simulation

September 14, 2024

```python
[10]: # Import the libraries
      import random
      import matplotlib.pyplot as plt

      #Define the cards and create the tuple to hold the whole deck
      suits = ['hearts', 'diamonds', 'clubs', 'spades']
      ranks = ['2', '3', '4', '5', '6', '7', '8', '9', '10', 'Jack', 'Queen', 'King',
       ↪'Ace']
      deck = [(rank, suit) for suit in suits for rank in ranks]

      # What is known
      total_cards = 52
      hearts_count = 13
      face_card_count = 12

      heart_prob = hearts_count / total_cards
      face_prob = face_card_count / total_cards
```

```python
[13]: print(f'Probability of picking the heart: \n {heart_prob}')
      print(f'Probability of picking face card: \n {face_prob:.2f}')
```

```
Probability of picking the heart:
 0.25
Probability of picking face card:
 0.23
```

```python
[14]: # Calculate probabilities in a sample
      def calculate_sample_probabilities(sample):
          hearts_in_sample = sum(1 for card in sample if card[1] == 'hearts')
          face_cards_in_sample = sum(1 for card in sample if card[0] in ['Jack',
       ↪'Queen', 'King'])
          return hearts_in_sample / len(sample), face_cards_in_sample / len(sample)
```

```python
[17]: # Simulate drawing cards
      sample_size_range = list(range(1, 53))
      prob_heart_simulation = []
      prob_face_simulation = []
```

```python
# Run simulations for sample sizes from 1 to 52
for sample_size in sample_size_range:
    sample = random.sample(deck, sample_size)
    prob_heart, prob_face = calculate_sample_probabilities(sample)
    prob_heart_simulation.append(prob_heart)
    prob_face_simulation.append(prob_face)

# Plot calculated and simulated probabilities for hearts and face cards
plt.figure(figsize=(10, 6))

# Plot hearts probabilities
plt.plot(sample_size_range, prob_heart_simulation, label='Simulated Heart␣
 ↪Probability', marker='o')
plt.axhline(y=heart_prob, color='r', linestyle='-', label='Theoretical Heart␣
 ↪Probability')

# Plot face card probabilities
plt.plot(sample_size_range, prob_face_simulation, label='Simulated Face Card␣
 ↪Probability', marker='x')
plt.axhline(y=face_prob, color='g', linestyle='-', label='Theoretical Face Card␣
 ↪Probability')

plt.xlabel('Sample Size')
plt.ylabel('Probability')
plt.title('Simulated vs Theoretical Probabilities (Hearts and Face Cards)')
plt.legend()
plt.grid(True)
plt.show()
```
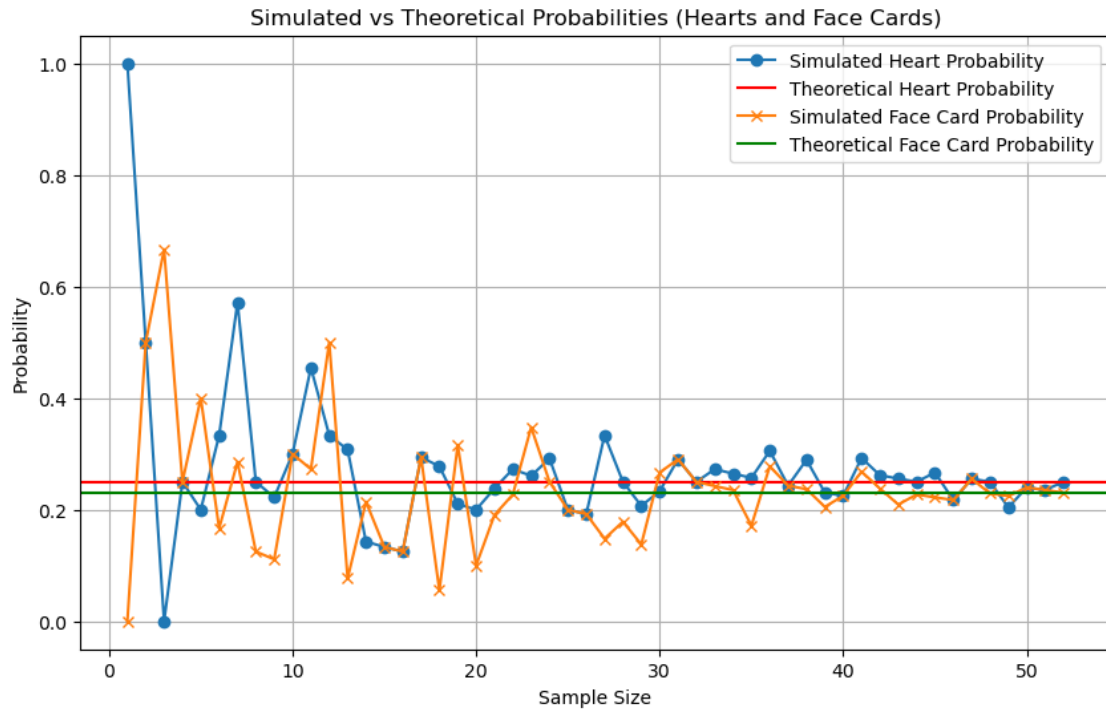
Simulated vs Theoretical Probabilities (Hearts and Face Cards)

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