The Cumulative Distribution Function - Lab

Introduction

In the previous lesson, you learned how you can create a cumulative distribution function for discrete and continuous random variables. In this lab, you'll try to calculate a CDF for a dice roll yourself, and visualize it.

Objectives

You will be able to:

- Calculate CDF in Python for a given discrete variable with a limited set of possible values
- Visualize and inspect a CDF in order to make assumptions about the underlying data

Calculating CDF in Python

Recall the formula to calculate the cumulative probability from the previous lesson:

$$F(x) = P(X \leq x)$$

So given a list of all possible values of x, We can easily calculate the CDF for a given possible value X by performing the following steps:

- Build a function `calculate_cdf(lst,X)` , where `lst` is a list of all possible values in a discrete variable x (6 values for a dice roll), and X is the value for which we want to calculate the cumulative distribution function
- Initialize a variable called `count`
- For all values in `lst` , if a value is less than or equal to X, add one to `count` - do nothing otherwise. (this will tell us the total number of values less than X)
- Calculate the cumulative probability of X dividing `count` by the total number of possible values
- Round by 3 decimals and return the cumulative probability of X

```
def calculate_cdf(lst, X):
    count = 0
    for value in lst:
        if value <= X:
            count += 1

    cum_prob = count / len(lst) # normalizing cumulative probabilities (as with pmfs
    return round(cum_prob, 3)

# test data
test_lst = [1,2,3]
test_X = 2

calculate_cdf(test_lst, test_X)
```

```
0.667
```

Now, use this function to calculate a CDF for each value in a dice roll so you can plot it later on.

Perform the following steps in the cell below:

- Create a list `dice_lst` with all possible values of a fair dice
- Initialize an empty list `dice_cum` for storing cumulative probabilities for these values.
- For each value in the `dice_lst` calculate its cumulative probability using the function above and store in `dice_cum` list.

```
dice_lst = [1,2,3,4,5,6]
dice_cum = []
for X in dice_lst:
    dice_cum.append(calculate_cdf(dice_lst, X))
dice_cum
```

```
[0.167, 0.333, 0.5, 0.667, 0.833, 1.0]
```

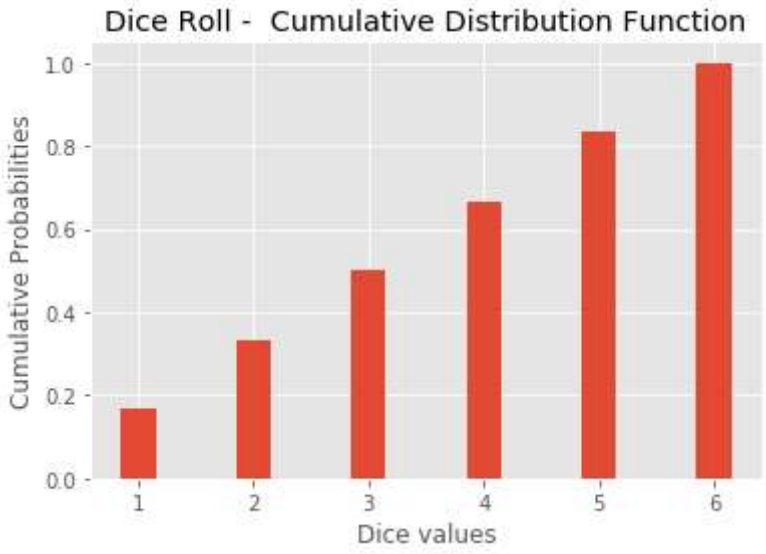
> CDFs are implemented with two sorted lists: one list which contains the potential outcome values of your discrete distribution, and another list which contains cumulative probabilities.

Following this, we now have a list of possible values and a second list containing cumulative probabilities for each value. Let's go ahead and plot these values in matplotlib using a bar plot.

- Use `dice_lst` for x-axis and `dice_cum` for y-axis

```
import matplotlib.pyplot as plt
%matplotlib inline
plt.style.use('ggplot')

plt.bar(dice_lst, dice_cum, width=0.3);
plt.title ("Dice Roll -  Cumulative Distribution Function");
plt.xlabel('Dice values')
plt.ylabel('Cumulative Probabilities');
```



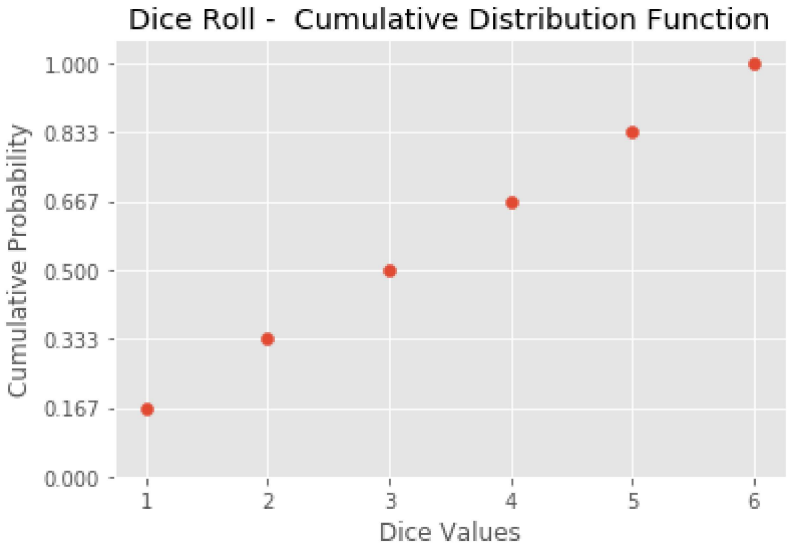
Level Up (optional)

CDFs (and PMFs) can be calculated using built-in NumPy and matplotlib methods. So we don't have create custom functions to calculate these. We can draw a histogram styled CDF as shown below using the following steps

You would need to perform these steps

- Use `np.histogram()` to automatically calculate the histogram with probabilities. Here is numpy histogram documentation to help you dig deeper.
- Use `plt.scatter()` method with `np.cumsum()` to calculate and plot cumulative probabilities (just like we did above).

```
import numpy as np
sample = [1,2,3,4,5,6]
hist = np.histogram(sample, bins=6, range=(1,7), normed=True)
plt.scatter(hist[1][:-1], np.cumsum(hist[0]))
plt.title ("Dice Roll -  Cumulative Distribution Function");
plt.xlabel("Dice Values")
plt.ylabel("Cumulative Probability")
plt.yticks(np.linspace(0,1,num=7))
plt.show()
```



Summary

In this lesson, we looked at developing a CDF - a percentile function of a discrete random variable. We looked at how to calculate and visualize a CDF. This technique can also be applied to continuous random variables which we shall see later in this section.

Releases

No releases published

Packages

No packages published

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Languages

Jupyter Notebook 97.9% Python 2.1%