DRogosa STAT 222 week 1

measurement of change examples

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.

link on class page

```
> mtruesig$theta = signif((mtrue$Xi5 - mtrue$Xi1)/4,4)
> mtruesig
     Xi1   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(~ Xi1 + Xi3 + Xi5 + W)
```

look real see pdf.

Artificial Data
perfect meas
exact straight line
$\mu_\theta = 5$

```
> cor(mtruesig)
             Xi1       Xi3       Xi5            W        theta
Xi1    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
```

rate of change

```
> truereg1 = lm(Xi5 ~ W + Xi1)
> truereg2 = lm(Xi5 ~ W + Xi3)
> truediffreg = lm(I(Xi5- Xi3) ~ W)
> summary(truereg1)
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
---
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
```

perfect meas. W important predictor of change

```
> summary(truereg2)
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 ***
---
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
```

perfect meas W important negative predictor of change

```
> 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
---
Residual standard error: 4.117 on 38 degrees of freedom
Multiple R-squared: 2.176e-06,  Adjusted R-squared: -0.0
F-statistic: 8.267e-05 on 1 and 38 DF,  p-value: 0.9928

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

change Δ on W no relation

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

##Same result if Difference Score is Outcome rather than final status

```
#First the true score regressions from [redacted]out
> truereg1D = lm(I(Xi5 - Xi1) ~ W + Xi1)
> summary(truereg1D)

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 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.
```

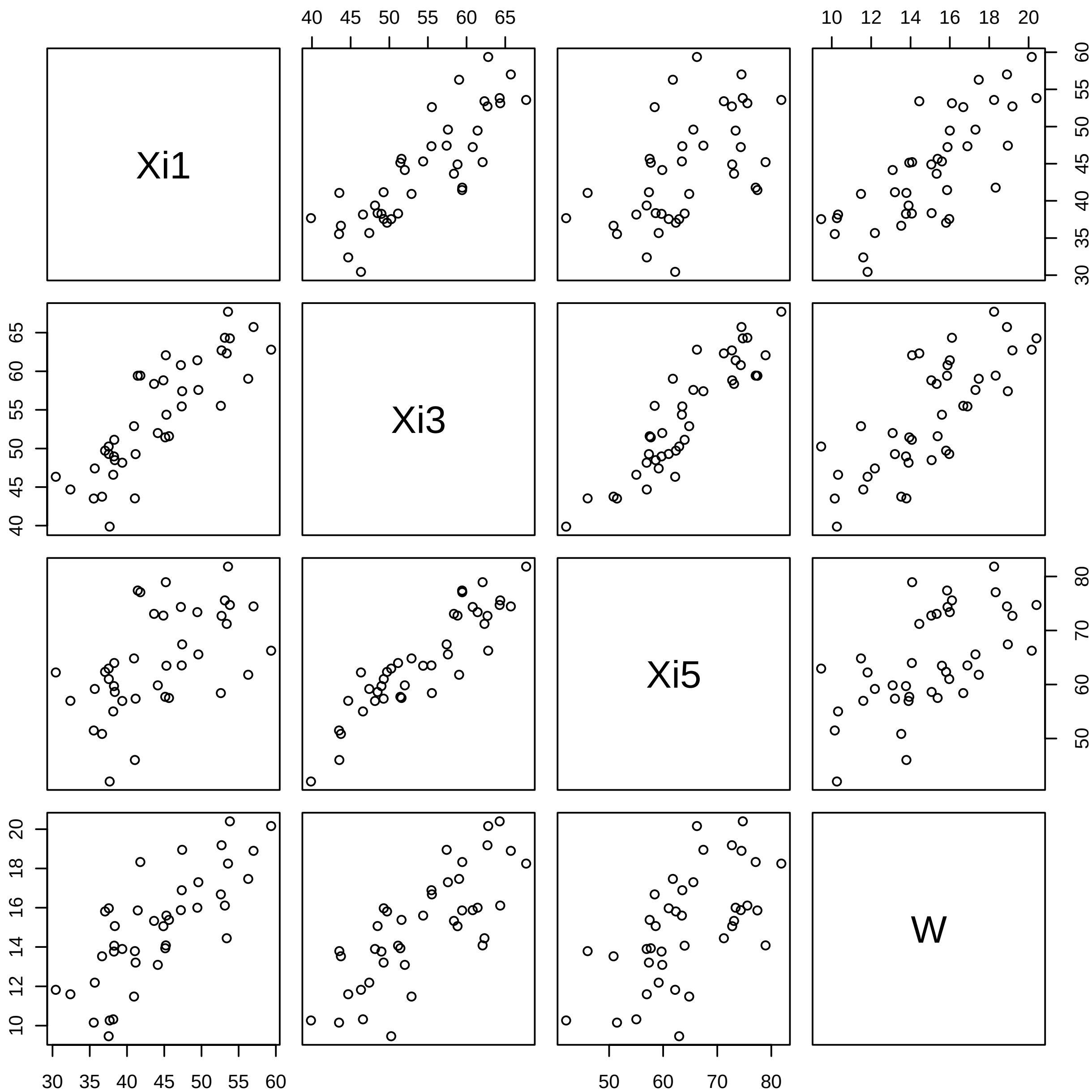
m

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
```

```
> truereg2D = lm(I(Xi5 - Xi3) ~ W + Xi3)
> summary(truereg2D)

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           0.3821     0.1290   2.963  0.00529 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

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)
```

match coeff t-stat



Xi1
Xi3
Xi5
W

STAT 222
week 1

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

coeff $\beta_{DW \cdot Y_1} = \beta_{D(W \cdot Y_1)} = \dfrac{Cov(Y_2 - Y_1, W - \beta_{WY_1} Y_1)}{Var(W \cdot Y_1)}$

(Note: $\beta_{WY_1} Var(Y_1) = Cov(Y_1, W)$)

$$= \frac{Cov(Y_2, W) - \beta_{WY_1} Cov(Y_1, Y_2) - Cov(Y_1, W) + \beta_{WY_1} Var(Y_1)}{Var(W \cdot Y_1)}$$

$$= \frac{Cov(Y_2, W) - \beta_{WY_1} Cov(Y_1, Y_2)}{Var(W \cdot Y_1)}$$

$$= \frac{Cov(Y_2, W \cdot Y_1)}{Var(W \cdot Y_1)} = \beta_{Y_2(W \cdot Y_1)} = \beta_{Y_2 W \cdot Y_1}$$

brute force,
quicker ways
to this

see STAT 209
week 1
adjusted
variables