User Engagement Analysis @Showwcase

September 17, 2020

1 User Engagement Analysis

1.1 Introduction

According to mixpanel.com, **user engagement** measures whether users find value in a product/service. This can be measured by a variety/combination of activities. Highly engaged users are generally more profitable, *provided their activities are tied to valuable outcomes.*

User engagement is dependent on the company's business model. In Showwcase's case, key metrics for user engagement include positive actions such as *projects_added*, *likes_given*, *comments_given*, *session_projects_added*, *session_likes_given*, *session_comments_given*. Other metrics that help deepen the company's understanding of user engagement include actions that suggest lesser engagement. These include *bugs_occurred*, *bugs_in_session*, and the relationship between *inactive_duration* and *session_duration*. The following analyses will focus on these metrics.

My analyses also seeks to answer the following questions related to user engagement:

1. Projects are a unique feature that allow users to "showcase" their skills to the greater tech community. They also do well to increase a profile's visibility. **That being said, what proportion of users add at least one project to their profiles? Among those who add projects, how many do they add on average?**
2. It is useful to show activity trends over the course of the month. **Did the number of logins increase or decrease throughout October 2019?**
3. How many times a user logs onto Showwcase is a key metric for user engagement. We want to be seeing users logging on multiple times. **Thus, what proportion of users logged on more than once over the course of the week?**
4. The user experience is fundamental to maintaining user engagement. Smooth user experiences allow Showwcase to increase customer loyalty. **That being said, how many sessions experienced bugs, and in what proportion of sessions did bigs occur?**
5. Do any two variables affect one another? **Are any two metrics correlated with one another?**

These analyses will also use Python data analysis libraries, which are installed below.

[2]:
```
# import libraries

import pandas as pd
import numpy as np
```

```
import matplotlib
import matplotlib.pyplot as plt
%matplotlib inline

import seaborn as sns
```

We begin the analyses by exploring various properties of the data and cleaning the data as deemed fit.

[8]:
```
# load the data into a pandas dataframe
sessions_df = pd.read_excel("showwcase_sessions.xls")

# ensure the dataframe has loaded properly
sessions_df.head(10)
```

[8]:
```
   session_id  customer_id login_date  projects_added  likes_given  \
0      624205        80746 2019-10-30           False         True
1      624241        24520 2019-10-30            True         True
2      111002        32047 2019-10-30            True         True
3      545113        23404 2019-10-30            True         True
4      750269        40235 2019-10-30            True         True
5      744943        73245 2019-10-30            True         True
6      922001        12407 2019-10-30            True        False
7      823895        29375 2019-10-30           False        False
8      490096        40572 2019-10-30            True         True
9      919319        23404 2019-10-29            True         True

   comment_given  inactive_status  bug_occured  session_projects_added  \
0           True             True        False                       0
1           True             True        False                       2
2           True             True        False                       1
3           True            False        False                       1
4          False             True        False                       3
5           True             True         True                       3
6           True            False        False                       5
7           True             True        False                       0
8          False            False        False                       1
9          False             True        False                       2

   session_likes_given  session_comments_given  inactive_duration  \
0                 24.0                       3               1146
1                  3.0                       5                133
2                  5.0                       5               1571
3                 10.0                      21                  0
4                 16.0                       0               1405
5                 27.0                       5               1746
6                  0.0                       5                  0
```

```
7                 0.0                     5             2474
8                25.0                     0                0
9                14.0                     0             2031

   bugs_in_session  session_duration
0                0              1564
1                0              1766
2                0              2230
3                0               633
4                0              1679
5                4              1490
6                0              1329
7                0              1875
8                0               290
9                0              1957
```

[23]:
```
# dimensions
print(sessions_df.shape)

# columns' datatypes
print(sessions_df.dtypes)
```

```
(300, 14)
session_id                            int64
customer_id                           int64
login_date                   datetime64[ns]
projects_added                         bool
likes_given                            bool
comment_given                          bool
inactive_status                        bool
bug_occured                            bool
session_projects_added                int64
session_likes_given                 float64
session_comments_given                int64
inactive_duration                     int64
bugs_in_session                       int64
session_duration                      int64
dtype: object
```

[32]:
```
# statistical properties of numeric variables
sessions_df.describe().apply(lambda s: s.apply(lambda x: format(x, 'f')))
```

[32]:
```
          session_id   customer_id session_projects_added session_likes_given  \
count     300.000000    300.000000             300.000000          299.000000
mean   530643.296667  44956.766667               1.620000           10.458194
std    280421.371240  26411.336491               1.334743            9.474839
min     22885.000000  10246.000000               0.000000            0.000000
```

```
25%    308358.000000  23571.250000              1.000000             0.000000
50%    553675.000000  38967.000000              2.000000             9.000000
75%    804120.250000  73245.000000              3.000000            19.000000
max    999480.000000  98653.000000              9.000000            27.000000

      session_comments_given  inactive_duration  bugs_in_session  \
count             300.000000         300.000000       300.000000
mean                2.406667         732.933333         1.233333
std                 2.247545         838.143032         1.757608
min                 0.000000           0.000000         0.000000
25%                 0.750000           0.000000         0.000000
50%                 2.000000         313.500000         0.000000
75%                 4.000000        1524.750000         2.250000
max                21.000000        2480.000000         5.000000

      session_duration
count       300.000000
mean       1186.763333
std         688.632138
min          10.000000
25%         611.250000
50%        1152.000000
75%        1778.000000
max        2395.000000
```

There appears to be an outlier in the dataset. In one of the sessions, the inactive duration is greater than the session duration. Based on my understanding, the inactive duration is supposed to be less than or equal to the session_duration. Thus, the outlier will be removed and the dataframe will be checked for missing data.

All redundant columns, essentially the boolean columns for likes, comments, projects, bugs, and inactive status, will also be dropped because they can be explained by their numeric representations.

[40]:
```python
# dropping redundant columns
df_cleaned = sessions_df.drop(['projects_added', 'likes_given',
                               'comment_given', 'bug_occured',␣
 ↪'inactive_status'], axis = 1)
df_cleaned
```

[40]:
```
     session_id  customer_id login_date  session_projects_added  \
0        624205        80746 2019-10-30                       0
1        624241        24520 2019-10-30                       2
2        111002        32047 2019-10-30                       1
3        545113        23404 2019-10-30                       1
4        750269        40235 2019-10-30                       3
..          …            …          …                     …
295      944212        40572 2019-10-01                       3
296      558332        87323 2019-10-01                       2
```

```
297      643880        51243  2019-10-01                       2
298      844518        23083  2019-10-01                       1
299      933954        38459  2019-10-01                       1

     session_likes_given  session_comments_given  inactive_duration  \
0                   24.0                       3               1146
1                    3.0                       5                133
2                    5.0                       5               1571
3                   10.0                      21                  0
4                   16.0                       0               1405
..                   …                       …                 …
295                 13.0                       0               1174
296                  0.0                       0                 97
297                  0.0                       0                906
298                  0.0                       0                139
299                  0.0                       0                  0

     bugs_in_session  session_duration
0                  0              1564
1                  0              1766
2                  0              2230
3                  0               633
4                  0              1679
..               …               …
295                0              2255
296                0              1692
297                0              1990
298                0              1113
299                0               306

[300 rows x 9 columns]
```

[49]:

```
# checking for missing values in the data
df_cleaned.isna()

# although it appears there are no missing data, drop rows which contain␣
↪missing data
df_cleaned = df_cleaned.dropna(axis = 0, how = 'any')
df_cleaned
```

[49]:

```
     session_id  customer_id login_date  session_projects_added  \
0        624205        80746  2019-10-30                       0
1        624241        24520  2019-10-30                       2
2        111002        32047  2019-10-30                       1
3        545113        23404  2019-10-30                       1
4        750269        40235  2019-10-30                       3
..         …           …        …                     …
```

```
295      944212        40572  2019-10-01                        3
296      558332        87323  2019-10-01                        2
297      643880        51243  2019-10-01                        2
298      844518        23083  2019-10-01                        1
299      933954        38459  2019-10-01                        1

     session_likes_given  session_comments_given  inactive_duration  \
0                   24.0                       3               1146
1                    3.0                       5                133
2                    5.0                       5               1571
3                   10.0                      21                  0
4                   16.0                       0               1405
..                   …                       …                 …
295                 13.0                       0               1174
296                  0.0                       0                 97
297                  0.0                       0                906
298                  0.0                       0                139
299                  0.0                       0                  0

     bugs_in_session  session_duration
0                  0              1564
1                  0              1766
2                  0              2230
3                  0               633
4                  0              1679
..               …               …
295                0              2255
296                0              1692
297                0              1990
298                0              1113
299                0               306

[299 rows x 9 columns]
```

One row contained missing data because we now have a 299 x 9 dataframe. This updated dataframe is stored in df_cleaned.

[50]:
```
# how many unique values does each variable contain?
df_cleaned.nunique(axis = 0)
```

[50]:
```
session_id                299
customer_id                48
login_date                 30
session_projects_added      8
session_likes_given        28
session_comments_given      9
inactive_duration         169
```

```
bugs_in_session              6
session_duration           278
dtype: int64
```

Notable insight: 48 unique customers logged onto Showwcase in October 2019.

[51]:
```
df_cleaned.describe().apply(lambda s: s.apply(lambda x: format(x, 'f')))
```

[51]:
```
          session_id   customer_id session_projects_added session_likes_given  \
count     299.000000    299.000000             299.000000          299.000000
mean   529534.652174  45028.849498               1.618729           10.458194
std    280232.153769  26426.038013               1.336799            9.474839
min     22885.000000  10246.000000               0.000000            0.000000
25%    307856.000000  23579.000000               1.000000            0.000000
50%    552796.000000  39475.000000               2.000000            9.000000
75%    802738.000000  73245.000000               3.000000           19.000000
max    999480.000000  98653.000000               9.000000           27.000000

      session_comments_given inactive_duration bugs_in_session  \
count             299.000000        299.000000      299.000000
mean                2.408027        731.638796        1.237458
std                 2.251190        839.247660        1.759100
min                 0.000000          0.000000        0.000000
25%                 0.500000          0.000000        0.000000
50%                 2.000000        312.000000        0.000000
75%                 4.000000       1525.500000        2.500000
max                21.000000       2480.000000        5.000000

      session_duration
count       299.000000
mean       1190.414716
std         686.871418
min          10.000000
25%         614.000000
50%        1152.000000
75%        1778.000000
max        2395.000000
```

1.2 Question 1

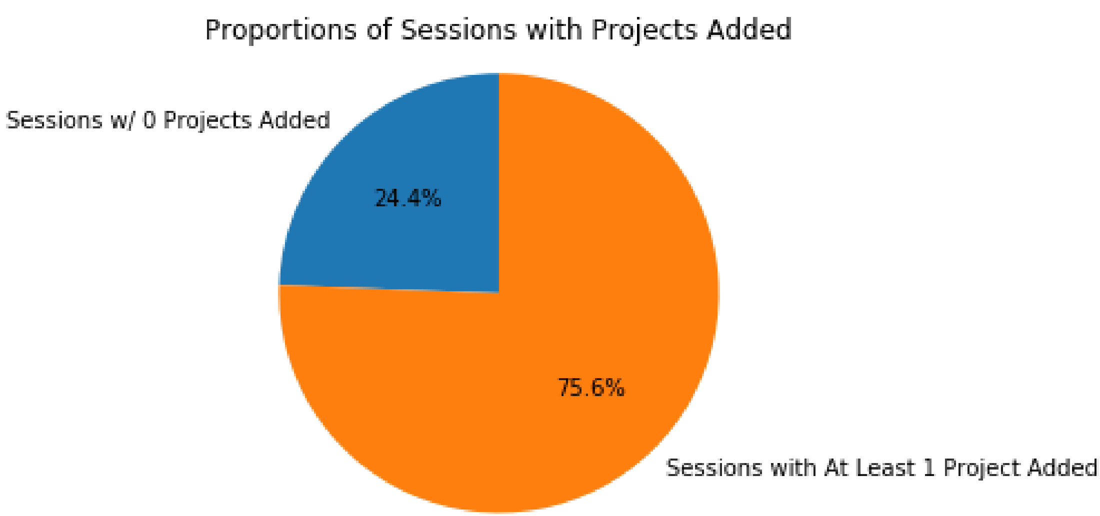
What proportion of users add at least one project to their profiles? Among those that have, how many do they add on average?

[108]:
```
# creating a dataframe where 0 projects were added
no_projects_added = df_cleaned.query('session_projects_added == 0')

# counting the number of sessions where 0 projects were added
# 73
```

```
no_projects_added['session_id'].agg('count')

# average number of projects added per session
# 2.14 projects/session
df_cleaned.query('session_projects_added > 0')['session_projects_added'].
 ↪agg('mean')
```

[108]: 2.1415929203539825

[94]:
```
# pie chart showing proportion of sessions where projects were added vs 0␣
 ↪projects

size = [100*73/299, 100*226/299]
labels = 'Sessions w/ 0 Projects Added', 'Sessions with At Least 1 Project␣
 ↪Added'

fig1, ax1 = plt.subplots()
ax1.pie(size, labels=labels, autopct='%1.1f%%', startangle = 90)
ax1.axis('equal') # ensures pie is drawn as a circle
plt.title("Proportions of Sessions with Projects Added")
plt.show()
```



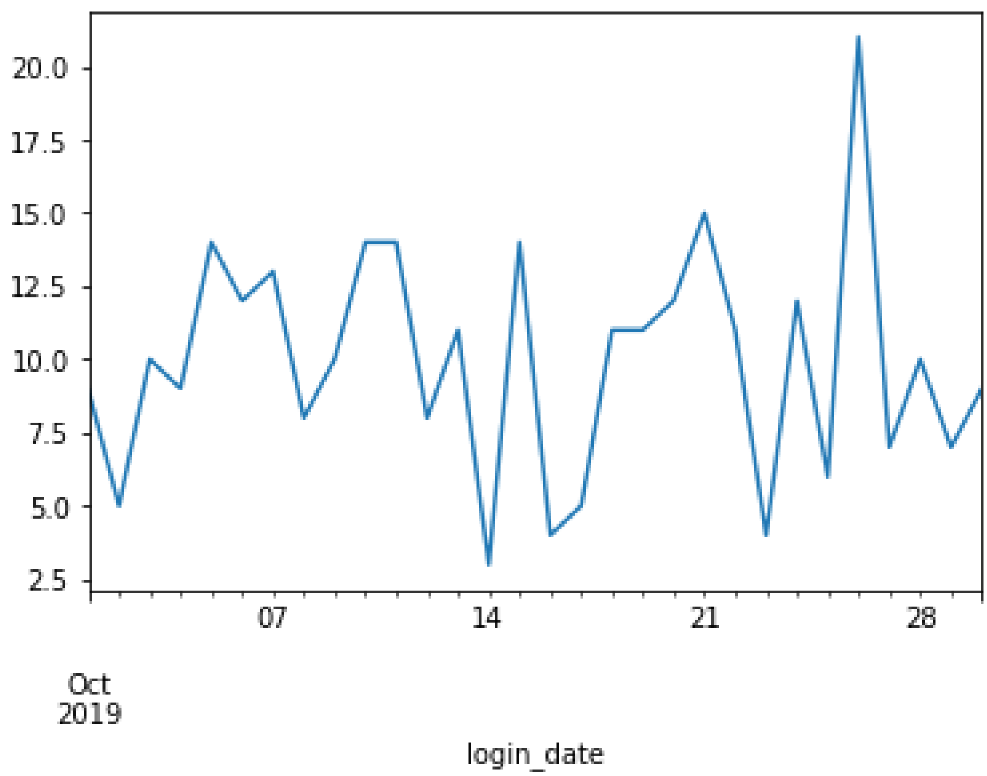
In 75.6% of sessions, users are adding at least 1 project to their profiles. This indicates that users are making use of the features relating to projects on Showwcase. Of all users who added a project, on average 2.14 projects were added per user.

1.3 Question 2

We want to observe trends in user activity over the course of the month. Did the number of logins per day increase, decrease, or remain the same during October 2019?

[85]:
```
# line plot showing the number of logins per day for October 2019

# displays how many lgogins occurred each day
sessions_per_day = df_cleaned.groupby(df_cleaned.login_date).count()

# this line contains the login_dates and the number of logins per day
sessions_per_day['session_id']

sessions_per_day['session_id'].plot.line(x = 'login_date', y = 'login count')
```

[85]: <matplotlib.axes._subplots.AxesSubplot at 0x7f8b6ba86d50>



Based on this simple pandas line plot, the number of logins fluctuates between days. However, the overall trend appears constant throughout October 2019.

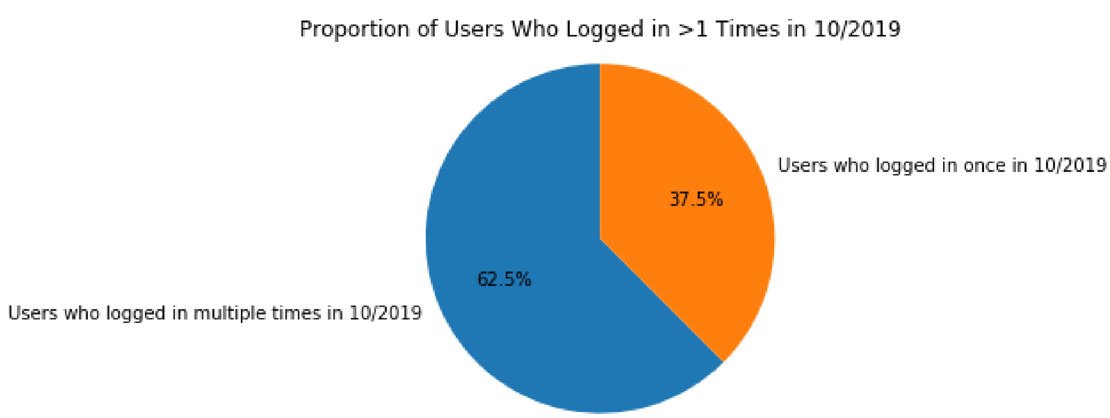
1.4 Question 3

How many users logged onto Showwcase more than once in October 2019?

[93]:
```
# group the dataframe by customer_id
logins_per_customer = df_cleaned.groupby(df_cleaned['customer_id']).count()
logins_per_customer

# the column we use after ...query(login_date > 1) doesn't matter because they␣
↪all contain
# the same value, which is 30
# I am only doing this to extract a single value
multiple_login_users = logins_per_customer.query('login_date >␣
↪1')['session_id'].count()
unique_users = df_cleaned['customer_id'].nunique()
single_login_users = unique_users - multiple_login_users
single_login_users
```

[93]: 18

[99]:
```
# pie chart showing proportion of multiple login users vs those who logged in␣
↪once
size = [100*multiple_login_users/unique_users, 100*single_login_users/
↪unique_users]
labels = 'Users who logged in multiple times in 10/2019', 'Users who logged in␣
↪once in 10/2019'

fig1, ax1 = plt.subplots()
ax1.pie(size, labels=labels, autopct='%1.1f%%', startangle = 90)
ax1.axis('equal') # ensures pie is drawn as a circle
plt.title("Proportion of Users Who Logged in >1 Times in 10/2019")
plt.show()
```



Of the 48 unique users who logged onto Showwcase in October 2019, 5/8 of them logged in multiple times. This implies that the majority of users are repeat users of the product.

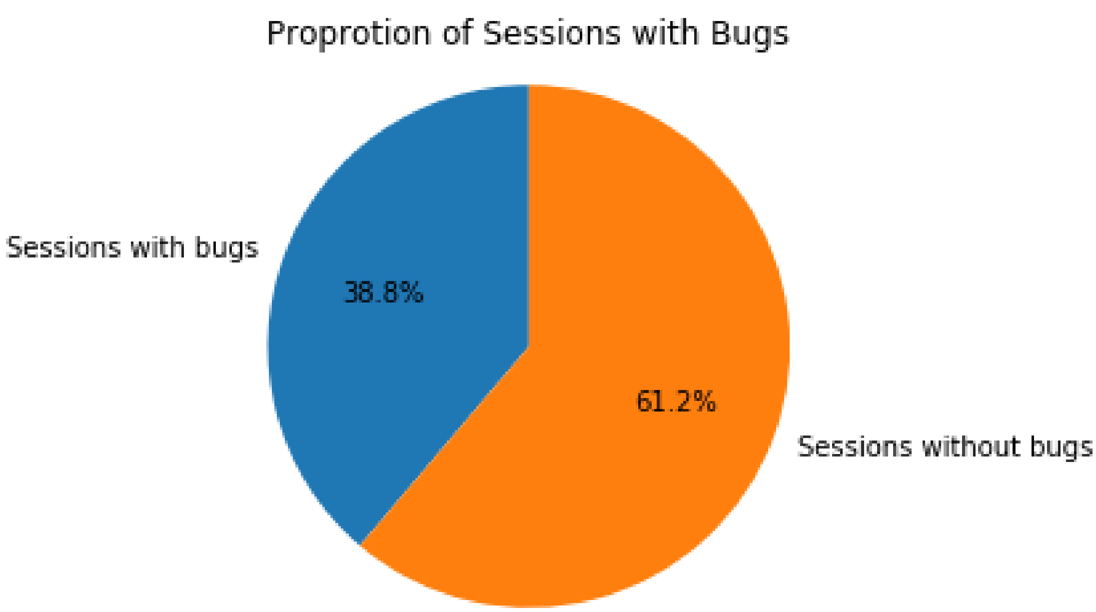
1.5 Question 4

How many sessions experienced bugs, and what proportion?

[101]:
```
# number of sessions (299)
sessions = df_cleaned['session_id'].count()

# number of buggy sessions (116)
buggy_sessions = df_cleaned.query('bugs_in_session > 0').count()
bug_sesh = buggy_sessions['bugs_in_session']

not_buggy = sessions - bug_sesh
not_buggy
```

[101]: 183

[102]:
```
# pie chart for proportion of buggy sessions
size = [100*bug_sesh/sessions, 100*not_buggy/sessions]
labels = 'Sessions with bugs', 'Sessions without bugs'

fig1, ax1 = plt.subplots()
ax1.pie(size, labels=labels, autopct='%1.1f%%', startangle = 90)
ax1.axis('equal') # ensures pie is drawn as a circle
plt.title("Proprotion of Sessions with Bugs")
plt.show()
```



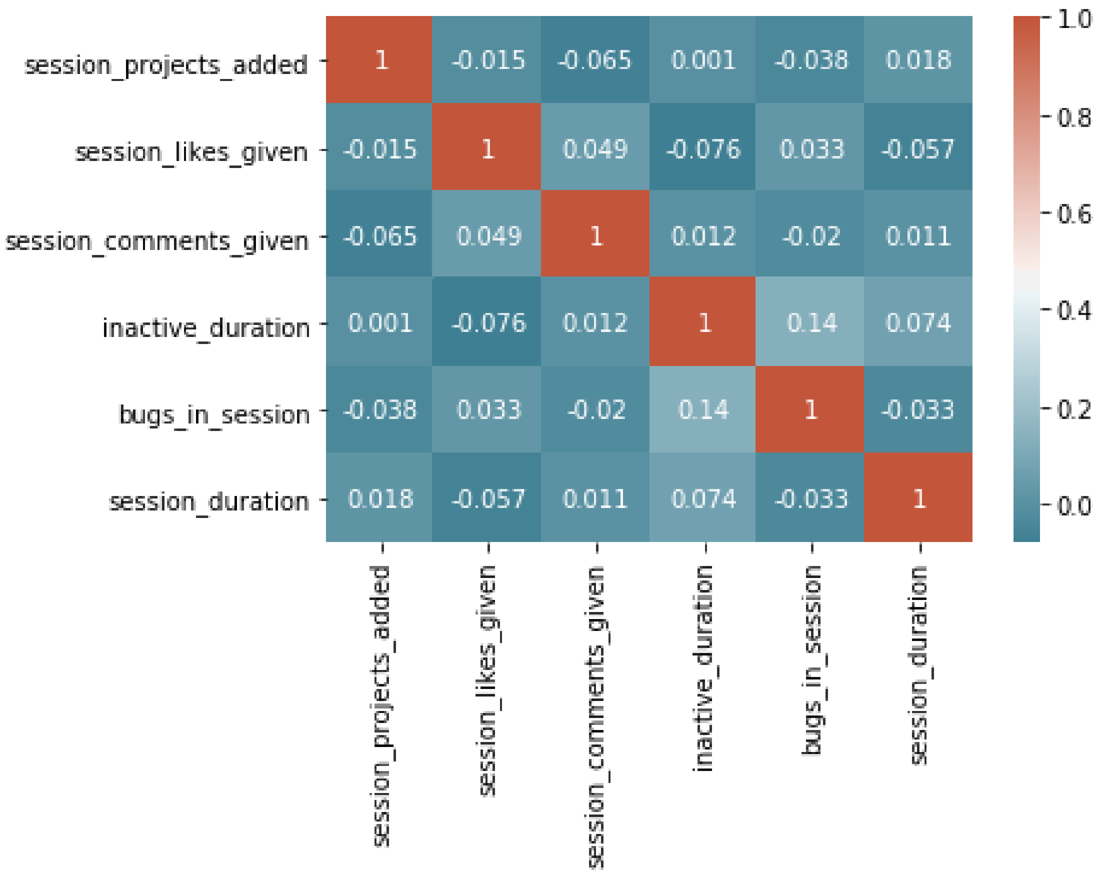
The data shows that 38.8% of sessions in October 2019 experienced at least one bug, a relatively high figure. While it hasn't been shown that bugs directly affect user engagement in a negative manner, bugs affect the user's experience on Showwcase, which can be a determining factor for user engagement.

1.6 Question 5

Are any two metrics for user engagement positively/negatively correlated with one another?

[106]:
```
# correlation matrix
# drop session_id, customer_id columns because they're not relevant here
corr_df = df_cleaned.drop(['session_id', 'customer_id'], axis = 1)
corr = corr_df.corr()
sns.heatmap(corr, xticklabels = corr.columns, yticklabels = corr.columns,
annot=True, cmap=sns.diverging_palette(220, 20, as_cmap=True))
```

[106]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x7f8b6c107690>
```



Correlation values range from -1 to 1, where -1 means two variables are strongly negatively correlated and 1 means they are strongly positively correlated. Based on my intuition of the variables, it could have been possible that variables such as *inactive_duration* and *session_duration* could have been correlated in some way. The same goes for *bugs_in_session* and *inactive_duration* and *session_projects_added* and *session_duration*. Ultimately, no two variables are strongly correlated with one another, with the highest correlation value being 0.14 between *inactive_duration* and *bugs_in_session*.

1.7 Future Considerations

User engagement is loosely defined, and there were few definitive ways to gain a better understanding of it. These metrics are useful for understanding the way users interact with the platform. In the future, I think it would be useful to devise a way to score a user's engagement with the platform. For example, considering all metrics, we could assign a user an engagement score from 0-5, where 0 is not engaged and 5 is actively engaged. This overall user engagement score, as well as the engagement metrics already at our disposal, can provide the Product team greater insight when making important product/marketing decisions.

I also tried to access customer and session id's as little as possible because these identifiers are personal to the user. I tried my best to maintain integrity and data privacy.