insurance-charge

September 13, 2024

1 By Prisca

[1]:
```
#This dataset contains information on the relationship between personal␣
 ↪attributes
#(age, gender, BMI, family size, smoking habits), geographic factors, and their␣
 ↪impact on medical insurance charges.
#It can be used to study how these features influence insurance costs and␣
 ↪develop
#predictive models for estimating healthcare expenses.
```

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

[3]:
```
df=pd.read_csv(r'C:\Users\USER\Documents\dataset\insurance.csv')
```

[4]:
```
df.head()
```

[4]:

	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	yes	southwest	16884.92400
1	18	male	33.770	1	no	southeast	1725.55230
2	28	male	33.000	3	no	southeast	4449.46200
3	33	male	22.705	0	no	northwest	21984.47061
4	32	male	28.880	0	no	northwest	3866.85520

[71]:
```
df.shape # dataset size
```

[71]:
```
(1337, 7)
```

2 data cleaning

[5]:
```
df.isnull().sum()
```

[5]:
```
age         0
sex         0
```

```
bmi         0
children    0
smoker      0
region      0
charges     0
dtype: int64
```

[6]:
```
df.duplicated().sum()
```

[6]:
```
1
```

[7]:
```
# duplicates removed
```

[8]:
```
dfr=df.drop_duplicates(inplace=True)
```

[9]:
```
df.head()
```

[9]:

	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	yes	southwest	16884.92400
1	18	male	33.770	1	no	southeast	1725.55230
2	28	male	33.000	3	no	southeast	4449.46200
3	33	male	22.705	0	no	northwest	21984.47061
4	32	male	28.880	0	no	northwest	3866.85520

[10]:
```
df.shape
```

[10]:
```
(1337, 7)
```

[11]:
```
df.groupby('sex')['smoker'].value_counts()

# we have 547 female that smoke ,115 that doesnt smoke, which means the number
 ↪of female that smaoke is high
#we have 516 male that doesnt smoke  and 159 that smoke
# female some more than male
```

[11]:
```
sex     smoker
female  no        547
        yes       115
male    no        516
        yes       159
Name: count, dtype: int64
```

[12]:
```
ft=df.groupby('region')['charges'].aggregate(['sum','mean'])
```

[13]:
```
ft
```

[13]:
```
                    sum          mean
region
northeast  4.343669e+06  13406.384516
northwest  4.034072e+06  12450.840844
southeast  5.363690e+06  14735.411438
southwest  4.012755e+06  12346.937377
```

[14]:
```
df.head()
```

[14]:

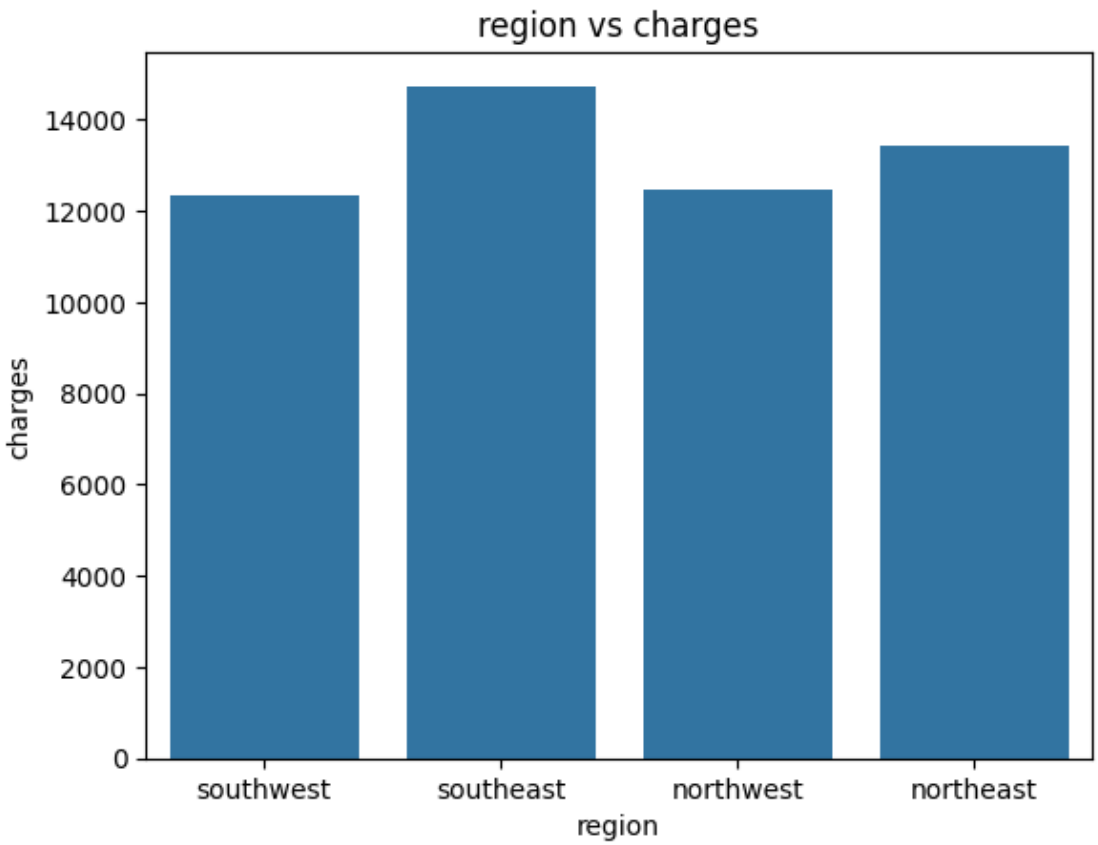
	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	yes	southwest	16884.92400
1	18	male	33.770	1	no	southeast	1725.55230
2	28	male	33.000	3	no	southeast	4449.46200
3	33	male	22.705	0	no	northwest	21984.47061
4	32	male	28.880	0	no	northwest	3866.85520

[15]:
```
# visualization
```

[16]:
```
import warnings
warnings . filterwarnings('ignore')
```

[17]:
```
sns.barplot(x='region',y='charges', data=df , ci=None)
plt.title('region vs charges')

# south East seems to be the highest who engage more in insurnce, the east␣
 ↪region at large
# the company is not getting more client from the west region
```

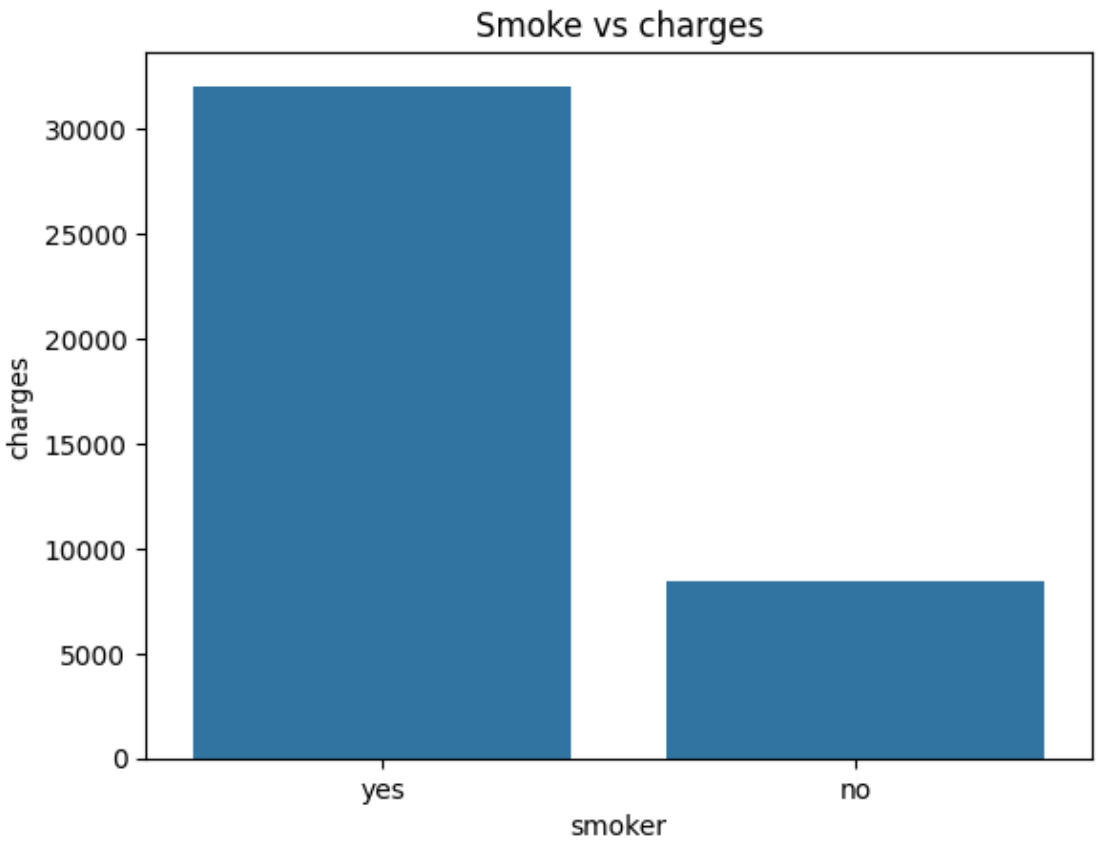
[17]:
```
Text(0.5, 1.0, 'region vs charges')
```



[ ]:

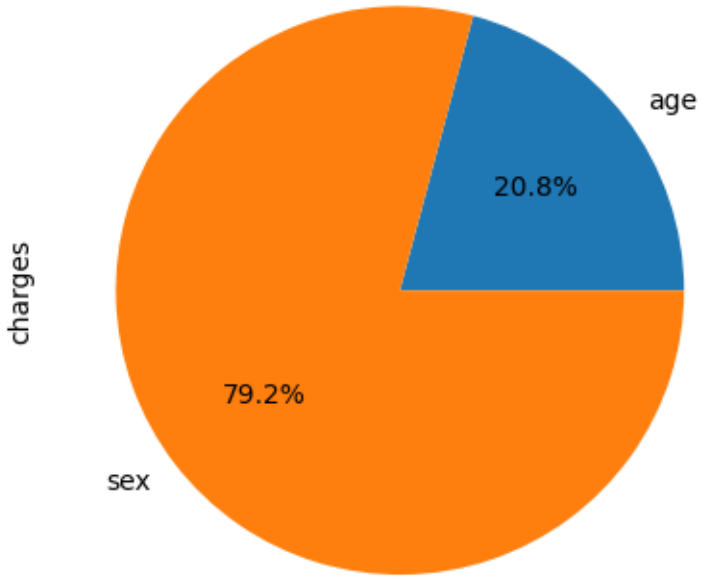
[18]:
```
sns.barplot(x='smoker',y='charges', data=df , ci=None)
plt.title('Smoke vs charges')

# this chart shows that high percent of the who are insured are smokers
```

[18]: Text(0.5, 1.0, 'Smoke vs charges')



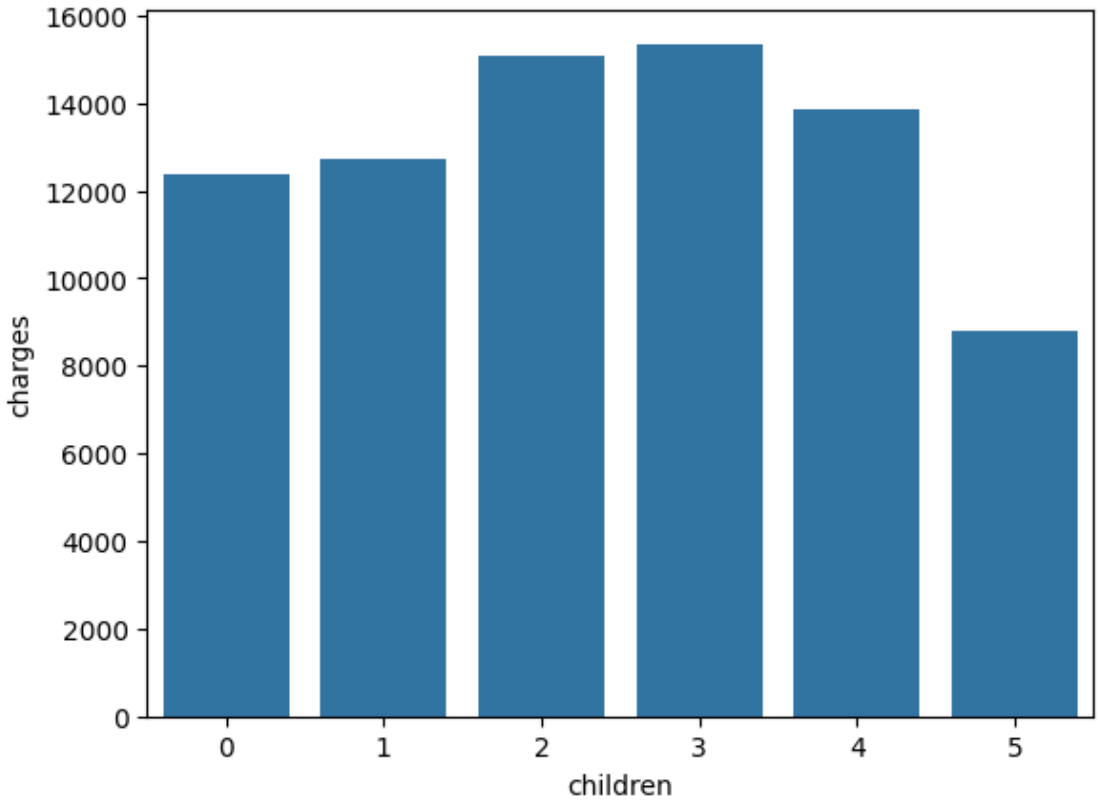
[19]:
```
df.groupby('smoker')['charges'].mean().plot(kind='pie', autopct='%1.1f%%',␣
↪labels=df)

# shows that 79.2% of the company customers are smokers
```

[19]: <Axes: ylabel='charges'>



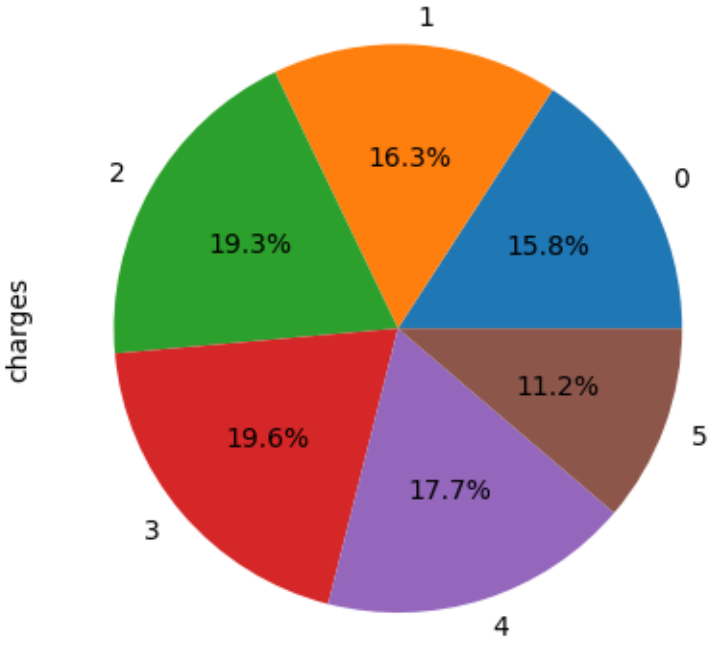
[20]:
```
sns.barplot(x='children',y='charges',data=df,ci=None)
# this shows that people who have 3-4 children are more interested in insurance
```

[20]:
```
<Axes: xlabel='children', ylabel='charges'>
```



[21]:
```
df.groupby('children')['charges'].mean().plot(kind='pie', autopct='%1.1f%%', )
 #only 11.2% of families with large children buys insurance
```

[21]: <Axes: ylabel='charges'>



[22]:
```
df.head()
```

[22]:

	age	sex	bmi	children	smoker	region	charges
0	19	female	27.900	0	yes	southwest	16884.92400
1	18	male	33.770	1	no	southeast	1725.55230
2	28	male	33.000	3	no	southeast	4449.46200
3	33	male	22.705	0	no	northwest	21984.47061
4	32	male	28.880	0	no	northwest	3866.85520

[ ]:
```
```

[27]:
```
dfr=df.groupby(['sex','smoker'])[['age','charges']].mean()
```

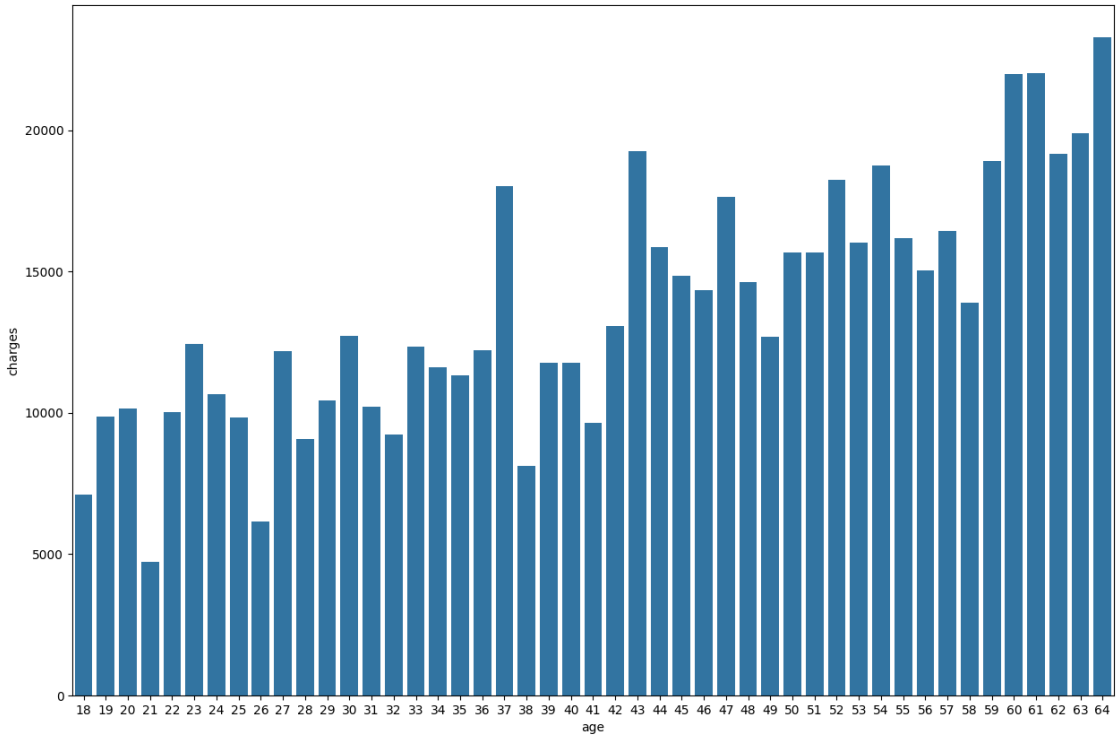
[28]:
```
dfr
```

[28]:

sex	smoker	age	charges
female	no	39.691042	8762.297300
	yes	38.608696	30678.996276
male	no	39.100775	8099.700161
	yes	38.446541	33042.005975

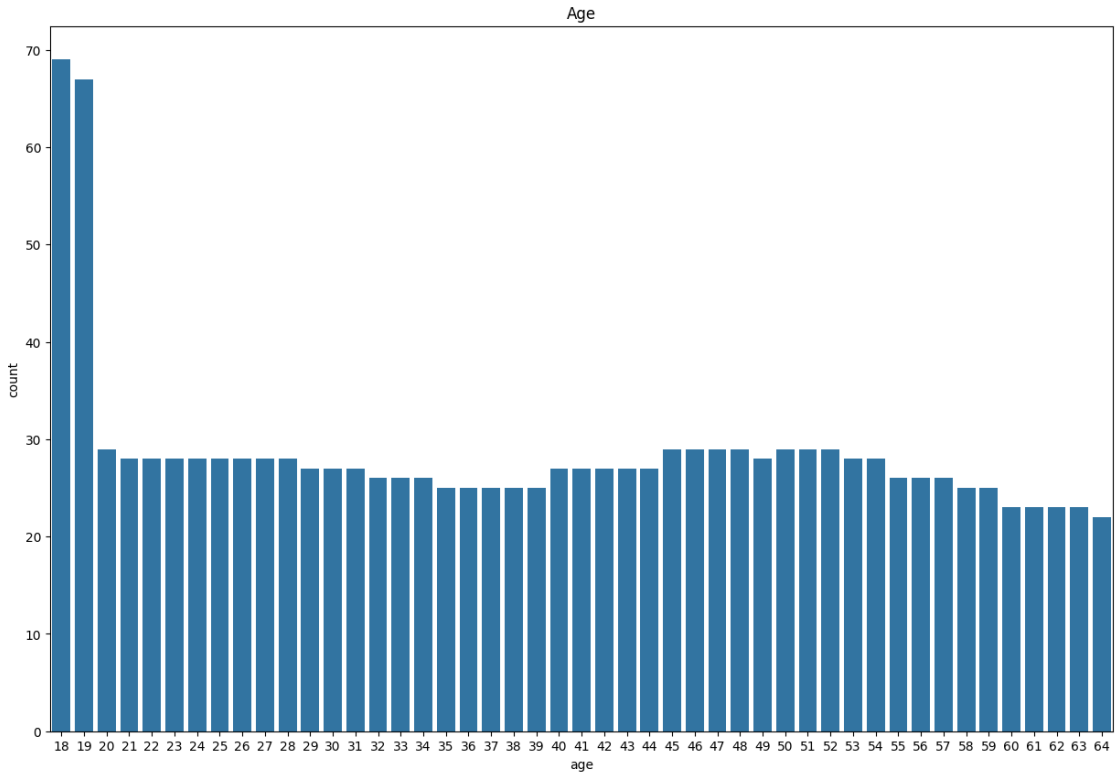
[42]:
```
plt.figure(figsize=(15,10))
sns.barplot(x='age',y='charges', data=df,ci=None)

# from this chart, you can see that the age of 37 and above purchase high␣
↪premium plans
```

[42]: <Axes: xlabel='age', ylabel='charges'>



[84]:
```
plt.figure(figsize=(15,10))
sns.countplot(x='age',data=df)
plt.title('Age')
```

[84]: Text(0.5, 1.0, 'Age')

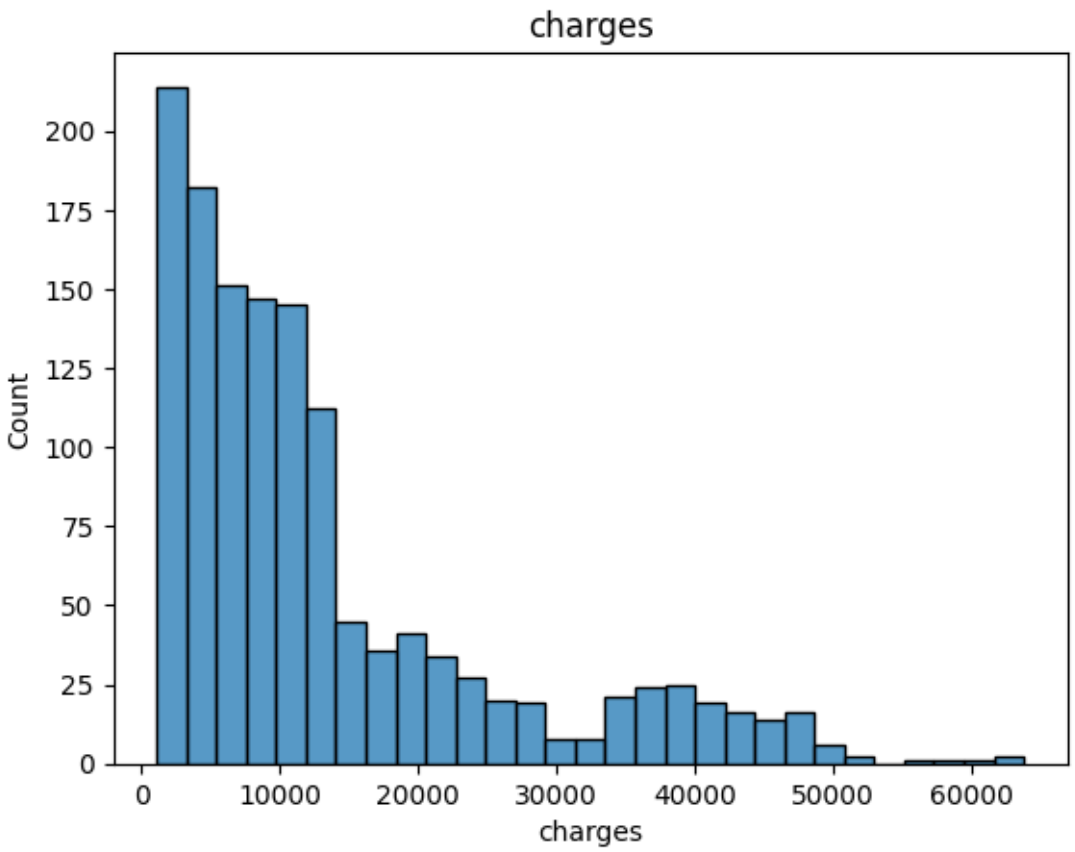


[40]:
```
df['age'].aggregate(['max','min'])
# the older client in the company is 64
# the least is 18 years
# if age 18 and 19 is this high in the insurance company, the premium plan the␣
 ↪will purchase will be the least
# it best the company diversfy into getting older people more because they have␣
 ↪the funds and will purchase high premium package
```

[40]:
```
max    64
min    18
Name: age, dtype: int64
```

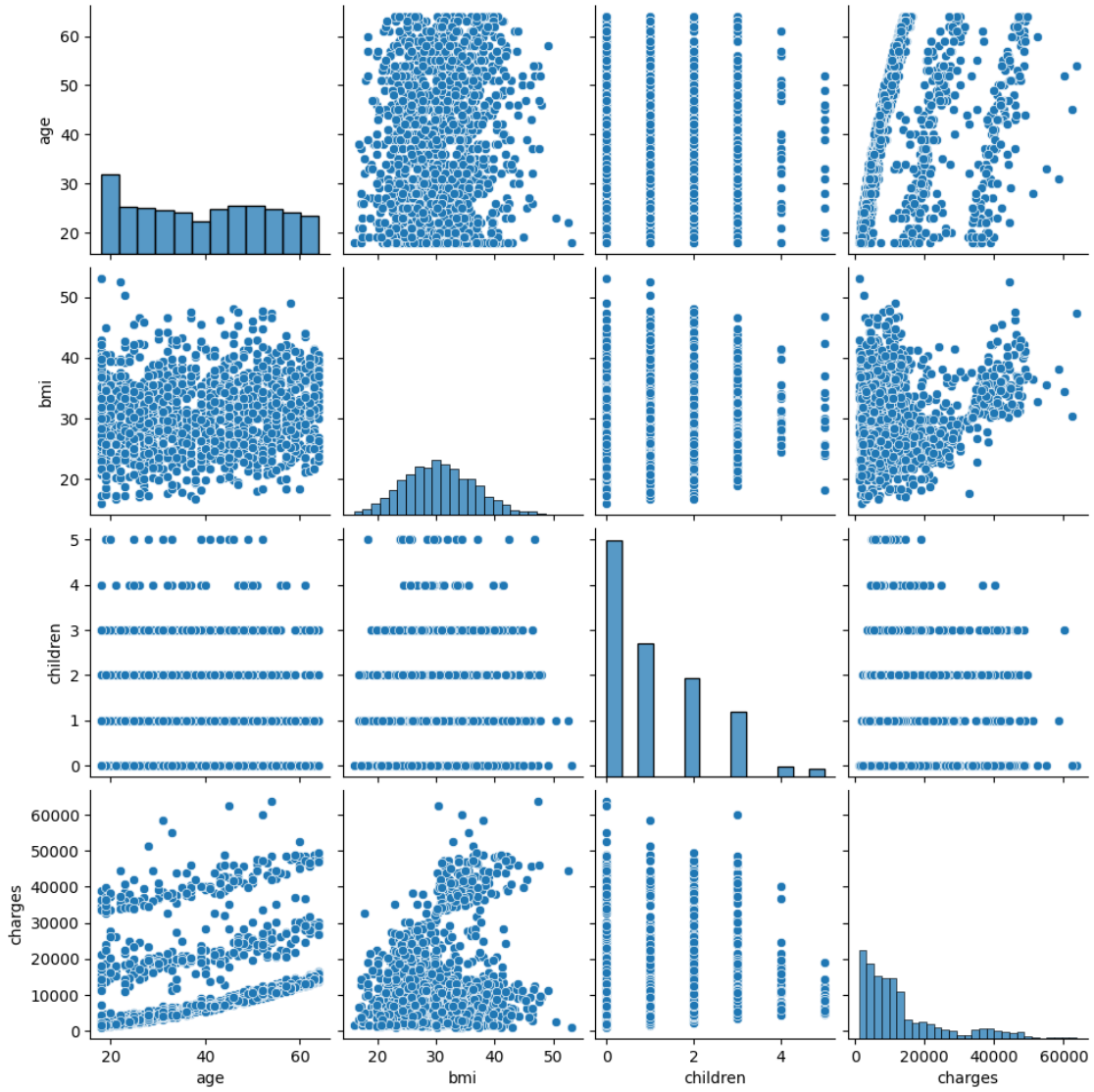
[82]:
```
sns.histplot(x='charges',data=df)
plt.title('charges')
# the clients who purchase 60,000 premium plan is very very low, while client␣
 ↪who purchase below 10,000 is extremely high
#this is why the revenue isnt growing
```

[82]:
```
Text(0.5, 1.0, 'charges')
```



[79]:
```
sns.pairplot(df)
# plotting all variable
```

[79]: <seaborn.axisgrid.PairGrid at 0x12eda1fa790>



[44]:
```
# convert categorical data to numerical
```

[45]:
```
from  sklearn .preprocessing import LabelEncoder
```

[46]:
```
le=LabelEncoder()
```

[47]:
```
df_in=df.copy() # copied the df beacuse i dont want the main df altered
```

[50]:
```
df_in['sex']=le.fit_transform(df_in['sex'])
```

[53]:
```
df_in['region']=le. fit_transform(df_in['region'])
```

[55]:
```
df_in['smoker']=le.fit_transform(df_in['smoker'])
```

[61]:
```
df_in.columns
```

[61]:
```
Index(['age', 'sex', 'bmi', 'children', 'smoker', 'region', 'charges'],
dtype='object')
```

[72]:
```
# correlation
```

[73]:
```
df_corr=df_in.corr()
```

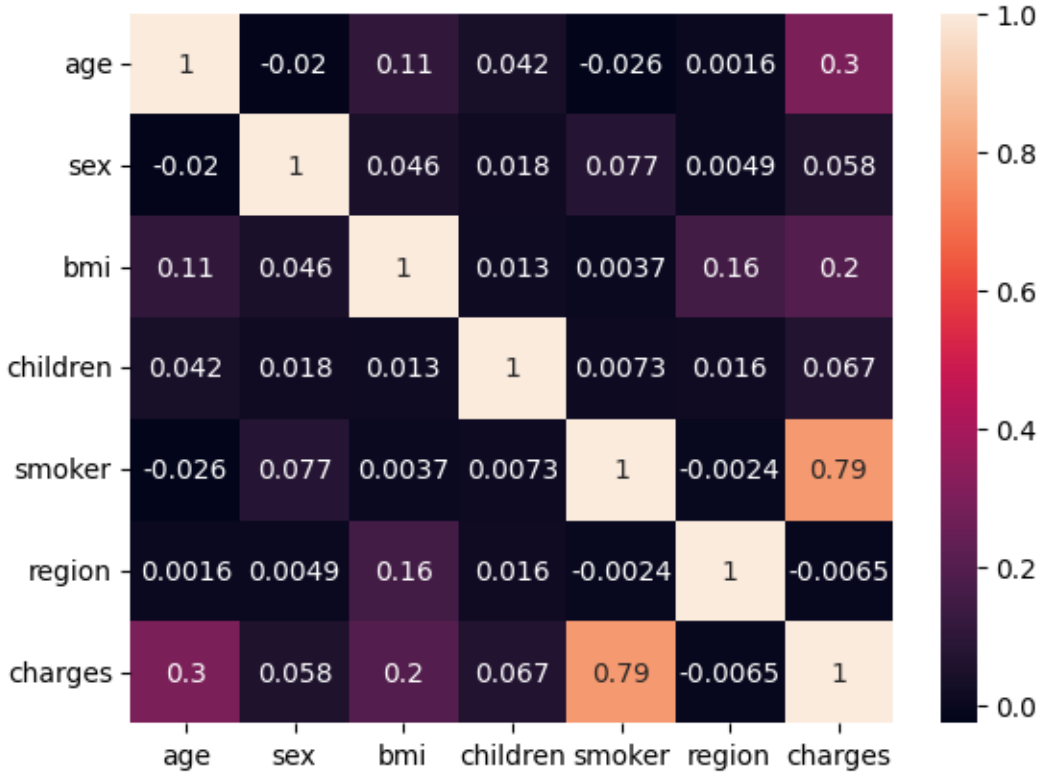
[74]:
```
df_corr
```

[74]:

	age	sex	bmi	children	smoker	region	charges
age	1.000000	-0.019814	0.109344	0.041536	-0.025587	0.001626	0.298308
sex	-0.019814	1.000000	0.046397	0.017848	0.076596	0.004936	0.058044
bmi	0.109344	0.046397	1.000000	0.012755	0.003746	0.157574	0.198401
children	0.041536	0.017848	0.012755	1.000000	0.007331	0.016258	0.067389
smoker	-0.025587	0.076596	0.003746	0.007331	1.000000	-0.002358	0.787234
region	0.001626	0.004936	0.157574	0.016258	-0.002358	1.000000	-0.006547
charges	0.298308	0.058044	0.198401	0.067389	0.787234	-0.006547	1.000000

[76]:
```
sns.heatmap(df_corr,annot=True)  # no high correlation detected to affect the␣
↪analysis
```

[76]:
```
<Axes: >
```



[ ]:

[ ]:

[ ]:

[63]:
```
x=df_in[['age', 'sex', 'bmi', 'children', 'smoker', 'region']]
y=df_in['charges']
```

[64]:
```
from sklearn .model_selection import train_test_split
```

[66]:
```
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,random_state=0)
```

3 Normalization

[58]:
```
from sklearn.preprocessing import MinMaxScaler
```

[60]:
```
scaler=MinMaxScaler()
```

[68]:
```
x_train=scaler.fit_transform(x_train)
x_test=scaler.transform(x_test)
```

[69]:
```
x_train.shape,x_test.shape
```

[69]:
```
((1069, 6), (268, 6))
```

[90]:
```
# build the model
```

[92]:
```
from sklearn.linear_model import LinearRegression
```

[93]:
```
model=LinearRegression()
```

[94]:
```
model.fit(x_train,y_train)
```

[94]:
```
LinearRegression()
```

[95]:
```
model.score(x_train,y_train)
```

[95]:
```
0.7487799749798774
```

4 predictions

[96]:
```
ypred=model.predict(x_test)
```

[97]:
```
pd.DataFrame({'actual':y_test,
              'predicted':ypred})
```

[97]:

	actual	predicted
1248	1633.96180	5249.621104
610	8547.69130	9614.071648
393	9290.13950	11264.864969
503	32548.34050	26114.255762
198	9644.25250	6987.316658
…	…	…
809	3309.79260	3702.024500
726	6664.68595	8024.566821
938	2304.00220	1835.569009
474	25382.29700	34190.783511
1084	15019.76005	14500.160201

[268 rows x 2 columns]

5 model Evaluation

[99]:
```
from sklearn .metrics import r2_score
```

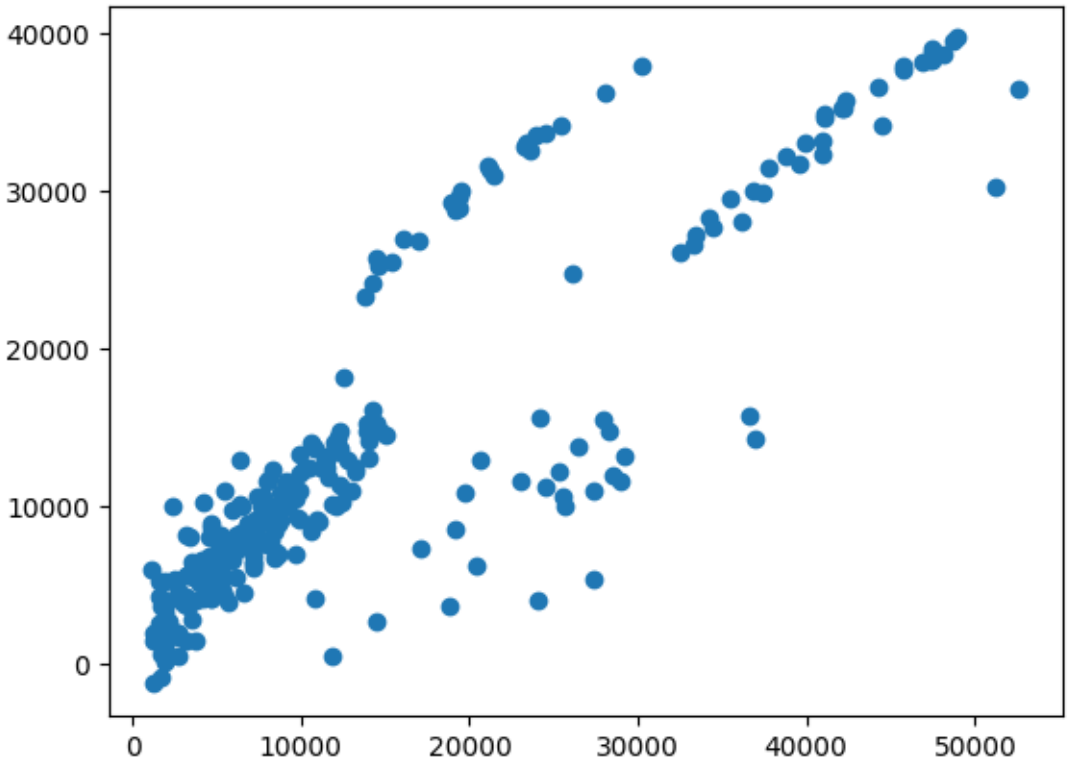
[108]:
```
r2_score(y_test,ypred) # accuracy score
```

[108]:
```
0.7526726290709554
```

[ ]:
```

```

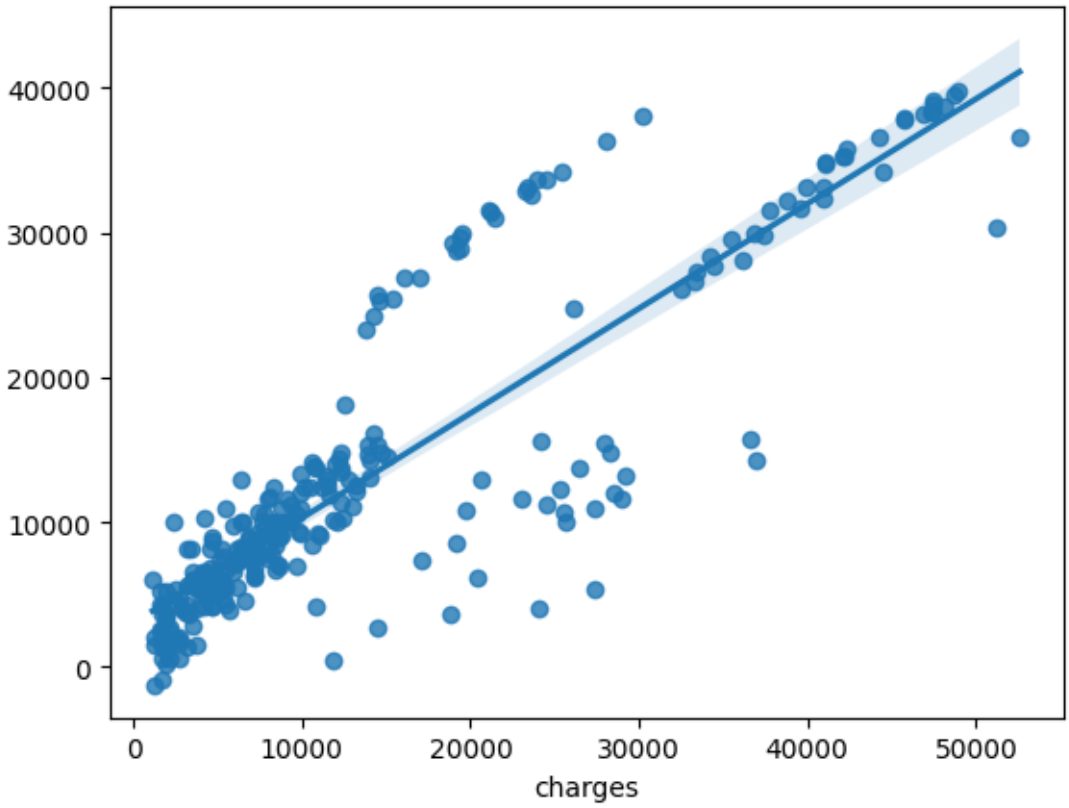
[105]:
```
plt.scatter(y_test,ypred)
```

[105]:
```
<matplotlib.collections.PathCollection at 0x12ee26369a0>
```



[107]:
```
sns.regplot(x=y_test,y=ypred)
```

[107]:
```
<Axes: xlabel='charges'>
```



6 validation

[110]:
```
from  sklearn.model_selection import KFold,cross_val_score
```

[111]:
```
kf=KFold(n_splits=5)
score=cross_val_score(model,x_train,y_train,cv=kf)
```

[113]:
```
score # no overfitting
```

[113]:
```
array([0.79074606, 0.63446072, 0.77162343, 0.74968057, 0.75313448])
```

[115]:
```
df_in.head()
```

[115]:

	age	sex	bmi	children	smoker	region	charges
0	19	0	27.900	0	1	3	16884.92400
1	18	1	33.770	1	0	2	1725.55230
2	28	1	33.000	3	0	2	4449.46200
3	33	1	22.705	0	0	1	21984.47061
4	32	1	28.880	0	0	1	3866.85520

7 model testing

[116]:
```
model.predict(scaler.transform([[18        ,1,        33.
↪770,        1        ,0,        2]]))
```

[116]:
```
array([3677.86055258])
```

[118]:
```
model.predict(scaler.transform([[32,        1,        28.
↪880,        0,        0        ,1        ]])) # model can still be modified
```

[118]:
```
array([5475.68705239])
```

8 conclusion

[ ]:
```
# Age ,bmi,and smoker are the features that impact highly on insurance charges
```

9 findings

[121]:
```
# the highest age of the client companies is 64 and lowest 18.
# this data shows that below 10000 premium charge are highly purchased than␣
↪that of 60000.
# the family size that purchase insurance in this company ranges from 3 and 4␣
↪sizes.
# the region that purchase more insurance are east region
# because the company has high teanagers who cant afford high insurance charge,␣
↪the company sales will be low
```

10 recommendation

[123]:
```
# To increase the sales and growth, they should implement the following:
# 1,Put effort into advertising their product to older people( 37yrs and above)␣
↪because the have the resource and
# high chances to buying high premium plan.
# 2,put bill boards or send their marketers to the west regions to escout more␣
↪client
# 3 they should educated and convince large families into buying insurance
```

[ ]:
```

```