An experiment was conducted with five levels of total solid (17%, 20%, 23%,26%,and 30%) to examine the influence on the quality of ice cream. A sensory evaluation was carried out by panel of seven judges. Compare quality of ice cream by considering total solid and judges as factors.

		Judges						
Total Solid content		1	2	3	4	5	6	7
	1	5.72	5.48	5.78	5.68	5.48	5.44	5.45
	2	5.58	5.48	5.78	5.68	5.48	5.44	5.45
	3	7.54	7.59	7.68	7.95	7.84	7.68	7.87
	4	4.32	5.00	5.36	4.98	4.87	4.65	4.00
	5	8.52	8.59	8.2	8.1	8.54	8.65	8.87

```
> data<-read.table(file = "clipboard",header = TRUE)
> View(data)
> str(data)
'data.frame':  35 obs. of  3 variables:
 $ solid : int  1 2 3 4 5 1 2 3 4 5 ...
 $ judges: int  1 1 1 1 1 2 2 2 2 2 ...
 $ score : num  5.72 5.58 7.54 4.32 8.52 5.48 5.48 7.59 5 8.59 ...
> data$solid<-as.factor(data$solid)
> data$judges<-as.factor(data$judges)
> str(data)
'data.frame':  35 obs. of  3 variables:
 $ solid : Factor w/ 5 levels "1","2","3","4",..: 1 2 3 4 5 1 2 3 4 5 ...
 $ judges: Factor w/ 7 levels "1","2","3","4",..: 1 1 1 1 1 2 2 2 2 2 ...
 $ score : num  5.72 5.58 7.54 4.32 8.52 5.48 5.48 7.59 5 8.59 ...
> boxplot(score~solid, data = data, xlab = "solid", ylab = "score",
        col = c("#00AFBB", "#E7B800"))
> boxplot(score~judges, data = data, xlab = "judges", ylab = "score",
       col = c("#00AFBB", "#E7B800"))
> model<-aov(score~judges+solid, data = data)
> summary(model)
            Df Sum Sq Mean Sq F value Pr(>F)
judges       6   0.21   0.034   0.449  0.838
solid        4  72.25  18.063 235.581 <2e-16 ***
Residuals   24   1.84   0.077
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
> library(lsmeans)
> lm1<-lm(score~judges+solid, data=data)
> lsm1<-lsmeans(lm1,"solid")
> lsm1
```

```
 solid lsmean    SE df lower.CL upper.CL
 1       5.58 0.105 24     5.36     5.79
 2       5.56 0.105 24     5.34     5.77
 3       7.74 0.105 24     7.52     7.95
 4       4.74 0.105 24     4.52     4.96
 5       8.50 0.105 24     8.28     8.71

Results are averaged over the levels of: judges
Confidence level used: 0.95
> pairs(lsm1)
 contrast estimate    SE df t.ratio p.value
 1 - 2       0.020 0.148 24   0.135 0.9999
 1 - 3      -2.160 0.148 24 -14.593 <.0001
 1 - 4       0.836 0.148 24   5.646 0.0001
 1 - 5      -2.920 0.148 24 -19.728 <.0001
 2 - 3      -2.180 0.148 24 -14.729 <.0001
 2 - 4       0.816 0.148 24   5.511 0.0001
 2 - 5      -2.940 0.148 24 -19.863 <.0001
 3 - 4       2.996 0.148 24  20.240 <.0001
 3 - 5      -0.760 0.148 24  -5.135 0.0003
 4 - 5      -3.756 0.148 24 -25.375 <.0001

Results are averaged over the levels of: judges
P value adjustment: tukey method for comparing a family of 5 estimates
> library(multcompView)
> CLD(lsm1,Letters = "abcde")
 solid lsmean    SE df lower.CL upper.CL .group
 4       4.74 0.105 24     4.52     4.96  a
 2       5.56 0.105 24     5.34     5.77   b
 1       5.58 0.105 24     5.36     5.79   b
 3       7.74 0.105 24     7.52     7.95    c
 5       8.50 0.105 24     8.28     8.71     d

Results are averaged over the levels of: judges
Confidence level used: 0.95
P value adjustment: tukey method for comparing a family of 5 estimates
significance level used: alpha = 0.05
> lsm2<-lsmeans(lm1,"judges")
> lsm2
 judges lsmean    SE df lower.CL upper.CL
 1        6.34 0.124 24     6.08     6.59
 2        6.43 0.124 24     6.17     6.68
 3        6.56 0.124 24     6.30     6.82
 4        6.48 0.124 24     6.22     6.73
```

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 5        6.44 0.124 24     6.19     6.70
 6        6.37 0.124 24     6.12     6.63
 7        6.33 0.124 24     6.07     6.58

Results are averaged over the levels of: solid
Confidence level used: 0.95
> pairs(lsm2)
 contrast estimate    SE df t.ratio p.value
 1 - 2      -0.092 0.175 24 -0.525  0.9982
 1 - 3      -0.224 0.175 24 -1.279  0.8547
 1 - 4      -0.142 0.175 24 -0.811  0.9815
 1 - 5      -0.106 0.175 24 -0.605  0.9960
 1 - 6      -0.036 0.175 24 -0.206  1.0000
 1 - 7       0.008 0.175 24  0.046  1.0000
 2 - 3      -0.132 0.175 24 -0.754  0.9872
 2 - 4      -0.050 0.175 24 -0.286  0.9999
 2 - 5      -0.014 0.175 24 -0.080  1.0000
 2 - 6       0.056 0.175 24  0.320  0.9999
 2 - 7       0.100 0.175 24  0.571  0.9971
 3 - 4       0.082 0.175 24  0.468  0.9990
 3 - 5       0.118 0.175 24  0.674  0.9929
 3 - 6       0.188 0.175 24  1.073  0.9299
 3 - 7       0.232 0.175 24  1.325  0.8338
 4 - 5       0.036 0.175 24  0.206  1.0000
 4 - 6       0.106 0.175 24  0.605  0.9960
 4 - 7       0.150 0.175 24  0.857  0.9757
 5 - 6       0.070 0.175 24  0.400  0.9996
 5 - 7       0.114 0.175 24  0.651  0.9941
 6 - 7       0.044 0.175 24  0.251  1.0000

Results are averaged over the levels of: solid
P value adjustment: tukey method for comparing a family of 7 estimates
```