# Section 1: Using the normal distribution

## Section test

1. A spelling test administered to a large number of 10-year-old children has a mean score of 14.3 (out of 20). A researcher is investigating whether a new approach to teaching spelling has any effect on the results of the test. She carries out a hypothesis test. The hypotheses she should use (where $\mu$ is the population mean score) are

   (a) $H_0$: $\mu = 14.3$ $H_1$: $\mu > 14.3$
   (b) $H_0$: $\mu = 14.3$ $H_1$: $\mu \neq 14.3$
   (c) $H_0$: $\mu = 14.3$ $H_1$: $\mu < 14.3$
   (d) $H_0$: $\mu > 14.3$ $H_1$: $\mu < 14.3$

2. A random sample of size 16 is taken from a Normal distribution with known standard deviation 7.8.
   A hypothesis test is carried out at the 5% level.
   The hypotheses are as follows:
   $H_0 : \mu = 120$
   $H_1 : \mu > 120$
   where $\mu$ is the true population mean.
   The sample mean is 123.5.
   What is the $p$-value and what is the conclusion?

3. A random sample of size 12 is taken from a Normal distribution with known standard deviation 4.4.
   A hypothesis test is carried out at the 2% level.
   The hypotheses are as follows:
   $H_0 : \mu = 51$
   $H_1 : \mu \neq 51$
   where $\mu$ is the true population mean.
   The sample mean is 48.2.
   What is the critical region and what is the conclusion?

4. A random sample of size 50 is taken from a Normal distribution with known standard deviation 25.8.
   A hypothesis test is carried out at the 3% level.
   The hypotheses are as follows:
   $H_0 : \mu = 800$
   $H_1 : \mu < 800$
   where $\mu$ is the true population mean.
   The sample mean is 793.5.
   What is the $p$-value and what is the conclusion?

5. An intelligence test was designed to have a mean score of 100 and standard deviation of 15. A researcher put forward a theory that people are becoming more intelligent (as measured by this particular test). A random sample of 120 people were selected and given the test. The following is a summary of the results:

   $n = 120 \qquad \sum_{i=1}^{n} X_i = 12420$

Assume that the test scores are Normally distributed and that the population standard deviation is 15.
A hypothesis test is carried out at the 5% level.
Find the sample mean.
What is the critical region?
What is the conclusion of the test?

# Edexcel A level Hypothesis testing 1 section test solns

## Solutions to section test

1) The null hypothesis is that the mean score stays the same, i.e. $H_0$: $\mu = 14.3$
The researcher is looking for a change in either direction, so the alternative hypothesis is given by $H_1$: $\mu \neq 14.3$.

2) $H_0: \mu = 120$
$H_1: \mu > 120$
where $\mu$ is the true population mean.
$\bar{X} \sim N\left(120, \frac{7.8}{\sqrt{16}}\right)$
$P(\bar{X} > 123.5) = 0.036$
$0.036 < 0.05$, so reject $H_0$.

3) $H_0: \mu = 51$
$H_1: \mu \neq 51$
where $\mu$ is the true population mean.
$\bar{X} \sim N\left(51, \frac{4.4}{\sqrt{12}}\right)$
Using a calculator, the inverse normal of 0.01 is 48.05
The critical region is $\bar{X} < 48.05$
48.2 is not in the critical region, so accept $H_0$.

4) $H_0: \mu = 800$
$H_1: \mu < 800$
where $\mu$ is the true population mean.
$\bar{X} \sim N\left(800, \frac{25.8}{\sqrt{50}}\right)$
$P(\bar{X} < 793.5) = 0.037$
$0.037 > 0.03$, so accept $H_0$.

5) $H_0: \mu = 100$
$H_1: \mu > 100$
where $\mu$ is the true population mean test score.
$\bar{x} = \frac{12420}{120} = 103.5$
$\bar{X} \sim N\left(100, \frac{17.2^2}{120}\right)$
From calculator inverse normal of 0.95 is 102.6
Critical region is $\bar{X} > 102.6$

Since 103.5 is in the critical region, reject $H_0$. The evidence suggests that people are scoring more highly on this particular test.