

# Z-scores: Takeaways

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## Syntax

- Writing a function that converts a value to a z-score:

```
def z_score(value, array, bessell = 0):
```

```
    mean = sum(array) / len(array)
```

```
    from numpy import std
```

```
    st_dev = std(array, ddof = bessell)
```

```
    distance = value - mean
```

```
    z = distance / st_dev
```

```
    return z
```

- Standardizing a `Series` :

```
standardized_distro = Series.apply(
```

```
    lambda x: (x - Series.mean()) / Series.std()
```

```
)
```

- Transforming a standardized distribution to a different distribution, with a predefined mean and standard deviation:

```
mean = some_mean
```

```
st_dev = some_standard_deviation
```

```
standardized_distro = Series.apply(
```

```
    lambda z: z * st_dev + mean
```

```
)
```

## Concepts

- A **z-score** is a number that describes the location of a value within a distribution. Non-zero z-scores (+1, -1.5, +2, -2, etc.) consist of two parts:
  - A *sign*, which indicates whether the value is above or below the mean.

- A *value*, which indicates the number of standard deviations that a value is away from the mean.
- The z-score of the mean is 0.
- To compute the z-score  $z$  for a value  $x$  coming from a population with mean  $\mu$  and standard deviation  $\sigma$ , we can use this formula:

$$z = \frac{x - \mu}{\sigma}$$

- To compute the z-score  $z$  for a value  $x$  coming from a sample with mean  $\bar{x}$  and standard deviation  $s$ , we can use this formula:

$$z = \frac{x - \bar{x}}{s}$$

- We can **standardize** any distribution by transforming all its values to z-scores. The resulting distribution will have a mean of 0 and a standard deviation of 1. Standardized distributions are often called **standard distributions**.
- Standardization is useful for **comparing values** coming from distributions with different means and standard deviations.
- We can transform any population of z-scores with mean  $\mu_z = 0$  and  $\sigma_z = 1$  to a distribution with any mean  $\mu$  and any standard deviation  $\sigma$  by converting each z-score  $z$  to a value  $x$  using this formula:

$$x = z\sigma + \mu$$

- We can transform any sample of z-scores with mean  $\bar{x}_z = 0$  and  $s_z = 1$  to a distribution with any mean  $\bar{x}$  and any standard deviation  $s$  by converting each z-score  $z$  to a value  $x$  using this formula:

$$x = zs + \bar{x}$$

## Resources

- [The `z-score\(\)` function from `scipy.stats.mstats`](#) — useful for standardizing distributions.
- [The Wikipedia entry on z-scores](#).



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