THE EFFECT OF TIME OF VOTING ON ELECTION RESULTS--BASED ON EXIT POLL DATA

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Introduction

Elections have been a part of the American political system for more than 200 years. Elections are a vital and interesting part of the American political scene, and because of the interest elections generate, people want to know who has won the election as soon as possible. Exit polls[1] in part, have been adopted as a popular tool to meet that need.

Early projections of winners have raised concern and have led to severe criticism of exit polls. One criticism is that early projections from data on the East Coast can influence the way people vote and whether they will vote on the West Coast. One argument is that Democrats vote earlier in the day than Republicans (Jenkins, 1989). Thus early returns and early projections could show a Democratic leaning. This could affect both Democratic and Republican voters on the West Coast who hear the early projection.

What, if any, is the relationship between the time of day an individual votes and the way that individual votes? Is there any evidence to conclude that voters of one political persuasion vote at a different time of day than those of a different political persuasion? An exit poll, if conducted the right way, with the right questions being asked, can provide the answer. If interviewers interview throughout the day, and the time of day an individual votes is recorded, the relationship between time and vote can be investigated.

To date, few studies dealing with time of voting and voting patterns have been done. A study done by Klorman (1976), using aggregate national data, examined various demographic variables and their relationship to time. Using indices of dissimilarity and the canonical correlation of dummy variables based on three sets of variables, he concluded that although relationships seem to exist across subpopulations based on demographic variables, when the population is looked at as a whole, the relationships tend to cancel each other out. He does suggest that dividing the population into subpopulations, using interactions between various variables, might do a better job of predicting voter behavior across time, but because of small sample sizes he was not able to pursue the issue.

A study done by Busch (1985) disagrees with Klorman's findings. Busch argues that Klorman's use of national data may minimize any effect of time in a specific area of the country. This is because characteristics in one part of the country may be reversed in another part of the country so that any overall effect is negligible. Using exit poll data taken from a special election held in Cleveland, Ohio, he concludes that the amount of discretionary time a voter has, affects their time of voting. Busch also explains other differences in voting behavior that were observed. He argues however, that if the election were held across the whole country, different metropolitan areas might cancel out any significant effect that was seen in a local area. He concludes that the time of exit poll interviews can affect exit poll results in local areas because different people are voting at different times.

The purpose of this study is to investigate the relationship between the time one votes and the way one votes using data from an exit poll conducted by students at Brigham Young University (BYU). Insofar as is possible we have tried to duplicate the analysis methods of Busch and Klorman for purposes of comparison.

Exit Poll Methodology

Exit polls have been conducted at BYU in 1982, 1984, 1986, and 1988. For this study we have used only the 1988 data. The exit poll conducted in 1988 by BYU students was a stratified, multi-stage probability sample with some counties and all voting districts selected with probabilities proportional to size. Individual voters were selected systematically within a voting place using a random start.

Utah is divided into three congressional districts. Therefore these districts were used as the basis for developing the sample design. Eight counties were included in the sample with certainty because of location, past voting behavior, or size (these counties are referred to as certainty units--selected with probability equal to one). The remaining counties were grouped into 3 strata. From these, three counties from congressional district 1 and three counties from congressional district 3 were sampled with probability proportional to size. The counties included in the sample are shown as "shaded" counties in Figure 1.

A total of 120 polling locations across the state were used, 40 locations per congressional district. Then, based on the counties sampled in the first stage, voting locations within each congressional district were allocated proportionately, based on estimated turnout for the selected counties. The number of polling locations sampled is also shown in Figure 1 beneath the county name.

Once the sample counties were known, an estimate of voter turnout for each voting location within each selected county was obtained using past election data. Based on the projections of voter turnout, polling locations were selected using pps sampling. In each county sampled, at least two locations were selected so that a measure of within-county variance could be obtained.

After polling locations were selected, the projected voter turnout for the location was used to establish voter sampling rates to produce a self-weighting sample. Thus, theoretically, every voter had an equal chance of being selected. Estimates of totals or means then become a constant multiplied by the sum of all the individual responses across the voting locations, counties and strata of interest.

Comparison With Busch's Study

Busch (1985) published results obtained in 1981 from a special election held in Cleveland, Ohio. This election dealt with a measure that would increase the city's income tax. Using data obtained from an exit poll, Busch used two and three-way tables as well as dissimilarity indices for his analysis. For his purposes, the election day was divided into five equal periods: (1) early morning (6:30 A.M. to 9:00 A.M.), (2) midmorning (9:00 A.M. to 11:30 A.M.), (3) noon (11:30 A.M. to 2:00 P.M.), (4) midafternoon (2:00 P.M. to 4:30 P.M.), and (5) late afternoon (4:30 P.M. to 7:00 P.M.). Next, Busch broke the population down by employment, sex, occupational status, education, age, race, party identification, and how they voted in the election.

Data taken from the BYU exit poll conducted by BYU students during the 1988 elections was divided by the same time intervals and the same demographic variables resulting in Table 1.
(Employment and occupational status were not obtained from respondents and are therefore excluded from the analysis). Table 1 shows the proportion of voters within

Table 1
Distribution of BYU Exit Poll Voters by Interview Time (Busch's Intervals)

Characteristics	Time of interview: Early Morn	Mid Morn	Noon	Mid After.	Late After.	N	Cramer's V Busch*	BYU
Sex								
Male	15.8	21.1	15.4	16.7	31.2	931	.19	.07
Female	12.4	21.1	19.9	17.7	29.1	826		
Education								
8th grade	21.4	42.9	14.3	7.1	14.3	14	.14	.08
Some High School	8.9	30.4	21.4	10.7	28.6	56		
High School	10.5	23.5	19.6	19.9	26.5	392		
Some College	12.7	18.4	18.5	18.2	32.2	670		
College Graduate	19.3	20.2	14.2	15.2	31.1	618		
Age								
18-24	11.2	20.7	18.7	18.0	31.5	445	.14	.14
25-34	11.6	15.3	17.7	17.7	37.7	406		
35-44	19.1	19.4	15.2	15.2	31.2	382		
45-54	14.0	18.6	11.6	23.3	32.6	258		
55-64	24.0	28.1	14.0	12.3	21.6	171		
65+	11.3	40.0	27.2	12.3	9.2	195		
Race								
White	14.3	21.1	17.4	17.2	30.0	1668	.11	.05
Black	0.0	12.5	37.5	0.0	50.0	8		
Other	16.0	13.3	14.7	18.7	37.3	75		
Party Identification								
Democrat	18.4	23.4	18.6	15.9	23.7	414	.07	.06
Republican	14.1	19.7	16.8	16.8	32.7	603		
Independent	12.6	23.1	16.6	16.9	30.7	739		
Other	14.9	14.9	18.8	22.8	28.7	101		
Tax Initiative A								
For	14.2	23.2	17.7	16.1	28.8	663	.14	.03
Against	14.8	21.0	16.7	17.4	30.1	1135		

All proportions have been rounded to one decimal place.
*Cramer's V obtained from Busch's data for the corresponding characteristic.

each time period based on demographic variables. During the 1988 elections, three tax initiatives (A, B, and C) were on the ballot. Tax initiative A was chosen as most comparable with the tax measure examined by Busch. Cramer's V is used as a measure of association to compare with values obtained by Busch. Significance levels are also given based on a chi-square test for homogeneity across time intervals. These significance levels are valid assuming the data is obtained from a simple random sample. This obviously is not the case since our sample is a stratified multi-stage sample. However, we found that the estimated variances (based on our sample design) of several characteristics were not much different than variances expected assuming that the data had come from a simple random sample rather than a stratified multi-stage sample. This leads to a design effect[2] close to 1. A design effect close to 1 would suggest that the contribution to the variability of the design under consideration is not much different than that which is expected under simple random sampling. For this reason, we include p-values as a measure of significance with the expectation that the statistical properties will not differ seriously from that of a simple random sample. This argument and interpretation applies to all sections of this article where p-values are cited or used.

One area of concern in Table 1 comes about because Busch's time intervals exaggerate the proportion of voters in the fifth time interval, since interviews were conducted over a different time frame in Utah (from 7:00 A.M. to 8:30 P.M. as compared to 6:30 A.M. to 7:00 P.M. for Busch). Therefore, Table 2 is produced using different time intervals. A post stratification procedure proposed by Cochran (pp. 127-131) was used so that the number of respondents sampled within each time interval was approximately the same. In keeping with Busch's analysis five time intervals were created: (1) early morning (7:00 A.M. to 9:30 A.M.) (2) midmorning (9:30 A.M. to 12:15 P.M.) (3) noon (12:15 P.M. to 3:00 P.M.) (4) afternoon (3:00 P.M. to 5:30 P.M.) (5) evening (5:30 P.M. to 8:30 P.M.).were used from Busch's.

Comparing Tables 1 and 2, we can see that whether Busch's or BYU's time intervals are used, Cramer's V obtained for the BYU data is smaller than that obtained by Busch. The p-values (on Cramer's V) for tax initiative A are the only ones that are not small. It is important to note while the small p-values suggest that some relationship with time of voting exists, the amount of association is not high. The small p-values may be the result of the large sample sizes. Even so, the variable of real interest, tax initiative A, is not statistically significant across time. These relationships support Klorman's conclusions that there is no voting pattern across the time of day. However, even though voting for initiative A does not change significantly across time of day, it may still be influential when voting for initiative A is examined across smaller demographical subdivisions.

Busch's other measure for homogeneity across time and subpopulations is a dissimilarity index. This index is defined as the measure of inequality in the cumulative distributions of two variables, in this case any two levels of the demographic variables being examined. For our data, it represents the proportion of voters that would have to shift in the time period they voted so that the distributions of the two levels being examined would be the same.[3] These indices are found in Table 3.

Table 2
Distribution of BYU Exit Poll Voters by Interview Time (BYU's Intervals)

Characteristics	Time of interview: Early Morn	Mid Morn	Noon	Mid After.	Late After.	N	Cramer's V	p *
Sex								
Male	21.6	17.7	18.7	21.3	20.7	931	.09	.009
Female	16.0	22.0	21.7	20.2	20.1	826		
Education								
8th grade	35.7	28.6	14.3	7.1	14.3	14	.07	.006
Some High School	17.9	30.4	17.9	19.6	14.3	56		
High School	14.8	22.7	23.5	21.7	17.4	392		
Some College	17.3	17.9	20.5	21.0	23.3	670		
College Graduate	23.8	17.6	17.8	20.7	20.1	618		
Age								
18-24	14.8	19.3	21.6	22.9	21.4	445	.13	.000
25-34	15.5	16.0	17.7	24.1	26.6	406		
35-44	24.6	16.5	18.6	17.5	22.8	382		
45-54	16.7	17.4	21.7	25.6	18.6	258		
55-64	31.0	24.0	14.6	18.1	12.3	171		
65+	20.5	28.0	25.1	10.8	15.6	195		
Race								
White	18.9	20.0	20.0	20.7	20.4	1668	.06	.097
Black	12.5	0.0	37.5	0.0	50.0	8		
Other	21.3	12.0	17.3	29.3	20.0	75		
Party Identification								
Democrat	22.7	22.7	21.3	18.4	15.0	414	.06	.039
Republican	19.1	18.4	19.7	19.7	23.1	603		
Independent	17.9	20.8	18.7	23.1	19.5	739		
Other	17.8	14.9	23.8	18.8	24.8	101		
Tax Initiative A								
For	19.9	21.1	19.6	19.5	19.9	663	.02	.898
Against	19.1	19.8	19.7	21.1	20.2	1135		

All proportions have been rounded to one decimal place.
*These are valid approximately for large n, assuming a simple random sample of size n.

Table 3
Indices of Dissimilarity of Time by Sex, Education, Age, Race, and Party Identification

Variable	(1)	(2)	(3)	(4)	(5)
Sex					
(1)Male					
(2)Female	7.3				
Education					
(1)8th grade					
(2)Some High School	17.9*				
(3)High School	27.1*	11.0			
(4)Some College	29.1*	13.0	8.4		
(5)College Graduate	22.9*	12.8	11.7	6.5	
Age					
(1)18-24					
(2)25-34	7.2				
(3)35-44	11.2	10.4			
(4)45-54	4.7	8.0	12.1		
(5)55-64	20.8*	23.5*	19.2*	20.9*	
(6)65+	27.9*	23.0*	23.0*	27.8*	24.5*
Race					
(1)White					
(2)Black	47.1*				
(3)Other	11.0	50.2*			
Party Identification					
(1)Democrat					
(2)Republican	9.5				
(3)Independent	9.4	9.3			
(4)Other	12.7	5.7	10.3		
Tax Initiative A					
(1)Against					
(2)For	2.2				

This table is constructed similar a correlation matrix. Each table is symmetric, therefore only the lower triangle is presented.
* Indicates a large difference in the two cumulative distributions relative to others in the table.

Using dissimilarity indices, Busch subjectively concludes that there is a difference in voting patterns across time. Specifically, he identifies the most dissimilar subgroups as those with the most discretionary time or those with irregular working hours. These groups include the unemployed, unskilled, grade school educated, college educated, professional, and voters over the age of 65. Based on results obtained from the BYU exit poll, the most dissimilar groups include voters with only an 8th grade education, those over 55 years of age, and black voters. It should be noted that these groups were chosen as dissimilar based only on the magnitude of their dissimilarity indices. If a Smirnov test is used to test for differences in the distribution functions, the only statistically significant differences exist between age groups 6 (65 years of age and older) and the rest, and 5 (55-64 years of age) and the rest (this test and the results are shown in the Appendix). All other differences between subpopulations are not significant.

One reason for dissimilarity may be attributed to the small samples obtained in these subgroups relative to the rest of the population. With BYU's data, for example, those with just an eighth grade education accounted for only 0.8% of interviewed voters, and blacks accounted for only 0.46% of interviewed voters. This leaves voters over the age of 55 as the only dissimilar group worthy of note from the exit poll data set.

The dissimilarity index for initiative A is 2.2 which indicates that 2.2% of voters would have to change the time period in which they voted in order to make the distributions of those voting for and against initiative A equal. These results support Klorman's conclusions.

In the next two sections we examine the exit poll data using log-linear models and analysis of variance to bring more sophisticated and powerful methods to bear on our analysis.

Analysis Using Log-Linear Models

Like the analysis in the previous section, the log-linear analysis used here does not deal with any simultaneous interrelationships between age, education, sex, party, or race because the sample sizes were too small in the resulting cross tabulations.

Models were fit using sex, age, education, party, and race, each in separate models in conjunction with time of voting as population variables in each of the models. In each case, the response variable was vote for tax initiative A. The purpose of these models was to test hypotheses about homogeneity of voting (V) for initiative A across the possible combinations of the population variables sex (S), age (A), education (D), party (P), race (R), and time (T). The reduced models associated with this analysis and their corresponding lack-of-fit tests and logits (expected probabilities) are shown in Table 4.

One conclusion that all of these models support is that there is not a significant relationship between the time when people vote and the the way they voted for initiative A. This relationship is represented by the TV term and three-way interactions (STV, ATV, DTV, PTV, AND RTV) in each of the saturated log-linear models. In each case these terms were not significant (based on α=.05) as is shown by the lack-of-fit tests in Table 4. This conclusion would correspond to the conclusions made in the previous section dealing with the effect of time on voting for Initiative A. In the case of sex, age, and party affiliation, the level of the variable was related to when people voted but not how they cast their votes. Therefore, across time, within a level of the above variables, voting for tax initiative A was apparently homogeneous. The reduced models for education and race indicate that the only difference existing is the actual vote for

Table 4.
Reduced Models, Lack of Fit Tests, and Logits

Variable	Reduced model	LOF Test	Logits	
Sex:	Y=ST+SV+E	Pearson's χ^2=8.40505	Males for	43%
		p=.39 8 df	Males against	57%
		Likelihood χ^2=8.44062	Females for	29%
		p=.39 8 df	Females against	71%
Education	Y=V+DT+E	Pearson's χ^2=22.70498	For	36%
		p=.54 24 df	Against	64%
		Likelihood χ^2=24.14556		
		p=.45 24 df		
Age:	Y=AT+AV+E	Pearson's χ^2=23.18143	18-24 for	28%
		p=.51 24 df	18-24 against	72%
		Likelihood χ^2=23.22793	25-34 for	35%
		p=.51 24 df	25-34 against	65%
			35-44 for	40%
			35-44 against	60%
			45-54 for	36%
			45-54 against	64%
			55-64 for	43%
			55-64 against	57%
			65+ for	40%
			65+ against	60%
Race:	Y=V+RT+E	Pearson's χ^2=9.80319	Whites for	36%
		p=.55 11 df	Whites against	64%
		Likelihood χ^2=9.89271	Blacks for	36%
		p=.54 11 df	Blacks against	64%
			Other for	36%
			Other against	64%
Party:	Y=PT+PV+E	Pearson's χ^2=18.67339	For	31%
		p=.29 16 df	Against	69%
		Likelihood χ^2=19.00442		
		p=.27 16 df		

initiative A. The results of these models are shown graphically in figures 2-6.

Despite evidence that no relationship exists between time of voting and exit poll results, smaller subpopulations or interactions between age, education, etc. still have not been examined. This could not be handled using the preceding procedure because of small sample sizes, missing cells within subpopulations, and computer storage limitations restrict the above analysis.

Analysis of Variance

Thus far, time-of-interview has been used as an independent categorical variable in an effort to predict how an individual would vote for Tax Initiative A. However, when the data was collected, the time-of-interview was recorded as a semi-continuous variable.[4] Therefore, time can also be considered as the dependent variable with characteristics of voter behavior used as independent variables (sex, education, vote for Initiative A, vote for president, etc.). This is the setup for an analysis of variance where the time a person votes is the dependent variable. However this data was not collected from a designed experiment but rather an observational study. Because of this, no causality can be proved between dependent variables and time of voting. For purposes of this analysis, interactions to be included in the model were limited to two and three-way interactions (all higher order interactions are assumed to be negligible). The initial model uses time-of-voting (Y) as the dependent variable and vote (T) for initiative A, vote (G) for the gubernatorial race, age (A), party (P), sex (S), and education level (D) as independent variables. County (C) was included as a blocking variable. The resulting model is written as:

Y=TAXA(T)+GOVN(G)+AGE(A)+PARTY(P)+SEX(S)+
EDUC(D)+TG+GA+GP+GS+GD+AS+PS+SD+AP+AD+
PD+TS+TA+TP+TD+APS+ASD+APD+PSD+TAS+TPS+
TSD+TAP+TAD+TPD+GAS+GPS+GSD+GAP+GAD+
GPD+TGS+TGA+TGP+TGD+CTY(C)+E.

The last term in the model, CTY (C), before the error is a blocking variable based on the county from which the voter was sampled. It is included in the model to check for any effect of local areas above the effect of other variables in the model. This is in response to Busch's argument that time of voting may effect election results differently across areas of the country. Because CTY is not significant, the effect of time does not appear to differ across the counties sampled. This supports Klorman's study across many locations. The model was highly unbalanced, therefore RUMMAGE (Bryce, 1980), a computer program for unbalanced data, was used. As can be seen from the AOV table in Table 5, all terms below the TAX by GOVN interaction do not appear to help predict the time a person would vote. These terms were dropped from the model and the reduced model[5]

$$Y = AGE(A) + TAX(T) + GOVN(G) + TG + E$$

was fit and a partial F calculated to test for the significance of the terms dropped from the full model above. The sums of squares and partial F calculation are found in Table 6. As can be seen, F(344,1298) = .878 which has a p-value of .93. This test justifies the model above. Because of the small size of the sums of squares for T (vote for initiative A), G (vote for the gubernatorial race), and TG (the interaction between voting for initiative A and voting for the gubernatorial race) relative to the sums of squares for age, all other models that included two-way interactions and age were examined for significance of the interaction. This was

Table 5.

Sequential AOV Table for Time of Voting as the Dependent Variable. Tax Initiative A (TAX), Gubernatorial Race (GOVN), Age Group (AGE), Party Affiliation (PARTY), Gender (SEX), and Education Level (EDUC) are included as main effects in a full factorial model (limited to two and three-way interactions) with County (CTY) included as a blocking variable.

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR>F
MODEL	354	55586752.68429219	157024.72509687	1.12	.0937
ERROR	1298	182713817.64574493	140765.65303987		
TOTAL(C)	1652	238300570.33003712	R-SQUARE = .233263		S = 375.18749052

SOURCE	DF	SS	F VALUE	PR > F
TAX	1	21999.44322653	0.16	0.6927
GOVN	2	392633.51272653	1.39	0.2483
AGE	5	11751748.30265090	16.70	0.0001
PARTY	3	791112.85231906	1.87	0.1322
SEX	1	108441.62763265	0.77	0.3803
EDUC	4	904093.04570513	1.61	0.1704
TAX*GOVN	2	843361.38117463	3.00	0.0504
AGE*GOVN	10	615574.26353648	0.44	0.9286
PARTY*GOVN	6	706196.18291447	0.84	0.5419
SEX*GOVN	2	291354.24311239	1.03	0.3556
EDUC*GOVN	8	1432078.41415355	1.27	0.2542
AGE*SEX	5	1174635.11964149	1.67	0.1391
SEX*PARTY	3	28459.16895774	0.07	0.9772
SEX*EDUC	4	374256.74426661	0.66	0.6166
AGE*PARTY	15	2432455.89625256	1.15	0.3040
AGE*EDUC	19	2681612.39411098	1.00	0.4546
PARTY*EDUC	11	973377.50431789	0.63	0.8055
SEX*TAX	1	10820.61531252	0.08	0.7816
AGE*TAX	5	309449.08036583	0.44	0.8210
PARTY*TAX	3	332263.99108912	0.79	0.5013
EDUC*TAX	3	165567.98973515	0.39	0.7587
AGE*SEX*PARTY	15	1054759.82187702	0.50	0.9420
AGE*SEX*EDUC	15	1363269.68141404	0.65	0.8384
AGE*PARTY*EDUC	37	4138315.50141954	0.79	0.8065
SEX*PARTY*EDUC	8	1413907.04700558	1.26	0.2630
AGE*SEX*TAX	5	459370.28906473	0.65	0.6595
SEX*PARTY*TAX	3	678154.47371204	1.61	0.1862
SEX*EDUC*TAX	3	429639.48877317	1.02	0.3840
AGE*PARTY*TAX	15	1407004.00707369	0.67	0.8193
AGE*EDUC*TAX	13	642829.80001905	0.35	0.9833
PARTY*EDUC*TAX	7	696986.88381952	0.71	0.6659
AGE*SEX*GOVN	10	1853566.08363605	1.32	0.2159
SEX*PARTY*GOVN	6	1656323.38725966	1.96	0.0682
SEX*EDUC*GOVN	6	506732.76964761	0.60	0.7306
AGE*PARTY*GOVN	27	2609520.27694338	0.69	0.8847
AGE*EDUC*GOVN	22	3844308.05481224	1.24	0.2025
PARTY*EDUC*GOVN	13	1075961.13689359	0.59	0.8654
SEX*TAX*GOVN	2	149612.23693492	0.53	0.5879
AGE*TAX*GOVN	10	2124894.24663893	1.51	0.1301
PARTY*TAX*GOVN	6	1162949.54522557	1.38	0.2205
EDUC*TAX*GOVN	4	253240.34414482	0.45	0.7726
CTY	14	1723915.83477485	0.87	0.5866

done in order to justify including TG in the model relative to all other two-way interactions. In each of the other models the two-way interactions were found to be non-significant for α=.05. This gave support for the above reduced model which includes TG[6]. Even with the significance of the model

$$Y = AGE(A) + TAX(T) + GOVN(G) + TG + E,$$

Table 6.

Sequential AOV Table for the Reduced Model--Age Group (AGE), Tax Initiative A (TAX), Gubernatorial Race (GOVN), and TAX*GOVN--for Time of Voting as the Dependent Variable

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	F VALUE	PR > F
MODEL	10	13051339.43670475	1305133.94367048	9.51	0.0001
ERROR	1642	225249230.89333237	137179.79956963		
TOTAL(C)	1652	238300570.33003712			

R-SQUARE = 0.054768 S = 370.37791453

SOURCE	DF	SS	F VALUE	PR > F
AGE	5	12026357.37968097	17.53	0.0001
TAX	1	18031.93035406	0.13	0.7170
GOVN	2	121991.94856893	0.44	0.6411
TAX*GOVN	2	884958.17810080	3.23	0.0400

Calculations for partial F:

$$F = \frac{\dfrac{225249230.89333237 - 182713817.64574493}{1642-1298}}{\dfrac{182713817.64574493}{1298}} = \frac{\dfrac{42535413.25}{344}}{140765.65303987} = .878406446$$

P(F>.8784) = .92996

only 5.5% of the variability in voting times is explained by this model. Fitting the full model (without higher order interactions), results in an explanation of only 23.3% of the variability in time.

Despite the significant interaction, age appears to have had the most influence over the time people voted. This supports our previous conclusions that voters over the age of 55 cast their ballots earlier in the day than their younger counterparts.

Conclusions and Recommendations

This article has used several methods in an attempt to determine what relationship time of voting has with the way a person votes. The methods and data used thus far indicate that time has little if anything to do with the outcome of the 1988 election in Utah. Dissimilarity indices as well as log-linear models show that if demographic variables are looked at individually, time of voting has little relation to how a person votes. However, with both of these methods, certain demographic variables demonstrate some relationship to time of voting. In the case of dissimilarity indices these variables are age, education and race. Log-linear analysis shows sex, age, and political party being related. In both cases age is the common factor.

The analysis of variance allowed interactions between demographic variables to be investigated. In this analysis , again age was the dominant factor relating to time of voting. The analysis of variance also implies that an interaction between initiative A and the gubernatorial race was useful in predicting voting time. Even with these terms being significant, they were only able to explain 5.5% of the variability in voting times. This brings up questions of statistical significance versus practical significance, our feeling being that though statistical significance is present, there is nothing of practical importance going on.

The major drawbacks of dissimilarity indices and log-linear models are their inability to check for significant relationships or interactions between time and the demographic variables. Because of the sample sizes necessary in the subpopulations, these methods were limited to separately examining the demographic variables and not their interactions with each other.

Future research should work towards solving the above problem as well as examining other ballot issues such as the more partisan issues, i.e. senatorial races, presidential races, etc.

1 Exit polls are conducted the day of the election by interviewing voters as they leave the polls. The voters are asked how they voted as well as demographical and other voter related questions. Exit polls are predominantly conducted by the media and political scientists. The media's primary interest is early projections while political scientists are interested in voting behavior. CBS first introduced exit polls in 1967 (Bogart 1985; Levy 1983); but exit polls received little credibility until 1972 when the three major networks pooled their strengths with major newspapers. Since that time, exit polls have been conducted for nearly every general and primary election.

2 The design effect for a given random variable X is the ratio of the variance of that random variable for the design under consideration to the variance of the same variable assuming simple random sampling. That is;

$$\text{Design Effect }(X)_{DESIGN} = \frac{V(X)_{DESIGN}}{V(X)_{SIMPLE\ RANDOM\ SAMPLING}}.$$

3 The index is calculated using the following formula (Busch, 1985):

$$D = \frac{1}{2}\sum_{i=1}^{k} |X_i - Y_i|.$$

For example, using the data from Table 1 for Sex results in the following index calculation:

$$D = \frac{1}{2}(|21.6 - 16.0| + |17.7 - 22.0| + |18.7 - 21.7| + |21.3 - 20.2| + |20.7 - 20.1|) = 7.3$$

This index says that in order for the cumulative distributions of males and females to be the same, 7.3% of those voting in these two groups would need to change the time intervals they voted. In other words, the proportion of males and females voting within each time interval are within 7.3% of each other.

4 Since time was recorded based on the hour and minute, 700-759, 800-859, 900-959, etc., discontinuities exist every 60 minutes from 760-799, 860-899, etc. Therefore, minutes were put on a scale from 1-100 rather than 1-60.

5 It should be noted that due to missing values, 204 observations were deleted from the full model. Therefore, for consistency, these observations were not included for the calculations involving the reduced model. When analysis was performed on these 204 observations, education level is significant with all other possible terms negligible including age, tax initiative A and gubernatorial race.

6 Generally, the average time of voting was about the same (1:30 p.m.) across the Tax*GOVN interaction except for one group voting for Cook and against initiative A. Their average time of voting was almost an hour later.

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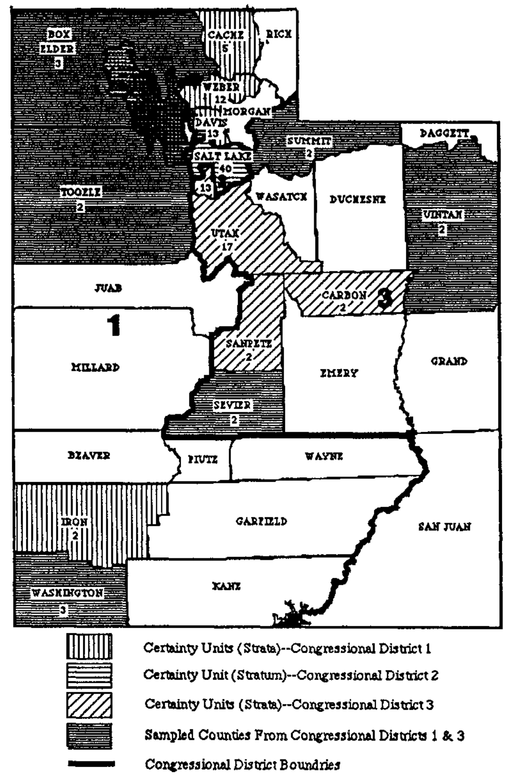

Figure 1. Sampled counties 1988

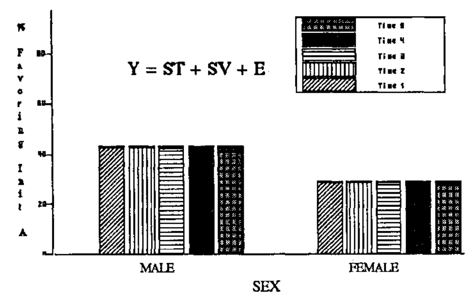

Figure 2 Support, based on logits, for Initiative A (V) by Sex (S) by Time (T)

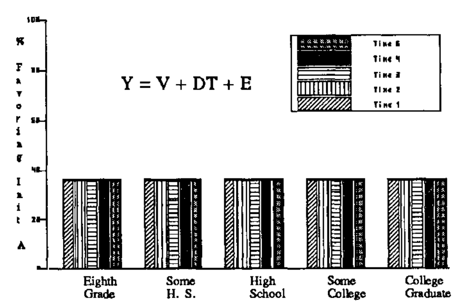

Figure 3 Support, based on logits, for Initiative A (V) by Education (D) by Time (T)

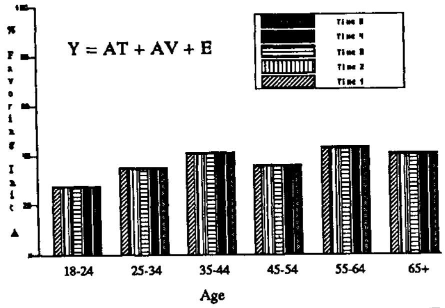

Figure 4 Support, based on logits, for Initiative A (V) by Age (A) by Time (T)

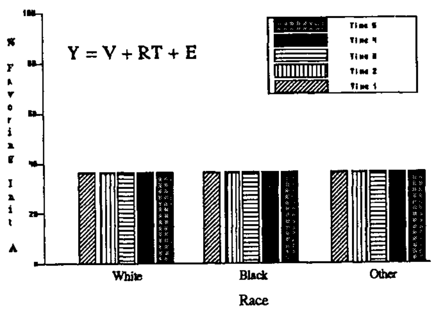

Figure 5 Support, based on logits, for Initiative A (V) by Race (R) by Time (T)

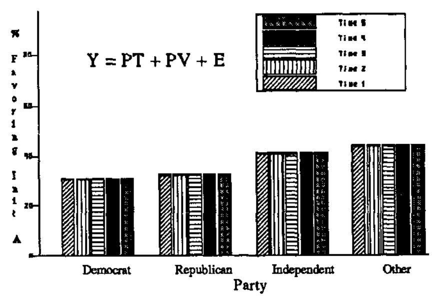

Figure 6 Support, based on logits, for Initiative A (V) by Party (P) by Time (T)

Appendix

In order to carry out a k-sample Smirnov test, the following assumptions should be met:

1. The samples are random and independent.
2. The measurement scale is at least ordinal.
3. The data should be continuous otherwise the test will be conservative.

In this case the samples are independent and random; and the measurement scale, time period of interview, is ordinal. However time period is not continuous therefore the test will be conservative.

The hypothesis tested by the Smirnov test is that the population distribution functions are the same for each distribution.

H_o: $F_1(x)=F_2(x)=F_3(x)=...=F_k(x)$

H_1: $F_i(x) \neq F_j(x)$ for some i, j, and x (where i and j are levels of x)

The test statistic is $T=\sup_x [S^{(1)}(x) - S^{(k)}(x)]$, the greatest vertical distance between $S^{(1)}(x)$ and $S^{(k)}(x)$. In order to perform this test, the sample distribution functions are presented in Table 1A. The maximum differences are marked by asterisks for each characteristic. Since sample sizes are not equal, the sample with the smallest size was used in determining the significance of the test. Based on the distribution functions shown in Table 1A, Age is the only characteristic for which there exist significant differences in the distribution functions. In this case, those over age 65 are significantly different from all other age groups. Given the large difference between those in the 55-64 age group and the younger age groups, a significant difference exists between these groups, but the difference among the first four age groups is not significant.

Table 1A

S(x) for levels of Sex, Education,Age, Race, Party and Initiative A

Characteristics	Early Morn	Mid Morn	Noon	Mid After.	Late After.	N	$\sup_x [S^{(1)}(x) - S^{(k)}(x)]$
	Time of interview						
Sex							.056 ns
Male	.216**	.393	.580	.793	1.00	931	
Female	.160*	.380	.597	.799	1.00	826	
Education							.291 ns
8th grade	.357	.643**	.786	.857	1.00	14	
Some High School	.179	.483	.662	.858	1.00	56	
High School	.148	.375	.610	.827	1.00	392	
Some College	.173	.352*	.557	.767	1.00	670	
College Graduate	.238	.414	.592	.799	1.00	618	
Age							.244
18-24	.148	.341	.557	.786	1.00	445	
25-34	.155	.315	.492*	.733	1.00	406	
35-44	.246	.411	.597	.772	1.00	382	
45-54	.167	.341	.558	.814	1.00	258	
55-64	.310	.550	.696	.877	1.00	171	
65+	.205	.485	.736**	.844	1.00	195	
Race							.299 ns
White	.189	.389	.589	.796	1.00	1668	
Black	.125	.125	.500	.500*	1.00	8	
Other	.213	.333	.506	.799**	1.00	75	
Party Identification							.127 ns
Democrat	.227	.454**	.667	.851	1.00	414	
Republican	.191	.375	.572	.769	1.00	603	
Independent	.179	.387	.574	.805	1.00	739	
Other	.178	.327*	.565	.753	1.00	101	
Tax Initiative A							.021 ns
Against	.199	.410**	.606	.801	1.00	663	
For	.191	.389*	.586	.797	1.00	1135	

* $S^{(1)}(x)$

** $S^{(k)}(x)$

Sex: $S^{(male)}(1) - S^{(female)}(1)=$	.056	N=826	p>.10
Educ: $S^{(8th\ gr)}(2) - S^{(some\ coll)}(2)=$	.291	N=14	p>.10
Age: $S^{(65+)}(3) - S^{(25-34)}(3)=$	.244	N=195	p<.005***
Race: $S^{(other)}(4) - S^{(black)}(4)=$	.299	N=8	p>.10
Party: $S^{(democrat)}(2) - S^{(other)}(2)=$	.127	N=101	p>.10
Tax: $S^{(against)}(2) - S^{(for)}(2)=$	.021	N=663	p>.10