

Project 3

For this project, your solutions should be written up neatly and completely on separate sheets of paper, with this page stapled on top.

In probability theory, the **Normal Distribution** (sometimes called a Gaussian Distribution or Bell Curve) is a very common continuous probability distribution. Normal distributions are important in statistics and are often used in the natural and social sciences to represent real-valued random variables whose distributions are not known. Describing the normal distribution using a mathematical function is called a probability distribution function (PDF) which is given here:

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

Normal Distribution Function
 μ = The mean of the distribution
 σ = The standard deviation

We can find the probability that a randomly selected data point x will fall in the range $\alpha \leq x \leq \beta$ by the integrating the normal PDF from α to β . i.e. $P(\alpha \leq x \leq \beta) = \int_{\alpha}^{\beta} f(x)dx$.

Here is the problem you will solve:

The lengths of a certain population of Atlantic croaker fish are normally distributed with average length of $\mu = 10$ inches and standard deviation $\sigma = 2$. Find the probability that a randomly selected croaker from this population will be between $\alpha = 11$ inches and $\beta = 13$ inches.

Note: The normal distribution function is essentially $f(x) = e^{-x^2}$ which is a non-integrable function. This means we can use its Maclaurin series expansion in order to integrate. Part of solving the problem is finding out how many terms of the series you will need to get an accurate result (within 0.1%).

