Clinical Science Program
Guidelines for Doctoral Dissertations

Please review and follow the Graduate School Formatting Guidelines
http://www.ucdenver.edu/academics/colleges/Graduate-School/Documents/GSOCTFORMS/Format-Guide.pdf

PhD dissertation research is the vehicle through which students learn to independently conduct, complete, and communicate research. The doctoral dissertation should reveal the student's ability to discover, analyze, interpret, synthesize, and disseminate information through the process of:

1. Generating research questions/hypotheses of interest and import to the student's chosen field;
2. Placing the research questions/hypotheses in the context of research literature relating to the project with a particular emphasis on prior scholarship on which the dissertation is built;
3. Describing and executing appropriate methodology;
4. Presenting results in a logical manner; and
5. Fully and coherently discussing the meaning of the results and placing it within the body of existing literature.

The dissertation should be:

1. Original (i.e., it builds on or extends what is currently known).
2. Substantial and researchable (i.e., it addresses a significant problem that:
    - Poses a puzzle to the field at a theoretical, methodological, or policy level;
    - Requires an analytical discussion, beyond simple cataloging or describing; and
    - Employs a reasonable research methodology).
    - Results in the equivalent of about 3 publications
3. Manageable (i.e., the scope of the project is appropriate given limited time and resources).

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Length: Most range between 150-200 pages

General Outline for Doctoral Dissertation

Title
The title must be pertinent to your project.

Abstract
The abstract is a brief summary of your work. It should include the research questions/hypothesis(es), the methodology and the key results. The abstract is typically written last. Abstract uses a structured format Background/ Rationale, Objective/Purpose, Methods, Results, Conclusion and is within the 350 words limit.

Chapter 1 Elements

Introduction

This is a *general* introduction to what the thesis is all about and its structure-- it is *not* just a description of the contents of each section. Briefly *summarize* the question (you will be stating the question in detail later), some of the reasons why it is a worthwhile question, and perhaps give an overview of your main results. This is a birds-eye view of the answers to the main questions answered and how this thesis adds value to the known literature.

What is the topic and why is it important? State the problem(s) as simply as you can. Try to step back mentally and take a broader view of the problem. How does it fit into the broader world of your area/discipline?

In the introduction, do not overestimate the reader's familiarity with your topic. You are writing for researchers in the general area, but not all of them need be specialists in your particular topic. The introduction should be interesting. For the first paragraph or two, tradition permits prose that is less dry than the scientific norm. Try to make the reader want to read the heavy bundle that has arrived uninvited on his/her desk. Go to the library and read several thesis introductions. Did any make you want to read on? Which ones were boring?

This section might go through several drafts to make it read well and logically, while keeping it short. For this section, it is a good idea to ask someone who is not a specialist to read it and to comment. Is it an adequate introduction? Is it easy to follow? Your introduction should tell where the thesis is going, and this may become clearer during the writing. This section will need revision following completion of the study.

Literature Review

The focus/topic of the dissertation must be well grounded in the relevant theoretical and/or empirical literature related to the topic. This means that an extensive literature review needs to be conducted as the basis for the proposal and the dissertation, in defense of the chosen topic. The extent and type of literature search strategy should be discussed with your mentor/committee. You should have a description, table or algorithm that describes your search strategy and results and approach to finding and reviewing the relevant research. This literature review must also widely and firmly support the research questions, the research design, and any hypotheses that may be tested.

Here you review the state of the literature relevant to your thesis. The idea is to *present* the major ideas right up to, but not including, your own personal brilliant ideas.

This section is organized *by idea*, and not by author or by publication.

Where did the problem come from? What is already known about this problem? What other methods have been tried to solve it?
Ideally, you will already have much of the hard work done, if you have been keeping up with the literature. If you have summarized those papers, then you have some good starting points for the review.

> For example, when you start reading about a topic, you should open a spread sheet file, or at least a word processor file, for your literature review. Of course, you want the reference but you also write a summary (anything from a couple of sentences to a couple of pages, depending on the relevance). In other columns of the spread sheet, you can add key words (your own and theirs) and comments about its importance, relevance to you and its quality.

How many papers? How relevant do they have to be before you include them? Well, that is a matter of judgment. You are the world expert on the topic of your thesis: you must demonstrate this.

Problem Statement, Research Questions, Hypotheses

You need to describe the overall or general "problem" to be solved and the specific research questions and/or hypotheses to be answered. In either case, this section has four main parts:

1. a concise statement of the problem
2. importance of the problem, i.e., why it is worth researching, why it matters to the field.
3. justification, by *direct* reference to the Literature Review chapter, that your question is previously unanswered- what gaps are addressed
4. specific aims, research questions/hypotheses that your thesis tackles

Items 2&3 above are where you *analyze/critically appraise* the information you presented

in the Literature Review. For example, maybe your problem is to "develop an algorithm capable of handling very large scale problems in reasonable time" (you would further describe what you mean by "large scale" and "reasonable time" in the problem statement). Now in your *analysis* of the state of the art you would show how each of the current approaches fails (i.e. can handle only small problems, takes too much time, requires very expensive software). In the last part of this section you would explain why having a large-scale fast algorithm is useful; e.g., by describing applications where it can be used.

You must make it clear in this section how what you want to do differs from what has been done before and how it builds upon the past work. You should also be able to show that the question you want to answer will further the state of knowledge in your field. Finally, the statement of problem should culminate in the identification of one or more testable hypotheses/research questions that you think will address the statement of problem.

Chapter 2 Elements

Theoretical OR Conceptual Model

Chapter 2 provides a conceptual model or theoretical foundation(s) supporting the problem/issue and a description of the methods used to address the research questions and hypotheses posed. The dissertation must have a theoretical framework that is steeped in and builds upon the relevant knowledge base. Theoretical frameworks must contribute to conceptual or theoretical models that can be tested by theoretical or empirical means. The theoretical or conceptual framework should be used to motivate the hypotheses and the empirical specifications that are used to test hypotheses. This can be a stand alone chapter or integrated into the Methods Chapter.

Study Design, Methods and Statistical Approach

The topic of the dissertation and the nature of the research question(s) or hypothesis(es) must lead the research design. Some questions/hypotheses may require different research designs. For example, some topics and research questions in the field are best suited to some form of qualitative research while others may be best suited to some form of quantitative research. Some topics may be best suited for a combination of qualitative and quantitative research. It is the nature of research questions that determines the appropriate research design.

Methods of data collection and techniques of analysis must be consistent with the research design. For example, if the research questions call for survey research, then they must conform to the best standards of survey research and subsequent statistical analysis. If the research questions call for an econometric model, then the methods of data collection and analysis must conform to the best standards of econometric modeling. If the research questions call for some form of qualitative research design, then the methods of data collection and analysis must conform to the best standards of a particular form of qualitative research. Data collection and analysis, whether quantitative or qualitative must

build a strong bridge between conceptualization (conceptual model/framework or theory) and operationalization. Standard Operating Procedures should be mentioned and provided in Appendices. Data collection instruments are also provided in the Appendices.

IRB and IACUC

Include COMIRB and other IRB submitted to and approved along with the protocol number(s) for all research involving human subjects/participants. For live animals, animal tissue or observational animal work, include your IACUC protocol number. Include your IRB and or IACUC submissions in Appendices.

Chapter 3 Elements

Results

Results of the research are presented clearly and address the research questions/ hypotheses. Styles for presenting results in your dissertation may vary. In general, there are 3 options:

1. Results are described through tables, figures, graphs, images and text.
2. Results are written as full manuscripts that are in submission-ready form as they would be submitted for publications (3 papers).
3. Published, In Press or submitted peer-reviewed manuscripts (3 papers) of your research results are presented in the results section or contained in the dissertation as separate chapters following chapter 2 (theoretical/conceptual framework and methods).

*For students that choose option 3- dissertations that use the style of presenting/inserting three Published, In Press or submitted peer-reviewed manuscript*s may choose to have each published paper serve as a separate chapter of the dissertation. The published papers must be re-formatted to follow the Graduate School Format Guide for Theses and Dissertations. (See above at the top of the document). In addition, for multi-authored papers, a description must be included that provides the full reference citation (could be included as a footnote or note at the top of the section/chapter) and describes the student's role and contributions, such as

> "This chapter is adapted from [Title] published in [Journal] and has been reproduced with the permission of the publisher and my co-authors [List co-authors]" and include the full citation required by the publisher. Students who use this approach may have shorter final conclusions and discussion chapters.

Students should discuss the best thesis structure option for their thesis early in the process (before the Comprehensive Examination). In addition, it is important to consult with your thesis committee regarding expectations for the methods and final conclusions and discussion chapters.

Last Chapter: Conclusions and Discussion
Generally, three things are covered in the Conclusions and Discussion Chapter, and each of these usually merits a separate subsection:

1. Conclusions
2. Summary of Contributions and Implications
3. Limitations of Research
4. Future Research

Conclusions are *not* a rambling summary of the thesis: they are *short*, *concise* statements of the inferences that you have made because of your work. It helps to organize these as short numbered paragraphs, ordered from most to least important. All conclusions should be directly related to the research question stated in the Problem Statement, Research Questions, Hypotheses chapter.

The Summary of Contributions and Implications will be sought and carefully read by the examiners. Here you list the contributions of *new* knowledge that your thesis makes and how it builds on existing literature as well as how your work contradicts the previous work of others. Of course, the thesis itself must substantiate any claims made here. There is often some overlap with the Conclusions, but that's okay. You also want to highlight/discuss the implications of your work. This summary should be organized around your contributions to and implications for research/methods, theories/models/framework, and clinical practice.

The Future Research subsection is included so that researchers picking up this work in future have the benefit of the ideas that you generated while you were working on the project. Future work should relate to the clinical area, methods, and theory.

Dissertations that use the style of presenting three Published, In Press or submitted manuscripts approach has the last chapter present and discuss linkages (i.e., similarities and differences) between the separate manuscripts that are included in the dissertation, striving as much as possible to present the document as representative of a coherent body of work. The conclusion chapter 'ties' everything together and helps the reader see how the various manuscripts, taken together, make a contribution to the knowledge base regarding the problem. The conclusion chapter should present/discuss research imperatives, or knowledge gaps, not visible when each manuscript is considered individually and should articulate an agenda for future research on the issues addressed in the dissertation. It should be clear the contributions to the literature made by the student's body of work in terms of research, theory, and practice as well as next steps to be taken or considered to move the state of the evidence forward.

References

The list of references is closely tied to the Literature Review. Most examiners scan your list

of references looking for the important works in the field, so make sure they are listed and referred to in the Literature Review. All references given *must* be referred to in the main body of the thesis. Note the difference from a Bibliography, which may include works that are not directly referenced in the thesis.

Appendices

What goes in the appendices? Any material which impedes the smooth development of your presentation, but which is important to your dissertation. Generally, it is material that is of too nitty-gritty a level of detail for inclusion in the main body of the thesis, but which should be available for perusal by the examiners to convince them sufficiently. Examples include data collection instruments, informed consent, immense tables of data, lengthy statistical formulae or outputs or derivations, etc.

Doctoral Dissertation Checklist

1. The title is clear and concise.
2. Abstract uses a structured format Background/Rationale, Objective/Purpose, Methods, Results, Conclusion and is within word limit.
3. Include COMIRB/IRB protocol number(s) in your Acknowledgements and Methods Chapter/Section. For live animals, animal tissue or observational animal work, include your IACUC protocol number in your Acknowledgements and Methods Chapter/Section.
4. Problem is significant and clearly stated.
5. Review of the literature is efficiently summarized.
6. Limitations of the literature are highlighted and well defined.
7. Important terms are well defined.
8. Hypotheses or research questions are clearly stated and are testable, discoverable, or answerable.
9. Problem statement, hypotheses, or research questions derive from the review of the literature. Rationale for work is clearly articulated.
10. Research design is clearly and comprehensively described, and demonstrated to be related to the research questions, and/or hypotheses.
11. Theoretical or conceptual model/framework used to guide work is well described.
12. Methods of data collection are clearly presented and demonstrated to be related to the research questions/hypotheses.
13. Plans for analysis whether quantitative or qualitative are clearly stated and justified within the context of the research design.
14. Tables and figures are used effectively. Textual explanation of the tables/figures is provided along with the tables and figures.
15. Results of the research are presented clearly and address the research questions/hypotheses.
16. Major findings are discussed clearly and related to previous research.
17. Importance of the findings is explained.
18. The relationship between the research and the findings is demonstrated with tight, logical reasoning.

19. Conclusions are clearly stated.
20. Conclusions are based on the results.
21. Generalizations are confirmed.
22. Limitations and weakness of the study/body of work are discussed.
23. Implications of findings to clinical care, research, methods and theory are discussed.
24. Relationship of the study to previous research is clear.
25. Suggestions for future research are offered regarding clinical care, research, methods and theory.
26. References are included (usually > 75).
27. Data collection instruments are included in Appendices.
28. IRB submission in Appendices
29. Sentence structure, grammar, spelling, and punctuation are correct.
30. Thesis is clearly written.
31. Tone is unbiased and impartial.

*Grossly borrowed with some adaptations from J. E. Mauch and J. W. Birch (1998), *Guide to the Successful Thesis and Dissertation*, Marcel Dekker.