```
import pandas as pd
import numpy as np
import seaborn as sns
import matplotlib.pyplot as plt

from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
from sklearn import metrics

import warnings
warnings.filterwarnings('ignore')

df = pd.read_csv('insurance.csv')

df.head()
```

	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

```
df.info
```

```
<bound method DataFrame.info of       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
...   ...     ...     ...       ...    ...        ...          ...
1333   50    male  30.970         3     no  northwest  10600.54830
1334   18  female  31.920         0     no  northeast   2205.98080
1335   18  female  36.850         0     no  southeast   1629.83350
1336   21  female  25.800         0     no  southwest   2007.94500
1337   61  female  29.070         0    yes  northwest  29141.36030

[1338 rows x 7 columns]>
```

There are no missing values

```
df.shape
```

```
(1338, 7)
```

```
df.isnull().sum()
```

```
age         0
sex         0
```

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

```
df['region'].value_counts().sort_values()
```

```
region
northeast    324
southwest    325
northwest    325
southeast    364
Name: count, dtype: int64
```

```
df['children'].value_counts().sort_values()
```

```
children
5     18
4     25
3    157
2    240
1    324
0    574
Name: count, dtype: int64
```

```
df['sex'].value_counts()
```

```
sex
male      676
female    662
Name: count, dtype: int64
```

```
df['smoker'].value_counts()
```

```
smoker
no     1064
yes     274
Name: count, dtype: int64
```

Now Data Analysis and Visualization

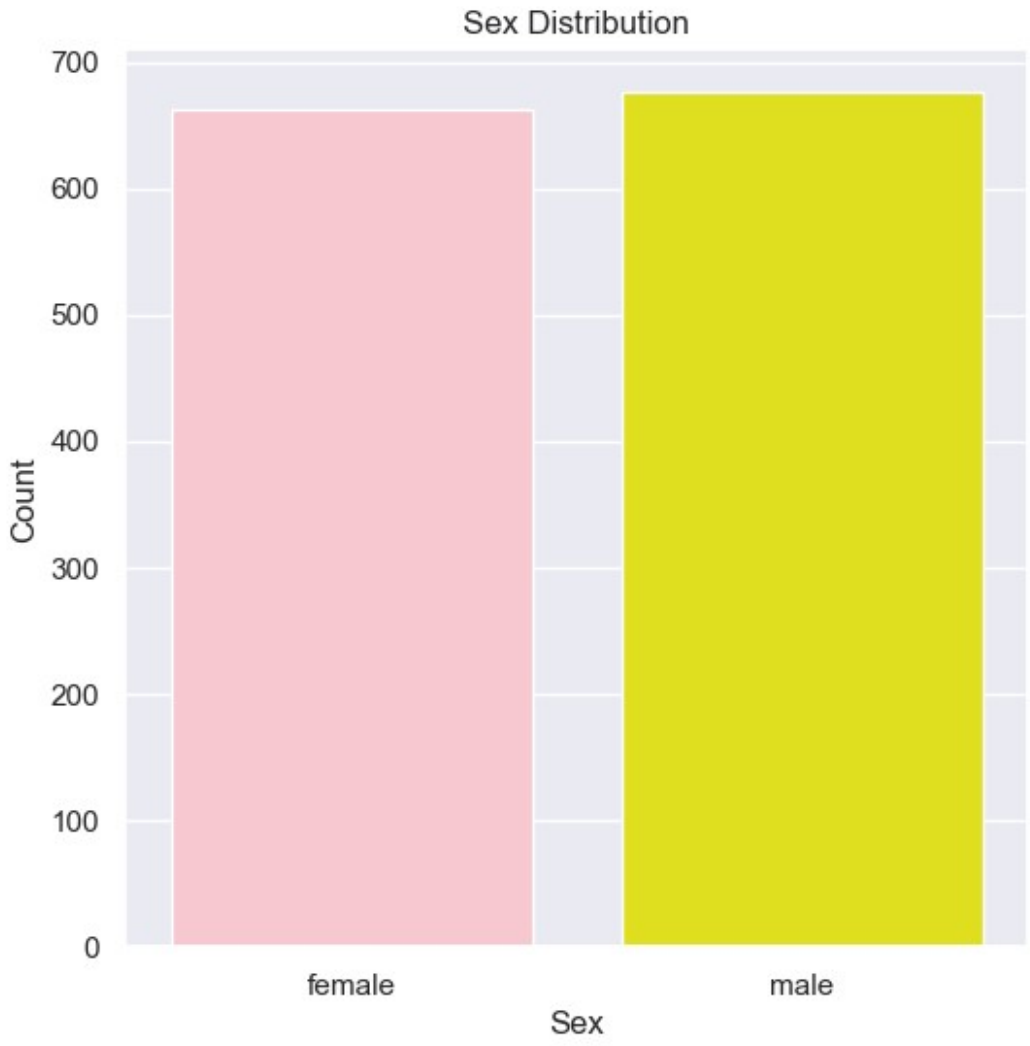
```
df.describe()
```

```
                age          bmi     children       charges
count  1338.000000  1338.000000  1338.000000   1338.000000
mean     39.207025    30.663397     1.094918  13270.422265
std      14.049960     6.098187     1.205493  12110.011237
min      18.000000    15.960000     0.000000   1121.873900
25%      27.000000    26.296250     0.000000   4740.287150
```

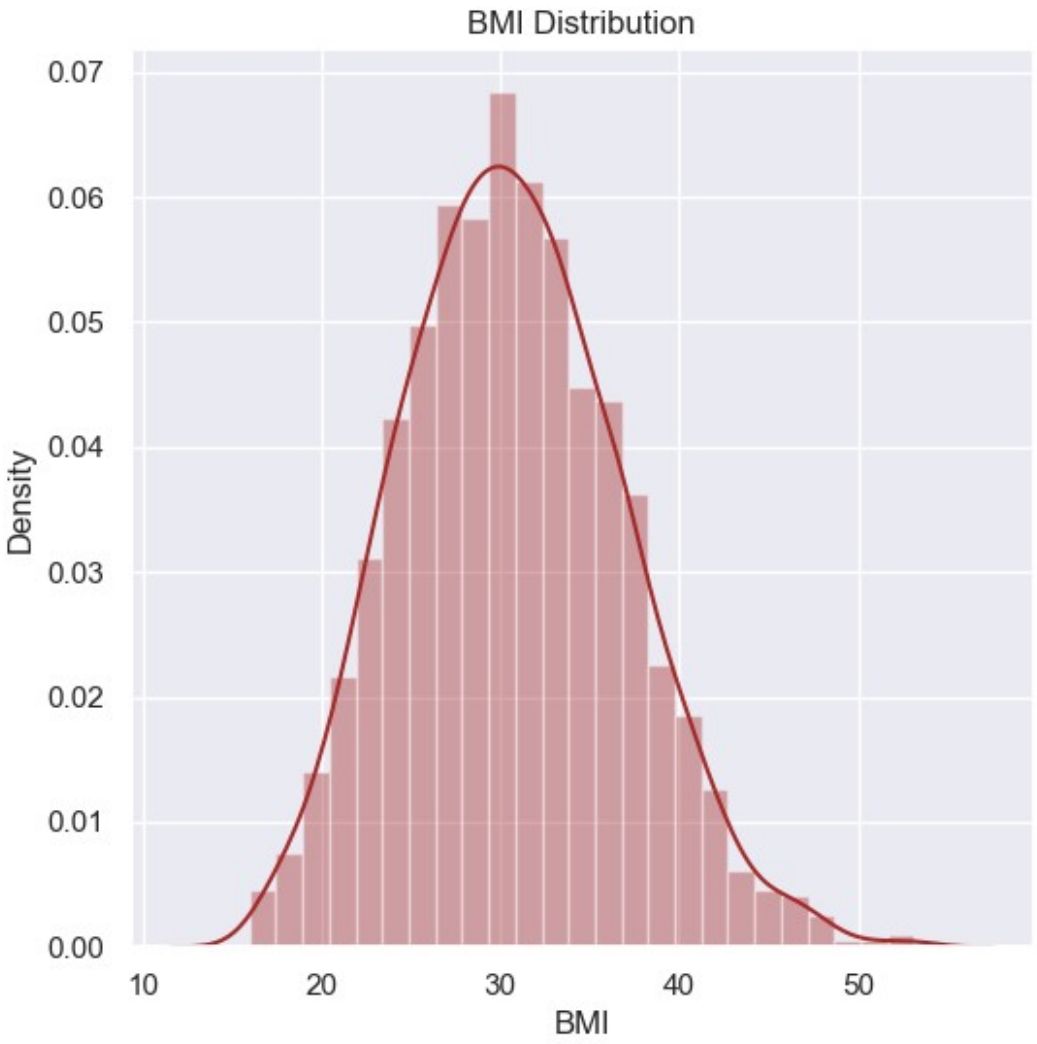
```
50%      39.000000    30.400000     1.000000   9382.033000
75%      51.000000    34.693750     2.000000  16639.912515
max      64.000000    53.130000     5.000000  63770.428010
```

```
sns.set()
plt.figure(figsize=(5, 5))
sns.distplot(df['age'], color='green')
plt.title('Age Distribution')
plt.xlabel('Age')
plt.ylabel('Density')
plt.show()
```

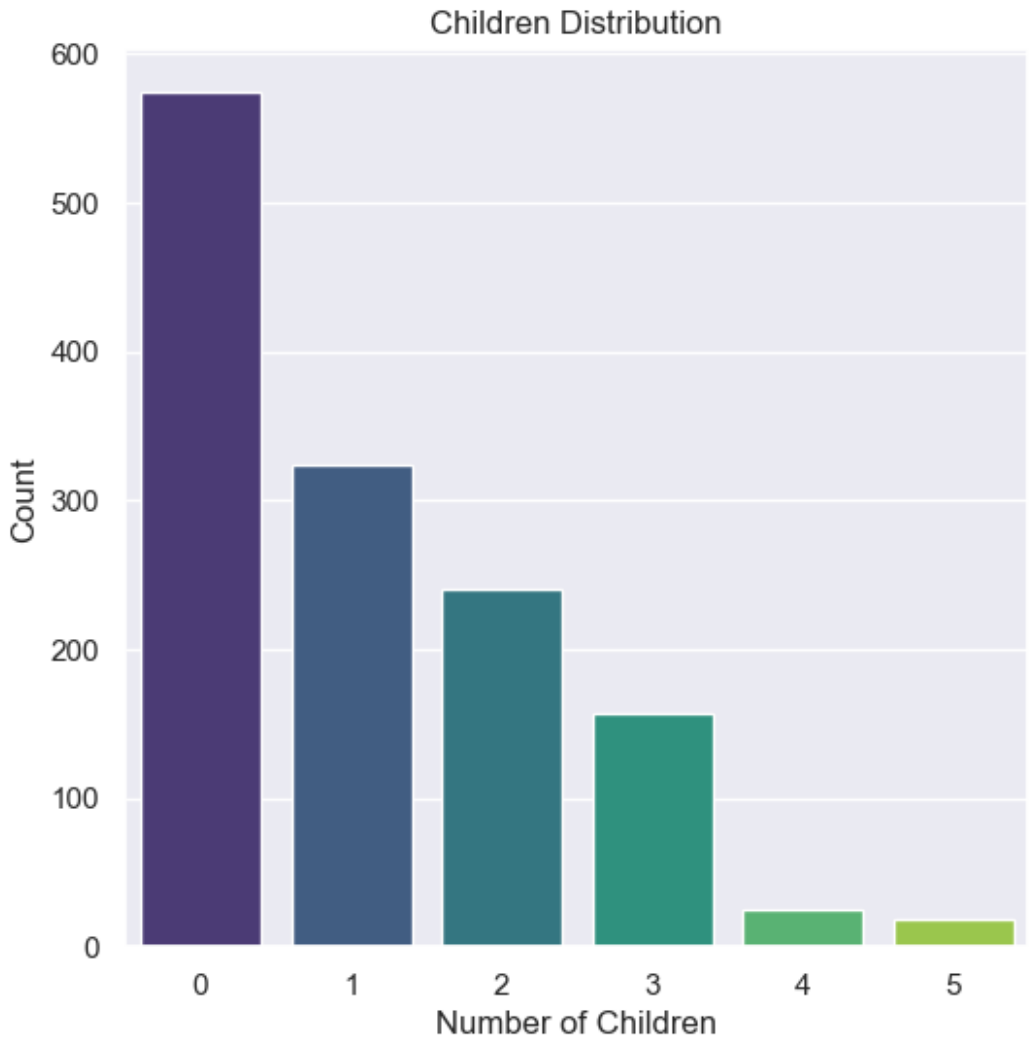

```
sns.set()
plt.figure(figsize=(6, 6))
sns.countplot(x='sex', data=df, palette=['pink', 'yellow'])
plt.title('Sex Distribution')
plt.xlabel('Sex')
plt.ylabel('Count')
plt.show()
```



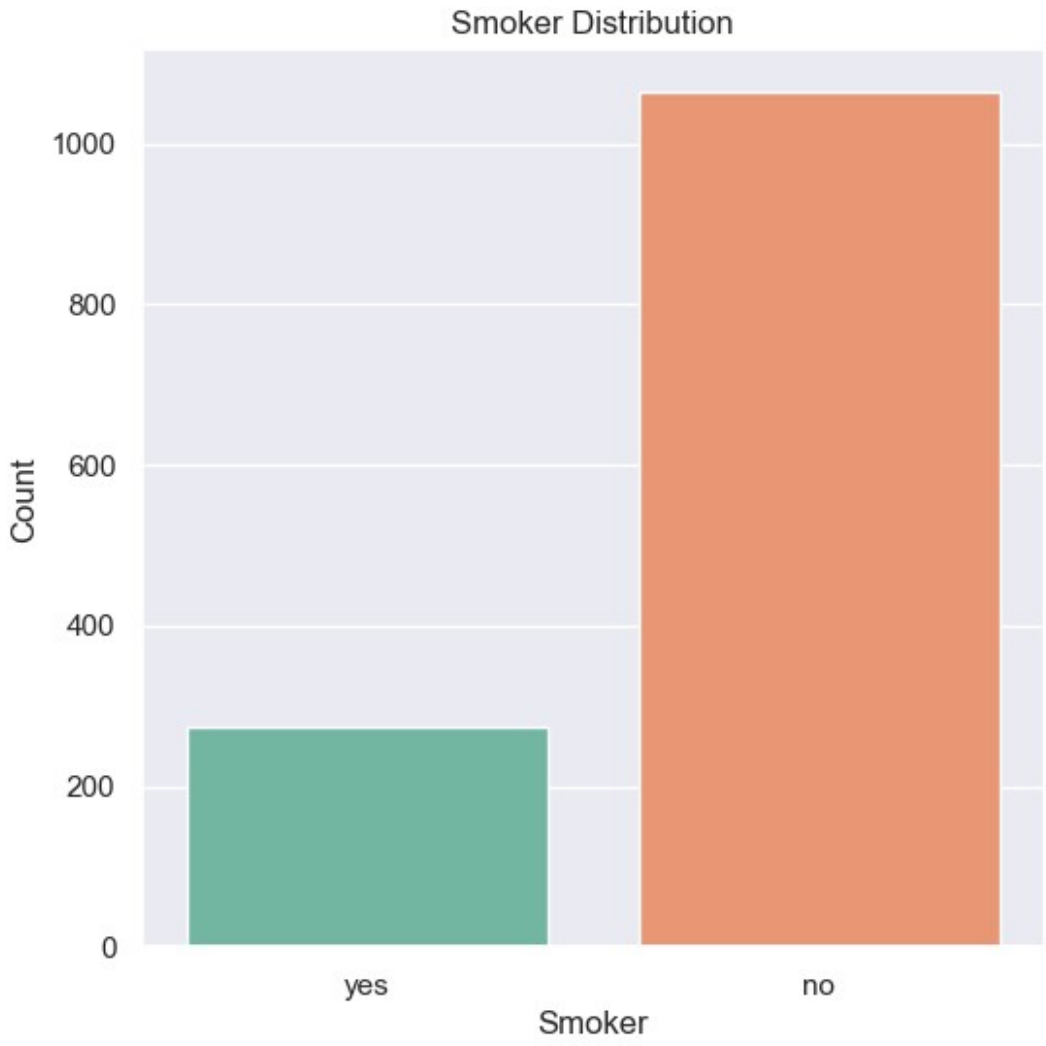

```
sns.set()
plt.figure(figsize=(6, 6))
sns.distplot(df['bmi'], color='brown')
plt.title('BMI Distribution')
plt.xlabel('BMI')
plt.ylabel('Density')
plt.show()
```



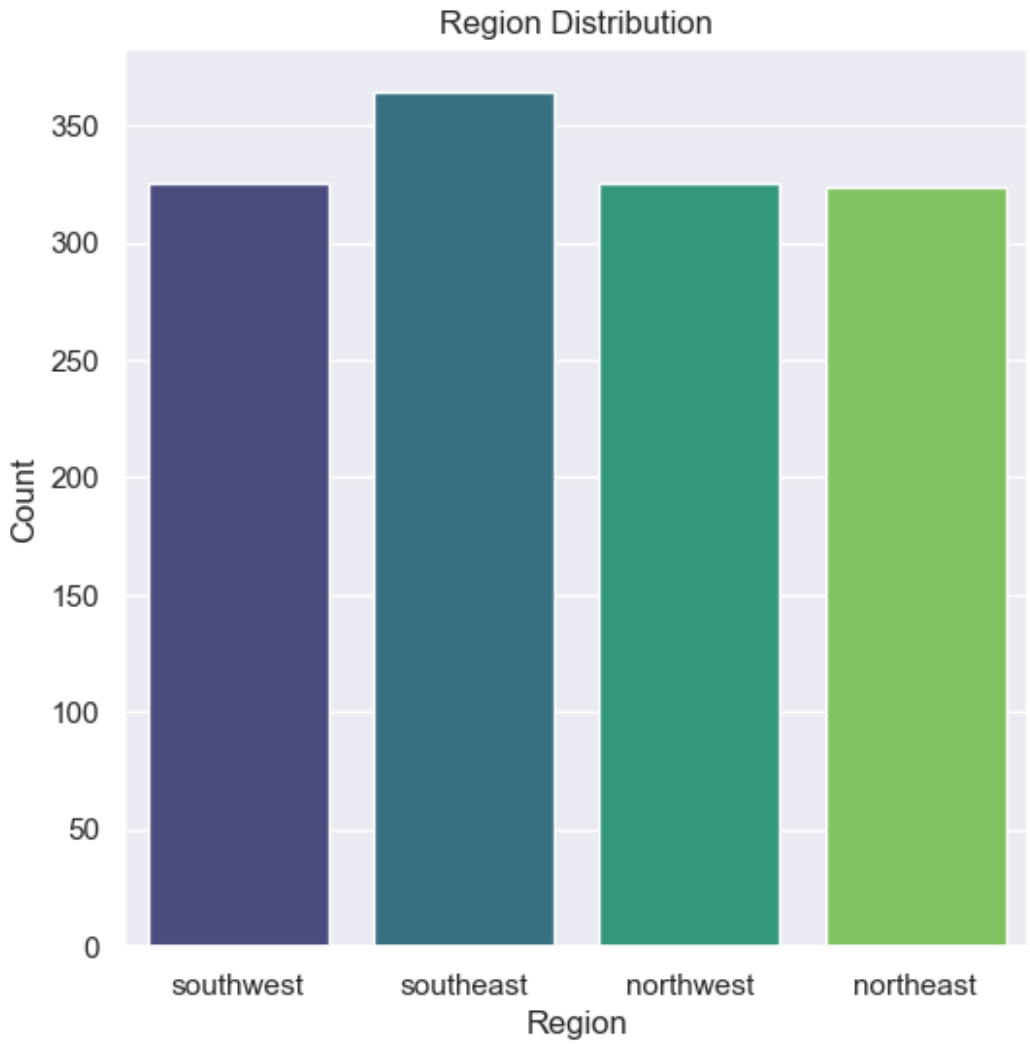

```
sns.set()
plt.figure(figsize=(6, 6))
sns.countplot(x='children', data=df, palette='viridis')
plt.title('Children Distribution')
plt.xlabel('Number of Children')
plt.ylabel('Count')
plt.show()
```



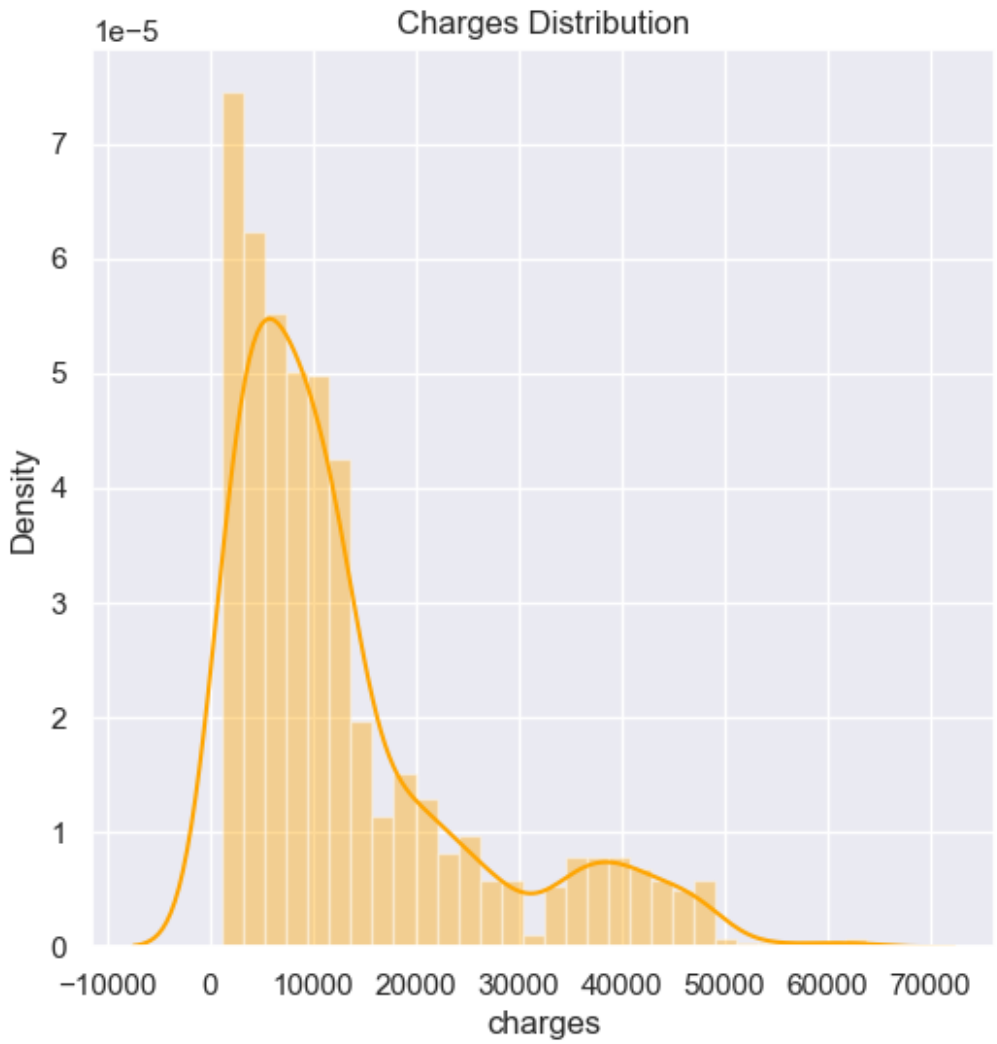

```
sns.set()
plt.figure(figsize=(6, 6))
sns.countplot(x='smoker', data=df, palette='Set2')
plt.title('Smoker Distribution')
plt.xlabel('Smoker')
plt.ylabel('Count')
plt.show()
```




```
sns.set()
plt.figure(figsize=(6, 6))
sns.countplot(x='region', data=df, palette='viridis')
plt.title('Region Distribution')
plt.xlabel('Region')
plt.ylabel('Count')
plt.show()
```




```
sns.set()
plt.figure(figsize=(6, 6))
sns.distplot(df['charges'], color='orange')
plt.title('Charges Distribution')
plt.show()
```



From the above graphs, we can deduce the below facts.

1. Insurance costs are higher among male population
2. Insurance costs are highest among the population of age groups 60-69.
3. Insurance costs increases among the smokers
4. Insurance costs increases among the obese population
5. Insurance costs are higher among the population in southwest region

Surprisingly, insurance costs are higher among the individuals with 2 or 3 children rather than with individuals with 4 or 5 children.

Converting Categorical Data Into Numerical Data

```
df.replace({'sex':{'male':0,'female':1}}, inplace=True)
df.replace({'smoker':{'yes':0,'no':1}}, inplace=True)
```

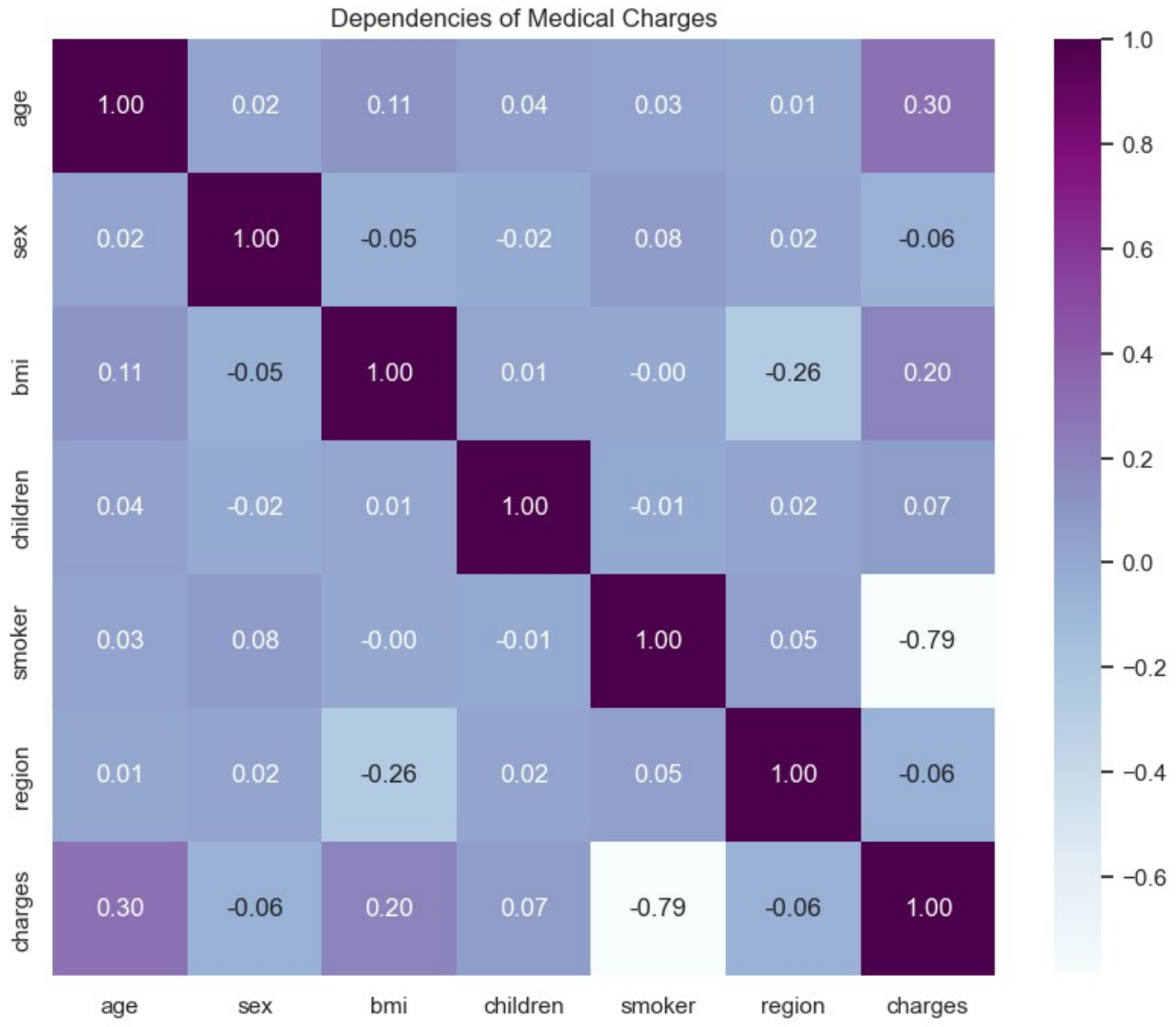
```
df.replace({'region':
{'southeast':0,'southwest':1,'northeast':2,'northwest':3}},
inplace=True)

df
```

	age	sex	bmi	children	smoker	region	charges
0	19	1	27.900	0	0	1	16884.92400
1	18	0	33.770	1	1	0	1725.55230
2	28	0	33.000	3	1	0	4449.46200
3	33	0	22.705	0	1	3	21984.47061
4	32	0	28.880	0	1	3	3866.85520
...	...	...	...	...	...	...	...
1333	50	0	30.970	3	1	3	10600.54830
1334	18	1	31.920	0	1	2	2205.98080
1335	18	1	36.850	0	1	0	1629.83350
1336	21	1	25.800	0	1	1	2007.94500
1337	61	1	29.070	0	0	3	29141.36030

[1338 rows x 7 columns]

```
corr = df.corr()
plt.figure(figsize=(10, 8))
sns.heatmap(corr, cmap='BuPu', annot=True, fmt=".2f")
plt.title("Dependencies of Medical Charges")
plt.show()
```



Sex, Children and Region do not affect the Charges. We might drop these 3 columns as they have less correlation

```
X = df.drop(columns='charges', axis=1)
Y = df['charges']

print(X)
```

```
      age  sex     bmi  children  smoker  region
0      19    1  27.900         0       0       1
1      18    0  33.770         1       1       0
2      28    0  33.000         3       1       0
3      33    0  22.705         0       1       3
4      32    0  28.880         0       1       3
...   ...  ...     ...       ...     ...     ...
1333   50    0  30.970         3       1       3
1334   18    1  31.920         0       1       2
```

```
1335   18    1  36.850         0       1       0
1336   21    1  25.800         0       1       1
1337   61    1  29.070         0       0       3

[1338 rows x 6 columns]
```

```
print(Y)
```

```
0       16884.92400
1        1725.55230
2        4449.46200
3       21984.47061
4        3866.85520
           ...
1333    10600.54830
1334     2205.98080
1335     1629.83350
1336     2007.94500
1337    29141.36030
Name: charges, Length: 1338, dtype: float64
```

Splitting the data into Training data & Testing Data

```
X_train, X_test, Y_train, Y_test = train_test_split(X, Y,
test_size=0.2, random_state=2)
```

```
print(X.shape, X_train.shape, X_test.shape)
```

```
(1338, 6) (1070, 6) (268, 6)
```

Modal Training and Evaluation

Linear Regression

```
regressor = LinearRegression()
```

```
regressor.fit(X_train, Y_train)
```

```
LinearRegression()
```

```
training_data_prediction =regressor.predict(X_train)
r2_train = metrics.r2_score(Y_train, training_data_prediction)
print('R squared value : ', r2_train)
```

```
R squared value :  0.751505643411174
```

```
test_data_prediction =regressor.predict(X_test)
r2_test = metrics.r2_score(Y_test, test_data_prediction)
print('R squared value : ', r2_test)
```

```
R squared value :  0.7447273869684077
```

Cost Analysis

```
target = df['charges']
features = df.drop(['age', 'bmi', 'charges'], axis=1)
min_cost = np.min(target)
max_cost = np.max(target)
mean_cost = np.mean(target)
median_cost = np.median(target)
std_cost = np.std(target)

print (target.describe())
print ('-'*60)
# calculated statistics
print ("Statistics for Medical Insurance:\n")
print ("Minimum insurance cost: Rs.{:,.2f}".format(min_cost))
print ("Maximum insurance acost: Rs.{:,.2f}".format(max_cost))
print ("Mean insurance cost: Rs.{:,.2f}".format(mean_cost))
print ("Median insurance cost Rs.{:,.2f}".format(median_cost))
print ("Standard deviation of insurance costs: Rs.
{:,.2f}".format(std_cost))
```

```
count     1338.000000
mean     13270.422265
std      12110.011237
min       1121.873900
25%       4740.287150
50%       9382.033000
75%      16639.912515
max      63770.428010
Name: charges, dtype: float64
------------------------------------------------------------
Statistics for Medical Insurance:

Minimum insurance cost: Rs.1,121.87
Maximum insurance acost: Rs.63,770.43
Mean insurance cost: Rs.13,270.42
Median insurance cost Rs.9,382.03
Standard deviation of insurance costs: Rs.12,105.48
```