

Value at Risk: What is it and How Can it be Used?

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■ Introduction

Your operation has a 20% (1 in 5) chance that its cash flow from operations for the next six months will be below -\$249,500.00.

The above statement is an example of the type of information that the risk management tool of Value at Risk provides. But how is this information calculated, what benefits can be gained from knowing this information, and how can it be used to manage some of the risks your operation faces?

■ Value at Risk

The risk management tool of Value at Risk (VaR) focuses specifically on the downside risk facing an operation, and measures these risks in financial terms by using a single monetary value that is easy to interpret (Jorion 2001), such as one given in the example above.

This presentation will give examples of calculating and using VaR. The examples in this presentation are based on a hypothetical 1000 sow farrow to finish operation, historical prices for Alberta up to the end of 2002, and average production statistics. This presentation will specifically look at the impact downside risks may have on operating cash flows and will produce forward looking cash flows for the first 6 months of 2003.

■ Risk Management

The process of risk management, as defined by Hardaker et al. (1997), can be simplified into three basic steps:

- **Identify** the sources of risk or the uncertain consequences that may impact an outcome of interest pertaining to the operation (ex. cash flow for our presentation).
- **Measure** the effects of risk sources by determining the probability of their occurrence and the severity of their consequences.
- **Manage** the risk by understanding where current risk management strategies do not address the sources of risk adequately, and then implement more effective strategies.

■ How Do You Calculate Value at Risk

Identify

Calculating and using VaR can be achieved by following the process of risk management identified above. First, producers must identify the main sources of risks that will impact a financial measure of interest to the operation, such as operating cash flows or earnings. It is important to identify the main risks of the operation, those that may have the largest impact on the financial measure chosen. It is also important to identify and choose the risks that have the potential to be managed, such as price of hogs, feed inputs, and production. Producers must also identify a time horizon of interest, such as the six-month time horizon used in our example.

In a United States survey conducted by Patrick et al. in 2000, producers ranked fourteen different risks that affect income. The survey ranked hog price variability, changes in input costs, and production performance as 1, 5, and 7 respectively (**Table 1**). Although there were other risks identified, these risks are the ones used in the VaR calculations of this presentation due to their importance and potential to impact operating cash flow, their ability to be managed, and the large amount of information that is available with regards to how they have behaved historically.

Table 1. A Ranking of Risk Sources That Affect Income

Risk Sources that Affect Income	Rank of Importance
Hog price variability	1
Changes in environmental regulations	2
Disease in hogs	3
Market access	4
Changes in input costs	5
Changes in arrangements with those who purchase your production	6
Variability in performance of hogs	7
Changes in social or community acceptance of hogs	8
Changes in government programs	9
Changes in demands of management due to changes in structure and/or technology	10
Changes in attitudes of lenders	11
Possibility of an environment accident	12
Labour/personnel	13
Possibility of a contractor failing to fulfil the terms of the contract	14

Source: Patrick et al., 2001

Measure

Now that the individual sources of risk have been identified (hog prices, feed prices, and production variability), the distribution and the probabilities of each outcome's occurrence must be measured. This can be achieved by analyzing historical price data, such as that available from Alberta Agriculture, Food, and Rural Development, as well as historical production data such as the data collected when using programs such as PIG CHAMP.

Measuring the distributions of historical hog prices, feed prices, and production numbers allows us to determine how often each value has occurred and how widely the values have ranged. From the distribution we can then estimate the probability of how often we expect the values to occur, both within and outside the range of the historical distribution.

Once the probability of each risk source has been measured individually, the combined effect is measured. This is accomplished by using computer software to simulate thousands of input prices, hog prices, and production variables. The simulated prices and variables are then combined into an operating cash flow statement in order to measure the distribution and probability of expected cash flows. We are now able to obtain the final VaR measurement value, such as the one given in the introduction example. A diagram of this process is shown in **Figure 1**.

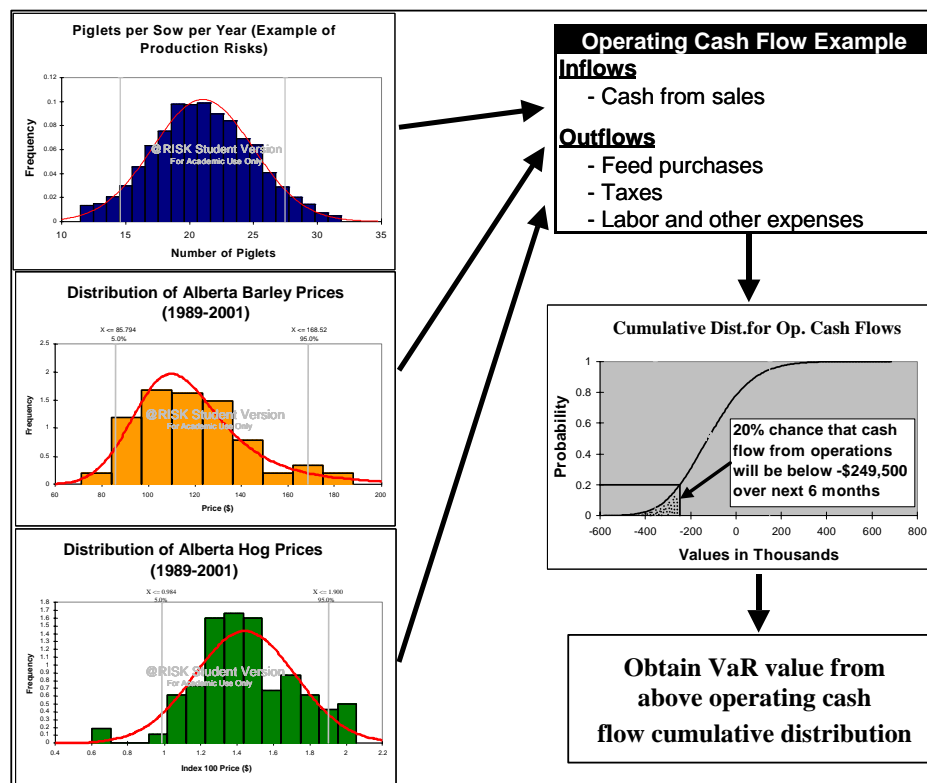


Figure 1. VaR Process

Manage

But how can the VaR information be used to manage risk? To explain this we will concentrate on hog and input price risks, and will ignore the management of production risks for the following examples. In the introduction example, where there is a 20% chance that the operation will experience a cash flow from operations below -\$249,500, it was assumed that all hogs sold and all feed

inputs purchased were at cash prices. Using the cash market will be referred to as the base case scenario because no price risk management strategies are used. Various risk management strategies are then added into the initial base case scenario. The effectiveness of each risk management strategy can then be analyzed by comparing the VaR measures from each risk management strategy to each other, and/or the base case. **(Note:** A 20% level and 6-month time period was used for this presentation, however, levels such as 5%, 10%, 30%, or 1 quarter, 1 year, etc, can be chosen, depending on what level or time horizon is of interest to the manager. Another approach would have the manager choose a dollar value that is of interest, such as -\$150,000, in order to determine the chance or percentage of falling below this value. **[Ex.** A manager feels that their operation can not withstand a loss to cash flow of -\$150,000 over the next 3 months, and the probability of this occurring is 13%])

■ Using Value at Risk to Choose the Best Risk Management Strategy

To demonstrate how VaR can be used to compare risk management strategies, a total of 6 different risk management strategies (including the base case) are evaluated and compared.

Strategy

- 1) Base case scenario where all hogs are marketed and feed inputs purchased at the simulated monthly market prices (cash prices).
- 2) Purchase 70% of feed barley using a hypothetical long-term agreement with a barley producer to store and deliver the barley for the price of \$131/tonne (Average barley price over last 20 years is \$114.97/tonne.)
- 3) Marketing 70% of finished hogs using a hypothetical window contract where the floor is \$1.29/kg and the ceiling is \$1.62/kg. (Average price is \$1.46/kg over last 20 years.) The remaining 30% of finished hogs are marketed at simulated market price (cash prices).
- 4) Marketing 70% of finished hogs using actual Western Hog Exchange (WHE) forward prices from January to June 2003 that were available December 30th, 2002. The remaining 30% of finished hogs are marketed at simulated market price (cash prices).
- 5) Combination of strategy 2 and 3.
- 6) Combination of strategy 2 and 4.

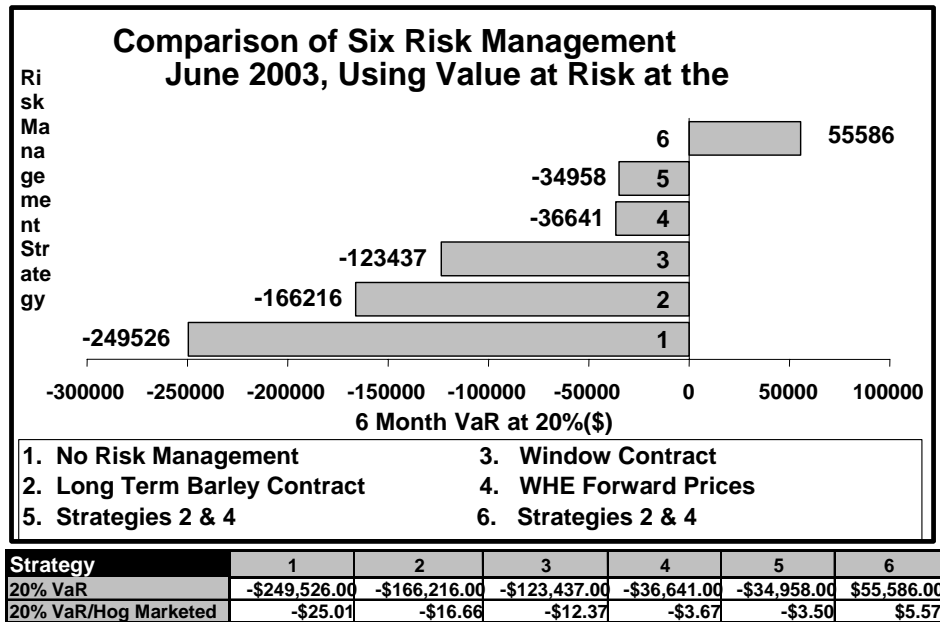


Figure 2. VaR Results for Six Risk Management Strategies

Looking at the 20% VaR from strategy #1 (base case) in **Figure 2** we are able to determine the level of downward risk that the firm's operation cash flow is exposed to when no risk management strategies are used. Comparing strategy #1 to #2 we can determine that the fixed price barley contract substantially lowers the 1 in 5 chance that cash flow from operations may fall below, from a level of -\$249,500 to -\$166,216 respectively. The use of either hog price risk management strategies #3 or #4 in our examples will reduce a larger amount of potential risk to operating cash flow than using the barley price management strategy (#2). This confirms the study by Patrick et al. (2000) where American producers identified output prices as a greater risk to income than input costs. Of strategies #2, #3, and #4, strategy #4 had the greatest risk reduction results for this specific instance for a 6 month time period, and was obtained using WHE forward price contracts.

Combining both a barley and hog price risk management strategy, such as strategy #5 and #6, reduced the greatest amount of potential risk. Strategy #5 is only marginally better than #4, however, #6 is substantially better than any other strategy, and actually reports that there is only a 20% chance that cash flow from operations will fall below a positive \$55,586.00 for the next six months. (*Note: The strategies found to be the most effective, such as #4 and #6, are only for this specific time period and are not representative of how effective they will always be. Other strategies may be better in the future,*

depending on cash prices, forward prices, other variables, and other available risk management strategies.)

■ **When Can Value at Risk be Used**

There are several ideal opportunities when VaR can be used. VaR may be very beneficial for an operation that is having liquidity problems and is approaching its capacity to obtain financing. For example, if an operation knows that it can only withstand a loss to their cash flow (or other financial measure of interest) over the next six months (1, 2 years, etc...) of XX dollars, then VaR can be used to help choose a risk management strategy that will greatly reduce the probability that the operation will experience a loss to cash flow (or other measure) below XX dollars.

Another potential use is when a manager has multiple risk management strategies to choose from, such as those shown in Figure 2, or when negotiating a price contract. Knowing the impact of choosing a strategy or negotiating a contract can be difficult. By including each strategy or potential contract into the VaR measure the manager can then see how each strategy, combination of strategies, or contract might change the operation's cash flow risks. This will help the manager to decide the best or most appropriate strategy or contract for their operation.

■ **How should Value at Risk be used**

It is important to remember that VaR is only one potential tool that can be used to help manage risks in an operation. There are many other risks that are not included in our example, such as changing government policy, environmental regulations, personal health, and so on. If considered to be very important to an operation, these risks and others may be included into the VaR, however, the potential effect that some of these risks could have may be more difficult to quantify and include into the VaR measure. Thus, it is important for managers to consider using VaR in addition to other risk management tools and methods currently in use by the operation.

One other important characteristic of VaR is that it does not deal with maximizing financial performance and choosing the most profitable contract or risk management strategy. VaR strictly focuses on managing an operation's downside risk. It is important to remember that partaking in risk management strategies often limits the upward potential of financial performance as well. Thus VaR should be used to manage or measure potential downside risk and not to choose the most profitable strategy.

■ Conclusion

VaR has the potential to be a valuable risk management tool for aiding managers in risk management decisions. First, it is a single value reported in dollars, making it easy to use and understand. Second, it has the capability of including important risks that managers believe are relevant to their operation and then measures the potential impact in financial terms. Third, managers can add risk management strategies into the VaR calculation that address the identified risks in order provide decision-making information. Finally, the VaR information can be used to help choose the risk management strategy that is most appropriate for the goals and objectives of the operation.

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