Best Practices Guide for Satisfactory Research

* Advisor and advisee should agree upon several goals for the semester that could ideally be completed in parallel. Some goals may be ambitious, but a clear minimum level of achievement that constitutes satisfactory research should be agreed upon. The goals should include or align with satisfactory progress towards the degree (proposal, qualifying exam, 5 dissertation defense).

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| Major Goals | Anticipated completion date |
| 1. Have a clear understanding of the research topic for the next six to eight months. | 6 weeks |
| 1. Have a working R program that implements new methods | 15 weeks |
| 1. Read Recommended Chapters of the book, Intro. To Robust Estimation and Hypothesis Testing. 2. Read more journal papers that relevant to the research. | 10 weeks |

I \_\_\_\_\_<advisee/signature>\_\_\_\_\_ agree that I must \_\_\_\_<accomplishments >\_\_\_\_\_\_ to earn a grade of SR.

* Advisees are encouraged to keep a brief weekly or monthly log that outlines weekly/monthly assigned objectives and outcomes, and have the log signed by advisor.

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| Week | Assigned objective for this week | Outcome | For next week |
| 1 |  |  |  |
| 2 | -Estimate power of SW test for Uniform and Exponentially distributed samples  - Estimate power and power loss of downstream t test  -Estimate inflation of Type I error rate of downstream t test | -Results of power loss and inflation of Type I error rates don’t look as expected. | Repeat methods using different distributions. Choose distributions purposely.  Do one sample t test using the same procedures. |
| 3 | -Repeat methods using different distributions. Choose distributions purposely.  -Do one sample t test using the same procedures. | - I repeated the procedure using Chi-squared, Gamma, Weibull, and Lognormal distributions.  -I also did the one sample equivalent of the simulations. | -Read Chapter 1 of the book “Intro. To robust estimation and hypothesis testing.” |
| 4 | -Read relevant cited papers in the assigned article for the journal club.  -debug r code on simulations on distributions with unreasonable results (Weibull distributions and others). | -I read and made a summary of chapter 1 of the book “Intro. to robust estimation and hypothesis testing.”  -I also fixed the errors in the simulations by changing the parameter values of the Weibull distribution. | -Read chapter 2 of the book “Intro. to robust estimation and hypothesis testing.” |
| 5 | -Read chapter 2 of the book “Intro. to robust estimation and hypothesis testing.” | -I could not read much of chapter 2 of the recommended book (robust estimation) | -Re-run the simulations and organize the r codes and results into GitHub.  - Read chapter 2 of the book “Intro. to robust estimation and hypothesis testing.” |
| 6 | -Re-run the simulations and organize the r codes and results into GitHub.  - Read chapter 2 of the book “Intro. to robust estimation and hypothesis testing.” | -I re-run the simulations and organized the r codes and results into GitHub. The one-sample test results look good.  -I also read chapter 2 of the book | -Derive the power function for the t tests procedure for non-normal distributions  -plot Type I error against power  -make a histogram and a density plot t test statistic of each distribution. Add a plot of the combined t distribution. |
| 7 | - Derive the exact power function for testing  -plot Type I error against power  -make a histogram and a density plot t test statistic of each distribution. Add a plot of the combined t distribution. | I made the histograms with density plots overlay of the t test statistics, but I did it wrongly.  -I plotted the Type I error against power  -I added contaminated distributions to the simulations  -I could not derive the exact power function for testing | -fix the mistakes in the plots of the histograms.  - Use the hints given in discussion to derive the exact power function for testing |
| 8 | fix the mistakes in the plots of the histograms.  - Use the hints given in discussion to derive the exact power function for testing | I could not make any progress because of midterm exams | Do week 8 tasks |
| 9 | Do week 8 tasks | -I fixed the errors in the contaminated distribution parameters.  -I plotted the histograms of the two samples’ t test statistic with the density curves overlaid.  -I made a wrong attempt at deriving the exact distribution of test statistic for the location test | -Find the joint density function of the and and use transformation to find exact distribution of test statistic for the location test |
| 10 | There was no meeting | | |
| 11 | Find the joint density function of the and and use transformation to find exact distribution of test statistic for the location test. | -I wrote down the derivation of the distribution of the t test statistics assuming normality.  -I could not get the joint distribution of the and | - Continue from the proof for independence of the and , define new variables and use transformation to get the joint distribution of the and ,  -fix the mistakes in the plots of the t test statistics in the simulations. |
| 12 | - Continue from the proof for independence of the and , define new variables and use transformation to get the joint distribution of the and ,  -fix the mistakes in the plots of the t test statistics in the simulations. | -I used the transformation method to derive the joint distribution of the sample mean and sample variance and then use it to derive the t test statistics for normal distribution.  - One-to-one condition of transformation method needs to be fixed in some part of the transformation | -Repeat same for a different distribution  - find a solution the quadratic term in the transformation to ensure one-to-one condition  -redo test statistic plots, calculate exact type I errors from the plots |
| 13 | Repeat same for a different distribution.  - find a solution for the quadratic term in the transformation to ensure one-to-one condition  -redo test statistic plots, calculate exact type I errors from the plots | Thanksgiving break  NO MEETING | Repeat same for a different distribution.  - find a solution for the quadratic term in the transformation to ensure one-to-one condition  -redo test statistic plots, calculate exact type I errors from the plots |
| 14 | Repeat same for a different distribution.  - find a solution for the quadratic term in the transformation to ensure one-to-one condition  -redo test statistic plots, calculate exact type I errors from the plots | -I could not figure out how to get rid of the quadratic term in the transformation to fix the one-to-one condition problem.  -I make the right plots of the test statistic and calculated the probability of Type I error rates for each distribution. | - Simulate the samples from the alternative distribution and then plot the test statistics for each distribution together with the test statistic of samples from normal distribution.  - Observe and write about what you see in the plots. |
| 15 |  |  |  |

Example of Major Goals

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| Major Goals | Anticipated completion date |
| 1. Develop R code that implements the 2 main existing methods | Week 8 |
| 1. Finish reading papers a, b, c, d. | Week 8 |
| 1. Develop expressions for M step in parameter estimators in new method and Implement R code. | Week 15 |

I \_\_\_\_\_Benedict Kongyir agree that I must \_\_\_\_Goals 1 and 2\_\_\_\_\_\_ to earn a grade of SR

Example of weekly progress report.

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| Week | Assigned objective for this week | Outcome | For next week |
| 1. | MG1: Read R Vignette and run some sample code provided.  MG2: Read paper a. | MG1: Read. Some code didn’t work.  MG 2: Question about theorem 2 in a. Read paper b. | MG1: Read about error messages and try to understand. Try small simulated data set  MG2: Provide example where conditions of thm 2 satisfied and verify. Continue with paper b, c |
| 2. | MG1: Read about error messages and try to understand. Try small simulated data set  MG2: Provide example where conditions of thm 2 satisfied. Continue with paper b, c | MG1: Matrix rank deficient is cause. Small simulated data set worked.  MG2: Uniform distribution example verified. Read b and c. | MG1: Determine why design matrix is rank deficient and methods for modifying it. Implement for data set.  MG2: Read paper d. Provide strengths and weaknesses for a – d and relate to data set. |
| 3. |  |  |  |
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Characteristics of a good advisee are below

* + Always on time and well prepared for each meeting. Schedules meetings with advisor.
  + Shows initiative – does research beyond expected (reads extra articles, runs a simulation study to debug, etc).
  + Learns from mistakes
  + Has a positive attitude
  + Self-aware (some examples below). “Know what you know and know what you don’t know”
    1. Good: “This method can’t be applied here or this theorem isn’t true because ….[proof or counter example provided]”
    2. Good: “I’m not sure if this method can be applied or if this theorem is true because I haven’t been able to verify the third equality in the proof of line 3
    3. Good: I’m not able to get output from the M step in the algorithm yet. Data inputted needs processed differently. I’m reading the help file and vignette”
    4. Good: “I can see that you don’t follow my reasoning for this. Let me work on improving my communication and get back to you.”
    5. Poor: This method can’t be applied here or this theorem isn’t true because there are bugs in the code
    6. Poor: This theorem can’t be true: I can’t verify the proof.