

Repeated Measures One: The tubes data

tuzo > cat tubes.dat

| | | | | | | | | | | | | |
|-------|-----|---|----|------|----|-----|------|----|-----|------|------|--------|
| 1 | 198 | 1 | 1 | 0.6 | . | . | 0.8 | . | . | . | . | |
| 2 | 198 | 1 | 2 | 1.8 | . | . | 2.8 | . | . | . | . | |
| 3 | 198 | 1 | 3 | 4.7 | 1 | . | 6.1 | 1 | . | . | . | |
| 4 | 198 | 1 | 4 | 7.8 | 4 | 2.0 | 8.7 | 5 | 2.1 | . | . | |
| 5 | 198 | 1 | 5 | 11.2 | 6 | 1.8 | 12.1 | 7 | 2.0 | . | . | |
| 6 | 198 | 1 | 6 | 14.3 | 12 | 1.9 | 15.0 | 11 | 1.4 | . | . | |
| 7 | 198 | 1 | 7 | 17.5 | 12 | 2.1 | 18.5 | 13 | 1.6 | . | . | |
| 8 | 198 | 1 | 8 | 20.9 | 19 | 1.1 | 21.9 | 19 | 1.7 | . | . | |
| 9 | 198 | 1 | 9 | 24.0 | 22 | 1.6 | 25.2 | 22 | 1.3 | . | . | |
| 10 | 198 | 1 | 10 | 27.2 | 26 | 2.1 | 28.4 | 26 | 1.2 | . | . | |
| 11 | 198 | 1 | 11 | 30.7 | 28 | 1.4 | 32.3 | 28 | 1.5 | . | . | |
| 12 | 198 | 1 | 12 | . | 31 | . | . | 31 | . | . | . | |
| 13 | 198 | 1 | 13 | . | 37 | . | . | 36 | . | . | . | |
| 14 | 198 | 1 | 14 | . | 37 | . | . | 38 | . | 3.11 | 3.18 | 0.5996 |
| 15 | 198 | 2 | 1 | 0.5 | . | . | 0.6 | . | . | . | . | . |
| 16 | 198 | 2 | 2 | 1.4 | . | . | 2.3 | . | . | . | . | . |
| 17 | 198 | 2 | 3 | 4.15 | 1 | . | 5.6 | 1 | . | . | . | . |
| 18 | 198 | 2 | 4 | 7.4 | 2 | 2.0 | 8.7 | 4 | 2.1 | . | . | . |
| 19 | 198 | 2 | 5 | 10.8 | 5 | 2.2 | 12.0 | 8 | 2.0 | . | . | . |
| 20 | 198 | 2 | 6 | 14.2 | 10 | 1.7 | 15.3 | 13 | 1.6 | . | . | . |
| . . . | | | | | | | | | | | | |
| 329 | 225 | 4 | 8 | 18.1 | 32 | 0.8 | 19.1 | 32 | 1.1 | . | . | . |
| 330 | 225 | 4 | 9 | 20.9 | 33 | 1.4 | 21.8 | 34 | 1.3 | . | . | . |
| 331 | 225 | 4 | 10 | 23.4 | 32 | 1.5 | 24.3 | 32 | 1.4 | . | . | . |
| 332 | 225 | 4 | 11 | 26.2 | 35 | 1.6 | 27.0 | 37 | 1.5 | . | . | . |
| 333 | 225 | 4 | 12 | 28.8 | 36 | 1.6 | 29.4 | 37 | 1.6 | . | . | . |
| 334 | 225 | 4 | 13 | 31.5 | 41 | 1.5 | 32.2 | 42 | 1.4 | . | . | . |
| 335 | 225 | 4 | 14 | . | 41 | . | . | 46 | . | 2.70 | 2.71 | 0.6627 |

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/* tuberead.sas */
options linesize=79 pagesize=100 noovp formdlim='_';
title "Kohn's Fungus Tube data";
/* Data definition file -- Use with %include */

data mould;
    infile 'tubes.dat';
input
    line1  mcg    replic1  day1  amlng1  amscl1  amlead1  pmlng1  pmscl1  pmlead1
    empa1  empb1
    line2  mcg2  replic2  day2  amlng2  amscl2  amlead2  pmlng2  pmscl2  pmlead2
    empa2  empb2
    line3  mcg3  replic3  day3  amlng3  amscl3  amlead3  pmlng3  pmscl3  pmlead3
    empa3  empb3
    line4  mcg4  replic4  day4  amlng4  amscl4  amlead4  pmlng4  pmscl4  pmlead4
    empa4  empb4
    line5  mcg5  replic5  day5  amlng5  amscl5  amlead5  pmlng5  pmscl5  pmlead5
    empa5  empb5
    line6  mcg6  replic6  day6  amlng6  amscl6  amlead6  pmlng6  pmscl6  pmlead6
    empa6  empb6
    line7  mcg7  replic7  day7  amlng7  amscl7  amlead7  pmlng7  pmscl7  pmlead7
    empa7  empb7
    line8  mcg8  replic8  day8  amlng8  amscl8  amlead8  pmlng8  pmscl8  pmlead8
    empa8  empb8
    line9  mcg9  replic9  day9  amlng9  amscl9  amlead9  pmlng9  pmscl9  pmlead9
    empa9  empb9
    line10 mcg10 replic10 day10 amlng10 amscl10 amlead10 pmlng10 pmscl10 pmlead10
    empa10 empb10
    line11 mcg11 replic11 day11 amlng11 amscl11 amlead11 pmlng11 pmscl11 pmlead11
    empa11 empb11
    line12 mcg12 replic12 day12 amlng12 amscl12 amlead12 pmlng12 pmscl12 pmlead12
    empa12 empb12
    line13 mcg13 replic13 day13 amlng13 amscl13 amlead13 pmlng13 pmscl13 pmlead13
    empa13 empb13
    line14 mcg14 replic14 day14 amlng14 amscl14 amlead14 pmlng14 pmscl14 pmlead14
    amslope pmslope weight;
rate=(amslope+pmslope)/2;

label mcg = 'Mycelial Compatibility Group';
label weight = 'Sclerotial Weight';
label rate = 'Growth Rate: Average of am & pm slope';

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/***** Average morning and evening observations   ***/
array am{28} amlng1-amlng14  amscl1-amscl14;
array pm{28} pmlng1-pmlng14  pmscl1-pmscl14;
array aver{28} length1-length14 sclr1-sclr14;
do i=1 to 28;
    aver{i}=(am{i}+pm{i})/2;
end;
/* If there are no sclerotia, number is missing. Make zero. */
array s{14} sclr1-sclr14;
do i=1 to 14;
    if s{i}=. then s{i}=0;
end;

/* Commented out
proc freq;
    tables mcg;

proc means n mean std;
    var length1-length14 sclr1-sclr14 rate weight;

*/

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Kohn's Fungus Tube data 1
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The FREQ Procedure

Mycelial Compatibility Group

| mcg | Frequency | Percent | Cumulative Frequency | Cumulative Percent |
|-----|-----------|---------|-------------------------|-----------------------|
| 198 | 4 | 16.67 | 4 | 16.67 |
| 205 | 4 | 16.67 | 8 | 33.33 |
| 213 | 4 | 16.67 | 12 | 50.00 |
| 221 | 4 | 16.67 | 16 | 66.67 |
| 223 | 4 | 16.67 | 20 | 83.33 |
| 225 | 4 | 16.67 | 24 | 100.00 |

The MEANS Procedure

| Variable | Label | N | Mean | Std Dev |
|----------|---------------------------------------|----|------------|-----------|
| length1 | | 24 | 0.5895833 | 0.0827242 |
| length2 | | 24 | 1.8239583 | 0.5208938 |
| length3 | | 24 | 4.4489583 | 0.7392519 |
| length4 | | 24 | 7.2447917 | 0.7834906 |
| length5 | | 24 | 10.2979167 | 0.8585224 |
| length6 | | 24 | 13.1479167 | 0.8913204 |
| length7 | | 24 | 16.1145833 | 0.9897825 |
| length8 | | 24 | 19.1166667 | 1.2197351 |
| length9 | | 24 | 22.1041667 | 1.3706486 |
| length10 | | 24 | 24.9395833 | 1.6023067 |
| length11 | | 24 | 28.1145833 | 1.8854407 |
| length12 | | 19 | 30.0131579 | 1.4178272 |
| length13 | | 7 | 31.2642857 | 0.9923517 |
| length14 | | 0 | . | . |
| sclr1 | | 24 | 0 | 0 |
| sclr2 | | 24 | 0 | 0 |
| sclr3 | | 24 | 0.7708333 | 0.9666073 |
| sclr4 | | 24 | 5.4791667 | 2.3427927 |
| sclr5 | | 24 | 10.6250000 | 3.6867860 |
| sclr6 | | 24 | 14.3958333 | 4.8944937 |
| sclr7 | | 24 | 17.1875000 | 5.6564940 |
| sclr8 | | 24 | 22.4791667 | 6.2527892 |
| sclr9 | | 24 | 25.5208333 | 6.6225556 |
| sclr10 | | 24 | 27.9583333 | 6.9202235 |
| sclr11 | | 24 | 29.4791667 | 7.0286358 |
| sclr12 | | 24 | 32.9583333 | 8.5413529 |
| sclr13 | | 24 | 37.1250000 | 8.5494088 |
| sclr14 | | 24 | 40.5833333 | 9.2097145 |
| rate | Growth Rate: Average of am & pm slope | 24 | 2.8529167 | 0.1966398 |
| weight | Sclerotial Weight | 24 | 0.6272708 | 0.0581010 |

```

%include 'tuberead.sas';
options pagesize=500;
Title2 'Test for Differences Between MCG Strains';
Title3 'Profile option on repeated measures gives ';
title4 'Contrasts representing Growth';

proc glm data=mould;
  class mcg;
  model length1-length11 = mcg / nouni;
  repeated time profile / summary;

proc means n mean std;
  class mcg;
  var length1-length11;

tuzo > cat tuberepeat1.lst

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                                Kohn's Fungus Tube data                                1
                                Test for Differences Between MCG Strains
                                Profile option on repeated measures gives
                                Contrasts representing Growth
                                                                22:33 Monday, November 21, 2005

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The GLM Procedure

Class Level Information

| Class | Levels | Values |
|-------|--------|-------------------------|
| mcg | 6 | 198 205 213 221 223 225 |

Number of observations 24

```

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                                Test for Differences Between MCG Strains
                                Profile option on repeated measures gives
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The GLM Procedure

Repeated Measures Analysis of Variance

Repeated Measures Level Information

| Dependent Variable | length1 | length2 | length3 | length4 | length5 | length6 |
|--------------------|---------|---------|---------|---------|---------|---------|
| Level of time | 1 | 2 | 3 | 4 | 5 | 6 |

Repeated Measures Level Information

| Dependent Variable | length7 | length8 | length9 | length10 | length11 |
|--------------------|---------|---------|---------|----------|----------|
| Level of time | 7 | 8 | 9 | 10 | 11 |

Manova Test Criteria and Exact F Statistics
for the Hypothesis of no time Effect
H = Type III SSCP Matrix for time
E = Error SSCP Matrix

S=1 M=4 N=3.5

| Statistic | Value | F Value | Num DF | Den DF | Pr > F |
|------------------------|--------------|---------|--------|--------|--------|
| Wilks' Lambda | 0.000042 | 21571.7 | 10 | 9 | <.0001 |
| Pillai's Trace | 0.999958 | 21571.7 | 10 | 9 | <.0001 |
| Hotelling-Lawley Trace | 23968.599481 | 21571.7 | 10 | 9 | <.0001 |
| Roy's Greatest Root | 23968.599481 | 21571.7 | 10 | 9 | <.0001 |

Manova Test Criteria and F Approximations
for the Hypothesis of no time*mcg Effect
H = Type III SSCP Matrix for time*mcg
E = Error SSCP Matrix

S=5 M=2 N=3.5

| Statistic | Value | F Value | Num DF | Den DF | Pr > F |
|------------------------|--------------|---------|--------|--------|--------|
| Wilks' Lambda | 0.00007896 | 6.16 | 50 | 44.411 | <.0001 |
| Pillai's Trace | 3.09495277 | 2.11 | 50 | 65 | 0.0024 |
| Hotelling-Lawley Trace | 150.07507945 | 23.87 | 50 | 16.683 | <.0001 |
| Roy's Greatest Root | 134.47570888 | 174.82 | 10 | 13 | <.0001 |

NOTE: F Statistic for Roy's Greatest Root is an upper bound.

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Kohn's Fungus Tube data
Test for Differences Between MCG Strains
Profile option on repeated measures gives
Contrasts representing Growth
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The GLM Procedure
Repeated Measures Analysis of Variance
Tests of Hypotheses for Between Subjects Effects

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|--------|----|-------------|-------------|---------|--------|
| mcg | 5 | 151.7520289 | 30.3504058 | 12.43 | <.0001 |
| Error | 18 | 43.9459801 | 2.4414433 | | |

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Kohn's Fungus Tube data
Test for Differences Between MCG Strains
Profile option on repeated measures gives
Contrasts representing Growth
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The GLM Procedure
 Repeated Measures Analysis of Variance
 Univariate Tests of Hypotheses for Within Subject Effects

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|-------------|-----|-------------|-------------|---------|--------|
| time | 10 | 21390.51955 | 2139.05195 | 38110.7 | <.0001 |
| time*mcg | 50 | 103.28253 | 2.06565 | 36.80 | <.0001 |
| Error(time) | 180 | 10.10293 | 0.05613 | | |

| Source | Adj Pr > F | |
|-------------|------------|--------|
| | G - G | H - F |
| time | <.0001 | <.0001 |
| time*mcg | <.0001 | <.0001 |
| Error(time) | | |

Greenhouse-Geisser Epsilon 0.2677
 Huynh-Feldt Epsilon 0.4062

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 Test for Differences Between MCG Strains
 Profile option on repeated measures gives
 Contrasts representing Growth
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The GLM Procedure
 Repeated Measures Analysis of Variance
 Analysis of Variance of Contrast Variables

time_N represents the nth successive difference in time

Contrast Variable: time_1

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|--------|----|-------------|-------------|---------|--------|
| Mean | 1 | 36.56835938 | 36.56835938 | 390.82 | <.0001 |
| mcg | 5 | 3.72429688 | 0.74485938 | 7.96 | 0.0004 |
| Error | 18 | 1.68421875 | 0.09356771 | | |

Contrast Variable: time_2

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|--------|----|-------------|-------------|---------|--------|
| Mean | 1 | 165.3750000 | 165.3750000 | 1889.63 | <.0001 |
| mcg | 5 | 0.9109375 | 0.1821875 | 2.08 | 0.1151 |
| Error | 18 | 1.5753125 | 0.0875174 | | |

Contrast Variable: time_3

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|--------|----|-------------|-------------|---------|--------|
| Mean | 1 | 187.6004167 | 187.6004167 | 4376.58 | <.0001 |
| mcg | 5 | 0.5780208 | 0.1156042 | 2.70 | 0.0547 |
| Error | 18 | 0.7715625 | 0.0428646 | | |

Contrast Variable: time_4

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|--------|----|-------------|-------------|---------|--------|
| Mean | 1 | 223.7177344 | 223.7177344 | 5517.51 | <.0001 |
| mcg | 5 | 0.4317969 | 0.0863594 | 2.13 | 0.1085 |
| Error | 18 | 0.7298437 | 0.0405469 | | |

Contrast Variable: time_5

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|--------|----|-------------|-------------|---------|--------|
| Mean | 1 | 194.9400000 | 194.9400000 | 9114.08 | <.0001 |
| mcg | 5 | 1.2050000 | 0.2410000 | 11.27 | <.0001 |
| Error | 18 | 0.3850000 | 0.0213889 | | |

Contrast Variable: time_6

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|--------|----|-------------|-------------|---------|--------|
| Mean | 1 | 211.2266667 | 211.2266667 | 7879.96 | <.0001 |
| mcg | 5 | 0.8558333 | 0.1711667 | 6.39 | 0.0014 |
| Error | 18 | 0.4825000 | 0.0268056 | | |

Contrast Variable: time_7

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|--------|----|-------------|-------------|---------|--------|
| Mean | 1 | 216.3001042 | 216.3001042 | 6113.29 | <.0001 |
| mcg | 5 | 3.7505208 | 0.7501042 | 21.20 | <.0001 |
| Error | 18 | 0.6368750 | 0.0353819 | | |

Contrast Variable: time_8

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|--------|----|-------------|-------------|---------|--------|
| Mean | 1 | 214.2037500 | 214.2037500 | 12240.2 | <.0001 |
| mcg | 5 | 0.6612500 | 0.1322500 | 7.56 | 0.0006 |
| Error | 18 | 0.3150000 | 0.0175000 | | |

Contrast Variable: time_9

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|--------|----|-------------|-------------|---------|--------|
| Mean | 1 | 192.9501042 | 192.9501042 | 9940.90 | <.0001 |
| mcg | 5 | 1.8230208 | 0.3646042 | 18.78 | <.0001 |
| Error | 18 | 0.3493750 | 0.0194097 | | |

Contrast Variable: time_10

| Source | DF | Type III SS | Mean Square | F Value | Pr > F |
|--------|----|-------------|-------------|---------|--------|
| Mean | 1 | 241.9350000 | 241.9350000 | 3536.92 | <.0001 |
| mcg | 5 | 2.6487500 | 0.5297500 | 7.74 | 0.0005 |
| Error | 18 | 1.2312500 | 0.0684028 | | |

Kohn's Fungus Tube data 6
 Test for Differences Between MCG Strains
 Profile option on repeated measures gives
 Contrasts representing Growth
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The MEANS Procedure

| Mycelial Compatibility Group | N Obs | Variable | N | Mean | Std Dev |
|------------------------------------|----------|----------|---|------------|-----------|
| 198 | 4 | length1 | 4 | 0.5937500 | 0.0718070 |
| | | length2 | 4 | 2.0375000 | 0.1931105 |
| | | length3 | 4 | 5.0187500 | 0.2544397 |
| | | length4 | 4 | 8.0750000 | 0.1258306 |
| | | length5 | 4 | 11.4000000 | 0.2041241 |
| | | length6 | 4 | 14.5375000 | 0.2015564 |
| | | length7 | 4 | 17.7500000 | 0.1914854 |
| | | length8 | 4 | 21.3750000 | 0.2901149 |
| | | length9 | 4 | 24.5750000 | 0.3175426 |
| | | length10 | 4 | 27.7750000 | 0.3095696 |
| | | length11 | 4 | 31.4500000 | 0.3135815 |
| 205 | 4 | length1 | 4 | 0.5687500 | 0.0239357 |
| | | length2 | 4 | 1.5812500 | 0.2609079 |
| | | length3 | 4 | 4.1000000 | 0.3240370 |
| | | length4 | 4 | 6.8500000 | 0.3391165 |
| | | length5 | 4 | 9.8875000 | 0.3902456 |
| | | length6 | 4 | 12.9000000 | 0.3464102 |
| | | length7 | 4 | 16.0500000 | 0.3807887 |
| | | length8 | 4 | 19.1625000 | 0.3198307 |
| | | length9 | 4 | 22.2750000 | 0.3122499 |
| | | length10 | 4 | 25.3375000 | 0.3092329 |
| | | length11 | 4 | 28.7125000 | 0.2809953 |

| | | | | | |
|-----|---|----------|---|------------|-----------|
| 213 | 4 | length1 | 4 | 0.5687500 | 0.1546165 |
| | | length2 | 4 | 1.3375000 | 0.6345930 |
| | | length3 | 4 | 3.8062500 | 0.8830286 |
| | | length4 | 4 | 6.4625000 | 1.0306753 |
| | | length5 | 4 | 9.4375000 | 1.1426395 |
| | | length6 | 4 | 12.4625000 | 1.2030344 |
| | | length7 | 4 | 15.5250000 | 1.2586368 |
| | | length8 | 4 | 18.8875000 | 1.0896291 |
| | | length9 | 4 | 22.0250000 | 1.2579746 |
| | | length10 | 4 | 25.0625000 | 1.2030344 |
| | | length11 | 4 | 28.4750000 | 1.0380270 |
| 221 | 4 | length1 | 4 | 0.5562500 | 0.0125000 |
| | | length2 | 4 | 1.6000000 | 0.2908321 |
| | | length3 | 4 | 4.0312500 | 0.5796461 |
| | | length4 | 4 | 6.8187500 | 0.4450538 |
| | | length5 | 4 | 9.7500000 | 0.4020779 |
| | | length6 | 4 | 12.4000000 | 0.4020779 |
| | | length7 | 4 | 15.1125000 | 0.4819665 |
| | | length8 | 4 | 17.7000000 | 0.3488075 |
| | | length9 | 4 | 20.4875000 | 0.3750000 |
| | | length10 | 4 | 22.9500000 | 0.4564355 |
| | | length11 | 4 | 25.9250000 | 0.8741663 |
| 223 | 4 | length1 | 4 | 0.6500000 | 0 |
| | | length2 | 4 | 2.6437500 | 0.0826009 |
| | | length3 | 4 | 5.4250000 | 0.3505947 |
| | | length4 | 4 | 8.0250000 | 0.4663690 |
| | | length5 | 4 | 10.9750000 | 0.1658312 |
| | | length6 | 4 | 13.4875000 | 0.2322893 |
| | | length7 | 4 | 16.2500000 | 0.2121320 |
| | | length8 | 4 | 18.8625000 | 0.1750000 |
| | | length9 | 4 | 21.6875000 | 0.2393568 |
| | | length10 | 4 | 24.3500000 | 0.1870829 |
| | | length11 | 4 | 27.1125000 | 0.2015564 |
| 225 | 4 | length1 | 4 | 0.6000000 | 0.1224745 |
| | | length2 | 4 | 1.7437500 | 0.2330728 |
| | | length3 | 4 | 4.3125000 | 0.3281895 |
| | | length4 | 4 | 7.2375000 | 0.3178705 |
| | | length5 | 4 | 10.3375000 | 0.3424787 |
| | | length6 | 4 | 13.1000000 | 0.2857738 |
| | | length7 | 4 | 16.0000000 | 0.2273030 |
| | | length8 | 4 | 18.7125000 | 0.1652019 |
| | | length9 | 4 | 21.5750000 | 0.3840573 |
| | | length10 | 4 | 24.1625000 | 0.5513242 |
| | | length11 | 4 | 27.0125000 | 0.6005206 |
