Snowed: Deceptive Advertising by Ski Resorts*

Jonathan Zinman
Dartmouth College

Eric Zitzewitz
Dartmouth College

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Preliminary, comments welcome

ABSTRACT

Casual empiricism suggests that deceptive advertising is prevalent, and several classes of theories explore its causes and consequences. We provide some unusually sharp empirical evidence on the extent, mechanics, and dynamics of deceptive advertising. Ski resorts self-report 23 percent more snowfall on weekends; there is no such weekend effect in government precipitation data. Resorts that plausibly reap greater benefits from exaggerating do it more. We find little evidence that competition restrains or encourages exaggeration. Near the end of our sample period, we observe a shock to the information environment: a new iPhone application feature makes it easier for skiers to comment on resort ski conditions in real time. Exaggeration falls sharply, especially at resorts where iPhones can get reception.

Other keywords: false advertising, misleading advertising, bait and switch, search costs, quality disclosure, product information, Internet

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"Jackson Hole/Teton Village DID NOT get 15" today…more like 0"

-Skier comment posted on SkiReport.com, 3/15/2009

Casual empiricism suggests that deceptive advertising is prevalent, and several classes of theories explore its causes and consequences. Yet there is little sharp empirical evidence that speaks to such theories. This gap is due in part to formidable measurement challenges; in most settings, measuring deceptive advertising requires detailed, high-frequency information (on ads, product quality, and inventories) that is difficult to observe.

We test for deceptive advertising by examining a critical component of product quality at ski resorts: new natural snowfall in the past 24 hours. Ski resorts issue "snow reports" on their websites roughly once a day. These reports are also collected by aggregators and then rebroadcast over the Internet and via print and broadcast media. A skier wishing to ski on fresh snow can use these snow reports to help decide whether and where to ski on a particular day.

The dynamics of customer acquisition by ski resorts suggest that the optimal (deceptive) advertising strategy may vary at high frequencies. Resorts only benefit from exaggerating snow reports when skiers condition purchase decisions on them. The cost of exaggeration is angering or losing credibility with skiers, including those who have already pre-committed (e.g., as part of a multi-day vacation) but use the snow report to help plan their day. The pre-committed should represent a larger share of (potential) skiers on weekdays than on weekends, when many skiers are less constrained by work schedules and (we hypothesize) more likely to condition resort choice on snow conditions. So if there is deceptive advertising we should expect to see more of it designed to attract weekend skiers.

We test that hypothesis using data from 2004-2008, and find that resorts do indeed report 23 percent more fresh snow on Saturday and Sunday mornings (1.54 inches vs. 1.24 inches, p-value = 0.013). We match resort reports with government weather data and find that there is no such weekend effect in actual snowfall.

Having found that deceptive advertising varies *within* resorts along with payoffs, we next explore whether deceptive advertising varies *across* resorts with plausibly different payoffs. Weekend effects in snow reporting are larger for resorts with more expert terrain and those within driving distance of population centers. This is consistent with expert skiers valuing fresh snow more highly and with resorts near cities having more potential to attract weekend skiers. We do not find any significant interactions between the density of competition and weekend effects.

How can exaggerated claims about product quality persist in equilibrium? Many theories show that deceptive advertising can prevail when consumer search or switching costs are high. These costs are likely high in our setting. On a one-shot basis, driving times are substantial even between "neighboring" resorts. On a longer-term basis, some consumers may find it costly to coordinate with peers on alternative destinations or to learn how to navigate the terrain and ancillary services (parking, rentals, dining, lodging) of a new mountain.

Our setting seems most closely characterized by models where firms take advantage of high search costs by "baiting" consumers with a high quality good that is not actually in stock, and then "switching" consumers to a lower quality good that is available (Lazear

1995). But our results relate to several other classes of models as well. In signal-jamming models (e.g., Holmstrom 1999), agents engage in costly effort to upwardly bias signals of their quality, but rational recipients of these signals anticipate these efforts and no information is lost. In settings with search or information costs, “obfuscation might lead to higher profits by making consumer learning less complete” (Ellison and Ellison, forthcoming).[1] Other theoretical models focus on deception, with motivating examples that relate to advertising (Kartik et al. 2007; Ettinger and Jehiel forthcoming).[2]

The hypothesis that search and information costs drive deceptive advertising is supported by a final finding from our setting: ski resorts stop exaggerating fresh snowfall after a technology shock dramatically reduces the cost of rapid information sharing between customers. In January 2009, *SkiReport.com* added a new feature to its popular iPhone application that makes it easier for skiers to post "first-hand reports" alongside the resort-provided reports. This feature sparked a sharp increase in the amount and timeliness of skier feedback on the accuracy of resort reports, with many first-hand reports filed from the chairlift or the lodge. But first-hand reports spike only at resorts with adequate coverage from AT&T's data network, and these covered resorts experience a disproportionate post-launch drop in exaggeration. This finding adds to the body of existing evidence that the Internet can reduce market frictions, at least for a time.[3] It also complements work showing that third-party interventions to improve quality disclosure can change firm behavior.[4]

[1] See Ellison (2005) for a model of obfuscation with add-ons that can be adapted to settings (unlike ours) where both low- and high-quality products are available at a point in time.
[2] Bagwell (2007) reviews the extensive theoretical literature on truthful advertising.
[3] See Ellison and Ellison (forthcoming) for related evidence and literature.
[4] See, e.g., Sauer and Leffler (1990); Melnick and Alm (2002); Jin and Leslie (2003); Greenstone et al (2006).

Although our findings provide unusually sharp evidence on the nature and dynamics of deceptive advertising,[5] our setup can only identify a subset of the behaviors of interest for modeling and policy analysis. We lack any data related to the resort profit functions, and hence cannot directly measure how skiers respond to snow reports.[6] This prevents us from sharply testing across the models discussed above, identifying whether consumers pierce the veil of firm deception, or measuring the welfare implications of (changes in) advertising practices.

Moreover, the external validity of our findings to other markets is uncertain. Nevertheless we argue that our findings have potentially broad applicability, as the market for skiers does not seem uniquely suited to deceptively advertising. There are many other markets where search and switching costs loom large. And many of the other conditions that contribute to deception in theory do *not* seem to prevail in our setting. Ski area customers get immediate and visceral feedback on the accuracy of snow reports. The potential for repeat play and learning is high.[7] And the exit rate of ski areas is low: there are few if any "fly-by-night" players with incentives to commit outright fraud. So we

[5] The closest study to ours we are aware of is Jin and Kato (2006), who audit claims about the quality of baseball cards being auctioned on eBay and find evidence of exaggeration. Jin and Kato's analysis focuses on the effect of deceptive claims on demand and auction prices, whereas our focus is on the supply of deception. Also related to our work is a small empirical literature following Gabaix and Laibson (2006) examines hidden or distorted *prices*; see, e.g., Brown et al (2007), Stango and Zinman (2009). Bertrand et al (forthcoming) explores the role of *persuasive* advertising that is not deceptive *per se*. There is also a substantial literature examining third-party forecasts or assessments of product quality that may be biased by commercial relationships: earnings forecasts (Lin and McNichols 1998; Michaely and Womack 1999), product recommendations (Reuter and Zitzewitz 2006), and sports judging (Zitzewitz 2006; Price et al. 2009).

[6] We conducted this study without industry cooperation, and hence our data on resorts is limited to what we could gather from websites. Nearly all resorts are privately held so publicly financial information on them is scarce, particularly at the daily frequency.

[7] The immediate feedback stands in contrast to the examples (e.g., tobacco use, investment advice) that motivate Glaeser and Ujelyi (2006) and Kartik et al (2007). The visceral feedback (and high stakes) contrasts with the "low involvement situations" (e.g,. voting, cheap products) that can make consumers susceptible to persuasion in Mullainathan et al (2008).

speculate that there are many other markets where conditions are ripe for deceptive advertising that varies sharply with advertiser incentives.

The paper proceeds as follows. Section II discusses our data. Section III details our identification strategy and results. Section IV concludes.

II. Data

Our data consist of resort-provided snow reports, government snow data, and resort characteristics.

We collect resort-provided reports from the websites of two popular aggregators: *SkiReport.com* and *OnTheSnow.com*. These websites do not supply archives of ski reports and thus we are forced to assemble our data from different sources. From February 15, 2008 until the end of our sample, we collected snow reports once per day from *SkiReport.com*. We collected snow reports from earlier time periods from two private Internet archives. Since these archives had better coverage of *OnTheSnow.com*, we used archived reports from this website. In the data collected from Internet archives, we are limited to collecting data for days on which the relevant web page was archived. We collect snow reports from archived pages that summarize all reports from a given state or province, so generally an entire state's data is either available or unavailable on a given day. The frequency of data collection in these archives increases over time. In the 2004-5 and 2005-6 seasons, snow reports are available for only about 10 percent of resort days between December and March. This ratio rises to 30 percent in the 2006-7 season and 65 percent in the 2007-8 season.

While it seems reasonable to assume that the archiving process in these Internet-wide archives was exogenous to actual or reported snow, we conduct three tests. First, we test whether reports were more likely to be archived on certain days of the week, and find that weekends account for almost exactly two sevenths of our resort reports (28.4%, p-value of difference with 2/7 = 0.945). Second, we simply examine the timing of the reports, finding that in one of our archives it increased from once every ten days, to once every five days, to once every three days, to essentially every day. Archiving frequencies were higher for states with more resorts (e.g., Colorado vs. South Dakota), suggesting that archiving responded to webpage popularity, but the regular sampling frequencies suggested that this response was not happening at high enough frequency to contribute to a weekend effect. Third, we test below whether the availability of a report is correlated with an interaction of government-reported snow and a weekend indicator variable, and find no evidence that it is.

We compare the resort reports of new snowfall to government data from two sources: actual reported snowfall from nearby government weather stations, and estimated snowfall from the Snow Data Assimilation System (SNODAS), a U.S. National Weather Service model that provides estimated snowfall from satellite, ground station, and airborne weather data collection.[8] SNODAS data are available for any point in the continental United States on a 30-arc-second grid.[9] We take the highest of the 25

[8] SNODAS data are described and available at http://nsidc.org/data/g02158.html.

[9] Thirty arc seconds are roughly 930 meters North-South and 660 meters East-West (at 45 degrees latitude).

SNODAS estimates from the 5x5 grid surrounding the main resort mountain as the estimate of actual snowfall that we match to the resort snow report.[10]

For the government weather stations, we match each resort with to up to 20 National Oceanographic and Atmospheric Administration (NOAA) or National Operational Hydrologic Remote Sensing Center (NOHRSC) weather stations within 25 miles horizontally and at elevations within 500 feet of the resort summit.[11] We match each resort snow report to mean reported snow from the surrounding stations that meet these criteria.

In matching the resort and government snow data, we match time periods as closely as possible. Resorts can issue and update snow reports on aggregator websites at any time, but they usually issue a report early in the morning local time.[12] This report is timed to capture as much overnight snowfall as possible while still being available in time to affect that day's skier purchasing decisions. Saturday's snow report issued at 7 AM local time would therefore reflect snowfall from 7 AM Friday to 7 AM Saturday, and so we attempt to match the Saturday resort report with SNODAS and government data from this time period. NOHRSC reports typically cover a 24-hour period beginning at 7 AM local time, so this matches the timing of resort reports well. NOAA stations

[10] We collect data on the latitude and longitude of resort mountains primarily from the U.S. Geological Survey, and supplement this data with hand-collected information from Google Maps.

[11] NOAA station data is described at http://www.ncdc.noaa.gov/oa/climate/ghcn-daily/. NOHRSC station is described at http://www.nohrsc.noaa.gov/nsa/reports.html.

[12] Our data collection methods will usually capture the last snow report issued on a given day (midnight-to-midnight local time), rather than the first. In data collected from Internet archives, we can determine the date and time of a snow report from a timestamp. In the data we collect ourselves, we collect snow reports at midnight Eastern time, so these reports will be the last issued on a given calendar day. If a resort receives snowfall during the day and updates its snow report, it is possible that the same snowfall will appear in the snow report for two consecutive days. For instance, if a resort received snow on Saturday morning between 8 AM and noon, it may issue an updated snow report at noon Saturday that includes this snow, as well as a regular snow report Sunday morning at 6 AM that includes the snow. To the extent resorts issue more updated snow reports on weekends, this may lead to more double counting of weekend snow and may contribute to our result. In practice, however, updated snow reports are quite rare (CITE percentage from subsample of data).

aggregate their data into 24-hour periods beginning at midnight Coordinated Universal Time (UTC), which corresponds to 7 PM Eastern Standard Time (EST) and 4 PM Pacific Standard Time (PST) in winter months. Since NOHRSC reports provide a better match with the timing of the resort reports, we match with NOAA reports only if matched NOHRSC stations are not available. SNODAS aggregates its data into 24-hour periods that begin at 6 AM (UTC), or 1 AM EST and 10 PM PST. Our analysis accounts for this asynchronicity.

Table 1 provides statistics on the size and distribution of our sample across region and time period. We include resorts in the U.S. and Canada in our sample. We distinguish between Eastern and Western resorts, defining Eastern as states and provinces that are entirely east of the continental divide. Eastern mountains have lower elevations, and we are able to match more Eastern mountains to government weather stations that are within 500 feet of summit elevation. SNODAS forecasts are not available in Canada, but are available for essentially all U.S. resorts. As mentioned above, the frequency of snow reports increases later in the sample, from about 12-13 reports per resort*year in 2004-5 and 2005-6, to 38 in 2006-7, to 69 in 2007-8.

Table 2, Panel A provides summary statistics on resorts collected from the ski report websites. Eastern and Western resorts differ on many of these characteristics, and so we report separate summary statistics for each group. Western resorts classify a larger share of their terrain as Expert (double black diamond), Advanced (black diamond) or, Intermediate (blue square), whereas Eastern resorts have a higher share of Beginner (green circle) terrain. Eastern mountains have lower base and summit elevations and vertical drops that are 60 percent smaller. Eastern resorts have roughly similar numbers of lifts, but less than half as many runs and one-ninth as many skiable acres.

To capture resort proximity to skiers who might be most influenced by snow reports in deciding whether and where to make a day- or weekend-trip, we calculate the population that lives in zip codes within 150 miles (as the crow flies) of the resort using U.S. census data. We also count the number of non-co-owned resorts within 50 miles as an indication of potential competition. Eastern resorts are closer to population centers and have more neighboring competitors.

Table 2, Panel B provides summary statistics for resort snow reports and snowfall data from government weather stations and SNODAS. Average reported snowfall from resort reports is 23 percent higher on weekends than during the week (1.59 vs. 1.29 inches). Resorts are 14 percent more likely to report at least some snow on weekend days (32.3 vs. 28.3 percent) and report 8 percent more snow conditional on reporting a positive amount. Resorts report more snow than is reported in government weather data on both weekdays and weekends, although this could be the result of resort being located on specific mountains that receive more snow than neighboring locations.[13] There is also more snow on weekends in government weather data, but the differences are smaller (and, as we will see below, are statistically insignificant).

III. Results

In this section, we test for a weekend effect in snow reports, examine the cross-sectional determinants of the weekend effect, and examine how the weekend effect changed with

[13] While the SNODAS model estimates snowfall for precise locations, it does so partly by interpolating between government weather stations. Thus strategic ski resort location decisions might exploit mountain-by-mountain variation in snowfall that SNODAS does not fully capture.

the introduction of an iPhone application that made it easier for skiers to post first-hand reports on snow conditions.

Our main specification for testing for weekend effects is:

$$s_{rt} = b*w_t + a_w + n_r + e_{rt} \qquad (1)$$

where s_{rt} is snowfall reported by resort r on day t, w_t is an indicator variable for whether t is a weekend day, a_w is a fixed effect for a specific calendar week (Wednesday-Tuesday), n_r is a fixed effect for a resort, and e_{rt} is an error term. The fixed effects control for any bias arising from the proportion of snow reports on weekends varying between more and less snowy weeks of the year (e.g., if resorts were open only on weekends at the beginning and end of the season) or between more and less snowy resorts. Point estimates actually change very little when these fixed effects are dropped (Table A1), so this potential omitted variable bias does not appear important in practice. That said, the fixed effects do improve the efficiency of estimation, by absorbing variation that would otherwise be captured by the error term.[14]

Since actual and reported snowfall may be correlated across resorts on the same day, we allow for clustering within day when calculating our standard errors. Since snow reports may be serially correlated, we also allow for clustering within resorts, using the two-dimensional clustering procedure in Petersen (2009). Allowing for clustering within days does meaningfully affect standard errors, while clustering within resort has essentially no effect.

[14] We also experimented with specifications that included resort*week fixed effects. Unfortunately we lose about a third of our degrees of freedom in this specification, causing a rise in standard errors. While this rise in standard errors causes our estimated weekend effect to lose statistical significance, the point estimate is not statistically (or economically) significantly different from the specifications in Table 3 (p-value 0.66), and the additional fixed effects are not collectively significant. See Table A1 for details.

Table 3 presents estimates of day of the week effects, and of weekend effects for various definitions of weekend (Sat-Sun, Fri-Sun). In resort-reported snow, we find that the largest day of the week effects are for Saturday, Sunday, Friday, and Monday. Regardless of our definition of weekend, we find that resorts report 0.20-0.25 more inches of snow on weekends. In contrast, we do not find evidence of a weekend effect in weather station or SNODAS data. For weather station data, we examine both the average weather station reports that are matched to ski resort reports, as well as every report (October to April for the 2003-4 to 2007-8 seasons) from every weather station that we match to any resort. The former analysis tests whether there is a weekend effect for the specific days that we have resort reports; the latter uses a larger sample to test whether there is a weekend effect in snowfall in general.[15] In all cases we find no statistically significant evidence of a weekend effect in government snowfall data. We do find a positive point estimate, however, and will therefore control for government snowfall data in most of the analysis where resort-reported snowfall is the dependent variable.

Table 4 examines the effect of controlling for government weather data on our estimated weekend effects. Adding a control for government snowfall data significantly improves the efficiency of estimation and has only a small effect on the point estimate. The first lead and lag of weather-station-reported snowfall are also correlated with resort-reported snow, although adding these controls does not substantially change the size of

[15] There is a small literature in climatology examining whether day of week effects in pollution affect precipitation and temperature. Cerveney and Balling (1998) find higher CO and O3 levels and higher precipitation on Fridays and Saturdays in areas downwind of the U.S. Eastern seacoast. Forster and Solomon (2003) find that nighttime low temperatures are 0.2 to 0.4 degrees Celsius higher on weekends in the middle of the United States but are 0.1 to 0.2 degrees lower in the Southeast and Southwest (weekend effects in the Northeast and West are smaller). Since the combined effect of these precipitation and temperature effects is uncertain, we test for weekend effects in snowfall in government data and include controls for government snow data in most of the regressions that follow.

the weekend effect. The second and longer leads and lags do not have statistically significant coefficients.

Controlling for SNODAS estimates of snowfall yields similar results. The point estimate of the weekend effect declines, but the efficiency of estimation improves. As with the government weather stations, correlations of resort reports with one lead and one lag of government data are statistically significant. We use the specifications in columns 4 and 7 of Table 4, which include either controls for weather station or SNODAS estimates of snow on days t-1, t, and t+1, as our preferred specifications for subsequent analysis.

Table 5 examines whether a selective-reporting bias affects our results. Selective reporting could be due to (possibly also deceptive) practices by resorts or aggregators that are subtly different than reporting more snow than has actually fallen. For example, resorts with no new snow might prefer to leave up a stale report rather than report no new snow, and the optimality of this strategy might vary over the week. Similarly, aggregators might condition whether to update the report on actual snowfall and the time of the week. In practice we find some weak evidence that reporting frequencies are higher when there is more actual snow, but no evidence that reporting is more or less selective on weekends.

Table 6 repeats the tests for a weekend effect on subsamples of the data. We use the specifications from columns 1, 4, and 7 of Table 4, which include no controls for actual snow, controls for weather station snow data from days t-1 to t+1, and controls for SNODAS estimates of snow on days t-1 to t+1, respectively. Our estimates of a weekend effect vary slightly during our sample period, although we cannot reject the hypothesis that the weekend effect is constant. The weekend effect is large early in the ski season and in January and March, and is essentially zero during the Christmas holidays and during April and May. These results are consistent with skier decisions being more sensitive to snowfall early in the season, with purchase decisions being made in advance during holiday periods, and with skiers being less sensitive to new snow during the "spring conditions" portion of the season. We find roughly equally sized weekend effects in the U.S. and Canada, and larger (albeit not statistically significantly) weekend effects in the West. We also find larger weekend effects among resorts that do not offer money-back guarantees and among publicly traded resorts and smaller weekend effects among government-owned resorts, although our estimates of the differences are imprecise, and even the economically large differences are statistically significant.

Table 7 uses interaction specifications to test where the weekend effect is largest. All regressions include controls for SNODAS estimates, a weekend indicator variable, selected resort characteristics, and interactions of these characteristics with the weekend indicator variable. We find that resorts with expert terrain report 0.16 inches more snow (relative to SNODAS estimates) on weekdays and an additional 0.13 extra inches of snow on weekends.[16] The first result could be due to resorts with expert terrain being especially well located, but the latter result suggests that these resorts exaggerate their snowfall more on weekends since fresh snow is especially appealing to expert skiers. We also find larger weekend effects for resorts with a larger population within driving distance. In contrast, we find little relationship between weekend effects and the number

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[16] We also experimented with specifications that interacted the share of terrain that was Intermediate, Advanced, and Expert with the weekend indicator (with Beginner terrain as the omitted category). These regressions find slightly positive but insignificant coefficients for Intermediate and Advanced terrain and a positive and significant coefficient for Expert terrain. A regression including an indicator variable for any Expert terrain and a continuous variable for the share of Expert terrain suggests that the weekend effect is mostly associated with the former. This is consistent with resorts needing Expert terrain to be in experts' choice sets, but with the exact amount being less important (or imprecisely measured).

of neighboring competing resorts.[17] Likewise, the differences in weekend effect between resorts with different types of owners (publicly traded, private, or government) and between those that do and do not offer money guarantees mentioned above are not statistically significant.

Finally, we examine the effect of a change to the information environment on exaggeration. On January 8, 2009, *SkiReport.com* introduced a feature in its popular iPhone application that allows users to file "first-hand" reports. These reports are then posted below the resort's official snow report (Figure 3). Although users previously had the ability to file first-hand reports on the SkiReport.com website, the iPhone application made it much easier to do so from the phone (as opposed to a computer), and hence in real time (e.g., from the chair lift). The volume of first-hand reports increased dramatically following the feature launch, with the increase largely confined to ski resorts with adequate data coverage from the AT&T network (the sole network provider for the iPhone in the United States).[18]

In Table 8, we estimate weekend effects for the 2004-8 seasons, for the 2008-9 season pre and post-feature launch, and then estimate the additional impact of the feature launch on the weekend effect for resorts most affected by the iPhone.[19] We find evidence of a weekend effect in the first half of 2008-9, but that the weekend effect declined sharply

[17] In the regressions in Table 7, we define two resorts as competitors if they are within 50 miles (as the crow flies), are not under common ownership, and either both or neither have expert terrain. We experimented with alternative definitions on all three dimensions but found no evidence of a relationship between weekend effects and competition.

[18] The mere threat of negative first-hand feedback might be sufficient to deter exaggeration in equilibrium, and there are also many actual reports questioning the veracity of resort reports. There are many positive reports as well, and many others about issues unrelated to snow (e.g., food, socializing opportunities). We will provide some descriptive statistics in a subsequent draft.

[19] In the current draft, we infer iPhone data coverage from the number of iPhone reviews, classifying resorts as "covered" if they received 10 or more iPhone reviews after January 8, 2009. We are working on developing a direct measure of coverage to avoid the possible endogeneity issues with our current approach.

after January 8, and that the decline was especially large for resorts most affected by the iPhone.

IV. Conclusion

We provide some unusually sharp empirical evidence on the extent, mechanics, and dynamics of deceptive advertising.

Ski resorts self-report 23 percent more snowfall on weekends; there is no such weekend effect in government precipitation data. Resorts that reap greater benefits from exaggerating do it more. We find little evidence that competition restrains or encourages exaggeration. Near the end of our sample period, we observe a shock to the information environment: a new iPhone application feature makes it easier for skiers to comment on resort ski conditions in real time. Exaggeration falls sharply, and much more at resorts with better iPhone reception. In all, the results suggest that deceptive advertising varies sharply with incentives, both within resorts (over time, at high-frequencies), and across resorts.

Although our setting may be unusual with its high-frequency variation in product quality, we speculate that our findings are broadly applicable. They relate to many classes of models on signaling, deception, obfuscation, and search costs. Search and information costs loom large in many other markets where product availability and pricing vary at high frequencies. Some of these markets presumably have conditions that are even more ripe for deceptive advertising than ours, with, for example, purchase decisions that are lower-stakes, quality realizations with longer lags, or fewer opportunities for repeat play and learning.

A particularly important direction for future research is to combine evidence on the nature and dynamics of deceptive advertising with evidence on consumer responses. This is critical for examining whether and how consumers pierce the veil of deception, and for measuring the welfare effects of deceptive advertising and innovations that amplify or discourage it.

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Table 1. Sample characteristics

	Ski resorts			Daily snow reports		
	Total	w/Weather Station	w/SNODAS	All	w/Weather Station	w/SNODAS
Region						
Eastern U.S.	232	227	195	38,683	34,092	18,808
Western U.S.	135	131	125	34,339	26,895	21,112
Eastern Canada	41	41	0	5,640	4,088	0
Western Canada	29	10	0	6,148	1,254	0
Total	437	409	320	84,810	66,329	39,920
Season						
2004-5	354	223	268	4,054	1,544	2,829
2005-6	363	310	277	4,807	2,566	3,714
2006-7	393	359	299	15,376	12,812	11,354
2007-8	429	399	315	32,165	26,197	22,023
2008-9	405	373	0	28,408	23,210	0
Total	437	409	320	84,810	66,329	39,920

States and provinces that are entirely east of the Continental Divide are considered Eastern.

Table 2. Summary statistics

Panel A. Resort characteristics	All resorts (437) Mean	SD	Eastern resorts (273) Mean	SD	Western resorts (164) Mean	SD
Terrain type (%)						
Beginner	27	11	29	11	22	10
Intermediate	41	12	41	12	42	11
Advanced	25	13	25	12	26	13
Expert	7	11	5	9	10	15
% with any expert terrain	42	49	40	49	46	50
Base elevation	3132	2946	1157	901	6419	2111
Summit elevation	4373	3580	1922	1178	8455	2266
Vertical drop	1242	1004	764	620	2036	1019
Lifts	7.8	5.1	7.1	3.7	8.8	6.7
Runs	41	35	29	24	63	42
Acres	671	1114	155	168	1461	1438
LN(Population within 150 mile radius)	15.6	1.2	16.0	1.0	14.7	1.0
Competing resorts within 50 miles	5.9	4.8	6.3	5	5.2	4.3

Panel B. Snowfall	Resort-reported		Weather station		SNODAS	
% of days with snowfall in range	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
0"	71.7	67.7	51.2	49.0	50.3	46.5
0.01 to 0.49			14.2	14.7	15.1	14.9
0.50 to 1.49	6.7	7.7	14.1	14.8	11.3	12.7
1.50 to 2.49	5.2	5.7	6.9	6.8	5.9	6.6
2.50 to 3.49	3.4	4.1	4.3	3.9	4.2	4.3
3.50 to 4.49	3.1	3.4	2.6	2.8	2.9	3.0
4.50 to 5.49	1.9	2.0	1.8	2.3	2.8	3.3
5.50 or more	8.0	9.4	5.0	5.8	7.5	8.7
Mean snowfall	1.29	1.59	1.05	1.15	1.17	1.32
SD snowfall	3.16	4.13	2.27	2.38	2.11	2.20
Observations	40,398	16,004	34,065	13,676	28,308	11,612
% on weekend	28.4%		28.6%		29.1%	
P-value (H0: % weekend = 2/7)	0.94		0.978		0.845	

States and provinces that are entirely east of the Continental Divide are considered Eastern. P-values reported are for a test of the null hypothesis that the proportion of snow reports on a weekend day (Saturday or Sunday) is 2/7. These tests allow for clustering of observations on days.

Table 3. Day of week effects in reported snowfall

Dependent variable: Inches of new natural snowfall reported

	Resort-reported	Weather station		SNODAS
		All	w/Resort report	
Specification 1. Day of week indicator variables (Sunday omited)				
Monday	-0.145	0.074	0.147	-0.005
	(0.166)	(0.056)	(0.157)	(0.144)
Tuesday	-0.389***	0.016	-0.264**	-0.0915
	(0.149)	(0.054)	(0.121)	(0.154)
Wednesday	-0.231	0.032	-0.0476	0.0439
	(0.162)	(0.055)	(0.152)	(0.160)
Thursday	-0.388**	0.001	-0.237*	0.128
	(0.165)	(0.052)	(0.137)	(0.168)
Friday	-0.131	0.043	0.000	0.101
	(0.156)	(0.051)	(0.144)	(0.165)
Saturday	-0.006	0.007	-0.0266	0.242
	(0.161)	(0.055)	(0.139)	(0.157)
Observations	56,402	231,952	43,119	39,920
Unique days	752	1,026	692	707
R^2	0.123	0.0403	0.166	0.133
F-test p-value	0.0550	0.2413	0.136	0.3558
Specification 2. Two-day weekend indicator variable (Sat&Sun)				
Weekend	0.246**	-0.029	0.0567	0.0958
	(0.0974)	(0.033)	(0.0896)	(0.0918)
R^2	0.123	0.0403	0.163	0.131
Specification 3. Three-day weekend indicator variable (Fri-Sun)				
Weekend	0.238***	-0.014	0.0859	0.102
	(0.0895)	(0.030)	(0.0837)	(0.0828)
R^2	0.123	0.0401	0.163	0.131

Estimation is via OLS regressions that include fixed effects for weeks (Wed-Tues) and resort. Standard errors allow for clustering within both day and resort.

Table 4. Weekend effect regressions controlling for actual snowfall per government data
Dependent variable: Inches of new natural snowfall reported by resort

Actual snow data source			Weather stations			SNODAS	
Observations included		Obs. w/data	Obs. w/data	Obs. w/data	Obs. w/data	Obs. w/data	Obs. w/data
Weekend (Sat&Sun)	0.246**	0.176*	0.131**	0.125**	0.242**	0.174*	0.183**
	(0.0974)	(0.097)	(0.0603)	(0.0579)	(0.113)	(0.0967)	(0.0848)
Actual (t+1)				0.0534**			0.359***
				(0.0234)			(0.0254)
Actual (t)			0.736***	0.672***		0.716***	0.621***
			(0.0414)	(0.0398)		(0.0327)	(0.0285)
Actual (t-1)				0.180***			0.104***
				(0.0230)			(0.0198)
Observations	56,402	43,119	43,119	43,119	39,920	39,920	39,920
Unique days	752	692	692	692	707	707	707
R^2	0.123	0.117	0.303	0.317	0.141	0.309	0.351

Estimation is via OLS regressions that include fixed effects for weeks (Wed-Tues) and resort. Standard errors allow for clustering within both day and resort.

Table 5. Tests for selection biases in resort snow reports

Dependent variable: = 1 if resort reported snow

Actual snow data source	None	Resort-specific weather station snow		State-avg weather station snow		State-avg SNODAS	
Weekend (Sat or Sun)	0.021	-0.026	-0.041	-0.009	-0.013	0.036	0.001
	(0.065)	(0.079)	(0.067)	(0.071)	(0.062)	(0.056)	(0.045)
Actual snow		0.055***	0.025***	0.052***	0.027***	0.062***	0.049***
		(0.010)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)
Actual snow*Weekend		0.007	0.007	0.016	0.014	0.013	0.006
		(0.018)	(0.017)	(0.016)	(0.014)	(0.016)	(0.016)
Month indicator variables (January omitted)							
November			-0.888***		-0.716***		-0.752***
			(0.095)		(0.085)		(0.058)
December			-0.234***		-0.181**		-0.331***
			(0.083)		(0.080)		(0.053)
February			0.221**		0.194*		0.217***
			(0.106)		(0.099)		(0.063)
March			0.172*		0.194**		-0.026
			(0.089)		(0.090)		(0.062)
April			-0.934***		-0.557***		-0.685***
			(0.082)		(0.084)		(0.058)
May			-2.248***		-1.859***		-1.318***
			(0.139)		(0.103)		(0.056)
Observations	382,077	53,147	53,147	168,487	168,487	108,262	108,262
Pseduo R2	0.0000	0.0047	0.1152	0.0058	0.0867	0.0065	0.0611

The table reports probit regressions predicting whether a resort snow report is available for a specific day. The sample includes every day in the 2004-2008 seasons (October 1 to May 31) for every resort. Actual snow is measured one of three ways: using the average snowfall reported by the NOAA stations matched to a resort, using the average of these values for resorts in the same state, and using the state average estimated snowfalls from the SNODAS model. Standard errors adjust for clustering within day.

Table 6. Weekend effect estimates for subsamples
Dependent variable: Inches of new natural snowfall reported by resort

	No weather controls			Controlling for weather station snow			Controlling for SNODAS		
	Obs.	Coef.	SE	Obs.	Coef.	SE	Obs.	Coef.	SE
All observations	56,402	0.246**	(0.095)	43,119	0.125**	(0.058)	39,920	0.183**	(0.085)
2004-5 Season	4,054	0.152	(0.410)	1,544	-0.308	(0.260)	2,829	0.136	(0.290)
2005-6 Season	4,807	0.571	(0.367)	2,566	0.519*	(0.298)	3,714	0.270	(0.287)
2006-7 Season	15,376	0.248	(0.184)	12,812	0.146	(0.098)	11,354	0.210*	(0.116)
2007-8 Season	32,165	0.219*	(0.130)	26,197	0.125*	(0.0722)	22,023	0.169	(0.126)
November	2,581	0.591	(0.357)	1,556	0.237	(0.308)	2,051	0.258	(0.321)
December	10,271	-0.0293	(0.194)	7,776	0.077	(0.147)	7,140	0.117	(0.157)
January	12,247	0.521*	(0.290)	9,541	0.253*	(0.142)	8,495	0.473	(0.288)
February	11,932	0.0880	(0.201)	9,428	0.146	(0.124)	9,137	-0.028	(0.182)
March	14,653	0.372*	(0.190)	11,487	0.170	(0.111)	9,704	0.244*	(0.140)
April and May	4,718	-0.0538	(0.207)	3,331	-0.141	(0.134)	3,393	0.0531	(0.167)
Christmas holiday	3,683	-0.0564	(0.277)	2,801	-0.177	(0.220)	1,746	-0.309	(0.206)
President's day week	2,395	0.509	(0.301)	1,991	0.253**	(0.105)	1,841	-0.146	(0.228)
Other periods	50,324	0.254**	(0.106)	38,327	0.129**	(0.062)	36,333	0.203**	(0.0910)
West	28,880	0.385**	(0.172)	19,190	0.252**	(0.111)	21,112	0.321**	(0.133)
East	27,522	0.0919	(0.126)	23,929	0.0443	(0.068)	18,808	0.0667	(0.108)
U.S.	49,215	0.234**	(0.106)	40,437	0.147**	(0.058)	39,920	0.183**	(0.085)
Canada	7,187	0.302**	(0.150)	2,682	-0.142	(0.182)		No data	
Money-back guarantee	2,161	0.0930	(0.171)	1,841	-0.001	(0.131)	1,904	0.098	(0.160)
No guarantee	8,881	0.424**	(0.166)	6,706	0.382**	(0.153)	6,330	0.275*	(0.150)
Publicly traded owner	1,612	0.425	(0.358)	1,166	0.162	(0.249)	1,582	0.338	(0.221)
Private owner	28,804	0.269**	(0.119)	23,781	0.154**	(0.068)	27,490	0.208**	(0.089)
Government owned	3,585	0.05	(0.156)	2,849	0.073	(0.114)	2,829	-0.030	(0.154)

This table repeats the specifications in Table 4 (columns 1, 4, and 7) for subsamples of the data. Estimation is via OLS regressions that include fixed effects for weeks (Wed-Tues) and resort. Standard errors allow for clustering within both day and resort.

Table 7. Variation in weekend effects

Dependent variable: Inches of new natural snowfall reported by resort

	(1)	(2)	(3)	(4)	(5)	(6)
Weekend (Sat&Sun)	0.134	0.0164	-0.090	-0.166	-0.005	-0.118
	(0.0878)	(0.116)	(0.132)	(0.147)	(0.165)	(0.154)
Interaction effects with weekend						
Expert terrain > 0	0.133**	0.119*	0.130*	0.134**	0.0870	0.143**
	(0.0669)	(0.0673)	(0.0672)	(0.067)	(0.133)	(0.073)
West		0.233	0.421	0.433	0.615*	0.464
		(0.214)	(0.287)	(0.285)	(0.354)	(0.304)
Ln(Population within 150 miles), normalized			0.175*	0.192*	0.222	0.191*
			(0.102)	(0.098)	(0.146)	(0.108)
1/(1+number of competitors within 50 miles)				0.233		
				(0.226)		
Money back guarantee?					-0.101	
					(0.165)	
Publicly traded owner						-0.104
						(0.185)
Government owner						-0.0433
						(0.154)
Main effects						
Expert terrain > 0	0.156***	0.135***	0.140***	0.136***	-0.184***	0.153***
	(0.0351)	(0.0360)	(0.0359)	(0.0353)	(0.0638)	(0.0398)
West		0.646***	0.702***	0.693***	0.695***	0.695***
		(0.0930)	(0.118)	(0.118)	(0.156)	(0.127)
Ln(Population within 150 miles), normalized			0.0508	0.0379	0.0923	0.0441
			(0.0406)	(0.0402)	(0.0783)	(0.0450)
1/(1+number of competitors within 50 miles)				-0.175		
				(0.112)		
Money back guarantee?					-0.0786	
					(0.0940)	
Publicly traded owner						-0.0301
						(0.108)
Government owner						0.267***
						(0.0659)
Observations	39,920	39,920	39,920	39,920	8,234	31,901
Unique days	707	707	707	707	707	707
R^2	0.351	0.351	0.352	0.352	0.371	0.357

Estimation is via OLS regressions that include fixed effects for weeks (Wed-Tues) and controls for SNODAS snow. Standard errors allow for clustering within both day and resort. Two resorts are considered competitors if they are within 50 miles, are not under common ownership, and either both or neither have expert terrain.

Table 8. Consumer monitoring and the weekend effect

Time period	2004-8 seasons	2008-9 season	2008-9 season	2008-9 season
Weekend (Sat&Sun)	0.246**	-0.110	0.777***	0.509**
	(0.0974)	(0.130)	(0.286)	(0.228)
Interaction effects with weekend				
Post-launch (1/7/2009)			-1.065***	-0.695***
			(0.315)	(0.247)
iPhone resort				0.329
				(0.225)
iPhone resort*post-launch				-0.459*
				(0.244)
Main effects				
Post-launch (1/7/2009)			-0.523***	-0.511**
			(0.187)	(0.213)
iPhone resort*post-launch				-0.0155
				(0.142)
Observations	56,402	28,408	28,408	28,408
Unique days	752	126	126	126
R^2	0.0745	0.0281	0.0329	0.0442

Estimation is via OLS regressions that include fixed effects for weeks (Wed-Tues) and resort. Standard errors allow for clustering within both day and resort.

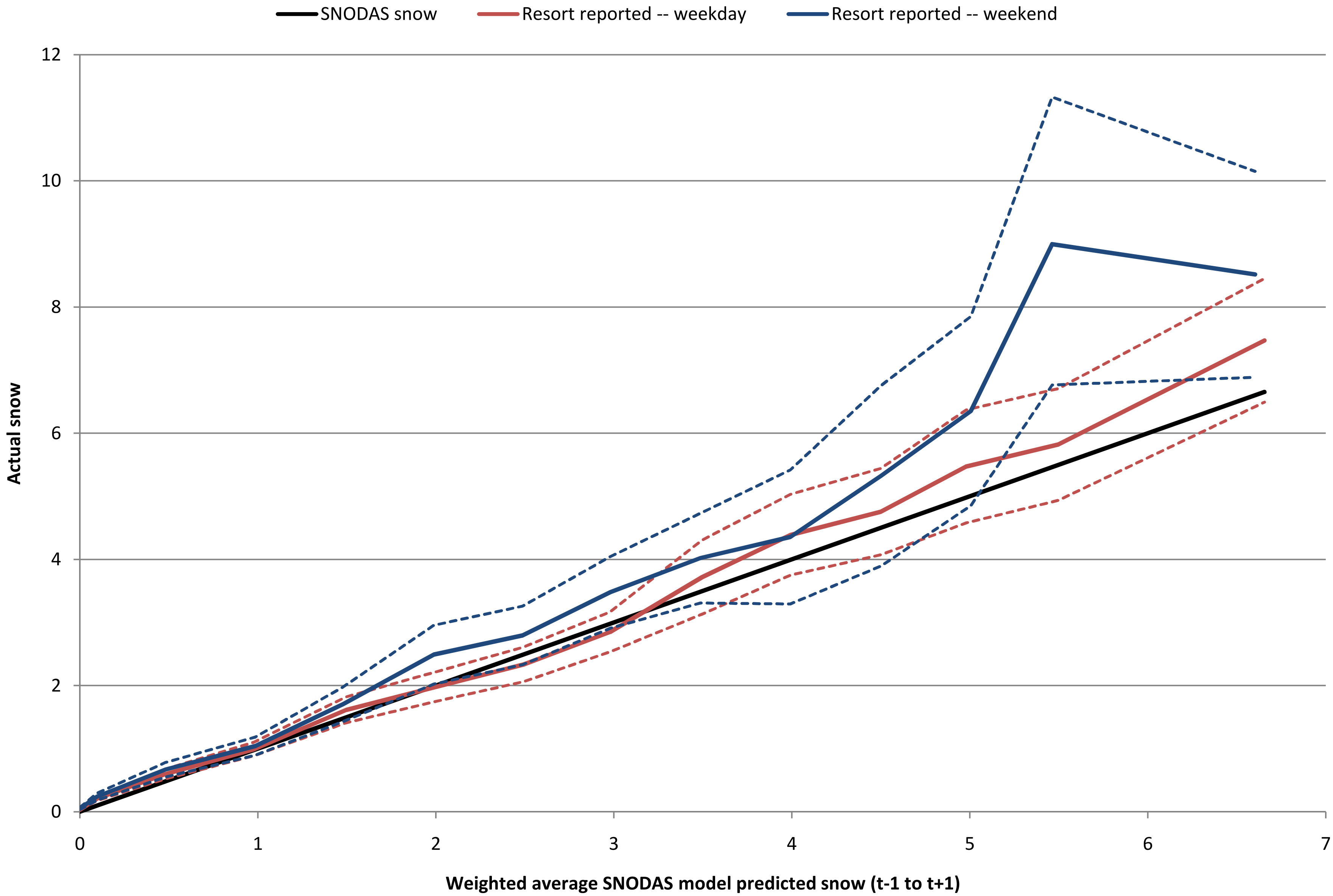
Table A1. Alternative specifications -- fixed effects and tobit

Dependent variable: Inches of new natural snowfall reported by resort

	(1)	(2)	(3)	(4)	(5)	(6)
Specifications without actual snow controls	Table 4, Col 1	No FEs	Resort FEs	Week FEs	Resort*week FEs	Tobit
Weekend (Sat&Sun)	0.246**	0.297**	0.277**	0.274***	0.230*	0.994**
	(0.0974)	(0.131)	(0.133)	(0.0976)	(0.135)	(0.397)
Constant	1.229***	1.297***	1.302***	1.303***	1.316***	-5.063***
	(0.077)	(0.0665)	(0.0665)	(0.0491)	(0.0598)	(0.335)
Ln(Sigma)						8.341***
						(0.301)
Observations	56,402	56,402	56,402	56,402	56,402	56,402
Unique days	755	755	755	755	755	755
R^2	0.123	0.001	0.064	0.060	0.453	N/A
Specifications controlling for weather station snow	Table 4, Col 4	No FEs	Resort FEs	Week FEs	Resort*week FEs	Tobit
Weekend (Sat&Sun)	0.125**	0.134*	0.111	0.151**	0.115	0.699***
	(0.0579)	(0.0788)	(0.0775)	(0.0596)	(0.0752)	(0.250)
Constant	0.403***	0.377***	0.337***	0.403***	0.333***	-7.996***
	(0.0476)	(0.0455)	(0.0497)	(0.0476)	(0.0781)	(0.357)
Ln(Sigma)						6.359***
						(0.205)
Observations	43,119	43,119	43,119	43,119	43,119	43,119
Unique days	692	692	692	692	692	692
R^2	0.317	0.255	0.303	0.270	0.562	N/A
Specifications controlling for SNODAS snow	Table 4, Col 7	No FEs	Resort FEs	Week FEs	Resort*week FEs	Tobit
Weekend (Sat&Sun)	0.183**	0.190*	0.182*	0.194**	0.161	0.615**
	(0.0848)	(0.105)	(0.103)	(0.0850)	(0.125)	(0.256)
Constant	-0.034	-0.0239	-0.0249	0.0343	0.0843	-6.473***
	(0.050)	(0.0431)	(0.0462)	(0.0533)	(0.0862)	(0.415)
Ln(Sigma)						6.721***
						(0.335)
Observations	39,920	39,920	39,920	39,920	39,920	39,920
Unique days	707	707	707	707	707	707
R^2	0.3434	0.2859	0.323	0.3075	0.5848	N/A

Note: Regressions are estimated by OLS or Tobit and include the indicated fixed effects. Standard errors allow for clustering within both date and resort. Week fixed effects are for Wednesday-Tuesday weeks (to include a weekend and the immediately surrounding weekdays). Weighted average SNODAS is the average of SNODAS snow on days t-1, t, and t+1,

Figure 1. Resort reported vs. SNODAS model



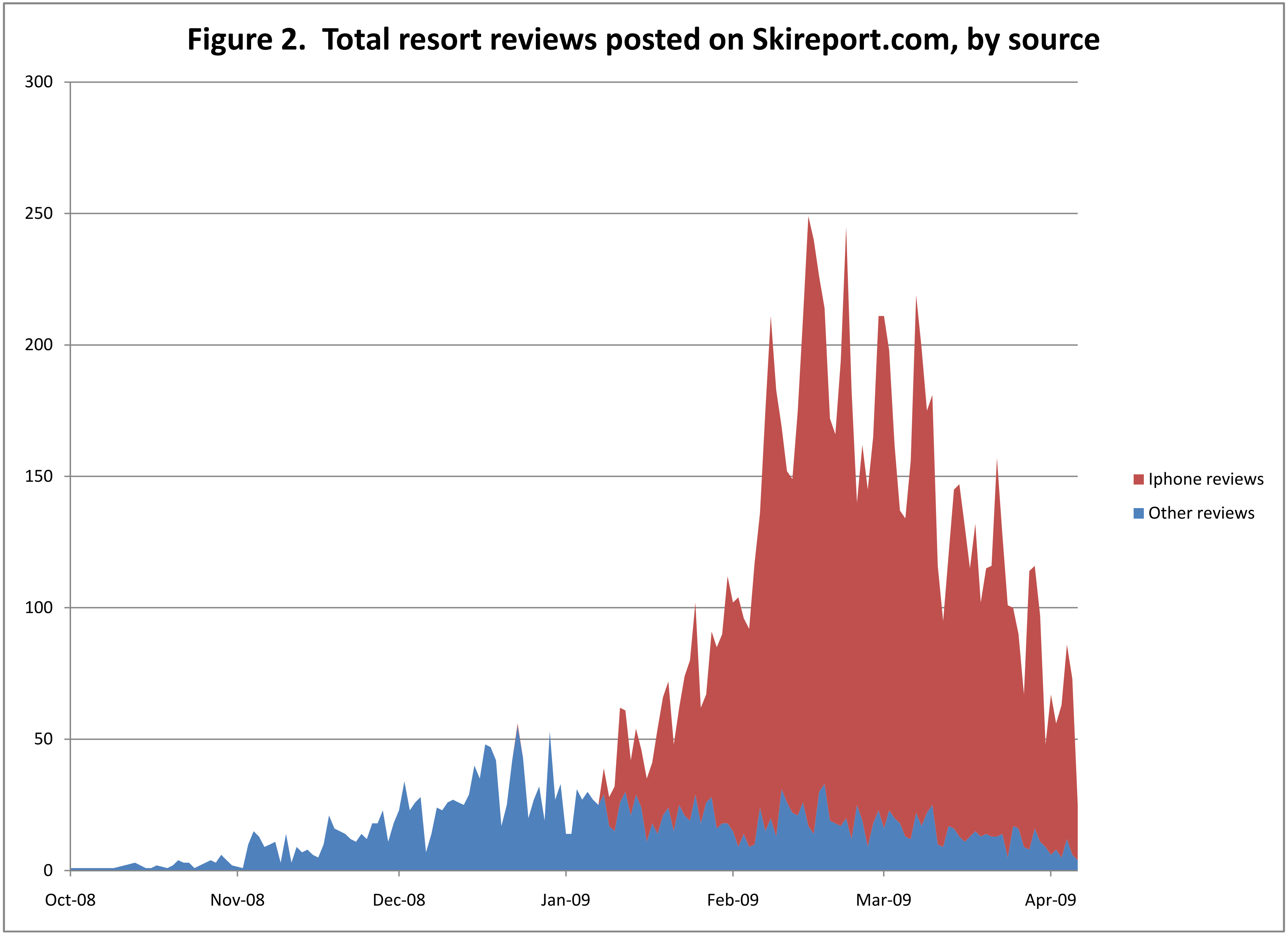


Figure 2. Total resort reviews posted on Skireport.com, by source
300
250
200
150
100
50
0
Oct-08
Nov-08
Dec-08
Jan-09
Feb-09
Mar-09
Apr-09
Iphone reviews
Other reviews

SkiReport.com YOUR SKI AND RIDE POWDER GUIDE sponsored by SPYDER

HOME | POWDER ALERTS | REPORTS ON YOUR WEBSITE | VACATIONS | GEAR

Home California Mammoth Ski Report

Search: GO

Jump to: Mammoth

Mammoth Ski Report

Mammoth

- **Ski Report**
- Ski Cams
- Weather
- Road Conditions
- Mountain Stats
- Trail Map
- Google Map
- Photo Gallery
- Area Profile
- Ticket Prices
- Lodging
- << California

Base	82-145 in | 208-368 cm
24 Hour Snowfall	No new snow
Last Snowfall	Apr 25 - 4 in | 10 cm
Previous Snowfall	Apr 15 - 1 in | 3 cm
Surface	Spring Conditions
Secondary Surface	Variable Conditions
Lifts Open	7 of 29
Trails Open	65 of 150
Percent Open	35%
Fri Weather	Rain likely, mainly after 11am. Cloudy, with a high near 55. Southwest wind between 5 and 15 mph. Chance of precipitation is 70%. (Weather Forecast)
Nearby Ski Areas	June, Sierra Summit, Badger Pass
Report Time	4/30/09 8:34 AM PST

Mammoth ski report provided by SnoCountry Mountain Reports

First-Hand Ski Reports

April 20th - iPhone Report
How's the conditions for this wknd

April 20th - iPhone Report
Went this past weekend. Awesome weather, good snow, just a little too hard packed in the morning, but gets loose as the day goes on. A bit slushy in the afternoon but can't complain, I'm from So Cal, I'm used to it. Still very worth the 6 hour drive.

April 20th - iPhone Report
They'll be closing some areas but the season is going to last till memorial day from what I read a few weeks ago. Heading up this weekend :)

April 20th - iPhone Report
What is Mammoth like this week- is it still worth it for spring skiing?

April 18th - iPhone Report
It was alot of fun runs are kind of ice in the morning but alot of fun you should go up

View All First-Hand Reports **(393)**

Post First-Hand Ski Report

Publish your personal ski report of Mammoth