U Wroclaw, Fall 2015
Applied Stats
DISCUSSION/LAB 10: Analysis of variance ANOVA
Factorial experiments

We will use two data sets: mortardata.xls, and dietdata.*.

Mortardata: A research article investigates the effect of age on tensile strength of mortar. Several specimens of various ages were loaded until failure, and the maximum load (in MPa) was recorded for each. The results are in the data set mortardata.*. Does age have an effect on the mean tensile strength of mortar? If the means differ, which do you think differ the most?

Results for: mortardata

One-way ANOVA: 3, 7, 28, 90, 180, 365

Method

```
Null hypothesis          All means are equal
Alternative hypothesis   At least one mean is
different
Significance level       α = 0.05

Equal variances were assumed for the analysis.
```

Factor Information

Factor	Levels	Values
Factor	6	3, 7, 28, 90, 180, 365

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	5	3.808	0.76161	7.91	0.000
Error	73	7.027	0.09627		
Total	78	10.835			

Model Summary

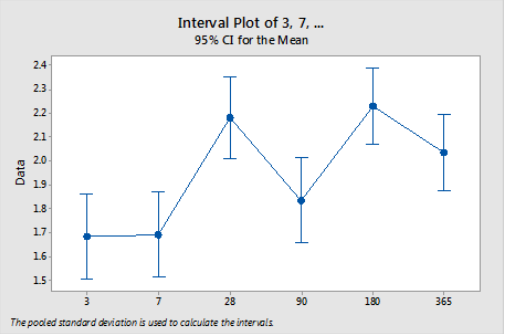
S	R-sq	R-sq(adj)	R-sq(pred)
0.310268	35.14%	30.70%	24.05%

Means

Factor	N	Mean	StDev	95% CI
3	12	1.6825	0.2373	(1.5040, 1.8610)
7	12	1.6900	0.2016	(1.5115, 1.8685)
28	13	2.182	0.473	(2.010, 2.353)
90	12	1.8333	0.3227	(1.6548, 2.0118)
180	15	2.2300	0.2806	(2.0703, 2.3897)
365	15	2.0353	0.2713	(1.8757, 2.1950)

```
Pooled StDev = 0.310268
```

Interval Plot of 3, 7, ...



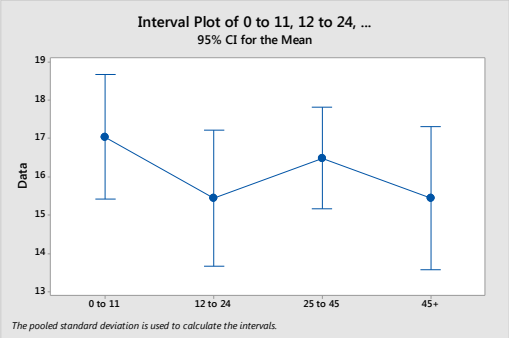
Answer:

Dietdata.*. Archeologists can determine the diets of ancient civilizations by measuring the ratio of carbon-13 to carbon -12 in bones found at burial sites. Large amounts of carbon-13 suggest a diet rich in grasses such as maize, while small amounts of carbon-13 suggest a diet based on herbaceous plants. A journal article reports ratios, as a difference from a standard in units of parts per thousand, for bones from individuals in several age groups. Are the mean concentration ratios different in different age groups? What does that say about the diet as people aged?

One-way ANOVA: 0 to 11, 12 to 24, 25 to 45, 45+

```
Method

Null hypothesis         All means are equal
Alternative hypothesis  At least one mean is
different
Significance level      α = 0.05

Equal variances were assumed for the analysis.

Factor Information

Factor  Levels  Values
Factor       4  0 to 11, 12 to 24, 25 to 45, 45+

Analysis of Variance

Source  DF  Adj SS  Adj MS  F-Value  P-Value
Factor   3   20.96   6.988     0.89    0.453
Error   45  352.95   7.843
Total   48  373.91

Model Summary

      S   R-sq  R-sq(adj)  R-sq(pred)
2.80058  5.61%      0.00%       0.00%

Means

Factor     N    Mean  StDev        95% CI
0 to 11   12  17.050  2.266  (15.422, 18.678)
12 to 24  10   15.45   3.64  ( 13.67,  17.23)
25 to 45  18  16.494  2.633  (15.165, 17.824)
45+        9  15.444  2.728  (13.564, 17.325)

Pooled StDev = 2.80058
```

Interval Plot of 0 to 11, 12 to 24, …



Answer and comments.