In [1]:

```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import matplotlib.ticker as tcr
```

In [2]:

```
#reading the json files
users = pd.read_json('/home/amybirdee/hobby_projects/health_first/USERS.json')
events = pd.read_json('/home/amybirdee/hobby_projects/health_first/EVENTS.json')
messages = pd.read_json('/home/amybirdee/hobby_projects/health_first/MESSAGES.json')
```

Data checking and cleaning

In [3]:

```
print(users.head())
```

```
                                    _id goalsAspiration gender motivatio
n  \
0  {'$oid': '5a2e417806d240124a6185a0'}          medium      F       look
s
1  {'$oid': '5a434efac3a72a107ce35c25'}            high      F      healt
h
2  {'$oid': '5a4feb9c0fb3cc7e95f244b8'}          medium      F     contro
l
3  {'$oid': '5a5b956b86ef893f9f93799a'}          medium      F      healt
h
4  {'$oid': '5a75a465eab9185480e42453'}          medium      F       look
s

    challenge   trigger  age  height  weight churnedAfterSix
0  motivation     tired   25   156.2    99.3              NA
1  motivation  emotions   66   154.9    60.3           False
2  motivation    social   61   174.0    65.8           False
3  motivation  emotions   55   172.7    80.7           False
4  motivation  emotions   61   162.6    98.9            True
```

In [4]:

```
#for all tables the user id column is formatted as a dictionary - the below code extrac
ts the values (user id) from these
#dictionaries and converts the data into a Series
users_1 = pd.json_normalize(users['_id'])
events_1 = pd.json_normalize(events['user'])
messages_1 = pd.json_normalize(messages['user'])
```

In [5]:

```
print(users_1.head())
```

```
                       $oid
0  5a2e417806d240124a6185a0
1  5a434efac3a72a107ce35c25
2  5a4feb9c0fb3cc7e95f244b8
3  5a5b956b86ef893f9f93799a
4  5a75a465eab9185480e42453
```

In [6]:

```
#since the user id is now its own series, the below code concatenates this series with
 the rest of the dataframe
users = pd.concat([users_1, users], axis = 1)
events = pd.concat([events_1, events], axis = 1)
messages = pd.concat([messages_1, messages], axis = 1)
```

In [7]:

```
print(messages.head())
```

```
                       $oid                                    _id  \
0  5a2e417806d240124a6185a0  {'$oid': '5ce7146a443e670e3c162086'}
1  5a2e417806d240124a6185a0  {'$oid': '5ce9b6fe443e670e3c1722c9'}
2  5a2e417806d240124a6185a0  {'$oid': '5ce9b7b5443e670e3c1722d5'}
3  5a2e417806d240124a6185a0  {'$oid': '5d032f844c772721eb101042'}
4  5a2e417806d240124a6185a0  {'$oid': '5d03c2144c772721eb104ee1'}

                                   user messageType  weekNumber  sentime
nt  \
0  {'$oid': '5a2e417806d240124a6185a0'}       group           0   1.0269
33
1  {'$oid': '5a2e417806d240124a6185a0'}       group           0   0.2956
21
2  {'$oid': '5a2e417806d240124a6185a0'}       group           0   0.0692
45
3  {'$oid': '5a2e417806d240124a6185a0'}     private           3   0.1415
59
4  {'$oid': '5a2e417806d240124a6185a0'}     private           3   0.1091
37

   questionsAsked  emojisUsed  mentionedScales  mentionedTracker
0             0.0         0.0              0.0               0.0
1             0.0         0.0              0.0               0.0
2             0.0         0.0              0.0               0.0
3             0.0         0.0              0.0               0.0
4             0.0         0.0              0.0               0.0
```

In [8]:

```
#the user id dictionary column is still there after concatenation - the below code dele
tes this.
del users['_id']
del events['_id']
del messages['_id']
del events['user']
del messages['user']
```

In [9]:

```
#checking column names in users table
users.columns
```

Out[9]:

```
Index(['$oid', 'goalsAspiration', 'gender', 'motivation', 'challenge',
       'trigger', 'age', 'height', 'weight', 'churnedAfterSix'],
      dtype='object')
```

In [10]:

```
#changing column names for users table
users = users.rename(columns = {'$oid': 'user_id', 'goalsAspiration': 'goals', 'churned
AfterSix': 'churned_after_six'})
```

In [11]:

```
#checking column names in events table
events.columns
```

Out[11]:

```
Index(['$oid', 'title', 'weekOnProgramme'], dtype='object')
```

In [12]:

```
events.head()
```

Out[12]:

	$oid	title	weekOnProgramme
0	5a2e417806d240124a6185a0	Added new food diary entry	0
1	5a2e417806d240124a6185a0	Sent message	0
2	5a2e417806d240124a6185a0	Sent message	0
3	5a2e417806d240124a6185a0	Sent message	0
4	5a2e417806d240124a6185a0	Read article	1

In [13]:

```
#changing column names for events table
events = events.rename(columns = {'$oid': 'user_id', 'weekOnProgramme': 'week_on_progra
mme'})
```

In [14]:

```
#checking column names in messages table
messages.columns
```

Out[14]:

```
Index(['$oid', 'messageType', 'weekNumber', 'sentiment', 'questionsAsked',
       'emojisUsed', 'mentionedScales', 'mentionedTracker'],
      dtype='object')
```

In [15]:

```
#changing column names for messages table
messages = messages.rename(columns = {'$oid': 'user_id', 'messageType': 'message_type',
'weekNumber': 'week_number',
                                     'questionsAsked': 'questions_asked', 'emojisUsed':
'emojis_used', 'mentionedScales':
                                     'mentioned_scales', 'mentionedTracker': 'mentioned
_tracker'})
```

In [16]:

```
#checking all tables turned out as expected with correct columns included and updated c
olumn names
print(users.head(3))
print(events.head(3))
print(messages.head(3))
```

```
                    user_id   goals gender motivation   challenge   trigge
r  \
0  5a2e417806d240124a6185a0  medium      F      looks  motivation     tire
d
1  5a434efac3a72a107ce35c25    high      F     health  motivation   emotion
s
2  5a4feb9c0fb3cc7e95f244b8  medium      F    control  motivation    socia
l

   age  height  weight churned_after_six
0   25   156.2    99.3                NA
1   66   154.9    60.3             False
2   61   174.0    65.8             False
                    user_id                      title  week_on_programme
0  5a2e417806d240124a6185a0  Added new food diary entry                  0
1  5a2e417806d240124a6185a0               Sent message                  0
2  5a2e417806d240124a6185a0               Sent message                  0
                    user_id message_type  week_number  sentiment  \
0  5a2e417806d240124a6185a0        group            0   1.026933
1  5a2e417806d240124a6185a0        group            0   0.295621
2  5a2e417806d240124a6185a0        group            0   0.069245

   questions_asked  emojis_used  mentioned_scales  mentioned_tracker
0              0.0          0.0               0.0                0.0
1              0.0          0.0               0.0                0.0
2              0.0          0.0               0.0                0.0
```

In [17]:

```
#checking datatypes for users table - goals and challenge include null entries, age, he
ight and weight are integers/floats
#so no need to convert
users.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 438 entries, 0 to 437
Data columns (total 10 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   user_id            438 non-null    object 
 1   goals              404 non-null    object 
 2   gender             438 non-null    object 
 3   motivation         438 non-null    object 
 4   challenge          405 non-null    object 
 5   trigger            438 non-null    object 
 6   age                438 non-null    int64  
 7   height             438 non-null    float64
 8   weight             438 non-null    float64
 9   churned_after_six  438 non-null    object 
dtypes: float64(2), int64(1), object(7)
memory usage: 34.3+ KB
```

In [18]:

```
#checking datatypes for events table - all cells are non-null, week_on_programme is an
 integer so no need to convert
events.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 56590 entries, 0 to 56589
Data columns (total 3 columns):
 #   Column             Non-Null Count  Dtype 
---  ------             --------------  ----- 
 0   user_id            56590 non-null  object
 1   title              56590 non-null  object
 2   week_on_programme  56590 non-null  int64 
dtypes: int64(1), object(2)
memory usage: 1.3+ MB
```

In [19]:

```
#checking datatypes for messages table - columns 4-7 include null entries, integer/floa
t columns are correct so no need to
#convert
messages.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 23711 entries, 0 to 23710
Data columns (total 8 columns):
 #   Column             Non-Null Count  Dtype  
---  ------             --------------  -----  
 0   user_id            23711 non-null  object 
 1   message_type       23711 non-null  object 
 2   week_number        23711 non-null  int64  
 3   sentiment          23711 non-null  float64
 4   questions_asked    22046 non-null  float64
 5   emojis_used        22046 non-null  float64
 6   mentioned_scales   22046 non-null  float64
 7   mentioned_tracker  22046 non-null  float64
dtypes: float64(5), int64(1), object(2)
memory usage: 1.4+ MB
```

In [20]:

```
#finding the null values in users table
users_null = users[users['goals'].isnull()]
print(users_null.head())
```

```
                     user_id goals gender motivation   challenge   trigg
er  \
8   5af86dd57e656f2faca52e19   NaN      F      looks  motivation     soci
al   
55  5cba40489203684bd4c4e04f   NaN      F      looks         NaN      oth
er   
62  5cbdf5854a95711131f8fe65   NaN      F      looks         NaN  emotio
ns   
64  5cbea7fd4a95711131f93b7d   NaN      F     health         NaN      tir
ed   
68  5cc3ff11aa2be51676641ea5   NaN      F     health         NaN      oth
er   

    age  height  weight churned_after_six  
8    68   170.0    65.0             False  
55   45   155.0    98.4                NA  
62   45   165.0    78.0             False  
64   37   164.0   122.0              True  
68   72   157.5    81.2             False  
```

In [21]:

```
#the goals and challenge columns take categorical values so will fill NaN values with
 'not answered' rather than creating
#an 'other' category for goals and inflating the existing 'other' category for challeng
e
users['goals'].fillna('not answered', inplace = True)
users['challenge'].fillna('not answered', inplace = True)
```

In [22]:

```
#the null columns in the messages table are all of datatype float so I will assume that
null means the users didn't ask
#any questions or use any emojis - filling NaN values with 0.0
messages.fillna(0.0, inplace = True)
```

In [23]:

```
#replacing true/false with 'churn'/'no churn' in churn column to avoid potential issues
with using boolean values later on
users = users.replace([False, True], ['No churn', 'Churn'])
```

In [24]:

```
#checking key stats in users table - average age of users is 47, main motivation to joi
n Health First is to improve looks
#biggest challenge is motivation, biggest trigger is stress, most users do not churn
users.describe(include = 'all')
```

Out[24]:

	user_id	goals	gender	motivation	challenge	trigger	age
count	438	438	438	438	438	438	438.0000(
unique	438	4	2	5	6	8	Na
top	5cd5260098495812a5292cd9	medium	F	looks	motivation	stress	Na
freq	1	272	410	172	207	122	Na
mean	NaN	NaN	NaN	NaN	NaN	NaN	47.3447
std	NaN	NaN	NaN	NaN	NaN	NaN	15.0532
min	NaN	NaN	NaN	NaN	NaN	NaN	23.0000(
25%	NaN	NaN	NaN	NaN	NaN	NaN	34.0000(
50%	NaN	NaN	NaN	NaN	NaN	NaN	48.0000(
75%	NaN	NaN	NaN	NaN	NaN	NaN	61.0000(
max	NaN	NaN	NaN	NaN	NaN	NaN	73.0000(

In [25]:

```
#checking key stats in events table - over 50,000 users included so many users had many
events
events.describe(include = 'all')
```

Out[25]:

	user_id	title	week_on_programme
count	56590	56590	56590.000000
unique	421	5	NaN
top	5cae4be5dfe728715c174f4c	Sent message	NaN
freq	894	23821	NaN
mean	NaN	NaN	2.405849
std	NaN	NaN	1.715860
min	NaN	NaN	0.000000
25%	NaN	NaN	1.000000
50%	NaN	NaN	2.000000
75%	NaN	NaN	4.000000
max	NaN	NaN	6.000000

In [26]:

```
#checking key stats in messages table - over 20,000 users included so many users sent m
any messages - mainly to the group
messages.describe(include = 'all')
```

Out[26]:

	user_id	message_type	week_number	sentiment	questions_ask
count	23711	23711	23711.000000	23711.000000	23711.0000
unique	414	2	NaN	NaN	N
top	5cae4be5dfe728715c174f4c	group	NaN	NaN	N
freq	680	19569	NaN	NaN	N
mean	NaN	NaN	2.341276	0.155524	0.1524
std	NaN	NaN	1.680317	0.245551	0.4712
min	NaN	NaN	0.000000	-1.570146	0.0000
25%	NaN	NaN	1.000000	0.000000	0.0000
50%	NaN	NaN	2.000000	0.123490	0.0000
75%	NaN	NaN	3.000000	0.288675	0.0000
max	NaN	NaN	6.000000	1.782857	6.0000

Exploratory data analysis - users table

In [27]:

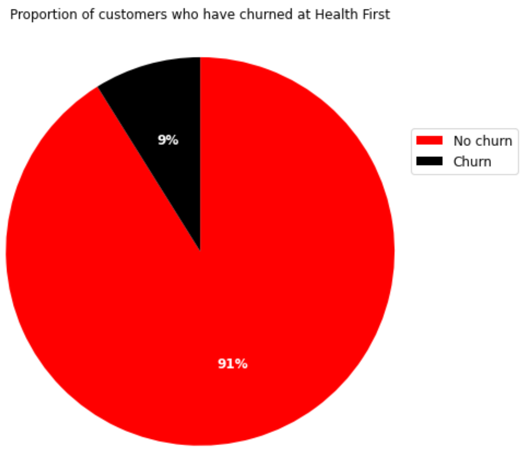
```
#grouping data to see how many customers churn and also dropping the row indexed at 2 a
s this contains the 'NA' variable
churn = users.groupby('churned_after_six').size().sort_values(ascending = False).to_fra
me().reset_index().\
rename(columns = {0: 'churn_count'})
churn = churn.drop([2]).reset_index(drop = True)
churn
```

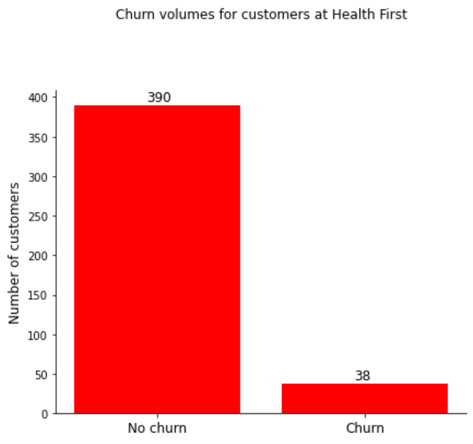
Out[27]:

	churned_after_six	churn_count
0	No churn	390
1	Churn	38

In [28]:

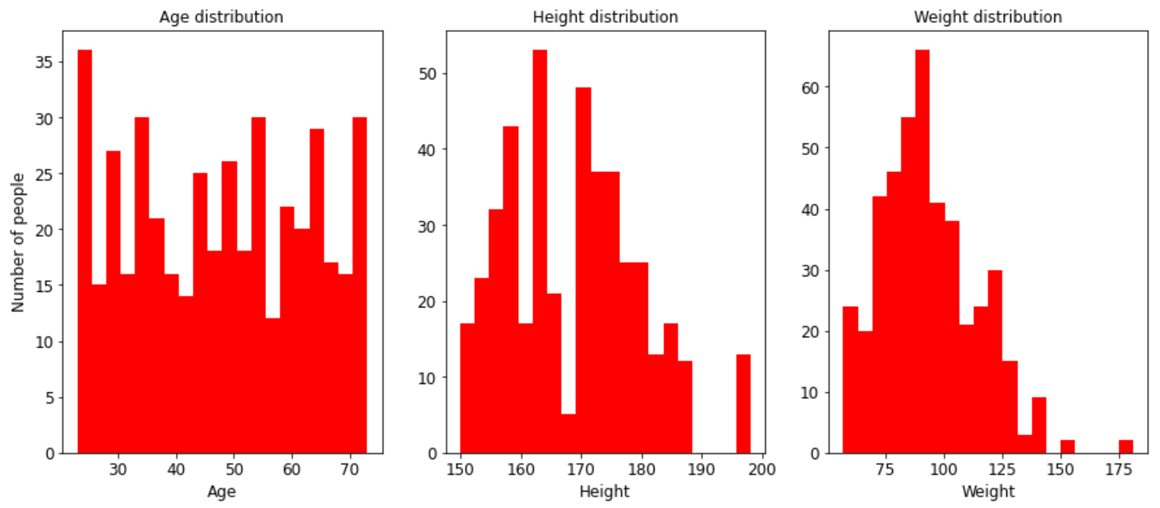
```
#creating charts to show churn - 91% of customers don't churn!

fig = plt.figure(figsize = (15, 6))
ax = plt.subplot(1, 2, 1)
_, _, autotexts = (plt.pie(churn['churn_count'], colors = ['red', 'black'], radius = 1.
5, autopct = ('%.0f%%'), \
                           counterclock = False, startangle = -270))

#bbox_to_anchor moves the legend around depending on the numbers fed in
plt.legend(labels = ['No churn', 'Churn'], loc = 'upper right', bbox_to_anchor = (1.5,
0.9), fontsize = 12)

#setting the colour of percentage labels to white
for autotext in autotexts:
    autotext.set_color('white')
    autotext.set_weight('bold')
    autotext.set_fontsize(12)

#the y = 1.2 shifts the title up above the chart
plt.title('Proportion of customers who have churned at Health First', y = 1.2, fontsize
= 12)

ax = plt.subplot(1, 2, 2)
plt.bar(churn['churned_after_six'], churn['churn_count'], color = 'red')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

#adding labels to the bars
bars = plt.bar(churn['churned_after_six'], churn['churn_count'], color = 'red')

#adding 0.35 shifts the label to the right so the alingment is more centered. Adding 5
 to yval shifts the values upwards
#upwards slightly
for bar in bars:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.35, yval + 5, yval, fontsize = 12)

plt.xticks(churn['churned_after_six'], labels = ['No churn', 'Churn'], fontsize = 12)
plt.ylabel('Number of customers', fontsize = 12)
plt.title('Churn volumes for customers at Health First', fontsize = 12, y = 1.2)
plt.tight_layout()
plt.savefig('churn_proportions_and_volumes')

plt.subplots_adjust(wspace = 0.8)
```


Proportion of customers who have churned at Health First
9%
91%
No churn
Churn


Churn volumes for customers at Health First
Number of customers
0
50
100
150
200
250
300
350
400
390
38
No churn
Churn

In [29]:

```
#checking age, height and weight distributions - no real pattern in the age data, heigh
t shows a relatively normal
#distribution, weight has a slight right skew which one would expect at a weight loss c
ompany

plt.figure(figsize = (15,6))

ax = plt.subplot(1, 3, 1)
users['age'].hist(bins = 20, color = 'red')
plt.xlabel('Age', fontsize = 12)
plt.ylabel('Number of people', fontsize = 12)
plt.tick_params(axis = 'x', labelsize = 12)
plt.tick_params(axis = 'y', labelsize = 12)
plt.title('Age distribution', fontsize = 12)
plt.grid(None)
plt.savefig('Age - histogram', bbox_inches = 'tight')

ax = plt.subplot(1, 3, 2)
users['height'].hist(bins = 20, color = 'red')
plt.xlabel('Height', fontsize = 12)
plt.ylabel('')
plt.tick_params(axis = 'x', labelsize = 12)
plt.tick_params(axis = 'y', labelsize = 12)
plt.title('Height distribution', fontsize = 12)
plt.grid(None)
plt.savefig('Height - histogram', bbox_inches = 'tight')

ax = plt.subplot(1, 3, 3)
users['weight'].hist(bins = 20, color = 'red')
plt.xlabel('Weight', fontsize = 12)
plt.ylabel('')
plt.tick_params(axis = 'x', labelsize = 12)
plt.tick_params(axis = 'y', labelsize = 12)
plt.title('Weight distribution', fontsize = 12)
plt.grid(None)
plt.savefig('Weight - histogram', bbox_inches = 'tight')
```



In [30]:

```
#grouping age and churn data and removing NAs - will then create age ranges to see whic
h age range churns the most
age = users.groupby(['age', 'churned_after_six']).size().to_frame().reset_index().renam
e(columns = {0: 'count'})
age = age[age.churned_after_six != 'NA']
age.head()
```

Out[30]:

	age	churned_after_six	count
0	23	Churn	2
1	23	No churn	11
3	24	No churn	13
4	25	Churn	1
6	25	No churn	7

In [31]:

```
#creating column for age ranges, ages range from 23-73
#grouping ages into 6 groups for barplot using pd.cut to cut the age column
bins = [20, 30, 40, 50, 60, 70, np.inf]
labels = ['<30', '30-40', '41-50', '51-60', '61-70', '70+']
age['age_range'] = pd.cut(age['age'], bins = bins, labels = labels)
age.head()
```

Out[31]:

	age	churned_after_six	count	age_range
0	23	Churn	2	<30
1	23	No churn	11	<30
3	24	No churn	13	<30
4	25	Churn	1	<30
6	25	No churn	7	<30

In [32]:

```
#pivoting the data for chart - this has also summed the age column which I will drop in
the next cell
age_pivot = age.pivot_table(columns = 'churned_after_six',
                            index = 'age_range',
                            aggfunc = 'sum').reset_index()
age_pivot
```

Out[32]:

	age_range	age		count	
churned_after_six		**Churn**	**No churn**	**Churn**	**No churn**
0	<30	135	212	8	67
1	30-40	213	355	8	73
2	41-50	272	455	8	74
3	51-60	221	555	4	78
4	61-70	319	585	6	74
5	70+	145	216	4	24

In [33]:

```
#dropping the age column to avoid confusion
age_pivot = age_pivot.drop(['age'], axis = 1)
```

```
/home/amybirdee/.local/lib/python3.6/site-packages/pandas/core/generic.py:
3889: PerformanceWarning: dropping on a non-lexsorted multi-index without
a level parameter may impact performance.
  obj = obj._drop_axis(labels, axis, level=level, errors=errors)
```

In [34]:

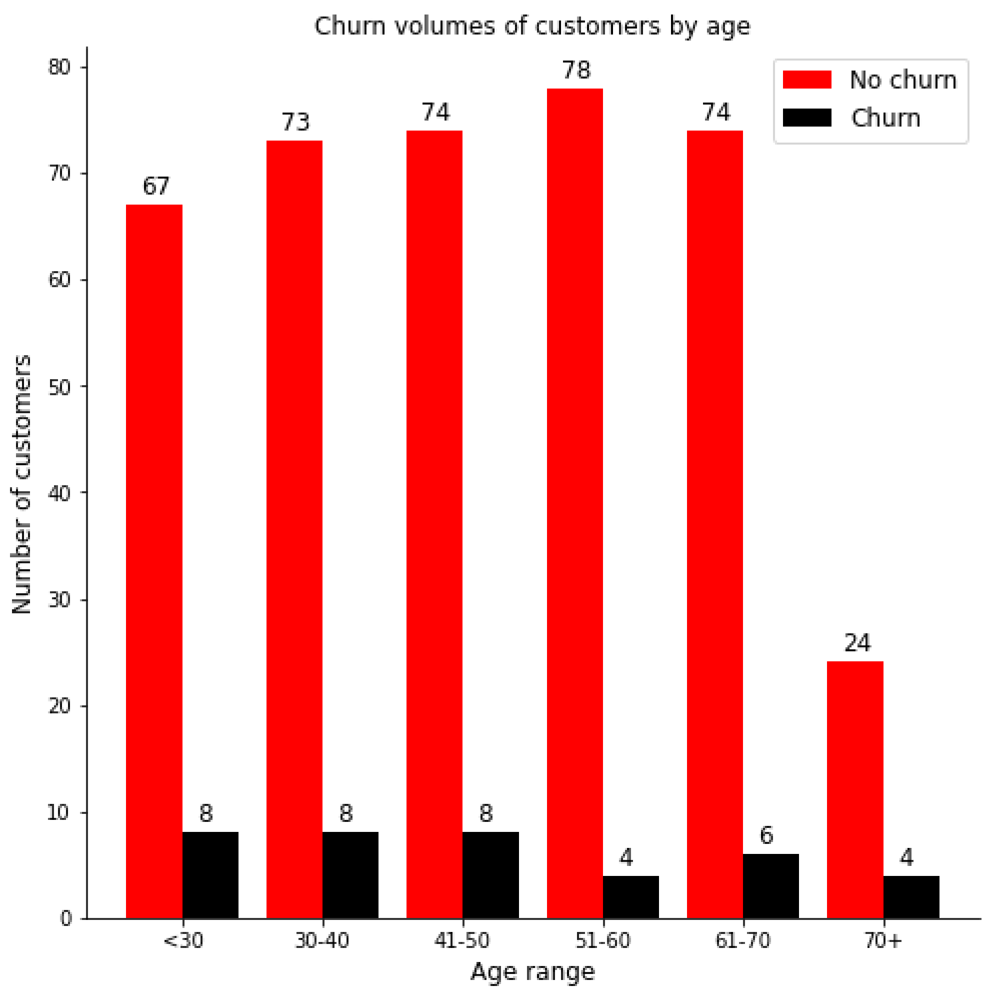
```
#the churn and no churn labels were previously subtitles which I couldn't access for th
e chart. The below code joins the
#title and subtitle
age_pivot.columns = list(map('_'.join, age_pivot.columns))
age_pivot
```

Out[34]:

	age_range_	count_Churn	count_No churn
0	<30	8	67
1	30-40	8	73
2	41-50	8	74
3	51-60	4	78
4	61-70	6	74
5	70+	4	24

In [35]:

```
#plotting bar chart - churn rates seem to be pretty stable across age ranges
num_bars = 6
width = 0.4

age_bars = np.arange(num_bars)

fig = plt.figure(figsize = (8, 8))
ax = fig.add_subplot()

bar_1 = ax.bar(age_bars, age_pivot['count_No churn'], width, color = 'red', label = 'No
churn')
bar_2 = ax.bar(age_bars + width, age_pivot['count_Churn'], width, color = 'black', labe
l = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

#adding data labels
for bar in bar_1:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.1, yval + 1, yval, fontsize = 12)

for bar in bar_2:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.1, yval + 1, yval, fontsize = 12)


ax.set_ylabel('Number of customers', fontsize = 12)
ax.set_xlabel('Age range', fontsize = 12)
ax.set_xticks(age_bars + width / 2)
ax.set_xticklabels(age_pivot.age_range_)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Churn volumes of customers by age', fontsize = 12)
plt.savefig('churn_by_age')
```



In [36]:

```
#grouping height and churn data and removing NAs - will then create height ranges to se
e which height range churns the most
height = users.groupby(['height', 'churned_after_six']).size().to_frame().reset_index()
.rename(columns = {0: 'count'})
height = height[height.churned_after_six != 'NA']
height.head()
```

Out[36]:

	height	churned_after_six	count
0	149.9	No churn	7
1	152.0	No churn	10
2	152.4	Churn	2
3	152.4	No churn	13
4	153.0	Churn	1

In [37]:

```
#creating column for height ranges, height range from 149-198 cm
#grouping heights into 6 groups for barplot using pd.cut to cut the height column
bins = [140, 150, 160, 170, 180, 190, np.inf]
labels = ['<150', '150-160', '161-170', '171-180', '181-190', '190+']
height['height_range'] = pd.cut(height['height'], bins = bins, labels = labels)
height.head()
```

Out[37]:

	height	churned_after_six	count	height_range
0	149.9	No churn	7	<150
1	152.0	No churn	10	150-160
2	152.4	Churn	2	150-160
3	152.4	No churn	13	150-160
4	153.0	Churn	1	150-160

In [38]:

```
#pivoting the data for chart - this has also summed the height column which I will drop
in the next cell
height_pivot = height.pivot_table(columns = 'churned_after_six',
                                   index = 'height_range',
                                   aggfunc = 'sum').reset_index()
height_pivot
```

Out[38]:

	height_range	count		height	
churned_after_six		**Churn**	**No churn**	**Churn**	**No churn**
0	<150	NaN	7.0	NaN	149.9
1	150-160	7.0	106.0	780.7	1558.8
2	161-170	8.0	87.0	985.1	1810.4
3	171-180	17.0	129.0	2094.4	2785.9
4	181-190	6.0	48.0	736.6	736.6
5	190+	NaN	13.0	NaN	198.1

In [39]:

```
#replacing NaNs with 0
height_pivot = height_pivot.replace(np.nan, 0.0)
```

In [40]:

```
#dropping the height column to avoid confusion
height_pivot = height_pivot.drop(['height'], axis = 1)
```

```
/home/amybirdee/.local/lib/python3.6/site-packages/pandas/core/generic.py:
3889: PerformanceWarning: dropping on a non-lexsorted multi-index without
a level parameter may impact performance.
  obj = obj._drop_axis(labels, axis, level=level, errors=errors)
```

In [41]:

```
#the churn and no churn labels were previously subtitles which I couldn't access for th
e chart. The below code joins the
#title and subtitle
height_pivot.columns = list(map('_'.join, height_pivot.columns))
height_pivot
```

Out[41]:

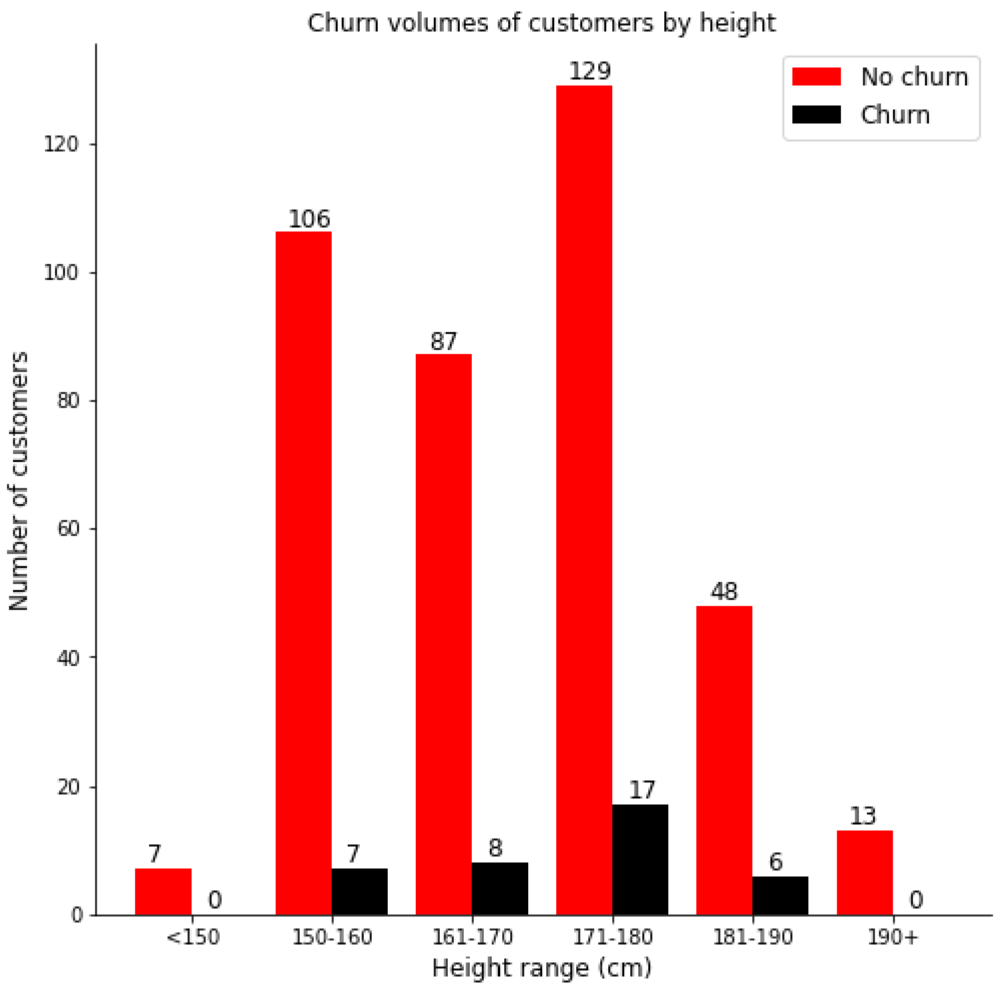
	height_range_	count_Churn	count_No churn
0	<150	0.0	7.0
1	150-160	7.0	106.0
2	161-170	8.0	87.0
3	171-180	17.0	129.0
4	181-190	6.0	48.0
5	190+	0.0	13.0

In [42]:

```
#converting height data to integers for chart labels
height_pivot['count_Churn'] = height_pivot['count_Churn'].astype(int)
height_pivot['count_No churn'] = height_pivot['count_No churn'].astype(int)
```

In [43]:

```
#plotting bar chart - churn rates highest in 171-180 group but this is likely because t
here are more people in this group
num_bars = 6
width = 0.4

height_bars = np.arange(num_bars)

fig = plt.figure(figsize = (8, 8))
ax = fig.add_subplot()

bar_1 = ax.bar(height_bars, height_pivot['count_No churn'], width, color = 'red', label
= 'No churn')
bar_2 = ax.bar(height_bars + width, height_pivot['count_Churn'], width, color = 'black'
, label = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

#adding data labels
for bar in bar_1:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.08, yval + 1, yval, fontsize = 12)

for bar in bar_2:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.1, yval + 1, yval, fontsize = 12)


ax.set_ylabel('Number of customers', fontsize = 12)
ax.set_xlabel('Height range (cm)', fontsize = 12)
ax.set_xticks(height_bars + width / 2)
ax.set_xticklabels(height_pivot.height_range_)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Churn volumes of customers by height', fontsize = 12)
plt.savefig('churn_by_height')
```



In [44]:

```
#grouping weight and churn data and removing NAs - will then create weight ranges to se
e which weight range churns the most
weight = users.groupby(['weight', 'churned_after_six']).size().to_frame().reset_index()
.rename(columns = {0: 'count'})
weight = weight[weight.churned_after_six != 'NA']
weight.head()
```

Out[44]:

	weight	churned_after_six	count
1	57.606	No churn	3
2	58.100	Churn	1
3	58.100	No churn	1
4	59.000	No churn	1
5	59.900	No churn	4

In [45]:

```
#creating column for weight ranges, weight range from 57-181 kg
#grouping weights into 8 groups for barplot using pd.cut to cut the weight column
bins = [40, 60, 80, 100, 120, 140, 160, 180, np.inf]
labels = ['<60', '60-80', '81-100', '101-120', '121-140', '141-160', '160-180', '180+']
weight['weight_range'] = pd.cut(weight['weight'], bins = bins, labels = labels)
weight.head()
```

Out[45]:

	weight	churned_after_six	count	weight_range
1	57.606	No churn	3	<60
2	58.100	Churn	1	<60
3	58.100	No churn	1	<60
4	59.000	No churn	1	<60
5	59.900	No churn	4	<60

In [46]:

```
#pivoting the data for chart - this has also summed the weight column which I will drop
in the next cell
weight_pivot = weight.pivot_table(columns = 'churned_after_six',
                                  index = 'weight_range',
                                  aggfunc = 'sum').reset_index()
weight_pivot
```

Out[46]:

	weight_range	count		weight	
churned_after_six		**Churn**	**No churn**	**Churn**	**No churn**
0	<60	1.0	9.0	58.10	234.606
1	60-80	7.0	96.0	407.90	3092.685
2	81-100	16.0	155.0	1259.33	5742.024
3	101-120	9.0	77.0	963.60	3916.092
4	121-140	5.0	46.0	498.70	2677.957
5	141-160	NaN	5.0	NaN	296.600
6	180+	NaN	2.0	NaN	181.000

In [47]:

```
#filling NaNs with 0
weight_pivot = weight_pivot.replace(np.nan, 0.0)
```

In [48]:

```
#dropping the weight column to avoid confusion
weight_pivot = weight_pivot.drop(['weight'], axis = 1)
```

```
/home/amybirdee/.local/lib/python3.6/site-packages/pandas/core/generic.py:
3889: PerformanceWarning: dropping on a non-lexsorted multi-index without
a level parameter may impact performance.
  obj = obj._drop_axis(labels, axis, level=level, errors=errors)
```

In [49]:

```
#the churn and no churn labels were previously subtitles which I couldn't access for th
e chart. The below code joins the
#title and subtitle
weight_pivot.columns = list(map('_'.join, weight_pivot.columns))
weight_pivot
```

Out[49]:

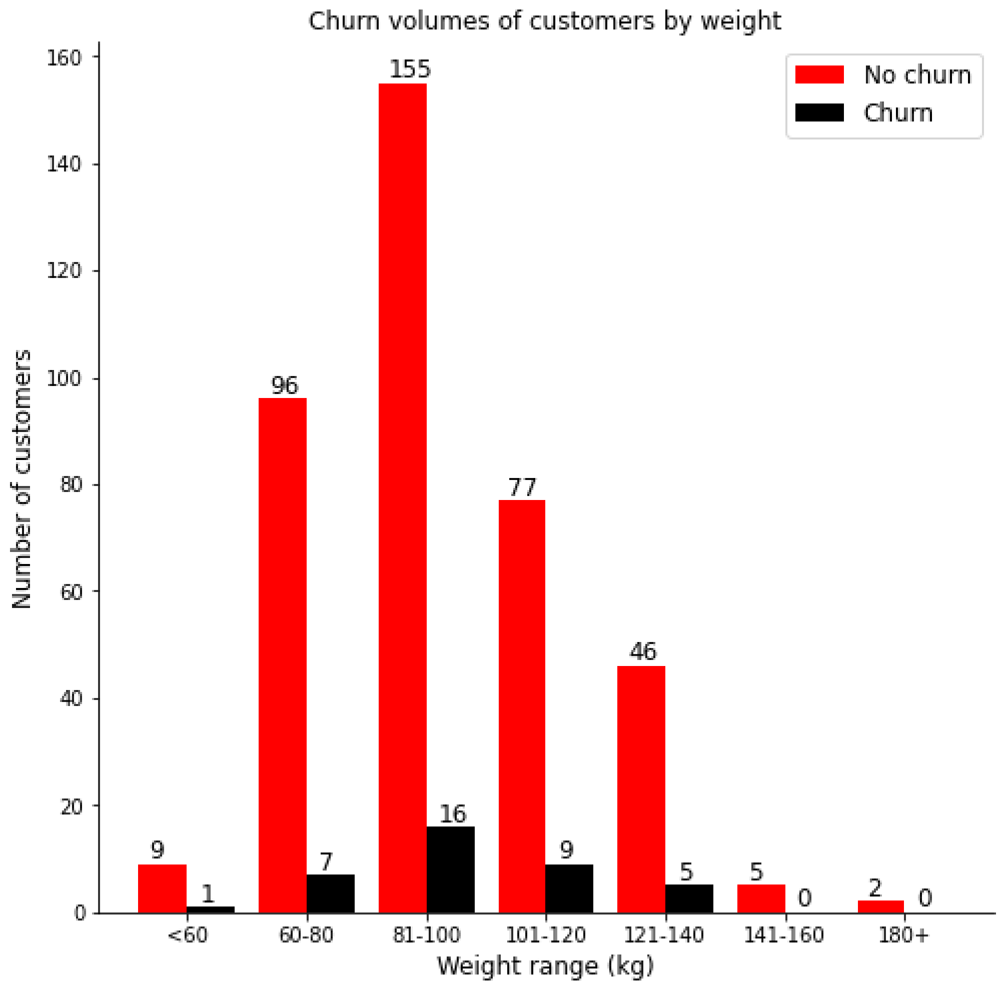
	weight_range_	count_Churn	count_No churn
0	<60	1.0	9.0
1	60-80	7.0	96.0
2	81-100	16.0	155.0
3	101-120	9.0	77.0
4	121-140	5.0	46.0
5	141-160	0.0	5.0
6	180+	0.0	2.0

In [50]:

```
#converting weight data to integers for chart labels
weight_pivot['count_Churn'] = weight_pivot['count_Churn'].astype(int)
weight_pivot['count_No churn'] = weight_pivot['count_No churn'].astype(int)
```

In [51]:

```
#plotting bar chart - churn rates are zero for those with the largest weight - good new
s as these customers need the
#program the most

num_bars = 7
width = 0.4

weight_bars = np.arange(num_bars)

fig = plt.figure(figsize = (8, 8))
ax = fig.add_subplot()

bar_1 = ax.bar(weight_bars, weight_pivot['count_No churn'], width, color = 'red', label
= 'No churn')
bar_2 = ax.bar(weight_bars + width, weight_pivot['count_Churn'], width, color = 'black'
, label = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

#adding data labels
for bar in bar_1:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.08, yval + 1, yval, fontsize = 12)

for bar in bar_2:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.1, yval + 1, yval, fontsize = 12)


ax.set_ylabel('Number of customers', fontsize = 12)
ax.set_xlabel('Weight range (kg)', fontsize = 12)
ax.set_xticks(weight_bars + width / 2)
ax.set_xticklabels(weight_pivot.weight_range_)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Churn volumes of customers by weight', fontsize = 12)
plt.savefig('churn_by_weight')
```



In [52]:

```
#grouping goals and churn data and removing NAs
goals = users.groupby(['goals', 'churned_after_six']).size().to_frame().reset_index().r
ename(columns = {0: 'count'})
goals = goals[goals.churned_after_six != 'NA']
goals.head()
```

Out[52]:

	goals	churned_after_six	count
0	high	Churn	5
2	high	No churn	62
3	low	Churn	6
5	low	No churn	57
6	medium	Churn	24

In [53]:

```
#pivoting the data for chart
goals_pivot = goals.pivot_table(columns = 'churned_after_six',
                           index = 'goals',
                           aggfunc = 'sum').reset_index()
goals_pivot
```

Out[53]:

	goals	count	
churned_after_six		**Churn**	**No churn**
0	high	5	62
1	low	6	57
2	medium	24	241
3	not answered	3	30

In [54]:

```
#creating one column title
goals_pivot.columns = list(map('_'.join, goals_pivot.columns))
goals_pivot
```

Out[54]:

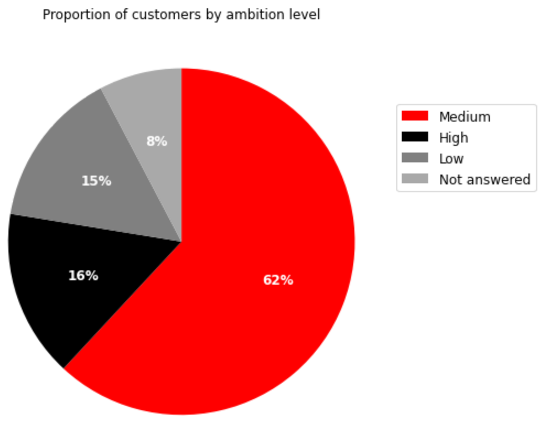
	goals_	count_Churn	count_No churn
0	high	5	62
1	low	6	57
2	medium	24	241
3	not answered	3	30

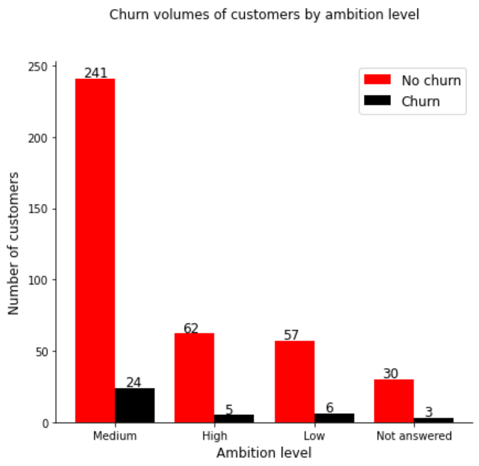
In [55]:

```
#adding a total column for chart and sorting it by total. Initially I used 'margins = T
rue' in the pivot code to get a total
#column but this gave me a row total as well which was interfering with my chart
goals_pivot['total'] = goals_pivot['count_Churn'] + goals_pivot['count_No churn']
goals_pivot.sort_values(by = 'total', ascending = False, inplace = True)
```

In [56]:

```
#Creating charts - those with medium level goals are more likely to churn but there are
also more people in this group.
#Numbers are similar for those with high or low ambitions

fig = plt.figure(figsize = (15, 6))
colors = ['red', 'black', 'grey','darkgrey']
labels = ['Medium', 'High', 'Low', 'Not answered']

ax = plt.subplot(1, 2, 1)
_, _, autotexts = (plt.pie(goals_pivot['total'], colors = colors, radius = 1.2, autopct
= ('%.0f%%'), \
                                        counterclock = False, startangle = -270))

#setting the colour of percentage labels to white
for autotext in autotexts:
    autotext.set_color('white')
    autotext.set_weight('bold')
    autotext.set_fontsize(12)

plt.legend(labels = labels, loc = 'best', bbox_to_anchor = (1.5, 0.9), fontsize = 12)

plt.title('Proportion of customers by ambition level', y = 1.1)

#second subplot
ax = plt.subplot(1, 2, 2)
num_bars = 4
width = 0.4

goals_bars = np.arange(num_bars)

bar_1 = ax.bar(goals_bars, goals_pivot['count_No churn'], width, color = 'red', label =
'No churn')
bar_2 = ax.bar(goals_bars + width, goals_pivot['count_Churn'], width, color = 'black',
label = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

#adding data labels
for bar in bar_1:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.08, yval + 1.3, yval, fontsize = 12)

for bar in bar_2:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.1, yval + 1.3, yval, fontsize = 12)


ax.set_ylabel('Number of customers', fontsize = 12)
ax.set_xlabel('Ambition level', fontsize = 12)
ax.set_xticks(goals_bars + width / 2)
ax.set_xticklabels(labels)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Churn volumes of customers by ambition level', fontsize = 12, y = 1.1)

plt.tight_layout()
plt.savefig('churn_by_ambition')
plt.subplots_adjust(wspace = 0.8)
```





In [57]:

```
#grouping gender and churn data and removing NAs
gender = users.groupby(['gender', 'churned_after_six']).size().to_frame().reset_index()
.rename(columns = {0: 'count'})
gender = gender[gender.churned_after_six != 'NA']
gender.head()
```

Out[57]:

	gender	churned_after_six	count
0	F	Churn	34
2	F	No churn	367
3	M	Churn	4
5	M	No churn	23

In [58]:

```
#pivoting the data for chart
gender_pivot = gender.pivot_table(columns = 'churned_after_six',
                           index = 'gender',
                           aggfunc = 'sum').reset_index()
gender_pivot
```

Out[58]:

	gender	count	
churned_after_six		**Churn**	**No churn**
0	F	34	367
1	M	4	23

In [59]:

```
#creating one column title
gender_pivot.columns = list(map('_'.join, gender_pivot.columns))
gender_pivot
```

Out[59]:

	gender_	count_Churn	count_No churn
0	F	34	367
1	M	4	23

In [60]:

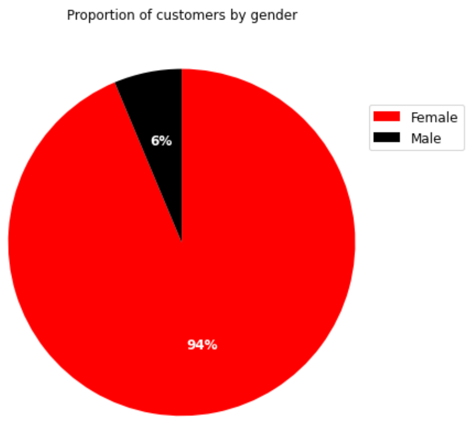
```
#adding a total column for chart and sorting it by total
gender_pivot['total'] = gender_pivot['count_Churn'] + gender_pivot['count_No churn']
gender_pivot.sort_values(by = 'total', ascending = False, inplace = True)
gender_pivot
```

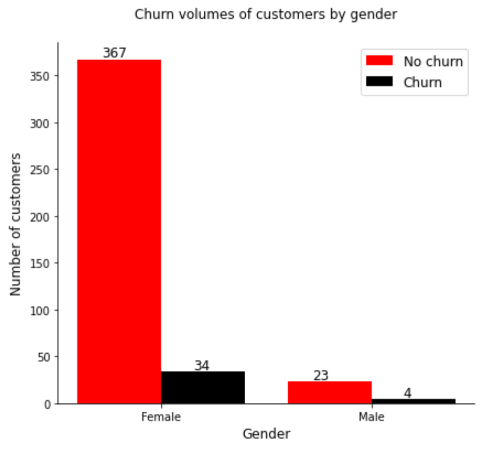
Out[60]:

	gender_	count_Churn	count_No churn	total
0	F	34	367	401
1	M	4	23	27

In [61]:

```
#Creating charts - females by far make up the most customers at Health First but their
 churn rate is lower than males -
#8% of females churn compared to 15% of males

fig = plt.figure(figsize = (15, 6))
colors = ['red', 'black']
labels = ['Female', 'Male']

ax = plt.subplot(1, 2, 1)
_, _, autotexts = (plt.pie(gender_pivot['total'], colors = colors, radius = 1.2, autopc
t = ('%.0f%%'), \
                                       counterclock = False, startangle = -270))

#setting the colour of percentage labels to white
for autotext in autotexts:
    autotext.set_color('white')
    autotext.set_weight('bold')
    autotext.set_fontsize(12)

plt.legend(labels = labels, loc = 'best', bbox_to_anchor = (1.3, 0.9), fontsize = 12)

plt.title('Proportion of customers by gender', y = 1.1)

#second subplot
ax = plt.subplot(1, 2, 2)
num_bars = 2
width = 0.4

gender_bars = np.arange(num_bars)

bar_1 = ax.bar(gender_bars, gender_pivot['count_No churn'], width, color = 'red', label
= 'No churn')
bar_2 = ax.bar(gender_bars + width, gender_pivot['count_Churn'], width, color = 'black'
, label = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

#adding data labels
for bar in bar_1:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.12, yval + 2.5, yval, fontsize = 12)

for bar in bar_2:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.15, yval + 2.5, yval, fontsize = 12)


ax.set_ylabel('Number of customers', fontsize = 12)
ax.set_xlabel('Gender', fontsize = 12)
ax.set_xticks(gender_bars + width / 2)
ax.set_xticklabels(labels)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Churn volumes of customers by gender', fontsize = 12, y = 1.05)

plt.tight_layout()
plt.savefig('churn_by_gender')
plt.subplots_adjust(wspace = 0.8)
```





In [62]:

```
#grouping motivation and churn data and removing NAs
motivation = users.groupby(['motivation', 'churned_after_six']).size().to_frame().reset
_index().rename(columns = {0: 'count'})
motivation = motivation[motivation.churned_after_six != 'NA']
motivation.head()
```

Out[62]:

	motivation	churned_after_six	count
0	control	Churn	5
2	control	No churn	68
3	fitness	Churn	6
5	fitness	No churn	51
6	health	Churn	10

In [63]:

```
#pivoting the data for chart
motivation_pivot = motivation.pivot_table(columns = 'churned_after_six',
                                  index = 'motivation',
                                  aggfunc = 'sum').reset_index()
motivation_pivot
```

Out[63]:

	motivation	count	
churned_after_six		**Churn**	**No churn**
0	control	5	68
1	fitness	6	51
2	health	10	115
3	looks	15	151
4	other	2	5

In [64]:

```
#creating one column title
motivation_pivot.columns = list(map('_'.join, motivation_pivot.columns))
motivation_pivot
```

Out[64]:

	motivation_	count_Churn	count_No churn
0	control	5	68
1	fitness	6	51
2	health	10	115
3	looks	15	151
4	other	2	5

In [65]:

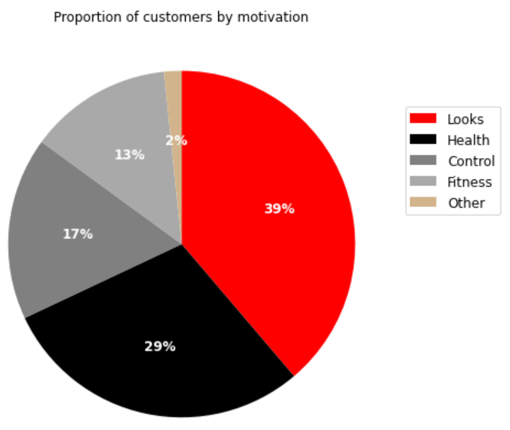
```
#adding a total column for chart and sorting it by total
motivation_pivot['total'] = motivation_pivot['count_Churn'] + motivation_pivot['count_N
o churn']
motivation_pivot.sort_values(by = 'total', ascending = False, inplace = True)
motivation_pivot
```

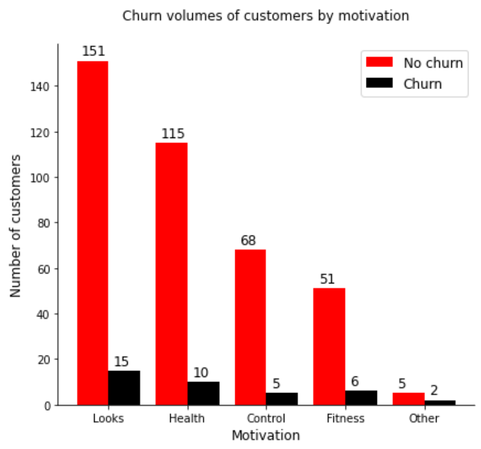
Out[65]:

	motivation_	count_Churn	count_No churn	total
3	looks	15	151	166
2	health	10	115	125
0	control	5	68	73
1	fitness	6	51	57
4	other	2	5	7

In [66]:

```
#Creating charts - most people say looks are their motivation for joining, those who sa
y fitness is their motivation
#have the highest churn rate at 11%, follwed closely by looks with 9% (ignoring 'othe
r')

fig = plt.figure(figsize = (15, 6))
colors = ['red', 'black', 'grey','darkgrey', 'tan']
labels = ['Looks', 'Health', 'Control', 'Fitness', 'Other']

ax = plt.subplot(1, 2, 1)
_, _, autotexts = (plt.pie(motivation_pivot['total'], colors = colors, radius = 1.2, au
topct = ('%.0f%%'), \
                                       counterclock = False, startangle = -270))

#setting the colour of percentage labels to white
for autotext in autotexts:
    autotext.set_color('white')
    autotext.set_weight('bold')
    autotext.set_fontsize(12)

plt.legend(labels = labels, loc = 'best', bbox_to_anchor = (1.4, 0.9), fontsize = 12)

plt.title('Proportion of customers by motivation', y = 1.1)

#second subplot
ax = plt.subplot(1, 2, 2)
num_bars = 5
width = 0.4

motivation_bars = np.arange(num_bars)

bar_1 = ax.bar(motivation_bars, motivation_pivot['count_No churn'], width, color = 're
d', label = 'No churn')
bar_2 = ax.bar(motivation_bars + width, motivation_pivot['count_Churn'], width, color =
'black', label = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

#adding data labels
for bar in bar_1:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.06, yval + 2.5, yval, fontsize = 12)

for bar in bar_2:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.06, yval + 2.5, yval, fontsize = 12)


ax.set_ylabel('Number of customers', fontsize = 12)
ax.set_xlabel('Motivation', fontsize = 12)
ax.set_xticks(motivation_bars + width / 2)
ax.set_xticklabels(labels)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Churn volumes of customers by motivation', fontsize = 12, y = 1.05)

plt.tight_layout()
plt.savefig('churn_by_motivation')
plt.subplots_adjust(wspace = 0.8)
```





In [67]:

```
#grouping challenge and churn data and removing NAs
challenge = users.groupby(['challenge', 'churned_after_six']).size().to_frame().reset_i
ndex().rename(columns = {0: 'count'})
challenge = challenge[challenge.churned_after_six != 'NA']
challenge.head()
```

Out[67]:

	challenge	churned_after_six	count
0	food	Churn	7
2	food	No churn	79
3	information	Churn	1
4	information	No churn	11
5	motivation	Churn	21

In [68]:

```
#pivoting the data for chart
challenge_pivot = challenge.pivot_table(columns = 'churned_after_six',
                               index = 'challenge',
                               aggfunc = 'sum').reset_index()
challenge_pivot
```

Out[68]:

	challenge	count	
churned_after_six		**Churn**	**No churn**
0	food	7	79
1	information	1	11
2	motivation	21	180
3	not answered	3	29
4	other	1	7
5	time	5	84

In [69]:

```
#creating one column title
challenge_pivot.columns = list(map('_'.join, challenge_pivot.columns))
challenge_pivot
```

Out[69]:

	challenge_	count_Churn	count_No churn
0	food	7	79
1	information	1	11
2	motivation	21	180
3	not answered	3	29
4	other	1	7
5	time	5	84

In [70]:

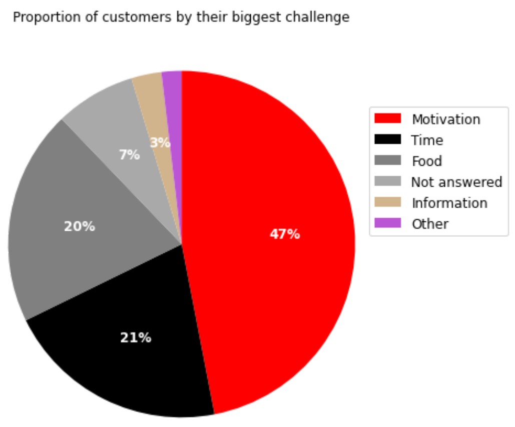
```
#adding a total column for chart and sorting it by total
challenge_pivot['total'] = challenge_pivot['count_Churn'] + challenge_pivot['count_No c
hurn']
challenge_pivot.sort_values(by = 'total', ascending = False, inplace = True)
challenge_pivot
```

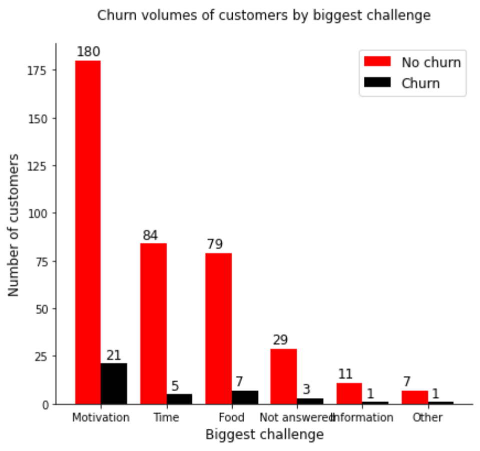
Out[70]:

	challenge_	count_Churn	count_No churn	total
2	motivation	21	180	201
5	time	5	84	89
0	food	7	79	86
3	not answered	3	29	32
1	information	1	11	12
4	other	1	7	8

In [71]:

```
#Creating charts - most people say motivation is their biggest challenge and this group
also has the highest churn rate at
#10% (ignoring 'other')

fig = plt.figure(figsize = (15, 6))
colors = ['red', 'black', 'grey','darkgrey', 'tan', 'mediumorchid']
labels = ['Motivation', 'Time', 'Food', 'Not answered', 'Information', 'Other']

#some percentages were overlapping so including this function to only include a percent
label if value is greater than 2%
def my_autopct(pct):
    return ('%.0f%%' % pct) if pct > 2 else ''

ax = plt.subplot(1, 2, 1)
_, _, autotexts = (plt.pie(challenge_pivot['total'], colors = colors, radius = 1.2, aut
opct = my_autopct, \
                                       counterclock = False, startangle = -270))

#setting the colour of percentage labels to white
for autotext in autotexts:
    autotext.set_color('white')
    autotext.set_weight('bold')
    autotext.set_fontsize(12)

plt.legend(labels = labels, loc = 'best', bbox_to_anchor = (1.0, 0.9), fontsize = 12)

plt.title('Proportion of customers by their biggest challenge', y = 1.1)

#second subplot
ax = plt.subplot(1, 2, 2)
num_bars = 6
width = 0.4

challenge_bars = np.arange(num_bars)

bar_1 = ax.bar(challenge_bars, challenge_pivot['count_No churn'], width, color = 'red',
label = 'No churn')
bar_2 = ax.bar(challenge_bars + width, challenge_pivot['count_Churn'], width, color =
'black', label = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

#adding data labels
for bar in bar_1:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.015, yval + 2.5, yval, fontsize = 12)

for bar in bar_2:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.06, yval + 2.5, yval, fontsize = 12)


ax.set_ylabel('Number of customers', fontsize = 12)
ax.set_xlabel('Biggest challenge', fontsize = 12)
ax.set_xticks(challenge_bars + width / 2)
ax.set_xticklabels(labels)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Churn volumes of customers by biggest challenge', fontsize = 12, y = 1.05
)

plt.tight_layout()
plt.savefig('churn_by_challenge')

plt.subplots_adjust(wspace = 0.8)
```





In [72]:

```
#grouping trigger and churn data and removing NAs
trigger = users.groupby(['trigger', 'churned_after_six']).size().to_frame().reset_index
().rename(columns = {0: 'count'})
trigger = trigger[trigger.churned_after_six != 'NA']
trigger.head()
```

Out[72]:

	trigger	churned_after_six	count
0	emotions	Churn	8
2	emotions	No churn	55
3	other	Churn	1
5	other	No churn	19
6	routine	Churn	2

In [73]:

```
#pivoting the data for chart
trigger_pivot = trigger.pivot_table(columns = 'churned_after_six',
                                   index = 'trigger',
                                   aggfunc = 'sum').reset_index()
trigger_pivot
```

Out[73]:

	trigger	count	
churned_after_six		**Churn**	**No churn**
0	emotions	8.0	55.0
1	other	1.0	19.0
2	routine	2.0	7.0
3	social	8.0	113.0
4	stress	11.0	108.0
5	supermarket	NaN	10.0
6	tired	8.0	69.0
7	treats	NaN	9.0

In [74]:

```
#replacing NaNs with 0
trigger_pivot = trigger_pivot.replace(np.nan, 0.0)
```

In [75]:

```
#creating one column title
trigger_pivot.columns = list(map('_'.join, trigger_pivot.columns))
trigger_pivot
```

Out[75]:

	trigger_	count_Churn	count_No churn
0	emotions	8.0	55.0
1	other	1.0	19.0
2	routine	2.0	7.0
3	social	8.0	113.0
4	stress	11.0	108.0
5	supermarket	0.0	10.0
6	tired	8.0	69.0
7	treats	0.0	9.0

In [76]:

```
#converting data to integers for chart labels
trigger_pivot['count_Churn'] = trigger_pivot['count_Churn'].astype(int)
trigger_pivot['count_No churn'] = trigger_pivot['count_No churn'].astype(int)
```

In [77]:

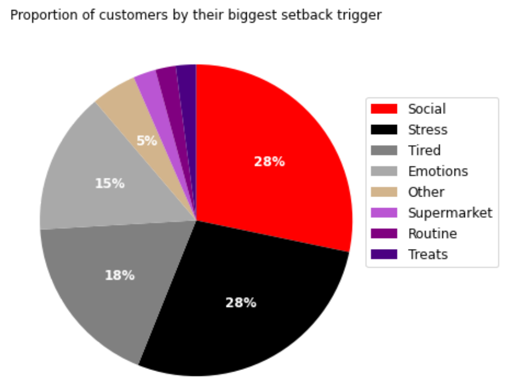
```
#adding a total column for chart and sorting it by total
trigger_pivot['total'] = trigger_pivot['count_Churn'] + trigger_pivot['count_No churn']
trigger_pivot.sort_values(by = 'total', ascending = False, inplace = True)
trigger_pivot
```

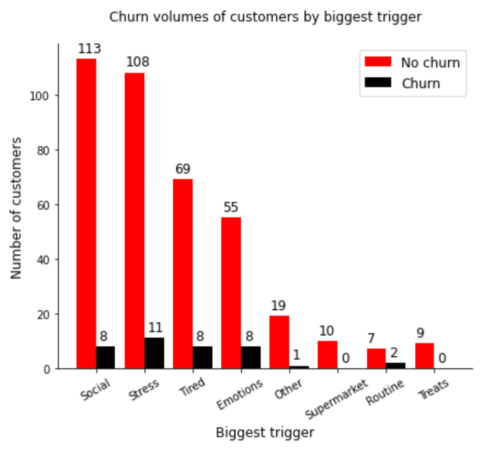
Out[77]:

	trigger_	count_Churn	count_No churn	total
3	social	8	113	121
4	stress	11	108	119
6	tired	8	69	77
0	emotions	8	55	63
1	other	1	19	20
5	supermarket	0	10	10
2	routine	2	7	9
7	treats	0	9	9

In [78]:

```
#Creating charts - socialising and stress are the biggest triggers. Routine has the hig
hest churn rate but numbers are small.
#Stress, tirednes and emotions all have high churn rates so many triggers are mental tr
iggers

fig = plt.figure(figsize = (15, 6))
colors = ['red', 'black', 'grey','darkgrey', 'tan', 'mediumorchid', 'purple', 'indigo']
labels = ['Social', 'Stress', 'Tired', 'Emotions', 'Other', 'Supermarket', 'Routine',
'Treats']

#only including a percent label if value is greater than 3%
def my_autopct(pct):
    return ('%.0f%%' % pct) if pct > 3 else ''

ax = plt.subplot(1, 2, 1)
_, _, autotexts = (plt.pie(trigger_pivot['total'], colors = colors, radius = 1.2, autop
ct = my_autopct, \
                                       counterclock = False, startangle = -270))

#setting the colour of percentage labels to white
for autotext in autotexts:
    autotext.set_color('white')
    autotext.set_weight('bold')
    autotext.set_fontsize(12)

plt.legend(labels = labels, loc = 'best', bbox_to_anchor = (1.0, 0.9), fontsize = 12)

plt.title('Proportion of customers by their biggest setback trigger', y = 1.1)

#second subplot
ax = plt.subplot(1, 2, 2)
num_bars = 8
width = 0.4

trigger_bars = np.arange(num_bars)

bar_1 = ax.bar(trigger_bars, trigger_pivot['count_No churn'], width, color = 'red', lab
el = 'No churn')
bar_2 = ax.bar(trigger_bars + width, trigger_pivot['count_Churn'], width, color = 'blac
k', label = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

#adding data labels
for bar in bar_1:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.015, yval + 2.5, yval, fontsize = 12)

for bar in bar_2:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.06, yval + 2.5, yval, fontsize = 12)


ax.set_ylabel('Number of customers', fontsize = 12)
ax.set_xlabel('Biggest trigger', fontsize = 12)
ax.set_xticks(trigger_bars + width / 2)
ax.set_xticklabels(labels, rotation = 30)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Churn volumes of customers by biggest trigger', fontsize = 12, y = 1.05)

plt.tight_layout()
plt.savefig('churn_by_trigger')

plt.subplots_adjust(wspace = 0.8)
```





Exploratory data analysis - messages table

In [79]:

```
#merging users and messages table
users_messages = users.merge(messages, how = 'right', left_on = 'user_id', right_on =
'user_id')
users_messages
```

Out[79]:

	user_id	goals	gender	motivation	challenge	trigger	age	hei
0	5a2e417806d240124a6185a0	medium	F	looks	motivation	tired	25	15
1	5a2e417806d240124a6185a0	medium	F	looks	motivation	tired	25	15
2	5a2e417806d240124a6185a0	medium	F	looks	motivation	tired	25	15
3	5a2e417806d240124a6185a0	medium	F	looks	motivation	tired	25	15
4	5a2e417806d240124a6185a0	medium	F	looks	motivation	tired	25	15
...	...	...	...	...	...	...	...	
23706	5ce6663e7de10312a89e572b	low	F	control	information	tired	42	15
23707	5ce6663e7de10312a89e572b	low	F	control	information	tired	42	15
23708	5ce6663e7de10312a89e572b	low	F	control	information	tired	42	15
23709	5ce6663e7de10312a89e572b	low	F	control	information	tired	42	15
23710	5ce6663e7de10312a89e572b	low	F	control	information	tired	42	15

23711 rows × 17 columns

In [80]:

```
#grouping message type and churn data and removing NAs
message_type = users_messages.groupby(['message_type', 'churned_after_six']).size().to_
frame().reset_index().rename(columns = {0: 'count'})
message_type = message_type[message_type.churned_after_six != 'NA']
message_type.head()
```

Out[80]:

	message_type	churned_after_six	count
0	group	Churn	1726
2	group	No churn	17586
3	private	Churn	492
5	private	No churn	3611

In [81]:

```
#pivoting the data for chart
message_type_pivot = message_type.pivot_table(columns = 'churned_after_six',
                                              index = 'message_type',
                                              aggfunc = 'sum').reset_index()
message_type_pivot
```

Out[81]:

	message_type	count	
churned_after_six		**Churn**	**No churn**
0	group	1726	17586
1	private	492	3611

In [82]:

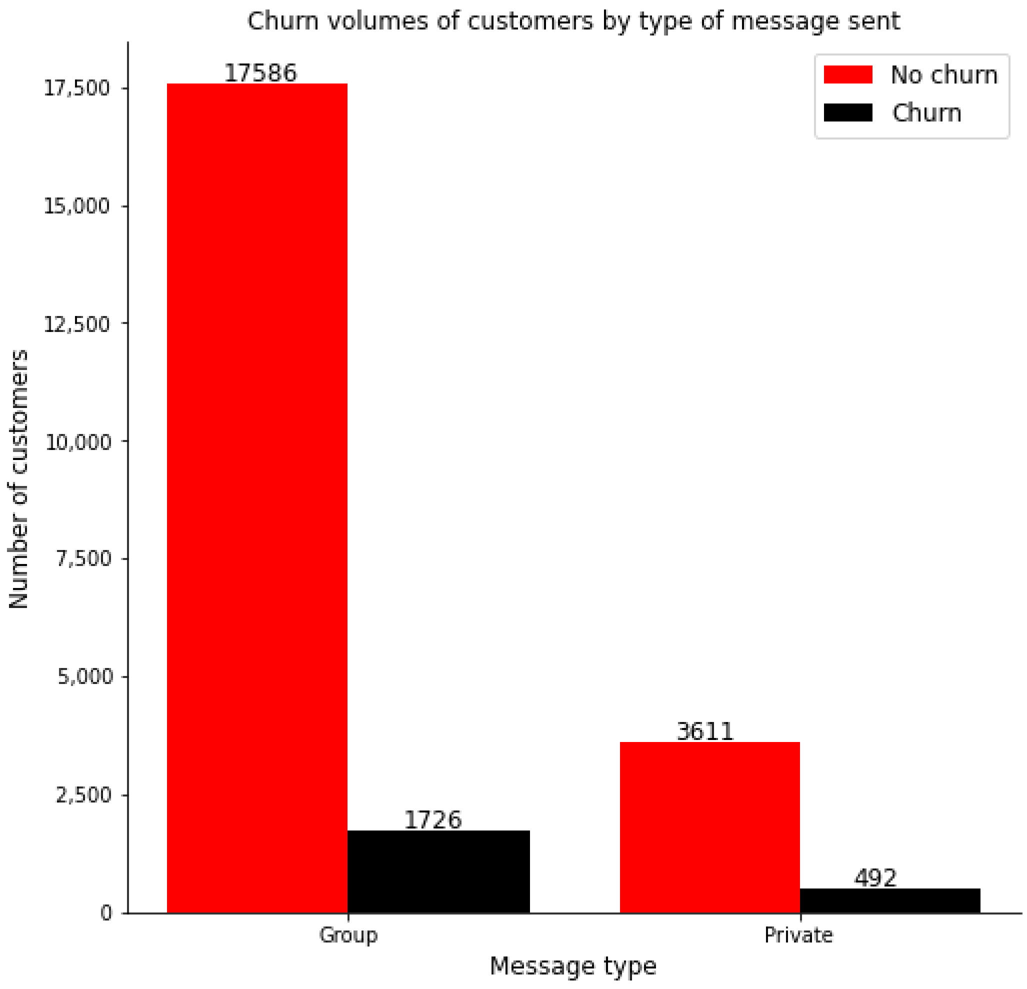
```
#creating one column title
message_type_pivot.columns = list(map('_'.join, message_type_pivot.columns))
message_type_pivot
```

Out[82]:

	message_type_	count_Churn	count_No churn
0	group	1726	17586
1	private	492	3611

In [83]:

```
#plotting bar chart - churn rates are highest for private messages than group messages
 - 12% versus 9%
num_bars = 2
width = 0.4
labels = ['Group', 'Private']

message_type_bars = np.arange(num_bars)

fig = plt.figure(figsize = (8, 8))
ax = fig.add_subplot()

bar_1 = ax.bar(message_type_bars, message_type_pivot['count_No churn'], width, color =
'red', label = 'No churn')
bar_2 = ax.bar(message_type_bars + width, message_type_pivot['count_Churn'], width, col
or = 'black', label = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

#function to add comma separator to labels
def comma(x, pos):
    return format(x, "6,.0f")

#adding data labels
for bar in bar_1:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.12, yval + 50, yval, fontsize = 12)

for bar in bar_2:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.12, yval + 50, yval, fontsize = 12)


ax.set_ylabel('Number of customers', fontsize = 12)
#this code adds a comma separator to the y tick marks
ax.yaxis.set_major_formatter(tcr.FuncFormatter(comma))

ax.set_xlabel('Message type', fontsize = 12)
ax.set_xticks(message_type_bars + width / 2)
ax.set_xticklabels(labels)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Churn volumes of customers by type of message sent', fontsize = 12)
plt.savefig('churn_by_message_type')
```


Churn volumes of customers by type of message sent
No churn
Churn
Number of customers
Message type
Group
Private
17586
1726
3611
492
0
2,500
5,000
7,500
10,000
12,500
15,000
17,500

In [84]:

```
#grouping week number and churn data and removing NAs
week_num = users_messages.groupby(['week_number', 'churned_after_six']).size().to_frame
().reset_index().rename(columns = {0: 'count'})
week_num = week_num[week_num.churned_after_six != 'NA']
week_num.head()
```

Out[84]:

	week_number	churned_after_six	count
0	0	Churn	217
2	0	No churn	2122
3	1	Churn	660
5	1	No churn	6170
6	2	Churn	469

In [85]:

```
#pivoting the data for chart
week_num_pivot = week_num.pivot_table(columns = 'churned_after_six',
                           index = 'week_number',
                           aggfunc = 'sum').reset_index()
week_num_pivot
```

Out[85]:

	week_number	count	
churned_after_six		**Churn**	**No churn**
0	0	217	2122
1	1	660	6170
2	2	469	4576
3	3	300	3064
4	4	222	2312
5	5	183	1739
6	6	167	1214

In [86]:

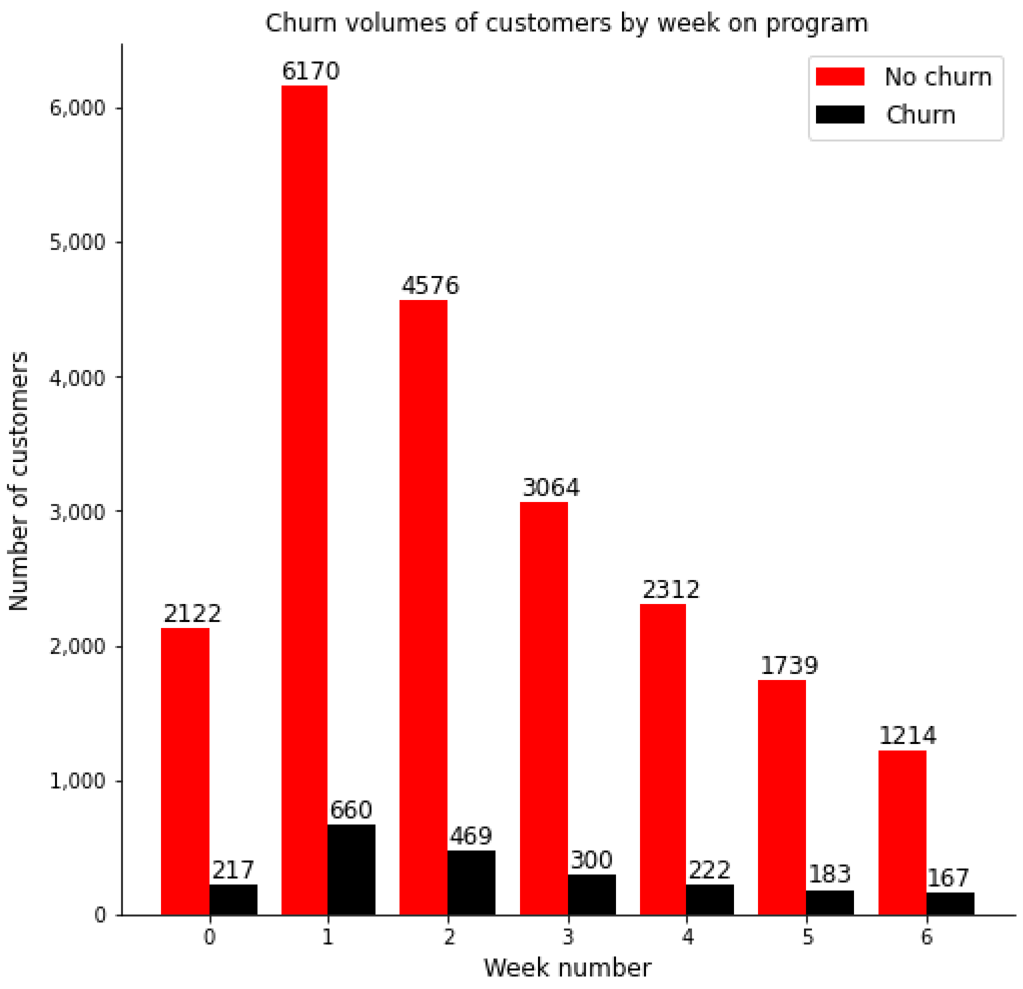
```
#creating one column title
week_num_pivot.columns = list(map('_'.join, week_num_pivot.columns))
week_num_pivot
```

Out[86]:

	week_number_	count_Churn	count_No churn
0	0	217	2122
1	1	660	6170
2	2	469	4576
3	3	300	3064
4	4	222	2312
5	5	183	1739
6	6	167	1214

In [87]:

```
#plotting bar chart - churn levels highest in the first and second weeks
num_bars = 7
width = 0.4

week_num_bars = np.arange(num_bars)

fig = plt.figure(figsize = (8, 8))
ax = fig.add_subplot()

bar_1 = ax.bar(week_num_bars, week_num_pivot['count_No churn'], width, color = 'red', l
abel = 'No churn')
bar_2 = ax.bar(week_num_bars + width, week_num_pivot['count_Churn'], width, color = 'bl
ack', label = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

#function to add comma separator to labels
def comma(x, pos):
    return format(x, "6,.0f")

#adding data labels
for bar in bar_1:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.001, yval + 50, yval, fontsize = 12)

for bar in bar_2:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.001, yval + 50, yval, fontsize = 12)


ax.set_ylabel('Number of customers', fontsize = 12)
#this code adds a comma separater to the y tick marks
ax.yaxis.set_major_formatter(tcr.FuncFormatter(comma))

ax.set_xlabel('Week number', fontsize = 12)
ax.set_xticks(week_num_bars + width / 2)
ax.set_xticklabels(week_num_pivot.week_number_)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Churn volumes of customers by week on program', fontsize = 12)
plt.savefig('churn_by_week_number')
```



In [88]:

```
#grouping questions and churn data and removing NAs
questions = users_messages.groupby(['questions_asked', 'churned_after_six']).size().to_
frame().reset_index().rename(columns = {0: 'count'})
questions = questions[questions.churned_after_six != 'NA'].reset_index(drop = True)
questions.head()
```

Out[88]:

	questions_asked	churned_after_six	count
0	0.0	Churn	1919
1	0.0	No churn	18709
2	1.0	Churn	238
3	1.0	No churn	2011
4	2.0	Churn	45

In [89]:

```
#pivoting the data
questions_pivot = questions.pivot_table(columns = 'churned_after_six',
                           index = ['questions_asked'],
                           aggfunc = 'sum').reset_index()
questions_pivot
```

Out[89]:

	questions_asked	count	
churned_after_six		**Churn**	**No churn**
0	0.0	1919	18709
1	1.0	238	2011
2	2.0	45	347
3	3.0	12	85
4	4.0	2	28
5	5.0	1	14
6	6.0	1	3

In [90]:

```
#creating one column title - majority of customers do not ask questions and churn volum
es are also high among these users
#not charting this as the 18,000 non-churners distort the data and make smaller values
 difficult to read
questions_pivot.columns = list(map('_'.join, questions_pivot.columns))
questions_pivot
```

Out[90]:

	questions_asked_	count_Churn	count_No churn
0	0.0	1919	18709
1	1.0	238	2011
2	2.0	45	347
3	3.0	12	85
4	4.0	2	28
5	5.0	1	14
6	6.0	1	3

In [91]:

```
#grouping emojis and churn data and removing NAs
emojis = users_messages.groupby(['emojis_used', 'churned_after_six']).size().to_frame()
.reset_index().rename(columns = {0: 'count'})
emojis = emojis[emojis.churned_after_six != 'NA'].reset_index(drop = True)
emojis.head()
```

Out[91]:

	emojis_used	churned_after_six	count
0	0.0	Churn	1783
1	0.0	No churn	17482
2	1.0	Churn	380
3	1.0	No churn	2831
4	2.0	Churn	41

In [92]:

```
#pivoting the data
emojis_pivot = emojis.pivot_table(columns = 'churned_after_six',
                                  index = ['emojis_used'],
                                  aggfunc = 'sum').reset_index()
emojis_pivot
```

Out[92]:

	emojis_used	count	
churned_after_six		**Churn**	**No churn**
0	0.0	1783.0	17482.0
1	1.0	380.0	2831.0
2	2.0	41.0	602.0
3	3.0	9.0	173.0
4	4.0	4.0	70.0
5	5.0	1.0	19.0
6	6.0	NaN	11.0
7	7.0	NaN	3.0
8	8.0	NaN	5.0
9	9.0	NaN	1.0

In [93]:

```
#replacing NaNs with 0
emojis_pivot = emojis_pivot.replace(np.nan, 0.0)
```

In [94]:

```
#creating one column title - majority of customers do not send emojis and churn volumes
are also high among these users
emojis_pivot.columns = list(map('_'.join, emojis_pivot.columns))
emojis_pivot
```

Out[94]:

	emojis_used_	count_Churn	count_No churn
0	0.0	1783.0	17482.0
1	1.0	380.0	2831.0
2	2.0	41.0	602.0
3	3.0	9.0	173.0
4	4.0	4.0	70.0
5	5.0	1.0	19.0
6	6.0	0.0	11.0
7	7.0	0.0	3.0
8	8.0	0.0	5.0
9	9.0	0.0	1.0

In [95]:

```
#grouping mentioned scales and churn data and removing NAs
scales = users_messages.groupby(['mentioned_scales', 'churned_after_six']).size().to_fr
ame().reset_index().rename(columns = {0: 'count'})
scales = scales[scales.churned_after_six != 'NA'].reset_index(drop = True)
scales.head()
```

Out[95]:

	mentioned_scales	churned_after_six	count
0	0.0	Churn	2191
1	0.0	No churn	20840
2	1.0	Churn	23
3	1.0	No churn	337
4	2.0	Churn	4

In [96]:

```
#pivoting the data
scales_pivot = scales.pivot_table(columns = 'churned_after_six',
                                  index = ['mentioned_scales'],
                                  aggfunc = 'sum').reset_index()
scales_pivot
```

Out[96]:

	mentioned_scales	count	
churned_after_six		**Churn**	**No churn**
0	0.0	2191.0	20840.0
1	1.0	23.0	337.0
2	2.0	4.0	17.0
3	3.0	NaN	2.0
4	5.0	NaN	1.0

In [97]:

```
#replacing NaNs with 0 - churn volumes fall when scales are mentioned more often - perh
aps these users are more engaged
#with the program
scales_pivot = scales_pivot.replace(np.nan, 0.0)
scales_pivot
```

Out[97]:

	mentioned_scales	count	
churned_after_six		**Churn**	**No churn**
0	0.0	2191.0	20840.0
1	1.0	23.0	337.0
2	2.0	4.0	17.0
3	3.0	0.0	2.0
4	5.0	0.0	1.0

In [98]:

```
#grouping mentioned tracker and churn data and removing NAs
tracker = users_messages.groupby(['mentioned_tracker', 'churned_after_six']).size().to_
frame().reset_index().rename(columns = {0: 'count'})
tracker= tracker[tracker.churned_after_six != 'NA'].reset_index(drop = True)
tracker.head()
```

Out[98]:

	mentioned_tracker	churned_after_six	count
0	0.0	Churn	2216
1	0.0	No churn	21084
2	1.0	Churn	2
3	1.0	No churn	108
4	2.0	No churn	5

In [99]:

```
#pivoting the data
tracker_pivot = tracker.pivot_table(columns = 'churned_after_six',
                                    index = ['mentioned_tracker'],
                                    aggfunc = 'sum').reset_index()
tracker_pivot
```

Out[99]:

	mentioned_tracker	count	
churned_after_six		**Churn**	**No churn**
0	0.0	2216.0	21084.0
1	1.0	2.0	108.0
2	2.0	NaN	5.0

In [100]:

```
#replacing NaNs with 0
tracker_pivot = tracker_pivot.replace(np.nan, 0.0)
tracker_pivot
```

Out[100]:

	mentioned_tracker	count	
churned_after_six		**Churn**	**No churn**
0	0.0	2216.0	21084.0
1	1.0	2.0	108.0
2	2.0	0.0	5.0

In [101]:

```
#creating dataframe to compare sentiment with questions asked
sentiment_questions = users_messages[['questions_asked', 'sentiment', 'churned_after_si
x']]
sentiment_questions.head()
```

Out[101]:

	questions_asked	sentiment	churned_after_six
0	0.0	1.026933	NA
1	0.0	0.295621	NA
2	0.0	0.069245	NA
3	0.0	0.141559	NA
4	0.0	0.109137	NA

In [102]:

```
#removing the NAs from churn column
sentiment_questions= sentiment_questions[sentiment_questions.churned_after_six != 'NA']
.reset_index(drop = True)
```

In [103]:

```
#pivoting the data
sentiment_questions_pivot = sentiment_questions.pivot_table(columns = 'churned_after_si
x',
                           index = ['questions_asked'],
                           values = 'sentiment').reset_index()
sentiment_questions_pivot
```

Out[103]:

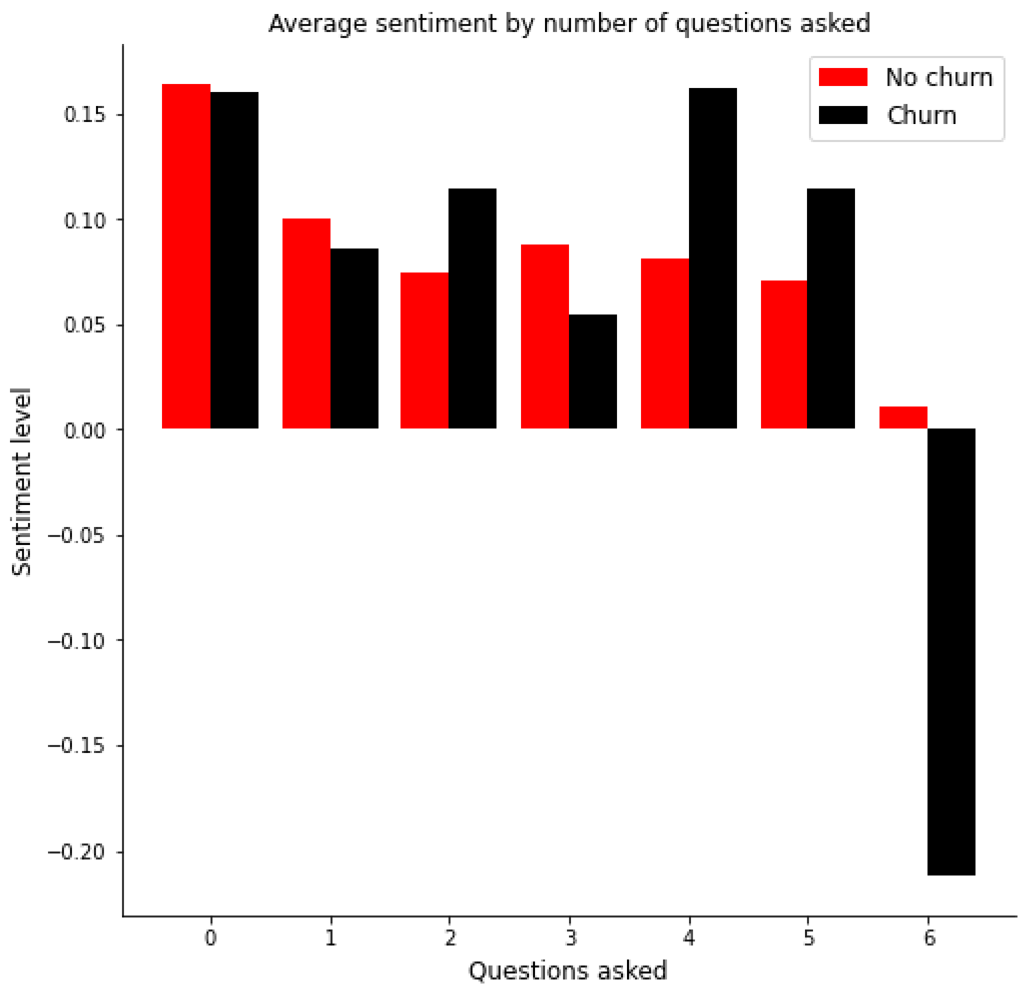
churned_after_six	questions_asked	Churn	No churn
0	0.0	0.160554	0.164324
1	1.0	0.086285	0.100046
2	2.0	0.114372	0.074546
3	3.0	0.054722	0.087766
4	4.0	0.162263	0.081528
5	5.0	0.114317	0.070867
6	6.0	-0.211830	0.011122

In [104]:

```
#converting questions asked data to integers for chart axis
sentiment_questions_pivot['questions_asked'] = sentiment_questions_pivot['questions_ask
ed'].astype(int)
```

In [105]:

```
#plotting chart - sentiment is highest before any questions ar asked.Sentiment falls
#dramatically when 6 questions are asked but this is due to just one person

num_bars = 7
width = 0.4

sent_ques_bars = np.arange(num_bars)

fig = plt.figure(figsize = (8, 8))
ax = fig.add_subplot()

bar_1 = ax.bar(sent_ques_bars, sentiment_questions_pivot['No churn'], width, color = 'r
ed', label = 'No churn')
bar_2 = ax.bar(sent_ques_bars + width, sentiment_questions_pivot['Churn'], width, color
= 'black', label = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

ax.set_ylabel('Sentiment level', fontsize = 12)
ax.set_xlabel('Questions asked', fontsize = 12)
ax.set_xticks(sent_ques_bars + width / 2)
ax.set_xticklabels(sentiment_questions_pivot.questions_asked)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Average sentiment by number of questions asked', fontsize = 12)
plt.savefig('sentiment_by_questions')
```



In [106]:

```
#creating dataframe to compare sentiment with emojis
sentiment_emojis = users_messages[['emojis_used', 'sentiment', 'churned_after_six']]
sentiment_emojis.head()
```

Out[106]:

	emojis_used	sentiment	churned_after_six
0	0.0	1.026933	NA
1	0.0	0.295621	NA
2	0.0	0.069245	NA
3	0.0	0.141559	NA
4	0.0	0.109137	NA

In [107]:

```
#removing the NAs from churn column
sentiment_emojis= sentiment_emojis[sentiment_emojis.churned_after_six != 'NA'].reset_in
dex(drop = True)
```

In [108]:

```
#pivoting the data
sentiment_emojis_pivot = sentiment_emojis.pivot_table(columns = 'churned_after_six',
                                   index = ['emojis_used'],
                                   values = 'sentiment').reset_index()
sentiment_emojis_pivot
```

Out[108]:

churned_after_six	emojis_used	Churn	No churn
0	0.0	0.129242	0.139500
1	1.0	0.234820	0.239325
2	2.0	0.273783	0.227311
3	3.0	0.172227	0.215560
4	4.0	0.548556	0.194247
5	5.0	0.029484	0.149057
6	6.0	NaN	0.294145
7	7.0	NaN	0.152852
8	8.0	NaN	0.328933
9	9.0	NaN	0.000443

In [109]:

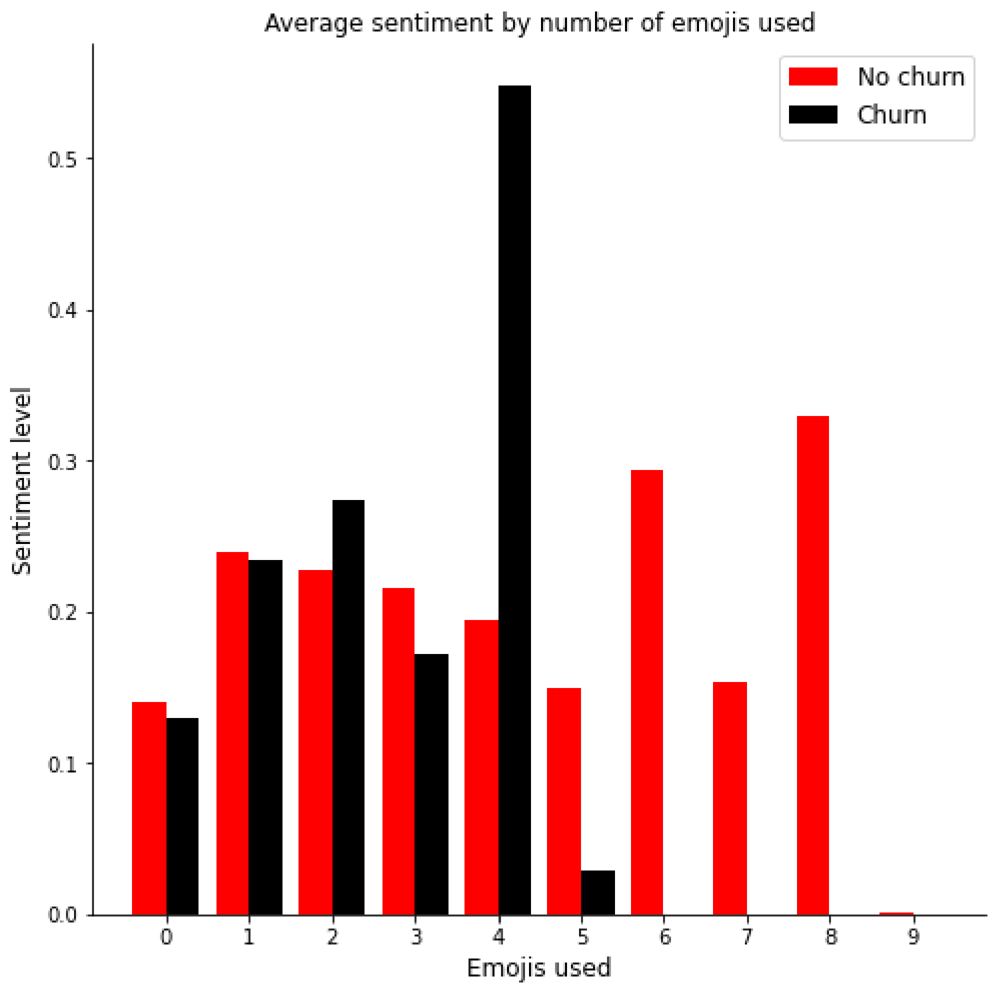
```
#replacing NaNs with 0
sentiment_emojis_pivot = sentiment_emojis_pivot.replace(np.nan, 0.0)
#converting emoji data to integers for chart axis
sentiment_emojis_pivot['emojis_used'] = sentiment_emojis_pivot['emojis_used'].astype(int)
sentiment_emojis_pivot
```

Out[109]:

churned_after_six	emojis_used	Churn	No churn
0	0	0.129242	0.139500
1	1	0.234820	0.239325
2	2	0.273783	0.227311
3	3	0.172227	0.215560
4	4	0.548556	0.194247
5	5	0.029484	0.149057
6	6	0.000000	0.294145
7	7	0.000000	0.152852
8	8	0.000000	0.328933
9	9	0.000000	0.000443

In [110]:

```
#plotting chart - high level of sentiment at 4 emojis despite churn but this consists o
f just 4 users. No churn and
#relatively high sentiment when 6 or more emojis are sent

num_bars = 10
width = 0.4

sent_emoj_bars = np.arange(num_bars)

fig = plt.figure(figsize = (8, 8))
ax = fig.add_subplot()

bar_1 = ax.bar(sent_emoj_bars, sentiment_emojis_pivot['No churn'], width, color = 'red'
, label = 'No churn')
bar_2 = ax.bar(sent_emoj_bars + width, sentiment_emojis_pivot['Churn'], width, color =
'black', label = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

ax.set_ylabel('Sentiment level', fontsize = 12)
ax.set_xlabel('Emojis used', fontsize = 12)
ax.set_xticks(sent_emoj_bars + width / 2)
ax.set_xticklabels(sentiment_emojis_pivot.emojis_used)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Average sentiment by number of emojis used', fontsize = 12)
plt.savefig('sentiment_by_emojis')
```



Exploratory data analysis - events table

In [111]:

```
#merging users and events table - i was not able to join users, messages and events tog
ether - this was either giving me
#a memory issue or killing my kernal
users_events = users.merge(events, how = 'right', left_on = 'user_id', right_on = 'user
_id')
users_events.head()
```

Out[111]:

	user_id	goals	gender	motivation	challenge	trigger	age	height
0	5a2e417806d240124a6185a0	medium	F	looks	motivation	tired	25	156.2
1	5a2e417806d240124a6185a0	medium	F	looks	motivation	tired	25	156.2
2	5a2e417806d240124a6185a0	medium	F	looks	motivation	tired	25	156.2
3	5a2e417806d240124a6185a0	medium	F	looks	motivation	tired	25	156.2
4	5a2e417806d240124a6185a0	medium	F	looks	motivation	tired	25	156.2

In [112]:

```
#grouping title and churn data and removing NAs
event = users_events.groupby(['title', 'churned_after_six']).size().to_frame().reset_in
dex().rename(columns = {0: 'count'})
event = event[event.churned_after_six != 'NA'].reset_index(drop = True)
event.head()
```

Out[112]:

	title	churned_after_six	count
0	Added new food diary entry	Churn	1095
1	Added new food diary entry	No churn	11265
2	Read article	Churn	830
3	Read article	No churn	10477
4	Saved recipe	Churn	83

In [113]:

```python
#pivoting the data
event_pivot = event.pivot_table(columns = 'churned_after_six',
                                index = ['title'],
                                aggfunc = 'sum').reset_index()
event_pivot
```

Out[113]:

	title	count	
churned_after_six		**Churn**	**No churn**
0	Added new food diary entry	1095	11265
1	Read article	830	10477
2	Saved recipe	83	1003
3	Sent message	2238	21284
4	Weigh-in	563	6820

In [114]:

```python
#creating one column title
event_pivot.columns = list(map('_'.join, event_pivot.columns))
event_pivot
```

Out[114]:

	title_	count_Churn	count_No churn
0	Added new food diary entry	1095	11265
1	Read article	830	10477
2	Saved recipe	83	1003
3	Sent message	2238	21284
4	Weigh-in	563	6820

In [115]:

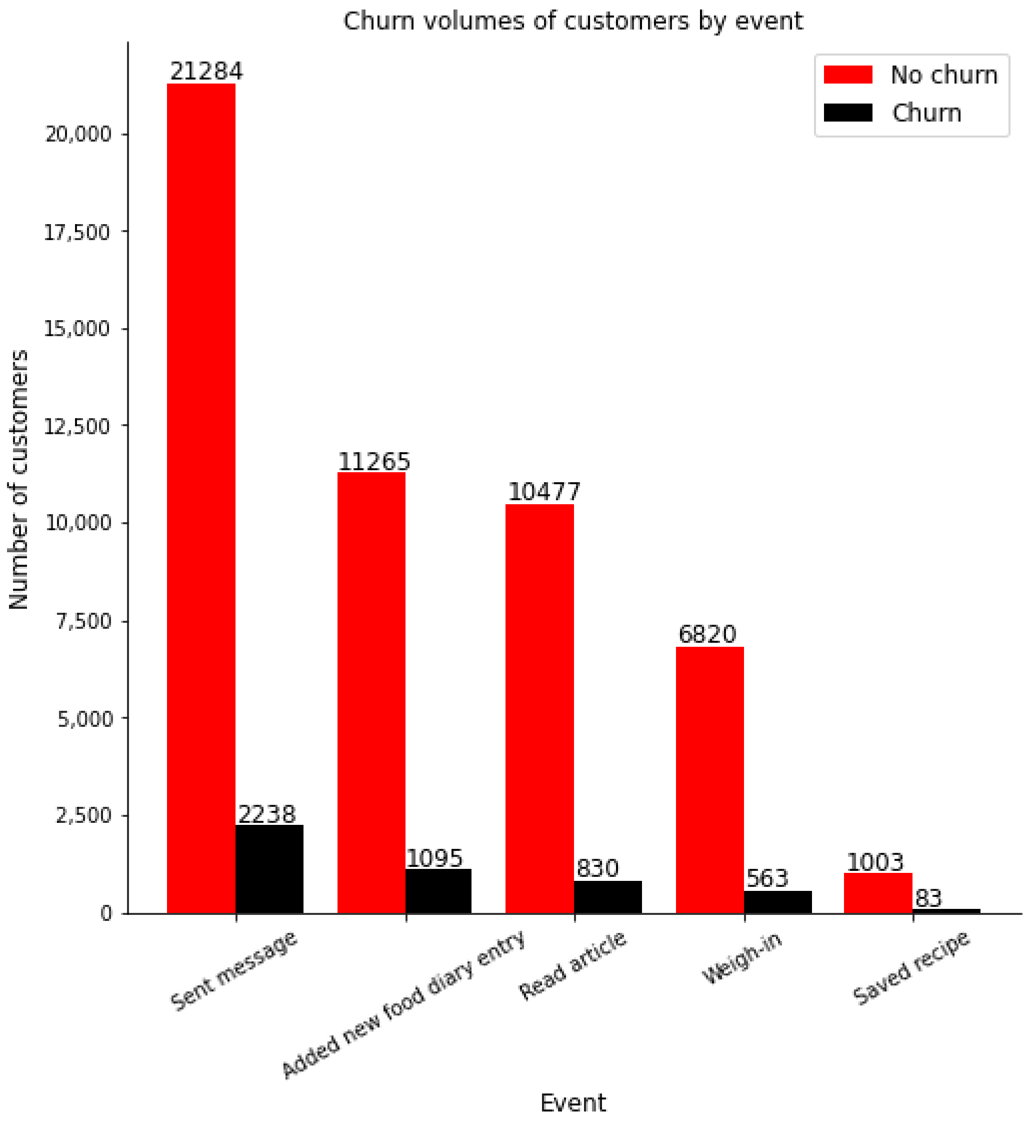
```python
#adding a total column for chart and sorting it by total
event_pivot['total'] = event_pivot['count_Churn'] + event_pivot['count_No churn']
event_pivot.sort_values(by = 'total', ascending = False, inplace = True)
event_pivot.reset_index(drop = True)
```

Out[115]:

	title_	count_Churn	count_No churn	total
0	Sent message	2238	21284	23522
1	Added new food diary entry	1095	11265	12360
2	Read article	830	10477	11307
3	Weigh-in	563	6820	7383
4	Saved recipe	83	1003	1086

In [116]:

```
#plotting bar chart - churn levels are lowest for customers who saved a recipe or did a
weigh-in
num_bars = 5
width = 0.4

event_bars = np.arange(num_bars)

fig = plt.figure(figsize = (8, 8))
ax = fig.add_subplot()

bar_1 = ax.bar(event_bars, event_pivot['count_No churn'], width, color = 'red', label =
'No churn')
bar_2 = ax.bar(event_bars + width, event_pivot['count_Churn'], width, color = 'black',
label = 'Churn')

#removing chart borders
ax.spines['top'].set_visible(False)
ax.spines['right'].set_visible(False)

#function to add comma separator to labels
def comma(x, pos):
    return format(x, "6,.0f")

#adding data labels
for bar in bar_1:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.001, yval + 100, yval, fontsize = 12)

for bar in bar_2:
    yval = bar.get_height()
    ax.text(bar.get_x() + 0.001, yval + 100, yval, fontsize = 12)


ax.set_ylabel('Number of customers', fontsize = 12)
#this code adds a comma separater to the y tick marks
ax.yaxis.set_major_formatter(tcr.FuncFormatter(comma))

ax.set_xlabel('Event', fontsize = 12)
ax.set_xticks(event_bars + width / 2)
ax.set_xticklabels(event_pivot.title_, rotation = 30)
ax.legend((bar_1, bar_2), ('No churn', 'Churn'), loc = 'upper right', fontsize = 12)
ax.set_title('Churn volumes of customers by event', fontsize = 12)
plt.savefig('churn_by_event')
```



In [117]:

```
#sending users_messages table to csv - this will be used for the prediction analysis in
another jupyter notebook
all_data = users_messages.to_csv('/home/amybirdee/hobby_projects/health_first/all_data.
csv', index = False)
```

In [ ]: