Assignment 1

Chinmaya Kumar Bansal

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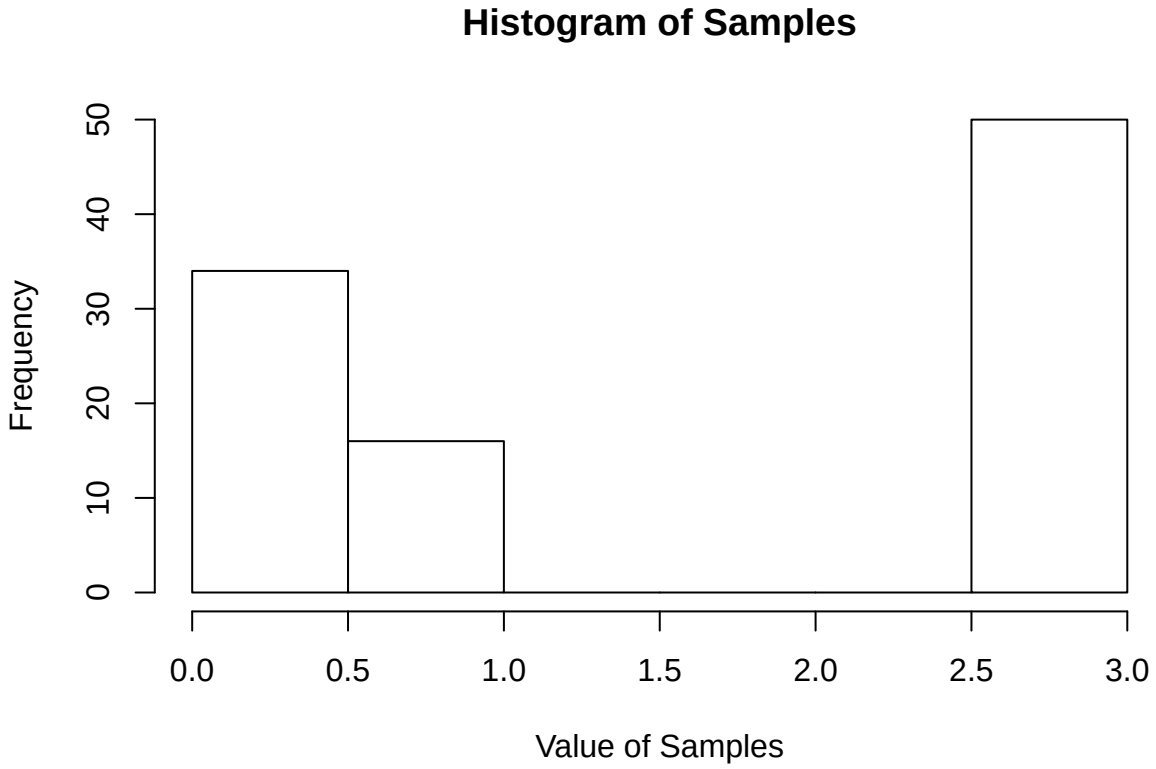
Question 1:

Consider the probability density function p(x) =(c/xˆ4) for x>=1,where c is a constant. Generate 100 random samples from this distribution and plot a histogram. How close is the average of the samples to the expected value of X?

Answer 1:



Average value of samples is

```
## [1] 1.681075
```

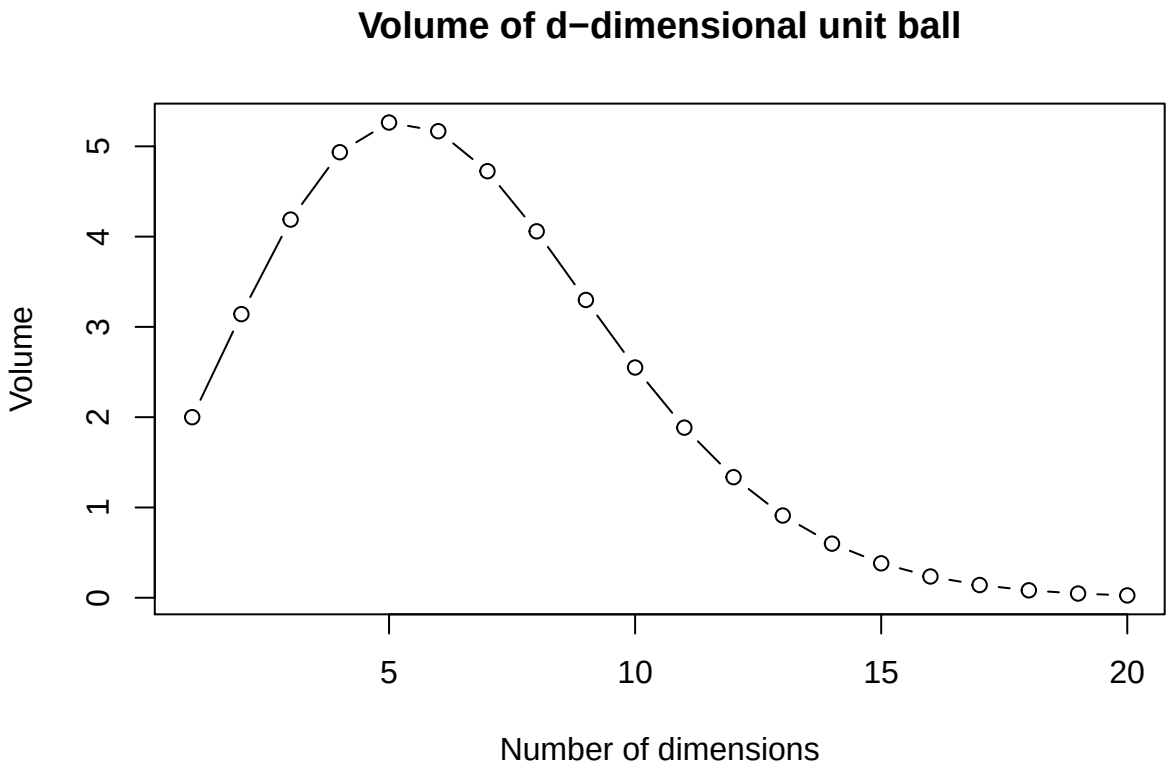
Expected value of X is

```
## 1.5 with absolute error < 1.7e-14
```

Question 2:

Draw a 2-D plot in which the Y-axis represents V(d), the volume of a d-dimensional unit ball, and the X-axis represents d= 1,2,3, ... State your observations

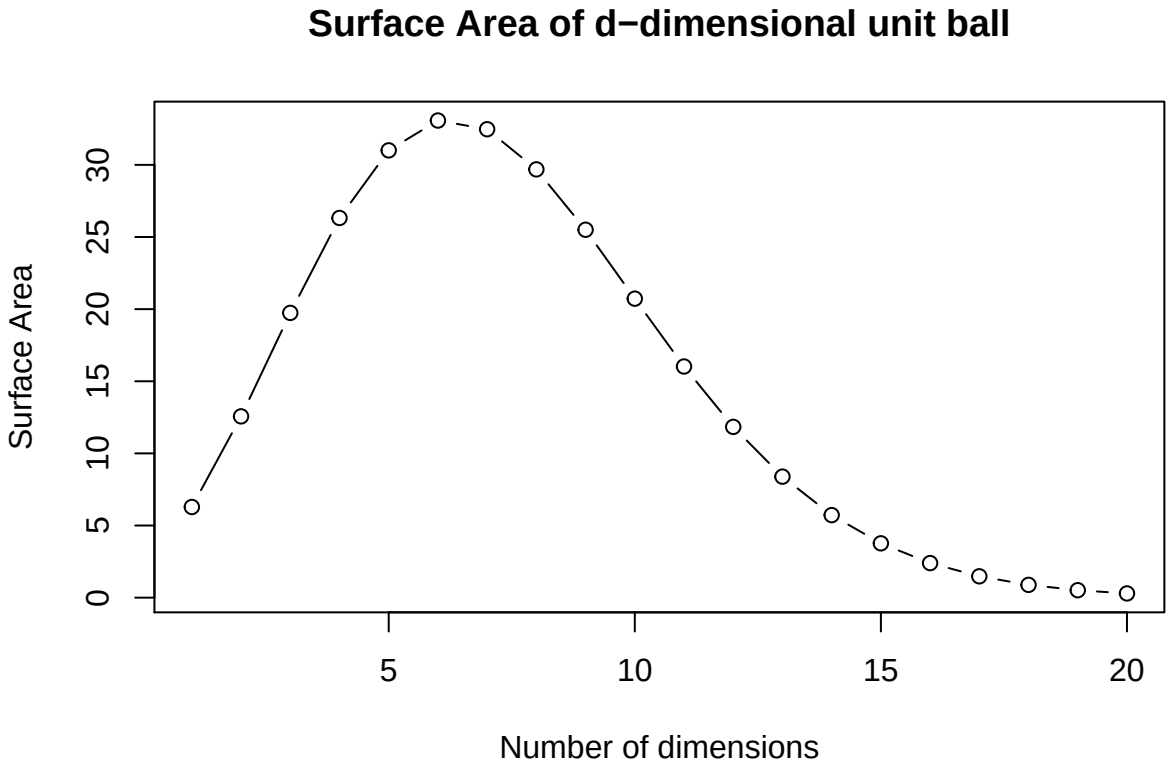
Answer 2:



Question 3:

Draw a 2-D plot in which the Y-axis represents S(d), the surface area of a d-dimensional unit ball, and the X-axis represents d= 1,2,3, ... State your observations.

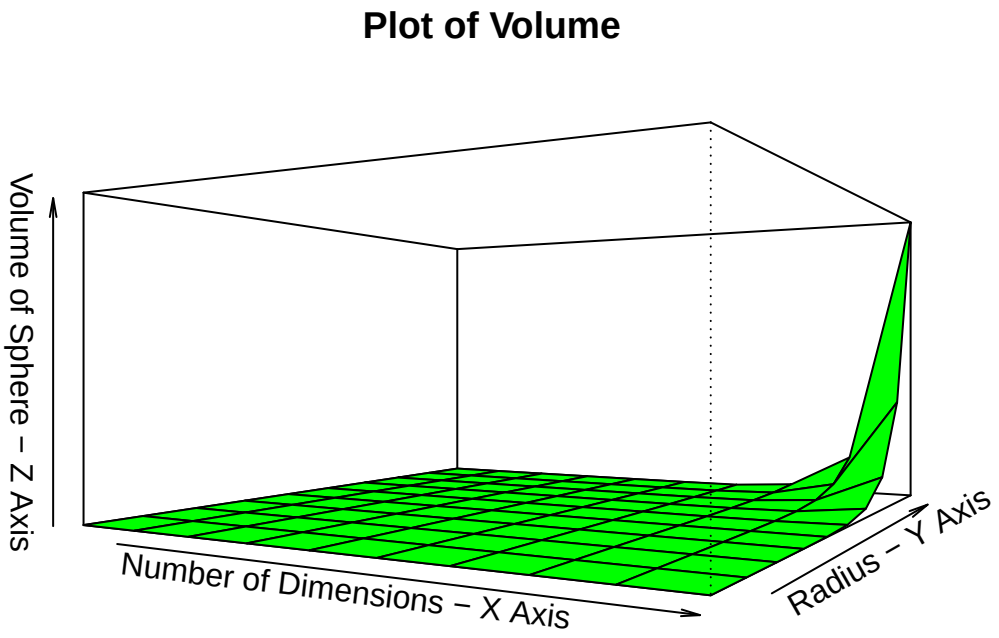
Anser 3:



Question 4:

Draw a 3-D plot in which the Z-axis represents V(d), the volume of a d-dimensional ball of radius R, and the X-axis represents d, and the Y-axis represents the radius R. State your observations.

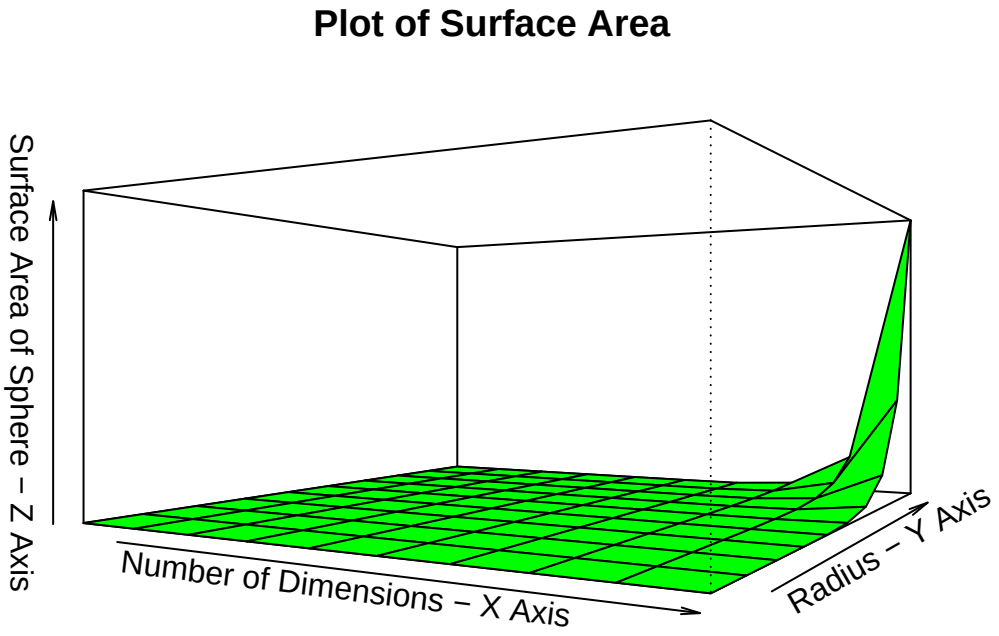
Answer 4:



Question 5:

Draw a 3-D plot in which the Z-axis represents S(d), the surface area of a d-dimensional ball of radius R, and the X -axis represents d, and the Y-axis represents the radius R. State your observations.

Answer 5:



Question 6:

Generate 20 points uniformly at random on a 900 -dimensional sphere of radius 30. Calculate the distance between each pair of points. Then, select a method of projection and project the data onto subspaces of dimension k = 100, 50,10,5,4,3,2,1 and calculate the difference between k^(1/2) times the original distances and the new pair-wise distances. For each value of k what is the maximum difference as a percent of k^(1/2).

Answer 6:

The differences in euclidean distances for the subspace projection is as follows:

```
## [1] "Subspace of dimension: 1"
## [1] 42.86912

## [1] "Subspace of dimension: 2"
## [1] 58.67276

## [1] "Subspace of dimension: 3"
## [1] 68.678

## [1] "Subspace of dimension: 4"
## [1] 76.32516

## [1] "Subspace of dimension: 5"
## [1] 83.78994

## [1] "Subspace of dimension: 10"
## [1] 109.1806
```