Take Home Test

October 26

2012

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Question 1

Chaos Theory: A modern development in mathematics and science that provides a framework for understanding irregular or erratic fluctuations in nature.

For example, Dr. Alan Hastings and his doctoral student, Kevin Higgins, used the mathematics of chaos theory to understand Dungeness crab population changes. They used a simplified computer model to study patterns of population change over 10 000 years. Contrary to their expectations, the population did not settle on any equilibrium value. This means yearly variations in Dungeness crabs may be due to chaotic forces within the population, rather than previously suspected external forces, such as environmental changes. This result also shows variability is the norm in some populations, not the exception.

Predator-prey populations tend to show chaotic behaviour within limits, where the sizes of populations change in a way that may appear random, but is in fact obeying deterministic laws based only on the relationship between a population and its food source illustrated by the Lotka–Volterra equation.

Chaotic systems all share one characteristic - they are extremely sensitive to initial conditions and therefore, the final results are unpredictable. Edward Lorenz, a meteorologist working at MIT in the 1960s was one of the first to recognize this characteristic while playing with a simplified weather computer model. He designed this toy weather' model hoping to find recognizable patterns that would eventually lead to long-term weather forecasting.

One day, wanting to review some intermediate results but not wanting to start all over, he stopped the program, input the intermediate numbers from the printout, and restarted it. Soon the computer showed radically different weather than it had previously. Lorenz knew the only difference had been that the printout produced numbers with three decimal places whereas the program normally calculated with six decimal place precision.

Newtonian physical laws would predict that such small differences would produce only small final variations. However, Newtonian laws apply to linear systems. From his unusual results, Lorenz hypothesized that weather was a nonlinear, chaotic system. Through further work, he confirmed this hypothesis and found that, in chaotic systems, tiny initial differences become magnified over time to produce dramatically different final results.

Lorenz once explained his work on chaotic systems in terms of the effect of a butterfly flapping its wings in Brazil. The butterfly could alter local wind patterns and as these changes
became magnified over time and space, they could play a role in the formation of a tornado in Texas. This explanation led to the popular term, the "Butterfly Effect," to describe the behaviour of chaotic systems. Such conclusions forced Lorenz to abandon his dream of long-term weather forecasting and his results remain true today - weather predictions are rarely good for much longer than a week.

Landscape architecture and landscape ecology are fundamentally concerned with the connections between landscape pattern and ecological process. Landscape ecologists typically assume that process creates pattern; landscape architects address pattern with the hope that process will follow. There is a relationship between pattern and process is a fundamental premise of landscape ecology. Some of the theoretical advances in ecology that affect the pattern/process relationship and scale dependence and some of the methods used to determine pattern at various scales include: sensitivity to initial conditions, contingency and chaos theory.

Chaos theory remains as a useful model to ecologists and other scientists. Their study, using chaos as a model, showed the unpredictable nature of population changes and will have an impact on resource management in the future (Population Ecology/Community Ecology).

Chaos theory has also given us fractal geometry, the visual representation of chaos theory. Fractals give the world a language and an explanation for the exquisite forms found in Nature. Chaos theory and fractal geometry have squarely turned mathematics around to face the problems and the beauty of the real world.
**Question 3**

These companies are among the largest and most powerful enterprises on the planet. The complexity of their organization and activities, the vastness of their reach, and the huge number of variables involved make objective ranking difficult. These Companies include ExxonMobil, ConocoPhillips, Royal Dutch Shell, Chevron, Valero Energy Corporation, Citgo and at the top rankings BP and Sunoco.

BP, the second-largest integrated oil company worldwide, is known for its large holdings in Alaska. BP lost all its environmental credibility when its Deepwater Horizon rig exploded in April 2010, precipitating the BP oil disaster in the Gulf of Mexico. The Gulf oil spill had hit the reputation not only of BP but of the entire oil industry, including among those who favour increased use of fossil fuels as the main source of energy. While the oil spill was unique to BP, it has caused consumers to question whether a similar incident could happen to other companies.

BP’s oil refinery in Texas City has been labelled one of the worst polluting plants in the United States. A March 2005 explosion at the facility killed 15 workers and injured more than 100 others. Following the explosion, the Occupational Safety and Health Administration found 300 safety and health violations at the refinery.

When an oil slick from a large oil spill reaches the beach, the oil coats and clings to every rock and grain of sand. If the oil washes into coastal marshes, mangrove forests or other wetlands, fibrous plants and grasses absorb the oil, which can damage the plants and make the whole area unsuitable as wildlife habitat. During oil spills, the process of photosynthesis which enhances plant diversity is impaired since the process is reduced due to the fact that spilled crude has a high absorbance property so when the crude spreads on to the surface of leaves, the latter find it difficult to photosynthesize and thus die, leading to biodiversity loss.

When some of the oil eventually stops floating on the surface of the water and begins to sink into the marine environment, it can have the same kind of damaging effects on fragile underwater ecosystems, killing or contaminating many fish and smaller organisms that are essential links in the global food chain.

Oil spills often take a deadly toll on fish, shellfish and other marine life, particularly if large numbers of fish eggs or larvae are exposed to the oil. The shrimp and oyster fisheries along the Louisiana coast were among the first casualties of the 2010 BP Deepwater Horizon
offshore oil spill. Similarly, the Exxon Valdez oil spill destroyed billions of salmon and herring eggs. Those fisheries still have not recovered.

Oil-covered birds are practically a universal symbol of the environmental damage wreaked by oil spills. Any oil spill in the ocean is a death sentence for sea birds. Some species of shore birds may escape by relocating if they sense the danger in time, but sea birds that swim and dive for their food are sure to be covered in oil. Oil spills also damage nesting grounds, which can have serious long-term effects on entire species. The 2010 BP Deepwater Horizon offshore oil spill in the Gulf of Mexico, for example, occurred during prime mating and nesting season for many bird and marine species, and the long-term environmental consequences of that spill won't be known for many years. Oil spills can even disrupt migratory patterns by contaminating areas where migrating birds normally stop.

The long-term damage to various species, and to the habitat and nesting or breeding grounds those species depend upon for their survival, is one of the most far-reaching environmental effects caused by oil spills. Even many species that spend most of their lives at sea—such as various species of sea turtles—must come ashore to nest. Sea turtles can be harmed by oil they encounter in the water or on the beach where they lay their eggs, the eggs can be damaged by the oil and fail to develop properly.

Ultimately, the severity of environmental damages caused by a particular oil spill depends on many factors, including the amount of the oil spilled, the type and weight of the oil, the location of the spill, the species of wildlife in the area, the timing or breeding cycles and seasonal migrations, and even the weather at sea during and immediately after the oil spill. But one thing never varies: oil spills are always bad news for the environment.
Question 4

Tourism is arguably the fastest growing industry in the world and is estimated that this trend will continue. The continued increase of the tourism industry has prompted discussion of adverse impacts on the natural environment. Visitor’s impacts include air pollution and congestion, overburdened infrastructure, disturbance of wildlife, visitor crowding and erosion. Areas freely open to public access are particularly susceptible to pressure.

Economic Pros and Cons

Tourism increases employment opportunities. Additional jobs, ranging from low-wage entry-level to high-paying professional positions in management and technical fields, generate income and raise standards of living. Particularly in rural areas, the diversification created by tourism helps communities that are possibly dependent on only one industry. As tourism grows, additional opportunities are created for investment, development, and infrastructure spending. Tourism often induces improvements in public utilities such as water, sewer, sidewalks, lighting, parking, public restrooms, litter control, and landscaping. Such improvements benefit tourists and residents alike. Likewise, tourism encourages improvements in transport infrastructure resulting in upgraded roads, airports, public transportation, and non-traditional transportation (e.g., trails). Tourism encourages new elements to join the retail mix, increasing opportunities for shopping and adding healthy competitiveness.

Tourism businesses may claim land that could have higher-value or other uses. Additionally, non-local owners and corporations may export profits out of the community. The community may have to generate funds (possibly through increased taxes) to maintain roads and transportation systems that have become more heavily used. Similarly, if additional infrastructure (water, sewer, power, fuel, medical, etc.) is required, additional taxes may also be needed to pay for them.

Environmental Pros and Cons

Areas with high-value natural resources, like oceans, lakes, waterfalls, mountains, unique flora and fauna, and great scenic beauty attract tourists and new residents (immigrants) who seek emotional and spiritual connections with nature. Because these people value nature, selected natural environments are preserved, protected, and kept from further ecological decline. Lands that could be developed can generate income by accommodating the
recreational activities of visitors. Tourist income often makes it possible to preserve and restore sites of indigenous fauna and flora.

Tourism can also degrade an environment. Visitors generate waste and pollution (air, water, solid waste, noise, and visual). Natural resource attractions can be jeopardized through improper uses or overuse. Providing tourist services can alter the landscape's appearance. For instance, visual pollution may occur from billboard proliferation. As tourism develops, demand for land increases, especially for prime locations like beachfronts, special views, and mountains. Without forethought, natural landscape and open space can be lost. The destruction or loss of flora and fauna can happen when desirable plants and animals are collected for sale or the land is trampled. Tourists or the businesses that cater to them often remove plants, animals, rocks, fossils, coral, and cultural or historical artefacts from an area. Uncontrolled visitation or overuse by visitors can degrade landscapes, historic sites, and monuments. Where water is scarce, tourists can overwhelm the available supply. Travellers can also inadvertently introduce nonindigenous species, as can increases in the trade of animals and plants. A constant stream of visitors and domestic pets may disrupt wildlife by disturbing their breeding cycles and altering natural behaviours. Many of the most sought-after environments for tourism are also the most fragile. Extra effort to plan appropriate access and use of fragile environments helps insure their long-term viability and continued attractiveness for tourism.