The following data

Beam Type	1	2	3	4
	790	840	800	640
Cycles	590	800	870	760
	750	950	870	830

are the number of cycles at which failure occurred for 4 types of concrete beams. Assuming the model

$$Y_{ij} = \mu_i + \varepsilon_{ij},$$

$i = 1, \ldots, 4$, $j = 1, 2, 3$ where ε_{ij} are iid $N(0, \sigma^2)$ answer the questions using the SAS output.

(1) Does the data present significant evidence at $\alpha = 0.05$ that the mean numbers μ_i of cycles to failure for the four types differ?

Solution: We reject Ho if $\tau = MS_{tr} / MS_{err} > F_{3,8,0.05}$, or equivalently, if the p-value for this statistic is less than 0.05. Since the p-value for τ is 0.1390 > 0.05, do not reject Ho. The answer is no.

(2) Give a 95% confidence interval for σ.

Solution: We know that $SSE/\sigma^2 \sim \chi^2_{4(3-1)}$ and therefore (why?) a 95% confidence interval for s is

$$\left(\sqrt{\frac{SSE}{\chi^2_{8,.025}}}, \sqrt{\frac{SSE}{\chi^2_{8,.975}}}\right) = \left(\sqrt{\frac{56200}{17.54}}, \sqrt{\frac{56200}{2.180}}\right) = (56.60, 160.56).$$

```
options ls=79;
options pagesize=50;
title'Cycles to Failure';
DATA cycl;
INPUT type cycles;
cards;
1 790
1 590
1 750
2 840
2 800
2 950
3 800
3 870
3 870
4 640
4 760
4 830
;
PROC anova;
class type;

MODEL cycles = type;
*************
```


1999

Analysis of Variance Procedure
Class Level Information

Class	Levels	Values
TYPE	4	1 2 3 4

Number of observations in data set = 12

2

1999

Analysis of Variance Procedure

Dependent Variable: CYCLES

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	51491.666667	17163.888889	2.44	0.1390
Error	8	56200.000000	7025.000000		
Corrected Total	11	107691.666667			

R-Square	C.V.	Root MSE	CYCLES Mean
0.478140	10.59835	83.815273	790.83333

Source	DF	Anova SS	Mean Square	F Value	Pr > F
TYPE	3	51491.666667	17163.888889	2.44	0.1390