Assignment 3

CS215: Data Structures and Algorithms

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Solutions

SOLUTION 1
Detecting Anomalous Transactions using KDE

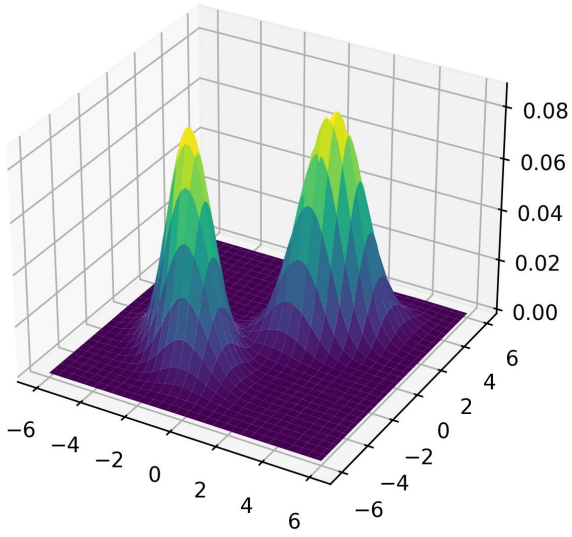

Figure 1.1: Distribution of transactions
As can be seen in the given figure, the resulting estimated distribution contains two nodes

SOLUTION 2
Higher-Order Regression

Part 1
Suppose our estimates for α and β are A and B respectively, then these values of A and B minimize

$$\sum_{i=1}^{n}(y_i - A - Bx_i)^2 \tag{1.1}$$

$$\implies \frac{\partial}{\partial A}\sum_{i=1}^{n}(y_i - A - Bx_i)^2 = 0 \tag{1.2}$$

$$\sum_{i=1}^{n} -2(y_i - A - Bx_i) = 0 \tag{1.3}$$

$$n\bar{y} - nA - nB\bar{x} = 0 \tag{1.4}$$

$$\bar{y} = A + B\bar{x} \tag{1.5}$$

Least square regression line is given by $y = A + Bx$. Thus by (1.5), $(\bar{x}, \bar{y})$ lies on the regression line.

Part 2

Suppose our estimates for β_0^* and β_1^* are A^* and B^* respectively, then A^* and B^* minimize $\sum_{i=1}^{n}(y_i - A^* - B^* z_i)^2$

$$\implies \frac{\partial}{\partial A^*}\sum_{i=1}^{n}(y_i - A^* - B^* z_i)^2 = 0 \qquad \frac{\partial}{\partial B^*}\sum_{i=1}^{n}(y_i - A^* - B^* z_i)^2 = 0 \tag{1.6}$$

$$\sum_{i=1}^{n} -2(y_i - A^* - B^* z_i) = 0 \qquad \sum_{i=1}^{n} -2z_i(y_i - A^* - B^* z_i) = 0 \tag{1.7}$$

$$n\bar{y} - nA^* - nB^*\bar{z} = 0 \qquad \sum z_i y_i - A^* n\bar{z} - B^*\sum z_i^2 = 0 \tag{1.8}$$

$$\sum y_i z_i - n(\bar{y} - B^*\bar{z})\bar{z} - B^*\sum z_i^2 = 0 \tag{1.9}$$

$$B^* = \frac{\sum y_i z_i - n\bar{y}\bar{z}}{n\bar{z}^2 - \sum z_i^2} \qquad A^* = \bar{y} - B^*\bar{z} \tag{1.10}$$