

# Experimental Design

4/15/2009

# Opening Discussion

- Project requirements.
- Guest speaker on Friday.

# Factors and Responses

- Factors are things we can control when we set up a simulation.
  - Quantitative
  - Qualitative
- Responses are values we get out of the simulation.
  - Sensitivity analysis
  - Metamodels/prediction surfaces
    - Predict behavior
    - Find optimum value

# Differences from Normal Experiments

- Can control a lot more.
- Can apply variance reduction.
- Don't have to randomize to treat against systematic errors.
- Ability to run a system repeatedly for statistical purposes.

# $2^k$ Factorial Designs

- Imagine a system with  $k$  factors. We want to vary each one to see how much the system depends on it.
- We can vary them each independently for sensitivity analysis. This gives  $2^k$  simulations. Requires lots of simulations and doesn't explore interactions.
- Look at average difference between all runs where a value is low vs. high.

# Interactions

- We can also look at two factor differences. We want the average for one factor at plus and minus only in cases where another factor was at plus or minus.

# Covering Parameter Space

- Sometimes you want more than just the + and – options for a value.
- In physical simulation there are often ranges of values that are physically significant and you want to check a range of those.
- This can only be done nicely for small dimensional parameter spaces.

# Example in Ring Dynamics

- I actually have an example of a 3-D parameter space that I have worked with.
- Let's talk about that system and look at what simulations were run and what results we have.



# Minute Essay

- Questions?
- Remember that we have a guest speaker on Friday.