16.881 – Robust System Design

Solution to Quiz #1
The Principles of Robust Design

1) The values of signal factors are set by
   a) The designer of the system
   b) The user of the system
   c) The manufacturer of the system
   d) They cannot be set, they vary randomly

B -- Signal factors are the factors used to define the desired response of the system. This choice is normally made by the user.

2) The values of control factors are set by
   a) The designer of the system
   b) The user of the system
   c) The manufacturer of the system
   d) They cannot be set, they vary randomly

C – Control factors are those factors used by the designer of the system to improve its robustness through parameter design.

3) Factors that can be used to control the variability of the response, but significantly affect the cost of a product are referred to as ____**Tolerance factors**_________.

Typically, the choice of levels of a control factors should not significantly impact the cost of the system. The designer is free to simply select the level that most improves robustness. When this does not hold, Phadke calls these factors tolerance factors. A cost-benefit analysis has to be made between the cost due of settings of the tolerance factors and quality loss.

4) Quality control activities that take place during the design of the product or process and before manufacture are called ___**off-line**____ quality control.

5) A response y is known to be governed by the relationship

$$y=ax+b$$

where x is a random variable with a mean of 1 and standard deviation of 1. The losses L due to deviation of y from its target m are given by

$$L(y)=k(y-m)^2$$

Which settings of a and b among those listed will give the lowest value of average quality loss?

a) a=2, b=m
b) a=2, b=m-2
c) a=1, b=m
d) a=1, b=m-1

D is the right answer. The principle here is the fundamental principle of two-step optimization. First, reduce sensitivity of the system to noise, then put the system on target. The sensitivity of the response y to the noise factor x is just the derivative $dx/dy=a$. So that narrows it down to answer c or d.

Now work to get on target. The mean value of y is

[illegible]

Now, the target value of $E(y)=m$. To put y on target choose $b=m-1$.