Nobel Prize Analysis

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?

In [2]:
```
import pandas as pd
import numpy as np
import plotly.express as px
import seaborn as sns
import matplotlib.pyplot as plt
```

In [14]:
```
pd.options.display.float_format = '{:,.2f}'.format
```

In [8]:
```
df = pd.read_csv('nobel_prize_data.csv')
```

The data is upto year 2020 Nobel prize laureates

Data Exploration & Cleaning

In [18]:
```
print('the shape of df',df.shape)
```

```
df.head()
```

```
the shape of df (962, 16)
```

Out[18]:

	year	category	prize	motivation	prize_share	laureate_type	full_name	bi
0	1901	Chemistry	The Nobel Prize in Chemistry 1901	"in recognition of the extraordinary services ...	1/1	Individual	Jacobus Henricus van 't Hoff	
1	1901	Literature	The Nobel Prize in Literature 1901	"in special recognition of his poetic composit...	1/1	Individual	Sully Prudhomme	
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	
3	1901	Peace	The Nobel Peace Prize 1901	NaN	1/2	Individual	Frédéric Passy	
4	1901	Peace	The Nobel Peace Prize 1901	NaN	1/2	Individual	Jean Henry Dunant	

In [19]:

```
df.columns
```

Out[19]:

```
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')
```

In [20]:

```
print('The year was the Nobel prize first awarded',df.year.min())
```

```
The year was the Nobel prize first awarded 1901
```

In [21]:

```
print('The year is the latest year included in the dataset',df.year.max())
```

```
The year is the latest year included in the dataset 2020
```

Check for Duplicates

In [22]:

```
df.duplicated().values.any()
```

Out[22]:

```
False
```

Checking Missing Values

In [24]:

```
for i in df.columns:
    print(f'"{i}" column has NaN values =',df[i].isna().values.any())
```

```
"year" column has NaN values = False
"category" column has NaN values = False
"prize" column has NaN values = False
"motivation" column has NaN values = True
"prize_share" column has NaN values = False
"laureate_type" column has NaN values = False
"full_name" column has NaN values = False
"birth_date" column has NaN values = True
"birth_city" column has NaN values = True
"birth_country" column has NaN values = True
"birth_country_current" column has NaN values = True
"sex" column has NaN values = True
"organization_name" column has NaN values = True
"organization_city" column has NaN values = True
"organization_country" column has NaN values = True
"ISO" column has NaN values = True
```

In [10]:

```
df.isna().sum()
```

Out[10]:

```
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
```

In [51]:

```
col_subset = ['year','category', 'laureate_type','full_name','birth_date', 'orga
df[df.organization_name.isna()][col_subset]
```

Out[51]:

	year	category	laureate_type	full_name	birth_date	organization_name
1	1901	Literature	Individual	Sully Prudhomme	1839-03-16	NaN
3	1901	Peace	Individual	Frédéric Passy	1822-05-20	NaN
4	1901	Peace	Individual	Jean Henry Dunant	1828-05-08	NaN
7	1902	Literature	Individual	Christian Matthias Theodor Mommsen	1817-11-30	NaN
9	1902	Peace	Individual	Charles Albert Gobat	1843-05-21	NaN
...	...	...	...	...	...	...
932	2018	Peace	Individual	Nadia Murad	1993-07-02	NaN
942	2019	Literature	Individual	Peter Handke	1942-12-06	NaN
946	2019	Peace	Individual	Abiy Ahmed Ali	1976-08-15	NaN
954	2020	Literature	Individual	Louise Glück	1943-04-22	NaN
958	2020	Peace	Organization	World Food Programme (WFP)	NaT	NaN

255 rows × 6 columns

when we look at for rows where the organization_name column has no value, we also see that many prizes went to people who were not affiliated with a university or research institute. This includes many of the Literature and Peace prize winners.

Type Conversions

Convert Year and Birth Date to Datetime

In [12]:

```
df.head()
```

Out[12]:

	year	category	prize	motivation	prize_share	laureate_type	full_name	bi
0	1901	Chemistry	The Nobel Prize in Chemistry 1901	"in recognition of the extraordinary services ...	1/1	Individual	Jacobus Henricus van 't Hoff	
1	1901	Literature	The Nobel Prize in Literature 1901	"in special recognition of his poetic composit...	1/1	Individual	Sully Prudhomme	
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	
3	1901	Peace	The Nobel Peace Prize 1901	NaN	1/2	Individual	Frédéric Passy	
4	1901	Peace	The Nobel Peace Prize 1901	NaN	1/2	Individual	Jean Henry Dunant	

In [13]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 962 entries, 0 to 961
Data columns (total 16 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    object
 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
dtypes: int64(1), object(15)
memory usage: 120.4+ KB
```

In [26]:
```
df.birth_date = pd.to_datetime(df.birth_date)
```

In [27]:
```
df.dtypes
```

Out[27]:

```
year                              int64
category                         object
prize                            object
motivation                       object
prize_share                      object
laureate_type                    object
full_name                        object
birth_date               datetime64[ns]
birth_city                       object
birth_country                    object
birth_country_current            object
sex                              object
organization_name                object
organization_city                object
organization_country             object
ISO                              object
dtype: object
```

Add a Column with the Prize Share as a Percentage

In [29]:

```
share_pct = df.prize_share.str.split("/",expand=True)
```

In [30]:

```
numerator = pd.to_numeric(share_pct[0])
denominator = pd.to_numeric(share_pct[1])
share_pct = numerator/denominator

df.insert(5,'share_pct',share_pct)
df.head()
```

Out[30]:

	year	category	prize	motivation	prize_share	share_pct	laureate_type	ful
0	1901	Chemistry	The Nobel Prize in Chemistry 1901	"in recognition of the extraordinary services ...	1/1	1.00	Individual	H vai
1	1901	Literature	The Nobel Prize in Literature 1901	"in special recognition of his poetic composit...	1/1	1.00	Individual	Prud
2	1901	Medicine	The Nobel Prize in Physiology or Medicine 1901	"for his work on serum therapy, especially its...	1/1	1.00	Individual	Em von
3	1901	Peace	The Nobel Peace Prize 1901	NaN	1/2	0.50	Individual	
4	1901	Peace	The Nobel Peace Prize 1901	NaN	1/2	0.50	Individual	Jea

Percentage of Male vs. Female Laureates

In [31]:

```
gender = df.sex.value_counts()
gender
```

Out[31]:

```
sex
Male      876
Female     58
Name: count, dtype: int64
```

In [44]:

```
fig = px.pie(
    title='Percentage of Male vs. Female Winners',
    labels=gender.index,
    values=gender.values,
    names=gender.index,
    hole=0.5
)
fig.update_traces(
    textposition='inside',
    textfont_size=15,
    textinfo='percent'
                 )
fig.show()
```

The first 3 Women to Win the Nobel Prize

In [45]:

```
first_top_women_prize = df[df['sex'] == "Female"][:3]
first_top_women_prize
```

Out[45]:

	year	category	prize	motivation	prize_share	share_pct	laureate_type	full_
18	1903	Physics	The Nobel Prize in Physics 1903	"in recognition of the extraordinary services ...	1/4	0.25	Individual	Cur Skloc
29	1905	Peace	The Nobel Peace Prize 1905	NaN	1/1	1.00	Individual	Ba Felic Suttr
51	1909	Literature	The Nobel Prize in Literature 1909	"in appreciation of the lofty idealism, vivid ...	1/1	1.00	Individual	La

In [46]:

```
first_top_women_prize.prize
```

Out[46]:

```
18       The Nobel Prize in Physics 1903
29            The Nobel Peace Prize 1905
51    The Nobel Prize in Literature 1909
Name: prize, dtype: object
```

In [47]:

```
print(first_top_women_prize.birth_country)
```

```
18              Russian Empire (Poland)
29    Austrian Empire (Czech Republic)
51                               Sweden
Name: birth_country, dtype: object
```

The Repeat Winners

In [54]:

```
multiple_winners = df[df.duplicated(subset=['full_name'],keep=False)]
multiple_winners[col_subset]
```

Out[54]:

	year	category	laureate_type	full_name	birth_date	organization_name
18	1903	Physics	Individual	Marie Curie, née Sklodowska	1867-11-07	NaN
62	1911	Chemistry	Individual	Marie Curie, née Sklodowska	1867-11-07	Sorbonne University
89	1917	Peace	Organization	Comité international de la Croix Rouge (Intern...	NaT	NaN
215	1944	Peace	Organization	Comité international de la Croix Rouge (Intern...	NaT	NaN
278	1954	Chemistry	Individual	Linus Carl Pauling	1901-02-28	California Institute of Technology (Caltech)
283	1954	Peace	Organization	Office of the United Nations High Commissioner...	NaT	NaN
297	1956	Physics	Individual	John Bardeen	1908-05-23	University of Illinois
306	1958	Chemistry	Individual	Frederick Sanger	1918-08-13	University of Cambridge
340	1962	Peace	Individual	Linus Carl Pauling	1901-02-28	California Institute of Technology (Caltech)
348	1963	Peace	Organization	Comité international de la Croix Rouge (Intern...	NaT	NaN
424	1972	Physics	Individual	John Bardeen	1908-05-23	University of Illinois
505	1980	Chemistry	Individual	Frederick Sanger	1918-08-13	MRC Laboratory of Molecular Biology
523	1981	Peace	Organization	Office of the United Nations High Commissioner...	NaT	NaN

There are 6 winners who were awarded the prize more than once,Only 4 of the repeat laureates were individuals.

In [55]:

```
multiple_winners.full_name.unique()
```

Out[55]:
```
array(['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'], dtype=object)
```

We see that Marie Curie actually got the Nobel prize twice - once in physics and once in chemistry. Linus Carl Pauling got it first in chemistry and later for peace given his work in promoting nuclear disarmament. Also, the International Red Cross was awarded the Peace prize a total of 3 times. The first two times were both during the devastating World Wars.

Number of Prizes per Category

In [56]:
```
df.category.unique()
```

Out[56]:
```
array(['Chemistry', 'Literature', 'Medicine', 'Peace', 'Physics',
       'Economics'], dtype=object)
```

In [57]:
```
df.category.nunique()
```

Out[57]:
```
6
```

In [58]:
```
price_per_category = df.category.value_counts()
price_per_category
```

Out[58]:
```
category
Medicine      222
Physics       216
Chemistry     186
Peace         135
Literature    117
Economics      86
Name: count, dtype: int64
```

In [28]:
```
# price_per_category = pd.DataFrame(price_per_category)
price_per_category
```

Out[28]:
```
category
Medicine      222
Physics       216
Chemistry     186
Peace         135
Literature    117
Economics      86
Name: count, dtype: int64
```

In [29]:
```
# price_per_category = df.category.count()
prizes_per_category = df.category.value_counts()

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

bar_fig.update_layout(
    xaxis_title='Categories',
    yaxis_title='No of Prize'
)

bar_fig.show()
```

Why are there so few prizes in the field of economics?

In [59]:
```
df[df['category'] == 'Economics'].head()
```

Out[59]:

	year	category	prize	motivation	prize_share	share_pct	laureate_type	fu
393	1969	Economics	The Sveriges Riksbank Prize in Economic Scienc...	"for having developed and applied dynamic mode...	1/2	0.50	Individual	T
394	1969	Economics	The Sveriges Riksbank Prize in Economic Scienc...	"for having developed and applied dynamic mode...	1/2	0.50	Individual	
402	1970	Economics	The Sveriges Riksbank Prize in Economic Scienc...	"for the scientific work through which he has ...	1/1	1.00	Individual	Sa
411	1971	Economics	The Sveriges Riksbank Prize in Economic Scienc...	"for his empirically founded interpretation of...	1/1	1.00	Individual	
419	1972	Economics	The Sveriges Riksbank Prize in Economic Scienc...	"for their pioneering contributions to general...	1/2	0.50	Individual	

We can see here, The economics prize is much newer. It was first awarded in 1969, compared to 1901 for physics.

Male and Female Winners by Category

We already saw that overall, only 6.2% of Nobel prize winners were female. Does this vary by category?

In [60]:

```
category_gender = df.groupby(['category','sex'],as_index=False).agg({'prize':pd.
category_gender.sort_values(by='prize',ascending=False,inplace=True)
category_gender
```

Out[60]:

	category	sex	prize
11	Physics	Male	212
7	Medicine	Male	210
1	Chemistry	Male	179
5	Literature	Male	101
9	Peace	Male	90
3	Economics	Male	84
8	Peace	Female	17
4	Literature	Female	16
6	Medicine	Female	12
0	Chemistry	Female	7
10	Physics	Female	4
2	Economics	Female	2

In [32]:

```
bar_category_gender = px.bar(
    x = category_gender.category,
    y=category_gender.prize,
    color=category_gender.sex
)

bar_category_gender.show()
```

We see that overall the imbalance is pretty large with physics, economics, and chemistry. Women are somewhat more represented in categories of Medicine, Literature and Peace.

Number of Prizes Awarded Over Time

In [64]:

```
prize_count = df.groupby('year').count().prize
prize_count
```

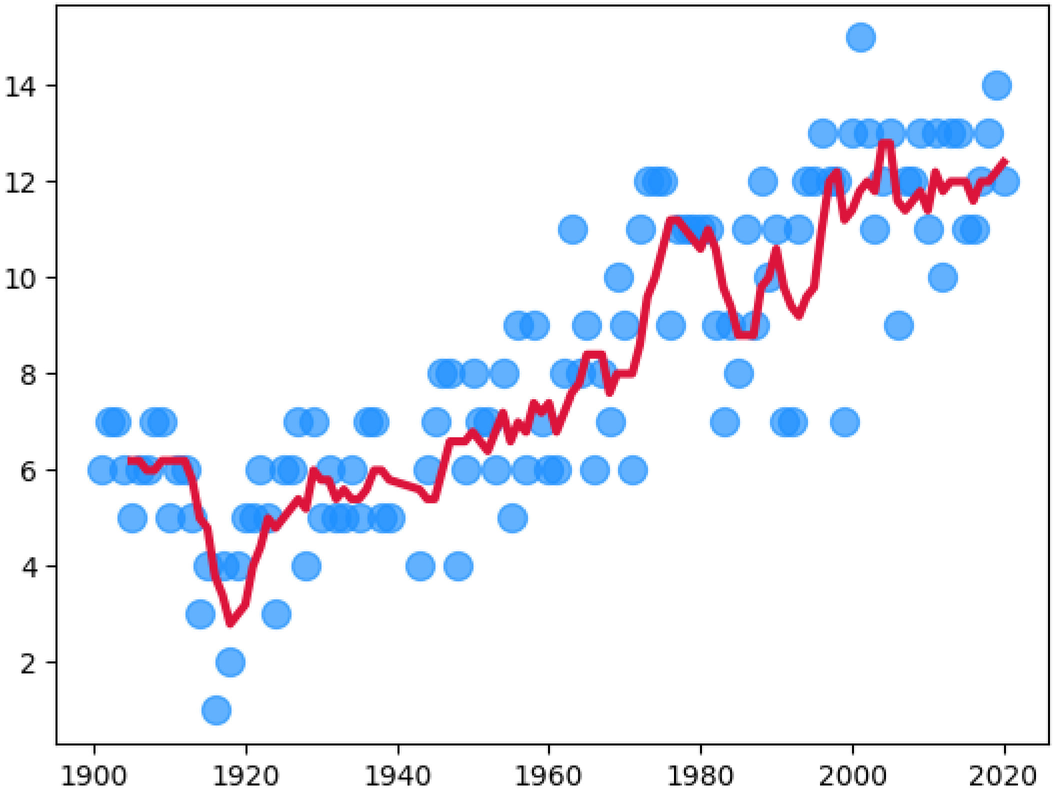
Out[64]:

```
year
1901     6
1902     7
1903     7
1904     6
1905     5
        ..
2016    11
2017    12
2018    13
2019    14
2020    12
Name: prize, Length: 117, dtype: int64
```

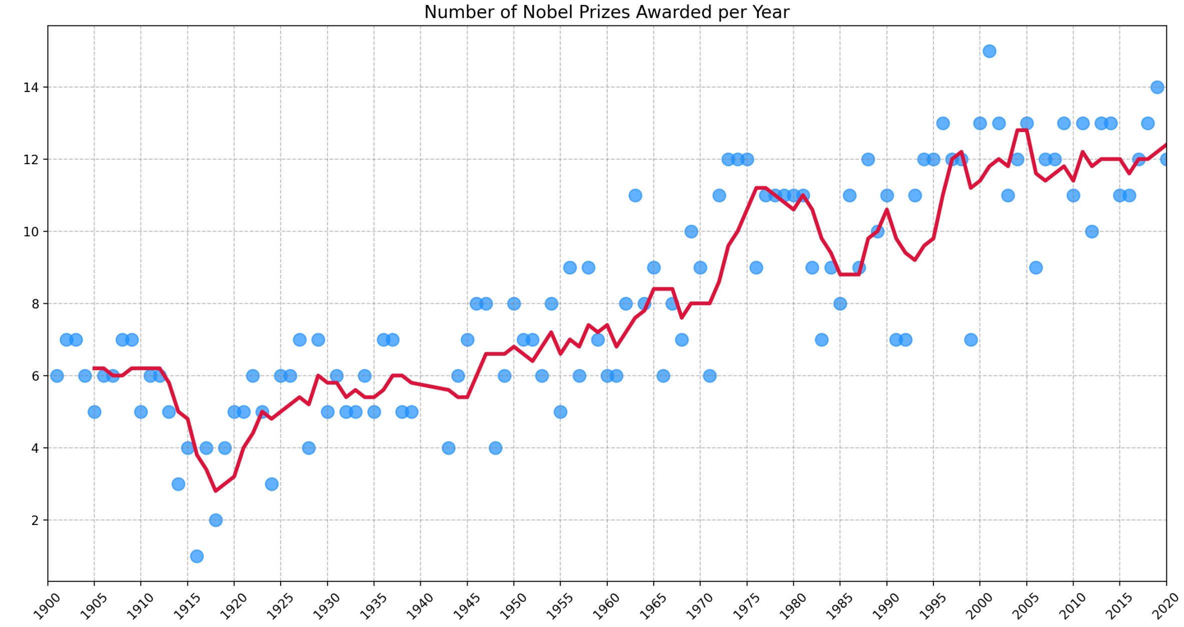
In [65]:
```
rolling_prize = prize_count.rolling(window=5).mean()
rolling_prize.head(10)
```

Out[65]:
```
year
1901     NaN
1902     NaN
1903     NaN
1904     NaN
1905    6.20
1906    6.20
1907    6.00
1908    6.00
1909    6.20
1910    6.20
Name: prize, dtype: float64
```

In [71]:
```
plt.scatter(x=prize_count.index,
            y=prize_count.values,
            c='dodgerblue',
            alpha=0.7,
            s=100)
plt.plot(prize_count.index,
         rolling_prize.values,
         c='crimson',
         linewidth=3)
plt.show()
```



In [74]:
```
plt.figure(figsize=(16,8),dpi=200)
plt.title("Number of Nobel Prizes Awarded per Year",fontsize=14)

plt.yticks(fontsize=10)
plt.xticks(
    ticks=np.arange(1900,2021,step=5),
    fontsize=10,
    rotation=45
)

ax= plt.gca()
ax.grid(color='grey',alpha=0.5, linestyle='--')

ax.set_xlim(1900,2020)

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

ax.plot(
    prize_count.index,
    rolling_prize.values,
    c='crimson',
    linewidth=3
)

plt.show()
```



Are More Prizes Shared Than Before?

```
In [77]: avg_share_year = df.groupby('year').agg({'share_pct':pd.Series.mean})
         avg_share_year
```

Out[77]:

	share_pct
year	
1901	0.83
1902	0.71
1903	0.71
1904	0.83
1905	1.00
...	...
2016	0.55
2017	0.50
2018	0.46
2019	0.43
2020	0.50

117 rows × 1 columns

In [78]:

```python
rolling_avg_share = avg_share_year.rolling(window=5).mean()
rolling_avg_share
```

Out[78]:

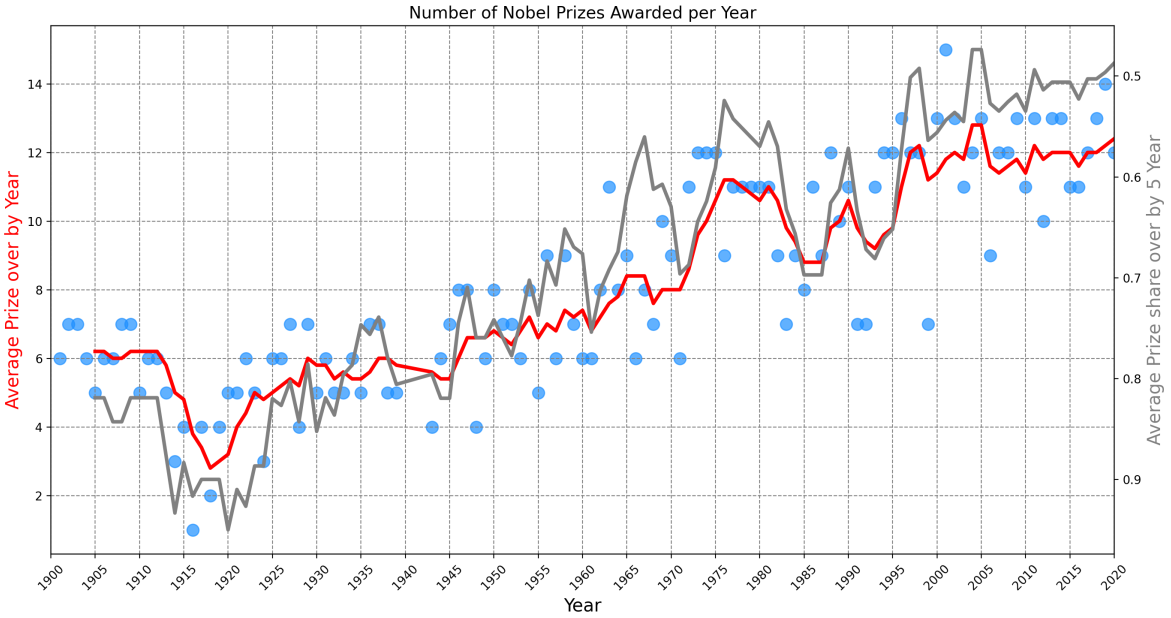
	share_pct
year	
1901	NaN
1902	NaN
1903	NaN
1904	NaN
1905	0.82
...	...
2016	0.52
2017	0.50
2018	0.50
2019	0.50
2020	0.49

117 rows × 1 columns

In [79]:

```python
plt.figure(figsize=(16,8),dpi=200)
plt.title('Number of Nobel Prizes Awarded per Year',
          fontsize=14)
```

```
plt.xticks(ticks=np.arange(1900,2021,step=5),
          fontsize=10,
          rotation=45
          )
ax1=plt.gca()
ax2=ax1.twinx()
ax1.set_xlim(1900,2020)
ax2.invert_yaxis()

ax1.grid(color='grey', linestyle='--')

ax1.set_xlabel('Year',fontsize=15)
ax1.set_ylabel('Average Prize over by Year',
              color='red',fontsize=15)
ax2.set_ylabel('Average Prize share over by 5 Year',
              color='gray',fontsize=15)

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

ax1.plot(prize_count.index,
        rolling_prize.values,
        c='red',
        linewidth=3
        )

ax2.plot(prize_count.index,
         rolling_avg_share.values,
         c='gray',
         linewidth=3
)


plt.show()
```



Well, there is clearly an upward trend in the number of prizes being given out as more and more prizes are shared. Also, more prizes are being awarded from 1969 onwards because of the addition of the economics category. We also see that very few prizes were awarded during the first and second world wars.

The Countries with the Most Nobel Prizes

In [80]:

```
top20_countries = df.groupby('birth_country_current',as_index=False).agg({'prize
top20_countries.sort_values(by='prize',ascending=True,inplace=True)

top20_countries
```

Out[80]:

	birth_country_current	prize
78	Zimbabwe	1
77	Yemen	1
32	Iceland	1
41	Kenya	1
29	Guadeloupe Island	1
...	...	...
67	Sweden	29
25	France	57
26	Germany	84
73	United Kingdom	105
74	United States of America	281

79 rows × 2 columns

In [84]:

```
top20_countries = top20_countries[-20:]
hor_bar = px.bar(
    x=top20_countries.prize,
    y=top20_countries.birth_country_current,
    orientation='h',
    color=top20_countries.prize,
    title='Top 20 countries Won the Nobel Prizes'
)

hor_bar.update_layout(
    xaxis_title='No of Prizes',
    yaxis_title='Country',
)
hor_bar.show()
```

we can see above USA had a most prize Laureates

In [86]:
```
df_country = df.groupby(['birth_country_current','ISO'],as_index=False).agg({'pr
df_country
```

Out[86]:

	birth_country_current	ISO	prize
0	Algeria	DZA	2
1	Argentina	ARG	4
2	Australia	AUS	10
3	Austria	AUT	18
4	Azerbaijan	AZE	1
...	...	...	...
74	United States of America	USA	281
75	Venezuela	VEN	1
76	Vietnam	VNM	1
77	Yemen	YEM	1
78	Zimbabwe	ZWE	1

79 rows × 3 columns

In [48]:

```
country_map = px.choropleth(df_country,
                            locations='ISO',
                            color='prize',
                            hover_name='birth_country_current',
                            color_continuous_scale=px.colors.sequential.matter
)
country_map.show()
```

In Which Categories are the Different Countries Winning Prizes?

In [89]:

```
top20_countries
```

Out[89]:

	birth_country_current	prize
7	Belgium	9
31	Hungary	9
33	India	9
2	Australia	10
20	Denmark	12
54	Norway	12
13	China	12
51	Netherlands	18
3	Austria	18
39	Italy	19
68	Switzerland	19
11	Canada	20
61	Russia	26
40	Japan	27
57	Poland	27
67	Sweden	29
25	France	57
26	Germany	84
73	United Kingdom	105
74	United States of America	281

In [96]:

```
country_category_grp = df.groupby(['birth_country_current','category'],as_index=
country_category_grp
```

Out[96]:

	birth_country_current	category	prize
0	Algeria	Literature	1
1	Algeria	Physics	1
2	Argentina	Medicine	2
3	Argentina	Peace	2
4	Australia	Chemistry	1
...	...	...	...
206	United States of America	Physics	70
207	Venezuela	Medicine	1
208	Vietnam	Peace	1
209	Yemen	Peace	1
210	Zimbabwe	Peace	1

211 rows × 3 columns

In [93]:

```
merged_grp = pd.merge(country_category_grp,top20_countries,
                     on='birth_country_current')
merged_grp.columns = ['birth_country_current','category','prize_by_categry','Tot
merged_grp.sort_values(by='Total_country_prize',inplace=True,ascending=True)
merged_grp
```

Out[93]:

	birth_country_current	category	prize_by_categry	Total_country_prize
12	Belgium	Peace	3	9
42	Hungary	Chemistry	3	9
43	Hungary	Economics	1	9
52	India	Physics	1	9
51	India	Peace	1	9
...	...	...	...	...
104	United States of America	Chemistry	55	281
105	United States of America	Economics	49	281
106	United States of America	Literature	10	281
107	United States of America	Medicine	78	281
109	United States of America	Physics	70	281

110 rows × 4 columns

In [66]:

```
# merged_grp = merged_grp.sort_values(by='Total_country_prize')
total_prize_bar = px.bar(
    x=merged_grp.prize_by_categry,
    y=merged_grp.birth_country_current,
    color=merged_grp.category,
    orientation='h',
    title='Top 20 country by Number of Prizes and Category',

    )

total_prize_bar.update_layout(
    xaxis_title='No of Prizes by Category',
    yaxis_title='Countries by Category'
)

total_prize_bar.show()
```

we see that the US has won incredible proportion of prizes

Prizes Won by Each Country Over Time

In [99]:

```
prize_by_year = df.groupby(['birth_country_current','year'],as_index=False).coun
prize_by_year = prize_by_year.sort_values('year')[['birth_country_current','year
prize_by_year
```

Out[99]:

	birth_country_current	year	prize
118	France	1901	2
346	Poland	1901	1
159	Germany	1901	1
312	Netherlands	1901	1
440	Switzerland	1901	1
...	...	...	...
31	Austria	2019	1
221	Germany	2020	1
622	United States of America	2020	7
533	United Kingdom	2020	2
158	France	2020	1

627 rows × 3 columns

In [120…

```
cumulative_prize = prize_by_year.groupby(['birth_country_current','year']).sum()
cumulative_prize.reset_index(inplace=True)
cumulative_prize.sort_values(by='year',ascending=True).head(20)
```

Out[120…

	birth_country_current	year	prize
118	France	1901	2
346	Poland	1901	1
159	Germany	1901	1
312	Netherlands	1901	1
440	Switzerland	1901	1
313	Netherlands	1902	3
236	India	1902	1
160	Germany	1902	3
441	Switzerland	1902	3
467	United Kingdom	1903	1
347	Poland	1903	2
119	France	1903	4
417	Sweden	1903	1
94	Denmark	1903	1
332	Norway	1903	1
468	United Kingdom	1904	3
120	France	1904	5
410	Spain	1904	1
378	Russia	1904	1
88	Czech Republic	1905	1

In [122…

```
line_by_prize = px.line(
    cumulative_prize,
    x='year',
    y='prize',
    color='birth_country_current',
    hover_name='birth_country_current'
)

line_by_prize.update_layout(
    xaxis_title='Year',
    yaxis_title='No of Prizes'
)

line_by_prize.show()
```

we see is that the United States really started to take off after the Second World War which decimated Europe. Very few laureates were chosen from other parts of the world. This has changed dramatically in the last 40 years or so. There are many more countries represented today than in the early days. Interestingly we also see that the UK and Germany traded places in the 70s and 90s on the total number of prizes won. Sweden being 5th place pretty consistently over many decades is quite interesting too.

What are the Top Research Organisations?

Many Nobel laureates are affiliated with a university, a laboratory, or a research organisation (apart from Literature and Peace prize winners as we've seen).

In [123…

```
df.organization_name.value_counts()[:20]
```

Out[123…

```
organization_name
University of California                          40
Harvard University                                29
Stanford University                               23
Massachusetts Institute of Technology (MIT)       21
University of Chicago                             20
University of Cambridge                           18
Columbia University                               17
California Institute of Technology (Caltech)      17
Princeton University                              15
Max-Planck-Institut                               13
Rockefeller University                            13
University of Oxford                              12
MRC Laboratory of Molecular Biology               10
Yale University                                    9
Cornell University                                 8
Bell Laboratories                                  8
Institut Pasteur                                   7
Harvard Medical School                             7
London University                                  7
Sorbonne University                                7
Name: count, dtype: int64
```

In [124…

```
org_prize = df.organization_name.value_counts()[:20]
org_prize.sort_values(ascending=True,inplace=True)


bar_org = px.bar(
    x=org_prize.values,
    y=org_prize.index,
    orientation='h',
    color=org_prize.values,
    title='Top 20 Organizations Won the Nobel Prizes'
)

bar_org.update_layout(
    xaxis_title='No of Prize',
    yaxis_title='Organizations',
)
bar_org.show()
```

In [85]:

```
org_prize = df.groupby(['organization_name'],as_index=False).count()[['organizat


bar_org = px.bar(
    x=org_prize.prize,
    y=org_prize.organization_name,
    orientation='h',
    color=org_prize.prize,
    title='Top 20 Organizations Won the Nobel Prizes'
)

bar_org.update_layout(
    xaxis_title='No of Prize',
    yaxis_title='Organizations',
)
bar_org.show()
```

Which Cities Make the Most Discoveries?

****Orginization cities****

In [126…

```
city_org = df.organization_city.value_counts()[:20]
city_org.sort_values(ascending=False,inplace=True)
city_org
```

Out[126…

```
organization_city
Cambridge, MA      50
New York, NY       45
Cambridge          31
London             27
Paris              25
Stanford, CA       24
Berkeley, CA       21
Chicago, IL        20
Princeton, NJ      19
Pasadena, CA       17
Berlin             12
Oxford             12
Stockholm          10
Moscow             10
Munich              9
Boston, MA          9
Heidelberg          9
New Haven, CT       9
Los Angeles, CA     8
Ithaca, NY          8
Name: count, dtype: int64
```

In [127…

```
city_org_bar = px.bar(x=city_org.values,
                     y=city_org.index,
                     orientation='h',
                     hover_name=city_org.index,
                     color=city_org.values)
city_org_bar.update_layout(
    xaxis_title='No of Prizes',
    yaxis_title='Orginization cities'
)
city_org_bar.show()
```

The Nobel Laureate Birth Cities

In [89]:

```
laureate_cities = df.birth_city.value_counts()[:20]
laureate_cities.sort_values(ascending=True,inplace=True)

laureate_cities_bar = px.bar(x=laureate_cities.values,
                     y=laureate_cities.index,
                     orientation='h',
                     hover_name=laureate_cities.index,
                     color=laureate_cities.values)
laureate_cities_bar.update_layout(
    xaxis_title='No of Prizes',
    yaxis_title= 'laureate Birth cities'
)
laureate_cities_bar.show()
```

A higher population definitely means that there's a higher chance of a Nobel laureate to be born there. New York, Paris, and London are all very populous. However, Vienna and Budapest are not and still produced many prize winners. That said, much of the ground-breaking research does not take place in big population centres, so the list of birth cities is quite different from the list above. Cambridge Massachusets, Stanford, Berkely and Cambridge (UK) are all the places where many discoveries are made, but they are not the birthplaces of laureates.

Combine Country, City, and Organisation

****combine these together in sunburst****

In [91]:

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

sunburst_df = sunburst_df.sort_values('prize',ascending=False)
sunburst_df
```

Out[91]:

	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
...	...	...	...	...
110	Japan	Sapporo	Hokkaido University	1
111	Japan	Tokyo	Asahi Kasei Corporation	1
112	Japan	Tokyo	Kitasato University	1
113	Japan	Tokyo	Tokyo Institute of Technology	1
290	United States of America	Yorktown Heights, NY	IBM Thomas J. Watson Research Center	1

291 rows × 4 columns

In [93]:

```
country_city_laur = px.sunburst(sunburst_df,
    path=[
        'organization_country',
          'organization_city',
          'organization_name'
    ],
    values='prize',
    title='Where Do Discoveries Takes Place'
)
country_city_laur.update_layout(
    xaxis_title='Number of Prizes',
    yaxis_title='City'
)

country_city_laur.show()
```

Patterns in the Laureate Age at the Time of the Award

```
In [95]: df.head()
```

Out[95]:

	year	category	prize	motivation	prize_share	share_pct	laureate_type	ful
0	1901	Chemistry	The Nobel Prize in Chemistry 1901	"in recognition of the extraordinary services ...	1/1	1.00	Individual	. H var
1	1901	Literature	The Nobel Prize in Literature 1901	"in special recognition of his poetic composit...	1/1	1.00	Individual	Prud
2	1901	Medicine	The Nobel Prize in Physiology or Medicine 1901	"for his work on serum therapy, especially its...	1/1	1.00	Individual	Em von
3	1901	Peace	The Nobel Peace Prize 1901	NaN	1/2	0.50	Individual	I
4	1901	Peace	The Nobel Peace Prize 1901	NaN	1/2	0.50	Individual	Jea

In [97]:

```
birth_year = df.birth_date.dt.year
winning_age = df.year - birth_year
winning_age
```

Out[97]:

```
0      49.00
1      62.00
2      47.00
3      79.00
4      73.00
        ...
957    71.00
958      NaN
959    55.00
960    68.00
961    89.00
Length: 962, dtype: float64
```

In [99]:

```
print('The Oldest Nobel Laureate age',winning_age.max())
df[df.index == winning_age.idxmax()]
```

```
The Oldest Nobel Laureate age 97.0
```

Out[99]:

	year	category	prize	motivation	prize_share	share_pct	laureate_type	
937	2019	Chemistry	The Nobel Prize in Chemistry 2019	“for the development of lithium-ion batteries”	1/3	0.33	Individual	Go

In [100…

```
print('The Youngest Nobel Laureate age',winning_age.min())
df[df.index == winning_age.idxmin()]
```

```
The Youngest Nobel Laureate age 17.0
```

Out[100…

	year	category	prize	motivation	prize_share	share_pct	laureate_type	full_nam
885	2014	Peace	The Nobel Peace Prize 2014	"for their struggle against the suppression of...	1/2	0.50	Individual	Mala Yousafz

In [103…

```
df.insert(1,'winning_age',pd.to_numeric(winning_age))
```

In [105…

```
df
```

Out[105…

	year	winning_age	category	prize	motivation	prize_share	share_pct	lau
0	1901	49.00	Chemistry	The Nobel Prize in Chemistry 1901	"in recognition of the extraordinary services ...	1/1	1.00	
1	1901	62.00	Literature	The Nobel Prize in Literature 1901	"in special recognition of his poetic composit...	1/1	1.00	
2	1901	47.00	Medicine	The Nobel Prize in Physiology or Medicine 1901	"for his work on serum therapy, especially its...	1/1	1.00	
3	1901	79.00	Peace	The Nobel Peace Prize 1901	NaN	1/2	0.50	
4	1901	73.00	Peace	The Nobel Peace Prize 1901	NaN	1/2	0.50	
...	...	...	...	...	...	...	...	
957	2020	71.00	Medicine	The Nobel Prize in Physiology or Medicine 2020	“for the discovery of Hepatitis C virus”	1/3	0.33	
958	2020	NaN	Peace	The Nobel Peace Prize 2020	“for its efforts to combat hunger, for its con...	1/1	1.00	C
959	2020	55.00	Physics	The Nobel Prize in Physics 2020	“for the discovery of a supermassive compact o...	1/4	0.25	
960	2020	68.00	Physics	The Nobel Prize in Physics 2020	“for the discovery of a supermassive compact o...	1/4	0.25	
961	2020	89.00	Physics	The Nobel Prize in Physics 2020	“for the discovery that black hole formation i...	1/2	0.50	

962 rows × 18 columns

In [107…

```
df.winning_age.describe()
```

Out[107…

```
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
```

In [109…

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

	year	winning_age	category	prize	motivation	prize_share	share_pct	laurea
937	2019	97.00	Chemistry	The Nobel Prize in Chemistry 2019	“for the development of lithium-ion batteries”	1/3	0.33	Ir

	year	winning_age	category	prize	motivation	prize_share	share_pct	laureate_ty
885	2014	17.00	Peace	The Nobel Peace Prize 2014	"for their struggle against the suppression of...	1/2	0.50	Individu

the one who oldest see above data is John Goodenough was 97 years old when he got the Nobel prize!!! Interestingly John was born to American parents while they were in Germany. This is one example where our analysis of countries counts an extra "German" prize even though he is an American citizen. Too bad we don't have a nationality column in our dataset! Nonetheless, this goes to show it is never too late to win a Nobel prize. I'm keeping my fingers crossed for you!

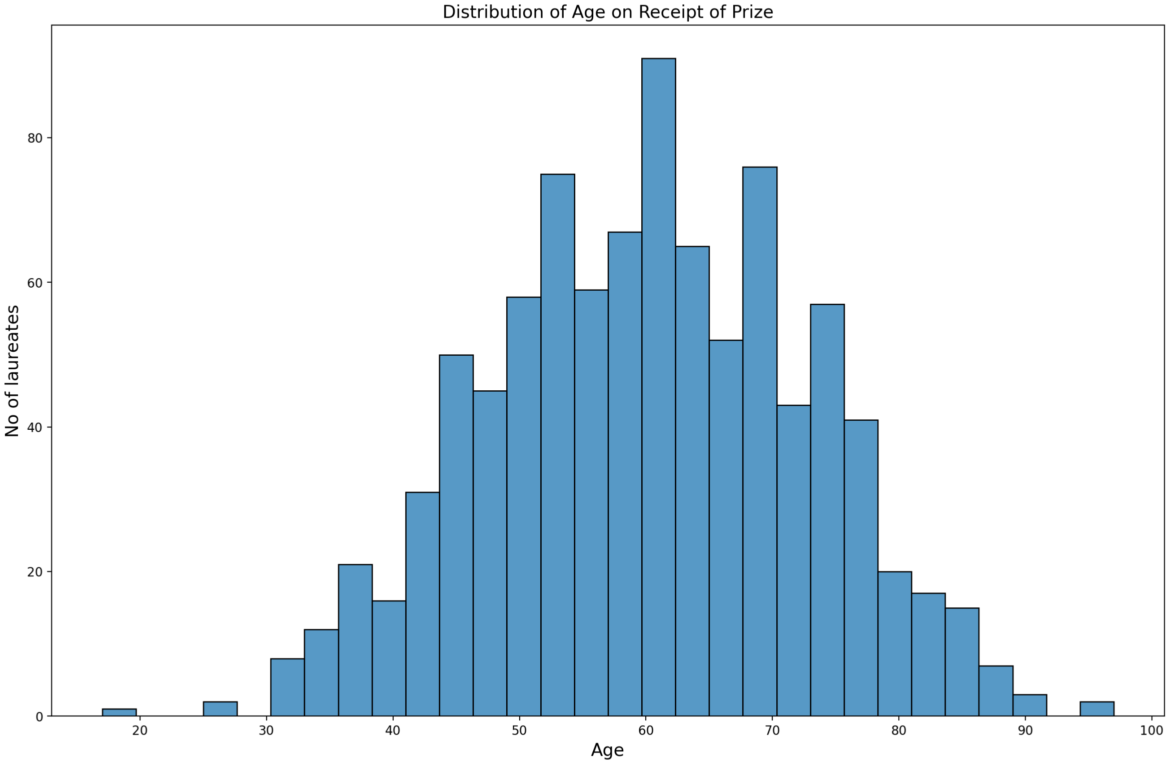
Descriptive Statistics for the Laureate Age at Time of Award

In [111…

```
plt.figure(figsize=(16,10),dpi=200)
sns.histplot(data=df,
            x=winning_age,
            bins=30)
```

```
plt.xlabel('Age',fontsize=14)
plt.ylabel('No of laureates',fontsize=14)
plt.title('Distribution of Age on Receipt of Prize',fontsize=14)
plt.show()
```

```
C:\Users\KARTHIK\anaconda3\Lib\site-packages\seaborn\_oldcore.py:1119: FutureWarn
ing:

use_inf_as_na option is deprecated and will be removed in a future version. Conve
rt inf values to NaN before operating instead.
```

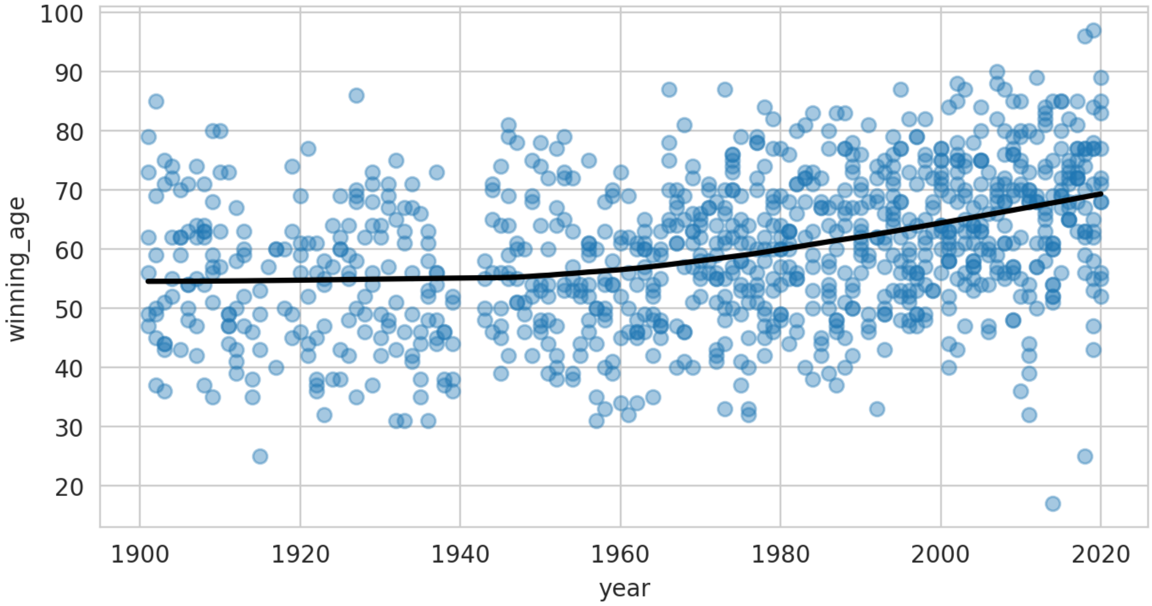


we see that most of that, which means average age of laureates are 59 Years old.

Age at Time of Award throughout History

In [113…

```
plt.figure(figsize=(8,4),dpi=200)

with sns.axes_style('whitegrid'):
    sns.regplot(data=df,
                x='year',
                y='winning_age',
                line_kws={'color':'black'},
                scatter_kws={'alpha':0.4},
                lowess=True
    )
plt.show()
```

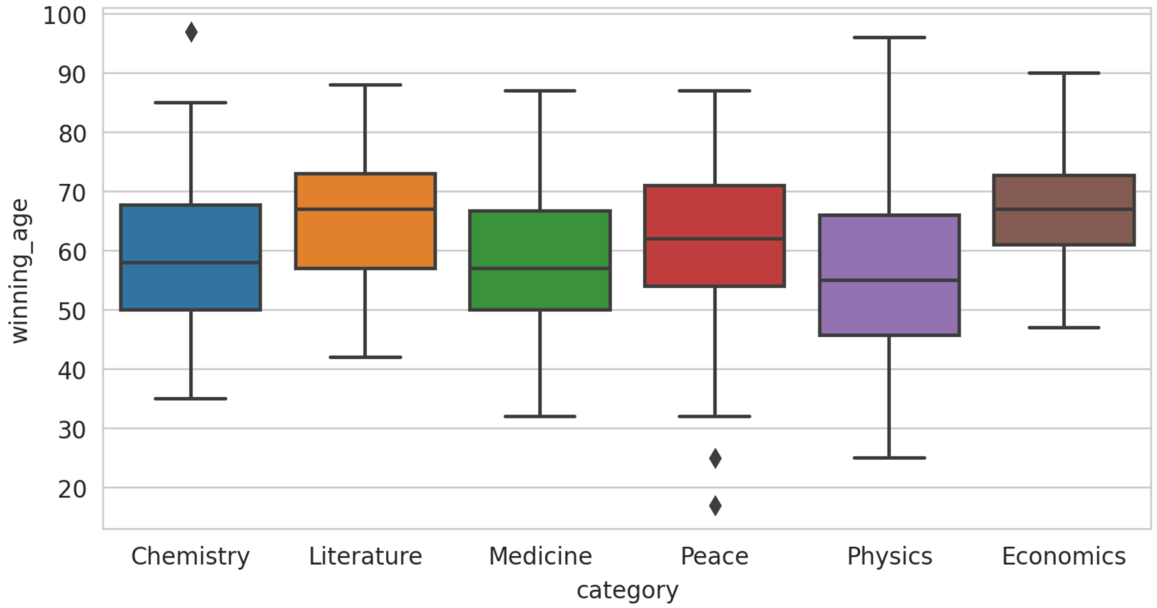


This is super neat because it clearly shows how the Nobel laureates are getting their award later and later in life. From 1900 to around 1950, the laureates were around 55 years old, but these days they are closer to 70 years old when they get their award! The other thing that we see in the chart is that in the last 10 years the spread has increased. We've see above, more very young and very old winners. In 1950s/60s winners were between 30 and 80 years old. Lately, that range has widened.

Laureates Age Across the Nobel Prize Categories

In [114…

```
plt.figure(figsize=(8,4),dpi=200)

with sns.axes_style('whitegrid'):
    sns.boxplot(data=df,
                x='category',
                y='winning_age'
    )
plt.show()
```



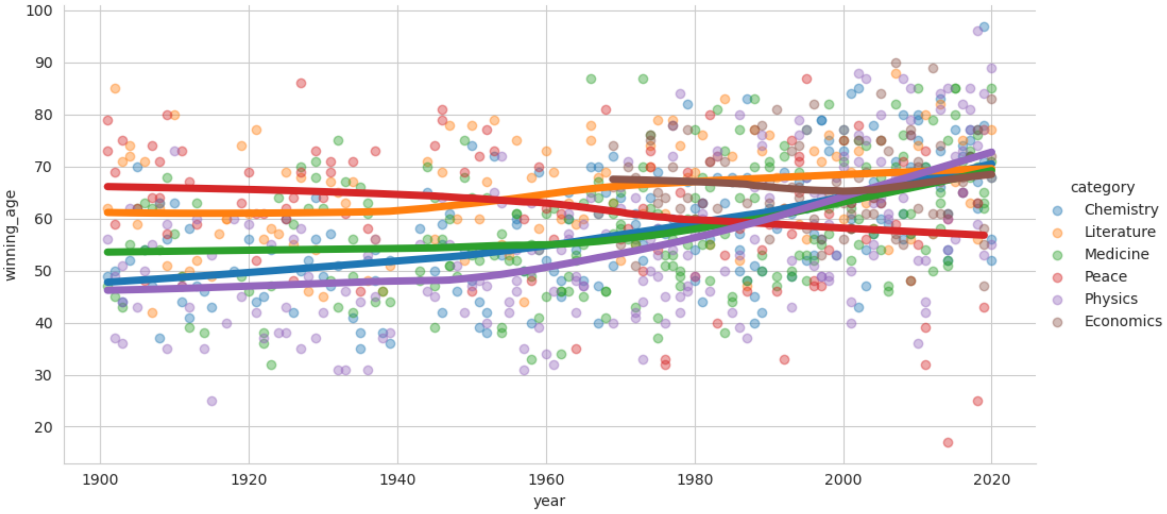
In [116…

```
age_category_box = px.box(
    x=df.category,
    y=df.winning_age,
    color=df.category,
)

age_category_box.show()
```

Laureate Age over Time by Category

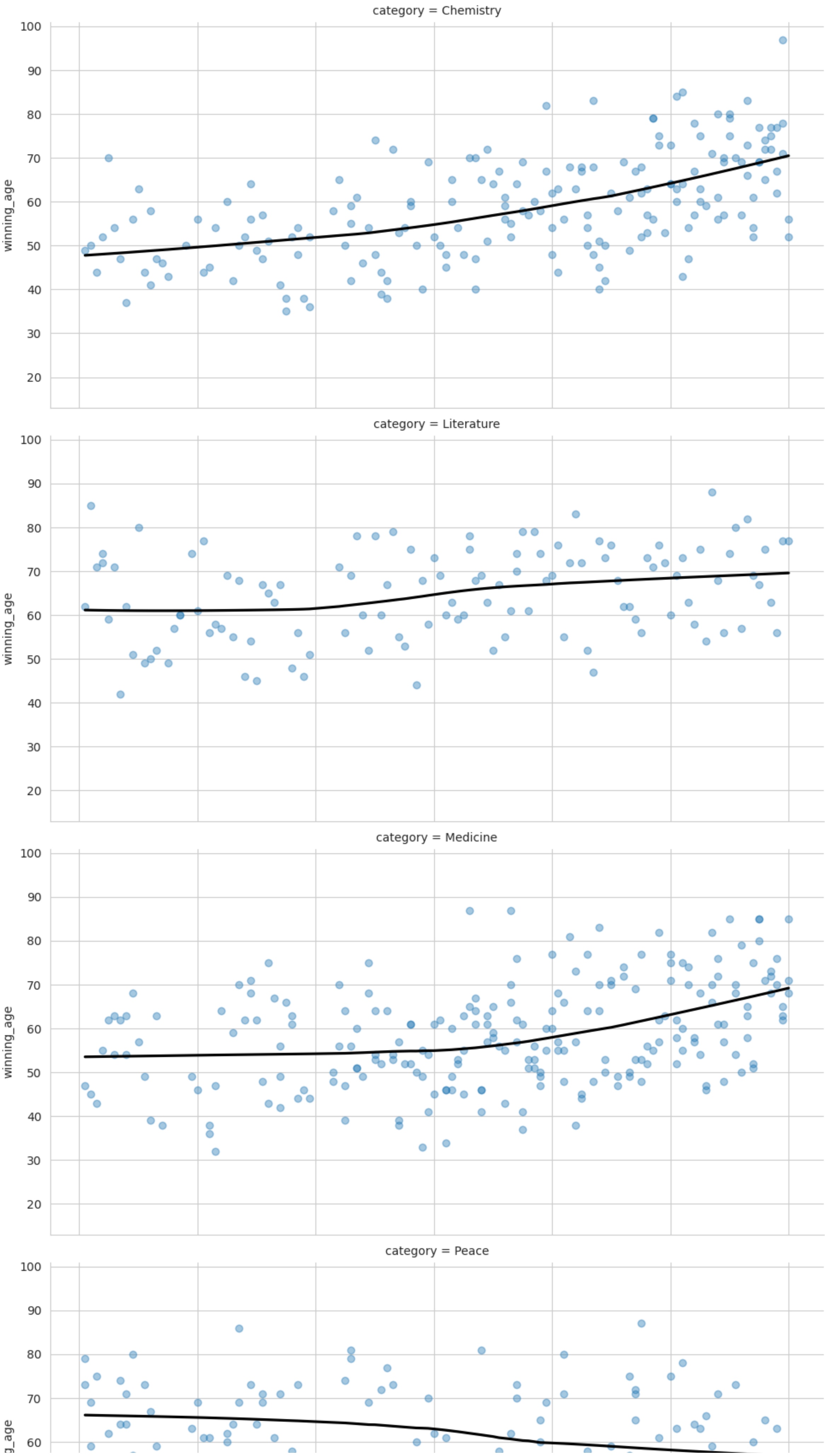
In [119…

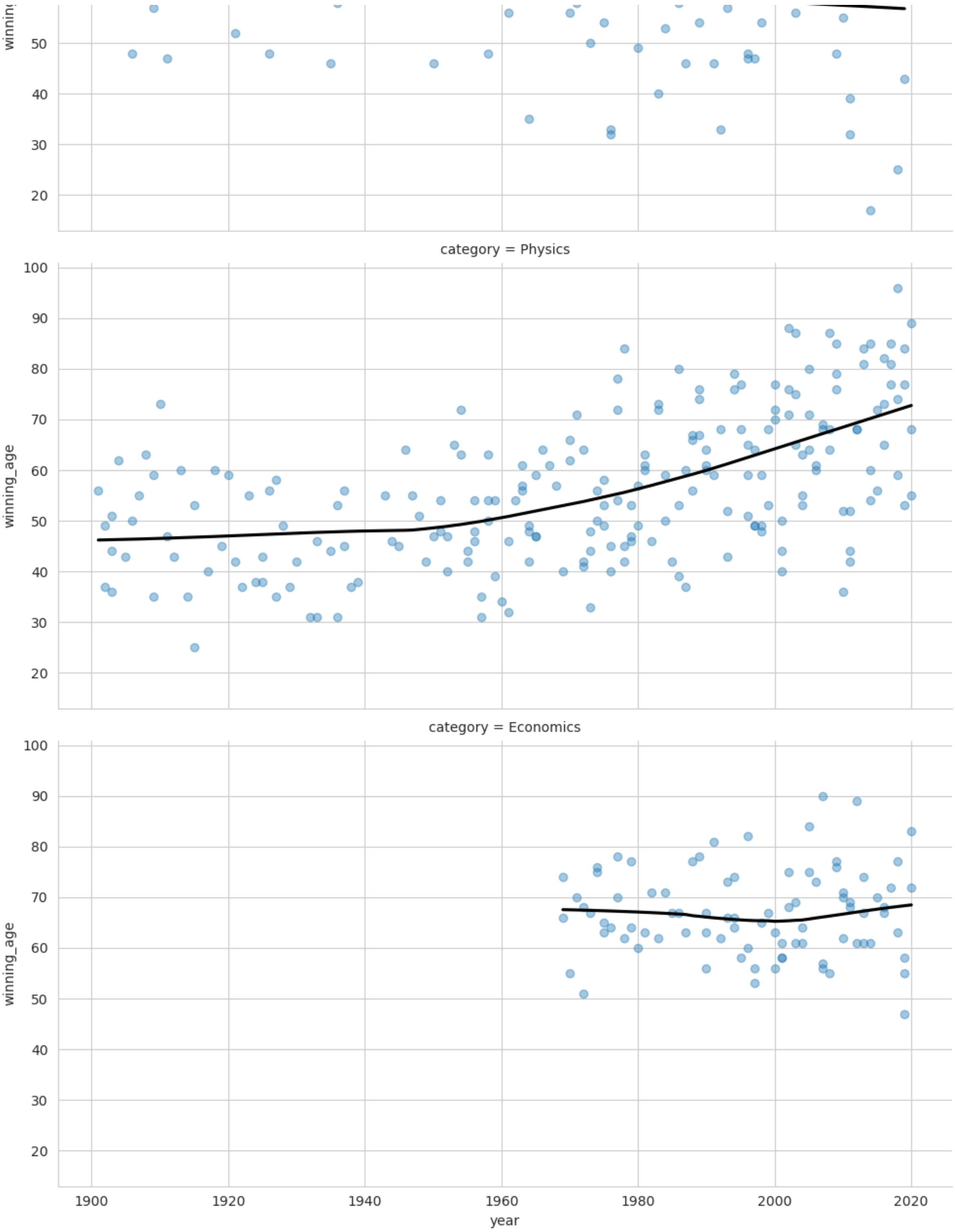
```
with sns.axes_style('whitegrid'):
    sns.lmplot(
        data=df,
        x='year',
        y='winning_age',
        hue='category',
        lowess=True,
        line_kws={'linewidth':5},
        scatter_kws={'alpha':0.4},
        aspect=2
    )
plt.show()
```



In [120…

```
with sns.axes_style('whitegrid'):
    sns.lmplot(data=df,
               x='year',
               y='winning_age',
               row='category',
               lowess=True,
               line_kws={'color':'black'},
               scatter_kws={'alpha':0.4},
               aspect=2
    )
plt.show()
```


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



We see that winners in physics, chemistry, and medicine have gotten older over time.

- The ageing trend is strongest for physics. The average age used to be below 50, but now it's over 70.
- Economics, the newest category, is much more stable in comparison.
- The peace prize shows the opposite trend where winners are getting younger!

As such, our scatter plots showing the best fit lines over time and our box plot of the entire dataset can tell very different stories!