Monday Exercise 3

Soil erosion can be modelled in many ways. A simple and often used way is through the well-known Universal Soil Loss Equation (USLE):

$$E = R \times K \times L \times S \times C \times P$$

where E = annual soil loss (ton/ha), R = erosivity of rainfall, K = erodibility of the soil, L = slope length, S = slope angle, C = cultivation parameter and P = protection parameter.

Assume that all inputs to the model are uncertain and represented by normal probability distributions. You may in addition assume that the uncertainties are uncorrelated. At some location, the means and standard deviations of the distributions are given by:

$\mu_R = 297$, $\sigma_R = 72$
$\mu_K = 0.10$, $\sigma_K = 0.05$
$\mu_L = 2.13$, $\sigma_L = 0.05$
$\mu_S = 1.17$, $\sigma_S = 0.12$
$\mu_C = 0.63$, $\sigma_C = 0.15$
$\mu_P = 0.50$, $\sigma_P = 0.10$

1. Calculate the uncertainty (sd) of the predicted erosion at this location using the Taylor series method.
2. Calculate the relative uncertainty (defined as $\frac{\sigma}{\mu} \times 100\%$) as well. How does it compare to the relative uncertainty of each of the six inputs?
3. Will the pdf of E be a normal distribution? If not, what will it look like?
4. Suppose that all input uncertainties are positively correlated. Would this lead to a smaller, larger or equal uncertainty in E?
5. Have we included all sources of uncertainty in the analysis or did we ignore another uncertainty source? If we did, which is it? Is it an important source of uncertainty?