Should we talk about the weather: an examination of the affect of inclement weather on voter turnout

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Should we talk about the weather: an examination of the affect of inclement weather on voter turnout

by

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This is to certify that the master’s thesis of

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Signatures have been redacted for privacy
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Chapter 1. General Introduction

1.1 Introduction

Inclement weather events are widely assumed to have electoral consequences. A rainy day may be bad for golfing, but when people routinely head to work or run errands in bad weather, why would anyone assume that it is enough to keep people away from the voting booth? The persistence of this assumption may lie in the fact that for most people, voting is an activity that produces little benefit. The rewards for voting are not as tangible as those that someone may receive from going to work or taking a trip to a local museum, and the chances that an election will be decided by an individual vote are almost non-existent. The fact that this assumption seems reasonable, however, should not excuse people from pursuing research on this topic. The research presented in this paper examines the evidence through existing theories of voter participation to determine empirically if weather has the power to deter voters from visiting the polls on Election Day.

1.2 Overview

When placing weather squarely within the theoretical framework of political science turnout models that emphasize the costs and benefits of voting, the notion that weather could have an effect on voters has intuitive appeal. What I argue in this paper is that inclement weather represents a cost to the voting public, and that its effect is greatest where the local conditions sharply contrast to what is normally experienced during that time of year. Empirically, I examine the effect of weather on turnout in nearly 300 counties over eleven U.S. elections between 1982 and 2000. The units of analysis are spread across five different
states in the west, and southwest as well as the central and northern plains regions, providing significant variation in both weather conditions and demographics. The scope of the data also permits testing of several different electoral conditions such as the number of contests on the ballot, the closeness of the election, and the type of race at the top of the ticket.

Results of this research lend some empirical support to the widely held notion that bad weather keeps some people from voting on Election Day. Specifically, I found that rainfall and colder than normal temperatures were both related to lower voter turnout. The effect of rainfall was most pronounced when analyzing only Presidential Elections, which may suggest that weather has a disproportionate effect on the less committed voter who tends to only participate in these higher profile events. Perhaps the biggest surprise was the effect of snowfall. Despite all of the travel difficulties associated with snow, snowfall in this sample was positively related to voter participation. The effect of snow however may be obscured by relative scarcity of observed snowfall in the data and the fact that none of the observations recorded more than six inches.

In the chapter that follows, I discuss some of the existing theoretical approaches that have been used to examine the turnout question and examine the assumptions of each as well as their limitations. Rational choice theory focuses on the costs and benefits involved in the activity of voting. The socioeconomic approaches to turnout predict that those having the resources (time, money, educational attainment) are more likely to participate in politics (including voting). Focusing more on the environment of the election itself, mobilization theory suggests that close elections attract resources that are used to mobilize the electorate that in turn lowers the cost of voting. The basic assumption in this paper is that inclement weather adds to the cost of voting and may be sufficient to encourage voter abstention. With
its emphasis on costs, rational choice theory comports well with research on the effect of weather on voters.

The next section presents existing research on the costs involved in voting and how weather fits within this framework. Physiological responses to extreme temperatures and dramatic temperature changes demonstrate the stress that weather can place on the human body. Inclement weather conditions can also create dangerous travel conditions, adding to the cost of taking a trip to the local polling place. The cost of exposure to weather conditions may depend largely on the degree to which an individual is acclimated to the local climate. The section comes to a close with information about general climate trends in North America during early November which coincides with Election Day in the United States.

In the third chapter, I describe each variable used in this study and detail its relevance to the research question. I also discuss how each of the variables are calculated during the initial measurement, reveal the sources for all data used in this study, and how the data are scaled for the purposes of this research. In addition, I offer some justification for the choices that were made as to why certain variables are included in this study while others were not. Using absolute measures of temperature for example do not account for the degree to which people acclimate to local climates. Measures that are relative to what is considered normal better approximate the way human beings respond to the weather. The next section deals with model specification. In this section I detail the model being used, go over some of the statistical problems, and discuss how using fixed effects regression corrects these problems.

In chapters four and five I present and interpret the results of the research, discuss the key findings, and suggest some direction for future research on this topic. The results indicate a general relationship between inclement weather and voter turnout, with most of the
coefficients in the expected direction. The addition of demographic information may help to identify specific groups of voters who are most likely to be deterred from voting by inclement weather events. The addition of more weather indicators such as the daily percentage of cloud cover and the temperature readings taken the 24 hours immediately preceding the election could also reveal those conditions that are most responsible for voter abstinences. Additional research that confirms these findings raises normative concerns that may justify changing the way we hold elections. Changing absentee ballot regulations, moving national elections to the weekend, or increasing remote voting stations may manipulate costs of voting to minimize the effects of weather. In the section that follows, I will discuss the popular assumptions that have been made regarding the affect that weather has on the voting public.

1.3 Existing Assumptions Regarding Weather and Turnout

Making assumptions about the effect of weather on the voting public has not been limited to local television meteorologists. Journalists, political operatives, and respected academics have all made claims and predictions about how weather may impact the voting public. The act of traveling to a polling place necessitates exposure to the elements outside, and, in some instances, voting itself requires prolonged interactions with inclement weather. In a front page article on November 3, 2004, the Cleveland Plain Dealer provided several accounts of voters across Ohio lining up outside polling places and enduring a cold steady rain for up to 11 hours to vote in the 2004 election (p.1a). It is easy to understand why people would broadly accept the theory that an individual would rather stay warm and dry than cast a vote that will not change the result of an election. Bad weather might make a trip to the
polls difficult or uncomfortable, and, since the outcome almost never hinges on one vote, a prospective voter will probably reap the benefits of the election outcome whether she votes or not.

1.3.1 Assumptions by Journalists

Evidence regarding the potential impact of weather on voter turnout presented in both academic and popular sources has been largely anecdotal. A quick search of popular news source yields scores of pre-election articles that cite election officials, academics, and those hopeful of winning elective office expressing either their consternation over a forecast of gloomy weather, or relief over fair weather predictions. Of note is the variety of voting behavior attributed to weather phenomena. A *New York Times* article printed the morning of primary elections in March of 1976 bore the headline “Bad Weather Cuts Down Voter Turnout” (p. 44). The *Augusta Free Press* issued its forecast on November 4, 2003 with a headline that read “Forecast: Good Weather, Low Turnout” (p. 1D). Finally, the *Washington Times* chimed in on November 5th 2003 with the banner “Temperatures High, Turnout Low” (p. 1B). These conflicting accounts do not seem to reveal much about voting behavior but instead highlight a preoccupation with talking about the weather.

1.3.2 Assumptions by Political Strategists

Journalists are not alone in making assumptions about the potential impact of weather on the voting public. Those who have a stake in election outcomes seem to believe the weather hypothesis as well. During a pre-election interview featured in the *Dallas Morning News* on November 7th 2000, George Bush’s campaign strategist Karl Rove commented that
rain in Florida might hurt their prospects of winning the presidency in 2000, but that a
snowstorm in the traditional democratic stronghold of Chicago would be a plus for
republican candidates (p. 4a). In the week leading up to the 2000 General Election, Donna
Brazile campaign manager for then Vice President Al Gore fretted over the weather forecasts
on her Blackberry device, often consulting them a dozen times or more throughout a single
day (p. 4a). These powerful political operatives, responsible for shaping the operations of a
massive campaign, apparently both believed that at least part of their success depended on
cooperation from Mother Nature. Individuals in this capacity are given the task of winning
the Presidency, and weather may be perceived as the one element that is entirely beyond their
control.

1.3.3 Assumptions by Academics

Evidence of the absence of rigorous inquiry into the potential effects that weather
may have on the voting public extends beyond those assertions made by journalists and
campaign operatives. Even those who possess the training to approach the subject
empirically have, for the most part, neglected to do so. A search through academic sources
turns up a number of journal articles that flatly declare without justification that weather is a
primary factor in determining the vote. In “Vote Stealing and Turnout Effects of Third Party
Candidates in U.S. Presidential Elections,” authors Dean Lacy and Barry Burden asserted
that weather is a factor for voters, while acknowledging its absence in models assessing voter
turnout. “…many of the determinants of abstention – foul weather, having child care
commitments, working late – are not typically measured in election surveys” (Lacy and
Burden 2000: 12). In this example, the authors seem to take for granted that these
explanations for why voters refrain from participating are matter of common sense. If, as they suggest, bad weather can close schools, snarl traffic, or knock out electricity in entire communities, it may be reasonable to assume it would keep voters at home on Election Day.

In yet another instance, political scientist Angus Campbell also takes this relationship for granted. In his seminal article “Surge and Decline: a Study of Electoral Change,” Campbell writes, “We may assume that bad weather or an epidemic may affect the vote in restricted areas or even nationally on occasion…” (Campbell 1960: 399). In similar fashion, bad weather has even been attributed to a proportionally higher number of voter abstentions among members of the majority party. In “The Effects of Turnout on Partisan Outcomes In U.S. Presidential Elections 1960-2000,” authors Michael Martinez and Jeff Gill argue that a lower overall turnout in Presidential elections favors the party with fewer registered voters. The authors note that the margin of victory in the 1976 Presidential election was so thin that “…Ford should have prayed for rain” (Martinez and Gill 2005: 1265). In this example, Martinez and Mill are leaning on the untested theory that rain would produce lower turnout without acknowledging that rain is a somewhat random event that is not evenly distributed across the country. Given the concentration of partisans in different regions of the country, even if rain were found to increase voter abstention, it could not have the effect of depressing turnout uniformly across the country. On the opposite extreme, there is also published material which dismisses bad weather as a possible determinant of voter abstention without any justification (Denver and Hands 1997: 729). In nearly all cases, academic research has neglected investigating the real possibility that weather may inhibit voter participation.
1.4 Why Could Weather Matter?

Because inclement weather conditions are unevenly spread across the country, any effect on turnout has the potential to alter elections for state or federal offices. Like weather conditions, the partisan makeup of the electorate is geographically disparate, and the localized nature of weather could suppress votes in traditional Democratic or Republican Party strongholds. Assuming that bad weather decreases turnout, a snowstorm in a swing state such as Ohio could adversely affect traditionally democratic areas of northern Ohio, while the more conservative southern portion of the state enjoys fair weather conditions. In this hotly contested swing state, such a scenario could increase the likelihood of the republican candidate winning Ohio’s twenty electoral votes and quite possibly winning the presidency. As recent history indicates, Presidential election outcomes can hinge on the results from just one state, and the turnout decisions of just a few hundred voters can decide a national contest.

Beyond changing the results of an election, weather may present other normative concerns regarding that could justify changes in current election law. There exists the possibility that some part of the voting population is disproportionately affected by inclement weather. If bad weather conditions result in lower higher levels of voter abstentions among a specific demographic group, there may be cause to change the way elections are administered. For example, people with lower incomes could be more reliant on public transportation than the general population. If this is the case, those who are economically disadvantaged on average may face additional weather related costs relative to the rest of the population. Walking to and from the bus stop in the rain or walking to a polling location several miles from home increases exposure to the elements, therefore increasing voting
costs for this population relative to those with private transportation. While any effect on turnout caused by bad weather does not amount to an outright disenfranchisement of voters, it is still cause for concern and may need to be addressed through legislation or other corrective action.

How great an obstacle could bad weather actually present to voters? In one example where people were asked to explain why they did not vote, very few responded that it was the weather which kept them home. In its post election survey, the U.S. Census Bureau included “bad weather” in a list of possible reasons for abstention in the 2000 presidential contest. Bad weather was cited by just .7% of non-voters, a lower percentage than either people who reported that they forgot to vote (4%) or who responded “I don’t know” (3%) (U.S Census Bureau 2002: 27). When considering the persistence of the weather-turnout assumption, such a low number offering weather as an excuse may be surprising, but a post election survey dependent on the memory of the respondent hardly puts the issue to rest. Existing research that examines the relationship between weather and voter turnout is scarce and may have measurement errors that obscure the true impact of weather. The research presented in this paper addresses these measurement problems using indicators that better approximate the way weather affects human behavior. In the next chapter, I examine popular theoretical approaches used in other studies of voter turnout and discuss their assumptions and limitations.
Chapter 2. Literature Review

2.1 Introduction

What follows is a discussion of the broad theoretical issues that concern the topic of weather and electoral participation. First, I will discuss some of the theory within existing studies of voter turnout including a detailed look at rational choice theory. A cost based theory of the turnout decision may be the most appropriate framework for this study because of the additional costs that are imposed on the public when interacting with inclement weather. Then I will discuss some of the reasons why weather may represent a cost to the voting public that is sufficient to encourage abstention. Following this, I will discuss the theory of climate acclimation and its importance in informing the choices that are made when deciding how to measure weather conditions to best approximate the way they are interpreted by people living in various climates. At the conclusion of the chapter I examine the other work that is specific to weather and voter turnout, and then follow with how this paper contributes to our understanding of the topic.

2.2 Theoretical Perspectives Regarding Voter Turnout

Literature contributing to our understanding of voter turnout has generally employed three different theoretical approaches: the rational choice model focusing on individual calculations of the costs and benefits of participation; the socioeconomic model which predicts that turnout is a function of individual resources; and the mobilization model that examines how cues from the environment interact with the voters overall attitude toward government. Research on turnout focuses largely on the cost associated with voting itself,
such as registration, the time it takes to vote, or finding and processing information, and often does not account for idiosyncratic costs such as weather, traffic, or personal health.

The rational choice perspective assumes that people vote in order to achieve personal goals. The decision to participate depends on whether or not the benefits of participation outweigh the costs which are involved (Downs 1957; Aldrich 1993). Formal rational choice models predict that the rational voter will abstain from voting because he understands his individual vote will not affect the election outcome, and that as a non-voter he cannot be excluded from benefits that result from any candidate winning elected office. Later versions of the model included a term measuring a voter’s sense of civic duty to help explain why people participate in this apparently irrational act (Riker and Ordeshook 1968).

When viewed through models of socioeconomic status (SES), the question of whether or not to vote depends upon an individual’s resources (time, money, civic skills) and her existing attitude toward the government. The SES model posits that those who are without resources are less able to handle the material costs of participation such as registering to vote, taking time away from work, or having the time to process needed information (Almond and Verba 1963, Verba and Nie 1972). Education develops the “civic skills” (public speaking, writing, etc.) necessary to take part in politics (Brady, Schlozman, and Verba 1995). Those with higher SES are psychologically oriented toward participating in public life due to a sense of efficacy and an obligation to participate (Verba and Nie 1972).

An extension of the rational choice theory, the mobilization model, accounts for changes in the costs of voting attributed to the political environment. The intensity of political advertising, direct mail efforts, and traditional “get out the vote” efforts provide cues which stimulate the voting public. As campaigns become more heated, there is an increase in
informal political discussions that may also help to mobilize voters (Kenney 1992). In addition, close elections attract resources from national and state party organizations in an attempt to gain an advantage against the opposition. These resources are used to hire staff and organize volunteers in order to reach voters. These campaign staff and volunteers often go into neighborhoods or other public spaces to register voters, dispense information, distribute and deliver absentee ballots, and offer rides to the polls to those voters who need them. Activities such as these make it easier to participate in an election and may be sufficient to encourage voting by those who are not usually inclined to do so (Rosenstone and Hansen 1993). Finally, efforts by a campaign or a political party to mobilize the electorate focus on contacting people to ask for money, time, and their vote. People are more likely to become involved in politics when they are asked to participate (Huckfeldt and Sprague 1992).

These three theoretical perspectives assert that the turnout question rests on some combination of social or psychological factors, individual status characteristics, or a rational calculation of the costs and benefits involved in voting. Studies of voting behavior assume that the costs of various factors in the turnout decision are weighted the same way across the population. This may be a safe assumption in the aggregate, but individual conduct may be difficult to predict because the characteristics of the voting population are not static and individual preferences change over time. Another limitation in cost based approaches to predicting voting behavior is that much of the literature focuses on the costs associated with the act of voting itself and does not account for factors that frequently inhibit other daily activities such as going to work or school. The inclusion of more random variables such as
weather, traffic, or physical health for example, may help explain more of the variation in voter turnout.

Weather is of particular interest because it is already widely assumed to have the power to dissuade voters. Addressing this assumption empirically is made easier by the availability of over a century of archived weather data from thousands of locations across the United States. The next section is a more detailed account of rational choice theory. The proposition raised in this paper rests on the notion that bad weather may increase the cost of voting enough to keep some individual voters away from the polls on Election Day. First, I will present the general assumptions of rational choice theory and how they apply to the act of voting, followed by a description of the elements in the formal model. In later sections of this chapter I introduce some examples that illustrate how marginal changes in the cost of voting can alter turnout.

2.3 The Rational Choice Framework

Rational choice theory assumes that people are goal oriented and that their actions are purposive (Downs 1957; Riker and Ordeshook 1968). People are thought to have preferences which are ordered hierarchically based on the utility or benefit that they expect to receive. When choosing between two or more particular courses of action, people make rational calculations to evaluate the options before them in terms of the costs involved in participation and the potential benefit that they will receive. Choices are made based on calculating the benefits associated with one course of action and weighing them against the perceived benefits of other actions. Rational choice also assumes that if people’s preferences are properly understood, that their behavior can be predicted. For example, if an individual is
weighing several opportunities for employment and compensation is the most important issue to him, rational choice theory would predict that he take the job which offers the highest salary provided all other considerations are equal. If the ability to spend time at home is also important, he may choose a job which offers slightly less pay if the employer offers a flexible work schedule or a shorter commute. The behavior of this individual can be altered if the employer alters the benefit structure to more closely match his preferences.

Rational choice theory has become one of the cornerstones of modern political theory and is most commonly found in research examining political behavior. The framework of rational choice has been useful for considering the questions regarding political participation and voting behavior. From the perspective of the rational voting calculus, people are more likely to participate in elections where the expected utility of casting a vote is greater than the costs involved (Downs 1957; Aldrich 1993). Rational voters evaluate a field of candidates by calculating the potential benefits that they will receive from each of them should they become elected. Rational voters also determine whether or not to participate by calculating the probability that their vote may break a tie and decide the election (Downs 1957, Aldrich 1993). Where the benefits of participation and the probability that a single vote will affect an election outcome are not sufficient to outweigh the costs of participation, the rational voter would abstain from voting.

In formal rational choice models, the net rewards of voting (the “R” term) is a function of the benefits resulting from the preferred election outcome and the probability of casting the deciding vote minus the opportunity costs involved in voting. Variables included in the rational choice equation includes the benefit (the “B” term) that a voter expects to receive should her preferred candidate win, multiplied by the probability (the “P” term) that
her individual vote will decide the election, plus any psychological gratification or solidarity benefit that she may receive from voting (the “D” term), minus the anticipated cost of voting (the “C” term) (Downs 1957; Riker and Ordeshook 1968). The “rational voting calculus” model looks like this:

\[ R = PB + D - C \]

According to this logic, participation is a function of a cost benefit analysis where if perceived costs of voting are lower than the benefits an individual believes he or she will receive, the rational actor will visit the polls on Election Day. Still, voting is a considered a classic collective action problem because the cost of participation is managed by each individual voter, while the benefits are shared by everyone whether they vote or not. Voters who realize that they may only reap collective benefits from voting do not turn out to vote (Downs 1957; Riker and Ordeshook 1968).

Following rational choice theory, voters are thought to be goal oriented and evaluate candidates in the light of their own preferences. If the prospect of having a lower tax burden is more important than other concerns, it is likely that they will favor the candidate who vows to cut personal income taxes. In the event that the voter discerns no difference in the potential benefits should any of the candidates win the election, there is little benefit in voting. To determine the probability that his vote will be decisive in an election, the rational voter considers how close the contest is as well as how many votes will be cast for a given elective office. In the event that election results are projected to be close, he will be more likely to vote due to the increased probability that he will cast the deciding vote. Conversely, where a candidate is expected to win by a comfortable margin, if he is rational, he will likely abstain
from voting because he will receive the expected benefits (or bear the costs) whether he votes or not.

Additional considerations include the voters' sense of civic duty as well as the individual costs associated with their participation. Voting may satisfy the need to feel like a good citizen or a desire to feel solidarity with those who share similar values. For a rational voter, a sense of fulfilling civic duty is an additional benefit of participation and may be sufficient to encourage her to visit the polling place. Most of the costs associated with voting generally involve a commitment of time on the part of the voter. This may include the time spent in act of voting itself including time taken to register to vote, any costs associated with traveling to the polls, as well as less direct costs like those associated with acquiring the information necessary to make a decision. Where time is dedicated to voting, registration, or processing information about candidates, there is less time available for other activities which may be preferred to voting. The rational voter is likely to vote when the potential benefits from voting are sufficient to overcome these costs.

The costs involved in casting a vote are usually very small for most people (Niemi 1976). Voting generally requires completing the registration form, making a short trip to the polling place, and taking some time to process information to make a decision. Registration forms for most states are readily available in multiple locations including government offices, libraries, internet websites, and local schools. Some states have committed public money to pay for postage to encourage people to complete registration forms. Excluding those in rural areas, most polling locations are close to home, making the trip to vote much like any other short errand. The cost of making a decision varies according to the length of the ballot and the complexity of the issues involved. There is no minimum threshold of
information required to vote however, and it is safe to assume that the time spent deciding how to vote is to some extent voluntary. The costs of voting and registration continue to decline as changes are made in state and federal election laws. Reforms such as the Motor Voter Act in 1993 increased the availability of registration forms and the recent liberalization in absentee ballot laws make it possible for many people to vote without ever leaving the house. The section which follows will discuss whether or not small changes in the cost of voting have any effect on the behavior of potential voters.

2.4 Research on the Cost of Voting

Much of the research on turnout focuses on the costs involved with voting and the status characteristics (education, money, skills) that enable people to manage those costs. To add some context to this framework, it is worth taking a look at the activities involved in voting and the kinds of things that prohibit voters from engaging in those activities.

In this section, I will talk about the costs that many Americans in the workforce encounter on Election Day, and then discuss some of the research regarding the costs specific to voting. In the United States, Election Day is held in the middle of the workweek, reducing the hours available to vote for much of the population. The availability of time appears to play a huge factor in determining turnout. Among registered voters that did not vote in the 2000 election, one in five reported that they were “too busy” to vote (United States Census 2002). If marginal changes in the voting calculus such as easing registration laws or letting people vote by mail has an effect on voter turnout, it is possible that the cost of inclement weather may be sufficient to encourage abstentions.
Voting delivers potential collective benefits to the voter, and the value of these benefits can be determined by the costs individual voters are willing to bear in order to receive them. Because voting is a low cost activity, small manipulations in the cost or benefit side of the voting calculus may be sufficient to change the outcome of the turnout decision.

In the United States, the process of registering to vote has been deemed be a significant obstacle for some people and is thought to contribute to voter abstentions (Wolfinger and Rosenstone 1980; Teixeira 1992). This additional administrative step is often overlooked in turnout literature and it may explain lower turnout among those who frequently change their place of residence. Research on state voter registration requirements conducted prior to the Motor Voter Act of 1993 estimated that turnout would increase a staggering 9% if requirements were relaxed across the country (Squire, Wolfinger, and Glass 1987). People who have recently moved may be reluctant to reinvest the cost of registration. Additional research examining the cost of registering to vote concluded that electoral turnout increases as the closing date for registration gets closer to the actual election (Patterson and Caldeira 1983). Chronic procrastinators, people who have recently moved, and those who are not that excited to vote in the first place may miss registration deadlines that are a month or more away from Election Day when cues about the forthcoming election are less prevalent.

There are also costs associated with the trip to the polls itself that also play a role in the turnout calculus. Several states have expanded access to absentee ballots and have begun experimenting with early voting and voting through remote polling stations. These types of conveniences manipulate the cost of voting and may be sufficient to change whether or not someone votes. Residents in the state of Oregon decided in 1993 to do away with polling locations altogether, mandating that residents vote by mail. The all mail turnout program has
been credited with a 10% increase in turnout since its implementation in Oregon (Southwell and Burchett 2000: 74). During the 2000 elections in the United Kingdom, the government allowed for a series of pilot projects which included advance voting, weekend voting, and various vote-by-mail programs (Rallings 2000: 16). In these trials, voting by mail was also found to increase turnout, suggesting that the cost of traveling to the polling place, an act similar to running a short errand, may present a significant obstacle for some voters. Those travel costs related to voting may be complicated by the timing of the election.

In the United States, Election Day falls in the middle of the traditional workweek. A 2004 survey conducted by the United States Census indicated that 84.6 percent of those who were employed out of the home worked “regular daytime schedules” (United States Census 2004). Scheduling the election on a Tuesday gives a significant portion of eligible voters only a handful of hours available to go to their polling location. To complicate matters further, many Americans spend a considerable amount of time traveling to work. According to the Bureau of Transportation Statistics, in 2001 the average one-way commute for workers in the United States takes 26.5 minutes (Bureau of Transportation Statistics 2002). This means that on average, people spend just shy of a full hour per day in transit to and from work. A long commute has the potential to exhaust the time available for voting on Election Day.

Another important consideration for the voting public is the distance that they have to travel to reach the polling place. Research suggests that distance from the polling place does have an impact on turnout. The effect of distance is most pronounced among voters in metropolitan areas who often face numerous impeding factors when traveling (Gimpel and Schukenecht 2003: 478). The fact that voting in the United States takes place on a weekday
reduces access to the polling place for those who are busy working and complicates travel, particularly for those who live in urban environments who may have to deal with significant traffic delays. The amount of time needed to vote is largely determined by the distance between the polling location and the voter’s residence. For those who may rely on public transportation, the impact of distance may be significant enough to encourage some to abstain from voting. Distance to the polling place is an important consideration that influences whether or not people participate in an election.

As mentioned previously, the cost of participation also varies with the context of the election. First, voters appear sensitive to the costs of information processing. Voters are often selective when filling out their ballot, choosing a candidate for Governor of their state and then opting out of making a choice for less visible offices appearing further down on the ballot. When filling out a ballot, people are thought to skip certain lower profile offices because they do not have enough information to cast a vote (Wattenberg, McAllister, and Salvanto 2000). Disinterested voters may not be willing to bear the costs involved with learning about the various candidates for local school board or the state secretary of agriculture. People in states that have a referendum process frequently have to wade through thick ballot pamphlets explaining in detail numerous proposals that are put in front of voters in every election. As races tighten, campaign activity intensifies and the needed information becomes more accessible (Cox and Munger 1989). Closer contests attract money from outside the region from party committees and other donors who have an interest in the outcome. This money is used to buy media, send out direct mail pieces, and even bring volunteers and paid staff into neighborhoods to visit with potential voters. Additional campaign activity increases the availability of information to the voting public and may ease
barriers to participation for people who may not be disposed to learn about the election on
their own.

There also exists a marked difference in turnout due to the election type. Observed
turnout during presidential elections is significantly higher than that observed in
congressional races. Angus Campbell’s theory of surge and decline predicts that those
considered “periphery voters” are stimulated by the grandeur of presidential contests and
tend to abstain from voting in off-year elections (Campbell 1960: 399). These less committed
voters who often provide the margin of victory during presidential years do not turn out in
off-year contests, often resulting in a loss of congressional seats for the party of the
president. Elections with more races on the ballot often feature more intense mobilization
efforts, particularly if the contests are competitive. The presence of additional federal offices
on a ballot is often more stimulating to the voting public and may encourage higher turnout.
Voters who participate in less stimulating contests like primaries and municipal elections are
more committed to the participatory ideal and are less sensitive to the costs of participation.

When applied to voter turnout, rational choice calculations also account for those
characteristics thought to effect political involvement. The costs associated with registration,
traveling to the polls, or information processing are not distributed equally across the
population, nor are the resources which enable people to negotiate these costs. Those with
greater social and economic resources are thought to be better equipped to manage the costs
involved in voting (Wolfinger and Rosenstone 1980; Verba and Nie 1972). Education
develops reading, vocabulary, and analytical skills which are necessary for political decision
making (Wolfinger and Rosenstone, 1980). Taking part in an election means sacrificing time
that may normally be allocated for other activities. Participating in politics may be far less
relevant to someone who is struggling to make a living and those with greater income may have leisure time that enables them to be involved in civic life. Finally, people who have more education and higher income have a greater sense of self efficacy, and those who believe their actions may influence government are more likely to participate in politics (Rosenstone and Hansen 1993).

If small variations in the costs determine whether or not someone votes, it is worth considering the effect of more random events that have the potential to change people’s activities. Traffic congestion, the onset of cold or flu season, increased demand from an employer, or inclement weather conditions may all have the capability to alter the turnout equation. Caring for a sick child, having to shovel snow, dealing with an extended commute, or working overtime may all exhaust time set aside for voting. The purpose of the research presented in this paper is to examine the effect that weather has on perspective voters. In the section which follows, I will explore how weather makes a difference in daily activities as well as the reasons why it may cause voter abstention.

2.4 Why Could Weather Matter?

The basic hypothesis being tested in this research is that bad weather conditions add to the cost of voting. This section will address some of the theoretical backing of that assumption to explain further why inclement weather may encourage voters to abstain on Election Day. First I address some reasons why would weather impose costs on any activity that requires travel or outdoor exposure. People are sensitive to environmental conditions, and weather could be added to the factors which discourage participation in elections. With the advent of indoor heating and cooling systems, people have the ability to avoid climate
conditions that cause discomfort. This innovation may have the unintended consequence of making human beings more sensitive to adverse weather. Patterns of use in public spaces reflect this sensitivity to weather conditions as people seek out climate controlled environments when outdoor conditions cause discomfort. The frequency of some types of criminal activity may also be sensitive to changes in temperature. Opportunities for criminal mischief decrease when potential victims retreat to indoor climate controlled environments.

A host of empirical studies show that weather has consequences on decision making processes and has been implicated at a contributing factor for various mental and physical health conditions (Kalkstein and Valimont: 1987). The relatively new field of biometeorology examines the interactions of atmospheric processes and living organisms. This discipline adapts raw measures like temperature, humidity, and barometric pressure to create indices which relate the weather to standards of human comfort or potential risks to human health. Already commonly included in weather forecasts are measurements of pollen counts and smog indices, both of which are important to allergy sufferers and people with asthma. Commercial services such as the Weather Channel combine several raw indicators into a single measure that details arthritis and migraine sufferers. Weather conditions affect decision making behavior and are given consideration when weighing whether or not to participate in outdoor activities (Katz 1993, Rotton and Cohn 2000).

Weather imposes basic logistical difficulties that add to the cost of all outdoor activities. With the onset of colder temperatures in the fall, extra layers of clothing need to be worn for protection. An outbreak of winter weather can cover sidewalks or driveways with snow which needs to be shoveled or removed prior to leaving the house. Roads wet from precipitation of any kind will slow traffic down on highways and major thoroughfares. Each
of these situations imposes costs which have to be accounted for prior to leaving the house. When considering that Election Day falls on a Tuesday, many working adults may already have significant time commitments to their employers and families. Considering that the polls are open for a finite period on Election Day, the already narrow window of opportunity to vote may be further limited by the time needed to deal with difficulties imposed by weather. For those who perceive few benefits from voting, the costs imposed by inclement weather conditions may be sufficient to keep them away from the polling place. Innovations in climate control technology make it increasingly possible to limit exposure to unpleasant weather. The resulting increase in sensitivity to weather may have consequences for turnout on Election Day.

Americans spend an overwhelming majority of their time in climate controlled environments. Of the 1440 minutes in a day, only 70 (4.3%) of those are spent outdoors (Robinson and Thomas 1991: 291). The development of central heating and air conditioning may have heightened our sensitivity to weather, decreasing the range of temperature that is conducive to human comfort. Studies which examine the effect of inclement weather on behavior indicate that people tend to stay indoors when conditions outside are unpleasant. In “Weather, Disorderly Conduct and Assaults,” criminologists James Rotton and Ellen Cohn find that extreme weather decreases social contact and therefore opportunities for criminal mischief (Rotton and Cohn 2000: 644). This finding is consistent with the negative affect escape theory (NAE) which includes extreme weather as a factor causing individuals to retreat to their primary territories (Rotton and Cohn 2000: 645). In another look at the theory, a study of outdoor plaza use in the cool and damp San Francisco climate found that use increased during milder weather and when wind speeds were relatively calm. Outdoor
seating becomes scarce during warm weather periods when people are seeking exposure to pleasant weather and public spaces become crowded with foot traffic (Zacharias et al. 2004: 642). This would suggest that in general, people are sensitive to and account for the costs associated with exposure to inclement weather.

There is some evidence suggesting that environmental conditions have an impact on whether or not people participate in elections. When comparing over 5,000 similar election events in the United Kingdom, turnout was found to undergo a seasonal decomposition which was related to differences in sunset times (Railings, Thrasher, and Borisyuk 2003: 66). Mean voter turnout for British by-elections was lowest during December and January, months which also have the least amount of daylight in the northern hemisphere (Railings et al. 2003: 71). This would suggest that voters may be sensitive to any additional costs associated with going outside during the darker months of the year. The rate of criminal activity and the probability of being involved in an automobile accident are both higher at night (FBI Uniform Crime Statistics 1998; Department of Transportation 2004). These additional costs involved with venturing out of the house after dark may be sufficient to keep voters at home.

2.5 You Get Used to it: a Word About Climate Acclimation

In the following section I will discuss climate acclimation and how regional differences in the prevailing weather conditions create variations on how weather is perceived. A day of sub-freezing temperatures is likely to be perceived very differently in places where the inhabitants are unaccustomed to dealing with cold weather. Exposure to the elements may therefore represent a cost, but that cost may be relative to what is expected
according to the regional climate and the seasons. For this reason, weather conditions which are measured in absolute values may not fully explain how people respond to weather events. This section concludes with a short examination of the general weather patterns which are typical of early November in the continental United States. This discussion should help contextualize some of the absolute values typically used to measure weather conditions.

The human body makes significant physiological adjustments to adapt to seasonal weather variations (Kalkstien 1987; Radomski and Boutelier 1982). For example, the onset of warmer weather leads to an increase in blood volume, an earlier onset of sweating, and increased sodium levels in the bloodstream to increase fluid retention, all adaptations which enhance the body’s ability to deal with heat stress. Acclimation to the weather is critical for human health. Recent evidence suggests that most deaths due to heat exposure occur early in the summer or during unusual periods of rapid rises in temperature (Kalkstein 1987). Rapid rises in temperature or unseasonal heat waves exact a higher toll on human health because they occur when the population is not fully acclimated to hotter weather. The same holds true for acclimation to cold climates. In a study examining adaptation to cold weather climates, participants who bathed in cold water for one half hour over nine consecutive days showed fewer symptoms of cold induced stress than those who did not participate in the cold water treatment (Radomski and Boutelier 1982).

The findings regarding temperature acclimation may hold significant meaning for this study because of where Election Day falls on the calendar. Early November is a transitional period for the weather in the United States, as much of the country begins to feel the intrusion of cooler air masses from the north. The onset of sub freezing temperatures which are typical of the fall does not always occur gradually. It is not uncommon for the daytime
high temperatures during this period to vary by twenty degrees or more in a single day (Harman 1991). Through much of the country, including the southern plains, parts of the southeast, and the west coast, the average date of the first freeze occurs sometime in the first week of November. Often a freeze will follow a cold front which is immediately preceded by a period of substantially warmer weather. For those who are not yet acclimated to the change of seasons, such dramatic drops in temperature may not be well tolerated. The onset of cold weather could make it seem particularly cold to the prospective voter and alter the perceived cost of outdoor exposure necessary to participate on Election Day.

Exposure to both extreme heat and extreme cold increases the risk for death due to heart attacks, strokes, and certain respiratory conditions. Research suggests that deaths related to climate stress are sensitive to regional climate differences (Curriero et. al. 2002, Kalkstien 1987). The relationship between temperature extremes and mortality rates is relative to the weather people are accustomed to experiencing. Excessive heat increases the mortality rates in cooler northern climates, while cold weather increases mortality rates across the south. In an examination of the temperature thresholds for exposure related deaths, no significant mortality increases were found at -40° Fahrenheit in Minneapolis, while mortality increases were noted in Atlanta at 32° Fahrenheit, or the temperature where water begins to freeze (Kalkstien and Davis 1985). Patterns of geographic acclimization can also be also found during hot weather, as mortality rates increase dramatically during heat waves in northern cities, while similar increases are not found in southern cities (Kalkstien and Davis 1985). These findings indicate that weather has health-related consequences relative to the type of climate which is typical of a given area. Variations in response to climate related
stress are an example of how the costs of weather events are sensitive to predominant regional weather patterns.

Patterns of geographical acclimation are also evident when looking at regional differences in human tolerance to snowfall. Consistent with findings related to temperature, regional differences are also evident in mortality related to snow. Research suggests that people living in locations with higher annual snowfall amounts seem to have an increased tolerance for it (Kalkstein and Valimont 1987). Merging snowfall data with mortality rates shows a significant increase in the amount of deaths in New York City after just 2 inches of snow fell, while the similar mortality threshold in Detroit, where annual snowfall is about 2 feet higher than in New York, was six inches (Kalkstein and Valimont 1987: 135). These findings add support for the notion that reactions to individual weather events are driven at least in part by the weather people are accustomed to experiencing. For this reason, absolute values such as the daily mean temperature or 24 hour rainfall in inches do not fully capture how people respond to weather events. There are, however, some useful generalizations that can be made based on conditions which are typical in the United States during early November.

Understanding the seasonal variations in weather patterns can help interpret commonly collected weather data and provide insight into how weather is perceived. Given the typical weather patterns in November, it is unlikely that a moderate amount of rainfall could come during a short period of time. The spring and summer months tend to support higher levels of convective activity, during which a thunderstorm could yield a period of intense rainfall of a short duration. The optimal conditions for thunderstorm formation generally include daytime heating sufficient to destabilize the upper atmosphere. These
conditions are associated with the late spring and summer months and tend to wane with the onset of fall (Harman 1991). In contrast to the localized nature of convective activity, precipitation in the fall often comes in the form of broad frontal systems which bring prolonged periods of light rain (Harman 1991). A quick summer downpour is likely perceived differently from a dreary overcast day with light rain in the fall. In early November when the United States holds its’ general election, rainfall of a half inch or more would more likely fall over a several hour period, which may encourage the perception that it is a rainy day.

Snow in early fall is generally limited to the mountain ranges in the West and the Northern Plains regions. Snow in the mountainous areas can be heavy with amounts of one foot or more typical in a 24 hour period, while November snowstorms in the Plains usually have lesser amounts of six inches or less. Without question, snow adds to the cost of voting on Election Day. Running a short errand in the car now requires clearing off windshields and often shoveling out driveways. The exertion required to shovel snow can be a trigger for heart attacks for those who are in poor health. Snow shoveling induced cardiac arrest resulted in 32 deaths following the Midwest Blizzard of 1999 (NCDC 1999). A few inches of snow is all that is needed to create treacherous road conditions, which would have an impact on a trip to the voting booth. Even in situations where polling places are close enough to reach by foot, slippery sidewalks and cold temperatures after a moderate snow may be enough to keep people home.

The months of November and May are the periods of the most pronounced shifts in atmospheric circulation over much of North America, which often results in sharp temperature contrasts, even across individual states (Harman 1991). Some generalizations
regarding temperature can be made. Sub freezing nighttime readings are typical in most locations east of the Sierra Nevada and Cascade mountain ranges along the west coast and north of the southern plains and southeastern United States. Mild daytime readings of at least 50 degrees Fahrenheit or warmer are normal in most locations except for the far northern plains and the northern Rockies. While the extreme heat of summer is gone, early November temperatures in the desert southwest and portions of the southeast are still warm with daytime readings in the 70s and 80s, (Ludlum 1991: 103). The polar jet stream which is responsible for bringing cold air into the continental United States can venture into the United States in early November, but it generally keeps the bitterly cold air (in the teens and single digits above zero) locked in the Arctic Circle until later in the month (Ludlum 1991: 109). With these things in mind, it seems that outside of very early outbreaks of arctic air, extremely warm or bitterly cold temperatures are unlikely in the period including Election Day. However, unseasonably cool temperatures may impose some cost on voters who are not yet acclimated to the cooler weather which is typical of the late fall.

Research suggests that weather has an impact on decision making behavior (Katz 1993, Rotton and Cohn 2000). Weather conditions have an impact on even the most ordinary activities such as the type of clothing that one wears or the route taken to and time allotted to reach a destination. Traveling to the voting booth is costlier to the voter who has to endure poor weather conditions. In the following section, I will review existing research that addresses this question, examine some of the strengths and weaknesses of each piece of work, and discuss how the work presented in this paper furthers the understanding of this topic.
2.6 Research Specific to Weather and Turnout

As mentioned previously, the body of existing research that is specific to the topic of weather and turnout is scarce. In this section, I will discuss the theoretical approaches that are taken with this research and examine some its strengths and weaknesses. Framing weather as an additional cost to the voting public places it within the framework of existing studies on turnout. Research that determines if some segments of the voting population are disproportionately affected by weather is more interesting and may have implications for shaping public policy. Existing studies use limited data sets that do not account for variations in election events and weather conditions. Some measures of weather are more suitable than others for addressing this question because they more closely represent the way conditions are interpreted by potential voters. Choices made with this data may distort the results and not measure the full effect that weather has on turnout. The study presented in this paper addresses some of these weaknesses by using data from different regions of the country, considering different types of election events, and using more appropriate measures for weather.

Two of the three papers I will discuss in this section talk about weather in terms of its potential cost to individual voters casting a ballot. The most recent effort is a working paper written by political scientists Brad Gomez, Thomas Hansford, and George Krause. In “The Linkage Between the Weather and Voter Turnout: Fact or Fiction,” the authors examine the question by focusing on the potential costs that bad weather exerts on the voting public. In doing so, this paper represents the first comprehensive empirical study of weather within the framework of the more traditional models of political participation. In emphasizing the potential costs involved in dealing with weather, the authors place weather events within
rational choice models that predict turnout by calculating the net benefit for the individual voter.

Assuming that the decision to vote is a function of calculating the costs and benefits involved, and that the net benefit of voting is small, the decision to vote may be effected by minor manipulations of the perceived costs of voting. Gomez, Hansford and Krause suggest that exposure to bad weather constitutes a small cost and include weather conditions among a host of other factors which may change the cost benefit structure and effect the turnout decision. They include in their model other variables thought to effect voter turnout including the registration deadline, the distance from the polling place, and the presence of additional races on the state ballot. The authors suggest that if there are other considerations such as these which increase the cost of voting, the additional cost of bad weather may simply be too much to bear (Gomez, Hansford, and Krause 2005: 5).

Geographers Jay Gatrell and Greg Bierly make similar assumptions regarding cost in “Weather and Turnout: Kentucky Primary and General Elections, 1990-2000.” Gatrell and Bierly account for the mobilization hypothesis by including a measure of competitiveness in their model as measured by the difference in party registrations. The authors here argue that absence of a competition lowers the perceived benefits of participating because the individual vote will not be decisive, and voters receive any perceived benefit from the election whether they participate or not (Gatrell and Bierly 2000: 13). The authors assert that the cost of exposure to bad weather may be sufficient to encourage abstention if voters perceive little benefit in participation. They also pool data together from specific election types, acknowledging that turnout is generally lower in primaries and special elections than it is in general elections, and that any effect from weather may vary according to the profile of the
election. In doing this, the authors assume that the more committed voters regularly participate in primaries and other lower profile elections, and that this group would be less sensitive to the costs associated with weather.

Some of the research includes certain demographic information in an effort to discover any difference in the effect weather may have on various groups of voters. Interacting weather data with demographic information may help explain whether or not there are groups of people which are more likely to abstain from voting due to inclement weather. Gomez, Hansford, and Krause incorporate variables of race, income, and education, enabling them to examine how weather events affect voters of different socioeconomic status. Including the demographic statistics adds to the explanatory value of the research by identifying which voters, if any, are impacted by inclement weather. If poor or elderly voters were particularly affected by weather events, it may be considered a de facto disenfranchisement of a part of the population and justify changes in the way we hold elections.

A similar approach is taken with partisanship to discover if inclement weather presents a competitive advantage that favors one political party. In “Does Rain Help Republicans”, author Stephen Knack addresses the long held assumption that rain suppresses Democratic vote share. Knack tests this hypothesis by using both the self reported partisanship of the voter and partisanship according to the party affiliation of the candidates that voters chose on the ballot. Gomez, Hansford, and Krause also tested this hypothesis by using the coefficients for weather from the original model and adding the republican vote share as a dependant variable.
The choices made when adopting weather measures can distort the results and render any conclusions unreliable. Precipitation totals are recorded in 24 hour periods and do not specify the timing of rain or snowfall events. Accounting for conditions during entire day through hourly weather observations makes any research on this subject more reliable because those conditions which occur when the polling places are closed can be eliminated from the analysis. The research by Stephen Knack uses hourly weather data to calculate the duration of rainfall events on Election Day, while other research on the subject uses rainfall data from the entire 24 hour period. Rain that falls in the early morning hours or late at night is less relevant to the turnout decision because the polls are not open. Analyzing only that data recorded during the portion of Election Day that the polls were open excludes information that is unlikely to factor into the decision of the voter. Knack calculates the hours that precipitation was recorded on Election Day, expressed as a percentage of the number of hours that the polls were open and used this as an alternate dependant variable. Knowing the number of rain-free hours available to voters offers a more complete picture of Election Day conditions.

Decisions on how to deal with the weather depend largely on how people perceive the conditions. An absolute measure like the mean temperature doesn’t account for the degree to which people acclimate to the local climate. The research conducted by Gatrell and Bierly uses the normal mean temperature as a baseline and then calculates the departure from normal at each reporting station on Election Day. People’s response to weather conditions depends largely on the type of weather they are accustomed to (Radomski and Boutelier 1982; Curriero et. al. 2002; Kalkstien 1984). By choosing this measure of temperature, the authors acknowledge that there is more than one standard for human comfort. Relative
indicators of temperature are better than absolute values because they approximate the criteria used by people making judgments about the weather, and therefore have more power to explain the behavior of voters. The next several paragraphs will address possible weaknesses of the research on this topic, followed by an explanation of how those problems may be addressed by this research.

One of the weaknesses found in work on this subject is the way that discomfort is conceptualized as it relates to measures of temperature. Both the Steven Knack paper as well as the work by Gomez, Hansford, and Krause use heating degree days to measure human discomfort resulting from cold weather. Heating degree days are a standardized indicator used by engineers to determine the amount of energy needed to heat the interior of a building. The figure is calculated by subtracting the daily mean temperature in a given location from the “ideal” indoor temperature of 65°Fahrenheit. In choosing this indicator, these authors assume that people living in different climates have uniform responses to the same weather. However, research suggests that physiological and behavioral responses to the weather are dependant on the degree to which people are acclimated to the local climate (Radomski and Boutelier 1982; Curriero et. al. 2002; Kalkstien 1984).

A small data set may not capture the broad spectrum of weather events and may not capture the full effect of inclement weather. Stephen Knack concludes that rainfall has little power to dissuade voters from participating (Knack 1994: 10). However, he dismisses the significance of the unusually low amounts of rainfall in his data. In his conclusion, Knack concedes that he may be missing some of the effect of rain because the maximum observed rainfall in during two of the three years in his panel was one half of an inch (Knack, 1994: 11). To rectify this, he pools the data from the dry years and compares the results to the year...
that has greater observed rainfall. Even during year that he considers to be “wet”, just 23% of
the total weather observations contain measurable rain (Knack, 1994: 11). It may be that a
threshold level of rain must be reached in order for effects to be realized. With such a limited
range of data, it is difficult to embrace the conclusions that Knack reaches regarding the
relationship between weather and voting behavior. Using small data sets limits the power of
the study to discover the specific conditions in which weather has an effect on voter turnout.

Elections are unique events which can stimulate the electorate in very different ways.
Voters in a state that is having a gubernatorial election featuring a very popular and heavily
favored incumbent may react much differently than voters in a state which is holding a
controversial referendum on reproductive rights. The research by Gomez, Hansford and
Krauss is limited to presidential election years and therefore explains only how voters
respond to weather in this very high profile event. The work of Gatrell and Bierly includes
only data from the state of Kentucky, discounting the effect of weather in different regions of
the country. This also prohibits comparisons between states that are electing different offices
or who may have different registration laws. A larger data set gathered from a broader
section of the country would help inform research on this topic by accounting for a variety of
political events that may alter the costs of participation.

As mentioned previously, the degree of competition in a particular race is another
factor that may cause variations in voter response (Rosenstone and Hansen 1993). Gatrell and
Bierly acknowledge that the level of competition may change the cost of participating in an
election and change the way voters respond to other costs. To account for this, the authors
include in their model a measure of competitiveness as calculated by the differences in
registration between the two major parties. People are free however to defect from the party
indicated on their registration form, and a substantial number of registered voters do not vote.

In an era of declining partisan identification and continuing southern realignment, this indicator may not reveal much about the closeness of individual contests. Knowing the level of competition in past elections can provide researchers important information about the political environment. A more accurate insight into pre election dynamics can be gained by looking at pre election polls or by sorting through news accounts.

The research presented in this paper includes data from five states and covers ten separate presidential and congressional election events. This permits an examination of how weather may affect voters in different regions of the country in a variety of election types. I account for the intensity of the election by indicating the number of high profile races (presidential, senate, house, and governor’s contests) on the ballot in each region. To avoid discrepancies between the party registration figures and the actual preferences of the voters, the competitiveness of each election is measured using the actual margin of victory of the office on the top of the ticket. The measure for temperature is a calculation of the departure from expected Election Day weather, accounting for acclimation to local climates. The research presented here also factors in snow, an element that creates potentially hazardous travel conditions that may not be conducive to voting. The effort by Gomez, Hansford, and Krause is the only research that takes snow into account, but its effect on voters was inconclusive (Gomez et al. 2004: 13).

The contributions by this research include the use of a larger set of data to account for a variety of weather conditions, incorporating of indices of human comfort when measuring weather conditions, and the merging of theoretical perspectives regarding both the behavioral responses to weather and voter turnout. To date, there have only been two previous studies
that analyze data from more than three elections, one of which focuses solely on the state of Kentucky. The variation in weather conditions from year to year during early November alone justifies the need for a larger data set. The use of raw temperature data in other studies may underestimate the effect that weather has on the voting public. Theories of climate acclimation support the use of relative climate indices used in this research such as the departure from normal temperature. Using these figures may be a more accurate method to measure the degree of human discomfort caused by the weather. Finally, the research here discusses key findings regarding behavioral responses to weather conditions as well as more general research about the effect that weather has on human health. This addition strengthens the theoretical section of the paper and adds support for the hypothesis that weather represents a potential cost to the voting public.
Chapter 3-Methods

3.1 Data Description

The general hypothesis of this research is that inclement weather represents a cost to the public that is sufficient to keep some affected people from voting on Election Day. Inclement weather conditions create logistical difficulties that can add to the cost of all outdoor activities. The impact that weather may have on the decision to vote varies with the costs of outdoor interaction, and these costs are not uniformly distributed across the population. Behavioral responses to weather events rely at least somewhat on the degree to which an individual has acclimated to the local climate. The first cold day during the fall season is likely have a greater impact on an individual than subsequent cold weather days even where the conditions are identical.

In this section I describe and detail the significance of the variables used in this study and how each one pertains to the research question. I also detail how the variables are calculated at the point where they are initially collected, the sources for all data used in this study, and how the data are scaled for the purposes of this research. In addition, I offer explanation for the choices that were made as to why certain variables are included in this study while others were not. For example, absolute measures of temperature are not as useful as relative indices because they do not provide as much insight into how people interpret the weather. Also included in this section are some interpretations of various weather phenomena and descriptions of how they could potentially interact with people during their trip to their polling place.
The dependent variable in this study is the percentage of registered voters who voted in a given election expressed as a ratio. Voter turnout information was obtained from the Secretary of States’ offices in Iowa, Missouri, Utah, Arizona, and Oregon. These offices compile official turnout data from each county for all elections held in each respective state. Much of the recent data was posted on official state websites, while older data had to be copied from paper files and sent in the mail. Turnout statistics are sorted by county into a panel containing cases from all federal elections held between 1982 and 2002.

The states selected in this study were chosen because of the responsiveness of the personnel, the uniformity in the way that they calculated turnout statistics, as well as to provide some geographic balance. Examining data from different parts of the country allows for the incorporation of a wide variety of weather conditions and election dynamics.

Independent variables are the mean temperature for the election date, the departure from normal mean temperature, rainfall measured in hundredths of an inch, and snowfall measured in tenths of an inch. County level data were collected from the National Climatic Data Center (NCDC) in Boulder, Colorado. Weather and climate data are collected daily and recorded by trained National Weather Service volunteers through the Cooperative Observing Program (COOP) at over 11,000 stations nationwide. Summary of the Day reports include the recorded daily maximum and minimum temperatures, and the 24-hour precipitation and snowfall totals. All weather data are taken from the date of the specified election and include the 24-hour precipitation and snowfall in inches, the mean daily temperature, and the 30-year average mean temperature.

People spend so little time outdoors and have adapted to indoor climates, which has led to a decreased tolerance for adverse weather events. The weather related effects on
human health are conditional on the degree to which people are adapted to the climate. In those regions where people are less adapted to temperature extremes or significant amounts of precipitation, inclement weather may be more uncomfortable, increasing chances for voter abstention. Considering the types of weather typical of the early fall months, rainfall of an inch or more, and snowfall or freezing temperatures outside of the northern plains or any mountainous region would be somewhat atypical. These are the conditions which would most likely deter voters if perceptions of weather depend on what people normally expect for a given time of the year.

To account for the way people interpret weather events, the mean daily temperature was computed at each reporting station and compared against the 30 year mean to provide an indication of the departure from normal temperature. Calculating the departure from mean rather than relying on a standardized measure of temperature helps to account for the degree to which people acclimate to local climates. Snowfall totals measured in inches for the 24 hours including the election are included as well. Using the 24-hour total does not account for the timing and duration of snowfall events, however even a light dusting can be hazardous and is likely to impact some portion of the trip to the polling place. Even in those communities that are vigilant in their snow removal, it seems unlikely that all walking and driving surfaces can be cleared within a single 24-hour period.

With respect to rain, the weather patterns that are typical of November make it unlikely that a moderate amount of rainfall could come during a short period of time. The spring and summer months tend to support higher levels of convective activity, during which a thunderstorm could yield a period of intense rainfall of a short duration, which is likely perceived differently from a dreary overcast day with light rain in the fall (Harman 1991). In
contrast to the more scattered nature of summertime rains, any amount of rainfall in the fall months would generally be accompanied with cloud cover for a significant period of the day. In addition, modest amounts of rainfall during the fall months would generally accumulate over a several hour period, which may encourage the perception that it was a rainy day. Rainfall totals are measured in hundredths of an inch for the 24 hour period including the election.

I also expect that the effect of weather may vary according to election type. Presidential elections may attract those voters who only vote in high profile contests (Campbell 1960). These voters may be less committed to civic norms and find it easier to abstain from voting entirely if it entails confronting bad weather. To control for the type of election, a pair of dummy variables will be created indicating the elective offices on the ballot for each state and election included in this analysis. House elections are the baseline event and will be coded as (0), while presidential and senate elections will each be coded (1). To measure election closeness, I will use the percentage margin of victory for the federal office at the top of each state ballot. When computing the margin for congressional district elections, I compute the weighted average margin of victory for all races in each county that contains multiple congressional districts.

Demographic factors including age, education, and income are also thought to have influence on voter turnout. Data from the United States Census Bureau suggests that those between the ages of 35 and 74 are the most likely to participate in elections (U.S. Bureau of Census). Those with both higher incomes and greater educational attainment also tend to vote at higher rates than the rest of the population (Verba and Nie 1972, Wolfinger and Rosenstone 1980). In addition, the rate of participation among southern voters has lagged
significantly behind their northern counterparts. As a proxy for all of these factors, I control for the effects of turnout in previous elections. Those areas of the country which tend to vote in higher numbers do so consistently and demographic shifts do not occur quickly enough to justify gathering variables that will not yield additional explanatory power. Controlling for past turnout is supported in the literature which suggests that the most powerful individual determinant of voting is whether or not someone has voted before. Any significant variation within a given area therefore is likely resulting from factors specific to the contest which may be partially accounted with measures of competitiveness and election type.

3.2 Model Specification

I model the effect of weather conditions on voter turnout using a cross sectional panel of US counties in five states. The empirical model looks to correct for serial correlation in the error term with an AR1 correction. The independent variables included in the model are competitiveness, ballot position, departure from mean, snowfall in inches, and rainfall in inches. The dependent variable is the proportion of voters that participated in the election. The model also includes fixed effects and robust standard errors, each clustered by county. The regression model examining the interaction between weather and voter turnout is as follows:
\[ B_0 + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + B_5X_5 + B_6X_6 + \alpha_i + e_i = Y_i \]

Where:
- \( X_1 \) = Departure from mean
- \( X_2 \) = Snowfall in inches
- \( X_3 \) = Precipitation in inches
- \( X_4 \) = Presidential races
- \( X_5 \) = Senate races
- \( X_6 \) = Margin
- \( \alpha_i \) = Fixed Effects
- \( Y_i \) = Turnout

I expect that adverse weather conditions including colder than normal temperatures, rainfall and snow events suppress voter turnout. Should these results be confirmed using aggregate turnout data it may justify an expanded study including more regional balance and additional measures to identify particular voting blocks or demographic groups who may be disproportionately impacted by unpleasant weather conditions. In the section that follows, I discuss the rationale behind the choices that were made when specifying the model.

### 3.3 Justification for Model Specification

As described previously, the data analyzed in this study comes from nearly three hundred county units spread over five states. It is reasonable to assume that these county units vary in ways that are not observed by the variables chosen for this study. These unobserved characteristics may affect the relationship between weather and voter turnout. Statistical models which exclude variables that impact the phenomenon being studied are said to be misspecified. An omitted variable that has a relationship with the dependant variable, or a conditional relationship with any of the independent variables, may introduce bias into the regression estimates. Omitted covariates resulting from unobserved characteristics in individual observations can also inflate standard errors, leading to
inefficient regression estimators. Biased or inefficient estimators can lead to incorrect inferences of statistical significance. In this section, I discuss the problems that may be present in the data used in this study and the various model corrections that I applied to remedy these problems.

3.3.1 Fixed Effects Regression

Biased regression coefficients can misrepresent the magnitude or significance of the relationship between the explanatory and dependant variables. One solution to this problem is to discover all phenomena that may have an impact and include them in the model as control variables. If the omitted variables are added so that the model is correctly specified, the bias also disappears as the estimates become more precise. In practice, it is nearly impossible to add control variables to account for everything that might affect the relationship that is being studied. With panel data, however, there are ways to control for some unobserved characteristics.

The estimated coefficients in this study may be biased because the county units differ in ways that are not explained by the control variables included in the model. In the classic linear regression model, the stochastic disturbance or error term represents the omitted or neglected variables that affect the dependant variable but are not included in the model. Some of the unobserved variance that affects voter turnout is said to be stable over time within each county unit. The fixed effects regression model adds a control for the omitted characteristics that are stable over time by treating each county as an individual unit with its own unique characteristics. This is the equivalent of adding a dummy variable for each
county. The fixed effects regression reduces the bias by controlling for the unobserved characteristics within the county units that are stable over time.

3.3.2 Serial Correlation

Bias can also be introduced into estimators from unobserved characteristics that are not stable over time. In statistics, a time series is a sequence of data points measured at uniformly spaced intervals of time. In time series data, events that impact a particular region or unit of analysis in one time period are likely to have an affect in future time periods in that same unit. This phenomenon may be due to unique events that cause a shock that persists over time, or simply because of momentum resulting from habitual behavior. If those events are not controlled for with the addition of independent variables, the residuals in the regression for an individual observation can correlate with the residuals in future observations. Autocorrelation of the residuals can introduce bias into ordinary least squares estimators and lead to incorrect inferences of statistical significance (Gujarati 1995: 401).

The use of panel data makes it possible to control for serial correlation. In this study, I assume that people base their decision to vote or abstain based on factors that encouraged them to vote or abstain in the last election. Factors that influence participation in a particular area are thought to have effects that linger over time. For instance, current voter participation in the south is thought to lag behind national averages due to the impact of registration barriers that disenfranchised voters over 40 years ago. The notion of persistence in voting behavior is supported by literature that suggests that the strongest predictor of turnout at the individual level is whether or not people have voted in previous elections (Matsusaka and Palda: 1999). Simply put, voters do not change their habits greatly between individual
election events. The direction and magnitude of past error terms can influence error terms in the future and cause bias in ordinary least squares measurements. Autoregressive corrections adjust the estimates of the error term by modeling the path of the past values of the dependant variable.

3.3.3 Heteroskedasticity

Variations in local political climates, demographic characteristics, and historical context make it reasonable to assume that counties in this study have unique unobserved characteristics that would cause the independent variables to have a different affect on the dependent variable turnout. If the postulation of unobserved heterogeneity is correct, unexplained variance will be unequal across all county units, therefore violating the assumption of equal variances across observations. Errors that have unequal variances are said to be heteroscedastic. Ordinary least squares regressions in the presence of heteroscedasticity does not result in biased estimators, but may cause inflation in the standard errors that can lead to incorrect inferences of significance (Kennedy 1998: 117). Where variances are not uniform, ordinary least squares regression no longer is efficient because it no longer minimizes the sum of squared errors. The inefficiency in the estimators can be solved by using robust estimators for the standard error.

To illustrate, a particular county in Arizona may be making an effort to expand remote voting and has been adding additional alternate polling locations in each election over the last ten years. The added convenience for voters has been responsible for the steady increases in voter turnout throughout the county. Because the model used in this study did not account for differences in the distribution of polling locations, the county in Arizona may
produce outliers in the data that can cause inflation in the standard errors. Robust estimators stabilize the error variance by taking a weighted sum of the absolute values of the errors in each unit of observation.

In the model used in this study, factors that are unique to each county may cause outliers that influence regression estimates. These factors, when not controlled for, can cause increase the error variance and produce inefficient estimators. Robust estimations are not affected by outliers in the data caused by unobserved variance resulting from characteristics that are unique to a particular unit of observation. Robust standard errors account for the characteristics of individual counties by giving more weight to those counties that have smaller standard errors. In the next two chapters, I present and interpret the results of the research, discuss the key findings, and suggest some direction for future research on this topic.
Chapter 4. Results and Discussion

Table 1 reports the results for the general model estimating the effect of weather on voter turnout for the 11 federal general elections between 1982 and 2002. The estimates confirm that there is a general relationship between weather and voter turnout. As expected, the results indicate that rainfall and colder than normal temperatures suppressed voter turnout in the five states included in the analysis. The coefficient for rainfall is -0.012, indicating that for every one-inch increase in rainfall, voter turnout decreases by 1.2 percent, when controlling for all other variables. An inch of rain in early November is likely the result of a moderate rainfall that falls over a five or six hour period. Without an umbrella or a raincoat, a moderate rain could soak through clothing and shoes in less than ten minutes. The potential for this kind of discomfort may be enough to give potential voters second thoughts about venturing outside on Election Day. The coefficient for departure for mean temperature is 0.0005, indicating that for every one degree increase in mean temperature relative to normal, voter turnout increases by a paltry 0.005 percent, when controlling for all other variables. At first glance this result may seem insignificant. When considering that temperatures in early November routinely deviate from normal readings by ten or twenty degrees, the effect of outdoor temperature on voters could prove more significant. An Election Day temperature that is twenty degrees below the normal temperature would result in a 1 percent decrease in turnout.

Looking at table 1, the result from snowfall is statistically significant, but not in the predicted direction. Snow events have the unexpected effect of bolstering voter turnout. The coefficient for snow is 0.006, indicating that for every one-inch increase in the amount of
snow, voter turnout increases by 0.6 percent, when controlling for all other variables. When looking at the data, the only two states with recorded snowfall are Utah and Iowa, both states that enjoy turnout that is high relative to turnout in Oregon, Missouri, and Arizona. The higher turnout should be accounted for however, making the results somewhat surprising.

Also worth mentioning from table is that the presence of Presidential and Senate races on the ballot both increase turnout as predicted. The controls for the election type are both positive and statistically significant at the .01 level. This is also evident in the summary statistics, as the mean turnout for Presidential elections was about 6 percent higher than the mean for Congressional elections. The coefficient for margin of victory for candidates at the top of the ballot was significant at the .01 level, but in the unexpected direction. Contrary to the predictions of rational choice and mobilization theories, closer elections in this sample were associated with a decrease in voter turnout.

To confirm the results from snow in the first model, I ran an equation including data from the two states in the original sample that observed measurable snowfall. Testing the effect of snow in those states that observed snowfall on Election Day did not change the results. Table 2 reports the effect of weather on those voters in Utah and Iowa. Out of a total of 1020 total observations between the two states, almost 13 percent of them contained measurable snowfall. All of the measures, except for the departure from mean, were statistically significant at the .05 level or better. The coefficient for snow is 0.007, indicating that for every one inch increase in the amount of snow, voter turnout increases by 0.7 percent, when controlling for all other variables. This unexpected result may be partially due to the fact that residents in Iowa and Utah are accustomed to dealing with snow. The coefficient for precipitation is -0.027, indicating that for each one inch increase in the amount
of rain, voter turnout decreases by 2.7 percent, when controlling for all other variables. This result suggests that rain may have a more pronounced effect on voters in Utah and Iowa.

Under the assumption that the cost imposed by weather events depends largely on individual perceptions, I made some adjustments to the basic model. I adapted the model to fit some conditions that aren’t captured in the general model and ran additional equations (see tables 3 and 4). First, I eliminated measurable rainfall from all cases in which a quarter inch or less of precipitation was recorded. People making judgments about weather conditions may be less likely to adjust their behavior if rainfall amounts are light. Also, smaller rainfall amounts are generally events of shorter duration, which would increase voters’ opportunities to avoid inclement weather and therefore make less of a factor for the voting public. I also created an interaction term that is a product of the mean temperature and precipitation variables. Doing so will help determine if a cold rain event is perceived any differently than a more mild rain event.

Table 3 models the combined effect of rainfall and temperature by adding the previously mentioned interaction term. Looking at the results, it is unclear whether temperature is a factor in how rainfall events are perceived. The product of mean temperature and precipitation did not achieve statistical significance. Remaining coefficients did achieve significance in and were in the same direction as the measures in the general model. Table 4 models the effect of heavier precipitation on voter turnout by eliminating observations of lighter amounts of rain that are present in the data. The coefficient for rainfall is -0.009, indicating that for every one-inch increase in the amount of rainfall, voter turnout decreases by 0.9 percent, when controlling for all other variables. This would suggest that even lighter
amounts of rain suppress turnout. This result may indicate that rainfall amounts are a less powerful determinant of behavioral responses than the cloud cover that accompanies the rain.

To determine if weather has more of an impact during specific election events, I estimated the effect of weather on turnout during Presidential elections. The results in table 5 model the effect of weather during Presidential election years. The coefficient for departure for mean temperature is -0.0018, indicating that for every one degree increase in mean temperature relative to normal, voter turnout decreases by around 0.002 percent, when controlling for all other variables. Contrary to expectations, this result suggests that warmer than normal temperatures decrease voter turnout in Presidential contests. The results for precipitation are somewhat striking. The coefficient for rainfall is -0.721, indicating that for every one-inch increase in the amount of rainfall, voter turnout decreases by 7.2 percent, when controlling for all other variables. This result may indicate that those who are not in the habit of voting are particularly sensitive to the costs associated with rain.

The results of this research may be a vindication of sorts to those who have assumed that a relationship between weather and voter turnout exists. The nervous hand-wringing of campaign strategists seems justifiable and the election eve questions posed to local television meteorologists by news anchors may not be idle chatter after all. The research presented here supports a general relationship between inclement weather and voter turnout. Two of the variables in particular produced results that were fairly consistent across the various conditions that were tested. In all five equations that were run, coefficients for rain were significant and negative, suggesting that rain suppresses turnout regardless of its intensity. This result holds true for all election types but may be particularly pronounced during Presidential Elections. The departure from mean temperature was also statistically significant.
and positive in all but one equation performed here. The negative coefficient during Presidential Elections might indicate that voters are more willing to brave colder temperatures to participate in high profile elections.

Some of the results presented here did not conform to my hypothesis. For example, the coefficients for the margin of victory and snowfall were significant, but not in the predicted direction. The results for snow are particularly surprising given the travel hazards that accompany even light amounts of snow. In the chapter that follows, I interpret these figures further, provide possible explanations for those results that were unexpected, and discuss how the work presented here provides direction for future research.
Table 1  Predicting the Effect of Weather Events  

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard Error</th>
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</thead>
<tbody>
<tr>
<td>Snow</td>
<td>.00632**</td>
<td>.00321</td>
</tr>
<tr>
<td>Precipitation</td>
<td>-.01248*</td>
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</tr>
<tr>
<td>Departure from Mean</td>
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<td>.00016</td>
</tr>
<tr>
<td>Presidential Elections</td>
<td>.14204*</td>
<td>.00313</td>
</tr>
<tr>
<td>Senate Elections</td>
<td>.00767*</td>
<td>.00242</td>
</tr>
<tr>
<td>Margin</td>
<td>.06264*</td>
<td>.00746</td>
</tr>
<tr>
<td>Constant</td>
<td>.52355*</td>
<td>.00254</td>
</tr>
</tbody>
</table>

N=1927  
\( \text{Chi}^2=2610.89^* \)  

*=p<.01  
*-=p<.05  
*-=p<.10  

Table 2  Iowa and Utah Only  

<table>
<thead>
<tr>
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<th>Coefficient</th>
<th>Standard Error</th>
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<tbody>
<tr>
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<td>Departure from Mean</td>
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<td>.00460</td>
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<tr>
<td>Senate Elections</td>
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<td>.00727</td>
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<tr>
<td>Constant</td>
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N=1020  
\( \text{Chi}^2=3950.2^* \)  

*=p<.01  
*-=p<.05  
*-=p<.10
### Table 3  Precipitation * Mean

<table>
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<th>Coefficient</th>
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<td>.00053</td>
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<td>.00313</td>
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<tr>
<td>Senate Elections</td>
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<td>.00249</td>
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N=1927  
$\chi^2=6981.27^*$

* = $p < .01$
* = $p < .05$
* = $p < .10$

### Table 4  If Precipitation > .25

<table>
<thead>
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<tbody>
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<td>Precipitation</td>
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<td>Departure from Mean</td>
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<td>.00730</td>
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<tr>
<td>Constant</td>
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<td>.00254</td>
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</table>

N=1927  
$\chi^2=2650.68$

* = $p < .01$
* = $p < .05$
* = $p < .10$
<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard Error</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>Precipitation</td>
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<tr>
<td>Departure from Mean</td>
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<td>Senate Elections</td>
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<td>.00439</td>
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<tr>
<td>Margin</td>
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<tr>
<td>Constant</td>
<td>.68699*</td>
<td>.00471</td>
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</table>

N=1170

$\text{Chi}^2=637.9^*$

*=p<.01

*=p<.05

*=p<.10
Chapter 5. Conclusion

The results of this research provide some support for my hypothesis that inclement weather deters some voters on Election Day. Out of all of the weather conditions that were tested, rain had the most consistent effect on voters across all of the models. Precipitation achieved statistical significance in all six of the regression equations performed in this study. Looking at the strength of the coefficients, the effect of rain was most pronounced during Presidential elections. Turnout during Presidential elections is on average significantly higher than congressional contests. The descriptive statistics from the data in this study reveal that the mean turnout during Presidential elections was 6.6% higher than in congressional elections. Assuming that there are a substantial number of voters who participate irregularly, the higher coefficient for rain in Presidential contests may be evidence that the cost imposed by weather is higher for those who are less committed to voting.

Even lighter amounts of rain in this sample suppressed voter turnout. Beyond any travel difficulties caused by wet streets, any day with measurable precipitation also contains some amount of cloud cover. In response to the increased darkness brought on by cloudy days, the brain produces melatonin, a naturally occurring hormone that encourages sleep. The increased darkness may make people feel tired at the end of the day, encouraging people to stay home rather than going out to vote. Published research demonstrated that voter turnout in British elections was lowest during the months of December and January, months that also feature the lowest amount of daylight during the calendar year (Rallings, Thrasher, and Borislyuk 2003: 66). The impact of the additional darkness from cloud cover may discourage voters who are considering a trip to the polls at the end of the work day. Future research on
this topic can account for the effects of darkness by calculating the percentage of sunshine during the day using weather stations that record hourly observations.

Given the significance of precipitation, results for snowfall are somewhat confounding. Road conditions during and following snowstorms are significantly more hazardous than dealing with roads which are wet from rain. The extra work often required to prepare for any kind of travel such as shoveling driveways and brushing off vehicles and should be enough to deter some voters from making trips which may be deemed unnecessary. Looking closely at the data, the most snow that I could find was six inches, an amount that occurred just three times through the data. The overwhelming majority of the observed snowfall was in the 1-2 inch range and fewer than ten events reached the 4-6 inch range. Again, the two states which saw significant observations of snowfall were Utah and Iowa, states whose average turnout is much higher than the other states in the analysis.

Results for temperature achieved significance in five of six equations, and were positive in all but one. This indicates that colder than normal temperatures suppress voter turnout. The change in the direction of the coefficient for temperature when including only Presidential contests may be an indication that voters are more willing to endure discomfort to participate in these high profile elections. The size of the coefficient (when compared to rainfall) and inconsistency in direction may simply mean that temperature is a pretty small determinant of voting behavior. Generally speaking, arctic cold outbreaks caused by the airflow from high pressure systems parked over the Hudson Bay region are less frequent in the month of November than they are in the winter months. This feature pushes cold air down into the continental U.S. from the Arctic Circle and can result in temperatures which are twenty degrees or more below normal (Ludlum 1991: 74). Looking at the frequency
distribution of the departure from mean temperature, few of the observed daily mean temperatures are more than ten degrees below the normal for Election Day. While the results are in the predicted direction, the coefficients may have been stronger if there were more pronounced cold weather events.

The negative coefficient for competitive elections in congressional elections may indicate that the voting public is not sensitive to mobilization attempts during presidential contests. Any effect from the additional stimulation which comes with closer contests may be "washed out" during Presidential elections due to the grandeur of the event itself. The chief executive is celebrated in media, history books, and folklore as a sort of a secular pope and the opportunity to participate in his or her selection may be stimulating enough. The enormous public profile given Presidential contests may increase the desire to take part an election because of the solidarity benefit or an increased sense of civic duty.

This examination of the weather hypothesis is limited, however the number of observations capture a great deal of the variability in weather conditions that are typical of November. With only five states, it is difficult to reach any definitive conclusions regarding how weather may affect voters. The theoretical approach of rational choice models does not assume that costs are weighted equally for everyone and also asserts that resources to deal with costs are unevenly distributed through the voting population. I believe the same to be true for weather events and adding additional states as well as some census data to look at demographic characteristics may explain who is impacted by the weather. People living in southern states who are unaccustomed to dealing with cold weather may be deterred from voting while voters in the northern plains or the northeast may be relatively unaffected. An
early November storm may deter voters living in the dry Western Plains, but have little effect in the persistently damp Pacific Northwest.

5.1 Suggestions for Future Research

Perhaps the most significant contribution of this research relative to other published work is the inclusion of the theory of climate acclimation. Much of the existing research on the effect of weather on behavior and human health that I reviewed in preparation for this work addressed the fact that weather does not impact people uniformly. To fully capture the degree to which weather deters people from voting, it may be necessary to incorporate additional measurements that can account for climate acclimation. For example, adding the date of the first frost in a given area can give an indication as to whether or not people have already experienced cold temperatures prior to Election Day. If the theory is correct, those people living in areas not yet impacted by a seasonal frost would be more sensitive to cold temperatures. Transitions to cooler weather are common in early November, and the first cold weather outbreak of the season may frequently coincide with Election Day. A measure indicating whether or not the first frost had occurred in a given area may explain more about how voters react to cold temperatures.

It may also be worthwhile to include variables which measure the costs for the voting public which are specific to each area. Interaction with the weather is just one of the potential costs associated with voting and may be less of a consideration if it is other costs are minimal and it is relatively easy to vote. Factors such as the length of the ballot, relative ease of registration, the number of polling places, or whether a county is more urban or rural may have an effect on the overall cost of voting in a particular region. Casting ballots in
referendum states such as California often contain multiple propositions, requiring voters to
digest more information to decide how to vote. The number of polling places and the distance
needed to travel to reach them may also be important factors to would be voters. Including
the average length of the commute time to work in a given region would also provide some
insight into the considerations faced by voters. As mentioned in previous chapters, long
commutes to and from the workplace can deplete the amount of time in a day that is available
for voting.

Finally, a study that explains more about who abstains from voting because of
weather would be more interesting than simply acknowledging a general effect. In spite of
the limited scope of this examination, there appear to be some climate conditions that are
inhospitable to at least a small portion of the voting public. If a particular demographic
within the population is more sensitive to any effect of weather, it may be of interest to both
policy makers and the strategists who help elect them. If weather does impact some of the
voting public more than others, those effects need not be substantial to change election
outcomes. The prospect that a portion of the population is highly susceptible to the costs
associated with weather raises normative concerns that may justify changing the way we hold
elections. Changes such as more liberal absentee ballot regulations, establishing Election Day
as a national holiday, or giving further thought to electronic voting all may manipulate the
costs involved with voting to minimalize the effects of weather. This study, while not at all
conclusive, does lend some empirical support to widely held assumptions regarding weather
and electoral participation.
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