Rolling Economic Drawdown Controlled Optimal Strategy

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Abstract

Drawdown based stopouts is a framework for informing the decision of stopping a portfolio manager or investment strategy once it has reached the drawdown or time under water limit associated with a certain confidence limit.

1 Rolling Economic Max

Rolling Economic Max at time t, looking back at portfolio Wealth history for a rolling window of length H is given by:

$$REM(t,h) = \max_{t-H \leq s} (1 + r_f)^{t-s} W_s$$

Here rf is the average realized risk free rate over a period of length t-s. If the risk free rate is changing. This is used to compound.

$$\prod_{i=s}^{t} (1 + r_i \triangle t)$$

here $r_i$enotes the risk free interest rate during i^{th}iscrete time interval $\triangle t$

1.1 Usage of the function

The Return Series ,risk free rate of return , lookback priod and the type of cumulative return is taken as the input. The Return Series can be an xts, vector, matrix, data frame, timeSeries or zoo object of asset returns.

```
> data(edhec)
> head(rollEconomicMax(edhec,0.08,100))
```

	Convertible Arbitrage	CTA Global	Distressed Securities
1997-01-31	NA	NA	NA
1997-02-28	NA	NA	NA
1997-03-31	NA	NA	NA
1997-04-30	NA	NA	NA
1997-05-31	NA	NA	NA
1997-06-30	NA	NA	NA

	Emerging Markets	Equity Market Neutral	Event Driven
1997-01-31	NA	NA	NA
1997-02-28	NA	NA	NA
1997-03-31	NA	NA	NA
1997-04-30	NA	NA	NA
1997-05-31	NA	NA	NA
1997-06-30	NA	NA	NA

	Fixed Income Arbitrage	Global Macro	Long/Short Equity
1997-01-31	NA	NA	NA
1997-02-28	NA	NA	NA
1997-03-31	NA	NA	NA
1997-04-30	NA	NA	NA
1997-05-31	NA	NA	NA
1997-06-30	NA	NA	NA

	Merger Arbitrage	Relative Value	Short Selling	Funds of Funds
1997-01-31	NA	NA	NA	NA
1997-02-28	NA	NA	NA	NA
1997-03-31	NA	NA	NA	NA
1997-04-30	NA	NA	NA	NA
1997-05-31	NA	NA	NA	NA
1997-06-30	NA	NA	NA	NA

2 Rolling Economic Drawdown

To calculate the rolling economic drawdown cumulative return and rolling economic max is calculated for each point. The Return series, risk free return(rf) and the lookback period(h) is taken as the input. Rolling Economic Drawdown is given by the equation.

$$REDD(t,h) = 1 - \frac{W_t}{/}REM(t,H)$$

Here REM stands for Rolling Economic Max

2.1 Usage

The Return Series ,risk free return and the type of cumulative return is taken as the input. The Return Series can be an xts, vector, matrix, data frame, timeSeries or zoo object of asset returns.

```
> data(edhec)
> head(rollDrawdown(edhec,0.08,100))
```

	Convertible Arbitrage	CTA Global	Distressed Securities
1997-01-31	NA	NA	NA
1997-02-28	NA	NA	NA
1997-03-31	NA	NA	NA
1997-04-30	NA	NA	NA
1997-05-31	NA	NA	NA
1997-06-30	NA	NA	NA

	Emerging Markets	Equity Market Neutral	Event Driven
1997-01-31	NA	NA	NA
1997-02-28	NA	NA	NA
1997-03-31	NA	NA	NA
1997-04-30	NA	NA	NA
1997-05-31	NA	NA	NA
1997-06-30	NA	NA	NA

	Fixed Income Arbitrage	Global Macro	Long/Short Equity
1997-01-31	NA	NA	NA
1997-02-28	NA	NA	NA
1997-03-31	NA	NA	NA
1997-04-30	NA	NA	NA
1997-05-31	NA	NA	NA
1997-06-30	NA	NA	NA

	Merger Arbitrage	Relative Value	Short Selling	Funds of Funds
1997-01-31	NA	NA	NA	NA
1997-02-28	NA	NA	NA	NA
1997-03-31	NA	NA	NA	NA
1997-04-30	NA	NA	NA	NA
1997-05-31	NA	NA	NA	NA
1997-06-30	NA	NA	NA	NA

3   Rolling Economic Drawdown Controlled Optimal Strategy

The Rolling Economic Drawdown Controlled Optimal Portfolio Strategy(REDD-COPS) has the portfolio fraction allocated to single risky asset as:

$$x_t = Max\left\{0, \left(\frac{\lambda/\sigma + 1/2}{1 - \delta.\gamma}\right).\left[\frac{\delta - REDD(t,h)}{1 - REDD(t,h)}\right]\right\}$$

The risk free asset accounts for the rest of the portfolio allocation $x_f = 1 - x_t$

For two risky assets in REDD-COPS,dynamic asset allocation weights are :

$$\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \frac{1}{1 - \rho^2} \begin{bmatrix} (\lambda_1 + 1/2\sigma_1 - \rho.(\lambda_2 + 1/2\sigma_2)/\sigma_1) \\ (\lambda_1 + 1/2\sigma_1 - \rho(\lambda_2 + 1/2\sigma_2)/\sigma_1) \end{bmatrix} Max\left\{0, \left(\frac{\lambda/\sigma + 1/2}{1 - \delta.\gamma}\right).\left[\frac{\delta - REDD(t,h)}{1 - REDD(t,h)}\right]\right\}$$

The portion of the risk free asset is $x_f = 1 - x_1 - x_2$

3.1   Usage

The Return series ,drawdown limit, risk free rate and the lookback period , the number of assets and the type of REDD-COPS is taken as the input.

```
> data(edhec)
> head(REDDCOPS(edhec,delta = 0.1,Rf = 0,h = 40))
```

	Convertible.Arbitrage	CTA.Global	Distressed.Securities
1997-01-31	NA	NA	NA
1997-02-28	NA	NA	NA
1997-03-31	NA	NA	NA
1997-04-30	NA	NA	NA
1997-05-31	NA	NA	NA
1997-06-30	NA	NA	NA
1997-07-31	NA	NA	NA
1997-08-31	NA	NA	NA
1997-09-30	NA	NA	NA
1997-10-31	NA	NA	NA
1997-11-30	NA	NA	NA
1997-12-31	NA	NA	NA
1998-01-31	NA	NA	NA
1998-02-28	NA	NA	NA
1998-03-31	NA	NA	NA

1998-04-30	NA	NA	NA
1998-05-31	NA	NA	NA
1998-06-30	NA	NA	NA
1998-07-31	NA	NA	NA
1998-08-31	NA	NA	NA
1998-09-30	NA	NA	NA
1998-10-31	NA	NA	NA
1998-11-30	NA	NA	NA
1998-12-31	NA	NA	NA
1999-01-31	NA	NA	NA
1999-02-28	NA	NA	NA
1999-03-31	NA	NA	NA
1999-04-30	NA	NA	NA
1999-05-31	NA	NA	NA
1999-06-30	NA	NA	NA
1999-07-31	NA	NA	NA
1999-08-31	NA	NA	NA
1999-09-30	NA	NA	NA
1999-10-31	NA	NA	NA
1999-11-30	NA	NA	NA
1999-12-31	NA	NA	NA
2000-01-31	NA	NA	NA
2000-02-29	NA	NA	NA
2000-03-31	NA	NA	NA
2000-04-30	1.6636508	0.67387366	2.2601149
2000-05-31	1.6636508	0.78721176	1.9574527
2000-06-30	1.6636508	0.66238386	2.4136496
2000-07-31	1.6636508	0.52875873	2.4886404
2000-08-31	1.6636508	0.71797003	2.4886404
2000-09-30	1.6636508	0.50531425	2.4460036
2000-10-31	1.6636508	0.58142221	2.2809841
2000-11-30	1.5413802	0.99511855	1.7984457
2000-12-31	1.5383606	1.07291501	1.8007543
2001-01-31	1.6636508	1.07291501	2.4886404
2001-02-28	1.6636508	1.05744028	2.4886404
2001-03-31	1.6636508	1.07291501	2.4054609
2001-04-30	1.6636508	0.71023011	2.4886404
2001-05-31	1.6636508	0.79073130	2.4886404
2001-06-30	1.6636508	0.71361165	2.4886404
2001-07-31	1.6636508	0.67338861	2.4886404

2001-08-31	1.6636508	0.82492328	2.4886404
2001-09-30	1.6636508	1.06271752	2.4572396
2001-10-31	1.6636508	1.07291501	2.4886404
2001-11-30	1.6636508	0.51847537	2.4886404
2001-12-31	1.5215704	0.66738943	2.4886404
2002-01-31	1.6636508	0.59441937	2.4886404
2002-02-28	1.5899225	0.38547718	2.4144830
2002-03-31	1.6636508	0.39477811	2.4886404
2002-04-30	1.6636508	0.28617113	2.4886404
2002-05-31	1.6636508	0.56071878	2.4886404
2002-06-30	1.6636508	1.07291501	2.2234842
2002-07-31	1.4217359	1.07291501	1.9180045
2002-08-31	1.4974313	1.07291501	1.9386575
2002-09-30	1.6636508	1.07291501	1.8372412
2002-10-31	1.6636508	0.69565562	1.7655666
2002-11-30	1.6636508	0.52836270	2.3052560
2002-12-31	1.6636508	1.00392616	2.4886404
2003-01-31	1.6636508	1.07291501	2.4886404
2003-02-28	1.6636508	1.07291501	2.4886404
2003-03-31	1.6636508	0.62320024	2.4886404
2003-04-30	1.6636508	0.68846470	2.4886404
2003-05-31	1.6636508	1.07291501	2.4886404
2003-06-30	1.5763016	0.88388594	2.4886404
2003-07-31	1.4670817	0.71260298	2.4886404
2003-08-31	1.3339495	0.79012736	2.4886404
2003-09-30	1.5912238	0.77120727	2.4886404
2003-10-31	1.6636508	0.87370391	2.4886404
2003-11-30	1.6636508	0.89141184	2.4886404
2003-12-31	1.6636508	1.07291501	2.4886404
2004-01-31	1.6636508	1.07291501	2.4886404
2004-02-29	1.6636508	1.07291501	2.4886404
2004-03-31	1.6636508	1.02341577	2.4886404
2004-04-30	1.6636508	0.47805765	2.4886404
2004-05-31	1.4695132	0.35565035	2.4662202
2004-06-30	1.3070207	0.01715118	2.4886404
2004-07-31	1.3269231	0.00000000	2.4886404
2004-08-31	1.3879175	0.00000000	2.4886404
2004-09-30	1.3619508	0.03165227	2.4886404
2004-10-31	1.2944457	0.40138622	2.4886404
2004-11-30	1.4177179	0.86970964	2.4886404

2004-12-31	1.5024685	0.86970964	2.4886404
2005-01-31	1.3557735	0.41808499	2.4886404
2005-02-28	1.2666281	0.42323795	2.4886404
2005-03-31	1.0483946	0.41705069	2.4886404
2005-04-30	0.5397366	0.03860541	2.3715632
2005-05-31	0.3227638	0.28100243	2.3850640
2005-06-30	0.4954729	0.54577031	2.4886404
2005-07-31	0.7559146	0.53251468	2.4886404
2005-08-31	0.8600393	0.63347147	2.4886404
2005-09-30	1.0809285	0.71260220	2.4886404
2005-10-31	1.0575601	0.61959428	2.4167375
2005-11-30	1.0637892	0.98875525	2.4886404
2005-12-31	1.2057521	0.83741165	2.4886404
2006-01-31	1.5821120	1.00658429	2.4886404
2006-02-28	1.6636508	0.82231720	2.4886404
2006-03-31	1.6636508	1.07291501	2.4886404
2006-04-30	1.6636508	1.07291501	2.4886404
2006-05-31	1.6636508	0.92984516	2.4886404
2006-06-30	1.6636508	0.78869063	2.4549933
2006-07-31	1.6636508	0.56923650	2.4751634
2006-08-31	1.6636508	0.58951577	2.4886404
2006-09-30	1.6636508	0.53343936	2.4886404
2006-10-31	1.6636508	0.63638556	2.4886404
2006-11-30	1.6636508	0.85944098	2.4886404
2006-12-31	1.6636508	1.00146518	2.4886404
2007-01-31	1.6636508	1.07291501	2.4886404
2007-02-28	1.6636508	0.93183365	2.4886404
2007-03-31	1.6636508	0.79171583	2.4886404
2007-04-30	1.6636508	1.02557206	2.4886404
2007-05-31	1.6636508	1.07291501	2.4886404
2007-06-30	1.6636508	1.07291501	2.4886404
2007-07-31	1.5838718	0.95365396	2.3625066
2007-08-31	1.3623972	0.67205530	2.0935509
2007-09-30	1.6044139	1.07291501	2.3080453
2007-10-31	1.6636508	1.07291501	2.4886404
2007-11-30	1.4649027	1.05744028	2.1036112
2007-12-31	1.3471749	1.07291501	2.1081668
2008-01-31	1.3334021	1.07291501	1.5647728
2008-02-29	1.2053233	1.07291501	1.5973775
2008-03-31	0.7001404	1.01853557	1.3001912

```
2008-04-30              0.8203433 0.94219734              1.5059393
2008-05-31              0.9877846 1.07291501              1.8219227
2008-06-30              0.8599948 1.07291501              1.7502004
2008-07-31              0.5577135 0.74028583              1.3213158
2008-08-31              0.4508884 0.62509966              1.1504167
2008-09-30              0.0000000 0.63519361              0.0000000
2008-10-31              0.0000000 0.97182145              0.0000000
2008-11-30              0.0000000 1.07291501              0.0000000
2008-12-31              0.0000000 1.07291501              0.0000000
2009-01-31              0.0000000 1.05744028              0.0000000
2009-02-28              0.0000000 1.02736474              0.0000000
2009-03-31              0.0000000 0.84953161              0.0000000
2009-04-30              0.0000000 0.70925305              0.0000000
2009-05-31              0.0000000 0.91822574              0.0000000
2009-06-30              0.0000000 0.77185348              0.0000000
2009-07-31              0.8453786 0.75989037              0.0000000
2009-08-31              1.3276089 0.81343523              0.2148404
           Emerging.Markets Equity.Market.Neutral Event.Driven
1997-01-31             NA                    NA           NA
1997-02-28             NA                    NA           NA
1997-03-31             NA                    NA           NA
1997-04-30             NA                    NA           NA
1997-05-31             NA                    NA           NA
1997-06-30             NA                    NA           NA
1997-07-31             NA                    NA           NA
1997-08-31             NA                    NA           NA
1997-09-30             NA                    NA           NA
1997-10-31             NA                    NA           NA
1997-11-30             NA                    NA           NA
1997-12-31             NA                    NA           NA
1998-01-31             NA                    NA           NA
1998-02-28             NA                    NA           NA
1998-03-31             NA                    NA           NA
1998-04-30             NA                    NA           NA
1998-05-31             NA                    NA           NA
1998-06-30             NA                    NA           NA
1998-07-31             NA                    NA           NA
1998-08-31             NA                    NA           NA
1998-09-30             NA                    NA           NA
1998-10-31             NA                    NA           NA
```

1998-11-30	NA	NA	NA
1998-12-31	NA	NA	NA
1999-01-31	NA	NA	NA
1999-02-28	NA	NA	NA
1999-03-31	NA	NA	NA
1999-04-30	NA	NA	NA
1999-05-31	NA	NA	NA
1999-06-30	NA	NA	NA
1999-07-31	NA	NA	NA
1999-08-31	NA	NA	NA
1999-09-30	NA	NA	NA
1999-10-31	NA	NA	NA
1999-11-30	NA	NA	NA
1999-12-31	NA	NA	NA
2000-01-31	NA	NA	NA
2000-02-29	NA	NA	NA
2000-03-31	NA	NA	NA
2000-04-30	0.28151959	7.7239943	2.2528643
2000-05-31	0.03168615	7.7239943	2.1793544
2000-06-30	0.21816976	7.7239943	2.3799920
2000-07-31	0.23209331	7.7239943	2.3799920
2000-08-31	0.42977328	7.7239943	2.3799920
2000-09-30	0.16957795	7.7239943	2.3799920
2000-10-31	0.02161253	7.7239943	2.2333392
2000-11-30	0.00000000	7.7239943	1.9359898
2000-12-31	0.00000000	7.7239943	2.2101795
2001-01-31	0.18805647	7.7239943	2.3799920
2001-02-28	0.06119548	7.7239943	2.3799920
2001-03-31	0.00000000	7.7239943	2.2896488
2001-04-30	0.02480512	7.7239943	2.3799920
2001-05-31	0.18105384	7.7239943	2.3799920
2001-06-30	0.26956499	7.7239943	2.3799920
2001-07-31	0.10669318	7.7239943	2.3799920
2001-08-31	0.12372654	7.7239943	2.3799920
2001-09-30	0.00000000	7.7239943	1.8217464
2001-10-31	0.03209962	7.7239943	2.1422794
2001-11-30	0.29792295	7.7239943	2.3673217
2001-12-31	0.52026349	7.7239943	2.3799920
2002-01-31	0.58015115	7.7239943	2.3799920
2002-02-28	0.58015115	7.6752991	2.2268230

2002-03-31	0.58015115	7.7239943	2.3799920
2002-04-30	0.58015115	7.7239943	2.3799920
2002-05-31	0.58015115	7.7239943	2.3799920
2002-06-30	0.42310158	7.7239943	1.7561534
2002-07-31	0.25160961	7.6335060	1.0743874
2002-08-31	0.31687676	7.7239943	1.2099274
2002-09-30	0.17509097	7.7239943	1.0506827
2002-10-31	0.26042372	7.7239943	1.1209874
2002-11-30	0.36374135	7.7239943	1.6004950
2002-12-31	0.38971796	7.7239943	1.6977445
2003-01-31	0.39620433	7.7239943	2.0329558
2003-02-28	0.44123069	7.7239943	2.0894031
2003-03-31	0.45139591	7.7239943	2.2681171
2003-04-30	0.58015115	7.7239943	2.3799920
2003-05-31	0.58015115	7.7239943	2.3799920
2003-06-30	0.58015115	7.7239943	2.3799920
2003-07-31	0.58015115	7.6822597	2.3799920
2003-08-31	0.58015115	7.7239943	2.3799920
2003-09-30	0.58015115	7.7239943	2.3799920
2003-10-31	0.58015115	7.7239943	2.3799920
2003-11-30	0.58015115	7.7239943	2.3799920
2003-12-31	0.58015115	7.7239943	2.3799920
2004-01-31	0.58015115	7.7239943	2.3799920
2004-02-29	0.58015115	7.7239943	2.3799920
2004-03-31	0.58015115	7.7239943	2.3799920
2004-04-30	0.44517138	7.1492507	2.3799920
2004-05-31	0.34643448	7.3170656	2.3306126
2004-06-30	0.35732286	7.6095134	2.3799920
2004-07-31	0.34258376	7.6512666	2.2028964
2004-08-31	0.41423454	7.5885803	2.2782223
2004-09-30	0.56096971	7.7239943	2.3799920
2004-10-31	0.58015115	7.6892190	2.3799920
2004-11-30	0.58015115	7.7239943	2.3799920
2004-12-31	0.58015115	7.7239943	2.3799920
2005-01-31	0.58015115	7.7239943	2.3799920
2005-02-28	0.58015115	7.7239943	2.3799920
2005-03-31	0.47522327	7.7239943	2.3714206
2005-04-30	0.44899594	7.5148190	2.0935794
2005-05-31	0.48725857	7.7239943	2.2337595
2005-06-30	0.57094759	7.7239943	2.3799920

2005-07-31	0.58015115	7.7239943	2.3799920
2005-08-31	0.58015115	7.7239943	2.3799920
2005-09-30	0.58015115	7.7239943	2.3799920
2005-10-31	0.45723274	7.7239943	2.0029036
2005-11-30	0.58015115	7.7239943	2.2720026
2005-12-31	0.58015115	7.7239943	2.3799920
2006-01-31	0.58015115	7.7239943	2.3799920
2006-02-28	0.58015115	7.7239943	2.3799920
2006-03-31	0.58015115	7.7239943	2.3799920
2006-04-30	0.58015115	7.7239943	2.3799920
2006-05-31	0.36881943	7.7239943	2.3799920
2006-06-30	0.31560615	7.7239943	2.3799920
2006-07-31	0.35211709	7.7239943	2.3564041
2006-08-31	0.42364274	7.6613736	2.3799920
2006-09-30	0.42955190	7.7239380	2.3799920
2006-10-31	0.56415204	7.7239943	2.3799920
2006-11-30	0.58015115	7.7239943	2.3799920
2006-12-31	0.58015115	7.7239943	2.3799920
2007-01-31	0.58015115	7.7239943	2.3799920
2007-02-28	0.58015115	7.7239943	2.3799920
2007-03-31	0.58015115	7.7239943	2.3799920
2007-04-30	0.58015115	7.7239943	2.3799920
2007-05-31	0.58015115	7.7239943	2.3799920
2007-06-30	0.58015115	7.7239943	2.3649875
2007-07-31	0.58015115	7.7239943	2.2961755
2007-08-31	0.43305545	7.0643437	1.9819975
2007-09-30	0.58015115	7.7239943	2.2704918
2007-10-31	0.58015115	7.7239943	2.3799920
2007-11-30	0.45340093	7.5986400	1.9383891
2007-12-31	0.52203413	7.7239943	1.9536814
2008-01-31	0.24241140	6.9365969	1.3451574
2008-02-29	0.39382658	7.7239943	1.5322062
2008-03-31	0.18080168	7.3816889	1.1517163
2008-04-30	0.28560392	7.7239943	1.4158484
2008-05-31	0.37407120	7.7239943	1.8029943
2008-06-30	0.22116983	7.7239943	1.5515881
2008-07-31	0.03073418	7.0218130	1.1760316
2008-08-31	0.00000000	6.0608959	1.1193301
2008-09-30	0.00000000	3.9727818	0.0000000
2008-10-31	0.00000000	3.6489816	0.0000000

2008-11-30	0.00000000	0.0000000	0.0000000
2008-12-31	0.00000000	0.0000000	0.0000000
2009-01-31	0.00000000	0.0000000	0.0000000
2009-02-28	0.00000000	0.0000000	0.0000000
2009-03-31	0.00000000	0.0000000	0.0000000
2009-04-30	0.00000000	0.0000000	0.0000000
2009-05-31	0.00000000	0.5426935	0.0000000
2009-06-30	0.00000000	0.8178131	0.0000000
2009-07-31	0.00000000	1.1374436	0.3333183
2009-08-31	0.00000000	1.6664580	0.8092256

	Fixed.Income.Arbitrage	Global.Macro	Long.Short.Equity
1997-01-31	NA	NA	NA
1997-02-28	NA	NA	NA
1997-03-31	NA	NA	NA
1997-04-30	NA	NA	NA
1997-05-31	NA	NA	NA
1997-06-30	NA	NA	NA
1997-07-31	NA	NA	NA
1997-08-31	NA	NA	NA
1997-09-30	NA	NA	NA
1997-10-31	NA	NA	NA
1997-11-30	NA	NA	NA
1997-12-31	NA	NA	NA
1998-01-31	NA	NA	NA
1998-02-28	NA	NA	NA
1998-03-31	NA	NA	NA
1998-04-30	NA	NA	NA
1998-05-31	NA	NA	NA
1998-06-30	NA	NA	NA
1998-07-31	NA	NA	NA
1998-08-31	NA	NA	NA
1998-09-30	NA	NA	NA
1998-10-31	NA	NA	NA
1998-11-30	NA	NA	NA
1998-12-31	NA	NA	NA
1999-01-31	NA	NA	NA
1999-02-28	NA	NA	NA
1999-03-31	NA	NA	NA
1999-04-30	NA	NA	NA
1999-05-31	NA	NA	NA

1999-06-30	NA	NA	NA
1999-07-31	NA	NA	NA
1999-08-31	NA	NA	NA
1999-09-30	NA	NA	NA
1999-10-31	NA	NA	NA
1999-11-30	NA	NA	NA
1999-12-31	NA	NA	NA
2000-01-31	NA	NA	NA
2000-02-29	NA	NA	NA
2000-03-31	NA	NA	NA
2000-04-30	2.0425913	1.7293964	1.35357325
2000-05-31	2.1745271	1.5450431	1.20423108
2000-06-30	2.1745271	1.9444692	1.66003307
2000-07-31	2.1745271	2.0400814	1.66003307
2000-08-31	2.1745271	2.6654332	1.66003307
2000-09-30	2.1745271	2.2840350	1.63609029
2000-10-31	2.1745271	2.2224539	1.50932585
2000-11-30	2.1745271	2.5392290	1.27484593
2000-12-31	2.1745271	2.7881230	1.64572027
2001-01-31	2.1745271	2.7881230	1.66003307
2001-02-28	2.1745271	2.6061424	1.25491407
2001-03-31	2.1745271	2.7018242	0.94333996
2001-04-30	2.1745271	2.7881230	1.31925443
2001-05-31	2.1745271	2.7881230	1.38468173
2001-06-30	2.1745271	2.7881230	1.41353663
2001-07-31	2.1745271	2.6873475	1.19165166
2001-08-31	2.1745271	2.7024548	1.04229451
2001-09-30	2.1490521	2.5249609	0.48135412
2001-10-31	2.1745271	2.7881230	0.63936766
2001-11-30	2.1274444	2.7881230	0.95232772
2001-12-31	2.1745271	2.7881230	1.22901146
2002-01-31	2.1745271	2.7881230	1.17192637
2002-02-28	2.1745271	2.6999887	0.97979376
2002-03-31	2.1745271	2.7881230	1.21821653
2002-04-30	2.1745271	2.7881230	1.15333917
2002-05-31	2.1745271	2.7881230	1.10064022
2002-06-30	2.1745271	2.7327965	0.70484256
2002-07-31	2.1745271	2.5350966	0.06148132
2002-08-31	2.1745271	2.6937776	0.12901372
2002-09-30	2.1097299	2.7881230	0.00000000

2002-10-31	1.9852417	2.5704503	0.06457720
2002-11-30	2.0913727	2.6888545	0.42686288
2002-12-31	2.1745271	2.7881230	0.18223322
2003-01-31	2.1745271	2.7881230	0.19043817
2003-02-28	2.1745271	2.7881230	0.12949608
2003-03-31	2.1745271	2.4782062	0.16237200
2003-04-30	2.1745271	2.7719843	0.63804803
2003-05-31	2.1745271	2.7881230	1.19569581
2003-06-30	2.1745271	2.7881230	1.39038314
2003-07-31	1.9928044	2.6999887	1.56776739
2003-08-31	2.0773764	2.7881230	1.66003307
2003-09-30	2.1745271	2.7881230	1.66003307
2003-10-31	2.1745271	2.7881230	1.66003307
2003-11-30	2.1745271	2.7881230	1.66003307
2003-12-31	2.1745271	2.7881230	1.66003307
2004-01-31	2.1745271	2.7881230	1.66003307
2004-02-29	2.1745271	2.7881230	1.66003307
2004-03-31	2.1745271	2.7881230	1.66003307
2004-04-30	2.1745271	2.3333712	1.40938243
2004-05-31	2.1745271	2.1247436	1.35602737
2004-06-30	2.1745271	2.0757131	1.49349953
2004-07-31	2.1745271	2.0395348	1.25721556
2004-08-31	2.1745271	1.9383575	1.22338628
2004-09-30	2.1745271	1.9590953	1.53966036
2004-10-31	2.1745271	2.3119513	1.65029065
2004-11-30	2.1745271	2.7881230	1.66003307
2004-12-31	2.1745271	2.7881230	1.66003307
2005-01-31	2.1745271	2.6696285	1.63459132
2005-02-28	2.1745271	2.7881230	1.66003307
2005-03-31	2.1745271	2.7201882	1.51521597
2005-04-30	2.1686542	2.5172766	1.23244691
2005-05-31	2.1490579	2.7385323	1.40716828
2005-06-30	2.1686346	2.7881230	1.66003307
2005-07-31	2.1745271	2.7881230	1.66003307
2005-08-31	2.1745271	2.7881230	1.66003307
2005-09-30	2.1745271	2.7881230	1.66003307
2005-10-31	2.1745271	2.6010497	1.39546847
2005-11-30	2.1745271	2.7881230	1.66003307
2005-12-31	2.1745271	2.7881230	1.66003307
2006-01-31	2.1745271	2.7881230	1.66003307

2006-02-28	2.1745271	2.7881230	1.66003307
2006-03-31	2.1745271	2.7881230	1.66003307
2006-04-30	2.1745271	2.7881230	1.66003307
2006-05-31	2.1745271	2.3930563	1.28009113
2006-06-30	2.1745271	2.3547667	1.18451306
2006-07-31	2.1745271	2.3700733	1.13657542
2006-08-31	2.1745271	2.2701903	1.31087521
2006-09-30	2.1745271	2.0974389	1.31851612
2006-10-31	2.1745271	2.3451390	1.60934132
2006-11-30	2.1745271	2.7881230	1.66003307
2006-12-31	2.1745271	2.7881230	1.66003307
2007-01-31	2.1745271	2.7881230	1.66003307
2007-02-28	2.1745271	2.7881230	1.66003307
2007-03-31	2.1745271	2.7881230	1.66003307
2007-04-30	2.1745271	2.7881230	1.66003307
2007-05-31	2.1745271	2.7881230	1.66003307
2007-06-30	2.1745271	2.7881230	1.66003307
2007-07-31	2.1745271	2.7881230	1.66003307
2007-08-31	2.0801345	2.4936268	1.41710140
2007-09-30	2.1745271	2.7881230	1.66003307
2007-10-31	2.1745271	2.7881230	1.66003307
2007-11-30	1.9888165	2.6290342	1.31613875
2007-12-31	2.0596846	2.7881230	1.38157939
2008-01-31	2.0360335	2.7630048	0.74746475
2008-02-29	1.9389827	2.7881230	0.96634061
2008-03-31	1.3137790	2.3567595	0.58846047
2008-04-30	1.6888344	2.5543095	0.93773632
2008-05-31	1.8933096	2.7881230	1.28538558
2008-06-30	1.8395642	2.7881230	1.03003269
2008-07-31	1.7936755	2.2420076	0.61275702
2008-08-31	1.7876882	1.8964095	0.37588004
2008-09-30	0.7240125	1.0568050	0.00000000
2008-10-31	0.0000000	0.6289441	0.00000000
2008-11-30	0.0000000	0.7185808	0.00000000
2008-12-31	0.0000000	1.0353621	0.00000000
2009-01-31	0.0000000	1.1129900	0.00000000
2009-02-28	0.0000000	0.9649504	0.00000000
2009-03-31	0.0000000	1.0935314	0.00000000
2009-04-30	0.0000000	1.4294687	0.00000000
2009-05-31	0.0000000	2.3190332	0.00000000

2009-06-30	0.0415280	2.1232727	0.00000000
2009-07-31	0.7185872	2.5438729	0.00000000
2009-08-31	1.1349164	2.6699294	0.14479900

	Merger.Arbitrage	Relative.Value	Short.Selling	Funds.of.Funds
1997-01-31	NA	NA	NA	NA
1997-02-28	NA	NA	NA	NA
1997-03-31	NA	NA	NA	NA
1997-04-30	NA	NA	NA	NA
1997-05-31	NA	NA	NA	NA
1997-06-30	NA	NA	NA	NA
1997-07-31	NA	NA	NA	NA
1997-08-31	NA	NA	NA	NA
1997-09-30	NA	NA	NA	NA
1997-10-31	NA	NA	NA	NA
1997-11-30	NA	NA	NA	NA
1997-12-31	NA	NA	NA	NA
1998-01-31	NA	NA	NA	NA
1998-02-28	NA	NA	NA	NA
1998-03-31	NA	NA	NA	NA
1998-04-30	NA	NA	NA	NA
1998-05-31	NA	NA	NA	NA
1998-06-30	NA	NA	NA	NA
1998-07-31	NA	NA	NA	NA
1998-08-31	NA	NA	NA	NA
1998-09-30	NA	NA	NA	NA
1998-10-31	NA	NA	NA	NA
1998-11-30	NA	NA	NA	NA
1998-12-31	NA	NA	NA	NA
1999-01-31	NA	NA	NA	NA
1999-02-28	NA	NA	NA	NA
1999-03-31	NA	NA	NA	NA
1999-04-30	NA	NA	NA	NA
1999-05-31	NA	NA	NA	NA
1999-06-30	NA	NA	NA	NA
1999-07-31	NA	NA	NA	NA
1999-08-31	NA	NA	NA	NA
1999-09-30	NA	NA	NA	NA
1999-10-31	NA	NA	NA	NA
1999-11-30	NA	NA	NA	NA
1999-12-31	NA	NA	NA	NA

2000-01-31	NA	NA	NA	NA
2000-02-29	NA	NA	NA	NA
2000-03-31	NA	NA	NA	NA
2000-04-30	5.700486	4.0304136	0.000000000	1.3966865
2000-05-31	5.700486	4.0304136	0.000000000	1.1843059
2000-06-30	5.700486	4.0304136	0.000000000	1.7093728
2000-07-31	5.700486	4.0304136	0.000000000	1.6721479
2000-08-31	5.700486	4.0304136	0.000000000	1.8592553
2000-09-30	5.700486	4.0304136	0.000000000	1.7429934
2000-10-31	5.700486	4.0158983	0.000000000	1.5659163
2000-11-30	5.700486	4.0304136	0.000000000	1.2095651
2000-12-31	5.700486	4.0304136	0.000000000	1.4377243
2001-01-31	5.700486	4.0304136	0.000000000	1.8119322
2001-02-28	5.700486	4.0304136	0.000000000	1.6612435
2001-03-31	5.385609	3.9904685	0.000000000	1.5453223
2001-04-30	5.683274	4.0304136	0.000000000	1.7207887
2001-05-31	5.700486	4.0304136	0.000000000	1.8546916
2001-06-30	5.250221	4.0304136	0.000000000	1.8592553
2001-07-31	5.655878	4.0304136	0.000000000	1.7920533
2001-08-31	5.700486	3.9176154	0.000000000	1.8239137
2001-09-30	4.293082	3.0953001	0.000000000	1.5823691
2001-10-31	4.737356	3.6956788	0.000000000	1.7424452
2001-11-30	4.810428	4.0304136	0.000000000	1.8396122
2001-12-31	5.044251	4.0304136	0.000000000	1.8592553
2002-01-31	5.441290	4.0304136	0.021926929	1.8592553
2002-02-28	5.213408	3.9904685	0.074046144	1.8341177
2002-03-31	5.588745	4.0304136	0.011660756	1.8592553
2002-04-30	5.521817	4.0304136	0.076108774	1.8592553
2002-05-31	5.521817	4.0304136	0.120732524	1.8592553
2002-06-30	4.631470	3.6380869	0.141043627	1.6987643
2002-07-31	3.704035	2.9469795	0.141043627	1.4588931
2002-08-31	4.027199	3.1624015	0.141043627	1.5220539
2002-09-30	3.878445	2.7492983	0.141043627	1.4655348
2002-10-31	4.047907	3.0621311	0.087463219	1.4122759
2002-11-30	4.332339	3.7385937	0.010909081	1.5924767
2002-12-31	4.573523	3.8225014	0.070278089	1.7223771
2003-01-31	4.782413	4.0304136	0.091642547	1.8429741
2003-02-28	4.876244	4.0158983	0.108566850	1.8592553
2003-03-31	4.839729	4.0304136	0.098729045	1.8525593
2003-04-30	5.351101	4.0304136	0.006640011	1.8592553

2003-05-31	5.700486	4.0304136	0.000000000	1.8592553
2003-06-30	5.700486	4.0304136	0.000000000	1.8592553
2003-07-31	5.700486	4.0304136	0.000000000	1.8592553
2003-08-31	5.700486	4.0304136	0.000000000	1.8592553
2003-09-30	5.700486	4.0304136	0.000000000	1.8592553
2003-10-31	5.700486	4.0304136	0.000000000	1.8592553
2003-11-30	5.700486	4.0304136	0.000000000	1.8592553
2003-12-31	5.700486	4.0304136	0.000000000	1.8592553
2004-01-31	5.700486	4.0304136	0.000000000	1.8592553
2004-02-29	5.700486	4.0304136	0.000000000	1.8592553
2004-03-31	5.700486	4.0304136	0.000000000	1.8592553
2004-04-30	5.499616	3.8664440	0.000000000	1.7446899
2004-05-31	5.499616	3.7311238	0.000000000	1.6053952
2004-06-30	5.587026	3.8114078	0.000000000	1.6629558
2004-07-31	5.109590	3.8369349	0.000000000	1.5795923
2004-08-31	5.166612	3.9496338	0.000000000	1.5625623
2004-09-30	5.383422	4.0304136	0.000000000	1.7295065
2004-10-31	5.700486	4.0304136	0.000000000	1.8434007
2004-11-30	5.700486	4.0304136	0.000000000	1.8592553
2004-12-31	5.700486	4.0304136	0.000000000	1.8592553
2005-01-31	5.700486	4.0304136	0.000000000	1.8592553
2005-02-28	5.700486	4.0304136	0.000000000	1.8592553
2005-03-31	5.700486	3.8774214	0.000000000	1.7853034
2005-04-30	5.156074	3.4797177	0.000000000	1.5449320
2005-05-31	5.644002	3.4723513	0.000000000	1.5755626
2005-06-30	5.700486	3.8189605	0.000000000	1.7956026
2005-07-31	5.700486	4.0304136	0.000000000	1.8592553
2005-08-31	5.700486	4.0304136	0.000000000	1.8592553
2005-09-30	5.700486	4.0304136	0.000000000	1.8592553
2005-10-31	4.945627	3.8920476	0.000000000	1.6061580
2005-11-30	5.522233	4.0304136	0.000000000	1.8592553
2005-12-31	5.700486	4.0304136	0.000000000	1.8592553
2006-01-31	5.700486	4.0304136	0.000000000	1.8592553
2006-02-28	5.700486	4.0304136	0.000000000	1.8592553
2006-03-31	5.700486	4.0304136	0.000000000	1.8592553
2006-04-30	5.700486	4.0304136	0.000000000	1.8592553
2006-05-31	5.700486	3.9395020	0.000000000	1.6337026
2006-06-30	5.700486	4.0157077	0.000000000	1.5860845
2006-07-31	5.700486	4.0304136	0.000000000	1.5775770
2006-08-31	5.700486	4.0304136	0.000000000	1.6891395

2006-09-30	5.700486	4.0304136	0.000000000	1.6840670
2006-10-31	5.700486	4.0304136	0.000000000	1.8592553
2006-11-30	5.700486	4.0304136	0.000000000	1.8592553
2006-12-31	5.700486	4.0304136	0.000000000	1.8592553
2007-01-31	5.700486	4.0304136	0.000000000	1.8592553
2007-02-28	5.700486	4.0304136	0.000000000	1.8592553
2007-03-31	5.700486	4.0304136	0.000000000	1.8592553
2007-04-30	5.700486	4.0304136	0.000000000	1.8592553
2007-05-31	5.700486	4.0304136	0.000000000	1.8592553
2007-06-30	5.427124	4.0304136	0.000000000	1.8592553
2007-07-31	5.147092	4.0304136	0.000000000	1.8592553
2007-08-31	5.152278	3.7489386	0.000000000	1.4793420
2007-09-30	5.700486	4.0304136	0.000000000	1.8132502
2007-10-31	5.700486	4.0304136	0.000000000	1.8592553
2007-11-30	4.924489	3.6195462	0.034627776	1.6078822
2007-12-31	4.793962	3.7000751	0.066322296	1.6755502
2008-01-31	4.127709	3.2629896	0.137118750	1.2025419
2008-02-29	4.443080	3.4985454	0.141043627	1.4460226
2008-03-31	4.205483	2.8924765	0.141043627	0.9846968
2008-04-30	4.980644	3.3725866	0.079696525	1.1538522
2008-05-31	5.678680	3.9506077	0.060527825	1.4487260
2008-06-30	5.113059	3.6426512	0.141043627	1.3313498
2008-07-31	5.170077	3.1785818	0.141043627	0.8632975
2008-08-31	5.433093	3.0929962	0.113152016	0.5823381
2008-09-30	3.969312	0.9772075	0.141043627	0.0000000
2008-10-31	2.637307	0.0000000	0.141043627	0.0000000
2008-11-30	2.669908	0.0000000	0.141043627	0.0000000
2008-12-31	3.536102	0.0000000	0.122235902	0.0000000
2009-01-31	3.833860	0.0000000	0.141043627	0.0000000
2009-02-28	3.865743	0.0000000	0.141043627	0.0000000
2009-03-31	4.521782	0.0000000	0.079557005	0.0000000
2009-04-30	4.943479	0.0000000	0.000000000	0.0000000
2009-05-31	5.494638	1.0024319	0.000000000	0.0000000
2009-06-30	5.700486	1.3954100	0.000000000	0.0000000
2009-07-31	5.700486	2.3814011	0.000000000	0.0000000
2009-08-31	5.700486	2.9859556	0.000000000	0.0000000

	Convertible Arbitrage	CTA Global	Distressed Securities
1997-01-31	NA	NA	NA
1997-02-28	NA	NA	NA
1997-03-31	NA	NA	NA

1997-04-30	NA	NA	NA
1997-05-31	NA	NA	NA
1997-06-30	NA	NA	NA

	Emerging Markets	Equity Market Neutral	Event Driven
1997-01-31	NA	NA	NA
1997-02-28	NA	NA	NA
1997-03-31	NA	NA	NA
1997-04-30	NA	NA	NA
1997-05-31	NA	NA	NA
1997-06-30	NA	NA	NA

	Fixed Income Arbitrage	Global Macro	Long/Short Equity
1997-01-31	NA	NA	NA
1997-02-28	NA	NA	NA
1997-03-31	NA	NA	NA
1997-04-30	NA	NA	NA
1997-05-31	NA	NA	NA
1997-06-30	NA	NA	NA

	Merger Arbitrage	Relative Value	Short Selling	Funds of Funds
1997-01-31	NA	NA	NA	NA
1997-02-28	NA	NA	NA	NA
1997-03-31	NA	NA	NA	NA
1997-04-30	NA	NA	NA	NA
1997-05-31	NA	NA	NA	NA
1997-06-30	NA	NA	NA	NA

4   Economic Drawdown

To calculate the economic drawdown cumulative return and economic max is calculated for each point. The Return series,risk free return(rf) and the lookback period(h) is taken as the input. Economic Drawdown is given by the equation

$$EDD(t) = 1 - \frac{W_t}{EM(t)}$$

Here EM stands for Economic Max.

4.1   Usage

The Return Series ,risk free return and the type of cumulative return is taken as the input. The Return Series can be an xts, vector, matrix, data frame, timeSeries or zoo object of asset returns.

```
> data(edhec)
> head(EDDCOPS(edhec,delta = 0.1,gamma = 0.7,Rf = 0))
```

	Convertible Arbitrage	CTA Global	Distressed Securities
1997-01-31	0	0.00000000	0.0000
1997-02-28	0	0.00000000	0.0000
1997-03-31	0	0.00210000	0.0012
1997-04-30	0	0.01906430	0.0000
1997-05-31	0	0.02053570	0.0000
1997-06-30	0	0.01221026	0.0000

	Emerging Markets	Equity Market Neutral	Event Driven
1997-01-31	0.0000000	0	0.00000000
1997-02-28	0.0000000	0	0.00000000
1997-03-31	0.0120000	0	0.00230000
1997-04-30	0.0002428	0	0.00279885
1997-05-31	0.0000000	0	0.00000000
1997-06-30	0.0000000	0	0.00000000

	Fixed Income Arbitrage	Global Macro	Long/Short Equity
1997-01-31	0	0.0000	0.0000000000
1997-02-28	0	0.0000	0.0006000000
1997-03-31	0	0.0119	0.0089949600
1997-04-30	0	0.0000	0.0006705177
1997-05-31	0	0.0000	0.0000000000
1997-06-30	0	0.0000	0.0000000000

	Merger Arbitrage	Relative Value	Short Selling	Funds of Funds
1997-01-31	0e+00	0	0.00000000	0.00000000
1997-02-28	0e+00	0	0.00000000	0.00000000
1997-03-31	0e+00	0	0.00000000	0.00770000
1997-04-30	1e-04	0	0.01290000	0.00680693
1997-05-31	0e+00	0	0.08564927	0.00000000
1997-06-30	0e+00	0	0.09159255	0.00000000

5 Economic Drawdown Controlled Optimal Strategy

The Economic Drawdown Controlled Optimal Portfolio Strategy(EDD-COPS) has the portfolio fraction allocated to single risky asset as:

$$x_t = Max\left\{0, \left(\frac{\lambda/\sigma + 1/2}{1 - \delta.\gamma}\right) . \left[\frac{\delta - EDD(t)}{1 - EDD(t)}\right]\right\}$$

The risk free asset accounts for the rest of the portfolio allocation $x_f = 1 - x_t$

5.1 Usage

```
> data(edhec)
> head(EDDCOPS(edhec,delta = 0.1,gamma = 0.7,Rf = 0))
```

	Convertible Arbitrage	CTA Global	Distressed Securities
1997-01-31	0	0.00000000	0.0000
1997-02-28	0	0.00000000	0.0000
1997-03-31	0	0.00210000	0.0012
1997-04-30	0	0.01906430	0.0000
1997-05-31	0	0.02053570	0.0000
1997-06-30	0	0.01221026	0.0000

	Emerging Markets	Equity Market Neutral	Event Driven
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1997-02-28	0.0000000	0	0.00000000
1997-03-31	0.0120000	0	0.00230000
1997-04-30	0.0002428	0	0.00279885
1997-05-31	0.0000000	0	0.00000000
1997-06-30	0.0000000	0	0.00000000

	Fixed Income Arbitrage	Global Macro	Long/Short Equity
1997-01-31	0	0.0000	0.0000000000
1997-02-28	0	0.0000	0.0006000000
1997-03-31	0	0.0119	0.0089949600
1997-04-30	0	0.0000	0.0006705177
1997-05-31	0	0.0000	0.0000000000
1997-06-30	0	0.0000	0.0000000000

	Merger Arbitrage	Relative Value	Short Selling	Funds of Funds
1997-01-31	0e+00	0	0.00000000	0.00000000
1997-02-28	0e+00	0	0.00000000	0.00000000
1997-03-31	0e+00	0	0.00000000	0.00770000
1997-04-30	1e-04	0	0.01290000	0.00680693
1997-05-31	0e+00	0	0.08564927	0.00000000
1997-06-30	0e+00	0	0.09159255	0.00000000