1. Introduction to the research space

1.1 Summary of research area

This research is offers a novel way of understanding the issue of food supply in Singapore. It take into account of the number of Livestock Slaughtered and presents a graphical representation of how the Livestock Slaughtered changes over the years. It can assist in understanding the problem of food supply as the Livestock Slaughtered is one of the main source of fresh meat. This report should assits policy makers to gain a better understanding of the food security in Singapore.

1.2 Aims and objectives

This research project aims to understand the general trend of the food security in Singapore by analysing the supply of live stock from 2010 to 2021. While this may not be an accurate representation of the general food supply in Singapore, however, it offers a view of the local food security. Ideally, this research could help policymakers to understand the changes in the supply of meat and aid them in making policies concerning food. The research question is how the supply of live stock for food in Singapore changes over time.

1.3 Acquire of dataset

The information regarding the historical data on the Livestock Slaughtered was acquired from the official website of the Singapore Department of Statistics (SingStats) via web API. The code for web scrapping is shown below.

In [1]:
```
#importing the relevent library
import requests
import json
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
```

I have imported the above libraries for these following reasons:

requests library is used to initiate HTTP get request to the website so that the python program is able to scrape for the data

json library is used to load the data scraped from the website into text file so that it is readable by other parts of the program

pandas library is used as it is a common data analytic tool to process and handle data frames in python. It is used to write to and read from csv files that saves the data. It also handles and processes the data to a proper format.

numpy library is used to handle calculations and make use of the numpy array for statistical calculation

The Matplotlib is used for ploting the data and represent it graphically after handled by numpy.

In [2]:
```
#function to return the url for the data
def getRequesturl():
    url = "https://tablebuilder.singstat.gov.sg/api/table/tabledata/M890521"
    return url
```

In [3]:
```
#functions to scrap the singstats website for the data
def getApiData(requestUrl):
    response = requests.get(requestUrl)
    data = json.loads(response.text)
    poultry =  data["Data"]["row"][0]["columns"]
    chicken = data["Data"]["row"][1]["columns"]
    duck = data["Data"]["row"][2]["columns"]
    quail = data["Data"]["row"][2]["columns"]
    pigs = data["Data"]["row"][2]["columns"]

    return poultry, chicken, duck, quail, pigs

def getApiDataPoultry(requestUrl):
    response = requests.get(requestUrl)
    data = json.loads(response.text)
    poultry =  data["Data"]["row"][0]["columns"]
    return poultry

def getApiDataChickens(requestUrl):
    response = requests.get(requestUrl)
    data = json.loads(response.text)
    chickens =  data["Data"]["row"][1]["columns"]
    return chickens

def getApiDataDucks(requestUrl):
    response = requests.get(requestUrl)
    data = json.loads(response.text)
    ducks =  data["Data"]["row"][2]["columns"]
    return ducks

def getApiDataQuails(requestUrl):
    response = requests.get(requestUrl)
    data = json.loads(response.text)
    quails =  data["Data"]["row"][3]["columns"]
    return quails

def getApiDataPigs(requestUrl):
    response = requests.get(requestUrl)
    data = json.loads(response.text)
    pigs =  data["Data"]["row"][4]["columns"]
    return pigs
```

In [4]:
```
#scraping for poultry
requestUrl = getRequesturl()

poultry = getApiDataPoultry(requestUrl)
dfPoul = pd.DataFrame(poultry)
# dfPoul #uncomment to view the dataframe
```

In [5]:
```
#scraping for chicken
```

```
chicken = getApiDataChickens(requestUrl)
dfChick = pd.DataFrame(chicken)
# dfchick #uncomment to view the dataframe
```

In [6]:
```
#scraping for Duck
ducks = getApiDataDucks(requestUrl)
dfDuck = pd.DataFrame(ducks)
# dfduck #uncomment to view the dataframe
```

In [7]:
```
#scraping for Quails
quail = getApiDataQuails(requestUrl)
dfQuail = pd.DataFrame(quail)
# dfquail #uncomment to view the dataframe
```

In [8]:
```
#scraping for pig
pigs = getApiDataPigs(requestUrl)
dfPig = pd.DataFrame(pigs)
# dfpig #uncomment to view the dataframe
```

The data acquired are saved in CSV files. (note, in case the website brokes down or prohibits web scrapping in the future, a backup of the files is available in the data folder. At the time of writing, both copies of data are identical.) Please run the code that is commended out below to continue if the website is unavaliable.

In [9]:
```
#save to csv
dfPoul.to_csv("poul.csv")
dfChick.to_csv("chick.csv")
dfDuck.to_csv("duck.csv")
dfQuail.to_csv("quail.csv")
dfPig.to_csv("pig.csv")

########## The code below are for the backup incase the website fails############
# #read from saved files
# dfPoul=pd.read_csv("data/poul.csv")
# dfChick=pd.read_csv("data/chick.csv")
# dfDuck=pd.read_csv("data/duck.csv")
# dfQuail=pd.read_csv("data/quail.csv")
# dfPig=pd.read_csv("data/pig.csv")
```

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1.4 Exploratory data analysis

In the exploratory data analysis, I am finding the maximum value of the particular Livestock Slaughtered and the corresponding year. I am also finding the possible none values.

notation used in the website:  original data in singstats

The picture above is a screen shot of the Singstats, it mentions the notation they use when the data is missing. With referece to this picture, the possible none values to be find will be "na", "nec", "nes" and "-"

Exploratory data analysis for Chicken:

In [10]:
```
max=dfChick[dfChick['value']==dfChick['value'].max()]#check for max value
min_year=dfChick[dfChick['key']==dfChick['key'].min()]#check for starting year
```

```
none1=dfChick[dfChick.isna().any(axis=1)]#check for na value
none2=dfChick.loc[dfChick['value'].isin(['na', 'nec', 'nes', '-'])]#possible none v

#print the output
print("max number slaughtered:")
display(max)

print("starting year:")
display(min_year)

print("none value(s):")
display(none1,none2)
```

max number slaughtered:

	key	value
25	2018	51400

starting year:

	key	value
0	1993	35506

none value(s):

key	value

key	value

Exploratory data analysis for Duck:

In [11]:
```
max=dfDuck[dfDuck['value']==dfDuck['value'].max()]#check for max value
min_year=dfDuck[dfDuck['key']==dfDuck['key'].min()]#check for starting year

none1=dfDuck[dfDuck.isna().any(axis=1)]#check for na value
none2=dfDuck.loc[dfDuck['value'].isin(['na', 'nec', 'nes', '-'])]#possible none va

#print the output
print("max number slaughtered:")
display(max)

print("starting year:")
display(min_year)

print("none value(s):")
display(none1,none2)
```

max number slaughtered:

	key	value
7	2000	7428

starting year:

	key	value
0	1993	6318

none value(s):

key	value

key	value

Exploratory data analysis for Quail:

In [12]:
```
max=dfQuail[dfQuail['value']==dfQuail['value'].max()]#check for max value
min_year=dfQuail[dfQuail['key']==dfQuail['key'].min()]#check for starting year


none1=dfQuail[dfQuail.isna().any(axis=1)]#check for na value
none2=dfQuail.loc[dfQuail['value'].isin(['na', 'nec', 'nes', '-'])]#possible none v

#print the output
print("max number slaughtered:")
display(max)

print("starting year:")
display(min_year)

print("none value(s):")
display(none1,none2)
```

max number slaughtered:

	key	value
7	2019	85

starting year:

	key	value
0	2012	80

none value(s):

key	value

key	value

Exploratory data analysis for Pigs

In [13]:
```
max=dfPig[dfPig['value']==dfPig['value'].max()]#check for max value
min_year=dfPig[dfPig['key']==dfPig['key'].min()]#check for starting year


none1=dfPig[dfPig.isna().any(axis=1)]#check for na value
none2=dfPig.loc[dfPig['value'].isin(['na', 'nec', 'nes', '-'])]#possible none value

#print the output
print("max number slaughtered:")
display(max)

print("starting year:")
display(min_year)

print("none value(s):")
display(none1,none2)
```

max number slaughtered:

	key	value
5	2020	431

```
starting year:
```

	key	value
0	2015	334

```
none value(s):
```

	key	value

	key	value

From the analysis above, I can conclude that the number of livestock slaughtered is generally in an increasing trend(except for duck). There is no na or none values in any of the data gathered, however, the data starts at different year.

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2. Justification of the relevance of data to the aims/objective and use of data source

2.1 Origin of the data

The data is originate from the official website of the Singapore Department of Statistics (link to Singstat). It offers a service called the SingStat Table Builder where the statistics in Singapore are displayed. The data chosen was the yearly data of Livestock Slaughtered in Singapore (link to data). Web API is used to retrieve the JSON(JavaScript Object Notation) file of the data. The .json file can be found here. The method of retriving the similar to that of week 10's lecture.

2.2 Appropriateness of the data

This data is appropriate as it offers an overview of the food supply in Singapore in terms of meat. The data also covers majority sources of the meat consumed in Singapore. The Livestock Slaughtered shows an insight of the meat supply to the local market. The number of Livestock Slaughtered influence the supply of meat greatly as it is one of the main source of fresh meat avaliable locally. On the other hand, the data is published by the Singapore Department of Statistics citing the source as "AGRI-FOOD AND VETERINARY AUTHORITY, SINGAPORE FOOD AGENCY". All parties involved are part of the Singapore government, making the source credible.

2.3 Case for working with this data

original data from website:  original data in singstats

The image above shows the original data in the Singstats website. With reference to the

research question mentioned in section 1.2. The rows concerning the analysis of the research questions are the Poultry, Chickens, Ducks, Quails and Pigs. The data in these rows shows the net number in thousands of the respective livestock slaughted. It answers the the changes in the supply of livestocks. The columns from 1993 to 2021 shows the time that the data is collected. This answers the part on how the data changes with respect to time.

As for the current dataframe used, I will use that of the poultry (dfPoul) as an example. The other dataframes are of similar structure.

In [14]:
```
display(dfPoul)
```

	key	value
0	1993	41824
1	1994	43012
2	1995	37429
3	1996	42505
4	1997	45514
5	1998	47391
6	1999	52215
7	2000	50155
8	2001	50213
9	2002	51721
10	2003	49315
11	2004	38653
12	2005	44336
13	2006	43327
14	2007	47912
15	2008	47709
16	2009	48922
17	2010	50976
18	2011	52140
19	2012	52075
20	2013	53110
21	2014	52321
22	2015	53709
23	2016	54420
24	2017	53572
25	2018	56932
26	2019	56608
27	2020	55949
28	2021	54684

The column heading "key" in the dataframe shown above refers to the year which the data is gathered. While the column heading "value" refers to the number of this particular livestock slaughtered. The current headings are identical for all other dataframes

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2.4 Formating the data

The current five dataframes (dfPoul, dfChick, dfDuck, dfQuail, dfPig) will be combined into one dataframe for the easy of analysis. The dataframe dfPoul will be discarted as it is not a representative of a particular livestock.

I will rename the column of each dataframe to a unique name and then combine them into one dataframe.

In [15]:
```
#dataframe changed and reindexed to regroup
#renaming df for chicken
dfChick. rename(columns = {'key':'year', 'value':'chi_num'}, inplace = True)
dfChick=dfChick.set_index('year')

#renaming df for duck
dfDuck. rename(columns = {'key':'year', 'value':'duck_num'}, inplace = True)
dfDuck=dfDuck.set_index('year')

#renaming df for quail
dfQuail. rename(columns = {'key':'year', 'value':'qui_num'}, inplace = True)
dfQuail=dfQuail.set_index('year')

#renaming df for pig
dfPig. rename(columns = {'key':'year', 'value':'pig_num'}, inplace = True)
dfPig=dfPig.set_index('year')
```

In [16]:
```
#create new dataframe for everything
frames = [dfChick, dfDuck, dfQuail, dfPig]
df_livestock = pd.concat(frames,axis=1).reindex(dfChick.index)

#store data as csv
df_livestock.to_csv("livestock.csv",index=False)
display(df_livestock)
```

year	chi_num	duck_num	qui_num	pig_num
1993	35506	6318	NaN	NaN
1994	35956	7056	NaN	NaN
1995	31264	6166	NaN	NaN
1996	36312	6193	NaN	NaN
1997	38631	6884	NaN	NaN
1998	41124	6268	NaN	NaN
1999	44858	7357	NaN	NaN
2000	42727	7428	NaN	NaN
2001	43484	6729	NaN	NaN
2002	44768	6953	NaN	NaN
2003	42838	6477	NaN	NaN
2004	34363	4290	NaN	NaN
2005	37845	6491	NaN	NaN
2006	37996	5331	NaN	NaN
2007	41537	6375	NaN	NaN
2008	41312	6398	NaN	NaN
2009	43075	5847	NaN	NaN
2010	44659	6317	NaN	NaN
2011	46193	5947	NaN	NaN
2012	46099	5896	80	NaN
2013	47036	6012	62	NaN
2014	46154	6084	83	NaN
2015	48008	5601	100	334
2016	48820	5489	111	333
2017	48323	5177	72	323
2018	51400	5429	103	306
2019	51212	5312	85	355
2020	50997	4869	83	431
2021	49384	5225	75	408

The data is now in one panda dataframe which is suitable for analysis

A CSV file from the website is also dowloaded to double check the accuracy of the data scapped

In [17]:
```
download=pd.read_csv("data/M890521-table.csv")
download
```

Out[17]:

	Unnamed: 0	Unnamed: 1	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unr
0	Theme: Industry	NaN	NaN	NaN	NaN	NaN	NaN	
1	Subject: Agriculture, Animal Production and Fi...	NaN	NaN	NaN	NaN	NaN	NaN	
2	Topic: Food Supply	NaN	NaN	NaN	NaN	NaN	NaN	
3	Table Title: Livestock Slaughtered, Annual	NaN	NaN	NaN	NaN	NaN	NaN	
4	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
5	Data last updated: 20/06/2022	NaN	NaN	NaN	NaN	NaN	NaN	
6	Source: AGRI-FOOD AND VETERINARY AUTHORITY, SI...	NaN	NaN	NaN	NaN	NaN	NaN	
7	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
8	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
9	Data Series	2021.0	2020.0	2019.0	2018.0	2017.0	2016.0	
10	Poultry	54684.0	55949.0	56608.0	56932.0	53572.0	54420.0	5
11	Chickens	49384.0	50997.0	51212.0	51400.0	48323.0	48820.0	4
12	Ducks	5225.0	4869.0	5312.0	5429.0	5177.0	5489.0	
13	Quails	75.0	83.0	85.0	103.0	72.0	111.0	
14	Pigs	408.0	431.0	355.0	306.0	323.0	333.0	
15	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
16	Footnotes:	NaN	NaN	NaN	NaN	NaN	NaN	
17	Prior to April 2019, data were from Agri-Food ...	NaN	NaN	NaN	NaN	NaN	NaN	
18	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
19	Notation:	NaN	NaN	NaN	NaN	NaN	NaN	
20	na not available or not applicable	NaN	NaN	NaN	NaN	NaN	NaN	
21	nec not elsewhere classified	NaN	NaN	NaN	NaN	NaN	NaN	
22	nes not elsewhere specified	NaN	NaN	NaN	NaN	NaN	NaN	
23	- nil or negligible or not significant	NaN	NaN	NaN	NaN	NaN	NaN	
24	Notes	NaN	NaN	NaN	NaN	NaN	NaN	
25	Numbers may not add up to the totals due to ro...	NaN	NaN	NaN	NaN	NaN	NaN	

	Unnamed: 0	Unnamed: 1	Unnamed: 2	Unnamed: 3	Unnamed: 4	Unnamed: 5	Unnamed: 6	Unr
26	Data are the latest available at the time of a...	NaN	NaN	NaN	NaN	NaN	NaN	
27	Values are shown in Singapore dollars (unless ...	NaN	NaN	NaN	NaN	NaN	NaN	
28	NaN	NaN	NaN	NaN	NaN	NaN	NaN	
29	Generated by: SingStat Table Builder	NaN	NaN	NaN	NaN	NaN	NaN	
30	Date generated: 27/06/2022	NaN	NaN	NaN	NaN	NaN	NaN	
31	Contact: info@singstat.gov.sg	NaN	NaN	NaN	NaN	NaN	NaN	

32 rows × 30 columns

2.5 Comparison of other data avaliable

During the ideation phase of this project, I have also considered a range of other data sets available. In particular, the Singapore Food Statistics from Singapore Food Agency (link to data) and Local Production And Local Landings by the Department of Statistic Singapore(link to data).

The Singapore Food Statistics provides more in-depth analyzed data on food supply in Singapore. It contains more indicators to analyze and thus gives a bigger picture of the issue. However, it is a complete report on a yearly basis. It is difficult to get the data as the arrangement of the report differs year to year.

The Local Production And Local Landings are from the same authority in my analysis. It is equally detailed and credible. However, Singapore is a tiny city-state with little emphasis on local agriculture and farm production. The local production of food is insignificant compared to that of locally slaughtered livestock which is mostly imported.

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3. Background Analysis</h3>

3.1 Reason for choosing the topic

Singapore has always been a resource-poor country due to its limited size. She is heavily reliant on imports even daily necessities like food and water. The current supply chain disruption has worsened the matter as one of its main supplier of chicken, Malaysia, has

decided to stop the export of the bird due to shortage in supply (source:AP NEWS, 2022). Singapore has responded by importing chicken from other sources, however, the price of chicken and eggs still risen locally (source:CNA, 2022). Singapore imports morethan 90% of its food while trying to maintain food security for it's citizens. The gloabl supply chain disruption has made the matter worse (source:WILLIS, 2022)

Personally, I have felt the rise in food and beverages in eateries and school canteens. Thus I have decided to conduct a study on the supply of food in Singapore, in particular, the supply of meat.

3.2 Uniqness of topic

There has being an established relationship between the livestock slaughted and the food security (source:(Falvey, 2015)). However, there has been little to no research in Singapore's context. Except for the Singapore Food Statistics discussed in section 2.5 which covers many indicators. Thus, this could be very novel research on drawing the link between food security and the livestock slaughtered.

Reference

Falvey, J., 2015. Food Security: The Contribution of Livestock. [online] ResearchGate. Available at: https://www.researchgate.net/publication/276308353_Food_Security_The_Contribution_of_Livest [Accessed 23 June 2022].

WILLIS, S., 2022. Can a country with no livestock become a meat producer? Singapore is going to try. [online] Fortune. Available at: https://fortune.com/2021/05/29/singapore-fake-meat-plant-based-protein-cultured-meat-eat-just-food-security/ [Accessed 22 June 2022].

AP NEWS. 2022. Distress in Singapore as Malaysia bans chicken export. [online] Available at: https://apnews.com/article/russia-ukraine-politics-global-trade-malaysia-4188e124f886aeea8549f3bb363b3d3b [Accessed 23 June 2022].

CNA. 2022. A week into Malaysia's chicken export ban: Some stalls in Singapore close while others find solutions. [online] Available at: https://www.channelnewsasia.com/singapore/week-malaysia-chicken-export-ban-stalls-close-solutions-2734541 [Accessed 25 June 2022].

3.3 Scope of work

This research will analyse how the livestock slaughtered in Singapore changes with respect to time. This research will not cover any prediction of future number of livestock slaughtered nor draw immediate conclusion to how the number of livestock slaughtered affects the cost of food. These two area could be explored in the future researches.

This research will also only focus on the changes in livestock slaughtered from 2010 to 2021 and will disregard the rest of the data

3.4 Analytical pipeline

This project first involves web scrapping data from the Singapore Department of Statistics. Then, I will do a short empirical analysis of the data to gain insight into its structure. Then I will proceed to clean the data to validate variables. Finally, I will drop graphical representations of the data to understand the trend and aid the policymakers in their decisions.

3.5 Method of evaluation of success

As this project aims to understand the general trend of the food security in Singapore by analyzing the supply of livestock, the final output will be deemed a success if it gives a clear and understandable graphical representation of the data collected.

4. Exploration of data

4.1 removing illegal values

Before conducting data analysis, the data gathered need to be cleaned first. The code below shows how the illegal values insdie the dataframe is remove and replaced.

In [18]:
```
#replace NaN value with 0
df_livestock=df_livestock.fillna(0)

display(df_livestock)
```

year	chi_num	duck_num	qui_num	pig_num
1993	35506	6318	0	0
1994	35956	7056	0	0
1995	31264	6166	0	0
1996	36312	6193	0	0
1997	38631	6884	0	0
1998	41124	6268	0	0
1999	44858	7357	0	0
2000	42727	7428	0	0
2001	43484	6729	0	0
2002	44768	6953	0	0
2003	42838	6477	0	0
2004	34363	4290	0	0
2005	37845	6491	0	0
2006	37996	5331	0	0
2007	41537	6375	0	0
2008	41312	6398	0	0
2009	43075	5847	0	0
2010	44659	6317	0	0
2011	46193	5947	0	0
2012	46099	5896	80	0
2013	47036	6012	62	0
2014	46154	6084	83	0
2015	48008	5601	100	334
2016	48820	5489	111	333
2017	48323	5177	72	323
2018	51400	5429	103	306
2019	51212	5312	85	355
2020	50997	4869	83	431
2021	49384	5225	75	408

4.2 Remove out of bound data

As the research question and the aim only targets year 2010 to 2021, all other year's data will be removed

In [19]:
```
df_livestock.drop(["1993","1994","1995","1996","1997","1998","1999", "2000","2001",
                   "2002","2003","2004","2005","2006","2007","2008","2009"], axis=
```

In [20]:
```
display(df_livestock)
```

year	chi_num	duck_num	qui_num	pig_num
2010	44659	6317	0	0
2011	46193	5947	0	0
2012	46099	5896	80	0
2013	47036	6012	62	0
2014	46154	6084	83	0
2015	48008	5601	100	334
2016	48820	5489	111	333
2017	48323	5177	72	323
2018	51400	5429	103	306
2019	51212	5312	85	355
2020	50997	4869	83	431
2021	49384	5225	75	408

4.3 Formatting data

The data will be left in dataframe to allow ploting of graph later. The data will also be copied and coverted to numpy arrray for statistical calculation. The values within the numpy array is also changed to integer allowe the calculation and comparison of nunbers. The code is shown below:

In [21]:
```
#changing to array
ls_array=df_livestock.to_numpy()

#array for chicken
chicken=([])
for i in range(0,len(ls_array)):
    chicken=chicken+[int(ls_array[i][0])]

#array for duck
duck=([])
for i in range(0,len(ls_array)):
    duck=duck+[int(ls_array[i][1])]

#array for quail
quail=([])
for i in range(0,len(ls_array)):
    quail=quail+[int(ls_array[i][2])]

#array for pig
pig=([])
for i in range(0,len(ls_array)):
    pig=pig+[int(ls_array[i][3])]

#create new array for the years (old one used for index)
```

```
year = np.array(list(range(2010, 2022)))
year
```

Out[21]:
```
array([2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020,
       2021])
```

4.4 Insights from data

The code below shows the standard deviation over the years for each type of meat.

The larger the value of standard deviation, the larger the spread of data

This means that the spread of data is the largest for chicken. It could be a significant increase or decrease in number over the years.

The smallest value is from quail, this means that it has the smallest spread of data. This could be due to the relatively small data size making it insignificant as compared to other types of meat.

In [22]:
```
#standard deviation of number of chicken
np.std(chicken)
```

Out[22]:
```
2150.4736477627953
```

In [23]:
```
#standard deviation of number of duck
np.std(duck)
```

Out[23]:
```
418.574532059571
```

In [24]:
```
#standard deviation of number of quail
np.std(quail)
```

Out[24]:
```
34.41131919716082
```

In [25]:
```
#standard deviation of number of pig
np.std(pig)
```

Out[25]:
```
178.4154795227514
```

5. Ethics of use of data

5.1 Origin of data

As stated above, the data is retrived from the Singapore Department of Statistics using a web API. The two images below show the terms and conditions of usage of API and the requirement for Intellectual property. I am using this data for a study purpose and using the web API for a non-commercial use. During the analysis, I did not inlcude any personal data through the API and the intellectual property has been refered to properly

Terms and condition:  terms and condition

Intellectual property:  Intellectual property

The use of web scrapping is allowed in the website for Singstats as shown in the https://tablebuilder.singstat.gov.sg/robots.txt, all User-agent are allowed to scrape data from this website.(The screenshot is attached below)

robots.txt in the website showing allow for web scrapping:  Intellectual property

5.2 Usage and reusage of data

The data analysis has the potential to create new forms of intellectual property. The compiled and cleaned csv files could be used for machine learning and linear regression for future projects.

5.3 Implication of utilising the data for purpose

This research assumes that the consumption of meat is a necessity for everyone. However, this could be uncomfortable for people whose religion requires them to be Vegetarian/Vegan. This research potentially discriminate against them and did not consider them as part of society. This could be a dangerouse assumption as Singapore is a multi-religion society, a discrimination agaist one group could spark disturbance to society.

5.4 Security of data

One negative side of this research is that the data is not encrypted nor secured during the data analysis. It is readily accessible in the Jupyter notebook. Anyone could access the data. This could lead to potential data leaks for this project. On the flip side, the data is anonymous as it does not involve nor contain information about any particular person or company.

5.5 Potential biases

As mentioned above, this data assumes that the consumption of meat is a necessity for people living in Singapore. However, only 42% of the population here are meat-eaters and 39% are flexitarian. There are also 7% of vegetarian/vegan (source:statista). This research did not consider their presence in society when using the number of livestock slaughtered to analyze the general food supply. Better research should consider a range of commonly eaten food/dishes.

6. Data analysis

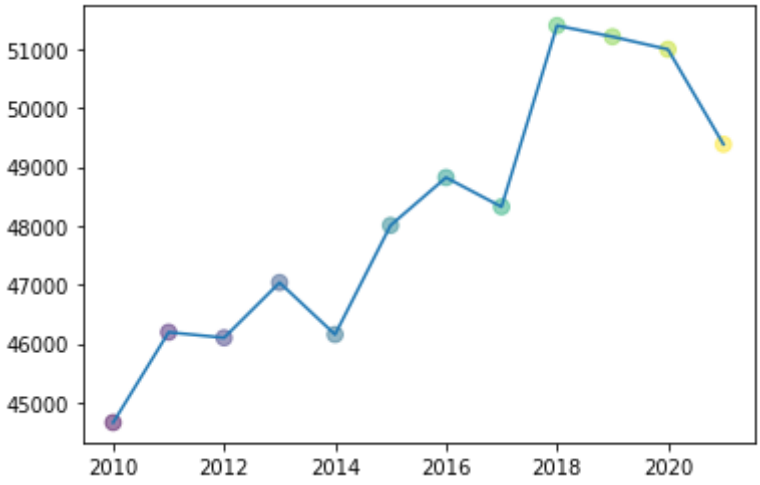
6.1 plotting of graph

To have a clearer view of the data, the following graphs are drawn

Plot for changes in chicken:

In [26]:
```
x = year
y_c= chicken
colors = year%255
area = 60

plt.scatter(x, y_c,s=area, c=colors, alpha=0.5)
plt.plot(x,y_c)
plt.show()
```



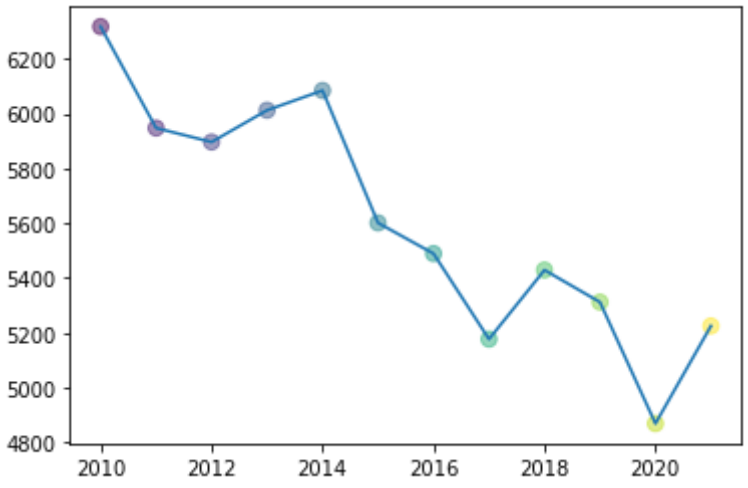
Findings:

The number of chicken slaughtered has been steadily increasing with some fluctuation over the years. This could mean that their is an increase in supply of chicken in the market in Singapore. However, the number has being decreasing dramatically in 2021, this could be due to the stricter testing for import raw material during covid-19

Plot for changes in duck:

In [27]:
```
x = year
y_d= duck
colors = year%255
area = 60

plt.scatter(x, y_d,s=area, c=colors, alpha=0.5)
plt.plot(x,y_d)
plt.show()
```



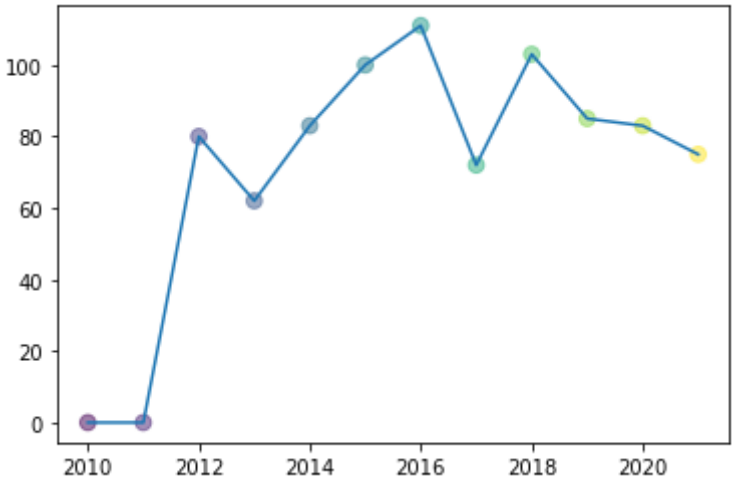
Findings:

The number of duck slaughtered has been decreasing with significatant fluctuation. It raised up to second highest in 2014 after decreasing for years. However, the general trend is still decreasing.

Plot for changes in quail:

In [28]:
```
x = year
y_q= quail
colors = year%255
area = 60

plt.scatter(x, y_q,s=area, c=colors, alpha=0.5)
plt.plot(x,y_q)
plt.show()
```



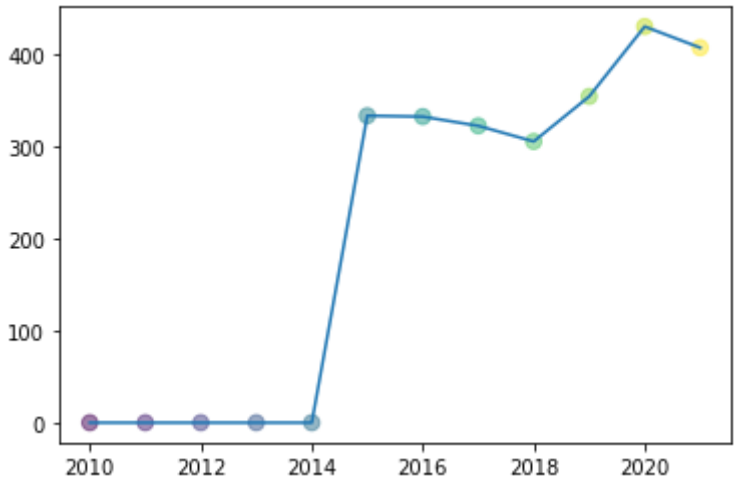
Findings:

The number of quail slaughtered has not being changing rapidly over the years. The overall supply of quail is also insignificant. This could be due to that quail is not the main source of meat in Singapore

Plot for changes in pig:

In [29]:
```
x = year
y_p= pig
colors = year%255
area = 60

plt.scatter(x, y_p,s=area, c=colors, alpha=0.5)
plt.plot(x,y_p)
plt.show()
```

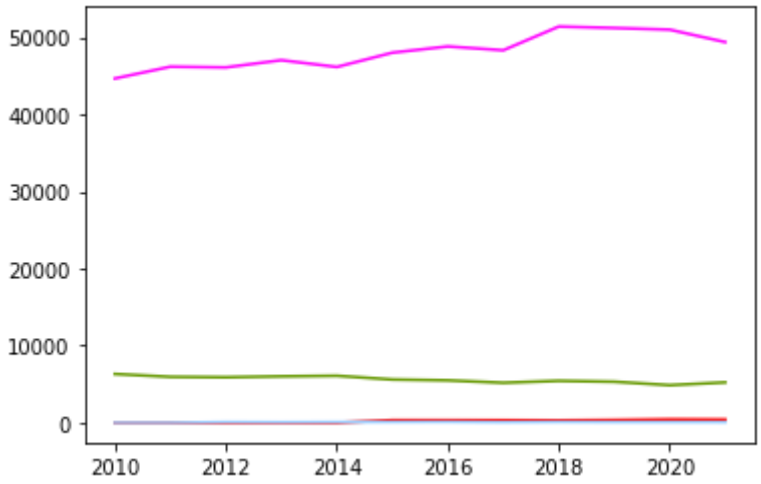


Findings:

There wasnt any pig slaughtered in Singapore until 2014. It is generally stable with some fluctuations. It reaches its peak in 2020 during the pandanmic. This could be due to an increase in home cook food during lockdown

Comparison plot for all livestocks togather(livestocks labelled in diffferent colours, refer to the comment for the colour)

In [30]:
```
plt.plot(x,y_p, color='#ff0000')#pig red
plt.plot(x,y_q, color="#99ccff")#quail blue
plt.plot(x,y_d, color="#669900") #duck green
plt.plot(x,y_c, color="#ff00ff") #chicken pink
plt.show()
```



Findings:

The Number of chicken slaughtered is significantly higher than any other kind of meat. The number of pig slaughtered is much high than duck and quail but still significantly less than that of chicken

6.2 Problem with data

The overall data is extremely imbalanced. The dataset for chicken is a few magnitude higher

than the other kinds of meat. This makes the comparison difficult using simple graphs.

6.3 Insights, evaluation and conclusion

This research found out that the main supply of meat in Singapore is very likely to be chicken as the number of chicken slaughtered is a few magnitude higher than other kinds of meat.

Policy makers should consider diversify the source of fresh meat in Singapore, one way is to start producing/slaughtering other sources of meat such as beef and fish locally. Another way is to invest in meatless meat/impossible meat where planet based ingredients were made into meat-like food.

The number of livestock slaughtered varys siginificantly over the years. However, They are generally in an increasing trend. This is a possitive news for the policy maker in Singapore as this ensure the food security locally to a large extent. Even there is limited food produced locally, increasing the mumber of livestocks slaughtered locally will enhance the position of Singapore in the supply chain of the food. Making the nation more durable at the time of crisis

6.4 Evaluation of flaws

The ideation of this project has an inherent flaw as it only considers the consumption of locally slaughtered meat. This is an overly simplification of the issue of food security. Firstly, there are other sources of meat such as frozen meat slaughtered elsewhere as well as processed meat. These are all some examples of substitutes for locally slaughtered meat. Moreover, as I mentioned before in this report, there are also other variances in food such as vegetables and rice. Only considering locally slaughtered meat will give an inaccurate representation of the overall food supply and security in Singapore. Policymakers should consider other factors and indicators as well during the decision-making process of things related to food to gain a better understanding.

In [ ]: