fvg

December 20, 2025

1 FVG

so today i tried doing the fvg thing and i was able computing when and fvg happened and when it returned. now its my task to check those events. and also see how i can group them in different regimes or something like that.

GPT Link for continuation of the conversation: https://chatgpt.com/share/6945b36b-b5c0-8004-a7c9-017617702071

[1]:
```
import pandas as pd
import numpy as np

df = pd.read_csv("/Users/ducjeremyvu/alpha/price_data/
↪US500_Minute5_20251219_1816.csv")

df["Time"] = pd.to_datetime(df["Time"])
df = df.sort_values("Time").reset_index(drop=True)

# Bar A (i-2) and Bar C (i)
A_high = df["High"].shift(2)
A_low  = df["Low"].shift(2)
B_open = df["Open"].shift(1)
B_close = df["Close"].shift(1)
C_low  = df["Low"]
C_high = df["High"]

# FVG conditions
bull = C_low > A_high
bear = C_high < A_low

# Build event table
events = pd.DataFrame({
    "Time": df["Time"],
    "Lower": np.where(bull, A_high, np.where(bear, C_high, np.nan)),
    "Upper": np.where(bull, C_low,  np.where(bear, A_low,  np.nan)),
    "B_size": (B_close - B_open).abs(),
})
```

```
# Direction as categorical (pandas-native)
events["Direction"] = np.nan
events.loc[bull, "Direction"] = "BULL"
events.loc[bear, "Direction"] = "BEAR"

# Keep only real FVGs
events = events.dropna(subset=["Direction"]).copy()

# Gap size
events["GapSize"] = events["Upper"] - events["Lower"]

events.head(10)
```

```
/var/folders/h_/czc68f1s1qbcn01xxzxjq4c40000gn/T/ipykernel_2620/3330977488.py:31
: FutureWarning: Setting an item of incompatible dtype is deprecated and will
raise an error in a future version of pandas. Value 'BULL' has dtype
incompatible with float64, please explicitly cast to a compatible dtype first.
  events.loc[bull, "Direction"] = "BULL"
```

[1]:

	Time	Lower	Upper	B_size	Direction	GapSize
6	2025-09-10 14:30:00	6552.3	6554.8	5.2	BEAR	2.5
7	2025-09-10 14:35:00	6551.0	6551.3	2.7	BEAR	0.3
16	2025-09-10 15:20:00	6538.8	6542.0	5.3	BEAR	3.2
20	2025-09-10 15:40:00	6540.8	6541.5	5.2	BULL	0.7
21	2025-09-10 15:45:00	6543.3	6544.0	2.7	BULL	0.7
22	2025-09-10 15:50:00	6545.5	6546.3	0.7	BULL	0.8
24	2025-09-10 16:00:00	6545.5	6546.3	3.0	BEAR	0.8
28	2025-09-10 16:20:00	6542.8	6543.3	1.5	BEAR	0.5
29	2025-09-10 16:25:00	6541.3	6542.3	1.7	BEAR	1.0
32	2025-09-10 16:40:00	6537.0	6537.3	2.2	BEAR	0.3

[2]:

```
print(f"Time Min: {df["Time"].min()}, Time Max: {df["Time"].max()}")
```

```
Time Min: 2025-09-10 14:00:00, Time Max: 2025-12-19 18:15:00
```

[3]:

```
# Gap size must always be positive
assert (events["GapSize"] > 0).all()

# Direction should only be BULL or BEAR
assert set(events["Direction"].unique()) <= {"BULL", "BEAR"}
```

[4]:

```
returns = []
bars_to_return = []

for idx, row in events.iterrows():
    i = row.name  # index in df
    lower = row["Lower"]
    upper = row["Upper"]
```

```
    future = df.iloc[i+1:]

    touched = future[
        (future["Low"] <= upper) &
        (future["High"] >= lower)
    ]

    if len(touched) == 0:
        returns.append(False)
        bars_to_return.append(np.nan)
    else:
        returns.append(True)
        bars_to_return.append(touched.index[0] - i)
```

[5]:
```
events["Returned"] = returns
events["BarsToReturn"] = bars_to_return
```

[6]:
```
# Convert Time to UTC and create NY time column
def add_timezones(df, time_col="Time"):
    df = df.copy()
    df[time_col] = pd.to_datetime(df[time_col], utc=True)
    df["Time_NY"] = df[time_col].dt.tz_convert("America/New_York")
    return df

events = add_timezones(events)
```

[ ]:
```
from datetime import time
events_us_business_hours = events[(events["Time_NY"].dt.time >= time(9,30)) &␣
↪(events["Time_NY"].dt.time < time(16))]
events_us_business_hours
```

[21]:
```
assert set(events_us_business_hours["Time_NY"].dt.hour.unique()) <= {9, 10, 11,␣
↪12, 13, 14, 15}
```

[32]:
```
gap_size_count = events_us_business_hours["GapSize"].value_counts(dropna=False).
↪reset_index()
gap_size_count
```

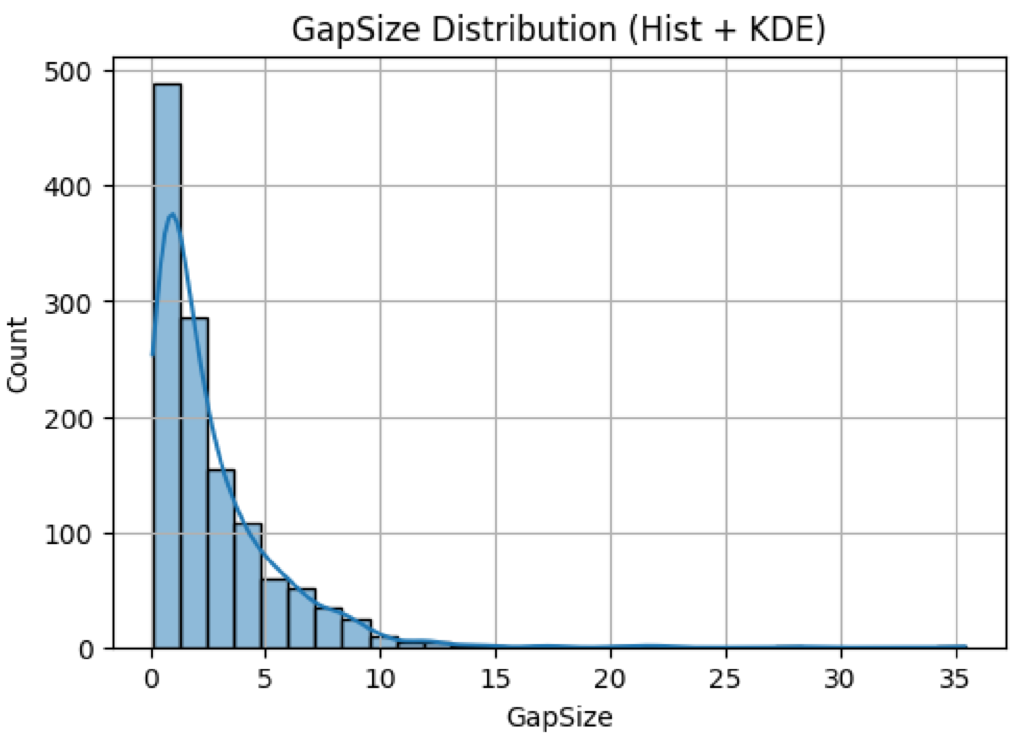
[32]:

	GapSize	count
0	0.5	108
1	1.0	78
2	1.5	68
3	0.2	61
4	0.7	54
..	…	…
139	7.1	1

```
140      7.7      1
141     13.8      1
142      4.1      1
143      0.9      1

[144 rows x 2 columns]
```

plotting the data now and check if there is anythign interesting

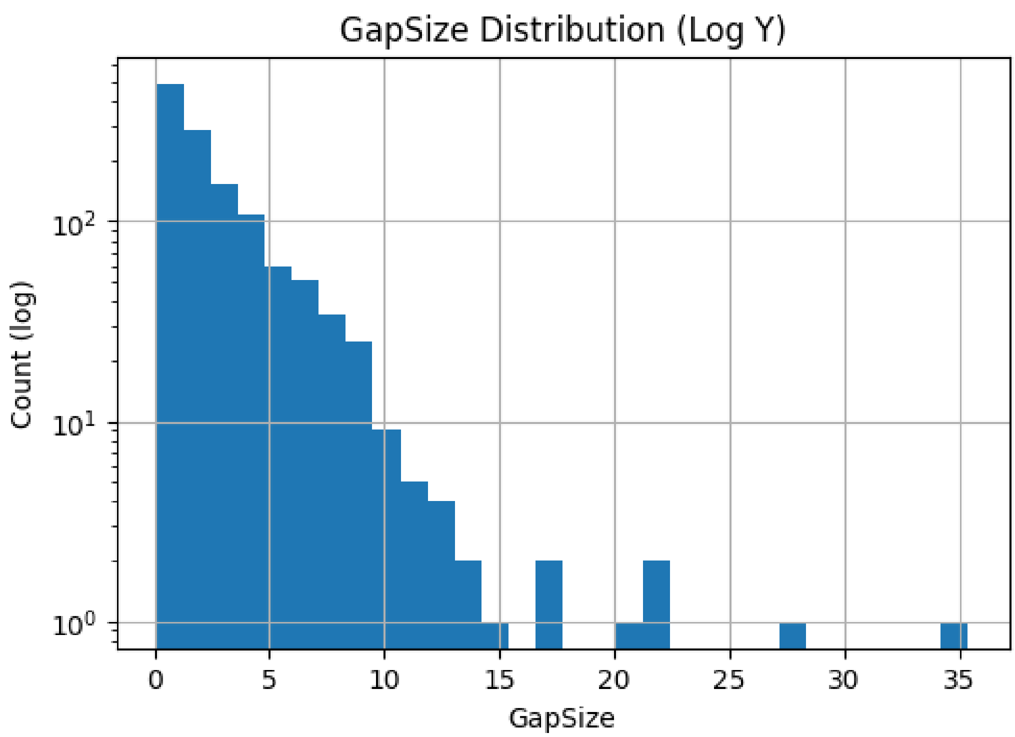
[36]:
```
# 1) Distribution: histogram + KDE
import seaborn as sns
import matplotlib.pyplot as plt

gaps = events_us_business_hours["GapSize"].dropna()

plt.figure(figsize=(6, 4))
sns.histplot(gaps, bins=30, kde=True)
plt.title("GapSize Distribution (Hist + KDE)")
plt.xlabel("GapSize")
plt.ylabel("Count")
plt.show()
```



this only tells me that tha gap size count decreases the greater the gap size but its kinda obvious but ok good to have it statistically backed.

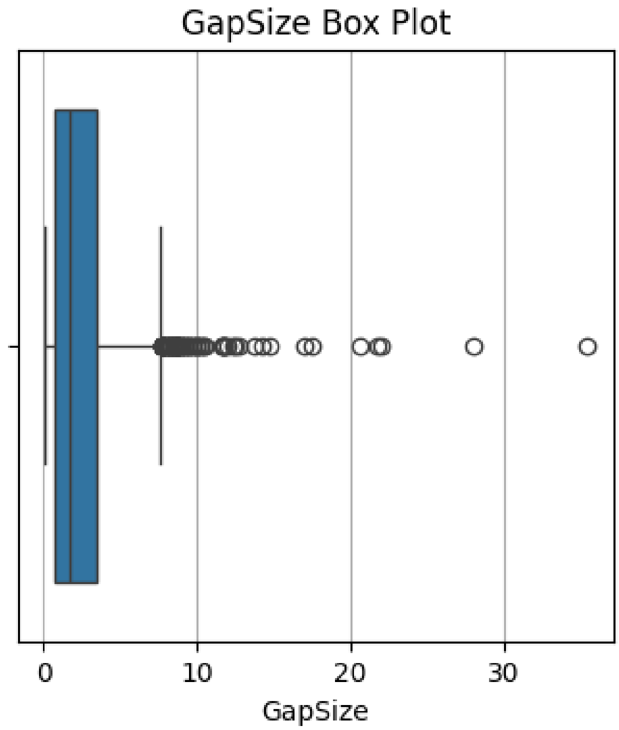
[37]:

```
# 2) Distribution on log scale (useful if right-skewed)
plt.figure(figsize=(6, 4))
plt.hist(gaps, bins=30)
plt.yscale("log")
plt.title("GapSize Distribution (Log Y)")
plt.xlabel("GapSize")
plt.ylabel("Count (log)")
plt.show()
```

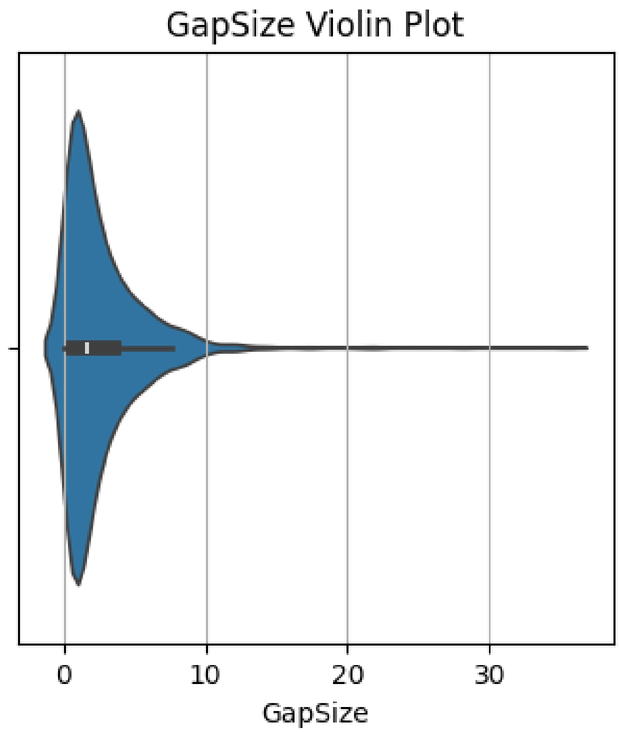


[38]:

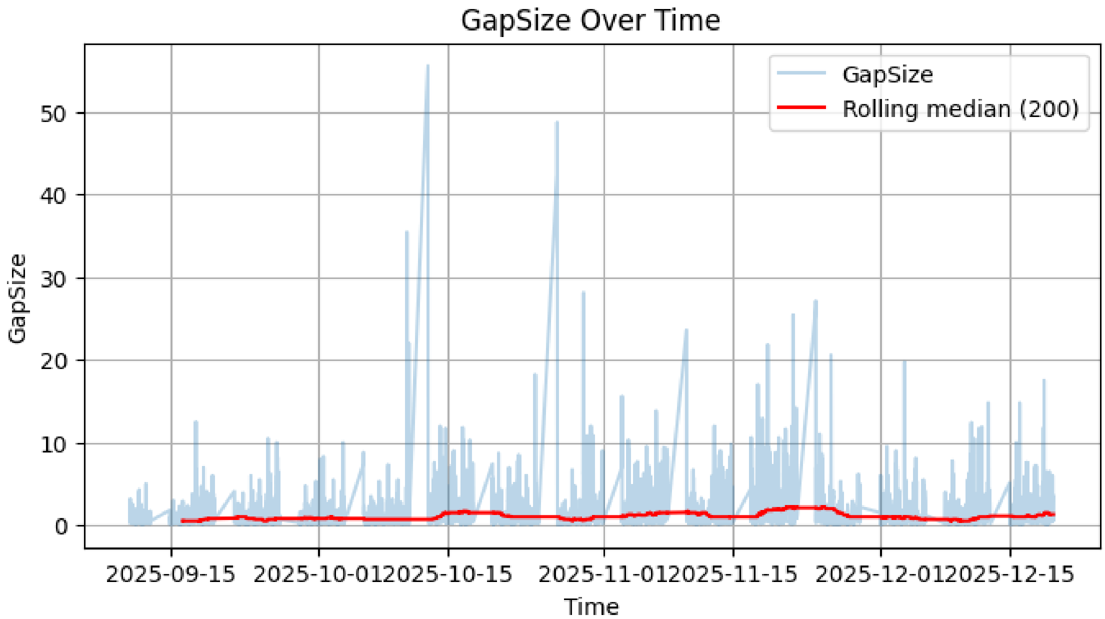
```
# 3) Outliers: box plot
plt.figure(figsize=(4, 4))
sns.boxplot(x=gaps)
plt.title("GapSize Box Plot")
plt.xlabel("GapSize")
plt.show()
```



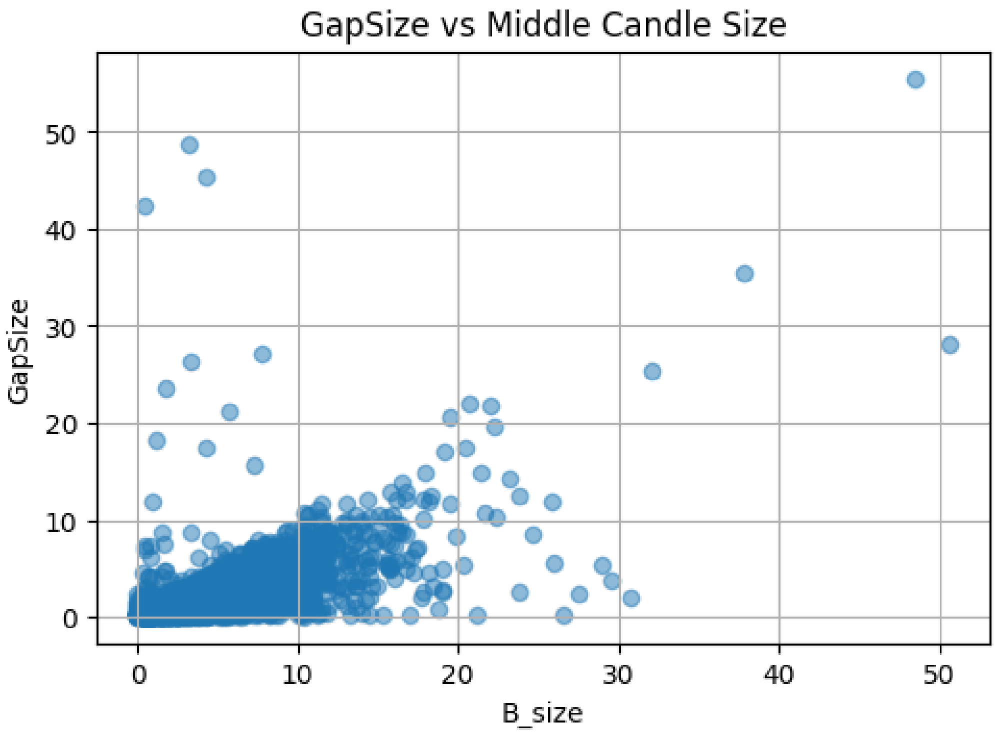
[39]:
```
# 4) Outliers: violin plot
plt.figure(figsize=(4, 4))
sns.violinplot(x=gaps)
plt.title("GapSize Violin Plot")
plt.xlabel("GapSize")
plt.show()
```



[40]:
```
# 5) Over time: rolling median
events_sorted = events.sort_values("Time")
events_sorted["GapSize_roll_med"] = events_sorted["GapSize"].rolling(200).
 ↪median()

plt.figure(figsize=(8, 4))
plt.plot(events_sorted["Time"], events_sorted["GapSize"], alpha=0.3,␣
 ↪label="GapSize")
plt.plot(events_sorted["Time"], events_sorted["GapSize_roll_med"], color="red",␣
 ↪label="Rolling median (200)")
plt.title("GapSize Over Time")
plt.xlabel("Time")
plt.ylabel("GapSize")
plt.legend()
plt.show()
```



[41]:
```python
# 6) Relationship: scatter vs B_size
plt.figure(figsize=(6, 4))
plt.scatter(events["B_size"], events["GapSize"], alpha=0.5)
plt.title("GapSize vs Middle Candle Size")
plt.xlabel("B_size")
plt.ylabel("GapSize")
plt.show()
```

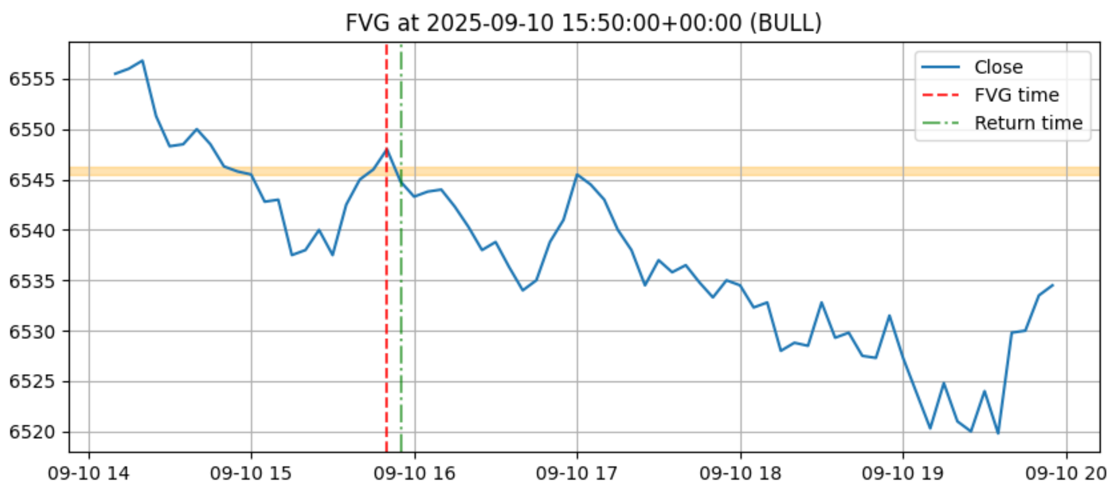


[43]:
```
import matplotlib.pyplot as plt

plt.rcParams["figure.figsize"] = (10, 4)
plt.rcParams["axes.grid"] = True
```

[44]:
```
i = events.index[5]  # pick one FVG
row = events.loc[i]

start = max(i - 20, 0)
end = i + 50

i_return = int(i + row["BarsToReturn"])
print(i)
print(i_return)
return_inside_window = i_return < end
print(return_inside_window)

slice_df = df.iloc[start:end]

plt.plot(slice_df["Time"], slice_df["Close"], label="Close")
plt.axvline(row["Time"], color="red", linestyle="--", alpha=0.8, label="FVG␣
↪time")
if return_inside_window:
```

```
    plt.axvline(df.iloc[i_return]["Time"], color="green", linestyle="-.",␣
↪alpha=0.6, label="Return time")
plt.axhspan(row["Lower"], row["Upper"], color="orange", alpha=0.3)

plt.title(f"FVG at {row['Time']} ({row['Direction']})")
plt.legend()
print(row)
plt.show()
```

```
22
23
True
Time            2025-09-10 15:50:00+00:00
Lower                              6545.5
Upper                              6546.3
B_size                                0.7
Direction                            BULL
GapSize                               0.8
Returned                             True
BarsToReturn                          1.0
Time_NY         2025-09-10 11:50:00-04:00
Name: 22, dtype: object
```



below is code for widget where you can toggle with keyboard buttons but it seems that it renders them all first so maybe try to limit the number of events per call

maybe:

pages:

```
p = input(1, 2, ... )
x_base = 10
```

```
x = x_base + p
page_start = x - 10
page_end = x
```

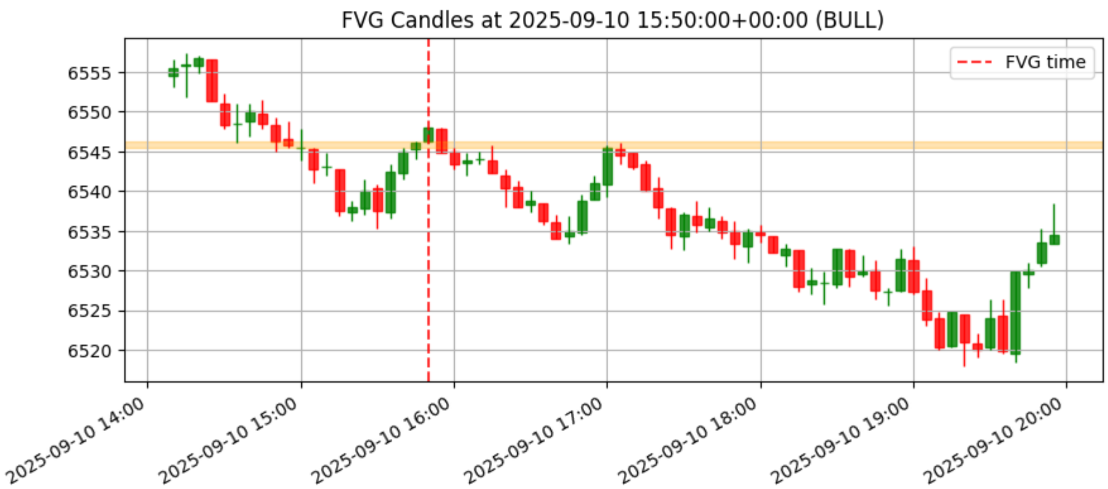
[ ]:
```
# import matplotlib.pyplot as plt
# import ipywidgets as widgets
# from IPython.display import display, clear_output

# def plot_fvg(event_pos):
#     # --- pick event ---
#     i = events.index[event_pos]
#     row = events.loc[i]

#     start = max(i - 20, 0)
#     end = i + 50

#     # handle NaNs defensively
#     if pd.isna(row["BarsToReturn"]):
#         i_return = None
#         return_inside_window = False
#     else:
#         i_return = int(i + row["BarsToReturn"])
#         return_inside_window = i_return < end

#     slice_df = df.iloc[start:end]

#     with out:
#         clear_output(wait=True)
#         plt.figure(figsize=(10, 4))
#         plt.plot(slice_df["Time"], slice_df["Close"], label="Close")

#         plt.axvline(row["Time"], color="red", linestyle="--", alpha=0.8,␣
↪label="FVG time")

#         if return_inside_window:
#             plt.axvline(
#                 df.iloc[i_return]["Time"],
#                 color="green",
#                 linestyle="-.",
#                 alpha=0.6,
#                 label="Return time",
#             )

#         plt.axhspan(row["Lower"], row["Upper"], color="orange", alpha=0.3)
#         plt.title(f"FVG #{event_pos} | {row['Direction']} |␣
↪BarsToReturn={row['BarsToReturn']}")
#         plt.legend()
```

```
#         plt.show()

#         display(row)  # nice touch: inspect the event live


# # --- widgets ---
# slider = widgets.IntSlider(
#     value=5,
#     min=0,
#     max=len(events) - 1,
#     step=1,
#     description="Event",
#     continuous_update=False
# )

# out = widgets.Output()

# slider.observe(lambda ch: plot_fvg(ch["new"]), names="value")

# display(slider, out)
# plot_fvg(slider.value)
```

[45]:

```
# Candlestick view of the same FVG window
import matplotlib.dates as mdates
from matplotlib.patches import Rectangle

slice_df = df.iloc[start:end].copy()
time_nums = mdates.date2num(slice_df["Time"])

fig, ax = plt.subplots(figsize=(10, 4))
if len(time_nums) > 1:
    candle_width = (time_nums[1] - time_nums[0]) * 0.7
else:
    candle_width = 0.0005

for t, (_, r) in zip(time_nums, slice_df.iterrows()):
    color = "green" if r["Close"] >= r["Open"] else "red"
    ax.vlines(r["Time"], r["Low"], r["High"], color=color, linewidth=1)
    lower = min(r["Open"], r["Close"])
    height = abs(r["Close"] - r["Open"])
    rect = Rectangle((t - candle_width / 2, lower), candle_width, max(height,␣
↪1e-9),
                     facecolor=color, edgecolor=color, alpha=0.8)
    ax.add_patch(rect)

ax.axhspan(row["Lower"], row["Upper"], color="orange", alpha=0.3)
```

```
ax.axvline(row["Time"], color="red", linestyle="--", alpha=0.8, label="FVG␣
↪time")

ax.xaxis.set_major_formatter(mdates.DateFormatter("%Y-%m-%d %H:%M"))
fig.autofmt_xdate()
ax.set_title(f"FVG Candles at {row['Time']} ({row['Direction']})")
ax.legend()
plt.show()
```



[46]:
```
events.head()
```

[46]:
```
                         Time   Lower   Upper  B_size Direction  GapSize  \
6   2025-09-10 14:30:00+00:00  6552.3  6554.8     5.2      BEAR      2.5
7   2025-09-10 14:35:00+00:00  6551.0  6551.3     2.7      BEAR      0.3
16  2025-09-10 15:20:00+00:00  6538.8  6542.0     5.3      BEAR      3.2
20  2025-09-10 15:40:00+00:00  6540.8  6541.5     5.2      BULL      0.7
21  2025-09-10 15:45:00+00:00  6543.3  6544.0     2.7      BULL      0.7

    Returned  BarsToReturn                   Time_NY
6       True         250.0 2025-09-10 10:30:00-04:00
7       True           1.0 2025-09-10 10:35:00-04:00
16      True           1.0 2025-09-10 11:20:00-04:00
20      True           8.0 2025-09-10 11:40:00-04:00
21      True           3.0 2025-09-10 11:45:00-04:00
```

[48]:
```
events[events["GapSize"] > 20]
```

[48]:
```
                           Time   Lower   Upper  B_size Direction  GapSize  \
5968  2025-10-10 15:00:00+00:00  6713.9  6749.3    37.8      BEAR     35.4
6027  2025-10-10 19:55:00+00:00  6555.6  6577.6    20.7      BEAR     22.0
```

6039	2025-10-12 22:00:00+00:00	6557.3	6612.8	48.5	BULL	55.5
6040	2025-10-12 22:05:00+00:00	6556.3	6601.6	4.3	BULL	45.3
8797	2025-10-26 22:00:00+00:00	6793.5	6835.9	0.5	BULL	42.4
8798	2025-10-26 22:05:00+00:00	6793.0	6841.7	3.2	BULL	48.7
9597	2025-10-29 18:40:00+00:00	6875.7	6903.8	50.6	BEAR	28.1
11555	2025-11-09 23:00:00+00:00	6741.0	6764.6	1.8	BULL	23.6
11556	2025-11-09 23:05:00+00:00	6742.5	6763.7	5.7	BULL	21.2
13434	2025-11-18 17:40:00+00:00	6608.2	6630.0	22.0	BULL	21.8
14201	2025-11-21 12:35:00+00:00	6522.3	6547.7	32.1	BULL	25.4
14313	2025-11-23 23:00:00+00:00	6615.5	6641.9	3.3	BULL	26.4
14314	2025-11-23 23:05:00+00:00	6613.8	6640.9	7.8	BULL	27.1
14778	2025-11-25 14:45:00+00:00	6689.0	6709.6	19.5	BEAR	20.6

	Returned	BarsToReturn	Time_NY
5968	True	815.0	2025-10-10 11:00:00-04:00
6027	True	1.0	2025-10-10 15:55:00-04:00
6039	True	1.0	2025-10-12 18:00:00-04:00
6040	True	367.0	2025-10-12 18:05:00-04:00
8797	True	1084.0	2025-10-26 18:00:00-04:00
8798	True	1.0	2025-10-26 18:05:00-04:00
9597	True	2.0	2025-10-29 14:40:00-04:00
11555	True	1.0	2025-11-09 18:00:00-05:00
11556	True	1.0	2025-11-09 18:05:00-05:00
13434	True	37.0	2025-11-18 12:40:00-05:00
14201	True	26.0	2025-11-21 07:35:00-05:00
14313	True	1.0	2025-11-23 18:00:00-05:00
14314	True	2.0	2025-11-23 18:05:00-05:00
14778	True	1.0	2025-11-25 09:45:00-05:00

[53]:
```
from scipy.stats import zscore

z = zscore(events_us_business_hours["GapSize"])
events_no_outliers = events_us_business_hours[(z > -3) & (z < 3)]
```

[54]:
```
events_no_outliers
```

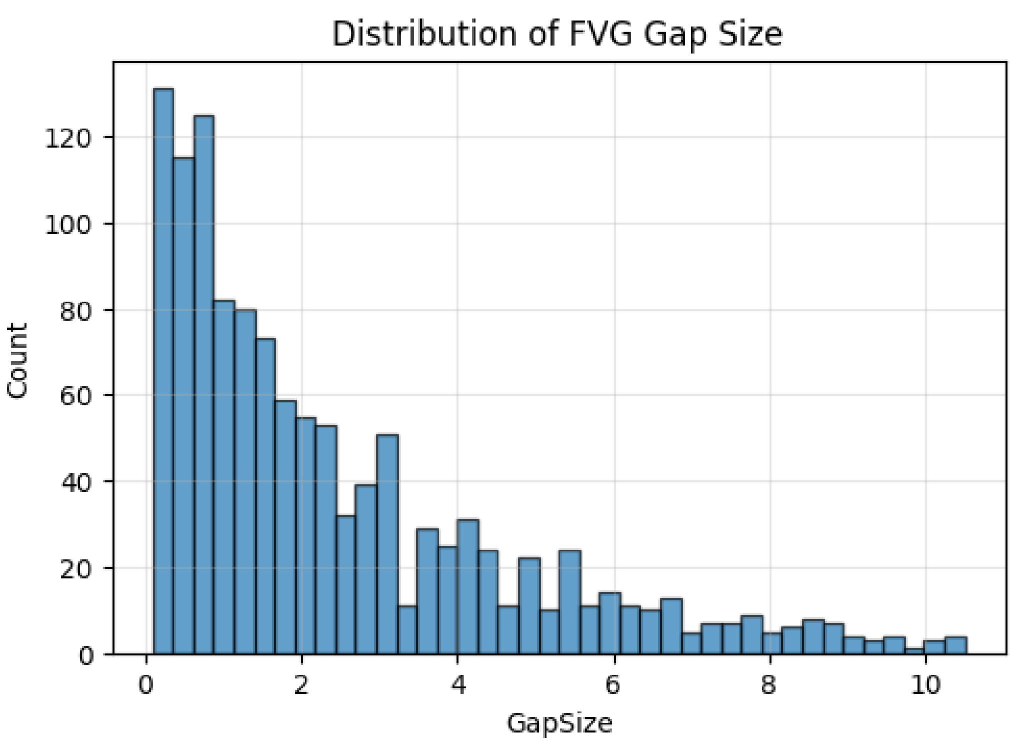
[54]:

	Time	Lower	Upper	B_size	Direction	GapSize	\
6	2025-09-10 14:30:00+00:00	6552.3	6554.8	5.2	BEAR	2.5	
7	2025-09-10 14:35:00+00:00	6551.0	6551.3	2.7	BEAR	0.3	
16	2025-09-10 15:20:00+00:00	6538.8	6542.0	5.3	BEAR	3.2	
20	2025-09-10 15:40:00+00:00	6540.8	6541.5	5.2	BULL	0.7	
21	2025-09-10 15:45:00+00:00	6543.3	6544.0	2.7	BULL	0.7	
…	… …	…	…	…	…	…	
19536	2025-12-19 15:45:00+00:00	6822.0	6823.3	8.5	BEAR	1.3	
19540	2025-12-19 16:05:00+00:00	6820.0	6820.5	5.0	BULL	0.5	
19541	2025-12-19 16:10:00+00:00	6822.5	6823.0	3.5	BULL	0.5	
19545	2025-12-19 16:30:00+00:00	6828.5	6829.3	3.7	BULL	0.8	

```
19555 2025-12-19 17:20:00+00:00   6829.5   6833.0     3.5      BULL      3.5

       Returned  BarsToReturn                   Time_NY
6          True         250.0 2025-09-10 10:30:00-04:00
7          True           1.0 2025-09-10 10:35:00-04:00
16         True           1.0 2025-09-10 11:20:00-04:00
20         True           8.0 2025-09-10 11:40:00-04:00
21         True           3.0 2025-09-10 11:45:00-04:00
…          …            …                         …
19536      True           3.0 2025-12-19 10:45:00-05:00
19540     False           NaN 2025-12-19 11:05:00-05:00
19541      True           1.0 2025-12-19 11:10:00-05:00
19545      True           1.0 2025-12-19 11:30:00-05:00
19555      True           2.0 2025-12-19 12:20:00-05:00

[1214 rows x 9 columns]
```

[55]:

```python
# Histogram of FVG gap sizes
plt.figure(figsize=(6, 4))
plt.hist(events_no_outliers["GapSize"], bins=40, alpha=0.7, edgecolor="black")
plt.xlabel("GapSize")
plt.ylabel("Count")
plt.title("Distribution of FVG Gap Size")
plt.grid(True, alpha=0.3)
plt.show()
```



idea

create an object, a class that contains preprocessing functions, like changing timezones etc. not sure if necessary but would be cool

[ ]:
```

```

[ ]:
```

```