In [1]:
```python
#import packages

import pandas as pd
import numpy as np
import seaborn as sns
import scipy.stats as ss
import statsmodels.stats.api as sms

import matplotlib.pyplot as plt
pd.set_option('display.max_columns', None)
from matplotlib.pyplot import figure
```

In [2]:
```python
# read data

T1 = pd.read_csv('t1_user_active_min.csv')
T2 = pd.read_csv('t2_user_variant.csv')
T3 = pd.read_csv('t3_user_active_min_pre.csv')
T4 = pd.read_csv('t4_user_attributes.csv')
```

In [3]:
```python
# look at data

T1.head(10)
```

Out[3]:

	uid	dt	active_mins
0	0	2019-02-22	5.0
1	0	2019-03-11	5.0
2	0	2019-03-18	3.0
3	0	2019-03-22	4.0
4	0	2019-04-03	9.0
5	0	2019-04-06	1.0
6	0	2019-04-17	1.0
7	0	2019-05-07	3.0
8	0	2019-05-14	1.0
9	0	2019-05-19	1.0

In [4]:
```python
T2.head(10)
```

Out[4]:

	uid	variant_number	dt	signup_date
0	0	0	2019-02-06	2018-09-24
1	1	0	2019-02-06	2016-11-07
2	2	0	2019-02-06	2018-09-17
3	3	0	2019-02-06	2018-03-04
4	4	0	2019-02-06	2017-03-09
5	5	0	2019-02-06	2018-06-25
6	6	0	2019-02-06	2017-01-22
7	7	0	2019-02-06	2016-08-12
8	8	0	2019-02-06	2019-01-18
9	9	0	2019-02-06	2018-05-02

In [5]:
```python
T3.head(10)
```

Out[5]:

	uid	dt	active_mins
0	0	2018-09-24	3.0
1	0	2018-11-08	4.0
2	0	2018-11-24	3.0
3	0	2018-11-28	6.0
4	0	2018-12-02	6.0
5	0	2018-12-04	1.0
6	0	2018-12-07	8.0
7	0	2018-12-09	5.0
8	0	2018-12-14	8.0
9	0	2018-12-15	2.0

In [6]:
```python
T4.head(10)
```

Out[6]:

	uid	gender	user_type
0	0	male	non_reader
1	1	male	reader
2	2	male	non_reader
3	3	male	non_reader
4	4	male	non_reader
5	5	female	non_reader
6	6	female	non_reader
7	7	male	non_reader
8	8	male	new_user
9	9	female	non_reader

Hypothesis: Changes implemented for group B has increased user engagement

I will also break down whether

1) Active usership time increased or decreased

2) Frequency of visits increased or decreased

3) Do the above two points for old/new users, male/female users, and if they are readers/non-readers.

In [7]:
```python
# see number of control group users and test group users.

T2['variant_number'].value_counts()

# 80% in control(40k), 20% in treatment/test group (10k)
```

Out[7]:
```
0    40000
1    10000
Name: variant_number, dtype: int64
```

In [8]:
```python
# load users into control and treatment/test group arrays.

user_control = []
user_treatment = []
for index,row in T2.iterrows():
    if row['variant_number'] == 0:
        user_control.append(row['uid'])
    else:
        user_treatment.append(row['uid'])
```

In [9]:
```python
# merge attributes table and variant table.

var_gen_ageinquora = pd.merge(T2,T4,how = "inner", on = "uid")
```

In [10]:
```python
var_gen_ageinquora.head()
```

Out[10]:

	uid	variant_number	dt	signup_date	gender	user_type
0	0	0	2019-02-06	2018-09-24	male	non_reader
1	1	0	2019-02-06	2016-11-07	male	reader
2	2	0	2019-02-06	2018-09-17	male	non_reader
3	3	0	2019-02-06	2018-03-04	male	non_reader
4	4	0	2019-02-06	2017-03-09	male	non_reader

In [11]:
```python
# split var_gen_ageinquora into control and treatment groups.

var_gen_ageinquora_control = var_gen_ageinquora[var_gen_ageinquora['variant_number'] == 0]
var_gen_ageinquora_treatment = var_gen_ageinquora[var_gen_ageinquora['variant_number'] == 1]
cat_cols = ['gender','user_type']
cont_cols = ['days_since_joined_till_AB_tested']
```

In [12]:
```python
# sort control and treatment groups into arrays based on if they are in treatment or control and date they joined before ab test.

uid_control         = list(var_gen_ageinquora_control["uid"])
uid_treatment       = list(var_gen_ageinquora_treatment["uid"])
before_AB_control   = T3[T3['uid'].isin(uid_control)]
before_AB_treatment = T3[T3['uid'].isin(uid_treatment)]
after_AB_control    = T1[T1['uid'].isin(uid_control)]
after_AB_treatment  = T1[T1['uid'].isin(uid_treatment)]
```

In [13]:
```python
# looks at created arrays

after_AB_treatment.head()
```

Out[13]:

	uid	dt	active_mins
886957	40000	2019-02-13	3.0
886958	40000	2019-03-02	18.0
886959	40000	2019-03-12	4.0
886960	40001	2019-02-14	16.0
886961	40001	2019-02-17	5.0

In [14]:
```python
after_AB_control.head()
```

Out[14]:

	uid	dt	active_mins
0	0	2019-02-22	5.0
1	0	2019-03-11	5.0
2	0	2019-03-18	3.0
3	0	2019-03-22	4.0
4	0	2019-04-03	9.0

In [15]:
```python
before_AB_treatment.head()
```

Out[15]:

	uid	dt	active_mins
989489	40001	2018-08-12	1.0
989490	40001	2018-08-21	1.0
989491	40001	2018-09-21	5.0
989492	40001	2018-09-23	3.0
989493	40001	2018-10-03	1.0

In [16]:
```python
before_AB_control.head()
```

Out[16]:

	uid	dt	active_mins
0	0	2018-09-24	3.0
1	0	2018-11-08	4.0
2	0	2018-11-24	3.0
3	0	2018-11-28	6.0
4	0	2018-12-02	6.0

In [17]:
```python
# merge the control/test and date tables with the attributes table

before_AB_control_base_table   = pd.merge(before_AB_control,var_gen_ageinquora, how = "inner", on = "uid")
before_AB_treatment_base_table = pd.merge(before_AB_treatment,var_gen_ageinquora, how = "inner", on = "uid")
after_AB_control_base_table    = pd.merge(after_AB_control,var_gen_ageinquora, how = "inner", on = "uid")
after_AB_treatment_base_table  = pd.merge(after_AB_treatment,var_gen_ageinquora, how = "inner", on = "uid")
```

In [18]:
```python
# renaming some columns

before_AB_control_base_table.rename(columns = {"dt_x":"date","dt_y":"AB_Date"}, inplace = True)
before_AB_treatment_base_table.rename(columns = {"dt_x":"date","dt_y":"AB_Date"}, inplace = True)
after_AB_control_base_table.rename(columns = {"dt_x":"date","dt_y":"AB_Date"}, inplace = True)
after_AB_treatment_base_table.rename(columns = {"dt_x":"date","dt_y":"AB_Date"}, inplace = True)
before_AB_control_base_table.head()
```

Out[18]:

	uid	date	active_mins	variant_number	AB_Date	signup_date	gender	user_type
0	0	2018-09-24	3.0	0	2019-02-06	2018-09-24	male	non_reader
1	0	2018-11-08	4.0	0	2019-02-06	2018-09-24	male	non_reader
2	0	2018-11-24	3.0	0	2019-02-06	2018-09-24	male	non_reader
3	0	2018-11-28	6.0	0	2019-02-06	2018-09-24	male	non_reader
4	0	2018-12-02	6.0	0	2019-02-06	2018-09-24	male	non_reader

In [19]:
```python
before_AB_treatment_base_table_noout = before_AB_treatment_base_table[before_AB_treatment_base_table.active_mins < np.percentile(before_AB_treatmen
after_AB_treatment_base_table_noout = after_AB_treatment_base_table[after_AB_treatment_base_table.active_mins < np.percentile(after_AB_treatment_ba
```

In [20]:
```python
before_AB_treatment_base_table_noout.head()
```

Out[20]:

	uid	date	active_mins	variant_number	AB_Date	signup_date	gender	user_type
0	40001	2018-08-12	1.0	1	2019-02-06	2017-04-29	male	non_reader
1	40001	2018-08-21	1.0	1	2019-02-06	2017-04-29	male	non_reader
2	40001	2018-09-21	5.0	1	2019-02-06	2017-04-29	male	non_reader
3	40001	2018-09-23	3.0	1	2019-02-06	2017-04-29	male	non_reader
4	40001	2018-10-03	1.0	1	2019-02-06	2017-04-29	male	non_reader

In [21]:
```python
# plot of male readers for before (orange) and after (blue) data
f, axes = plt.subplots(1, 2)
plt.style.use('ggplot')
pd.set_option('display.max_rows', None)

sns.distplot(before_AB_treatment_base_table_noout[(before_AB_treatment_base_table_noout["gender"] == 'female')&(before_AB_treatment_base_table_noou
             hist=False,color='red', axlabel = "Active Mins, Female Readers",ax=axes[0])
sns.distplot(after_AB_treatment_base_table_noout[(after_AB_treatment_base_table_noout["gender"] == 'female')&(after_AB_treatment_base_table_noout["
             hist=False,color='blue', axlabel = "Active Mins, Female Readers",ax=axes[0])
sns.distplot(before_AB_treatment_base_table_noout[(before_AB_treatment_base_table_noout["gender"] == 'female')&(before_AB_treatment_base_table_noou
             hist=False,color='red', axlabel = "Active Mins, Female Non-Readers",ax=axes[1])
sns.distplot(after_AB_treatment_base_table_noout[(after_AB_treatment_base_table_noout["gender"] == 'female')&(after_AB_treatment_base_table_noout["
             hist=False,color='blue', axlabel = "Active Mins, Female Non-Readers",ax=axes[1])


plt.show()
```

```
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
  warnings.warn(msg, FutureWarning)
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
  warnings.warn(msg, FutureWarning)
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
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C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
  warnings.warn(msg, FutureWarning)
```

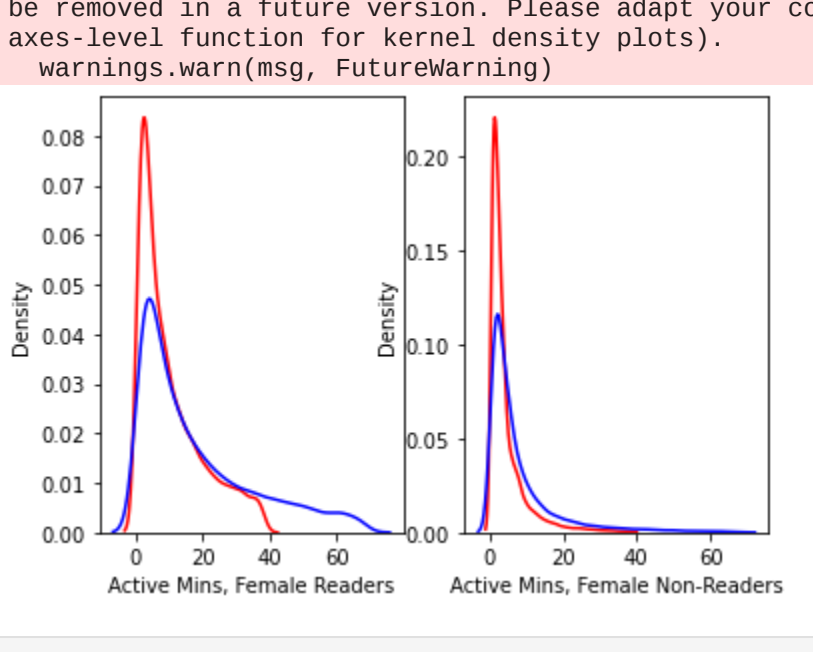

In [22]:
```python
# plot of male readers for before (orange) and after (blue) data
f, axes = plt.subplots(1, 2)
plt.style.use('ggplot')
pd.set_option('display.max_rows', None)

sns.distplot(before_AB_treatment_base_table_noout[(before_AB_treatment_base_table_noout["gender"] == 'male')&(before_AB_treatment_base_table_noout[
             hist=False, color='red', axlabel = "Active Mins, Male Readers",ax=axes[0])
sns.distplot( after_AB_treatment_base_table_noout[(after_AB_treatment_base_table_noout["gender"] == 'male')&(after_AB_treatment_base_table_noout["u
             hist=False, color='blue', axlabel = "Active Mins, Male Readers",ax=axes[0])
sns.distplot(before_AB_treatment_base_table_noout[(before_AB_treatment_base_table_noout["gender"] == 'male')&(before_AB_treatment_base_table_noout[
             hist=False,color='red', axlabel = "Active Mins, Male Non-Readers",ax=axes[1])
sns.distplot( after_AB_treatment_base_table_noout[(after_AB_treatment_base_table_noout["gender"] == 'male')&(after_AB_treatment_base_table_noout["u
             hist=False,color='blue', axlabel = "Active Mins, Male Non-Readers",ax=axes[1])


plt.show()
```

```
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
  warnings.warn(msg, FutureWarning)
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  warnings.warn(msg, FutureWarning)
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
  warnings.warn(msg, FutureWarning)
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  warnings.warn(msg, FutureWarning)
```
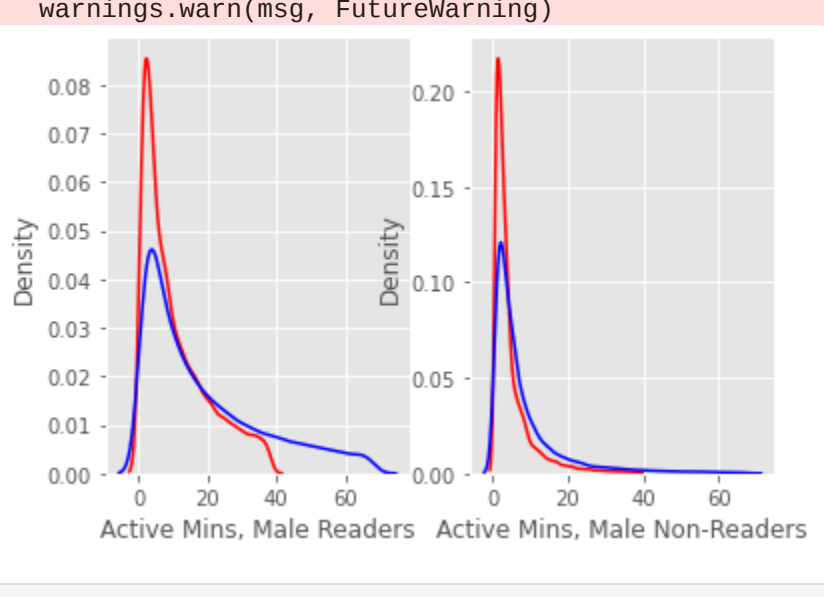
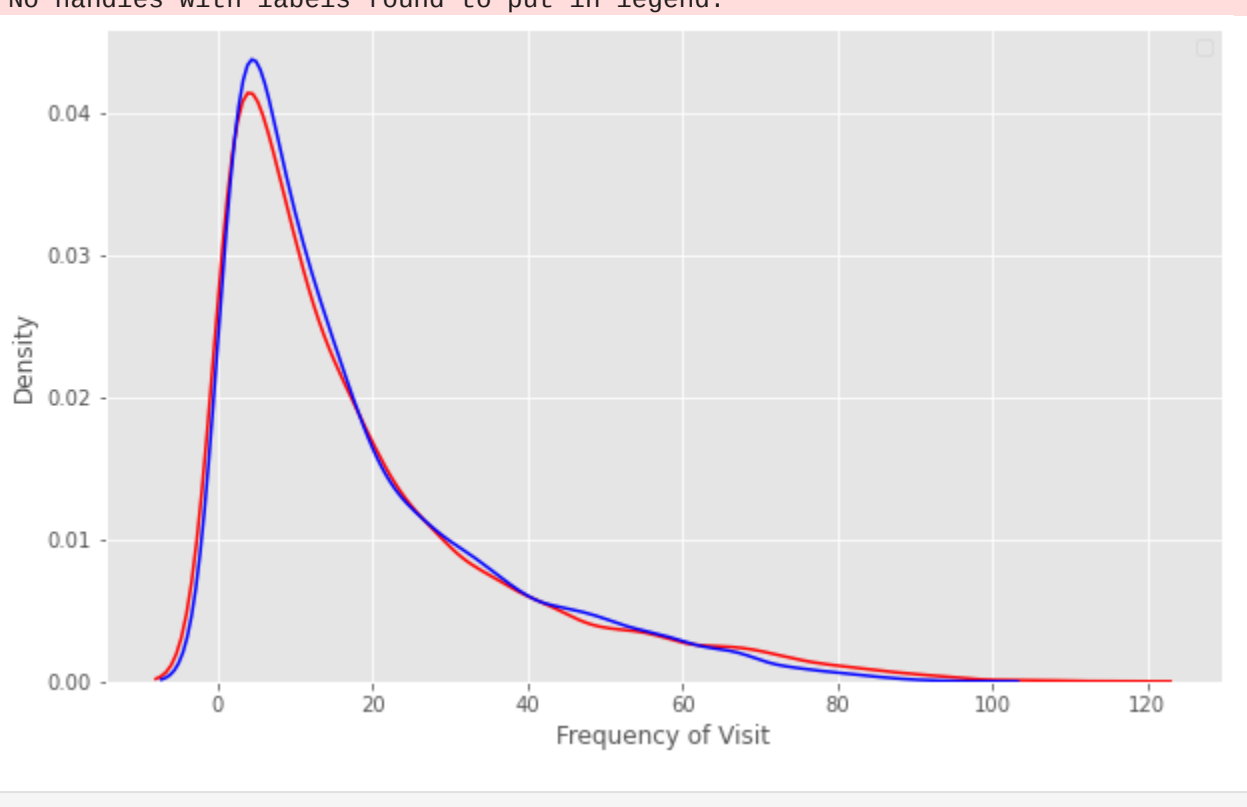



In [23]:
```python
user_count_before_AB = pd.DataFrame(before_AB_treatment_base_table_noout['uid'].value_counts())
user_count_before_AB.reset_index(inplace = True)
user_count_before_AB.rename(columns = {'uid':'before_count', 'index':'uid'}, inplace = True)
user_count_after_AB = pd.DataFrame(after_AB_treatment_base_table_noout['uid'].value_counts())
user_count_after_AB.reset_index(inplace = True)
user_count_after_AB.rename(columns = {'uid':'after_count', 'index':'uid'}, inplace = True)
```

In [24]:
```python
fig = plt.figure(figsize=(10,6))
plt.style.use('ggplot')
pd.set_option('display.max_rows', None)

sns.distplot(user_count_before_AB['before_count'], hist=False, color='red', axlabel = "Frequency of Visit")
sns.distplot(user_count_after_AB['after_count'], hist=False, color='blue', axlabel = "Frequency of Visit")

plt.legend()
plt.show()
```

```
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
  warnings.warn(msg, FutureWarning)
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
  warnings.warn(msg, FutureWarning)
No handles with labels found to put in legend.
```



In [25]:
```python
after_AB_control_base_table_noout = after_AB_control_base_table[after_AB_control_base_table.active_mins < np.percentile(after_AB_control_base_table
after_AB_treatment_base_table_noout = after_AB_treatment_base_table[after_AB_treatment_base_table.active_mins < np.percentile(after_AB_treatment_ba
```

In [26]:
```python
after_AB_treatment_base_table_noout.head()
```

Out[26]:

	uid	date	active_mins	variant_number	AB_Date	signup_date	gender	user_type
0	40000	2019-02-13	3.0	1	2019-02-06	2019-02-04	male	new_user
1	40000	2019-03-02	18.0	1	2019-02-06	2019-02-04	male	new_user
2	40000	2019-03-12	4.0	1	2019-02-06	2019-02-04	male	new_user
3	40001	2019-02-14	16.0	1	2019-02-06	2017-04-29	male	non_reader
4	40001	2019-02-17	5.0	1	2019-02-06	2017-04-29	male	non_reader

In [27]:
```python
after_AB_control_base_table_noout.head()
```

Out[27]:

	uid	date	active_mins	variant_number	AB_Date	signup_date	gender	user_type
0	0	2019-02-22	5.0	0	2019-02-06	2018-09-24	male	non_reader
1	0	2019-03-11	5.0	0	2019-02-06	2018-09-24	male	non_reader
2	0	2019-03-18	3.0	0	2019-02-06	2018-09-24	male	non_reader
3	0	2019-03-22	4.0	0	2019-02-06	2018-09-24	male	non_reader
4	0	2019-04-03	9.0	0	2019-02-06	2018-09-24	male	non_reader

In [28]:
```python
# plot of male/female readers for control and treatment data after the ab date


f, axes = plt.subplots(1, 2)
plt.style.use('ggplot')
pd.set_option('display.max_rows', None)

sns.distplot(after_AB_control_base_table_noout[(after_AB_control_base_table_noout["gender"] == 'female')&(after_AB_control_base_table_noout["user_t
             hist=False, axlabel = "Active Mins, Male Readers",ax=axes[0])
sns.distplot(after_AB_treatment_base_table_noout[(after_AB_treatment_base_table_noout["gender"] == 'female')&(after_AB_treatment_base_table_noout["
             hist=False, axlabel = "Active Mins, Male Readers",ax=axes[0])
sns.distplot(after_AB_control_base_table_noout[(after_AB_control_base_table_noout["gender"] == 'male')&(after_AB_control_base_table_noout["user_typ
             hist=False, axlabel = "Active Mins, Female Readers",ax=axes[1])
sns.distplot(after_AB_treatment_base_table_noout[(after_AB_treatment_base_table_noout["gender"] == 'male')&(after_AB_treatment_base_table_noout["us
             hist=False, axlabel = "Active Mins, Female Readers",ax=axes[1])


plt.show()
```

```
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
  warnings.warn(msg, FutureWarning)
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
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C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
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  warnings.warn(msg, FutureWarning)
```
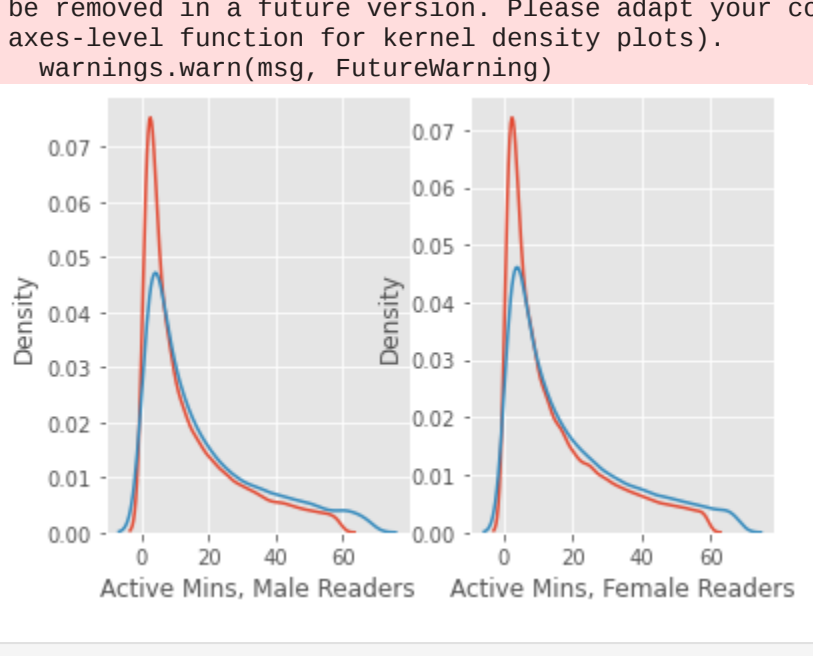
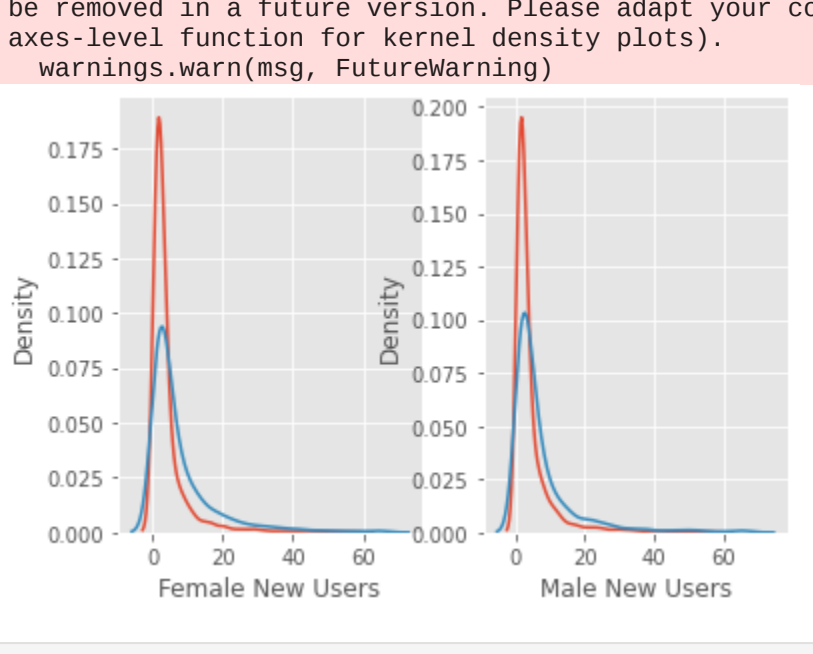



In [29]:
```python
# plot of male/female readers for control and treatment data after the ab date


f, axes = plt.subplots(1, 2)
plt.style.use('ggplot')
pd.set_option('display.max_rows', None)

sns.distplot(after_AB_control_base_table_noout[(after_AB_control_base_table_noout["gender"] == "female")&(after_AB_control_base_table_noout["user_t
             hist=False, axlabel = "Female New Users",ax=axes[0])
sns.distplot(after_AB_treatment_base_table_noout[(after_AB_treatment_base_table_noout["gender"] == "female")&(after_AB_treatment_base_table_noout["
             hist=False, axlabel = "Female New Users",ax=axes[0])
sns.distplot(after_AB_control_base_table_noout[(after_AB_control_base_table_noout["gender"] == "male")&(after_AB_control_base_table_noout["user_typ
             hist=False, axlabel = "Male New Users",ax=axes[1])
sns.distplot(after_AB_treatment_base_table_noout[(after_AB_treatment_base_table_noout["gender"] == "male")&(after_AB_treatment_base_table_noout["us
             hist=False, axlabel = "Male New Users",ax=axes[1])


plt.show()
```

```
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
  warnings.warn(msg, FutureWarning)
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
  warnings.warn(msg, FutureWarning)
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
  warnings.warn(msg, FutureWarning)
C:\Users\avand\anaconda3\envs\Data_sci\lib\site-packages\seaborn\distributions.py:2557: FutureWarning: `distplot` is a deprecated function and will be removed in a future version. Please adapt your code to use either `displot` (a figure-level function with similar flexibility) or `kdeplot` (an axes-level function for kernel density plots).
  warnings.warn(msg, FutureWarning)
```



In [30]:
```python
#columns i don't need

col_to_drop = ['date','AB_Date','signup_date']
```

In [31]:
```python
# function to turn gender into dummy variable

def mapMaleFemale(df):
    return df['gender'].map({'female':0, 'male':1})
```

In [32]:
```python
# add gender to arrays of attributes and active minutes for control and treatment

before_AB_treatment_base_table['gender'] = mapMaleFemale(before_AB_treatment_base_table)
before_AB_control_base_table['gender'] = mapMaleFemale(before_AB_control_base_table)
after_AB_control_base_table['gender'] = mapMaleFemale(after_AB_control_base_table)
after_AB_treatment_base_table['gender'] = mapMaleFemale(after_AB_treatment_base_table)
after_AB_control_base_table.head()
```

Out[32]:

	uid	date	active_mins	variant_number	AB_Date	signup_date	gender	user_type
0	0	2019-02-22	5.0	0	2019-02-06	2018-09-24	1.0	non_reader
1	0	2019-03-11	5.0	0	2019-02-06	2018-09-24	1.0	non_reader
2	0	2019-03-18	3.0	0	2019-02-06	2018-09-24	1.0	non_reader
3	0	2019-03-22	4.0	0	2019-02-06	2018-09-24	1.0	non_reader
4	0	2019-04-03	9.0	0	2019-02-06	2018-09-24	1.0	non_reader

In [33]:
```python
total_control= pd.merge(after_AB_control_base_table,before_AB_control_base_table,how = "inner",on = "uid")
total_treatment=pd.merge(before_AB_treatment_base_table,after_AB_treatment_base_table, how='inner',on='uid')
```

In [34]:
```python
# Function to order tables how i would like them for my analysis

def finalizeDataTables(df,col_to_drop, generateFile):
    # dum_1 = pd.get_dummies(before_AB_control_base_table['gender'])
    dum_2 = pd.get_dummies(df['user_type'])
    df = pd.concat([df,dum_2], axis = 1)
    df.drop(columns = col_to_drop, inplace = True)
    a = pd.DataFrame(df['uid'].value_counts())
    a.reset_index(inplace = True)
    a.rename(columns = {'uid':'appearences','index':'uid'}, inplace = True)
    df = pd.merge(df,a,how = "inner",on = "uid")
    col_to_group_by = list(df.columns)
    col_to_group_by.remove('active_mins')
    df = pd.DataFrame(df.groupby(col_to_group_by)['active_mins'].sum())
    df.reset_index(inplace = True)
    df.drop(columns = ['user_type'], inplace = True)
    df['avg_time_per_user'] = df['active_mins']/df['appearences']
    if generateFile:
        df.to_csv(df+".csv", index = False)
    return df
```

In [35]:
```python
# passing tables through above function
before_AB_control_base_table = finalizeDataTables(before_AB_control_base_table,col_to_drop, False)
before_AB_treatment_base_table = finalizeDataTables(before_AB_treatment_base_table,col_to_drop, False)
after_AB_control_base_table = finalizeDataTables(after_AB_control_base_table,col_to_drop, False)
after_AB_treatment_base_table = finalizeDataTables(after_AB_treatment_base_table,col_to_drop, False)
```

In [36]:
```python
before_AB_control_base_table.describe()
```

Out[36]:

	uid	variant_number	gender	contributor	new_user	non_reader	reader	appearences	active_mins	avg_time_per_user
count	33655.000000	33655.0	33655.000000	33655.000000	33655.000000	33655.000000	33655.000000	33655.000000	3.365500e+04	33655.000000
mean	19988.265102	0.0	0.657644	0.024335	0.083019	0.715941	0.176705	25.609568	9.373640e+02	13.675639
std	11544.409961	0.0	0.474505	0.154090	0.275915	0.450972	0.381424	27.398864	1.748716e+04	183.041285
min	0.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	1.000000e+00	1.000000
25%	9999.500000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	6.000000	1.900000e+01	2.620690
50%	19967.000000	0.0	1.000000	0.000000	0.000000	1.000000	0.000000	15.000000	5.700000e+01	4.000000
75%	30011.500000	0.0	1.000000	0.000000	0.000000	1.000000	0.000000	35.000000	2.050000e+02	7.323529
max	39999.000000	0.0	1.000000	1.000000	1.000000	1.000000	1.000000	133.000000	1.345714e+06	15448.000000

In [37]:
```python
# filter outliers
before_AB_control_base_table=before_AB_control_base_table[(np.abs(ss.zscore(before_AB_control_base_table['avg_time_per_user'])) < 4)]
before_AB_treatment_base_table=before_AB_treatment_base_table[(np.abs(ss.zscore(before_AB_treatment_base_table['avg_time_per_user'])) < 4)]
after_AB_control_base_table=after_AB_control_base_table[(np.abs(ss.zscore(after_AB_control_base_table['avg_time_per_user'])) < 4)]
after_AB_treatment_base_table=after_AB_treatment_base_table[(np.abs(ss.zscore(after_AB_treatment_base_table['avg_time_per_user'])) < 4)]

before_AB_control_base_table.describe()
```

Out[37]:

	uid	variant_number	gender	contributor	new_user	non_reader	reader	appearences	active_mins	avg_time_per_user
count	33605.000000	33605.0	33605.000000	33605.000000	33605.000000	33605.000000	33605.000000	33605.000000	33605.000000	33605.000000
mean	19986.213302	0.0	0.657521	0.023330	0.083142	0.716947	0.176581	25.493736	466.111620	8.701608
std	11543.755725	0.0	0.474546	0.150951	0.276101	0.450489	0.381319	27.233079	1588.811397	16.050014
min	0.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	1.000000	1.000000
25%	9997.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	6.000000	19.000000	2.616667
50%	19963.000000	0.0	1.000000	0.000000	0.000000	1.000000	0.000000	15.000000	57.000000	4.000000
75%	30011.000000	0.0	1.000000	0.000000	0.000000	1.000000	0.000000	35.000000	204.000000	7.291667
max	39999.000000	0.0	1.000000	1.000000	1.000000	1.000000	1.000000	133.000000	33696.000000	303.567568

In [38]:
```python
after_AB_treatment_base_table.head()
```

Out[38]:

	uid	variant_number	gender	contributor	new_user	non_reader	reader	appearences	active_mins	avg_time_per_user
0	40000	1	1.0	0	1	0	0	3	25.0	8.333333
1	40001	1	1.0	0	0	1	0	32	299.0	9.343750
2	40002	1	1.0	0	0	1	0	26	183.0	7.038462
3	40004	1	0.0	0	0	1	0	9	56.0	6.222222
4	40005	1	0.0	0	0	1	0	36	289.0	8.027778

In [39]:
```python
after_AB_treatment_base_table.describe()
```

Out[39]:

	uid	variant_number	gender	contributor	new_user	non_reader	reader	appearences	active_mins	avg_time_per_user
count	7733.000000	7733.0	7733.000000	7733.000000	7733.000000	7733.000000	7733.000000	7733.000000	7733.000000	7733.000000
mean	44993.647355	1.0	0.662873	0.012932	0.084314	0.763481	0.139273	19.763869	433.462304	11.316615
std	2889.811774	0.0	0.472759	0.112987	0.277876	0.424972	0.346254	20.408404	1372.059525	18.113017
min	40000.000000	1.0	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	1.000000	1.000000
25%	42470.000000	1.0	0.000000	0.000000	0.000000	1.000000	0.000000	5.000000	24.000000	3.888889
50%	44996.000000	1.0	1.000000	0.000000	0.000000	1.000000	0.000000	12.000000	72.000000	6.000000
75%	47494.000000	1.0	1.000000	0.000000	0.000000	1.000000	0.000000	27.000000	234.000000	10.723684
max	49999.000000	1.0	1.000000	1.000000	1.000000	1.000000	1.000000	107.000000	21659.000000	274.640000

In [40]:
```python
after_AB_control_base_table.describe()
```

Out[40]:

	uid	variant_number	gender	contributor	new_user	non_reader	reader	appearences	active_mins	avg_time_per_user
count	31700.000000	31700.0	31700.000000	31700.000000	31700.000000	31700.000000	31700.000000	31700.000000	31700.000000	31700.000000
mean	19969.485710	0.0	0.661640	0.024953	0.059779	0.729464	0.185804	24.294322	453.681798	8.663970
std	11539.422572	0.0	0.473159	0.155983	0.237081	0.444244	0.388955	24.514830	1473.349634	16.404811
min	0.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	1.000000	1.000000
25%	10006.500000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	6.000000	17.000000	2.500000
50%	19931.500000	0.0	1.000000	0.000000	0.000000	1.000000	0.000000	15.000000	55.000000	3.750000
75%	29985.250000	0.0	1.000000	0.000000	0.000000	1.000000	0.000000	34.000000	202.000000	7.043972
max	39999.000000	0.0	1.000000	1.000000	1.000000	1.000000	1.000000	110.000000	26887.000000	265.967742

In [41]:
```python
before_AB_control_base_table.describe()
```

Out[41]:

	uid	variant_number	gender	contributor	new_user	non_reader	reader	appearences	active_mins	avg_time_per_user
count	33605.000000	33605.0	33605.000000	33605.000000	33605.000000	33605.000000	33605.000000	33605.000000	33605.000000	33605.000000
mean	19986.213302	0.0	0.657521	0.023330	0.083142	0.716947	0.176581	25.493736	466.111620	8.701608
std	11543.755725	0.0	0.474546	0.150951	0.276101	0.450489	0.381319	27.233079	1588.811397	16.050014
min	0.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	1.000000	1.000000
25%	9997.000000	0.0	0.000000	0.000000	0.000000	0.000000	0.000000	6.000000	19.000000	2.616667
50%	19963.000000	0.0	1.000000	0.000000	0.000000	1.000000	0.000000	15.000000	57.000000	4.000000
75%	30011.000000	0.0	1.000000	0.000000	0.000000	1.000000	0.000000	35.000000	204.000000	7.291667
max	39999.000000	0.0	1.000000	1.000000	1.000000	1.000000	1.000000	133.000000	33696.000000	303.567568

In [42]:
```python
before_AB_treatment_base_table.describe()
```

Out[42]:

	uid	variant_number	gender	contributor	new_user	non_reader	reader	appearences	active_mins	avg_time_per_user
count	8324.000000	8324.0	8324.000000	8324.000000	8324.000000	8324.000000	8324.000000	8324.000000	8324.000000	8324.000000
mean	44984.990149	1.0	0.659298	0.012734	0.112926	0.743393	0.130947	20.632028	272.658698	6.933849
std	2891.714242	0.0	0.473974	0.112132	0.316522	0.436787	0.337362	22.723148	970.466033	10.970080
min	40001.000000	1.0	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	1.000000	1.000000
25%	42464.500000	1.0	0.000000	0.000000	0.000000	0.000000	0.000000	5.000000	16.000000	2.600000
50%	44979.500000	1.0	1.000000	0.000000	0.000000	1.000000	0.000000	13.000000	46.000000	3.875000
75%	47485.250000	1.0	1.000000	0.000000	0.000000	1.000000	0.000000	27.000000	142.250000	6.657143
max	49999.000000	1.0	1.000000	1.000000	1.000000	1.000000	1.000000	126.000000	17853.000000	184.051546

In [43]:
```python
# assigning variables that are easier to type

a= after_AB_control_base_table['avg_time_per_user'] #t1
b= after_AB_treatment_base_table['avg_time_per_user'] #t1
c= before_AB_treatment_base_table['avg_time_per_user'] #t3
d= before_AB_control_base_table['avg_time_per_user'] #t3
```

In [69]:
```python
# get t statistic, p value for T1 (after ab test date) control and test tables

t_stat, p_val= ss.ttest_ind(a,b, equal_var=True)
t_stat , p_val
```

Out[69]:
```
(-12.48381060947884, 1.0690013765752004e-35)
```

In [67]:
```python
# get 95% confidence interval for post ab experiment data

cm = sms.CompareMeans(sms.DescrStatsW(a), sms.DescrStatsW(b))
print(cm.tconfint_diff(usevar='unequal'))
```

```
(-3.0949496863815096, -2.2103404290865125)
```

In [61]:
```python
# join pre and post experiment data into combined control and treatment/test tables.

test = pd.concat([d,a],axis=0)#, axis=0, join='outer', ignore_index=False)
control = pd.concat([b,c],axis=0)#, axis=0, join='outer', ignore_index=False)
```

In [81]:
```python
# find 95% confidence interval for the combined pre and post ab experiment data

cm = sms.CompareMeans(sms.DescrStatsW(b), sms.DescrStatsW(c))
print(cm.tconfint_diff(usevar='unequal'))
```

```
(3.91526419657959, 4.850267153163217)
```

In [82]:
```python
# get t statistic, p value for combined pre and post ab experiment data

t_stat, p_val= ss.ttest_ind(b,c)
t_stat , p_val
```

Out[82]:
```
(18.692252002247365, 3.768786941330395e-77)
```

In [ ]: