Camaign DataSet

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

In [2]:
```
path=r"C:\Users\$AHIL\Desktop\Merkle Sokrati\Data Analyst Assignment.xlsx"
```

In [3]:
```
# Method-1 to read the excel files

wb=xlrd.open_workbook(path)
```

In [4]:
```
sheet1=wb.sheet_by_index(0)
for i in range(sheet1.ncols):
    print(sheet1.cell_value(0, i))
```

```
Date
product
phase
campaign_platform
campaign_type
communication_medium
subchannel
audience_type
creative_type
creative_name
device
age
spends
impressions
clicks
link_clicks
```

In [5]:
```
# Method-2 to read the excel files

data = pd.read_excel(path, sheet_name='Assignment-1')
```

In [6]:
```
data.head()
```

Out[6]:

	Date	product	phase	campaign_platform	campaign_type	communication_medium	subch
0	2019-10-16	Product 1	Performance	Google Ads	Search	Search Keywords	I
1	2019-10-16	Product 1	Performance	Google Ads	Search	Search Keywords	I
2	2019-10-16	Product 1	Performance	Google Ads	Search	Search Keywords	I
3	2019-10-16	Product 1	Performance	Google Ads	Search	Search Keywords	I
4	2019-10-18	Product 1	Performance	Google Ads	Search	Search Keywords	I

In [7]:
```
data.shape
```

Out[7]: (16834, 16)

In [8]:
```
data.describe()
```

Out[8]:

	spends	impressions	clicks	link_clicks
count	16834.000000	16834.000000	16834.000000	16288.000000
mean	148.694236	287.959190	11.977783	2.170371
std	483.895724	2444.450313	44.796963	18.659132
min	0.000000	0.000000	0.000000	0.000000
25%	0.180000	3.000000	0.000000	0.000000
50%	22.535000	13.000000	2.000000	0.000000
75%	110.020000	64.000000	8.000000	0.000000
max	9221.960000	67454.000000	1075.000000	450.000000

In [9]:
```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 16834 entries, 0 to 16833
Data columns (total 16 columns):
Date                    16834 non-null datetime64[ns]
product                 16834 non-null object
phase                   16834 non-null object
campaign_platform       16834 non-null object
campaign_type           16834 non-null object
communication_medium    16834 non-null object
subchannel              16834 non-null object
audience_type           16834 non-null object
creative_type           16834 non-null object
creative_name           16834 non-null object
device                  16834 non-null object
age                     16834 non-null object
spends                  16834 non-null float64
impressions             16834 non-null int64
clicks                  16834 non-null int64
link_clicks             16288 non-null float64
dtypes: datetime64[ns](1), float64(2), int64(2), object(11)
memory usage: 2.1+ MB
```

In [10]:
```
data.nunique()
```

Out[10]:
```
Date                    257
product                   1
phase                     1
campaign_platform         2
campaign_type             2
communication_medium      2
subchannel                4
audience_type             4
creative_type             3
creative_name             4
device                    4
age                       7
spends                 9087
impressions            1188
clicks                  263
link_clicks             160
dtype: int64
```

In [11]:
```
# We can see that the columns: product and phase are having singular values
# We can drop those columns since the act like constants and doesnt have any impa

data.drop(["product","phase"],axis=1,inplace=True)
```

In [12]:
```
# analysis of audience_type, creative_type and creative_name since it is having l

print(data.audience_type.value_counts())
print(data.creative_type.value_counts())
print(data.audience_type.value_counts())
```

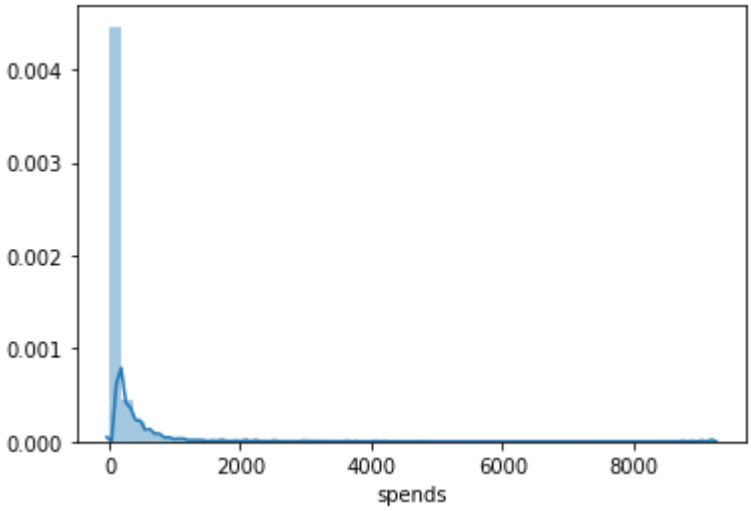
```
'-            15101
Audience 1      813
Audience 2      738
Audience 3      182
Name: audience_type, dtype: int64
'-          15101
Image        1130
Carousal      603
Name: creative_type, dtype: int64
'-            15101
Audience 1      813
Audience 2      738
Audience 3      182
Name: audience_type, dtype: int64
```

In [13]:
```
# the above results clearly shows that the unknown string value ie. " '- " is goi
# so replace them with name "other"
# Note: we cannot replace it with mean median or mode because the count of this f

data.audience_type[data.audience_type=="'-"] = "Other"
data.creative_type[data.creative_type=="'-"] = "Other"
data.creative_name[data.creative_name=="'-"] = "Other"
```

```
C:\Andaconda\lib\site-packages\ipykernel_launcher.py:5: SettingWithCopyWarnin
g:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy (http://pandas.pydata.org/pandas
-docs/stable/indexing.html#indexing-view-versus-copy)
  """
C:\Andaconda\lib\site-packages\ipykernel_launcher.py:6: SettingWithCopyWarnin
g:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy (http://pandas.pydata.org/pandas
-docs/stable/indexing.html#indexing-view-versus-copy)

C:\Andaconda\lib\site-packages\ipykernel_launcher.py:7: SettingWithCopyWarnin
g:
A value is trying to be set on a copy of a slice from a DataFrame

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/st
able/indexing.html#indexing-view-versus-copy (http://pandas.pydata.org/pandas
-docs/stable/indexing.html#indexing-view-versus-copy)
  import sys
```

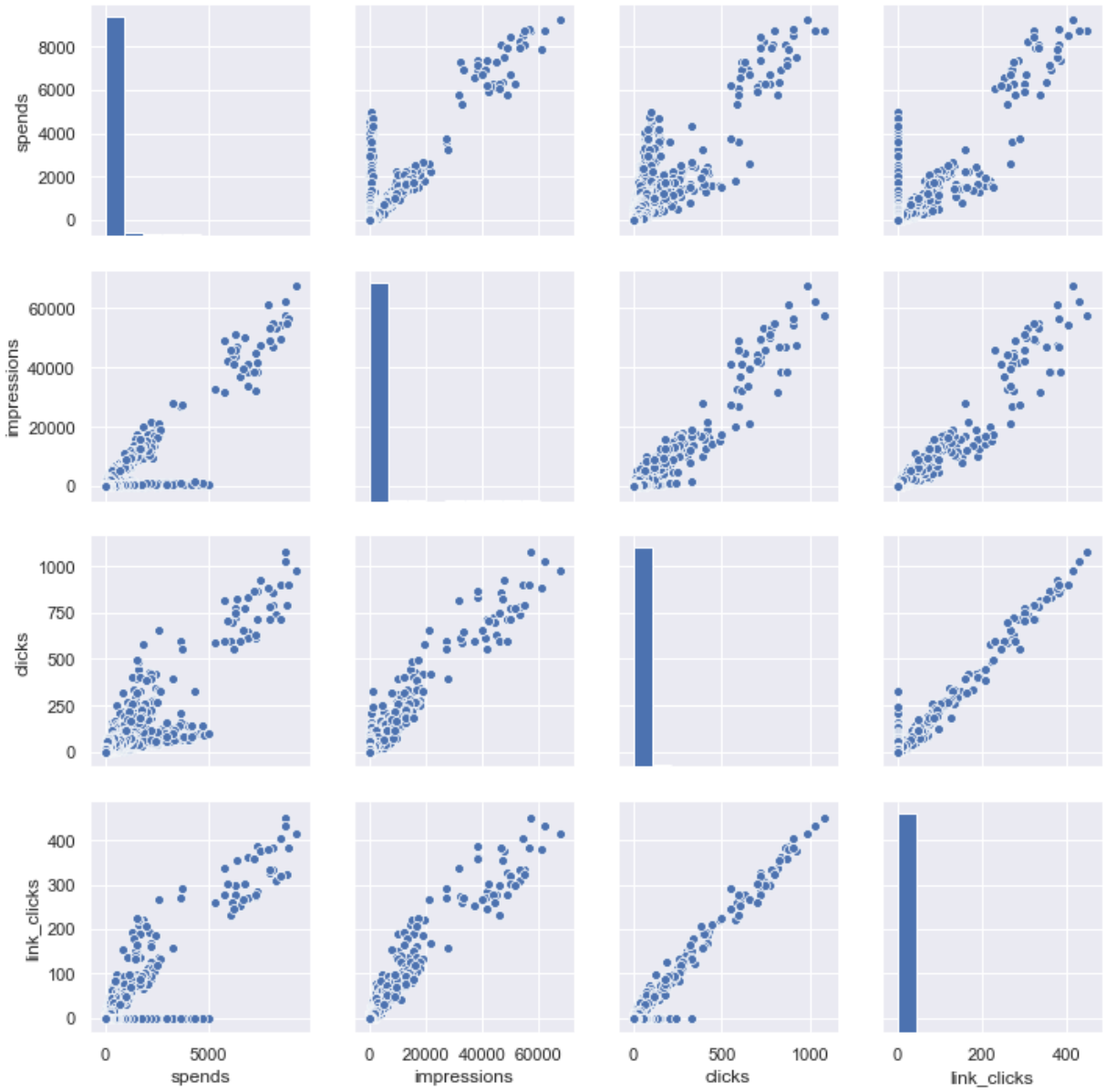
In [14]:
```
sns.distplot(data.spends)
```

Out[14]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x25b6f3fc668>
```



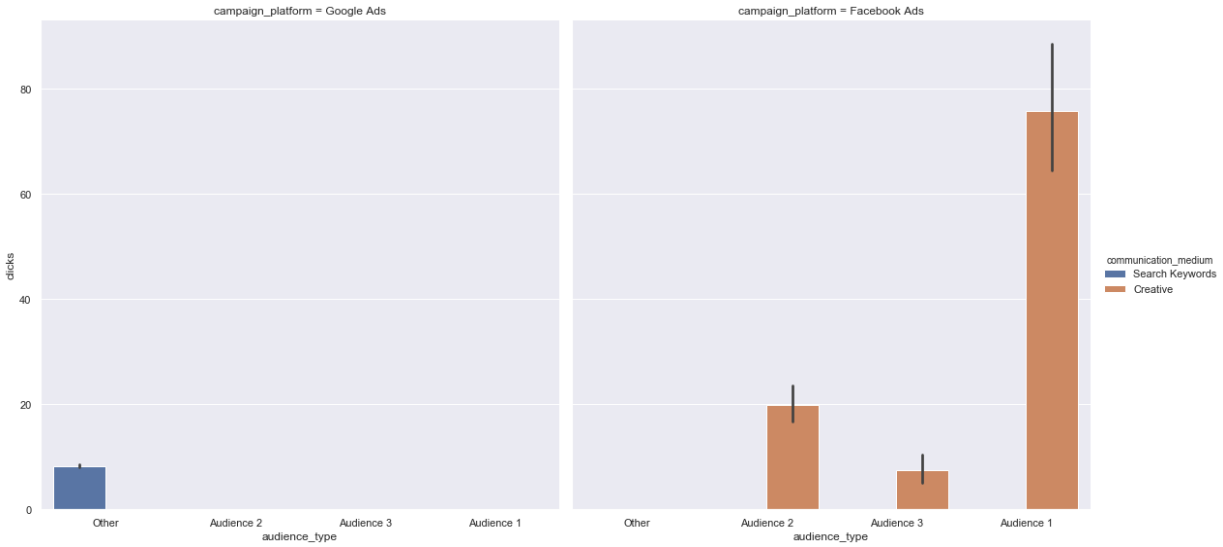
In [15]:
```
#scatterplot
sns.set()
sns.pairplot(data, size = 2.5)
plt.show();
```

```
C:\Andaconda\lib\site-packages\seaborn\axisgrid.py:2065: UserWarning: The `size
` parameter has been renamed to `height`; pleaes update your code.
  warnings.warn(msg, UserWarning)
C:\Andaconda\lib\site-packages\numpy\lib\histograms.py:839: RuntimeWarning: inv
alid value encountered in greater_equal
  keep = (tmp_a >= first_edge)
C:\Andaconda\lib\site-packages\numpy\lib\histograms.py:840: RuntimeWarning: inv
alid value encountered in less_equal
  keep &= (tmp_a <= last_edge)
```

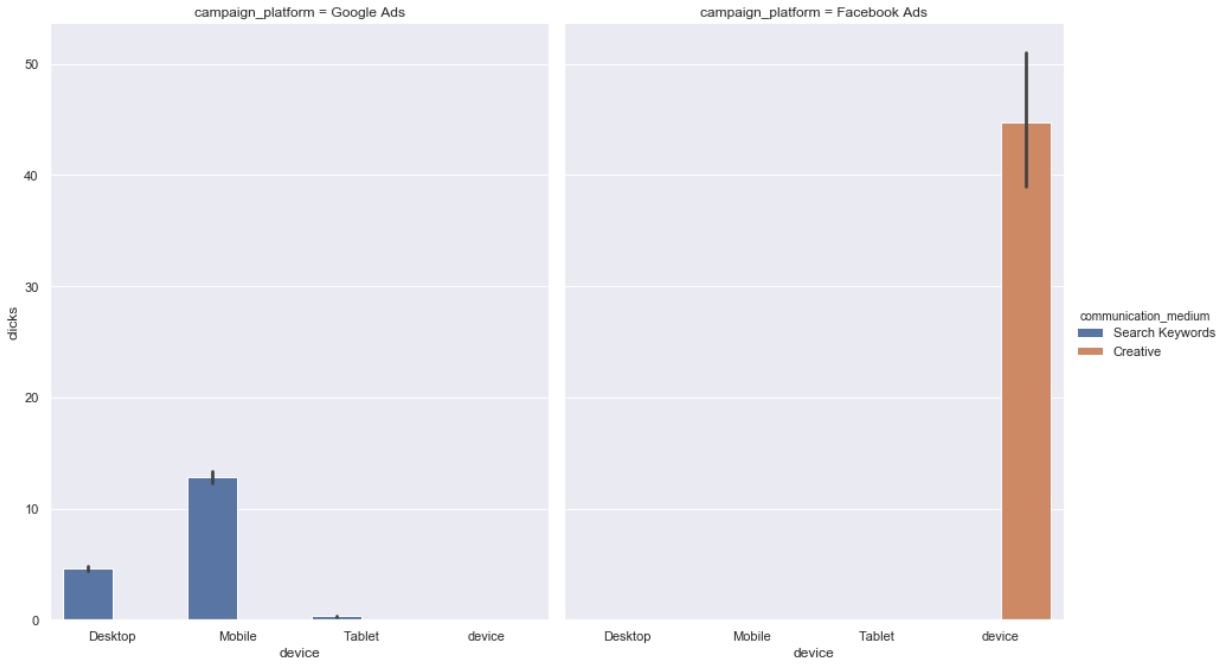


In [16]:
```
sns.catplot(x="audience_type", y="clicks",
                hue="communication_medium", col="campaign_platform",
                data=data, kind="bar",
                height=8, aspect=1)

# this shows that Google audience data is not present in dataset
```

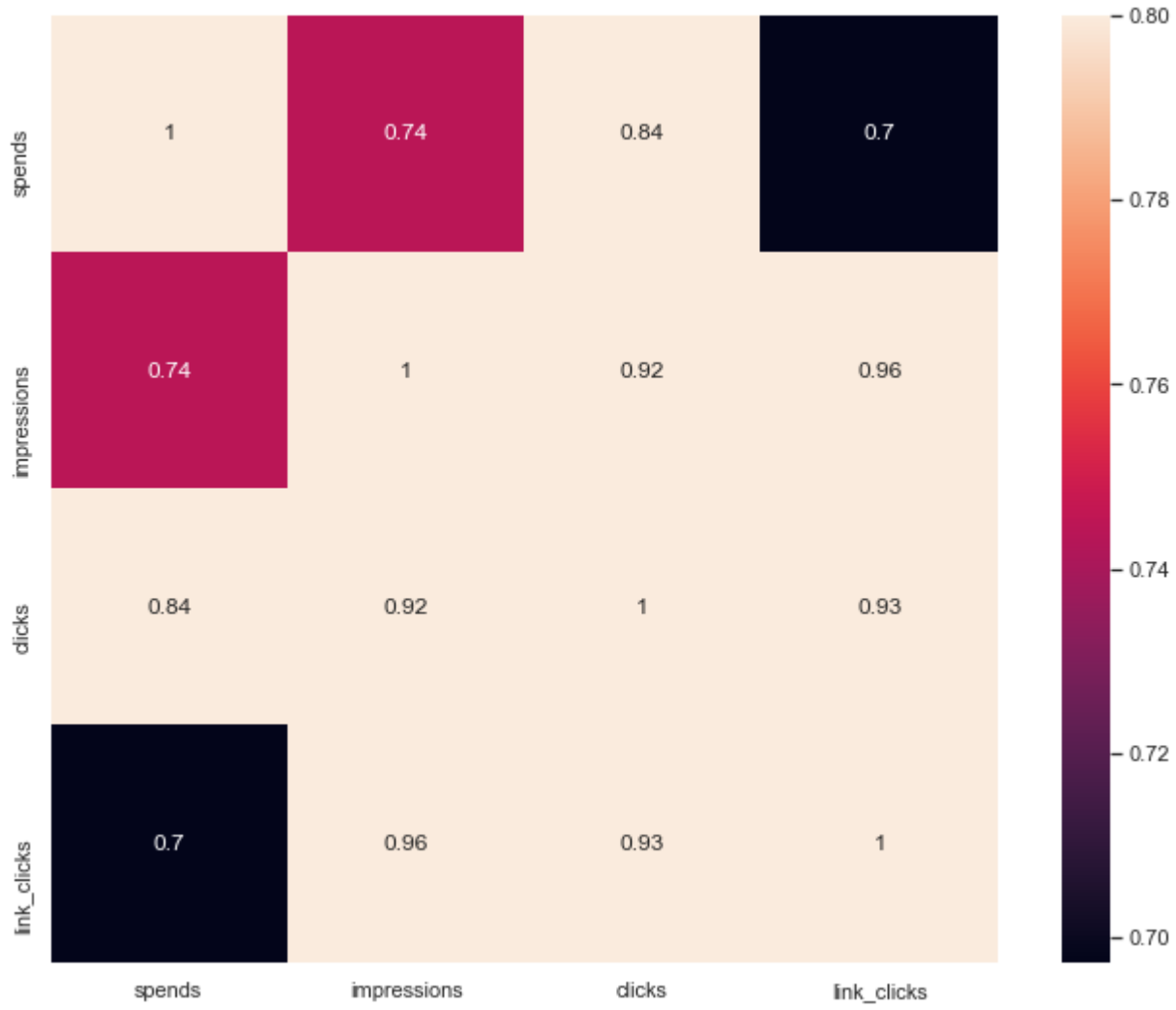
Out[16]:
```
<seaborn.axisgrid.FacetGrid at 0x25b70021be0>
```



In [17]:
```
sns.catplot(x="device", y="clicks",
            hue="communication_medium", col="campaign_platform",
            data=data, kind="bar",
            height=8, aspect=.8);

# this shows that the Facebook didnt captured any divice info data
```



In [18]:
```
#correlation matrix

numeric_columns = ["spends","impressions","clicks","link_clicks"]

corrmat = data.corr()
f, ax = plt.subplots(figsize=(12, 9))
sns.heatmap(corrmat, annot=True, vmax=.8, square=True);
```



In [19]:
```
#missing data
total = data.isnull().sum().sort_values(ascending=False)
percent = (data.isnull().sum()/data.isnull().count()).sort_values(ascending=False
missing_data = pd.concat([total, percent*100], axis=1, keys=['Total', 'in %'])
missing_data.head(20)
```

Out[19]:

	Total	in %
link_clicks	546	3.243436
clicks	0	0.000000
impressions	0	0.000000
spends	0	0.000000
age	0	0.000000
device	0	0.000000
creative_name	0	0.000000
creative_type	0	0.000000
audience_type	0	0.000000
subchannel	0	0.000000
communication_medium	0	0.000000
campaign_type	0	0.000000
campaign_platform	0	0.000000
Date	0	0.000000

In [20]:
```
# factor/categorical Data

# taking backup of the dataset
df = data.copy("deep")

from sklearn.preprocessing import LabelEncoder
df['campaign_platform'] = LabelEncoder().fit_transform(df['campaign_platform'])
df['communication_medium'] = LabelEncoder().fit_transform(df['communication_mediu
df['subchannel'] = LabelEncoder().fit_transform(df['subchannel'])
df['device'] = LabelEncoder().fit_transform(df['device'])
df['age'] = LabelEncoder().fit_transform(df['age'])
df['audience_type'] = LabelEncoder().fit_transform(df['audience_type'])
df['creative_type'] = LabelEncoder().fit_transform(df['creative_type'])
df['creative_name'] = LabelEncoder().fit_transform(df['creative_name'])
df['campaign_type'] = LabelEncoder().fit_transform(df['campaign_type'])
```

In [21]:
```
# remove date column since we are not doing time series analysis

df.drop("Date",axis=1,inplace=True)
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 16834 entries, 0 to 16833
Data columns (total 13 columns):
campaign_platform       16834 non-null int32
campaign_type           16834 non-null int32
communication_medium    16834 non-null int32
subchannel              16834 non-null int32
audience_type           16834 non-null int32
creative_type           16834 non-null int32
creative_name           16834 non-null int32
device                  16834 non-null int32
age                     16834 non-null int32
spends                  16834 non-null float64
impressions             16834 non-null int64
clicks                  16834 non-null int64
link_clicks             16288 non-null float64
dtypes: float64(2), int32(9), int64(2)
memory usage: 1.1 MB
```

Regression Model Building for Predicting Missing Values

In [22]:
```
# since column link_clicks is having 546 null values, lets build a Predictive ML-

# since the link_clicks is continuous, lets build Regression Model

# Split the data on the base of link_clicks column: where train = non null data &

from sklearn.model_selection import train_test_split

test = df[df['link_clicks'].isnull()]
train = df[df['link_clicks'].notnull()]

X,y = train.iloc[:,:-1], train.link_clicks

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.33, random_

# X_test, y_test = test.iloc[:,:-1], test.link_clicks
# X_train, y_train = train.iloc[:,:-1], train.link_clicks

print(X_train.shape, y_train.shape)
print(X_test.shape, y_test.shape)
```

```
(10912, 12) (10912,)
(5376, 12) (5376,)
```

In [24]:
```
# Linear Regression

from statsmodels.api import OLS
import statsmodels.api as sm

X = sm.add_constant(X_train)
Xtest = sm.add_constant(X_test)
linear_reg = sm.OLS(y_train,X).fit()
linear_reg.summary()
```

Out[24]:

OLS Regression Results

Dep. Variable:	link_clicks	**R-squared:**	0.957
Model:	OLS	**Adj. R-squared:**	0.957
Method:	Least Squares	**F-statistic:**	2.426e+04
Date:	Sat, 22 Aug 2020	**Prob (F-statistic):**	0.00
Time:	12:13:57	**Log-Likelihood:**	-30230.
No. Observations:	10912	**AIC:**	6.048e+04
Df Residuals:	10901	**BIC:**	6.056e+04
Df Model:	10		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	4.6854	0.341	13.755	0.000	4.018	5.353
campaign_platform	-1.1900	0.231	-5.141	0.000	-1.644	-0.736
campaign_type	-1.1900	0.231	-5.141	0.000	-1.644	-0.736
communication_medium	-1.1900	0.231	-5.141	0.000	-1.644	-0.736
subchannel	0.1953	0.030	6.513	0.000	0.137	0.254
audience_type	-1.3542	0.224	-6.057	0.000	-1.792	-0.916
creative_type	10.1764	0.586	17.358	0.000	9.027	11.326
creative_name	-6.0719	0.351	-17.277	0.000	-6.761	-5.383
device	-0.3450	0.060	-5.742	0.000	-0.463	-0.227
age	0.0112	0.019	0.603	0.546	-0.025	0.048
spends	-0.0072	0.000	-49.320	0.000	-0.008	-0.007
impressions	0.0049	3.86e-05	127.298	0.000	0.005	0.005
clicks	0.1795	0.003	67.677	0.000	0.174	0.185

Omnibus:	9567.361	**Durbin-Watson:**	1.998
Prob(Omnibus):	0.000	**Jarque-Bera (JB):**	4388751.958
Skew:	3.250	**Prob(JB):**	0.00
Kurtosis:	101.033	**Cond. No.**	4.08e+19

```
Warnings:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
[2] The smallest eigenvalue is 4.32e-29. This might indicate that there are
strong multicollinearity problems or that the design matrix is singular.
```

In [25]:
```
pred = linear_reg.predict(X)
residuals=y_train-pred
print("Residuals: ",residuals.mean())  # residuals must be near to zero

# Prediction on splited test data
p1=linear_reg.predict(Xtest)
sse=round(sum((y_test-p1)**2),2)
mse=round(sse/len(y_test),2)

print("SSE = {} \nMSE = {}".format(sse,mse))
```

```
Residuals:  -2.5396001691305887e-13
SSE = 82994.08
MSE = 15.44
```

In [29]:
```
# Ridge Regression & Lasso Regression

# to Penalize the Magnitude of Coefficients

from sklearn import datasets, linear_model
from sklearn.model_selection import cross_val_score

# ridge = linear_model.Ridge()
# print(cross_val_score(ridge, X_train, y_train, cv=3))


cols = list(data.columns)
cols

cols.remove('link_clicks')
cols

alpha=np.linspace(0.1,0.9,10)
ridge_sse=[]

for a in alpha:
    print('alpha={}'.format(a))

    #build ridge model and predict
    r1=linear_model.Ridge(alpha=a).fit(X_train,y_train)
    p2= r1.predict(X_test)

    #calc the sse
    e1=np.mean((p2-y_test)**2)
    ridge_sse.append(e1)

    #print the coefficients
    r_coeff =list(r1.coef_)
    print(list(zip(cols,r_coeff)))
    print("\n")

print(ridge_sse)
min(ridge_sse)

#print the sse of 2 models
print("\n\n")
print("MSE: \nLinear_reg = {}, \nRidge = {}".format(mse,min(ridge_sse)))
```

```
alpha=0.1
[('Date', -1.188067836852517), ('campaign_platform', -1.1880678368481792),
('campaign_type', -1.188067836843813), ('communication_medium', 0.19537623773
097804), ('subchannel', -1.3533756683033897), ('audience_type', 10.1452356985
42368), ('creative_type', -6.0551529169199), ('creative_name', -0.34499251564
8597), ('device', 0.011285244918055128), ('age', -0.0072348145569425025), ('s
pends', 0.004915950955218106), ('impressions', 0.17948879351222405)]


alpha=0.18888888888888888
[('Date', -1.1863558255943907), ('campaign_platform', -1.1863558255961821),
```

```
('campaign_type', -1.1863558255984186), ('communication_medium', 0.1954008350
9935047), ('subchannel', -1.3526896005827969), ('audience_type', 10.117720841
56907), ('creative_type', -6.0403619099350205), ('creative_name', -0.34495694
02047532), ('device', 0.011322568800003294), ('age', -0.00723542944947232),
('spends', 0.004915945783546154), ('impressions', 0.17950878973603743)]


alpha=0.2777777777777778
[('Date', -1.1846517751317116), ('campaign_platform', -1.1846517751323027),
('campaign_type', -1.1846517751299093), ('communication_medium', 0.1954253141
8455372), ('subchannel', -1.3520073947400957), ('audience_type', 10.090349796
122474), ('creative_type', -6.0256489356540675), ('creative_name', -0.3449213
767063683), ('device', 0.011359693138619911), ('age', -0.007236041220784561),
('spends', 0.004915940646506347), ('impressions', 0.17952868252393311)]


alpha=0.3666666666666667
[('Date', -1.1829556263634198), ('campaign_platform', -1.182955626377066),
('campaign_type', -1.1829556263723648), ('communication_medium', 0.1954496758
9292273), ('subchannel', -1.3513290182137498), ('audience_type', 10.063121436
494702), ('creative_type', -6.0110133816282225), ('creative_name', -0.3448858
252154897), ('device', 0.011396619503505036), ('age', -0.007236649895169901),
('spends', 0.004915935543862386), ('impressions', 0.17954847268340562)]


alpha=0.4555555555555556
[('Date', -1.1812673208352), ('campaign_platform', -1.1812673208326712), ('ca
mpaign_type', -1.1812673208326157), ('communication_medium', 0.19547392112143
3), ('subchannel', -1.350654438792863), ('audience_type', 10.03603464869747
2), ('creative_type', -5.996454641791227), ('creative_name', -0.3448502857928
895), ('device', 0.011433349447876474), ('age', -0.0072372554966665436), ('sp
ends', 0.00491593047538034), ('impressions', 0.1795681610135454)]


alpha=0.5444444444444445
[('Date', -1.179586800630184), ('campaign_platform', -1.1795868006284405),
('campaign_type', -1.1795868006298706), ('communication_medium', 0.1954980507
578406), ('subchannel', -1.349983624612842), ('audience_type', 10.00908833031
1796), ('creative_type', -5.981972116377815), ('creative_name', -0.3448147584
9807963), ('device', 0.011469884508788192), ('age', -0.007237858049063906),
('spends', 0.004915925440828433), ('impressions', 0.17958774830516058)]


alpha=0.6333333333333333
[('Date', -1.177914008451356), ('campaign_platform', -1.1779140084542092),
('campaign_type', -1.177914008457502), ('communication_medium', 0.19552206568
077815), ('subchannel', -1.349316544150791), ('audience_type', 9.982281390337
866), ('creative_type', -5.967565211841805), ('creative_name', -0.34477924338
93119), ('device', 0.011506226207332633), ('age', -0.007238457575905312), ('s
pends', 0.004915920439977184), ('impressions', 0.17960723534087064)]


alpha=0.7222222222222222
[('Date', -1.1762488875828208), ('campaign_platform', -1.1762488875802315),
('campaign_type', -1.1762488875803092), ('communication_medium', 0.1955459667
5988992), ('subchannel', -1.3486531662207029), ('audience_type', 9.9556127490
46622), ('creative_type', -5.953233340775118), ('creative_name', -0.344743740
```

```
5236278), ('device', 0.011542376048853773), ('age', -0.0072390541004916), ('s
pends', 0.004915915472599278), ('impressions', 0.17962662289522213)]


alpha=0.8111111111111111
[('Date', -1.1745913818538491), ('campaign_platform', -1.1745913818516929),
('campaign_type', -1.1745913818522316), ('communication_medium', 0.1955697548
5593656), ('subchannel', -1.3479934599695935), ('audience_type', 9.9290813378
35127), ('creative_type', -5.938975921829181), ('creative_name', -0.344708249
956849), ('device', 0.011578335523145394), ('age', -0.007239647645883972),
('spends', 0.004915910538469597), ('impressions', 0.1796459117347863)]


alpha=0.9
[('Date', -1.172941435673172), ('campaign_platform', -1.1729414356749424),
('campaign_type', -1.1729414356752663), ('communication_medium', 0.1955934308
209167), ('subchannel', -1.347337394872854), ('audience_type', 9.902686099084
182), ('creative_type', -5.9247923796372275), ('creative_name', -0.3446727717
43617), ('device', 0.011614106104654146), ('age', -0.007240238234907251), ('s
pends', 0.004915905637365138), ('impressions', 0.17966510261826615)]


[15.437528150804061, 15.437217087526077, 15.436913699718792, 15.4366178799421
57, 15.436329522367426, 15.436048522749397, 15.43577477840003, 15.43550818816
2187, 15.435248652383564, 15.434996072891709]



MSE:
Linear_reg = 15.44,
Ridge = 15.434996072891709
```

In [28]:
```
# Lasso Regression

# lasso = linear_model.Lasso()
# print(cross_val_score(lasso, X_train, y_train, cv=3))

alpha=np.linspace(0.1,0.9,10)
lasso_sse=[]

for a in alpha:
    print('alpha={}'.format(a))

    #build ridge model and predict
    l1=linear_model.Lasso(alpha=a).fit(X_train,y_train)
    p3= l1.predict(X_test)

    #calc the sse
    el1=np.mean((p3-y_test)**2)
    lasso_sse.append(el1)

    #print the coefficients
    l_coeff =list(l1.coef_)
    print(list(zip(cols,l_coeff)))
    print("\n")

print(lasso_sse)
min(lasso_sse)

print("\n\n")
print("MSE: \nLinear_reg = {}, \nRidge = {}, \nLasso = {}".format(mse,min(ridge_s
```

```
alpha=0.1
[('Date', -0.0), ('campaign_platform', -0.0), ('campaign_type', -0.0), ('comm
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('audience_type', -0.0), ('creative_type', -0.6629665819998716), ('creative_n
ame', -0.0), ('device', 0.0), ('age', -0.007506281008260995), ('spends', 0.00
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alpha=0.18888888888888888
[('Date', -0.0), ('campaign_platform', -0.0), ('campaign_type', -0.0), ('comm
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('audience_type', -0.0), ('creative_type', -0.38734899430680153), ('creative_
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alpha=0.2777777777777778
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('audience_type', -0.0), ('creative_type', -0.11173263764385283), ('creative_
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5011133127817946), ('impressions', 0.18623998791268456)]


alpha=0.3666666666666667
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```

```
unication_medium', 0.06649220341302564), ('subchannel', -0.9594315288099347),
('audience_type', -0.0), ('creative_type', -0.0), ('creative_name', 0.0), ('d
evice', -0.0), ('age', -0.007624269909691414), ('spends', 0.00503861466817565
2), ('impressions', 0.18642836361887946)]


alpha=0.4555555555555556
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('audience_type', -0.0), ('creative_type', -0.0), ('creative_name', 0.0), ('d
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27), ('impressions', 0.1867147296778361)]


alpha=0.5444444444444445
[('Date', -0.0), ('campaign_platform', -0.0), ('campaign_type', -0.0), ('comm
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('age', -0.007713703430256888), ('spends', 0.005093589359506513), ('impressio
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alpha=0.6333333333333333
[('Date', -0.0), ('campaign_platform', -0.0), ('campaign_type', -0.0), ('comm
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('age', -0.007791681308935741), ('spends', 0.005119789669724568), ('impressio
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alpha=0.7222222222222222
[('Date', -0.0), ('campaign_platform', -0.0), ('campaign_type', -0.0), ('comm
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alpha=0.8111111111111111
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alpha=0.9
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[15.808259542349166, 15.885780555581416, 16.01809135118326, 16.1876025039273
3, 16.395086864703224, 16.65000943870573, 16.92978901196049, 17.2234118711899
03, 17.224153305020717, 17.225040003245084]
```

```
MSE:
Linear_reg = 15.44,
Ridge = 15.434996072891709,
Lasso = 15.808259542349166
```

In [ ]:

In [ ]: