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Computational Genomics Data Analysis

Problem Set 4, Exercise 3

1. 1.20532 E-6
2. 4.2435 E-7

Work shown below:

EX 3. 1) $G_1 \sim N(0, 1)$
2) $G_2 \sim N(0, 1)$

3) $G_3 | G_1, G_2 \sim N(G_1 + \frac{1}{2}G_2, 1)$
4) $G_4 | G_2 \sim N(2G_2 + \frac{1}{2}, 2)$
5) $G_5 | G_3, G_4 \sim N(G_3 + G_4, 1)$

1. $p(G_1 = 0.5, G_2 = 1, G_3 = 0, G_4 = -1, G_5 = 2)$

$p(x_1, \dots, x_n) = \prod p(x_i | \text{pa}(x_i))$

$\left(\frac{1}{\sqrt{2 \cdot 1 \cdot \pi}} e^{-\frac{(0.5-0)^2}{2 \cdot 1}} \right) \left(\frac{1}{\sqrt{2 \cdot 1 \cdot \pi}} e^{-\frac{(1-0)^2}{2 \cdot 1}} \right) \left(\frac{1}{\sqrt{2 \cdot 1 \cdot \pi}} e^{-\frac{(0-1)^2}{2 \cdot 1}} \right) \cdot$
 $\left(\frac{1}{\sqrt{2 \cdot 2 \cdot \pi}} e^{-\frac{(-1-2 \cdot 1)^2}{2 \cdot 2}} \right) \left(\frac{1}{\sqrt{2 \cdot 1 \cdot \pi}} e^{-\frac{(2-(-1))^2}{2 \cdot 1}} \right) = 1.20532 \text{ E-6}$

2) $p(G_5 = 2 | G_1 = 0.5, G_2 = 1, G_3 = 0, G_4 = -1)$

$\left(\frac{1}{\sqrt{2 \cdot 1 \cdot \pi}} e^{-\frac{(0.5-0)^2}{2 \cdot 1}} \right) \left(\frac{1}{\sqrt{2 \cdot 1 \cdot \pi}} e^{-\frac{(1-0)^2}{2 \cdot 1}} \right) \left(\frac{1}{\sqrt{2 \cdot 1 \cdot \pi}} e^{-\frac{(0-1)^2}{2 \cdot 1}} \right) \cdot$
 $\left(\frac{1}{\sqrt{2 \cdot 2 \cdot \pi}} e^{-\frac{(-1-2 \cdot 1)^2}{2 \cdot 2}} \right) \left(\frac{1}{\sqrt{2 \cdot 1 \cdot \pi}} e^{-\frac{(2-(-1))^2}{2 \cdot 1}} \right) \left(\frac{1}{\sqrt{2 \cdot 1 \cdot \pi}} e^{-\frac{(2-0)^2}{2 \cdot 1}} \right)$
 $= 4.2435 \text{ E-7}$