EE527: Programming Assignments

Linear Algebra & Statistics

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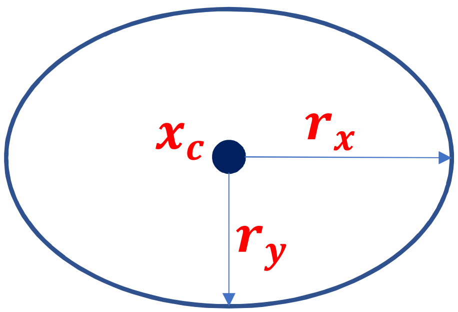
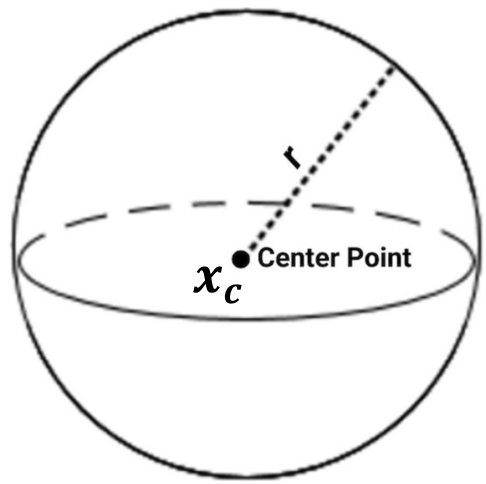
Generation of Points



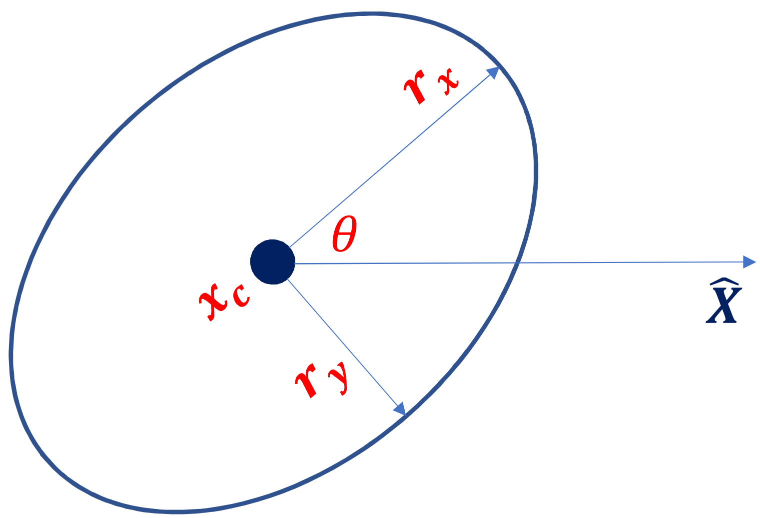
Randomly generate $n = 1000$ 2D points $\boldsymbol{S_e} = \{\boldsymbol{x}_1, \boldsymbol{x}_2, \dots \boldsymbol{x}_n\}$ inside a 2D ellipse of axes $r_x = 150$, $r_y = 100$ and centered at $\boldsymbol{x_c} = (-10,20)$. The axes of ellipse are aligned with the co-ordinate system axes.

Randomly generate $n = 1000$ points $\boldsymbol{S_{hs}} = \{\boldsymbol{x}_1, \boldsymbol{x}_2, \dots \boldsymbol{x}_n\}$ inside a 10 Dimensional hypersphere of radius $r = 100$, centered at $\boldsymbol{x_c} = (-1,2,-1,0,0,0,3,4,9,0)$.



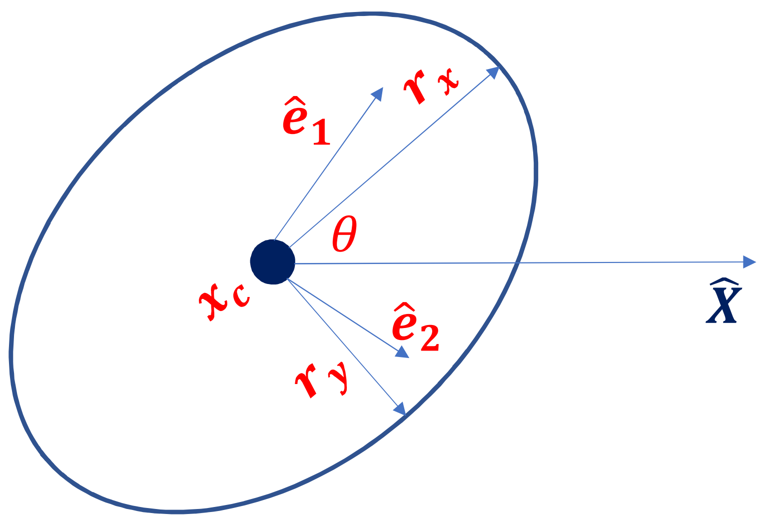
Generation of Points

Randomly generate $n = 1000$ 2D points $\boldsymbol{S_{eo}} = \{\boldsymbol{x}_1, \boldsymbol{x}_2, \ldots \boldsymbol{x}_n\}$ inside an oriented 2D ellipse of axes $r_x = 150$, $r_y = 100$ and centered at $\boldsymbol{x_c} = (-10,20)$. The major axis makes an angle of $\theta = \frac{\pi}{3}$ with the horizontal axis $\widehat{\boldsymbol{X}}$.



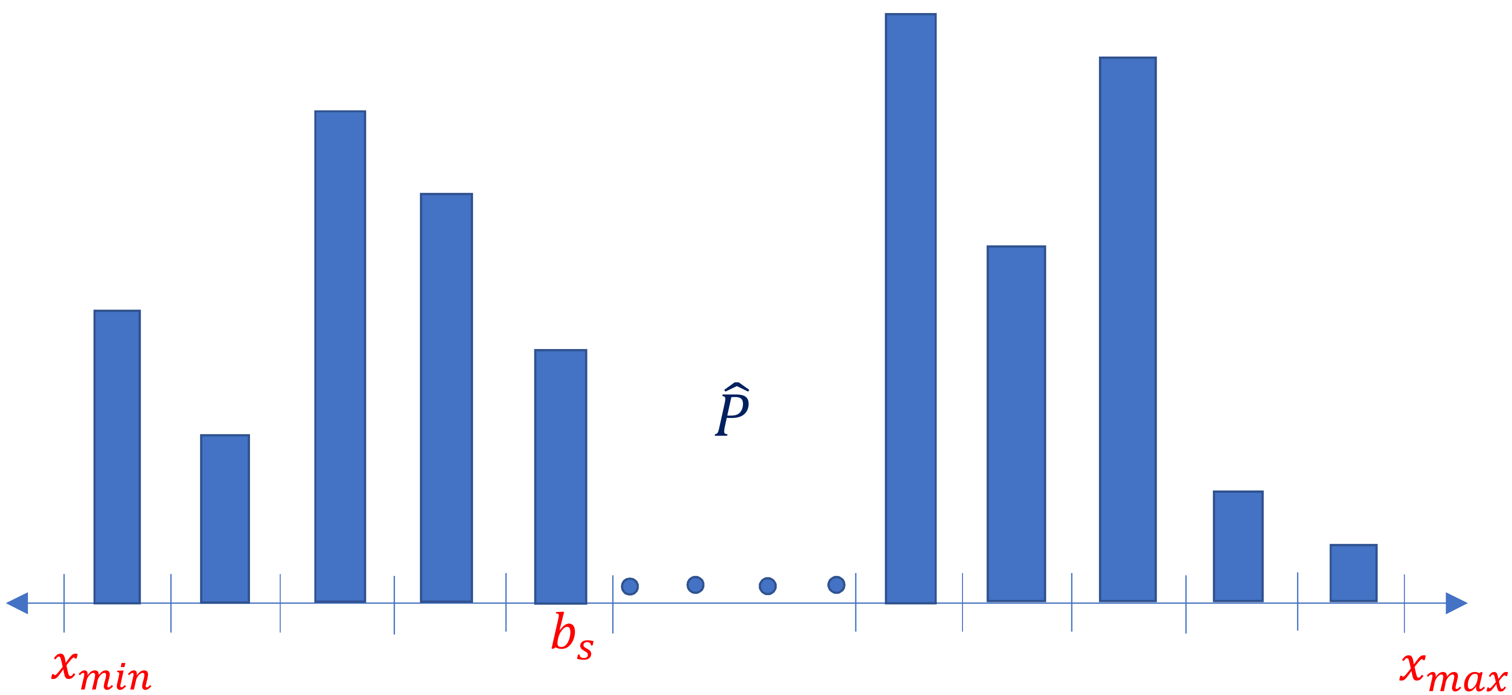
Covariance Matrix Computation

Compute the 2×2 Covariance Matrix $\boldsymbol{C}$ using the points in $\boldsymbol{S_{eo}}$. Plot the Eigen Vectors $(\hat{\boldsymbol{e}}_{\mathbf{1}}, \hat{\boldsymbol{e}}_{\mathbf{2}})$ of $\boldsymbol{C}$ and the axes of the oriented ellipse, all originating from the center $\boldsymbol{x_c}$. The lengths of $(\hat{\boldsymbol{e}}_{\mathbf{1}}, \hat{\boldsymbol{e}}_{\mathbf{2}})$ should be respectively set to $\left(k\sqrt{\lambda_1}, k\sqrt{\lambda_2}\right)$. Change the value of n and report observations. Try plotting with $k = 3,4,5$.



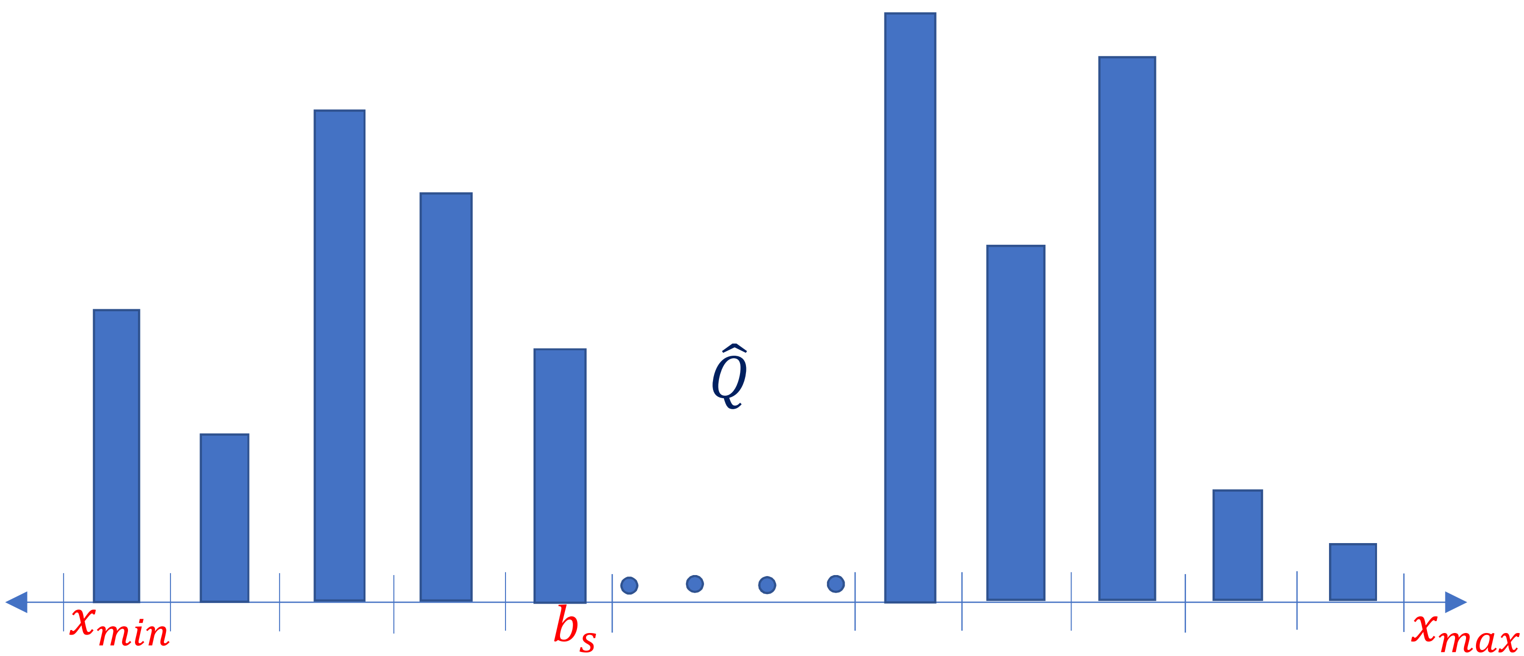
Distribution Estimation

Generate $n = 5000$ numbers $S = \{x_1, x_2, \dots x_n\}$ between $x_{min} = -750$ and $x_{max} = 750$. Estimate the distribution (p.m.f.) $\hat{P}$ from this dataset by using a bin-size of $b_s = 5$.



Data Generation & Distribution Estimation

Generate $n' = 3000$ random numbers $S' = \{x'_1, x'_2, \dots x'_n\}$ between $x_{min} = -750$ and $x_{max} = 750$ by using the distribution (p.m.f.) $\hat{P}$. Estimate the distribution (p.m.f.) $\hat{Q}$ from S' by using a bin-size of $b_s = 5$.



Comparing the Distributions

Compute the Similarity between Distributions $\hat{P}$ and $\hat{Q}$ by using the Bhattacharya Coefficient $BC\left(\hat{P}\,,\hat{Q}\right)$.

$$BC\left(\hat{P}\,,\hat{Q}\right) = \sum_{k=1}^{m} \sqrt{\hat{P}[k]\hat{Q}[k]}$$

m is the number of bins in Distributions $\hat{P}$ and $\hat{Q}$

Experiment with different values of n, n' and b_s ($n \geq n'$).
Report the different values of $BC\left(\hat{P}\,,\hat{Q}\right)$.

Thank You