

Model for the Infrastructure of Engineering Education

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Introduction

There are many ways to describe and model physical systems. The infrastructure of engineering education in the United States is an example of such a system, and it is the intent of this report to describe and model this infrastructure. The means for doing this starts with the graduation statistics for the year 1989 given by the Computer Aided Science Policy Analysis & Research Database System (CASPAR) developed for the National Science Foundation by Quantum Research Corporation [1], and uses a simple categorization for the institutions that contribute to those statistics. This categorization sorts the post-secondary institutions in the United States which enroll engineering students into three types: community colleges (or two year institutions), non-PhD granting institutions (Bachelors and/or Masters engineering degree granting), and PhD engineering degree granting institutions. The intent is to ascertain the contribution of each type of institution to the infrastructure of engineering education.

The National Model

Figure 1 presents the distribution of engineering degrees in the United States based upon the data given in Table I for the engineering PhDs and Bachelors degrees conferred in 1989 [1]. This data lists by academic institution the number of PhD and Bachelor degrees granted, with the institutions sorted first by the number of PhD degrees granted, and second by the number of Bachelor degrees for the non-PhD institutions. Columns in Table I also present the cumulative number of degrees and their corresponding cumulative percent of the total number of degrees. For example, MIT is indexed "1" for the PhD granting institutions with 217 PhD degrees, and it granted 633 Bachelor degrees; and the University of Arizona is indexed "33" with 41 engineering PhD degrees and 562 engineering Bachelor degrees. For the non-PhD institutions, California Poly St U, San Luis Obispo is indexed first in the second sort criteria, or "163" in the total list, with 562 engineering Bachelor degrees; and, Bucknell University is indexed "209" overall with 116 engineering Bachelor degrees.

The curves in Figure 1 plot the cumulative percent of the total degrees for both PhDs and Bachelors presented in the Table as a function of the index of the academic institution. For example, at index "40", University of California-Davis, 68% of the PhD degrees have been conferred, and 35% of the Bachelor degrees have been conferred; or put another way, the top 40 PhD granting institutions graduate 68% of the PhD students, but only 35% of the Bachelor degree students. Note that for the 162 PhD granting institutions, approximately two-thirds of the degrees are obtained at about one-quarter of the institutions. Nationally, 76% of all engineering Bachelor degrees are granted by the PhD granting institutions.

National data must be interpreted properly for the various states to prevent drawing erroneous conclusions. In Figure 2 the data for the state of California is plotted using the data in Table II. The data in the Table is presented using the same process as the national data, i.e., institutions are indexed first by the number PhD degrees conferred and then by the number of Bachelor degrees awarded by the non-PhD granting institutions. Table II is just a subset from the data in Table I, and, in principle, the data for each state can be plotted in an analogous fashion. In California, the PhD granting institutions only award 42% of the Bachelor degrees with the non-PhD granting institutions graduating 58% of the Bachelor degrees. The reason for this difference with the national curve for the Bachelor degrees can be attributed to the policy that the state initiated in the early 60's, called the "Master Plan", which created a three-tiered system of public higher education based upon the community colleges, the California State University, and the University of California. Following the same process, figures and tables are presented for Florida, Illinois, Massachusetts, Montana, New York, and Texas. Clearly, each state has its own characteristic.

Community College Contributions

Information on the contribution of community colleges to the graduates in engineering is difficult to acquire at this time. Nationally, it is estimated that in 1987, 25% of the engineering Bachelor degree students transferred one or more courses to their graduating institution from a community college [2]. Therefore, to obtain precise information, a simple model is proposed. Logically, there are three possibilities for a Bachelor degree graduate to enter the institution from which they received their degree: 1) as a Freshman, 2) as a transfer student from another four year institution, and 3) as a transfer student from a community college. Using this model, information was requested from at least a dozen states to determine the percentage of Bachelor degrees students in engineering who entered their graduating institution by transferring from a community college. While all the states contacted were enthusiastic about obtaining the data, only a few states could provide preliminary data addressing the request.

Florida estimated that in 1989-90, 14.6% of the graduates in engineering from the nine public-supported universities transferred from community colleges [3]. California estimates that 24% of the University of California and 47% of the California State University Bachelor degrees in engineering in 1985-86 resulted from transfer students from community colleges [4]. Washington estimates that about 30% of the engineering graduates from the University of Washington in 1990-91

transferred from community colleges [5]. Lastly, Colorado estimates that at least 3.8% of the engineering graduates from the six public-supported engineering institutions transferred from community colleges.

Conclusion

In summary, it is hoped that this presentation will give some insight into the nature of the infrastructure of engineering education, nationally as well as for each state. The data has many interpretations, and this report should initiate much discussion regarding the mission of each institution and its contribution to the infrastructure of engineering education in the United States.

Bibliography

1. CASPAR data: Data collected by the National Center for Education Statistics, U.S. Department of Education, Completions Survey, 1989
2. Preliminary data provided by Elizabeth Teles, AACJC Fellow at the National Science Foundation, 6 July 1992
3. Telephone conversation with Joan Roddenberry, Division of Community Colleges of Florida, 12 July 1991
4. 1988 California Post-Secondary Education Commission report entitled "Update of California Transfer Students Fall 1987" (thanks to Jim Palmer, Center for Community College Education, George Mason University, in telephone conversation on 6 June 1991)
5. Data provided by Geogory P. Smith, Coordinator of Institutional Research and Education, Colorado Community College & Occupational Education System on 21 April 1992 (thanks to Lourdes Tinajero, AACJC Fellow at the National Science Foundation)

Table I

Engineering Ph.D.s and Bachelor's Degrees Conferred in the United States, by Institution: 1989

Academic Institution	PhDs	Bach	Cum PhDs	Cum Bach	Rank	Cum PhD %	Cum Bach %
						0	0
Massachusetts Institute of Technology	217	633	217	633	1	5	1
University of California-Berkeley	201	517	418	1,150	2	9	2
Stanford University	173	273	591	1,423	3	13	2
University of Illinois-Urbana	136	1,259	727	2,682	4	16	4
Purdue University-All Campuses	132	1,221	859	3,903	5	19	6
University of Michigan	122	1,006	981	4,909	6	22	7
University of Texas-Austin	107	647	1,088	5,556	7	24	8
Texas A & M University-All Campuses	98	1,013	1,186	6,569	8	26	10
University of Wisconsin-Madison	98	836	1,284	7,405	9	28	11
Ohio State University-All Campuses	97	702	1,381	8,107	10	30	12
Virginia Polytechnic Inst & State Univ	97	862	1,478	8,969	11	33	13
Pennsylvania State University-All Cam	95	1,101	1,573	10,070	12	35	15
Cornell University	88	568	1,661	10,638	13	37	16
University of Southern California	80	319	1,741	10,957	14	38	16
Georgia Institute of Technology-All Cam	78	1,015	1,819	11,972	15	40	18
Carnegie-Mellon University	76	277	1,895	12,249	16	42	18
North Carolina State University-Raleigh	76	924	1,971	13,173	17	43	20
University of Minnesota	75	724	2,046	13,897	18	45	21
Case Western Reserve University	74	256	2,120	14,153	19	47	21
Northwestern University	74	250	2,194	14,403	20	48	21
Rensselaer Polytechnic Institute	73	618	2,267	15,021	21	50	22
University of Florida	60	583	2,327	15,604	22	51	23
University of California-Los Angeles	59	327	2,386	15,931	23	53	24
University of Maryland-College Park	57	660	2,443	16,591	24	54	25
Iowa State University of Science & Tech	56	791	2,499	17,382	25	55	26
University of Colorado	47	631	2,546	18,013	26	56	27
University of Washington	45	616	2,591	18,629	27	57	28
University of Massachusetts System	43	418	2,634	19,047	28	58	28
Columbia University	42	238	2,676	19,285	29	59	29
University of Pennsylvania	42	237	2,718	19,522	30	60	29
Princeton University	41	165	2,759	19,687	31	61	29
SUNY-Buffalo	41	525	2,800	20,212	32	62	30
University of Arizona	41	562	2,841	20,774	33	63	31
California Institute of Technology	39	147	2,880	20,921	34	63	31
Lehigh University	38	388	2,918	21,309	35	64	32
Michigan State University	38	529	2,956	21,838	36	65	32
University of Utah	37	290	2,993	22,128	37	66	33
Arizona State University	35	453	3,028	22,581	38	67	34

Colorado State University	35	248	3,063	22,829	39	68	34
University of California-Davis	35	372	3,098	23,201	40	68	35
University of Virginia	33	245	3,131	23,446	41	69	35
University of Houston	32	202	3,163	23,648	42	70	35
Rutgers State University of New Jersey	31	452	3,194	24,100	43	70	36
University of Pittsburgh	31	387	3,225	24,487	44	71	36
University of Missouri-Columbia	28	433	3,253	24,920	45	72	37
George Washington University	27	171	3,280	25,091	46	72	37
Johns Hopkins University	27	181	3,307	25,272	47	73	38
Rice University	27	145	3,334	25,417	48	74	38
University of California-San Diego	27	284	3,361	25,701	49	74	38
University of Cincinnati-All Campuses	26	404	3,387	26,105	50	75	39
University of Delaware	26	203	3,413	26,308	51	75	39
University of Illinois-Chicago	26	411	3,439	26,719	52	76	40
Clarkson University	25	659	3,464	27,378	53	76	41
Clemson University	25	505	3,489	27,883	54	77	41
Oklahoma State University	25	314	3,514	28,197	55	77	42
University of Missouri-Rolla	25	737	3,539	28,934	56	78	43
Drexel University	24	544	3,563	29,478	57	79	44
Syracuse University-All Campuses	24	239	3,587	29,717	58	79	44
Duke University	23	171	3,610	29,888	59	80	44
University of California-Santa Barbara	23	194	3,633	30,082	60	80	45
University of Rhode Island	23	184	3,656	30,266	61	81	45
Auburn University-All Campuses	22	820	3,678	31,086	62	81	46
University of Notre Dame	22	279	3,700	31,365	63	82	47
Oregon State University	21	314	3,721	31,679	64	82	47
Southern Methodist University	21	91	3,742	31,770	65	82	47
University of California-Irvine	21	181	3,763	31,951	66	83	48
University of Iowa	21	221	3,784	32,172	67	83	48
University of Oklahoma	21	247	3,805	32,419	68	84	48
University of Tennessee-Knoxville	21	447	3,826	32,866	69	84	49
Brigham Young University-All Campuses	20	287	3,846	33,153	70	85	49
University of New Mexico	20	231	3,866	33,384	71	85	50
Polytechnic University	19	413	3,885	33,797	72	86	50
University of Connecticut	19	273	3,904	34,070	73	86	51
Illinois Institute of Technology	18	314	3,922	34,384	74	86	51
University of Texas-Arlington	18	340	3,940	34,724	75	87	52
Yale University	18	27	3,958	34,751	76	87	52
University of Akron-All Campuses	17	259	3,975	35,010	77	88	52
University of Kansas	17	283	3,992	35,293	78	88	53
West Virginia University	17	225	4,009	35,518	79	88	53
Texas Tech University	16	243	4,025	35,761	80	89	53
Vanderbilt University	16	205	4,041	35,966	81	89	54
Washington University	16	183	4,057	36,149	82	89	54
Stevens Institute of Technology	15	233	4,072	36,382	83	90	54
SUNY-Stony Brook	15	187	4,087	36,569	84	90	54
University of Idaho	15	166	4,102	36,735	85	90	55
University of Rochester	15	179	4,117	36,914	86	91	55
Louisiana State University-All Campuses	14	285	4,131	37,199	87	91	55
New Jersey Institute of Technology	14	417	4,145	37,616	88	91	56
University of Kentucky	14	220	4,159	37,836	89	92	56
Colorado School of Mines	13	274	4,172	38,110	90	92	57
Utah State University	13	121	4,185	38,231	91	92	57
Wichita State University	13	162	4,198	38,393	92	93	57
University of Alabama	12	245	4,210	38,638	93	93	57
Wayne State University	12	179	4,222	38,817	94	93	58
Old Dominion University	11	205	4,233	39,022	95	93	58
University of Toledo	11	288	4,244	39,310	96	94	58
Brown University	10	87	4,254	39,397	97	94	59
University of Nebraska-Lincoln	10	241	4,264	39,638	98	94	59
Washington State University	10	363	4,274	40,001	99	94	60
Worcester Polytechnic Institute	10	408	4,284	40,409	100	94	60
Louisiana Tech University	9	192	4,293	40,601	101	95	60
Mississippi State University	9	328	4,302	40,929	102	95	61
Northeastern University	9	583	4,311	41,512	103	95	62
University of Alabama-Huntsville	9	199	4,320	41,711	104	95	62
University of Miami (FL)	9	266	4,329	41,977	105	95	62
University of South Carolina-All Campuses	9	202	4,338	42,179	106	96	63
CUNY-Graduate School and University Cntr	8	0	4,346	42,179	107	96	63
Kansas State University of Ag & Appl Sci	8	390	4,354	42,569	108	96	63
New Mexico State University-All Campuses	8	242	4,362	42,811	109	96	64

University of Dayton	8	160	4,370	42,971	110	96	64
Catholic University of America	7	91	4,377	43,062	111	96	64
Michigan Technological University	7	738	4,384	43,800	112	97	65
University of Mississippi	7	63	4,391	43,863	113	97	65
University of Wyoming	7	183	4,398	44,046	114	97	66
Tennessee Technological University	6	301	4,404	44,347	115	97	66
University of Arkansas-Fayetteville	6	287	4,410	44,634	116	97	66
University of South Florida	6	380	4,416	45,014	117	97	67
Alfred University-Main Campus	5	89	4,421	45,103	118	97	67
Cleveland State University	5	188	4,426	45,291	119	98	67
Florida Atlantic University	5	143	4,431	45,434	120	98	68
Institute of Paper Chemistry	5	0	4,436	45,434	121	98	68
Ohio University-All Campuses	5	206	4,441	45,640	122	98	68
Tulane University of Louisiana	5	151	4,446	45,791	123	98	68
University of Maine-Orono	5	201	4,451	45,992	124	98	68
University of North Carolina-Chapel Hill	5	0	4,456	45,992	125	98	68
Harvard University	4	27	4,460	46,019	126	98	68
Oregon Graduate Center	4	0	4,464	46,019	127	98	68
Tufts University	4	158	4,468	46,177	128	99	69
University of Louisville	4	203	4,472	46,380	129	99	69
Air Force Institute of Technology	3	0	4,475	46,380	130	99	69
Boston University	3	385	4,478	46,765	131	99	70
Florida Institute of Technology	3	237	4,481	47,002	132	99	70
New Mexico Institute of Mining & Technol	3	48	4,484	47,050	133	99	70
North Dakota State University-All Cam	3	346	4,487	47,396	134	99	71
Oakland University	3	124	4,490	47,520	135	99	71
Portland State University	3	132	4,493	47,652	136	99	71
University of Detroit	3	108	4,496	47,760	137	99	71
University of Tulsa	3	137	4,499	47,897	138	99	71
University of Vermont	3	127	4,502	48,024	139	99	71
Albany Law School Union University	2	0	4,504	48,024	140	99	71
Howard University	2	108	4,506	48,132	141	99	72
Marquette University	2	392	4,508	48,524	142	99	72
Montana State University	2	304	4,510	48,828	143	99	73
South Dakota School of Mines & Tech	2	201	4,512	49,029	144	99	73
University of Alabama-Birmingham	2	101	4,514	49,130	145	100	73
University of Central Florida	2	293	4,516	49,423	146	100	74
University of Hawaii-Manoa	2	181	4,518	49,604	147	100	74
University of Nevada-Reno	2	102	4,520	49,706	148	100	74
University of New Hampshire	2	154	4,522	49,860	149	100	74
University of Texas-Dallas	2	0	4,524	49,860	150	100	74
Dartmouth College	1	101	4,525	49,961	151	100	74
George Mason University	1	0	4,526	49,961	152	100	74
Lamar University	1	82	4,527	50,043	153	100	74
Naval Postgraduate School	1	8	4,528	50,051	154	100	74
New York University	1	0	4,529	50,051	155	100	74
Santa Clara University	1	128	4,530	50,179	156	100	75
SUNY-Binghamton	1	58	4,531	50,237	157	100	75
University of California-San Francisco	1	0	4,532	50,237	158	100	75
University of Lowell	1	381	4,533	50,618	159	100	75
University of Southwestern Louisiana	1	207	4,534	50,825	160	100	76
University of Texas-Hlth Sci Cntr Hston	1	0	4,535	50,825	161	100	76
University of Wisconsin-Milwaukee	1	171	4,536	50,996	162	100	76
California Poly St U, San Luis Obispo	0	562		51,558	163		77
University of Puerto Rico-Mayaguez Cam	0	518		52,076	164		77
GMI Engineering and Management Institute	0	505		52,581	165		78
California State Polytech Univ, Pomona	0	435		53,016	166		79
California State Univ, Long Beach	0	407		53,423	167		79
US Naval Academy	0	399		53,822	168		80
CUNY-City College	0	329		54,151	169		81
US Air Force Academy	0	312		54,463	170		81
San Diego State University	0	305		54,768	171		81
San Jose State University	0	288		55,056	172		82
Manhattan College	0	280		55,336	173		82
California State Univ, Sacramento	0	270		55,606	174		83
Temple University	0	268		55,874	175		83
University of Wisconsin-Platteville	0	267		56,141	176		84
Rochester Institute of Technology	0	260		56,401	177		84
California State Univ, Fullerton	0	232		56,633	178		84
Lawrence Institute of Technology	0	228		56,861	179		85
Villanova University	0	215		57,076	180		85

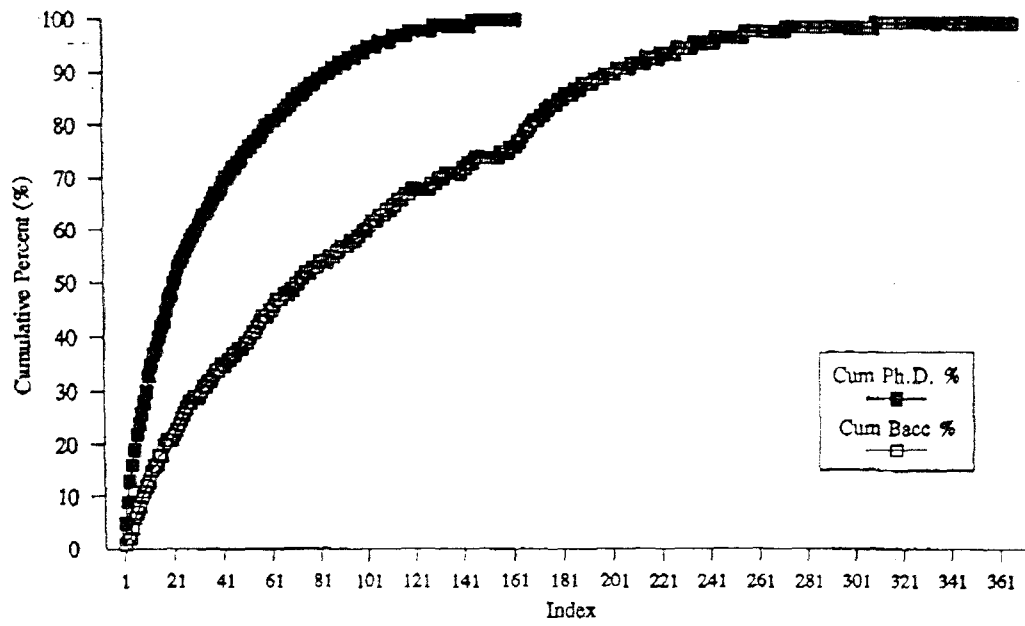
Rose-Hulman Institute of Technology	0	211	57,287	181	85
New York Institute of Technology	0	206	57,493	182	86
California State Univ, Fresno	0	197	57,690	183	86
Southern Illinois University-Carbondale	0	197	57,887	184	86
California State Univ, Chico	0	195	58,082	185	86
Wright State University	0	191	58,273	186	87
Milwaukee School of Engineering	0	188	58,461	187	87
California State Univ, Northridge	0	183	58,644	188	87
Memphis State University	0	170	58,814	189	88
South Dakota State University	0	167	58,981	190	88
Western Michigan University	0	166	59,147	191	88
ITT Technical Institute-Indianapolis	0	163	59,310	192	88
California State Univ, Los Angeles	0	160	59,470	193	88
West Virginia Institute of Technology	0	157	59,627	194	89
University of Texas-El Paso	0	154	59,781	195	89
Widener University Pennsylvania Campus	0	151	59,932	196	89
Bradley University	0	143	60,075	197	89
Southeastern Massachusetts University	0	136	60,211	198	90
Youngstown State University	0	134	60,345	199	90
Tri-State University	0	132	60,477	200	90
Florida International University	0	131	60,608	201	90
North Carolina Agri & Tech State Univ	0	128	60,736	202	90
Northrop University	0	128	60,864	203	91
Universidad Politecnica de Puerto Rico	0	123	60,987	204	91
Embry-Riddle Aeronautical University	0	122	61,109	205	91
University of New Haven	0	121	61,230	206	91
Union College (NY)	0	119	61,349	207	91
Texas A & I University	0	118	61,467	208	91
Bucknell University	0	116	61,583	209	92
Pratt Institute	0	116	61,699	210	92
Lafayette College	0	114	61,813	211	92
Fairleigh-Dickinson University	0	113	61,926	212	92
University of Hartford	0	113	62,039	213	92
University of North Carolina-Charlotte	0	111	62,150	214	92
Cooper Union	0	110	62,260	215	93
Southern Illinois Univ-Edwardsville	0	109	62,369	216	93
Southern University and A & M College	0	108	62,477	217	93
San Francisco State University	0	107	62,584	218	93
University of North Dakota	0	107	62,691	219	93
Montana College of Mineral Sci & Tech	0	106	62,797	220	93
Seattle University	0	105	62,902	221	94
University of Portland	0	104	63,006	222	94
University of New Orleans	0	103	63,109	223	94
University of the Pacific	0	101	63,210	224	94
Florida State University	0	100	63,310	225	94
University of South Alabama	0	99	63,409	226	94
University of Evansville	0	98	63,507	227	94
Kent State University-All Campuses	0	95	63,602	228	95
Prairie View Agric & Mech Univ	0	93	63,695	229	95
Maine Maritime Academy	0	90	63,785	230	95
Virginia Military Institute	0	89	63,874	231	95
Western New England College	0	87	63,961	232	95
SUNY-Maritime College	0	85	64,046	233	95
Northern Arizona University	0	82	64,128	234	95
US Coast Guard Academy	0	79	64,207	235	96
University of Bridgeport	0	78	64,285	236	96
Indiana University-All Campuses	0	76	64,361	237	96
Ohio Northern University	0	76	64,437	238	96
Tennessee State University	0	74	64,511	239	96
US Merchant Marine Academy	0	74	64,585	240	96
Gannon University	0	73	64,658	241	96
Citadel Military College of S Carolina	0	70	64,728	242	96
University of Tennessee-Chattanooga	0	69	64,797	243	96
Christian Brothers College	0	68	64,865	244	97
Valparaiso University	0	67	64,932	245	97
Gonzaga University	0	66	64,998	246	97
Tuskegee University	0	64	65,062	247	97
University of Alaska-Fairbanks	0	64	65,126	248	97
University of Maryland-Baltimore County	0	64	65,190	249	97
Hofstra University	0	63	65,253	250	97

University of Texas-San Antonio	0	61	65,314	251	97
Grove City College	0	56	65,370	252	97
Saint Cloud State University	0	49	65,419	253	97
University of the District of Columbia	0	49	65,468	254	97
Bridgeport Engineering Institute	0	47	65,515	255	97
Norwich University-Military Coll of VT	0	47	65,562	256	98
Harvey Mudd College	0	46	65,608	257	98
Loyola Marymount University	0	46	65,654	258	98
Walla Walla College	0	46	65,700	259	98
Calvin College	0	45	65,745	260	98
Geneva College	0	45	65,790	261	98
University of Nevada-Las Vegas	0	44	65,834	262	98
Miami University-All Campuses (OH)	0	43	65,877	263	98
University of California-Santa Cruz	0	43	65,920	264	98
West Coast University	0	42	65,962	265	98
Northern Illinois University	0	41	66,003	266	98
Wilkes College	0	38	66,041	267	98
Saginaw Valley State College	0	36	66,077	268	98
Le Tourneau College	0	32	66,109	269	98
California Maritime Academy	0	31	66,140	270	98
Merrimack College	0	31	66,171	271	98
Mankato State University	0	30	66,201	272	98
University of Wisconsin-Parkside	0	29	66,230	273	99
McNeese State University	0	28	66,258	274	99
Pacific Lutheran University	0	26	66,284	275	99
CUNY-College of Staten Island	0	25	66,309	276	99
Idaho State University	0	24	66,333	277	99
Monmouth College (NJ)	0	24	66,357	278	99
University of Scranton	0	24	66,381	279	99
Wentworth Institute of Technology (MA)	0	24	66,405	280	99
Marietta College	0	23	66,428	281	99
Colorado Technical College	0	22	66,450	282	99
Southwest Texas State University	0	22	66,472	283	99
University of Georgia	0	22	66,494	284	99
Dowling College	0	21	66,515	285	99
Morgan State University	0	21	66,536	286	99
University of Alaska-Anchorage	0	20	66,556	287	99
Webb Institute of Naval Architecture	0	20	66,576	288	99
Arkansas State University-All Campuses	0	19	66,595	289	99
Baylor University	0	19	66,614	290	99
Humboldt State University	0	19	66,633	291	99
Swarthmore College	0	19	66,652	292	99
Murray State University	0	18	66,670	293	99
Saint Mary's University of San Antonio	0	17	66,687	294	99
Loyola College	0	16	66,703	295	99
Saint Martin's College	0	16	66,719	296	99
Trinity College (CT)	0	16	66,735	297	99
West Virginia Wesleyan College	0	14	66,749	298	99
Roosevelt University	0	13	66,762	299	99
Saint Ambrose College	0	13	66,775	300	99
Boise State University	0	12	66,787	301	99
Millikin University	0	12	66,799	302	99
Seattle Pacific University	0	12	66,811	303	99
University of Redlands	0	12	66,823	304	99
John Brown University	0	11	66,834	305	99
Salem State College	0	11	66,845	306	99
Trinity University	0	11	66,856	307	99
University of Wisconsin-Stout	0	11	66,867	308	99
Barry University	0	10	66,877	309	99
Fairfield University	0	10	66,887	310	100
Hampton University	0	10	66,897	311	100
Hope College	0	10	66,907	312	100
Oral Roberts University	0	10	66,917	313	100
Philadelphia College of Textiles & Sci	0	10	66,927	314	100
SUNY-College at New Paltz	0	10	66,937	315	100
University of Houston-Clear Lake	0	10	66,947	316	100
Dordt College	0	9	66,956	317	100
East Central University	0	9	66,965	318	100

Norfolk State University	0	9	66,974	319	100
University of Denver	0	9	66,983	320	100
Florida Agricultural and Mechanical Univ	0	8	66,991	321	100
Mercer University-All Campuses	0	8	66,999	322	100
United States International University	0	8	67,007	323	100
University of Puerto Rico-Arecibo Tech U	0	8	67,015	324	100
Alabama Agricultural & Mechanical Univ	0	7	67,022	325	100
Arkansas Tech University	0	7	67,029	326	100
College of Saint Thomas	0	7	67,036	327	100
Franciscan University of Steubenville	0	7	67,043	328	100
La Salle University	0	7	67,050	329	100
David Lipscomb College	0	6	67,056	330	100
Roger Williams College	0	6	67,062	331	100
Saint Anselm College	0	6	67,068	332	100
Andrews University	0	5	67,073	333	100
Claremont McKenna College	0	5	67,078	334	100
Graceland College	0	5	67,083	335	100
Grand Valley State Colleges	0	5	67,088	336	100
Indiana Institute of Technology	0	5	67,093	337	100
Juniata College	0	5	67,098	338	100
Northeastern State University	0	5	67,103	339	100
Oklahoma Christian College	0	5	67,108	340	100
Peabody Institute of Johns Hopkins Univ	0	5	67,113	341	100
Radcliffe College	0	5	67,118	342	100
University of Southern Colorado	0	5	67,123	343	100
Wheaton College (IL)	0	5	67,128	344	100
Baldwin-Wallace College	0	4	67,132	345	100
Bemidji State University	0	4	67,136	346	100
New England College	0	4	67,140	347	100
Northwest Nazarene College	0	4	67,144	348	100
Nova University	0	4	67,148	349	100
Point Loma Nazarene College	0	4	67,152	350	100
Stonehill College	0	4	67,156	351	100
University of San Francisco	0	4	67,160	352	100
Westmont College	0	4	67,164	353	100
De Pauw University	0	3	67,167	354	100
Maharishi International University	0	3	67,170	355	100
Messiah College	0	3	67,173	356	100
Southeast Missouri State University	0	3	67,176	357	100
Wheeling Jesuit College	0	3	67,179	358	100
Wilmington College (OH)	0	3	67,182	359	100
Bates College	0	2	67,184	360	100
Beloit College	0	2	67,186	361	100
Catholic University of Puerto Rico	0	2	67,188	362	100
Cogswell College North	0	2	67,190	363	100
Illinois College	0	2	67,192	364	100
Reed College	0	2	67,194	365	100
Spelman College	0	2	67,196	366	100
Washington and Lee University	0	2	67,198	367	100
Ball State University	0	1	67,199	368	100
Bluffton College	0	1	67,200	369	100
Central State University (OH)	0	1	67,201	370	100
Clark College (GA)	0	1	67,202	371	100
College of Saint Scholastica	0	1	67,203	372	100
Concordia College (WI)	0	1	67,204	373	100
Davis & Elkins College	0	1	67,205	374	100
Eastern Nazarene College	0	1	67,206	375	100
Elizabethtown College	0	1	67,207	376	100
Illinois Benedictine College	0	1	67,208	377	100
Kentucky State University	0	1	67,209	378	100
MacMurray College	0	1	67,210	379	100
Oberlin College	0	1	67,211	380	100
Ohio Wesleyan University	0	1	67,212	381	100
Saint Francis College (PA)	0	1	67,213	382	100
Wake Forest University	0	1	67,214	383	100

Figure 1

Distribution of Engineering Degrees in the United States, 1989



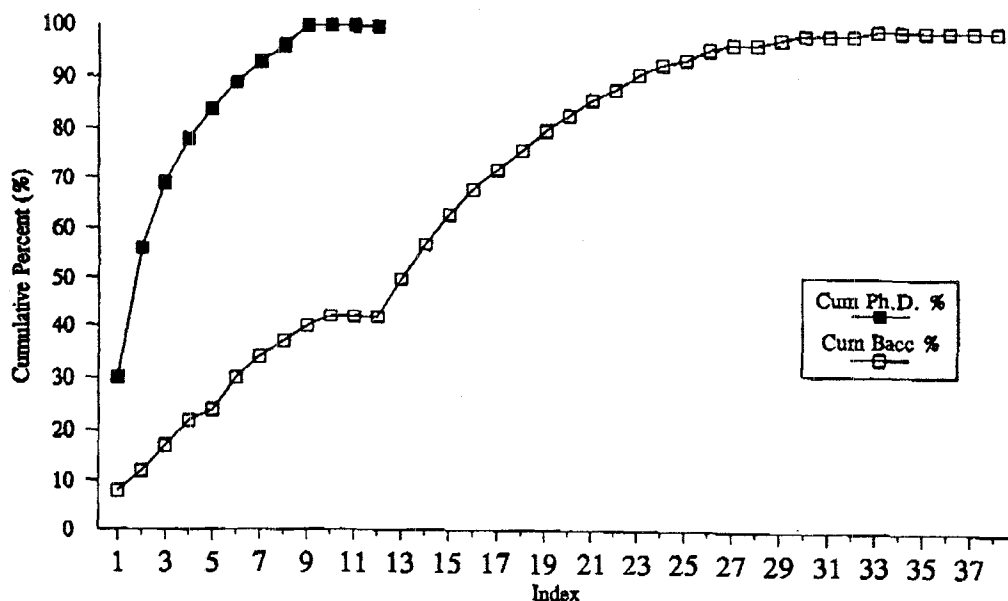
Engineering Ph.D.s and Bachelor's Degrees Conferred in California, by Institution: 1989

Table II

Academic Institution	PhDs	Bach	Cum PhDs	Cum Bach	Rank	Cum PhD %	Cum Bach %
						0	0
University of California-Berkeley	201	517	201	517	1	30	8
Stanford University	173	273	374	790	2	57	12
University of Southern California	80	319	454	1,109	3	69	17
University of California-Los Angeles	59	327	513	1,436	4	78	22
California Institute of Technology	39	147	552	1,583	5	84	24
University of California-Davis	35	372	587	1,955	6	89	30
University of California-San Diego	27	284	614	2,239	7	93	34
University of California-Santa Barbara	23	194	637	2,433	8	96	37
University of California-Irvine	21	181	658	2,614	9	100	40
Santa Clara University	1	128	659	2,742	10	100	42
Naval Postgraduate School	1	8	660	2,750	11	100	42
University of California-San Francisco	1	0	661	2,750	12	100	42
California Poly St U, San Luis Obispo	0	562		3,312	13		50
California State Polytech Univ, Pomona	0	435		3,747	14		57
California State Univ, Long Beach	0	407		4,154	15		63
San Diego State University	0	305		4,459	16		68
San Jose State University	0	288		4,747	17		72
California State Univ, Sacramento	0	270		5,017	18		76
California State Univ, Fullerton	0	232		5,249	19		80
California State Univ, Fresno	0	197		5,446	20		83
California State Univ, Chico	0	195		5,641	21		86
California State Univ, Northridge	0	183		5,824	22		88
California State Univ, Los Angeles	0	160		5,984	23		91
Northrop University	0	128		6,112	24		93
San Francisco State University	0	107		6,219	25		94
University of the Pacific	0	101		6,320	26		96
Harvey Mudd College	0	46		6,366	27		97
Loyola Marymount University	0	46		6,412	28		97
University of California-Santa Cruz	0	43		6,455	29		98
West Coast University	0	42		6,497	30		99
California Maritime Academy	0	31		6,528	31		99
Humboldt State University	0	19		6,547	32		99
University of Redlands	0	12		6,559	33		100
United States International University	0	8		6,567	34		100
Claremont McKenna College	0	5		6,572	35		100
Point Loma Nazarene College	0	4		6,576	36		100
University of San Francisco	0	4		6,580	37		100
Westmont College	0	4		6,584	38		100

Distribution of Engineering Degrees in California, 1989

Figure 2



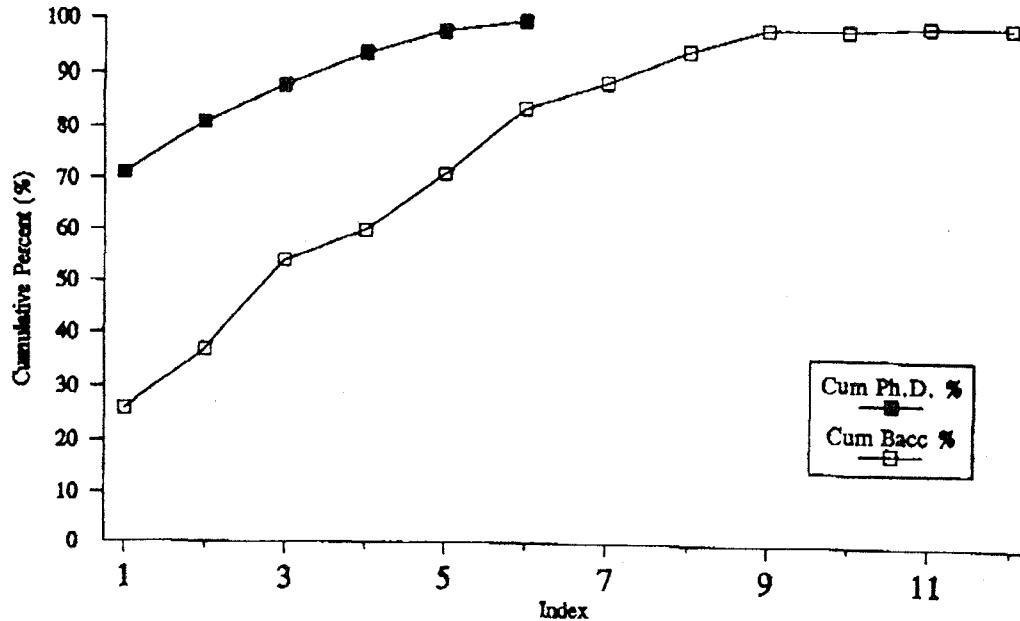
Engineering Ph.D.s and Bachelor's Degrees Conferred in Florida, by Institution: 1989

Table III

Academic Institution	PhDs	Bach	Cum PhDs	Cum Bach	Rank	Cum PhD %	Cum Bach %
University of Florida	60	583	60	583	1	71	26
University of Miami (FL)	9	266	69	849	2	81	37
University of South Florida	6	380	75	1,229	3	88	54
Florida Atlantic University	5	143	80	1,372	4	94	60
Florida Institute of Technology	3	237	83	1,609	5	98	71
University of Central Florida	2	293	85	1,902	6	100	84
Florida International University	0	131		2,033	7		89
Embry-Riddle Aeronautical University	0	122		2,155	8		95
Florida State University	0	100		2,255	9		99
Barry University	0	10		2,265	10		99
Florida Agricultural and Mechanical Univ	0	8		2,273	11		100
Nova University	0	4		2,277	12		100

Distribution of Engineering Degrees in Florida, 1989

Figure 3



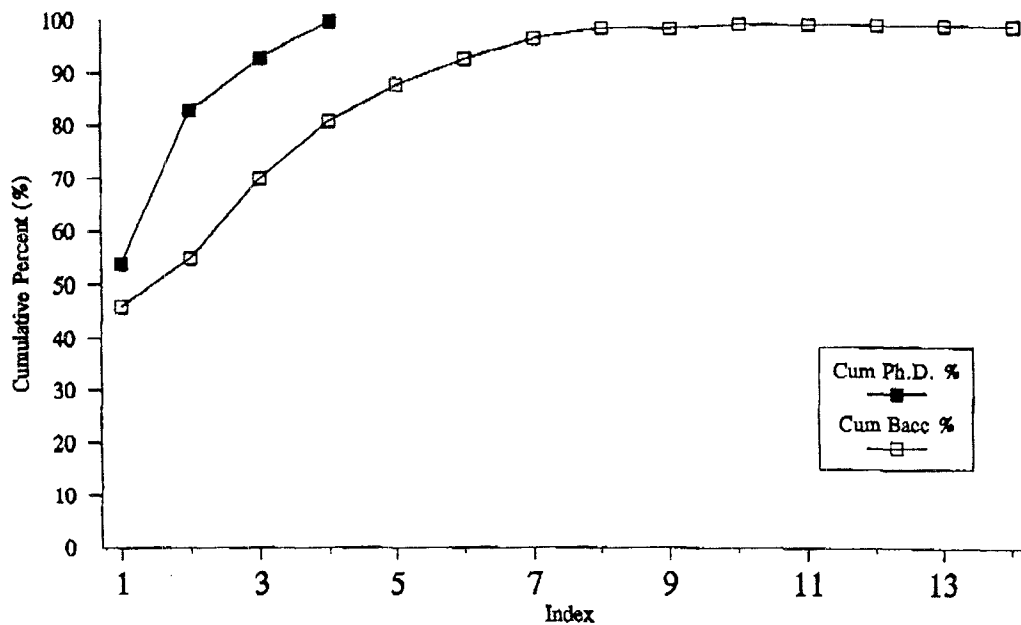
Engineering Ph.D.s and Bachelor's Degrees Conferred in Illinois, by Institution: 1989

Table IV

Academic Institution	PhDs	Bach	Cum PhDs	Cum Bach	Rank	Cum PhD %	Cum Bach %
						0	0
University of Illinois-Urbana	136	1,259	136	1,259	1	54	46
Northwestern University	74	250	210	1,509	2	83	55
University of Illinois-Chicago	26	411	236	1,920	3	93	70
Illinois Institute of Technology	18	314	254	2,234	4	100	81
Southern Illinois University-Carbondale	0	197		2,431	5		88
Bradley University	0	143		2,574	6		93
Southern Illinois Univ-Edwardsville	0	109		2,683	7		97
Northern Illinois University	0	41		2,724	8		99
Roosevelt University	0	13		2,737	9		99
Millikin University	0	12		2,749	10		100
Wheaton College (IL)	0	5		2,754	11		100
Illinois College	0	2		2,756	12		100
Illinois Benedictine College	0	1		2,757	13		100
MacMurray College	0	1		2,758	14		100

Distribution of Engineering Degrees in Illinois, 1989

Figure 4



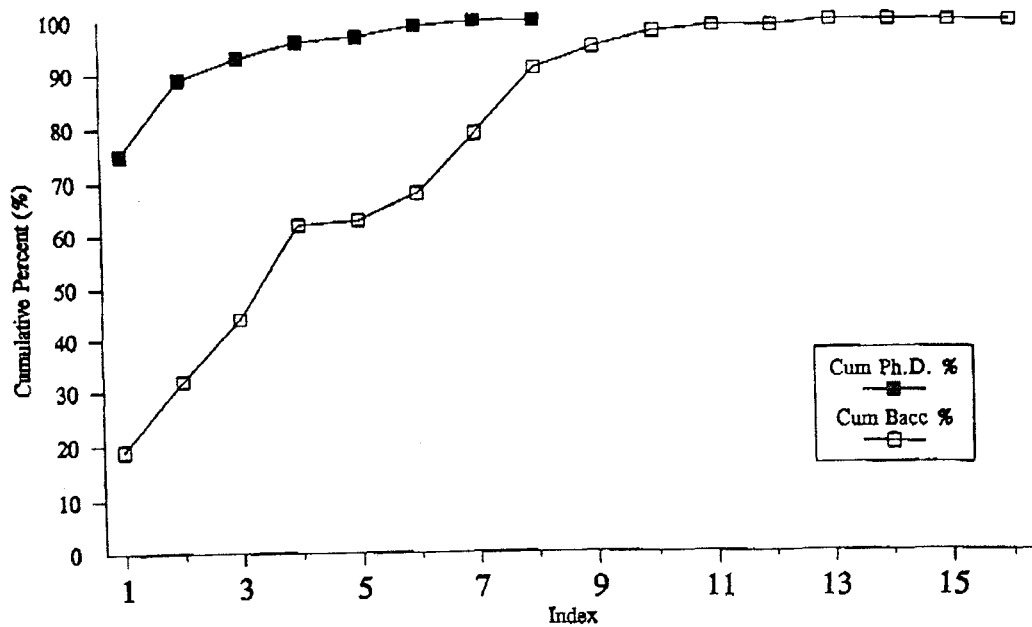
Engineering Ph.D.s and Bachelor's Degrees Conferred in Massachusetts, by Institution: 1989

Table V

Academic Institution	PhDs	Bach	Cum PhDs	Cum Bach	Rank	Cum PhD %	Cum Bach %
						0	0
Massachusetts Institute of Technology	217	633	217	633	1	75	19
University of Massachusetts System	43	418	260	1,051	2	89	32
Worcester Polytechnic Institute	10	408	270	1,459	3	93	44
Northeastern University	9	583	279	2,042	4	96	62
Harvard University	4	27	283	2,069	5	97	63
Tufts University	4	158	287	2,227	6	99	68
Boston University	3	385	290	2,612	7	100	79
University of Lowell	1	381	291	2,993	8	100	91
Southeastern Massachusetts University	0	136		3,129	9		95
Western New England College	0	87		3,216	10		98
Merrimack College	0	31		3,247	11		99
Wentworth Institute of Technology (MA)	0	24		3,271	12		99
Salem State College	0	11		3,282	13		100
Radcliffe College	0	5		3,287	14		100
Stonehill College	0	4		3,291	15		100
Eastern Nazarene College	0	1		3,292	16		100

Distribution of Engineering Degrees in Massachusetts, 1989

Figure 5

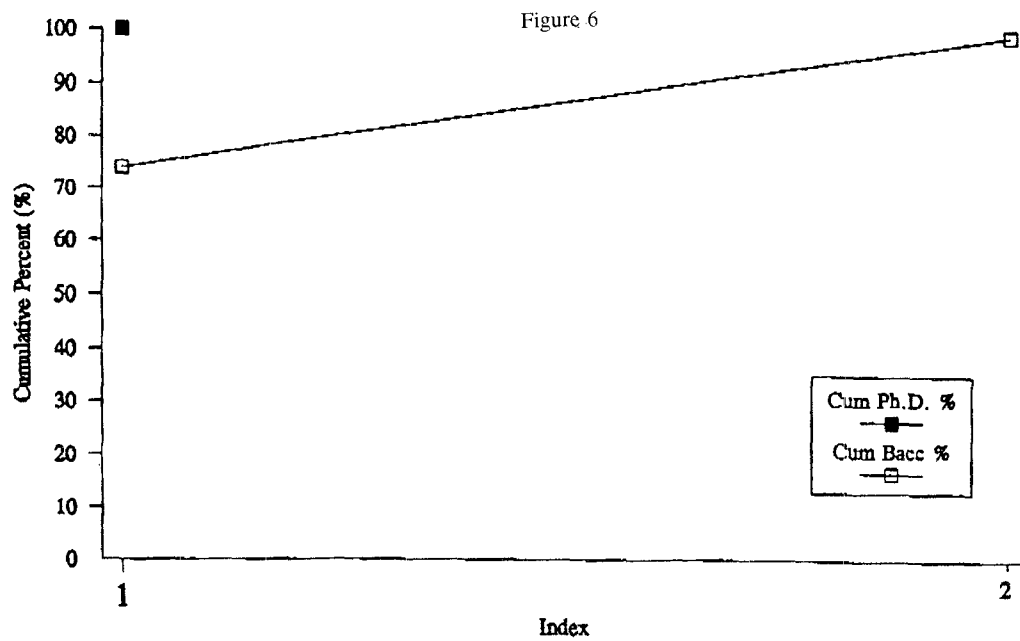


Engineering Ph.D.s and Bachelor's Degrees Conferred in Montana, by Institution: 1989

Table VI

Academic Institution	PhDs	Bach	Cum PhDs	Cum Bach	Rank	Cum PhD %	Cum Bach %
						0	0
Montana State University	2	304	2	304	1	100	74
Montana College of Mineral Sci & Tech	0	106	2	410	2		100

Distribution of Engineering Degrees in Montana, 1989

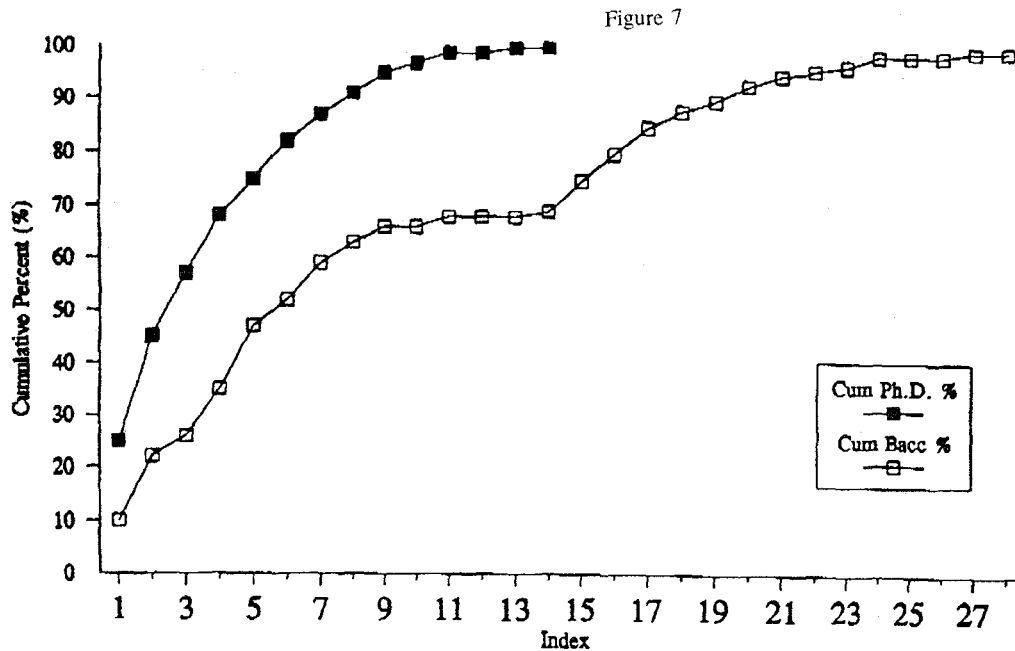


Engineering Ph.D.s and Bachelor's Degrees Conferred in New York, by Institution: 1989

Table VII

Academic Institution	PhDs	Bach	Cum PhDs	Cum Bach	Rank	Cum PhD %	Cum Bach %
						0	0
Cornell University	88	568	88	568	1	25	10
Rensselaer Polytechnic Institute	73	618	161	1,186	2	45	22
Columbia University	42	238	203	1,424	3	57	26
SUNY-Buffalo	41	525	244	1,949	4	68	35
Clarkson University	25	659	269	2,608	5	75	47
Syracuse University-All Campuses	24	239	293	2,847	6	82	52
Polytechnic University	19	413	312	3,260	7	87	59
SUNY-Stony Brook	15	187	327	3,447	8	91	63
University of Rochester	15	179	342	3,626	9	95	66
CUNY-Graduate School and University Cntr	8	0	350	3,626	10	97	66
Alfred University-Main Campus	5	89	355	3,715	11	99	68
Albany Law School Union University	2	0	357	3,715	12	99	68
New York University	1	0	358	3,715	13	100	68
SUNY-Binghamton	1	58	359	3,773	14	100	69
CUNY-City College		329		4,102	15		75
Manhattan College		280		4,382	16		80
Rochester Institute of Technology		260		4,642	17		85
New York Institute of Technology		206		4,848	18		88
Union College (NY)		119		4,967	19		90
Pratt Institute		116		5,083	20		93
Cooper Union		110		5,193	21		95
SUNY-Maritime College		85		5,278	22		96
US Merchant Marine Academy		74		5,352	23		97
Hofstra University		63		5,415	24		99
CUNY-College of Staten Island		25		5,440	25		99
Dowling College		21		5,461	26		99
Webb Institute of Naval Architecture		20		5,481	27		100
SUNY-College at New Paltz		10		5,491	28		100

Distribution of Engineering Degrees in New York, 1989



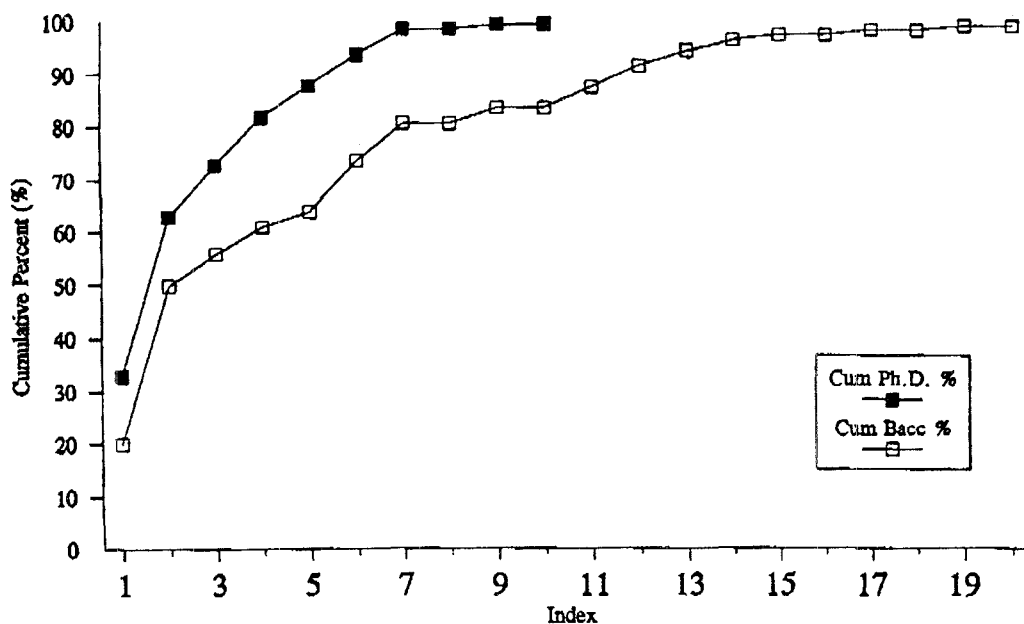
Engineering Ph.D.s and Bachelor's Degrees Conferred in Texas, by Institution: 1989

Table VIII

Academic Institution	PhDs	Bach	Cum PhDs	Cum Bach	Rank	Cum PhD %	Cum Bach %
University of Texas-Austin	107	647	107	647	1	0	0
Texas A & M University-All Campuses	98	1,013	205	1,660	2	33	20
University of Houston	32	202	237	1,862	3	73	56
Rice University	27	145	264	2,007	4	82	61
Southern Methodist University	21	91	285	2,098	5	88	64
University of Texas-Arlington	18	340	303	2,438	6	94	74
Texas Tech University	16	243	319	2,681	7	99	81
University of Texas-Dallas	2	0	321	2,681	8	99	81
Lamar University	1	82	322	2,763	9	100	84
University of Texas-Hlth Sci Cntr Hston	1	0	323	2,763	10	100	84
University of Texas-El Paso	0	154		2,917	11		88
Texas A & I University	0	118		3,035	12		92
Prairie View Agric & Mech Univ	0	93		3,128	13		95
University of Texas-San Antonio	0	61		3,189	14		97
Le Tourneau College	0	32		3,221	15		98
Southwest Texas State University	0	22		3,243	16		98
Baylor University	0	19		3,262	17		99
Saint Mary's University of San Antonio	0	17		3,279	18		99
Trinity University	0	11		3,290	19		100
University of Houston-Clear Lake	0	10		3,300	20		100

Distribution of Engineering Degrees in Texas, 1989

Figure 8



James G. Harris

James G. Harris received the B.S. and M.S. from UC-Berkeley in 1961 and 1962, and the Ph.D. from Syracuse University in 1968, all degrees in E.E. He taught at Howard University and the University of the District of Columbia, and worked at TRW in Redondo Beach, CA. He is a Professor at Cal Poly-SLO in the Electronic and Electrical Engineering Department, where he served as Head. He just completed two years as a Program Director at the National Science Foundation in the Division of Undergraduate Education. He is a member of IEEE, SIAM, ACM, AAAS, and ASEE.

Karen Frair

Karen Frair is currently the Associate Dean for Administration in the College of Engineering at the University of Alabama. She received her B.S. from the University in 1967 and her M.S. and PhD degrees from the University of Oklahoma in 1972 and 1974, all degrees in M.E. She was a member of the faculty in the Department of Engineering Science & Mechanics at VPI&SU, served as Associate Dean for Academic Affairs at Fresno State University, and was a Program Director in the Division of Undergraduate Education at NSF during the 1991-92 academic year. She is an Associate Editor of the Journal of Engineering Education, and is listed in American Men and Women of Science.

Win Aung

Since joining the National Science Foundation in 1974, Win has held a number of responsible positions with the agency. He currently serves as Senior Staff Associate in the Division of Engineering Education and Centers, and works with programs dealing with research and education. Active in professional society service, he is a ASME Council on Education representative and member, Board on Research and Technology Development, and is chairman of the AIChE Field Committee on Emerging Technology. He was co-chairman of the 1992 Engineering Foundation Conference on Engineering Education: Curriculum Innovation and Integration, and chairman of the 1990 International Symposium on Materials Processing and Manufacturing. He is an adjunct professor at the University of Maryland and Howard University where he teaches and carries out research. He has published over 100 technical articles and edited six books. Selected as the NSF Federal Engineer of the Year for 1985, Win is a Fellow of ASME and a registered Professional Engineer in the District of Columbia.

Susan T. Hill

Susan Hill is a statistician who has worked with Federal education data bases for almost 20 years. She did her undergraduate work at University of Maryland, College Park and her graduate work at George Washington University, Washington, D.C. She has been at the National Science Foundation since 1988 and has published reports on degree production in science/engineering fields.