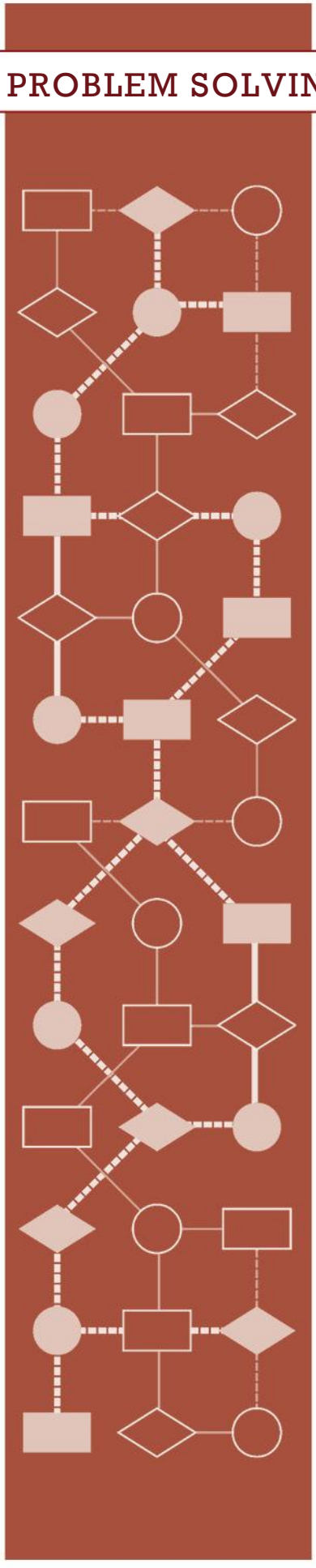
PROBLEM SOLVING



Mathematics Assessment Project

CLASSROOM CHALLENGES

A Formative Assessment Lesson

# Solving Real-life Problems: Selling Soup

Mathematics Assessment Resource Service
University of Nottingham & UC Berkeley

Beta Version

For more details, visit: http://map.mathshell.org
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# Optimization Problems: *Selling Soup*

## MATHEMATICAL GOALS

This lesson unit is intended to help you assess how well students are able to solve real-life mathematical problems. In particular, students will develop their abilities in the following areas:

- Using proportional relationships to solve multistep ratio and percent problems.
- Drawing inferences about a population from a random sample of data.
- Making and stating assumptions based on real-life situations.

## COMMON CORE STATE STANDARDS

This lesson relates to the following *Mathematical Practices* in the *Common Core State Standards for Mathematics*:

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.

This lesson gives students the opportunity to apply their knowledge of the following *Standards for Mathematical Content* in the *Common Core State Standards for Mathematics*:

6.RP Understand ratio concepts and use ratio reasoning to solve problems.

## INTRODUCTION

The lesson unit is structured in the following way:

- Before the lesson, students attempt the *Selling Soup* task individually. You review their solutions and formulate questions that will help students to improve their work.
- At the start of the lesson, students respond individually to the questions set.
- In groups, students combine their thinking and work together to produce a collaborative solution in the form of a poster.
- In the same small groups, students evaluate and comment on some sample responses. They evaluate these responses and compare them with their own work.
- In a whole-class discussion, students explain and compare solution strategies.
- Finally, students reflect on their work and their learning.

## MATERIALS REQUIRED

- Each student will need a copy of the task sheet, *Selling Soup*, pages 1 to 4 of *Responses to Martha's Survey*, some plain paper to work on, a copy of the *How Did You Work?* questionnaire, a mini-whiteboard, pen, and an eraser.
- Each small group of students will need a sheet of poster paper, a marker, and copies of the *Sample Responses to Discuss*.
- Provide calculators for students who choose to use them.
- There is a projector resource to support whole-class discussion.

## TIME NEEDED

20 minutes before the lesson and a 120-minute lesson (or two 60-minute lessons). Timings are approximate. Exact timings will depend on the needs of your class.

## BEFORE THE LESSON

### Introducing the task: *Selling Soup* (20 minutes)

Ask the students to do this task, in class or for homework, a day or more before the lesson. This will give you an opportunity to assess their work and to find out the kinds of difficulties students have with it. You should then be able to target your help more effectively in the follow-up lesson.

Before students are given the task, take time to help them to understand the problem context.

*Have you ever bought soup from a stall at a fair or a market?*

*What different kinds of soup were available?*

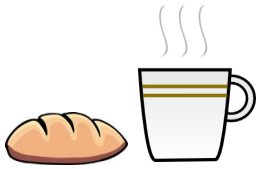
Give the students a copy of the task *Selling Soup* and some plain paper to work on.

**Selling Soup**

Martha wants to set up a soup stall at a Farmer's Market. She plans to donate any profit she makes to charity.

Martha hopes to sell 500 mugs of soup, each with a white or brown bread roll.

She will sell a mug of soup with a bread roll for $1.25.

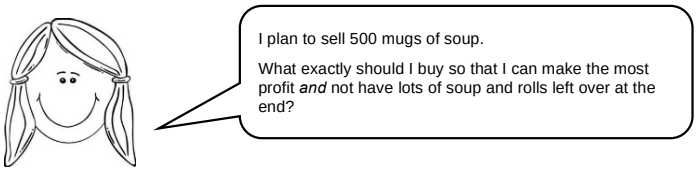


Martha knows that:

- She can buy the soup in 2.5 liter bottles.
- Each bottle of soup costs $5 and provides ten servings.
- Bread rolls are sold in packs of 10. Each pack costs $2.
- The mugs will not cost her anything, as she can borrow these from a friend.

Martha surveys 40 people to find out what flavor soup they would be most likely to buy and what kind of bread roll they would prefer. The responses she collects are shown on the next four pages.

Martha needs your help.




Write a response to Martha's question.

Show every step of your reasoning and state any assumptions you make.

In this task students are asked to figure out what Martha has to buy, to allow her to work out her costs and the profit for her soup stall. They use the information gathered from a survey of 40 participants to guide their decisions. Explain what you are asking students to do.

*Read through the task carefully and try to answer Martha's question as well as you can.*

*Show all your work so that I can understand your reasoning and try to show your findings in an organized way.*

Students may spend time on unnecessary tasks, for example, displaying the results of Martha's survey graphically. Remind students that they have twenty minutes to respond to Martha's question, showing their calculations and explaining their reasoning.

It is important that, as far as possible, students are allowed to complete the task without assistance. If students are struggling to get started then ask questions that help them understand what is required, but make sure you do not do the task for them.

Students who sit together often produce similar responses and then, when they come to compare their work, they have little to discuss. For this reason we suggest that, when students do the task individually, you ask them to move to different seats. At the beginning of the formative assessment lesson allow them to return to their usual seats. Experience has shown that this produces more profitable discussions. When all students have made a reasonable attempt at the task, tell them that they will have time to revisit and revise their solutions later.

## Assessing students' responses

Collect students' responses to the task. Make some notes on what their work reveals about their current levels of understanding, and their problem solving strategies.

We suggest that you do not score students' work. The research shows that this will be counterproductive, as it will encourage students to compare scores and distract their attention from what they can do to improve their mathematics.

Instead, help students to make further progress by summarizing their difficulties as a series of questions. Some suggestions for these are given in the Common issues table on the next page. These have been drawn from common difficulties observed in trials of this unit.

We suggest you make a list of your own questions, based on your students' work. We recommend you either:

- Write one or two questions on each student's work, or
- Give each student a printed version of your list of questions and highlight the questions for each individual student.

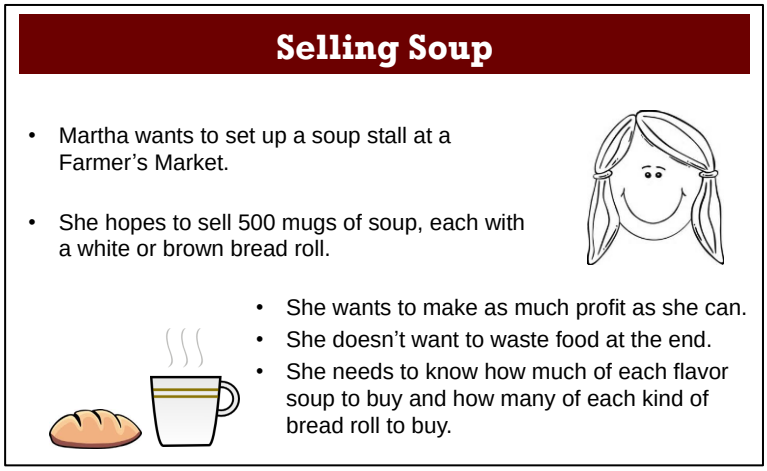
If you do not have time to do this, you could select a few questions that will be of help to the majority of students and write these on the board when you return the work to the students at the beginning of the lesson.

| Common issues: | Suggested questions and prompts: |
|---|---|
| **Student cannot get started** | • What information have you been given?<br>• How many different flavors of soup are there?<br>• What decisions does Martha need to make? |
| **Student ignores the information given about peoples' preferences**<br>For example: The student assumes that Martha will buy equal quantities of each kind of soup.<br>Or: The student presents the survey responses graphically but does not relate the information to their response to Martha's question. | • Have you used all the information given?<br>• Can you use the information from the survey to help decide how much of each flavor soup Martha should buy? |
| **Student does not collate the data systematically** | • How can you make sure you have counted every response?<br>• How can you organize your work to help you keep track of where you are in your data collation? |
| **Student does not show any calculations** | • How did you calculate Martha's costs/income/profit? |
| **Student's calculations are incorrect**<br>For example: The student correctly calculates that 40% of the survey responses chose tomato but calculates 40% of 500 as 125 (¼).<br>Or: The student calculates the profit as the total income rather than 'total income – total expenditure'. | • What is 40% as a fraction?<br>• What is ¼ as a percentage?<br>• What does it mean to make a profit?<br>• How can we calculate the amount of profit made? |
| **Student considers only the most popular soup flavor**<br>For example: The student advises Martha to buy 50 bottles of tomato soup. | • What are the benefits of Martha selling one soup flavor only? What could the possible drawbacks be? |
| **Student does not take into account real-life constraints**<br>For example: The student suggests that Martha should buy 12½ bottles of soup.<br>Or: The student refers to a number of soup servings of a particular flavor, not divisible by 10. | • What size bottles does the soup come in?<br>• Can you buy part of a bottle?<br>• How can you get 75 servings of coriander and carrot soup if there are 10 servings in a bottle? |
| **Student completes the task** | • Explain what assumptions you made. Can you think of any problems that these assumptions might lead to for Martha? |

## SUGGESTED LESSON OUTLINE

### Reviewing individual solutions to the task (10 minutes)

Give each student a mini-whiteboard, a pen, and an eraser.
Display Slide P-1 of the projector resource:




*Recall the Selling Soup problem we were working on previously?*

*Today you are going to work together to try to improve your initial attempts at this task.*

*First, I have had a look at your work, and have some questions I would like you to think about.*

*On your own, carefully read through the questions I have written. I would like you to use the questions to help you to think about ways of improving your own work.*

*Use your mini-whiteboards to make a note of anything you think will help to improve your work.*

Return your students' work on *Selling Soup*.

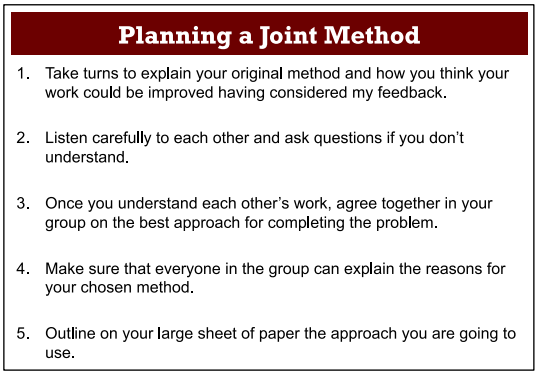
If you have not added questions to individual pieces of work or highlighted questions on a printed list of questions then write your list of questions on the board. Students should select from this list only those questions they think are appropriate to their own work.

### Collaborative activity: producing a joint solution (35 minutes)

Organize students into groups of two or three. Grouping students who have taken different approaches may lead to more profitable discussions. Give each group a large sheet of paper for making a poster and a marker.

#### Planning a Joint Method

Display Slide P-2 of the projector resource and describe how students are to plan a joint method:



To confirm students know what they have to do, ask a couple of students to explain, in succession, the different steps of the activity.

Once students have had chance to agree together on their joint method, it may be helpful to ask a few groups to share their planned method for their joint solution. It is important that students think carefully about which method to use and do not simply revert to one of the individual methods. The aim is to produce a joint solution that is better than either of the individual responses.

*What method do you plan to use?*

*In what ways is this approach different to your individual methods?*

*How has looking at other strategies in your group influenced your thinking?*

Each member of the group should be able to explain the reasons for their chosen method.

### Implementing the Method

Students are now to turn their large sheet of paper over and write their joint solution clearly on the poster paper.

*Turn over your large sheet of paper and on this other side write a joint solution to the task. State clearly your reasons for your choice of method.*

While students work in small groups you have two tasks: to note their different approaches to the task and to support student problem solving.

### Note different student approaches to the task

Listen and watch students carefully. Note different approaches to the task and what assumptions students make. How organized are the students in the way they collate the data? How are they using the information from Martha's survey? Are they discussing their assumptions? Are they able to calculate how many bottles of each flavor soup are needed, based on Martha's results? Do they take into account the real-life constraint of being able to buy only whole bottles of soup? Do they work systematically?

### Support student problem solving

If students are struggling to produce a joint solution to the task, try not to make suggestions that move them towards a particular approach. Instead, ask questions that help them to clarify their thinking, focusing on the strategies rather than the solution. Encourage students to justify any decisions they make.

*What have you found out so far?*

*What decisions do you need to make?*

*How can you systematically consider the possibilities?*

*What is your strategy? What do you need to do next?*

You may want to use the questions in the *Common issues* table to support your questioning. If the whole class is struggling on the same issue, you could write one or two relevant questions on the board or hold a brief whole-class discussion.

## Sharing posters (5 minutes)

When students have had sufficient time to work on their posters, give them the opportunity to compare their work, by one person from each group visiting the poster of another group.

The visiting student should try to make sense of what is on the poster and the assumptions the group has made.

The group being visited should explain their work to the visitor and justify their advice to Martha.

### Whole-class discussion (10 minutes)

Hold a whole-class discussion to review how students have worked. Have students solved the problem using a variety of methods? Or have you noticed some interesting ways of working or some incorrect methods? If so, you may want to focus the discussion on these. Equally, if you have noticed different groups use similar strategies but make different assumptions you may want to compare solutions.

*What did you do first? Did anybody do something different as a first step?*

*Which flavors of soup did you advise Martha to buy? Why did you suggest Martha buy just one/two/three/four soup flavor(s)? What are the advantages and disadvantages of this?*

*What assumptions did you make about the survey results?*

*What choices did you have to make in your method? How did you decide what to do?*

*What is most important to Martha?*

#### Extending the lesson over two days

If you are taking two days to complete the unit then you may want to end the first lesson here. At the start of the second day, briefly remind students of the problem before moving on to the collaborative analysis of sample responses.

### Collaborative analysis of *Sample Responses to Discuss* (20 minutes)

Distribute to each group of students, copies of the *Sample Responses to Discuss*. This task gives students an opportunity to evaluate different ways of approaching the task.

*In your groups you are now going to look at two pieces of student work on the task. Notice in what ways this work is similar to yours and in which ways it is different.*

*There are some questions for you to answer as you look at the work. You may want to make notes on the work on your mini-whiteboard as you think about the answers to the questions.*

Slide P-3 of the projector resource, *Sample Responses to Discuss* describes how students are to work together:

**Sample Responses to Discuss**

1. Choose a sample response to work through and each write your answers on your mini-whiteboards.
2. Explain your answers to the rest of the group.
3. Listen carefully to explanations. Ask questions if you don't understand.
4. Once you are all in agreement, write the answers to the questions below the sample response.

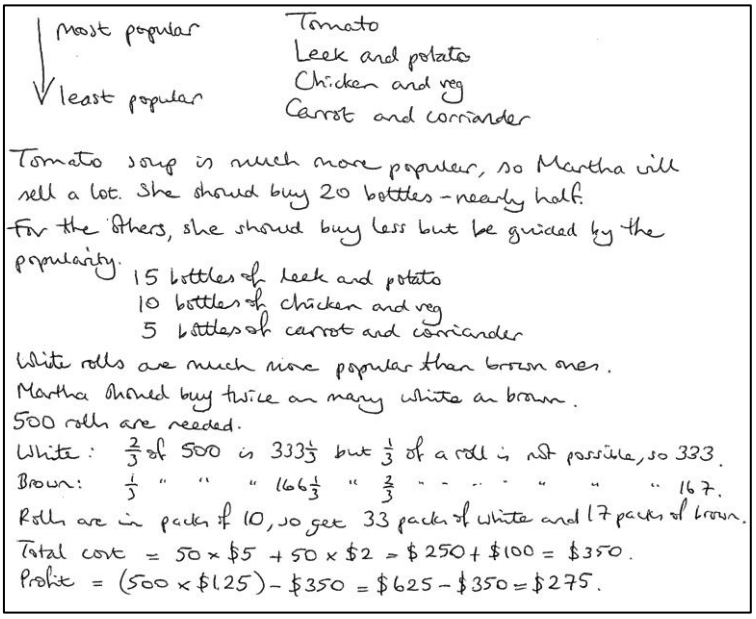
Encourage students to focus on evaluating the math contained in the student work, not whether the student has neat writing etc.

During the small group work, support the students as in the first collaborative activity. Also, check to see which of the two methods students find most difficult to understand. Note similarities and differences between the sample approaches and those the students took in the collaborative group work.

**Zach** has correctly ranked the 4 soup flavors from 'most' to 'least popular', based on the survey responses. He has decided that Martha should buy 20 bottles of tomato soup, as this flavor is the most popular and 20 bottles is nearly half of the 50 bottles needed. He has then used the popularity of the other 3 flavors to determine the number of bottles to be bought. He has not justified his choice of 15, 10 and 5 bottles.

Zach has correctly identified that white bread rolls are more popular than brown bread rolls and has decided that Martha should buy twice as many white rolls as brown rolls. He has chosen not to use the same proportion as the survey responses $(\frac{3}{4},\frac{1}{4})$ but has not explained why.

Zach has calculated the profit correctly.

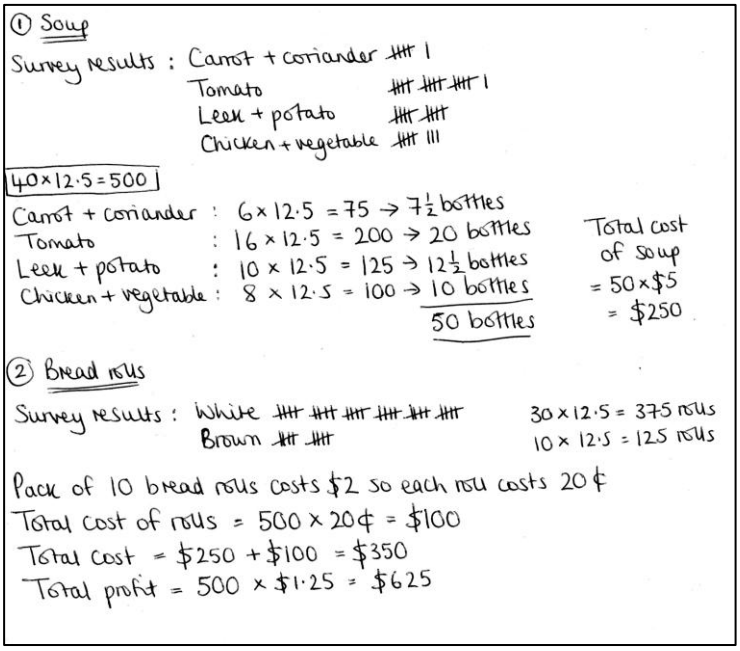



**Bradley** has taken a highly organized approach and correctly tallied the survey responses.

He has recognized that the number of survey responses is a smaller sample size than the number of servings Martha plans to sell and so has scaled up by a factor of 12.5 in the same proportions as the survey responses.

Bradley has not recognized that he cannot buy half bottles of soup and has assumed that the cost of the bread rolls can be based on the individual price of a roll, forgetting that the rolls can only be bought in packs of 10.

When calculating the profit he has actually calculated the total income from the sale of 500 servings of soup.



### Whole-class discussion: comparing different solution methods (10 minutes)

Organize a whole-class discussion to consider the different methods used in the sample student work. Ask the students to compare the different methods.

*Which method did you like best? Why?*

*Which method did you find most difficult to understand? Why?*

*How could Zach/Bradley improve his answer?*

To support the discussion, you may want to use Slides P-4 and P-5 of the projector resource.

### Review of *Selling Soup* (20 minutes)

Display Slide P-6 of the projector resource:

**Selling Soup – Actual Orders**

Martha has the following 500 requests for soup and rolls:

| | *White roll* | *Brown roll* |
|---|---|---|
| Carrot and coriander | 44 | 10 |
| Leek and potato | 96 | 27 |
| Tomato | 220 | 55 |
| Chicken and vegetable | 38 | 10 |

If Martha had followed your advice, how many of the 500 orders would she have been able to complete?
How much profit would she have made?

Explain to students that at the Farmer's Market 500 requests for soup and bread rolls were made as shown above.

Give each student a copy of the questionnaire *How Did You Work?*

*Spend some time, on your own, reflecting on your work on this task and answering the questions.*

*For both your individual response to Martha and your group's response, you will need to calculate how many of the 500 actual orders taken at the Farmer's Market Martha would have been able to complete including how much profit she would have made in each case, if she had followed your advice.*

*Remember that to complete an order you need to be able to complete both the soup and bread roll part of the order.*

Students may want to use their mini-whiteboards to jot down any notes and/or calculations as they complete the questionnaire or they could use plain paper if they prefer.

### Whole-class discussion (10 minutes)

Hold a brief whole-class discussion about what the students have learnt. The number of orders Martha would, or wouldn't, have been able to complete may have surprised them. Check to see whether students recognize why buying soup and rolls for the 500 orders in the same proportion as the survey responses does not guarantee that all 500 could have been completed.

*What surprised you about the number of orders Martha could complete following your advice? Why were you surprised?*

*In what way did the actual orders relate to Martha's survey responses?*

*Could we have guaranteed that Martha could have been able to complete all 500 orders? Why/Why not?*

*What have you learnt?*

It may also be helpful to discuss the real-life context of the problem:

*How likely is it that a customer at the farmer's market might make a second choice of soup flavor or bread roll if supplies have run out?*

*How do stores make sure they can supply demand without having excessive waste?*

## SOLUTIONS

There are a number of decisions to be made when completing this task, for example:

- Should Martha buy all 4 soup flavors/both types of bread roll?
- Should the proportions of each soup flavor/bread roll type bought be proportional to the survey responses?
- Should Martha buy exactly 50 bottles of soup/500 bread rolls?

In a good solution students will justify the choices made whilst taking into account the real-life context of the problem. For example:

- Part bottles of soup cannot be bought.
- Packs of 10 bread rolls cannot be split.

Solutions to the task will vary depending on the choices made. Here is one possible solution:

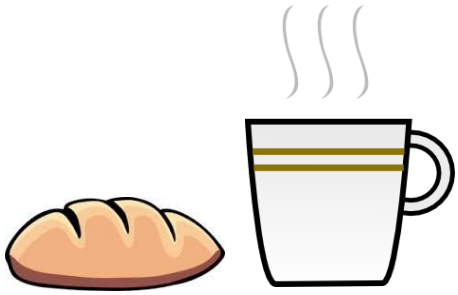
<table>
<tr>
<td>1. Produces tally charts or tables to show the survey results.</td>
<td>
<table>
<tr><th>Carrot and coriander</th><th>Tomato</th><th>Leek and potato</th><th>Chicken and vegetable</th></tr>
<tr><td>6</td><td>16</td><td>10</td><td>8</td></tr>
</table>
<table>
<tr><th>White</th><th>Brown</th></tr>
<tr><td>30</td><td>10</td></tr>
</table>
</td>
</tr>
<tr>
<td>2. Decides to buy soup and bread rolls in the same proportion as the 40 survey responses. Calculates the proportions as fractions and/or percentages.</td>
<td>
Carrot & coriander: $\frac{6}{40}=\frac{3}{20}$ or 15%<br>
Tomato: $\frac{16}{40}=\frac{2}{5}$ or 40%<br>
Leek & potato: $\frac{10}{40}=\frac{1}{4}$ or 25%<br>
Chicken & vegetable: $\frac{8}{40}=\frac{1}{5}$ or 20%<br>
White bread rolls: $\frac{30}{40}=\frac{3}{4}$ or 75%<br>
Brown bread rolls: $\frac{10}{40}=\frac{1}{4}$ or 25%
</td>
</tr>
<tr>
<td>3. Calculates how many servings of each type of soup and bread roll represent these proportions (using percentages, fractions or other methods)</td>
<td>
Carrot & coriander: 15% of 500 = 75 servings<br>
Tomato: 40% of 500 = 200 servings<br>
Leek & potato: 25% of 500 = 125 servings<br>
Chicken & vegetable: 20% of 500 = 100 servings<br>
(Check: 75+200+125+100 = 500)<br>
White bread: 75% of 500 = 375 bread rolls.<br>
Brown bread: 25% of 500 = 125 bread rolls.<br>
(Check: 375 + 125 = 500)
</td>
</tr>
</table>

| | |
|---|---|
| 4. Calculates how many bottles of each flavor soup to buy, taking into consideration that half bottles cannot be bought. | There are 10 servings in one bottle so bottles of soup needed are:<br>Carrot & coriander: 7.5 bottles - need to buy 8.<br>Tomato: 20 bottles.<br>Leek and potato: 12.5 bottles - need to buy 13.<br>Chicken & vegetable: 10 bottles.<br>Total: 51 bottles of soup are needed |
| 5. Calculates how many packs of each type of bread roll to buy taking into account that they come in packs of 10. | There are 10 rolls in a pack:<br>White: 375 rolls - will need 38 packs.<br>Brown: 125 rolls - will need 13 packs.<br>Total: 51 packs of rolls are needed. |
| 6. Calculates total costs | Cost for the soup: 51 x $5 = $255<br>Cost for the rolls: 51 x $2 = $102<br>Total cost: $357 |
| 7. Calculates total income assuming all 500 portions are sold | Income: 500 x $1.25 = $625 |
| 8. Calculates profit | Profit = income – total cost = $625 - $357 = $268 |

A sample response from students is illustrated below.

Selling Soup
With Ma
SOUP
TOMATO-16 votes
16/40 ×12.5 = 200/500 mugs
20 bottles
LEEK & POTATO-10 votes
10/40 = 125/500
12 bottles
CARROT & CORRIANDER-6 votes
6/40 = 75/500
8 bottles
CHICKEN & VEGETABLE-8 votes
8/40 = 100/500
10 bottles
Martha should sell: 200 mugs of tomato,
125 mugs of Leek + Potato, 75 mugs of Carrot + Corriander,
& 100 mugs of Chicken + Vegetable
PRICE
($5 for ten servings)
TOMATO SOUP:
$100 of tomato
LEEK + POTATO SOUP:
$65 of Leek + Potato
CARROT + CORRIANDER:
$40 of Carrot + Coriander
CHICKEN + VEGETABLE:
$50 of Chicken + Vegetable
TOTAL:
$255.00
IN SOUP WE TRUST
BREAD
WHITE BREAD-30 votes
30/40 = 375/500 rolls
75% / 3/4 will be white rolls
BROWN BREAD-10 votes
10/40 = 125/500
25% / 1/4 will be brown rolls
PRICE
($2 for 1 pack of 10)
WHITE BREAD:
$75 rolls
BROWN BREAD:
$25 rolls
TOTAL:
$100.00
IN BREAD WE TRUST
PROFIT & MONEY
She will earn $625.00.
She spends $350.00 on bread & soup
Her profit is $270.00.
$625.00
-$350.00
$270.00

# Selling Soup



Martha wants to set up a soup stall at a Farmer's Market. She plans to donate any profit she makes to charity.

Martha hopes to sell 500 mugs of soup, each with a white or brown bread roll.

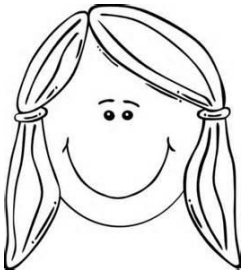
She will sell a mug of soup with a bread roll for $1.25.

Martha knows that:

- She can buy the soup in 2.5 liter bottles.
- Each bottle of soup costs $5 and provides ten servings.
- Bread rolls are sold in packs of 10. Each pack costs $2.
- The mugs will not cost her anything, as she can borrow these from a friend.

Martha surveys 40 people to find out what flavor soup they would be most likely to buy and what kind of bread roll they would prefer. The responses she collects are shown on the next four pages.

Martha needs your help.



I plan to sell 500 mugs of soup.

What exactly should I buy so that I can make the most profit *and* not have lots of soup and rolls left over at the end?

Write a response to Martha's question.

Show every step of your reasoning and state any assumptions you make.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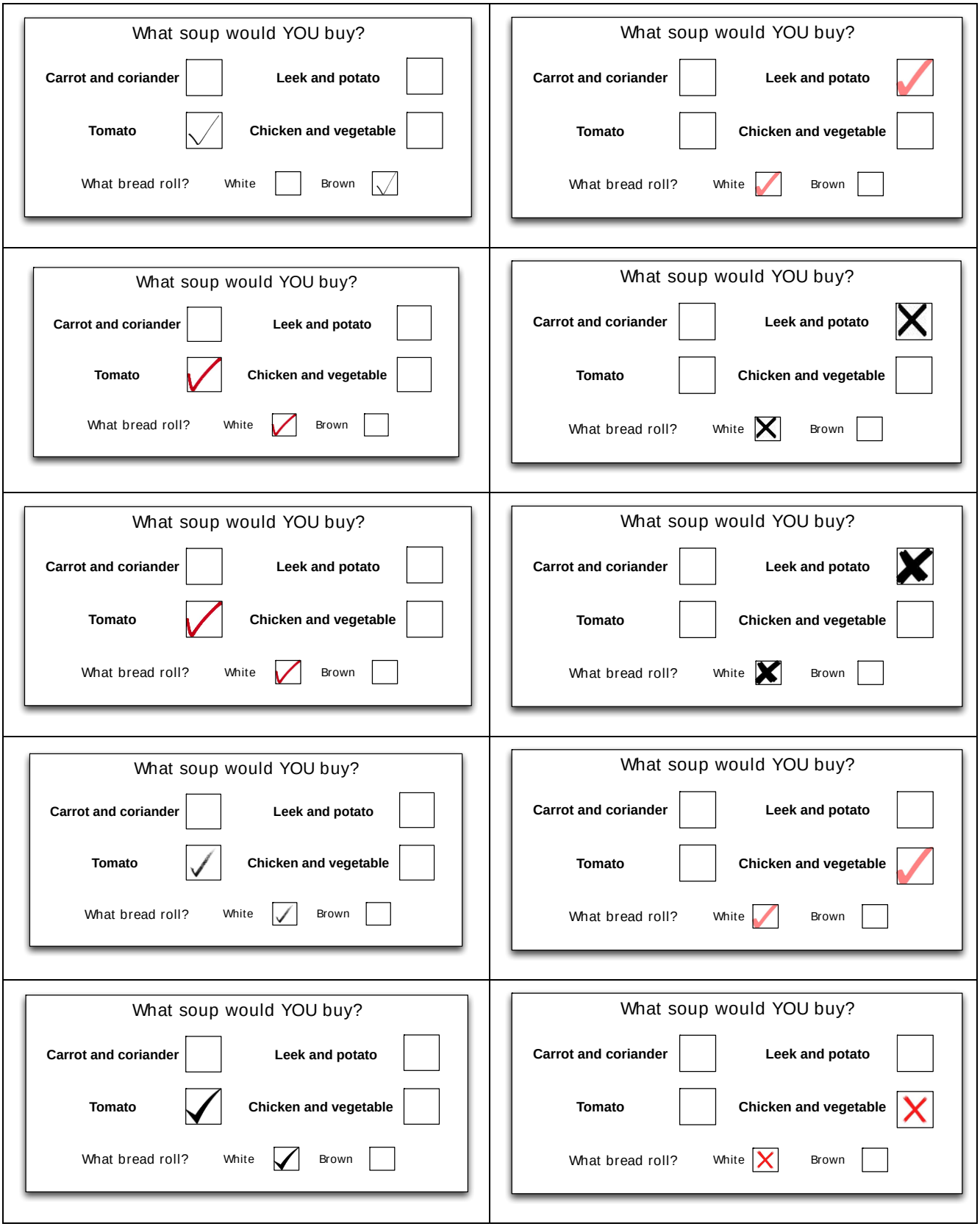
# Responses to Martha's Survey: Page 1





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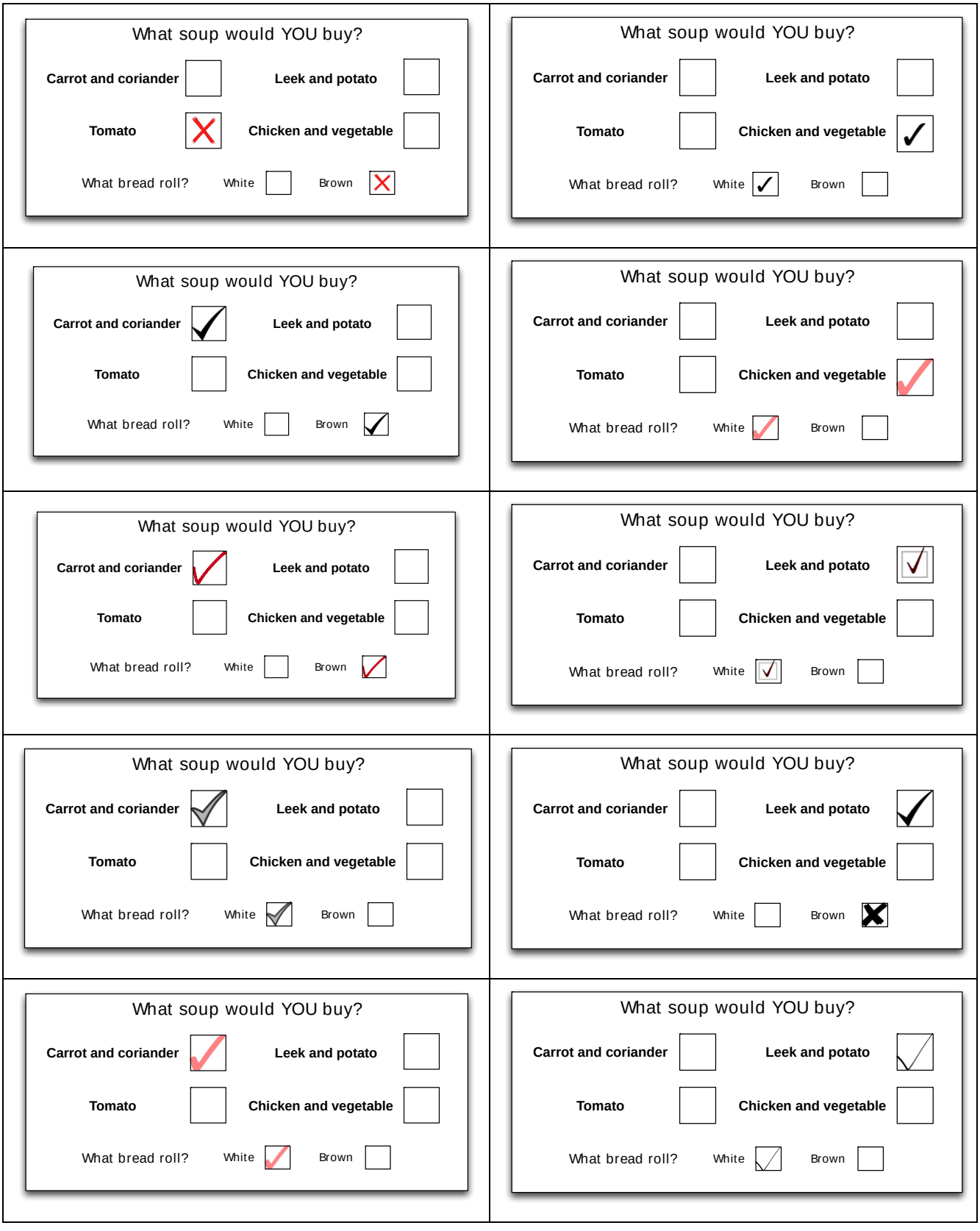
# Responses to Martha's Survey: Page 2





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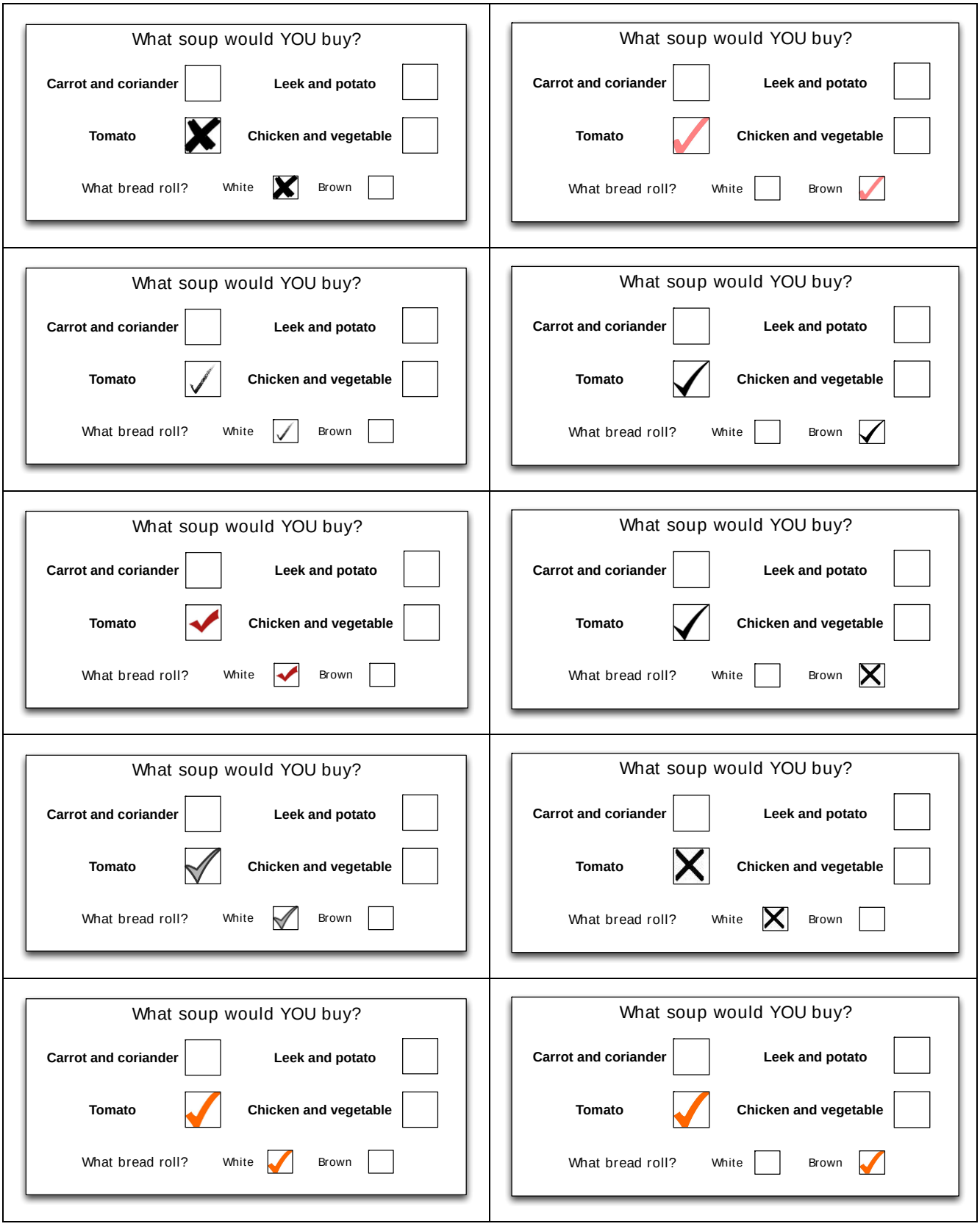
# Responses to Martha's Survey: Page 3





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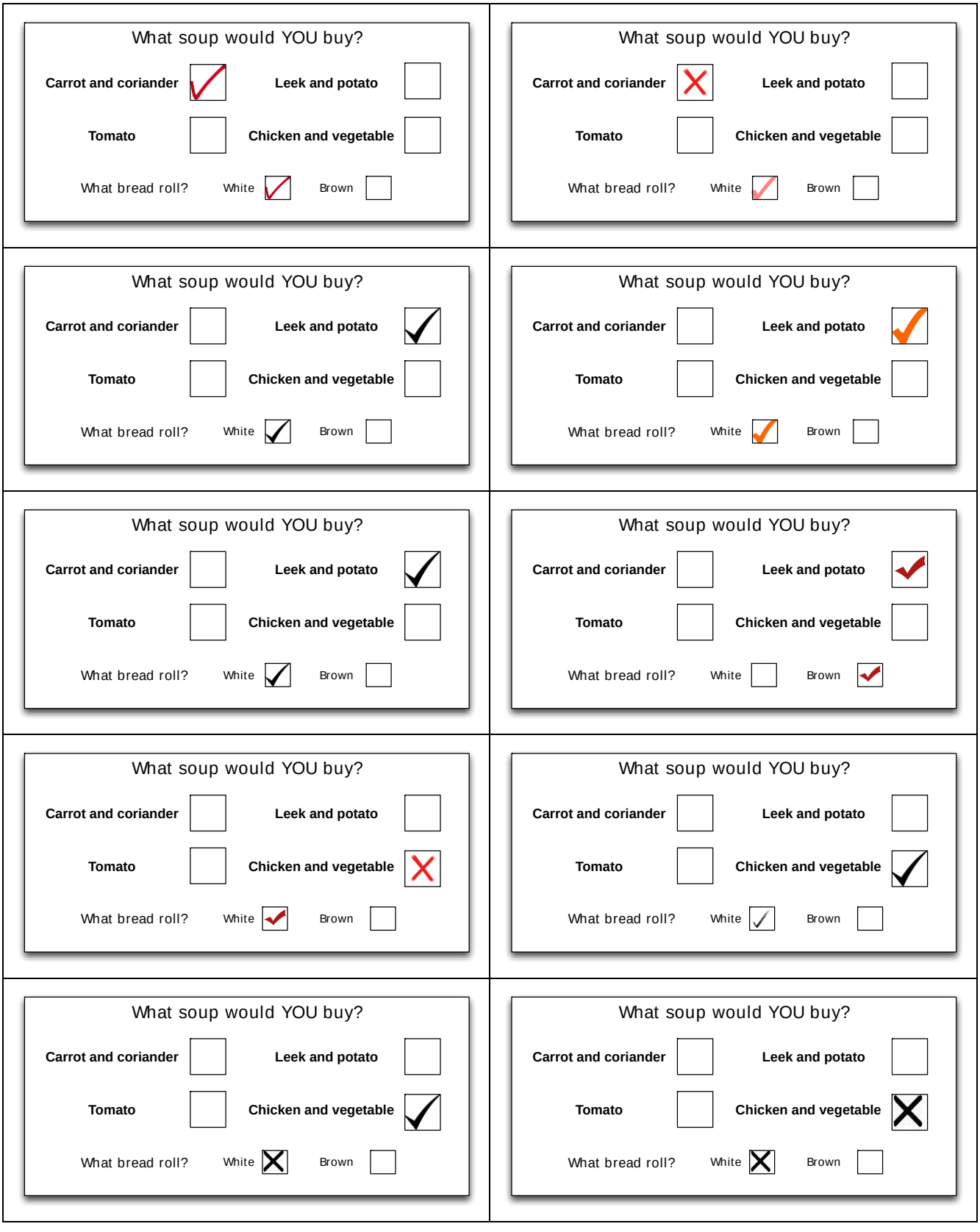
# Responses to Martha's Survey: Page 4





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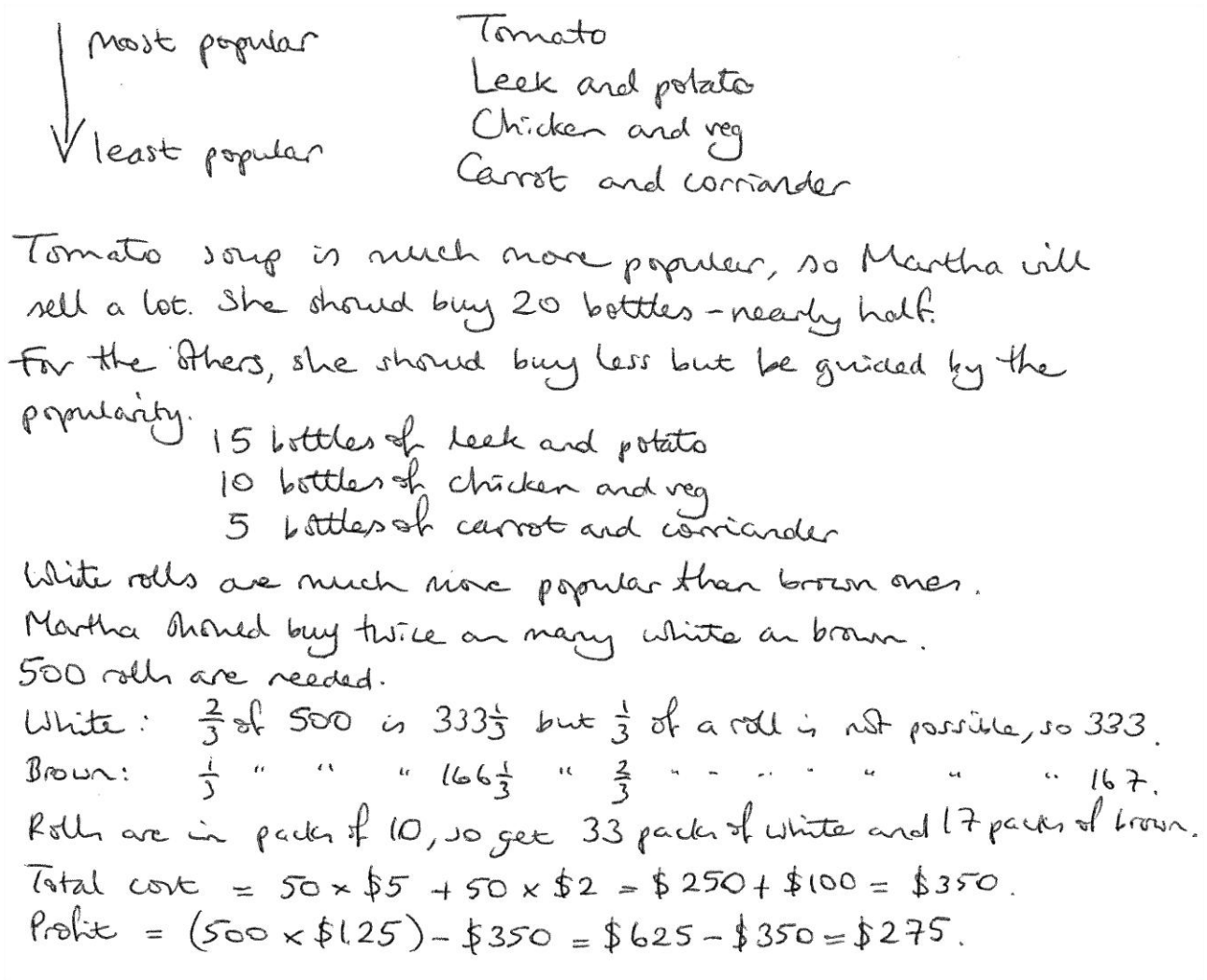
# Sample Responses to Discuss: Zach




Explain how Zach solved the problem.

Does Zach's thinking make sense? Explain your answer.

In what ways could Zach's work be improved?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# Sample Responses to Discuss: Bradley

① Soup

Survey results : Carrot + coriander 𝍸 |
Tomato 𝍸 𝍸 𝍸 |
Leek + potato 𝍸 𝍸
Chicken + vegetable 𝍸 |||

40 × 12·5 = 500

Carrot + coriander : 6 × 12·5 = 75 → 7½ bottles
Tomato : 16 × 12·5 = 200 → 20 bottles
Leek + potato : 10 × 12·5 = 125 → 12½ bottles
Chicken + vegetable : 8 × 12·5 = 100 → 10 bottles
50 bottles

Total cost of soup
= 50 × $5
= $250

② Bread rolls

Survey results : White 𝍸 𝍸 𝍸 𝍸 𝍸 𝍸
Brown 𝍸 𝍸

30 × 12·5 = 375 rolls
10 × 12·5 = 125 rolls

Pack of 10 bread rolls costs $2 so each roll costs 20¢
Total cost of rolls = 500 × 20¢ = $100
Total cost = $250 + $100 = $350
Total profit = 500 × $1·25 = $625

What has Bradley not taken into account when calculating how many bottles of soup to buy?

In what ways could Bradley's calculation for the cost of bread rolls be improved?

Explain why Bradley's solution is incomplete.


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# How Did You Work?

Complete the sentences and mark the boxes that apply to your work.

1. The method I used to complete the task on my own was _____

_____

_____

Martha would have been able to complete ☐ of the 500 orders and make a ☐ profit.

2. The method we used in our group was _____

_____

_____

Martha would have been able to complete ☐ of the 500 orders and make a ☐ profit.

3. My method is similar to one of the sample responses ☐ OR My method is different from **both** the sample responses ☐

My method is similar to ☐ *(Add name of sample response)*

Because _____

_____

Because _____

_____

4. Our method is similar to one of the sample responses ☐ OR Our method is different from **both** the sample responses ☐

Our method is similar to ☐ *(Add name of sample response)*

Because _____

_____

_____

Because _____

_____

_____



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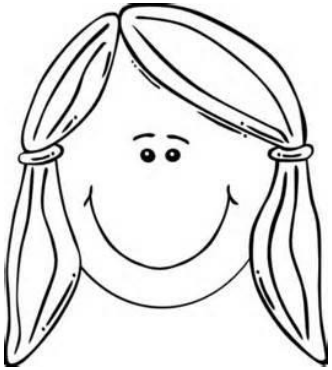
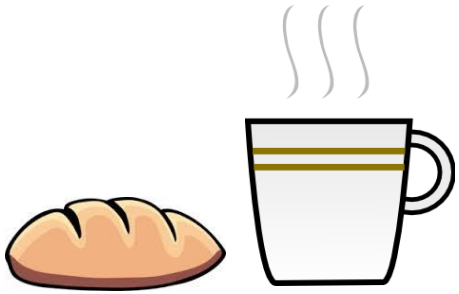
# Selling Soup

- Martha wants to set up a soup stall at a Farmer's Market.
- She hopes to sell 500 mugs of soup, each with a white or brown bread roll.





- She wants to make as much profit as she can.
- She doesn't want to waste food at the end.
- She needs to know how much of each flavor soup to buy and how many of each kind of bread roll to buy.

# Planning a Joint Method

1. Take turns to explain your original method and how you think your work could be improved having considered my feedback.

2. Listen carefully to each other and ask questions if you don't understand.

3. Once you understand each other's work, agree together in your group on the best approach for completing the problem.

4. Make sure that everyone in the group can explain the reasons for your chosen method.

5. Outline on your large sheet of paper the approach you are going to use.

# Sample Responses to Discuss

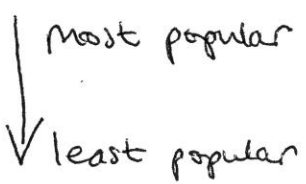
1. Choose a sample response to work through and each write your answers on your mini-whiteboards.

2. Explain your answers to the rest of the group.

3. Listen carefully to explanations. Ask questions if you don't understand.

4. Once you are all in agreement, write the answers to the questions below the sample response.

# Sample Responses to Discuss: Zach




Tomato
Leek and potato
Chicken and veg
Carrot and corriander

Tomato soup is much more popular, so Martha will sell a lot. She should buy 20 bottles - nearly half.
For the others, she should buy less but be guided by the popularity.

15 bottles of leek and potato
10 bottles of chicken and veg
5 bottles of carrot and corriander

White rolls are much more popular than brown ones.
Martha should buy twice as many white as brown.
500 rolls are needed.
White: $\frac{2}{3}$ of 500 is $333\frac{1}{3}$ but $\frac{1}{3}$ of a roll is not possible, so 333.
Brown: $\frac{1}{3}$ " " " $166\frac{1}{3}$ " $\frac{2}{3}$ " - " " " " " 167.
Rolls are in packs of 10, so get 33 packs of white and 17 packs of brown.
Total cost = $50 \times \$5 + 50 \times \$2 = \$250 + \$100 = \$350$.
Profit = $(500 \times \$1.25) - \$350 = \$625 - \$350 = \$275$.

# Sample Responses to Discuss: Bradley

① Soup

Survey results : Carrot + coriander 𝍸 |
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Total profit = 500 × $1·25 = $625

# Selling Soup – Actual Orders

Martha has the following 500 requests for soup and rolls:

| | *White roll* | *Brown roll* |
|---|---|---|
| Carrot and coriander | 44 | 10 |
| Leek and potato | 96 | 27 |
| Tomato | 220 | 55 |
| Chicken and vegetable | 38 | 10 |

If Martha had followed your advice, how many of the 500 orders would she have been able to complete?
How much profit would she have made?

Mathematics Assessment Project

# CLASSROOM CHALLENGES

This lesson was designed and developed by the
Shell Center Team
at the
University of Nottingham
**Malcolm Swan, Clare Dawson, Sheila Evans,**
**Marie Joubert and Colin Foster**
with
**Hugh Burkhardt, Rita Crust, Andy Noyes, and Daniel Pead**

It was refined on the basis of reports from teams of observers led by
**David Foster, Mary Bouck, and Diane Schaefer**
based on their observation of trials in US classrooms
along with comments from teachers and other users.

This project was conceived and directed for
MARS: Mathematics Assessment Resource Service
by
**Alan Schoenfeld, Hugh Burkhardt, Daniel Pead, and Malcolm Swan**
and based at the University of California, Berkeley

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