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**Q1.** Five different sets of parameters chosen are as follows:

- $\alpha_1 = 5, \alpha_2 = 5$
- $\alpha_1 = 2, \alpha_2 = 3$
- $\alpha_1 = 3, \alpha_2 = 5$
- $\alpha_1 = 4, \alpha_2 = 1$
- $\alpha_1 = 1, \alpha_2 = 6$

We can observe that both values are  $\geq 1$  and at least one of them is  $> 1$ .

**Q2.** For each set of values, the point at which  $f(x)$  attains its maximum value was calculated using the below formula:

$$x^* = \frac{\alpha_1 - 1}{\alpha_1 + \alpha_2 - 2}$$

- $\alpha_1 = 5, \alpha_2 = 5, x^* = 0.5$
- $\alpha_1 = 2, \alpha_2 = 3, x^* = 0.33$
- $\alpha_1 = 3, \alpha_2 = 5, x^* = 0.33$
- $\alpha_1 = 4, \alpha_2 = 1, x^* = 1$
- $\alpha_1 = 1, \alpha_2 = 6, x^* = 0$

**Q3.** Five different sets of parameters chosen are as follows:

The max value of  $f(x)$  was calculated which is attained at  $x^*$ .

- $\alpha_1 = 5, \alpha_2 = 5, f(x^*) = c = 2.4609375$
- $\alpha_1 = 2, \alpha_2 = 3, f(x^*) = c = 1.7777778$
- $\alpha_1 = 3, \alpha_2 = 5, f(x^*) = c = 2.3045267$
- $\alpha_1 = 4, \alpha_2 = 1, f(x^*) = c = 4.0$
- $\alpha_1 = 1, \alpha_2 = 6, f(x^*) = c = 6.0$

**Q4.**

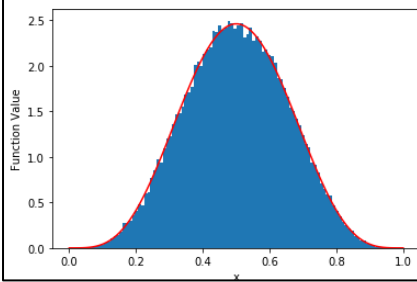
Using the acceptance rejection method, the values from the distribution were calculated. Here,  $g(x)$  is taken to the uniform density function between 0 to 1. Here,  $f(x)$  is the pdf of the beta function. The value of  $c$  chosen has already been given above. 80,000 values of  $X$  from the beta distribution were generated.

**Q5.**

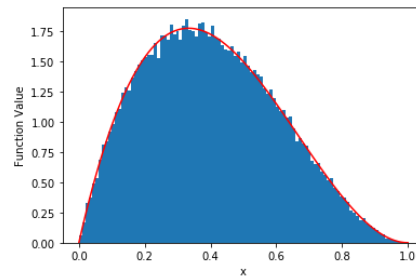
Using the generated samples (generated using acceptance rejection method), density histograms were created. Python has in built functions which automatically adjusts the histograms so that the area under the histograms adds up to be 1. Hence, density plots were obtained for each case (which is represented in blue color) using the generated values. Using the actual formula for  $f(x)$ , the probability density function was plotted out on the same graph (represented by the red line). It can be clearly observed the theoretical PDF almost matches the density plot (histogram) in each case.

The plots are given on the next page.

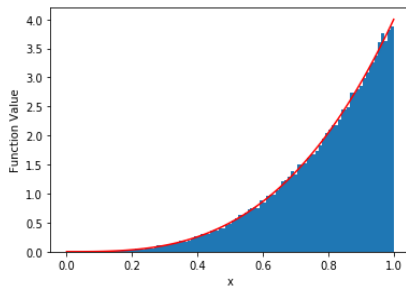
The Value of aplha1 is 5  
The Value of aplha2 is 5  
The Value of x\* calculated is 0.5  
The maximum value of f(x) is = f(x\*) = c = 2.4609375  
The number of values generated is 80000  
The density graph generated from the sample data generated is as follows(blue):  
The red curve represents the actual pdf obtained from the formula.



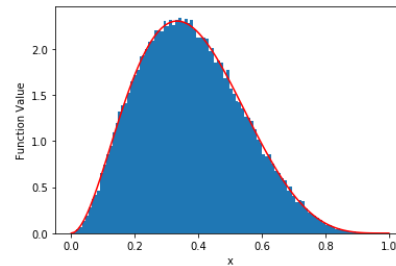
The Value of aplha1 is 2  
The Value of aplha2 is 3  
The Value of x\* calculated is 0.3333333333333333  
The maximum value of f(x) is = f(x\*) = c = 1.777777777777781  
The number of values generated is 80000  
The density graph generated from the sample data generated is as follows(blue):  
The red curve represents the actual pdf obtained from the formula.



The Value of aplha1 is 4  
The Value of aplha2 is 1  
The Value of x\* calculated is 1.0  
The maximum value of f(x) is = f(x\*) = c = 4.0  
The number of values generated is 80000  
The density graph generated from the sample data generated is as follows(blue):  
The red curve represents the actual pdf obtained from the formula.



The Value of aplha1 is 3  
The Value of aplha2 is 5  
The Value of x\* calculated is 0.3333333333333333  
The maximum value of f(x) is = f(x\*) = c = 2.304526748971194  
The number of values generated is 80000  
The density graph generated from the sample data generated is as follows(blue):  
The red curve represents the actual pdf obtained from the formula.



The Value of aplha1 is 1  
The Value of aplha2 is 6  
The Value of x\* calculated is 0.0  
The maximum value of f(x) is = f(x\*) = c = 6.0  
The number of values generated is 80000  
The density graph generated from the sample data generated is as follows(blue):  
The red curve represents the actual pdf obtained from the formula.

