Nevada Cost Function Study

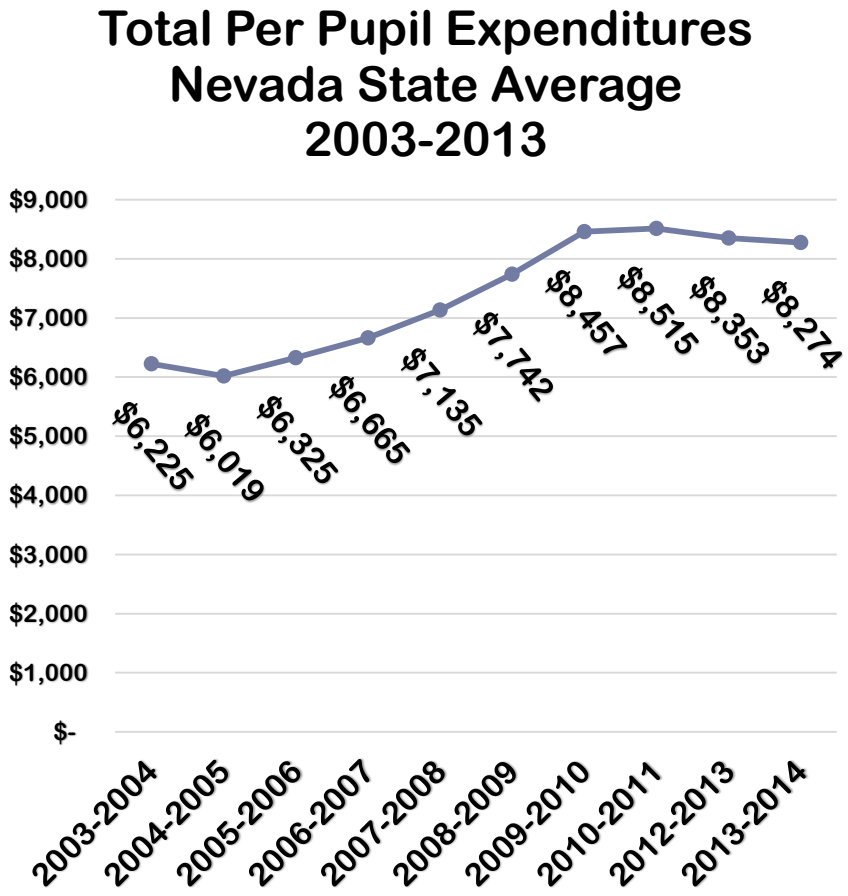
Results So Far and Future Research

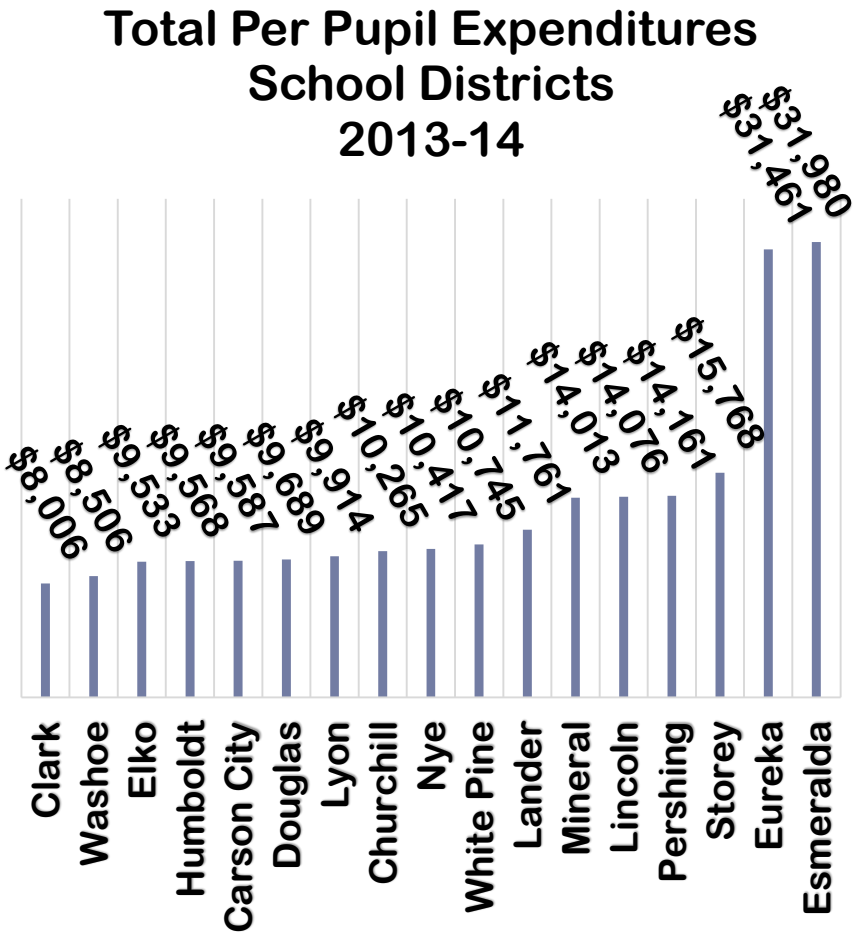
Today's presentation

- Current Nevada School Funding System
- Cost Function Study
  - Study Goals
  - Dataset Created
  - Descriptive Statistics: School Spending, Student Performance, and Student Characteristics
  - Cost function study: progress and future directions

Current Nevada School Funding System

State and County Per Pupil Expenditures





Source: Nevada Report Card, 2014

Components of the Nevada Plan (1967-Present)

- Based on enrollment with adjustments made for district economic and geographic characteristics and the ability to raise revenue.
- Equitable for taxpayers not necessarily for students.
- Categorical state funding exists for specific purposes such as class-size reduction and early childhood programs.
- No state funding for building, maintaining, or renovating facilities.
- Majority of the revenues are local and from sales tax.

Revenue Sources			
Local	**State**	**Federal**	
62.6%	30.8%	6.6%	
Sales Tax	**Property Tax**	**Gaming Tax**	**Other Sources**
51%	19%	15%	15%

Source: American Institutes for Research (2012, August 22). Study of a new method of funding for public schools in Nevada. Report submitted to Nevada Legislative Counsel Bureau; Legislative Counsel Bureau, Fiscal Analysis Division, 2013 Legislative Session, The *Nevada Plan* for School Finance: An Overview.

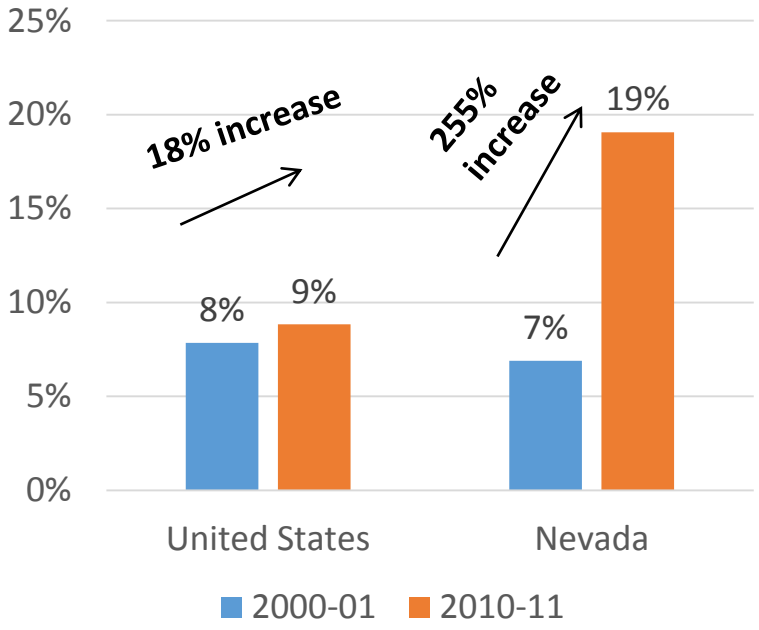
Nevada Funding for Education

- Several issues with the Nevada Plan including:
  - Unstable: The tax base relies heavily on sales and property taxes which fluctuates. Also, categorical funding is not guaranteed over the long term.
  - Unfair: Localities responsible for capital outlay but a lack of local control in terms of other funding and spending.
  - Insufficient and Outdated: Does not account for students needs according to characteristics such as income or language.

Source: American Institutes for Research (2012, August 22). Study of a new method of funding for public schools in Nevada. Report submitted to Nevada Legislative Counsel Bureau.

Nevada's English Language Learners: Demographics & Funding

Percentage of English Language Learners In K-12 Schools



Federal and State Level Funding For ELL Education by School District

Comparison Districts 2010-11	Total ELL Students	ELL Federal & State Funding	Funding Per ELL Student
Broward (TX)	25,112	$121,472,538	**$4,837**
Miami-Dade (FL)	67,842	$318,300,988	**$4,677**
Houston (TX)	62,178	$160,923,036	**$2,588**
Clark (NV)	55,818	$6,668,517	**$119**

Nevada ranked 3rd nationally in relative growth of ELLs from 2000 to 2010 , with the nation's highest density of ELLs in 2007

Nevada was one of eight states that did not fund ELLs until 2013

CCSD ↓ funding over 55% from 2009 to 2013;

ELL enrollment ↑ 18%

Source: Horsford, S. D., C. Mokhtar and C. Sampson. 2013. *Nevada's English Language Learners: A Review of Enrollment, Outcomes, and Opportunities.* Las Vegas: University of Nevada Las Vegas, Lincy Institute.

Cost Function Study

Study Goals

Cost Function Study Goals

- Assemble an integrated district- and school-level dataset with information about school spending, student performance, student characteristics, and other environmental characteristics that affect school spending and student performance.

- Use cost function technology and the above dataset to:
  - Estimate empirically the level of funding necessary to allow a typical student an opportunity to obtain an "adequate" education
  - Estimate any funding adjustments necessary to allow "at-risk" students to obtain this same level of education.

Cost Function Study

Data Collection and Datasets Created

Data Collection and Dataset

- Primary Accomplishments
  - Creation of school-level dataset with student performance indicators, school expenditures, student demographics, and selected demographic, economic, and geographic characteristics of the surrounding counties/districts for school years 2011-2012 and 2012-2013.
  - Creation of district-level dataset for 2011-2012 and 2012-2013 with the same variables reported at the district level.

Data Collection and Datasets

- Limitations of current datasets: some school groups not currently integrated into the dataset.
  - State-sponsored charter schools
  - Schools that do not report expenditures separately for elementary, middle, and secondary levels

Data Collection and Datasets

- Remaining to do:
  - Integrate omitted schools
  - Add data for all variables for additional school years
  - Integrate with Applied Analysis My Researcher project to allow automatic update of data

Cost Function Study

What we know: Descriptive Statistics

Descriptives: Data Basics

- Descriptives reported here: School Spending, Student Performance, and Student Characteristics
- Individual schools are units of analysis. All statistics report/reflect unweighted school-level values (unless noted).
- Statistics are reported for 2013.
- Omitted schools: private schools, state sponsored private schools, schools that did not report spending data separately for elementary, middle, and high schools.

Descriptives: Data Basics

- Descriptives report school level data.
- Descriptives are reported for Nevada schools as a whole.
- Descriptives are reported on the basis of three groupings of school type, based on the allocation of districts into types for purposes of the Distributive School Account.
  - Small, centralized: Carson City, Churchill, Douglas, Lyon
  - Large, urban: Clark, Washoe
  - Rural (rest of state)

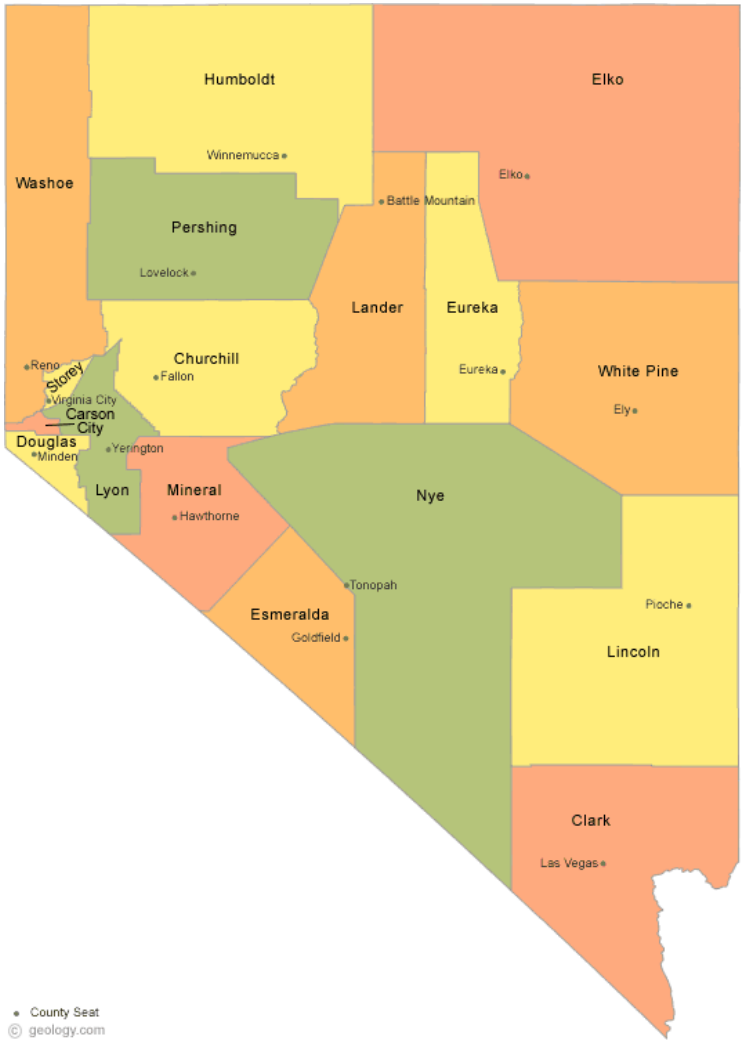
Descriptives: DSA Groupings

Table 1
School Distributional Group Composition: Study Schools
(AY 2013)

Group	Districts Included	Schools: Level (Number)*
Small, centralized	Carson City Churchill Douglas Lyon	Elementary (n=25) Middle School (n=9) High School (n=6) Total (n=40)
Rural (rest of state)	Elko Esmeralda** Eureka Humboldt Lander Lincoln Mineral Nye Pershing Story White Pine	Elementary (n=40) Middle School (n=19) High School (n=17) Total (n=76)
Large	Clark Washoe	Elementary (n=284) Middle School (n=69) High School (n=66) Total (n=419)

* Includes only schools reporting expenditures separately by level for Academic Year 2013. Numbers of schools may be slightly different for AY 2012. ** No schools in Esmeralda reported spending separately by level. Therefore, no schools from Esmeralda were included in this study.

Descriptives: Data Basics



DSA Groupings: District Characteristics

Table 2

School Distributional Group

Community Characteristics

Group (n) Statistic	Land Area (square miles)[2]	Persons per square mile [2]	Population	Owner Occupied Housing (%) [3]	Bachelor's degree (%) [3]	Median HH Income [3]	Median Home Value [3]
Small, centralized (n=4)							
Mean	1946.5	117.7	44204.5	65.5	19.8	52,006	189250
Standard Deviation	2135.7	172.6	13732.6	65.9	4.2	5907.5	61246.41
Minimum	144.7	4.9	24063	58.1	16.7	46137	133400
Maximum	4930.5	373.8	54080	71.8	25.7	60100	271400
Rural (n=10) [1]							
Mean (SD)	8421.9	2.8	15088.7	72.2	15.1	54438	132070
Standard Deviation	5764.4	4.4	17674.13	8.7	4.7	13325.52	28741.69
Minimum	262.9	0.5	2076	62.9	10.5	33017	95500
Maximum	18181.9	15	52384	93.8	24.7	72742	184300
Large (n=2)							
Mean (SD)	7096.9	162.9	1230800	56.2	24.7	52956.5	184150
Standard Deviation	1123.64	133.04	1127225	2.5	3.7	118.09	27082.19
Minimum	6302.4	68.8	433731	54.4	22.1	52873	165000
Maximum	7891.4	257	2027868	58	27.3	53040	203300

Notes

[1] Esmeralda omitted

[2] As of 2010

[3] As of 2013

Descriptives: Definition of Measures

School Spending Measures

- **Total spending** includes all actual expenditures from whatever source (federal, state, and local) used for the operation of schools. It excludes capital expenditures and debt service. Expenditure data are allocated to schools using activity based accounting.

- **Instructional spending** = total spending less transportation, food service, safety, building upkeep and maintenance, and administrative business services (.e.g. payroll).

- Both expenditure measures are reported on a per pupil basis.

Descriptives: Definition of Measures

- Student Performance Measures
  - % students achieving proficiency (or higher) on Math CRT
  - % students achieving proficiency (or higher) on Reading CRT
  - School Performance Index Score (0-100)

Descriptives: Definition of Measures

- Elementary and Middle School Performance Index Score Components

  - 30 points: Percent of students meeting proficiency expectations on math and reading CRTs
  - 40 points: Two measures of individual student improvement in math and reading CRTs.
  - 20 points: % of IEP, ELL, FRL students meeting "Adequate Growth Percentile" (on track to attain proficiency in three years or by 8th grade).
  - 10 points: Other – currently attendance

Descriptives: Definition of Measures

- High School Performance Index Score Components
  - 20 points: % of 10th and 11th grade students meeting proficiency expectations
  - 10 points: student growth measure
  - 10 points: "Cumulative % of 11th Grade IEP, ELL, FRL Proficiency Gap
  - 30 points: Overall graduation rate (15 points) and IEP, ELL, and FRL graduation rate gap (15)
  - 16 points: Assorted college and career readiness measures
  - 14 points: Attendance (10 points); % of pth grade students who are credit deficient (4 points)

Descriptives: Tables

School Spending and Performance Indicators
by Distributional Group
Academic Year 2013

Group	Total Spending per pupil [1] Mean (SD) (n)	Instructional Spending per pupil [2] Mean (SD) (n)	Total Enrollment Mean (SD) (n)	Index Score [3] Mean (SD) (n)	Percent Proficient Math Mean (SD) (n)	Percent Proficient Reading Mean (SD) (n)
Small, centralized	$9226 (1389) (40)	$7528 (1104) (40)	584 (332) (40)	62.96 (8.30) (40)	69.86 (12.57) (40)	72.93 (8.93) (40)
Rural (rest of state)	$12800 (8072) (76)	$9806 (5861) (76)	297 (299) (72)	53.02 (13.96) (66)	57.60 (19.91) (68)	63.57 (16.18) (68)
Large	$8461 (5365) (419)	$6954 (3389) (419)	885 (582) (413)	61.68 (14.97) (407)	68.55 (16.18) (412)	66.88 (15.28) (412)
Total Nevada	$9135 (5138) (535)	$7402 (3859) (535)	782 (574) (525)	60.67 (14.71) (513)	67.22 (16.87) (520)	66.92 (15.13) (520)

Notes

[1] Spending data collected and categorized by Schoolnomics of San Diego, CA, under contract to the Legislative Counsel Bureau of the State of Nevada. Spending is allocated to individual schools using "IN$ITE" a patented "Activity Based Costing" method. Total spending per pupil includes all federal, state, and local dollars allocated to a given school. It excludes debt service, capital projects, retiree benefits,and enterprise operations.

[2] Spending data collected and categorized by Schoolnomics of San Diego, CA, under contract to the Legislative Counsel Bureau of the State of Nevada. Spending is allocated to individual schools using "IN$ITE" a patented "Activity Based Costing" method. Instructional spending consists of Total Spending less spending for non-instructional purposes such as transportation, food, safety, building maintenance, utilities, data processing and business operations

[3] Total possible value = 100.

Descriptives: Tables

Table 4

At-Risk Students
by Distributional Group
Academic Year 2013

Group	Total Enrollment Mean (SD) (n)	FRL Percent [3] Mean (SD) (n)	ELL Percent [4] Mean (SD) (n)	IEP Percent [5] Mean (SD) (n)	Percent Black Mean (SD) (n)	Percent Hispanic Mean (SD) (n)
Small, centralized	584 (332) (40)	46.54 (14.9) (40)	10.95 (10.84) (38)	12.42 (2.78) (40)	1.67 (.74) (6)	10.95 (10.84) (38)
Rural (rest of state)	297 (299) (72)	38.41 (23.35) (51)	6.81 (10.31) (39)	11.60 (3.49) (37)	N/A	25.00 (17.07) (39)
Large	885 (582) (413)	53.87 (25.31) (410)	20.84 (18.63) (395)	11.67 (3.74) (404)	11.37 (9.62) (357)	43.98 (22.97) (407)
Total Nevada	782 (574) (525)	51.71 (24.90) (501)	18.88 (18.12) (472)	11.73 (3.65) (481)	17.60 (49.49) (385)	41.02 (22.86) (486)

Notes

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[3] Percent of students eligible for federal Free and Reduced Price Lunch program.

[4] Percent of students classified as English Language Learners

[5] Percent of students whose disability qualifies them for an Individualized Education Plan.

Descriptives: Tables

Table 5

Total Spending, Student Performance, and At-Risk Populations

Bivariate Correlations within Distributional Groups

Academic Year 2013

Group	Total Spending[1] /IndexScore	Total Spending[1] /Math	Total Spending[1] /Reading	Total Spending[1] /FRL [3]	Total Spending[1] /ELL [4]	Total Spending[1] /IEP [5]
	r	r	r	r	r	r
	(n)	(n)	(n)	(n)	(n)	(n)
Small, centralized	-0.13 (40)	0.16 (40)	-0.03 (40)	0.45 (40)	0.22 (38)	0.31 (40)
Rural (rest of state)	0.14 (66)	-0.06 (68)	-0.13 (68)	-0.18 (39)	0.22 (51)	0.34 (37)
Large	-0.15 (407)	-0.01 (412)	-0.04 (412)	0.08 (410)	0.07 (395)	**0.47** (404)
Total Nevada	-0.2 (503)	-0.34 (517)	-0.19 (517)	0.06 (501)	0.01 (472)	0.43 (481)

Notes

Numbers in bold: p<.05

[1] Spending data collected and categorized by Schoolnomics of San Diego, CA, under contract to the Legislative Counsel Bureau of the State of Nevada. Spending is allocated to individual schools using "IN$ITE" a patented "Activity Based Costing" method. Total spending per pupil includes all federal, state, and local dollars allocated to a given school. It excludes debt service, capital projects, retiree benefits,and enterprise operations.

[3] Percent of students eligible for federal Free and Reduced Price Lunch program.

[4] Percent of students classified as English Language Learners

[5] Percent of students whose disability qualifies them for an Individualized Education Plan.

Descriptives: Tables

Table 6

Instructional Spending, Student Performance, and At-Risk Populations

Bivariate Correlations within Distributional Groups

Academic Year 2013

Group	Instructional Spending[1] /IndexScore	Instructional Spending[1] /Math	Instructional Spending[1] /Reading	Instructional Spending[1] /FRL [3]	Instructional Spending[1] /ELL [4]	Instructional Spending[1] /IEP [5]
	r	r	r	r	r	r
	(n)	(n)	(n)	(n)	(n)	(n)
Small, centralized	-.14 (40)	.20 (40)	-.03 (40)	.47 (40)	.22 (38)	.32 (40)
Rural (rest of state)	.17 (66)	.001 (68)	-.10 (68)	-.12 (39)	.15 (51)	.27 (37)
Large	-.17 (407)	-.002 (412)	-.07 (412)	0.11 (410)	.11 (395)	.44 (404)
Total Nevada	-.16 (503)	-0.3 (517)	-0.17 (517)	.06 (501)	.01 (472)	.41 (481)

Notes

Numbers in bold: p<.05

[1] Spending data collected and categorized by Schoolnomics of San Diego, CA, under contract to the Legislative Counsel Bureau of the State of Nevada. Spending is allocated to individual schools using "IN$ITE" a patented "Activity Based Costing" method. Instructional spending consists of Total Spending less spending for non-instructional purposes such as transportation, food, safety, building maintenance, utilities, data processing and business operations

[3] Percent of students eligible for federal Free and Reduced Price Lunch program.

[4] Percent of students classified as English Language Learners

[5] Percent of students whose disability qualifies them for an Individualized Education Plan.

Cost Function Studies

Methodology Basics

Cost Function Studies: Basics

- Goal of this study:
  - Identify and collect quantitative data that measure both the controllable and the uncontrollable factors that affect school spending in Nevada
  - Use regression techniques to model school spending per pupil as a function of those factors.
  - Estimate empirically the level of funding necessary to allow a typical student an opportunity to obtain an "adequate" education (as measured by student performance indicators)
  - Estimate any funding adjustments necessary to allow "at-risk" students to (IEP, FRL, ELL) obtain this same level of education.

Cost Function Studies: Basics

- Cost function study basics:
  - Based on econometric techniques using costs, inputs, and outputs
  - School expenditures result from two types of factors:
    - Factors that educators and policymakers can control (or at least hope to influence)
      - Level of student education: what students know and can do
      - Efficiency with which schools use resources to educate students
    - Factors outside school and district control
      - Characteristics and needs of students they serve
      - Resource costs such as labor costs
      - Structural and environmental characteristics such as enrollment #s, population density.

Cost Function Studies: Variables and Nevada Measures

- Dependent Variable: Per Pupil Expenditures (total and instructional)
- Uncontrollable cost factors
  - Student characteristics: and needs: percent IEP, ELL, and FRL students
  - Structural and resources costs
    - Average teacher salary (5 yrs experience) or comparative wage index
    - Enrollment (and enrollment squared)
- Controllable cost factors
  - Student achievement: IndexScore, % Proficient Math, % Proficient Reading
  - Efficiency (collection of variables theoretically and/or empirically associated with efficiency of local government operations)

Cost Function Studies

Progress

Cost Function Studies: Progress

- Data collected for primary variables for years 2012 and 2013.
- Preliminary regression estimates revealed unexpected technical challenges which make accurate and unbiased estimates difficult.

Cost Function Studies: Progress

- Technical Challenges

  - Scholars estimating education cost functions recognize that school spending and student performance are likely endogenous.
  - Two possible sources for endogeneity applicable hear are simultaneity or omitted variable bias
  - In order for cost function analyses to return unbiased coefficients (measurements of the impact of the independent variables on the dependent variables), certain assumptions must be met.
  - Endogeneity (correlated errors) violates these assumptions

Cost Function Studies: Progress

- Technical Challenges (cont'd)
  - Two stage least squares (2SLS) represents an accepted means of correcting endogeneity like this.
  - 2SLS requires an instrumental variable which is one that is correlated with the endogenous independent variable (here performance) but does not affect the dependent variable other than through the independent variable.
  - Statistical tests can gauge the adequacy of an instrumental variable.
  - We have not found instrumental variables that perform well on these tests yet. (We are still looking.)
  - Therefore, we do not yet have confidence in our estimates.

Cost Function Studies

Next Steps

Cost Function Studies: Conclusions and Next Steps

- Primary Conclusion: Must correct for endogeneity. Current results are uncertain and can change.

- Next steps:
  - Continue to pursue potential instrumental variables
  - Continue to look at options for modeling data.
  - Consider incorporating production function analysis
  - Present models and results to scholars for review and suggestions
  - Add additional years of data to increase estimation options and reduce error