

A QUICK GUIDE TO TAX EFFICIENT INVESTMENT

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SUMMARY

- The volatility and correlation of stocks in a portfolio has a significant impact upon post-tax performance. Tax significantly alters a portfolios risk and return characteristics.
- Managers should manage the realised and unrealised capital gains of their portfolios. The decision to crystallise capital gains should only be done with the awareness of the taxation consequences of the decision
- Tax aware optimisers should be used to optimise tax aware portfolios
- Turnover is not a good metric for relating a portfolios pre-tax performance to its post-tax performance
- There is no such thing as a universal post-tax benchmark. Portfolios managed on a post-tax basis should have their performance measured against a benchmark portfolio which has the same starting period, cash flows and standardised accounting methods

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OVERVIEW

“The objective for taxable investors is to maximise post-tax terminal wealth. The goal is not to minimise tax payments but rather to produce the best after-tax returns”
(Peters 2003)

The aim of this paper is to provide a fast-track guide to the current state of tax aware investment research. It is not intended to be an all encompassing “how to” for fund managers to adopt and utilise in their systems and methodologies. Rather, this paper outlines some of the issues and highlights research undertaken in the field.

Historically, investment management has been undertaken in Australia on a pre-tax basis. In general, fund managers have been investing on the premise that the taxation circumstances of their clients were of a relatively minor concern. Investment mandates specify pre-tax benchmarks as the metric for performance measurement. Manager performance tables produced by asset consultants also use pre-tax performance to compare the performance of managers. So, for quite some time, tax has not been the focus for a considerable number of Australian fund managers.

Life is about to change. Morningstar have announced that they will be introducing a post-tax performance ranking by the end of this year. For the first time Australian fund managers will be ranked using a system that more closely represents an investor’s view of fund performance. As many readers will recognise, good pre-tax performance does not necessarily translate into good post-tax performance.

DIFFERENCES BETWEEN PRE-TAX AND AFTER-TAX INVESTING

Difficult and complex

Comparing the difference between pre-tax investment and post-tax investment is like comparing silent black and white movies to colour with sound.

Tax aware investment management adds a considerable degree of complexity to all aspects of investment management. The added intricacy means that it is significantly more difficult to perform well compared to pre-tax investment management.

Importantly, the investment management team must have a working knowledge of the relevant tax laws and be aware of the implications of those laws on the day to day investment operations. This means that the investment team must have a broader spectrum of expertise. The team must be aware of, and have access to, a finer degree of detail of its investment portfolios. It must also be aware of the tax implications of any intended changes to the underlying holdings.

The incorporation of the taxation aspects of an investment process into the operational procedures requires a high degree of integration between the front and back offices. A simple knowledge of the amounts of stock held is not enough to make informed decisions. Making tax aware investment decisions requires the decision maker or investment process to be cognisant of the details of all stock parcels held; when and at what price each parcel was purchased, when the likely sales are to take place and at what price, in conjunction with the overall portfolio objectives. These details are essential to determine a reasonable estimate of the capital gain the trade is likely to crystallise.

Increasing the post-tax wealth of clients poses a number of issues for the investment team. Does the client require income or capital gains? Can clients utilise the franking credits? For how long does the client intend to hold the investment? In a pre-tax world these are not big issues, but in a post-tax world they are of vital importance. When, if ever, will the portfolio be liquidated? This is important as it should bias the investment methodology used in relation to unrealised and realised capital gains. Do the clients have a broad range of tax rates or is the client base concentrated in a small band of rates? Managers have to be able to incorporate this type of information into the investment processes if their investment decisions are to match the investment objectives and requirements of their clients.

Unrewarded

Until recently, the primary focus of the majority of Australian investment management has been to maximise pre-tax returns. Tax aware investment management has generally been restricted to relatively small enhanced income products. In fact, trying to run a significant equity-based fund with the aim of maximising post-tax returns has been carried out in the knowledge that it has the potential to penalise the manager or institution in main stream rankings. Currently, no asset consultant group provides the means of comparing the relative post-tax performance of fund managers, nor is there any government stipulated requirement for funds to publish after-tax returns. Most equity-based wholesale investment mandates are measured against a pre-tax benchmark. It has, therefore, not been in a manager's interest to improve post-tax returns at the expense of pre-tax performance.

Why do it?

Given that managers are not ranked according to their post-tax performance, that asset consultants do not ask many tax related questions, that trustees do not demand that mandates ensure efficient taxation management and customers generally accept the status quo, why even consider it? Firstly, the performance of managers will be measured and compared on a post-tax basis in the near future¹. Due to the significant time lag involved in producing a credible investment track record, the earlier managers adopt post-tax investment methods, the greater the advantage they will have over the managers that delay. Secondly, since a significant proportion of fund investors pay tax, and that the ultimate aim of the investor is to improve their wealth, fund managers should take improving clients wealth as being their primary investment objective.

It is a well know phenomenon that private client funds are 'sticky', that is once a client has decided to invest with a manager the monies tend to persist with that fund manager, even through periods of less than stellar performance. There are a number of possible reasons for that loyalty other than performance; service standards, perceived status, access to market information, and forums; to name a few. However, the downside of this persistence is that once the clients' loyalty is tested and the client decides to change, then the manager has lost the client, probably forever. It is highly likely that the upcoming post-tax performance tables will be the trigger for many clients to take the opportunity to review their investments.

Post-tax reporting has been in place in the USA for a number of years. The US Securities and Exchange Commission adopted a ruling in 2001² that requires all mutual funds to disclose

¹ Morningstar has announced its intention to introduce a post-tax ranking system in Australia in late 2005.

² SEC RIN 3235-AH77 "Disclosure of Mutual Fund After-Tax Returns", April 16 2001
<http://www.sec.gov/rules/final/33-7941.htm>

standardised post-tax returns. The aim of the ruling was to improve tax disclosure to investors in a standardised manner. By standardising the calculation methodology, investors are given the opportunity to compare the performance of different funds in a fair and reasonable manner.

In Australia, a small but growing number of fund managers are publishing post-tax returns. As mentioned previously, Morningstar is planning to introduce a post-tax performance table in the latter half of 2005. Those that incorporate tax effective investment practices into their investment process early will be the clear winners in these rankings.

A considerable amount of research has been undertaken to investigate the impact of taxes on investment returns. Apelfeld's³ research in this area is illuminating. This study compared the performance of various investment strategies against a pre-tax benchmark, a pre-liquidation post-tax benchmark and a post liquidation post-tax benchmark. The results of the study indicate that, in general, tax aware investment strategies underperform tax unaware investment strategies when measured against a pre-tax benchmark. No surprises there. However, when performance is measured against a post-tax benchmark the tax aware investment strategies outperform. No surprises there either.

What is striking is the difference in performance between the two types of strategies. When measured on a pre-tax basis, the tax aware strategies underperform the tax unaware strategies by approximately 30 bps. More importantly, when measured on an after-tax basis, the tax aware strategies outperform the tax unaware strategies by over 200 bps. The disparity between these two figures is significant and noteworthy. Managers that incorporate the impact of taxes into their investment processes significantly improve the wealth of their investors relative to managers that do not.

³ Apelfeld et al (1996)

CURRENT INVESTMENT PRACTICES

Use of LIFO and FIFO

The use of the LIFO (last in, first out) and FIFO (first in, first out) algorithms for the allocation of trading parcels has its roots in pre computer days. Stock allocation is a difficult problem. Faced with having to provide a viable solution but without the means of calculating a particular answer, LIFO and FIFO provided the means by which the allocation of trades to holdings could be completed in a fair but not necessarily unbiased or optimal manner.

Whilst it is possible to justify the historical use of LIFO and FIFO, their continued use is open to question. Allocating the first or last parcel purchased bears no direct relationship to the level of capital gain, to any tax law or to the overall aims of clients. Given that in the very long term markets tend to grow, the use of LIFO is loosely related to allocating the parcels with the lowest gain and FIFO with the highest gain. But, that relationship is imprecise at best, and random at worst, in volatile markets. It would appear that LIFO and FIFO are still used for reasons that tend to be expedient.

LIFO and FIFO practices have been adopted in the past because they are easy to utilise as allocation methodologies and because the problem of allocating trades to holdings is computationally very complex⁴. With the advent of computers and the recent advances in allocation algorithms, there is now no reason to persist in using them. However, it should be recognised that even with the assistance of computers, it is only possible to completely evaluate all possible allocation combinations in the simplest of cases.

⁴ See Appendix for an introduction to NP problems

TAX EFFECTIVE INVESTING

An extra dimension

To be effective, the management of tax has to be an integral component of the investment process and not an after thought. What may be regarded as good investment practice in a pre-tax world can be extremely inefficient after-tax.

Use of FIFO and LOFO

The application of computer technology to deal with the problem of stock allocation has led to the use of methodologies such as FIFO (highest in, first out) and the lesser known LOFO (lowest in, first out)⁵. FIFO has the effect of producing a relatively low capital gain tax allocation. LOFO has the reverse effect.

These methodologies are a giant step towards actively managing the capital gains of a fund⁶. They allow the fund manager to choose between a high or low level of unrealised and realised capital gains in their funds. Whilst this style of allocation is still not best practice, it is a significant advance on the use of LIFO and FIFO.

Loss Harvesting

Stock loss harvesting is the practice of selling and repurchasing shares that have fallen below their original cost price. Where allowed, it can be a worthwhile exercise if the costs associated with executing the harvesting are low enough⁷. The process of methodically harvesting capital losses can provide a significant offset for capital gains in the portfolio.

Research undertaken in the US⁸ indicates that the use of FIFO accounting and loss harvesting increases the post-tax performance of a portfolio by an amount in the order of 40 to 50bps. Although differences between the tax laws of Australia and the US do not allow for the results of this study to directly translate into the Australian context, it might be expected that a comparable analysis in Australia would yield results with a similar order of magnitude.

⁵ See Appendix for a note on simple solutions

⁶ Berken & Ye (2003) and Chance (2003)

⁷ Dickson (2000), Grimblatt(2002) and Odean(1998)

⁸ Berkin & Ye (2003) and Chance (2003)

Benchmarks

Benchmarks take on a whole new meaning in a post-tax world. Pre-tax benchmarks can be utilised by any number of funds as a means of comparison. The most common benchmarks in use throughout the world are capitalisation indices. But, pre-tax benchmarks suffer from a number of problems when used as metrics for post-tax performance. After tax performance is extremely sensitive to significant cash flows and to stock holding periods. This is due to the influence of taxation law. Capital gains are subject to a number of different legislative adjustment methods which are period specific. Some periods are relative and others absolute. For example, holding a share parcel for a period greater than twelve months permits the manager to discount the capital gain by 50%. Likewise, a manager that sells a parcel of shares purchased before the 21st of September, 1999 has the option of applying one of two different capital gains discount methods.

Fund flows are a critical factor in determining post-tax performance. The most significant effect occurs when fund outflows force the crystallisation of capital gains at a time that may not be tax effective. Sizeable outflows have the potential to crystallise significant gains, which can have a detrimental impact on fund performance. Inflows to a fund have the potential to have a positive effect. The magnitude of this effect is dependant upon whether the manager invests in stocks already held or not. If the manager purchases unheld stocks, the tax position of the fund is not improved. However, if the manager purchases additional parcels in already held stocks, the effect is to provide the manager with greater scope for managing realised capital gains in the future.

The combination of tax law capital gains adjustments and fund cash flows reduce the effectiveness of pre-tax benchmarks as a means of comparing the post-tax performance of funds. For a post-tax benchmark to meet investment requirements⁹ as well as the taxation requirements, a post-tax benchmark must mimic the underlying fund starting point and cash flows as well as any underlying changes in the benchmark composition. The only way these conditions can be met is if a benchmark portfolio is used as the means of comparing fund performances.

A benchmark portfolio must have the same cash flows as the measured fund. Similarly it must also receive income from dividends and franking credits in a like manner. Accounting methods have a significant impact upon after-tax performance measurement. For an equitable comparison to be made between different portfolios, benchmark portfolios must utilise standardised accounting methods. There is no such thing as a one size fits all post-tax benchmark¹⁰.

⁹ Appropriate, unambiguous, specified in advance, investable and measurable

¹⁰ Price (2001)

From a practical perspective, post-tax benchmarks are actually benchmark portfolios, matched with the investment portfolio both in terms of front and back office practices. This additional complexity makes the comparison of performance of separate portfolios in a post-tax universe difficult. To make results comparable, standards must be set for determining the performance of the underlying benchmark portfolios. The standards must reflect the traditional aspects of index composition as well as the requirement to specify all back office procedures that impact upon after-tax performance. The adoption of common benchmark portfolio standards will allow for the relative performances of funds to be gauged and compared, even though this has limitations as a perfect solution.

Capital Gain Policy

Once the decision to manage a fund on a post-tax basis has been made, one of the most pressing questions that has to be answered is what to do with the capital gains¹¹. Unrealised gains carry a contingent future tax liability. However, accounting for that liability is difficult. What is the probability of the liability being crystallised? What are the likely market outcomes during the term of the fund? What is the possibility of a change in government policy? These questions raise a significant number of issues that impact upon the management of capital gains.

In light of this, the simplest way to manage these issues is to have a consistent capital gains policy, outlining the objectives and time horizon of the fund. To further ensure consistency, this policy should be aligned with the existing investment objectives and time horizon of the fund. For example, if the expectation of the manager is that the market will experience a downturn within the specified investment horizon, then it would make sense to minimise the realisation of capital gains during that period. As described above, the application of a simple FIFO and loss harvesting strategy, under these circumstances, can improve performance significantly.

Stock selection

Stock selection in a post-tax world is a complex subject that, if treated in depth, would require many research papers. This paper is not intended to cover the topic in any detail except to highlight that, in an after-tax world, stock selection requires the analyst to compare potential stock candidates in terms of likely capital gain, franking credits and dividends. The process of altering the composition of a portfolio requires the contemplation of the impact of realising capital gains on the performance of the portfolio.

¹¹ Poterba (2000)

Portfolio construction

A considerable amount of research has been undertaken in the field of post-tax portfolio construction. The work undertaken on single/multi asset portfolios indicates that construction for post-tax performance requires some rethinking of the conventional process.

Apelfeld¹² demonstrates that in order to maximise the post-tax performance, then a portfolio optimiser that is tax aware is required. The level of information necessary to optimise on a post-tax basis is significantly greater than for pre-tax optimising. The optimiser must have the appropriate functionality for the various tax adjustments required for different types of funds¹³. Stock information must include the date and purchase price for every parcel, along with the quantity, and the optimisation date must be specified in order for the optimiser to determine the appropriate capital gains adjustment.

A study by Brunel¹⁴ provides numerous insights into the constituents of a high tax efficiency portfolio. A four way comparison was considered, with portfolios constructed using a combination of highly and lowly correlated stocks and high and low volatility stocks.

The study procedure rebalanced the portfolios at the end of each year. The performance of the four portfolios is instructive. The worst performing portfolio, on a pre liquidation basis, was constructed from lowly correlated, low volatility stocks. The best performing portfolio was constructed from the highly correlated, high volatility stocks. The reason for the performance differentiation can be attributed to the greater volatility, which in turn provided more opportunity for loss harvesting. Brunel describes these opportunities as “free options”. The low correlation portfolio performance is interesting as, on a pre liquidation basis, the portfolio requires less annual rebalancing. Annual rebalancing, on a post tax basis, can be bad from a taxation perspective as it may crystallise capital gains that may not be offset. The net gains crystallised are lower for highly correlated portfolios. Fund managers should be very cognisant of the impact of realising capital gains and be aware of the consequential performance drag.

Turning to the post liquidation performance comparison¹⁵, Brunel found that the best performing portfolio was composed of negatively correlated, high volatility stocks. This test case forces all capital gains to be crystallised eventually, and the high volatility, negative correlation stock portfolio has the greatest number of embedded “free options” relative to all the rest. This result leaves tax aware fund managers and/or asset consultants with an

¹² Apelfeld et al (1996)

¹³ i.e. insurance, investment or superannuation funds

¹⁴ Brunel (1997)

¹⁵ The portfolios were rebalanced each year for ten years then liquidated

interesting dilemma. Firstly, utilising high volatility stocks in a portfolio improves post-tax performance. However, should a fund manager utilise low or high correlation stocks? If the manager expects that it will have control of the assets indefinitely, then utilising high correlation stocks will deliver better performance in the long term. But, if the manager has a relatively short horizon (say, 3 to 5 years) then it can better serve the fund beneficiaries by utilising relatively low correlation stocks in the portfolio.

The impact of turnover on portfolio performance has been addressed in several research studies. Unrealised capital gains can earn income indefinitely, whereas realised capital gains attract taxes which must be paid at the end of the financial year. This led a number of early research pieces to suggest that turnover in general is detrimental to fund performance and that buy and hold strategies would be best for good post tax performance. More recent research shows that this is not always the case. Apelfeld¹⁶ summarises the research by stating that turnover of itself is not detrimental to performance but superior results can be achieved by minimising **net** turnover. The work also suggests that portfolio managers have to quantify the tax consequences of turnover in conjunction with their risk/return calculations.

There has also been considerable work undertaken in the area of multi manager portfolios¹⁷. The examples used in this research indicate that a single core/multiple satellite approach can be very tax effective. In both examples, the core portfolio was managed in a passive but tax effective manner. Aggressive tax loss harvesting was utilised to reduce the impact of realised capital gains in the satellites. The results also indicate that the satellite portfolios should be devised so that there is minimal stock holding overlap and that each has a concentrated risk profile. Reducing the stock holding overlap between satellites tends to reduce the chance of one satellite buying stocks that another is selling and thereby reduces the unnecessary realisation of capital gains. Alternatively, the unnecessary realisation of capital gains may be reduced by having the core and satellite portfolios utilise a common back office. This functionality facilitates the transfer of stock between the various funds and assists in the reduction of unnecessary market transactions.

Risk assessment

The relationship between tracking error and risk is changed in a post-tax world¹⁸. Most countries allow capital gains tax losses to be offset against gains, which thus reduce the range of post-tax volatility. However, how that knowledge can be translated back into the portfolio construction process is unresolved at present. The optimal approach is highly dependant upon the starting point and holding period for each stock.

¹⁶ Apelfeld et al (1996)

¹⁷ Quisenberry (2003), Brunel (2002) and Stein(2001)

¹⁸ Apelfeld et al (1996), Peters (2003) and Stein (2000)

Stein's¹⁹ study of the tax consequences of tracking error shows that fund managers must be aware that a tax realisation/ tracking error trade off has to be made. Increasing the diversification of holdings reduces tracking error but incurs a tax penalty. Fund managers need to undertake a portfolio sensitivity analysis in order to determine an appropriate level of risk for their investment style and benchmark.

Use of derivatives

Derivatives can be very useful for improving the post-tax performance of a fund²⁰. They can be used to change market exposure whilst minimising the crystallisation of capital gains. Moverover they can be used to defer the crystallisation of capital gains and to alter the transaction price and possibly the amount of realised capital gains.

Hedging and/or the use of swaps are widely accepted investment tools whose utility greatly increases in a post-tax world. Managers can alter their market exposure using derivatives to gain the expected increase in performance without incurring a tax penalty. Obviously, the manager has to be aware that there is a trade off between the cost of implementing the strategy and the tax consequences. However, for a manager with significant unrealised gains it is one of the methods that could be very beneficial.

Derivatives can enable a manager to defer a gain realising transaction combined but achieve the desired market exposure. For example, if a manager wanted to sell a parcel of stock that had been held for eleven months, then selling it immediately in the market would incur maximum gains tax liability. However, if the manager can delay the sale so that the holding period is greater than twelve months, realised capital gains are reduced by half²¹.

Another useful way in which derivatives can be utilised to manage capital gains is to take advantage of the exercise price of the contract. For example, if a stock was purchased for \$10 eleven months ago and the current price is \$12. If the manager sold the stock immediately the trade would incur gains on \$2. However, if the manager bought a three month \$12 put option for \$0.35, thereby postponing the physical sell down but achieving the same economic portfolio exposure, the taxable gain on the stock would be \$1. Overall the gain on the stock combined with the loss on the put would give the manager an improved position of \$0.65.

¹⁹ Stein (2000)

²⁰ Brunel (2002) and Miller (2002)

²¹ Assuming that the fund is eligible for the discount

Portfolio Turnover

Portfolio turnover is another area of post-tax research that has received a considerable degree of attention²². Early work in this area²³ suggested that there was an inverse relationship between turnover and returns. However, more recent studies indicate that the relationship between turnover and returns is not particularly simple. Some researchers have generated results that show there is no relationship²⁴.

A simulation study by Means²⁵ demonstrated the impact of turnover rates on investment styles. The results indicated that any style with very high levels of turnover (>200%) cannot achieve high levels of tax efficiency. Although the study was undertaken using US tax laws, it is of interest to Australian managers as US law differentiates between short term and long term gains in a manner similar to Australian law. A key result from the study is that when fund managers adopt investment styles with low to medium turnover (25% - 50%) very high levels of tax efficiency can be achieved. These levels are comparable, if not better, than those attained with buy and hold investment styles.

Another paper²⁶ used the analogy of cholesterol to illustrate the effect of turnover on portfolio post-tax performance. "There is good, and there is bad. Good turnover is the harvesting of losses and the early realisation of positions that have losses. Bad turnover is the selling of gains and the early triggering of capital gains tax liability."

Dickson and Peterson's²⁷ examine the influence of fund flows on the overall post-tax performance of the fund. Their studies show that a fund that experiences significant redemptions will crystallise capital gains, causing the fund to under perform on a comparable post-tax basis. Alternatively, a fund with significant inflows will provide the manager with the potential to achieve an improved post-tax outcome.

²² Means (2002), Petersen et al (2002) and Poterba (2000)

²³ Arnott and Jeffrey (1993)

²⁴ Peterson et al (2002)

²⁵ Means (2002)

²⁶ Poterba (2000)

²⁷ Dickson et al (2000) and Peterson et al(2002)

CONCLUSION

Portfolio management on an after-tax basis is complex and difficult relative to pre-tax. Investment management teams require more detailed information and greater levels of co-ordination between the front and back offices. Investment decisions and back office practices have far more significant impacts upon the degree of capital gains realised and subsequently investment performance.

The decision to realise capital gains or not takes on increased significance in an after-tax world. At the very least, the realisation process should be managed in such a way as to minimise the net capital gains realised and to minimise the impact of the capital gains on investment performance.

Performance measurement benchmarks become highly complex when taking tax into account. In practice, benchmark portfolios are required as the basis for assessing investment performance. Benchmark portfolios allow for the complex influence of accounting standards and cash flows to be taken into account when gauging performance and as such facilitate a more thorough measure of the capability of a fund management operation.

Investment practices that are designed to incorporate tax effects are shown to significantly improve investor wealth over those that do not. The use of FIFO and loss harvesting alone improves after-tax performance by around 50bps. Studies of investment performances in the US indicate that when measured on an after-tax basis, tax aware managers outperform tax unaware managers by approximately 200bps per annum. This is indicative of the likely quantum of saving that might be achieved if a similar study were conducted in Australia.

The investment practices reviewed and results described within this paper have the intent of providing fund managers with an insight into the research and investment practices being undertaken in this field. The many excellent papers provided in the reference section below are recommended for anyone that wishes to gain a greater understanding of the topic.

APPENDICES

NP Problems

What is a NP problem

Within the range of all possible problems, the class of problems known as NP lies on the border between the impossible to compute and the possible.

In terms of computational complexity, non-deterministic polynomial time (NP) problems are a set of decision problems that are solvable in polynomial time ($O(n^k)$) on a non-deterministic Turing machine.

What this means in plain English is that problems belonging to class NP are very complex. That complexity is such that it is not possible to know if the best solution derived so far is optimal. Given that there will always be universal constraints upon time and computational capacity, the best that can ever be hoped for with a NP problem is for a good solution. There is no such thing as a perfect answer to an NP problem, only good, or best so far, solutions.

The classic problem used as an example is the travelling salesman problem. Given a number of cities and costs for travelling between each city, what is the cheapest round trip that visits each city once and returns to the point of origin?

Another well defined NP problem is the knapsack problem. From a set of items, each with a cost and value, choose a subset so that the total cost is at or below a certain amount and the total value is as large as possible. The stock allocation problem is a form of knapsack problem.

Simple Solutions

"For every complex problem there is a simple solution ... and it is wrong"

Henry Louis Mencken (1880 - 1956) , George Bernard Shaw (1856 - 1950)

Greedy Algorithm

It is possible to derive a solution to an NP problem that will be adequate. For example, in the travelling salesman problem, you can simply visit each city in sequence and return to the point of origin. This is a solution, but most likely not a good solution. Similarly, for stock allocation problems, solutions given by using methodologies such as FIFO and LIFO produce valid results. The problem with FIFO and LIFO is that the results produced are (usually) not very good.

The “Greedy Algorithm” is a reasonable methodology to produce solutions to difficult problems. This algorithm is a step by step method that picks the highest (or lowest) value pieces of the solution for each iteration of the algorithm. Whilst this methodology is not guaranteed to produce good results for every problem, it can produce good results in many cases. FIFO is an example of a greedy algorithm.

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