

Analysis Report

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SAMPLE REPORT - Rafael Data Analysis Portfolio

Descriptive Statistics

The report begins with tables presenting the country-level statistics. The USA was a significant outlier for GDP and GDP per capita, with a standardized score (Z-score) of 3.88 and 2.76. Thus, these variables were log-transformed to alleviate their impact on the statistical models. The resulting Z-scores were reduced to 2.08 and 1.92.

With respect to average PISA scores, a notable observation is Singapore's exceptional performance, with the highest mean scores in all three domains: 568.287 in Math, 548.458 in Reading, and 549.973 in Science, accompanied by relatively high standard deviations, indicating some variation in scores. Estonia also stands out with high mean scores, particularly in Science (530.115) and Reading (523.275), suggesting a strong educational emphasis in these areas.

On the other end of the spectrum, countries like Brazil and Georgia show considerably lower mean scores across all domains. Brazil's scores are 384.990 in Math, 415.651 in Reading, and 405.490 in Science, while Georgia has 399.589 in Math, 381.298 in Reading, and 383.679 in Science, indicating potential areas for educational improvement.

Other noteworthy countries include Japan and the Netherlands, both demonstrating strong performances, particularly in Math (526.591 for Japan and 514.102 for the Netherlands). The United States shows balanced scores across the three domains but does not lead in any, with scores of 473.312 in Math, 500.568 in Reading, and 497.562 in Science.

Country	School Count	Student Count	Director Leadership		ESCS		Job Satisfaction		Desk (%)	Room (%)	QuietPlace (%)	Computer (%)	Internet (%)
			Mean	SD	Mean	SD	Mean	SD					
AUS	762	14239	2.632	0.449	0.229	0.547	3.051	0.191	89.3%	93.1%	87.9%	93.9%	97.7%
BRA	597	10691	2.775	0.430	-1.289	0.766	2.966	0.197	62.1%	74.0%	78.6%	58.5%	90.9%
CHL	254	7621	2.852	0.490	-0.357	0.870	3.064	0.220	78.8%	85.2%	88.3%	85.0%	90.4%
COL	247	7521	2.917	0.487	-1.252	0.922	3.302	0.194	71.0%	69.4%	75.8%	66.4%	71.6%
ESP	1089	35943	2.601	0.430	-0.111	0.558	3.159	0.157	97.8%	88.4%	93.3%	92.2%	98.0%
EST	230	5316	2.301	0.367	-0.022	0.445	2.965	0.159	97.1%	89.7%	93.1%	86.5%	99.5%
GEO	321	5572	2.963	0.353	-0.579	0.551	3.093	0.171	94.5%	84.1%	88.8%	79.2%	94.0%
JPN	183	6109	2.290	0.306	-0.117	0.371	2.780	0.166	94.0%	86.4%	87.0%	60.9%	95.2%
KAZ	616	19507	2.930	0.410	-0.504	0.469	2.958	0.151	94.8%	83.3%	90.6%	79.6%	91.2%
MEX	286	7299	2.910	0.456	-1.178	0.926	3.260	0.163	82.4%	54.2%	74.7%	60.5%	71.9%
NLD	156	4765	2.437	0.382	0.278	0.429	3.068	0.132	93.1%	97.2%	96.6%	94.9%	98.8%
NZL	192	6173	2.529	0.358	0.107	0.476	2.987	0.262	85.3%	91.9%	89.3%	92.3%	97.5%
RUS	263	7608	2.566	0.302	0.073	0.400	3.009	0.190	97.3%	82.0%	88.7%	93.9%	98.5%
SGP	166	6676	2.661	0.397	0.133	0.471	2.904	0.156	91.9%	64.9%	77.6%	87.8%	98.3%
SVN	345	6401	2.636	0.360	-0.145	0.570	2.964	0.143	98.4%	92.8%	92.3%	96.2%	99.3%
SWE	223	5504	2.229	0.305	0.347	0.412	2.963	0.190	91.4%	94.9%	93.1%	94.7%	99.0%
TUR	186	6890	2.854	0.494	-1.197	0.754	2.861	0.192	89.6%	74.6%	87.0%	66.7%	75.9%
USA	164	4838	2.770	0.493	0.089	0.527	3.073	0.220	78.2%	87.5%	89.0%	87.3%	96.2%

Country	ESCS	SHW SELFDIRECT	SHW POWER	SHW SECUR	SHW HEDONISM	SHW BENEVOLENCE	SHW ACHIEV	SHW STIMUL	SHW CONFORM	SHW SPIRIT	SHW TRAD
AUS	0.320	2.910	4.560	2.700	3.710	2.760	3.630	3.940	2.830	2.720	3.440
BRA	-1.130	2.610	4.860	1.960	2.600	1.970	3.100	4.240	2.340	2.110	2.490
CHL	-0.310	2.490	3.900	1.930	2.310	2.110	3.080	3.600	2.670	2.570	2.560
COL	-1.060	2.420	4.400	1.830	2.610	1.860	2.560	3.860	2.250	1.740	2.050
ESP	-0.040	2.890	4.330	2.660	2.950	2.180	3.220	3.700	2.340	2.350	2.580
EST	0.100	3.230	4.180	2.810	3.560	3.180	3.860	4.120	2.810	2.860	2.920
GEO	-0.370	2.930	3.950	1.930	3.880	2.020	2.640	3.740	1.960	1.880	1.610
JPN	-0.110	3.640	4.930	3.370	4.100	3.850	4.160	4.830	3.800	3.330	4.110
KAZ	-0.330	3.350	3.640	2.790	3.660	2.790	3.230	4.120	2.700	3.050	2.640
MEX	-1.070	2.840	4.840	2.020	2.580	2.210	2.740	3.970	2.630	2.020	2.290
NLD	0.260	3.400	4.880	3.230	3.470	3.110	4.440	4.500	3.330	3.100	3.930
NZL	0.180	2.800	4.600	2.790	3.870	2.780	3.760	3.930	3.020	2.750	3.320
RUS	0.170	2.730	2.980	2.370	2.870	2.570	2.820	3.090	2.460	2.550	2.340
SGP	0.150	2.940	3.410	2.540	3.190	2.660	2.950	3.410	2.860	2.940	2.870
SVN	-0.010	2.640	4.570	2.290	2.980	2.190	2.760	4.110	2.470	1.940	2.770
SWE	0.360	2.480	4.590	2.750	3.150	2.910	3.820	3.940	3.320	2.460	3.150
TUR	-1.170	2.360	3.290	2.170	2.640	2.220	2.360	3.430	2.470	2.240	2.080
USA	0.060	3.020	4.550	2.680	3.990	2.740	3.530	3.930	3.010	2.950	3.030

Country	Gov expend	Govexp GDPDol	GDP DOLLAR	GDP PERCAPITA	log GDP DOLLAR	log GDP PERCAPITA
AUS	5.12	74	\$1,432.00	\$49,882.00	\$7.27	\$10.82
BRA	6.32	118	\$1,869.00	\$15,500.00	\$7.53	\$9.65
CHL	5.42	16	\$298.00	\$24,588.00	\$5.70	\$10.11
COL	4.54	14	\$330.00	\$14,455.00	\$5.80	\$9.58
ESP	4.6	65	\$1,426.00	\$38,171.00	\$7.26	\$10.55
EST	4.96	1.5	\$30.00	\$31,473.00	\$3.43	\$10.36
GEO	3.57	0.6	\$16.00	\$10,644.00	\$2.83	\$9.27
JPN	3.4	169	\$4,971.00	\$42,659.00	\$8.51	\$10.66
KAZ	2.75	4.7	\$171.00	\$25,286.00	\$5.15	\$10.14
MEX	4.52	55	\$1,224.00	\$19,480.00	\$7.11	\$9.88
NLD	5.18	47	\$913.00	\$53,582.00	\$6.82	\$10.89
NZL	6.26	13	\$205.00	\$38,502.00	\$5.33	\$10.56
RUS	4.69	77	\$1,658.00	\$24,789.00	\$7.41	\$10.12
SGP	2.77	10	\$364.00	\$90,531.00	\$5.90	\$11.41
SVN	4.78	2.5	\$54.00	\$34,064.00	\$4.01	\$10.44
SWE	7.56	41	\$551.00	\$51,264.00	\$6.31	\$10.84
TUR	3.4	26	\$767.00	\$26,453.00	\$6.64	\$10.18
USA	6.1	1250	\$20,494.00	\$59,495.00	\$9.93	\$10.99

Country	Pisa - Math		Pisa - Reading		Pisa - Science	
	Mean	SD	Mean	SD	Mean	SD
AUS	490.692	85.227	502.838	105.489	503.167	95.283
BRA	384.990	79.542	415.651	95.201	405.490	83.646
CHL	434.624	80.886	469.373	90.180	459.943	80.803
COL	400.018	75.457	422.494	86.729	422.258	77.566
ESP	491.161	79.096	482.729	88.089	482.729	88.089
EST	523.476	74.625	523.275	89.661	530.115	82.565
GEO	399.589	81.073	381.298	81.733	383.679	75.594
JPN	526.591	80.430	503.479	93.982	529.012	87.509
KAZ	440.594	84.088	404.426	84.103	415.203	80.080
MEX	415.584	68.871	427.640	78.678	424.955	68.801
NLD	514.102	90.236	479.822	102.888	497.374	101.734
NZL	496.356	86.032	508.217	102.482	510.376	96.592
RUS	488.761	78.335	480.334	90.337	479.038	78.650
SGP	568.287	88.374	548.458	106.929	549.973	93.806
SVN	496.848	81.199	480.100	90.715	493.254	83.991
SWE	502.393	84.351	505.525	103.701	499.345	92.240
TUR	452.610	81.216	464.591	84.356	467.602	78.027
USA	473.312	86.474	500.568	104.975	497.562	94.576

Statistical Models

Three sets of mixed effect models were performed using Restricted Maximum Likelihood Estimators (REML), one for each PISA thematic. Nested hierarchical models were employed for each theme, on the following way:

1. Model 1: Null model, with the addition of random effects only;
2. Model 2: Addition of Student-level variables
3. Model 3: Addition of Country-Level variables.

Country and School were added as random effects, to account for the fact that data points (students) within the same group (country or school) are not independent. Random effects are also reported on the tables below.

There were multicollinearity issues on Model 3 for all PISA themes, after adding country-level variables. For instance, some measurements showed Variance Inflation Factors (VIF) higher than 40, which indicate excessive correlations. Indeed, correlation matrices showed correlations higher than 0.900 in some cases. Models had problems to fit with these levels of multicollinearity. Four scales were removed ($VIF > 40$): "CNT_SHW_ACHIEV"; "CNT_SHW_HEDONISM"; "CNT_SHW_POWER"; "CNT_SHW_STIMUL". Models converged after taking this step and resulting VIFs were lower than 20.

Intra-class Correlation Coefficients were calculated for School and Country and are reported on the bottom of the tables. ICC serves as a statistical measure to quantify how strongly units in the same group resemble each other. Essentially, it helps in understanding the degree of correlation or similarity within clusters or groups in your hierarchical data.

Effect	Term	Model 1			Model 2			Model 3		
		estimate	std.error	p.value	estimate	std.error	p.value	estimate	std.error	p.value
fixed	(Intercept)	467.100	12.398	0.000	462.216	13.760	0.000	200.105	292.136	0.519
Student -Level										
fixed	In your home: A desk to study at				11.041	0.807	0.000	11.028	0.807	0.000
fixed	In your home: A room of your own				-2.350	0.647	0.000	-2.349	0.647	0.000
fixed	In your home: A quiet place to study				4.405	0.734	0.000	4.407	0.734	0.000
fixed	In your home: A computer you can use for school or work				14.326	0.674	0.000	14.326	0.674	0.000
fixed	In your home: A link to the Internet				7.374	0.996	0.000	7.375	0.996	0.000
School -Level										
fixed	ESCS				55.190	1.095	0.000	55.029	1.097	0.000
fixed	Job Satisfaction				-2.020	3.490	0.563	-1.710	3.490	0.624
fixed	Director Leadership				-0.418	1.523	0.784	-0.289	1.525	0.850
Country -Level										
fixed	CNT_SHW_SELFDIRECT							-18.133	45.115	0.702
fixed	CNT_SHW_SECUR							1.032	49.446	0.984
fixed	CNT_SHW_HEDONISM							-36.811	21.586	0.139
fixed	CNT_SHW_BENEVOLENCE							89.395	47.782	0.110
fixed	CNT_SHW_CONFORM							-31.654	48.105	0.535
fixed	CNT_SHW_SPIRIT							-43.615	29.870	0.194
fixed	CNT_SHW_TRAD							10.687	32.892	0.756
fixed	CNT_Gov_expend							-12.366	7.769	0.162
fixed	Govexp_GDPDoI							0.015	0.044	0.739
fixed	log_CNT_GDP_DOLLAR							-0.536	5.984	0.932
fixed	log_CNT_GDP_PERCAPITA							41.332	23.909	0.135
Random Part										
random	School	2757.097	52.508		1055.673	32.491		515.822	22.712	
random	Country	4260.913	65.276		4138.719	64.333		4138.706	64.333	
ICC	School	0.518								
ICC	Country	0.269								

Dependent variable: PISA Math

effect	term	Model 1			Model 2			Model 3		
		estimate	std.error	p.value	estimate	std.error	p.value	estimate	std.error	p.value
fixed	(Intercept)	467.100	12.398	0.000	468.456	14.417	0.000	488.979	407.673	0.276
Student -Level										
fixed	In your home: A desk to study at				10.280	0.867	0.000	10.277	0.868	0.000
fixed	In your home: A room of your own				-3.632	0.695	0.000	-3.631	0.695	0.000
fixed	In your home: A quiet place to study				4.132	0.789	0.000	4.135	0.789	0.000
fixed	In your home: A computer you can use for school or work				14.984	0.725	0.000	14.985	0.725	0.000
fixed	In your home: A link to the Internet				7.576	1.070	0.000	7.575	1.070	0.000
School -Level										
fixed	ESCS				54.151	1.151	0.000	54.054	1.153	0.000
fixed	Job Satisfaction				-3.048	3.661	0.405	-2.732	3.664	0.456
fixed	Director Leadership				-0.115	1.598	0.943	0.011	1.599	0.994
Country -Level										
fixed	CNT_SHW_SELFDIRECT							-59.036	62.981	0.385
fixed	CNT_SHW_SECUR							-31.535	69.067	0.664
fixed	CNT_SHW_HEDONISM							-38.951	30.125	0.244
fixed	CNT_SHW_BENEVOLENCE							111.017	66.659	0.147
fixed	CNT_SHW_CONFORM							-48.761	67.120	0.495
fixed	CNT_SHW_SPIRIT							-37.153	41.690	0.407
fixed	CNT_SHW_TRAD							47.788	45.900	0.338
fixed	CNT_Gov_expend							-13.900	10.841	0.247
fixed	Govexp_GDPDoI							0.051	0.061	0.435
fixed	log_CNT_GDP_DOLLAR							-1.155	8.348	0.895
fixed	log_CNT_GDP_PERCAPITA							22.192	33.381	0.531
Random Part										
random	School	2283.112	47.782		1146.868	33.865		1146.844	33.865	
random	Country	2757.097	52.508		1151.074	33.927		1012.124	31.814	
ICC	School	0.475								
ICC	Country	0.222								

Dependent variable: PISA Science

effect	term	Model 1			Model 2			Model 3		
		estimate	std.error	p.value	estimate	std.error	p.value	estimate	std.error	p.value
fixed	(Intercept)	467.138	11.202	0.000	455.738	14.930	0.000	401.714	434.221	0.391
Student -Level										
fixed	In your home: A desk to study at				10.801	0.948	0.000	10.803	0.948	0.000
fixed	In your home: A room of your own				-4.741	0.759	0.000	-4.737	0.759	0.000
fixed	In your home: A quiet place to study				5.332	0.862	0.000	5.335	0.862	0.000
fixed	In your home: A computer you can use for school or work				16.120	0.792	0.000	16.119	0.792	0.000
fixed	In your home: A link to the Internet				11.293	1.169	0.000	11.294	1.169	0.000
School -Level										
fixed	ESCS				57.859	1.217	0.000	57.801	1.220	0.000
fixed	Job Satisfaction				-0.923	3.864	0.811	-0.679	3.868	0.861
fixed	Director Leadership				-0.256	1.686	0.879	-0.152	1.688	0.928
Country -Level										
fixed	CNT_SHW_SELFDIRECT							-54.880	67.083	0.445
fixed	CNT_SHW_SECUR							-51.424	73.566	0.511
fixed	CNT_SHW_HEDONISM							-34.760	32.087	0.320
fixed	CNT_SHW_BENEVOLENCE							107.105	71.000	0.182
fixed	CNT_SHW_CONFORM							-44.520	71.491	0.556
fixed	CNT_SHW_SPIRIT							-26.058	44.406	0.579
fixed	CNT_SHW_TRAD							32.751	48.890	0.528
fixed	CNT_Gov_expend							-8.414	11.547	0.494
fixed	Govexp_GDPDoI							0.035	0.065	0.608
fixed	log_CNT_GDP_DOLLAR							1.398	8.891	0.880
fixed	log_CNT_GDP_PERCAPITA							29.015	35.555	0.446
Random Part										
random	School	2678.766	51.757		1146.868	33.865		1146.844	33.865	
random	Country	2247.032	47.403		1151.074	33.927		1012.124	31.814	
ICC	School	0.446								
ICC	Country	0.183								

Dependent variable: PISA Reading

Main Conclusions

In the PISA Mathematics models, the progression from Model 1 to Model 3 highlights significant student-level variables. Notably, having a desk to study at ($\beta = 11.04, p < .001$) and a computer for schoolwork ($\beta = 14.33, p < .001$) are positively associated with PISA Math scores. Conversely, having a room of one's own is negatively associated with these scores ($\beta = -2.35, p < .001$). The inclusion of country-level variables in Model 3 does not yield significant changes in these associations.

For PISA Science, similar trends emerge with student-level variables. The presence of a desk to study at ($\beta = 10.80, p < .001$) and a computer for schoolwork ($\beta = 16.12, p < .001$) positively influences Science scores, while having a room of one's own shows a negative association ($\beta = -4.74, p < .001$). Again, the addition of country-level predictors in Model 3 does not significantly alter these findings.

In the context of PISA Reading, the patterns observed in Mathematics and Science persist. Access to a desk for studying ($\beta = 10.80, p < .001$) and a computer for schoolwork ($\beta = 16.12, p < .001$) are positively linked with higher Reading scores, and having a room of one's own is negatively associated ($\beta = -4.74, p < .001$). The incorporation of country-level variables in Model 3 maintains these significant relationships.

Across all models and PISA subjects, the student-level predictors related to home study environments consistently demonstrate significant effects on PISA scores. The stability of these effects, regardless of the inclusion of country-level variables, underscores the importance of home study resources in students' academic performance. However, the lack of significant changes with the addition of country-level variables suggests that these broader factors may not have a strong direct influence on individual PISA scores, at least not within the scope of variables considered in these models.