CEE 518 Homework Due on Monday November 9th.

1) A random variable y is a function of three other random variables x_1, x_2 and x_3 as follows:

$$y = \frac{ax_1}{x_2 x_3}.$$

The parameter "a" is a constant. The following information is given about these random variables:

$$\mu_{x_1} = 4.0, \sigma_{x_1} = 0.4$$
$$\mu_{x_2} = 2.0, \sigma_{x_2} = 0.2$$
$$\mu_{x_3} = 1.0, \sigma_{x_3} = 0.1$$
$$\rho_{12} = \rho_{23} = \rho_{13} = 0$$

Find the expected value and standard deviation for y using the Taylor Series approximation.

2) The strength R and the load-induced stress Q for the design of a component are lognormally distributed with the following information:

$$\mu_R = 750 \text{ MPa}; \sigma_R = 50 \text{ MPa}$$
$$\mu_Q = 500 \text{ MPa}; \sigma_Q = 80 \text{ MPa}$$

Compute the reliability of the component.

3) A propped cantilever beam of rectangular cross-section is to be designed for a specified reliability of 0.990. The loading of the beam is given as shown.

The following data are provided:

$$\bar{P} = 20{,}000N \quad \sigma_P = 2000N$$
$$\bar{L} = 5.0m \quad \sigma_L = 0.2m$$
$$\bar{a} = 3.0m \quad \sigma_a = 0.3m$$

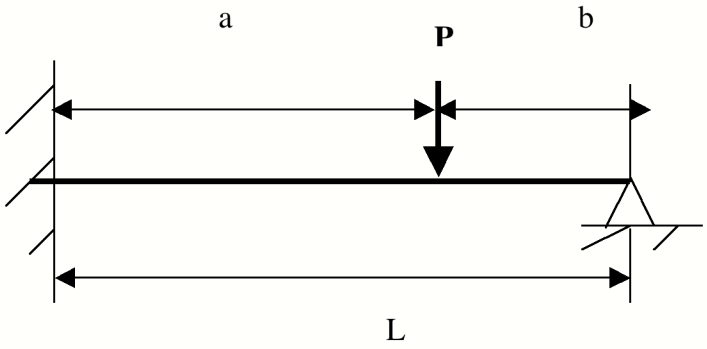
The depth *d* of the beam is twice the width *w*. The maximum allowable stress has an expected value of 560 MPA with a standard deviation of 30 MPA.

From the design handbooks, there are two maximum moments: M_1 underneath P and M_2 at the fixed end. They are defined below.

$$M_1 = \frac{Pa^2}{2L^3}(3L - a)(L - a)$$

$$M_2 = \frac{P(L - a)a(2L - a)}{2L^2}$$

Use a Taylor Series approach to find the solution.



4) From the text: Problem 6.14.