

SF2863 Systems Engineering, 7.5 HP

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Optimization and Systems Theory
Department of Mathematics
KTH Royal Institute of Technology

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- 1 Course Information
- 2 Examples of Applications
- 3 Introduction to Markov Chains

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- Main Literature: “Introduction to operations research”, Ninth edition, by Hillier and Lieberman.

Should be available at the KTH Bookshop

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

- Exercises in SF2863 Systems Engineering, 2011.

Further material will be posted on the homepage.

On the course homepage

<http://www.math.kth.se/optsys/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)

For full credits, both a written and possibly an oral presentation have to be performed. Attendance on the exercise sessions on 6/11 and 29/11 is therefore required.

The maximal result on the exam (not counting bonus points) is 50 points.

Preliminary grade limits:

Grade	A	B	C	D	E	FX
Points	43-50	38-42	33-37	28-32	25-27	23-24

- At the exam a brief formula sheet will be handed out. No other tools, such as calculators, are allowed.
- The first written exam is December 12, at 14.00-19.00.
- It is necessary to sign up for the exam, and it can be done on “My pages”.

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.”

- 1 Markov chains/processes
- 2 Queueing theory
- 3 Spare parts optimization
- 4 Marginal Allocation
- 5 Deterministic/Stochastic Inventory theory
- 6 Dynamic Programming
- 7 Markov Decision Processes

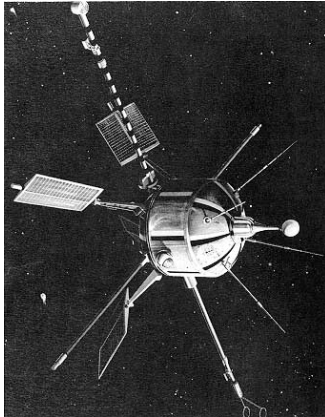
The diagram illustrates the state space S for a fleet of four fighters. It includes a 'Fleet' of four fighters, a 'Repair shop' building, and three states: s_1 (4 red blocks), s_2 (7 green blocks), and s_0 (3 fighters with green/red indicators).

How many newspapers should the salesman buy each day ?



Marginal Allocation Problem

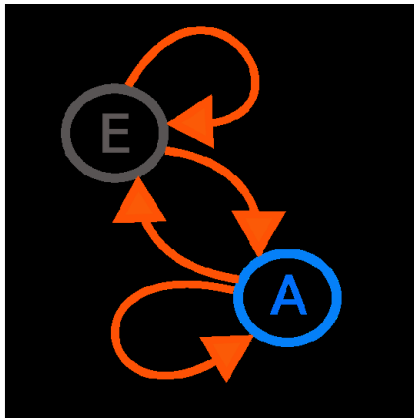
Where should you use redundancy to get the best reliability ?
(relative to the weight)



What is the expected time waiting in a queue?



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



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

- X_t = wind condition $\{1 = \text{Calm}, 2 = \text{breeze}, 3 = \text{storm}, \}$ 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 $\{1 = \text{stable}, 2 = \text{manic}, 3 = \text{depressive}\}$ on day t .