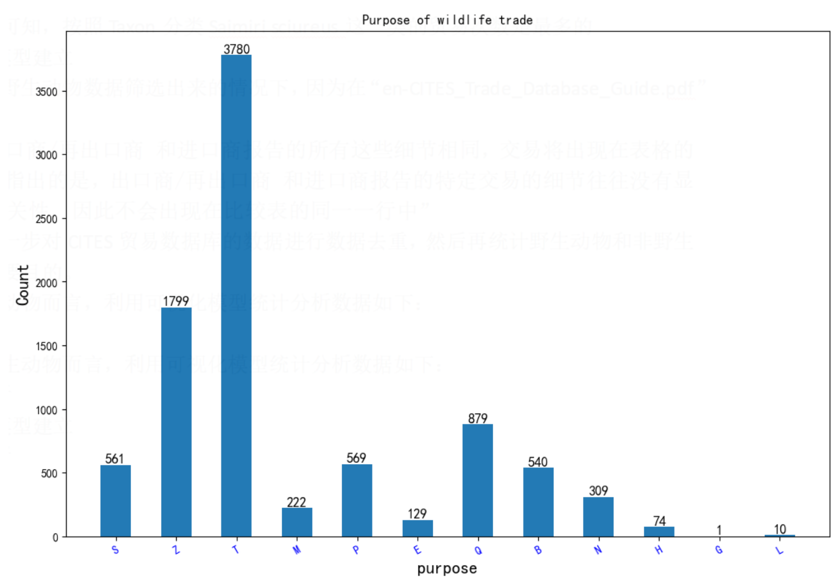


Figure 5:

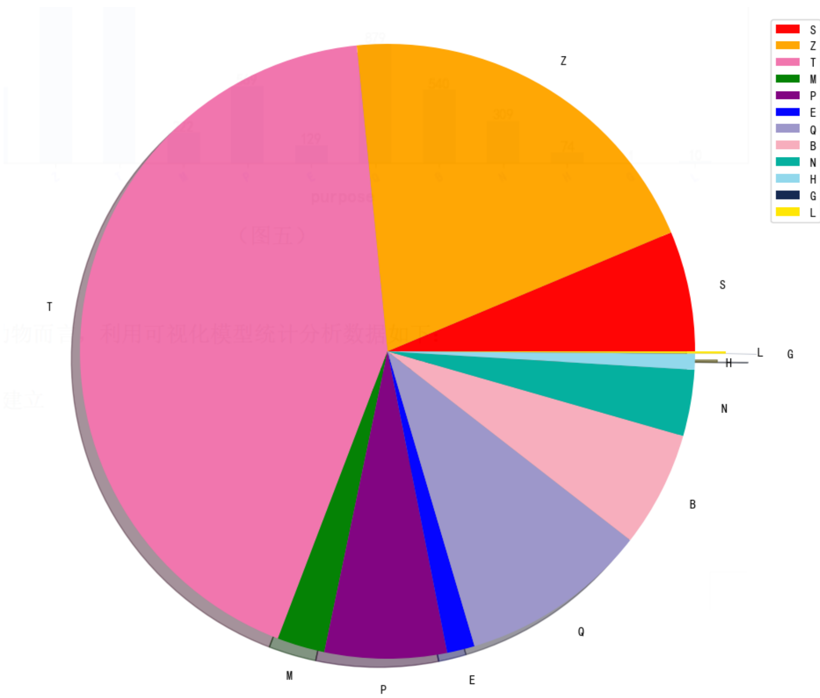


Figure 6:

- For non-wild animals, the data were analyzed by using visual models as follows:

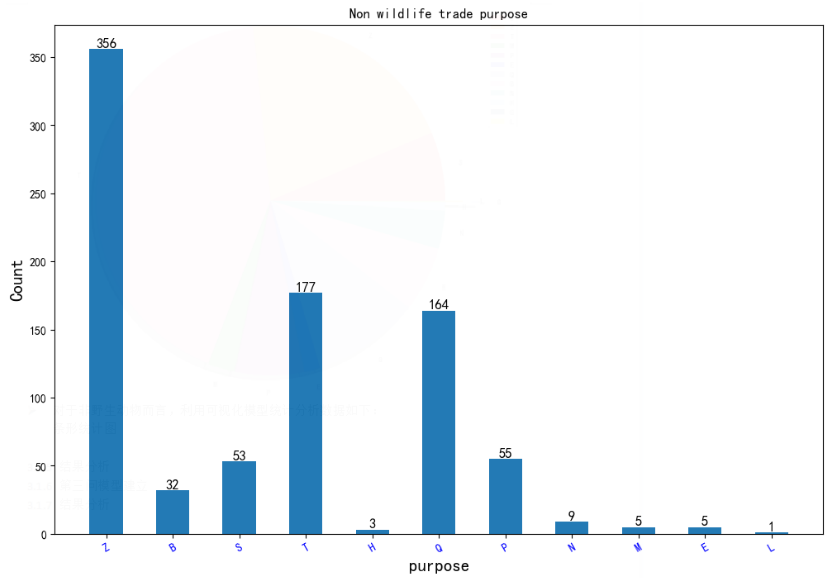

Non wildlife trade purpose
Count
purpose
356
32
53
177
3
164
55
9
5
5
1
Z
B
S
T
H
Q
P
N
M
E
L
0
50
100
150
200
250
300
350

Figure 7:

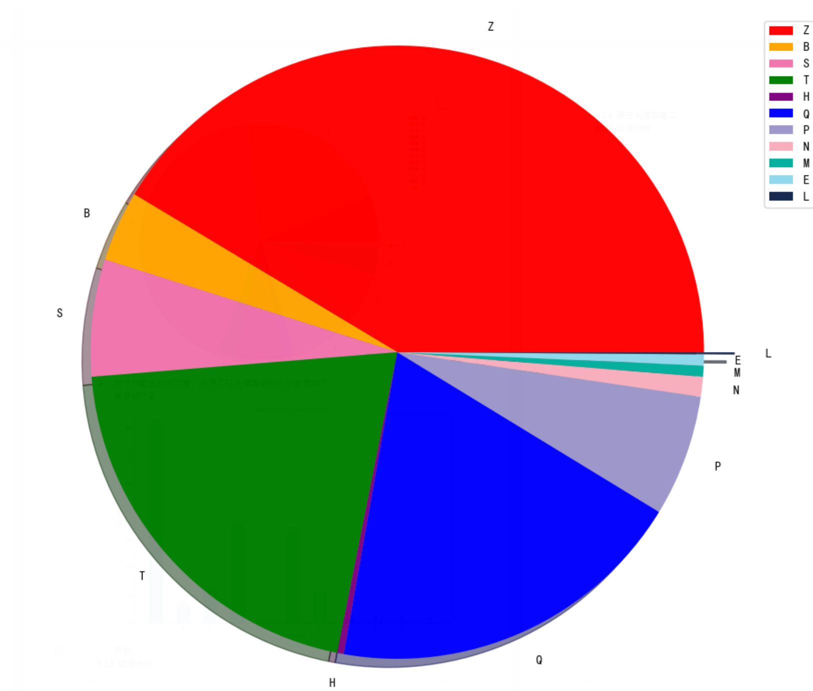


Figure 8:

3.2.1 Interpretation of results

According to Figure 5 and Figure 6, the purpose of wildlife trade is mainly commercial and zoo.

According to Figure 7 and Figure 8, the purpose of non-wildlife trade is mainly zoo and commercial.

In the case of wildlife, a statistical analysis will be used for commercial wildlife, calculated as follows:

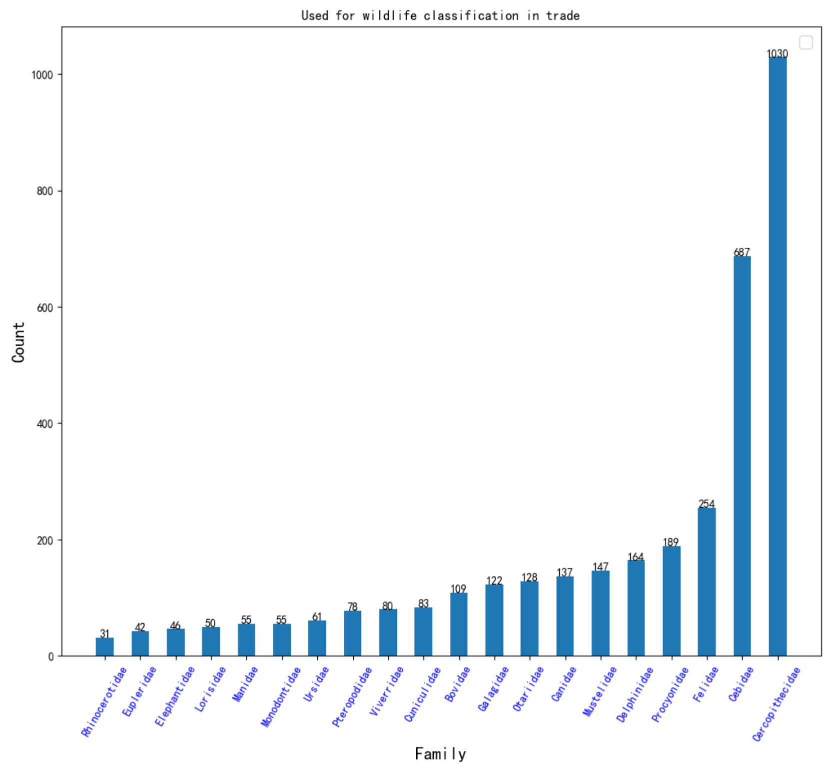


Figure 9:

According to Figure 8, combined with the false publicity of various health programs, the traditional ideas of the older generation and the backward thought of ”where to eat”, this part of consumers will mainly choose to buy the organs of wild animals for health care and treatment of certain diseases.[1]

Even if they have the same effect in the market, they will still subconsciously think that wildlife can provide higher nutrition than those raised in captivity, so they choose to buy wildlife. And macaque family, Capuchin family is loved by the people.[2]

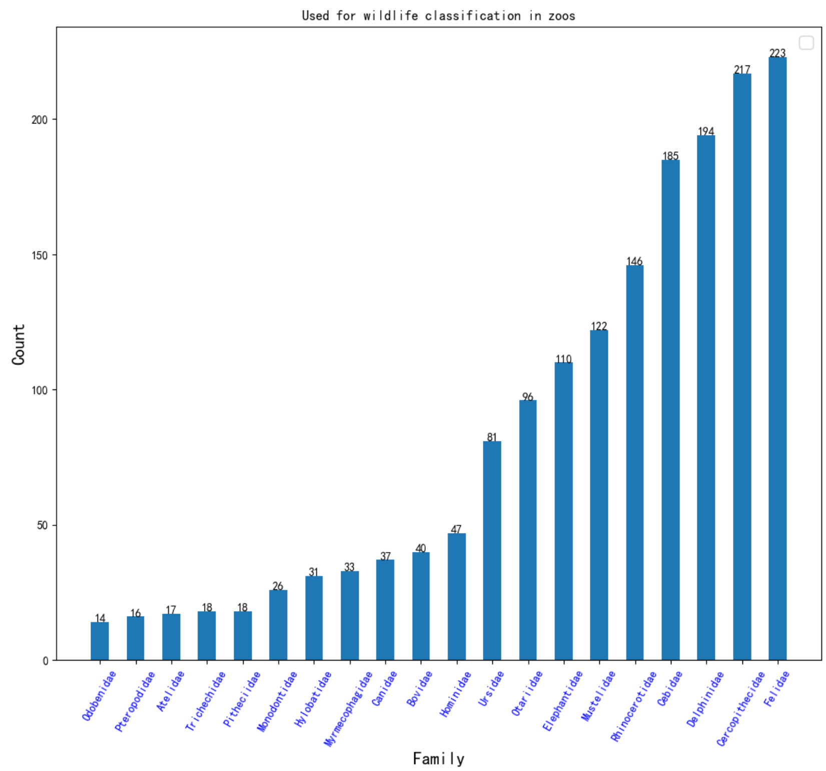


Figure 10:

According to Figure 10, the cats and macaques are mainly used in zoos, etc. These categories of wild animals have high ornamental value and high accessibility.

Combined with the statistical classification of wildlife in the main uses of commercial and zoo, it can be seen that a very large number of monkey wildlife are used for trade, its main purpose for (commercial) consumption and (zoo) viewing.

3.2.2 The third question is about model building

The annual export, import and total trade data from 2003 to 2021 are extracted from the CITES trade database for statistics, and then visualized in the form of a line chart to clearly represent the fluctuations and changes of the trade data from 2003 to 2022, and select the years with large data fluctuations for analysis.

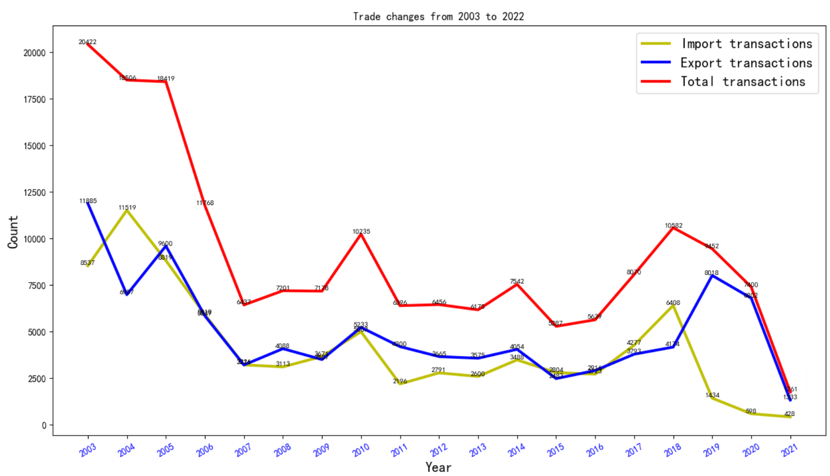


Figure 11: 11

3.2.3 Interpretation of result

In 2003, the total wildlife trade volume reached a peak.The main reason for this was the global outbreak of SARS and subsequent evidence that reducing the flow of wildlife to the market did indeed act as a deterrent. [3] as a result, the market demand has declined and the total trade volume has declined significantly.

From 2005 to 2007, the volume of import and export trade showed a straight downward trend. One of the possible reasons is that bird flu swept the United States and some Asian countries in early 2004, and other countries in China, Japan and Vietnam. In early 2005, bird flu swept the world, affecting the United States and more than a dozen Asian countries and regions, including Vietnam, Indonesia, Thailand and China. Since then, Russia, Ukraine, Romania, the United Kingdom, Colombia and Turkey. The outbreak has killed millions of poultry and even many from bird flu. In order to prevent the further spread of avian flu and spread the virus from person to person, the United Nations and other international organizations held meetings to discuss countermeasures, and the local governments responded positively and decided to rectify the animal market.

Since 2018, imports fell sharply, the lowest in nearly a decade in 2021; total trade fell between 2018 and 2021, and fell sharply in 2020, the lowest in nearly a decade in 2021. One of the main reasons is that most countries around the world have been deeply affected by the COVID-19 pandemic, and studies have shown that the wildlife market is the suspected source of the major outbreak, so many countries have also tightened their wildlife trade rules.

3.3 Correlation analysis model establishment and solution

3.3.1 Assumptions of the model

The model explores the correlation of wildlife trade with major outbreaks, assuming that other non-important factors of significant outbreaks are ignored, and only the Source=W data is counted as wildlife data. Take the SARS epidemic and COVID-19 as examples to solve the fourth question.

3.3.2 Analysis of correlation factors

Assuming there is a correlation between the outbreak and wildlife trade:

Correlation 1: In the countries with the worst SARS outbreak, its wildlife trade should be more equivalent to that of other countries;

Correlation 2: When the SARS outbreak occurs, the number of wildlife import or export should be at a peak value, and after the outbreak, people's consumer demand will decline significantly, and the government will take relevant policies to vigorously suppress it, and the wildlife trading volume will show a sharp downward trend.

3.3.3 Take SARS as an example

According to the latest statistics released by the World Health Organization on August 15,2003, the total number of SARS cases worldwide is 8,422, involving 32 countries and regions. The global death toll from SARS was 919, with a case fatality rate of nearly 11According to the above data, China is one of the countries with the worst SARS outbreak, so is the epidemic somewhat related to the wildlife trade? At the beginning of the SARS outbreak in 2003, wildlife imports from various countries and China's wildlife import data from 1990 to 2022 fluctuated were visualized as follows:

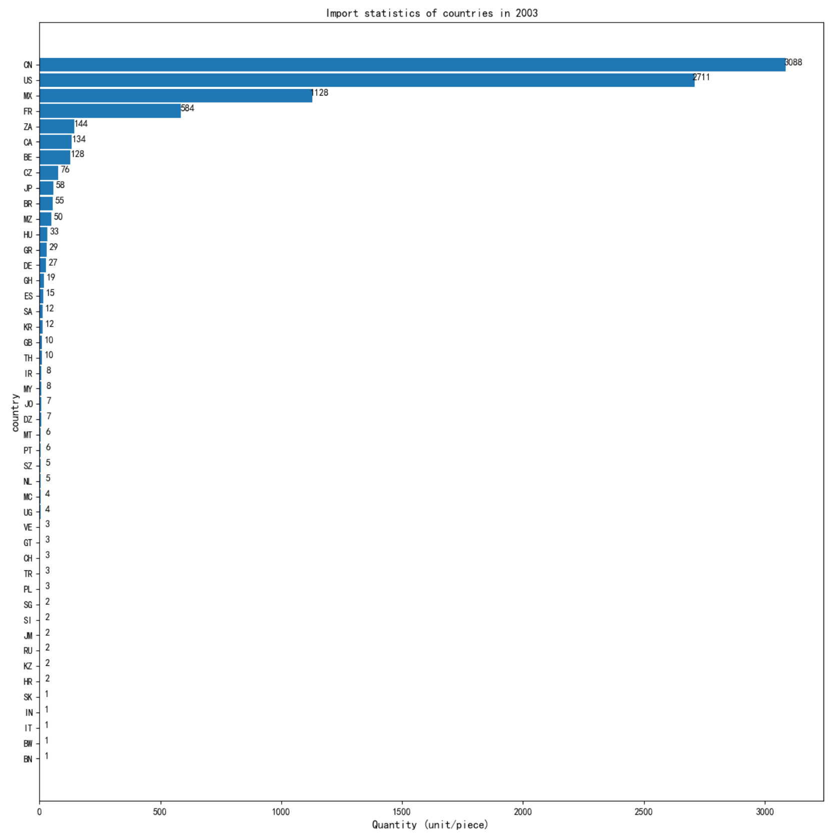

Import statistics of countries in 2003
country
Quantity (unit/piece)
CN
US
MX
FR
ZA
CA
BE
CZ
JP
BR
MZ
HU
GR
DE
GH
ES
SA
KR
GB
TH
IR
MY
JO
DZ
MT
PT
SZ
NL
MC
UG
VE
GT
CH
TR
PL
SG
SI
JM
RU
KZ
HR
SK
IN
IT
BW
BN
3088
2711
1128
584
144
134
128
76
58
55
50
33
29
27
19
15
12
12
10
10
8
8
7
7
6
6
5
5
4
4
3
3
3
3
3
2
2
2
2
2
2
1
1
1
1
1
0
500
1000
1500
2000
2500
3000

Figure 12:

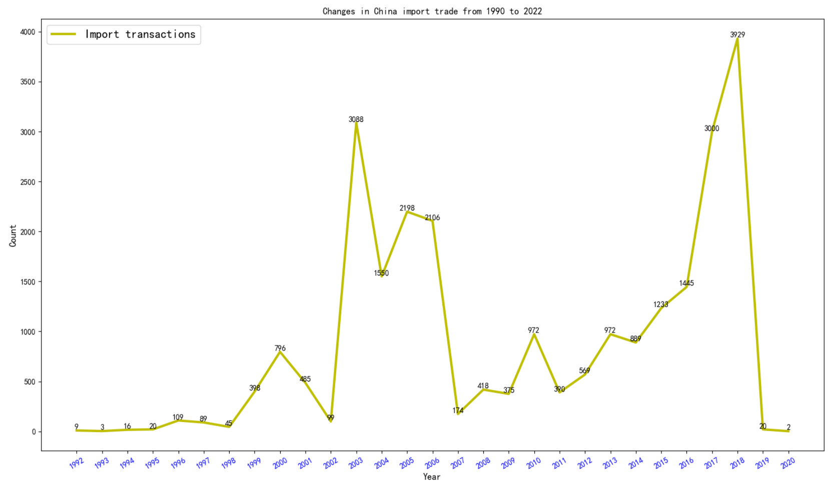


Figure 13:

3.3.4 Analysis of the SARS model results

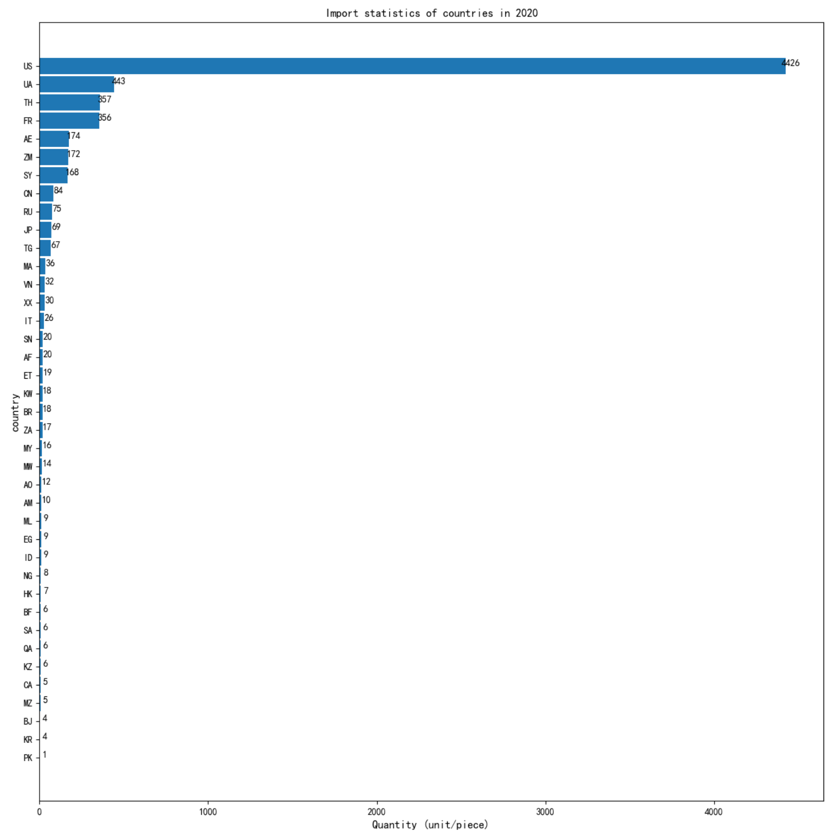
According to Figure 13 and the statistics of the World Health Organization (WHO) [4], in 2003, China imported 3088 wild animals, ranking first in the world. In 2003, the SARS epidemic in China happened to be the most serious. The results show that there is a strong correlation 1 between wildlife trade and major epidemics.It is assumed that this is true.

According to Figure 14 and the statistics of the World Health Organization (WHO) [4], the import volume of wild animals in China was at the peak in 2003, and then after 2003, the trade volume of wild animals in China dropped sharply. The results show that there is a strong correlation 2 between the trade of wild animals and major epidemics.It is assumed that this is true.

3.3.5 Take the COVID-19 as an example

According to the real-time global data, the ten countries with the most deaths from COVID-19 are: the United States (614007), Brazil (479791), India (363097), Mexico (228754), Britain (127867), Italy (126690), Russia (125278), France (110202), Germany (90280), and Spain (80196).5

According to the above data, one of the countries with the most serious COVID-19 outbreak in the United States (ignoring policy and other reasons), so whether the correlation of the SARS model is still valid, so count the number of wildlife imports in each country in 2020; and the wildlife trade in the US from 1990 to 2022, and then establish the model.


Import statistics of countries in 2020
country
Quantity (unit/piece)
US
UA
TH
FR
AE
ZM
SY
CN
RU
JP
TG
MA
VN
XX
IT
SN
AF
ET
KW
BR
ZA
MY
MW
AO
AM
ML
EG
ID
NG
HK
BF
SA
QA
KZ
CA
MZ
BJ
KR
PK
4426
443
357
356
174
172
168
84
75
69
67
36
32
30
26
20
20
19
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12
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9
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7
6
6
6
6
5
5
4
4
1
0
1000
2000
3000
4000

Figure 14:

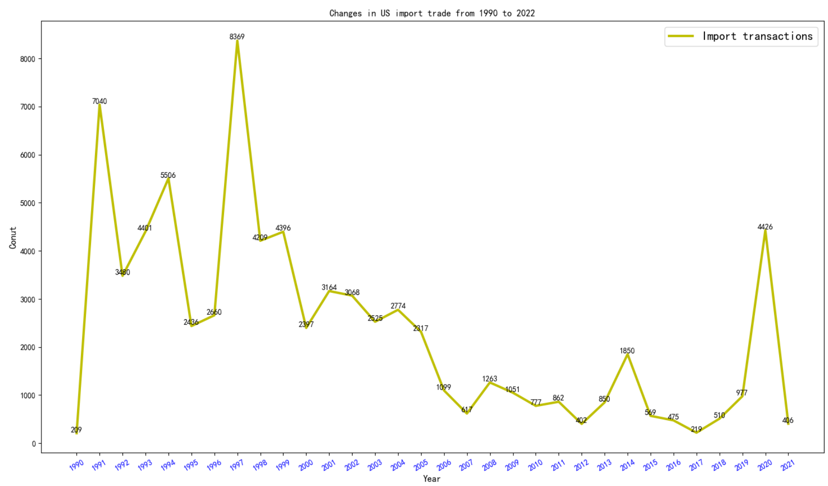


Figure 15:

3.3.6 Analysis of the COVID-19 model results

According to figure 15 and data from the World Health Organization (WHO) , the outbreak in 2020 was the largest in the world, the characteristics of us wildlife imports in 2020 were also similar to those of China during the SARS outbreak in 2003, suggesting a correlation 1 between wildlife trade and major outbreaks,the assumption is true.

According to Figure 16, the fluctuation of the US wild animal import data from 1990 to 2022, it can be seen that the wild animal import data in the United States reached a peak in 2020, and then showed a rapid downward trend, like the correlation 2 of SARS in 2003, and the assumption is also true.

3.3.7 Binding analysis

In summary, Under the hypothetical conditions, Wildlife trade and major outbreaks have strong associations, In terms of quantity, At the time of the SARS outbreak in 2003, The country with the most wildlife imports is also one of the worst with SARS outbreaks, Also at the time of the COVID-19 outbreak, meet the same relevance: the United States, which imports the most wildlife, is also one of the worst COVID-19 outbreaks; In terms of data fluctuations, China's data fluctuations around 2003 and the US data fluctuations in 2020 have a high correlation coefficient, This correlation also complies with the peak theory of a major outbreak, Therefore, data from Chinese wildlife trade from 1990-2020 and US wildlife trade from 1990-2020 also indicate that wildlife trade and major outbreaks have a strong correlation. It also shows that the wildlife trade is related to a major epidemic!

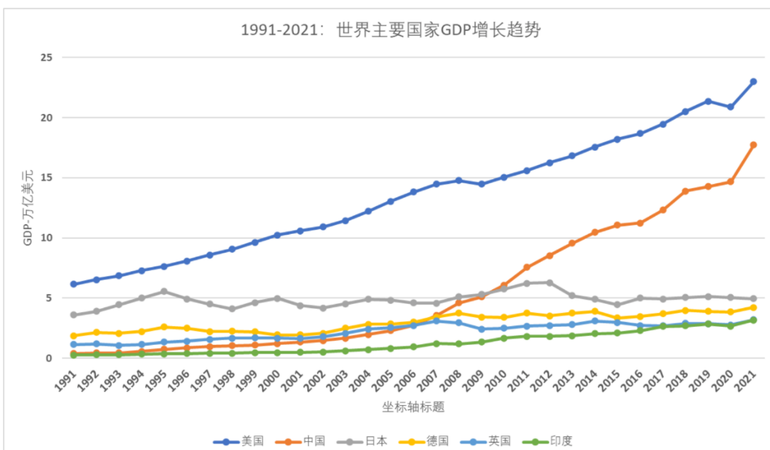
3.4 Question 5 for argument

3.4.1 Views

By solving the model, we found that major infectious disease outbreaks are closely linked to the wildlife trade, so we agree with the long-term ban on the wildlife trade.

3.4.2 Argument 1, on the economy

On the basis of the fourth question, the economic impact of the long-term ban on wildlife trade is not particularly large in the long term, citing the GDP growth trend in the major countries in the world from 1991 to 2021.



美国/中国/日本/德国/英国/印度-1991至2021近30年世界主要国家GDP增长趋势

Figure 16:

From the World Bank's public data, look at GDP growth trends in the world's major countries from 1991 to 2021, as shown in Figure 17,it can be seen some information: in addition to China, other countries in novel coronavirus outbreak, the economy has appeared a negative growth or no growth trend, and for the outbreak of 50 billion annual losses are almost negligible, so for long-term sustainable development, a long-term ban on wildlife trade is completely necessary.

3.4.3 Demonstration 2, about society

A long-term ban on wildlife trade will have a certain impact on society and a great impact on the wildlife market, and even unemployed 1 million people in China, but these are negligible compared with the impact of the epidemic.

A novel coronavirus virus (COVID-19) causing respiratory diseases was first reported in Wuhan city, Hubei province, China, in 2019. In less than a year, the COVID-19 pandemic has claimed more than 1.6 million lives and infected more than 75 million people worldwide. These huge data make everyone scared. The measures taken during the outbreak, such as home quarantine, banning visiting relatives and friends, suspending gatherings, suspending, and brief handling,it can be seen that the sudden epidemic has seriously affected people's normal life and the reasonable operation of the national economy.

It is reported that during the outbreak in 2020, many countries took a series of emergency measures to save themselves, setting off a "wave of closures " around the world. Italy has imposed a three-month (March-June) state ban; Canada extends its foreign entry ban until July 31; and Malaysia may not consider easing entry restrictions until August 31.[**?**]

To sum up, a long-term ban on wildlife trade to prevent the epidemic is of great significance to the sustainable development of society.

3.4.4 Argument 3, about ecology

Related literature shows that since the 16th century, with the rapid population growth of the 16th century, more than 150 species of birds and nearly 110 species of mammals have become completely extinct. China is also a major distribution country of endangered animals.[**?**] More than 400 species of fish, amphibians and birds listed in the Red Book of Endangered Animals; 257 species listed in the State Wildlife List; among 640 species listed in China, more than 120 endangered species originated in China are below the minimum survival quantity, which shows the urgency and importance of banning wildlife trade and ecological balance protection.

4 A letter to the relevant U. S. staff member

Dear Sir:

Hello!

Our team has analyzed the data of the wildlife trade market in recent years, and by establishing mathematical modeling, combined with the data from major infectious outbreaks, we believe that there is an inseparable link between the wildlife trade and major infectious outbreaks. You know that the United States has become the second largest market for the wildlife trade and one of the countries most affected by the epidemic. Therefore, our team wants to give you some advice to help you resolve this problem.

First,Vigorously publicize the harm of wildlife to the public. Under the influence of false propaganda from various media, in the eyes of many people, wild animals are the good medicine for some difficult diseases, and the nutritional value of wild animals is much higher than that of artificial breeding, but there is no exact scientific basis to prove this. Not only that, some endangered species are regarded as signs of wealth and status, and they are often used to show off their wealth and ”save face”. People know little about wildlife, and the harm of wildlife is easily affected by the surrounding environment.”Star power” and advertising can be used to inform people about the dangers of wildlife.

Second,Strengthen the supervision of the wildlife market. At present, the so-called ”fresh markets” are complex and diverse, such as seafood markets with good management systems, land and sea game that do not meet quarantine standards and markets for home feeding livestock and poultry, and underground markets that sell endangered wild animals. These market hygiene and substandard food standards are all possible routes for virus transmission, posing a great threat to people’s health. Therefore, comprehensive and strict regulatory measures should be taken to punish and rectify the non-standard game market and illegal wildlife trade, and to crack down on the underground game market and trading behavior to escort people’s food safety.

third,Starting from the source, one of the best ways to reduce the amount of wildlife trade is to protect the wildlife from its habitat, before its resource utilization, trade, and consumption occur. The huge challenges in wildlife conservation are the possible loss of wildlife-based tourism and the disappearance of related jobs, which could further lead to increased hunting and smuggling of wildlife, especially high-risk or endangered animals. In this difficulty, the government can support the unemployed and provide them with living security.

Above is the advice from our team. Hope that our suggestions will help you.

5 Reference

References

[1] Adam J Dutton, Cameron Hepburn, and David W Macdonald. A stated preference investigation into the chinese demand for farmed vs. wild bear bile. *PloS one*, 6(7):e21243, 2011.

[2] Z Liu, ZG Jiang, and AF Yang. Research progress on trade and consumer behavior of wild animals. *Chinese Journal of Wildlife*, 38(4):712–719, 2017.

6 Appendix

6.1 Symbol table

Purpose	
B	Breeding in captivity or artificial propagation
E	Educational
G	Botanical garden
H	Hunting trophy
L	Law enforcement / judicial / forensic
M	Medical (including biomedical research)
N	Reintroduction or introduction into the wild
P	Personal
Q	Circus or travelling exhibition
S	Scientific
T	Commercial
Z	Zoo

Country and territory codes	
CN	CHINA
US	UNITED STATES OF AMERICA
FR	FRANCE
ZA	SOUTH AFRICA
CA	CANADA
BE	BELGIUM
CZ	CZECH REPUBLIC
JP	JAPAN
BR	BRAZIL
MZ	MOZAMBIQUE
HU	HUNGARY
GR	GREECE
DE	GERMANY
GH	GHANA
ES	SPAIN
SA	SAUDI ARABIA
KR	KOREA, REPUBLIC OF
GB	UNITED KINGDOM OF GREAT BRITAIN
TH	THAILAND
IR	IRAN, ISLAMIC REPUBLIC OF
MY	MALAYSIA
JO	JORDAN
DZ	ALGERIA
MT	MALTA
PT	PORTUGAL
SZ	SWAZILAND
NL	NETHERLANDS
MC	MONACO
UG	UGANDA
VE	VENEZUELA, BOLIVARIAN REPUBLIC OF
GT	GUATEMALA
CH	SWITZERLAND
TR	TURKEY
PL	POLAND
SG	SINGAPORE
SI	SLOVENIA
JM	JAMAICA
RU	RUSSIAN FEDERATION
KZ	KAZAKHSTAN
HR	CROATIA
SK	SLOVAKIA
IN	INDIA
IT	ITALY

Country and territory codes	
BW	BOTSWANA
BN	BRUNEI DARUSSALAM
UA	UKRAINE
AE	UNITED ARAB EMIRATES
ZM	ZAMBIA
SY	SYRIAN ARAB REPUBLIC
TG	TOGO
MA	MOROCCO
VN	VIET NAM
XX	UNKNOWN
SN	SENEGAL
AF	AFGHANISTAN
ET	ETHIOPIA
KW	KUWAIT
MW	MALAWI
AO	ANGOLA
AM	ARMENIA
ML	MALI
EG	EGYPT
ID	INDONESIA
NG	NIGERIA
HK	HONG KONG
BF	BURKINA FASO
QA	QATAR
KZ	KAZAKHSTAN

6.2 Code

```
#
\begin{python}
#
import pandas as pd
import math
import matplotlib.pyplot as plt
from wordcloud import WordCloud
from collections import Counter
import matplotlib.ticker as ticker

#      Order
def plot_by_order(order, s):
    # print(s)
    cnt = {}
    for i in range(len(order)):
        if(s[i] != 'W'):
            continue
        cnt[order[i]] = cnt.get(order[i], 0) + 1
```

```
    tmp = dict(sorted(cnt.items(), key=lambda x : x[1]))
    x,y = [], []
    for a, b in tmp.items():
        x.append(a)
        y.append(b)
    #
    plt.rcParams['font.sans-serif'] = ['SimHei']   #
    plt.rcParams['axes.unicode_minus'] = False   #
    plt.figure(figsize=(12, 8))
    plt.barh(x, y, height=0.5)
    plt.title('Count by Order')
    for x, y in zip(x,y):
        plt.text(y+30, x, '%.0F' % y, ha='center', fontsize=10)
    plt.xlabel('Order', fontsize=15)
    plt.ylabel('Count', fontsize=15)
    plt.show()


#       Family
def plot_by_family(Family, s):
    # print(s)
    cnt = {}
    for i in range(len(Family)):
        if(s[i] != 'W'):
            continue
        cnt[Family[i]] = cnt.get(Family[i], 0) + 1

    tmp = dict(sorted(cnt.items(), key=lambda x: x[1]))
    x, y = [], []
    for a, b in tmp.items():
        x.append(a)
        y.append(b)
    #
    print(y)

    plt.rcParams['font.sans-serif'] = ['SimHei']   #
    plt.rcParams['axes.unicode_minus'] = False   #
    plt.figure(figsize=(12, 10))
    plt.barh(x[-20:], y[-20:], height=0.5)
    plt.title('Count by Family')
    for x, y in zip(x[-20:], y[-20:]):
        plt.text(y+30, x, '%.0F' % y, ha='center', fontsize=10)
    plt.xlabel('Family', fontsize=15)
    plt.ylabel('Count', fontsize=15)
    plt.show()


#       Genus
def plot_by_Genus(Genus, s):
    # print(s)
    cnt = {}
    for i in range(len(Genus)):
        if(s[i] != 'W'):
            continue
        cnt[Genus[i]] = cnt.get(Genus[i], 0) + 1
```

```
    tmp = dict(sorted(cnt.items(), key=lambda x: x[1]))
    x, y = [], []
    for a, b in tmp.items():
        x.append(a)
        y.append(b)
    #
    print(y)

    plt.rcParams['font.sans-serif'] = ['SimHei']  #
    plt.rcParams['axes.unicode_minus'] = False  #
    plt.figure(figsize=(12, 10))
    plt.barh(x[-20:], y[-20:], height=0.5)
    plt.title('Count by Genus')
    for x, y in zip(x[-20:], y[-20:]):
        plt.text(y+20, x, '%.0F' % y, ha='center', fontsize=10)
    plt.xlabel('Genus', fontsize=15)
    plt.ylabel('Count', fontsize=15)
    plt.show()


#       Taxon
def plot_by_Taxon(Taxon, s):
    # print(s)
    cnt = {}
    for i in range(len(Taxon)):
        if(s[i] != 'W'):
            continue
        cnt[Taxon[i]] = cnt.get(Taxon[i], 0) + 1

    tmp = dict(sorted(cnt.items(), key=lambda x: x[1]))
    x, y = [], []
    for a, b in tmp.items():
        x.append(a)
        y.append(b)
    #
    # print(y)

    plt.rcParams['font.sans-serif'] = ['SimHei']  #
    plt.rcParams['axes.unicode_minus'] = False  #
    plt.figure(figsize=(12, 10))
    plt.barh(x[-20:], y[-20:], height=0.5)
    plt.title('Count by Taxon')
    for x, y in zip(x[-20:], y[-20:]):
        plt.text(y+10, x, '%.0F' % y, ha='center', fontsize=10)
    plt.xlabel('Taxon', fontsize=15)
    plt.ylabel('Count', fontsize=15)
    plt.show()


def plot_by_purpose(Taxon,  pur, s):
    W_name = []
    cnt_w, cnt = {}, {}
    for i in range(len(Taxon)):
        if(s[i] == 'W'):
            cnt_w[str(pur[i])] = cnt_w.get(str(pur[i]), 0) + 1
            W_name.append(Taxon[i])
        else:
```

```
        if(Taxon[i] in W_name):
            continue
        else:
            cnt[str(pur[i])] = cnt.get(str(pur[i]), 0) + 1

# print(cnt_w)
    #
x, y = [], []
for a, b in cnt_w.items():
    if(a == "nan"):
        continue
    x.append(a)
    y.append(b)
plt.rcParams['font.sans-serif'] = ['SimHei']  #
plt.rcParams['axes.unicode_minus'] = False  #
plt.figure(figsize=(12, 8))
plt.bar(x, y, width=0.5)
plt.title('Purpose of wildlife trade')
for tmp_x, tmp_y in zip(x,y):
    plt.text(tmp_x, tmp_y, '%.0F' %
             tmp_y, ha='center', va='bottom', fontsize=12)

plt.xticks(rotation=30, color='b')
plt.xlabel('purpose', fontsize=15)
plt.ylabel('Count', fontsize=15)
plt.show()

#
xx, yy = [], []
for a, b in cnt.items():
    if(a == "nan"):
        continue
    xx.append(a)
    yy.append(int(b))
plt.figure(figsize=(12, 8))
plt.bar(xx, yy, width=0.5)
plt.title('Non wildlife trade purpose')
for tmp_x, tmp_y in zip(xx, yy):
    plt.text(tmp_x, tmp_y, '%.0F' %
             tmp_y, ha='center', va='bottom', fontsize=12)

plt.xticks(rotation=30, color='b')
plt.xlabel('purpose', fontsize=15)
plt.ylabel('Count', fontsize=15)
plt.show()

#
Num = 0
for tmp in y:
    Num += int(tmp)
#
print(y)
sizes = [y[0]/Num*200, y[1]/Num*200, y[2]/Num*200, y[3] / Num*200,
         y[4]/Num*200, y[5]/Num*200, y[6]/Num*200, y[7]/Num*200,
         y[8]/Num*200, y[9]/Num*200, y[10]/Num*200, y[11]/Num*200,
         ]
#
```

```
    colors = ['red', 'orange', '#f173ac', 'green', 'purple', 'blue', '#
                                    9b95c9',
              '#f7acbc', '#00ae9d', '#90d7ec', '#11264f', '#ffe600', '
                                              black']
    #
    expodes = (0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.2, 0.1)
    plt.figure(figsize=(12, 10))
    #
    plt.pie(sizes, pctdistance=0.9, explode=expodes, labels=x, shadow=
                                    True, colors=colors)
    ##
    plt.axis('equal')
    #
    plt.legend()
    plt.show()

    #
    Num = 0
    for tmp in yy:
        Num += int(tmp)
    #
    sizes = [yy[0]/Num*200, yy[1]/Num*200, yy[2]/Num*200, yy[3] / Num*
                                    200,
             yy[4]/Num*200, yy[5]/Num*200, yy[6]/Num*200, yy[7]/Num*200
                                          ,
             yy[8]/Num*200, yy[9]/Num*200, yy[10]/Num*200,
             ]
    #
    expodes2 = (0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0.1)
    plt.figure(figsize=(12, 10))
    #
    plt.pie(sizes, pctdistance=0.9, explode=expodes2,
            labels=xx, shadow=True, colors=colors)
    ##
    plt.axis('equal')
    #
    plt.legend()
    plt.show()



#
def plot_importer(num_importer, importer, s, year):
    cnt = {}
    cnt2 = {}
    for i in range(len(s)):

        if(s[i] == 'W' and str(num_importer[i]) != 'nan' and str(
                                        importer[i]) != 'nan'
           and year[i] == 2003):
            # print(str(s[i]) + ' ' + str(importer[i]) + ' ' + str(
                                            num_importer[i]))
            cnt[importer[i]] = cnt.get(importer[i], 0) + int(
                                            num_importer[i])
        if(s[i] == 'W' and str(num_importer[i]) != 'nan' and str(
                                        importer[i]) == 'CN'):
            cnt2[year[i]] = cnt2.get(year[i], 0) + int(num_importer[i])
```

```
    cnt = dict(sorted(cnt.items(), key=lambda x: x[1]))
    x, y = [], []
    for a, b in cnt.items():
        x.append(a)
        y.append(b)
    #
    plt.rcParams['font.sans-serif'] = ['SimHei']  #
    plt.rcParams['axes.unicode_minus'] = False  #
    plt.figure(figsize=(15, 15))
    plt.barh(x, y, height=0.9)
    plt.title('Import statistics of countries in 2003')
    for x, y in zip(x, y):
        plt.text(y+30, x, '%.0F' % y, ha='center', fontsize=10)
    plt.xlabel('Quantity (unit/piece)', fontsize=12)
    plt.ylabel('country', fontsize=12)
    plt.show()
    # print(cnt)

    #      C     N
    x_year, y_year = [], []
    for a, b in cnt2.items():
        x_year.append(a)
        y_year.append(b)
    plt.figure(figsize=(18, 10))
    plt.title('Changes in China import trade from 1990 to 2022')
    plt.plot(x_year, y_year, lw=3, ls='-', c='y', label='Import
                                    transactions')
    for xx, yy in zip(x_year, y_year):
        plt.text(xx, yy, '%.0F' % yy, ha='center', va='bottom',
                                        fontsize=10)
    plt.xlabel('Year', fontsize=12)
    plt.ylabel('Count', fontsize=12)
    plt.xticks(x_year, rotation=30, color='b')
    plt.legend(fontsize=15)
    plt.show()


def plot_xingguan(num_importer, importer, s, year):
    cnt = {}
    cnt2 = {}
    for i in range(len(s)):

        if(s[i] == 'W' and str(num_importer[i]) != 'nan' and str(
                                        importer[i]) != 'nan'
           and year[i] == 2020):
            # print(str(s[i]) + ' ' + str(importer[i]) + ' ' + str(
                                            num_importer[i]))
            cnt[importer[i]] = cnt.get(importer[i], 0) + int(
                                            num_importer[i])
        if(s[i] == 'W' and str(num_importer[i]) != 'nan' and str(
                                        importer[i]) == 'US'):
            cnt2[year[i]] = cnt2.get(year[i], 0) + int(num_importer[i])

    cnt = dict(sorted(cnt.items(), key=lambda x: x[1]))
    x, y = [], []
    for a, b in cnt.items():
```

```
        x.append(a)
        y.append(b)
    #
    plt.rcParams['font.sans-serif'] = ['SimHei']  #
    plt.rcParams['axes.unicode_minus'] = False  #
    plt.figure(figsize=(15, 15))
    plt.barh(x, y, height=0.9)
    plt.title('Import statistics of countries in 2020')
    for x, y in zip(x, y):
        plt.text(y+30, x, '%.0F' % y, ha='center', fontsize=10)
    plt.xlabel('Quantity (unit/piece)', fontsize=12)
    plt.ylabel('country', fontsize=12)
    plt.show()
    # print(cnt)

    #     C    N
    x_year, y_year = [], []
    for a, b in cnt2.items():
        x_year.append(a)
        y_year.append(b)
    plt.figure(figsize=(18, 10))
    plt.title('Changes in US import trade from 1990 to 2022')
    plt.plot(x_year, y_year, lw=3, ls='-', c='y', label='Import
                                    transactions')
    for xx, yy in zip(x_year, y_year):
        plt.text(xx, yy, '%.0F' % yy, ha='center', va='bottom',
                                        fontsize=10)
    plt.xlabel('Year', fontsize=12)
    plt.ylabel('Conut', fontsize=12)
    plt.xticks(x_year, rotation=30, color='b')
    plt.legend(fontsize=15)
    plt.show()


def plot_T(pur,s,fen):
    cnt = {}
    for i in range(len(pur)):
        if(pur[i] == 'Z' and s[i] == 'W'):
            cnt[fen[i]] = cnt.get(fen[i], 0) + 1
    # print(cnt)
    tmp = dict(sorted(cnt.items(), key=lambda x: x[1]))
    x, y = [], []
    for a, b in tmp.items():
        x.append(a)
        y.append(b)
    #
    # print(y)

    plt.rcParams['font.sans-serif'] = ['SimHei']  #
    plt.rcParams['axes.unicode_minus'] = False  #
    plt.figure(figsize=(12, 10))
    plt.bar(x[-20:], y[-20:], width=0.5)
    plt.title('Used for wildlife classification in zoos')
    for xx, yy in zip(x[-20:], y[-20:]):
        plt.text(xx, yy, '%.0F' % yy, ha='center', fontsize=10)
    plt.xlabel('Family', fontsize=15)
    plt.ylabel('Count', fontsize=15)
```

```
    plt.xticks(x[-20:], rotation=60, color='b')
    plt.legend(fontsize=15)
    plt.show()


def solve():

    data = pd.read_excel('trade_mammals_wild_live_1990_2021.xlsx')


    year = data.iloc[:,0]
    name = data.iloc[:,2]
    order = data.iloc[:,4]
    family = data.iloc[:, 5]
    Genus = data.iloc[:,6]
    Importer = data.iloc[:,7]
    Exporter = data.iloc[:,8]
    Origin = data.iloc[:,9]
    num_Importer = data.iloc[:, 10]
    num_Exporter = data.iloc[:, 11]
    pur  = data.iloc[:,14]
    Source = data.iloc[:,15]


    plot_by_order(order,Source)
    plot_by_family(family, Source)
    plot_by_Genus(Genus, Source)
    plot_by_Taxon(name, Source)
    plot_by_purpose(name, pur, Source)
    plot_importer(num_Importer, Importer, Source, year)
    plot_xingguan(num_Exporter, Importer, Source, year)
    plot_T(pur, Source, family)


if __name__ == '__main__':
    solve()
```