In [1]:
```python
import numpy as np
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
import pylab as pl
from sklearn.linear_model import LogisticRegression
from sklearn.neighbors import KNeighborsClassifier
from sklearn.linear_model import SGDClassifier
from sklearn.preprocessing import LabelEncoder
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression, Lasso
from sklearn.linear_model import Ridge
from sklearn.model_selection import cross_val_score
import warnings
warnings.filterwarnings('ignore')
import os
```

In [2]:
```python
df = pd.read_csv('Student_Math_Alcohol.csv')
```

In [3]:
```python
df.head()
```

Out[3]:

	school	sex	age	address	famsize	Pstatus	Medu	Fedu	Mjob	Fjob	...	famrel	f
0	GP	F	18	U	GT3	A	4	4	at_home	teacher	...	4	
1	GP	F	17	U	GT3	T	1	1	at_home	other	...	5	
2	GP	F	15	U	LE3	T	1	1	at_home	other	...	4	
3	GP	F	15	U	GT3	T	4	2	health	services	...	3	
4	GP	F	16	U	GT3	T	3	3	other	other	...	4	

5 rows × 33 columns

In [4]:
```python
df.describe()
```

Out[4]:

	age	Medu	Fedu	traveltime	studytime	failures	famrel	
count	395.000000	395.000000	395.000000	395.000000	395.000000	395.000000	395.000000	3
mean	16.696203	2.749367	2.521519	1.448101	2.035443	0.334177	3.944304	
std	1.276043	1.094735	1.088201	0.697505	0.839240	0.743651	0.896659	
min	15.000000	0.000000	0.000000	1.000000	1.000000	0.000000	1.000000	
25%	16.000000	2.000000	2.000000	1.000000	1.000000	0.000000	4.000000	
50%	17.000000	3.000000	2.000000	1.000000	2.000000	0.000000	4.000000	
75%	18.000000	4.000000	3.000000	2.000000	2.000000	0.000000	5.000000	
max	22.000000	4.000000	4.000000	4.000000	4.000000	3.000000	5.000000	

In [5]:
```
df.shape
```

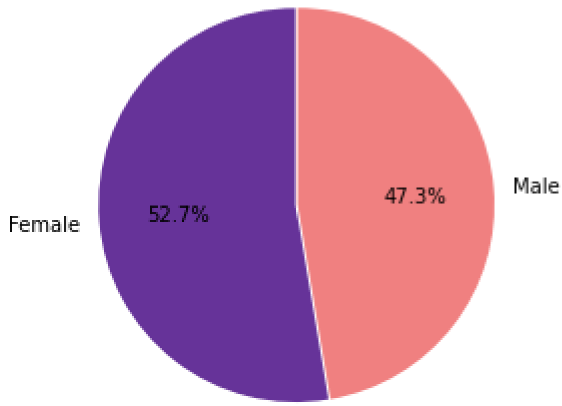
Out[5]:
```
(395, 33)
```

In [6]:
```
df.dtypes
```

Out[6]:
```
school        object
sex           object
age            int64
address       object
famsize       object
Pstatus       object
Medu           int64
Fedu           int64
Mjob          object
Fjob          object
reason        object
guardian      object
traveltime     int64
studytime      int64
failures       int64
schoolsup     object
famsup        object
paid          object
activities    object
nursery       object
higher        object
internet      object
romantic      object
famrel         int64
freetime       int64
goout          int64
Dalc           int64
Walc           int64
health         int64
absences       int64
G1             int64
G2             int64
G3             int64
dtype: object
```

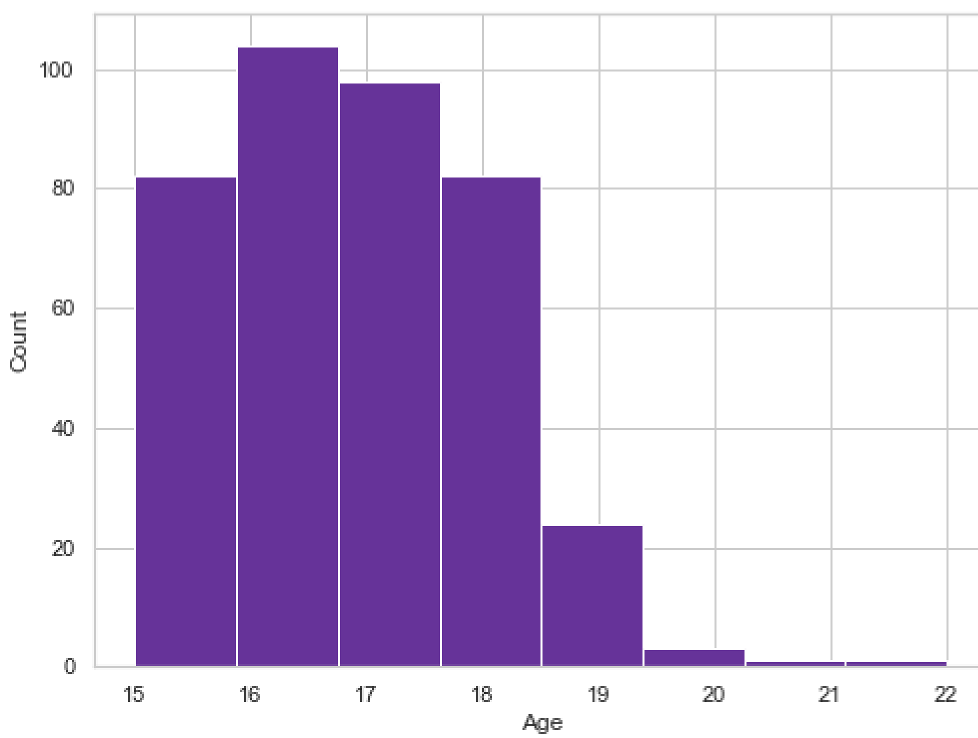
In [7]:

```
plt.pie(df['sex'].value_counts().tolist(),
        labels=['Female', 'Male'], colors=['rebeccapurple', 'lightcoral'],
        autopct='%1.1f%%', explode=[0,0.01], startangle=90)
axis = plt.axis('equal')
```



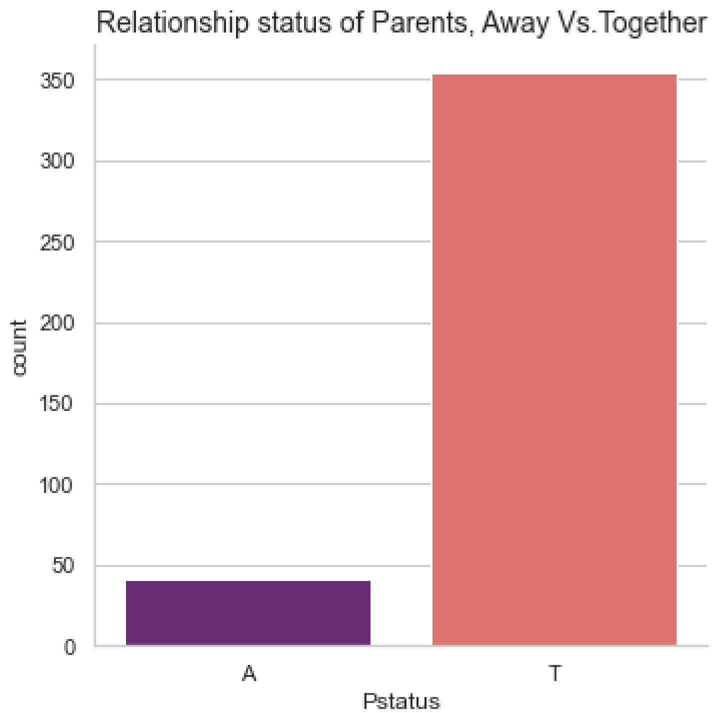
In [8]:

```
sns.set(style="whitegrid")
fig, ax = plt.subplots(figsize=(8, 6))
sns.distplot(df['age'],
             hist_kws={"alpha": 1, "color": "rebeccapurple"},
             kde=False, bins=8)
ax = ax.set(ylabel="Count", xlabel="Age")
```



In [9]:
```python
sns.catplot(x="Pstatus", kind="count",palette="magma", data=df, height = 5, l
plt.title("Relationship status of Parents, Away Vs.Together", fontsize=14)
```

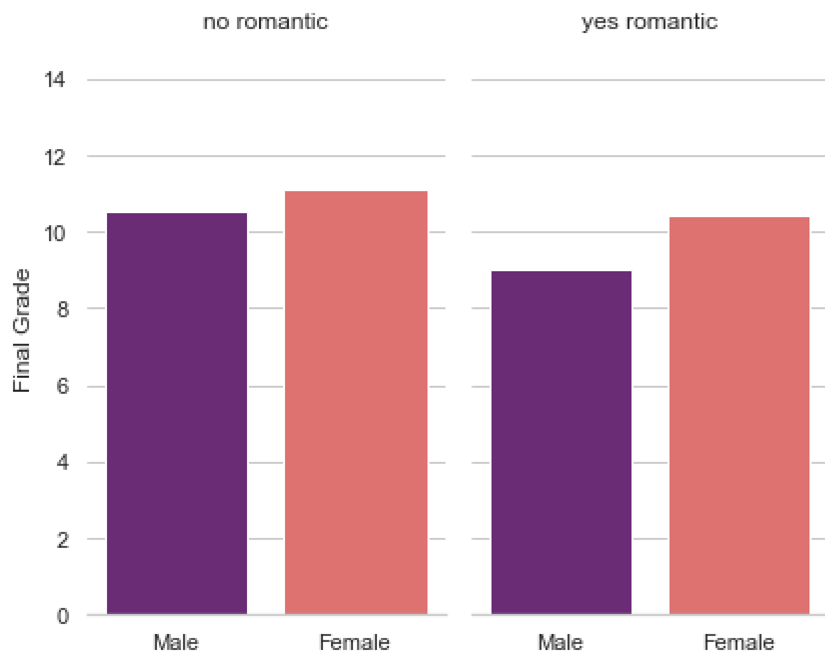
Out[9]:
```
Text(0.5, 1.0, 'Relationship status of Parents, Away Vs.Together')
```



In [10]:

```python
g = sns.catplot(x="sex", y="G3", col="romantic",
                data=df, saturation=.75,
                kind="bar", ci=None, aspect=.6, palette="magma")
(g.set_axis_labels("", "Final Grade")
.set_xticklabels(["Male", "Female"])
.set_titles("{col_name} {col_var}")
.set(ylim=(0, 15))
.despine(left=True))
```

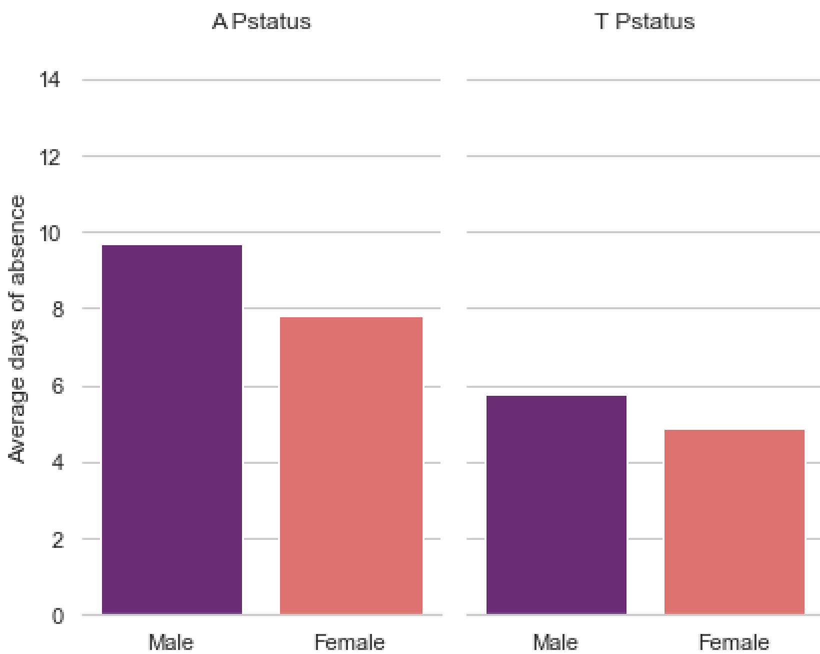
Out[10]: <seaborn.axisgrid.FacetGrid at 0x1796f9c2400>



In [11]:

```
g = sns.catplot(x="sex", y="absences", col="Pstatus",
                data=df, saturation=.75,
                kind="bar", ci=None, aspect=.6, palette="magma")
(g.set_axis_labels("", "Average days of absence")
.set_xticklabels(["Male", "Female"])
.set_titles("{col_name} {col_var}")
.set(ylim=(0, 15))
.despine(left=True))
```

Out[11]: <seaborn.axisgrid.FacetGrid at 0x1796f9c2f10>

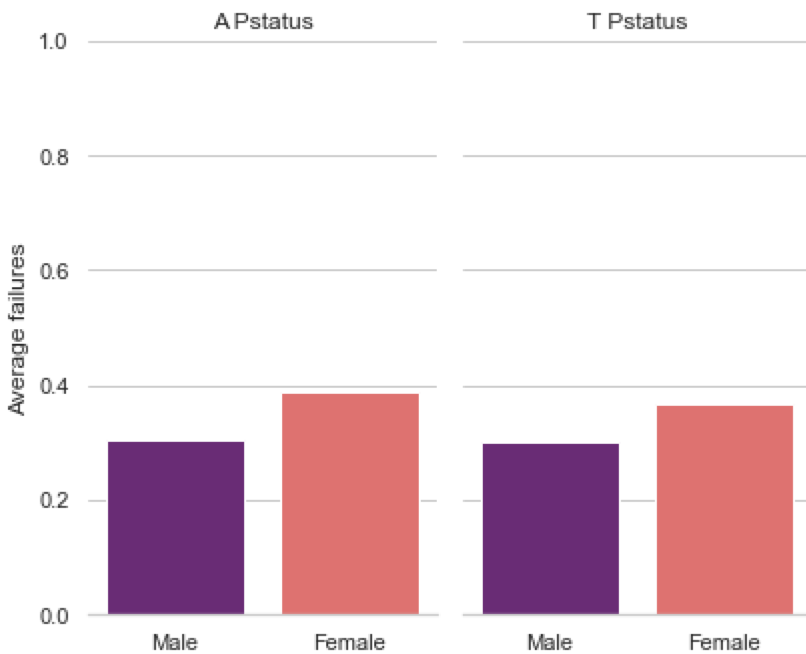


In [12]:

```
g = sns.catplot(x="sex", y="failures", col="Pstatus",
                data=df, saturation=.75,
                kind="bar", ci=None, aspect=.6, palette="magma")
(g.set_axis_labels("", "Average failures")
.set_xticklabels(["Male", "Female"])
.set_titles("{col_name} {col_var}")
.set(ylim=(0, 1))
.despine(left=True))
```

Out[12]:

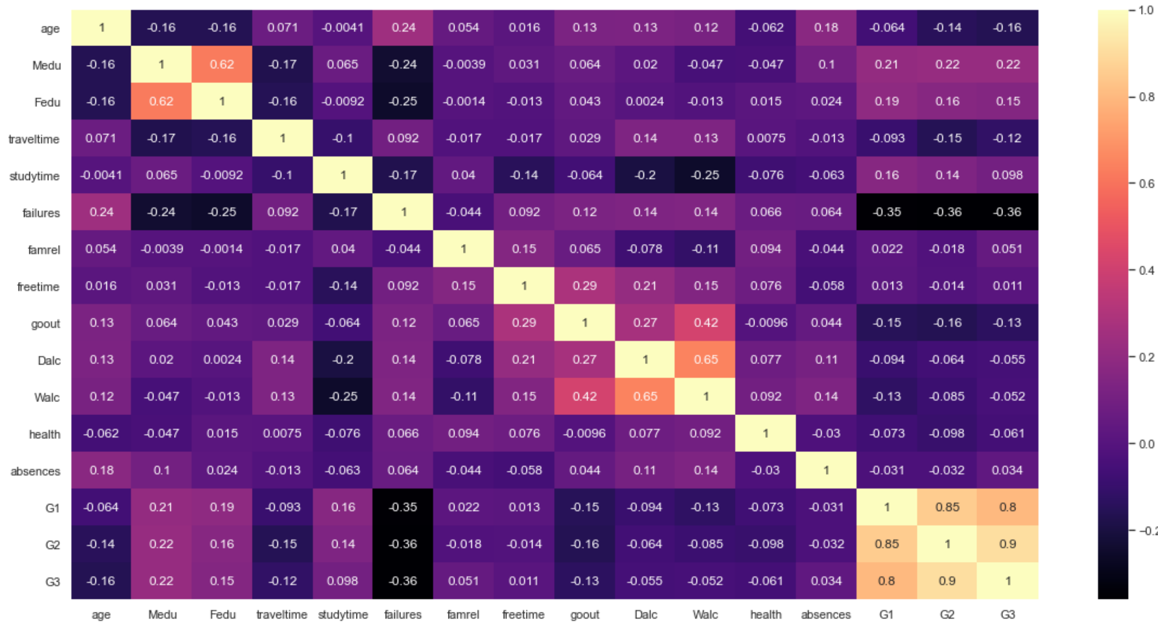
```
<seaborn.axisgrid.FacetGrid at 0x1796fb13dc0>
```



In [13]:

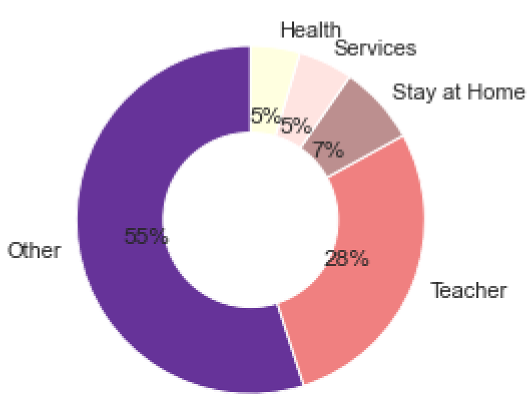
```
def show_correlations(df, show_chart = True):
    fig = plt.figure(figsize = (20,10))
    corr = df.corr()
    if show_chart == True:
        sns.heatmap(corr,
                    xticklabels=corr.columns.values,
                    yticklabels=corr.columns.values,
                    annot=True, cmap= "magma")
    return corr

correlation_df = show_correlations(df,show_chart=True)
```



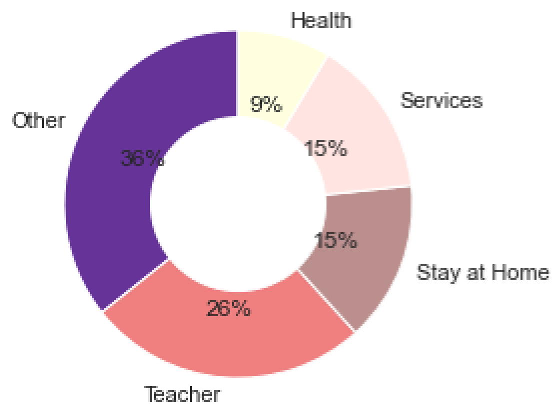
In [14]:

```
plt.pie(df['Fjob'].value_counts().tolist(),
        labels=['Other', 'Teacher', 'Stay at Home', 'Services', 'Health'],
        colors=['rebeccapurple', 'lightcoral', 'rosybrown', 'mistyrose', 'lig
         autopct='%1.0f%%', startangle=90)
my_circle=plt.Circle( (0,0), 0.5, color='white')
p=plt.gcf()
p.gca().add_artist(my_circle)
plt.show()
```



In [15]:

```
plt.pie(df['Mjob'].value_counts().tolist(),
        labels=['Other', 'Teacher', 'Stay at Home', 'Services', 'Health'],
        colors=['rebeccapurple', 'lightcoral', 'rosybrown', 'mistyrose', 'lig
         autopct='%1.0f%%', startangle=90)
my_circle=plt.Circle( (0,0), 0.5, color='white')
p=plt.gcf()
p.gca().add_artist(my_circle)
plt.show()
```



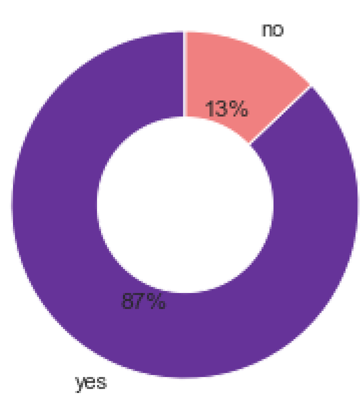
In [16]:

```
pip install squarify
```

```
Requirement already satisfied: squarify in c:\users\mumitul\anaconda3\lib\s
ite-packages (0.4.3)
Note: you may need to restart the kernel to use updated packages.
```

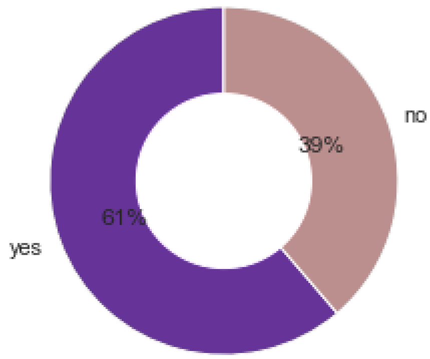
In [17]:

```
plt.pie(df['schoolsup'].value_counts().tolist(),
        labels=['yes', 'no'],
        colors=['rebeccapurple', 'lightcoral'],
         autopct='%1.0f%%', startangle=90)
my_circle=plt.Circle( (0,0), 0.5, color='white')
p=plt.gcf()
p.gca().add_artist(my_circle)
plt.show()
```



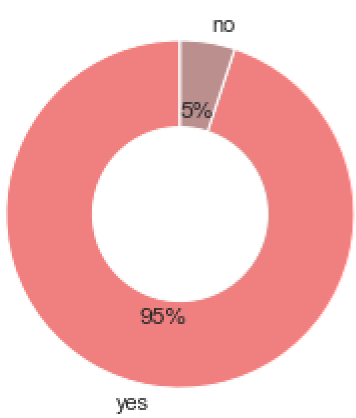
In [18]:

```
plt.pie(df['famsup'].value_counts().tolist(),
        labels=['yes', 'no'],
        colors=['rebeccapurple', 'rosybrown'],
         autopct='%1.0f%%', startangle=90)
my_circle=plt.Circle( (0,0), 0.5, color='white')
p=plt.gcf()
p.gca().add_artist(my_circle)
plt.show()
```



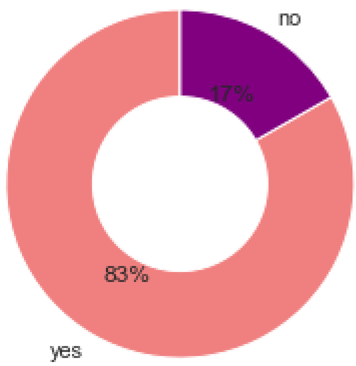
In [19]:

```
plt.pie(df['higher'].value_counts().tolist(),
        labels=['yes', 'no'],
        colors=['lightcoral', 'rosybrown'],
         autopct='%1.0f%%', startangle=90)
my_circle=plt.Circle( (0,0), 0.5, color='white')
p=plt.gcf()
p.gca().add_artist(my_circle)
plt.show()
```



In [20]:

```
plt.pie(df['internet'].value_counts().tolist(),
        labels=['yes', 'no'],
        colors=['lightcoral', 'purple'],
         autopct='%1.0f%%', startangle=90)
my_circle=plt.Circle( (0,0), 0.5, color='white')
p=plt.gcf()
p.gca().add_artist(my_circle)
plt.show()
```

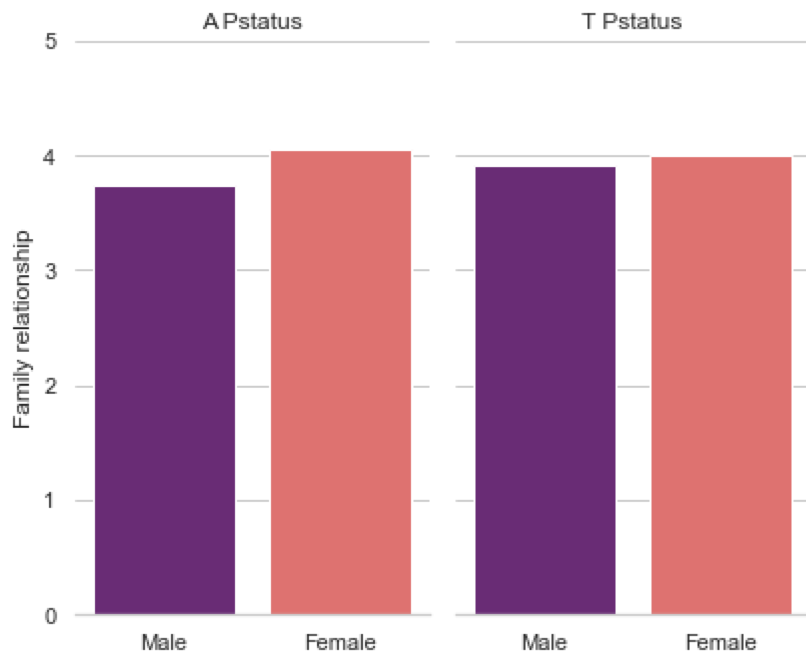


In [21]:

```python
g = sns.catplot(x="sex", y="famrel", col="Pstatus",
                data=df, saturation=.75,
                kind="bar", ci=None, aspect=.6, palette="magma")
(g.set_axis_labels("", "Family relationship")
.set_xticklabels(["Male", "Female"])
.set_titles("{col_name} {col_var}")
.set(ylim=(0, 5))
.despine(left=True))
```

Out[21]:

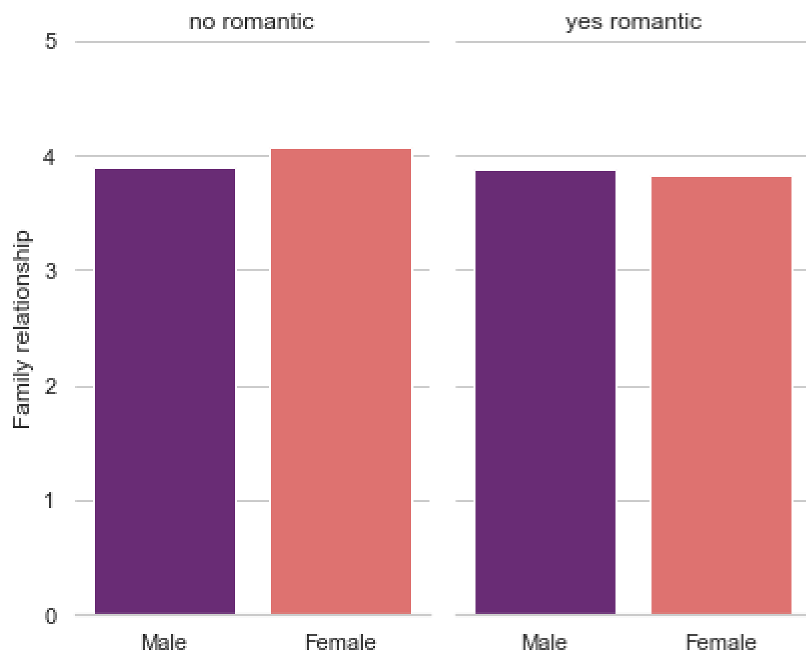
```
<seaborn.axisgrid.FacetGrid at 0x17971627190>
```



In [22]:

```
g = sns.catplot(x="sex", y="famrel", col="romantic",
                data=df, saturation=.75,
                kind="bar", ci=None, aspect=.6, palette="magma")
(g.set_axis_labels("", "Family relationship")
.set_xticklabels(["Male", "Female"])
.set_titles("{col_name} {col_var}")
.set(ylim=(0, 5))
.despine(left=True))
```

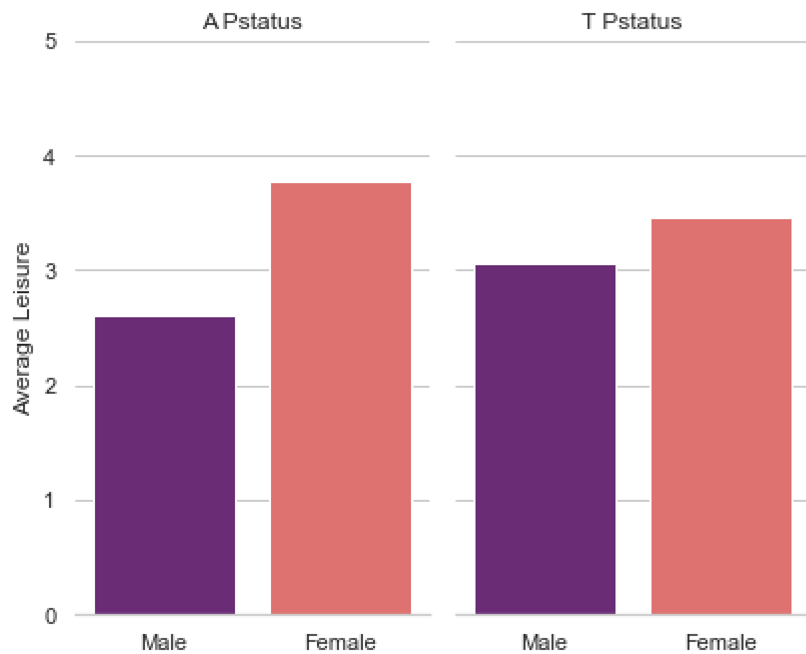
Out[22]: <seaborn.axisgrid.FacetGrid at 0x179716c89d0>



In [23]:

```
g = sns.catplot(x="sex", y="freetime", col="Pstatus",
                data=df, saturation=.75,
                kind="bar", ci=None, aspect=.6, palette="magma")
(g.set_axis_labels("", "Average Leisure")
.set_xticklabels(["Male", "Female"])
.set_titles("{col_name} {col_var}")
.set(ylim=(0, 5))
.despine(left=True))
```

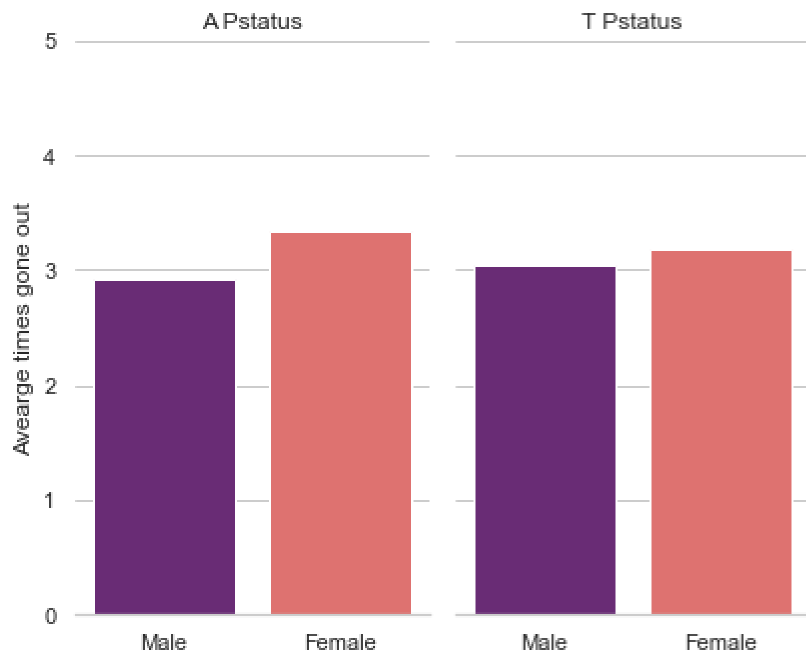
Out[23]: <seaborn.axisgrid.FacetGrid at 0x1797175f250>



In [24]:

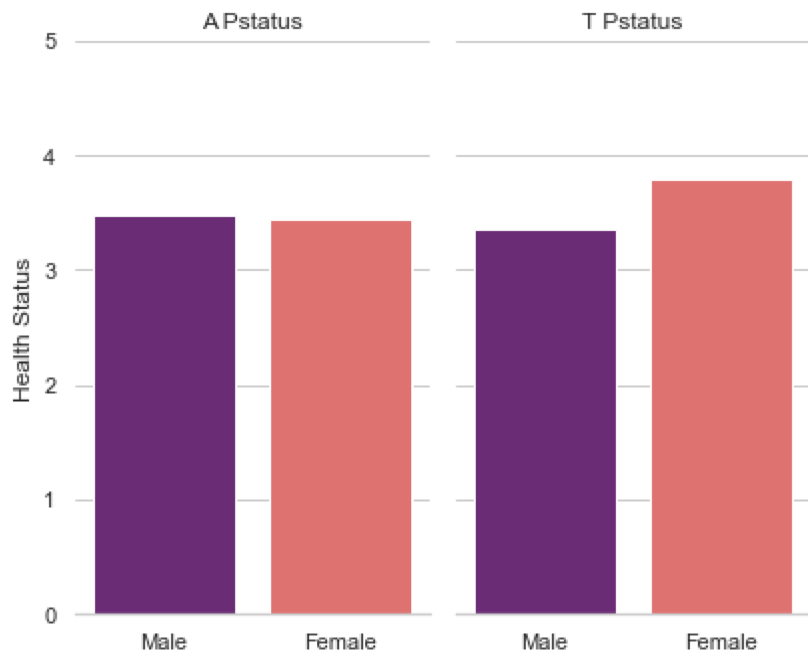
```
g = sns.catplot(x="sex", y="goout", col="Pstatus",
                data=df, saturation=.75,
                kind="bar", ci=None, aspect=.6, palette="magma")
(g.set_axis_labels("", "Avearge times gone out")
.set_xticklabels(["Male", "Female"])
.set_titles("{col_name} {col_var}")
.set(ylim=(0, 5))
.despine(left=True))
```

Out[24]: <seaborn.axisgrid.FacetGrid at 0x179717f1fd0>



In [25]:
```
g = sns.catplot(x="sex", y="health", col="Pstatus",
                data=df, saturation=.75,
                kind="bar", ci=None, aspect=.6, palette="magma")
(g.set_axis_labels("", "Health Status")
.set_xticklabels(["Male", "Female"])
.set_titles("{col_name} {col_var}")
.set(ylim=(0, 5))
.despine(left=True))
```

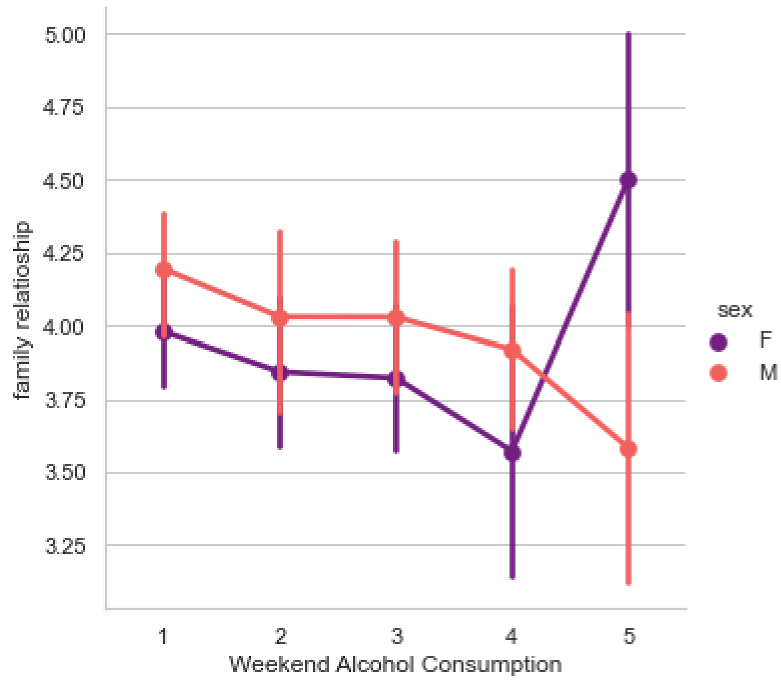
Out[25]: <seaborn.axisgrid.FacetGrid at 0x17971888550>

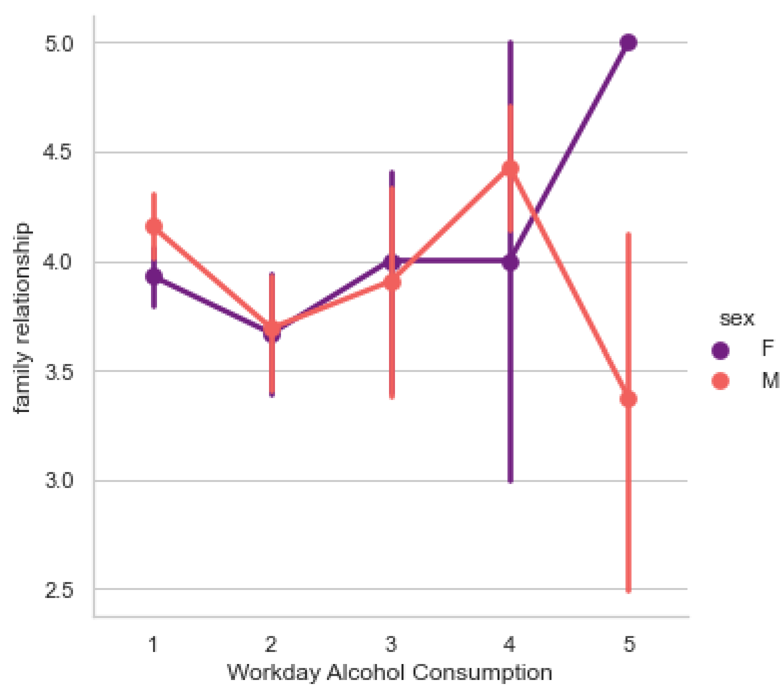


In [26]:
```
plot1 = sns.factorplot(x="Walc", y="famrel", hue="sex", data=df, palette='mag
plot1.set(ylabel="family relatioship", xlabel="Weekend Alcohol Consumption")

plot2 = sns.factorplot(x="Dalc", y="famrel", hue="sex", data=df, palette='mag
plot2.set(ylabel="family relationship", xlabel="Workday Alcohol Consumption")
```

Out[26]: `<seaborn.axisgrid.FacetGrid at 0x179718ecfa0>`

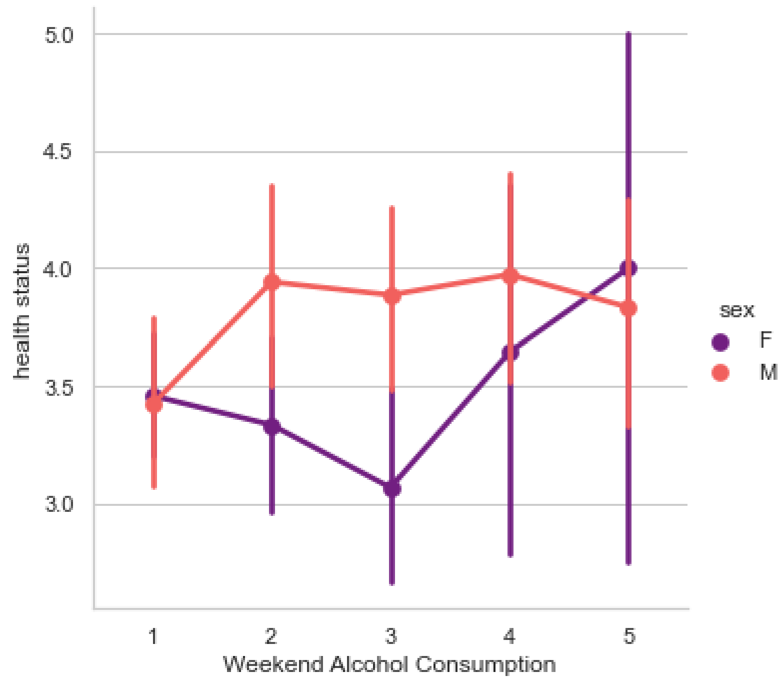


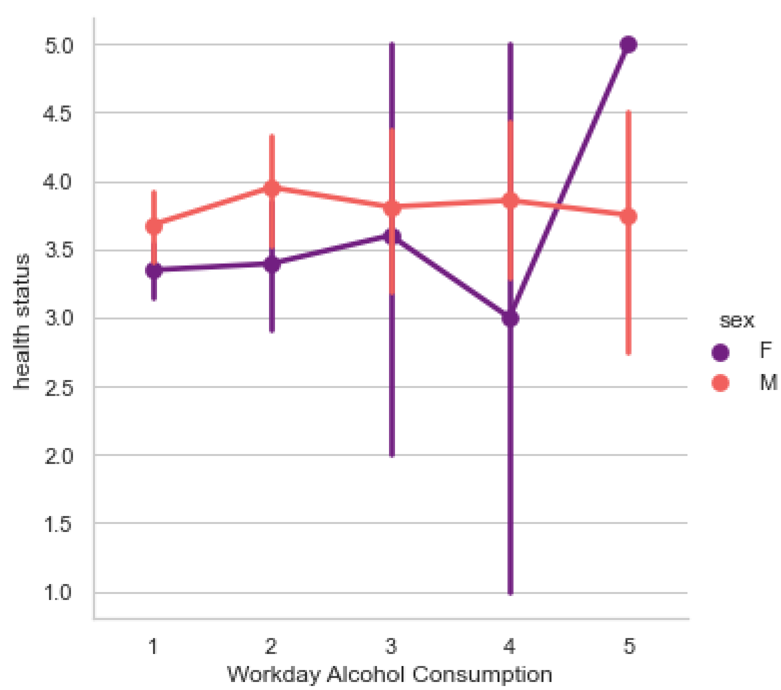


In [27]:
```
plot1 = sns.factorplot(x="Walc", y="health", hue="sex", data=df, palette='mag
plot1.set(ylabel="health status", xlabel="Weekend Alcohol Consumption")

plot2 = sns.factorplot(x="Dalc", y="health", hue="sex", data=df, palette='mag
plot2.set(ylabel="health status", xlabel="Workday Alcohol Consumption")
```

Out[27]: <seaborn.axisgrid.FacetGrid at 0x17971670be0>

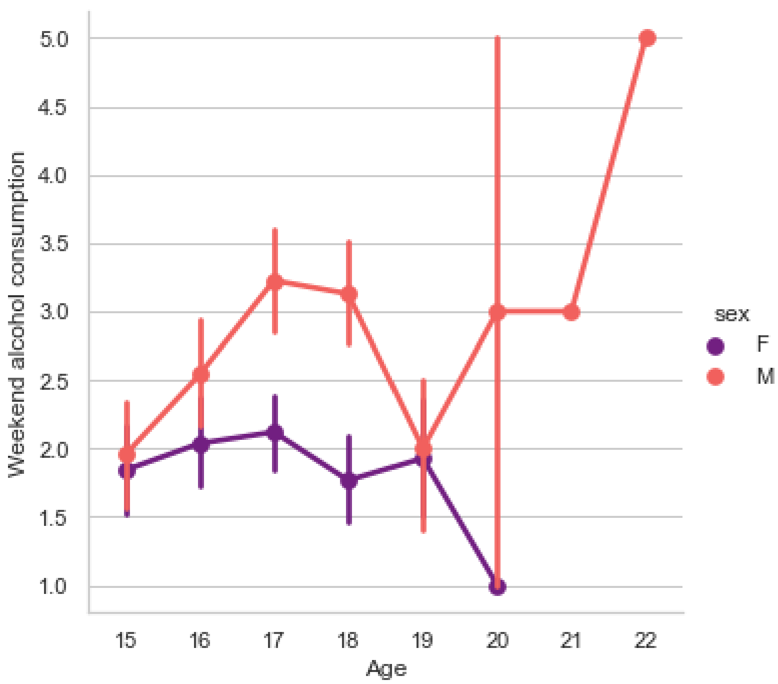


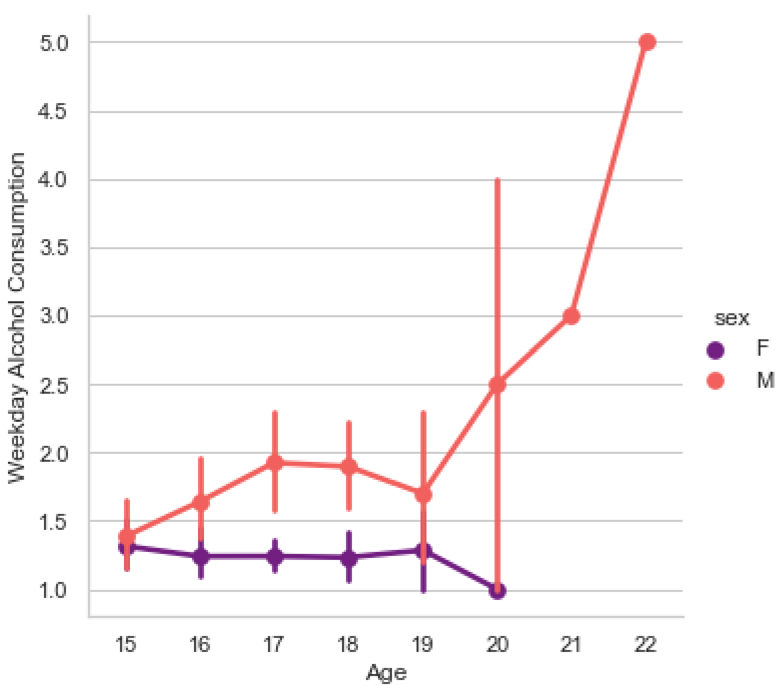


In [28]:
```
plot1 = sns.factorplot(x="age", y="Walc", data=df, palette='magma', hue='sex'
plot1.set(ylabel="Weekend alcohol consumption", xlabel="Age")

plot2 = sns.factorplot(x="age", y="Dalc", data=df, palette='magma', hue='sex'
plot2.set(ylabel="Weekday Alcohol Consumption", xlabel='Age')
```

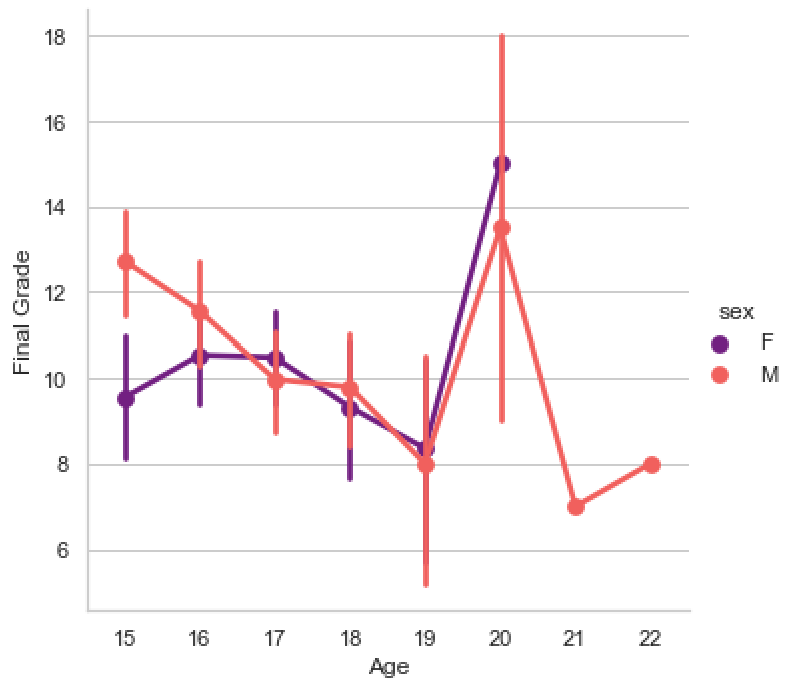
Out[28]: <seaborn.axisgrid.FacetGrid at 0x179717c7580>





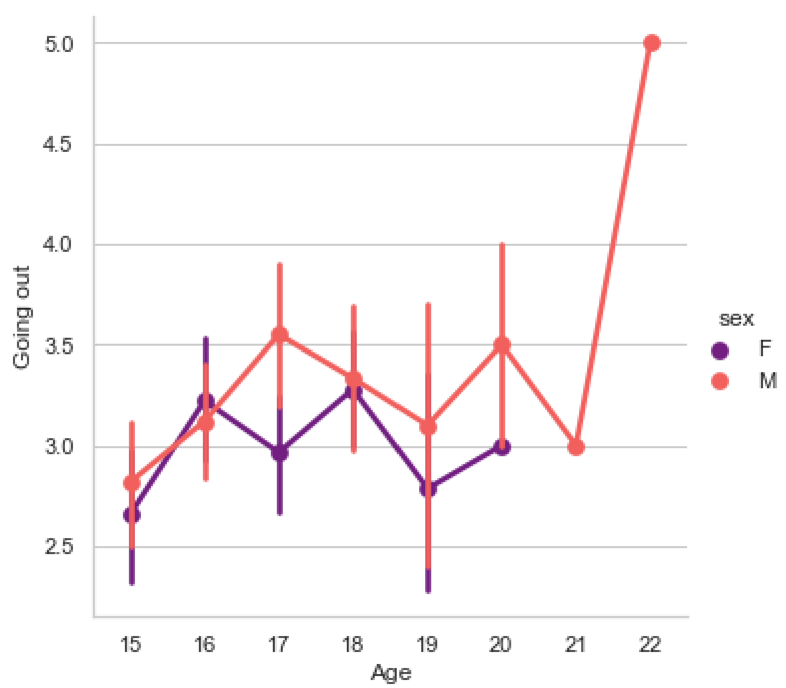
In [29]:
```
plot1 = sns.factorplot(x="age", y="G3", data=df, hue='sex', palette='magma')
plot1.set(ylabel="Final Grade", xlabel="Age")
```

Out[29]: <seaborn.axisgrid.FacetGrid at 0x17971592910>



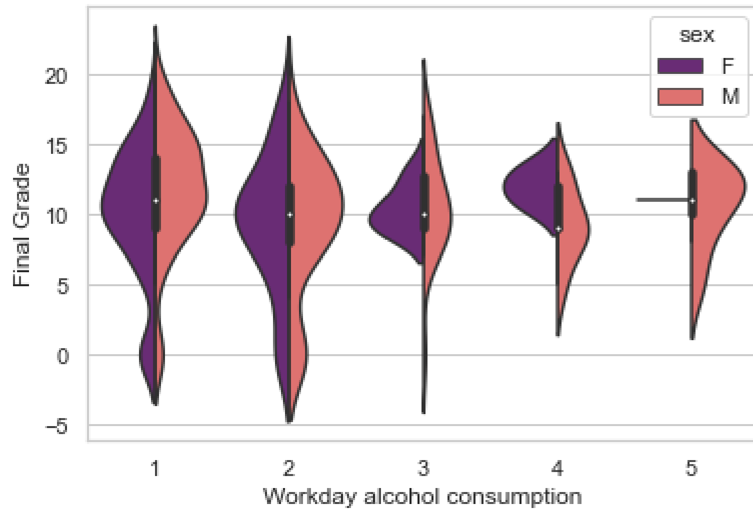
In [30]:
```
plot1 = sns.factorplot(x="age", y="goout", data=df, hue='sex', palette='magma
plot1.set(ylabel="Going out", xlabel="Age")
```

Out[30]: <seaborn.axisgrid.FacetGrid at 0x1796fc02760>



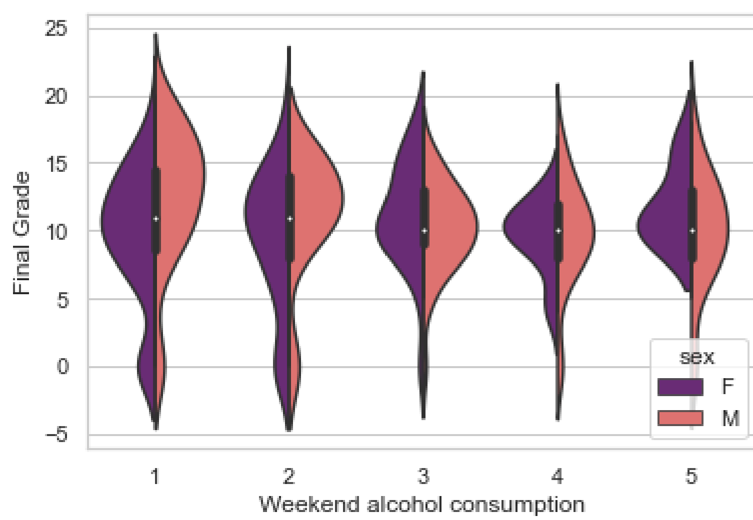
In [31]:
```python
plot2= sns.violinplot(x="Dalc", y="G3", hue="sex",
                      data=df, palette="magma", split=True, dodge='false')
plot2.set(ylabel="Final Grade", xlabel="Workday alcohol consumption")
```

Out[31]:
```
[Text(0, 0.5, 'Final Grade'), Text(0.5, 0, 'Workday alcohol consumption')]
```



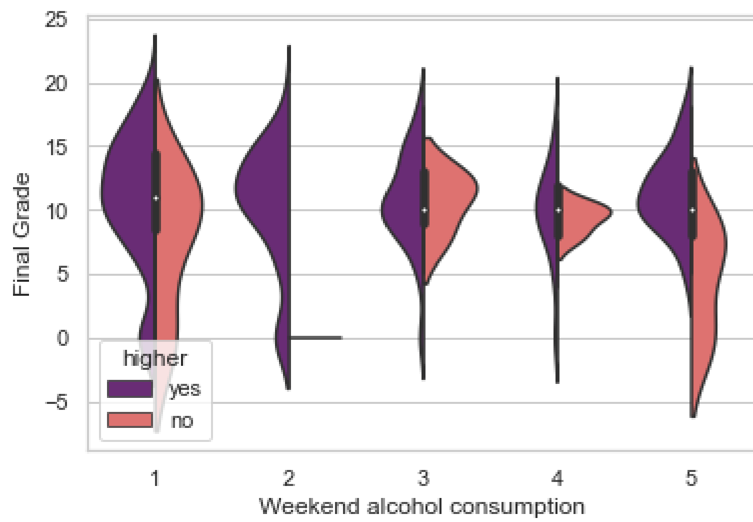
In [32]:
```python
plot2= sns.violinplot(x="Walc", y="G3", hue="sex",
                      data=df, palette="magma", split=True, dodge='false')
plot2.set(ylabel="Final Grade", xlabel="Weekend alcohol consumption")
```

Out[32]:
```
[Text(0, 0.5, 'Final Grade'), Text(0.5, 0, 'Weekend alcohol consumption')]
```



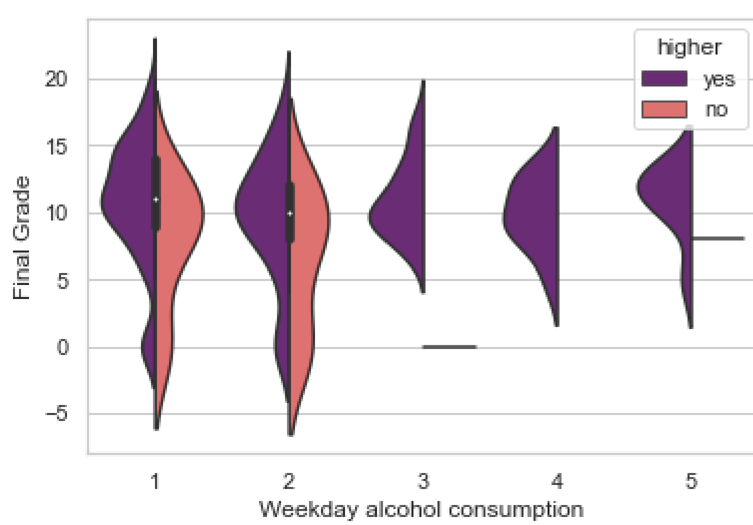
In [33]:
```
plot2= sns.violinplot(x="Walc", y="G3", hue="higher",
                      data=df, palette="magma", split=True, dodge='false')
plot2.set(ylabel="Final Grade", xlabel="Weekend alcohol consumption")
```

Out[33]: `[Text(0, 0.5, 'Final Grade'), Text(0.5, 0, 'Weekend alcohol consumption')]`



In [34]:
```
plot2= sns.violinplot(x="Dalc", y="G3", hue="higher",
                      data=df, palette="magma", split=True, dodge='false')
plot2.set(ylabel="Final Grade", xlabel="Weekday alcohol consumption")
```

Out[34]: `[Text(0, 0.5, 'Final Grade'), Text(0.5, 0, 'Weekday alcohol consumption')]`



In [35]:
```
dfobject=df.select_dtypes(['object'])
len(dfobject.columns)
```

Out[35]: 17

In [36]:
```
def labelencode(columnname):
    df[columnname] = LabelEncoder().fit_transform(df[columnname])
```

In [37]:
```
for i in range(1,len(dfobject.columns)):
    labelencode(dfobject.columns[i])
```

In [38]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 395 entries, 0 to 394
Data columns (total 33 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   school      395 non-null    object
 1   sex         395 non-null    int32
 2   age         395 non-null    int64
 3   address     395 non-null    int32
 4   famsize     395 non-null    int32
 5   Pstatus     395 non-null    int32
 6   Medu        395 non-null    int64
 7   Fedu        395 non-null    int64
 8   Mjob        395 non-null    int32
 9   Fjob        395 non-null    int32
 10  reason      395 non-null    int32
 11  guardian    395 non-null    int32
 12  traveltime  395 non-null    int64
 13  studytime   395 non-null    int64
 14  failures    395 non-null    int64
 15  schoolsup   395 non-null    int32
 16  famsup      395 non-null    int32
 17  paid        395 non-null    int32
 18  activities  395 non-null    int32
 19  nursery     395 non-null    int32
 20  higher      395 non-null    int32
 21  internet    395 non-null    int32
 22  romantic    395 non-null    int32
 23  famrel      395 non-null    int64
 24  freetime    395 non-null    int64
 25  goout       395 non-null    int64
 26  Dalc        395 non-null    int64
 27  Walc        395 non-null    int64
 28  health      395 non-null    int64
 29  absences    395 non-null    int64
 30  G1          395 non-null    int64
 31  G2          395 non-null    int64
 32  G3          395 non-null    int64
dtypes: int32(16), int64(16), object(1)
memory usage: 77.3+ KB
```

In [39]:
```
#Dropping school name for modelling
df1 = df.drop(['school'], axis = 1)
```

In [40]:
```
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.naive_bayes import GaussianNB
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC
from sklearn.neural_network import MLPClassifier
from sklearn.ensemble import AdaBoostClassifier
from sklearn.ensemble import GradientBoostingClassifier
from sklearn.ensemble import ExtraTreesClassifier
from sklearn.linear_model import LogisticRegression
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
from sklearn.preprocessing import LabelEncoder
from xgboost import XGBClassifier
```

In [41]:
```
X = df1.drop('G3', 1)
y = df1['G3']
```

In [42]:
```
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size = 0.30, rar

classifiers = [['DecisionTree :',DecisionTreeClassifier()],
               ['RandomForest :',RandomForestClassifier()],
               ['Naive Bayes :', GaussianNB()],
               ['KNeighbours :', KNeighborsClassifier()],
               ['SVM :', SVC()],
               ['LogisticRegression :', LogisticRegression(max_iter=500)],
               ['Neural Network :', MLPClassifier()],
               ['ExtraTreesClassifier :', ExtraTreesClassifier()],
               ['AdaBoostClassifier :', AdaBoostClassifier()],
               ['GradientBoostingClassifier: ', GradientBoostingClassifier()]

predictions_df = pd.DataFrame()
predictions_df['actual_labels'] = y_test

for name,classifier in classifiers:
    classifier = classifier
    classifier.fit(X_train, y_train)
    predictions = classifier.predict(X_test)
    predictions_df[name.strip(" :")] = predictions
    print(name, accuracy_score(y_test, predictions))
```

```
DecisionTree : 0.2857142857142857
RandomForest : 0.4957983193277311
Naive Bayes : 0.2689075630252101
KNeighbours : 0.3025210084033613
SVM : 0.226890756302521
LogisticRegression : 0.3277310924369748
Neural Network : 0.3445378151260504
ExtraTreesClassifier : 0.40336134453781514
AdaBoostClassifier : 0.2773109243697479
GradientBoostingClassifier:  0.4789915966386555
```

In [43]:
```python
new = df[['G3','failures','Dalc', 'Walc', 'absences', 'famrel', 'health', 'gc
```

In [44]:
```python
new.describe()
```

Out[44]:

	G3	failures	Dalc	Walc	absences	famrel	health	
count	395.000000	395.000000	395.000000	395.000000	395.000000	395.000000	395.000000	3
mean	10.415190	0.334177	1.481013	2.291139	5.708861	3.944304	3.554430	
std	4.581443	0.743651	0.890741	1.287897	8.003096	0.896659	1.390303	
min	0.000000	0.000000	1.000000	1.000000	0.000000	1.000000	1.000000	
25%	8.000000	0.000000	1.000000	1.000000	0.000000	4.000000	3.000000	
50%	11.000000	0.000000	1.000000	2.000000	4.000000	4.000000	4.000000	
75%	14.000000	0.000000	2.000000	3.000000	8.000000	5.000000	5.000000	
max	20.000000	3.000000	5.000000	5.000000	75.000000	5.000000	5.000000	

In [45]:
```python
U = new.drop('G3', 1)
V = new['G3']
```

In [51]:
```
U_train, U_test, V_train, V_test = train_test_split(U,V,test_size = 0.30, rar

classifiers = [['DecisionTree :',DecisionTreeClassifier()],
               ['RandomForest :',RandomForestClassifier()],
               ['Naive Bayes :', GaussianNB()],
               ['KNeighbours :', KNeighborsClassifier()],
               ['SVM :', SVC()],
               ['LogisticRegression :', LogisticRegression(max_iter=500)],
               ['Neural Network :', MLPClassifier()],
               ['ExtraTreesClassifier :', ExtraTreesClassifier()],
               ['AdaBoostClassifier :', AdaBoostClassifier()],
               ['GradientBoostingClassifier: ', GradientBoostingClassifier()]

predictions_df = pd.DataFrame()
predictions_df['actual_labels'] = V_test

for name,classifier in classifiers:
    classifier = classifier
    classifier.fit(U_train, V_train)
    predictions = classifier.predict(U_test)
    predictions_df[name.strip(" :")] = predictions
    print(name, accuracy_score(V_test, predictions))
```

```
DecisionTree : 0.2184873949579832
RandomForest : 0.2857142857142857
Naive Bayes : 0.25210084033613445
KNeighbours : 0.2184873949579832
SVM : 0.33613445378151263
LogisticRegression : 0.3445378151260504
Neural Network : 0.31092436974789917
ExtraTreesClassifier : 0.2184873949579832
AdaBoostClassifier : 0.2605042016806723
GradientBoostingClassifier:  0.25210084033613445
```

In [53]:
```
new = df[['G3','failures','G1', 'G2']]
```

In [54]:
```
C = new.drop('G3', 1)
D = new['G3']
```

In [55]:

```
C_train, C_test, D_train, D_test = train_test_split(C,D,test_size = 0.30, rar

classifiers = [['DecisionTree :',DecisionTreeClassifier()],
               ['RandomForest :',RandomForestClassifier()],
               ['Naive Bayes :', GaussianNB()],
               ['KNeighbours :', KNeighborsClassifier()],
               ['SVM :', SVC()],
               ['LogisticRegression :', LogisticRegression(max_iter=500)],
               ['Neural Network :', MLPClassifier()],
               ['ExtraTreesClassifier :', ExtraTreesClassifier()],
               ['AdaBoostClassifier :', AdaBoostClassifier()],
               ['GradientBoostingClassifier: ', GradientBoostingClassifier()]

predictions_df = pd.DataFrame()
predictions_df['actual_labels'] = D_test

for name,classifier in classifiers:
    classifier = classifier
    classifier.fit(C_train, D_train)
    predictions = classifier.predict(C_test)
    predictions_df[name.strip(" :")] = predictions
    print(name, accuracy_score(D_test, predictions))
```

```
DecisionTree : 0.453781512605042
RandomForest : 0.4957983193277311
Naive Bayes : 0.3865546218487395
KNeighbours : 0.42016806722689076
SVM : 0.5042016806722689
LogisticRegression : 0.5126050420168067
Neural Network : 0.3025210084033613
ExtraTreesClassifier : 0.43697478991596664
AdaBoostClassifier : 0.2773109243697479
GradientBoostingClassifier:  0.46218487394957986
```

In [49]:

```
# In these model I tried to see if weekend and weekly alcohol consumption is
# in a maths class.Logistic regression seems to be the best model among the b
# Based on my analysis, alcohol consumption doesn't actually influence the fi
# Naturally, past failures and grades in first and second exams are better pr
# More observations will most likely boost up the accuracy.
```