**Multilevel LME Models.**

**Implemementation in R**

In the “workers” example, the random effects exist at two levels; at the “worker” level and at the “machine within worker” level.

In the call to ***lme*** this is expressed as “Worker/Machine”, which reads as “worker and machine within worker”.

…

…random=~1|Worker/Machine

…

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Single random effect for each group and the grouping is given by the variable “worker”

…random=~1|Worker

**Example: Wafer data**

Wafer: Semicondcutor experiment described in section 2.2 of Littel et al (1996).

Twelve wafers were assigned to four experimental treatments with three wafers per treatment. The levels for the wafer factor were 1,2 and 3 respectively, but the wafer factor is only meaningful within the same level of the treatment factor. There is nothing associating wafer 1 of the third treatment group with wafer 1 of the first treatment group.

**Coding**

This nesting would be verbalised as "wafer within ET". In SAS this nesting of factors is denoted "wafer(et)". In R it would be denoted “ET/Wafer”.

…

random=list(ET=~1,Wafer=~1)

..

random= ~1| ET/Wafer #equivalent to previous

….

**Roy’s SAS Code**

In Roy's SAS code, the repeated statement is as follows.

**SAS : rep(subject)**

This is verbalised as “Replicates within subject”.