



Measuring the Rate of Motion

“Cut and slash” refers to an inefficient and wasteful method of design in which the designer assembles components and builds machines without making the effort to perform a careful or considered analysis beforehand.

Deterministic design methods are a preferred way of going about the process of creating and inventing mechanisms. Deterministic design methods require mathematical analysis and experimentation, and they save time, effort and lessen the frustration of building mechanisms that under perform or do not work at all.

Engineers that employ deterministic design methods are often engaged in collecting data in order to assess and predict the performance of the machines they design and build. Deterministic design methods require the engineer to obtain data or determine sets of values. The speed at which mechanisms move is a good example of data that is useful in predicting the performance of machines. The rate at which components or assemblies move is an important engineering consideration.

**In this exercise we will consider the rate at which objects move.
We call this the speed of the object.**

Speed = Distance/Time

Expressed Algebraically the

$$S = \frac{d}{t}$$

equation looks like this



An Engineering Problem with Speed

An example of using deterministic methods and engineered estimates

It is necessary to walk from Downtown Plymouth Massachusetts to South Station in Boston. This is a distance of nearly 50 miles. The people making the trek need to know where they might stay overnight if they leave at 10AM on March 21st.

They are also concerned if they will be able to make the journey in 2 or 3 days, if they only walk during daylight hours?

Can you help them out by making an estimate of the following:

- How far they might travel the first day during daylight hours?
- How far they might travel the second day during daylight hours?
- Will they need to travel a third day, and if so, how long will they need to walk?

What do you do first?

Right! You do an experiment.

One experiment might require that the entire class walk at a leisurely pace, overland (up and down hills) for a measured distance of 1 mile. Time how long It takes each person to walk the distance.

Do you think it would be wise to take the fastest persons time, or the slowest person, or an average of all the times?

My gut feeling is to use the average of the slowest 25% of the walkers. My thinking is that the entire group will be limited to the pace of the slower walkers if they intend to stay together. I admit that this is only an opinion, you can do as you see fit. I only mention this because this typifies the types of engineering assumptions you will be required to make as you collect data in an effort to mathematically model performance.

Complete the exercise and advise the group on where to spend their night, or nights. To do this you will need an atlas of eastern Massachusetts, a scale and a perhaps a set of dividers.

I think your getting it. Engineers use every available resource they can acquire to obtain the information they need to solve a problem or make a prediction...and to solve it in the best way they can possibly devise.

Is there an exact answer to this problem?

Can you think of additional information you might want in order to make more accurate predictions?