Problem 1:

Problem 2:

Problem 3: Variance Reduction with Control Variates

- Are the control variates independent from X?

  Most certainly not. We'd actually like them to be highly dependent on each other!

Problem 4:

- Which random variables should we apply the bootstrap to?

  In this problem, the r.v.'s V_i are very easy to generate. Generating the X_N is not easy. So, apply the bootstrap to th r.v.'s X_N.

- What value of p should we consider for computing the expected shortfall?

  The homework is now asking for a reasonable calculation. Before, it was asking for nonsense.

- What does $\mathbf{E}_{V_0}$ mean?

  It means we are taking the expectation conditional on the value of V_0.

- Is X_N a random quantity?

  If V_0 were unknown and random, then yes. But we know V_0, so X_N is not random. It is the value of that expectation and we want to estimate it.

Problem 5:

- We don't know anything about ϕ, what are we supposed to do with this?

  We want to say something about $X(t)-x(t)$. An ODE like this can be written in an equivalent integral form. That might help.

Problem 6:

- What do you mean by "develop" an approximation?

  This problem comes out of the notes on the small noise approximation. The example in the notes leading up to this problem will give you an idea of something akin to what we would like.

Problem 7:

- Part 5.: Convert the setup into polar coordinates. That is, ask yourself the following questions: in polar coordinates, (1), what is the algorithm doing, (2), what is it returning, and (3), how is that related to the inversion formula?

Problem 8:

Problem 9: Least Squares Estimation

- Aside from a model like $y_i = \beta + \alpha x_i + \epsilon_i$, what other models are there with only the variables Height and Weight?

  When we refer to a linear model, we mean "linear in the coefficients." Thus, a model of the form $y_i = \beta + \alpha_1 x_i + \alpha_2 x_i^2 + \epsilon_i$ is *also* linear. This can be generalized to considering the model

$$y_i = \sum_{j=1}^{p} \alpha_j \phi_j(x_i) + \epsilon_i,$$

  where ϕ_j is an arbitrary function of your choosing. The model is still linear in the coefficients and everything as before still applies.

- How do we determine which model is best? Should we go by the highest R^2 statistic, tightest coefficient confidence intervals, minimal estimated error variance, or something else?

  Since this isn't a statistics course, we won't get into all the methods of measuring regression models against each other. If you'd like to know about that, consider taking Stat 305. Instead, use whatever measure you want. A perfectly valid (and probably quickest) is to just look at the results of the model and pick the one you *think* works best.

Problem 10:

- What is W_∞ in the case when $N = 0$?

  The problem was written incorrectly. The correct probabilities for N are now given. N is geometric with no possibility of being 0. Consult the Wikipedia page for the geometric distribution to see the subtle difference between a geometric distribution with the possibility of 0 and one without.

Problem 11:

Extra Credit Problems

Problem 1:

Problem 2:

Problem 3: