

Exam I
Administered: Monday, February 5, 2001
24 points

For each problem part: 0 points if not attempted or no work shown,
 1 point for partial credit, if work is shown,
 2 points for correct numerical value of solution

Problem 1. (4 points)

Consider the PDF

$$f(x, y) = C \cdot_x P_y \quad \text{for } x = 1, 2, \text{ and } 3 \text{ and } y = 1 \text{ to } x$$

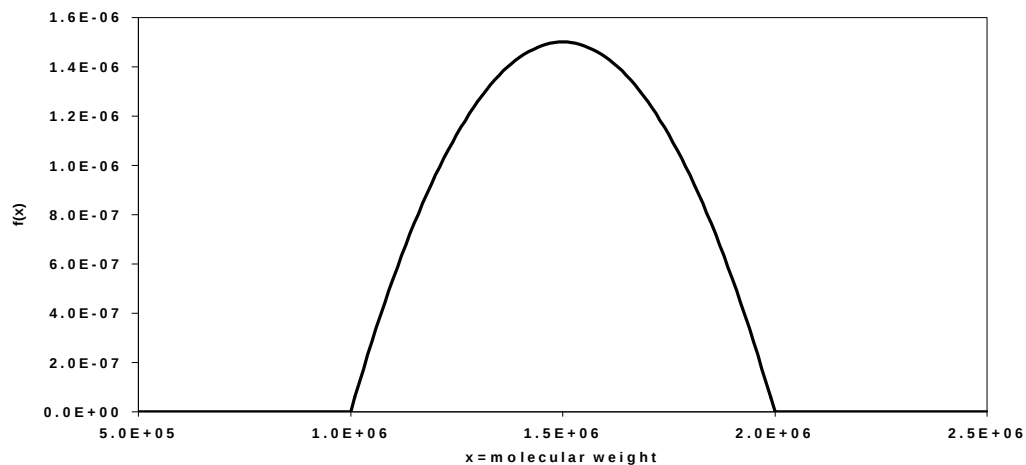
- (a) find the value of C that makes this PDF legitimate.
(b) find $P(y = 1 | x = 2)$

Problem 2. (10 points)

An experimental polymer reactor creates polyethylene with a molecular weight distribution of

$$f(x) = \begin{cases} -1.2 \cdot 10^{-5} + 1.8 \cdot 10^{-11}x - 6.0 \cdot 10^{-18}x^2 & 1 \cdot 10^6 \leq x \leq 2 \cdot 10^6 \\ 0 & \text{otherwise} \end{cases}$$

where x is the molecular weight. A plot of $f(x)$ is shown below.



- (a) Is this problem continuous or discrete?
(b) What is the probability of obtaining a polymer with molecular weight in the range $5 \cdot 10^5 \leq x \leq 1.25 \cdot 10^6$?
(c) What is the probability of obtaining a polymer with molecular weight greater than $1.25 \cdot 10^6$?
(d) What is the mean molecular weight?
(e) What is the mean of the compressibility, if the compressibility of the polymer is given by the following?

$$\kappa = 6.5 \cdot 10^{-6}x - 0.59$$

Problem 3. (10 points)

You are monitoring a process using a packed bed of 2 adsorbents (zeolite-X & zeolite-Y) to adsorb methane and ethane. The zeolite-X in the bed adsorbs 70% of the molecules adsorbed. The probability that a given adsorbed molecule is methane in zeolite X is 0.08. The probability that a molecule is ethane given that it is adsorbed in zeolite-Y is 0.8537. Answer the following questions. Where appropriate, report to 4 significant figures.

- (a) Draw a Venn Diagram of the sample space for the type and location of an adsorbed molecule.
- (b) What is the probability that a molecule is methane, given that it is adsorbed in zeolite-X?
- (c) What is the probability that a molecule adsorbed in zeolite-Y?
- (d) What is the probability that a molecule is ethane and in zeolite Y?
- (e) What is the probability that a molecule is methane?