

Problem 1

$X \sim N(5, 10)$ (Read: X has a normal distribution with mean 5 and variance 10) Compute:

- (i) $\Pr(X > 5)$
- (ii) $\Pr(X > 5 + 2 \times \sqrt{10})$
- (iii) $\Pr(X = 8)$
- (iv) $\Pr(X > 7)$
- (v) Find the value of q such that $\Pr(X > q) = 0.75$

Problem 2

Here's a simplified look at a spam filter algorithm:

We are getting a tremendous volume of mail referencing a "*Nigerian prince*" and our IT team has figured out that 20% of spam emails contain the term "Nigerian prince", while only 0.1% of legitimate emails contain the term "Nigerian prince" In addition, they estimate that half of our emails are spam.

1. What is the marginal probability of seeing "*Nigerian prince*" in a message? In other words, what is $\Pr(\text{"Nigerian prince"})$?
2. If the spam filter always classifies a message containing "*Nigerian prince*" as junk, what is the probability it will make a mistake when it sees a message containing the phrase "Nigerian prince"?

Problem 3

A construction company needs to complete a project within 11 weeks, or they will incur significant cost overruns, including penalties due to the client. The manager of the company has assessed that the project will take between 10 and 14 weeks to complete. The manager has also estimated the probability of each possible outcome:

Weeks to complete	Probability
10	0.075
11	0.65
12	0.2
13	0.05
14	0.025

1. What is the probability of completing the project on time?
2. What is the probability of not completing the project on time?

3. What is the expected value of the time to complete the project?
4. What is the variance of the time to complete the project?
5. The company must pay a penalty of \$5,000 for every additional week (beyond 12) that they work, plus a \$50,000 penalty if the work extends beyond 13 weeks. What is the expected value of the penalty incurred?
6. Suppose you're the engineer in charge of bidding for the project (i.e. estimating the total cost of the job, plus overhead and profit). How would you use the information from the previous question to price this job?

Problem 4

Suppose I repeated our randomized response exercise in another cohort of 42 BBA Honors students. Each student flips a coin; if the coin comes up heads, they answer a sensitive yes/no question honestly. If it comes up tails, they answer yes if their Social Security number ends in an odd number and no otherwise. Thirty one students gave a “yes” answer, so we can approximate $P(Yes)$ as $31/42$. Estimate the proportion of students in the class who would answer “yes” to the sensitive question.