Medical Cost Personal Dataset

Let us import all the required libraries for the data preprocessing and visualisation

In [10]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline
import warnings
warnings.filterwarnings('ignore')

path = 'C:/Users/Hemanth/Documents/Python/Data preporcessing/Major/Datasets/medical_cost_personal.csv'
data = pd.read_csv(path)
print("")
print("Data Frame Shape is ", data.shape)
print("")
```

```
Data Frame Shape is  (1338, 7)
```

DataFrame contains 1338 column and 7 rows

In [6]:

```
data.head()
```

Out[6]:

	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

Let us check if the data set contains any missing values

In [9]:

```
data.isnull().sum()
```

Out[9]:

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

From the above output it is clear that there are no missing values in the dataset

Here is another way to check the missing values

In [11]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1338 entries, 0 to 1337
Data columns (total 7 columns):
age         1338 non-null int64
sex         1338 non-null object
bmi         1338 non-null float64
children    1338 non-null int64
smoker      1338 non-null object
region      1338 non-null object
charges     1338 non-null float64
dtypes: float64(2), int64(2), object(3)
memory usage: 73.2+ KB
```

As we see the result it is clear that there are no missing values in the data set. Each column has the respected data type in them

age - int64

sex - object (may be we can change this to category)

bmi - float64

children - int64

smoker - object (may be we can change this to category)

region - object

charges - float64

Converting sex and smoker columns to Categorial values

In [13]:

```
data['sex']=data['sex'].astype('category')
data['smoker']=data['smoker'].astype('category')
```

Double check if the change has been made

In [14]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1338 entries, 0 to 1337
Data columns (total 7 columns):
age         1338 non-null int64
sex         1338 non-null category
bmi         1338 non-null float64
children    1338 non-null int64
smoker      1338 non-null category
region      1338 non-null object
charges     1338 non-null float64
dtypes: category(2), float64(2), int64(2), object(1)
memory usage: 55.1+ KB
```

Let us see a bit more about the data frame

In [15]:

```
data.describe()
```

Out[15]:

	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

Since the sex and smoker column consists of categorial data it is listed above.

Statistical calculation cannot be done on strings

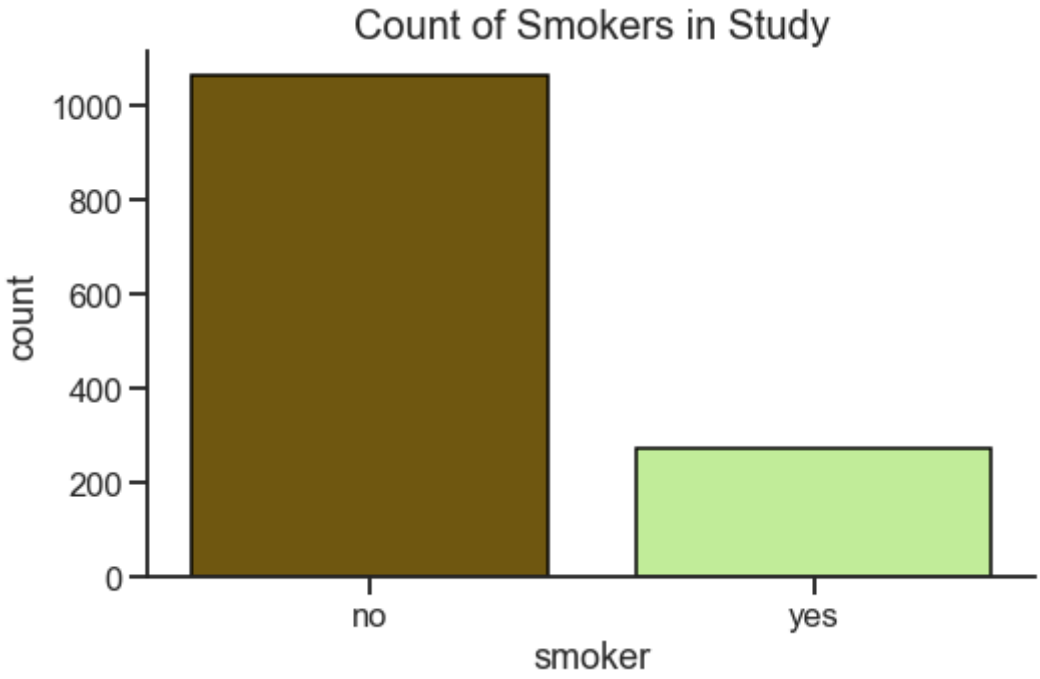
Data Visualisation

Let me see how may smokers and non-smoker are there in the data frame

In [20]:

```
col_list = ["shit","pistachio"]
col_list_palette = sns.xkcd_palette(col_list)
sns.set_palette(col_list_palette)

sns.set(rc={"figure.figsize": (10,6)},
            palette = sns.set_palette(col_list_palette),
            context="talk",
            style="ticks")

# How many smokers are in this study?
sns.catplot(x = 'smoker', data=data, kind='count',height=5,aspect=1.5, edgecolor="blac
k")
plt.title('Count of Smokers in Study', fontsize = 20)
print(data['smoker'].value_counts())
```

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



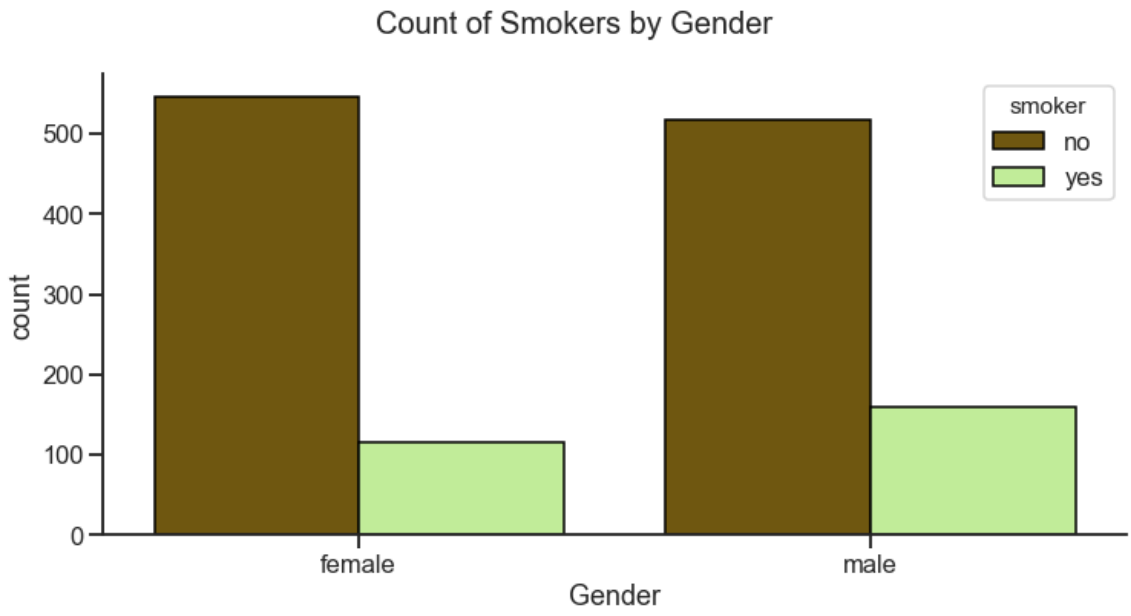
From the above bar graph it is clear that total number of non-smokers are more in the dataset

Let me split the dataframe based on their sex . so that the statistical calcluations are based on their sex from now

In [41]:

```
# Count of Smokers by Sex
sns.catplot(x ='sex',hue='smoker', data=data, kind="count",height=6, aspect=1.8,legend_
out=False, edgecolor="black")
plt.suptitle('Count of Smokers by Gender', fontsize = 20)
plt.xlabel('Gender')
plt.tight_layout(rect=[0, 0.03, 1, 0.95])
print(pd.crosstab(data['smoker'],data['sex']))
```

```
sex     female  male
smoker
no         547   517
yes        115   159
```



In [16]:

```
male_data = data[data['sex']=='male']
female_data = data[data['sex']=='female']
```

Now let me the shape of newly created dataframes

In [17]:

```
print('male data shape'+ str(male_data.shape))
print('Female data shape'+ str(female_data.shape))
```

```
male data shape(676, 7)
Female data shape(662, 7)
```

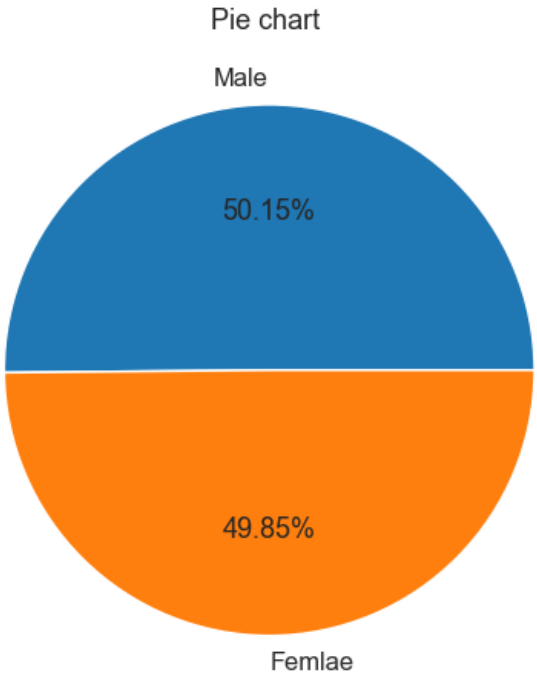
From the above result we can see that

Male - Total no : 676

Female - Total no : 662

In [23]:

```
fig = plt.figure()
ax = fig.add_axes([0,0,1,1])
ax.axis('equal')
langs = ['Male','Femlae']
students = [676,672]
ax.pie(students, labels = langs,autopct='%1.2f%%',colors = ["#1f77b4", "#ff7f0e"])
plt.title('Pie chart ')
plt.show()
```



Now I'm Dividing the Male and Female dataframes into younger and older dataframes based on the mean values of age

The reason why I'm doing this is for better understanding of the data . Now we can see how much difference the younger ones are spending than the older on medical is known very easy for the visuals

In [24]:

```
print("Median value of Male age is:"+str(male_data['age'].mean()))
print("Median value of Femalemale age is:"+str(female_data['age'].mean()))
```

```
Median value of Male age is:38.917159763313606
Median value of Femalemale age is:39.503021148036254
```

So now divide the dataframes into

younger_male < 38.917159763313606 (round the mean coz age in an int)

older_male > 38.917159763313606 (round the mean coz age in an int)

younger_female < 39.503021148036254 (round the mean coz age in an int)

older_female > 39.503021148036254 (round the mean coz age in an int)

In [25]:

```
male_smoking_young = data[(data['age']<38) & (data['sex']=='male') & (data['smoker']==
'yes')]
male_nonsmoking_young = data[(data['age']<38) & (data['sex']=='male') & (data['smoker']
=='no')]
male_smoking_older = data[(data['age']>38) & (data['sex']=='male') & (data['smoker']==
'yes')]
male_nonsmoking_older = data[(data['age']>38) & (data['sex']=='male') & (data['smoker']
=='no')]

female_smoking_young = data[(data['age']<38) & (data['sex']=='female') & (data['smoker'
]=='yes')]
female_nonsmoking_young = data[(data['age']<38) & (data['sex']=='female') & (data['smok
er']=='no')]
female_smoking_older =  data[(data['age']>38) & (data['sex']=='female') & (data['smoke
r']=='yes')]
female_nonsmoking_older = data[(data['age']>38) & (data['sex']=='female') & (data['smok
er']=='no')]
```

Now let us see the average amount of money spent by each dataframe

In [31]:

```
print('Younger boys who smoke and their avg spending on medical is = ' + str(male_smoki
ng_young['charges'].mean()) +' $')
print("")
print('Younger boys who dont smoke and their avg spending on medical is = ' + str(male_
nonsmoking_young['charges'].mean()) +' $')
print("")
print('Older men who smoke and their avg spending on medical is = ' + str(male_smoking_
older['charges'].mean()) +' $')
print("")
print('Older men who dont smoke and their avg spending on medical is = ' + str(male_non
smoking_older['charges'].mean()) +' $')
print("")
```

```
Younger boys who smoke and their avg spending on medical is = 29668.952685
316453 $

Younger boys who dont smoke and their avg spending on medical is = 4798.74
5074897121 $

Older men who smoke and their avg spending on medical is = 36564.894164487
174 $

Older men who dont smoke and their avg spending on medical is = 11188.3529
47424235 $
```

In [32]:

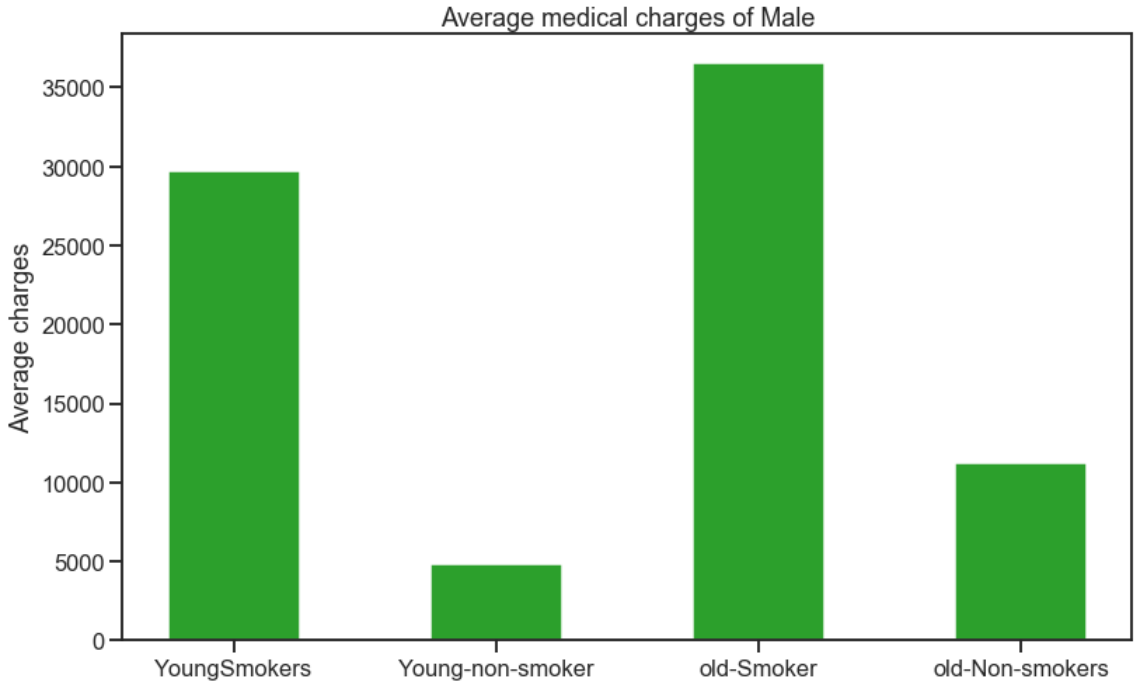
```
print('Younger gilrs who smoke and their avg spending on medical is ='+ str(female_smok
ing_young['charges'].mean())+' $')
print("")
print('Younger gilrs who dont smoke and their avg spending on medical is ='+ str(female
_nonsmoking_young['charges'].mean())+' $')
print("")
print('Older gilrs who smoke and their avg spending on medical is ='+ str(female_smokin
g_older['charges'].mean())+' $')
print("")
print('Older gilrs who dont smoke and their avg spending on medical is ='+ str(female_n
onsmoking_older['charges'].mean())+' $')
print("")
```

```
Younger gilrs who smoke and their avg spending on medical is =27652.377414
035076 $

Younger gilrs who dont smoke and their avg spending on medical is =5154.33
6350730616 $

Older gilrs who smoke and their avg spending on medical is =33653.43205465
518 $

Older gilrs who dont smoke and their avg spending on medical is =11926.056
861314872 $
```

Let us visually see the average spedings

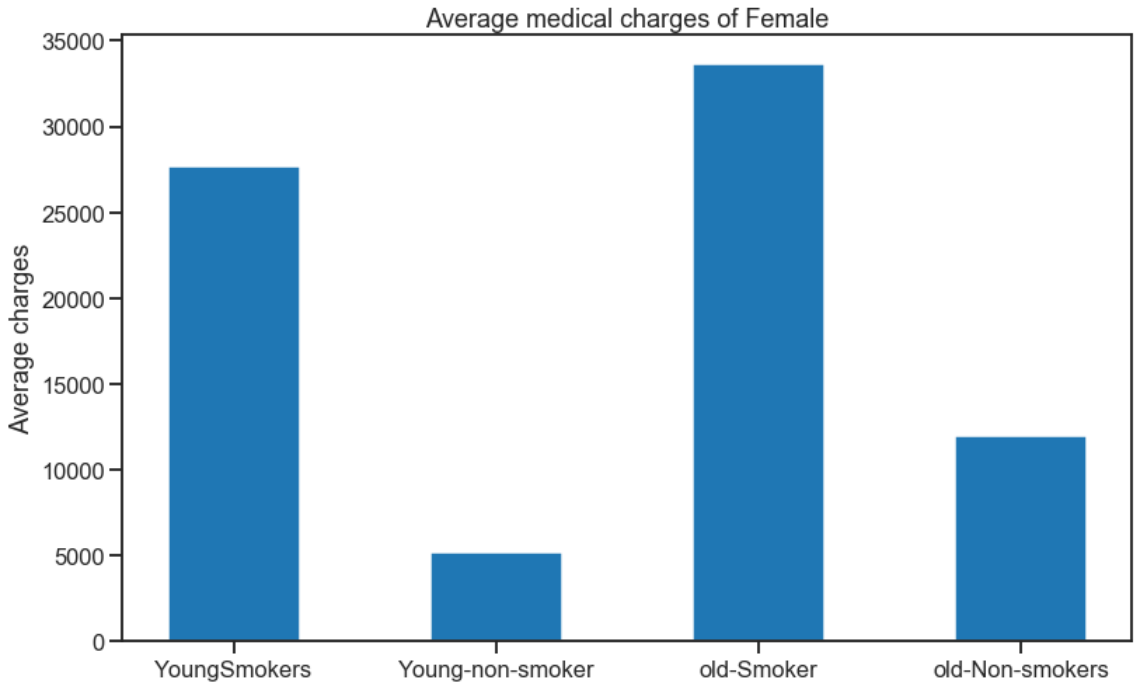
In [37]:

```
values = [(male_smoking_young['charges'].mean()),(male_nonsmoking_young['charges'].mean
()),(male_smoking_older['charges'].mean()),(male_nonsmoking_older['charges'].mean())]
import matplotlib.pyplot as plt
fig = plt.figure()
ax = fig.add_axes([0,0,1,1])
names = ['YoungSmokers', 'Young-non-smoker', 'old-Smoker', 'old-Non-smokers']
ax.set_ylabel('Average charges')
ax.set_title('Average medical charges of Male')
ax.bar(names,values,width = 0.5,color=["#2ca02c"])
plt.show()
```



In [35]:

```
values = [(female_smoking_young['charges'].mean()),(female_nonsmoking_young['charges'].
mean()),(female_smoking_older['charges'].mean()),(female_nonsmoking_older['charges'].me
an())]
import matplotlib.pyplot as plt
fig = plt.figure()
ax = fig.add_axes([0,0,1,1])
names = ['YoungSmokers', 'Young-non-smoker', 'old-Smoker', 'old-Non-smokers']
ax.set_ylabel('Average charges')
ax.set_title('Average medical charges of Female')
ax.bar(names,values,width = 0.5,color=["#1f77b4"])
plt.show()
```



Let us see the results based on their regions

In [39]:

```
print(data['region'].unique())
```

```
['southwest' 'southeast' 'northwest' 'northeast']
```

As we can see there are only 4 regions given in the dataset

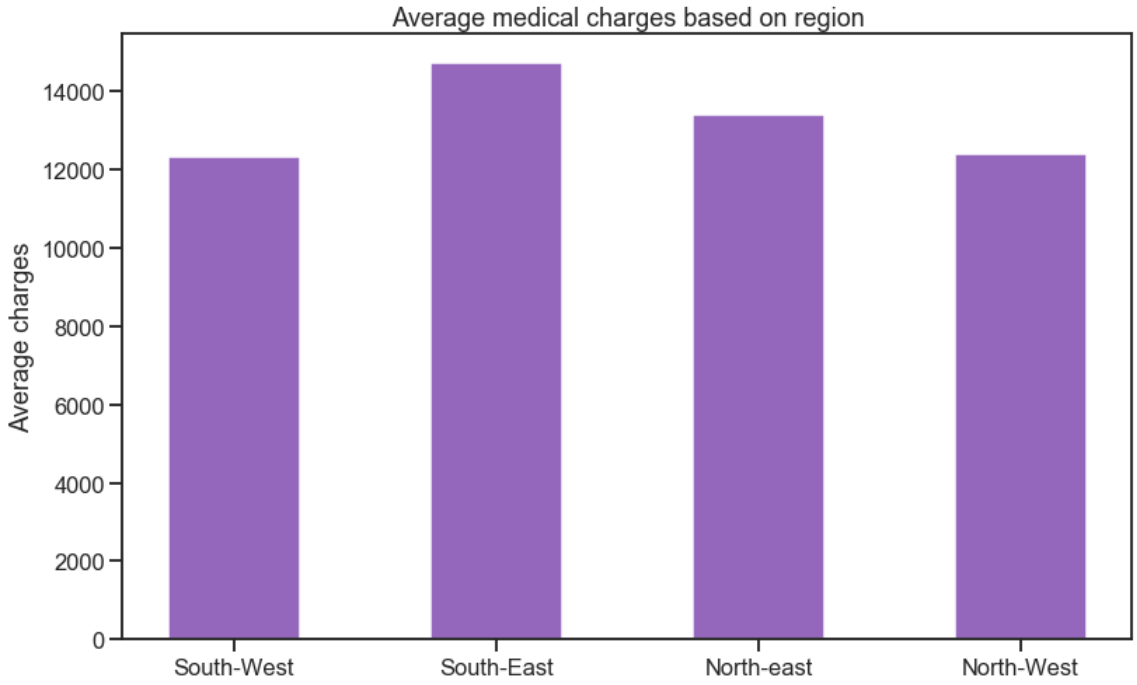
Let me spilt the data based on regions

In [43]:

```
southwest = data[data['region']=='southwest']
southeast = data[data['region']=='southeast']
northeast = data[data['region']=='northeast']
northwest = data[data['region']=='northwest']
```

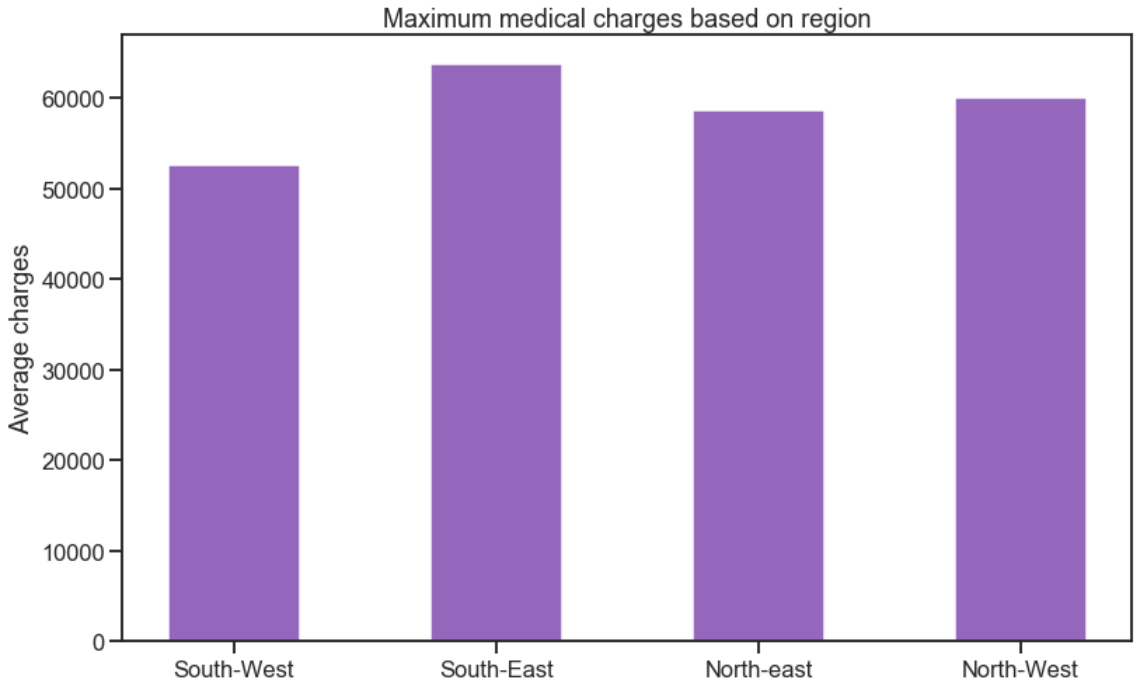
In [45]:

```
values = [(southwest['charges'].mean()),(southeast['charges'].mean()),(northeast['charg
es'].mean()),(northwest['charges'].mean())]
import matplotlib.pyplot as plt
fig = plt.figure()
ax = fig.add_axes([0,0,1,1])
names = ['South-West','South-East','North-east','North-West']
ax.set_ylabel('Average charges')
ax.set_title('Average medical charges based on region')
ax.bar(names,values,width = 0.5,color=["#9467bd"])
plt.show()
```



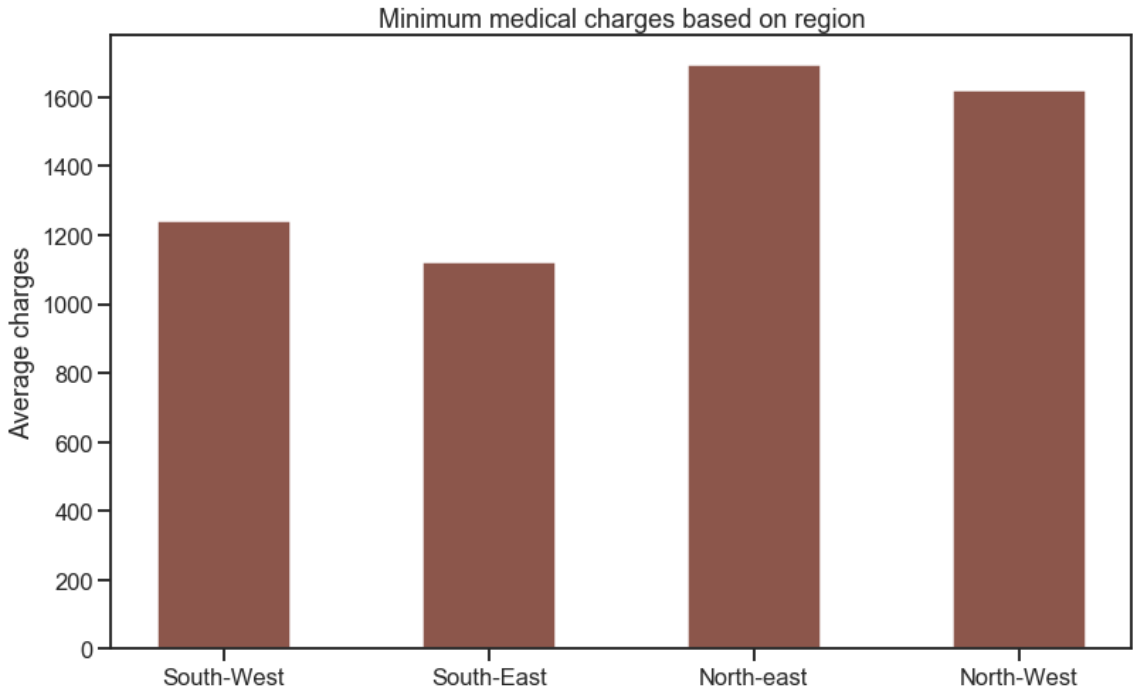
In [46]:

```
values = [(southwest['charges'].max()),(southeast['charges'].max()),(northeast['charge
s'].max()),(northwest['charges'].max())]
import matplotlib.pyplot as plt
fig = plt.figure()
ax = fig.add_axes([0,0,1,1])
names = ['South-West','South-East','North-east','North-West']
ax.set_ylabel('Average charges')
ax.set_title('Maximum medical charges based on region')
ax.bar(names,values,width = 0.5,color=["#9467bd"])
plt.show()
```



In [48]:

```
values = [(southwest['charges'].min()),(southeast['charges'].min()),(northeast['charge
s'].min()),(northwest['charges'].min())]
import matplotlib.pyplot as plt
fig = plt.figure()
ax = fig.add_axes([0,0,1,1])
names = ['South-West','South-East','North-east','North-West']
ax.set_ylabel('Average charges')
ax.set_title('Minimum medical charges based on region')
ax.bar(names,values,width = 0.5,color=["#8c564b"])
plt.show()
```



From the above bar charts we can tell that South-east people are the ones who are paying more on thier medical charges

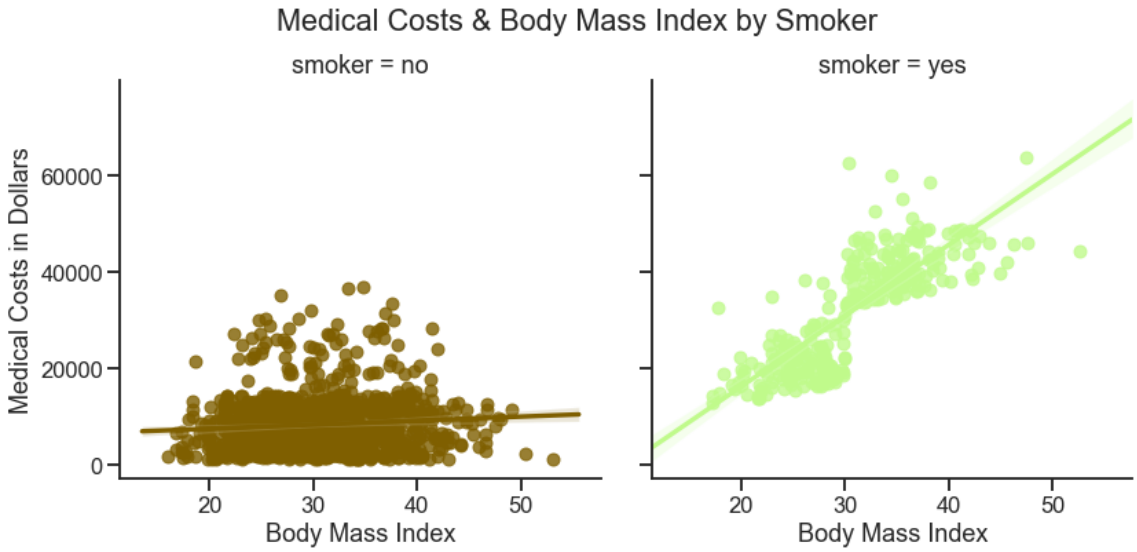
Now let us see medical costs and body mass index by smokers

In [49]:

```
#-------------------------------------------------------#
#####   Medical Costs & Body Mass Index by Smoker  #####
#-------------------------------------------------------#

a = sns.lmplot(x="bmi", y="charges", col="smoker",
           hue="smoker", data=data, height = 6)
plt.suptitle('Medical Costs & Body Mass Index by Smoker')
plt.tight_layout(rect=[0, 0.03, 1, 0.95])
a.set_axis_labels('Body Mass Index', 'Medical Costs in Dollars')
```

Out[49]:

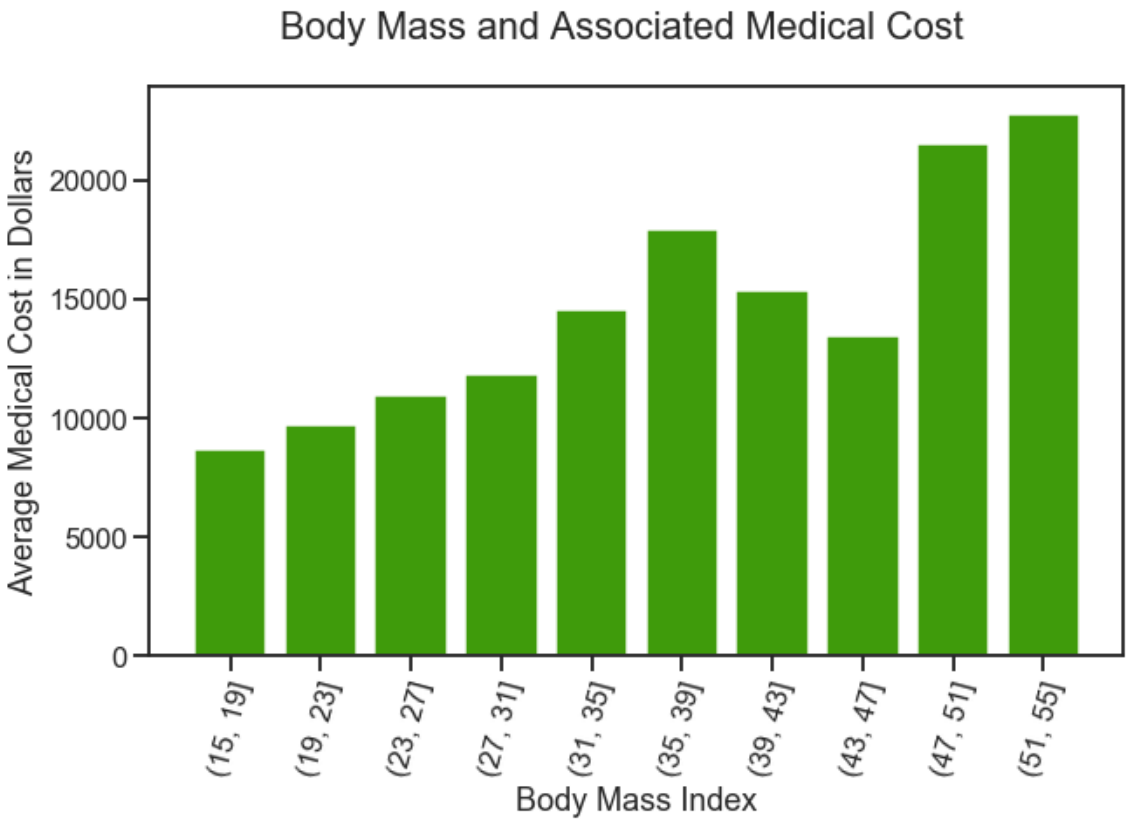
```
<seaborn.axisgrid.FacetGrid at 0x220f510fc18>
```



Body Mass and associated medical costs

In [50]:

```
#-----------------------------#
####  binning the bmi data  ####
#-----------------------------#

mnb = round(min(data.bmi)-1)
mxb = round(max(data.bmi)+2)
bm = np.linspace(mnb, mxb, num=11).astype(int)
data['bmi_binned'] = pd.cut(data['bmi'], bins = bm); data.head(10)
# Group by the bin and calculate averages
avg_bmi  = data.groupby('bmi_binned').mean()

#---------------------------------------#
####  Body Mass Index & Medical Costs   ####
#---------------------------------------#

plt.bar(avg_bmi.index.astype(str), avg_bmi['charges'], color='#3f9b0b')
plt.xticks(rotation = 75); plt.xlabel('Body Mass Index'); plt.ylabel('Average Medical C
ost in Dollars')
plt.suptitle('Body Mass and Associated Medical Cost');
```



Simple statistics from our data

In [51]:

```
#-------------------------------------------------#
####  Age Distribution of Study Participants   #####
#-------------------------------------------------#

print('#####  Age Statistics  #######\n')
print('      Minimum     ',int(data['age'].min()))
print('      Average     ',int(data['age'].mean()))
print('      Median      ', int(np.median(data['age'])))
print('      Max         ',int(data['age'].max()))
print('   Std Deviation  ', int(data['age'].std()))
```

```
#####  Age Statistics  #######

      Minimum      18
      Average      39
      Median       39
      Max          64
   Std Deviation   14
```

In [52]:

```
####  Body Mass Distribution of Study Participants   #####
#-------------------------------------------------------#

# Distribution of Body Mass
print('#####  Body Mass Statistics  #######\n')
print('      Minimum     ',int(data['bmi'].min()))
print('      Average     ',int(data['bmi'].mean()))
print('      Median      ', int(np.median(data['bmi'])))
print('      Max         ',int(data['bmi'].max()))
print('   Std Deviation  ', int(data['bmi'].std()))
```

```
#####  Body Mass Statistics  #######

      Minimum      15
      Average      30
      Median       30
      Max          53
   Std Deviation   6
```

In [53]:

```
print('################################################')
print('############     Report Summary    #############')
print('################################################\n')
print('Average Age')
print('--------------')
print('Smoker      %0.0f' % data[data['smoker']=='yes']['age'].mean())
print('Non-Smoker  %0.0f' %data[data['smoker']=='no']['age'].mean(),'\n')
print('Average Body Mass')
print('--------------------')
print('Smoker      %0.0f' % data[data['smoker']=='yes']['bmi'].mean())
print('Non-Smoker  %0.0f' % data[data['smoker']=='no']['bmi'].mean(),'\n')
print('Average Medical Cost by Gender')
print('-----------------------------')
print('Female      ${:,.0f}'.format(data[data['sex']=='female']['charges'].mean()))
print('Male        ${:,.0f}'.format(data[data['sex']=='male']['charges'].mean()), '\n')
print('Average Medical Cost by Smoker')
print('-------------------------------')
print('Non-Smoker   ${:,.0f}'.format(data[data['smoker']=='no']['charges'].mean()))
print('Smoker      ${:,.0f}'.format(data[data['smoker']=='yes']['charges'].mean()))
```

```
################################################
############     Report Summary    #############
################################################

Average Age
--------------
Smoker      39
Non-Smoker  39

Average Body Mass
--------------------
Smoker      31
Non-Smoker  31

Average Medical Cost by Gender
-----------------------------
Female      $12,570
Male        $13,957

Average Medical Cost by Smoker
-------------------------------
Non-Smoker   $8,434
Smoker      $32,050
```

In [72]:

```
temp = {"no" : 0, "yes" : 1}
data.smoker = [temp[item] for item in data.smoker]

print('################################################')
print('############    Correlations       #############')
print('################################################')
print('\n')
print('Cost to Smoker   ', round(data['charges'].corr(data['smoker'])*100,1),'%')
print('Cost to Age      ', round(data['charges'].corr(data['age'])*100,1),'%')
print('Cost to Body Mass ', round(data['charges'].corr(data['bmi'])*100,1),'%')
```

```
################################################
############    Correlations       #############
################################################


Cost to Smoker    78.7 %
Cost to Age       29.9 %
Cost to Body Mass  19.8 %
```

The above correlation is used for linear regression models

In [ ]:

```

```