STA 220 Assignment 1

Due **January 26, 2024** by **11:59pm**. Submit your work by uploading it to Gradescope through Canvas.

Instructions:

1. Provide your solutions in new cells following each exercise description. Create as many new cells as necessary. Use code cells for your Python scripts and Markdown cells for explanatory text or answers to non-coding questions. Answer all textual questions in complete sentences.
2. The use of assistive tools is permitted, but must be indicated. You will be graded on you proficiency in coding. Produce high quality code by adhering to proper programming principles.
3. Export the .jpynb as .pdf and submit it on Gradescope in time. To facilitate grading, indicate the area of the solution on the submission. Submissions without indication will be marked down. No late submissions accepted.
4. If test cases are given, your solution must be in the same format.
5. The total number of points is 10.

Exercise 1

Answer the following questions by querying Lahman Baseball Database. The 2019 version together with the description (`readme2019.txt`) are on Piazza. Answer the following questions.

The purpose of this assignment is to practice accessing and analyzing data in a database. For full credit for (a) and (b), query the correct table with `pandas.read_sql` and a single SQL query. Unless otherwise specified, return in the same format of the test case.

(a, i) Which pitcher has the second most home runs allowed in the American League? **(ii)** Which pitcher has the worst home runs allowed per game ratio?

In [ ]:
```
import pandas as pd
import sqlite3 as sql
import numpy as np
from re import sub
import geopandas
import matplotlib.pyplot as plt
```

In [ ]:
```
db = sql.connect("../Data/lahmansbaseballdb.sqlite")
```

In [ ]:
```
# most home runs allowed in the American League:
result = pd.read_sql("""SELECT nameFirst, nameLast, sum(hr) as HR FROM Pitching as
                        LEFT JOIN People as p
                        on pi.playerID = p.playerID
                        WHERE lgID = 'AL'
                        GROUP BY pi.playerID
                        ORDER BY sum(hr) DESC
                        LIMIT 1
                        OFFSET 1""", db).squeeze()
print(result['nameFirst'] + " " + result['nameLast'] + " (" + str(result["HR"]) + "
```

```
Tim Wakefield (401)
```

In [ ]:
```
result = pd.read_sql("""SELECT nameFirst, nameLast, SUM(HR) as HRS, TOTAL(HR) as HR
                        LEFT JOIN People as p
                        on pi.playerID = p.playerID
                        WHERE lgID = 'AL'
                        GROUP BY pi.playerID
                        ORDER BY RATIO DESC
                        LIMIT 1""", db ).squeeze()
print(result['nameFirst'] + " " + result['nameLast'] + " (" + str(result["Ratio"])
```

```
Ryan Snare (3.0)
```

(b, i) Amongst all players in the American League that have passed, report their average lifespan in full years. **(ii)** Return the six schools with most hall-of-fame alumni. **(iii)** What fraction of managers have not been professional players?

In [ ]:
```
# average lifespan for passed players in the National League
result = pd.read_sql("""SELECT AVG(deathYear - birthYear) as avglifespan FROM Peopl
                        WHERE deathYear IS NOT NULL""", db).squeeze()
print(round(result))
```

```
68
```

In [ ]:
```
#Six schools with most hall-of-fame alumni
result = pd.read_sql("""SELECT Sc.name_full, COUNT(HoF.playerID) as Count FROM Hall
                        INNER JOIN CollegePlaying as CP
                        ON HoF.playerID = CP.playerID
                        INNER JOIN Schools as Sc
                        ON CP.schoolID = Sc.schoolID
                        WHERE inducted = 'Y'
                        GROUP BY CP.schoolID
                        ORDER BY COUNT(HoF.playerID) DESC
                        LIMIT 6""", db).squeeze()
print(result)
```

```
                         name_full  Count
0         St. Bonaventure University      7
1             University of Michigan      6
2           University of Minnesota      6
3  University of Southern California      6
4         San Diego State University      5
5              University of Alabama      4
```

In [ ]:
```
#What fractions of managers not been professional players
result = pd.read_sql("""SELECT CAST(COUNT(DISTINCT m.playerID) AS float)/(SELECT CO
                     FROM Managers as m
                     INNER JOIN Batting as b
                     ON  m.playerID = b.playerID
                     INNER JOIN pitching as p
                     ON b.playerID = p.playerID
                     INNER JOIN Fielding as f
                     ON p.playerID = f.playerID
                     WHERE m.playerID NOT IN (b.playerID OR p.playerID OR f.playerI
print(1 - result)
```

```
      RATIO
0  0.794118
```

(c) Create a world map with a color gradient corresponding to the log-number of players per country in the data set. Use `pandas.read_html` to retrieve the ISO codes from wikipedia, and merge those records as good as you can. Match no more than ten countries to their ISOs manually.

In [ ]:
```
url = 'https://en.wikipedia.org/wiki/List_of_ISO_3166_country_codes'
table = pd.read_html(url)
```

In [ ]:
```
countries = table[0][1:]
countries
```

Out[ ]:

	ISO 3166[1]	Unnamed: 1_level_0	Unnamed: 2_level_0	ISO 3166-1[2]			ISO 3166-2[3]	Unnamed: 7_level_0
	Country name[5]	Official state name per the World Factbook[6][a]	Sovereignty [6][7][8]	A-2 [5]	A-3 [5]	N.c. [5]	Subdivision code links[3]	TLD [9]
1	Afghanistan	The Islamic Republic of Afghanistan	UN member state	.mw-parser-output .monospaced{font-family:mono...	AFG	004	ISO 3166-2:AF	.af
2	Åland Islands	Åland	Finland	AX	ALA	248	ISO 3166-2:AX	.ax
3	Albania	The Republic of Albania	UN member state	AL	ALB	008	ISO 3166-2:AL	.al
4	Algeria	The People's Democratic Republic of Algeria	UN member state	DZ	DZA	012	ISO 3166-2:DZ	.dz
5	American Samoa	The Territory of American Samoa	United States	AS	ASM	016	ISO 3166-2:AS	.as
...	...	...	...	...	...	...	...	...
267	Wallis and Futuna	The Territory of the Wallis and Futuna Islands	France	WF	WLF	876	ISO 3166-2:WF	.wf
268	Western Sahara [aj]	The Sahrawi Arab Democratic Republic	Disputed [ak]	EH	ESH	732	ISO 3166-2:EH	[al]
269	Yemen	The Republic of Yemen	UN member state	YE	YEM	887	ISO 3166-2:YE	.ye
270	Zambia	The Republic of Zambia	UN member state	ZM	ZMB	894	ISO 3166-2:ZM	.zm
271	Zimbabwe	The Republic of Zimbabwe	UN member state	ZW	ZWE	716	ISO 3166-2:ZW	.zw

271 rows × 8 columns

In [ ]:
```
def remove(string):
    '''
    Removes everything inside [], a whitespace before that and *'s.
    '''
    if isinstance(string, str):
        string = sub(r'\s*\[.*\]\**', '', string)
    return string

countries = countries.applymap(remove)

country_name = countries.iloc[:,0]
country_iso = countries.iloc[:,4]

country = pd.DataFrame({"Country":country_name, "ISO":country_iso})
country['Country'] = country['Country'].str.replace(r'\([^)]*\)', '', regex=True)
country['Country'] = country['Country'].str.strip()
country['Country'].replace('Curaçao', 'Curacao', inplace=True)
```

In [ ]:
```
country_df = pd.read_sql("""SELECT birthCountry, COUNT(birthCountry) FROM People
                     GROUP BY birthCountry
                     ORDER BY COUNT(birthCountry) DESC""", db)
country_df.columns = ['Country', 'Frequency']
country_df['log_freq'] = np.log(country_df['Frequency'])
country_df

full_df = country_df.merge(country, how='left', on = "Country")
```

```
c:\Users\alanp\anaconda3\Lib\site-packages\pandas\core\arraylike.py:396: RuntimeWar
ning: divide by zero encountered in log
  result = getattr(ufunc, method)(*inputs, **kwargs)
```

In [ ]:
```
df_all_countries = full_df.drop(full_df.tail(1).index)
df_all_countries
```

Out[ ]:

	Country	Frequency	log_freq	ISO
0	USA	17254	9.755799	NaN
1	D.R.	761	6.634633	NaN
2	Venezuela	408	6.011267	VEN
3	P.R.	268	5.590987	NaN
4	CAN	255	5.541264	NaN
5	Cuba	218	5.384495	CUB
6	Mexico	129	4.859812	MEX
7	Japan	67	4.204693	JPN
8	Panama	63	4.143135	PAN
9	United Kingdom	51	3.931826	NaN
10	Ireland	50	3.912023	IRL
11	Germany	45	3.806662	DEU
12	Australia	31	3.433987	AUS
13	Colombia	24	3.178054	COL
14	South Korea	23	3.135494	NaN
15	Taiwan	16	2.772589	TWN
16	Nicaragua	15	2.708050	NIC
17	Curacao	15	2.708050	CUW
18	V.I.	14	2.639057	NaN
19	Netherlands	12	2.484907	NaN
20	Russia	9	2.197225	NaN
21	Italy	7	1.945910	ITA
22	France	7	1.945910	FRA
23	Czech Republic	6	1.791759	NaN
24	Bahamas	6	1.791759	BHS
25	Poland	5	1.609438	POL
26	Brazil	5	1.609438	BRA
27	Aruba	5	1.609438	ABW
28	Sweden	4	1.386294	SWE
29	Spain	4	1.386294	ESP
30	Jamaica	4	1.386294	JAM
31	Austria	4	1.386294	AUT
32	Norway	3	1.098612	NOR

	Country	Frequency	log_freq	ISO
33	South Africa	2	0.693147	ZAF
34	Saudi Arabia	2	0.693147	SAU
35	Honduras	2	0.693147	HND
36	Guam	2	0.693147	GUM
37	Viet Nam	1	0.000000	VNM
38	Switzerland	1	0.000000	CHE
39	Slovakia	1	0.000000	SVK
40	Singapore	1	0.000000	SGP
41	Portugal	1	0.000000	PRT
42	Philippines	1	0.000000	PHL
43	Peru	1	0.000000	PER
44	Lithuania	1	0.000000	LTU
45	Latvia	1	0.000000	LVA
46	Indonesia	1	0.000000	IDN
47	Hong Kong	1	0.000000	HKG
48	Greece	1	0.000000	GRC
49	Finland	1	0.000000	FIN
50	Denmark	1	0.000000	DNK
51	China	1	0.000000	CHN
52	Belize	1	0.000000	BLZ
53	Belgium	1	0.000000	BEL
54	At Sea	1	0.000000	NaN
55	American Samoa	1	0.000000	ASM
56	Afghanistan	1	0.000000	AFG

In [ ]:
```
df_all_countries.iloc[0,3]= 'USA'
df_all_countries.iloc[1,3]= 'DOM'
df_all_countries.iloc[3,3]= 'PRI'
df_all_countries.iloc[4,3]= 'CAN'
df_all_countries.iloc[9,3]= 'GBR'
df_all_countries.iloc[14,3]= 'KOR'
df_all_countries.iloc[18,3]= 'VIR'
df_all_countries.iloc[19,3]= 'NLD'
df_all_countries.iloc[20,3]= 'RUS'
df_all_countries.iloc[23,3]= 'CZE'
```

In [ ]:
```
df_all_countries_greater = df_all_countries[df_all_countries["log_freq"] > 0]
print(sum(df_all_countries_greater['ISO'].isna()))
```

```
0
```

In [ ]:
```
df_all_countries_greater
```

Out[ ]:

	Country	Frequency	log_freq	ISO
0	USA	17254	9.755799	USA
1	D.R.	761	6.634633	DOM
2	Venezuela	408	6.011267	VEN
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	Country	Frequency	log_freq	ISO
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36	Guam	2	0.693147	GUM

In [ ]:
```
world = geopandas.read_file(geopandas.datasets.get_path('naturalearth_lowres'))
```

```
C:\Users\alanp\AppData\Local\Temp\ipykernel_67060\3939914640.py:1: FutureWarning: T
he geopandas.dataset module is deprecated and will be removed in GeoPandas 1.0. You
can get the original 'naturalearth_lowres' data from https://www.naturalearthdata.c
om/downloads/110m-cultural-vectors/.
  world = geopandas.read_file(geopandas.datasets.get_path('naturalearth_lowres'))
```

In [ ]:
```
world.head()
```

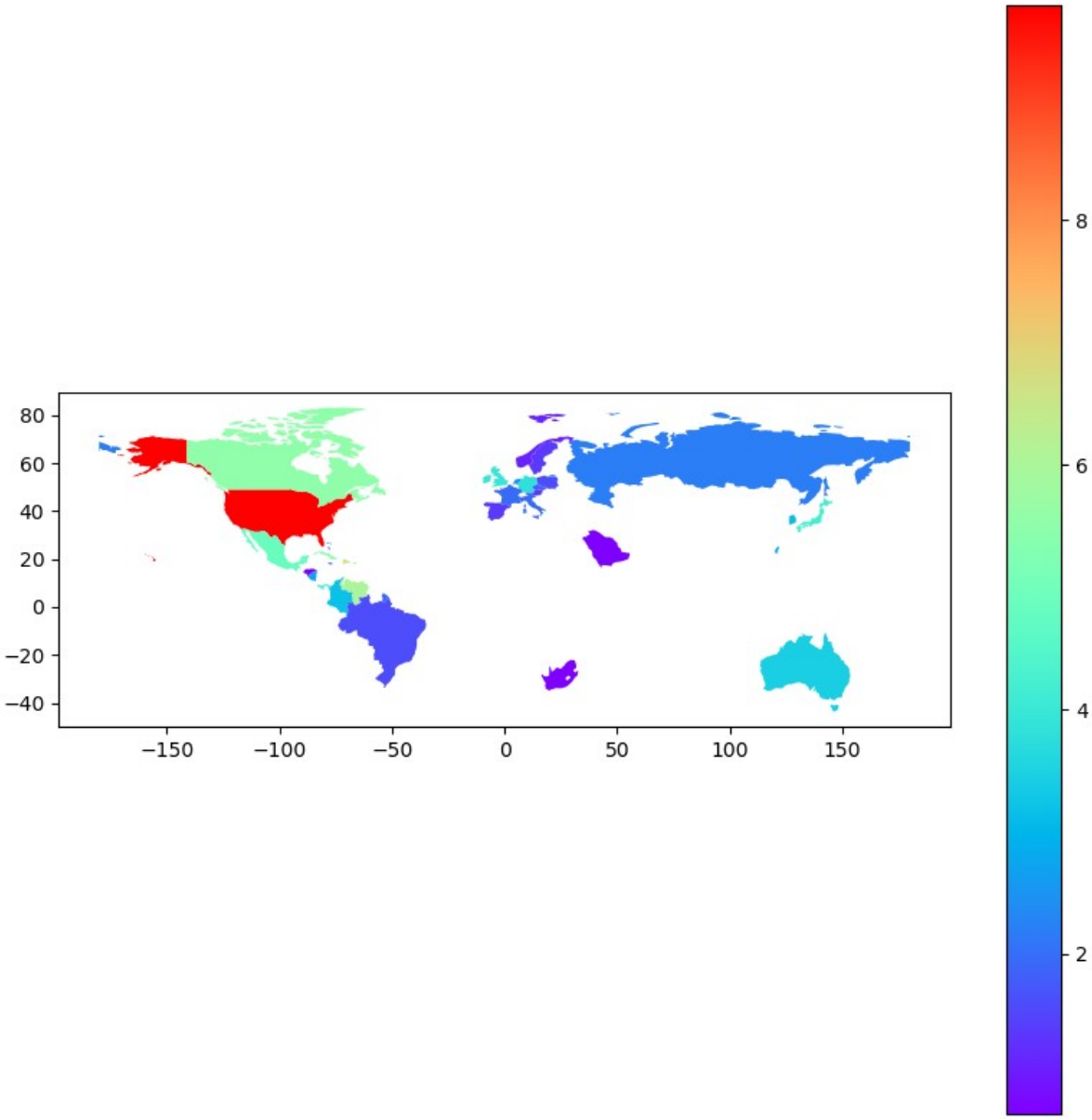
Out[ ]:

	pop_est	continent	name	iso_a3	gdp_md_est	geometry
0	889953.0	Oceania	Fiji	FJI	5496	MULTIPOLYGON (((180.00000 -16.06713, 180.00000...
1	58005463.0	Africa	Tanzania	TZA	63177	POLYGON ((33.90371 -0.95000, 34.07262 -1.05982...
2	603253.0	Africa	W. Sahara	ESH	907	POLYGON ((-8.66559 27.65643, -8.66512 27.58948...
3	37589262.0	North America	Canada	CAN	1736425	MULTIPOLYGON (((-122.84000 49.00000, -122.9742...
4	328239523.0	North America	United States of America	USA	21433226	MULTIPOLYGON (((-122.84000 49.00000, -120.0000...

In [ ]:
```
geo = df_all_countries_greater.merge(world, how='left', left_on='ISO',right_on = 'i
geo = geopandas.GeoDataFrame(geo, crs='EPSG:4326', geometry='geometry')
```

In [ ]:
```
fig, ax = plt.subplots(figsize=(10,10))
geo.plot(ax=ax, column='log_freq', cmap='rainbow', legend=True)
```

Out[ ]:
```
<Axes: >
```


80
60
40
20
0
−20
−40
−150
−100
−50
0
50
100
150
8
6
4
2

In [ ]:
```
"""import plotly.graph_objects as go

fig = go.Figure(data=go.Choropleth(
    locations = df_all_countries_greater['ISO'],
    z = df_all_countries_greater['log_freq'],
    text = df_all_countries_greater['Country'],
    colorscale = 'Ice',
    autocolorscale=False,
    reversescale=True,
    marker_line_color='darkgray',
    marker_line_width=0.5,
    colorbar_title = 'Log_Frequency of Players born in Country',
))

fig.update_layout(
    width=10,
    height=10,
    geo=dict(
        showframe=False,
        showcoastlines=False,
        projection_type='equirectangular'
    )
)
static_image = fig.to_image(format='jpg')
fig.write_image("../images/img1.jpg")
"""
```

Out[ ]:
```
'import plotly.graph_objects as go\n\nfig = go.Figure(data=go.Choropleth(\n    loca
tions = df_all_countries_greater[\'ISO\'],\n    z = df_all_countries_greater[\'log_
freq\'],\n    text = df_all_countries_greater[\'Country\'],\n    colorscale = \'Ice
\',\n    autocolorscale=False,\n    reversescale=True,\n    marker_line_color=\'dar
kgray\',\n    marker_line_width=0.5,\n    colorbar_title = \'Log_Frequency of Playe
rs born in Country\',\n))\n\nfig.update_layout(\n    width=10,\n    height=10,\n
geo=dict(\n        showframe=False,\n        showcoastlines=False,\n        project
ion_type=\'equirectangular\'\n    )\n)\nstatic_image = fig.to_image(format=\'jpg\')
\nfig.write_image("../images/img1.jpg")\n'
```

Exercise 2

We will use the lichess API to retrieve some information about the current state of chess in the world. In order to answer below questions, make precise and economical requests. You may use:

```
import requests
import json
import pandas

from datetime import datetime
```

In [ ]:
```
import requests
import json
import pandas
from datetime import datetime as dt
```

(a) What is the real name of the leader of the blitz leaderboard?

In [ ]:
```
url = 'https://lichess.org/api/player/top/1/blitz'
response = requests.get(url)
username = response.json()['users'][0]['username']

response2 = requests.get(f"https://lichess.org/api/user/{username}")
first_name = response2.json()['profile']['firstName']
last_name = response2.json()['profile']['lastName']

print(f"The real name of the top 1 player in blitz chess is {first_name}, {last_nam
```

```
The real name of the top 1 player in blitz chess is Vladislav, Artemiev
```

(b, i) Get the username of the last player that played a rapid game against user `athena-pallada` . **(ii)** In all games against this user, how many times did `athena-pallada` win? *(Provide code that answers the question in case more than just a single game is returned)*

In [ ]:
```
#Request the information
url = 'https://lichess.org/api/games/user/athena-pallada'
response = requests.get(url, params={'max': '1',
                                     'perfType':'rapid'},
                                headers={"Accept":"application/x-ndjson"})
```

In [ ]:
```
#Turn it into json and start to filter until I find opponent
game = response.json()
opponent = game['players']['black']['user']['name']
#print the username
print(f"The last player that played a rapid game against user athena-pallada is {op
```

```
The last player that played a rapid game against user athena-pallada is Bacio129
```

In [ ]:
```
response = requests.get(url, params = {"vs": f"{opponent}"},
                                headers={"Accept":"application/x-ndjson"})
json_data = [json.loads(line) for line in response.iter_lines(decode_unicode=True)
```

In [ ]:
```
wins = 0
for i in np.arange(2):
    winner = json_data[i]['winner']
    if json_data[i]['players'][f"{winner}"]['user']['name'] == "athena-pallada":
        wins += 1
print(f"athena-pallada won {wins} times against Bacio129")
```

```
athena-pallada won 2 times against Bacio129
```

(c) Consider the top ten players in the bullet leaderboard. **(i)** Which player has the most bullet games overall? **(ii)** Which player has played the most bullet games relative to account age in days? **(iii)** Which player has the worst win-to-loss ratio over all formats?

In [ ]:
```
#Create empty dataframe to store data
df_top_ten = pd.DataFrame({'UserName':[],'Games':[]})
#get top 10 blitz players
url = "https://lichess.org/api/player/top/10/blitz"
response = requests.get(url)
response.json()

for i in np.arange(10):
    username = response.json()['users'][i]['id']
    url2 = f"https://lichess.org/api/user/{username}"
    response2 = requests.get(url2)
    account_age = (pd.to_datetime('now') - pd.to_datetime(response2.json()['created
    wins = response2.json()['count']['win']
    loss = response2.json()['count']['loss']
    draw = response2.json()['count']['draw']
    dictionary = pd.Series({'UserName':username, 'Games':response2.json()['perfs'][
                            'Wins':wins, 'Loss':loss, 'Draws':draw })
    df_top_ten = pd.concat([df_top_ten, dictionary.to_frame().T], ignore_index=True

name = df_top_ten.sort_values(by='Games', ascending=False).iloc[0,0]
num_games = df_top_ten.sort_values(by='Games', ascending=False).iloc[0,1]
print(f"The person with the highest number of blitz games in the top 10 leader boar
```

```
The person with the highest number of blitz games in the top 10 leader board is ath
ena-pallada, with 7669 games
```

In [ ]:
```
df_top_ten['games/age'] = df_top_ten['Games']/df_top_ten['Account_Age']
name = df_top_ten.sort_values(by='games/age', ascending=False).iloc[0,0]
ratio = df_top_ten.sort_values(by='games/age', ascending=False).iloc[0,3]
print(f"The person with the most games relative to their age is {name}, with a rati
```

```
The person with the most games relative to their age is lintchevski_daniil, with a
ratio of 1440
```

In [ ]:
```
df_top_ten['win/loss'] = df_top_ten['Wins']/df_top_ten['Loss']
name = df_top_ten.sort_values(by='win/loss', ascending=False).iloc[0,0]
ratio = df_top_ten.sort_values(by='win/loss', ascending=False).iloc[0,6]
print(f"The person with the highest win/loss ratio is {name}, with a ratio of {rati
```

```
The person with the highest win/loss ratio is konevlad, with a ratio of 1.203651685
3932584
```

(d) Get all games from user `manwithavan` . Group them by opening and print the ten most popular.

In [ ]:
```
url = 'https://lichess.org/api/games/user/manwithavan'
response = requests.get(url, params = {'opening':True}, headers = {"Accept":"applic
json_data = [json.loads(line) for line in response.iter_lines(decode_unicode=True)
```

In [ ]:
```
opening_list = []
for i in np.arange(len(json_data)):
    try:
        opening_list.append(json_data[i]['opening']['name'])
    except:
        pass

opening = pd.DataFrame(opening_list, columns=['openings'])
```

In [ ]:
```
top_openings = pd.DataFrame(opening.value_counts())
top_openings.head(10)
```

Out[ ]:

openings	count
Nimzo-Larsen Attack: Modern Variation	7
Van't Kruijs Opening	7
Mieses Opening	6
Pirc Defense	6
Nimzo-Larsen Attack	5
Zukertort Opening: Kingside Fianchetto	5
Modern Defense	5
Queen's Pawn Game	5
Zukertort Opening: Queenside Fianchetto Variation	5
Caro-Kann Defense: Breyer Variation	5