

MAR 04 2016

MARYLAND HIGHER EDUCATION COMMISSION
ACADEMIC PROGRAM PROPOSAL

PROPOSAL FOR:

- NEW INSTRUCTIONAL PROGRAM**
- SUBSTANTIAL EXPANSION/MAJOR MODIFICATION**
- COOPERATIVE DEGREE PROGRAM**
- WITHIN EXISTING RESOURCES or** **REQUIRING NEW RESOURCES**

(For each proposed program, attach a separate cover page. For example, two cover pages would accompany a proposal for a degree program and a certificate program.)

Loyola University Maryland

Institution Submitting Proposal

Spring 2017

Projected Implementation Date

Master of Science

Award to be Offered

0702-01

Suggested HEGIS Code

Loyola College of Arts and Sciences

Department of Proposed Program

Data Science

Title of Proposed Program

11.0401

Suggested CIP Code

Dr. Dawn Lawrie

Name of Department Head

Dr. Westley Forsythe

Contact Name

wforsythe@loyola.edu

Contact E-Mail Address

410-617-2317

Contact Phone Number



Signature and Date

President/Chief Executive Approval

2/17/2016

Date

Date Endorsed/Approved by Governing Board

Executive Summary

The Computer Science and Mathematics and Statistics departments propose to offer a Master of Science in Data Science. The program will make use of a blended delivery of courses, but face to face delivery will constitute the majority of every course. The academic content includes data management and data analysis skills needed to collect, manage and analyze an organization's data to create new knowledge.

The Master of Science in Data Science offers students a thorough data science educational experience through a thirty-four-credit program, eleven three-credit courses and one one-credit course. The program includes a Data Science core, which is at the nexus of business, computer science, and statistics. This degree blends computer science and statistics courses to render students adaptable to any domain with rigorous statistical and computational skills. Following the five-course core, there are seven additional courses: two statistics courses; two computer science courses; one elective from business, statistics, or computer science; a one-credit design course for the research project; and a capstone research project conducted with a partner in local industry/government/non-profit. The required statistics courses develop students' modeling skills, and the computer science course exposes the students to machine learning and artificial intelligence.

It is planned to recruit international students to the program beginning in Fall 2021. At that time we expect to also offer the program on the Evergreen campus to take advantage of the campus, foster community, and establish ties to Loyola. This is especially important for international students, so they can both live and learn in proximity to the university with fewer logistical barriers.

A strength of the program is the required two-semester practicum, which could include a summer internship. The practicum is an independent or group project that uses the Data Science techniques acquired during the program in an applied manner to solve a practical problem with a local partner. In the first semester, students design the project and present their plan to the program's board; this could be part of a paid internship. The program director will work to develop opportunities by developing a strong advisory board,

comprised of industry, government, and not-for-profit representatives. In the second semester, students implement their project and present the results of the project to the board for approval. The faculty member in charge of DS796 oversees the projects, receives regular updates, and ensures the students are prepared for presentations.

A. Centrality to mission and planning priorities, relationship to the program emphasis as outlined in the mission statements, and an institutional priority for program development;

One of the fundamental characteristics of a Loyola education is its Jesuit heritage. Jesuit ideals focus on academic excellence and care of the whole person, which will be central to this program. Care of the whole person is demonstrated through student-faculty relationships, mentoring beyond the classroom and course sizes that encourage the development of relationship. Fr. Kolvenbach, former Superior General, declared in 2000, that tomorrow's whole person is one "who is educated in solidarity for the real world."¹ This solidarity is developed through contact rather than concepts. Exposing students to real world situations through partnerships with not-for-profits and industry permits this contact. The Jesuits have always recognized the need to meet students where they are and to adjust to the changing times in which we live. Decree 15th of the 34th meeting of the General Congregation called Jesuits to understand the changes that are occurring² which acknowledges both the advancement of technology and the need for programs such as this that complementarily meet a societal need. The data science curriculum is current, relevant

¹ Kolvenbach, H. (October 8, 2000) Commitment to Justice in Jesuit Higher Education," at Santa Clara University (California),

² GC 34

and meets students where they are by providing a curriculum that is diverse and permits practical application of learned concepts through a capstone practicum that transfers the classroom skills to the marketplace.

Recent job forecasting numbers indicate that the need for data scientists has risen from 6,000 jobs in 2013 to 7,500 jobs in 2015, in the Baltimore region alone there are at least 50 companies seeking data scientists.³

The program also complements the university's last strategic plan, which states

Great Catholic universities transform their diverse external communities through graduate programs that inspire students to create a more just world. In addition, we recognize that in today's world, a graduate degree is often required for entry into many professions. Inspired by many of the same principles that shape our undergraduate programs, including academic excellence, inquiry and diversity, our graduate programs will focus on providing already accomplished students with the means to apply their skills and experiences to greater intellectual and professional challenges. We seek to prepare our graduate students for lives of meaningful professional service and leadership. We will also capitalize on potential benefits to both undergraduate and graduate students in terms of research opportunities, mentoring, and networking that are unique to comprehensive institutions⁴.

Conscious of the Jesuit commitment to social justice the program will develop partnerships with not-for-profits enterprises and with industry that can have an impact upon issues of social justice and so engendering within the program's graduates an appreciation of regional and national issues of social justice and how their education could positively affect those issues.

Consequently, the M.S. in Data Science curriculum is one that is problem-based, grounded in ethical decision-making, and focused on making the world a better place. It uniquely equips the graduates of the Data Science masters as leaders in their respective

³ Personal communication October 27, 2015

⁴ *Grounded in Tradition Educating for the Future* 2008-2013
<http://www.loyola.edu/department/strategicplan>

fields. The proposed twelve course, thirty-four credit curriculum in Data Science is a rigorous applied program, integrating knowledge from three disciplines: computer science, statistics, and business, helping prosecute Loyola's vision of becoming a leading national liberal arts university. The broad knowledge and transferable skills coupled with a strong sense of values, ethics, clear communication skills, and high student-faculty engagement, typical of a liberally educated student, are evident in the Data Science Master's program. The program integrates Ethics as a fundamental tenet of several courses, reflecting one of the program's primary learning aims, and buttressed by students' participation in practicum experiences where they partner with local businesses, industry and not-for-profits. Additionally, Decree 17 of the 34th General Congregation for the Society of Jesus (the Jesuits), calls for interdisciplinary work to inform new perspectives and new areas of research.⁵ This interdisciplinary program answers that call.

B. Critical and compelling regional or Statewide need as identified in the State Plan;

Goal five of the State Plan entitled 'Economic growth and vitality' extolls 'the importance of collaborative data collection and reporting efforts among education, businesses, and government should continue to be fostered, reinforced, and improved. Reliable and timely data will allow postsecondary institutions, the State, and employers to anticipate and respond to student and workforce needs.'⁶ Graduates who will work as data managers and analysts will contribute to this goal in all relevant sectors.

⁵ General Congregation 34 Decree 17 (1995)
http://www.sjweb.info/documents/education/CG34_D17_ENG.pdf

⁶ Maryland Higher Education Commission, *Maryland Ready: State plan for postsecondary education, 2013-17*, (Baltimore, 2014), p. 55.

Additionally, the State Plan places a general emphasis upon the importance of Science, Technology, Engineering, and Mathematics (STEM) graduates in developing a prosperous economy that can help address many contemporary and anticipated societal challenges.⁷ This program, being a STEM program, axiomatically will contribute to this public policy objective.

⁷ *Ibid., Passim.*

C. Quantifiable and reliable evidence and documentation of market supply and demand in the region and service area;

Market supply

Table 1: Annual enrollments in Maryland programs with the following Classification of Instructional Program (CIP) codes, 52.1301 Management Science, 52.1302 Business Statistics, 52.1304 Actuarial Science, and 11.0401 Information Science⁸

School Name	Award Level	Program Name	CIP	Add/Dis/Mov/Red	2010	2011	2012	2013	2014
Bowie State University	Post Baccalaureate Certificate	Information Systems Analyst	110401	Approved In 1984	0	0	2	2	2
Coppin State University	Bachelors	Management Information Systems	110401	Approved In 2012	0	0	7	17	17
Frostburg State University	Bachelors	Computer Information Systems	110401	Approved In 2009	2	9	16	23	26
Salisbury University	Bachelors	Information Systems	110401	Approved In 1990	108	135	149	160	137
Towson University	Bachelors	Information Systems	110401	Approved In 1996	256	206	174	192	168
Towson University	Bachelors	Information Technology (Btps)	110401	Discontinued In 2010	10	4	2	1	0

⁸ Maryland Higher Education Commission, *Trends Data*, (2014). Retrieved on October 20, 2015 from https://data.mhec.state.md.us/mac_Trend.asp

School Name	Award Level	Program Name	CIP	Add/Dis/Mov/Red	2010	2011	2012	2013	2014
Towson University	Masters	Applied Information Technology	110401	Approved In 1999	254	319	325	266	263
Towson University	Doctorate(Research & Scholarship)	Information Technology	110401	Redesignated App2004	69	70	63	62	66
University Of Baltimore	Bachelors	Applied Information Technology	110401	Approved In 1999	105	112	96	82	84
Univ. Of Md, Baltimore County	Bachelors	Information Systems Management	110401	Approved In 1979	542	556	603	628	646
Univ. Of Md, Baltimore County	Masters	Information Systems	110401	Approved In 1987	315	272	320	338	348
Univ. Of Md, Baltimore County	Masters	Human Centered Computing	110401	Approved In 2006	41	38	41	45	38
Univ. Of Md, Baltimore County	Doctorate(Research & Scholarship)	Information Systems	110401	Redesignated App1987	50	46	56	48	53
Univ. Of Md, Baltimore County	Doctorate(Research & Scholarship)	Human Centered Computing	110401	Redesignated App2006	10	17	21	18	19
Univ. Of Md, College Park	Bachelors	Operations Management	521301	Approved In 1997	86	75	54	38	33
Univ. Of Md, College Park	Bachelors	Information Systems	110401	Approved In 2003	83	95	112	121	123
Univ. Of Md, College Park	Masters	Information Management	110401	Approved In 2003	100	74	78	142	165

School Name	Award Level	Program Name	CIP	Add/Dis/Mov/Red	2010	2011	2012	2013	2014
Univ. Of Md University College	Upper Division Certificate	Computer Networking	110401	Approved In 2006	39	50	80	60	81
Univ. Of Md University College	Upper Division Certificate	Management	521301	Approved In 2000	0	1	3	6	13
Univ. Of Md University College	Bachelors	Information Systems Management	110401	Approved In 2000	961	915	924	794	1038
Univ. Of Md University College	Bachelors	Computer Networks & Security	110401	Approved In 2000	1239	1359	1580	1876	2321
Univ. Of Md University College	Post Baccalaureate Certificate	Foundations In Business Analytics	521302	Approved In 2013	0	0	0	0	10
Univ. Of Md University College	Post Baccalaureate Certificate	Predictive Analytics	521302	Approved In 2013	0	0	0	2	13
Univ. Of Md University College	Post Baccalaureate Certificate	Informatics	110401	Approved In 2000	16	13	13	11	12
Univ. Of Md University College	Post Baccalaureate Certificate	Leadership And Management	521301	Approved In 2000	56	39	45	51	45
Univ. Of Md University College	Post Baccalaureate Certificate	Database Systems Technology	110401	Approved In 2003	20	18	18	20	20
Univ. Of Md University College	Post Baccalaureate Certificate	Information Assurance	110401	Approved In 2003	79	52	34	39	29
Univ. Of Md University College	Post Baccalaureate Certificate	Foundations Of Information Technolo	110401	Approved In 2003	13	17	15	8	15

School Name	Award Level	Program Name	CIP	Add/Dis/Mov/Red	2010	2011	2012	2013	2014
Univ. Of Md University College	Masters	Data Analytics	521302	Approved In 2013	0	0	0	45	193
Univ. Of Md University College	Masters	Health Informatics Administration	110401	Approved In 2005	167	182	155	166	194
Univ. Of Md University College	Masters	Information Technology	110401	Approved In 2000	2012	1879	1779	1518	1483
Morgan State University	Bachelors	Actuarial Science	521304	Approved In 2008	14	21	21	24	20
Morgan State University	Bachelors	Information Systems	110401	Approved In 1983	75	94	99	101	114
Capitol Technology University	Post Baccalaureate Certificate	Client-Server & Wireless Devices	110401	Approved In 2001	0	0	0	0	0
Capitol Technology University	Masters	Electronic Commerce	110401	Approved In 1999	0	0	0	0	0
Capitol Technology University	Masters	Internet Engineering	110401	Approved In 2001	9	8	9	12	12
Hood College	Post Baccalaureate Certificate	Geographic Information Systems	110401	Approved In 2013	0	0	0	1	1
Johns Hopkins University	Post Baccalaureate Certificate	Geographic Information Systems	110401	Approved In 2008	14	11	18	12	4
Johns Hopkins University	Post Baccalaureate Certificate	Information Systems Engineering	110401	Approved In 2010	1	1	1	2	0

School Name	Award Level	Program Name	CIP	Add/Dis/Mov/Red	2010	2011	2012	2013	2014
Johns Hopkins University	Post Baccalaureate Certificate	Information Security Management	110401	Discontinued In 2000	5	1	0	0	0
Johns Hopkins University	Masters	Geographic Information Systems	110401	Approved In 2012	0	0	0	18	38
Johns Hopkins University	Masters	Information Systems Engineering	110401	Approved In 1996	187	123	120	102	123
Notre Dame Of Maryland University	Bachelors	Computer Information Systems	110401	Approved In 1986	10	12	13	6	8
Notre Dame Of Maryland University	Masters	Analytics In Knowledge Management	110401	Approved In 2011	0	0	5	8	2
Sojourner-Douglass College	Bachelors	Information Systems Administration	110401	Approved In 2006	15	6	10	6	0
Stevenson University	Bachelors	Business Information Systems	110401	Approved In 2002	67	53	58	57	50
Stevenson University	Masters	Business And Technology Management	110401	Approved In 2001	68	104	116	125	159
Washington Adventist University	Bachelors	Information Systems	110401	Approved In 1994	12	14	11	7	16
Total annual enrollments					7,110	7,001	7,246	7,260	8,202

Table 2: Annual graduations from Maryland programs with the following Classification of Instructional Program (CIP) codes, 52.1301 Management Science, 52.1302 Business Statistics, 52.1304 Actuarial Science, and 11.0401 Information Science⁹

School Name	Award Level	Program Name	CIP	Add/Discontinue	2010	2011	2012	2013	2014
Bowie State University	Post Baccalaureate Certificate	Geo. Info. Systems & Image Processi	110401	Approved In 1998	0	0	0	0	0
Bowie State University	Post Baccalaureate Certificate	Information Systems Analyst	110401	Approved In 1984	0	0	0	0	0
Coppin State University	Bachelors	Management Information Systems	110401	Approved In 2012	0	0	0	0	2
Frostburg State University	Bachelors	Computer Information Systems	110401	Approved In 2009	0	0	0	3	5
Frostburg State University	Bachelors	Actuarial Science	521304	Discontinued In 2005	0	0	0	0	0
Salisbury University	Bachelors	Information Systems	110401	Approved In 1990	26	35	54	64	64
Towson University	Bachelors	Information Systems	110401	Approved In 1996	53	79	72	39	54
Towson University	Bachelors	Information Technology (Btps)	110401	Discontinued In 2010	5	6	3	0	0

⁹ Ibid.

School Name	Award Level	Program Name	CIP	Add/Discontinue	2010	2011	2012	2013	2014
Towson University	Masters	Applied Information Technology	110401	Approved In 1999	71	64	89	99	105
Towson University	Doctorate (Prior To 2009)	Applied Information Technology	110401	Moved In 2009	0	0	0	0	0
Towson University	Doctorate(Research/Scholarship)	Information Technology	110401	Redesignated App-04	8	4	4	10	7
University Of Baltimore	Bachelors	Applied Information Technology	110401	Approved In 1999	17	18	22	25	19
Univ. Of Md, Baltimore County	Upper Division Certificate	Decision Making Support	110401	Approved In 2005	7	4	0	0	0
Univ. Of Md, Baltimore County	Upper Division Certificate	Network Administration	110401	Approved In 2005	19	41	37	43	45
Univ. Of Md, Baltimore County	Upper Division Certificate	Web Management	110401	Approved In 2005	23	22	26	30	23
Univ. Of Md, Baltimore County	Upper Division Certificate	ect Mngmnt For rmation Tchn	110401	Approved In 2008	0	0	0	0	0
Univ. Of Md, Baltimore County	Bachelors	Information Systems Management	110401	Approved In 1979	124	144	147	147	167
Univ. Of Md, Baltimore County	Masters	Information Systems	110401	Approved In 1987	85	118	117	94	93
Univ. Of Md, Baltimore County	Masters	Human Centered Computing	110401	Approved In 2006	5	6	18	10	20

School Name	Award Level	Program Name	CIP	Add/Discontinue	2010	2011	2012	2013	2014
Univ. Of Md, Baltimore County	Doctorate(Research/Scholarship)	Information Systems	110401	Redesignated App-87	8	7	6	4	6
Univ. Of Md, Baltimore County	Doctorate(Research/Scholarship)	Human Centered Computing	110401	Redesignated App-06	0	0	0	0	2
Univ. Of Md, College Park	Bachelors	Operations Management	521301	Approved In 1997	38	47	50	35	28
Univ. Of Md, College Park	Bachelors	Information Systems	110401	Approved In 2003	35	72	75	76	87
Univ. Of Md, College Park	Masters	Information Management	110401	Approved In 2003	70	61	32	29	43
Univ. Of Md University College	Upper Division Certificate	Computer Networking	110401	Approved In 2006	22	41	35	37	55
Univ. Of Md University College	Upper Division Certificate	General Management Studies	521301	Discontinued In 2012	1	0	1	0	1
Univ. Of Md University College	Upper Division Certificate	Management	521301	Approved In 2000	0	4	6	6	5
Univ. Of Md University College	Bachelors	Information Systems Management	110401	Approved In 2000	183	208	190	189	174
Univ. Of Md University College	Bachelors	Computer Networks & Security	110401	Approved In 2000	114	150	201	239	300
Univ. Of Md University College	Post Baccalaureate Certificate	Informatics	110401	Approved In 2000	6	9	7	5	11

School Name	Award Level	Program Name	CIP	Add/Discontinue	2010	2011	2012	2013	2014
Univ. Of Md University College	Post Baccalaureate Certificate	Leadership And Management	521301	Approved In 2000	26	47	66	65	43
Univ. Of Md University College	Post Baccalaureate Certificate	Database Systems Technology	110401	Approved In 2003	3	13	9	12	3
Univ. Of Md University College	Post Baccalaureate Certificate	Information Assurance	110401	Approved In 2003	27	53	47	30	28
Univ. Of Md University College	Post Baccalaureate Certificate	Foundations Of Information Technolo	110401	Approved In 2003	12	32	30	28	28
Univ. Of Md University College	Masters	Health Informatics Administration	110401	Approved In 2005	9	23	30	30	33
Univ. Of Md University College	Masters	Information Technology	110401	Approved In 2000	223	409	442	482	396
Morgan State University	Bachelors	Actuarial Science	521304	Approved In 2008	0	0	1	2	7
Morgan State University	Bachelors	Information Systems	110401	Approved In 1983	12	9	14	14	14
Capitol Technology University	Post Baccalaureate Certificate	Electronic Commerce Mgt.	110401	Discontinued In 2010	0	0	0	0	0
Capitol Technology University	Post Baccalaureate Certificate	Component Tech & Online Collaborati	110401	Approved In 2001	0	0	0	0	0
Capitol Technology University	Post Baccalaureate Certificate	Client-Server & Wireless Devices	110401	Approved In 2001	0	0	0	0	0

School Name	Award Level	Program Name	CIP	Add/Discontinue	2010	2011	2012	2013	2014
Capitol Technology University	Masters	Electronic Commerce	110401	Approved In 1999	0	0	0	0	0
Capitol Technology University	Masters	Internet Engineering	110401	Approved In 2001	3	3	1	2	4
Hood College	Post Baccalaureate Certificate	Geographic Information Systems	110401	Approved In 2013	0	0	0	0	5
Johns Hopkins University	Bachelors	Information Systems	110401	Discontinued In 2000	10	9	2	0	1
Johns Hopkins University	Post Baccalaureate Certificate	Geographic Information Systems	110401	Approved In 2008	0	4	4	4	6
Johns Hopkins University	Post Baccalaureate Certificate	Information Systems Engineering	110401	Approved In 2010	3	0	0	0	1
Johns Hopkins University	Post Baccalaureate Certificate	Information Security Management	110401	Discontinued In 2000	3	5	2	1	1
Johns Hopkins University	Masters	Geographic Information Systems	110401	Approved In 2012	0	0	0	0	2
Johns Hopkins University	Masters	Information Systems Engineering	110401	Approved In 1996	37	65	51	33	33
Johns Hopkins University	Post Masters Certificate	Information Systems Engineering	110401	Approved In 2010	0	3	1	0	4
Kaplan College	Bachelors	Information Technology	110401	Discontinued In 2009	0	0	0	0	0

School Name	Award Level	Program Name	CIP	Add/Discontinue	2010	2011	2012	2013	2014
Notre Dame Of Maryland University	Bachelors	Computer Information Systems	110401	Approved In 1986	9	1	2	3	3
Notre Dame Of Maryland University	Masters	Analytics In Knowledge Management	110401	Approved In 2011	0	0	0	0	2
Sojourner-Douglass College	Bachelors	Information Systems Administration	110401	Approved In 2006	0	0	0	0	0
Stevenson University	Bachelors	Business Information Systems	110401	Approved In 2002	12	19	16	11	21
Stevenson University	Masters	Business And Technology Management	110401	Approved In 2001	20	18	25	38	48
Washington Adventist University	Bachelors	Information Systems	110401	Approved In 1994	4	4	6	5	1
Total annual graduations					1,220	1,717	1,817	1,833	1,854

Market demand

Table 3: Department of Labor, Licensing, and Regulation, employment projections 2012-2022¹⁰

Occ Code	Occupational Title	Employment		Change			Education Value
		2012	2022	Change	Replacement	Total	
15-2011	Actuaries	295	315	20	84	104	Bachelor's degree
25-1011	Business Teachers, Postsecondary	1,785	2,044	259	268	527	Doctoral or professional degree
11-1011	Chief Executives	3,428	3,515	87	730	817	Bachelor's degree
15-1111	Computer and Information Research Scientists	3,492	4,099	607	549	1,156	Doctoral or professional degree

¹⁰ Maryland Department of Labor, Licensing, and Regulation, *Occupational projections, 2012-2022*. Retrieved on October 20, 2015 from <http://www.dlir.state.md.us/lmi/iandoproj/>

Occ Code	Occupational Title	Employment		Change			Education Value
		2012	2022	Change	Replacement	Total	
11-3021	Computer and Information Systems Managers	10,671	12,245	1,574	1,483	3,057	Bachelor's degree
15-1199	Computer Occupations, All Other	14,195	14,113	-82	2,231	2,231	Bachelor's degree
25-1021	Computer Science Teachers, Postsecondary	592	667	75	89	164	Doctoral or professional degree
11-1021	General and Operations Managers	50,595	54,798	4,203	9,465	13,668	Bachelor's degree
13-2053	Insurance Underwriters	1,652	1,367	-285	448	448	Bachelor's degree
25-1022	Mathematical Science Teachers, Postsecondary	833	927	94	125	219	Doctoral or professional degree

Occ Code	Occupational Title	Employment		Change			Education Value
		2012	2022	Change	Replacement	Total	
15-2031	Operations Research Analysts	2,850	3,577	727	641	1,368	Bachelor's degree
15-1133	Software Developers, Systems Software	14,020	17,124	3,104	1,797	4,901	Bachelor's degree
15-2041	Statisticians	3,166	3,730	564	1,003	1,567	Master's degree
19-3022	Survey Researchers	1,013	1,169	156	139	295	Master's degree
Employment projections total		108,587	119,690	11,103	19,052	30,522	

Table 2 above demonstrates that in 2014 Maryland institutions educated 1,854 individuals from programs with the CIP code 52.13 ('Management Sciences and Quantitative Methods'), and 11.0401 Information Science) denoting that they completed programs taxonomically similar to that recommended in this proposal.

Meanwhile Table 3, reflects the potential Maryland employment demand for graduates of these programs. These projections reflect a cross-referencing of the program's general taxonomical category with corresponding Maryland Department of Labor, Licensing, and Regulation employment projections. These employment projections indicate that Maryland has an average annual employment need of 3,052 for positions that graduates of the M.S. in Data Science could fulfil. While consideration of workforce demand should accommodate other programs that might fulfil this needs of these occupations, it does indicate a very healthy marketplace into which graduates will pursue a career.

Additionally, number of companies seeking employees with data science skills grew from 6,000 in December 2013 to 7,500 in January 2015. Locally, there is a need to support the business and governmental sectors. Recently, fifty companies were identified in the region seeking to hire data scientists.¹¹

The program also plans to recruit international students from China, India, the Middle East, and elsewhere, to create a thriving program with sufficient students. Given the employment needs and the wide draw of students, the outlook for this degree is promising. In fact five program are available in Chicago, and all are thriving.¹² In this area, UMUC offers the closest program. It has about 200 students in its online master's program and is still growing.¹³

¹¹ *Data Science Central*, retrieved on October 20, 2015 from <https://www.datasciencecentral.com/profiles/blog/list?month=01&year=2015>

¹² Faculty consultations with peers throughout Summer 2015.

¹³ Maryland Higher Education Commission, *Trend Data*, retrieved on October 20, 2015 from <http://data.mhec.state.md.us/macAux.asp#api>

D. Reasonableness of program duplication, if any;

Table 1 above identifies all those programs with a CIP code analogous to Loyola's proposed M.S. in Data Science; the broad and inter-disciplinary nature of the area identifies a large number of programs offered in Maryland, with the following CIP codes: 52.1301 Management Science; 52.1302 Business Statistics; 52.1304 Actuarial Science; and 11.0401 Information Science. Loyola's proposed M.S. in Data Science is an inter-disciplinary program representing a blend of the taxonomical description and is a collaboration between three departments and two schools. This feature alone engenders a very distinct and arguably unique program.

Additionally, this program, being a graduate program, is orientated to established professionals in numerous fields across the entire economy, both nationally and internationally. Consequently, any duplication analysis is more appropriately confined to other Master's programs, of which there are thirteen in Maryland. Many of these are obviously non-duplicative of Loyola's proposed program, being much more concerned with subjects like Geographic Information Systems, e-commerce, and health information. The programs most analogous to Loyola's are UMUC's M.S. Information Technology¹⁴, UMUC's M.S. in Data Analytics, and UMBC's M.S. Information Systems.¹⁵ It is obvious from UMUC's Information Systems curriculum and its variety of 'specializations' that the program is orientated toward I.T. professionals and those with a strong computer science background, differing from this proposal's focus on the use of 'big-data' in a business environment, including an emphasis on analysis of 'big-data' to inform operational and strategic considerations.

UMBC's program is perhaps more broadly orientated than UMUC's but also does not have a 'big-data' focus but rather concentrates on the development and use of network systems and associated architecture, including website construction and design, rather than the application of 'big-data' in a business context.

¹⁴ UMUC's M.S. in Information Technology curriculum retrieved on October 19, 2015 from <http://www.umuc.edu/academic-programs/masters-degrees/information-technology.cfm>

¹⁵ UMBC's M.S. in Information Systems curriculum retrieved on October 19, 2015 from <http://onlinems.umbc.edu/admissions/degree-requirements/>

The program most analogous to Loyola's proposed M.S. in Data Science is UMUC's M.S. in Data Analytics that according to Maryland Higher Education Commission data, had 193 enrollees in 2014, following MHEC approval in 2013.¹⁶ However, given the robust demand for graduates in this emerging area there is ample scope for an additional program in this arena.

E. Relevance to the implementation or maintenance of high-demand programs at HBIs;

According to an analysis of MHEC trend data, no Historically Black College or University offers a Master's program in data analytics or information systems.

F. Relevance to the support of the uniqueness and institutional identities and missions of HBIs;

At this time, Loyola does not envisage this program having an impact upon the uniqueness or institutional identity and mission of a Historically Black College or University, although it notes the existence of Morgan State's Bachelor degree in Information Systems.

¹⁶ Maryland Higher Education Commission, *Trends Data*, retrieved on October 19, 2015 from <http://data.mhec.state.md.us/macAux.asp#api>

G. Adequacy of curriculum design and delivery to related learning outcomes consistent with Regulation .10 of this chapter;

Data Science involves extracting information or learning from data to generative predictive scenarios of the future. Methods include combining multiple sources of data, applying artificial intelligence and machine learning techniques, and modeling data using statistical methods. After earning a master's degree, the student will be qualified to work in industry and government where their skills will help support decision-making.

LEARNING AIMS

- Students will understand the underlying principles of data science and be able to keep up with this expanding field.
- Students will be proficient in analyzing complex data from diverse sources by discovering key relationships within the data.
- Students will be able to model data using machine learning techniques.
- Students will be able to model data using statistical models.
- Students will be able to predict future outcomes that can be used to advise decision makers on their course of action.

PROGRAM PREREQUISITES:

A student is expected to have mathematical maturity (to be judged by the admissions committee), and have had an introduction to computer science/programming. The programming prerequisite can be satisfied by taking an online programming course such as Code Academy's Python Course. This will likely be followed by an exam to assure sufficient proficiency.

DEGREE REQUIREMENTS

The thirty-four credit program consists of twelve courses. The requirements include:

- five core courses in business, statistics, and computer science.
- two statistics courses;
- two computer science courses;
- an elective from statistics, computer science, or business;
- a one-credit capstone design course; and
- a technical capstone project.

For the required statistics and computer science courses, one course is prescribed while the other is an elective.

Table 4: Curriculum outline

Course code	Course name	Credit total
Core requirements, all five courses		
CS703	Programming for Data Science	3
ST710	Statistical Computing	3
GB730	Business Analytics and Strategic Decision Making	3
GB731	Foundations of Data Analytics	3
GB851	Business Intelligence and Data Mining	3
Additional requirements		
CS737	Machine Learning and one additional computer science elective from the list below.	(3crs x 2)
CS7XX		6
ST765	Linear Statistical Models and one additional statistics elective from the list below.	(3crs x 2)
ST7XX		6
DS795	Data Science Project Design	1
DS796	Data Science Project	3
One additional elective from either Computer Science, Business, or Statistics as listed below		3
Total program credits		34

Computer Science Elective Courses

CS745 Multimedia data analysis and mining

CS746 Data Visualization

CS750 Special Topics in Computer Science

CS751 Independent Study

CS752 Parallel Computing

CS753 Big Data

CS761 Modeling and Simulation

CS765 Database Retrieval

CS766 Information Retrieval and Natural Language Processing

Statistics Elective Courses

ST767 Multivariate Analysis

ST775 Generalized Linear Models and Multilevel Models

ST776 Bayesian Inference

ST777 Numerical Analysis for Statisticians

ST781 Operations Research

ST791 Special Topics in Statistics

ST792 Independent Study

Business Elective Courses

GB701 Operations Management and Process Strategies

GB705 Leadership and Management

GB732 Data Management and Governance

GB733 Enterprise Systems

GB736 Data Visualization for Decision Making

GB852 Advanced Analytics

GB853 Social Media and Web Mining

GB735 Project Management

This interdisciplinary degree is mainly taught by the departments of Computer Science and Mathematics and Statistics. In addition, three or four courses are taught by Sellinger School of Business and Management departments.

It is anticipated that this program will enroll a significant number of international students beginning in Fall 2021 to complement local students. Consequently, the curriculum facilitates the completion of the program in two years, where students take two courses per semester and a summer course. In addition a fifteen month full-time schedule is also possible, which begins in the spring term and concludes the following spring. To support both offerings, Table 5 lists the courses that would be offered in the first, second, and subsequent years of the program, assuming that international students join in the spring of the second year of the program.

Table 5: Projected courses to be offered to support the program in the first, second, and subsequent years of the program.

Calendar in program's initial year (Domestic students only)		Calendar in program's initial year (Domestic enrollment)			Anticipated calendar beyond the program's second year		
Spring 2017	Summer	Fall	Spring 2018	Summer	Fall	Spring 2019	Summer
Statistics (ST)710	ST710	Computer Science (CS)703	ST710	CS elective	CS703	ST710	CS elective
		ST765	CS737		CS737	CS elective	ST710
			ST elective	<i>(Data Science (DS)795)¹⁷</i>	ST765	ST elective	DS796
					DS795	DS796	
					DS796		
					<i>CS or ST elective</i>		GB851
General Business (GB)730	GB851	GB730	GB851	GB elective	GB730	GB851	ST elective
GB731 ¹⁸		GB731	GB elective		GB731		

¹⁷ Courses in italics will be offered to support the initial spring cohort but will not be offered in those semesters in perpetuity.

¹⁸ GB 731 will be waived by the program director for those with sufficient statistics background.

COURSE DESCRIPTIONS

DS795 Data Science Project Design

This project is spread over two semesters. Students must register for DS795/DS796 for the Fall and Spring semesters (from September to May) or for the Summer and Fall semesters (from June to December).

Prerequisite: All required core courses completed. (CS703, ST710, GB851)

Co-requisite: Required computer science and statistics courses. (CS737, ST765)

Students must pursue an independent or small group research project that uses Data Science methods acquired during the program to address a real problem. This one-credit design course requires that students identify a suitable project including the data that will be used and the questions that will be asked of the data. The problem statement and the data stem from real-world situations similar to those that students might encounter within industry, government, non-profit, or academic research. Depending upon a project's complexity, students may work individually or in small approved teams. The problem is usually specified by an industry, governmental, or non-profit sponsor with the data sets provided by the sponsor. Academic and governmental research groups may also propose projects. Each project team will be supervised by the course director (in some cases with a relevant faculty advisor) and advised by the project coach assigned from the academic, governmental, or industry sponsor, generally representing the organization that supplied the data. The design of the project will be reviewed by the course director and either the program board or, in the case of confidential data, the project will be reviewed by the course director after signing a confidentiality agreement is signed and a group internal to the organization.

DS796 Data Science Project

Prerequisite: DS795

Students will complete the independent or small group research project proposed in DS795. Students will present their work at an end-of-semester symposium. Within the project, students use the complete process of addressing a real data science project: from collecting and processing the data, to applying an appropriate method to the problem, to reporting on the problem and its solution. Each project team will be supervised by the course director (in some cases with a relevant

faculty advisor) and advised by the project coach assigned from the academic, governmental, or industry sponsor.

ST710 Statistical Computing

Prerequisite: GB731 (may be waived by program director).

An introduction to statistical programming using SAS and R. As a vehicle for introducing statistical computing, the course reviews a number of statistics topics. Both SAS and R will be used for graphical and statistical analysis of data. In addition, topics in SAS include data management, manipulation, cleaning, macros, and matrix computations. Topics in R include data frames, functions, objects, flow control, input and output, matrix computations, and the use of R packages. The course will include an introduction to the resampling and bootstrap approaches to statistical inference. Statistics topics include: graphical and numerical descriptive statistics, probability distributions, one and two sample tests and confidence intervals, simple and multiple linear regression, and chi-square tests. *Required of all students as one of the four core courses. This must be the first Statistics course taken as SAS and/or R will be used in all following statistics courses.*

ST765 Linear Statistical Models:

Prerequisite: ST710.

Review of simple and multiple regression. Logistic regression and non-linear regression. Analysis of variance, analysis of covariance, factorial and fractional factorial designs. Coverage includes interactions, blocking, replication, nesting, and repeated measures. Each topic will include model diagnostics. *Required of all students.*

STATISTICS ELECTIVES:

ST767 Multivariate Analysis

Prerequisite: ST710.

This course develops methodologies to the analysis of multivariate data. Topics include: multivariate normal distributions, principal components analysis, factor analysis, cluster analysis,

discriminant analysis, Hotelling's T^2 , multivariate regression, and multivariate analysis of variance.

ST775 Generalized Linear Models and Multilevel Models

Prerequisite: ST765.

This course extends and generalizes methods introduced in ST765 by introducing generalized linear models (GLMs) and correlated data methods. GLMs cover logistic and Poisson regression, and more. Correlated data methods include longitudinal data analysis and multi-level models.

ST776 Bayesian Inference

Prerequisite: ST765.

Course provides an introduction to Bayesian methods with an emphasis on modeling and applications. Likelihood function of parameters, choices of models, Bayes' Theorem, subjective basis for probability, prior and posterior distributions. Binomial, Poisson, exponential, and normal populations, comparison of two normal distributions, and Bayesian linear regression. Bayesian estimation and testing, predictive distributions, assessment of model assumptions, robustness of inference, hierarchical Bayesian models. Markov Chain Monte Carlo (MCMC) approaches to fitting Bayesian models.

ST777 Numerical Analysis for Statisticians

Prerequisite: CS703, ST765.

Every advancement in computer technology results in statisticians working on more challenging numerical problems. In order to handle these problems, a strong foundation in numerical analysis is necessary. This course will teach students to evaluate different algorithms that are associated with statistical problems and be able to evaluate the advantages and disadvantages of each algorithm. Issues of specific concern will deal with numerical stability, accuracy, and efficiency of algorithms dealing with linear and nonlinear equations, eigen problems, interpolation and quadrature.

ST781 Operations Research

Prerequisite: ST710.

Linear, nonlinear, and integer programming. Formulation of problems. Duality theory and solvability. The simplex method and related methods for efficient computer solution. Sensitivity analysis. Applications and extensions, such as network flows, game theory, economic models, and quadratic programming.

ST791 Special Topics in Statistics

Prerequisite: Varies with topic. An on-demand course for a current topic. *May be repeated for credit.*

ST792 Independent Study

Students must submit a written proposal to a member of the faculty of the statistics program prior to the last day of class registration. Proposed topics, which are normally discussed in advance with the professor, should permit study and/or data analysis in considerable depth beyond the scope of a course offered in the curriculum.

COMPUTER SCIENCE COURSES

CS703 Programming for Data Science

Prerequisite: A prior Introductory Programming Course (Required of all students)

This course will blend methods of organizing data with algorithms for extracting and manipulating data from very large data sets to enable students to prepare data and generate features for unstructured text. Data structures such as hashing, trees, queues, lists, priority queues, and graphs will be studied. Algorithms such as sorting, searching, and basic graph algorithms will be included. The map-reduce framework will also be introduced.

CS737 Machine Learning

Prerequisite: CS703 (Required of all students)

This course will introduce core machine learning models and algorithms for classification, regression, clustering, and dimensionality reduction. The course will focus on both understanding the theory of learning approaches, and effectively using them to solve real-world data science problems. Topics will include least squares methods, linear classification, support vector machines, Bayesian networks and inference, the EM algorithm, and kernel methods.

COMPUTER SCIENCE ELECTIVES:

CS745 Multimedia data analysis and mining

Prerequisites: ST710 and CS737.

Explores the analysis of images, video and audio for identification and extraction of meaningful information from large databases. Will apply techniques from areas such as image processing, pattern recognition, machine learning and computer vision to the large datasets produced in applications including medical imaging, robotic vision, remote satellite sensing and surveillance. Students will learn to transform, compress, segment, track, and classify structured multimedia data.

CS746 Data Visualization

Prerequisites: ST710 and CS703

Techniques for both exploratory graphical analysis, and effective visual presentation, of complex data. Covers both analytic techniques for data preparation as well as cognitive and perceptual issues in designing informative and effective visualizations. Students will learn to model, reduce and interpret large sets of discrete and continuous data for display and interactive visualization. Through case studies and student projects, reviews how to use and choose standard methods in charting and plotting data, and create these with statistical design software tools and languages. Prerequisites: Programming for data science, intro statistics.

CS750 Special Topics in Computer Science

Prerequisite: Varies with topic. An on-demand course for a current topic. May be repeated twice times for credit.

CS751 Independent Study

Students must submit a written proposal to a member of the faculty of the computer science program prior to the last day of class registration. Proposed topics, which are normally discussed in advance with the professor, should permit study and/or laboratory work in considerable depth beyond the scope of a course offered in the curriculum.

CS752 Parallel Computing

Prerequisites: CS703

Presents the fundamentals of parallel computing from both hardware and software perspectives with an emphasis on writing and analyzing parallel data analysis and visualization algorithms. The course examines various parallel processor and memory architectures (including, but not limited to SMP and multi-core) and introduces appropriate parallel programming models, focusing on threading models. Metrics and tools for algorithm and architecture analysis are also discussed.

CS753 Big Data

Prerequisites: CS703

The course covers a range of topics from big data storage and processing to large-scale machine learning libraries. As a hands-on programming course, students will learn the details of the design and administration of a cluster as well as use it to process "big data". By the end of the course, students should understand the challenges associated with big data and the tools available to support answering big data questions.

CS761 Modeling and Simulation

Prerequisite: CS737

General theory of modeling and simulation as applied to computational science, studying a variety of systems: physical processes, computer systems, and biological systems. Simulation approaches include agent-based modeling, discrete-event modeling, and complex network analysis. This course includes the entire modeling and simulation life cycle, including analysis of initial problem, abstraction to a model, simulation and validation of the model, and analysis of results.

CS765 Database Retrieval

Prerequisite: CS 703

This course focuses on how to retrieve data from relational and NoSQL databases. Topics include physical organization; query processing including formal languages, SQL, and optimization; transaction modeling; and concurrency issues. Students are exposed to graph-based databases, key-value stores, and other NoSQL databases. Includes laboratory experiences with the use of database management systems.

CS766 Information Retrieval and Natural Language Processing

Prerequisites: CS737

This course blends textual information retrieval with natural language processing to focus on topics a data scientist can use to collect web data and make use of unstructured text in data models. Topics include basic and advanced techniques for text-based information systems including indexing and text representation; text classification and Naïve Bayes; and web search, crawling and indexing as well as statistical inference, Markov models, and clustering.

BUSINESS PREREQUISITE, REQUIRED, AND ELECTIVE COURSES

GB701 Operations Management and Process Strategies (3 cr) Focuses on how operations can be used for competitive advantage in today's world by improving the use of an organization's resources. Frameworks are provided by linking business processes, metrics, best practices, and technologies to add value for the ultimate customer of the firm. Topics cover enterprise decisions related to both product and service companies such as process mapping, value stream mapping, quality management, lean philosophy, continuous process improvement, inventory control, waiting line management, and capacity management. Pedagogical methods include lectures, simulations, cases, and projects. Students develop competencies in process analysis, value stream mapping, inventory control, and queuing management.

GB705 Leadership and Management (3 cr) This course prepares students to be leaders in a competitive, global, diverse economy, adding value through managing the work of people in organizations. The human side of enterprise is addressed using readings, lectures, cases, team

exercises, videos, written assignments, and discussion applying leadership and management skills to practical decisions. Topics include the elements of management, the concepts and process of leadership, and the transformation of people and organizations.

GB730: Business Analytics and Strategic Decision Making (3.0 cr) Emphasizes strategic decision making using a data-driven approach to facilitate business decisions. Students learn to effectively identify, design, and implement integrated analytics solutions to business problems. Major topics include the scope of decision analysis technologies and their usefulness for improving strategic business decisions, the formulation of objectives, the development of alternatives, multi-objective value analysis, and simulation. Technologies considered include cloud computing, analytical technologies and the business user, SAP, web, intranet, extranet technologies, ERP, CRM, data visualization.

GB731 Foundations of Data Analytics (3.0 cr) – This course can be waived by the department chair by demonstrating equivalent course content. Topics include data presentation and summarization, regression analysis, multiple linear regression, logistic regression and odds ratio, fundamental probability theory and random variables, introductory decision analysis, estimation, confidence intervals, hypothesis testing and One Way ANOVA. (Taught by economics faculty.)

GB851 Business Intelligence and Data Mining (3.0 cr) - Pre-requisite GB730 and GB731. Introduces the student to the concepts of managerial decision making through business intelligence (BI) and data mining along with an introduction to data mining software such as SAS Enterprise Miner™. Students will develop an understanding of the strengths and limitations of data mining techniques as well as actively engage in data mining projects applying these techniques. We provide broad overviews to both descriptive and predictive modeling techniques including association, clustering and prediction. The concepts of data input, data partitioning, variable selection, transformation, imputation, and model assessment (specifically lift charts and ROC curves) are presented. A key objective of this course is to allow the student to observe and participate in the entire data mining process from data acquisition to final model deployment. Managerial concepts are discussed using cases. This objective is met through a real world project that serves as the culmination of this sequence.

GB732 Data Management and Governance (3.0 cr) – Prerequisite GB730. Theoretical and practical foundations of data management and data governance that will include review of issues and policies surrounding design, analysis, implementation, and use. Privacy, ethical and global issues will be discussed. Topics include data valuation, information life cycle management, e-discovery, data storage, data de-duplication and disaster recovery. Case studies will be used throughout the course.

GB733 Enterprise Systems (3.0 cr) – Prerequisite GB730. Theoretical and practical foundations of enterprise systems that will include review of issues surrounding design, analysis, implementation, and use. Comparison of Hadoop with data warehouse technologies will be discussed. Lecture material will be combined with hands-on projects utilizing SAP. This class will conclude with a real case study involving data from multiple sources using different formats and containing data quality problems.

GB736 Data Visualization for Decision Making (3.0 cr.) – Investigates the human processing of information and appropriate representation of data in a visual form. Introduction to technologies for data visualization such as Tableau and SAS Visual Analytics™.

GB852 Advanced Analytics (3.0 cr) - Prerequisite GB851. This course allows the student to apply analytics to their organization's dataset or to a dataset provided by the instructor. This advanced course provides a more in-depth coverage of the technical aspects of each of the modeling tools discussed in previous courses and expands the knowledge set to techniques such as optimization and risk management. Application to National Security concerns will be examined.

GB853 Social Media and Web Mining (3.0 cr) – Prerequisite GB851 CS703. This course focuses on understanding text and natural language on social media and other websites. Topics covered include content categorization, contextual analysis, ontology management, sentiment analysis and text mining.

GB735 Project Management (3.0 cr) Develops principles and techniques for the successful completion of projects. Students investigate the planning and execution of large, cross-functional

change. New methods, programs, products, and systems are implemented with substantial human costs and scheduling and business disruption challenges. This course presents and evaluates planning, scheduling, and costing methods, examples, cases, and project success techniques to increase effectiveness. Data analytics project management will be emphasized.

H. Adequacy of any articulation;

The program does not anticipate a requirement for articulation agreements, and the institutions standard credit transfer policy, found in its catalogue, will apply to students seeking to transfer credits.

I. Adequacy of faculty resources consistent with Regulation .11 of this chapter;

As is evident from the planned and anticipated program teaching, full-time faculty will deliver well in excess of half the program.

Table 6: Faculty

Course Code	Faculty	Faculty type
CS703	Eastman/Adjunct	Initially will be fulltime. After the course is developed an adjunct will likely teach this course
CS737	Lawrie/Olsen	Fulltime
CS745	Eastman	Fulltime
CS746	Eastman/Adjunct	Fulltime or Adjunct - likely an adjunct the first time it is offered
CS750	Adjunct	Adjunct
CS751	Fulltime	Fulltime
CS752	Isaacman/Adjunct	Fulltime or Adjunct - likely an adjunct the first time it is offered
CS753	Broderick/Adjunct	Adjunct
CS761	Olsen	Fulltime
CS765	Lawrie	Fulltime
CS766	Adjunct/Lawrie	likely to be an adjunct
DS795	Isaacman	Fulltime
DS796	Isaacman	Fulltime
GB730	Phillips-Wren	Fulltime
GB851	Sharkey	Fulltime
ST710	Morrell	Fulltime
ST765	Morrell	Fulltime
ST767	Auer	Fulltime
ST775	Fulltime	Fulltime
ST776	Adjunct	Adjunct
ST777	Shah	Fulltime
ST781	Sarkar-Dey/Adjunct	Fulltime or Adjunct
ST791	FT/Adj	FT/Adj - depends on topic
ST792	Fulltime	Fulltime
Business Electives		
GB701	Brown	Fulltime
GB705	Mento	Fulltime
GB732	Tallon	Fulltime
GB733	Srinivasan	Fulltime
GB735	Wagner	Fulltime
GB736	Phillips-Wren	Fulltime
GB852	Jefferson	Fulltime
GB853	Tallon	Fulltime

J. Adequacy of library resources consistent with regulation .12 of this chapter

A small amount is budgeted for library resources (currently \$1000). The library has an adequate selection of statistics and computer science book and online journals (including books and journals related to machine learning and visualization – important areas of Data Science). There may be modest needs for additional book and articles through interlibrary loan. It is expected that most data sets for projects will come from the companies from which the students come, non-profits in the area, and various local, state, and federal government agencies. The library does currently provide access to some data sets and this is likely to be beneficial. They also have the ability to purchase data and if the program grows dramatically there may be need to purchase data sets. The library budget can be revisited at a later time as needs demand.

There are few library and technology demands. Although this program involves technology, most of computer programs are freely available. Those that are not are already supported at Loyola. Some courses will require computer-enabled classrooms that are amply available.

Notre Dame of Maryland University offers a Master's degree in Analytics in Knowledge Management. It is likely that the needs of the two programs will overlap and consequently some of the library resources that support the Notre Dame of Maryland University will be useful for Loyola's Data Science program.

K. Adequacy of physical facilities, infrastructure, and instructional equipment consistent with Regulation .13 of this chapter;

Loyola University Maryland, established in 1852, is accredited by the Middle States Commission for Higher Education is entirely equipped to offer graduate programs, including doctoral programs in select areas. This includes the necessary classroom resources, technology, student support and development assets and laboratory space. Additionally, a study of other schools' infrastructural requirements have demonstrated that Loyola's Computer Science department can accommodate any needs for this program's first cohort and to develop the

processing speed and capacity, and data storage necessary for subsequent cohorts. Additionally, while the preference is to retain this support as in-house, the university can avail of additional resources and capacity through Amazon Web Services (AWS), if unanticipated demand and need arises.

L. Adequacy of financial resources with documentation consistent with Regulation .14 of this chapter;

Please see attached at Appendix I the MHEC expenditures and resources financial tables .

M. Adequacy of provisions for evaluation of program consistent with Regulation .15 of this chapter;

The institution's Assessment Plan will accommodate this program for the evaluation graduate student learning aims¹⁹. Additionally, Academic Affairs will incorporate regular review of the program within its cyclical review of programs through its Academic Program Review calendar.

¹⁹ Graduate Learning Aims, retrieved on October 19, 2015 from <http://www.loyola.edu/admission/graduate/learning-goals>

N. Consistency with the Commission's minority student achievement goals; and

Loyola remains committed to an inclusive and diverse academic environment and upholding and fostering the principle enshrined in Title VI of the 1964 Civil Rights Act. This year's freshman class is Loyola's most diverse and reflects its long-term commitment to diversity and social justice. At Loyola University Maryland, diversity related programs and offices are plentiful throughout the campus. African, Latino, Asian, and Native American Services (ALANA) support programming throughout the year that is focused on multicultural diversity and student support. The Center for Community Service and Justice engages students and the broader Loyola community in education through service for a just and equitable world. OUTLoyola is a group of faculty, staff, and administrators of all backgrounds who are interested in promoting equality for the LGBT members of the campus community and informed dialogue about LGBT issues at Loyola.²⁰

Additionally, this program anticipate enrolling a not inconsiderable number of international students, and as it common amongst its graduate programs, to enroll students from the Baltimore area, which considering the socio-economic and demographic milieu, necessitates a commitment to minority students' achievement.

²⁰ Maryland Independent Colleges and Universities Association, *Cultural diversity report, 2015*, p. 14. Retrieved on October 19, 2015 from <http://www.micua.org/images/2015MICUACulturalDiversityReport.pdf>
Cf. The Alana website <http://www.loyola.edu/departement/alana/about>

Appendix 1: Financial tables

Table 1: Resources

Resource categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Reallocated funds					
2. Tuition/fee revenue	30000	291720	728000	875325	892650
<i>a. Number of full-time students</i>	5	13	25	25	25
<i>b. Credit hour rate</i>	1,000	1020	1040	1061	1082
<i>c. Annual credit hours</i>	6	22	28	33	33
<i>d. Total full-time revenue (a x b x c)</i>	30000	291720	728000	875325	892650
<i>e. Number of part-time students</i>	0	0	0	0	
<i>f. Credit hour rate</i>					
<i>g. Annual credit hours</i>					
<i>h. Total part-time revenue</i>	0	0	0	0	0
3. Grants, contracts, and other external sources					
4. Other sources					
Total	30000	291720	728000	875325	892650

Table 2: Expenditures

Expenditure categories	Year 1	Year 2	Year 3	Year 4	Year 5
1. Faculty (b+c below)	22917	129832	194498	162771	167654
<i>a. No. FTE faculty</i>					
<i>b. Total salary</i>	22917	129832	194498	162771	167654
<i>c. Total benefits</i>					
2. Administrative staff	46428	122190	142477	136879	142114
<i>a. No. FTE administrative staff</i>					
<i>b. Total salary</i>	29632	61041	62872	64758	66701
<i>c. Total benefits*</i>	16796	61149	79605	72121	75413
3. Support staff	0	0	0	0	0
<i>a. FTE administrative staff</i>					
<i>b. Total salary</i>					
<i>c. Total benefits</i>					
4. Equipment					
5. Library	500	1000	1000	1000	1000
6. New or renovated space					
7. Other expenses	72,850	101,770	139,382	163,336	189,852
Total	142695	354792	477357	463986	500620

* Benefits in this row includes that for both faculty and staff.

