use-case2

November 17, 2024

1 Module 5: Data Manipulation

1.1 Case Study – 2

[42]:
```
from matplotlib import pyplot as plt
import numpy as np
import pandas as pd
```

[3]:
```
# Load the data
data = pd.read_csv('Salaries.csv')
data.info()
data.head()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 148648 entries, 0 to 148647
Data columns (total 13 columns):
 #   Column            Non-Null Count   Dtype
---  ------            --------------   -----
 0   Id                148648 non-null  int64
 1   EmployeeName      148648 non-null  object
 2   JobTitle          148648 non-null  object
 3   BasePay           148043 non-null  float64
 4   OvertimePay       148648 non-null  float64
 5   OtherPay          148648 non-null  float64
 6   Benefits          112490 non-null  float64
 7   TotalPay          148648 non-null  float64
 8   TotalPayBenefits  148648 non-null  float64
 9   Year              148648 non-null  int64
 10  Notes             0 non-null       float64
 11  Agency            148648 non-null  object
 12  Status            38119 non-null   object
dtypes: float64(7), int64(2), object(4)
memory usage: 14.7+ MB
```

```
C:\Users\akram\AppData\Local\Temp\ipykernel_19200\2829350274.py:2: DtypeWarning:
Columns (12) have mixed types. Specify dtype option on import or set
low_memory=False.
  data = pd.read_csv('Salaries.csv')
```

[3]:
```
   Id       EmployeeName                                       JobTitle  \
0   1     NATHANIEL FORD  GENERAL MANAGER-METROPOLITAN TRANSIT AUTHORITY
1   2       GARY JIMENEZ                 CAPTAIN III (POLICE DEPARTMENT)
2   3     ALBERT PARDINI                 CAPTAIN III (POLICE DEPARTMENT)
3   4  CHRISTOPHER CHONG            WIRE ROPE CABLE MAINTENANCE MECHANIC
4   5    PATRICK GARDNER    DEPUTY CHIEF OF DEPARTMENT,(FIRE DEPARTMENT)

     BasePay  OvertimePay   OtherPay  Benefits   TotalPay  TotalPayBenefits  \
0  167411.18         0.00  400184.25       NaN  567595.43         567595.43
1  155966.02    245131.88  137811.38       NaN  538909.28         538909.28
2  212739.13    106088.18   16452.60       NaN  335279.91         335279.91
3   77916.00     56120.71  198306.90       NaN  332343.61         332343.61
4  134401.60      9737.00  182234.59       NaN  326373.19         326373.19

   Year  Notes         Agency Status
0  2011    NaN  San Francisco    NaN
1  2011    NaN  San Francisco    NaN
2  2011    NaN  San Francisco    NaN
3  2011    NaN  San Francisco    NaN
4  2011    NaN  San Francisco    NaN
```

[7]:
```
# Check Null values
data .isnull().sum()
```

[7]:
```
Id                     0
EmployeeName           0
JobTitle               0
BasePay              605
OvertimePay            0
OtherPay               0
Benefits           36158
TotalPay               0
TotalPayBenefits       0
Year                   0
Notes             148648
Agency                 0
Status            110529
dtype: int64
```

[14]:
```
# 1. Compute how much total salary cost has increased from 2011 to 2014
# Group data by year and sum TotalPayBenefits for each year
total_cost_by_year = data.groupby('Year')['TotalPayBenefits'].sum()
print(total_cost_by_year.info)
# Iterate through the grouped data
for year, tot_cost in total_cost_by_year.items():
    print(f"Year: {year}, Total Salary Cost: ${tot_cost:.2f}")
```

```
# Calculate the increase from 2011 to 2014
cost_increase = total_cost_by_year[2014] - total_cost_by_year[2011]
print(f"Total salary cost increased by: ${cost_increase:.2f}")
```

```
<bound method Series.info of Year
2011    2.594113e+09
2012    3.696790e+09
2013    3.814772e+09
2014    3.821866e+09
Name: TotalPayBenefits, dtype: float64>
Year: 2011, Total Salary Cost: $2594113030.72
Year: 2012, Total Salary Cost: $3696790118.45
Year: 2013, Total Salary Cost: $3814772184.37
Year: 2014, Total Salary Cost: $3821865780.60
Total salary cost increased by: $1227752749.88
```

[36]:
```
# 2. Which Job Title in the Year 2014 has the highest mean salary?
# Filter data for the year 2014
data_2014 = data[data['Year'] == 2014]
print(data_2014.info())
print(data_2014.isnull().sum())  # check null values
print(data_2014.head(5))

JobTitle_BasePay_2014 = data_2014.groupby('JobTitle')['BasePay'].mean()

# Sort by BasePay in descending order and get the top 5
top_jobs_2014 = JobTitle_BasePay_2014.sort_values(ascending=False)

# Print the top 5 job titles with their mean salaries
print("\nTop 5 Job Titles with the highest mean salaries in 2014:")
for jobtitle, basepay in top_jobs_2014[:5].items():
    print(f"Job Title: {jobtitle}, Mean Salary: ${basepay:.2f}")

# Group by JobTitle and calculate mean BasePay
highest_mean_salary_job = data_2014.groupby('JobTitle')['BasePay'].mean().
 ↪idxmax()
print(f"\nJob Title with the highest mean salary in 2014:␣
 ↪{highest_mean_salary_job}")
```

```
<class 'pandas.core.frame.DataFrame'>
Index: 38119 entries, 110529 to 148647
Data columns (total 13 columns):
 #   Column            Non-Null Count  Dtype
---  ------            --------------  -----
 0   Id                38119 non-null  int64
 1   EmployeeName      38119 non-null  object
 2   JobTitle          38119 non-null  object
 3   BasePay           38119 non-null  float64
```

```
 4   OvertimePay       38119 non-null  float64
 5   OtherPay          38119 non-null  float64
 6   Benefits          38119 non-null  float64
 7   TotalPay          38119 non-null  float64
 8   TotalPayBenefits  38119 non-null  float64
 9   Year              38119 non-null  int64
 10  Notes             0 non-null      float64
 11  Agency            38119 non-null  object
 12  Status            38119 non-null  object
dtypes: float64(7), int64(2), object(4)
memory usage: 4.1+ MB
None
Id                     0
EmployeeName           0
JobTitle               0
BasePay                0
OvertimePay            0
OtherPay               0
Benefits               0
TotalPay               0
TotalPayBenefits       0
Year                   0
Notes              38119
Agency                 0
Status                 0
dtype: int64
           Id          EmployeeName                  JobTitle    BasePay  \
110529  110532           David Shinn            Deputy Chief 3  129150.01
110530  110533             Amy P Hart         Asst Med Examiner  318835.49
110531  110534  William J Coaker Jr.  Chief Investment Officer  257340.00
110532  110535         Gregory P Suhr           Chief of Police  307450.04
110533  110536  Joanne M Hayes-White    Chief, Fire Department  302068.00

        OvertimePay   OtherPay  Benefits   TotalPay  TotalPayBenefits  Year  \
110529         0.00  342802.63  38780.04  471952.64         510732.68  2014
110530     10712.95   60563.54  89540.23  390111.98         479652.21  2014
110531         0.00   82313.70  96570.66  339653.70         436224.36  2014
110532         0.00   19266.72  91302.46  326716.76         418019.22  2014
110533         0.00   24165.44  91201.66  326233.44         417435.10  2014

        Notes         Agency Status
110529    NaN  San Francisco     PT
110530    NaN  San Francisco     FT
110531    NaN  San Francisco     PT
110532    NaN  San Francisco     FT
110533    NaN  San Francisco     FT

Top 5 Job Titles with the highest mean salaries in 2014:
```

```
Job Title: Chief of Police, Mean Salary: $307450.04
Job Title: Chief, Fire Department, Mean Salary: $302068.00
Job Title: Gen Mgr, Public Trnsp Dept, Mean Salary: $294000.18
Job Title: Administrator, DPH, Mean Salary: $282619.96
Job Title: Mayor, Mean Salary: $281537.17

Job Title with the highest mean salary in 2014: Chief of Police
```

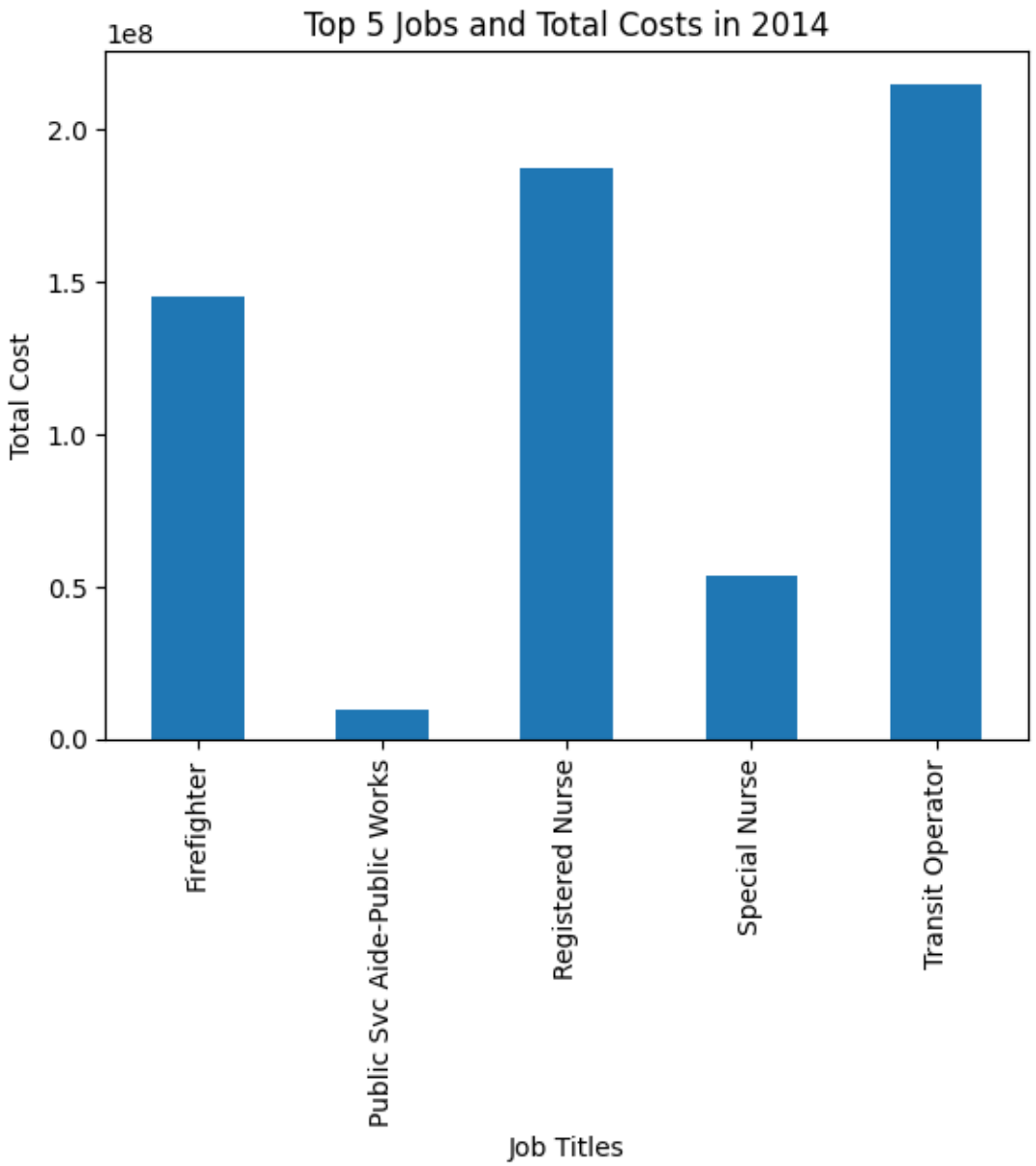
[7]:
```python
# 3. How much money could have been saved in the Year 2014 by stopping␣
 ↪OverTimePay?
# Sum OverTimePay for 2014
overtime_cost_2014 = data_2014['OvertimePay'].sum()
print(f"Money saved by stopping OverTimePay in 2014: ${overtime_cost_2014:.2f}")
```

```
Money saved by stopping OverTimePay in 2014: $205918599.27
```

[41]:
```python
# 4. Top 5 common jobs in 2014 and their total cost to SFO # SFO stands for San␣
 ↪Francisco
# Finding Top 5 Common Jobs:
top_5_jobs = data_2014['JobTitle'].value_counts().head(5)
# The .value_counts() method in pandas returns the counts of unique values in a␣
 ↪Series. It is commonly used to find the frequency of occurrences for each␣
 ↪value in a column.

print("Top 5 common jobs in 2014 \n", top_5_jobs)

# Calculate the total cost for each of these jobs
# Filtering Data for Top 5 Jobs: the 5 most common jobs in 2014
data_top_5_jobs = data_2014[data_2014['JobTitle'].isin(top_5_jobs.index)]
#print(data_top_5_jobs)

# Calculating Total Costs: Calculate the total cost for each of these jobs
top_5_jobs_cost = data_top_5_jobs.groupby('JobTitle')['TotalPayBenefits'].sum()
print("\nTop 5 common jobs in 2014 and their total costs:")
print(top_5_jobs_cost)


print("\nTop 5 common jobs in 2014 and their total costs:")
for job, cost in top_5_jobs_cost.items():
    print(f"Job Title: {job}, Total Cost: ${cost:,.2f}")


top_5_jobs_cost.plot(kind='bar', title='Top 5 Jobs and Total Costs in 2014',␣
 ↪ylabel='Total Cost', xlabel='Job Titles')
plt.show()
```

```
Top 5 common jobs in 2014
 JobTitle
```

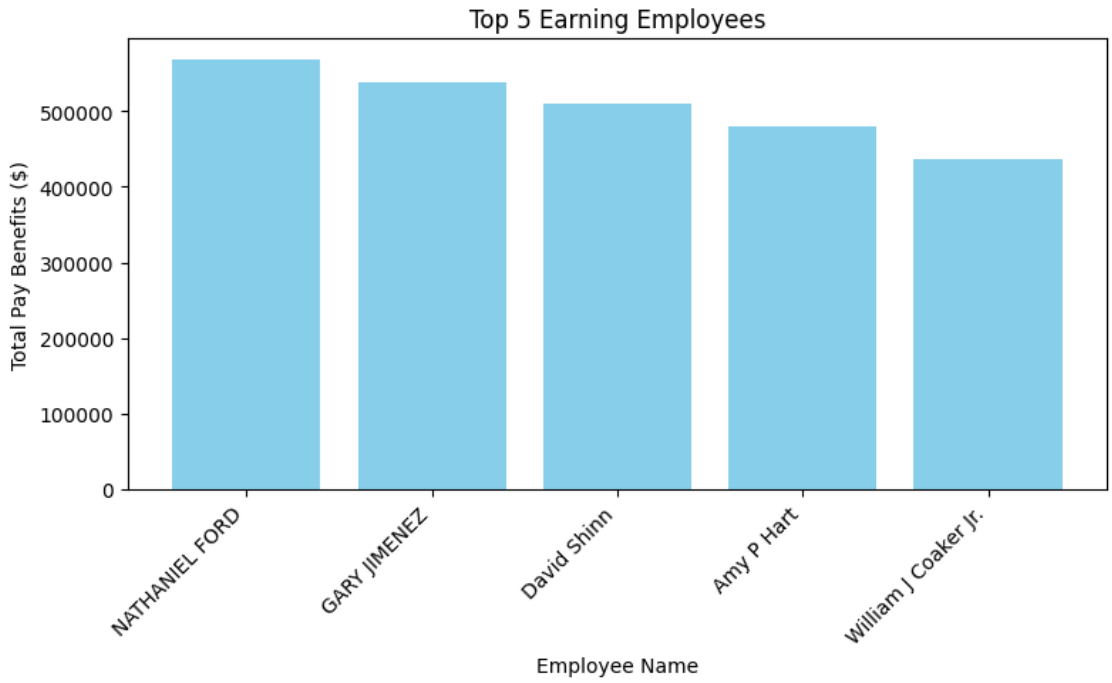
```
Transit Operator                2479
Special Nurse                   1478
Registered Nurse                1234
Public Svc Aide-Public Works     916
Firefighter                      815
Name: count, dtype: int64

Top 5 common jobs in 2014 and their total costs:
JobTitle
Firefighter                     1.448270e+08
Public Svc Aide-Public Works    9.806317e+06
Registered Nurse                1.872165e+08
Special Nurse                   5.344305e+07
Transit Operator                2.149764e+08
Name: TotalPayBenefits, dtype: float64

Top 5 common jobs in 2014 and their total costs:
Job Title: Firefighter, Total Cost: $144,827,011.84
Job Title: Public Svc Aide-Public Works, Total Cost: $9,806,317.44
Job Title: Registered Nurse, Total Cost: $187,216,454.08
Job Title: Special Nurse, Total Cost: $53,443,054.51
Job Title: Transit Operator, Total Cost: $214,976,389.79
```



[45]:
```
# 5. Who was the top earning employee across all the years?
# Find the employee with the highest TotalPayBenefits
top_earner = data.loc[data['TotalPayBenefits'].idxmax()]
print(f"Top earning employee across all years: {top_earner['EmployeeName']}␣
 ↪with TotalPayBenefits: ${top_earner['TotalPayBenefits']:.2f}")


# Get the top 5 rows with the highest TotalPayBenefits
top_5_earners = data.nlargest(5, 'TotalPayBenefits')
```

```
# Print the results
print("\nTop 5 earning employees across all years:")
for index, row in top_5_earners.iterrows():
    print(f"Employee: {row['EmployeeName']}, Job Title: {row['JobTitle']},␣
 ↪TotalPayBenefits: ${row['TotalPayBenefits']:.2f}")

# Plot a bar chart
plt.figure(figsize=(8, 5))
plt.bar(top_5_earners['EmployeeName'], top_3_earners['TotalPayBenefits'],␣
 ↪color='skyblue')

# Add labels and title
plt.xlabel('Employee Name')
plt.ylabel('Total Pay Benefits ($)')
plt.title('Top 5 Earning Employees')
plt.xticks(rotation=45, ha='right')  # Rotate x-axis labels for better␣
 ↪visibility

# Display the plot
plt.tight_layout()
plt.show()
```

```
Top earning employee across all years: NATHANIEL FORD with TotalPayBenefits:
$567595.43

Top 5 earning employees across all years:
Employee: NATHANIEL FORD, Job Title: GENERAL MANAGER-METROPOLITAN TRANSIT
AUTHORITY, TotalPayBenefits: $567595.43
Employee: GARY JIMENEZ, Job Title: CAPTAIN III (POLICE DEPARTMENT),
TotalPayBenefits: $538909.28
Employee: David Shinn, Job Title: Deputy Chief 3, TotalPayBenefits: $510732.68
Employee: Amy P Hart, Job Title: Asst Med Examiner, TotalPayBenefits: $479652.21
Employee: William J Coaker Jr., Job Title: Chief Investment Officer,
TotalPayBenefits: $436224.36
```



[10]:
```
#Enhancements
# 6.1: Last 5 common jobs in 2014 and their total costs
# Get the last 5 common jobs in 2014
last_5_jobs = data_2014['JobTitle'].value_counts().tail(5).index

# Calculate the total cost for each of these jobs
last_5_jobs_cost = data_2014[data_2014['JobTitle'].isin(last_5_jobs)].
 ↪groupby('JobTitle')['TotalPayBenefits'].sum()
print("Last 5 common jobs in 2014 and their total costs:")
print(last_5_jobs_cost)
```

```
Last 5 common jobs in 2014 and their total costs:
JobTitle
Baker                          14114.55
Cashier 3                       2074.60
Chief Investment Officer      436224.36
Transit Planner 2              14803.33
Transit Planner 4              16008.88
Name: TotalPayBenefits, dtype: float64
```

[11]:
```
# 6.2: OverTimePay as a percentage of TotalPayBenefits in 2011
# Filter data for the year 2011
data_2011 = data[data['Year'] == 2011]

# Calculate percentage of OverTimePay to TotalPayBenefits
```

```
overtime_percentage_2011 = (data_2011['OvertimePay'].sum() /␣
 ↪data_2011['TotalPayBenefits'].sum()) * 100
print(f"OverTimePay as a percentage of TotalPayBenefits in 2011:␣
 ↪{overtime_percentage_2011:.2f}%")
```

```
OverTimePay as a percentage of TotalPayBenefits in 2011: 6.32%
```

[48]:
```
# 6.3: Job Title in 2014 with the lowest mean salary
# Job Title with the lowest mean BasePay in 2014
# Group by JobTitle and calculate mean BasePay
mean_salary_by_job = data_2014.groupby('JobTitle')['TotalPayBenefits'].mean()
#mean_salary_by_job.info()

# Find the Job Title with the lowest mean salary
lowest_mean_salary_job = mean_salary_by_job.idxmin()
lowest_mean_salary_value = mean_salary_by_job.min()

# Print the results
print(f"Job Title with the lowest mean salary in 2014:␣
 ↪{lowest_mean_salary_job}")
print(f"Lowest mean salary in 2014: ${lowest_mean_salary_value:.2f}")
```

```
<class 'pandas.core.series.Series'>
Index: 996 entries, ACPO,JuvP, Juv Prob (SFERS) to Youth Comm Advisor
Series name: TotalPayBenefits
Non-Null Count  Dtype
--------------  -----
996 non-null    float64
dtypes: float64(1)
memory usage: 15.6+ KB
Job Title with the lowest mean salary in 2014: BdComm Mbr, Grp2,M=$25/Mtg
Lowest mean salary in 2014: $345.42
```

1.1.1 Summary of Outputs

1. Salary increase: Difference in total costs between 2011 and 2014.
2. Highest-paying job: Job title with the highest average BasePay in 2014.
3. Savings by cutting OverTimePay: Total amount spent on OverTimePay in 2014.
4. Top 5 jobs in 2014: List of jobs and their total costs.
5. Top earner: Employee with the highest total pay benefits across all years.
6. Additional insights: Last 5 jobs, overtime percentage, and lowest-paying job in 2014

[ ]:
```

```