

# How can I run a growth model in wide form with unequally spaced time points (tscore)?

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The process of running a growth model in wide form with unequally spaced time points, also known as tscore, involves analyzing data over a period of time to understand the trend or pattern of growth. This method allows for the incorporation of data from varying time intervals, which may not be evenly spaced, to accurately capture the growth trajectory. By inputting data in a wide format, where each time point is represented as a separate column, the model can be run to identify any changes or fluctuations in growth over time. This approach is particularly useful for analyzing data sets with irregular time intervals, such as annual or quarterly data, and can provide valuable insights into the development of a particular phenomenon.

## **How can I run a growth model in wide form with unequally spaced time points (tscore)? | Mplus FAQ**

**This page was created using Mplus version 5.2, the output and/or syntax may be different for other versions of Mplus.**

**Sometimes repeated measures data include measurements at unequal time points. For example, in a medical study, instead of all patients returning for follow-up at 2, 6, 12, and 24 months, there might have been variation in follow-up gaps, one patient might have returned at 1, 5, 7, and 20 months, while another returned at 3, 4, 8, and 12 months, and another may have returned at 2, 5, and 12 months (only three**

**measurement**

**occasions). One common method of analyzing such data is to analyze the data**

**using a mixed model when the data is structured in long format. However, there may be cases where**

**we would want to run similar analysis using the same data in wide format, for example if one wishes to run a parallel process model.**

**Below we demonstrate how to run such models in wide form. We will start**

**with a relatively simple model and built up to a more complex model. This is**

**mainly for demonstration purposes, yet building up a model in steps**

**is a good practice in general.**

**The dataset for this example includes 1000 cases, each with 5 measurement**

**occasions (labeled t0-t4). In this case, t0 is equal to**

**zero in all cases, but the first time point could also be unequal, for example,**

**if the time points were children's ages, and the age at which children entered**

**the study varied. The outcome variables are y0-y4**

(one for each measurement occasion), the values of the time varying covariate (predictor) are in the variables a0-a4, and the time invariant covariate (predictor) is the variable x. The variables t0-t4 give the value of time at each of the measurement occasion. The dataset can be downloaded by clicking here:  
<https://stats.idre.ucla.edu/wp-content/uploads/2016/02/tscore.dat>.

In addition to the Mplus input, we have included Stata commands for equivalent models. The Stata commands assume that the data is in long form, and make use of an additional variable, timepoint, calculated using the syntax below.

```
sort id t  
by id: gen timepoint = _n
```

**Modeling the outcome variable over time (intercept and slope for**

time)

The **usevariables** option of the **variables** command lists the variables used in the model, since not all of the variables in the dataset (named in the **names** option) are used in the current model. The **tscores** option of the **variable** command lists the variables giving the value of time at each measurement occasion. The **type=random** option of the **analysis** command allows for the estimation of the random intercept and slope. In the model command, the **i** and **s** followed by the vertical bar (i.e. | ) specify a random intercept (**i**) and slope (**s**) . The vertical bar is followed by the list of outcome variables (**y0-y4**) followed by the **at** keyword and a list of the time variables (**t0-t4**) which give the value of time at each measurement occasion. This tells Mplus that **y0** is the value of the outcome measured when time is equal to the value

given in  $t_0$ , and so on. Note that the names of the random effects are arbitrary, the type of random effect is determined by the number and order of the terms. The first term (in this case  $i$ ) specifies the random intercept, the second (in this case  $s$ ) a random slope, a third term a quadratic (squared) term, and a fourth an additional quadratic term (cubed). The number of terms determines the type of model run, since we have specified two terms, the model will include a random slope and intercept, if we had included only one term, the model would contain only a random intercept, had we included a third term, the model would have included a squared term for growth.

**Data:**

file <https://stats.idre.ucla.edu/wp-content/uploads/2016/02/tscore.dat> ;

**Variable:**

names are `id t0 t1 t2 t3 t4 a0 a1 a2 a3 a4 y0 y1 y2 y3 y4`

```
x;  
usevariables are t0 t1 t2 t3 t4 y0 y1 y2 y3 y4;  
tscores = t0 t1 t2 t3 t4;  
Analysis:  
type = random;  
Model:  
i s | y0 y1 y2 y3 y4 AT t0 t1 t2 t3 t4;
```

The same model can be run in Stata using the command:

```
xtmixed y t || id: t, var cov(un) resid(ind, by(timepoint))  
ml
```

### Adding a time invariant covariate

The model shown below is similar to the example above except for two changes.

First, in the model command, the line `i s` on `x;` indicates that the time invariant covariate `x` should be used to predict the intercept and slope for growth. Second, we have simplified the syntax by listing sets of variables with dashes rather than writing out the full variable names (e.g. `y0-y4`, rather than `y0`

y1...).

**Data:**

file <https://stats.idre.ucla.edu/wp-content/uploads/2016/02/tscore.dat> ;

**Variable:**

names are id t0-t4 a0-a4 y0-y4 x;

usevariables are t0-t4 y0-y4 x;

tscores = t0-t4;

**Analysis:**

type = random ;

**Model:**

i s | y0-y4 at t0-t4;

i s on x;

The same model can be run in Stata using the syntax:

```
xtmixed y t x c.x#c.t || id: t, var cov(un) resid(ind, by(timepoint)) ml
```

**Adding time varying covariates**

In this model we use the time varying covariates a0-a4 to predict the outcome at each

time period ( $y_0$ - $y_4$ ). For example the line  $y_0$  on  $a_0$ ; uses the variable  $a_0$  to predict  $y_0$ . Note that in this model, the relationship (slope) for  $y$  on  $a$  is allowed to be different at each time point.

**Data:**

file <https://stats.idre.ucla.edu/wp-content/uploads/2016/02/tscore.dat> ;

**Variable:**

Names are id t0-t4 a0-a4 y0-y4 x;  
 usevariables are t0-t4 y0-y4 x a0-a4;  
 tscores = t0-t4;

**Analysis:**

type = random ;

**Model:**

i s | y0-y4 AT t0-t4;

y0 on a0;

y1 on a1;

y2 on a2;

y3 on a3;

y4 on a4;

**i s on x;**

**The equivalent command in Stata is:**

```
xtmixed y t x c.x#c.t c.a#i.timepoint || id: t, var cov(un)
resid(ind, by(timepoint)) ml
```

**Time varying covariates with fixed slopes**

**Although it's not necessarily the next step in building up our model, you might also want to estimate a model where the relationship between a and y is constant across time. In this model we fix the slope for the time varying covariates a0-a4 predicting the outcome at each time period (y0-y4).**

**Data:**

**file**

**is**

**<https://stats.idre.ucla.edu/wp-content/uploads/2016/02/tscore.dat> ;**

**Variable:**

**Names are id t0-t4 a0-a4 y0-y4 x;**

**usevariables are t0-t4 y0-y4 x a0-a4;**

**tscores = t0-t4;**

**Analysis:**

**type = random ;**

**Model:**

**i s | y0-y4 AT t0-t4;**

**y0 on a0 (1);**

**y1 on a1 (1);**

**y2 on a2 (1);**

**y3 on a3 (1);**

**y4 on a4 (1);**

**i s on x;**

**The equivalent command in Stata is:**

```
xtmixed y t x c.x#c.t a || id: t, var cov(un) resid(ind,  
by(timepoint)) ml
```

**Adding random slopes for the time varying covariates**

**This model includes a random effect for the time varying covariates (a0-a4)**

**predicting the outcome at each time (y0-y4). In the model command, the**

**random slope is indicated by the name of the random effect (in this case st)**

followed by a vertical bar (i.e. | ) preceding the desired regression. For example, the line `st | y0 on a0;` indicates that the slope of `a0` predicting `y0` is random. Looking at the last line of the model command (i.e. `i s st on x;`) you can see that we have used the time invariant covariate `x` to predict the random effect `st`, along with the random intercept and slope for time (`i` and `s`). We also model the correlation structure among the random effects.

**Data:**

`file` <https://stats.idre.ucla.edu/wp-content/uploads/2016/02/tscore.dat>;

**Variable:**

`names are id t0-t4 a0-a4 y0-y4 x;`  
`usevariables are t0-t4 y0-y4 x a0-a4;`  
`tscores = t0-t4;`

**Analysis:**

**type = random ;**

**Model:**

**i s | y0-y4 AT t0-t4;**

**st | y0 on a0;**

**st | y1 on a1;**

**st | y2 on a2;**

**st | y3 on a3;**

**st | y4 on a4;**

**i s st on x;**

**i with s st;**

**s with st;**

**The equivalent command in Stata is:**

**xtmixed y t x c.x#c.t a c.x#c.a || id: t a, var cov(un)  
resid(ind, by(timepoint)) ml**