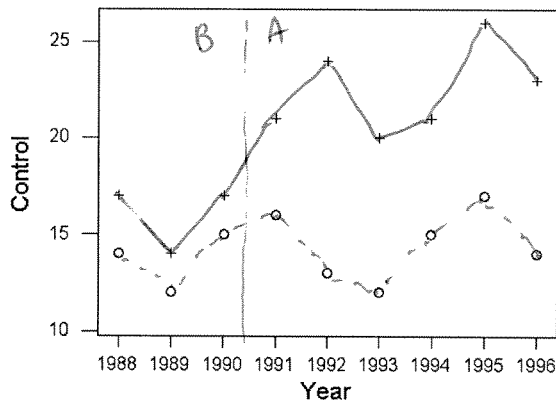


Statistical Ecology  
Stat 555

BACI Design

Problem: Estimates of larval insect abundance in sediments above and below a pull mill for 3 years before plant operation and 6 years after.

Year	Control	Impact	Difference	Treat
1988	14	17	-3	B
1989	12	14	-2	B
1990	15	17	-2	B
1991	16	21	-5	A
1992	13	24	-11	A
1993	12	20	-8	A
1994	15	21	-6	A
1995	17	26	-9	A
1996	14	23	-9	A



MTB > TwoT 'Difference' 'Treatment'.

Two-sample T for Difference

Treatment	N	Mean	StDev	SE Mean
A	6	-8.00	2.19	0.89
B	3	-2.333	0.577	0.33

$$H_0: \bar{X}_{DB} = \bar{X}_{DA}$$

$$H_A: \bar{X}_{DB} \neq \bar{X}_{DA}$$

Difference = mu (A) - mu (B)

Estimate for difference: -5.667

95% CI for difference: (-8.003, -3.330)

T-Test of difference = 0 (vs not =): T-Value = -5.94 P-Value = 0.001 DF = 6

Effect  
Size

$$\frac{-8.00}{-2.33} = 3.43 \text{ or } 343\% \text{ increase}$$

✓  
Reject  $H_0$

Full Model :

```
MTB > GLM 'Data' = BA CI BA*CI Time (BA) Time*CI;
SUBC> Random 'Time';
SUBC> Brief 2 .
```

$$X = \mu + BA + CI + T(BA) + BA \times CI + T \times CI + e$$

↳ assume zero  
or have replicated C & I

**General Linear Model: Data versus BA, CI, Time**

Factor	Type	Levels	Values
BA	fixed	2	A, B
CI	fixed	2	C, I
Time(BA)	random	9	1991, 1992, 1993, 1994, 1995, 1996, 1988, 1989, 1990

Analysis of Variance for Data, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
BA	1	53.778	53.778	53.778	9.11	0.019
CI	1	168.056	106.778	106.778	60.60	0.000
BA*CI	1	32.111	32.111	32.111	18.23	0.004
Time(BA)	7	41.333	41.333	5.905	3.35	0.067
CI*Time(BA)	7	12.333	12.333	1.762	**	
Error	0	*	*	*		
Total	17	307.611				

\*\* Denominator of F-test is zero.

S = \*

```
MTB > GLM 'Data' = BA CI BA*CI Time( BA);
SUBC> Random 'Time';
SUBC> Brief 2 .
```

Actual Model

**General Linear Model: Data versus BA, CI, Time**

Factor	Type	Levels	Values
BA	fixed	2	A, B
CI	fixed	2	C, I
Time(BA)	random	9	1991, 1992, 1993, 1994, 1995, 1996, 1988, 1989, 1990

$$X = \mu + BA + CI + BA \times CI + T(BA) + e$$

Analysis of Variance for Data, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
BA	1	53.778	53.778	53.778	9.11	0.019
CI	1	168.056	106.778	106.778	60.60	0.000
BA*CI	1	32.111	32.111	32.111	18.23	0.004 ✓
Time(BA)	7	41.333	41.333	5.905	3.35	0.067
Error	7	12.333	12.333	1.762		
Total	17	307.611				

→ Equivalent to T-test

S = 1.32737 R-Sq = 95.99% R-Sq(adj) = 90.26%