

## 620.370 Statistics for Mechanical Engineers — Semester 2, 2009

### Homework set 1

Problems to be discussed at next week's tutorial: Quiz1; 6, 7, 8, 11.

#### Homework questions

*The first five questions are multiple-choice questions, for each of which exactly one of the proposed alternative answers should be selected.*

- 1.1 If  $\Pr(F) = 0.5$ ,  $\Pr(F \cup G) = 0.7$  and  $F$  and  $G$  are independent, then  $\Pr(G)$  is equal to:  
[A.] 0.2; [B.] 0.3; [C.] 0.4; [D.] 0.5; [E.] 0.6.
- 1.2 If  $\Pr(F) = 0.2$ ,  $\Pr(G) = 0.3$  and  $\Pr(H) = 0.4$  and the events are independent, then the probability that at least one occurs is equal to:  
[A.] 0.36; [B.] 0.90; [C.] 0.50; [D.] 0.98; [E.] 0.66 .
- 1.3 If  $\Pr(F) = \Pr(G) = \Pr(H) = \frac{1}{3}$  and  $F$ ,  $G$  and  $H$  are independent, then the probability that exactly one of the events  $F$ ,  $G$  and  $H$  occurs is equal to:  
[A.]  $\frac{1}{9}$ ; [B.]  $\frac{1}{3}$ ; [C.]  $\frac{4}{9}$ ; [D.]  $\frac{19}{27}$ ; [E.]  $\frac{26}{27}$ .
- 1.4 If  $\Pr(F|G) = \Pr(G|F) > 0$ , then the events  $F$  and  $G$  are  
[A.] exhaustive; [B.] equiprobable; [C.] independent;  
[D.] mutually exclusive; [E.] positively related.
- 1.5 A testing device which tests items coming off a production line signals a fault with probability 0.99 when there is a fault present, but it also signals a fault with probability 0.01 when there is no fault present. If about 2% of items are faulty, the percentage of items signalled as faulty that are actually faulty is equal to:  
[A.] 3%; [B.] 33%; [C.] 50%; [D.] 67%; [E.] 98%.
- 1.6 Items from a production line are classified as having no fault, having a minor fault or having a major fault. On average, 90% have no fault, 9% have a minor fault and 1% have a major fault.  
A fault detector is to be trialled. The probability that it signals a fault is 0.01 for items with no fault; 0.7 for items with a minor fault; and 0.99 for items with a major fault.
- For what proportion of items is a fault signalled?
  - Of those items for which a fault is signalled, what proportion have a major fault? a minor fault? no fault?

### Quiz 1

Q1.1  $F$  and  $G$  are events such that  $\Pr(F) = 0.3$ ,  $\Pr(G) = 0.6$ ,  $\Pr(F \cap G') = 0.1$ .  
 $\Pr(F | G')$  is equal to:

- [A.]  $\frac{1}{3}$ ; [B.]  $\frac{1}{4}$ ; [C.]  $\frac{1}{5}$ ; [D.]  $\frac{1}{6}$ ; [E.]  $\frac{1}{7}$ .

*The following two questions refer to the information below:*

In a bolt factory, machines  $X$ ,  $Y$  and  $Z$  produce 20%, 30% and 50% of the total output respectively. Of their outputs, 5%, 4% and 2% respectively are defective.

Q1.2 The percentage of defective bolts produced at the factory is equal to:

- [A.] 3.20%; [B.] 3.33%; [C.] 3.50%; [D.] 3.67%; [E.] 3.80%.

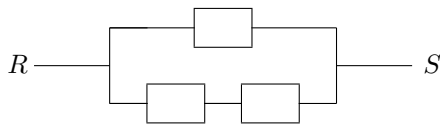
Q1.3 A bolt, chosen at random from a days production is found to be defective.  
The probability that it was produced by machine  $X$  is equal to:

- [A.] 0.20; [B.] 0.25; [C.] 0.31; [D.] 0.33; [E.] 0.45.

Q1.4 Two fair dice are rolled. The conditional probability that one is a six, given that the two results are different, is equal to:

- [A.]  $\frac{1}{12}$ ; [B.]  $\frac{1}{6}$ ; [C.]  $\frac{2}{9}$ ; [D.]  $\frac{5}{18}$ ; [E.]  $\frac{1}{3}$ .

Q1.5 In the diagram below, the switches are usually open and, in an emergency, close independently with probability  $p$ . In an emergency, what is the probability that  $R$  and  $S$  are connected?



- [A.]  $2p^2 - p^3$ ; [B.]  $p + p^2$ ; [C.]  $p^3$ ; [D.]  $p + p^2 - p^3$ ; [E.]  $3p$ .