Technical Supplement: Canadians' Arts Participation, Health, and Well-Being

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Introduction

The goal of this study is to examine predictors of four aspects of Canadians' health and well-being: self-rated health; self-rated mental health; self-rated satisfaction with life; and self-rated satisfaction with feeling part of community. Data drawn from Statistics Canada's *General Social Survey* of 2016 are used to determine which demographic factors and arts activities can predict very good or excellent health, very good or excellent mental health, above-average satisfaction with life, and above-average satisfaction with feeling part of community.

The *General Social Survey*, a hybrid telephone-online survey of a representative sample of 9,844 Canadians 15 years of age or older, included questions about people's arts attendance and participation during the 12 months prior to the survey.[1] In this report, an arts attendee or participant is generally defined as someone who attended or participated at least once during the 12-month period. This is a low threshold of arts participation. In fact, repeated or deeply engaged arts experiences may generate stronger impacts.

Seven arts activities were selected for this analysis:

- Participating in any of eight arts activities or hobbies (also called "active arts participation")
- Live theatre or comedy attendance
- Popular or classical music attendance
- Heritage or ethnic performance attendance
- Arts or cultural festival attendance
- Public art gallery attendance
- Book reading (in any format)

This technical supplement discusses variable selection and coding as well as the results of four logistic regression models. Logistic regression analysis was used to determine the odds ratio (or likelihood) of people with the characteristic of an independent variable (e.g., people who visited an art gallery during the previous year) having very good or excellent health, very good or excellent mental health, strong satisfaction with life, or strong sense of community belonging, compared with others (e.g., those who did not visit an art gallery during the previous year), holding other factors constant.

Details of the exploratory analysis of the connections between arts attendance and Canadians' health and well-being are provided in the main report for this project, available at hillstrategies.com. The exploratory data highlights the potential relationships between 15 arts, culture, and heritage activities and four aspects of health and well-being:

- Health (self-rating of very good or excellent)
- Mental health (self-rating of very good or excellent)

[1] The survey design excluded residents of the three territories. All computations, use, and interpretation of these data were conducted by Hill Strategies Research, not Statistics Canada.

- Satisfaction with life (self-rating of 8-10 on a scale from 0-10)
- Satisfaction with feeling part of community (self-rating of 8-10 on a scale from 0-10)

The exploratory analysis helped inform the independent and dependent variables selected for the regression analysis. The main report also provides a summary of the results of the regression analysis (which are described in greater detail in this technical supplement).

Methods

Logistic Regression

Logistic regression was used to predict the probability of having (for example) very good or excellent health, due to other characteristics under investigation – the demographic variables and arts activities. More specifically, binary logistic regression was used, as the dependent variables in this study are dichotomous (i.e., yes/no variables). This method measured the statistical significance of the independent (predictor) variables, the multicollinearity of the independent variables, and the effect of the predictor variables on the dependent variable.

Binary (or binomial) logistic regression is a type of analysis where logistic regression equations are solved iteratively, in contrast to other types of regression analysis where a mathematical equation is solved explicitly. In binary logistic regression a trial equation is fitted and adjusted in order to improve the fit:

$$\text{logit}[p] = \log [p/1- p] = \alpha + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_i x_i \qquad \text{[Equation 1]}$$

where p is the probability of the event occurring, α is the constant of the equation and β_i are the coefficients of the predictor values. The user determines when the iterations stop. That is, either an explicit number of iterations are performed or a cut-value is selected so that the iterations stop when the improvement from step to the next is less than the cut-value.

Once the equation is fitted, odds ratios can be determined. An odds ratio is a prediction about how likely the respondent was to have very good or excellent health (or very good or excellent mental health, or high satisfaction with life). This is calculated by raising the base of the natural logarithm to the βth power, where β is the coefficient of the predictor variable from the trial equation. That is:

$$\text{ODDS} = e^{\beta} = p/1-p \qquad \text{[Equation 2]}$$

where β is the slope of the logistic regression equation for a specific dependent variable. Once the odds of an event occurring have been calculated, they can be converted to probabilities:

$$p = \text{ODDS}/ (1 + \text{ODDS}) \qquad \text{[Equation 3]}$$

Probabilities can be more useful when describing the effects of the predictor variables on the dependent variable.

Predictive analytic software (SPSS) was used to perform the iterations necessary to derive the logistic regression equation. The weighted dataset for the 2016 General Social Survey was used.[2]

Once the logistic regression equation was fitted, the software's output presented the coefficients of the predictor variables as well as a 95% confidence interval used for error analysis.

Variable Selection

A model was constructed for each of the four dependent variables (self-rated very good or excellent health; self-rated very good or excellent mental health; self-rated above-average satisfaction with life; and ; self-rated above-average satisfaction with feeling part of community), using forward stepwise conditional logistic regression.

The statistical models include demographic variables that might be significant, based on exploratory analysis from this dataset as well as previous research on this topic. The initial goal was to create the best possible models using only demographic factors.[3]

At this point, the arts and culture activities were added individually to the models. The ultimate goal was to find whether each of the activities has some explanatory value in each model, above and beyond demographic information. The goal was not to find which arts activity or activities created the best possible overall models of the health and well-being variables.

While the statistical models can provide evidence of a connection between arts activities, health, and well-being, it is very difficult to provide irrefutable evidence of a cause and effect relationship between the variables in a statistical model in the absence of an experiment to directly measure the impacts of the arts on health and well-being.

In addition, because existing survey data were used, there was no opportunity to include customized questions in the survey. In this case, useful predictors of health might have included exercise frequency, for example.

2 The weights were rescaled to have the average weight equal to 1. This was done to provide more meaningful calculations of variances.
3 Model accuracy was measured by the statistical significance of the model, in particular, the -2 log likelihood. The steps of adding and removing different combinations of variables was done until the -2 log likelihood was as small as possible, while other statistical tests showed that the data fit the model well and that the predictor variables did not exhibit multicollinearity.

Table 1 lists the independent variables that were entered into the models.

Table 1: Independent variables in the logistic regression models

Demographic and other non-cultural factors	Arts activities
Level of education	Public art gallery
Family income	Live music (pop or classical)
Age group	Live theatre/comedy performance
Gender	Artistic or cultural festival
Children at home	Heritage or ethnic performance
Region (BC, Prairies, Ontario, Quebec, Atlantic)	Making or performing art in any way
Urban / rural	
Household language	
Indigenous person	
Racialized person	
Immigrant	
Eating habits (self-rated quality)	
Disability status	
Smoking frequency (currently)	
Frequency of alcohol consumption	

Variable Coding

A dichotomous structure was created for each of the dependent variables (i.e., the four aspects of health and well-being). For self-rated health and mental health, ratings of "excellent" and "very good" were combined and compared with ratings of "good", "fair" and "poor". The two self-rated satisfaction questions (satisfaction with life and satisfaction with feeling of belonging to community) were separated into above-average ratings (i.e., ratings of 8-10 on a scale from 0-10) and lower ratings (0-7).

Many of the variables in the model have two possible response options, typically "yes" and "no". For these dichotomous variables, "no" was coded "0" and "yes" was coded "1".

Other (categorical) variables have multiple response options. For example, the response options for household language were coded as: English (alone) = 0; French (alone or in equal combination with English) = 1; Non-official language (alone or in equal combination with English or French) = 2.

In cases where the questions included the response options "don't know" and "not stated", these responses were excluded in the regression analysis. When these results were excluded for all demographic and arts variables, there were 9,188 complete records in the dataset, rather than the 9,844 original records.

Results

Data Interpretation

The results obtained from the SPSS output are provided in Appendix 1 for four "core" models (i.e., models with demographic variables only).

Information about the statistical importance of the arts activities is provided below the core models in Appendix 1. The seven arts activities, which were entered separately to the core demographic models, are: public art gallery attendance; live music attendance (including pop and classical music); live theatre or comedy attendance; heritage or ethnic performance attendance; arts or cultural festival attendance; book reading (in any format); and participation in any of eight arts activities or hobbies (also called "active arts participation").

Some of the coefficients for the core demographic factors changed slightly when a statistically significant arts activity was entered into the model. These changes were generally very small and are not provided here.

The odds ratio – denoted as exp(B) – for each independent variable is a positive real number. If the odds ratio is greater than one, then the independent variable predicts a greater likelihood of having very good or excellent health (or very good or excellent mental health, above-average satisfaction with life, or above-average satisfaction with feeling part of community), compared with people in the reference class for that variable. Conversely, if the odds ratio is less than one, there is a lower likelihood.

For dichotomous variables, the odds ratio indicates that someone who responded "yes" to the given question is exp(B) times as likely to have very good or excellent health (in the first example) than someone who responded "no" to the same question. For example, the first row of the arts activities portion of Appendix Table 1 shows that art gallery visitors are 1.141 times as likely as non-visitors to have very good or excellent health. In other words, they are about 14% more likely to report very good or excellent health, a result that is statistically significant ("Sig" = 0.006, which is less than 0.05).

All variables that are not significant predictors are excluded from the tables in this technical supplement.

For categorical variables, if the respondent fits into one of the classes (or segments) of the variable, then they are exp(B) times as likely to have very good or excellent health compared with someone in the reference class. The reference class is the first option listed and always has an empty entry for exp(B). For household language, the odds are shown relative to the reference category ("English alone"). The SPSS output for satisfaction with life (Appendix Table 3, Exp(B) column) shows that respondents with a non-official household language (alone or in equal combination

with English or French) are 1.395 times more likely to report above-average satisfaction with life as respondents who speak English in their household. In other words, they are about 40% more likely to report above-average satisfaction with life. This result is statistically significant ("Sig" = 0.002, which is less than 0.05). On the other hand, the result for people who speak French most often at home (either alone or in equal combination with English) does not show a significant variation from English speakers (the reference class for this variable).

Care must be used when examining the results for the categorical variables, as not all classes are necessarily significant. Categorical variables with *at least one* class that is useful are included in the model. Classes that are not significant are greyed out in the tables. For example, the SPSS output for health (Appendix Table 1) shows that the finding for respondents with family income in the three classes of $75,000 or more are not statistically significant (Sig greater than 0.05 in all three cases). As such, the odds ratios in the Exp(B) column should be ignored for these classes.

For each of the classes that has a value for exp(B), there are columns entitled "Lower" and "Upper". These represent the 95% confidence interval (margin of error) for the odds ratio. If the 95% confidence interval contains the value "1", then it contains both a prediction of "yes" and "no" with regards to the dependent variable. This corresponds to a value larger than .05 in the "Sig" column, indicating that the independent variable is not an effective predictor in the model.

The independent variables were entered into the models with the coding of "0" as the reference level. The reference level is listed first in the following tables.

Appendix 1: SPSS Output for the Binary Logistic Regression Models of Four Indicators of Health and Well-being

Appendix Table 1: Results of the model to predict very good or excellent health

Factors in health							95% C.I. for Exp(B)	
	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Education: High school or less			48.376	2	0			
Education: College, CÉGEP, trades	-0.413	0.059	48.341	1	0	0.662	0.589	0.743
Education: University degree or certificate	-0.229	0.06	14.71	1	0	0.795	0.708	0.894
Family income: Less than $25,000			28.4	5	0			
Family income: $25,000 to $49,999	-0.408	0.087	22.233	1	0	0.665	0.561	0.788
Family income: $50,000 to $74,999	-0.212	0.075	7.983	1	0.005	0.809	0.698	0.937
Family income: $75,000 to $99,999	-0.134	0.07	3.712	1	0.054	0.874	0.763	1.002
Family income: $100,000 to $124,999	-0.043	0.073	0.345	1	0.557	0.958	0.831	1.105
Family income: $125,000 or more	0.001	0.077	0	1	0.991	1.001	0.86	1.165
Age group: 15 to 24			125.056	6	0			
Age group: 25 to 34	0.923	0.104	78.443	1	0	2.517	2.052	3.087
Age group: 35 to 44	0.582	0.103	32.158	1	0	1.789	1.463	2.187
Age group: 45 to 54	0.396	0.104	14.613	1	0	1.486	1.213	1.82
Age group: 55 to 64	0.446	0.103	18.836	1	0	1.561	1.277	1.909
Age group: 65 to 74	0.297	0.101	8.708	1	0.003	1.346	1.105	1.639
Age group: 75 and over	0.093	0.106	0.774	1	0.379	1.097	0.892	1.35
Region: Ontario			21.206	4	0			
Region: BC	0.01	0.095	0.011	1	0.918	1.01	0.839	1.215
Region: Prairies	-0.189	0.107	3.099	1	0.048	0.828	0.671	1.022
Region: Quebec	0.115	0.102	1.277	1	0.258	1.122	0.919	1.369
Region: Atlantic	0.146	0.098	2.2	1	0.138	1.157	0.954	1.404
Indigenous people (Not Indigenous, Indigenous)	-0.484	0.131	13.698	1	0	0.616	0.477	0.796
Racialized people (Not racialized, racialized)	-0.12	0.061	3.84	1	0.05	0.887	0.786	1

Eating habits (Good/fair/ poor, very good/excellent)	1.572	0.047	1109.321	1	0	4.816	4.39	5.283
Alcohol consumption: Never or not in past month			20.959	2	0			
Alcohol consumption: Once a week or month	-0.274	0.061	19.803	1	0	0.761	0.674	0.858
Alcohol consumption: Multiple times per week	-0.091	0.056	2.637	1	0.104	0.913	0.818	1.019
Constant	-0.528	0.138	14.73	1	0	0.59		
-2 Log likelihood = 11572.59								

Arts activities added separately to the initial demographic model

Health	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Public art gallery attendance (no, yes)	0.132	0.048	7.556	1	0.006	1.141	1.039	1.254
Live music attendance, pop and/or classical (no, yes)	0.205	0.047	19.458	1	0	1.228	1.121	1.345
Live theatre and/or comedy attendance (no, yes)	0.23	0.047	23.699	1	0	1.259	1.147	1.381
Arts or cultural festival attendance (no, yes)	0.116	0.05	5.369	1	0.02	1.123	1.018	1.239
Heritage or ethnic performance attendance (no, yes)	Not retained as a significant factor.							
Book reading	0.141	0.056	6.462	1	0.011	1.152	1.033	1.284
Active arts participation, any of 8 activities (no, yes)	0.099	0.046	4.627	1	0.031	1.104	1.009	1.208

Appendix Table 2: Results of the model to predict very good or excellent mental health

Factors in mental health							95% C.I. for Exp(B)	
	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Education: High school or less			13.19	2	0.001			
Education: College, CÉGEP, trades	-0.183	0.059	9.721	1	0.002	0.833	0.742	0.934
Education: University degree or certificate	-0.194	0.06	10.645	1	0.001	0.823	0.733	0.925
Family income: Less than $25,000			45.263	5	0			
Family income: $25,000 to $49,999	-0.513	0.082	38.742	1	0	0.598	0.509	0.703
Family income: $50,000 to $74,999	-0.288	0.073	15.507	1	0	0.75	0.65	0.865
Family income: $75,000 to $99,999	-0.14	0.069	4.077	1	0.043	0.87	0.76	0.996
Family income: $100,000 to $124,999	-0.135	0.072	3.46	1	0.063	0.874	0.758	1.007
Family income: $125,000 or more	-0.053	0.077	0.473	1	0.492	0.948	0.815	1.104
Age group: 15 to 24			25.03	6	0			
Age group: 25 to 34	0.086	0.099	0.743	1	0.389	1.089	0.897	1.323
Age group: 35 to 44	0.283	0.099	8.185	1	0.004	1.327	1.093	1.611
Age group: 45 to 54	0.047	0.1	0.222	1	0.637	1.048	0.862	1.274
Age group: 55 to 64	0.306	0.099	9.492	1	0.002	1.358	1.118	1.65
Age group: 65 to 74	0.166	0.097	2.917	1	0.088	1.18	0.976	1.427
Age group: 75 and over	0.289	0.103	7.925	1	0.005	1.335	1.092	1.632
Region: Ontario			69.701	4	0			
Region: BC	0.15	0.092	2.673	1	0.102	1.161	0.971	1.39
Region: Prairies	-0.022	0.104	0.043	1	0.835	0.979	0.799	1.199
Region: Quebec	0.104	0.098	1.118	1	0.29	1.11	0.915	1.346
Region: Atlantic	0.525	0.096	29.911	1	0	1.69	1.4	2.04
Racialized people (Not racialized, racialized)	0.232	0.059	15.353	1	0	1.262	1.123	1.417
Eating habits (Good/fair/ poor, very good/excellent)	1.093	0.047	532.141	1	0	2.983	2.718	3.273
-2 Log likelihood = 11770.06								

Arts activities added separately to the initial demographic model

Mental health	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Public art gallery attendance (no, yes)	Not retained as a significant factor.							
Live music attendance, pop and/or classical (no, yes)	0.136	0.046	8.821	1	0.003	1.146	1.047	1.254
Live theatre and/or comedy attendance (no, yes)	0.176	0.047	13.957	1	0	1.193	1.087	1.308
Arts or cultural festival attendance (no, yes)	Not retained as a significant factor.							
Heritage or ethnic performance attendance (no, yes)	Not retained as a significant factor.							
Book reading (none, at least one)	0.206	0.055	13.977	1	0	1.228	1.103	1.368
Active arts participation, any of 8 activities (no, yes)	Not retained as a significant factor.							

Appendix Table 3: Results of the model predict above-average satisfaction with life (self-rating of 8-10 on a scale from 0-10)

Factors in above-average satisfaction with life							95% C.I. for Exp(B)	
	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Education: High school or less			10.416	2	0.005			
Education: College, CÉGEP, trades	0.171	0.06	8.189	1	0.004	1.187	1.055	1.334
Education: University degree or certificate	0.014	0.059	0.059	1	0.808	1.015	0.903	1.14
Family income: Less than $25,000			63.645	5	0			
Family income: $25,000 to $49,999	-0.588	0.084	49.181	1	0	0.556	0.471	0.655
Family income: $50,000 to $74,999	-0.431	0.075	33.235	1	0	0.65	0.561	0.752
Family income: $75,000 to $99,999	-0.271	0.07	14.908	1	0	0.762	0.664	0.875
Family income: $100,000 to $124,999	-0.235	0.073	10.235	1	0.001	0.791	0.685	0.913
Family income: $125,000 or more	-0.106	0.078	1.845	1	0.174	0.899	0.771	1.048
Age group: 15 to 24			86.819	6	0			
Age group: 25 to 34	-0.497	0.11	20.431	1	0	0.609	0.491	0.755
Age group: 35 to 44	-0.653	0.108	36.696	1	0	0.521	0.422	0.643
Age group: 45 to 54	-0.771	0.108	50.745	1	0	0.463	0.374	0.572
Age group: 55 to 64	-0.755	0.107	49.52	1	0	0.47	0.381	0.58
Age group: 65 to 74	-0.482	0.107	20.447	1	0	0.617	0.501	0.761
Age group: 75 and over	-0.205	0.114	3.265	1	0.071	0.815	0.652	1.018
Urban-rural (urban residents, rural or PEI residents)	0.265	0.067	15.608	1	0	1.304	1.143	1.487
Region: Ontario			14.919	4	0.005			
Region: BC	-0.299	0.1	9.026	1	0.003	0.741	0.61	0.901
Region: Prairies	-0.225	0.111	4.076	1	0.043	0.798	0.642	0.993
Region: Quebec	-0.1	0.106	0.896	1	0.344	0.905	0.736	1.113
Region: Atlantic	-0.195	0.123	2.521	1	0.112	0.823	0.647	1.047
Racialized people (Not racialized, racialized)	0.231	0.076	9.328	1	0.002	1.26	1.086	1.461
Immigrant to Canada (Not an immigrant, immigrant)	0.276	0.074	13.813	1	0	1.318	1.139	1.525

Household language: English (alone)			9.349	2	0.009			
Household language: French (alone or in combination with English)	0.117	0.077	2.31	1	0.129	1.124	0.967	1.308
Household language: Non-official language (alone plus all combinations)	0.333	0.109	9.327	1	0.002	1.395	1.127	1.727
Eating habits (Good/fair/ poor, very good/excellent)	0.743	0.048	243.485	1	0	2.103	1.916	2.309
Constant	1.038	0.164	40.301	1	0	2.824		
-2 Log likelihood = 11523.35								

Arts activities added separately to the initial demographic model

Satisfaction with life	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Public art gallery attendance (no, yes)	Not retained as a significant factor.							
Live music attendance, pop and/or classical (no, yes)	0.226	0.047	23.532	1	0	1.254	1.144	1.374
Live theatre and/or comedy attendance (no, yes)	0.204	0.048	18.161	1	0	1.227	1.117	1.347
Arts or cultural festival attendance (no, yes)	Not retained as a significant factor.							
Heritage or ethnic performance attendance (no, yes)	Not retained as a significant factor.							
Book reading (none, at least one)	Not retained as a significant factor.							
Active arts participation, any of 8 activities (no, yes)	0.101	0.046	4.75	1	0.029	1.106	1.01	1.211

Appendix Table 4: Results of the model predict above-average satisfaction with feeling part of community (self-rating of 8-10 on a scale from 0-10)

Factors in above-average community belonging							95% C.I. for Exp(B)	
	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Education: High school or less			13.307	2	0.001			
Education: College, CÉGEP, trades	0.15	0.055	7.388	1	0.007	1.162	1.043	1.296
Education: University degree or certificate	-0.04	0.056	0.516	1	0.473	0.961	0.861	1.072
Age group: 15 to 24			62.296	6	0			
Age group: 25 to 34	-0.077	0.096	0.631	1	0.427	0.926	0.767	1.119
Age group: 35 to 44	-0.434	0.096	20.352	1	0	0.648	0.536	0.782
Age group: 45 to 54	-0.499	0.101	24.51	1	0	0.607	0.498	0.74
Age group: 55 to 64	-0.514	0.099	27.139	1	0	0.598	0.493	0.726
Age group: 65 to 74	-0.209	0.095	4.84	1	0.028	0.811	0.673	0.977
Age group: 75 and over	-0.053	0.101	0.28	1	0.597	0.948	0.778	1.156
Urban-rural (urban residents, rural or PEI residents)	0.321	0.062	26.764	1	0	1.379	1.221	1.557
Region: Ontario			11.713	4	0.02			
Region: BC	-0.282	0.093	9.122	1	0.003	0.754	0.628	0.906
Region: Prairies	-0.299	0.105	8.17	1	0.004	0.741	0.604	0.91
Region: Quebec	-0.187	0.099	3.592	1	0.058	0.83	0.684	1.006
Region: Atlantic	-0.192	0.096	3.981	1	0.046	0.826	0.684	0.997
Immigrant to Canada (Not an immigrant, immigrant)	0.184	0.055	11.136	1	0.001	1.202	1.079	1.34
Child at home (No child at home, at least 1 child at home)	0.126	0.052	5.871	1	0.015	1.134	1.024	1.256
Eating habits (Good/fair/ poor, very good/excellent)	0.655	0.044	220.637	1	0	1.925	1.766	2.099
Alcohol consumption: Never or not in past month			11.263	2	0.004			
Alcohol consumption: Once a week or month	0.112	0.057	3.835	1	0.05	1.118	1	1.25
Alcohol consumption: Multiple times per week	-0.062	0.053	1.391	1	0.238	0.94	0.848	1.042
Constant	0.212	0.128	2.729	1	0.099	1.236		
-2 Log likelihood = 12459.72								

Arts activities added separately to the initial demographic model

Community belonging	B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Public art gallery attendance (no, yes)	Not retained as a significant factor.							
Live music attendance, pop and/or classical (no, yes)	0.186	0.044	17.457	1	0	1.204	1.104	1.314
Live theatre and/or comedy attendance (no, yes)	0.185	0.045	16.833	1	0	1.203	1.102	1.315
Arts or cultural festival attendance (no, yes)	0.126	0.048	6.959	1	0.008	1.134	1.033	1.245
Heritage or ethnic performance attendance (no, yes)	Not retained as a significant factor.							
Book reading (none, at least one)	Not retained as a significant factor.							
Active arts participation, any of 8 activities (no, yes)	Not retained as a significant factor.							

Bibliography

Logistic Regression, 2002, http://userwww.sfsu.edu/~efc/classes/biol710/logistic/logisticreg.htm

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