WileyWinters_Week6_Assignment

February 24, 2024

0.0.1 Week 6 Assignment

- Wiley Winters
- MSDS 670 — Data Visualization
- 25-FEB-2024

0.0.2 Dataset Information

Dataset: Jobs and Salaries in Data Science Metadata: - `work_year`: Year in which data was recorded. - `job_title`: Specific title of the job role. - `job_category`: Classification of the job role into broader categories for easier analysis - `salary_currency`: Currency in which the salary is paid - `salary`: Annual gross salary of the role in the local currency - `salary_in_usd`: Annual gross salary in USD - `employee_residence`: Country of residence - `experience_level`: Classifies the professional experience level of the employee - `employment_type`: Specifies the type of employment such as *full-time*, *part-time*, *contract*, *etc* - `work_setting`: Work setting or environment such as *remote*, *in-person*, or *hybrid* - `company_location`: Country where the company is located - `company_size`: Size of the employer company categorized as *small (S)*, *medium (M)*, and *large (L)*

Formal Reference to Dataset

Qaasim, H. (2023, December). Jobs and Salaries in Data Science. Version 6. Retrieved December 25, 2023 from https://www.kaggle.com/datasets/hummaamqaasim/jobs-in-data/data

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Import required packages and libraries. Set global configuration items.

[1]:

```python
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import matplotlib.ticker as mtick
from matplotlib import rcParams
import numpy as np

# Suppress Warnings
import warnings
warnings.filterwarnings('ignore')

# Set matplotlab autolayout to True
```

```
rcParams.update({'figure.autolayout': True})
```

Read dataset into a Pandas DataFrame

[2]:
```
jobs_df = pd.read_csv('../data/jobs_in_data.csv')
jobs_df.sample(5)
```

[2]:
```
      work_year           job_title                      job_category  \
7517       2022        Data Analyst                     Data Analysis
5348       2023        Data Manager         Leadership and Management
9157       2020  Research Scientist         Data Science and Research
7581       2022       Data Engineer                  Data Engineering
6954       2023      Data Architect  Data Architecture and Modeling

     salary_currency  salary  salary_in_usd employee_residence  \
7517             USD  150000         150000      United States
5348             USD  110000         110000      United States
9157             USD  450000         450000      United States
7581             USD   75000          75000      United States
6954             USD  115000         115000      United States

     experience_level employment_type work_setting company_location  \
7517        Mid-level       Full-time    In-person    United States
5348        Mid-level       Full-time    In-person    United States
9157        Mid-level       Full-time    In-person    United States
7581           Senior       Full-time    In-person    United States
6954           Senior       Full-time       Remote    United States

     company_size
7517            M
5348            M
9157            M
7581            M
6954            M
```

[3]:
```
jobs_df.describe().T
```

[3]:
```
                count           mean           std      min       25%  \
work_year      9355.0    2022.760449      0.519470   2020.0    2023.0
salary         9355.0  149927.981293  63608.835387  14000.0  105200.0
salary_in_usd  9355.0  150299.495564  63177.372024  15000.0  105700.0

                    50%       75%       max
work_year        2023.0    2023.0    2023.0
salary         143860.0  187000.0  450000.0
salary_in_usd  143000.0  186723.0  450000.0
```

The dataset covers years from 2020 to 2023. In order to not double count some values. I will only work with 2023 data

Check some basic items to see if the dataset requires cleaning or not

[4]:
```
print(jobs_df.info())
print('\nNaN Values:\n', jobs_df.isna().sum())
print('\nDuplicates: ', jobs_df.duplicated().sum())
print('\nSize: ', jobs_df.size)
print('\nDistribution:\n', jobs_df.describe().T)
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 9355 entries, 0 to 9354
Data columns (total 12 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   work_year           9355 non-null   int64
 1   job_title           9355 non-null   object
 2   job_category        9355 non-null   object
 3   salary_currency     9355 non-null   object
 4   salary              9355 non-null   int64
 5   salary_in_usd       9355 non-null   int64
 6   employee_residence  9355 non-null   object
 7   experience_level    9355 non-null   object
 8   employment_type     9355 non-null   object
 9   work_setting        9355 non-null   object
 10  company_location    9355 non-null   object
 11  company_size        9355 non-null   object
dtypes: int64(3), object(9)
memory usage: 877.2+ KB
None

NaN Values:
 work_year             0
job_title             0
job_category          0
salary_currency       0
salary                0
salary_in_usd         0
employee_residence    0
experience_level      0
employment_type       0
work_setting          0
company_location      0
company_size          0
dtype: int64

Duplicates:  4014

Size:  112260
```

```
Distribution:
                count           mean           std      min       25%  \
work_year      9355.0    2022.760449      0.519470   2020.0    2023.0
salary         9355.0  149927.981293  63608.835387  14000.0  105200.0
salary_in_usd  9355.0  150299.495564  63177.372024  15000.0  105700.0

                    50%       75%       max
work_year        2023.0    2023.0    2023.0
salary         143860.0  187000.0  450000.0
salary_in_usd  143000.0  186723.0  450000.0
```

Looks like there is a lot of duplicates. I will remove them.

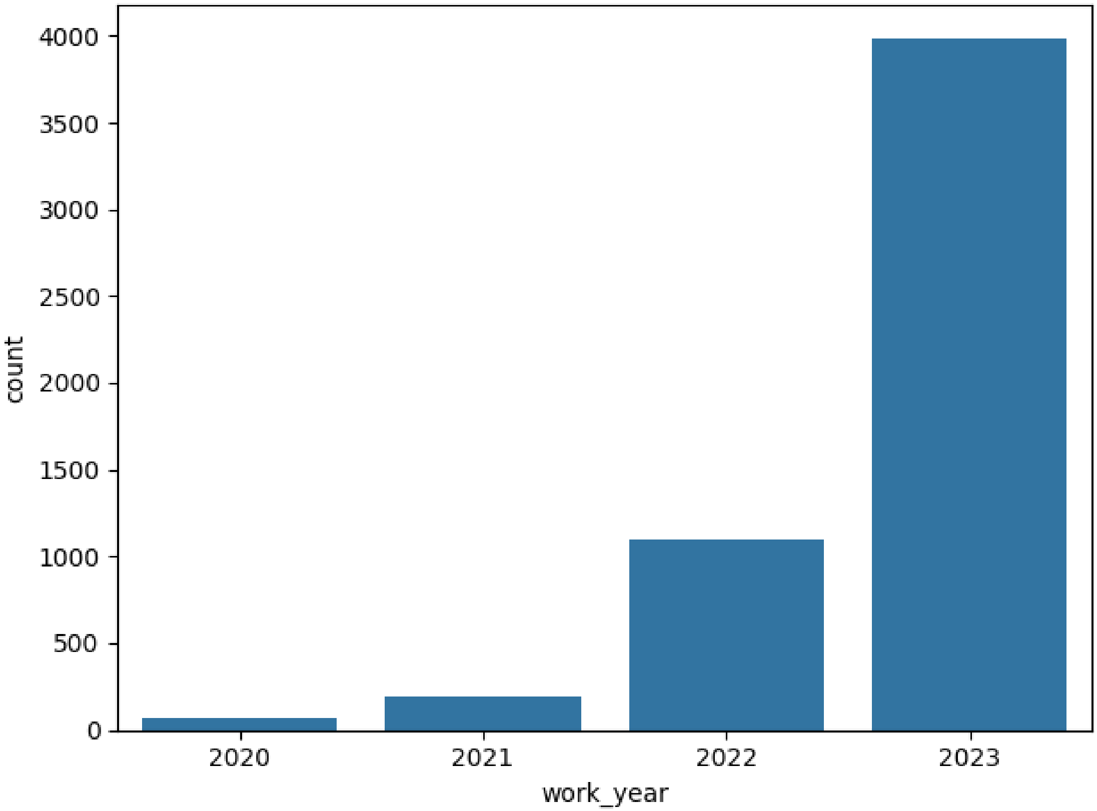
[5]:
```
jobs_df.drop_duplicates(keep='first', inplace=True)
jobs_df.duplicated().sum()
```

[5]:
```
0
```

0.0.3 Basic EDA

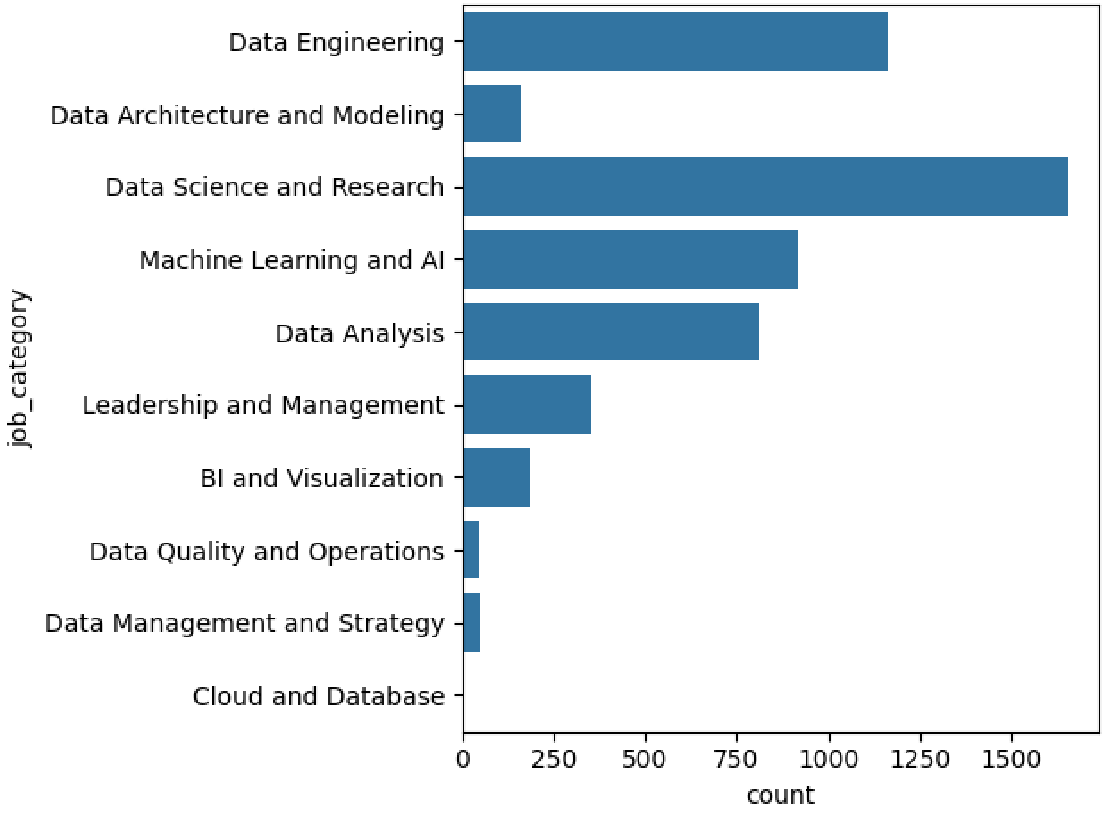
[6]:
```
sns.countplot(jobs_df, x='work_year')
```

[6]:
```
<Axes: xlabel='work_year', ylabel='count'>
```



```
[7]: sns.countplot(jobs_df, y='job_category')
```

```
[7]: <Axes: xlabel='count', ylabel='job_category'>
```

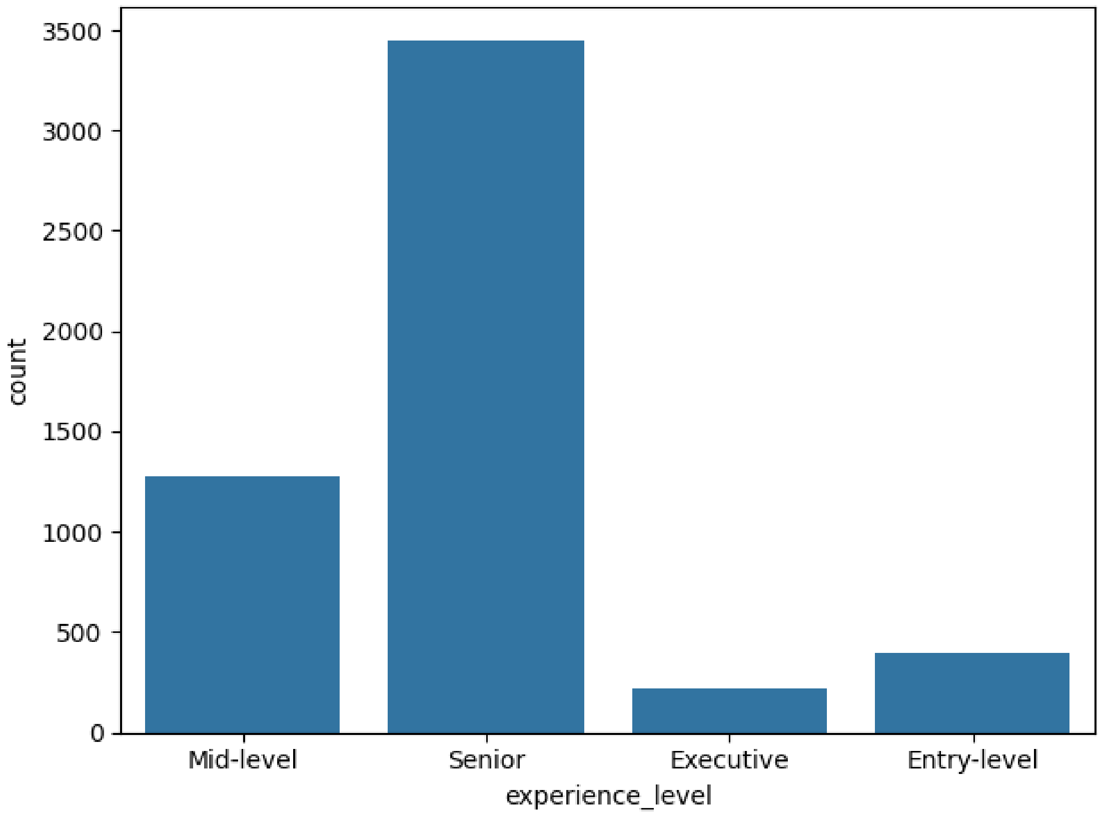


```
[8]: jobs_df['employee_residence'].value_counts().head(10)
     #sns.countplot(data=jobs_df, y='employee_residence')
```

```
[8]: employee_residence
     United States     4255
     United Kingdom     351
     Canada             196
     Germany             65
     Spain               63
     France              53
     Portugal            26
     Netherlands         21
     Italy               20
     Brazil              19
     Name: count, dtype: int64
```

```
[9]: sns.countplot(data=jobs_df, x='experience_level')
```

```
[9]: <Axes: xlabel='experience_level', ylabel='count'>
```

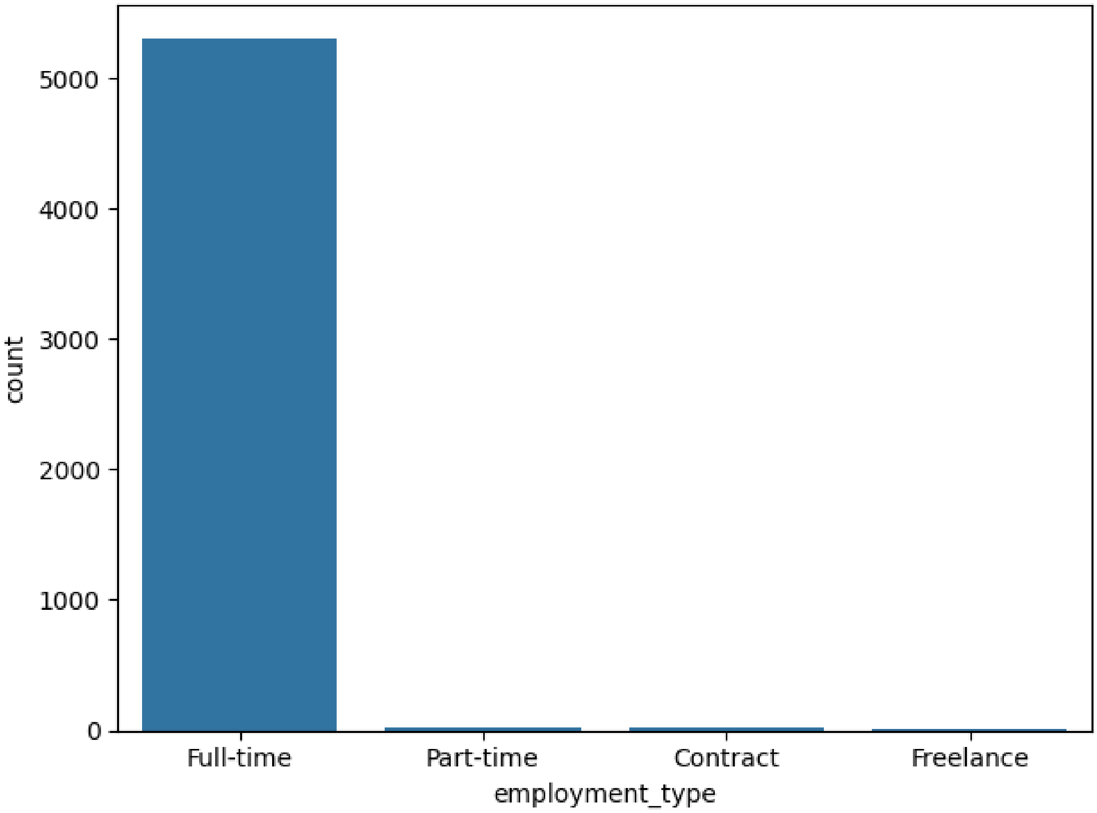


```
[10]: jobs_df['experience_level'].value_counts()
```

```
[10]: experience_level
      Senior         3444
      Mid-level      1274
      Entry-level     400
      Executive       223
      Name: count, dtype: int64
```

```
[11]: sns.countplot(data=jobs_df, x='employment_type')
```

```
[11]: <Axes: xlabel='employment_type', ylabel='count'>
```

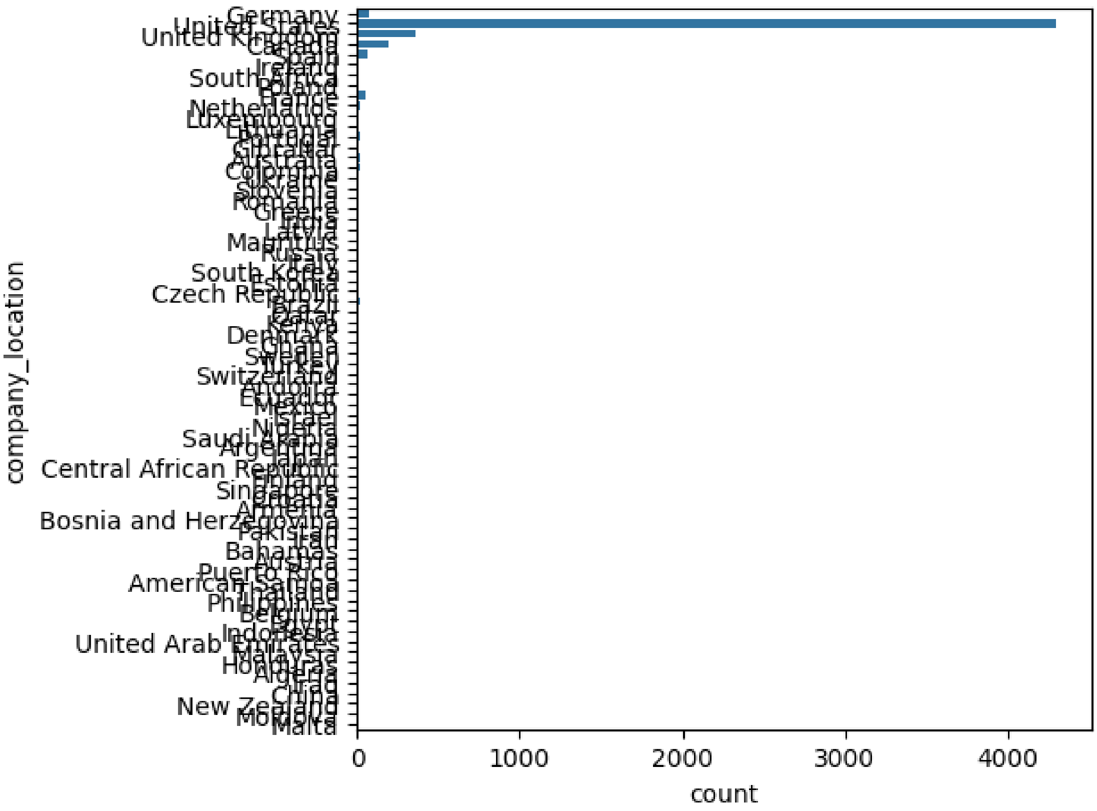


```
[12]: jobs_df['employment_type'].value_counts()
```

```
[12]: employment_type
      Full-time    5296
      Contract       19
      Part-time      15
      Freelance      11
      Name: count, dtype: int64
```

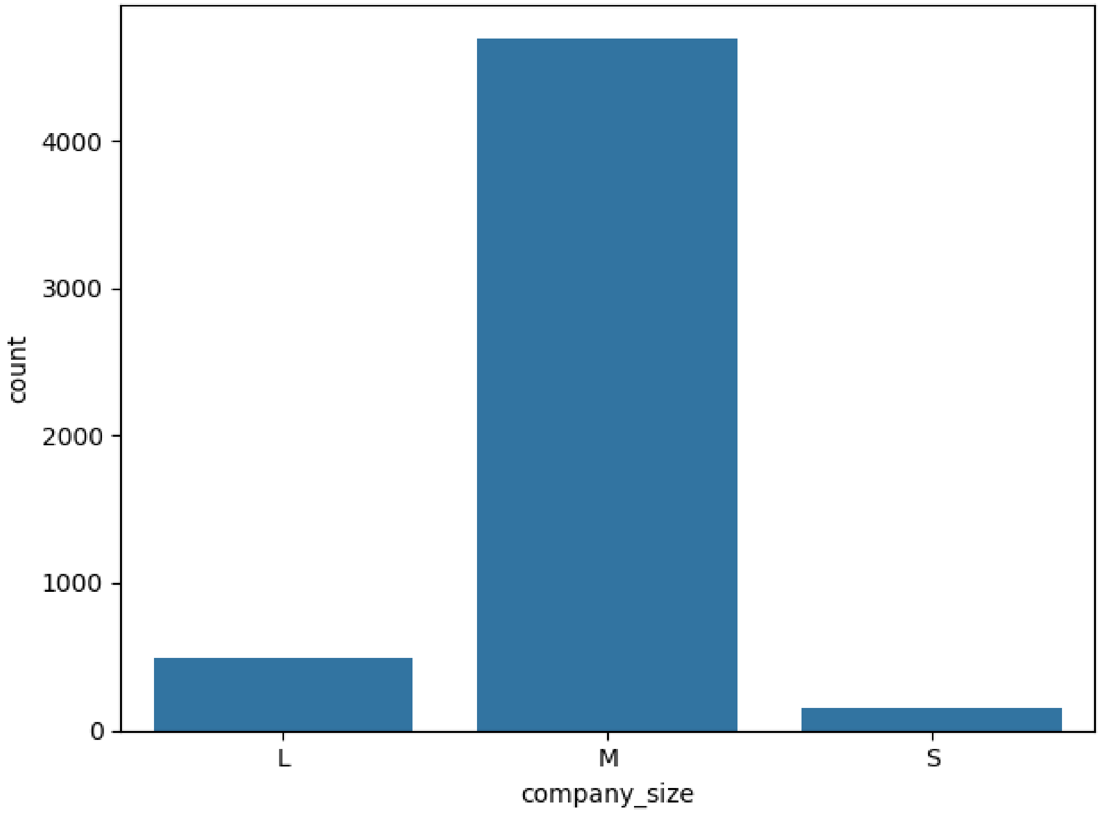
```
[13]: sns.countplot(data=jobs_df, y='company_location')
```

```
[13]: <Axes: xlabel='count', ylabel='company_location'>
```



[14]:
```
sns.countplot(data=jobs_df, x='company_size')
```

[14]:
```
<Axes: xlabel='company_size', ylabel='count'>
```



Based on EDA performed, I will limit the number of `company_location` and `employee_residence` to 10 countries. I found that some of the countries are only listed a couple of time; therefore, are not well distributed.

```
[15]: jobs_df.value_counts(['company_location', 'employee_residence']).head(15)
```

```
[15]: company_location  employee_residence
      United States     United States         4249
      United Kingdom    United Kingdom         350
      Canada            Canada                 192
      Germany           Germany                 60
      Spain             Spain                   57
      France            France                  46
      Portugal          Portugal                23
      Netherlands       Netherlands             19
      Brazil            Brazil                  17
      Australia         Australia               17
      Colombia          Colombia                14
      Italy             Italy                   13
      Greece            Greece                  11
      Mexico            Mexico                   9
```

```
Ireland          Ireland                   8
Name: count, dtype: int64
```

[16]:
```
countries = ['United States', 'United Kingdom', 'Canada', 'Germany',
             'Spain', 'France', 'Portugal', 'Netherlands', 'Australia',
             'Brazil', 'Colombia', 'Italy', 'Greece']
jobs_df = jobs_df[jobs_df['company_location'].isin(countries)]
jobs_df = jobs_df[jobs_df['employee_residence'].isin(countries)]
jobs_df.sample(10)
```

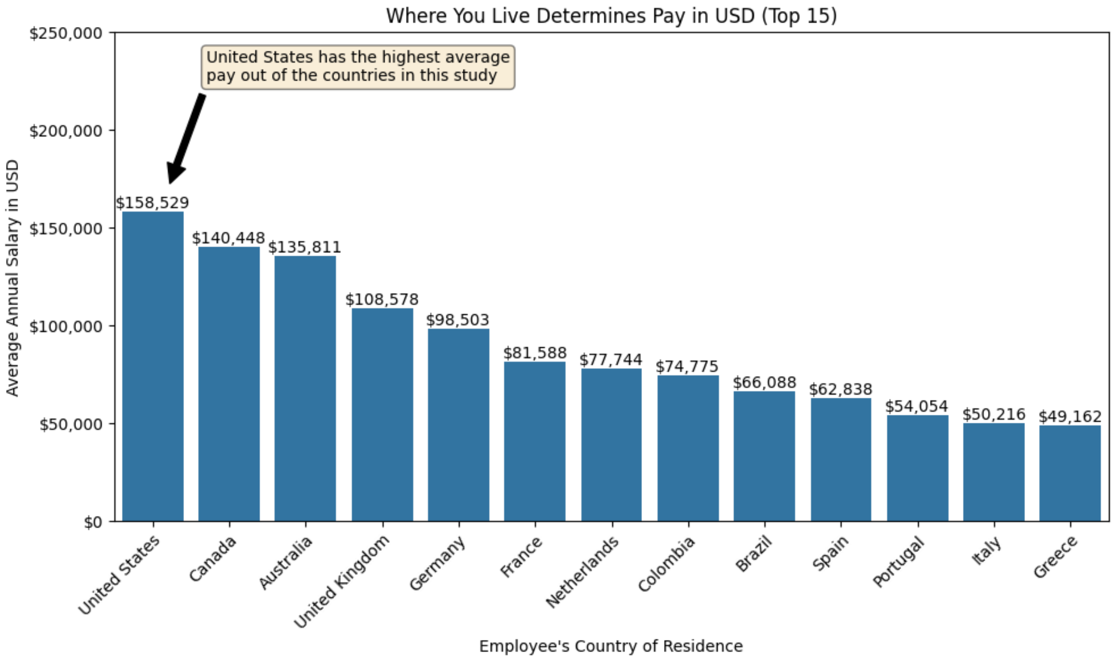
[16]:
```
      work_year                    job_title                job_category  \
2813       2023           Analytics Engineer     Leadership and Management
856        2023    Machine Learning Engineer       Machine Learning and AI
1076       2023                Data Engineer              Data Engineering
5228       2023               Data Scientist     Data Science and Research
675        2023               Data Scientist     Data Science and Research
5029       2023               Data Scientist     Data Science and Research
2684       2023                 Data Analyst                 Data Analysis
4363       2023                 Data Analyst                 Data Analysis
4140       2023           Research Scientist     Data Science and Research
2960       2023  Data Integration Specialist  Data Management and Strategy

     salary_currency  salary  salary_in_usd employee_residence  \
2813             USD  134000         134000      United States
856              USD  214500         214500      United States
1076             USD  112000         112000      United States
5228             USD  150120         150120      United States
675              USD   92000          92000      United States
5029             USD   85000          85000      United States
2684             USD  130000         130000      United States
4363             USD  113220         113220      United States
4140             USD  220000         220000      United States
2960             USD   85000          85000             Canada

     experience_level employment_type work_setting company_location  \
2813           Senior       Full-time       Remote    United States
856            Senior       Full-time    In-person    United States
1076           Senior       Full-time    In-person    United States
5228           Senior       Full-time       Remote    United States
675         Mid-level       Full-time    In-person    United States
5029        Mid-level       Full-time    In-person    United States
2684           Senior       Full-time       Remote    United States
4363           Senior       Full-time    In-person    United States
4140        Mid-level       Full-time       Remote    United States
2960      Entry-level       Full-time    In-person           Canada

     company_size
```

```
2813            M
856             M
1076            M
5228            M
675             M
5029            M
2684            S
4363            M
4140            M
2960            M
```

0.0.4 Look for interesting items to plot

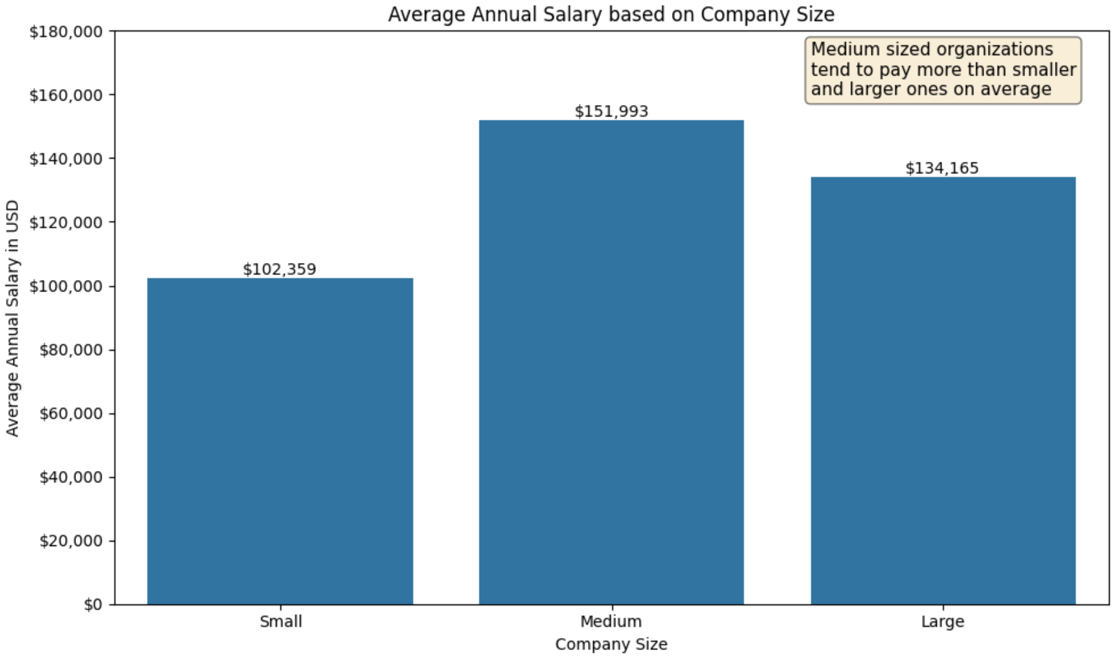
[17]:

```
# Highest pay by employee_residence in USD. Top 15
pay_residence = jobs_df.groupby('employee_residence').agg({'salary_in_usd':␣
 ↪'mean'}). \
                               sort_values('salary_in_usd', ascending=False).
 ↪head(15)
fig, ax = plt.subplots(figsize=(10,6))
props = dict(boxstyle='round', facecolor='wheat', alpha=0.5)
ax.yaxis.set_major_formatter(mtick.StrMethodFormatter('${x:,.0f}'))
ax.set(xlabel='Employee\'s Country of Residence', ylabel='Average Annual Salary␣
 ↪in USD', \
       title='Where You Live Determines Pay in USD (Top 15)', ylim=(0,250000))
sns.barplot(data=pay_residence, x='employee_residence', y='salary_in_usd')
plt.xticks(rotation=45, ha='right', rotation_mode='anchor')
textstr = '\n'.join(('United States has the highest average',
                     'pay out of the countries in this study'))
ax.annotate(textstr, xy=(0.2,170000), xytext=(0.7,225000), bbox=props,
            fontsize=10, arrowprops=dict(facecolor='black', shrink=0.05))
ax.bar_label(ax.containers[0], fmt='${:,.0f}')
fig.savefig('../images/highResidenceUSD.png', bbox_inches='tight', dpi=300)
```



[18]:

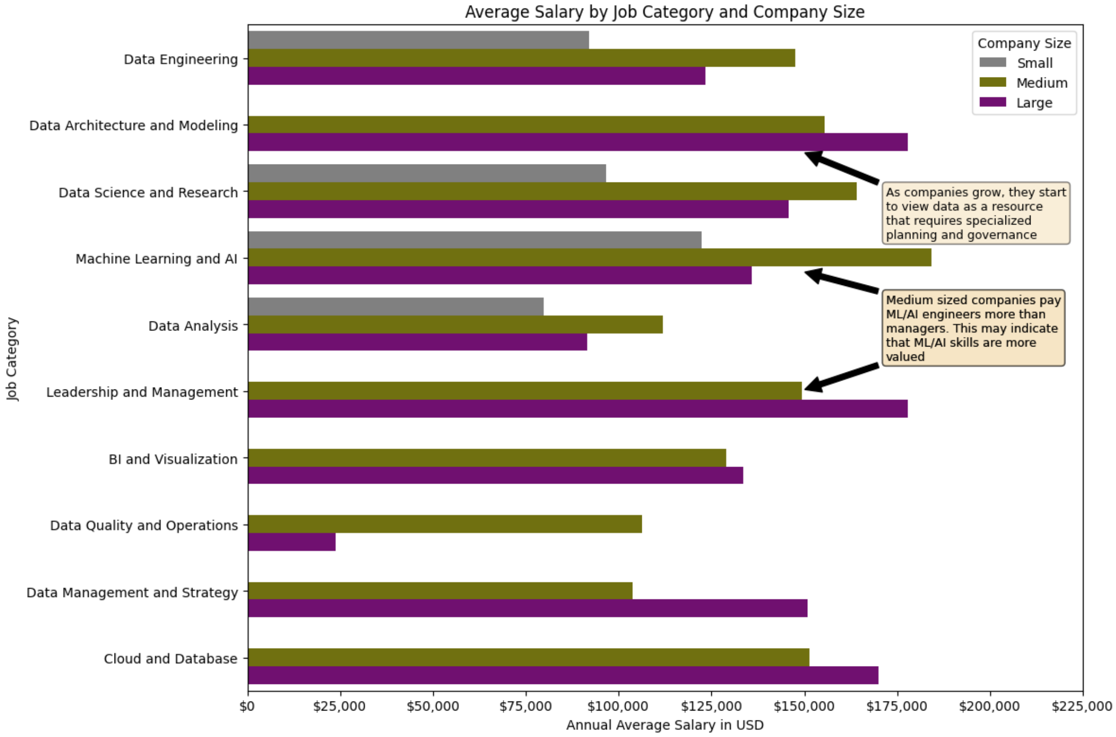
```python
# Average salary based on company size
sizes = ('Small','Medium','Large')
size = jobs_df.groupby('company_size').agg({'salary_in_usd': 'mean'}). \
                        sort_values('company_size', ascending=False)
fig, ax = plt.subplots(figsize=(10,6))
sns.barplot(data=size, x='company_size', y='salary_in_usd')
ax.yaxis.set_major_formatter(mtick.StrMethodFormatter('${x:,.0f}'))
x_pos = np.arange(len(sizes))
ax.set_xticks(x_pos, labels=sizes)
ax.set(xlabel='Company Size', ylabel='Average Annual Salary in USD',
       title='Average Annual Salary based on Company Size',
       ylim=(0,180000))
textstr = '\n'.join(('Medium sized organizations',
                     'tend to pay more than smaller',
                     'and larger ones on average'))
props = dict(boxstyle='round', facecolor='wheat', alpha=0.5)
ax.text(0.7, 0.98, textstr, transform=ax.transAxes, fontsize=11,
        verticalalignment='top', bbox=props)
ax.bar_label(ax.containers[0], fmt='${:,.0f}')
fig.savefig('../images/aveCompanySize.png', bbox_inches='tight', dpi=300)
```



Medium sized organizations
tend to pay more than smaller
and larger ones on average

[24]:

```python
# Average salary by job category and company size
fig, ax = plt.subplots(figsize=(12,8))
ax.xaxis.set_major_formatter(mtick.StrMethodFormatter('${x:,.0f}'))
ax.set(xlabel='Annual Average Salary in USD', ylabel='Job Category',
       title='Average Salary by Job Category and Company Size',
       xlim=(0,225000))
hue_order = ['S', 'M', 'L']
bar_colors = ['grey', 'olive', 'purple']
sns.barplot(data=jobs_df, x='salary_in_usd', y='job_category', hue='company_size',
            hue_order=hue_order, palette=bar_colors, ci=None)
ax.legend(['Small','Medium', 'Large'], title='Company Size')
props = dict(boxstyle='round', facecolor='wheat', alpha=0.5)
text1 = '\n'.join(('As companies grow, they start',
                   'to view data as a resource',
                   'that requires specialized',
                   'planning and governance'))
text2 = '\n'.join(('Medium sized companies pay',
                   'ML/AI engineers more than',
                   'managers. This may indicate',
                   'that ML/AI skills are more',
                   'valued'))
an1 = ax.annotate(text1, xytext=(172000,2.70), xy=(149000,1.4), bbox=props,
                  fontsize=9, arrowprops=dict(facecolor='black', shrink=0.05))
an2 = ax.annotate(text2, xytext=(172000,4.53), xy=(149000,3.2), bbox=props,
                  fontsize=9, arrowprops=dict(facecolor='black', shrink=0.05))
an3 = ax.annotate(text2, xytext=(172000,4.53), xy=(149000,5.0), bbox=props,
                  fontsize=9, arrowprops=dict(facecolor='black', shrink=0.05))
fig.savefig('../images/aveCatSize.png', bbox_inches='tight', dpi=300)
```



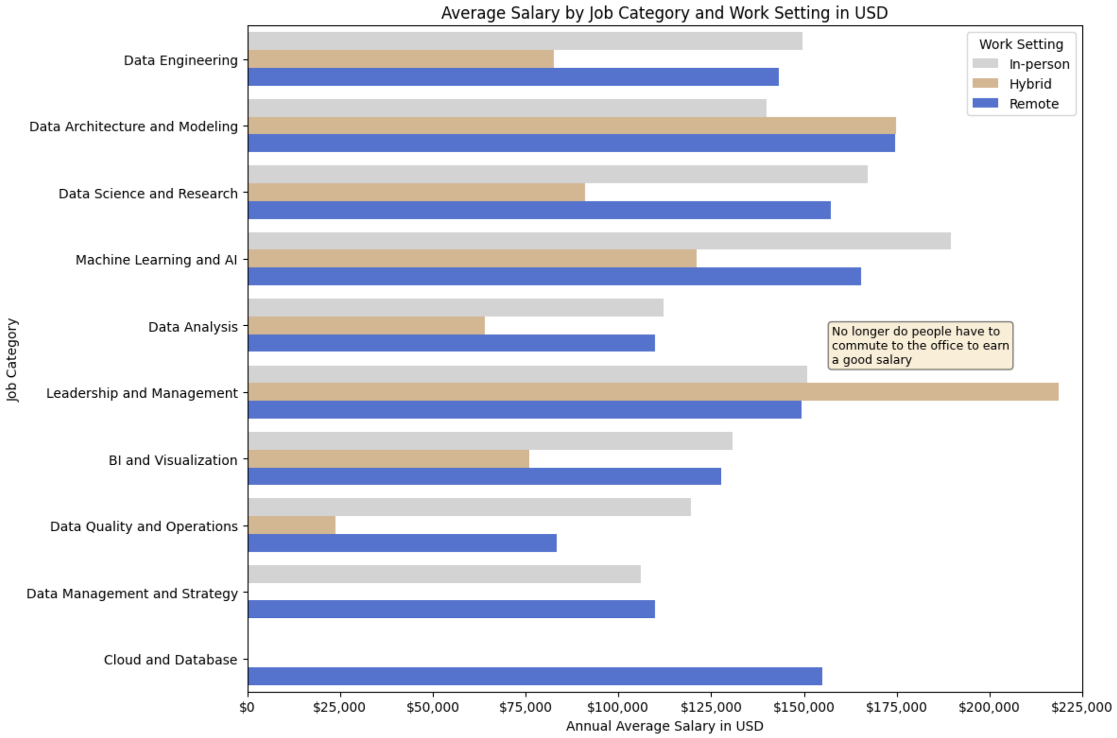
As companies grow, they start to view data as a resource that requires specialized planning and governance

Medium sized companies pay ML/AI engineers more than managers. This may indicate that ML/AI skills are more valued

[20]:

```
# Average Salary by job category and work setting
fig, ax = plt.subplots(figsize=(12,8))
ax.xaxis.set_major_formatter(mtick.StrMethodFormatter('${x:,.0f}'))
ax.set(xlabel='Annual Average Salary in USD', ylabel='Job Category',
       title='Average Salary by Job Category and Work Setting in USD',␣
 ↪xlim=(0,225000))
hue_order = ['In-person', 'Hybrid', 'Remote']
bar_colors = ['lightgrey', 'burlywood', 'royalblue']
props = dict(boxstyle='round', facecolor='wheat', alpha=0.5)
sns.barplot(data=jobs_df, x='salary_in_usd', y='job_category',␣
 ↪hue='work_setting',
            hue_order=hue_order, palette=bar_colors, ci=None)
ax.legend(title='Work Setting')
text1 = '\n'.join(('No longer do people have to',
                   'commute to the office to earn',
                   'a good salary'))
ax.text(0.7, 0.55, text1, transform=ax.transAxes, fontsize=9,
        verticalalignment='top', bbox=props)
```

```
fig.savefig('../images/aveCatWork.png', bbox_inches='tight', dpi=300)
```



```
[ ]:
```