Online Appendix

Not For Publication

Table A1: Descriptive Statistics, Full Sample

	Mean	Std.Dev	Min	Max
	(1)	(2)	(3)	(4)
I. Student Characteristics				
11^{th} Grade				
Female	0.563	0.496	0	1
Total Absences (in Hours)	50.851	27.425	1	450
Prop. of Students in Classics	0.366	0.482	0	1
Prop. of Students in Science	0.280	0.449	0	1
Prop. of Students in Exact Science	0.344	0.475	0	1
GPA 11^{th} Grade	72.335	14.159	0	100
12^{th} Grade				
Total Absences (in Hours)	73.443	30.752	1	208
Prop. of Students in Classics	0.369	0.483	0	1
Prop. of Students in Science	0.159	0.366	0	1
Prop. of Students in Exact Science	0.463	0.499	0	1
GPA 12^{th} Grade	76.976	12.526	44	100
II. School Characteristics				
Private School	0.037	0.190	0	1
Experimental School	0.044	0.207	0	1
Public School	0.919	0.275	0	1
Urban	0.896	0.306	0	1
Postcode Income (in 2009 Euro)	22455.029	7945.331	11784.5	66521.38
II. University Enrollment Characteristics				
National Exams Average Score	64.987	20.178	10.35	99.3
Retake the National Exams	0.113	0.317	0	1
Number of University Departments in Preference List	25.014	22.071	1	257
Rank in Preference List of the Actual University Attended	8.399	10.616	1	242
Enrollment in University or Vocational Schooling	0.817	0.386	0	1
Exact Science Department	0.153	0.360	0	1
Science Apartment	0.042	0.201	0	1
Humanities Department	0.193	0.395	0	1
Social Science Department	0.220	0.414	0	1
Vocational Schooling	0.209	0.407	0	1

Note: All statistics reported include students who graduate from high school between 2003 and 2011. Total absences are measured in hours per year. *GPA11* and *GPA12* include the average over the school exam scores in the first and second term, in 11^{th} and 12^{th} grade. The full sample of schools is used. There are three types of schools in the sample: public, private, and experimental schools. Experimental are public schools and school admission is based on a lottery for the sample years. A school is located in an urban area if the area has more than 20,000 inhabitants. Postcode income is expressed in 2009 Euro.

Table A2: Random Assignment: Balancing Test of Student Characteristics and Teacher Characteristics by Student Gender

	Girls			Boys		
	(1)	(2)	(3)	(4)	(5)	(6)
	Student Prior Performance	Student Age	Class Size	Student Prior Performance	Student Age	Class Size
Female Teacher (=1 if Female)	0.058	0.017	-0.258*	0.029	-0.014	-0.128
	(0.039)	(0.012)	(0.143)	(0.042)	(0.013)	(0.193)
Obs.	10,351	10,351	10,351	7,612	7,612	7,612
Teacher Previous Year Quality	0.100	-0.054	0.726	0.228	-0.020	1.146
	(0.147)	(0.050)	(0.615)	(0.177)	(0.042)	(0.954)
Obs.	10,349	10,349	10,349	7,612	7,612	7,612
Teacher Experience	0.006	-0.002*	0.008	-0.000	0.000	-0.020
	(0.004)	(0.001)	(0.014)	(0.003)	(0.001)	(0.022)
Obs.	10,351	10,351	10,351	7,612	7,612	7,612
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Grade FE	Yes	Yes	Yes	Yes	Yes	Yes
Class FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The table presents the estimated effects from separate regressions of each of the student pre-assignment characteristics and prior test scores on teacher gender (1=female), teacher previous year quality, and teacher experience. Each estimate in this table is generated from a different regression. Student test scores are standardized and have a zero mean and a standard deviation of one. All regressions condition on subject fixed effects, year fixed effects, grade fixed effects, and class fixed effects. Robust standard errors clustered at the class level are reported in parentheses.

Table A3: Random Assignment: Balancing Test of Teacher Characteristics and Student Characteristics by Student Gender

	Girls Female Teacher	Boys Female Teacher	Girls Previous TVA	Boys Previous TVA	Girls Teacher Experience	Boys Teacher Experience
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged Test Score	0.006	0.003	0.000	0.001	0.062	-0.007
	(0.004)	(0.004)	(0.001)	(0.001)	(0.040)	(0.043)
Class Size	-0.010*	-0.004	0.001	0.002	0.037	-0.094
	(0.006)	(0.007)	(0.001)	(0.002)	(0.071)	(0.102)
Age	0.006	-0.003	-0.001	0.000	-0.082*	-0.006
	(0.004)	(0.002)	(0.001)	(0.000)	(0.049)	(0.030)
Observations	10,351	7,612	10,349	7,612	10,351	7,612
Grade FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Class FE	Yes	Yes	Yes	Yes	Yes	Yes
Mean of Y Variable	0.35	0.32	-0.00	-0.00	9.92	10.00
F-statistics	3.43	1.12	1.03	1.05	1.21	0.30
P-value of the F-model	0.02	0.34	0.38	0.37	0.31	0.83

Notes: All estimates in each column are generated from the same regression. The table reports OLS estimates from separate regressions of each of the remaining teacher characteristics on all student pre-assignment characteristics and class size, separately by student gender. Estimated effects for female students are shown in column (1) and for male students in column (2). A student's pre-assignment characteristics are prior test scores, and age. The remaining teacher characteristics are the following: a teacher's gender (1=female), a teacher previous year quality (measured by previous year's value added), and experience (measured by how many times a teacher teaches in the whole sample period 2003-2011). All regressions include class fixed effects, year fixed effects and grade fixed effects. Robust standard errors clustered at the class level are reported in parentheses.

Table A4: Effect of 12^{th} Grade Teacher Bias on National Exam Score in 11^{th} Grade

	Boys				Girls			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: All Subjects								
	0.189	-0.032	-0.016	-0.072	-0.022	-0.111	0.171	0.262
	(0.260)	(0.234)	(0.248)	(0.358)	(0.223)	(0.196)	(0.210)	(0.325)
Sample Size	15,932	15,932	15,932	15,908	18,712	18,712	18,712	18,670
Panel B: Core Subjects								
	0.368	0.190	-0.024	-0.095	0.160	0.052	-0.262	0.274
	(0.260)	(0.234)	(0.248)	(0.358)	(0.223)	(0.196)	(0.210)	(0.325)
Sample Size	5,438	5,438	5,438	5,434	6,763	6,763	6,763	6,756
Panel C: Classics Subjects								
	0.100	-0.040	-0.035	-1.011	-0.346	-0.436	-0.219	0.174
	(0.445)	(0.401)	(0.374)	(1.042)	(0.277)	(0.249)	(0.256)	(0.467)
Sample Size	2,517	2,517	2,517	2,389	8,760	8,760	8,760	8,745
Panel D: Science Subjects								
	0.864	0.780	0.833	1.524	0.297	0.159	0.530	-0.309
	(0.445)	(0.401)	(0.374)	(1.042)	(0.277)	(0.249)	(0.256)	(0.467)
Sample Size	3,607	3,607	3,607	3,522	4,370	4,370	4,370	4,268
Panel E: Exact Science Subjects								
	0.061	-0.082	0.028	-0.314	0.201	0.016	0.492	0.892
	(0.279)	(0.263)	(0.288)	(0.403)	(0.295)	(0.264)	(0.269)	(0.605)
Sample Size	9,606	9,606	9,606	9,548	5,374	5,374	5,374	5,246
Subject FE	✓	✓	✓		✓	✓	✓	
Year FE	✓	✓	✓		✓	✓	✓	
School FE		✓				✓		
Class FE			✓				✓	
School-by-Subject-by-Year FE				✓				✓

Notes: The datasets for the core subjects and each of the track subjects include stacked observations for each subject/exam. The estimation is based on the sample of 21 schools. Each row presents estimates from a separate regression using an empirical Bayes estimation strategy. The standard errors are reported in parentheses and are corrected using a two-step bootstrapping method. This process of two-step bootstrap sampling and estimation is repeated 1,000 times. All specifications include the teacher's gender as control. A student's 11^{th} grade subject-specific national exam performance is used as an outcome. The variable of interest is the teacher gender bias in 12^{th} grade. The first panel includes all subjects. The second panel includes all core subjects. Panel C includes all classics track subjects. Panel D includes all science track subjects. Panel E includes all exact science track subjects. Standard errors are also clustered by class.

Table A5: Effect of 12^{th} Grade Teacher Bias on School Exam Score in 11^{th} Grade

	Boys				Girls			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: All Subjects								
	0.368	0.166	0.015	-0.130	0.112	0.067	0.025	-0.014
	(0.169)	(0.131)	(0.134)	(0.236)	(0.122)	(0.111)	(0.125)	(0.185)
Sample Size	16,126	16,126	16,126	16,102	18,955	18,955	18,955	18,913
Panel B: Core Subjects								
	0.172	0.042	-0.184	-0.158	-0.016	-0.021	-0.280	-0.028
	(0.208)	(0.182)	(0.179)	(0.242)	(0.164)	(0.153)	(0.175)	(0.188)
Sample Size	5,438	5,438	5,438	5,434	6,763	6,763	6,763	6,756
Panel C: Classics Subjects								
	0.137	0.001	-0.091	-0.757	-0.081	-0.078	-0.029	0.062
	(0.273)	(0.229)	(0.217)	(0.737)	(0.168)	(0.158)	(0.174)	(0.284)
Sample Size	2,559	2,559	2,559	2,431	8,882	8,882	8,882	8,867
Panel D: Science Subjects								
	0.513	0.382	0.042	0.360	0.133	0.094	-0.087	-0.354
	(0.226)	(0.219)	(0.254)	(0.527)	(0.169)	(0.162)	(0.193)	(0.445)
Sample Size	3,680	3,680	3,680	3,595	4,453	4,453	4,453	4,351
Panel E: Exact Science Subjects								
	0.279	0.123	0.048	-0.397	0.192	0.039	0.058	-0.263
	(0.187)	(0.148)	(0.150)	(0.276)	(0.165)	(0.131)	(0.135)	(0.338)
Sample Size	9,685	9,685	9,685	9,627	5,412	5,412	5,412	5,284
Subject FE	✓	✓	✓		✓	✓	✓	
Year FE	✓	✓	✓		✓	✓	✓	
School FE		✓				✓		
Class FE			✓				✓	
School-by-Subject-by-Year FE				✓				✓

Notes: The datasets for the core subjects and each of the track subjects include stacked observations for each subject/exam. The estimation is based on the sample of 21 schools. Each row presents estimates from a separate regression using an empirical Bayes estimation strategy. The standard errors are reported in parentheses and are corrected using a two-step bootstrapping method. This process of two-step bootstrap sampling and estimation is repeated 1,000 times. All specifications include the teacher's gender as control. A student's 11^{th} grade second-semester school exam performance is used as an outcome. The variable of interest is the teacher gender bias in 12^{th} grade. The first panel includes all subjects. The second panel includes all core subjects. Panel C includes all classics track subjects. Panel D includes all science track subjects. Panel E includes all exact science track subjects. Standard errors are also clustered by class.

Table A6: Effect of 11^{th} Grade Teacher Bias on National Test Scores in 12^{th} Grade for STEM and non-STEM subjects

Dependent Variable: Test score in 12^{th} grade national exams								
	Boys				Girls			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: STEM Subjects								
	0.162	0.120	0.178	0.113	0.045	-0.017	-0.085	-0.011
	(0.044)	(0.041)	(0.044)	(0.062)	(0.038)	(0.037)	(0.042)	(0.052)
Sample Size	9,000	9,000	9,000	8,992	9,425	9,425	9,425	9,410
Panel B: Non-STEM Subjects								
	0.033	0.135	0.197	0.117	-0.159	-0.025	-0.030	-0.203
	(0.060)	(0.055)	(0.066)	(0.068)	(0.046)	(0.044)	(0.048)	(0.062)
Sample Size	3,274	3,274	3,274	3,248	5,588	5,588	5,588	5,586
Subject FE	✓	✓	✓		✓	✓	✓	
Year FE	✓	✓	✓		✓	✓	✓	
School FE		✓				✓		
Class FE			✓				✓	
School-by-Subject-by-Year FE				✓				✓

Notes: As non-STEM subjects we have grouped together all non-STEM subjects in the core (modern Greek and history) and all subjects in the classics track. As STEM subjects we have grouped together all STEM subjects in the core (Physics, Algebra and Geometry) and all subjects in the science and exact science tracks. The estimation is based on the sample of 21 schools. Each row presents estimates from a separate regression using an empirical Bayes estimation strategy. The standard errors are also corrected using a two-step bootstrapping method that we describe in the text. This process of two-step bootstrap sampling and estimation is repeated 1,000 times. All specifications include the students' 11^{th} second-semester school exam performance and the teacher's gender as controls. All scores are standardized z-scores. STEM subjects include algebra, geometry, physics from the core, and all science and exact science track subjects. Non-STEM subjects include history, and modern Greek from the core, and all classics track subjects. Standard errors are clustered by class.

Table A7: Descriptive Statistics for the Teacher Bias by Teacher Gender, Sample of 21 Schools

	Male Teachers		Female Teachers			
	Mean	Std.Dev	Mean	Std.Dev	Diff.	s.e.
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: 11^{th} Grade						
I. Core Subjects						
Algebra	-0.155	0.228	-0.073	0.307	-0.081	0.045
Geometry	-0.212	0.215	-0.076	0.308	-0.136	0.046
History	-0.185	0.354	-0.080	0.380	-0.105	0.061
Modern Greek	-0.150	0.402	-0.060	0.303	-0.090	0.065
Physics	-0.149	0.223	-0.163	0.315	0.014	0.044
II. Classics Track						
Ancient Greek	-0.216	0.440	-0.305	0.428	0.089	0.134
Latin	-0.137	0.365	-0.183	0.419	0.046	0.119
Philosophy	-0.170	0.389	-0.153	0.411	-0.018	0.124
III. Science Track						
Chemistry	-0.154	0.203	-0.079	0.306	-0.075	0.100
Mathematics	-0.148	0.175	-0.006	0.291	-0.143	0.084
Physics	-0.035	0.242	-0.039	0.302	0.004	0.094
IV. Exact Science Track						
Mathematics	-0.149	0.236	-0.045	0.286	-0.104	0.091
Physics	-0.154	0.404	-0.144	0.239	-0.010	0.102
Technology and Computers	-0.318	0.191	-0.250	0.385	-0.068	0.118
Panel B: 12^{th} Grade						
I. Core Subjects						
Biology	-0.035	0.526	-0.211	0.487	0.175	0.070
History	-0.238	0.366	-0.203	0.367	-0.035	0.064
Mathematics	-0.159	0.281	-0.153	0.363	-0.007	0.047
Modern Greek	-0.153	0.351	-0.132	0.292	-0.022	0.040
Physics	-0.156	0.235	-0.187	0.356	0.031	0.055
II. Classics Track						
Ancient Greek	-0.154	0.455	-0.186	0.394	0.031	0.088
History	-0.192	0.360	-0.244	0.381	0.053	0.080
Latin	-0.192	0.453	-0.196	0.397	0.004	0.097
Literature	-0.181	0.408	-0.251	0.382	0.070	0.087
III. Science Track						
Biology	0.068	0.296	-0.287	0.409	0.355	0.155
Chemistry	-0.254	0.582	-0.181	0.347	-0.073	0.163
Mathematics	-0.222	0.218	-0.261	0.421	0.039	0.139
Physics	-0.274	0.239	-0.309	0.262	0.035	0.094
IV. Exact Science Track						
Business Administration	-0.167	0.459	-0.130	0.516	-0.037	0.100
Computer Science	-0.153	0.418	-0.209	0.526	0.056	0.106
Mathematics	-0.061	0.383	-0.191	0.358	0.131	0.081
Physics	-0.129	0.311	-0.191	0.308	0.062	0.070
V. Optional						
Economics	-0.122	0.329	-0.041	0.457	-0.081	0.049

This table presents the means, standard deviations and differences of teacher biases measured in all other classes by teacher gender for the sample of 21 schools. These teacher biases by teacher gender are presented for each subject in 11^{th} and 12^{th} grades. A teacher sample is used here. A negative bias means that the teacher is pro-girl. The baseline sample is 11^{th} grade students in 2003-2005 and 12^{th} grade students in 2003-2011.

Table A8: Heterogeneity in the Effect of 11^{th} Grade Gender Bias on Blind 12^{th} Grade Score by the Gender of the Teacher

Dependent Variable: Blind score in 12^{th} grade national exams								
	Boys				Girls			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
All Subjects								
Bias	0.092	0.056	0.054	0.059	0.005	-0.027	-0.116	0.052
	(0.046)	(0.045)	(0.045)	(0.063)	(0.043)	(0.041)	(0.041)	(0.060)
Bias × Female Teacher	-0.044	0.016	0.026	0.069	-0.124	-0.071	0.042	-0.241
	(0.065)	(0.064)	(0.061)	(0.091)	(0.062)	(0.061)	(0.059)	(0.088)
Female Teacher	-0.018	-0.006	-0.003	-0.009	-0.019	0.002	-0.015	0.028
	(0.013)	(0.013)	(0.012)	(0.027)	(0.012)	(0.012)	(0.011)	(0.025)
Sample Size	18,503	18,503	18,503	18,474	21,119	21,119	21,119	21,111
Core Subjects								
Bias	0.085	0.032	0.030	0.060	0.063	-0.006	-0.110	0.065
	(0.051)	(0.053)	(0.053)	(0.063)	(0.049)	(0.050)	(0.050)	(0.060)
Bias × Female Teacher	0.013	0.104	0.073	0.082	-0.191	-0.093	0.023	-0.233
	(0.075)	(0.077)	(0.076)	(0.091)	(0.072)	(0.074)	(0.077)	(0.088)
Female Teacher	-0.040	-0.032	-0.027	-0.010	-0.026	-0.007	-0.022	0.027
	(0.017)	(0.017)	(0.015)	(0.028)	(0.014)	(0.014)	(0.013)	(0.025)
Sample Size	12,407	12,407	12,407	12,407	14,979	14,979	14,979	14,977
Classics Subjects								
Bias	-0.205	-0.003	-0.066	-0.029	-0.265	-0.015	-0.142	-0.089
	(0.120)	(0.108)	(0.095)	(0.149)	(0.092)	(0.084)	(0.086)	(0.143)
Bias × Female Teacher	0.280	0.123	0.246	0.177	0.111	-0.098	0.129	-0.164
	(0.138)	(0.125)	(0.111)	(0.178)	(0.109)	(0.100)	(0.099)	(0.168)
Female Teacher	0.010	0.057	0.003	0.037	-0.004	0.035	-0.011	-0.025
	(0.027)	(0.027)	(0.022)	(0.045)	(0.022)	(0.021)	(0.018)	(0.039)
Sample Size	3,679	3,679	3,679	3,679	7,226	7,226	7,226	7,224
Science Subjects								
Bias	0.123	0.060	0.105	0.069	0.132	0.047	-0.094	0.117
	(0.052)	(0.053)	(0.054)	(0.068)	(0.048)	(0.049)	(0.050)	(0.067)
Bias × Female Teacher	0.006	0.100	0.045	0.047	-0.160	-0.064	0.010	-0.162
	(0.085)	(0.088)	(0.094)	(0.118)	(0.088)	(0.087)	(0.093)	(0.115)
Female Teacher	-0.040	-0.033	-0.007	-0.030	-0.021	0.000	-0.023	0.067
	(0.019)	(0.020)	(0.020)	(0.035)	(0.017)	(0.017)	(0.018)	(0.031)
Sample Size	10,994	10,994	10,994	10,992	11,794	11,794	11,794	11,792
Exact Science Subjects								
Bias	0.127	0.072	0.084	0.069	0.082	0.023	-0.103	0.115
	(0.053)	(0.052)	(0.055)	(0.068)	(0.051)	(0.052)	(0.053)	(0.067)
Bias × Female Teacher	-0.126	-0.051	0.005	0.049	-0.124	-0.055	0.018	-0.161
	(0.083)	(0.083)	(0.090)	(0.118)	(0.088)	(0.086)	(0.090)	(0.115)
Female Teacher	-0.052	-0.037	-0.023	-0.031	-0.036	0.014	-0.023	0.068
	(0.017)	(0.018)	(0.017)	(0.035)	(0.017)	(0.017)	(0.018)	(0.031)
Sample Size	13,113	13,113	13,113	13,113	12,011	12,011	12,011	12,007
Subject FE	✓	✓	✓		✓	✓	✓	
Year FE	✓	✓	✓		✓	✓	✓	
School FE		✓				✓		
Class FE			✓				✓	
School-by-Subject-by-Year FE				✓				✓

Notes: Each row presents estimates from a separate regression using an empirical Bayes estimation strategy. The standard errors are corrected using a two-step bootstrapping method. The process of two-step bootstrap sampling and estimation is repeated 1,000 times. All specifications include the students' 11^{th} grade first-semester score as a control. All scores are standardized z-scores. The first panel "Core Subjects" includes all core subjects. The second panel "Classics Subjects" includes relevant exams from the core (history and modern Greek) and all the classics track subjects. The third panel "Science Subjects" includes relevant exams from the core (algebra, geometry and physics) and all the science track subjects. The fourth panel "Exact Science Subjects" includes relevant exams from the core (algebra, geometry and physics) and all the exact science track subjects. All specifications include the students' 11^{th} grade first-semester test scores as controls.

Table A9: Heterogeneity in the Effect of 11^{th} Grade Gender Bias on Blind 12^{th} Grade Score by the Gender of the Principal

Dependent Variable: Blind score in 12^{th} grade national exams		
	Boys	Girls
	(1)	(2)
All Subjects		
Bias	0.051	-0.075
	(0.058)	(0.047)
Bias × Female Principal	0.048	0.074
	(0.076)	(0.068)
Female Principal	0.037	0.031
	(0.026)	(0.022)
Sample Size	12,881	15,376
Core Subjects		
Bias	0.047	-0.036
	(0.069)	(0.057)
Bias × Female Principal	0.121	0.079
	(0.091)	(0.079)
Female Principal	0.013	-0.001
	(0.026)	(0.021)
Sample Size	8,805	11,074
Classics Subjects		
Bias	-0.007	-0.173
	(0.089)	(0.063)
Bias × Female Principal	0.123	0.058
	(0.139)	(0.108)
Female Principal	0.104	0.107
	(0.043)	(0.034)
Sample Size	2,689	5,297
Science Subjects		
Bias	0.112	0.147
	(0.079)	(0.73)
Bias × Female Principal	0.039	-0.024
	(0.098)	(0.098)
Female Principal	-0.012	-0.067
	(0.027)	(0.023)
Sample Size	7,633	8,561
Exact Science Subjects		
Bias	0.143	0.086
	(0.077)	(0.068)
Bias × Female Principal	-0.081	-0.007
	(0.098)	(0.097)
Female Principal	0.004	-0.039
	(0.027)	(0.024)
Sample Size	9,099	8,823
Subject FE	✓	✓
Year FE	✓	✓

Notes: Each panel presents estimates from a separate regression using an empirical Bayes estimation strategy. Standard errors are clustered using a two-step bootstrapping method. All specifications include the students' first-semester test score in grade 11 as a control. All scores are standardized z-scores. The first panel "All Subjects" includes all subjects from the core and the tracks. The second panel "Core Subjects" includes all core subjects. The third panel "Classics Subjects" includes relevant exams from the core (history and modern Greek) and all the classics track subjects. The fourth panel "Science Subjects" includes relevant exams from the core (algebra, geometry and physics) and all the science track subjects. The firth panel "Exact Science Subjects" includes relevant exams from the core (algebra, geometry and physics) and all the exact science track subjects.

Table A10: Effect of Teacher Gender Bias on the Quality of the Program Students Enrolled In

	Boys		Girls	
	(1) Rank	(2) Stand Rank	(3) Rank	(4) Stand Rank
Bias in All Subjects	1.693	0.059	-1.841	-0.064
	(0.943)	(0.033)	(0.808)	(0.028)
Sample Size	8,452	8,452	10,125	10,125
Bias in Core Subjects	1.258	0.043	-3.305	-0.114
	(1.034)	(0.036)	(0.939)	(0.032)
Sample Size	4,986	4,986	6,053	6,053
Bias in Classics Subjects	2.583	0.090	0.201	0.007
	(1.740)	(0.061)	(1.527)	(0.053)
Sample Size	2,668	2,668	4,134	4,134
Bias in Science Subjects	0.478	0.017	-2.009	-0.069
	(1.320)	(0.046)	(1.203)	(0.041)
Sample Size	3,637	3,637	4,342	4,342
Bias in Exact Science Subjects	1.246	0.043	-1.221	-0.042
	(1.536)	(0.053)	(1.211)	(0.042)
Sample Size	4,264	4,264	4,199	4,199
Year FE	✓	✓	✓	✓
Subject FE	✓	✓	✓	✓
Grade FE	✓	✓	✓	✓
Class FE	✓	✓	✓	✓

Notes: Year 2003 is excluded from the analysis, as it is used to calculate the quality measures for the post-secondary program students enroll in. "Rank" represents the ranking of each post-secondary program based on the 2003 threshold score for each university department. This is calculated as the admission score of the last admitted/marginal student. "Stand Rank" is the standardized measure of "Rank" which is normalised to have a zero mean and a standard deviation of 1. We assign this measure of program quality to the relevant post-secondary programs and drop the year 2003 from the regressions. We then look at the effects of teacher biases on student quality of enrolled post-secondary program. All specifications include the students' first semester 11^{th} grade performance and the teacher's gender as controls. All estimates are adjusted for the empirical Bayes technique. Standard errors are adjusted using a two-step bootstrapping technique.

Table A11: Summary Statistics for Sample Used to Estimate Value-Added Models

	Mean	Std.Dev	Min	Max
	(1)	(2)	(3)	(4)
Student Characteristics				
Born in the First Quarter of Birth Year (Yes=1)	0.238	0.426	0	1
Gender (Female=1)	0.576	0.494	0	1
Test Scores (s.d.)	-0.045	0.995	-2.937	3.608
Proportion of Students in Classics	0.391	0.488	0	1
Proportion of Students in Science	0.174	0.379	0	1
Proportion of Students in Exact Science	0.435	0.496	0	1
Lagged Test Scores (s.d)	0.025	0.963	-4.365	3.807
No.of Subject-School Combinations per Student	10.044	5.233	1	22
Missing Lagged Test Scores	0.041	0.198	0	1
Class/School/Neighborhood Characteristics				
Class Size	18.818	3.761	4	25
School Grade Enrollment Size	62.170	28.504	4	104
Neighorhood Income (in Euro)	19,718.846	3,794.528	12,265.880	26,586.330
Urban Locality (yes=1)	0.781	0.414	0	1
Teacher Characteristics				
Teacher Gender (Female=1)	0.337	0.473	0	1
No.of other Classes a Teacher Taught (Experience)	6.529	5.582	1	22

Notes: All statistics reported are for the sample used in estimating the baseline TVA model. This sample includes only students who have non-missing baseline controls. Student data are from the administrative records of 21 schools in Greece. The sample period of 2003-2005 is used to obtain the TVA estimates. All test scores are standardized. Summary statistics (number of observations, mean, s.d., min., and max.) for the baseline variables are reported in the table. Outcome test scores are measured in 11^{th} and 12^{th} grade and the prior test scores are measured in 10^{th} and 11^{th} grade. The variables are weighted by the number of students in the school-year-class-subject-year cell. Only the "Number of other Classes a Teacher Taught" is weighted by the number of teachers in the school-year-class-subject-year cell. The age is measured in years for students the day they start the 11^{th} or 12^{th} grade class. Born in the First Quarter of Birth Year is a dummy that takes the value of one if a student is born in the first quarter of the calendar year, and zero otherwise. Students who are born in the first quarter of the calendar year are eligible to enroll a year earlier in the 1^{st} grade. There are three tracks available: classics, science or exact science. The school grade enrollment size denotes the number of 11^{th} or 12^{th} graders in a given school and year. The number of subject-school combinations per student is the number of subjects that students take. Each student takes on average 10 subjects. When prior test scores are missing, we set the prior score equal to 0 and include an indicator for missing data. On average, 6 percent of lagged scores are missing. The total number of observations used here is 50,970. In the last panel that reports teachers' characteristics, a class corresponds to a subject-class-year-grade cell.

Table A12: Comparisons of Mean Teacher Value Added for Pro-Boys, Neutral, and Pro-Girls Teachers

	(1) Neutral /sd	(2) Pro-Boy /sd	(3) Difference /se
		Panel A	
Teacher Value Added	0.035	-0.006	0.041
	0.147	0.154	0.020
N	99	132	231
	Neutral /sd	Pro-Girl /sd	Difference /se
		Panel B	
Teacher Value Added	0.035	-0.045	0.080
	0.147	0.204	0.023
N	99	187	286

Notes: We pool data on test scores for 11^{th} and 12^{th} grades for the period 2003-2005. The TVA measures are derived following the procedure described in the text. Pro-boy teachers exhibit bias larger than or equal to 0.10. Pro-girl teachers exhibit bias smaller than or equal to -0.10. We define as neutral teachers who exhibit bias that is larger than -0.10 and smaller than or equal to 0.10. The teacher bias measures are derived as the average bias across subjects, grades and classes a teacher exhibits in the 2006-2011 sample. Our sample includes only students who have non-missing baseline controls to estimate the TVA model. Our baseline TVA model controls for a rich set of student demographics and other variables, as well as teacher, class, and school level variables. In particular, our baseline TVA model controls for a student's gender, age, a dummy whether the student is born in the first quarter of a calendar year, his/her lagged performance in the same subject, class size, school-level-grade enrollment, a dummy that takes the value of 1 if the teacher is female and 0 otherwise, how many classes each teacher taught in the sample (our proxy for a teacher's experience), students' average performance in all other classes taught by the same teacher in the sample and neighborhood income. When the prior test score is missing, we set the prior score equal to 0 and include an indicator for missing data. In Panel A, we compare the mean TVA of teachers who are neutral (column 1) to the mean TVA of teachers who are pro-boy (column 2). The related standard deviations are reported below the means. Column 3 reports the difference of the means and the respective standard error. In Panel B, we compare the mean TVA of teachers who are neutral (column 1) to the mean TVA of teachers who are pro-girl (column 2). The related standard deviations are reported below the means. Column 3 reports the difference of the means and the standard error.

Table A13: Correlations Between Teacher Bias And Teacher Quality (TVA) for Pro-Girl and Pro-Boy Teachers (Spline Variables)

Dependent Variable: Teacher Quality (Measured by TVA)				
	(1)	(2)	(3)	(4)
Spline for Pro-Girls Teachers	0.040	0.039	0.041	0.042
	(0.028)	(0.029)	(0.029)	(0.030)
Spline for Pro-Boys Teachers	-0.021	-0.020	-0.019	-0.021
	(0.022)	(0.022)	(0.022)	(0.022)
Female Teacher		0.011	0.011	0.011
		(0.011)	(0.011)	(0.011)
Class Size			-0.002	-0.002
			(0.002)	(0.002)
Experience				-0.001
				(0.002)
Obs.	418	418	418	418
Year FE	✓	✓	✓	✓
School FE	✓	✓	✓	✓
Grade FE	✓	✓	✓	✓

The "Spline for Pro-Girl Teachers" takes the actual negative teacher bias values, and the value of zero for the positive ones. The "Spline for Pro-Boy Teachers" takes the actual positive teacher bias values, and the value zero for the negative ones. The teacher gender bias measures the average bias a teacher exhibits in different subjects and classes in the 2006-2011 sample. We include the two splines simultaneously in the regression. The outcome variable is the teacher value-added derived using the 2003-2005 sample and is described in detail in the text. "Teacher experience" measures the different combination of classes and subjects a teacher has taught in 11^{th} and 12^{th} grades in the sample period 2003-2011. Standard errors are clustered by school and year and are reported in parentheses. The empirical Bayes estimates of teacher gender biases are used.

Table A14: Comparisons of Mean Teacher Value Added for Pro-Boys, Neutral, and Pro-Girls Teachers (Measured by TVA on Enrolled Program Quality)

	(1) Neutral /sd	(2) Pro-Boy /sd	(3) Difference /se
		Panel A	
Teacher Value Added	1.685	-0.979	2.665
	9.525	9.503	1.542
N	67	88	155
	Neutral /sd	Pro-Girl /sd	Difference /se
		Panel B	
Teacher Value Added	1.685	-1.480	3.165
	9.525	9.771	1.467
N	67	125	192

Notes: Year 2003 is excluded from the analysis, since it is used to define the quality of the enrolled university degree program. We pool data on test scores for 11^{th} and 12^{th} grades for the period 2004-2005. The TVA measures are derived following the procedure described in the text. Pro-boy teachers exhibit bias larger than or equal to 0.10. Pro-girl teachers exhibit bias smaller than or equal to -0.10. We define as neutral teachers who exhibit bias that is larger than -0.10 and smaller than or equal to 0.10. The teacher bias measures are derived as the average bias across subjects, grades and classes a teacher exhibits in the 2006-2011 sample. Our sample includes only students who have non-missing baseline controls to estimate the TVA model. Our baseline TVA model controls for a rich set of student demographics and other variables, as well as teacher, class, and school level variables. In particular, our baseline TVA model controls for a student's gender, age, a dummy whether the student is born in the first quarter of a calendar year, his/her lagged performance in the same subject, class size, school-level-grade enrollment, a dummy that takes the value of 1 if the teacher is female and 0 otherwise, how many classes each teacher taught in the sample (our proxy for a teacher's experience), students' average performance in all other classes taught by the same teacher in the sample and neighborhood income. When the prior test score is missing, we set the prior score equal to 0 and include an indicator for missing data. In Panel A, we compare the mean TVA of teachers who are neutral (column 1) to the mean TVA of teachers who are pro-boy (column 2). The related standard deviations are reported below the means. Column 3 reports the difference of the means and the respective standard error. In Panel B, we compare the mean TVA of teachers who are neutral (column 1) to the mean TVA of teachers who are pro-girl (column 2). The related standard deviations are reported below the means. Column 3 reports the difference of the means and the standard error.

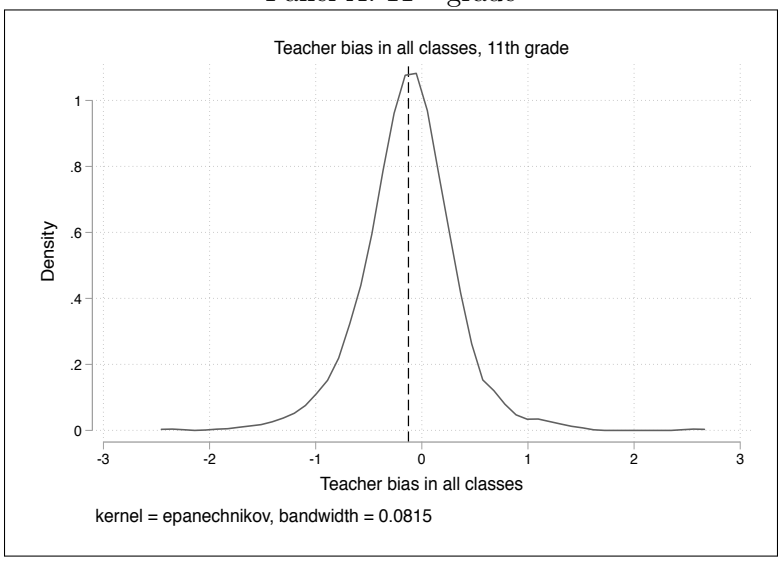
Table A15: Correlations Between Teacher Gender Bias And Teacher Quality (Measured by TVA on Enrolled Program Quality)

Dependent Variable: Teacher Quality (Measured by TVA)				
	(1)	(2)	(3)	(4)
Pro-Girl Teacher Indicator	-0.586	-0.601	-0.607	-0.553
	(0.816)	(0.807)	(0.809)	(0.786)
Pro-Boy Teacher Indicator	0.171	0.170	0.212	0.260
	(0.677)	(0.680)	(0.688)	(0.688)
Female Teacher		-0.151	-0.198	-0.160
		(0.707)	(0.693)	(0.687)
Class Size			-0.174	-0.184
			(0.156)	(0.158)
Experience				-0.068
				(0.068)
Obs.	279	279	279	279
Year FE	✓	✓	✓	✓
School FE	✓	✓	✓	✓
Grade FE	✓	✓	✓	✓

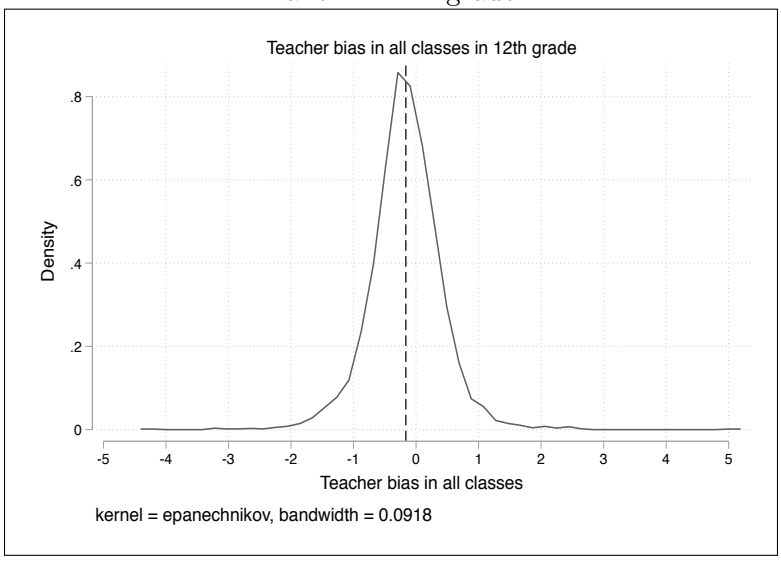
Notes: Year 2003 is excluded from the analysis, since it is used to define the quality of the enrolled university degree program. The "Pro-Girl Teacher Indicator" takes the value of one if the teacher exhibits a bias that is smaller than or equal to -0.10. The "Pro-Boy Teacher Indicator" takes the value of one if the teacher exhibits a bias that is above 0.10. We define as neutral teachers those who have a bias that is larger than -0.10 and smaller than or equal to 0.10. The omitted category in the regression is neutral teachers. The teacher bias is calculated in the sample period of 2006-2011. The outcome variable is the TVA derived using the 2003-2005 sample and described in the text. "Teacher experience" measures the different combination of classes and subjects a teacher has taught in 11^{th} and 12^{th} grades in the sample period 2003-2011. The empirical Bayes estimates of teacher gender biases are used. Standard errors are clustered by school and year and are reported in parentheses.

Figure A1: Distribution of Teacher Gender Bias in 11^{th} and 12^{th} Grade, Sample of 21 Schools

Panel A: 11^{th} grade

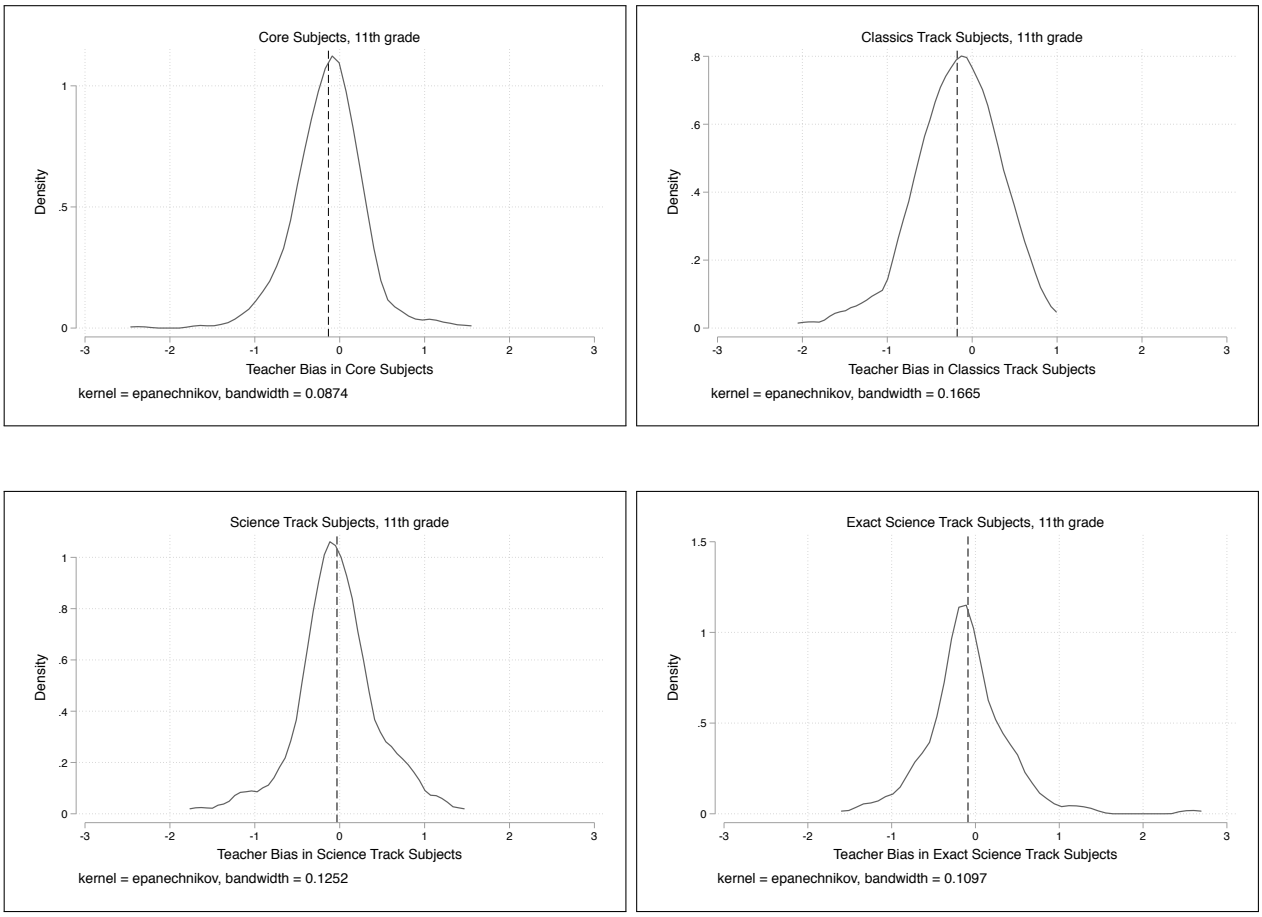


Panel B: 12^{th} grade



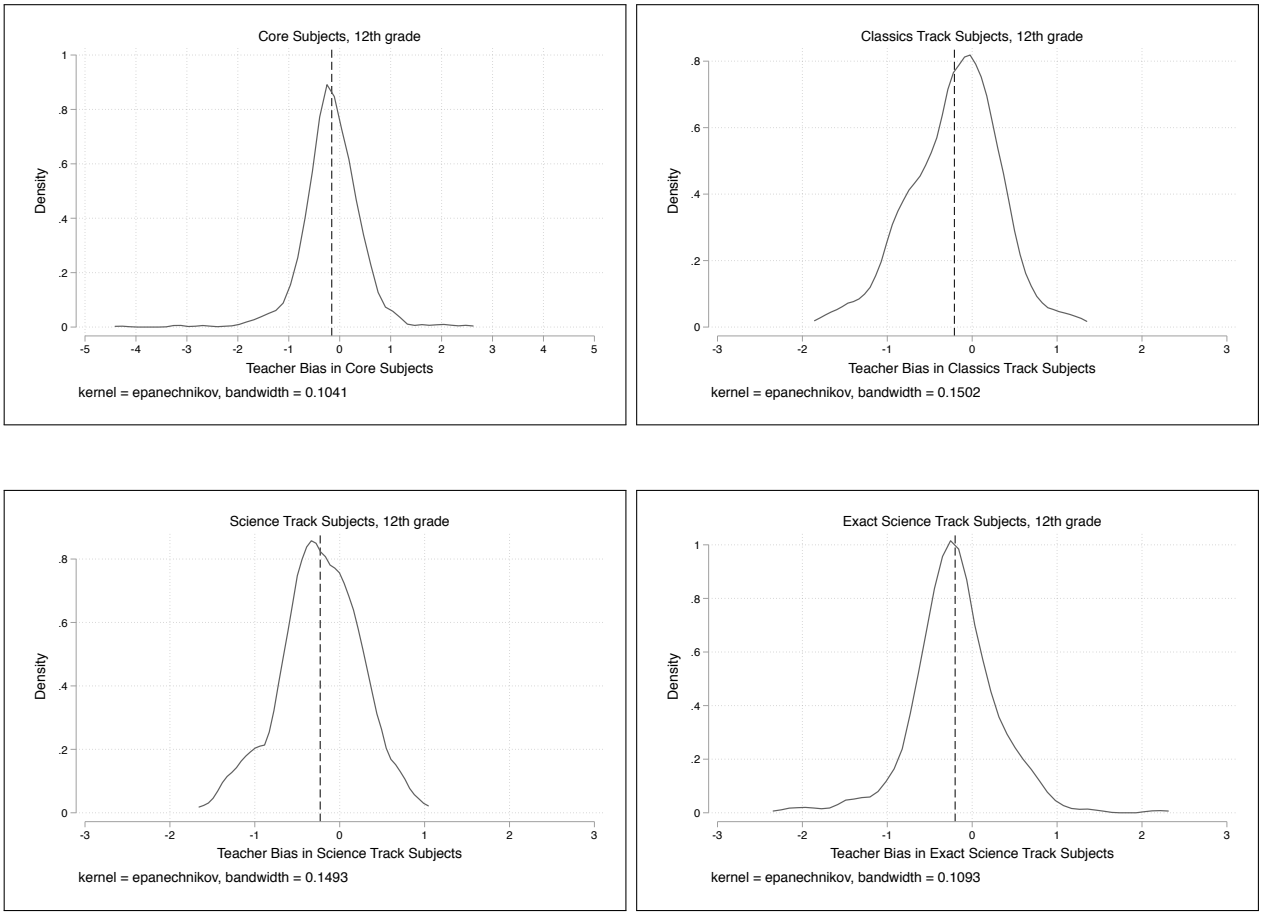
Notes: Panels A and B show the teacher-class level distribution of bias based on all classes (including the own) in grades 11^{th} and 12^{th}, respectively. We use data for the sample period 2003-2011. The teacher bias in all classes that a teacher taught is measured as the average bias that a teacher exhibited in all classes she/he ever taught in the sample period 2003-2011 in each grade.

Figure A2: Histograms of the Bias Measured in All Classes in Core and Track Subjects in 11^{th} Grade



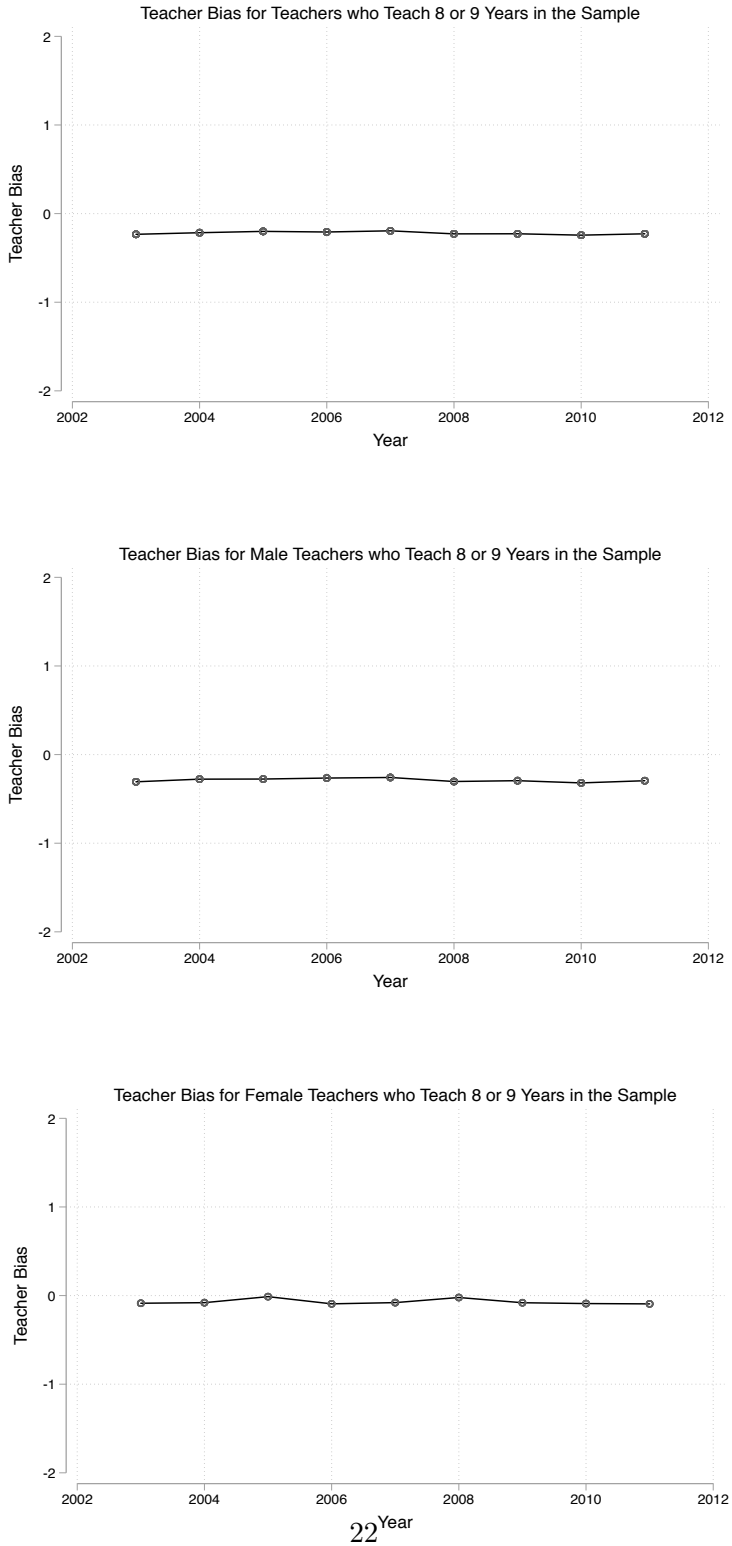
Notes: This figure presents a teacher-class level distribution of bias based on all classes (including the own) for core and track subjects. In 11^{th} grade the core subjects taught are: modern Greek, history, physics, algebra and geometry. There are the following tracks in 11^{th} grade: Classics, Science and Exact Science. In the classics track the 11^{th} grade subjects are: ancient Greek, philosophy and Latin; in the science track: mathematics, physics, chemistry, and in the exact science track: mathematics, physics and technology and computers. The mean (s.d.) of the teacher-level measure of the gender bias based on all classes is -0.123 (0.418), -0.166 (0.514), -0.029 (0.502) and -0.065 (0.516) in core, classics track, science track, and exact classics track subjects, respectively.

Figure A3: Histograms of the Bias Measured in All Classes in Core and Track Subjects in 12^{th} Grade



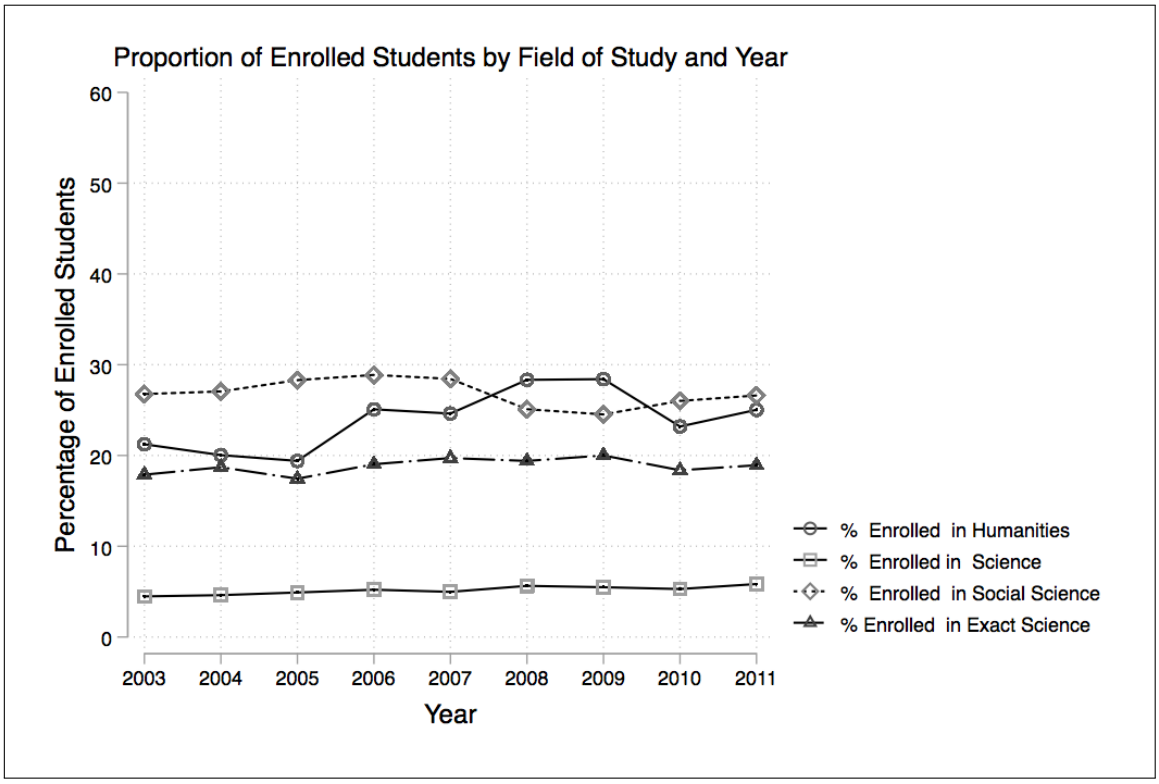
Notes: This figure presents a teacher-class level distribution of bias based on all classes (including the own) for core and track subjects. In 12^{th} grade the core subjects taught are: modern Greek, history, physics, biology and mathematics. There are the following tracks in 12^{th} grade: Classics, Science and Exact Science. In the classics track the 12^{th} grade subjects are: ancient Greek, Latin, literature and history; in the science track: biology, mathematics, physics and chemistry, and in the exact science track: mathematics, physics, business administration and computer science. The mean (s.d.) of the teacher-level measure of the gender bias based on all classes is -0.139 (0.491), -0.197 (0.478), -0.197 (0.472) and -0.171 (0.430) in core, classics track, science track, and exact classics track subjects, respectively.

Figure A4: Evolution of Teacher Bias, All, Male and Female Teachers who Teach 8 or 9 Years in the Sample



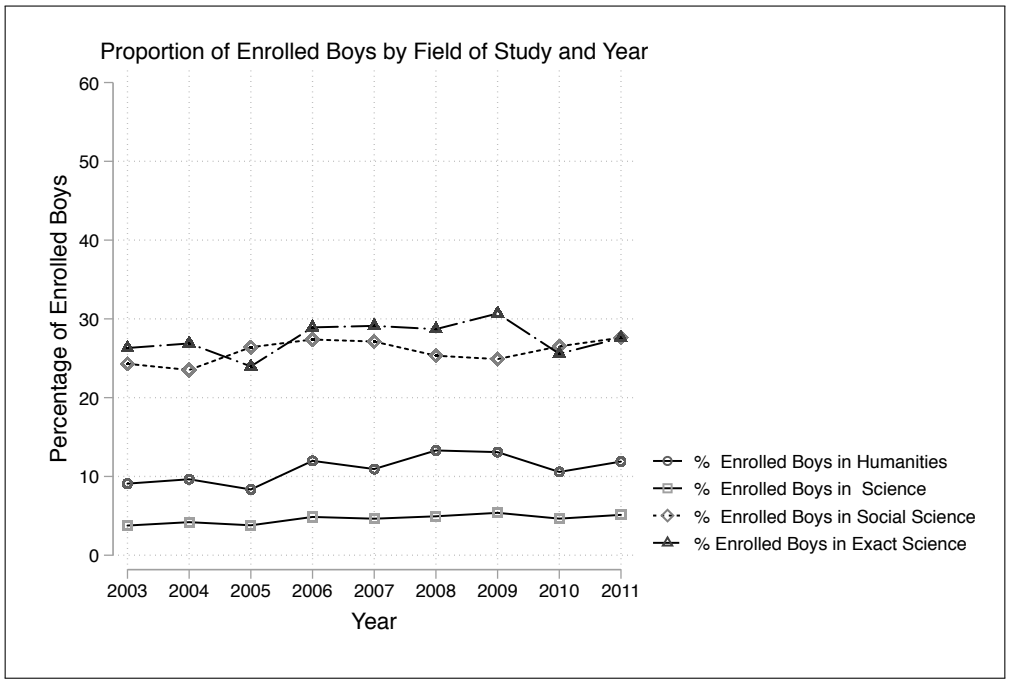
Notes: We calculate the annual bias across subjects and classes for all teachers in the sample. We then plot the evolution of teacher bias for male and female teachers who teach 8 or 9 years in the sample. We consider years from 2003 up to and including 2011.

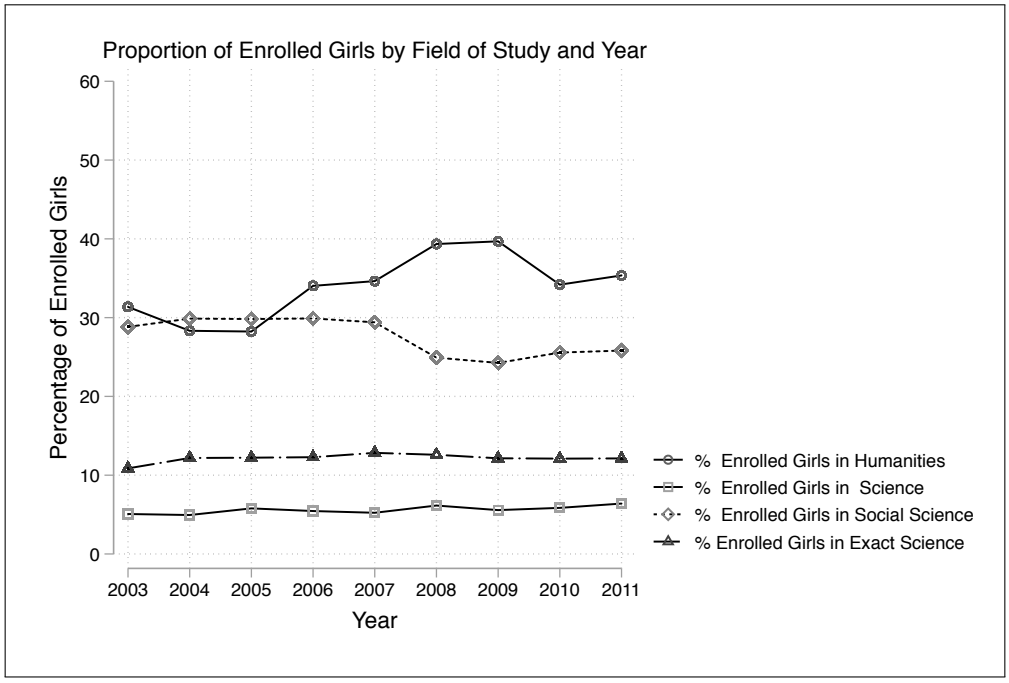
Figure A5: Proportion of University Students Enrolled By University Field of Studies, Sample of 21 schools



Notes: This figure presents the proportion of enrolled students in each field of university study and year. We consider four broad categories: humanities, science, social science and exact science. The remaining students enroll in vocational studies. Humanities include the departments of liberal Arts, literature, psychology, journalism, philosophy, education, Greek language, history, foreign languages, home economics and law. Social Science includes the departments of economics, statistics, business and management, accounting, political science and European studies. Exact Science includes the departments of mathematics, engineering, physics and computer science. Science includes the departments of biology, chemistry, medicine, pharmacy, veterinary studies and dentistry.

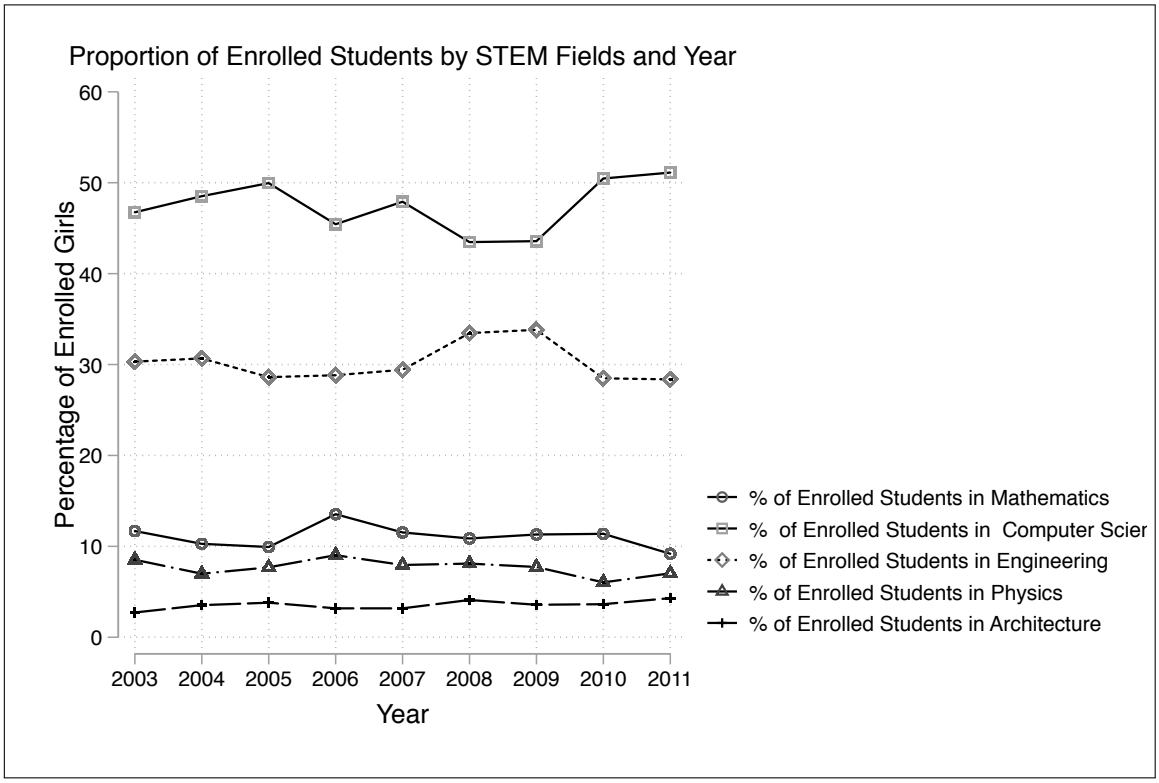
Figure A6: Proportion of University Students Enrolled By Field of Studies and By Gender, Sample of 21 schools





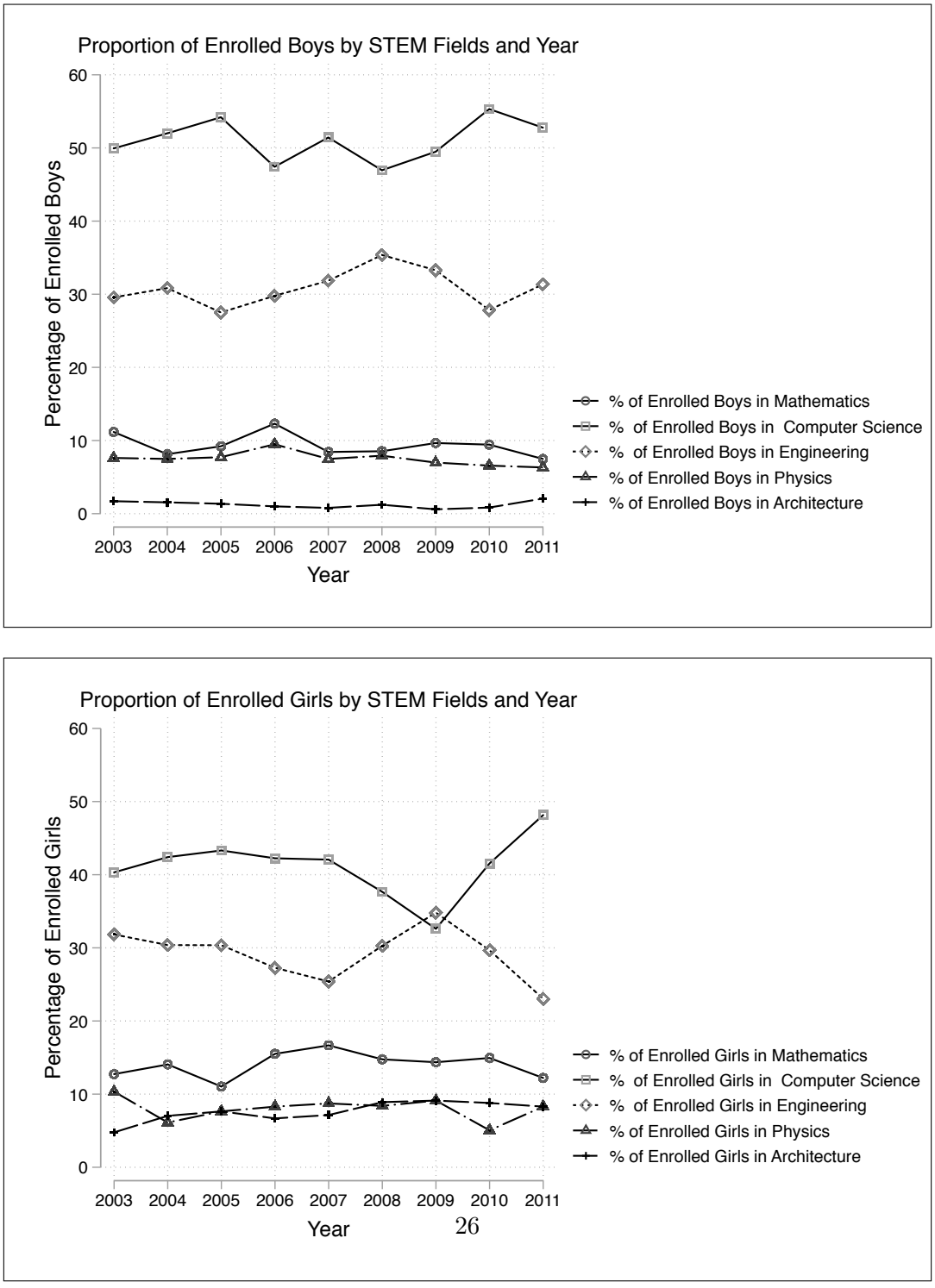
Notes: The top figure presents the proportion of enrolled boys (out of enrolled students) in each field of university study and year. The bottom figure presents the proportion of enrolled girls (out of enrolled students) in each field of university study and year. We consider four broad categories: humanities, science, social science and exact science.

Figure A7: Proportion of University Students Enrolled in STEM by Subject, Sample of 21 schools



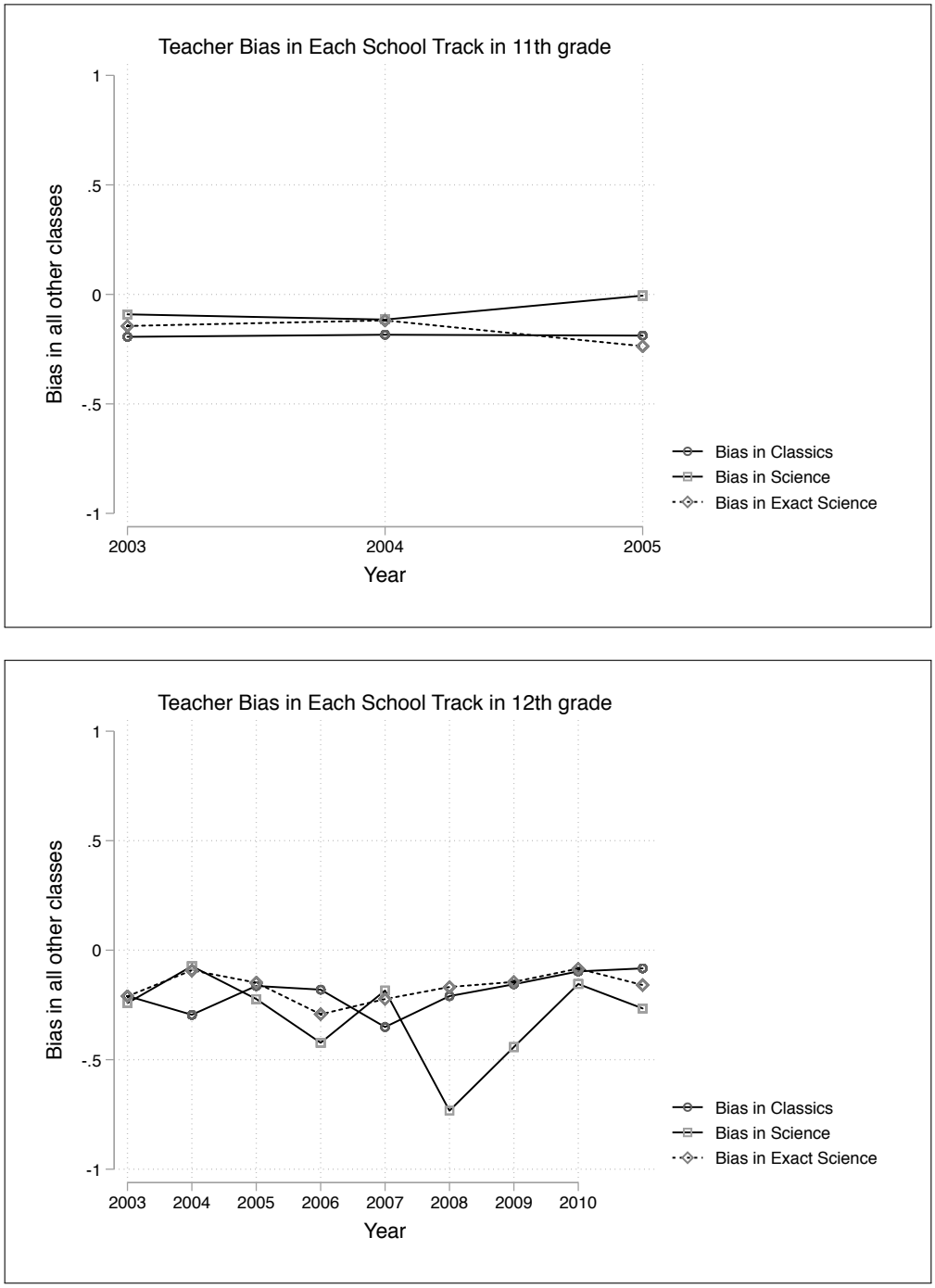
Notes: This figure presents the proportion of enrolled students in each stem field and year. We use the following five broad fields: mathematics, engineering, physics, computer science and architecture.

Figure A8: Proportion of University Students in STEM fields by Gender, Sample of 21 schools



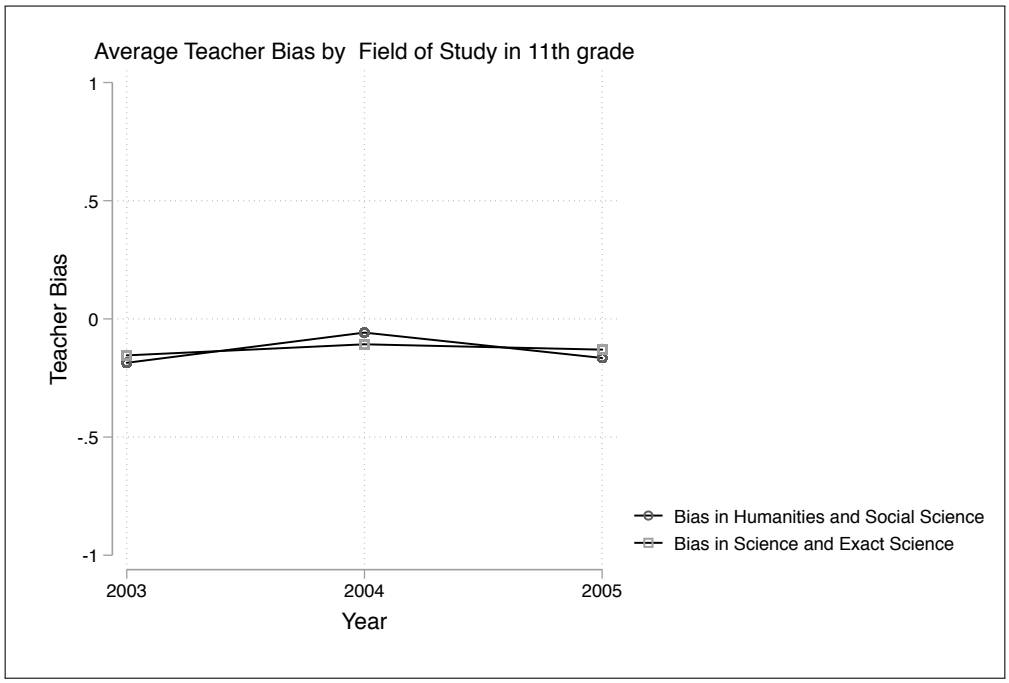
Notes: The top figure presents the proportion of enrolled boys in each STEM field and year. The bottom figure presents the proportion of enrolled girls in each STEM field and year. Five broad fields are used: mathematics, engineering, physics, computer science and architecture.

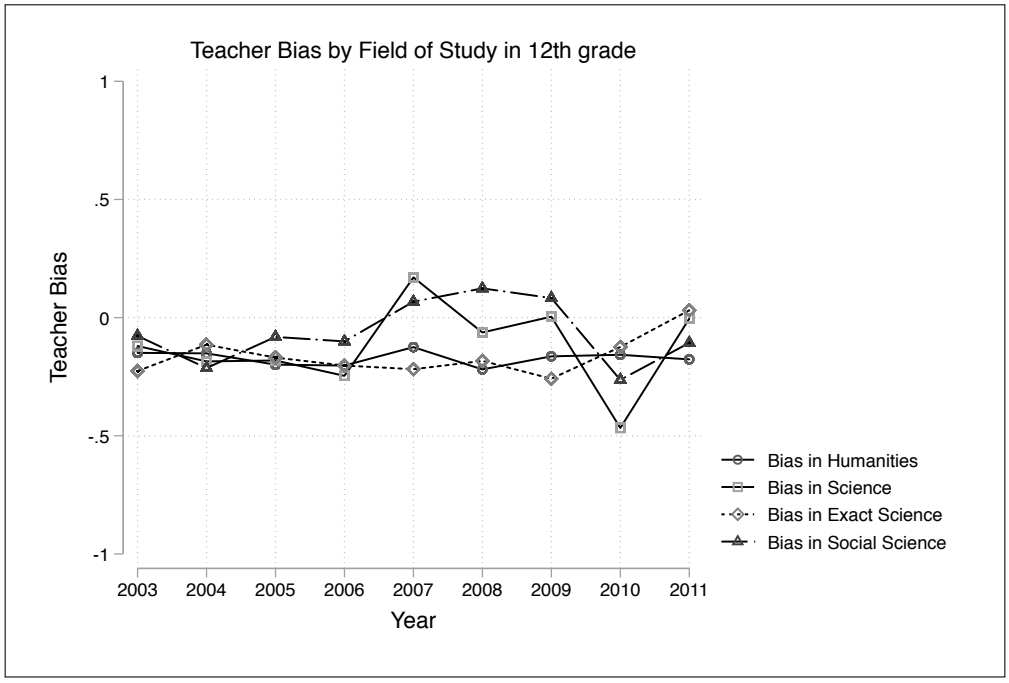
Figure A9: Evolution of Teacher Gender Bias by School Track, Sample of 21 Schools



Notes: The 11^{th} grade bias in Classics is the average bias in ancient Greek, philosophy and Latin. The 11^{th} grade bias in Science is the average bias in mathematics, physics and chemistry. The 11^{th} grade bias in Exact Science is the average bias in mathematics, physics and computer science. The 12^{th} grade bias in Classics is the average bias in ancient Greek, Latin, literature and history. The 12^{th} grade bias in Science is the average bias in mathematics, physics, biology and chemistry. The 12^{th} grade bias in Exact Science is the average bias in mathematics, physics, business administration and computer science. All teacher biases that are used here are calculated based on all other classes that a teacher taught in the sample.

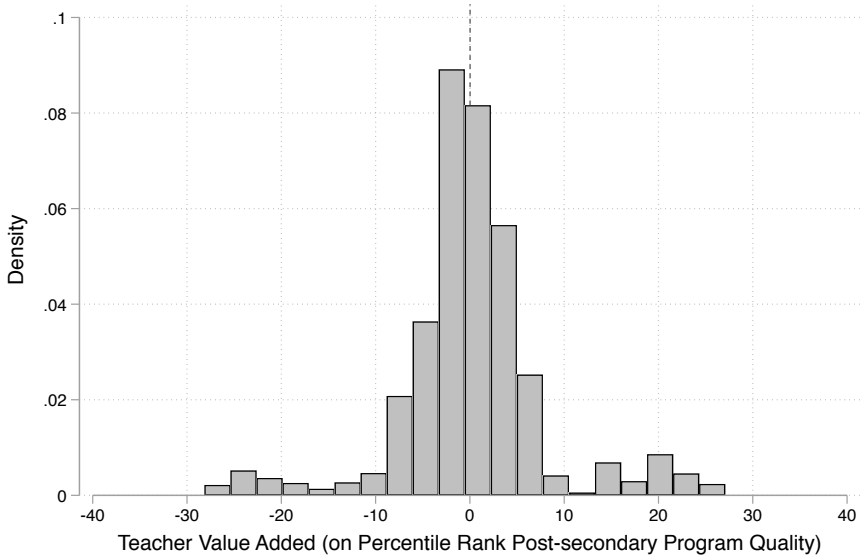
Figure A10: Evolution of Teacher Gender Bias by Field of Study, Sample of 21 schools





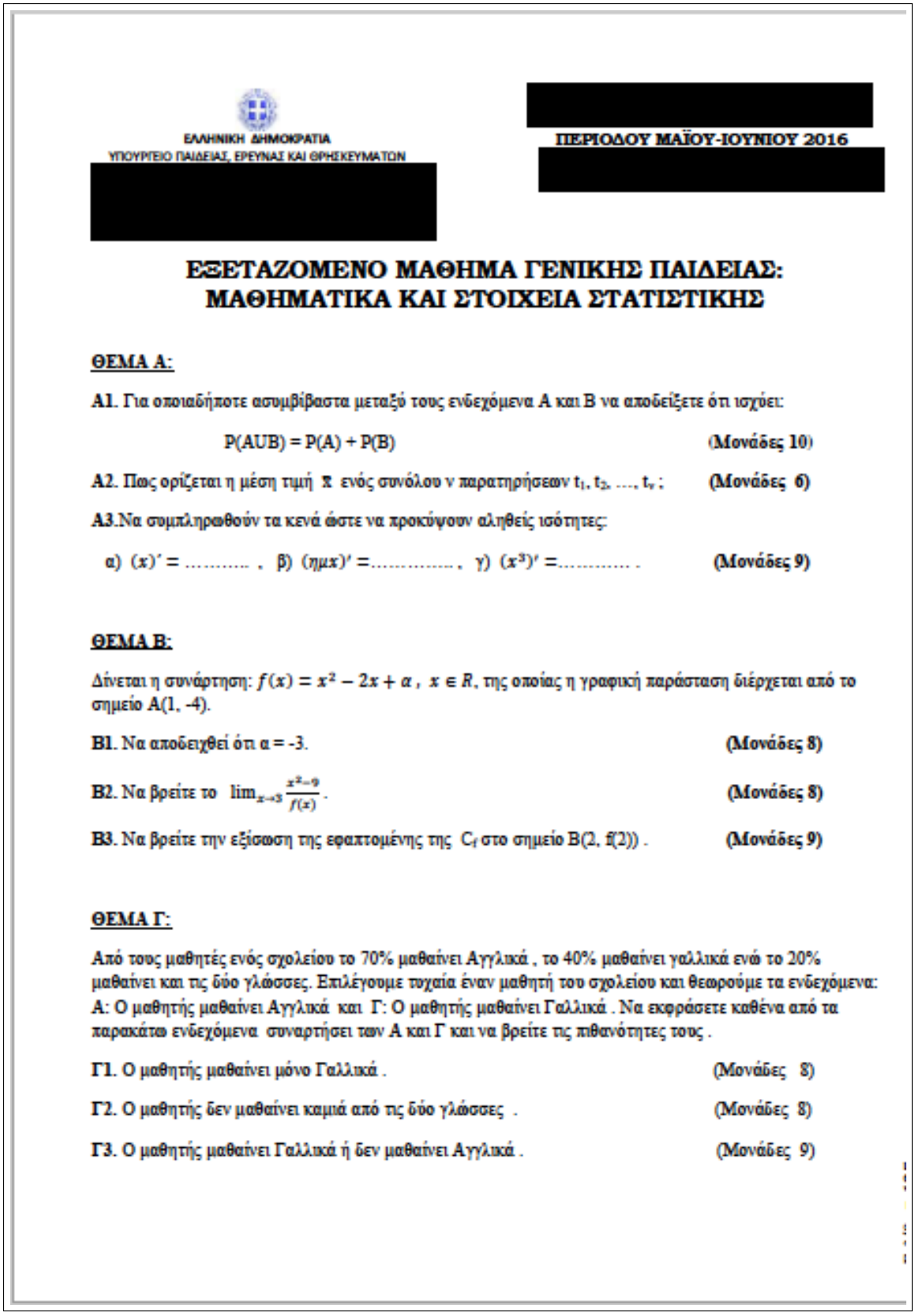
Notes: These figures show the evolution (over time) of the teacher bias in terms of the fields of study at the university level. These fields of study include departments in the following fields: humanities, social science, science and exact science. The 11^{th} grade bias (measured in all other classes) for humanities and social science departments is the average bias in modern Greek and history in 11^{th} grade. The 11^{th} grade bias (measured in all other classes) for Science and Exact Science departments is the average bias in algebra, geometry and physics in 11^{th} grade. The 12^{th} grade bias (measured in all other classes) for exact science, science, humanities and social science departments is the bias in mathematics and physics (average), biology, modern Greek and history (average), and economics, respectively.

Figure A11: Histogram of Teacher Value-Added Measure on the Quality of the Program Students Enrolled in



Notes: This figure presents the distribution of the TVA measure, which is weighted by the number of students in the school-year-grade-subject-class year cell. Teacher value-added is measured on the enrolled university degree quality. The enrolled university degree quality ranges from 0 to 100, which the value of 100 being assigned to the program of the highest quality. Year 2003 is excluded, as it is used to calculate the quality measures for the post-secondary program students enroll in. The program quality is measured as the ranking of each post-secondary program based on the 2003 mean performance of enrolled students in each post-secondary program. To derive these value-added measures we pool the 11^{th} and 12^{th} grade data for the years 2004-2005. We use 10^{th} and 11^{th} grade performance as a prior measure of performance. We follow closely the value-added procedure described in **?**. This sample includes only students who have non-missing baseline controls to estimate the TVA model. TVA is estimated using the baseline control vector, which includes: lagged own-subject scores, student-level characteristics including age, gender, a dummy for being born in the first quarter of the birth year, dummies for whether students expressed a special interest in classics, science or exact science (indicated by the track they have chosen), class size, school-grade enrollment, income as well as school, year, and subject dummies. When prior test scores are missing, we set the prior score equal to 0 and include an indicator for missing data. Student data are from the administrative records of 21 schools in Greece. The structure of the dataset is one observation per teacher-year-grade-subject-class cell.

Figure B1: Example of a School Exam Script in a Random School in Academic Year 2005-2006



ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ, ΕΡΕΥΝΑΣ ΚΑΙ ΘΡΗΣΚΕΥΜΑΤΩΝ

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ΠΕΡΙΟΔΟΥ ΜΑΪΟΥ-ΙΟΥΝΙΟΥ 2016

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ΕΞΕΤΑΖΟΜΕΝΟ ΜΑΘΗΜΑ ΓΕΝΙΚΗΣ ΠΑΙΔΕΙΑΣ:
ΜΑΘΗΜΑΤΙΚΑ ΚΑΙ ΣΤΟΙΧΕΙΑ ΣΤΑΤΙΣΤΙΚΗΣ

ΘΕΜΑ Α:

Α1. Για οποιαδήποτε ασυμβίβαστα μεταξύ τους ενδεχόμενα Α και Β να αποδείξετε ότι ισχύει:

$P(A \cup B) = P(A) + P(B)$ **(Μονάδες 10)**

Α2. Πως ορίζεται η μέση τιμή $\bar{x}$ ενός συνόλου ν παρατηρήσεων $t_1, t_2, \ldots, t_v$; **(Μονάδες 6)**

Α3. Να συμπληρωθούν τα κενά ώστε να προκύψουν αληθείς ισότητες:

α) $(x)' = \ldots\ldots\ldots$, β) $(\eta\mu x)' = \ldots\ldots\ldots$, γ) $(x^3)' = \ldots\ldots\ldots$. **(Μονάδες 9)**

ΘΕΜΑ Β:

Δίνεται η συνάρτηση: $f(x) = x^2 - 2x + \alpha$, $x \in R$, της οποίας η γραφική παράσταση διέρχεται από το σημείο Α(1, -4).

Β1. Να αποδειχθεί ότι α = -3. **(Μονάδες 8)**

Β2. Να βρείτε το $\lim_{x \to 3} \frac{x^2-9}{f(x)}$. **(Μονάδες 8)**

Β3. Να βρείτε την εξίσωση της εφαπτομένης της C_f στο σημείο Β(2, f(2)) . **(Μονάδες 9)**

ΘΕΜΑ Γ:

Από τους μαθητές ενός σχολείου το 70% μαθαίνει Αγγλικά , το 40% μαθαίνει γαλλικά ενώ το 20% μαθαίνει και τις δύο γλώσσες. Επιλέγουμε τυχαία έναν μαθητή του σχολείου και θεωρούμε τα ενδεχόμενα: Α: Ο μαθητής μαθαίνει Αγγλικά και Γ: Ο μαθητής μαθαίνει Γαλλικά . Να εκφράσετε καθένα από τα παρακάτω ενδεχόμενα συναρτήσει των Α και Γ και να βρείτε τις πιθανότητες τους .

Γ1. Ο μαθητής μαθαίνει μόνο Γαλλικά . (Μονάδες 8)

Γ2. Ο μαθητής δεν μαθαίνει καμιά από τις δύο γλώσσες . (Μονάδες 8)

Γ3. Ο μαθητής μαθαίνει Γαλλικά ή δεν μαθαίνει Αγγλικά . (Μονάδες 9)

ΕΛΛΗΝΙΚΗ ΔΗΜΟΚΡΑΤΙΑ
ΥΠΟΥΡΓΕΙΟ ΠΑΙΔΕΙΑΣ, ΕΡΕΥΝΑΣ ΚΑΙ ΘΡΗΣΚΕΥΜΑΤΩΝ

[redacted]

[redacted]

ΠΕΡΙΟΔΟΥ ΜΑΪΟΥ-ΙΟΥΝΙΟΥ 2016

[redacted]

ΕΞΕΤΑΖΟΜΕΝΟ ΜΑΘΗΜΑ ΓΕΝΙΚΗΣ ΠΑΙΔΕΙΑΣ: ΜΑΘΗΜΑΤΙΚΑ ΚΑΙ ΣΤΟΙΧΕΙΑ ΣΤΑΤΙΣΤΙΚΗΣ

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α) $(x)' =$ ..... , β) $(\eta\mu x)' =$ ..... , γ) $(x^3)' =$ ..... . **(Μονάδες 9)**

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Δίνεται η συνάρτηση: $f(x) = x^2 - 2x + \alpha$, $x \in R$, της οποίας η γραφική παράσταση διέρχεται από το σημείο Α(1, -4).

Β1. Να αποδειχθεί ότι α = -3. **(Μονάδες 8)**

Β2. Να βρείτε το $\lim_{x \to 3} \frac{x^2-9}{f(x)}$. **(Μονάδες 8)**

Β3. Να βρείτε την εξίσωση της εφαπτομένης της C_f στο σημείο Β(2, f(2)) . **(Μονάδες 9)**

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Από τους μαθητές ενός σχολείου το 70% μαθαίνει Αγγλικά , το 40% μαθαίνει γαλλικά ενώ το 20% μαθαίνει και τις δύο γλώσσες. Επιλέγουμε τυχαία έναν μαθητή του σχολείου και θεωρούμε τα ενδεχόμενα: Α: Ο μαθητής μαθαίνει Αγγλικά και Γ: Ο μαθητής μαθαίνει Γαλλικά . Να εκφράσετε καθένα από τα παρακάτω ενδεχόμενα συναρτήσει των Α και Γ και να βρείτε τις πιθανότητες τους .

Γ1. Ο μαθητής μαθαίνει μόνο Γαλλικά . (Μονάδες 8)

Γ2. Ο μαθητής δεν μαθαίνει καμιά από τις δύο γλώσσες . (Μονάδες 8)

Γ3. Ο μαθητής μαθαίνει Γαλλικά ή δεν μαθαίνει Αγγλικά . (Μονάδες 9)

Figure B2: Example of a National Exam Script in Academic Year 2005-2006

ΑΡΧΗ 1ΗΣ ΣΕΛΙΔΑΣ
ΝΕΟ & ΠΑΛΑΙΟ ΣΥΣΤΗΜΑ - Γ΄ ΗΜΕΡΗΣΙΩΝ

ΠΑΝΕΛΛΑΔΙΚΕΣ ΕΞΕΤΑΣΕΙΣ

Γ΄ ΤΑΞΗΣ ΗΜΕΡΗΣΙΟΥ ΓΕΝΙΚΟΥ ΛΥΚΕΙΟΥ

ΠΑΡΑΣΚΕΥΗ 20 ΜΑΪΟΥ 2016

ΕΞΕΤΑΖΟΜΕΝΟ ΜΑΘΗΜΑ:

ΜΑΘΗΜΑΤΙΚΑ ΚΑΙ ΣΤΟΙΧΕΙΑ ΣΤΑΤΙΣΤΙΚΗΣ ΓΕΝΙΚΗΣ ΠΑΙΔΕΙΑΣ

ΣΥΝΟΛΟ ΣΕΛΙΔΩΝ: ΤΕΣΣΕΡΙΣ(4)

ΘΕΜΑ Α

Α1. Αν A και A' είναι δύο συμπληρωματικά ενδεχόμενα ενός δειγματικού χώρου Ω να αποδείξετε ότι για τις πιθανότητές τους ισχύει:

$$P(A') = 1 - P(A).$$

Μονάδες 7

Α2. Να δώσετε τον ορισμό της διαμέσου (δ) ενός δείγματος ν παρατηρήσεων.

Μονάδες 4

Α3. Έστω f μία συνάρτηση με πεδίο ορισμού το Α. Πότε λέμε ότι η συνάρτηση f παρουσιάζει τοπικό ελάχιστο στο $x_0 \in A$;

Μονάδες 4

Α4. *Να χαρακτηρίσετε τις προτάσεις που ακολουθούν, γράφοντας στο τετράδιό σας, δίπλα στο γράμμα που αντιστοιχεί σε κάθε πρόταση, τη λέξη* ***Σωστό****, αν η πρόταση είναι σωστή, ή* ***Λάθος****, αν η πρόταση είναι λανθασμένη.*

α) Αν Α και Β είναι δύο ενδεχόμενα ενός δειγματικού χώρου Ω με $A \subseteq B$, τότε για τις πιθανότητές τους ισχύει $P(A) \leq P(B)$.

β) Ο σταθμισμένος αριθμητικός μέσος ή σταθμικός μέσος είναι μέτρο διασποράς.

γ) Αν οι συναρτήσεις f και g είναι παραγωγίσιμες, τότε ισχύει ότι:

$$(f(x)\cdot g(x))' = f'(x)g(x) + f(x)g'(x).$$

δ) Το ραβδόγραμμα χρησιμοποιείται για τη γραφική παράσταση των τιμών μιας ποιοτικής μεταβλητής.

ε) Αν μία συνάρτηση f είναι παραγωγίσιμη σε ένα διάστημα Δ και ισχύει $f'(x) > 0$ για κάθε εσωτερικό σημείο του Δ, τότε η f είναι γνησίως φθίνουσα στο Δ.

Μονάδες 10

ΤΕΛΟΣ 1ΗΣ ΑΠΟ 4 ΣΕΛΙΔΕΣ

ΘΕΜΑ Β

Δίνεται η συνάρτηση f με τύπο $f(x)=\frac{x^3}{3}-\frac{5}{2}x^2+6x-1,\ x\in\mathbb{R}$.

Β1. Να βρείτε τα ακρότατα της συνάρτησης f.

Μονάδες 9

Β2. Να βρείτε την εξίσωση της εφαπτομένης της γραφικής παράστασης της συνάρτησης f στο σημείο της $A(0,f(0))$.

Μονάδες 8

Β3. Να υπολογίσετε το όριο $\lim\limits_{x\to -1}\frac{f'(x)-12}{x+1}$.

Μονάδες 8

ΘΕΜΑ Γ

Μεταξύ των οικογενειών με τρία παιδιά επιλέγουμε τυχαία μία οικογένεια και εξετάζουμε τα παιδιά της ως προς το φύλο και ως προς τη σειρά γέννησής τους.

Γ1. Να προσδιορίσετε το δειγματικό χώρο Ω του πειράματος χρησιμοποιώντας ένα δενδροδιάγραμμα.

Μονάδες 4

Γ2. Να παρασταθούν με αναγραφή των στοιχείων τους τα ενδεχόμενα που προσδιορίζονται από την αντίστοιχη ιδιότητα:

Α: «το πρώτο παιδί είναι κορίτσι»

Β: «ο αριθμός των κοριτσιών υπερβαίνει τον αριθμό των αγοριών»

Γ: «τα δύο πρώτα παιδιά είναι του ίδιου φύλου».

Μονάδες 6

Γ3. Υποθέτουμε ότι ο δειγματικός χώρος Ω αποτελείται από ισοπίθανα απλά ενδεχόμενα.

α) Να υπολογίσετε την πιθανότητα των παρακάτω ενδεχομένων:

$$\Delta=A\cap B,\quad E=A\cup B,\quad Z=\Gamma-E.$$

(μονάδες 9)

β) Να υπολογίσετε την πιθανότητα των παρακάτω ενδεχομένων:

Η: «δεν πραγματοποιείται κανένα από τα Α,Β»

Θ: «πραγματοποιείται ακριβώς ένα από τα Α,Β».

(μονάδες 6)
Μονάδες 15

ΘΕΜΑ Δ

Οι χρόνοι (σε λεπτά) που χρειάστηκαν ν υπολογιστές για να τρέξουν ένα πρόγραμμα, έχουν ομαδοποιηθεί σε 4 ισοπλατείς κλάσεις πλάτους C, όπως στον παρακάτω πίνακα:

Χρόνος (σε λεπτά)	Κεντρική Τιμή x_i	Συχνότητα v_i
[8 ,)		20
[,)	14	15
[,)		10
[,)		v_4
ΣΥΝΟΛΟ		ν=.....

Δ1. Να αποδείξετε ότι $C=4$.

Μονάδες 4

Δ2. Αν η μέση τιμή των χρόνων είναι $\bar{x}=14$, να αποδείξετε ότι $v_4=5$ (μονάδες 4) και στη συνέχεια να μεταφέρετε στο τετράδιό σας τον παραπάνω πίνακα κατάλληλα συμπληρωμένο (μονάδες 2).

Μονάδες 6

Δ3. Αν οι παρατηρήσεις είναι ομοιόμορφα κατανεμημένες σε κάθε κλάση, να βρείτε πόσοι υπολογιστές χρειάστηκαν τουλάχιστον 9 λεπτά για να τρέξουν το πρόγραμμα.

Μονάδες 5

Δ4. Να αποδείξετε ότι η τυπική απόκλιση των χρόνων είναι S=4 και να εξετάσετε αν το δείγμα των χρόνων είναι ομοιογενές.

Μονάδες 6

Δ5. Αντικαθιστούμε τον επεξεργαστή κάθε υπολογιστή με έναν ταχύτερο και βρίσκουμε ότι κάθε υπολογιστής τρέχει τώρα το πρόγραμμα στο 80% του χρόνου που χρειαζόταν πριν. Να εξετάσετε ως προς την ομοιογένεια το καινούργιο δείγμα χρόνων.

Μονάδες 4

ΑΡΧΗ 4ΗΣ ΣΕΛΙΔΑΣ
ΝΕΟ & ΠΑΛΑΙΟ ΣΥΣΤΗΜΑ – Γ΄ ΗΜΕΡΗΣΙΩΝ

ΟΔΗΓΙΕΣ (για τους εξεταζομένους)

1. **Στο εξώφυλλο** να γράψετε το εξεταζόμενο μάθημα. **Στο εσώφυλλο πάνω-πάνω** να συμπληρώσετε τα ατομικά σας στοιχεία. **Στην αρχή των απαντήσεών σας** να γράψετε πάνω-πάνω την ημερομηνία και το εξεταζόμενο μάθημα. **Να μην αντιγράψετε** τα θέματα στο τετράδιο και **να μη γράψετε** πουθενά στις απαντήσεις σας το όνομά σας.
2. Να γράψετε το ονοματεπώνυμό σας στο πάνω μέρος των φωτοαντιγράφων, αμέσως μόλις σας παραδοθούν. **Τυχόν σημειώσεις σας πάνω στα θέματα δεν θα βαθμολογηθούν σε καμία περίπτωση**. Κατά την αποχώρησή σας, να παραδώσετε μαζί με το τετράδιο και τα φωτοαντίγραφα.
3. Να απαντήσετε **στο τετράδιό σας** σε όλα τα θέματα **μόνο** με μπλε ή **μόνο** με μαύρο στυλό με μελάνι που δεν σβήνει.
4. Κάθε απάντηση επιστημονικά τεκμηριωμένη είναι αποδεκτή.
5. Διάρκεια εξέτασης: τρεις (3) ώρες μετά τη διανομή των φωτοαντιγράφων.
6. Χρόνος δυνατής αποχώρησης: 10.30 π.μ.

ΣΑΣ ΕΥΧΟΜΑΣΤΕ ΚΑΛΗ ΕΠΙΤΥΧΙΑ

ΤΕΛΟΣ ΜΗΝΥΜΑΤΟΣ

ΤΕΛΟΣ 4ΗΣ ΑΠΟ 4 ΣΕΛΙΔΕΣ

Figure B3: Map of Schools in the Sample

This figure shows the counties with schools that we use in the main analysis.