

D Rogosa STAT 209 week 9 Correlates of Change

Time1-Time2 regressions
 Example from Rogosa, D. R. (1995). Myths and methods: "Myths about longitudinal research," plus supplemental questions. In The analysis of change, J. M. Gottman, Ed. Hillsdale, New Jersey: Lawrence Erlbaum Associates, 3-65.

measurement of change examples
 (W = G, as correlate of change)

```
> mtruesig$theta = signif((mtrue$Xi5 - mtrue$Xi1)/4,4) link on class page
> mtruesig
  Xil  Xi3  Xi5      W theta
1  37.56 49.29 61.02 15.970 5.866
2  45.65 51.58 57.51 15.380 2.965
3  40.94 52.88 64.82 11.480 5.970
4  47.36 55.45 63.54 16.890 4.045
5  52.71 62.70 72.70 19.180 4.999
6  30.45 46.34 62.23 11.820 7.944
7  43.65 58.37 73.09 15.330 7.362
8  41.16 49.26 57.37 13.210 4.054
9  44.15 52.00 59.84 13.090 3.923
10 38.16 46.59 55.03 10.320 4.217
11 37.68 39.87 42.06 10.260 1.096
12 45.30 54.38 63.47 15.600 4.541
13 39.37 48.15 56.94 13.900 4.392
14 36.66 43.75 50.84 13.530 3.544
15 53.40 62.32 71.23 14.450 4.459
16 59.35 62.80 66.25 20.160 1.724
17 53.14 64.35 75.56 16.110 5.605
18 44.90 58.82 72.75 15.060 6.962
19 41.79 59.44 77.09 18.330 8.827
20 38.25 48.98 59.71 13.770 5.367
21 47.24 60.79 74.34 15.880 6.776
22 53.57 67.71 81.84 18.250 7.068
23 35.54 43.51 51.48 10.150 3.984
24 37.54 50.25 62.95 9.462 6.353
25 37.07 49.71 62.35 15.810 6.321
26 32.40 44.69 56.98 11.600 6.145
27 45.22 62.08 78.94 14.080 8.430
28 35.67 47.42 59.17 12.190 5.875
29 38.30 51.13 63.97 14.070 6.416
30 52.61 55.52 58.42 16.680 1.452
31 38.36 48.49 58.62 15.070 5.064
32 45.14 51.44 57.73 13.940 3.148
33 53.82 64.27 74.73 20.400 5.228
34 49.46 61.42 73.39 16.000 5.984
35 56.29 59.04 61.80 17.470 1.378
36 49.59 57.58 65.57 17.300 3.995
37 41.45 59.43 77.41 15.860 8.991
38 47.42 57.42 67.43 18.950 5.002
39 57.00 65.73 74.47 18.900 4.367
40 41.06 43.54 46.03 13.790 1.241
> pairs(~ Xil + Xi3 + Xi5 + W) looks real secpdt.
> cor(mtruesig)
      Xil      Xi3      Xi5      W      theta
Xil  1.0000000  0.8422138  0.5359036  0.766175758 -0.280851506
Xi3  0.8422138  1.0000000  0.9065331  0.765188951  0.280906648
Xi5  0.5359036  0.9065331  1.0000000  0.598501096  0.659788513
W    0.7661758  0.7651890  0.5985011  1.000000000 -0.001592367
theta -0.2808515  0.2809066  0.6597885 -0.001592367  1.000000000
```

Artificial Data
 perfect meas
 exact straight line
 $\Delta G = 5$

```
> trureg1 = lm(Xi5 ~ W + Xi1)
> trureg2 = lm(Xi5 ~ W + Xi3)
> truediffreg = lm(I(Xi5 - Xi3) ~ W)
> summary(trureg1)
Call: lm(formula = Xi5 ~ W + Xi1)
Coefficients:
      Estimate Std. Error t value Pr(>|t|)
(Intercept)  31.2139      7.5445  4.137 0.000194 ***
W              1.5002      0.6680  2.246 0.030788 *
Xi1            0.2392      0.2588  0.924 0.361290
---
```

perfect meas.
 W important
 predictor of change

```
Residual standard error: 7.514 on 37 degrees of freedom
Multiple R-squared: 0.3727, Adjusted R-squared: 0.33
F-statistic: 10.99 on 2 and 37 DF, p-value: 0.0001792

> summary(trureg2)
Call: lm(formula = Xi5 ~ W + Xi3)
Coefficients:
      Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.6874      4.5537  0.151 0.8808
W            -0.7570      0.3329 -2.274 0.0289 *
Xi3          1.3821      0.1290 10.718 6.7e-13 ***
---
```

perfect meas
 W important
 negative predictor of change

```
Residual standard error: 3.751 on 37 degrees of freedom
Multiple R-squared: 0.8437, Adjusted R-squared: 0.83
F-statistic: 99.83 on 2 and 37 DF, p-value: 1.232e-15

> summary(truediffreg)
Call: lm(formula = I(Xi5 - Xi3) ~ W)
Coefficients:
      Estimate Std. Error t value Pr(>|t|)
(Intercept) 10.086567    3.586436  2.812 0.00774 **
W           -0.002139    0.235245 -0.009 0.99279
---
```

change Δ on W
 no relation

```
> cor(W, theta) [1] -0.001592367
```

create straight-line data
 W s.t. $\rho_{W\theta} = 0$
 try out standard regression approaches using prior Xi's as predictor

rate of change

Same result if Difference Score is Outcome rather than final status

```
#First the true score regressions from the 2/8 handout
> trureg1D = lm(I(Xi5 - Xi1) ~ W + Xi1)
> summary(trureg1D)

Call:
lm(formula = I(Xi5 - Xi1) ~ W + Xi1)

Residuals:
    Min       1Q   Median       3Q      Max
-15.692  -4.348  -1.051   6.406  15.788

Coefficients:
      Estimate Std. Error t value Pr(>|t|)
(Intercept)  31.2139      7.5445  4.137 0.000194 ***
W              1.5002      0.6680  2.246 0.030788 *
Xi1           -0.7608      0.2588  -2.940 0.005624 **
---
```

```
> trureg2D = lm(I(Xi5 - Xi3) ~ W + Xi3)
> summary(trureg2D)

Call:
lm(formula = I(Xi5 - Xi3) ~ W + Xi3)

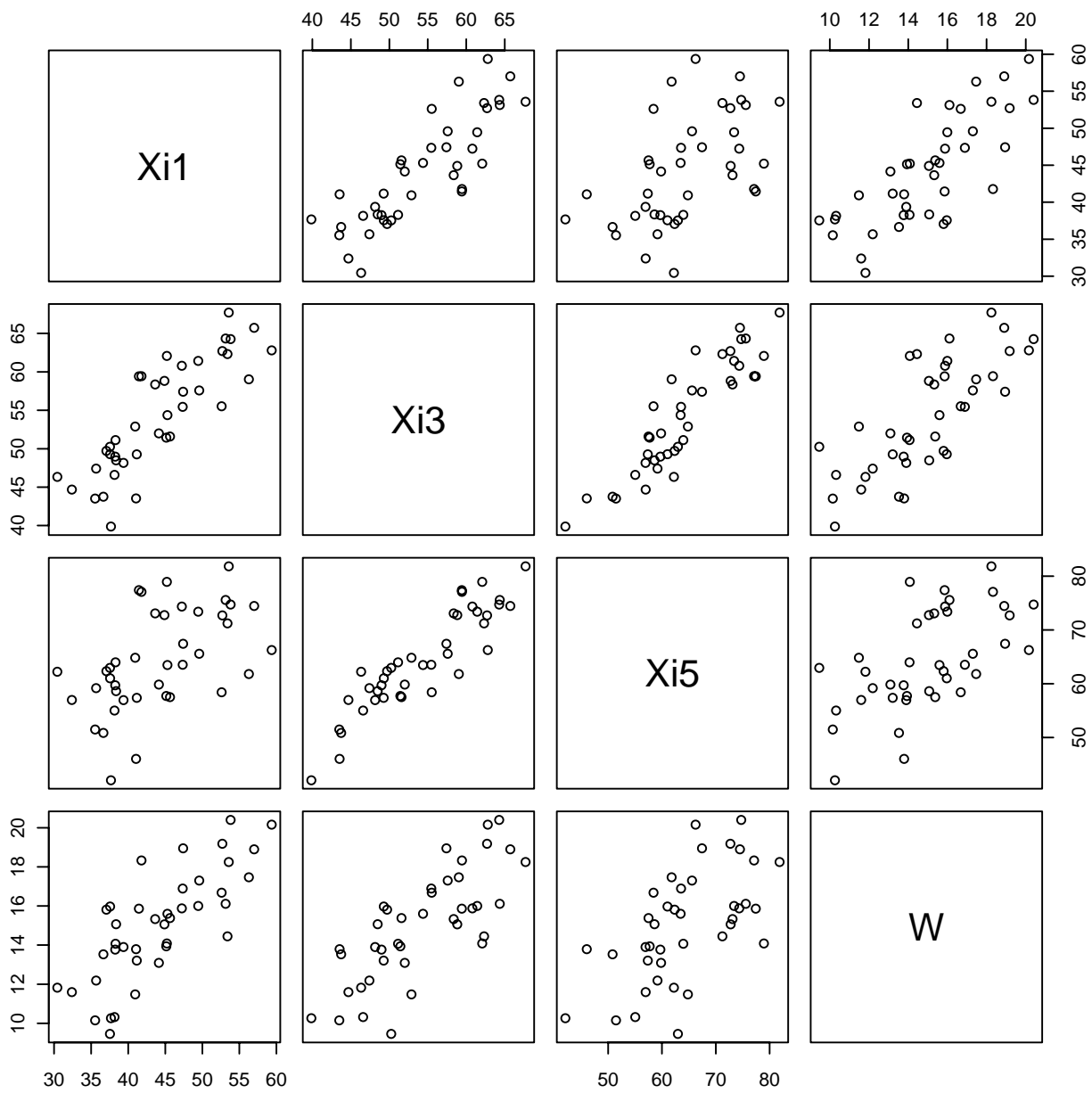
Residuals:
    Min       1Q   Median       3Q      Max
-7.26371 -2.36848 -0.07474  2.20751  8.12447

Coefficients:
      Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.6874      4.5537  0.151 0.88083
W            -0.7570      0.3329 -2.274 0.02886 *
Xi3          1.3821      0.1290 10.718 6.7e-13 ***
---
```

match coeff t-stat

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
 match coeff, t-statistic
 Residual standard error: 7.514 on 37 degrees of freedom
 Multiple R-squared: 0.1894, Adjusted R-squared: 0.1
 F-statistic: 4.323 on 2 and 37 DF, p-value: 0.02055

```
Residual standard error: 3.751 on 37 degrees of freedom
Multiple R-squared: 0.1918, Adjusted R-squared: 0.1481
F-statistic: 4.391 on 2 and 37 DF, p-value: 0.01945
> detach(mtruesig)
```



Demonstration:

time 1, time 2 Regressions

DATA

y_2, y_1, w
exog.

D on y_1, w same as y_2 on y_1, w

coefficients for w in population or sample,

perfect or fallible measurement

$$\text{coeff } \beta_{Dw \cdot y_1} = \beta_{D(w \cdot y_1)} = \frac{\text{Cov}(y_2 - y_1, w - \beta_{wy_1} y_1)}{\text{Var}(w \cdot y_1)}$$

(Note: $\beta_{wy_1} \text{Var}(y_1) = \text{Cov}(y_1, w)$)

$$= \frac{\text{Cov}(y_2, w) - \beta_{wy_1} \text{Cov}(y_1, y_2) - \text{Cov}(y_1, w) + \beta_{wy_1} \text{Var}(y_1)}{\text{Var}(w \cdot y_1)}$$

$$= \frac{\text{Cov}(y_2, w) - \beta_{wy_1} \text{Cov}(y_1, y_2)}{\text{Var}(w \cdot y_1)}$$

$$= \frac{\text{Cov}(y_2, w \cdot y_1)}{\text{Var}(w \cdot y_1)} = \beta_{y_2(w \cdot y_1)} = \beta_{y_2 w \cdot y_1}$$

brute force,
quicker ways
to this

see STAT 209
week 1
adjusted
variables