

▼ Data Visualization

Project 1

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```
import pandas as pd
import plotly.express as px

income = pd.read_csv("gdp_pcap.csv")
babiesPerWoman = pd.read_csv("children_per_woman_total_fertility.csv")
population = pd.read_csv("pop.csv")
literacyRate = pd.read_csv("literacy_rate_adult.csv")
lifeExpectancy = pd.read_csv("lex.csv")
fertilityRate = pd.read_csv("sp_dyn_tfrt_in.csv")
```

income

	country	1800	1801	1802	1803	1804	1805	1806	1807	1808	...	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
0	Afghanistan	583	583	583	583	583	583	583	583	583	...	3570	3700	3720	3830	3930	4030	4130	3900	4070	4030
1	Angola	452	454	456	458	460	462	464	466	468	...	20.6k	21.1k	21.7k	21.9k	22.3k	22.5k	23k	23.5k	24k	24.6k
2	Albania	569	571	572	574	576	577	579	581	582	...	37.6k	38.5k	39.4k	39.9k	40.9k	41.9k	41.4k	42.4k	43.7k	45.7k
3	Andorra	1660	1660	1670	1670	1670	1680	1680	1680	1690	...	59.2k	60k	60.3k	61k	61.7k	62.7k	61.9k	62.5k	62.9k	62.1k
4	UAE	1390	1390	1390	1400	1410	1410	1420	1420	1430	...	86.2k	85.4k	84.1k	84.3k	84.6k	83.9k	84.2k	84k	84.1k	84.3k
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
190	Samoa	1940	1940	1940	1940	1940	1940	1940	1950	1950	...	12.6k	12.9k	13.3k	13.6k	13.9k	14.3k	14.7k	14.7k	15.6k	16k
191	Yemen	1220	1230	1230	1230	1240	1240	1240	1250	1250	...	4680	4620	4680	4880	5060	5260	5370	5490	5610	5730
192	South Africa	2120	2100	2070	2050	2030	1920	1920	2080	1820	...	36.5k	37.3k	38.1k	39k	39.6k	40.2k	40.9k	41.6k	42.1k	42.7k
193	Zambia	646	648	650	651	653	654	656	658	659	...	10.6k	10.9k	10.8k	11.1k	11.4k	11.7k	12k	12.3k	12.5k	12.8k
194	Zimbabwe	1170	1170	1170	1170	1170	1170	1180	1180	1180	...	5970	6190	6360	6570	6600	6750	6890	7080	7200	7380

195 rows × 302 columns

babiesPerWoman

	country	1800	1801	1802	1803	1804	1805	1806	1807	1808	...	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
0	Aruba	5.64	5.64	5.64	5.64	5.64	5.64	5.64	5.64	5.64	...	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.82	1.83	1.83
1	Afghanistan	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	...	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74	1.74
2	Angola	6.93	6.93	6.93	6.93	6.93	6.93	6.93	6.94	6.94	...	2.54	2.52	2.50	2.48	2.47	2.45	2.43	2.42	2.40	2.40
3	Albania	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	4.60	...	1.78	1.78	1.78	1.79	1.79	1.79	1.79	1.79	1.79	1.79
4	Netherlands Antilles	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	5.80	...	2.00	2.00	2.01	2.01	2.01	2.01	2.01	2.02	2.02	2.02
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
197	Samoa	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	6.98	...	2.10	2.09	2.08	2.07	2.06	2.05	2.04	2.03	2.02	2.02
198	Yemen	6.88	6.88	6.88	6.88	6.88	6.88	6.88	6.88	6.88	...	1.68	1.68	1.69	1.69	1.69	1.69	1.70	1.70	1.70	1.70
199	South Africa	6.47	6.47	6.47	6.47	6.47	6.47	6.47	6.47	6.47	...	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80
200	Zambia	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	6.71	...	2.59	2.57	2.56	2.54	2.53	2.51	2.50	2.48	2.46	2.46
201	Zimbabwe	6.75	6.75	6.75	6.75	6.75	6.75	6.75	6.75	6.75	...	1.85	1.85	1.85	1.84	1.84	1.84	1.83	1.83	1.83	1.83

202 rows × 302 columns

population

	country	1800	1801	1802	1803	1804	1805	1806	1807	1808	...	2091	2092	2093	2094	2095	2096	2097	2098
0	Afghanistan	3.28M	3.28M	3.28M	3.28M	3.28M	3.28M	3.28M	3.28M	3.28M	...	108M	108M	109M	109M	109M	110M	110M	110M
1	Angola	1.57M	1.57M	1.57M	1.57M	1.57M	1.57M	1.57M	1.57M	1.57M	...	125M	126M	127M	128M	129M	130M	131M	131M
2	Albania	400k	402k	404k	405k	407k	409k	411k	413k	414k	...	1.35M	1.32M	1.29M	1.26M	1.23M	1.21M	1.18M	1.15M
3	Andorra	2650	2650	2650	2650	2650	2650	2650	2650	2650	...	62.5k	62.2k	61.9k	61.7k	61.4k	61.2k	60.9k	60.7k
4	UAE	40.2k	40.2k	40.2k	40.2k	40.2k	40.2k	40.2k	40.2k	40.2k	...	13.5M	13.5M	13.6M	13.7M	13.8M	13.8M	13.9M	14M
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
192	Samoa	47.3k	47.3k	47.3k	47.3k	47.3k	47.3k	47.3k	47.2k	47.2k	...	432k	434k	435k	436k	437k	438k	439k	440k
193	Yemen	2.59M	2.59M	2.59M	2.59M	2.59M	2.59M	2.59M	2.59M	2.59M	...	73.2M	73.3M	73.5M	73.6M	73.7M	73.8M	73.9M	74M
194	South Africa	1.45M	1.45M	1.46M	1.46M	1.47M	1.47M	1.48M	1.49M	1.49M	...	75.6M	75.5M	75.4M	75.3M	75.2M	75.1M	75M	74.8M
195	Zambia	747k	758k	770k	782k	794k	806k	818k	831k	843k	...	60.3M	60.7M	61.1M	61.5M	61.9M	62.2M	62.6M	62.9M
196	Zimbabwe	1.68M	1.68M	1.68M	1.68M	1.68M	1.68M	1.68M	1.68M	1.68M	...	65.4M	65.6M	65.8M	65.9M	65.9M	65.9M	65.9M	65.9M

literacyRate

	country	1975	1976	1977	1978	1979	1980	1981	1982	1983	...	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
0	Aruba	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	96.8	NaN
1	Afghanistan	NaN	NaN	NaN	NaN	18.2	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	39.0
2	Angola	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	70.4
3	Anguilla	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
4	Albania	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	95.9	NaN	NaN	96.8
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
151	Samoa	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	98.5	NaN	NaN	NaN	NaN	NaN	NaN	98.8
152	Yemen	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	54.8	NaN	NaN	NaN	NaN	NaN	NaN	65.3
153	South Africa	NaN	NaN	NaN	NaN	NaN	76.2	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	88.7	NaN	NaN	NaN	93.0
154	Zambia	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	69.2	NaN	NaN	NaN	NaN	61.4	NaN	NaN	NaN	NaN
155	Zimbabwe	NaN	NaN	NaN	NaN	NaN	NaN	NaN	77.8	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	83.6

156 rows × 38 columns

lifeExpectancy

	country	1800	1801	1802	1803	1804	1805	1806	1807	1808	...	2091	2092	2093	2094	2095	2096	2097	2098	2099	2100
0	Afghanistan	28.2	28.2	28.2	28.2	28.2	28.2	28.1	28.1	28.1	...	75.5	75.7	75.8	76.0	76.1	76.2	76.4	76.5	76.6	76.8
1	Angola	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	27.0	...	78.8	79.0	79.1	79.2	79.3	79.5	79.6	79.7	79.9	80.0
2	Albania	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	35.4	...	87.4	87.5	87.6	87.7	87.8	87.9	88.0	88.2	88.3	88.4
3	Andorra	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
4	UAE	30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7	30.7	...	82.4	82.5	82.6	82.7	82.8	82.9	83.0	83.1	83.2	83.3
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
190	Samoa	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	...	79.8	79.9	80.0	80.1	80.3	80.4	80.5	80.6	80.7	80.8
191	Yemen	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	23.4	...	76.9	77.0	77.1	77.3	77.4	77.5	77.6	77.8	77.9	78.0
192	South Africa	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	33.5	...	76.4	76.5	76.7	76.8	77.0	77.1	77.3	77.4	77.5	77.7
193	Zambia	32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6	32.6	...	75.8	76.0	76.1	76.3	76.4	76.5	76.7	76.8	77.0	77.1
194	Zimbabwe	33.7	33.7	33.7	33.7	33.7	33.7	33.7	33.7	33.7	...	73.3	73.4	73.5	73.7	73.8	73.9	74.0	74.2	74.3	74.4

195 rows × 302 columns

fertilityRate

	country	1960	1961	1962	1963	1964	1965	1966	1967	1968	...	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
0	Aruba	4.82	4.66	4.47	4.27	4.06	3.84	3.63	3.42	3.23	...	1.78	1.79	1.81	1.83	1.85	1.87	1.89	1.90	1.90	1.90
1	Afghanistan	7.45	7.45	7.45	7.45	7.45	7.45	7.45	7.45	7.45	...	5.77	5.56	5.36	5.16	4.98	4.80	4.63	4.47	4.32	4.18
2	Angola	6.71	6.79	6.87	6.95	7.04	7.12	7.19	7.27	7.33	...	6.12	6.04	5.95	5.86	5.77	5.69	5.60	5.52	5.44	5.37
3	Albania	6.49	6.40	6.28	6.13	5.96	5.77	5.58	5.39	5.22	...	1.67	1.68	1.69	1.69	1.68	1.66	1.64	1.62	1.60	1.58
4	Andorra	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	...	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
203	Samoa	7.65	7.64	7.63	7.60	7.57	7.52	7.46	7.40	7.33	...	4.28	4.21	4.15	4.09	4.03	3.98	3.93	3.88	3.83	3.79
204	Yemen	7.94	7.96	7.99	8.03	8.07	8.11	8.17	8.22	8.28	...	4.55	4.44	4.33	4.21	4.10	3.99	3.89	3.79	3.70	3.61
205	South Africa	6.04	6.03	6.01	5.99	5.96	5.92	5.88	5.83	5.78	...	2.58	2.56	2.54	2.51	2.48	2.46	2.43	2.40	2.38	2.36

```
income = income.melt(id_vars=['country'], var_name='Year', value_name='income')
babiesPerWoman = babiesPerWoman.melt(id_vars=['country'], var_name='Year', value_name='babiesPerWoman')
population = population.melt(id_vars=['country'], var_name='Year', value_name='population')
literacyRate = literacyRate.melt(id_vars=['country'], var_name='Year', value_name='literacyRate')
lifeExpectancy = lifeExpectancy.melt(id_vars=['country'], var_name='Year', value_name='lifeExpectancy')
fertilityRate = fertilityRate.melt(id_vars=['country'], var_name='Year', value_name='fertilityRate')
```

```
income = income.sort_values(by=['country', 'Year']).reset_index(drop=True)
babiesPerWoman = babiesPerWoman.sort_values(by=['country', 'Year']).reset_index(drop=True)
population = population.sort_values(by=['country', 'Year']).reset_index(drop=True)
literacyRate = literacyRate.sort_values(by=['country', 'Year']).reset_index(drop=True)
lifeExpectancy = lifeExpectancy.sort_values(by=['country', 'Year']).reset_index(drop=True)
fertilityRate = fertilityRate.sort_values(by=['country', 'Year']).reset_index(drop=True)
```

income



	country	Year	income
0	Afghanistan	1800	583
1	Afghanistan	1801	583
2	Afghanistan	1802	583
3	Afghanistan	1803	583
4	Afghanistan	1804	583
...	...	...	...
58690	Zimbabwe	2096	6750
58691	Zimbabwe	2097	6890
58692	Zimbabwe	2098	7080
58693	Zimbabwe	2099	7200
58694	Zimbabwe	2100	7380

58695 rows × 3 columns

babiesPerWoman



	country	Year	babiesPerWoman	
0	Afghanistan	1800	7.00	
1	Afghanistan	1801	7.00	

population

	country	Year	population	
0	Afghanistan	1800	3.28M	
1	Afghanistan	1801	3.28M	
2	Afghanistan	1802	3.28M	
3	Afghanistan	1803	3.28M	
4	Afghanistan	1804	3.28M	
...	...	...	...	
59292	Zimbabwe	2096	35.5M	
59293	Zimbabwe	2097	35.5M	
59294	Zimbabwe	2098	35.6M	
59295	Zimbabwe	2099	35.6M	
59296	Zimbabwe	2100	35.6M	

59297 rows × 3 columns

literacyRate

	country	Year	literacyRate	
0	Afghanistan	1975	NaN	
1	Afghanistan	1976	NaN	
2	Afghanistan	1977	NaN	
3	Afghanistan	1978	NaN	
4	Afghanistan	1979	18.2	
...	...	...	...	
5767	Zimbabwe	2007	NaN	
5768	Zimbabwe	2008	NaN	
5769	Zimbabwe	2009	NaN	
5770	Zimbabwe	2010	NaN	
5771	Zimbabwe	2011	83.6	

5772 rows × 3 columns

lifeExpectancy

	country	Year	lifeExpectancy
0	Afghanistan	1960	28.2

	country	Year	fertilityRate
0	Afghanistan	1960	7.45
1	Afghanistan	1961	7.45
2	Afghanistan	1962	7.45
3	Afghanistan	1963	7.45
4	Afghanistan	1964	7.45
...	...	...	...
12683	Zimbabwe	2016	3.80
12684	Zimbabwe	2017	3.71
12685	Zimbabwe	2018	3.62
12686	Zimbabwe	2019	3.53
12687	Zimbabwe	2020	3.46

12688 rows x 3 columns

```
merged = pd.merge(income,babiesPerWoman, on=['country','Year'])
merged = pd.merge(merged,population, on=['country','Year'])
merged = pd.merge(merged,lifeExpectancy, on=['country','Year'])
merged = pd.merge(merged,fertilityRate, on=['country','Year'])
merged = pd.merge(merged,literacyRate, on=['country','Year'])
```

```
country_to_continent = {
    'Afghanistan': 'Asia',
    'Albania': 'Europe',
    'Algeria': 'Africa',
    'Angola': 'Africa',
    'Antigua and Barbuda': 'North America',
    'Argentina': 'South America',
    'Armenia': 'Asia',
    'Azerbaijan': 'Asia',
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'Yemen': 'Asia',
'Zambia': 'Africa',
'Zimbabwe': 'Africa',
}

```

```
merged['continent'] = merged['country'].map(country_to_continent)
```

```

def convertMk(string):
    if string[-1] == 'M':
        string = string.replace("M", "")
        string = float(string)
        string = string * 1000000
    elif string[-1] == 'k':
        string = string.replace("k", "")
        string = float(string)
        string = string * 1000
    elif string[-1] == 'B':
        string = string.replace("B", "")
        string = float(string)
        string = string * 1000000000
    return float(string)

```

```
merged['population'] = merged['population'].astype(str).apply(convertMk)
```

```
merged
```

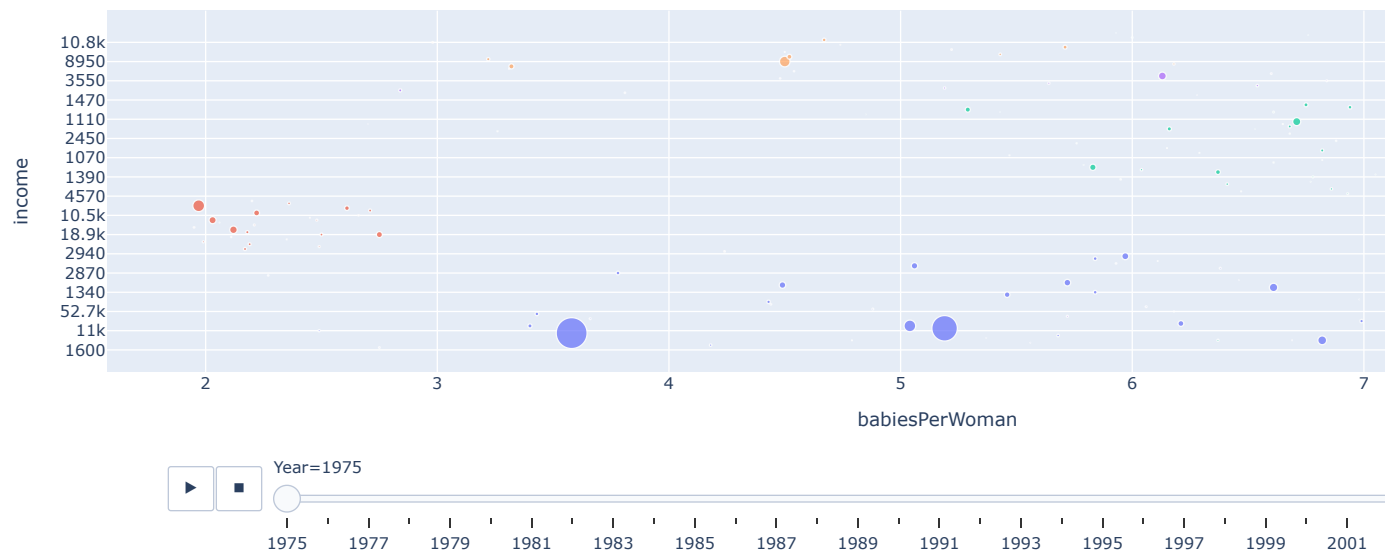
```

country Year income babiesPerWoman population lifeExpectancy fertilityRate literacyRate continent
fig1 = px.scatter(merged, x="babiesPerWoman", y="income", animation_frame="Year", animation_group="country",
                  size="population", hover_name="country",color="continent",
                  title="Decrease of Babies per Woman when Income Increases")

fig1.write_html("Decrease of Babies per Woman when Income Increases.html")
fig1.show()

```

Decrease of Babies per Woman when Income Increases

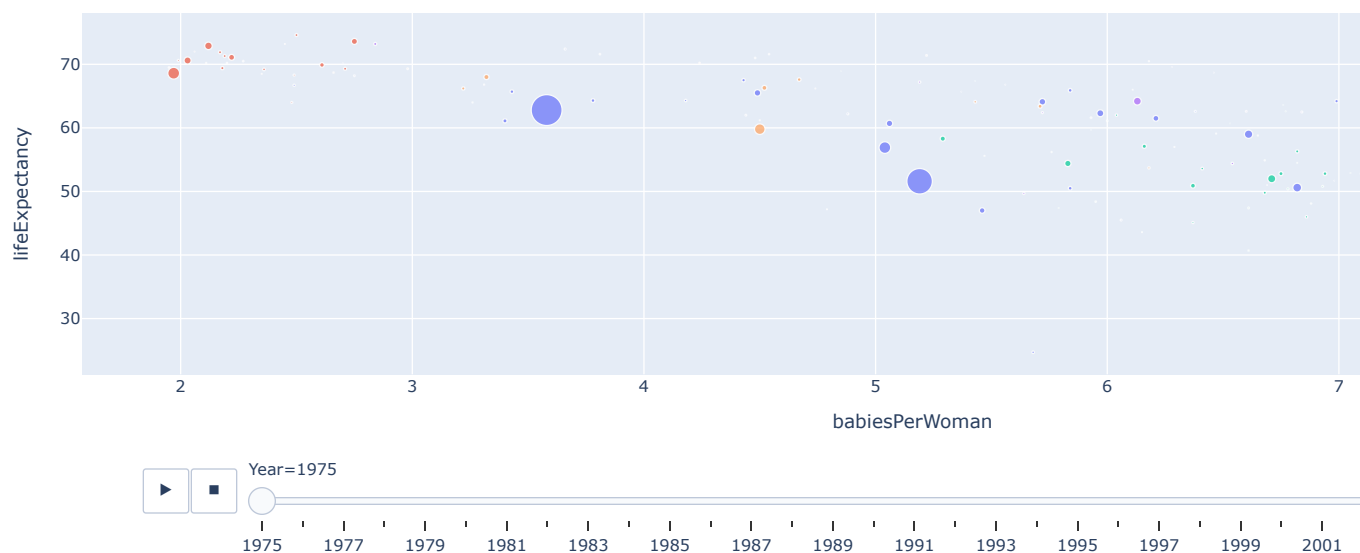


```

fig2 = px.scatter(merged, x="babiesPerWoman", y="lifeExpectancy", animation_frame="Year", animation_group="country",
                  size="population", hover_name="country",color="continent",
                  title="Decrease of Babies per Woman when Life Expectancy Increases")
fig2.write_html("Decrease of Babies per Woman when Life Expectancy Increases.html")
fig2.show()

```

Decrease of Babies per Woman when Life Expectancy Increases



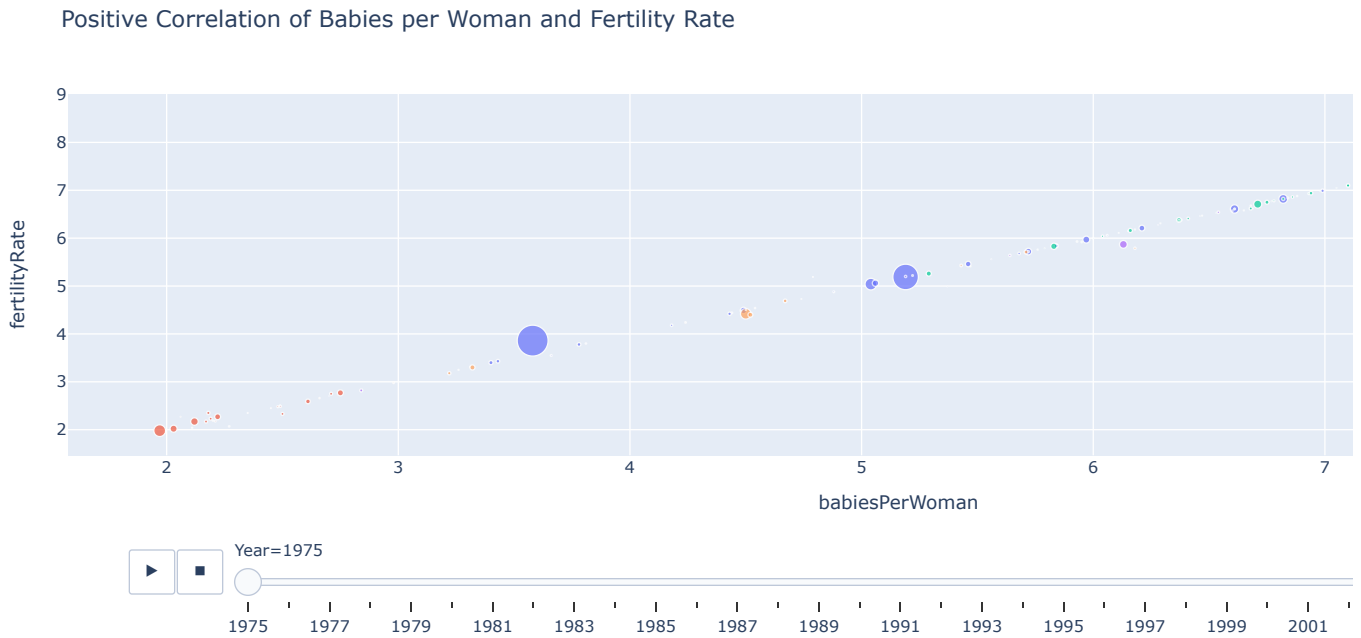
```

fig3 = px.scatter(merged, x="babiesPerWoman", y="fertilityRate", animation_frame="Year", animation_group="country",
                  size="population", hover_name="country",color="continent",
                  title="Positive Correlation of Babies per Woman and Fertility Rate")

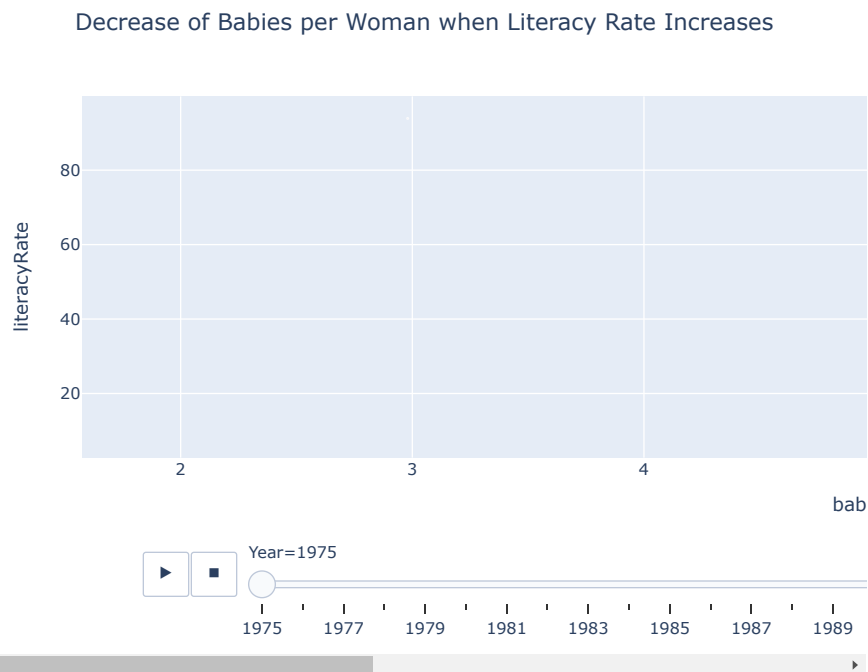
```



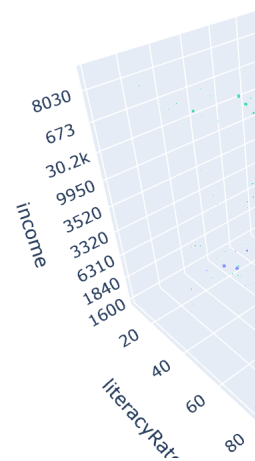
```
fig3.write_html("Positive Correlation of Babies per Woman and Fertility Rate.html")
fig3.show()
```



```
fig4 = px.scatter(merged, x="babiesPerWoman", y="literacyRate", animation_frame="Year", animation_group="country",
                  size="population", hover_name="country", color="continent",
                  title="Decrease of Babies per Woman when Literacy Rate Increases")
fig4.write_html("Decrease of Babies per Woman when Literacy Rate Increases.html")
fig4.show()
```

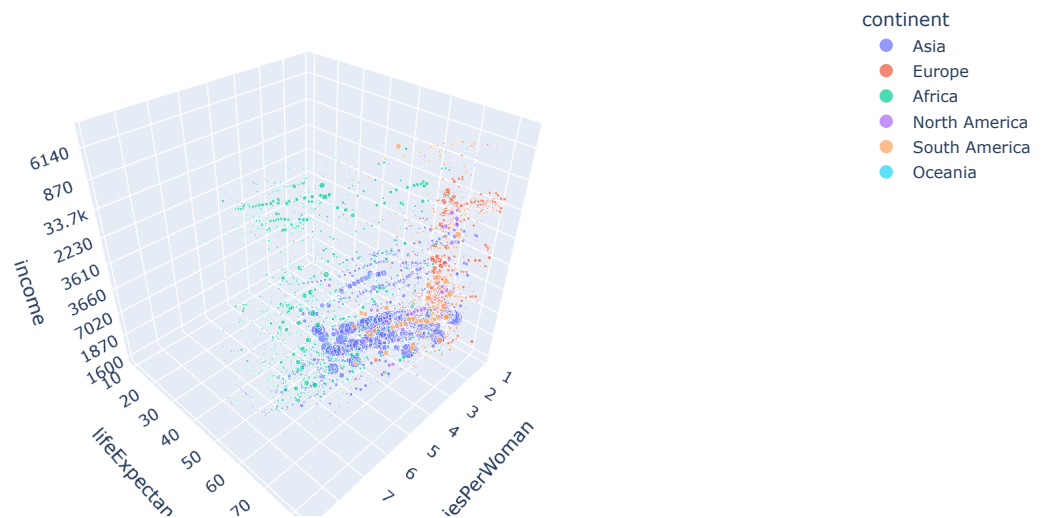


```
fig = px.scatter_3d(merged, x='babiesPerWoman', y='literacyRate', z='income', size='population',
                   color='continent', hover_name="country")
fig.write_html("3d_babiesPerWoman_literacyRate_income.html")
fig.show()
```



We can observe that literacy rate influences the number of babies per woman when compared to income.

```
fig = px.scatter_3d(merged, x='babiesPerWoman', y='lifeExpectancy', z='income',
                    color='continent', hover_name="country", size='population')
fig.write_html("3d_babiesPerWoman_lifeExpectancy_income.html")
fig.show()
```



We can see that the higher the life expectancy and income the less babies are created per woman.

