Portfolio Picker

Case Studies

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Document Details

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Document History

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About

The official download page for Portfolio Picker is:

https://www.quintessa.org/software/downloads-and-demos/portfolio-picker

Official downloads are signed with a digital signature that guarantees that they were produced by Quintessa Limited. Please do not download Portfolio Picker from other sources.

Feedback on Portfolio Picker is welcome. Please direct such feedback to PortfolioPicker@quintessa.org

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Summary

Portfolio Picker is a generic portfolio selection tool that uses basic decision theory to compute an optimal selection amongst several choices when there are potentially multiple factors contributing to the outcome. This document describes case studies which highlight key aspects of the tool and are examples of how version 1.1.1 of Portfolio Picker can be used.

Contents

1   Introduction

Portfolio Picker is a generic portfolio selection tool that uses basic decision theory to compute an optimal selection amongst several choices when there are potentially multiple factors contributing to the outcome. This document describes case studies which highlight key aspects of the tool and are examples of how version 1.1.1 of Portfolio Picker can be used.

Each case study provides a high-level description of the decision trying to be made. Two case studies include a full description and justification of the selection, along with results from Portfolio Picker and a description of which aspects of the tool are being demonstrated. The remaining case studies are provided as further examples of the use of Portfolio Picker in every-day situations.

Key points or helpful hints to be considered when defining your own selections are highlighted with this icon:

Key point described here.

The files mentioned in the subsequent sections can be found in the Case Studies directory next to Portfolio Picker in the Quintessa Start Menu folder.

Note: If Portfolio Picker is used in a non-personal (eg: commercial, or academic) setting, then we would appreciate if its use is attributed using the following information:

- ▲ Software name: Portfolio Picker
- ▲ Software version: Please check the Help > About menu.
- ▲ Developers: Quintessa Limited (https://www.quintessa.org/)
- ▲ Software URL: https://www.quintessa.org/software/downloads-and-demos/portfolio-picker

2   Investment Portfolio

A standard example of a portfolio selection in decision theory is the 'investment portfolio'. In this example, there are three routes of investment (with eight of each route available) and three criteria to be met. The example file is called 'InvestmentPortfolio.ppf'.

Features Demonstrated

This example demonstrates the basic functionality of Portfolio Picker, that is, the ability to define categories (with a number available) and criteria (with importance values), and to score each category-criterion pair. Results are updated interactively as information is input.

This example does not employ any 'balancing' strategies.

Building up the Case Study

The routes of investment are: building society; bonds; and shares. Each route was defined as a category with 8 of each route available.

The three criteria to be considered are:

- Expected return: How much profit can be made through this investment?
- Acceptability of worst case: If the investment does not work out, has the investment lost a lot of money or not?
- Ease of exit: Is the money easily accessible?

The criteria were given importance values (given in brackets) as follows: Expected Return (70); Acceptability of Worst Case (50); Ease of Exit (30). These values suggest that the most important criteria to be met is the expected return, and that acceptability of worst case is more important that the ease of exit. These options could therefore reflect someone who wanted to make a long-term investment with average risk, since accessing their money is less important than the acceptability of the worst case.

Each category is scored against each criterion to rate how well that investment route meets the criterion. For example, building societies have a low rate of return, but a very high ease of exit. Similarly, shares have the highest expected return, but the lowest score for acceptability of worst case (deeming this route to be the least safe with respect to this criterion). The following scores were given:

	Expected Return	Acceptability of Worst Case	Ease of Exit
Building Society	3	10	10
Bonds	7	7	5
Shares	10	1	8

It is noted here that the phrasing and scoring of criteria must be chosen appropriately. Higher scores should always correspond to an improved portfolio. For the example above, scores for 'Acceptability of Worst Case' are used to indicate how acceptable the situation is in the worst-case loss of an investment. So high scores represent good outcomes and low scores represent poor outcomes. However, if the criteria had been expressed as 'worst-case loss', high scores would have been given to those investments where the worst-case loss was large, and the 'optimal' selection would have favoured poor outcomes!

*High scores **must** be in favour of selecting objects from that option for the selection. Another example would be rating three options for a new supermarket based on the cost of development. If the goal was to minimise costs, then the options that have a high cost should have **low** scores, effectively saying 'this option is expensive, so it does not score highly'.*

It was specified that ten items were to be chosen in the selection, and the 'No Penalty' balancing strategy was used.

Results

Manual calculations show that, for a no penalty balancing strategy, the building society option has the highest utility per item, followed by bonds and shares who share the same utility per item. Thus, 'optimal' choices are:

- ▲ 8 building society, 2 bonds, 0 shares;
- ▲ 8 building society, 0 bonds, 2 shares; or
- ▲ 8 building society, 1 bond, 1 share.

Portfolio Picker makes these three options available on the Optimal Selection tab, as can be seen in Figure 1.

The plots are greyed out when the first selection is not chosen because the plots show how the first selection varies with importance values. The results are still valid when this is the case.
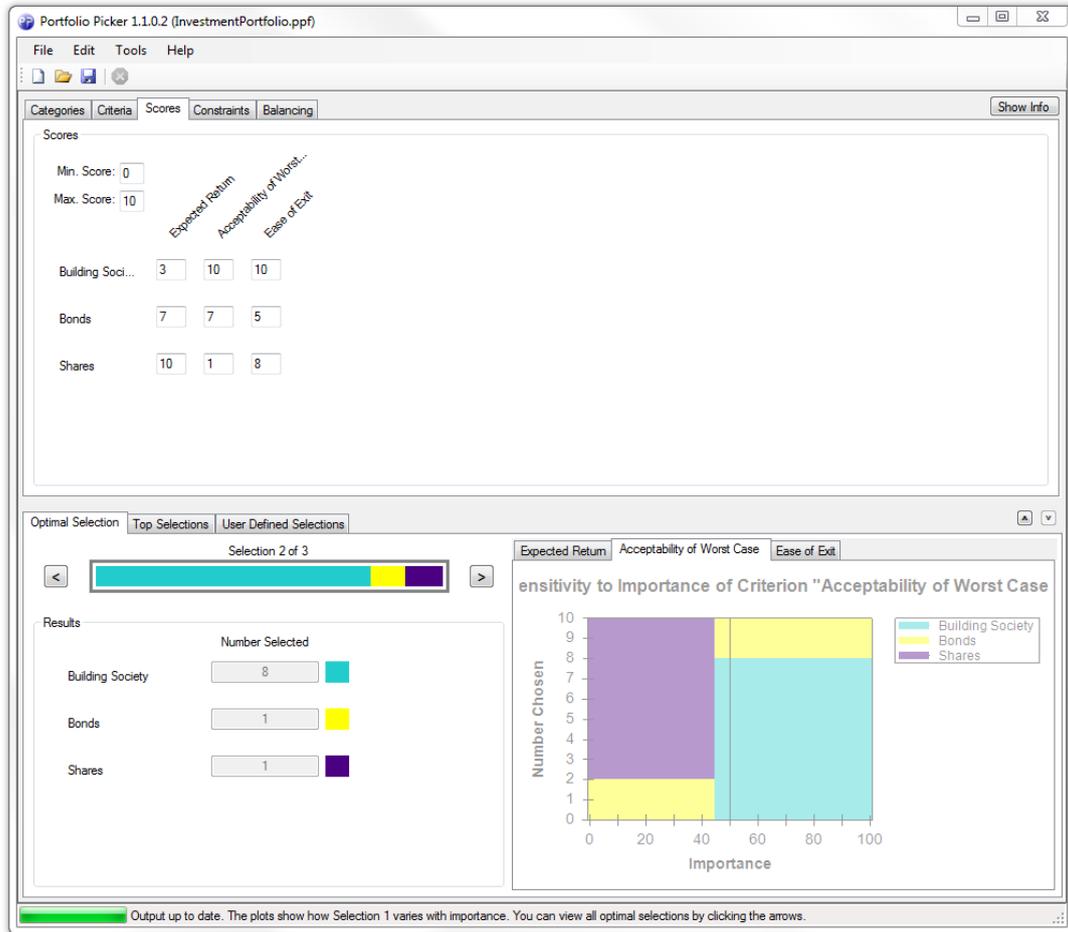
Figure 1: Screenshot from Portfolio Picker for the Investment Selection example

The "Top Selections" tab displays, in this case, all of the possible selections for the given inputs. Without a balancing penalty, the selections are all nearly optimal (see Figure 2). However, if the balancing penalty is changed to the Product Method with a value of 0.6, the tab changes accordingly (see Figure 3). There is now only one optimal selection, as well as a larger range of selections with different relative percentages.

If there are more than 100 possible selections for the given inputs, the "Top Selections" tab will only show the first 100 selections.
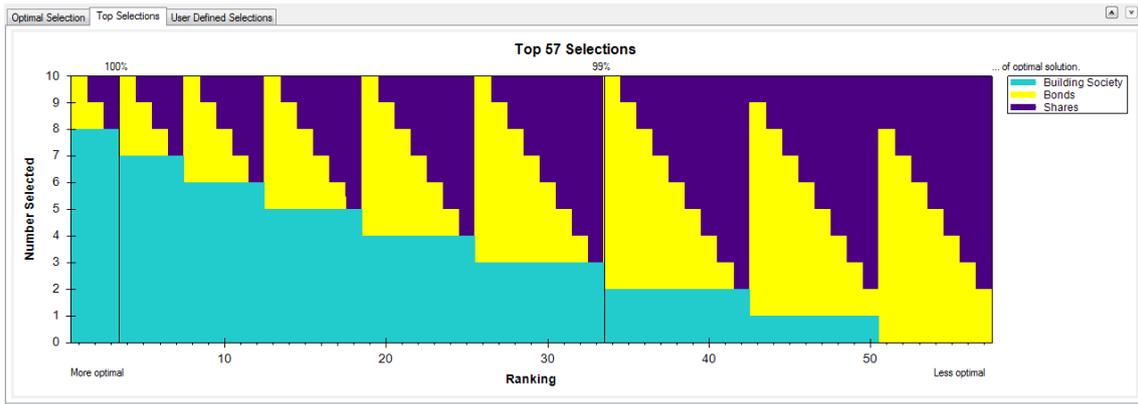
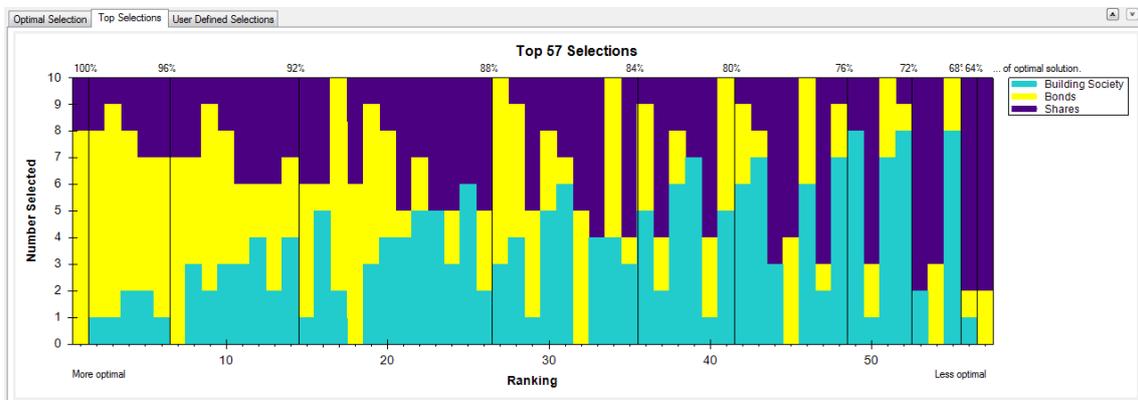**Figure 2: The "Top Selections" tab when No Penalty is selected as the balancing strategy**

Figure 3: The "Top Selections" tab when the penalty is changed to Product Method (0.6)

Exercises

▲ Think of another investment route and another criterion to score each route on and add these to the portfolio. Does the selection change?

▲ How do the different balancing strategies affect the optimal selection?

▲ How does the selection change from high risk ("Acceptability of Worst-Case" importance is low) to low risk ("Acceptability of Worst-Case" importance is high), and how could this affect the decision of someone who is planning to make an investment?

3   University Choices

A decision that every student needs to make before they go to university is *which* university they should go to. It is also a decision that many students struggle to answer easily. This case study demonstrates how Portfolio Picker can be used to help make that decision. The example file is called UniversityChoices.ppf.

This type of decision, where you have a list of options and you wish to choose one, is sometimes referred to as Multi-Characteristic Decision Making. For a fuller description of this method, including useful discussions on scoring (a vital aspect of this approach), and further examples and exercises, see, for example, Murty (2003).

Features Demonstrated

This example mainly seeks to show the user how Portfolio Picker can be used to make an optimal selection of **one** option from a list of many, each scored against the same criteria.

A balancing strategy is used here to ensure that each criterion provides enough information for the chosen selection.

Building up the Case Study

This particular student has applied to five universities, namely Swansea, Cardiff, Bristol, Bath, and Cambridge. She has been offered places at each university and now wants to decide which one to name her top choice based on the following criteria:

- ▲ The entry requirements;
- ▲ The distance away from her home town (which is Swansea);
- ▲ The friendliness of the institution and city (based on her visits to each university);
- ▲ Whether or not it is a campus university;
- ▲ The accommodation facilities;
- ▲ And the cost of living in that area (affordability of the area).

The student has given each criterion an importance value by using the AHP Method. The completed AHP window is shown in Figure 4. The AHP Method is described in the Portfolio Picker Technical Guide, available from the Help menu in Portfolio Picker. The calculated values are given in Table 1, along with the justification she used to make the comparisons.

The process of arriving at the criteria to be considered is an important step of the decision-making procedure. When you have a concrete idea of what aspects are important for each option available you can score the options against each criterion, either using a subjective scale or by standardising the scale with research you have carried out.

The scores that the student gave each category-criterion pair are summarised in Table 2 followed by the system that she used to score them. This system would be different for different students, as would the importance values given in Table 1.

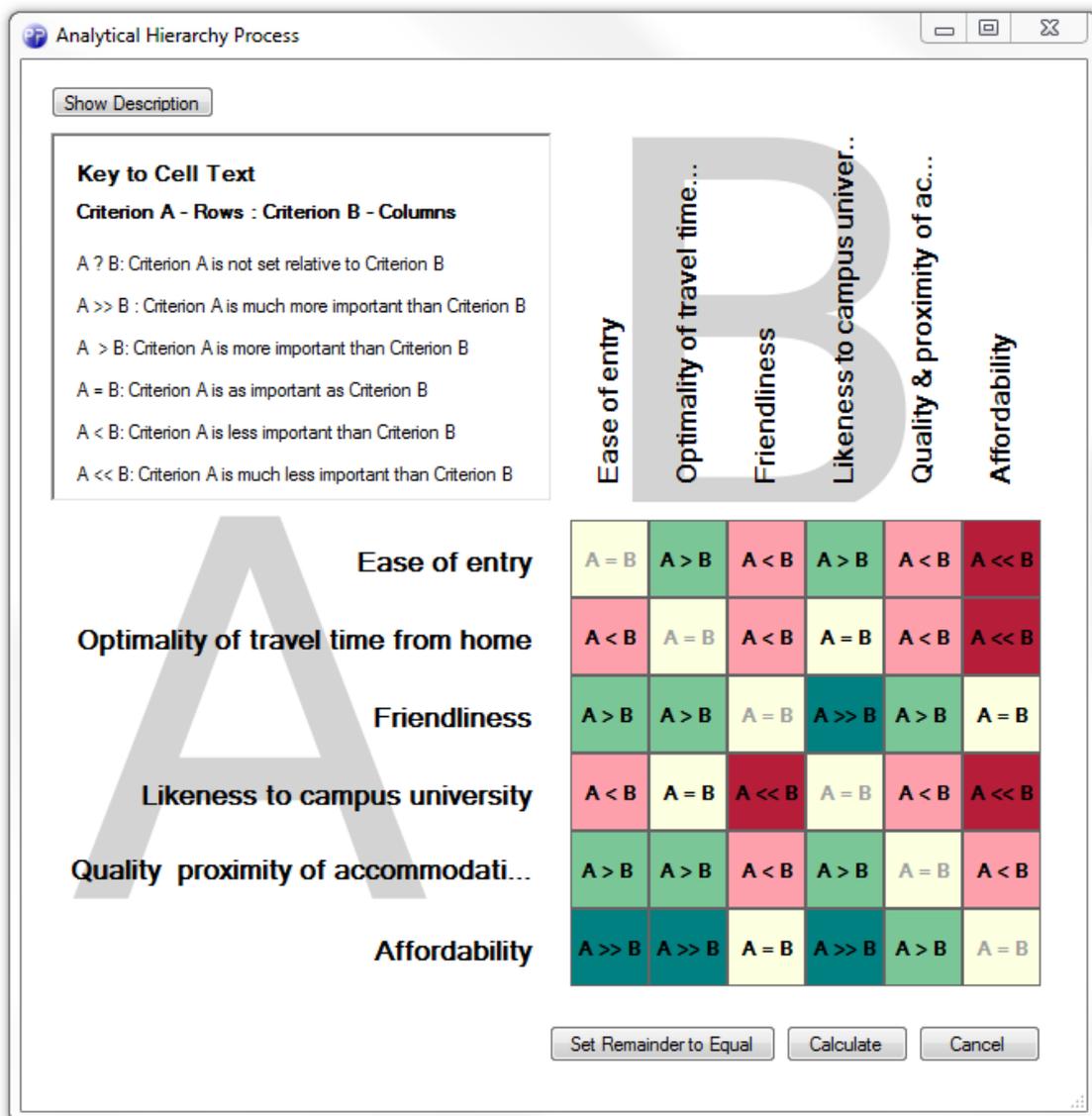The 'Avoid Weak Criteria' balancing strategy was chosen, but the user is invited to experiment with changing this.

Figure 4: The completed AHP window for the student

Table 1: Criteria and Importance Values with justification of why each value was chosen

Criterion	Importance Value	Justification
Ease of entry	34	This is important, but not as important as 'Friendliness' or 'Affordability'. This is as important as the 'Quality & proximity of accommodation'.
Optimality of travel time from home	16	This has some bearing on her decision, but she does not consider it as important as other criteria (all except the 'Likeness to a campus university', which she considers equally important).
Friendliness	84	She wants to live in a friendly city and wants to feel welcome at the university she studies at, so this has a high importance value.
Likeness to campus university	15	It is not vital that the university is all in one place for this student
Quality & proximity of accommodation	37	This is important, and as important as the entry requirements, but other criteria have more importance for the student.
Affordability	100	This is the most important aspect for the student.

Table 2: Scores for the university choice selection

	Ease of entry	Optimality of travel time from home	Friendliness	Likeness to campus university	Quality & proximity of accommodation	Affordability
Swansea	6	1	6	6	4	8
Cardiff	5	2	6	5	6	7
Bristol	5	4	5	3	2	6
Bath	4	6	7	8	6	5
Cambridge	3	1	4	6	6	4

The scoring system that was used is as follows:

▲ Ease of entry: Universities with a 'lower' entry requirement (for example, ABB compared with AAA) have a higher score.

▲ Optimality of travel time from home: The student does not want to be too close to home, but also does not want to travel too far away. In terms of hours it takes to get to the city, the scores increase as they get further away from Swansea until it peaks at around 2 hours away (a little further than Bath), and then decreases as this distance is passed. Thus, although Cambridge is on the opposite side of the UK, this has a low score because it is too far away.

▲ Friendliness: Having visited each of the universities, these scores reflect the level of friendliness the student felt during her time there. A high score means that she felt very welcome and thought the city was very friendly.

▲ Likeness to campus university: The student considers a campus university to be better for her than a non-campus university. College-style or departmental campuses score better than completely non-campus universities, but not as high as a fully campus university.

▲ Quality & proximity of accommodation: A combination of distance from place of study and the standard of accommodation is taken into consideration. In short, close and high standard scores highly, close and low standard scores mid-way,

far away and low standard scores very low, and far away and high standard scores mid-way.

▲ Affordability: Places where cost of living would be low score highly, whereas expensive places have lower scores.

Results

The result obtained by Portfolio Picker is shown in Figure **5**. It shows, based on her scoring and importance values for criteria, that Swansea is the optimal choice for this student. Manual calculations show that this is the only optimal solution in this case. The sensitivity plot for "Optimality of travel time from home" is also shown, and this demonstrates how the importance value for a criterion can affect the selection. In this case, if the student felt that how far away she studied was a little more important, then the best option would be for her to study at Bath, according to the values she has defined for this selection.

The previous version of this document used manually chosen importance values rather than values chosen using the AHP method. These were: Ease of entry, 60; Optimality of travel time from home, 40; Friendliness, 80; Likeness to campus university, 30; Quality & proximity of accommodation, 60; and Affordability, 90. The values were chosen reflect the student's justifications in Table 1, *and are more spread out than the ones calculated using the AHP method. A different result is produced with these values, and the optimal selection is Bath.*
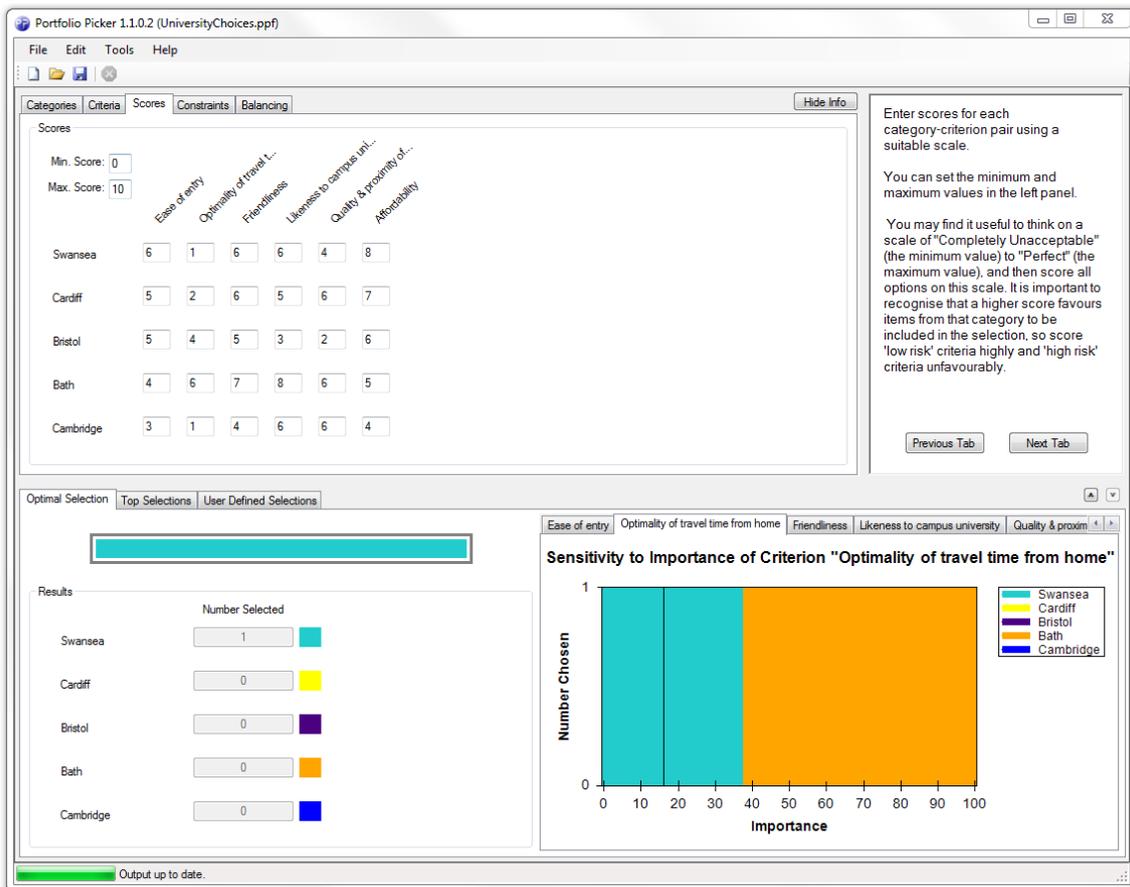
Figure 5**: Screenshot from Portfolio Picker for the university choices example**

Exercises

▲ Other important criteria that might be considered by students are the quality of teaching, the position of the university in league tables, or the level of student satisfaction. Try finding the relevant information online for each university and standardise it to the scoring scale of 0 to 10. Does it affect the optimal selection produced by Portfolio Picker?

▲ This example could quite easily be changed to choosing a holiday destination. Have a go at changing the locations and criteria to plan your next holiday.

▲ Experiment with changing the importance of each criterion, observing how the graphs change as you do so. What do you notice about the graph of the criterion importance you are changing compared with the other criteria?

4   Other Case Studies

A further few case studies are described in this section in less detail than the previous two examples. Try creating them yourself with Portfolio Picker to become accustomed with the interface, or open the files from the Case Studies directory next to Portfolio Picker in the Quintessa Start Menu folder. Add your own or edit categories or criteria, and adjust the values to fit your own ratings. Then have fun with creating your own selections!

4.1 Outfit Planner

Which outfit should I wear today? This example shows an example of what someone might wear to a 'smart-casual' event during a summer's day. The file is called OutfitPlanner.ppf.

CHOOSE 1	#	Appropriateness	Comfort	Style	My Mood
Importance		75	35	60	45
Top and Jeans	1	6	7	5	2
Dress and Heels	1	8	3	7	1
Summer Dress and Flats	1	5	6	8	4
Skirt and Blouse	1	6	4	4	1
Trousers and Top	1	8	7	6	5
Top, Jeans, and Jacket	1	2	5	6	1
Joggers and Vest	1	0	8	1	8
Balancing:	Avoid Weak Criteria				

4.2 Week Meal Planner

If you struggle to plan a week's worth of meals, Portfolio Picker may be able to help! This example gives a list of different meals (with a varying number of each available, to give an upper limit to how many times that option can be included in the week), and an optimal selection calculated by Portfolio Picker. The tool picks 14 meals, 7 for lunch and 7 for dinner, but does not distinguish between them. That's up to you! This file is called WeekMealPlanner.ppf.

CHOOSE 14	#	Ease of Preparation	Affordability	Healthiness	Rapidity	Tastiness
Importance		50	90	60	30	80
Stir Fry (Homemade)	3	70	70	80	60	65
Take Away	2	100	50	15	40	55
Roast Dinner	2	30	45	75	10	70
Curry (Homemade)	2	50	60	65	50	60
Chilli Con Carne	3	50	55	65	50	60
Plain Salad	3	90	90	95	70	40
Chicken or Tuna Salad	3	80	80	100	60	50
Pizza (Delivered)	2	100	10	10	50	80
Pizza (Home-baked)	2	90	70	10	50	60
Pasta and Sauce	4	75	80	55	75	50
Meat and two veg	4	60	70	80	45	50
Balancing:	Minimum Method (0.8)					

This example file also includes some user defined selections on the "User Defined Selections" tab. This can be used to compare your own selections against the optimal value. The "User Defined Selections" tab for this example file is shown in Figure 6.

Try adding your own selections in some of the example files, and your own files. Sometimes, a desired selection is almost as optimal as the one calculated by Portfolio Picker.
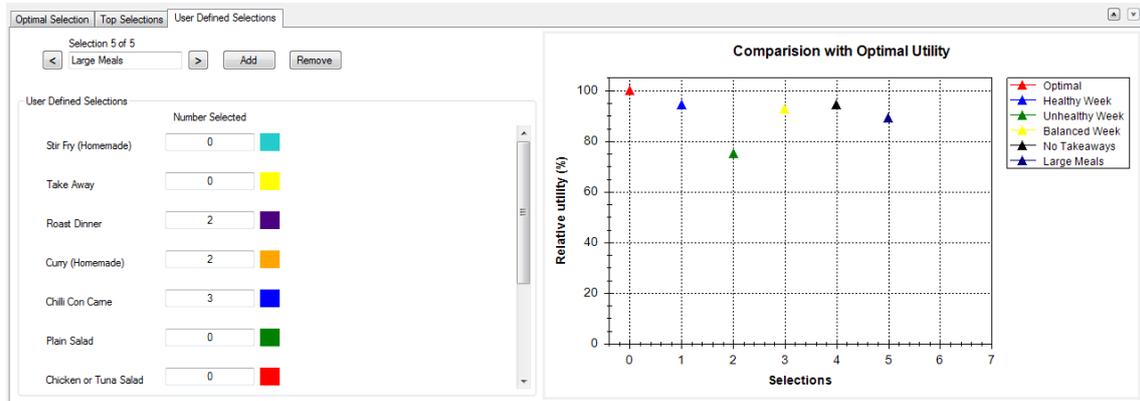

Figure 6: The "User Defined Selections" tab for WeakMealPlanner.ppf

4.3 Apples, Oranges, and Pears

This example demonstrates how the different balancing strategies can have a rather large impact on the selection. The problem is that you want to buy four pieces of fruit, and there are three apples, three oranges, and three pears to choose from. Depending on how balanced a selection you want, Portfolio Picker gives you various different combinations. This file is called FruitSelection.ppf.

CHOOSE 4	#	Tastiness	Cheapness	Juiciness	Lack of Pips
Importance		75	50	30	60
Apples	3	8	2	1	3
Oranges	3	3	10	10	2
Pears	3	10	2	8	1
Balancing:		Vary them to see how the selection changes! The No Penalty strategy will give you the most desirable fruit, without considering how balanced the selection is. The Avoid Weak Criteria strategy will ensure that selections that do not provide enough information for a particular criterion are not considered as optimal selections. The Product and Minimum Methods consider the selections as a whole to give you different results. The Product Method (0.3) gives the most balanced selection, but varying the sliders on both of these options will give you different optimal selections.				

References

Murty K G (2003). Optimization Models for Decision Making: Volume 1 Chapter 2. Junior Level Self-Teaching Web-Book. Available at: http://www-personal.umich.edu/~murty/books/opti_model/