Insights into Exports:

Mathematics and statistics activities to support the use of SOPI in schools

CONTENTS

CONNECTIONS TO THE NEW ZEALAND CURRICULUM

CURRICULUM PRINCIPLES

The principles set out below embody beliefs about what is important and desirable in the school curriculum – nationally and locally. They should underpin all school decision making.

> These principles put students at the centre of teaching and learning, asserting that they should experience a curriculum that engages and challenges them, is forward-looking and inclusive, and affirms New Zealand's unique identity.
> The New Zealand Curriculum (2007) p. 9

The principles that relate to this resource are:

Community engagement: The curriculum has meaning for students, connects with their wider lives, and engages the support of their families, whānau, and communities.

Coherence: The curriculum offers all students a broad education that makes links within and across learning areas, provides for coherent transitions, and opens up pathways to further learning.

Future focus: The curriculum encourages students to look to the future by exploring such significant future-focused issues as sustainability, citizenship, enterprise, and globalisation.

KEY COMPETENCIES

The New Zealand Curriculum identifies five key competencies:

· thinking
· using language, symbols, and texts
· managing self
· relating to others
· participating and contributing.

> People use the key competencies to live, learn, work, and contribute as active members of their communities. More complex than skills, the competencies draw also on knowledge, attitudes, and values in ways that lead to action. They are not separate or stand-alone. They are the key to learning in every learning area.
> The New Zealand Curriculum (2007) p. 12

The following key competencies are relevant to this resource:

Participating and contributing: contributing to class discussion; participating in group tasks focused on contributing ideas about trends in primary exports.

Thinking: exploring new ideas; making connections with prior knowledge; thinking critically; being a problem solver; analysing real and hypothetical situations.

Using language, symbols, and texts: recognising symbols and vocabulary related to specific statistical terminology; using appropriate language to describe trends and percentage changes in export data.

Managing self: working independently on a task; listening to, and carefully following instructions; showing initiative.

ACHIEVEMENT OBJECTIVES

Number (Algebra)

Level 4: Use graphs, tables, and rules to describe linear relationships found in number and spatial patterns.

Level 5: Reason with linear proportions; know and apply standard form, significant figures, rounding, and decimal place value.

Measurement (Geometry)

Level 4: Interpret and use scales, timetables, and charts.

Statistics (Probability) and statistical literacy

Level 5: Evaluate statistical investigations or probability activities undertaken by others, including data collection methods, choice of methods, and validity of findings.

KEY UNDERSTANDINGS

- Broaden students' understanding of the importance of primary industry exports to the New Zealand economy.
- Develop awareness of the reasons that export receipts from primary exports can change from year to year due to outside factors.
- Develop awareness of the contribution of kiwifruit and the wider horticulture industry to our national exports.
- Understand that biosecurity incursions can influence returns from primary exports for several seasons.

NOTES FOR TEACHERS

Mathematics is the exploration and use of patterns and relationships in quantities, space, and time. Statistics is the exploration and use of patterns and relationships in data. These two disciplines are related but different ways of thinking and of solving problems. Both equip students with effective means for investigating, interpreting, explaining, and making sense of the world in which they live.

Mathematicians and statisticians use symbols, graphs, and diagrams to help them find and communicate patterns and relationships, and they create models to represent both real-life and hypothetical situations. These situations are drawn from a wide range of social, cultural, scientific, technological, health, environmental, and economic contexts.

The New Zealand Curriculum (2007) p. 26

The Situation and Outlook for Primary Industries (SOPI) reports, published annually by the Ministry of Primary Industries (MPI), give teachers access to real and relevant data to augment their mathematics and statistics teaching and learning programmes. The SOPI (2016) Report is available online and includes a wide range of data representations easily accessible for statistical investigation.

The data reported in SOPI reports gives students an insight into the New Zealand primary industries sector and the financial impact of this sector on the country's economy year on year. The data collections within each section enable students to explore and utilise their numeric and statistical understanding within the authentic context of the primary industries sector. Students can use these data sets across multiple years to look at trends, identify and evaluate features, and practise predicting outcomes to justify, verify, and identify patterns.

A feature of the SOPI reports are their attractive use of 'Infographics' and colourful representations of data. These non-traditional representations of data are becoming more commonplace in digital and print based media platforms. They are cleverly designed and constructed to communicate information in a way that encourages people to make further connections and gain deeper insight into data. In Infographics, the size of images often helps emphasis the scale of the numbers or quantities used. The MPI Mathematics and Statistics activities provide a framework for students to utilise their numeric reasoning skills and proportional thinking to make sense of a range of different ways to represent data. There are opportunities for students to make use of spreadsheets as well as to collect, display and analyse their own data. The students may not actually produce their own infographic but they will learn how to interpret them and gain an appreciation of how they are produced.

Students have an opportunity to explore how the horticultural sector and other primary industries relate to one another. They can identify current export markets and the extent to which different industries contribute to the New Zealand economy. Having an authentic context using up-to-date data provides opportunities for students to make connections between ideas and to think more deeply about the way the information is presented. It also gives young people the opportunity to gain some insight into the significance of the Primary Industries to New Zealand and the potential career paths this sector can offer.

TEACHING AND LEARNING PLAN
How these resources work

These resources are made up of a case study and a set of six activities for the learning areas of mathematics, science, social studies, and technology. The case study has been developed as an introduction to the context of the New Zealand kiwifruit industry and is suitable to be used with students across all learning areas. This can be shared using a variety of approaches (shared, guided, or independent) depending on what best suits the students you teach.

When the case study has been shared and discussed, choose the relevant set of subject-specific activities to explore this context in more detail. These activities can be used in any order and with any number of students.

The following mathematics activities have been developed to be taught over several sessions. Indicative time frames for the activities are:

· Activity one: 2–3 hours
· Activity two: 2–3 hours
· Activity three: 1–2 hours
· Activity four: 1–2 hours
· Activity five: 2–3 hours
· Activity six: 3 hours

ACTIVITY 1:
IN THE BEGINNING

Students create a timeline of the New Zealand kiwifruit industry over the past 100 years, detailing how it has changed and contributed to the New Zealand economy.

Discussion questions to support and enhance the understanding of these historical events could include:

How has the kiwifruit industry changed during this time?

What are the main factors that have contributed to these changes?

What did you learn about Isabel Fraser, Hayward Wright, and Jack Turner?

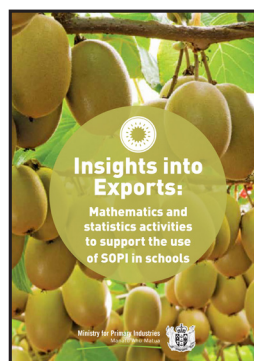How could you sequence these events – months, years, colour codes for economic and historical events, other ways?

SUPPORTING RESOURCES

Situation and Outlook for Primary Industries publications
SOPI (2015) Report pages 48–53
SOPI (2014) Report pages 36–39
SOPI (2013) Report pages 38–41
SOPI (2012) Report pages 37–40

Links and tools for gathering ideas and presenting information
Creating electronic timelines
Isabel Fraser
Hayward Wright
Jack Turner
Te Ara's history of kiwifruit
Tūhono Whenua Horticulture Ltd
Te Moana ā Toi: Māori Kiwifruit Grower Toolkit
The story of Zespri kiwifruit
Sustainability the Zespri way
Breeding Psa resistant kiwifruit – Video produced by Plant and Food Research

Going for Gold:
Snapshot of the kiwifruit industry to support the use of SOPI in schools

Ministry for Primary Industries
Manatū Ahu Matua

Kiwi protection through Diversity:
Science activities to support the use of SOPI in schools

Ministry for Primary Industries
Manatū Ahu Matua

Insights into Exports:
Mathematics and statistics activities to support the use of SOPI in schools

Ministry for Primary Industries
Manatū Ahu Matua

People and Place in the Kiwi World:
Social studies activities to support the use of SOPI in schools

Ministry for Primary Industries
Manatū Ahu Matua

The Technological Kiwi:
Technology activities to support the use of SOPI in schools

Ministry for Primary Industries
Manatū Ahu Matua

ACTIVITY 1:

WHAT'S UP WITH OUR PRIMARY EXPORTS?

Students use data from SOPI (2016) Report industry summaries for seafood (pages 55-72) and horticulture (pages 48–53) to create their own tables and graphs for the categories "Horticulture" and "Seafood" to justify conclusions about the trends that are evident in the linear relationships shown.

Note: This activity is in two parts and the information gathered will be used to make comparisons in activities 2 and 3.

Part 1

Using an Excel spreadsheet and the data supplied, have the students study the horticulture industry summary and follow steps 1–8 to develop a graph.

1. In cell A1, enter "Year".

Horticulture

Horticulture export revenues are expected to exceed $5.0 billion for the first time in the year ending June 2016. The two largest horticultural sectors, wine and kiwifruit, are showing strong growth, as are pipfruit volumes, which are expected to continue growing over the outlook period. Wine export revenue is expected to nearly reach $1.6 billion in the 2015/16 year, and kiwifruit revenue is expected to be near $1.7 billion on the back of record export volumes. Gold kiwifruit orchards are now reaching maturity after recovery from the Psa bacterial disease. Vegetable revenues have also increased, driven by squash and onion exports, and this is forecast to continue over the medium term. Growth prospects for the horticultural sectors are positive with $5.7 billion in export revenue expected by 2019/20.

	Actual			Forecast				
	2013	2014	2015	2016*	2017	2018	2019	2020
Export Revenue	$3 540m	$3 781m	$4 165m	$5 015m	$5 335m	$5 448m	$5 545m	$5 726m
Y/Y % Change	-0.4%	+7%	+10%	+20%	+6%	+2%	+2%	+3%

2. In cell A2, enter "2013" and in A3, enter "2014".

3. Highlight the year titles in the data supplied and enter the years sequentially down column A. (Note: You may need to show students that they can do this by dragging the bottom-right corner box to incorporate the years 2013 – 2020.)

4. In cell B1, enter "Horticulture exports (NZ $Millions)".

5. In cells B2 to B9, enter the values from the table.

6. Highlight all the populated cells (A1–B9) and enter a chart (scatter).

7. Place the mouse over one of the data points, right click, and enter trend line (linear)
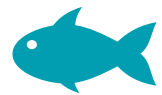
Have the students write three statements from the information shown in the graph they have created.

Statements based on the information displayed	Questions to generate and justify the statements	
What relevant features do you notice in the scatter plot?	How do you know? What numbers might be useful as evidence for this point?	What might this mean for primary-sector exports and foods?
1.		
2.		
3.		

Have the students discuss and compare their conclusions.

Part 2

Using the data from the seafood industries summaries and the Excel spreadsheet created in Part 1, have the students follow steps 1-5.

Seafood

Seafood exports will be driven by increasing demand in the USA and China, and a depreciating currency. As aquaculture increases as a proportion of total seafood exports the overall value of our seafood exports will also increase. Wild capture volumes are expected to remain stable as they are managed at the maximum sustainable yield. Increased export revenue will come from increased prices, as global demand, particularly in China and the USA, drives prices upwards. Export earnings are forecast to grow from $1.8 billion in the 2015/16 year to $2.1 billion in the year ending June 2020.

	Actual			Forecast				
	2013	2014	2015	2016*	2017	2018	2019	2020
Export Revenue	$1 546m	$1 500m	$1 562m	$1 789m	$1 821m	$1 965m	$2 033m	$2 117m
Y/Y % Change	+0.1%	−3%	+4%	+15%	2%	+8%	+3%	+4%

1. Using their Excel spreadsheets, enter "Seafood Exports (NZ $Millions)" into cell C1.

2. In cells C2–C9 enter the values from the seafood summary.

3. Highlight all the populated cells (A1–C9) and enter a chart (scatter).

4. Right click one of the set of data points and enter a trend line (linear).

5. Right click the other set of data points and enter a trend line (linear).

Have the students compare and contrast the three statements they wrote in Part 1 with the information in the graphs they created in Part 2.

Statements based on the information displayed	Questions to generate and justify the statements	
What relevant features do you notice in the scatter plot?	How do you know? What numbers might be useful as evidence for this point?	What might this mean for primary-sector exports and foods?
1.		
2.		
3.		

Have the students discuss and compare their conclusions.

SUPPORTING RESOURCES

Situation and Outlook for Primary Industries publications

· SOPI (2016) Report pages 55-72

· Video: Scatter Diagram with Trendline

ACTIVITY 2:

SHOW ME THE PERCENTAGE CHANGE

Part 1

Have the students use data from Table 1.1 on page 7 of the [SOPI (2016) Report](#), percentage change calculations tables, and reading resources to draw conclusions about the trends for New Zealand primary exports.

TABLE 1.1: EXPORT REVENUES BY SECTOR ($ MILLIONS), 2013 – 2020

		Actual		Forecast				
YEAR TO 30 JUNE	2013	2014	2015	2016*	2017	2018	2019	2020
DAIRY	13 139	17 791	14 050	13 230	13 814	16 626	17 055	17 735
MEAT & WOOL	7 794	8 162	9 001	9 055	8 345	8 510	8 534	8 804
FORESTRY	4 527	5 199	4 682	5 069	5 645	6 012	6 116	6 325
HORTICULTURE	3 540	3 781	4 165	5 015	5 335	5 448	5 545	5 726
OTHER	1 689	1 677	2 089	2 374	2 609	2 796	2 847	2 936
SEAFOOD	1 546	1 500	1 562	1 789	1 821	1 965	2 033	2 117
ARABLE	225	228	177	202	208	218	229	243
TOTAL	32 460	38 338	35 726	36 734	37 777	41 575	42 359	43 886
Y/Y % Change	+0.5%	+18%	-7%	+3%	+3%	+10%	+2%	+4%

* Estimate for year ended June.
Other Primary Sector Exports and Foods includes live animals, honey, and processed foods such as chocolate and tomato sauce.

Have the students read Table 1.1 on page 7 of the SOPI (2016) Report and create a spreadsheet.

Figure 2.1

	A	B	C	D	E	F	G
		Part 1			Part 2		
	A	B	C	D	E	F	G
1	Primary Industry Sector	2014	2015	Actual percentage change	2015	2016 (estimate)	Estimated percentage change
2	Dairy	17791	14050	=100*(C2-B2)/B2	14050	13230	
3	Forestry						
4	Horticulture						
5	Arable						

Figure 2.1 shows the format they can use for their spreadsheet.

Students can then enter the data from Table 1.1 on their spreadsheet by following steps 1–9.

1. In cell A1 enter "Primary Industry Sector".
2. In cell A2 enter "Dairy".
3. Repeat for cells A3–A5 entering "Forestry", "Horticulture", and "Arable" in the cells.
4. In B1 enter "2014".
5. In C1 enter "2015" and in D1 enter "actual percentage change".
6. Use the information in Table 1.1 to enter the data for dairy, forestry, horticulture, and arable.
7. In D1 enter the following formula: =100*(C2-B2)/B2
8. Highlight these and complete the column. (Note: You may need to show students that they can do this by dragging the bottom-right corner box across the cells relating to forestry, horticulture, and the arable sector).

Activities and discussion questions to support and enhance the understanding of this data include:

1. Write four statements about the information on the students' spreadsheet.
2. Discuss which sectors had the greatest and the least percentage change between 2014–2016.
3. Read "Situation and Outlook for Primary Industries" on page 6 of the SOPI (2016) Report and discuss the reasons for the trends shown in percentage changes on the students' spreadsheet.

Part 2

Using Table 1.1, together with the spreadsheet created in Part 1, follow steps 1–6.

1. In E1, enter "2015".
2. In F1, enter "2016 Estimate" and in G1, enter "Estimated percentage change".
3. Have the students continue to add data to the spreadsheet by entering the values on Table 1.1 into cells E2-E5 and F2-F5, as in step 2.
4. In G2, enter the following formula: =100*(F2-E2)/E2.
5. Highlight these and complete the column. (Note: You may need to show students that they can do this by dragging the bottom-right corner box across cells relating to forestry, horticulture, and the arable sector)

Discussion questions to justify statements and draw conclusions about this data include:

1. Why is the term "estimate" used for 2016?
2. How is the term "estimate" different to "forecast"? Which of these figures is most likely to be more accurate? Why?
3. Why does the MPI publish forecasts in their SOPI documents?
4. Write four statements that could be extrapolated from the information shown in the spreadsheet you have created in Part 2.
5. Which sectors are expected to experience the greatest and the least percentage change between 2015–2016?

SUPPORTING RESOURCES

· Help sheet: How to find the percentage change with Excel
· SOPI (2016) Report pages 6-7

ACTIVITY 3:
FOCUS ON HORTICULTURE

Students use data from the SOPI (2016) Report and draw conclusions about the trends for horticulture exports by analysing tables and reading resources.

Note: Students will use the Excel spreadsheets they generated in Activities 1 and 2 to complete Activity 3. Students compare their completed spreadsheet values to those on the infographics on page 62 of the SOPI (2016) Report.

Compare and contrast the export values (NZ $millions) 2013–2016, with the products examined in Activities 1 and 2.

Read the "Key Factors" section on page 62 of the SOPI (2016) Report and give three explanations for the trends shown in horticulture export values from 2015–2016.

Statements based on the information displayed	Questions to generate and justify the statements	
1.	How do you know? What numbers might be useful as evidence for this point?	What might this mean for horticulture exports?
2.	How do you know? What numbers might be useful as evidence for this point?	What might this mean for horticulture exports?
3.	How do you know? What numbers might be useful as evidence for this point?	What might this mean for horticulture exports?

Using the infographic of the Top 10 Horticulture Export Markets by Value on page 63 of the SOPI (2016) Report, discuss the following questions:

1. What does the term "infographic" mean?
2. When is an infographic an appropriate tool to use?
3. Why are the circles different sizes? How could the different circle sizes be calculated?
4. Which market destination is the most important for New Zealand kiwifruit?
5. How do you know this? What evidence supports this view?

SUPPORTING RESOURCES
· Web link: What is an infographic?
· SOPI (2016) Report pages 62-72

ACTIVITY 4:

WHO'S BUYING OUR HORTICULTURAL PRODUCTS?

Students use data from the SOPI (2016) Report on kiwifruit and apple and pear exports and draw conclusions about the impact of markets and trade conditions on the recorded trends.

Using the graphs on the lower third of page 63 of the SOPI (2016) Report pose the following questions to discuss the information presented:

1. What does the scale on the horizontal axis represent? Give an example.

2. What do you notice about the kiwifruit market compared to the other five horticulture markets?

3. Choose two countries that buy our horticulture exports and describe the similarities and differences between the amounts of the products they buy from each horticultural sector. Use numbers to support your points.

4. Although Australia is our biggest horticultural export destination, why do you think Australia is not a significant market for New Zealand apples and pears?

5. Where are our key markets for apples and pears? Explain why these countries are key markets even though they may grow their own apples and pears.

SUPPORTING RESOURCES

·   Video: Kiwi apples: Aussie's forbidden fruit
·   Video: Australian retailers reject New Zealand apples
·   Video: New Zealand's popular golden Kiwi becomes more expensive!
·   SOPI (2016) Report pages 62-72
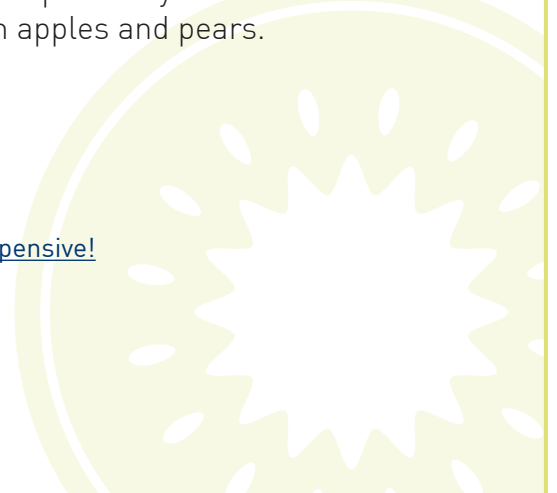
ACTIVITY 5:
GREEN VERSUS GOLD

Students conduct a statistical investigation to find out whether gold or green kiwifruit is most popular. Use Zespri varieties of kiwifruit to identify gold and green kiwifruit.

Part 1 Setting up and collecting the data

This activity can be undertaken in groups or as a whole-class activity.

- Decide whether different cultivars for each variety will be included in the investigation.
- Discuss the advantages and disadvantages of this decision.
- Brainstorm the attributes that could be used for comparison (look, feel, flavour, size) before students decide which attribute to test for.
- Discuss how the participants will be asked to describe their preferences on a scale of 1–5 and how their responses will be categorised. This is an opportunity to discuss types of data and the benefits of collecting and displaying numeric versus categorical data.
- Discuss the materials, data collection, and recording that will be required to conduct the survey.
- Conduct the survey.
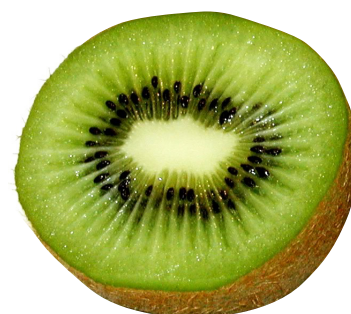
Part 2 Displaying the data

- Students use the data they have collected to graph their findings.
- Groups share their graphs and discuss the data collected, including the strengths and weaknesses of each.
- Make a chart listing these for students to refer to later.

Part 3 Making comparisons

- Students collect additional data by asking family or friends to take part in their survey and contribute to the data they are gathering.
- Students work in small groups to produce graphs of the combined data from their class and the wider survey.
- As a class, have the students compare histograms of preferences, made from data gathered in class and data from the wider survey. Focus the discussion on similarities and differences between the data.

Part 4 Comparing class data to international kiwifruit sales

Have the students compare the results from their surveys to the trends shown on Table 6.2 (page 65) of the SOPI (2016) Report.

TABLE 6.2: KIWIFRUIT EXPORT VOLUMES, PRICES AND VALUES, 2013–2020, MARCH YEAR END

YEAR TO 31 MARCH		Actual				Forecast				
		2012	2013	2014	2015	2016*	2017	2018	2019	2020
Export volume (million[1] trays)	Green kiwifruit	83	78	77	77	91	85	77	73	70
	Gold kiwifruit	27	23	12	18	35	50	57	64	68
	Total	111	101	89	96	128	136	135	138	139
FOB[2] price ($/tray)	Green kiwifruit	7.7	8.1	8.0	8.9	10.0	11.0	11.4	11.4	11.5
	Gold kiwifruit	14.2	17.4	16.7	17.2	15.0	14.1	14.4	14.7	15.1
	Total	9.3	10.3	9.1	10.4	11.4	12.1	12.7	13.0	13.3
Export value (million)	Green kiwifruit	639	632	612	687	917	935	879	835	805
	Gold kiwifruit	389	405	198	304	529	703	822	943	1 026
	Total [3]	1 034	1 043	815	1 002	1 463	1 657	1 721	1 798	1 851

* Estimate for year ended June.   Sources: Statistics New Zealand and MPI.

1 One tray equals 3.6kg.

2 Free on board is the value of the goods delivered to the port of export and loaded onto a vessel for transportation out of the country of origin.

3 Total may not round due to the 'other kiwifruit' category.

Discuss the general trends in gold and green kiwifruit exports.

1. What conclusions can we make from the data presented in Table 6.2 and from our class survey?

2. How do our results support the trends shown on Table 6.2?

3. In what ways could we improve the accuracy of our survey?

Read the supporting information on pages 64-65 of the SOPI (2016) Report and discuss what the New Zealand kiwifruit industry's market growth might look like in the future.

SUPPORTING RESOURCES

· Information: The statistical enquiry cycle
· Information: Zespri varieties of kiwifruit
· Video: History of gold kiwifruit
· Video: New kiwifruit variety
· SOPI (2016) Report pages 62-72