Course Project_Jesse-Jackson_Zigi

February 25, 2024

[1]:
```
import pandas as pd
import matplotlib.pyplot as plt
import plotly.express as px
import seaborn as sns
import numpy as np
from statsmodels.graphics.mosaicplot import mosaic
```

[2]:
```
filename="http://archive.ics.uci.edu/ml/machine-learning-databases/adult/adult.
 ↪data"

df=pd.read_csv(filename,sep=",", header=None, names=['age', 'workclass',␣
 ↪'fnlwgt', 'education', 'education-num', 'marital-status', 'occupation',␣
 ↪'relationship', 'race', 'sex', 'capital-gain', 'capital-loss',␣
 ↪'hours-per-week', 'native-country', 'income'])

# df = df.drop(labels = ['fnlwgt','capital-gain', 'capital-loss',␣
 ↪'hours-per-week'], axis=1)
display(df)
```

	age	workclass	fnlwgt	education	education-num	\
0	39	State-gov	77516	Bachelors	13	
1	50	Self-emp-not-inc	83311	Bachelors	13	
2	38	Private	215646	HS-grad	9	
3	53	Private	234721	11th	7	
4	28	Private	338409	Bachelors	13	
…	…	…	…	…	…	
32556	27	Private	257302	Assoc-acdm	12	
32557	40	Private	154374	HS-grad	9	
32558	58	Private	151910	HS-grad	9	
32559	22	Private	201490	HS-grad	9	
32560	52	Self-emp-inc	287927	HS-grad	9	

	marital-status	occupation	relationship	race	\
0	Never-married	Adm-clerical	Not-in-family	White	
1	Married-civ-spouse	Exec-managerial	Husband	White	
2	Divorced	Handlers-cleaners	Not-in-family	White	
3	Married-civ-spouse	Handlers-cleaners	Husband	Black	
4	Married-civ-spouse	Prof-specialty	Wife	Black	

```
…                    …                  …               …     …
32556   Married-civ-spouse        Tech-support            Wife   White
32557   Married-civ-spouse   Machine-op-inspct         Husband   White
32558              Widowed        Adm-clerical       Unmarried   White
32559        Never-married        Adm-clerical       Own-child   White
32560   Married-civ-spouse     Exec-managerial            Wife   White

           sex  capital-gain  capital-loss  hours-per-week  native-country  \
0         Male          2174             0              40   United-States
1         Male             0             0              13   United-States
2         Male             0             0              40   United-States
3         Male             0             0              40   United-States
4       Female             0             0              40            Cuba
…         …            …             …              …             …
32556   Female             0             0              38   United-States
32557     Male             0             0              40   United-States
32558   Female             0             0              40   United-States
32559     Male             0             0              20   United-States
32560   Female         15024             0              40   United-States

       income
0       <=50K
1       <=50K
2       <=50K
3       <=50K
4       <=50K
…       …
32556   <=50K
32557    >50K
32558   <=50K
32559   <=50K
32560    >50K

[32561 rows x 15 columns]
```

[27]:
```
col = df.columns
for c in col:
    df = df[df[c]!=' ?']
    if all(isinstance(n, str) for n in df[c]):
        df[c] = df[c].str.strip()
races = df['race'].unique()
abbr_races = ['W', 'B', 'API', 'AIE','Oth']
df['race'].replace(races, abbr_races, inplace=True)
```

[28]:
```
edu_mapped = {}
val_map = {}
for index, row in df[['education', 'education-num']].iterrows():
```

```
     edu_mapped[row['education-num']] = row['education']
for val in edu_mapped:
    if val in (5, 6, 7, 8):
        edu_mapped[val] = 'HS-dropout'
        val_map['HS-dropout'] = 6
    if val in (3 , 4):
        edu_mapped[val] = 'MidSch'
        val_map['MidSch-dropout'] = 3
    if val == 2:
        edu_mapped[val] = 'PrimSch'

for index, row in df[['education', 'education-num']].iterrows():
    df.at[index,'education'] = edu_mapped[row['education-num']]
    if row['education'] in val_map.keys():
        df.at[index,'education-num'] = val_map[row['education']]
df.head()
```

[28]:

	age	workclass	fnlwgt	education	education-num	marital-status	occupation	relationship	race	sex	capital-gain	capital-loss	hours-per-week	native-country	income
0	39	State-gov	77516	Bachelors	13	Never-married	Adm-clerical	Not-in-family	W	Male	2174	0	40	United-States	<=50K
1	50	Self-emp-not-inc	83311	Bachelors	13	Married-civ-spouse	Exec-managerial	Husband	W	Male	0	0	13	United-States	<=50K
2	38	Private	215646	HS-grad	9	Divorced	Handlers-cleaners	Not-in-family	W	Male	0	0	40	United-States	<=50K
3	53	Private	234721	HS-dropout	6	Married-civ-spouse	Handlers-cleaners	Husband	B	Male	0	0	40	United-States	<=50K
4	28	Private	338409	Bachelors	13	Married-civ-spouse	Prof-specialty	Wife	B	Female	0	0	40	Cuba	<=50K

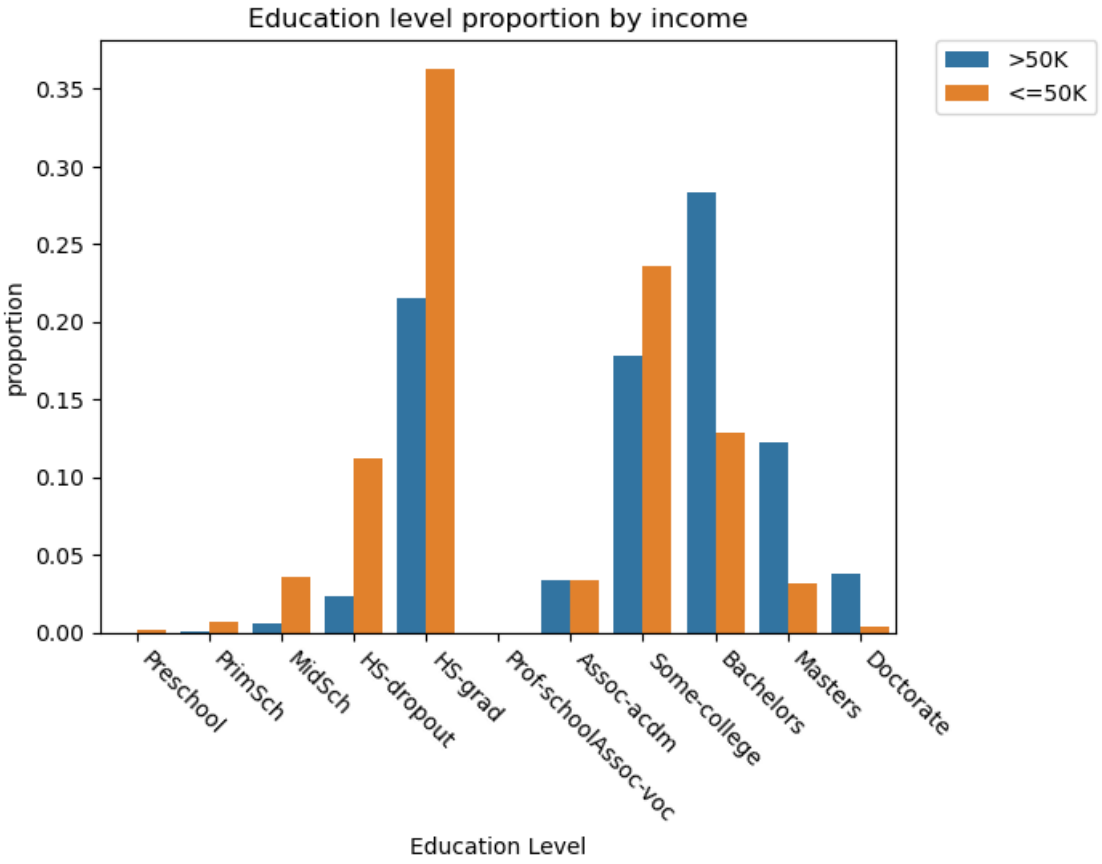
[50]:
```
df_below = df[df['income']=='<=50K']
df_above = df[df['income']=='>50K']
display(df_below)
```

	age	workclass	fnlwgt	education	education-num
0	39	State-gov	77516	Bachelors	13
1	50	Self-emp-not-inc	83311	Bachelors	13
2	38	Private	215646	HS-grad	9
3	53	Private	234721	HS-dropout	6
4	28	Private	338409	Bachelors	13

```
…    …              …      …           …             …
32553   32           Private  116138       Masters            14
32555   22           Private  310152  Some-college            10
32556   27           Private  257302    Assoc-acdm            12
32558   58           Private  151910       HS-grad             9
32559   22           Private  201490       HS-grad             9

           marital-status         occupation   relationship race     sex  \
0           Never-married       Adm-clerical  Not-in-family    W    Male
1      Married-civ-spouse    Exec-managerial        Husband    W    Male
2                Divorced  Handlers-cleaners  Not-in-family    W    Male
3      Married-civ-spouse  Handlers-cleaners        Husband    B    Male
4      Married-civ-spouse     Prof-specialty           Wife    B  Female
…                     …                  …            …  …     …
32553       Never-married       Tech-support  Not-in-family  API    Male
32555       Never-married    Protective-serv  Not-in-family    W    Male
32556  Married-civ-spouse       Tech-support           Wife    W  Female
32558             Widowed       Adm-clerical      Unmarried    W  Female
32559       Never-married       Adm-clerical      Own-child    W    Male

       capital-gain  capital-loss  hours-per-week native-country income
0              2174             0              40  United-States  <=50K
1                 0             0              13  United-States  <=50K
2                 0             0              40  United-States  <=50K
3                 0             0              40  United-States  <=50K
4                 0             0              40           Cuba  <=50K
…               …             …               …              …    …
32553             0             0              11         Taiwan  <=50K
32555             0             0              40  United-States  <=50K
32556             0             0              38  United-States  <=50K
32558             0             0              40  United-States  <=50K
32559             0             0              20  United-States  <=50K

[22654 rows x 15 columns]
```

[30]:
```
below_normalizer = len(df_below['education'])
above_normalizer = len(df_above['education'])

edu_above = df_above.reindex(columns=['education','education-num'])
edu_above = edu_above.groupby('education').count().pipe(lambda x: x/
 ↪above_normalizer)
edu_above = edu_above.reset_index()
edu_above.rename(columns={'education':'Education Level', 'education-num':
 ↪'proportion'}, inplace=True)

edu_below = df_below.reindex(columns=['education','education-num'])
```

```
edu_below = edu_below.groupby('education').count().pipe(lambda x: x/
 ↪below_normalizer)
edu_below = edu_below.reset_index()
edu_below.rename(columns={'education':'Education Level', 'education-num':
 ↪'proportion'}, inplace=True)

edu_above['ds']='>50K'
edu_below['ds']='<=50K'

edu_df = pd.concat([edu_above, edu_below])

ed_lvl_order = ['Preschool','PrimSch', 'MidSch', 'HS-dropout', 'HS-grad',␣
 ↪'Prof-school' 'Assoc-voc', 'Assoc-acdm', 'Some-college', 'Bachelors',␣
 ↪'Masters', 'Doctorate']

sns.barplot(data=edu_df, x='Education Level', y='proportion', hue='ds',␣
 ↪order=ed_lvl_order)

plt.gca().legend(bbox_to_anchor=(1.05, 1),
                         loc='upper left', borderaxespad=0.)
plt.xticks(rotation = 315, ha = 'left')
plt.title('Education level proportion by income')
plt.show()
plt.savefig("Education level proportion by income.png")
display(edu_df)
```

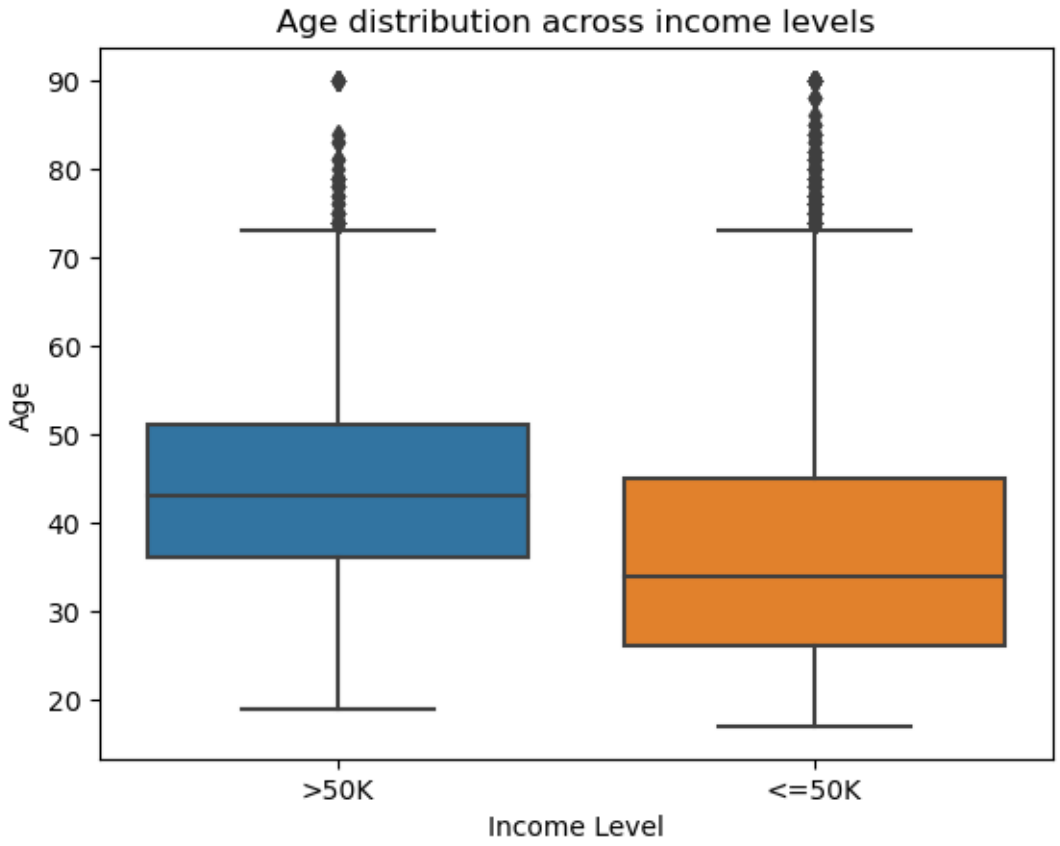


	Education Level	proportion	ds
0	Assoc-acdm	0.034097	>50K
1	Assoc-voc	0.045818	>50K
2	Bachelors	0.283165	>50K
3	Doctorate	0.037294	>50K
4	HS-dropout	0.022909	>50K
5	HS-grad	0.215370	>50K
6	Masters	0.122270	>50K
7	MidSch	0.006260	>50K
8	PrimSch	0.000799	>50K
9	Prof-school	0.054076	>50K
10	Some-college	0.177944	>50K
0	Assoc-acdm	0.033195	<=50K
1	Assoc-voc	0.042509	<=50K
2	Bachelors	0.128807	<=50K
3	Doctorate	0.004194	<=50K
4	HS-dropout	0.111592	<=50K
5	HS-grad	0.362982	<=50K
6	Masters	0.031297	<=50K
7	MidSch	0.035226	<=50K

```
8         Preschool    0.001986  <=50K
9           PrimSch    0.006401  <=50K
10     Prof-school    0.006003  <=50K
11    Some-college    0.235808  <=50K
```

```
<Figure size 640x480 with 0 Axes>
```

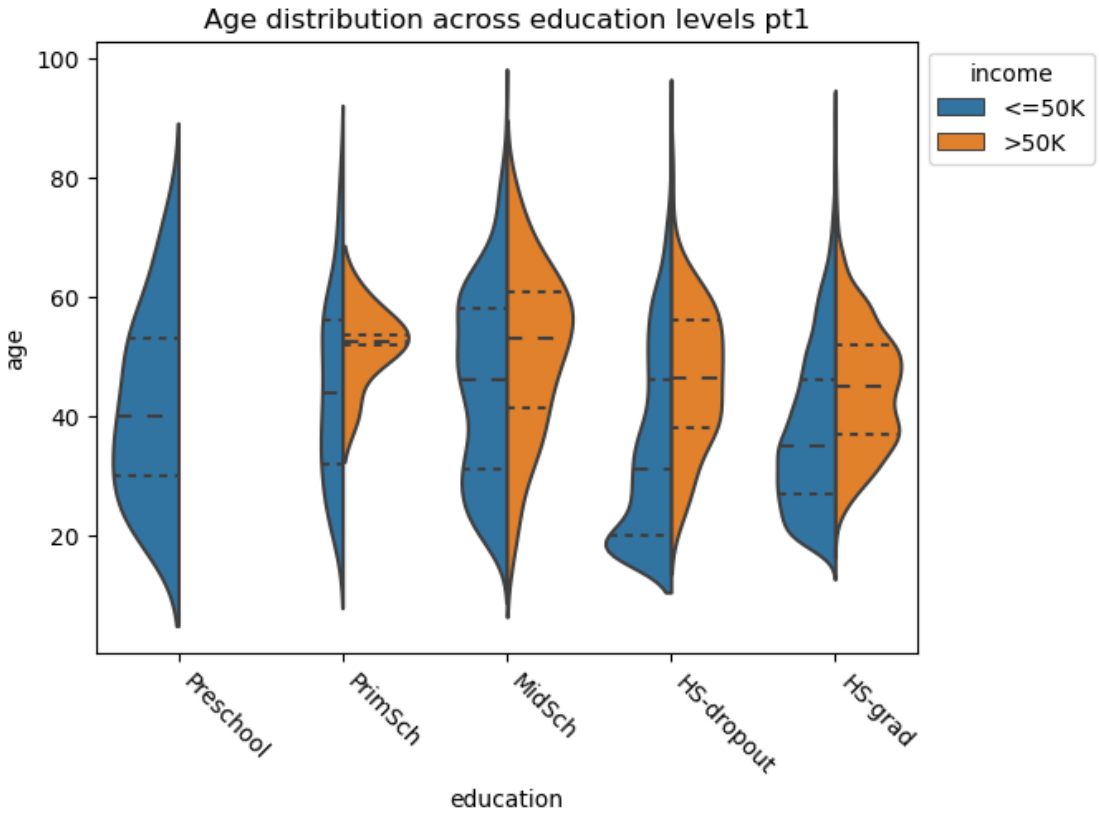
[31]:
```
above_age = list(df_above['age'])
below_age = list(df_below['age'])
age_distr = pd.concat([pd.Series(above_age, name='>50K'), pd.
  ↪Series(below_age,name='<=50K') ], axis=1)
sns.boxplot(data=age_distr).set(xlabel="Income Level", ylabel='Age')
plt.title('Age distribution across income levels')
plt.show()
plt.savefig("Age distribution across income levels.jpg")
```



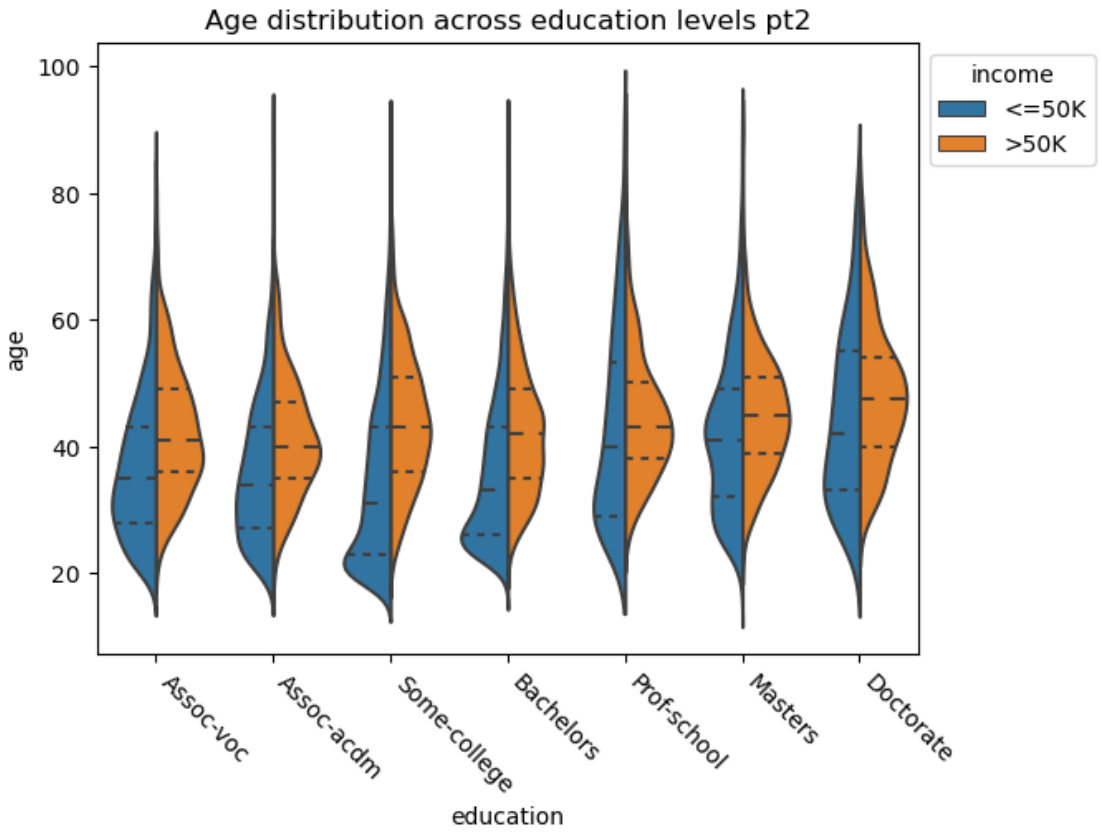

```
<Figure size 640x480 with 0 Axes>
```

[73]:
```
age_edu_data = df[['age','education', 'income'] and df['education-num']<10]
lvl_order = ['Preschool','PrimSch', 'MidSch', 'HS-dropout', 'HS-grad']
```

```
ax = sns.violinplot(data=age_edu_data, x='education', order=lvl_order, ␣
 ↪y='age', hue='income', split=True, inner="quart", legend='full')
sns.move_legend(ax, "upper left", bbox_to_anchor=(1, 1))
plt.xticks(rotation = 315, ha = 'left')
plt.title("Age distribution across education levels pt1")
plt.savefig("Age distribution across education levels pt1.jpg")
plt.show()
```

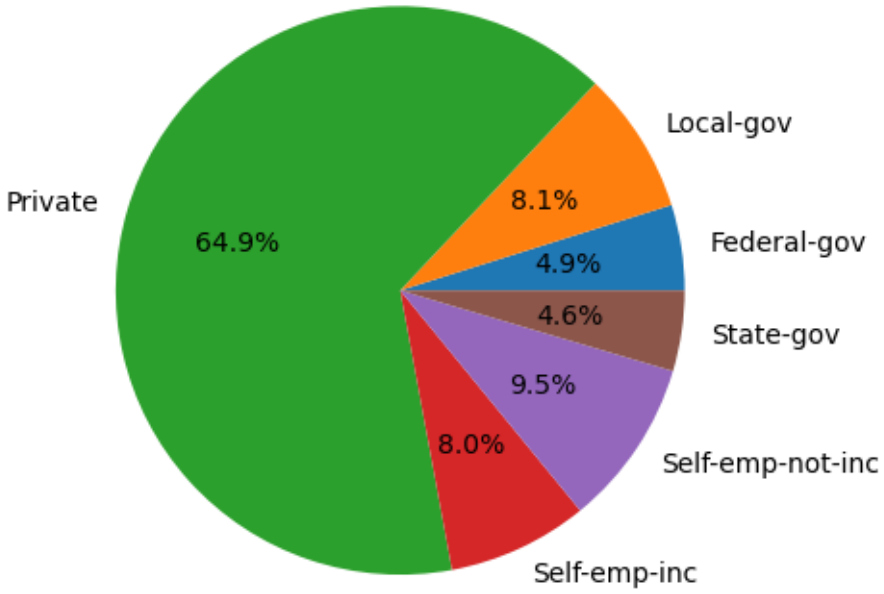


[76]:
```
age_edu_data = df[['age','education', 'income'] and df['education-num']>=10]
lvl_order = ['Assoc-voc', 'Assoc-acdm', 'Some-college', 'Bachelors',␣
 ↪'Prof-school', 'Masters', 'Doctorate']
ax = sns.violinplot(data=age_edu_data, x='education', y='age', order=lvl_order,␣
 ↪hue='income', split=True, inner="quart", legend='full')
sns.move_legend(ax, "upper left", bbox_to_anchor=(1, 1))
plt.xticks(rotation = 315, ha = 'left')
plt.title("Age distribution across education levels pt2")
plt.savefig("Age distribution across education levels pt2.jpg")
plt.show()
```



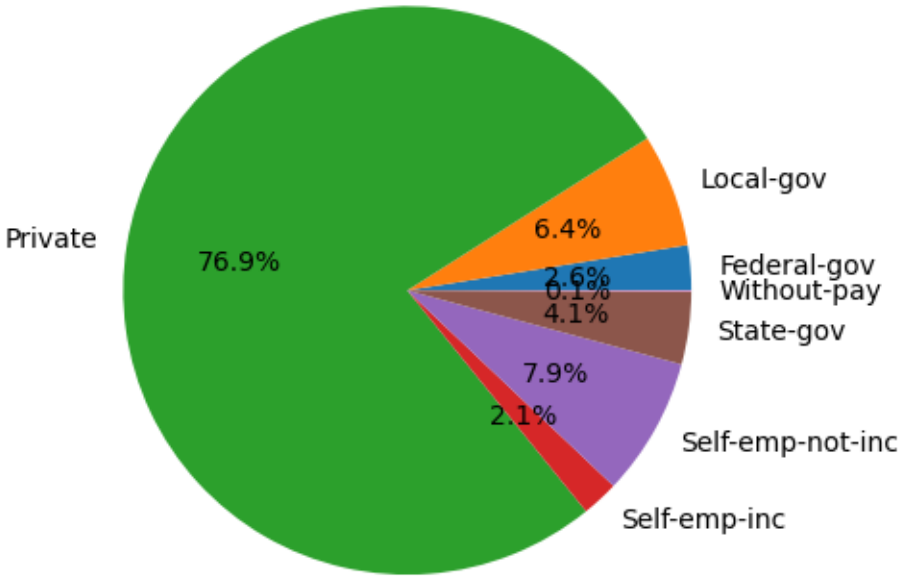
[34]:
```
color_palette = sns.color_palette()
fig, ax = plt.subplots()
df_sector_above = df_above[['workclass','occupation']]
df_sector_above = df_sector_above.groupby('workclass').count().
  ↪rename(columns={"occupation":"count"})
df_sector_above = df_sector_above.reset_index()
display(df_sector_above)
labels = list(df_sector_above.workclass)
sizes = list(df_sector_above['count'])
ax.pie(sizes, labels=labels, autopct='%1.1f%%', colors=color_palette)
plt.show()
```

	workclass	count
0	Federal-gov	365
1	Local-gov	609
2	Private	4876
3	Self-emp-inc	600
4	Self-emp-not-inc	714
5	State-gov	344

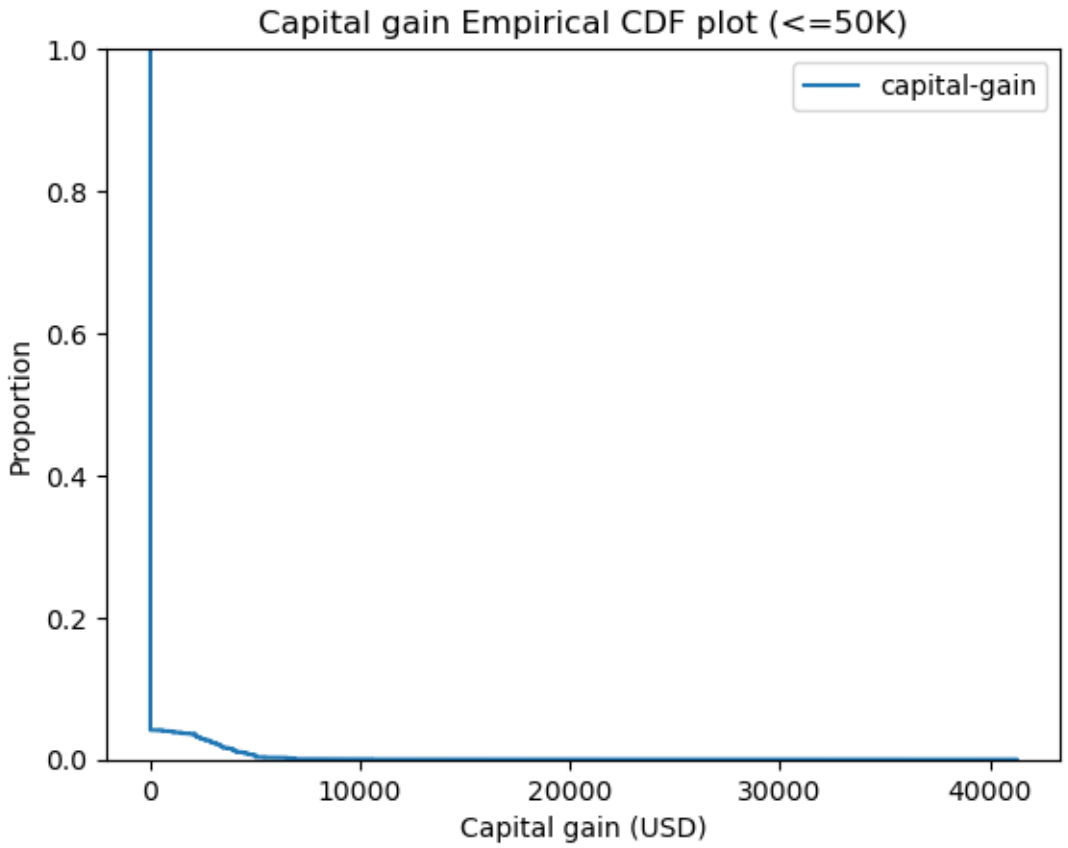


[35]:
```
color_palette = sns.color_palette()
fig, ax = plt.subplots()
df_sector_below = df_below[['workclass','occupation']]
df_sector_below = df_sector_below.groupby('workclass').count().
 ↪rename(columns={"occupation":"count"})
df_sector_below = df_sector_below.reset_index()
display(df_sector_below)
labels = list(df_sector_below.workclass)
sizes = list(df_sector_below['count'])
ax.pie(sizes, labels=labels, autopct='%1.1f%%', colors=color_palette)
plt.show()
```

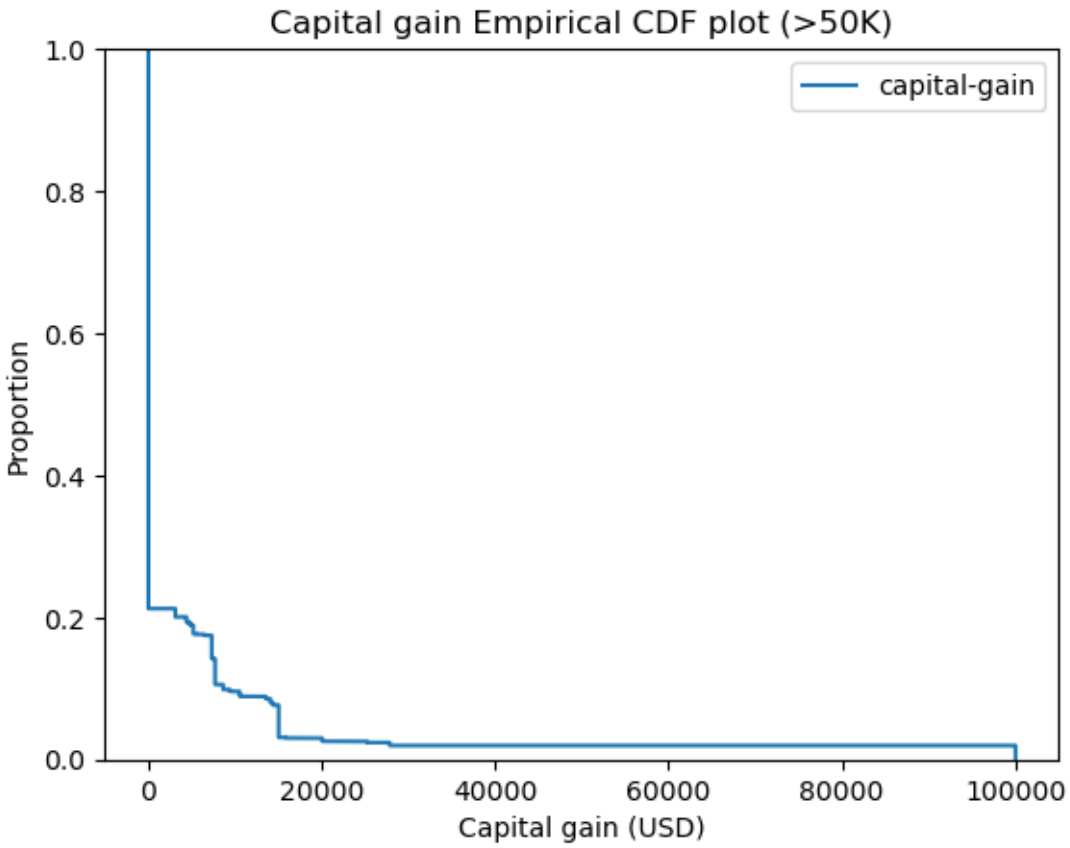
	workclass	count
0	Federal-gov	578
1	Local-gov	1458
2	Private	17410
3	Self-emp-inc	474
4	Self-emp-not-inc	1785
5	State-gov	935
6	Without-pay	14



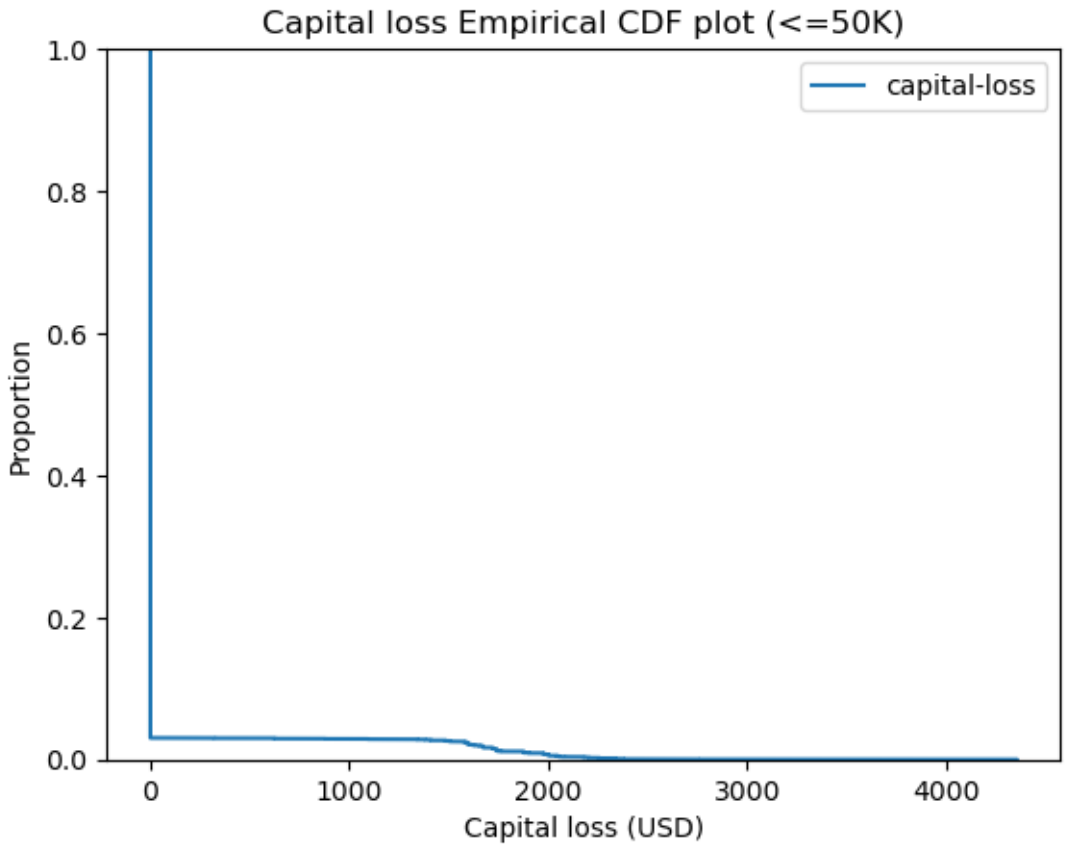
[36]:
```
df_cap_gain_below = df_below[['capital-gain']]
ax = sns.ecdfplot(df_cap_gain_below, complementary=True)
ax.set(xlabel='Capital gain (USD)', title = 'Capital gain Empirical CDF plot␣
 ↪(<=50K)')
plt.show()
```



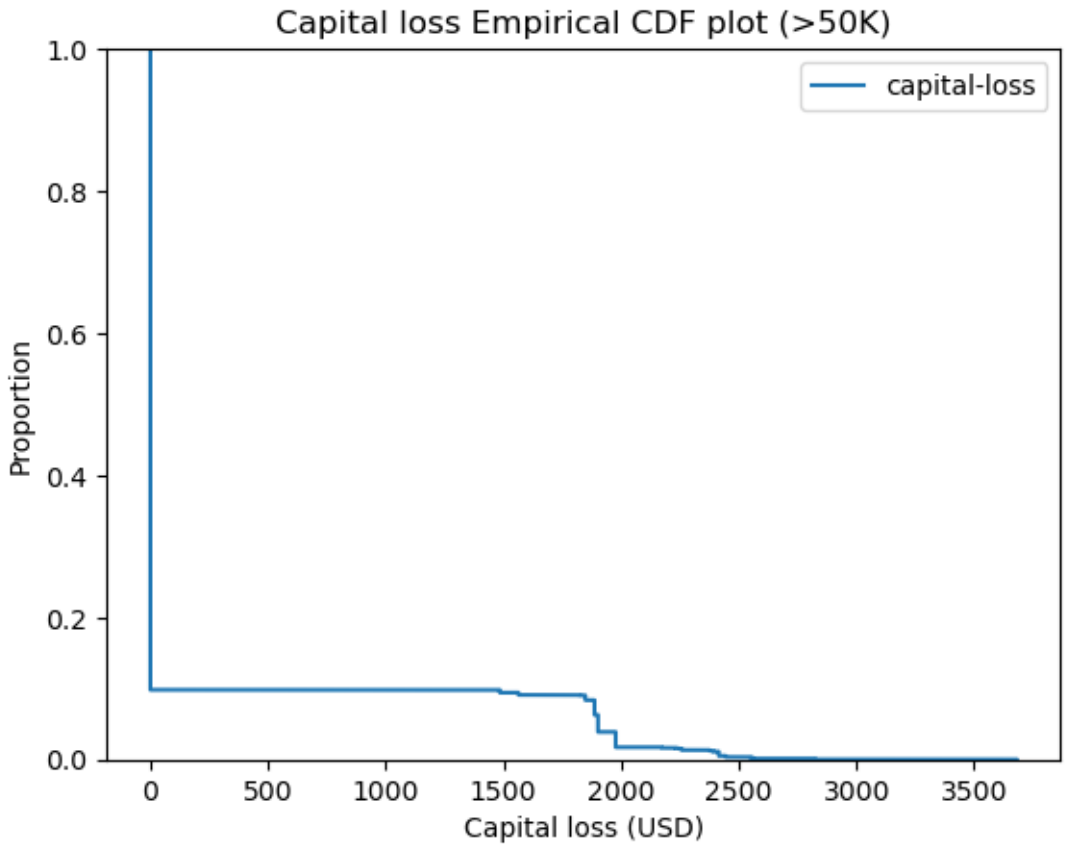
[37]:
```
df_cap_gain_above = df_above[['capital-gain']]
ax = sns.ecdfplot(df_cap_gain_above, complementary=True)
ax.set(xlabel='Capital gain (USD)', title = 'Capital gain Empirical CDF plot␣
↪(>50K)')
plt.show()
```



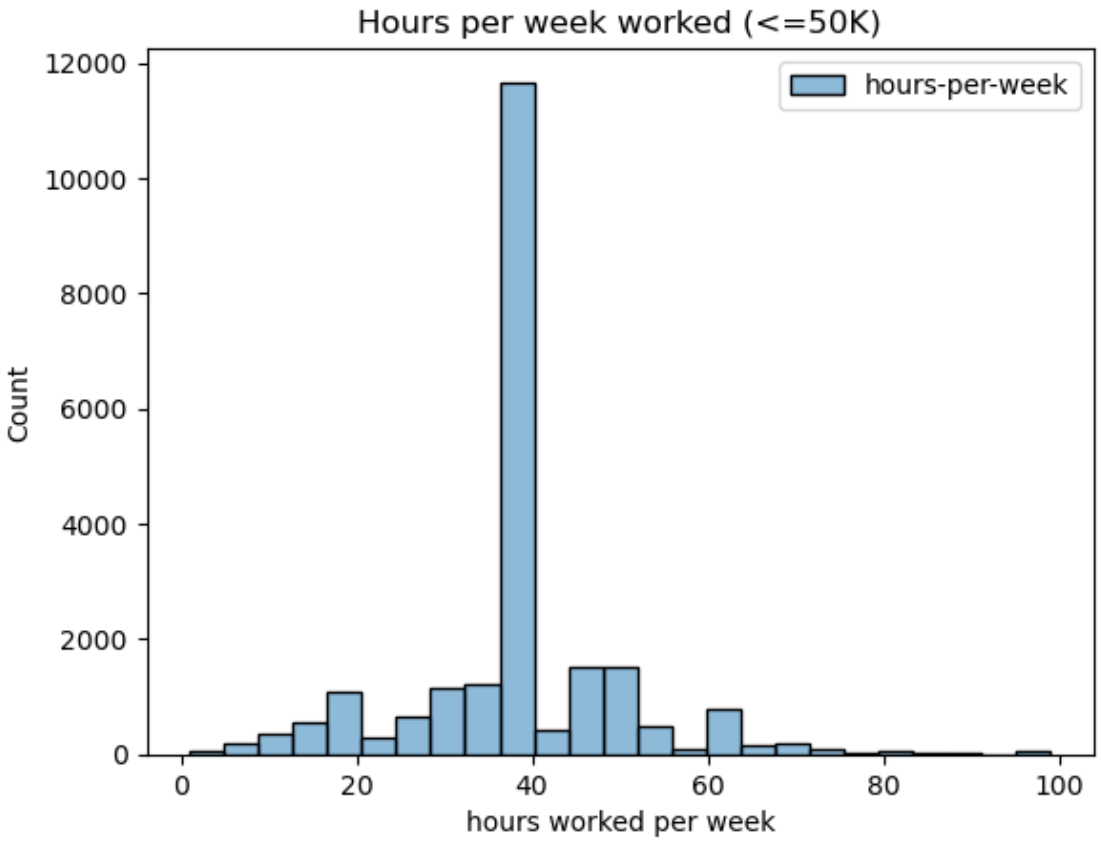
[38]:
```
df_cap_loss_below = df_below[['capital-loss']]
ax = sns.ecdfplot(df_cap_loss_below, complementary=True)
ax.set(xlabel='Capital loss (USD)', title = 'Capital loss Empirical CDF plot␣
↪(<=50K)')
plt.show()
```



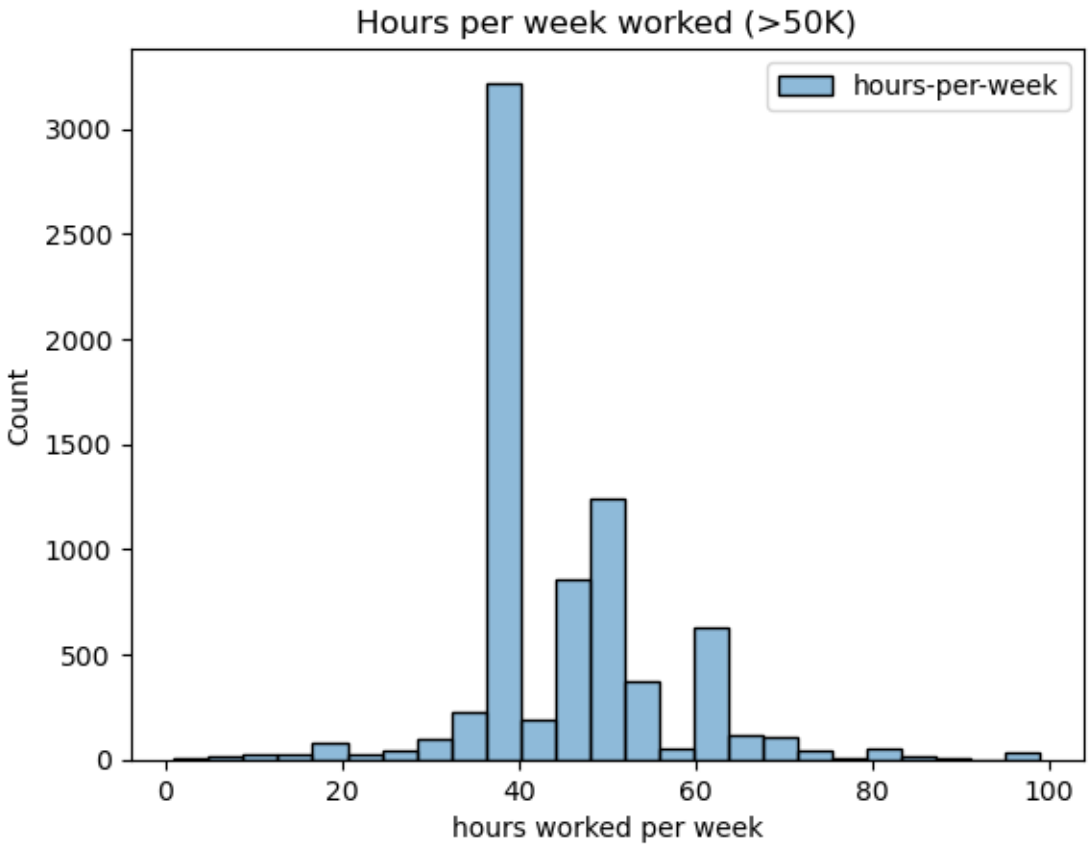
[39]:
```
df_cap_loss_above = df_above[['capital-loss']]
ax = sns.ecdfplot(df_cap_loss_above, complementary=True)
ax.set(xlabel='Capital loss (USD)', title = 'Capital loss Empirical CDF plot␣
↪(>50K)')
plt.show()
```



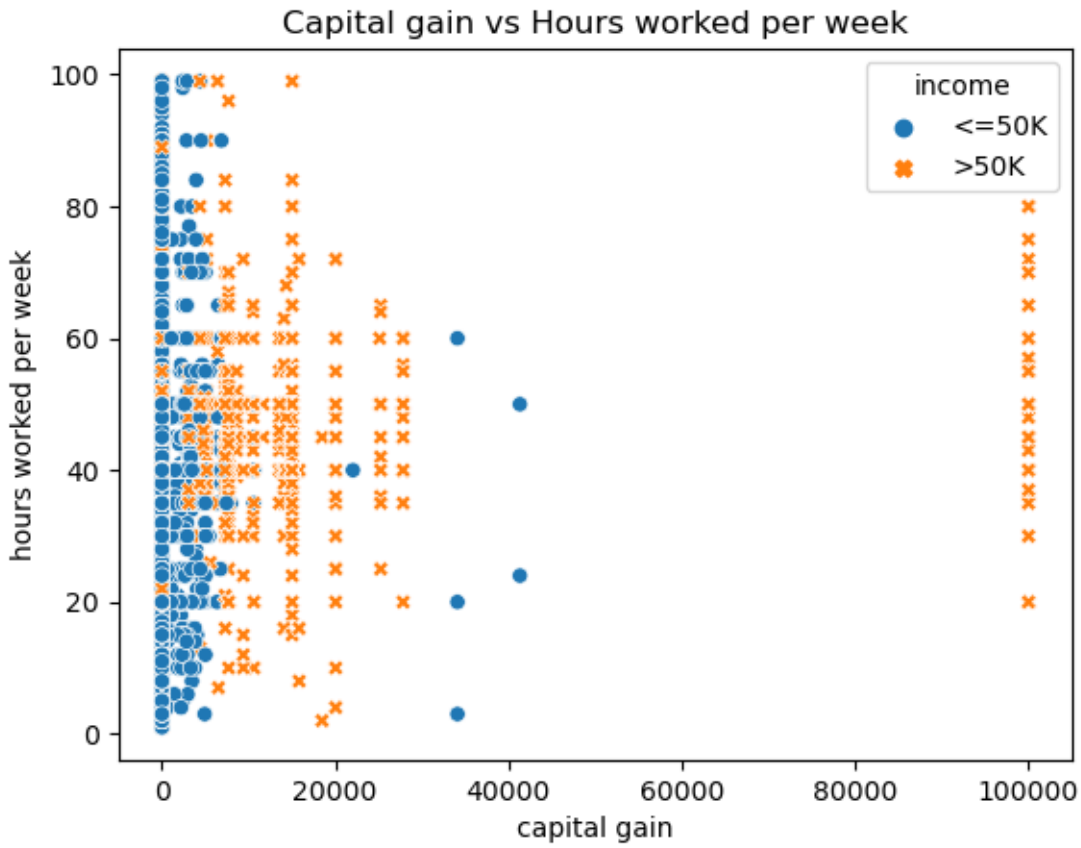
[40]:
```
df_hours_below = df_below[['hours-per-week']]
ax = sns.histplot(df_hours_below, bins=25)
ax.set(xlabel='hours worked per week', title='Hours per week worked (<=50K)')
plt.show()
```



[41]:
```
df_hours_above = df_above[['hours-per-week']]
ax = sns.histplot(df_hours_above, bins=25)
ax.set(xlabel='hours worked per week', title='Hours per week worked (>50K)')

plt.show()
```

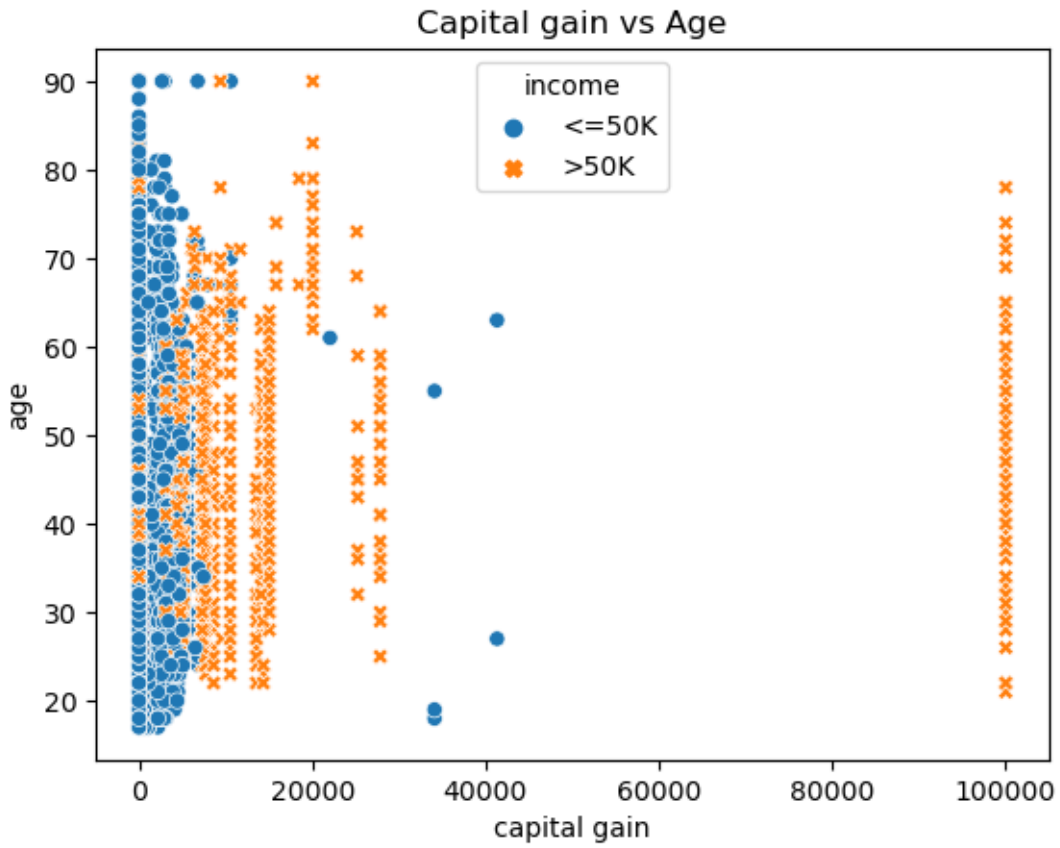


[42]:
```
ax = sns.scatterplot(df, y='hours-per-week', x='capital-gain', hue='income',␣
 ↪style='income')
ax.set(ylabel='hours worked per week', xlabel='capital gain', title='Capital␣
 ↪gain vs Hours worked per week')
plt.show()
corr = df[['hours-per-week', 'capital-gain']].corr(method='pearson')
print("Pearson Correlation: {corr}".format(corr=corr))
```




```
Pearson Correlation:                hours-per-week  capital-gain
hours-per-week          1.000000       0.080432
capital-gain            0.080432       1.000000
```

[43]:
```
ax = sns.scatterplot(df, y='age', x='capital-gain', hue='income',␣
 ↪style='income')
ax.set(ylabel='age', xlabel='capital gain', title='Capital gain vs Age')
plt.show()
corr = df[['age', 'capital-gain']].corr(method='pearson')
print("Pearson Correlation: {corr}".format(corr=corr))
```

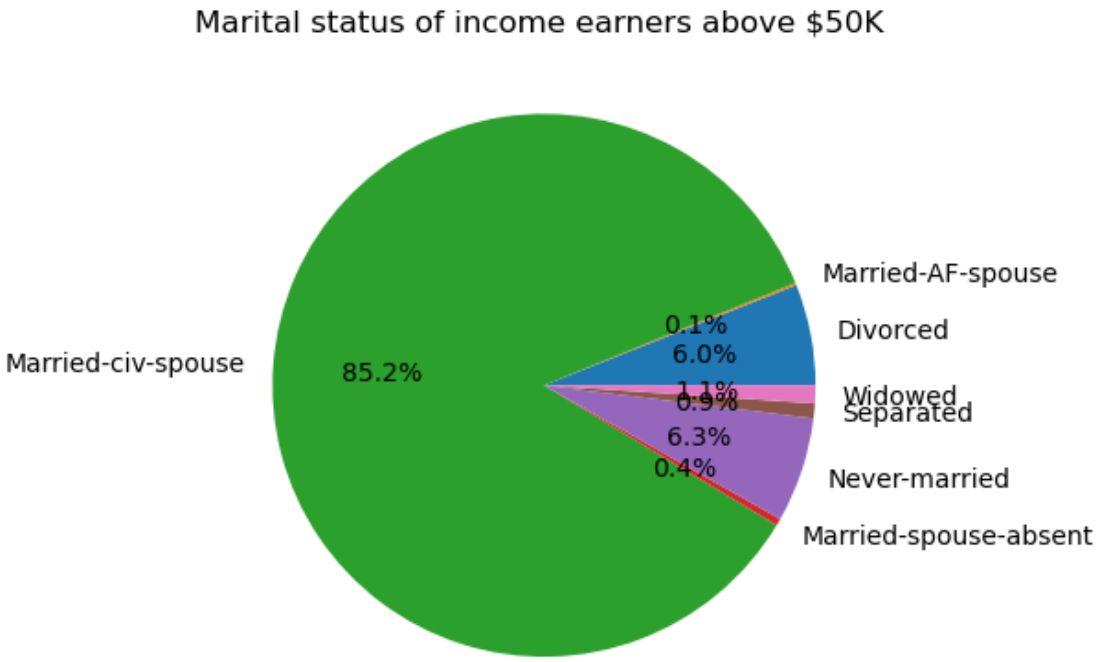



```
Pearson Correlation:                    age  capital-gain
age           1.000000      0.080154
capital-gain  0.080154      1.000000
```

[44]:
```
color_palette = sns.color_palette()
fig, ax = plt.subplots()
df_marital_status_above = df_above[['marital-status','occupation']]
df_marital_status_above = df_marital_status_above.groupby('marital-status').
  ↪count().rename(columns={"occupation":"count"})
df_marital_status_above = df_marital_status_above.reset_index()
display(df_sector_above)
labels = list(df_marital_status_above['marital-status'])
sizes = list(df_marital_status_above['count'])
ax.pie(sizes, labels=labels, autopct='%1.1f%%', colors=color_palette)
plt.title("Marital status of income earners above $50K ")
plt.show()
```

```
          workclass  count
0       Federal-gov    365
1         Local-gov    609
2           Private   4876
```

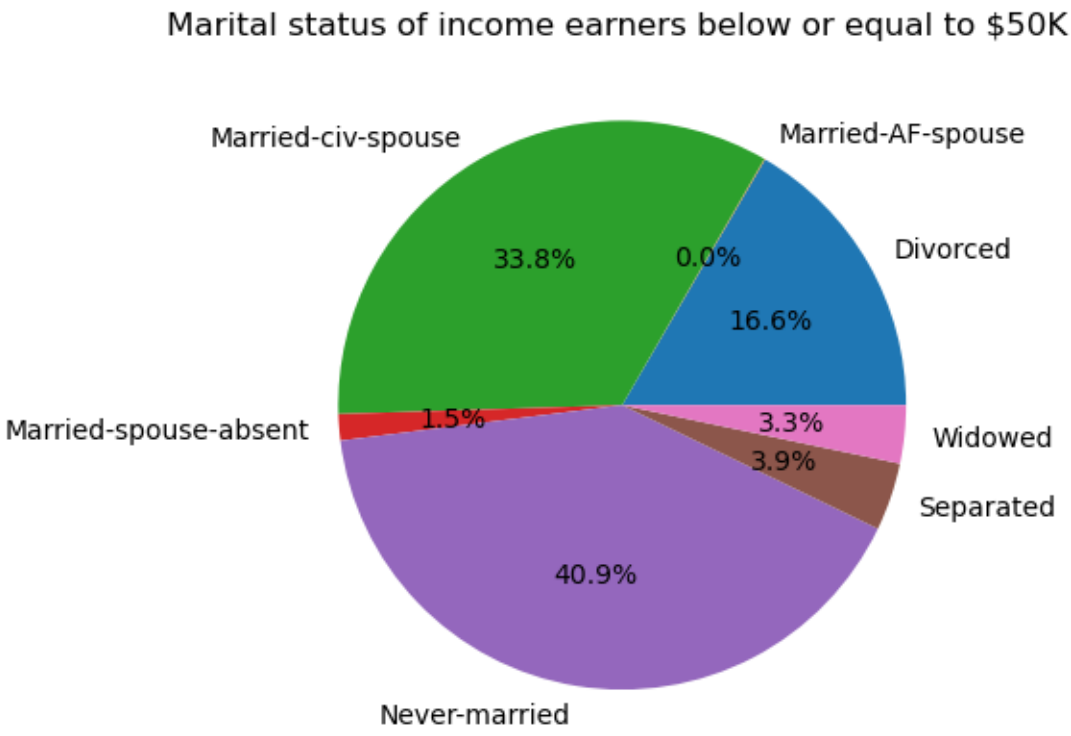
```
3      Self-emp-inc    600
4  Self-emp-not-inc    714
5         State-gov    344
```



[45]:
```
color_palette = sns.color_palette()
fig, ax = plt.subplots()
df_marital_status_below = df_below[['marital-status','occupation']]
df_marital_status_below = df_marital_status_below.groupby('marital-status').
 ↪count().rename(columns={"occupation":"count"})
df_marital_status_below = df_marital_status_below.reset_index()
display(df_sector_below)
labels = list(df_marital_status_below['marital-status'])
sizes = list(df_marital_status_below['count'])
ax.pie(sizes, labels=labels, autopct='%1.1f%%', colors=color_palette)
plt.title("Marital status of income earners below or equal to $50K ")
plt.show()
```

```
          workclass  count
0       Federal-gov    578
1         Local-gov   1458
2           Private  17410
3      Self-emp-inc    474
4  Self-emp-not-inc   1785
5         State-gov    935
```

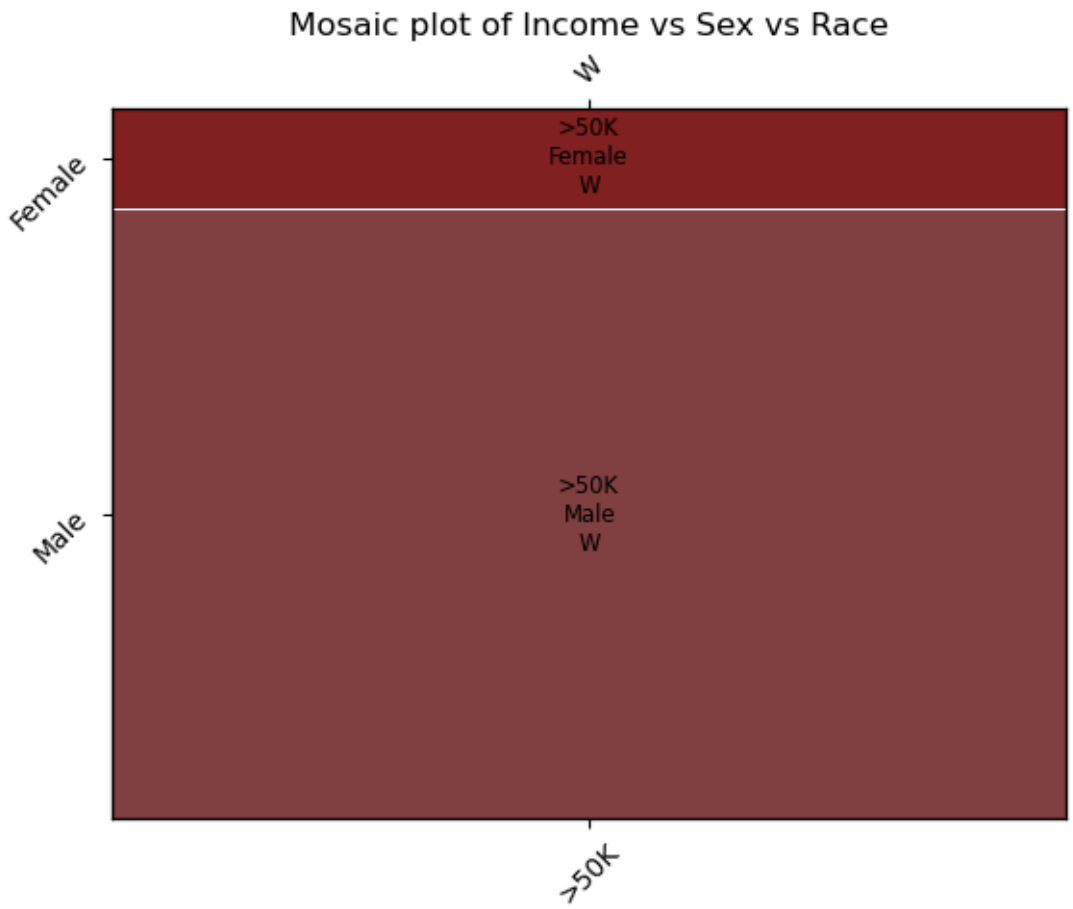
```
6        Without-pay      14
```



[78]:
```
fig = px.treemap(df, path=[px.Constant("all"), 'income', 'marital-status'],
                 values='capital-gain')
fig.update_layout(margin = dict(t=50, l=25, r=25, b=25))
fig.update_traces(root_color="lightgrey")
fig.show()
```

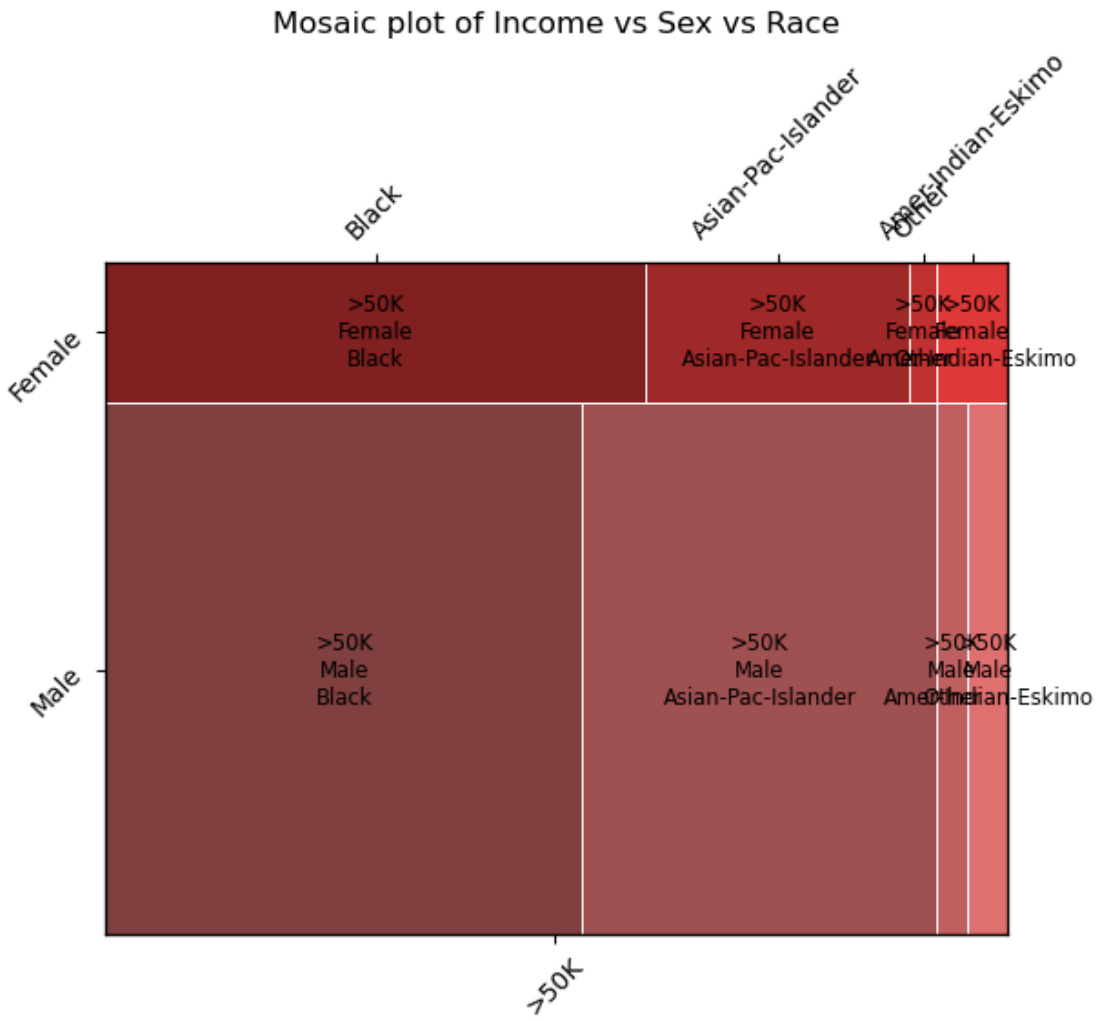
[47]:
```
df_white = df_above[df['race']=='W']
mosaic(df_white, [ 'income', 'sex', 'race'], title='Mosaic plot of Income vs␣
 ↪Sex vs Race', label_rotation=45)
plt.show()
```

```
C:\Users\jzjac\AppData\Local\Temp\ipykernel_33880\1799894732.py:1: UserWarning:

Boolean Series key will be reindexed to match DataFrame index.
```



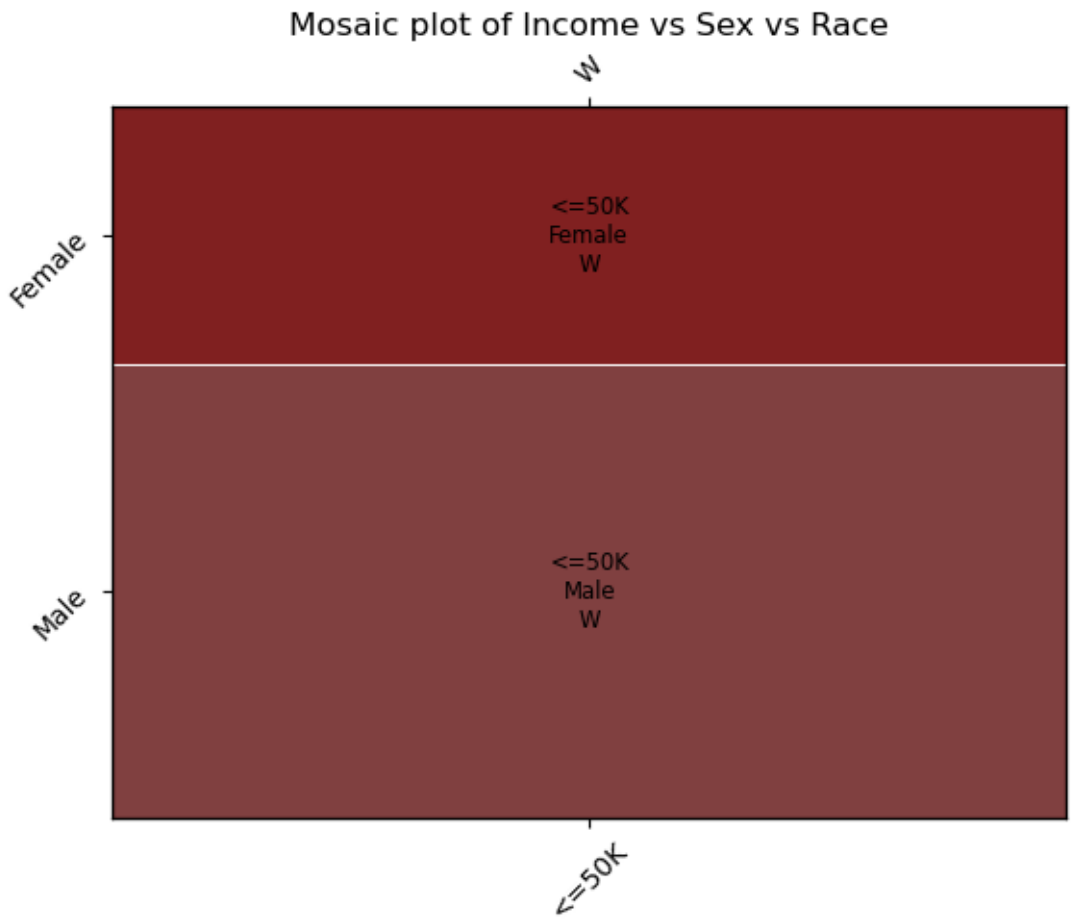
[393]:
```
df_non_white = df_above[df['race']!='White']
mosaic(df_non_white, [ 'income', 'sex', 'race'], title='Mosaic plot of Income␣
 ↪vs Sex vs Race', label_rotation=45)
plt.show()
```

```
C:\Users\jzjac\AppData\Local\Temp\ipykernel_1868\1587150755.py:1: UserWarning:

Boolean Series key will be reindexed to match DataFrame index.
```



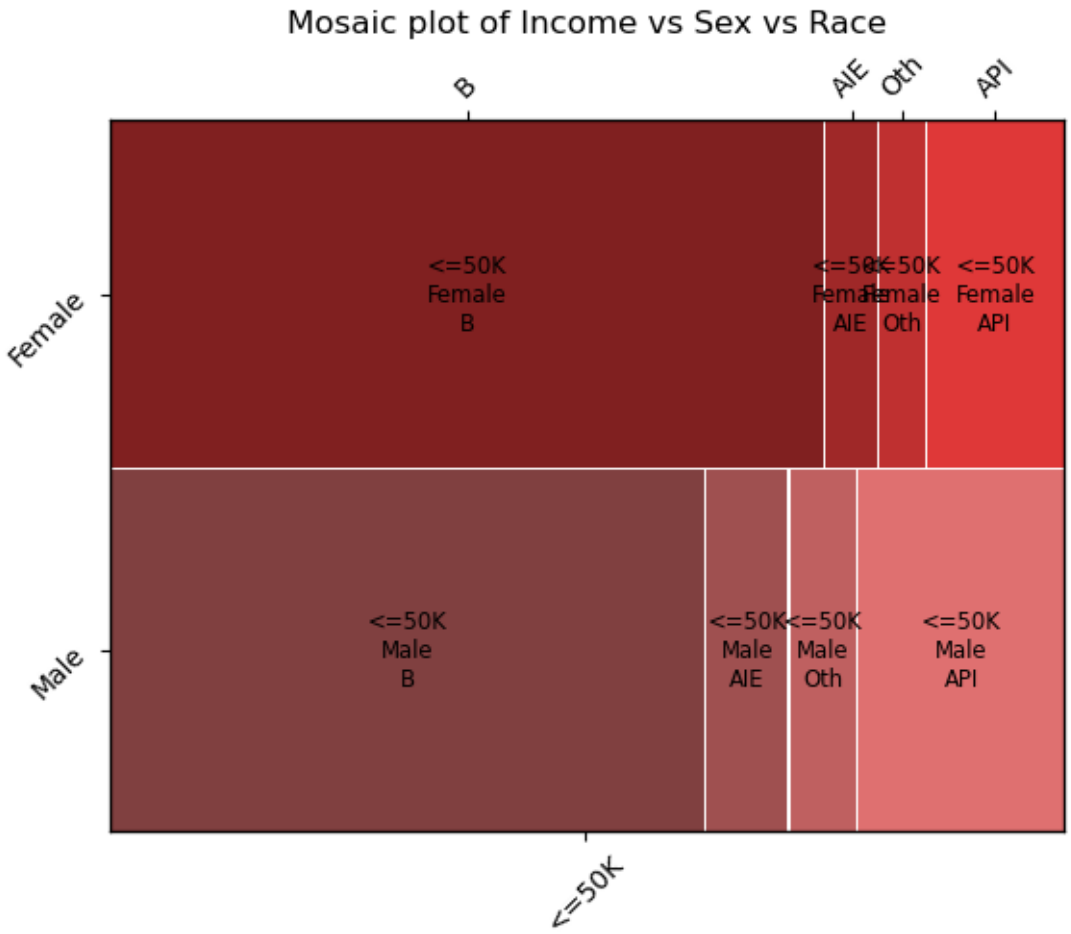
[48]:
```
df_white = df_below[df['race']=='W']
mosaic(df_white, [ 'income', 'sex', 'race'], title='Mosaic plot of Income vs Sex vs Race', label_rotation=45)
plt.show()
```

```
C:\Users\jzjac\AppData\Local\Temp\ipykernel_33880\3333757602.py:1: UserWarning:

Boolean Series key will be reindexed to match DataFrame index.
```



[49]:
```
df_non_white = df_below[df['race']!='W']
mosaic(df_non_white, [ 'income', 'sex', 'race'], title='Mosaic plot of Income␣
↪vs Sex vs Race', label_rotation=45)
plt.show()
```

```
C:\Users\jzjac\AppData\Local\Temp\ipykernel_33880\2112468729.py:1: UserWarning:

Boolean Series key will be reindexed to match DataFrame index.
```


Mosaic plot of Income vs Sex vs Race
B
AIE
Oth
API
Female
Male
<=50K
Female
B
<=50K
Female
AIE
<=50K
Female
Oth
<=50K
Female
API
<=50K
Male
B
<=50K
Male
AIE
<=50K
Male
Oth
<=50K
Male
API
<=50K

[ ]: