Sprint 6 Task 1 (S06_T01)

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Level 1

Practice 1

Grab a sports theme dataset you like and select an attribute from the dataset. Calculate the mode, median, standard deviation, and arithmetic mean.

To solve this practice we start by **importing** all the required libraries:

In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from scipy import stats
import statistics
```

For this practice, I'm going to use data from the ATP (Association of Professional Tennis) matches from the year 2018, the same one I used for Sprint 5.
In this data set, the winner and loser are coded with an ID. We have another dataset that references this ID with player information.

For the matches dataset we have the following column reference:

- ace = absolute number of aces
- df = number of double faults
- svpt = total serve points
- 1stin = 1st serve in
- 1stwon = points won on 1st serve
- 2ndwon = points won on 2nd serve
- SvGms = serve games
- bpSaved = break point saved
- bpFaced = break point faced

source: https://www.kaggle.com/datasets/pablodroca/atp-tennis-matches-20002019?select=atp_matches_2019.csv

In [2]:
```
ranking = pd.read_csv('atp_matches_2018.csv') # matches 2018
players = pd.read_csv('atp_players.csv') # players information
```

In [3]:
```
pd.set_option('display.max_columns', 50)
ranking.sample(5)
```

Out[3]:

	tourney_id	tourney_name	tourney_date	surface	winner_id	loser_id	score	best_of	round	minutes	w_ace	w_df	w_svpt	w_1stIn
183	2018-580	Australian Open	20180115	Hard	111202	104999	6-2 4-1 RET	5	R128	48.0	3.0	2.0	35.0	21.0
2768	2018-0328	Basel	20181022	Hard	104468	105208	7-6(4) 7-6(0)	3	R16	136.0	4.0	4.0	76.0	38.0
2734	2018-0429	Stockholm	20181015	Hard	104259	104269	4-6 7-5 7-6(5)	3	R16	165.0	10.0	0.0	112.0	67.0
2045	2018-0319	Kitzbuhel	20180730	Clay	104797	104259	5-7 6-3 6-1	3	R16	129.0	6.0	6.0	93.0	64.0
92	2018-0301	Auckland	20180108	Hard	105449	132482	7-5 7-6(4)	3	R32	104.0	12.0	1.0	78.0	43.0

In [4]:
```
ranking.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 2889 entries, 0 to 2888
Data columns (total 32 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   tourney_id          2889 non-null   object
 1   tourney_name        2889 non-null   object
 2   tourney_date        2889 non-null   int64
 3   surface             2889 non-null   object
 4   winner_id           2889 non-null   int64
 5   loser_id            2889 non-null   int64
 6   score               2889 non-null   object
 7   best_of             2889 non-null   int64
 8   round               2889 non-null   object
 9   minutes             2854 non-null   float64
 10  w_ace               2863 non-null   float64
 11  w_df                2863 non-null   float64
 12  w_svpt              2863 non-null   float64
 13  w_1stIn             2863 non-null   float64
 14  w_1stWon            2863 non-null   float64
 15  w_2ndWon            2863 non-null   float64
 16  w_SvGms             2863 non-null   float64
 17  w_bpSaved           2863 non-null   float64
 18  w_bpFaced           2863 non-null   float64
 19  l_ace               2863 non-null   float64
 20  l_df                2863 non-null   float64
 21  l_svpt              2863 non-null   float64
 22  l_1stIn             2863 non-null   float64
 23  l_1stWon            2863 non-null   float64
 24  l_2ndWon            2863 non-null   float64
 25  l_SvGms             2863 non-null   float64
 26  l_bpSaved           2863 non-null   float64
 27  l_bpFaced           2863 non-null   float64
 28  winner_rank         2882 non-null   float64
 29  winner_rank_points  2882 non-null   float64
 30  loser_rank          2858 non-null   float64
 31  loser_rank_points   2858 non-null   float64
dtypes: float64(23), int64(4), object(5)
memory usage: 722.4+ KB
```

In [5]:
```
players.head()
```

Out[5]:

	player_id	name_first	name_list	hand	birthdate	country
0	100001	Gardnar	Mulloy	R	19131122.0	USA
1	100002	Pancho	Segura	R	19210620.0	ECU
2	100003	Frank	Sedgman	R	19271002.0	AUS
3	100004	Giuseppe	Merlo	R	19271011.0	ITA
4	100005	Richard Pancho	Gonzales	R	19280509.0	USA

In [6]:
```
players.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 54067 entries, 0 to 54066
Data columns (total 6 columns):
 #   Column      Non-Null Count  Dtype
---  ------      --------------  -----
 0   player_id   54067 non-null  int64
 1   name_first  53890 non-null  object
 2   name_list   54025 non-null  object
 3   hand        48289 non-null  object
 4   birthdate   43099 non-null  float64
 5   country     54067 non-null  object
dtypes: float64(1), int64(1), object(4)
memory usage: 2.5+ MB
```

I want to merge both dataframes in order to replace in **matches** the **winner_id** and **loser_id** with actual name and contry from **players**.

In [7]:
```
# new column for players with joined name

players['player'] =  players ['name_list'] + ', ' + players['name_first']
```

In [8]:
```
# merge dataframes, first winner and then loser

winners = pd.merge(ranking, players.loc[:, ['player_id', 'country', 'player']],
                   left_on=['winner_id'], right_on=['player_id']).drop(columns = ['winner_id', 'player_id'])

atp_2018 = pd.merge(winners, players.loc[:, ['player_id', 'country', 'player']], how= 'inner',
                    left_on=['loser_id'], right_on=['player_id']).drop(columns = ['loser_id', 'player_id'])
```

In [9]:
```
# reorder and rename columns

atp_2018 = atp_2018[['tourney_id', 'tourney_name', 'tourney_date', 'surface', 'player_x', 'country_x',  'player
                     'country_y', 'score', 'best_of', 'round', 'minutes', 'w_ace', 'w_df', 'w_svpt', 'w_1stIn',
                     'w_1stWon', 'w_2ndWon', 'w_SvGms', 'w_bpSaved', 'w_bpFaced', 'l_ace', 'l_df', 'l_svpt', 'l_1st
                     'l_1stWon', 'l_2ndWon', 'l_SvGms', 'l_bpSaved', 'l_bpFaced', 'winner_rank', 'winner_rank_point
                     'loser_rank', 'loser_rank_points']]

atp_2018.rename(columns={'player_x': 'winner', 'country_x': 'country_winner',
                         'player_y': 'loser', 'country_y': 'country_loser' }, inplace=True)
```

In [10]:
```
atp_2018.head()
```

Out[10]:

	tourney_id	tourney_name	tourney_date	surface	winner	country_winner	loser	country_loser	score	best_of	round	minutes
0	2018-M020	Brisbane	20180101	Hard	Harrison, Ryan	USA	Mayer, Leonardo	ARG	6-4 3-6 6-2	3	R32	123.0
1	2018-6242	Winston Salem	20180820	Hard	Edmund, Kyle	GBR	Mayer, Leonardo	ARG	6-3 6-3	3	R32	72.0
2	2018-M016	Eastbourne	20180625	Grass	Millman, John	AUS	Mayer, Leonardo	ARG	7-6(7) 7-6(4)	3	R16	121.0
3	2018-M007	Miami Masters	20180319	Hard	Coric, Borna	CRO	Mayer, Leonardo	ARG	6-7(5) 6-3 6-4	3	R64	176.0
4	2018-0414	Hamburg	20180723	Clay	Basilashvili, Nikoloz	RUS	Mayer, Leonardo	ARG	6-4 0-6 7-5	3	F	132.0

In [11]:
```
atp_2018.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 2889 entries, 0 to 2888
Data columns (total 34 columns):
 #   Column              Non-Null Count  Dtype
---  ------              --------------  -----
 0   tourney_id          2889 non-null   object
 1   tourney_name        2889 non-null   object
 2   tourney_date        2889 non-null   int64
 3   surface             2889 non-null   object
 4   winner              2889 non-null   object
 5   country_winner      2889 non-null   object
 6   loser               2889 non-null   object
 7   country_loser       2889 non-null   object
 8   score               2889 non-null   object
 9   best_of             2889 non-null   int64
 10  round               2889 non-null   object
 11  minutes             2854 non-null   float64
 12  w_ace               2863 non-null   float64
 13  w_df                2863 non-null   float64
 14  w_svpt              2863 non-null   float64
 15  w_1stIn             2863 non-null   float64
 16  w_1stWon            2863 non-null   float64
 17  w_2ndWon            2863 non-null   float64
 18  w_SvGms             2863 non-null   float64
 19  w_bpSaved           2863 non-null   float64
 20  w_bpFaced           2863 non-null   float64
 21  l_ace               2863 non-null   float64
 22  l_df                2863 non-null   float64
 23  l_svpt              2863 non-null   float64
 24  l_1stIn             2863 non-null   float64
 25  l_1stWon            2863 non-null   float64
 26  l_2ndWon            2863 non-null   float64
 27  l_SvGms             2863 non-null   float64
 28  l_bpSaved           2863 non-null   float64
 29  l_bpFaced           2863 non-null   float64
 30  winner_rank         2882 non-null   float64
 31  winner_rank_points  2882 non-null   float64
 32  loser_rank          2858 non-null   float64
 33  loser_rank_points   2858 non-null   float64
dtypes: float64(23), int64(2), object(9)
memory usage: 790.0+ KB
```

Now we have the dataframe as we wanted it!! Let's do the **mode, median, standard deviation, and arithmetic mean** for the number of aces per minute from the winner of the match, It will be new column **w_ace/hour** (since we have matches "to the best of 3 games" and "to the best of 5 games").

Let's see about **NaN** values in **w_ace** and **minutes** columns:

In [12]:
```
atp_2018[atp_2018['w_ace'].isnull() | atp_2018['minutes'].isnull()]
```

Out[12]:

	tourney_id	tourney_name	tourney_date	surface	winner	country_winner	loser	country_loser	score	best_of	round	minutes
61	2018-M001	Sydney	20180108	Hard	Medvedev, Daniil	RUS	De Minaur, Alex	AUS	1-6 6-4 7-5	3	F	133.0
276	2018-5014	Shanghai Masters	20181008	Hard	Cecchinato, Marco	ITA	Chung, Hyeon	KOR	4-6 7-6(5) 7-6(5)	3	R32	NaN
301	2018-5014	Shanghai Masters	20181008	Hard	Bautista Agut, Roberto	ESP	Mcdonald, Mackenzie	USA	3-6 6-4 6-1	3	R32	NaN
309	2018-6242	Winston Salem	20180820	Hard	Harrison, Ryan	USA	Simon, Gilles	FRA	W/O	3	R32	NaN
392	2018-5014	Shanghai Masters	20181008	Hard	Zverev, Alexander	GER	Basilashvili, Nikoloz	RUS	7-5 6-4	3	R32	NaN
395	2018-M-DC-2018-G2-EPA-M-GEO-MAR-01	Davis Cup G2 R1: GEO vs MAR	20180203	Clay	Ouahab, Lamine	ALG	Basilashvili, Nikoloz	RUS	6-1 6-3	3	RR	NaN
456	2018-M006	Indian Wells Masters	20180305	Hard	Raonic, Milos	CAN	Baghdatis, Marcos	CYP	W/O	3	R16	NaN
498	2018-5014	Shanghai Masters	20181008	Hard	Querrey, Sam	USA	Fritz, Taylor Harry	USA	6-3 6-7(4) 7-5	3	R32	NaN
640	2018-5014	Shanghai Masters	20181008	Hard	Edmund, Kyle	GBR	Seppi, Andreas	ITA	6-3 6-4	3	R32	NaN
727	2018-0311	London	20180618	Grass	Lopez, Feliciano	ESP	Raonic, Milos	CAN	W/O	3	R16	NaN
728	2018-0410	Monte Carlo Masters	20180416	Clay	Cilic, Marin	CRO	Raonic, Milos	CAN	W/O	3	R16	NaN
738	2018-0352	Paris Masters	20181029	Hard	Federer, Roger	SUI	Raonic, Milos	CAN	W/O	3	R32	NaN
779	2018-5014	Shanghai Masters	20181008	Hard	De Minaur, Alex	AUS	Paire, Benoit	FRA	6-4 6-3	3	R32	NaN
888	2018-M035	Washington	20180730	Hard	De Minaur, Alex	AUS	Murray, Andy	GBR	W/O	3	QF	NaN
900	2018-0451	Doha	20180101	Hard	Monfils, Gael	FRA	Rublev, Andrey	RUS	6-2 6-3	3	F	60.0
1057	2018-5014	Shanghai Masters	20181008	Hard	Anderson, Kevin	RSA	Kukushkin, Mikhail	KAZ	6-3 6-2	3	R32	NaN
1394	2018-0451	Doha	20180101	Hard	Monfils, Gael	FRA	Thiem, Dominic	AUT	W/O	3	SF	NaN
1476	2018-5014	Shanghai Masters	20181008	Hard	Federer, Roger	SUI	Medvedev, Daniil	RUS	6-4 4-6 6-4	3	R32	NaN
1545	2018-0407	Rotterdam	20180212	Hard	Goffin, David	BEL	Berdych, Tomas	CZE	W/O	3	QF	NaN
1725	2018-0414	Hamburg	20180723	Clay	Jarry, Nicolas	CHI	Gasquet, Richard	FRA	W/O	3	R16	NaN
1729	2018-5014	Shanghai Masters	20181008	Hard	Del Potro, Juan Martin	ARG	Gasquet, Richard	FRA	7-5 7-6(7)	3	R32	NaN
1752	2018-0352	Paris Masters	20181029	Hard	Fognini, Fabio	ITA	Fucsovics, Marton	HUN	W/O	3	R32	NaN
1833	2018-7485	Antwerp	20181015	Hard	Edmund, Kyle	GBR	Ivashka, Ilya	BLR	W/O	3	QF	NaN
1916	2018-M015	Beijing	20181001	Hard	Del Potro, Juan Martin	ARG	Fognini, Fabio	ITA	W/O	3	SF	NaN
2040	2018-M014	Moscow	20181015	Hard	Basic, Mirza	BIH	Kyrgios, Nick	AUS	W/O	3	R16	NaN
2472	2018-5014	Shanghai Masters	20181008	Hard	Tsitsipas, Stefanos	GRE	Khachanov, Karen	RUS	6-4 7-6(8)	3	R32	NaN
2494	2018-M-DC-2018-G2-EPA-M-SLO-POL-01	Davis Cup G2 R1: SLO vs POL	20180203	Hard	Bedene, Aljaz	SLO	Majchrzak, Kamil	POL	6-3 6-4	3	RR	NaN
2637	2018-0337	Vienna	20181022	Hard	Anderson, Kevin	RSA	Melzer, Jurgen	AUT	W/O	3	R16	NaN
2678	2018-5014	Shanghai Masters	20181008	Hard	Nishikori, Kei	JPN	Wu, Yibing	CHN	3-6 6-0 6-3	3	R32	NaN
2757	2018-M-DC-2018-G1-AM-M-COL-BRA-01	Davis Cup G1 R2: COL vs BRA	20180406	Hard	Gonzalez, Alejandro	COL	Sorgi, Joao Pedro	BRA	6-3 7-6(0)	3	RR	NaN
2776	2018-M-DC-2018-G2-AM-M-BOL-PER-01	Davis Cup G2 R1: BOL vs PER	20180203	Clay	Panta Herreros, Jorge Brian	PER	Mendoza, Alejandro	BOL	6-2 6-4	3	RR	NaN
2777	2018-M-DC-2018-G2-AM-M-BOL-PER-01	Davis Cup G2 R1: BOL vs PER	20180203	Clay	Chavez Villalpando, Luis Diego	ESP	Echazu, Mauricio	PER	6-3 3-6 [10-8]	3	RR	NaN
2792	2018-M-DC-2018-G2-EPA-M-IRL-DEN-01	Davis Cup G2 R1: IRL vs DEN	20180203	Hard	Hess Olesen, Soren	DEN	Carr, Simon	IRL	2-6 6-2 [10-8]	3	RR	NaN
2804	2018-M-DC-2018-G2-AO-M-LBN-TPE-01	Davis Cup G2 R1: LBN vs TPE	20180203	Hard	Chen, Ti	TPE	Ballout, Jad	TPE	6-1 6-1	3	RR	NaN
2826	2018-M-DC-2018-G2-EPA-M-SLO-POL-01	Davis Cup G2 R1: SLO vs POL	20180203	Hard	Hurkacz, Hubert	POL	Kocevar Desman, Tom	SLO	6-3 6-2	3	RR	NaN
2840	2018-M-DC-2018-G2-EPA-M-TUN-FIN-01	Davis Cup G2 R1: TUN vs FIN	20180203	Hard	Heliovaara, Harri	FIN	Chargui, Moez	TUN	3-6 6-4 6-4	3	RR	NaN
2843	2018-M-DC-2018-G2-EPA-M-TUR-ZIM-01	Davis Cup G2 R1: TUR vs ZIM	20180203	Hard	Agabigun, Sarp	TUR	Sibanda, Mehluli Don Ayanda	ZIM	7-5 6-4	3	RR	NaN

Half of these rows are W/O (walk over) matches in **score** column. This means matches that have not been played or finished early due to some problem. Some other rows are from matches in early stages of the tournament where no data has been collected. We could fill these NaN values with the mean from the rest, but early stages of a tournament indicates """"not so good players"""" (among a lot of quotes) and it might not be a good idea to replace them with the average aces of winners in advenced stages of the tournament. Both these rows are missing **w_ace** and **minutes** data.

Conclusion: I'll drop these rows and the remaing ones were only the **minutes** are missing I will fill them with mean. In this case only in matches "to the best of three" are missing the minutes.

In [13]:
```
atp_2018.dropna(subset = ['w_ace'], how = 'any', inplace = True) # rows with NaN values in -w_ace- column
```

In [14]:
```
atp_2018[atp_2018['w_ace'].isnull() | atp_2018['minutes'].isnull()] # rows with NaN in -minutes- column
```

Out[14]:

	tourney_id	tourney_name	tourney_date	surface	winner	country_winner	loser	country_loser	score	best_of	round	minutes
276	2018-5014	Shanghai Masters	20181008	Hard	Cecchinato, Marco	ITA	Chung, Hyeon	KOR	4-6 7-6(5) 7-6(5)	3	R32	NaN
301	2018-5014	Shanghai Masters	20181008	Hard	Bautista Agut, Roberto	ESP	Mcdonald, Mackenzie	USA	3-6 6-4 6-1	3	R32	NaN
392	2018-5014	Shanghai Masters	20181008	Hard	Zverev, Alexander	GER	Basilashvili, Nikoloz	RUS	7-5 6-4	3	R32	NaN
498	2018-5014	Shanghai Masters	20181008	Hard	Querrey, Sam	USA	Fritz, Taylor Harry	USA	6-3 6-7(4) 7-5	3	R32	NaN
640	2018-5014	Shanghai Masters	20181008	Hard	Edmund, Kyle	GBR	Seppi, Andreas	ITA	6-3 6-4	3	R32	NaN
779	2018-5014	Shanghai Masters	20181008	Hard	De Minaur, Alex	AUS	Paire, Benoit	FRA	6-4 6-3	3	R32	NaN
1057	2018-5014	Shanghai Masters	20181008	Hard	Anderson, Kevin	RSA	Kukushkin, Mikhail	KAZ	6-3 6-2	3	R32	NaN
1476	2018-5014	Shanghai Masters	20181008	Hard	Federer, Roger	SUI	Medvedev, Daniil	RUS	6-4 4-6 6-4	3	R32	NaN
1729	2018-5014	Shanghai Masters	20181008	Hard	Del Potro, Juan Martin	ARG	Gasquet, Richard	FRA	7-5 7-6(7)	3	R32	NaN
2472	2018-5014	Shanghai Masters	20181008	Hard	Tsitsipas, Stefanos	GRE	Khachanov, Karen	RUS	6-4 7-6(8)	3	R32	NaN
2678	2018-5014	Shanghai Masters	20181008	Hard	Nishikori, Kei	JPN	Wu, Yibing	CHN	3-6 6-0 6-3	3	R32	NaN

In [15]:
```
grouped_mins = atp_2018.groupby('best_of')['minutes'].mean() # excluding missing values by default
grouped_mins
```

Out[15]:
```
best_of
3     99.371666
5    156.341593
Name: minutes, dtype: float64
```

In [16]:
```
mean_bo3 = round(grouped_mins.loc[3,], 2) # minutes average for matches "to the best of 3"
atp_2018['minutes'].fillna(value = mean_bo3, inplace=True)
```

In [17]:
```
atp_2018[atp_2018['w_ace'].isnull() | atp_2018['minutes'].isnull()]
```

Out[17]:

tourney_id	tourney_name	tourney_date	surface	winner	country_winner	loser	country_loser	score	best_of	round	minutes	w_ace

I will round the new **aces** column without decimals to have a useful **mode** value. Otherwise, the mode would be 0 since the variable **minutes** is a continuous with no repeatability. Let's see:

In [18]:
```
atp_2018['aces'] = (atp_2018['w_ace'] * 60) / atp_2018['minutes'] # new column in hours!

atp_2018.groupby('aces')['minutes'].count()
```

Out[18]:
```
aces
0.000000     91
0.270270      1
0.298507      1
0.306122      1
0.312500      1
             ..
19.245283     1
19.830508     1
20.210526     1
21.428571     1
22.352941     1
Name: minutes, Length: 1177, dtype: int64
```

In [19]:
```
atp_2018['aces'] = round(atp_2018['aces'], 0) # rounded
```

In [20]:
```
atp_2018[atp_2018['aces'].isnull()] # check if there are any NaN values in new column (they shouldn't)
```

Out[20]:

tourney_id	tourney_name	tourney_date	surface	winner	country_winner	loser	country_loser	score	best_of	round	minutes	w_ace

In [21]:
```
atp_2018.sample(10)
atp_2018.to_csv('atp_2018.csv', index = False) # save csv with data handling
```

Mode: the value or values that occurs most often.

In [22]:
```
w_ace_mode = atp_2018.aces.mode()
print(f"Aces from winner mode is {w_ace_mode[0]} per hour of match")
```

```
Aces from winner mode is 2.0 per hour of match
```

In [23]:
```
atp_2018.groupby('aces')['minutes'].count()
```

Out[23]:
```
aces
0.0     137
1.0     353
2.0     488
3.0     441
4.0     361
5.0     293
6.0     225
7.0     164
8.0     116
9.0      77
10.0     64
11.0     45
12.0     30
13.0     22
14.0     19
15.0     10
16.0      8
17.0      3
18.0      2
19.0      1
20.0      2
21.0      1
22.0      1
Name: minutes, dtype: int64
```

Median: the "middle" of a sorted list of numbers.

In [24]:
```
w_ace_median = round(atp_2018.aces.median(), 2)
print(f"Aces from winner median is {w_ace_median} per hour of match")
```

```
Aces from winner median is 4.0 per hour of match
```

Standard Deviation: a measure of how spread out numbers are.

In [25]:
```
w_ace_sd = round(atp_2018.aces.std(), 2)
print(f'Aces from winner standard deviation is {w_ace_sd} per hour of match')
```

```
Aces from winner standard deviation is 3.17 per hour of match
```

Arithmetic Mean: the average of the numbers.

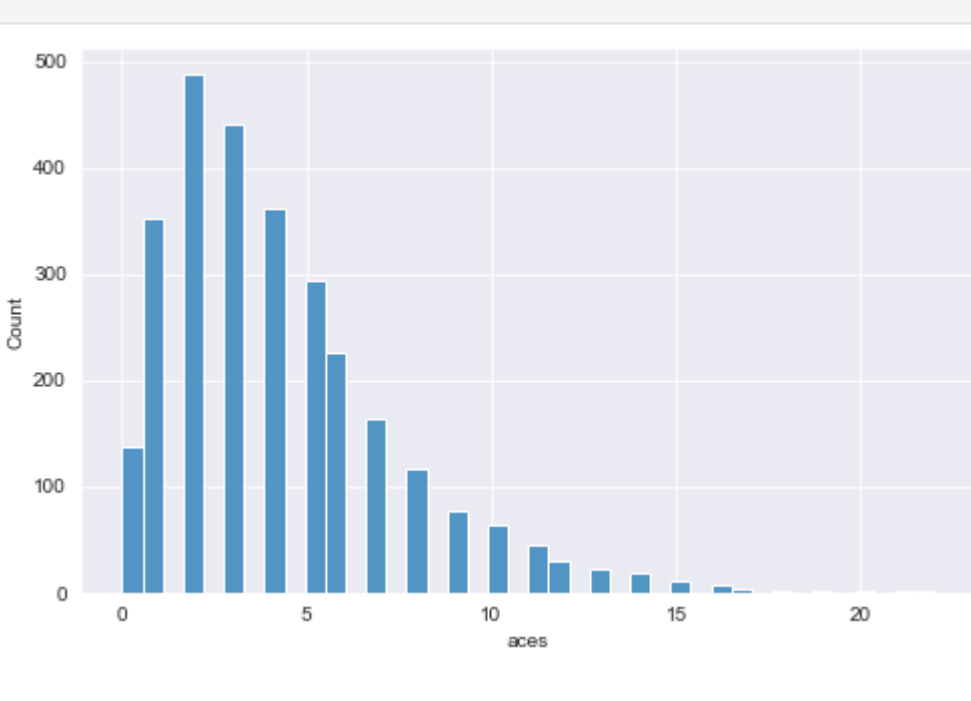
In [26]:
```
w_ace_mean = round(atp_2018.aces.mean(), 2)
print(f'Aces from winner mean is {w_ace_mean} per hour of match')
```

```
Aces from winner mean is 4.26 per hour of match
```

In [27]:
```
atp_2018.aces.describe()
```

Out[27]:
```
count    2863.000000
mean        4.259169
std         3.168994
min         0.000000
25%         2.000000
50%         4.000000
75%         6.000000
max        22.000000
Name: aces, dtype: float64
```

In [28]:
```
sns.set_style('darkgrid')
fig, ax = plt.subplots(figsize = (8, 5))
sns.histplot(data = atp_2018, x = 'aces')
plt.show()
```

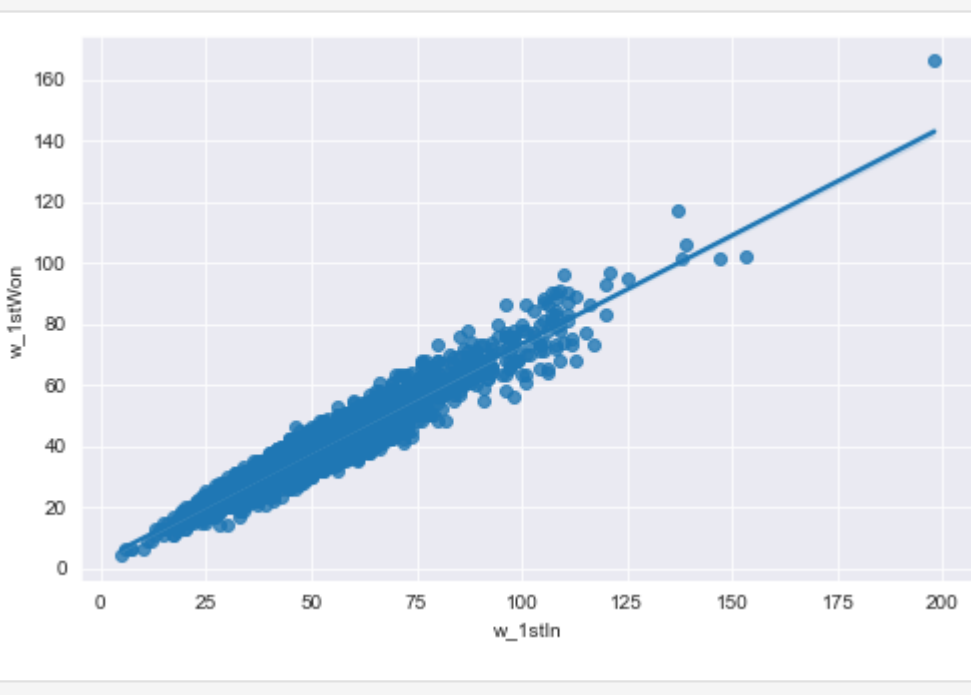


Practice 2

Continuing with the sports topic data, select two attributes and calculate their correlation.

For this practice we are going to study if there is a linear correlation between **w_1stin** (if the match winner's first serve is in) and **w_1stwon** (if the match winner wins the points when his first serve is in).

In [29]:
```
sns.set_style('darkgrid')
fig, ax = plt.subplots(figsize = (8, 5))
sns.regplot(data = atp_2018, x = 'w_1stIn', y = 'w_1stWon')
plt.show()
```



In [30]:
```
corr_1serve = round(atp_2018['w_1stIn'].corr(atp_2018.w_1stWon),2)
print(f'Correlation is = {corr_1serve}')
```

```
Correlation is = 0.96
```

We have a strong correlation between these two variables as expected.

Level 2

Practice 3

Continue with the sports theme data and calculate the correlation of all the attributes with each other and represent them in a matrix with different colors of intensity.

In [31]:
```
m_corr = atp_2018.corr()
m_corr
```

Out[31]:

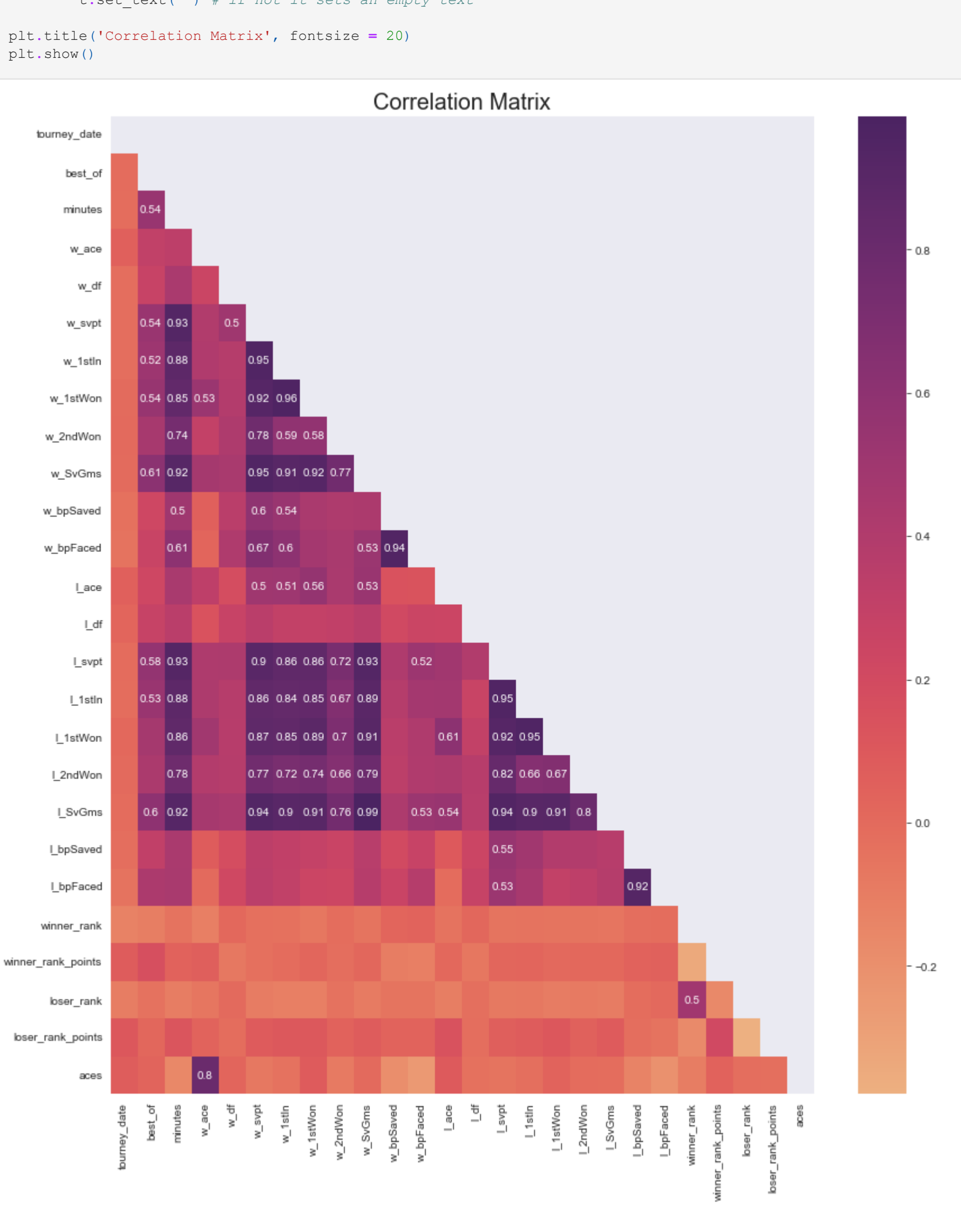
	tourney_date	best_of	minutes	w_ace	w_df	w_svpt	w_1stIn	w_1stWon	w_2ndWon	w_SvGms	w_bpSaved
tourney_date	1.000000	-0.008574	-0.012827	0.056677	-0.020459	-0.018216	-0.020190	-0.000830	0.005194	-0.000169	-0.03645
best_of	-0.008574	1.000000	0.539414	0.304515	0.276776	0.535535	0.516630	0.544029	0.455529	0.613999	0.22717
minutes	-0.012827	0.539414	1.000000	0.332365	0.437339	0.931744	0.879850	0.851796	0.744651	0.916823	0.50496
w_ace	0.056677	0.304515	0.332365	1.000000	0.253984	0.402197	0.409156	0.531201	0.298220	0.468578	0.05479
w_df	-0.020459	0.276776	0.437339	0.253984	1.000000	0.501430	0.378405	0.387648	0.416339	0.444594	0.34917
w_svpt	-0.018216	0.535535	0.931744	0.402197	0.501430	1.000000	0.948638	0.917985	0.776821	0.946403	0.59613
w_1stIn	-0.020190	0.516630	0.879850	0.409156	0.378405	0.948638	1.000000	0.963444	0.588498	0.909590	0.53864
w_1stWon	-0.000830	0.544029	0.851796	0.531201	0.387648	0.917985	0.963444	1.000000	0.579515	0.917655	0.43951
w_2ndWon	0.005194	0.455529	0.744651	0.298220	0.416339	0.776821	0.588498	0.579515	1.000000	0.766735	0.41730
w_SvGms	-0.000169	0.613999	0.916823	0.468578	0.444594	0.946403	0.909590	0.917655	0.766735	1.000000	0.42698
w_bpSaved	-0.036452	0.227174	0.504969	0.054797	0.349178	0.596137	0.538640	0.439512	0.417308	0.426982	1.00000
w_bpFaced	-0.047810	0.264494	0.607579	0.029783	0.411981	0.672171	0.604863	0.472831	0.447466	0.529008	0.94032
l_ace	0.055314	0.225535	0.445721	0.326831	0.179204	0.502972	0.506834	0.561286	0.438093	0.533813	0.13942
l_df	0.026738	0.278739	0.346973	0.139567	0.273874	0.348081	0.301854	0.296135	0.310803	0.356462	0.21038
l_svpt	-0.008925	0.575630	0.927772	0.417092	0.421448	0.897608	0.860645	0.862112	0.717810	0.932306	0.41373
l_1stIn	-0.014529	0.533555	0.876322	0.426619	0.371141	0.857997	0.840073	0.846299	0.667861	0.893905	0.37744
l_1stWon	0.012592	0.467438	0.861621	0.487516	0.363460	0.869358	0.854924	0.885945	0.698582	0.905565	0.34922
l_2ndWon	0.003595	0.433885	0.781837	0.385111	0.373330	0.766681	0.717137	0.736378	0.660676	0.793465	0.33657
l_SvGms	-0.005731	0.599869	0.917922	0.459802	0.438218	0.937074	0.900792	0.908516	0.755735	0.986701	0.42254
l_bpSaved	-0.017603	0.312247	0.439936	0.085304	0.179692	0.340544	0.313799	0.290238	0.261148	0.362323	0.20430
l_bpFaced	-0.046112	0.430731	0.442988	0.003591	0.222259	0.343964	0.306119	0.245874	0.239152	0.368113	0.25857
winner_rank	-0.122711	-0.102684	-0.047692	-0.112014	0.014527	-0.027278	-0.036286	-0.064260	-0.015774	-0.049243	0.02941
winner_rank_points	0.082659	0.162423	0.044151	0.066913	-0.070576	-0.031774	-0.009039	0.021493	-0.020961	0.016982	-0.10108
loser_rank	-0.100999	-0.041247	-0.096548	-0.059397	0.002794	-0.092674	-0.107947	-0.109267	-0.042437	-0.087514	-0.05288
loser_rank_points	0.107870	0.020397	0.123315	0.037538	-0.012051	0.085971	0.102195	0.101408	0.044112	0.081371	0.03857
aces	0.079191	0.033950	-0.159249	0.804302	0.028598	-0.070888	-0.041173	0.085925	-0.080515	0.000597	-0.18989

In [32]:
```
mask = np.triu(np.ones_like(m_corr, dtype = bool)) # mask the upper triangle, easier to read
f, ax = plt.subplots(figsize = (14, 16))

sns.heatmap(m_corr, mask = mask, cmap = 'flare', annot = True, annot_kws = {"size": 10})

for t in ax.texts:
    if float(t.get_text()) >= 0.5:
        t.set_text(t.get_text()) # if the value is greater than 0.5 then I set the text
    elif float(t.get_text()) < -0.5: # if the value is smaller than -0.5 then I set the text
        t.set_text(t.get_text())
    else:
        t.set_text("") # if not it sets an empty text

plt.title('Correlation Matrix', fontsize = 20)
plt.show()
```



Level 3

Practice 4

Continuing with the sports theme data, select an attribute and calculate the geometric mean and harmonic mean.

Geometric Mean: is a special type of average where we multiply the numbers together and then take a square root (for two numbers), cube root (for three numbers) etc. Is useful when we want to compare things with very different properties.

$$\sqrt[n]{(a_1 \times a_2 \times \ldots \times a_n)}$$

In [33]:
```
geom_mean = stats.gmean(atp_2018.loc[:,'w_1stWon'])
print(f'The geometric mean is: {round(geom_mean,2)}')
```

```
The geometric mean is: 35.37
```

Harmonic Mean: the reciprocal of the average of the reciprocals. The harmonic mean is little influenced by the existence of certain values much larger than the set of others, being instead sensitive to values much smaller than the set.

$$\text{Harmonic Mean} = \frac{n}{\frac{1}{a} + \frac{1}{b} + \frac{1}{c} + \ldots}$$

In [34]:
```
harm_mean = statistics.harmonic_mean(atp_2018['w_1stWon'])
print(f'The harmonic mean is: {round(harm_mean, 2)}')
```

```
The harmonic mean is: 33.04
```