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The Loyola Experience (1993-2009): Optimal Data Analysis in the Department of Psychology

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This article traces the origins and development of the use of optimal data analysis (ODA) within the Department of Psychology at Loyola University Chicago over the past 17 years. An initial set of ODA-based articles by Loyola faculty laid the groundwork for a sustained upsurge in the use of ODA among graduate students which has lasted for more than a decade and a half. These student projects subsequently fueled an increase in ODA-based publications by other Loyola Psychology faculty, who directly supervised the various student projects. Thus, ODA initially trickled down from faculty to students, but later grew up in the opposite direction. The most frequent use of ODA in Loyola's Psychology Department has been to conduct classification tree analysis, with less common uses of ODA including optimal discriminant analysis and the iterative structural decomposition of transition tables. As more Loyola Psychology graduate students find academic jobs and continue using ODA in their research, we expect that they will replicate the Loyola experience in these new academic settings.

When you discover a new tool that you believe is superior to other tools you've used before, naturally you want not only to use the new tool, but also to tell others about it so they can enjoy its benefits too. Such has been the case in the Department of Psychology at Loyola University Chicago since early 1993, when the first version of Optimal Data Analysis (ODA) 1.0 for DOS became publicly available. The purpose of this brief article is to describe the 17-year process through which the use of ODA sprang up, took hold, and spread among graduate students and faculty in Loyola's Psychology Department.

The Early Days of ODA at Loyola

I have known Paul Yarnold and Rob Soltysik since they first began working on the problem of optimal classification in the early 1980s. I served as a beta-tester for both the original DOS-based¹ and more recent Windows-based² versions of the ODA software. In late 1992, I cheered from the sidelines as Paul and Rob put the finishing touches on ODA 1.0 for DOS. And when ODA 1.0 for DOS appeared in print, I wrote the first published review of the

new software³ and began using ODA in my research. Later I also published the first review of ODA for Windows.⁴

Having fallen in love with the power, versatility, and elegance of ODA, I began publishing research articles using ODA as a statistical tool in 1994.⁵ I first directly collaborated with departmental colleagues to use ODA in 1996, in publishing an article using optimal discriminant analysis as an alternative to Student's *t* test with two Loyola clinicians in the *Journal of Consulting and Clinical Psychology*.⁶ At the same time, I continued publishing ODA-based research on my own, and began extolling the capabilities of the new ODA software to my graduate students. Interestingly, it was the

graduate students, rather than the faculty, who more eagerly embraced ODA as a statistical tool in their research.

How Loyola Researchers Have Used ODA

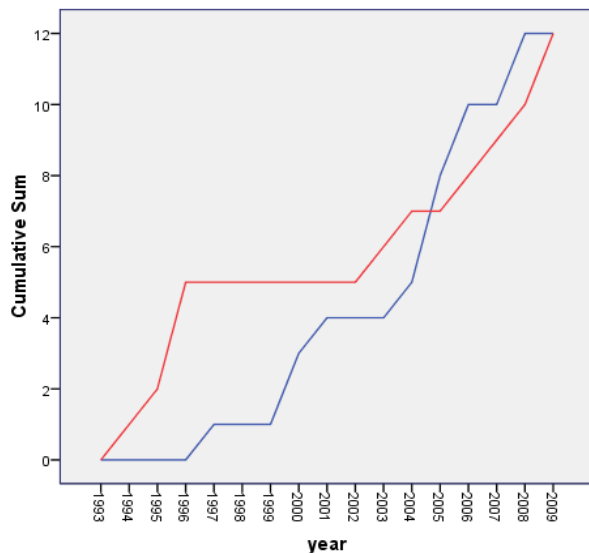
At Loyola, researchers have used ODA in multiple ways to address a wide variety of different research questions in clinical psychology, social psychology, neuropsychology, behavioral medicine, and biochemistry. Table 1 summarizes the 12 faculty publications and 12 graduate student projects (11 dissertations and 1 master's thesis) in Loyola's Psychology Department that have used ODA over the past 16 years (1994-2009).

TABLE 1: Published Journal Articles and Graduate Student Projects (Master's Theses and Dissertations) in Loyola's Psychology Department Using ODA by Year (1993-2009)

Year	Student Projects	Published Journal Articles
1993	0	0
1994	0	1
1995	0	1
1996	0	3
1997	1	0
1998	0	0
1999	0	0
2000	2	0
2001	1	0
2002	0	0
2003	0	1
2004	1	1
2005	3	0
2006	2	1
2007	0	1
2008	2	1
2009	0	2
TOTAL	12	12

Figure 1 illustrates the cumulative number of faculty publications (red) and graduate student projects (blue) from 1993 to 2009.

FIGURE 1: Loyola Psychology Department Publications (Red) and Dissertations/Theses (Blue) Using ODA From 1993-2009



Note the patterns that emerge across the 17-year span. The Loyola Psychology Department's experience with ODA originated in the early publications by department faculty. This initial set of articles laid the groundwork for a sustained upsurge in the use of ODA by Loyola graduate students over more than a decade and a half. These graduate student projects subsequently fueled the increase in ODA-based publications by other Loyola Psychology faculty, who directly supervised the various student projects. Thus, although ODA initially trickled down from faculty to students, it later grew up in the opposite direction.

Classification Tree Analysis

By far, the most frequent use of ODA at Loyola has been to conduct multiattribute classification tree analysis (CTA). For example, Loyola graduate students have used CTA to

identify predictive models for discriminating students who drop out versus return to college following the first year⁷, children's emotional responsiveness versus unresponsiveness during psychotherapy⁸, child molesters versus non-molesters⁹, positive versus nonpositive adaptation to childhood¹⁰, convicted juvenile delinquents versus non-delinquent youth¹¹, positive versus negative morbidity and mortality outcomes following bone marrow transplant¹², high versus low effect sizes in a meta-analysis of methodological and intervention characteristics associated with primary prevention programs for children and adolescents¹³, engaging versus not engaging in risky sexual behavior among minority adolescents¹⁴ and adult male homosexuals¹⁵, high versus low social competence among children with spina bifida¹⁶, and state mental health care agency decisions to commit children to residential treatment versus foster homes.¹⁷ In addition, department faculty and graduate students have jointly published journal articles using CTA to predict early sexual debut among adolescents¹⁸, positive adaptation to childhood¹⁹, psychiatric hospital admission decisions for children in foster care²⁰, malingering in forensic neuropsychological examinations²¹, change in job status following traumatic brain injury²², and clinically significant sexual concerns in a child welfare population.²³

Optimal Discriminant Analysis

The next most common use of ODA in Loyola's Psychology Department has been to conduct optimal discriminant analysis, as an exact-probability alternative to parametric discriminant analysis or Student's *t* test. For example, Loyola faculty publications have used ODA in this fashion to discriminate Type As versus Type Bs using the Type A Self-Rating Inventory⁵ and the Students Jenkins Activity Survey²⁴, males versus females in self-ratings of affective intensity²⁵, high- versus low-quality child therapy sessions based on therapist discourse⁶, and physicians versus undergraduates

in levels of sympathy and empathy.²⁶ Layden et al. used this form of discriminant analysis to identify an optimal cut-score for using psychiatric ratings to assess toxicity in patients undergoing lithium treatment for bipolar depression.²⁷

Iterative Structural Decomposition

Another Loyola dissertation in clinical psychology used ODA to conduct an analysis for which no alternative statistical test exists. In this particular project, the student had couples discuss an area of disagreement in their marriage for 15 minutes, and then used an established interaction scoring system to code these interactions. Based on existing theory, the student predicted that couples having only one depressed spouse would engage in the following sequence of behaviors: (a) depressive behavior, followed by (b) spouse's supportive behavior, followed by (c) more depressive behavior, followed by (d) spouse's incongruent behavior, followed by (e) angry/defensive behavior, followed finally by (f) spouse's critical/rejecting behavior. Following procedures outlined by Yarnold and Soltysik² (pp. 209-222), the data were organized into transition tables representing the frequencies of various verbal exchanges between spouses over time. Supporting the hypothesized temporal model, an iterative structural decomposition of the transition tables revealed that the data conformed to the predicted sequence of behaviors significantly more than would be expected by chance alone.²⁸ It is unclear how one would test the hypothesized behavioral sequence using any other inferential statistical tool.

The Future of ODA in Psychology

If the past is any indication of the future, then ODA has a bright future, not only at Loyola but elsewhere. The recent availability of ODA-based software that automatically constructs classification tree models is likely to accelerate the use of CTA across a wider variety

of research disciplines. In the future, enumerated CTA models may well replace traditional hierarchically-optimal CTA models, particularly given the superior classification accuracy of the former. The automated CTA software also offers the ability to analyze class variables that have more than two levels, thereby enabling new forms of nonlinear optimal regression modeling. We can foresee a vast array of new applications for CTA, including meta-analysis, cross-cultural tests of similarities and differences, and optimal path analysis.

Obviously, it is relatively easy to export the Loyola Experience with ODA to other universities. All that is needed is a faculty member to lay the groundwork through an initial set of ODA-based publications, along with graduate students who are seeking to analyze data for their dissertation or master's thesis. As more Loyola Psychology graduates find academic jobs and continue to use ODA in their research, we expect that they will replicate the Loyola experience in these new academic settings.

I close by noting an unanticipated aspect of the Loyola experience with ODA. Namely, some of the graduate students who have used ODA in their dissertation research have later had the opportunity to teach introductory statistics in psychology at the undergraduate level, both at Loyola and at other colleges and universities. Naturally, these graduate instructors have taught their students about ODA and its statistical advantages, and these undergraduates are now approaching faculty members in psychology at Loyola and elsewhere to supervise independent research projects and honors theses that use ODA. Once again, the process of learning has come full circle, as the students themselves become teachers and disseminate statistical methods to students, faculty, and beyond.

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