Analysis of Yelp Business Intelligence Data

We will analyze a subset of Yelp's business, reviews and user data. This dataset comes to us from Kaggle although we have taken steps to pull this data into a publis s3 bucket: `s3://sta9760-yelpdataset/yelp-light/*business.json`

Installation and Initial Setup

Begin by installing the necessary libraries that you may need to conduct your analysis. At the very least, you must install `pandas` and `matplotlib`

In [1]:
```
sc.install_pypi_package("pandas==1.0.3")
```

Starting Spark application

ID	YARN Application ID	Kind	State	Spark UI	Driver log	Current session?
2	application_1619538268223_0006	pyspark	idle	Link	Link	✔

```
SparkSession available as 'spark'.

Collecting pandas==1.0.3
  Using cached https://files.pythonhosted.org/packages/4a/6a/94b219b8ea0f2d58016
9e85ed1edc0163743f55aaeca8a44c2e8fc1e344e/pandas-1.0.3-cp37-cp37m-manylinux1_x86
_64.whl
Requirement already satisfied: pytz>=2017.2 in /usr/local/lib/python3.7/site-pac
kages (from pandas==1.0.3)
Requirement already satisfied: numpy>=1.13.3 in /usr/local/lib64/python3.7/site-
packages (from pandas==1.0.3)
Collecting python-dateutil>=2.6.1 (from pandas==1.0.3)
  Using cached https://files.pythonhosted.org/packages/d4/70/d60450c3dd48ef87586
924207ae8907090de0b306af2bce5d134d78615cb/python_dateutil-2.8.1-py2.py3-none-an
y.whl
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/site-package
s (from python-dateutil>=2.6.1->pandas==1.0.3)
Installing collected packages: python-dateutil, pandas
Successfully installed pandas-1.0.3 python-dateutil-2.8.1
```

In [2]:
```
sc.install_pypi_package("matplotlib==3.2.1")
```

```
Collecting matplotlib==3.2.1
  Using cached https://files.pythonhosted.org/packages/b2/c2/71fcf957710f3ba1f09
088b35776a799ba7dd95f7c2b195ec800933b276b/matplotlib-3.2.1-cp37-cp37m-manylinux1
_x86_64.whl
Requirement already satisfied: python-dateutil>=2.1 in /mnt/tmp/1619578930139-0/
lib/python3.7/site-packages (from matplotlib==3.2.1)
Collecting pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 (from matplotlib==3.2.1)
  Using cached https://files.pythonhosted.org/packages/8a/bb/488841f56197b13700a
fd5658fc279a2025a39e22449b7cf29864669b15d/pyparsing-2.4.7-py2.py3-none-any.whl
Collecting cycler>=0.10 (from matplotlib==3.2.1)
  Using cached https://files.pythonhosted.org/packages/f7/d2/e07d3ebb2bd7af69644
0ce7e754c59dd546ffe1bbe732c8ab68b9c834e61/cycler-0.10.0-py2.py3-none-any.whl
Requirement already satisfied: numpy>=1.11 in /usr/local/lib64/python3.7/site-pa
ckages (from matplotlib==3.2.1)
```

```
Collecting kiwisolver>=1.0.1 (from matplotlib==3.2.1)
  Using cached https://files.pythonhosted.org/packages/d2/46/231de802ade4225b76b
96cffe419cf3ce52bbe92e3b092cf12db7d11c207/kiwisolver-1.3.1-cp37-cp37m-manylinux1
_x86_64.whl
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/site-package
s (from python-dateutil>=2.1->matplotlib==3.2.1)
Installing collected packages: pyparsing, cycler, kiwisolver, matplotlib
Successfully installed cycler-0.10.0 kiwisolver-1.3.1 matplotlib-3.2.1 pyparsing
-2.4.7
```

In [3]:

```
sc.install_pypi_package("seaborn==0.11.1")
```

```
Collecting seaborn==0.11.1
  Using cached https://files.pythonhosted.org/packages/68/ad/6c2406ae175f59ec616
714e408979b674fe27b9587f79d59a528ddfbcd5b/seaborn-0.11.1-py3-none-any.whl
Requirement already satisfied: numpy>=1.15 in /usr/local/lib64/python3.7/site-pa
ckages (from seaborn==0.11.1)
Collecting scipy>=1.0 (from seaborn==0.11.1)
  Using cached https://files.pythonhosted.org/packages/7d/e8/43ffca541d2f208d516
296950b25fe1084b35c2881f4d444c1346ca75815/scipy-1.6.3-cp37-cp37m-manylinux1_x86_
64.whl
Requirement already satisfied: matplotlib>=2.2 in /mnt/tmp/1619578930139-0/lib/p
ython3.7/site-packages (from seaborn==0.11.1)
Requirement already satisfied: pandas>=0.23 in /mnt/tmp/1619578930139-0/lib/pyth
on3.7/site-packages (from seaborn==0.11.1)
Requirement already satisfied: python-dateutil>=2.1 in /mnt/tmp/1619578930139-0/
lib/python3.7/site-packages (from matplotlib>=2.2->seaborn==0.11.1)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.1 in /mnt/
tmp/1619578930139-0/lib/python3.7/site-packages (from matplotlib>=2.2->seaborn==
0.11.1)
Requirement already satisfied: cycler>=0.10 in /mnt/tmp/1619578930139-0/lib/pyth
on3.7/site-packages (from matplotlib>=2.2->seaborn==0.11.1)
Requirement already satisfied: kiwisolver>=1.0.1 in /mnt/tmp/1619578930139-0/li
b/python3.7/site-packages (from matplotlib>=2.2->seaborn==0.11.1)
Requirement already satisfied: pytz>=2017.2 in /usr/local/lib/python3.7/site-pac
kages (from pandas>=0.23->seaborn==0.11.1)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/site-package
s (from python-dateutil>=2.1->matplotlib>=2.2->seaborn==0.11.1)
Installing collected packages: scipy, seaborn
Successfully installed scipy-1.6.3 seaborn-0.11.1
```

In [4]:

```
sc.install_pypi_package("bokeh==2.3.1")
```

```
Collecting bokeh==2.3.1
Collecting typing-extensions>=3.7.4 (from bokeh==2.3.1)
  Using cached https://files.pythonhosted.org/packages/60/7a/e881b5abb54db0e6e67
1ab088d079c57ce54e8a01a3ca443f561ccadb37e/typing_extensions-3.7.4.3-py3-none-an
y.whl
Requirement already satisfied: python-dateutil>=2.1 in /mnt/tmp/1619578930139-0/
lib/python3.7/site-packages (from bokeh==2.3.1)
Collecting tornado>=5.1 (from bokeh==2.3.1)
  Using cached https://files.pythonhosted.org/packages/bf/fa/2befee379094720b540
65daa9c6117f3edb7d35f86cde0f50b3a28ecfadf/tornado-6.1-cp37-cp37m-manylinux1_x86_
64.whl
Collecting pillow>=7.1.0 (from bokeh==2.3.1)
  Using cached https://files.pythonhosted.org/packages/33/34/542152297dcc6c47a9d
cb0685eac6d652d878ed3cea83bf2b23cb988e857/Pillow-8.2.0-cp37-cp37m-manylinux1_x86
_64.whl
Collecting packaging>=16.8 (from bokeh==2.3.1)
  Using cached https://files.pythonhosted.org/packages/3e/89/7ea760b4daa42653ece
```

```
2380531c90f64788d979110a2ab51049d92f408af/packaging-20.9-py2.py3-none-any.whl
Requirement already satisfied: numpy>=1.11.3 in /usr/local/lib64/python3.7/site-
packages (from bokeh==2.3.1)
Requirement already satisfied: PyYAML>=3.10 in /usr/local/lib64/python3.7/site-p
ackages (from bokeh==2.3.1)
Collecting Jinja2>=2.7 (from bokeh==2.3.1)
  Using cached https://files.pythonhosted.org/packages/7e/c2/1eece8c95ddbc9b1aeb
64f5783a9e07a286de42191b7204d67b7496ddf35/Jinja2-2.11.3-py2.py3-none-any.whl
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/site-package
s (from python-dateutil>=2.1->bokeh==2.3.1)
Requirement already satisfied: pyparsing>=2.0.2 in /mnt/tmp/1619578930139-0/lib/
python3.7/site-packages (from packaging>=16.8->bokeh==2.3.1)
Collecting MarkupSafe>=0.23 (from Jinja2>=2.7->bokeh==2.3.1)
  Using cached https://files.pythonhosted.org/packages/98/7b/ff284bd8c80654e471b
769062a9b43cc5d03e7a615048d96f4619df8d420/MarkupSafe-1.1.1-cp37-cp37m-manylinux1
_x86_64.whl
Installing collected packages: typing-extensions, tornado, pillow, packaging, Ma
rkupSafe, Jinja2, bokeh
Successfully installed Jinja2-2.11.3 MarkupSafe-1.1.1 bokeh-2.3.1 packaging-20.9
pillow-8.2.0 tornado-6.1 typing-extensions-3.7.4.3
```

In [5]:

```python
sc.list_packages()
```

```
Package                    Version
-------------------------- ---------
beautifulsoup4             4.9.1
bokeh                      2.3.1
boto                       2.49.0
click                      7.1.2
cycler                     0.10.0
Jinja2                     2.11.3
jmespath                   0.10.0
joblib                     0.16.0
kiwisolver                 1.3.1
lxml                       4.5.2
MarkupSafe                 1.1.1
matplotlib                 3.2.1
mysqlclient                1.4.2
nltk                       3.5
nose                       1.3.4
numpy                      1.16.5
packaging                  20.9
pandas                     1.0.3
Pillow                     8.2.0
pip                        9.0.1
py-dateutil                2.2
pyparsing                  2.4.7
python-dateutil            2.8.1
python37-sagemaker-pyspark 1.4.0
pytz                       2020.1
PyYAML                     5.3.1
regex                      2020.7.14
scipy                      1.6.3
seaborn                    0.11.1
setuptools                 28.8.0
six                        1.13.0
soupsieve                  1.9.5
tornado                    6.1
tqdm                       4.48.2
typing-extensions          3.7.4.3
wheel                      0.29.0
windmill                   1.6
```

Importing

Now, import the installed packages from the previous block below.

In [6]:
```
import pandas as pd
import seaborn as sns
import matplotlib.pyplot as plt
from bokeh.plotting import figure, output_file, show
```

Loading Data

We are finally ready to load data. Using `spark` load the data from S3 into a `dataframe` object that we can manipulate further down in our analysis.

In [7]:
```
business_data= spark.read.json('s3://yelp-spark-dataset/yelp_academic_dataset_bu
review_data=spark.read.json('s3://yelp-spark-dataset/yelp_academic_dataset_revie
user_data=spark.read.json('s3://yelp-spark-dataset/yelp_academic_dataset_user.js
```

Overview of Data

Display the number of rows and columns in our dataset.

In [8]:
```
print('Yelp Business Data Set | Rows: '+ str(business_data.count())+' | Columns:
print('Yelp Review Data Set | Rows: '+ str(review_data.count())+ ' | Columns:'+
print('Yelp User Data Set | Rows: '+ str(user_data.count())+' | Columns:'+ str(l
```

```
Yelp Business Data Set | Rows: 160585 | Columns:14
Yelp Review Data Set | Rows: 8635403 | Columns:9
Yelp User Data Set | Rows: 2189457 | Columns:22
```

Display the DataFrame schema below.

In [9]:
```
business_data.printSchema()
review_data.printSchema()
user_data.printSchema()
```

```
root
 |-- address: string (nullable = true)
 |-- attributes: struct (nullable = true)
 |    |-- AcceptsInsurance: string (nullable = true)
 |    |-- AgesAllowed: string (nullable = true)
 |    |-- Alcohol: string (nullable = true)
 |    |-- Ambience: string (nullable = true)
 |    |-- BYOB: string (nullable = true)
 |    |-- BYOBCorkage: string (nullable = true)
 |    |-- BestNights: string (nullable = true)
 |    |-- BikeParking: string (nullable = true)
 |    |-- BusinessAcceptsBitcoin: string (nullable = true)
 |    |-- BusinessAcceptsCreditCards: string (nullable = true)
```

```
 |    |-- BusinessParking: string (nullable = true)
 |    |-- ByAppointmentOnly: string (nullable = true)
 |    |-- Caters: string (nullable = true)
 |    |-- CoatCheck: string (nullable = true)
 |    |-- Corkage: string (nullable = true)
 |    |-- DietaryRestrictions: string (nullable = true)
 |    |-- DogsAllowed: string (nullable = true)
 |    |-- DriveThru: string (nullable = true)
 |    |-- GoodForDancing: string (nullable = true)
 |    |-- GoodForKids: string (nullable = true)
 |    |-- GoodForMeal: string (nullable = true)
 |    |-- HairSpecializesIn: string (nullable = true)
 |    |-- HappyHour: string (nullable = true)
 |    |-- HasTV: string (nullable = true)
 |    |-- Music: string (nullable = true)
 |    |-- NoiseLevel: string (nullable = true)
 |    |-- Open24Hours: string (nullable = true)
 |    |-- OutdoorSeating: string (nullable = true)
 |    |-- RestaurantsAttire: string (nullable = true)
 |    |-- RestaurantsCounterService: string (nullable = true)
 |    |-- RestaurantsDelivery: string (nullable = true)
 |    |-- RestaurantsGoodForGroups: string (nullable = true)
 |    |-- RestaurantsPriceRange2: string (nullable = true)
 |    |-- RestaurantsReservations: string (nullable = true)
 |    |-- RestaurantsTableService: string (nullable = true)
 |    |-- RestaurantsTakeOut: string (nullable = true)
 |    |-- Smoking: string (nullable = true)
 |    |-- WheelchairAccessible: string (nullable = true)
 |    |-- WiFi: string (nullable = true)
 |-- business_id: string (nullable = true)
 |-- categories: string (nullable = true)
 |-- city: string (nullable = true)
 |-- hours: struct (nullable = true)
 |    |-- Friday: string (nullable = true)
 |    |-- Monday: string (nullable = true)
 |    |-- Saturday: string (nullable = true)
 |    |-- Sunday: string (nullable = true)
 |    |-- Thursday: string (nullable = true)
 |    |-- Tuesday: string (nullable = true)
 |    |-- Wednesday: string (nullable = true)
 |-- is_open: long (nullable = true)
 |-- latitude: double (nullable = true)
 |-- longitude: double (nullable = true)
 |-- name: string (nullable = true)
 |-- postal_code: string (nullable = true)
 |-- review_count: long (nullable = true)
 |-- stars: double (nullable = true)
 |-- state: string (nullable = true)

root
 |-- business_id: string (nullable = true)
 |-- cool: long (nullable = true)
 |-- date: string (nullable = true)
 |-- funny: long (nullable = true)
 |-- review_id: string (nullable = true)
 |-- stars: double (nullable = true)
 |-- text: string (nullable = true)
 |-- useful: long (nullable = true)
 |-- user_id: string (nullable = true)

root
 |-- average_stars: double (nullable = true)
 |-- compliment_cool: long (nullable = true)
 |-- compliment_cute: long (nullable = true)
 |-- compliment_funny: long (nullable = true)
```

```
 |-- compliment_hot: long (nullable = true)
 |-- compliment_list: long (nullable = true)
 |-- compliment_more: long (nullable = true)
 |-- compliment_note: long (nullable = true)
 |-- compliment_photos: long (nullable = true)
 |-- compliment_plain: long (nullable = true)
 |-- compliment_profile: long (nullable = true)
 |-- compliment_writer: long (nullable = true)
 |-- cool: long (nullable = true)
 |-- elite: string (nullable = true)
 |-- fans: long (nullable = true)
 |-- friends: string (nullable = true)
 |-- funny: long (nullable = true)
 |-- name: string (nullable = true)
 |-- review_count: long (nullable = true)
 |-- useful: long (nullable = true)
 |-- user_id: string (nullable = true)
 |-- yelping_since: string (nullable = true)
```

Display the first 5 rows with the following columns:

- `business_id`
- `name`
- `city`
- `state`
- `categories`

In [10]:

```
business_data.select("business_id","name","city","state","stars","categories").s
```

```
+--------------------+--------------------+-----------+-----+-----+-------------
-------+
|         business_id|                name|       city|state|stars|          cat
egories|
+--------------------+--------------------+-----------+-----+-----+-------------
-------+
|6iYb2HFDywm3zjuRg...| Oskar Blues Taproom|    Boulder|   CO|  4.0|Gastropubs, F
ood,...|
|tCbdrRPZA0oiIYSmH...|Flying Elephants ...|   Portland|   OR|  4.0|Salad, Soup, 
Sand...|
|bvN78flM8NLprQ1a1...|      The Reclaimory|   Portland|   OR|  4.5|Antiques, Fas
hion...|
|oaepsyvc0J17qwi8c...|         Great Clips|Orange City|   FL|  3.0|Beauty & Spa
s, Ha...|
|PE9uqAjdw0E4-8mjG...|   Crossfit Terminus|    Atlanta|   GA|  4.0|Gyms, Active 
Life...|
+--------------------+--------------------+-----------+-----+-----+-------------
-------+
only showing top 5 rows
```

Analyzing Categories

Let's now answer this question: **how many unique categories are represented in this dataset?**

Essentially, we have the categories per business as a list - this is useful to quickly see what each business might be represented as but it is difficult to easily answer questions such as:

- How many businesses are categorized as `Active Life`, for instance
- What are the top 20 most popular categories available?

Association Table

We need to "break out" these categories from the business ids? One common approach to take is to build an association table mapping a single business id multiple times to each distinct category.

For instance, given the following:

business_id	categories
abcd123	a,b,c

We would like to derive something like:

business_id	category
abcd123	a
abcd123	b
abcd123	c

What this does is allow us to then perform a myriad of rollups and other analysis on this association table which can aid us in answering the questions asked above.

Implement the code necessary to derive the table described from your original yelp dataframe.

In [11]:
```
from pyspark.sql.functions import explode, split, trim
business_data_exploded=business_data.select("business_id","categories")
business_data_exploded = business_data_exploded.withColumn('categories',explode(
business_data_exploded = business_data_exploded.withColumn('categories', trim(bu

#business_data_exploded.columns = business_data_exploded.columns.strip()
business_data_exploded.count()
```

```
708968
```

Display the first 5 rows of your association table below.

In [12]:
```
business_data_exploded.show(5)
```

```
+--------------------+------------+
|         business_id|  categories|
+--------------------+------------+
|6iYb2HFDywm3zjuRg...|   Gastropubs|
|6iYb2HFDywm3zjuRg...|         Food|
|6iYb2HFDywm3zjuRg...|Beer Gardens|
|6iYb2HFDywm3zjuRg...| Restaurants|
|6iYb2HFDywm3zjuRg...|         Bars|
```

```
+--------------------+------------+
only showing top 5 rows
```

Total Unique Categories

Finally, we are ready to answer the question: **what is the total number of unique categories available?**

Below, implement the code necessary to calculate this figure.

In [13]:
```
business_data_exploded.select('categories').distinct().count()
```

```
1330
```

Top Categories By Business

Now let's find the top categories in this dataset by rolling up categories.

Counts of Businesses / Category

So now, let's unroll our distinct count a bit and display the per count value of businesses per category.

The expected output should be:

category	count
a	15
b	2
c	45

Or something to that effect.

In [14]:
```
business_data_exploded.groupby('categories').count().show()
```

```
+--------------------+-----+
|          categories|count|
+--------------------+-----+
|      Dermatologists|  351|
|      Paddleboarding|   67|
|        Aerial Tours|    8|
|         Hobby Shops|  610|
|          Bubble Tea|  779|
|             Embassy|    9|
|             Tanning|  701|
|            Handyman|  507|
|      Aerial Fitness|   13|
|             Falafel|  141|
|        Summer Camps|  308|
|       Outlet Stores|  184|
|     Clothing Rental|   37|
```

```
|       Sporting Goods| 1864|
|      Cooking Schools|  114|
|   College Counseling|   20|
|   Lactation Services|   47|
|Ski & Snowboard S...|   55|
|              Museums|  336|
|               Doulas|   52|
+--------------------+-----+
only showing top 20 rows
```

Bar Chart of Top Categories

With this data available, let us now build a barchart of the top 20 categories.

HINT: don't forget about the matplotlib magic!

```
%matplot plt
```

In [15]:

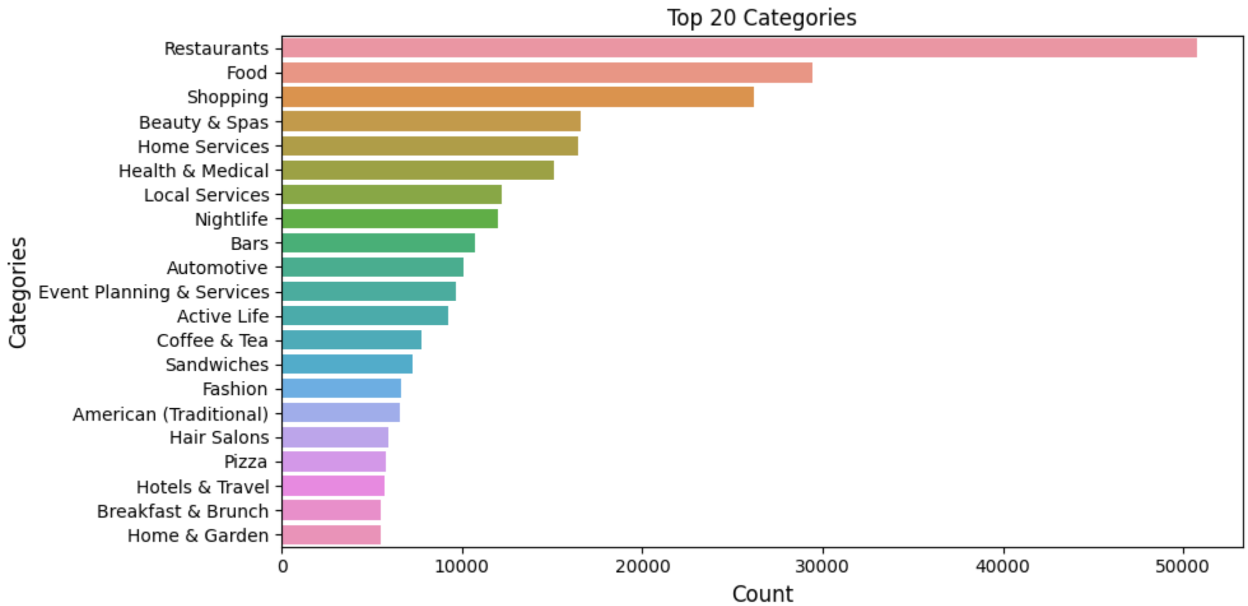
```
count_business=business_data_exploded.groupby('categories').count().orderBy('cou
```

In [16]:

```
barchart= count_business.toPandas()
barchart=barchart.head(21)
```

In [17]:

```
plt.figure(figsize=(10,5))
barchart_viz= sns.barplot(x='count',y='categories',data=barchart)
barchart_viz.set_title('Top 20 Categories')
barchart_viz.set_xlabel( "Count" , size = 12 )
barchart_viz.set_ylabel( "Categories" , size = 12 )
plt.tight_layout()
#plt.show()
%matplot plt
```



Do Yelp Reviews Skew Negative?

Oftentimes, it is said that the only people who write a written review are those who are extremely *dissatisfied* or extremely *satisfied* with the service received.

How true is this really? Let's try and answer this question.

Loading User Data

Begin by loading the user data set from S3 and printing schema to determine what data is available.

In [18]:
```
review_data.printSchema()
review_data.count()
```

```
root
 |-- business_id: string (nullable = true)
 |-- cool: long (nullable = true)
 |-- date: string (nullable = true)
 |-- funny: long (nullable = true)
 |-- review_id: string (nullable = true)
 |-- stars: double (nullable = true)
 |-- text: string (nullable = true)
 |-- useful: long (nullable = true)
 |-- user_id: string (nullable = true)

8635403
```

Let's begin by listing the `business_id` and `stars` columns together for the user reviews data.

In [19]:
```
star_data=review_data.select("business_id","stars")
star_data.show(5)
```

```
+--------------------+-----+
|         business_id|stars|
+--------------------+-----+
|buF9druCkbuXLX526...|  4.0|
|RA4V8pr014UyUbDvI...|  4.0|
|_sS2LBIGNT5NQb6PD...|  5.0|
|0AzLzHfOJgL7ROwhd...|  2.0|
|8zehGz9jnxPqXtOc7...|  4.0|
+--------------------+-----+
only showing top 5 rows
```

Now, let's aggregate along the `stars` column to get a resultant dataframe that displays *average stars* per business as accumulated by users who **took the time to submit a written review**.

In [20]:

```
avg_review_data=star_data.groupby('business_id').mean()
avg_review_data.show()
```

```
+--------------------+------------------+
|         business_id|        avg(stars)|
+--------------------+------------------+
|uEUweopM30lHcVxjO...|               3.0|
|wdBrDCbZopowEkIEX...| 4.538461538461538|
|L3WCfeVozu5etMhz4...|               4.2|
|bOnsvrz1VkbrZM1jV...|               3.8|
|R0IJhEI-zSJpYT1YN...| 3.606060606060606|
|XzXcpPCb8Y5huklEN...| 4.666666666666667|
|yHtuNAlYKtRZniO8O...| 4.714285714285714|
|O_BAT_rvszHYBNEM6...|              2.45|
|E8Fl7qE_y-bhRbkkd...| 4.666666666666667|
|MPzc6QuEjwk3E3jVT...|            3.3125|
|dXhuCvyz5nnaboNzp...| 4.392857142857143|
|deTlQzwpIRfgmAuDa...|3.7604790419161676|
|VmujhV_mpJh1TW3Cx...|2.7884615384615383|
|bzny-7M_JjYHsKuoC...| 4.648648648648648|
|BnfkEAmvnUyIEUvG3...| 3.979591836734694|
|jZBhw30QecAQNDtpM...|               5.0|
|tI_czdTHfsy1ndBwt...| 4.428571428571429|
|4T6yFKDishcRS5k9p...| 4.333333333333333|
|nM6X2lQp5kiVteXBM...| 3.909090909090909|
|ERI2yvYf9QEN_fFOK...|2.2718446601941746|
+--------------------+------------------+
only showing top 20 rows
```

Now the fun part - let's join our two dataframes (reviews and business data) by `business_id` .

In [21]:

```
bus_data= business_data.select("business_id","name","city","state","stars")
avg_data= avg_review_data.select("business_id","avg(stars)")
all_stars_data = bus_data.join(avg_data, bus_data.business_id == avg_data.busine
```

Let's see a few of these:

In [22]:

```
new_stars_skew=all_stars_data.select("avg(stars)","stars","name","city","state")
new_stars_skew.show(5)
```

```
+------------------+-----+--------------------+----------+-----+
|        avg(stars)|stars|                name|      city|state|
+------------------+-----+--------------------+----------+-----+
|               5.0|  5.0|    CheraBella Salon|   Peabody|   MA|
|             3.875|  4.0|Mezcal Cantina & ...|  Columbus|   OH|
|3.8666666666666667|  4.0|    Red Table Coffee|    Austin|   TX|
|               5.0|  5.0|          WonderWell|    Austin|   TX|
|             3.375|  3.5|         Avalon Oaks|Wilmington|   MA|
+------------------+-----+--------------------+----------+-----+
only showing top 5 rows
```

Compute a new dataframe that calculates what we will call the *skew* (for lack of a better word) between the avg stars accumulated from written reviews and the *actual* star rating of a business (ie: the average of stars given by reviewers who wrote an actual review **and** reviewers who just provided a star rating).

The formula you can use is something like:

```
(row['avg(stars)'] - row['stars']) / row['stars']
```

If the **skew** is negative, we can interpret that to be: reviewers who left a written response were more dissatisfied than normal. If **skew** is positive, we can interpret that to be: reviewers who left a written response were more satisfied than normal.

In [23]:

```
new_stars_skew=new_stars_skew.withColumn('skew',
                                        ((new_stars_skew['avg(stars)']-new_stars
new_stars_skew.show(5)
```

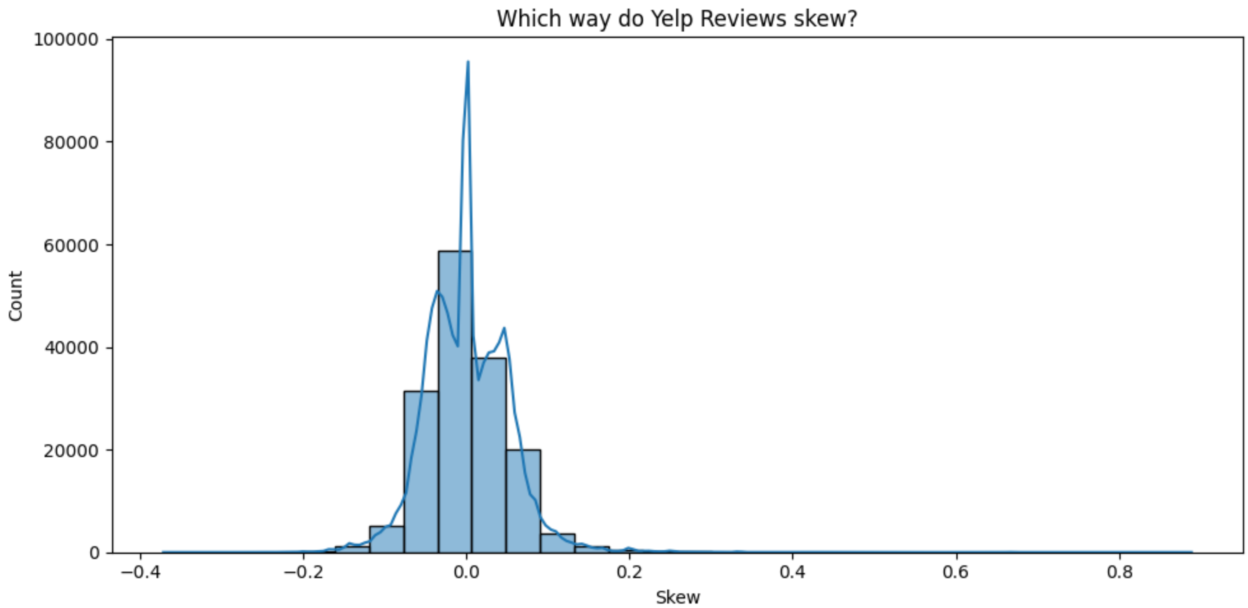
```
+------------------+-----+--------------------+----------+-----+----------------
----+
|        avg(stars)|stars|                name|      city|state|
skew|
+------------------+-----+--------------------+----------+-----+----------------
----+
|               5.0|  5.0|    CheraBella Salon|   Peabody|   MA|
0.0|
|             3.875|  4.0|Mezcal Cantina & ...|  Columbus|   OH|            -0.0
3125|
|3.8666666666666667|  4.0|    Red Table Coffee|    Austin|   TX|-0.0333333333333
3...|
|               5.0|  5.0|          WonderWell|    Austin|   TX|
0.0|
|             3.375|  3.5|         Avalon Oaks|Wilmington|   MA|-0.0357142857142
8571|
+------------------+-----+--------------------+----------+-----+----------------
----+
only showing top 5 rows
```

And finally, graph it!

In [24]:

```
new_histplot= new_stars_skew.toPandas()
#new_histplot.head()
plt.figure(figsize=(10,5))
skew_histogram= sns.histplot(data=new_histplot, x='skew',bins=30,kde=True)
skew_histogram.set_title('Which way do Yelp Reviews skew?')
skew_histogram.set_xlabel( "Skew" , size = 10 )
```

```
skew_histogram.set_ylabel( "Count" , size = 10 )
plt.tight_layout()
plt.show()
%matplot plt
```



In [25]:

```
print (new_histplot.skew())
```

```
avg(stars)   -0.563063
stars        -0.541505
skew          0.874749
dtype: float64
```

So, do Yelp (written) Reviews skew negative? Does this analysis actually prove anything? Expound on implications / interpretations of this graph.

In [ ]:

```
#The Yelp (written) Review are skewing positively. This shows there is a balance
#Therefore it would probably give everyone who uses Yelp a balanced view of diff
```

Should the Elite be Trusted? (Or, some other analysis of your choice)

For the final portion - you have a choice:

- Try and analyze some interesting dimension to this data. The **ONLY** requirement is that you must use the **Users** dataset and join on either the **business* or** reviews** dataset
- Or, you may try and answer the question posed: how accurate or close are the ratings of an "elite" user (check Users table schema) vs the actual business rating.

Feel free to use any and all methodologies at your disposal - only requirement is you must render one visualization in your analysis

In [26]:
```
user_data.printSchema()
user_data.count()
```

```
root
 |-- average_stars: double (nullable = true)
 |-- compliment_cool: long (nullable = true)
 |-- compliment_cute: long (nullable = true)
 |-- compliment_funny: long (nullable = true)
 |-- compliment_hot: long (nullable = true)
 |-- compliment_list: long (nullable = true)
 |-- compliment_more: long (nullable = true)
 |-- compliment_note: long (nullable = true)
 |-- compliment_photos: long (nullable = true)
 |-- compliment_plain: long (nullable = true)
 |-- compliment_profile: long (nullable = true)
 |-- compliment_writer: long (nullable = true)
 |-- cool: long (nullable = true)
 |-- elite: string (nullable = true)
 |-- fans: long (nullable = true)
 |-- friends: string (nullable = true)
 |-- funny: long (nullable = true)
 |-- name: string (nullable = true)
 |-- review_count: long (nullable = true)
 |-- useful: long (nullable = true)
 |-- user_id: string (nullable = true)
 |-- yelping_since: string (nullable = true)

2189457
```

In [27]:
```
review_data.printSchema()
```

```
root
 |-- business_id: string (nullable = true)
 |-- cool: long (nullable = true)
 |-- date: string (nullable = true)
 |-- funny: long (nullable = true)
 |-- review_id: string (nullable = true)
 |-- stars: double (nullable = true)
 |-- text: string (nullable = true)
 |-- useful: long (nullable = true)
 |-- user_id: string (nullable = true)
```

In [28]:
```
df_user_data=user_data.select("user_id","average_stars","review_count")
df_review_data=review_data.select("user_id","business_id","stars")
df_stars_data = df_user_data.join(df_review_data, df_user_data.user_id == df_rev
df_stars_data.show(5)
df_stars_data.count()
```

```
+--------------------+-------------+------------+--------------------+-----+
|             user_id|average_stars|review_count|         business_id|stars|
+--------------------+-------------+------------+--------------------+-----+
|--1UpCuUDJQbqiuFX...|         2.62|          12|GgR7kcKykuqXB11fW...|  5.0|
|--3Bk72HakneTyp3D...|         3.67|          11|rxNfidGLHtMYyLNeo...|  5.0|
|--3Hl2oAvTPlq-f7K...|         2.73|          11|2OaX6XjAoI7VD6jLd...|  2.0|
|--3Hl2oAvTPlq-f7K...|         2.73|          11|IfOj3AxPl3Exsd_Yl...|  1.0|
|--3Hl2oAvTPlq-f7K...|         2.73|          11|bAuYOa-VuqTOnKzWN...|  2.0|
+--------------------+-------------+------------+--------------------+-----+
only showing top 5 rows
```

```
8635403
```

In [29]:

```
all_stars_data.printSchema()
```

```
root
 |-- name: string (nullable = true)
 |-- city: string (nullable = true)
 |-- state: string (nullable = true)
 |-- stars: double (nullable = true)
 |-- business_id: string (nullable = true)
 |-- avg(stars): double (nullable = true)
```

In [30]:

```
elite_review_data=df_stars_data.select('business_id',"average_stars")
elite_review_data=elite_review_data.groupby('business_id').mean()
elite_review_data.show()
elite_review_data.count()
```

```
+--------------------+------------------+
|         business_id|avg(average_stars)|
+--------------------+------------------+
|SEHexDtZaL3Gv81aE...| 3.378604651162792|
|B9LGNspzZYVRs5Sl8...|3.8768181818181815|
|XVZDMELcUCdyWjbEz...|2.8222857142857145|
|6KGBXOeSJYf9ePdyA...|3.7497374429223744|
|xm4QAhRiwd6Urq6ku...|           4.02675|
|quL0Dqop3Ni5qcwd2...|3.6404109589041096|
|2boQDeHxopolPtJhV...| 3.749166666666667|
|8e3_PgOlFLeAys6X-...| 3.881111111111111|
|08n38tS38iznDwL_X...| 3.939647887323944|
|g8sJbkPtA78h0yNQQ...|              3.94|
|x_LapuF4Zkn5lySuA...|3.2118750000000005|
|kUV8r9IQ5l09XMyjW...|2.8674999999999997|
|6qlWc-OVhTQfcyVi3...| 4.288823529411765|
|dcAzi-fNs05qLl3lw...|3.3847272727272717|
|EvYWMhT0o9M_9NaaI...|3.1781249999999996|
|BnBnPjmUeUaMAnbJH...| 3.472857142857142|
|boF5lsuImrqbuDkuF...| 3.596279069767443|
|TMxgR8YnOI-0HxrTg...|             3.623|
|UK5t99N509A12UjUn...| 3.735933333333333|
|ESntdVKBhAdDqERly...|3.7782352941176462|
+--------------------+------------------+
only showing top 20 rows

160585
```

In [31]:

```
ddf = elite_review_data.join(all_stars_data, all_stars_data. business_id == elit
ddf.show(5)
ddf.count()
```

```
+------------------+--------------------+----------+-----+-----+----------------
----+------------------+
|avg(average_stars)|                name|      city|state|stars|         busines
s_id|        avg(stars)|
+------------------+--------------------+----------+-----+-----+----------------
----+------------------+
|3.8949999999999996|    CheraBella Salon|   Peabody|   MA|  5.0|--JuLhLvq3gyjNnX
```

```
T...|                5.0|
|              4.085|Mezcal Cantina & ...|  Columbus|   OH|  4.0|--_nBudPOb1lNRgK
f...|              3.875|
|3.6570000000000005|    Red Table Coffee|    Austin|   TX|  4.0|--kyOk0waSrCDlbS
v...|3.8666666666666667|
| 4.410714285714286|          WonderWell|    Austin|   TX|  5.0|--z9usx6Fin8P_f0
v...|                5.0|
|3.8206249999999997|         Avalon Oaks|Wilmington|   MA|  3.5|-0qeY1293steyCqY
h...|              3.375|
+------------------+--------------------+----------+-----+-----+----------------
----+------------------+
only showing top 5 rows

160585
```

In [33]:

```
df_correlation=ddf.select("business_id","avg(stars)","avg(average_stars)")
df_correlation.show(2)
df_correlation.count()
```

```
+--------------------+----------+------------------+
|         business_id|avg(stars)|avg(average_stars)|
+--------------------+----------+------------------+
|--JuLhLvq3gyjNnXT...|       5.0|             3.895|
|--_nBudPOb1lNRgKf...|     3.875|             4.085|
+--------------------+----------+------------------+
only showing top 2 rows

160585
```

In [43]:

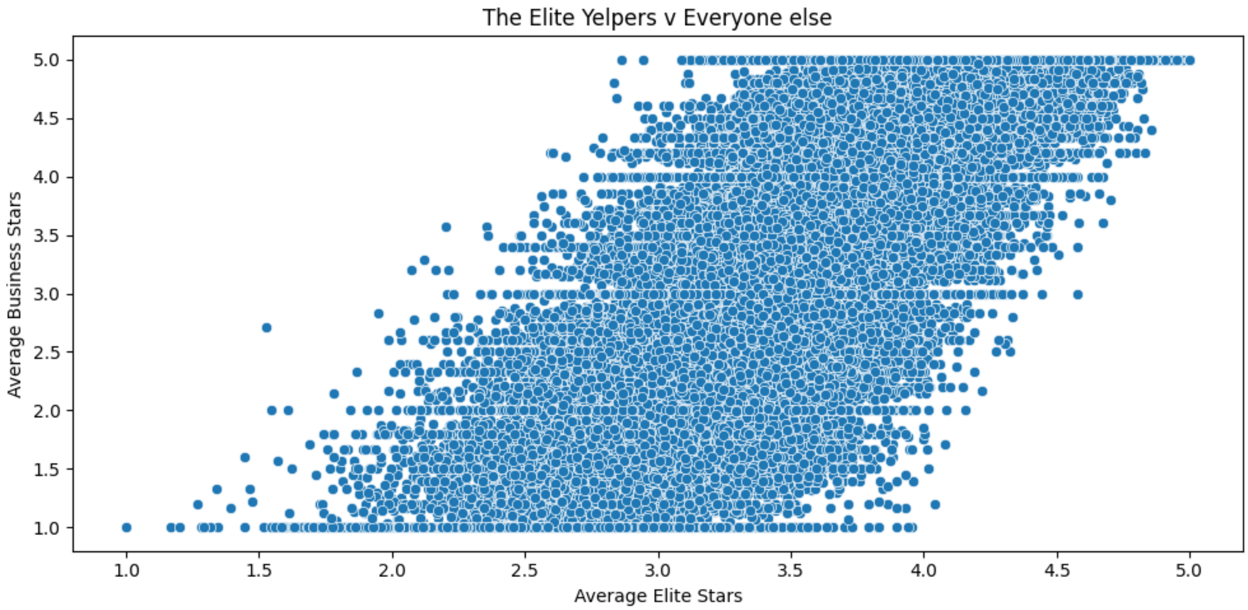
```
new_scatplot= df_correlation.toPandas()
new_scatplot=new_scatplot.drop_duplicates()
new_scatplot
```

	business_id	avg(stars)	avg(average_stars)
0	--JuLhLvq3gyjNnXT9Q95w	5.000000	3.895000
1	--_nBudPOb1lNRgKfjLtrw	3.875000	4.085000
2	--kyOk0waSrCDlbSvYtAOw	3.866667	3.657000
3	--z9usx6Fin8P_f0vc7DGQ	5.000000	4.410714
4	-0qeY1293steyCqYhqckMA	3.375000	3.820625
...	...	...	...
160580	zptEZZLh0iP5PnslDAUbkw	3.092105	3.608289
160581	zvaKvoKVDpgTtKK6Mc1SKw	4.215909	3.828750
160582	zwOz6JjjQ0leNlKWhr5Shw	4.789474	4.196842
160583	zwT7rrAMgEMA9q8twm7DGg	5.000000	4.540000
160584	zzgP0DV4OZfXkPdGNvtANQ	4.200000	4.142000

[160585 rows x 3 columns]

In [37]:

```
plt.figure(figsize=(10,5))
scattter_plot= sns.scatterplot(data=new_scatplot, x="avg(average_stars)", y="avg
scattter_plot.set_title('The Elite Yelpers v Everyone else')
scattter_plot.set_xlabel( "Average Elite Stars" , size = 10 )
scattter_plot.set_ylabel( "Average Business Stars" , size = 10 )
plt.tight_layout()
plt.show()
%matplot plt
```



In [45]:
```
correlation = new_scatplot['avg(stars)']. corr(new_scatplot['avg(average_stars)'
print ('The following is the correlation between Elite Avg Star and Average Star
```

```
The following is the correlation between Elite Avg Star and Average Stars: 0.809
5213594120078
```

In [ ]:
```
# Although the graph is too cluttered to make an accurate read of the correlatio
#Using the correlation calculation, there is a strong postitive correlation betw
#do make a difference in the average rating of a business
```