Risk Proofing Nova Scotia Agriculture

A Risk Assessment Systems Pilot Project

Grape Operations Model

Final Report

Canmac Economics Limited

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Risk Proofing Nova Scotia Agriculture: A Risk Assessment System Pilot (AgriRisk)

Nova Scotia Federation of Agriculture would like to recognize the collaborative relationships that exist among Agriculture and Agri-Food Canada and the Nova Scotia Departments of Agriculture and Environment.

Contents

Summary

This report and accompanying data drive provides a grape production model (version 1.0) with forecasts out to 2035. The model can be used as a template for production planning at the farm level. Its primary use is as a building block in Nova Scotia Wine Industry Bayesian Network Model.

Model results show that profitability is sensitive to yield levels.

Chapter 1 - Introduction

1.1 Introduction

One of the critical components to the Risk Proofing Nova Scotia Agriculture Pilot Project is development of a grape operations model at the farm level. This report describes the grape operations model and presents benchmark forecasts to 2035.

The project builds on previous work undertaken in this area. First, Canmac's proprietory econometric model of the Nova Scotia economy is used to develop a base case scenario forecast of inflation. This is used to drive the grape production model indices. The grape operations production model builds on previous work done in the Nova Scotia Department of Agriculture. In particular, the report "Wine Grape Production in Nova Scotia".

The economic indices projections used Statistics Canada's Nova Scotia Farm input price indices. The production inputs – labour etc. and output – grape yields etc. were taken from the aforementioned Nova Scotia Department of Agriculture report. The industry could improve the quality of the grape production model by undertaking a cost of production study. The cost of production study would provide a more statistically rigorous estimation of the input data and enable estimation of productivity as a function of size of farm.

1.2 Report Outline

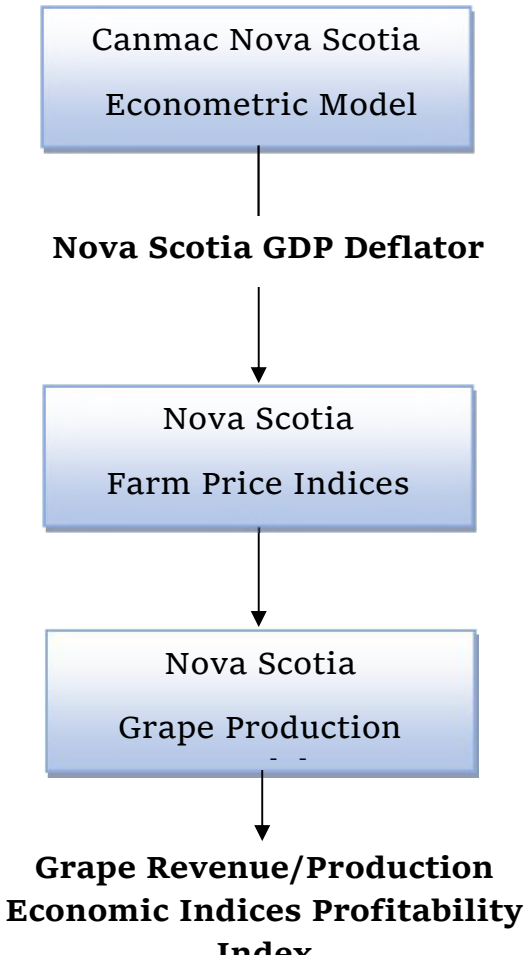
The report consists of four chapters including the present one. Chapter Two presents the model – its structure and equation description. Chapter Three provides representative model output. Chapter Four concludes with a summary and further research needs. Appendices provide references and data sources, a detailed model listing and relevant data definitions.

Chapter 2 – Wine Grape Production Model

2.1 Model Development

The model framework is shown in Figure 1. The first phase of the model is linked to Canmac's proprietory econometric model of the Nova Scotia economy. The Nova Scotia model provides forecasts of the key inflation rate (GDP price deflator) that drives the Wine Grape Production Model. Phase II is the link to the Grape Production Model.

Figure 1: Wine Grape Production Model



Grape Production Model Description

The grape Production Model provides forecasts to 2035 of the revenue and operation costs for fourteen grape varieties in Nova Scotia. The model is built in Excel. Each grape variety revenues/costs are estimated for four farm types – 5 acre, 10 acre, 20 acre and 30 acre. Appendix A shows a model printout that provides the model layout. The grape production model is composed of four modules; 1) input price module, 2) operations cost module, 3) revenue module, and 4) owner return module.

Input Price Module

The input price module provides forecasts of various Nova Scotia farm input price indices. The forecasts were estimated in the EViews econometric package using a Bayes Regression approach (Appendix D). In general, each price index equation was estimated as a lag of itself and the Nova Scotia GDP deflator. The Nova Scotia GDP deflator is provided from Canmac's econometric macro forecast model.

Table 2.1 shows the specific price index equations used to drive the model and their associated definitions. Appendix A contains the equation estimation diagnostic details for the ordinary least squares version of the equation. In general, the price index equations have high R^2 in the 90 percent range. The agriculture wage index fit is less satisfying with an R^2 of 60 percent due to the greater variability in wages from year to year.

Table 2.1
Agriculture Price Indices Equations

EQUATIONS

AGRWWAGEINDEX = 0.438968288616*AGRWWAGEINDEX(-1) + 0.809075966965*FIRMPRICENS*.01

Series02 = 0.302970952015*FIRMPRICENS + 0.779701795022*SERIES02(-1)

Series14 = 1.00088272288*FIRMPRICENS + 0.456417115723*SERIES14(-1)

Series16 = 1.13862131877*FIRMPRICENS

Series22 = 0.0264237378134*FIRMPRICENS + 0.993890511582*SERIES22(-1)

Series24 = 0.619070432349*SERIES24(-1) + 0.722191961781*FIRMPRICENS

Series26 = 0.945021108574*FIRMPRICENS + 0.302458363113*SERIES26(-1)

VARIABLE DEFINITION

Series02 = Farm Input Total
Table 328-0015 Farm input price index, annual (index, 2002=100)

Series14 = Machinery Fuel
Table 328-0015 Farm input price index, annual (index, 2002=100)

Series16 = Machinery Repairs
Table 328-0015 Farm input price index, annual (index, 2002=100)

Series22 = Commercial Seed and Plant
Table 328-0015 Farm input price index, annual (index, 2002=100)

Series 24 = Fertilizer
Table 328-0015 Farm input price index, annual (index, 2002=100)

Series26 = Nitrogen Fertilizers
Table 328-0015 Farm input price index, annual (index, 2002=100)

Operations Cost Module

The operations module predicts annual operating costs and the annual financing of capital costs.

The estimation of current dollar costs for the inputs used in grape production takes as its starting point the input costs for 2010 as provided by the Nova Scotia Department of Agriculture in their 2014 study Nova Scotia Wine Grape Cost of Production and Cash Flow Analysis. These are provided in Table 2.2 for the steady state year. In 2010, these costs totaled $4,871/acre.

Table 2.2

Per Acre Expense Nova Scotia Vineyard

Variable Costs	
Labour	
Vineyard Management	$2,750
Bird/Pest Control Labour	600
Harvesting Labour	450
Vine Replacement, 2%	48
Tying Material	20
Pesticides/Herbicide	300
Soil Amendments & Testing	140
Building Maintenance	63
Tractor Expenses (maintenance & Fuel)	500
Total	$4,871

Source: N.S. Department of Agriculture, 2014 study Nova Scotia Wine Grape Cost of Production and Cash Flow Analysis

The next step is forecasting operating costs in current dollars multiplies the per acre expenses by the forecasted price indexes. The price indices are in 2000 = 100 so before multiplying we adjust the expense items to 2000 dollars.

Vineyard Assumptions

The following describes the 10 acre vineyard modelled in this report.

Vineyard Assumptions:

- Vineyard spacing: 10 vineyard rows, 500 ft. in length with vines at 4 ft spacing and a row spacing of 9 ft. This will allow for approximately 1,200 vines/acre at $2/vine;
- The vineyards are 80% hybrid plants and 20% vinifera plants;
- The trellis system is a vertical shoot positioning system (VSP);
- Grapes are hand harvested;
- The combination of grape varieties return an average price of $2,500/tonne;
- The vineyards have a 28' x 32' farm structure priced at $35/ft^2 for storage of equipment and machinery;
- The capital requirements (e.g. machinery, equipment, tools, bird control) for the modelled 10 acre vineyard include:

30-40 HP Tractor (used)	$15,000
Airblast Sprayer (500-1000L)	$10,000
Herbicide Sprayer	$ 3,000
Backpack Sprayer	$ 200
Rotary Mower (6-8')	$ 4,500
Hedger	$10,000
Fertilizer Spreader	$ 2,000
Trailers	$ 2,500
Hand Equipment (pruning, weekding, max tapener)	$ 500
Harvesting Equipment	$ 500
Bird Netting/Walers/Cannons	$ 5,000
Total	$53,200

Source: N.S. Department of Agriculture, Nova Scotia Wine Grape Cost of Production and Cash Flow Analysis 2014.

- The capital requirements (e.g. machinery, equipment, tools, bird control) for the modelled 20 acre vineyard include:

50 HP Tractor (used)	$25,000
Airblast Sprayer (1000-2000L)	$15,000
Herbicide Sprayer	$ 3,000
Backpack Sprayer	$ 200
Rotary Mower (6-8')	$ 4,500
Hedger	$10,000
Fertilizer Spreader	$ 2,000
Trailers	$ 2,500
Utility Vehicle (Gator, Kubota, ATC)	$ 5,000
Hand Equipment (pruning, weekding, max tapener)	$ 500
Harvesting Equipment	$ 1,000
Bird Netting/Walers/Cannons	$10,000
Total	$78,700

Source: N.S. Department of Agriculture, Nova Scotia Wine Grape Cost of
Production and Cash Flow Analysis 2014.

The estimated capital cost for the 5 acre and 30 acre farm were scaled by the difference in the 10 and 20 acre farms. The capital costs and annual capital payments estimates over the period 2018 – 2035 are as follows:

Farm Size (acres)	**Capital Cost ($)**	**Annual Payment ($)**
5	$27,700	$2,754
10	$53,200	$5,289
20	$78,700	$7,834
30	$104,200	$10,359

Revenue Module

The revenue equation is provided over a 10-year horizon and is defined as:

Revenue (t) = price of grapes x productivity

Per acre x farm size (acres)

Productivity = metric tons/acre depending on grape produced

Prices are forecast using historic prices and the relationship between prices and the Nova Scotia GDP deflator.

The revenue model has a stochastic component. A given grape variety has an average yield per acre and a standard deviation associated with the average. We assume a normal distribution. Each model simulation provides a random normal estimate of the yield. We use the Excel inverted normal distribution command. First, a uniform random distribution simulates a random draw of a percentile. The normal distribution command then solves for the yield associated with this percentile.

Owners Return Module

The owner return module is a gross profitability measure. It is defined as revenue less costs. The owner's return includes 'soft costs' such as administrative accounting costs, owner's management time, etc.

Chapter 3 – Model Output and Results

The Nova Scotia Grape Production Model is a first-generation model and should be viewed as providing preliminary results – based on current information. The model shows increasing owner return as we increase the size of the farm. This is due to keeping the capital impact costs fixed as farm size is increased. Implicitly it is due to better utilization of the fixed amount of capital.

Detailed model output and results are provided in the appendix.

Nova Scotia Grape Production Model

Charts 3.1 to 3.14 show the model predictions by grape type to 2035 for total revenue, total costs and owner gross profitability for a representative 20-acre farm producing one grape type. In general, the profitability of the farm increases in revenue is greater than the incremental increase in capital costs. As an example, L'Acadia Blanc average annual owner returns are as follows:

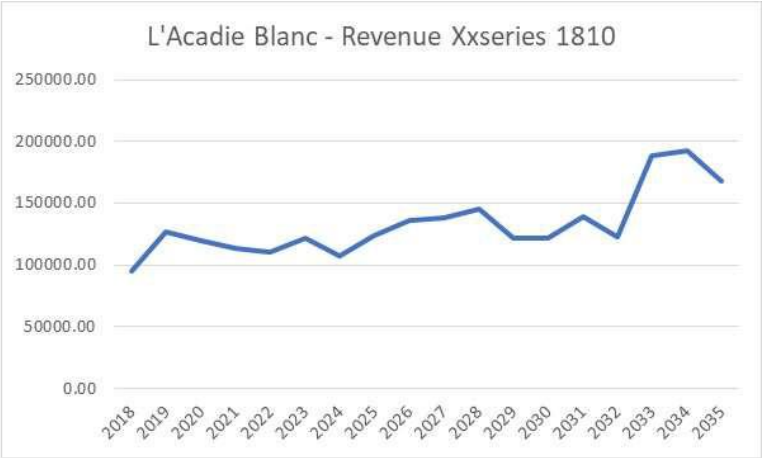
- 5 acre farm $17,546.77
- 10 acre farm $34,822.48
- 20 acre farm $66,948.96
- 30 acre farm $115,346.91

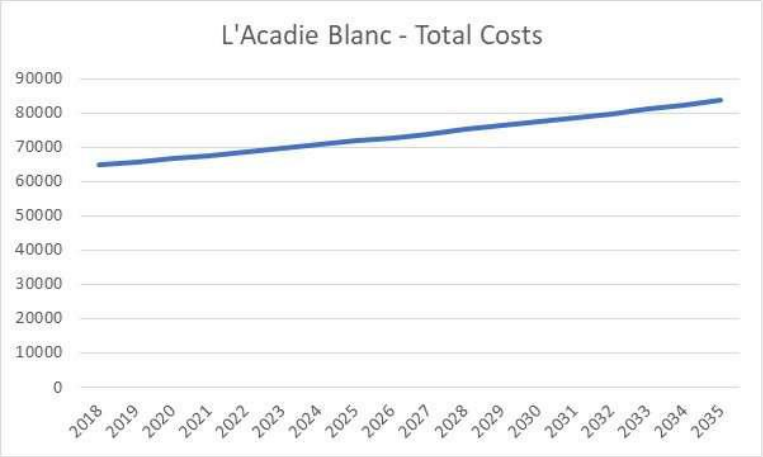
Table 3.1 shows the average annual owner return over the 2018-2035 period by grape type. Given the variability in yields and hence revenues, the model can exhibit high variability in gross profits. This is an important observation

as yields are sensitive to climate change, farm characteristics and disease. A key risk management issue is the management of yield.

Table 3.1 Owner Average Return 2018-2035 20 Acre Grape Farm			
		Range	
	Average	Lowest	Highest
L'Acadie Blanc	71,867	41,467	98,335
Chardonnay	-20,487	-74,756	28,555
Pinot Noir	38,895	-40,357	163,221
Geisenheim 318	-11,090	-31,487	8,533
Riesling	102,607	3,699	250,994
Seyval Blanc	40,068	18,827	72,253
Vidal Blanc	56,660	-13,005	135,950
Frontenac Blanc	59,460	-2,301	90,563
Cabernet Franc	10,759	-68,235	111,192
Gamay Noir	75,642	-105,366	196,505
Leon Millet	17,530	-8,014	44,227
Marquette	16,477	-30,738	117,463
Muscat NY	68,657	-46,547	170,513
Marchel Foch	147,888	99,476	228,297
Source: Canmac Grape Production Model			

Chart 3.1 – L'Acadie Blanc





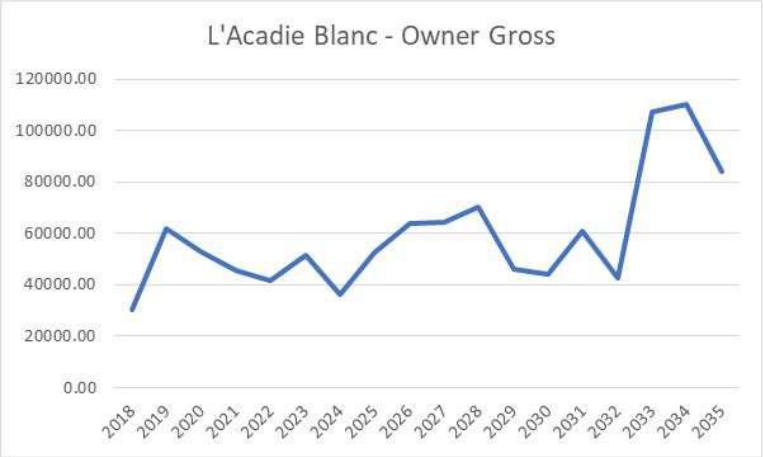
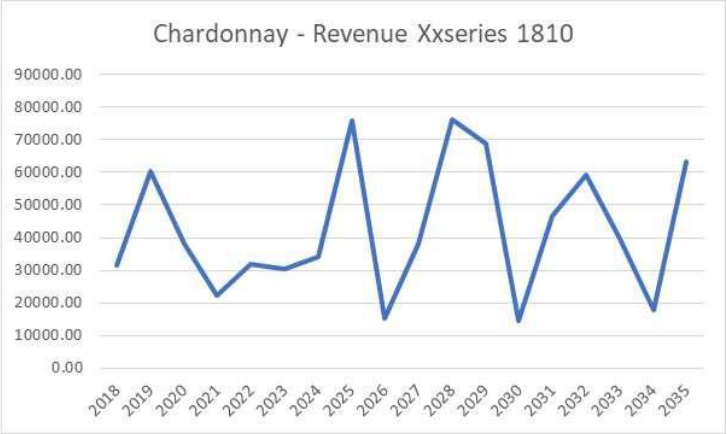
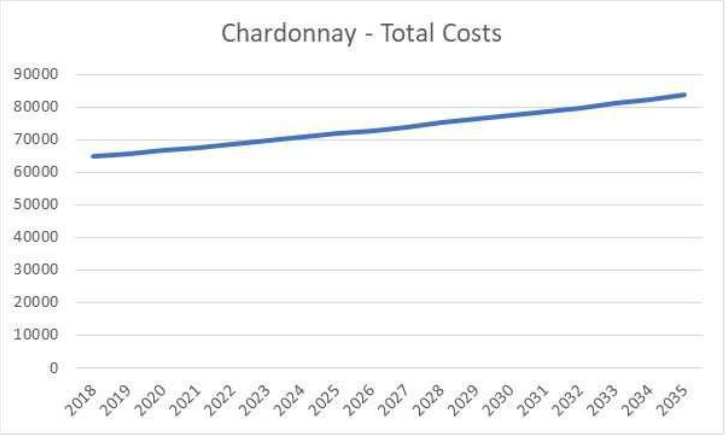


Chart 3.2 – Chardonnay





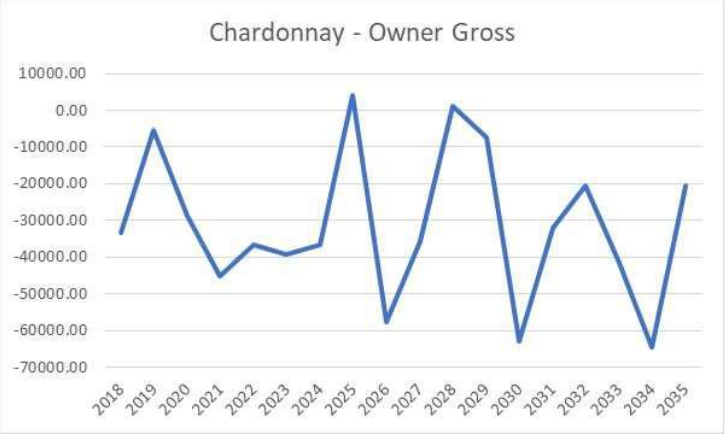
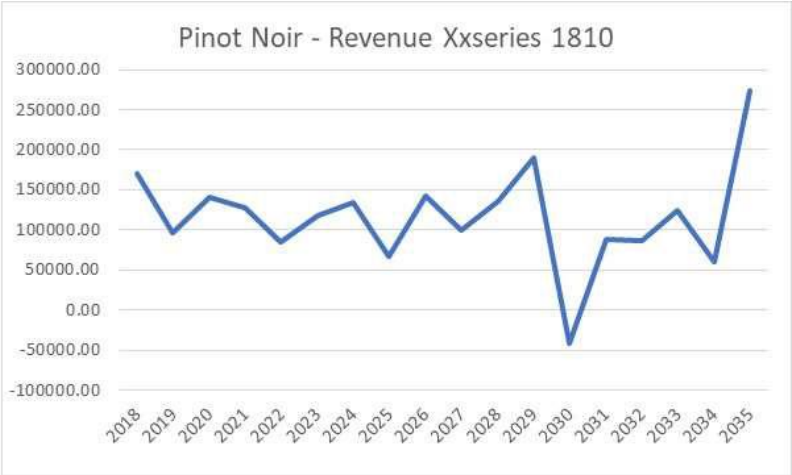
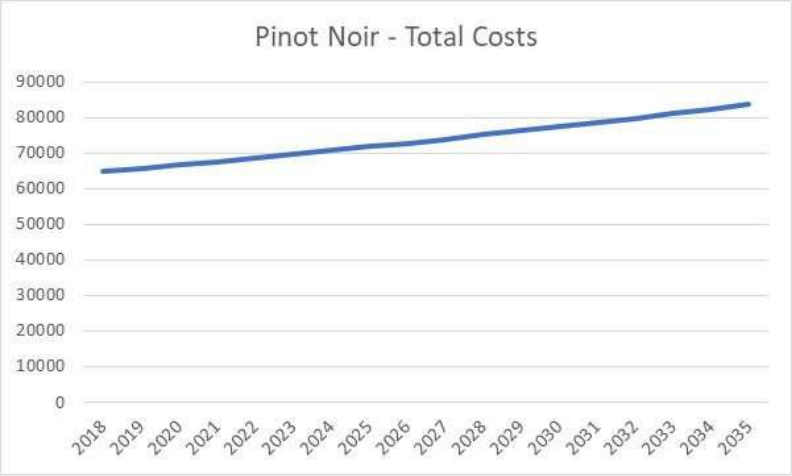


Chart 3.3 – Pinot Noir





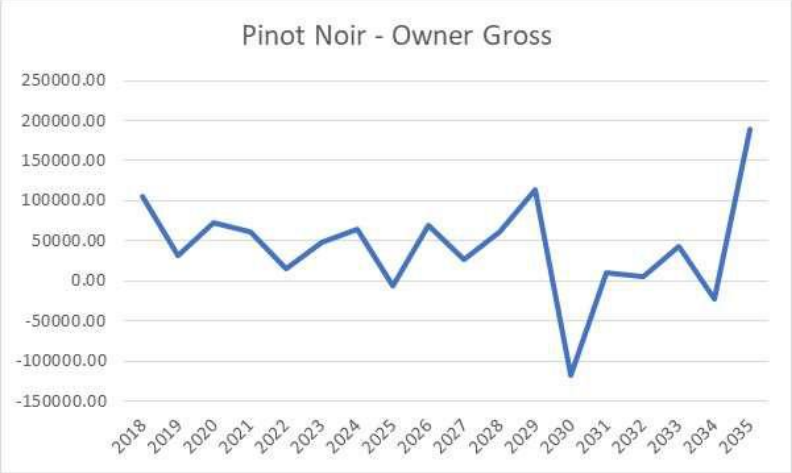
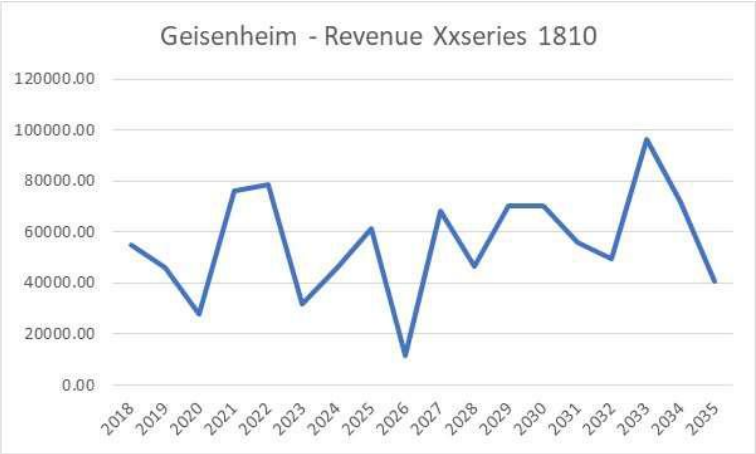
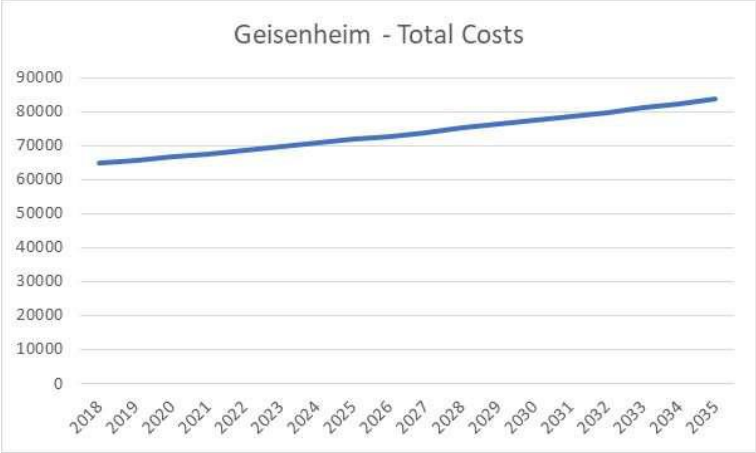


Chart 3.4 – Geisenheim





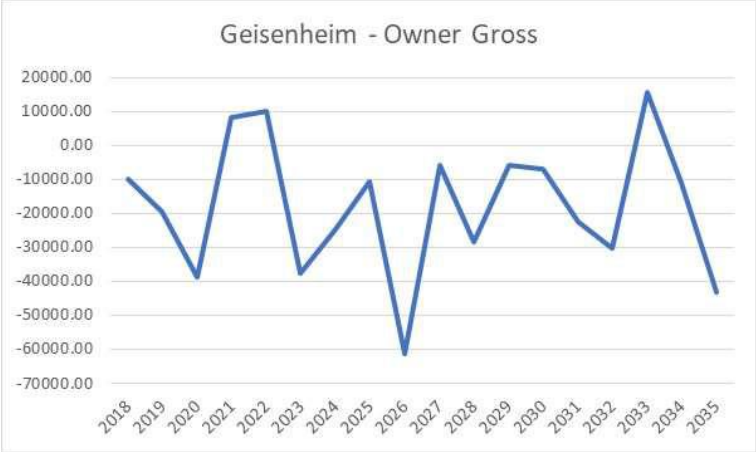
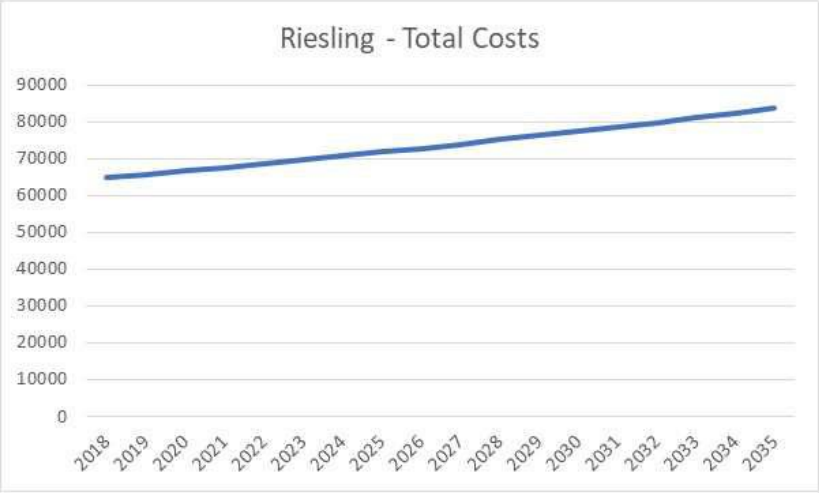


Chart 3.5 – Riesling



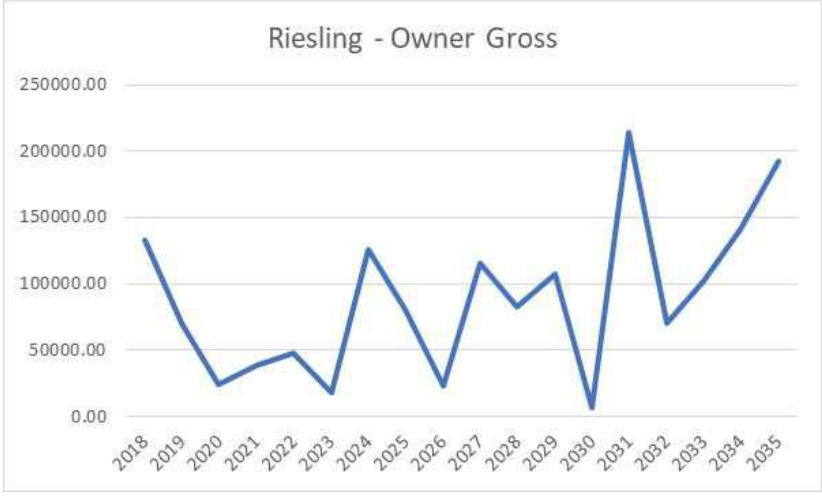
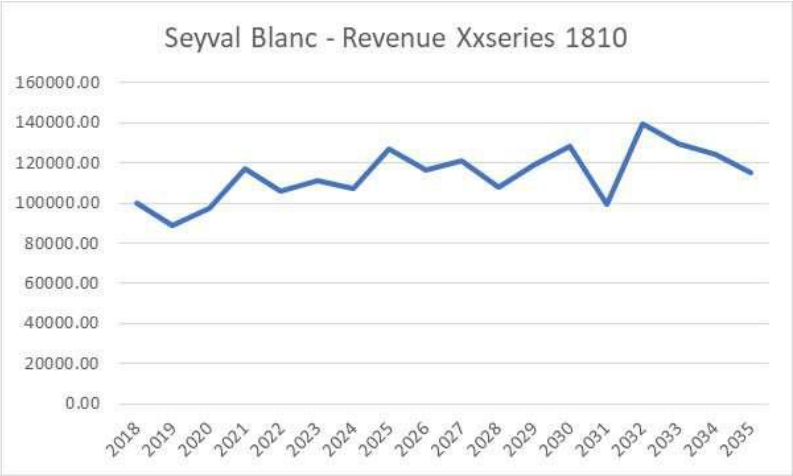
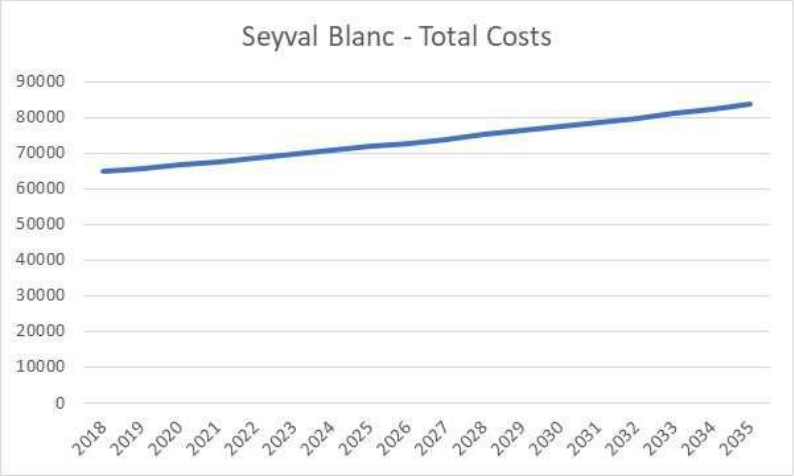


Chart 3.6 – Seyval Blanc





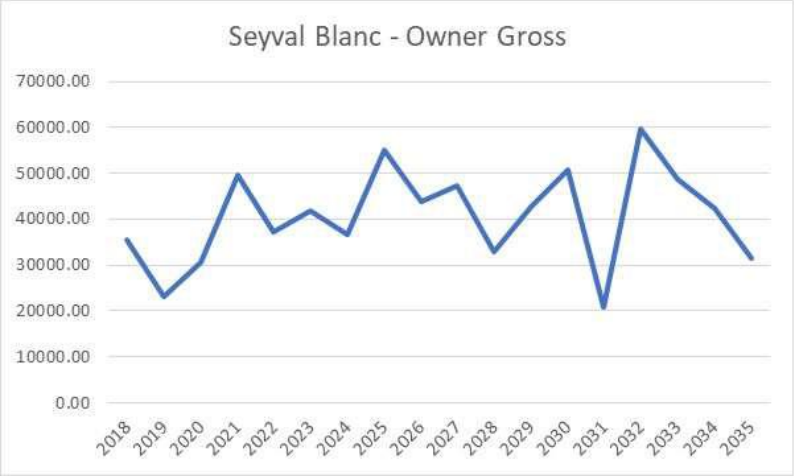
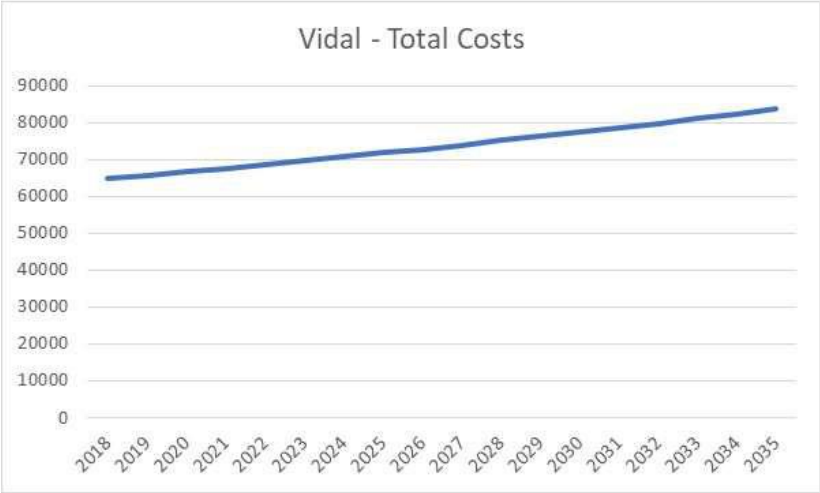


Chart 3.7 – Vidal



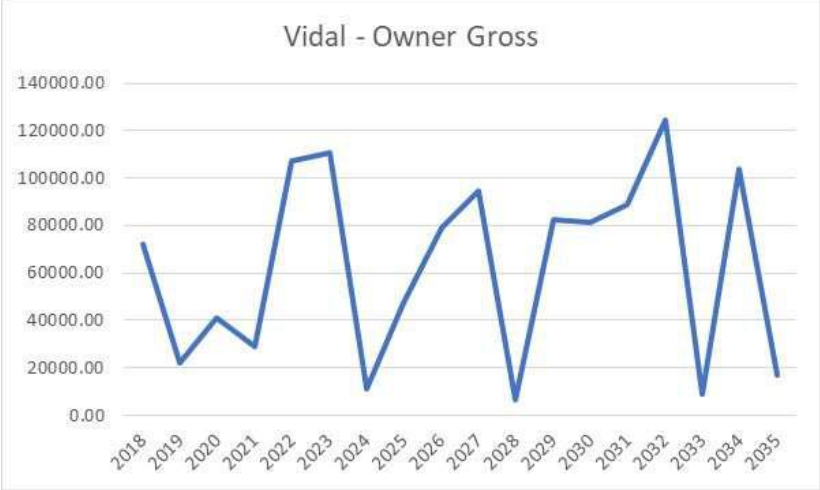
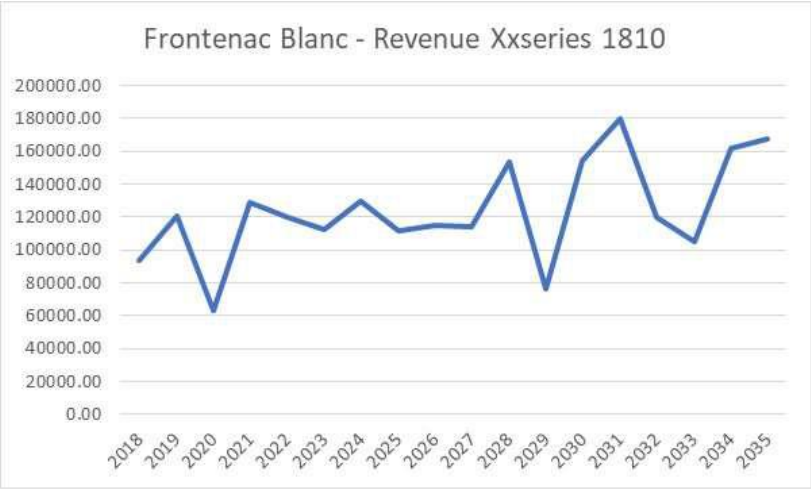
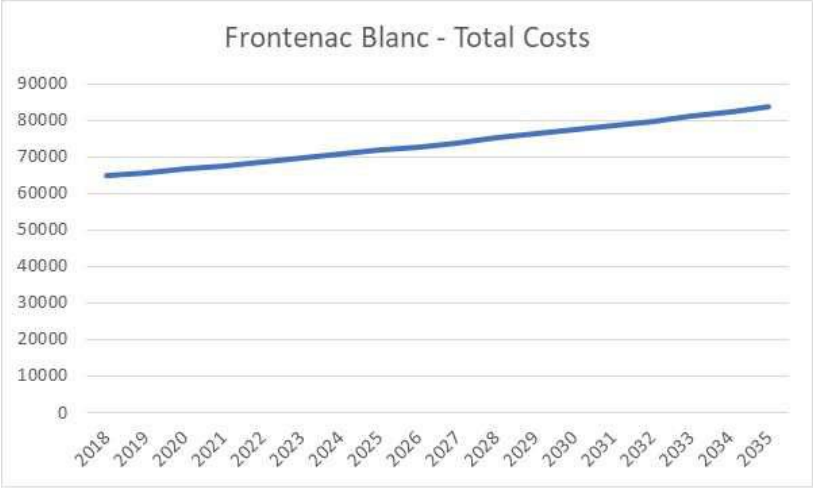


Chart 3.8 – Frontenac Blanc





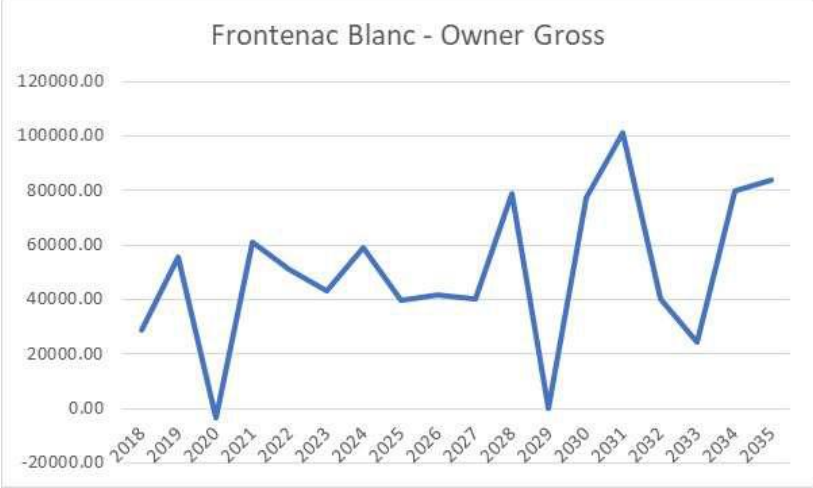
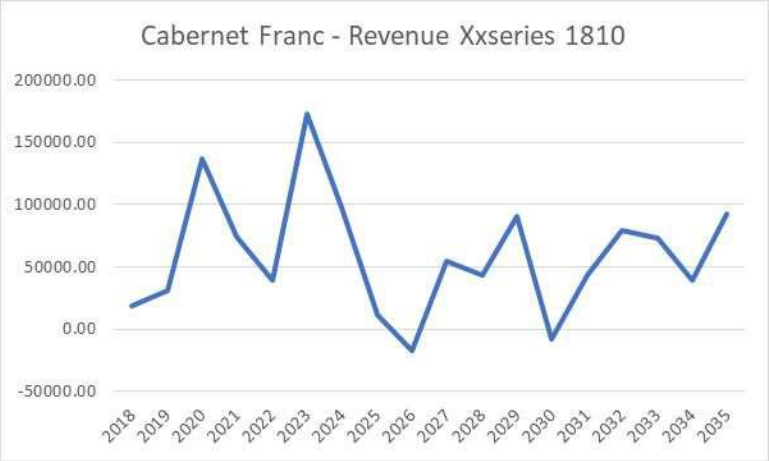
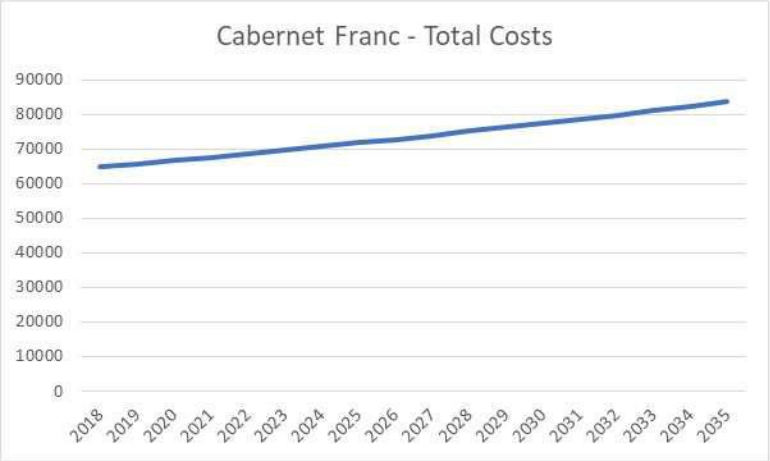


Chart 3.9 – Cabernet Franc


Cabernet Franc - Revenue Xxseries 1810
200000.00
150000.00
100000.00
50000.00
0.00
-50000.00
2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035


Cabernet Franc - Total Costs
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035

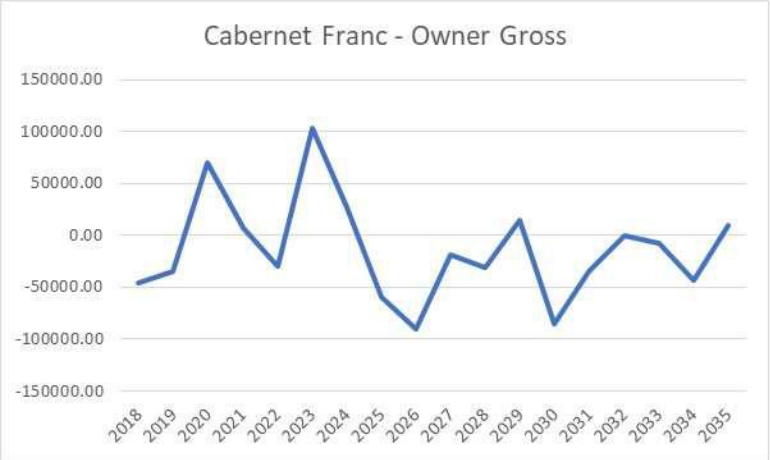

Cabernet Franc - Owner Gross
150000.00
100000.00
50000.00
0.00
-50000.00
-100000.00
-150000.00
2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035

Chart 3.10 – Gamay Noir

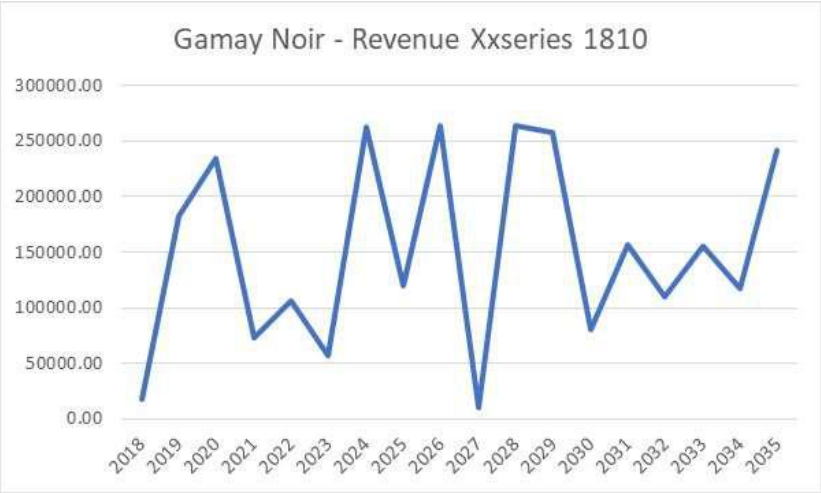
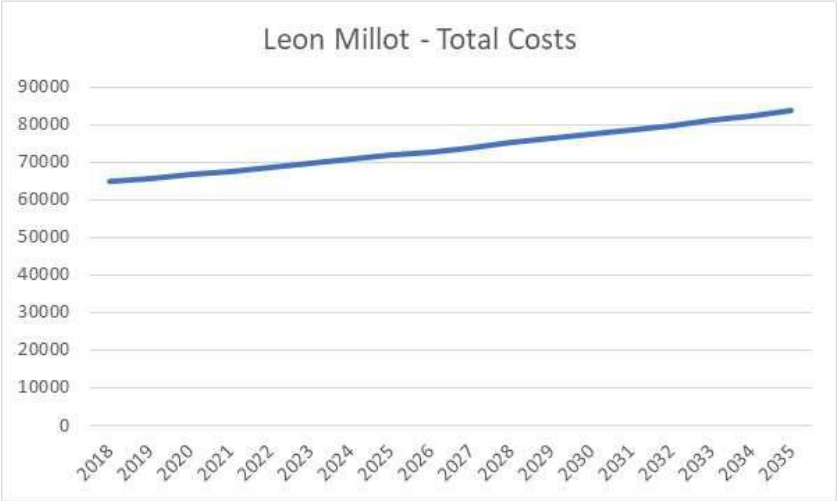


Chart 3.11 – Leon Millet



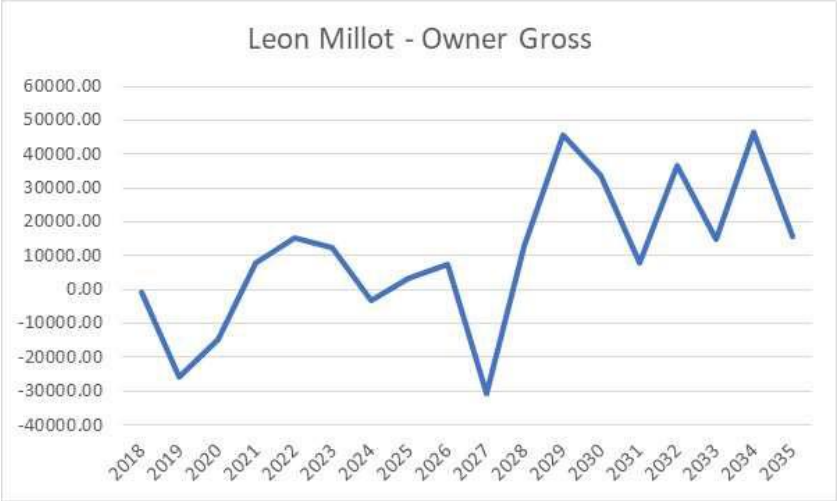
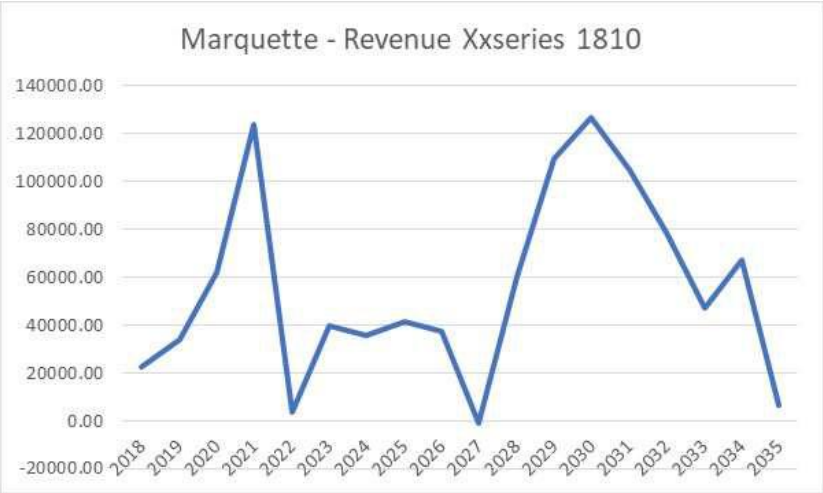
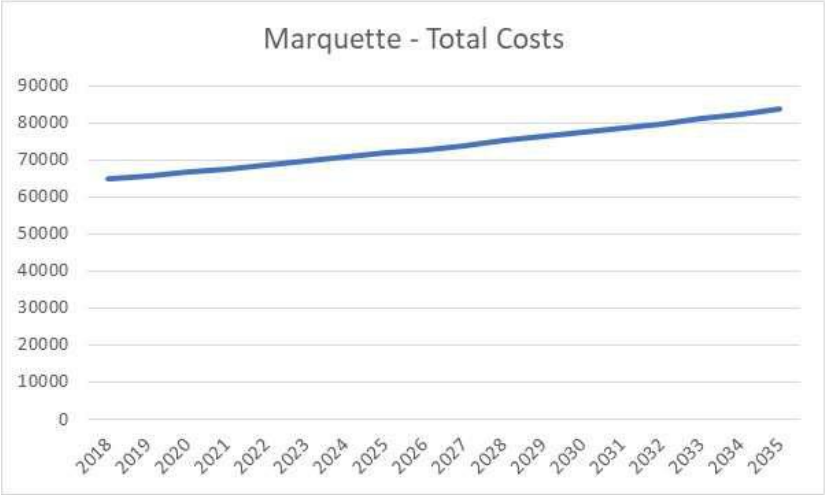


Chart 3.12 – Marquette





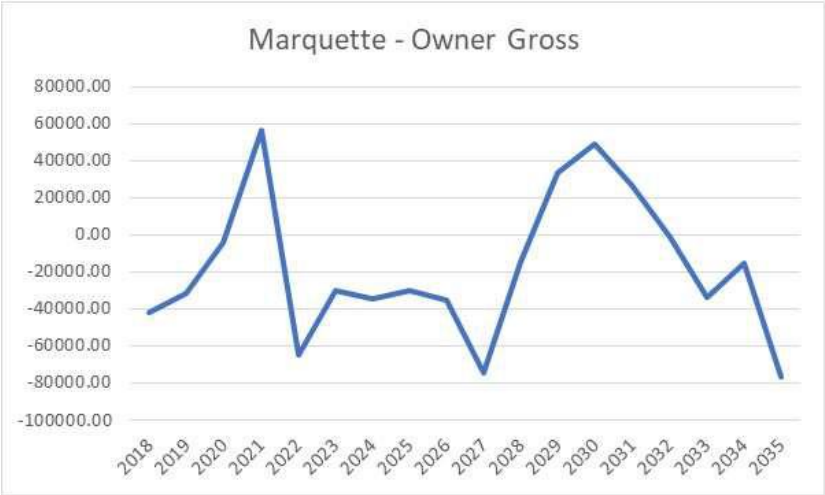
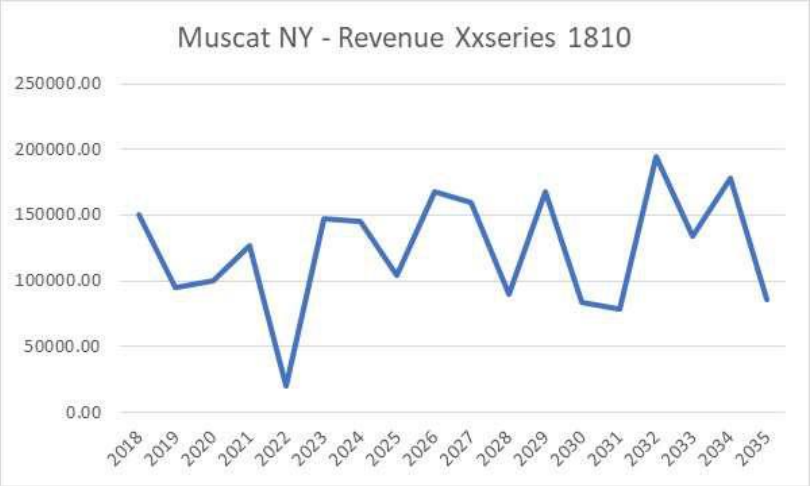
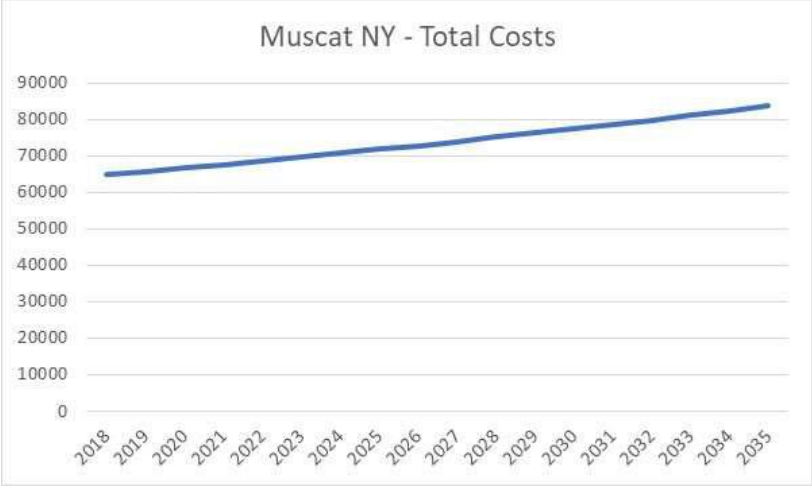


Chart 3.13 – Muscat NY





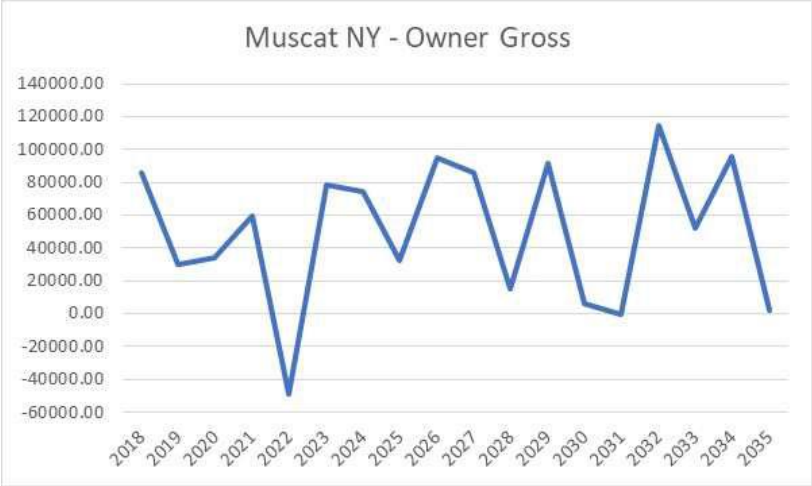
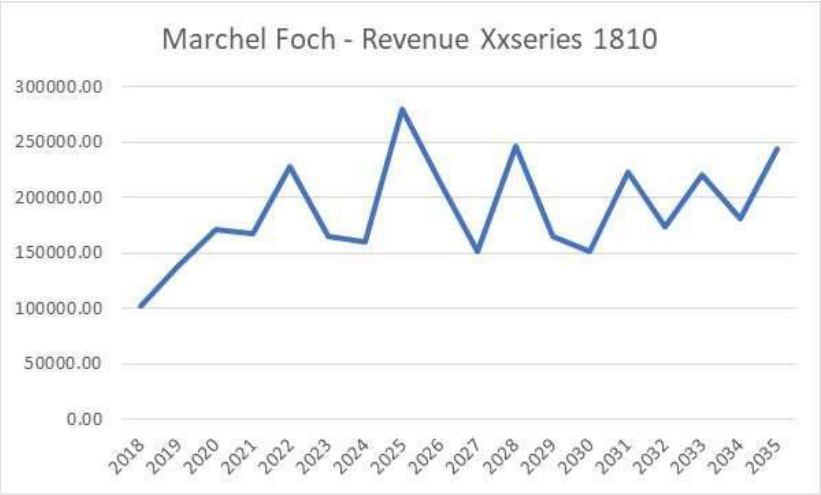


Chart 3.14 – Marchel Foch



Chapter 4 – Moving Forward

The Nova Scotia economic indices and grape operations model provide a first general model. The model can be used as a template to examine various revenue and expenditure scenarios by the user.

Moving forward, the model should incorporate several features to make it more realistic. Secondly, the model should be validated with actual operations once data is available. The key model issues to address in a second generation model are as follows:

1) Economies of scale
2) Production cost variability by grape type
3) Price versus yield
4) Stochastic estimates of production

Economies of Scale

One expects that total costs per unit of output would decrease significantly as the size of the farm increases. A second-generation model could readily incorporate this from key informant surveys as the model structure is already set up to do so.

Production Cost Variability by Grape Type

It is an open empirical question as to how much production costs vary by grape type. It would seem that since harvest labour costs – a major cost

component would be the same for the harvest activity across grape types that costs would not vary much. However, if growing days by grape type vary significantly then annual production costs would exhibit variability.

Price Versus Yield

Grape yield is a management decision related to grape quality. Prices paid increases for higher grape quality. Due to a lack of data, this relationship is not captured in the present model.

Stochastic Estimates of Production Costs

The present model treats production costs such as labour as fixed inputs. These costs would vary in a more realistic setting due to management decisions, climate change and site characteristics. A lack of data prevented inclusion of the uncertainty in the present version of the model.

Appendix A – Reference List and Data Sources

SERIES22

Last updated: 04/12/17 - 09:32
Commercial seed and plant
Table 328-0015 Farm input price index, annual (index, 2002=100)(1,2,
Imported from 'K:\Grape Data Workbook.xls'

1987	NA
1988	NA
1989	NA
1990	NA
1991	NA
1992	NA
1993	NA
1994	NA
1995	NA
1996	NA
1997	NA
1998	NA
1999	NA
2000	NA
2001	NA
2002	100.0
2003	105.2
2004	106.6
2005	108.6
2006	108.9
2007	107.7
2008	107.2
2009	109.8
2010	110.9
2011	115.4
2012	116.6
2013	119.5
2014	121.8
2015	126.2
2016	NA
2017	NA
2018	NA
2019	NA
2020	NA
2021	NA
2022	NA
2023	NA
2024	NA
2025	NA
2026	NA
2027	NA
2028	NA
2029	NA
2030	NA

Reference List

- Minister of Agriculture, Food and Rural Affairs. "Establishment & Production Costs for Grapes in Ontario – 2009 Economic Report." 2009
- Minister of Agriculture, Food and Rural Affairs. "Wine Grape Production Outside Traditional Areas in Ontario." nd.
- Nova Scotia Department of Agriculture. "Nova Scotia Wine Grape Cost of Production and Cash Flow." 2014
- Rimerman, Frank. "The Economic Impact of the Wine and Grape Industry in Canada". 2015.
- Statistics Canada. "Analysis in Brief -- From the Vine to the Glass: Canada's Grape and Wine Industry." 2006
- University of California Cooperative Extension. "Same Costs to Establish a Vineyard and Produce Wine Grapes." 2015
- VQA Ontario and Deloitte. "Ontario Wine and Grape Industry Performance Study." 2016

Data Source

Data on price indices came from Statistics Canada published Nova Scotia Farm Price Indices.

Data on prices and yield came from special requests to the Nova Scotia Department of Agriculture.

Input prices came from the 2014 study "Nova Scotia Wine Grape Cost of Production and Cash Flow Analysis".

Appendix B – Model Listing

Nova Scotia Grape Production Model								2/12/2018
Section 1 Inputs								
Series			2	14	16	22	24	26
Year	**Firm Price**	**AGR Wage Index**	**Farm Input Total**	**Machine Fuel**	**Machine Repairs**	**Commercial seed and plant**	**Fertilizer**	**Nitrogen Fertilizers**
2002	86.9	1.123502	104.2983552	132.6184202	98.9461926	101.685274	124.6655247	112.3681706
2003	91.4	1.232677184	109.0131598	152.0099977	104.0699885	103.4791586	143.1850856	120.3616223
2004	93.9	1.300828527	113.4467288	163.3628524	106.9165418	105.3281429	156.4554781	125.1418614
2005	96.6	1.352589856	117.721612	171.2468729	109.9908194	107.2371749	166.620704	129.1392416
2006	97.7	1.384211274	121.3880142	175.9462458	111.2433028	109.1636098	173.7081059	131.3878059
2007	100	1.416700821	124.9435478	180.3931503	113.8621319	111.1390497	179.7567484	134.2414516
2008	102.3	1.449571449	128.4126369	184.7248239	116.4809609	113.1631954	185.1623256	137.2781091
2009	100.6	1.450246321	130.6024412	185.0003732	114.5453047	115.1300542	187.2810323	136.5900357
2010	103.2	1.471578544	133.0975601	187.7284338	117.5057201	117.1535982	190.4703601	138.838977
2011	104.9	1.494697004	135.5580594	190.6750679	119.4413763	119.2096997	193.672505	141.125724
2012	106.4	1.516981415	137.9309715	193.5212862	121.1493083	121.2928752	196.7381461	143.2349014
2013	108.7	1.545372312	140.4779686	197.1223793	123.7681374	123.424098	200.2970354	146.0463883
2014	109.7	1.565925775	142.7668377	199.7668625	124.9067587	125.568724	203.2224305	147.8417672
2015	111.2	1.587084233	145.0059295	202.475174	126.6146906	127.739883	206.1167441	149.8023262
2016	113.4	1.614171796	147.4182895	205.9132357	129.1196575	129.9559095	209.4973503	152.4743601
2017	115.7	1.644671125	149.9960441	209.7844561	131.7384866	132.2191718	213.2512252	155.4560876
2018	118	1.67666811	152.7027571	213.8533777	134.3573156	134.5293814	217.2361797	158.5314846
2019	120.4	1.710131595	155.5403165	218.1126217	137.0900068	136.8888937	221.4364079	161.7297148
2020	122.8	1.744238827	158.4798969	222.458732	139.8226979	139.2974076	225.7699057	164.9650969
2021	125.2	1.778628643	161.4990232	226.8444897	142.5553891	141.7546237	230.1859067	168.211716
2022	127.7	1.813951582	164.6104689	231.3484314	145.4019424	144.2628868	234.7252023	171.5562358
2023	130.3	1.850493206	167.8241931	236.0064026	148.3623578	146.8245274	239.4130451	175.0248687
2024	132.9	1.887569796	171.1176641	240.7346754	151.3227733	149.4392194	244.1928491	178.5310406
2025	135.6	1.925690294	174.503611	245.5951234	154.3970508	152.1092811	249.1018027	182.1430686
2026	138.3	1.964269035	177.9616614	250.5158984	157.4713284	154.8343741	254.090709	185.7871137
2027	141	2.00304893	181.4759311	255.4642077	160.5456059	157.6141623	259.1291117	189.4408426
2028	143.8	2.042726201	185.0643321	260.5251724	163.7337456	160.4509539	264.2703753	193.1920026
2029	146.7	2.083606468	188.7408306	265.7376432	167.0357475	163.347043	269.5475363	197.0671335
2030	149.7	2.125823888	192.5163159	271.1193522	170.4516114	166.3047097	274.9810465	201.0742626

Grape Variety	L'Acadie Blanc					
Average Yield/acre	2.56					
Standard Deviation	0.36					
NSLC Name	L'Acadie Blanc					
Base Price/tonne	2070	1904.323827				
Source:						
Janice Plumstead NS Dept of Agriculture= Grape Variety; Average Yeild, Standard Deviation						
Basic Price = Master Data Collection Sheet Dec18 - 1 & 2& 3 &5, Grape Deliveries to Wineries						
Note: For multiple price listings we picked the first occurance						
26472.56883						
21578.72082						
39370.19575						

Section 2 Grape Production Business Model								
Grape Production Model 0-5 Acres				2/12/2018				
Series			110	210	310	410	510	610
Year		Revenue Xxseries 1810	Vineyard Management	Harvesting Labour	Bird/Pest Control Labour	Vine Replacement	Tying Material	Pesticides/ Herbicides
2002		26484.50	10554.1242	2814.433119	703.6082797	204.2214707	73.24322699	892.1674001
2003		17055.94	11579.71067	3087.922844	771.9807111	207.8242516	76.55418526	1024.702426
2004		21345.83	12219.92113	3258.645635	814.6614087	211.5376928	79.66764661	1119.671837
2005		20553.85	12706.16459	3388.310557	847.0776393	215.371732	82.66967137	1192.41916
2006		25775.95	13003.21468	3467.523915	866.8809787	219.2407226	85.24439201	1243.140071
2007		24487.61	13308.41993	3548.911983	887.2279956	223.2081334	87.74125547	1286.427112
2008		19117.18	13617.20505	3631.254679	907.8136698	227.2733631	90.17741354	1325.112063
2009		24992.12	13623.54476	3632.94527	908.2363174	231.2235398	91.71519751	1340.274564
2010		23057.51	13823.93864	3686.383638	921.5959094	235.2875612	93.46738773	1363.098951
2011		29181.34	14041.11236	3744.296629	936.0741572	239.4169702	95.19526644	1386.015064
2012		26503.96	14250.45105	3800.12028	950.0300699	243.6007535	96.86163732	1407.95429
2013		32036.80	14517.15378	3871.241008	967.8102519	247.8810337	98.65025884	1433.423441
2014		32728.92	14710.23203	3922.728541	980.6821354	252.1882323	100.2576107	1454.358997
2015		20556.97	14908.99358	3975.73162	993.9329051	256.5487189	101.8300067	1475.072119
2016		30310.65	15163.45285	4043.587428	1010.896857	260.9993161	103.5240797	1499.265389
2017		27802.34	15449.96209	4119.989891	1029.997473	265.5447803	105.3343006	1526.129952
2018		19404.29	15750.54025	4200.144065	1050.036016	270.1845317	107.2350823	1554.648233
2019		34693.44	16064.89463	4283.971901	1070.992975	274.9233012	109.2277503	1584.707117
2020		29104.09	16385.29634	4369.412357	1092.353089	279.7604839	111.2920624	1615.719745
2021		25972.85	16708.35263	4455.560702	1113.890176	284.6954786	113.4122354	1647.322806
2022		37098.84	17040.17463	4544.046568	1136.011642	289.7329944	115.5972394	1679.808223
2023		33035.41	17383.44491	4635.585309	1158.896327	294.8777119	117.8540682	1713.356716
2024		37456.36	17731.74062	4728.464166	1182.116042	300.1289762	120.166899	1747.563328
2025		33223.98	18089.84277	4823.958071	1205.989518	305.4914431	122.5446706	1782.694198
2026		31539.51	18452.24962	4920.599898	1230.149975	310.9644334	124.9730768	1818.397249
2027		27099.10	18816.5461	5017.745627	1254.436407	316.5472716	127.4409628	1854.454521
2028		23225.10	19189.2725	5117.139332	1279.284833	322.2445937	129.9609074	1891.247915
2029		41150.57	19573.29977	5219.546606	1304.886651	328.0610069	132.5427181	1929.013857
2030		34870.40	19969.8882	5325.30352	1331.32588	334.0010906	135.1940421	1967.898711

710	810	910	1010			
Soil Amendments & Testing	**Building Maintenance**	**Tractor Expenses**	**Administrative Costs**	**XXlongterm10**	**Total Costs**	**Owner Gross Per 10 Acre**
416.3447867	251.9648397	1455.426034	879.5103496	17061	24751.91951	-664.77
478.1944652	265.0125011	1668.239659	964.9758889	17061	25606.40693	2136.18
522.513524	272.2612019	1792.832006	1018.326761	17061	26151.11771	-9077.83
556.4622746	280.0897988	1879.355497	1058.847049	17061	26561.60338	-903.41
580.1320331	283.2792271	1930.928949	1083.601223	17061	26820.97151	-5841.47
600.3326521	289.9480319	1979.731676	1109.034995	17061	27073.56383	-11406.74
618.3856295	296.6168366	2027.269797	1134.767087	17061	27319.67054	-946.55
625.461463	291.6877201	2030.293824	1135.295397	17061	27348.13329	-3042.89
636.1128439	299.2263689	2060.233031	1151.994887	17061	27508.40058	-2073.72
646.80703	304.1554854	2092.570982	1170.092697	17061	27675.62428	-5776.18
657.0453353	308.5047059	2123.806917	1187.537587	17061	27836.46158	198.93
668.9309389	315.1735106	2163.327253	1209.762815	17061	28037.20051	-1694.05
678.7008653	318.072991	2192.349237	1225.852669	17061	28186.19128	-2219.75
688.3669888	322.4222114	2222.071707	1242.416131	17061	28339.39241	906.50
699.6571815	328.8010681	2259.80285	1263.621071	17061	28531.15524	-3434.61
712.1939774	335.4698729	2302.28771	1287.496841	17061	28745.4448	-5117.76
725.5025085	342.1386776	2346.942249	1312.54502	17061	28970.37638	929.59
739.5299882	349.0974304	2393.685488	1338.741219	17061	29205.87717	-3614.54
754.0025476	356.0561831	2441.382046	1365.441362	17061	29446.41988	2585.04
768.7506427	363.0149359	2489.513715	1392.362719	17061	29689.52341	-4146.88
783.9105039	370.2636367	2538.942399	1420.014552	17061	29939.32776	2705.14
799.5664674	377.8022855	2590.061486	1448.620409	17061	30197.62078	972.03
815.5295532	385.3409343	2641.952101	1477.645052	17061	30459.90705	4292.49
831.9239593	393.1695312	2695.293277	1507.486897	17061	30729.55157	-4289.19
848.5853831	400.9981281	2749.296515	1537.687468	17061	31002.65213	3612.97
865.4121096	408.8267249	2803.601928	1568.045509	17061	31277.51106	646.13
882.5823603	416.9452698	2859.143683	1599.106041	17061	31558.65494	-2710.84
900.2064666	425.3537627	2916.348147	1631.108314	17061	31848.06753	2737.40
918.3527317	434.0522037	2975.409924	1664.15735	17061	32146.69545	516.83

Grape Production Model 6-10 Acres				2/12/2018				
Series			110	210	310	410	510	610
Year		**Revenue Xxseries 1810**	**Vineyard Management**	**Harvesting Labour**	**Bird/Pest Control Labour**	**Vine Replacement**	**Tying Material**	**Pesticides/ Herbicides**
2002		37849.44	21108.24839	5628.866238	1407.216559	408.4429415	146.486454	1784.3348
2003		43036.56	23159.42133	6175.845689	1543.961422	415.6485032	153.1083705	2049.404851
2004		46336.79	24439.84226	6517.291269	1629.322817	423.0753856	159.3352932	2239.343674
2005		44488.28	25412.32918	6776.621115	1694.155279	430.7434639	165.3393427	2384.83832
2006		52243.99	26006.42936	6935.04783	1733.761957	438.4814451	170.488784	2486.280142
2007		44443.32	26616.83987	7097.823965	1774.455991	446.4162668	175.4825109	2572.854223
2008		53705.65	27234.41009	7262.509358	1815.62734	454.5467263	180.3548271	2650.224127
2009		48340.77	27247.08952	7265.890539	1816.472635	462.4470796	183.430395	2680.549127
2010		61003.58	27647.87728	7372.767276	1843.191819	470.5751224	186.9347755	2726.197902
2011		44446.20	28082.22472	7488.593258	1872.148314	478.8339404	190.3905329	2772.030129
2012		62335.93	28500.9021	7600.240559	1900.06014	487.2015069	193.7232746	2815.90858
2013		44945.79	29034.30756	7742.482015	1935.620504	495.7620675	197.3005177	2866.846881
2014		47640.55	29420.46406	7845.457083	1961.364271	504.3764645	200.5152215	2908.717994
2015		62354.41	29817.98715	7951.46324	1987.86581	513.0974379	203.6600133	2950.144238
2016		60281.80	30326.90571	8087.174855	2021.793714	521.9986323	207.0481594	2998.530778
2017		57656.95	30899.92418	8239.979782	2059.994946	531.0895605	210.6686012	3052.259903
2018		60469.09	31501.08049	8400.288131	2100.072033	540.3690634	214.4701645	3109.296465
2019		63460.52	32129.78926	8567.943802	2141.98595	549.8466025	218.4555007	3169.414235
2020		62849.73	32770.59268	8738.824714	2184.706178	559.5209679	222.5841248	3231.43949
2021		49284.25	33416.70527	8911.121405	2227.780351	569.3909571	226.8244709	3294.645612
2022		62049.23	34080.34926	9088.093136	2272.023284	579.4659888	231.1944788	3359.616445
2023		66445.75	34766.88982	9271.170618	2317.792655	589.7554238	235.7081364	3426.713432
2024		69548.40	35463.48125	9456.928333	2364.232083	600.2579524	240.333798	3495.126656
2025		73371.41	36179.68553	9647.916142	2411.979035	610.9828863	245.0893413	3565.388397
2026		61748.29	36904.49924	9841.199796	2460.299949	621.9288667	249.9461536	3636.794499
2027		73737.44	37633.0922	10035.49125	2508.872814	633.0945433	254.8819257	3708.909041
2028		64722.38	38378.54499	10234.27866	2558.569666	644.4891873	259.9218148	3782.49583
2029		83947.61	39146.59954	10439.09321	2609.773303	656.1220138	265.0854362	3858.027714
2030		73903.50	39939.7764	10650.60704	2662.65176	668.0021812	270.3880842	3935.797421

710	810	910	1010			
Soil Amendments & Testing	**Building Maintenance**	**Tractor Expenses**	**Administrative Costs**	**XXlongterm10**	**Total Costs**	**Owner Gross Per 10 Acre**
832.6895735	503.9296794	2910.852067	1759.020699	17061	32442.83901	5406.60
956.3889305	530.0250022	3336.479317	1929.951778	17061	34151.81386	8884.74
1045.027048	544.5224038	3585.664012	2036.653522	17061	35241.23543	11095.56
1112.924549	560.1795976	3758.710995	2117.694098	17061	36062.20676	8426.07
1160.264066	566.5584543	3861.857898	2167.202447	17061	36580.94302	15663.05
1200.665304	579.8960637	3959.463352	2218.069989	17061	37086.12767	7357.20
1236.771259	593.2336732	4054.539594	2269.534174	17061	37578.34108	16127.31
1250.922926	583.3754401	4060.587648	2270.590794	17061	37635.26658	10705.50
1272.225688	598.4527378	4120.466061	2303.989774	17061	37955.80116	23047.78
1293.61406	608.3109708	4185.141964	2340.185393	17061	38290.24856	6155.95
1314.090671	617.0094118	4247.613833	2375.075175	17061	38611.92315	23724.01
1337.861878	630.3470213	4326.654505	2419.52563	17061	39013.40102	5932.39
1357.401731	636.1459819	4384.698474	2451.705338	17061	39311.38256	8329.17
1376.733978	644.8444229	4444.143415	2484.832263	17061	39617.78482	22736.62
1399.314363	657.6021363	4519.6057	2527.242142	17061	40001.31048	20280.49
1424.387955	670.9397457	4604.57542	2574.993682	17061	40429.8896	17227.06
1451.005017	684.2773552	4693.884497	2625.090041	17061	40879.75277	19589.34
1479.059976	698.1948607	4787.370976	2677.482438	17061	41350.75434	22109.77
1508.005095	712.1123663	4882.764092	2730.882723	17061	41831.83975	21017.89
1537.501285	726.0298718	4979.027431	2784.725439	17061	42318.04682	6966.20
1567.821008	740.5272734	5077.884799	2840.029105	17061	42817.65552	19231.58
1599.132935	755.604571	5180.122971	2897.240818	17061	43334.24156	23111.51
1631.059106	770.6818687	5283.904201	2955.290104	17061	43858.8141	25689.58
1663.847919	786.3390624	5390.586554	3014.973794	17061	44398.10313	28973.31
1697.170766	801.9962561	5498.59303	3075.374936	17061	44944.30425	16803.98
1730.824219	817.6534498	5607.203857	3136.091017	17061	45494.02212	28243.42
1765.164721	833.8905396	5718.287366	3198.212083	17061	46056.30987	18666.07
1800.412933	850.7075255	5832.696295	3262.216629	17061	46635.13506	37312.47
1836.705463	868.1044074	5950.819847	3328.3147	17061	47232.39091	26671.11

Grape Production Model 11-20 Acres				2/12/2018				
Series			110	210	310	410	510	610
Year		**Revenue Xxseries 1810**	**Vineyard Management**	**Harvesting Labour**	**Bird/Pest Control Labour**	**Vine Replacement**	**Tying Material**	**Pesticides/ Herbicides**
2002		84927.38	42216.49678	11257.73248	2814.433119	816.885883	292.972908	3568.669601
2003		107841.67	46318.84267	12351.69138	3087.922844	831.2970064	306.216741	4098.809702
2004		81591.51	48879.68452	13034.58254	3258.645635	846.1507711	318.6705865	4478.687349
2005		64572.56	50824.65836	13553.24223	3388.310557	861.4869278	330.6786855	4769.67664
2006		105559.69	52012.85872	13870.09566	3467.523915	876.9628903	340.977568	4972.560283
2007		116654.15	53233.67974	14195.64793	3548.911983	892.8325335	350.9650219	5145.708447
2008		96423.74	54468.82019	14525.01872	3631.254679	909.0934525	360.7096541	5300.448253
2009		85564.61	54494.17904	14531.78108	3632.94527	924.8941591	366.86079	5361.098254
2010		118080.61	55295.75457	14745.53455	3686.383638	941.1502449	373.8695509	5452.395805
2011		105854.68	56164.44943	14977.18652	3744.296629	957.6678807	380.7810658	5544.060257
2012		93640.08	57001.80419	15200.48112	3800.12028	974.4030138	387.4465493	5631.81716
2013		99559.67	58068.61512	15484.96403	3871.241008	991.5241349	394.6010354	5733.693762
2014		128030.11	58840.92812	15690.91417	3922.728541	1008.752929	401.030443	5817.435988
2015		99207.95	59635.9743	15902.92648	3975.73162	1026.194876	407.3200267	5900.288476
2016		113789.78	60653.81142	16174.34971	4043.587428	1043.997265	414.0963187	5997.061555
2017		106541.47	61799.84837	16479.95956	4119.989891	1062.179121	421.3372024	6104.519806
2018		139803.05	63002.16098	16800.57626	4200.144065	1080.738127	428.9403291	6218.59293
2019		127302.22	64259.57851	17135.8876	4283.971901	1099.693205	436.9110013	6338.82847
2020		87825.89	65541.18535	17477.64943	4369.412357	1119.041936	445.1682496	6462.878979
2021		132373.05	66833.41054	17822.24281	4455.560702	1138.781914	453.6489417	6589.291223
2022		130825.25	68160.69852	18176.18627	4544.046568	1158.931978	462.3889576	6719.232891
2023		127601.37	69533.77964	18542.34124	4635.585309	1179.510848	471.4162728	6853.426864
2024		128162.78	70926.9625	18913.85667	4728.464166	1200.515905	480.6675959	6990.253313
2025		116749.85	72359.37106	19295.83228	4823.958071	1221.965773	490.1786826	7130.776794
2026		122582.75	73808.99847	19682.39959	4920.599898	1243.857733	499.8923073	7273.588998
2027		112860.17	75266.18441	20070.98251	5017.745627	1266.189087	509.7638513	7417.818082
2028		124123.51	76757.08998	20468.55733	5117.139332	1288.978375	519.8436295	7564.99166
2029		113592.85	78293.19909	20878.18642	5219.546606	1312.244028	530.1708725	7716.055428
2030		133604.33	79879.5528	21301.21408	5325.30352	1336.004362	540.7761683	7871.594843

710	810	910	1010			
Soil Amendments & Testing	**Building Maintenance**	**Tractor Expenses**	**Administrative Costs**	**XXlongterm10**	**Total Costs**	**Owner Gross Per 10 Acre**
1665.379147	1007.859359	5821.704134	3518.041399	17061	47824.67802	37102.70
1912.777861	1060.050004	6672.958635	3859.903555	17061	51242.62773	56599.05
2090.054096	1089.044808	7171.328024	4073.307043	17061	53421.47085	28170.04
2225.849099	1120.359195	7517.42199	4235.388197	17061	55063.41352	9509.15
2320.528132	1133.116909	7723.715796	4334.404894	17061	56100.88605	49458.80
2401.330608	1159.792127	7918.926704	4436.139978	17061	57111.25533	59542.90
2473.542518	1186.467346	8109.079188	4539.068349	17061	58095.68216	38328.06
2501.845852	1166.75088	8121.175296	4541.181587	17061	58209.53317	27355.08
2544.451376	1196.905476	8240.932123	4607.979547	17061	58850.60231	59230.01
2587.22812	1216.621942	8370.283929	4680.370786	17061	59519.49712	46335.18
2628.181341	1234.018824	8495.227666	4750.150349	17061	60162.8463	33477.24
2675.723756	1260.694043	8653.309011	4839.05126	17061	60965.80204	38593.87
2714.803461	1272.291964	8769.396948	4903.410677	17061	61561.76512	66468.34
2753.467955	1289.688846	8888.286829	4969.664525	17061	62174.56963	37033.38
2798.628726	1315.204273	9039.211399	5054.484285	17061	62941.62096	50848.16
2848.77591	1341.879491	9209.15084	5149.987364	17061	63798.77919	42742.69
2902.010034	1368.55471	9387.768994	5250.180082	17061	64698.50553	75104.55
2958.119953	1396.389721	9574.741952	5354.964876	17061	65640.50868	61661.71
3016.01019	1424.224733	9765.528184	5461.765446	17061	66602.6795	21223.21
3075.002571	1452.059744	9958.054861	5569.450878	17061	67575.09364	64797.96
3135.642016	1481.054547	10155.7696	5680.05821	17061	68574.31103	62250.94
3198.26587	1511.209142	10360.24594	5794.481636	17061	69607.48312	57993.89
3262.118213	1541.363737	10567.8084	5910.580208	17061	70656.62821	57506.15
3327.695837	1572.678125	10781.17311	6029.947589	17061	71735.20626	45014.64
3394.341532	1603.992512	10997.18606	6150.749873	17061	72827.60851	49755.14
3461.648438	1635.3069	11214.40771	6272.182034	17061	73927.04424	38933.13
3530.329441	1667.781079	11436.57473	6396.424165	17061	75051.61974	49071.89
3600.825866	1701.415051	11665.39259	6524.433257	17061	76209.27012	37383.58
3673.410927	1736.208815	11901.63969	6656.6294	17061	77403.78181	56200.55

Grape Production Model 21-30 Acres				2/12/2018				
Series			110	210	310	410	510	610
Year		**Revenue Xxseries 1810**	**Vineyard Management**	**Harvesting Labour**	**Bird/Pest Control Labour**	**Vine Replacement**	**Tying Material**	**Pesticides/ Herbicides**
2002		100158.22	63324.74517	16886.59871	4221.649678	1225.328824	439.4593619	5353.004401
2003		121501.45	69478.264	18527.53707	4631.884267	1246.94551	459.3251115	6148.214553
2004		149858.24	73319.52678	19551.87381	4887.968452	1269.226157	478.0058797	6718.031023
2005		164402.15	76236.98754	20329.86334	5082.465836	1292.230392	496.0180282	7154.51496
2006		115476.16	78019.28808	20805.14349	5201.285872	1315.444335	511.4663521	7458.840425
2007		124302.83	79850.51961	21293.4719	5323.367974	1339.2488	526.4475328	7718.56267
2008		215378.06	81703.23028	21787.52807	5446.882019	1363.640179	541.0644812	7950.67238
2009		163109.54	81741.26857	21797.67162	5449.417904	1387.341239	550.291185	8041.647381
2010		169938.32	82943.63185	22118.30183	5529.575457	1411.725367	560.8043264	8178.593707
2011		187461.17	84246.67415	22465.77977	5616.444943	1436.501821	571.1715986	8316.090386
2012		147443.45	85502.70629	22800.72168	5700.180419	1461.604521	581.1698239	8447.72574
2013		145535.80	87102.92267	23227.44605	5806.861512	1487.286202	591.901553	8600.540643
2014		151466.59	88261.39218	23536.37125	5884.092812	1513.129394	601.5456645	8726.153983
2015		175939.77	89453.96145	23854.38972	5963.59743	1539.292314	610.98004	8850.432713
2016		198186.17	90980.71712	24261.52457	6065.381142	1565.995897	621.1444781	8995.592333
2017		192127.32	92699.77255	24719.93935	6179.984837	1593.268682	632.0058037	9156.779709
2018		202197.96	94503.24147	25200.86439	6300.216098	1621.10719	643.4104936	9327.889395
2019		162930.66	96389.36777	25703.83141	6425.957851	1649.539807	655.366502	9508.242705
2020		155026.41	98311.77803	26216.47414	6554.118535	1678.562904	667.7523744	9694.318469
2021		188724.49	100250.1158	26733.36421	6683.341054	1708.172871	680.4734126	9883.936835
2022		198119.08	102241.0478	27264.27941	6816.069852	1738.397966	693.5834363	10078.84934
2023		149558.30	104300.6695	27813.51186	6953.377964	1769.266272	707.1244092	10280.1403
2024		200689.19	106390.4437	28370.785	7092.69625	1800.773857	721.0013939	10485.37997
2025		115612.88	108539.0566	28943.74843	7235.937106	1832.948659	735.2680238	10696.16519
2026		198696.79	110713.4977	29523.59939	7380.899847	1865.7866	749.8384609	10910.3835
2027		237952.26	112899.2766	30106.47376	7526.618441	1899.28363	764.645777	11126.72712
2028		222759.86	115135.635	30702.83599	7675.708998	1933.467562	779.7654443	11347.48749
2029		214220.55	117439.7986	31317.27964	7829.319909	1968.366041	795.2563087	11574.08314
2030		250018.62	119819.3292	31951.82112	7987.95528	2004.006544	811.1642525	11807.39226

710	810	910	1010			
Soil Amendments & Testing	**Building Maintenance**	**Tractor Expenses**	**Administrative Costs**	**XXlongterm10**	**Total Costs**	**Owner Gross Per 10 Acre**
2498.06872	1511.789038	8732.556202	5277.062098	17061	63206.51704	36951.70
2869.166791	1590.075007	10009.43795	5789.855333	17061	68333.44159	53168.01
3135.081144	1633.567212	10756.99204	6109.960565	17061	71601.70628	78256.53
3338.773648	1680.538793	11276.13298	6353.082295	17061	74064.62028	90337.53
3480.792198	1699.675363	11585.57369	6501.60734	17061	75620.82907	39855.33
3601.995913	1739.688191	11878.39006	6654.209967	17061	77136.383	47166.45
3710.313777	1779.70102	12163.61878	6808.602523	17061	78613.02324	136765.04
3752.768778	1750.12632	12181.76294	6811.772381	17061	78783.79975	84325.74
3816.677063	1795.358213	12361.39818	6911.969321	17061	79745.40347	90192.92
3880.84218	1824.932913	12555.42589	7020.556179	17061	80748.74569	106712.42
3942.272012	1851.028235	12742.8415	7125.225524	17061	81713.76945	65729.68
4013.585634	1891.041064	12979.96352	7258.576889	17061	82918.20306	62617.60
4072.205192	1908.437946	13154.09542	7355.116015	17061	83812.14768	67654.45
4130.201933	1934.533269	13332.43024	7454.496788	17061	84731.35445	91208.41
4197.943089	1972.806409	13558.8171	7581.726427	17061	85881.93144	112304.24
4273.163864	2012.819237	13813.72626	7724.981046	17061	87167.66879	104959.65
4353.015051	2052.832066	14081.65349	7875.270123	17061	88517.2583	113680.70
4437.179929	2094.584582	14362.11293	8032.447314	17061	89930.26302	73000.40
4524.015285	2136.337099	14648.29228	8192.648169	17061	91373.51925	63652.89
4612.503856	2178.089615	14937.08229	8354.176317	17061	92832.14047	95892.35
4703.463024	2221.58182	15233.6544	8520.087315	17061	94330.96655	103788.12
4797.398805	2266.813713	15540.36891	8691.722455	17061	95880.72468	53677.57
4893.177319	2312.045606	15851.7126	8865.870312	17061	97454.44231	103234.75
4991.543756	2359.017187	16171.75966	9044.921383	17061	99072.30939	16540.57
5091.512298	2405.988768	16495.77909	9226.124809	17061	100710.9128	97985.88
5192.472658	2452.96035	16821.61157	9408.273051	17061	102360.0664	135592.20
5295.494162	2501.671619	17154.8621	9594.636248	17061	104046.9296	118712.94
5401.2388	2552.122576	17498.08888	9786.649886	17061	105783.4052	108437.14
5510.11639	2604.313222	17852.45954	9984.9441	17061	107575.1727	142443.45

Sheets contained in Model include separate worksheets for:

- L'Acadie Blanc
- Chardonnay
- Pinot Noir
- Geisenheim
- Riesling
- Seyval Blanc
- Vidal
- Frontenac Blanc
- Cabernet Franc
- Gamay Noir
- Leon Millot
- Marguette
- Muscat NY
- Marchel Foch

Appendix C – Data Definition

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Appendix D – Bayes Estimation and OLS Regression Diagnostics

Model Estimation

The grape production model takes as its starting point input requirements as provided in the 2008 Department of Agriculture Study. Nova Scotia historic farm selling prices and costs price indexes are provided by Statistics Canada. The model parameters are estimated using a Bayes Regression approach. The technique allows for a Bayes learning network. The Bayes regression uses the conjugate prior methodology. The posterior distribution is a normal integrated inverted gamma. Regression parameters are updated according to the following equations:

$$
\begin{aligned}
\boldsymbol{\mu}_n &= (\mathbf{X}^{\mathrm{T}}\mathbf{X} + \boldsymbol{\Lambda}_0)^{-1}(\boldsymbol{\Lambda}_0\boldsymbol{\mu}_0 + \mathbf{X}^{\mathrm{T}}\mathbf{X}\hat{\boldsymbol{\beta}}) = (\mathbf{X}^{\mathrm{T}}\mathbf{X} + \boldsymbol{\Lambda}_0)^{-1}(\boldsymbol{\Lambda}_0\boldsymbol{\mu}_0 + \mathbf{X}^{\mathrm{T}}\mathbf{y}),\\
\boldsymbol{\Lambda}_n &= (\mathbf{X}^{\mathrm{T}}\mathbf{X} + \boldsymbol{\Lambda}_0),\\
a_n &= a_0 + \frac{n}{2},\\
b_n &= b_0 + \frac{1}{2}(\mathbf{y}^{\mathrm{T}}\mathbf{y} + \boldsymbol{\mu}_0^{\mathrm{T}}\boldsymbol{\Lambda}_0\boldsymbol{\mu}_0 - \boldsymbol{\mu}_n^{\mathrm{T}}\boldsymbol{\Lambda}_n\boldsymbol{\mu}_n).
\end{aligned}
$$

Dependent Variable: AGRWWAGEINDEX
Method: Least Squares
Date: 03/13/18 Time: 12:34
Sample (adjusted): 2002 2015
Included observations: 14 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AGRWWAGEINDEX(-1)	0.438968	0.308189	1.424348	0.1798
FIRMPRICENS*.01	0.809076	0.415061	1.949294	0.0750

R-squared	0.625424	Mean dependent var	1.403954
Adjusted R-squared	0.594210	S.D. dependent var	0.236323
S.E. of regression	0.150541	Akaike info criterion	-0.817593
Sum squared resid	0.271953	Schwarz criterion	-0.726299
Log likelihood	7.723153	Hannan-Quinn criter.	-0.826044
Durbin-Watson stat	1.776116		

Dependent Variable: SERIES02
Method: Least Squares
Date: 03/13/18 Time: 12:35
Sample (adjusted): 2003 2015
Included observations: 13 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FIRMPRICENS	0.302971	0.172234	1.759070	0.1063
SERIES02(-1)	0.779702	0.141530	5.509099	0.0002

R-squared	0.916692	Mean dependent var	127.0231
Adjusted R-squared	0.909118	S.D. dependent var	16.12974
S.E. of regression	4.862575	Akaike info criterion	6.141652
Sum squared resid	260.0910	Schwarz criterion	6.228567
Log likelihood	-37.92073	Hannan-Quinn criter.	6.123787
Durbin-Watson stat	1.762243		

Dependent Variable: SERIES14
Method: Least Squares
Date: 03/13/18 Time: 12:35
Sample (adjusted): 2003 2015
Included observations: 13 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FIRMPRICENS	1.000883	0.387391	2.583647	0.0254
SERIES14(-1)	0.456417	0.218429	2.089547	0.0607

R-squared	0.544429	Mean dependent var	182.0538
Adjusted R-squared	0.503014	S.D. dependent var	39.30968
S.E. of regression	27.71225	Akaike info criterion	9.622265
Sum squared resid	8447.658	Schwarz criterion	9.709180
Log likelihood	-60.54472	Hannan-Quinn criter.	9.604400
Durbin-Watson stat	1.924928		

Dependent Variable: SERIES16
Method: Least Squares
Date: 03/13/18 Time: 12:36
Sample (adjusted): 2002 2015
Included observations: 14 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FIRMPRICENS	1.138621	0.013521	84.21374	0.0000

R-squared	0.808976	Mean dependent var	114.7786
Adjusted R-squared	0.808976	S.D. dependent var	11.71358
S.E. of regression	5.119578	Akaike info criterion	6.172770
Sum squared resid	340.7310	Schwarz criterion	6.218417
Log likelihood	-42.20939	Hannan-Quinn criter.	6.168545
Durbin-Watson stat	0.716350		

Dependent Variable: SERIES22
Method: Least Squares
Date: 03/13/18 Time: 12:36
Sample (adjusted): 2003 2015
Included observations: 13 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FIRMPRICENS	0.026424	0.299133	0.088334	0.9312
SERIES22(-1)	0.993891	0.275990	3.601182	0.0042

R-squared	0.915806	Mean dependent var	112.6462
Adjusted R-squared	0.908152	S.D. dependent var	6.616723
S.E. of regression	2.005293	Akaike info criterion	4.370096
Sum squared resid	44.23320	Schwarz criterion	4.457011
Log likelihood	-26.40562	Hannan-Quinn criter.	4.352231
Durbin-Watson stat	1.417644		

Dependent Variable: SERIES24
Method: Least Squares
Date: 03/13/18 Time: 12:37
Sample (adjusted): 2003 2015
Included observations: 13 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SERIES24(-1)	0.619070	0.211250	2.930513	0.0137
FIRMPRICENS	0.722192	0.368696	1.958776	0.0760

R-squared	0.571715	Mean dependent var	178.3308
Adjusted R-squared	0.532780	S.D. dependent var	53.97231
S.E. of regression	36.89196	Akaike info criterion	10.19450
Sum squared resid	14971.19	Schwarz criterion	10.28142
Log likelihood	-64.26427	Hannan-Quinn criter.	10.17664
Durbin-Watson stat	1.804491		

Dependent Variable: SERIES26
Method: Least Squares
Date: 03/13/18 Time: 12:37
Sample (adjusted): 2003 2015
Included observations: 13 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FIRMPRICENS	0.945021	0.341526	2.767055	0.0183
SERIES26(-1)	0.302458	0.261372	1.157193	0.2717

R-squared	0.428132	Mean dependent var	136.1692
Adjusted R-squared	0.376144	S.D. dependent var	20.23097
S.E. of regression	15.97935	Akaike info criterion	8.521109
Sum squared resid	2808.735	Schwarz criterion	8.608025
Log likelihood	-53.38721	Hannan-Quinn criter.	8.503244
Durbin-Watson stat	1.863978		