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1.010 Uncertainty in Engineering
Fall 2008

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1.010 Fall 2008
Homework Set #8
Due November 13, 2008 (in class)

1. A concrete column has square cross-section with side length 0.5m. The column is subject to a random axial stress S contributed by two random loads W_1 and W_2 , i.e. $S = \frac{W_1}{A} + \frac{W_2}{A}$ where A is the cross-sectional area of the column. The mean value and coefficient of variation of W_1 are $m_{W_1} = 2500\text{kN}$ and $V_{W_1} = 0.2$, whereas for W_2 , $m_{W_2} = 3000\text{kN}$ and $V_{W_2} = 0.15$. W_1 and W_2 have correlation coefficient $\rho = 0.5$. The compressive strength of concrete, f_c , is also random and independent of W_1 and W_2 , with mean value $m_{f_c} = 30000 \text{ kN/m}^2$ and coefficient of variation $V_{f_c} = 0.1$. Find in approximation the mean value and variance of the safety factor $SF = f_c/S$.

2. Daily temperature and humidity are measured each day of a week in August, and the resulting sample is:

| T (°F) | H (%) |
|--------|-------|
| 70 | 81 |
| 84 | 86 |
| 79 | 90 |
| 65 | 77 |
| 68 | 78 |
| 86 | 95 |
| 77 | 86 |

- Plot the sample (Plot H against T).
- Estimate the mean values and variances of T and H. (Replace the expectation in the definition of m and σ^2 with the sample average)
- Find the covariance and correlation coefficient between T and H. (Again replace the expectation in the definition of m and σ^2 with the sample average)
- Suppose that one day temperature is reported to be 80°F. What would you expect the humidity to be? How much uncertainty would you have on H?