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ABSTRACT

Over the last five decades, life expectancy at birth in the United States and in the Mountain States has been increasing steadily for both males and females. Previous studies of mortality or life expectancy have looked at relatively small cohorts of people over time, or have looked at mortality or life expectancy at the national or state level. The larger-scale studies have usually concentrated on only one or a few of the determinants of life expectancy. The Harvard Center for Population and Development Studies recently published life expectancy tables for all U.S. counties for both males and females. Life expectancy varies greatly across counties in the eight Mountain States. This study examines the impact of demographic, economic, educational, social, and geographic factors on life expectancy by Mountain States county for males and females born in 1990. The models tested here can explain between 62 and 84 percent of the total county-level variability in life expectancy for men and for women. In general, we conclude that educational attainment is positively associated with life expectancy for both sexes; and that the percentage of the county population age five and older speaking a language other than English at home is positively associated with average female life expectancy; while the percentage of the county population foreign-born is positively associated with average male life expectancy. The percentage of the county whose primary ancestry is Northern European has a generally positive affect on both female and male life expectancies. The percentage of the population black and the percentage American Indian, Eskimo, and Aleut decreases mean

county life expectancies for both men and women, *ceteris paribus*, but the effect is more significant in the statistical sense for female life expectancy. Violent crime rates are negatively associated with life expectancies for men and women, but population density seems to have a negative effect primarily on mean male life expectancy. The percentages of the county population classified as urban and as rural farm, the percentage of households married, and household size all have a positive effect on mean county life expectancies for both sexes. The only economic variables that seem to matter in determining life expectancy are income and income squared, which have the expected pattern of signs that give rise to a U-shaped relationship between income and life expectancy, but only for men. Latitude and elevation seem to be negatively associated with life expectancy, especially for women. Other things equal, life expectancy is greater than expected for both men and women in Colorado, Idaho, New Mexico, and Utah; while life expectancy is less than expected for both men and women in Nevada and Wyoming. In Montana, men live longer than the rest of the model predicts, while women have a shorter life expectancy.

II. DATA

The dependent variables in the current study are life expectancy by Mountain States county for males/females born in 1990. The life expectancy data are taken from life tables created by the Harvard Center for Population and Development Studies. These life tables are derived from mortality data found in the National Center for Health Statistics detailed cause of death file. County life expectancy data are obtained for both males (LIFEXPM) and females (LIFEXPF) born in 1990. To preserve 95 percent confidence levels the HCPDS created geographic units with at least 10,000 males and 10,000 females, merging contiguous counties into county clusters. After county mergers, life expectancy was determined for both males and females in 2,077 counties and county clusters, encompassing the entire population of the United States. In our study, we examine the determinants of life expectancy for males and females in the 135 counties and county clusters in the Mountain States. In our sample, mean county life expectancies for males born in 1990 range from 67.64 years in Big Horn, Rosebud, and Treasure counties, Montana to 77.42 years in Cache and Rich counties, Utah, with an average county life expectancy of 72.76 years. Mean county life expectancies for females born in 1990 range from 75.53 years in Big Horn, Rosebud, and Treasure counties, Montana, to 81.83 years in Cache and Rich counties, Utah, with an average county life expectancy of 79.41 years. Table 1 shows the top five highest and lowest counties by life expectancy for men and women in the Mountain States. The purpose of this study is to identify the factors that lead to these variations in life expectancy.

Table 1. Life Expectancy by County, Mountain States

FEMALE LIFE EXPECTANCY

Maximum

1.	Cache, Rich, UT	81.83
2.	Clear Creek, Eagle, Gilpin, Grand, Jackson, Park, Summit, CO	81.75
3.	Gallatin, MT	81.56
4.	Boulder, CO	81.48
5.	Washington, UT	81.47

Minimum

1.	Big Horn, Rosebud, Treasure, MT	75.53
2.	Benewah, Shoshone, ID	76.79
3.	McKinley, NM	76.79
4.	Navajo, AZ	77.17
5.	Daniels, Garfield, McCone, Petroleum, Roosevelt, Sheridan, MT	77.23

MALE LIFE EXPECTANCY

Maximum

1.	Cache, Rich, UT	77.42
2.	Douglas, Elbert, CO	77.11
3.	Davis, UT	76.48
4.	Gallatin, MT	76.29
5.	Boulder, CO	76.03

Minimum

1.	Big Horn, Rosebud, Treasure, MT	67.64
2.	Apache, AZ	68.20
3.	Rio Arriba, NM	68.41
4.	Navajo, AZ	69.02
5.	Mohave, AZ	69.05

The independent variables used to explain differences in life expectancies by county include the percent of the county population living in an urban area (URBAN), percent of the county population living on a rural farm (RURFARM), mean household size (HHSIZE), percent of county households in which a married couple resides (MARRIED), per capita income in thousands of dollars (INCOME), per capita income in thousands of dollars squared (INCOME2), percent of the county population below the poverty level (POVERTY), violent crimes per 1000 people (VIOLCRIM), persons per square mile (POPDENS), percent of persons 25 years or older who have completed at least 12 years of education (EDUCATN), civilian labor force unemployment rate (UNEMP), percent of persons 5 years and older speaking a language other than English at home (LANGUAGE), percent of the county population born in a foreign country (FORNBRN), latitude of the county seat (LATITUDE), the log of the elevation of the county seat (LNELEVAT), 23 ancestry variables, 8 race variables, 3 Hispanic origin variables, and 7 state dummy variables. The data on ancestry, race, and origin represent self-classification by people according to the group with which they most closely identify. Both ancestry and origin refer to a person's ethnic origin, lineage, or place of birth of the person or the person's parents before their arrival in the United States.

Other than the dummy variables, all of the data are expressed in per capita terms with the exception of VIOLCRIM (violent crimes/1000 persons), POPDENS (population per square mile), HHSIZE (population per household), MARRIED, LATITUDE, and LNELEVAT. In order to combine the data into county clusters when necessary, weighted averages using population weights were calculated for both latitude and elevation. Because of the relatively large variation in elevation among counties, the elevation data has been logged.

Data for population, urban population, rural farm population, households, land area, poverty, educational attainment, language, foreign born, ancestry, race and origin are taken from the U.S. Bureau of the Census. Income data are taken from the U.S. Bureau of Economic Analysis. Unemployment data are taken from the U.S. Bureau of Labor Statistics. Crime data are taken from the U.S. Federal Bureau of Investigation. Latitude and elevation data are taken from the U.S. Geological Survey.

Expected effects of included variables. We expected that the degree of urbanization would have both positive and negative consequences for life expectancies. Easier access to health care and other amenities would be expected to increase average life expectancy, whereas higher levels of pollution and stress associated with urban environments would be expected to decrease average life expectancy. We thought that the negative impacts of urbanization would outweigh the positive impacts; hence, we expected the URBAN coefficient to be negative.

We believed that the percentage of the county population living on rural farms would positively affect average life expectancies because of the health effects associated with a more physically active and less stressful life style. In addition, we believed that rural farm families would, on average, have better nutritional habits and/or opportunities than would urban-dwellers. Also, rural farmer are more likely to earn nonmarket income than are urban workers. Because of these reasons, we anticipated that the RURFARM coefficient would be positive.

We thought that larger household size potentially could increase or decrease life expectancy. On the one hand, larger households may put more physical and emotional stress on parents, particularly mothers. Childbearing itself has health and risk effects for women. On the other hand, for children, the number of siblings has implications for physical, psychological, and emotional development. Also, for rural farm families, household size has work (and associated stress and health) implications that may affect life expectancy. Finally, household size may affect the quality of life of elderly parents who need assistance and support after retirement. Our assumption is that the more children available to help elderly parents, the better the quality of the help, and the higher the parents' life expectancy, *ceteris paribus*. With potential positive and negative effects of average household size on life expectancy, we had no prior expectation as to the sign of the HHSIZE coefficient.

Past research as to the effect of marriage on life expectancy has found that marriage increases life expectancy, particularly for men. For children, there is evidence that living in a two-parent household has beneficial effects. On this basis, we thought that the MARRIED coefficient would be positive.

People with higher incomes are better able to purchase good quality food, shelter, health care, and other amenities. Also, people with higher incomes are more likely to be working in safer and healthier environments. We anticipated that income would be positively associated with longevity, but believed that the effect might be nonlinear. Hence, we included both income per capita and squared income per capita in the model. We expected at least one of the income variables to have a positive coefficient.

Because poverty reduces people's access to adequate nutrition, health care, shelter, and protection from environmental problems, we expected the POVERTY coefficient to be negative.

Higher incidence of violent crime would probably reduce life expectancy not only because of the direct threat to mortality, but also because of the indirect effects associated with increased stress and larger claims on income to hedge against crime as incidence of crime increases. Hence, we include violent crime in the model, even though it is a direct cause of mortality. We expected the VIOLCRIM coefficient to be negative.

We believed that stress, pollution, and incidence of communicable disease would all increase as population density increased, hence, we expected the POPDENS coefficient to be negative. We thought that the higher the percentage of a county population with at least 12 years of education, the higher would be life expectancy, other things equal. We believed that people with more education are less likely to contract certain diseases, are more likely to obtain appropriate health care, are more likely to have a nutritious diet, and are more likely to work in less-polluted environments. Because of these reasons, and based on the results of previous studies, we expected the EDUCATN coefficient to be positive.

Unemployment makes it more difficult for people to access health care, good diet and other quality of life factors. Also, unemployment creates additional stress for the unemployed and their families. Even though low average income leads to similar effects on longevity, the distribution of income is also crucial. Hence, unemployment, (like the percentage of the population below the poverty line) is expected to have an independent detrimental effect on life expectancy. We expected the UNEMP coefficient to be negative.

The next two variables, the percentage of county population over age 5 speaking a language other than English at home (LANGUAGE) and the percent foreign-born (FORNBRN) are problematic. One might expect that speaking a language other than English or being foreign-born could lead to discrimination in employment and greater difficulty obtaining education. On the other hand, because of immigration laws, many immigrants must have skills that are in short supply in the United States in order to be allowed in immigrate. For these people, education and income might be expected to be higher than average. However, in either case, these effects are handled separately with the employment, income and education variables. Other longevity effects of being foreign-born are not clear. Because immigrants are self-selected, individuals who are ambitious and persistent enough to immigrate may have other characteristics that lead to either higher or lower life expectancy. Likewise, speaking a language other than English at home could indicate a failure to assimilate that might also affect life expectancy. This possibility is buttressed by the fact that in the Mountain States, the mean percentage of county populations foreign-born (which includes some native English speakers) is only 3.59 percent, while the mean percentage of county populations speaking a language other than English at home is 14.06 percent. We had no prior expectation as to the sign of the LANGUAGE and FORNBRN coefficients.

The next two variables are intended to capture effects of geography and environment on life expectancy. We believed that the latitude variable would help capture climatic and environmental effects that might affect longevity. For example, northern latitudes experience both lower average temperatures and larger temperature extremes than do southern latitudes, as well as fewer hours of sunlight. The variety and cost of fresh foods also varies from north to south in the Mountain States. We believed that more moderate temperatures and a longer growing season would positively affect health and longevity, but were uncertain as to the net effects of more sunlight. On balance, we expected the LATITUDE coefficient to be negative. Similarly, we believed that elevation would likely affect longevity, primarily because of environmental factors. Higher elevation is generally associated with better quality air and water, which should increase life expectancy. Also, the lower humidity found at higher elevation is often believed to reduce health problems associated with respiratory difficulties. However, higher elevation is also associated with a higher concentration of damaging UV rays. Because we believed the net effect of elevation would enhance longevity, we expected the LNELEVAT coefficient to be positive.

The 23 ancestry variables included in the model show the percent of the county population reporting each of the following as primary ancestry: Czech (CZECH), Danish (DANISH), Dutch (DUTCH), English (ENGLISH), French (except Basque) (FRENCH), French Canadian (FRCANAD), German (GERMAN), Greek (GREEK), Hungarian (HUNGARY), Irish (IRISH), Italian (ITALIAN), Norwegian (NORWEG), Polish (POLISH), Portuguese (PORTUGS), Russian (RUSSIAN), Scotch-Irish (SCTIRSH), Scottish (SCOTTISH), Slovak (SLOVAK), Swedish (SWEDISH), Swiss (SWISS), United States or American (USA), Welsh (WELSH), and West Indian (excluding Hispanic origin groups) (WESTINDN). The control group is "other or not reported." These ancestry variables are included for two main reasons. First, ancestry may carry with it cultural and social attitudes and habits that affect longevity. Second, ancestry may carry with it genetic qualities that affect life expectancy, such as disease resistance. We had no prior expectation as to the sign of the various ancestry coefficients, except for those representing Northern European ancestry, which we expected to be positive. This expectation is based on the longer average life expectancies currently enjoyed by populations in Northern Europe and the British Isles relative to most other countries. To the extent that these life expectancies are determined by genetics and/or cultural and social attitudes; and in the second case, to the extent that these attitudes are shared by Northern European immigrants to the U.S. and their descendants, we would expect the coefficients of DANISH, DUTCH, ENGLISH, GERMAN, IRISH, NORWEG, SCTIRSH, SCOTTISH, SWEDISH, SWISS, AND WELSH to be positive.

The eight race variables included in the model show the percent of the county population reporting each of the following as primary race: Black (BLACK), American Indian, Eskimo, or

Aleut (AMINESAL), Chinese (CHINESE), Filipino (FILIPINO), Japanese (JAPANESE), Asian Indian (ASININDN), Korean (KOREAN), and Vietnamese (VIETNMSE). White is the control group. As with the ancestry variables, race and origin may affect longevity independently because of genetic factors or because of cultural and social attitudes and habits. Based on previous studies of life expectancy of black Americans and life expectancy on American Indian reservations, we expected the coefficients of BLACK and AMINESAL to be negative, and have no expectation for the signs of the other coefficients. The three Hispanic origin variables include the percent of the county population reporting each of the following as primary origin: Mexican (MEXICAN), Puerto Rican (PRTORCAN), and Cuban (CUBAN). We had no prior expectation as to the sign of the Hispanic origin coefficients.

Dummy variables are included for 7 of the states in order to capture the effects of differences in state laws controlling health care, environmental protection, law enforcement, public assistance, prostitution, gambling, and other factors that might affect life expectancy; as well as differences among states in funding of education, health care, public safety, etc. These dummy variables may also capture life style and cultural differences among states and regions. Arizona is the control variable. We had no prior expectation as to the sign of the state dummy coefficients.

III. ECONOMETRIC MODEL

An econometric model was formulated for both male life expectancy by county and female life expectancy by county, incorporating all of the independent variables listed above. The model is linear in the variables, except for the natural log of elevation.

Algebraic Representation of The Model:

$$LIFEXPM_i \text{ or } LIFEXPF_i = \beta_0 + \beta_1 URBAN_i + \beta_2 RURFARM_i + \beta_3 HHSIZE_i + \beta_4 MARRIED_i + \beta_5 INCOME_i + \beta_6 INCOME2_i + \beta_7 POVERTY_i + \beta_8 VIOLCRIM_i + \beta_9 POPDENS_i + \beta_{10} EDUCATN_i + \beta_{11} UNEMP_i + \beta_{12} LANGUAGE_i + \beta_{13} FORNBRN_i + \beta_{14} CZECH_i + \beta_{15} DANISH_i + \beta_{16} DUTCH_i + \beta_{17} ENGLISH_i + \beta_{18} FRENCH_i + \beta_{19} FRCANAD_i + \beta_{20} GERMAN_i + \beta_{21} GREEK_i + \beta_{22} HUNGARY_i + \beta_{23} IRISH_i + \beta_{24} ITALIAN_i + \beta_{25} NORWEG_i + \beta_{26} POLISH_i + \beta_{27} PORTUGS_i + \beta_{28} RUSSIAN_i + \beta_{29} SCTIRSH_i + \beta_{30} SCOTTISH_i + \beta_{31} SLOVAK_i + \beta_{32} SWEDISH_i + \beta_{33} SWISS_i + \beta_{34} USA_i + \beta_{35} WELSH_i + \beta_{36} WESTINDN_i + \beta_{37} BLACK_i + \beta_{38} AMINESAL_i + \beta_{39} CHINESE_i + \beta_{40} FILIPINO_i + \beta_{41} JAPANESE_i + \beta_{42} ASININDN_i + \beta_{43} KOREAN_i + \beta_{44} VIETNMSE_i + \beta_{45} MEXICAN_i + \beta_{46} PRTORCAN_i + \beta_{47} CUBAN_i + \beta_{48} LATITUDE_i + \beta_{49} LNELEVAT_i + \beta_{50} CO_i + \beta_{51} ID_i + \beta_{52} MT_i + \beta_{53} NV_i + \beta_{54} NM_i + \beta_{55} UT_i + \beta_{56} WY_i + \varepsilon_i$$

where

$LIFEXPM_i/LIFEXPF_i$ = life expectancy for males/females born in 1990 in the i^{th} county

$URBAN_i$ = Percentage of the population of the i^{th} county living in an urban area

$RURFARM_i$ = Percentage of the population of the i^{th} county living on a rural farm

$HHSIZE_i$ = Mean household size of the i^{th} county

$MARRIED_i$ = Percentage of households of the i^{th} county in which a married couple resides

$INCOME_i$ = Per capita income of the i^{th} county

$INCOME2_i$ = Squared per capita income of the i^{th} county

$POVERTY_i$ = Percentage of population of the i^{th} county with income below the poverty level

$VIOLCRIM_i$ = Violent crimes per 1000 people in the i^{th} county

$POPDENS_i$ = Persons per square mile in the i^{th} county

$EDUCATN_i$ = Percentage of persons 25 years or older who have completed at least 12 years of education in the i^{th} county

$UNEMP_i$ = Civilian labor force unemployment rate of the i^{th} county

$LANGUAGE_i$ = Percentage of persons 5 years and older speaking a language other than English at home in the i^{th} county

$FORBRN_i$ = Percentage of the population of the i^{th} county born in a foreign country

$CZECH_i$ = Percentage of the population of the i^{th} county reporting Czech as primary ancestry

$DANISH_i$ = Percentage of the population of the i^{th} county reporting Danish as primary ancestry

$DUTCH_i$ = Percentage of the population of the i^{th} county reporting Dutch as primary ancestry

$ENGLISH_i$ = Percentage of the population of the i^{th} county reporting English as primary ancestry

$FRENCH_i$ = Percentage of the population of the i^{th} county reporting French (Except Basque) as primary ancestry

$FRCANAD_i$ = Percentage of the population of the i^{th} county reporting French Canadian as primary ancestry

$GERMAN_i$ = Percentage of the population of the i^{th} county reporting German as primary ancestry

$GREEK_i$ = Percentage of the population of the i^{th} county reporting Greek as primary ancestry

$HUNGARY_i$ = Percentage of the population of the i^{th} county reporting Hungarian as primary ancestry

$IRISH_i$ = Percentage of the population of the i^{th} county reporting Irish as primary ancestry

$ITALIAN_i$ = Percentage of the population of the i^{th} county reporting Italian as primary ancestry

$NORWEG_i$ = Percentage of the population of the i^{th} county reporting Norwegian as primary ancestry

$POLISH_i$ = Percentage of the population of the i^{th} county reporting Polish as primary ancestry

$PORTUGS_i$ = Percentage of the population of the i^{th} county reporting Portuguese as primary ancestry

$RUSSIAN_i$ = Percentage of the population of the i^{th} county reporting Russian as primary ancestry

$SCTIRSH_i$ = Percentage of the population of the i^{th} county reporting Scots-Irish as primary ancestry

$SCOTTISH_i$ = Percentage of the population of the i^{th} county reporting Scottish as primary ancestry

$SLOVAK_i$ = Percentage of the population of the i^{th} county reporting Slovak as primary ancestry

$SWEDISH_i$ = Percentage of the population of the i^{th} county reporting Swedish as primary ancestry

$SWISS_i$ = Percentage of the population of the i^{th} county reporting Swiss as primary ancestry

USA_i = Percentage of the population of the i^{th} county reporting United States or American as primary ancestry

$WELSH_i$ = Percentage of the population of the i^{th} county reporting Welsh as primary ancestry

$WESTINDN_i$ = Percentage of the population of the i^{th} county reporting West Indian (Excluding Hispanic Origin Groups) as primary ancestry

$BLACK_i$ = Percentage of the population of the i^{th} county reporting Black as primary race

$AMINESAL_i$ = Percentage of the population of the i^{th} county reporting American Indian, Eskimo, or Aleut as primary race

$CHINESE_i$ = Percentage of the population of the i^{th} county reporting Chinese as primary race

$FILIPINO_i$ = Percentage of the population of the i^{th} county reporting Filipino as primary race

$JAPANESE_i$ = Percentage of the population of the i^{th} county reporting Japanese as primary race

$ASININDN_i$ = Percentage of the population of the i^{th} county reporting Asian Indian as primary race

$KOREAN_i$ = Percentage of the population of the i^{th} county reporting Korean as primary race

$VIETNMSE_i$ = Percentage of the population of the i^{th} county reporting Vietnamese as primary race

$MEXICAN_i$ = Percentage of the population of the i^{th} county reporting Mexican as primary origin

$PRTORCAN_i$ = Percentage of the population of the i^{th} county reporting Puerto Rican as primary origin

$CUBAN_i$ = Percentage of the population of the i^{th} county reporting Cuban as primary origin

$LATITUDE_i$ = Latitude of the county seat of the i^{th} county

$LNELEVAT_i$ = Elevation of the county seat of the i^{th} county

CO_i, ID_i, MT_i, NV_i, NM_i, UT_i, and WY_i = Dummy variables indicating the state of the i^{th} county

ε_i = Error term.

IV. REGRESSION RESULTS

The life expectancy models were tested using four sets of ordinary least squares regressions. In order to maintain consistency in the overall model, it was decided to omit from the regressions any ethnic, racial, or ancestral group whose numbers did not represent as many as 1 percent of any county. Several of these groups dropped out of the model under this criterion. Because of the problem of multicollinearity between the state dummy variables and other variables in the model, a model was also tested that omitted the state dummy variables. Finally, because it is not clear that all of the variables belong in the model, a backward stepwise technique was used to determine which variables should be included with and without state dummy variables. The regression results are reported below in tables 2 through 9. Three asterisks after the variable name indicates that the coefficient estimate is statistically significant at .01, two asterisks indicate significance at .05, and one asterisk indicates significance at .10.

Table 2. Female Life Expectancy Regression: Full Model

Summary of Fit

RSquare	0.727624
RSquare Adj	0.585246
Root Mean Square Error	0.705934
Mean of Response	79.406
Observations (or Sum Wgts)	135

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	46	117.15189	2.54678	5.1105
Error	88	43.85421	0.49834	Prob > F
C. Total	134	161.00610		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	70.407731	6.246197	11.27	<.0001
% urban 1990	0.003262	0.005683	0.57	0.5674
% rural farm 1990	0.0381411	0.039684	0.96	0.3391
hhsize	0.404579	0.799185	0.51	0.6140
married	0.0115851	0.033548	0.35	0.7307
income	0.2483491	0.292044	0.85	0.3974
income2	-0.000006	0.000008	-0.74	0.4612
% under poverty level 1990	0.0452733	0.040371	1.12	0.2652
violent crimes/1000 1990	-0.053049	0.043803	-1.21	0.2291
pop/sqmi 1990	-0.000042	0.000382	-0.11	0.9125
educational attainment 1990 **	0.0592613	0.029351	2.02	0.0465
unemployment 1990	0.0182125	0.054914	0.33	0.7409
5 and over not E @ home 1990 *	0.0517285	0.028203	1.83	0.0700
foreign born 1990	0.0186643	0.044914	0.42	0.6787
Czech *	0.6978924	0.369732	1.89	0.0624
Danish	-0.010885	0.055061	-0.20	0.8437
Dutch **	0.2843965	0.14062	2.02	0.0462
English	0.0036784	0.035866	0.10	0.9185
French (except Basque)	-0.045958	0.196118	-0.23	0.8153
French Canadian *	1.1223825	0.595032	1.89	0.0626
German	0.0343235	0.03017	1.14	0.2583
Irish	-0.045821	0.063497	-0.72	0.4724
Italian	0.1034596	0.082389	1.26	0.2125
Norwegian	0.0657646	0.060765	1.08	0.2821
Polish	-0.089266	0.202293	-0.44	0.6601
Portuguese	-0.521255	0.626811	-0.83	0.4079
Russian	0.4357888	0.457587	0.95	0.3435
Scotch/Irish	0.0071487	0.206491	0.03	0.9725
Scottish	0.2714655	0.223947	1.21	0.2287
Slovak	0.0679476	0.565276	0.12	0.9046
Swedish	0.034594	0.155929	0.22	0.8249
Swiss *	0.4923248	0.255438	1.93	0.0572
United States or American	-0.041508	0.063737	-0.65	0.5166
Welsh	0.159531	0.233295	0.68	0.4959
Black *	-0.12054	0.072488	-1.66	0.0999
American Indian, Eskimo, or Aleut **	-0.030718	0.014958	-2.05	0.0430
Filipino	-0.074505	0.685526	-0.11	0.9137
Mexican	-0.006443	0.023545	-0.27	0.7850
latitude	-0.055878	0.094628	-0.59	0.5564
lnelevat	-0.208931	0.250707	-0.83	0.4069
CO	0.4960547	0.565287	0.88	0.3826
ID	0.0609132	0.881691	0.07	0.9451
MT	-0.692291	1.051086	-0.66	0.5118
NV	-0.698837	0.692993	-1.01	0.3160
NM	0.3289734	0.413785	0.80	0.4287
UT	0.5320829	0.792938	0.67	0.5040
WY	-0.622204	0.778083	-0.80	0.4261

Table 3. Male Life Expectancy Regression: Full Model

Summary of Fit

RSquare	0.842281
RSquare Adj	0.759837
Root Mean Square Error	0.894535
Mean of Response	72.76435
Observations (or Sum Wgts)	135

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	46	376.05456	8.17510	10.2164
Error	88	70.41702	0.80019	Prob > F
C. Total	134	446.47158		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	57.79308	7.914963	7.30	<.0001
% urban 1990	0.0095232	0.007201	1.32	0.1894
% rural farm 1990	0.0553584	0.050286	1.10	0.2740
hhsize	0.6093035	1.012699	0.60	0.5489
married	0.0347913	0.042511	0.82	0.4153
income	-0.34394	0.370068	-0.93	0.3552
income2	0.0000119	0.00001	1.21	0.2285
% under poverty level 1990	0.0144274	0.051157	0.28	0.7786
violent crimes/1000 1990	-0.086774	0.055505	-1.56	0.1216
pop/sqmi 1990 *	-0.000878	0.000484	-1.82	0.0728
educational attainment 1990 ***	0.1718682	0.037193	4.62	<.0001
unemployment 1990	0.034463	0.069586	0.50	0.6217
5 and over not E @ home 1990	0.0194766	0.035738	0.54	0.5871
foreign born 1990	0.0533526	0.056914	0.94	0.3511
Czech	-0.195514	0.468512	-0.42	0.6775
Danish	-0.050245	0.069772	-0.72	0.4734
Dutch	0.2327627	0.178188	1.31	0.1949
English	-0.016671	0.045448	-0.37	0.7146
French (except Basque)	0.0445075	0.248514	0.18	0.8583
French Canadian	1.0867765	0.754003	1.44	0.1530
German	0.0134977	0.038231	0.35	0.7249
Irish	-0.084175	0.080461	-1.05	0.2984
Italian	0.0602714	0.1044	0.58	0.5652
Norwegian	0.0023613	0.076999	0.03	0.9756
Polish	-0.054388	0.256339	-0.21	0.8325
Portuguese	-0.278217	0.794273	-0.35	0.7270
Russian	0.3387211	0.579838	0.58	0.5606
Scotch/Irish	0.0890461	0.261659	0.34	0.7344
Scottish	0.1995637	0.283778	0.70	0.4838
Slovak	-0.05748	0.716298	-0.08	0.9362
Swedish *	0.3490286	0.197588	1.77	0.0808
Swiss *	0.5394159	0.323683	1.67	0.0992
United States or American	0.0450385	0.080765	0.56	0.5785
Welsh	-0.158176	0.295623	-0.54	0.5940
Black	-0.059043	0.091854	-0.64	0.5220
American Indian, Eskimo, or Aleut	-0.024878	0.018954	-1.31	0.1928
Filipino	-0.693641	0.868674	-0.80	0.4267
Mexican *	0.0501445	0.029835	1.68	0.0964
latitude	-0.095048	0.119909	-0.79	0.4301
lnelevat	-0.011031	0.317687	-0.03	0.9724
CO	1.0428898	0.716312	1.46	0.1490
ID	0.9992011	1.117248	0.89	0.3736
MT	0.7095846	1.3319	0.53	0.5955
NV	-0.546754	0.878137	-0.62	0.5351
NM	0.225371	0.524334	0.43	0.6684
UT	1.1441641	1.004783	1.14	0.2579
WY	-0.368411	0.985959	-0.37	0.7096

Table 4. Female Life Expectancy Regression: Omitting State Dummy Variables

Summary of Fit

RSquare	0.670804
RSquare Adj	0.53566
Root Mean Square Error	0.746942
Mean of Response	79.406
Observations (or Sum Wgts)	135

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	39	108.00350	2.76932	4.9636
Error	95	53.00260	0.55792	Prob > F
C. Total	134	161.00610		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	73.290191	5.433158	13.49	<.0001
% urban 1990	0.0020799	0.005634	0.37	0.7128
% rural farm 1990	0.0451221	0.041399	1.09	0.2785
hhsize	0.1170188	0.765389	0.15	0.8788
married	0.0242463	0.032446	0.75	0.4567
income	0.1034681	0.302247	0.34	0.7329
income2	-0.000002	0.000008	-0.22	0.8269
% under poverty level 1990	0.0573595	0.040336	1.42	0.1583
violent crimes/1000 1990	-0.037558	0.043644	-0.86	0.3916
pop/sqmi 1990	0.0002156	0.000385	0.56	0.5772
educational attainment 1990 ***	0.083548	0.025812	3.24	0.0017
unemployment 1990	0.009338	0.052712	0.18	0.8598
5 and over not E @ home 1990 *	0.0518318	0.026556	1.95	0.0539
foreign born 1990	0.0397732	0.045001	0.88	0.3790
Czech *	0.7044243	0.38692	1.82	0.0718
Danish	-0.040066	0.055274	-0.72	0.4703
Dutch **	0.3603928	0.141773	2.54	0.0126
English	0.0100576	0.029655	0.34	0.7352
French (except Basque)	-0.09114	0.205781	-0.44	0.6588
French Canadian *	1.0500089	0.568291	1.85	0.0678
German	0.0289915	0.028091	1.03	0.3047
Irish	-0.077301	0.056639	-1.36	0.1755
Italian	0.1355175	0.082743	1.64	0.1048
Norwegian	0.0055363	0.053693	0.10	0.9181
Polish	-0.28511	0.202188	-1.41	0.1618
Portuguese *	-1.119082	0.579119	-1.93	0.0563
Russian	0.4725187	0.463675	1.02	0.3108
Scotch/Irish	0.050769	0.209388	0.24	0.8089
Scottish	0.0612841	0.229266	0.27	0.7898
Slovak	0.1502876	0.56165	0.27	0.7896
Swedish	0.1611865	0.149263	1.08	0.2829
Swiss	0.3322939	0.255378	1.30	0.1963
United States or American	-0.037315	0.065168	-0.57	0.5683
Welsh	0.1516382	0.236296	0.64	0.5226
Black *	-0.134844	0.073868	-1.83	0.0711
American Indian, Eskimo, or Aleut ***	-0.040366	0.014935	-2.70	0.0081
Filipino	-0.358985	0.686896	-0.52	0.6025
Mexican	-0.024161	0.022758	-1.06	0.2911
latitude **	-0.105033	0.044184	-2.38	0.0195
lnelevat	-0.298434	0.224659	-1.33	0.1872

Table 5. Male Life Expectancy Regression: Omitting State Dummy Variables

Summary of Fit

RSquare	0.804 366
RSquare Adj	0.724053
Root Mean Square Error	0.958864
Mean of Response	72.76435
Observations (or Sum Wgts)	135

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	39	359.12668	9.20838	10.0154
Error	95	87.34490	0.91942	Prob > F
C. Total	134	446.47158		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	58.080477	6.974651	8.33	<.0001
% urban 1990	0.007812	0.007233	1.08	0.2828
% rural farm 1990	0.0669652	0.053145	1.26	0.2107
hhsize	-0.090167	0.982545	-0.09	0.9271
married	0.0540237	0.041651	1.30	0.1978
income	-0.589298	0.388	-1.52	0.1321
income2 *	0.0000178	0.00001	1.71	0.0897
% under poverty level 1990	0.0464038	0.05178	0.90	0.3724
violent crimes/1000 1990 *	-0.094783	0.056027	-1.69	0.0940
pop/sqmi 1990	-0.000546	0.000495	-1.10	0.2728
educational attainment 1990 ***	0.2154401	0.033135	6.50	<.0001
unemployment 1990	0.0122954	0.067667	0.18	0.8562
5 and over not E @ home 1990	0.018948	0.03409	0.56	0.5796
foreign born 1990	0.0923796	0.057769	1.60	0.1131
Czech	-0.120078	0.496696	-0.24	0.8095
Danish	-0.085498	0.070956	-1.20	0.2312
Dutch *	0.3191696	0.181997	1.75	0.0827
English	0.0116595	0.038069	0.31	0.7601
French (except Basque)	0.0011496	0.264165	0.00	0.9965
French Canadian	0.850927	0.729526	1.17	0.2464
German	0.0146959	0.036061	0.41	0.6845
Irish	-0.065179	0.072708	-0.90	0.3723
Italian	0.1242751	0.106219	1.17	0.2449
Norwegian	-0.043868	0.068927	-0.64	0.5260
Polish	-0.399673	0.259553	-1.54	0.1269
Portuguese	-0.917411	0.743426	-1.23	0.2202
Russian	0.560322	0.595229	0.94	0.3489
Scotch/Irish	0.0642636	0.268796	0.24	0.8116
Scottish	-0.116788	0.294314	-0.40	0.6924
Slovak	0.233373	0.721001	0.32	0.7469
Swedish **	0.4521816	0.191611	2.36	0.0203
Swiss	0.3388935	0.327834	1.03	0.3039
United States or American	0.0363146	0.083658	0.43	0.6652
Welsh	-0.10338	0.303337	-0.34	0.7340
Black	-0.06173	0.094825	-0.65	0.5166
American Indian, Eskimo, or Aleut	-0.029592	0.019172	-1.54	0.1260
Filipino	-1.043211	0.881782	-1.18	0.2397
Mexican	0.0388544	0.029215	1.33	0.1867
latitude	-0.056248	0.05672	-0.99	0.3239
lnelevat	-0.203589	0.288399	-0.71	0.4820

Table 6. Female Life Expectancy Backward Stepwise Regression: Full Model

Summary of Fit

RSquare	0.679255
RSquare Adj	0.635764
Root Mean Square Error	0.661546
Mean of Response	79.406
Observations (or Sum Wgts)	135

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	16	109.36423	6.83526	15.6184
Error	118	51.64186	0.43764	Prob > F
C. Total	134	161.00610		<.0001

Parameter Estimates

Term		Estimate	Std Error	t Ratio	Prob>|t|
Intercept		72.570986	0.961843	75.45	<.0001
violent crimes/1000 1990 **		-0.066738	0.032577	-2.05	0.0427
educational attainment 1990 ***		0.0619772	0.012399	5.00	<.0001
5 and over not E @ home 1990 ***		0.0524193	0.008935	5.87	<.0001
Czech ***		0.8580857	0.284364	3.02	0.0031
Dutch *		0.2134824	0.114265	1.87	0.0642
German ***		0.0438037	0.014807	2.96	0.0037
Irish *		-0.062382	0.032699	-1.91	0.0589
Italian **		0.1007393	0.04652	2.17	0.0324
Portuguese *		-0.9092	0.472273	-1.93	0.0566
Scottish *		0.2732504	0.156709	1.74	0.0838
Swiss ***		0.5083916	0.171437	2.97	0.0037
Black *		-0.070205	0.037719	-1.86	0.0652
American Indian, Eskimo, or Aleut ***		-0.027058	0.006009	-4.50	<.0001
MT ***		-0.717941	0.224535	-3.20	0.0018
NV **	0	-0.783556	0.395705	-1.98	0.0500
WY ***		-1.167025	0.23601	-4.94	<.0001

Table 7. Male Life Expectancy Backward Stepwise Regression: Full Model

Summary of Fit

RSquare	0.80285
RSquare Adj	0.779849
Root Mean Square Error	0.856455
Mean of Response	72.76435
Observations (or Sum Wgts)	135

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	14	358.44980	25.6036	34.9053
Error	120	88.02177	0.7335	Prob > F
C. Total	134	446.47158		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	60.956106	1.996487	30.53	<.0001
hhsize **	1.1044591	0.460799	2.40	0.0181
violent crimes/1000 1990 **	-0.098441	0.041261	-2.39	0.0186
educational attainment 1990 ***	0.1741776	0.0135	12.90	<.0001
foreign born 1990 ***	0.1395436	0.025069	5.57	<.0001
Danish **	-0.111071	0.045729	-2.43	0.0166
Irish *	-0.074926	0.04369	-1.71	0.0889
Black ***	-0.194405	0.048952	-3.97	0.0001
American Indian, Eskimo, or Aleut ***	-0.047136	0.009666	-4.88	<.0001
latitude ***	-0.111266	0.034842	-3.19	0.0018
CO ***	1.1018528	0.232555	4.74	<.0001
ID ***	1.3908714	0.349442	3.98	0.0001
MT **	1.0820898	0.414724	2.61	0.0102
NV **	-0.780856	0.363543	-2.15	0.0337
UT **	0.8446353	0.402516	2.10	0.0380

Table 8. Female Life Expectancy Backward Stepwise Regression: Omitting State Dummy Variables

Summary of Fit

RSquare	0.619943
RSquare Adj	0.572036
Root Mean Square Error	0.717088
Mean of Response	79.406
Observations (or Sum Wgts)	135

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	15	99.81454	6.65430	12.9407
Error	119	61.19156	0.51421	Prob > F
C. Total	134	161.00610		<.0001

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	74.513828	1.482534	50.26	<.0001
% rural farm 1990 *	0.0515673	0.02744	1.88	0.0627
educational attainment 1990 ***	0.0732261	0.014504	5.05	<.0001
5 and over not E @ home 1990 ***	0.0554446	0.010584	5.24	<.0001
Czech **	0.6942199	0.307356	2.26	0.0257
Dutch ***	0.4376693	0.118425	3.70	0.0003
French Canadian **	0.9775263	0.431556	2.27	0.0253
German *	0.0259954	0.015218	1.71	0.0902
Irish **	-0.094275	0.039667	-2.38	0.0191
Italian **	0.1046048	0.049044	2.13	0.0350
Portuguese ***	-1.303106	0.345836	-3.77	0.0003
Swedish **	0.262458	0.115951	2.26	0.0254
Swiss ***	0.6358546	0.187127	3.40	0.0009
Black ***	-0.114123	0.0398	-2.87	0.0049
American Indian, Eskimo, or Aleut ***	-0.025091	0.006504	-3.86	0.0002
latitude ***	-0.092023	0.026854	-3.43	0.0008

Table 9. Male Life Expectancy Backward Stepwise Regression: Omitting State Dummy Variables

Summary of Fit						
RSquare			0.76825			
RSquare Adj			0.741213			
Root Mean Square Error			0.928573			
Mean of Response			72.76435			
Observations (or Sum Wgts)			135			
Analysis of Variance						
Source	**DF**	**Sum of Squares**	**Mean Square**	**F Ratio**		
Model	14	343.00189	24.5001	28.4143		
Error	120	103.46968	0.8622	Prob > F		
C. Total	134	446.47158		<.0001		
Parameter Estimates						
Term			**Estimate**	**Std Error**	**t Ratio**	**Prob>|t|**
Intercept			62.016169	2.395588	25.89	<.0001
% urban 1990 *			0.0085766	0.004942	1.74	0.0852
% rural farm 1990 ***			0.0909837	0.034039	2.67	0.0086
income ***			-0.878955	0.240637	-3.65	0.0004
income2 ***			0.0000233	0.000007	3.29	0.0013
violent crimes/1000 1990 **			-0.103315	0.048398	-2.13	0.0348
pop/sqmi 1990 **			-0.000811	0.000324	-2.50	0.0138
educational attainment 1990 ***			0.2180585	0.021387	10.20	<.0001
foreign born 1990 ***			0.1174525	0.042545	2.76	0.0067
Danish **			-0.085875	0.041544	-2.07	0.0409
Norwegian ***			-0.125352	0.037995	-3.30	0.0013
Swedish ***			0.4105234	0.128495	3.19	0.0018
American Indian, Eskimo, or Aleut **			-0.025005	0.010298	-2.43	0.0167
Filipino ***			-1.786248	0.581706	-3.07	0.0026
Mexican **			0.0460063	0.019962	2.30	0.0229

It is interesting to note that the models explain average male life expectancy by county better than they do average female life expectancy. The R^2 for the male life expectancy regressions varies from .84 in regression 3 to .77 in regression 9; while for the female life expectancy regressions, it varies from .73 in regression 2 to .62 in regression 8. In each of the regressions, the F-statistic rejects the null hypothesis of no explanatory power in the model at the .0001 level.

Significant coefficients. Perhaps the most striking regression result is the significance of educational attainment in increasing life expectancy for both men and women. The estimated coefficient of educational attainment is statistically significant at .0001 in each of the male regressions, and is statistically significant at .0001 in the two female stepwise regressions, and at .01 and .05, respectively, in the normal OLS regressions. The impact of education on life expectancy is larger for men than for women in the models, with a one-percentage point increase in men over age 25 completing at least 12 years of school increasing average county male life expectancy by 2.0-2.5 months; while a 1-percentage point increase for women increases average county female life expectancy by 0.7-1.0 months. Another interesting result was the impact of the percentage of the county over age 5 speaking a language other than English at home on female life expectancy. In all four female regressions, the estimated coefficient is significant; and in three of the four regressions, the coefficient is statistically significant at .10 or better. For men, however, this variable is not statistically significant in any of the regressions. On the other hand, the percentage of the county foreign-born has a statistically significant estimated coefficient at .01 in both male stepwise regressions, and has the expected sign in the normal regressions. This variable does not appear in the female stepwise regressions. The results for the racial, ethnic, and ancestry variables correspond generally to expectations, with the anticipated signs being shown for most of the estimated coefficients. As expected, northern European ancestry is positively associated with mean county life expectancy for both men and women; with the exception of Danish and Irish, which have negative estimated coefficients. Black and American Indian, Eskimo, and Aleut estimated coefficients show the expected negative signs in both male and female regressions, with the coefficients being statistically significant in all of the female life expectancy regressions. In the male life expectancy regressions, the coefficient for black is statistically significant in only one regression, and the coefficient for American Indian, Eskimo, and Aleut is significant in two. Urbanization and rural farm coefficients are generally positive, and are statistically significant in some of the stepwise regressions. Similarly, average household size and percent of households married are positively related to life expectancy for both men and women, though not statistically significant except for household size in one male stepwise regression. Economic variables do not seem to have much impact on mean county life expectancy, except in the male life expectancy backward stepwise regression. In that regression, the income and income squared variables have the expected signs and are statistically significant at .01. Other variables of interest include violent crime rate and population density. Violent crime coefficients show the expected negative sign in all of the male regressions, and are statistically significant in all but one regression. In the female regressions, violent crime coefficients are negative in the three models in which they appear, and the coefficient is significant in one regression. Population density seems to be more important in affecting male life expectancy than female life expectancy. The estimated coefficient is negative in the three male life expectancy regressions in which it appears, and is statistically significant in two. The variable is not selected in either female stepwise regression, and has an insignificant coefficient in the other two regressions. The coefficients for both geographical variables, latitude and elevation are consistently negative where they appear in the regressions. This is a bit surprising for the elevation variable, which we guessed would be positive. The regression results indicate that the latitude variable is the more significant of the two, particularly when the state dummy variables are omitted from the regression. The results also suggest that the geographical variables are more important in influencing female life expectancy. The state dummy variables are quite interesting. In all regressions where they appear, the estimated coefficients for Colorado, Idaho, New Mexico, and Utah are positive, suggesting that life expectancies for both men and women in those states are higher than one would predict from the rest of the model, *ceteris paribus.* For Nevada and Wyoming, life expectancies are lower than the rest of the model would predict. Montana is unusual in that the estimated coefficient is positive in the male regressions, and negative in the female regressions. The only state dummy coefficient that is statistically significant for both male and female life expectancy regressions is Nevada. One can speculate as to the causes of this negative impact on life expectancy. Perhaps the liberal laws regarding gambling and prostitution, and the lifestyle with which those activities are associated is one possible explanation.

V. CONCLUSIONS

Life expectancy varies greatly across counties in the eight Mountain States. The models tested here can explain between 62% and 84% of the total county-level variability in life expectancy for men and for women. In general, we conclude that educational attainment is positively associated with life expectancy for both sexes; and that the percentage of the county population age 5 and older speaking a language other than English at home is positively associated with average female life expectancy; while the percentage of the county population foreign-born is positively associated with average male life expectancy. The percentage of the county whose primary ancestry is northern European has a generally positive effect on both female and male life expectancies. The percentage of the population black and the percentage American Indian, Eskimo, and Aleut decreases mean county life expectancies for both men and women, *ceteris paribus*, but the effect is more significant in the statistical sense for female life expectancy. Violent crime rates are negatively associated with life expectancies for men and women, but population density seems to have a negative effect primarily on mean male life expectancy. The percentages of the county population classified as urban and as rural farm, the percentage of households married, and household size all have a positive effect on mean county life expectancies for both sexes. The only economic variables that seem to matter in determining life expectancy are income and income squared, which have the expected pattern of signs that give rise to a U-shaped relationship between income and life expectancy, but only for men. Latitude and elevation seem to be negatively associated with life expectancy, especially for women. Other things equal, life expectancy is greater than expected for both men and women in Colorado, Idaho, New Mexico, and Utah; while life expectancy is less than expected for both men and women in Nevada and Wyoming. In Montana, men live longer than the rest of the model predicts, while women have a shorter life expectancy.

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