

1. (48 pts.) Book Problems

- (a) Section 7.1, Exercise 8
- (b) Section 7.1, Exercise 16
- (c) Section 7.1, Exercise 24
- (d) Section 7.2, Exercise 10
- (e) Section 7.2, Exercise 20
- (f) Section 7.3, Exercise 32

2. (52 pts.) Central Limit

You can calculate the probability that a random variable, X , with probability density function f is in a range (a, b) by integrating the density function over that range as in:

$$\Pr(a \leq X \leq b) = \int_a^b f(x)dx$$

For the following problems, you will need to calculate the area under a normal curve. You can use the definition of a normal distribution below and approximate the integral by writing a program.

Definition 0.1 (Normal distribution): The Normal distribution with mean μ and variance σ^2 is the distribution with density function

$$f(x) = \frac{1}{\sigma\sqrt{2\pi}}e^{-(x-\mu)^2/2\sigma^2}.$$

- (a) Write a function *normalDistArea* in either Java or C++ that approximates the probability that a normally distributed variable is in a particular range. The prototype is below.

```
// returns the probability that a normal distributed with mean mu
// and variance sigma^2 is between a and b
double normalDistArea(double mu, double sigma, double a, double b)
```

- (b) What is the probability, that a normal distributed value with mean 0 is in the interval $(-1.5\sigma, 1.5\sigma)$?
- (c) Let X be the number of times that a fair coin flipped 50 times, lands heads. Find the probability that $X = 25$ by using the normal approximation and then compare it to the exact solution.
- (d) The lifetime of a hard drive is a random variable X with mean value 4 years with a standard deviation of 2 years. A hard drive is used until it fails at which point it is replaced by a new one. Assuming a stockpile of 10 such drives with independent lifetimes, approximate the probability that over 44 years of use can be obtained.