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Types of Forecasts

Reliable economic forecasts are essential to making smart investment decisions. In that light, understanding how to interpret different types of economic forecasts is essential. In this paper we examine three different forecast types, and discuss their uses and advantages.

Reliable economic forecasts are critical for making sound business decisions relating to investments, capital expenditures, and other strategic initiatives. Economic forecasts can be made of a wide variety of variables, such as revenue, profitability, and any factors that measure economic activity. Such forecasts are commonly reported in a variety of ways, as illustrated in Figure 1:

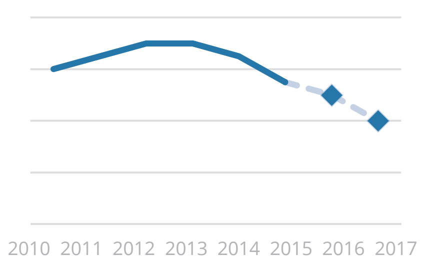

Figure 1A Point forecasts are reported as a single number (least complex)

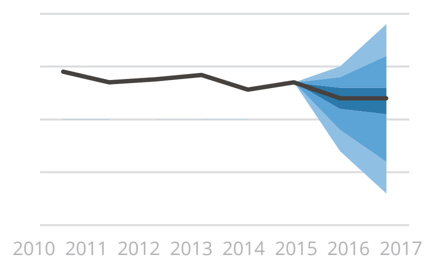

Figure 1B Interval forecasts are reported as an interval within which the outcome is expected to fall (more complex)

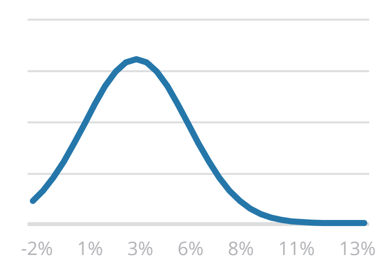

Figure 1C Density forecasts are reported as a full probability distribution (or density) for the outcome (most complex)

Point Forecasts

A common practice is to report economic forecasts as a single number, which is often referred to as a point forecast. Since the point forecast only reports a single number, the goal is to communicate the value that is closest to the eventual outcome, which by definition is not known and thus uncertain. In some sense, the point forecast is intended to represent the outcome that is “most likely” to occur.

Typically, the point forecast represents the expected value of the outcome and, accordingly, is a number that weights different possible outcomes by how likely they are to occur. As an illustration, suppose that there are three possible outcomes with corresponding probabilities of occurrence:

- Outcome of -4 that occurs with 25% probability;
- Outcome of 0 that occurs with 50% probability; and
- Outcome of +2 that occurs with 25% probability.

The expected value in this illustration would be -0.5, which is calculated as $-4 \times 0.25 + 0 \times 0.5 + 2 \times 0.25 = -0.5$. If the outcome in this illustration was repeatedly drawn a number of times from the listed distribution, then on average the value will be -0.5; this motivates reporting this particular value as the point forecast. Note that the outcome can never actually be -0.5 in this illustration; however, -0.5 is the value that, on average, is closest in expectation to the uncertain outcome.

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Alternatively, the point forecast can be reported as the median value of the possible outcomes. The median of a set of observations is the number such that one-half of the observations are below it, and one-half are above it. In our illustration, the median is zero.

A third alternative is to report the point forecast as the mode of the outcome distribution. The mode of a set of observations is the value in that set that is most likely to occur, or that is observed most often. In our illustration, the mode is zero.

Regardless of which measure is used to report the point forecast (i.e., expected value, median, or mode), point forecasts are well suited to computing and communicating revisions in forecasts. For example, if economic growth slows down or a company issues downbeat guidance, the point forecast will likely be revised downward relative to the previous forecast. The amount by which the forecast is reduced conveys a sense of the expected impact of the negative news on the future, uncertain outcome.

As an example of this, **Figure 2** shows the distribution of analysts' percentage revisions to their FY2016 revenue forecasts on 1/28/2016 following bad news about Boeing's prospects released on the previous day. As the figure shows, all analysts revised their 2016 forecasts downward following the news. For example, five analysts changed their 2016 forecasts by between 2.4 and 3.4 percent.

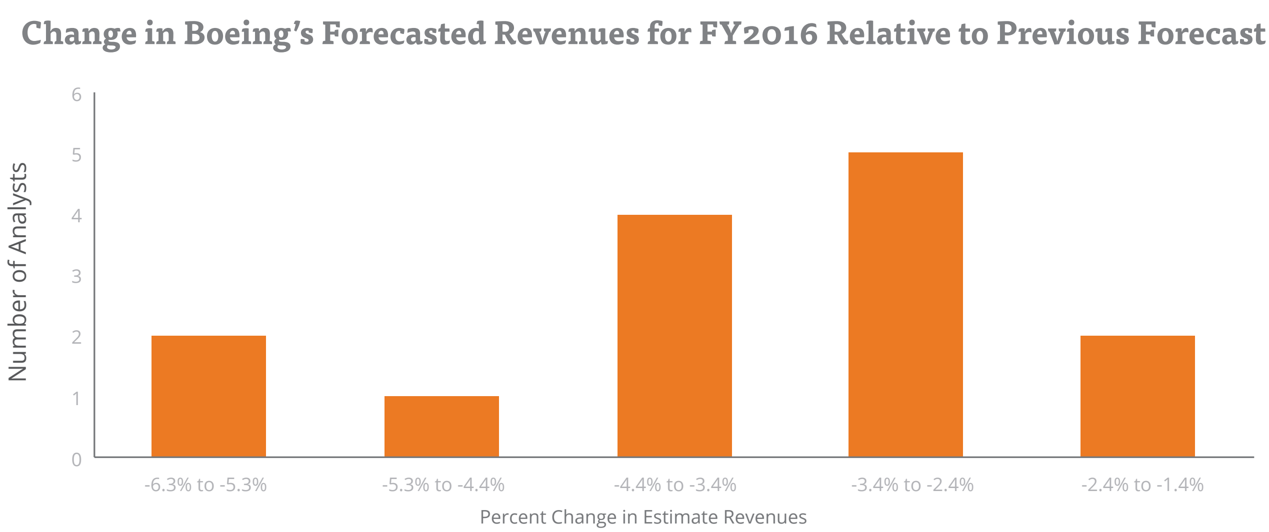

Figure 2 shows the distribution of analysts' percentage revision to their fiscal year 2016 Boeing revenue forecasts on January 28, 2016, following bad news about Boeing's prospects.

Point forecasts can be reported across different forecast horizons. For example, suppose the point forecasts of a company's revenue growth is as follows:

- 10% revenue growth in the next (first) fiscal year;
- 8% revenue growth in the following (second) fiscal year; and
- 5% revenue growth in the subsequent (third) fiscal year.

In this example, demonstrated in **Figure 3**, the point forecasts signal an expected slowdown in the growth of the company's revenues. Accordingly, point forecasts reported across multiple horizons can be used to map out a likely future trajectory that is being forecasted.

While point forecasts are easily communicated and represent a reasonable starting point for a forecasting analysis, they also have some shortcomings. Most importantly, point forecasts do not convey a sense of how much uncertainty surrounds a predicted outcome. Moreover, point forecasts do not indicate if and how the level of uncertainty varies over time.

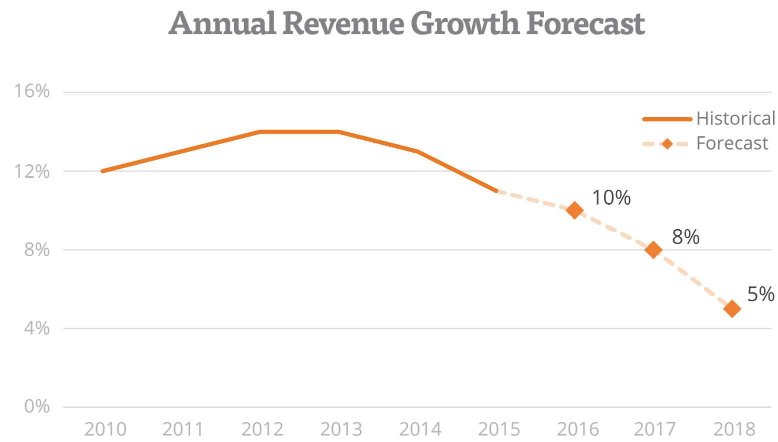

Figure 3 shows an example of a point forecast. This point forecast signals an expected slowdown in the growth of the company's revenues.

The global financial crisis of 2008-2009 provides an informative example. During the peak of the financial crisis, some companies ceased providing guidance for their earnings because the uncertainty of their revenue increased so much that the companies did not have sufficient confidence in their own forecasts. Naturally, a point forecast in this type of environment may not be interpreted with the same confidence as a point forecast issued under more normal circumstances during which revenues of companies are more stable and easier to predict.

Interval Forecasts

Interval forecasts are one way to communicate the amount of uncertainty surrounding a particular forecast. For a given level of confidence, expressed as a probability such as 25%, 50% or 80%, interval forecasts report the range of values for the outcome that will occur with this probability. For example, suppose that the point forecast of a company's revenue growth for the next fiscal year (e.g., 2016) is 3%. Additionally, suppose there is the following set of interval forecasts (see **Figure 4A**):

- 25% probability that the outcome will fall between 2% and 4%;
- 50% probability that the outcome will fall between 1% and 5%; and
- 80% probability that it will fall between -1% and 7%.

This interval forecast can be displayed in a so-called "fan chart". Fan charts often use different shades or colors to plot varying levels of confidence.

Figure 4A reveals a hypothetical forecast for a company during normal economic times. In contrast, during the global financial crisis of 2008-2009, the interval forecasts for this same hypothetical company's revenue growth might have been centered on -4%, with a 25% probability of falling between -8% and -2%, a 50% probability of falling between -14% and +2%, and an 80% probability of falling between -23% and +2%. See **Figure 4B.** There are three items to note from this illustration. First, the center of the distribution (i.e., point forecast) is shifted down between the two periods (from 3% to -4%), reflecting the difference in company performance between a normal growth period and a recession. Second, the uncertainty (as measured by the width of the interval forecasts) is greater during 2008-2009, reflecting the uncertain nature of a financial crisis. Third, the "downside risk," which is the probability of a large negative outcome, is particularly large in a crisis period, such that the interval forecast is no longer symmetric in the tails.

This point will be described in more detail in the section on density forecasts below.

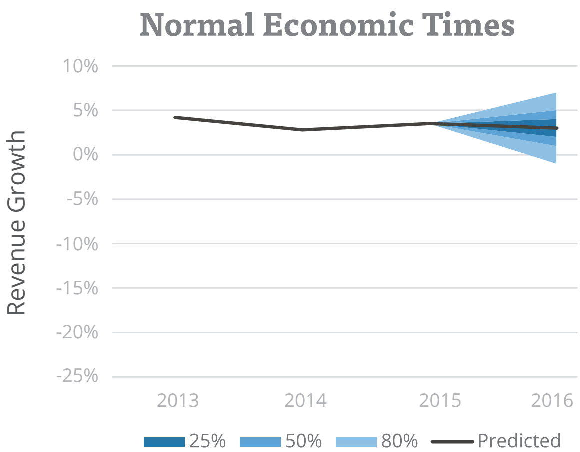

Figure 4A shows an example of a hypothetical interval forecast during normal economic times.

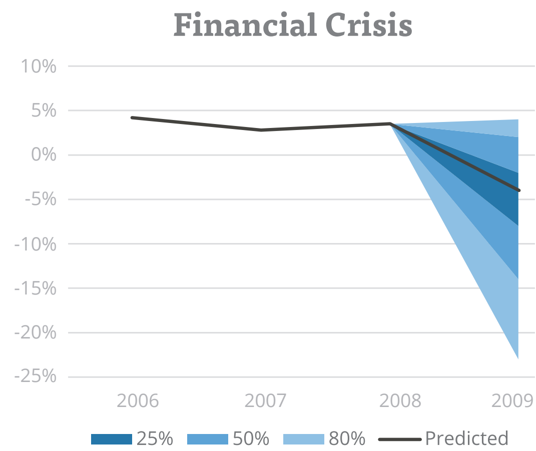

Figure 4B shows an example of a hypothetical interval forecast during the global financial crisis of 2008-2009.

Interval forecasts also communicate how forecast uncertainty varies across different forecast horizons spanning the near future (e.g., next fiscal quarter), through medium and longer term horizons, up to several years into the future (e.g., fiscal year five). On average, it is often easier to predict financial performance (e.g., revenue) for the near future compared to financial performance in the more distant future, as more uncertainty surrounds the distant future. Interval forecasts can be used to communicate if this is the case in a particular situation. For example, the 50% interval forecast for 2016 may be 1% through +5%, whereas the 50% interval forecast for 2017 may be -1% through +7%. The extra width of the two-year-ahead interval forecast compared to the one-year-ahead interval forecast conveys a sense of how quickly uncertainty increases as we forecast further into the future. See **Figure 5**.

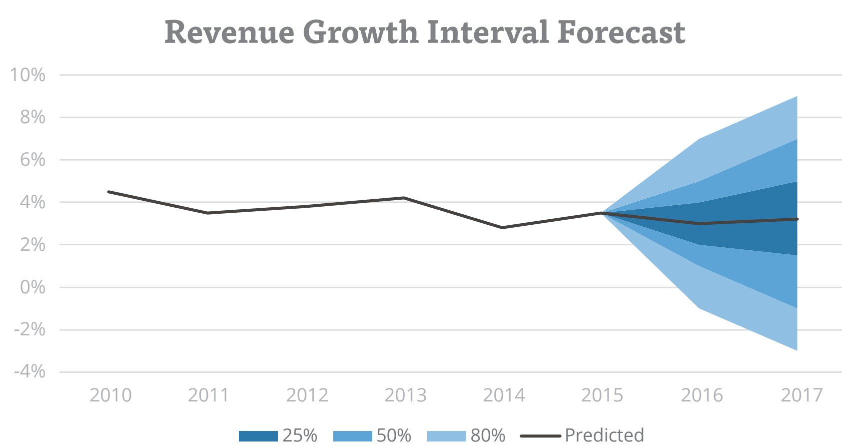

Figure 5 shows an example of a revenue growth forecast interval. Because revenue is easier to predict in the short term, the interval ranges are narrower in 2016 than in 2017.

Plotting on a chart the level of uncertainty surrounding future outcomes against the forecast horizon, sometimes referred to as the forecast "term", provides the "term structure" of uncertainty. For companies operating in industries subject to substantial technological innovation and disruption, uncertainty is likely to grow relatively quickly as the forecast horizon expands. In contrast, the growth of uncertainty at longer horizons can be expected to be lower in more stable industries.

Density Forecasts

Another way to present forecasts is by reporting the full probability distribution of future outcomes. This is sometimes called a density forecast and is often communicated as a chart that, for each possible value of the outcome, shows how likely it is that the outcome falls near that value. The more likely a particular outcome, i.e. the higher the probability of that outcome, the taller the chart is at that outcome value.

Density forecasts convey the rate at which outcomes become increasingly unlikely as we move from the center (i.e. mean) of the distribution of outcomes into the tails of the distribution. Typically, the tails of a distribution are associated with observations far below or far above the mean; those to the far left are said to lie in the left tail of the distribution, and those to the far right are in the right tail. The higher the probability of the outcomes in the left or right tail, the thicker the respective tails of the distribution. Distributions whose left tail is thicker than the right tail are sometimes called left-skewed or asymmetric. Distributions where the right tail is thicker than the left tail are called right-skewed. See **Figure 6**. An example of a left-skewed and thick-tailed distribution is that of daily stock market returns, where the left tail represents days with large negative outcomes (crashes), which are historically more likely than the days of large positive outcomes.

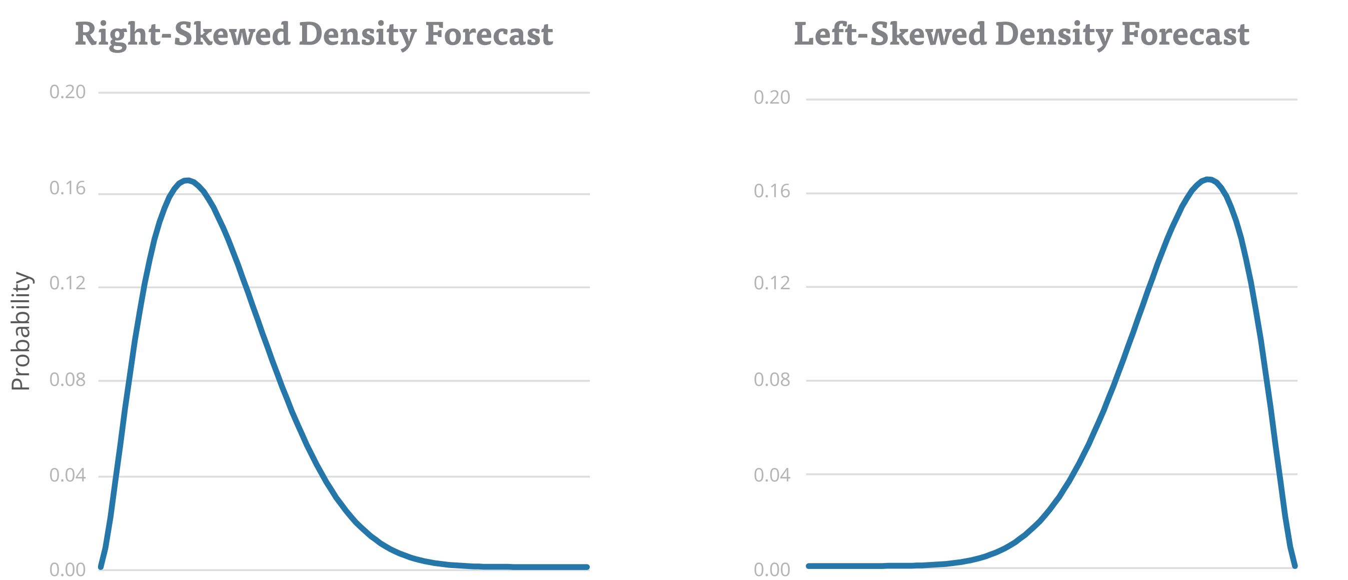

Figure 6 shows two density forecasts, one skewed to the left and the other to the right. Density forecasts convey the rate at which outcomes become increasingly unlikely as we move from the center of the distribution of outcomes into the tails of the distribution.

Time periods with greater uncertainty about the future outcome will have density forecasts that are flatter and more dispersed, i.e. have thinner tails. In contrast, time periods with less uncertainty about the future outcome will have density forecasts that are taller and more narrow, i.e. feature thicker tails. See **Figure 7**. Comparing predictive density charts at different points in time conveys a sense of how the probability distribution shifts, for example when uncertainty about the future shifts due to a change in the underlying industry or macroeconomic environment.

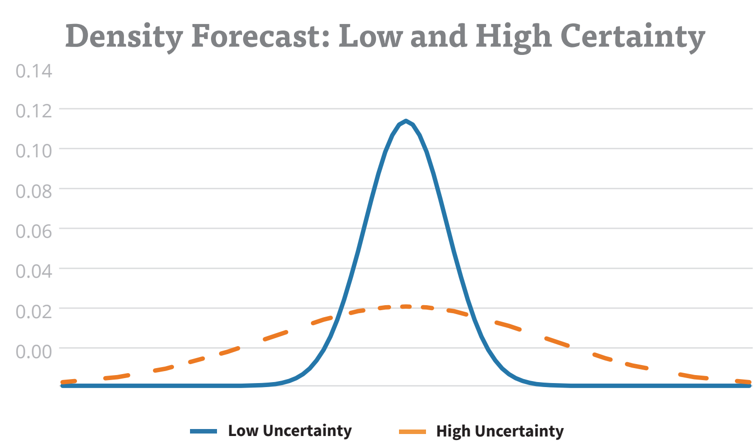

Figure 7 shows density forecasts for low and high uncertainty scenarios. Forecasts with less uncertainty about the future have density forecasts that are taller and more narrow relative to forecasts with high uncertainty.

It is common to compare probability distributions to the normal distribution curve well-known from statistics. **See Figure 8.** The normal distribution is characterized by two numbers, namely the mean (center) and the standard deviation (spread) of the distribution. Knowing these two values, it is easy to compute density and interval forecasts. For example, there is a two-thirds (68%) chance that the outcome will fall within the mean plus or minus one standard deviation and there is a 95% chance that the outcome will fall within the mean plus or minus two (1.96) standard deviations. In contrast, thick-tailed distributions may have considerably more than a five percent chance of generating a draw that is more than two standard deviations away from the mean.

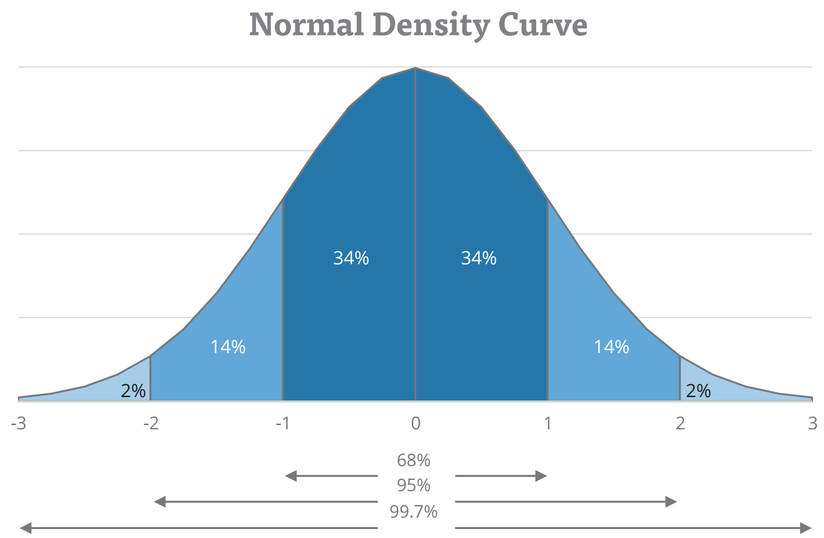

Figure 8 shows a normal distribution curve, where there is a 68% chance that the outcome will fall within the mean plus or minus one standard deviation and there is a 95% chance that the outcome will fall within the mean plus or minus two standard deviations.

All figures described herein are for illustrative purposes only

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Intensity generates excellence through powerful research, analysis, and expertise to solve the most complex challenges in the marketplace and courtroom. We consistently deliver reliable results that are built upon meticulous research, intense scrutiny, and scientific analysis.

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