Applied Mathematics 30

Student Project: Operating a Ski Resort

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Alberta
EDUCATION

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Project: Operating a Ski Resort

Introduction

The owners of service industry businesses must have a wide range of skills. In addition to having sound business practices, these people must also possess strong analytic and design skills. These skills enable them to create valid business plans and undertake capital development projects. By completing this project, you will gain insight into how the concepts you have learned in Applied Mathematics 30 can be applied to operating a service industry business.

Part A

The owners of a particular ski resort are considering building a super pipe for snowboarders for the next ski season. To determine whether or not to go ahead with this project, the owners first collected data on how many patrons were skiers and how many patrons were snowboarders. They found that on any given day at the ski resort, 55% of the patrons are skiers and 45% are snowboarders.

1. On the opening day of the current season, 200 patrons were randomly interviewed. How many of these patrons would have been expected to be snowboarders?

2. The owners of the ski resort repeated the survey of 200 patrons many times during the season. They found that the number of snowboarders on any given day forms a normal distribution. Determine the symmetric 95% confidence interval for the number of snowboarders in any sample of 200 patrons on any given day.

3. Based on previous surveys, the owners know that 20% of skiers switch to snowboarding the next season and 15% of snowboarders switch to skiing the next season.

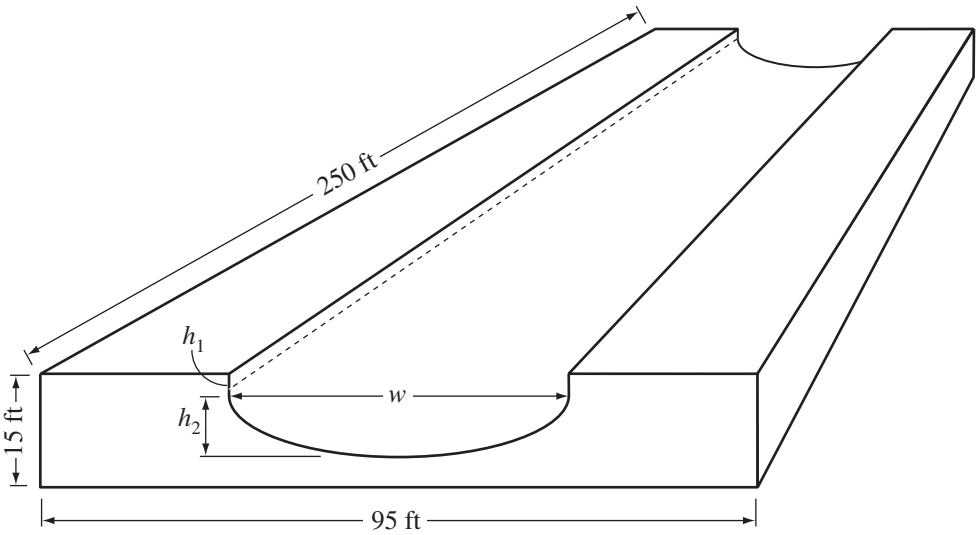
- Use an initial probability matrix and a transition matrix to predict the percentage of patrons who will be skiers and the percentage of patrons who will be snowboarders next season. Label the elements of your product matrix.

- Assume that this trend continues. Predict the percentage of patrons who will be skiers and the percentage who will be snowboarders in 5 seasons. Label the elements of your product matrix.

- Based on these predictions, should the ski resort owners go ahead with the building of a super pipe? Explain your answer.

Part B

A super pipe is a structure that is made out of packed snow. To construct a super pipe, snow is piled up and then packed, and then specialized machinery attached to a snow cat is used to form the U-shaped course. The basic shape and dimensions of the super pipe that the owners of the ski resort will build next season are shown below.



$h_1 = 3$ ft $\quad h_2 = 8$ ft $\quad w = 45$ ft

A formula that approximates the volume of the U-shaped cutout portion of the course is

$$V = lw(0.93h_2 + h_1),$$

where l is the length of the super pipe and where w, h_1, and h_2 have the values given above.

1. • Determine the volume of snow that must be piled and packed before the super pipe structure is formed.

• The super pipe at the ski resort will be built out of manmade snow. The snow-making machines can produce 19 000 ft^3 of snow in 24 h. Determine how many days, to the nearest whole day, it will take to produce the snow needed to build the super pipe.

• Determine the volume of snow that remains after the U-shaped course is formed.

2. Once the snow is made, the super pipe will be constructed using both machines and manual labour. Two snow cats will each be operated for 50 h, and 4 labourers will each work three 8-h days. The cost to operate each snow cat, including the operator, is $140/h. Each labourer is paid $12.50/h. What will be the total cost of the machines and labour used in the construction of the super pipe?

3. In addition to the machinery and labour costs calculated above, what are some of the other costs involved in building the super pipe?

Part C

To help them project future revenue, the owners of the ski resort randomly collected data on patrons' daily spending habits. Patrons typically purchase items such as lift tickets, food, and souvenirs. The daily amount spent per patron is summarized in the table below.

Daily Amount Spent per Patron ($)	**Frequency**
40	150
45	275
50	550
55	700
60	800
65	525
70	400
75	200

1. • Draw a histogram to organize these data.

• Can these data be modelled by a normal distribution? Explain your answer.

2. Calculate the mean daily amount spent per patron and the standard deviation.

3. Using the mean and standard deviation that you calculated in question 2, determine the daily amount spent per patron that is

• one standard deviation below the mean

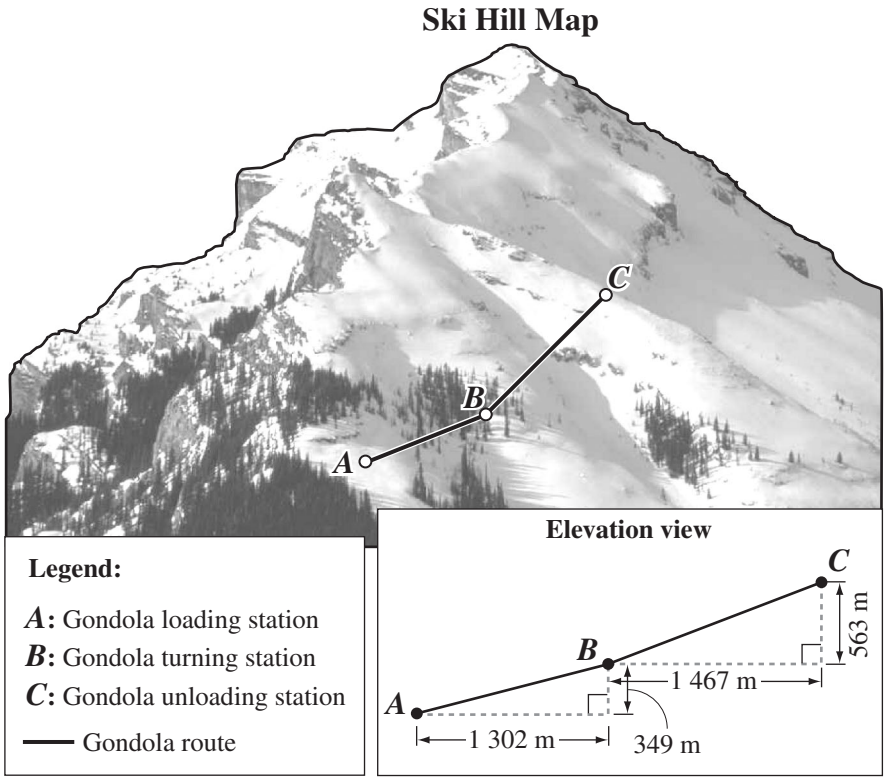
• one standard deviation above the mean

4. The owners of the ski resort want to project how much daily revenue they can reasonably expect in the next ski season. The average ski season is 165 consecutive days (for example, November 17 to April 30). During the season, the ski resort averages 1 000 patrons on a weekday and 2 000 patrons on a weekend day.

• Use your calculations from this section to help the owners determine a reasonable projection for revenue for the next season. Justify your projection.

Part D

In the future, the owners of the ski resort are going to expand their operations to include additional runs and a new gondola. A map of the proposed expansion and an elevation view of the proposed gondola are shown below.



1. The new gondola will follow a path from the loading station (A) to the unloading station (C), passing through the turning station (B). The elevation view shown above gives the horizontal distance between the loading station and the turning station as 1 302 m, with an elevation gain of 349 m, and the horizontal distance between the turning station and the unloading station as 1 467 m, with an elevation gain of 563 m.

The cable for the gondola will run from A to B to C and **back** again. An extra 200 m of cable must be added for slack and for splices. Determine the length of cable required. Express your answer to a whole number of metres.

2. The particular gondola system that will be installed is supported by a series of towers and has the following safety requirements:

- the cable must be attached on both sides of each tower
- the towers that support the cable must be spaced a maximum distance of 85 m apart
- the gondola cars that are on the cable must be spaced a minimum distance of 65.5 m apart

The chart below shows the approximate costs, excluding GST, for the materials needed for the construction of the gondola system.

Item	Cost, excluding GST
Tower (including foundation)	$27 000/tower
Cable	$25/m
Gondola Car	$24 000/car
Loading Station	$1 500 000
Turning Station	$650 000
Unloading Station	$1 000 000

Design a spreadsheet that can be used to determine the approximate cost for the materials for the gondola system, including 6% GST. Use the length of the cable that you determined in question 1 and use formulas in the spreadsheet, where possible. Supply two printouts of your spreadsheet—one printout showing all lengths, costs, and totals and the other printout showing the formulas within the cells.

3. **a.** To finance the planned expansion, the ski resort owners plan to negotiate a 10-year loan with an interest rate of prime plus 1%. (Assume that prime is 6.0%.) The bank will require a down payment of 35%. On equipment loans, the amount borrowed is divided by the number of payments; this becomes the principal payment. Each year, interest is then calculated on the outstanding principal and added to the principal payment to determine the yearly loan payment. Therefore, each yearly loan payment is different.

- Determine the amount of the first yearly loan payment.

b. The bank wants to determine whether the ski resort can afford to repay the loan. As part of this determination, the bank calculates the business's "Debt Service Coverage." One way to calculate this is to first determine the EBITD (Earnings Before Interest, Tax, and Depreciation). The EBITD is then divided by the first yearly loan payment, as shown below. The result of this calculation must be greater than 150%.

$$\frac{\text{EBITD}}{\text{First Yearly Loan Payment}}$$

- The ski resort's EBITD is $1 800 000. Will the ski resort be able to repay the loan? Justify your answer.

Part E

During the course of this project, you have investigated various aspects of operating a ski resort. You have answered questions related to statistical analysis, design, and finance. There are many issues—ranging from finances to expansion and environmental concerns—facing ski resorts today. Research and write a one-page or two-page report on issues facing ski resort development in Alberta.

The following web sites may help in your research.

www.castlewilderness.ca/campaigncmr.html
www.cpawscalgary.org/
www.issues.albertawilderness.ca
www.wildcanada.net
www.eomonline.com/Common/currentissues/July01/shirley.htm

Note: Web site addresses sometimes change. If the sites above are not available, use a search engine and type in keywords such as "Alberta ski resort" and "environmental concerns."

OR

Prepare a PowerPoint presentation that could be made to an investor group to summarize the main aspects of this project. The presentation should include an analysis of the cost and benefits for building the super pipe, customer spending habits and revenue projections, and a summary of the planned expansion, including cost estimations.