Patterns over time

EXPLORATORY DATA ANALYSIS IN PYTHON

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Patterns over time

```
divorce = pd.read_csv("divorce.csv")
divorce.head()
```

```
  marriage_date  marriage_duration
0    2000-06-26                5.0
1    2000-02-02                2.0
2    1991-10-09               10.0
3    1993-01-02               10.0
4    1998-12-11                7.0
```

Importing DateTime data

- DateTime data needs to be explicitly declared to Pandas

```
divorce.dtypes
```

```
marriage_date          object
marriage_duration     float64
dtype: object
```

Importing DateTime data

```
divorce = pd.read_csv("divorce.csv", parse_dates=["marriage_date"])
divorce.dtypes
```

```
marriage_date         datetime64[ns]
marriage_duration            float64
dtype: object
```

Converting to DateTime data

- `pd.to_datetime()` converts arguments to DateTime data

```
divorce["marriage_date"] = pd.to_datetime(divorce["marriage_date"])
divorce.dtypes
```

```
marriage_date        datetime64[ns]
marriage_duration           float64
dtype: object
```

Creating DateTime data

```
divorce.head(2)
```

```
   month  day  year  marriage_duration
0      6   26  2000                5.0
1      2    2  2000                2.0
```

```
divorce["marriage_date"] = pd.to_datetime(divorce[["month", "day", "year"]])
divorce.head(2)
```

```
    month  day  year  marriage_duration  marriage_date

 0      6   26  2000                5.0     2000-06-26
 1      2    2  2000                2.0     2000-02-02
```

Creating DateTime data

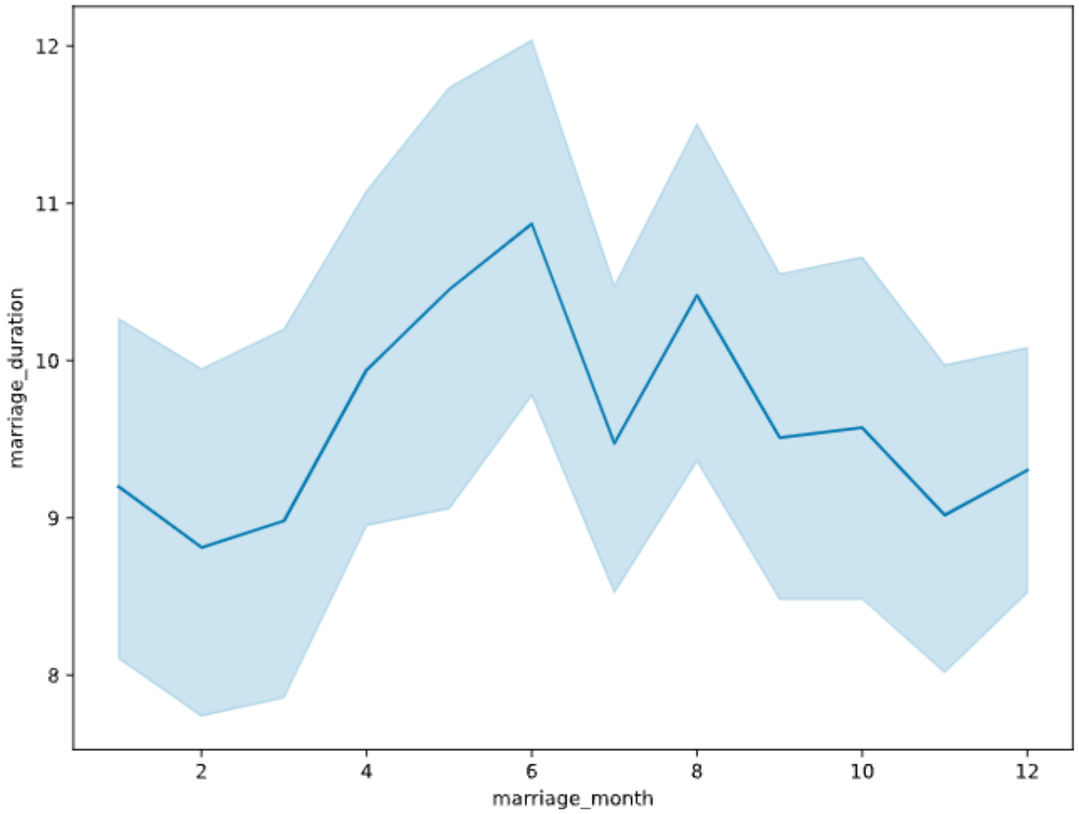
- Extract parts of a full date using `dt.month` , `dt.day` , and `dt.year` attributes

```
divorce["marriage_month"] = divorce["marriage_date"].dt.month
divorce.head()
```

```
   marriage_date  marriage_duration  marriage_month
0     2000-06-26                5.0               6
1     2000-02-02                2.0               2
2     1991-10-09               10.0              10
3     1993-01-02               10.0               1
4     1998-12-11                7.0              12
```

Visualizing patterns over time

```
sns.lineplot(data=divorce, x="marriage_month", y="marriage_duration")
plt.show()
```



Let's practice!

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Correlation

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Correlation

- Describes direction and strength of relationship between two variables
- Can help us use variables to predict future outcomes

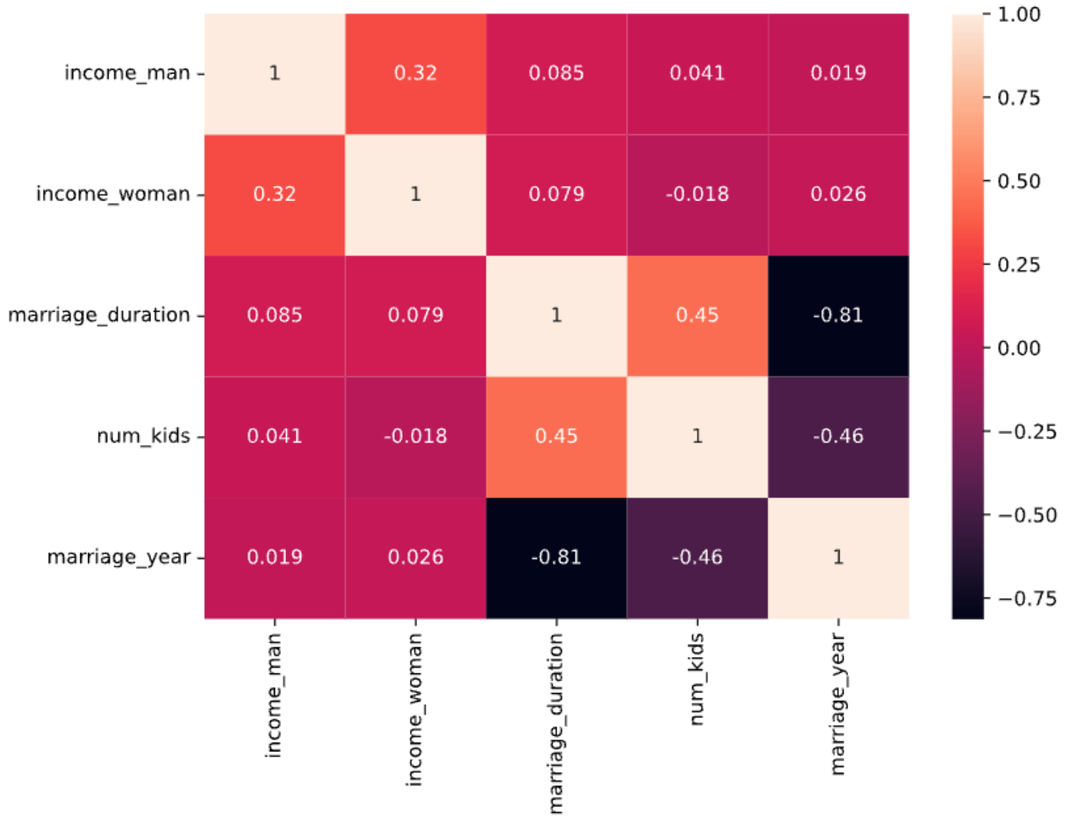
```
divorce.corr()
```

	income_man	income_woman	marriage_duration	num_kids	marriage_year
income_man	1.000	0.318	0.085	0.041	0.019
income_woman	0.318	1.000	0.079	-0.018	0.026
marriage_duration	0.085	0.079	1.000	0.447	-0.812
num_kids	0.041	-0.018	0.447	1.000	-0.461
marriage_year	0.019	0.026	-0.812	-0.461	1.000

- `.corr()` calculates Pearson correlation coefficient, measuring *linear* relationship

Correlation heatmaps

```
sns.heatmap(divorce.corr(), annot=True)
plt.show()
```



Correlation in context

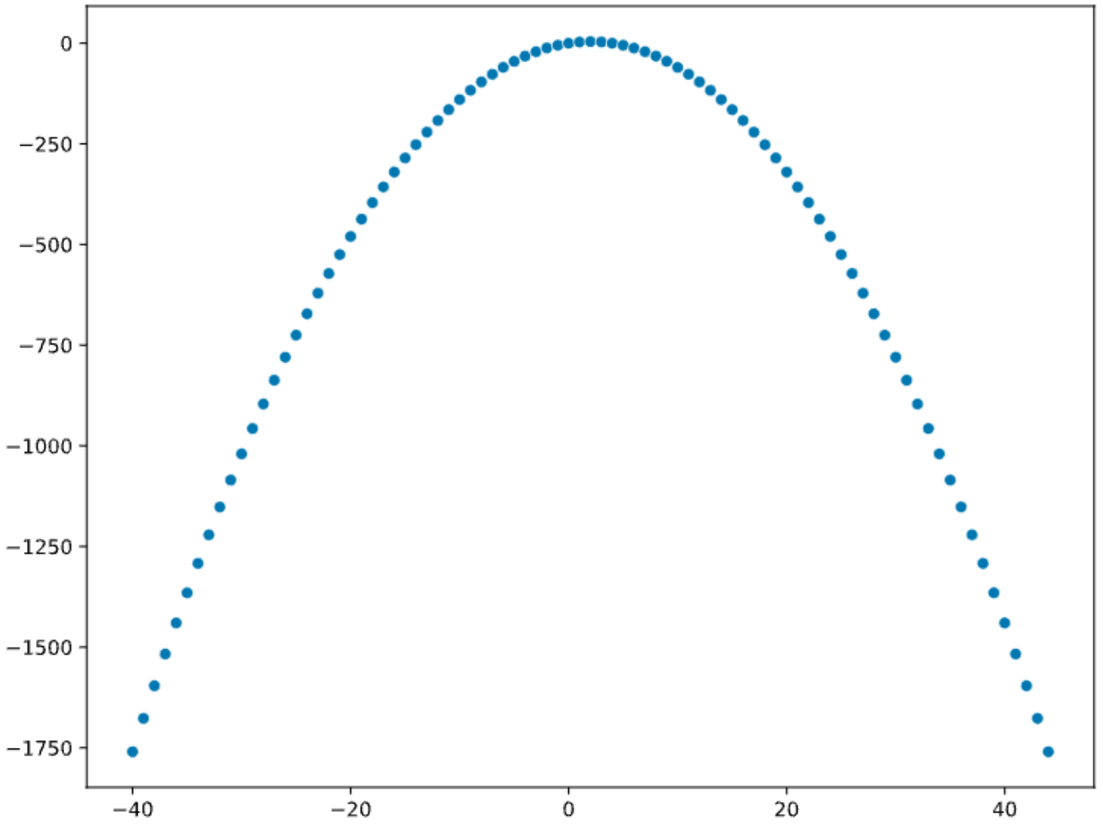
```
divorce["divorce_date"].min()
```

```
Timestamp('2000-01-08 00:00:00')
```

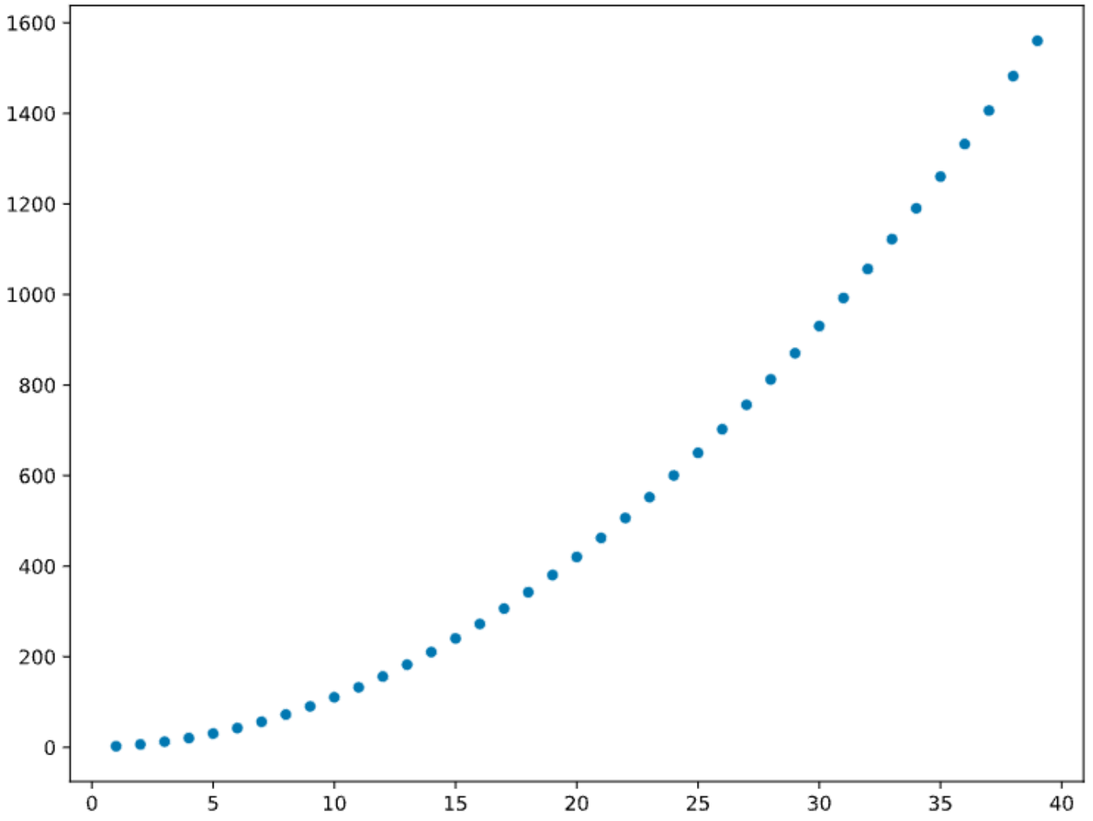
```
divorce["divorce_date"].max()
```

```
Timestamp('2015-11-03 00:00:00')
```

Visualizing relationships



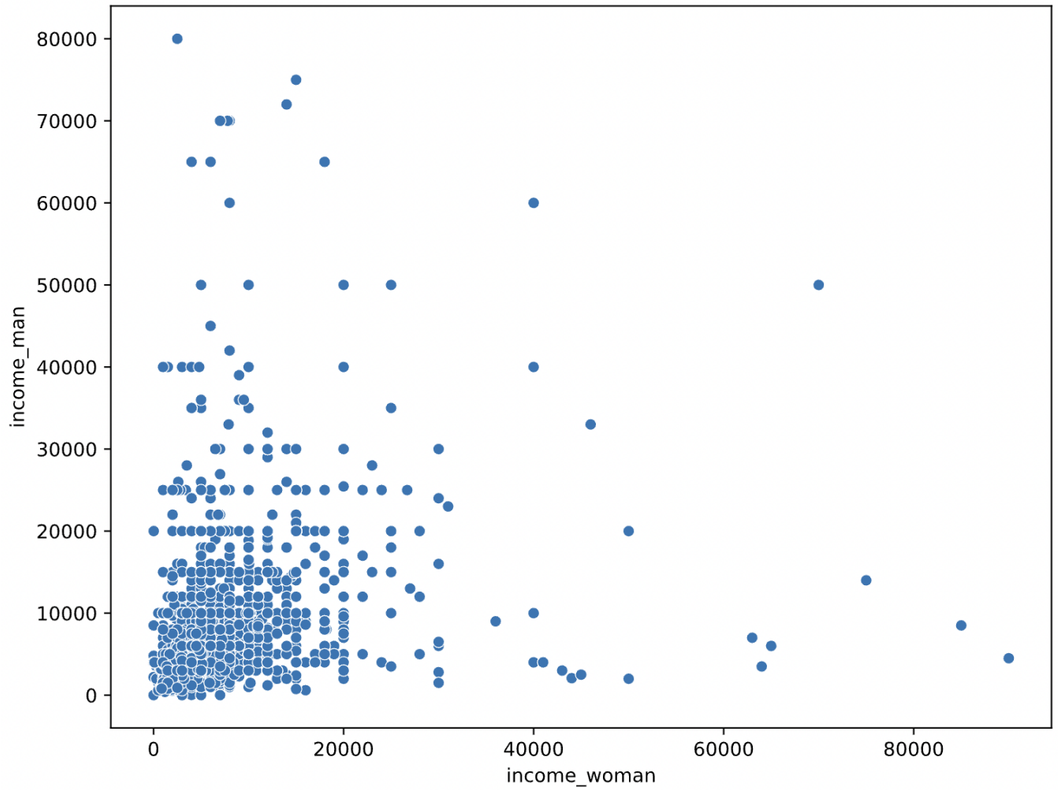
- Strong relationship—but not linear
- Pearson correlation coefficient: `-6.48e-18`



- Quadratic relationship; not linear
- Pearson correlation coefficient: `.971211`

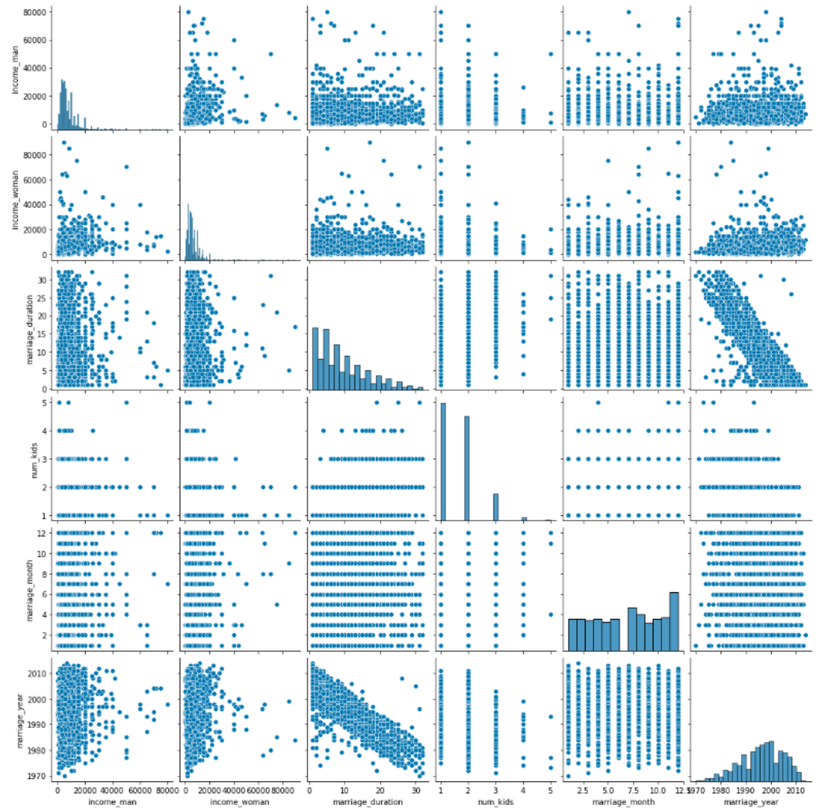
Scatter plots

```
sns.scatterplot(data=divorce, x="income_man", y="income_woman")
plt.show()
```



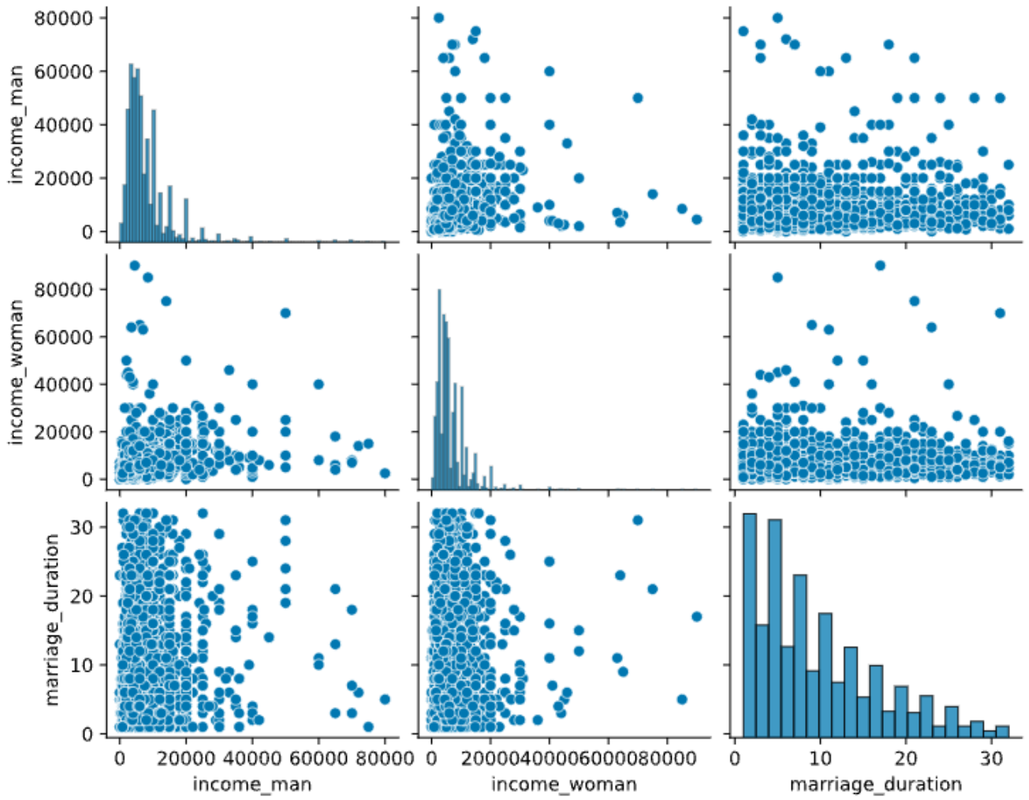
Pairplots

```
sns.pairplot(data=divorce)
plt.show()
```



Pairplots

```
sns.pairplot(data=divorce, vars=["income_man", "income_woman", "marriage_duration"])
plt.show()
```



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Factor relationships and distributions

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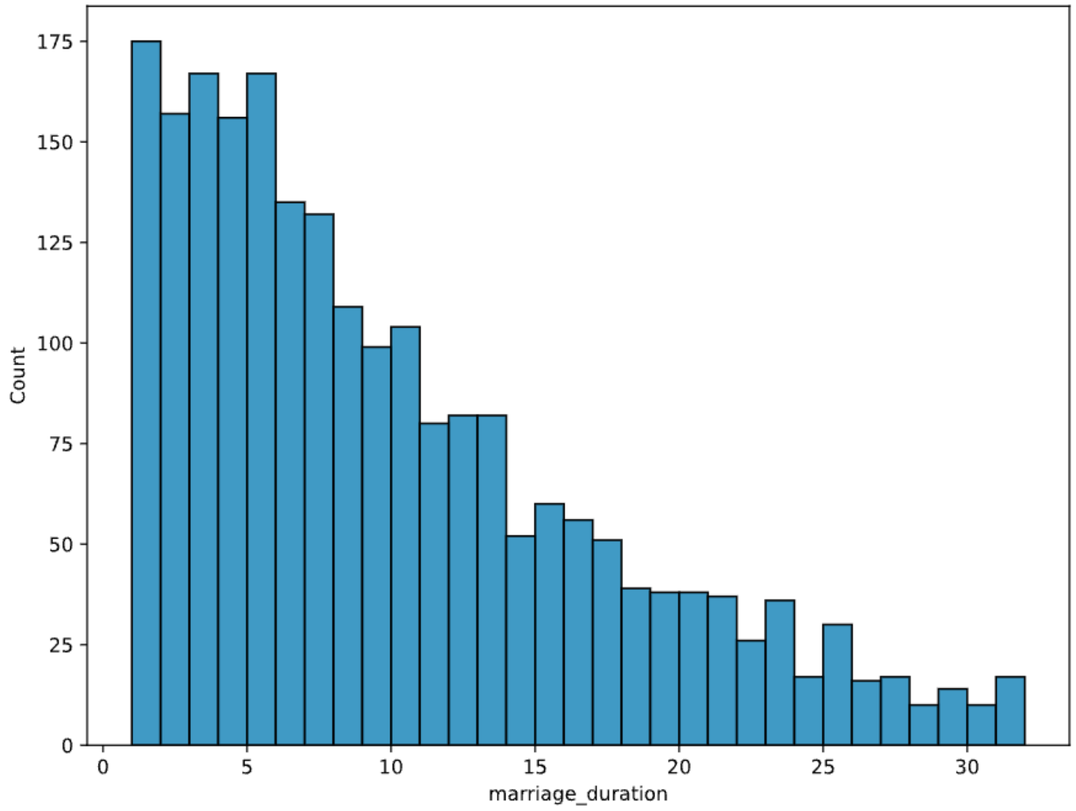
Level of education: male partner

```
divorce["education_man"].value_counts()
```

```
Professional    1313
Preparatory      501
Secondary        288
Primary          100
None               4
Other              3
Name: education_man, dtype: int64
```

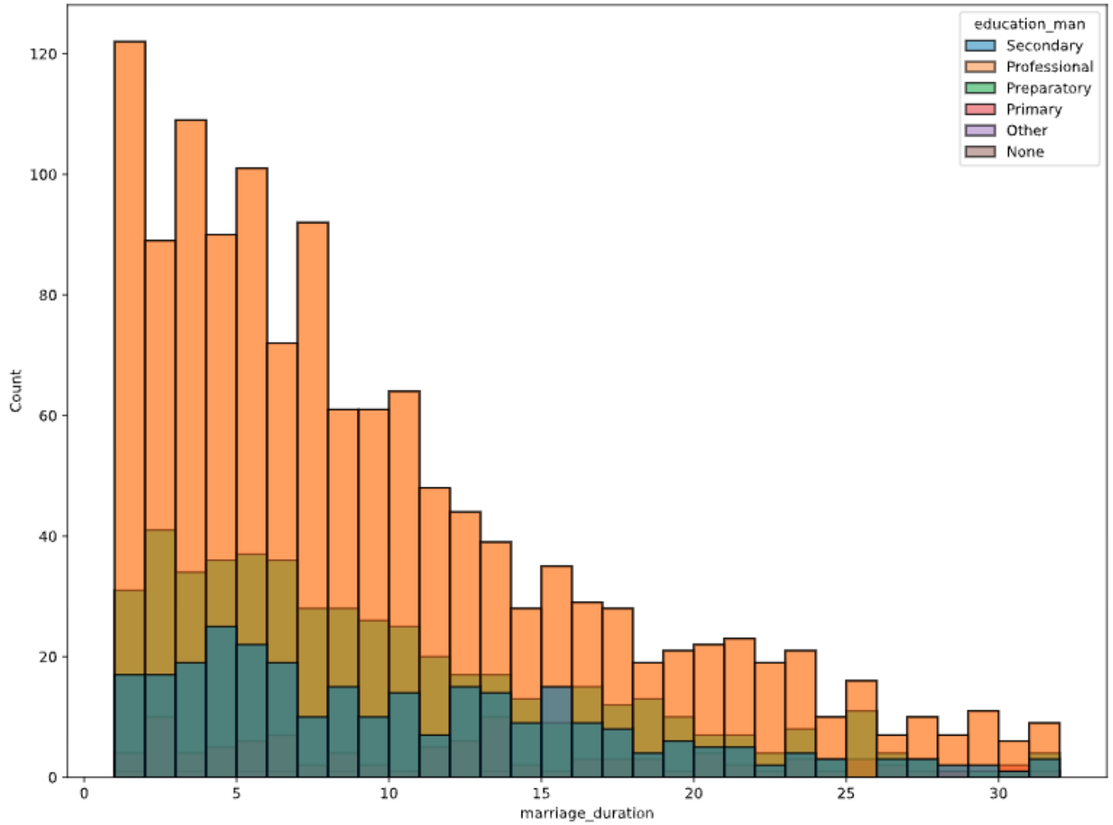
Exploring categorical relationships

```
sns.histplot(data=divorce, x="marriage_duration", binwidth=1)
plt.show()
```



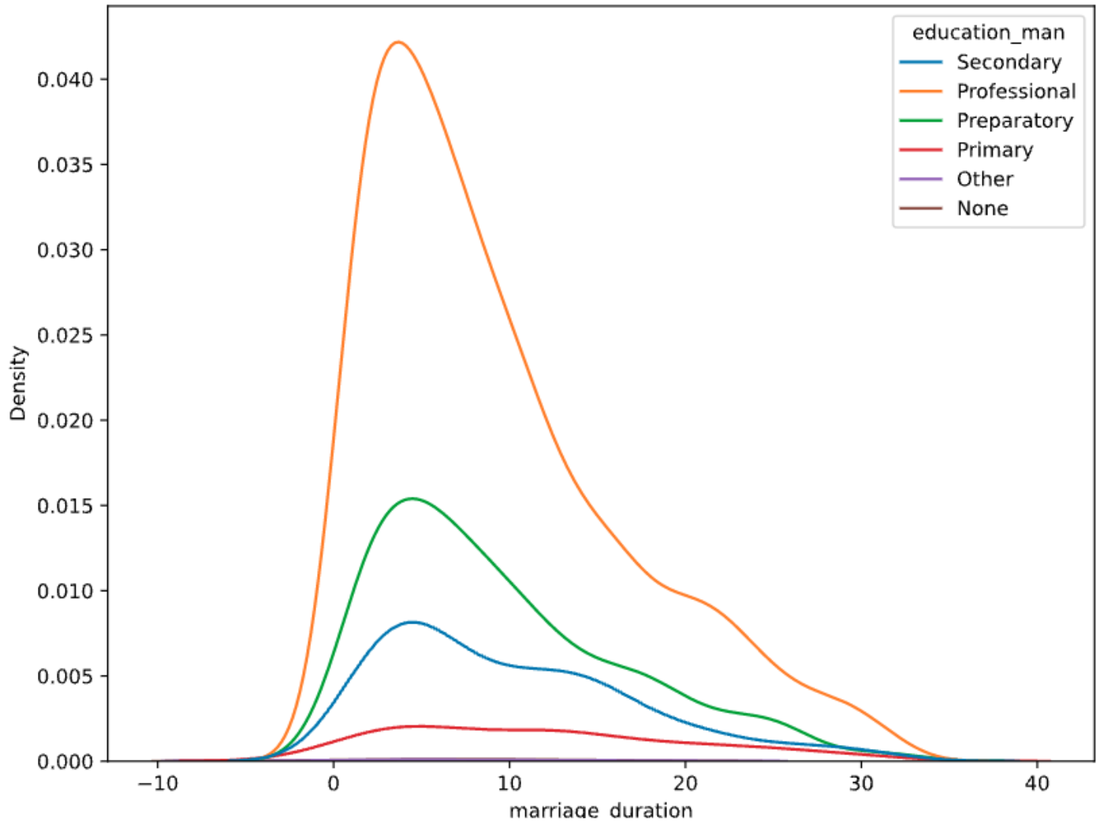
Exploring categorical relationships

```
sns.histplot(data=divorce, x="marriage_duration", hue="education_man", binwidth=1)
plt.show()
```

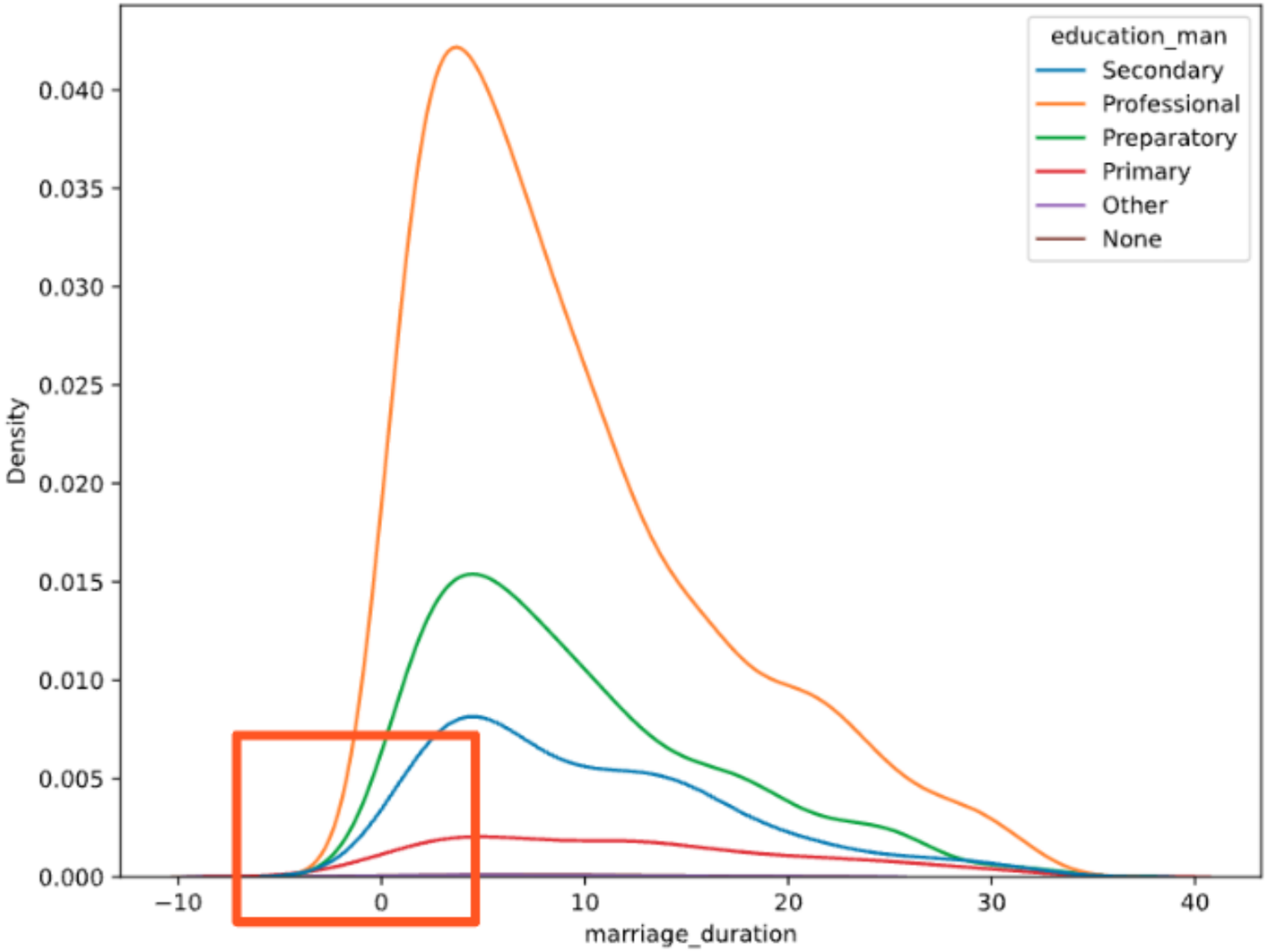


Kernel Density Estimate (KDE) plots

```
sns.kdeplot(data=divorce, x="marriage_duration", hue="education_man")
plt.show()
```

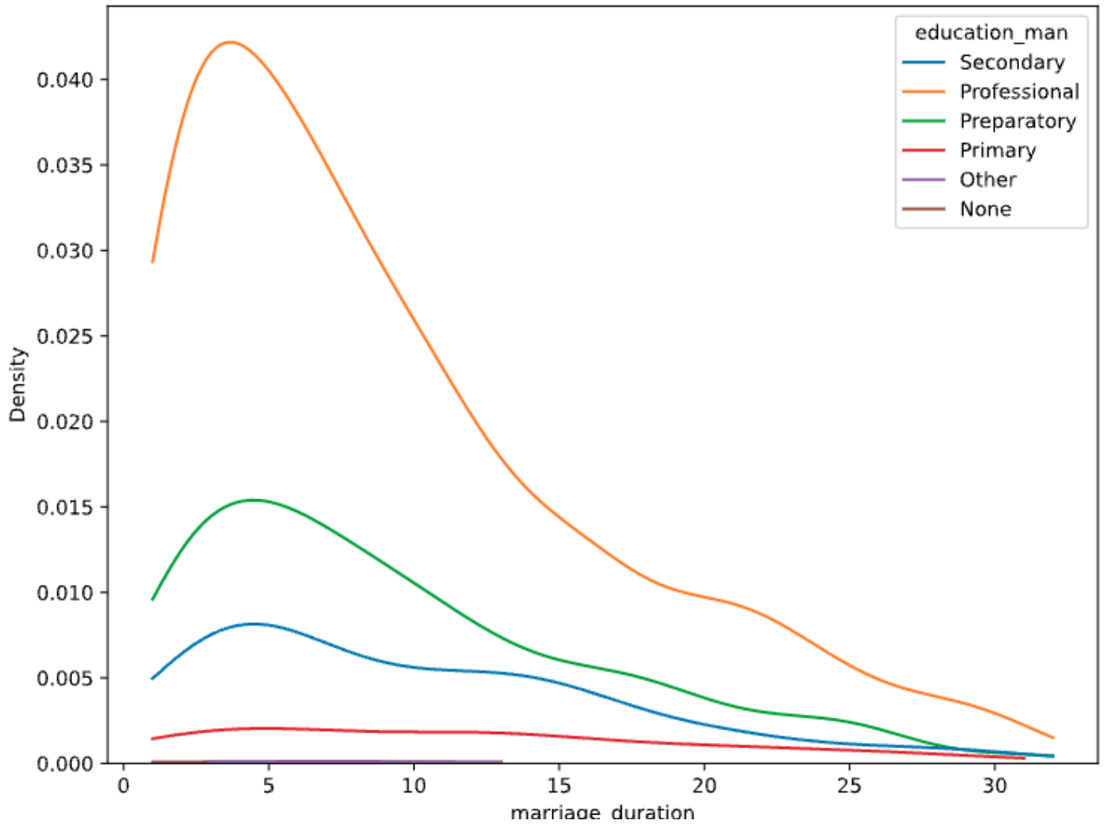


Kernel Density Estimate (KDE) plots



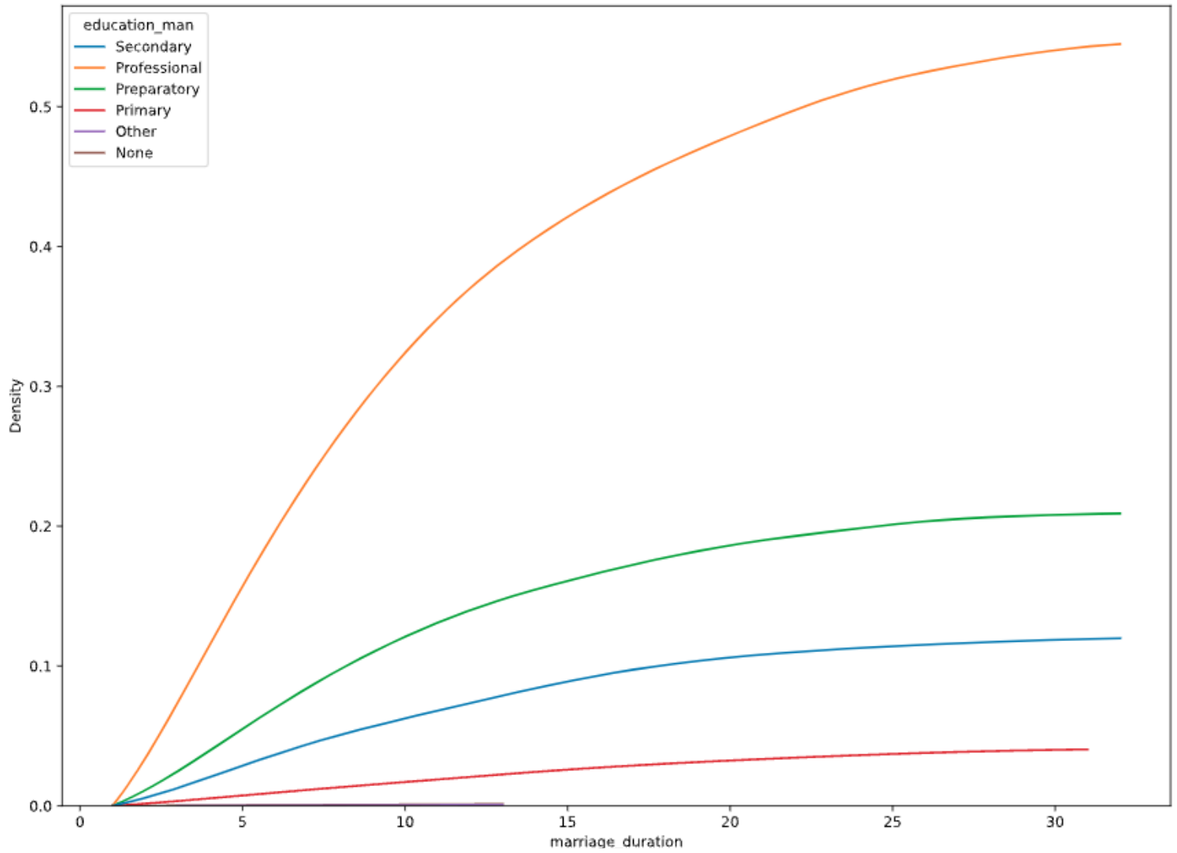
Kernel Density Estimate (KDE) plots

```
sns.kdeplot(data=divorce, x="marriage_duration", hue="education_man", cut=0)
plt.show()
```



Cumulative KDE plots

```
sns.kdeplot(data=divorce, x="marriage_duration", hue="education_man", cut=0, cumulative=True)
plt.show()
```



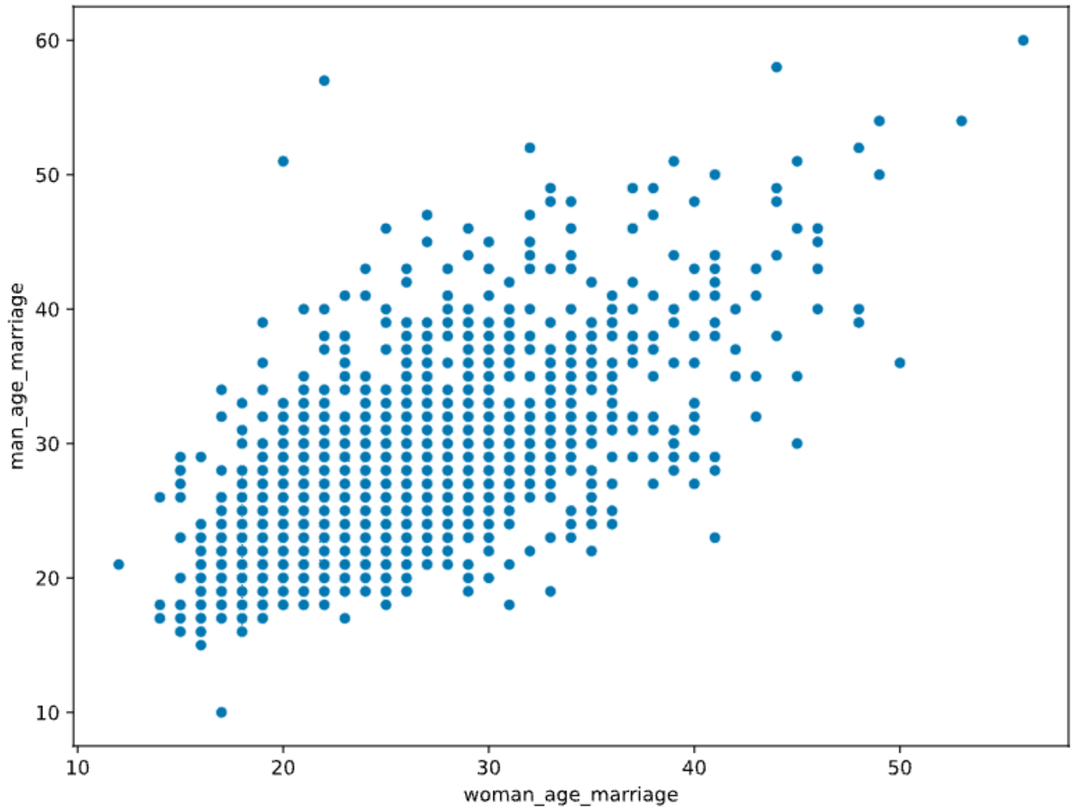
Relationship between marriage age and education

- Is there a relationship between age at marriage and education level?

```
divorce["man_age_marriage"] = divorce["marriage_year"] - divorce["dob_man"].dt.year
divorce["woman_age_marriage"] = divorce["marriage_year"] - divorce["dob_woman"].dt.year
```

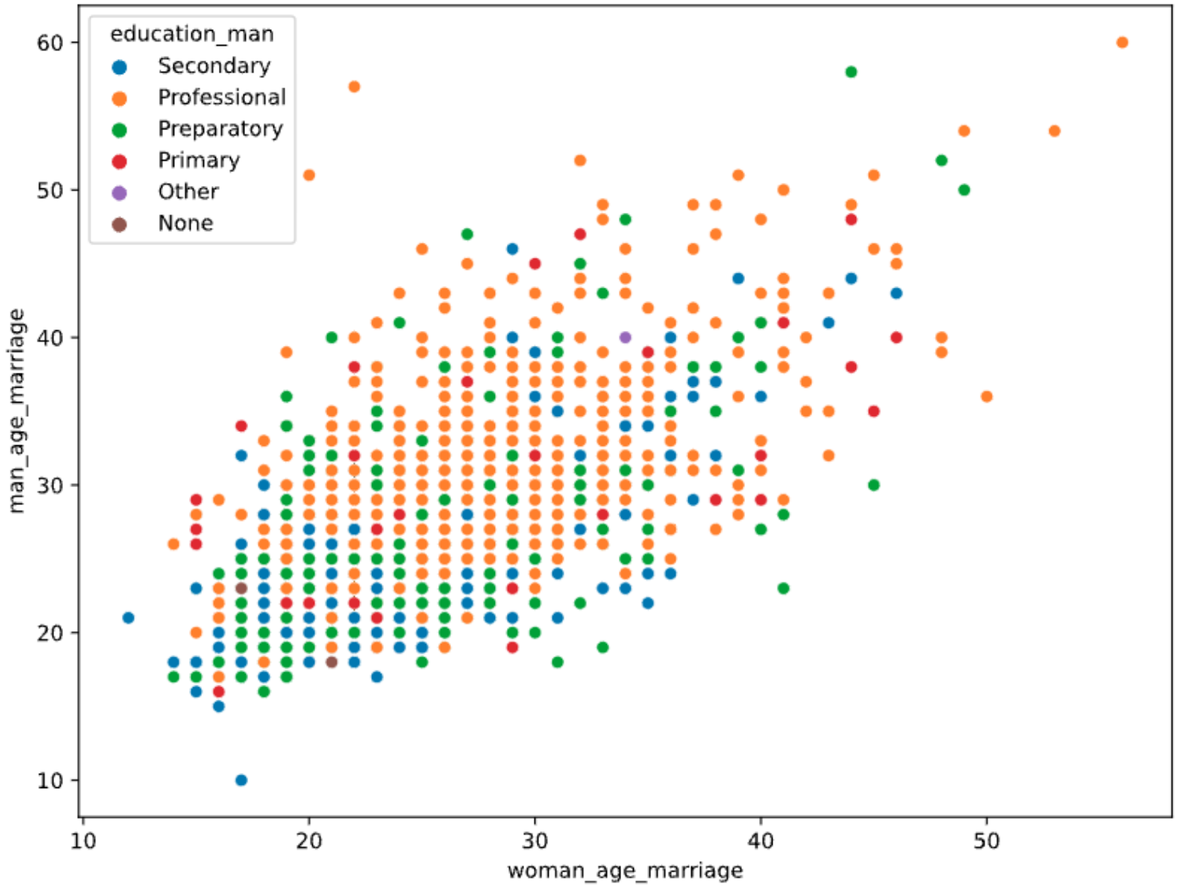
Scatter plot with categorical variables

```
sns.scatterplot(data=divorce, x="woman_age_marriage", y="man_age_marriage")
plt.show()
```



Scatter plot with categorical variables

```
sns.scatterplot(data=divorce,
                x="woman_age_marriage",
                y="man_age_marriage",
                hue="education_man")
plt.show()
```



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