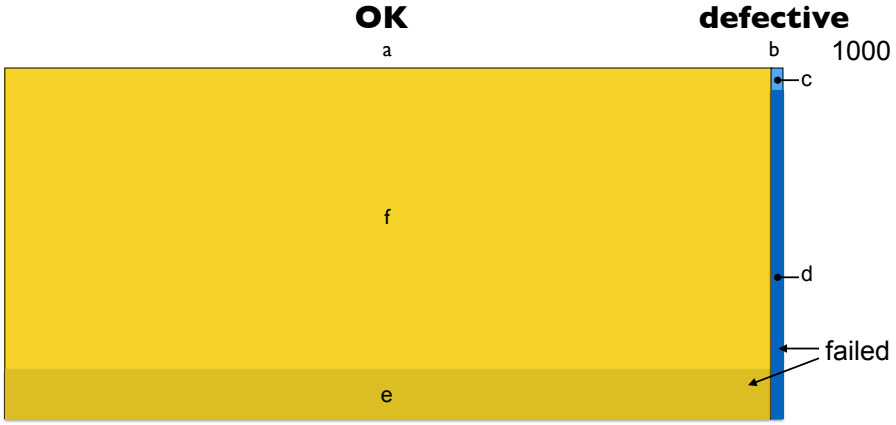
Optimisation and Statistical Data Analysis
Exercise Set 8 (Categorical distribution)

Problem 1

3% of the bottles produced in a factory are defective. Before the bottles are shipped, an inspector grades them "pass" or "fail". The inspector fails 90% of bottles that are defective and fails 20% of bottles that are ok.

(a) Use a frequency diagram for 1000 bottles to determine the probability that a failed bottle is defective and the probability that a passed bottle is defective.

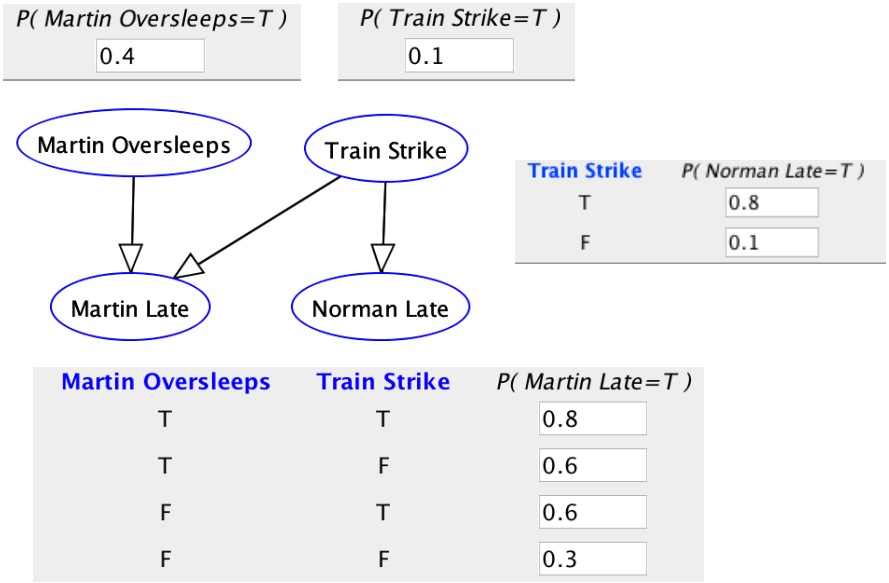


(b) Use Bayes' formula to find the probabilities in (a).

(c) Suppose that a bottle is shipped if and only if it is passed by two independent inspectors. Using the answer from (b), find the probability that a shipped bottle is defective

Problem 2

Build the following belief network using the *Belief and decision network tool* from `aispace.org/downloads.shtml/`



(a) You observe that Martin is late today. Which is the more probable cause of Martin's lateness, oversleeping or train strike?

(b) You discover that Norman is also late. Now which is the most probable cause of Martin's lateness?

(c) What is the probability that both Martin and Norman are late?

Extra problems

(a) Solve problem 1 using the *Belief and decision network tool*.

(b) Solve problem 2 using Bayes' formula.

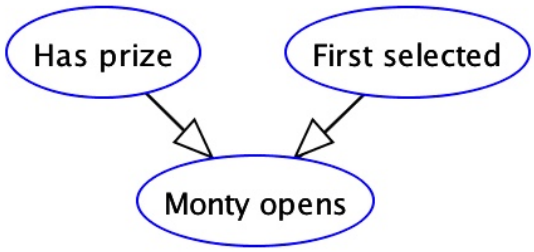
(c) Solve the Monty Hall problem (i.e. show that it is better to switch than not to switch) using a belief network with three nodes:

First selected: the door is first selected by the contestant;

Monty opens: the door is then opened by Monty Hall;

Has prize: the door has the prize.

Every node has three states: *door #1*, *door #2*, *door #3*.



Answers 1. (a) 12.22%, 0.39% (c) 0.05%
2. (a) oversleeping (b) train strike (c) 9.22%