

Introduction

The objective of this study is to determine which 100 or 200 level courses have the most connection with separating degree earning from non-degree earning students on the basis of failing the course. In effect, this is an effort to determine which North Dakota University System courses act as "gatekeeper" courses - courses that, if failed, are associated with failure to complete a Bachelor or Associate degree. While certainly no course is positively associated with degree completion by failing to earn credit in it, this study attempts to identify those courses that have the strongest estimated negative effect on degree earning.

Methodology

Course Selection

Courses were selected for further examination if they were a 100 or 200 level course and had a total enrollment count for the years 2010-2018 in the top 100 of all 100/200 level NDUS courses.

Student Matching Procedure

Students who pass a course cannot directly be compared to students who do not pass the same course in regards to degree completion rate. This is due to the underlying differences in academic ability - students performing at a high academic level are naturally more likely to pass a course, and thus graduate. To then compare the effect of passing or failing any given course, students must have a very similar academic background.

For example, the differences between students in this study who were enrolled in CSCI 101: Introduction to Computers is shown below. This illustrates the difficulty in directly comparing degree earning rates between the groups, as it is impossible to ascertain whether the difference is caused by the act of failing the course, or some other underlying academic difference.

Student Group	n	High School Averages				NDUS Degree Earned Rate
		ACT Composite	Free/Reduced Lunch	IEP	GPA	
Did Not Pass CSCI 101	1400	19.4	20.0%	6.1%	2.72	24.1%
Passed CSCI 101	6408	21.1	15.2%	4.0%	3.21	70.6%

Table 1: CSCI 101 Group Differences Before Matching

For each of the 100 courses selected, the following procedure was followed:

Enrollment information for the course in the years Fall 2009 - Spring 2013 was collected, at which point students enrolled in the course were split into two groups - those who earned credit in the course, and those that did not (this also includes students whose grade was recorded as a W). To create a matched group of students earning credits to those not earning credits, high school information was used, thereby restricting this study to only North Dakota high school students.

To create groups of students with similar academic background, students were matched one-to-one (a passing student with a failing student) using propensity score matching on the following high school variables:

- ACT Composite Score
- High School GPA
- Free/Reduced Lunch Status
- IEP Status

If a student did not have the data indicated, they were removed from the study and were not matched. After the completion of the student matching process, two groups of similar matched students existed: one group that passed the course and a second group who did not pass the course. For example, here are the differences in the two group of CSCI 101 students *following* matching. As the following table demonstrates, the differences between the groups are much lower, making estimating the effect of the course failure more valid.

Student Group	n	High School Averages				NDUS Degree Earned Rate
		ACT Composite	Free/Reduced Lunch	IEP	GPA	
Did Not Pass CSCI 101	1296	19.6	18.8%	5.1%	2.79	26.0%
Passed CSCI 101	1296	19.6	18.9%	4.9%	2.80	60.9%

Table 2: CSCI 101 Group Differences After Matching

Estimating Course Failure Effect

To estimate the effect of failing any given course, each pair of students were split into one of four categories based on whether or not they eventually went on to complete a Bachelor or Associate degree within the North Dakota University System.

Results for Each Pair Of Students			
Student Who Passed Course	Student Who Did Not Pass Course		Count
Earned Degree	Earned Degree		224
Earned Degree	Did Not Earn Degree		557
Did Not Earn Degree	Earned Degree		112
Did Not Earn Degree	Did Not Earn Degree		403

Table 3: Results of Student Pairs in CSCI 101

Following the compilation of these results, McNemar's test was conducted for each course to determine the confidence interval for the effect of failing the course, using a family-wise error rate of 5% with a Bonferroni correction. For example, for CSCI 101, the estimated difference of degree attainment rates for similar students who fail the course versus those passing the course falls between -40.1% and -28.6%.

Results

Of the 100 courses that were tested, 39 courses showed that failing the course had an estimated difference in degree attainment rates for similar students greater than -20%. Those 39 courses are shown on the following pages, along with the ranges of the effect estimate and a tabular summary of the information. The courses are sorted by the upper bound of the estimate.

Graphical Summary of Results



Tabular Summary of Results

Course Description	Course Num.	n Pairs	Degree Earned By ____ Student(s)				Effect of Failing Course	
			Both	Passing	Failing	Neither	Lower Bound	Upper Bound
Introduction To Computers	CSCI 101	1296	224	557	112	403	-40.1%	-28.6%
Principles of Microeconomics	ECON 201	1565	349	674	154	388	-38.6%	-27.8%
College Composition I	ENGL 110	6589	1184	2602	715	2088	-31.3%	-26.0%
Intro To Professional Writing	ENGL 125	1008	307	407	83	211	-38.6%	-25.7%
American Government	POLS 115	917	181	397	99	240	-39.7%	-25.3%
Elements of Accounting I	ACCT 200	1580	370	650	177	383	-35.4%	-24.5%
U.S. to 1877	HIST 103	1280	247	538	150	345	-36.5%	-24.2%
Concepts Of Fitness & Wellness	HPER 100	847	154	347	81	265	-38.6%	-24.2%
College Composition II	ENGL 120	5617	1254	2143	639	1581	-29.6%	-23.9%
Abnormal Psychology	PSYC 270	682	172	288	70	152	-40.2%	-23.8%
Developmental Psychology	PSYC 250	1291	287	528	143	333	-35.8%	-23.8%
General Biology II Laboratory	BIOL 151L	745	157	323	87	178	-39.8%	-23.6%
Western Civilization II	HIST 102	477	139	200	42	96	-42.6%	-23.6%
Music Appreciation	MUSC 100	663	162	273	65	163	-39.6%	-23.2%
Interpersonal Communication	COMM 212	614	179	261	65	109	-40.6%	-23.2%
Intro/Visual Arts	ART 110	362	79	150	28	105	-44.3%	-23.1%
Introduction to Psychology	PSYC 111	3709	668	1390	422	1229	-29.6%	-22.6%
Trigonometry	MATH 105	1274	343	497	135	299	-34.4%	-22.5%
Concepts of Biology Lab	BIOL 111L	851	186	343	89	233	-37.1%	-22.5%
Business Use of Computers	CSCI 116	669	174	270	67	158	-38.5%	-22.2%
U.S. Since 1877	HIST 104	1081	242	425	115	299	-35.1%	-22.2%
First-Year Spanish I	SPAN 101	656	181	266	67	142	-38.6%	-22.1%
General Biology I Laboratory	BIOL 150L	1584	349	616	180	439	-32.9%	-22.1%
First Aid and CPR	HPER 210	507	104	199	42	162	-40.0%	-22.0%
College Algebra	MATH 103	4978	1077	1855	613	1433	-28.0%	-21.9%

Table 4: Degree Earning by Student Pairs and Course

Course Description	Course Num.	n Pairs	Degree Earned By _____ Student(s)				Effect of Failing Course	
			Both	Passing	Failing	Neither	Lower Bound	Upper Bound
Concepts of Biology	BIOL 111	902	171	362	100	269	-36.2%	-21.9%
Introduction to Philosophy	PHIL 101	615	152	239	56	168	-38.1%	-21.5%
Calculus I	MATH 165	2059	568	794	255	442	-31.0%	-21.4%
Applied Voice	MUSC 167	358	102	150	34	72	-43.5%	-21.3%
Intro to Soil Science	SOIL 210	346	86	149	36	75	-44.2%	-21.1%
World Food Crops	PLSC 110	489	103	208	57	121	-40.8%	-20.9%
Calculus II	MATH 166	1397	423	535	168	271	-32.1%	-20.5%
Introduction to Media Writing	COMM 200	365	112	152	37	64	-42.6%	-20.4%
General Chemistry I	CHEM 121	1635	457	638	215	325	-31.4%	-20.4%
Introductory Chemistry Lab	CHEM 115L	570	129	226	59	156	-38.2%	-20.4%
Fundamentals/ Public Speaking	COMM 110	6583	1301	2405	891	1986	-25.7%	-20.3%
Principles of Macroeconomics	ECON 202	1157	315	444	137	261	-32.9%	-20.2%
Intermediate Algebra	MATH 102	3221	929	1186	415	691	-27.8%	-20.1%
Intro/Criminal Justice	CJ 201	628	106	257	76	189	-37.6%	-20.0%

Table 1: Degree Earning by Student Pairs and Course