



# 2009 Colorado School District Cost of Living Study

Colorado Legislative Council

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# 2009 COLORADO SCHOOL DISTRICT COST OF LIVING STUDY

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CONDUCTED FOR THE COLORADO LEGISLATIVE COUNCIL

## SECTION 1: INTRODUCTION

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Corona Insights is pleased to present this report to the Colorado Legislative Council. The following report provides the 2009 cost of living index for each of Colorado's 178 school districts, along with a description of the project design and research methodology.

### BACKGROUND

In August of 2009, Corona Insights was retained to conduct the 2009 Colorado School District Cost of Living Study for the Colorado Legislative Council. This study measures the differences in the cost to purchase a typical "market basket" of goods among the 178 public school districts in the State of Colorado. Final cost of living factors detailed within this study reflect the relative cost differences for all notable site-specific living expenses (i.e., housing, transportation, food, services and taxes) among Colorado's school districts. The cost of living indices developed herein is used as one component of each district's per pupil funding formula.

This report is the latest in a series of biennial reports that were first conducted as a result of the Public School Finance Act of 1994.

## SECTION 2: GENERAL OVERVIEW OF RESEARCH DESIGN

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The goal of the project is to develop comparative cost of living figures for each of the 178 school districts in the state. To do that requires answering five major questions:

1. What is a “typical” (archetypal) Colorado household in terms of size and income?
2. What types of goods and services does that archetypal household buy?
3. Where do they buy those goods and services?
4. How much do those goods and services cost in differing geographic locations?
5. If an archetypal household lives in each of the 178 school districts, what is the difference between their costs to buy those goods, based on the prices where they shop?

The research process therefore sought to answer each of these questions.

As a structure for this approach, the cost of living estimates are based on the following global assumptions:

### RESEARCH STRUCTURE

- ⇒ We begin with an archetypal household of three people with a total household income of \$47,500;
- ⇒ Then we place that household in each school district in Colorado;
- ⇒ That household then spends their income on the same suite of goods and services that are purchased by the average household of that size and income level throughout the United States;
- ⇒ The archetypal household then shops inside and outside their district in a pattern that emulates the geographic shopping patterns of all households in that district;
- ⇒ The price for goods and services in each district where they shop may differ, even if the good or service is identical, based on market factors;
- ⇒ Final Cost of Living findings are then calculated. These final findings detail the differences in costs of living for the archetypal household in each district to purchase a standard suite of goods and services.

An overview of the methodology is provided in Section 4 of this report, with additional detail provided in Appendix B. Appendix C denotes notable methodological changes between the 2007 study and the 2009 study.

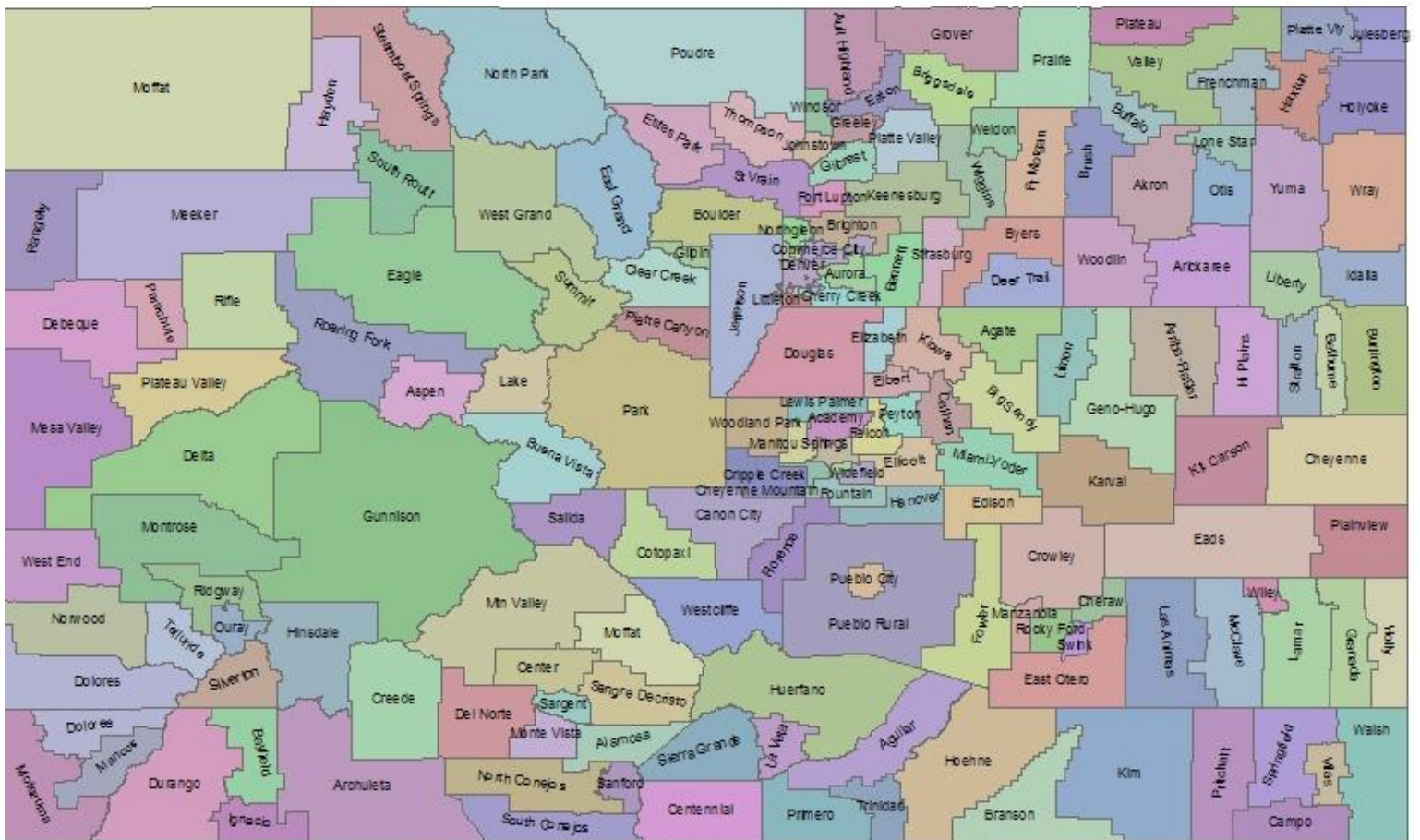
## SECTION 3: 2009 COLORADO SCHOOL DISTRICT COST OF LIVING FINDINGS

The table that extends across the following several pages provides the overall cost of living in each of Colorado's 178 school districts, as calculated in 2009. Figures are reported in order by District number (and alphabetically by County name), along with appropriate rankings, ratings, and comparisons.

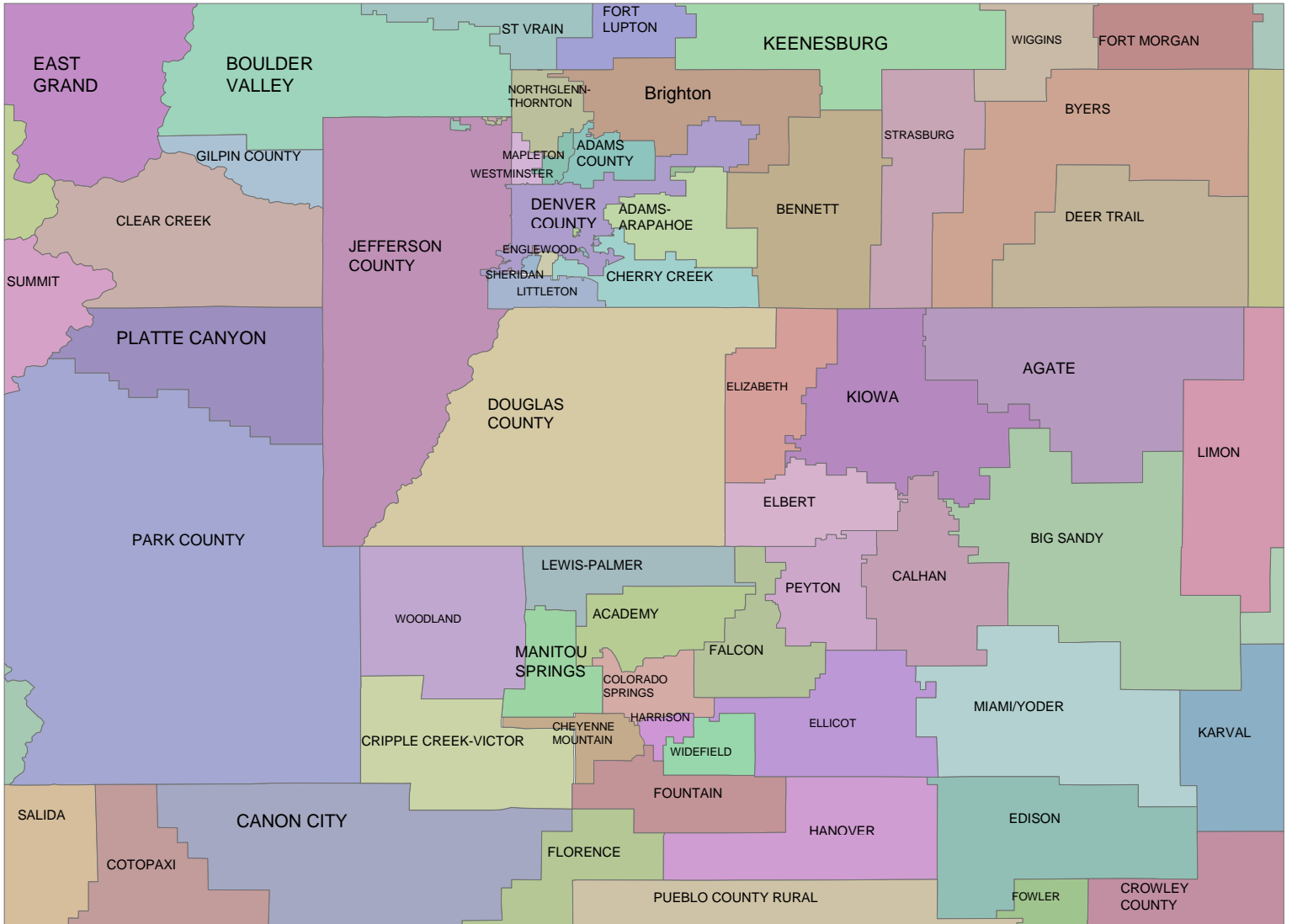
Cost of living figures relate to the cost of buying a market basket of goods and services that represents the spending patterns in the United States of the average archetypal household. (See Section 4 for more discussion of the archetypal household.) More detailed results by expense category may be seen in Appendix A. Raw data for selected goods may be seen in Appendix D.

Below, a map detailing the location of each of the 178 school districts is provided for the reader's convenience. An easy to read electronic map of all Colorado School Districts can also be found at: <http://www.cde.state.co.us/cdereval/download/PDF/Maps/map-district.pdf>

**EXHIBIT 3-1: MAP OF COLORADO SCHOOL DISTRICTS, 2009**



**EXHIBIT 3-2: DETAILED MAP OF SCHOOL DISTRICTS IN THE DENVER AND COLORADO SPRINGS METRO AREAS, 2009**



**EXHIBIT 3-3: COST OF LIVING BY SCHOOL DISTRICT, 2009**

County	District	Total	Rank
	State	\$47,500	
Adams	MAPLETON 1	\$45,216	87
Adams	ADAMS 12 FIVE STAR SCHOOLS	\$46,776	62
Adams	ADAMS COUNTY 14	\$43,626	117
Adams	BRIGHTON 27J	\$46,109	71
Adams	BENNETT 29J	\$46,012	72
Adams	STRASBURG 31J	\$46,792	61
Adams	WESTMINSTER 50	\$46,010	73
Alamosa	ALAMOSA RE-11J	\$42,651	134
Alamosa	SANGRE DE CRISTO RE-22J	\$43,455	118
Arapahoe	ENGLEWOOD 1	\$47,128	48
Arapahoe	SHERIDAN 2	\$46,886	57
Arapahoe	CHERRY CREEK 5	\$47,101	50
Arapahoe	LITTLETON 6	\$48,005	39
Arapahoe	DEER TRAIL 26J	\$44,840	99
Arapahoe	ADAMS-ARAPAHOE 28J	\$44,919	95
Arapahoe	BYERS 32J	\$45,525	80
Archuleta	ARCHULETA COUNTY 50 JT	\$48,660	32
Baca	WALSH RE-1	\$40,550	158
Baca	PRITCHETT RE-3	\$39,095	177
Baca	SPRINGFIELD RE-4	\$40,009	169
Baca	VILAS RE-5	\$39,658	172
Baca	CAMPO RE-6	\$39,432	173
Bent	LAS ANIMAS RE-1	\$39,283	176
Bent	MC CLAVE RE-2	\$39,941	171
Boulder	ST VRAIN VALLEY RE 1J	\$47,319	45
Boulder	BOULDER VALLEY RE 2	\$52,624	11
Chaffee	BUENA VISTA R-31	\$46,850	60
Chaffee	SALIDA R-32	\$47,321	44
Cheyenne	KIT CARSON R-1	\$40,358	162
Cheyenne	CHEYENNE COUNTY RE-5	\$41,873	144
Clear Creek	CLEAR CREEK RE-1	\$51,454	17
Conejos	NORTH CONEJOS RE-1J	\$40,758	157

**EXHIBIT 3-3: COST OF LIVING BY SCHOOL DISTRICT, 2009 (CONT'D)**

<b>County</b>	<b>District</b>	<b>Total</b>	<b>Rank</b>
Conejos	SANFORD 6J	\$40,335	163
Conejos	SOUTH CONEJOS RE-10	\$40,921	155
Costilla	CENTENNIAL R-1	\$41,365	151
Costilla	SIERRA GRANDE R-30	\$43,067	127
Crowley	CROWLEY COUNTY RE-1-J	\$39,427	174
Custer	CONSOLIDATED C-1	\$48,069	38
Delta	DELTA COUNTY 50(J)	\$47,125	49
Denver	DENVER COUNTY 1	\$48,593	33
Dolores	DOLORES COUNTY RE NO.2	\$44,163	109
Douglas	DOUGLAS COUNTY RE 1	\$48,004	40
Eagle	EAGLE COUNTY RE 50	\$57,393	6
Elbert	ELIZABETH C-1	\$50,456	20
Elbert	KIOWA C-2	\$47,008	55
Elbert	BIG SANDY 100J	\$44,373	106
Elbert	ELBERT 200	\$49,965	27
Elbert	AGATE 300	\$45,922	75
El Paso	CALHAN RJ-1	\$44,573	102
El Paso	HARRISON 2	\$45,013	93
El Paso	WIDEFIELD 3	\$46,391	67
El Paso	FOUNTAIN 8	\$46,921	56
El Paso	COLORADO SPRINGS 11	\$45,173	89
El Paso	CHEYENNE MOUNTAIN 12	\$50,060	25
El Paso	MANITOU SPRINGS 14	\$48,768	30
El Paso	ACADEMY 20	\$47,988	41
El Paso	ELLCOTT 22	\$43,912	112
El Paso	PEYTON 23 JT	\$46,402	66
El Paso	HANOVER 28	\$45,411	82
El Paso	LEWIS-PALMER 38	\$50,374	22
El Paso	FALCON 49	\$46,641	64
El Paso	EDISON 54 JT	\$44,754	100
El Paso	MIAMI/YODER 60 JT	\$43,753	116
Fremont	CANON CITY RE-1	\$43,957	111
Fremont	FLORENCE RE-2	\$44,937	94
Fremont	COTOPAXI RE-3	\$45,111	92
Garfield	ROARING FORK RE-1	\$59,981	5
Garfield	GARFIELD RE-2	\$51,096	18
Garfield	GARFIELD 16	\$48,524	34



**EXHIBIT 3-3: COST OF LIVING BY SCHOOL DISTRICT, 2009 (CONT'D)**

County	District	Total	Rank
Gilpin	GILPIN COUNTY RE-1	\$48,396	36
Grand	WEST GRAND 1-JT.	\$49,972	26
Grand	EAST GRAND 2	\$56,205	7
Gunnison	GUNNISON WATERSHED RE1J	\$50,915	19
Hinsdale	HINSDALE COUNTY RE 1	\$51,588	15
Huerfano	HUERFANO RE-1	\$42,364	137
Huerfano	LA VETA RE-2	\$45,127	90
Jackson	NORTH PARK R-1	\$44,532	103
Jefferson	JEFFERSON COUNTY R-1	\$47,270	46
Kiowa	EADS RE-1	\$40,474	161
Kiowa	PLAINVIEW RE-2	\$40,242	166
Kit Carson	ARRIBA-FLAGLER C-20	\$42,617	135
Kit Carson	HI-PLAINS R-23	\$43,155	124
Kit Carson	STRATTON R-4	\$42,907	130
Kit Carson	BETHUNE R-5	\$43,336	120
Kit Carson	BURLINGTON RE-6J	\$45,117	91
Lake	LAKE COUNTY R-1	\$49,429	29
La Plata	DURANGO 9-R	\$52,073	14
La Plata	BAYFIELD 10 JT-R	\$50,342	23
La Plata	IGNACIO 11 JT	\$48,194	37
Larimer	POUDRE R-1	\$46,701	63
Larimer	THOMPSON R-2J	\$45,975	74
Larimer	PARK (ESTES PARK) R-3	\$52,390	13
Las Animas	TRINIDAD 1	\$44,351	107
Las Animas	PRIMERO REORGANIZED 2	\$43,215	123
Las Animas	HOEHNE REORGANIZED 3	\$43,791	115
Las Animas	AGUILAR REORGANIZED 6	\$42,413	136
Las Animas	BRANSON REORGANIZED 82	\$41,641	147
Las Animas	KIM REORGANIZED 88	\$40,306	165
Lincoln	GENOA-HUGO C113	\$43,123	125
Lincoln	LIMON RE-4J	\$44,674	101
Lincoln	KARVAL RE-23	\$41,186	153
Logan	VALLEY RE-1	\$44,380	105
Logan	FRENCHMAN RE-3	\$42,183	140
Logan	BUFFALO RE-4	\$43,085	126
Logan	PLATEAU RE-5	\$41,452	149
Mesa	DE BEQUE 49JT	\$44,879	97

**EXHIBIT 3-3: COST OF LIVING BY SCHOOL DISTRICT, 2009 (CONT'D)**

County	District	Total	Rank
Mesa	PLATEAU VALLEY 50	\$47,404	43
Mesa	MESA COUNTY VALLEY 51	\$46,856	59
Mineral	CREEDE CONSOLIDATED 1	\$46,639	65
Moffat	MOFFAT COUNTY RE:NO 1	\$46,865	58
Montezuma	MONTEZUMA-CORTEZ RE-1	\$45,290	84
Montezuma	DOLORES RE-4A	\$47,054	53
Montezuma	MANCOS RE-6	\$47,417	42
Montrose	MONTROSE COUNTY RE-1J	\$46,142	70
Montrose	WEST END RE-2	\$47,068	52
Morgan	BRUSH RE-2(J)	\$45,633	78
Morgan	FORT MORGAN RE-3	\$45,613	79
Morgan	WELDON VALLEY RE-20(J)	\$45,703	77
Morgan	WIGGINS RE-50(J)	\$47,019	54
Otero	EAST OTERO R-1	\$40,477	160
Otero	ROCKY FORD R-2	\$39,979	170
Otero	MANZANOLA 3J	\$38,948	178
Otero	FOWLER R-4J	\$40,112	168
Otero	CHERAW 31	\$39,355	175
Otero	SWINK 33	\$40,772	156
Ouray	OURAY R-1	\$52,566	12
Ouray	RIDGWAY R-2	\$52,732	10
Park	PLATTE CANYON 1	\$50,400	21
Park	PARK COUNTY RE-2	\$50,276	24
Phillips	HOLYOKE RE-1J	\$41,723	146
Phillips	HAXTUN RE-2J	\$42,072	143
Pitkin	ASPEN 1	\$110,043	1
Prowers	GRANADA RE-1	\$40,315	164
Prowers	LAMAR RE-2	\$41,772	145
Prowers	HOLLY RE-3	\$40,190	167
Prowers	WILEY RE-13 JT	\$41,300	152
Pueblo	PUEBLO CITY 60	\$43,231	122
Pueblo	PUEBLO COUNTY 70	\$44,901	96
Rio Blanco	MEEKER RE1	\$48,714	31
Rio Blanco	RANGELY RE-4	\$46,361	68
Rio Grande	DEL NORTE C-7	\$45,404	83
Rio Grande	MONTE VISTA C-8	\$43,350	119

**EXHIBIT 3-3: COST OF LIVING BY SCHOOL DISTRICT, 2009 (CONT'D)**

<b>County</b>	<b>District</b>	<b>Total</b>	<b>Rank</b>
Rio Grande	SARGENT RE-33J	\$42,347	138
Routt	HAYDEN RE-1	\$51,464	16
Routt	STEAMBOAT SPRINGS RE-2	\$60,353	4
Routt	SOUTH ROUTT RE 3	\$54,383	8
Saguache	MOUNTAIN VALLEY RE 1	\$41,410	150
Saguache	MOFFAT 2	\$44,277	108
Saguache	CENTER 26 JT	\$41,037	154
San Juan	SILVERTON 1	\$54,241	9
San Miguel	TELLURIDE R-1	\$71,110	2
San Miguel	NORWOOD R-2J	\$49,725	28
Sedgwick	JULESBURG RE-1	\$42,795	132
Sedgwick	PLATTE VALLEY RE-3	\$42,100	142
Summit	SUMMIT RE-1	\$62,992	3
Teller	CRIPPLE CREEK-VICTOR RE-1	\$44,864	98
Teller	WOODLAND PARK RE-2	\$47,237	47
Washington	AKRON R-1	\$43,818	114
Washington	ARICKAREE R-2	\$42,918	129
Washington	OTIS R-3	\$42,950	128
Washington	LONE STAR 101	\$42,228	139
Washington	WOODLIN R-104	\$42,816	131
Weld	GILCREST RE-1	\$44,460	104
Weld	EATON RE-2	\$47,095	51
Weld	KEENESBURG RE-3(J)	\$45,210	88
Weld	WINDSOR RE-4	\$48,511	35
Weld	JOHNSTOWN-MILLIKEN RE-5J	\$46,340	69
Weld	GREELEY 6	\$45,273	86
Weld	PLATTE VALLEY RE-7	\$45,733	76
Weld	WELD COUNTY S/D RE-8	\$45,472	81
Weld	AULT-HIGHLAND RE-9	\$45,283	85
Weld	BRIGGSDALE RE-10	\$43,862	113
Weld	PRAIRIE RE-11	\$42,690	133
Weld	PAWNEE RE-12	\$41,465	148
Yuma	YUMA 1	\$43,967	110
Yuma	WRAY RD-2	\$43,321	121
Yuma	IDALIA RJ-3	\$42,176	141
Yuma	LIBERTY J-4	\$40,548	159

## SECTION 4: PROJECT METHODOLOGY

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As described in Section 2, the project was structured upon addressing and linking five distinct research questions. These research questions included:

1. What is a “typical” (archetypal, or “benchmark”) Colorado household?

**(See “Identifying the Benchmark Household” in this section)**

2. What types of goods and services does that archetypal household buy?

**(See “Identifying the Market Basket of Goods and Services” in this section)**

3. Where do they buy those goods and services?

**(See “Identifying and Measuring Geographic Shopping Patterns” in this section)**

4. How much do those goods and services cost in differing geographic locations?

**(See “Data Collection” in this section)**

5. If an archetypal household lives in each of the 178 school districts, what is the difference between their costs to buy those goods, based on the prices where they shop?

**(See “Developing Final Cost of Living Measures” in this section)**

Corona’s methodological approach to answering each of these research questions is presented in this section of the report. Appendix B provides additional detail for each methodological section of the study for interested readers.

## IDENTIFYING THE "BENCHMARK" HOUSEHOLD

The characteristics of the 2009 benchmark household mirrored the benchmark households used in the previous Colorado School District Cost of Living studies. The benchmark household used in past studies has typically been a household of average size for the state, with an income related to typical teaching incomes. The 2009 benchmark household was defined by the Colorado Legislative Council to be a three-person household with a total household income of \$47,500.

Over the past four studies, the household size has not changed, and the household income has increased at a moderate rate. The exhibit provided below details the current and previous benchmark households used for the study:

### EXHIBIT 4-1: DEFINITION OF THE ARCHETYPAL HOUSEHOLD

Year	Size of the Benchmark Household	Household Income of Benchmark Household
2009 (Current Study)	3 people	\$47,500
2007 Study	3 people	\$44,500
2005 Study	3 people	\$43,000
2003 Study	3 people	\$40,000

## IDENTIFYING THE “MARKET BASKET” OF GOODS AND SERVICES

### Methodology at a Glance

**Goal: Develop a list of specific goods and services that collectively serve as a proxy for all spending by the archetype household.**

1. *The Bureau of Labor Statistics compiles annual data on consumer spending habits through Consumer Expenditures Surveys.*
2. *Corona Insights examined the most recent Consumer Expenditure Survey Data (2007 - 2008) to identify major categories of spending (housing, food at home, etc.) A total of 18 categories were defined.*
3. *Corona Insights and the Colorado Legislative Council jointly identified a “market basket” of individual items that represent each major category of spending. For example, a variety of goods such as milk, bread, and other foods were identified to represent grocery expenditures.*
4. *All items that were selected to be included in the “market basket” were identified with as much specificity as possible in terms of size and quality, so that directly comparable data could be gathered in every school district where that item was sold.*
5. *Some items, such as energy costs, are monopolistic goods or services. These items were merely measured on a per-unit cost in each district.*
6. *The market basket was designed to be consistent with the 2007 study where possible and appropriate. In fact, only three notable items were changed from 2007: Women’s jeans were replaced by Women’s pantyhose as an apparel item, Women’s turtleneck was replaced by a Women’s Polo shirt as an apparel item, and a Men’s Canvas Lace-up Shoe replaced Women’s Shoes as an apparel item. Minor changes in the quantities of goods that were selected were also made to the “market basket”, to enhance the comparativeness of goods across all districts. See **Appendix C** for more detail.*
7. *The average expenditures per major category were calculated and set aside for the final calculations, as the collected data was weighted in proportion to those average expenditures.*

The goal of this step of the process was to develop a list of goods and services that, in combination, can represent the full range of purchases for the archetypal household. The primary data source for this type of analysis is Consumer Expenditure Surveys (CES) that are compiled by the Bureau of Labor Statistics. Data was used from the 2007-2008 Consumer Expenditure Survey, which was the most recently published CES available at the time of analysis.

Data in the Consumer Expenditure Surveys are available by household size and year. Corona used the data for three-person households, and interpolated between the results for three-person household incomes of \$40,000 to \$49,999 and three-person household incomes of \$50,000 to \$69,999 (from CES Table 38) to estimate expenditures for a household with an income of \$47,500.

Two key types of data were produced from this analysis: 1) a set of categories that reflect major types of expenditures and 2) average spending levels for the archetypal household within each of those categories. That data is shown in the following exhibit. Also shown in the exhibit are individual items that were selected jointly by the Corona Insights team and the Colorado Legislative Council as being representative of each major expenditure category. Prices gathered for these items (with statistical weightings to ensure that their pricing matches total spending) formed the basis of 2009 Cost of Living estimates.

## EXHIBIT 4-2: SPENDING PATTERNS OF THE ARCHETYPAL HOUSEHOLD

### Consumer Expenditure Survey Categories and Specific Weights Utilized in Cost of Living Index (Weight as a percentage of income)

Expenditure Category	% of Income	Representative Market Basket Items
<b>Food</b>	<b>14.48%</b>	
Food at home	9.11%	
Cereals and bakery products	1.21%	White Bread, Spaghetti
Meats, poultry, fish, and eggs	2.27%	
Beef	1.42%	Ground Beef
Poultry	0.85%	Whole Fryer Chicken
Dairy products	0.92%	Milk
Fruits and vegetables	1.55%	
Fresh fruits	0.50%	Bananas
Fresh vegetables	0.46%	Potatoes
Processed fruits	0.29%	Canned Peaches
Processed vegetables	0.30%	Canned Green Beans
Other food at home	3.17%	Coffee, Soup, Frozen Waffles
<b>Food away from home</b>	<b>5.36%</b>	Cheeseburger Meal, Cheese Pizza Meal, NY Strip Steak Meal
<b>Alcoholic beverages</b>	<b>0.69%</b>	Beer
<b>Housing</b>	<b>33.81%</b>	
Mortgage interest and charges	14.09%	Mortgage Payment
Property taxes	2.67%	Property Taxes
Maintenance, repairs, insurance, other expenses	1.88%	Homeowners' insurance, home maintenance and repairs
Utilities, fuels, and public services	8.86%	
Natural gas	1.18%	Natural Gas
Electricity	3.51%	Electric
Fuel oil and other fuels	0.31%	
Telephone services	3.07%	Telephone
Water and other public services	1.10%	Water and Sewer
Household operations	1.86%	Daycare Services
Housekeeping supplies	1.40%	Laundry Soap
Household furnishings and equipment	3.05%	Mattress

**Consumer Expenditure Survey Categories and Specific Weights Utilized in Cost of Living Index  
(Weight as a percentage of income)**

<b>Expenditure Category</b>	<b>% of Income</b>	<b>Representative Market Basket Items</b>
<b>Apparel and services</b>	<b>4.48%</b>	
Men and boys	1.10%	Men's Dress Shirt, Men's T-Shirt
Women and girls	2.12%	Women's Polo Shirt, Women's Pantyhose
Footwear	1.26%	Men's Canvas Lace-up Shoes
<b>Transportation</b>	<b>18.07%</b>	
Vehicle purchases (net outlay)	6.40%	Car Payment / Auto Financing
Gasoline and motor oil	6.32%	Gasoline: 85 unleaded
Other vehicle expenses	5.99%	
Vehicle finance charges	0.86%	Interest rate for full purchase price / bank charges
Maintenance and repairs	1.83%	Oil Change, Front-end Alignment
Vehicle insurance	3.52%	Insurance Premiums
<b>Healthcare</b>	<b>6.30%</b>	Health Insurance Premium
<b>Entertainment</b>	<b>4.76%</b>	
Fees and admissions	0.64%	Movie (first run, full length)
Audio and visual equipment and services	2.18%	DVD Player
Pets, toys, hobbies, and playground equipment	0.99%	Pet Food
Other entertainment supplies, equipment, and service	0.95%	Batteries (AA)
<b>Personal care products and services</b>	<b>1.39%</b>	Women's / Men's Haircuts, Tampons, Shaving Cream, Toothpaste
<b>Reading</b>	<b>0.16%</b>	
<b>Education</b>	<b>1.20%</b>	
<b>Tobacco products and smoking supplies</b>	<b>1.28%</b>	<b>Cigarettes</b>
<b>Miscellaneous</b>	<b>1.55%</b>	
<b>Cash contributions</b>	<b>2.18%</b>	
<b>Personal insurance and pensions</b>	<b>8.64%</b>	
<b>Personal taxes (not including stimulus)</b>	<b>1.00%</b>	

**NOTE:** Disaggregated results for the cost of living by major category are provided in Section 5 and detailed raw data are provided in Appendix D.



## IDENTIFYING AND MEASURING GEOGRAPHIC SHOPPING PATTERNS

### *Methodology at a Glance*

**Goal:** Develop a series of matrices that shows where residents of each school district shop for various goods and services.

1. *Prior to 2007, a shopping matrix developed in 1997 was used to identify shopping patterns. In 2007, Corona Insights, in consultation with the Colorado Legislative Council, began a multiyear effort to develop an ongoing matrix that could be updated biennially.*
2. *In the 2007 study, Corona Insights conducted 2,731 surveys of randomly selected households throughout the state, stratifying the sample so that 271 surveys were conducted in each of ten region types. Using a combined data analysis and modeling approach, this amount of data was sufficient to provide 2007 shopping patterns for each district.*
3. *For the current 2009 study, Corona conducted an additional 2,718 surveys of both randomly selected households in targeted areas throughout the state, with a goal of conducting surveys in every school district. These additional surveys were added to the surveys conducted in 2007 to enhance the shopping patterns database. Areas where little or no data was captured in 2007 were specifically targeted for additional collection in the current study, so that the final shopping patterns matrix would be more data driven in as many areas of the state as possible. Where data were not sufficient, modeling or a mix of modeling and data analysis were used to estimate shopping patterns. The goal of this portion of the study is to build up data for all districts over a 10 year period, where shopping patterns data is available for all Colorado School Districts. After 10 years, old data will be removed from the shopping patterns data base, and new data will be added to keep all shopping patterns data as fresh and representative as possible for the study.*
4. *Each survey respondent was asked to state the town in which his or her household made their most recent purchase of a sample of household goods. (They could also state that their last purchase was online, or that they never purchase that particular good.) Respondents in urban areas were also asked to provide the distance that they traveled, since some large communities contain more than one school district.*
5. *The survey instrument is provided in Appendix E.*
6. *If sufficient data were available for a district, Corona Insights used that data alone to estimate shopping patterns. This was the case for slightly more than half of all districts. For those where data were not sufficient, Corona used a sliding weight of data and a suite of mathematical models to estimate geographic shopping patterns within each region. The models utilized some combination of raw survey results, cross-product geographic patterns, and radius modeling.*
7. *The output of the model was a large matrix for each product category, where each row described the residents of an individual school district (a “home” district), and each column represented a district where goods or services could be purchased (a “buying” district). The intersection of a given row and column represented the proportion of purchases among residents of the “home” district who could be expected to purchase that product in that particular “buying” district. The sum of each row represented each home district’s shopping pattern, totaling to 100 percent of purchases of that particular product. This matrix could then be multiplied by a matrix of prices for each product in each district to produce an overall price in the home district.*
8. *Online purchases were considered a “buying” district for calculation purposes. Prices were gathered from online outlets exactly as they were gathered from each school district. Calculations were performed identically for online shopping in comparison to geographic shopping areas.*

9. *In some instances, geographic outliers were identified in purchasing patterns. For example, a respondent may have identified a very distant town as a purchase location. Even though respondents were specifically told not to list purchase locations that may have occurred during travel, distant purchases are certainly possible in some scenarios (e.g., second-home ownership, driving for work, etc.) In instances where a respondent listed a location that was more than 100 miles away and which required passing through a larger community than the “buying” district, those purchases were reclassified as “distant Colorado”, and a statewide average was used to estimate the price of the purchase. The reason for this is because these outliers were just that – outliers – and the aforementioned method accounts for the fact that some portion of purchases may happen in this manner, but that the location is not deemed to be representative. The system used accounted for the fact that these long-distance purchases may indeed occur, but they may not typically occur in the exact community that was identified.*
10. *In some cases, purchase patterns may be reported for a district that does not sell a particular product. For example, the model may predict that residents of District X buy 20 percent of their cars in District Y, but District Y does not have a sales outlet that sells cars. There are many reasons for this, including a survey reporting a private transaction with an individual, a purchase from an outlet that closed down, a modeling prediction that doesn’t recognize a lack of sales outlets, or many other reasons. In the final calculations, the calculations took this into account and removed that data point and scaled up other data points.*

If every resident in a school district made all of their purchases within a school district, calculating the cost of living in that district would be straightforward. However, this is not the case. Often, residents leave their district to make purchases, either because they can obtain a better price, better selection, more convenience, or some other benefit. Because prices will vary across district boundaries (sometimes notably), it is necessary to understand these geographic shopping patterns in order to develop the actual cost of living in each school district.

For all previous cost of living studies conducted from 1997 through 2005, geographic shopping patterns were estimated based on a large statewide survey that was conducted in 1997. For the 2007 study, Corona Insights was asked to update the analysis of geographic shopping patterns, and began developing a system that will allow for rolling updates on future studies. This rolling update will provide a more smooth accounting of the evolution of shopping patterns over time.

Ideally, updating the analysis of geographic shopping patterns would involve conducting statistically robust surveys in each and every school district, which would determine geographic shopping patterns for each product in the market basket. However, the large number of school districts in the state mean that this approach is not feasible, as the cost to do so would have been quite high (estimated at approximately one million dollars to complete the described ideal analysis in 2007, or in any year where an update was requested).

In both the 2007 and the 2009 Cost of Living study, Corona Insights took an alternate approach to update and enhance the data collected for the shopping patterns matrix, and to build the groundwork for a permanent solution where updates are made on a rolling basis. The research team is building this system around a periodic survey that asks about geographic purchasing patterns for several types of products.

In order to develop a strong update for 2007 to replace the 1997 shopping matrix, a model-based system was used, where the surveys were used to inform not just geographic shopping patterns for a particular good or service by residents of each district, but also other goods and services purchased by residents of those districts, and similar goods and services purchased by residents in geographically similar districts. Where raw data was sufficient to draw geographic shopping patterns without modeling, the raw data was used instead. In the 2009 shopping patterns data, new surveys were combined with the previously collected surveys from

2007 and beyond to provide more power. Surveys were conducted in every district, but surveys were oversampled in specific districts so that the overall shopping patterns matrix could be developed from the raw data for as many districts as possible, reducing the need for model-based estimates. As of 2009, approximately half of the districts are now data-based and half are model-based. In the future, surveys will again oversample the remaining model-based districts until all districts' shopping patterns are data-based. At that point, the system will be mature, and with each new survey the oldest data in the system will be replaced.

A total of 2,718 surveys were completed in 2009 using both a stratified random sampling technique (primarily in the metro areas of Colorado) and a targeted listed sampling technique (primarily in small rural areas of Colorado). After all of the 2,718 shopping patterns surveys were collected, they were merged with the 2007 shopping patterns data (2,731 surveys) to create a large sampling of shopping patterns among Colorado residents over the past two years. The final shopping patterns matrix for 2009 used these data alone for shopping matrix development for districts with sufficient data to do so, and used a combined data/modeling approach for districts where data are not yet sufficient to eliminate the need for modeling.

The survey itself asks about purchasing patterns for a number of items. For small product categories, respondents were asked where they or a member of their household most recently purchased each item. Residents outside metro areas were asked about the town where they purchased the item, while residents within metro areas were asked about both the town and the distance that they traveled. (Residents were also allowed to state that they bought the product online, or that they never buy the product.)

The twelve small product categories were:

- Non-perishable groceries such as canned goods
- Fruits, vegetables, or other produce
- Perishable groceries such as milk or ice cream
- Household products such as laundry soap, batteries, or toothpaste
- A meal at a restaurant
- Alcoholic beverages that were purchased to drink at home (not at a bar or restaurant)
- Clothes or shoes
- Gasoline
- Car maintenance and repair services
- Movie tickets at a theater
- Haircut
- Pet food

For the three larger products, residents were asked if they had purchased in the past 3 years; and if so, whether they were living in their current community when they bought each one. They were then asked what city they purchased any such items in (which could include "online" if they bought the item on a computer). They were then asked what town or city they thought they would go to if they were going to buy these items tomorrow. The three large products were:

- Car
- Mattress
- DVD player

The larger products were asked in a different manner because for some of these products, the person could have made the purchase several years earlier when living in a different place, or they could simply not

remember their purchase location if their last purchase was several years ago.

The final shopping patterns matrices are presented in Appendix F, and more detailed information about the methodology of the survey and model is presented at the end of Appendix F.

## DATA COLLECTION PROCEDURES

### *Methodology at a Glance*

**Goal:** Gather pricing data for a large variety of goods and services in all school districts where those goods and services are sold.

**NOTE:** Different data collection techniques were used to collect the various items that made up the market basket. Below we provide a very short summary of the methodological approaches that were used to obtain prices for each category of goods. Additional overview information is provided in this section of the report, and detailed information is provided in Appendix B.

1. **Retail Purchases** - Pricing for a number of basic retail items were gathered on-site at retail stores across the state. These included all “food at home” items (perishables, non-perishables, and produce), alcoholic beverages, household goods, pet food, personal care products, tobacco, clothing, shoes, furniture, entertainment (DVD player), electronics, and restaurant meals. Additionally, data was collected via telephone to collect pricing for Movie Theater pricing (an entertainment category).
2. **Housing** – Average home values for a home with specified characteristics were provided by the Colorado Legislative Council as a product of a separate research contract with another consulting firm.
3. **Homeowner’s insurance** – Pricing data for a home with specified characteristics was provided by a large insurance company that provides coverage throughout the state.
4. **Home maintenance** - Costs were estimated by examining comparative wage levels of workers in home maintenance industries such as plumbing, electrical, and other services, and weighting those services based on typical home expenditures, as reported in U.S. census data.
5. **Utilities** - Data on utility prices was gathered from the Public Utilities Commission via 2008 annual reports and/or sales reports filed by electric, telephone, and gas utility providers. (Some adjustment and estimation was required above and beyond the report data.)
6. **Water/Sewer** – Data were gathered via phone calls from Corona Insights to over 250 cities and towns throughout the state, as well as visits to municipal web sites. Rates were then applied to specified “typical” usage rates.
7. **Day Care** – Information by county was obtained from the 2009 Market Rate Survey of Child Care Providers, conducted by Qualistar Early Learning as part of a contract with the Colorado Department of Human Services, Division of Child Care. These rates were then applied to specific school districts.
8. **Transportation** – Vehicle financing rates were gathered for a specified vehicle (a 2007 Honda Civic) from local lending institutions throughout the state. Using the standard blue book value for purchase price, payment costs (principal and interest) were estimated by county and then mapped to school districts.
9. **Vehicle insurance** – Pricing data for two vehicles with specified characteristics was provided by a large vehicle insurance company that provides coverage throughout the state.
10. **Vehicle Maintenance** – Prices for an oil and filter change and for a front end alignment were gathered via telephone calls to a stratified random sample of vehicle maintenance shops in Colorado school districts.

11. **Gasoline** – Gasoline prices were gathered during a single-day round of visits and phone calls to a stratified random sample of gas stations in Colorado school districts.
12. **Health Insurance** – Prices from four of the largest health insurance providers in the state – the top two most popular health plans for each company – were used to develop pricing for a three-person family of a specified age and gender profile.
13. **Personal Services** – Prices for men’s and women’s haircuts were used as the proxy for this category. Prices were gathered via telephone inquiries to a stratified random sample of hair cutting and styling establishments throughout the state.
14. **Other types of expenses** – Some types of expenses that were deemed to be more or less constant across geographic areas were not analyzed. These include reading, education, “miscellaneous expenses”, contributions, personal insurance, pension payments, and personal taxes. However, it should be noted that taxes were added to all of the previous categories where applicable.

For each category of market basket items listed below, we describe how the cost of those items was collected, and also summarize the amount of data that was collected in the 2007 study. Additional data collection details for each category are presented in Appendix B.

#### Methodology Note

Corona developed a sophisticated sampling plan for data collection efforts where onsite collection was required at retail establishments. Using a list of firms compiled by Dun & Bradstreet, Corona examined revenue data by store and then developed an algorithm to sample firms within each district in a manner that ensured that a representative variety of stores were being sampled, based on their market share. The algorithm first identified the preferred number of stores to be sampled, and then identified specific stores based on their revenue size compared to their competitors. This approach ensured that high-sales outlets were sampled in proportion to their sales, as opposed to a random sampling approach that would oversample smaller stores.

## FOOD AT HOME

Food at home items consisted of potatoes, bananas, canned green beans, canned peaches, ground beef, whole fryer chicken, milk, white bread, spaghetti, coffee, soup, and frozen waffles. Prices for these items were gathered by in-person visits to grocery stores throughout the state. The number of grocery stores visited (and in metro areas, the selection of stores to visit) were determined with a sampling algorithm developed by Corona Insights, applied to a database of business listings provided by Dun & Bradstreet, that was supplemented with lists of Wal-Mart Supercenters and Super Targets. This was the same sampling methodology used in the 2007 study, to ensure comparability. All sampling for items making up the food at home category was done at the school district level after geo-coding business listings within the appropriate school district locations. After prices were collected, the dataset of prices for each item was screened for outliers, taxes were added, average prices were computed for each district, and then average prices were weighted using the shopping patterns survey to produce final prices for each district.

Detailed descriptions of the food at home items used in the 2009 market basket and the number of prices collected for each market basket item is provided in the table below:

## Food At Home

CES Category	Specific Item	Description	Collection Method	N of Observations
Fruits and vegetables	Potatoes	Price for a 10 lb. bag of lowest price Russet potatoes. If 10 lb. bag is not available, substitute nearest sack size. DO NOT USE PRICE OF POTATOES BY THE POUND	On-Site	309
Fruits and vegetables	Bananas	Price per pound. If bananas are priced by the bag or by the banana, report the price and weigh a bunch.	On-Site	338
Fruits and vegetables	Canned Green Beans	Price of store brand cut green beans, 14.5 oz.	On-Site	460
Fruits and vegetables	Canned Peaches	Price of store brand sliced peaches in heavy syrup, 15 to 15.25 oz. Collectors should get the cheapest available in each store and note the brand if it is not the generic store brand.	On-Site	445
Meats, poultry fish and eggs	Ground Beef	Price per pound of regular ground beef, 80% lean or most comparable. Note if different percent lean. Average size package, loose prepackaged, i.e., 1 to 2 pound package. DO NOT PRICE FAMILY PACK.	On-Site	320
Meats, poultry fish and eggs	Chicken, whole fryer	Price per pound of one whole fryer chicken. If whole fryer not available, price whole fryer chicken, cut up. Least expensive brand.	On-Site	299
Dairy	Milk	Price for one gallon (128 Fl. oz.) 2% milk, store brand or lowest price.	On-Site	489
Cereals and bakery products	White Bread	Price for store brand 24 oz. (1.5 lb.) loaf of sliced white bread. If store brand not available, record price of lowest priced brand.	On-Site	438
Cereals and bakery products	Spaghetti	Price of store brand spaghetti noodles, 16 oz. package. If store brand is not available, record price of lowest priced brand.	On-Site	440
Other food at home	Coffee	Price for a 11.3 oz. can of Folgers Classic Roast Coffee, ground, red can. DO NOT PRICE DECAFFINATED.	On-Site	474
Other food at home	Soup	Price for a 10 ¾ oz. can of original Campbell's Chicken Noodle Soup. Not "HomeStyle" or "Classic" packaging or other variations.	On-Site	470
Other food at home	Frozen Waffles	Price of 10 waffles, buttermilk or plain flavored, store brand, prebaked, 12.3 oz.	On-Site	333

## FOOD AWAY FROM HOME

Food away from home items consisted of a cheeseburger meal, a pizza, and a steak meal. Prices for these items were gathered by in-person visits to restaurants throughout the state. The number of restaurants to be visited was determined with a sampling algorithm developed by Corona Insights, applied to a database of business listings provided by Dun & Bradstreet that was supplemented with Dex Online directory listings. All sampling for food away from home items was done at the school district level after coding the business listings to the appropriate school district. After prices were collected, the dataset of prices for each item was screened for outliers, taxes were added, average prices were computed for each district, and then average prices were weighted using the shopping patterns survey results to produce final prices for each district.

Detailed descriptions of the food away from home items in the market basket and the number of prices collected are provided in the table below:

Food Away From Home				
CES Category	Specific Item	Description	Collection Method	N of Observations
Restaurants	Lunch	Price for a McDonald's quarter pounder with cheese meal (including fries and a regular Coke). If you're not collecting at a McDonald's, price a cheese burger with a medium fries, and a coke (the most similar type meal to a quarter pounder with cheese meal).	On-Site	366
Restaurants	Dinner	Price for a Pizza Hut cheese pizza, regular or thin crust, 14" diameter (note size if other).	On-Site	312
Restaurants	Dinner	Price for 12 oz. New York Strip steak, potato, soup or salad. If they don't have a New York Strip steak in 12 ounces, get the price in whatever ounce size the steak comes in at that restaurant. If New York strip not available, price a Ribeye. If the Ribeye is not available, price a Sirloin. Note size of steak if not 12 oz. DO NOT PRICE CHOPPED SIRLOIN.	On-Site	314

## ALCOHOLIC BEVERAGES

Alcoholic beverage prices were collected for a 6-pack of beer. Prices were gathered by in-person visits to grocery and liquor stores throughout the state. Beer was treated as a grocery item and so the initial sample of stores were the grocery stores selected by the food at home sampling. However, because not all grocery stores sell beer, the sample of stores was supplemented with a list of Liquor Stores from Dun and Bradstreet. All sampling for alcoholic beverages was done at the school district level after coding the business listings to the appropriate school district. After prices were collected, the dataset of prices for each item was screened



for outliers, taxes were added, average prices were computed for each district, and then average prices were weighted using the shopping patterns survey results to produce final prices for each district.

A detailed description of the alcoholic beverage item in the market basket and the number of prices collected are provided in the table below:

Alcoholic Beverages				
CES Category	Specific Item	Description	Collection Method	N of Observations
Alcoholic beverages	Beer	Price for a 6-pack of 12 oz. bottles Coors Light or Original beer, 3.2% alcohol by volume or higher. If not Coors, then price Budweiser or Miller Light products.	On-Site	538

## HOUSING

### **Shelter** – *Mortgage payment/Property taxes*

Similar to previous Cost of Living studies, mortgage payments were provided by an outside consultant. Corona Insights added property tax estimates based Division of Property Taxation website. ([http://www.dola.state.co.us/dpt/publications/docs/2008\\_annual\\_report/SECXI.pdf](http://www.dola.state.co.us/dpt/publications/docs/2008_annual_report/SECXI.pdf)). This report was the most recent available data from the Division of Property Taxation.

### **Shelter** – *Homeowner's Insurance*

In obtaining homeowner's insurance rates, hazard insurance was sought for a \$100,000 frame dwelling built in 1970 with \$80,000 contents coverage, \$100,000 liability/medical payments, and a \$250 deductible. These are the same specifications use in previous studies. One homeowner's insurance company (with a market share in the top three of all homeowner's insurers in Colorado) was willing to provide homeowner insurance rates by zip code to Corona Insights to be used in the study. The rates were averaged to the county level, and then district averages were created from the final county homeowner's insurance rates. These district averages represented the final homeowner insurance rates per district.

### **Utilities** - *Electric*

In order to calculate the average monthly electric bill for residents around the state, Corona Insights examined the 2008 Annual Reports filed by electric companies from around the state with the Colorado Public Utilities Commission (PUC). The detailed reports filed by electric companies provide enough information to calculate an average bill (for a company's service area). After all of the 2008 annual reports were gathered and analyzed, electric bill monthly rates were assigned to school districts based on the service areas for all electric companies operating in the state of Colorado.

### **Utilities** - *Gas*

The methodology used to calculate the average monthly natural gas bill for Colorado school districts was similar to that described for electric providers (see above). Every natural gas provider operating in the state of Colorado is required to file natural gas sales figures by community with the Public Utilities Commission

(PUC). These detailed reports were used to calculate an average bill for each service area. After all of the 2008 annual reports were gathered and analyzed, natural gas monthly rates were assigned to school districts based on the service areas for all natural gas providers. It should also be noted that some service areas do not utilize natural gas, but instead depend on propane for their heating needs. In specific cases where services areas (and the school districts residing within those areas) used propane, Corona used data from the Energy Information Administration to calculate the relative cost of using propane for energy instead of natural gas, based on the actual energy output for each fuel in BTU's and the 2008 average cost for each fuel in Colorado. After determining this "conversion factor," the cost of propane service for each school district without natural gas service was computed by averaging the natural gas bills of the surrounding districts and inflating that average based on the analysis described above.

#### **Utilities - Telephone**

In order to calculate the average monthly telephone bill for residents around the state, Corona obtained telephone rates from the Public Utilities Commission's "2008 ILEC Annual Report." This report detailed the monthly base rates being charged by each "incumbent local exchange carrier" around the state. Once again, the methodology used to calculate the average monthly telephone bill within each school district mirrored the methodology described for electricity providers. The monthly base rates detailed in the "2008 ILEC Annual Report" were assigned to each of the school districts based on the providers' coverage areas. Additional to the base rates found in each school district, a variety of other fees (different depending on the area and provider) were incorporated into the final total monthly telephone bill for an area (and ultimately school district). Final monthly telephone rates were calculated for each district depending on the service providers in a districts area and the different fees attached to those providers operating within a specific school district.

#### **Utilities – Water/Sewer**

In order to determine the average monthly payments for water and sewer bills in each school district, Corona Insights conducted a telephone survey of over 250 cities throughout the state of Colorado in order to collect water/sewer rate information for municipalities located within Colorado's school districts. An attempt was made to collect data from each of the 256 agencies contacted in previous studies, but in certain municipalities or areas where no contact information could be found, no data could be found or in towns that used only wells or septic tanks, proxy values were used based on the rates charged in the nearest town. Once all water/sewer rate information was collected, final district averages were calculated and weighted based on the total populations of cities and municipalities located within a school district.

#### **Household Operations – Day Care**

The average cost of day care for the 2009 Cost of Living study was based on day care costs in each county in Colorado. Average day care cost information was obtained from the 2009 Market Rate Survey of Child Care Providers, conducted by Qualistar Early Learning. The Market Rate Survey of Child Care Providers provides full-time weekly rates of caring for children between 0 and 12 months, 1 to 2 years, and between 2 to 5 years in all 64 Colorado counties.

In determining the average weekly costs for childcare services, the average of child care centers (CCC's) and family care centers (FCC's) for all age groups provided, 0 to 12 months, 1 to 2 years, and 2 to 5 years, was calculated. The averages were then weighted based on the national proportion of children in either "Center" or "Family" day care. These proportions were based on the National Survey of American Families study conducted in 2002 by the Urban Institute. The report can be found here: <http://www.icpsr.umich.edu/icpsrweb/ICPSR/series/00216/studies/4582>.

Weekly rates were then converted to a monthly cost by multiplying the weekly cost of care by 52 weeks per year and then dividing it by 12. Final district average prices were assigned from the appropriate county in which the district resides.

### **Housekeeping Supplies – *Laundry Soap***

Expenditures for housekeeping supplies were gathered by collecting prices for laundry soap. Prices were gathered by in-person visits to grocery stores throughout the state. Laundry soap was treated as a grocery item and so the stores sampled were the grocery stores selected by the food at home sampling. After prices were collected, the dataset of prices for each item was screened for outliers, taxes were added, average prices were computed for each district, and then average prices were weighted using the shopping patterns survey to produce final prices for each district.

A detailed description of the housekeeping supplies item in the market basket and the number of prices collected are provided in the table at the end of this section (below).

### **Household Furnishings and Equipment - *Mattress***

Expenditures for household furnishings were gathered by collecting prices for mattresses. Prices were gathered by in-person visits to furniture and mattress stores throughout the state. After prices were collected, the dataset of prices for each item was screened for outliers, taxes were added, average prices were computed for each district, and then average prices were weighted using the shopping patterns survey to produce final prices for each district.

A detailed description of the household furnishings item in the market basket and the number of prices collected are provided in the table at the end of this section (below):

Housing				
CES Category	Specific Item	Description	Collection Method	N of Observations
Shelter	Mortgage Payment	Mortgage payment, including principle, interest, and property taxes, based on housing values provided buy outside consultant	Online	
Shelter	Homeowners' Insurance	\$100,000 frame dwelling built in 1970. \$80,000 contents coverage, \$100,000 liability/medical payments. \$250 deductible	Call	
Shelter	Home Maintenance	Average hourly cost of labor for household maintenance and repair tasks per the State of Colorado Occupational Employment Statistics.	Database (Census & Occupational Employment Statistics)	
Utilities	Utilities	Annual average bill for electric, natural gas, telephone, and water and sewer services collected from utility providers throughout the state.	PUC Database/Call	
Household Operations	Day Care Services	Weekly cost of daycare.	Database	1 per county
Housekeeping Supplies	Laundry Soap	Price for 50 Fl. oz. of Tide liquid household laundry detergent. If Tide is not available, price of Cheer.	On-Site	483
Household furnishings and equipment	Mattress	Price of Queen size mattress. Sealy Posturepedic with 736 coils where possible. If not available, price Simmons Beautyrest with 759 coils, then SpringAir with 700 coils, then Serta with 800 coils. Price full set (mattress / box spring.) Find out if price includes bed frame and delivery in local area. If not, get prices for frame and delivery.	On-Site	117

## APPAREL

Apparel items consisted of men's dress shirts, men's T-shirts, women's pantyhose, women's T-shirts, and men's canvas lace-up shoes. Prices for these items were gathered by in-person visits to clothing stores throughout the state. The number of clothing stores visited was determined with a sampling algorithm developed by Corona Insights and applied to a database of business listings provided by Dun & Bradstreet. The Dun & Bradstreet list was also supplemented with lists of Wal-Mart Supercenters and Super Targets so that apparel prices would also be obtained at these supercenters. All sampling for clothing items was done at the school district level after coding the business listings to the appropriate school district. After prices were collected, the dataset of prices for each item was screened for outliers, taxes were added, average prices were computed for each district, and then average prices were weighted using the shopping patterns survey results to produce final prices for each district.

Detailed descriptions of the apparel items in the market basket and the number of prices collected are provided in the table below:

Apparel				
CES Category	Specific Item	Description	Collection Method	N of Observations
Men and Boys	Men's Dress Shirt	Price for white or solid color Oxford (button-down collar), long sleeve, button cuff shirt. Arrow brand where possible, poly/cotton blend. If store does not have Arrow, price comparable label (inexpensive). Try to get prices for shirts sized 15/32 through 16/34.	On-Site	200
Men and Boys	Men's T Shirt	Price for one 3-pack of men's white t-shirts, v-neck. Hanes brand where possible, Fruit of the Loom or Jockey, otherwise 100% cotton. Must be in a 3 pack	On-Site	200
Women and Girls	Women's Pantyhose	Price of Legg Sheer Energy pantyhose, with control top and sheer toe design. If this is not available, price the most similar type Legg pantyhose. If Legg pantyhose is not available, price the most similar available brand of pantyhose available.	On-Site	339
Women and Girls	Women's T-shirt	Price a women's (not juniors) solid color, short-sleeved polo shirt, with no pocket, ribbed collar & sleeve cuffs, size M. 100% cotton or cotton/spandex blend. Price store label or, if none, price least expensive brand. At Target, price Merona brand, at Walmart, price Riders brand, at Kmart, price Basic Editions brand.	On-Site	180
Footwear	Men's Canvas Lace-up Shoe	Price a men's canvas lace-up sneaker, flat bottom (no arch), with molded or ridged tread, size 9 - 11. Price the lowest priced men's canvas shoe that meets the described criteria.	On-Site	203

## TRANSPORTATION

### Vehicle Financing

Vehicle financing estimate were derived by contacting lending institutions in all possible districts and gathering data on finance rates for a four-year loan for a 2007 Honda Civic LX Sedan. The Corona Insights team then calculated a monthly payment that included the purchase price, loan charges, and any applicable taxes, title fees, or registration fees.

### Vehicle insurance

Insurance companies with a large market share for vehicle insurance in Colorado were determined by analyzing the 2008 "Annual Report of the Commissioner of Insurance". Companies with the largest market share were then contacted to determine vehicle insurance rates by zip code. Corona was able to obtain vehicle insurance data (by zip code, for the entire state) from one willing insurance company. That insurance company had a large portion of the market share in Colorado (the company's name will not be released, in

order to ensure pricing confidentiality of the company).

Insurance rates were gathered and averaged for the two vehicles types used throughout the study (a 2007 Honda Civic and a 2005 Ford Ranger) at the zip code level and the reassigned to the proper school district (in order to determine final vehicle insurance costs per district).

#### **Vehicle expenses – Oil Change & Front-End Alignment**

Vehicle maintenance expense items consisted of oil changes and front-end alignments. Prices for these items were gathered by phone calls to auto repair shops throughout the state. The number of shops to sample was determined with a sampling algorithm developed by Corona Insights which was applied to a database of business listings provided by Dun & Bradstreet. In areas where the original Dun & Bradstreet list of business was insufficient, Dex Online yellow pages were utilized to create a more robust list of vehicle maintenance businesses. All sampling for vehicle maintenance items was done at the school district level after coding the business listings to the appropriate district. After prices were collected, the dataset of prices for each item was screened for outliers, taxes were added where applicable, average prices were computed for each district, and then average prices were weighted using the shopping patterns survey results to produce final prices for each district.

Detailed descriptions of the vehicle maintenance items in the market basket and the number of prices collected are provided at the end of this section.

#### **Gasoline**

Gasoline prices were gathered on a single day via telephone calls to gas stations throughout the state. The number of shops to sample was determined with a sampling algorithm developed by Corona Insights which was applied to a database of business listings provided by Dun & Bradstreet. In areas where the original Dun & Bradstreet list of business of gas stations was insufficient, Dex Online yellow pages were utilized to create a more robust list of gas stations. All sampling for gasoline prices was done at the school district level after coding the business listings to the appropriate district. After prices were collected, the dataset of prices for each item was screened for outliers, average prices were computed for each district, and then average prices were weighted using the shopping patterns survey results to produce final prices for each district.

Detailed descriptions of the transportation items in the market basket and the number of prices collected are provided in the table below:

Transportation				
CES Category	Specific Item	Description	Collection Method	N of Observations
Transportation	Vehicle Payment	Payment calculated using Blue Book purchase value and interest rate on loan for full purchase price and bank charges for 2007 Honda Civic for four years. (2007 Honda Civic LX Sedan, 4-door. Engine: 4-cyl. 1.8 liters. Trans: 5-speed manual. Mileage: 24,000. Amenities: air conditioning, pwr. steering, cruise control, air bags)	Online (Bluebook Values) Call	412
Transportation	Vehicle Insurance	Insurance premiums for 2005 Ford Ranger and 2007 Honda Civic (2005 Ford Ranger XL Long Bed Pickup. Engine: V6 4.0 liter, Trans: 5-speed manual, Drive: 2-wheel drive. Mileage: 60,000. Amenities: A/C, pwr. steering, cruise control, air bags standard)	Call	
Transportation	Oil and Filter Change	Price of an oil and filter change for a 2005 Ford Ranger pickup. Oil must not be synthetic; filter should be the least expensive available.	Call	405
Transportation	Front-End Alignment	Price of front-end alignment for a 2005 Ford Ranger pickup; 2 wheel drive.	Call	226
Transportation	Gasoline	Price of self-serve, 85 Octane, unleaded gasoline.	Call (one-day)	449

## HEALTH CARE - HEALTH INSURANCE MONTHLY PREMIUM

In order to determine the average monthly health insurance premium rate in each school district, Corona Insights collected rate information from four of the largest health insurance providers in the state. Data was collected for PPO's from three of the companies, and an HMO from the remaining provider. Rates for the two most popular plans for each of the four participating companies were obtained. Health insurance monthly premium rates were collected by zip code and/or county (depending on the provider) and weighted averages were created for each health care company (based on market share). Final health care costs were then assessed by zip code or county final data and then appropriated to the appropriate school district.

**Note:** Final monthly health care costs were assessed with the assumption that monthly costs were for a family of three non-smokers who were all in good shape. Criteria are detailed in the table below:

Health Care				
CES Category	Specific Item	Description	Collection Method	N of Observations
Health Care	Health Insurance Premium	Monthly cost of family health insurance coverage for a family of three, all non-smokers, all in good health.	Database	6 - 8 per county

## ENTERTAINMENT

Entertainment items consisted of movie tickets, a DVD player, batteries, and pet food. Prices for movie tickets were gathered by phone calls to movie theaters throughout the state. Prices for DVD players, batteries, and pet food were gathered by in-person visits to grocery and electronics stores throughout the state. The number of stores visited was determined with a sampling algorithm developed by Corona Insights that was applied to a database of business listings provided by Dun & Bradstreet. The Dun & Bradstreet list was also supplemented with lists of Wal-Mart Supercenters and Super Targets so that entertainment item prices would also be obtained at these supercenters. All sampling for entertainment items was done at the school district level after coding the business listings to the appropriate school district. After prices were collected, the dataset of prices for each item was screened for outliers, taxes were added where applicable, average prices were computed for each district, and then average prices were weighted using the shopping patterns survey results to produce final prices for each district.

Detailed descriptions of the entertainment items in the market basket and the number of prices collected are provided in the table below:

Entertainment				
CES Category	Specific Item	Description	Collection Method	N of Observations
Fees and Admissions	Movie	Price of adult admission to a first-run, full-length movie.	Call	82
Television, Radios, Sound Equipment	DVD Player	Single-disc player, NO DVR (i.e. TIVO), Blu-Ray/HD format, recorder, or combo units (i.e. vcr included); Sony, if not available then Panasonic, otherwise cheapest brand offered.	On-Site	206
Other supplies, equipment, and services	Batteries	4 Pack AA Batteries. Energizer brand; if not available then Duracell, otherwise cheapest 4 pack of AA. DO NOT PRICE LITHIUM BATTERIES.	On-Site	502
Pets, Toys, and Playground Equipment	Pet Food	Price for a 5.5 oz. can of Friskies cat food. If Friskies not available, price of 9 Lives or Whiskas.	On-Site	478

## PERSONAL CARE PRODUCTS AND SERVICES

Personal care items consisted of haircuts, shaving cream, toothpaste, and tampons. Prices for haircuts were gathered by phone calls to beauty and barber shops throughout the state. Prices for shaving cream, toothpaste, and tampons were gathered by in-person visits to grocery stores throughout the state. The number of stores visited was determined with a sampling algorithm developed by Corona Insights that was applied to a database of business listings provided by Dun & Bradstreet. The Dun & Bradstreet list was also supplemented with lists of Wal-Mart Supercenters and Super Targets so that personal care product prices would also be obtained at these supercenters. All sampling for personal care items was done at the school district level after coding the business listings to the appropriate school district. After prices were collected,



the dataset of prices for each item was screened for outliers, taxes were added where applicable, average prices were computed for each district, and then average prices were weighted using the shopping patterns survey results to produce final prices for each district.

Detailed descriptions of the personal care items in the market basket and the number of prices collected are provided in the table below:

<b>Personal Care Products and Services</b>				
<b>CES Category</b>	<b>Specific Item</b>	<b>Description</b>	<b>Collection Method</b>	<b>N of Observations</b>
Personal Care Services	Man's Haircut	Price of man's wash, cut and dry	Call	613
Personal Care Services	Woman's Haircut	Price of woman's wash, cut and dry	Call	595
Personal Care Products	Shaving Cream	Price of Barbasol regular shaving cream 11.0 oz. If you can't find Barbasol, price Gillette.	On-Site	463
Personal Care Products	Toothpaste	Price of Crest regular Paste Tartar Protection 6.4 oz. Always get Crest 6.4 ounces, but if it's not available, get Colgate 6.4 ounces.	On-Site	451
Personal Care Products	Tampons	Price for one box of 20 Tampax Regular Absorbency (not the slender style.) Note if different size box.	On-Site	493

## TOBACCO

Tobacco and smoking expenditures were represented by a carton of cigarettes. Prices for cigarettes were gathered by in-person visits to grocery stores throughout the state. The number of stores visited was determined with a sampling algorithm developed by Corona Insights that was applied to a database of business listings provided by Dun & Bradstreet. The Dun & Bradstreet list was also supplemented with lists of Wal-Mart Supercenters and Super Targets so that tobacco prices would also be obtained at these supercenters. All sampling for tobacco items was done at the school district level after coding the business listings to the appropriate school district. After prices were collected, the dataset of prices for each item was screened for outliers, taxes were added, average prices were computed for each district, and then average prices were weighted using the shopping patterns survey results to produce final prices for each district.

A detailed description of the tobacco item in the market basket and the number of prices collected are provided in the table below:

<b>Tobacco Products/Smoking Supplies</b>				
<b>CES Category</b>	<b>Specific Item</b>	<b>Description</b>	<b>Collection Method</b>	<b>N of Observations</b>
Tobacco	Cigarettes	Price for one carton (200 cigarettes) of Marlboro Filter, hard pack, flip-top cigarettes. If Marlboro cigarettes aren't available, get prices for Camel cigarettes.	On-Site	456

## READING, EDUCATION, AND MISCELLANEOUS EXPENSES

The major expenditure categories for Reading, Education, Miscellaneous Expenses, Cash Contributions, Personal Insurance and Pensions and Personal Taxes were considered to be constant for the relevant benchmark household and were not sampled in this 2009 Cost of Living study. These categories have been held constant throughout all previous Cost of Living studies. No geographical variations are expected for these across the state of Colorado, so all districts receive the same average costs for each of these categories.

## DEVELOPING FINAL COST OF LIVING MEASURES

After the collection of all pricing data and shopping patterns data, two major steps were taken to develop the final cost of living measures. First, the price data for the market basket items was integrated with the shopping patterns model in order to develop prices for each district that reflect where people in the district purchase their items. Second, annual expenditures are calculated by determining the ratio of the district average price to the statewide average price for each good and then multiplying by the typical expenditure on that item according to the Consumer Expenditure Survey. This second step scales up costs so that the limited numbers of (for example) grocery items for which data are collected represent the full expenditures for food for the benchmark household. Each of these steps is described in further detail below.

### INTEGRATE PRICE DATA WITH SHOPPING PATTERNS SURVEY

As previously described, people do not make all of their purchases in the school district in which they live. The shopping patterns survey gathered data which examined where people shop for 15 categories of items and services: produce, perishable groceries, non-perishable groceries, alcoholic beverages, pet food, household products, clothing and shoes, cars, gas, car maintenance and repair, mattresses, DVD players, movie tickets, and where they go for haircuts and restaurant meals. For each of these items, Corona Insights developed matrices that specify where people living in each district shop for each item. For example, people who live in the Denver County school district may buy gasoline in not only Denver but also neighboring school districts such as Adams-Arapahoe, Boulder Valley, Brighton, Cherry Creek, Jefferson County, and others. By multiplying the shopping patterns matrices that link “home district” with “shopping districts”, regional variations in costs and shopping preferences are reflected.

### CALCULATE ANNUAL EXPENDITURES

Calculating the annual expenditures for each district involved determining the district average price for each item, weighting that price by the proportion of teachers in the district to calculate a state average price, calculating the ratio of the district average price to the state average price, and then multiplying that ratio by the typical expenditures in a category according to the Consumer Expenditure Survey. These steps are elaborated below.

Mirroring the methodology used in the 2007 cost of living study, the majority of the market basket items were sampled by school district in 2009. This helped to ensure that all final cost of living data was specific to an exact school district. In a few cases the data was only available at a county or region level, and needed to be applied to districts based on location. Utilities prices, day care prices, and insurance prices are a few of the cases where data was available at the county or region level and had to be applied to districts. In these cases, the county (or other) price was assigned to each district located in that county in order to arrive at a price for each district.

Statewide average prices were then calculated by weighting the average price in each district by the proportion of the state’s teachers in that district and then adding together the weighted prices for all districts. District average prices were then compared to state average prices by calculating the ratio of the district average price to the state average price. These ratios were then multiplied by the typical expenditure for the category according to the Consumer Expenditure Survey in order to determine a final annual expenditure on that item for each district.

This process was conducted for each market basket item, and then all of the expenditures on items in a common category were added to determine annual expenditures for that category (i.e., categories include food

at home, food away from home, housing, transportation, etc.). Finally, annual expenditures in each category were combined to provide total annual expenditures for each district.

## CALCULATE CONFIDENCE INTERVALS

Confidence intervals were also calculated for most expenditure categories to estimate the uncertainty in the prices available to consumers in each district. For each district sampled, the variance of the mean (i.e., standard error), was calculated for the prices available from that district. These variances were weighted by the shopping patterns for each district and the teacher populations to calculate a state average variance, and then ratio variances were calculated by comparing the variance for a district to the state average variance. Ratio variances were aggregated over items in a category and a confidence interval was calculated for the category as a whole. Details of the statistical methods involved were provided in an appendix to the 2007 Cost of Living Report, and are also discussed in Appendix G of this 2009 report.

Essentially, large confidence intervals reflect a large variance of the mean, which means there is a large variability in the prices collected and relatively few prices collected. In some cases, variability in the error may be reduced by additional sampling in those districts; however this is only likely to be true in large districts where the universe of stores available to sample from is large. In, for example, a small, rural district with only one substantial grocery store, where a convenience store has also been sampled, the variance of the mean will be large, but sampling additional convenience stores (if even any are available) is likely to only artificially inflate the mean price for the district, because convenience stores tend to charge higher prices than grocery stores. In cases like this there is a tradeoff between reducing error variability and accurately estimating the cost of living in a district. Whether additional sampling is needed should be evaluated on a case by case basis. It should be noted that other factors in addition to the variability of the mean district price will affect uncertainty in the cost of living indices, but currently no additional factors are incorporated in the confidence interval estimates.

See Appendix G for a more detailed discussion of statistical measures used in this study.

## **APPENDIX A: DETAILED RESULTS**

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Appendix A provides an additional level of detail about the results of the study, breaking out costs of living in each direct by major expenditure category.

Readers receiving this report electronically will need to review an accompanying spreadsheet file, due to the volume of data.

## APPENDIX B: DETAILED METHODOLOGICAL DISCUSSION – DATA COLLECTION

In Section 4 of the report, a methodological overview is provided regarding the data collection methods for each major expenditure category, and for the development of geographic shopping patterns matrices. Appendix B provides additional detail on those topics for the interested reader.

In the bulk of this appendix, data collection techniques are expanded upon. Notable sampling techniques, data collection procedures and weighting techniques are expanded upon for each major expenditure category.

**Reporting Note:** Where sampling, data collection, and weighting techniques were identical between expenditure categories, these techniques will not be repeated in each write-up in order to reduce redundancy.

### FOOD AT HOME

All Food At Home item prices were collected in-person throughout each of the 178 school districts in Colorado. Business listings for grocery stores in Colorado were collected from the Dun & Bradstreet database. This list was supplemented with a complete list of Wal-Mart Supercenters and Super Target locations to ensure that food prices were collected at these stores. Corona labeled each of the businesses with the school district it is located in using arc-GIS software. Then we developed a sampling plan based on the number of businesses in each school district, which resulted in a goal of sampling the larger of five (businesses) or five percent of businesses in each district. Corona attempted to sample all businesses from districts with fewer than five stores in a given category. In metro area districts with large numbers of businesses in each category, the businesses to be sampled were chosen based on store revenues provided by Dun & Bradstreet. The total revenue for a district was divided by the number of stores to be sampled from that district ( $n$ ), then stores were rank-ordered by their revenue values and one store was chosen from each  $n$ -tile of the distribution.

**Training Note:** Corona Insights staff then conducted a multi-day training with their own internal data collection team to ensure that all data collected in-person throughout the state was collected in a the exact same manner throughout each of the 178 school districts. Trainings focused on using established sampling techniques, a thorough review of the market basket and other data collection logistics. For the 2009 study, the Corona Insights data collection team used hand-held PDA devices to collect market basket prices. These devices helped data collectors collect data more efficiently and enhanced data collection procedures. The market basket of goods was programmed into each of these devices, and data collectors were able to input prices directly into the PDA devices while in the field. Training took place at a number of different types of stores that would be visited during the data collection process (primarily in the Denver Metro area).

Field research was then conducted by Corona Insights data collection team who visited each district and attempted to collect prices from the number of stores identified by the sampling plan. Gathering prices at gas stations or convenience stores was to be avoided unless no other businesses could be identified in a district. All data that was collected by the data collection team was uploaded to a final database with market basket prices for all goods and for all districts. The database was checked for outliers by identifying prices that were outside three standard deviations from the mean for their region (using regions from the shopping patterns survey to group similar districts together). Grocery tax for each location was then added to each price, and an average price was calculated for each district.

## FOOD AWAY FROM HOME

All Food Away From Home item prices were collected in-person throughout the school districts. Business listings for eating places in Colorado were collected from the Dun & Bradstreet database, and then Corona labeled each by school district using arc-GIS software. The sampling plan for items in the Food Away From Home Category was developed similarly to the Food At Home Category (see above). The main difference between the sampling for the Food Away From Home Category was data collectors were asked to obtain at least three different prices for each of the three different Food Away From Home items (that would be three different prices in each district for cheeseburgers meals, pizza meals and steak meals). In Colorado metro areas with a plethora of eating places, data collectors were instructed to obtain an increased number of prices for each Food Away From Home item so that the overall sample for those districts would be more representative of the overall eating places district population. Corona attempted to sample all businesses from districts with fewer than three stores in a given category (cheeseburger, pizza or steak dining establishments).

Field data collection and training was conducted and entered with the same research method described in the **Food At Home section (see above)**. It should be noted that in 2009 prices were gathered at fast food restaurants, specifically for the cheeseburger meal. This methodological shift was made in an effort to enhance the comparability of cheeseburger meals across all districts. All outliers for Food Away From Home were analyzed and checked with the same method described in the Food At Home Section (see above). Dining tax for each location was then added to each price, and an average price was calculated for each district.

## ALCOHOLIC BEVERAGES

All Alcoholic Beverage item prices (a six pack of beer) were collected in-person throughout the school districts. Alcoholic Beverage prices and Food At Home items were collected at the same time and utilized the same methodology (**see Food At Home detailed methodology**, above). Beer prices were collected at all grocery stores where beer was sold. In districts where beer prices were not obtainable at grocery stores (or if there were too few grocery stores available in a district), data collectors were instructed to obtain beer prices at local convenience or liquor stores. It should be noted that business listings for liquor stores in Colorado were collected from the Dun & Bradstreet database and added to the final data collector list of stores to be sampled (data was collected primarily at liquor stores in districts that had fewer than five total grocery stores to be sampled). Liquor stores were also geo-coded and labeled to the appropriate district using arc-GIS.

After all data was collected, entered and outliers were analyzed and removed, sales tax was added to each price, and an average price was calculated for each district.

## HOUSING

### SHELTER – MORTGAGE PAYMENT/PROPERTY TAXES

Mortgage payments were provided to Corona Insights by the Colorado Legislative Council via a study by an outside consultant, based on a specified home size. This is the same approach used in previous years.

Owners of residential homes are subject to property tax on their dwelling. The entire value of the home is not taxed; only the assessed value of the home can be taxed. The assessed value of a home is the actual home value multiplied by an assessment percentage. This assessment percentage is the same for the entire state of Colorado and is 7.96%. The assessed value of the home is then multiplied by the decimal equivalent of the total mill levy. The total mill levy is the sum of the mill levies from the county, city, school district, and

any other special levies an area may have. To get the decimal equivalent of a mill levy, the levy is multiplied by .001.

In order to get mill levies, the 2008 annual report for the Department of Local Affairs Division of Property Taxation was obtained from Division of Property Taxation website. ([http://www.dola.state.co.us/dpt/publications/docs/2008\\_annual\\_report/SECXI.pdf](http://www.dola.state.co.us/dpt/publications/docs/2008_annual_report/SECXI.pdf)). This report was the most recent report available from the Division of Property Taxation. The report includes mill levies for every county, city, school district, and any other applicable levy in the state of Colorado. The mill levies were summed by school district. The stated home price for each school district was multiplied by the assessment percentage (7.96%) to get the assessed value. The assessed value was multiplied by the total of all applicable mill levies for the district (county, school district, average municipal value in the county, and any special levy). This value is the property tax. This process was repeated for all school districts.

### SHELTER – HOMEOWNER’S INSURANCE

Insurance companies with a large market share for homeowner’s insurance in Colorado were determined by analyzing the 2008 “Annual Report of the Commissioner of Insurance”. These companies were contacted to determine homeowner’s insurance rates by zip code. In obtaining homeowner’s insurance rates, hazard insurance was sought for a \$100,000 frame dwelling built in 1970 with \$80,000 contents coverage, \$100,000 liability/medical payments, and a \$250 deductible. These are the same specifications use in previous studies.

The rates were provided to Corona Insights by zip code. The rates were averaged to the county level, and then final district averages were created from the final county homeowner’s insurance rates.

### SHELTER – HOME MAINTENANCE/REPAIRS

The Shelter subcomponent also included costs for household maintenance and repairs. Data from the U.S. Bureau of Census data provided information regarding the typical costs residents spent on maintenance and repairs such as painting, plumbing, heating/air conditioning, electrical, and other miscellaneous services. The research team developed weights for each of these areas as a function of maintenance expenditures, as a percentage of the total spending on maintenance and repairs.

Once relative weights for the services were determined, Corona Insights obtained regional Occupational Employment Statistics (OES) wage data by occupation for the state of Colorado for six different regions within the state. These wage levels were used as a proxy for measuring the relative costs of household maintenance and repairs. Final costs for the maintenance and repairs component were assessed by region and then mapped into the appropriate school districts to create the final home maintenance and repairs cost per district.

### UTILITIES – ELECTRIC

In order to calculate the average monthly electric bill for residents around the state, Corona examined the 2008 Annual Reports filed by electric companies from around the state with the Colorado Public Utilities Commission. Specifically, these reports contain data about each company’s annual residential revenues and average number of residential customers. Using this information, it is possible to calculate an average bill, which includes both base and usage fees charged by each electric company.

In a select few cases, data for a company or municipality electric provider was not available from the Public Utilities Commission. In such cases, telephone calls were made to the offices of the appropriate organization to obtain their annual revenues and number of customers so that an average billing rate could be calculated as described above.



After an average bill had been calculated for each of the state's electric providers, these rates were assigned to each of Colorado's 178 school districts. In cases where a single organization provides electric service for the entire school district, this process was very straightforward. In some cases, however, a single school district may have as many as three major electric providers. In this situation, the school district's average billing weight was calculated by averaging the district's billing rates, weighted by the number of people in the district covered by each electric provider.

One possible limitation of this methodology is that each electric provider's annual report only contains data on their service area as a whole. For some providers which have a fairly small service area, this likely results in an accurate value being assigned to each school districts. For providers which serve a highly-varied area, however, this average may tend to underestimate the high-usage areas and overestimate the low-usage areas.

### UTILITIES – GAS

In order to calculate the average monthly natural gas bill for residents around the state, Corona used a methodology very similar to that described for electric providers. Each of the state's natural gas providers is required to file their sales of natural gas by community with the PUC each year. As with the annual reports for electric providers, these filings contain annual residential revenues and residential customers for each of the providers' service areas. This data can then be used to calculate an average bill for each service area.

Unlike electric providers, which report their revenues and customer counts across the entire state, natural gas providers are required to provide their data for each of their individual service areas. For this reason, the average bill for each service area should be very accurate, since the geographic coverage of each service area is relatively small.

After compiling the average monthly bill for each service area, these values were allocated to the school districts covered by each area as was done for both electric and telephone providers. Again, in areas where multiple providers serve a single school district, a weighted average based on population size covered was used to calculate the rate to be assigned to each district.

One unique aspect of determining an average bill for natural gas across the state is that some school districts depend on propane for their heating needs rather than natural gas. While it is possible to gather information on propane *prices* around the state, propane providers do not have an accurate measurement of the actual propane *usage* in their area. Trying to estimate the true cost of propane service based on some estimated usage value, therefore, would likely be very inaccurate. Instead, Corona used data from the Energy Information Administration to calculate the relative cost of using propane for energy instead of natural gas, based on the actual energy output for each fuel in BTU's and the 2008 average cost for each fuel in Colorado.

After determining this "conversion factor," the cost of propane service for each school district without natural gas service was computed by averaging the natural gas bills of the surrounding districts and inflating that average based on the analysis discussed above. This methodology was consistent with the methodology used in the 2007 study and this analysis should yield a far more robust analysis than simply estimating the usage in each area arbitrarily.

### UTILITIES – TELEPHONE

In order to calculate the average monthly telephone bill for residents around the state, Corona obtained telephone rates from the Public Utilities Commission's "2008 ILEC Annual Report." This report detailed the monthly base rates being charged by each "incumbent local exchange carrier" around the state. Each

provider charges the same rate throughout their service area, with the exception of CenturyTel. In this case, each of CenturyTel's rate areas was considered to be a separate provider for the purposes of computing an average bill.

Similar to the process used for electric providers, these rates were assigned to each of the school districts based on the providers' coverage areas. In areas where multiple providers serve a single school district, a weighted average based on population size covered was used to calculate the rate to be assigned to each district.

In addition to the base rates being charged by each company, a variety of other fees contribute to the total monthly bill in an area. First, a number of fees are assessed on telephone bills across the entire state. Specifically, the high cost surcharge, hearing impaired relay fund, low income surcharge, and subscriber line charges are the same across the entire state. Similarly, all applicable utility taxes were applied to all districts. Other charges, such as the 911 surcharge, vary from one area of the state to another. These charges were, therefore, applied on a district-by-district basis to calculate the overall average bill.

### UTILITIES – WATER/SEWER

In order to determine the average monthly payments for water and sewer bills in each school district, Corona Insights collected rate information for 256 cities and towns throughout the state. The data collection was initiated by using a spreadsheet that held contact data and information from similar research performed in 2007. Corona employees attempted to collect data from each of the 256 agencies; most of the information was collected via phone calls, although rates for some towns were found online. Phone calls proved to be the fastest source of information in most cases. In the event that no contact information could be found, or if a town used only wells or septic tanks, proxy values were used based on rates charged in the nearest town.

After data collection was complete, equations for determining monthly totals were written into the spreadsheet for each of the 256 towns. The equations figured rate totals based on a home that uses 6,000 gallons of water per month, and produces 6,000 gallons of wastewater for processing per month. These totals were then applied to the appropriate school districts. In some cases, rates had only been researched for one town within a district; in these cases, that rate was simply applied to the entire district. Other school districts were host to multiple towns, and data had been collected from several towns within the district. In those cases, each rate was weighted according to population so that a more accurate value for each district could be determined.

### HOUSEHOLD OPERATIONS – DAY CARE

Average day care costs (by Colorado County) were obtained from the 2009 Market Rate Survey of Child Care Providers which is conducted by Qualistar Early Learning. Qualistar Early Learning is the result of a merger that occurred in 2004 between two early education non-profit organizations based in Colorado – Educare Colorado and the Colorado Office of Resource and Referral Agencies (CORRA). Qualistar Early Learning is under contract to the Colorado Department of Human Services, Division of Child Care as the State Resource and Referral Agency. As part of this contract they conduct this bi-yearly market research study of state-wide day care costs.

Included in the Market Rate Survey of Child Care Providers are costs for licensed child care centers (CCC), family child care providers (FCC), and school-age child care (SACC) facilities in all 64 counties. Full-time weekly rates of caring for children between 0 to 12 months, 1 to 2 years, and 2 to 5 years were provided in Qualistar's 2009 report.

In determining the average weekly costs for childcare services, the average of child care centers (CCC's) and family care centers (FCC's) for all age groups provided, 0 to 12 months, 1 to 2 years, and 2 to 5 years, was calculated. The averages were then weighted based on the national proportion of children in either "Center" or "Family" day care. These proportions were based on the National Survey of American Families study conducted in 2002 by the Urban Institute. The report can be found here: <http://www.icpsr.umich.edu/icpsrweb/ICPSR/series/00216/studies/4582>.

Weekly rates were then converted to a monthly cost by multiplying the weekly cost of care by 52 weeks per year and then dividing it by 12. Final district average day care costs were then reallocated from the county level to the final district level.

### HOUSEKEEPING SUPPLIES – LAUNDRY SOAP

All Housekeeping Supplies item prices were collected in-person throughout the school districts. Laundry soap was used as the item to be collected for the Housekeeping Supplies Category. Laundry Soap prices were collected at the same time and using the same sampling methodology described for Food At Home items (see **Food At Home Methodology Section**, above).

After all data was collected, entered and outliers were analyzed and removed, sales tax was added to each price, and an average price was calculated for each district.

### HOUSEHOLD FURNISHINGS AND EQUIPMENT – MATTRESS

Mattress prices were used to represent the Household Furnishings and Equipment category. Mattress prices were collected in-person throughout the school districts. Business listings for mattresses in Colorado were collected from the Dun & Bradstreet database, and then Corona labeled each by school district using arc-GIS software. The sampling plan for mattresses was developed similarly to the Food At Home Category (see **Food At Home Methodology section**, above) in that the goal was to sample the larger of five (mattress businesses) or five percent of mattress businesses in each district.

Data collectors were instructed to get prices for one of four specific brands of mattresses (Sealy Posturepedic – 736 coil count; Simmons Beautyrest – 759 coil count; Spring air – 700 coil count; or a Serta mattress with 800 coil count) which were agreed to be relatively comparable items by the Corona Insights and Colorado Legislative Council. Due to the multitude of different mattress options available at different stores throughout the state, those four brands specified in the market basket were sometimes not readily available for pricing at each store visited. When this was the case, data collectors were instructed to obtain help from mattress sales representatives to find the mattress in that store which was most comparable to the target mattress brands in the market basket.

After all data was collected, entered and outliers were analyzed and removed, sales tax was added to each price, and an average price was calculated for each district.

### APPAREL

Apparel prices were collected in-person throughout the school districts. The apparel items to be collected for the Apparel Category included Men's dress shirts, Men's T-shirts, Women's pantyhose, Women's T-shirts, and Men's canvas lace-up shoes. Business listings for apparel business in Colorado were collected from the Dun & Bradstreet database. The Dun & Bradstreet list was also supplemented with lists of Wal-Mart Supercenters and Super Targets so that apparel prices would also be obtained at these supercenters. Corona then geo-coded and labeled each apparel store into the appropriate school district using arc-GIS software.

Similar to the sampling plan detailed in Food At Home (see above), the sampling plan for apparel was based on the number of businesses in each school district, which resulted in a goal of sampling the larger of five (apparel stores) or five percent of apparel stores in each district for each apparel item. Corona attempted to sample all apparel stores from districts with fewer than five stores in a given category. Overall, in each district it was the minimum goal to obtain five different prices for each item, but this was not possible in many districts which did not have five total apparel stores.

It should be noted that specific brands and types of clothing items were targeted for pricing for each item, but often those specific brands would not be available within a given store. When this was the case, data collectors were instructed to find brands and item types which most closely replicated the initial target brands.

After all data was collected, entered and outliers were analyzed and removed, sales tax was added to each price, and an average price for each apparel item was calculated for each district.

## TRANSPORTATION

### VEHICLE FINANCING

Vehicle pricing was gathered for a 2007 Honda Civic LX Sedan. The purchase price of the 2007 Honda Civic was \$16,995 (per blue book information assuming the vehicle had 24,000 miles at the time of purchase) was the base price used to determine annual car payments for a four-year loan. This price was assumed to be constant throughout the state, as had been assumed in previous cost of living studies.

Financing rates for vehicle loans were obtained from telephone surveys of banking institutions and credit unions throughout the state. The list of banking institutions to survey came from information provided by the Federal Deposit Insurance Corporation (FDIC) and National Credit Union Administration (NCUA) which provided market share information for the institutions. This data was gathered on a county basis and then mapped to the district level to obtain the rate for each district. Average monthly car payments were then calculated, given the total amount financed (including the purchase price, all bank loan charges, and any applicable tax, title, and registration fees) and the interest rate charged by the bank or credit union.

### VEHICLE INSURANCE

Insurance companies with a large market share for vehicle insurance in Colorado were determined by analyzing the 2008 “Annual Report of the Commissioner of Insurance” These companies were contacted to determine vehicle insurance rates by zip code.

For vehicle insurance, two vehicles were used to calculate rates. The first vehicle was a 2007 Honda Civic LX sedan with a four cylinder 1.8 liter engine, five speed manual transmission, 24,000 miles, air conditioning, power steering, power windows, power locks, tilt, cruise control, AM/FM CD, and dual airbags. The coverage was comprehensive with liability policy limits of \$25,000/\$50,000/\$15,000 with a \$250 deductible and 15,000 miles per year. The second vehicle was a 2005 Ford Ranger XL long bed pickup with a 4.0 liter V6 engine, 5 speed manual transmission with two wheel drive, 60,000 miles, air conditioning, power steering, cruise control, AM/FM CD, and airbags. The coverage was liability only with liability policy limits of \$25,000/\$50,000/\$15,000 with 15,000 miles per year. These two cars are similar to the ones used in previous studies and represent highly popular makes and models. The model year was updated from 2003 to 2005 from the previous study and some features had to be adjusted accordingly for this study.

For each car and across each zip code, the driver’s characteristics were held constant. The driver was assumed to be a thirty year old married man with good credit and a good driving record. The particular characteristics of the driver were not vitally important because the comparison of the rates were done using

ratios, and as long as the driver's information was held constant by each insurance company, the utilization of the ratio method can be assumed to be a valid method of comparison. Data was given for six months, so the total of the two vehicle's insurance was summed and multiplied by two to get the yearly rate for both cars.

As previously detailed in the main body of the report, vehicle insurance data was obtained from one vehicle insurance provider that has a large share of the vehicle insurance market in Colorado. The name of that company will not be provided in this report in order to ensure pricing confidentiality to that company. Vehicle insurance rates were provided from the participating vehicle insurance company for each vehicle by zip code. Once the zip codes for each county were determined, the rates for each zip code were averaged for each county and then were redistributed to the proper school district as final vehicle insurance rates.

### OIL AND FILTER CHANGE

Oil Change prices were collected by telephone for every district. Business listings for automobile maintenance and repair shops in Colorado were collected from the Dun & Bradstreet database, and Dex Online yellow pages information was used to supplement those lists when additional automobile maintenance shops were needed to sample in a specific district. Each gas station was then geo-coded and labeled into the appropriate school district using arc-GIS software. The Oil Change Prices obtained were for a 2005 Ford Ranger (see the Transportation table in Section 4).

Similar to the sampling plan detailed in Food At Home (see above), Corona attempted to sample the larger of five (auto maintenance shops) or five percent of all auto maintenance shops in each district. Ultimately in many of the smaller (mostly rural) districts where fewer automotive maintenance and repair shops existed, an attempt to obtain oil change prices was made at any (and all) maintenance shops available in the district.

After all data was collected, entered and outliers were analyzed and removed, sales tax was added to each price, and an average price was calculated for each district. It should be noted that sales tax was only applied to the parts of an oil change, and this was standardized across all oil change prices to reflect approximately 40 percent of the total oil change price. Therefore, 40 percent of all final oil change prices were taxed with the local sales tax, and the remaining 60 percent was left untaxed.

### FRONT-END ALIGNMENT

Front-End Alignment prices were collected at the same time and with the exact same methodology as Oil Changes (see Oil Change Methodology, above). After all data was collected, entered and outliers were analyzed and removed, an average price was calculated for each district. It should be noted that no tax was applied to Front-End Alignment prices, because it is considered a service that is not taxed.

### GASOLINE

Gasoline prices were gathered on a single day via telephone calls to gas stations throughout the state. All gas prices had to be obtained on the same day due to the relative instability of gas prices on a national and regional level. Unleaded grade 85 octane gasoline was priced for the category. Business listings for gas stations in Colorado were collected from the Dun & Bradstreet database. Each gas station was then geo-coded and labeled into the appropriate school district using arc-GIS software.

Similar to the sampling plan detailed in Food At Home (see above), the sampling plan for gas stations was based on the number of businesses in each school district, which resulted in a goal of sampling the larger of five (gas stations) or five percent of all gas stations in each district. Corona attempted to sample all gas stations from districts with fewer than five stores in a given category, and an attempt was made to obtain gas

prices for each district (though some districts had no gas stations located in their boundaries or the few gas stations that were in their boundaries would not divulge that information over the phone).

After all data was collected, entered and outliers were analyzed and removed, an average price was calculated for each district.

## HEALTH CARE

In order to determine the average monthly health insurance premium rate in each school district, Corona Insights collected rate information from four of the largest health insurance providers in the state. Data were collected for PPO's from three of the companies, and an HMO from the remaining provider. Using each insurance provider's website, Corona employees gathered rates as they would apply to a family of three, all non-smokers, and in good health. The family of three was described as:

- ⇒ 1 Male, 37, DOB 6/20/1972;
- ⇒ 1 Female, 36, DOB 2/4/1973; and
- ⇒ 1 Male, 4, DOB 4/5/2005.

Most of the websites determined rates based on location within the state as indicated by county or zip code. In the cases when a zip code was required, the code from the applicable county seat was used.

Rates for the two most popular plans for each of the four participating companies were obtained. Corona project staff consulted with representatives from each of the four companies to select the final plans that were used from each company. The plans are not necessarily comparable between all companies because benefits varied widely among the providers. In addition to recording plan rates, Corona employees also noted the benefits provided by each plan.

Average health insurance costs were averaged for each of the four companies (between the two most popular plans) and then final health care costs were calculated by multiplying these final company averages by the weighted (comparative) average market share of each company to obtain final costs by zip code. The costs collected for each zip code were then applied to school districts within each county.

## ENTERTAINMENT

### MOVIE TICKET

Movie Ticket prices were collected by telephone for every district. Business listings for movie theaters in Colorado were collected from the Dun & Bradstreet database, and Dex Online yellow pages information was used to supplement those lists when additional movie theaters were needed to sample in a specific district. Each movie theater was then geo-coded and labeled into the appropriate school district using arc-GIS software.

Data collectors were instructed to obtain the price of an adult admission ticket for each movie theater sampled, and only movie theaters showing current release movies were sampled (no Dollar Movie Theater prices were used in the final district averages).

After all data was collected, entered and outliers were analyzed and removed, an average price for movie tickets was calculated for each district. It should be noted that no tax was applied to movie theater prices, because it is not considered a taxable good.

## DVD PLAYER

In previous Cost of Living Studies, the market basket good for Television, Radios and Sound Equipment was a 20 inch RCA television. Due to the increasing technological changes in the television landscape at the current time, in 2007 Corona Insights and the Colorado Legislative Council agreed to change this market basket good to a DVD player. DVD Player prices were collected in-person throughout all of the districts.

Business listings for electronics and home appliance stores in Colorado were collected from the Dun & Bradstreet database, and Dex Online yellow pages information was used to supplement those lists when additional electronics stores were needed to sample in a specific district. Each electronic store was then geo-coded and labeled into the appropriate school district using arc-GIS software.

Similar to the sampling plan detailed in Food At Home (see above), Corona attempted to sample the larger of five (electronics stores) or five percent of all electronics stores in each district. Ultimately, many of the smaller (mostly rural) districts often did not have electronics stores, and in those districts data collectors would do their best to obtain at least one price per district. In several districts, there were no DVD prices to be obtained (due to a general shortage of available stores selling DVD players in that district).

After all data was collected, entered and outliers were analyzed and removed, sales tax was added to each price, and an average price was calculated for each district.

## BATTERIES

All battery prices were obtained in-person at the same time grocery prices were collected. Therefore, the sampling, data collection and analysis plan for batteries is exactly the same as described in the **Food At Home Methodology** section (see above).

After all data was collected, entered and outliers were analyzed and removed, sales tax was added to each price, and an average price was calculated for each district. It should be noted that film was gathered in previous Cost of Living studies, and in 2007 Corona Insights and the Colorado Legislative Council agreed to substitute battery prices for film prices for the 2007 study. Use of battery prices as an entertainment item was continued in the 2009 study.

## PET FOOD

All pet food prices were sampled in-person at the same time grocery prices were collected. Therefore, the sampling, data collection and analysis plan for pet food is exactly the same as described in the **Food at Home Methodology** described earlier in this section (see above). Cat food was the specific item priced for pet food.

After all data was collected, entered and outliers were analyzed and removed, sales tax was added to each price, and an average price was calculated for each district.

## PERSONAL CARE PRODUCTS AND SERVICES

### PERSONAL CARE PRODUCTS - SHAVING CREAM, TOOTHPASTE, TAMPONS

All personal care product prices such as shaving cream, toothpaste and tampons were sampled in-person at the same time grocery prices were collected. Therefore, the sampling, data collection and analysis plan for shaving cream, toothpaste, and tampons is exactly the same as described in the **Food at Home Methodology** described earlier in this section (see above).

After all data was collected, entered and outliers were analyzed and removed, sales tax was added to each price for each personal care product, and an average price was calculated for each district for each of the three products in this category.

## HAIRCUT

Both men's and women's haircut prices were collected by telephone for every district. Business listings for beauty salons and barber shops in Colorado were collected from the Dun & Bradstreet database, and Dex Online yellow pages information was used to supplement those lists when additional beauty salons/barber shops were needed to sample in a specific district. Each beauty shop/barber shop was then geo-coded and labeled into the appropriate school district using arc-GIS software.

Data collectors were instructed to ask for the price of full cut, wash and dry haircut. Each beauty salon/barber shop were asked for the price of both women's and men's haircuts, but some stores only offered either women's or men's cuts.

Corona attempted to sample the larger of five (beauty shops) or five percent of all beauty shops in each district for both men's and women's haircuts. As seen in other market basket categories, many of the smaller (mostly rural) districts often did not have as many beauty shops, and in those districts data collectors would do their best to obtain at least one price per district.

After all data was collected, entered and outliers were analyzed and removed, an average price was calculated for each district. No sales tax was applied to the final haircut prices, because haircuts are considered a service not a taxable good.

## TOBACCO

Cigarette prices were sampled in-person at the same time grocery prices were collected. Therefore, the sampling, data collection and analysis plan for cigarette prices is exactly the same as described in the **Food at Home Methodology** described earlier in this section (see above). An attempt was made to obtain cigarette prices at all grocery stores that were visited by data collectors. Similar to the sampling approach used for beer prices, data collectors were instructed to obtain cigarette prices at local convenience or liquor stores in districts where cigarette prices were not obtainable at grocery stores (or if there were too few grocery stores available in a district).

It should be noted that business listings for liquor stores in Colorado were collected from the Dun & Bradstreet database and added to the final data collector list of stores to be sampled for cigarettes (cigarette data was collected primarily at liquor stores in districts that had fewer than five total grocery stores to be sampled). Liquor stores were also geo-coded and labeled to the appropriate district using arc-GIS. The Dun & Bradstreet list was also supplemented with lists of Wal-Mart Supercenters and Super Targets so that cigarette prices would also be obtained at these supercenters.

After all data was collected, entered and outliers were analyzed and removed, sales tax was added to each price, and an average price was calculated for each district.

## READING, EDUCATION, MISCELLANEOUS EXPENSES, CASH CONTRIBUTIONS, PERSONAL INSURANCE AND PENSIONS, AND PERSONAL TAXES

Mirroring previous Cost of Living studies, the major expenditure categories for Reading, Education, Miscellaneous Expenses, Cash Contributions, Personal Insurance and Pensions and Personal Taxes were not



sampled in this 2009 Cost of Living study. Similar to the previous studies, these expenditure categories were expected to be constant for the relevant benchmark family and were thus held constant for all districts. No significant geographic variation or trends were expected to be seen for these goods, and the final costs divvied across the districts came directly from the benchmark families spending level calculated for each category from the *Consumer Expenditure Survey*.

# APPENDIX C: NOTABLE METHODOLOGICAL CHANGES FROM THE 2007 COST OF LIVING STUDY

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A few notable methodological changes were implemented between the 2007 and 2009 Cost of Living Reports. In the opinion of the research team, each of these changes had a positive impact on the quality of the data.

## MINOR CHANGES TO THE MARKET BASKET

Minor changes were made to a few of the goods included in the market basket. These changes are detailed below:

- ⇒ **Change in cigarette brand collected.** After conducting the cost of living study in 2007, it was noted that Marlboro cigarettes were more readily available for pricing than Winston cigarettes. So for the 2009 study Corona Insights Staff and Colorado Legislative Council Staff agreed to price a carton of Marlboro Filter, hard pack, flip-top cigarettes. This change helped bolster overall comparability of cigarette prices between districts. It should be noted that Winston cigarettes were still priced in the current study if Marlboro brand cigarettes were unavailable in a specific district. The same unit size (one carton) was collected in 2009 as in previous studies.
- ⇒ **Women's Jeans changed to Women's Pantyhose.** Corona Insights Staff and Colorado Legislative Council Staff agreed to collect pricing for women's pantyhose in the 2009 study instead of women's jeans because there was less variability in the type, brand and price of women's pantyhose as had been observed in the data collection of women's jeans. Women's jeans had a large range of options, and difficulties in data collection and final pricing for women's jeans were encountered due to this wide variability range. It was more efficient and reliable for the data collection team to price women's pantyhose due to a decreased style and brand options. This change helped ensure pricing differences were due to market factors, not differences in style, name brand, cut or materials.
- ⇒ **Women's Turtleneck changed to Women's T-shirt.** Corona Insights Staff and Colorado Legislative Council Staff agreed to collect pricing for a women's T-shirt in the 2009 study instead of a women's turtleneck because there was less variability in the type, brand and price of a women's T-shirt as had been observed in the data collection of a women's turtleneck during the 2007 study. Women's turtlenecks have a large range of options, and difficulties in data collection and final pricing for these items were encountered due to this wide range of product variability. It was more efficient and reliable for the data collection team to price a women's T-shirt due to Corona having an increased ability to identify a particular style and brand options for this item. This change helped ensure pricing differences were due to market factors, not differences in style, name brand, cut or materials.
- ⇒ **Women's Black Leather Pumps (shoes) changed to Men's Canvas Lace-up Shoes.** In the 2007 study, difficulties in pricing black leather pumps were noted by the Corona data collection team. Finding Women's Black Leather Pumps that fit the exact criteria for the market basket was often a cumbersome process. In order to increase the comparability of the shoe collected, Corona Insights and the Colorado Legislative Council Staff agreed to collect Men's Canvas Lace-up Shoes in the 2009 study in place of Women's Black Leather Pump shoes. This change helped ensure pricing differences were due to market factors, not differences in style, name brand, cut or materials.

- ⇒ **Cheeseburger meal type changed slightly in the 2009 study.** For the 2009 study, the Corona Insights Staff and Colorado Legislative Council Staff agreed to primarily obtain cheeseburger prices from fast food chains. This shift was primarily made to target fast food cheeseburger prices so that the similarity of cheeseburger prices collected was enhanced. Burger prices were sought primarily at McDonalds, Burger King, Sonic, and Dairy King locations. Quarter pound cheeseburger meals were very comparable at all of these different locations, and these similarities enabled final pricing differences to be based primarily on market factors, as opposed to differences in restaurant type, ingredients or restaurant prestige.
- ⇒ **The ounce size collected for coffee decreased:** Corona Insights Staff and Colorado Legislative Council Staff also agreed to change the ounce size for the coffee pricing from 39 ounces to 11.3 ounces. This minor change was conducted so that coffee pricing in more rural districts (where ounce size of coffee available is sometimes lower than in more populated areas of the state) were more comparable to more populated districts.
- ⇒ **The ounce size collected for laundry soap decreased:** Corona Insights Staff and Colorado Legislative Council Staff also agreed to change the ounce size for the laundry soap pricing from 100 ounces to 50 ounces. This minor change was conducted so that laundry soap pricing in more rural districts (where ounce size of laundry soap available is sometimes lower than in more populated areas of the state) were more comparable to more populated districts.

## SHOPPING PATTERNS SURVEY SAMPLING DESIGN

- ⇒ The completion of the new shopping patterns survey and the development of a new shopping patterns matrix was a major milestone for the 2007 Cost of Living Project, and was the first step of developing a more global system of updating shopping patterns in the future. As part of this system, the 2009 shopping patterns sampling technique differed slightly (and by design) from the initial sampling method used in the 2007 study.

The 2007 study conducted roughly 271 surveys in 10 different regions (2,731 total surveys) within the state that were based on differences in employment characteristics and markets. These data were used to develop models to predict geographic shopping patterns within each district. Where enough data were available to use the data themselves, the data overrode the modeling, but the vast majority of districts used modeled estimates.

In the 2009 study, another 2,718 surveys were conducted and were combined with the 2007 data to continue developing a larger database of shopping patterns. The 2009 data collection focused on districts where the research team could achieve either or both of two goals: maximize the number of districts where analysis of the raw data could override the modeling process in developing a shopping patterns matrix, and strategically collect data that could continue to inform model development where necessary. As a result of this system, the shopping patterns for roughly half the districts are now exclusively data-based and the remainder use a combination of data and modeling. This sampling change was agreed upon by both Corona Insights and Colorado Legislative Council Staff.

## **APPENDIX D: RAW PRICING DATA FOR SELECTED PURCHASE CATEGORIES**

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This appendix provides the raw pricing data that underpins the analysis. Readers receiving this report electronically will need to review an accompanying spreadsheet file, due to the volume of data.

# APPENDIX E: SHOPPING PATTERNS SURVEY INSTRUMENT

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Good evening. My name is \_\_\_\_\_ and I am calling to conduct a 7-minute survey about where people shop. May I begin?

## FILTER QUESTIONS

1. First, may I ask your age? \_\_\_\_\_ (IF AGE IS >18 SKIP TO Q\_2)

Refused 999 [IF RESPONDENT REFUSES TO ANSWER, ASK Q1a]

**Q1a** Are you 18 years old or older?

\_\_\_ YES (1) [SKIP TO Q2]

\_\_\_ NO (2) [ASK Q1b]

**Q1b.** Is there an adult over 18 years of age or older in the household that I could speak with?

\_\_\_ YES (1) [RETURN TO INTRO AND Q\_1]

\_\_\_ NO (2) [THANK AND TERMINATE]

2. Are you a Colorado resident?

\_\_\_ YES (1) [CONTINUE]

\_\_\_ NO (2) [THANK & TERMINATE]

**Q2a** Can you please tell me the name of the town in Colorado where you currently live?

\_\_\_  Does not live in a town [SELECT FROM DROP DOWN BOX "DO NOT LIVE IN A TOWN" ASK Q2b]

\_\_\_  Lives in a town [SELECT TOWN FROM DROP DOWN BOX AND SKIP TO Q2c]

\_\_\_ Other town [ASK Q2a\_other, THEN SKIP TO Q2c]

**Q2a\_other** \_\_\_\_\_

**Q2b** What is the name of the closest town in Colorado to where you live? \_\_\_\_\_ [SELECT TOWN FROM DROP DOWN BOX]

**Q2c** What county do you live in? [DO NOT READ RESPONSES, SELECT ONE COUNTY FROM DROP DOWN BOX]

**Q2d** And just so we can more precisely map responses, what is your Zip Code? \_\_\_\_\_

3. **Q3a** Do you know what school district you live in? We're not talking about specific schools, but rather the whole school district.

- 1 Yes (What is it? **Q3b**\_\_\_\_\_ ) [Note that many school districts have similar names, so be sure to confirm if there are two that are close in name.]
- 2 No [I'm going to name some school districts near where you live; please tell me if you recognize the name of your school district. If you're not sure, you can say "not sure". **READ POSSIBLE OPTIONS FROM LIST (in NeighboringDistricts.xls) THE SAMPLE HAS A SCHOOL DISTRICT IDENTIFIED FOR EACH PERSON, NAME THAT DISTRICT, THEN NAME ITS NEIGHBORS FROM THE LIST, IF DISTRICT IS RECOGNIZED, ENTER IT IN Q3b**\_\_\_\_\_]

## SHOPPING LOCATIONS

I'm going to read you a list of 12 items, and please tell me the name of the city or town where you or a member of your household last purchased each item. Please be as specific as possible about the city or town where you last purchased each item, for example, if you purchased the item in Centennial, say Centennial rather than Denver. If the last time you purchased the item was when you were traveling away from home, please tell us where you last purchased the item when not traveling. Also, if your last purchase of that item was online using a computer, you can answer "online".

### 4a. Non-perishable groceries such as canned goods

Select city from drop down list [Codes 3-653]  
 [IF METRO DISTRICT ASK Q\_5a MILEAGE]  
 [IF CODE 159 DENVER METRO ASK Q4a\_1]  
 [IF CODE 654 "OTHER CITY" ASK Q\_4a\_other]  
 Purchased Online [Code 1 SKIP TO Q\_4B]  
 Never buys Item [Code 2 SKIP TO Q\_4B]

4a\_other. Q4a\_other \_\_\_\_\_

4a\_1. "Do you mean the City of Denver or another city in the Denver metro area?"

1 The city of Denver [IF CITY OF DENVER ASK Q5a MILEAGE]

2 Another city in metro area [SELECT CITY FROM DROP DOWN BOX, IF METRO DISTRICT ASK Q5a MILEAGE]

Q5a. About how many miles from your home did you buy this item? \_\_\_\_\_ Please make your best guess if you're not sure.

### 4b. Fruits, vegetables, or other produce

Select city from drop down list [Codes 3-653]  
 IF METRO DISTRICT ASK Q5b MILEAGE]  
 [IF CODE 654 "OTHER CITY" ASK Q4b\_other]  
 Purchased Online [Code 1 SKIP TO Q4c]  
 Never buys Item [Code 2 SKIP TO Q4c]

4b\_other. Q\_4b\_other \_\_\_\_\_

5b. About how many miles from your home did you buy this item? \_\_\_\_\_ Please make your best guess if you're not sure.

**4c. Perishable groceries such as milk, meat or ice cream**

Select city from drop down list [Codes 3-653]  
**IF METRO DISTRICT ASK Q5c MILEAGE]**  
**[IF CODE 654 "OTHER CITY" ASK Q4c\_other]**  
Purchased Online [Code 1 SKIP TO Q4d]  
Never buys Item [Code 2 SKIP TO Q4d]

4c\_other: **Q\_4c\_other** \_\_\_\_\_

5c. About how many miles from your home did you buy this item? \_\_\_\_\_ Please make your best guess if you're not sure.

**4d. Household products such as laundry soap, batteries, or toothpaste**

Select city from drop down list [Codes 3-653]  
**IF METRO DISTRICT ASK Q5d MILEAGE]**  
**[IF CODE 654 "OTHER CITY" ASK Q4d\_other]**  
Purchased Online [Code 1 SKIP TO Q4e]  
Never buys Item [Code 2 SKIP TO Q4e]

4d\_other **Q\_4d\_other** \_\_\_\_\_

5d. About how many miles from your home did you buy this item? \_\_\_\_\_ Please make your best guess if you're not sure.

**4e. Meal at a restaurant**

Select city from drop down list [Codes 3-653]  
**IF METRO DISTRICT ASK Q5e MILEAGE]**  
**[IF CODE 654 "OTHER CITY" ASK Q4e\_other]**  
Purchased Online [Code 1 SKIP TO Q4f]  
Never buys Item [Code 2 SKIP TO Q4f]

4e\_other **Q\_4e\_other** \_\_\_\_\_

5e. About how many miles from your home did you buy this item? \_\_\_\_\_ Please make your best guess if you're not sure.

**4f. Alcoholic beverages purchased to drink at home (not at a bar or restaurant)**

Select city from drop down list [Codes 3-653]  
**IF METRO DISTRICT ASK Q5f MILEAGE]**  
**[IF CODE 654 "OTHER CITY" ASK Q4f\_other]**  
Purchased Online [Code 1 SKIP TO Q4g]  
Never buys Item [Code 2 SKIP TO Q4g]

4f\_other **Q\_4f\_other** \_\_\_\_\_

5f. About how many miles from your home did you buy this item? \_\_\_\_\_ Please make your best guess if you're not sure.

**4g. Clothes or shoes**

Select city from drop down list [Codes 3-653]  
**IF METRO DISTRICT ASK Q5g MILEAGE]**  
**[IF CODE 654 "OTHER CITY" ASK Q4g\_other]**  
Purchased Online [Code 1 SKIP TO Q4h]  
Never buys Item [Code 2 SKIP TO Q4h]

4g\_other **Q\_4g\_other** \_\_\_\_\_

5g. About how many miles from your home did you buy this item? \_\_\_\_\_ Please make your best guess if you're not sure.

**4h. Gasoline**

Select city from drop down list [Codes 3-653]  
**IF METRO DISTRICT ASK Q5h MILEAGE]**  
**[IF CODE 654 "OTHER CITY" ASK Q4h\_other]**  
Never buys Item [Code 2 SKIP TO Q4i]

4h\_other **Q\_4h\_other** \_\_\_\_\_

5h. About how many miles from your home did you buy this item? \_\_\_\_\_ Please make your best guess if you're not sure.

**4i. Car maintenance and repair services**

Select city from drop down list [Codes 3-653]  
**IF METRO DISTRICT ASK Q5i MILEAGE]**  
**[IF CODE 654 "OTHER CITY" ASK Q4i\_other]**  
Purchased Online [Code 1 SKIP TO Q4j]  
Never buys Item [Code 2 SKIP TO Q4j]

4i\_other **Q\_4i\_other** \_\_\_\_\_

5i. About how many miles from your home did you buy this item? \_\_\_\_\_ Please make your best guess if you're not sure.

**4j. Movie tickets at a theater**

Select city from drop down list [Codes 3-653]  
**IF METRO DISTRICT ASK Q5j MILEAGE]**  
**[IF CODE 654 "OTHER CITY" ASK Q4j\_other]**  
Purchased Online [Code 1 SKIP TO Q4k]



Never buys Item [Code 2 SKIP TO Q4k]

4j\_other Q\_4j\_other \_\_\_\_\_

5j. About how many miles from your home did you buy this item? \_\_\_\_\_ Please make your best guess if you're not sure.

**4k. Haircut**

Select city from drop down list [Codes 3-653]

**IF METRO DISTRICT ASK Q5k MILEAGE]**

**[IF CODE 654 "OTHER CITY" ASK Q4k\_other]**

Never buys Item [Code 2 SKIP TO Q4l]

4k\_other Q\_4k\_other \_\_\_\_\_

5k. About how many miles from your home did you buy this item? \_\_\_\_\_ Please make your best guess if you're not sure.

**4l. Pet food**

Select city from drop down list [Codes 3-653]

**IF METRO DISTRICT ASK Q5l MILEAGE]**

**[IF CODE 654 "OTHER CITY" ASK Q4l\_other]**

Purchased Online [Code 1 SKIP TO Q4m]

Never buys Item [Code 2 SKIP TO Q4m]

4l\_other Q\_4l\_other \_\_\_\_\_

5l. About how many miles from your home did you buy this item? \_\_\_\_\_ Please make your best guess if you're not sure.

We're almost done. My last questions are about three less frequent purchases.

**6a. Have you purchased a car in the past 3 years?**

YES [ASK Q6b]

NO [SKIP TO Q6d]

DON'T KNOW [SKIP TO Q6d]

6b. Were you living in your current community when you bought it?

YES [ASK Q6c]

NO [SKIP TO Q6d]

DON'T KNOW [SKIP TO Q6d]

6c. In what city did you purchase the item? You can answer "online" if you bought the item on a computer

Select city from drop down list [SELECT Codes 3-653, Then SKIP TO Q7a]  
[IF CODE 654 "OTHER CITY" ASK Q6c\_other]  
Purchased Online [Code 1 SKIP TO Q7a]

6c\_other: Q6c\_other \_\_\_\_\_ [SKIP TO Q7a]

6d. What town or city do you think you would go to if you were going to buy a car tomorrow?

Select city from drop down list [Codes 3-653, Then GO TO Q7a]  
[IF CODE 654 "OTHER CITY" ASK Q6d\_other]  
Purchased Online [Code 1 Then GO TO q7a]

6d\_other: Q6d\_other \_\_\_\_\_

**7a. Have you purchased a mattress in the past 3 years?**

YES [ASK Q7b]  
NO [SKIP TO Q7d]  
DON'T KNOW [SKIP TO Q7d]

7b. Were you living in your current community when you bought it?

YES [ASK Q7c]  
NO [SKIP TO Q7d]  
DON'T KNOW [SKIP TO Q7d]

7c. In what city did you purchase the item? You can answer "online" if you bought the item on a computer

Select city from drop down list [SELECT Codes 3-653, Then SKIP TO Q8a]  
[IF CODE 654 "OTHER CITY" ASK Q6c\_other]  
Purchased Online [Code 1 SKIP TO Q8a]

7c\_other: Q7c\_other \_\_\_\_\_ [SKIP TO Q8a]

7d. What town or city do you think you would go to if you were going to buy a mattress tomorrow?

Select city from drop down list [Codes 3-653, Then GO TO Q8a]  
[IF CODE 654 "OTHER CITY" ASK Q7d\_other]  
Purchased Online [Code 1 Then GO TO q8a]

7d\_other: Q7d\_other \_\_\_\_\_

**8a. Have you purchased a DVD Player in the past 3 years?**

YES [ASK Q8b]  
NO [SKIP TO Q8d]  
DON'T KNOW [SKIP TO Q8d]

8b. Were you living in your current community when you bought it?

YES [ASK Q8c]  
NO [SKIP TO Q8d]  
DON'T KNOW [SKIP TO Q8d]

8c. In what city did you purchase the item? You can answer "online" if you bought the item on a computer

Select city from drop down list [SELECT Codes 3-653, Then SKIP TO Q9]  
[IF CODE 654 "OTHER CITY" ASK Q8c\_other]  
Purchased Online [Code 1 SKIP TO Q8a]

8c\_other: Q8c\_other \_\_\_\_\_ [SKIP TO Q9]

8d. What town or city do you think you would go to if you were going to buy a DVD player tomorrow?

Select city from drop down list [Codes 3-653, Then GO TO Q9]  
[IF CODE 654 "OTHER CITY" ASK Q8d\_other]  
Purchased Online [Code 1 Then GO TO Q9]

8d\_other: Q8d\_other \_\_\_\_\_

9. GENDER [RECORD BY OBSERVATION IF POSSIBLE.]

1 Male

2 Female

Thank you. We appreciate your time.

# APPENDIX F: GEOGRAPHIC SHOPPING MATRICES

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Appendix F provides two volumes of information. First, this appendix provides additional detail about the methodology used to define geographic shopping patterns. Second, the actual matrices are presented.

## ANALYSIS OF GEOGRAPHIC SHOPPING PATTERNS

Because residents often leave their school district to make purchases, and because prices often vary across district boundaries, it is necessary to understand the geographic shopping patterns of each school district in order to develop the actual cost of living in each district.

For all previous cost of living studies conducted from 1997 through 2005, geographic shopping patterns were estimated based on a large statewide survey that was conducted in 1997. For the 2007 study, Corona Insights was asked to update the analysis of geographic shopping patterns. In 2007, Corona began implementing a more global long-term system of updating shopping patterns, the implementation of which continued into 2009 and will likely be complete and mature in approximately 2015.

Ideally, updating the analysis of geographic shopping patterns would involve conducting statistically robust surveys in each and every school district, which would determine geographic shopping patterns for each product in the market basket. However, the large number of school districts in the state mean that this approach is not feasible, as the cost to do so would have been quite high.

## THE SHOPPING PATTERNS SURVEY

In both the 2007 and the 2009 Cost of Living study, Corona Insights took a long-term approach to update and enhance the data collected for the shopping patterns matrix. The research team designed a survey that asked about geographic purchasing patterns for 15 types of products. For 12 small product categories, respondents were asked where they or a member of their household most recently purchased each item. Residents outside metro areas were asked about the town where they purchased the item, while residents within metro areas were asked about both the town and the distance that they traveled. (Residents were also allowed to state that they bought the product online, or that they never buy the product.)

The twelve small product categories were:

- Non-perishable groceries such as canned goods
- Fruits, vegetables, or other produce
- Perishable groceries such as milk or ice cream
- Household products such as laundry soap, batteries, or toothpaste
- A meal at a restaurant
- Alcoholic beverages that were purchased to drink at home (not at a bar or restaurant)
- Clothes or shoes
- Gasoline
- Car maintenance and repair services
- Movie tickets at a theater
- Haircut

- Pet food

For the three larger products, residents were asked if they had purchased in the past 3 years; and if so, whether they were living in their current community when they bought each one. They were then asked what city they purchased any such items in (which could include “online” if they bought the item on a computer). They were then asked what town or city they thought they would go to if they were going to buy these items tomorrow. The three large products were:

- Car
- Mattress
- DVD player

The larger products were asked in a different manner because for some of these products, the person could have made the purchase several years earlier when living in a different place, or they could simply not remember if their last purchase was several years ago.

## ANALYSIS AND MODELING

One of two methods were used to assess geographic shopping patterns within a district, with some variations within each method.

The most favored method was to simply analyze the surveys available by residents within a district, and use that data directly. After examining the data, Corona determined that any district with at least 30 responses offered enough data to develop shopping patterns for those residents. While the margin of error is relatively large, this number of responses appears to represent global patterns well, based on inspection of the data, with enough responses to identify shopping destinations with less than a ten percent market share.

91 of the 178 districts met this threshold, and shopping patterns were based exclusively on the collected survey data, with the following exception. Nine of those districts were located in El Paso and Teller Counties, and pose an additional challenge because of the presence of several school districts in the city of Colorado Springs. This multiple-district presence means that a respondent who shops in Colorado Springs cannot be definitely linked to an individual school district. To address this issue, adjustments were made as follows:

- For districts located in the city (e.g., Colorado Springs 11, Widefield, etc.), residents of each district were also asked how many miles they drove to buy each product. Those radii were then mapped onto the district and shopping patterns were developed based on a weighted combination of geographic proximity to other districts and to the number of relevant businesses operating within those districts.
- For districts located outside the city, but within El Paso or Teller Counties, shopping in Colorado Springs was apportioned to each in-city district based on the proportion of relevant businesses operating within that district.

In the Denver metro area, there are some minor overlaps of cities and school districts, but to a minor enough degree that similar adjustments were not necessary for those districts.

Not every district had 30 responses, which was expected at this stage of system development. However, many had a significant number of surveys (15 or more), which provided some education. For the remaining 87 districts, the research team used a weighted combination of three factors: the direct survey responses for

the product, the survey responses for other products of similar scale purchased by residents of the district, and the 2007 modeling estimates. In general, the weighting of the direct survey responses was the proportion of surveys to the threshold of 30. If a district had 20 surveys, those surveys were 2/3<sup>rd</sup> of the input of the shopping patterns matrix (20/30). If a district had 5 surveys, those surveys were 1/6<sup>th</sup> of the input (5/30). The remainder of the weighting was divided between the shopping patterns for similar goods and the 2007 modeling based on a standardized formula, with the former weighted more heavily as more surveys were available and the latter weighted more heavily where fewer surveys were available.

Using this system, 50 of the remaining districts had a weighting of more than 50 percent toward the data, and the remaining 37 had a weighting of more than 50 percent toward the modeling and other goods patterns.

Once the data were developed, the same adjustments were made for El Paso and Teller County districts as discussed for the data-only districts. In total, five of these districts were still primarily based on direct data, and three were based primarily on modeling or other goods patterns.

Just as the team handled “outlier” data in the rural model, a provision was also made to handle random outlier events in the urban model. In most cases, shopping patterns appeared logical – people shopped in their district or a nearby district, and occasionally shopped in larger communities that were more distant. Those patterns were acknowledged in the data. Outliers were labeled in instances where purchases were made roughly 100 miles or more distant, and where the resident would have passed through a larger community to reach the stated shopping destination. (For example, a resident in Burlington RE-4J district states that they purchased produce in Steamboat Springs RE-2.) In these instances, the research team acknowledged that residents of districts may travel outside their district more and shop in seemingly random locations on occasion, but that the actual location would likely vary each time the survey is conducted. As a solution, these observations were counted as “Colorado Distant” destinations, and statewide average pricing was used instead of the destination’s pricing.

## **GEOGRAPHIC SHOPPING MATRICES**

The following tables show the relationships between geographic areas and the shopping patterns of residents. In the tables, each row represents a district and a product category, and each column represents the proportion of shopping that occurs in a particular region. Therefore, each row adds up to 100 percent of the shopping for a particular product category in a particular district.

As previously described, these tables are based on a variety of modeling methods, survey data, and geographic data. As such, the rows represent predominant areas of shopping and are not intended to model every potential shopping trip. The goal was to develop major patterns sufficient to develop cost estimates for products.

Readers receiving this report electronically will need to review an accompanying spreadsheet file, due to the volume of data.

## APPENDIX G: STATISTICAL MEASURES USED IN THIS REPORT

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Mirroring the statistical review process used in the 2007 study, in 2009 the research team evaluated the method of calculating confidence intervals of cost of living indices as outlined in the document “Statistical Methodology 2005 Colorado School District Cost of Living Study,” by Thomas Bengtsson. The general concept employed in this methodology is the propagation of uncertainty. Uncertainty propagation examines how the uncertainty in a calculated result depends on the uncertainty in the measured values that are entered into the formula. The generalized equation for error propagation for a function  $f(x, y, z, \dots)$  where variables  $x$ ,  $y$  and  $z$  are uncorrelated is:

$$\sigma_f^2 = \left(\frac{\partial f}{\partial x}\right)^2 \sigma_x^2 + \left(\frac{\partial f}{\partial y}\right)^2 \sigma_y^2 + \left(\frac{\partial f}{\partial z}\right)^2 \sigma_z^2 + \dots \quad [1]$$

where  $\sigma_i^2$  is the variance of variable  $i$ . For this project, we are interested in determining the variances (the 95% confidence interval of  $f$  is approximately  $1.96\sigma_f$ ) of the cost of living index  $COL = f(\mu_D, S, p, w)$  where  $\mu_D$  are the mean prices of consumer products in the district,  $S$  are the shopping patterns,  $p$  are the decimal population fractions in each district, and  $w$  are weights that determine the contributions of individual consumer products to the overall cost of living. All four of these variable types are estimated from surveys of one type or another, and hence have error associated with them. However, only the errors in the district consumer prices  $\mu_D$  are considered in the Bengtsson treatment.

The Bengtsson derivations for the propagation of  $\mu_D$  errors are approximate in that equation [1] is not applied directly to the  $COL$  function. Rather, for simplicity, equation [1] is applied successively to components of the  $COL$  function in order to build up the final expression for  $\sigma_f^2$ . This simplification is probably necessary given the complexity of the  $COL$  function. An amplification of the derivation of the variances of interest is provided later. The conceptual part of this appendix will address some key questions.

*Does a large variance in the item cost data automatically translate to a large confidence interval?* Consider that you wanted to get a haircut in Aspen. It is likely that you could find haircuts ranging from around \$20 to well over \$100, leading to a large variance in the price of haircuts in Aspen. Does this necessarily mean that the cost of living index will have a large confidence error? No, because the confidence interval depends on the *variance of the estimate of the mean price* as opposed to the variance of the sample. But districts with large price variances do require more intensive sampling. Consider a simplified example where there are 20 places to get a haircut in Aspen, and at half of them you can get a \$20 haircut and at the other half haircuts cost \$100. Let's also assume that by chance whenever we sample haircut prices that we sample equally between the two haircut prices. Table 1 illustrates what happens to the variance and 95% confidence interval of the estimate of the mean price as a function of number of prices sampled.

**TABLE G-1: VARIANCE AND CONFIDENCE INTERVAL OF MEAN PRICE ESTIMATE AS A FUNCTION OF SAMPLE SIZE.**

N	Estimate of Mean Price	Variance of Sample	Variance of Estimate of Mean Price	95% Confidence Interval of Estimate of Mean Price
2	\$60	3200	1516	\$76
4	\$60	2133	449	\$42
8	\$60	1829	144	\$24
16	\$60	1797	24	\$10

While this example is somewhat extreme, it does illustrate that large variances in the district prices can be overcome by more intensive sampling. However, a question arises; are the higher priced haircuts even pertinent to the middle-income population targeted by the study, given the availability of lower priced haircuts? Seemingly, much of this problem would go away with a careful outlier detection process, as was implemented in the 2007 study and used in the current 2009 study. If additional sampling of certain districts is indicated by large CI, more detailed outlier removal for that shopping district may be indicated.

*Does a large CI always signal a need for additional price sampling?* The primary motivation of determining confidence intervals of COL indices is to determine if additional sampling is needed. The question arises, is additional sampling always indicated when the CI is large? Probably not. Consider a rural area where there may be one grocery store in which the majority of people shop, but also several small convenience stores with somewhat higher prices. Provided the initial price sampling included the grocery store, additional sampling of convenience stores will likely artificially inflate the mean price. The uncertainty in the size of the shopping universe also complicates this situation (see first paragraph of the appendix). As n approaches U, the uncertainty in the mean price estimate approaches zero. So, in a small district with large price variances, the strategy for reducing the CI would be to sample every store. However, in some cases the number of stores sampled to date exceeded the size supposed value of U. This uncertainty of U makes it difficult to be certain that every store has been sampled. The need to increase sampling of high CI districts needs to be evaluated on a case by case basis. Most of the challenges described so far could be eliminated with store-specific shopping patterns for the target income groups. However, reliable collection of such data is probably impossible.

*What are the limitations of the methodology used to calculate the confidence intervals of the COL indices?* One of the major limitations of the methodology of calculating CI is that only uncertainty in mean district prices is taken into account. There is also likely to be uncertainty in the shopping patterns, which also propagates through the calculation and would affect the uncertainty in the COL indices. There may also be smaller errors associated with the weighting and population factors, depending on what these measures are designed to represent. Mathematically, the derivation of an analytical expression to propagate uncertainty in the district prices, shopping patterns, and other sources of uncertainty may be difficult. A Monte Carlo method may be



more practical. However, given the expected size of the uncertainty in the shopping patterns, the overall uncertainty in the COL indices may appear to be unacceptably large to the client without prior education.

Alternatively, a separate CI interval could be calculated using uncertainty of the shopping pattern alone, without consideration of the uncertainty in shopping patterns. The purpose of this CI would be to determine if additional surveying of shopping patterns is needed.

*What does the confidence interval actually tell us?* The confidence interval as calculated by the Bengtsson method indicates the level of uncertainty in the COL indices as affected by uncertainty in the prices available to consumers. It does not reflect the overall uncertainty in the mean COL estimates. It can be used as a screening tool to identify districts that may potentially benefit from additional price sampling. However, once identified, some additional consideration needs to be given to whether additional price sampling would actually be beneficial or whether tools such as outlier detection may be more appropriate. In general, shopping areas that have a large number of consumer choices and large price variances may benefit from additional sampling. If the shopping district has relatively few choices, additional sampling could help provided 1) the new stores sampled actually capture a significant market share and 2) the total universe of stores in the district is known with certainty.

### *Statistical Appendix*

To illustrate the application of equation 1 to the COL function and to aid in decoding the vector notation in the Bengtsson methodology, we will consider a simple case in which there are two school districts and three shopping districts in the state. For each consumer item that contributes to the COL index, we estimate the mean price within the district  $\mu_D$  by a shopping survey of a subset  $n$  of the stores. We also calculate the variance of the sample  $\sigma_D$  from the sample data. The *variance of the estimate of  $\mu_D$*  is given by  $\sigma_\mu^2 = \sigma_D^2/n$ , which is also the square of the standard error of the sample. As  $n$  approaches the total number of stores that have that item ( $U$ ), the accuracy of our estimate of  $\mu_D$  increases. We account for this effect on  $\sigma_\mu^2$  by multiplying by the factor  $(U - n)/(U - 1)$ . So for our example we have:  $\boldsymbol{\mu}_D = (\mu_{D1}, \mu_{D2}, \mu_{D3})'$  and  $\boldsymbol{\sigma}_\mu = (\sigma_{\mu1}^2, \sigma_{\mu2}^2, \sigma_{\mu3}^2)'$ . We also have the shopping pattern matrix (note that the shopping matrix assembled by Corona Insights is actually  $\mathbf{S}'$  as shown below):

$$\mathbf{S}' = \begin{pmatrix} S_{11} & S_{12} & S_{13} \\ S_{21} & S_{22} & S_{23} \end{pmatrix} \quad [2]$$

The actual prices paid by consumer in the district is the shopping-pattern-weighted costs  $\boldsymbol{\mu}_{SD} = \mathbf{S}'\boldsymbol{\mu}_D$ . If we expand this for school district 1 we get:

$$\mu_{SD1} = S_{11}\mu_{D1} + S_{12}\mu_{D2} + S_{13}\mu_{D3} \quad [3]$$

If we now apply equation [1] to find  $\sigma_{S\mu1}^2$  (the variance of  $\mu_{SD1}$ ):

$$\sigma_{S\mu1}^2 = \left( \frac{\partial \mu_{SD1}}{\partial \mu_{D1}} \right)^2 \sigma_{\mu1}^2 + \left( \frac{\partial \mu_{SD1}}{\partial \mu_{D2}} \right)^2 \sigma_{\mu2}^2 + \left( \frac{\partial \mu_{SD1}}{\partial \mu_{D3}} \right)^2 \sigma_{\mu3}^2 = S_{11}^2 \sigma_{\mu1}^2 + S_{12}^2 \sigma_{\mu2}^2 + S_{13}^2 \sigma_{\mu3}^2$$

This corresponds to the vector notation:

$$\sigma_{S\mu}^2 = S' \sigma_{\mu}^2 S$$

Where  $\sigma_{\mu}^2$  and  $\sigma_{S\mu}^2$  are square matrices with the elements of interest on the diagonals.

The state-average price is given by:

$$\begin{aligned} \mu_{SS} &= p_1(S_{11}\mu_{D1} + S_{12}\mu_{D2} + S_{13}\mu_{D3}) + p_2(S_{21}\mu_{D1} + S_{22}\mu_{D2} + S_{23}\mu_{D3}) \\ &= (p_1S_{11} + p_2S_{21})\mu_{D1} + (p_1S_{12} + p_2S_{22})\mu_{D2} + (p_1S_{13} + p_2S_{23})\mu_{D3} \end{aligned}$$

To find the variance of the state-average price we again apply equation [1]:

$$\begin{aligned} \sigma_{SS}^2 &= \left( \frac{\partial \mu_{SS}}{\partial \mu_{D1}} \right)^2 \sigma_{\mu1}^2 + \left( \frac{\partial \mu_{SS}}{\partial \mu_{D2}} \right)^2 \sigma_{\mu2}^2 + \left( \frac{\partial \mu_{SS}}{\partial \mu_{D3}} \right)^2 \sigma_{\mu3}^2 \\ &= (p_1S_{11} + p_2S_{21})^2 \sigma_{\mu1}^2 + (p_1S_{12} + p_2S_{22})^2 \sigma_{\mu2}^2 + (p_1S_{13} + p_2S_{23})^2 \sigma_{\mu3}^2 \end{aligned}$$

This corresponds to the vector notation:

$$\sigma_{SS}^2 = p' S' \sigma_{\mu}^2 S p \leftarrow \text{imagine this in bold}$$

The *COL* is a weighted function of the ratios  $r_D = \mu_{SD} / \mu_{SS}$ . Now for district 1 we calculate the variance  $\sigma_{r1}^2$  of the ratio  $r_{D1} = \mu_{SD1} / \mu_{SS}$  by application of equation [1] again, remembering that the variances of  $\mu_{SD1}$  and  $\mu_{SS}$  are  $\sigma_{S\mu1}^2$  and  $\sigma_{SS}^2$ , respectively:

$$\begin{aligned} \sigma_{r1}^2 &= \left( \frac{\partial r_D}{\partial \mu_{SD1}} \right)^2 \sigma_{S\mu1}^2 + \left( \frac{\partial r_D}{\partial \mu_{SS}} \right)^2 \sigma_{SS}^2 \\ &= \frac{1}{\mu_{SS}^2} \sigma_{S\mu1}^2 + \frac{\mu_{SD1}^2}{\mu_{SS}^4} \sigma_{SS}^2 = \frac{1}{\mu_{SS}^2} \left( \sigma_{S\mu1}^2 + r_{D1}^2 \sigma_{SS}^2 \right) \end{aligned}$$

where we assume  $r_{D1}$  can be approximated by 1. Finally the cost of living index over *i* items is given by:

$$COL = \sum w_i r_{Di}$$

and its variance is given by:

$$\sigma_{COL}^2 = \sum w_i^2 \sigma_{ri}^2$$