

## Technical Appendix A1: Completion Probability and Student Quality

*High school completion.* Over the last two decades, about 25% of high school students failed to graduate on time.<sup>1</sup> Many of these dropouts eventually pass a high school equivalency test such as the GED. For practical purposes, however, a GED is *not* equivalent to high school graduation. Indeed, the labor market treats GED holders as if they were high school dropouts.<sup>2</sup> In the end, about 20% of American adults never earn a standard high school diploma.<sup>3</sup>

How should we expect Excellent, Good, Fair, and Poor Students to compare to the average? Hundreds of studies statistically analyze high school completion.<sup>4</sup> Unfortunately, only a small minority provide enough details to allow readers to calculate completion probabilities by type of student.<sup>5</sup> Furthermore, major data sets often inappropriately pool GEDs with regular high school graduates.<sup>6</sup> In the end, I rely on Herrnstein and Murray's analysis of high school graduation in the NLSY.<sup>7</sup> They provide enough information to compute exact probabilities – and separately analyze high school dropouts and GEDs. Despite their controversial reputation, their results on this topic are quite mainstream.<sup>8</sup>

Herrnstein and Murray use cognitive ability and parental socio-economic status to predict probabilities of (a) permanently dropping out of high school, and (b) earning a GED instead of a regular diploma.<sup>9</sup> To derive a four-year non-completion rate from overall non-completion rate, I assume the observed *ratio* of four-year non-completion to overall non-completion ( $25\%/20\%=1.25$ ) does not vary by student ability.

How can we use Herrnstein and Murray's equations to calculate high school completion probabilities for my four archetypes? For cognitive ability, I plug in my standard percentiles: 82<sup>nd</sup> percentile for Excellent Students, 73<sup>rd</sup> for Good, 41<sup>st</sup> for Fair, 24<sup>th</sup> for Poor.<sup>10</sup> What about socio-economic status? In the NLSY, cognitive ability and socio-economic status have a .552

correlation. I use this correlation to derive students' predicted socio-economic status from their cognitive ability. Table A1 brings all the results together.

**Table A1: High School Completion Probabilities by Student Ability**

	Permanently Quits High School	Gets GED Instead of High School Diploma	Gets Diploma in Four Years
Excellent Student	0.9%	4.1%	93.8%
Good Student	1.6%	5.0%	91.7%
Fair Student	8.4%	9.1%	78.1%
Poor Student	20.1%	12.6%	59.1%
Source: Herrnstein, Richard, and Charles Murray. 1994. <i>The Bell Curve: Intelligence and Class Structure in American Life</i> . NY: The Free Press, pps.146-51, 597-8.			

By default, this book analyzes rates of return for “balanced” populations – half male, half female. Since young males slightly outnumber females, Table A1’s probabilities are not quite right. To get the right numbers, we must separately compute returns for men and women, then take the average. While Herrnstein and Murray do not report high school diploma results down by gender, both of their predictors – cognitive ability and parental socio-economic status – are uncorrelated with gender. As a result, we can plausibly adjust their predicted success rates to fit the latest cohort’s real-world gender gap: 3.9% below-average for men, 4.2% above-average for women, then take the average to get balanced completion probabilities.<sup>11</sup>

**Table A2: Four-Year High School Completion Probabilities by Student Ability and Sex**

	Men	Women	Balanced
Excellent Student	90.9%	97.8%	94.4%
Good Student	88.9%	95.6%	92.3%
Fair Student	75.7%	81.4%	78.6%
Poor Student	57.3%	61.6%	59.5%
<i>Source:</i> Herrnstein, Richard, and Charles Murray. 1994. <i>The Bell Curve: Intelligence and Class Structure in American Life</i> . NY: The Free Press, pps.146-51, 597-8, adjusted by percentage gender gaps from See Heckman, James, and Paul LaFontaine. 2010. "The American High School Graduation Rate: Trends and Levels." <i>Review of Economics and Statistics</i> 92, pp.254, Table 3, latest cohort (born 1976-80)			

*B.A. Completion.* Finishing college is a far more challenging than finishing high school. At first glance, the Department of Education's numbers show that success is unbelievably rare. Out of students who started four-year public institutions in 2005, a measly 32% finished on time, and only 56% finished in *six* years.<sup>12</sup> However, these numbers are misleading in two big ways. First, they only count graduation from students' *initial* colleges, even though many students transfer. Second, they lump full- and part-time students together. Nobody sensible expects a part-time student to earn a B.A. in four years.

Fortunately, the National Student Clearinghouse (NSC), an association that includes virtually all American institutions of higher education, has recently created a huge and comprehensive data set (over two million students!) that handles both problems. Out of full-time students who started at four-year public institutions in 2007, the NSC reports that 72% possessed a

bachelor's degree from that school six years later. 82%, however, possessed a bachelor's degree from *somewhere*.<sup>13</sup> That's far above 56%, but still implies that *most* full-time students fail to finish their degree on time.

To repeat, that's an average. How should we expect my student archetypes to measure up? Once again, many studies statistically analyze college completion, but few provide enough details to allow readers to calculate completion probabilities by type of student.<sup>14</sup> Even the best studies typically lump full- and part-time students together, and use twentieth-century data.<sup>15</sup> In the end, I rely on UCLA's Higher Education Research Institute's (HERI) analysis of the NSC numbers.<sup>16</sup> In particular, I use HERI's simple model that predicts full-time students' four-year completion as a function of SAT scores and high school GPA. For SAT scores, I plug in my standard percentiles – 82<sup>nd</sup> for Excellent Students, 73<sup>rd</sup> for Good, 41<sup>st</sup> for Fair, and 24<sup>th</sup> for Poor.<sup>17</sup> For GPA, I assign Excellent Students an "A+/A," Good Students a B+, Fair Students a C+, and Poor Students a D. Although the NSC data takes student transfers into account, HERI's analysis does not.<sup>18</sup> To remedy this problem, I raise HERI's probabilities by 14%.<sup>19</sup> Table A3 reports results broken down by gender, along with the implied balance results.

**Table A3: Transfer-Corrected Four-Year College Completion Probabilities by Student Ability and Sex**

	Men	Women	Balanced
Excellent Student	58.8%	74.1%	66.5%
Good Student	36.1%	50.9%	43.5%
Fair Student	10.8%	17.6%	14.2%
Poor Student	4.5%	7.7%	6.1%
<i>Source:</i> DeAngelo et al., “Completing College: Assessing Graduation Rates at Four-Year Institutions,” p.17, Table 8, model 3, and National Student Clearinghouse Research Center, “Completing College,” Table 2.			

*Master’s degree completion.* While data on master’s completion is sparse, the overall rate for graduate and professional school is a mere 50%.<sup>20</sup> Researchers often focus on specific types of programs, including law degree, medical degrees, and Ph.D.s.<sup>21</sup> Rare wider-ranging studies often fail to report enough details to allow readers to calculate completion probabilities by type of student.<sup>22</sup>

Given these lacunae, I simply assign Excellent Students the average completion rate of 50%. This may seem odd. If advanced degree students are a mixture of Excellent, Good, Fair, and Poor, shouldn’t the Excellent have *above-average* success rates? But remember: Excellent Students by construction fit the profile of the average person with an advanced degree, so some students *must* be better than Excellent. To fill in the rest of the table, I assume that completion probabilities are proportional to those in Table A3. Table A4 brings the results together.

**Table A4: Two-Year Master's Completion Probabilities by Student Ability and Sex**

	Men	Women	Balanced
Excellent Student	44.2%	55.7%	50.0%
Good Student	27.1%	38.3%	32.7%
Fair Student	8.1%	13.2%	10.7%
Poor Student	3.4%	5.8%	4.6%
<i>Source:</i> Balanced sample of Excellent Students are assigned the average of 50%; other probabilities are proportional to those in Table A3.			

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**Notes**

<sup>1</sup> Digest of Education Statistics 2012, Table 124.

<sup>2</sup> See especially Heckman, James, John Humphries, and Tim Kautz. 2014. *The Myth of Achievement Tests: The GED and the Role of Character in American Life*. Chicago: University of Chicago Press.

<sup>3</sup> See Heckman, James, and Paul LaFontaine. 2010. "The American High School Graduation Rate: Trends and Levels." *Review of Economics and Statistics* 92, pp.253-9.

<sup>4</sup> See generally Rumberger, Russell. 2011. *Dropping Out: Why Students Drop Out of High School and What Can Be Done About It*. Cambridge: Harvard University Press. For an encyclopedic literature review, see Rumberger, Russell, and Sun Ah Lim. October 2008. "Why Students Drop Out of School: A Review of 25 Years of Research." California Dropout Research Project.

<sup>5</sup> In particular, most papers either fail to report their constants, or control for student traits (including academic performance) without reporting their coefficients. These are understandable decisions given the authors' research focus, but it renders their research useless for estimating completion probabilities.

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<sup>6</sup> Data sets that lump ordinary high school graduates together with GEDs include the Current Population Survey and the General Social Survey.

<sup>7</sup> See Herrnstein, Richard, and Charles Murray. 1994. *The Bell Curve: Intelligence and Class Structure in American Life*. NY: The Free Press, pps.146-51, 597-8.

<sup>8</sup> For example, Belley, Philippe, and Lance Lochner. 2007. "The Changing Role of Family Income and Ability in Determining Educational Achievement." *Journal of Human Capital* 1, pp.47, break NLSY results down by AFQT quartiles, with very similar results.

<sup>9</sup> Herrnstein and Murray's GED results exclude respondents who obtained neither a high school diploma or GED – about 10% of the population. To derive the fraction of the overall population with a GED, I therefore multiply their estimates by .9.

<sup>10</sup> To be more precise, I plug in the z-scores associated with these percentiles.

<sup>11</sup> Heckman and LaFontaine. 2010, p. "The American High School Graduation Rate: Trends and Levels." *Review of Economics and Statistics* 92, pp.254, Table 3, column for cohort born 1976-1980.

<sup>12</sup> The *Digest of Education Statistics*, Table 376.

<sup>13</sup> "Completing College: A State-Level View of Student Attainment Rates." *National Student Clearinghouse Research Center*. Tables 1 and 2, p.9, 11.

<sup>14</sup> The problem, again, is that papers either fail to report their constants, or control for student traits (including academic performance) without reporting their coefficients.

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<sup>15</sup> See especially Bound, John, Michael Lovenheim, and Sarah Turner. 2010. "Why Have College Completion Rates Declined? An Analysis of Changing Student Preparation and Collegiate Resources." *American Economic Journal: Applied Economics* 2, pp.129-57; and Light, Audrey, and Wayne Strayer. 2000. "Determinants of College Completion: School Quality or Student Ability?" *Journal of Human Resources* 35, pp.299-332.

<sup>16</sup> DeAngelo, Linda, Ray Franke, Sylvia Hurtado, John Pryor, and Serge Tran. 2011. "Completing College: Assessing Graduation Rates at Four-Year Institutions." Higher Education Research Institute at UCLA.

<sup>17</sup> DeAngelo et al. use combined verbal and math SAT scores. I convert my percentiles to their SAT scores using the College Board's "Interpreting and Using SAT Scores." URL [http://www.collegeboard.com/prod\\_downloads/counselors/hs/sat/resources/handbook/4\\_InterpretingScores.pdf](http://www.collegeboard.com/prod_downloads/counselors/hs/sat/resources/handbook/4_InterpretingScores.pdf)

<sup>18</sup> As DeAngelo et al. p.6 explain, "Similar to previous HERI studies, we have limited this analysis to degree completion at the institution of initial enrollment... We acknowledge, however, that a small percentage of students transfer and graduate from institutions other than the institution where they initially enroll, and that in the dataset for this study these students would be considered 'dropouts.' Forthcoming studies from HERI using this dataset will comprehensively examine the population of students who transfer and graduate from institutions other than where they initially enroll..."

<sup>19</sup> In the NSC data, the total six-year completion rate of 82% exceeds the "first completion at starting institution" of 72% by 14%.

<sup>20</sup> Strayhorn, Terrell. 2010. "Money Matters: The Influence of Financial Factors on Graduate Student Persistence." *Journal of Student Financial Aid* 40, p.4 summarizes the evidence. The 50% rate includes part-time students who almost certainly have below-average completion rates. At the same time,



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however, an eventual completion rate of 50% implies a much lower *on-time* completion rate. Given these offsetting factors and the sparseness of the evidence, I just treat the 50% graduation rate as the on-time rate.

Perna, Laura. 2004. "Understanding the Decision to Enroll in Graduate School: Sex and Racial/Ethnic Group Differences." *Journal of Higher Education* 75, pp.487-527 and Mullen, Ann, Kimberly Goyette, and Joseph Soares. 2003. "Who Goes to Graduate School? Social and Academic Correlates of Educational Continuation After College." *Sociology of Education* 76, pp.143-169 both confirm that strong undergraduates are much more likely to go to graduate school.

<sup>21</sup> See e.g. Rothstein, Jesse, and Albert Yoon. 2006. "Mismatch in Law School." NBER Working Paper #14275; Callahan, Clara, Mohammadreza Hojat, Jon Veloski, Jams Erdmann, and Joseph Gonnella. 2010. "The Predictive Validity of Three Versions of the MCAT in Relation to Performance in Medical School, Residency, and Licensing Examinations: A Longitudinal Study of 36 Classes of Jefferson Medical College." *Academic Medicine* 85, pp.980-7; and Bair, Carolyn, and Jennifer Haworth. 2004. "Doctoral Student Attrition and Persistence: A Meta-Synthesis of Research." In Smart, J.C., ed. *Higher Education: Handbook of Theory and Research* 19, pp.481-534.

<sup>22</sup> Strayhorn 2010, pp.8-13, confirms that poor undergraduate performance strongly predicts graduate school dropout. But he does not report constants for his logistic regressions. Luan, Jing, and Robert Fenske. 1996. "Financial Aid, Persistence, and Degree Completion in Master's Degree Programs." *Journal of Student Financial Aid* 26, pp.17-31 reports constants, but lacks measures of student quality.