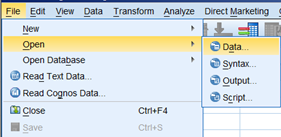
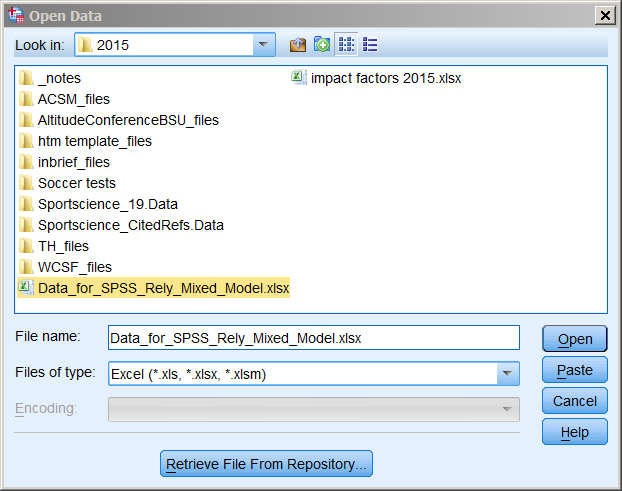
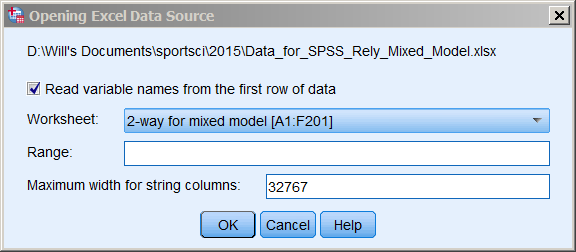
Open SPSS and import the data:



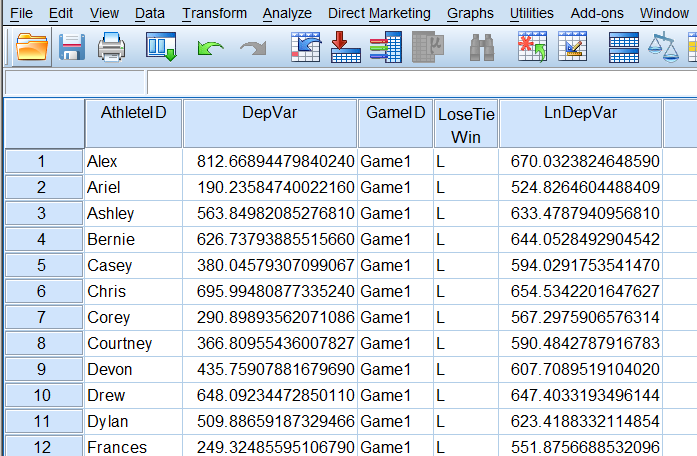
Find the file "Data\_for\_SPSS\_Rely\_Mixed\_Model.xlsx":



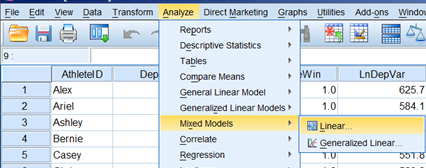
Choose this worksheet:



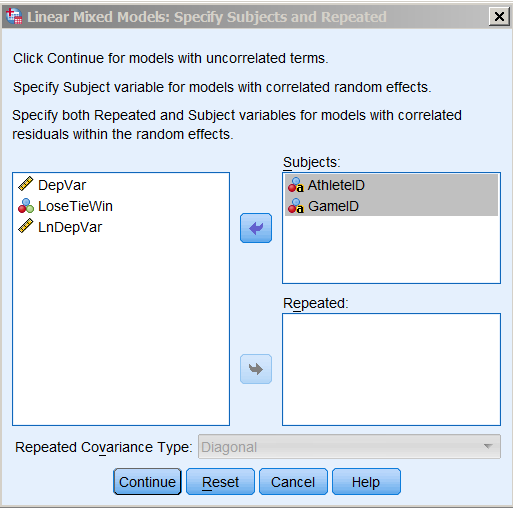
Don't worry about all the decimal places:



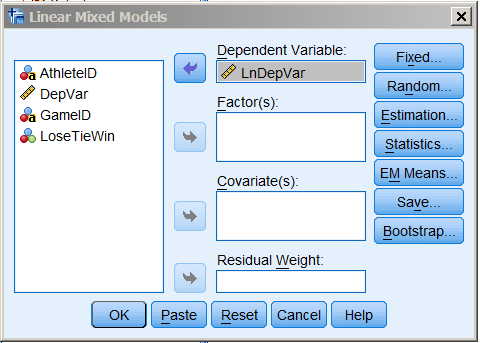
Choose **Analyze/Mixed Models/Linear**:



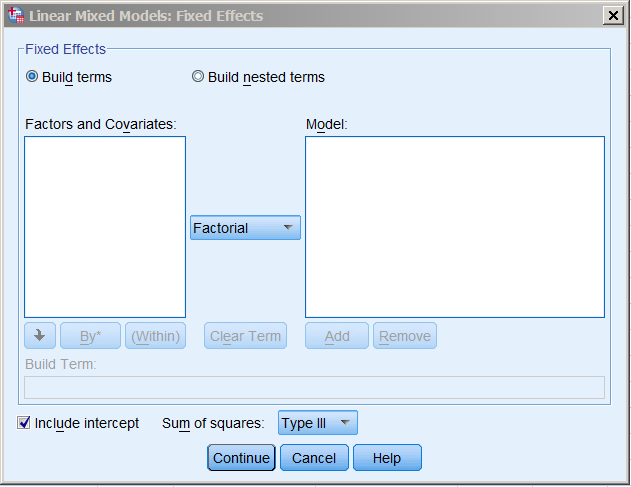
Make AthleteID and GameID the **Subjects** (we will use AthleteID only, first), then **Continue**:



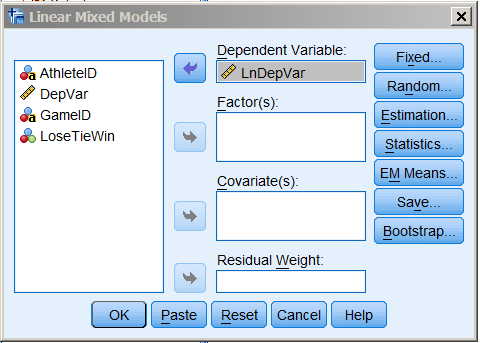
Choose LnDepVar as the **Dependent Variable**. then **Fixed**:



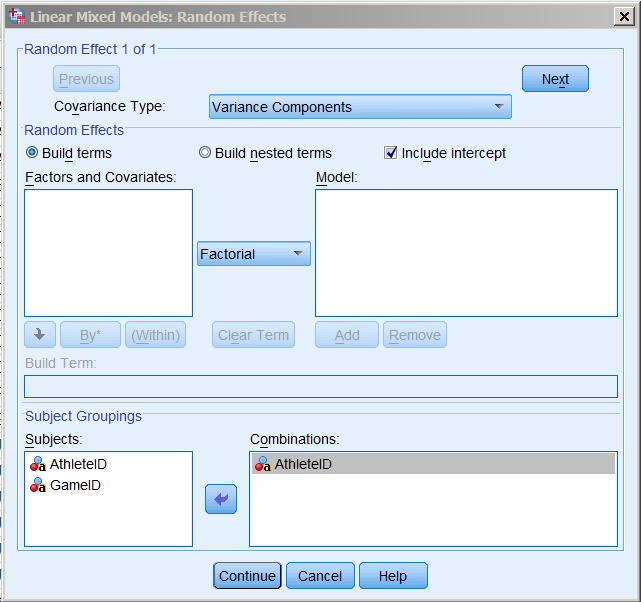
Nothing to do here. **Continue**:



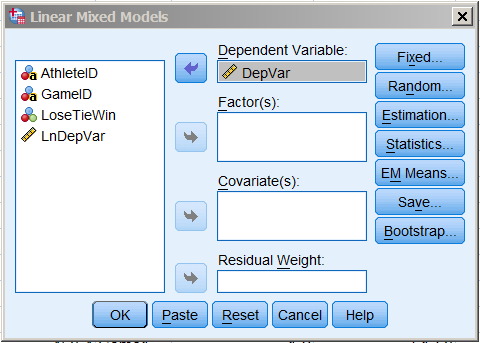
Click **Random**:



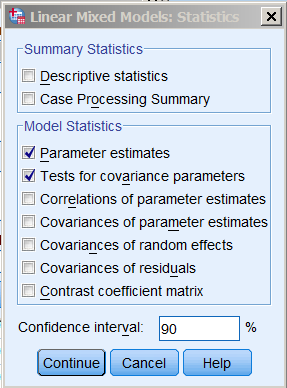
Put AthleteID into **Combinations** and select **Include intercept** (too difficult to explain this jargon; all it means is that we're going to estimate a variance for the athletes). At this stage we won't run GameID as a random effect. So click **Continue**:



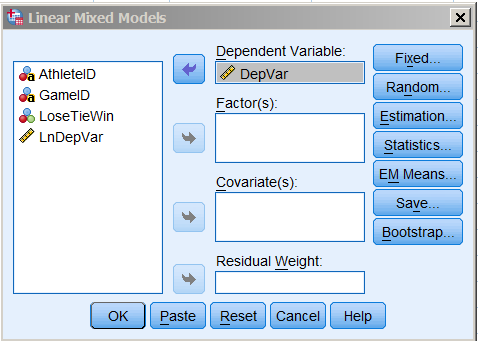
Now click on **Statistics**:



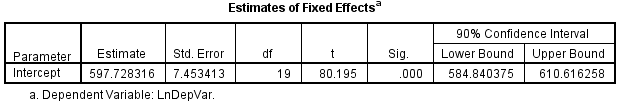
Choose these two options, change the confidence interval to 90%, then **Continue**:



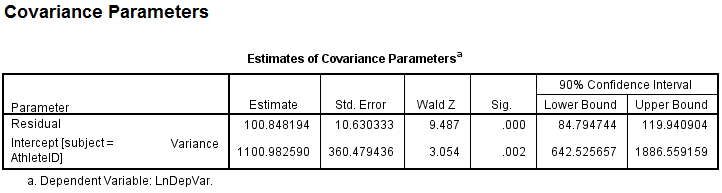
Click **OK**:



This bit of the output is just the overall mean:



Here's the part of the output with the random effects (aka Covariance Parameters):

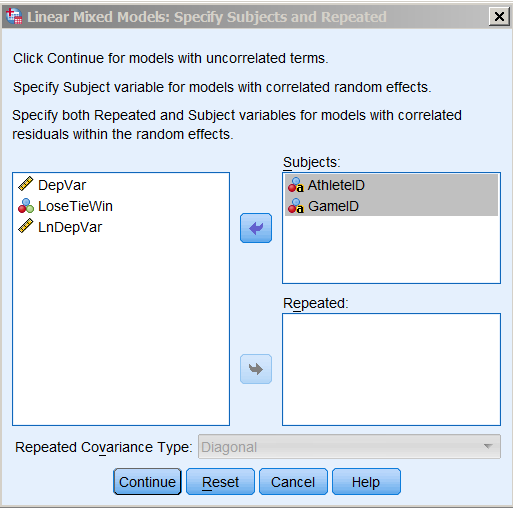


These are variances. Compare with the analysis in the 1-way reliability spreadsheet.

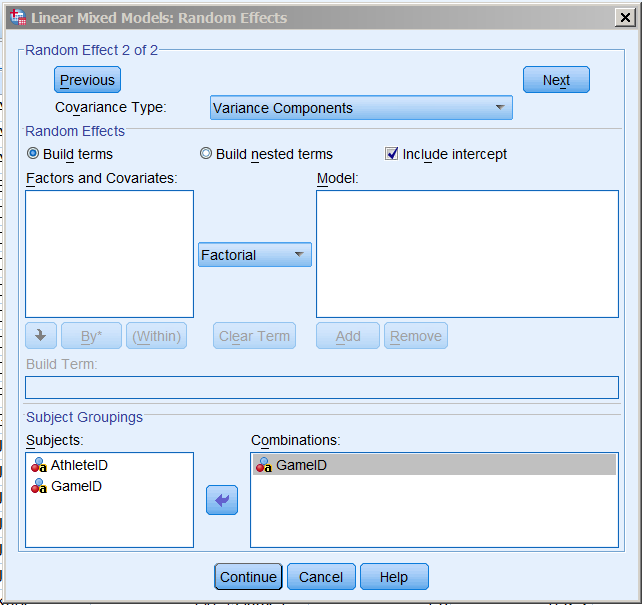
You have to take square roots of the estimate and confidence limits, then back-transform them to percents. The ICC is given by (AthleteID variance)/(AthleteID variance + Residual). Confidence limits for the ICC are a bit more difficult.

Now let's do the analysis with GameID included as a random effect. In other words, imagine that the games are also a random sample.

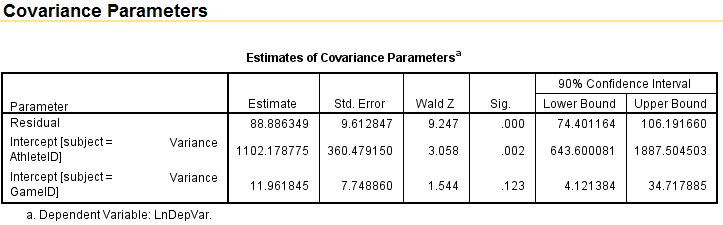
Choose **Analyze/Mixed Models/Linear** again. You should see this, again:



Click **Continue**, and choose **Random**. Owing to a bug, you will have to do something to allow you to click **Next**. I unselected Include intercept, then selected it again. Now click **Next** and put GameID into **Combinations**. Make sure you tick **Include intercept** before you **Continue**:



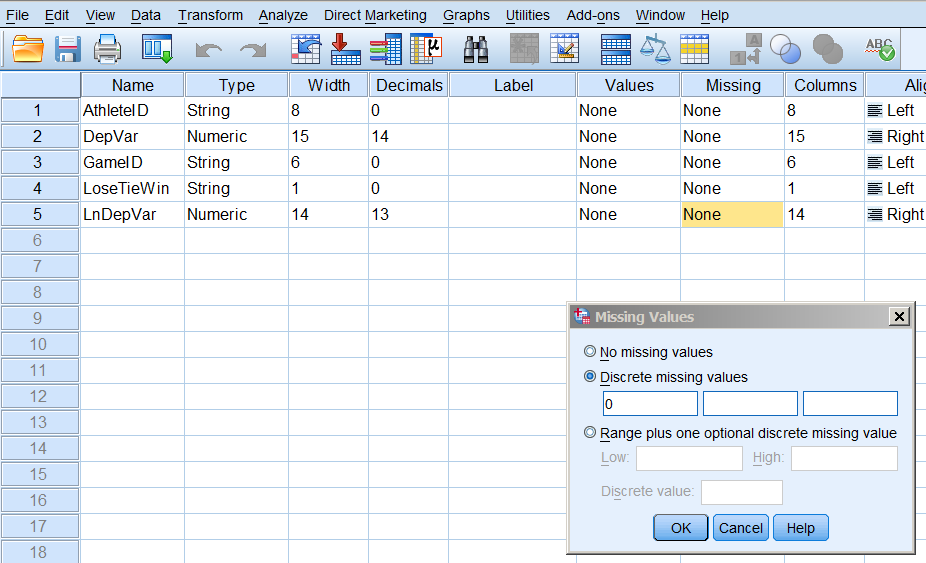
Here's the output you want:



Compare with the analysis in the 2-way reliability spreadsheet.

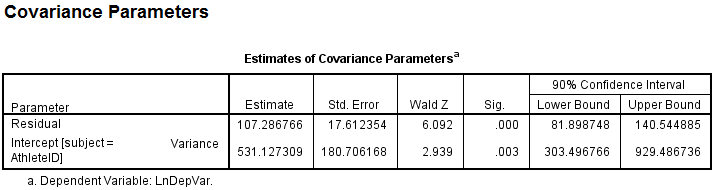
As before, these are variances. You have to take square roots of the estimates and confidence limits, then back-transform them to percents. The ICC is again given by (AthleteID variance)/(AthleteID variance + Residual). Confidence limits for the ICC are even more difficult.

Now, for practice, repeat the above with data with missing values. Use the same workbook and import the spreadsheet "2-way missing for mixed model". Missings are shown as zero in that spreadsheet (this time it's a Microsoft bug), so when you have imported the data, switch to **Variable View** (bottom left-hand end of the data window) and set values of 0 to missing:

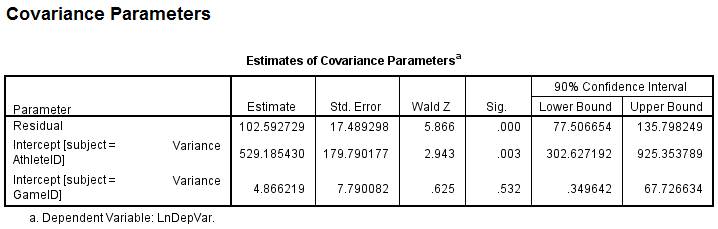


Alternatively delete all rows with values of zero for LnDepVar, or just make the zeros blank.

Here's the output from the 1-way analysis, which you can compare with the spreadsheet:

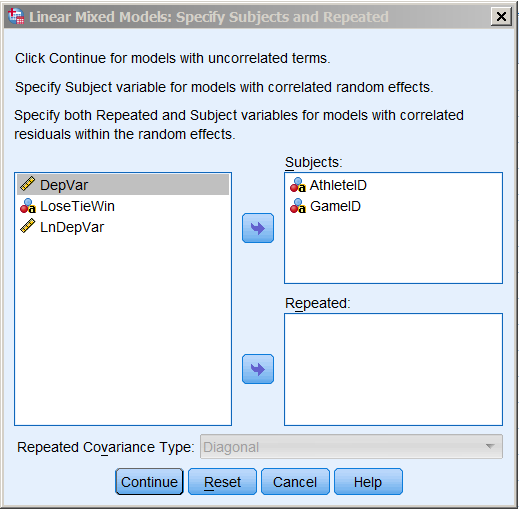


And here's the output from the 2-way, which I have put into the spreadsheet, but the spreadsheet doesn't work:

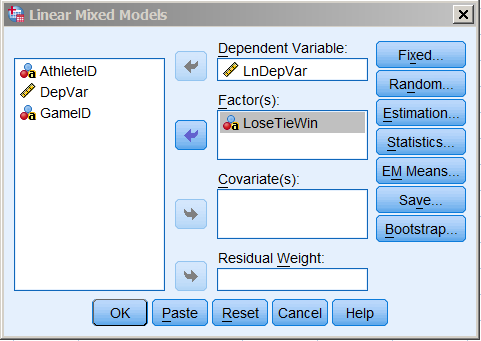


Now let's estimate the effect of WinTieLose, first of all with the dataset without missing values. Bring that dataset to the front, or you will end up analysing the dataset with missing values.

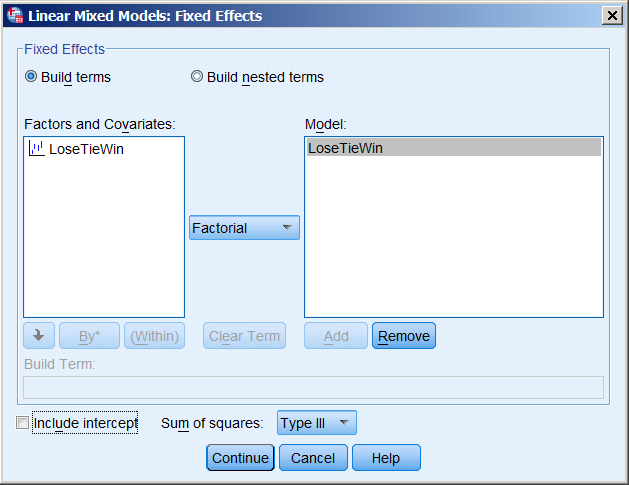
Choose **Analyze/Mixed Models/Linear** again. You should see this again:



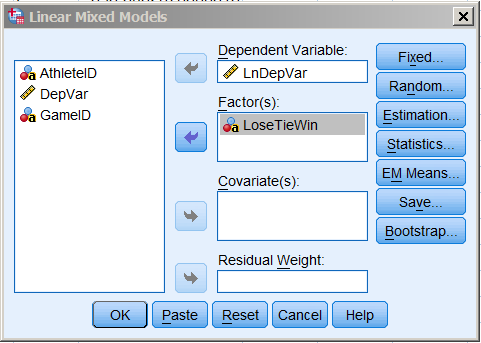
Click **Continue**, and put LoseTieWin into **Factor(s)**. Then **Fixed**:



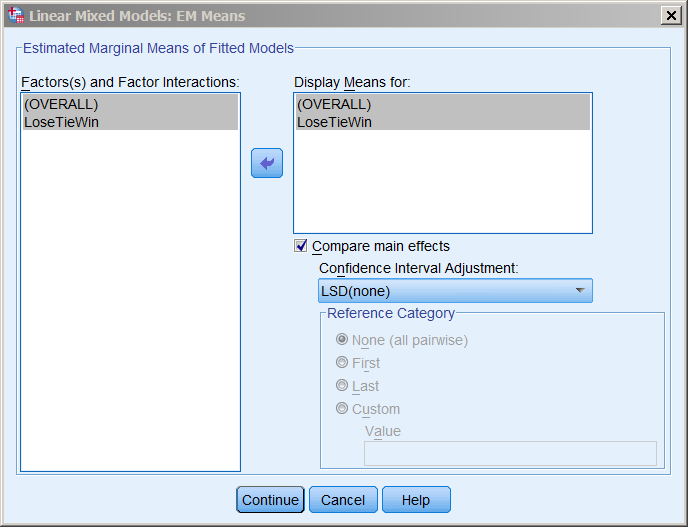
Add LoseTieWin to the **Model**. The **Factorial** button doesn't matter here. Also, it doesn't matter whether you **Include Intercept** or not, but it's slightly less confusing if you unselect it. (If you select it, the last of the three means for LoseTieWin is assigned zero in the Parameter Estimates. But we will use EM Means next, and these work regardless.) **Continue**:



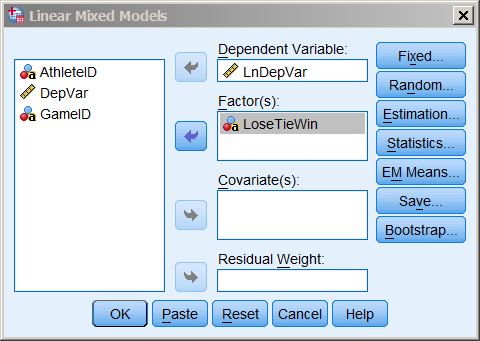
Select **EM Means**. This stands for estimated marginal means, another name for least-squares means (but they aren't strictly least-squares means in a mixed model, because the method of estimation is restricted maximum likelihood, not ANOVA…). The EM means are the means of the levels of nominal predictors (factors) evaluated at the mean value of all covariates and averaged over all levels of all other fixed and random nominal predictors.



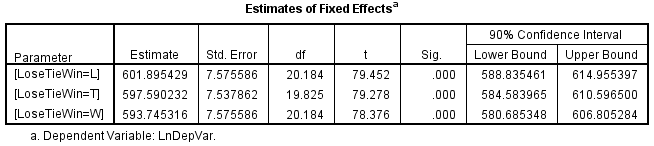
Put Overall and LoseTieWin into **Display Means for**, and tick **Compare main effects**. Then **Continue**:

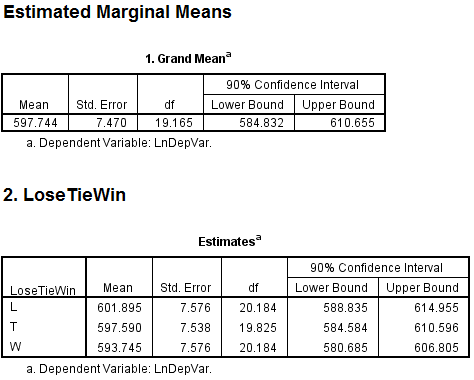


Click **OK**:

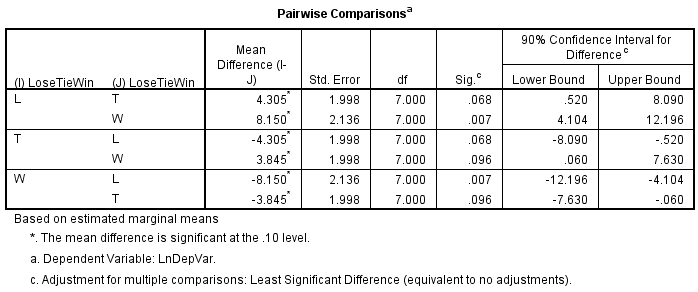


The Estimates of Fixed Effects is the output of the Parameter Estimates (one of the boxes we ticked for statistics long ago). These are the same as the Estimated Marginal Means.

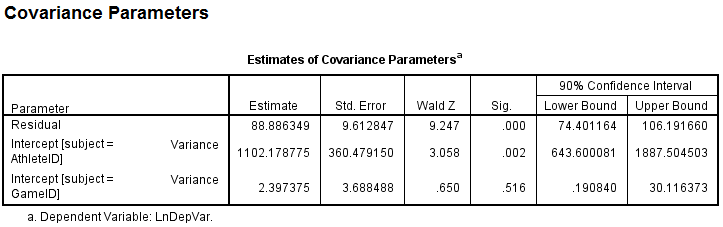




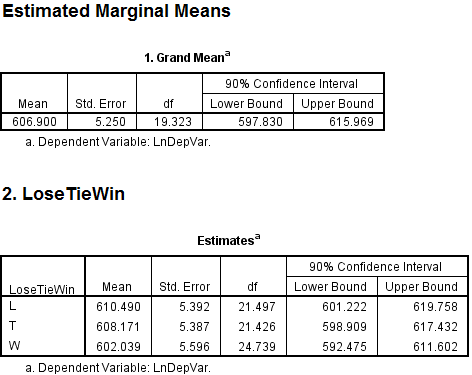
And here's the comparisons of the levels of LoseTieWin. These have to be back-transformed, but they are almost exactly percents. Our population values for these were 5%, which are contained within the confidence intervals:

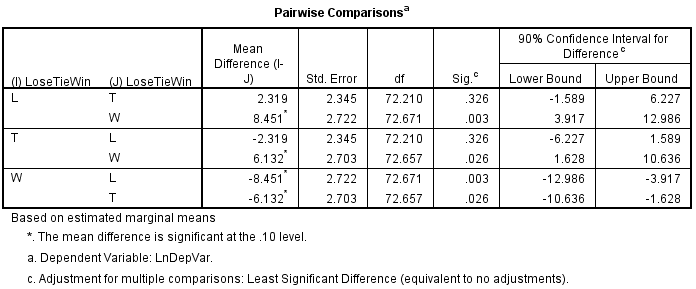


Here's the random effects. Notice that the value for GameID is now smaller (because we have accounted for some of the differences between games with the LoseTieWin fixed effect):

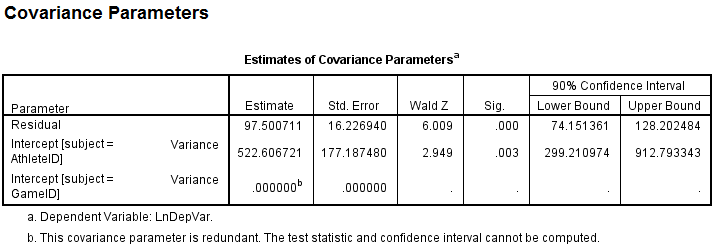


Now bring the dataset with missing values to the front, and repeat the analysis. You get similar answers for the fixed effect, but with wider confidence intervals, because there are less data:





The random effects now show something a bit strange:



According to this output, the random effect for GameID is redundant. That is, the model is overspecified, or there aren't enough data to estimate all the parameters than we've asked for. Well, that's not strictly true. What it really means is that, owing to sampling variation, the variance for this random effect is negative, and SPSS can't estimate negative variance, so it sets it to zero. SAS can estimate negative variance, and the confidence limits for the variance would tell us the extent to which the variance could be positive. The upper confidence limit would almost certainly be positive. In this case SAS would give better estimates for all the other effects, although the differences would probably be negligible.