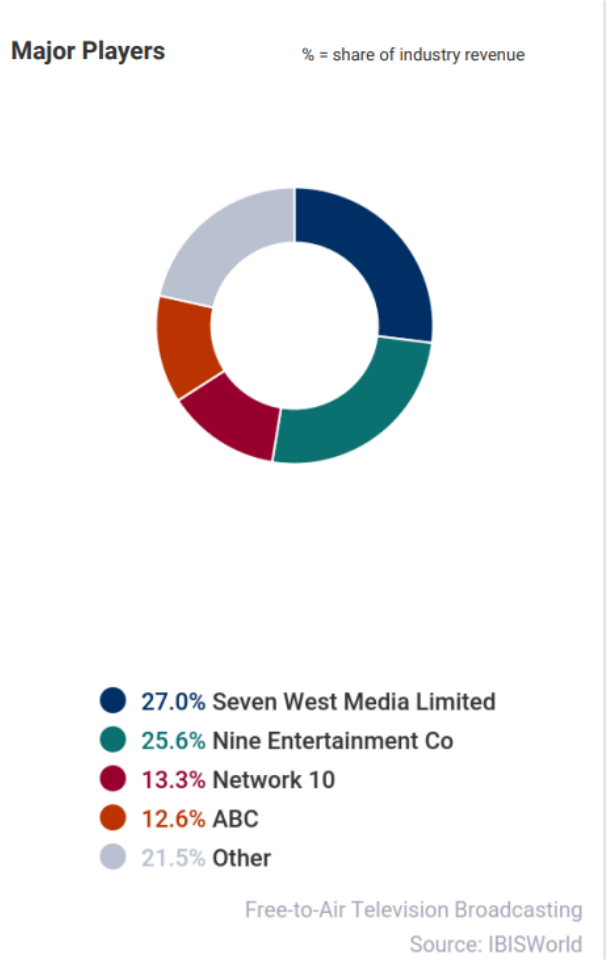
Question 1. Free-to-Air Television Industry Characteristic

Following answers assume that "the television industry" in the question referring to the Free-to-Air television industry.

Following are the 5 key characteristic of the television industry that is relevant to this share price analysis:

1. Major players in the television industry also have business activities in other industries.



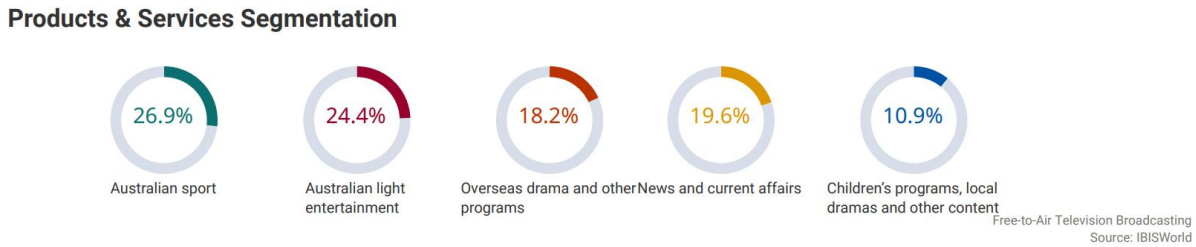
For example, the biggest player in this industry Seven West Media Limited's parent company, the Seven Group Holdings Limited also has significant involvement in Industrial Services & Energy sector.

And the second largest player, Nine Entertainment Co owns >50% of the share of Domain Group, which is not directly relates to the television industry.

Thus, there are many factors other than the tweets can have influences on the share price of SEV and NEC. The fact that we are did not take account these factors to explain the price movement could undermine the effectiveness of our model and analysis.

In addition, between SEV & NEC, NEC's television business accounts for higher percentage of its business. Thus, for the rest of the modelling and analysis, we will focus on the NEC only, as its business is less diversified, and thus less likely to be impacted by factors that is not accounted for in our analysis.

2. Products & Services Segmentation



As shown from the graph above, these are the 5 major types of show the Television industry produces. These categories could be helpful in terms of predicting the share price movement. For example, "News and current affairs" can have stronger impacts on share price comparing to "Children's programs" since news tends to have a greater social impact.

In addition, these labels can help us evaluate the quality and characteristic of the clusters from unsupervised learning. Thus, we have manually labelled the twitter accounts at interests with these categories and used them as part of the features for modelling and clustering exercise.

3. Increasing Emphasis on Time-Sensitive Program

Due to the recent trends of increasing demand of SVOD (Subscription Video on Demand), and the increasing rate of NBN roll out, simply broadcasting the traditional dramas on free-to-air television channels can no longer effectively attract audiences.

Thus, the networks have changed in their strategy and focusing on broadcasting time-sensitive programs such as Live Sports & News, which loss its values after being aired for a period of time. Program with this time-sensitive nature is very hard to be replace by SVOD, and thus worked well in terms of attracting customers and maintaining a high rating.

Based on this piece of information, we should expect that tweets from Live Sports and News type of programs have a stronger link to the share price movement than the programs from other categories.

4. A Zero-Sum Game

The number of audiences watching free-to-air television is declining in the past few years, especially among the younger audiences. And the audiences can't watch more than 1 channel at the same time, that means highly rated program will not only attract more audiences and increase advertisement revenue, but it can also reduce the advertisement revenue of its competitor.

Thus, the players in this industry often compete for content rights and right to broadcast, the ability to broadcast a program with high potential rating can largely increase the value of the network.

Thus, it likely that the tweets from Nine Network's programmes will have a positive corelation with its share price. On the other hand, the tweets from Seven Network's programmes will have a negative correlation with the share price of Nine Network.

5. COVID-19 Impacted Negatively on the Television Industry

Advertisement revenue is one of the major sources of profits for the players in the free-to-air television industry. However, the economic downturn caused by the COVID-19 pandemic leads to a significant drop in demand from advertisers in 2019-20, and the profit margins has fell significantly as a result.

However, Industry profitability is anticipated to recover in the current year as economic activity continues to recover from disruption caused by the pandemic. For this reason, we should expect that COVID related tweets are more powerful in terms of its linkage with the share price movement than other types of tweets.

In addition, the timing of the tweets can also make a difference, if the tweet was posted during 2019-2020 when COVID pandemic just started to hit Australia, then it likely to that the news carry a negative sentiment, and thus potentially will leads to a fall in share price.

On the other hand, if the tweet was posted during 2021 as Australia recovered from COVID pandemic, then it likely to that the news carry a with positive sentiment which can leads the share price to increase.

Reference list:

Chapman, W., 2021. AU INDUSTRY (ANZSIC) REPORT J5621 Free-to-Air Television Broadcasting in Australia. *IBIS World*, June 2021.

Question 2. Legal Considerations

The trading strategy is developed based on the tweets, thus it's important to ensure that we have used it in a way that is comply with the twitter's developer policy.

Overall, there are 4 key rules that are relevant to our purpose:

No Pay to Engage

The developer policy of Twitter API requires the service (our trading strategy) does not incentivise people to take actions on Twitter, and the possible actions include but not limited to, Tweets, follows, unfollows, retweets, likes, comments, and replies.

Thus, it's important to ensure that the Nine Network and any monitored users does not find out about the details about our trading strategy. Otherwise, if they have realized that their tweets can influence the share price, then it is possible that they could be incentivised to post certain type of tweets to influence the share price to move in particular direction that would benefit them, which is not only violation of the Twitter API's developer policy, it could also potentially reduce the effectiveness of our trading strategy.

One way to reduce the risk of violation of this rule is to ask all the relevant stakeholders to sign a confidentiality agreement about this trading strategy.

Content compliance

Twitter API's developer policy has clearly stated that, any Twitter contents that have been stored offline must be kept up to date with their current state on Twitter.

And since our trading strategy is constructed based on the tweets that we have collected from Twitter API and stored offline, we are subject to this rule.

Specifically, we will need to set-up the following automated process:

1. Firstly, we need a process to monitor the modifications that has happened to the historical tweets that we have collected. According to the developer policy, if we got notified about the modification from the users or Twitter management, we will need to make the corresponding deletion / modification within 24 hours after the notification, thus it would be reasonable to set the monitoring interval as every 24 hours.
2. Then, if we have detected any of the historically collected tweets have been deleted / modified, we can then set up an automated process to apply the same changes to the offline contents that we have collected.
3. Lastly, we will also need to set-up a process to automatically delete the collected offline contents that has lose its relevance. By doing this on a regular basis, we can reduce the number of historical tweets that we will need to monitor and hence reduce computation cost and run-time of the process.

Off-Twitter matching

Off-Twitter matching involves associating Twitter Content, including a Twitter @handle or user ID, with a person, household, device, browser, or other off-Twitter identifier. Such process might be carried out by us if we are interested in obtaining and analysis more data that are associated with the Twitter users at interest to improve the accuracy of our trading strategy.

However, according to the developer policy of Twitter API, in order to carry out off-twitter matching, we will need the express opt-in consent from the person before making the association, which is not possible since by doing so, we will be at risk of violating the “No Pay to Engage” rule.

Although without the opt-in consent, we can still attempt to match our records about someone to a Twitter identity based on following data:

- Information provided directly to you by the person.
- Public data.
- Information on Twitter about a person that is publicly available, including Tweets, Profile information, account bio and publicly stated location, Display name and @handle.

Twitter performance benchmarking

As part of the implementation, we might want to measure the stability of the process that we are going to implement, and which may involve measuring Twitter API’s availability, performance, functionality or usage of Twitter, however such action is prohibited by Twitter API’s developer policy, thus the stability of the process has to be measured indirectly from other metrics.

In addition, during feature engineering process, the analysts could have generated aggerated statistics (such as the total number of Monthly Actives or Daily Actives) of the tweets data and fed them into the model as one of the model features, which might be a violation of this rule as such aggregated metrics is a type of usage data.

Thus, it is important to this clear to all relevant analysts about the existence of such rule, even if the use of such aggregated metrics could improve the accuracy of the model.

Question 5. Potential Risks

Key Risks (a)

1. Implementation Risk

Mistakes can be made during implementation of the strategy, and such mistakes can turn the winning trading strategy into a loss-making one. To reduce the possibility of this risk, robust testing should be done in the testing environment prior productizing the trading strategy.

2. Wrong Assumptions

Following assumptions was made as part of the model construction process:

- When the buy / sell actions are triggered, the share price remained unchanged from the opening price of the 10-min interval it belongs to.
- The brokage fee of any one buy / sell action is 5 basis point of the transaction value.

The first assumption is unlikely to be true, but since the share price data that was given to us is in the 10-min interval, such assumption is the best we can do, but if such assumption turns out to far from what is actually happening in the market, then we could be making a loss from this strategy.

For the second assumption, brokage fees of 5 bps are very typical among the active funds, however if the brokage fee turns out to be significantly higher than that, then we are at risk of making a loss from this strategy.

3. Environment and Distribution Shift

Overtime, the market may react differently to the tweets, and assumptions that we have made are no longer true, there is no guarantee that short-term success can last forever. Thus, it's important to monitor the performance of our strategy overtime, if needed, we should make appropriate adjustments to the model / strategy in a timely manner.

Implementation Consideration (b)

Following are the things that were not consider during the model building process, and they needed to be considered during implementation.

Frequency of monitoring

During the model building phase, the tweets data have been collected retrospectively via Twitter API. However, going forward, we will need to collect the tweets data in real-time with a pre-defined frequency e.g. monitor and collect any new tweets from the users every 1 min / 1 s / 1 ms.

Generally speaking, the faster the frequency of monitoring, the faster we can trigger the trade action from the time the tweets were sent, and the more profits can be generated from such trade. However, the marginal benefit from monitoring tweets in 1 ms vs 1 s might not be able to justify the additional computation resource that is required, so to maximize the profit, we should pick the monitoring frequency at equilibrium e.g. marginal benefit = marginal cost.

Cloud Computing vs On-Premises Computing

To execute the trading strategy, we will need computation resources to run the process and storage space to store the data. These resources can be obtained either rent from a cloud service provider or purchase directly and stored on-premises, each of them has their own pros & cons, we should consider them carefully before committing to either one / a hybrid of them.

Costs

On-premises computing will require higher up-front investment costs for setting up the required IT infrastructure, while cloud computing much cheaper to set-up as the cloud provider have already set-up most of the required IT infrastructure.

The downside of cloud computing is that it operates in a PAYG model, which can lead to higher on-going operational cost as all computation has a price to it. Whereas on-premises computing will only cost you electricity cost plus the rent for storing the server once you have bought the server.

Thus, if our firm has already heavily invested in on-premises computing, then we should leverage that as much as possible before considering the cloud computing option.

Privacy & Security

Generally speaking, on-premises computing offer greater security as the physical server owns and runs by the company itself, thus the company has greater control on the level of the security. However, depends on the scale of the company, they might not be able to afford setting up another data centre to store the synchronized back-up of the data. And even if they could do that, the choice of location might be limited, so they might be expose to concentration risk if the two data centres located closely to each other.

On the other hand, the cloud servers sit in the data centres of the cloud provider, which are scattered around the world with multiple synchronized copies, thus even small companies with limited budget on IT infrastructure can enjoy high availability & synchronized copies with cloud computing.

Scalability & Availability

Another thing that should be consider is that Cloud computing generally a lot easier to scale. Computing power and storage space can be scaled up / down within minutes with minimum downtime. While on-premises computing may require someone physical turn-off the servers, unpack it, put in the additional CPU / Storage, put it back together, and turn it back on. And because of that the downtime can be significantly longer than the cloud computing.

Algorithm / Strategy Scalability

Algorithm scalability indicates how quickly the required computing resource would increase as the input data to the process grow. Algorithm scalability is crucial as if the trading strategy turns out to be very profitable, the fund is likely to expand such strategy into sectors other than television network, and more funds will be flowed into such strategy, and more twitter users will need to be monitored.

Thus, if we need to ensure both computation cost and run-time scale linearly or sub-linearly as the # of Share / Users monitored increase, otherwise the required computation resource would grow quickly to an unsustainable size.

In addition, the strategy scalability should also be considered, as the fund under management increase to a certain size, trading action would disrupt the share price as it executed, so the strategy will not be as effective as before. In that case, an exit strategy will need to be carefully designed to maximize the profits.