Python-based salary analysis for Datascience jobs

August 12, 2022

1 Project Title - Datascience job salaries

1.0.1 Introduction

In this project, I will examine a dataset on the pay for several data science professions that I downloaded from Kaggle. Using this dataset, I'll provide answers to a number of questions, including: Does a person's work role have an impact on their salary? Does the sort of employment affect the wage earned? Does the size and location of the company have an impact on the salary paid? To answer these questions, I'll be utilizing Python libraries such as Numpy and Pandas for computations, and Matplotlib and Seaborn for visualizations. A lot of what I'll be doing derives its inspiration from the course offered by Jovian; Data Ananlysis: Zerotopandas.

1.1 Downloading the Dataset

[1]:
```
!pip install jovian opendatasets --upgrade --quiet
```

Let's begin by downloading the data, and listing the files within the dataset.

[2]:
```
dataset_url = 'https://www.kaggle.com/datasets/ruchi798/
↪data-science-job-salaries'
```

[3]:
```
import opendatasets as od
od.download(dataset_url)
```

```
Please provide your Kaggle credentials to download this dataset. Learn more:
http://bit.ly/kaggle-creds
Your Kaggle username: moseskinuthia
Your Kaggle Key: ·····
Downloading data-science-job-salaries.zip to ./data-science-job-salaries

100%|      | 7.37k/7.37k [00:00<00:00, 6.25MB/s]
```

The dataset has been downloaded and extracted.

[4]:
```
data_dir = './data-science-job-salaries'
```

[5]:
```
import os
os.listdir(data_dir)
```

[5]:
```
['ds_salaries.csv']
```

Let us save and upload our work to Jovian before continuing.

[6]:
```
project_name = "datascience-jobs-salaries"
```

[7]:
```
!pip install jovian --upgrade -q
```

[8]:
```
import jovian
```

[9]:
```
jovian.commit(project=project_name)
```

```
<IPython.core.display.Javascript object>
```

```
[jovian] Updating notebook "moseskinuthia73/datascience-jobs-salaries" on
https://jovian.ai
[jovian] Committed successfully! https://jovian.ai/moseskinuthia73/datascience-
jobs-salaries
```

[9]:
```
'https://jovian.ai/moseskinuthia73/datascience-jobs-salaries'
```

1.2 Data Preparation and Cleaning

TODO In this step, I'll be preparing the dataset for analysis by removing any null values and duplicate values and reorganizing the dataset in a way that will make the analysis's findings informative.

[10]:
```
import pandas as pd
import numpy as np
import os
```

[11]:
```
salary_df = pd.read_csv('./data-science-job-salaries/ds_salaries.csv')
```

[12]:
```
salary_df
```

[12]:

	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	
..	…	…	…	…	
602	602	2022	SE	FT	
603	603	2022	SE	FT	
604	604	2022	SE	FT	

```
605         605       2022               SE              FT
606         606       2022               MI              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
..                          …     …               …             …
602              Data Engineer  154000             USD         154000
603              Data Engineer  126000             USD         126000
604               Data Analyst  129000             USD         129000
605               Data Analyst  150000             USD         150000
606               AI Scientist  200000             USD         200000

    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
..                  …           …                 …           …
602                 US           100               US            M
603                 US           100               US            M
604                 US             0               US            M
605                 US           100               US            M
606                 IN           100               US            L

[607 rows x 12 columns]
```

[13]:
```
salary_df.drop(["Unnamed: 0"], axis = 1, inplace = True)
```

[14]:
```
salary_df.columns
```

[14]:
```
Index(['work_year', 'experience_level', 'employment_type', 'job_title',
       'salary', 'salary_currency', 'salary_in_usd', 'employee_residence',
       'remote_ratio', 'company_location', 'company_size'],
      dtype='object')
```

[15]:
```
salary_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 607 entries, 0 to 606
Data columns (total 11 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
```

```
 0   work_year           607 non-null    int64
 1   experience_level    607 non-null    object
 2   employment_type     607 non-null    object
 3   job_title           607 non-null    object
 4   salary              607 non-null    int64
 5   salary_currency     607 non-null    object
 6   salary_in_usd       607 non-null    int64
 7   employee_residence  607 non-null    object
 8   remote_ratio        607 non-null    int64
 9   company_location    607 non-null    object
 10  company_size        607 non-null    object
dtypes: int64(4), object(7)
memory usage: 52.3+ KB
```

[16]:
```
salary_df.describe()
```

[16]:

	work_year	salary	salary_in_usd	remote_ratio
count	607.000000	6.070000e+02	607.000000	607.00000
mean	2021.405272	3.240001e+05	112297.869852	70.92257
std	0.692133	1.544357e+06	70957.259411	40.70913
min	2020.000000	4.000000e+03	2859.000000	0.00000
25%	2021.000000	7.000000e+04	62726.000000	50.00000
50%	2022.000000	1.150000e+05	101570.000000	100.00000
75%	2022.000000	1.650000e+05	150000.000000	100.00000
max	2022.000000	3.040000e+07	600000.000000	100.00000

[17]:
```
import jovian
```

[18]:
```
jovian.commit()
```

```
<IPython.core.display.Javascript object>
```

```
[jovian] Updating notebook "moseskinuthia73/datascience-jobs-salaries" on
https://jovian.ai
[jovian] Committed successfully! https://jovian.ai/moseskinuthia73/datascience-
jobs-salaries
```

[18]:
```
'https://jovian.ai/moseskinuthia73/datascience-jobs-salaries'
```

1.3 Exploratory Analysis and Visualization

An exploratory analysis is a thorough examination meant to uncover the underlying structure of a data set and is important because it exposes trends, patterns, and relationships that are not readily apparent.

Let's begin by importing`matplotlib.pyplot` and `seaborn`.

[19]:
```
import seaborn as sns
import matplotlib
```

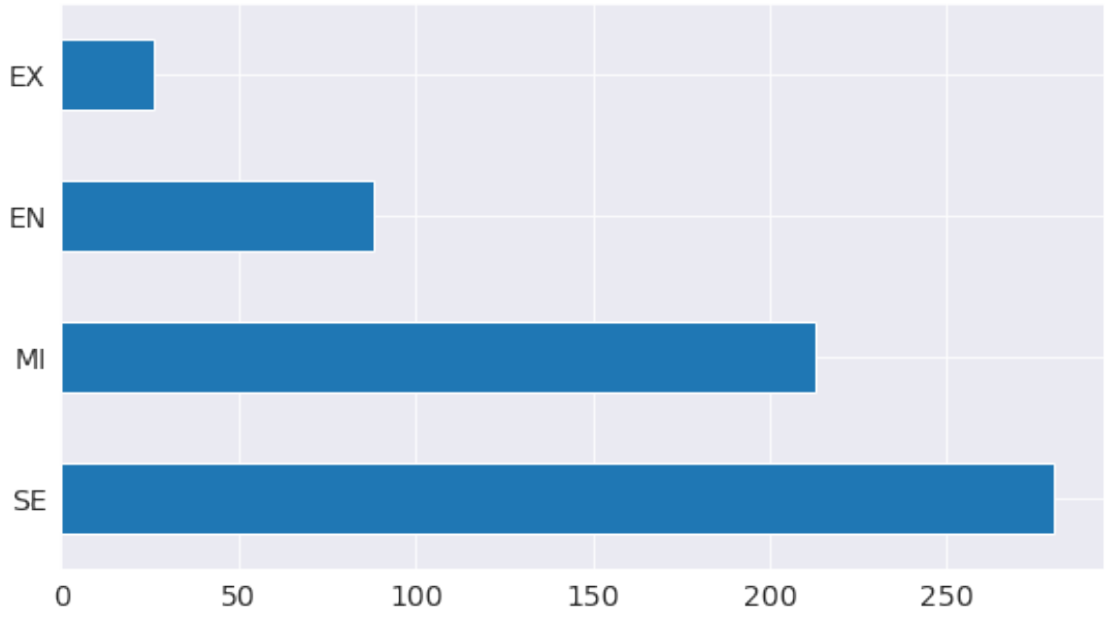
```
import matplotlib.pyplot as plt
%matplotlib inline

sns.set_style('darkgrid')
matplotlib.rcParams['font.size'] = 14
matplotlib.rcParams['figure.figsize'] = (9, 5)
matplotlib.rcParams['figure.facecolor'] = '#00000000'
```

TODO - Explore one or more columns by plotting a graph below, and add some explanation about it

[20]:
```
# The level of experience of each job holder.
salary_df.experience_level.value_counts().plot.barh()
```

[20]: <AxesSubplot:>

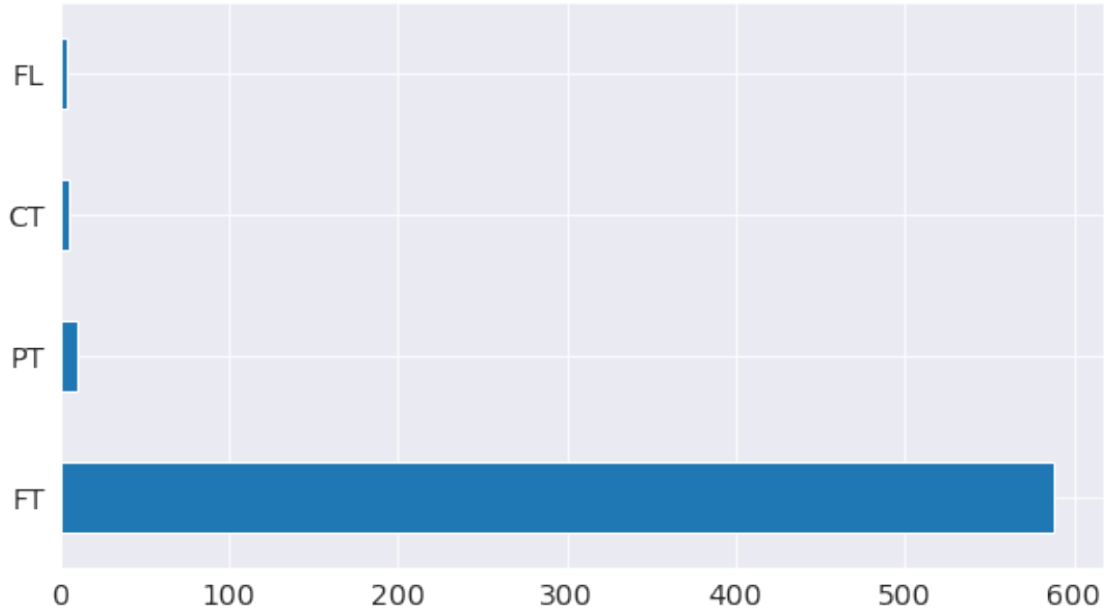


From the above graph, we can see that the senior level of experience has the highest number of job holders, followed by the middle level, entry level, and the executive level.

TODO - Explore one or more columns by plotting a graph below, and add some explanation about it

[21]:
```
# The number of job holders per the type of employment
salary_df.employment_type.value_counts().plot.barh()
```

[21]: <AxesSubplot:>

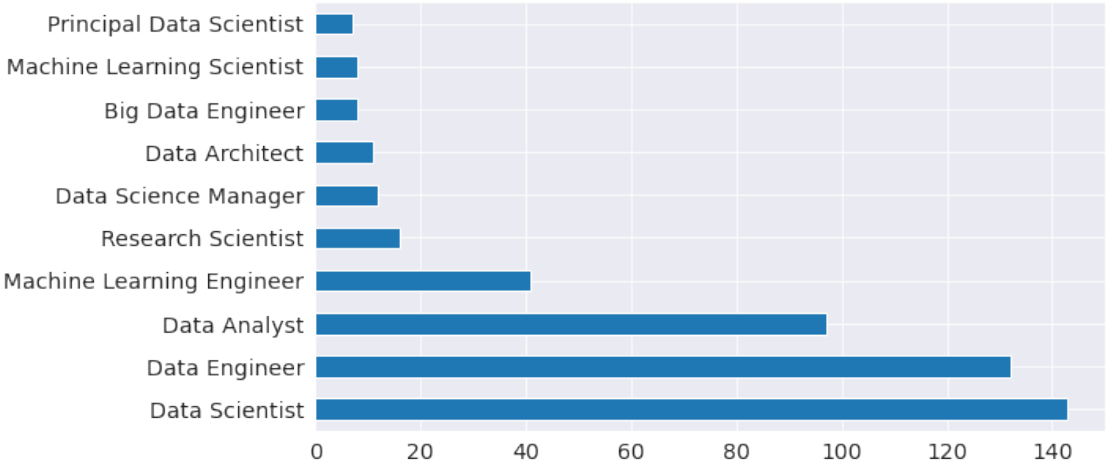


From the above graph, it can be seen that most of the job holders are employed on a full time basis.

TODO - Explore one or more columns by plotting a graph below, and add some explanation about it

[22]:
```
# The number of job holders per the job title
salary_df.job_title.value_counts().head(10).plot.barh()
```

[22]: <AxesSubplot:>



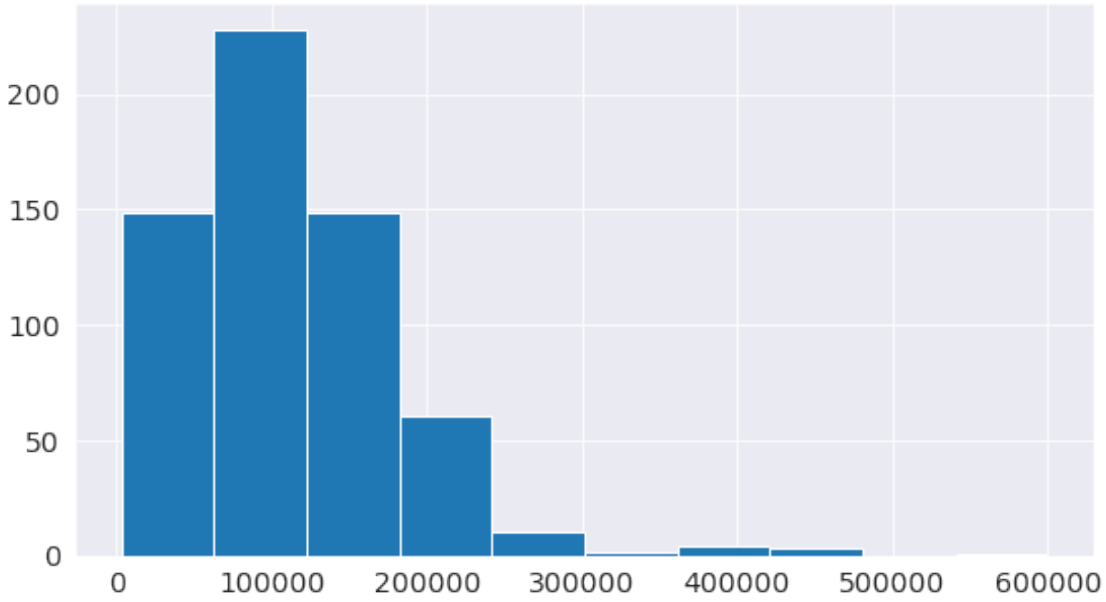
Due to the large number of job roles inherent in our dataset, I've decided to use a sample of 10,

starting with the job role having the highest number of employees. From the above diagram, it can be seen that a large number of employees in our dataset are data scientist, followed by data engineers, data analysts, machine learning engineers, research scientists, data science managers, data architects, big data engineers, machine learning scientists, and principal data scientists.

TODO - Explore one or more columns by plotting a graph below, and add some explanation about it

[23]:
```
# The distribution of the salary_in_usd
plt.hist(salary_df.salary_in_usd)
```

[23]:
```
(array([149., 228., 149.,  61.,  10.,   2.,   4.,   3.,   0.,   1.]),
 array([  2859. ,  62573.1, 122287.2, 182001.3, 241715.4, 301429.5,
        361143.6, 420857.7, 480571.8, 540285.9, 600000. ]),
 <BarContainer object of 10 artists>)
```

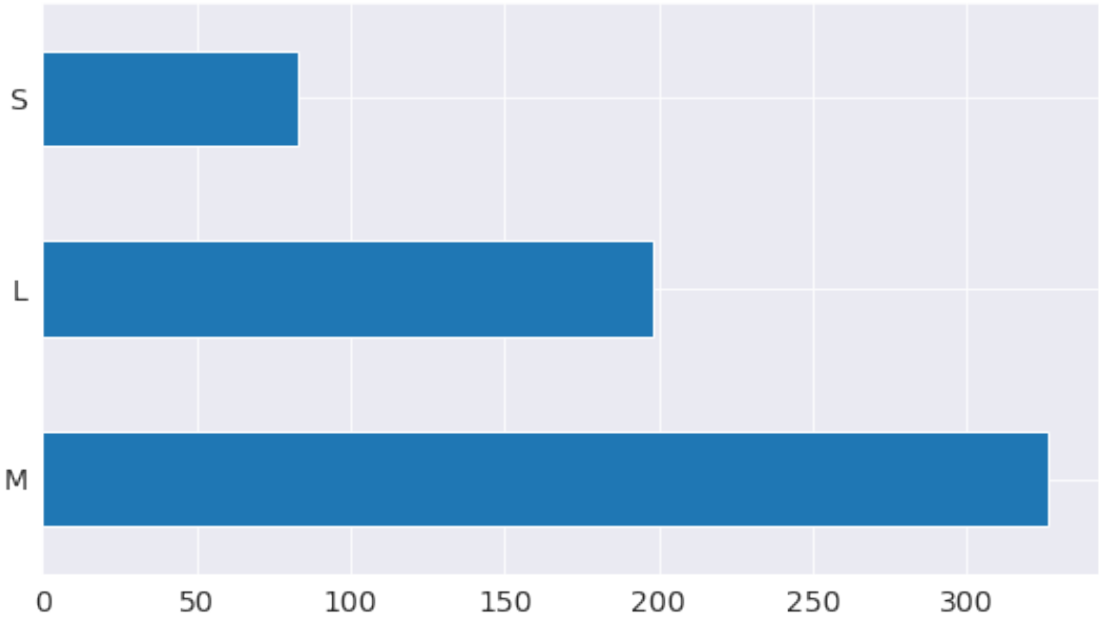


From the above diagram, it can be seen that a huge number of employees' salary range from 50,000 to 100,000. We also have outliers, as one of the employees is receiving a salary of 600,000 usd.

TODO - Explore one or more columns by plotting a graph below, and add some explanation about it

[24]:
```
# The number of job holders per the company size
salary_df.company_size.value_counts().plot.barh()
```

[24]:
```
<AxesSubplot:>
```

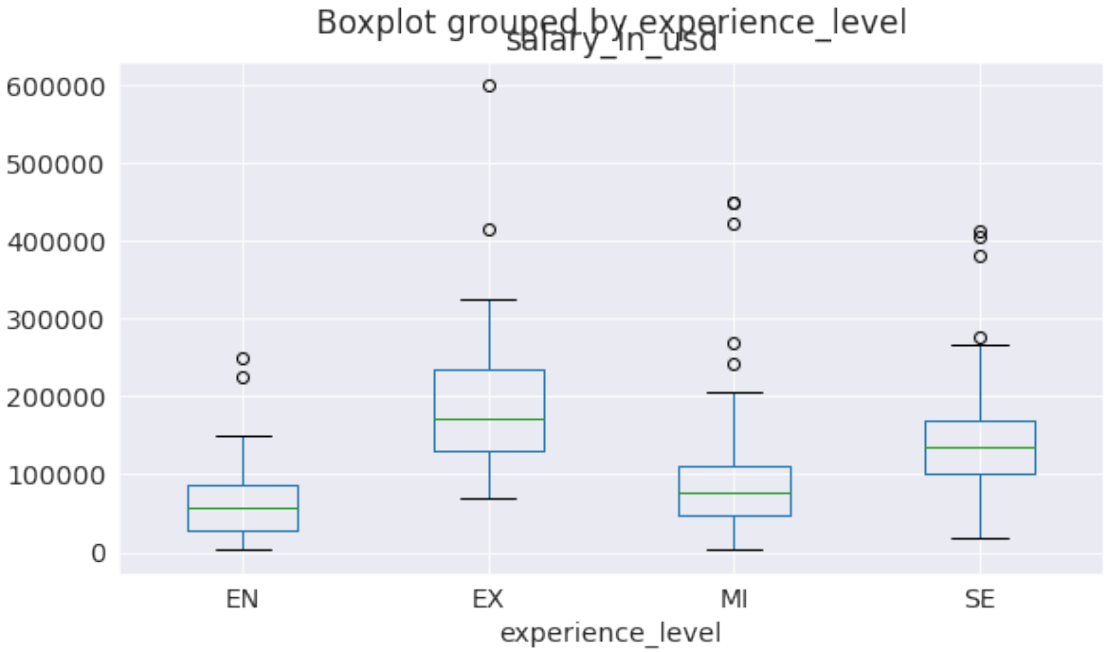


From the above graph, it can be seen that a huge number of employees are employed in medium sized companies, followed by large sized companies, and small sized companies.

TODO - Explore one or more columns by plotting a graph below, and add some explanation about it

[25]:
```
# we will now determine the relationship between the level of experience of the job holder and the salary (in usd)
salary_df.boxplot(column='salary_in_usd', by='experience_level')
```

[25]:
```
<AxesSubplot:title={'center':'salary_in_usd'}, xlabel='experience_level'>
```

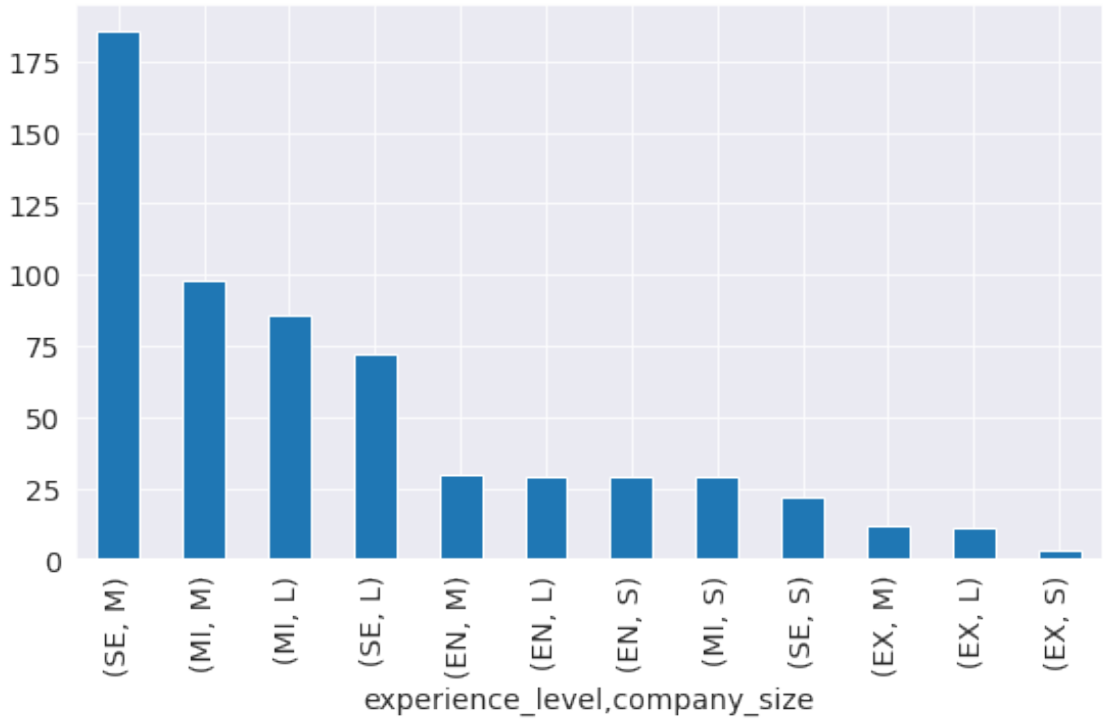


From the above diagram, it can be seen that there is a correlation between the job holders' level of experience and the amount of salary (in usd) received. The job holders at the executive level receive the highest salary, followed by the ones at the senior level, middle level, and the entry level.

TODO - Explore one or more columns by plotting a graph below, and add some explanation about it

[26]:
```
# we will now determine the relationship between the level of experience and␣
↪the size of the company.
combined = salary_df[['experience_level', 'company_size']]
combined.value_counts().plot.bar()
```

[26]:
```
<AxesSubplot:xlabel='experience_level,company_size'>
```



From the above graph, it can be seen that most of the job holders at the senior level are employed in medium sized companies. The number of job holders at the executive level is low for both the large, medium, and small sized companies.

Let us save and upload our work to Jovian before continuing

[27]:
```
import jovian
```

[28]:
```
jovian.commit()
```

```
<IPython.core.display.Javascript object>
```

```
[jovian] Updating notebook "moseskinuthia73/datascience-jobs-salaries" on
https://jovian.ai
[jovian] Committed successfully! https://jovian.ai/moseskinuthia73/datascience-
jobs-salaries
```

[28]:
```
'https://jovian.ai/moseskinuthia73/datascience-jobs-salaries'
```

1.4 Asking and Answering Questions

In this section, I will be answering various questions regarding our dataset. #### The importance of asking good questions cannot be over-emphasized, as good questions highlight insights in our dataset that could act as the basis of many decisions regarding employment in the future.

[29]:
```
#pd.set_option('display.max_rows', None)
```

Q1: TODO - Is there a relationship between the level of experience of the job holder and the amount of salary received?

[30]:
```
salary_df
```

[30]:

```
     work_year experience_level employment_type                  job_title  \
0         2020               MI              FT             Data Scientist
1         2020               SE              FT  Machine Learning Scientist
2         2020               SE              FT           Big Data Engineer
3         2020               MI              FT        Product Data Analyst
4         2020               SE              FT   Machine Learning Engineer
..         …                …               …                          …
602       2022               SE              FT               Data Engineer
603       2022               SE              FT               Data Engineer
604       2022               SE              FT                Data Analyst
605       2022               SE              FT                Data Analyst
606       2022               MI              FT                AI Scientist

     salary salary_currency  salary_in_usd employee_residence  remote_ratio  \
0     70000             EUR          79833                 DE             0
1    260000             USD         260000                 JP             0
2     85000             GBP         109024                 GB            50
3     20000             USD          20000                 HN             0
4    150000             USD         150000                 US            50
..      …               …              …                  …             …
602  154000             USD         154000                 US           100
603  126000             USD         126000                 US           100
604  129000             USD         129000                 US             0
605  150000             USD         150000                 US           100
606  200000             USD         200000                 IN           100

    company_location company_size
0                 DE            L
1                 JP            S
2                 GB            M
3                 HN            S
4                 US            L
..               …            …
602               US            M
603               US            M
604               US            M
605               US            M
606               US            L

[607 rows x 11 columns]
```

[31]:
```
experience=salary_df[['experience_level', 'salary_in_usd']]
experience.sort_values(by=['salary_in_usd'], ascending=False)
```

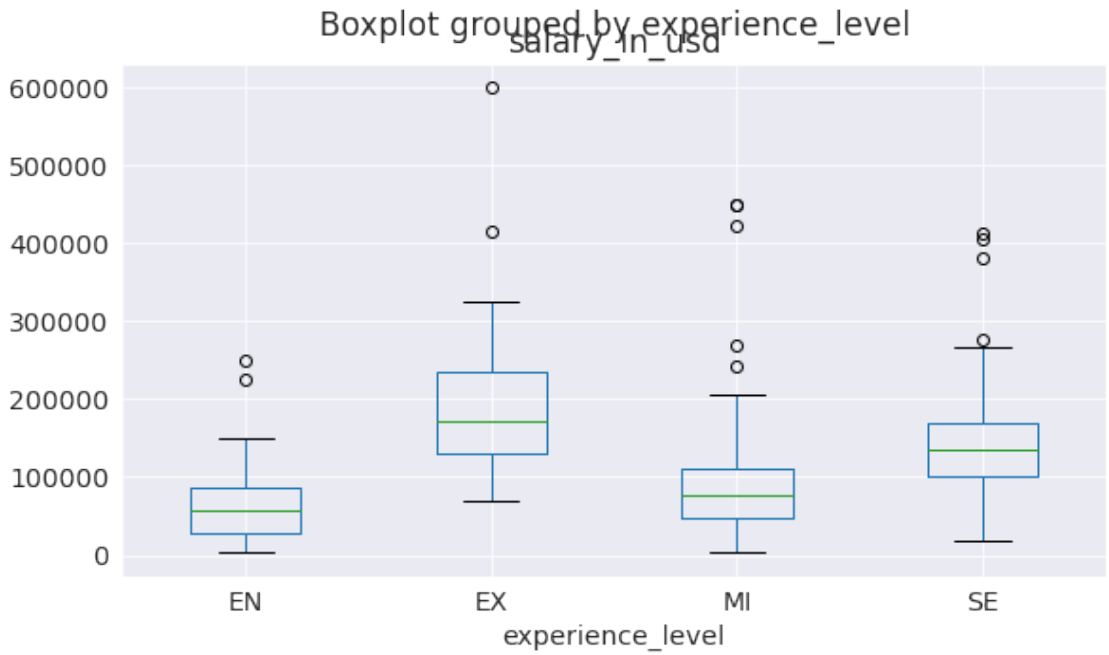
[31]:

	experience_level	salary_in_usd
252	EX	600000
97	MI	450000
33	MI	450000
157	MI	423000
225	EX	416000
..	…	…
179	MI	5679
77	MI	5409
238	EN	4000
185	MI	4000
176	MI	2859

[607 rows x 2 columns]

[32]:
```
salary_df.boxplot(column='salary_in_usd', by='experience_level')
```

[32]:
```
<AxesSubplot:title={'center':'salary_in_usd'}, xlabel='experience_level'>
```



It is evident that there is a relationship between the level of experience and the salary (in usd), as job holders at the more senior and executive levels tend to receive the highest amount of salary.

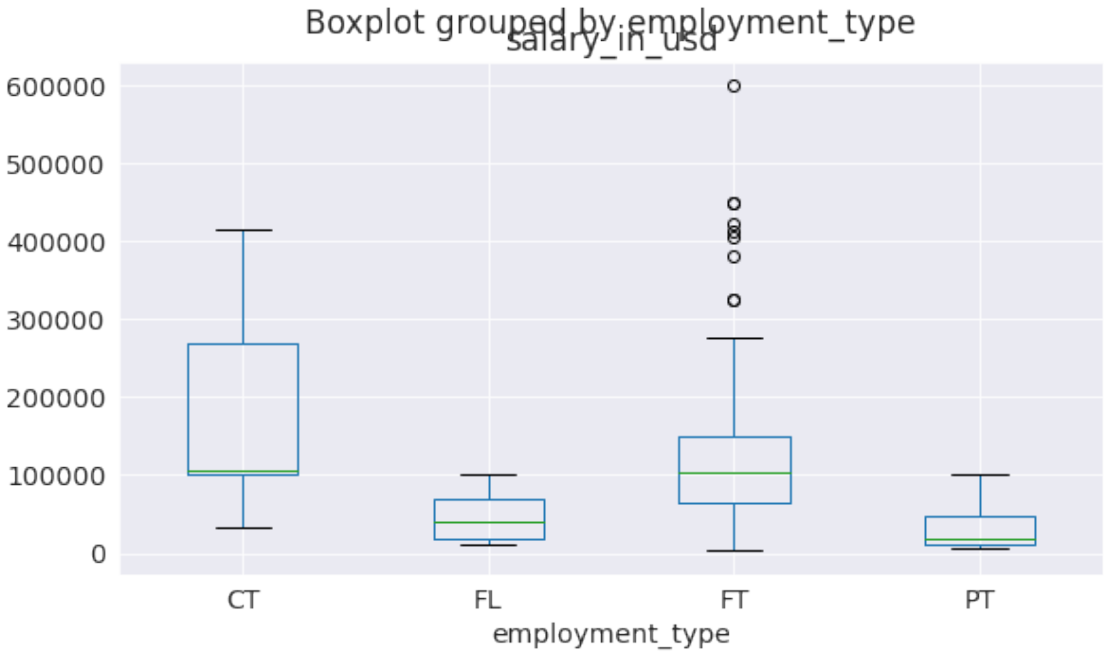
Q2: TODO - Is there a relationship between the type of employment and the amount of salary received by the job holder?

[33]:
```
type=salary_df[['employment_type', 'salary_in_usd']]
type.sort_values(by=['salary_in_usd'], ascending=False)
salary_df.employment_type.value_counts()
```

[33]:
```
FT    588
PT     10
CT      5
FL      4
Name: employment_type, dtype: int64
```

[34]:
```
salary_df.boxplot(column='salary_in_usd', by='employment_type')
```

[34]:
```
<AxesSubplot:title={'center':'salary_in_usd'}, xlabel='employment_type'>
```



From the above diagram, we can see that there is a correlation between the type of employment and the amount of salary received. A significant number of job holders under the full mode of employment receive large sums of money. The exception is that a few individuals under the contract mode of employment also receive huge sums of money.

Q3: TODO - Is there a relationship between the role of the job holder and the amount of salary received?

[35]:
```
title=salary_df[['job_title', 'salary_in_usd']]
title.sort_values(by=['salary_in_usd'], ascending=False)
```

[35]:
```
                              job_title  salary_in_usd
252             Principal Data Engineer         600000
97               Financial Data Analyst         450000
33                   Research Scientist         450000
157  Applied Machine Learning Scientist         423000
225            Principal Data Scientist         416000
..                                   …            …
179                      Data Scientist           5679
77         3D Computer Vision Researcher           5409
238                      Data Scientist           4000
185                       Data Engineer           4000
176                      Data Scientist           2859

[607 rows x 2 columns]
```

From our analysis, it is evident that the amount of salary received is proportional to the seniority of the job position held.

Q4: TODO - Is there a relationship between the company location and the amount of salary received? (regardless of the job role)

[36]:
```
location=salary_df[['company_location', 'salary_in_usd']]
location.sort_values(by=['salary_in_usd'], ascending=False)
```

[36]:
```
    company_location  salary_in_usd
252               US         600000
97                US         450000
33                US         450000
157               US         423000
225               US         416000
..               …            …
179               US           5679
77                IN           5409
238               VN           4000
185               IR           4000
176               MX           2859

[607 rows x 2 columns]
```

The majority of the companies in our dataset are based in the United States. Compared to those outside of the US, the majority of these pay their staff enormous sums of money.

Q5: TODO - Is there a relationship between the size of the company and the amount of salary received? (regardless of the job role)

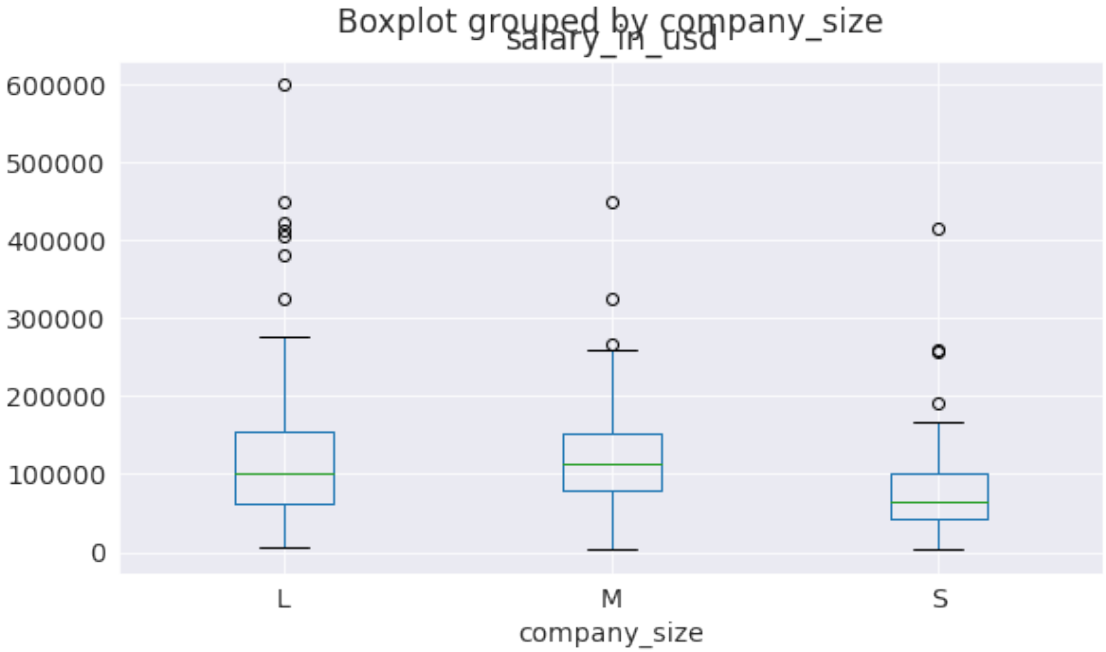
[37]:
```
size=salary_df[['company_size', 'salary_in_usd']]
size.sort_values(by=['salary_in_usd'], ascending=False)
```

[37]:
```
    company_size  salary_in_usd
252            L         600000
97             L         450000
33             M         450000
157            L         423000
225            S         416000
..           …             …
179            S           5679
77             M           5409
238            M           4000
185            M           4000
176            S           2859

[607 rows x 2 columns]
```

[38]:
```
salary_df.boxplot(column='salary_in_usd', by='company_size')
```

[38]:
```
<AxesSubplot:title={'center':'salary_in_usd'}, xlabel='company_size'>
```



From the above diagram; there is a correlation between the size of the company and the salary. As a significant number of individuals receiving huge amounts of money are employed in large companies.

Let us save and upload our work to Jovian before continuing.

[40]:
```
import jovian
```

[41]:
```
jovian.commit()
```

```
<IPython.core.display.Javascript object>
```

```
[jovian] Updating notebook "moseskinuthia73/datascience-jobs-salaries" on
https://jovian.ai
[jovian] Committed successfully! https://jovian.ai/moseskinuthia73/datascience-
jobs-salaries
```

[41]:
```
'https://jovian.ai/moseskinuthia73/datascience-jobs-salaries'
```

1.5 Inferences and Conclusion

From our analysis, it is evident that the more senior a position is in a company, the higher the amount of salary it receives. From our dataset, most of the companies are located in the US. It can be deduced that the United States has made significant investments in technology, as evidenced by the salaries that US-based companies pay their employees. In conclusion, it can be said that there is a great potential for growth in the tech industry (US) as more and more companies are recruiting individuals in tech-related roles, especially in data science.

[42]:
```
import jovian
```

[43]:
```
jovian.commit()
```

```
<IPython.core.display.Javascript object>
```

```
[jovian] Updating notebook "moseskinuthia73/datascience-jobs-salaries" on
https://jovian.ai
[jovian] Committed successfully! https://jovian.ai/moseskinuthia73/datascience-
jobs-salaries
```

[43]:
```
'https://jovian.ai/moseskinuthia73/datascience-jobs-salaries'
```