Historical approach to estimating the volatility parameter

In [9]:
```
library("tidyverse")
library("lubridate")
```

```
Attaching package: ‘lubridate’


The following objects are masked from ‘package:base’:

    date, intersect, setdiff, union
```

In [54]:
```
MSFT_orig <- read_csv("StockPrice.csv")

MSFT <- MSFT_orig

MSFT <- MSFT %>% mutate(Date = dmy(Date))
```

```
── Column specification ────────────────────────────────────────────────────────
cols(
  Date = col_character(),
  Close = col_double()
)
```

In [48]:
```
MSFT %>% glimpse()
```

```
Rows: 61
Columns: 2
$ Date  <date> 2001-11-12, 2001-11-09, 2001-11-08, 2001-11-07, 2001-11-06, 20…
$ Close <dbl> 65.79, 65.21, 64.42, 64.25, 64.78, 63.27, 61.40, 61.84, 58.15, …
```

In [56]:
```
MSFT <- MSFT %>% mutate(LagClose = lag(Close),  #get the lag 1 Close da
                RatioPriceChange = Close / LagClose,
                logPriceRat = log(RatioPriceChange, base = exp(1)),
                        Xi = logPriceRat) # calculate the price ratio

MSFT
```

A spec_tbl_df: 61 × 6

Date	Close	LagClose	RatioPriceChange	logPriceRat	Xi
<date>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
2001-11-12	65.79	NA	NA	NA	NA
2001-11-09	65.21	65.79	0.9911841	-0.008855020	-0.008855020

Date	Close	LagClose	RatioPriceChange	logPriceRat	Xi
<date>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
2001-11-08	64.42	65.21	0.9878853	-0.012188688	-0.012188688
2001-11-07	64.25	64.42	0.9973611	-0.002642420	-0.002642420
2001-11-06	64.78	64.25	1.0082490	0.008215190	0.008215190
2001-11-05	63.27	64.78	0.9766903	-0.023585631	-0.023585631
2001-11-02	61.40	63.27	0.9704441	-0.030001448	-0.030001448
2001-11-01	61.84	61.40	1.0071661	0.007140569	0.007140569
2001-10-31	58.15	61.84	0.9403299	-0.061524525	-0.061524525
2001-10-30	58.88	58.15	1.0125537	0.012475595	0.012475595
2001-10-29	59.64	58.88	1.0129076	0.012825015	0.012825015
2001-10-26	62.20	59.64	1.0429242	0.042028510	0.042028510
2001-10-25	62.56	62.20	1.0057878	0.005771096	0.005771096
2001-10-24	61.32	62.56	0.9801790	-0.020020042	-0.020020042
2001-10-23	60.43	61.32	0.9854860	-0.014620384	-0.014620384
2001-10-22	60.16	60.43	0.9955320	-0.004477991	-0.004477991
2001-10-19	57.90	60.16	0.9624335	-0.038290295	-0.038290295
2001-10-18	56.76	57.90	0.9803109	-0.019885532	-0.019885532
2001-10-17	56.03	56.76	0.9871388	-0.012944591	-0.012944591
2001-10-16	58.45	56.03	1.0431911	0.042284426	0.042284426
2001-10-15	58.06	58.45	0.9933276	-0.006694729	-0.006694729
2001-10-12	56.38	58.06	0.9710644	-0.029362473	-0.029362473
2001-10-11	56.32	56.38	0.9989358	-0.001064774	-0.001064774
2001-10-10	55.51	56.32	0.9856179	-0.014486527	-0.014486527
2001-10-09	54.56	55.51	0.9828860	-0.017262171	-0.017262171
2001-10-08	58.04	54.56	1.0637830	0.061831414	0.061831414
2001-10-05	57.72	58.04	0.9944866	-0.005528694	-0.005528694
2001-10-04	56.64	57.72	0.9812890	-0.018888285	-0.018888285
2001-10-03	56.23	56.64	0.9927613	-0.007265027	-0.007265027
2001-10-02	53.05	56.23	0.9434466	-0.058215557	-0.058215557
⋮	⋮	⋮	⋮	⋮	⋮
2001-09-28	51.17	51.79	0.9880286	-0.012043658	-0.012043658
2001-09-27	49.96	51.17	0.9763533	-0.023930738	-0.023930738
2001-09-26	50.27	49.96	1.0062050	0.006185792	0.006185792

Date	Close	LagClose	RatioPriceChange	logPriceRat	Xi
<date>	<dbl>	<dbl>	<dbl>	<dbl>	<dbl>
2001-09-25	51.30	50.27	1.0204894	0.020282274	0.020282274
2001-09-24	52.01	51.30	1.0138402	0.013745256	0.013745256
2001-09-21	49.71	52.01	0.9557777	-0.045229888	-0.045229888
2001-09-20	50.76	49.71	1.0211225	0.020902523	0.020902523
2001-09-19	53.87	50.76	1.0612687	0.059465094	0.059465094
2001-09-18	54.32	53.87	1.0083534	0.008318747	0.008318747
2001-09-17	52.91	54.32	0.9740427	-0.026300126	-0.026300126
2001-09-10	57.58	52.91	1.0882631	0.084582928	0.084582928
2001-09-07	55.40	57.58	0.9621396	-0.038595691	-0.038595691
2001-09-06	56.02	55.40	1.0111913	0.011129176	0.011129176
2001-09-05	57.74	56.02	1.0307033	0.030241404	0.030241404
2001-09-04	56.10	57.74	0.9715968	-0.028814362	-0.028814362
2001-08-31	57.05	56.10	1.0169340	0.016792264	0.016792264
2001-08-30	56.94	57.05	0.9980719	-0.001929994	-0.001929994
2001-08-29	60.25	56.94	1.0581314	0.056504491	0.056504491
2001-08-28	60.74	60.25	1.0081328	0.008099887	0.008099887
2001-08-27	62.31	60.74	1.0258479	0.025519467	0.025519467
2001-08-24	62.05	62.31	0.9958273	-0.004181415	-0.004181415
2001-08-23	59.12	62.05	0.9527800	-0.048371235	-0.048371235
2001-08-22	60.66	59.12	1.0260487	0.025715226	0.025715226
2001-08-21	60.78	60.66	1.0019782	0.001976285	0.001976285
2001-08-20	62.70	60.78	1.0315893	0.031100660	0.031100660

In [70]:
```
Xi <- MSFT$logPriceRat  #Create an Array of all independent variables

Xi

X_bar <- mean(Xi, na.rm = TRUE) #this is the average

X_bar #this is the average

MSFT <- MSFT %>% mutate(DevFromMean = Xi - X_bar)
```

<NA> · -0.00885501969279577 · -0.012188687502058 · -0.00264242012772366 · 0.00821518996785407 · -0.0235856305843902 · -0.0300014480056963 · 0.00714056912606979 · -0.0615245253144932 · 0.0124755954559475 · 0.0128250154759168 · 0.0420285098485961 ·

0.00577109649192187 · -0.0200200422334423 · -0.0146203836301462 · -0.00447799073188281 · -0.0382902950626349 · -0.0198855322871077 · -0.0129445907146487 · 0.0422844263408844 · -0.00669472932159364 · -0.0293624729105174 · -0.00106477383617953 · -0.0144865271477171 · -0.0172621711668632 · 0.0618314144807804 · -0.00552869411031694 · -0.0188882845202057 · -0.00726502708135401 · -0.0582155572441182 · -0.024037784624192 · -0.0120436576187996 · -0.0239307375596236 · 0.00618579244710699 · 0.0202822744722398 · 0.0137452556082572 · -0.0452298876783998 · 0.0209025227396055 · 0.0594650938462554 · 0.00831874655799834 · -0.0263001263344004 · 0.0845829282679896 · -0.0385956914307917 · 0.0111291760787245 · 0.0302414044028266 · -0.0288143617061385 · 0.0167922637794339 · -0.00192999445819315 · 0.0565044905208729 · 0.00809988724683835 · 0.0255194669385279 · -0.00418141490551447 · -0.0483712350106699 · 0.0257152256204888 · 0.00197628522821196 · 0.031100660150228 · -0.0131644219340096 · 0.0433269346914869 · -0.0222196592435405 · 0.0233023289030823 · 0.0174690314238913
1.01301730313107e-05

In [85]:
```
n = length(Xi) -1

Ssquared = sum(MSFT$DevFromMean, na.rm = TRUE) / n

S = sqrt(Ssquared)

n # number of observations
Ssquared
S # volatility parameter
```

60
1.04806210006932e-19
3.23737872370429e-10

In [ ]:
```
#
```