example_basketball

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```
In [2]: import matplotlib.pyplot as plt
        from scipy.stats import binom
        import numpy as np
        import math

        trials = 100
        prob_two_point = 0.6
        prob_three_point = 0.4

        inputs_two_point = [binom.ppf(x, trials, prob_two_point) for x in np.arange(0, 1, 0.01
        inputs_three_point = [binom.ppf(x, trials, prob_three_point) for x in np.arange(0, 1, 
        pdf_two_point = [binom.pmf(x, trials, prob_two_point) for x in inputs_two_point]
        pdf_three_point = [binom.pmf(x, trials, prob_three_point) for x in inputs_three_point]
        plt.plot(inputs_two_point[1:], pdf_two_point[1:])
        plt.plot(inputs_three_point[1:], pdf_three_point[1:])

Out[2]: [<matplotlib.lines.Line2D at 0x115672cf8>]

In [27]: trials = 100
         prob_two_point = 0.6
         prob_three_point = 0.4

         fig, axs = plt.subplots(2, 1)

         shot_attempts = list(range(101))
         points_twos = [2*s for s in shot_attempts]
         points_threes = [3*s for s in shot_attempts]
         pdf_two_point = [1 / 2 * binom.pmf(x, trials, prob_two_point) for x in shot_attempts]
         pdf_three_point = [1 / 3 * binom.pmf(x, trials, prob_three_point) for x in shot_attem
         axs[0].plot(points_twos[34:90], pdf_two_point[34:90], label='two_point')
         axs[0].plot(points_threes[23:60], pdf_three_point[23:60], label='three_point')
         axs[0].legend(loc='upper left')
         axs[0].set_title('point pdf')

         cdf_two_point = np.array(pdf_two_point).cumsum() * 2
         cdf_three_point = np.array(pdf_three_point).cumsum() * 3
         axs[1].plot(points_twos[34:95], cdf_two_point[34:95], label='two_point')
```

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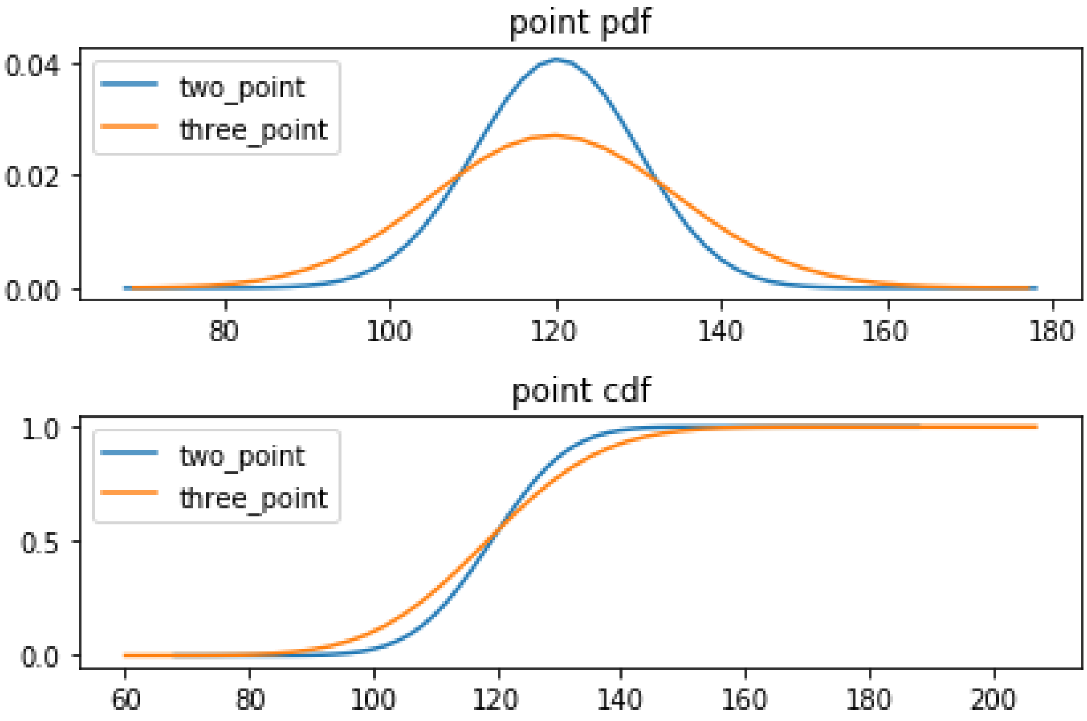
axs[1].plot(points_threes[20:70], cdf_three_point[20:70], label='three_point')
axs[1].legend(loc='upper left')
axs[1].set_title('point cdf')
plt.tight_layout()
```



```
In [120]: def game_outcome_probabilities(shot_attempts, prob_three, prob_two):
              """probability of a three point only shooting team beating a two point only
              shooting team x_N_pt = number of baskets made for the N point shooting team
              Prob(three_point_team_wins) =
              Prob(two_point_team_points < three_point_team_points) =
              P(2*x_two_pt < 3*x_three_pt) =
              P(x_two_pt < 1.5*x_three_pt) =
              Sum[n=0..trials]P(x_two_pt < 1.5*x_three_pt|x_three_pt = n)P(x_three_pt = n)

              Args:
                  shot_attempts (int): number of shots taken by each team
                  prob_three (float): probability of score for the three point taking team
                  prob_two (float): probability of score for the two point taking team

              Returns:
                  float: probability that team 3 beats team 2
              """
              prob_three_wins = 0
              prob_tie = 0
```

```
    for made_threes in np.arange(shot_attempts + 1):
        prob_made_threes = binom.pmf(made_threes, shot_attempts, prob_three)
        max_two_made_still_lose = math.floor(1.5*made_threes)
        if 2 * max_two_made_still_lose == 3 * made_threes:
            prob_tie = (prob_tie
                        + binom.pmf(max_two_made_still_lose, shot_attempts, prob_two
                        * prob_made_threes)
            max_two_made_still_lose = max_two_made_still_lose - 1
        if max_two_made_still_lose < 0:
            continue
        two_make_cdf = binom.cdf(max_two_made_still_lose, shot_attempts, prob_two)
        prob_three_wins = prob_three_wins + two_make_cdf * prob_made_threes

        res = {'three wins': prob_three_wins,
               'tie': prob_tie,
               'two wins': 1 - prob_three_wins - prob_tie}
    return res
```

In [121]:
```
game_outcome_probabilities(100, 0.4, 0.6)
```

Out[121]:
```
{'three wins': 0.48669876602489426,
 'tie': 0.022551579228201415,
 'two wins': 0.49074965474690435}
```

In [14]:
```
pdf_two_point.cum_sum()
```

```
    ---------------------------------------------------------------------------

    AttributeError                            Traceback (most recent call last)

    <ipython-input-14-a4c314c3eeca> in <module>
----> 1 pdf_two_point.cum_sum()


    AttributeError: 'list' object has no attribute 'cum_sum'
```

In [ ]: