M.S. Degree in Psychology with Concentration in Quantitative Psychology

Department of Psychology

University of Mary Hardin-Baylor

1 Overview

In an increasingly data-driven world, psychological scientists are uniquely positioned to lead advances in quantitative analyses of human behavior and decision analytics. Between 2012 and 2022, the U.S. Bureau of Labor Statistics (2014) projects the field of data and statistical science to grow at approximately 27%, much faster than the average.

Scientists in these and related fields should be able to apply psychological principles and theories to large data sets, possess intermediate to advanced knowledge of a computational statistical programming language (e.g., R), employ predictive analytics to model human behavior, summarize and visualize large sets of data, mine large data sets to test hypotheses, and articulate and summarize results for relevant constituents (Yarkoni, 2012).

A foundation in psychology, combined with advanced training in the quantitative and data sciences will combine to both set UMHB apart from other peer and aspirant institutions, but fulfill Imperative x in the university's vision statement to "offer exceptional academic programs that distinguish UMHB as a leading university."

2 Peer and Aspirant Institutions

Of the 39 UMHB peer and aspirant institutions, 22 offer graduate programs in psychology and/or counseling. Of those, none offer a graduate program in quantitative psychology/methods. However, several offer graduate programs in data science. Table 1 summarizes this group.

Table 1: *Peer and Aspirant Institutions with Programs in Data Science*

Institution	Department	Degree	Program	Hours
Mercer University	School of Business and Economics	Certificate	Data Analytics	2 days
Mercyhurst University	School of Intelligence Studies and Information Science	M.S.	Data Science	36
St. Thomas University	School of Engineering	M.S.	Data Science	36
Elmhurst College	Online Center	M.S.	Data Science	30
Lipscomb University	College of Computing and Technology	M.S.	Data Science	30

Based on the growing need in the field and scarcity of graduate programs in this discipline, we propose a 36 hour M.S. degree in quantitative psychology/data science. A program description with goals, anticipated outcomes, and proposed coursework are provided.

3 Program Description

3.1 Goals

Goals of the proposed program are for students:

1. To gain advanced knowledge of applied statistics and predictive modeling.
2. To apply coursework to solve complex problems encountered during myriad decision-making processes.
3. To gain intermediate knowledge of statistical and scientific programming languages (e.g., R, LaTeX).
4. To apply best-practices in big data retrieval and organization.
5. To demonstrate evidence of scholarly competence by publishing empirical, peer-reviewed research.

3.2 Outcomes

Outcomes of the proposed program are for students to expect:

1. Improved competitiveness for admission to a doctoral program in the psychological or data sciences.
2. Increased eligibility for a variety of jobs in the private and public sectors with quantitative and data science emphases.

3.3 Coursework

A select group of non-peer and aspirant colleges and universities offer at least masters-level graduate programs in quantitative psychology. This list includes: (a) Arizona State University (ASU, 2016); (b) James Madison University (JMU, 2016); (c) University of California, Los Angeles (UCLA, 2016); (d) University of Texas at Dallas (UTD, 2016); and (e) Vanderbilt University (VU, 2016). Across the above institutions, coursework in these programs tends to include a varying number of psychology core courses with the remainder of credits to be earned in the area of specialization.

In general, courses in the specialization include offerings in correlation and regression analysis, analysis of variance, multivariate analysis, item response theory, exploratory/graphical data analysis, structural equation modeling, factor analysis, multilevel modeling, latent trait analysis, and categorical data analysis.

Coursework for the proposed program is patterned after that of the above list and will start with a 12 hour foundation in the core psychological sciences. The purpose of the psychology core is provide students with graduate-level exposure to advanced theories of human learning, personality, and social-organizational constructs. The focus of the proposed program is on the 24 hour concentration in quantitative psychology/data science. Coursework in the concentration will focus on advanced statistics and predictive modeling strategies useful in the psychological sciences. A sample graduate catalog entry is provided in Appendix A, while course descriptions for the core and concentration are provided in Appendix B.

3.3.1 Psychology Core (12 hours)

COURSE	CREDIT HOURS
Learning and Behavior Theory	3
Social-Organizational Psychology	3
Advanced Personality Psychology	3
Cognitive Psychology	3
TOTAL:	**12**

3.3.2 Quantitative/Data Science Concentration (24 hours)

COURSE	CREDIT HOURS
Quantitative Methods I	3
Exploratory Data Analysis	3
Statistical Computing	3
Linear and Multiple Regression Modeling	3
Survey Design and Analysis	3
Quantitative Methods II	3
Generalized Linear Modeling	3
Internship/Practicum in Quantitative Psychology	3
TOTAL:	**24**

3.4 Duration of the Program

Students who attempt at least 9 hours per fall, spring, and summer semester can expect to complete coursework in 18 calendar months. For example, Figure 1 presents a potential course sequence below:

4 Cost-Benefit Analysis

A simple cost-benefit analysis was conducted to determine anticipated start-up costs to include the hiring of a new faculty member plus approximate benefits and technology set-up. Tuition rates and student fees were based on 2015-2016 graduate tuition, assuming an initial cohort of 8 students at 9 hours per fall, spring, and summer I and II semesters. Thus, 8 students who attempt 9 hours in each semester net $234,720, as seen below:

$$((8 \text{ students} \times 9 \text{ hours}) \times 4 \text{ semesters}) \times \$815.00 \text{ per hour} = \$234{,}720.$$

Table 2 provides a detailed estimate of anticipated costs and benefits of creating the M.S. degree program in quantitative psychology.

5 Prospective Student Employment

At the master's degree level, jobs in the statistical, data, psychological, and survey sciences are expected to grow at 27%, 27%, 30%, and 18%, respectively. Median salaries can range between $54,000 and $75,000 (U.S. Bureau of Labor Statistics, 2014).

Students who complete the M.S. program in quantitative psychology will be highly qualified for admission to competitive doctoral programs in fields such as experimental psychology, industrial/organizational psychology, and quantitative psychology, leading to careers in either academic or industry professions. For those not seeking doctoral training, the M.S. degree will also equip graduates with requisite knowledge, skills, and abilities necessary for careers in behavioral analytics, data science, and quantitative analysis in both private and public industry settings.

Table 2: *Cost-Benefit Analysis of Year One UMHB M.S. in Quantitative Psychology*

Costs

Category	Item	Qty	Price	Total
Faculty	Adjunct overload pay	3	$4,500	$13,500
Equipment	Recruitment stands	2	$165.00	$330.00
	Recruitment table cloth	1	$350.00	$350.00
Annual Recruiting Needs	Print material	400	$3.75	$1,500
	Travel	2	$750.00	$1,500
			Total Cost:	**$17,180.00**

Benefits

Category	Item	Qty	Price	Total
Tuition	Graduate	288	$815.00	$234,720
Fees	General service	8	$60.00	$480.00
	Technology	288	$15.00	$4,320
	Transportation	8	$100.00	$800.00
			Total Benefit:	**$240,320.00**
			Net Difference:	**$223,140.00**

Note: Tuition/fees based on 2015-2016 graduate catalog assuming an initial cohort of 8 students at 9 hours per semester (fall, spring, and summer I and II combined $[(8 \times 9) \times 4) = 288]$.

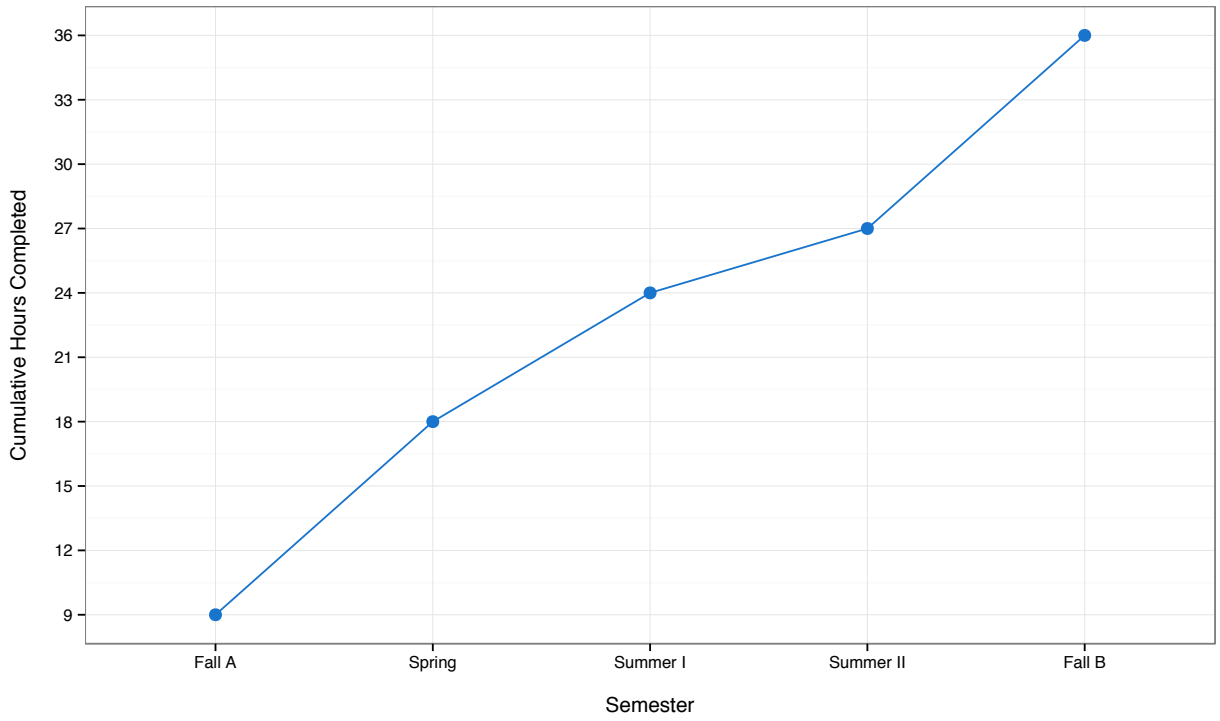

Figure 1: Hypothetical sequence of coursework completion at full-time status.

6 UMHB Student Interest Survey

UMHB undergraduate psychology majors and minors, along with math majors, were surveyed in December 2015 regarding their potential interest in a master's-level graduate program in quantitative psychology ($N = 333$). Using a 5-point Likert scale, we asked students to indicate whether or not they had interest in a similar program at UMHB.

6.1 General Interest

Although the focus of data collection was to gain insight into UMHB students' interest in a graduate program in quantitative psychology, we initially asked respondents to indicate their current plans to attend graduate school in general. Of those who responded to the survey ($n = 93$), 74 (80%) indicated they do plan to attend graduate school, while 17 (18%) indicated they may plan to attend graduate school. Table 3 displays full results of the question pertaining to graduate school plans.

Table 3: *Number of Students With Plans to Attend a Graduate Program*

Graduate School Plans	*n*	*N*	Proportion
Maybe	17	93	0.18
No	2	93	0.02
Yes	74	93	0.80

As to the focus of the survey, 61 students surveyed (66%) indicated they would be at least possibly interested in a M.S. degree in quantitative psychology at UMHB. Table 4 displays the sample-size and proportion of responses in all categories. Figure 2 displays frequencies of total student interest in the M.S. degree plan.

Table 4: *Number of Students With Interest in a M.S. Degree in Quantitative Psychology*

Interest	*n*	*N*	Proportion
Not at all Interested	18	93	0.19
Not Provided	1	93	0.01
Not Sure	13	93	0.14
Possibly Interested	23	93	0.25
Somewhat Interested	28	93	0.30
Very Interested	10	93	0.11

6.2 Gender

Approximately 65% of respondents (women = 49%, men = 16%) indicated they would be at least possibly interested in a M.S. degree in quantitative psychology at UMHB. Table 5 displays the sample-size and proportion of responses in all categories of interest by gender. Figure 3 displays frequencies of interest in the M.S. degree plan by gender.

6.3 Major

We also examined student's major as a potential factor in interest. Most notably, 42 psychology majors (45%) indicated they would be at least possibly interested in a graduate program in quantitative psychology at UMHB. Other majors indicating at least possible interest included biology (6%), nursing (6%), and

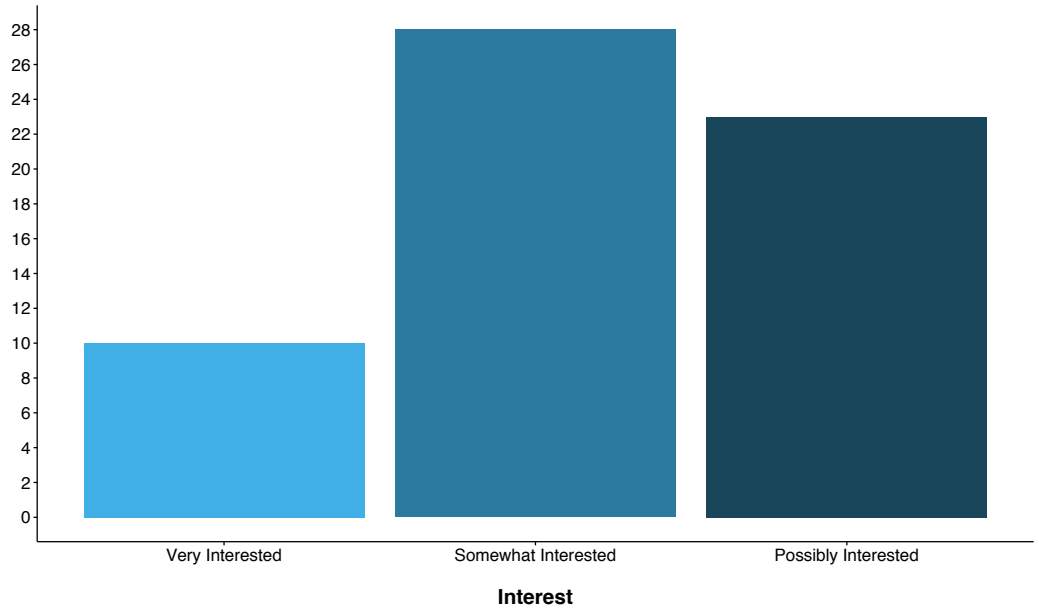

Figure 2: *Total student interest in a M.S. degree in quantitative psychology.*

Table 5: *Number of Students With Interest in a M.S. Degree in Quantitative Psychology by Gender*

Interest	Gender	*n*	*N*	Proportion
Not at all Interested	Female	14	93	0.15
Not at all Interested	Male	3	93	0.03
Not at all Interested	Not Provided	1	93	0.01
Not Provided	Female	1	93	0.01
Not Sure	Female	10	93	0.11
Not Sure	Male	3	93	0.03
Possibly Interested	Female	17	93	0.18
Possibly Interested	Male	5	93	0.05
Possibly Interested	Not Provided	1	93	0.01
Somewhat Interested	Female	20	93	0.22
Somewhat Interested	Male	8	93	0.09
Very Interested	Female	8	93	0.09
Very Interested	Male	2	93	0.02

engineering (2%). We initially expected a larger sample from math majors, and likewise, a moderate to high degree of interest. However, only 4 students who indicated they were math majors responded. This may be due to the fact that the list of UMHB math majors we received was outdated. Table 6 displays the sample-size and proportion of responses in all categories of interest by major Figure 4 displays frequencies of interest in the M.S. degree plan by major.

Table 6: *Number of Students With Interest in a M.S. Degree in Quantitative Psychology by Major*

Interest	Major	n	N	Proportion
Not at all Interested	Chemistry and Geology	1	93	0.01
Not at all Interested	Communication and Media Studies	1	93	0.01
Not at all Interested	Criminal Justice	1	93	0.01
Not at all Interested	Exercise Physiology	1	93	0.01
Not at all Interested	Mathematics	2	93	0.02
Not at all Interested	Music	1	93	0.01
Not at all Interested	Nursing	2	93	0.02
Not at all Interested	Psychology	9	93	0.10
Not Provided	Not Provided	1	93	0.01
Not Sure	Mathematics	2	93	0.02
Not Sure	Nursing	1	93	0.01
Not Sure	Political Science	1	93	0.01
Not Sure	Psychology	9	93	0.10
Possibly Interested	Biology	2	93	0.02
Possibly Interested	Engineering Science	1	93	0.01
Possibly Interested	Nursing	1	93	0.01
Possibly Interested	Political Science	1	93	0.01
Possibly Interested	Psychology	18	93	0.19
Somewhat Interested	Biology	3	93	0.03
Somewhat Interested	Chemistry and Geology	1	93	0.01
Somewhat Interested	Engineering Science	1	93	0.01
Somewhat Interested	Exercise Physiology	1	93	0.01
Somewhat Interested	Nursing	4	93	0.04
Somewhat Interested	Psychology	17	93	0.18
Somewhat Interested	Spanish	1	93	0.01
Very Interested	Biology	1	93	0.01
Very Interested	Education	1	93	0.01
Very Interested	Nursing	1	93	0.01
Very Interested	Psychology	7	93	0.08

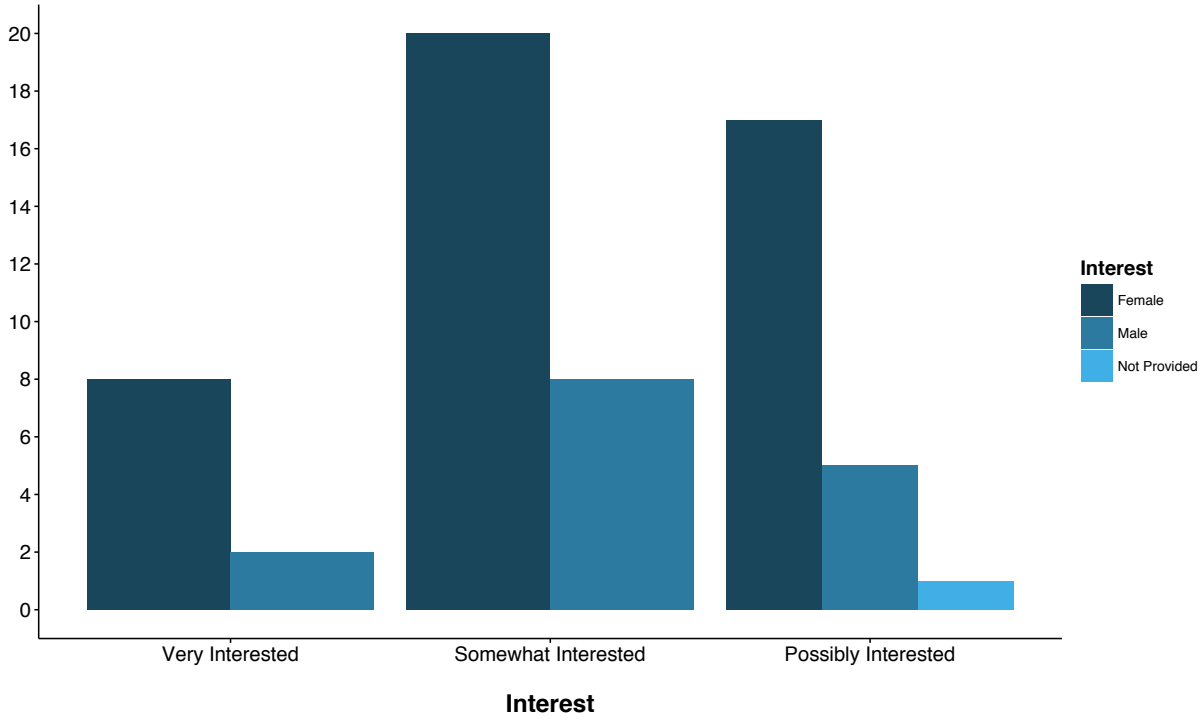

Figure 3: *Student interest in a M.S. degree in quantitative psychology by gender.*

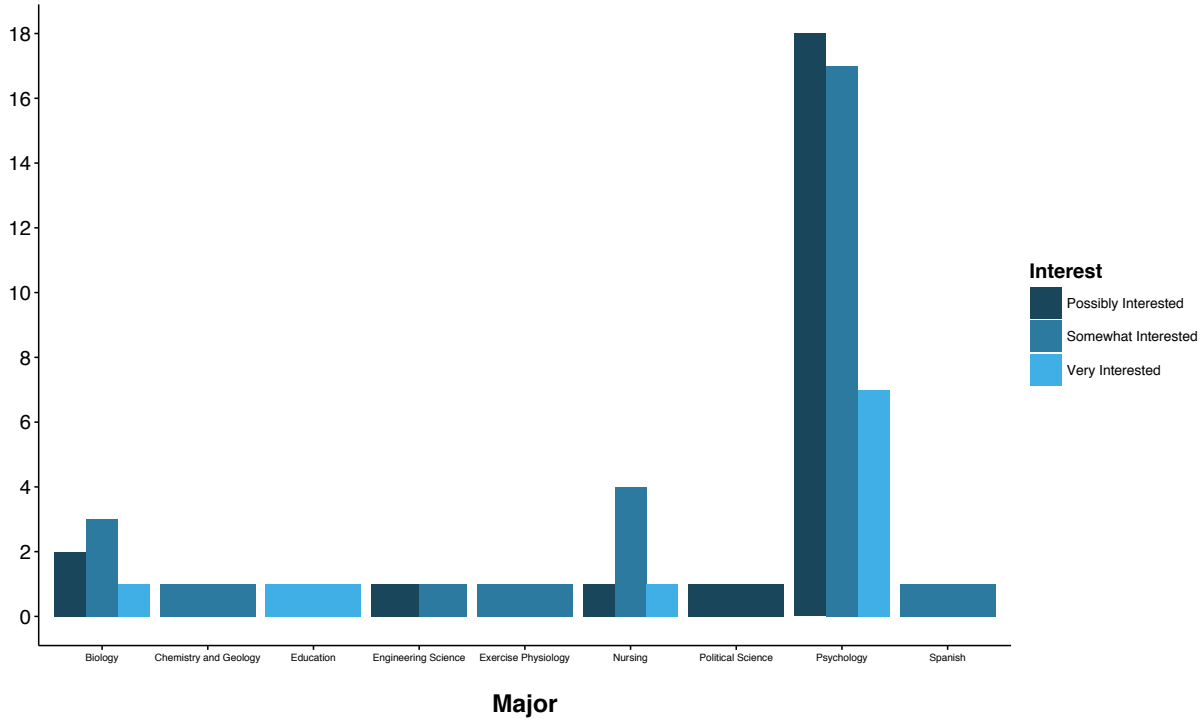

Figure 4: *Student interest in a M.S. degree in quantitative psychology by major.*

6.4 Minor

In addition to student's major, we asked students to indicate their minor, if any. Similar to the results from majors above, 15 psychology minors (16%) indicated they would be at least possbily interested in a graduate program in quantitative psychology at UMHB. Likewise, other minors indicating at least possible interest included students with no minor (27%), sociology (5%), Christian studies (3%), and business (2%). Table 7 displays the sample-size and proportion of responses in all categories of interest by major Figure 5 displays frequencies of interest in the M.S. degree plan by major.

Table 7: *Number of Students With Interest in a M.S. Degree in Quantitative Psychology by Minor*

Interest	Minor	n	N	Proportion
Not at all Interested	Business	1	93	0.01
Not at all Interested	Christian Studies	2	93	0.02
Not at all Interested	Education	2	93	0.02
Not at all Interested	N/A	7	93	0.08
Not at all Interested	Psychology	6	93	0.06
Not Provided	Not Provided	1	93	0.01
Not Sure	Education	2	93	0.02
Not Sure	Exercise Physiology	1	93	0.01
Not Sure	Management	1	93	0.01
Not Sure	Mathematics	1	93	0.01
Not Sure	N/A	5	93	0.05
Not Sure	Psychology	2	93	0.02
Not Sure	Spanish	1	93	0.01
Possibly Interested	Business	2	93	0.02
Possibly Interested	Christian Studies	2	93	0.02
Possibly Interested	Management	1	93	0.01
Possibly Interested	Mathematics	1	93	0.01
Possibly Interested	N/A	9	93	0.10
Possibly Interested	Psychology	4	93	0.04
Possibly Interested	Sociology	4	93	0.04
Somewhat Interested	Art	2	93	0.02
Somewhat Interested	Biology	1	93	0.01
Somewhat Interested	Christian Studies	1	93	0.01
Somewhat Interested	Computer Studies	1	93	0.01
Somewhat Interested	Mathematics	2	93	0.02
Somewhat Interested	N/A	12	93	0.13
Somewhat Interested	Psychology	9	93	0.10
Very Interested	Art	1	93	0.01
Very Interested	Music	1	93	0.01
Very Interested	N/A	4	93	0.04
Very Interested	Not Provided	1	93	0.01
Very Interested	Psychology	2	93	0.02
Very Interested	Sociology	1	93	0.01

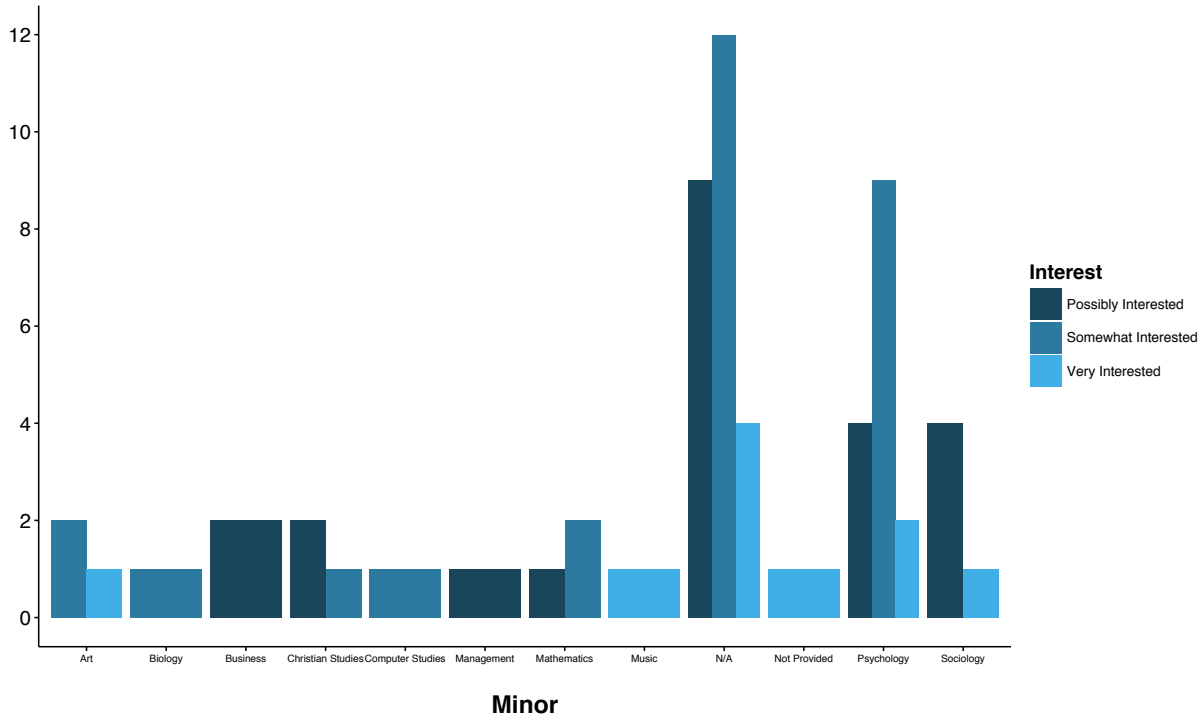

Figure 5: *Student interest in a M.S. degree in quantitative psychology by minor.*

7 Conclusion

Quantitative psychology is an emerging field with growing job opportunities and a limited number of supporting graduate programs in place. Our initial survey of interest given to UMHB students indicates that recruiting an initial cohort solely from our graduates is feasible. If we anticipate similar levels of interest from students at other nearby peer universities (Hardin-Simmons University, Abilene Christian University, Howard Payne University, Dallas Baptist University, etc.) and even larger schools such as Baylor, a program that is sustainable both initially and for the long-haul seems well within reach. Additionally, we are excited by the opportunity to be one of very few schools in the nation that offer this type of training from the perspective of our Christian mission. A recent article (Fung, 2015) in the Harvard Business Review describes the growing problem stemming from a lack of ethical training in those who work with and manipulate large data sets. The author states: "Business managers are missing the real issue: the people who collect, store, manage and process our data are not being held to any ethical standards. The emerging data science discipline is expanding so fast that few workers are thinking about the ethical implications of their everyday actions." We are confident that in addressing this industry need we can create a program that is a valuable UMHB distinctive.

Appendix A

MASTER OF SCIENCE IN PSYCHOLOGY (M.S.)
QUANTITATIVE PSYCHOLOGY

Dr. Aaron R. Baggett, Program Director

Purpose of the Program

In an increasingly data-driven world, psychological scientists are uniquely positioned to lead advances in quantitative analyses of human behavior and decision analytics. Therefore, the University of Mary Hardin-Baylor aspires to be a leader in the field of quantitative psychology on both a regional and national level.

The purpose of the graduate program in Quantitative Psychology is to provide students with advanced knowledge of applied statistics and predictive modeling used in solving complex problems in a myriad of human behavior related decision-making processes. Students who successfully complete the M.S. degree in Quantitative Psychology should enjoy improved competitiveness for admission to doctoral programs in the psychological sciences as well as increased eligibility for a variety of jobs in private and public sectors with quantitative and data science emphases.

CURRICULUM

Psychology Core (12 hours)

Learning and Behavior Theory 3
Social-Organizational Psychology 3
Advanced Personality Psychology 3
Cognitive Psychology 3

Quantitative Concentration (24 hours)

Quantitative Methods I 3
Exploratory Data Analysis 3
Statistical Computing 3
Linear and Multiple Regression Modeling 3
Survey Design and Analysis 3
Quantitative Methods II 3
Generalized Linear Modeling 3
Internship/Practicum in Quantitative Psychology 3

Program Requirements:

1. Bachelor's degree in psychology, or related field, and/or the following courses:
    - 3 hours–Introductory Psychology (or similar)
    - 3 hours–Research Methods (or similar)
    - 3 hours–Introductory Statistics (or similar)
2. 3.0 GPA
3. Interview with Graduate Program Director

Appendix B

COURSE DESCRIPTIONS

PSYC 63XX-01: Learning and Behavior Theory
The purpose of this course is for students to master the major contributions of learning and behavior theory as applied in organizational settings. Particular attention will be paid to human learning and human motivational theory to provide a framework for this psychological study where motivation is treated as a crucial aspect of the learning process. Students are required to design, conduct, report, evaluate, and submit for publication an experiment pertaining to a major theory of human learning and motivation.

PSYC 63XX-01: Social-Organizational Psychology
The purpose of this course is for students to gain knowledge of the use of psychological principles and research methods focusing on interpersonal relationships to solve problems in the workplace and to improve the quality of life. The course is concerned with issues of leadership, job satisfaction, employee motivation, organizational communication, conflict management, organizational change, and group processes within an organization. Students will learn to work as a consultant in a collaborative process to work with leadership and management to plan and develop policies, carry out screening and training sessions, and develop a plan for the future for an organization.

PSYC 63XX-01: Advanced Personality Psychology
This course will closely examine topics related to human personality from the perspectives of contemporary psychological science. Students will be introduced to competing views of human personality and their implications for how psychological science understands the context of human development. Coursework will emphasize reading, discussion, and interacting with the latest scientific and empirical literature related to contemporary psychological perspectives on human personality.

PSYC 63XX-01: Cognitive Psychology
This course will provide an overview of human cognition, including topics related to attention, language, memory, and decision making. Students will be expected to research topics of current relevance in these sub-disciplines, and present findings to classmates as they each play an active role in teaching the course. Upon completion of the course, students will be able to interpret situations and real-world problems through the lens of current cognitive theories and frameworks.

PSYC 63XX-01: Quantitative Methods I
Part 1 of an advanced introduction to the range of general linear modeling methods both researchers and data analysts in quantitative psychology use to test experimental and non-experimental hypotheses. Particular emphasis is placed on one- and two-sample t-tests as well as one-way and factorial analyses of variance.

PSYC 63XX-01: Exploratory Data Analysis
Emphasizes methods and best practices in data management and storage. Students will utilize select R package libraries to clean, manipulate, and summarize data from secondary sources.

PSYC 63XX-01: Statistical Computing
Introduces students to modern and advanced statistical computing techniques. Students will utilize the RStudio IDE to learn and master the R programming language while also developing dynamic scientific reports with embedded source code and results. Students will also learn fundamentals of select R package syntax.

PSYC 63XX-01: Linear and Multiple Regression Modeling
Introduces students to predictive data analysis through the use of linear and multiple regression modeling. Students will model data primarily from secondary sources such as surveys, educational records, and post-hoc experiment data. Particular emphasis is placed on the identification and interpretation of predictor and outcome variables as well as visualizing model results.

PSYC 63XX-01: Survey Design and Analysis
Introduces students to designing, administering, and analyzing data from behavioral and social surveys and questionnaires. Particular emphasis is placed on participant sampling techniques and nonparametric methods of survey data analysis. Course requirements include designing and administering an IRB-approved survey-based research study.

PSYC 63XX-01: Quantitative Methods II
Part 2 of an advanced introduction to the range of general linear modeling methods both researchers and data analysts in quantitative psychology use to test experimental and non-experimental hypotheses. Particular emphasis is placed on methods of experimental design and data analysis including analysis of variance for fixed, mixed, and random models, analysis of covariance, and repeated measures designs.

PSYC 63XX-01: Generalized Linear Modeling
Generalized linear models extend general linear models to include non-continuous outcomes such as binomial and multinomial variables. Students will estimate these models using data primarily from secondary sources such as surveys, educational records, and post-hoc experiment data. Particular emphasis is placed on the identification and interpretation of predictor and outcome variables as well as visualizing model results.

PSYC 63XX-01: Internship/Practicum in Quantitative Psychology
Emphasizes a variety of practical methods employed by quantitative psychologists via a student-arranged supervised internship or practicum. Students will complete a culminating research project or study suitable for publication and/or conference presentation.

Appendix C

COURSE SEQUENCES

Cohort	Semester	Course	Instructor
1	Fall 2017	PSYC 63XX: Learning and Behavior Theory	Staff/Adjunct
		PSYC 63XX: Quantitative Methods I	Baggett
		PSYC 63XX: Statistical Computing	Baggett
1	Spring 2018	PSYC 63XX: Social-Organizational Psychology	Staff/Adjunct
		PSYC 63XX: Exploratory Data Analysis	Baggett
		PSYC 63XX: Linear and Multiple Regression Modeling	Baggett
1	Summer 2018	PSYC 63XX: Advanced Personality Psychology	Staff/Adjunct
		PSYC 63XX: Survey Design and Analysis	Baggett/Adjunct
		PSYC 63XX: Quantitative Methods II	Baggett
1	Fall 2018	PSYC 63XX: Cognitive Psychology	Staff/Adjunct
		PSYC 63XX: Generalized Linear Modeling	Baggett
		PSYC 63XX: Internship in Quantitative Psychology	Baggett
2		PSYC 63XX: Learning and Behavior Theory	Staff/Adjunct
		PSYC 63XX: Quantitative Methods I	Baggett
		PSYC 63XX: Statistical Computing	Baggett

References

Arizona State University [ASU]. (2016) Quantitative curriculum. Retrieved from https://psychology.clas.asu.edu/quantitative-curriculum

Bureau of Labor Statistics, U.S. Department of Labor, Occupational Outlook Handbook, 2014-15 Edition, Statisticians. (January 8, 2014). Retrieved from http://www.bls.gov/ooh/math/statisticians.htm

James Madison University [JMU]. (2016). Quantitative psychology concentration. Retrieved from http://www.jmu.edu/gradcatalog/15/masters/psyc.shtml#QuantitativePsychologyConcentration

University of California, Los Angeles [UCLA]. (2016). Quantitative psychology. Retrieved from https://www.psych.ucla.edu/graduate/areas-of-study/quantitative-psychology

University of Texas at Dallas [JMU]. (2016). Psychological sciences M.S. Retrieved from http://bbs.utdallas.edu/psyscims/#resources

Vanderbilt University [VU]. (2016). Quantitative methods. Retrieved from http://www.vanderbilt.edu/psychological_sciences/graduate/programs/quantitative-methods/

Yarkoni, T. (2012). Psychoinformatics: New horizons at the interface of the psychological and computing sciences. *Current Directions in Psychological Science, 21*(6), 391-397.