

Snowboarding in New York State

A GIS Case Study

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Project Background

Property developer and investor Stone Barrington has just returned from a trip to the 2002 Winter Olympics in Park City, Utah. During the months prior, he had been analyzing potential investments for clients in the Northeast, but was having difficulty identifying attractive real-estate ventures with mass-market appeal. The excitement of the young crowd, the intensity of the athletes, and the media coverage demonstrated that snowboarding was a rapidly growing sport with great potential for continued growth. In fact, Stone was so impressed with the event that he decided to look into developing property for the sport as his next major project; this was a solid commercial opportunity that, if done correctly, had the potential to attract the attention of some of his more adventurous clients. To gauge interest in the project, he decided to develop a proposal for a special snowboarding resort based in Upstate New York for his northeastern clients. Stone knew that he had to convince Wilfred Drake III, the leader of this client group, to support him at this month's investors' meeting in order to get the project off the ground.

Drake: Stone, great to have you back in our boardroom this morning. It's always a pleasure to see you pitch your ideas. I heard you were on vacation. How was your trip to the Olympics in Utah?

Stone: Thank you, Mr. Drake, it's great to be back. Park City was a great place to visit, but the first few days were rather uneventful. The opening ceremony was somewhat moving, and the men's 5000-meter speed skating trials were certainly worth the price of admission. But, overall, my Olympic experience was nothing really worth writing home about until I found a truly inspiring event that I will talk about today at this meeting....

Drake: OK, let's get this meeting called to order then! Attention everyone! Today, Mr. Barrington is giving us an overview of his new ideas for property development. Stone, the floor is yours.

Stone: Thanks, Mr. Drake. It's great to be here speaking to you all again. I'd like to tell you about a great new opportunity in Upstate New York, specifically the viability of a new snowboarding park. I was inspired to develop this potential investment opportunity for you after seeing an impressive contest at the 2002 Olympics in Salt Lake City.

On day four of the events, I found myself in the noisy throng of 16,000 rowdy spectators for the finish of the Women's Halfpipe Snowboarding Competition. The USA's Kelly Clark had the last run of the day. With a good run, Clark had a solid chance to overtake Dorian Vidal of France and Fabienne Reutuler of Switzerland, currently in first and second in the competition, respectively. Waiting for Clark to make the final run, I surveyed the frenzied hometown crowd that was oblivious to the forceful Rockies' wind and bitter cold temperatures. The fans stood behind the fenced-in area along the sides of the U-shaped halfpipe and along the fenced-in finish area at

the bottom of the descent. This halfpipe was an impressive open tunnel of hard-packed snow, 525 feet long and 17 feet deep. The spectators surrounding the halfpipe were electric from the fabulous stunts the contestants had been pulling throughout the competition.

The previous 23 riders had performed well, but reigning champ Vidal had the best run of the day. In this competition, five judges award up to 10 points in each of the following areas: technique, rotation, height, landings, and technical merit. The rider with the highest score wins. Vidal was leading with a high score of 43.0 that featured smooth riding, but fell on her only attempt at the difficult 720 air trick. Clark, the eighteen-year-old boarder, had one final chance on the last run of the competition. In order to come from behind and steal the gold, she would certainly need to land a big trick like the one missed by Vidal.

Suddenly, the Guns 'N' Roses song "Welcome to the Jungle" blared across the competition area and the crowd grew even more frantic as Clark descended from the chute. She began zigzagging down the pipe, crisply sliding up the 15 foot walls and nearly 10 feet more up into the air before smoothly landing. She had impressed the judges with the height she had reached up into the air, gaining many points in this category. She next pulled off the spectacular McTwist trick, rotating 540 degrees in a backwards direction while performing a front flip, and then landing going forward. With the crowd cheering her on, she next attempted the very difficult trick needed to win the gold, the 720 Air. Launching herself up the pipe and over, she rotated 720 degrees, the equivalent of two full spins, before calmly nailing the landing.

As she glided into the finish area, the crowd around the fences erupted in excitement as she had completed arguably one of the best runs ever. Capping the dramatic finish, the judges gave her a score of 47.9 out of a possible 50 points, topping Vidal's 43.0 to steal the victory. The exciting finish left a strong impression on me as Clark took home the first gold medal for the United States in 2002 and the first American gold medal in this event since...

Mr. Drake, frowning, interrupts Stone in mid-sentence.

Drake: Stone, this is all very interesting, but is this really going to work? We're here to make money, not to hear the latest fads for these crazy kids...

Stone: I see your point, Mr. Drake. Following the Olympics, I investigated this idea further and quickly found the selling point I was looking for. I learned that while western ski resorts have obvious advantages over those in the east regarding the average length of ski runs, the shorter runs in the east typically fostered more refined technical abilities. The skiing/boarding mentality produced by the east coast environment also lends itself to the technical aspects of snowboarding, particularly halfpipe competition. This is a sport that has grown tremendously since its inception as an Olympic event in 1998. Although many of the nearly 50 ski resorts in the state of New York offer facilities for boarders, only a few cater directly to snowboarding as a sport.

Since there is an existing support infrastructure, I propose the purchase and modification of an existing resort to specifically cater to the interests of snowboarders.

Redeveloping an existing resort would offer investors the benefit of an established workforce, restaurants and lodgings, and a civic environment suitable for continued investment and development. I have identified eight potential New York ski resorts here in my preliminary proposal.

Drake: Well, this looks promising, Stone. I admit you've picked many winners in the past and we're willing to give you a shot. What's the next step?

Stone: In order to complete the analysis we need a series of thorough site investigations to determine the optimal choice. Several independent consulting firms would carry out the site investigations. If you agree to support the initial cost of these analyses, I assure you we'll be rewarded with a great payoff.

Suddenly wary of the added expense, the group collectively begins to grumble to each other, shaking their heads in displeasure.

Drake: Stone, as you know, the market is down and we can't afford to take another loss. If we agree to fund the competing proposals, we need you to deliver the best resort possible. Don't let us down!

Stone: Well, I have several good consulting groups in mind. I've already contacted a few to provide us with an analysis of the best location to develop this park. I've given them my instructions and they should be back to us in about four weeks with their final reports.



Data Resources and Project Goals

The preliminary report prepared by Stone's team identified eight New York ski resorts as potentially viable options for investment. However, further investigation is needed to identify the most suitable location and to secure the optimal return on the initial venture. Your task is threefold:

- First, develop a detailed set of criteria for selecting the optimal resort. Factors to consider include resort access (roads, public transit, etc.), access to skiing population, price range versus population income, and the like. These are not the only factors you should consider—come up with factors you think are important based upon the data resources that have been made available to you. (You may also consider other resources that are easily accessed via the Internet.) Remember, Stone's clients are not excited about this added expense. It is up to you to offer new insights into their decision and prove that your consultation was money well spent. We will discuss some important factors to consider in class, so be prepared to discuss some of the factors you have chosen and how you will use them to make a final selection.
- Second, using the criteria as a basis for analysis, determine the top sites for investment. Rank the sites based upon these criteria and, if necessary, discuss the benefits and limitations of different courses of action. Prepare a series of visualizations, such as maps, diagrams, or graphs, to support your claims.
- Third, present your results and make a convincing argument to Stone and his clients based upon your analysis. There is no "single" correct answer to this problem. However, you must be able to support/defend your site ranking based upon the decision criteria and available data sources.

As a basis for your analysis, a variety of information sources have been made available to your group (available on the data CD). This includes statewide census data on population, income, education and labor, interstate highways, annual snowfall, and site-specific data including digital elevation models (DEM),

orthophotos, and 1:24,000 topographic maps for each individual ski resort. Spatial analysis and map production will be completed using geographic information system (GIS) software and associated tools. You also have access on the CD to the individual websites of the ski resorts. A more detailed description of the data sources and analysis methods follows.

Written Report

Develop a written report (approximately 5 to 7 pages, 12 point font, double-spaced, 1 inch margins) discussing your decision criteria, spatial analysis, and suggestions for investment. Include printouts of all maps necessary to make your argument (reference the maps in the text and include as an appendix). In order to model a business report and to standardize student reports, please organize your paper in the following manner:

- Introduction—List the goals/criteria of the project (audience, aims, etc.).
- Methodology—List the criteria developed for analysis, necessary data sources, cartographic approaches (generalizations, etc.) that were used in approaching the problem. Also, in this section, discuss the data sources you used and any assumptions/limitations inherent in the data sources.
- Analysis—Why were certain criteria used as a basis for analysis? Are some criteria more important than others? What criteria/data sources were ignored and why? What types of spatial patterns exist in the data? What other sources of data would be useful to solve the problem?
- Conclusion—What are the most/least suitable sites for development? Why? What were the strengths/weaknesses of your approach? Discuss any limitations of the data/technology and what could be done to develop better tools for analysis, better maps?
- References—Properly cite any academic articles or material from the Internet and data sources in this section. Proper citation format for this report will be based on the APA Style Manual.

Note that most public printers print only in black and white. Black and white (grayscale) maps are acceptable. However, make sure that the color scale you use produces useful maps in which different data classifications can be easily identified.

Evaluation

- Decision Criteria / Analysis / Visualizations
 - 75% of the project grade.
 - Originality and completeness. Grammar and neatness count, too, since this is akin to a business document.
 - Maps will be evaluated on completeness and the analysis, using mapmaking techniques (and problems of misuse) discussed in this course.
- Presentation
 - 25% of the project grade.
 - Your group will be required to present your findings and state a clear course for investment (or several viable courses). Structure your presentation as if you were presenting your results to Stone and his clients and make a strong case for the results of your investigation. You will have 15 minutes for the presentation and may use this time in any way you like. A computer/projector will be available if needed.

- This portion will be evaluated by the other groups in the class through the use of a rubric handed out to students. The rubric consists of subjective evaluation of the effectiveness of problem analysis, clarity and quality of presentation, and overall effectiveness of the group argument.

Getting Started

1. Briefly review the following articles to get some background on the sport of snowboarding:
 - Snowboarding Comes of Age. Las Vegas Review-Journal.
http://www.reviewjournal.com/lvrj_home/2002/Dec-04-Wed-2002/sports/20088572.html
 - Halfpipe: An American Sport? The Mountain Zone
<http://classic.mountainzone.com/olympics/nagano/pipe.html>
 - Snowboarding. The President's Council on Physical Fitness and Sports.
<http://www.fitness.gov/snowboarding.html>
2. You will need a copy of the data CD and a basic understanding of ESRI ArcView 3.3. Appendix A and Appendix B provide basic information on the software and data CD.
3. You should begin by exploring the data CD and the GIS software. Become familiar with the different types of data that can be used to develop your decision criteria. You should also begin to develop a basic familiarity with ArcView 3.3 software package.
4. When you have a sufficient grasp of the software and data, outline the criteria that you think will be important to solve the problem at hand.
5. Analyze the criteria using the GIS software and available data.
6. Develop a series of conclusions and produce maps from the data to support your claims.

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Appendix A—Getting Started with ArcView GIS Software

These instructions provide a basic introduction to ESRI ArcView 3.3 and are intended to get you started with the software and CD data resources.

1. Open the software by clicking on the *Start menu, programs, ArcView GIS 3.3*, and the program *ArcView GIS 3.3*.
2. When the “Welcome to ArcView GIS” window appears, select “Open an existing project” from the options and click “OK.”
3. Search for the “project” (.apr) file named “skipproject.apr” on the data CD and open it.
 - o Note: If this is the first time you are using this CD on a particular computer, it may be necessary to create the links between the project and the data files on the CD. When prompted, simply navigate to each file on the data CD to create links between the .dbf files and the .shp files. You should only have to complete this step one time for a particular computer.



In the “view” window you should see a map of New York (and surrounding states) with a variety of data themes (i.e., Ski_resorts, cities, roads, etc.). The “view” is the window where all your GIS themes will be displayed. You can open as many of these “views” as you like; each one will be separate from the other (each will contain a unique set of data).


In the left hand column of the “view” there are a variety of themes listed (i.e., Ski_resort.shp). The themes are the different types of data that are present in the view window. You may turn them on/off by clicking the check box for each theme (try it now). You may also control the order in which the themes are presented (in the display) by clicking on a theme and dragging it up/down in the column (for example, try dragging the “Counties_newyork” theme up above the “Roads” theme). (*It may be useful to think of the themes as different layers in a sandwich.*)

Each theme has a database table of information (similar to an excel file) associated with it (i.e., each of the ski resorts has an address, phone number, etc., associated with it). This table can be viewed by clicking on the theme (in the left column) and then clicking the “table” button  on the toolbar at the top of the ArcView window. When you do this, an attribute table will open and display a variety of information on each ski resort (Latitude, Longitude, Phone, County, etc.).

ArcView Toolbar

You should also make yourself familiar with the GIS tools available in ArcView.

 **Identify Tool:** Allows you to view attribute information for each symbol on the map. To use this, click on a theme (i.e., Roads_newyork, Ski_resorts, etc.) in the view, click on the Identify Tool , and select (click on) a feature on the map (i.e., a “star” if you chose Ski_resort as your theme). An attribute window will pop up displaying information about that feature. Similar to the “table” button listed above, this feature allows you to access attribute information. However, this tool only displays attribute information for the selected feature (not the entire theme).

 **Select Tool:** Select features on the map. This tool allows you to select different map features (points, lines & polygons). Note: The “shift” key can be used to select features in this program in the same way it is used in the Microsoft Excel program.



Zoom In/Out Tool: Zoom in and out on the map.




Measure Tool: Allows you to measure distances on the map.


Adding More Themes to the View

The themes visible in the “view” are only a small portion of the information available to you in this project. The instructions below describe how to add more themes to the view. The GIS data on the CD is partitioned into two directories (“shapefiles” and “ski_resorts”). The “ski_resorts” directory offers datasets that cater to each of the eight individual resorts (*Please note the extra steps required to add this data to the view.*)

Opening shapefiles

1. Click  to add a new theme.
2. Navigate to the “shapefiles” directory on the CD (make sure that the Data Source Type is set as “Feature Data Source”).
3. Click on the appropriate shapefile and click “OK.”

Opening ski_resorts data

1. Click  to add a new theme.
2. Navigate to the “ski_resorts” directory and open the directory for the ski resort you want information on.
3. Each ski resort directory has the following information. (*Note: you may have to zoom into the particular area to view the image.*)

To Open a Digital Elevation Model (DEM)

- Open the DEM directory
- Change the Data Source Types to “Grid Data Source”
- Choose the DEM file and click “OK”

To Open an Orthophoto of the Resort

- Open the orthophoto directory
- Change the Data Source Types to “Image Data Source”
- Choose the appropriate orthophoto and click “OK”

To Open a Digital Topographic Quad

- Open the topo_quads directory
- Change the Data Source Types to “Image Data Source”
- Choose the appropriate topographic map and click “OK”

Printing Maps

When you have reached the point that you would like to print maps, this is done by creating a “Layout” by clicking on “Layout” under the “View” dropdown menu. Please feel free to explore this option on your own. A more detailed discussion will be presented in class. Note: The “export” function (found under the “file” drop down menu can be used to export views and layouts as image files (.jpg, .bmp, etc.). This will be very useful for creating PowerPoint presentations.

Appendix B—The Data CD

The data CD offers a wide range of data resources. Instructors can request a copy of the CD from the National Center for Case Study Teaching in Buffalo by emailing snowboard@sciencecases.org. You are not expected to use all of the resources provided. The data CD is partitioned into three primary directories; ResortInformation, Shapefiles, and Ski_resorts. This appendix provides a brief description of each type of information, specifically the attributes in each data file. Note that all spatial data is projected in UTM Zone 18 (NAD 83).

Resort Information

Contains information on the individual ski resorts such as the number of ski runs, ski lifts, web address, etc. This file also contains links to the existing web sites for the individual ski resorts. Permission has been granted (*by the resorts*) to use any and all information and images available.

Shapefiles

This directory contains all of the shapefiles that may be accessed through the ArcView software. The following shapefiles are visible when the project is opened in ArcView:

- Cities_Canada—Cities in Canada
- Cities_NewYork—Cities in New York
- Counties_NewYork—New York Counties
- Roads_NewYork—Interstate highways in New York
- Ski_Resorts—Locations of eight ski resorts
- State_Boundary_NewYork—Map of New York
- SurroundingStates—States immediately bordering New York

Weather Shapefiles

SnowfallData—Annual snowfall averages for selected cities in New York.

Demographic Shapefiles

The demographic data is available at the county level and at tract level. Information is available on education, income, labor, and population. Below, definitions are provided for the attributes that can be found in the attribute table for each shapefile.

County Data Files

- population_ny_cnty.shp
 - shape, areaname, areakey, intplat, intplng, totpop90
 - s_totpop—Total population
 - s_urbpop—Urban population
 - s_rurpop—Rural population
 - s_frmppop—Farm population
- historical_population_ny_cnty.shp
 - shape, areaname, areakey, intplat, intplng, totpop90
 - hist1900—Historical population as of 1900
 - hist1910—Historical population as of 1900
 - hist1920—Historical population as of 1900
 - hist1930—Historical population as of 1900
 - hist1940—Historical population as of 1900

- hist 1950—Historical population as of 1900
- hist1960—Historical population as of 1900
- hist1970—Historical population as of 1900
- hist1980—Historical population as of 1900
- hist1990—Historical population as of 1900

- education_ny_cnty.shp
 - shape, areaname, areakey, intplat, intplng, totpop90
 - s_9_12gr—Grades 9 through 12, no diploma
 - s_hsgrad—High school graduate
 - s_somcol—Some college, no degree
 - s_asodeg—Associates degree
 - s_bchdeg—Bachelors degree
 - s_grddeg—Graduate or professional degree
 - s_pcthsp—Percent high school graduate or higher
 - s_pctbcj—Percent bachelors degree or higher

- income_ny_cnty.shp
 - shape, areaname, areakey, intplat, intplng, totpop90
 - houshlds—households
 - hi4999—0–4999
 - hi9999—5000–9999
 - hi14999—10,000–14,999
 - hi24999—15,000–24,999
 - hi34999—25,000–34,999
 - hi49999—35,000–49,999
 - hi74999—50,000–74,999
 - hi99999—75,000–99,999
 - hi149999—100,000–149,999
 - hi150p—150,000 +
 - medhsin—Median household income

- labor_ny_cnty.shp
 - shape, areaname, areakey, intplat, intplng, totpop90
 - l_16p—Persons of age 16+
 - l_wrkfor—16+ in work force
 - l_pctwrk—Percent in work force
 - l_cvlwkf—Civilian in work force
 - l_employ—Employed
 - l_unempl—Unemployed
 - l_pctump—Percent unemployed
 - l_armfor—Armed forces
 - l_ntwkfo—Not in work force

Tract Data Files

Tract data is at a finer resolution, but the attributes are the same as the county data.

- population_ny_tract.shp (see attribute listing for County Data Files)
- education_ny_tract.shp (see attribute listing for County Data Files)
- income_ny_tract.shp (see attribute listing for County Data Files)
- labor_ny_tract.shp (see attribute listing for County Data Files)

Ski_Resorts

The data sets provided for the ski resorts are specific to each resort (they are not statewide datasets). Data is presented for the following eight resorts:

- Catamount
- Gore Mountain
- Hickory Hill
- Holiday Valley
- Holimont
- Hunter
- Kissing Bridge
- Windham

In each directory you will find three products: a Digital Elevation Model (DEM), orthophoto, and a 1:24,000 USGS topographic map.

Digital Elevation Models (DEM)

A DEM contains elevation values in digital form. The DEMs used in this project are 1:24,000, 7.5 minutes quads published by the U.S. Geological Survey during the late 1990s. This data was collected as part of the National Data Mapping Program.

Orthophotos

An orthophoto is an aerial photograph that is processed to remove the effect of planimetric shift. A digital orthophoto is a raster image of remotely sensed data in which displacement in the image due to sensor orientation and terrain relief has been removed. The color infrared photography (CIR) used in this study was produced from 1994–1999 under the federal Digital Orthoimagery Quadrangle Program and the New York State Department of Environmental Conservation. They offer 1-meter pixel ground resolution and are projected in UTM18 (NAD 83). Note: The red tones on the image indicate healthy vegetation.

Topographic Map

A topographic map shows the shape and elevation of the terrain. The maps available in this study are raster images of scanned USGS topographic map including the collar information, georeferenced to the UTM grid. They are known as U.S. Geological Survey (USGS) Digital Raster Graphic (DRG) Quadrangles. The maps were first published in the mid 1960s and converted to digital form in the 1990s. The original data was acquired in UTM Zone 17/18 (NAD 1927), 1:24,000 scale.