Absolute Ranks, Percentile Ranks, and Fractional Ranks
Methodology

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Absolute Ranks

In order to assign percentile ranks to funds, Morningstar first assigns an absolute rank.

The following procedure is used for assigning absolute ranks to funds:

1. Pull in the returns for the time period being ranked for all funds in a category.

2. Sort the returns in descending order.

3. Assign a value of 1 to the highest return value.

4. When two share classes or two distinct portfolios share the same return, assign the same absolute rank to the share class or distinct portfolio.

Exhibit 1 Assigning the Same Rank

Name	Total Return Annualized 3-Year	Absolute Rank
AXP Global Technology A	1.8386	36
AXP Global Technology Y	1.8386	36

5. For the next return that has a different value, assign a rank equal to the absolute rank of the previous fund, plus the number of share classes or distinct portfolios that shared the same return. In the example below, two share classes shared the same return of 1.8386.

Exhibit 2 Assigning the Next Rank After Equal Values

Name	Total Return Annualized 3-Year	Absolute Rank
AXP Global Technology A	1.8386	36
AXP Global Technology Y	1.8386	36
Fidelity Select Software & Comp	1.7194	38

6. Continue counting until the last absolute rank is assigned. The last absolute rank value should be equal to the number of share classes in the category (n). This value will be used in the formula for calculating the percentile rank.

Please note that Morningstar freezes absolute ranks and counts at the end of each month. If a discrepancy is found in a fund return, Morningstar may recalculate the fund's percentile rank by using breakpoints. By using breakpoints, Morningstar does not have to recalculate the percentile ranking for the entire peer group. Recalculation is not possible with absolute ranks; therefore, instances may occur where absolute rank and percentile rank do not match. We expect these instances to occur very seldom.

Percentile Ranks

Morningstar uses the following formula to determine the percentile rank of an item in a series. It is commonly used for calculating an investment's total return percentile rank against others in its Morningstar Category. With this method, percentile ranks always range from 1 (best) to 100 (worst), with all intermediate values spread evenly over that range.

All observations are ranked in the desired order (usually descending). Percentile ranks are assigned as follows:

$$PctRank(v[i]) = RoundUp\{100 * \left({}^{C[i]-1}/n - 1\right)\}$$

With a special case whereby any PctRank=0 is transformed to PctRank=1
RoundUp is a function to round the result up to the next integer.

where:
PctRank(v[i]) = Percentile rank for fund i
v[i]   = The value being ranked for fund i
C[i]   = The absolute rank of fund i
n   = The total number of observations

Morningstar does not require a minimum number of items in order to percentile-rank a set of data. For example, if there are only three funds in a category for a certain time period, we will percentile-rank those three (1, 50, 100).

Exhibit 3 Percentile Ranks Mapped Into Deciles and Quartiles

Range	Decile	Range	Quartile
0 < Percentile Rank <=10	1	0 < Percentile Rank <=25	1
10 < Percentile Rank <=20	2	25 < Percentile Rank <=50	2
20 < Percentile Rank <=30	3	50 < Percentile Rank <=75	3
30 < Percentile Rank <=40	4	75 < Percentile Rank <=100	4
40 < Percentile Rank <=50	5		
50 < Percentile Rank <=60	6		
60 < Percentile Rank <=70	7		
70 < Percentile Rank <=80	8		
80 < Percentile Rank <=90	9		
90 < Percentile Rank <=100	10		

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Fractional Ranks

Category ranks for performance-based data such as trailing and periodic returns are now based on the number of distinct portfolios in a category, rather than giving equal weight to each share class. This ensures that funds with multiple share classes do not have a disproportionate weight compared with single-share funds. For example, if a fund has five share classes with three years of returns available, each share class will get a weight of 0.20 for ranking three-year returns. When several funds are merely different share classes of the same underlying portfolio, each share class is counted as a fraction of that fund, as in the case of Master/Feeder funds. Formerly, this methodology was only used when ranking the Morningstar Risk-Adjusted Return in order to derive the Morningstar Rating for funds, or the "star rating."

The first step in assigning ranks is to assign a fractional weight to each fund in the category.

Exhibit 4 Assign a Fractional Weight for Each Fund in the Category

Name	Oldest Share Class	3-Year Return %	Fractional Weight
Convertible A	Yes	−5.412	0.2
Convertible Adv	No	−5.412	0.2
Convertible B	No	−6.125	0.2
Convertible C	No	−6.107	0.2
Convertible I	No	−5.178	0.2
US Convertible I	Yes	−3.91	0.5
US Convertible II	No	−3.809	0.5
Convertible Securities A	Yes	−10.835	0.33
Convertible Securities B	No	−10.835	0.33
Convertible Securities C	No	−11.484	0.33
Convertible Securities Adv	No	—	—

The fractional weight is assigned based on the number of share classes and whether each share class has a return available. In this example, Convertible Securities is assigned a fractional weight based on three share classes because the fourth share class, the Adv share class, does not have a three-year return.

There are three distinct portfolios in the example above: Convertible, US Convertible, and Convertible Securities.

The next step is to sort all the funds in the category with the highest value first and the lowest value last.

Exhibit 5 Sort Return (and Most Other Data Points) in Descending Order

Name	Oldest Share Class	3-Year Return %	Fractional Weight
US Convertible II	No	−3.809	0.5
US Convertible I	Yes	−3.91	0.5
Convertible I	No	−5.178	0.2
Convertible A	Yes	−5.412	0.2
Convertible Adv	No	−5.412	0.2
Convertible C	No	−6.107	0.2
Convertible B	No	−6.125	0.2
Convertible Securities A	Yes	−10.835	0.33
Convertible Securities B	No	−10.835	0.33
Convertible Securities C	No	−11.484	0.33

Next, calculate the cumulative weight for each share class. There are two steps to assigning the cumulative weight.

Step 1. The cumulative weight for the first share class is equal to that fund's fractional weight. The cumulative weight for the second share class is equal to the fractional weight of the second share class plus the cumulative weight of the first share class, and so forth.

Exhibit 6 Share Class Cumulative Weight

Name	Oldest Share Class	3-Year Return %	Fractional Weight	Cumulative Weight Step 1
US Convertible II	No	−3.809	0.5	0.5
US Convertible I	Yes	−3.91	0.5	1
Convertible I	No	−5.178	0.2	1.2
Convertible A	Yes	−5.412	0.2	1.4
Convertible Adv	No	−5.412	0.2	1.6
Convertible C	No	−6.107	0.2	1.8
Convertible B	No	−6.125	0.2	2
Convertible Securities A	Yes	−10.835	0.33	2.33
Convertible Securities B	No	−10.835	0.33	2.67
Convertible Securities C	No	−11.484	0.33	3

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Step 2. Compare the returns of the share classes. When two or more share classes have the same return, they should be given the cumulative weight of the first tied share class. The tied share classes are sorted in ascending order of their fractional weights.

In the example above, if we did not undertake this step before assigning the percentile rank, Convertible Securities A and Convertible Securities B would receive different rankings even though they have the same return.

Exhibit 7 Share-Class Return Comparison

Name	Oldest Share Class	3-Year Return %	Fractional Weight	Final Cumulative Weight
US Convertible II	No	-3.809	0.5	0.5
US Convertible I	Yes	-3.91	0.5	1
Convertible I	No	-5.178	0.2	1.2
Convertible A	Yes	-5.412	0.2	1.4
Convertible Adv	No	-5.412	0.2	1.4
Convertible C	No	-6.107	0.2	1.8
Convertible B	No	-6.125	0.2	2
Convertible Securities A	Yes	-10.835	0.33	2.33
Convertible Securities B	No	-10.835	0.33	2.33
Convertible Securities C	No	-11.484	0.33	3

The last share class in the peer group receives a cumulative weight equal to the number of distinct portfolios, except when there is a tie for the last value. In this case, the final cumulative weight remains as that of the first of the values tied for last.

The last step is to assign a percentile rank to each share class.

The formula used to calculate the percentile ranks for each share class is:

$$PctRank(v[i]) = RoundUp\left\{ 100 * \left(\frac{(C[i] - Cmin)}{(Cmax - Cmin)} \right) \right\}$$

With a special case whereby any PctRank=0 is transformed to PctRank=1. RoundUp is a function to round the result up to the next integer.

The exception is when ranking Morningstar risk adjusted returns for the calculation of the Morningstar Rating, when the formula is:

$$PctRank(v[i]) = 100 * \left(\frac{(C[i] - C\min)}{(C\max - C\min)} \right)$$

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where:

PctRank(v[i])	=	Percentile rank for fund i
v[i]	=	The value being ranked for fund i
C[i]	=	The cumulative weight of fund i
Cmin	=	The minimum of the cumulative weight's rank
Cmax	=	The maximum of cumulative weight's rank

If a category has only one share class for any period, that share class is assigned a percentile rank of 1. Morningstar does not require a minimum number of distinct portfolios to percentile-rank a set of data. Five distinct portfolios are required to calculate the Morningstar Rating.

The reason the percentile rank is not rounded in the calculation of Morningstar Ratings is because the breakpoints between some of the rating bands are not at round values. The five rating bands: top 10% is 5 stars; the next 22.5% is 4 stars; the next 35% is 3 stars; the next 22.5% is 2 stars; and the bottom 10% is 1 star. Thus, the breakpoint between 4 stars and 3 stars is at 32.5%, and the breakpoint between 3 stars and 2 stars is at 67.5%. It would not be possible to assign the ratings precisely if the percentiles were rounded. The percentile rank for Morningstar risk adjusted returns have a range of 0 - 100.

Exhibit 8 Category Share-Class Rank

Name	Oldest Share Class	3-Year Return %	Final Cumulative Weight	Distinct Portfolio Percentile Rank
US Convertible II	No	-3.809	0.5	1
US Convertible I	Yes	-3.91	1	20
Convertible I	No	-5.178	1.2	28
Convertible A	Yes	-5.412	1.4	36
Convertible Adv	No	-5.412	1.4	36
Convertible C	No	-6.107	1.8	52
Convertible B	No	-6.125	2	60
Convertible Securities A	Yes	-10.835	2.33	74
Convertible Securities B	No	-10.835	2.33	74
Convertible Securities C	No	-11.484	3	100

This technique allows Morningstar to rank each fund share class individually, while ensuring that any single portfolio with many versions does not crowd out others within a range.

Many funds are offering hedged share classes as part of their funds lineup. These share classes are for investors who want to hold cross-border assets without the foreign exchange risk.

To accommodate funds within the Europe, Asia, and Africa classification region, Morningstar puts the hedged currency share class in a different category, which reflects the fund's investing style as well as the currency-hedging strategy.

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For rating purposes, a portfolio with a hedged share class and a nonhedged share class will be represented as distinct portfolios in different categories.

Exhibit 9 Portfolio Example: Investment A, Nonhedged

Dollar Bond	Category	Fractional Weight
A1 USD	USD	0.5
A2 EUR	USD	0.5

This example represents one distinct nonhedged portfolio in the USD category. Note the base currency of a class does not have an impact on its classification absent hedging.

Exhibit 10 Portfolio Example: Investment A, Hedged

Dollar Bond	Category	Fractional Weight
A1 EUR Hedged	EUR	0.5
A2 EUR Hedged	EUR	0.5

This example represents one distinct hedged portfolio in the EUR category. These classes are placed in a different category as they are hedged to euros.

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Methodology Changes

The following is a timeline of significant methodology changes to the Morningstar ranking methodologies.

Date: August 2017

Description: Morningstar moved all percentile calculations based on categories (except for Fee Level calculations) from equal-weighted ranking to fractional-weighted ranking. In addition, there was a minor adjustment to the percentile-ranking formula. The old formula was:

PctRank = i for i = 1

FLOOR [99*(i-1)/(n-1)+1] for i > 1,

where

n	=	Total number of observations
i	=	Absolute rank of each observation
Floor	=	A function that rounds down to the next integer (for example, 89.83 rounds down to 89)

Date: November 2016

Description: Minor adjustment to the fractional ranking formula for the Morningstar Rating. The old formula was:

$$PctRank(v[i]) = 100 * \left({C[i]} \big/ {Cmax} \right)$$

where C[i] is the cumulative weight of share class i and Cmax is the maximum cumulative weight of all share classes (also equal to the total number of distinct funds in the peer group).

Date: June 2018

Description: Clarified the text around the formula used for Morningstar risk adjusted returns. The rounding function is not used nor the special case replacing a rank of 0 with 1. Hence Morningstar risk adjusted return percentile ranks have a range of 0-100. Ⓜ

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