1 Course Information

2 Examples of Applications

3 Introduction to Markov Chains
Teachers

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Should be available at the KTH Bookshop

The following material is sold at the math student office, Lindstedtsvägen 25.


Further material will be posted on the homepage.
On the course homepage
http://www.math.kth.se/optsyst/grundutbildning/kurser/SF2863/
you can find

1. a preliminary schedule
2. reading instructions, recommended exercises etc.
3. home assignments, rules and information about deadlines
4. these slides
There will be two voluntary home assignments.

- HA 1: Markov chain/process example - the ferry (2 bonus points)
- HA 2: Spare parts optimization (4 bonus points)
The maximal result on the exam (not counting bonus points) is 50 points.

Preliminary grade limits:

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<tr>
<th>Grade</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
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- At the exam a brief formula sheet will be handed out. No other tools, such as calculators, are allowed.
- The first written exam is January 13, 2014, at 14.00-19.00.
- It is necessary to sign up for the exam, and it can be done on “My pages”, Nov. 25 - Dec. 8.
Course in Systems Engineering with Introduction to Markov Chain/Process theory.

“We use statistics, probability theory and differential/difference equations to build mathematical models for processes, combine them to complex systems, analyze them and optimize to find the best control/management policy.”
Markov chains/processes
Queueing theory
Spare parts optimization
Marginal Allocation
Deterministic/Stochastic Inventory theory
Dynamic Programming
Markov Decision Processes
Spare Parts Optimization

How many spareparts of each type should be held, in which location, and where should they be repaired?
Newsboy Problem

How many newspapers should the salesman buy each day?
Marginal Allocation Problem

Where should you use redundancy to get the best reliability? (relative to the weight)
What is the expected time waiting in a queue?
Markov Chain

Example with two states, 'E' and 'A'.
Examples

Markov Chains with state $X_t$ where $t = 0, 1, 2, \ldots$

- $X_t =$ wind condition \{1 = Calm, 2 = breeze, 3 = storm, \} at a particular place on day $t$.
- $X_t =$ number of items in stock of a particular item on day $t$.
- $X_t =$ accumulated sum of points after $t$ rolls of a die.
- $X_t =$ number of rabbits living on Gärdet at time $t$.
- $X_t =$ number of complaint phone calls to the help desk at day $t$.
- $X_t =$ condition of patient \{1 = stable, 2 = manic, 3 = depressive\} on day $t$. 
Some useful results from probability theory

The **conditional probability** of $A$ given $B$ is defined by

$$P(A|B) = \frac{P(A \cap B)}{P(B)}$$

**Law of total probability**

If $B_n$ form a partition of the sample space, i.e., the $B_n$ are disjoint and the union is the whole sample space, then

$$Pr(A) = \sum_n Pr(A|B_n)Pr(B_n)$$

In particular, if $X$ and $Y$ are discrete valued stochastic variables, then

$$Pr(X = x) = \sum_y Pr(X = x|Y = y)Pr(Y = y)$$