Exploratory Data Analysis on Data Science Salaries

Preprocessing and Data Cleaning

In [1]:
```
import pandas as pd
import seaborn as sns
import numpy as np
import matplotlib.pyplot as plt
```

In [2]:
```
df = pd.read_csv("/Users/shruthi/Downloads/ds_salaries.csv")
df
```

Out[2]:

k_year	experience_level	employment_type	job_title	salary	salary_currency	salary_in_usd	employee_residence	remot
2023	SE	FT	Principal Data Scientist	80000	EUR	85847	ES	
2023	MI	CT	ML Engineer	30000	USD	30000	US	
2023	MI	CT	ML Engineer	25500	USD	25500	US	
2023	SE	FT	Data Scientist	175000	USD	175000	CA	
2023	SE	FT	Data Scientist	120000	USD	120000	CA	
...	...	...	...	...	...	...	...	
2020	SE	FT	Data Scientist	412000	USD	412000	US	
2021	MI	FT	Principal Data Scientist	151000	USD	151000	US	
2020	EN	FT	Data Scientist	105000	USD	105000	US	
2020	EN	CT	Business Data Analyst	100000	USD	100000	US	
2021	SE	FT	Data Science Manager	7000000	INR	94665	IN	

× 11 columns

In [3]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3755 entries, 0 to 3754
Data columns (total 11 columns):
 #   Column              Non-Null Count  Dtype 
---  ------              --------------  ----- 
 0   work_year           3755 non-null   int64 
 1   experience_level    3755 non-null   object
 2   employment_type     3755 non-null   object
 3   job_title           3755 non-null   object
 4   salary              3755 non-null   int64 
 5   salary_currency     3755 non-null   object
 6   salary_in_usd       3755 non-null   int64 
 7   employee_residence  3755 non-null   object
 8   remote_ratio        3755 non-null   int64 
 9   company_location    3755 non-null   object
 10  company_size        3755 non-null   object
dtypes: int64(4), object(7)
memory usage: 322.8+ KB
```

In [4]:
```
df.shape
```

Out[4]:
```
(3755, 11)
```

In [5]:
```
#No. of null values in each column
df.isnull().sum()
```

Out[5]:
```
work_year             0
experience_level      0
employment_type       0
job_title             0
salary                0
salary_currency       0
salary_in_usd         0
employee_residence    0
remote_ratio          0
company_location      0
company_size          0
dtype: int64
```

In [6]:
```
#No. of uniques values in each colum;
df.nunique()
```

Out[6]:
```
work_year               4
experience_level        4
employment_type         4
job_title              93
salary                815
salary_currency        20
salary_in_usd        1035
employee_residence     78
remote_ratio            3
company_location       72
company_size            3
dtype: int64
```

In [7]:
```
#Experience Level
df.experience_level.unique()
```

Out[7]:
```
array(['SE', 'MI', 'EN', 'EX'], dtype=object)
```

In [11]:
```
#Employment Type
df.employment_type.unique()
```

Out[11]:
```
array(['FT', 'CT', 'FL', 'PT'], dtype=object)
```

In [14]:
```
#Company Size
df.company_size.unique()
```

Out[14]:
```
array(['L', 'S', 'M'], dtype=object)
```

In [17]:
```
# Replacing some names for better understanding

df['experience_level']= df['experience_level'].replace('EN','Entry Level')
df['experience_level']= df['experience_level'].replace('MI','Mid Level')
df['experience_level']= df['experience_level'].replace('SE','Senior Level')
df['experience_level']= df['experience_level'].replace('EX','Executive Level')

df['employment_type'] = df['employment_type'].replace('FT', 'Full Time')
df['employment_type'] = df['employment_type'].replace('CT', 'Contractor')
df['employment_type'] = df['employment_type'].replace('PT', 'Part Time')
df['employment_type'] = df['employment_type'].replace('FL', 'Freelancer')


df['company_size'] = df['company_size'].replace('L', 'Large')
df['company_size'] = df['company_size'].replace('M', 'Medium')
df['company_size'] = df['company_size'].replace('S', 'Small')
```

In [19]:
```
#Rename columns
df.rename(columns={'salary_in_usd':'Salary(USD)'},inplace = True)
df.rename(columns={'work_year':'Year'},inplace=True)
```

In [20]:
```
df
```

Out[20]:

	Year	experience_level	employment_type	job_title	salary	salary_currency	Salary(USD)	employee_residence	remot
0	2023	Senior Level	Full Time	Principal Data Scientist	80000	EUR	85847	ES	
1	2023	Mid Level	Contractor	ML Engineer	30000	USD	30000	US	
2	2023	Mid Level	Contractor	ML Engineer	25500	USD	25500	US	
3	2023	Senior Level	Full Time	Data Scientist	175000	USD	175000	CA	
4	2023	Senior Level	Full Time	Data Scientist	120000	USD	120000	CA	
..	...	...	...	...	...	...	...	...	
0	2020	Senior Level	Full Time	Data Scientist	412000	USD	412000	US	
1	2021	Mid Level	Full Time	Principal Data Scientist	151000	USD	151000	US	
2	2020	Entry Level	Full Time	Data Scientist	105000	USD	105000	US	
3	2020	Entry Level	Contractor	Business Data Analyst	100000	USD	100000	US	
4	2021	Senior Level	Full Time	Data Science Manager	7000000	INR	94665	IN	

5 rows × 11 columns

In [22]:
```
#Dropping features that is unnecessary for my analysis
df.drop(['salary'], axis = 1, inplace=True)
df.drop(['salary_currency'],axis=1,inplace=True)
df.drop(['employee_residence'], axis=1, inplace=True)
```

In [35]:
```
#Final dataframe
df1=df
df1
```

Out[35]:

	Year	experience_level	employment_type	job_title	Salary(USD)	remote_ratio	company_location	company_size
0	2023	Senior Level	Full Time	Principal Data Scientist	85847	100	ES	Large
1	2023	Mid Level	Contractor	ML Engineer	30000	100	US	Small
2	2023	Mid Level	Contractor	ML Engineer	25500	100	US	Small
3	2023	Senior Level	Full Time	Data Scientist	175000	100	CA	Medium
4	2023	Senior Level	Full Time	Data Scientist	120000	100	CA	Medium
...	...	...	...	...	...	...	...	...
3750	2020	Senior Level	Full Time	Data Scientist	412000	100	US	Large
3751	2021	Mid Level	Full Time	Principal Data Scientist	151000	100	US	Large
3752	2020	Entry Level	Full Time	Data Scientist	105000	100	US	Small
3753	2020	Entry Level	Contractor	Business Data Analyst	100000	100	US	Large
3754	2021	Senior Level	Full Time	Data Science Manager	94665	50	IN	Large

3755 rows × 8 columns

Data Analysis using Seaborn and Matplotlib

Agenda

- Top 10 jobs in the US
- Salaries Based on Features
  - Experience Level and Salary
  - Company size and Salary
  - Employment Type and Salary
  - Remote ratio and Salary
  - Top 5 Companies Located and Salaries
- Average Data Science Salaries based on Year
- Combining two or more features
  - Salary in terms of experience level, Employment Type
  - Salaries with respect to experience level, year (of work), job title
- Confusion Matrix

Top 10 Jobs

In [26]:
```
top_10=df['job_title'].value_counts()[:10].rename_axis('job_title').reset_index(name='cou
top_10.style.background_gradient(cmap='Blues')
```

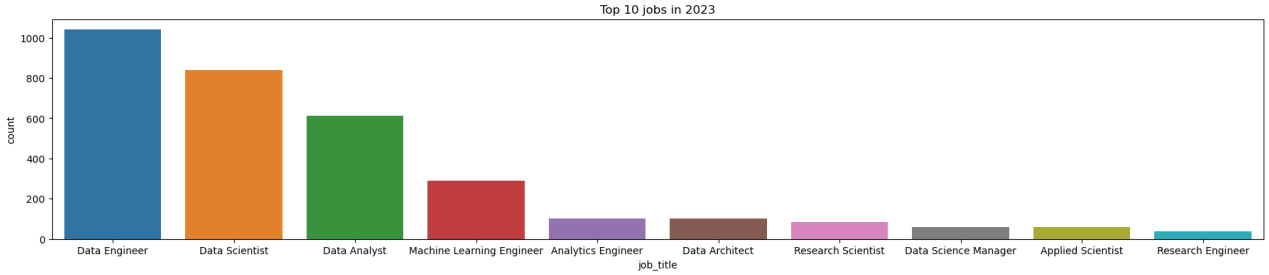
Out[26]:

	job_title	count
0	Data Engineer	1040
1	Data Scientist	840
2	Data Analyst	612
3	Machine Learning Engineer	289
4	Analytics Engineer	103
5	Data Architect	101
6	Research Scientist	82
7	Data Science Manager	58
8	Applied Scientist	58
9	Research Engineer	37

In [30]:
```
plt.figure(figsize=(22,4))   #Set the width and height of the figure
plt.title("Top 10 jobs in 2023")     #Add title

sns.barplot(x=top_10['job_title'], y=top_10['count'])
```

Out[30]:
```
<Axes: title={'center': 'Top 10 jobs in 2023'}, xlabel='job_title', ylabel='count'>
```



In [36]:
```
#to find the highest paid jobs in 2023

df2=df1[df1.Year==2023].sort_values(by='Salary(USD)', ascending=False, ignore_index=True
df2.head()
```

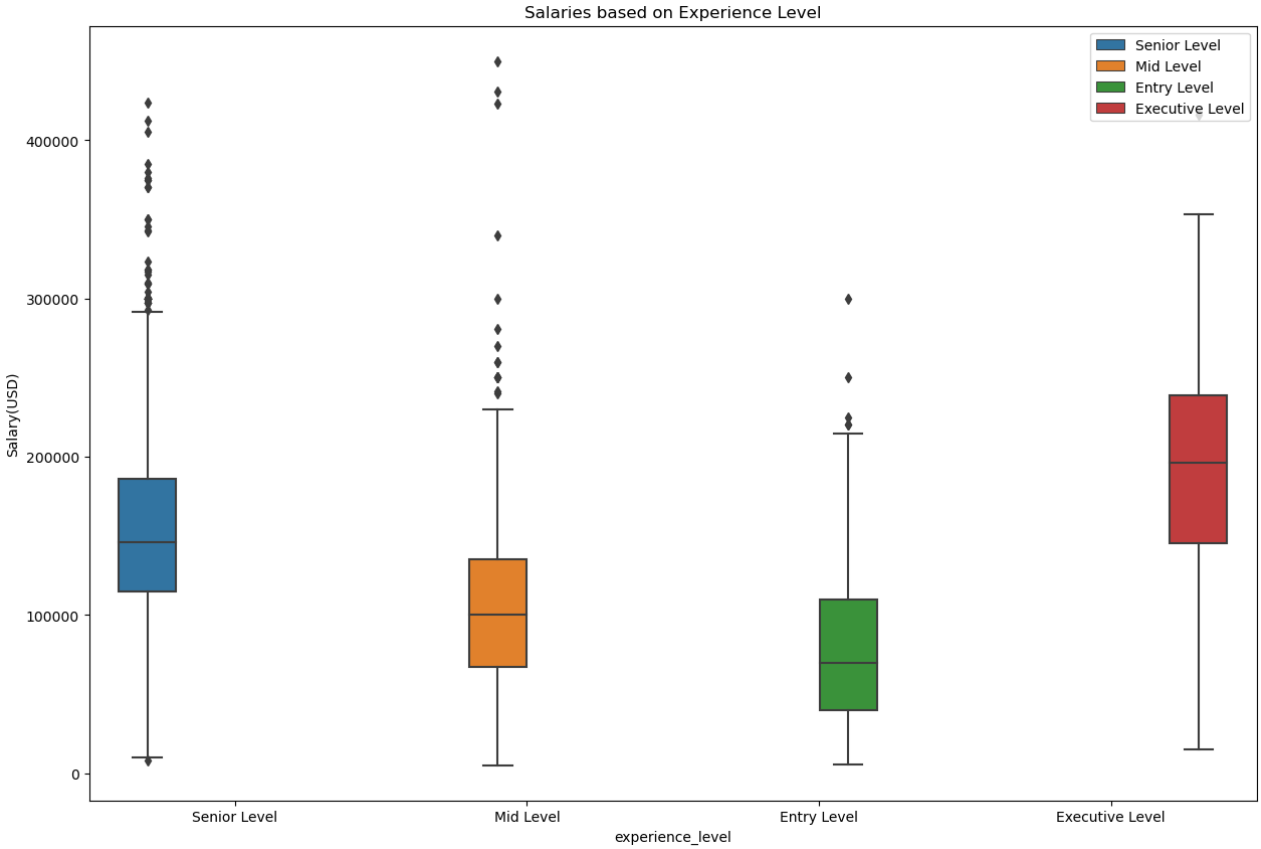
Out[36]:

	Year	experience_level	employment_type	job_title	Salary(USD)	remote_ratio	company_location	company_size
0	2023	Senior Level	Full Time	AI Scientist	423834	0	IL	Large
1	2023	Senior Level	Full Time	Data Analyst	385000	0	US	Medium
2	2023	Senior Level	Full Time	Data Architect	376080	100	US	Medium
3	2023	Senior Level	Full Time	Data Scientist	370000	0	US	Medium
4	2023	Senior Level	Full Time	Research Scientist	370000	0	US	Medium

Salaries based on Features

In [58]:
```
# Experience Level and Salary
plt.figure(figsize=(15,10))
plt.title("Salaries based on Experience Level")
sns.boxplot(x=df1['experience_level'],y = df1['Salary(USD)'], hue= df1['experience_level
plt.legend(loc='upper right')
```

Out[58]:
```
<matplotlib.legend.Legend at 0x7fb1867de050>
```

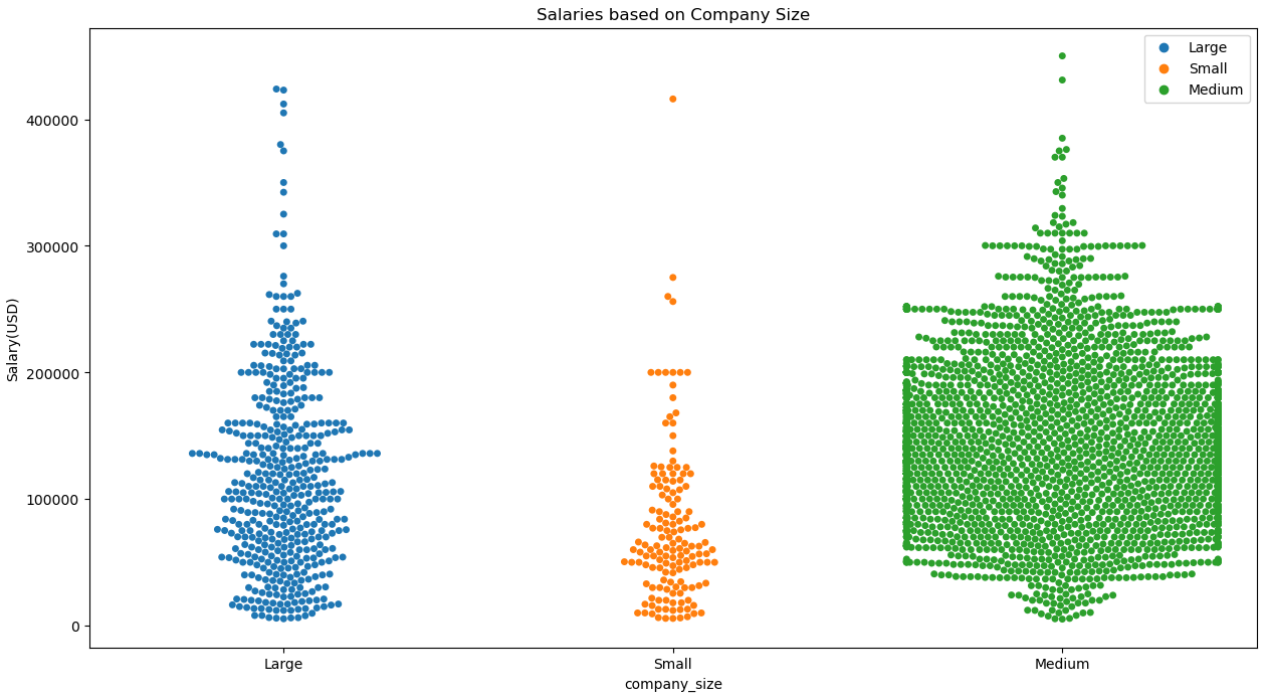


In [60]:
```
# Company size and Salary
plt.figure(figsize=(15,8))
plt.title("Salaries based on Company Size")
sns.swarmplot(x=df1['company_size'],y = df1['Salary(USD)'], hue= df1['company_size'])
plt.legend(loc='upper right')
```

```
/Users/shruthi/anaconda3/lib/python3.10/site-packages/seaborn/categorical.py:3544: UserWarning: 32.7% of the points cannot be placed; you may want to decrease the size of the markers or use stripplot.
  warnings.warn(msg, UserWarning)
```

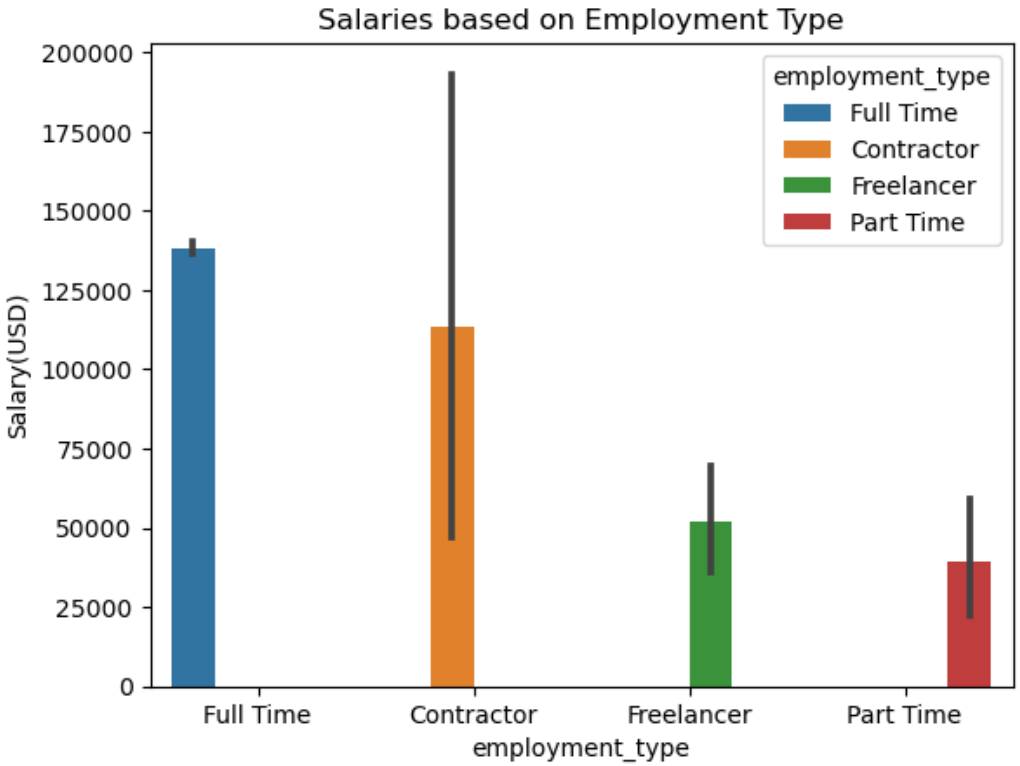
Out[60]:
```
<matplotlib.legend.Legend at 0x7fb1a26a1420>
```

```
/Users/shruthi/anaconda3/lib/python3.10/site-packages/seaborn/categorical.py:3544: UserWarning: 46.0% of the points cannot be placed; you may want to decrease the size of the markers or use stripplot.
  warnings.warn(msg, UserWarning)
```



In [54]:
```
# Employment type and Salary
plt.title("Salaries based on Employment Type")
sns.barplot(x=df1['employment_type'],y = df1['Salary(USD)'], hue= df1['employment_type']
```

Out[54]:
```
<Axes: title={'center': 'Salaries based on Employment Type'}, xlabel='employment_typ
e', ylabel='Salary(USD)'>
```

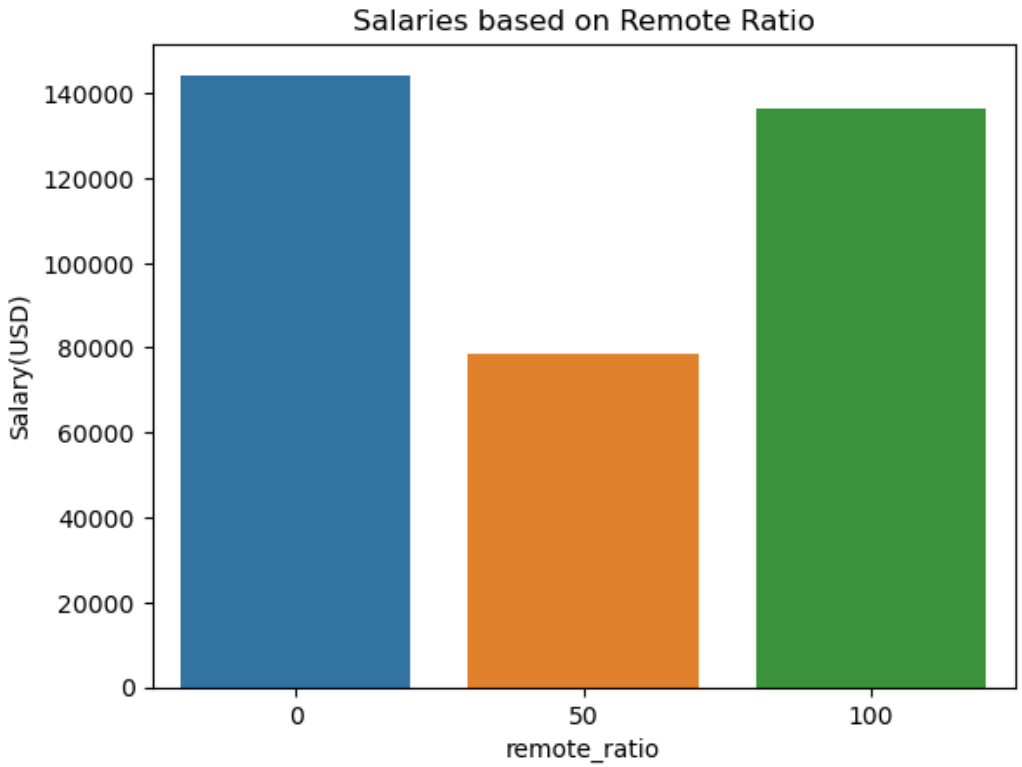


In [62]:
```
# Salaries based on Remote Ratio
sal_by_rem=df1["Salary(USD)"].groupby(df.remote_ratio).mean()
sal_by_rem
```

Out[62]:
```
remote_ratio
0      144316.202288
50      78400.687831
100    136481.452830
Name: Salary(USD), dtype: float64
```

In [65]:
```
plt.title("Salaries based on Remote Ratio")
sns.barplot(x=sal_by_rem.index,y = sal_by_rem)
```

Out[65]:
```
<Axes: title={'center': 'Salaries based on Remote Ratio'}, xlabel='remote_ratio', ylab
el='Salary(USD)'>
```



In [99]:
```
# Top 5 Companies Located and Salaries
sal_by_loc = df["Salary(USD)"].groupby(df.company_location).mean()
sal_by_loc.sort_values(ascending=False,inplace=True)
sal_by_loc.head()
```

Out[99]:
```
company_location
IL    271446.500000
PR    167500.000000
US    151822.009539
RU    140333.333333
CA    131917.689655
Name: Salary(USD), dtype: float64
```

Top 5 places where their salaries are most

Average Data Science Salaries based on Year

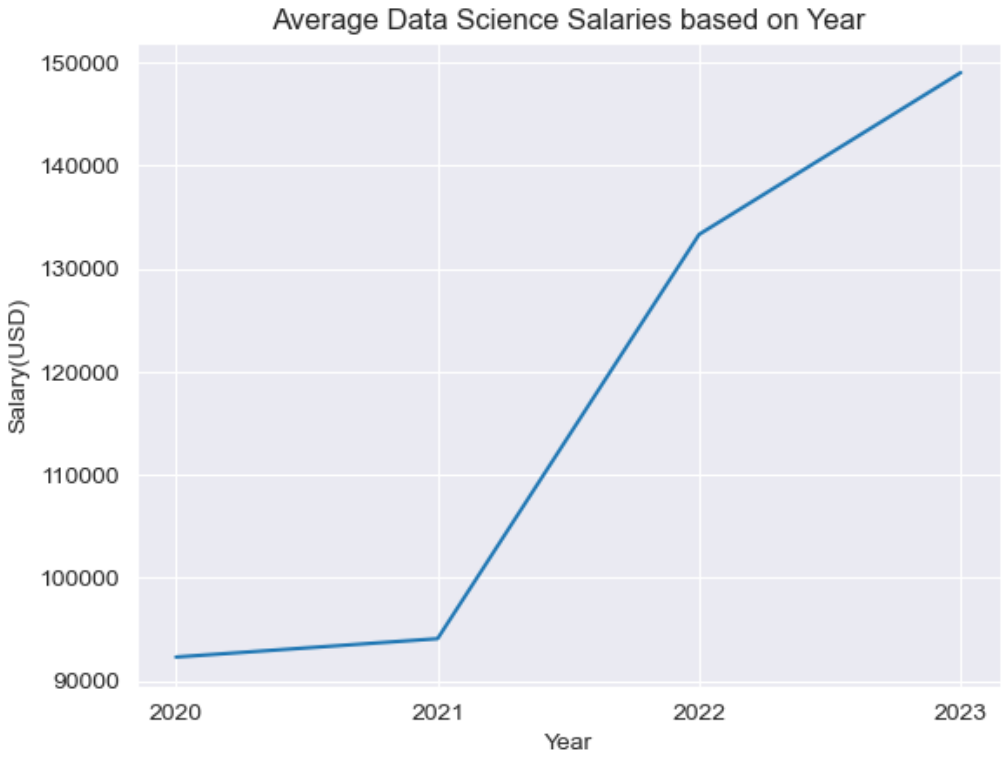
In [124]:
```
average_salary_on_year= df1["Salary(USD)"].groupby(df.Year).mean()
average_salary_on_year
```

Out[124]:
```
Year
2020     92302.631579
2021     94087.208696
2022    133338.620793
2023    149045.541176
Name: Salary(USD), dtype: float64
```

In [123]:
```
plt.title('Average Data Science Salaries based on Year')
plt.xlabel('Year')
plt.ylabel('Salary(USD)')


sns.lineplot(x=['2020', '2021', '2022','2023'],y=average_salary_on_year)
```

Out[123]:
```
<Axes: title={'center': 'Average Data Science Salaries based on Year'}, xlabel='Year',
ylabel='Salary(USD)'>
```



Combining two or more features

In [110]:
```
# Salary in terms of experience level, Employment Type
sal_exp_emp_loc = df1.groupby(['experience_level','employment_type']).mean()
sal_df= sal_exp_emp_loc.drop(['Year','remote_ratio'],axis=1)
sal_df
```

```
/var/folders/72/z8ryl7mx5yjdpxvp9q9pyp380000gn/T/ipykernel_51136/3705546557.py:2: Futu
reWarning: The default value of numeric_only in DataFrameGroupBy.mean is deprecated. I
n a future version, numeric_only will default to False. Either specify numeric_only or
select only columns which should be valid for the function.
  sal_exp_emp_loc = df1.groupby(['experience_level','employment_type']).mean()
```

Out[110]:

		Salary(USD)
experience_level	**employment_type**	
Entry Level	**Contractor**	65234.500000
	Freelancer	75000.000000
	Full Time	80496.529801
	Part Time	38885.000000
Executive Level	**Contractor**	416000.000000
	Full Time	192974.566372
Mid Level	**Contractor**	78600.000000
	Freelancer	41615.600000
	Full Time	105321.489899
	Part Time	42561.000000
Senior Level	**Contractor**	97500.000000
	Freelancer	53333.333333
	Full Time	153214.454799

In [113]:
```
# Salaries with respect to experience level, year and job title

# To find the total count of unique elements in the experience level column
df['experience_level'].value_counts()
```

Out[113]:
```
Senior Level       2516
Mid Level           805
Entry Level         320
Executive Level     114
Name: experience_level, dtype: int64
```

In [130]:
```
# to create a table with selected features - experience level, year, and job title
comb_features=df.groupby(['Year','experience_level','job_title']).mean()
comb_features_sal=comb_features.drop(['remote_ratio'], axis=1)
comb_features_sal
comb_features_sal.style.background_gradient(cmap='Greens')
```

BI Analyst	132500.000000
BI Data Analyst	71897.000000
BI Developer	129750.000000
Big Data Architect	151902.000000
Business Intelligence Engineer	174150.000000
Cloud Database Engineer	141666.666667
Computer Vision Engineer	224711.111111
Computer Vision Software Engineer	53654.000000
Data Analyst	125788.944724
Data Analytics Manager	155850.000000
Data Analytics Specialist	95000.000000
Data Architect	158910.434783
Data DevOps Engineer	53654.000000

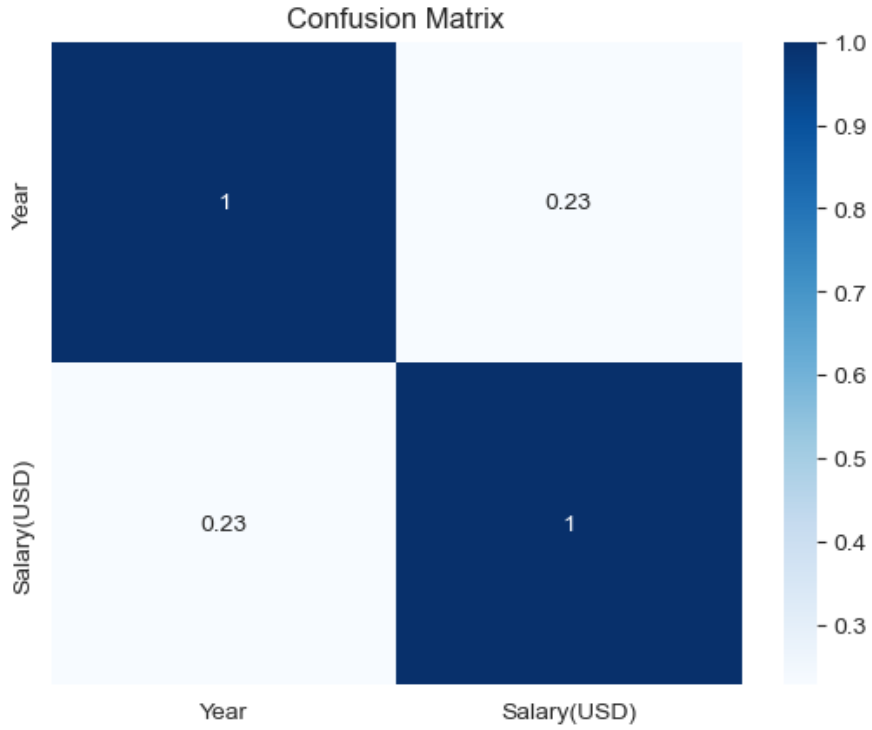
From above table we can easly understand the relationship between the features - experience level, Year, job title with salary. Dark green indicates the hightest salary rates in each job title under year 2020, 2021, 2022, 2023, while the lightest green indicates the least salary.

Confusion Matrix

In [128]:
```
#Heatmap of confusion matrix
plt.title('Confusion Matrix')
df2=df1.drop(['remote_ratio'],axis =1)
sns.heatmap(df2.corr(),annot=True,cmap='Blues')
```

```
/var/folders/72/z8ryl7mx5yjdpxvp9q9pyp380000gn/T/ipykernel_51136/3237722803.py:4: Futu
reWarning: The default value of numeric_only in DataFrame.corr is deprecated. In a fut
ure version, it will default to False. Select only valid columns or specify the value
of numeric_only to silence this warning.
  sns.heatmap(df2.corr(),annot=True,cmap='Blues')
```

Out[128]: <Axes: title={'center': 'Confusion Matrix'}>



In [129]:
```
# Average of the Salaries in USD
sal=df['Salary(USD)'].mean()
print('Average Salary: ',round(sal,0),"(USD)")
```

```
Average Salary:  137570.0 (USD)
```

Through my Analysis, I have noticed a positive rise in Salary difference over the past 3 years. Data Science Jobs have an average of USD 137,570. However, the salary depends on various factors such as experience level, employment type, company location & size, remote ratio. Advancement of Technology in recent years have increased the importance of Data Science across different fields of work hence why the salaries have significantly shown an increase.