Instructions.

1. Show all your work. If you do not understand something, ask me.

2. You may use any books and notes, but you may not copy anything directly from other sources (including phrases from the course notes).

3. Sign this honor pledge: I certify that the work on this exam is entirely my own work.

Signature: 

1. A sports clothing manufacturer is comparing 5 different materials for lightweight jackets. The manufacturer wants to test the materials under 5 different types of exercise. The response variable is a measure of moisture that accumulates inside the jacket when the wearer performs the different types of exercise.

   (a) (10 points) The manufacturer wants to use 10 people for this experiment using Latin squares. Draw a diagram of such a design (unrandomized).

   (b) (5 points) Explain how to randomize the design.
(c) (10 points) Write down the model for the design, including all assumptions.

(d) (5 points) What terms in the model are orthogonal to each other?
(e) (15 points) Suppose that the treatment means are 10, 15, 13, 9, and 13 for materials 1, 2, 3, 4, and 5 respectively, and the estimated residual variance is MSE=2. Suppose that materials 1, 2, and 3 use a specific kind of absorbent component and materials 4 and 5 do not have this absorbent component. The manufacturer claims that materials with the absorbent component should stay drier, i.e. $y$ should be lower, than the materials without the absorbent component. Test whether the average for the materials with the absorbent component is less than the average for the other two materials. Show your work!
2. Suppose that a plant pathologist is studying how fast isolates of a pathogen grow. The plant pathologist has collected 25 isolates and intends to grow them in petri dishes in an incubator at a specified temperature. One incubator can hold 5 petri dishes. Design an experiment for comparing the means of the 25 isolates using 2 replicates.

   (a) (20 points) Give the name of the design and draw a diagram of the experimental layout (unrandomized) for one replicate.

(b) (35 points) Suppose that the residual variance is 1.5. Give the average variance of a difference between two treatment means. Show your work!