**Problem 3(a)**

**Given Multivariate Gaussian Distribution**

A close up of a mans face

Description automatically generated

**Mean and Variance of Sampled Points:**

[[4.27808445 2.40991407 2.05275031 ... 2.97926342 2.1962627 3.06908942]

[2.40991407 1.35754352 1.1563474 ... 1.6782672 1.23719025 1.72886764]

[2.05275031 1.1563474 0.98496976 ... 1.42953791 1.05383122 1.47263906]

...

[2.97926342 1.6782672 1.42953791 ... 2.07476281 1.52948012 2.13731776]

[2.1962627 1.23719025 1.05383122 ... 1.52948012 1.12750693 1.57559457]

[3.06908942 1.72886764 1.47263906 ... 2.13731776 1.57559457 2.20175875]]

0.03586188161776395

**Problem 3(b)**

**Histogram for the x-coordinates of X and y-coordinates of X:**

**A close up of text on a white background

Description automatically generated**

**Problem 3(c)**

Both the x coordinates of X and y coordinates of X follow gaussian distribution.

**Mean and Variance of x coordinate and y coordinate respectively:**

x coordinate variance= 1.034708922316794

y coordinate variance = 5.075328237402045

x coordinate mean = 0.01047830014298007

y coordinate mean = 0.061245463092547824

**Problem 3(d)**

Sampling 1000 numbers from a 1D Gaussian distribution with the mean and variance of the x-coordinates and y coordinates and creating scatter plot with them:

A picture containing drawing

Description automatically generated

**Difference:**

Comparing two scatter plots it is evident that there are some differences on the distributions of data. In the previous plot the two-dimension dataset represents arbitrary confidence ellipse which defines the region that contains 95%-97% of all samples that can be drawn from the underlying Gaussian distribution. Here the variances are parallel to what will become the major and minor axis of the confidence ellipse. But in the second distribution as the co-variance is zero the two-dimension dataset represents the axis-aligned confidence ellipse. Here variances are parallel to the x-axis and y-axis.

**Problem 3(e)**

**Plotting line over 2D Gaussian:**

**A picture containing text, white, ready, red

Description automatically generated**

**Projecting 2D Gaussian samples onto line:**

**A picture containing building, white, air, man

Description automatically generated**

A close up of a person

Description automatically generated

**Problem 3(e):**

Yes, the x-coordinates of the projected points sampled from some Gaussian distribution

A close up of a logo

Description automatically generated

Mean and Variance are respectively -0.2805785310579377 0.5612202950214332.