Setup and Context

Introduction

On November 27, 1895, Alfred Nobel signed his last will in Paris. When it was opened after his death, the will caused a lot of controversy, as Nobel had left much of his wealth for the establishment of a prize.

Alfred Nobel dictates that his entire remaining estate should be used to endow “prizes to those who, during the preceding year, have conferred the greatest benefit to humankind”.

Every year the Nobel Prize is given to scientists and scholars in the categories chemistry, literature, physics, physiology or medicine, economics, and peace.

Let's see what patterns we can find in the data of the past Nobel laureates. What can we learn about the Nobel prize and our world more generally?

Upgrading plotly (only Google Colab Notebook) if necessary

```
# pip install --upgrade plotly
```

Import Statements

```
import pandas as pd
import numpy as np
import plotly.express as px
import seaborn as sns
import matplotlib.pyplot as plt
```

Notebook Presentation

```
pd.options.display.float_format = '{:,.2f}'.format
```

Read the Data

```
df_data = pd.read_csv('data/nobel_prize_data.csv')
```

The exact birth dates for Michael Houghton, Venkatraman Ramakrishnan, and Nadia Murad are unknown.

Data Exploration & Cleaning

Preliminary data exploration.

- What is the shape of `df_data`? How many rows and columns?
- What are the column names?
- In which year was the Nobel prize first awarded?
- Which year is the latest year included in the dataset?

```
df_data.head()
```

	year	category	prize	motivation	prize_share	laureate_type	full_name	birth_date	birth_city	birth_country	birth_country_current	sex	organizatio
0	1901	Chemistry	The Nobel Prize in Chemistry 1901	"in recognition of the extraordinary services ...	1/1	Individual	Jacobus Henricus van 't Hoff	1852-08-30	Rotterdam	Netherlands	Netherlands	Male	Berlin Un
1	1901	Literature	The Nobel Prize in Literature 1901	"in special recognition of his poetic composit...	1/1	Individual	Sully Prudhomme	1839-03-16	Paris	France	France	Male	
2	1901	Medicine	The Nobel Prize in Physiology or Medicine 1901	"for his work on serum therapy, especially its...	1/1	Individual	Emil Adolf von Behring	1854-03-15	Hansdorf (Lawice)	Prussia (Poland)	Poland	Male	Marburg Un
3	1901	Peace	The Nobel Peace Prize 1901	NaN	1/2	Individual	Frédéric Passy	1822-05-20	Paris	France	France	Male	
4	1901	Peace	The Nobel Peace Prize 1901	NaN	1/2	Individual	Jean Henry Dunant	1828-05-08	Geneva	Switzerland	Switzerland	Male	

```
print(f"shape of the data set: {df_data.shape}")
```

```
shape of the data set: (962, 16)
```

```
df_data.columns
```

```
Index(['year', 'category', 'prize', 'motivation', 'prize_share',
       'laureate_type', 'full_name', 'birth_date', 'birth_city',
       'birth_country', 'birth_country_current', 'sex', 'organization_name',
       'organization_city', 'organization_country', 'ISO'],
      dtype='object')
```

```
df_data.tail()
```

	year	category	prize	motivation	prize_share	laureate_type	full_name	birth_date	birth_city	birth_country	birth_country_current	sex	organiz
957	2020	Medicine	The Nobel Prize in Physiology or Medicine 2020	“for the discovery of Hepatitis C virus”	1/3	Individual	Michael Houghton	1949-07-02	NaN	United Kingdom	United Kingdom	Male	Univers
958	2020	Peace	The Nobel Peace Prize 2020	“for its efforts to combat hunger, for its con...	1/1	Organization	World Food Programme (WFP)	NaN	NaN	NaN	NaN	NaN	
959	2020	Physics	The Nobel Prize in Physics 2020	“for the discovery of a supermassive compact o...	1/4	Individual	Andrea Ghez	1965-06-16	New York, NY	United States of America	United States of America	Female	
960	2020	Physics	The Nobel Prize in Physics 2020	“for the discovery of a supermassive compact o...	1/4	Individual	Reinhard Genzel	1952-03-24	Bad Homburg vor der Höhe	Germany	Germany	Male	
961	2020	Physics	The Nobel Prize in Physics 2020	“for the discovery that black hole formation i...	1/2	Individual	Roger Penrose	1931-08-08	Colchester	United Kingdom	United Kingdom	Male	Univers

Checking for:

- duplicate values in the dataset?
- NaN values in the dataset?
- columns that tend to have NaN values?
- Count of NaN values per column?
- Why do these columns have NaN values?

Check for Duplicates

```
print(f"Any duplicates: {df_data.duplicated().values.any()}")
print(f"Any NaN values among the data: {df_data.isna().values.any()}")
```

```
Any duplicates: False
Any NaN values among the data: True
```

Check for NaN Values

```
# counts NaN values per column
df_data.isna().sum()
```

```
year                     0
category                 0
```

```
prize                      0
motivation                88
prize_share                0
laureate_type              0
full_name                  0
birth_date                28
birth_city                31
birth_country             28
birth_country_current     28
sex                       28
organization_name        255
organization_city        255
organization_country     254
ISO                       28
dtype: int64
```

Exploring the NaN values in the columns

Checking the NaN vales in birth year

```
col_subsets = ['year','category', 'laureate_type',
              'birth_date','full_name', 'organization_name']
df_data.loc[df_data.birth_date.isna()][col_subsets][:7]
```

	year	category	laureate_type	birth_date	full_name	organization_name
24	1904	Peace	Organization	NaN	Institut de droit international (Institute of ...	NaN
60	1910	Peace	Organization	NaN	Bureau international permanent de la Paix (Per...	NaN
89	1917	Peace	Organization	NaN	Comité international de la Croix Rouge (Intern...	NaN
200	1938	Peace	Organization	NaN	Office international Nansen pour les Réfugiés ...	NaN
215	1944	Peace	Organization	NaN	Comité international de la Croix Rouge (Intern...	NaN
237	1947	Peace	Organization	NaN	American Friends Service Committee (The Quakers)	NaN
238	1947	Peace	Organization	NaN	Friends Service Council (The Quakers)	NaN

Checking the NaN vales in organization name

```
col_subset = ['year','category', 'laureate_type','full_name', 'organization_name']
df_data.loc[df_data.organization_name.isna()][col_subset][:7]
```

	year	category	laureate_type	full_name	organization_name
1	1901	Literature	Individual	Sully Prudhomme	NaN
3	1901	Peace	Individual	Frédéric Passy	NaN
4	1901	Peace	Individual	Jean Henry Dunant	NaN
7	1902	Literature	Individual	Christian Matthias Theodor Mommsen	NaN
9	1902	Peace	Individual	Charles Albert Gobat	NaN
10	1902	Peace	Individual	Élie Ducommun	NaN
14	1903	Literature	Individual	Bjørnstjerne Martinus Bjørnson	NaN

Type Conversions

- Converting the `birth_date` column to Pandas `Datetime` objects
- Adding a Column called `share_pct` which has the laureates' share as a percentage in the form of a floating-point number.

Convert Year and Birth Date to Datetime

```
df_data.birth_date = pd.to_datetime(df_data.birth_date)
print(type(df_data.birth_date[0]))
```

```
<class 'pandas._libs.tslibs.timestamps.Timestamp'>
```

Add a Column with the Prize Share as a Percentage

```
separated_values = df_data.prize_share.str.split("/", expand=True)
numerator = pd.to_numeric(separated_values[0])
denomenator = pd.to_numeric(separated_values[1])
df_data["share_pct"] = numerator / denomenator
```

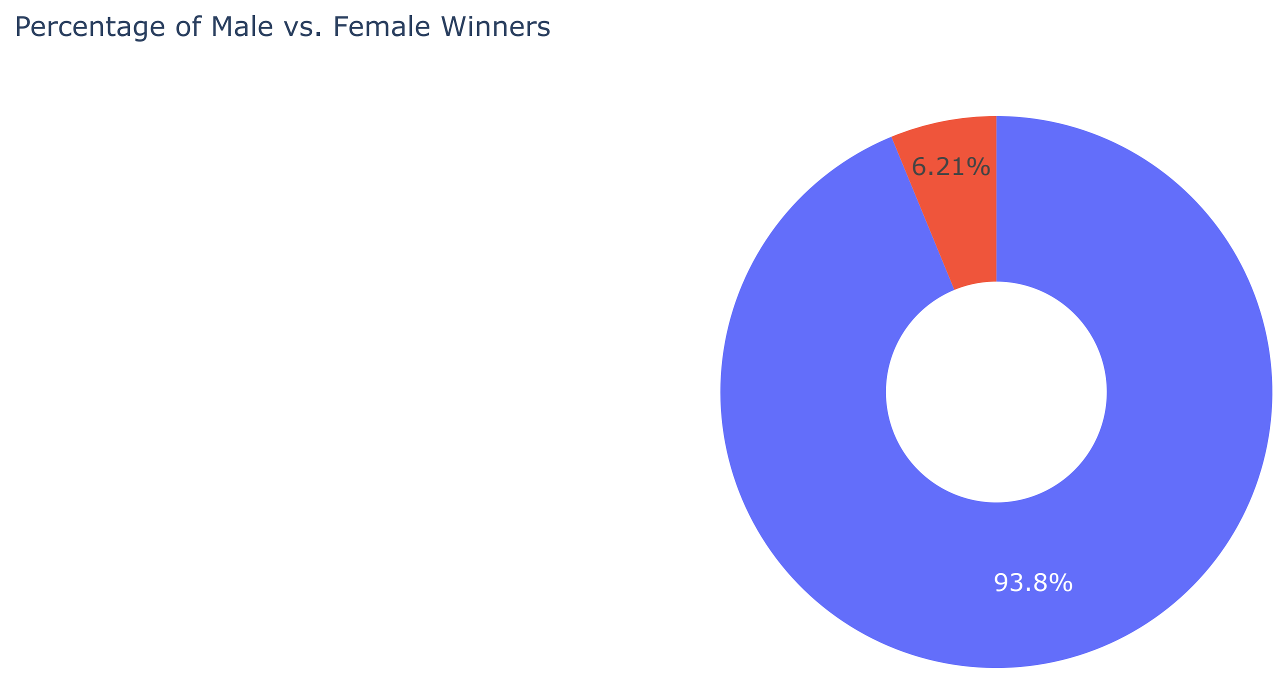
```
df_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 962 entries, 0 to 961
Data columns (total 17 columns):
 #   Column                 Non-Null Count  Dtype
---  ------                 --------------  -----
 0   year                   962 non-null    int64
 1   category               962 non-null    object
 2   prize                  962 non-null    object
 3   motivation             874 non-null    object
 4   prize_share            962 non-null    object
 5   laureate_type          962 non-null    object
 6   full_name              962 non-null    object
 7   birth_date             934 non-null    datetime64[ns]
 8   birth_city             931 non-null    object
 9   birth_country          934 non-null    object
 10  birth_country_current  934 non-null    object
 11  sex                    934 non-null    object
 12  organization_name      707 non-null    object
 13  organization_city      707 non-null    object
 14  organization_country   708 non-null    object
 15  ISO                    934 non-null    object
 16  share_pct              962 non-null    float64
dtypes: datetime64[ns](1), float64(1), int64(1), object(14)
memory usage: 127.9+ KB
```

Plotly Donut Chart: Percentage of Male vs. Female Laureates

Creating a donut chart using plotly which shows how many prizes went to men compared to how many prizes went to women. What percentage of all the prizes went to women?

```
biology = df_data.sex.value_counts()

fig = px.pie(
        labels=biology.index,
        values=biology.values,
        title="Percentage of Male vs. Female Winners",
        names=biology.index,
        hole=0.4,
)

fig.update_traces(
    textposition='inside',
    textfont_size=15,
    textinfo='percent',
)

fig.show()
```



Who were the first 3 Women to Win the Nobel Prize?

Checking:

- What are the names of the first 3 female Nobel laureates?
- What did the win the prize for?

```
df_data[df_data.sex == 'Female'].sort_values("year", ascending=True)[:3]
```

year category prize motivation prize_share laureate_type full_name birth_date birth_city birth_country birth_country_current sex organizati

Find the Repeat Winners

Checking: If some people get a Nobel Prize more than once.

The Baroness

```
is_winner = df_data.duplicated(subset=["full_name"], keep=False)
multiple_winners = df_data[is_winner]
print(f"There are {multiple_winners.full_name.unique()} \
    winners who were awarded the prize more than once.")
```

```
There are ['Marie Curie, née Sklodowska'
 'Comité international de la Croix Rouge (International Committee of the Red Cross)'
 'Linus Carl Pauling'
 'Office of the United Nations High Commissioner for Refugees (UNHCR)'
 'John Bardeen' 'Frederick Sanger']     winners who were awarded the prize more than once.
```

```
col_subset = ['year', 'category', 'laureate_type', 'full_name']
multiple_winners[col_subset]
```

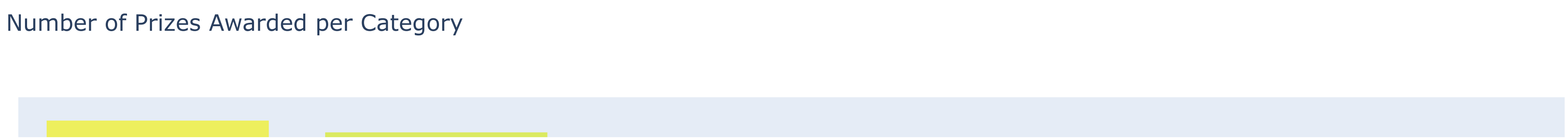
	year	category	laureate_type	full_name
18	1903	Physics	Individual	Marie Curie, née Sklodowska
62	1911	Chemistry	Individual	Marie Curie, née Sklodowska
89	1917	Peace	Organization	Comité international de la Croix Rouge (Intern...
215	1944	Peace	Organization	Comité international de la Croix Rouge (Intern...
278	1954	Chemistry	Individual	Linus Carl Pauling
283	1954	Peace	Organization	Office of the United Nations High Commissioner...
297	1956	Physics	Individual	John Bardeen
306	1958	Chemistry	Individual	Frederick Sanger
340	1962	Peace	Individual	Linus Carl Pauling
348	1963	Peace	Organization	Comité international de la Croix Rouge (Intern...
424	1972	Physics	Individual	John Bardeen
505	1980	Chemistry	Individual	Frederick Sanger
523	1981	Peace	Organization	Office of the United Nations High Commissioner...

Number of Prizes per Category

Checking:

- In how many categories are prizes awarded?
- Create a plotly bar chart with the number of prizes awarded by category.
- Which category has the most number of prizes awarded?
- Which category has the fewest number of prizes awarded?

```
prizes_per_category = df_data.category.value_counts()

v_bar = px.bar(
    x = prizes_per_category.index,
    y = prizes_per_category.values,
    color = prizes_per_category.values,
    color_continuous_scale='Aggrnyl',
    title="Number of Prizes Awarded per Category",
)

v_bar.update_layout(
    xaxis_title='Nobel Prize Category',
    coloraxis_showscale=False,
    yaxis_title='Number of Prizes',
)

v_bar.show()
```



the first prize in the field of Economics and who did it go to?

```
df_data[df_data.category == 'Economics'].sort_values('year')[:3]
```

	year	category	prize	motivation	prize_share	laureate_type	full_name	birth_date	birth_city	birth_country	birth_country_current	sex	organizatic
393	1969	Economics	The Sveriges Riksbank Prize in Economic Scienc...	"for having developed and applied dynamic mode...	1/2	Individual	Jan Tinbergen	1903-04-12	the Hague	Netherlands	Netherlands	Male	The Neth School of Ecc
394	1969	Economics	The Sveriges Riksbank Prize in Economic Scienc...	"for having developed and applied dynamic mode...	1/2	Individual	Ragnar Frisch	1895-03-03	Oslo	Norway	Norway	Male	University
402	1970	Economics	The Sveriges Riksbank Prize in Economic Scienc...	"for the scientific work through which he has ...	1/1	Individual	Paul A. Samuelson	1915-05-15	Gary, IN	United States of America	United States of America	Male	Massac Ins Technolog

Male and Female Winners by Category

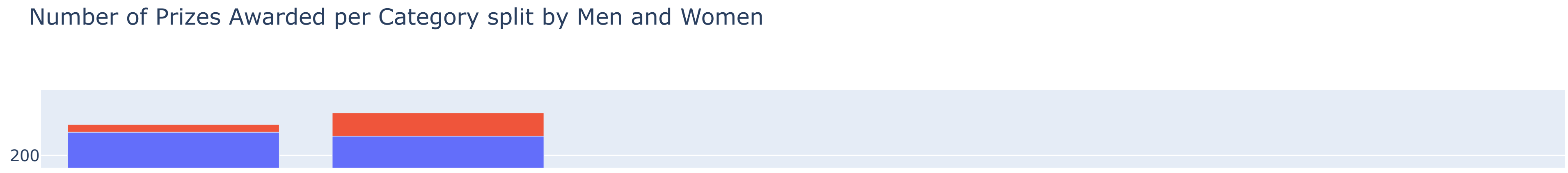
Creating a plotly bar chart that shows the split between men and women by category.

- Hover over the bar chart for details

```
cat_men_women = df_data.groupby(
                            ['category', 'sex'],
                            as_index=False).agg(
                                            {'prize': pd.Series.count}
                        )
cat_men_women.sort_values('prize', ascending=False, inplace=True)
cat_men_women.head()
```

	category	sex	prize
11	Physics	Male	212
7	Medicine	Male	210
1	Chemistry	Male	179
5	Literature	Male	101
9	Peace	Male	90

```
v_bar_split = px.bar(
    x = cat_men_women.category,
    y = cat_men_women.prize,
    color = cat_men_women.sex,
    title = 'Number of Prizes Awarded per Category split by Men and Women'
)

v_bar_split.update_layout(
    xaxis_title='Nobel Prize Category',
    yaxis_title='Number of Prizes',
)

v_bar_split.show()
```



Number of Prizes Awarded Over Time

Are more prizes awarded recently than when the prize was first created? Showing the trend in awards visually.

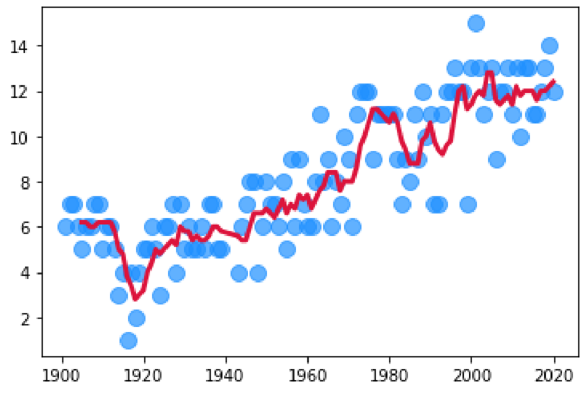
- Counting the number of prizes awarded every year.
- Creating a 5 year rolling average of the number of prizes.
- Using Matplotlib superimpose the rolling average on a scatter plot.
- Showing a tick mark on the x-axis for every 5 years from 1900 to 2020.
- Using the named colours to draw the data points in `dogerblue` while the rolling average is coloured in `crimson`.

Key things to consider

- Looking at the chart, did the first and second world wars have an impact on the number of prizes being given out?
- What could be the reason for the trend in the chart?

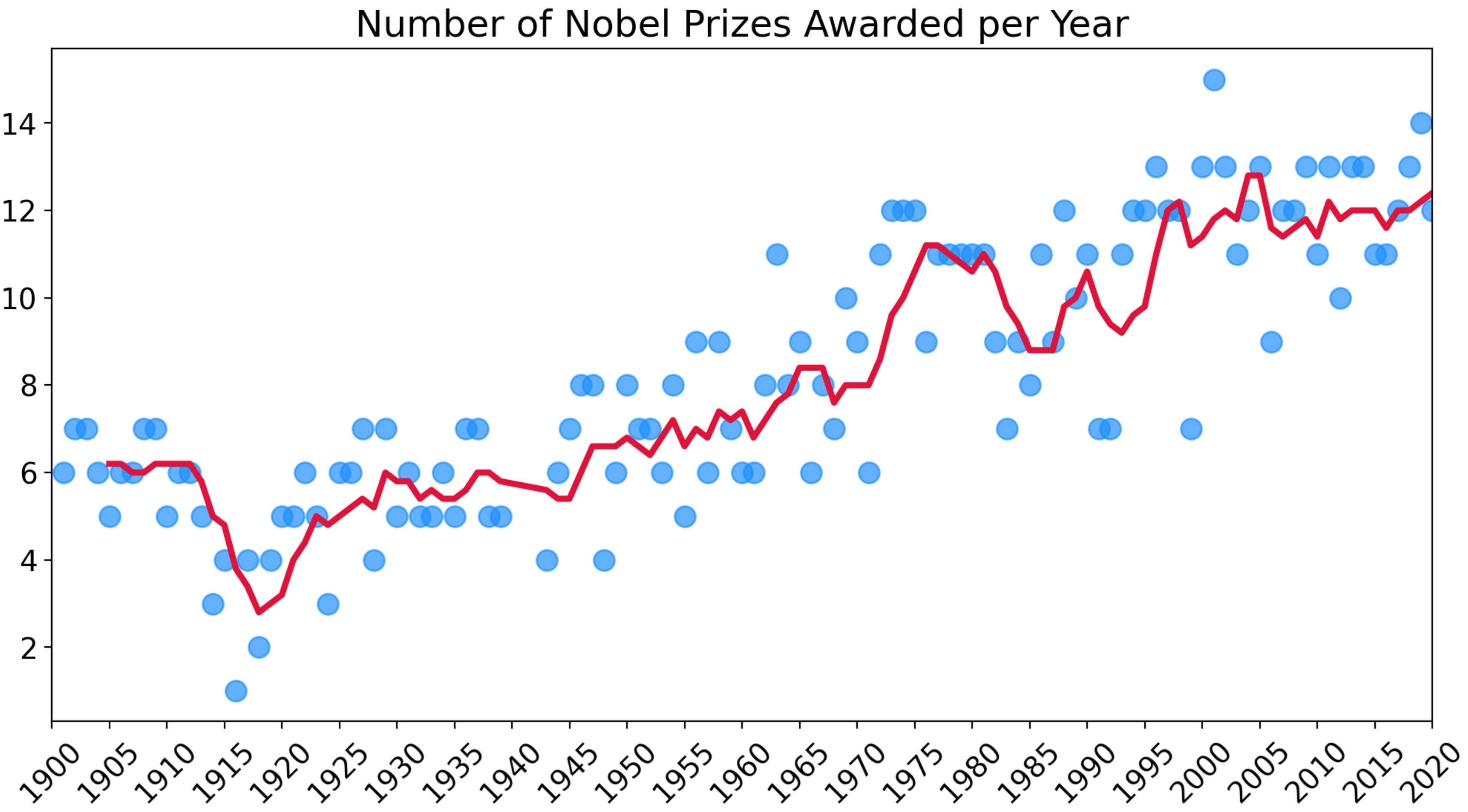
```
prize_per_year = df_data.groupby("year").count().prize
# 5 year moving average
moving_average = prize_per_year.rolling(window=5).mean()
```

```
plt.scatter(
    x=prize_per_year.index,
    y=prize_per_year.values,
    c='dodgerblue',
    alpha=0.7,
    s=100,
)


plt.plot(
    prize_per_year.index,
    moving_average.values,
    c='crimson',
    linewidth=3,
)

plt.show()
```



adding styling to the above chart

```
plt.figure(figsize=(12,6), dpi=200)
plt.title('Number of Nobel Prizes Awarded per Year', fontsize=18)
plt.yticks(fontsize=14)
plt.xticks(
    ticks=np.arange(1900, 2021, step=5),
    fontsize=14,
    rotation=45
)

# get curetn axes
ax = plt.gca()
ax.set_xlim(1900, 2020)

ax.scatter(
    x=prize_per_year.index,
    y=prize_per_year.values,
    c='dodgerblue',
    alpha=0.7,
    s=100,
)


ax.plot(
    prize_per_year.index,
    moving_average.values,
    c='crimson',
    linewidth=3,
)

plt.show()
```



Are More Prizes Shared Than Before?

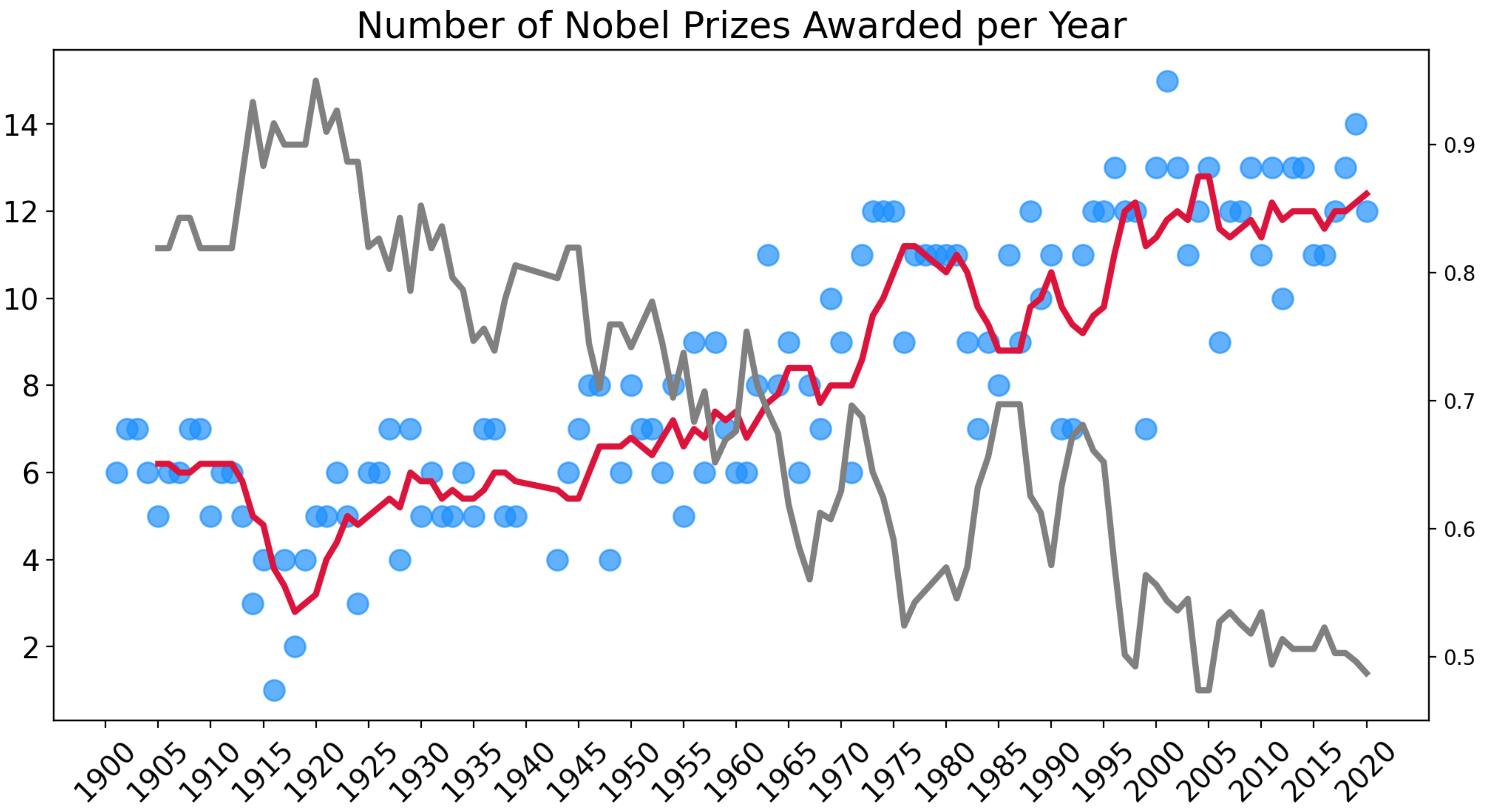
Investigating if more prizes are shared than before.

- Calculating the average prize share of the winners on a year by year basis.
- Calculating the 5 year rolling average of the percentage share.
- Modifing the code to add a secondary axis to the Matplotlib chart.
- Ploting the rolling average of the prize share on this chart.
- Inverting the secondary y-axis to make the relationship even more clear.

```
yearly_avg_share = df_data.groupby(by='year').agg(
                                                {'share_pct': pd.Series.mean}
)
share_moving_average = yearly_avg_share.rolling(window=5).mean()
```

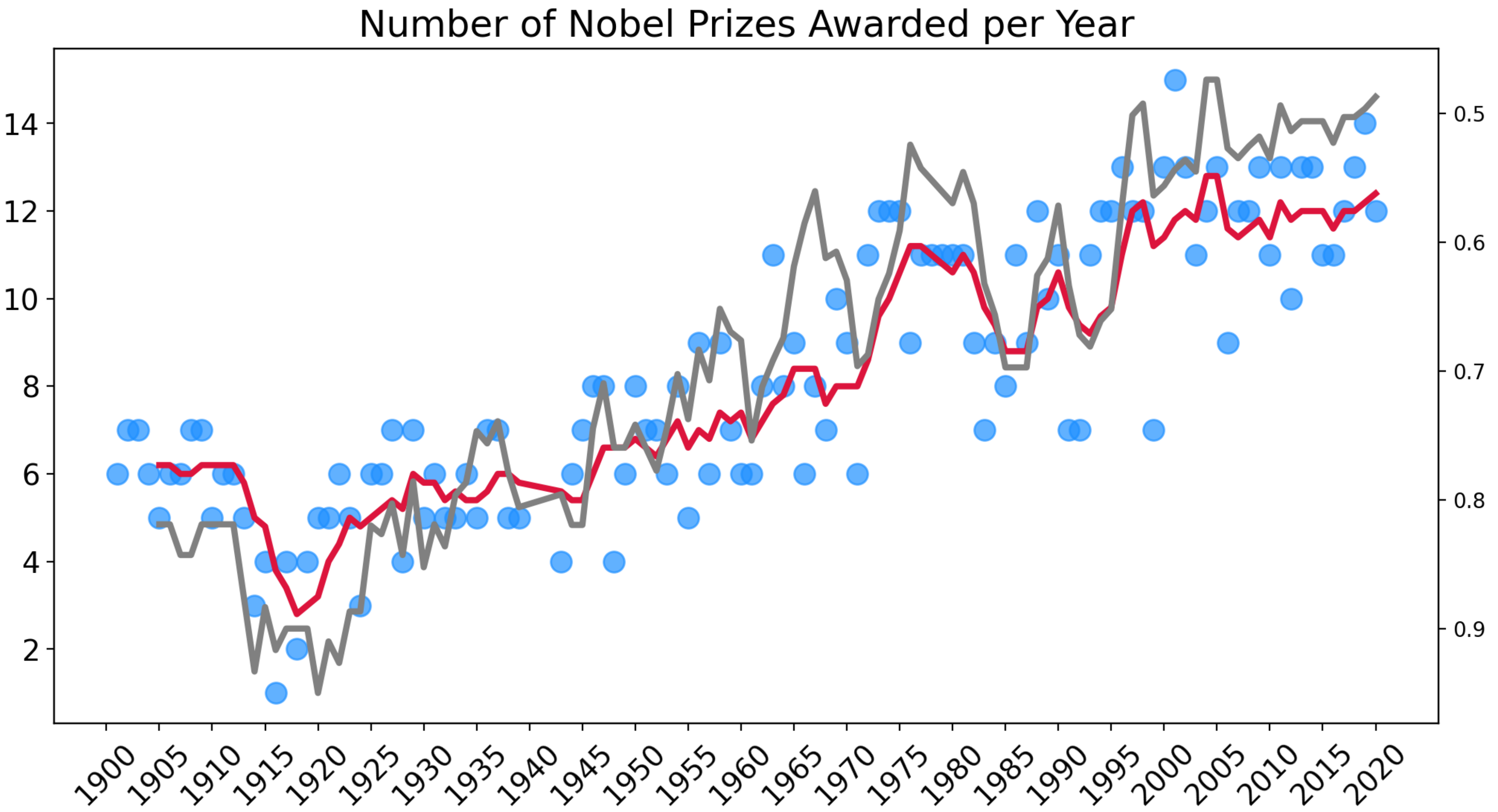
```
plt.figure(figsize=(12,6), dpi=200)
plt.title('Number of Nobel Prizes Awarded per Year', fontsize=18)
plt.yticks(fontsize=14)
plt.xticks(
    ticks=np.arange(1900, 2021, step=5),
    fontsize=14,
    rotation=45
)

# get curetn axes
ax1 = plt.gca()
# create second y-axis
ax2 = ax1.twinx()
ax.set_xlim(1900, 2020)

ax1.scatter(
    x=prize_per_year.index,
    y=prize_per_year.values,
    c='dodgerblue',
    alpha=0.7,
    s=100,
)


ax1.plot(
    prize_per_year.index,
    moving_average.values,
    c='crimson',
    linewidth=3,
)

# Adding prize share plot on second axis
ax2.plot(
    prize_per_year.index,
    share_moving_average.values,
    c='grey',
    linewidth=3,
)
```

```
plt.show()
```



Inverting the second y-axis to see better the relationship between the number of prizes and the laureate share.

```
plt.figure(figsize=(12,6), dpi=200)
plt.title('Number of Nobel Prizes Awarded per Year', fontsize=18)
plt.yticks(fontsize=14)
plt.xticks(
    ticks=np.arange(1900, 2021, step=5),
    fontsize=14,
    rotation=45
)

# get curetn axes
ax1 = plt.gca()
# create second y-axis
ax2 = ax1.twinx()
ax.set_xlim(1900, 2020)

# inverting y axis
ax2.invert_yaxis()

ax1.scatter(
    x=prize_per_year.index,
    y=prize_per_year.values,
    c='dodgerblue',
    alpha=0.7,
    s=100,
)


ax1.plot(
    prize_per_year.index,
    moving_average.values,
    c='crimson',
    linewidth=3,
)

# Adding prize share plot on second axis
ax2.plot(
    prize_per_year.index,
    share_moving_average.values,
    c='grey',
    linewidth=3,
)

plt.show()
```



The Countries with the Most Nobel Prizes

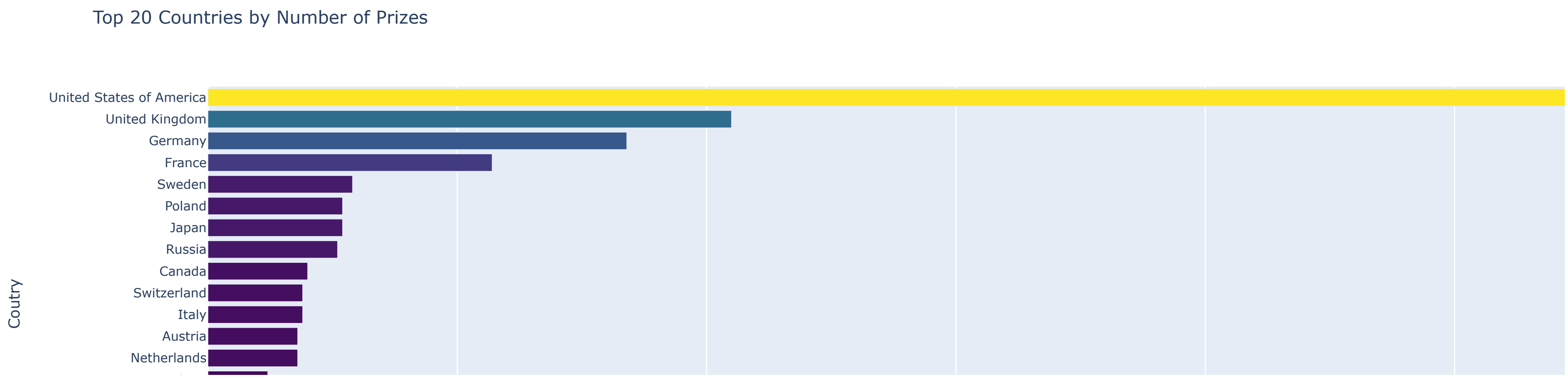
Creating a Pandas DataFrame called `top20_countries` that has the two columns. The `prize` column should contain the total number of prizes won.

- Using plotly to create a horizontal bar chart showing the number of prizes won by each country.
- What is the ranking for the top 20 countries in terms of the number of prizes?

```
top20_countries = df_data.groupby(
    ['birth_country_current'],
    as_index=False).agg(
                        {'prize': pd.Series.count}
                        )

top20_countries.sort_values(by='prize', inplace=True)
top20_countries = top20_countries[-20:]
top20_countries.tail()
```

	birth_country_current	prize
67	Sweden	29
25	France	57
26	Germany	84
73	United Kingdom	105
74	United States of America	281

```
h_bar = px.bar(
    x = top20_countries.prize,
    y = top20_countries.birth_country_current,
    orientation='h',
    color=top20_countries.prize,
    color_continuous_scale='Viridis',
    title='Top 20 Countries by Number of Prizes',
)

h_bar.update_layout(
    xaxis_title = "Number of Prizes",
    yaxis_title = "Coutry",
    coloraxis_showscale=False,
    font=dict(size=10)
)

h_bar.show()
```



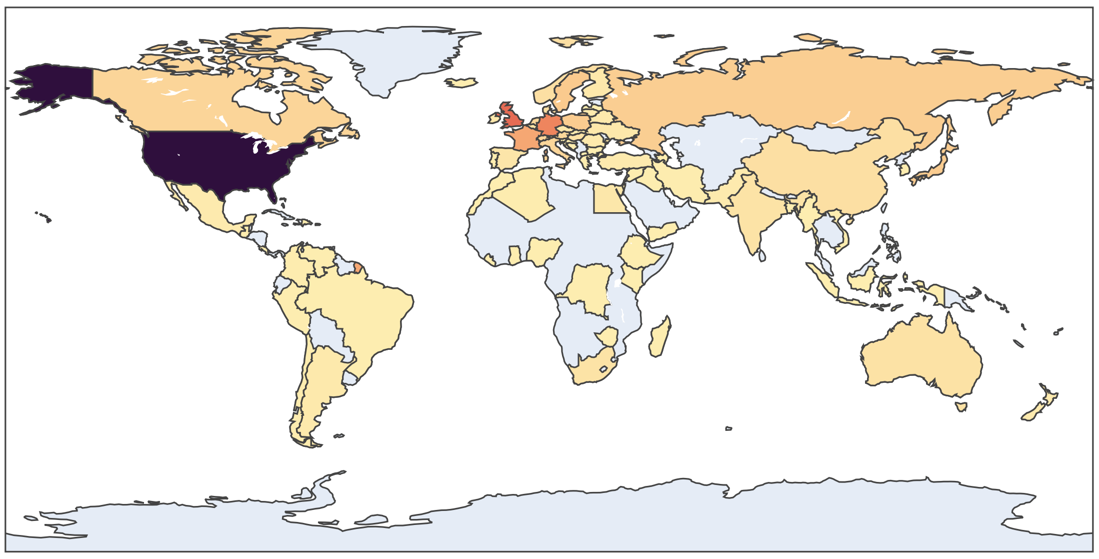
Using a Choropleth Map to Show the Number of Prizes Won by Country

- Creating this choropleth map using the plotly documentation:
- plotly's available colours.

```
df_countries = df_data.groupby(
    ['birth_country_current','ISO'],
    as_index=False
).agg({'prize': pd.Series.count})
df_countries.sort_values('prize', ascending=False).head()
```

	birth_country_current	ISO	prize
74	United States of America	USA	281
73	United Kingdom	GBR	105
26	Germany	DEU	84
25	France	FRA	57
67	Sweden	SWE	29

```
# creating Choropleth Map
world_map = px.choropleth(
    df_countries,
    locations='ISO',
    color='prize',
    hover_name='birth_country_current',
    color_continuous_scale=px.colors.sequential.matter,
)

world_map.update_layout(coloraxis_showscale=True,)

world_map.show()
```



In Which Categories are the Different Countries Winning Prizes?

Dividing up the plotly bar chart you created above to show the which categories made up the total number of prizes. This will help answer questions like:

- In which category does Germany have more prizes than the UK?
- In which categories does France have more prizes than Germany?
- Which category makes up most of Australia's nobel prizes?
- Which category makes up half of the prizes in the Netherlands?
- Does the United States have more prizes in Economics than all of France? What about in Physics or Medicine?

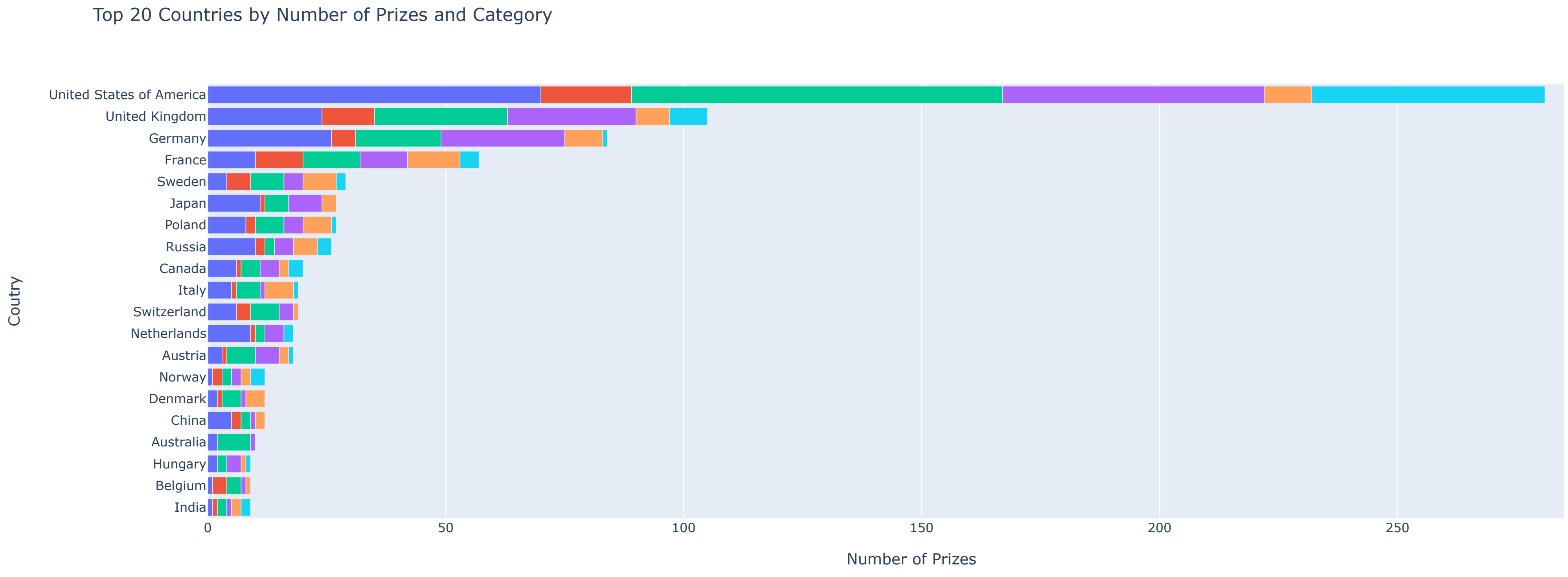
```
cat_country = df_data.groupby(
    ['birth_country_current','category'],
    as_index=False,
).agg(
    {'prize': pd.Series.count}
)
cat_country.sort_values(by='prize',ascending=False, inplace=True)
cat_country.head()
```

	birth_country_current	category	prize
204	United States of America	Medicine	78
206	United States of America	Physics	70
201	United States of America	Chemistry	55
202	United States of America	Economics	49
198	United Kingdom	Medicine	28

```
# mergin data
merged_df = pd.merge(cat_country, top20_countries, on='birth_country_current')
# changing column names
merged_df.columns = ['birth_country_current', 'category',
                 'cat_prize', 'total_prize']
merged_df.sort_values(by='total_prize', inplace=True)
merged_df.head()
```

	birth_country_current	category	cat_prize	total_prize
109	India	Physics	1	9
108	India	Peace	1	9
88	Belgium	Peace	3	9
89	Belgium	Medicine	3	9
90	Belgium	Chemistry	1	9

```
# creating bar chart
cat_cntry_bar = px.bar(
    x = merged_df.cat_prize,
    y = merged_df.birth_country_current,
    color=merged_df.category,
    orientation='h',
    title='Top 20 Countries by Number of Prizes and Category',
)

cat_cntry_bar.update_layout(
    xaxis_title = "Number of Prizes",
    yaxis_title = "Coutry",
    font=dict(size=10)
)

cat_cntry_bar.show()
```



Number of Prizes Won by Each Country Over Time

- When did the United States eclipse every other country in terms of the number of prizes won?
- Which country or countries were leading previously?
- Calculating the cumulative number of prizes won by each country in every year. Again, using the `birth_country_current` of the winner to calculate this.
- Creating a plotly line chart where each country is a coloured line.

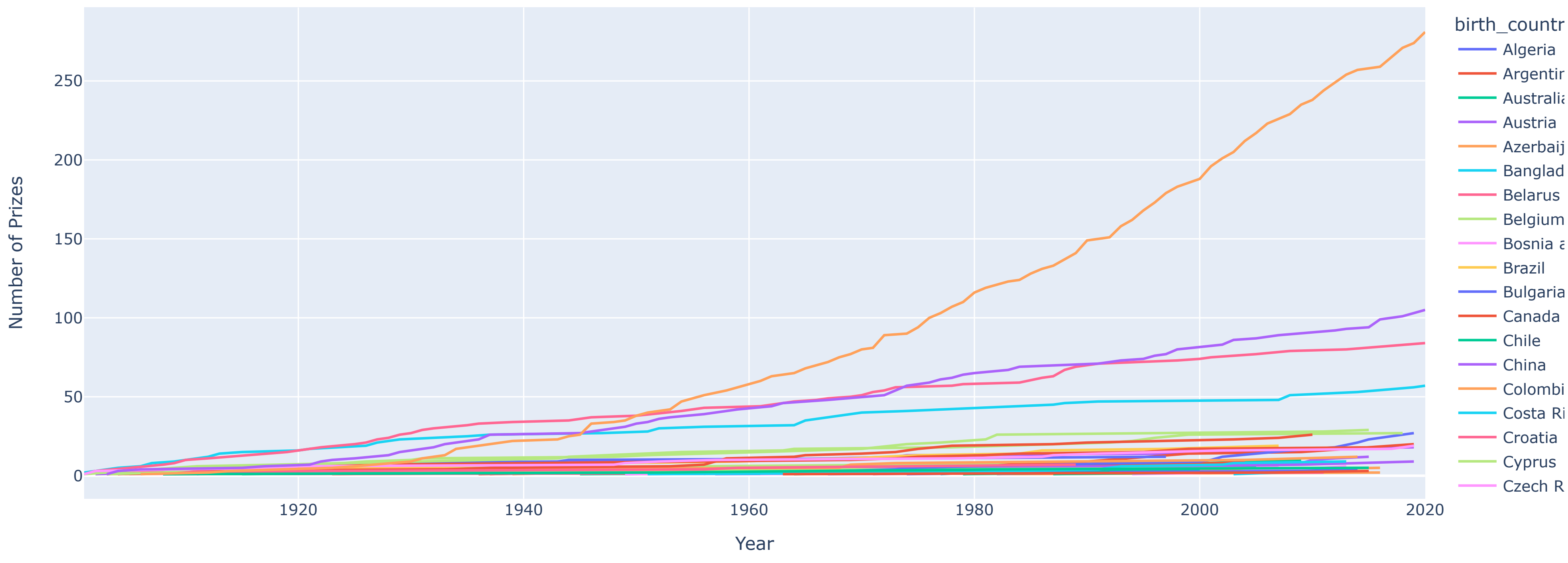
```
prize_per_year = df_data.groupby(
    by=['birth_country_current','year'],
    as_index=False,
).count()

prize_per_year = prize_per_year.sort_values('year')[['year',
                                        'birth_country_current','prize']]

prize_per_year.head()
```

	year	birth_country_current	prize
118	1901	France	2
346	1901	Poland	1
159	1901	Germany	1
312	1901	Netherlands	1
440	1901	Switzerland	1

```
cumulative_prizes = prize_per_year.groupby(
    by=['birth_country_current','year']
).sum().groupby(level=[0]).cumsum()

cumulative_prizes.reset_index(inplace=True)
cumulative_prizes.head()
```

	birth_country_current	year	prize
0	Algeria	1957	1
1	Algeria	1997	2
2	Argentina	1936	1
3	Argentina	1947	2
4	Argentina	1980	3

```
#  creating a chart
l_chart = px.line(
    cumulative_prizes,
    x='year',
    y='prize',
    color='birth_country_current',
    hover_name='birth_country_current',

)

l_chart.update_layout(
    xaxis_title='Year',
    yaxis_title='Number of Prizes',
)

l_chart.show()
```



What are the Top Research Organisations?

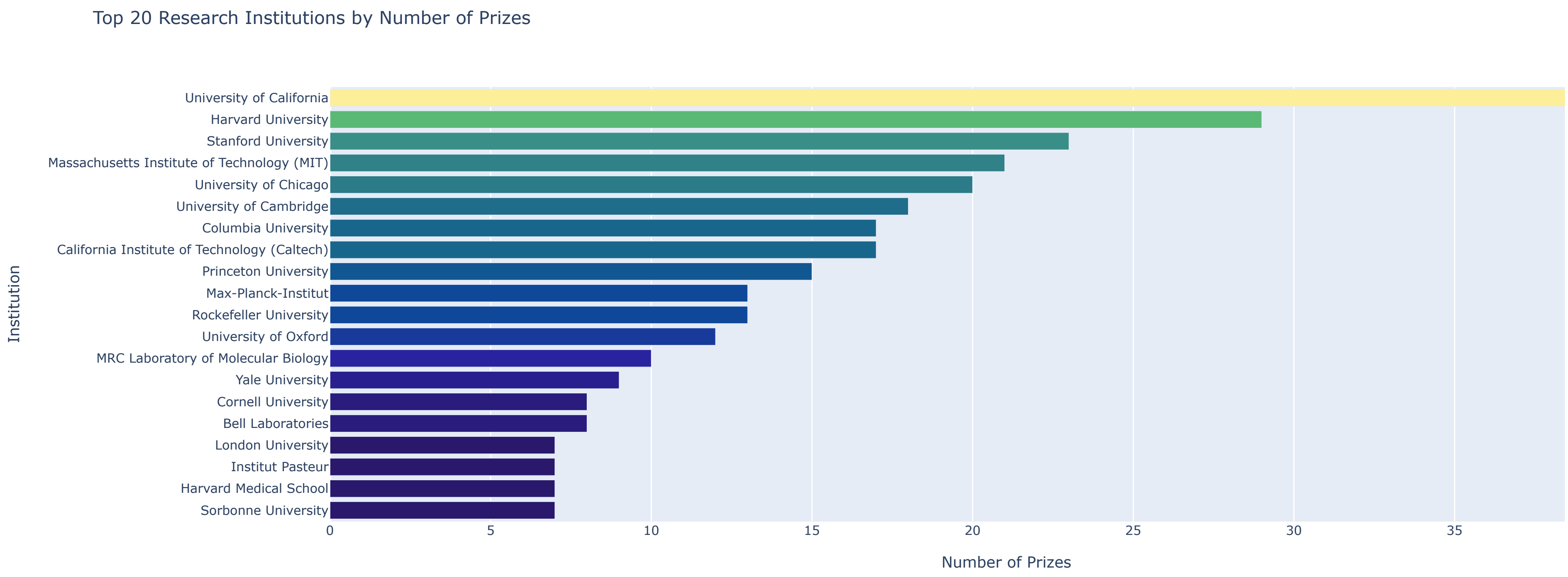
Creating a bar chart showing the organisations affiliated with the Nobel laureates.

- Which organisations make up the top 20?
- How many Nobel prize winners are affiliated with the University of Chicago and Harvard University?

```
top20_orgs = df_data.organization_name.value_counts()[:20]
top20_orgs.sort_values(ascending=True, inplace=True)
top20_orgs.head()
```

```
Sorbonne University       7
Harvard Medical School    7
Institut Pasteur          7
London University         7
Bell Laboratories         8
Name: organization_name, dtype: int64
```

```
# bar chart
org_bar = px.bar(
    x = top20_orgs.values,
    y = top20_orgs.index,
    orientation='h',
    color=top20_orgs.values,
    color_continuous_scale=px.colors.sequential.haline,
    title='Top 20 Research Institutions by Number of Prizes'
)

org_bar.update_layout(
    xaxis_title='Number of Prizes',
    yaxis_title='Institution',
    coloraxis_showscale=False,
    font=dict(size=10),
)

org_bar.show()
```



Which Cities Make the Most Discoveries?

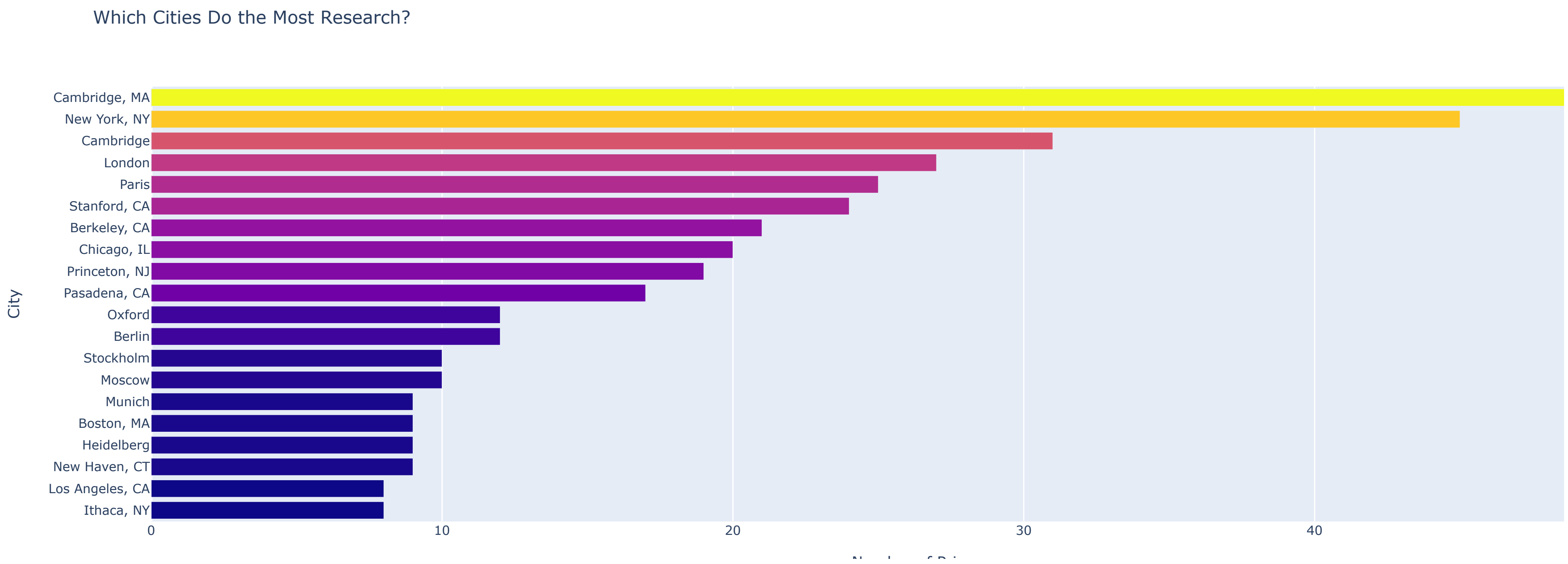
Where do major discoveries take place?

- Creating another plotly bar chart graphing the top 20 organisation cities of the research institutions associated with a Nobel laureate.
- Where is the number one hotspot for discoveries in the world?
- Which city in Europe has had the most discoveries?

```
top20_cities = df_data.organization_city.value_counts()[:20]
top20_cities.sort_values(ascending=True, inplace=True)
top20_cities.head()
```

```
Ithaca, NY         8
Los Angeles, CA    8
New Haven, CT      9
Heidelberg         9
Boston, MA         9
Name: organization_city, dtype: int64
```

```
# bar chart
city_bar = px.bar(
    x = top20_cities.values,
    y = top20_cities.index,
    orientation='h',
    color=top20_cities.values,
    color_continuous_scale=px.colors.sequential.Plasma,
    title='Which Cities Do the Most Research?'
)

city_bar.update_layout(
    xaxis_title='Number of Prizes',
    yaxis_title='City',
    coloraxis_showscale=False,
    font=dict(size=10),
)

city_bar.show()
```



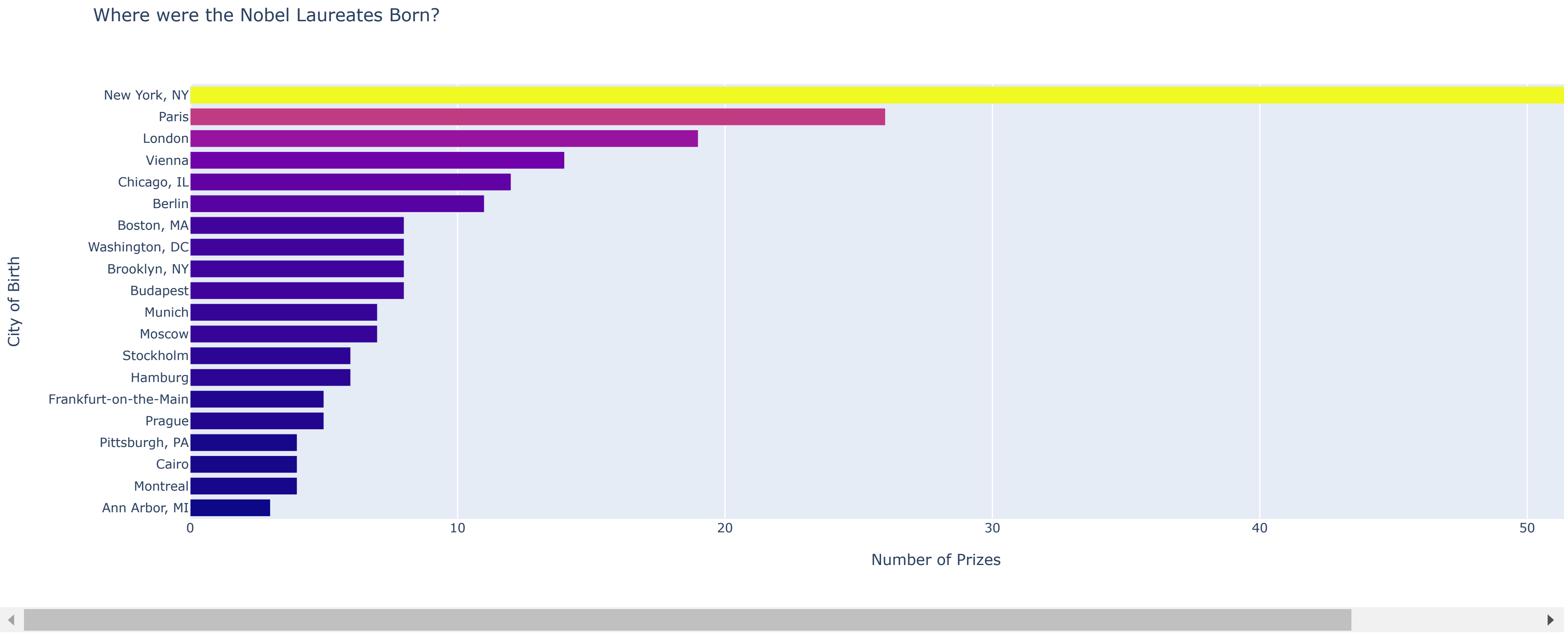
Where are Nobel Laureates Born? Chart the Laureate Birth Cities

- Creating a plotly bar chart graphing the top 20 birth cities of Nobel laureates.
- Using a named colour scale called `Plasma` for the chart.
- What percentage of the United States prizes came from Nobel laureates born in New York?
- How many Nobel laureates were born in London, Paris and Vienna?
- Out of the top 5 cities, how many are in the United States?

```
top20_cities_laureates = df_data.birth_city.value_counts()[:20]
top20_cities_laureates.sort_values(ascending=True, inplace=True)
top20_cities_laureates.head()
```

```
    Ann Arbor, MI     3
    Montreal          4
    Cairo             4
    Pittsburgh, PA    4
    Prague            5
    Name: birth_city, dtype: int64
```

```
# bar chart
city_laureate_bar = px.bar(
    x = top20_cities_laureates.values,
    y = top20_cities_laureates.index,
    orientation='h',
    color=top20_cities_laureates.values,
    color_continuous_scale=px.colors.sequential.Plasma,
    title='Where were the Nobel Laureates Born?'
)

city_laureate_bar.update_layout(
    xaxis_title='Number of Prizes',
    yaxis_title='City of Birth',
    coloraxis_showscale=False,
    font=dict(size=10),
)

city_laureate_bar.show()
```



Plotly Sunburst Chart: Combine Country, City, and Organisation

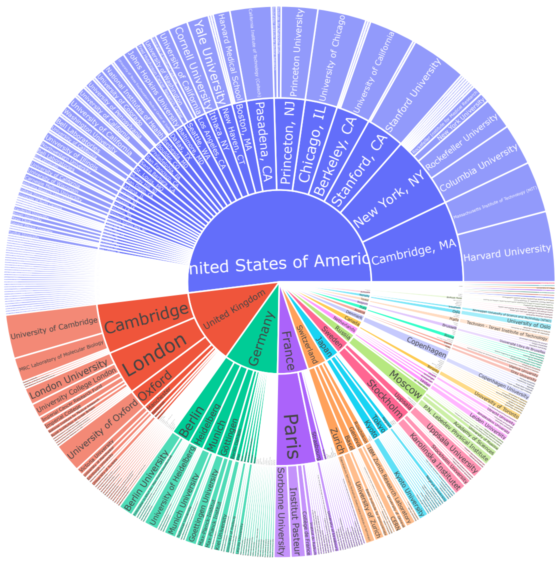
- Creating a DataFrame that groups the number of prizes by organisation.
- Using the plotly documentation to create a sunburst chart
- Click around in your chart, to expand it.

```
country_city_org = df_data.groupby(
    by=['organization_country', 'organization_city', 'organization_name'],
    as_index=False,
).agg({'prize': pd.Series.count })

country_city_org = country_city_org.sort_values('prize', ascending=False)

country_city_org.head()
```

	organization_country	organization_city	organization_name	prize
205	United States of America	Cambridge, MA	Harvard University	29
280	United States of America	Stanford, CA	Stanford University	23
206	United States of America	Cambridge, MA	Massachusetts Institute of Technology (MIT)	21
209	United States of America	Chicago, IL	University of Chicago	20
195	United States of America	Berkeley, CA	University of California	19

```
# creating sunburst chart
burst = px.sunburst(
    country_city_org,
    path=['organization_country', 'organization_city', 'organization_name'],
    values='prize',
    title='Where do Discoveries Take Place?'
)

burst.update_layout(
                xaxis_title='Number of Prizes',
                yaxis_title='City',
                coloraxis_showscale=False
                )

burst.show()
```

Where do Discoveries Take Place?



Patterns in the Laureate Age at the Time of the Award

How Old Are the Laureates When the Win the Prize?

Calculating the age of the laureate in the year of the ceremony and add this as a column called `winning_age` to the `df_data` DataFrame. https://pandas.pydata.org/pandas-docs/stable/reference/api/pandas.Series.dt.html

```
birth_years = df_data.birth_date.dt.year
df_data["winning_age"] = df_data.year - birth_years
df_data.head()
```

	year	category	prize	motivation	prize_share	laureate_type	full_name	birth_date	birth_city	birth_country	birth_country_current	sex	organizatio
0	1901	Chemistry	The Nobel Prize in Chemistry 1901	"in recognition of the extraordinary services ...	1/1	Individual	Jacobus Henricus van 't Hoff	1852-08-30	Rotterdam	Netherlands	Netherlands	Male	Berlin Un
1	1901	Literature	The Nobel Prize in Literature 1901	"in special recognition of his poetic composit...	1/1	Individual	Sully Prudhomme	1839-03-16	Paris	France	France	Male	
2	1901	Medicine	The Nobel Prize in Physiology or	"for his work on serum therapy,	1/1	Individual	Emil Adolf von Behring	1854-03-15	Hansdorf (Lawice)	Prussia (Poland)	Poland	Male	Marburg Un

Who were the oldest and youngest winners?

Finding out:

- What are the names of the youngest and oldest Nobel laureate?
- What did they win the prize for?
- What is the average age of a winner?
- 75% of laureates are younger than what age when they receive the prize?
- Using Seaborn to create histogram to visualise the distribution of laureate age at the time of winning. Experimenting with the number of `bins` to see how the visualisation changes.

```
display(df_data.nlargest(n=1, columns='winning_age'))
display(df_data.nsmallest(n=1, columns='winning_age'))
```

	year	category	prize	motivation	prize_share	laureate_type	full_name	birth_date	birth_city	birth_country	birth_country_current	sex	organizat
937	2019	Chemistry	The Nobel Prize in Chemistry 2019	“for the development of lithium-ion batteries”	1/3	Individual	John Goodenough	1922-07-25	Jena	Germany	Germany	Male	University

	year	category	prize	motivation	prize_share	laureate_type	full_name	birth_date	birth_city	birth_country	birth_country_current	sex	organization_
885	2014	Peace	The Nobel Peace Prize 2014	"for their struggle against the suppression of...	1/2	Individual	Malala Yousafzai	1997-07-12	Mingora	Pakistan	Pakistan	Female	

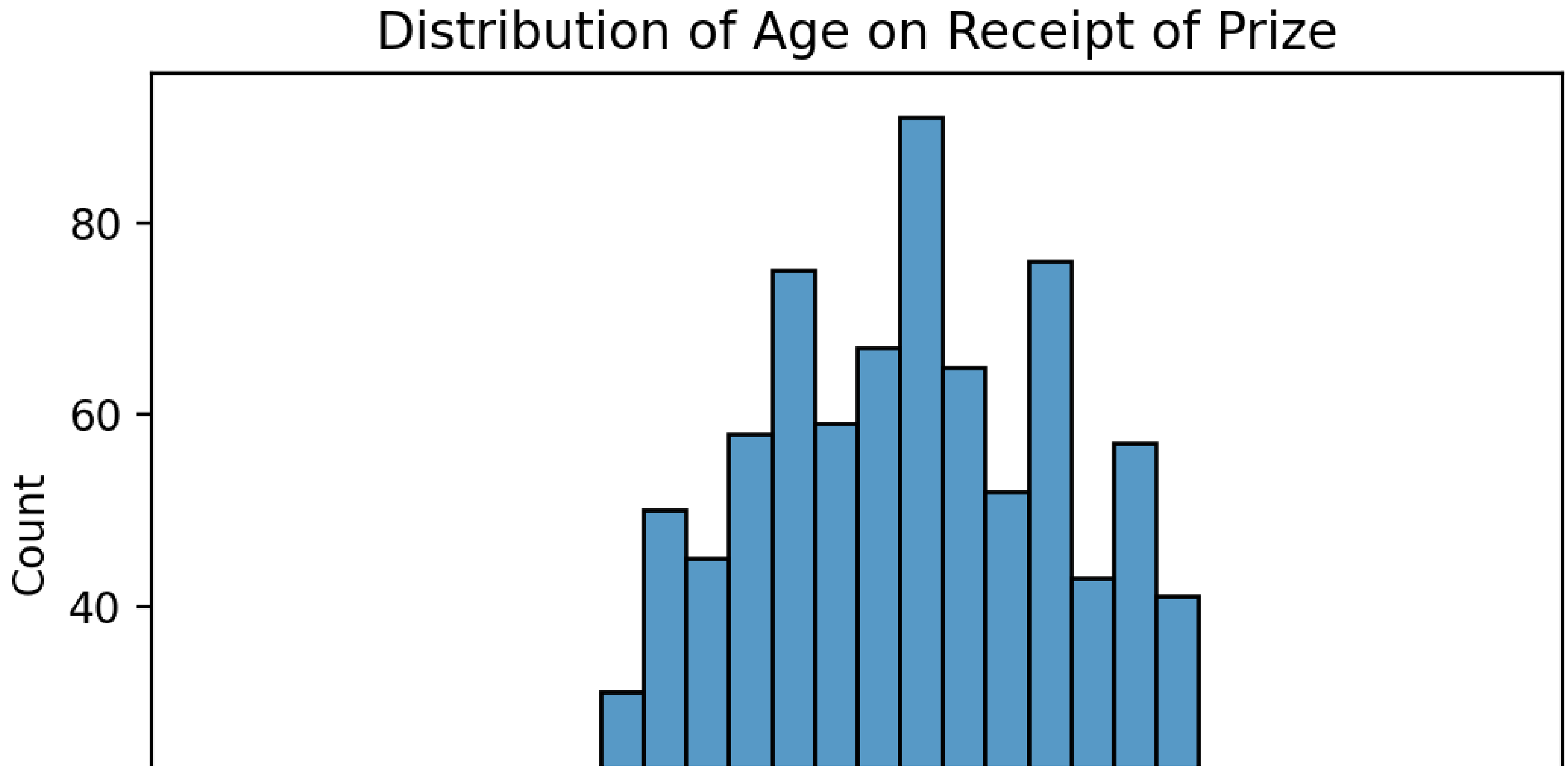
Descriptive Statistics for the Laureate Age at Time of Award

- Calculating the descriptive statistics for the age at the time of the award.
- Visualising the distribution in the form of a histogram using Seaborn's .histplot() function.
- Experimenting with the `bin` size.

```
df_data.winning_age.describe()
```

```
count   934.00
mean     59.95
std      12.62
min      17.00
25%      51.00
50%      60.00
75%      69.00
max      97.00
Name: winning_age, dtype: float64
```

```
# ploting the histogram
plt.figure(figsize=(6,4), dpi=200)

sns.histplot(
    data= df_data,
    x= df_data.winning_age,
    bins=30,
)

plt.xlabel("Age")
plt.title("Distribution of Age on Receipt of Prize")
plt.show()
```



Age at Time of Award throughout History

Are Nobel laureates being nominated later in life than before? Have the ages of laureates at the time of the award increased or decreased over time?

- Using Seaborn to create a .regplot with a trendline.
- Setting the `lowess` parameter to `True` to show a moving average of the linear fit.
- According to the best fit line, how old were Nobel laureates in the years 1900-1940 when they were awarded the prize?
- According to the best fit line, what age would it predict for a Nobel laureate in 2020?

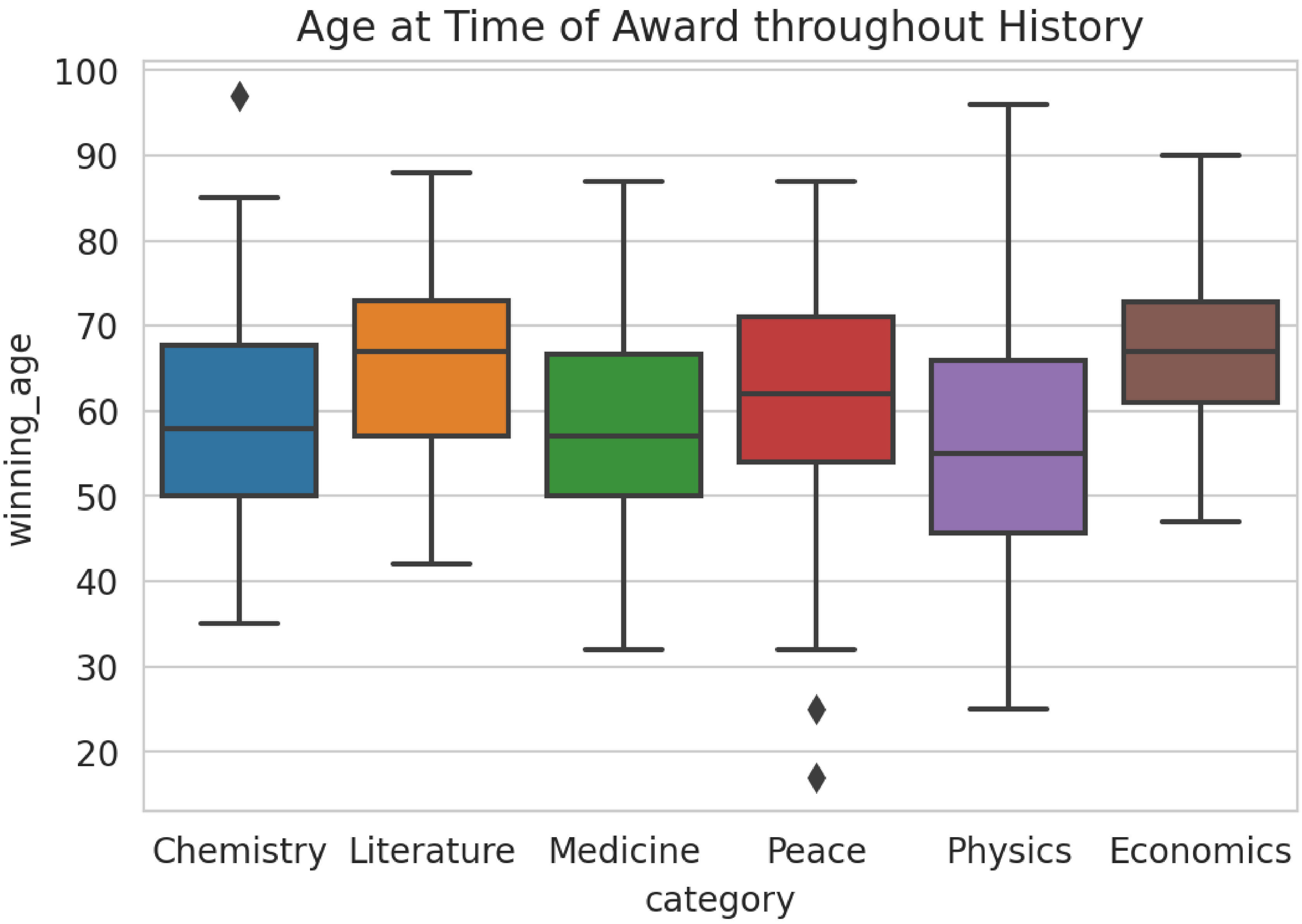
```
# ploting the regplot
plt.figure(figsize=(6,4), dpi=200)

with sns.axes_style('whitegrid'):
    ax = sns.regplot(
        data= df_data,
        x= 'year',
        y='winning_age',
        lowess=True,
        scatter_kws= {'alpha': 0.4},
        line_kws={'color': 'black'},
    )
    ax.set(
        title = "Age at Time of Award throughout History"
    )

plt.show()
```

Winning Age Across the Nobel Prize Categories

How does the age of laureates vary by category?

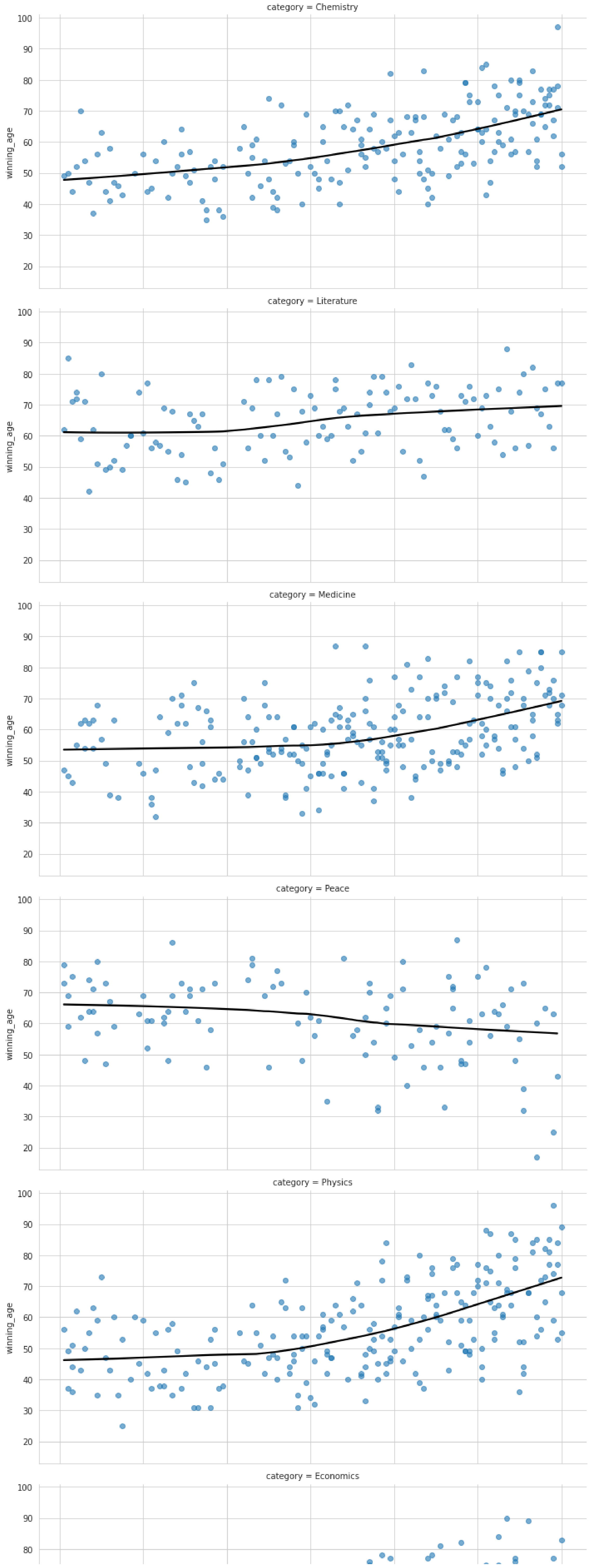
- Using Seaborn's `.boxplot()` to show how the mean, quartiles, max, and minimum values vary across categories. Which category has the longest "whiskers"?
- In which prize category are the average winners the oldest?
- In which prize category are the average winners the youngest?

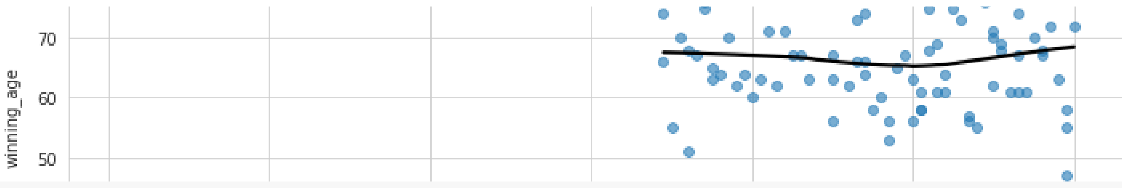
```
# ploting the boxplot
plt.figure(figsize=(6,4), dpi=200)

with sns.axes_style('whitegrid'):
    ax = sns.boxplot(
        data= df_data,
        x= 'category',
        y='winning_age',
    )
    ax.set(
        title = "Age at Time of Award throughout History"
    )

plt.show()
```



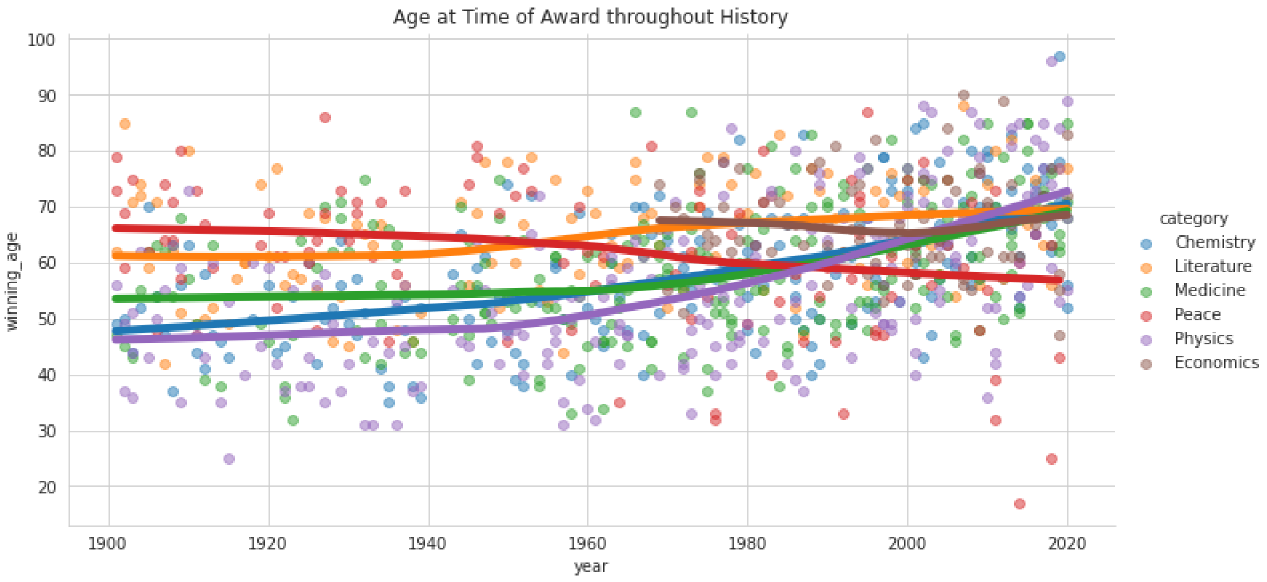
- Using Seaborn's `.lmplot()` and the `row` parameter to create 6 separate charts for each prize category. with `lowess` parameter `True`.
- What are the winning age trends in each category?
- Which category has the age trending up and which category has the age trending down?
- Is this `.lmplot()` telling a different story from the `.boxplot()`?
- Creating another chart with Seaborn. This time using `.lmplot()` to put all 6 categories on the same chart using the `hue` parameter.

```
with sns.axes_style('whitegrid'):
    sns.lmplot(data=df_data,
               x='year',
               y='winning_age',
               row = 'category',
               lowess=True,
               aspect=2,
               scatter_kws = {'alpha': 0.6},
               line_kws = {'color': 'black'},)

plt.show()
```


category = Chemistry
category = Literature
category = Medicine
category = Peace
category = Physics
category = Economics
winning_age
100
90
80
70
60
50
40
30
20



```
# combining all charts using hue parameter
with sns.axes_style('whitegrid'):
    ax =sns.lmplot(
        data=df_data,
        x='year',
        y='winning_age',
        hue='category',
        lowess=True,
        aspect=2,
        scatter_kws = {'alpha': 0.5},
        line_kws = {'linewidth': 5},
        )

    ax.set(
        title = "Age at Time of Award throughout History"
    )

plt.show()
```



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