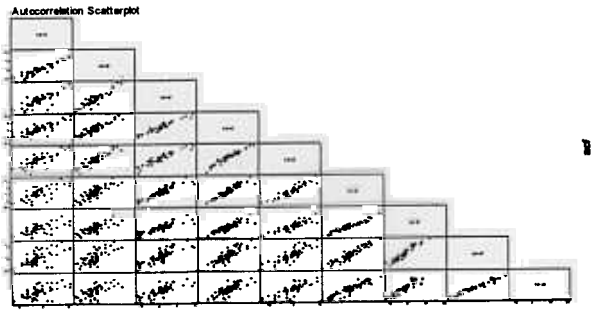
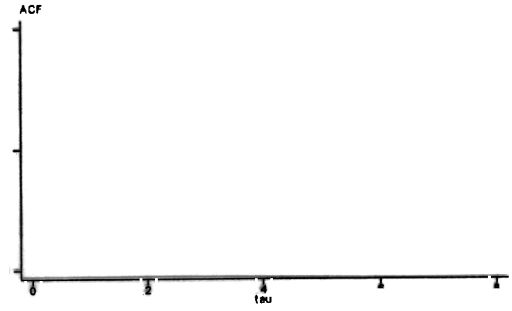
48 pigs 9 week





autocor weekr time Id

	time1	time2	time3	time4	time5	time6	time7
time1	1.0000						
time2	0.9156	1.0000					
time3	0.8015	0.9118	1.0000				
time4	0.7958	0.9084	0.9582	1.0000			
time5	0.7494	0.8809	0.9280	0.9621	1.0000		
time6	0.7051	0.8353	0.9058	0.9327	0.9219	1.0000	
time7	0.6551	0.7759	0.8435	0.8681	0.8546	0.9633	1.0000
time8	0.6255	0.7133	0.8167	0.8293	0.8104	0.9280	0.9586
time9	0.5581	0.6638	0.7689	0.7856	0.7856	0.8893	0.9170

	time8	time9
time8	1.0000	
time9	0.9695	1.0000

	acf
1	.9425781
2	.8870165
3	.8462396
4	.7962576
5	.7724156
6.	.7121489
7.	.6407955
8.	.5581002

ANOVA TABLE

Y_i groups to compare , $Y_i = (Y_{i1}, \dots, Y_{im})'$

Variation in all observations = Var. between each obs. and its group mean + Var. between each group mean and the overall mean

$$SST = SSW + SSB$$

ANOVA TABLE

Source	SS	DF	
Modal (between)	$\sum_i \sum_j (Y_{i\cdot} - \bar{Y})^2$	$n-1$	$\hat{\sigma}^2_b = \frac{SSB}{n-1}$
Residual (within)	$\sum_i \sum_j (Y_{ij} - Y_{i\cdot})^2$	$N-n$	$\hat{\sigma}^2_w = \frac{SSW}{N-n}$
Total	$\sum_i \sum_j (Y_{ij} - \bar{Y})^2$	$N-1$	$\hat{\sigma}^2 = \frac{SST}{N-1}$

$N = n \cdot m$ (total # of obs.)

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xtsumcorr weekr
```

Variable		Mean	Std. Dev	Min	Max	Observations
weekr	overall	3.04e-09	4.386947	-11.90509	13.17512	N = 432
	between		3.953498	-7.405093	9.372685	n = 48
	within		1.976177	-7.728472	8.160417	T = 9
	corr. between		3.855132			
	corr. within		2.083625			
	rho		.7722	(betw fract of total)		

$\sigma_W^2 = \sqrt{4.38} = 2.09$

$\sigma_b^2 = \sqrt{19.25 - 4.38} = 3.86$

```
anova weekr Id
```

Number of obs =	432	R-squared =	0.7971
Root MSE =	2.09362	Adj R-squared =	0.7722

Source	Partial SS	df	MS	F	Prob > F
Model	6611.55323	47	140.671345	32.09	0.0000
Id	6611.55323	47	140.671345	32.09	0.0000
Residual	1683.17352	384	4.38326437		
Total	8294.72675	431	19.2453057		

$$\rho = \frac{\sigma_b^2}{\sigma_b^2 + \sigma_W^2} = \frac{\sigma_b^2}{\sigma_b^2 + \sigma_e^2}$$

$$\rho = \frac{\sigma_b^2}{\sigma^2}$$

$$\sigma_W^2 = \sigma_e^2$$

within-subject correlation

OLS

Y_{ij} $i = 1, 48$

$Y_{ij} = \beta_0 + \beta_1 t_j + \varepsilon_{ij}$ $j = 1, 9$

$\varepsilon_{ij} \overset{iid}{\sim} N(0, \sigma^2)$

```
. regress week time

      Source |       SS       df       MS              Number of obs =     432
-------------+------------------------------           F(  1,   430) = 5757.41
       Model |  111060.882     1  111060.882            Prob > F      =  0.0000
    Residual |  8294.72677   430  19.2900622            R-squared     =  0.9305
-------------+------------------------------           Adj R-squared =  0.9303
       Total |  119355.609   431  276.927167            Root MSE      =   4.392

------------------------------------------------------------------------------
        week |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   6.209896   .0818409    75.88   0.000     6.049038    6.370754
       cons  |   19.35561   .4605447    42.03   0.000     18.45041    20.26081
------------------------------------------------------------------------------
```

$E[Y_{ij}] = \beta_0 + \beta_1 t_j$

$V(Y_{ij}) = \sigma^2$

$Cov(Y_{ij}, Y_{ik}) = 0$

$i = 1, \dots, m$

$j = 1, \dots, n_i$

$Y_{ij} = \beta_0 + \beta_1 t_j + \varepsilon_{ij}$

$E(Y_{ij}) = \beta_0 + \beta_1 t_j$

$V(Y_{ij}) = \sigma^2$

$\mathrm{Corr}(Y_{ij}, Y_{ik}) = \rho$

Uniform correlation model

```
. xtgee week time, i(Id) corr(exc)

Iteration 1: tolerance = 5.585e-15

GEE population-averaged model                   Number of obs      =       432
Group variable:                        Id       Number of groups   =        48
Link:                                  identity Obs per group: min =         9
Family:                                Gaussian                avg =       9.0
Correlation:                           exchangeable            max =         9
                                                Wald chi2(1)       =  25337.48
Scale parameter:                       19.20076 Prob > chi2        =    0.0000

------------------------------------------------------------------------------
        week |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   6.209896   .0390124   159.18   0.000     6.133433    6.286359
       _cons |   19.35561   .5974055    32.40   0.000     18.18472    20.52651
------------------------------------------------------------------------------

. xtcorr

Estimated within-Id correlation matrix R:

          c1       c2       c3       c4       c5       c6       c7       c8       c9
r1   1.0000
r2   0.7717   1.0000
r3   0.7717   0.7717   1.0000
r4   0.7717   0.7717   0.7717   1.0000
r5   0.7717   0.7717   0.7717   0.7717   1.0000
r6   0.7717   0.7717   0.7717   0.7717   0.7717   1.0000
r7   0.7717   0.7717   0.7717   0.7717   0.7717   0.7717   1.0000
r8   0.7717   0.7717   0.7717   0.7717   0.7717   0.7717   0.7717   1.0000
r9   0.7717   0.7717   0.7717   0.7717   0.7717   0.7717   0.7717   0.7717   1.0000
```

$V = \sigma^2[(1-\rho)I + \rho J]$

$\mathrm{Var}(Y_{\vec{i}}) = \sigma^2 \begin{pmatrix} V_0 & & 0 \\ & \ddots & \\ 0 & & V_0 \end{pmatrix}$

$V_0 = \begin{pmatrix} 1 & \cdots & \rho \\ \vdots & & 1 \\ \rho & \cdots & 1 \end{pmatrix}$

$$Y_{ij} = \beta_0 + U_{0i} + (\beta_1 + U_{2ij}) t_j + \varepsilon_{ij}$$

$$Y_{ij} = \beta_0 + U_i + \beta_1 t_j + \varepsilon_{ij}$$

$$U_i \sim N(0, \sigma_b^2)$$

$$\varepsilon_{ij} \sim N(0, \sigma_w^2)$$

$$E[Y_{ij} | U_i] = \beta_0 + \beta_1 t_j$$

$$V(Y_{ij} | U_i) = \sigma^2 = \sigma_b^2 + \sigma_w^2$$

Random effect model w/ random intercept

```
. xtreg week time, re i(Id)

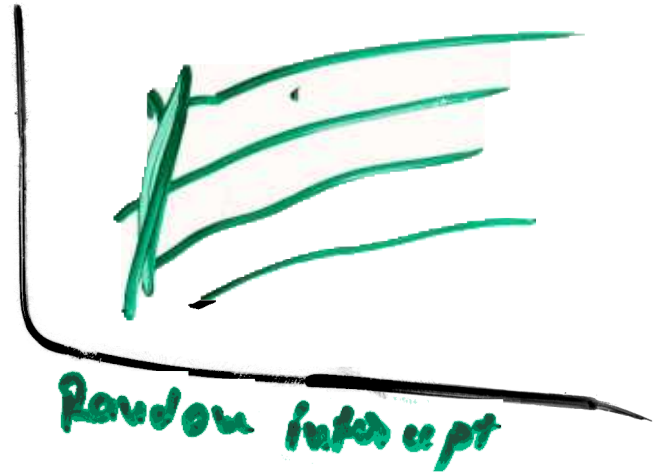
Random-effects GLS regression                   Number of obs      =       432
Group variable (i): Id                          Number of groups   =        48

R-sq:  within  = 0.9851                         Obs per group: min =         9
       between = 0.0000                                        avg =       9.0
       overall = 0.9305                                        max =         9

Random effects u_i ~ Gaussian                   Wald chi2(1)       =  25271.50
corr(u_i, X)       = 0 (assumed)                Prob > chi2        =    0.0000

------------------------------------------------------------------------------
        week |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   6.209896   .0390633   158.97   0.000     6.133333    6.286458
       _cons |   19.35561    .603139    32.09   0.000     18.17348    20.53774
-------------+----------------------------------------------------------------
     sigma_u |  3.8912528
     sigma_e |  2.0963561
         rho |  .77505203   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

Random slope



Random intercept

Both

Exponential correlation model

$Y_{ij} = \beta_0 + \beta_1 t_j + \varepsilon_{ij}$

$E(Y_{ij}) = \beta_0 + \beta_1 t_j$ $\quad E(Y_{ij} \mid Y_{ij-1}) = \rho Y_{ij-1}$

$V_0 = \begin{pmatrix} 1 & \rho & \cdots & \rho^8 \\ \rho^8 & \cdots & & 1 \end{pmatrix}$ $\quad Cov(Y_{ij}, Y_{ik}) = \sigma^2 \rho^{|j-k|}$

```
. xtgee week time, i(Id) corr(ar1)

Iteration 1: tolerance = .02513276
Iteration 2: tolerance = .00009237
Iteration 3: tolerance = 4.366e-07

GEE population-averaged model                   Number of obs      =       432
Group and time vars:                 Id time    Number of groups   =        48
Link:                              identity     Obs per group: min =         9
Family:                            Gaussian                  avg =       9.0
Correlation:                         AR(1)                   max =         9
                                                Wald chi2(1)       =   6254.91
Scale parameter:                   19.26754     Prob > chi2        =    0.0000

------------------------------------------------------------------------------
        week |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   6.272089   .0793052    79.09   0.000     6.116654    6.427524
       _cons |   18.84218   .6745715    27.93   0.000     17.52004    20.16431
------------------------------------------------------------------------------

. xtcorr

Estimated within-Id correlation matrix R:

          c1      c2      c3      c4      c5      c6      c7      c8      c9
r1    1.0000
r2    0.9167  1.0000
r3    0.8403  0.9167  1.0000
r4    0.7702  0.8403  0.9167  1.0000
r5    0.7061  0.7702  0.8403  0.9167  1.0000
r6    0.6472  0.7061  0.7702  0.8403  0.9167  1.0000
r7    0.5933  0.6472  0.7061  0.7702  0.8403  0.9167  1.0000
r8    0.5438  0.5933  0.6472  0.7061  0.7702  0.8403  0.9167  1.0000
r9    0.4985  0.5438  0.5933  0.6472  0.7061  0.7702  0.8403  0.9167  1.0000
```