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Your Levy at Work

Rumen8

USER GUIDE

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INTRODUCTION

Rumen8 is a software application running on Microsoft Windows computers that allows farmers and consultants to easily manage dairy cow diets to increase production and reduce costs. It was originally developed by the staff of the Department of Agriculture and Food, Western Australia as an 'in-house' tool for managing the dairy herds on the Vasse Research Station near Busselton, Western Australia. An emphasis on ease of use sets it apart from many other nutrition packages and it is this that makes it ideal for quickly creating or checking cow diets.

Version 1 of Rumen8 was released free to the dairy industry and is used in Australia on research farms, by consultants and farm managers. Its nutrition model is suitable for the pasture-dominated diets common across Australia.

Rumen8 was given to the Western Australian dairy industry by the Department of Agriculture and Food in 2014. The new owners, Western Dairy and Dairy Australia, have provided funds to update it ensuring compatibility with contemporary versions of Windows and the addition of sought-after features to make the process of managing dairy diets even easier.

WHAT DOES RUMEN8 DO?

Rumen8 allows the user to design a diet from up to 15 feeds or mixes and ensure a cow's dietary needs are met. Multiple diets can be stored and compared and if milk and feed prices are entered, the difference between feed price and return from milk calculated.

Rumen8 uses a relatively simple nutrition model that we have found accurate enough over many years using it on farms and Research Stations. More sophisticated models of dairy cow nutrition exist but they require a higher level of user knowledge, depend on less readily available and more expensive feed analyses, and require more time to use. We have found that Rumen8 provides a good balance between ease and speed of use and performance that is fitting for the pasture-dominated dairy diets common in Australia.

Dairy Australia have independently evaluated Rumen8 version 1 (many years before they owned it) against a range of nutrition models in use in Australia at the time and it performed admirably. You can read the report yourself as it is available from the Rumen8 and Dairy Australia web sites (A review of 11 applied dairy nutrition models used in Australia, 2009). The nutrition model in Rumen8 version 2 & 3 is unchanged from version 1.

WHAT RUMEN8 DOESN'T DO

Like most nutrition programs, Rumen8 works on a linear response to feeding. This means it assumes the same response to a kilogram of grain whether it is the first kilogram or the tenth kilogram fed to the cow. Due to this Rumen8 can be misleading when asking questions such as 'What happens if I feed another kilogram of grain' as it presents the average response for the first diet, and then the average response for the second diet that includes the additional feed. Rumen8 cannot be used to predict the response to just the last kilogram of additional feed. Generally, we would suggest halving the marginal response for grain. When Rumen8 calculates you would get an additional 2 litres of milk for an extra 1 kg of grain, we suggest you reduce the predicted milk response by half (in this case to 1 litre).

A WARNING BEFORE YOU START

Like any cow nutrition application, Rumen8 depends on a model of a cow that it 'feeds' and then estimates milk production and growth. No model is completely accurate and it is possible to create a balanced diet in Rumen8 that will reduce cow performance or even adversely affect their health. For this reason, we recommend Rumen8 is used with your nutritionist, and depending on your level of knowledge, between their visits to adjust diets.

That statement leads us on nicely to the inevitable disclaimer.

TERMS AND CONDITIONS

While all reasonable efforts have been taken to ensure the accuracy of the Rumen8 application, use of the information it provides is at one's own risk. To the fullest extent permitted by Australian law, Western Dairy, Dairy Australia and the developers disclaims all liability for any losses, costs, damages and the like sustained or incurred as a result of the use of or reliance upon the information provided, including liability stemming from reliance upon any part which may contain inadvertent errors, whether typographical or otherwise, or omissions of any kind.

ACKNOWLEDGEMENTS

Martin Staines and Richard Morris developed Rumen8 while they were employed by the Department of Agriculture and Food, Western Australia. The Western Australian Government gave Rumen8 to the Western Australian dairy industry. Thanks must go to the Board of Western Dairy for seeing value in it and providing a home and funds for development of subsequent versions.

WHAT'S NEW IN VERSION 3?

- The number of diet ingredients has been increased from 10 to 15.
- The window layout has been improved with important diet financial parameters always visible.
- Feed mixes can be created and used in multiple diets as a single ingredient.
- Animal demand and supply of the minerals calcium, phosphorous and magnesium has been included.
- The feed library has been updated and expanded to over 250 feeds.
- Diet DCAD is now calculated if ingredient DCAD is available.
- Greatly expanded help and nutrition information is available via tooltips (hover the mouse pointer over an item to see them).
- Four sets of recommended levels (early, mid or late lactation for example) can be set for important diet parameters by the user and then feedback is provided via traffic lights on the Diet tabs.
- Notes about the current diet can be kept within Rumen8.
- An expanded range of cost, margin and feed efficiency parameters are now calculated for each diet allowing better comparisons between diets.
- ME and MP Detail windows can remain open while changes are made to the diet allowing easier monitoring of supply and demand calculations.
- The Fat: Protein ratio and energy corrected milk have been added to the Animal tab.
- The Forage: Concentrate ratio is now calculated for the diet.
- Concentration and proportion units can be changed to percent by the user in the Preferences.
- Multiple feed libraries are now supported.
- The Optimiser now works with Microsoft Excel 2010, 2013 and 2016.
- Animal activity has been simplified.
- The standard cows have been expanded to include 9000 and 10000 litre lactations.
- Changing animal values has been made faster and easier with sliders instead of input boxes.
- Days in milk and days pregnant can now be set on a calendar.
- Diets being compared can now have a description.
- The dry cow period has been split into early and springer mobs.
- Energy, protein and ingredient details are now accessible from the menu.
- Feed and mix details are available by hovering the mouse over the ingredient name.
- The traffic lights are now suitable for most colour blind users.
- Diet ingredient amounts can be entered as fed or as dry matter.
- The total diet weight is now displayed as fed and on a dry matter basis.
- The Preferences can be reset to the default values.
- The Preferences have been split into General and Advanced options.
- Rumen8 is compatible with Windows 10.
- Amino acids have been removed.
- A saved diet file (.rm8) has been associated with Rumen8 so can be opened in Windows Explorer.
- Rumen8 files are now databases so are independent of text file localisation.
- Rumen8 version 2 diet files can be imported.
- Updated User Guide and Training Manual along with a new Feed Companion.

GETTING STARTED

SYSTEM REQUIREMENTS

Rumen8 requires the Microsoft Windows operating system to run. This can be Windows Vista, 7, 8(8.1) or 10. It is recommended you have run Windows Update and installed all the updates recommended by Microsoft.

If your computer can run Windows adequately, it will be sufficient to run Rumen8. The minimum screen resolution required to run Rumen8 comfortably is 1280 x 800 pixels.

Rumen8 requires the Microsoft NET Framework version 4 or higher to be installed. If your computer has been fully updated this will be installed automatically.

UPGRADING FROM RUMEN8 VERSION 2

Rumen8 version 3 can be installed on a computer that already has Rumen8 version 2 installed and they will run independently of each other and will not share library files.

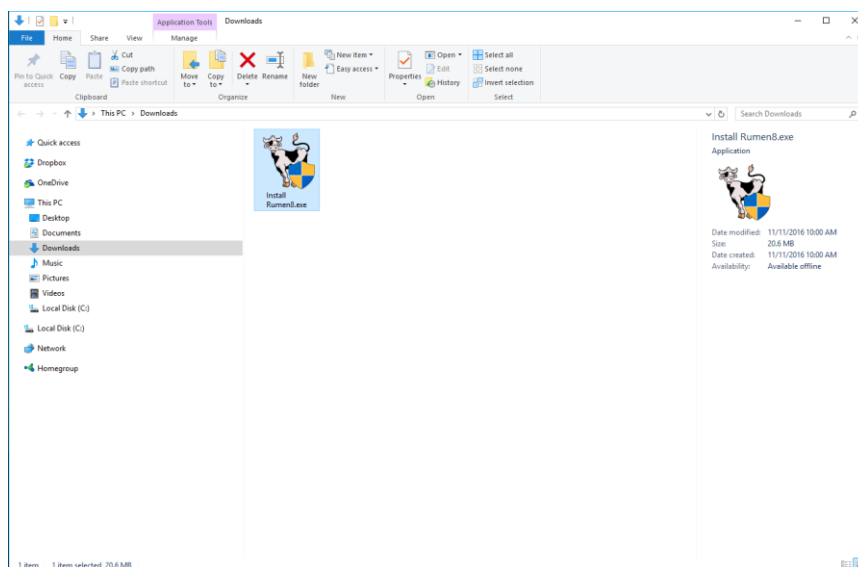
Rumen8 version 3 uses a new file format for diet, feed library, milk price and preference files (the old cow.csv file is now included in the preferences). Old diet and feed libraries can be imported into Rumen8 from the File menu and in the Feed Editor.

INSTALLATION

The Rumen8 setup file can be downloaded from the Downloads page of the Rumen8 website at <http://www.rumen8.com.au>

Once the executable file has been saved to your Downloads folder (the default Windows download destination) double click on the file in Windows Explorer to commence the installation process.

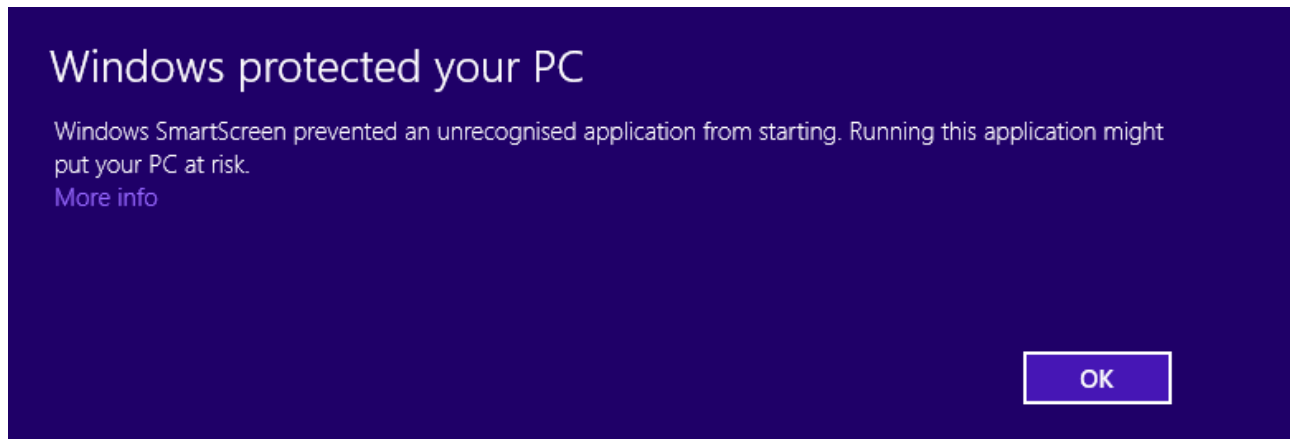
Figure 1. The Windows 10 Downloads folder with the 'Install Rumen8' application ready to be run.



Windows SmartScreen problems with Windows 8 and 10

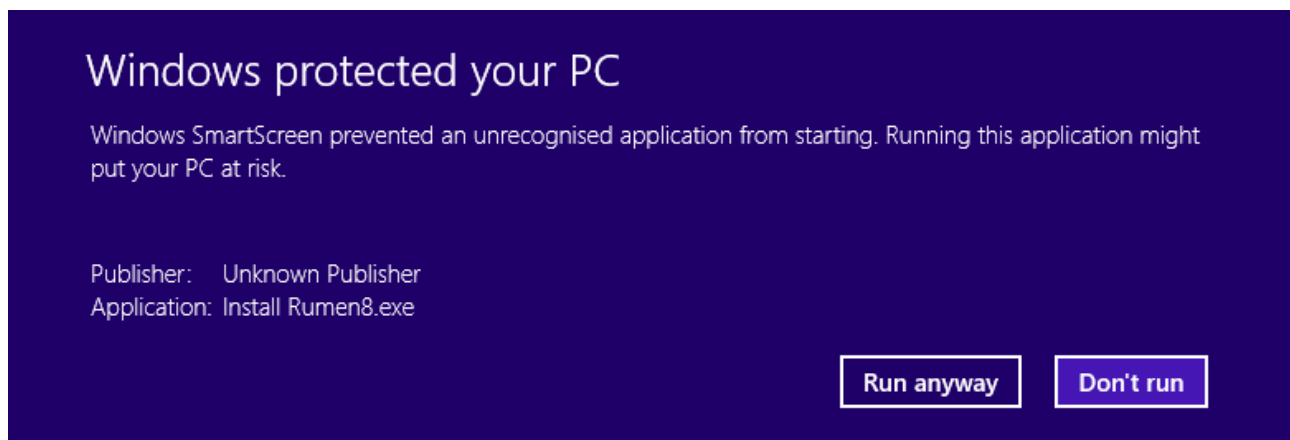
Microsoft has added another layer of security to try and protect their users from malicious downloads. Unfortunately, it is not obvious what to do if you trust the downloaded file. The Rumen8 download may trigger a warning because it is from a software developer Microsoft do not recognise. When you double click on the Rumen8 install executable a warning banner will appear across the centre of the screen.

Figure 2. Windows 8 & 10 unknown software developer warning.



Simply click on the 'More info' link and the option to run the installer anyway will appear.

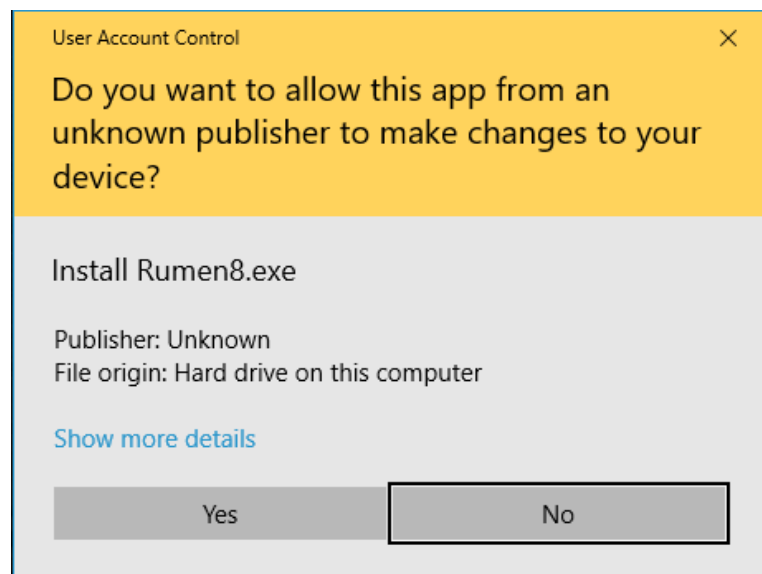
Figure 3. Run the installer anyway option exposed.



Click on the 'Run anyway' button to continue installing Rumen8.

Windows may ask for confirmation that you want to allow the following program from an unknown publisher to make changes to this computer.

Figure 4. Windows user access control during Rumen8 installation.



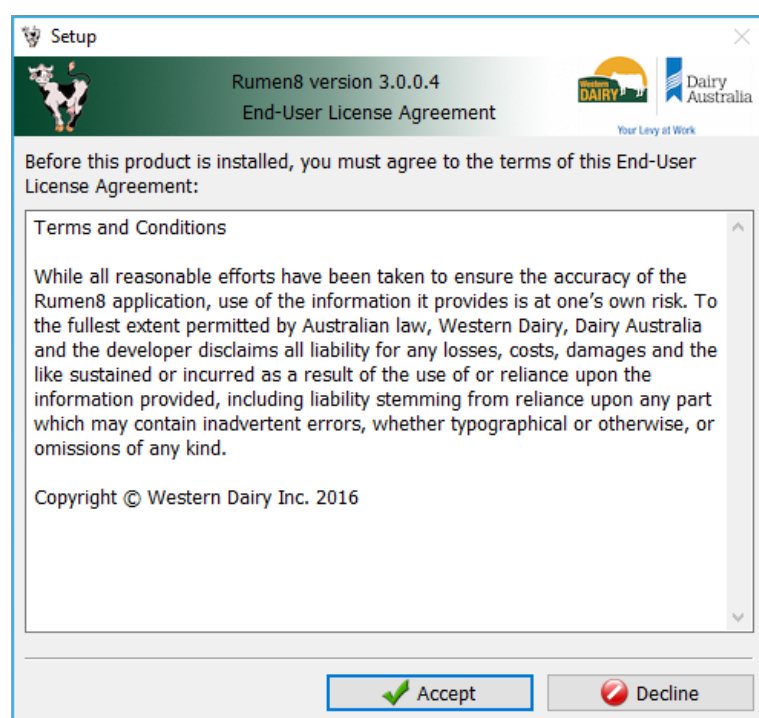
Click 'Yes' to continue the installation and the Rumen8 Setup Wizard will appear.

Figure 5. The Rumen8 setup wizard.



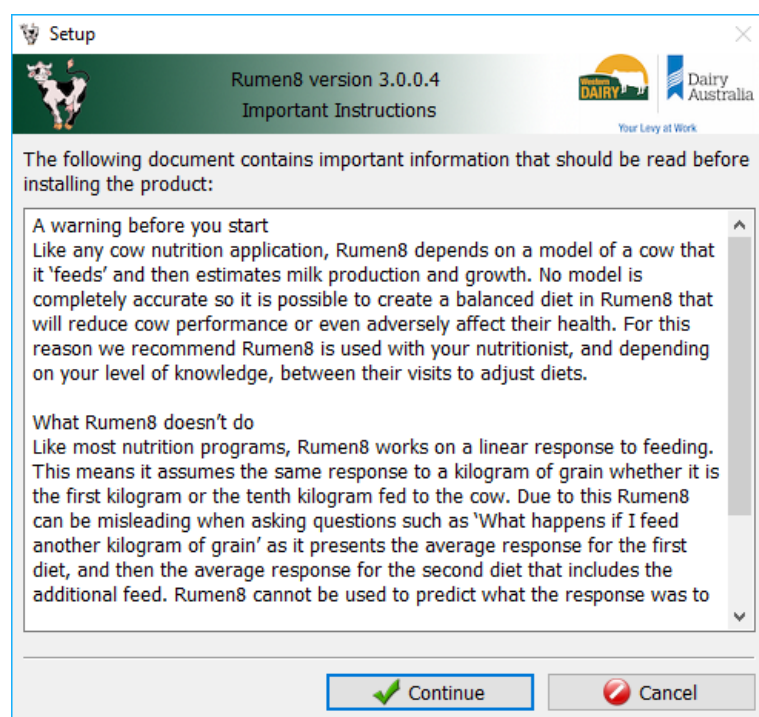
Click on the 'Continue' button to continue to the license agreement window.

Figure 6. The Rumen8 license agreement window.



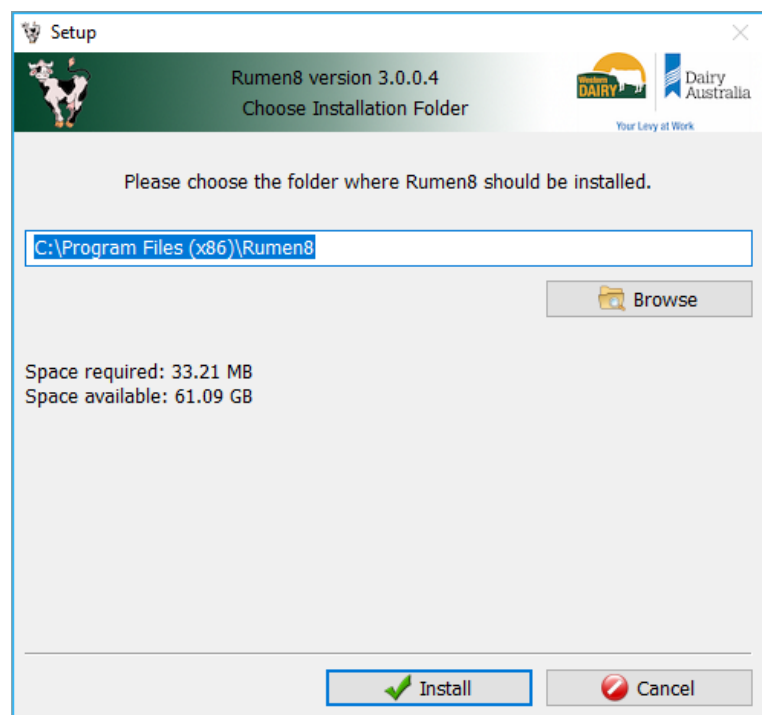
Read the Terms and Conditions and if you agree with them click on the 'Accept' button and move to the 'Important Instructions' window. This covers the limitations of nutrition software like Rumen8 and suggests it should be used alongside your nutritionist to ensure no cow health or production issues arise from its use.

Figure 7. The Rumen8 'Important Instructions' window.



If you agree click the 'Continue' button to choose the installation folder.

Figure 8. The installation folder window.



Use the 'Browse' button to change the installation folder if required. The default folder will be suitable for almost everyone.

Click on the 'Install' button to confirm installation. You may get a window open asking you to confirm the creation of the installation folder. Just click on 'Yes' to continue.

Figure 9. Rumen8 is installing.

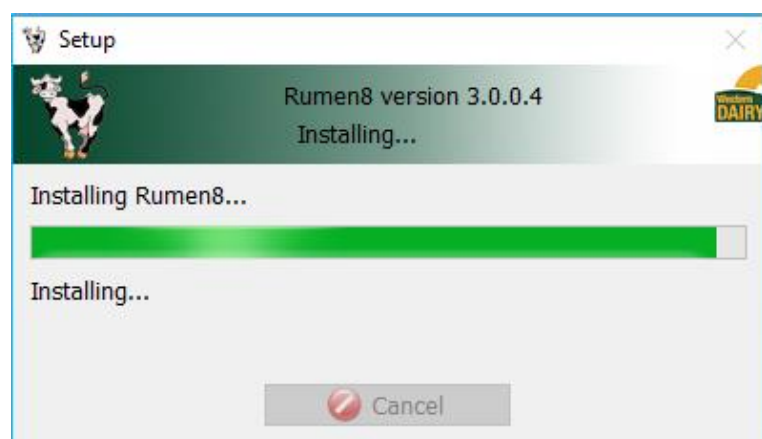
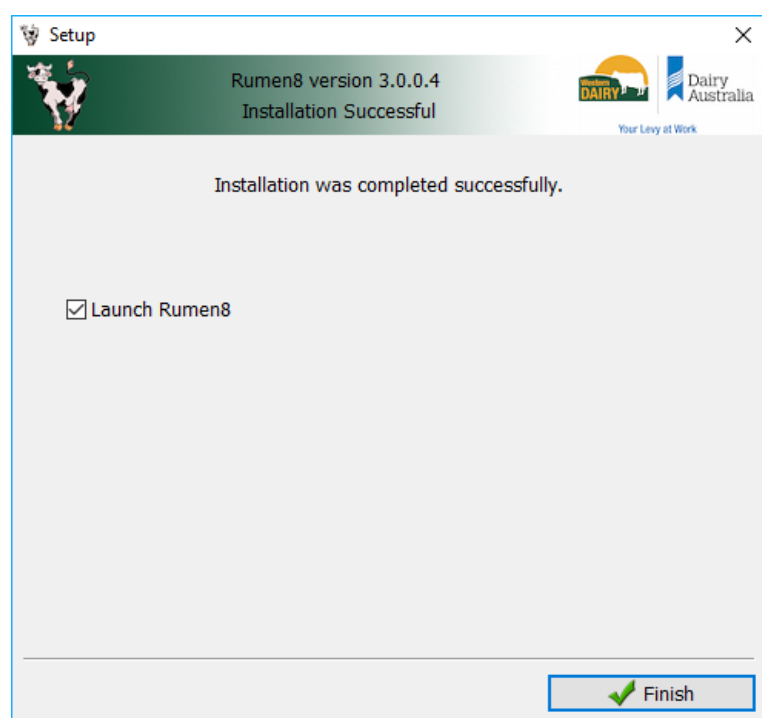


Figure 10. The installation is complete.

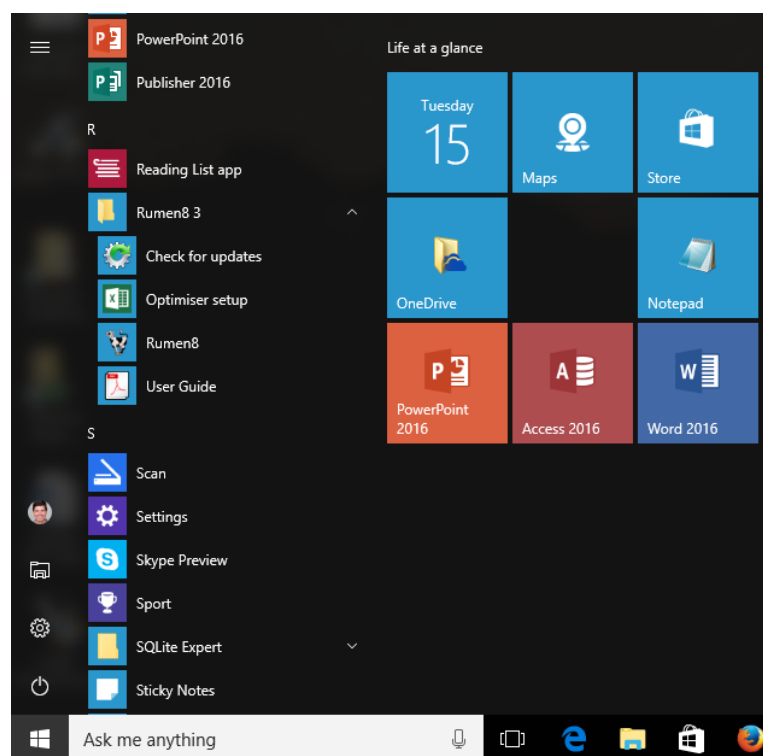


Installation of Rumen8 is complete, click on the 'Finish' button to exit the installer and run Rumen8 for the first time. The installer also creates a Rumen8 icon on the Desktop so you can start it from there or in the Applications list of the Windows Start button.

STARTING RUMEN8 FOR THE FIRST TIME

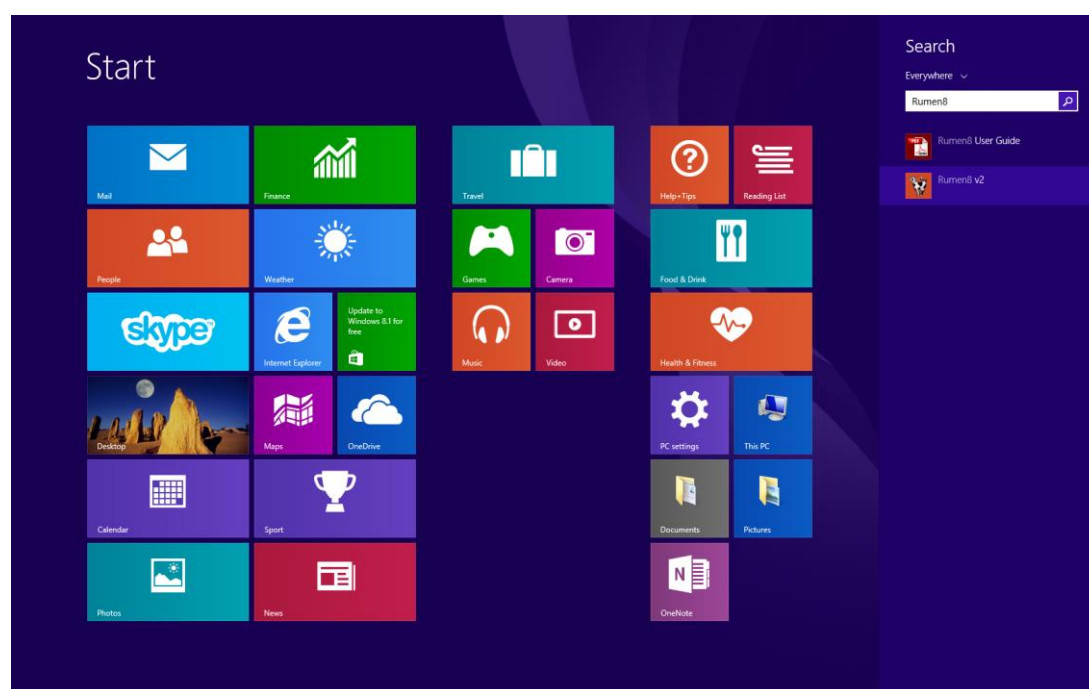
Rumen8 can be started from the Start Menu of Windows Vista, 7 and 10 in the 'All programs' list. The Windows 7 start menu is shown in the figure below. Options to Pin the Rumen8 icon to the Taskbar, Start menu or Send a shortcut to the Desktop can be accessed by right clicking on the Rumen8 icon.

Figure 11. Starting Rumen8 under Window 10.



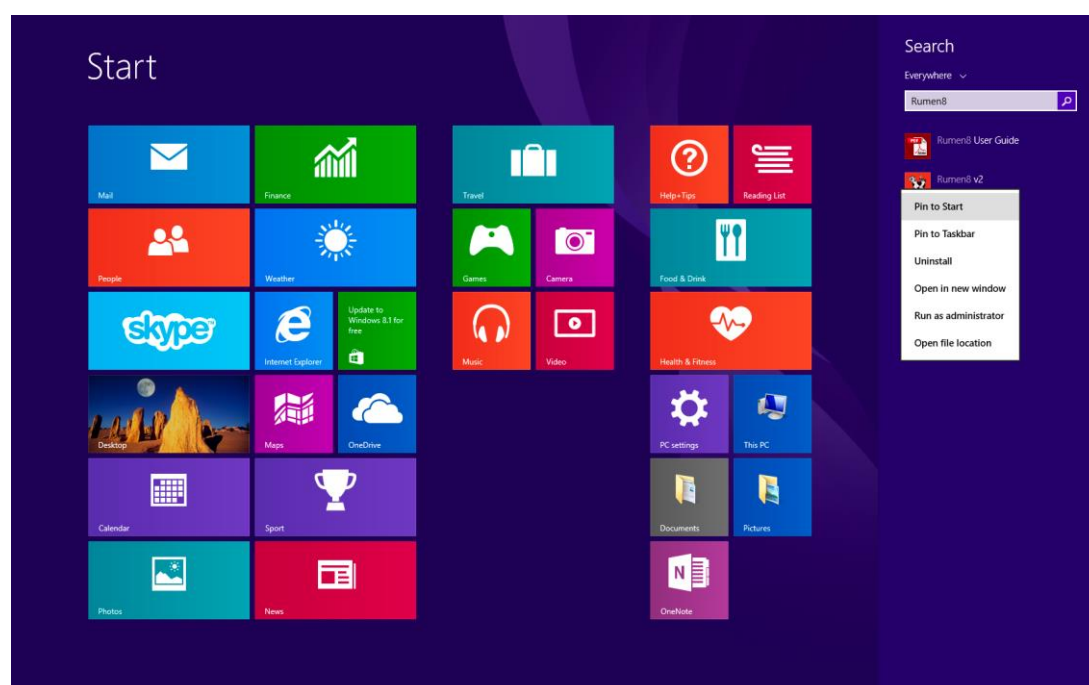
For Windows 8 users type 'Rumen8' while in the Modern tiled interface and options to install, run and read the Rumen8 User Guide will appear in the search window down the right of the screen.

Figure 12. Starting Rumen8 for the first time in Windows 8.



To pin an icon to the tile interface and the Desktop so you can start Rumen8 without typing its name in the future, right click on the Rumen8 icon. Select 'Pin to Start' and/or 'Pin to Taskbar' to place the Rumen8 icon in these locations.

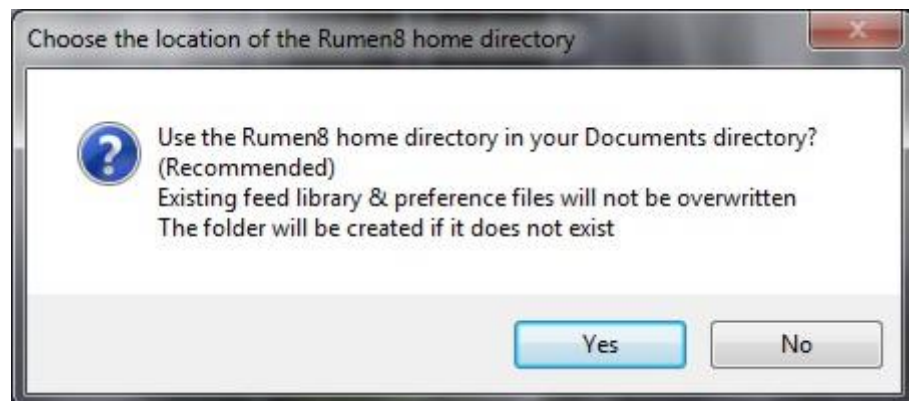
Figure 13. Pin the Rumen8 icon to the Start bar and Taskbar.



Finally, left click on the Rumen8 icon to start the application.

When Rumen8 starts for the first time it will ask you where to create a Rumen8 folder into which will be placed a Libraries folder with your copy of the feed library, preferences and milk prices files. Copying these files may take a few minutes so the first time you run Rumen8 it will take a little longer to get to the main window than normal.

Figure 14. Choose the location of the Rumen8 folder.



Your Documents folder is the recommended location as this is easy to access and is more likely to get backed up. If you are happy with the default location click the 'Yes' button but if you would like another location for the Rumen8 folder click 'No'. This will take you to a folder browser where you may specify the location yourself.

Rumen8 will then create a folder called 'Rumen8' at the chosen location and within it another folder called 'Libraries'. In this folder will be copied a feed library, preferences and milk prices file used by the application for this user. If multiple users use the computer, each user will have their own copy of the Rumen8 library files and can tailor Rumen8 for their own requirements.

If a folder called 'Rumen8' already exists in the location you have chosen it will be used and no files will be deleted. If a 'Libraries' folder already exists within the Rumen8 folder it will also be used. If you already have the library files from a previous installation in the Libraries directory they will be left untouched and the defaults not copied from the application folder. In this way you can remove and reinstall Rumen8 manually and your feed library and settings will remain.

If you wish to revert to the default original version of any of the library files just delete them and then start Rumen8 and it will offer to copy a new file as a replacement.

The Rumen8 folder is the recommended location for your saved diet files.

The main Rumen8 window will now open ready for use.

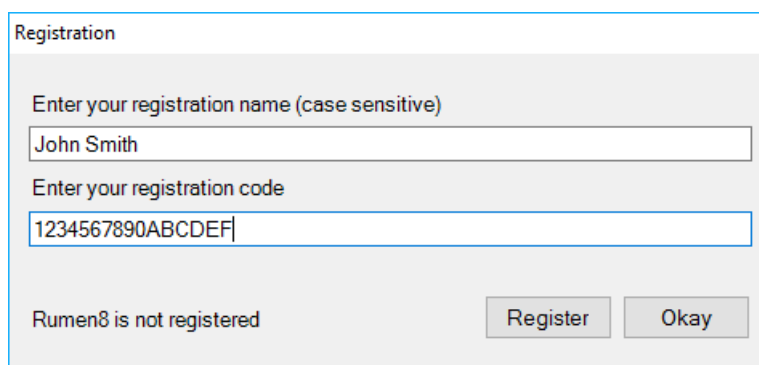
REGISTERING RUMEN8

When Rumen8 is run for the first time it will start in trial mode. This allows you to use all the functions of the application but you are restricted to diets with only two ingredients. To get full access to all the diet ingredients please register, which is free. We ask you to register so we have an estimate of the number of people using the application. This information will be used for future funding applications for further development. By not registering or if you share your registration name and number you may reduce the chance of future improvements to Rumen8.

To register send an email to support@rumen8.com.au specifying the name you would like to register and the email address you would like to be contacted on if it is different to the one used to send the email. Your email will only be used to contact you for registration purposes and very infrequently for matters concerning Rumen8 in the future. It will not be passed on to any other person or group. You should receive a registration email within 48 hours containing a registration code that is linked to your name.

If you go to the Registration option under the Help menu you can enter your name and registration number exactly as specified in the email from Rumen8 support. The best way to be sure you have entered them exactly is by using copy (control-c) and paste (control-v) to copy them from the email and then paste them into Rumen8. Click the 'Register' button and all the feed ingredients will become available.

Figure 15. Entering registration details.



The screenshot shows a 'Registration' dialog box with a light gray background. At the top, the title 'Registration' is in a darker gray bar. Below the title, there are two text input fields. The first field is labeled 'Enter your registration name (case sensitive)' and contains the text 'John Smith'. The second field is labeled 'Enter your registration code' and contains the text '1234567890ABCDEF'. At the bottom left of the dialog, the text 'Rumen8 is not registered' is displayed. At the bottom right, there are two buttons: 'Register' and 'Okay'.

REMOVING YOUR RUMEN8 REGISTRATION

If you plan to give your computer to someone else, before uninstalling Rumen8 go to the Registration option under the Help menu and click the 'Deregister' button. Your name and registration code will be removed from the machine and Rumen8 will revert to trial mode.

QUICK START GUIDE

Start Rumen8 and the main screen will open. If you are unsure what something within Rumen8 is, hover your mouse over it and for most objects a tooltip will appear providing a more detailed explanation.

The Rumen8 window is shown below and is divided into 3 sections. The Diet Ingredients section where you specify the animal diet (1), the tabbed section where you can specify the cow details, evaluate the current diet, adjust feed costs and milk payments, compare alternative diets and keep notes (2) and the bottom costs and efficiency strip that reports feed costs, milk income, feed efficiency and margins (3).

Figure 16. The sections of the main Rumen8 window. Diet ingredients (1), detail tabs (2) and diet costs and efficiencies (3).

The screenshot shows the Rumen8 software interface. The top menu bar includes 'File', 'Edit', 'Animal', 'View', and 'Help'. The main window is titled 'New Diet - Rumen8 registered to Richard Morris'. The interface is divided into three main sections, numbered 1, 2, and 3.

Section 1: Diet ingredients (left side)

	DM	As Fed
1. None	0.00	0.00
2. None	0.00	0.00
3. None	0.00	0.00
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00

Section 2: Animal details (right side, under the 'Animal' tab)

Breed: Holstein

Live weight (kg): 600

Live weight change (kg/d): 0.0

Days pregnant: 31

Days in milk: 31

Number of cows in herd: 1

Milk yield (L/d): 25.0

Milk fat (% m/v): 4.0

Milk true protein (% m/v): 3.0

Fat:Protein ratio: 1.33

Fat, Protein, F+P (kg/d): 1.00 0.75 1.75

Energy corrected: 0.98 0.81 1.80

Cow Activity: Flat (selected), Undulating, Steep

Farm terrain: Distance walked (km/d) 5.0

Section 3: Costs and Efficiencies (bottom)

Feed costs	Milk income	Feed efficiency	Margin
\$/tonne -	\$/L raw milk -	Kg ECM/kg DM -	\$/cow/day -
c/MJ ME -	\$/kg ECM -	Gm MS/kg DM -	\$/herd/day -
\$/kg CP -	\$/kg MS -	\$Milk/\$Feed -	Feed % income -
\$/cow/day -	\$/cow/day -		Milk yield adjustment (L/d) 25.0

Click on the 'Animal' tab to show the cow description.

DESCRIBE A COW

Using the entry sliders describe the cow you wish to feed, or the average cow that represents your herd. You can adjust live-weight, growth rate, milk yield and components, stage of lactation and number of days pregnant. Less important parameters let you adjust the activity level of the cow if you have a large or hilly farm.

Figure 17. The Animal tab.

New Diet* - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients

	DM	As Fed
1. None	0.00	0.00
2. None	0.00	0.00
3. None	0.00	0.00
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00

Animal | Diet | Diet detail | Milk price | Feed cost | Compare | Notes

Breed: Holstein

Live weight (kg): 600

Live weight change (kg/d): 0.0

Days pregnant: 31

Days in milk: 31

Number of cows in herd: 1

Milk yield (L/d): 30.0

Milk fat (% m/v): 4.0

Milk true protein (% m/v): 3.2

Fat:Protein ratio: 1.25

Fat, Protein, F+P (kg/d): 1.20 0.96 2.16

Energy corrected: 1.20 0.99 2.19

Cow Activity

Farm terrain: Distance walked (km/d) 5.0

☒ Flat ☐ Undulating ☐ Steep

Feed costs		Milk income		Feed efficiency		Margin	
\$/tonne	-	\$/L raw milk	-	Kg ECM/kg DM	-	\$/cow/day	-
c/MJ ME	-	\$/kg ECM	-	Gm MS/kg DM	-	\$/herd/day	-
\$/kg CP	-	\$/kg MS	-	\$Milk/\$Feed	-	Feed % income	-
\$/cow/day	-	\$/cow/day	-			Milk yield adjustment (L/d)	30.0

Now click on the 'Diet' tab to the right of the 'Animal' tab to view how well our diet will feed the cow. It doesn't show anything as we have not added any ingredients to the diet.

Figure 18. The Diet tab.

New Diet* - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients

	DM	As Fed
1. None	0.00	0.00
2. None	0.00	0.00
3. None	0.00	0.00
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00

Diet | Animal | Diet detail | Milk price | Feed cost | Compare | Notes

Dry Matter Intake - % Limit

Metabolisable Energy - % Req't

Metabolisable Protein - % Req't

Calcium - % Req't

Phosphorus - % Req't

Magnesium - % Req't

NDF (% DM) - %

Starch (% DM) - %

Forage: Conc. ratio -

Feed costs		Milk income		Feed efficiency		Margin	
\$/tonne	-	\$/L raw milk	-	Kg ECM/kg DM	-	\$/cow/day	-
c/MJ ME	-	\$/kg ECM	-	Gm MS/kg DM	-	\$/herd/day	-
\$/kg CP	-	\$/kg MS	-	\$Milk/\$Feed	-	Feed % income	-
\$/cow/day	-	\$/cow/day	-			Milk yield adjustment (L/d)	30.0

ENTER A DIET

Fifteen ingredients can be added to a diet using the drop-down lists on the left of the window. Click on ingredient 1 and select 'Barley grain' as our first feed in the diet.

Figure 19. Selecting a feed in the first diet component menu.

The screenshot shows the 'New Diet' window with the 'Diet ingredients' list on the left. Ingredient 1 is selected, and a dropdown menu is open showing various feed options. 'Barley grain' is highlighted. The 'DM' and 'As Fed' columns show 0.00 for all ingredients. The right panel shows various nutritional requirements and limits, such as Dry Matter Intake, Metabolisable Energy, and Metabolisable Protein.

Diet ingredients	DM	As Fed
1. None	0.00	0.00
2. None	0.00	0.00
3. Canola meal	0.00	0.00
4. Lupins grain	0.00	0.00
5. Oats grain	0.00	0.00
6. Ryegrass - Dryland - early annual	0.00	0.00
7. Ryegrass - Dryland - late annual	0.00	0.00
8. Ryegrass/clover hay - Average	0.00	0.00
9. Ryegrass/clover hay - Good	0.00	0.00
10. Ryegrass/clover hay - Poor	0.00	0.00
11. Ryegrass/clover silage - Average - Pit	0.00	0.00
12. Ryegrass/clover silage - Average - Round	0.00	0.00
13. Ryegrass/clover silage - Good - Pit	0.00	0.00
14. Ryegrass/clover silage - Good - Round	0.00	0.00
15. Ryegrass/clover silage - Poor - Pit	0.00	0.00
16. Ryegrass/clover silage - Poor - Round	0.00	0.00
17. Urea	0.00	0.00
18. Wheat grain	0.00	0.00

Feed costs

\$/tonne	-
c/MJ ME	-
\$/kg CP	-
\$/cow/day	-

Milk income

\$/L raw milk	-
\$/kg ECM	-
\$/kg MS	-
\$/cow/day	-

Feed efficiency

Kg ECM/kg DM	-
Gm MS/kg DM	-
\$Milk/\$Feed	-

Margin

\$/cow/day	-
\$/herd/day	-
Feed % income	-

Milk yield adjustment (L/d) 30.0

Select 'Lupins grain' for ingredient 2 and 'Ryegrass – Dryland – late annual' in ingredient 3. The diet should now look like the figure below.

Figure 20. Three ingredients in the diet.

The screenshot shows the 'New Diet' window with three ingredients selected: Barley grain, Lupins grain, and Ryegrass - Dryland - late annual. The 'DM' and 'As Fed' columns show 0.00 for all ingredients. The right panel shows various nutritional requirements and limits, such as Dry Matter Intake, Metabolisable Energy, and Metabolisable Protein.

Diet ingredients	DM	As Fed
1. Barley grain	0.00	0.00
2. Lupins grain	0.00	0.00
3. Ryegrass - Dryland - late annual	0.00	0.00
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00

Feed costs

\$/tonne	-
c/MJ ME	-
\$/kg CP	-
\$/cow/day	-

Milk income

\$/L raw milk	-
\$/kg ECM	-
\$/kg MS	-
\$/cow/day	-

Feed efficiency

Kg ECM/kg DM	-
Gm MS/kg DM	-
\$Milk/\$Feed	-

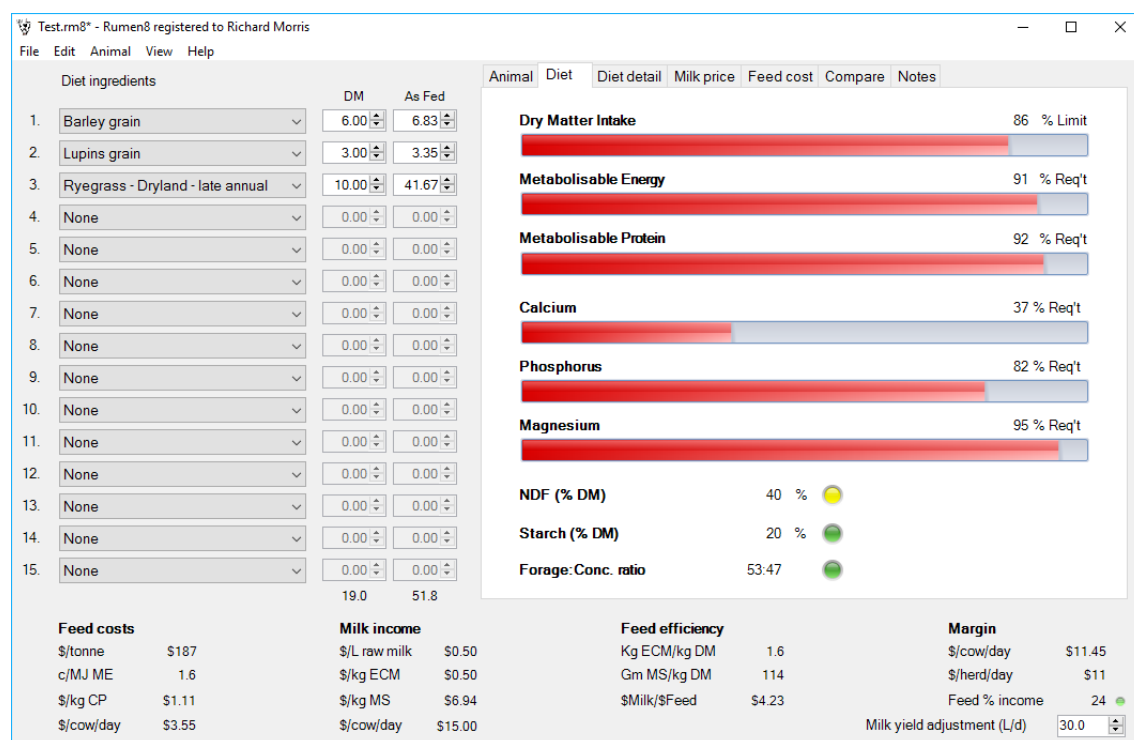
Margin

\$/cow/day	-
\$/herd/day	-
Feed % income	-

Milk yield adjustment (L/d) 30.0

Now let's feed our cow. Enter the amount of each ingredient fed to the cow using the 'DM' entry box to the right of their name. Enter 6 kilograms of barley grain, 3 kilograms of lupins grain and 10 kilograms of ryegrass. The window should now look like the figure below.

Figure 21. Feeding our cow.



EVALUATE A DIET

The 'Diet' tab shows nine of the parameters you need to consider when formulating a diet for dairy cows. For this example we will consider the first three. With the current diet, we can see there is insufficient metabolisable energy (ME 91%) and protein (MP 92%) for the cow we described earlier. However, the cows' dry matter intake is only 86% of her potential so this means she can physically eat more food if it is presented to her.

Increase the amount of barley grain to 8.3 kg, the lupins to 3.7 kg and decrease the ryegrass to 8.2 kg. Now you will see both ME and MP are at 100% of the cow requirement and intake potential is still below 100% so she can eat this amount of feed. Your screen should look like the figure below.

Figure 22. A diet balanced for energy and protein.



This brings us to a very important point that is true of all nutrition models. The application tells us we have a diet that meets the ME, MP and intake requirements of our cow, but a nutritionist is unlikely to recommend this particular diet. The starch content and the proportion of the diet that is highly digestible concentrate are high (25% and 59% respectively) leading to a risk of acidosis. That is before we consider the lost production from feeding our cows less than they can eat.

Rumen8 is a tool that will assist someone with nutritional knowledge to better and more cost effectively feed their cows, but in the hands of someone without that knowledge it can create diets that appear balanced on paper but may decrease cow performance or adversely affect their health.

We recommend Rumen8 is used with your nutritionist and depending on your level of knowledge, used to adjust diets between their visits.

This diet is now balanced for energy and protein and the cow can physically eat the feed when it is presented to her. This demonstrates the process when designing a diet for your cows, and you can now further refine the diet by looking at other important parameters such as starch and NDF content. More information about the current diet is presented in the 'Diet detail' tab.

The remaining tabs allow you to change milk payment ('Milk price' tab) and the cost of the feeds in the current diet ('Feed cost' tab). With feed costs and milk price Rumen8 can show you diet costs and margins to better compare alternatives. Use the 'Compare' tab to save and compare related diets before choosing the best one. The 'Notes' tab allows you to keep a description of the diet for reference in the future. How to use these functions is detailed in 'Using Rumen8' section of this document.

THE PROBLEM OF MEASURING PASTURE INTAKE

It all sounds simple, choose the ingredients your cows are being fed, enter the quantities you provide and balance the diet. Easy, but what about grazed pasture? Accurately measuring how much grazed pasture a cow eats is very expensive and time consuming so may not be done on farm. To solve this problem, we 'back calculate' how much pasture the cows are eating by subtraction of all the ingredients you do know. It is easier than it sounds.

1. Enter the values that describe the average cow in your herd on the 'Animal' tab. Include the current milk production and yield. Rumen8 will calculate the metabolisable energy needed for the cow and this is displayed on the 'Diet' and 'Diet detail' tabs.
2. Add all the supplementary feed provided to the cows to the Diet ingredients drop-down lists. This includes grain fed in the dairy and forages in the paddock. Everything except grazed pasture.
3. Rumen8 now calculates the metabolisable energy provided by the supplements and the difference between this and the cow's requirement must be supplied by grazed pasture. This is shown on the 'Diet detail' tab as the 'Balance' under the 'Metabolisable energy' section and the remaining percentage of the metabolisable energy bar on the 'Diet' tab.
4. Select a suitable pasture for your farm and time of year and as the next diet ingredient. Increase the quantity of this until the metabolisable energy provided by the diet is the same as the requirement of the cow.

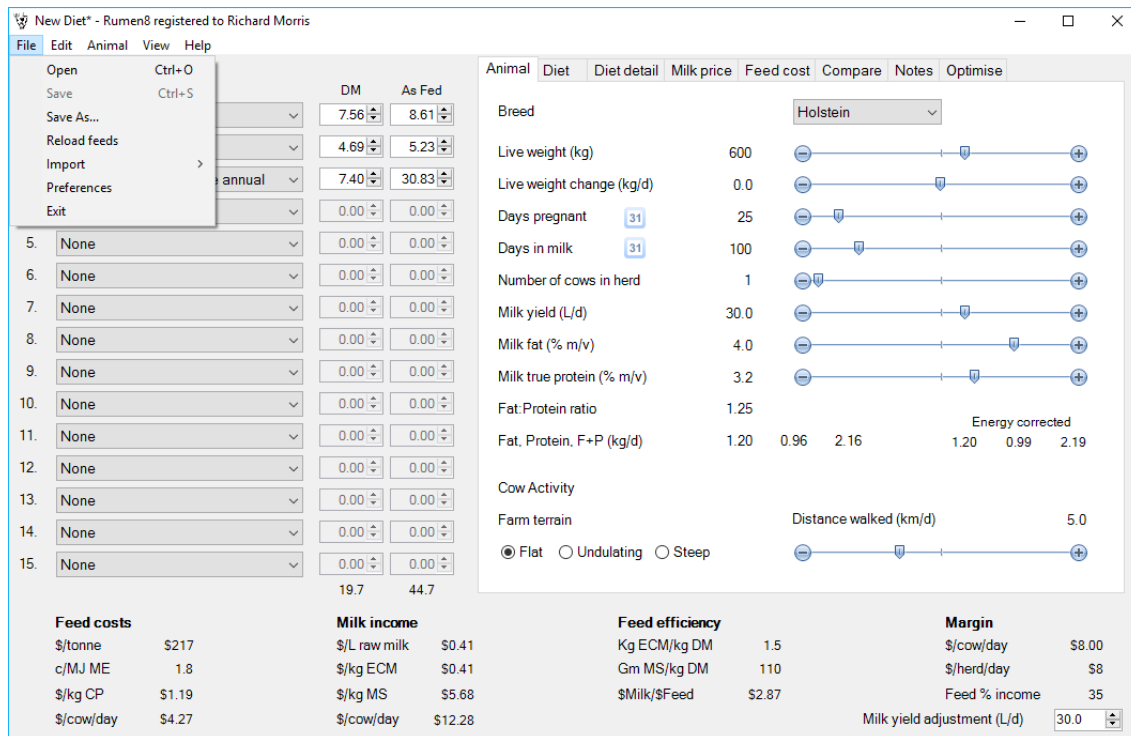
You now have the diet that reflects the current situation with an estimate of the amount of pasture each cow is eating. With this information you can explore alternative diets that include pasture assuming you will maintain the amount of pasture on offer for the herd in the future.

MENU COMMANDS

The menu is along the top of the main window and has five choices, File, Edit, Animal, View and Help.

FILE MENU

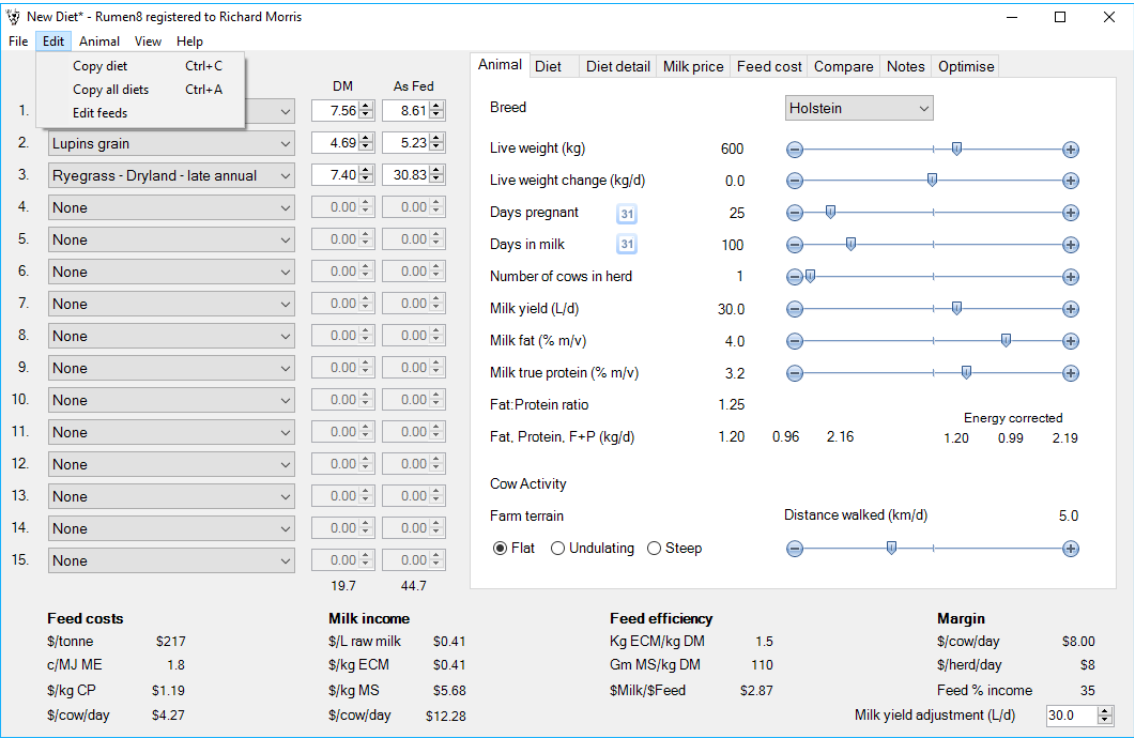
Figure 23. The File menu.



Open	Allows you to load a previously saved diet.
Save	Save the current diet. This is only available if the diet has been previously named and saved using the 'Save As' menu.
Save As	Name and then save the current diet. If changes to the current diet have not been saved an * will appear next to the diet name in the title bar.
Reload feeds	This updates all the feed data from the feed library. This is useful if you have multiple instances of Rumen8 running and have made a change to a feed in one of them and wish to quickly update the others.
Import	This will import a Rumen8 version 2 diet file.
Preferences	Opens the Preferences allowing you to change Rumen8 settings. A more detailed explanation is given in the Preferences section.
Exit	Close Rumen8. You will be prompted to save an unsaved diet.

EDIT MENU

Figure 24. The Edit menu.



- Copy diet Copy the current diet to the clipboard for later pasting into Excel or Word for example.
- Copy all diets Copy the current diet and the three stored diets to the clipboard.
- Edit feeds Opens the Feed Editor to change feeds and mixes and the ingredients available in the ingredient drop-down lists. A more detailed explanation is given in the Feed Editor section.

ANIMAL MENU

Figure 25. The Animal menu.

The screenshot shows the Rumen8 software interface. The 'Animal' menu is open, displaying options: 'Save current animal as the default', 'Reload default animal', 'Use standard animal', 'Dry off the current animal', and 'Move current animal into springer mob'. The main window shows a Holstein cow with various input fields and sliders for parameters like live weight, pregnancy, lactation, and milk production. At the bottom, there are summary tables for feed costs, milk income, feed efficiency, and margin.

Feed costs		Milk income		Feed efficiency		Margin	
\$/tonne	\$217	\$/L raw milk	\$0.41	Kg ECM/kg DM	1.5	\$/cow/day	\$8.00
c/MJ ME	1.8	\$/kg ECM	\$0.41	Gm MS/kg DM	110	\$/herd/day	\$8
\$/kg CP	\$1.19	\$/kg MS	\$5.68	\$Milk/\$Feed	\$2.87	Feed % income	35
\$/cow/day	\$4.27	\$/cow/day	\$12.28			Milk yield adjustment (L/d)	30.0

Save current animal as the default

Save the current animal as the default that will be loaded each time Rumen8 starts.

Reload default animal

Replace the current animal with the default animal.

Use standard animal

Replace the current animal with a pre-defined generic cow in early, mid or late lactation for total lactation production of 5000 to 10000 litres. These definitions should only be used for general analyses. For on-farm use actual milk production and composition for the herd of interest should be used.

Dry off the current animal

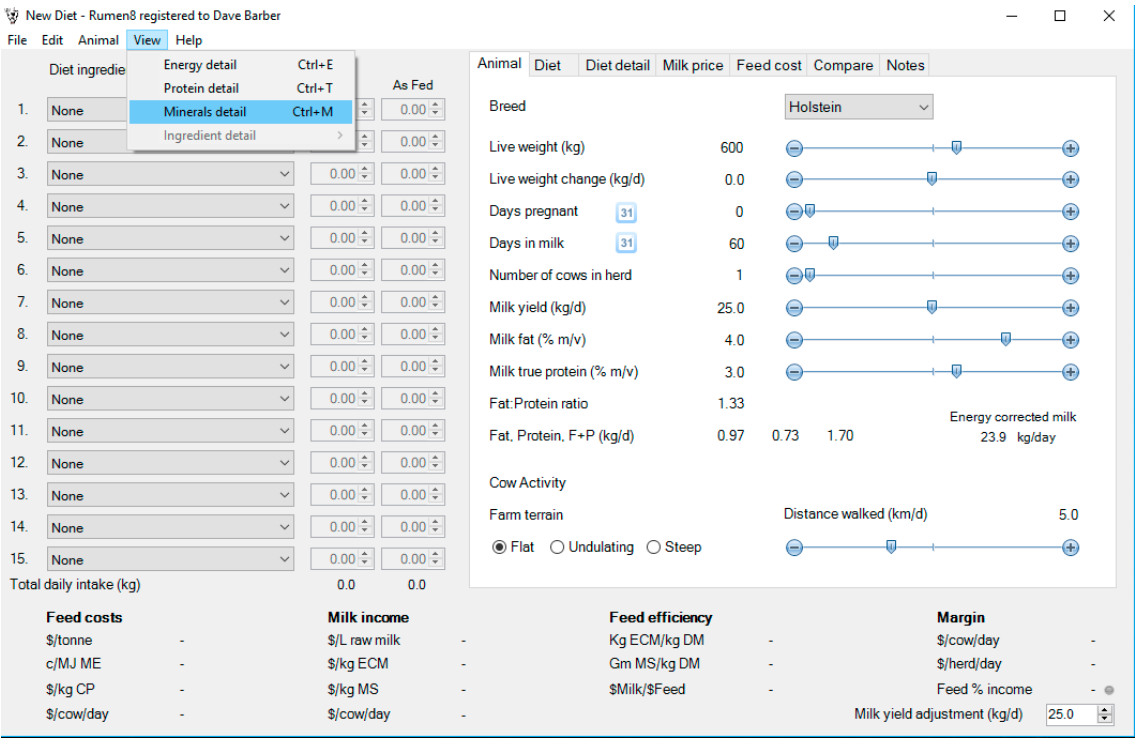
Change the parameters for the current animal as if it had been dried off and was mid-way through a 65-day dry period.

Move current animal into 'springer' mob

Change the parameters for the current animal to one that is 2 weeks prior to calving and has entered 'transition'.

VIEW MENU

Figure 26. The View menu.



- | | |
|-------------------|--|
| Energy detail | Displays the details of the metabolisable energy demand calculated for the animal. |
| Protein detail | Displays the details of the metabolisable protein supply and demand calculated for the animal. |
| Minerals detail | Displays the details of the calcium, phosphorus and magnesium demand and supply. |
| Ingredient detail | Displays the details of the diet ingredient. |

HELP MENU

Figure 27. The Help menu.

New Diet* - Rumen8 registered to Richard Morris

File Edit Animal View **Help**

Diet ingredients

		As Fed
1. Barley grain		8.61
2. Lupins grain	4.69	5.23
3. Ryegrass - Dryland - late annual	7.40	30.83
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00

19.7 44.7

Check for updates
About
Registration

Diet detail

Breed: Holstein

Live weight (kg): 600

Live weight change (kg/d): 0.0

Days pregnant: 31

Days in milk: 31

Number of cows in herd: 1

Milk yield (L/d): 0.0

Milk fat (% m/v): 4.0

Milk true protein (% m/v): 3.2

Fat:Protein ratio: 1.25

Fat, Protein, F+P (kg/d): -

Cow Activity

Farm terrain: Distance walked (km/d) 0.2

☒ Flat ☐ Undulating ☐ Steep

Feed costs

\$/tonne	\$217
c/MJ ME	1.8
\$/kg CP	\$1.19
\$/cow/day	\$4.27

Milk income

\$/L raw milk	-
\$/kg ECM	-
\$/kg MS	-
\$/cow/day	-

Feed efficiency

Kg ECM/kg DM	-
Gm MS/kg DM	-
\$/Milk/\$Feed	\$2.87

Margin

\$/cow/day	-
\$/herd/day	-
Feed % income	-

Milk yield adjustment (L/d): 0.0

Check for updates	Check to see if a newer version of Rumen8 is available. This can only be done if your computer is connected to the Internet.
-------------------	--

About	Display information about Rumen8 such as the version number, website address and email for support.
-------	---

Registration Enter your registration number and name here to unlock all the diet ingredients.

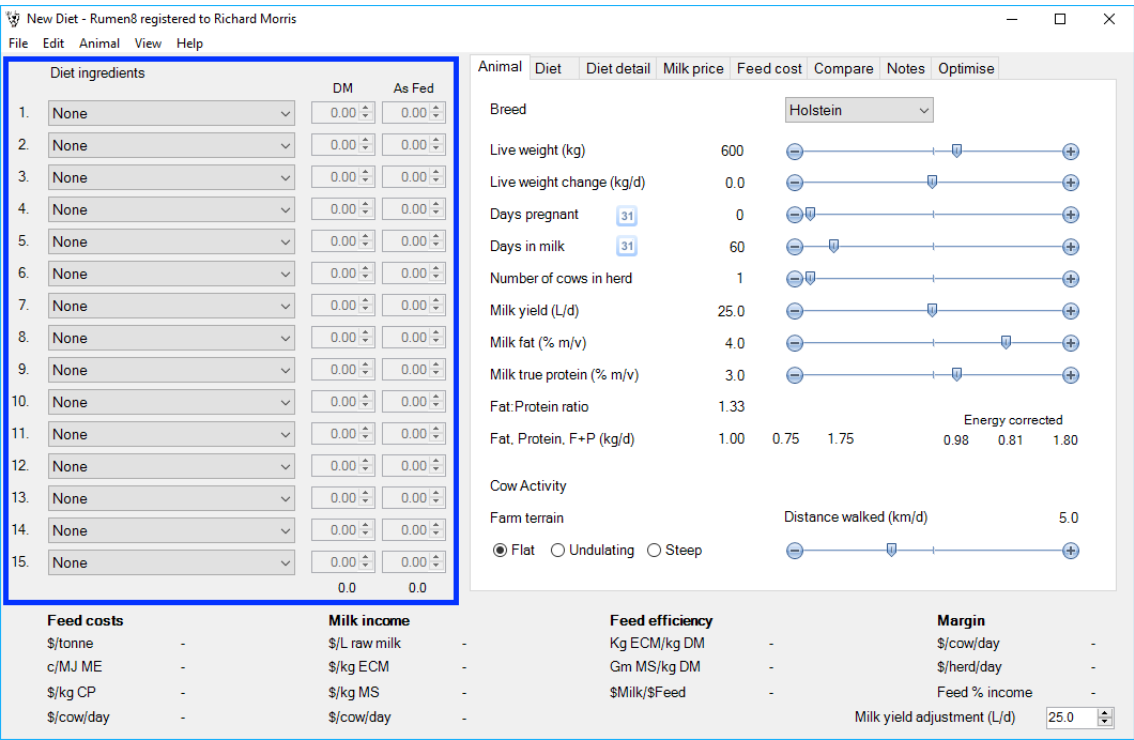
USING RUMEN8

This section will describe the main parts of the Rumen8 window and how you use them.

DIET COMPONENTS

The left section of the main window is where you add ingredients to your diet and specify the quantity fed each day. In the figure below it is highlighted within a blue rectangle.

Figure 28. The diet ingredients section of the main window shown within the blue rectangle.



Clicking on the down arrowhead to the right of the drop-down lists you can choose any of the feeds available from the feed library. Once a feed has been selected the 'DM' and 'As fed' entry box becomes active and you can either type the kilograms to be fed in directly or click on the up and down buttons to vary the existing amount.

You can enter the value on a dry matter basis in the 'DM' column and the amount will be displayed on an as fed basis in the 'As fed' entry box. If you prefer to enter the amount as fed the reverse works in the same manner. Internally Rumen8 always uses the value on a dry matter basis.

Up to fifteen feeds or mixes can be added to a diet. To see the details of a selected ingredient, click on the ingredient number and the detail window will open. Alternatively hover the mouse over ingredient name and a tooltip will appear showing the feed or mix attributes.

The total diet weight on a dry matter basis and as fed are displayed at the bottom of each of the columns.

Figure 29. The diet ingredient detail window.

Diet Ingredient Detail					
Barley grain					
Management	Concentrate	Source			
Protein type	Other non-forage	Comment			
Particle size	Concentrate	Ruminal acidosis risk (risk level depends on many herd, feed and feeding management factors)			
DM (%)	87.8	Calcium (%)	0.07	NDF (%)	20.0
ME (MJ/kg)	12.8	Calcium absorption (%)	60	eNDF in NDF (%)	31.7
CP (%)	12.2	Phosphorus (%)	0.38	Starch (%)	56.8
Fat (%)	2.1	Phosphorus absorption (%)	70	Sugar (%)	3.4
aN (%)	28	Magnesium (%)	0.14		
bN (%)	66	Magnesium absorption (%)	16	Max feeding rate (%)	40.0
cN (%)	22			Wet density (m3)	650
		Potassium (%)	0.55	Cost (\$/t DM)	\$250
ADIN (%)	0.07	Sulphur (%)	0.15	Cost (\$/t fresh)	\$285
Ash (%)	2.5	Sodium (%)	0.02	Losses (%)	0
		Chloride (%)	0.15	Cost -losses (\$/t DM)	\$250
		DCAD (mEq/kg)	10	Cost -losses (\$/t fresh)	\$285

Figure 30. The diet ingredient tooltip window.

New Diet* - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients

1. Barley grain DM 0.00 As Fed 0.00

2. None

3. None

4. None

5. None

6. None

7. None

8. None

9. None

10. None

11. None

12. None

13. None

14. None

15. None

Barley grain
 Category: Concentrate
 Type: Other non-forage
 Class: Concentrate
 Comment: Ruminal acidosis risk (risk level depends on many herd, feed and feeding management factors)
 Dry matter (g/kg): 878
 ME (MJ/kg): 12.8
 Crude protein (g/kg): 122
 Fat (g/kg): 21
 aN: 0.28
 bN: 0.66
 cN: 0.22
 ADIN (g/kg): 0.7
 Ash (g/kg): 25
 NDF (g/kg): 200
 eNDF (g/kg): 317
 Starch (g/kg): 568
 Sugar (g/kg): 34
 Calcium (g/kg): 0.7
 Calcium abs.: 0.60
 Phosphorus (g/kg): 3.8
 Phosphorus abs.: 0.70
 Magnesium (g/kg): 1.4
 Magnesium abs.: 0.16
 Potassium (g/kg): 5.5
 Sulphur (g/kg): 1.5
 Sodium (g/kg): 0.2
 Chloride (g/kg): 1.5
 DCAD (g/kg): 10
 Max. feeding rate (g/kg): 400
 Wet density (kg/m3): 650
 Losses (%): 0
 Cost (\$/t DM): \$250
 Cost (\$/t fresh): \$285
 Cost -losses (\$/t DM): \$250
 Cost -losses (\$/t fresh): \$285

Breed: Holstein

Live weight (kg): 600

Live weight change (kg/d): 0.0

Days pregnant: 31

Days in milk: 31

Number of cows in herd: 1

Milk yield (L/d): 25.0

Milk fat (% m/v): 4.0

Milk true protein (% m/v): 3.0

St: Protein ratio: 1.33

St, Protein, F+P (kg/d): 1.00 0.75 1.75

Energy corrected: 0.98 0.81 1.80

Low Activity

Farm terrain: Distance walked (km/d) 5.0

Flat Undulating Steep

Feed cost

\$/tonne -

c/MJ ME -

\$/kg CP -

\$/cow/day -

Feed efficiency

Kg ECM/kg DM -

Gm MS/kg DM -

\$Milk/\$Feed -

Margin

\$/cow/day -

\$/herd/day -

Feed % income -

Milk yield adjustment (L/d) 25.0

As feeds are added or quantities are adjusted Rumen8 recalculates energy and nutrient supply relative to energy and nutrient demand, thus showing the adequacy of your diet in meeting production objectives.

ANIMAL

The Animal tab is the first of the tabbed section of the main window and is used to describe the cow, or the cow that represents the herd average, for the diet that we are creating.

Figure 31. The Animal tab highlighted in the blue rectangle.

Test.rm8 - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients

	DM	As Fed
1. Barley grain	8.30	9.45
2. Lupins grain	3.70	4.13
3. Ryegrass - Dryland - late annual	8.20	34.17
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00

20.2 47.7

Feed costs

\$/tonne	\$207
c/MJ ME	1.7
\$/kg CP	\$1.21
\$/cow/day	\$4.19

Milk income

\$/L raw milk	\$0.50
\$/kg ECM	\$0.50
\$/kg MS	\$6.94
\$/cow/day	\$15.00

Feed efficiency

Kg ECM/kg DM	1.5
Gm MS/kg DM	107
\$Milk/\$Feed	\$3.58

Margin

\$/cow/day	\$10.81
\$/herd/day	\$11
Feed % income	28

Milk yield adjustment (L/d) 30.0

Animal Diet Diet detail Milk price Feed cost Compare Notes

Breed Holstein

Live weight (kg) 600

Live weight change (kg/d) 0.0

Days pregnant 31 25

Days in milk 31 100

Number of cows in herd 1

Milk yield (L/d) 30.0

Milk fat (% m/v) 4.0

Milk true protein (% m/v) 3.2

Fat:Protein ratio 1.25

Fat, Protein, F+P (kg/d) 1.20 0.96 2.16

Energy corrected 1.20 0.99 2.19

Cow Activity

Farm terrain

Distance walked (km/d) 6.0

Flat Undulating Steep

Using the sliders adjust live weight, growth rate, milk yield and components, days pregnant and days in milk. The value can be changed quickly by moving the slider left and right or adjusted 1 unit at a time by clicking on the – and + symbols at either end.

Days pregnant and days in milk can also be set by specifying the date of conception or calving by clicking on the calendar icon .

For convenience, the milk yield is also expressed as fat: protein ratio and fat plus protein kilograms per day based on the input milk yield and components. The energy corrected values display the yield in kg corrected to the international standard 4.0% m/m fat and 3.3% m/m protein.

Additional parameters let you adjust the activity level of your cows if you have a large or hilly farm. Note that a grazing cow will typically walk 4-5 km over a day in the paddock, in addition to the distance to and from the dairy for milking

Breed

The cow breed is used to estimate mineral demand and has a relatively small influence so don't worry too much if your actual breed is not an option. Choose the closest related breed.

Live weight

Mean live weight (kg) of the herd of interest at the time of interest. If unknown, use the following as a guide.

“North American” Holstein cows are 600-650 kg live weight.

Australian Friesian cows are 550-600 kg live weight.

Cross-bred cows 450-500 kg live weight.

Jersey cows 375-425 kg.

First calvers are 10-20% less than their mature counterparts.

Cows that are weighed on farm are the best guide.

For culled cows that are sold ‘over the hooks’, dairy cows typically dress out at ~40-45% of live weight. For example, a 260-290 kg dressed weight equates to ~650 kg live weight. Note that cull cows are (or should be) older cows, so these may not be representative of the average live weight of the herd.

Live weight change

This is the estimate of the amount of live weight that is being lost across the herd (kg/cow/day). Some typical figures are shown below.

Figure 32. Typical estimates of live weight change during a lactation.

Days in milk	0-30	30-60	60-90	90 - 120	120 - 150	150 - 180	180 - 210	210 - 240	240 - 270	270 - 300	Dry period
LWC kg/d	-0.8	-0.6	-0.2	0	0	0.05	0.15	0.3	0.4	0.5	0.1

Days Pregnant

Affects nutritional requirements, which becomes significant from 140 days onwards. Days Pregnant should be the weighted average of the herd (see below example of Days in milk). The number of days since conception can be entered directly with the slider or click on the calendar icon to select the date of conception.

Days in milk

Days in milk (DIM) is also required to estimate feed intake potential, as stage of lactation influences the amount of feed a cow can consume. Feed intake (kg DM/cow/day) is estimated as per NRC (2001). Peak dry matter intake (DMI) generally occurs at 80-100 days post calving. Where cows have been exceptionally well prepared for calving and then well fed post calving without any metabolic or health issues peak DMI may occur 60-80 days.

Where cows have had restricted energy intake through this period peak DMI is more likely to be 100-120 days.

Days in milk must be calculated as a **weighted average** for the herd. For example

100 cows @ 100 DIM = 10,000 cow days

200 cows @ 280 DIM = 56,000 cow days

30 cows @ 350 DIM = 10,500 cow days

330 cows 76,500 cow days

Weighted herd average = 76,500 cow days / 330 cows = ~230 DIM

The number of days since calving can be entered directly with the slider or click on the calendar icon to select the (mean) calving date.

Number of cows in the herd

This is used only to calculate the herd margin (daily milk income minus daily feed costs in \$/herd/day) and can be left set to 1 if you are more interested in daily milk income minus daily feed costs per cow/day.

Milk fat and protein

Ensure you set the correct unit in “preferences”: in Australia this is almost always mv%, while in NZ it is mm%. Protein% is true protein (in some countries it is analysed as crude protein which is about 6% higher than true protein). Take the average of the latest 5 days of available factory figures. When estimating production for groups of cows within the milking herd the milk fat and protein %'s are likely to be significantly different to the herd average e.g. early lactation cows at peak production vs late lactation cows.

Milk yield

(litres or kilograms/cow/day) – if milking numbers are stable this should be the last 5-10 days average milk yield per cow. Yield should include all milk produced per cow, including milk that is being fed to calves and milk not suitable for consumption.

Distance walked

This influences the amount of energy required for maintenance.

Cows grazing a large farm (300 Ha) with centrally located dairy will on average walk 4 km to and from the dairy plus distance walked while grazing ~5 km. Daily total 9 km.

Cows grazing a medium sized farm (150 Ha) with centrally located dairy will on average walk 3 km to and from the dairy plus distance walked while grazing ~4 km. Daily total 7 km.

Cows grazing a smaller sized farm (75 Ha) with centrally located dairy will on average walk 2 km to and from the dairy plus distance walked while grazing 3 km. Daily total 5 km.

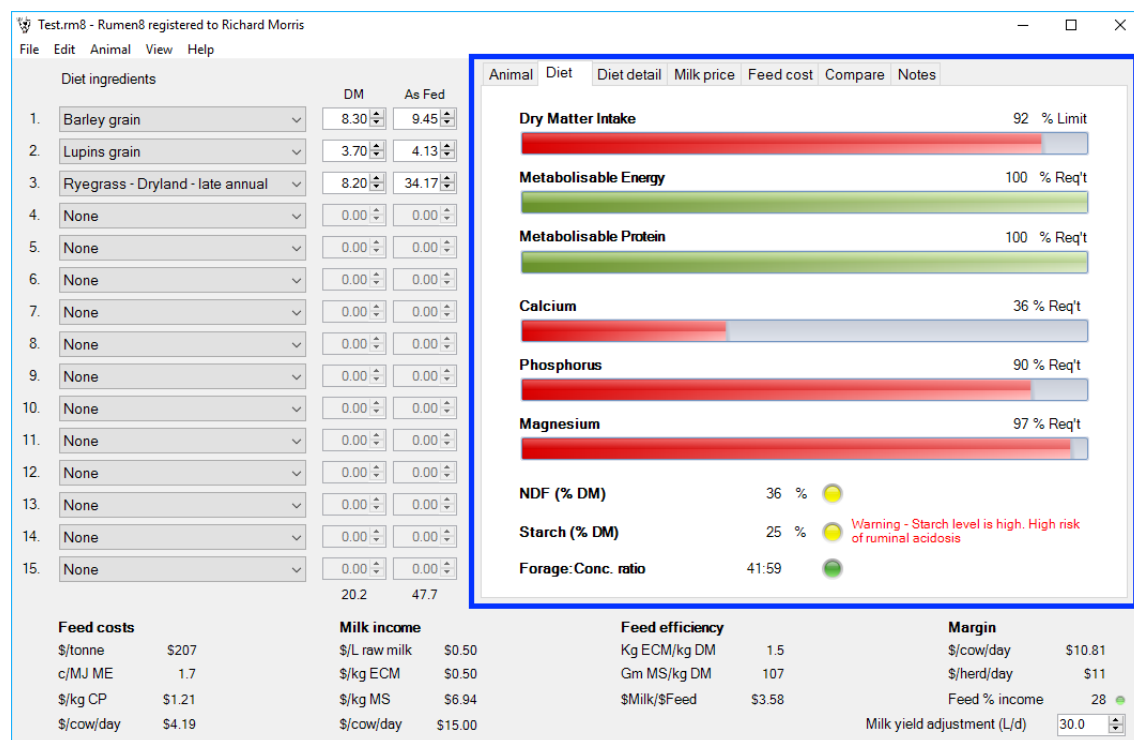
Farm terrain

This influences the amount of energy required for maintenance. Note that walking 1 ‘vertical meter’ requires the same energy as walking 10 ‘horizontal meters’.

DIET

The diet tab provides an overview of the current diet performance. It is highlighted within a blue rectangle in the figure below.

Figure 33. The Diet tab.



The Diet tab has six horizontal bars representing the dry matter intake, metabolisable energy (ME), metabolisable protein (MP), calcium, phosphorus and magnesium in the diet. Below these are the neutral detergent fibre (NDF) and starch percentage of the diet and the forage to concentrate ratio.

Metabolisable energy, protein and minerals are expressed as a percentage of the cow's requirement so a balanced diet should have these parameters around 100%. When the cow's requirement is not being met the progress-bar will be red. When the diet meets the cow's requirement the bar will be green. If there is an excess of ME, MP or minerals in the diet the corresponding bar will be yellow.

The intake bar shows the percentage of the animal's maximum intake the current diet represents. When the cow is eating to potential the bar will be green. If the diet contains too much feed for the cow to eat the bar will turn yellow and if the cow is being underfed the bar will be red.

How close to 100% progress bars must be to turn green is set in the preferences.

The starch and NDF bars show the percentage of the diet made up of these components. The final value show the ratio of forage to concentrate in the diet.

If recommended levels are set for NDF, starch and forage: concentrate a traffic light will appear and show whether the current value is under, within or above the recommended range. See the preferences section for how to set recommended levels. Independent of the recommended levels a warning may appear next to each of these parameters if the dietary level suggests the cow may be in danger of ruminal acidosis.

DIET DETAIL

The 'Diet Detail' tab is used in a similar way to the 'Diet' tab, but contains much more information about the diet performance.

Figure 34. The Diet Detail tab shown within the blue rectangle.

Test.rm8 - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients

	DM	As Fed
1. Barley grain	8.30	9.45
2. Lupins grain	3.70	4.13
3. Ryegrass - Dryland - late annual	8.20	34.17
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00
	20.2	47.7

Feed costs

\$/tonne	\$207
c/MJ ME	1.7
\$/kg CP	\$1.21
\$/cow/day	\$4.19

Milk income

\$/L raw milk	\$0.50
\$/kg ECM	\$0.50
\$/kg MS	\$6.94
\$/cow/day	\$15.00

Feed efficiency

Kg ECM/kg DM	1.5
Gm MS/kg DM	107
\$Milk/\$Feed	\$3.58

Margin

\$/cow/day	\$10.81
\$/herd/day	\$11
Feed % income	28
Milk yield adjustment (L/d)	30.0

Diet detail

Animal | Diet | Diet detail | Milk price | Feed cost | Compare | Notes

Metabolisable energy (Green traffic light)

Supply (MJ)	241
Demand (MJ)	240
Balance (MJ)	1
Density (MJ/kg DM)	11.9

Metabolisable protein (Green traffic light)

Supply (g)	2220
Demand (g)	2221
Balance (g)	-1
CP (%DM)	17.1

Dry matter intake (Red traffic light)

Max. NDF DMI%	100
Max. NRC DMI%	92

Calcium (Red traffic light)

Supply (g)	20.3
Demand (g)	56.3
Balance (g)	-36.0

Magnesium (Red traffic light)

Supply (g)	6.2
Demand (g)	6.4
Balance (g)	-0.2

Phosphorus (Red traffic light)

Supply (g)	44.5
Demand (g)	49.2
Balance (g)	-4.7

DCAD (Red traffic light)

Calculated	157
Recommended	>250

Starch (%DM) 25.4 (Yellow traffic light)

Sugar (%DM)	7.8
NFC (%DM)	38.5
Forage : Conc	41:59

Fat (Green traffic light)

Fat (%DM)	3.3
-----------	-----

Active recommended levels

One (Selected) Two Three Four

Early lactation

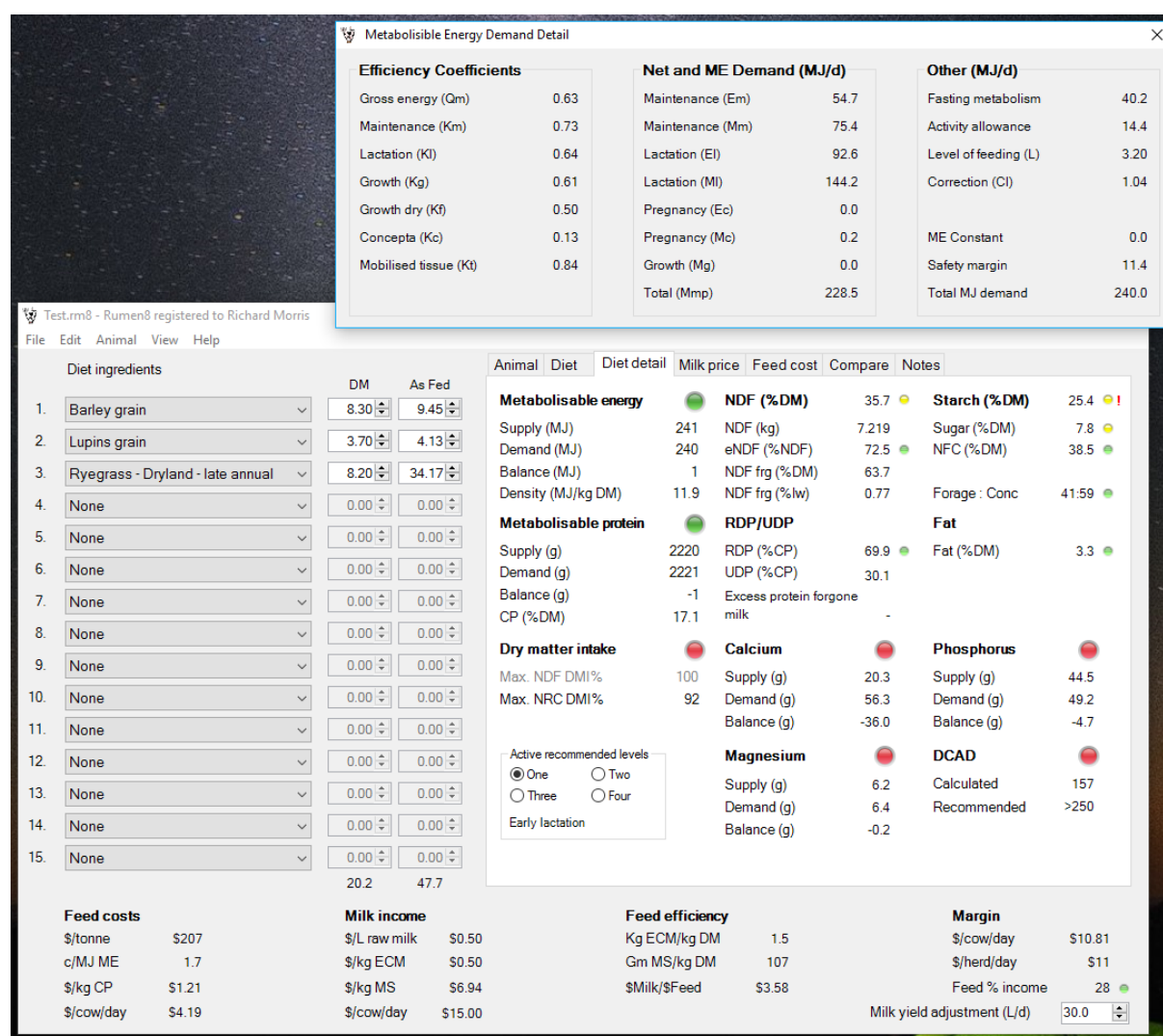
The diet detail tab is divided into several sections covering metabolisable energy, metabolisable protein, dry matter intake, fibre, rumen protein, starch, fat, minerals and DCAD. In addition, the active set of recommended levels can be changed in the bottom left corner of the tab.

Metabolisable energy

This section shows the total ME supplied by the diet, demand from the cow and the consequent balance. Below is the energy density of the diet.

The 'traffic light' to the right is red when ME from the diet is insufficient, green when it meets the cows demand and yellow when it exceeds the cow's needs. Clicking on the title 'Metabolisable Energy' (or the menu option View, Energy detail) will bring up the detail window that provides more information about the energy model used by Rumen8 and how ME demand is calculated. The detail window can remain open while the diet and cow is adjusted so the influence on components of the total ME demand can be seen.

Figure 35. The metabolisable energy detail window.



Metabolisable protein

This section shows the total MP supplied by the diet, demand by the cow and the subsequent balance. Below is the diet's crude protein content. Crude protein content of the total diet is only provided for reference. The 'traffic light' to the right is red when MP from the diet is insufficient, green when it meets the cow's requirement and yellow when it exceeds the cow's needs. Clicking on the title 'Metabolisable protein' (or the menu option View, Protein detail) will bring up the MP supply and demand detail window that provides more information about the protein model used by Rumen8. The detail window can remain open while the diet and cow is adjusted so the influence on components of the total MP supply and demand can be investigated.

As with the rest of the Rumen8 application, hovering the mouse over each parameter will provide additional explanatory information. If you hover over the text 'MP system flowchart' on the detail window a chart will appear that shows the path protein takes through the animal that corresponds to the values Rumen8 calculates when estimating MP supply.

Test.rm8 - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients

	DM	As Fed
1. Barley grain	8.30	9.45
2. Lupins grain	3.70	4.13
3. Ryegrass - Dryland - late annual	8.20	34.17
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00

20.2

47.7

Feed costs

\$/tonne	\$207
c/MJ ME	1.7
\$/kg CP	\$1.21
\$/cow/day	\$4.19

Metabolisable Protein Detail

Supply (g/d)

Crude protein (CP)	3454	Fermentable ME (FME MJ)	217.3	Metabolisable pr. (MP)	2220
Level of feeding (L multiple)	3.20	Rumen microbial protein (y)	2399	Limited by	ERDP+MP
Rumen outflow (r fraction/hr)	0.08	Effective rumen degrad. pr. (ERDP)	2196	Excess protein	0
Rumen degradable protein (RDP)	2415	Microbial crude protein (MCP)	2196	Min MP cost	0
Undegradable dietary protein (UDP)	1039	Microbial true protein (MTP)	1647	Max MP cost	0
Quickly degradable protein (QDP)	1092	Digestible microbial true pr. (DMTP)	1400		
Slowly degradable protein (SDP)	1322	Digestible undegraded protein (DUP)	820	MP system flowchart	

Demand (g/d)

Maintenance (MPm)	279	Dermal loss of scurf/hair (MPd)	14	Total (MPmp)	1692
Endogenous basal (MPb)	265	Lactation (MPI)	1412	MP Correction	423
Liveweight gain (MPg)	0	Pregnancy (MPc)	1	Safety margin	106
				Total MP demand	2221

Animal

Diet

Diet detail

Milk price

Feed cost

Compare

Notes

Metabolisable energy

NDF (%DM)

35.7

Starch (%DM)

25.4

Supply (MJ)

241

NDF (kg)

7.219

Sugar (%DM)

7.8

Demand (MJ)

240

eNDF (%NDF)

72.5

NFC (%DM)

38.5

Balance (MJ)

1

NDF frg (%DM)

63.7

Density (MJ/kg DM)

11.9

NDF frg (%lw)

0.77

Forage : Conc

41:59

Metabolisable protein

RDP/UDP

Fat

Supply (g)

2220

RDP (%CP)

69.9

Fat (%DM)

3.3

Demand (g)

2221

UDP (%CP)

30.1

Balance (g)

-1

Excess protein forgone

CP (%DM)

17.1

milk

-

Dry matter intake

Calcium

Phosphorus

Max. NDF DMI%

100

Supply (g)

20.3

Supply (g)

44.5

Max. NRC DMI%

92

Demand (g)

56.3

Demand (g)

49.2

Balance (g)

-36.0

Balance (g)

-4.7

Active recommended levels

One

Two

Three

Four

Early lactation

Magnesium

DCAD

Supply (g)

6.2

Calculated

157

Demand (g)

6.4

Recommended

>250

Balance (g)

-0.2

Feed efficiency

Kg ECM/kg DM

1.5

\$/cow/day

\$10.81

Gm MS/kg DM

107

\$/herd/day

\$11

\$Milk/\$Feed

\$3.58

Feed % income

28

Milk yield adjustment (L/d)

30.0

The intake section shows the dry weight of the current diet and the percentage of maximum intake this weight represents for two methods of calculating intake potential. It is recommended you refer to the NRC DMI%, as we suggest this is more reliable than determining intake potential by calculating NDF intake as a percentage of live weight for lactating cow diets that contain concentrates.

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Fibre, rumen protein, starch and fat

The four sections in the top right of the diet detail tab reports a range of diet parameters for the current diet. These cover things like NDF, starch and sugar through to rumen degradable protein and forage concentrate ratio. If you are unsure what one of the abbreviations means hover your mouse over the text and a tooltip will appear with a more detailed explanation.

The 'Excess protein' section shows the effect of having too much protein in the diet. There is a metabolic cost to remove the additional protein and this is expressed as forgone milk production or live weight growth. The calculation can be adjusted in the preferences.

If recommended levels have been set for some of these diet parameters a small traffic light appears next to the value and shows if it is below, within or above the recommended range. In addition, the NDF, starch and forage concentrate ratio may show a red exclamation mark if the current value may result in the animal being at high risk of ruminal acidosis.

Minerals

The bottom right section of the diet detail tab displays supply and demand for the diet's calcium, phosphorus and magnesium levels. A traffic light for each shows if the current level is below (red), equal to (green) or above (yellow) the animal's requirement. If all the feed ingredients have a DCAD value the dietary DCAD is calculated and compared with a recommended level depending on whether the cow is lactating, in the early dry period or the 'springer' herd.

Clicking on any of the titles 'Calcium', 'Phosphorus' or 'Magnesium' (or the menu option View, Minerals detail) will bring up the Minerals supply and demand detail window that provides more information about the animal demand and diet supply of each of the minerals. The detail window can remain open while the diet and cow is adjusted so the influence on mineral supply and demand can be investigated by adjusting cow or dietary parameters.

Figure 37. The minerals detail window.

Minerals Detail

Calcium		Phosphorus		Magnesium	
Maintenance	18.6	Maintenance	21.4	Maintenance	1.8
Lactation	30.5	Lactation	22.5	Lactation	3.8
Pregnancy	0.0	Pregnancy	0.0	Pregnancy	0.0
Growth	0.0	Growth	0.0	Growth	0.0
Net requirement	49.1	Net requirement	43.9	Net requirement	5.6
Total requirement	102.7	Total requirement	65.0	Total requirement	34.7
Dietary supply	60.5	Dietary supply	86.7	Dietary supply	41.5
Absorption	0.48	Absorption	0.68	Absorption	0.16
Balance	-42.1	Balance	21.7	Balance	6.8

New Diet* - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients

	DM	As Fed
1. Barley grain	8.30	9.45
2. Lupins grain	3.70	4.13
3. Ryegrass ann. - Dry - Spr - Med. qual	8.20	45.56
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00
Total daily intake (kg)	20.2	59.1

Feed costs

\$/tonne	\$103
c/MJ ME	0.9
\$/kg CP	\$0.52
\$/cow/day	\$2.08

Milk income

\$/L raw milk	\$0.40
\$/kg ECM	\$0.41
\$/kg MS	\$5.73
\$/cow/day	\$9.73

Feed efficiency

Kg ECM/kg DM	1.2
Gm MS/kg DM	84
\$Milk/\$Feed	\$4.69

Margin

\$/cow/day	\$7.66
\$/herd/day	-
Feed % income	21
Milk yield adjustment (kg/d)	25.0

Animal | **Diet** | **Diet detail** | **Milk price** | **Feed cost** | **Compare** | **Notes**

Breed: Holstein

Live weight (kg): 600

Live weight change (kg/d): 0.0

Days pregnant: 31

Days in milk: 31

Number of cows in herd: 1

Milk yield (kg/d): 25.0

Milk fat (% m/v): 4.0

Milk true protein (% m/v): 3.0

Fat:Protein ratio: 1.33

Fat, Protein, F+P (kg/d): 0.97 0.73 1.70

Energy corrected milk: 23.9 kg/day

Cow Activity

Farm terrain: Distance walked (km/d): 5.0

☒ Flat ☐ Undulating ☐ Steep

Recommended levels

The section in the bottom left of the diet detail tab shows which set of recommended levels has been selected, if any, and allows the user to change between sets. In the figure above a set of recommended levels that applies to early lactating cows has been selected and the small traffic lights are linked to this. See the preferences section for how to turn on and off and adjust the recommended levels.

MILK PRICE

The price of milk is used to calculate milk income and margins of milk income over feed costs. A total of 24 milk prices can be entered as two sets of 12 prices. One set of twelve prices is entered as payment by volume and the other set as payment for components.

Which set of prices is used by Rumen8 is determined by the 'Payment' box to the right of the tab. Click on the 'Components' button to use the 12 payment prices entered as payment for fat plus protein minus a volume discount, or the 'Volume' button to select the 12 volume prices entered as cents per litre.

Figure 38. The milk price tab with payment by volume selected.

Test.rm8 - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients

	DM	As Fed
1. Barley grain	8.30	9.45
2. Lupins grain	3.70	4.13
3. Ryegrass - Dryland - late annual	8.20	34.17
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00
	20.2	47.7

Feed costs

\$/tonne	\$207
c/MJ ME	1.7
\$/kg CP	\$1.21
\$/cow/day	\$4.19

Milk income

\$/L raw milk	\$0.50
\$/kg ECM	\$0.50
\$/kg MS	\$6.94
\$/cow/day	\$15.00

Feed efficiency

Kg ECM/kg DM	1.5
Gm MS/kg DM	107
\$Milk/\$Feed	\$3.58

Margin

\$/cow/day	\$10.81
\$/herd/day	\$11
Feed % income	28
Milk yield adjustment (L/d)	30.0

Animal Diet Diet detail Milk price Feed cost Compare Notes

Milk Payment

	Price (cpl)	Equivalent by MS (\$/kg)	Payment
1.	50	6.94	<input checked="" type="radio"/> Volume
2.	0	0.00	<input type="radio"/> Components
3.	0	0.00	
4.	0	0.00	
5.	0	0.00	
6.	0	0.00	
7.	0	0.00	
8.	0	0.00	
9.	0	0.00	
10.	0	0.00	
11.	0	0.00	
12.	0	0.00	

Figure 39. The milk price tab with payment by components selected.

Test.rm8 - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients

	DM	As Fed
1. Barley grain	8.30	9.45
2. Lupins grain	3.70	4.13
3. Ryegrass - Dryland - late annual	8.20	34.17
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00
	20.2	47.7

Feed costs

\$/tonne	\$207
c/MJ ME	1.7
\$/kg CP	\$1.21
\$/cow/day	\$4.19

Milk income

\$/L raw milk	\$0.47
\$/kg ECM	\$0.47
\$/kg MS	\$6.54
\$/cow/day	\$14.13

Feed efficiency

Kg ECM/kg DM	1.5
Gm MS/kg DM	107
\$Milk/\$Feed	\$3.37

Margin

\$/cow/day	\$9.94
\$/herd/day	\$10
Feed % income	30
Milk yield adjustment (L/d)	30.0

Animal Diet Diet detail Milk price Feed cost Compare Notes

Milk Payment

Payment

☒ Components

☐ Volume

	Fat (\$/kg)	Protein (\$/kg)	Volume (cpl)	Equivalent by vol (cpl)
1. <input checked="" type="radio"/>	6	8	2.5	47.1
2. <input type="radio"/>	0	0	0	0.0
3. <input type="radio"/>	0	0	0	0.0
4. <input type="radio"/>	0	0	0	0.0
5. <input type="radio"/>	0	0	0	0.0
6. <input type="radio"/>	0	0	0	0.0
7. <input type="radio"/>	0	0	0	0.0
8. <input type="radio"/>	0	0	0	0.0
9. <input type="radio"/>	0	0	0	0.0
10. <input type="radio"/>	0	0	0	0.0
11. <input type="radio"/>	0	0	0	0.0
12. <input type="radio"/>	0	0	0	0.0

If the payment is entered by volume, the equivalent value expressed as payment for components is shown alongside it, and if by components, the equivalent shows the price calculated by volume. The calculation of equivalent price uses the current milk components entered on the animal tab.

Each of the 12 prices are entered in the entry box/s alongside the numbers 1 to 12. The current price is selected with the button to the left of the number.

FEED COST

The feed cost tab allows you to quickly adjust feed prices and losses for feeds in the current diet without returning to the feed library. This is useful for comparing groups of feed sources at different prices without having to create a new feed for each.

Figure 40. The feed costs tab.

Test.rm8 - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients

	DM	As Fed
1. Barley grain	8.30	9.45
2. Lupins grain	3.70	4.13
3. Ryegrass - Dryland - late annual	8.20	34.17
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00
	20.2	47.7

Feed costs

\$/tonne	\$207
c/MJ ME	1.7
\$/kg CP	\$1.21
\$/cow/day	\$4.19

Milk income

\$/L raw milk	\$0.47
\$/kg ECM	\$0.47
\$/kg MS	\$6.54
\$/cow/day	\$14.13

Feed efficiency

Kg ECM/kg DM	1.5
Gm MS/kg DM	107
\$/Milk/\$Feed	\$3.37

Margin

\$/cow/day	\$9.94
\$/herd/day	\$10
Feed % income	30
Milk yield adjustment (L/d)	30.0

Animal Diet Diet detail Milk price Feed cost Compare Notes

Animal	Diet	Diet detail	Milk price	Feed cost	Compare	Notes
		\$/t DM	\$/t as fed	Losses (%)	Cost after losses DM	Cost after losses as fed
		250	220	0	\$250	\$220
		350	314	0	\$350	\$314
		100	24	0	\$100	\$24

For each of the current diet feed ingredients you may change the cost on a dry or as fed basis and the losses that occur before the cow eats it. The final cost is expressed on a dry matter basis, and then after losses for both dry and wet weights.

The new values are changed in the feed library so if you are investigating the influence of feed price changes don't forget to put the actual feed cost back when you have finished.

Losses are not applied to the amount of feed eaten by the animal, but represent the amount of feed lost from when it was costed (usually at delivery or harvest) and when it is eaten. This means the losses only influence the feed cost, not the feed amounts. For example, if the barley grain in the figure above costs \$250/t DM delivered to the farm and losses are set to 2%, it means the loss occurs after the grain was delivered to the silo and before the cow eats it. The cow still eats 8.30 kg/day of barley grain.

The diet ingredient amounts are always the amount the animal eats, regardless of losses.

COMPARE

The 'Compare' tab allows you to build a diet and then save it for comparison with other diets. Think of it as three slots where you can put away a diet while you experiment with other feeds in the main window and then compare them before recalling the best one.

Figure 41. The compare tab.

Test.rm8 - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients

	DM	As Fed
1. Barley grain	8.30	9.45
2. Lupins grain	3.70	4.13
3. Ryegrass - Dryland - late annual	8.20	34.17
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00

20.2 47.7

Feed costs

\$/tonne	\$207
c/MJ ME	1.7
\$/kg CP	\$1.21
\$/cow/day	\$4.19

Milk income

\$/L raw milk	\$0.47
\$/kg ECM	\$0.47
\$/kg MS	\$6.54
\$/cow/day	\$14.13

Feed efficiency

Kg ECM/kg DM	1.5
Gm MS/kg DM	107
\$Milk/\$Feed	\$3.37

Margin

\$/cow/day	\$9.94
\$/herd/day	\$10
Feed % income	30

Milk yield adjustment (L/d) 30.0

Compare

Animal Diet Diet detail Milk price Feed cost Compare Notes

1. S R C 2. S R C 3. S R C

Name Diet 1

1	8.30kg Barley grain	-	-
2	3.70kg Lupins grain	-	-
3	8.20kg Ryegrass - Dryland - lat	-	-
4	-	-	-
5	-	-	-
6	-	-	-
7	-	-	-
8	-	-	-
9	-	-	-
10	-	-	-
11	-	-	-
12	-	-	-
13	-	-	-
14	-	-	-
15	-	-	-
DMI	20.2kg (100/92 % DMI)	-	-
ME	241 / 240 MJ	-	-
MP	2220 / 2221 g (17%)	-	-
Margin	\$9.94/cow/day	-	-

There is room for three diets numbered 1, 2 and 3 from left to right. To store the current diet click the 'S' button (store) for one of the diet slots. The 15 ingredients that make up the diet will appear in the slot along with important parameters below. You can make changes to the current diet, store an additional two versions, decide which offers the best solution and then recall that one to the main window by clicking the 'R' button (recall) for that slot. Clicking the 'C' button (clear) will empty the slot.

NOTES

The notes tab allows you to write anything about the current diet you may wish to remember when looking at it later. This is often useful if you save diets by date and then refer to them in later years for guidance. The notes can also be used to communicate with your nutritionist if you can save the diet file and email it to them for comment or adjustment.

Figure 42. The notes tab.

Test.rm8* - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients		DM	As Fed
1.	Barley grain	8.30	9.45
2.	Lupins grain	3.70	4.13
3.	Ryegrass - Dryland - late annual	8.20	34.17
4.	None	0.00	0.00
5.	None	0.00	0.00
6.	None	0.00	0.00
7.	None	0.00	0.00
8.	None	0.00	0.00
9.	None	0.00	0.00
10.	None	0.00	0.00
11.	None	0.00	0.00
12.	None	0.00	0.00
13.	None	0.00	0.00
14.	None	0.00	0.00
15.	None	0.00	0.00
		20.2	47.7

Animal Diet Diet detail Milk price Feed cost Compare Notes

Enter any notes about the current diet here...

Feed costs		Milk income		Feed efficiency		Margin	
\$/tonne	\$207	\$/L raw milk	\$0.47	Kg ECM/kg DM	1.5	\$/cow/day	\$9.94
c/MJ ME	1.7	\$/kg ECM	\$0.47	Gm MS/kg DM	107	\$/herd/day	\$10
\$/kg CP	\$1.21	\$/kg MS	\$6.54	\$Milk/\$Feed	\$3.37	Feed % income	30
\$/cow/day	\$4.19	\$/cow/day	\$14.13			Milk yield adjustment (L/d)	30.0

OPTIMISE (ADVANCED USERS)

The Optimise function within Rumen8 is not supported, as the setup is difficult unless you have a good knowledge of Microsoft Windows and Excel. It requires Microsoft Excel and the Solver add-in to be installed (versions 2013 or 2016) and configured for use with Rumen8. See the Optimiser Installation section for details.

The Optimise tab and button will only be available if it is enabled in the Rumen8 Preferences. Optimising allows you to fine tune a diet to minimise cost. The optimiser will vary the amount fed of each ingredient to find the cheapest diet that meets the constraints you have chosen. Using the optimiser requires all feeds have costs entered in the feed library or the feed costs tab.

You should first add your feeds to the diet in the approximate quantities required. For the first run of the optimiser enable the ME and MP constraints to ensure it is possible to calculate a diet from the feeds selected that meets the cow's requirements. Once a feasible diet has been found progressively add additional constraints starting with your preferred intake estimate until you have a diet that meets your needs or the optimiser cannot find a feasible solution. This step-by-step approach is far more likely to result in an optimised diet than simply turning on all the constraints immediately. This is because if a feasible diet cannot be found you know it was the last constraint that is the issue and you can then either exclude that or relax other constraints until a feasible diet can be found.

Remember, the optimiser simply treats the diet as a mathematical problem to solve and has no nutritional awareness. It can find a feasible diet that minimises cost and meets the constraints but that may harm your cows. Evaluate each feasible diet carefully.

Figure 43. The Optimise tab.

The screenshot displays the 'Optimise' tab in the Rumen8 software. The interface is divided into several sections:

- Diet ingredients:** A list of 15 ingredients with their respective DM and As Fed values. The first three are Barley grain (DM: 8.30, As Fed: 9.45), Lupins grain (DM: 3.70, As Fed: 4.13), and Ryegrass - Dryland - late annual (DM: 8.20, As Fed: 34.17). The remaining 12 are set to 'None'.
- Constraints and Sliders:** A central panel with checkboxes for various constraints and sliders for their values. Constraints include ME demand, MP min. demand, NDF (%DM), eNDF (%NDF), NDF from forage (%DM), CP (%DM), Forage % in F:C ratio, Concentrate (kg), Starch (%DM), Sugar (%DM), Fat (%DM), and Ingredient 1, 2, and 3 (kg). Sliders are provided for each constraint, with some having numerical ranges (e.g., 28 - 40 for NDF (%DM)).
- Feed costs:** A table showing costs for different feed types: \$/tonne, c/MJ ME, \$/kg CP, and \$/cow/day.
- Milk income:** A table showing income for different milk types: \$/L raw milk, \$/kg ECM, \$/kg MS, and \$/cow/day.
- Feed efficiency:** A table showing efficiency metrics: Kg ECM/kg DM, Gm MS/kg DM, and \$Milk/\$Feed.
- Margin:** A table showing margin metrics: \$/cow/day, \$/herd/day, Feed % income, and Milk yield adjustment (L/d).

\$/tonne	\$207
c/MJ ME	1.7
\$/kg CP	\$1.21
\$/cow/day	\$4.19

\$/L raw milk	\$0.47
\$/kg ECM	\$0.47
\$/kg MS	\$6.54
\$/cow/day	\$14.13

Kg ECM/kg DM	1.5
Gm MS/kg DM	107
\$Milk/\$Feed	\$3.37

\$/cow/day	\$9.94
\$/herd/day	\$10
Feed % income	30
Milk yield adjustment (L/d)	30.0

You can add constraints to control the diet content of NDF, eNDF, NDF supplied by forage, crude protein, forage concentrate ratio, kilograms of concentrate, starch, sugar and fat. For each of these constraints you must specify the minimum and maximum levels that are acceptable using the left and right sliders. The actual values will be displayed to the left of the slider. The narrower the range the less likely a feasible diet can be found. To make the constraint active click the box to the left of the constraint name to put a tick in it.

The last three constraints, Ingredient 1, 2 and 3, refer to diet ingredients 1, 2 and 3. Using these you can specify the amount of each of the three feeds in the diet. The 'F' button enables you to fix an ingredient at the amount currently entered. This is useful when the amount of pasture available has been previously determined and can be fixed. Then the remainder of the diet ingredients that are supplements can be changed to optimise the diet.

Figure 44. The Optimiser has been unable to find a feasible diet.

The screenshot shows the Rumen8 Optimiser software interface. The 'Optimise' tab is active, displaying a message: 'Unable to formulate a diet within the specified constraints (5)'. The interface includes a list of diet ingredients on the left, a central panel for constraints and sliders, and a bottom section for feed costs, milk income, feed efficiency, and margin.

Diet ingredients		DM	As Fed
1. Barley grain		8.09	9.21
2. Lupins grain		3.94	4.40
3. Ryegrass - Dryland - late annual		8.02	33.42
4. None		0.00	0.00
5. None		0.00	0.00
6. None		0.00	0.00
7. None		0.00	0.00
8. None		0.00	0.00
9. None		0.00	0.00
10. None		0.00	0.00
11. None		0.00	0.00
12. None		0.00	0.00
13. None		0.00	0.00
14. None		0.00	0.00
15. None		0.00	0.00
		20.1	47.0

Constraints		Value	Slider
<input checked="" type="checkbox"/> ME demand	<input checked="" type="checkbox"/> Intake (kg NDF)		
<input checked="" type="checkbox"/> MP min. demand	<input type="checkbox"/> Intake (kg)		
<input checked="" type="checkbox"/> NDF (%DM)		28 - 40	
<input type="checkbox"/> eNDF (%NDF)		0 - 100	
<input type="checkbox"/> NDF from forage (%DM)		0 - 100	
<input type="checkbox"/> CP (%DM)		16 - 22	
<input checked="" type="checkbox"/> Forage % in F:C ratio		40 - 100	
<input type="checkbox"/> Concentrate (kg)		1.0 - 8.0	
<input checked="" type="checkbox"/> Starch (%DM)		15 - 25	
<input checked="" type="checkbox"/> Sugar (%DM)		0 - 6	
<input type="checkbox"/> Fat (%DM)		0 - 12	
<input type="checkbox"/> Ingredient 1 (kg)		0.0 - 0.0	F
<input type="checkbox"/> Ingredient 2 (kg)		0.0 - 0.0	F
<input type="checkbox"/> Ingredient 3 (kg)		0.0 - 0.0	F

Feed costs		Milk income		Feed efficiency		Margin	
\$/tonne	\$210	\$/L raw milk	\$0.47	Kg ECM/kg DM	1.5	\$/cow/day	\$9.93
c/MJ ME	1.8	\$/kg ECM	\$0.47	Gm MS/kg DM	108	\$/herd/day	\$10
\$/kg CP	\$1.21	\$/kg MS	\$6.54	\$Milk/\$Feed	\$3.36	Feed % income	30
\$/cow/day	\$4.20	\$/cow/day	\$14.13			Milk yield adjustment (L/d)	30.0

When a feasible diet cannot be found check the diet detail tab to see how close the optimiser was to the specified level. This may give you a hint as to which constraint is preventing optimisation. You can then either add additional feeds or relax a constraint until a feasible diet is found.

Figure 45. Successful optimisation after relaxing the sugar constraint.

Test.rm8* - Rumen8 registered to Richard Morris

File Edit Animal View Help

Diet ingredients			DM	As Fed
1.	Barley grain		8.11	9.24
2.	Lupins grain		3.81	4.25
3.	Ryegrass - Dryland - late annual		8.18	34.08
4.	None		0.00	0.00
5.	None		0.00	0.00
6.	None		0.00	0.00
7.	None		0.00	0.00
8.	None		0.00	0.00
9.	None		0.00	0.00
10.	None		0.00	0.00
11.	None		0.00	0.00
12.	None		0.00	0.00
13.	None		0.00	0.00
14.	None		0.00	0.00
15.	None		0.00	0.00
			20.1	47.6

Feed costs		Milk income		Feed efficiency		Margin	
\$/tonne	\$208	\$/L raw milk	\$0.47	Kg ECM/kg DM	1.5	\$/cow/day	\$9.95
c/MJ ME	1.7	\$/kg ECM	\$0.47	Gm MS/kg DM	107	\$/herd/day	\$10
\$/kg CP	\$1.21	\$/kg MS	\$6.54	\$Milk/\$Feed	\$3.38	Feed % income	30
\$/cow/day	\$4.18	\$/cow/day	\$14.13			Milk yield adjustment (L/d)	30.0

Animal Diet Diet detail Milk price Feed cost Compare Notes Optimise

Optimise

Feasible diet found (all constraints satisfied)

☒ ME demand ☒ Intake (kg NDF)

☒ MP min. demand ☐ Intake (kg)

☒ NDF (%DM) 28 - 40

☐ eNDF (%NDF) 0 - 100

☐ NDF from forage (%DM) 0 - 100

☐ CP (%DM) 16 - 22

☒ Forage % in F:C ratio 40 - 100

☐ Concentrate (kg) 1.0 - 8.0

☒ Starch (%DM) 15 - 25

☒ Sugar (%DM) 0 - 12

☐ Fat (%DM) 0 - 12

☐ Ingredient 1 (kg) 0.0 - 0.0 F

☐ Ingredient 2 (kg) 0.0 - 0.0 F

☐ Ingredient 3 (kg) 0.0 - 0.0 F

COSTS, INCOME, EFFICIENCIES, AND MARGINS

The bottom of the Rumen8 window displays a range of parameters that allow you to evaluate the financial performance of the current diet. All feeds in the diet must have a feed cost entered and a milk price is also required.

Figure 46. The costs, income, efficiency and margin measures.

The screenshot shows the Rumen8 software interface. The top menu bar includes File, Edit, Animal, View, and Help. The main window is divided into several sections:

- Diet ingredients:** A list of 15 ingredients with dropdown menus and input fields for DM and As Fed values. The total DM is 20.1 and the total As Fed is 47.6.
- Animal tab:** Contains various parameters for a Holstein cow, including live weight, pregnancy status, milk yield, and farm terrain. Sliders are used to adjust many of these values.
- Financial Performance Summary:** A table at the bottom showing feed costs, milk income, feed efficiency, and margins.

Feed costs		Milk income		Feed efficiency		Margin	
\$/tonne	\$208	\$/L raw milk	\$0.47	Kg ECM/kg DM	1.5	\$/cow/day	\$9.95
c/MJ ME	1.7	\$/kg ECM	\$0.47	Gm MS/kg DM	107	\$/herd/day	\$10
\$/kg CP	\$1.21	\$/kg MS	\$6.54	\$Milk/\$Feed	\$3.38	Feed % income	30
\$/cow/day	\$4.18	\$/cow/day	\$14.13			Milk yield adjustment (L/d)	30.0

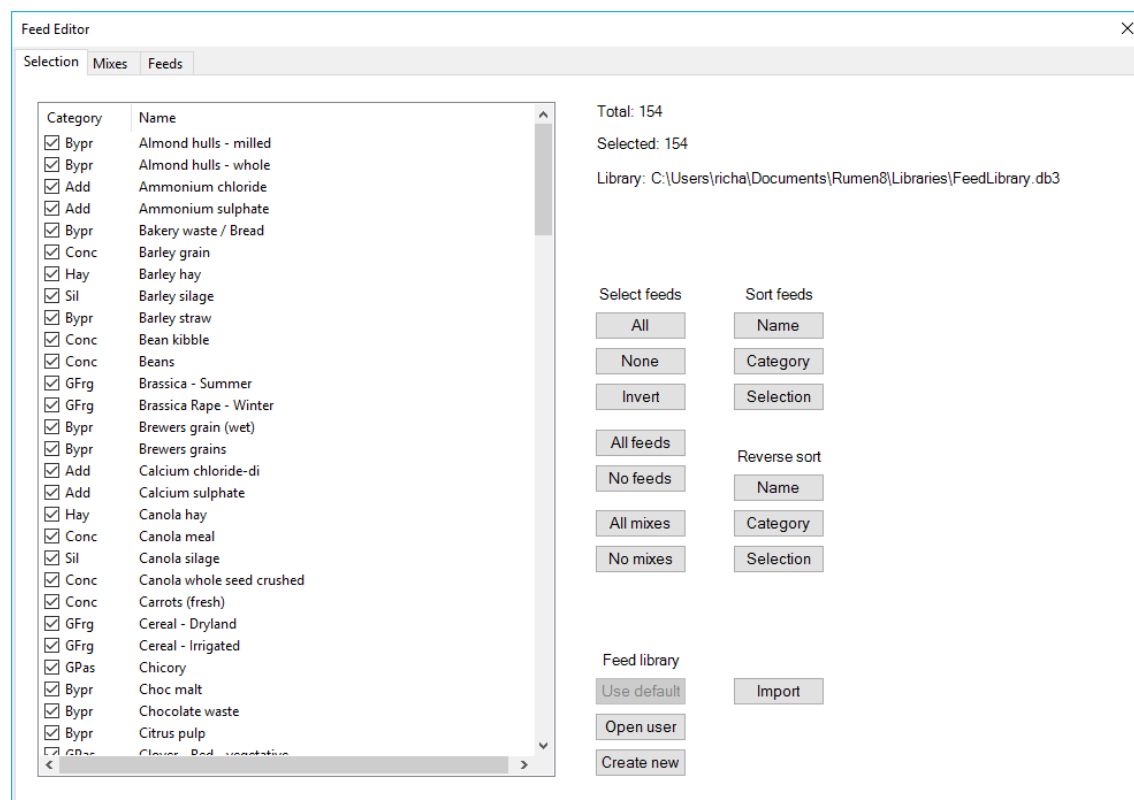
These parameters are divided into four groups. From left to right they are feed costs, milk income, feed efficiencies and margins. The first two of the feed efficiency measures and the feed as a percent of income measure may also have a recommended level set in preferences to quickly show if they are within the recommended range via a small traffic light.

The current milk yield can also be adjusted in the bottom right of the window allowing the animal performance to be fine-tuned while the Animal tab is not visible.

THE FEED LIBRARY EDITOR

The feed library is accessible from the edit menu of the main Rumen8 window. It allows you to edit all the parameters for each feed and define commonly used mixes. The feed library window is divided into three tabbed sections, the first tab (Selection) shows all the feeds available in the library, the second (Mixes) allows creation of feed mixes and the last (Feeds) the details of every feed.

Figure 47. The Selection tab of the feed editor.



SELECTION

The list of feeds in the left of the feed library window shows all the feeds and mixes available in the current library. Feeds with a tick in the box to the left of their name will be visible in the diet ingredient drop-down lists of the main Rumen8 window. This allows you to have a large feed library but only make a smaller more manageable number of feeds visible when creating diets.

The right of the feed list shows the total number of feeds and the number currently visible in the diet ingredient drop-down lists. Below that the path to the current feed library is shown, which is useful if you are changing between the default feed library and user feed libraries.

Select feeds

The Select buttons allow you to select all, none, or invert the current selection of the feeds and mixes with a single click. Beneath those you can select all or none of just the feeds or just the mixes.

Sort feeds

The sort feeds buttons allow you to change the order of the feeds and mixes so they are listed in ascending or descending (reverse) order by name, category or if they are selected.

Feed libraries

You may have multiple feed libraries and switch between them. When Rumen8 starts, it will load the library used last time if it is still available. If not, it will revert to the default feed library. Feed libraries must be called Feed.db3 so you cannot have two libraries in a folder.

The 'Open user' button allows you to open a user feed library from another folder on the disk. The 'Create new' button allows you to save a copy of the current library in a new folder. The 'Use default' button re-loads the default feed library held in the ~\Rumen8\Libraries folder. There must always be a default library in the Libraries folder and if it is removed Rumen8 will replace it when it starts.

If you have a user feed library loaded the UFL flag will also appear in the main window and the path to the feed library will be shown in flag's tooltip (hover the mouse over it to see it).

Figure 48. The user feed library flag in the main window (highlighted with a blue arrow).

The screenshot shows the Rumen8 software interface. The main window is titled "Test.rm8 - Rumen8 registered to Richard Morris". It has a menu bar with "File", "Edit", "Animal", "View", and "Help". The interface is divided into several sections:

- Diet ingredients:** A list of 15 ingredients with dropdown menus and numerical input fields for "DM" and "As Fed" values. The ingredients are: 1. Barley grain, 2. Lupins grain, 3. Ryegrass - Dryland - late annual, 4. None, 5. None, 6. None, 7. None, 8. None, 9. None, 10. None, 11. None, 12. None, 13. None, 14. None, 15. None.
- Animal:** A section with a "Breed" dropdown (set to "Holstein") and various input fields for animal characteristics: Live weight (kg), Live weight change (kg/d), Days pregnant, Days in milk, Number of cows in herd, Milk yield (L/d), Milk fat (% m/v), Milk true protein (% m/v), Fat:Protein ratio, Fat, Protein, F+P (kg/d), Cow Activity, and Farm terrain.
- Feed costs:** A table showing costs for different feed components.
- Milk income:** A table showing income for different milk components.
- Feed efficiency:** A table showing efficiency metrics.
- Margin:** A table showing margin metrics.

A blue arrow points to the "UFL" flag, which is a small blue square with the letters "UFL" in white, located in the bottom left corner of the main window.

Diet ingredients	DM	As Fed
1. Barley grain	8.11	9.24
2. Lupins grain	3.81	4.25
3. Ryegrass - Dryland - late annual	8.18	34.08
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00
	20.1	47.6

Feed costs	
\$/tonne	\$208
c/MJ ME	1.7
\$/kg CP	\$1.21
\$/cow/day	\$4.18

Milk income	
\$/L raw milk	\$0.47
\$/kg ECM	\$0.47
\$/kg MS	\$6.54
\$/cow/day	\$14.13

Feed efficiency	
Kg ECM/kg DM	1.5
Gm MS/kg DM	107
\$Milk/\$Feed	\$3.38

Margin	
\$/cow/day	\$9.95
\$/herd/day	\$10
Feed % income	30
Milk yield adjustment (L/d)	30.0

Importing old feed libraries

The Import button allows you to import an older Rumen8 feed library held in a feed.csv file.

Figure 49. The import window of the feed editor. Barley grain is already present in the feed library.

Import feed 1 of 4

Name

1. Feed management category

☐ Grazed pasture ☐ Grazed other ☐ Hay ☐ Silage

☐ Concentrate ☐ Additive ☐ Byproduct

2. Feed protein type

☐ Grass silage ☒ Other non-forage

☐ OtherSilage ☐ Other forage ☐ Distillery byproduct

3. Feed particle size classification

☐ Concentrate ☐ Forage ☐ Other

Select the feed.csv file to import and then the window shown above will appear. Rumen8 version 3 requires two additional categories for each feed, management category and particle size classification. You can step through each feed to be imported and provide these. If they can be determined from other feed information the importer will select them for you.

Each feed must have a unique name so if the import feed name already exists the Name label will turn red and you must provide an alternative.

Once the import feed has a unique name and the all three categories the Add button will become active so you can add it to the feed library. At any stage, you can click on the Skip button to ignore the current import feed and move to the next. Pressing Cancel will finish the feed importing. Feeds already added will remain in the feed library.

MIXES

The mixes tab lets you define commonly used mixes of feeds that can be selected as a single ingredient in a diet.

Figure 50. The mixes editor in the feed editor.

The screenshot shows the 'Feed Editor' window with the 'Mixes' tab selected. On the left, there is a list of mixes: 'Mix 1', 'Mix 2', and 'Mix 3'. Above this list are buttons for 'Edit', 'Add New', 'Add Copy', and 'Delete'. The 'Edit' section on the right contains a table with the following data:

Percent	Feed
10.0	Barley grain
55.0	Lupins grain
35.0	Wheat grain

Below the table, it says 'Total: 100.0'. There are also input fields for 'Name' (set to 'Mix 1'), 'Max feeding rate (g/Kg)' (300), 'Cost (\$/t)' (100), 'Wet density (kg/m3)' (200), 'Losses (%)' (26), 'Source' (Source 1), and 'Comment' (Comment 1). On the right side of the 'Edit' section, there is a list of available feeds categorized by type (Bypr, Conc, GFrg, GPas, Hay). The list includes items like 'Almond hulls - milled', 'Almond hulls - whole', 'Ammonium chloride', 'Ammonium sulphate', 'Bakery waste / Bread', 'Barley hay', 'Barley silage', 'Barley straw', 'Bean kibble', 'Beans', 'Brassica - Summer', 'Brassica Rape - Winter', 'Brewers grain (wet)', 'Brewers grains', 'Calcium chloride-di', 'Calcium sulphate', 'Canola hay', 'Canola meal', 'Canola silage', 'Canola whole seed crushed', 'Carrots (fresh)', 'Cereal - Dryland', 'Cereal - Irrigated', 'Chicory', 'Choc malt', 'Chocolate waste', 'Citrus pulp', 'Clover - Red - vegetative', and 'Clover hay'.

The left part of the window shows all the mixes in the feed library and the Edit section shows the details of the currently selected mix. You can use the buttons above the mix list to create, change, and delete mixes.

Edit Edit the parameters of the currently selected mix.

Add Copy Add a new mix to the library that is a copy of the currently selected mix.

Add New Add a new blank mix to the library.

Delete Remove the currently selected mix from the library.

The Edit section becomes active when a mix is being created or changed. The feed list on the right shows all the feeds in the current feed library that are not in the mix. They can be added to the mix table singly or in groups by selecting them and clicking on the add (<) button. Multiple feeds can be selected by choosing the first one and then holding down the control key while clicking on subsequent ones. Groups of feeds can be moved into the mix by selecting the first feed and then holding down the shift key when selecting the last one. Alternatively, you can double click on a single feed to move it straight into the mix.

To remove a feed from the mix, click on the row header in the mix table to highlight the row and press the remove (>) button.

Once all the feeds have been moved into the mix table you must give each one a percentage on a dry weight basis. You cannot save the mix unless all the feed percentages add up to 100. The total at the bottom of the mix table shows the current percentage and will be red if it isn't 100%. If the percentage is under or

over 100 the difference is shown in brackets. Change each feed percent by double clicking on the value in the table.

Below the mix table are the remaining parameters needed to define a mix. The mix name must be unique among both feeds and mixes and will turn red if this is not the case. You will be unable to save the mix until it has a unique name. If you are unsure what the parameters are, hover your mouse over the name and a tooltip will appear with the full name. Abbreviations are also listed at the end of this document.

If you enter an invalid value into the entry box for any of the parameters, the parameter name will turn red.

FEEDS

The Feeds tab lets you edit all the parameters for each of the feeds in the current library. The currently highlighted feed has its parameters displayed in edit section of the window.

Figure 51. The mixes editor in the feed editor.

Category	Name
Bypr	Almond hulls - milled
Bypr	Almond hulls - whole
Add	Ammonium chloride
Add	Ammonium sulphate
Bypr	Bakery waste / Bread
Conc	Barley grain
Hay	Barley hay
Sil	Barley silage
Bypr	Barley straw
Conc	Bean kibble
Conc	Beans
GFRg	Brassica - Summer
GFRg	Brassica Rape - Winter
Bypr	Brewers grain (wet)
Bypr	Brewers grains
Add	Calcium chloride-di
Add	Calcium sulphate
Hay	Canola hay
Conc	Canola meal
Sil	Canola silage
Conc	Canola whole seed crushed
Conc	Carrots (fresh)
GFRg	Cereal - Dryland
GFRg	Cereal - Irrigated
GPas	Chicory
Bypr	Choc malt
Bypr	Chocolate waste
Bypr	Citrus pulp
GPas	Clover - Red - vegetative

Edit			
Name: Almond hulls - milled			
1. Feed management category			
<input type="radio"/> Grazed pasture <input type="radio"/> Grazed other <input type="radio"/> Hay <input type="radio"/> Silage <input type="radio"/> Concentrate <input type="radio"/> Additive <input checked="" type="radio"/> Byproduct			
2. Feed protein type			
<input type="radio"/> Grass silage <input checked="" type="radio"/> Other non-forage <input type="radio"/> OtherSilage <input type="radio"/> Other forage <input type="radio"/> Distillery byproduct			
3. Feed particle size classification			
<input checked="" type="radio"/> Concentrate <input type="radio"/> Forage <input type="radio"/> Other			
ME (MJ/kg)	9.0	aN	0.30
CP (g/Kg)	52	bN	0.35
DM (g/Kg)	877	cN	0.05
Fat (g/Kg)	30	ADIN (g/Kg)	2.7
Ca (g/Kg)	2.8	Ca abspn	0.60
P (g/Kg)	1.2	P abspn	0.70
Mg (g/Kg)	1.2	Mg abspn	0.16
K (g/Kg)	27.6	Max feeding rate (g/Kg)	150
Na (g/Kg)	0.2	Wet density (kg/m3)	300
Cl (g/Kg)	0.5	Source	
S (g/Kg)	0.6	Comment	Feed value varies according to proportion
DCAD (MEq)	663		
Starch (g/Kg)	20		
Sugar (g/Kg)	283		
Ash (g/Kg)	78		
NDF (g/Kg)	354		
eNDF in NDF	340		
Cost (\$/t DM)			
Cost (\$/t fed)			
Losses (%)	0		
Cost +losses	\$		
Cost +loss. fr	\$		

Required feed parameter names are in bold
All units are on a DM basis unless shown otherwise

Edit Edit the parameters of the currently selected feed.

Add Copy Add a new feed to the library that is a copy of the currently selected feed.

Add New Add a new blank feed to the library.

Delete Remove the currently selected feed from the library.

To edit an individual feed highlight it in the feed list and click the 'Edit' button. The entry boxes in the Edit section of the window will become active and allow you to change any of the feed parameters.

As a minimum, eleven parameters are required for a feed to be accepted as valid and their names are in bold in the edit section. These are a unique name, management category, protein type, particle size classification, ME, CP, DM, Fat, aN, bN and cN. Until valid values for these parameters are entered you will be unable to save the feed.

If you unsure what the parameters refer to, hover your mouse over the name and a tooltip will appear with the full name and an explanation. Abbreviations are also listed at the end of this document.

If you enter an invalid value into the entry box for any of the parameters, the parameter name will turn red. Once you have entered all the feed parameters you have, or have edited an existing feed, click on the 'Okay' button to save your changes and return to feed selection.

Figure 52. Entering parameters for an individual feed.

Feed Editor

Selection | Mixes | Feeds

Category	Name
Bypr	Almond hulls - milled
Bypr	Almond hulls - whole
Add	Ammonium chloride
Add	Ammonium sulphate
Bypr	Bakery waste / Bread
Conc	Barley grain
Hay	Barley hay
Sil	Barley silage
Bypr	Barley straw
Conc	Bean kibble
Conc	Beans
Gfgr	Brassica - Summer
Gfgr	Brassica Rape - Winter
Bypr	Brewers grain (wet)
Bypr	Brewers grains
Add	Calcium chloride-di
Add	Calcium sulphate
Hay	Canola hay
Conc	Canola meal
Sil	Canola silage
Conc	Canola whole seed crushed
Conc	Carrots (fresh)
Gfgr	Cereal - Dryland
Gfgr	Cereal - Irrigated
GPas	Chicory
Bypr	Choc malt
Bypr	Chocolate waste
Bypr	Citrus pulp
GPas	Clover - Red - vegetative

Edit

Name: Barley grain

1. Feed management category

☐ Grazed pasture ☐ Grazed other ☐ Hay ☐ Silage

☒ Concentrate ☐ Additive ☐ Byproduct

2. Feed protein type

☐ Grass silage ☒ Other non-forage

☐ OtherSilage ☐ Other forage ☐ Distillery byproduct

3. Feed particle size classification

☒ Concentrate ☐ Forage ☐ Other

ME (MJ/kg)	12.8	aN	0.28	Starch (g/Kg)	568
CP (g/Kg)	122	bN	0.66	Sugar (g/Kg)	34
DM (g/Kg)	878	cN	0.22	Ash (g/Kg)	25
Fat (g/Kg)	21	ADIN (g/Kg)	0.7	NDF (g/Kg)	200
Ca (g/Kg)	0.7	Ca abspn	0.60	eNDF in NDF	317
P (g/Kg)	3.8	P abspn	0.70	Cost (\$/t DM)	250
Mg (g/Kg)	1.4	Mg abspn	0.16	Cost (\$/t fed)	220
K (g/Kg)	5.5	Max feeding rate (g/Kg)	400	Losses (%)	0
Na (g/Kg)	0.2	Wet density (kg/m3)	650	Cost +losses	\$250
Cl (g/Kg)	1.5			Cost +loss. fr	\$220
S (g/Kg)	1.5	Source			
DCAD (MEq)	10	Comment	Ruminal acidosis risk (risk level depends c		

Required feed parameter names are in bold
All units are on a DM basis unless shown otherwise

Okay Cancel

IMPORTANT

Given the importance of the correct management category, protein type and particle size classification of a feed, and the difficulty in obtaining aN, bN and cN values for feeds, we strongly suggest you ALWAYS create a new feed in your feed library by adding a copy of a closely matching existing feed from the original Rumen8 feed library, which can then be modified for DM, ME, CP, fat and other feed values. For this reason we also suggest you NEVER edit feeds in the original Rumen8 feed library, but add copies of these feeds instead which can then be modified to reflect your feeds.

Although Rumen8 can function with just these required parameters, to make full use of the features of the program, all feed values should be entered if possible. Entering feed costs and keeping these up to date is also important if you wish to compare diets to determine the lowest cost option.

As the aN, bN, cN and ADIN values are not easily obtained, a generic list is provided here that indicates typical values for different feed classes (AFRC 1993).

Table 1. Typical protein degradability (aN, bN and cN) and ADIN (g/kg DM) values for different feed classes

Feed class	aN	bN	cN	ADIN
Fresh forages	0.24	0.67	0.12	1.2
Roots	0.25	0.65	0.41	1.2
Grass and legume silages	0.59	0.31	0.13	1.2
Cereal silage incl maize	0.69	0.20	0.10	2.2
Grass hays	0.22	0.60	0.08	1.2
Legume hays	0.20	0.65	0.29	2.0
Cereal straws	0.30	0.50	0.12	1.0
Cereals	0.47	0.48	0.27	0.4
Legume seeds	0.41	0.57	0.16	0.5
Cereal byproducts	0.36	0.55	0.09	1.0
Beet and citrus pulps	0.39	0.57	0.05	1.2
Oils meals, high fibre	0.24	0.69	0.11	3.3
Oil meals, low fibre	0.14	0.79	0.09	2.1

PREFERENCES

Access to the preferences window is via the Preferences option in the File menu of the main Rumen8 window. The settings you can adjust in Rumen8 are divided into General, Recommended levels and Advanced tabs.

GENERAL PREFERENCES

Figure 53. The General preferences tab.

Preferences

GeneralRecommended levelsAdvanced

Milk yield units

☒ Litres

☐ Kilograms

Milk component units

☐ Mass/mass

☒ Mass/volume

Feed concentration units

☒ g/Kg

☐ Percentage

Feed proportion units

☒ Proportion

☐ Percentage

Total solids ratio

☒ Fat:Protein

☐ Protein:Fat

ToolTips detail

☐ None

☐ Standard

☒ Extended

Dry matter intake estimate

☐ NDF intake as

1.20

 percentage of liveweight

☒ NRC (2001) intake estimation

☒ Show Diet tab

Change Rumen8 home directory after Rumen8 quits

Change home

Restore all the preferences to their default setting

Restore Defaults

⌵ Optimiser disabled

Close

Milk yield units

Milk yield can be entered and reported in litres or kilograms.

Milk component units

The fat, protein and lactose percentage of milk can be entered and reported in mass/volume (kg/litre) or mass/mass (kg/kg) units (mm% or mv%).

Feed concentration units	The units for concentration used by Rumen8 can be set to g/kg or percentage.
Feed proportion units	The units for parameters such as aN, bN or cN can entered and displayed as a proportion (0 to 1) or a percentage.
Total solids ratio	The total solids ratio displayed on the Animal tab can be shown as Fat: Protein or Protein: Fat.
Tooltips detail	This allows you to set the level of information provided by the tooltips. None turns tooltips off completely so there will be no additional information when you hover the mouse over an item. Standard provides a one line explanation and Extended provides the default longer explanations with diagrams.
Dry matter intake estimate	The animal's feed intake potential can be estimated using the 'maximum NDF as a percentage of live weight rule' or the NRC (2001) calculation. The NRC calculation is the method we recommend for lactating cows receiving concentrate in their diet.
Maximum NDF intake as a % of live weight	Enter the percentage of live weight used for calculation of potential intake by the NDF method. The default is 1.2%.
Show the diet tab	The Diet tab can be turned off by un-ticking this box. Useful if you only use the Diet detail tab.
Change the Rumen8 home directory after restart	If you want to change where Rumen8 stores its files (usually ~\Documents\Rumen8) then clicking the 'Change home' button will cause Rumen8 to ask you where to place the Rumen8 directory next time it is started. If this is a new directory the default feed library and preferences files will be copied across. If you wish to retain your existing library files you should copy them into the new location using Windows Explorer.
Restore all the preferences to their default setting	This will set all the preference settings back to their default values.
Optimiser disabled/enabled	The Optimiser tab will be available in the main window if this box is selected. This also makes available the Optimiser preferences below it. See the Optimiser section of this document for more information on using the optimiser as it requires Microsoft Excel and the Solver add-in along with careful setup. It will not work if you just enable it here!

The Optimiser parameters

Excel visible during optimization

Tick this to see Excel load and optimise the diet. Usually left un-ticked.

Excel saves diet after optimization

Tick this to make Excel save the optimiser spreadsheet after optimising the diet. This is useful for debugging and is usually left un-ticked.

ADVANCED PREFERENCES

The advanced section of the preferences contains those settings that are unlikely to need adjustment and may have a significant impact on the cow nutrition model if they are changed. Please change them only in consultation with a highly experienced and qualified nutritionist. Or better, contact us to discuss the impact of the changes you are wanting to make.

Figure 54. The Advanced preferences tab.

Preferences

General Recommended levels **Advanced**

Nutrition model settings. Changes may have a significant impact on the animal model estimates so adjust them with care.

☒ 5% energy and protein safety margin (recommended on)

Gross energy in 1 kg dry matter MJ

Fasting metabolism correction factor

Fixed addition to ME requirement MJ

MP requirement correction

Excess protein removal cost - KJ/gram

Net energy for liveweight change

Gain	Loss
<input type="text" value="19"/>	<input type="text" value="19"/>

 MJ/kg LWT

Cow time standing hours/d

Cow position changes No./d

Milk true protein content % CP

Milk lactose (m/v) %

Weight of a litre of milk kg

DCAD target levels

Early dry cows < Springers < Lactating cows >

Traffic light and progress bar accuracy

The percentage above or below the requirement the light is green

ME	MP	DMI	Minerals
<input type="text" value="2"/>	<input type="text" value="2"/>	<input type="text" value="2"/>	<input type="text" value="2"/>

Close

5% energy and protein safety margin	Turn this on to add a 5% safety margin to the cow's energy and protein requirement. Turning this on is recommended by the feeding standard.
Gross energy in 1 kg of dry matter	Enter the gross energy contained in 1 kilogram of dry matter in mega joules. Used as part of the cow energy requirement calculation.
Fasting metabolism correction factor	Rumen8 will increase the fasting metabolism energy requirement by multiplying it by this value.
Fixed addition to ME requirement	Rumen8 will add this value to the cow's energy requirement.
MP requirement correction	The cow's total protein requirement will be multiplied by this value.
Excess protein removal cost	The range of values for the cost of removing excess protein by the cow. A range is provided as there are differing values quoted in the literature, which vary depending on the degree of N recycling via saliva.
Net energy for live weight change	The net energy liberated by live weight loss or required for live weight gain.
Cow time standing	Leave at 14 hours unless you have access to a better estimate.
Cow position changes	The number of times a cow gets up or down during the day. Leave at 10 unless you have access to a better estimate.
Milk true protein content	The percentage of crude protein in milk that is true protein.
Milk lactose	The lactose content (%) of the milk for your cows.
Weight of a litre of milk	The weight of one litre of milk in kilograms.
DCAD target levels	The DCAD targets for early dry cows (dry off to entering the springer herd), 'springers' (transition 2 weeks prior to calving) and lactating cows.
Traffic light and progress bar accuracy	These parameters set the sensitivity of the 'traffic lights' for the cow's energy, protein, intake and minerals on the Diet detail tab and the progress bars in the Diet tab. The lights will show green if the diet provides an amount of energy, protein, dry matter intake or mineral that is within this percentage of the cow demand.

RECOMMENDED LEVELS

Rumen8 allows the user to set a recommended level range for several important diet parameters. These provide quick feedback on the suitability of the current level of a diet measure on the Diet and Diet detail tabs with a traffic light. Four sets of recommended levels can be defined and quickly switched between on the Diet detail tab. These could be used for early, mid and late lactation cow diets for example.

Figure 55. The Recommended levels tab in Preferences showing example ranges for early lactation cows.

Preferences

General Recommended levels Advanced

Recommended levels set

☒ One ☐ Two ☐ Three ☐ Four

Description Early lactation

<input checked="" type="checkbox"/> NDF (%DM)	28 - 30	
<input checked="" type="checkbox"/> eNDF (%NDF)	50 - 100	
<input type="checkbox"/> NDF forage (%DM) 50 - 100		
<input type="checkbox"/> NDF forage (%LW) 0.0 - 3.0		
<input checked="" type="checkbox"/> Sugar (%DM)	0 - 6	
<input checked="" type="checkbox"/> Starch (%DM)	20 - 25	
<input checked="" type="checkbox"/> Fat (%DM)	0 - 6	
<input checked="" type="checkbox"/> NFC (%DM)	35 - 40	
<input checked="" type="checkbox"/> RDP (%CP)	66 - 72	
<input type="checkbox"/> UDP (%CP)	0 - 100	
<input checked="" type="checkbox"/> Forage % in F:C	40 - 100	
<input type="checkbox"/> FE ECM/ kg DMI	0.0 - 4.0	
<input type="checkbox"/> FE MS/ kg DMI	0 - 400	
<input checked="" type="checkbox"/> Feed % income	0 - 60	

Close

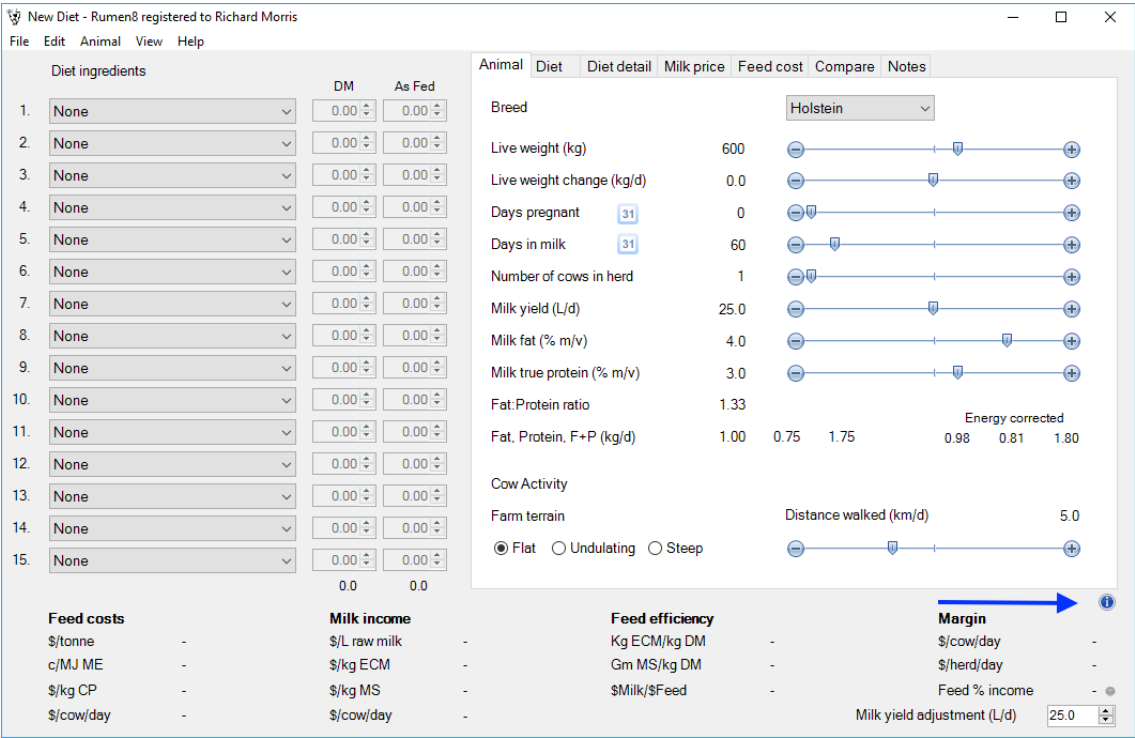
Select the current recommended levels set by clicking on one of the buttons across the top of the tab. Describe the use of the set with a short description below.

For each of the 14 diet measures you can set an acceptable range by moving the minimum and maximum sliders left or right. The actual values are displayed to the left of the slider. So, if you wish to target NDF levels of 28-30% in early lactation activate the NDF recommended levels by clicking on the checkbox to the left and then move the sliders until that range is displayed. Now a traffic light will appear on the Diet and Diet detail tabs that will show you if the diet NDF level is below (red), within (green) or above (yellow) your recommended NDF level. Repeat this process for each of the diet measures for you wish to display a recommended level traffic light.

KEEPING RUMEN8 UPDATED

Rumen8 can check for updates if your computer is connected to the Internet. Select ‘Check for updates’ under the Help menu and if an update is available a small blue information icon will appear above the Margin section of the main window.

Figure 56. The information icon that means an update is available highlighted with a blue arrow.



Clicking on the blue information icon will roll out a menu telling you the update will be installed the next time Rumen8 starts. If you click on this text a drop down menu gives you the choice to install the update now or view the changes in the new version.

Figure 57. Installing an update or viewing changes.

The screenshot shows the Rumen8 software interface with a message box indicating that an update will be installed on the next start. The message box contains the text "Update will be installed on next start." and "Install update now". Below the message box, there is a button labeled "View changes in version 3.0.0.6". The interface also displays various input fields for diet ingredients, animal parameters, and feed costs.

Diet ingredients	DM	As Fed
1. None	0.00	0.00
2. None	0.00	0.00
3. None	0.00	0.00
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00

Feed costs	Milk income	Feed efficiency
\$/tonne	\$/L raw milk	Kg ECM/kg DM
c/MJ ME	\$/kg ECM	Gm MS/kg DM
\$/kg CP	\$/kg MS	\$Milk/\$Feed
\$/cow/day	\$/cow/day	

Animal parameters: Breed: Holstein, Live weight (kg): 600, Live weight change (kg/d): 0.0, Days pregnant: 31, Days in milk: 31, Number of cows in herd: 1, Milk yield (L/d): 25.0, Milk fat (% m/v): 4.0, Milk true protein (% m/v): 3.0, Fat:Protein ratio: 1.33, Fat, Protein, F+P (kg/d): 1.00, 0.75, 1.75, Energy corrected: 0.98, 0.81, 1.80, Cow Activity: Farm terrain: Distance walked (km/d): 5.0, Flat (selected), Undulating, Steep.

When Rumen8 is restarted, it will download the files required, update your installation of Rumen8 and then start the new version. The blue information icon will be replaced by a green tick which when clicked will confirm you have updated to the latest version.

If you check for updates and there is not one available a green tick will appear above the Margin section of the main window and if you click on it, it will confirm you already have the latest version of Rumen8.

Figure 58. You have the latest version of Rumen8.

The screenshot shows the Rumen8 software interface with a green tick mark above the Margin section, indicating that the user has the latest version. The interface displays various input fields for diet ingredients, animal parameters, and feed costs. A blue arrow points to the green tick mark above the Margin section.

Diet ingredients	DM	As Fed
1. None	0.00	0.00
2. None	0.00	0.00
3. None	0.00	0.00
4. None	0.00	0.00
5. None	0.00	0.00
6. None	0.00	0.00
7. None	0.00	0.00
8. None	0.00	0.00
9. None	0.00	0.00
10. None	0.00	0.00
11. None	0.00	0.00
12. None	0.00	0.00
13. None	0.00	0.00
14. None	0.00	0.00
15. None	0.00	0.00

Feed costs	Milk income	Feed efficiency	Margin
\$/tonne	\$/L raw milk	Kg ECM/kg DM	\$/cow/day
c/MJ ME	\$/kg ECM	Gm MS/kg DM	\$/herd/day
\$/kg CP	\$/kg MS	\$Milk/\$Feed	Feed % income
\$/cow/day	\$/cow/day		Milk yield adjustment (L/d): 25.0

Animal parameters: Breed: Holstein, Live weight (kg): 600, Live weight change (kg/d): 0.0, Days pregnant: 31, Days in milk: 31, Number of cows in herd: 1, Milk yield (L/d): 25.0, Milk fat (% m/v): 4.0, Milk true protein (% m/v): 3.0, Fat:Protein ratio: 1.33, Fat, Protein, F+P (kg/d): 1.00, 0.75, 1.75, Energy corrected: 0.98, 0.81, 1.80, Cow Activity: Farm terrain: Distance walked (km/d): 5.0, Flat (selected), Undulating, Steep.

Rumen8 will check for updates every day automatically if your computer has a connection to the Internet. The update system has been optimised for slow connections so it only downloads the file changes that are necessary, not the entire Rumen8 installation each time.

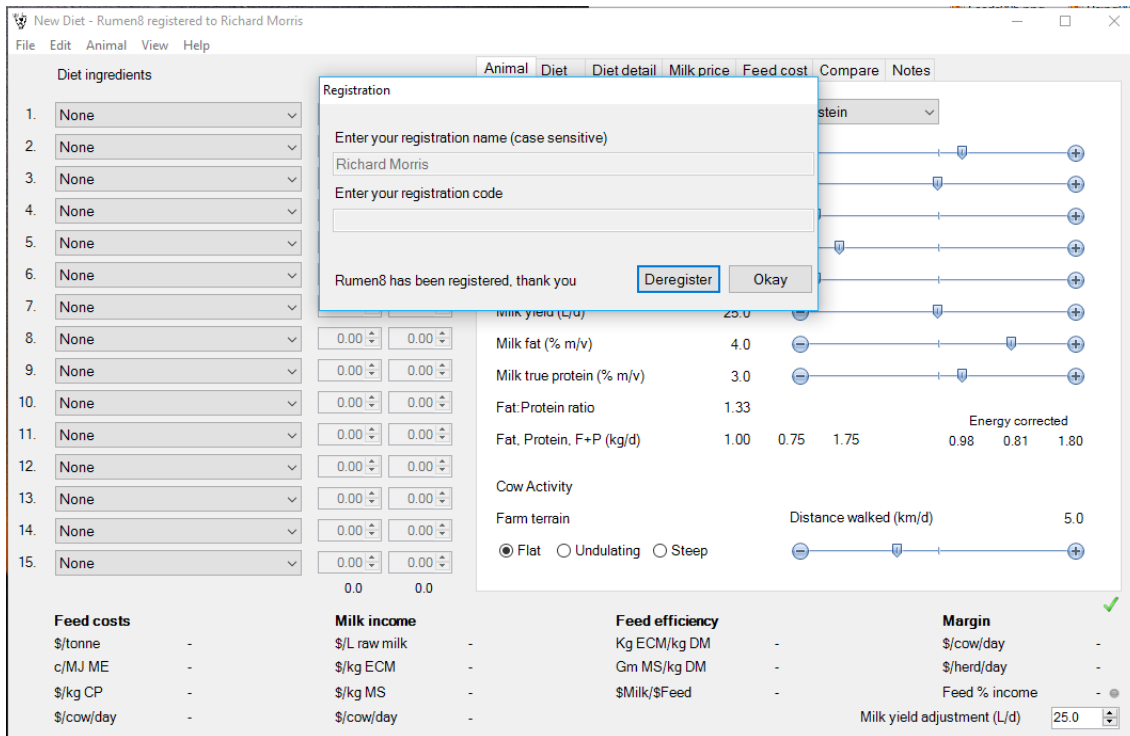
If your computer is offline, you can download the latest version of Rumen8 from the website and then install the new version manually. Your library and diet files will not be changed when you do this.

UNINSTALLING RUMEN8

Completely removing Rumen8 from your computer will take three steps.

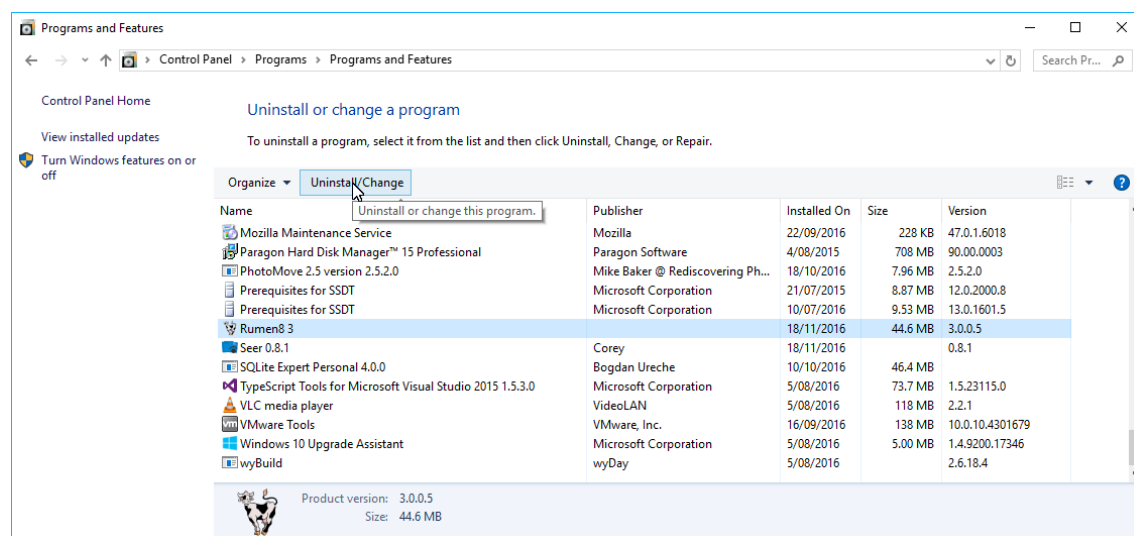
1. Remove your registration information from the computer.
Go to the Registration option under the Help menu and click the 'Deregister' button. Your details will be removed from the computer and Rumen8 will revert to trial mode.

Figure 59. Removing the registration information from Rumen8.



2. Uninstall the Rumen8 software.
Go to the Windows Control Panel and in the 'Programs' section click on 'Uninstall a program' in Category view, or 'Programs and features' in icon view. Select Rumen8 from the list and click the 'Uninstall' button at the top of the list. Follow the prompts and Rumen8 will be removed from your computer.

Figure 60. Uninstalling Rumen8



3. Delete the Rumen8 folder from your Documents folder.
If you do this you will lose your feed library, preferences and any saved diet files.
4. (Optional) Delete the 'Western_Dairy_Inc' folder containing the settings files from the AppData\Local folder from within your user folder. This folder is normally hidden so this step is for advanced users only. These files only take up a tiny amount of disk space so this isn't important.

OPTIMISER INSTALLATION (ADVANCED USERS)

The optimise function in Rumen8 is unsupported. This is because it requires communication with specific versions of Microsoft Excel and configuration is difficult. However, if you have a good knowledge of Microsoft Excel and Windows and would like to try, the steps for Excel 2016 are listed below. The process is very similar for Excel 2010 and 2013.

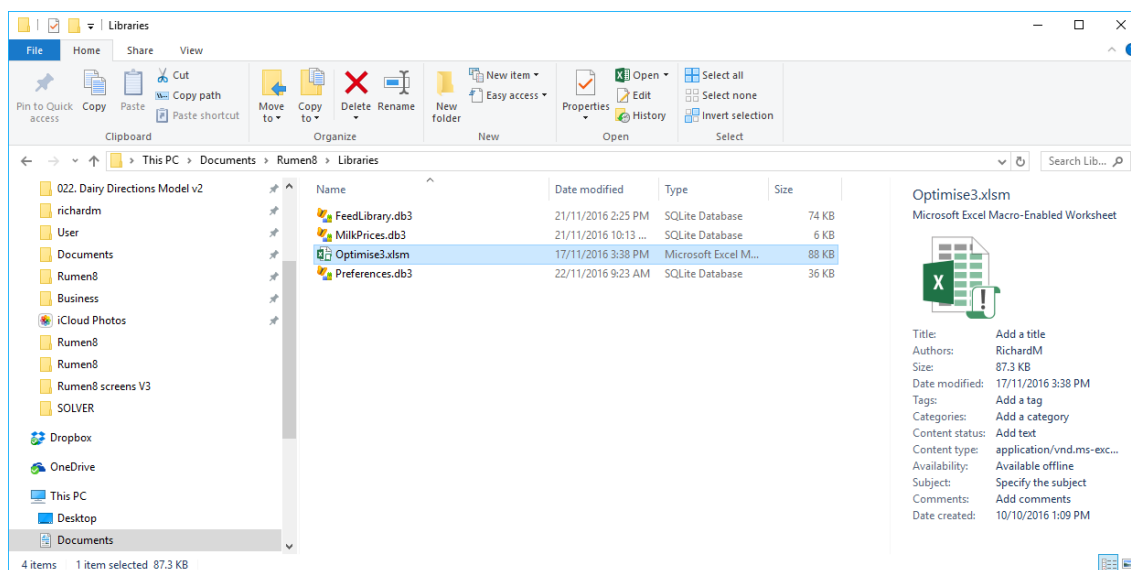
Rumen8 only supports Microsoft Excel 2010, (version 14), 2013 (version 15) and 2016 (version 16) and it requires the Solver add-in to be installed. The animal model used by Rumen8 requires non-linear optimisation to estimate the lowest cost diet from the chosen ingredients and Solver provides this.

Rumen8 copies the current diet into the Optimise3.xlsm spreadsheet, configures Solver with the required constraints, runs it and then copies the results back into Rumen8. To do this the Optimise3.xlsm spreadsheet must have Excel macro security set correctly, the Solver add-in installed and a Visual Basic for Applications Reference added to give access to the local Solver file. The steps below show you how to do this.

INSTALLATION INSTRUCTIONS FOR EXCEL 2016

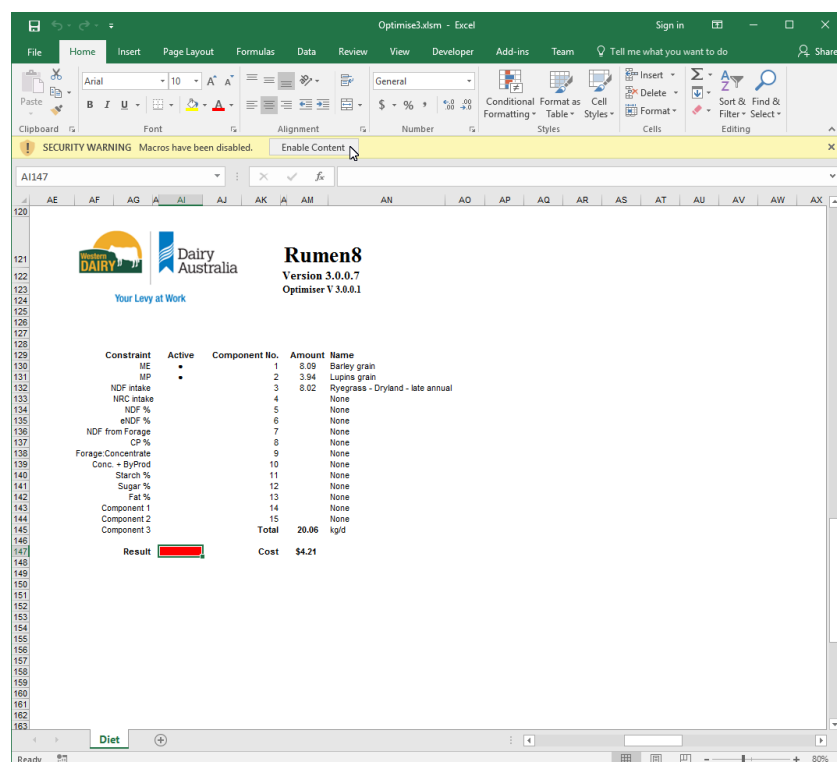
1. Open the Optimise.xlsm spreadsheet in the ~\Documents\Rumen8\libraries folder in Excel.

Figure 61. Open the Optimise.xlsm spreadsheet.



2. If Excel's security level is still set to the defaults you will be prompted under the ribbon menu with a Security warning that macros have been disabled. Click on 'Enable content' in the message that appears. If Excel's security level is set too high, it will automatically and silently disable macros which will prevent Rumen8 from optimising diets.

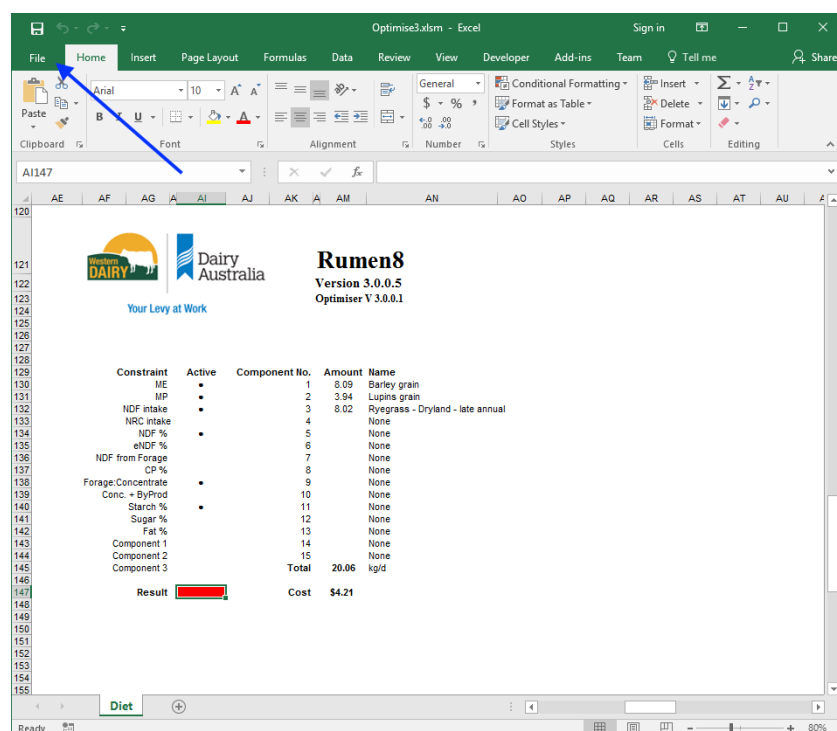
Figure 62. Enable macros in the optimiser spread sheet.



SET EXCEL SECURITY LEVELS

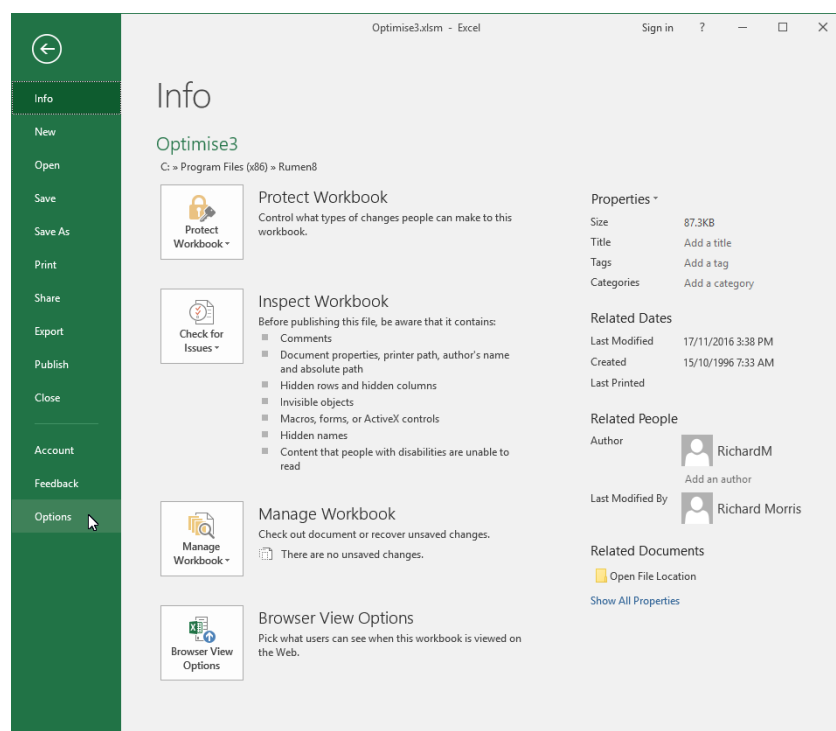
- To ensure the macros settings are correct we must go into the File menu. It is the left most menu on the ribbon.

Figure 63. Click on the File ribbon menu to access Excel options.



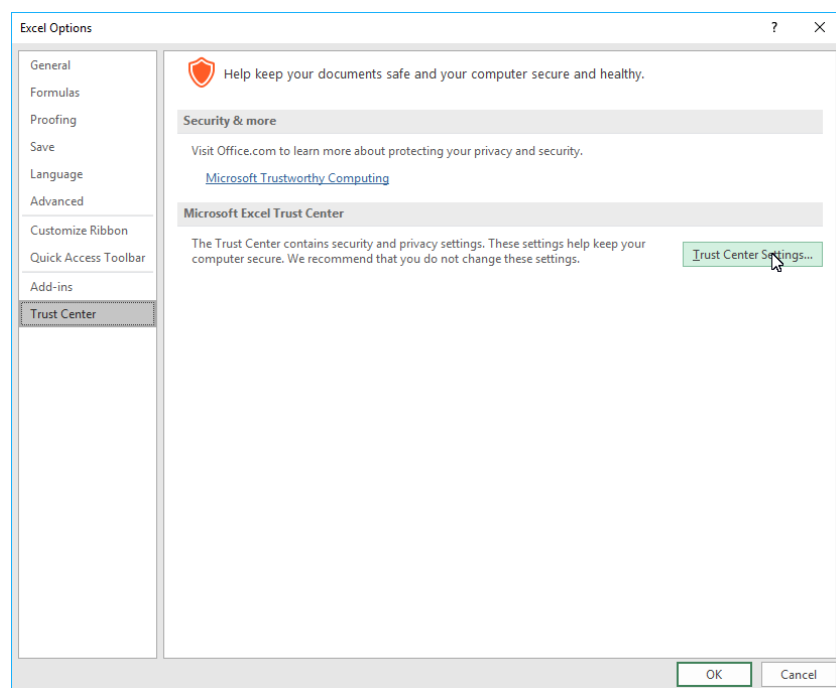
- Click on the 'Excel Options' button at the bottom of the menu.

Figure 64. Accessing Excel Options from the Excel menu.



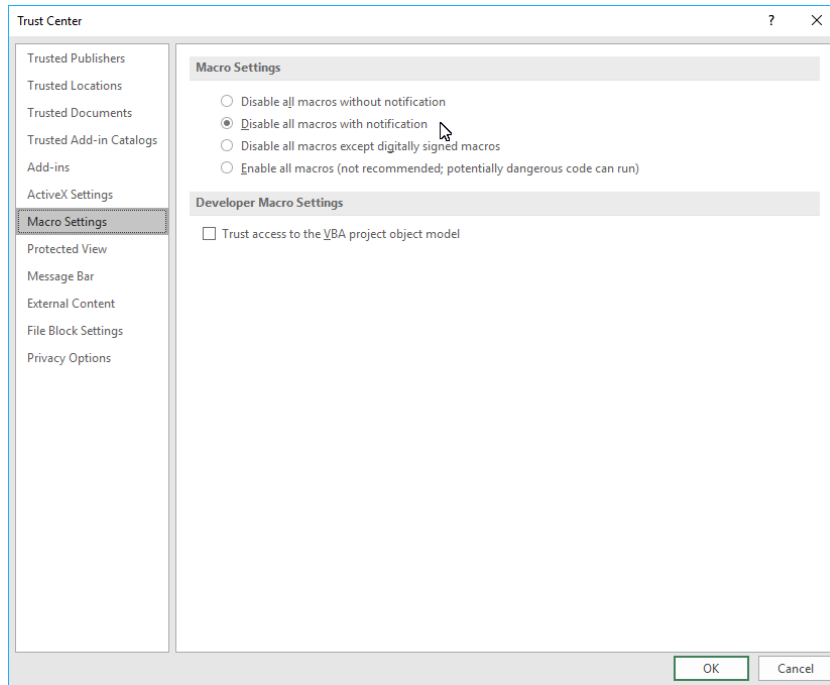
- On the left side of the window click on the 'Trust Centre' and then the 'Trust Center Settings' button to enter the Trust center.

Figure 65. Enter the Trust Centre in Excel.



6. Check that Macro Settings are set to 'Disable all macros with notification'. If the macro security level is set higher than this Rumen8 will not be able to run the optimiser. Click on 'Okay' to exit the Trust Centre once you have finished.

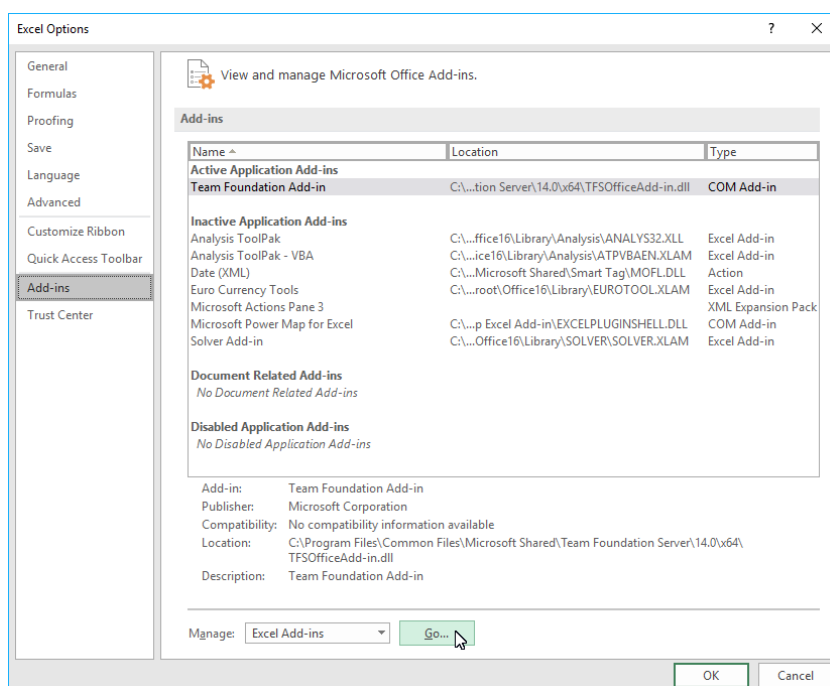
Figure 66. Enter the Trust Centre in Excel.



INSTALL THE SOLVER ADD-IN

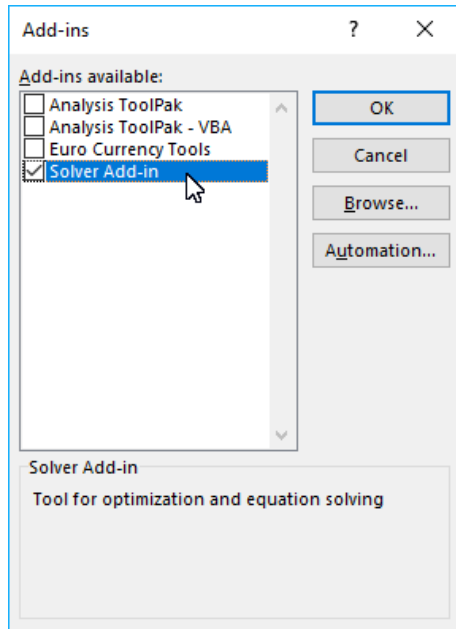
7. Click on the 'Add-Ins' option on the left of the window and then set the Manage drop-down list at the bottom of the window to 'Excel Add-Ins' and click the 'Go' button.

Figure 67. Enter the Add-ins manager.



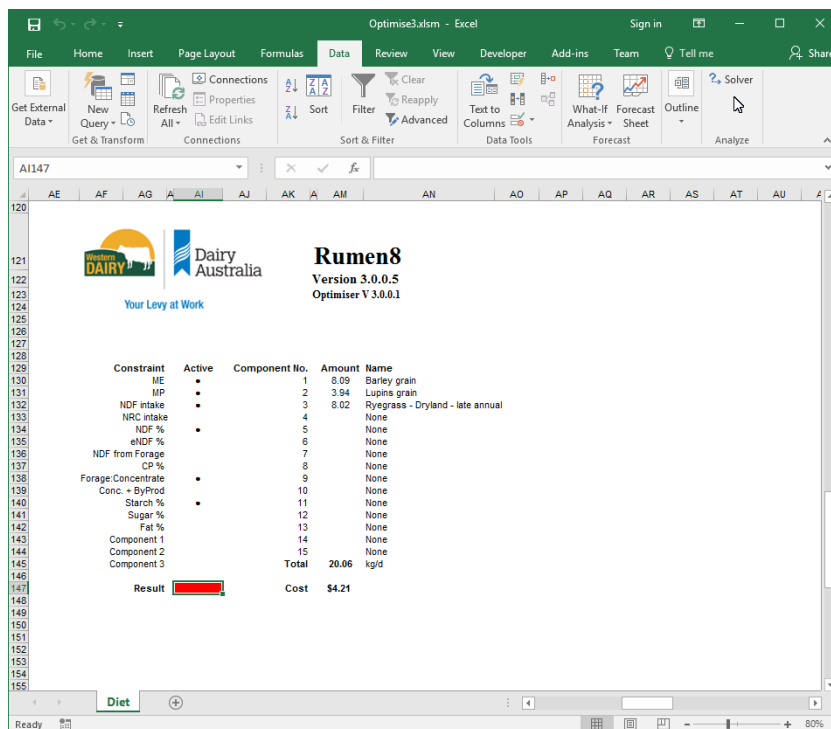
8. A list of possible Add-Ins appears in the new window. Click on the checkbox alongside 'Solver Add-In' to install it if it is not already selected. Click 'Okay' to install Solver and exit Options back to the spreadsheet.

Figure 68. Install the Solver Add-In.



9. Confirm Solver is correctly installed by ensuring 'Solver' is visible at the end of the 'Data' ribbon.

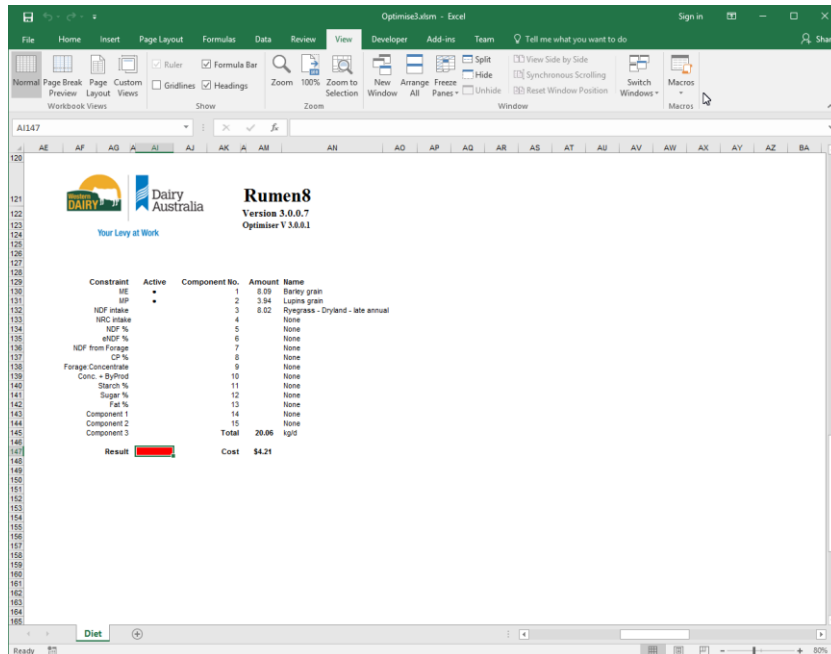
Figure 69. Solver is visible at the end of the Data menu in the Ribbon.



ADD THE REFERENCE TO SOLVER IN THE VISUAL BASIC FOR APPLICATIONS EDITOR

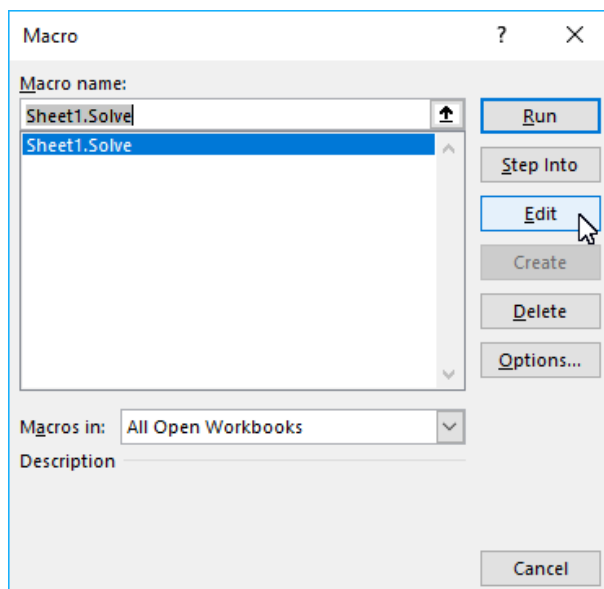
10. Click on the 'View' menu of the ribbon. The last option is called 'Macro', click on the drop-down menu and select 'View macros' from it.

Figure 70. The Macro menu in the View ribbon.



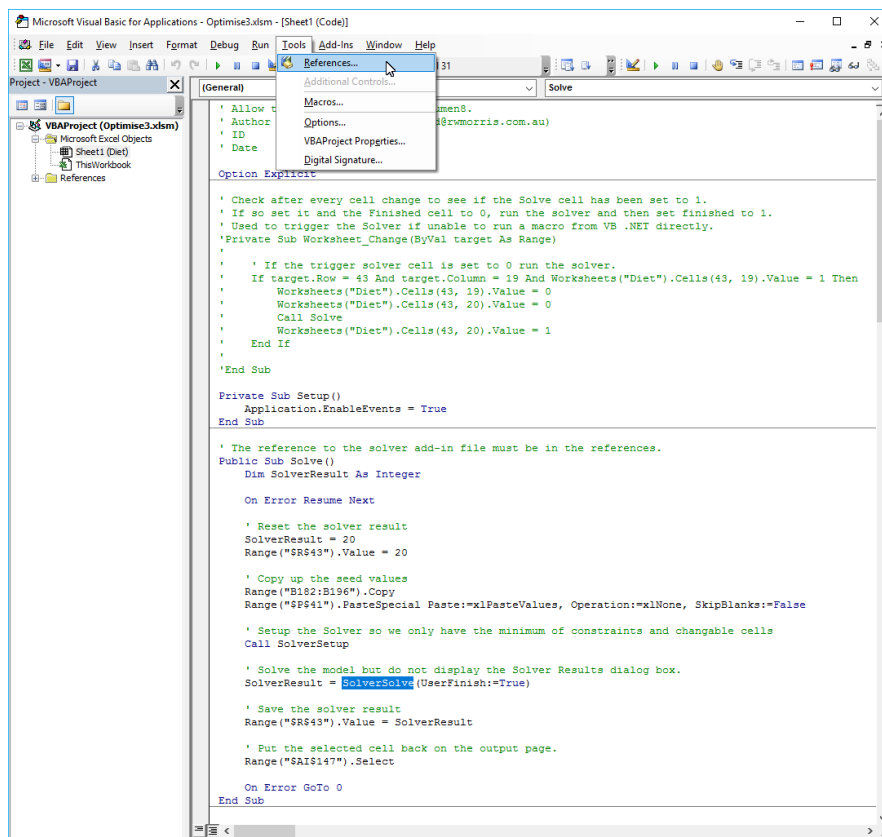
11. In the Macro window that opens select the macro 'Sheet1.Solve' and then click the 'Edit' button.

Figure 71. Start the Visual Basic for Applications editor.



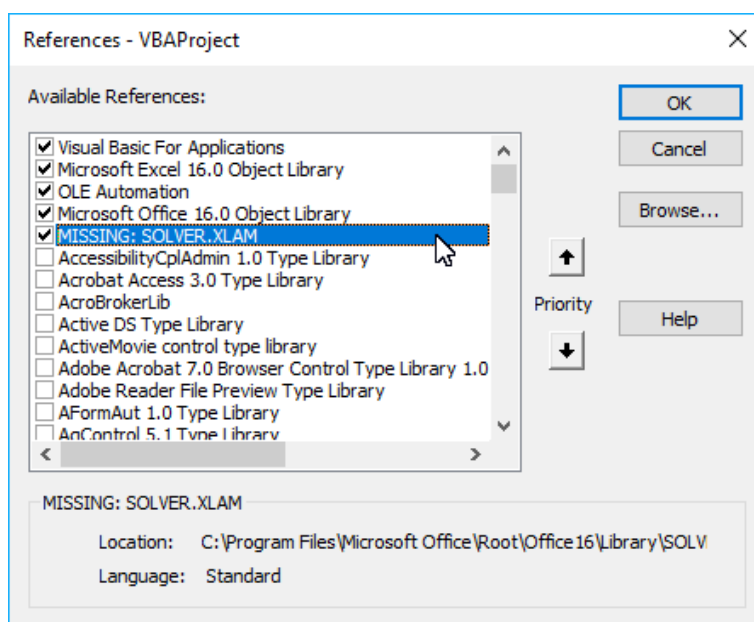
12. In the Visual Basic Editor select 'References' from the 'Tools' menu.

Figure 72. Open the Visual Basic for Applications References editor.



13. Visual Basic for Applications also needs to know where to find the Solver add-in. You may need to search down the list to find the Solver entry. When you first open the editor, it may be listed as missing. Even if it doesn't say MISSING continue with the steps below.

Figure 73. The Solver reference is missing in the Visual Basic for Applications References editor.

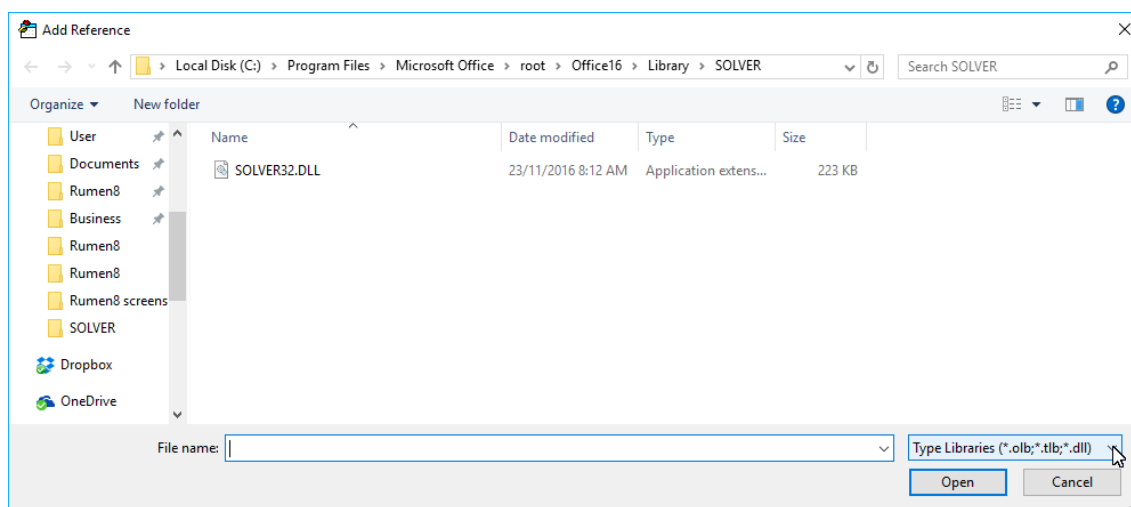


14. Click on the 'MISSING: SOLVER.XLAM' line and then the Browse button. At the bottom of the dialog box change the "Files of type" drop-down to show all files.
Now navigate to the directory in which Microsoft Office has installed the solver files.

For Office365 Excel 2016 this is usually the folder "C:\Program Files\Microsoft Office\Root\Office 16\Library\SOLVER\".

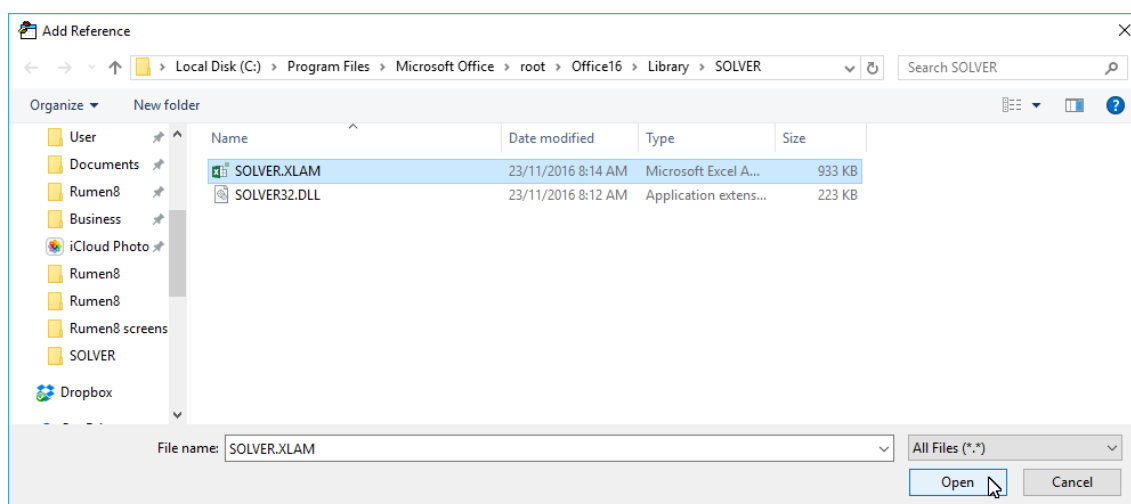
If you are using an earlier version of Office the number 16 in the path will be lower, 15 for Office 2013 for example. Standalone installations may not include the 'Root' folder part of the path. It is important to find the SOLVER.XLAM file used by the default version of Excel on your computer.

Figure 74. The SOLVER folder for Office 365 Excel 2016.



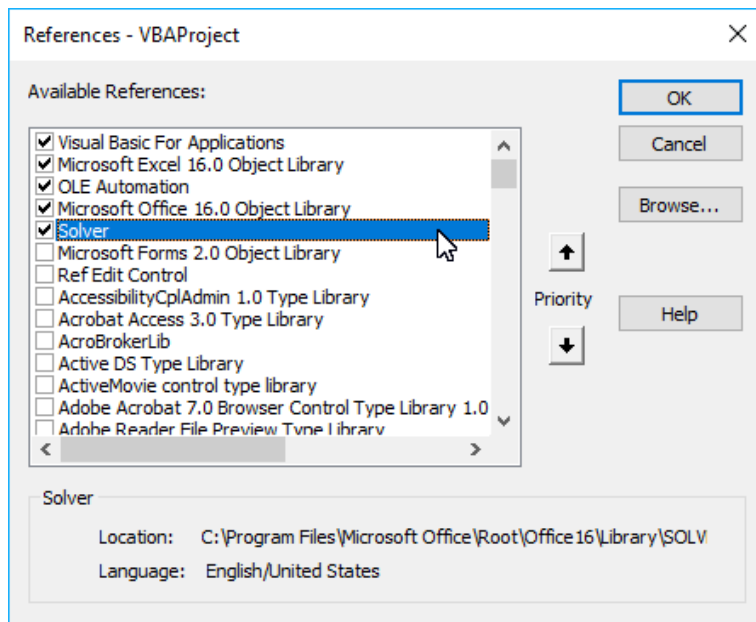
15. With 'All Files' selected SOLVER.XLAM should now be visible. Select it and click on "Open".

Figure 75. The SOLVER folder for Office 365 Excel 2016.



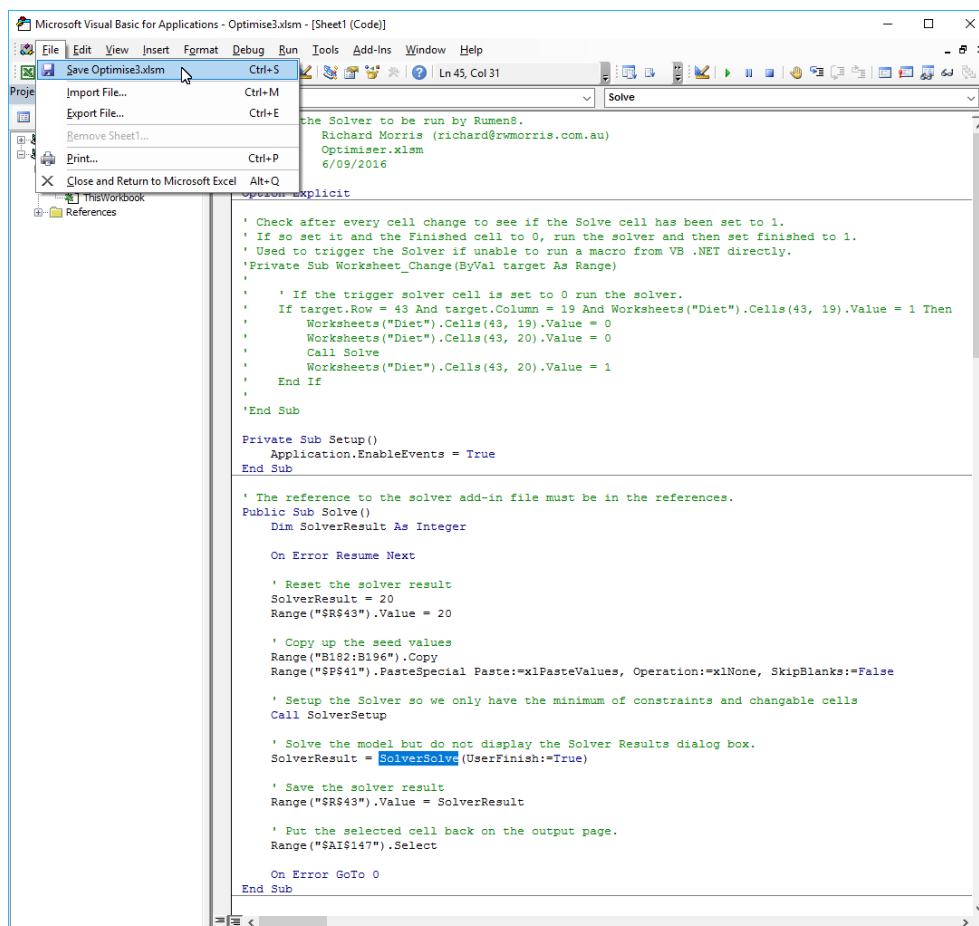
16. The Solver reference should no longer be listed as missing. Ensure it has a tick against it and click the 'Okay' button to exit the window.

Figure 76. Solver is installed correctly for Visual Basic for Applications.



17. Save the Optimiser3.xlsm file by selecting 'Save Optimise3.xlsm' from the File menu.

Figure 77. Save the optimiser spreadsheet.



18. Exit back to the spreadsheet using the 'File' menu and the 'Close and Return to Microsoft Excel' option.
19. Excel setup for use with Rumen8 optimisation is now complete so exit from Excel saving changes if you are prompted to do so.
20. Rumen8 defaults to not allow access to the optimiser so the final step is to tell it you have configured Excel correctly. In the Rumen8 Preferences General tab enable the Optimiser tab by clicking on the down arrow to the left of 'Optimiser disabled' at the bottom of the window. The Optimiser settings box will open and the title will change to 'Optimiser enabled'. Both settings in the box should be left off for normal use.

Figure 78. Setup the Rumen8 preferences to use the optimiser.

The screenshot shows the 'Preferences' dialog box with the 'General' tab selected. The 'Optimiser enabled' section is expanded, displaying the following text and controls:

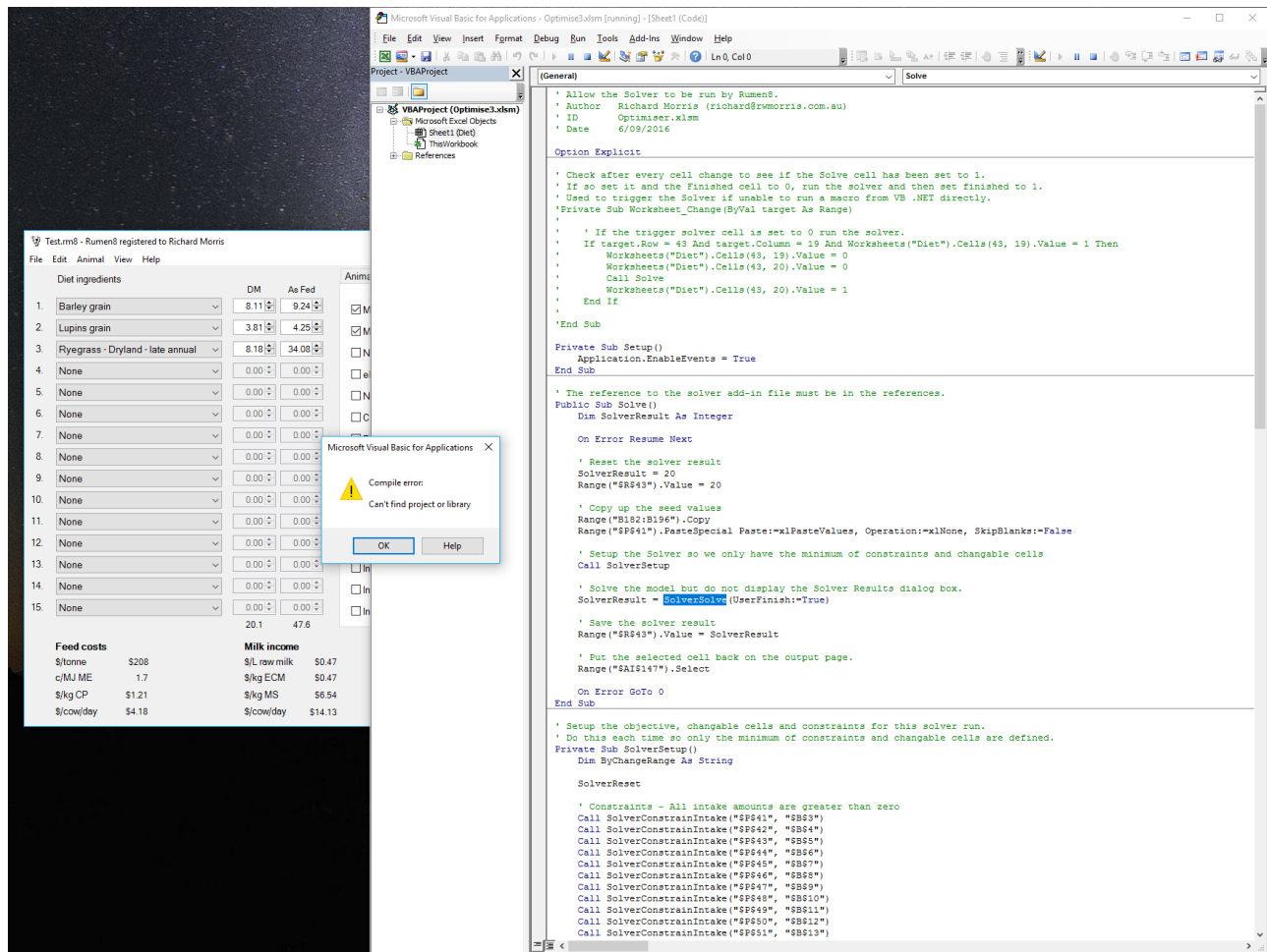
- General** | Recommended levels | Advanced
- Milk yield units**: ☒ Litres, ☐ Kilograms
- Milk component units**: ☐ Mass/mass, ☒ Mass/volume
- Feed concentration units**: ☒ g/Kg, ☐ Percentage
- Feed proportion units**: ☒ Proportion, ☐ Percentage
- Total solids ratio**: ☒ Fat:Protein, ☐ Protein:Fat
- ToolTips detail**: ☐ None, ☐ Standard, ☒ Extended
- Dry matter intake estimate**: ☐ NDF intake as 1.20 percentage of liveweight, ☒ NRC (2001) intake estimation
- ☒ Show Diet tab
- Change Rumen8 home directory after Rumen8 quits [Change home]
- Restore all the preferences to their default setting [Restore Defaults]
- Optimiser enabled** (indicated by a star icon)
- The optimiser requires the Excel spreadsheet in the Rumen8 libraries folder to have the Solver Add-on installed and a reference to it added in the Visual Basic editor. See the user manual for setup instructions.
- ☐ Excel visible during optimisation ☐ Excel saves diet after optimisation
- [Close]

Now when you return to the main Rumen8 window a new tab called 'Optimiser' will be available.

OPTIMISER TROUBLESHOOTING

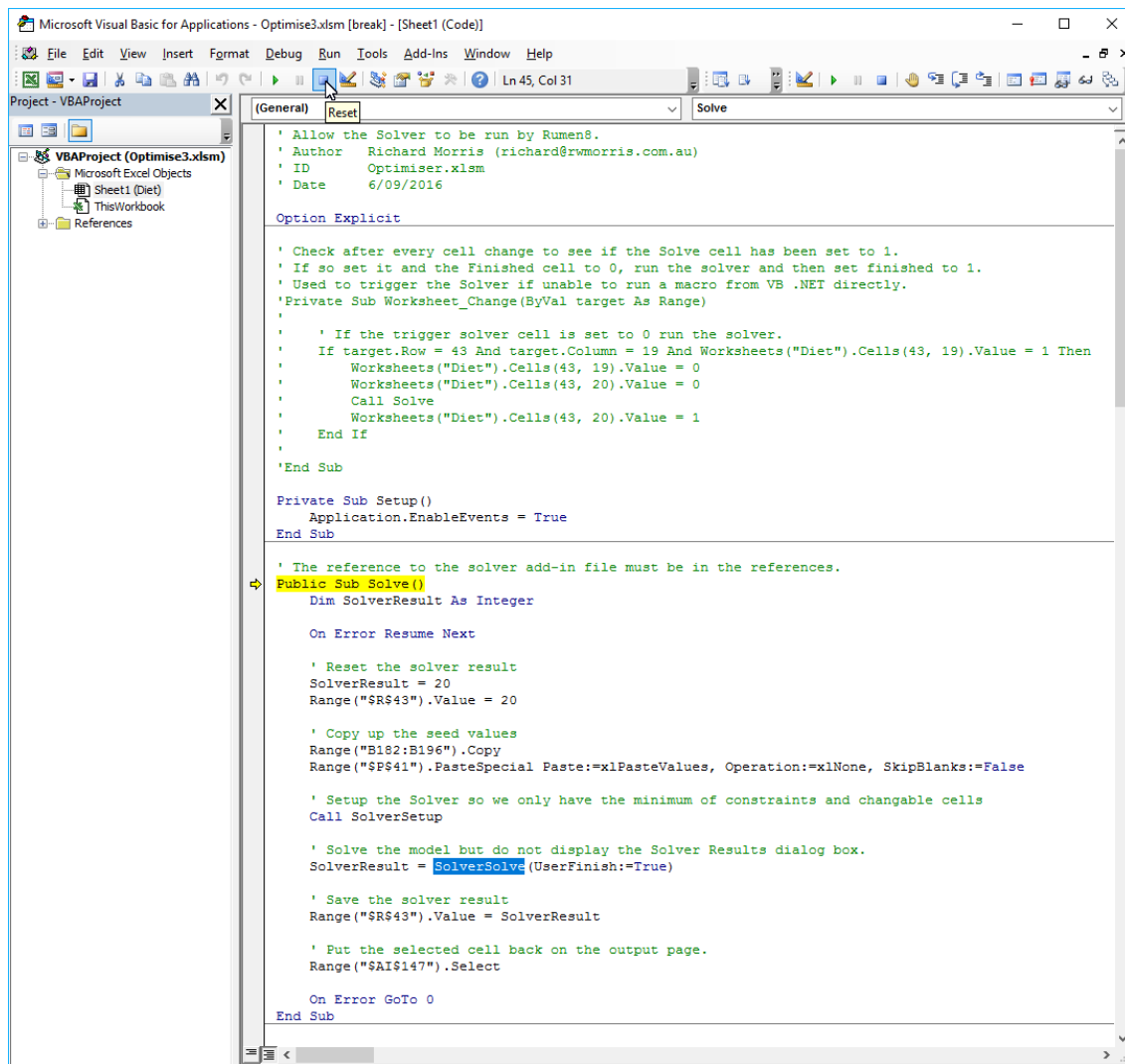
If you have followed the setup instructions for the Optimiser and it fails when you try to optimise, the most likely problem is the VBA reference to the SOLVER.XLAM file. If this happens you will see the Visual Basic for Applications editor appear with an error message telling you it cannot compile because it cannot find a project or library (the SOLVER.XLAM file).

Figure 79. Trying to optimise causes the VBA editor to appear with a compile error message.



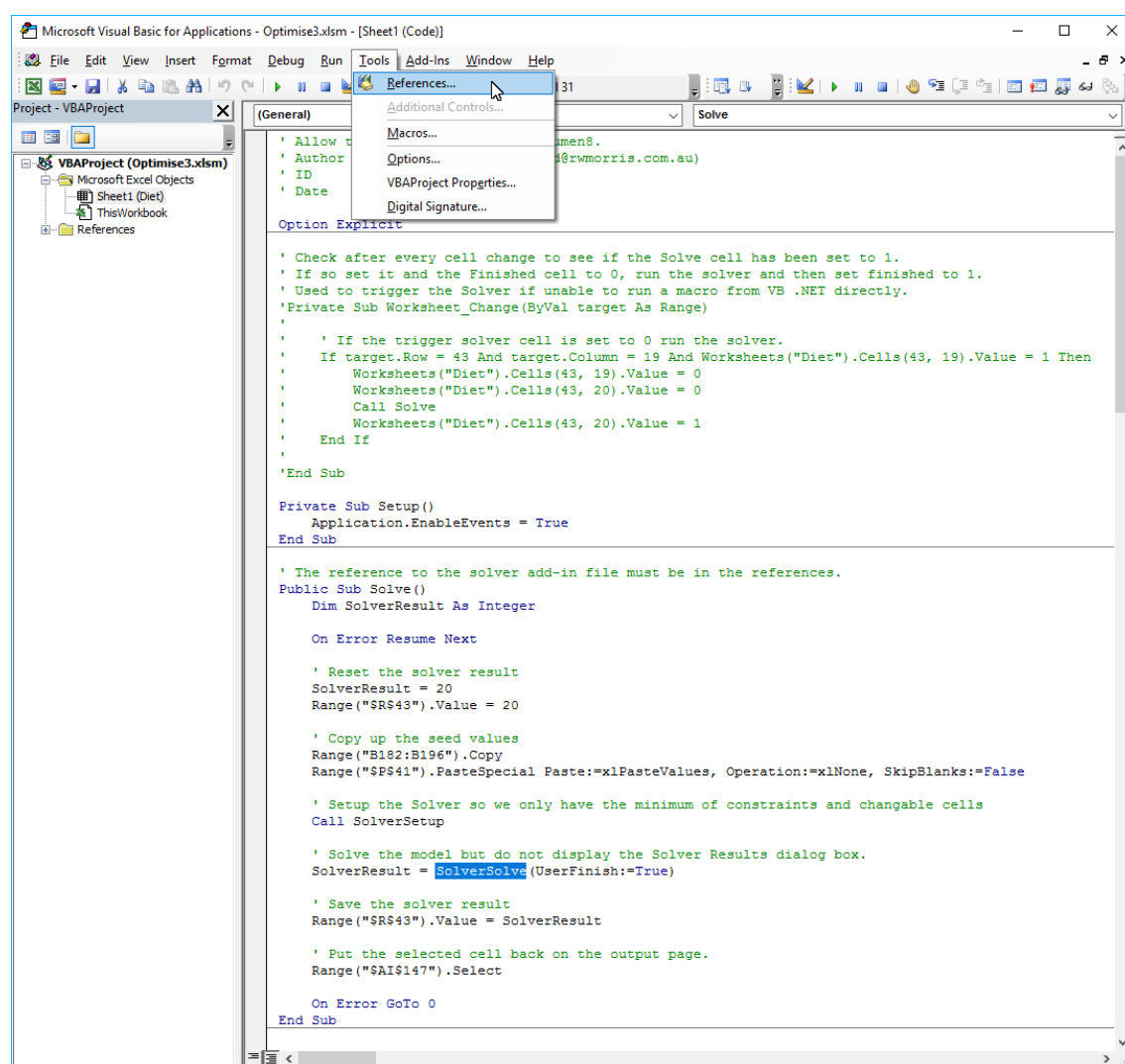
Close the error message by clicking on the 'Okay' button and then reset the macro by clicking on the Reset button in the toolbar. It is a square stop button in the style of VCR play, pause and stop buttons (see the figure below).

Figure 80. Reset the macro execution with the stop button in the toolbar.



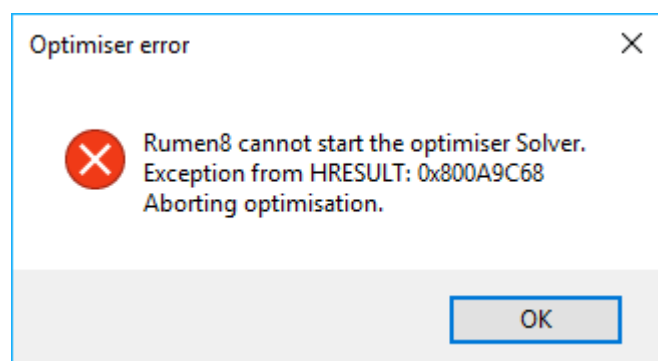
Now you can update the reference to the SOLVER.XLAM file as you did in the third part of the optimiser setup instructions starting with the References editor in the 'Tools' menu.

Figure 81. Accessing the References editor in the VBA editor.



From this point follow the instructions as you did when you originally set up the optimiser from step 12. The only difference is when you return to Rumen8 after saving your changes it will have an error message telling you it couldn't start the Solver. Click 'Okay' and then try optimising again.

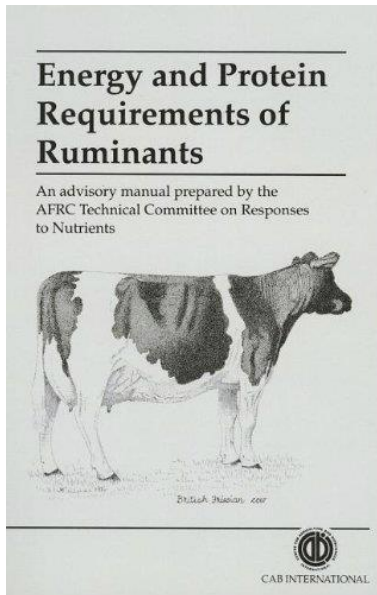
Figure 82. The Rumen8 error message saying it could not start the Solver in Excel.



REFERENCES

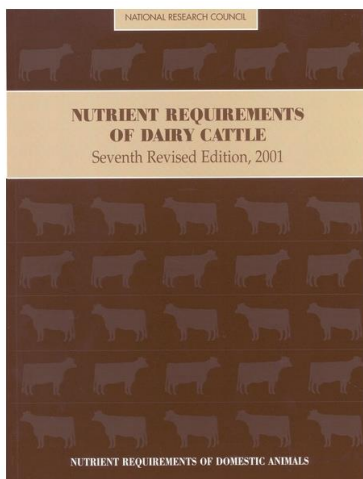
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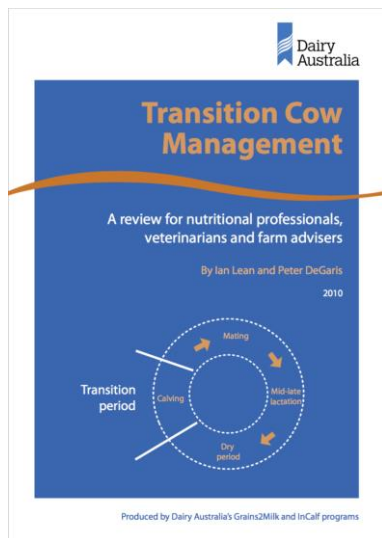
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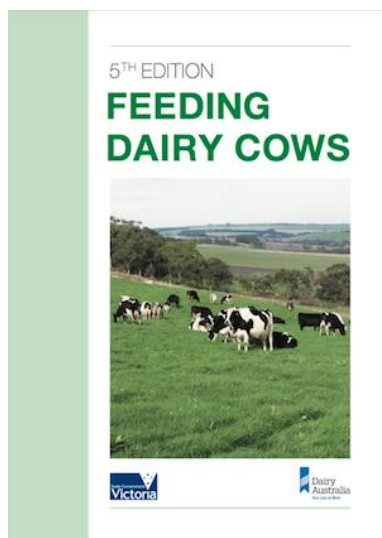
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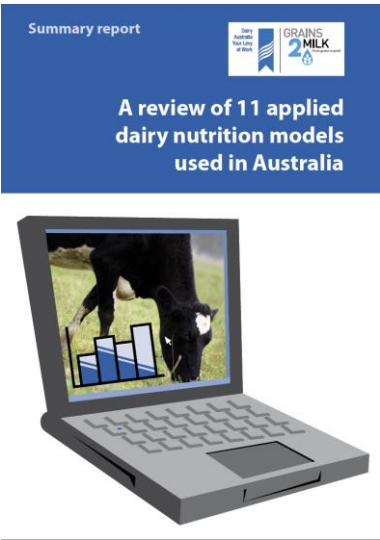


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Rumen8 version 1 was independently evaluated by the Dairy Australia Grains2Milk project and the report can be downloaded from the Rumen8 and Dairy Australia websites. Note, Rumen8 was owned by the Department of Agriculture and Food, Western Australia when this review was conducted. The nutrition model in Rumen8 version 3 is unchanged from version 1

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ABBREVIATIONS

Abbreviation	Units	Description
A	MJ/d	activity allowance
ADIN	g/kg DM	acid detergent insoluble nitrogen
aN		proportion of water soluble N in the total N of the feed
Ash	g/kg DM	ash content of feed (after heating to 600 C for 10 hrs)
Balance (MJ)	MJ	the difference between metabolisable energy requirements and supply
bN		proportion of degradable N, other than water soluble N, in the feed
Ca		Calcium
Calcium	g/kg or g/kg DM	concentration of calcium in the diet
CI	MJ/d	plane of nutrition correction factor in calculating ME requirements
cN		fractional rumen degradation rate per hour of the b fraction of the feed N with time
Comp. 1	kg	the amount of component 1 must fall within specified minimum and maximum values
Comp. 2	kg	the amount of component 2 must fall within specified minimum and maximum values
Comp. 3	kg	the amount of component 3 must fall within specified minimum and maximum values
Con+By (kg)	kg	amount of concentrate and byproduct in the diet
Conc. + ByPr.	g	the total amount of concentrate + byproduct in the diet must fall within specified minimum and maximum values
Conc. + ByPr.	g/kg	the concentration of concentrate + byproduct in the diet must fall within specified minimum and maximum values
Cost	\$/cow and c/MJ	diet cost (\$/cow and c/MJ) and margin (\$/cow)
Cost	\$/tonne	cost to produce or buy 1 tonne of feed (nominate if wet or dry)
Cost (\$/t)	\$/tonne	diet cost per tonne
Cost (c/MJ)	c/MJ	diet cost on a metabolisable energy basis
Cost A.L. DM	\$/tonne DM	cost after losses on a dry matter basis
Cost A.L. wet	\$/tonne wet	cost after losses on a wet or fresh basis

Abbreviation	Units	Description
CP	g/kg	the concentration of CP in the diet must fall within specified minimum and maximum values
CP	g/kg DM	crude protein ($N * 6.25$)
Days in milk	d	number of days the cow has been lactating
Days pregnant	d	number of days the cow has been pregnant
Distance walked	m/d	distance walked each day by the cow
DM	g/kg	dry matter
DMI	kg and %	dry matter intake (kg) and % of maximum intake (NDF/NRC methods)
DMTP	g	digestible microbial true protein
DUP	g	digestible undegraded protein
Ec	MJ/d	net energy retained in concept (foetus and placenta etc)
El	MJ/d	net energy secreted as milk
Em	MJ/d	net energy for maintenance
eNDF	g/kg	the concentration of effective NDF in the diet must fall within specified minimum and maximum values
eNDF	g/kg DM	effective neutral detergent fibre
eNDF (%)	%DMI	effective NDF in the diet
ERDP	g	effective rumen degradable dietary protein
ERDP CP	%	percentage of the CP that is effective rumen degradable dietary protein
Excess MP	g	MP in excess of requirements which will take ME to remove from the body
Excess MP cost	\$??	the metabolic cost to remove excess metabolisable protein expressed as forgone weight change or milk production
F	MJ/d	fasting metabolism
fat	g/kg	the concentration of fat in the diet must fall within specified minimum and maximum values
Fat	g/kg DM	Fat
Feed (\$/cow)	\$/cow/day	feed cost
FME	MJ	fermentable ME of the diet
Height walked	m/d	height change during walk each day

Abbreviation	Units	Description
Intake (kg)	kg	the maximum DMI cannot exceed 100% as determined by live weight, milk yield and week of lactation
Intake (max. NDF)	g	the maximum DMI cannot exceed 100% as determined by NDF intake and live weight
Kc		efficiency of utilisation of ME for growth of the concepta
Kg		efficiency of utilisation of ME for weight change when lactating
Kl		efficiency of utilisation of ME for lactation
Km		efficiency of utilisation of ME for maintenance
Kt		efficiency of utilisation of mobilised tissue for lactation
L	MJ/d	level of feeding as a multiple of MJ of ME for maintenance
Limited by		factor limiting MP supply
Live weight	kg	the cow's live weight
Live weight change	kg/d	cow's daily live weight change
Losses	%	dry matter loss from feed after costing
Magnesium	g/kg or g/kg DM	concentration of magnesium in the diet
Mg		Magnesium
Margin (\$/cow)	\$/cow/day	margin (milk income - feed costs)
Max DM Intake %	%	percentage of predicted maximum intake currently provided by the diet based on live weight, milk yield and stage of lactation
Max MP cost	MJ	Maximum ME cost to remove excess MP
Max NDF DMI %	%	percentage of predicted maximum intake currently provided by the diet based on NDF intake and live weight
Mc	MJ/d	ME requirement for growth of concepta
MCP	G	microbial crude protein
ME	MJ	metabolisable energy supplied and required
ME	MJ/kd DM	metabolisable energy
ME requirement	MJ	the diet must provide the ME required for maintenance and production
M _g	MJ/d	ME requirement for live weight change when lactating
Milk (\$/cow)	\$/cow/day	milk income

Abbreviation	Units	Description
Milk fat	% m/v	percentage of milk that is fat
Milk lactose	% m/v	percentage of milk that is lactose
Milk protein	% m/v	percentage of milk that is true protein
Milk yield	L	daily milk production
Min MP cost	MJ	Minimum ME cost to remove excess MP
MI	MJ/d	ME requirement for milk production
Mm	MJ/d	ME requirement for maintenance
Mmp	MJ/d	ME requirement for maintenance and production
MP	g	metabolisable protein
MP balance	g	metabolisable protein balance
MP min. requirement	g	the diet must provide an MP supply at least that required for maintenance and production
MP required	g	the amount of metabolisable protein required for the production level
MPb	g/d	basal endogenous nitrogen requirement
MPc	g/d	MP requirement for the growth of the concepta
MPd	g/d	dermal loss as scurf and hair
MPg	g/d	MP requirement for live weight gain when lactating
MPI	g/d	MP requirement for milk production
MPm	g/d	MP requirement for maintenance
MPmp	g/d	MP requirement for maintenance and production
MTP	g	microbial true protein
NDF	g/kg	the concentration of NDF in the diet must fall within specified minimum and maximum values
NDF	g/kg DM	neutral detergent fibre
NDF (%)	%DMI	neutral detergent fibre in the diet
NDF (kg)	kg	total NDF in the diet
NDF forage	g/kg	the concentration of NDF from forage in the diet must fall within specified minimum and maximum values
NDF frge (%)	%DMI	NDF in the diet supplied from forages
NFC (%)	%DMI	non fibrous carbohydrate in the diet
Phosphorus	g/kg or g/kg DM	concentration of phosphorus in the diet
P		Phosphorus
Position changes	no./d	number of body position changes per day (lying down / standing up)

Abbreviation	Units	Description
Protein	g and %	metabolisable protein supplied and required and crude protein %
QDP	g	quickly degradable protein
Qm		metabolisability of GE at maintenance
r(fraction/hr)		rumen digesta fractional outflow rate per hour
RDP	g	rumen degradable protein
Required (MJ)	MJ	metabolisable energy supply required from the diet for specified production
SDP	g	slowly degradable protein
Source	source of information	FIM (feed information manual) / TFD (top fodder data) / VMF (Vasse Milk Farmlets) / MvHS (M Staines data) / Protein Plus project etc.
starch	g/kg or g/kg DM	the concentration of starch in the diet must fall within specified minimum and maximum values
Starch (%)	%DMI	starch in the diet
sugar	g/kg or g/kg DM	the concentration of sugar in the diet must fall within specified minimum and maximum values
Sugar (%)	%DMI	sugar in the diet
Time standing	hr/d	time cow spends standing each day
Total (kg)	kg	total dry matter in the diet
Total (MJ)	MJ	total metabolisable energy supplied from the diet
Total MP (g)	g	total metabolisable protein in the diet
Type	name	other forage / grass silage / other silage / distillery product / other non-forage
UDP	g	undegradable dietary protein
y	g	potential microbial protein yield in the rumen from FME