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| **General Info** | **STATA** | **SPSS** | **Excel** | **SAS** | **R** |
| Access | Citrix Workspace ->Stata-64 app | Citrix Workspace ->SPSS Statistics 26 app | (installed on most computers) | SAS website -> On demand for academics -> SAS Studio | https://cran.r-project.org https://rstudio.com/ |
| Features | Command line; drop-down menus; user-written programs | Drop-down menus; within-software data spreadsheet | Interactive spreadsheet; functions; add-on functionality | Within-software code sheet; consistent structure; high support | Command line; R commander; R Studio; additional packages  |
| Resources | **STATA*** https://www.stata.com/links/resources-for-learning-stata/
* https://data.princeton.edu/stata/
* https://dsc.gmu.edu/files/Advanced\_Stata\_Skills.pdf
* https://www.stata.com/bookstore/statacheatsheets.pdf

**SPSS*** https://www.spss-tutorials.com/basics/
* statisticshowto.com/probability-and-statistics/spss-tutorial-beginners/
* https://students.shu.ac.uk/lits/it/documents/pdf/analysing\_data\_using\_spss.pdf
* https://rslblissett.com/resources/spss\_cheat\_sheet/

**XCEL*** https://www.excel-easy.com/data-analysis/analysis-toolpak.html
* https://www.excel-easy.com/data-analysis/charts.html
* https://edu.gcfglobal.org/en/excel2016/functions/1/
* https://www.customguide.com/cheat-sheet/excel-cheat-sheet.pdf

**SAS*** https://documentation.sas.com/?cdcId=pgmsascdc&cdcVersion=9.4\_3.3&docsetId=pgmsashome&docsetTarget=home.htm&locale=en
* https://www.tutorialspoint.com/sas/index.htm
* listendata.com/p/sas-tutorials.html
* https://sites.ualberta.ca/~ahamann/teaching/renr480/SAS-Cheat.pdf

**R*** statmethods.net/r-tutorial/index.html
* https://www.tutorialspoint.com/r/index.htm
* https://daviddalpiaz.github.io/appliedstats/applied\_statistics.pdf
* https://rstudio.com/wp-content/uploads/2016/10/r-cheat-sheet-3.pdf
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| **Examples** | **STATA** | **SPSS** | **Excel** | **SAS** | **R** |
| Summary statistics | Data->Describe Data-> Summary Statistics **OR**summarize ***num\_var*** | Analyze -> Descriptive Statistics -> Descriptives | =AVERAGE(***num\_var***)=MEDIAN(***num\_var***)=STDEV.S(***num\_var***) … | PROC UNIVARIATE;var ***num\_var;*** | summary(***num\_var***) |
| Histogram | Graphics-> Histogram**OR**histogram ***num\_var*** | Graphs -> Chart Builder -> Histogram | Insert (Charts)-> Histogram | PROC SGPLOT;histogram ***num\_var;*** | hist(***num\_var***) |
| Boxplot | Graphics-> Box plot**OR**graph box ***num\_var***, over(***cat\_var***) | Graphs -> Chart Builder -> Boxplot | Insert (Charts)-> Box and Whisker | PROC SGPLOT;vbox ***num\_var***/ group=***cat\_var;*** | plot(***num\_var***~***cat\_var***) |
| Bar plot | Graphics-> Bar Chart**OR**graph bar (mean) ***num\_var***, over(***cat\_var***) | Graphs -> Chart Builder -> Bar | Insert (Charts)-> Column | PROC SGPLOT;vbarparm category=***cat\_var*** treatment=***num\_mean***; | ***means*** <- c(***mean\_cat1, mean\_cat2***)barplot(***means***) |
| Scatterplot | Graphics -> Twoway graph**OR**twoway (scatter ***num\_var1 num\_var2***) | Graphs -> Chart Builder -> Scatter/Dot | Insert (Charts)-> Scatter | PROC SGPLOT;Scatter y=***num\_var1*** x=***num\_var2***; | plot(***num\_var1, num\_var2***) |
| T-test | Statistics -> Summaries, tables, and tests -> Classical tests of hypotheses -> t tests**OR**ttest ***num\_var***, by(***cat\_var***) | Analyze -> Compare means-> Independent-Samples T Test | =TTEST(***num\_var1, num\_var2, tails, type***) | PROC TTESt;var ***num\_var***;class ***cat\_var***; | t.test(***num\_var***~***cat\_var***) |
| ANOVA | Statistics-> Linear models and related -> ANOVA/MANOVA -> One-way ANOVA**OR**oneway ***num\_var cat\_var*** | Analyze -> Compare means-> One-Way ANOVA | Data Analysis (add-on) -> Anova: Single Factor | PROC ANOVA;class ***cat\_var***;model ***num\_var***=***cat\_var***; | aov(***num\_var***~***cat\_var***) |
| Normal linear regression model | Statistics-> Linear models and related -> Linear regression**OR**regress ***num\_var1 num\_var2*** | Analyze -> Regression-> Linear | Data Analysis (add-on) -> Regression | PROC REG;model ***num\_var1= num\_var2***; | lm(***num\_var1*** ~***num\_var2***) |
| Logistic regression model | Statistics-> Binary outcomes-> Logistic regression**OR**logit ***binary\_var num\_var*** | Analyze -> Regression-> Binary Logistic | N/A | PROC LOGISTIC;model ***event/trial= num\_var2***; | glm(***binary\_var*** ~ ***num\_var***, family=biniomial)  |
| Poisson regression model | Statistics -> Count outcomes-> Poisson regression**OR**Poisson ***count\_var num\_var*** | Analyze -> Regression-> Generalized Linear Models | N/A | PROC GLIMMIX;model ***count\_var***= ***num\_var*** /dist=Poisson; | glm(***count\_var*** ~ ***num\_var***, family=Poisson) |
| Generalized linear mixed model | Statistics -> Multilevel mixed-effects models -> Generalized linear model**OR**meglm ***var1 var2*** || ***rand\_var\_eqn***, family(***distribution***) link(***link\_function***) | Analyze-> Mixed Models-> Generalized Linear | N/A | PROC GLIMMIX;class ***cat\_var***;model ***num\_var1= num\_var2 cat\_var rand\_var***;random ***rand\_var***; | Package lme4Lmer(***num\_var1***~ ***num\_var2*** + ***cat\_var*** + (1|***rand\_var***) |