Running A Mixed Model in SPSS with *mixed* command

A step-to-step guide of the essentials

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What is *mixed*?

- Mixed is an SPSS command that fits linear mixed effects model
- As a function, mixed takes arguments:
  - The data
  - The dependent variable Y
  - The independent variables (X) = fixed effects
  - The random effects

} Formula

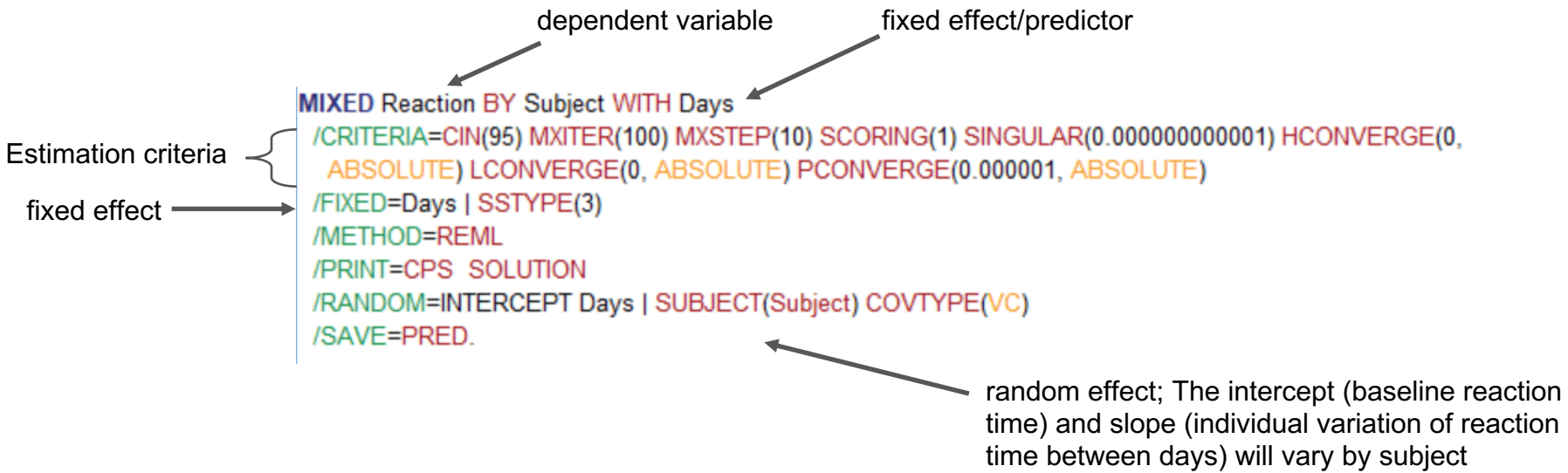
The Working Example: Reaction Times In A Sleep Deprivation Study

Background: On day 0 the subjects had their normal amount of sleep. Starting that night they were restricted to 3 hours of sleep per night for 10 days. The observations represent the average reaction time on a series of tests given each day to each subject (see Belenky et al., 2003)

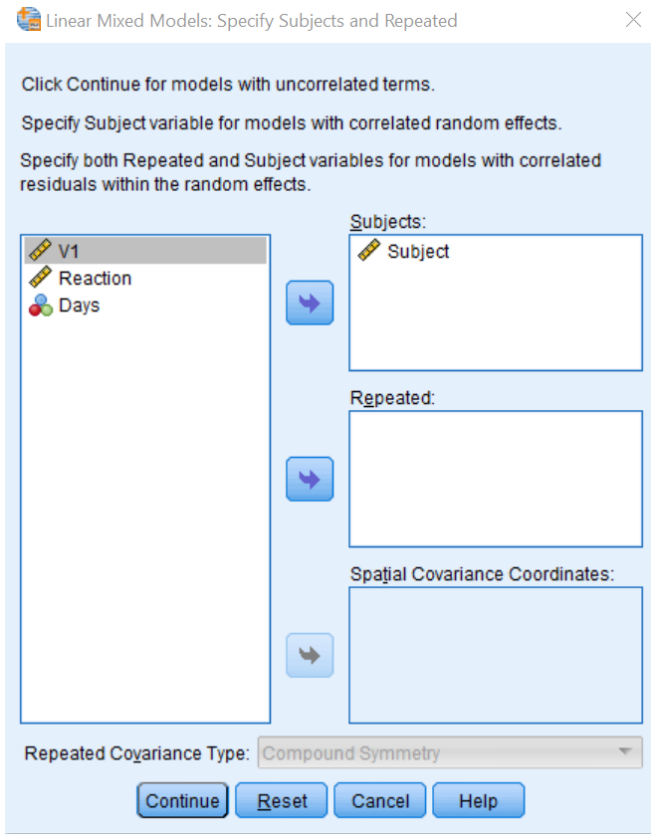
Variables:

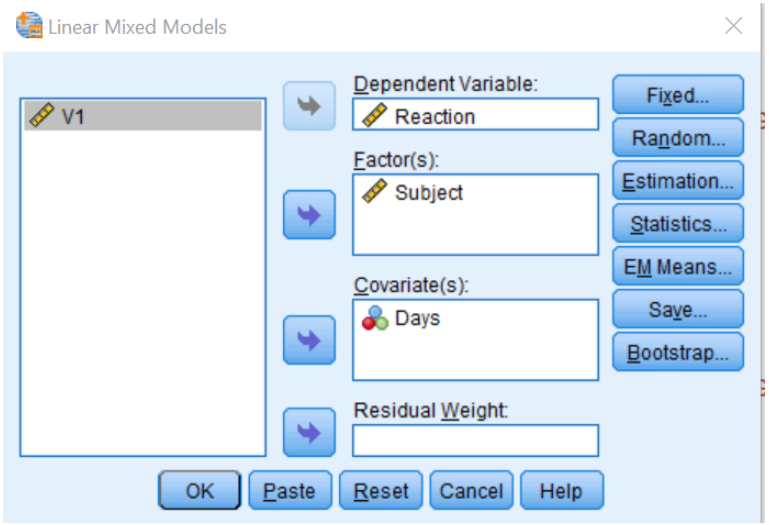
- Reaction: Average reaction time (ms).
- Days: Number of days of sleep deprivation
- Subject: Subject number on which the observation was made (18)

The Syntax

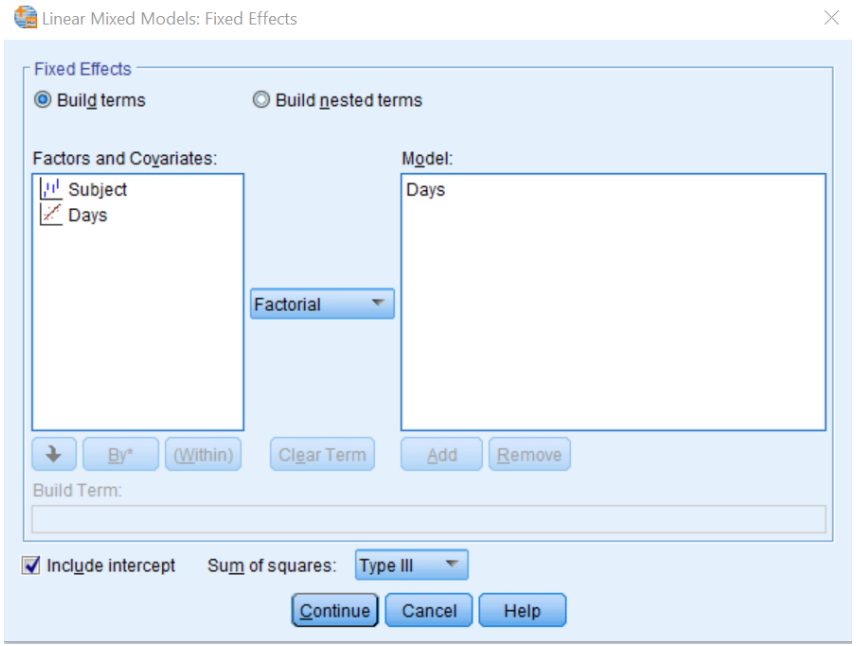

dependent variable
fixed effect/predictor
MIXED Reaction BY Subject WITH Days
/CRITERIA=CIN(95) MXITER(100) MXSTEP(10) SCORING(1) SINGULAR(0.000000000001) HCONVERGE(0,
ABSOLUTE) LCONVERGE(0, ABSOLUTE) PCONVERGE(0.000001, ABSOLUTE)
/FIXED=Days | SSTYPE(3)
/METHOD=REML
/PRINT=CPS SOLUTION
/RANDOM=INTERCEPT Days | SUBJECT(Subject) COVTYPE(VC)
/SAVE=PRED.
Estimation criteria
fixed effect
random effect; The intercept (baseline reaction time) and slope (individual variation of reaction time between days) will vary by subject

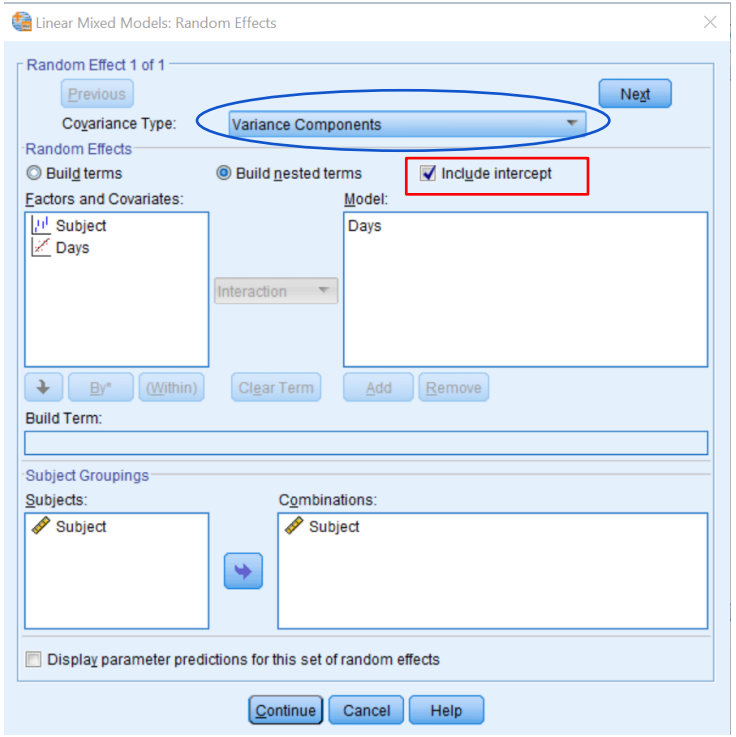
The GUI


Linear Mixed Models: Specify Subjects and Repeated
Click Continue for models with uncorrelated terms.
Specify Subject variable for models with correlated random effects.
Specify both Repeated and Subject variables for models with correlated residuals within the random effects.
V1
Reaction
Days
Subjects:
Subject
Repeated:
Spatial Covariance Coordinates:
Repeated Covariance Type:
Compound Symmetry
Continue
Reset
Cancel
Help

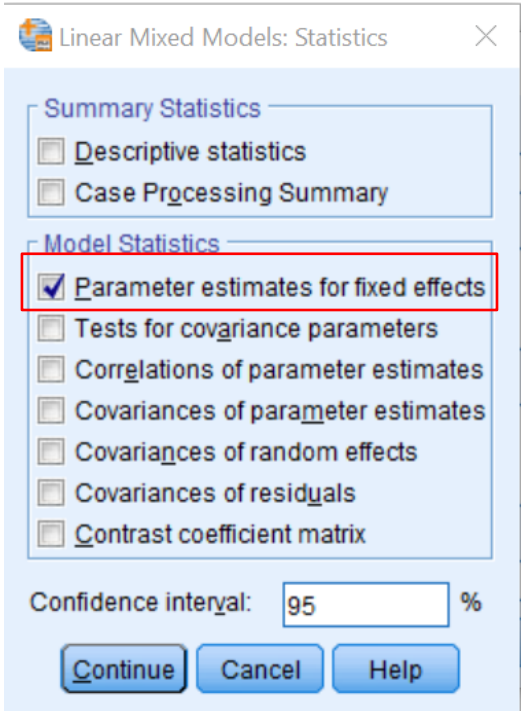

Linear Mixed Models
V1
Dependent Variable:
Reaction
Factor(s):
Subject
Covariate(s):
Days
Residual Weight:
Fixed...
Random...
Estimation...
Statistics...
EM Means...
Save...
Bootstrap...
OK
Paste
Reset
Cancel
Help

The GUI


Linear Mixed Models: Fixed Effects
Fixed Effects
Build terms
Build nested terms
Factors and Covariates:
Subject
Days
Factorial
Model:
Days
By*
(Within)
Clear Term
Add
Remove
Build Term:
Include intercept
Sum of squares:
Type III
Continue
Cancel
Help


Linear Mixed Models: Random Effects
Random Effect 1 of 1
Previous
Next
Covariance Type:
Variance Components
Random Effects
Build terms
Build nested terms
Include intercept
Factors and Covariates:
Subject
Days
Interaction
Model:
Days
By*
(Within)
Clear Term
Add
Remove
Build Term:
Subject Groupings
Subjects:
Subject
Combinations:
Subject
Display parameter predictions for this set of random effects
Continue
Cancel
Help

The GUI


Linear Mixed Models: Statistics
Summary Statistics
Descriptive statistics
Case Processing Summary
Model Statistics
Parameter estimates for fixed effects
Tests for covariance parameters
Correlations of parameter estimates
Covariances of parameter estimates
Covariances of random effects
Covariances of residuals
Contrast coefficient matrix
Confidence interval:
95
%
Continue
Cancel
Help

The Model Output

Information Criteria[a]

-2 Restricted Log Likelihood	1743.669
Akaike's Information Criterion (AIC)	1749.669
Hurvich and Tsai's Criterion (AICC)	1749.807
Bozdogan's Criterion (CAIC)	1762.215
Schwarz's Bayesian Criterion (BIC)	1759.215

The information criteria are displayed in smaller-is-better form.

a. Dependent Variable: Reaction.

Type III Tests of Fixed Effects[a]

Source	Numerator df	Denominator df	F	Sig.
Intercept	1	18.156	1333.190	.000
Days	1	18.156	45.046	.000

a. Dependent Variable: Reaction.

The Fixed Effects

Estimates of Fixed Effects[a]

Parameter	Estimate	Std. Error	df	t	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Intercept	251.405105	6.885381	18.156	36.513	.000	236.948371	265.861839
Days	10.467286	1.559566	18.156	6.712	.000	7.192779	13.741793

a. Dependent Variable: Reaction.

The Random Effects

Covariance Parameters

Estimates of Covariance Parameters[a]

Parameter		Estimate	Std. Error
Residual		653.583815	76.588015
Intercept [subject = Subject]	Variance	627.569061	283.704250
Days [subject = Subject]	Variance	35.858199	14.533702

a. Dependent Variable: Reaction.

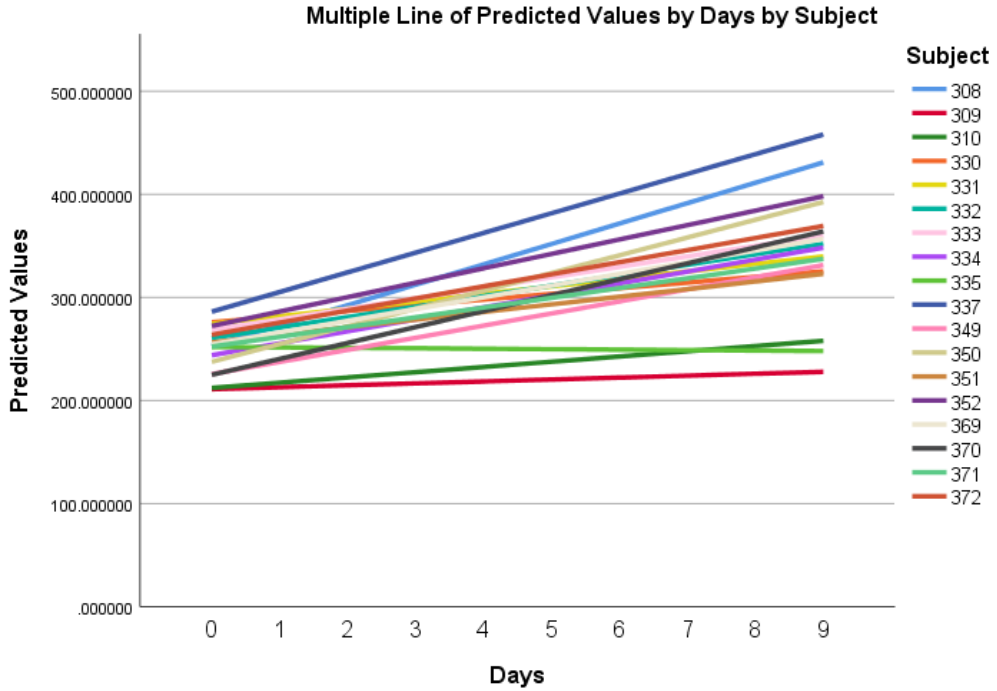
Reporting

- Parameter estimates (example: Intercept = …, Slope = …), Standard Errors, Confidence Intervals (and method used to calculate them). Example: SE = …, 95% CI = … - ...
- Anova: Test statistics, degrees of freedom, significance tests.

  Example: Chi/F/T(df) = …, p </= …

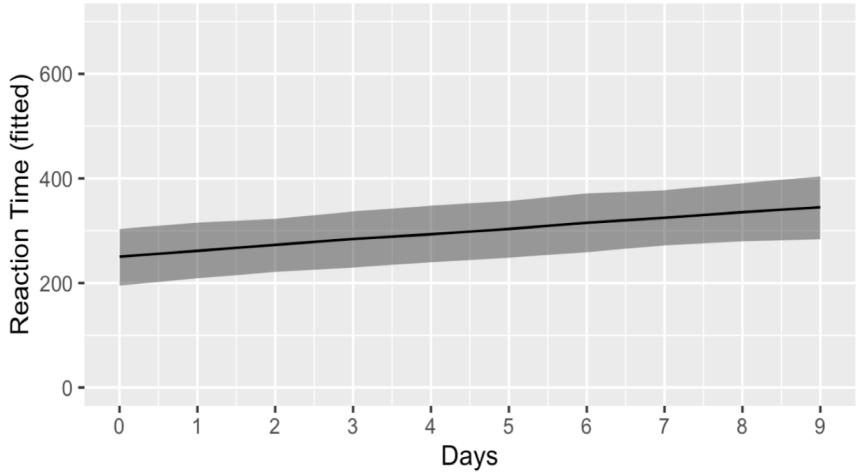
- Variance and Standard deviations of random effects with confidence intervals

Plotting a Mixed Model



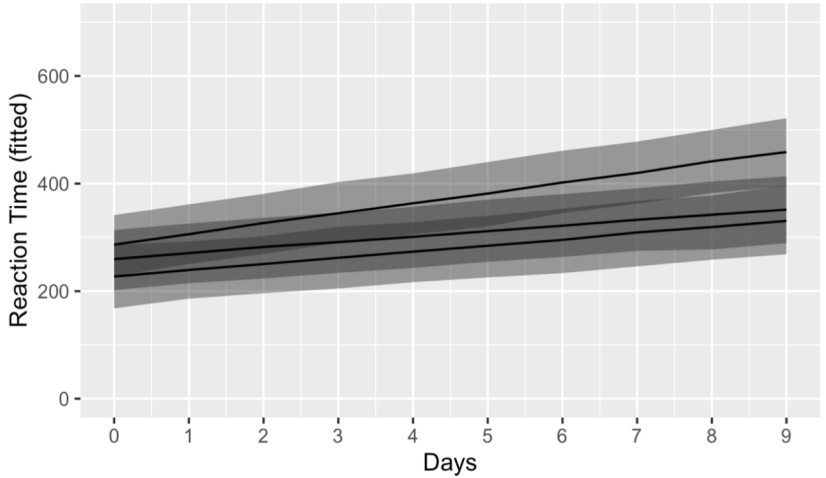
Plotting a Mixed Model

- Fixed Effects: plotting the fitted values of an “invented” subject with 95% confidence intervals



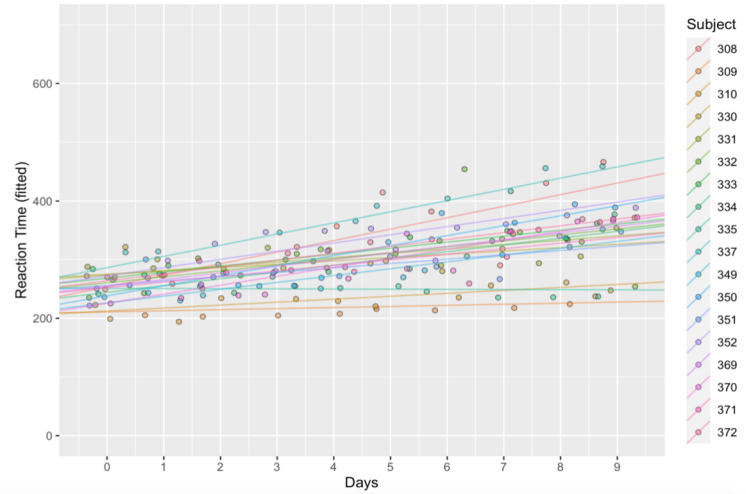
Plotting a Mixed Model

- Representing the Random Effect: plotting the fitted values of 3 random subjects, with 95% confidence intervals



Plotting a Mixed Model

- Representing the Random Effect: plotting all the individual coefficients plus the raw data



Exercise

What if I want to plot the fitted values of all subjects with 95% confidence intervals?

Now it's your turn! Fitting LMM on the Stroop Dataset

A dataset containing reaction-times, accuracy, and other attributes (10 total variables) of 5400 experimental trials (Stroop, 1935).

Task: Build a model that investigates how reaction times change based on target_type, assuming varying intercept and slope for subjects

Use the variables:

- Subject: Case identifier, in numerals
- Target_type: Type of stimulus for a given trial. 1 means congruent stimulus, 2 means incongruent stimulus
- Rt: Reaction time, in milliseconds

Hint: use lmer to fit the formula *rt ~ Target_Type + (…)* ← *write the random effect in brackets!*