Trip Leg Tables and Trail Profiles

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What we will cover during this lecture:

- What is a Contour line
- Common map features
- Why use Trip Leg Tables and Trail Profiles
- How to build a Trip Leg Table
    - Naismith's Rule
    - Additional Time Factors
    - Squiggle Factors
- How to build a Trail Profile
- How to do a quick trip estimate using Naismith's Rule

In order to complete the Trip Leg Table and the Trail Profile you have to have a basic understanding of contour lines on a map and some basic markings/symbols that indicate features of the terrain and trail.

CONTOUR LINES

Your map is covered in brown lines, some darker and some lighter, which indicate the height of the ground at that particular point. These brown lines are called contour lines. The height represents feet above sea level, or elevation. These are essential features on a map that are used to represent the third dimension on a flat, two dimensional map. Some basic facts about these contour lines are:

- Each line continues along a path of exactly the same elevation.
- Every line will form a complete loop, regardless of what you can or cannot see on the map.
- The contour lines will never intersect.
- The contour lines are spaced at equal changes of elevation on the map. The interval of these lines can be found at the bottom center of the map under the scale dimension.
- Every 5th contour line will be darker and contain a labeled elevation number. These are called index contour lines.
- The light contour lines will not have an index number marking elevation. You will have to do a little math to reach the elevation of that line using the numbers of the darker contour lines which surround it.
- Be aware of how your map is measuring the contour intervals. Some measure in feet and some in meters. ALWAYS check the legends, scales and dimensions on your map.
- When contour lines are close together, it represents a part of the terrain where you will gain elevation very rapidly
- When contour lines are farther apart, it represents a part of terrain that is a gentle slope of little elevation gain
- When a series of contour lines form successive "V"s that point towards the direction of elevation loss, this is a ridge. This would be a high point along a path of travel when you get onto a ridge.
- When a series of contour lines form successive "V"s that point towards the direction of elevation gain, this is a gully. This would be a low point along a path of travel when you get into a gully. Gullies will often have solid blue lines (perennial) or dashed blue lines (intermittent) representing streams.
- When a series of contour lines form a nesting of successive closed loops, you are looking at a peak/summit or the lowest spot in a valley/depression, depending on how the elevation is either increasing or decreasing.

COMMON MAP FEATURES

Besides the brown contour lines found on your map, you've got tons of other markings and symbols which indicate trails, streams, peak locations, water, park boundaries, trailheads, established camp sites and many more.

- - - - - - - - - - - -	trail (black)
——— . . . ———	Intermittent stream (blue)
X	high point or summit (often accompanied with the elevation) (black)

A map will always provide a scale which indicates how many miles are represented in a particular measurement, for example: 1 inch on a 7.5 minute USGS Topo map will cover 0.4 miles of life size terrain. 1 inch on a 15 minute USGS Topo map will cover 1 mile of life size terrain.

Now with a basic understanding of what we're looking at on the Topo maps, lets dive into the Leg Table and the Trail Profile.

TRIP LEG TABLE and TRAIL PROFILE

Trip leg tables and trail profiles are for the purpose of preparing for your climb/backpack/hike as well as estimating the time you will need to safely execute your trip (during daylight hours). The data you collect in your trip leg table will ultimately give you to the total mileage and elevation gain for your trip. These two bits of info are plugged into an equation called the Naismith Rule to determine how long it will take you to complete your hike or backpack. There's two variations of the equation that take into consideration the load you are carrying, a day pack or a fully loaded overnight backpack. We'll look at those in a moment. For now, let's take a look at the benefits of using a Trail Leg Table and a Trail Profile.

IN TERMS OF PREPARATION:

- What are the features you will be looking for to reassure yourself you're on route?
- Are there any features in the terrain that would cause you to have to bring special gear? Extra water shoes for a stream crossing or a rope and belay system for a steep section where a participant could possibly request assistance to ascend/descend.
- Are there other trails crossing our path or forking off from our path that need to be prepared for. Make notes to take the right/left fork.
- Where will you arrange to have breaks and stops in order to re-group and rest at regular intervals?

These don't **just** aid in validating that you're on course, but also help you to define your trip leg segments to measure distance and time.

IN TERMS OF TIME AND DISTANCE ESTIMATION:

- How long will it take me to navigate across this section of the trail that is short but gains a lot of elevation?
- What time do I have to start hiking to ensure I'm off the mountain or at camp by dusk?
- I've done this hike plenty of times before by myself, how much time do I add now that I'm bringing 397 of my closest friends?

You will be preparing a Trip Leg Table and Trail Profile for the Mount Wilson Conditioning Test Hike. We'll cover each step on how to execute building your Table and Profile.

WHERE TO BEGIN: To create a Trip Leg Table, you want to start with the basic chart layout shown here.

SELECTED POINTS	Elevation	Elev. Gain	Cumulative	Miles	Cum.	Time	Time for	Cum.	Clock Time
	This Point	This Leg	Elev. Gain	This Leg	Miles	This Leg	Rest/Lunch	Time	Start

Now, take a look at your topographic map and note geographical elements that you can use as markers or indicators. Remember these are the features like stream crossings and forks in the trail that were mentioned above. Other features that you could pick out easily on your trip would be notably steep sections, sharp turns, a campsite or the trailhead. Pick a handful of these points along the trail/route which will become the legs of your trip table.

Measure the distance using the mileage scale on your map between each of the points to obtain each leg's distance.

Using the contour lines and indexes, find the elevation of each of your points.

Then, calculate the net gain only between these points. If the elevation change is a negative (losing elevation), then use a "0" because Naismith's rule isn't built to give you negative or credit hours for the time spent going downhill. Downhill is treated as flat ground and you apply the 3 mile an hour rule.

Use your "Cumulative" columns to add up the elevation gain and the mileage from each of your legs.

Now, you have total mileage and total elevation gain for your trip. Plugging these two factors into the Naismith Rule, you can determine how long this trip will take.

The Naismith Rule for ***day hiking with a smaller day pack*** assumes that you can travel 3 miles in one hour on flat terrain. For every 1000 feet in elevation that you will gain, it adds half an hour to your travel time.

For the elevation gain….translate into K feet. Example: 1000 feet = 1K feet, 5500 feet = 5.5K feet. This is the only way your math will come out correctly in hours.

Naismith Rule for Hiking: $\frac{\text{total mileage}}{3} + \frac{\text{elevation gain in K feet}}{2} =$ Hours to compete trip

To apply the rule to ***backpacking with a full pack***, we assume you can travel 2 miles in one hour on flat terrain. For every 1000 feet in elevation that you will gain, it adds an hour to your travel time.

Backpacking Rule: $\frac{\text{total mileage}}{2} +$ elevation gain in K feet = Hours to compete trip

Now, it's unrealistic that you will hike continuously for the entire duration of your trip. You may have to pee, you will want to break for a snack or a meal, you will spend some time at the summit or the return point, etc. You can use the following rough estimates as add on times for these factors:

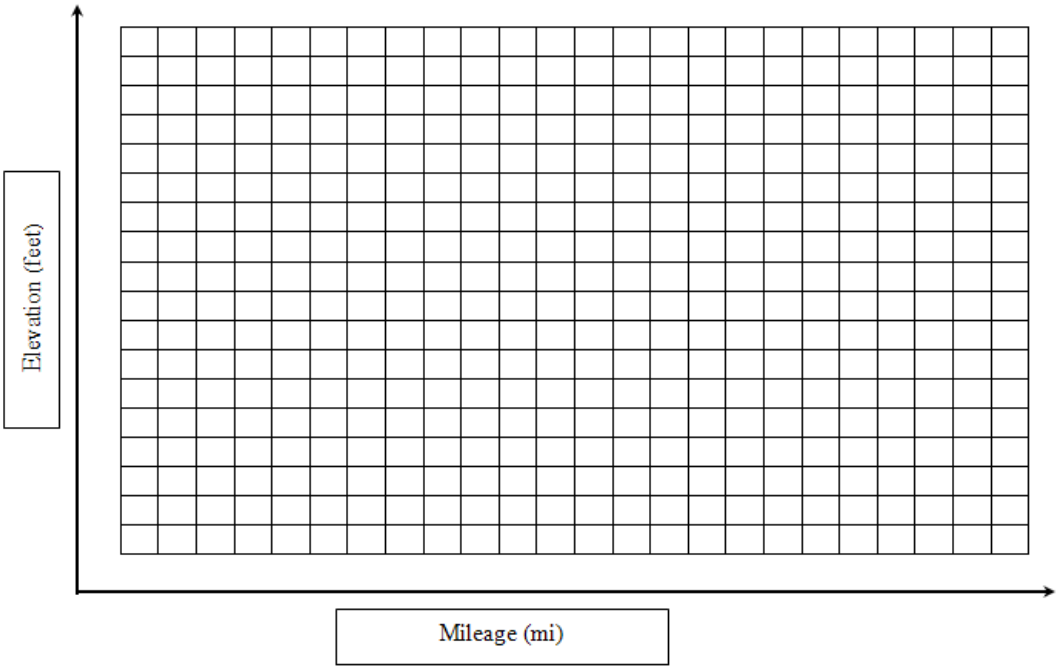
- 5 minutes of break time per hour of hiking for bathroom, rest and snack breaks
- 40 minutes for lunch
- 30 minutes of summit time for enjoying the view, pictures, signing the summit register

You also must account for additional time or delays caused by the nature of the terrain, the characteristics of the trail and the group you are traveling with. These are called "squiggle factors" and you can use the following rough estimates below to add on time for these:

- Add 1% of your total time for each additional person in your group
- 3-5 minutes for stream crossings
- 10 minutes for regrouping at trail junctions, crossings or forks

FINALLY, you've considered all the elements of your trip and you can feel confident in the travel time that you have allotted for this hike. Use this total travel time to estimate when you'll have to start in order to finish by sundown or reach a camping destination in time to still set up camp with light to spare. With your completed trip leg table, you're ready to use these elements to build a Trail Profile.

WHERE TO BEGIN: You will need a graph page with X and Y axis to represent Mileage (X axis) and Elevation in Feet (Y Axis). Use the total mileage as the limit for your X Axis and your highest point of elevation as the limit for your Y axis.



Using your trip leg table, you will determine where to plot each point using your Point Elevation (on the Y axis) and Cumulative Mileage (on the X axis).

(X, Y) = (Cum Mileage at Point, Elevation at Point)

Plot your points and connect the dots to see a profile of what your trip will look like. This is the rough cross section of your trail or route.

NAISMITHS RULE FOR QUICK ESTIMATES:

So let's say its Friday night and you managed to get a group together for a conditioning hike in the morning. You don't have time to do a full blown Trip Leg Table or Trail Profile. You just need the quick and dirty math to tell people when to arrive at the trailhead to start hiking so that you can be off the mountain by dusk.

You know the following:

- It's a day hike with day packs
- It's a total of 15 miles
- It s a total gain of 4000 feet
- You've got 20 people
- You have to cross a stream
- The sun sets at 6pm

Here's how your math will go:

1. First apply Naismith's rule for Hiking to the total miles and total gain:

15 miles + 4.0K feet gain = 7 hours
3 2

2. Next, apply your breaks and lunch:

   - 5 minutes (or .08 hours) of break for each hour of hiking = .08 hours X 7 = .56 hours
   - 45 minutes (or .72 hours) for lunch

7 hours + .56 hours (breaks) + .72 hours (lunch) = 8.28 hours

3. Now add some squiggle room for your group size and your stream crossing:

   - 5 minutes (.08 hours) for each of 20 people to cross the stream = .08 hours x 20 ppl = 1.6 hours
   - 1% of total time added for each of 20 people = 7 hours X .20 = 1.4 hours

8.28 hours + 1.6 hours (stream) + 1.4 hours (group size) = 11.28 hours TOTAL

4. What this tells you is that you will have to subtract 11.28 hours from the time of dusk to determine your start time. If the sun sets at 6pm, you will start your hike at about 6:45am in order to provide enough daylight to complete the trip. You then tell everyone to be at the trailhead at 6:15am (with time to tighten boots, apply sunscreen, adjust clothing layers, fiddle with pack straps) for a 6:45am departure.