COST OF LIVING TOOL METHODOLOGY

JOB SERVICE NORTH DAKOTA
Labor Market Information Center
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BACKGROUND

This product was produced either in whole or in part with Department of Labor-funded Workforce Information Grants (WIGS).

The Labor Market Information Center of Job Service North Dakota developed the Cost of Living (COL) tool because cost of living information is frequently requested, and no such data is publicly available at the county level for North Dakota. Interest in cost of living information has been especially high in recent years due to high demand for labor in North Dakota.

The COL data presents the annual household gross income needed to sustain a "basic life" in North Dakota. A "basic life" includes the costs of: food, housing, health care, transportation, child care, other necessities, and taxes. Users can use the COL tool to compare the cost of living in one North Dakota county or region to others or simply view the breakdown of "basic life" costs by household type at a statewide, regional, or county level.

MINNESOTA'S COST OF LIVING TOOL AS A MODEL

To create the COL tool, we first looked to other cost of living resources available online, particularly those made by other states. We found Minnesota to have the best cost of living tool available because its data was calculated at the county level and its methodology provided step-by-step instructions for reproducing such data. For these reasons, the Minnesota Cost of Living Study (2017) created by the Labor Market Information office of Minnesota Employment and Economic Development (MN DEED) was used as the primary model for the North Dakota COL tool.

For most inputs in our model, we used the same or similar processes as Minnesota did to pull data and calculate costs. In some cases where state-specific data was not available, we created our own processes to adjust national and regional data to better represent North Dakota and its counties.

Minnesota Resources:

Minnesota Cost of Living tool: https://mn.gov/deed/data/data-tools/col/
Minnesota Cost of Living methodology: https://mn.gov/deed/data/data-tools/col/method-col.jsp

"BASIC LIFE" DEFINITION

The term "basic life" is used often in this methodology of the COL tool. For simplicity of data and the tool itself, we estimated incomes that cover the expenses of necessities (food, housing, health care, transportation, child care, other necessities, and taxes) without limiting households to a "bare bones" lifestyle that can only be sustained with the most minimal income.

We did not want to limit the households in our model to a "bare bones" lifestyle because we do not believe such data would be useful for most households or employers. We assume most casual users of this tool would not identify with a "bare bones" lifestyle when exploring the COL data, thus making it less relevant to their economic decisions (e.g. taking a new job, moving, etc.). Likewise, for employers and economic developers using this tool, we assume the costs of a "bare bones" lifestyle would not provide useful insight on wages that might generate economic and/or population growth.

While the costs modeled are not the absolute minimum for survival, they are not accommodating of non-necessity spending, either. The costs are intended to be sufficient to keep a household fed, housed, clothed, and able to get to school/church/grocery store, but do not allow for non-necessity spending that might make life more enjoyable. Such spending includes saving money for the future, going on vacation, and dining at a restaurant. Additionally, the model does not allow for "extra" spending to cover the unexpected. Such spending includes long-term care for an illness, damage to property, and funeral expenses. These costs are not incorporated into the model, even though they are common expenses for families. Similarly, debt payments are not included in the expenses, either.

The assumptions underlying our "basic life" definitions are outlined in more detail under each cost input. For example, under "Food," we state that food needs are estimated using the United States Department of Agriculture's "Moderate-cost plan," which is the second-highest cost plan out of the four outlined. And, while the food plan is more expensive than thriftier options, we also assume that all meals are prepared at home (i.e. no restaurant meals), which cuts down on overall food expenses.

QUARTERLY DATA UPDATES

As of May 2021, the Cost of Living data will be updated on a regular quarterly basis. Data will be updated and released in February, May, August, and November. Where data is available in current year dollars, it will be adjusted to the most recent quarter available based on its reference period and release. Where data is not available in current year dollars, it will be first adjusted to the most recent calendar year's inflation and then adjusted to the most recent quarter of inflation data (where Q1 dollars is the average of January, February, and March dollars in the current year, etc.).

HOUSEHOLDS

Before we can approximate the needs and associated costs of a "basic life" in North Dakota, we must first define whose "basic life" we want to model. In this COL tool, we define 24 separate households, all of which represent families. For example, adults are assumed to have legal guardianship of all children in their households, and adults are assumed to be married if there are two in the household. The assumption of family relationships is important to the calculations of tax costs.

Users of the COL tool must make 4 selections to determine which household will be used to model COL data. The factors that must be selected for are: Adult Age, Marital Status, Working Status, and Number of Children.

ADULT AGE
Users can choose between 2 options for the age of the adult(s) in the household. Adults can either be of "younger working age" (19-50 years) or "older working age" (51+ years). The age groups match those used by the US Department of Agriculture (USDA) for estimating meal plan costs.

MARITAL STATUS
Users can choose between 2 options for the marital status of the adult(s) in the household, which essentially decides the number of adults in the household. Adults can either be single or married. Single adults have only 1 adult in the household; Married adults have 2 adults in the household. The marital status corresponds with tax filing status for the COL model. Though the simplicity of marital status in the model is not perfectly applicable all households (e.g. adults who are partnered but not married, roommates, etc.), it allows us a basis for calculating costs for the COL tool.

WORKING STATUS
In all households, one adult is assumed to be a full-time worker. No selection is needed for Working Status for households with a single adult, as the single adult is assumed to be a full-time worker. For married adult households, there are 3 options for Working Status: (1) 1 full-time worker, (2) 1 full-time worker and 1 part-time worker, or (3) 2 full-time workers.

ADULT 1
The smallest household contains 1 single adult (Adult 1). Adult 1 can be either female or male. In this COL tool, adults are not identified as female or male because the only cost where identity was relevant was regarding food costs (a difference of a few dollars each month between males and females). We decided to not identify the adults by sex in the COL tool so that is more representative of the variety of households that exist (e.g. single fathers, single women and men without children, same-sex married couples, etc.).

ADULT 2
Adult 2 appears only in the "married" households. Adult 2 can be either female or male.

NUMBER OF CHILDREN
Users can also choose the number of children assumed to be in the household. Only adults of a "younger working age" (aged 19-50 years) are presumed to have children living in the home, and the adult(s) is presumed to be the legal guardian of all children in the household. All children are assumed to be under 18-years-old in the model. Households may have as little as 0 or as many as 4 children.

Following Minnesota's example, we defined the 4 children used in our calculations and add them to the household in an unchanging order (e.g. 1 child = Child 1; 2 children = Child 1 and Child 2, etc.). Each additional child grows in age, with Child 1 being the youngest and Child 4 being the oldest. Every other child is assigned to be male or female. Whereas adults may be either male or female, children are identified as male or female because of the implications for both food costs and housing parameters. A profile of each child is listed below:

CHILD 1
Child 1 is a 2-year-old male. We chose a toddler-aged child because full-time child care would be an important cost to households with children this age if no adult is available to provide it (i.e. all households except for those with married couples with only 1 adult working).

CHILD 2
Child 2 is a 7-year-old female. We chose a young school-aged child because part-time child care would be an important cost to households with children this age if no adult is available to provide it.

CHILD 3
Child 3 is a 13-year-old male. We chose a middle school-aged child because child care would no longer be necessary, but general household expenses would increase, particularly for food.

CHILD 4
Child 4 is a 16-year-old female. We chose a high school-aged child because child care would no longer be necessary, but general household expenses would increase, particularly for food.

All 24 distinct households are detailed in a table below. For “younger working age” adults (aged 19-50 years), household sizes range from 1 (Single Adult) to 6 (2 Married Adults with 4 children). For “older working age” adults (aged 51+ years), household sizes range from 1 (Single Adult) to 2 (2 Married Adults).

24 HOUSEHOLDS DEFINED

HOUSEHOLD		FAMILY SIZE	ADULT 1	ADULT 2	CHILD 1	CHILD 2	CHILD 3	CHILD 4
1	**Single: 1 FT Worker**	1	Age 19-50	---	---	---	---	---
2	**Single: 1 FT Worker** (older)	1	Age 51+	---	---	---	---	---
3	**Single: 1 FT Worker**	2	Age 19-50	---	Male Age 2	---	---	---
4		3		---		Female Age 7	---	---
5		4		---			Male Age 13	---
6		5		---				Female Age 16
7	**Married: 1 FT Worker**	2	Age 19-50	Age 19-50	---	---	---	---
8	**Married: 1 FT Worker** (older)	2	Age 51+	Age 51+	---	---	---	---
9	**Married: 1 FT Worker**	3	Age 19-50	Age 19-50	Male Age 2	---	---	---
10		4				Female Age 7	---	---
11		5					Male Age 13	---
12		6						Female Age 16
13	**Married: 1 FT Worker, 1 PT Worker**	2	Age 19-50	Age 19-50	---	---	---	---
14	**Married: 1 FT Worker, 1 PT Worker** (older)	2	Age 51+	Age 51+	---	---	---	---
15	**Married: 1 FT Worker, 1 PT Worker**	3	Age 19-50	Age 19-50	Male Age 2	---	---	---
16		4				Female Age 7	---	---
17		5					Male Age 13	---
18		6						Female Age 16
19	**Married: 2 FT Workers**	2	Age 19-50	Age 19-50	---	---	---	---
20	**Married: 2 FT Workers** (older)	2	Age 51+	Age 51+	---	---	---	---
21	**Married: 2 FT Workers**	3	Age 19-50	Age 19-50	Male Age 2	---	---	---
22		4				Female Age 7	---	---
23		5					Male Age 13	---
24		6						Female Age 16

FOOD

Food costs in the COL tool are estimated using data from the USDA's monthly Moderate-cost food plan. Though released monthly, we used USDA data from June because it is the month the USDA uses for calculating Supplemental Nutrition Assistance Program (SNAP) maximum allotments each fiscal year.

Because the monthly food plan costs are provided by sex and age, we matched the monthly costs of the Moderate-cost plan for each family member in every household. For adults, we averaged the costs of food plans for males and females (ages 19-50, ages 51-71+). Then, we assigned each of the 24 households a multiplier based on Minnesota's model. The multiplier adjusts for the economy of scale of larger family sizes. A family of 4 is used as the base (=1). For families of 5 or 6, the multiplier decreases by 0.05 (0.95); for families of 3, the multiplier increases by 0.05 (1.05); for families of 2, the multiplier increases by 0.10 (1.10); and for families of 1, the multiplier increases by 0.20 (1.20).

The next step was to adjust the national data to better estimate food costs for North Dakota and its smaller geographies. To scale the data to the state and counties, two scaling factors were applied to the national USDA food cost data: 1) a North Dakota scaling factor and 2) an area scaling factor.

The North Dakota scaling factor was created using per capita personal consumption expenditures data by state (Food and beverages purchased for off-premises consumption) from the Bureau of Economic Analysis (BEA). We used the US average annual cost as the base (1), and then calculated the difference between it and North Dakota's annual cost (0.92, or 8% lower than the US average).

The area scaling factor was created using two datasets. First, all North Dakota counties were given an area designation of either "rural," "metro<100", or "metro>100," depending on their rolling five-year average populations. The "100" in the designations refers to a population of 100,000. Counties with populations less than 15,000 people were designated "rural;" counties with populations greater than 15,000 but less than 100,000 were designated "metro<100;" and counties/combined metropolitan areas with populations greater than or equal to 100,000 were designated "metro>100." Although North Dakota is one of the smallest states by population, the differences between counties of low, medium, and high populations have an important effect on costs of living (e.g. differing availability of goods, transportation needs, etc.).

The second data used in the area scaling factor were the costs of "Food at Home" from the Consumer Expenditure Survey (by population size of area of residence). The food costs provided the scaling factor used for each area designation. Three areas were used: "Outside urban area" (rural), "Less than 100,000" (metro<100), and "100,000 to 249,999" (metro>100). The average food costs of all three areas was used as the base (1), and the differences between each area and the average was used to calculate the scaling factors (1.08 for rural, 1.05 for metro<100, and 0.87 for metro>100).

The third and final scaling factor adjusted total food costs for inflation from June 2021 to Q3 2021 dollars. Using Food and Beverages data from the Consumer Price Index (CPI), we created an inflation adjustment factor for June 2021-Q3 2021 by dividing the average Q3 2021 number by the June 2021 number (110.399 / 108.376 = 1.02).

EXAMPLE 1.1: Total Food Cost Calculation

Household: **#3** (Single adult, 1 child)
County: **Bottineau**
Food Cost: ($327.86 + $187.77) = **$515.63**
Family size multiplier: **1.10**
ND scaling factor: **0.92**
Area designation factor (rural): **1.08**
June 2021-Q3 2021 inflation factor: **1.02**
Monthly Food Cost Calculation: (((\$515.63* 1.10) * 0.92) * 1.08) * 1.02) = **$524.61***

*The equation outlined above has been simplified by rounding the area designation factor up to 2 decimal places. The calculated cost presented is the product of the actual calculation, which did not use rounded numbers.

ASSUMPTIONS IN THE MODEL: Food

The cost of food fits our "basic life" model because it is neither "bare bones" nor does it include nonessential food spending. We chose the second-highest cost plan of the four the USDA outlines, so the estimated cost allows for a bit of flexibility for preparing meals at home that would not be included in either the Low-cost or Thrifty plans. We assume that all meals are prepared at home, which means our model excludes restaurant spending. The combined effect of these two parameters is to estimate a realistic cost of food for each household.

FOOD DATA SOURCES

DATA	SOURCE	MO / YEAR	WEBSITE	USE
Moderate-cost food plan (monthly)	US Department of Agriculture (USDA)	June 2021	https://www.fns.usda.gov/cnpp/usda-food-plans-cost-food-reports-monthly-reports	Base number for monthly food costs
Per capita personal consumption expenditures by state Food and beverages purchased for off-premises consumption (annual)	Bureau of Economic Analysis (BEA)	2020	https://apps.bea.gov/itable/iTable.cfm?ReqID=70&step=1	Scaling factor to convert national cost to North Dakota cost
Population Estimates by North Dakota counties PEPANNRES (annual)	US Census Bureau *(Explore Census Data)*	2020	https://data.census.gov/cedsci	Designate counties "rural," "metro<100," or "metro>100"
Population size of area of residence: Average annual expenditures and characteristics Table 2400 Food at Home (annual)	Consumer Expenditure Survey	2020	https://www.bls.gov/cex/tables.htm#avgexp	Scaling factor to convert statewide costs to urban and rural area costs
CPI-All Urban Consumers (Current Series) Series Id: CUUR0200SAF Not Seasonally Adjusted Area: West North Central Item: Food and beverages (monthly, annual)	Bureau of Labor Statistics (BLS) *Consumer Price Index (CPI)*	2021	https://www.bls.gov/cpi/data.htm	Inflation adjustment for food costs from June 2021 to Q3 2021 dollars

HOUSING

Housing costs in the COL tool are estimated using data from the American Community Survey (ACS) from the US Census Bureau. The ACS provides median monthly rent costs for the state and each county, which is used as the base for the cost of rent. To derive the cost of rent for each household in each county in the COL tool, housing parameters were defined for each household, and a scaling factor was created to adjust the rent costs accordingly.

HOUSING PARAMETERS

The housing parameters in the COL tool follow those used in Minnesota's model. All families are assumed to be renting a property, the size of which scales to the size of each household. Households comprised of adults (Single or Married) without children are assumed to need either a studio or 1-bedroom rental; households with one child are assumed to need a 2-bedroom rental; and households with two or more children are assumed to need a 3-bedroom rental. For households with children, we assume that children of the same sex share a bedroom.

HOUSING COSTS

We used ACS median monthly rent costs as the bases for the costs of rent for each county. To adjust the median rents to the housing parameters outlined above, a scaling factor was created from Fair Market Rent data produced by the US Department of Housing and Urban Development (HUD). The HUD data provides average monthly rent costs for each county in North Dakota by the size of rental (e.g. 0 bedrooms, 1 bedroom, etc.). For each county, the average HUD rent was calculated. The scaling factors were then calculated by comparing HUD rents for each size of rental to the average HUD rent in each county.

EXAMPLE 2.1: HUD Scaling Factor Calculation

Household: **#24** (Married couple, 4 children)
County: **Adams**
Average Rent in County: **$744.75** (HUD)
Rental needed for Family: **3-bedroom, $1,075.00** (HUD)
HUD Scaling Factor for 3-bd in Adams County: $1,075.00 / $744.75 **= 1.44 scaling factor for 3-bd rental in Adams County**

NOTE: While the HUD data provides average rents for the housing parameters we need, we opted to use the ACS median rent and apply a scaling factor derived from HUD data instead. This decision was made for two reasons. First, LMI uses ACS housing data in other publications, and using it as the base cost was consistent with our other methodologies. Second, the cost of rent from the HUD data was unexpectedly high in many counties, particularly rural counties that were unaffected by the oil boom of recent years. By comparison, the median rents from ACS were more reasonable.

With the scaling factors established, the cost of rent for each household in each county was calculated by multiplying the median rent for that county by the appropriate scaling factor, depending on rental size, and an inflation adjustment factor. For each county, the cost of rent was calculated for a 0-, 1-, 2-, and 3-bedroom rental. Using Housing data from the Consumer Price Index (CPI), we created an inflation adjustment factor for 2019-2020 by dividing the annual 2020 number by the annual 2019 number (107.157 / 105.123 = 1.02). We then adjusted total Housing costs from 2020 to Q3 2021 dollars by dividing the Q3 2021 number by the annual 2020 number (113.044 / 107.157 = 1.05).

EXAMPLE 2.2: Total Housing Cost Calculation

Household: **#15** (Married couple, 1 child)
County: **McIntosh**
Rental needed for Family: **2-bedroom**
Median Rent: **$545.00** (ACS)
Scaling Factor: **0.97** (HUD)
2019-20 Inflation factor: **1.02**
2020-Q3 2021 Inflation factor: **1.05**
Monthly Housing Cost Calculation: (($545 * 0.97) * 1.02) * 1.05) **= $566.97***

* The equation outlined above has been simplified by rounding the scaling factor to 2 decimal places. The calculated cost presented is the product of the actual calculation, which did not use rounded numbers.

For households with no children, the 0- and 1-bedroom rental costs were combined. ACS data was used to provide the ratio of people renting studio apartments to those renting 1-bedroom apartments in North Dakota (20:80, studios:1-bedrooms). The calculated cost of housing for each was then multiplied by their share (0.20 or 0.80) and then added together to produce the final rent cost.

EXAMPLE 2.3: Total Housing Cost Calculation (Studio or 1-bedroom)

Household: **#1** (Single adult, no children)
County: **Dunn**
Possible Rentals Cost Calculations: **Studio** (($1,031 * 1.02) * 0.75) = **$785.41); 1-bedroom** (($1,031 * 1.02) * 0.83) = **$867.45)**
2020-Q3 2021 Inflation factor: **1.05**
Monthly Housing Cost Calculation: (($785.41 * 0.20) + ($867.45 * 0.80)) * 1.05 **= $897.54***

*This equation has been simplified by rounding the pre-calculation housing costs to 2 decimal places. The calculated cost presented is the product of the actual calculation, which did not use rounded numbers.

ASSUMPTIONS IN THE MODEL: Housing

The cost of housing for the month fits our "basic life" model because it neither requires households to live in the least expensive accommodations possible, nor does it assume homeownership or overly spacious accommodations. In this model, households are assumed to be renters rather than homeowners. And, while children are assumed to share rooms with other children of the same sex, rentals are scaled to the size of each family.

HOUSING DATA SOURCES

DATA	SOURCE	MO / YEAR	WEBSITE	USE
Selected Housing Characteristics by North Dakota counties Median Rent DP04 (annual)	American Community Survey (ACS) *(Explore Census Data)*	2015-2019	https://data.census.gov/cedsci/	Base for monthly housing costs
Fair Market Rents (FMR) by North Dakota Counties Rent Estimates (annual)	US Department of Housing and Urban Development (HUD)	FY 2022	https://www.huduser.gov/portal/datasets/fmr.html	Scaling factor to convert median rent costs to different rental sizes
Selected Housing Characteristics by North Dakota counties Bedrooms DP04 (annual)	American Community Survey (ACS) *(Explore Census Data)*	2015-2019	https://data.census.gov/cedsci/	Share of 0-bedroom and 1-bedroom rentals, used to combine rents for the two based on share
CPI-All Urban Consumers (Current Series) Series Id: CUUR0200SAH Not Seasonally Adjusted Area: West North Central Item: Housing (monthly, annual)	Bureau of Labor Statistics (BLS) *Consumer Price Index (CPI)*	2019-2021	https://www.bls.gov/cpi/data.htm	Inflation adjustment for housing costs from 2019 to 2020 dollars Inflation adjustment for housing costs from 2020 to Q3 2021 dollars

HEALTH CARE

Health Care costs in the COL tool are estimated using data from the Medical Expenditure Panel Survey (MEPS) from the US Department of Health & Human Services for both the premium and out of pocket costs. For both costs, we reproduced the calculations used in the Minnesota model and then adjusted to create better cost estimates specifically for North Dakota and its counties.

PREMIUM COSTS

Before calculating the premium costs, we made two assumptions about the adults in the COL tool: 1) the adults in the model work for private sector employers, and 2) employers provide and partially pay for health insurance coverage. Though obviously imperfect, these assumptions cover a majority of the population in North Dakota.

With those assumptions, we used annual premium contributions from Table IX.A.2 from MEPS. The contribution costs represent the employee-paid portion of health insurance premiums. We used the costs from “Single contribution,” “Employee-plus-one contribution,” and “Family contribution.” We then determined which type of insurance coverage would be required for each household: “Single” premiums for single adults with no children, “Employee-plus-one” for single adults with one child and married couples with no children, and “Family contribution” for all other households. The data from MEPS was divided into two regions for North Dakota: “Fargo, ND portion” and “Remainder of state.” We assigned the “Fargo” values to Cass County, and the “Remainder of state” values to all other counties in North Dakota.

The premium costs were adjusted for annual inflation. Using Medical Care data from the Consumer Price Index (CPI), we created an inflation adjustment factor for 2019-2020 by dividing the annual 2020 number by the annual 2019 number (102.935 / 108.180 = 1.05). The premium costs were calculated by applying the inflation adjustment factor.

The premium contribution costs were then adjusted to the costs paid by employees in the second lowest quartile of average wages, which we got from the Bureau of Labor Statistics (BLS) National Compensation Survey. To create the scaling factor, we took the “average flat monthly employee contribution” number for the “Second 25 percent” of average wages and divided it by the “average flat monthly employee contribution” for “All workers.” In 2020, the scaling factor was 1.03 ($590.94 / $605.78). All premium costs were then multiplied by the scaling factor.

3.1 EXAMPLE: Annual Premium Calculation

Household: **#10** (Married couple, 2 children)
County: **Mercer**
Insurance: **Family contribution**
Premium Cost: **$6,234.00** (MEPS)
2019-20 Inflation factor: **1.05**
Scaling Factor: **1.03** (BLS)
Annual Premium Cost Calculation: ($6,234.00 * 1.05) * 1.03 **= $6390.55* annual family coverage premium cost**

* The equation outlined above has been simplified by rounding each integer to 2 decimal places. The calculated cost presented is the product of the actual calculation, which did not use rounded numbers.

OUT-OF-POCKET COSTS

The out-of-pocket costs were calculated using data pulled from the MEPS Household Component summary tables: Use, expenditures, and population. We used the MEPS tool to pull two datasets: 1) Mean expenditure per person by insurance coverage and source of payment, and 2) Mean expenditure per person by age group and source of payment. We then used the two datasets to estimate out-of-pocket costs: dataset 1 provided the base cost and was adjusted using a scaling factor derived from dataset 2.

From the “Mean expenditure per person by insurance coverage and source of payment” data, we used the “Out of pocket” expenses for “Any private, all ages.” The use of private insurance coverage is consistent with the assumptions already built into our model. The most recent out-of-pocket expense for this category was $924, which was used as the base cost.

From the “Mean expenditure per person by age group and source of payment” data, we created a scaling factor for each age group. Of the age groups available, we used: “Under 5,” “5-17”, “18-44,” “45-64,” and “65+.” Though not exactly aligned, we used best-matches for the age groups to the people used in our model: “Under 5” for Child 1; “5-17” for Child 2, 3, and 4; “18-44” for adults aged 19-50; and the average of “45-64” and “65+” for adults aged 51+. Using North Dakota Census population estimates for each age group, we calculated weighted average costs for each age group and all ages. The weighted average of out-of-pocket expenses for all ages was $799.39. The weighted average expenses for each age group were divided by the total weighted average out-of-pocket expense to derive age scaling factors. The scaling factors for each age group were applied to the base ($929) to calculate out-of-pocket costs for each household member in the COL tool.

The out-of-pocket costs for each age group were then adjusted one last time for inflation. Using Medical Care data from the Consumer Price Index (CPI), we created an inflation adjustment factor for 2019-2020 by dividing the annual 2020 number by the annual 2019

number (108.180 / 102.935 = 1.051). The final out-of-pocket costs were calculated by applying the inflation adjustment factor to the adjusted out-of-pocket expense numbers for each age group.

3.2 EXAMPLE: Out-of-pocket Costs Calculation

Age: **51+ years**
Base Cost (MEPS): **$929**
Age Group Scaling Factor (MEPS): (($1,561.03 * 0.39) + ($955.92 * 0.61)) / $799.39) = **1.60**
The values 0.39 and 0.61 represent the proportion of people aged 65+ and 45-64, respectively, in the total ND population aged 45+
2019-20 Inflation factor: **1.05**
Out-of-pocket Cost Calculation: ($929 * 1.60) * 1.05 **= $1,561.03* annual out-of-pocket costs**

*The equation outlined above has been simplified by rounding each integer to 2 decimal places. The calculated cost presented is the product of the actual calculation, which did not use rounded numbers.

TOTAL HEALTH CARE COSTS

The total health care costs were calculated by first adding together the annual premium and out-of-pocket costs and then adjusting them by 3 scaling factors. Those factors scaled total costs to: 1) North Dakota; 2) each area designation ("rural," "metro>100," and "metro<100"); and 3) 2019 to 2020 inflation.

The first scaling factor scaled the total health care costs to North Dakota. We used Per Capita Personal Consumption Expenditures (Health care) data for all states from the BEA. To create the scaling factor, we divided North Dakota's annual expenditures on health care to the national average ($8,998 / $7,006 = 1.28).

The second scaling factor adjusted total health care costs to each area designation we created (see: Food, p. 7). We used "Healthcare" data from the Consumer Expenditure Survey (by population size of area of residence). The costs provided the scaling factor used for each area designation. The average healthcare costs for all three areas was used as the base (=1), and the differences between each area and the average was used to calculate the scaling factors (1.14 for rural, 0.92 for metro<100, and 0.94 for metro>100).

The third and final scaling factor adjusted total health care costs for inflation from 2020 to Q3 2021 dollars. Using Medical Care data from the Consumer Price Index (CPI), we created an inflation adjustment factor for 2020-Q3 2021 by dividing the Q3 2021 number by the annual 2020 number (110.925 / 108.180 = 1.03).

The total health care costs were adjusted by these three factors in order: first, by the North Dakota scaling factor, then by the area designation factor, and finally adjusted for inflation.

3.3 EXAMPLE: Total Health Care Cost Calculation

Household: **#8** (Married couple (older, 51+), no children)
County: **Stutsman**
Annual Premium Cost: **$6,390.55**
Annual Out-of-pocket Cost: **$3,122.07**
ND scaling factor: **1.28**
Area designation factor: **0.92** (metro<100)
2020-Q3 2021 Inflation factor: **1.03**
Annual Total Health Care Cost Calculation: [(($6,390.55 + $3,122.07 * 1.28) * 0.92) * 1.03] **= $9,831.24***
Monthly Total Health Care Cost: **$819.27***

*This equation outlined above has been simplified by rounding each integer to 2 decimal places. The calculated cost presented is the product of the actual calculation, which did not use rounded numbers.

ASSUMPTIONS IN THE MODEL: Health Care

The cost of health care fits our "basic life" model because we assume households are lower wage earners but have access to group health care coverage through their employer(s). Employer(s) are assumed to pay a portion of the health coverage, so households are assumed to pay some amount of health insurance costs in addition to out-of-pocket expenses. The employee(s) in each family are assumed to be in the second lowest quartile of average wages, which gives them the second highest flat employee contribution toward health insurance. This model assumes a degree of healthiness, meaning the need or costs for extraordinary care is not included (e.g. long-term care, hospitalization, etc.)

HEALTH CARE DATA SOURCES

DATA	SOURCE	MO / YEAR	WEBSITE	USE
Table IX.A.2 Average total premiums and employee contributions (in dollars) for private-sector establishments for areas with States: United States, 2020 Medical Expenditure Panel Survey (annual)	US Department of Health & Human Services	2020	https://meps.ahrq.gov/data_stats/summ_tables/insr/state/series_9/2019/tixa2.pdf	Base costs for annual premiums by types of coverage
Table 14. Medical care benefits, family coverage: Employer and employee premiums by employee contribution requirement, civilian workers, March 2021 National Compensation Survey - Benefits (annual)	Bureau of Labor Statistics (BLS)	2021	https://www.bls.gov/ncs/ebs/benefits/2021/employee-benefits-in-the-united-states-march-2021.pdf	Scaling factor to anchor employee-paid portion of annual premiums to average paid by employees with average wages in the "Second [lowest] 25 percent"
Household Component summary tables: Use, expenditures, and population Medical Expenditure Panel Survey 1. Mean expenditure per person (Cross-sectional) by insurance coverage and source of payment 2. Mean expenditure per person (Cross-sectional) by age groups and source of payment	US Department of Health & Human Services	2019	https://meps.ahrq.gov/mepstrends/home/index.html	1. Base out-of-pocket costs for people with private insurance coverage 2. Scaling factor to convert general out-of-pocket costs to specific age groups
CPI-All Urban Consumers (Current Series) Series Id: CUUR0200SAM Not Seasonally Adjusted Area: West North Central Item: Medical Care (monthly, annual)	Bureau of Labor Statistics (BLS) *Consumer Price Index (CPI)*	2019-2021	https://www.bls.gov/cpi/data.htm	(1) Inflation adjustment for out-of-pocket costs from 2019 to 2020 dollars to match other health care data (2) Inflation adjustment for total health costs from 2020 to Q3 2021 dollars
Per capita personal consumption expenditures (PCE) by state SAEXP2 (annual)	Bureau of Economic Analysis (BEA)	2020	https://apps.bea.gov/itable/iTable.cfm?ReqID=70&step=1	Scaling factor to convert national cost to North Dakota cost
Population size of area of residence: Average annual expenditures and characteristics Table 2400 Healthcare (annual)	Consumer Expenditure Survey	2020	https://www.bls.gov/cex/tables.htm#avgexp	Scaling factor to convert statewide costs to urban and rural area costs

TRANSPORTATION

Transportation costs in the COL tool are estimated using a combination of many datasets. In our calculation of transportation costs, we relied significantly on Minnesota's model as a guide. Because the total transportation cost for each household relies on the sum of fixed and variable costs, we first determine the fixed costs, then calculate the variable cost multipliers, and lastly the factors that vary (the biggest being annual vehicle miles traveled, or VMT). The final step is to calculate the variable costs and add to the fixed costs.

FIXED COSTS

Before we began to calculate transportation costs, we made four important assumptions about the households in the COL tool: 1) households, regardless of size, have one vehicle; 2) the vehicle owned by the household is a newer model (aged 5 years or less); 3) households fully own their one vehicle (as opposed to leasing or financing); and 4) households only use their vehicle for basic transportation needs (e.g. to/from work, school, errands). Here, we followed the model used by Minnesota. As explained in the Minnesota Study methodology, the assumption of a household owning 1 newer vehicle allows for flexibility, as it can be used "as a proxy for any efficient arrangement a family might find to meet basic needs for transportation, including, for example, owning and operating two older cars than one newer car" (Minnesota Cost of Living Study, Methodology, p. 10).

The next step is to determine the fixed transportation costs. The fixed transportation costs in our model are 1) insurance (liability) and 2) license, registration, and fees. For insurance costs, we used the 2018 Liability Average Premium from the Auto Insurance Database Report by the National Association of Insurance Commissioners (NAIC). For North Dakota, the cost was $307.97.

The insurance cost was then adjusted for 2018-2020 inflation. Using Transportation data from the Consumer Price Index (CPI), we created an inflation adjustment factor for 2018-2020 by dividing the annual 2020 number by the annual 2018 number (96.929 / 103.303 = 0.938). With the adjustments, the final car insurance cost used in our model was $288.97 (2020 dollars).

The other fixed cost used in the COL tool was the combined cost of license, registration, and fees. We initially looked to the AAA brochure "Your Driving Costs" for the annual costs of license, registration, and fees for a sedan. The brochure provides three different sedan types: small, medium, and large. The AAA average cost for license, registration, and taxes for the three sedan sizes was $741. After reviewing that number, we decided not to use it because we deemed it was too expensive and unrealistic for North Dakota, since the state has no vehicle property tax.

From the North Dakota Department of Transportation (DOT), the cost of a license in North Dakota is $15 ($25 if a written and driving test are also needed). The cost of vehicle registration was less transparent; the fee is calculated "based on the year the vehicle is first registered and the weight of the vehicle" (DOT General Information FAQ, p. 1). Not having exact numbers to calculate a reasonable annual cost, we decided to use a fixed cost of $100 annually to cover license, registration, and fees. This seems reasonable for a current resident who would need to renew a license and pay registration and fees on a sedan in a year ($15 + est. $85). While this may be too low for a new resident to the state, the costs would be high only initially (applying for a new driver's license, initial registration of the vehicle), before falling the second year.

With these estimations, the combined annual fixed transportation cost for North Dakota is $388.97.

VARIABLE COSTS

The variable transportation cost in our model requires two inputs: 1) the multiplier (which represents costs that vary per mile, like maintenance and gas) and 2) the variable amount (for transportation, this is the vehicle miles traveled, or VMT).

For the multiplier, we used three types of data from the AAA brochure "Your Driving Costs:" 1) Fuel cost per mile, 2) Maintenance, repair, and tires cost per mile, and 3) depreciation (which we converted to per-mile costs). For both the fuel cost per mile and maintenance, repair, and tires cost per mile, an average cost per mile was calculated using the costs provided for three sizes of sedans (small, medium, large).

4.1 EXAMPLE: Fuel Cost Per Mile Calculation

Small Sedan fuel cost: **$0.0715** per mile
Medium Sedan fuel cost: **$0.0831** per mile
Large Sedan fuel cost: **$0.1143** per mile
Fuel Cost Calculation: ($0.0715 + $0.0831 + $0.1143) / 3 **= $0.8963 fuel cost per mile** (for all annual VMTs)

Using the same methodology for maintenance, repair, and tires cost per mile, we calculated a final cost of $0.0896 per mile (for all annual VMTs).

The final input to the multiplier was the cost of depreciation per mile. From AAA, we found flat annual depreciation costs for each size sedan based on an annual VMT of 10,000, 15,000, or 20,000. To convert the flat depreciation costs to per mile costs, we divided the

depreciation costs by their associated VMTs for each size sedan. The final step was to average the per mile costs for the three sedans at each VMT level.

4.2 EXAMPLE: Depreciation Cost Conversion (Flat to Per Mile)

Small Sedan (10k VMT) depreciation flat cost: **$2,552** ($2,769 - $217, or 15k VMT depreciation – 10k Decreased depreciation)
Small Sedan (10k VMT) depreciation per mile cost: **$0.17** ($2,552 / 15,000 miles)

Medium Sedan (10k VMT) depreciation cost: **$3,161** ($3,394 - $233)
Medium Sedan (10k VMT) depreciation per mile cost: **$0.21** ($3,161 / 15,000 miles)

Large Sedan (10k VMT) depreciation cost: **$4,610** ($4,914 - $304)
Large Sedan (10k VMT) depreciation per mile cost: **$0.31** ($4,610 / 15,000 miles)

Depreciation Cost Calculation: ($0.17 + $0.21 + $0.31) / 3 **= $0.23 depreciation cost per mile** (for annual VMTs < 15,000)

Depreciation costs were converted for each of the annual VMT levels (10,000, 15,000, and 20,000). We maintained the VMT levels when creating the multipliers. For each VMT level, the corresponding depreciation cost per mile was combined with the fuel cost per mile and the maintenance, repair, and tires cost per mile.

4.3 EXAMPLE: Variable Costs Multiplier Calculation (for annual VMTs > 15,000)

Fuel cost per mile: **$0.09** per mile
Maintenance, repair, and tires cost per mile: **$0.09** per mile
Depreciation cost per mile (20k VMT): **$0.26** per mile
Multiplier Calculation: $0.09 + $0.09 + $0.26 **= $0.45 fuel cost per mile** (for annual VMTs > 15,000)

We now convert each VMT level to a range: 10,000 becomes a range of 0-14,999 miles; 15,000 becomes a range of 15,000-19,999 miles; and 20,000 becomes 20,000+ miles.

With the first input (the multipliers) created, the second input (annual VMT) must be estimated for each household before we can calculate the final variable transportation costs.

The VMT was calculated using data from the National Household Travel Survey (NHTS) from the Federal Highway Administration (FHWA) of the US Department of Transportation. The initial data was pulled using the NHTS Explorer tool. Three sets of data were pulled (US level data): (1) VMT data, (2) Household data, and (3) Age data. Here is how the explorer tool was used to pull that data:

(1) **VMT data:**
Analysis Variable: Annual vehicle miles of travel (Travel Day VMT)
Row Variable: HHSIZE
Column Variable: R_AGE

(2) **Household data:**
Analysis Variable: Households
Row Variable: HHSIZE

(3) **Age data:**
Analysis Variable: Persons
Row Variable: R_AGE

Average annual VMT was then calculated by household size and by age, respectively (VMT data by Household Size / Households by Household Size; VMT data by Age / Persons by Age).

To calculate the VMT used in our modeling, we started with the average VMT by our age groups (19-50, 51+). The average annual VMTs were 8,602 miles for people aged 19-50 years and 7,717 miles for people aged 51+ years. Then, we created scaling factors for each household size. For each household size in our model (1-6 people in the household), we divided average annual VMT for each household size by the average annual VMT of all households (17,795).

4.4 EXAMPLE: Household Size Scaling Factor

Household size: **4 people**
Total VMT for households of 4: **443,193,000,000** miles
Total number of households of 4: **16,944,000** households
Average VMT for households of 4: (443,193,000,000 / 16,944,000) = **26,156** miles

Average VMT for all households: **17,795** miles
Household size scaling factor calculation: 26,156 / 17,795 = **1.47** scale factor for a household of 4

Next, we needed a VMT base number to multiply by the household size scaling factors so that we can establish final VMT numbers for each household size. To do this, we assumed a household size of 1 would be equal to the average annual VMT we calculated for the two different ages of adults in the model. That is, it would equal 8,602 miles for a younger working aged single adult, and 7,717 miles for an older working aged single adult. With that assumption, we then know what the final VMT should be for households of 1 (8,602 or 7,717) and we know the household scaling factor for that household size (0.51). We then solved for the VMT base that would yield either 8,062 miles or 7,717 miles by dividing the final VMT miles by the household factor (8,602 / 0.51 = 16,731 miles; and 7,717 / 0.51 = 15,010 miles).

For households with a "younger working aged adult," the VMT base of 16,731 miles was used. For households with an "older working aged adult," the VMT base of 15,010 miles was used. VMTs for each household were then calculated using the appropriate VMT base and household size scaling factor.

The final step was to adjust the VMT for each household to match our assumption that "households only use their vehicle for basic transportation needs." We do this using a trip purpose adjustment factor derived from data pulled using the NHTS Explorer tool. Here is how the explorer tool was used to pull that data:

VMT by Trip Purpose data:
Analysis Variable: Annual vehicle miles of travel (Travel Day VMT)
Row Variable: WHYTRP1S
Column Variable: Household State (North Dakota)

The trip purpose adjustment factor was then calculated by dividing the VMT for "basic needs" trips by total VMT. We defined "basic needs" trips to include Home, Work, School/Daycare/Religious activity, Medical/Dental services, Shopping/Errands, and Transport someone. Trip purposes excluded Social/Recreational, Meals, and Something else. The trip factor adjustment in our model was calculated to be 0.819, or 81.9% of VMT were for "basic needs" trips (1.72 billion / 2.10 billion = 81.9). The trip adjustment factor was then applied to the VMT we had calculated for each household, creating the final VMT per family used in our model.

4.5 EXAMPLE: VMT per Family Calculation

Household: **#4** (Single adult, 2 children)
Household Size: **3** people
VMT Base: **16,731** miles
Household size scaling factor: **1.28**
Trip adjustment factor: **0.819**
VMT per family Calculation: (16,731 * 1.28) * 0.819 **= 17,516 VMT***

*This equation outlined above has been simplified by rounding each integer. The calculated cost presented is the product of the actual calculation, which did not use rounded numbers.

Now, we have calculated a VMT for each household in our model. The next (and last) adjustment to make is to scale VMT for each household by county. In a state like North Dakota, where the population is small relative to its geographic size, the differences of average commute times among counties have an important effect on the VMT for households in different counties. Following Minnesota's example, we created a county VMT scaling factor using travel times and travel speed.

First, we used the mean travel time to work (minutes) from the ACS for North Dakota counties and the US to calculate travel time scaling factors for each county. To do this, we divided county mean travel time by the US mean travel time. Travel time scaling factors greater than 1 would indicate longer-than-average times traveled, thus (we assume) longer-than-average distances traveled.

Second, we used the average commute speeds from the Summary of Travel Trends publication (2017 NHTS data) for MSA sizes and the US to calculate travel speed scaling factors for each county. Here, we labeled counties as "rural" if they were considered "rural" or "metro<100" by the area designations we used in other modeling, and we labeled counties as "MSA" if they were considered "metro>100" by the area designations. To calculate the travel speed scaling factor, we divided the average commute speed by MSA size by the US average commute speed. Travel speed scaling factors greater than 1 would indicate longer-than-average speeds traveled, thus (we assume) longer-than-average distances traveled.

To create the county VMT scaling factor, we multiplied the travel time scaling factor by the travel speed scaling factor.

4.6 EXAMPLE: County VMT Scaling Factor

County: **Stark**
Travel time scaling factor: **0.66** (18.3 min / 27.6 min)
Travel speed scaling factor (Rural): **1.09** (27.6 mph / 25.22 mph)
County VMT scaling factor Calculation: 0.66 * 1.09 = **0.73**

TOTAL TRANSPORTATION COSTS

Now, all inputs for the final transportation costs have been calculated. The VMT per household is multiplied by the appropriate county VMT scaling factor, resulting in final annual VMT estimates. The final annual VMT is multiplied by the variable costs multipliers, depending on its corresponding range.

The total transportation cost was then adjusted for 2020-Q3 2021 inflation. Using Transportation data from the Consumer Price Index (CPI), we created an inflation adjustment factor by dividing the Q3 2021 number by the annual 2021 number (118.740 / 96.929 = 1.225).

4.7 EXAMPLE: Total Transportation Cost Calculation

Household: **#12** (Married couple, 4 children)
County: **Towner**
Final annual VMT: **12,626.30** (21,552.70 * 0.586)
Variable costs multiplier: **$0.41** per mile
Variable costs: **$5,176.78** (12,626.30 * $0.41)
Fixed costs: **$388.97**
2020-Q3 2021 Inflation factor: **1.23**
Annual Total Transportation Costs Calculation: [($5,176.78 + $388.97) * 1.23] **= $6,836.20***
Monthly Total Transportation Care Cost: **$569.68***

*This equation outlined above has been simplified by rounding each integer to 2 decimal places. The calculated cost presented is the product of the actual calculation, which did not use rounded numbers.

ASSUMPTIONS IN THE MODEL: Transportation

The estimated transportation costs adhere to our "basic life" model because we assume households own and operate their own car (which is a newer model). We do not assume any households own multiple vehicles, though the costs of owning one newer vehicle may be comparable to the costs of owning two older vehicles. We also do not assume that households rely on public transportation, biking, or walking as a means of travel, though these options would be less expensive. Our transportation costs are modeled with the assumption that a private vehicle is only used for necessities (travel to/from work, school, errands). We do not include the costs of extraneous travel, where the purpose is recreation, socializing, or dining out.

TRANSPORTATION DATA SOURCES

DATA	SOURCE	MO / YEAR	WEBSITE	USE
Auto Insurance Database Report Table 1B Average Premiums and Expenditures 2014-2018, Liability Written Exposures (annual)	National Association of Insurance Commissioners (NAIC)	2018	https://www.naic.org/prod_serv_publications.htm	Annual car insurance premium cost (Liability) in North Dakota
CPI-All Urban Consumers (Current Series) Series Id: CUUR0200SAT Not Seasonally Adjusted Area: West North Central Item: Transportation (monthly, annual)	Bureau of Labor Statistics (BLS) *Consumer Price Index (CPI)*	2018-2021	https://www.bls.gov/cpi/data.htm	(1) Inflation adjustment for insurance cost from 2018 to 2020 dollars to match other transportation data (2) Inflation adjustment for total transportation costs from 2020 to Q3 2021 dollars
Licensing Fees North Dakota Driver's License	ND Department of Transportation (DOT)	2021	https://www.dot.nd.gov/divisions/driverslicense/fees.htm	Cost of a driver's license in North Dakota
Vehicle Registration Fees North Dakota	ND Department of Transportation (DOT)	Not Applicable	https://www.dot.nd.gov/dotnet2/view/faq.aspx?cat=REG&site=E	General cost of car registration in North Dakota is unavailable
Your Driving Costs Brochure (annual)	AAA NewsRoom	2020	https://newsroom.aaa.com/	Fixed and variable costs per mile of owning and operating a vehicle

Vehicle Miles Traveled (VMT) by Household Size and Age for both North Dakota and United States National Household Travel Survey (NHTS) via Explore NHTS Data tool 1. Analysis Variable: Annual vehicle miles of travel (Travel Day VMT) Row Variable: HHSIZE Column Variable: R_AGE 2. Analysis Variable: Households Row Variable: HHSIZE 3. Analysis Variable: Persons Row Variable: R_AGE 4. Analysis Variable: Annual vehicle miles of travel (Travel Day VMT) Row Variable: WHYTRP1S Column Variable: North Dakota	US Department of Transportation *Federal Highway Administration (FHWA)*	2017	https://nhts.ornl.gov/	1. Annual VMT for US, cross-sectioned by household size and age 2. Total number of households surveyed in US by household size; used to calculate average VMT by household size 3. Total number of respondents surveyed in US by age; used to calculate average VMT by age 4. VMT per trip purpose, used to calculate a trip adjustment factor, or the amount of VMT for basic need trips as a percent of total VMT
Selected economic characteristics by North Dakota counties, US Mean travel time to work DP03 (annual)	American Community Survey (ACS) *(Explore Census Data)*	2015-2019	https://data.census.gov/cedsci/	Average commute time, used to calculate travel time scaling factor
1. Table 27. Trends in General Commute Patterns by Mode of Transportation (Private Vehicle) Summary of Travel Trends 2017 National Household Travel Survey Average Commute Speed (miles per hour) **2. Table 28. Trends in Average Commute Speed by MSA Size (Miles per Hour)** Summary of Travel Trends 2017 National Household Travel Survey Rural, Not in MSA Less than 250,000	US Department of Transportation *Federal Highway Administration (FHWA)*	2017	https://nhts.ornl.gov/assets/2017_nhts_summary_travel_trends.pdf	1. Average US commute speed, used to calculate travel speed scaling factor 2. Average MSA/rural commute speed, used to calculate travel speed scaling factor

CHILD CARE

Child Care costs in the COL tool are estimated using child care cost data from Child Care Aware of North Dakota (CCAND). In our estimations of child care costs, we first determine the type of child care needed in each household, then determine associated costs.

CHILD CARE HOURS

Before we determine the type of child care needed for each household, we make four important assumptions for the households in our model: (1) school-aged children attend public school; (2) children 12 years and older can be home alone during parent(s)' working hours; (3) older children do not provide child care for younger siblings; and (4) households require child care outside the home for all households except those where one adult is not employed (Married: 1 FT worker, households #9-#12).

The first assumption is based on information from the brochure "Home Alone: Is Your Child Ready?" from the ND Department of Human Services. The brochure notes that children 10-11 years old "may be left alone for longer periods of time" and that children 12 years and older "may be permitted to act as baby-sitters" for an appropriate number of other children. For this reason, we assume children ages 12+ have the maturity and ability to be home alone when they are not in school and their parent(s) are working.

The children in our model represent a variety of ages: Child 1 is 2 years-old, Child 2 is 7 years-old, Child 3 is 13 years-old, and Child 4 is 16 years-old. Based on our assumptions, child care is necessary for Child 1 and Child 2 in households where they exist and where all adults in the household are working (FT or PT).

Child 1 is 2 years old, and therefore not school-aged. He requires annual full-time child care for all of his parent(s)' working hours. For Child 1, we can assume annual child care costs are applicable, so all we need is to find that cost for each county (see: Child Care Hourly Rate below).

Child 2 is 7 years old and is school-aged. She requires part-time child care for all of her parent(s)' working hours minus the hours that she is in school. Unlike Child 1, we need to determine the hours of child care she needs in a year, and an annual rate is not applicable. To calculate the hours of child care needed for Child 2, we need to determine the number of hours her parent(s) works and the number of hours that she is in school.

For the parent(s) work hours, we first assume the workday is 8 hours. Then, we adjust the 8 hours by adding the time needed to commute to and from work; for each county, we multiply the mean travel time to work from the ACS by 2, and then add to 8. We assume full-time work consists of 40 hours (5 days) a week for 52 weeks a year (2,080 hours total).

With the parent(s) work hours calculated, we move onto determining school hours for Child 2. According to North Dakota Century Code (15.1-06-04 School calendar – Length), schools must provide at least 175 days of instruction and a full day of instruction is at least 5.5 hours for elementary students. With this information we know that Child 2 will need partial child care for 175 of her parent(s) workdays and full child care for 85 days when she is not in school but her parent(s) is working.

5.1 FORMULA: Child Care Hours Needed for Child 2
County mean travel time = **t**
Child care hours needed = **h**
Formula: **h =** [((8 hrs + 2t) – 5.5 hrs) * 175 days] + [(8 hrs + 2t) * 85 days]

With the needs for child care established, the next step is to determine costs by type of child care needed.

CHILD CARE COSTS

For child care costs, we need to find the annual cost for a 2 year-old (Child 1) and the hourly cost for a 7 year-old (Child 2). The hourly cost will then be multiplied by the child care hours we calculated.

Child care cost data by county for children up to 5 years-old is publicly available through Child Care Aware of North Dakota (CCAND). The data provides two average costs for each age group—one for home-based programs and one for centers and group facilities. We took a conservative approach and used the higher average annual cost of the two provided for the age group 18 to 35 months for each county (Child 1 is 24 months). In 2019, for ages 18 to 35 months, the average annual cost of centers and group facilities were used for 45 counties and the average annual cost of home-based programs was used for 8 counties.

The cost of child care for Child 2 required a calculation using two inputs: (1) the hours of child care needed, which we calculated in the previous section; and (2) the hourly cost of child care for children ages 6-12. Unlike child care costs for children ages 5 and younger, the costs for school-aged children are not available publicly because the cost and administration of care is largely nonstandard among providers. We specially requested the data from CCAND and received the county-level data reported in a combination of hourly, daily, weekly, and monthly rates.

Through calculations, all daily, weekly, and monthly rates were converted to hourly rates. The conversions used 2080 hours for a year, 173.3 hours a month (2080 / 12), 21.67 days a month (173.3 / 8), and county-specific hours per month [21.67 days * (8 hrs + (2 *

county mean travel time))]. Because child care rates for school-aged children was not available for each county, we averaged child care rates by planning region instead.

We then calculated child care costs for Child 2. The formula we used to calculate child care cost for Child 2 was simply child care hours needed (see 5.1 Formula) multiplied by child care costs for the relevant region or area.

The final child care cost was then adjusted for 2020-Q3 2021 inflation. Using Tuition, other school fees, and childcare data from the Consumer Price Index (CPI), we created an inflation adjustment factor for 2020-Q3 2021 by dividing the Q3 2021 number by the annual 2020 number (102.425 / 101.942 = 1.005).

ASSUMPTIONS IN THE MODEL: Child Care

The cost of child care fits our "basic life" model because we assume families must pay for child care in the households where both adults are working, regardless of their full-time or part-time employment status. The only households who are assumed to provide their own child care are those where there are two adults and only one works full-time (i.e. families 9 – 12). Additionally, we do not assume any children are responsible for child care, though older children, particularly Child 4 (a 16 year-old girl), may be adequately responsible to do so. Because the cost of child care is an important and unavoidable expense for many families with working parents, we allow few exceptions for the households in our model and assume most households must pay for care for their younger children.

CHILD CARE DATA SOURCES

DATA	SOURCE	MO / YEAR	WEBSITE	USE
Child supervision guidelines for North Dakota families Home Alone: Is Your Child Ready?	ND Department of Human Services	2018	https://www.nd.gov/dhs/info/news/2018/4-24-brochure-offers-guidance-child-supervision-parents-caregivers.pdf	Basis for assumption that children 12 years and older can be home alone during parent(s)' working hours
The Cost of Child Care in North Dakota County-level and Region-level costs	Child Care Aware of North Dakota	2020	https://ndchildcare.org/parents/cost/ *For children aged 6-12 years data was procured via special request to CCAND*	Annual cost of full-time child care by county for children aged 3-5 years and hourly cost of part-time child care by region for children aged 6-12 years.
Selected economic characteristics by North Dakota counties Mean travel time to work DP03 (annual)	American Community Survey (ACS) *(Explore Census Data)*	2015-2019	https://data.census.gov/cedsci/	Average commute time, doubled and added to 8-hour workday to determine hours of child care needed
15.1-06-04 School calendar – Length Item 1a Item 4a	ND Century Code *(ND Legislative Branch)*	2020	https://www.legis.nd.gov/cencode/t15-1.html	(1a) Number of school days per year (4a) Number of school hours per day
CPI-All Urban Consumers (Current Series) Series Id: CUUR0200SEEB Not Seasonally Adjusted Area: West North Central Item: Tuition, other school fees, and childcare (monthly, annual)	Bureau of Labor Statistics (BLS) *Consumer Price Index (CPI)*	2020-2021	https://www.bls.gov/cpi/data.htm	Inflation adjustment for child care costs from 2020 to Q3 2021 dollars

OTHER NECESSITIES

Other Necessities costs in the COL tool represent the additional life expenses not covered in other areas of the COL tool. Following Minnesota's example, these costs included apparel, personal care, reading, education, and miscellaneous expenses. The costs for Other Necessities were determined using data from the Consumer Expenditure Survey.

OTHER NECESSITIES COSTS

For Other Necessities costs, we took data from the Consumer Expenditure Survey (BLS) for each category, totaled the expenses, and created a multiplier that represents the costs of Other Necessities in proportion to the combined costs of Food and Housing. The use of the multiplier ensures that the costs of Other Necessities scale to the size of households without the availability of data that shows those costs by household size.

First, we took the mean values of Food and Housing from the Consumer Expenditure Survey and combined them. As we did with health insurance premiums, we used the second lowest quartile of income for pulling data. For Food, we used the mean cost for Food at home. For Housing, we used the combined mean costs for (1) Maintenance, repairs, insurance, other expenses, (2) Rented dwellings, and (3) Utilities, fuels, and public services. In 2019, the total of Food and Housing costs equaled $13,140 ($3,672 food + $9,468 housing).

Next, we totaled the mean costs for (1) Apparel and services, (2) Personal care products and services, (3) Reading, (4) Education, and (5) Miscellaneous. In 2019, these costs equaled $3,033 ($1,246 apparel + $552 personal + $62 reading + $491 education + $682 miscellaneous). The final step is to use the two inputs to calculate a multiplier for Other Necessities.

6.1 EXAMPLE: Other Necessities Multiplier Calculation

Food + Housing costs (CES): ($3,792 + $9,513) = **$13,305**
Other Necessities costs (CES): ($995 + $538 + $83 + $438 + $696) = **$2,750**
Other Necessities Multiplier Calculation: $2,750 / $13,305 **= 0.207 Other Necessities multiplier**

We then calculate Other Necessities costs for each household in each county by applying the multiplier to the combined costs of food and housing that we estimated for the COL tool.

6.2 EXAMPLE: Other Necessities Costs Calculation

Household: **#1** (Single adult, no children)
County: **Golden Valley**
Food + Housing costs: ($363.89 + $648.74) = **$1,012.63**
Monthly Other Necessities Costs Calculation: ($1,012.63 * 0.207) = **$209.30**

Because the multiplier is applied to costs that have already been adjusted for inflation and scaled to each county, there are no additional adjustments needed.

ASSUMPTIONS IN THE MODEL: Other Necessities

The cost of other necessities fits our "basic life" model because we assume a variety of necessary costs for hygiene, clothing, and education. We also allow for a buffer of "miscellaneous" expenses. We assume those costs to be similar to the average costs for households in the second lowest quartile of income, so the costs neither represent luxury nor deprivation.

OTHER NECESSITIES DATA SOURCES

DATA	SOURCE	MO / YEAR	WEBSITE	USE
Table 1101. Quintiles of income before taxes: Annual expenditure means, shares, standard errors, and coefficients of variation Consumer Expenditure Survey, 2020 Aggregate expenditure share tables	Bureau of Labor Statistics (BLS)	2020	https://www.bls.gov/cex/tables.htm	Costs for apparel, personal care, reading, education, and miscellaneous expenses; costs for food and housing; both sets used to create multiplier of necessities to food and housing

TAXES

The costs of taxes are estimated in the COL tool by totaling the costs of all other inputs (food, housing, health care, transportation, child care, and other necessities) and applying a tax rate multiplier. The total cost of all other inputs is then added to the estimated taxes to return a final "income" that would sustain each household's basic needs.

The calculation of "taxes" is the most difficult because we start from the net income (the totaled cost of inputs), rather than the gross income (the total cost of inputs plus taxes). Taxes in real life are determined by a household's gross income, which we can only estimate once we know the amount of taxes needed, thus presenting a problem of circular reference. To get around this problem, and determine the tax costs in the COL tool, we conduct a series of calculations to estimate taxes and then average the calculated tax rates for each household type to create a tax multiplier. The tax multiplier is applied to the net income of each household in each county, which gives us the taxes used in our model.

TAX MULTIPLIER

Rather than calculate taxes and credits for each household in our model, we created a tax rate multiplier to represent the effective taxes that each household might pay. The tax multiplier was applied to the total costs of other inputs (net income) to find the approximate gross income needed to sustain a "basic needs" life. By opting for a multiplier, we are not bound by the numerous complexities involving actual preparation of each household's taxes. Rather, the taxes in the COL tool serve as reasonable estimations.

> **NOTE:** For COL users who are interested in more exact tax costs to calculate their own cost of living, we recommend using real incomes/salaries and referencing the tax tables and tax credit information available from both the Internal Revenue Service and the North Dakota Tax Commissioner (see: Tax Data Sources).

To create the multipliers, we made assumptions about each household's tax situation, calculated taxes and credits for each household in the model, calculated effective tax rates for each household by county, and then created 24 multipliers for our basic households informed by the average effective tax rates for each household (not specific to county). Through this method, we are not reliant on each household in each county following the specific assumptions we made about their tax situations, but we still have a reasonable tax cost. The multipliers necessarily provide flexibility on actual tax rates and claimed credits while still providing a general idea of cost.

The assumptions we made about each household's tax situation were as follows: (1) households #1 & #2 are filing as "single," households #3-#6 are filing as "head of a household," and all other households are filing as "married filing jointly;" (2) all children meet the qualifications for the federal child tax credits; (3) all families claim the federal child tax credits for all children in their household; (4) all households take the standard deduction only for their federal taxes; (5) all incomes end in an even 100 (e.g. $20,300, $20,400, etc.), (6) taxes are allowed to be reduced down to $0 via credits, but we do not account for refundable portions of tax credits, (7) the only tax credits claimed are child tax credits and/or earned income credits, (8) all households with qualifying gross income are eligible for the earned income tax credit, and (9) income is derived solely from wages, salaries, tips, etc. (not dividends, pensions, annuities, etc.).

For our purposes, we tried to make the calculations and assumptions as simple as possible. As evidenced by the many assumptions made for a "simple" tax calculation, even this is complicated. The complexity and variance of taxes among real households is precisely the reason we ultimately used a tax multiplier as a proxy for the total taxes a household might pay.

With our assumptions made, we set up the inputs for calculating taxes. First, we needed a gross income. To find a placeholder gross income, we took the total costs of other COL inputs and used the equation: [Total COL inputs] / (1 – placeholder tax rate). We used a placeholder tax rate of 15% (0.15), which was relatively arbitrary. A true total of tax rates would be approximately 20% (10-12% federal income tax, 1-2% state income tax, 6.2% social security tax, 1.45% Medicare tax). The true total of tax rates does not account for standard deductions or tax credits, though, so we lowered our placeholder tax rate to 15%.

We inserted the placeholder tax rate into the equation and calculated placeholder gross incomes for all households in all counties. The placeholder gross incomes were then rounded to the nearest $100 for simplicity.

Next, we subtracted the standard deduction from the placeholder gross incomes to determine the taxable income for each household. The standard deductions for 2020 were $12,400 for single filers, $18,650 for head of household filers, and $24,800 for married, filing jointly filers. Then, we used these taxable incomes to determine both North Dakota state income taxes and federal income taxes.

For North Dakota income taxes, we followed the tax rate schedules from the 2020 State and Local Tax Tables from the ND Tax Commissioner. For households in the lowest income bracket (varied by filing type), the tax rate was 1.10% (0.011); for households in the second lowest income bracket (varied by filing type), the tax rate was applied to income over the first bracket cutoff amount (which was taxed at 2.04%, or 0.0204), which was added to a base tax amount (0.011 times the first bracket cutoff amount). Overall, the ND taxes calculated ranged from $57.20 to $851.35.

For federal income taxes, we did not do any calculation. We looked up taxable incomes by filing status and used the corresponding tax amount from the 1040 tax tables available from the Internal Revenue Service (IRS). Overall, the federal taxes calculated ranged from $523 to $8,984.

In addition to both state and federal income taxes, we calculated social security and Medicare taxes. Social security taxes were calculated by multiplying the placeholder gross incomes by 0.062. Overall, social security taxes calculated ranged from $1,153.20 to

$5,741.20. Medicare taxes were calculated by multiplying the placeholder gross incomes by 0.0145. Overall, Medicare taxes calculated ranged from $269.70 to $1,342.70. The rates of 6.2% for social security tax and 1.45% for Medicare tax are sourced from the IRS.

For tax credits, we only used 2 federal income tax credits: (1) the child tax credit (CTC) and (2) the earned income tax credit (EITC). Since all children in the household are under 17 years old and assumed to meet the qualifications for the CTC, households are assumed to receive $2,000 for every child in the household. In our model, that means households with children received a credit between $2,000-$8,000, depending on the number of children in the household.

The EITCs were not calculated, rather they were looked up in the EITC tables. Using placeholder gross incomes, we looked up the EITC for households by filing status and number of children (0 to 3+) for households whose income level qualified for the credit. The EITCs ranged from $0 to $1,457.

With all the taxes and credits calculated, we proceeded to calculate total tax liability. First, we subtracted the total federal tax credits (CTC, EITC) from the federal income tax liability. Even though the CTC and EITC are refundable credits, we did not calculate refunded amounts. We did allow income tax burdens to be reduced to $0 if the credits were greater than the federal income tax liabilities. After this step, the adjusted federal income tax liabilities ranged from $0 to $2,300.

The next step was to add together the adjusted federal income tax liability, ND income tax liability, social security tax liability, and Medicare tax liability for each household in each county. The total provided us a number for “taxes” and the effective tax rate for each household in each county. Overall, the “taxes” ranged from $2,114.10 to $8,912.88, and the effective tax rates ranged from 9.4% to 17.0%.

At this point, all the “taxes” and tax rates were calculated, and we were ready to calculate the tax multipliers. To do this, we averaged all tax rates by household number, reducing the 1,272 tax rates (24 households x 53 counties) to 24 average tax rates. In 2020, the tax rate multipliers were as follows:

HOUSEHOLD		FILING STATUS	# OF KIDS	TAX MULTIPLIER
1	**Single: 1 FT Worker**	Single	0	15.1%*
2	**Single: 1 FT Worker** (older)			
3	**Single: 1 FT Worker**	Head of Household	1	11.3%
4			2	11.6%
5			3	10.3%
6			4	10.0%
7	**Married: 1 FT Worker**	Married, filing jointly	0	13.1%*
8	**Married: 1 FT Worker** (older)			
9	**Married: 1 FT Worker**		1	12.2%**
10			2	11.3%**
11			3	9.8%**
12			4	9.8%**
13	**Married: 1 FT Worker, 1 PT Worker**	Married, filing jointly	0	13.1%*
14	**Married: 1 FT Worker, 1 PT Worker** (older)			
15	**Married: 1 FT Worker, 1 PT Worker**		1	12.2%**
16			2	11.3%**
17			3	9.8%**
18			4	9.8%**
19	**Married: 2 FT Workers**	Married, filing jointly	0	13.1%*
20	**Married: 2 FT Workers** (older)			
21	**Married: 2 FT Workers**		1	12.2%**
22			2	11.3%**
23			3	9.8%**
24			4	9.8%**

* The tax multipliers of 15.1% and 13.1% are the averages of younger and older single adults with 0 children and younger and older married couples with 0 children, respectively. Because younger and older households with 0 children represent essentially the same tax situations, we give them the same tax rate in the COL model. When calculated separately, though, each type of family returned different effective tax rates due to the slight differences in incomes needed to live a “basic life” between those two age groups.

** The tax multipliers for households #9-#12 were originally slightly different than those for #15-#18 and #21-#24 (which were identical to each other). This was due to the lower necessary incomes for households #9-#12, as child care is assumed to be provided by the non-working spouse and costs $0. The lower incomes resulted in slightly lower tax multipliers. Because we expect households with similar compositions to have similar tax situations, we gave them the same tax rate in the COL model.

TAX COSTS

With the tax multipliers calculated, we can calculate both the annual gross income needed to cover the costs of the inputs (including taxes) and the tax costs. To calculate the gross incomes, we used the equation: [Total COL inputs without taxes] / (1 – tax multiplier).

7.1 EXAMPLE: Annual Gross Income Calculation

Household: **#5** (Single adult, 3 children)
County: **Logan**
Total COL inputs (without taxes): **$59,396.47**
Tax multiplier: **0.105**
Annual Gross Income Calculation: $59,396.47 / (1 – 0.105) = **$66,393.57* annual gross income**

*This equation outlined above has been simplified by rounding each integer to 2 decimal places. The calculated cost presented is the product of the actual calculation, which did not use rounded numbers.

Finally, we calculated the annual tax costs using the equation: [Gross Income] * [Tax Multiplier].

7.2 EXAMPLE: Tax Costs Calculation

Household: **#5** (Single adult, 3 children)
County: **Logan**
Annual Gross Income: **$66,393.57**
Tax multiplier: **0.105**
Annual Tax Costs Calculation: $66,393.57 * 0.105 = **$6,997.10***
Monthly Tax Costs Calculation: $**583.09***

*This equation outlined above has been simplified by rounding each integer to 2 decimal places. The calculated cost presented is the product of the actual calculation, which did not use rounded numbers.

ASSUMPTIONS IN THE MODEL: Taxes

The cost of taxes fits our "basic life" model because we assume households fall into the lowest tax brackets, that they qualify for only basic federal tax credits, and that they qualify for all credits available to them. We kept our tax estimates conservative, in that we did not calculate the refundable amounts for any of the credits the households in our model hypothetically would apply for.

TAX DATA SOURCES

DATA	SOURCE	MO / YEAR	WEBSITE	USE
Form ND-1 Booklet Individual Income Tax Return Booklet 2020 Tax Rate Schedules, p 32	ND Tax Commissioner	2020	https://www.nd.gov/tax/user/individuals/forms--publications/individual-income-tax/forms-instructions-iit/current-year-individual-income-tax-forms--instructions/	North Dakota state income tax rates for tax year 2020
1040 Tax and Earned Income Credit Tables (2020) (pdf)	Internal Revenue Service (IRS)	2020	https://www.irs.gov/instructions	1. Federal income tax rates for tax year 2020 by income 2. Earned income credits for tax year 2020 by income and household type
Topic Number 751 – Social Security and Medicare Withholding Rates	Internal Revenue Service (IRS)	2020	https://www.irs.gov/taxtopics/tc751	Social security tax rate and Medicare tax rate
Publication 972, Child Tax Credit and Credit for Other Dependents	Internal Revenue Service (IRS)	2020	https://www.irs.gov/forms-pubs/about-publication-972	Child tax credit information for federal income taxes