Clayton Kershaw

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Imports

In [1]:
```
import math
import matplotlib.patches as mpatches
from matplotlib.patches import Rectangle
from matplotlib.ticker import PercentFormatter

import warnings
warnings.filterwarnings('ignore')
```

Data

In [2]:
```
kershaw = pd.read_csv('../data/clayton-kershaw.csv')
kershaw.drop(columns = ['Unnamed: 0'], inplace = True)

# Font Dictionary
font_title = {
    'size': 14,
    'weight': 'bold',
    'verticalalignment': 'center_baseline',
    'horizontalalignment': 'center'
}

pd.set_option('max_columns', None)
print(kershaw.shape)
kershaw.head(2)
```

(1806, 84)

Out[2]:

	pitch_type	game_date	release_speed	release_pos_x	release_pos_z	player_name	batter	pitcher	events	description	zone
0	SL	2021-05-30	87.5	1.6	6.13	Kershaw, Clayton	592332	477132	strikeout	called_strike	8
1	FF	2021-05-30	90.4	1.6	6.12	Kershaw, Clayton	592332	477132	NaN	called_strike	6

In [3]:
```
gen_data = kershaw[['pitch_type', 'release_speed', 'release_spin_rate',
                    'true_spin', 'spin_eff', 'phi', 'theta', 'pfx_x',
                    'is_strike', 'release_pos_x', 'release_pos_z', 'bauer_units']]

col_dict = {
    'release_speed': 'velo', 'release_spin_rate': 'spin', 'phi': 'spin_axis', 'theta': 'gyro_spin_deg',
    'pfx_x': 'hb', 'pfx_z': 'vb', 'is_strike': 'strike', 'release_pos_z': 'r_height',
    'release_pos_x': 'r_side'
}
gen_data.rename(columns = col_dict, inplace = True)

hit_labels = [1, 2, 3, 4, 5]
kershaw['hard_hit_summary'] = pd.qcut(kershaw['launch_speed'], [0, .5262, .617, .7283, .8278, 1],
                                     labels = hit_labels)
```

Index DataFrame to Get Pitch Types

In [4]:
```
# kershaw.pitch_type.value_counts(normalize = True)
r_kershaw = kershaw.loc[kershaw['stand'] == 'R']
l_kershaw = kershaw.loc[kershaw['stand'] == 'L']
# all hitters
sl = kershaw.loc[kershaw['pitch_type'] == 'SL']
ff = kershaw.loc[kershaw['pitch_type'] == 'FF']
cu = kershaw.loc[kershaw['pitch_type'] == 'CU']
ch = kershaw.loc[kershaw['pitch_type'] == 'CH']
# RHH
r_sl = r_kershaw.loc[r_kershaw['pitch_type'] == 'SL']
r_ff = r_kershaw.loc[r_kershaw['pitch_type'] == 'FF']
r_cu = r_kershaw.loc[r_kershaw['pitch_type'] == 'CU']
r_ch = r_kershaw.loc[r_kershaw['pitch_type'] == 'CH']
# LHH
l_sl = l_kershaw.loc[l_kershaw['pitch_type'] == 'SL']
l_ff = l_kershaw.loc[l_kershaw['pitch_type'] == 'FF']
l_cu = l_kershaw.loc[l_kershaw['pitch_type'] == 'CU']
l_ch = l_kershaw.loc[l_kershaw['pitch_type'] == 'CH']
order = ['SL', 'FF', 'CU', 'CH']

sl_tilt = sl['phi'].mean()
ff_tilt = ff['phi'].mean()
cu_tilt = cu['phi'].mean()
ch_tilt = ch['phi'].mean()
```

Pitcher Overview

General Pitch Data

In [5]:
```
gen_data.groupby(['pitch_type'], sort = False).mean()
```

Out[5]:

	velo	spin	true_spin	spin_eff	spin_axis	gyro_spin_deg	hb	vb	strike	r_side
pitch_type										
SL	87.075000	2654.045402	501.376237	0.192000	223.276316	78.878947	8.182326	4.712372	0.734884	1.513756
FF	90.636707	2505.066566	1532.497284	0.624158	184.323024	51.099656	19.353897	0.525861	0.641994	1.525317
CU	74.239927	2535.466864	1372.876019	0.558889	345.722222	55.777778	-15.283516	4.782857	0.538462	1.178608
CH	87.045455	2163.272727	1684.480000	0.780000	137.363636	38.000000	15.665455	-12.992727	0.272727	1.790909

Slider: combo sweeping slider/gyro ball movement profile

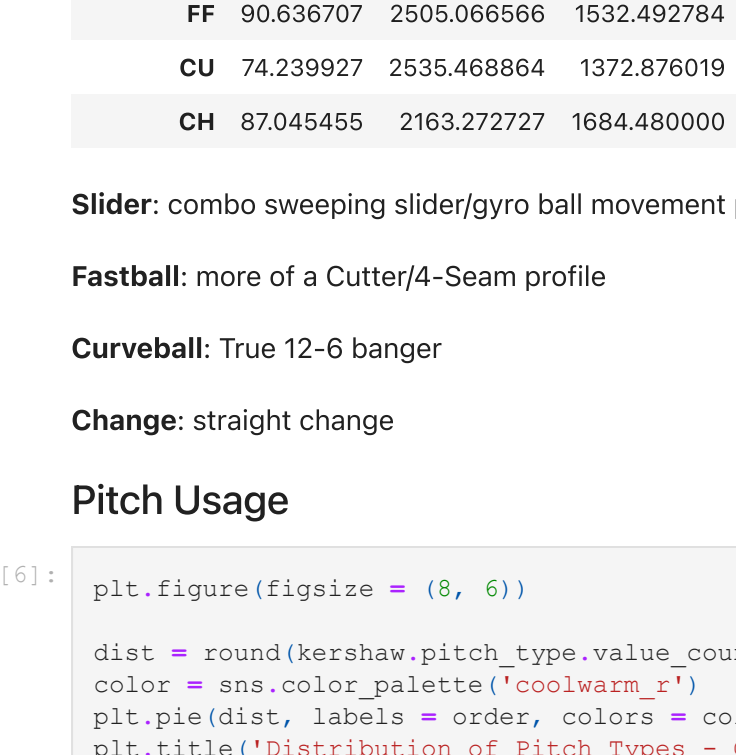
Fastball: more of a Cutter/4-Seam profile

Curveball: True 12-6 banger

Change: straight change

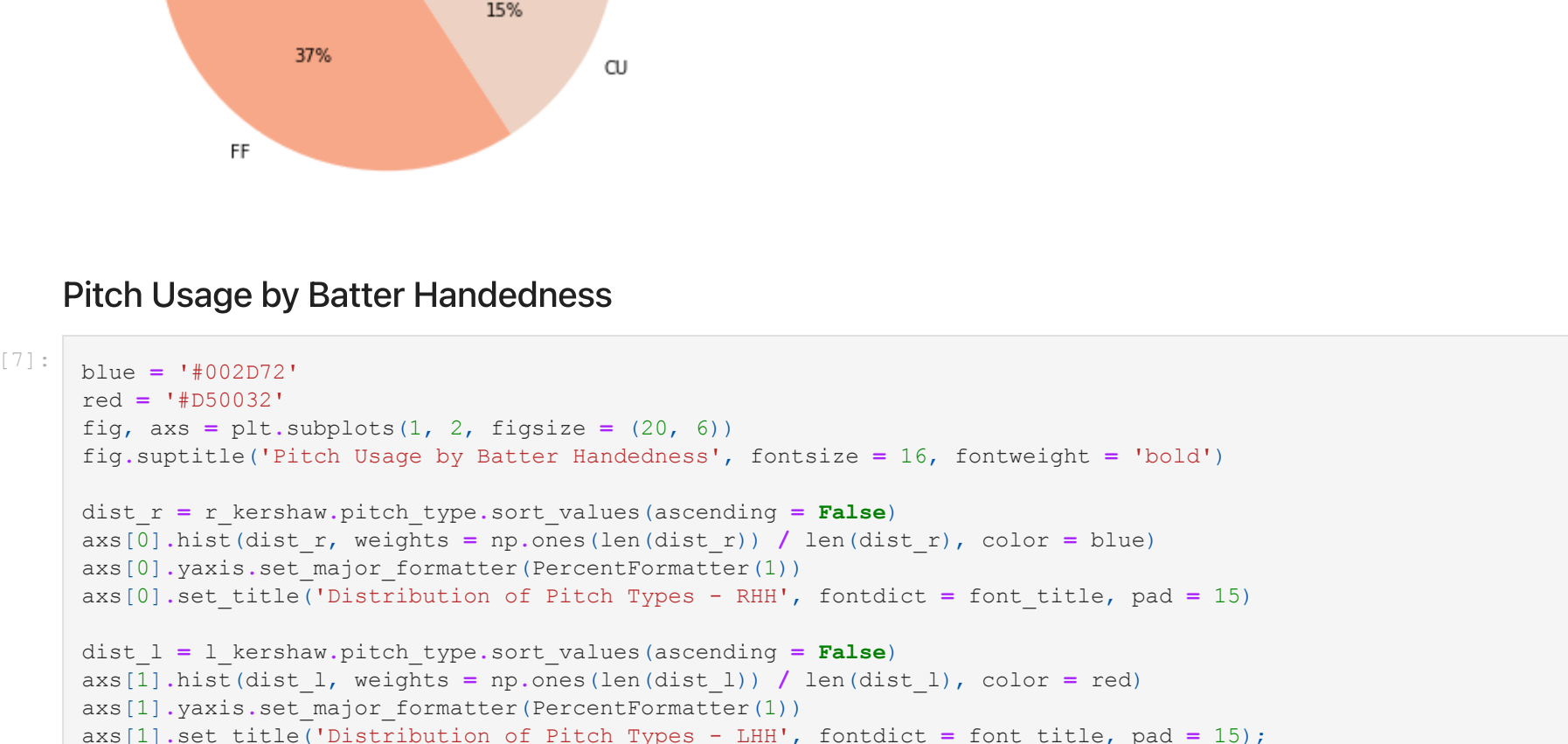
Pitch Usage

In [6]:
```
plt.figure(figsize = (8, 6))

dist = round(kershaw.pitch_type.value_counts(normalize = True), 2)
color = sns.color_palette("coolwarm_r")
plt.pie(dist, labels = dist.index, colors = color, autopct = '%.0f%%')
plt.title('Distribution of Pitch Types - Clayton Kershaw', fontdict = font_title, pad = 15);
```



Pitch Usage by Batter Handedness

In [7]:
```
blue = '#002D72'
red = '#D50032'
fig, axs = plt.subplots(1, 2, figsize = (20, 6))
fig.suptitle('Pitch Usage by Batter Handedness', fontsize = 16, fontweight = 'bold')

dist_r = r_kershaw.pitch_type.value_counts(ascending = False)
axs[0].hist(dist_r, weights = np.ones(len(dist_r)) / len(dist_r), color = blue)
axs[0].yaxis.set_major_formatter(PercentFormatter(1))
axs[0].set_title('Distribution of Pitch Types - RHH', fontdict = font_title, pad = 15)

dist_l = l_kershaw.pitch_type.value_counts(ascending = False)
axs[1].hist(dist_l, weights = np.ones(len(dist_l)) / len(dist_l), color = red)
axs[1].yaxis.set_major_formatter(PercentFormatter(1))
axs[1].set_title('Distribution of Pitch Types - LHH', fontdict = font_title, pad = 15);
```

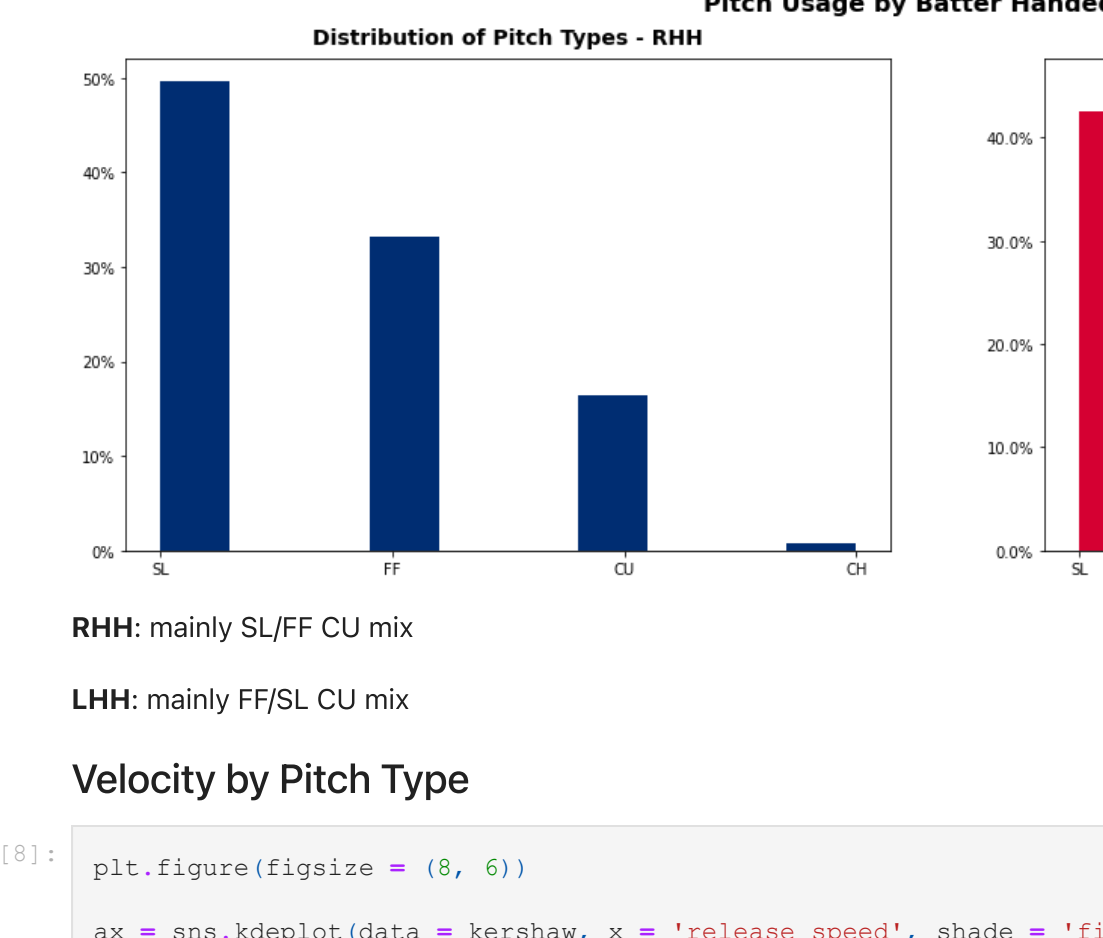


RHH: mainly SL/FF CU mix

LHH: mainly FF/SL CU mix

Velocity by Pitch Type

In [8]:
```
plt.figure(figsize = (8, 6))

ax = sns.kdeplot(data = kershaw, x = 'release_speed', shade = 'fill', hue = 'pitch_type',
                 hue_order = order, palette = 'tab10')
sns.move_legend(ax, 'upper left')
plt.title('Distribution of Velocity by Pitch Type - Clayton Kershaw', fontdict = font_title, pad = 15);
```



Slider: Sits 86 - 88 mph (league avg: 85 mph)

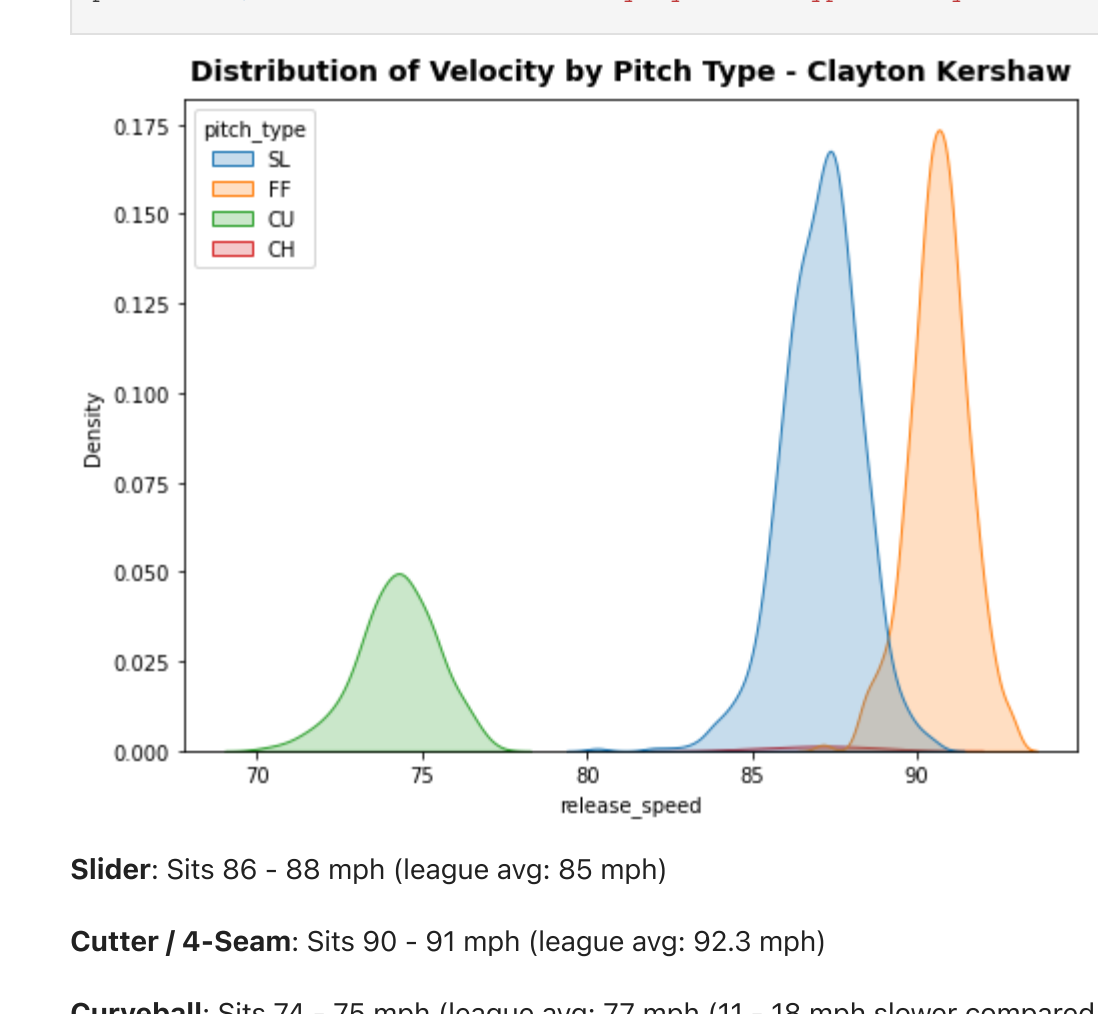
Cutter / 4-Seam: Sits 90 - 91 mph (league avg: 92.3 mph)

Curveball: Sits 74 - 75 mph (league avg: 77 mph (11 - 18 mph slower compared to FB))

Changeup: Sits 86 - 88 mph (league avg: 85 mph (8 - 12 mph difference from FB))

Pitch Velocity by Inning

In [9]:
```
plt.figure(figsize = (8, 6))

sns.lineplot(data = kershaw, x = 'inning', y = 'release_speed', hue = 'pitch_type',
             hue_order = order, palette = 'tab10')
plt.title('Pitch Velocity by Inning', fontdict = font_title, pad = 15);
```

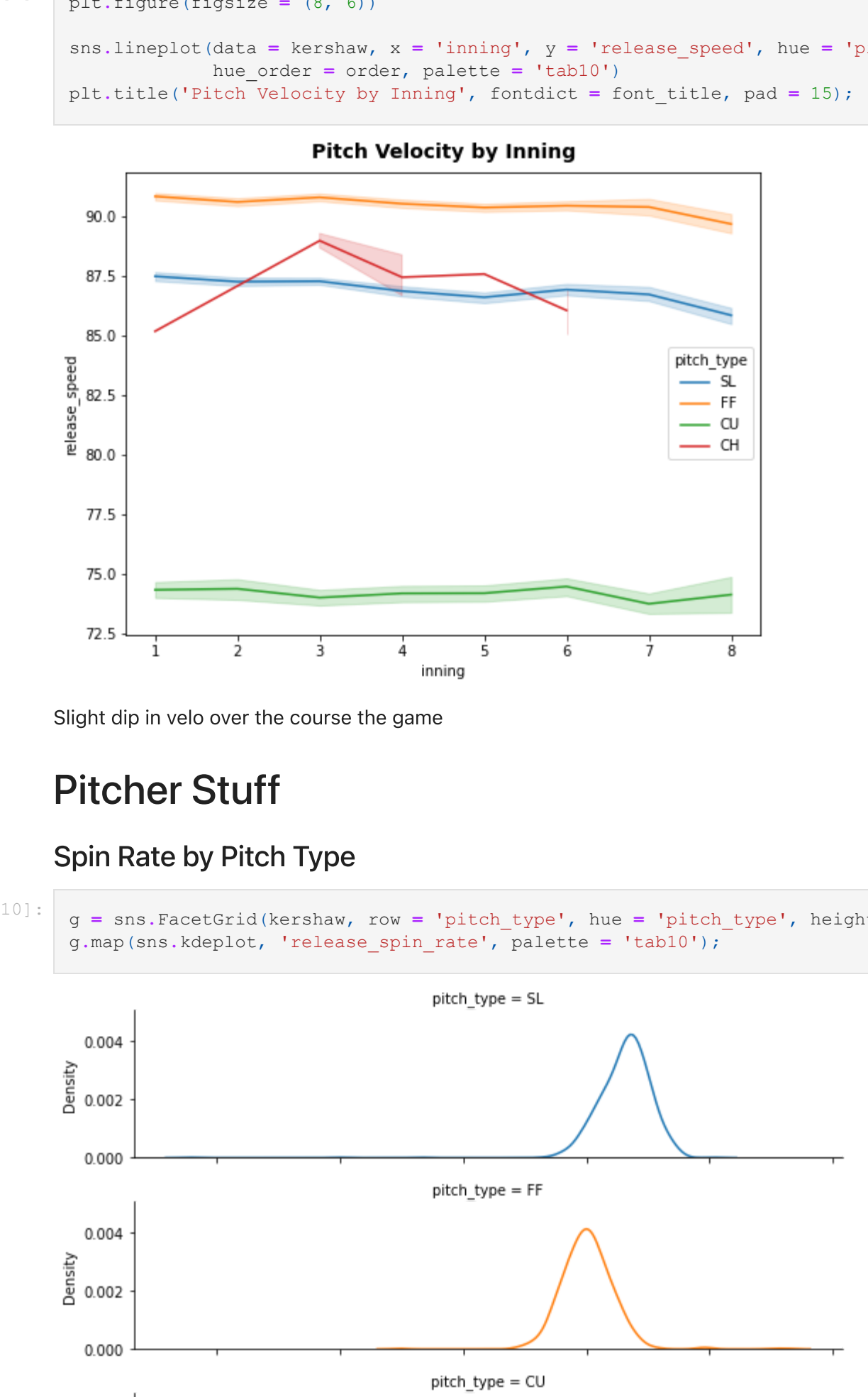


Slight dip in velo over the course the game

Pitcher Stuff

Spin Rate by Pitch Type

In [10]:
```
g = sns.FacetGrid(kershaw, row = 'pitch_type', hue = 'pitch_type', height = 2, aspect = 4, );
g.map(sns.kdeplot, 'release_spin_rate', palette = 'tab10');
```



Slider: Above avg spin (league avg: ~2450 rpm)

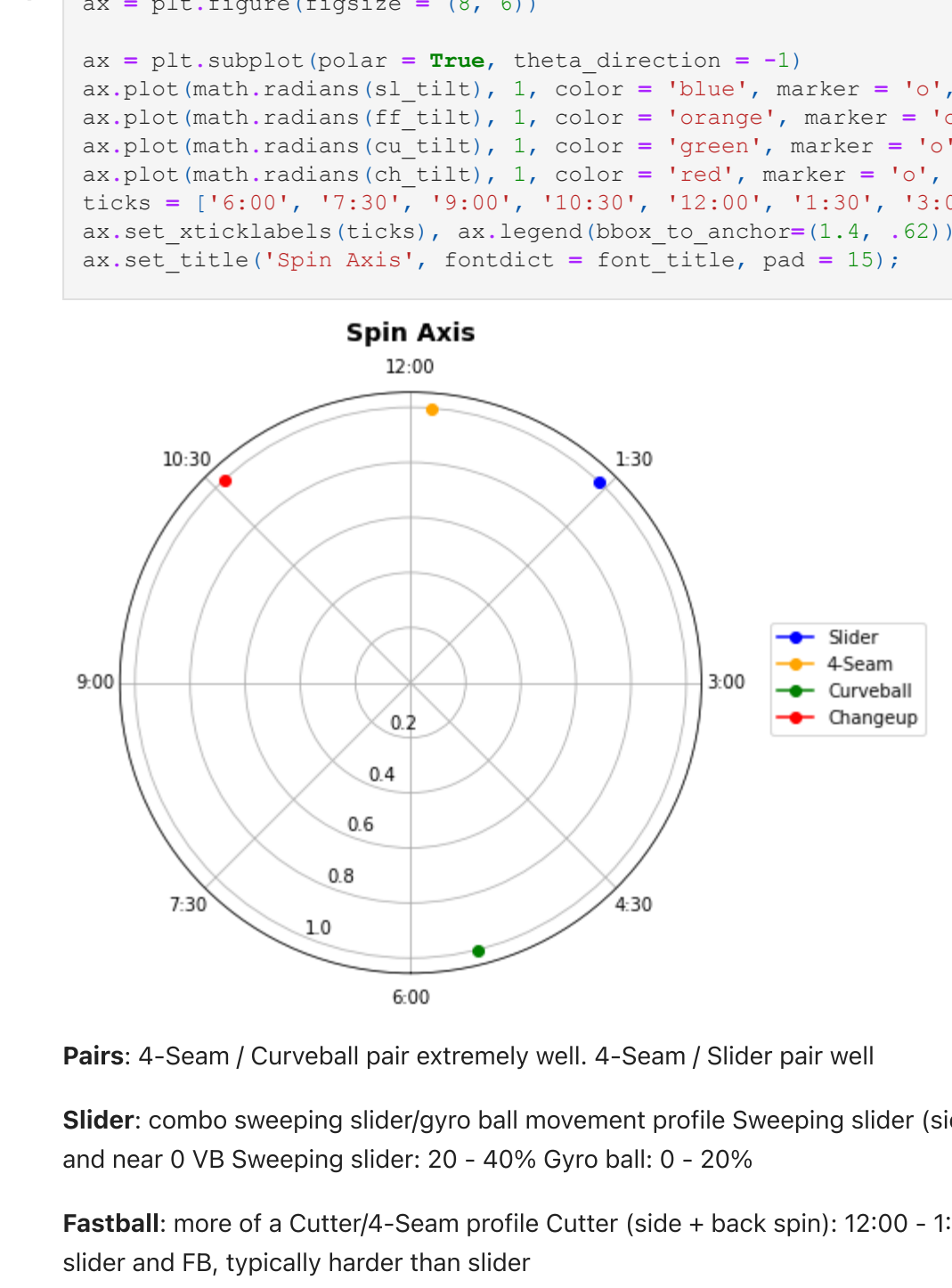
4-Seam: Above avg spin (league avg: ~2200 rpm)

Curveball: Above average spin (league avg: ~2500 rpm)

Changeup: Above average spin (league avg range: ~1200 2400 rpm)

Spin Axis

In [11]:
```
ax = plt.figure(figsize = (8, 6))

ax = plt.subplot(polar = True, theta_direction = -1)
ax.plot(math.radians(sl_tilt), 1, color = 'blue', marker = 'o', label = 'Slider')
ax.plot(math.radians(ff_tilt), 1, color = 'orange', marker = 'o', label = '4-Seam')
ax.plot(math.radians(cu_tilt), 1, color = 'green', marker = 'o', label = 'Curveball')
ax.plot(math.radians(ch_tilt), 1, color = 'red', marker = 'o', label = 'Changeup')
ticks = ['6:00', '7:30', '9:00', '10:30', '12:00', '1:30', '3:00', '4:30']
ax.set_xticklabels(ticks), ax.legend(bbox_to_anchor=(1.4, .62)), ax.set_theta_zero_location("S")
ax.set_title('Spin Axis', fontdict = font_title, pad = 15);
```



Pairs: 4-Seam / Curveball pair extremely well. 4-Seam / Slider pair well

Slider: combo sweeping slider/gyro ball movement profile Sweeping slider (side spin): 2:00 - 4:00 L spin tilt Decent amount of HB and near 0 VB Sweeping slider: 20 - 40% Gyro ball: 0 - 20%

Fastball: more of a Cutter/4-Seam profile Cutter (side + back spin): 12:00 - 1:30 L spin tilt Positive VB & Some HB Hybrid between slider and FB, typically harder than slider

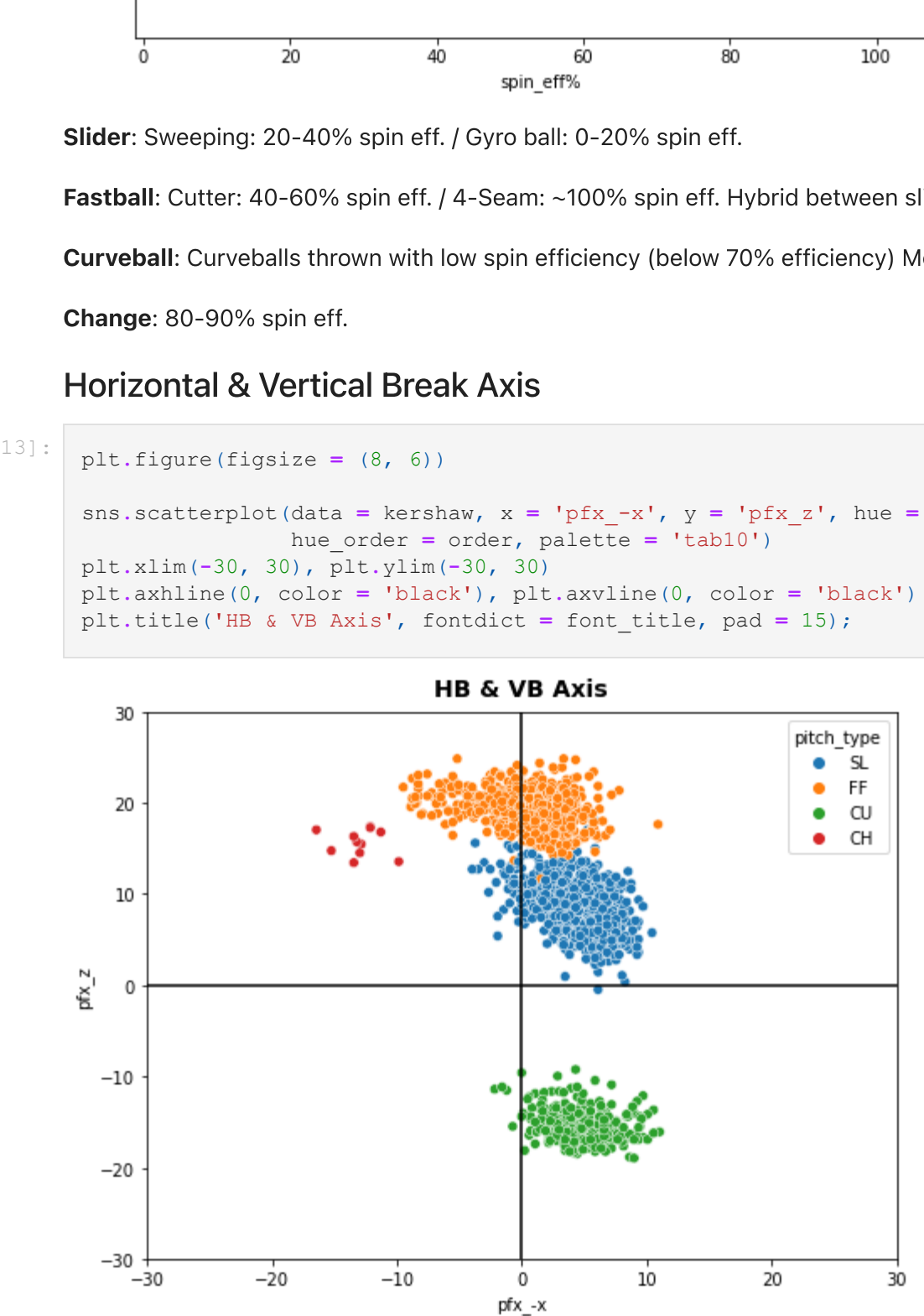
Curveball: True 12-6 banger True 12 - 6 CB: 5:00 - 6:00 L spin tiltMuch more negative VB and minimal HB Curveballs thrown with low spin efficiency (below 70% efficiency) Movement profile gets closer to (0, 0) Higher spin efficiency Movement profile gets further from (0, 0)

Change: straight change Straight change: 10:30 - 12:00 L spin tilt More VB & less HB Spin rate: 1700 - 1800 rpm Spin efficiency: 90% Arm slot: overhand

Spin Efficiency

In [12]:
```
sns.catplot(data = kershaw, x = 'spin_eff%', y = 'pitch_type', kind = 'violin', aspect= 1.5, palette = 'tab10')
plt.title('Spin Efficiency', fontdict = font_title, pad = 15);
print('Slider Avg Spin Eff:', round(sl['spin_eff%'].mean(), 2))
print('4-Seam Avg Spin Eff:', round(ff['spin_eff%'].mean(), 2))
print('Curveball Avg Spin Eff:', round(cu['spin_eff%'].mean(), 2))
print('Changeup Avg Spin Eff:', round(ch['spin_eff%'].mean(), 2));
```

```
Slider Avg Spin Eff: 19.2
4-Seam Avg Spin Eff: 62.42
Curveball Avg Spin Eff: 55.89
Changeup Avg Spin Eff: 78.0
```



Slider: Sweeping: 20–40% spin eff. / Gyro ball: 0–20% spin eff.

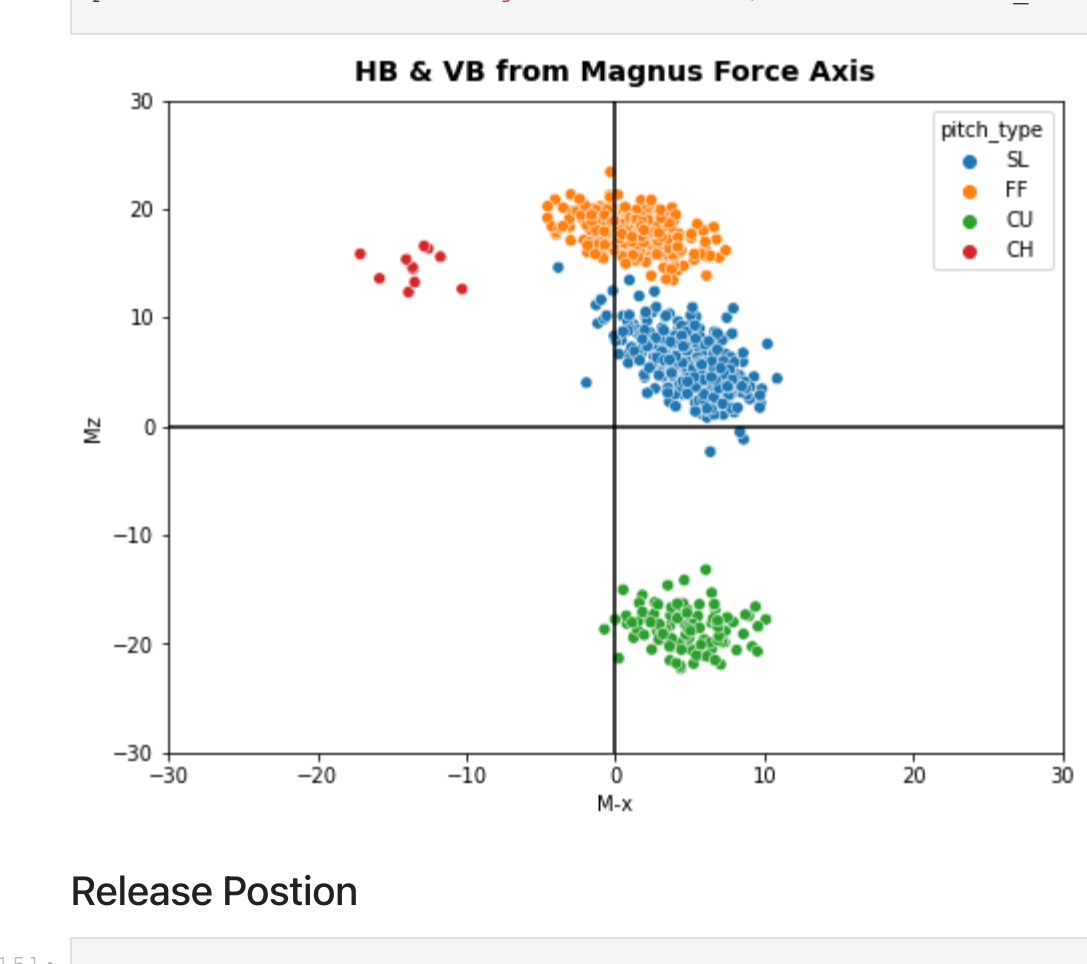
Fastball: Cutter: 40–60% spin eff. / 4-Seam: ~100% spin eff. Hybrid between slider and FB, typically harder than slider

Curveball: Curveballs thrown with low spin efficiency (below 70% efficiency) Movement profile gets closer to (0, 0)

Change: 80–90% spin eff.

Horizontal & Vertical Break Axis

In [13]:
```
plt.figure(figsize = (8, 6))

sns.scatterplot(data = kershaw, x = 'pfx_-x', y = 'pfx_z', hue = 'pitch_type',
                hue_order = order, palette = 'tab10')
plt.xlim(-30, 30), plt.ylim(-30, 30)
plt.axhline(0, color = 'black'), plt.axvline(0, color = 'black')
plt.title('HB & VB Axis', fontdict = font_title, pad = 15);
```



Slider: Decent amount of HB & minimal VB

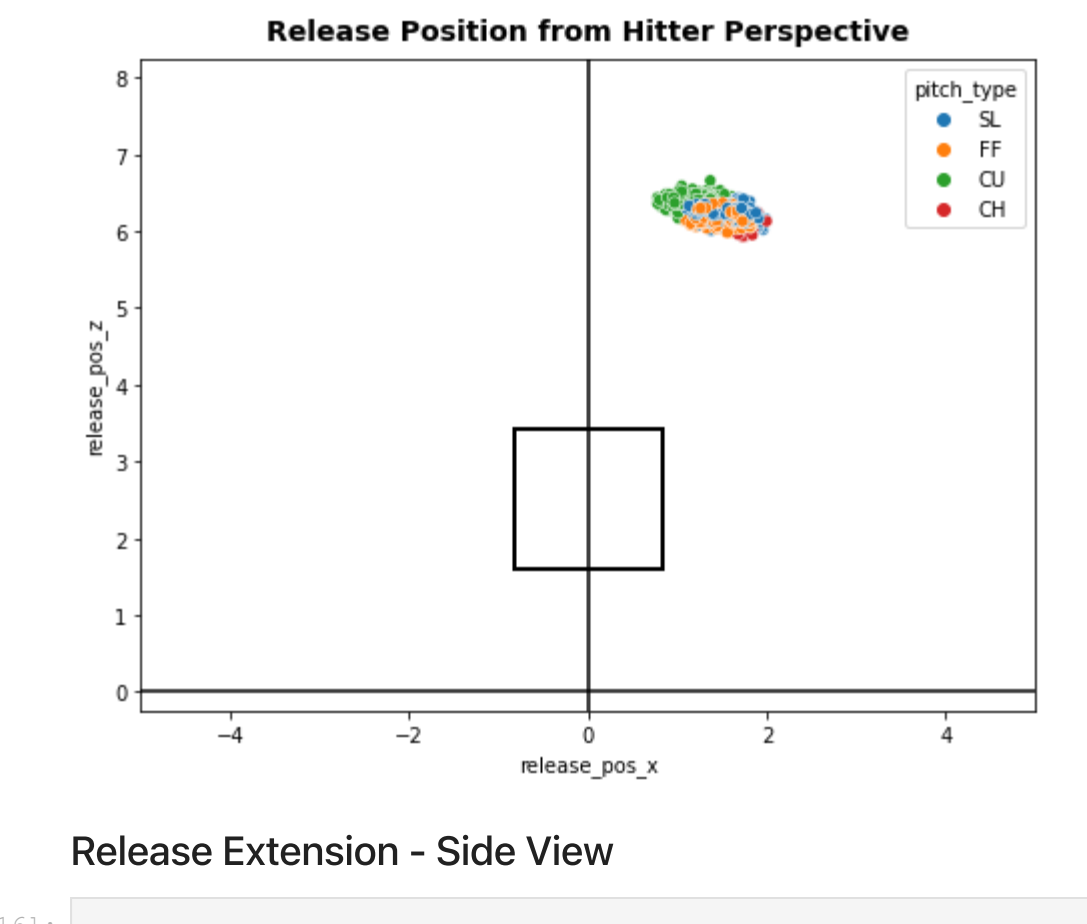
Fastball: Ton of HB & near 0 VB

Curveball: Minimal HB & much more negative VB

Change: Decent HB & VB

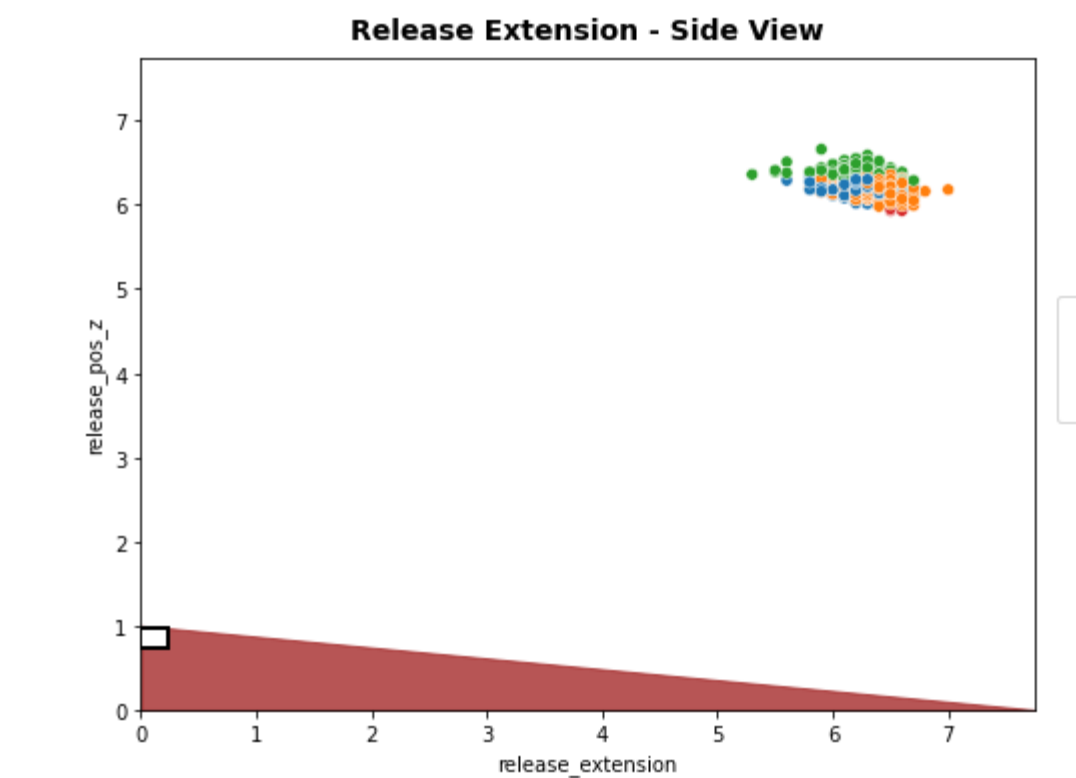
Horizontal & Vertical Break Due to Magnus Force Axis

In [14]:
```
plt.figure(figsize = (8, 6))

sns.scatterplot(data = kershaw, x = 'M-x', y = 'Mz', hue = 'pitch_type',
                hue_order = order, palette = 'tab10')
plt.xlim(-30, 30), plt.ylim(-30, 30)
plt.axhline(0, color = 'black'), plt.axvline(0, color = 'black')
plt.title('HB & VB from Magnus Force Axis', fontdict = font_title, pad = 15);
```



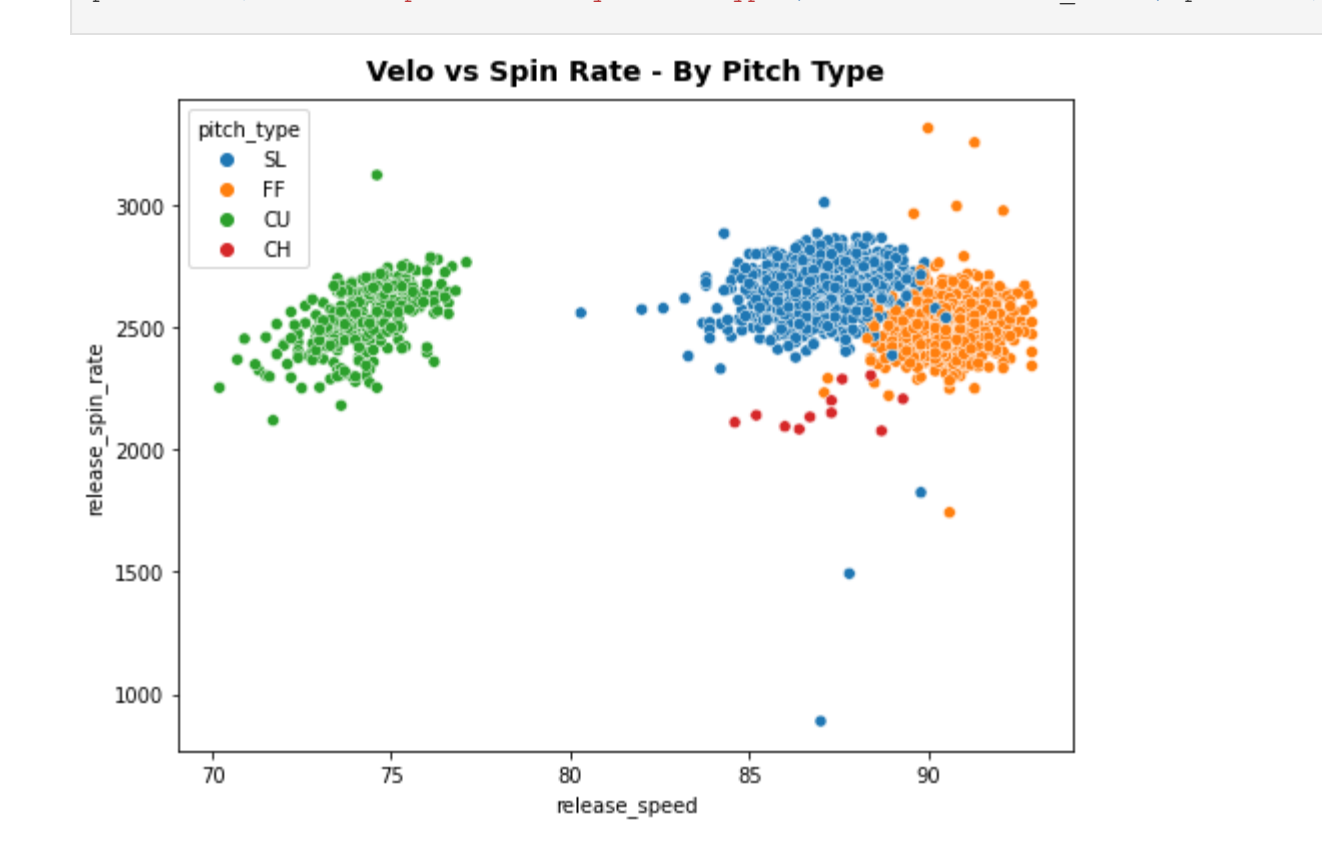
Release Postion

In [15]:
```
plt.figure(figsize = (8, 6))

sns.scatterplot(data = kershaw, x = 'release_pos_x', y = 'release_pos_z', hue = 'pitch_type',
                hue_order = order, palette = 'tab10')
plt.xlim(-5, 5), plt.ylim(-0.25, 8.25)
plt.axvline(0, color = 'black'), plt.axhline(0, color = 'black')
left, bottom, width, height = (-.83, 1.59, 1.66, 1.82)
rect = mpatches.Rectangle((left, bottom), width, height, fill = False, color = 'black', linewidth = 2)
plt.gca().add_patch(rect)
plt.title('Release Position from Hitter Perspective', fontdict = font_title, pad = 15);
```



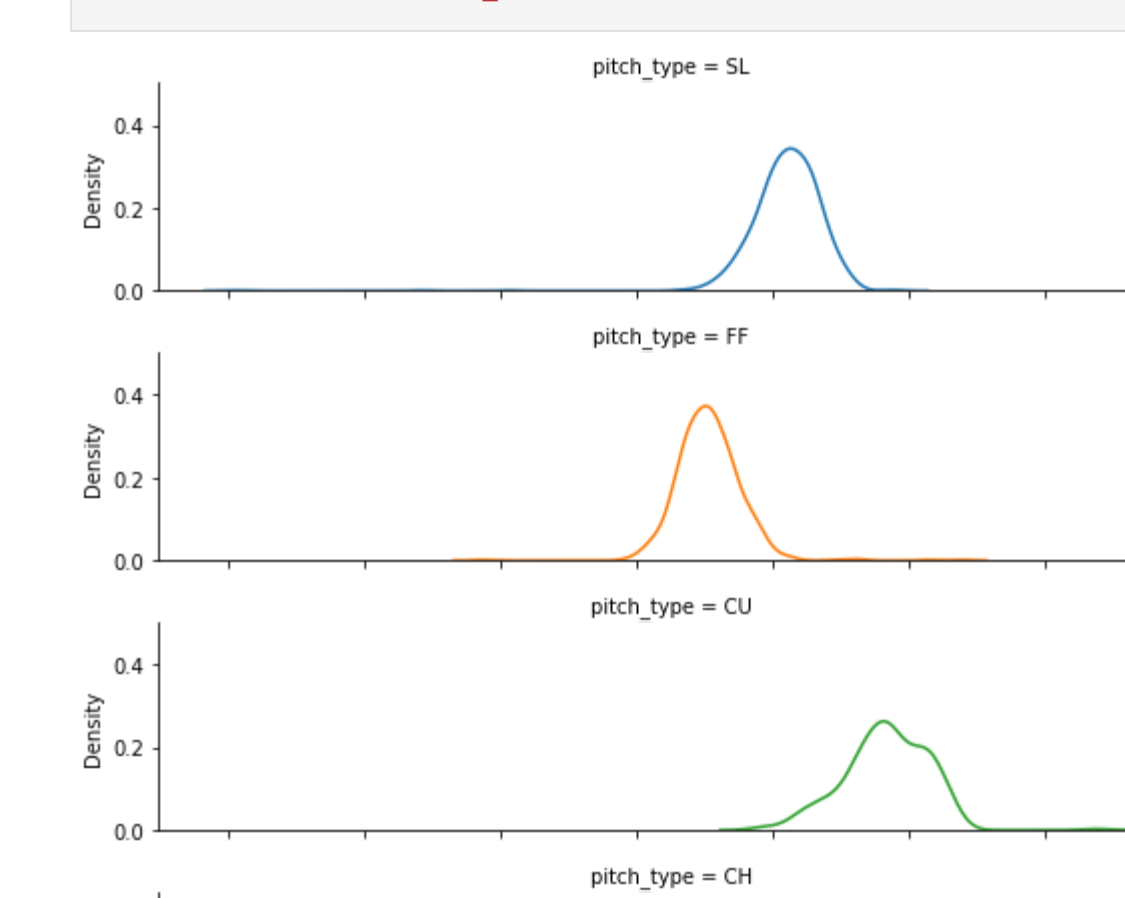
Release Extension - Side View

In [16]:
```
plt.figure(figsize = (8, 6))

sns.scatterplot(data = kershaw, x = 'release_extension', y = 'release_pos_z', hue = 'pitch_type',
                hue_order = order, palette = 'tab10')
plt.xlim(0, 7.75), plt.ylim(0, 7.75)
plt.gca().add_patch(Rectangle((0, .74), .24, .24, fill = True, fc = 'white', ec = 'black', linewidth = 2))
plt.fill_between((7.75, 0), (0, 1), color = 'brown', alpha = .8)
plt.legend(bbox_to_anchor=(1.15, .65))
plt.title('Release Extension - Side View', fontdict = font_title, pad = 15);
```



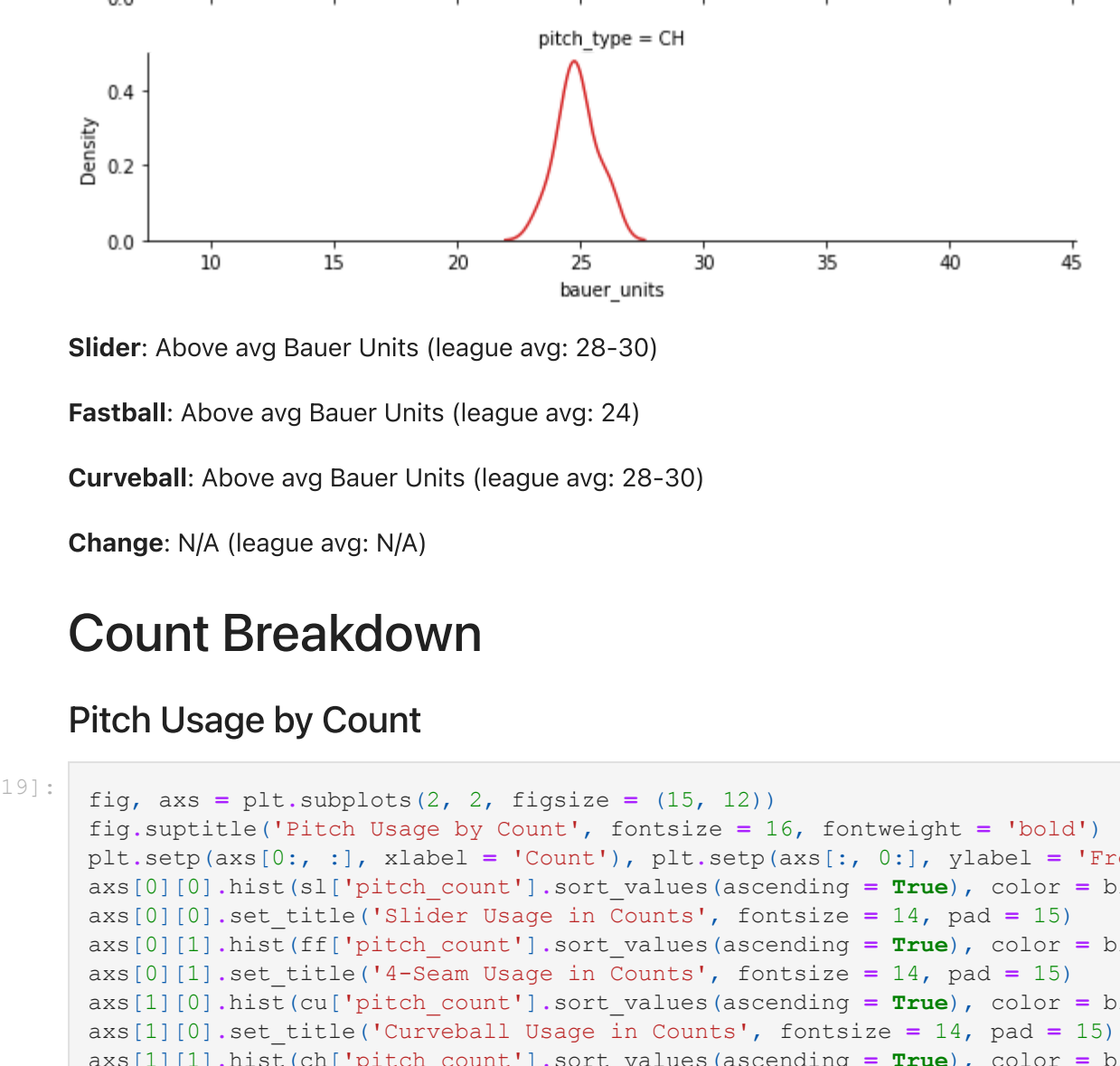
Velocity & Spin Rate

In [17]:
```
plt.figure(figsize = (8, 6))

sns.scatterplot(data = kershaw, x = 'release_speed', y = 'release_spin_rate', hue = 'pitch_type',
                hue_order = order, palette = 'tab10')
plt.title('Velo vs Spin Rate - By Pitch Type', fontdict = font_title, pad = 15);
```



Bauer Units

In [18]:
```
g = sns.FacetGrid(kershaw, row = 'pitch_type', hue = 'pitch_type', height = 2, aspect = 4, )
g.map(sns.kdeplot, 'bauer_units', palette = 'tab10');
```



Slider: Above avg Bauer Units (league avg: 28-30)

Fastball: Above avg Bauer Units (league avg: 24)

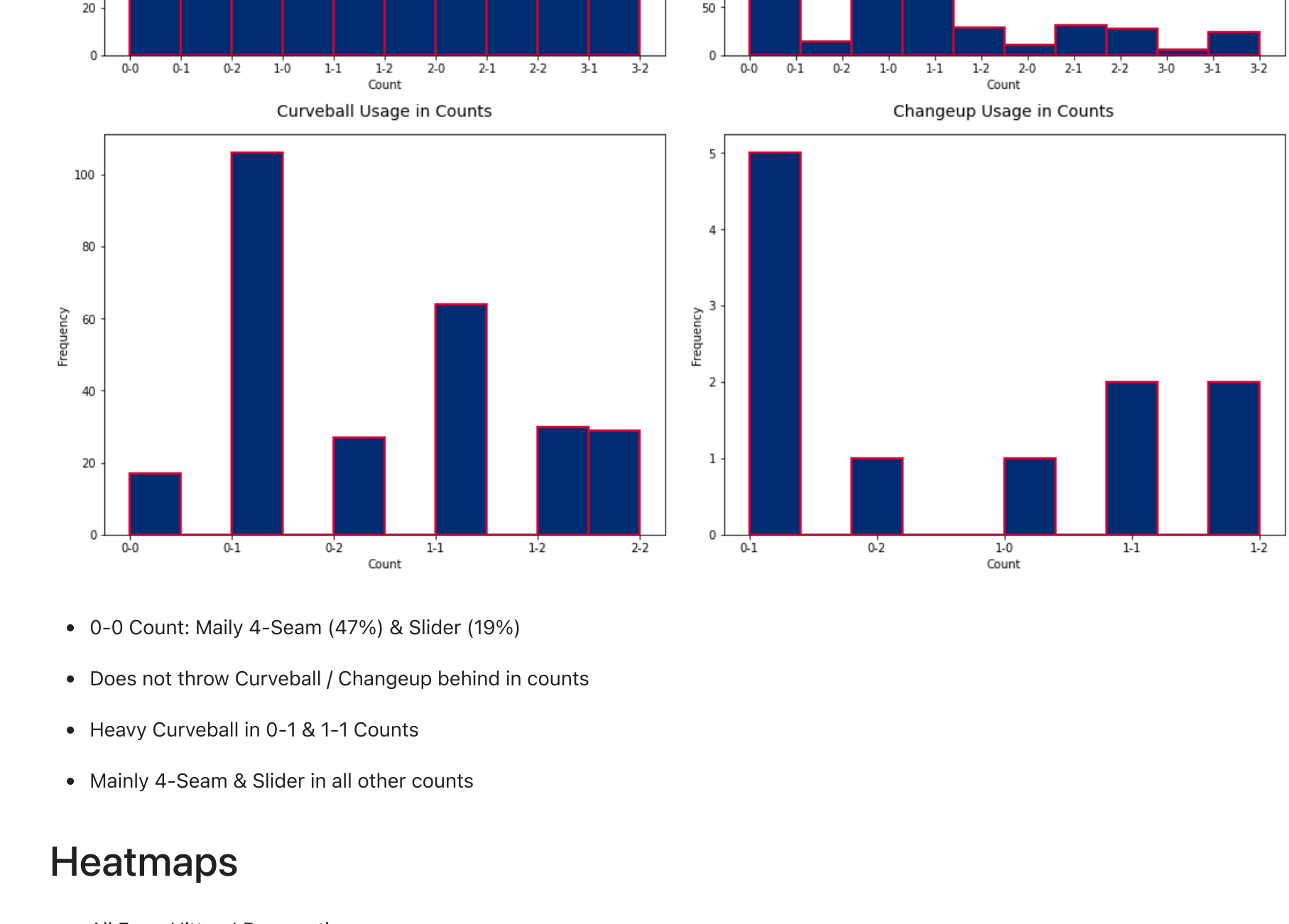
Curveball: Above avg Bauer Units (league avg: 28-30)

Change: N/A (league avg: N/A)

Count Breakdown

Pitch Usage by Count

In [19]:
```
fig, axs = plt.subplots(2, 2, figsize = (15, 12))
fig.suptitle('Pitch Usage by Count', fontsize = 16, fontweight = 'bold')
plt.setp(axs[0:, :], xlabel = 'Count'), plt.setp(axs[:, 0:], ylabel = 'Frequency')
axs[0][0].hist(sl['pitch_count'].sort_values(ascending = True), color = blue, edgecolor = red, linewidth = 2)
axs[0][0].set_title('Slider Usage in Counts', fontsize = 14, pad = 15)
axs[0][1].hist(ff['pitch_count'].sort_values(ascending = True), color = blue, edgecolor = red, linewidth = 2)
axs[0][1].set_title('4-Seam Usage in Counts', fontsize = 14, pad = 15)
axs[1][0].hist(cu['pitch_count'].sort_values(ascending = True), color = blue, edgecolor = red, linewidth = 2)
axs[1][0].set_title('Curveball Usage in Counts', fontsize = 14, pad = 15)
axs[1][1].hist(ch['pitch_count'].sort_values(ascending = True), color = blue, edgecolor = red, linewidth = 2)
axs[1][1].set_title('Changeup Usage in Counts', fontsize = 14, pad = 15)
plt.tight_layout();
```



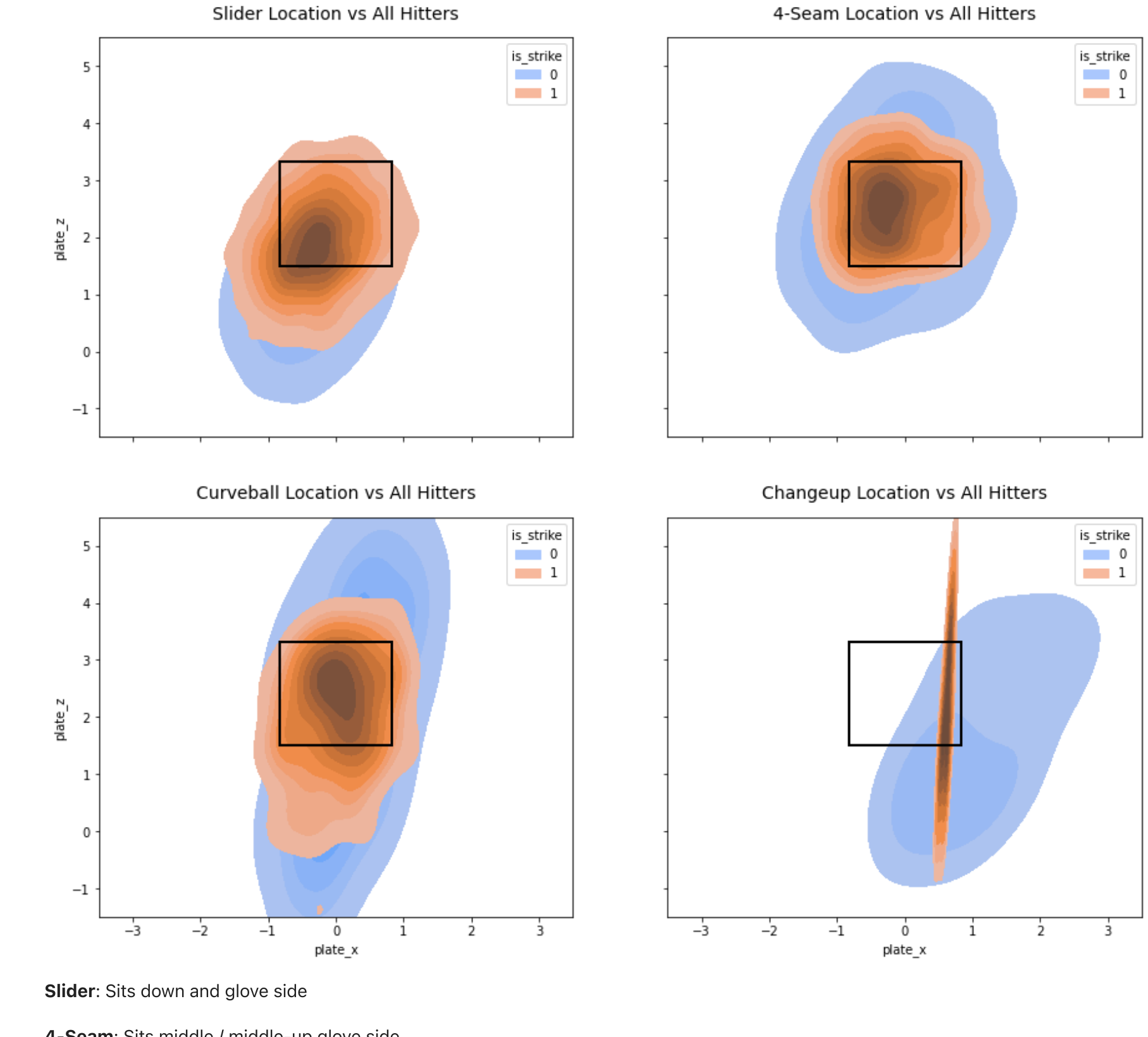
- 0-0 Count: Maily 4-Seam (47%) & Slider (19%)
- Does not throw Curveball / Changeup behind in counts
- Heavy Curveball in 0-1 & 1-1 Counts
- Mainly 4-Seam & Slider in all other counts

Heatmaps

- All From Hitters' Perspective

Pitch Location by Pitch Type

In [20]:
```
fig, axs = plt.subplots(2, 2, figsize = (15, 13), sharex = True, sharey = True)
fig.suptitle('Pitch Location by Pitch Type', fontsize = 16, fontweight = 'bold')
plt.axis(xmin = -3.5, xmax = 3.5), plt.axis(ymin = -1.5, ymax = 5.5)
sns.kdeplot(ax = axs[0][0],data=sl,x='plate_x',y='plate_z',fill=True,hue='is_strike',palette='coolwarm')
axs[0][0].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][0].set_title('Slider Location vs All Hitters', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[0][1],data=ff,x='plate_x',y='plate_z',fill = True,hue='is_strike',palette='coolwarm')
axs[0][1].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][1].set_title('4-Seam Location vs All Hitters', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[1][0],data=cu,x='plate_x',y='plate_z',fill=True,hue='is_strike',palette='coolwarm')
axs[1][0].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][0].set_title('Curveball Location vs All Hitters', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[1][1],data=ch,x='plate_x',y='plate_z',fill=True,hue='is_strike',palette='coolwarm')
axs[1][1].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][1].set_title('Changeup Location vs All Hitters', fontsize = 14, pad = 15);
```



Slider: Sits down and glove side

4-Seam: Sits middle / middle-up glove side

Curveball: Sits middle middle

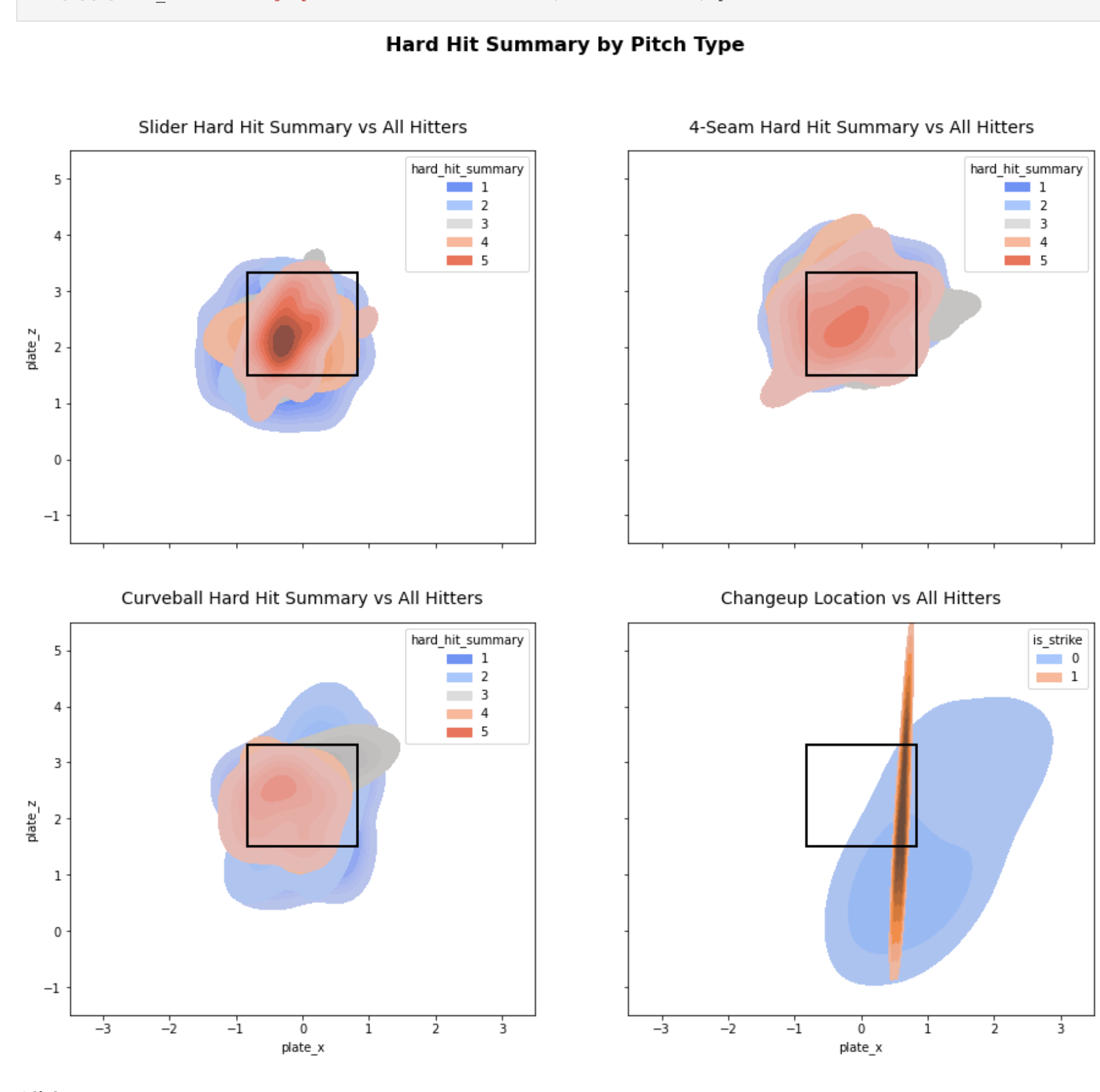
Changeup: Sits down and arm side

Hard Hit Summary by Pitch Type

1. 0-85 EV 2. 85-90 EV 3. 90-95 EV 4. 95-100 EV 5. 100+ EV

In [21]:

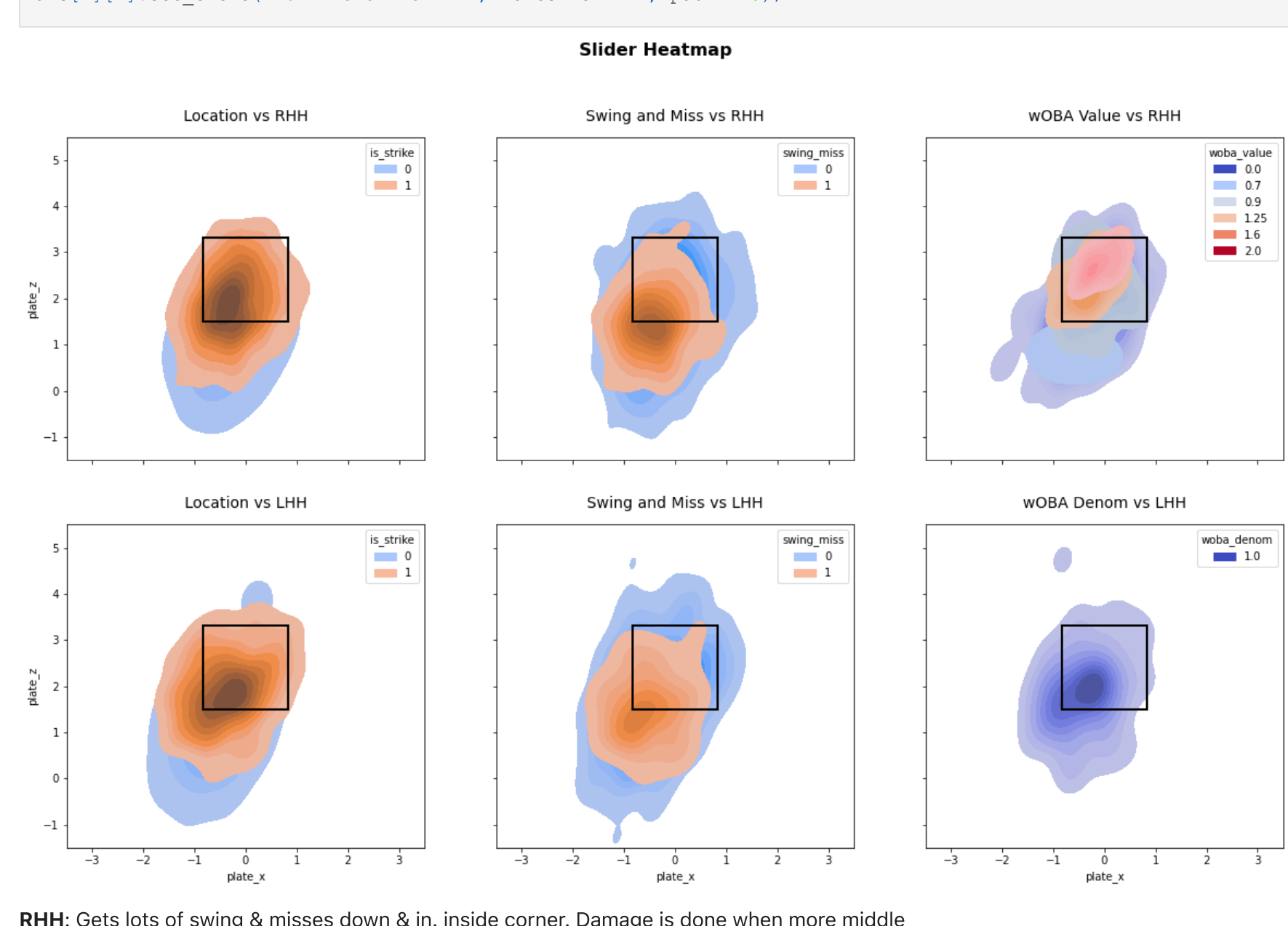
```
fig, axs = plt.subplots(2, 2, figsize = (15, 13), sharex = True, sharey = True)
fig.suptitle('Hard Hit Summary by Pitch Type', fontsize = 16, fontweight = 'bold')
plt.axis(xmin = -3.5, xmax = 3.5), plt.axis(ymin = -1.5, ymax = 5.5)
sns.kdeplot(ax=axs[0][0],data=sl,x='plate_x',y='plate_z',fill=True,hue='hard_hit_summary',palette='coolwarm')
axs[0][0].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][0].set_title('Slider Hard Hit Summary vs All Hitters', fontsize = 14, pad = 15)
sns.kdeplot(ax=axs[0][1],data=ff,x='plate_x',y='plate_z',fill = True,hue='hard_hit_summary',palette='coolwarm')
axs[0][1].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][1].set_title('4-Seam Hard Hit Summary vs All Hitters', fontsize = 14, pad = 15)
sns.kdeplot(ax=axs[1][0],data=cu,x='plate_x',y='plate_z',fill=True,hue='hard_hit_summary',palette='coolwarm')
axs[1][0].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][0].set_title('Curveball Hard Hit Summary vs All Hitters', fontsize = 14, pad = 15)
sns.kdeplot(ax=axs[1][1],data=ch,x='plate_x',y='plate_z',fill=True,hue='is_strike',palette='coolwarm')
axs[1][1].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][1].set_title('Changeup Location vs All Hitters', fontsize = 14, pad = 15);
```



Slider Heatmaps

In [22]:

```
fig, axs = plt.subplots(2, 3, figsize = (20, 12), sharex = True, sharey = True)
fig.suptitle('Slider Heatmap', fontsize = 16, fontweight = 'bold')
plt.axis(xmin = -3.5, xmax = 3.5), plt.axis(ymin = -1.5, ymax = 5.5)
sns.kdeplot(ax = axs[0][0],data=r_sl,x='plate_x',y='plate_z',fill=True,hue='is_strike',palette='coolwarm')
axs[0][0].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][0].set_title('Location vs RHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[0][1],data=r_sl,x='plate_x',y='plate_z',fill = True,hue='swing_miss',palette='coolwarm')
axs[0][1].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][1].set_title('Swing and Miss vs RHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[0][2],data=r_sl,x='plate_x',y='plate_z',fill=True,hue='woba_value',palette='coolwarm')
axs[0][2].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][2].set_title('wOBA Value vs RHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[1][0],data=l_sl,x='plate_x',y='plate_z',fill=True,hue='is_strike',palette='coolwarm')
axs[1][0].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][0].set_title('Location vs LHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[1][1],data=l_sl,x='plate_x',y ='plate_z',fill=True,hue='swing_miss',palette='coolwarm')
axs[1][1].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][1].set_title('Swing and Miss vs LHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[1][2],data=l_sl,x='plate_x',y='plate_z',fill=True,hue='woba_denom',palette='coolwarm')
axs[1][2].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][2].set_title('wOBA Denom vs LHH', fontsize = 14, pad = 15);
```



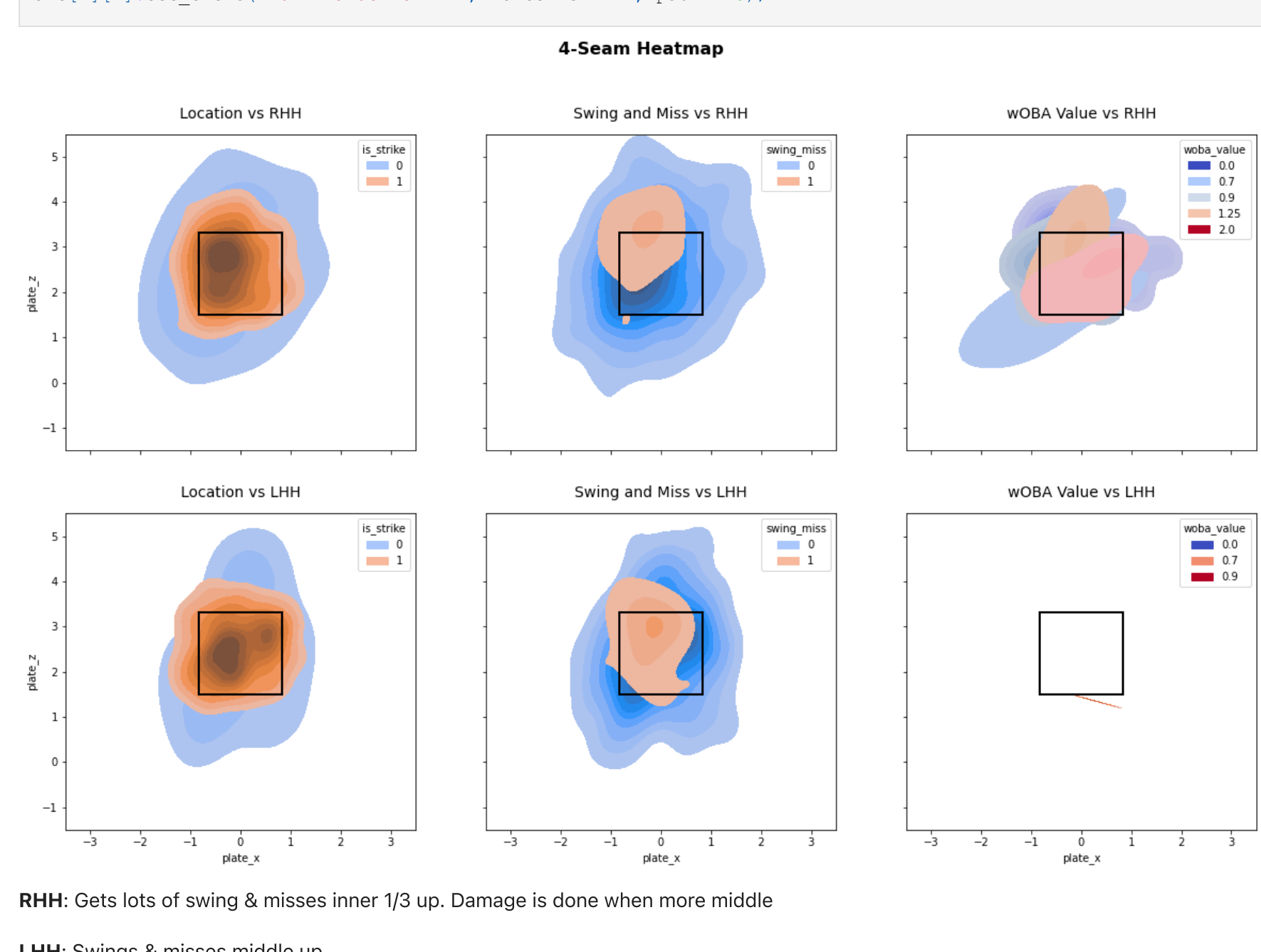
RHH: Gets lots of swing & misses down & in. inside corner. Damage is done when more middle

LHH: Lots of swings & misses down & away. Damage done middle middle

4-Seam Heatmaps

In [23]:

```
fig, axs = plt.subplots(2, 3, figsize = (20, 12), sharex = True, sharey = True)
fig.suptitle('4-Seam Heatmap', fontsize = 16, fontweight = 'bold')
plt.axis(xmin = -3.5, xmax = 3.5), plt.axis(ymin = -1.5, ymax = 5.5)
sns.kdeplot(ax = axs[0][0],data=r_ff,x='plate_x',y='plate_z',fill=True,hue='is_strike',palette='coolwarm')
axs[0][0].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][0].set_title('Location vs RHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[0][1],data=r_ff,x='plate_x',y='plate_z',fill = True,hue='swing_miss',palette='coolwarm')
axs[0][1].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][1].set_title('Swing and Miss vs RHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[0][2],data=r_ff,x='plate_x',y='plate_z',fill=True,hue='woba_value',palette='coolwarm')
axs[0][2].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][2].set_title('wOBA Value vs RHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[1][0],data=l_ff,x='plate_x',y='plate_z',fill=True,hue='is_strike',palette='coolwarm')
axs[1][0].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][0].set_title('Location vs LHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[1][1],data=l_ff,x='plate_x',y ='plate_z',fill=True,hue='swing_miss',palette='coolwarm')
axs[1][1].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][1].set_title('Swing and Miss vs LHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[1][2],data=l_ff,x='plate_x',y='plate_z',fill=True,hue='woba_value',palette='coolwarm')
axs[1][2].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][2].set_title('wOBA Value vs LHH', fontsize = 14, pad = 15);
```



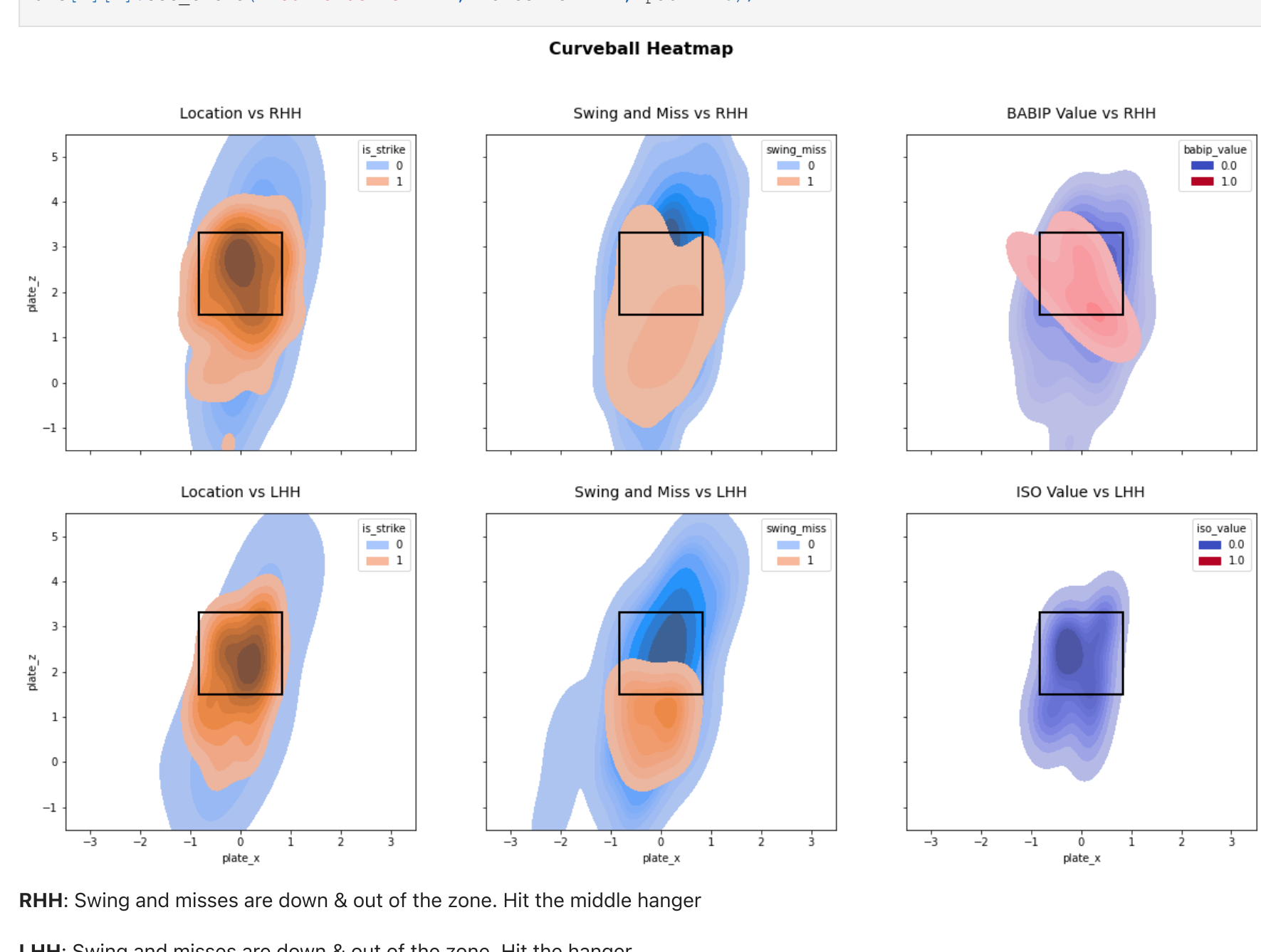
RHH: Gets lots of swing & misses inner 1/3 up. Damage is done when more middle

LHH: Swings & misses middle up

Curveball Heatmaps

In [24]:

```
fig, axs = plt.subplots(2, 3, figsize = (20, 12), sharex = True, sharey = True)
fig.suptitle('Curveball Heatmap', fontsize = 16, fontweight = 'bold')
plt.axis(xmin = -3.5, xmax = 3.5), plt.axis(ymin = -1.5, ymax = 5.5)
sns.kdeplot(ax = axs[0][0],data=r_cu,x='plate_x',y='plate_z',fill=True,hue='is_strike',palette='coolwarm')
axs[0][0].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][0].set_title('Location vs RHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[0][1],data=r_cu,x='plate_x',y='plate_z',fill = True,hue='swing_miss',palette='coolwarm')
axs[0][1].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][1].set_title('Swing and Miss vs RHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[0][2],data=r_cu,x='plate_x',y='plate_z',fill=True,hue='babip_value',palette='coolwarm')
axs[0][2].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[0][2].set_title('BABIP Value vs RHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[1][0],data=l_cu,x='plate_x',y='plate_z',fill=True,hue='is_strike',palette='coolwarm')
axs[1][0].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][0].set_title('Location vs LHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[1][1],data=l_cu,x='plate_x',y ='plate_z',fill=True,hue='swing_miss',palette='coolwarm')
axs[1][1].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][1].set_title('Swing and Miss vs LHH', fontsize = 14, pad = 15)
sns.kdeplot(ax = axs[1][2],data=l_cu,x='plate_x',y='plate_z',fill=True,hue='iso_value',palette='coolwarm')
axs[1][2].add_patch(Rectangle((-.83, 1.5), 1.66, 1.82, fill = False, color = 'black', linewidth = 2))
axs[1][2].set_title('ISO Value vs LHH', fontsize = 14, pad = 15);
```



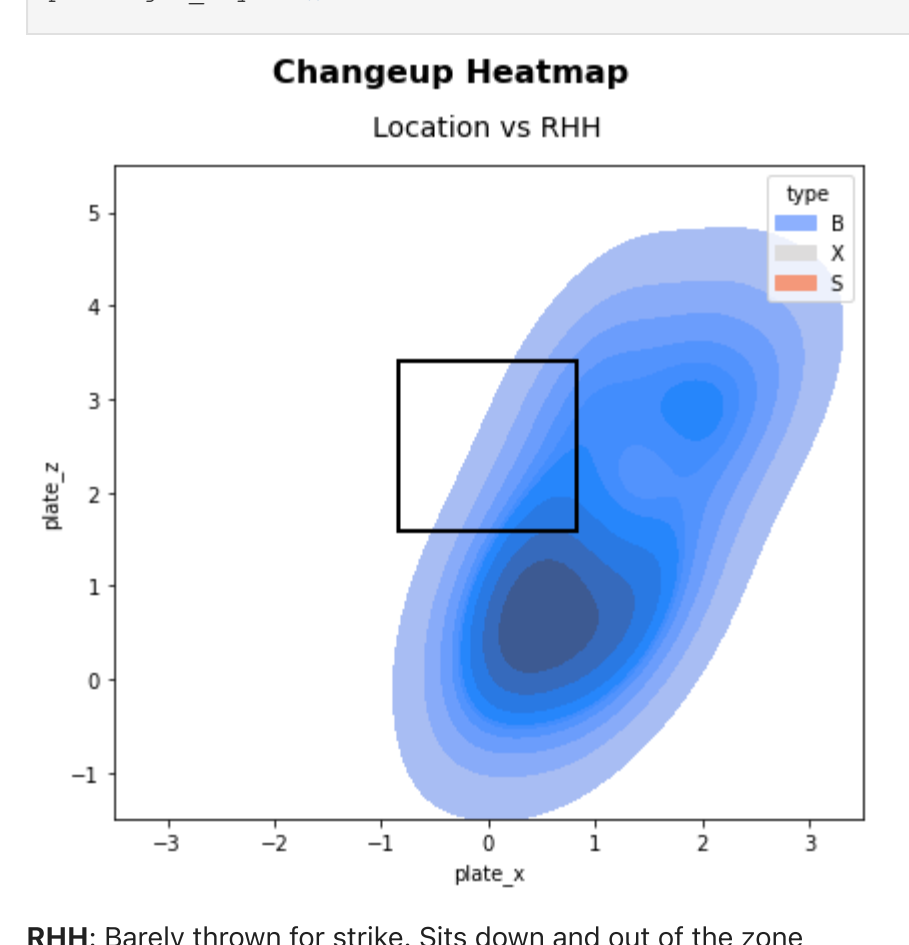
RHH: Swing and misses are down & out of the zone. Hit the middle hanger

LHH: Swing and misses are down & out of the zone. Hit the hanger

Changeup Heatmaps

In [25]:

```
plt.figure(figsize = (6, 6))

sns.kdeplot(data = r_ch, x = 'plate_x', y = 'plate_z', fill = True, hue = 'type', palette='coolwarm')
plt.gca().add_patch(Rectangle((left, bottom), width, height, fill = False, color = 'black', linewidth = 2))
plt.xlim(-3.5, 3.5), plt.ylim(-1.5, 5.5)
plt.suptitle('Changeup Heatmap', fontsize = 16, fontweight = 'bold')
plt.title('Location vs RHH', fontsize = 14, pad = 15)
plt.tight_layout();
```



RHH: Barely thrown for strike. Sits down and out of the zone