News Sentiment Analysis Using R to Predict Stock Market Trends

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Motivation

- It's well known that news items have significant impact on stock indices and prices.
- Lots of previous work on finding sentiment from static text using Text Mining and NLP techniques.
- We analyze news items for sentiment using dynamic data sources – such as online news stories and streaming data such as blogs.

R Resources for Financial News

- R allows real-time news gathering using:
  - tm package
  - tm package plugins:
    tm.plugin.webmining
    tm.plugin.sentiment
  - XML package

- Allow financial news to be aggregated using sources such as Google Finance, Yahoo Finance, Twitter, etc.

R Resources for Financial News

- Creating a corpus using Google Finance:

```
> corpus <-  WebCorpus(GoogleFinanceSource("AAPL"))
```

- Returns a corpus of documents with several useful attributes:

- Time Stamp (Filter out old stories)
- Heading (Find breaking news)
- Short Description (Check if it's relevant)
- Author (Authority?)
- Source (Reliable source?)

Types of Corpuses

Three types of text corpuses are constructed from the news articles:

- Construced from Filtered Sentences
- Construced from just the Headlines
- Constructed from the Short Description Attribute

Extracting Relevant Sentences

- Our approach filters the news articles to only those sentences which contain the stock symbol.
- Instead of tagging the entire news story, we focus only on relevant sentences.

Apple Inc. (AAPL) sank 2.8 percent, the most since October, to $605.23. After rising to a record on April 9, the most valuable technology company fell for a fourth day in the longest losing streak since December.

Coinstar Inc. (CSTR) surged 7.3 percent to $65.78. The owner of the Redbox movie-rental kiosks said first-quarter sales and profit exceeded its previous projection and lifted its earnings forecast for 2012 to at least $4.40 a share.

Both snippets are from same article:
http://www.bloomberg.com/news/2012-04-13/u-s-stock-index-futures-decline-as-china-s-growth-slows.html

Filtered Sentence Corpus

- Used R package openNLP to break the corpus into sentences.

```
>stock ← “AAPL”
>sentences ← sentDetect(corpus)
>filteredSentences ← sentences[grepl(stock,sentences)]
```

- Filtered sentences more likely to contain company specific news, analysis, and predictions.

Headlines & Description Corpus

- WebCorpus allows us to look at the headlines.

```
> sapply(corpus,FUN=function(x){attr(x,"Heading")})
```

- Corpus items have a “Description” attribute

```
> stock ← “PCLN”
> desc ← sapply(corpus,FUN=function(x) { attr(x,"Description") } )
> filteredDesc ← desc[grepl(stock,desc)]
```

filteredDesc contains stock specific current news.

Identifying Polarity of Words

- Used following sources to create list of "sentiment" words:

1. Multi-Perspective Question Answering (MPQA) Subjectivity Lexicon
   http://www.cs.pitt.edu/mpqa/subj_lexicon.html

2. List of sentiment words from R package tm.plugin.tags

3. List of sentiment words from Jeffrey Breen's tutorial
http://jeffreybreen.wordpress.com/2011/07/04/twitter-text-mining-r-slides/

Scoring Text Corpus

- An instance (sentence, headline) is positive if the count of positive words is greater than count of negative words and vice versa.

For example, the sentence:

"AAPL continues its phenomenal run"

is a positive sentence as count(positive) = 2 and count(negative) = 0

"Cracks develop in PCLN"

is negative heading as count(positive) = 0 and count(negative) = 1

Scoring Text Corpus

- For an entire corpus, we count the positive and negative instances and compute the score as:

Corpus Score = Positive instances / Total instances

- Three types of Corpus Scores:

1. Sentences Corpus Score
2. Headlines Corpus Score
3. Short Description Corpus Score

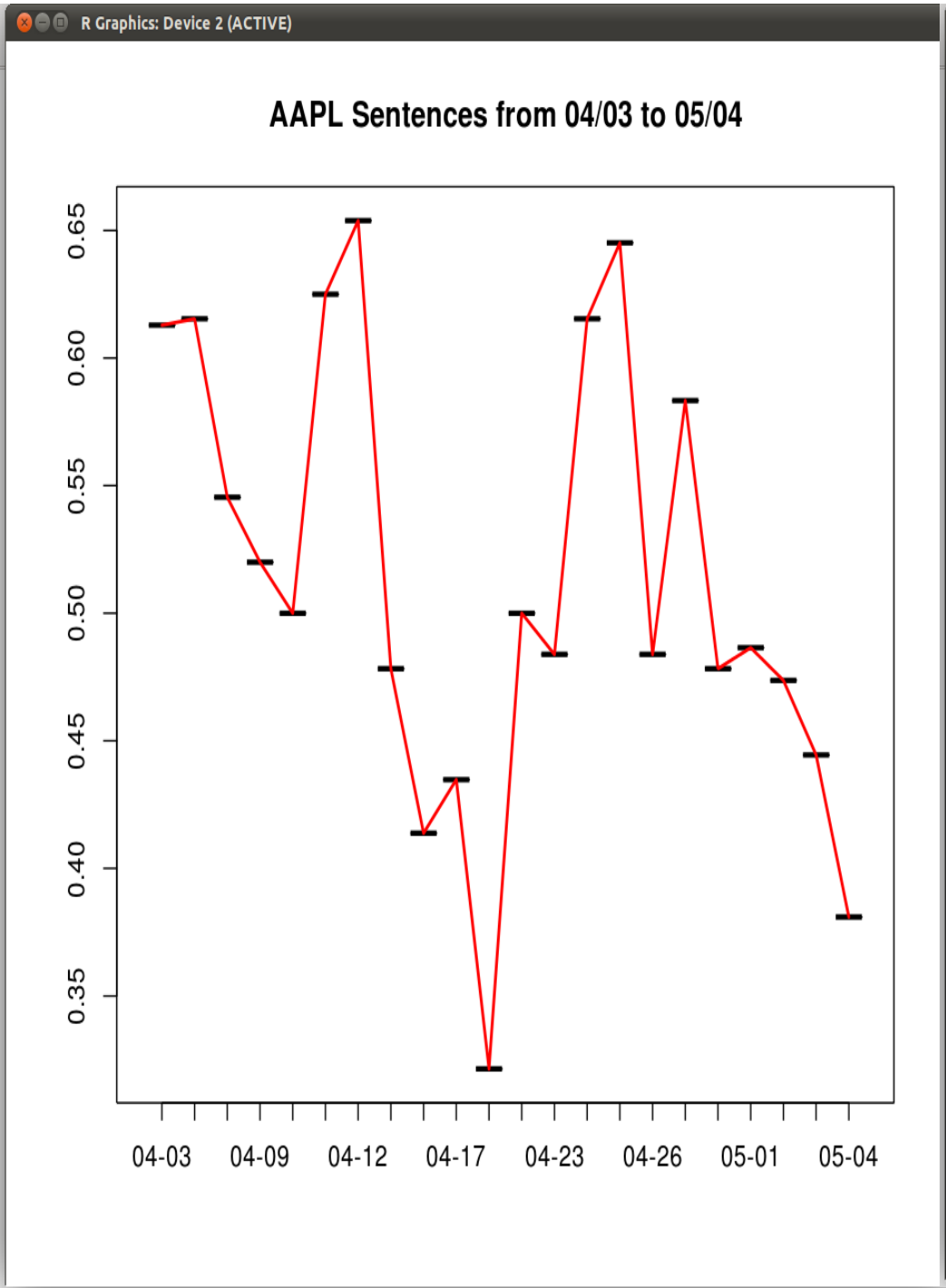
Scoring Text Corpus Code

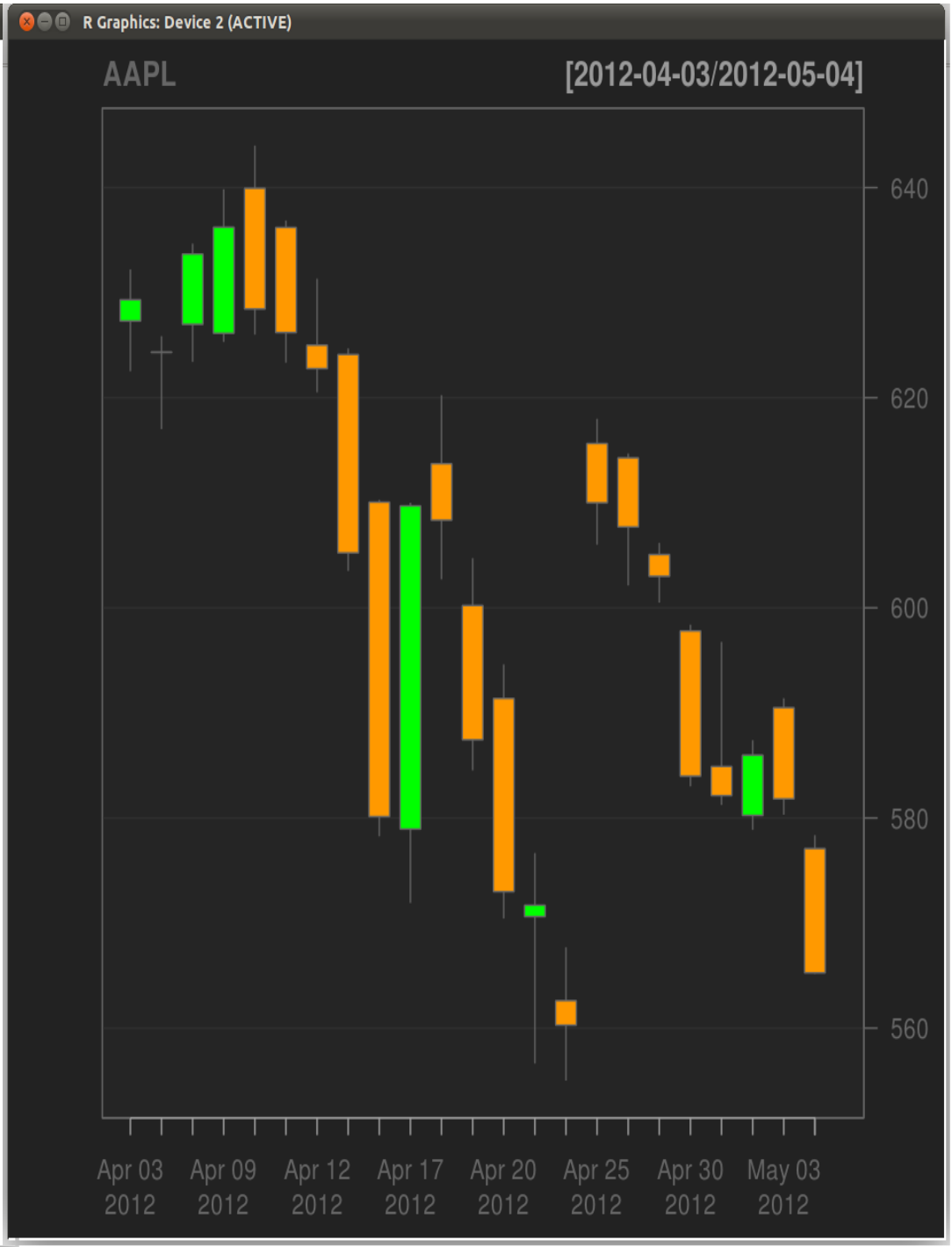
```
# text is from the news, pos and neg are positive and negative word lists
    scoreCorpus <- function(text, pos, neg) {
        corpus <- Corpus(VectorSource(text))
        termfreq_control <- list(removePunctuation = TRUE,
                    stemming=FALSE, stopwords=TRUE, wordLengths=c(2,100))
        dtm <-DocumentTermMatrix(corpus, control=termfreq_control)
        # term frequency matrix
        tfidf <- weightTfIdf(dtm)
        # identify positive terms
        which_pos <- Terms(dtm) %in% pos
        # identify negative terms
        which_neg <- Terms(dtm) %in% neg
        # number of positive terms in each row
        score_pos <- row_sums(dtm[, which_pos])
        # number of negative terms in each row
        score_neg <- row_sums(dtm[, which_neg])
        # number of rows having positive score makes up the net score
        net_score <- sum((score_pos – score_neg)>0)
        # length is the total number of instances in the corpus
        length <- length(score_pos – score_neg)
        score <- net_score /length
         return(score)
    }
```

Results

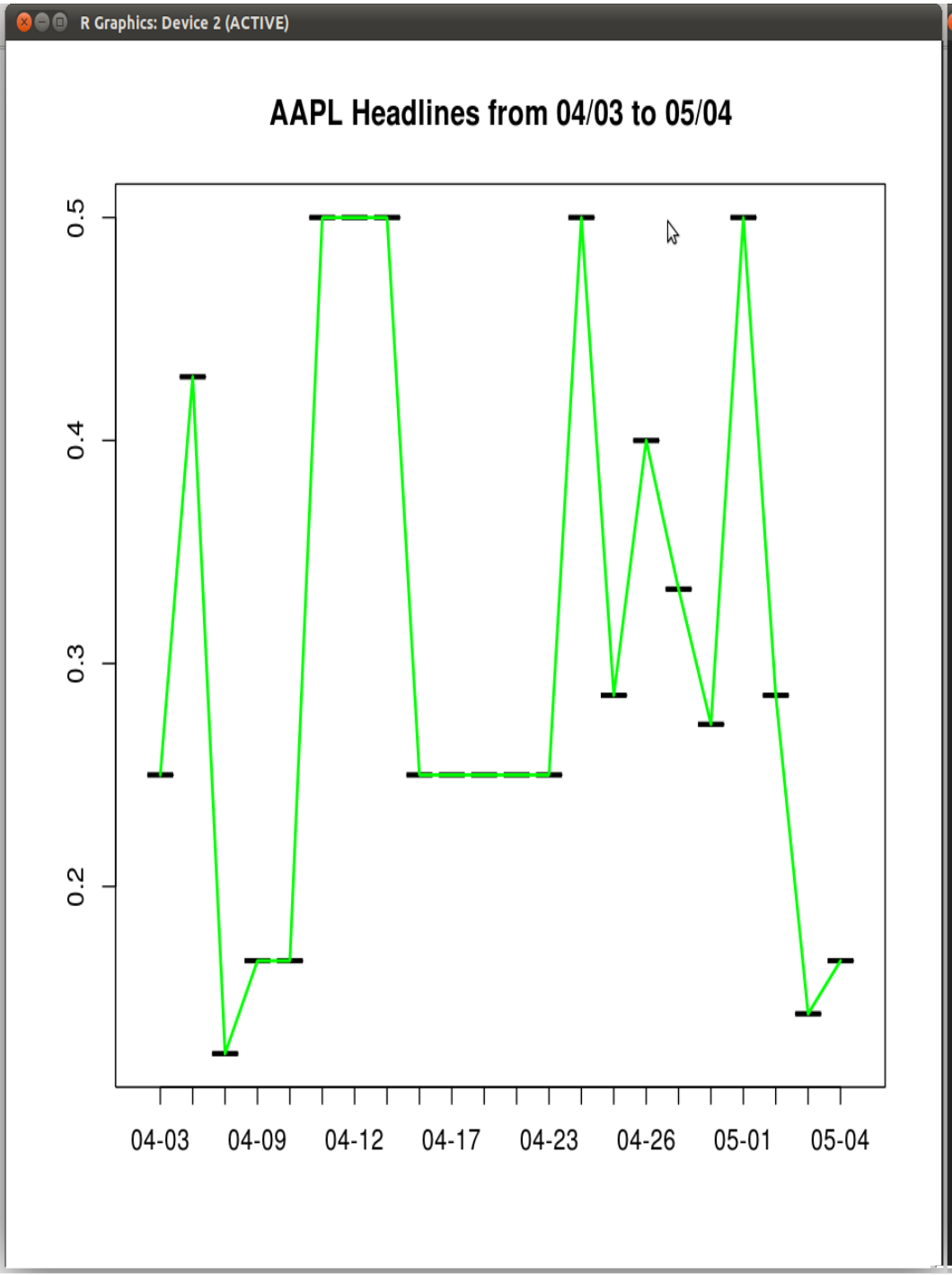
- Next slides will compare Sentiment Score trends with Stock Price movement for Apple Corp (AAPL).
- Note the similarity in the shape and trend of the curves.
- Sentiment scores are able to predict the movement of stocks quite accurately.
- Sentence Sentiment scores are often more accurate because of the larger sample size.

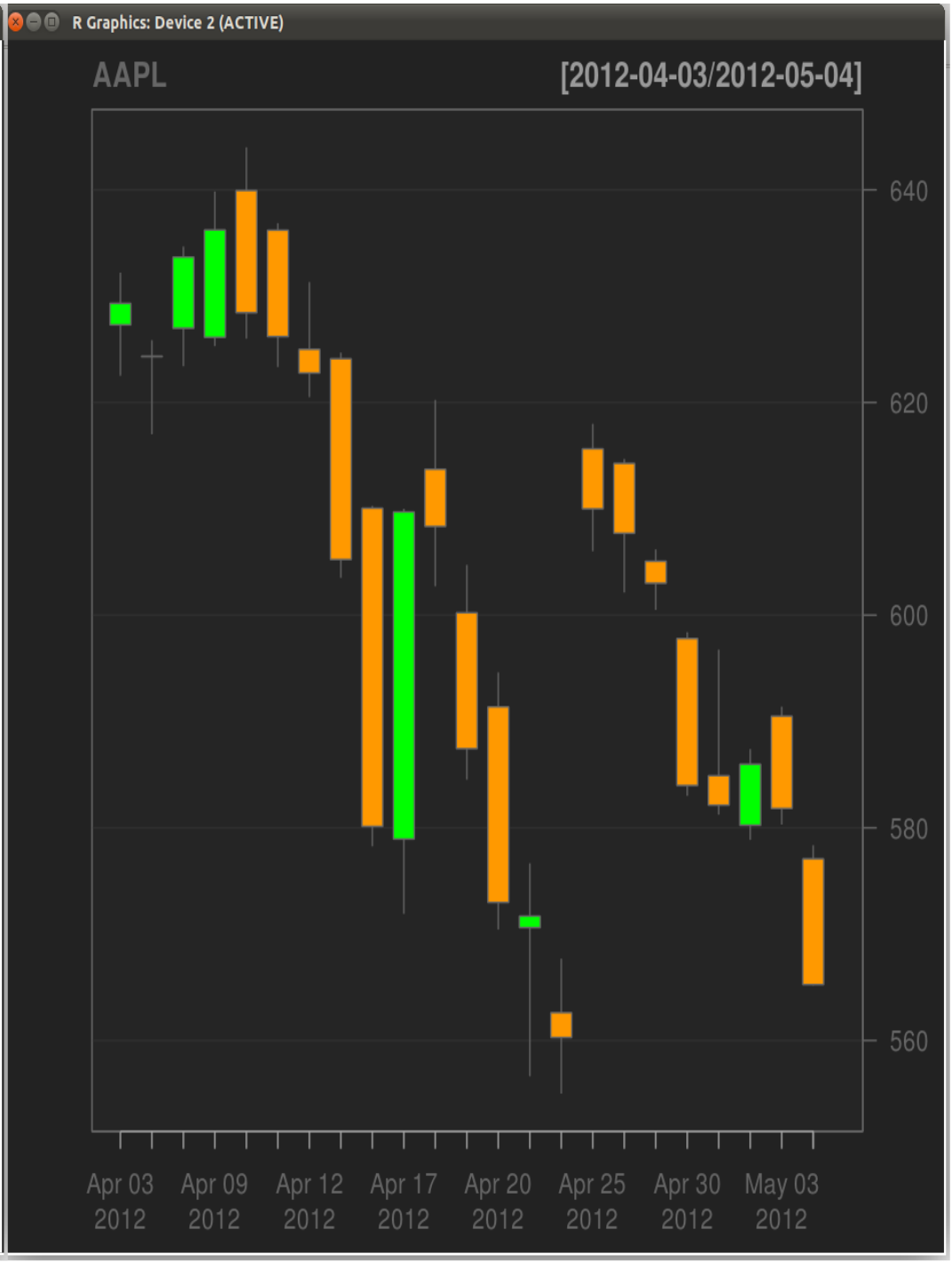
Results – AAPL Sentences vs Stock



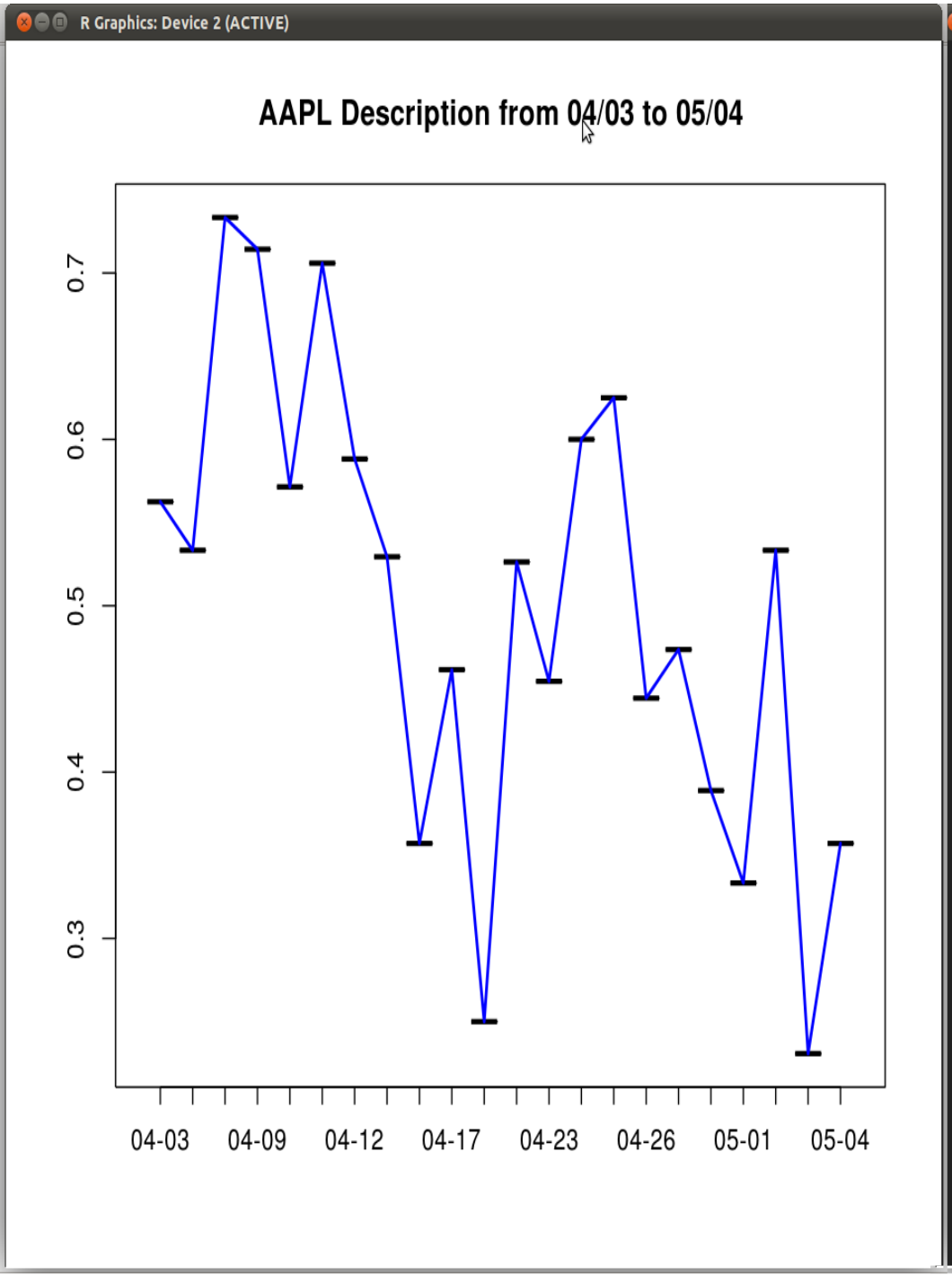


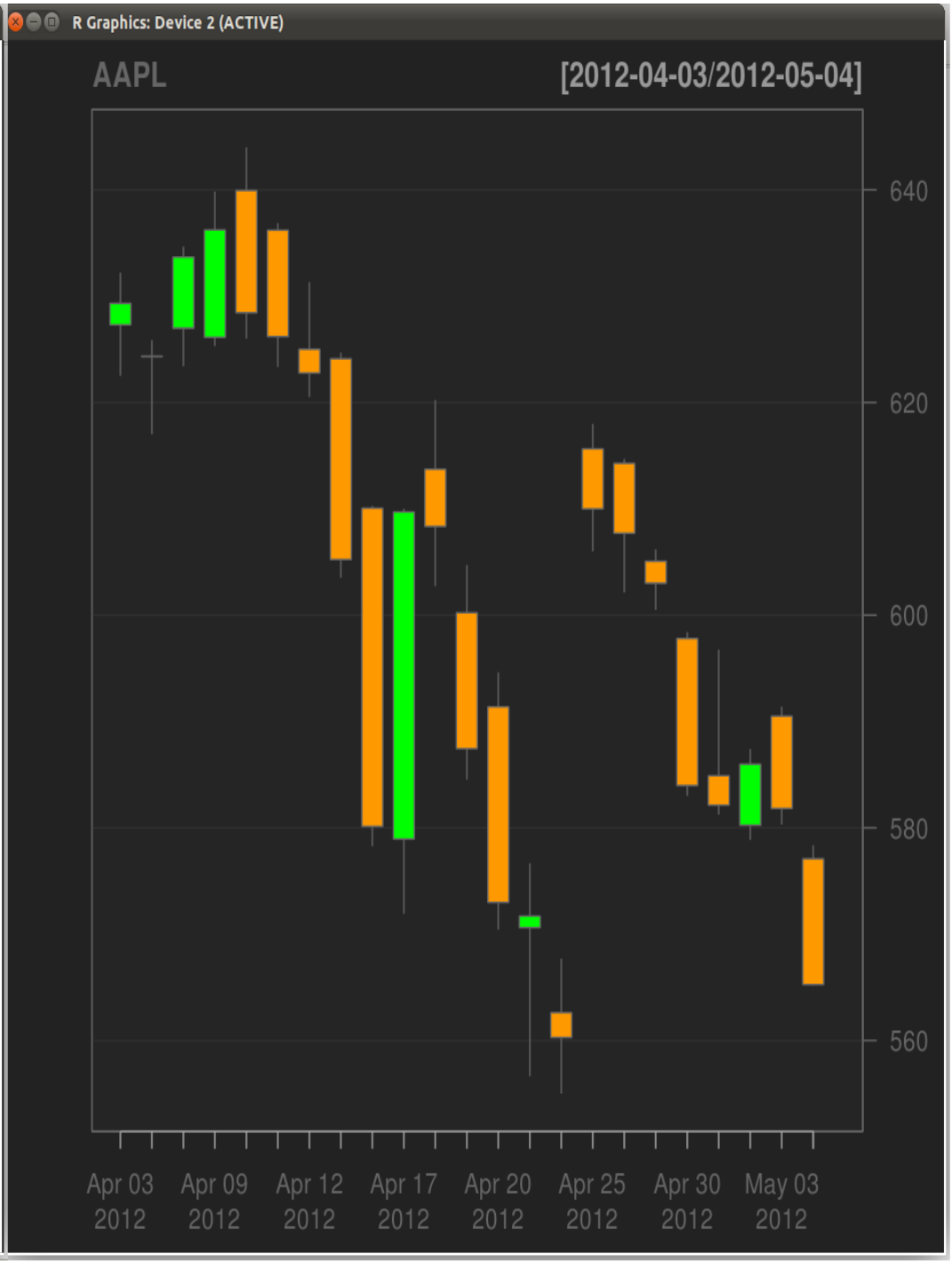
Results – AAPL Headlines vs Stock





Results – AAPL Description vs Stock





Discussion

- Strong visual correlation between stock price movement and News Sentiment Score.
- Accuracy can be further improved by incorporating stock market specific terms into the tagging scheme.
- This scheme can be used along with other techniques to provide a very strong indicator of stock market movement.

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