Introduction

This notebook presents a basic EDA (Exploratory Data Analysis) of horticulture crops cultivation pattern in India over the Years 1991-92 to 2017-18.

Data: Horticulture Data

Notes

- The column names ending with 'A' represent area in '000 Ha.
- The column names ending with 'P' represents production in '000 MT.
- The column names ending with 'Pdy' represents productivity in MT/Ha.
- 'FAM' represents Flowers, Aromatic and Medicinal plant

Author: Ankit Kumar

Importing libraries

```
import pandas as pd
pd.plotting.register_matplotlib_converters()
import matplotlib.pyplot as plt
import seaborn as sns
```

```
# Load the dataset with year as index
my_filepath ="/Horticulture_Data.csv"
my_data = pd.read_csv(my_filepath, index_col = "Year", parse_dates = True)
```

EDA

```
my_data.head()
```

	Fruits_A	Fruits_P	Fruits_Pdy	Veg_A	Veg_P	Veg_Pdy	FAM_A	FAM_P	FAM_Pdy	Plantation_Crops_A
Year										
1991-92	2874	28632	9.96	5593	58532	10.47	Nil	Nil	Nil	2298
2001-02	4010	43001	10.72	6156	88622	14.40	106	535	5.05	2984
2002-03	3788	45203	11.93	6092	84815	13.92	70	735	10.5	2984
2003-04	4661	45942	9.86	6082	88334	14.52	101	580	5.74	3102
2004-05	5155	50988	9.89	6744	101246	15.01	249	818	3.29	3147

We have some non-numeric values - 'Nil', it means the respective horticulture crop was not produced during that year. So lets replace them with zero.

```
my_data.shape
```

```
(18, 18)
```

```
my_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 18 entries, 1991-92 to 2017-18
Data columns (total 18 columns):
 #   Column                Non-Null Count  Dtype
 ---  ------                --------------  -----
  0   Fruits_A              18 non-null     int64
  1   Fruits_P              18 non-null     int64
  2   Fruits_Pdy            18 non-null     float64
  3   Veg_A                 18 non-null     int64
  4   Veg_P                 18 non-null     int64
  5   Veg_Pdy               18 non-null     float64
  6   FAM_A                 18 non-null     object
  7   FAM_P                 18 non-null     object
  8   FAM_Pdy               18 non-null     object
  9   Plantation_Crops_A    18 non-null     int64
  10  Plantation_Crops_P    18 non-null     int64
  11  Plantation_Crops_Pdy  18 non-null     float64
  12  Spices_A              18 non-null     int64
  13  Spices_P              18 non-null     int64
  14  Spices_Pdy            18 non-null     float64
  15  Total_A               18 non-null     int64
  16  Total_P               18 non-null     int64
  17  Total_Pdy             18 non-null     float64
 dtypes: float64(5), int64(10), object(3)
 memory usage: 2.7+ KB
```

```
# Replacing "Nil" values with 0 "zero" and change data type to float
my_data = my_data.replace("Nil", 0)

my_data["FAM_A"]=my_data.FAM_P.astype('float64')
my_data["FAM_P"]=my_data.FAM_P.astype('float64')
my_data["FAM_Pdy"]=my_data.FAM_P.astype('float64')
my_data.head()
```

	Fruits_A	Fruits_P	Fruits_Pdy	Veg_A	Veg_P	Veg_Pdy	FAM_A	FAM_P	FAM_Pdy	Plantation_Crops_A
Year										
1991-92	2874	28632	9.96	5593	58532	10.47	0.0	0.0	0.0	2298
2001-02	4010	43001	10.72	6156	88622	14.40	535.0	535.0	535.0	2984
2002-03	3788	45203	11.93	6092	84815	13.92	735.0	735.0	735.0	2984
2003-04	4661	45942	9.86	6082	88334	14.52	580.0	580.0	580.0	3102
2004-05	5155	50988	9.89	6744	101246	15.01	818.0	818.0	818.0	3147

```
my_data.dtypes
```

```
 Fruits_A                  int64
 Fruits_P                  int64
 Fruits_Pdy              float64
 Veg_A                     int64
 Veg_P                     int64
 Veg_Pdy                 float64
 FAM_A                   float64
 FAM_P                   float64
 FAM_Pdy                 float64
 Plantation_Crops_A        int64
 Plantation_Crops_P        int64
 Plantation_Crops_Pdy    float64
 Spices_A                  int64
 Spices_P                  int64
 Spices_Pdy              float64
 Total_A                   int64
 Total_P                   int64
 Total_Pdy               float64
 dtype: object
```

```
my_data.dtypes
```

```
 Fruits_A                  int64
 Fruits_P                  int64
 Fruits_Pdy              float64
 Veg_A                     int64
```

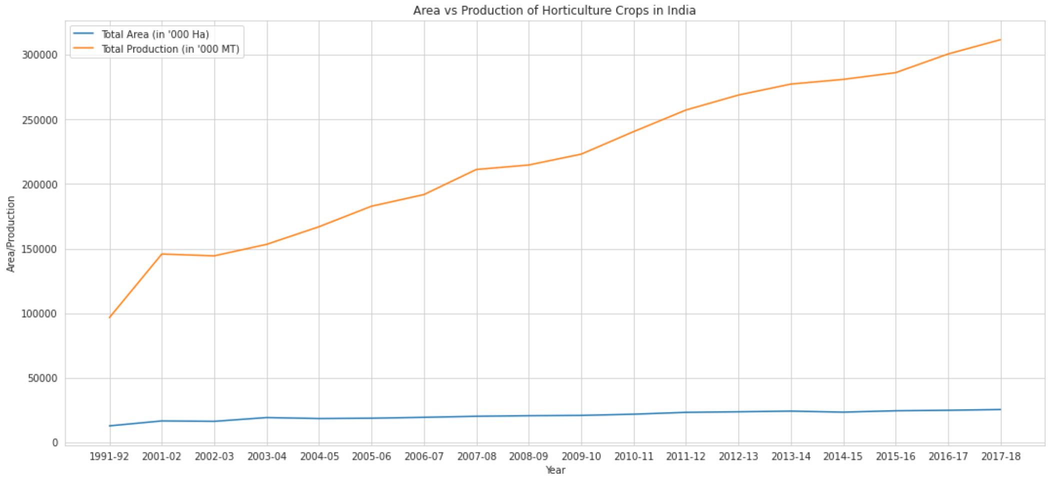
```
Veg_P                     int64
Veg_Pdy                 float64
FAM_A                   float64
FAM_P                   float64
FAM_Pdy                 float64
Plantation_Crops_A        int64
Plantation_Crops_P        int64
Plantation_Crops_Pdy    float64
Spices_A                  int64
Spices_P                  int64
Spices_Pdy              float64
Total_A                   int64
Total_P                   int64
Total_Pdy               float64
dtype: object
```

Production and Area Trend

Let's see how the horticulture production has changed with change in area under cultivation throught these years.

```
plt.figure(figsize=(18,8))
sns.set_style("whitegrid")
plt.title( "Area vs Production of Horticulture Crops in India" )
sns.lineplot(data=my_data["Total_A"], label="Total Area (in '000 Ha)")
sns.lineplot(data=my_data['Total_P'], label ="Total Production (in '000 MT)")
plt.xlabel("Year")
plt.ylabel("Area/Production")
```

```
Text(0, 0.5, 'Area/Production')
```



We see that the area under cultivation has not changed as much compared to the growth in production. This may be due to enhanced farming technology or more efficient farming techniques overall. Lesser growth in area under cultivation means there must be tremendous increase in productivity.

Productivity Trend

Let's see a plot to check our above statement.

```
# Total productivity over the years
my_data.loc[:,'Total_Pdy']
```

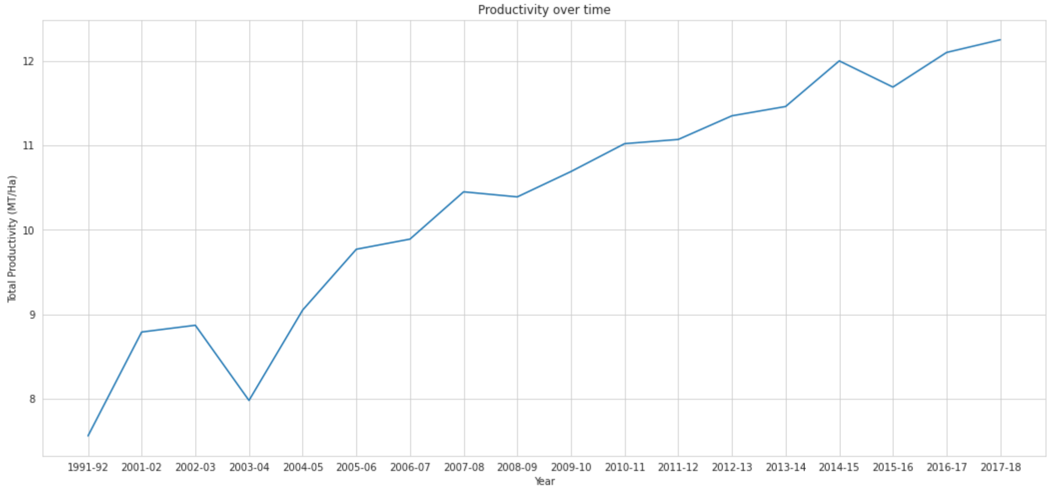
```
Year
1991-92     7.56
2001-02     8.79
2002-03     8.87
```

```
2003-04     7.98
2004-05     9.05
2005-06     9.77
2006-07     9.89
2007-08    10.45
2008-09    10.39
2009-10    10.69
2010-11    11.02
2011-12    11.07
2012-13    11.35
2013-14    11.46
2014-15    12.00
2015-16    11.69
2016-17    12.10
2017-18    12.25
Name: Total_Pdy, dtype: float64
```

Lets plot it

```
plt.figure(figsize=(18,8))
plt.title("Productivity over time")
sns.lineplot(data=my_data['Total_Pdy'])
plt.ylabel('Total Productivity (MT/Ha)')
```

```
Text(0, 0.5, 'Total Productivity (MT/Ha)')
```



We can see from the plot that productivity has increased to over 12 MT/Ha from below 8 MT/Ha in nearly three decades

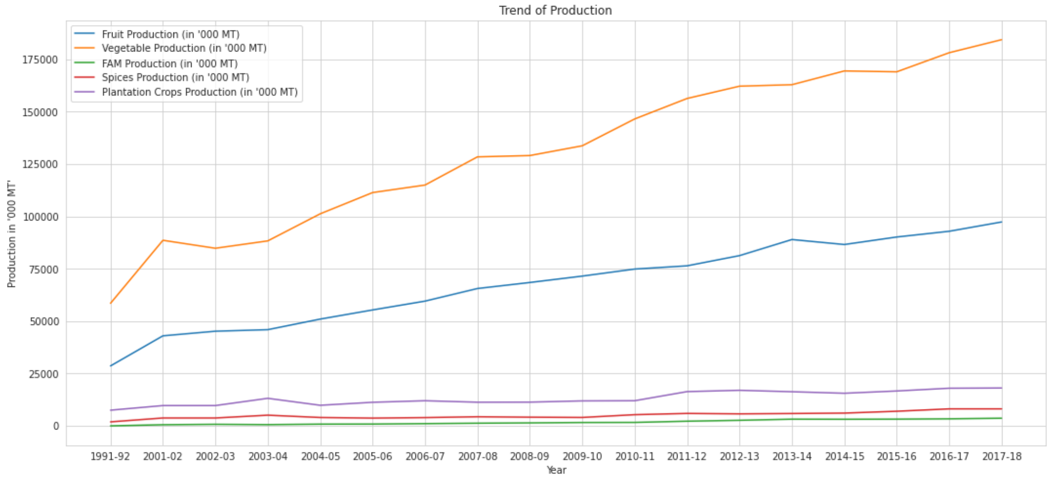
Production trend of each crop

```
my_data.columns
```

```
Index(['Fruits_A', 'Fruits_P', 'Fruits_Pdy', 'Veg_A', 'Veg_P', 'Veg_Pdy',
       'FAM_A', 'FAM_P', 'FAM_Pdy', 'Plantation_Crops_A', 'Plantation_Crops_P',
       'Plantation_Crops_Pdy', 'Spices_A', 'Spices_P', 'Spices_Pdy', 'Total_A',
       'Total_P', 'Total_Pdy'],
      dtype='object')
```

```
plt.figure(figsize=(18,8))
plt.title("Trend of Production")
sns.lineplot(data=my_data['Fruits_P'], label ="Fruit Production (in '000 MT)")
sns.lineplot(data=my_data['Veg_P'], label ="Vegetable Production (in '000 MT)")
sns.lineplot(data=my_data['FAM_P'], label ="FAM Production (in '000 MT)")
sns.lineplot(data=my_data['Spices_P'], label ="Spices Production (in '000 MT)")
sns.lineplot(data=my_data['Plantation_Crops_P'], label ="Plantation Crops Production (in '000 MT)")
plt.ylabel("Production in '000 MT'")
```

```
Text(0, 0.5, "Production in '000 MT'")
```



It is clear from the graph that vegetables makes the largest chunk of total production. Also, there has been roughly a linear increase in the production of each crop.

Let's see a comparitive analysis of area and production stats over last two decades

- Note: We have only 8 years data for the last decade i.e., till 2018

Comparing total production

```
# Find out total production for the two decades
dec1_total = round(my_data.loc['2001-02': '2009-10', 'Total_P'].sum()/10**3,2) # for the 1st decade
print("Total Production during 2001-2010 was: {} billion MT \n".format(dec1_total))

dec2_total = round(my_data.loc['2010-11':, 'Total_P'].sum()/ 10**3,2) # for the 2nd decade
print("Total Production during 2011-2018 was: {} billion MT \n".format(dec2_total))

pct_change = ((dec2_total - dec1_total)/dec1_total)*100
print("Total Production increased by {}%".format(round(pct_change)))
```

```
Total Production during 2001-2010 was: 1634.08 billion MT

Total Production during 2011-2018 was: 2223.54 billion MT

Total Production increased by 36%
```

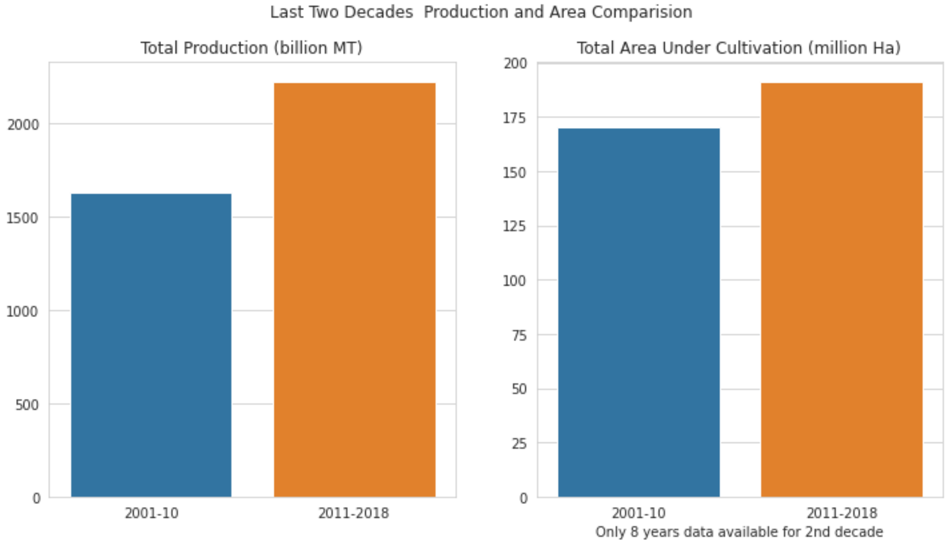
Comparing total area under cultivation

```
# Calculate total area under cultivation during the 1st decade
dec1_area = round(my_data.loc['2001-02': '2009-10', 'Total_A'].sum()/1000, 2)
print("Total area cultivated during 2001-10 was: {} milion Ha \n".format(dec1_area))

dec2_area = round(my_data.loc['2010-11':, 'Total_A'].sum()/1000,2)
print("Total area cultivated during 2011-18 was: {} million Ha \n".format(dec2_area))

pct_change = ((dec2_area - dec1_area)/dec1_area)*100
print("Total area under cultivation increased by {}%".format(round(pct_change)))
```

```
Total area cultivated during 2001-10 was: 170.36 milion Ha

Total area cultivated during 2011-18 was: 191.12 million Ha

Total area under cultivation increased by 12%
```

```
fig, ax = plt.subplots(1,2, figsize=(12,6))
fig.suptitle('Last Two Decades  Production and Area Comparision')
ax[0].ticklabel_format(style='plain')
ax[0].set_title("Total Production (billion MT)")
sns.barplot(ax = ax[0], y= [dec1_total, dec2_total],
            x = ["2001-10", "2011-2018"])

ax[1].set_title("Total Area Under Cultivation (million Ha)")
sns.barplot(ax = ax[1], y= [dec1_area, dec2_area],
            x = ["2001-10", "2011-2018"])
plt.xlabel("Only 8 years data available for 2nd decade")
```

```
Text(0.5, 0, 'Only 8 years data available for 2nd decade')
```



We can see that 8 years production has beat the previous entire decade's production - a 36% increase, whearas area under cultivation has increased by 12%.

As seen in the productivity trend we can say that increase in productivity has been the key driver production increase. Lets get a deeper insight into the productivity:

Comapring mean productivity

```
# Calculate mean productivity during the 1st decade
dec1_pdy = round(my_data.loc['2001-02': '2009-10', 'Total_Pdy'].mean(), 2)
print("Mean productivity during 2001-10 was: {} MT/Ha \n".format(dec1_pdy))

# Calculate mean productivity during the 2nd decade
dec2_pdy = round(my_data.loc['2010-11':, 'Total_Pdy'].mean(), 2)
print("Mean productivity during 2011-18 was: {} MT/Ha".format(dec2_pdy))
```

```
Mean productivity during 2001-10 was: 9.54 MT/Ha

Mean productivity during 2011-18 was: 11.62 MT/Ha
```

Mean productivity has increased by about 2 MT/Ha

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