Problem B: Ski Slope

Summary

Every four years since 1924, athletes skilled in various winter sports have gathered to display their jaw-dropping feats of athletic prowess to a worldwide audience of millions. Known as the Winter Olympics, this international competition brings pride and prestige to the area chosen as host. A group of wealthy sports fans are hoping to host this event in Utah, and are in need of a new mountain to develop into a ski resort. Their agent, Ms. Mogul, has approached the owners of the Wasatch Peaks Ranch in Morgan County, Utah, in the hopes that we can develop a ski resort suitable for hosting the grand and prestigious winter games. Our objective was to design and identify potential ski slopes that meet the International Olympic Committee's requirements for an Olympian site, and exceed the standards found in similar locations across North America.

We determined the location of ski trails by utilizing interactive maps of Wasatch. Our model maximises the number of straight trails in order to allow for more trails to be built on the mountain. All trails end at the bottom of the summit for convenience of all spectators, both sports fans and media representatives. We calculated the percent slope at the steepest point of each trail, and used this value to determine the trail's difficulty level. Trails of similar difficulty were congregated in certain areas of the resort for added convenience. We calculated the total distance of each trail by adding together the distance of the steepest part of each trail with the average distance for the more level parts of each trail. We then added together each trail's total distance in order to receive a total sum of 191.14 kilometers of total trails, an amount which far exceeds the minimum required length of 160 kilometers. We adjusted the percentages of each trail difficulty after determining the ideal location and number of trails that could possibly exist in each given area. The model we originally developed involved an almost equal number of trails for each difficulty level, which did not match the required ratios of 20% beginner level trails, 40% intermediate level trails, and 40% advanced level trails. We made adjustments in order to decrease the number of beginner trails, as well as increase the number of intermediate and advanced to fit the requirements.

We then compared the statistics of the model with the average statistics for the best ski resorts in America, including number of ski trails, total length of the trails per each level of difficulty, mountain elevation, average snowfall, and distance from the nearest major city. This comparison revealed that the model exceeds the North American averages in all categories except for total length of intermediate level trails. Additionally, we compared the model to the previous locations of the Winter Olympics, and the model we designed exceeded each of these locations in all categories we researched. Therefore, according to the averages of North America and previous Winter Olympic locations, the model we constructed represents one of the best ski resorts in the country, and therefore due to its layout and statistics, would make an ideal location to host the Winter Olympics.

MEMO

TO: Ms. Marcia Mogul, Realtor, Rich Sports Fans Inc.
FROM: Team 7413, Designers, Wasatch Peaks Ranch Building Co.
DATE: November 10, 2017
SUBJECT: Developing Wasatch Peaks Ranch into an Olympic Resort

Dear Ms. Mogul,

You recently reached out to our team here at Wasatch Peaks Ranch, in the hopes that we could provide a design for our ranch that would prove its suitability for hosting the Winter Olympics in the future. We have embraced this task wholeheartedly, and we hope that you and the fans you represent will consider developing our ranch into international greatness.

You gave us a series of requirements, and we have fulfilled them all. Our ranch will have 41 trails, representing over 191 kilometers of skiable slopes, well over the minimum requirement of 160 kilometers. Around 21% of our slopes are beginner-ranked slopes, around 39% of our slopes are ranked intermediate, and another 39% are considered advanced, ratios which align precisely with the requirements you set out for us.

Our design involves mainly straight ski slopes, with a few turns on several of the more challenging black diamonds. By keeping our slopes straight and steep, we maximised the space on our ranch while avoiding a sacrifice of the trail difficulties. Our trails are 12 kilometers wide, as per the regulations for Olympic ski trails set by the International Olympic Committee. This width not only allows our trails to support a large volume of talented skiers, but also increases the carrying capacity of our resort as a whole. With so many wide trails around our ranch, there will be plenty of room for fans, distinguished guests, and the media to watch the action without getting in the way of the athletes.

With over 41 different trails to choose from, it should come as no surprise that our slopes vary in their length. While all end at the base of the mountain for the convenience of spectators, each trail starts at a different elevation. From our 2.39 km trail perfect for taking the kids on their first skiing adventure, to our 7.02 km trail ideal for displaying the athletic prowess of Olympic skiers, there is a trail length to suit every person who wishes to come and ski.

Our proximity to nearby Salt Lake City enhances the value of our property. Visitors to Wasatch can enjoy a complete wilderness experience, while experiencing the excitement of a nearby large city. Salt Lake City, which features one of the largest international airports in the southwest, is an ideal hub to start a vacation. This spacious airport can handle the large volume of athletes and sports fans who wish to fly in and watch the Olympic Games. The minimal amount of travel required between Wasatch and Salt Lake City will keep traveling costs low for

all attendees, and the closeness of Salt Lake City's world-class hospitals will ensure that no skiing accidents end in tragedy.

Our ranch design also aligns with the requirements set forth by the International Olympic Committee, making the process of applying to become an Olympic site much easier. Our tallest peak is nearly 1.8 kilometers taller than the average highest peaks found in previous Olympic venues, and we have 97 kilometers more trails than the average past Olympic site, with 3 more kilometers of beginner trails, 19 more kilometers of intermediate trails, and 50 more kilometers of advanced trails. We are also 26 kilometers closer to the nearest large city than the average previous Olympic venue, which provides us with the benefits listed above.

Wasatch Peaks also blows its North American counterparts out of the water. Our tallest peak is around 1.7 kilometers higher than the average tallest peaks in possible Olympic venues across the continent. We have, on average, 12 kilometers of more trails, 3 kilometers of more beginner trails and 9 kilometers of more advanced trails. We also make up for any deficits in intermediate trail volume by our close proximity to Salt Lake city and its resources, being 151 kilometers closer to a major city than our average North American competitors.

Making an investment in the Wasatch Peaks Ranch will not only get you and your clients a suitable Olympic venue, it will also get you a gorgeous winter resort that can be used for years to come. Wasatch is a wonderful retreat for your families to take a break from their busy, sports-filled lives to ski and relax in a gorgeous, well-designed landscape. If you wish to get more monetary use out of the property, it can be opened to the general public as a high-class resort, ideal for family vacations, couples retreats, adventure travel, and business trips that want to bring a little extra excitement to their meetings.

We wish to thank you for giving us the opportunity to have our lovely ranch a featured component of the incredible Winter Olympics. We hope that you will move forward with our proposition to develop the ranch into a lavish ski resort, and we know that should you chose Wasatch Peaks Ranch to promote and develop, the Winter Olympics of 2026 will be a global sensation.

Sincerely,

Team 7413
Wasatch Peaks Ranch Building Co.

Problem Restatement

Yesterday morning, we were approached by Ms. Marcia Mogul, a realtor representing the rich sports fans at Rich Sports Fans Inc. She tasked us with designing a ski resort at the Wasatch Peaks Ranch near Peterson, Utah, that would provide an ideal location to hold the Winter Olympics in 2016. We had to make sure our design included at least 160 kilometers worth of trails, of which 20% needed to be ranked as beginner level trails, 40% ranked as intermediate level trails, and the remaining 40% ranked as advanced level trails. Once we completed the design for our resort, we then had to prove to Ms. Mogul and Rich Sports Fans Inc. that Wasatch would meet Olympic standards, and surpass the typical site requirements for comparable venues around North America.

Assumptions

- The Wasatch Peaks Ranch is entirely undeveloped.
- The International Olympic Committee is scouting venues in North America for the 2026 Winter Olympics, the Winter Olympics after 2022 in Beijing.
- All areas of the mountain have equal opportunity to be developed into trails and ski slopes.
- The wealthy winter sports enthusiasts can afford the expenses to build and maintain as many trails as desired.
- The terrain roughness is constant throughout the ski resort.
- After the steepest slope of the trail, the slope to the end of the trail is uniform in gradient of steepness.
- There are no obstructions on the trails; this includes rocks, trees, and water.
- The trails all have uniform width of 12m, the maximum width required for skiing events by the International Olympic Committee.
- All trails extend from the summit of the trail to the boundary of the skiable area.
- All the trails are uniformly maintained and regularly groomed to an equal and adequate level of safety.
- The measurements on the provided maps are both accurate and to scale.
- The Winter Olympics occur sometime during the time span of November to March, during the typical ski season.
- There is adequate amount of space for the spectators and the media to watch the events.
- Non-ski-related events, such as ice skating and hockey, will not be hosted at this resort; they will be situated at other venues, and therefore will not be accounted for.
- All previous Winter Olympic venues meet the International Olympic Committee's venue standards.
- The Winter Olympic standards have not changed since the 1936 Olympic Winter Games.

Definitions

Table 1: Definitions of terms used in this paper.

Term	Definition
Slopes	Synonym for trails.
Percent slope gradient	The increase in height of the landform over its horizontal increase, multiplied by 100.
Topographical map	A map that uses contour lines to indicate steepness of an area.
Advanced	Rating of difficulty that corresponds to difficult and expert. This type of trail is known as a black diamond in North America, and as a black circle in other parts of the globe.
Hypotenuse	The length of a trail, derived from taking the square root of the sum of the horizontal and vertical elevations.
Standard(s)	The averages of certain criteria for North America and past Olympic venues, to which we compared Wasatch to

Part I: Designing Trails

Calculating Trail Difficulty Levels

We determined the difficulty level of a trail by calculating the percent slope of the steepest point along the trail. Using the lines on the topographical map provided, we were able to estimate the steepest section of each potential trail. We also used the live map provided on the ranch's website in order to determine the elevation at the highest and lowest points in the steep section. We subtracted the bottom elevation of the steepest part from the top elevation of the steepest part in order to find the difference in elevation, which we classified as the vertical height of the steepest section. We then calculated the horizontal distance between the highest point and the lowest point of the steep section using the ruler function provided by the live map (Figure 1). To calculate percent slope at the steepest point, we the divided the vertical height by the horizontal distance and multiplied this value by 100 to receive a percent. If the percent slope was

less than 25%, we classified the trail as beginner level. If the percent slope was between 25% and 40%, we classified the trail as intermediate level. If the percent slope exceeded 40%, we classified the trail as advanced level.

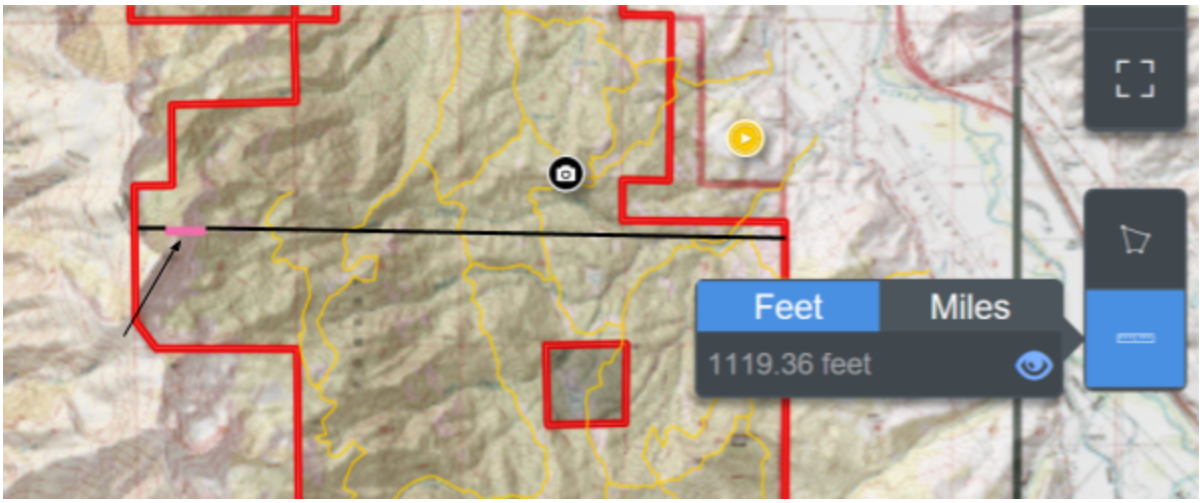

Figure 1: The method used to determine trail percent slope and trail length. The pink line represents the horizontal span of the steepest point of the trail, and the remaining black lines are the remainder of the trail that we averaged to find the percent slope of the rest of the trail. The difference of elevation at the beginning of the pink line and the end of the pink line was used as the vertical height of the steepest section of the trail, and the elevation at the end of the pink line was used as the height of the more level parts of the trail.

Calculations of Ideal Trail Locations

We determined that the locations of ideal trails would preferably start from the top of the summit, run towards the bottom, and form straight lines, in order to maximise the number of trails that could be constructed. We started the trails from the top of the summit to maximise the percent slope that could be attained for the advanced trails, and we ended each trail at the bottom of the mountain for the convenience of spectators. We did not curve trails any more than 45 degrees, and those that did have curves were not curved to the point where the difficulty level of the trail would be altered. First, we determined the possible locations for each trail level difficulty by calculating the percent slope of the steepest locations on the mountain as we described in the previous section. We classified areas that had a percent slope gradient of 40% or higher at their steepest points as advanced trails. We classified areas that had a percent slope gradient between 25% and 39% at their steepest points as intermediate trails. We classified areas that had a percent slope gradient of less than 25% at their steepest points as beginner trails. We also arranged the location of trails in order to congregate the trails of common difficulty level in one general area for convenience.

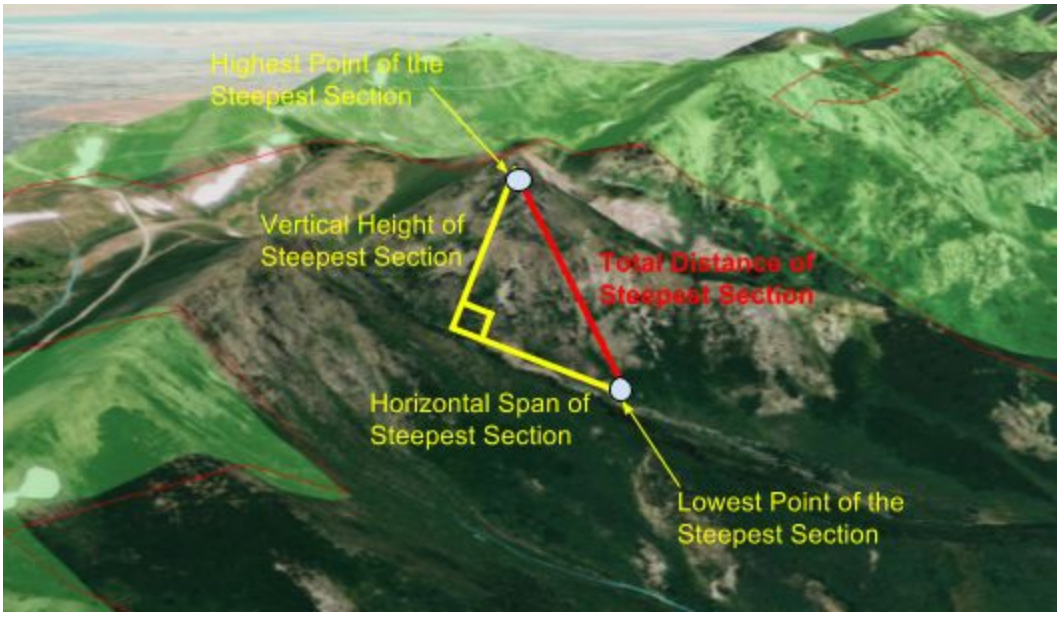

Figure 2: We used the live map to determine the altitudes of the lowest and highest points of the steepest section of each trail. These points were used to find the total vertical height of the steepest section, which was then used as a leg of a right triangle when the total distance of the entire section was calculated.

Calculating Trail Lengths

We determined the lengths of each trail based on the length of both the steepest area and the length of the average remaining parts of the trail. We used the vertical height of the steepest area in each trail in order to calculate the average length of the steepest area by using the pythagorean theorem and calculating the hypotenuse. We squared the vertical height of the steepest area and added that value to the squared value of the horizontal span of the steepest part. The square root of this sum represented the length of the steepest area of the trail. We repeated this process with the lowest elevation of steepest area, and the horizontal distance of the remainder of the trail not including the steepest section. We then squared these two values, added them together and then classified the square root of the sum as the length of the more level part of the trail. We added together the length of the steepest area and the length of the more level areas in order to find the total trail length of each individual trail. We used this method in order to maximise the accuracy of the trail lengths because it takes into account that the distance could increase with the incline of the terrain.

Calculating Ratios of Trail Difficulty

The ideal ratios for trail difficulty distribution, as stated by the incredibly wealthy sports fans, require that around 20% of trails meet the criteria for beginner, around 40% of trails meet the criteria for intermediate, and around 40% of trails meet the criteria for advanced. We calculated the percentages of each difficulty level slopes by dividing the number of trails of a specific difficulty level by the total number of trails, assuming the percentages refer to the

number of trails and not the total distance of the trails. Originally, we identified 12 beginner trails, 12 intermediate trails, and 10 advanced trails, for a total of 34 trails. When we calculated the original trail distribution, it came out to 34% beginner, 34% intermediate, and 31% advanced. This set of trails did not match the required ratios. In order to reach the ideal ratios, we set ideal numbers of trails at 16 intermediate, 16 advanced, and 9 beginner trails. We then removed three beginner trails, and established eight new trails, four intermediate and four advanced. This resulted in 21.95% of trails ranked as beginner, and 39.05% of trails ranked as both intermediate and advanced. These ratios are within 1% of the required ratio percentages, and therefore are considered to fully comply with the requirements provided.

Determining Variety of Trail Length

We ensured the variety of trail lengths by adhering to the non-uniform boundary lines of the available area. Many of the trails begin at high points and end at varying points of depth along the boundary line at the bottom of the mountain range. The method that we used to determine the trails allowed for a natural variance in trail lengths, enabling a wide variety of different trails available for use. We calculated the standard deviation of total trail lengths of all difficulty levels to be 1.33, showing that the values varied by about plus or minus 1.33 kilometers in either direction of the mean of 4.66 kilometers, which is a significant amount for the units of kilometers.

Map of Proposed Resort

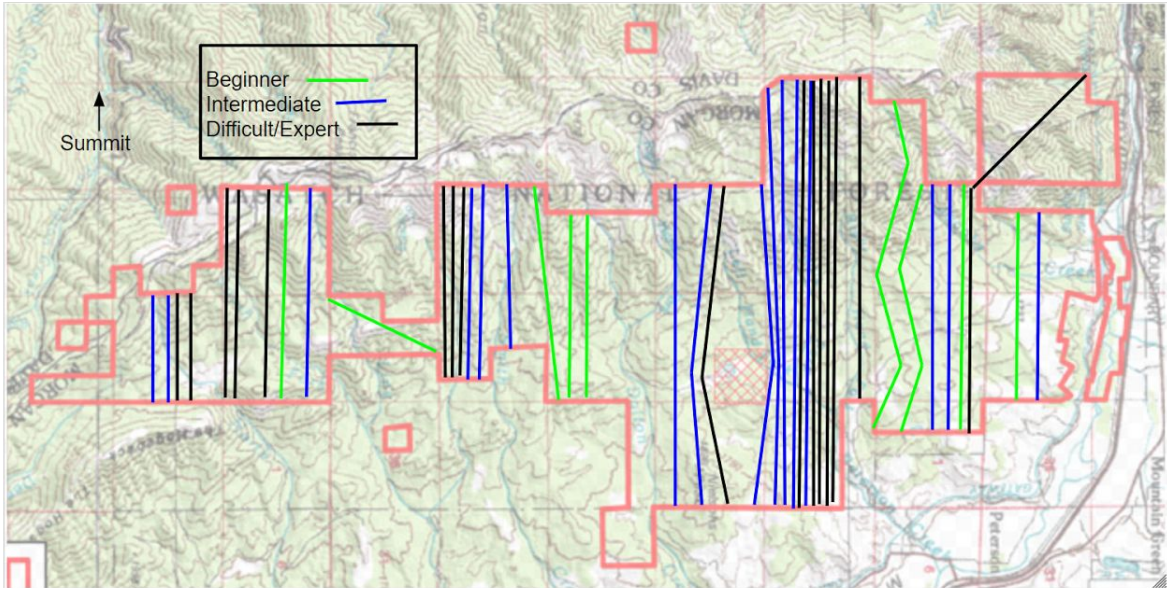

Figure 3. Topographical map showing the different trails created and color coded by difficulty level. The pink lines represent the boundary lines of the current Wasatch Peaks Ranch. The widths of the trails on the map are not drawn to scale.

Part I Strengths

The strongest aspect of our model lies in the fact that it has met or exceeded all requirements for the resort site outlined by both Ms. Mogul and the wealthy buyers she represents, as well as the International Olympics Committee. The 41 trails blocked out on the map are of varied length, with high standard deviations and a large range between the shortest trail and longest trail. With 16 advanced trails, 16 intermediate trails, and 9 beginner trails, our ranch meets the requirements for percentage of trails per type, with 39.02%, 39.02% and 21.95% respectively. By keeping the trails mostly straight, we increased the number of trails able to fit on the mountain, which in turn increases the number of people who can comfortably fit within the Wasatch Ranch, and expands the carrying capacity of the resort. Straight trails also allow for a safer competition with less chance of injuries due to sharp turns. This decision allows for the trails to have recreational use past the Olympic games, making it a viable option for business trips, family vacations, and practicing Olympians hoping to test their mettle on slopes the greatest athletes of their sport once roamed. The minimum total trail length given was 160 kilometers, and our model utilises roughly 191 kilometers of trails, far exceeding the minimum amount required. The increased trail lengths will allow for more skiers to use trails at a time, and more competitions to occur simultaneously.

Part I Weaknesses

While a perfect model is certainly ideal, our model is restricted by the necessity of making assumptions. Given that multiple wealthy individuals are participating in this project, we assume an unlimited amount of wealth can be spent on the purchase and development of the ski resort. Furthermore, we assume that the remainder of the trail has a uniform percent slope gradient except for at the steepest point. Since the steepest point is the most crucial point for qualifying the difficulty level of the trail, we averaged the rest of the trail in order to determine the remaining percent slope gradient. We then used the averaged percent slope gradient for the remainder of the trail in order to determine the remaining length of the trail. Depending on how accurate our calculations for average slope were, our model may have slight inaccuracies that could cause our total trail length to fluctuate by a few kilometers.

Part II: Comparison of the Designed Model

Purpose

Our model was compared to existing ski resorts in order to evaluate its relative strengths and weaknesses. We designed the Wasatch resort to be a successful ski resort and to host a future Olympic game. Therefore, we decided it was appropriate to compare our newly developed model with its existing competitors and previous Olympic hosting resorts.

Determining Criteria for Comparison of our Resort

In order to compare the proposed ski area to other North American competitors and to consider it a candidate for the Winter Olympics Games, our design must be evaluated against certain criteria. The data given to us about the potential North American competitors was peak elevation, base elevation, skiable acres, total slopes in kilometers, total beginner slopes in kilometers, total intermediate slopes in kilometers, total advanced slopes in kilometers, and the number of lifts per each venue. We were not provided with skiable acres for every property, so they were excluded from our considerations. We also excluded the number of lifts while making comparisons, because due to the sports fans' unlimited wealth, necessary lifts can be added at whim. We converted peak elevation and base elevation into mountain height by subtracting the base elevation from the peak elevation. We did this conversion because certain areas of the world have different elevations above sea level, which would be known as the base elevation, but what matters for our model is the height of the mountain, where one would ski. We researched the peak elevation and base elevation for Wasatch and used those values to determine the mountain height (see Appendix). We determined the total length of the trails by adding together the individual trail lengths calculated when designing the layout of the slopes. We determined the total length of the beginner trails in kilometers by adding all the beginner trail lengths together in the same manner that we used to find the total trail lengths. We repeated the same process to find the total intermediate and advanced trail lengths as well. We determined another aspect of a quality ski resort to be its proximity to major cities, which we defined as the nearest city with an international airport. We also took terrain and climate into consideration. We determined the terrain, climate, and location of each resort and past Olympic venues via research on sites provided in the bibliography.

North American Rating

We used the provided North American resorts as a standard for the current model; the latter should exceed the standards set by the former. We assumed that all resorts provided are the finest resorts North America has to offer, so the quality of each resort was determined by reviews on the *Powderhounds* and *OntheSnow* websites. Both online resources use a five-star rating system to convey the rating of existing resorts; we collected the star rating of both sources (see Appendix). If the average of both ratings exceeded 4.0, we included the resort in the comparison data. If the average of their ratings was less than 4.0, we did not account for the data in the comparison model. In the five star rating system, a one star was considered bad and a 5 star considered good. If the resort was listed within the top 10 of the Forbes or Business Insider ranking lists, then the resort automatically qualified for comparison. To determine the amount of snowfall needed, we collected the annual snowfall of all qualified resorts. We calculated the average snowfall and compared it to the snowfall average of Wasatch Peaks. We used this same process for the given terrain, peak elevation, and the location to large cities. If the current

model's data lands within the 50th percentile of the normal model of the collected data, then the designed model is considered as one of the best ski resorts in North America. Furthermore, if the z-score was between -1 and 1, we considered the data to meet the standard.

Olympic Rating

To determine whether Wasatch is a qualified candidate for the 2026 Olympic Games, we used past winter Olympic venues as the standard for an acceptable Winter Olympic games venue. Since data for just two Olympic sites was provided, we researched the other past Winter Olympic sites from 1936 to 2010 in order to find corresponding data. We did not find any information for the Winter Olympics that took place before 1936. From there, we took the averages and standard deviations of the mountain height, slope length, trail lengths for each level of difficulty, and proximity to cities. This data forms the basis of the Olympic standard, which was the average of all the Olympic sites' data for each aspect outlined above. We then compared this average against the designed model in order to determine how Wasatch Peaks fared against Olympic standards.

Comparison of Slope Lengths

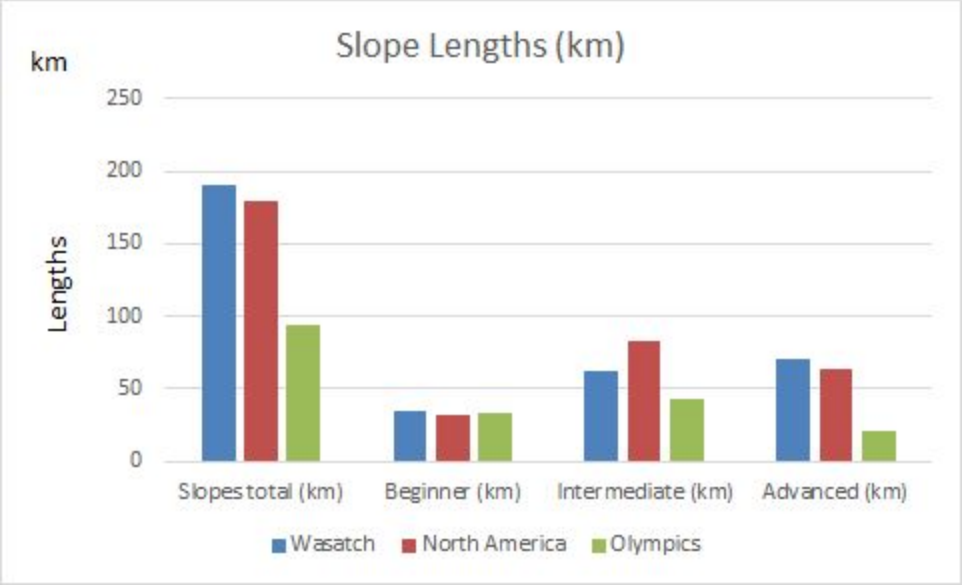

Figure 4: A bar graph which represents the total slope lengths, the total beginner trail lengths, the total intermediate trail lengths, and total difficult/expert trail lengths for Wasatch, the North American averages, and the Olympic averages.

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Figure 4 shows a bar graph comparing the total slopes distance in kilometers between Wasatch, the average North American site, and the average Olympic venue. We determined the North American standard by taking the average of the total slopes in kilometers for all the North

American ski areas that were considered the best via the method outlined above. We repeated the same process in order to find the total length of beginner, intermediate, and advanced trails. We repeated the same process again in order to determine the Olympic standards, by taking averages of all the Winter Olympic sites for each aspect under consideration. The graph shows that Wasatch outperforms both the North American and Olympic standards in nearly all categories. For total slopes distance, Wasatch has 191.14 kilometers, as opposed to the average North American slopes distance of 179.2 kilometers and the Olympic average of 94.41 kilometers. Wasatch also exceeds the standards for beginner slopes distance with a 35.19 kilometers, as opposed to the North American standard of 32.50 kilometers, and the Olympic standard of 32.54 kilometers. Wasatch surpasses the standards for advanced slope distance as well, with 61.55 kilometers as opposed to the North American standard of 64.25 kilometers and the Olympic standard of 20.35 kilometers. The only slope category in which Wasatch fall short is intermediate trail distance. Wasatch's intermediate trails, with a total length of 61.55 kilometers, exceeds the Olympic standard of 42.67 kilometers, but does not exceed the North American average of 82.45 kilometers, falling short by 20.9 kilometers. Despite this flaw, by exceeding the Olympic standards in all other aspects, Wasatch is a prime candidate for the future 2026 Winter Olympic games. Wasatch exceeds the majority of the North American standards, and has other qualities that rank it one of the best in North America.

Comparison of Mountain Heights

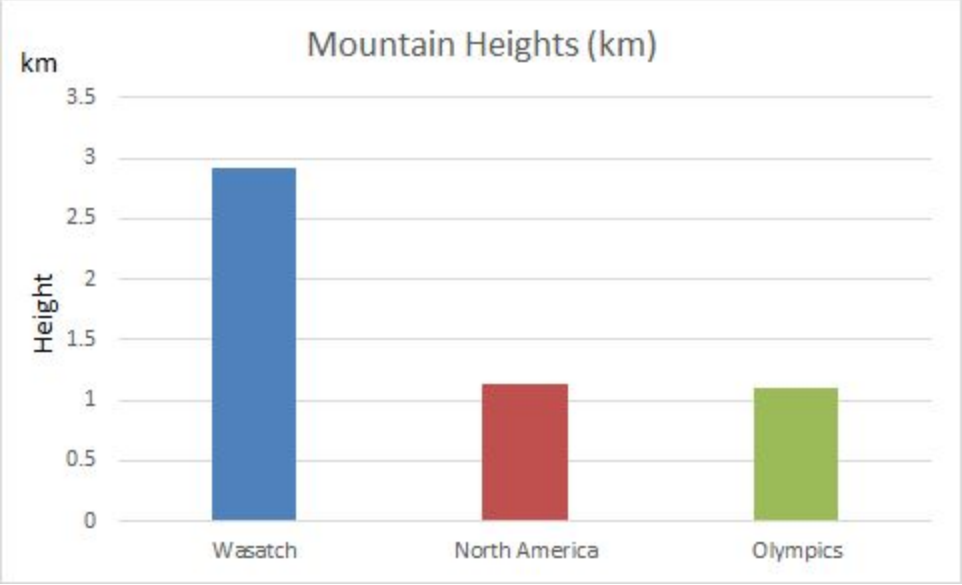

Figure 5: A bar graph which represents the mountain heights for Wasatch, North America (on average) and the Olympic venues (on average).

Figure 5 shows a bar graph comparing the peak elevation of Wasatch with the average peak elevations of the designated resorts from around North America and previous Olympic venues. We considered the heights of mountains for additional criteria because the best mountains for skiing are taller mountains; the height of a mountain corresponds with skiable surface area and range of trail difficulty. Taller mountains have more trails and a greater variety of trails. Wasatch, with a height of 2.92 km, comfortably exceeds the average height for North American mountains, at 1.14 km, as well as the average height for Olympic sites, at 1.1 km. By exceeding the standards in mountain height, Wasatch can be considered an Olympic venue candidate and one of the best in North America.

Comparison of Proximity to Major Cities

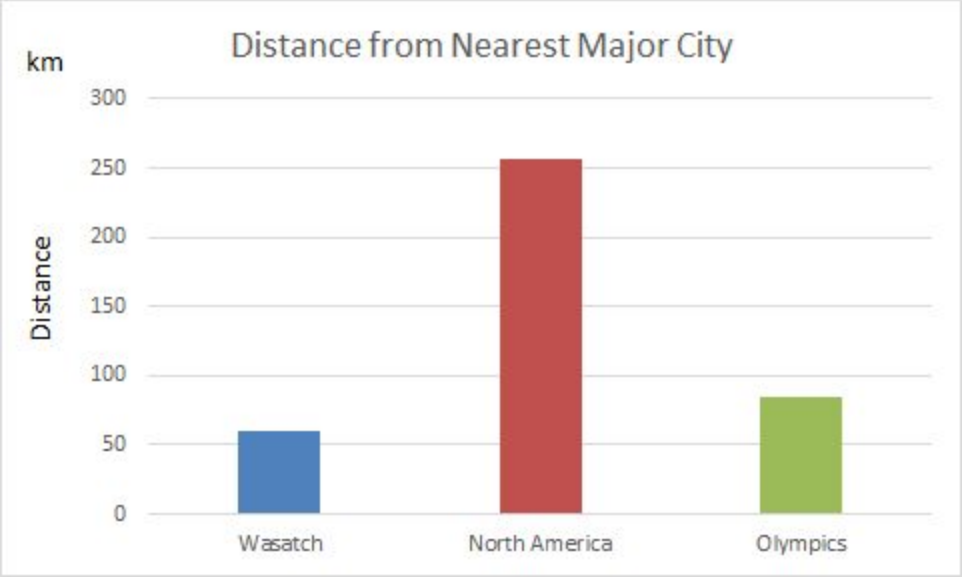

Figure 6: A bar graph which shows the distance of Wasatch to the nearest major city, and the average distance the ski resorts of North America and Olympic venues are from their respective nearest major cities.

Figure 6 shows a bar graph comparing the distance that Wasatch lies from the nearest major city with the average of the distances, in kilometers, that the resorts in North America and the previous Olympic sites lie from their respective closest major cities. If a resort is close to a major city, it has easier access to the city's facilities, such as hospitals, hotels, and places of interest to entertain people when they are not participating in winter sports. Large cities also have public transportation, which will lower the costs for athletes and spectators traveling to the games. We defined the nearest large city as the closest city with an international airport, and was determined via the approximations given by the *TravelMath* website. We researched the distances between resorts located in the United States and their nearest major cities in miles, and then converted them to kilometers so that they could be compared with locations outside the

United States. For resorts and Olympic sites that appeared to take place within the confines of a city, such as the Vancouver Olympics in 2010, 10 kilometers was automatically included as that location's proximity in order to account for the fact that the majority of Olympic events would not be held within the city proper. Wasatch has the smallest distance from its closest major city, Salt Lake City, with a distance of only 59.55 km, as opposed to the average distances for North American resorts of 206.33 kilometers, and the average distance of Olympics venues of 85.21 km. Wasatch's close proximity to its nearest major city makes it a prime tourist attraction and increases its safety when compared to its the North American counterparts, creating a stronger case for bringing the Olympics to Wasatch.

Comparison of Average Snowfall

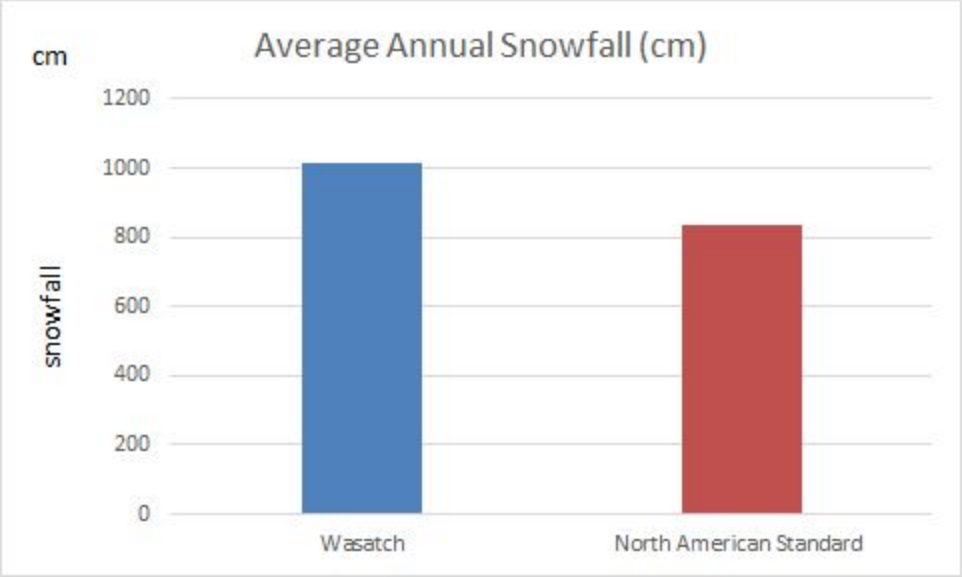

Figure 7: This bar graph shows the average annual snowfall of Wasatch and the North American standard, in centimeters.

Figure 7 shows a bar graph which compares the average annual snowfall of Wasatch with the North American standard. We determined the North American standard by researching the annual snowfall for all the ski resorts considered to be the best in North America, then taking the average. As shown by the graph, Wasatch has a greater average annual snowfall than the North American standard, of 1016 centimeters and 832.76 centimeters respectively. Having more snowfall improves the quality of a ski resort because with more snow, the trails are in better condition, enhancing skier experience.

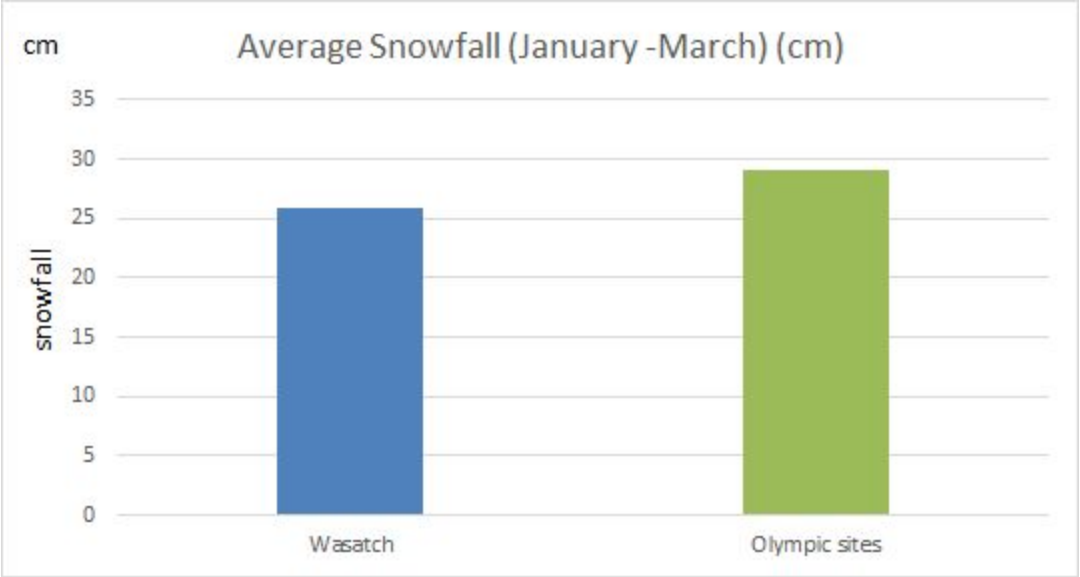

Figure 8: This bar graph compares the average annual snowfall between January and March since 2009 of Wasatch and previous Olympic locations.

Figure 8 compares the average annual snowfall between January and March since 2009 of Wasatch and previous Olympic locations. We determined the Olympic standards by researching annual snowfall for previous Olympic hosting areas since 1936. We did not take into account the Winter Olympics hosted in Lake Placid in 1980, Cortina d'Ampezzo in 1956, and St. Moritz in 1948 in this model because there is no record of their average snowfall during the Olympics. According to the data, the average snowfall in Wasatch, 25.91 centimeters, is below the average Olympic site snowfall, 29.0 centimeters. However, the z-score of Wasatch compared to the mean of Olympic sites is -0.137. Therefore, the Wasatch snowfall data falls within one standard deviation, meaning that the Wasatch resort is still suitable to qualify as an Olympic resort.

Conclusion: North America Ranking

Table 2: Compares Wasatch criteria to the North American Standard

	North American Standard	Wasatch
Average Annual Snowfall (cm)	832.764	1016
Mountain Height (km)	1135.7	1447.8
Distance to nearest city (km)	256	59.55
Total Slopes (km)	179.2	191.14
Beginner Slopes (km)	32.5	35.19
Intermediate Slopes (km)	82.45	61.55
Advanced Slopes (km)	64.25	70.51

We compared the data against the North American standard, which is the average snowfall, mountain height, distance to nearest city, total slope distance, and total beginner, intermediate and advanced slope distance of all the best North American ski resorts. We used the averages because we assumed that the data was normally distributed and the standard deviations of each criteria data were low enough that the averages could be considered a fair representation of the North American resorts. When we compare Wasatch to the North American standards, Wasatch exceeds the standards in all criteria except for intermediate slope lengths. However for intermediate slope lengths, the model still falls within one standard deviation of the North American standard, as shown by a z-score of -0.69, which means it meets the standard. Therefore, the proposed Wasatch resort is ranked as one of the top ski resorts in North America.

Conclusion: Olympic Candidacy

The model meets the Olympic standards, as shown by the data and graphs. Wasatch was compared to the Olympic standard, which we derived up above, as well as a sample of North American resorts, because it was not possible in the time frame to compare Wasatch to all existing North American ski resorts. The averages for North America are a fair representation of all the past Olympic sites since the standard deviation of all the averages were relatively low, and the data was assumed to be normally distributed. The model for the proposed ski resort exceeds all Olympic standards for the criteria considered: mountain height, slope distance, beginner slope distance, intermediate slope distance, advanced slope distance, average snowfall, and distance from nearest major city. In fact, the nearest major city, Salt Lake City, Utah, has hosted the

Winter Olympics as recently as 2002, which means Wasatch has all the necessities to host the Olympics in close proximity, such as hospitals, hotels, and places of interest. Therefore, the proposed design meets all the necessary criteria to be considered a future Winter Olympics location.

Part II Strengths

The strengths of this model lie in the fact that it takes into account many different criteria in order to determine whether the proposed resort meets the standards for both North America and the Olympics. The model goes beyond the criteria given initially, which was peak elevation, base elevation, skiable acres, total slopes distance, total beginner slope distance, total intermediate slope distance, total advanced slope distance, and lifts. We also considered proximity to the nearest major city, mountain elevation, and average annual snowfall because they are also important aspects in deciding the ranking of a ski resort. Even with more criteria considered, the proposed Wasatch ski resort exceeded the standard for both the best North American resorts and past Winter Olympic venues.

Part II Weaknesses

The weaknesses in the model include the lack of analysis of average temperature in each competitor's region. We assumed that the average temperature would have too large of a variance in data for a multitude of years to gather an accurate average number. Although we accounted for the average snowfall, the temperature does affect the ability for the snow to remain on the ground and the quality of the snowfall. When comparing the Wasatch model's statistics to the average North American ski resort statistics, the model exceeds all categories observed except for the total length of intermediate trails. However, if we increased the total length of intermediate trails, the percent of each trail difficulty level would no longer align with the requirements from the sports enthusiasts, so leaving the model the way it is still classifies it as a prime example of an ideal ski resort. We did not calculate the number of lifts in this model, but the clustering of trail locations would require only a minimal number of lifts.

Proposition

The model contains many advantageous aspects to hosting the Olympic games and to creating an effective and functional ski resort. The model exceeds all standards for the Olympics, classifying it as an ideal venue for the upcoming Olympic games. The model also exceeds the average of the best North American ski resort statistics in all but one category, making it one of the best resorts on the continent.

Extensions

Given more time to experiment, we could improve the model so it addresses the weaknesses. For instance, we could design it to account for a fixed, reasonable expenditure for the construction of the ski resort. The model could potentially account for non uniform percent slope gradients after the steepest part of each trail, and the trails could be curved more than 45 degrees to change their difficulty rating. The ranking for ski resorts could also take into account average temperature rather than just annual snowfall, because the temperature affects the quality of snow.

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Appendix

Table A1: Given/Initial Data of Selected North American Ski Resorts

Name	State	Country	Peak Elevation (m)	Base Elevation (m)	Skiable Acres	Slopes Total (km)	• Green (km)	■ Blue (km)	♦ Black (km)	Lifts
Beaver Creek	Colorado	USA	3488	2255	1832	150	28.5	64.5	57	16
Big Sky Resort	Montana	USA	3398	2072	5800	250	55	69	126	28
Breckenridge	Colorado	USA	3914	2926	2908	153	28	60	65	23
Breckenridge	British Columbia	Canada	2134	1052	2500	142	42	58	42	9
Jackson Hole	Wyoming	USA	3185	1924	2500	116	16	50	50	12
Killington	Vermont	USA	1285	355	1509	126.4	37.4	43	46	20
Lake Louis	Alberta	Canada	2637	1646	4200	139	35	62	42	7
Park City Mountain	Utah	USA	3029	2080	7300	250	27	152	71	38
Silver Star	British Columbia	Canada	1915	1155	3269	115	20	50	45	12
Squaw Valley	California	USA	2760	1890	3600	100	25	45	30	24
Steamboat Springs	Colorado	USA	3221	2103	2956	165	25	95	45	17
Sugarloaf Mountain	Maine	USA	1286	426	1153	119	28	40	51	13
Sun Peaks	British Columbia	Canada	2082	1198	4270	135	13.5	78	43.5	9
Vail	Colorado	USA	3433	2457	5289	234	57	84	93	25
Whistler Blackomb	British Columbia	Canada	2284	653	8171	200	40	110	50	26
Winter Park Resort	Colorado	USA	3676	2743	3000	143	11	53	79	22

Table A2: Given/Initial Data of Previous Olympic Sites

Name	City	Country	Peak Elevation (m)	Base Elevation (m)	Skiable Acres	Slopes Total (km)	• Green (km)	■ Blue (km)	♦ Black (km)	Lifts
YongPong Alpine	PyeongChang	South Korea	1438	700		24.2	2.8	11.4	10	15
Ski Resort Jeongseon	PyeongChang	South Korea	1370	418		10	3	3	4	4
Rosa Khutor	Sochi	Russia	2320	940		77	30	26	21	24

Table A3: Condensed Data of Ski Resorts Based on Online Reviews

Name	State	Country	Peak Elevation (m)	Base Elevation (m)	Skiable Acres	Slopes Total (km)	• Green (km)	■ Blue (km)	♦ Black (km)	Lifts
Beaver Creek	Colorado	USA	3488	2255	1832	150	28.5	64.5	57	16
Big Sky Resort	Montana	USA	3398	2072	5800	250	55	69	126	28
Breckenridge	Colorado	USA	3914	2926	2908	153	28	60	65	23
Jackson Hole	Wyoming	USA	3185	1924	2500	116	16	50	50	12
Lake Louis	Alberta	Canada	2637	1646	4200	139	35	62	42	7
Park City Mountain	Utah	USA	3029	2080	7300	250	27	152	71	38
Steamboat Springs	Colorado	USA	3221	2103	2956	165	25	95	45	17
Sun Peaks	British Columbia	Canada	2082	1198	4270	135	13.5	78	43.5	9
Vail	Colorado	USA	3433	2457	5289	234	57	84	93	25
Whistler Blackomb	British Columbia	Canada	2284	653	8171	200	40	110	50	26

Table A4: Original Trail Measurements of Designed Model

Trail Number	Top Height	Bottom Height	X Distance	Total Bump Height	Gradient	Percent Gradient	Ranking	Trail Bump Length (top feet)	Trail Bump Length top (km)	Trail Uniform Length horizontal (Feet)	Trail Uniform Length (ft)	Trail Uniform Length (km)	Total Trail Length
1	9449.109	7,988.81	2,697.00	1,460.30	0.54	54.15		3,066.96	0.93	11,716.32	14,180.74	4.32	5.26
2	8352	7,848.00	2,074.00	504.00	0.24	24.30		2,134.36	0.65	4,772.00	9,184.94	2.80	3.45
3	8927	8,448.00	1,764.00	479.00	0.27	27.15		1,827.88	0.56	7,836.11	11,522.73	3.51	4.07
4	8227	7,570.00	1,556.00	657.00	0.42	42.22		1,689.02	0.51	6,847.00	10,207.17	3.11	3.63
5	9028	8,502.00	1,451.00	526.00	0.36	36.25		1,543.40	0.47	18,456.30	20,320.41	6.19	6.66
6	8059	7,647.00	1,347.00	412.00	0.31	30.59		1,408.60	0.43	5,396.00	9,359.14	2.85	3.28
7	7578	7,319.00	939.00	259.00	0.28	27.58		974.06	0.30	7,777.44	10,679.72	3.26	3.55
8	7939	7,692.00	939.00	247.00	0.26	26.30		970.94	0.30	14,208.28	16,156.80	4.92	5.22
9	5190	5,074.00	1,247.00	116.00	0.09	9.30		1,252.38	0.38	2,792.80	5,791.82	1.77	2.15
10	8885	8,290.00	622.00	595.00	0.96	95.66		860.76	0.26	9,083.47	12,297.70	3.75	4.01
11	6828	6,401.00	1,243.00	427.00	0.34	34.35		1,314.30	0.40	10,570.56	12,357.57	3.77	4.17
12	8248	7,395.00	1,975.00	853.00	0.43	43.19		2,151.33	0.66	3,477.40	8,171.80	2.49	3.15
13	8088	7,986.00	1,571.00	102.00	0.06	6.49		1,574.31	0.48	4,931.50	9,385.94	2.86	3.39
14	5950	5,841.00	882.45	109.00	0.12	12.35		889.16	0.27	11,214.80	12,644.72	3.85	4.13
15	5698.8	5,362.00	1,394.00	336.80	0.24	24.16		1,434.11	0.44	3,520.00	6,414.16	1.96	2.39
16	9453	7,425.00	4,618.00	2,028.00	0.44	43.92		5,043.68	1.54	15,416.00	17,110.92	5.22	6.75
17	7828	6,741.00	3,519.00	1,087.00	0.31	30.89		3,683.06	1.12	12,070.00	13,824.83	4.21	5.34
18	8284	8,045.00	1,254.00	239.00	0.19	19.06		1,276.57	0.39	9,025.80	12,090.79	3.69	4.07
19	7924	7,863.00	1,082.00	61.00	0.06	5.64		1,083.72	0.33	16,178.00	17,987.62	5.48	5.81
20	7886	7,550.00	1,601.00	336.00	0.21	20.99		1,635.88	0.50	13,630.00	15,581.38	4.75	5.25
21	9289	7,867.00	3,048.00	1,422.00	0.47	46.65		3,363.39	1.03	17,886.00	19,539.67	5.96	6.98
22	9019	7,121.00	2,728.00	1,898.00	0.70	69.57		3,323.31	1.01	18,361.00	19,693.53	6.00	7.02
23	5774	5,356.00	1,978.00	418.00	0.21	21.13		2,021.68	0.62	7,327.00	9,075.88	2.77	3.39
24	7379	7,181.00	1,121.00	198.00	0.18	17.66		1,138.35	0.35	16,141.00	17,666.31	5.38	5.73
25	9387	8,238.00	2,110.00	1,149.00	0.54	54.45		2,402.56	0.73	18,913.00	20,629.26	6.29	7.02
26	7904	7,415.00	1,138.00	489.00	0.43	42.97		1,238.61	0.38	13,597.00	15,487.43	4.72	5.10
27	7357	6,702.00	5,877.00	655.00	0.11	11.15		5,913.39	1.80	5,877.00	8,913.81	2.72	4.52
28	8060	7766	1068	294.00	0.28	27.53		1,107.73	0.34	7045	10,485.36	3.20	3.53
29	9337	8196	3100	1,141.00	0.37	36.81		3,303.31	1.01	17961	19,742.64	6.02	7.02
30	8800	8041	1692	759.00	0.45	44.86		1,854.44	0.57	11331	13,894.22	4.23	4.80
31	7405	6651	1158	754.00	0.65	65.11		1,381.84	0.42	18512	19,670.53	6.00	6.42
32	8013	7595	1716	418.00	0.24	24.36		1,766.18	0.54	7334	10,558.01	3.22	3.76
33	7674	7227	1391	447.00	0.32	32.14		1,461.06	0.45	7848	10,668.68	3.25	3.70
34	6701	6254	1566	447.00	0.29	28.54		1,628.55	0.50	10334	12,079.08	3.68	4.18
35	8884	8278	3456	606.00	0.18	17.53		3,508.73	1.07	6972	10,822.85	3.30	4.37

Total Uniform Trail Distance (km):	141.49	Total Trails:	35	Percentage of trails
Total Steep Trail Distance (km):	21.71	Total Beginner Trails:	12	34.29
Total Trail Length (km):	163.20	Total Intermediate Trails:	12	34.29
		Total Advanced Trails:	11	31.43

Table A5: Trail Measurement of Designed Model (Adjusted With Ratio)

Trail Number	Top Height	Bottom Height	X Distance	Total Bump Height	Gradient	Percent Gradient	Ranking	Trail Bump Length (top feet)	Trail Bump Length top (km)	Trail Uniform Length horizontal (Feet)	Trail Uniform Length (ft)	Trail Uniform Length (km)	**Total Trail Length (km)**	Standard Deviation of Total Trail Length	Total Trail Length By Color	Ratios	Mean of Total Trail Length
1	9449.109	7,988.81	2,697.00	1,460.30	0.54	54.15		3,066.96	0.93	11,716.32	14,180.74	4.32	5.26	1.328536244	35.19	41	4.66
2	8352	7,848.00	2,074.00	504.00	0.24	24.30		2,134.36	0.65	4,772.00	9,184.94	2.80	3.45		61.55	0.3902439024	
3	8927	8,448.00	1,764.00	479.00	0.27	27.15		1,827.88	0.56	7,836.11	11,522.73	3.51	4.07		70.52	0.2195121951	
4	8227	7,570.00	1,556.00	657.00	0.42	42.22		1,689.02	0.51	6,847.00	10,207.17	3.11	3.63		167.26		
5	9028	8,502.00	1,451.00	526.00	0.36	36.25		1,543.40	0.47	18,456.30	20,320.41	6.19	6.66				
6	8059	7,647.00	1,347.00	412.00	0.31	30.59		1,408.60	0.43	5,396.00	9,359.14	2.85	3.28				
7	7578	7,319.00	939.00	259.00	0.28	27.58		974.06	0.30	7,777.44	10,679.72	3.26	3.55	Min=	2.39		
8	7939	7,692.00	939.00	247.00	0.26	26.30		970.94	0.30	14,208.28	16,156.80	4.92	5.22	Max=	7.02		
9	8885	8,290.00	622.00	595.00	0.96	95.66		860.76	0.26	9,083.47	12,297.70	3.75	4.01				
10	6828	6,401.00	1,243.00	427.00	0.34	34.35		1,314.30	0.40	10,570.56	12,357.57	3.77	4.17				
11	8248	7,395.00	1,975.00	853.00	0.43	43.19		2,151.33	0.66	3,477.40	8,171.80	2.49	3.15				
12	5950	5,841.00	882.45	109.00	0.12	12.35		889.16	0.27	11,214.80	12,644.72	3.85	4.13				
13	5698.8	5,362.00	1,394.00	336.80	0.24	24.16		1,434.11	0.44	3,520.00	6,414.16	1.96	2.39				
14	9453	7,425.00	4,618.00	2,028.00	0.44	43.92		5,043.68	1.54	15,416.00	17,110.92	5.22	6.75				
15	7828	6,741.00	3,519.00	1,087.00	0.31	30.89		3,683.06	1.12	12,070.00	13,824.83	4.21	5.34				
16	8284	8,045.00	1,254.00	239.00	0.19	19.06		1,276.57	0.39	9,025.80	12,090.79	3.69	4.07				
17	7924	7,863.00	1,082.00	61.00	0.06	5.64		1,083.72	0.33	16,178.00	17,987.62	5.48	5.81				
18	7886	7,550.00	1,601.00	336.00	0.21	20.99		1,635.88	0.50	13,630.00	15,581.38	4.75	5.25				
19	9289	7,867.00	3,048.00	1,422.00	0.47	46.65		3,363.39	1.03	17,886.00	19,539.67	5.96	6.98				
20	9019	7,121.00	2,728.00	1,898.00	0.70	69.57		3,323.31	1.01	18,361.00	19,693.53	6.00	7.02				
21	7379	7,181.00	1,121.00	198.00	0.18	17.66		1,138.35	0.35	16,141.00	17,666.31	5.38	5.73				
22	9387	8,238.00	2,110.00	1,149.00	0.54	54.45		2,402.56	0.73	18,913.00	20,629.26	6.29	7.02				
23	7904	7,415.00	1,138.00	489.00	0.43	42.97		1,238.61	0.38	13,597.00	15,487.43	4.72	5.10				
24	7357	6,702.00	5,877.00	655.00	0.11	11.15		5,913.39	1.80	5,877.00	8,913.81	2.72	4.52				
25	8060	7766	1068	294.00	0.28	27.53		1,107.73	0.34	7045	10,485.36	3.20	3.53				
26	9337	8196	3100	1,141.00	0.37	36.81		3,303.31	1.01	17961	19,742.64	6.02	7.02				
27	8800	8041	1692	759.00	0.45	44.86		1,854.44	0.57	11331	13,894.22	4.23	4.80				
28	7405	6651	1158	754.00	0.65	65.11		1,381.84	0.42	18512	19,670.53	6.00	6.42				
29	8013	7595	1716	418.00	0.24	24.36		1,766.18	0.54	7334	10,558.01	3.22	3.76				
30	7674	7227	1391	447.00	0.32	32.14		1,461.06	0.45	7848	10,668.68	3.25	3.70				
31	6701	6254	1566	447.00	0.29	28.54		1,628.55	0.50	10334	12,079.08	3.68	4.18				
32	8884	8278	3456	606.00	0.18	17.53		3,508.73	1.07	6972	10,822.85	3.30	4.37				
33	8803	7863	1928	940.00	0.49	48.76		2,144.94	0.65	12828	15,046.07	4.59	5.24				
34	9077	8680	1466	397.00	0.27	27.08		1,518.80	0.46	18504	20,438.70	6.23	6.69				
35	8225	7882	1176	343.00	0.29	29.17		1,225.00	0.37	3743	8,725.59	2.66	3.03				
36	8217	7950	734	267.00	0.36	36.38		781.05	0.24	4697	9,233.87	2.81	3.05				
37	8732	7915	1353	817.00	0.60	60.38		1,580.54	0.48	9103	12,062.83	3.68	4.16				
38	8892	8156	1037	736.00	0.71	70.97		1,271.64	0.39	9321	12,385.53	3.78	4.16				
39	8634	8191	1068	443.00	0.41	41.48		1,156.23	0.35	8809	12,028.76	3.67	4.02				
40	8240	7828	1030	412.00	0.40	40.00		1,109.34	0.34	4331	8,946.24	2.73	3.06				
41	5960	5626	1135	334.00	0.29	29.43		1,183.12	0.36	8180	9,927.95	3.03	3.39				
Total	334532.909	308,550.81	73,053.45	25,982.10	15.02	1,501.73		78,349.92	23.88	438,823.48	548,740.04	167.26	191.14				
Average	8159.339244	7,525.63	1,781.79	633.71	0.37	36.63		1,910.97	0.58	10,703.01	13,383.90	4.08	4.66				
SD	947.8911403	782.0177615	1082.645897	448.8249884	0.1797406567	17.97406567		1138.520285	0.3470209829	4861.43828	4013.395111	1.22328283	1.328536244				

Table A6: Final Tail Ratio and Total Distances of Model's Trails

Difficulty	Total Number of Tracks	Percent Number of Tracks	Total Distance
Beginner	9	21.95%	35.19
Intermediate	16	39.02%	61.55
Advanced	16	39.02%	70.51
Total	41	100.00%	191.14

Table A7: Final Statistics of Designed Model

Resort	Peak Elevation (m)	Base Elevation (m)	Mountain Height (m)	Slopes Total (km)	●Green (km)	■Blue (km)	♦ Black (km)	Average Snowfall (cm)	Distance (km)
Wasatch	2916.94	1469.14	1447.8	191.14	35.19	61.55	70.51	1016	59.55

Table A8: Statistical Data of Competitors in North America

	Mountain elevation	Slopes total	Begin	intermediate	Adv.	Snowfall	Distance
Beaver Creek	1233	150	28.5	64.5	57	825.5	209.00
Big Sky Resort	1326	250	55	69	126	1016	610.00
Breckenridge	988	153	28	60	65	990.6	167.00
Jackson Hole	1261	116	16	50	50	1158.24	454.00
Lake Louis	991	139	35	62	42	355.6	190.00
Park City Mountain	949	250	27	152	71	900	53.00
Steamboat Springs	1118	165	25	95	45	444.5	288.00
Sun Peaks	884	135	13.5	78	43.5	558.8	259.00
Vail	976	234	57	84	93	914.4	195.00
Whistler Blackcomb	1631	200	40	110	50	1164	135.00
average	1135.7	179.2	32.5		64.25	832.764	256.00
st dev	229.3672698	50.29424531	14.62494065	30.28425517	26.7511682	286.5247945	163.1665815

Table A9: Statistical Data of Previous Olympic Resorts (Since 1936)

City	Country	Peak Elevation	Base Elevation (m)	Mountain Height (m)	Slopes Total (km)	Beginner	Intermediate	Difficult/Expert	Major City	Distance From Major City (km)
PyeongChang	South Korea	1,404.00	559.00	845.00	34.20	5.80	14.40	14.00	Seoul	126
Sochi	Russia	2,320.00	940.00	1,380.00	77.00	30.00	26.00	21.00	Stavropol	242
Vancouver	Canada	2,284.00	653.00	1,631.00	200.00	40.00	110.00	50.00	Vancouver	10
Turin	Italy	2,749.00	1,372.00	1,377.00	400.00	96.00	220.00	84.00	Turin	10
Salt Lake City	USA	2,850.00	1,948.00	902.00	26.00	5.00	28.00	15.00	Salt Lake City	45
Nagano	Japan	1,831.00	760.00	1,071.00	52.00	16.00	26.00	10.00	Nagano	10
Lillehammer	Norway	1,030.00	195.00	835.00	44.00	33.00	7.00	4.00	Oslo	151
Albertville	France	3,456.00	1,550.00	1,906.00	300.00	170.00	78.00	52.00	Geneva, Swiss	100
Calgary	Canada	2,260.00	1,525.00	735.00	25.00	4.20	14.70	6.10	Calgary	10
Sarajevo	Bosnia and Her	2,060.00	1,270.00	790.00	14.00	5.00	7.00	2.00	Sarajevo	10
Lake Placid	USA	1,340.00	371.00	969.00	35.00	7.00	15.00	13.00	Hartford	237
Innsbruck	Austria	2,340.00	1,580.00	760.00	30.00	7.00	21.00	2.00	Innsbruck	10
Sapporo	Japan	1,023.00	340.00	683.00	44.50	13.35	17.80	13.35	Sapporo	53
Grenoble	France	2,250.00	1,400.00	850.00	90.00	45.00	35.00	10.00	Lyon	95
Squaw Valley	USA	2,760.00	1,890.00	870.00	100.00	25.00	45.00	30.00	Sacramento	117
Cortina d'Ampezzo	Italy	2,924.00	1,224.00	1,700.00	120.00	45.00	55.00	20.00	Venice	116
Oslo	Norway	1,188.00	180.00	1,008.00	25.00	17.00	5.00	3.00	Oslo	50
St. Moritz	Switzerland	3,057.00	1,720.00	1,337.00	155.00	42.00	79.00	34.00	Altenrhein	172
Garmisch-Partenkirchen	Austria	2,240.00	1,000.00	1,240.00	22.00	12.00	6.80	3.20	Innsbruck	55
Averages:			Averages	1,099.42	94.41	32.54	42.67	20.35		85.21
			Stdev	361.9102583	104.2540086	40.19844142	51.75811319	21.52175256		75.33892232

Table A10: Snowfall of Previous Olympic Resorts (Since 1936)

City	2009	2010	2011	2012	2013	2014	2015	2016	2017	Average	Standard Deviation
PyeongChang	11.1	48.2	24.2	19.3	11.9	9.3	5	4.07	8.63	15.74444444	13.77377046
Sochi	10.1	3.6	7.8	10.8	0.27	2.9	0.1	5.23	5.53	5.147777778	3.879113229
Vancouver	15.4	2	153	12.4	0.1	4.63	0	0	14.9	22.49222222	49.36379791
Turin	13.1	17.2	0.7	4.23	11.8	5.77	0.633	7.63	0.5	6.840333333	6.084015409
Salt Lake City	45	35.2	41.5	29.1	16	11.7	3.2	21.7	29.8	25.91111111	13.93147914
Nagano	28.2	27.9	19.9	12.8	3.73	8.43	8.67	5.73	25.4	15.64	9.811684361
Lillehammer	88	49	29	20	10.5	67.4	38.4	22.8	26.5	39.06666667	24.99955
Albertville	0.7	7.13	14.1	0.26	0.33	5.63	5.13	1.33	0.867	3.941888889	4.623329386
Calgary	25.7	6.5	1270	6.27	7.33	12.5	15.3	9.03	15.3		419.298079
Sarajevo	95.4	87.7	34.4	71.6	47.8	14.6	62.2	37.6	44	55.03333333	26.36512848
Lake Placid											
Innsbruck	103	62.6	13	54.7	40.9	34.4	26.9	29.6	21.6	42.96666667	27.37731725
Sapporo	124	122.5	55.8	49.9	56.4	56.7	50.3	54.3	44.4	68.25555556	31.42909127
Grenoble	27.9	34.8	2.17	12.3	24	10.8	20.4	17.1	10.2	17.74111111	10.11172394
Squaw Valley	2.13	3.06	3.3	2.2	2	1.07	0	1.7	1.03	1.832222222	1.031561653
Cortina d'Ampezzo											
Oslo	91.5	64.7	38.1	21.4	13.4	81.9	58	46.4	37.7	50.34444444	26.17790629
St. Moritz											
Garmisch-Partenkirchen	141	87.7	17.6	60.8	42.6	38.3	64.4	69.1	57	64.27777778	35.0834996
									Average	29.0157037	
Averages:									STDEV	22.63699975	