**JASP Exercises**

*Learning to use JASP for the evaluation of informative hypotheses*

*with GORIC (using restriktor package) and Bayesian model selection (using the bain package)*

**Exercise 1. Informative hypothesis evaluation**

**Exercise 1A. GORIC**

Go through the following steps to evaluate informative hypotheses in an ANOVA model using the GORIC.

If you like, some example JASP files can be found in the subfolder ‘Examples GORIC(A) in JASP’ on the github repository ‘https://github.com/rebeccakuiper/Tutorials’.

1. Open JASP.
2. Go to the sandwich in the upper left-hand corner (“Show main menu”), select “Open – Computer”, and (by using the ‘Browse’ button) open the data file sesamesim.txt (which is contained in the ‘JASP meeting’ folder, that is, the same directory as this exercise).
3. *Optional*: Read the description at the end of this document to obtain an impression regarding what is contained in sesamesim.txt.
4. Come up with one or more informative hypotheses, after considering the meaning of postnumb and site.

In this case, do not hesitate to be inspired by the descriptives, which can be obtained in Step 6; but in practice, one should never do this of course.

1. Go to the ANOVA icon/button and click ANOVA (under the header ‘Classical’) from the drop-down menu.
2. Specify your model at the top: Use site as the factor and postnumb as the dependent variable.

*Note 1:* It is of course best if you also check the model assumptions, which is easily done in JASP (in the tab ‘Assumption Checks’).

*Note 2:* You can also tick the descriptive box, but make sure that (at least, when doing this on your own data) your hypotheses are known before looking at the descriptive statistics.

1. Then, go to the tab “Order Restricted Hypotheses”. Here, you can specify the hypotheses of interest (and select the additional failsafe hypothesis).

*Note* that there is a help-file that can be opened via the blue circle containing “i”. This contains information about how to specify the hypotheses.

E.g., ‘=’ can be used to specify an equality restriction and ‘>’ or ‘<’ for an inequality (i.e., µ1 = µ2 > µ3 for a factor called group can be specified by group1 = group2 > group 3).

The restrictions in one hypothesis/model should be entered in one Model-tab. The restrictions themselves can be specified using one or more constraints per line (i.e., µ1 > µ2 > µ3 for a factor called group can be denoted by the line ‘group1 > group2 > group3’ or by the two lines ‘group1 > group2’ and ‘group2 > group3’).

If you check the ‘Show available coefficients’ box, you can find the names of the coefficients, which should be used to specify the hypotheses.

1. In the box labelled Model 1, enter an informative hypothesis.

*Note 1*: A hypothesis is specified using population parameters, but with JASP (or R) one should use the variable/factor name and the level. Thus, one should use here: site1, …, site5 [see checking the ‘Show available coefficients’ box].

*In case of multiple factors, one should take into account different components / estimates to obtain the group means (e.g., mean of boy in site 1 may be, depending on the reference category, sex1+site1). In the future, this may be easier to specify in JASP. You could of course also create yourself a grouping variable based on the multiple factors and run a one-way ANOVA with that grouping variable.*

*Note 2*: If you would check the ‘Include intercept’ box, site1 to site5 would no longer reflected the 5 groups means (but the differences with respect to the reference category). Then, one may have to use “.Intercept.” as well (see the help-file via the blue i icon).

1. In case of multiple informative hypotheses: Click on the + sign after the ‘Model 1’ tab to add another model-box, labelled Model 2. Enter another informative hypothesis.

Do this for all the hypotheses you came up with.

1. Decide on the choice of failsafe (in ‘Add to comparison’ dropdown menu).

In case of one hypothesis of interest, one can use its complement as failsafe (set as default when specifying only one hypothesis). The complement of a hypothesis consists of all hypotheses / theories except the one of interest.

In case you have multiple informative, competing hypotheses that do not cover all possible theories / hypotheses, you need a failsafe hypothesis. Then, you need the unconstrained hypothesis as failsafe (which is included by default), to make sure that at least one informative hypothesis is not weak. The unconstrained does not restrict any parameters and, therefore, represents all possible hypotheses/theories, including the ones in the set. Bear in mind that the unconstrained will always obtain support, so you should not see it as a competing hypothesis.

1. Interpret the analysis results that are presented in the right-hand screen.

*Optional:*

It is probably better to take into account the pre-test knowledge as well. Try if you can do the above for

* either an ANCOVA model correcting for the variable prenumb.
* or an ANOVA with the difference score postnumb-prenumb as outcome.

This new variable can be made in the data file [click in the arrow to the left in the middle of the screen] by using the + sign on the top right.

**Exercise 1B. bain**

1. Open JASP
2. Use the sandwich in the upper left hand corner, select “open – computer” in JASP to open the data file sesamesim.txt which is contained in the same directory as this exercise.
3. Read the description at the end of this document to get an impression of what is contained in sesamesim.txt.
4. Use the + button in the upper right-hand corner and add bain to the menu at the top of the screen.
5. Open bain ANOVA.
6. Note that there is a help-file that can be opened via the blue circle containing “i”. Everything works rather intuitively, but if you get stuck, the help-file usually contains “the answer”.
7. Use site as the factor and postnumb as the dependent variable. Also tick the descriptive box. As you can see the results are immediately displayed on the rights hand side of your screen. Interpret the results.
8. Click on the “model constraints button” and enter the null hypotheses that all means are equal and an informative hypotheses that you construct after considering the meaning of postnumb and site (don’t hesitate to be inspired by the descriptives that have been displayed when executing Step 7). Constraints are formulated using site1, site2 etc. representing the means in the respective groups. Constraints can be a = b = c or a = b & b = c or a > b > c or a > b + 2 & b > c + 2 or a > (b,c) which is equal to a > b & a > c. For a complete description of the possibilities see the help file. Use one line for each hypothesis you specify.
9. Prest cntrl-enter or cmd-enter to run the analysis you specified.
10. Interpret the analysis results that are presented in the right-hand screen.

**Exercise 2. Updating**

**Exercise 2A. GORIC (ANOVA)**

1. Open the data file sesamesim30.txt.

By doing this, you pretend that you are a researcher that has so far collected only a sample containing 30 cases.

1. Follow the steps from Exercise 1A.
2. One can now update these results by doing the same for the data sets where more observations are collected.

That is, re-run the same analysis for the data sets containing 60, 90, and 120 cases (files are available in the ‘JASP meeting’ folder).

By doing this, you pretend that you added 30 persons to your sample, recomputed the GORIC (weights), and repeated that two more times.

1. You have now executed a GORIC updating. What is your conclusion? How many children did you need to obtain convincing conclusions?

**Exercise 2B. bain (linear regression)**

1. Open the data file sesamesim30.txt. By doing this you pretend that you are a researcher that has so far collected only a sample containing 30 cases.
2. Select bain linear regression.
3. Note that, there is a help- file that can be opened via the blue circle containing “i”. Use postnumb as the dependent variable and age, prenumb, and peabody as the independent variables.
4. Click on the “model constraints button” and enter the null-hypotheses that all regression coefficients are equal to zero, and an informative hypotheses that all regression coefficients are larger than 0.
5. Look at the BFs and the PMPs. Do you want to stop, or do you want the evidence to be stronger and continue to update? Write down the most important BFs and PMPs.
6. Repeat Steps 1 through 5 for the data sets containing 60-90-and-120 cases. By doing this you pretend that you added 30 persons to your sample, recomputed the BFs and PMPs, and repeated that two more times.
7. You have executed a Bayesian updating. What is your conclusion, how many children do you need to obtain convincing conclusions?

**Exercise 3. NHST vs evaluating informative hypotheses**

Use classical statistics (NHST) to answer the same research questions you addressed in Exercises 1 and 2. Use the ANOVA and regression buttons you find in the bar at the top of the JASP screen.

*What can and can’t you achieve using classical statistics?*

*What do you think are the advantages and disadvantages of classical and Bayesian statistics?*

**Exercise 4. The sky is the limit**

You can try out evaluating informative hypotheses using other data sets stored in JASP or using your own data.

**Description of the Sesamesim data**

**Description Sesamesim, a Simulated Data Set Inspired by the Sesame Data**

The exercises use a simulated data set inspired by the Sesame Street data set from:

Stevens, J. P. (1996). *Applied Multivariate Statistics for the Social Sciences*. Mahwah NJ: Lawrence Erlbaum.

This data set is included in the folder containing these exercises.

The data are obtained from children before and after watching Sesame street (an educative program for children) for a year.

The variables contained in sesamesim are subsequently:

* sex (1 = boy, 2 = girl) of the child
* site (1 = disadvantaged inner city, 2 = advantaged suburban , 3 = advantaged rural, 4 = disadvantaged rural, 5 = disadvantaged Spanish speaking) from which the child originates
* setting (1 = at home, 2 = at school) in which the child watches sesame street
* age (in months) of the child
* viewenc (0 = no, 1 = yes), whether or not the child is encouraged to watch Sesame Street
* peabody (mental age) score of the child (higher score is higher mental age)
* prenumb (score on a numbers test before watching Sesame Street for a year)
* postnumb (score on a numbers test after watching Sesame Street for a year)
* funumb (follow up numbers test score measured one year after postnumb)
* Bb Knowledge of body parts before
* Bl Knowledge of letters before
* Bf Knowledge of forms before
* Bn Knowledge of numbers before
* Br Knowledge of relations before
* Bc Knowledge of classifications before
* Ab Knowledge of body parts after
* Al Knowledge of letters after
* Af Knowledge of forms after
* An Knowledge of numbers after
* Ar Knowledge of relations after
* Ac Knowledge of classifications after