

**Statistics 5303
Fall 2004**

Exam #2 Data

Our second exam is Monday, November 29. The exam is open book and open notes. Analyze the data set below and bring notes on your analysis to class. Answer the exam questions on these data from your notes; attach your notes to your exam when done.

This preliminary analysis should be considered part of your exam. Do your own work. Discuss these data only with the instructor.

(1) I know you guys just can't get enough cheese, so here are some more cheese data. The viscosity of melting processed cheese is important, because it has to have enough give to ooze around your burger or drip on your nachos, but you don't want it to be runny. Apparent viscosity is measured in an instrument at a specific shear rate (the rotational speed used in the instrument) which can be varied. We also expect the viscosity to depend on the temperature of the cheese (we've got to melt it after all).

Here we have chosen two random samples of process cheese, and each is divided into nine cubes. These cubes are then randomly assigned to the nine factor/level combinations of heating temperature (80, 85, and 90 C) and rpm (100, 200, and 300). Cubes are tested in random order by heating the cube to its assigned temperature (with 1 ml of propylene glycol) and then measuring the apparent viscosity at the assigned rpm. (All the units for viscosity seem pretty bizarre to me: Pascal seconds, or Newton seconds per meter squared, or kg/m/s, etc.)

We are interested in finding out if and how viscosity depends on temperature and rpm, if and by how much these might change depending on the sample, and so on.

```
MATRIX          18          4
) This is an experiment to determine how sample, temperature,
) and rpm affect viscosity of processed cheese. Two random
) samples of process cheese are obtained, and each is divided
) into nine cubes. These cubes are then randomly assigned to
) the nine factor/level combinations of heating temperature
) (80, 85, and 90 C) and rpm (100, 200, and 300). Cubes are
) tested in random order by heating the cube to its assigned
) temperature (with 1 ml of propylene glycol) and then measuring
) the apparent viscosity at the assigned rpm.
) The columns below are sample, temperature, rpm, and response.
) Data from Lisa Leman.
)"%lf %lf %lf %lf"
1 1 1 1746
1 1 2 1341
1 1 3 1237
1 2 1 1239
1 2 2 1012
1 2 3 984
1 3 1 1177
1 3 2 913
1 3 3 827
2 1 1 1279
```

2 1 2 1076
2 1 3 1103
2 2 1 1043
2 2 2 891
2 2 3 863
2 3 1 1030
2 3 2 807
2 3 3 754