

5.8 Sampling Distributions for Differences in Sample Means

Name: _____ Class: _____ Date: _____

Total: 9 marks

Objective

Build the skills to answer exam questions on **the sampling distribution of a difference in sample means**.

You must be able to:

- use the mean $\mu_{\bar{x}_1 - \bar{x}_2} = \mu_1 - \mu_2$
- use the standard deviation $\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$

1 Worked examples

Study these first. Each one shows the method for a question type used later.

■ Difference in means

To compare two group means, use $\bar{x}_1 - \bar{x}_2$:

$$\mu_{\bar{x}_1 - \bar{x}_2} = \mu_1 - \mu_2, \quad \sigma = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}.$$

Again the two **variances** add under the square root.

■ Example

$$\sigma_1 = 6, n_1 = 36, \sigma_2 = 8, n_2 = 64: \sigma = \sqrt{\frac{36}{36} + \frac{64}{64}} = \sqrt{2} \approx 1.41.$$

2 Practice

2.1 Write the mean of the sampling distribution of $\bar{x}_1 - \bar{x}_2$. [1]

2.2 For $\sigma_1 = 6$, $n_1 = 36$, $\sigma_2 = 8$, $n_2 = 64$, find the standard deviation. [2]

2.3 State what this sampling distribution compares.

[1]

3 Exam-style questions

3.1 The mean of $\bar{x}_1 - \bar{x}_2$ is

[1]

- **A** $\mu_1 \cdot \mu_2$
- **B** $\mu_1 - \mu_2$
- **C** $\mu_1 + \mu_2$
- **D** 0

3.2 The standard deviation of $\bar{x}_1 - \bar{x}_2$ is $\sqrt{\quad}$ where the blank is

[1]

- **A** $\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}$
- **B** $\frac{\sigma_1}{n_1} + \frac{\sigma_2}{n_2}$
- **C** $\sigma_1^2 - \sigma_2^2$
- **D** $\sigma_1 \cdot \sigma_2$

3.3 $\sigma_1 = 10$, $n_1 = 25$, $\sigma_2 = 10$, $n_2 = 25$.

(a) Write the formula for the standard deviation.

[1]

(b) Find its value.

[2]

4 Go further

- work through the **5.8 Sampling Distributions for Differences in Sample Means** lesson on the **Learn** page;
- read the **Sampling Distributions** section of the AP Statistics handout on the **Know** page.

Solutions

2.1 $\mu_1 - \mu_2$.

2.2 $\sqrt{\frac{36}{36} + \frac{64}{64}} = \sqrt{1 + 1} = \sqrt{2} \approx 1.41$.

2.3 the difference between two population means.

3.1 B.

3.2 A.

3.3 (a) $\sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$. (b) $\sqrt{\frac{100}{25} + \frac{100}{25}} = \sqrt{8} \approx 2.83$.