

```
In [44]: import pandas as pd
pd.options.mode.chained_assignment = None # default='warn'
from datetime import datetime, date, timedelta
import pickle
```

```
In [45]: now = datetime.now().date()
sdate= datetime(2021,6,1).date()
datediff = (now-sdate).days
```

```
In [46]: allwind = pd.read_pickle('ppoint_raw_2021-06-01_2022-10-23.pkl')
```

```
In [47]: allwind[::len(allwind)//10]
```

Out[47]:

	Date	Time	Season	Month	Daypart	Temp	Wind	Azimuth	Speed	Gust
0	2021-06-01	12:04 AM	Summer	Jun	Overnight	52.8	WSW	247.5	0.2	1.7
63	2021-07-22	5:18 AM	Summer	Jul	Overnight	54.7	WSW	247.5	0.1	0.4
173	2021-09-10	2:29 PM	Fall	Sep	Afternoon	69.7	SE	135.0	3.5	7.4
220	2021-10-31	6:24 PM	Fall	Oct	Evening	58.1	West	270.0	0.0	0.4
281	2021-12-20	11:29 PM	Winter	Dec	Overnight	44.8	WNW	292.5	1.0	1.7
253	2022-02-10	9:13 PM	Winter	Feb	Evening	55.5	West	270.0	0.1	0.2
32	2022-04-03	2:44 AM	Spring	Apr	Overnight	48.4	WNW	292.5	1.2	1.9
203	2022-05-23	5:24 PM	Spring	May	Afternoon	62.0	ESE	112.5	2.9	7.1
206	2022-07-14	5:14 PM	Summer	Jul	Afternoon	67.1	ESE	112.5	3.9	10.0
6	2022-09-03	12:34 AM	Fall	Sep	Overnight	58.4	East	90.0	0.0	0.0
287	2022-10-23	11:59 PM	Fall	Oct	Overnight	51.1	NW	315.0	0.6	1.6

```
In [48]: wind_wsw = allwind.query('Wind == "WSW"')
wind_ene = allwind.query('Wind == "ENE"')
```

```
In [49]: print(f'wsw = {round(100*len(wind_wsw)/len(allwind),1)}% | ene = {round(100*len(wind_ene)/len(allwind),1)}%')

wsw = 6.1% | ene = 1.1%
```

```
In [50]: def dftostrFF(df):
          print(df.reset_index(drop=False).to_string(index=False))
def dftostrTT(df):
          print(df.reset_index(drop=True).to_string(index=True))
def dftostrTF(df):
          print(df.reset_index(drop=True).to_string(index=False))
def dftostrFT(df):
          print(df.reset_index(drop=False).to_string(index=True))
```

```
In [51]: ordir={"North":0.0,
               "NNE":22.5,
               "NE": 45.0,
               "ENE":67.5,
               "East":90.0,
               "ESE":112.5,
               "SE":135.0,
               "SSE":157.5,
               "South":180,
               "SSW":202.5,
               "SW":225.0,
               "WSW":247.5,
               "West":270.0,
               "WNW":292.5,
               "NW":315.0,
               "NNW":337.5}
revdir = [(value, key) for key, value in ordir.items()]
print('mapping of 16 angular wind directions to 16 compass points:\n')
print(pd.DataFrame(revdir,columns=['Azimuth', 'Compass']).to_string(index=False))
revord = dict(revdir)
```

mapping of 16 angular wind directions to 16 compass points:

Azimuth	Compass
0.0	North
22.5	NNE
45.0	NE
67.5	ENE
90.0	East
112.5	ESE
135.0	SE
157.5	SSE
180.0	South
202.5	SSW
225.0	SW
247.5	WSW
270.0	West
292.5	WNW
315.0	NW
337.5	NNW

```
In [52]: def ordinalify(df,groupcol,grouporder):
    avgdir = df.groupby(groupcol)['Azimuth'].mean()[grouporder]
    avgint = avgdir.astype(int)
    clsdir = round(avgdir/22.5,0)*22.5
    dford = pd.concat([pd.concat([pd.DataFrame(avgint),pd.DataFrame(clsdir)
    dford.columns=['Azimuth','Closest','Compass']
    dford = dford.reset_index(drop=False)
    return dford
```

```
In [53]: print("average wind Azimuth by season and daypart:\n")
dfs = allwind.groupby(['Season','Daypart'])['Azimuth'].mean().round(1)
dfs = dfs.reset_index(drop=False)
dfs['Season'] = pd.Categorical(dfs['Season'], ['Winter','Spring','Summer','
dfs['Daypart'] = pd.Categorical(dfs['Daypart'], ['Overnight','Morning','Mid
dftostrTF(dfs.sort_values(['Season','Daypart'])))
```

average wind Azimuth by season and daypart:

Season	Daypart	Azimuth
Winter	Overnight	283.8
Winter	Morning	267.0
Winter	Midday	193.9
Winter	Afternoon	223.5
Winter	Evening	269.9
Spring	Overnight	220.7
Spring	Morning	211.1
Spring	Midday	190.5
Spring	Afternoon	193.3
Spring	Evening	196.4
Summer	Overnight	193.9
Summer	Morning	186.4
Summer	Midday	184.1
Summer	Afternoon	181.9
Summer	Evening	156.9
Fall	Overnight	250.4
Fall	Morning	242.4
Fall	Midday	196.7
Fall	Afternoon	199.2
Fall	Evening	200.4

```
In [54]: print("average wind speed by season and daypart:\n")
dfs = allwind.groupby(['Season', 'Daypart'])['Speed'].mean().round(1)
dfs = dfs.reset_index(drop=False)
dfs['Season'] = pd.Categorical(dfs['Season'], ['Winter', 'Spring', 'Summer', 'Fall'])
dfs['Daypart'] = pd.Categorical(dfs['Daypart'], ['Overnight', 'Morning', 'Midday', 'Afternoon', 'Evening'])
dftostrTF(dfs.sort_values(['Season', 'Daypart']))
```

average wind speed by season and daypart:

Season	Daypart	Speed
Winter	Overnight	0.9
Winter	Morning	0.9
Winter	Midday	1.8
Winter	Afternoon	1.3
Winter	Evening	0.8
Spring	Overnight	0.7
Spring	Morning	1.2
Spring	Midday	2.8
Spring	Afternoon	3.0
Spring	Evening	1.8
Summer	Overnight	0.5
Summer	Morning	1.0
Summer	Midday	2.7
Summer	Afternoon	2.9
Summer	Evening	1.5
Fall	Overnight	0.6
Fall	Morning	0.8
Fall	Midday	2.1
Fall	Afternoon	2.0
Fall	Evening	0.8

```
In [55]: print("ascending avg wind speed by season and daypart:\n")
dftostrTF(dfs.sort_values('Speed'))
```

ascending avg wind speed by season and daypart:

Season	Daypart	Speed
Summer	Overnight	0.5
Fall	Overnight	0.6
Spring	Overnight	0.7
Fall	Evening	0.8
Winter	Evening	0.8
Fall	Morning	0.8
Winter	Morning	0.9
Winter	Overnight	0.9
Summer	Morning	1.0
Spring	Morning	1.2
Winter	Afternoon	1.3
Summer	Evening	1.5
Spring	Evening	1.8
Winter	Midday	1.8
Fall	Afternoon	2.0
Fall	Midday	2.1

```
In [56]: print("unweighted average wind azimuth direction by season:\n")
orderszn = ['Winter', 'Spring', 'Summer', 'Fall']
dftostrTF(ordinalify(allwind, 'Season', orderszn))
print("\n\nunweighted average wind azimuth direction by month:\n")
ordermth=['Jan', 'Feb', 'Mar', 'Apr', 'May', 'Jun', 'Jul', 'Aug', 'Sep', 'Oct', 'Nov']
dftostrTF(ordinalify(allwind, 'Month', ordermth))
```

unweighted average wind azimuth direction by season:

Season	Azimuth	Closest	Compass
Winter	253	247.5	WSW
Spring	205	202.5	SSW
Summer	182	180.0	South
Fall	223	225.0	SW

unweighted average wind azimuth direction by month:

Month	Azimuth	Closest	Compass
Jan	257	247.5	WSW
Feb	255	247.5	WSW
Mar	237	247.5	WSW
Apr	206	202.5	SSW
May	173	180.0	South
Jun	187	180.0	South
Jul	177	180.0	South
Aug	184	180.0	South
Sep	200	202.5	SSW
Oct	232	225.0	SW
Nov	249	247.5	WSW
Dec	247	247.5	WSW

```
In [57]: def groupwavg(groupcol, grouporder):
    wgtldir = (nnwind['Speed']).multiply(nnwind['Azimuth'])
    dfwgt = pd.concat([nnwind, pd.DataFrame(wgtldir, columns=['Wgtldir'])], axis=1)
    dfsum = dfwgt.groupby(groupcol).sum()
    wavgd = (dfsum.Wgtldir/dfsum.Speed)
    wintd = wavgd.astype(int)
    wclsd = round(wavgd/22.5, 0)*22.5
    wcomp = wclsd.map(revord)
    dfwavg = pd.concat([pd.concat([wintd, wclsd], axis=1), wcomp], axis=1)
    dfwavg.columns = ['Azimuth', 'Closest', 'Compass']
    dfwavg = dfwavg.reset_index(drop=False)
    dfwavg[groupcol] = pd.Categorical(dfwavg[groupcol], grouporder)
    return dfwavg.sort_values(groupcol)
```

```
In [58]: nnwind = allwind[allwind['Azimuth'].notnull()]
```

```
In [59]: print("speed weighted average wind azimuth direction by Season:\n")
          dftostrTF(groupwavg('Season', ['Winter', 'Spring', 'Summer', 'Fall']))
          print("\n\nspeed weighted average wind azimuth direction by Month:\n")
          dftostrTF(groupwavg('Month', ordermth))
```

speed weighted average wind azimuth direction by Season:

Season	Azimuth	Closest	Compass
Winter	250	247.5	WSW
Spring	214	225.0	SW
Summer	183	180.0	South
Fall	221	225.0	SW

speed weighted average wind azimuth direction by Month:

Month	Azimuth	Closest	Compass
Jan	248	247.5	WSW
Feb	256	247.5	WSW
Mar	236	247.5	WSW
Apr	221	225.0	SW
May	192	202.5	SSW
Jun	189	180.0	South
Jul	178	180.0	South
Aug	182	180.0	South
Sep	199	202.5	SSW
Oct	234	225.0	SW
Nov	249	247.5	WSW
Dec	246	247.5	WSW

```
In [60]: print("difference in monthly average azimuth without vs with wind speed as
dfdiff=pd.concat([pd.Series(ordermth),(ordinalify(allwind,'Month',ordermth)
dfdiff.columns=['Month','Azimuth']
dftostrTF(dfdiff)
print("\n\ndifference in seasonal average azimuth without vs with wind spee
dfdiff=pd.concat([pd.Series(orderszn),(ordinalify(allwind,'Season',orderszn)
dfdiff.columns=['Season','Azimuth']
dftostrTF(dfdiff)
```

difference in monthly average azimuth without vs with wind speed as weights:

Month	Azimuth
Jan	36
Feb	73
Mar	-9
Apr	-50
May	-75
Jun	9
Jul	-12
Aug	-52
Sep	8
Oct	-17
Nov	15
Dec	48

difference in seasonal average azimuth without vs with wind speed as weights:

Season	Azimuth
Winter	32
Spring	-9
Summer	-1
Fall	-27

```
In [61]: list(ordir.keys())
```

```
Out[61]: ['North',
          'NNE',
          'NE',
          'ENE',
          'East',
          'ESE',
          'SE',
          'SSE',
          'South',
          'SSW',
          'SW',
          'WSW',
          'West',
          'WNW',
          'NW',
          'NNW']
```

```
In [65]: allwind.query("Wind == ''")
```

Out[65]:

	Date	Time	Season	Month	Daypart	Temp	Wind	Azimuth	Speed	Gust
284	2021-06-02	11:44 PM	Summer	Jun	Overnight	53.6		NaN	0.1	0.2
100	2021-06-07	8:24 AM	Summer	Jun	Morning	53.1		NaN	1.0	3.0
77	2021-06-08	6:29 AM	Summer	Jun	Morning	46.5		NaN	0.0	0.0
11	2021-06-09	12:59 AM	Summer	Jun	Overnight	52.6		NaN	0.1	1.2
66	2021-06-10	5:34 AM	Summer	Jun	Overnight	45.6		NaN	0.0	1.5
...
159	2022-10-23	1:19 PM	Fall	Oct	Midday	71.7		NaN	1.4	3.6
170	2022-10-23	2:14 PM	Fall	Oct	Afternoon	73.5		NaN	1.3	3.9
186	2022-10-23	3:34 PM	Fall	Oct	Afternoon	74.9		NaN	1.3	4.0
196	2022-10-23	4:24 PM	Fall	Oct	Afternoon	75.3		NaN	0.8	2.4
201	2022-10-23	4:49 PM	Fall	Oct	Afternoon	74.8		NaN	1.4	2.7

881 rows × 10 columns


```
In [66]: allwind.query("Azimuth.isnull()")
```

Out[66]:

	Date	Time	Season	Month	Daypart	Temp	Wind	Azimuth	Speed	Gust
284	2021-06-02	11:44 PM	Summer	Jun	Overnight	53.6		NaN	0.1	0.2
100	2021-06-07	8:24 AM	Summer	Jun	Morning	53.1		NaN	1.0	3.0
77	2021-06-08	6:29 AM	Summer	Jun	Morning	46.5		NaN	0.0	0.0
11	2021-06-09	12:59 AM	Summer	Jun	Overnight	52.6		NaN	0.1	1.2
66	2021-06-10	5:34 AM	Summer	Jun	Overnight	45.6		NaN	0.0	1.5
...
159	2022-10-23	1:19 PM	Fall	Oct	Midday	71.7		NaN	1.4	3.6
170	2022-10-23	2:14 PM	Fall	Oct	Afternoon	73.5		NaN	1.3	3.9
186	2022-10-23	3:34 PM	Fall	Oct	Afternoon	74.9		NaN	1.3	4.0
196	2022-10-23	4:24 PM	Fall	Oct	Afternoon	75.3		NaN	0.8	2.4
201	2022-10-23	4:49 PM	Fall	Oct	Afternoon	74.8		NaN	1.4	2.7

881 rows × 10 columns

```
In [63]: [print(x) for x in allwind.query("Wind == ''").Date.unique()]
```

2021-06-02
2021-06-07
2021-06-08
2021-06-09
2021-06-10
2021-06-12
2021-06-17
2021-06-21
2021-06-22
2021-06-24
2021-06-29
2021-07-02
2021-07-05
2021-07-06
2021-07-08
2021-07-10
2021-07-11
2021-07-12
2021-07-13
2021-07-16

```
In [64]: print("average wind speed by direction:\n")
dfs = allwind.groupby('Wind')['Speed'].mean().round(1)
dfs = dfs.reset_index(drop=False)
dfs['Wind'] = pd.Categorical(dfs['Wind'], list(ordir.keys()))
dftostrTF(dfs.sort_values('Wind'))

print("ascending avg wind speed by direction:\n")
dftostrTF(dfs.sort_values('Speed'))
```

average wind speed by direction:

Wind	Speed
North	0.1
NNE	0.3
NE	0.5
ENE	0.6
East	0.7
ESE	1.3
SE	1.9
SSE	1.7
South	1.7
SSW	1.8
SW	1.9
WSW	1.6
West	0.9
WNW	1.4
NW	1.1
NNW	0.4
NaN	0.2

ascending avg wind speed by direction:

Wind	Speed
North	0.1
NaN	0.2
NNE	0.3
NNW	0.4
NE	0.5
ENE	0.6
East	0.7
West	0.9
NW	1.1
ESE	1.3
WNW	1.4
WSW	1.6
SSE	1.7
South	1.7
SSW	1.8
SE	1.9
SW	1.9

