Some terminology

Factor

   Input variable

Trial

   Application of one factor combination on one experimental unit

Experiment

   Performance of a planned set of trials

Level

   Category into which a factor has been divided

Experimental unit

   The entities to which the treatments are applied

Treatment

   Set of repeatable operations under the control of the experimenter, that may be applied to experimental units

Response

    Result of a trial wrt a particular treatment

Effects

    Measures of the change in response produced by a change in the level of a factor

Interaction

    A measure of the extent to which the effect of one factor is different for different levels of another factor

ANOVA

    A simple summary of the variation in the experimental data

    One of the most widely used statistical methods

Statistics 215a – 10/20/03 – D.R. Brillinger

Hardness of gold alloy fillings experiment.

The question

What is the dental gold filling that is hardest?

Experimental unit

   dental filling

Factor A levels

   8 types of gold alloy

Factor B levels

   3 methods of condensation

Factor C levels

   5 dentists

Response

   hardness

Fit

Y_{ijk} = m + a_i + b_j + c_k + $(ab)_{ij}$ + $(ac)_{ik}$ + $(bc)_{jk}$ +

r_{ijk}

The data (Brown, 1975)

entries are hardnesses (totals of ten)

D = dentist, C = condensation method, G = alloy

D	C	G								
	1	792	824	813	792	792	907	792	835	
1	2	772	772	782	698	665	1115		835	870
	3	782	803	752	620	835	847	560	585	
	1	803	803	715	803	813	858	907	882	
2	2	752	772	772	782	743	933	792	824	
	3	715	707	835	715	673	698	734	681	
	1	715	724	743	627	752	858	762	724	
3	2	792	715	813	743	613	824	847	782	
	3	762	606	743	681	743	715	824	681	
	1	673	946	792	743	762	894	792	649	
4	2	657	743	690	882	772	813	870	858	
	3	690	245	493	707	289	715	813	312	
	1	634	715	707	698	715	772	1048		870
5	2	649	724	803	665	752	824	933	835	
	3	724	627	421	483	405	536	405	312	

Full factorial experiment

   8*3*5 = 120

[parallel boxplots by factor]

Results

$m = \overline{y}_{...} = 736.7$

$\{a_i\} = \{\overline{y}_{i..} - \overline{y}_{...}\} =$

  $\{-9.1,\ -21.5,\ -11.7\ -27.3,\ -48.0,\ 83.9,\ 57.6,- 23.3\}$

$\{b_j\} = \{\overline{y}_{.j.} - \overline{y}_{...}\} = \{49.5,\ 50.3,\ -99.8\}$

$\{c_k\} = \{\overline{y}_{..k} - \overline{y}_{...}\} = \{48.3,\ 43.0,\ 4.5,\ -36.6,\ -59.2\}$

$\{(ab)_{ij}\} = \{\overline{y}_{ij.} - \overline{y}_{i..} - \overline{y}_{.j.} + \overline{y}_{...}\}$

$$\{r_{ijk}\} = \{y_{ijk} - \overline{y}_{i..} - \overline{y}_{.j.} - \overline{y}_{..k} + ...\}$$

Stem-and-leaf

N = 120   Median = -1.091667
Quartiles = -42.825, 38.10833

Decimal point is 2 places to the right of the colon

Low: -215

```
 -1 : 75
 -1 : 3100
 -0 : 99988877776666555555
 -0 : 44444444333333333333322222111100
  0 : 000111111111122222222223333334444
  0 : 66666667777788889
  1 : 00013444
  1 : 88
```

Overlays