# DSE5002_Project1_cbrookshier

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## 1 DSE5002 - Module 5, Project 1

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## 2 Project Instructions

" " " Created on Wed Apr 2 10:32:25 2025 Project Mission statement: Utilize rdataproject.csv and answer the following from the following assignment instructions - Your CEO has decided that the company needs a full-time data scientist, and possibly a team of them in the future. She thinks she needs someone who can help drive data science within then entire organization and could potentially lead a team in the future. She understands that data scientist salaries vary widely across the world and is unsure what to pay them. To complicate matters, salaries are going up due to the great recession and the market is highly competitive. Your CEO has asked you to prepare an analysis on data science salaries and provide them with a range to be competitive and get top talent. The position can work offshore, but the CEO would like to know what the difference is for a person working in the United States. Your company is currently a small company but is expanding rapidly.

Prepare your analysis in an R file. Your final product should be a power point presentation giving your recommendation to the CEO. CEOs do not care about your code and don't want to see it. They want to see visuals and a well thought out analysis. You will need to turn in the power point and the code as a flat R file. (Updated instructions dictate that code analysis should be done in Python per J.Lowhorn)

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### 2.1 I. Problem Definition (Introduction)

#### Questions to consider: #### 1. What was the interquartile salary range of Senior/Lead data scientists by year? #### 2. What is the rate of salary increase by year? #### 3. What is the salary difference between a US vs. non-US data scientist #### 4. Which candidate will offer the greatest bang/buck?

### 2.2 II. How Problem was solved (Analysis)

#### 1. To find the IQR salary for senior and lead data scientists, aggregate Data Scientist column by the cells which include the word lead/senior. Create 2 boxplots for this set, one US, one non-US #### 2. Separate initial lead dataset by year and create boxplot. Calculate percent increase by year & projection to 2025. #### 3. Create 2 boxplots for lead set, one US, one non-US, summarize differences with code.

## 2.3 III. Conclusion (Recommendation)

#### 4. Concise clear verbal summary based upon abovementioned data & boxplots

## Project 1 has 2 deliverables -> #### a. 3-5 pg Powerpoint #### b. PDF of Jupyter notebook with code

# 3 Herefollows an Analysis of the given data set, a more CURRENT data set is analyzed at the end.

[2]:

```
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
import seaborn as sns
import os

# check on the current working directory
#change directory for use of relative paths
os.chdir('/Users/caseybrookshier/Desktop/Merrimack/DSE5002/Project_1')
os.getcwd()

proj1_salary= pd.read_csv("r project data-1.csv")
print(proj1_salary.head())
```

```
   Unnamed: 0  work_year experience_level employment_type  \
0           0       2020               MI              FT
1           1       2020               SE              FT
2           2       2020               SE              FT
3           3       2020               MI              FT
4           4       2020               SE              FT

                    job_title  salary salary_currency  salary_in_usd  \
0              Data Scientist   70000             EUR          79833
1  Machine Learning Scientist  260000             USD         260000
2           Big Data Engineer   85000             GBP         109024
3        Product Data Analyst   20000             USD          20000
4   Machine Learning Engineer  150000             USD         150000

  employee_residence  remote_ratio company_location company_size
0                 DE             0               DE            L
1                 JP             0               JP            S
2                 GB            50               GB            M
3                 HN             0               HN            S
4                 US            50               US            L
```

[3]:

```
# aggregate Data Scientist job_title column by the rows in which include the␣
 ↪word lead is present.
# Create 2 boxplots for this set, one US, one non-US
# Check if 'lead' is in the 'job_title' column
#Filter out EN & EX from experience_level as data too LIMITED to created useful␣
 ↪boxplot (discovered by experiment)
proj1_salary_lead = proj1_salary[proj1_salary['job_title'].str.contains('lead',␣
 ↪case=False, na=False) & proj1_salary['experience_level'].isin(['SE','MI'])]
proj1_salary_lead_US = proj1_salary_lead[proj1_salary_lead['company_location'].
 ↪str.contains('US',case=False, na=False)]
proj1_salary_lead_nonUS =␣
 ↪proj1_salary_lead[~proj1_salary_lead['company_location'].str.
 ↪contains('US',case=True, na=False)]

# Display the 1st filtered result first five rows
print(proj1_salary_lead[:5])

# Get summary statistics 'lead' filtered, US, nonUS results
print(proj1_salary_lead.describe())
print(proj1_salary_lead_US.describe())
print(proj1_salary_lead_nonUS.describe())
```

```
    Unnamed: 0  work_year experience_level employment_type  \
6            6       2020               SE              FT
9            9       2020               SE              FT
13          13       2020               MI              FT
19          19       2020               MI              FT
24          24       2020               MI              FT

              job_title  salary salary_currency  salary_in_usd  \
6   Lead Data Scientist  190000             USD         190000
9    Lead Data Engineer  125000             USD         125000
13    Lead Data Analyst   87000             USD          87000
19   Lead Data Engineer   56000             USD          56000
24  Lead Data Scientist  115000             USD         115000

   employee_residence  remote_ratio company_location company_size
6                  US           100               US            S
9                  NZ            50               NZ            S
13                 US           100               US            L
19                 PT           100               US            M
24                 AE             0               AE            L
       Unnamed: 0    work_year        salary  salary_in_usd  remote_ratio
count   13.000000    13.000000  1.300000e+01      13.000000     13.000000
mean   140.769231  2020.769231  4.760769e+05  141174.692308     65.384615
std    170.846010     0.725011  8.435264e+05  104748.365651     42.742521
min      6.000000  2020.000000  5.600000e+04   19609.000000      0.000000
25%     19.000000  2020.000000  8.700000e+04   87000.000000     50.000000
50%     92.000000  2021.000000  1.600000e+05  115000.000000    100.000000
75%    129.000000  2021.000000  2.760000e+05  170000.000000    100.000000
```

```
max    523.000000  2022.000000  3.000000e+06  405000.000000    100.000000
       Unnamed: 0    work_year         salary  salary_in_usd  remote_ratio
count    7.000000     7.000000       7.000000       7.000000      7.000000
mean   143.857143  2020.714286  192000.000000  192000.000000     78.571429
std    189.670265     0.755929  117939.249899  117939.249899     39.339790
min      6.000000  2020.000000   56000.000000   56000.000000      0.000000
25%     16.000000  2020.000000  123500.000000  123500.000000     75.000000
50%     88.000000  2021.000000  170000.000000  170000.000000    100.000000
75%    179.000000  2021.000000  233000.000000  233000.000000    100.000000
max    523.000000  2022.000000  405000.000000  405000.000000    100.000000
       Unnamed: 0    work_year        salary  salary_in_usd  remote_ratio
count    6.000000     6.000000  6.000000e+00        6.00000       6.00000
mean   137.166667  2020.833333  8.075000e+05    81878.50000      50.00000
std    163.869969     0.752773  1.202584e+06    42496.88796      44.72136
min      9.000000  2020.000000  7.500000e+04    19609.00000       0.00000
25%     41.000000  2020.250000  8.875000e+04    52410.50000      12.50000
50%    102.000000  2021.000000  1.200000e+05    95546.00000      50.00000
75%    124.750000  2021.000000  1.118750e+06   112040.00000      87.50000
max    457.000000  2022.000000  3.000000e+06   125000.00000     100.00000
```

The interquartile range (IQR) of lead data scientist salaries for those with experience levels middle to senior is 87,000-170,000 USD. The IQR for comparable US an non-US populations is approximately 123,000-233,000 USD and 52,000-112,000 USD, respectively.

IQR lead DS salaries ALL = 87,000-170,000 USD. IQR lead DS salaries US = 123,000-233,000 USD. IQR lead DS salaries non-US = 52,000-112,000 USD.

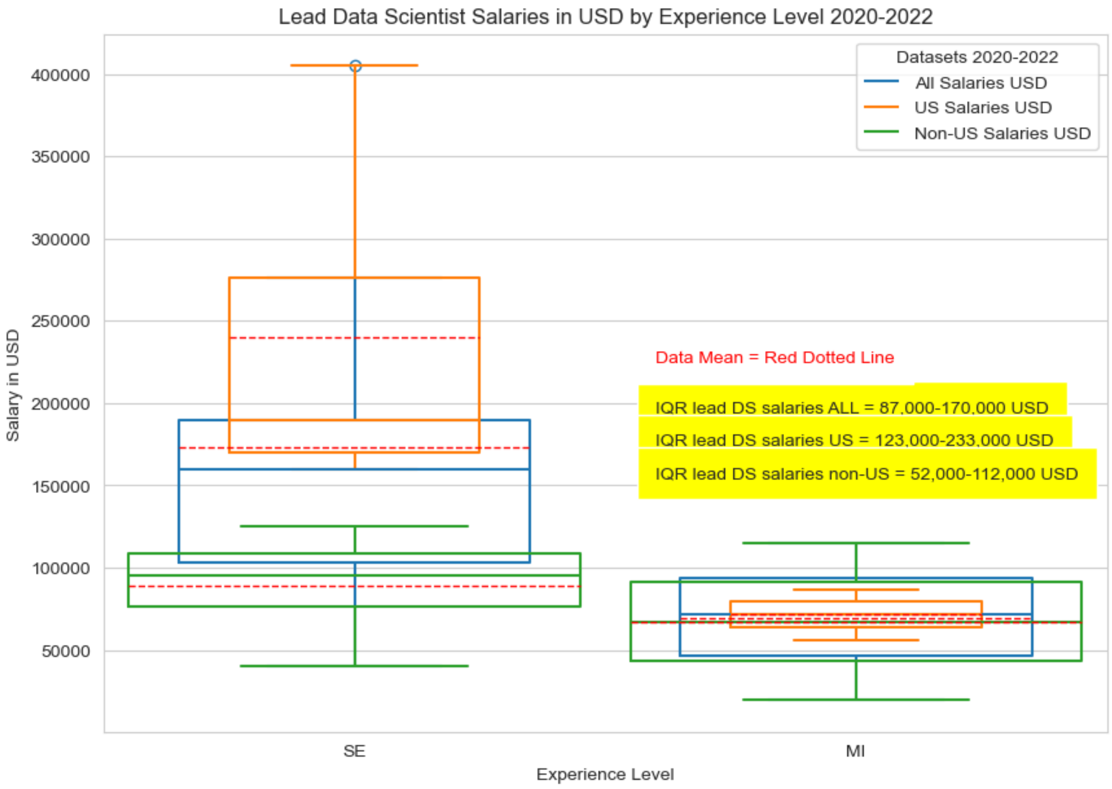
```
[4]: # Create a boxplot representing the salary_in_usd for the filtered data by␣
      ↪experience level
     # Create 3 plots, showing subsets created above, superimposed for comparison
     sns.set_style("whitegrid")
     plt.figure(figsize=(10,7))
     sns.boxplot(proj1_salary_lead,x='experience_level',y="salary_in_usd",␣
      ↪orient="v",fill=False, width=.7, showmeans=True, meanline=True,␣
      ↪meanprops={"linewidth": 1, "color": "red"},label='All Salaries USD').
      ↪set(title="Lead Data Scientist Salaries in USD by Experience Level␣
      ↪2020-2022")
     sns.boxplot(proj1_salary_lead_US,x='experience_level',y="salary_in_usd",␣
      ↪orient="v",fill=False, showmeans=True, meanline=True, meanprops={"linewidth":
      ↪ 1, "color": "red"}, width=.5,label='US Salaries USD').set(title="Lead Data␣
      ↪Scientist Salaries in USD by Experience Level 2020-2022")
     sns.boxplot(proj1_salary_lead_nonUS,x='experience_level',y="salary_in_usd",␣
      ↪orient="v",fill=False, width=.9,showmeans=True, meanline=True,␣
      ↪meanprops={"linewidth": 1, "color": "red"},label='Non-US Salaries USD').
      ↪set(title="Lead Data Scientist Salaries in USD by Experience Level␣
      ↪2020-2022")

     #Adding Textbox
```

```
plt.text(0.6, 195000, 'IQR lead DS salaries ALL = 87,000-170,000 USD',␣
 ↪fontsize=10, bbox={'facecolor': 'yellow', 'pad': 10, 'alpha': 1})
plt.text(0.6, 175000, 'IQR lead DS salaries US = 123,000-233,000 USD',␣
 ↪fontsize=10, bbox={'facecolor': 'yellow', 'pad': 10, 'alpha': 1})
plt.text(0.6, 155000, 'IQR lead DS salaries non-US = 52,000-112,000 USD',␣
 ↪fontsize=10, bbox={'facecolor': 'yellow', 'pad': 10, 'alpha': 1})
plt.text(0.6, 225000, 'Data Mean = Red Dotted Line',color='red', fontsize=10,␣
 ↪bbox={'facecolor': 'white', 'pad': 10, 'alpha': 1})

# Set axis labels using plt.xlabel() and plt.ylabel()
plt.xlabel('Experience Level')
plt.ylabel('Salary in USD')

# Adding legend
plt.legend(title='Datasets 2020-2022')
plt.show()
```



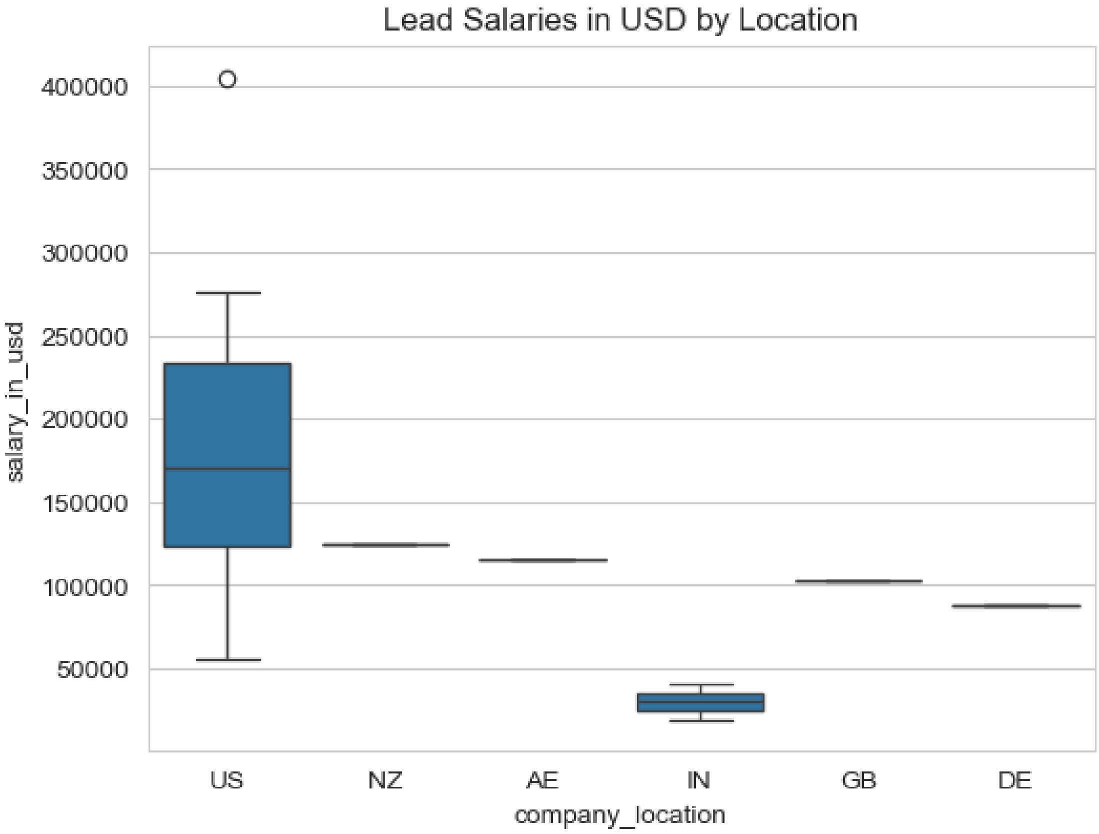
# 4 The following boxplots were created out of curiosity, and to consider different ways in which to analyze the data.

```
[5]: # Create a boxplot representing the salary_in_usd for the filtered data by year
     # Code canceled as 2025 boxplot more informative
     '''plt.figure(figsize=(10, 10))
     sns.boxplot(proj1_salary_lead,x='work_year',y="salary_in_usd", orient="v").
      ↪set(title="Lead Salaries in USD by Year")'''
```

```
[5]: 'plt.figure(figsize=(10,
     10))\nsns.boxplot(proj1_salary_lead,x=\'work_year\',y="salary_in_usd",
     orient="v").set(title="Lead Salaries in USD by Year")'
```

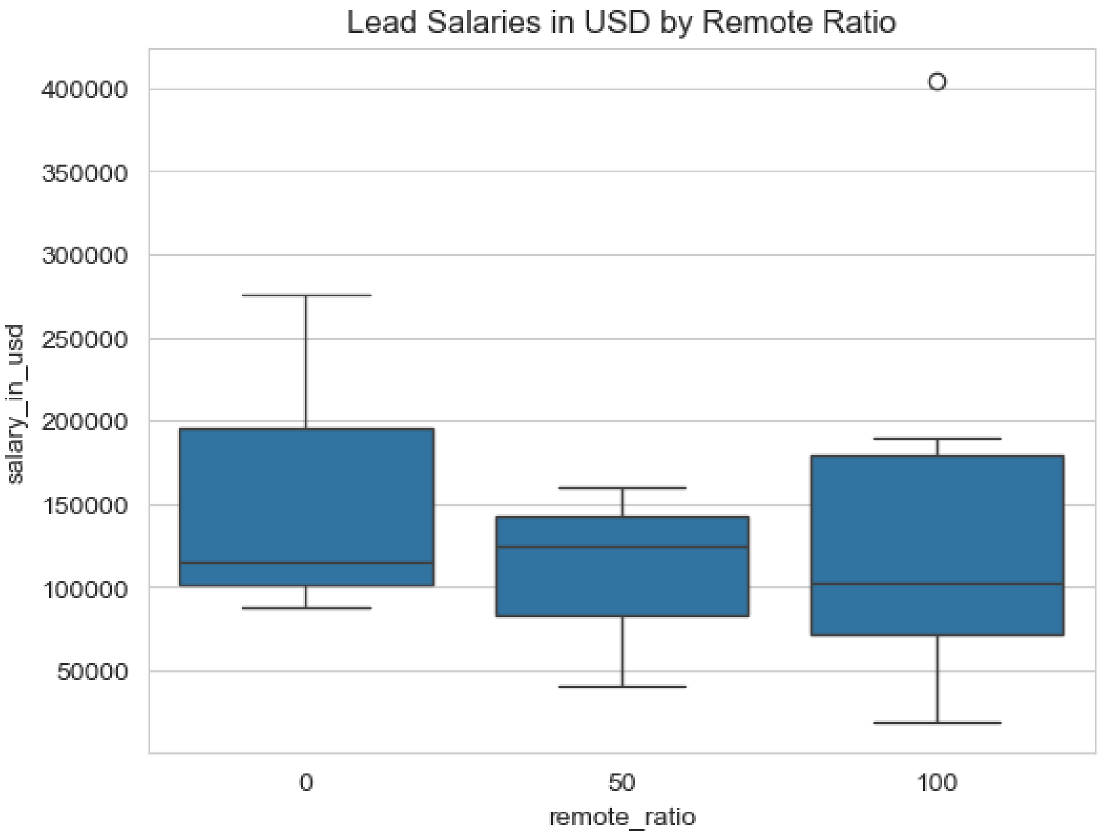
```
[6]: # Create a boxplot representing the salary_in_usd for the filtered data by␣
      ↪company location
     sns.boxplot(proj1_salary_lead,x='company_location',y="salary_in_usd",␣
      ↪orient="v").set(title="Lead Salaries in USD by Location")
```

```
[6]: [Text(0.5, 1.0, 'Lead Salaries in USD by Location')]
```



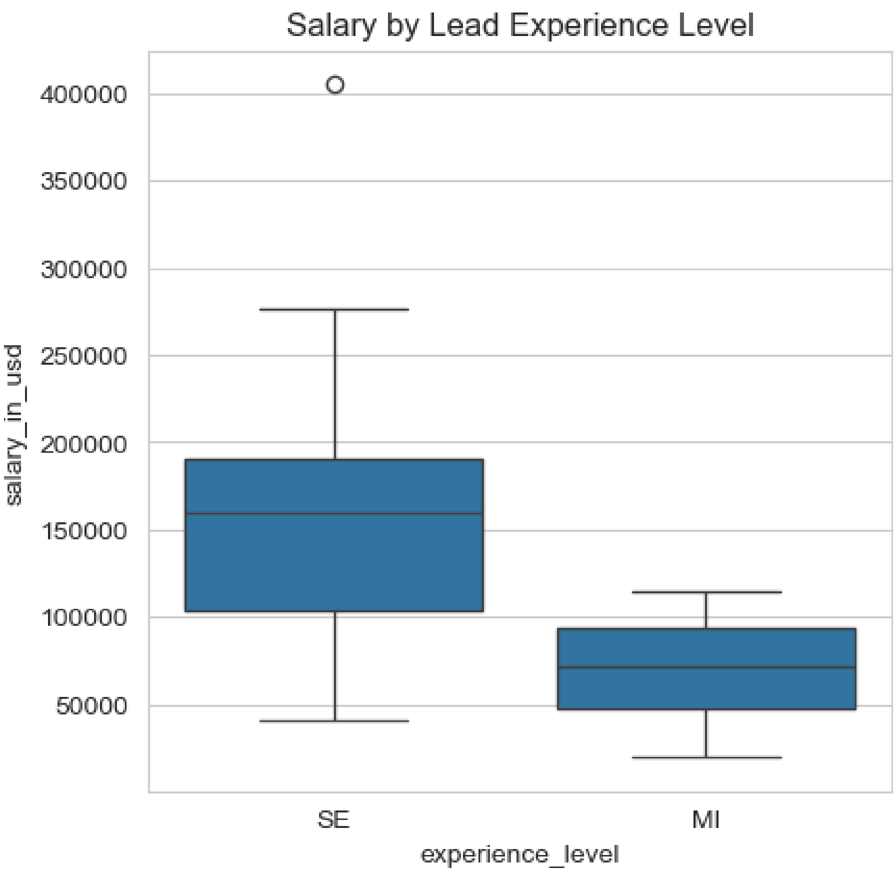
[7]:
```
# Create a boxplot representing the salary_in_usd for the filtered data by␣
 ↪remote status
sns.boxplot(proj1_salary_lead,x='remote_ratio',y="salary_in_usd", orient="v").
 ↪set(title="Lead Salaries in USD by Remote Ratio")
```

[7]:
```
[Text(0.5, 1.0, 'Lead Salaries in USD by Remote Ratio')]
```



[8]:
```
#create a boxplot that shows Salary by 'Lead' Experience Level.
plt.figure(figsize=(5, 5))
sns.boxplot(proj1_salary_lead,x='experience_level',y="salary_in_usd",␣
 ↪orient="v").set(title="Salary by Lead Experience Level")
```

[8]:
```
[Text(0.5, 1.0, 'Salary by Lead Experience Level')]
```



## 5 In the interest of going the extra mile, a more current data set was obtained from Kaggle.

**Kaggle is reputed to offer numerous accurate datasets for data science and machine learning enthusiasts.**

[9]:

```
#Download 2025 dataset from Kaggle for up-to-date comparison to original set.
os.chdir('/Users/caseybrookshier/Desktop/Merrimack/DSE5002/Project_1/
 ↪DSE5002_project1')
os.getcwd()

proj1_20to25_salary= pd.read_csv("DataScience_salaries_2025.csv")
print(proj1_20to25_salary.head())
```

```
   work_year experience_level employment_type          job_title  salary  \
0       2025               MI              FT  Research Scientist  208000
1       2025               MI              FT  Research Scientist  147000
2       2025               SE              FT  Research Scientist  173000
3       2025               SE              FT  Research Scientist  117000
4       2025               MI              FT         AI Engineer  100000
```

```
  salary_currency  salary_in_usd employee_residence  remote_ratio  \
0             USD         208000                 US             0
1             USD         147000                 US             0
2             USD         173000                 US             0
3             USD         117000                 US             0
4             USD         100000                 US           100

  company_location company_size
0               US            M
1               US            M
2               US            M
3               US            M
4               US            M
```

[10]:

```
# aggregate Data Scientist job_title column by the rows in which include the␣
 ↪word lead is present.
# Create 2 boxplots for this set, one US, one non-US
# Check if 'lead' or 'senior' is in the 'job_title' column
proj1_20to25_lead = proj1_20to25_salary[proj1_20to25_salary['job_title'].str.
 ↪contains('lead', case=False, na=False)]
proj1_20to25_lead_US = proj1_20to25_lead[proj1_20to25_lead['company_location'].
 ↪str.contains('US',case=False, na=False)]
proj1_20to25_lead_nonUS =␣
 ↪proj1_20to25_lead[~proj1_20to25_lead['company_location'].str.
 ↪contains('US',case=True, na=False)]

# Display the 1st filtered result first five rows
print(proj1_20to25_lead[:5])

# Get summary statistics LEAD-filtered, US, & nonUS results
print(proj1_20to25_lead.describe())
print(proj1_20to25_lead_US.describe())
print(proj1_20to25_lead_nonUS.describe())
```

```
     work_year experience_level employment_type             job_title  salary  \
142       2025               SE              FT  Data Governance Lead  229500
143       2025               SE              FT  Data Governance Lead  123500
344       2025               SE              FT  Data Management Lead  147000
345       2025               SE              FT  Data Management Lead  106900
510       2025               SE              FT             Data Lead   99816

    salary_currency  salary_in_usd employee_residence  remote_ratio  \
142             USD         229500                 US             0
143             USD         123500                 US             0
344             USD         147000                 US           100
345             USD         106900                 US           100
510             USD          99816                 US             0
```

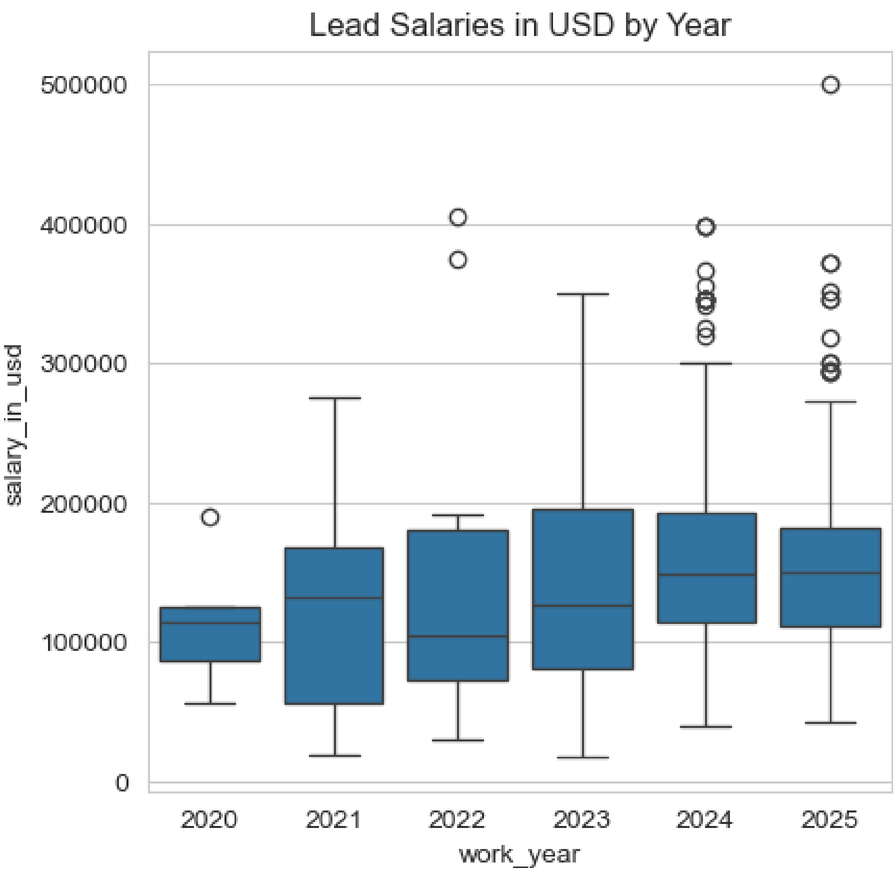
```
    company_location company_size
142               US            M
143               US            M
344               US            M
345               US            M
510               US            M
         work_year        salary  salary_in_usd  remote_ratio
count   892.000000  8.920000e+02     892.000000    892.000000
mean   2024.237668  1.874198e+05  155149.060538     22.533632
std       0.725992  3.957572e+05   66573.374472     41.263354
min    2020.000000  1.800000e+04   17511.000000      0.000000
25%    2024.000000  1.107682e+05  110054.750000      0.000000
50%    2024.000000  1.500000e+05  149620.000000      0.000000
75%    2025.000000  1.925000e+05  189700.000000      0.000000
max    2025.000000  7.500000e+06  500000.000000    100.000000
         work_year         salary  salary_in_usd  remote_ratio
count   763.000000     763.000000     763.000000    763.000000
mean   2024.298820  165688.872870  165803.235911     21.494102
std       0.647901   64542.345907   64366.106910     41.025194
min    2020.000000   38000.000000   38000.000000      0.000000
25%    2024.000000  117880.000000  117880.000000      0.000000
50%    2024.000000  156000.000000  156000.000000      0.000000
75%    2025.000000  196000.000000  196000.000000      0.000000
max    2025.000000  500000.000000  500000.000000    100.000000
         work_year        salary  salary_in_usd  remote_ratio
count   129.000000  1.290000e+02     129.000000    129.000000
mean   2023.875969  3.159526e+05   92132.503876     28.682171
std       1.007842  1.022734e+06   38838.861667     42.285855
min    2020.000000  1.800000e+04   17511.000000      0.000000
25%    2024.000000  5.760000e+04   63750.000000      0.000000
50%    2024.000000  8.500000e+04   89285.000000      0.000000
75%    2024.000000  1.191320e+05  117950.000000     50.000000
max    2025.000000  7.500000e+06  210000.000000    100.000000
```

[11]:

```
#Calculate Lead Salaries in USD by year
plt.figure(figsize=(5,5))
sns.boxplot(proj1_20to25_lead,x='work_year',y="salary_in_usd", orient="v").
 ↪set(title="Lead Salaries in USD by Year")
```

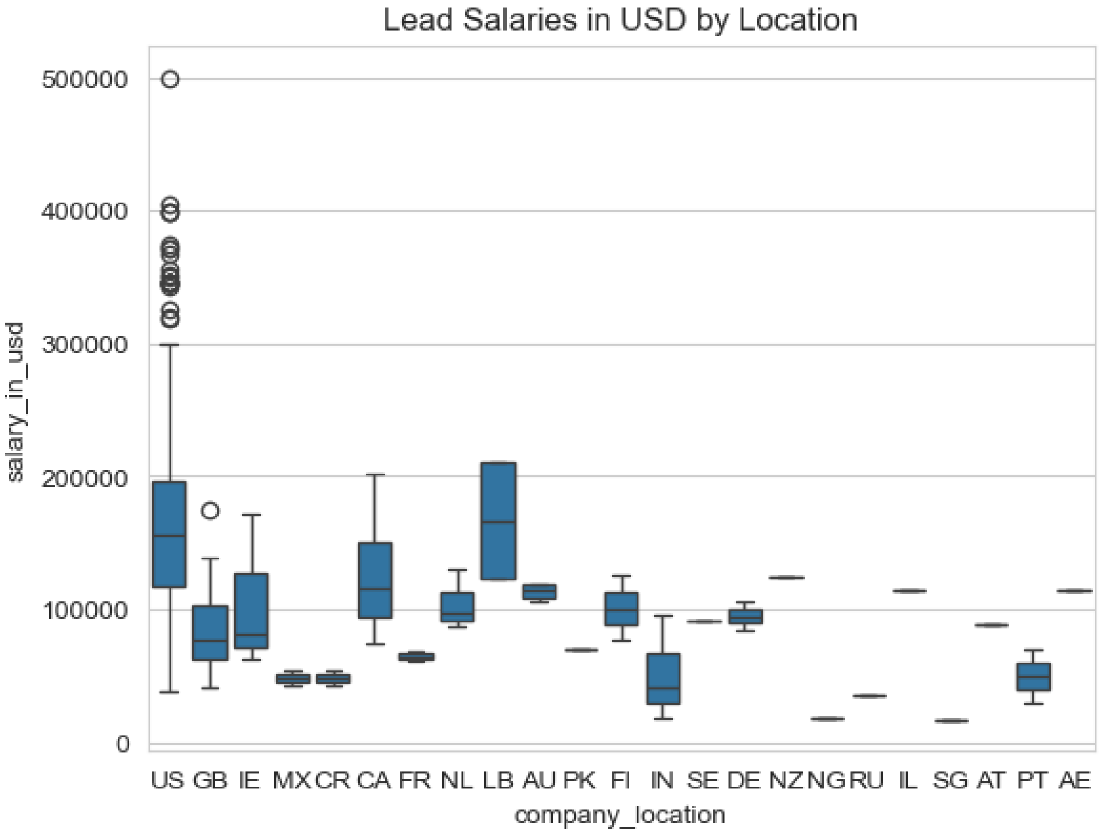
[11]:

```
[Text(0.5, 1.0, 'Lead Salaries in USD by Year')]
```



```
[12]: # Create a boxplot representing the salary_in_usd for the filtered data by␣
      ↪company location
      # Though not especially useful - this shows visually shows the clear advantage␣
      ↪the US has over most countries.
      sns.boxplot(proj1_20to25_lead,x='company_location',y="salary_in_usd",␣
      ↪orient="v").set(title="Lead Salaries in USD by Location")
```

```
[12]: [Text(0.5, 1.0, 'Lead Salaries in USD by Location')]
```



[13]:
```
# As with original data set, create similar filters for lead, US, and nonUS␣
 ↪subsets for 2025
proj1_2025_lead = proj1_20to25_lead[proj1_20to25_lead['work_year']==2025]
proj1_2025_lead_US = proj1_2025_lead[proj1_2025_lead['company_location'].str.
 ↪contains('US',case=False, na=False)]
proj1_2025_lead_nonUS = proj1_2025_lead[~proj1_2025_lead['company_location'].
 ↪str.contains('US',case=True, na=False)]

# Display the 1st filtered result first five rows
print(proj1_2025_lead[:5])
print(proj1_2025_lead.describe())
print(proj1_2025_lead_US.describe())
print(proj1_2025_lead_nonUS.describe())
```

```
     work_year experience_level employment_type             job_title  salary  \
142       2025               SE              FT  Data Governance Lead  229500
143       2025               SE              FT  Data Governance Lead  123500
344       2025               SE              FT  Data Management Lead  147000
345       2025               SE              FT  Data Management Lead  106900
510       2025               SE              FT             Data Lead   99816
```

```
    salary_currency  salary_in_usd employee_residence  remote_ratio  \
142             USD         229500                 US             0
143             USD         123500                 US             0
344             USD         147000                 US           100
345             USD         106900                 US           100
510             USD          99816                 US             0

    company_location company_size
142               US            M
143               US            M
344               US            M
345               US            M
510               US            M
       work_year         salary  salary_in_usd  remote_ratio
count      304.0     304.000000     304.000000    304.000000
mean      2025.0  152982.194079  153319.486842     22.368421
std          0.0   66377.191981   65625.305842     41.739991
min       2025.0   38916.000000   42000.000000      0.000000
25%       2025.0  111000.000000  111000.000000      0.000000
50%       2025.0  150000.000000  150000.000000      0.000000
75%       2025.0  182127.500000  182017.500000      0.000000
max       2025.0  500000.000000  500000.000000    100.000000
       work_year         salary  salary_in_usd  remote_ratio
count      276.0     276.000000     276.000000    276.000000
mean      2025.0  160430.956522  160430.956522     21.739130
std          0.0   64054.520517   64054.520517     41.322027
min       2025.0   46000.000000   46000.000000      0.000000
25%       2025.0  115000.000000  115000.000000      0.000000
50%       2025.0  150000.000000  150000.000000      0.000000
75%       2025.0  188640.000000  188640.000000      0.000000
max       2025.0  500000.000000  500000.000000    100.000000
       work_year         salary  salary_in_usd  remote_ratio
count       28.0      28.000000      28.000000     28.000000
mean      2025.0   79558.678571   83220.714286     28.571429
std          0.0   38689.354018   30464.747616     46.004371
min       2025.0   38916.000000   42000.000000      0.000000
25%       2025.0   53862.250000   61444.250000      0.000000
50%       2025.0   62301.000000   75377.500000      0.000000
75%       2025.0   96250.000000  103481.000000    100.000000
max       2025.0  210000.000000  150000.000000    100.000000
```

[14]:

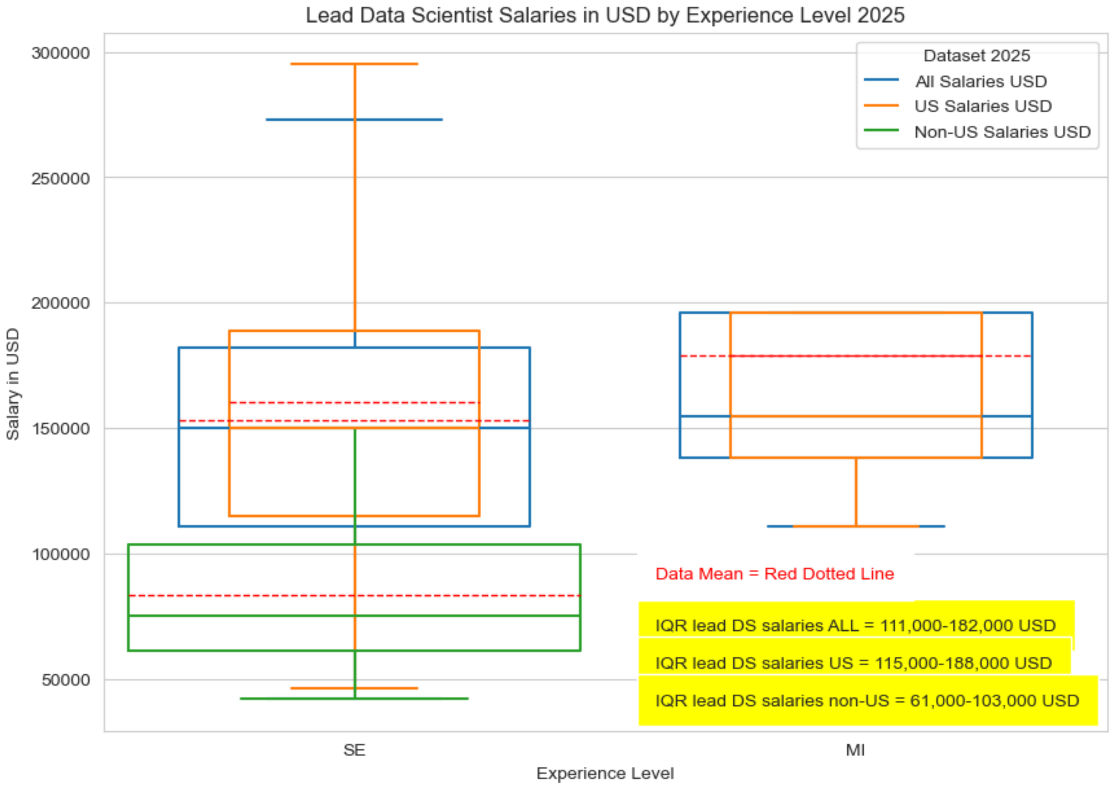
```
# Create a boxplot representing the salary_in_usd for the filtered data by␣
 ↪experience level
# Create 3 plots, showing subsets created above, superimposed for comparison
# Remove outliers to reduce boxplot to a more managable size
```

```
sns.set_style("whitegrid")
plt.figure(figsize=(10,7))
sns.boxplot(proj1_2025_lead,x='experience_level',y="salary_in_usd",␣
 ↪orient="v",showfliers=False,fill=False, width=.7, showmeans=True,␣
 ↪meanline=True, meanprops={"linewidth": 1, "color": "red"},label='All␣
 ↪Salaries USD').set(title="Lead Data Scientist Salaries in USD by Experience␣
 ↪Level 2025")
sns.boxplot(proj1_2025_lead_US,x='experience_level',y="salary_in_usd",␣
 ↪orient="v",showfliers=False,fill=False, showmeans=True, meanline=True,␣
 ↪meanprops={"linewidth": 1, "color": "red"}, width=.5,label='US Salaries␣
 ↪USD').set(title="Lead Data Scientist Salaries in USD by Experience Level␣
 ↪2025")
sns.boxplot(proj1_2025_lead_nonUS,x='experience_level',y="salary_in_usd",␣
 ↪orient="v",showfliers=False,fill=False, width=.9,showmeans=True,␣
 ↪meanline=True, meanprops={"linewidth": 1, "color": "red"},label='Non-US␣
 ↪Salaries USD').set(title="Lead Data Scientist Salaries in USD by Experience␣
 ↪Level 2025")

#Adding Textbox
plt.text(0.6, 70000, 'IQR lead DS salaries ALL = 111,000-182,000 USD',␣
 ↪fontsize=10, bbox={'facecolor': 'yellow', 'pad': 10, 'alpha': 1})
plt.text(0.6, 55000, 'IQR lead DS salaries US = 115,000-188,000 USD',␣
 ↪fontsize=10, bbox={'facecolor': 'yellow', 'pad': 10, 'alpha': 1})
plt.text(0.6, 40000, 'IQR lead DS salaries non-US = 61,000-103,000 USD',␣
 ↪fontsize=10, bbox={'facecolor': 'yellow', 'pad': 10, 'alpha': 1})
plt.text(0.6, 90000, 'Data Mean = Red Dotted Line',color='red', fontsize=10,␣
 ↪bbox={'facecolor': 'white', 'pad': 10, 'alpha': 1})

# Set axis labels using plt.xlabel() and plt.ylabel()
plt.xlabel('Experience Level')
plt.ylabel('Salary in USD')

plt.legend(title='Dataset 2025')
plt.show()
```


Lead Data Scientist Salaries in USD by Experience Level 2025
300000
250000
200000
150000
100000
50000
Salary in USD
SE
MI
Experience Level
Dataset 2025
All Salaries USD
US Salaries USD
Non-US Salaries USD
Data Mean = Red Dotted Line
IQR lead DS salaries ALL = 111,000-182,000 USD
IQR lead DS salaries US = 115,000-188,000 USD
IQR lead DS salaries non-US = 61,000-103,000 USD

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[ ]:
```

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[ ]:
```