# Overview of PerformanceAnalytics' Charts and Tables

## Brian G. Peterson

Diamond Management & Technology Consultants
Chicago, IL

R/Rmetrics User and Developer Workshop, 2007

# Outline

# Overview

- Utilize charts and tables to display and analyze data:
  - asset returns
  - compare an asset to other similar assets
  - compare an asset to one or more benchmarks
- Utilize common performance and risk measures to aid the investment decision
- Examples developed using data for six (hypothetical) managers, a peer index, and an asset class index

# Install PerformanceAnalytics.

- As of version 0.9.4, PerformanceAnalytics is available in CRAN
- Version 0.9.5 was released at the beginning of July
- Install with:
  > install.packages("PerformanceAnalytics")
- Required packages include Hmisc, zoo, and Rmetrics packages such as fExtremes.
- Load the library into your active R session using:
  > library("PerformanceAnalytics").

# Load and Review Data.

```
> data(managers)
> head(managers)

            HAM1 HAM2    HAM3    HAM4 HAM5 HAM6 EDHEC.LS.EQ SP500.TR
1996-01-31  0.0100  NA  0.0359  0.0208  NA  NA          NA   0.0340
1996-02-29  0.0215  NA  0.0295  0.0231  NA  NA          NA   0.0093
1996-03-31  0.0226  NA  0.0253 -0.0053  NA  NA          NA   0.0096
1996-04-30  0.0008  NA  0.0478  0.0200  NA  NA          NA   0.0147
1996-05-31  0.0158  NA  0.0337  0.0122  NA  NA          NA   0.0258
1996-06-30 -0.0086  NA -0.0293 -0.0089  NA  NA          NA   0.0038
           US.10Y.TR US.3m.TR
1996-01-31   0.00380  0.00456
1996-02-29  -0.03532  0.00398
1996-03-31  -0.01057  0.00371
1996-04-30  -0.01739  0.00428
1996-05-31  -0.00543  0.00443
1996-06-30   0.01507  0.00412
```

# Set Up Data for Analysis.

```
> dim(managers)

[1] 132  10

> managers.length = dim(managers)[1]
> colnames(managers)

 [1] "HAM1"        "HAM2"        "HAM3"        "HAM4"        "HAM5"
 [6] "HAM6"        "EDHEC.LS.EQ" "SP500.TR"    "US.10Y.TR"   "US.3m.TR

> manager.col = 1
> peers.cols = c(2, 3, 4, 5, 6)
> indexes.cols = c(7, 8)
> Rf.col = 10
> trailing12.rows = ((managers.length - 11):managers.length)
> trailing12.rows

 [1] 121 122 123 124 125 126 127 128 129 130 131 132

> trailing36.rows = ((managers.length - 35):managers.length)
> trailing60.rows = ((managers.length - 59):managers.length)
> frInception.rows = (length(managers[, 1]) - length(managers[,
+     1][!is.na(managers[, 1])]) + 1):length(managers[, 1])
```
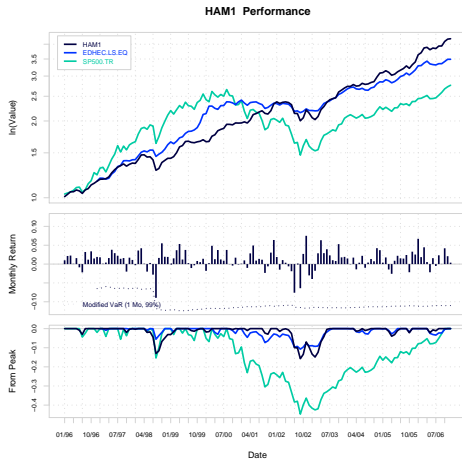
# Draw a Performance Summary Chart.

```
> charts.PerformanceSummary(managers[, c(manager.col, indexes.cols)],
+     colorset = rich6equal, lwd = 2, ylog = TRUE)
```

# Show Calendar Performance.

```
> t(table.Returns(managers[, c(manager.col, indexes.cols)]))

            1996 1997 1998 1999 2000  2001  2002 2003 2004 2005 2006
Jan          1.0  1.8 -0.3  0.0 -1.8   0.1   1.9 -4.0  1.5  0.4  6.7
Feb          2.1  0.1  3.6  1.5  0.2   1.0  -1.5 -1.8 -0.1  1.8  1.8
Mar          2.3  0.4  4.2  3.7  4.9  -1.0   1.1  2.9  1.7 -1.4  4.5
Apr          0.1  1.6  0.1  5.3  1.3   2.8   0.4  6.3 -1.4 -2.6  0.5
May          1.6  3.8 -2.0  1.2  3.7   4.9  -0.6  2.9  0.4  0.9 -2.2
Jun         -0.9  2.9  0.3  3.8  1.2   0.9  -1.9  3.9  2.2  2.2  1.6
Jul         -2.2  2.2 -2.8  0.2  0.9   1.4  -7.6  2.3 -1.0  1.5 -0.5
Aug          3.2  1.4 -8.9 -1.1  3.8   1.2   0.0  1.0  0.4  1.5  2.3
Sep          1.2  1.6  1.6 -0.3  0.0  -2.3  -6.4  0.8  1.4  2.4  0.0
Oct          3.4 -2.0  5.5  0.8 -0.4  -0.6   2.7  5.3  0.7 -2.2  4.2
Nov          1.5  1.7  1.9  0.5  1.7   3.0   7.5  1.8  4.2  3.3  2.1
Dec          1.9  1.1  1.9  1.4 -0.1   6.4  -3.0  1.9  3.7  2.5  0.4
HAM1        16.1 17.8  4.4 18.3 16.2  18.9  -8.1 25.5 14.4 10.5 23.3
EDHEC.LS.EQ  0.0 21.4 14.6 31.4 12.0  -1.2  -6.4 19.3  8.6 11.3 10.1
SP500.TR    23.0 33.4 28.6 21.0 -9.1 -11.9 -22.1 28.7 10.9  4.9 15.8
```

# Calculate Statistics.

```
> table.MonthlyReturns(managers[, c(manager.col, peers.cols)])

                     HAM1     HAM2     HAM3     HAM4     HAM5     HAM6
Observations     132.0000 125.0000 132.0000 132.0000  77.0000  64.0000
NAs                0.0000   7.0000   0.0000   0.0000  55.0000  68.0000
Minimum           -0.0895  -0.0429  -0.0738  -0.1800  -0.1386  -0.0402
Quartile 1         0.0000  -0.0105  -0.0066  -0.0213  -0.0184  -0.0034
Median             0.0132   0.0060   0.0107   0.0139   0.0045   0.0146
Arithmetic Mean    0.0112   0.0138   0.0122   0.0105   0.0034   0.0121
Geometric Mean     0.0109   0.0131   0.0115   0.0091   0.0025   0.0118
Quartile 3         0.0231   0.0248   0.0312   0.0440   0.0298   0.0276
Maximum            0.0750   0.1521   0.1774   0.1583   0.1660   0.0544
SE Mean            0.0022   0.0033   0.0032   0.0047   0.0051   0.0030
LCL Mean (0.95)    0.0069   0.0072   0.0058   0.0013  -0.0067   0.0062
UCL Mean (0.95)    0.0156   0.0203   0.0186   0.0197   0.0136   0.0180
Variance           0.0006   0.0014   0.0014   0.0029   0.0020   0.0006
Stdev              0.0251   0.0369   0.0371   0.0536   0.0447   0.0238
Skewness          -0.6871   1.4564   0.8091  -0.4198  -0.0131  -0.2312
Kurtosis           2.4001   2.4099   2.3632   0.8703   2.1288  -0.5305
```

# Compare Distributions.

```
> chart.Boxplot(managers[trailing36.rows, c(manager.col, peers.cols,
+      indexes.cols)], main = "Trailing 36-Month Returns")
```



**Trailing 36–Month Returns**
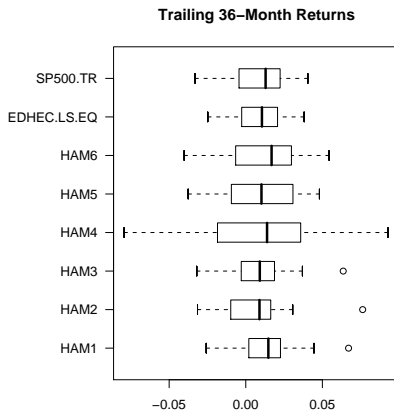
# Compare Distributions.

```
> layout(rbind(c(1, 2), c(3, 4)))
> chart.Histogram(managers[, 1, drop = F], main = "Plain", methods = NULL)
> chart.Histogram(managers[, 1, drop = F], main = "Density", breaks = 40,
+     methods = c("add.density", "add.normal"))
> chart.Histogram(managers[, 1, drop = F], main = "Skew and Kurt",
+     methods = c("add.centered", "add.rug"))
> chart.Histogram(managers[, 1, drop = F], main = "Risk Measures",
+     methods = c("add.risk"))
```
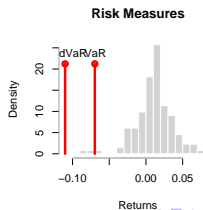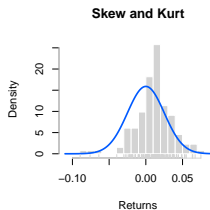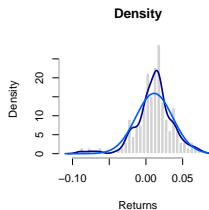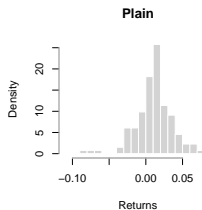
# Show Relative Return and Risk.

```
> chart.RiskReturnScatter(managers[trailing36.rows, 1:8], rf = 0.03/12
+     main = "Trailing 36-Month Performance", colorset = c("red",
+         rep("black", 5), "orange", "green"))
```



**Trailing 36–Month Performance**

# Calculate Statistics.

```
> table.MonthlyReturns(managers[, c(manager.col, peers.cols)])
```

|                  | HAM1    | HAM2    | HAM3    | HAM4    | HAM5    | HAM6   |
|------------------|---------|---------|---------|---------|---------|--------|
| Observations     | 132.0000| 125.0000| 132.0000| 132.0000| 77.0000 | 64.0000|
| NAs              | 0.0000  | 7.0000  | 0.0000  | 0.0000  | 55.0000 | 68.0000|
| Minimum          | -0.0895 | -0.0429 | -0.0738 | -0.1800 | -0.1386 | -0.0402|
| Quartile 1       | 0.0000  | -0.0105 | -0.0066 | -0.0213 | -0.0184 | -0.0034|
| Median           | 0.0132  | 0.0060  | 0.0107  | 0.0139  | 0.0045  | 0.0146 |
| Arithmetic Mean  | 0.0112  | 0.0138  | 0.0122  | 0.0105  | 0.0034  | 0.0121 |
| Geometric Mean   | 0.0109  | 0.0131  | 0.0115  | 0.0091  | 0.0025  | 0.0118 |
| Quartile 3       | 0.0231  | 0.0248  | 0.0312  | 0.0440  | 0.0298  | 0.0276 |
| Maximum          | 0.0750  | 0.1521  | 0.1774  | 0.1583  | 0.1660  | 0.0544 |
| SE Mean          | 0.0022  | 0.0033  | 0.0032  | 0.0047  | 0.0051  | 0.0030 |
| LCL Mean (0.95)  | 0.0069  | 0.0072  | 0.0058  | 0.0013  | -0.0067 | 0.0062 |
| UCL Mean (0.95)  | 0.0156  | 0.0203  | 0.0186  | 0.0197  | 0.0136  | 0.0180 |
| Variance         | 0.0006  | 0.0014  | 0.0014  | 0.0029  | 0.0020  | 0.0006 |
| Stdev            | 0.0251  | 0.0369  | 0.0371  | 0.0536  | 0.0447  | 0.0238 |
| Skewness         | -0.6871 | 1.4564  | 0.8091  | -0.4198 | -0.0131 | -0.2312|
| Kurtosis         | 2.4001  | 2.4099  | 2.3632  | 0.8703  | 2.1288  | -0.5305|

# Examine Performance Consistency.

```
> charts.RollingPerformance(managers[, c(manager.col, peers.cols,
+     indexes.cols)], rf = 0.03/12, colorset = c("red", rep("darkgray"
+     5), "orange", "green"), lwd = 2)
```
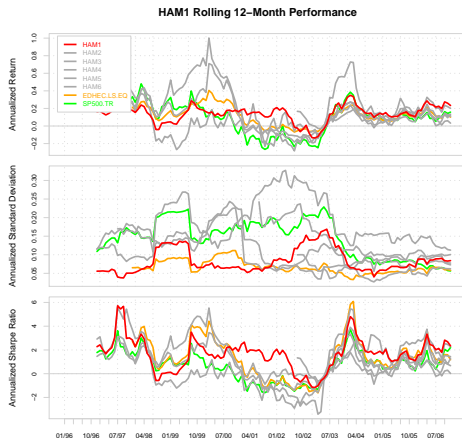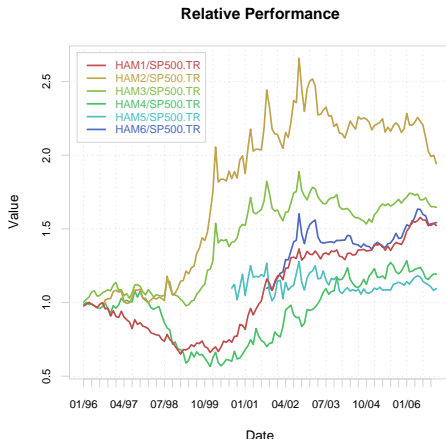
# Display Relative Performance.

```
> chart.RelativePerformance(managers[, manager.col, drop = FALSE],
+     managers[, c(peers.cols, 7)], colorset = tim8equal[-1], lwd = 2,
+     legend.loc = "topleft")
```



**Relative Performance**
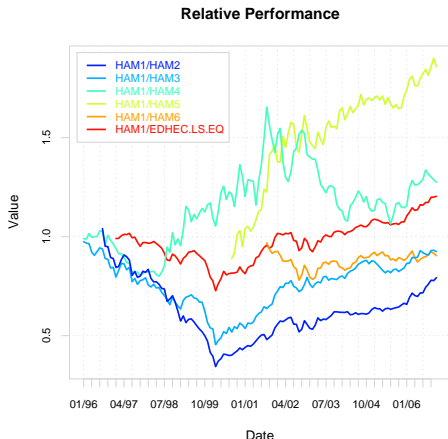
# Compare to a Benchmark.

```
> chart.RelativePerformance(managers[, c(manager.col, peers.cols)],
+       managers[, 8, drop = F], colorset = rainbow8equal, lwd = 2,
+       legend.loc = "topleft")
```



**Relative Performance**

# Compare to a Benchmark.

```
> table.CAPM(managers[trailing36.rows, c(manager.col, peers.cols)],
+     managers[trailing36.rows, 8, drop = FALSE], rf = managers[trailing36.rows,
+         Rf.col])
```

|  | HAM1 to SP500.TR | HAM2 to SP500.TR | HAM3 to SP500.TR |
|---|---|---|---|
| Alpha | 0.0061 | 0.0006 | 0.0015 |
| Beta | 0.6713 | 0.4178 | 0.7349 |
| R-squared | 0.4397 | 0.1715 | 0.5907 |
| Annualized Alpha | 0.0755 | 0.0076 | 0.0180 |
| Correlation | 0.6631 | 0.4142 | 0.7686 |
| Correlation p-value | 0.0000 | 0.0120 | 0.0000 |
| Tracking Error | 0.0868 | 0.0601 | 0.0021 |
| Active Premium | 0.0538 | -0.0359 | -0.0010 |
| Information Ratio | 0.6201 | -0.5974 | -0.4973 |
| Treynor Ratio | 0.1870 | 0.0857 | 0.0962 |
|  | HAM4 to SP500.TR | HAM5 to SP500.TR | HAM6 to SP500.TR |
| Alpha | 0.0005 | 0.0015 | 0.0033 |
| Beta | 1.1570 | 0.8442 | 0.8574 |
| R-squared | 0.3697 | 0.4887 | 0.4830 |
| Annualized Alpha | 0.0059 | 0.0181 | 0.0399 |
| Correlation | 0.6080 | 0.6991 | 0.6950 |
| Correlation p-value | 0.0001 | 0.0000 | 0.0000 |
| Tracking Error | 0.0302 | 0.0119 | 0.0508 |
| Active Premium | 0.0120 | 0.0061 | 0.0299 |
| Information Ratio | 0.3984 | 0.5148 | 0.5889 |
| Treynor Ratio | 0.0724 | 0.0922 | 0.1186 |

# Compare to a Benchmark.

```
> charts.RollingRegression(managers[, c(manager.col, peers.cols),
+       drop = FALSE], managers[, 8, drop = FALSE], rf = 0.03/12,
+       colorset = redfocus, lwd = 2)
```



Rolling 12–Month Regression
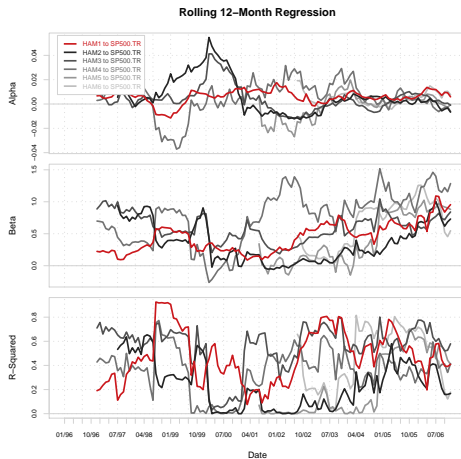
# Calculate Downside Risk.

```
> table.DownsideRisk(managers[, 1:6], rf = 0.03/12)
```

|                              | HAM1    | HAM2    | HAM3    | HAM4    | HAM5      |
|------------------------------|---------|---------|---------|---------|-----------|
| Semi Deviation               | 0.0188  | 0.0203  | 0.0239  | 0.0397  | 0.0320    |
| Gain Deviation               | 0.0164  | 0.0347  | 0.0296  | 0.0314  | 0.0298    |
| Loss Deviation               | 0.0209  | 0.0099  | 0.0187  | 0.0371  | 0.0321    |
| Downside Deviation (MAR=10%) | 0.0175  | 0.0168  | 0.0218  | 0.0386  | 0.0346    |
| Downside Deviation (rf=3%)   | 0.0151  | 0.0133  | 0.0188  | 0.0357  | 0.0316    |
| Downside Deviation (0%)      | 0.0142  | 0.0119  | 0.0176  | 0.0345  | 0.0303    |
| Maximum Drawdown             | -0.1573 | -0.2240 | -0.2786 | -0.2913 | -0.3775 - |
| VaR (99%)                    | 0.0696  | 0.0996  | 0.0985  | 0.1352  | 0.1075    |
| Beyond VaR                   | 0.0704  | 0.1010  | 0.0997  | 0.1366  | 0.1078    |
| Modified VaR (99%)           | 0.1101  | 0.0814  | 0.1150  | 0.1971  | 0.1614    |

# Summary

- ▶ Performance and Risk analysis are greatly facilitated by the use of charts and tables.
- ▶ The display of your infomation is in many cases as important as the analysis.
- ▶ The observer should have gained a working knowledge of how specific visual techniques may be utilized to aid investment decision making.

- ▶ Further Work
  - ▶ Additional parameterization to make charts more useful.
  - ▶ Pertrac or Morningstar-style sample reports.
  - ▶ Functions and graphics for more complicated topics such as factor analysis and optimization.