Statistical Examination of K-12 Education Spending

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Introduction to Analysis

To analyze the relationships between revenue and expense in the United States (U.S.) K-12 schools, various data from 2012-2013 were collected from all 50 states, and the District of Columbia, using the National Center for Education Statistics. Revenue data were collected and included Federal, State, and Local revenue sources. In addition, K-12 education spending on a per capita basis and political affiliation data were collected for each State. Per capita spending is defined as the amount a State spends on K-12 education per person in the State (NCES, 2013). Descriptive and inferential statistical tests were used to determine whether associations existed among the aforementioned variables to analyze spending in the K-12 Market.

Examination 1: Analysis of education funding, enrollment and spending

The following examination tests the correlation of education funding and student enrollment to state spending on education. The test is used to determine where federal, state, and local revenues have a direct significant association to increase spending. In addition, enrollment factor is incorporated to determine is higher enrollment does increase spending in school districts across the U.S.

Hypothesis

The null and alternative hypothesis for this test is as follows:

H_{O1}: Total educational funding and enrollment do not have a significant affect on education spending

H_{A1}: Total educational funding and enrollment do have a significant affect on education spending

Statistic Test

A bivariate correlation test was used to analyze the association and correlation between total revenue and enrollment on education spending.

Descriptive Statistics & Sampling

Descriptive Statistics

	Mean	Std. Deviation	N
Spending on Education	11162364.2	13274977.9	51
Total Revenue	11836999.7	13861189.2	51
Enrollment	975904.27	1160968.24	51

As shown in the descriptive statistics above, there were **51** samples datum taken **(N=51)** from the NCES database**.** *See appendix I* The sample mean for spending, revenue, and enrolment were, **$11,162,364.2, $11,836,999.7,** and **975,904.27**, respectively. The sample standard deviation for spending, revenue, and enrolment were **$13,274,977.9, $12,861,189.2**, and **1,160,968.24**, respectively.

Correlation Statistics Results

Correlations

		Spending on Education	Enrollment	Total Revenue
Spending on Education	Pearson Correlation	1	.939**	.998**
	Sig. (2-tailed)		.000	.000
	N	51	51	51
Enrollment	Pearson Correlation	.939**	1	.934**
	Sig. (2-tailed)	.000		.000
	N	51	51	51
Total Revenue	Pearson Correlation	.998**	.934**	1
	Sig. (2-tailed)	.000	.000	
	N	51	51	51

**. Correlation is significant at the 0.01 level (2-tailed).

Correlation results for total revenue has a very strong association to increase spending with a Pearson Correlation **(r)** of **.998, N = 51**, and **P < .05**. Likewise, student enrollment has a very strong association to increase spending with a Pearson Correlation **(r)** of **.934, N = 51**, and **P < .05**. Both variables have a nearly perfect positive correlation to education spending.

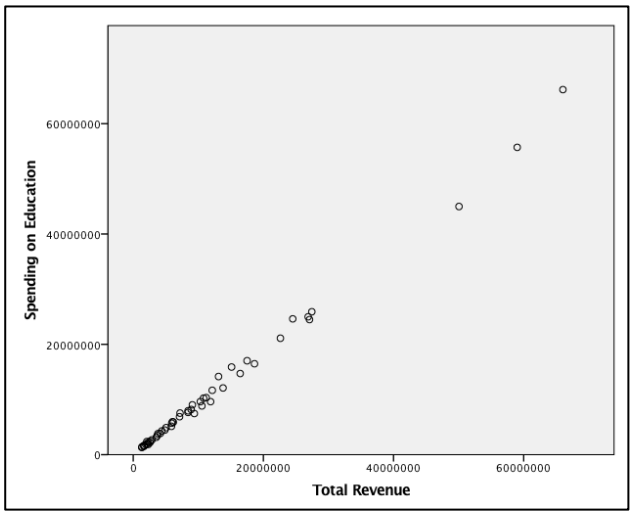


Figure 1: Scatter plot of total 2013 total education revenue and spending by state

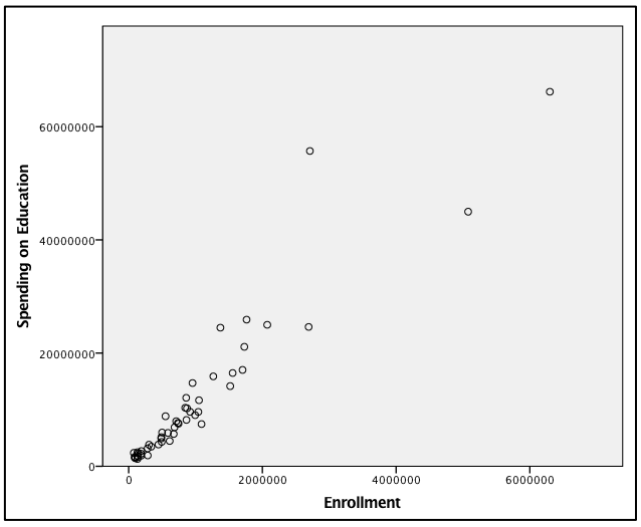


Figure 2: Scatter plot of total 2013 K-12 enrollment and education spending by state

Conclusion

The data results of the bivariate correlation test resulted in statistically significant Pearson Correlation statistics (r) and P-values for both total revenue and student enrollment's association to spending on education by State. Therefore, the null hypothesis is can be rejected. Furthermore, the alternative hypothesis can be accepted with the determination that both student enrollment and funding have a statistically significant direct positive impact on educational spending in K-12 school across the United State.

Examination 2: Analysis of region and political affiliation effect on educational spending by State

This analysis tests the differences in education spending by regional and political factors. Regional and political factors are two categorical independent variables while education spending is a quantitative dependent variable. This analysis presents multiple factors and independent variables to find the individual and group effect on educational spending. Therefore, a factorial ANOVA test was used. According to Neil Salkind, when more than one factor or independent variable is tested, the researcher can look not only at the individual effects of each factor, but also at the simultaneous effects of both, through what is called an interaction (Salkind, 2013). Furthermore, this examination identifies individual associations and combined interactions of a States region and federal funding on education spending in the State.

Statistic Test

A factorial ANOVA test was used to tests the differences in education spending by regional and political factors.

Hypothesis

The null and alternative hypothesis for this test is as follows:

H_{O1}: There is no significant difference in educational spending by region and political party

H_{A1}: There is a significant in difference educational spending by region and political party

Descriptive Statistics & Sampling & Results

Between-Subjects Factors

		Value Label	N
Region	1	Northeast	9
	2	South	17
	3	Midwest	12
	4	West	13
Polictical Party	1	Democrat	26
	2	Republican	25

Descriptive Statistics

Dependent Variable: Spending on Education

Region	Polictical Party	Mean	Std. Deviation	N
Northeast	Democrat	16959515.8	18439310.1	8
	Republican	2688741.33	.	1
	Total	15373874.2	17892330.0	9
South	Democrat	8495174.31	8784120.13	6
	Republican	12653043.4	11581473.2	11
	Total	11185560.2	10589578.3	17
Midwest	Democrat	16630093.1	6527053.98	5
	Republican	5267178.18	3435991.72	7
	Total	10001726.1	7494445.37	12
West	Democrat	14445086.0	23045563.2	7
	Republican	3270811.19	2307409.92	6
	Total	9287728.40	17360435.7	13
Total	Democrat	14265893.9	16011099.3	26
	Republican	7934693.31	8877625.22	25
	Total	11162364.2	13274977.9	51

As shown in the descriptive statistics above, the samples taken for the categorical independent variables and dependent quantitative variables were **N = 51**. Samples means and standard deviations for each variable were presented above. The samples were retrieved from NCES 2013 datasets. *See appendix I*

Levene's Test of Equality of Error Variances[a]

Dependent Variable: Spending on Education

F	df1	df2	Sig.
2.037	7	43	.072

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + Region + PolicticalParty + Region * PolicticalParty

A Levene's Test of the Equality of Error Variance was conducted to test the differences in variance of the groups. The was not significant difference in variances of the groups with **F(7, 43) = 2.037, P = .072**.

Tests of Between-Subjects Effects

Dependent Variable: Spending on Education

Source		Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	Hypothesis	3.177E+15	1	3.177E+15	6.065	.246	.858
	Error	5.239E+14	1	5.239E+14[a]			
Region	Hypothesis	3.210E+13	3	1.070E+13	.051	.982	.048
	Error	6.318E+14	3	2.106E+14[b]			
PolicticalParty	Hypothesis	5.239E+14	1	5.239E+14	2.589	.172	.353
	Error	9.588E+14	4.738	2.024E+14[c]			
Region * PolicticalParty	Hypothesis	6.318E+14	3	2.106E+14	1.198	.322	.077
	Error	7.562E+15	43	1.759E+14[d]			

a. MS(PolicticalParty)
b. MS(Region * PolicticalParty)
c. .763 MS(Region * PolicticalParty) + .237 MS(Error)
d. MS(Error)

Conclusion

A factorial ANOVA test was used to tests the differences in education spending by regional and political factors. Results showed that there was no significant effect played by the region on education spending per state with **P >.05** for the conditions **[F(3,3) = .051, P > .982]**. Additionally, there was also no significant effect played by the political party on education

spending per state with **P >.05** for the conditions **[F(1,4.738) = 2.589, P > .172]**. Lastly, when combining both state region and political affiliation to analyze the interaction of the two variables on spending, no significant effect was found on education spending per state with **P >.05** for the conditions **[F(3,43) = 1.198, P > .332].** Therefore, given the lack of significant findings, the null hypothesis is accepted. There is no significant difference in educational spending by region and political party.

Examination 3: Analysis of region and per capita spending on educational outcomes

This analysis examines the impact of per capita state spending, a quantitative variable, and region, a categorical variable, on differences in education outcomes in the form of combined average math and reading scores by state. This examination presents two independent factors and one dependent variable to analyze the impact on educational outcomes.

Statistic Test

An ANCOVA test is used to examine the effect of region and per capita spending on educational outcome. Per capita spend was used a covariate that may influence educational outcomes. An ANCOVA test for difference in samples variance and adds additional variables in the form of covariates to determine combine affect (Salkind, 2013).

Hypothesis

The null and alternative hypothesis for this test is as follows:

H_{O1}: Region and per capita spending does not have a significant effect on educational outcome

H_{A1}: Region and per capita spending does have a significant effect on educational outcome

Descriptive Statistics & Sampling

Between-Subjects Factors

		Value Label	N
Region	1	Northeast	9
	2	South	17
	3	Midwest	12
	4	West	13

Descriptive Statistics

Dependent Variable: Avg Math and Reading Scores

Region	Mean	Std. Deviation	N
Northeast	281.56	5.016	9
South	270.44	6.210	17
Midwest	277.59	2.404	12
West	274.46	5.498	13
Total	275.11	6.433	51

As shown in the descriptive statistics above, the samples taken for the independent variables and dependent quantitative variables were **N = 51**. The sample mean and standard deviations for each region are shown respectively above. The sample data were retrieved from NCES 2013 datasets for education outcomes in Mathematics, English Language Arts, region, and per capita spending. *See appendix I*

Results

Levene's Test of Equality of Error Variances[a]

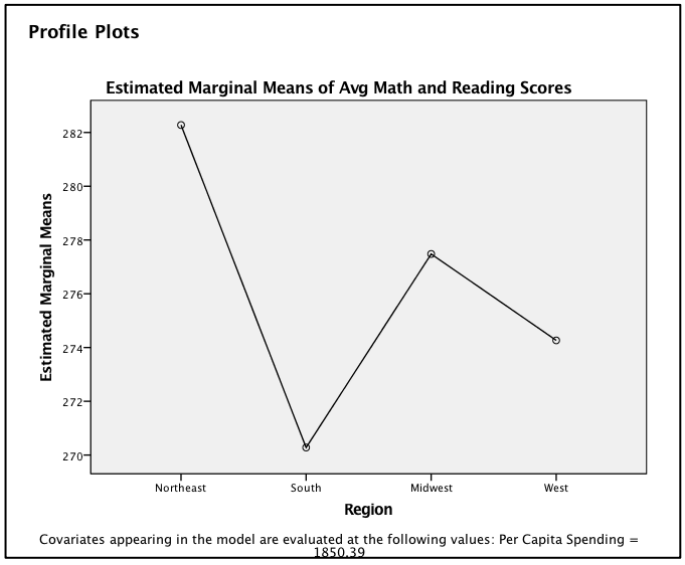
Dependent Variable: Avg Math and Reading Scores

F	df1	df2	Sig.
3.680	3	47	.018

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Design: Intercept + PerCapitaSpending + Region

A Levene's Test of the Equality of Error Variance was conducted to test the differences in variance of the groups. The test showed a significant difference in variances of the groups for the conditions **F (3, 47) = 3.680, P = .018**.



The graph above plots the average educational outcomes for each region with per capita spending as a covariate independent variables for each region. The graph shows that the Northeast and Midwest region are significantly higher that the South and West region.

Tests of Between-Subjects Effects

Dependent Variable: Avg Math and Reading Scores

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	854.983[a]	4	213.746	8.097	.000	.413
Intercept	226806.880	1	226806.880	8591.319	.000	.995
PerCapitaSpending	30.172	1	30.172	1.143	.291	.024
Region	840.941	3	280.314	10.618	.000	.409
Error	1214.379	46	26.400			
Total	3861953.02	51				
Corrected Total	2069.362	50				

a. R Squared = .413 (Adjusted R Squared = .362)

Conclusion

An ANCOVA test is used to examine the effect of region and per capita spending on educational outcome. Results showed that there was no significant effect of per capita spending on education outcome per state with **P >.05** for the conditions **[F (1,46) = 1.143, P > .291]**. However, there was a significant effect on educational outcome by region with **P < .001** for the conditions **[F (1,46) = 10.618, P < .001]**. Additionally, the combined interaction of region and per capita spend on educational outcome were reasonable with a Correlation of Determination of **R Squared = .413** and Pearson Correlation **R = .6426**. **R Squared** means that approximately 40% of the change in educational outcome could be explained by changes in region and per capita spending. Additionally, **R** shows that the combination of per capita spending and region has a strong positive correlation to educational outcomes. Therefore, the null hypothesis can be rejected. Furthermore, the alternative hypothesis can be accepted. Region and per capita spending does have a significant effect on educational outcome.

Appendix I: Dataset

Location	Region	Polictical Party	Total Revenue	Per Capita Spending	Spending on Education	Enrollment	Avg Math and Reading
Alabama	2	2	7,188,210	1,560	7,535,842	744,637	263
Alaska	4	2	2,670,758	3,387	2,495,461	131,489	271
Arizona	4	2	9,385,733	1,125	7,452,431	1,089,384	270
Arkansas	2	2	5,051,804	1,659	4,909,892	486,157	270
California	4	1	66,026,445	1,726	66,173,604	6,299,451	269
Colorado	4	1	8,905,156	1,555	8,188,884	863,561	280
Connecticut	1	1	10,549,973	2,458	8,840,274	550,954	280
Delaware	2	1	1,909,503	1,997	1,847,745	129,026	274
District of Columbia	2	1	2,094,445	3,647	2,367,388	76,140	256
Florida	2	1	24,506,837	1,257	24,622,773	2,692,162	273
Georgia	2	2	17,492,816	1,705	17,028,223	1,703,332	272
Hawaii	4	1	2,331,839	1,339	1,883,132	184,760	271
Idaho	4	2	2,103,804	1,187	1,913,368	284,834	278
Illinois	3	1	26,879,107	1,940	24,990,757	2,072,880	276
Indiana	3	2	11,887,836	1,463	9,607,553	1,041,369	278
Iowa	3	2	6,033,012	1,928	5,960,698	499,825	277
Kansas	3	2	5,866,415	1,777	5,140,786	489,043	278
Kentucky	2	1	7,120,960	1,562	6,874,478	685,167	275
Louisiana	2	2	8,439,545	1,719	7,953,042	710,903	265
Maine	1	1	2,584,962	1,677	2,229,343	185,739	279
Maryland	2	1	13,800,320	2,039	12,092,530	859,638	280
Massachusetts	1	1	16,436,188	2,193	14,708,444	954,773	289
Michigan	3	1	18,632,336	1,664	16,474,809	1,555,370	273
Minnesota	3	1	11,215,788	1,908	10,339,714	845,404	283
Mississippi	2	2	4,394,942	1,441	4,308,096	493,650	262
Missouri	3	2	10,311,473	1,592	9,618,261	917,900	275
Montana	4	2	1,657,908	1,617	1,639,832	142,908	280
Nebraska	3	2	3,800,737	2,039	3,810,601	303,505	277
Nevada	4	1	4,140,625	1,377	3,837,493	445,707	270
New Hampshire	1	2	2,875,406	2,033	2,688,741	188,974	285
New Jersey	1	1	27,087,144	2,752	24,486,583	1,372,203	286
New Mexico	4	1	3,695,203	1,663	3,467,350	338,220	264
New York	1	1	59,007,178	2,832	55,706,794	2,710,703	274
North Carolina	2	2	13,107,879	1,440	14,167,683	1,518,465	275
North Dakota	3	2	1,354,505	1,990	1,441,145	101,111	279
Ohio	3	1	22,609,388	1,824	21,107,776	1,729,916	279
Oklahoma	2	2	5,912,975	1,483	5,712,640	673,483	269
Oregon	4	1	6,160,158	1,502	5,897,642	587,564	276
Pennsylvania	1	1	27,446,614	2,027	25,909,062	1,763,677	281
Rhode Island	1	1	2,336,776	2,156	2,270,127	142,481	275
South Carolina	2	2	8,414,913	1,606	7,659,326	735,998	271
South Dakota	3	2	1,323,242	1,528	1,291,203	130,471	278
Tennessee	2	2	9,084,504	1,391	9,037,141	993,496	272
Texas	2	2	50,053,709	1,699	44,985,106	5,077,659	276
Utah	4	2	4,860,217	1,539	4,466,086	613,279	277
Vermont	1	1	1,641,315	2,432	1,525,499	89,624	285
Virginia	2	2	15,106,627	1,923	15,886,487	1,265,419	278
Washington	4	1	12,142,892	1,674	11,667,497	1,051,694	281
West Virginia	2	1	3,543,326	1,708	3,166,132	283,044	266
Wisconsin	3	1	10,809,097	1,783	10,237,410	872,436	278
Wyoming	4	2	1,694,441	2,845	1,657,689	91,533	280

*N = 51

*Political and education data were retrieved from Gallup.com and NCES databases, respective

References:

NCES, National Center for Educational Statistics. (2015). Enrollment in public elementary and secondary schools, by region, state, and jurisdiction: Selected years, fall 1990 through fall 2025. Retrieved from https://nces.ed.gov/programs/digest/d15/tables/dt15_203.20.asp

Saad, L. (2014). Not as many U.S. states lean democratic in 2013. Retrieved from http://www.gallup.com/poll/167030/not-states-lean-democratic-2013.aspx

Salkind, N. J. (2013). *Statistics for people who (think they) hate statistics* Sage Publications.