1. My son’s favorite board game is called “Going on a Bear Hunt” and is played with a spinner. The three sections of the spinner are colored yellow, red and blue. The yellow section is marked with the number ‘1’, the red section with the number ‘2’, and the blue section with the number ‘3’. When spun, the pointer has equal chance of landing on each of the three sections.

The first three spots on the board, not including the starting spot, are red, yellow and blue (in that order). (After these three come many more spots of all the colors.) If you arrive on the blue spot, you take a card which determines what you do next.

(a) When using the spinner, are color and number independent?

(b) What is the chance of arriving at the first blue spot in exactly two spins?

(c) If I’m playing the game with my two kids, what’s the chance that all three of us will miss landing on the first blue spot?
2. A family has four children. Assuming that each child is a boy or a girl with equal chance, which of the following two breakdowns are more likely?

(a) 2 boys and 2 girls
(b) 3 of one sex, and one of the other
3. Draws are being made at random with replacement from a box. The number of draws is getting larger and larger. Say whether each of the following statements is true or false, and explain. (“Converges” means “gets closer and closer”.)

(a) The probability histogram for the sum of the draws (when put in standard units) converges to the normal curve.

(b) The histogram for the numbers in the box (when put in standard units) converges to the normal curve.

(c) The histogram for the numbers drawn (when put in standard units) converges to the normal curve.

(d) The probability histogram for the product of draws (when put in standard units) converges to the normal curve.

(e) The histogram for the numbers drawn converges to the histogram for the numbers in the box.

[TURN OVER]
4. You might sell insurance to a 21 year old friend. The probability that a man aged 21 will die in the next year is about 0.0015. You decide to charge $200 for a policy that will pay $100,000 if your friend dies.

(a) What is your expected profit?

(b) Although you expect to make a profit, you would be foolish to sell your friend this policy. Why?

(c) An insurance company sells 100,000 such policies. They expect to make $_________ plus or minus $_________.

(d) What is the chance that the insurance company makes less than $3 million? Greater than $6 million?

(e) The CEO’s bonus is based on the company making more than $6 million each year for a trailing 3-year period. What’s the chance of the CEO not getting a bonus if the company sells 100,000 policies each year?
5. Read the news report “Daily Sweets ’linked to violence’ ” printed at the end of this exam paper.

(a) Was this a controlled experiment or an observational study? Explain briefly.

(b) List three confounding factors that were considered.

(c) The article states that the link between confectionery consumption and aggression “remained, even after for controlling for other factors such as parenting behavior....”. What does “controlling for” mean in this context?

(d) The report says that the researchers looked at data on 17,500 people, and that 69% of the participants who were violent at the age of 34 had eaten sweets and chocolate nearly every day during childhood, compared to 42% who were non-violent. How many people in the study were classed as violent?

(e) Does eating sweets daily as a child cause delinquency in adults? Explain briefly.
Children who eat sweets and chocolate every day are more likely to be violent as adults, according to UK researchers.

The Cardiff University study involving 17,500 people is the first into effects of childhood diet on adult violence.

It found 10-year-olds who ate sweets daily were significantly more likely to have a violence conviction by age 34.

Researchers suggested they had not learnt to delay gratification, but other experts said already "difficult" children might be given more sweets.

The researchers looked at data on around 17,500 people and found that 69% of the participants who were violent at the age of 34 had eaten sweets and chocolate nearly every day during childhood, compared to 42% who were non-violent.

Delinquents

This link between conveyerbelt consumption and later aggression remained even after controlling for other factors such as parenting behaviour, the area where the child lived, not having educational qualifications after the age of 16 and whether they had access to a car when they were 34.

The researchers put forward several explanations for the link including the idea that the confectionery makes the adult addicted to certain additives and that these may contribute towards adult aggression.

The study was reported in the British Journal of Psychiatry.

Stunted learning

Dr Simon Moore, who led the study, has carried out previous research on young offenders.

He was aware that they tend to have very poor diets including lots of confectionery - but was intrigued to find the link.

He said: "Our favoured explanation is that giving children sweets and chocolate regularly may stop them learning how to wait to obtain something they want.

"Not being able to defer gratification may push them towards more impulsive behaviour, which is strongly associated with delinquency.

"Targeting resources at improving children's diet may improve health and reduce aggression."

Professor Alan Maryon-Davis, president of the UK Faculty of Public Health, said: "Another explanation is that children who are already