harmeny

Actuarial Risk Management

How does it work?

Imagine you are applying for life insurance. You are asked a set of standard questions about your health (are you a smoker?), your occupation (do you work with asbestos or caustic chemicals?), your life-style (do you engage in extreme sports?) and family traits (is there a history of diabetes in the family?). Your answers to these questions are used to assign you to a risk group, with a profile similar to yours. For each risk group there are statistics representing your probability of survival to a certain age—and these statistics are used to define your insurance rates. People more likely to die young pay more for insurance than people whose profile suggests they will live a long time.

Exactly the same logic can be used to determine whether or not trees in a plantation will meet different performance targets (such as free growing targets) given: differences in genetics, nursery cultural regimes, silviculture practices, and the site and stand conditions in which people are operating in. The environment (for both humans and trees) is extremely complex—and thus we can never explicitly account for all of the variables that affect the life of a person, or a tree. The actuarial approach deals with such irreducible complexity by representing situations in terms of probabilities or likelihoods. It is more likely that if you keep smoking your life expectancy will be shorter. But there will be a few smokers who live to a ripe old age. We are interested in the probability of success relative to the costs and benefits of obtaining it. From this, we can determine appropriate expectations for performance standards. If you were to quit smoking today—how many more years would you be likely to enjoy? If we plant a bigger tree in the site—within what time period is it likely to reach the free growing target?

The "actuarial approach" balances risk, cost, and benefits with respect to performance. Performance is measured in terms of the degree to which the desired balance is produced.

Risk measures the potential for regret should our management actions not lead to desired outcomes.

Cost measures the investments we are willing to make to reduce the potential for regret, and realize potential benefits.

Benefit measures the potential to produce desired results.

Standards: the usual approach has been to set standards *a priori* without adequate information, and then worry about how to achieve the standards later. The actuary approach puts the establishment of standards on a more scientific basis, by using data that describes actual outcomes under different scenarios, and allows one to define the range of initial conditions (such as stock size, for example) that produces consistently acceptable results.

Thresholds: we reach a threshold when a small change in circumstances can produce an inordinately large effect—the inflection or tipping point. One example is vegetation competition thresholds. The actuarial approach provides an objective method to identifying such inflection points, so one can fine-tune management actions to those circumstances in which they are likely to produce measurable benefits.

The Actuarial System helps you define: what is the performance target (i.e. set expectations), what risk am I willing to accept in reaching those targets (i.e. assess uncertainties), and what costs am I willing to bear to reduce risk (i.e. assess cost of investments towards success, versus cost of failure).

This is the essence of adaptive management. While the actuarial system is a simple framework—its basic ideas of balancing performance, risk, and cost underpin all of the systems and software we develop.

Complex environments are about uncertainty. One uses information to reduce that uncertainty. Then one needs to make a decision and act. It is at that point, where information becomes the basis for action, that forest biology becomes forest management.