

Topic assessment

1. Sweets called “Scruffies” are sold in packets of 18.

Scruffies come in a variety of colours, and market research shows that red is the most popular. Scruffies are packed randomly, and on average 25% are red.

- (i) Find the probability that a packet contains no more than 6 red Scruffies. [2]
- (ii) Find the probability that a packet contains exactly 4 red Scruffies. [2]

Because of a fault in the packing machine, one packet in ten now contains 19 Scruffies instead of 18.

- (iii) Find the new probability that a randomly selected packet contains exactly 4 red Scruffies. [5]

In order to increase sales, the manufacturer claims to have increased the proportion of red Scruffies. Eric decides to test the manufacturer’s claim by purchasing a packet of Scruffies. (Assume that all packets now contain 18 Scruffies.)

- (iv) The packet contains 8 red Scruffies. Does this support the manufacturer’s claim at the 5% significance level? Write down your hypotheses clearly and show your working in full. [6]

2. In a national survey, it was found that 40% of young people failed a standard fitness test.

A random sample of 30 young people is taken.

- (i) Explain why, for such random samples, the mean number of those who failed the fitness test is 12. [1]
- (ii) Find the probability of the mean number occurring. Explain how you would check whether the mean is also the modal value. *No further calculations are necessary.* [4]

A local health authority wishes to investigate whether or not the proportion of young people in its area who failed the fitness test is 40%. A random sample of 20 young people contains 12 who failed the test.

- (iii) Carry out a suitable hypothesis test at the 5% significance level, stating your hypothesis and conclusions carefully. Find the critical region for the test. [10]

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3. *Joggers* produce packets of crisps. On average, 1 in every 5 packets, chosen randomly, contains a prize voucher.

A box contains 30 packets of *Joggers* crisps.

- (i) State the expected number of packets containing a prize voucher and find the probability of exactly this number occurring. [4]
- (ii) Show that it is almost certain that at least one packet will contain a voucher. [2]

Sprinters also produce packets of crisps, some of which contain a prize voucher. Jean wishes to test whether the proportion of packets of *Sprinters* crisps with prize vouchers is also $\frac{1}{5}$.

- (iii) State suitable null and alternative hypotheses for the test. [2]

Jean buys 12 packets of *Sprinters* crisps and finds no vouchers at all.

- (iv) Carry out the hypothesis test at the 5% significance level, giving the critical region for the test and stating your conclusions carefully. [5]
 - (v) How many packets of crisps would Jean have to buy for the critical region to have a non-empty lower tail? [2]
4. A police road-safety team examines the tyres of a large number of commercial vehicles. They find that 17% of lorries and 20% of vans have defective tyres.
- (i) Six lorries are stopped at random by the road-safety team. Find the probability that
 - (A) none of the lorries have defective tyres, [2]
 - (B) exactly two lorries have defective tyres. [3]

Following a road-safety campaign to reduce the proportion of vehicles with defective tyres, 18 vans are stopped at random and their tyres are inspected. Just one of the vans has defective tyres.

You are to carry out a suitable hypothesis test to examine whether the campaign appears to have been successful.

- (ii) State your hypotheses clearly, justifying the form of the alternative hypothesis. [3]
- (iii) Carry out the test at the 5% significance level, stating your conclusions clearly. [3]
- (iv) State, with a reason, the critical value for the test. [2]
- (v) Give a level of significance such that you would come to the opposite conclusion for your test. Explain your reasoning. [2]

Total 60 marks