

**Statistics 5303
Fall 2003**

Exam #2 Data

Our second exam is Friday, November 21. 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. In your analyses, remember to check for assumptions and study interactions. Your analysis should go beyond just the ANOVA and what is significant; it should try to explain what is going on in the data.

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

(1) I think that chocolate chip cookies should be chewy, not crispy. We are going to run an experiment to determine a good way to make chewy cookies. In general, moist and thick cookies are chewier. It is difficult to measure moistness, but easy to measure thickness, so we will measure thickness as a surrogate for chewiness.

How should we make the cookies? Well, there is all kinds of folklore handed down from your mother, but we will just look at the type of dough and the (pre-bake) temperature of the dough. We will consider four kinds of dough: made from scratch using butter, made from scratch using margarine, pre-made dough in a tube, and made from a dry mix. We consider three temperatures for the dough: room temperature, refrigerated, and frozen.

One batch of each dough is made and divided into 2 tablespoon portions, which are rolled into balls and put in sealed plastic bags. The balls of dough are randomly assigned to the temperature treatments and then chilled as necessary.

We will bake five sheets of cookies. Each sheet will have twelve cookies, one from each of the twelve dough/temperature combinations. The twelve balls of dough are randomly assigned to the twelve positions on the cookie sheet. The oven is pretty good, but it may not be able to maintain a constant temperature over the entire baking period.

After the cookies bake, they cool 10 minutes, and we then measure the thickness. The data from this experiment are attached below and also reproduced on the file `cookies.txt` on the data button of the class web page. (Regardless of how the thicknesses come out, the pre-made mix cookies tasted foul, and will not be recommended.)

```
MATRIX          60      4
) Depths of chocolate chip cookies.  Variables are
) cookie sheet, dough type (from scratch with butter,
) from scratch with margarine, pre-made dough in tube,
) pre-made dry mix), dough pre-bake temperature (room
) temperature, refrigerated, frozen), and cookie depth
) in cm.  Data from London (2003).
)"%lf %lf %lf %lf"
      1          1          1          1.7
      1          4          1          1.3
      1          4          2          1.5
      1          4          3          1.7
      1          2          2          1.2
      1          2          3          1.3
      1          3          3          1.65
```

1	3	1	1.4
1	2	1	1.5
1	1	2	1.9
1	1	3	2
1	3	2	1.7
2	1	2	2
2	4	2	2.1
2	4	1	1.85
2	2	3	1.25
2	1	3	1.8
2	3	1	1.5
2	4	3	2
2	3	3	1.8
2	3	2	1.4
2	2	1	1
2	2	2	1.1
2	1	1	1.7
3	4	1	1.6
3	2	3	1.4
3	1	1	1.6
3	4	2	1.9
3	1	3	1.6
3	1	2	1.7
3	2	2	1
3	4	3	2.1
3	3	1	1.6
3	2	1	1.2
3	3	2	1.4
3	3	3	1.4
4	3	3	1.6
4	2	2	1
4	4	3	1.6
4	1	3	1.8
4	1	2	1.7
4	3	2	1.6
4	4	2	1.6
4	4	1	1.4
4	2	3	0.9
4	1	1	1.3
4	3	1	1.2
4	2	1	0.9
5	2	2	1.35
5	3	1	1.4
5	4	3	2.2
5	4	2	2.1
5	4	1	1.6
5	3	2	1.3
5	1	1	1.5
5	1	2	1.6
5	2	1	1.2
5	3	3	1.5
5	2	3	1
5	1	3	1.5