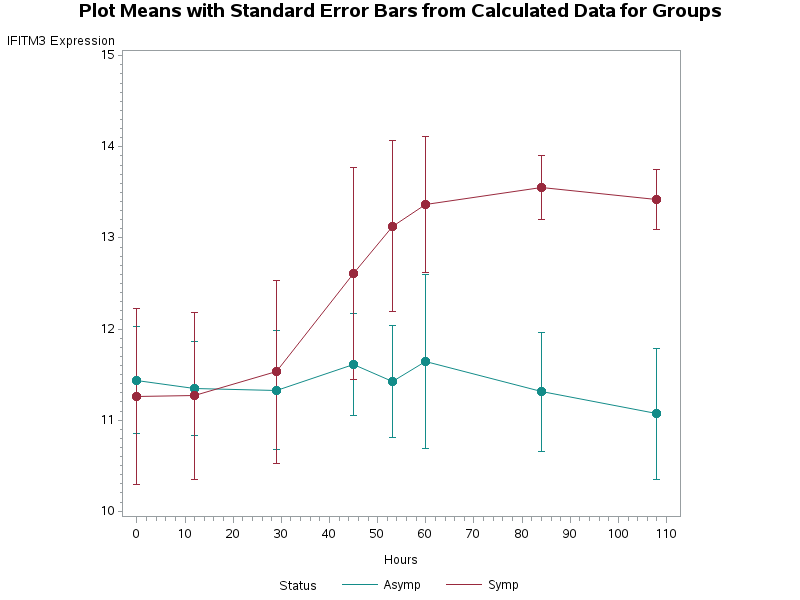
HW 5 Solutions

#1. To generate the plot we just need to repurpose the code from Unit 3 ANOVA. It will yield something like this depending on options the student picks. We can see that it appears that the symptomatic group starts to rise at the hour 45 mark. We will need to see what statistics say.



The following code gets us everything we need for the remaining questions

\*Repeated measures model;  
ods graphics on;  
proc mixed data=flu;  
class Hours Status;  
model IFITM3=Hours Status Hours\*Status / residual;  
repeated Hours / type=cs subject=subject;  
LSMEANS hours\*status / slice=hours;  
run;  
ods graphics off;

#2 Residuals: Everything here looks great. The assumption of normality looks more than reasonable with constant variance. Residuals are correlated (not independent) as we modeled that using the repeated statement.



#3. A) Do the changes that potentially exist over time depend on which symptom status you are a part of? Provide the statistical details: test statistic, p-value, and conclusion that yields the answer to this question.

Answer: Yes. To answer this global question we need to examine the interaction F test in the Type 3 Fixed Effects table. We already see evidence that this is true from the figure in #1. The lines are not parallel. The interaction is statistically significant with an F statistic of 7.58 yielding a pvalue <.0001.



b) This can be done a multiple of ways either using contrasts, the slice option, or diff option. Below is the F tests from using the slice option. This is valid because we just have two groups (symp vs asymp). I’ve included the big output using the diff option which most students will use. You will see that the pvalues are identical to the highlighted comparisons in yellow. Since t-squared is an F distribution in this case.

Answer to question one. We fail to reject the null hypothesis that there is a difference in mean expression levels between the symptomatic and asymptomatic group at Hr 0, pre flu introduction. Fstatistc .23 pvalue=.6346.

Examining the effect slice table, statistically significant difference in mean expression levels between symptomatic and asymptomatic groups begin at Hour 45 and onward. Specifically at Hour 45, we reject the null hypothesis in favor of the alternative, there is a difference in mean values between Symptomatic and Asymptomatic groups at Hour 45 (Fstat=7.05 pvalue=.009). Similar conclusions for the remaining time points.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tests of Effect Slices** | | | | | |
| **Effect** | **Hours** | **Num DF** | **Den DF** | **F Value** | **Pr > F** |
| **Hours\*Status** | 0 | 1 | 120 | 0.23 | 0.6346 |
| **Hours\*Status** | 12 | 1 | 120 | 0.05 | 0.8240 |
| **Hours\*Status** | 29 | 1 | 120 | 0.29 | 0.5933 |
| **Hours\*Status** | 45 | 1 | 120 | 7.05 | 0.0090 |
| **Hours\*Status** | 53 | 1 | 120 | 20.74 | <.0001 |
| **Hours\*Status** | 60 | 1 | 120 | 21.14 | <.0001 |
| **Hours\*Status** | 84 | 1 | 120 | 35.64 | <.0001 |
| **Hours\*Status** | 108 | 1 | 120 | 39.20 | <.0001 |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Differences of Least Squares Means** | | | | | | | | | |
| **Effect** | **Status** | **Hours** | **\_Status** | **\_Hours** | **Estimate** | **Standard Error** | **DF** | **t Value** | **Pr > |t|** |
| **Hours\*Status** | Asymp | 0 | Symp | 0 | 0.1790 | 0.3756 | 120 | 0.48 | 0.6346 |
| **Hours\*Status** | Asymp | 0 | Asymp | 12 | 0.09083 | 0.3865 | 120 | 0.24 | 0.8146 |
| **Hours\*Status** | Asymp | 0 | Symp | 12 | 0.1745 | 0.3756 | 120 | 0.46 | 0.6430 |
| **Hours\*Status** | Asymp | 0 | Asymp | 29 | 0.1119 | 0.3865 | 120 | 0.29 | 0.7727 |
| **Hours\*Status** | Asymp | 0 | Symp | 29 | -0.08921 | 0.3756 | 120 | -0.24 | 0.8127 |
| **Hours\*Status** | Asymp | 0 | Asymp | 45 | -0.1730 | 0.3865 | 120 | -0.45 | 0.6553 |
| **Hours\*Status** | Asymp | 0 | Symp | 45 | -1.1705 | 0.3756 | 120 | -3.12 | 0.0023 |
| **Hours\*Status** | Asymp | 0 | Asymp | 53 | 0.01926 | 0.3865 | 120 | 0.05 | 0.9603 |
| **Hours\*Status** | Asymp | 0 | Symp | 53 | -1.6913 | 0.3756 | 120 | -4.50 | <.0001 |
| **Hours\*Status** | Asymp | 0 | Asymp | 60 | -0.2006 | 0.3865 | 120 | -0.52 | 0.6046 |
| **Hours\*Status** | Asymp | 0 | Symp | 60 | -1.9277 | 0.3756 | 120 | -5.13 | <.0001 |
| **Hours\*Status** | Asymp | 0 | Asymp | 84 | 0.1270 | 0.3865 | 120 | 0.33 | 0.7430 |
| **Hours\*Status** | Asymp | 0 | Symp | 84 | -2.1151 | 0.3756 | 120 | -5.63 | <.0001 |
| **Hours\*Status** | Asymp | 0 | Asymp | 108 | 0.3688 | 0.3865 | 120 | 0.95 | 0.3419 |
| **Hours\*Status** | Asymp | 0 | Symp | 108 | -1.9827 | 0.3756 | 120 | -5.28 | <.0001 |
| **Hours\*Status** | Symp | 0 | Asymp | 12 | -0.08816 | 0.3756 | 120 | -0.23 | 0.8148 |
| **Hours\*Status** | Symp | 0 | Symp | 12 | -0.00446 | 0.3644 | 120 | -0.01 | 0.9903 |
| **Hours\*Status** | Symp | 0 | Asymp | 29 | -0.06708 | 0.3756 | 120 | -0.18 | 0.8586 |
| **Hours\*Status** | Symp | 0 | Symp | 29 | -0.2682 | 0.3644 | 120 | -0.74 | 0.4632 |
| **Hours\*Status** | Symp | 0 | Asymp | 45 | -0.3519 | 0.3756 | 120 | -0.94 | 0.3506 |
| **Hours\*Status** | Symp | 0 | Symp | 45 | -1.3495 | 0.3644 | 120 | -3.70 | 0.0003 |
| **Hours\*Status** | Symp | 0 | Asymp | 53 | -0.1597 | 0.3756 | 120 | -0.43 | 0.6714 |
| **Hours\*Status** | Symp | 0 | Symp | 53 | -1.8703 | 0.3644 | 120 | -5.13 | <.0001 |
| **Hours\*Status** | Symp | 0 | Asymp | 60 | -0.3796 | 0.3756 | 120 | -1.01 | 0.3142 |
| **Hours\*Status** | Symp | 0 | Symp | 60 | -2.1067 | 0.3644 | 120 | -5.78 | <.0001 |
| **Hours\*Status** | Symp | 0 | Asymp | 84 | -0.05199 | 0.3756 | 120 | -0.14 | 0.8901 |
| **Hours\*Status** | Symp | 0 | Symp | 84 | -2.2941 | 0.3644 | 120 | -6.30 | <.0001 |
| **Hours\*Status** | Symp | 0 | Asymp | 108 | 0.1898 | 0.3756 | 120 | 0.51 | 0.6143 |
| **Hours\*Status** | Symp | 0 | Symp | 108 | -2.1617 | 0.3644 | 120 | -5.93 | <.0001 |
| **Hours\*Status** | Asymp | 12 | Symp | 12 | 0.08370 | 0.3756 | 120 | 0.22 | 0.8240 |
| **Hours\*Status** | Asymp | 12 | Asymp | 29 | 0.02108 | 0.3865 | 120 | 0.05 | 0.9566 |
| **Hours\*Status** | Asymp | 12 | Symp | 29 | -0.1800 | 0.3756 | 120 | -0.48 | 0.6326 |
| **Hours\*Status** | Asymp | 12 | Asymp | 45 | -0.2638 | 0.3865 | 120 | -0.68 | 0.4962 |
| **Hours\*Status** | Asymp | 12 | Symp | 45 | -1.2614 | 0.3756 | 120 | -3.36 | 0.0011 |
| **Hours\*Status** | Asymp | 12 | Asymp | 53 | -0.07156 | 0.3865 | 120 | -0.19 | 0.8534 |
| **Hours\*Status** | Asymp | 12 | Symp | 53 | -1.7821 | 0.3756 | 120 | -4.74 | <.0001 |
| **Hours\*Status** | Asymp | 12 | Asymp | 60 | -0.2915 | 0.3865 | 120 | -0.75 | 0.4522 |
| **Hours\*Status** | Asymp | 12 | Symp | 60 | -2.0186 | 0.3756 | 120 | -5.37 | <.0001 |
| **Hours\*Status** | Asymp | 12 | Asymp | 84 | 0.03617 | 0.3865 | 120 | 0.09 | 0.9256 |
| **Hours\*Status** | Asymp | 12 | Symp | 84 | -2.2059 | 0.3756 | 120 | -5.87 | <.0001 |
| **Hours\*Status** | Asymp | 12 | Asymp | 108 | 0.2780 | 0.3865 | 120 | 0.72 | 0.4734 |
| **Hours\*Status** | Asymp | 12 | Symp | 108 | -2.0735 | 0.3756 | 120 | -5.52 | <.0001 |
| **Hours\*Status** | Symp | 12 | Asymp | 29 | -0.06262 | 0.3756 | 120 | -0.17 | 0.8679 |
| **Hours\*Status** | Symp | 12 | Symp | 29 | -0.2637 | 0.3644 | 120 | -0.72 | 0.4706 |
| **Hours\*Status** | Symp | 12 | Asymp | 45 | -0.3475 | 0.3756 | 120 | -0.93 | 0.3567 |
| **Hours\*Status** | Symp | 12 | Symp | 45 | -1.3451 | 0.3644 | 120 | -3.69 | 0.0003 |
| **Hours\*Status** | Symp | 12 | Asymp | 53 | -0.1553 | 0.3756 | 120 | -0.41 | 0.6801 |
| **Hours\*Status** | Symp | 12 | Symp | 53 | -1.8658 | 0.3644 | 120 | -5.12 | <.0001 |
| **Hours\*Status** | Symp | 12 | Asymp | 60 | -0.3752 | 0.3756 | 120 | -1.00 | 0.3199 |
| **Hours\*Status** | Symp | 12 | Symp | 60 | -2.1023 | 0.3644 | 120 | -5.77 | <.0001 |
| **Hours\*Status** | Symp | 12 | Asymp | 84 | -0.04753 | 0.3756 | 120 | -0.13 | 0.8995 |
| **Hours\*Status** | Symp | 12 | Symp | 84 | -2.2896 | 0.3644 | 120 | -6.28 | <.0001 |
| **Hours\*Status** | Symp | 12 | Asymp | 108 | 0.1943 | 0.3756 | 120 | 0.52 | 0.6060 |
| **Hours\*Status** | Symp | 12 | Symp | 108 | -2.1572 | 0.3644 | 120 | -5.92 | <.0001 |
| **Hours\*Status** | Asymp | 29 | Symp | 29 | -0.2011 | 0.3756 | 120 | -0.54 | 0.5933 |
| **Hours\*Status** | Asymp | 29 | Asymp | 45 | -0.2849 | 0.3865 | 120 | -0.74 | 0.4625 |
| **Hours\*Status** | Asymp | 29 | Symp | 45 | -1.2825 | 0.3756 | 120 | -3.41 | 0.0009 |
| **Hours\*Status** | Asymp | 29 | Asymp | 53 | -0.09265 | 0.3865 | 120 | -0.24 | 0.8110 |
| **Hours\*Status** | Asymp | 29 | Symp | 53 | -1.8032 | 0.3756 | 120 | -4.80 | <.0001 |
| **Hours\*Status** | Asymp | 29 | Asymp | 60 | -0.3125 | 0.3865 | 120 | -0.81 | 0.4203 |
| **Hours\*Status** | Asymp | 29 | Symp | 60 | -2.0396 | 0.3756 | 120 | -5.43 | <.0001 |
| **Hours\*Status** | Asymp | 29 | Asymp | 84 | 0.01509 | 0.3865 | 120 | 0.04 | 0.9689 |
| **Hours\*Status** | Asymp | 29 | Symp | 84 | -2.2270 | 0.3756 | 120 | -5.93 | <.0001 |
| **Hours\*Status** | Asymp | 29 | Asymp | 108 | 0.2569 | 0.3865 | 120 | 0.66 | 0.5076 |
| **Hours\*Status** | Asymp | 29 | Symp | 108 | -2.0946 | 0.3756 | 120 | -5.58 | <.0001 |
| **Hours\*Status** | Symp | 29 | Asymp | 45 | -0.08374 | 0.3756 | 120 | -0.22 | 0.8239 |
| **Hours\*Status** | Symp | 29 | Symp | 45 | -1.0813 | 0.3644 | 120 | -2.97 | 0.0036 |
| **Hours\*Status** | Symp | 29 | Asymp | 53 | 0.1085 | 0.3756 | 120 | 0.29 | 0.7732 |
| **Hours\*Status** | Symp | 29 | Symp | 53 | -1.6021 | 0.3644 | 120 | -4.40 | <.0001 |
| **Hours\*Status** | Symp | 29 | Asymp | 60 | -0.1114 | 0.3756 | 120 | -0.30 | 0.7672 |
| **Hours\*Status** | Symp | 29 | Symp | 60 | -1.8385 | 0.3644 | 120 | -5.05 | <.0001 |
| **Hours\*Status** | Symp | 29 | Asymp | 84 | 0.2162 | 0.3756 | 120 | 0.58 | 0.5659 |
| **Hours\*Status** | Symp | 29 | Symp | 84 | -2.0259 | 0.3644 | 120 | -5.56 | <.0001 |
| **Hours\*Status** | Symp | 29 | Asymp | 108 | 0.4580 | 0.3756 | 120 | 1.22 | 0.2251 |
| **Hours\*Status** | Symp | 29 | Symp | 108 | -1.8935 | 0.3644 | 120 | -5.20 | <.0001 |
| **Hours\*Status** | Asymp | 45 | Symp | 45 | -0.9976 | 0.3756 | 120 | -2.66 | 0.0090 |
| **Hours\*Status** | Asymp | 45 | Asymp | 53 | 0.1922 | 0.3865 | 120 | 0.50 | 0.6199 |
| **Hours\*Status** | Asymp | 45 | Symp | 53 | -1.5183 | 0.3756 | 120 | -4.04 | <.0001 |
| **Hours\*Status** | Asymp | 45 | Asymp | 60 | -0.02768 | 0.3865 | 120 | -0.07 | 0.9430 |
| **Hours\*Status** | Asymp | 45 | Symp | 60 | -1.7548 | 0.3756 | 120 | -4.67 | <.0001 |
| **Hours\*Status** | Asymp | 45 | Asymp | 84 | 0.2999 | 0.3865 | 120 | 0.78 | 0.4392 |
| **Hours\*Status** | Asymp | 45 | Symp | 84 | -1.9422 | 0.3756 | 120 | -5.17 | <.0001 |
| **Hours\*Status** | Asymp | 45 | Asymp | 108 | 0.5417 | 0.3865 | 120 | 1.40 | 0.1636 |
| **Hours\*Status** | Asymp | 45 | Symp | 108 | -1.8098 | 0.3756 | 120 | -4.82 | <.0001 |
| **Hours\*Status** | Symp | 45 | Asymp | 53 | 1.1898 | 0.3756 | 120 | 3.17 | 0.0019 |
| **Hours\*Status** | Symp | 45 | Symp | 53 | -0.5207 | 0.3644 | 120 | -1.43 | 0.1556 |
| **Hours\*Status** | Symp | 45 | Asymp | 60 | 0.9699 | 0.3756 | 120 | 2.58 | 0.0110 |
| **Hours\*Status** | Symp | 45 | Symp | 60 | -0.7572 | 0.3644 | 120 | -2.08 | 0.0398 |
| **Hours\*Status** | Symp | 45 | Asymp | 84 | 1.2975 | 0.3756 | 120 | 3.45 | 0.0008 |
| **Hours\*Status** | Symp | 45 | Symp | 84 | -0.9446 | 0.3644 | 120 | -2.59 | 0.0107 |
| **Hours\*Status** | Symp | 45 | Asymp | 108 | 1.5393 | 0.3756 | 120 | 4.10 | <.0001 |
| **Hours\*Status** | Symp | 45 | Symp | 108 | -0.8122 | 0.3644 | 120 | -2.23 | 0.0277 |
| **Hours\*Status** | Asymp | 53 | Symp | 53 | -1.7106 | 0.3756 | 120 | -4.55 | <.0001 |
| **Hours\*Status** | Asymp | 53 | Asymp | 60 | -0.2199 | 0.3865 | 120 | -0.57 | 0.5704 |
| **Hours\*Status** | Asymp | 53 | Symp | 60 | -1.9470 | 0.3756 | 120 | -5.18 | <.0001 |
| **Hours\*Status** | Asymp | 53 | Asymp | 84 | 0.1077 | 0.3865 | 120 | 0.28 | 0.7809 |
| **Hours\*Status** | Asymp | 53 | Symp | 84 | -2.1344 | 0.3756 | 120 | -5.68 | <.0001 |
| **Hours\*Status** | Asymp | 53 | Asymp | 108 | 0.3495 | 0.3865 | 120 | 0.90 | 0.3676 |
| **Hours\*Status** | Asymp | 53 | Symp | 108 | -2.0020 | 0.3756 | 120 | -5.33 | <.0001 |
| **Hours\*Status** | Symp | 53 | Asymp | 60 | 1.4907 | 0.3756 | 120 | 3.97 | 0.0001 |
| **Hours\*Status** | Symp | 53 | Symp | 60 | -0.2364 | 0.3644 | 120 | -0.65 | 0.5176 |
| **Hours\*Status** | Symp | 53 | Asymp | 84 | 1.8183 | 0.3756 | 120 | 4.84 | <.0001 |
| **Hours\*Status** | Symp | 53 | Symp | 84 | -0.4238 | 0.3644 | 120 | -1.16 | 0.2471 |
| **Hours\*Status** | Symp | 53 | Asymp | 108 | 2.0601 | 0.3756 | 120 | 5.48 | <.0001 |
| **Hours\*Status** | Symp | 53 | Symp | 108 | -0.2914 | 0.3644 | 120 | -0.80 | 0.4254 |
| **Hours\*Status** | Asymp | 60 | Symp | 60 | -1.7271 | 0.3756 | 120 | -4.60 | <.0001 |
| **Hours\*Status** | Asymp | 60 | Asymp | 84 | 0.3276 | 0.3865 | 120 | 0.85 | 0.3983 |
| **Hours\*Status** | Asymp | 60 | Symp | 84 | -1.9145 | 0.3756 | 120 | -5.10 | <.0001 |
| **Hours\*Status** | Asymp | 60 | Asymp | 108 | 0.5694 | 0.3865 | 120 | 1.47 | 0.1433 |
| **Hours\*Status** | Asymp | 60 | Symp | 108 | -1.7821 | 0.3756 | 120 | -4.74 | <.0001 |
| **Hours\*Status** | Symp | 60 | Asymp | 84 | 2.0547 | 0.3756 | 120 | 5.47 | <.0001 |
| **Hours\*Status** | Symp | 60 | Symp | 84 | -0.1874 | 0.3644 | 120 | -0.51 | 0.6080 |
| **Hours\*Status** | Symp | 60 | Asymp | 108 | 2.2965 | 0.3756 | 120 | 6.11 | <.0001 |
| **Hours\*Status** | Symp | 60 | Symp | 108 | -0.05497 | 0.3644 | 120 | -0.15 | 0.8803 |
| **Hours\*Status** | Asymp | 84 | Symp | 84 | -2.2421 | 0.3756 | 120 | -5.97 | <.0001 |
| **Hours\*Status** | Asymp | 84 | Asymp | 108 | 0.2418 | 0.3865 | 120 | 0.63 | 0.5328 |
| **Hours\*Status** | Asymp | 84 | Symp | 108 | -2.1097 | 0.3756 | 120 | -5.62 | <.0001 |
| **Hours\*Status** | Symp | 84 | Asymp | 108 | 2.4839 | 0.3756 | 120 | 6.61 | <.0001 |
| **Hours\*Status** | Symp | 84 | Symp | 108 | 0.1324 | 0.3644 | 120 | 0.36 | 0.7170 |
| **Hours\*Status** | Asymp | 108 | Symp | 108 | -2.3515 | 0.3756 | 120 | -6.26 | <.0001 |