In [1]:

```
import numpy as np
import re
import pandas as pd
import seaborn as sb
import matplotlib.pyplot as plt
from sklearn.preprocessing import LabelEncoder, StandardScaler, OneHotEncoder
from sklearn.metrics import confusion_matrix, accuracy_score, mean_squared_error, r2_scor
e
from sklearn.linear_model import LogisticRegression
from sklearn.linear_model import LinearRegression
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.cluster import KMeans
import plotly.express as px
import scipy.stats as stats
import scipy.cluster.hierarchy as ch
```

In [ ]:

```

```

In [2]:

```
data = {
    'CustomerId': [1001,1002,1003,1004,1005],
    'Age': [33,28,42,51,37],
    'Gender': ['Male','Female','Male','Female','Male'],
    'MaritalStatus': ['Married','Single','Single','Married','Divorced'],
    'AnnualIncome (USD)': [65000, 45000, 55000, 80000, 58000],
    'TotalPurchases': [18,15,20,12,10],
    'PreferredCategory': ['Electronics','Appliances','Electronics','Electronics','Applian
ces']
}
data = pd.DataFrame(data)
```

In [3]:

```
data
```

Out[3]:

	CustomerId	Age	Gender	MaritalStatus	AnnualIncome (USD)	TotalPurchases	PreferredCategory
0	1001	33	Male	Married	65000	18	Electronics
1	1002	28	Female	Single	45000	15	Appliances
2	1003	42	Male	Single	55000	20	Electronics
3	1004	51	Female	Married	80000	12	Electronics
4	1005	37	Male	Divorced	58000	10	Appliances

In [4]:

```
additional_rows = 500 - len(data)
new_rows = []

for i in range(additional_rows):
    new_id = max(data['CustomerId']) + i + 1
    age = np.random.randint(25, 75)
    gender = np.random.choice(['Male', 'Female'])
    marital_status = np.random.choice(['Single', 'Married', 'Divorced'])
    income = np.random.randint(35000, 100000)
    purchases = np.random.randint(10, 40)
    category = np.random.choice(['Electronics', 'Appliances'])
```

```
    new_row = {
        'CustomerId': new_id,
        'Age': age,
        'Gender': gender,
        'MaritalStatus': marital_status,
        'AnnualIncome (USD)': income,
        'TotalPurchases': purchases,
        'PreferredCategory': category
    }
    new_rows.append(new_row)

data = pd.concat([data, pd.DataFrame(new_rows)], ignore_index=True)
data.tail()
```

Out[4]:

	CustomerId	Age	Gender	MaritalStatus	AnnualIncome (USD)	TotalPurchases	PreferredCategory
495	1496	48	Female	Single	49444	10	Appliances
496	1497	68	Female	Divorced	67917	25	Electronics
497	1498	58	Female	Single	75464	23	Electronics
498	1499	32	Male	Divorced	79715	19	Appliances
499	1500	61	Female	Married	64695	29	Appliances

In [5]:

```
data
```

Out[5]:

	CustomerId	Age	Gender	MaritalStatus	AnnualIncome (USD)	TotalPurchases	PreferredCategory
0	1001	33	Male	Married	65000	18	Electronics
1	1002	28	Female	Single	45000	15	Appliances
2	1003	42	Male	Single	55000	20	Electronics
3	1004	51	Female	Married	80000	12	Electronics
4	1005	37	Male	Divorced	58000	10	Appliances
...	...	...	...	...	...	...	...
495	1496	48	Female	Single	49444	10	Appliances
496	1497	68	Female	Divorced	67917	25	Electronics
497	1498	58	Female	Single	75464	23	Electronics
498	1499	32	Male	Divorced	79715	19	Appliances
499	1500	61	Female	Married	64695	29	Appliances

500 rows × 7 columns

In [6]:

```
data.shape
```

Out[6]:

```
(500, 7)
```

In [7]:

```
data.info
```

Out[7]:

```
<bound method DataFrame.info of      CustomerId  Age  Gender MaritalStatus  AnnualIncome
(USD)  \
0          1001   33    Male       Married                 65000
```

```
1          1002   28  Female        Single              45000
2          1003   42    Male        Single              55000
3          1004   51  Female       Married              80000
4          1005   37    Male      Divorced              58000
..          ...  ...     ...           ...                ...
495        1496   48  Female        Single              49444
496        1497   68  Female      Divorced              67917
497        1498   58  Female        Single              75464
498        1499   32    Male      Divorced              79715
499        1500   61  Female       Married              64695

     TotalPurchases PreferredCategory
0                18       Electronics
1                15        Appliances
2                20       Electronics
3                12       Electronics
4                10        Appliances
..              ...               ...
495              10        Appliances
496              25       Electronics
497              23       Electronics
498              19        Appliances
499              29        Appliances

[500 rows x 7 columns]>
```

In [8]:

```
data.describe()
```

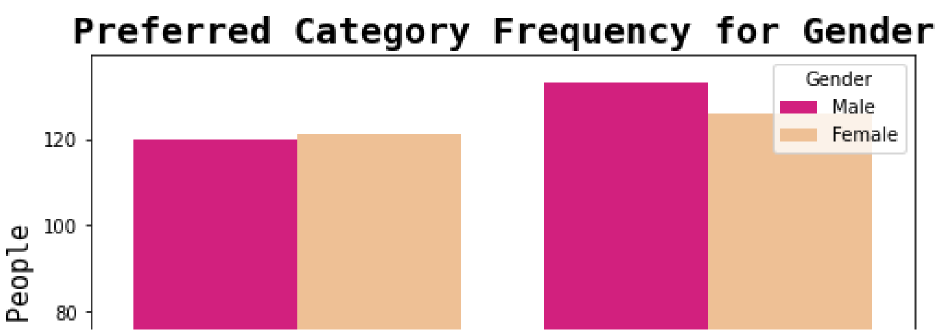
Out[8]:

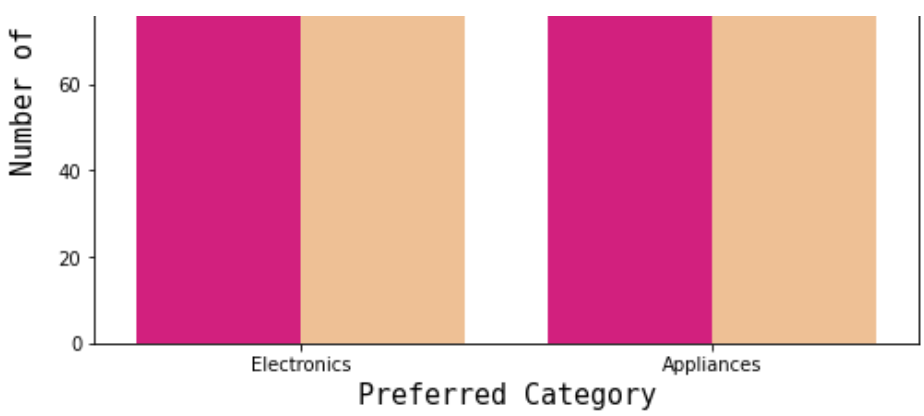
	CustomerId	Age	AnnualIncome (USD)	TotalPurchases
count	500.000000	500.000000	500.000000	500.00000
mean	1250.500000	49.036000	67354.378000	24.40000
std	144.481833	14.477912	18936.930653	8.46826
min	1001.000000	25.000000	35075.000000	10.00000
25%	1125.750000	36.000000	50596.250000	17.00000
50%	1250.500000	49.000000	67647.500000	24.00000
75%	1375.250000	62.000000	84767.750000	31.00000
max	1500.000000	74.000000	99839.000000	39.00000

EXPLORATORY DATA ANALYSIS

In [9]:

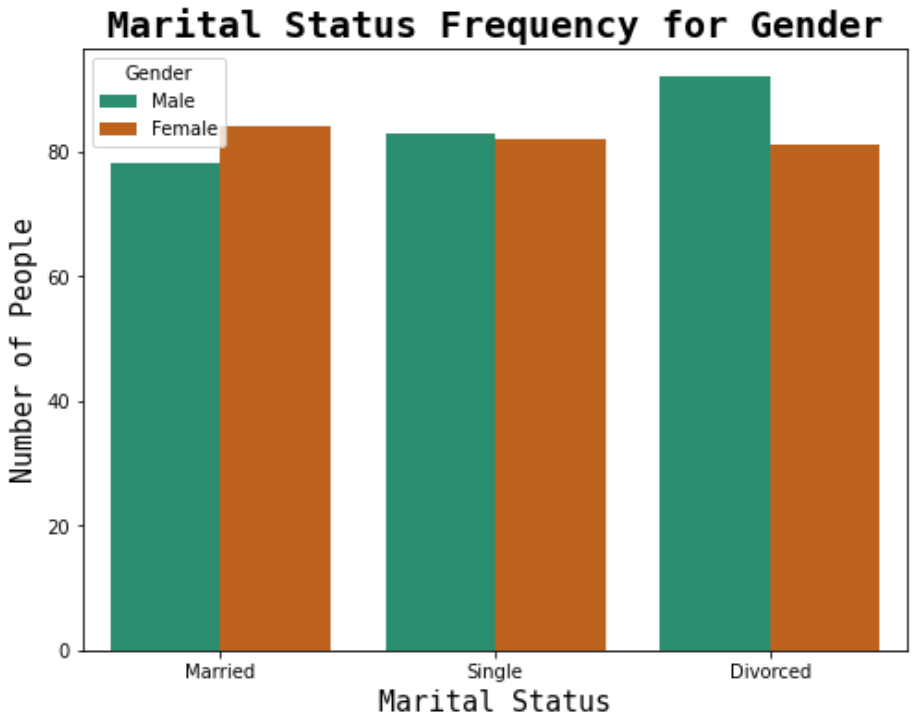
```
plt.figure(figsize=[8,6])
sb.countplot(data = data ,x = 'PreferredCategory', hue = 'Gender',palette = 'Accent_r')
plt.title('Preferred Category Frequency for Gender', fontdict={'fontname': 'Monospace', '
fontsize': 20, 'fontweight': 'bold'})
plt.xlabel('Preferred Category', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Number of People', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.show()
```





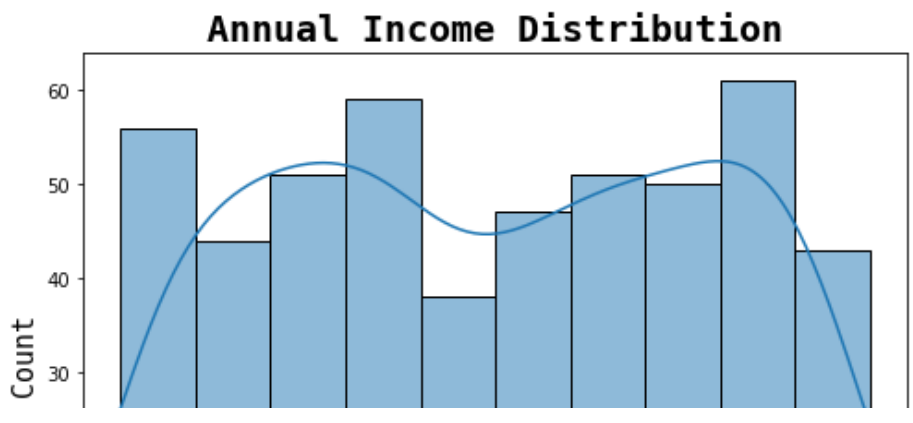
In [10]:

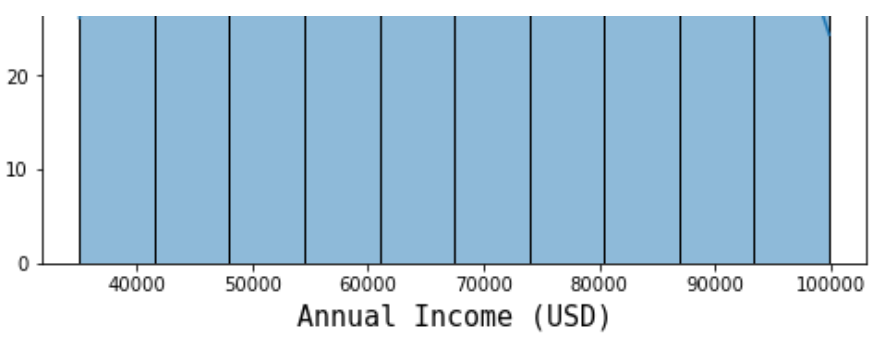
```
plt.figure(figsize=[8,6])
sb.countplot(data = data ,x = 'MaritalStatus', hue = 'Gender', palette = 'Dark2')
plt.title('Marital Status Frequency for Gender', fontdict={'fontname': 'Monospace', 'font
size': 20, 'fontweight': 'bold'})
plt.xlabel('Marital Status', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Number of People', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.show()
```



In [11]:

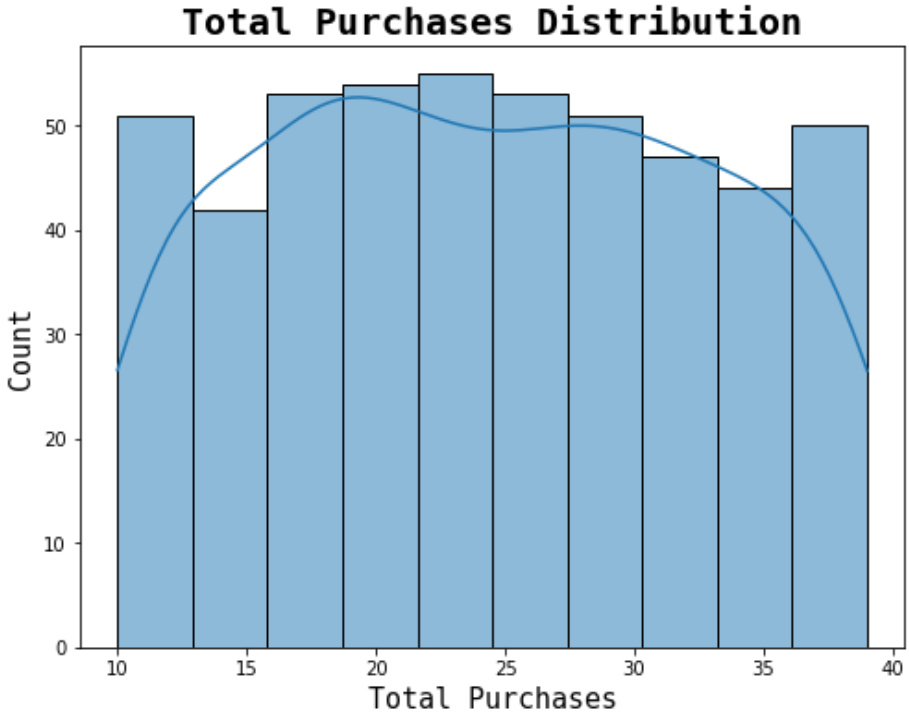
```
plt.figure(figsize=(8, 6))
sb.histplot(data = data, x = 'AnnualIncome (USD)', kde = True, palette = 'CMRmap')
plt.title('Annual Income Distribution', fontdict={'fontname': 'Monospace', 'fontsize': 2
0, 'fontweight': 'bold'})
plt.xlabel('Annual Income (USD)', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Count', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.show()
```





In [12]:

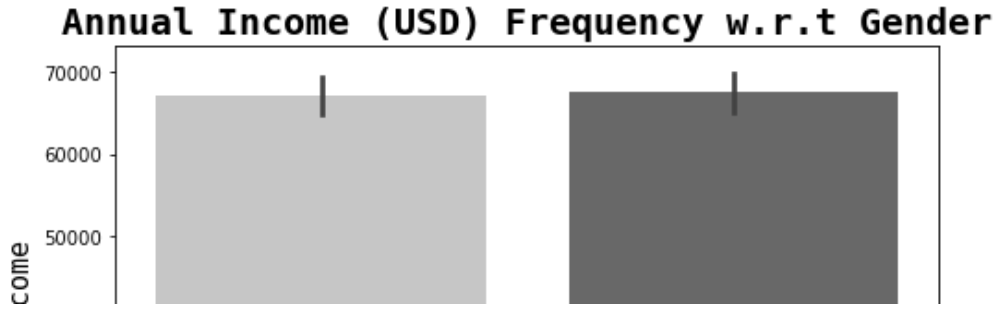
```
plt.figure(figsize=(8, 6))
sb.histplot(data = data, x = 'TotalPurchases', kde = True)
plt.title('Total Purchases Distribution', fontdict={'fontname': 'Monospace', 'fontsize':
20, 'fontweight': 'bold'})
plt.xlabel('Total Purchases', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Count', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.show()
```

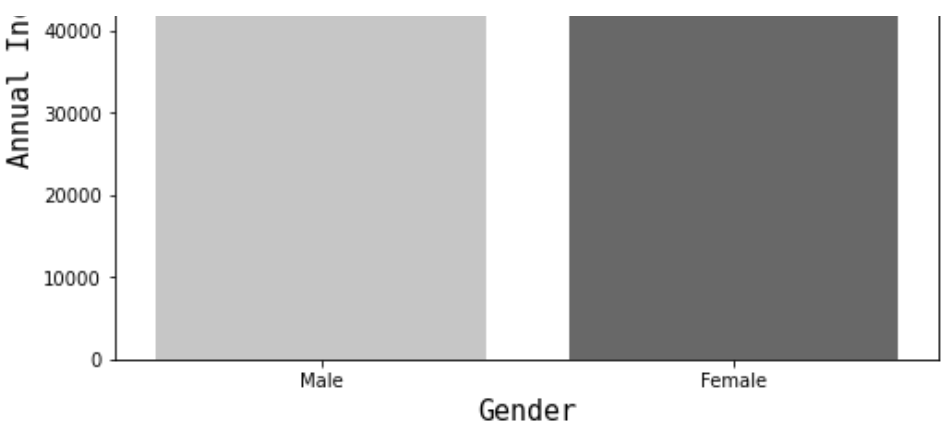


In [13]:

```
plt.figure(figsize=[8,6])
sb.barplot(data['Gender'], data['AnnualIncome (USD)'], palette = 'Greys')
plt.title('Annual Income (USD) Frequency w.r.t Gender', fontdict={'fontname': 'Monospace'
, 'fontsize':20, 'fontweight': 'bold'})
plt.xlabel('Gender', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Annual Income', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.show()
```

```
c:\Users\Mannahil Miftah\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWar
ning: Pass the following variables as keyword args: x, y. From version 0.12, the only val
id positional argument will be `data`, and passing other arguments without an explicit ke
yword will result in an error or misinterpretation.
  warnings.warn(
```

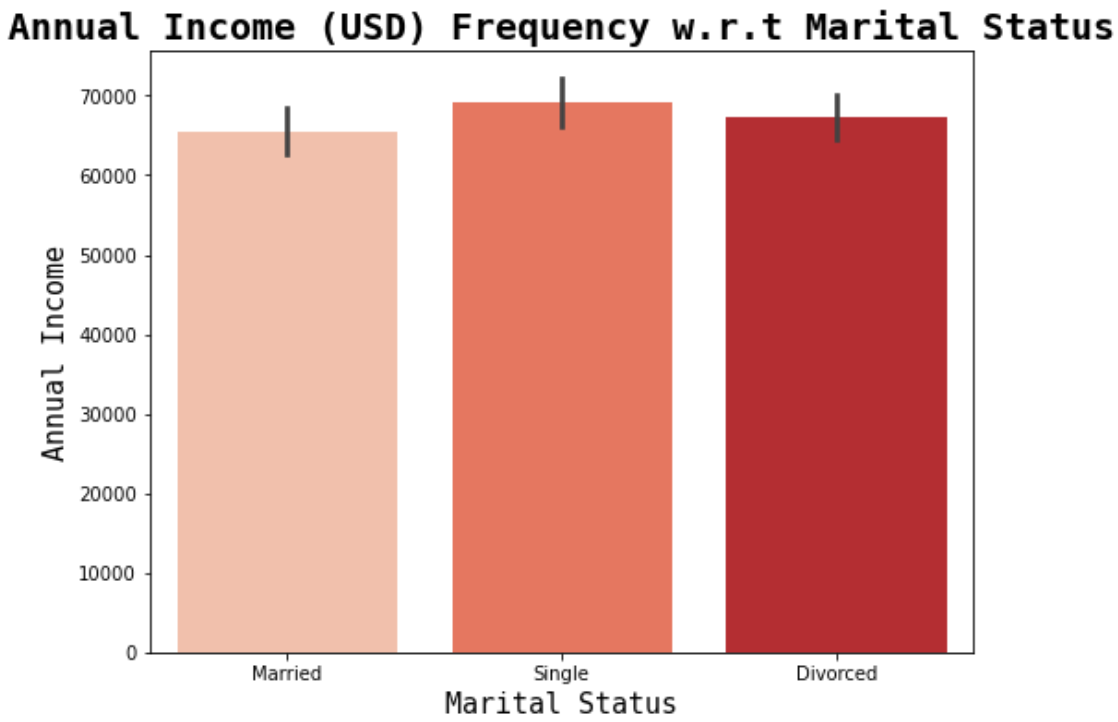




In [24]:

```
plt.figure(figsize=[8,6])
sb.barplot(data['MaritalStatus'], data['AnnualIncome (USD)'], palette = 'Reds')
plt.title('Annual Income (USD) Frequency w.r.t Marital Status', fontdict={'fontname': 'Mo
nospace', 'fontsize':20, 'fontweight': 'bold'})
plt.xlabel('Marital Status', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Annual Income', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.show()
```

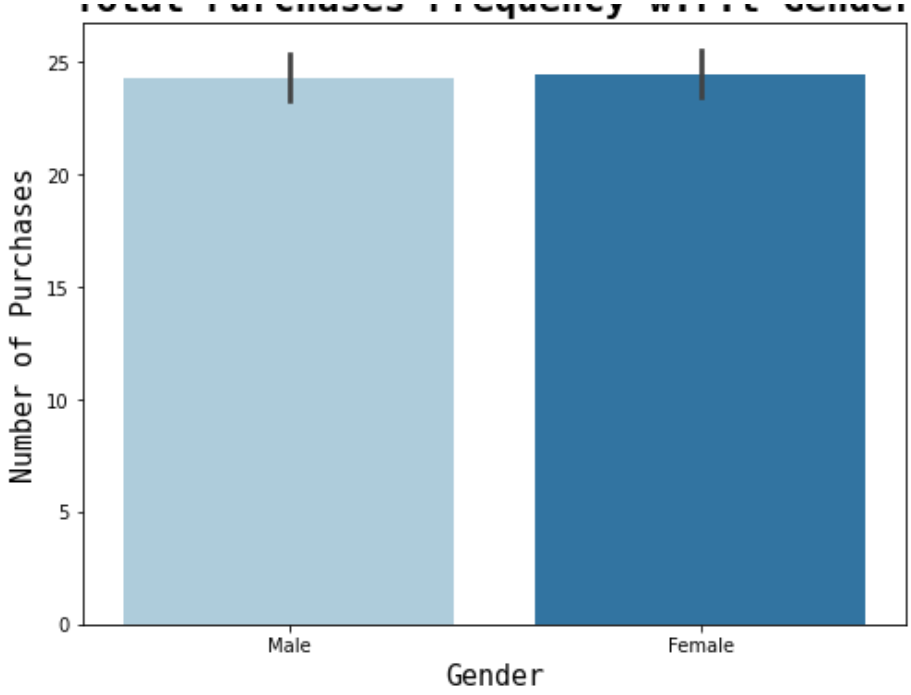
```
c:\Users\Mannahil Miftah\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWar
ning: Pass the following variables as keyword args: x, y. From version 0.12, the only val
id positional argument will be `data`, and passing other arguments without an explicit ke
yword will result in an error or misinterpretation.
  warnings.warn(
```



In [14]:

```
plt.figure(figsize=[8,6])
sb.barplot(data['Gender'], data['TotalPurchases'], palette = 'Paired')
plt.title('Total Purchases Frequency w.r.t Gender', fontdict={'fontname': 'Monospace', 'f
ontsize':20, 'fontweight': 'bold'})
plt.xlabel('Gender', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Number of Purchases', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.show()
```

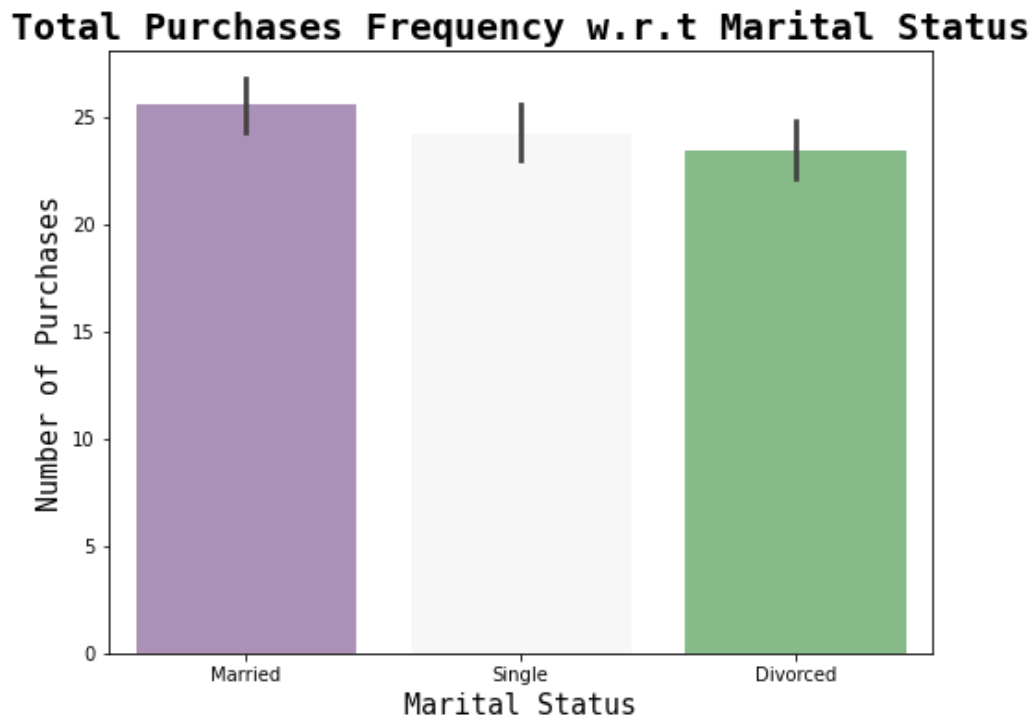
```
c:\Users\Mannahil Miftah\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWar
ning: Pass the following variables as keyword args: x, y. From version 0.12, the only val
id positional argument will be `data`, and passing other arguments without an explicit ke
yword will result in an error or misinterpretation.
  warnings.warn(
```



In [22]:

```
plt.figure(figsize=[8,6])
sb.barplot(data['MaritalStatus'], data['TotalPurchases'], palette = 'PRGn')
plt.title('Total Purchases Frequency w.r.t Marital Status', fontdict={'fontname': 'Monosp
ace', 'fontsize':20, 'fontweight': 'bold'})
plt.xlabel('Marital Status', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Number of Purchases', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.show()
```

```
c:\Users\Mannahil Miftah\anaconda3\lib\site-packages\seaborn\_decorators.py:36: FutureWar
ning: Pass the following variables as keyword args: x, y. From version 0.12, the only val
id positional argument will be `data`, and passing other arguments without an explicit ke
yword will result in an error or misinterpretation.
  warnings.warn(
```



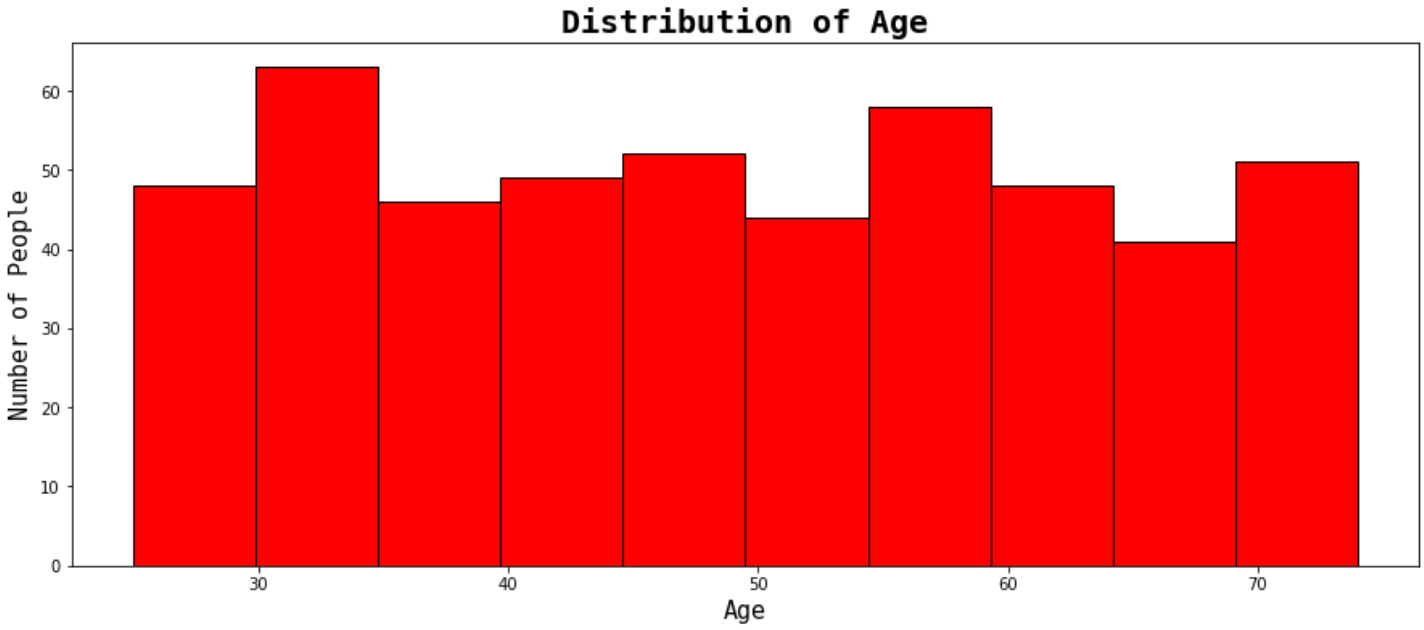
In [15]:

```
plt.figure(figsize=[15,6])
plt.hist(data = data, x = 'Age', color = 'red', ec = 'black')
plt.title('Distribution of Age', fontdict={'fontname': 'Monospace', 'fontsize': 20, 'font
weight': 'bold'})
plt.xlabel('Age', fontdict={'fontname':'Monospace', 'fontsize': 15,})
```

```
plt.ylabel('Number of People', fontdict={'fontname':'Monospace', 'fontsize': 15,})
```

Out[15]:

```
Text(0, 0.5, 'Number of People')
```

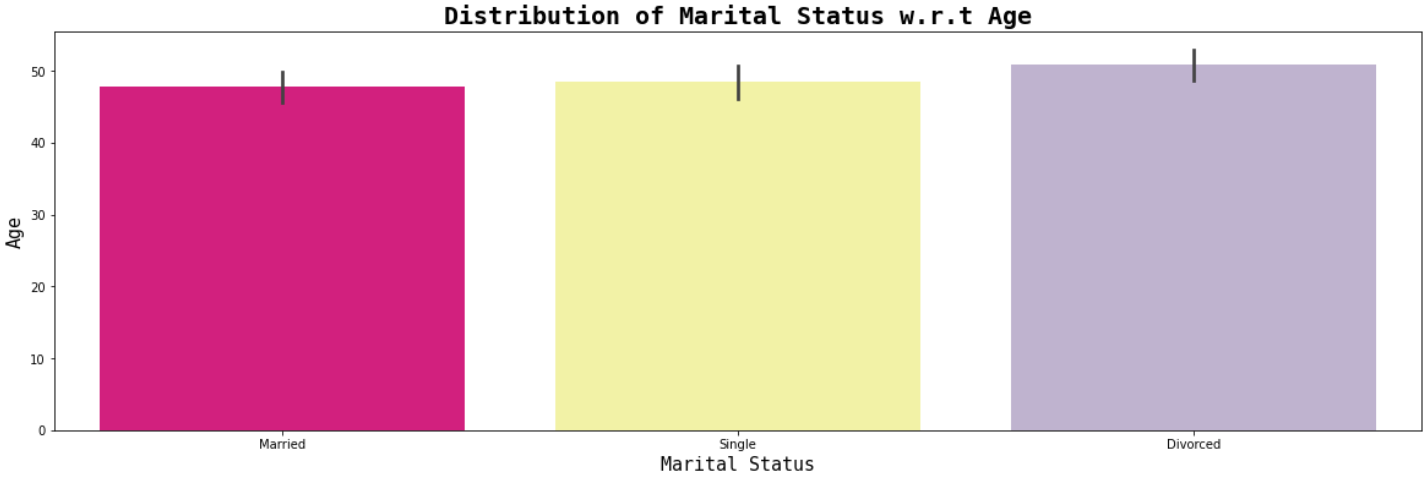


In [16]:

```
plt.figure(figsize=[20,6])
sb.barplot(data = data, x = 'MaritalStatus', y = 'Age', palette = 'Accent_r')
plt.title('Distribution of Marital Status w.r.t Age', fontdict={'fontname': 'Monospace',
'fontsize': 20, 'fontweight': 'bold'})
plt.xlabel('Marital Status', fontdict={'fontname':'Monospace', 'fontsize': 15,})
plt.ylabel('Age', fontdict={'fontname':'Monospace', 'fontsize': 15,})
```

Out[16]:

```
Text(0, 0.5, 'Age')
```



K-MEANS

In [25]:

```
data1 = data.copy()
```

In [26]:

```
data1 = data1.apply(LabelEncoder().fit_transform)
data1
```

Out[26]:

	CustomerId	Age	Gender	MaritalStatus	AnnualIncome (USD)	TotalPurchases	PreferredCategory

	CustomerId	Age	Gender	MaritalStatus	AnnualIncome (USD)	TotalPurchases	PreferredCategory
0	0	8	1	1	232	8	1
1	1	3	0	2	74	5	0
2	2	17	1	2	155	10	1
3	3	26	0	1	338	2	1
4	4	12	1	0	185	0	0
...	...	...	...	...	...	...	...
495	495	23	0	2	115	0	0
496	496	43	0	0	253	15	1
497	497	33	0	2	305	13	1
498	498	7	1	0	337	9	0
499	499	36	0	1	231	19	0

500 rows × 7 columns

In [27]:

```
category = data1['PreferredCategory']
```

In [28]:

```
scaler = StandardScaler().fit(data1.drop('PreferredCategory', axis = 1))
features = scaler.transform(data1.drop('PreferredCategory', axis = 1))
```

In [29]:

```
X_train, X_test, y_train, y_test = train_test_split(features, category, test_size = 0.1)
```

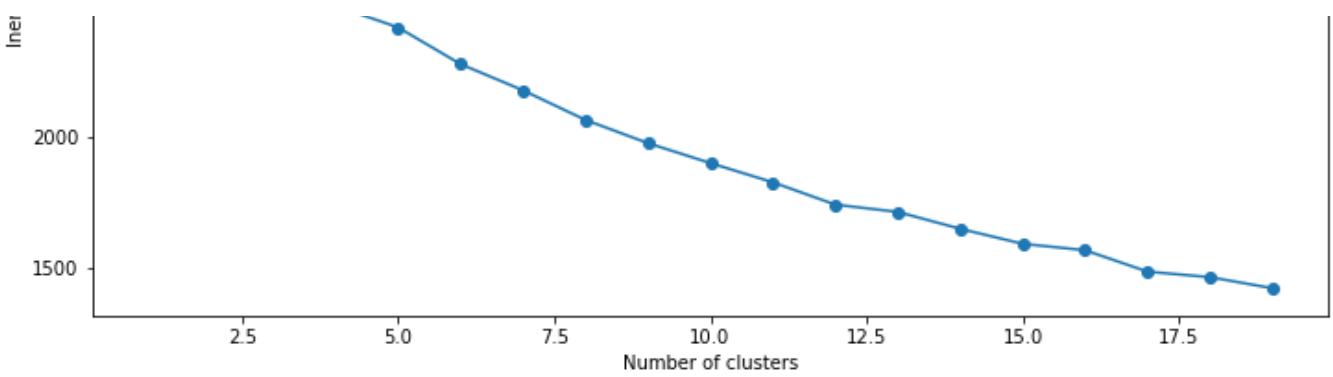
In [30]:

```
scaler = StandardScaler()
data_scaled = scaler.fit_transform(data1)
pd.DataFrame(data_scaled)
kmeans = KMeans(n_clusters=2, init='k-means++')
kmeans.fit(data_scaled)
SSE = []
for cluster in range(1,20):
    kmeans = KMeans(n_clusters = cluster, init='k-means++')
    kmeans.fit(data_scaled)
    SSE.append(kmeans.inertia_)
frame = pd.DataFrame({'Cluster':range(1,20), 'SSE':SSE})
plt.figure(figsize=(12,6))
plt.plot(frame['Cluster'], frame['SSE'], marker='o')
plt.xlabel('Number of clusters')
plt.ylabel('Inertia')
```

```
c:\Users\Mannahil Miftah\anaconda3\lib\site-packages\sklearn\cluster\_kmeans.py:881: User
Warning: KMeans is known to have a memory leak on Windows with MKL, when there are less c
hunks than available threads. You can avoid it by setting the environment variable OMP_NU
M_THREADS=2.
  warnings.warn(
```

Out[30]:

```
Text(0, 0.5, 'Inertia')
```



In [34]:

```
kmeans = KMeans(n_clusters = 9, init='k-means++')
kmeans.fit(data_scaled)
pred = kmeans.predict(data_scaled)
frame = pd.DataFrame(data_scaled)
frame['cluster'] = pred
frame['cluster'].value_counts()
```

Out[34]:

```
5    65
6    65
4    63
3    62
1    56
0    52
8    50
2    48
7    39
Name: cluster, dtype: int64
```

In [ ]:

```

```