ACT Research & Policy

Technical Brief

may 2017

Evidence for Standard Setting: Probabilities of Success in "Benchmark" College Courses, by ACT Test Scores

Jeff Allen, PhD, Justine Radunzel, PhD, and Joann Moore, PhD

Introduction

The ACT College Readiness Benchmarks are the ACT scores associated with a 50% chance of earning a B or higher grade in selected first-year credit-bearing courses at a typical postsecondary institution. The Benchmarks were established by linking ACT test scores with grades in first-year college courses from the same subject area. Benchmarks were first established for ACT English, Mathematics, Reading, and Science scores (Allen & Sconing, 2005; Allen, 2013) and have also been established for ACT STEM (Mattern, Radunzel, & Westrick, 2015; Radunzel, Mattern, Crouse, & Westrick, 2016) and ACT ELA scores (Radunzel, Westrick, Bassiri, & Li, 2017). Table 1 provides the ACT College Readiness Benchmarks and the respective college courses used to establish the Benchmarks. Students scoring at each Benchmark have a 50% chance of earning a B or higher grade in the respective course or courses at a typical postsecondary institution, and approximately a 75% chance of earning a C or higher grade. The purpose of this brief is to present the full range of course success probabilities, by ACT test score, for each of the college courses or course combinations listed in Table 1.

Table 1. ACT College Readiness Benchmarks

ACT Test Score	College Courses	Benchmark
English	English Composition I	18
Mathematics	College Algebra	22
Reading	American History, Other History, Psychology, Sociology, Political Science, Economics	22
Science	Biology	23
STEM[1]	Calculus, Chemistry, Biology, Physics, Engineering	26
ELA[2]	English Composition I, American History, Other History, Psychology, Sociology, Political Science, Economics	20

[1] The ACT STEM score is the rounded average of the ACT mathematics and science test scores.
[2] The ACT ELA score is the rounded average of the ACT English, reading, and writing scores.

Acknowledgement: The authors thank Krista Mattern and Emily Neff for their reviews and suggestions for improving this report.

Jeff Allen is a statistician in the Research division at ACT. He specializes in longitudinal research linking test scores to educational outcomes and student growth models.

Justine Radunzel is a principal research scientist in Statistical and Applied Research specializing in postsecondary outcomes research and validity evidence for the ACT® test.

Joann Moore is a research scientist in Statistical and Applied Research specializing in prediction of secondary and postsecondary outcomes from academic and non-cognitive factors.

Email research.policy@act.org for more information.

Evidence for Standard Setting

The ACT College Readiness Benchmarks can be used by states and districts as cut scores for performance levels indicating college readiness. However, rather than adopting the ACT College Readiness Benchmarks, states or districts may be interested in setting their own performance standards for the ACT test. Methods for setting performance standards (including standards for "proficient" and "college-ready") require panelists to use their professional judgment to determine what level of performance is sufficient for meeting the standard.

Traditional methods for establishing performance standards are based on content, requiring panelists to review entire tests or samples of test items. More recently, as greater emphasis has been placed on college and career readiness, empirically-based standard setting methods have become more prevalent, where the evidence upon which cut score determinations are made includes actual student success in college. Both methods require some level of professional judgment. In a content-based standard setting, the judgment typically relates to the knowledge and skills expected of a minimally college-ready student and the probability that such a student would answer a given test item correctly. For an empirically-based method such as that used to develop the ACT College Readiness Benchmarks, the judgments focus on three decisions:

- *What outcome reflects college readiness*? The Benchmarks use first-year college course grades in some of the more commonly taken courses in the same subject areas as outcomes.
- *What constitutes success in each course*? The Benchmarks use B or higher grades as the indicators of success.
- *What probability level is indicative of readiness*? The Benchmarks use a 50% chance of success as the threshold for readiness.

Because judgment was exercised in developing the ACT College Readiness Benchmarks, it would be possible for a standard setting panel to recommend a different set of college readiness cut scores, even if they based their recommendation on the same set of data used to establish the Benchmarks.

In some cases, multiple cut scores such as Basic, Proficient, and Advanced may be required. Multiple forms of evidence can be used during the standard setting process, which could include the empirical evidence used to develop the ACT College Readiness Benchmarks. The evidence supporting the Benchmarks includes the probabilities of different levels of course success (C or higher, B or higher, and A grades), by each ACT score point. These probabilities can be used to help standard setting panelists understand the relationship between potential cut scores and success in first-year college courses.

In this brief, we present the course success probabilities, by ACT test score, for each of the college courses or course combinations listed in Table 1. While the ACT research reports documenting the development of ACT Benchmarks contain some information on course success probabilities, the full ranges of probabilities across the ACT score scales are not presented consistently in both graphical and tabular format. Moreover, the research report detailing the Benchmarks for English, mathematics, reading, and science (Allen, 2013) does not include the course success probabilities obtained after weighting the sample to make it representative of the population of ACT-tested college enrollees with respect to institution type and selectivity. In this brief, we present the weighted probabilities supporting all six ACT College Readiness Benchmarks.

Course Success Probabilities

On the pages that follow, the course success probabilities are presented in graphical and then tabular format. Probabilities are presented for three levels of success (C or higher, B or higher, and A grades). The probabilities represent the chance of success at the typical postsecondary institution. As described in the cited research reports, the probabilities are derived by fitting logistic regression models with intercepts and slopes specific to institutions and courses. The logistic regression model allows us to estimate probabilities at each ACT score, even for score regions with no or very few students. In each table, we provide the sample size at each score point so the reader can identify regions of the score distributions where extrapolations are being made.

In summary, these tables and figures can be used by states and districts when considering local definitions of college readiness or for setting cut scores at other performance levels such as Basic or Advanced. ACT defines college readiness as having the knowledge and skills necessary to succeed in credit-bearing college courses without remediation. Tying performance on the ACT to predicted performance in college provides an empirical definition of college readiness that is based on actual student outcomes. Other data sources, including impact data at the state and national level and state-specific post-secondary enrollment, remediation, and longer-term college outcomes, can support the process of defining college readiness or other performance levels.

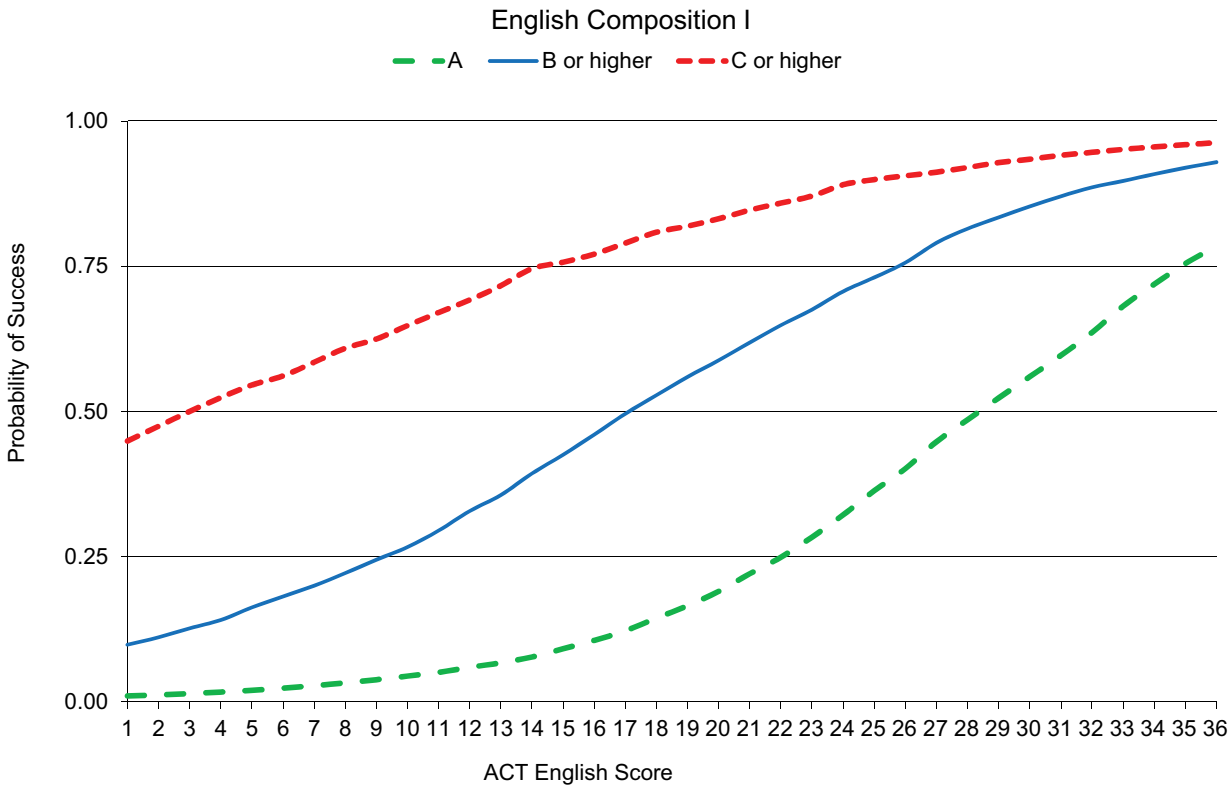

Figure 1. Probability of success in English Composition I, by ACT English score

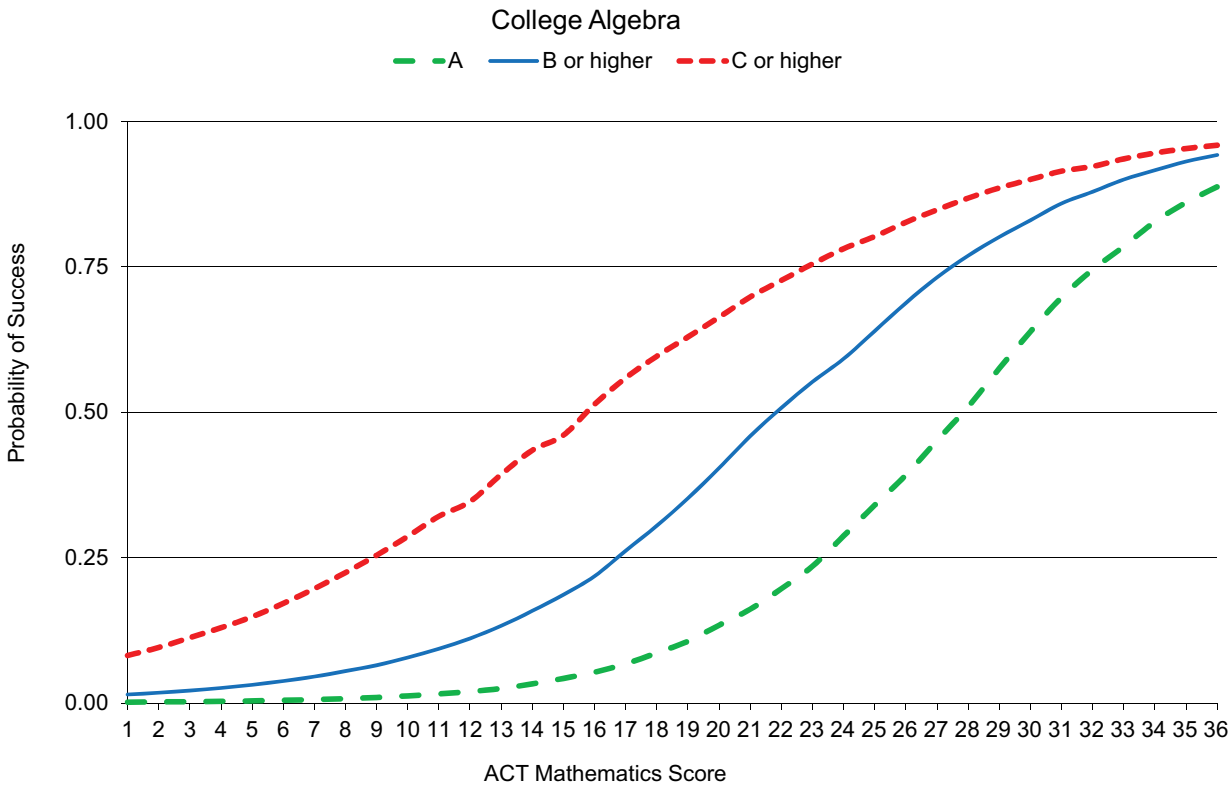

Figure 2. Probability of success in College Algebra, by ACT mathematics score

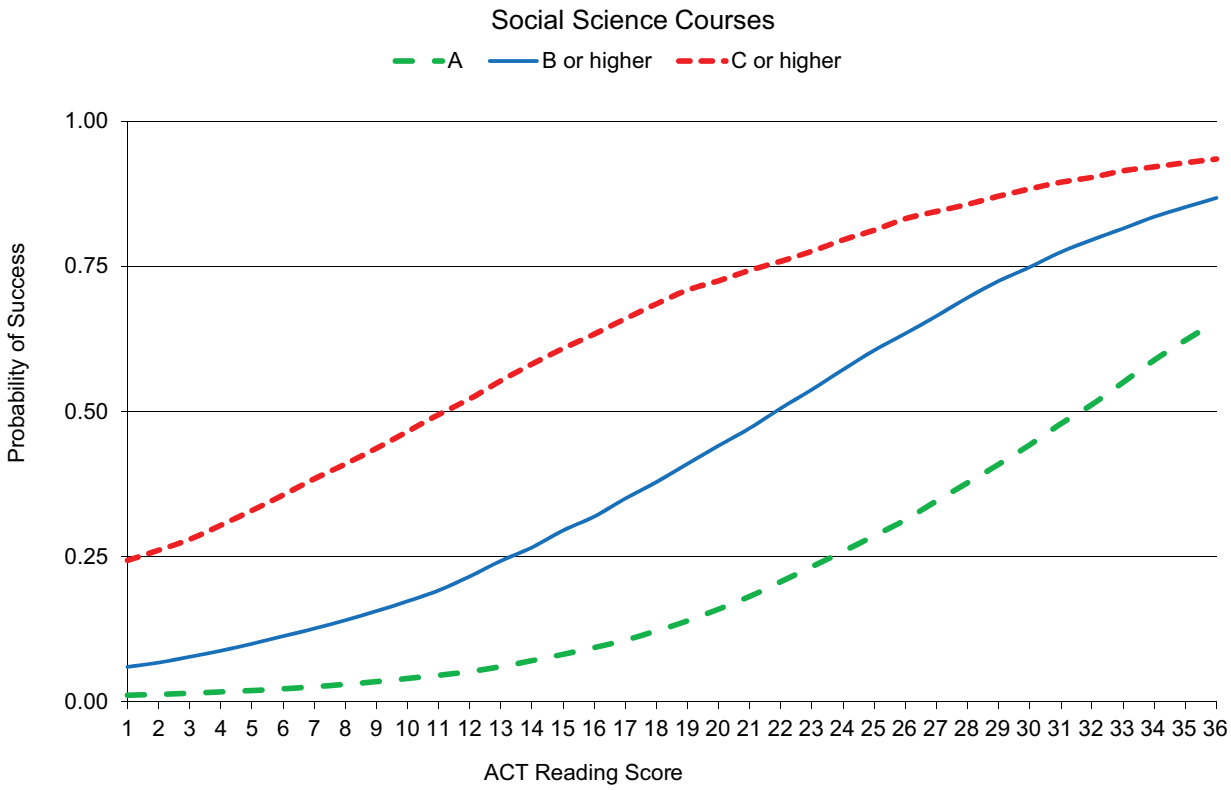

Figure 3. Probability of success in social science courses, by ACT reading score

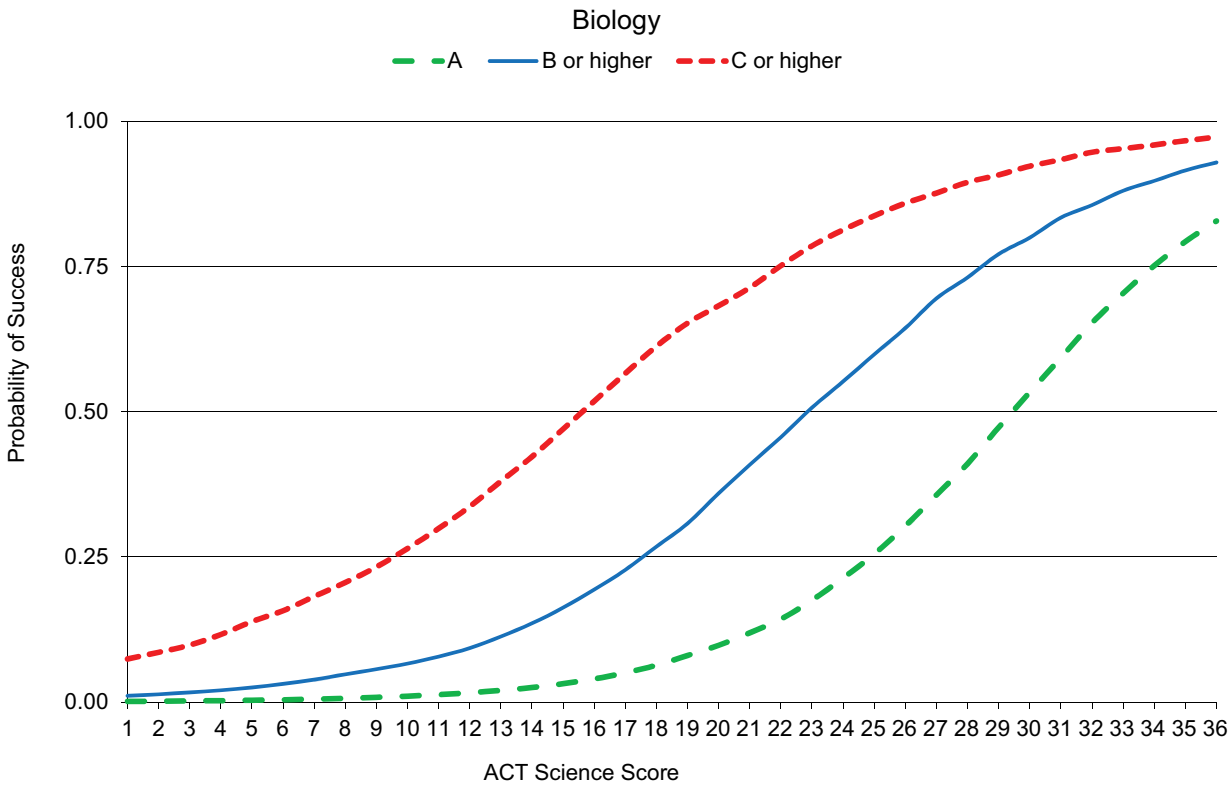

Figure 4. Probability of success in Biology, by ACT science score

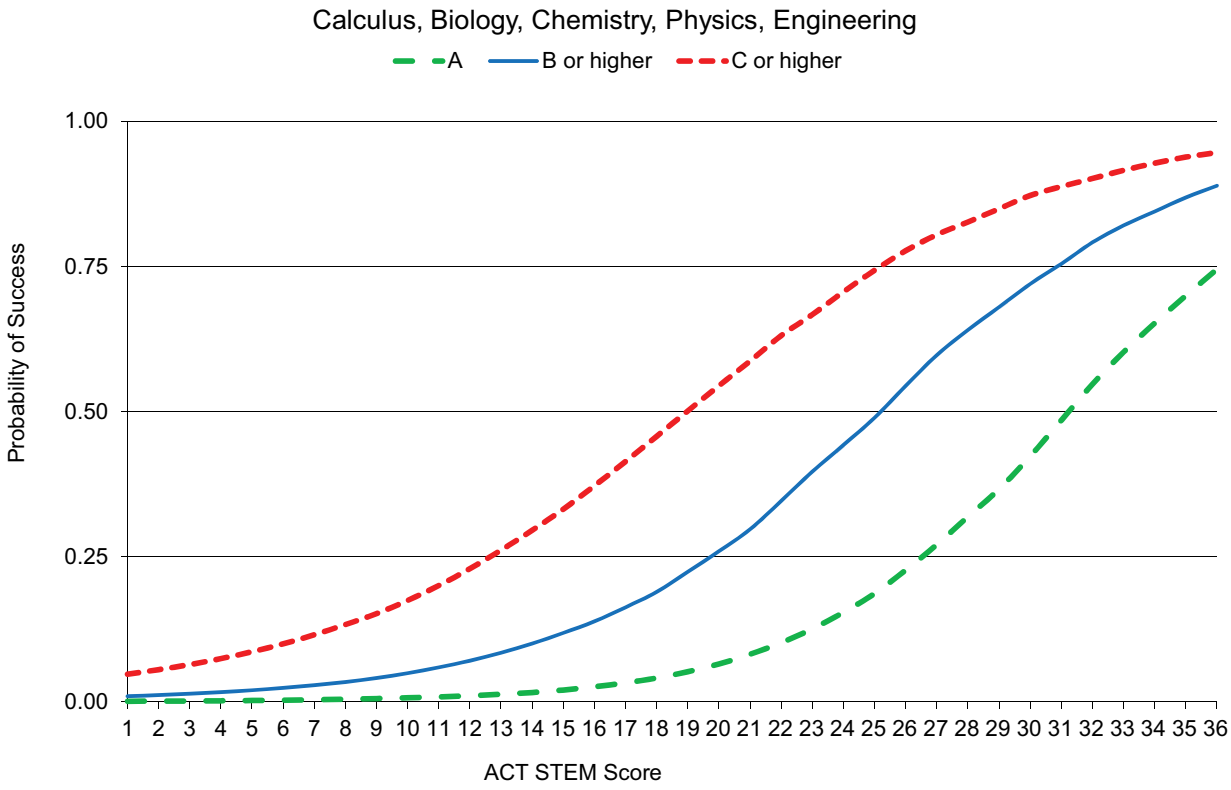

Figure 5. Probability of success in STEM courses, by ACT STEM score

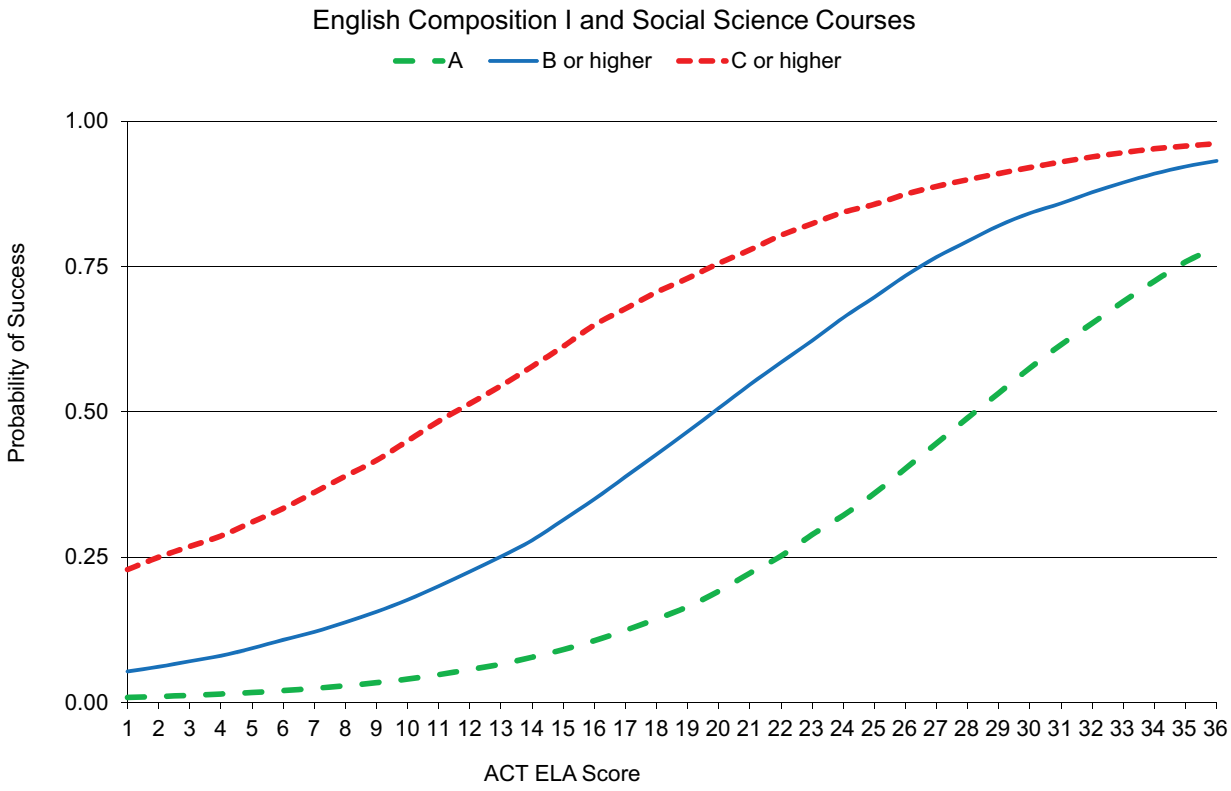

Figure 6. Probability of success in ELA courses, by ACT ELA score

Table 2. Probability of Success in English Composition I, by ACT English Score

		English Composition I Success Level		
ACT English Score	**N**	**A**	**B or higher**	**C or higher**
1	0	0.010	0.098	0.449
2	0	0.012	0.111	0.474
3	1	0.014	0.126	0.500
4	5	0.017	0.141	0.524
5	9	0.020	0.162	0.545
6	33	0.023	0.181	0.561
7	109	0.028	0.200	0.585
8	373	0.032	0.221	0.609
9	498	0.038	0.244	0.625
10	888	0.044	0.266	0.648
11	1,234	0.051	0.295	0.670
12	1,511	0.059	0.328	0.692
13	2,023	0.067	0.356	0.716
14	3,531	0.077	0.393	0.746
15	5,489	0.091	0.425	0.757
16	5,879	0.106	0.460	0.771
17	5,858	0.122	0.496	0.790
18	6,558	0.144	0.528	0.808
19	8,466	0.165	0.559	0.819
20	9,828	0.190	0.588	0.832
21	9,499	0.220	0.618	0.847
22	7,869	0.249	0.648	0.859
23	5,659	0.283	0.675	0.871
24	5,248	0.322	0.706	0.890
25	4,839	0.363	0.730	0.899
26	3,163	0.401	0.756	0.905
27	2,067	0.448	0.790	0.912
28	1,865	0.486	0.814	0.920
29	1,358	0.523	0.834	0.928
30	927	0.560	0.853	0.934
31	628	0.596	0.870	0.941
32	407	0.636	0.886	0.946
33	297	0.681	0.897	0.951
34	306	0.719	0.908	0.955
35	138	0.754	0.919	0.959
36	20	0.784	0.929	0.963

Table 3. Probability of Success in College Algebra, by ACT Mathematics Score

ACT Mathematics Score	N	College Algebra Success Level		
		A	B or higher	C or higher
1	0	0.001	0.014	0.082
2	0	0.002	0.018	0.095
3	0	0.002	0.021	0.112
4	0	0.003	0.026	0.129
5	0	0.003	0.031	0.148
6	0	0.004	0.038	0.171
7	0	0.006	0.045	0.197
8	1	0.007	0.055	0.224
9	2	0.009	0.065	0.254
10	4	0.012	0.078	0.286
11	13	0.016	0.093	0.321
12	65	0.020	0.111	0.346
13	236	0.025	0.133	0.393
14	803	0.033	0.158	0.434
15	2,095	0.042	0.186	0.460
16	4,757	0.053	0.218	0.513
17	6,044	0.067	0.262	0.559
18	5,978	0.086	0.305	0.596
19	6,870	0.106	0.352	0.629
20	6,467	0.134	0.404	0.663
21	6,474	0.161	0.459	0.698
22	5,670	0.196	0.507	0.726
23	5,853	0.235	0.552	0.755
24	5,985	0.287	0.592	0.781
25	4,232	0.340	0.639	0.802
26	3,313	0.392	0.688	0.826
27	2,204	0.451	0.732	0.848
28	1,261	0.509	0.769	0.868
29	877	0.575	0.801	0.885
30	389	0.638	0.830	0.900
31	306	0.697	0.859	0.914
32	199	0.745	0.879	0.922
33	159	0.785	0.900	0.935
34	138	0.827	0.916	0.945
35	55	0.860	0.931	0.953
36	14	0.887	0.942	0.959

Table 4. Probability of Success in Social Science Courses, by ACT Reading Score

		Social Science Course Success Level		
ACT Reading Score	**N**	**A**	**B or higher**	**C or higher**
1	0	0.011	0.060	0.243
2	1	0.013	0.067	0.261
3	1	0.015	0.077	0.280
4	0	0.017	0.088	0.304
5	10	0.019	0.100	0.329
6	22	0.022	0.113	0.356
7	45	0.026	0.126	0.384
8	62	0.030	0.140	0.409
9	127	0.035	0.156	0.436
10	417	0.040	0.173	0.465
11	1,112	0.046	0.192	0.494
12	2,504	0.052	0.216	0.521
13	3,519	0.060	0.242	0.553
14	5,799	0.071	0.266	0.581
15	5,285	0.082	0.295	0.608
16	7,362	0.093	0.319	0.633
17	8,085	0.106	0.350	0.659
18	6,972	0.122	0.378	0.685
19	10,009	0.139	0.410	0.709
20	11,775	0.159	0.441	0.725
21	9,456	0.181	0.471	0.743
22	8,680	0.207	0.505	0.758
23	10,794	0.232	0.538	0.776
24	8,856	0.259	0.572	0.795
25	7,036	0.286	0.605	0.812
26	6,818	0.313	0.634	0.832
27	6,041	0.346	0.664	0.844
28	5,232	0.377	0.696	0.856
29	4,452	0.409	0.724	0.870
30	4,030	0.442	0.748	0.883
31	3,453	0.479	0.774	0.894
32	2,391	0.512	0.795	0.903
33	2,209	0.550	0.815	0.914
34	1,716	0.588	0.835	0.921
35	980	0.622	0.852	0.928
36	568	0.654	0.867	0.934

Table 5. Probability of Success in Biology, by ACT Science Score

		Biology Success Level		
ACT Science Score	**N**	**A**	**B or higher**	**C or higher**
1	1	0.001	0.011	0.074
2	0	0.002	0.013	0.086
3	1	0.002	0.017	0.098
4	0	0.002	0.020	0.116
5	0	0.003	0.025	0.138
6	3	0.004	0.031	0.157
7	3	0.005	0.039	0.182
8	21	0.006	0.048	0.206
9	51	0.008	0.057	0.232
10	149	0.010	0.066	0.264
11	235	0.013	0.078	0.299
12	340	0.016	0.093	0.337
13	468	0.020	0.113	0.380
14	587	0.025	0.136	0.422
15	826	0.032	0.162	0.470
16	1,339	0.040	0.194	0.518
17	1,832	0.051	0.227	0.566
18	2,858	0.063	0.268	0.612
19	3,770	0.080	0.307	0.652
20	4,615	0.098	0.359	0.682
21	4,345	0.119	0.408	0.713
22	4,231	0.143	0.456	0.751
23	3,787	0.175	0.507	0.785
24	3,349	0.213	0.552	0.813
25	2,585	0.255	0.598	0.837
26	2,205	0.303	0.644	0.859
27	1,226	0.356	0.695	0.876
28	849	0.410	0.731	0.895
29	569	0.473	0.771	0.907
30	335	0.533	0.799	0.922
31	345	0.593	0.834	0.934
32	221	0.653	0.855	0.946
33	210	0.703	0.880	0.952
34	130	0.751	0.897	0.959
35	111	0.792	0.915	0.966
36	57	0.828	0.929	0.972

Table 6. Probability of Success in STEM Courses, by ACT STEM Score

		STEM Course Success Level		
ACT STEM Score	**N**	**A**	**B or higher**	**C or higher**
1	0	0.001	0.010	0.048
2	0	0.001	0.012	0.056
3	0	0.002	0.014	0.064
4	0	0.002	0.017	0.075
5	0	0.002	0.020	0.086
6	0	0.003	0.024	0.100
7	0	0.004	0.029	0.116
8	0	0.005	0.034	0.133
9	0	0.006	0.041	0.152
10	3	0.007	0.050	0.175
11	11	0.009	0.059	0.200
12	50	0.011	0.071	0.229
13	164	0.013	0.085	0.261
14	356	0.016	0.101	0.295
15	708	0.020	0.119	0.332
16	1,312	0.026	0.139	0.372
17	2,148	0.033	0.163	0.414
18	3,287	0.041	0.189	0.457
19	4,237	0.052	0.224	0.501
20	4,815	0.065	0.259	0.544
21	5,434	0.082	0.297	0.587
22	6,245	0.102	0.346	0.630
23	7,082	0.126	0.396	0.667
24	8,123	0.154	0.442	0.706
25	8,400	0.186	0.489	0.743
26	8,007	0.227	0.544	0.777
27	6,639	0.271	0.597	0.804
28	5,068	0.319	0.640	0.826
29	3,845	0.366	0.680	0.849
30	2,965	0.423	0.719	0.872
31	2,206	0.485	0.754	0.887
32	1,554	0.547	0.791	0.901
33	1,036	0.602	0.820	0.915
34	742	0.652	0.844	0.927
35	387	0.699	0.868	0.938
36	95	0.745	0.889	0.946

Table 7. Probability of Success in ELA Courses, by ACT ELA Score

		ELA Course Success Level		
ACT ELA Score	**N**	**A**	**B or higher**	**C or higher**
1	0	0.009	0.053	0.229
2	0	0.010	0.061	0.250
3	0	0.012	0.071	0.268
4	0	0.015	0.080	0.286
5	5	0.017	0.093	0.310
6	12	0.020	0.108	0.334
7	62	0.024	0.121	0.361
8	107	0.029	0.138	0.389
9	210	0.034	0.156	0.417
10	399	0.040	0.177	0.450
11	862	0.048	0.200	0.484
12	1,514	0.057	0.225	0.514
13	2,790	0.066	0.251	0.545
14	4,563	0.078	0.279	0.578
15	6,909	0.091	0.314	0.612
16	9,751	0.106	0.350	0.649
17	12,198	0.124	0.388	0.677
18	14,957	0.144	0.427	0.706
19	17,103	0.165	0.466	0.730
20	18,279	0.191	0.506	0.755
21	18,398	0.222	0.547	0.778
22	17,559	0.252	0.585	0.804
23	15,862	0.289	0.622	0.824
24	13,449	0.322	0.662	0.843
25	11,268	0.360	0.697	0.857
26	9,139	0.402	0.734	0.874
27	7,244	0.446	0.766	0.888
28	5,432	0.490	0.793	0.899
29	3,889	0.532	0.820	0.910
30	2,614	0.575	0.842	0.920
31	1,743	0.615	0.859	0.930
32	1,033	0.652	0.878	0.938
33	633	0.689	0.894	0.946
34	252	0.725	0.909	0.952
35	37	0.758	0.922	0.957
36	2	0.783	0.932	0.961

Note. The sample used to develop the ACT ELA Benchmark was comprised of students who had taken the former ACT Writing test. Students' ACT ELA scores were estimated by calculating the rounded average of the ACT English, reading, and concorded writing scores.

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