VCE Mathematical Methods Unit 4

Sample modelling or problem-solving task: Proportions of popularity

The modelling or problem-solving task is to be of 2–3 hours’ duration over a period of 1 week.

Introduction

Polls provide a topical and regular insight into the relative popularity of political parties over time, in particular as events occur and are reported in the media and trends change.

Popularity on a two-party preferred basis as indicated by polls is a context for inference about proportions with respect to a population based on sampling. Consider a country that has a population of around 15 million voters on an electoral roll. Polls inform public consideration and debate on various matters of policy.

Part 1

1. Plot graphs of the distribution of sample proportions for sample sizes of 50, 100 and 200 for  
   *p* = 0.43, 0.52, 0.61
2. Explain what these graphs indicate.

Part 2

1. Randomly select an integer in the range [30, 60] and use this to generate a population of 1000 voters, with that value as the percentage of the population who would vote for a given party on a two-party preferred basis.
2. Generate 50 random samples of size *n* = 60 from this population and use each of these to find a point estimate for the true population proportion. Graph the distribution of the sample proportions and state its mean and standard deviation.
3. Use each point estimate to construct a confidence interval for *p* at a 90% level of confidence. Graph all of these intervals together as a set of horizontal line segments, one under the other, and use them to explain the relationship between the true value of the population proportion, *p*, and this set of confidence intervals for a 90% level of confidence.

Part 3

The [Margin of Error Table](https://www.qualtrics.com/au/experience-management/research/margin-of-error/?rid=ip&prevsite=en&newsite=au&geo=AU&geomatch=au#calculator) relates sample size, sample proportion and margin of error at a 95% level of confidence.

1. Show how the figures for the row corresponding to a sample size of 2000 are obtained.
2. Draw graphs of several functions to illustrate how the maximum margin of error varies for different sample sizes and levels of confidence.
3. Suppose that it costs $50 per individual response gathered as part of a survey. Discuss what you think might be a reasonable combination of sample size, level of confidence, margin of error and total cost.

Areas of study

The following content from the areas of study is addressed through this task.

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| **Area of study** | **Content dot points** |
| Functions, relation and graphs | – |
| Algebra, number and structure | – |
| Calculus | – |
| Data analysis, probability and statistics | 1, 2, 4 |

Outcomes

The following outcomes, key knowledge and key skills are addressed through this task.

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| **Outcome** | **Key knowledge dot points** | **Key skills dot points** |
| 1 | 1, 14, 16, 17 | 1, 16, 18, 19, 20 |
| 2 | 1, 2, 4, 5 | 1, 2, 3, 4, 6, 7 |
| 3 | 1, 2, 3, 4, 6, 7, 8 | 1, 3, 4, 5, 8, 9, 10, 11 |