Case 1

Forecasting Sales at Ska Brewing Company

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Background

Ska Brewing Company is a purveyor of fine craft beers located in Durango, Colorado. With its flagships Pinstripe Red Ale and True Blonde Ale, medal-winning Buster Nut Brown Ale and Steel Toe Stout, and seasonal Mexican Logger and Euphoria Pale Ale, Ska has enjoyed double-digit growth for more than a decade with no signs of slowing down. Learn more about Ska by visiting its tasting room at 225 Girard Street, Durango, Colorado, or online.[1]

In the early '90s, founders/owners Dave and Bill were dissatisfied with watered-down corporate beer and decided to take matters into their own hands, literally. They began brewing their own beer in their basement, much to the delight of everyone who knew them. Eventually, it became clear that they might be able to make a living doing what they loved to do, and they founded Ska Brewing Company in 1995 with third owner/founder Matt. Through hard work and a laser-like focus on brewing great beer, Ska continued to grow, and in 2008

[1] http://www.skabrewing.com/

the company moved into its $4.8 million, 24,000-square-foot world headquarters. In 2012, Ska brewed more than 25,000 barrels of beer (1 barrel = 2 standard kegs = 252 pints = 4,032 ounces), with sales exceeding $6.5 million.

Ska was not alone in its success. Durango, a town with fewer than 20,000 people, has four long-term successful breweries/brewpubs, a brand new brewpub that opened in 2012, and another one in the works. Rather than considering these other breweries as competition, Ska has worked together with them (as well as others across the state of Colorado) to brew specialty beers for festivals and other occasions; Ska also contract brews beer for Steamworks Brewing Company (using its recipes) because Steamworks has exceeded its own brewing capacity. Owner Dave calls this unique relationship "coopitition." Steamworks and Ska are just examples, however.

The craft brewing industry has seen phenomenal growth during the last three decades across the United States and in other countries as well. According to the Brewers Association,[2] the craft brewing renaissance started in the late 1970s and saw periods of incredible growth during the 1990s. Historically, before Prohibition, small breweries were everywhere across the United States; the 18th Amendment caused most of the small breweries to go out of business, and only the larger breweries survived until the 21st Amendment repealed Prohibition 13 years later. It took several decades for smaller breweries to begin the resurgence that we see today.

But our concern is more specific: Will the growth and success at Ska continue? Can Ska anticipate how much beer it will produce, and what sales will be so that the company can plan wisely for the future? In fact, current plans are to increase brewing capacity yet again—a costly investment with potentially high returns. Is this a good decision or not? This is where *you* come in.

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[2] http://www.brewersassociation.org/pages/about-us/history-of-craft-brewing

Mission

Despite its success, Ska is still a relatively small operation. The company has one main numbers person, accountant Erik. In a nutshell, Erik would like to predict Ska's sales dollars and barrels sold for the current year, 2013. He has done some of this work on his own, but he would like you to confirm (or refute) his forecasts, and to do so in much greater detail, as Erik is too busy (presumably because he spends his days counting all of Ska's money). To get you started, Exhibit 1.1 contains Ska's total barrels (BBLS) sold and sales ($$$) over the previous 13 years. More precise monthly data is available in Exhibits 1.2 through 1.6. Please note that this is actual (not phony textbook) data.

Even a cursory glance at the information in the table shows that both the number of barrels and sales are increasing annually at a pretty good rate. In fact, both values have shown tenfold growth between the years 2000 and 2012. What will these two numbers look like at the end of 2013? You might have studied forecasting techniques previously, and ideally you learned that when forecasting real data, there is no "one-size-fits-all" approach; ahead you will try several approaches and then combine them to make a final prediction.

Your task is not only to forecast these two values for 2013, but to give Erik, Dave, Bill, and Matt a better picture of what is happening with their business overall. To do so, you will be asked to produce several graphs, both on annual and monthly bases, to consider growth as a percentage, and to consider the likely errors that go along with your forecasts. You will first be asked to learn a little more about the brewing industry in general, to give you a better idea of the current status of craft brewing. Your final report should be thorough, professional, and accurate. Good luck!

Questions about Breweries

1. What is a craft brewery? How is it different from a brewpub? Go online and research these definitions. You should fairly easily find a quantitative definition of the number of barrels produced by a craft brewery (or microbrewery). For comparison, find out how many barrels are produced annually by a very large brewery such as Anheuser-Busch, MillerCoors, on Heineken. Write a paragraph or two with your findings and, as always, be sure to cite your sources.

2. Are there any local breweries in your area? If so, which categories do they fall under? If not, why not? Discuss the feasibility and likely success or failure of a new brewery in your area. Of course, a cool name like Ska might be one of the keys to a new brewery's success; what will you name your new brewery?

3. The claim was made earlier that the "craft brewing industry has seen phenomenal growth during the last three decades." Go online and find evidence to support this claim. Specifically, how many craft breweries are there now compared to 30 years ago? How has the craft brewing market share grown (out of total beer sales)? How have the major breweries reacted to the growth of craft brewing? Write a paragraph or two with what you learn.

Questions about Ska's Annual Data

4. Now onto Ska's annual data: Use Microsoft Excel to draw scatter plots of both year versus barrels and year versus sales. (Hint: You might want to change the year range from 2000–2012 to 0–12 to simplify the equations of the curves that Excel will eventually fit to the data.) What kind of curve do both scatter plots look like? Consider the barrels data first; then repeat for the sales data:

a. Have Excel fit a linear trendline to the data and determine the equation of the line and the r^2 value. Interpret the slope of the line and the coefficient of determination. Is this a good fit?

b. The pattern on the graph should be clearly nonlinear. Now instead, have Excel fit an exponential curve to the data and again determine the equation of the curve and the r^2 value. Is this a better fit?

c. Using the equation for the curve from 4b, plug in 13 (or 2013) to get your first forecast. Does it seem reasonable, or does it seem too low or too high? (Note: To see where the forecast falls, Excel will let you extend the curve by one period when you draw the trendline. When you format the trendline, forecast forward one period.)

Be sure to do 4a–4c for both barrels and sales.

5. Now draw a scatter diagram of barrels versus sales. This pattern should appear quite linear. Fit a line to the data and interpret both the slope of the line (Hint: 1 barrel = 2 kegs) and the coefficient of determination. Can you reasonably conclude that the more beer Ska produces, the more money it makes?

6. Reconsider the graphs from question 4. Although the growth does appear to be exponential, your predictions in 4c shouldn't quite look right. Let's try it another way: Consider the last four points on each graph, from 2009 to 2012. Ignoring the rest of the data, do those four points appear to have an (obvious) pattern?

a. Using only the last four years' data, fit a line for both barrels and for sales. Interpret both the slope and r^2 value for each line.

b. Plug a 13 into each line to get your second forecast for barrels and sales in 2013. How confident do you feel with these predictions?

7. Your predictions in question 6 might seem pretty good, but take it one step further:

    a. For both barrels and sales, determine the MAD for each of your predictions. If you are not familiar with the concept of MAD, go online and search for "mean absolute deviation." You should quickly find a website that explains the concept and shows you how to calculate it. What are your forecasts for 2013 including the MAD? What information does the MAD tell you?

    b. Repeat 7a but now for the MAPE, or mean absolute percentage error. Interpret the MAPE.

    c. As one final check, repeat what you did in question 6 but this time use the data from 2008 to 2011 to predict 2012 and compare your prediction for 2012 to the actual value. Do this for both barrels and sales. Does this forecasting method appear to be promising?

8. In both 4c and 6b, you forecasted barrels and sales for 2013. Consider one more way to do this before you make your final decision. Determine the percentage growth for both barrels and sales for each year. For example, from 2000 to 2001, barrels increased from 2,595 to 3,025, or a growth rate of $(3025 − 2595)/2595 = 17\%$. Calculate these rates for years 1 to 12 for both columns of data.

    a. Determine the average and median growth rates for both barrels and sales.

    b. Considering only sales, draw a scatter plot of year versus sales growth. Do any of the growth rates look like outliers? (Hint: Recall that Ska moved into its new world headquarters in 2008, increasing its brewing capacity tremendously.)

    c. The outliers in 8b might be obvious, but they aren't always so easy to identify. So, use a box plot (Tukey's Method) to find the outliers. For each column of percentage data,

determine the first and third quartiles; these are the points where 25% of the data are below and 25% of the data are above, respectively. (Hint: Use Excel's =quartile() function to find both Q1 and Q3.) Calculate the IQR = Q3 – Q1 and the range of "typical" values (Q1 – 1.5°IQR, Q3 – 1.5°IQR). Any data point within the range is typical, whereas any point outside the range is atypical, or an outlier. What are the two outliers for each column in this case?

d. Eliminate the outliers and recalculate the average and median growth rates for both barrels and sales. Multiply these growth rates by the 2012 actual values for barrels and sales and make your third (and *final*) set of forecasts for 2013. How do you feel about these predictions?

e. As a side note, Erik, the accountant, asked the owners to do a quick, back-of-the-beer-coaster estimate of what growth would be for 2013. Their immediate response was "20%." Would you say that Dave, Bill, and Matt are guessing, or do they know their business very well?

Questions about Ska's Monthly Data

Another concern at Ska is seasonal variation. The brewery is much busier during the summer months than during the winter months. Two possible explanations for this phenomenon are that 1) people simply buy more beer during the summer, and 2) Ska releases two very popular seasonal beers, Mexican Logger and Euphoria Pale Ale, at the beginning and end of the summer season. To get a better handle on the seasonal variations at Ska, your task is to draw some clear pictures of what's happening (sometimes called *data visualization*).

To achieve this goal, consider Exhibits 1.2–1.6 with the complete monthly data for all 13 years. You will see the barrels information in

white and the sales information in gray. Use this data to display the seasonal patterns at Ska:

9. Thirteen years provides 156 months' worth of data. In Excel, develop one column from 1 to 156. In the next column, list the barrels sold for each year in chronological order (so the first 12 data points will be the 196.5–238.1 from year 2000, the next 12 will be the 243.2–258.9 from year 2001, and so on.) (Hint: You can build this using simple cut/copy and paste, or there's likely a better way.) In the third column, list all the monthly sales data.

   a. Graph a scatter plot of both month versus barrels and month versus sales.

   b. Fit exponential curves to both graphs.

   c. Look carefully at the last four years of each graph. When does Ska tend to get busier during these four years? Does each graph indicate that summertime is crunch time? Which months in particular appear to be the busiest?

10. For the final forecasts for 2013, predict each month of 2013 and add them to the scatter plot from question 9. As you did in question 4, use only the last four years from 2009 to 2012 to forecast 2013.

   a. For each month, make a linear forecast using the monthly data from 2009 to 2012. So, for example, to predict barrels for January 2013, use the data points 706.6, 1017.3, 1272.4, and 1484.9, and make a straightforward linear prediction. Do this for both barrels and sales for each month.

   b. Now, add these forecasted values onto the scatter plots from question 9. Make the forecasted values a different color from the actual data to make them stand out and label the final graphs accordingly. These two graphs should give the stakeholders at Ska a clear picture of what 2013 might look like, depending on how accurate the forecasts end up being.

(Note: Adding these extra points to a pre-existing scatter plot in Excel is a little tricky. To do so, right-click on the scatter plot itself and choose Select Data. Click the Add button and add your forecasted values as a new series of data.) According to the two graphs (including actual monthly data and forecasted values), when will Ska be busiest in 2013?

Conclusion

Congratulations, you have just completed a very thorough analysis of Ska Brewing Company's production in barrels and sales figures. At this point, it might be worth reconsidering how accurate forecasts will help Ska. According to Erik, "An accurate sales budget is the root of the entire budgeting process." In addition, Dave says that accurate forecasts would help "tremendously," allowing Ska to "increase efficiencies from a production standpoint," and help "make decisions about whether or not Ska could enter any new markets."

Now it's time to tie everything together and make your best forecast for 2013 for both barrels and sales, including some kind of estimate of the error term. Carefully combine your forecasts from 4c, 6b, 7a, 7b, and 8d. Be bold and use a large font—*you* are an expert now!

Year	Forecasted Barrels	Forecasted Sales
2013		

(Note to students: The actual values for 2013 have not yet been realized as I (the author) prepare this case study. When they become available in early 2014, I will get them from Ska and record them. If you are curious about how good your final forecasts actually were, send them to Dr. Eric Huggins,[3] and I'll reply with the actual values when they become available.)

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[3] huggins_e@fortlewis.edu

Exhibits

Exhibit 1.1 Barrels Sold and Sales Volume at Ska Brewing Company

Year	BBLS	$$$
2000	2,595	$521,050
2001	3,025	$629,866
2002	3,465	$739,153
2003	4,031	$883,378
2004	4,525	$1,011,409
2005	5,273	$1,234,628
2006	6,268	$1,481,759
2007	7,289	$1,754,272
2008	7,943	$2,080,795
2009	11,681	$3,179,390
2010	16,026	$4,376,982
2011	21,258	$5,317,535
2012	25,771	$6,553,145

Exhibit 1.2 Monthly Data for Barrels and Sales (2000–2002)

	2000		2001		2002	
	BBLS	$$	BBLS	$$$	BBLS	$$$
Jan	196.5	$40,458	243.2	$53,093	290.80	$62,989
Feb	193.2	$35,615	239.9	$48,819	254.80	$53,912
Mar	229.7	$43,306	241.3	$49,782	267.50	$56,477
Apr	190.2	$34,885	214.2	$44,515	252.30	$54,720
May	195.1	$40,879	227.6	$50,671	306.90	$67,387
Jun	261.9	$53,378	309.3	$64,764	323.80	$68,196
Jul	230.2	$46,850	292.5	$59,947	336.80	$71,179
Aug	247.7	$50,118	327.9	$67,821	326.00	$69,643
Sep	210.6	$43,872	226.2	$46,102	272.70	$57,426
Oct	203.3	$41,805	242.9	$50,403	262.90	$55,944
Nov	198.2	$39,317	201.3	$40,892	248.70	$55,639
Dec	238.1	$50,569	258.9	$53,058	321.70	$65,643
Total	2,594.7	$521,050	3,025.2	$629,866	3,464.9	$739,153

Exhibit 1.3 Monthly Data for Barrels and Sales (2003–2005)

	2003		2004		2005	
	BBLS	**$$$**	**BBLS**	**$$$**	**BBLS**	**$$$**
Jan	336.3	$74,218	336.6	$74,072	411.1	$93,769
Feb	269.4	$57,567	317.6	$69,847	374.7	$83,907
Mar	284.8	$58,822	405.6	$86,334	396.2	$95,687
Apr	273.5	$59,089	344	$76,337	388.4	$91,712
May	367.0	$81,849	391.5	$94,853	435.9	$101,683
Jun	383.0	$85,636	492.1	$110,477	526.3	$122,572
Jul	388.3	$87,031	410.9	$90,578	492.1	$114,097
Aug	416.1	$91,560	418.4	$90,768	492.7	$114,925
Sep	292.5	$65,976	411.3	$90,308	449.6	$103,899
Oct	386.0	$84,438	309.6	$69,961	434.3	$104,706
Nov	266.0	$58,368	308.7	$69,073	433.4	$102,354
Dec	368.1	$78,824	378.9	$88,808	437.9	$105,317
Total	**4031**	**$883,378**	**4525.2**	**$1,011,409**	**5272.6**	**$1,234,628**

Exhibit 1.4 Monthly Data for Barrels and Sales (2006–2008)

	2006		2007		2008	
	BBLS	**$$$**	**BBLS**	**$$$**	**BBLS**	**$$$**
Jan	455.9	$107,422	598.7	$141,177	581.5	$153,098
Feb	437.2	$101,495	512.4	$124,511	628.7	$163,893
Mar	619.7	$140,082	560.3	$133,152	658.3	$164,180
Apr	368.6	$88,973	628.5	$142,942	628.5	$176,973
May	635.2	$149,576	621.9	$151,621	685.7	$177,043
Jun	587.5	$139,916	780.1	$182,735	661.8	$168,823
Jul	597.8	$141,982	641.9	$152,912	780.8	$201,482
Aug	557.1	$133,007	728.6	$176,702	725.5	$190,317
Sep	567.6	$132,330	571.3	$136,517	626.8	$156,337
Oct	478.3	$115,470	641.2	$159,959	676	$186,388
Nov	424.1	$100,695	418.8	$107,104	518.5	$138,374
Dec	538.8	$130,823	585	$144,939	770.9	$203,889
Total	**6267.8**	**$1,481,759**	**7288.7**	**$1,754,272**	**7943**	**$2,080,795**

Exhibit 1.5 Monthly Data for Barrels and Sales (2009–2011)

	2009		2010		2011	
	BBLS	**$$$**	**BBLS**	**$$$**	**BBLS**	**$$$**
Jan	706.6	$193,481	1,017.3	$267,782	1,272.4	$319,313
Feb	641.3	$170,674	853.3	$225,592	1,275.9	$323,726
Mar	884.8	$228,095	1,124.2	$356,604	1,333.2	$342,353
Apr	862.4	$232,372	999.1	$274,723	1,356	$361,315
May	1,061.3	$288,188	1,434.1	$377,369	2,471.1	$612,500
Jun	1,110	$304,763	1,673.3	$439,907	2,276.3	$564,599
Jul	1,269.5	$337,825	1,626.7	$430,999	2,102.3	$518,422
Aug	1,269.7	$342,121	1,871.7	$485,822	2,556.2	$623,860
Sep	1,147.5	$320,011	1,398	$407,577	1,631.4	$412,091
Oct	1,107.4	$304,756	1,649.4	$450,284	2,140.4	$530,636
Nov	766.1	$221,514	1,111.2	$315,238	1,258.1	$313,034
Dec	854.8	$235,591	1,267.5	$345,135	1,584.3	$395,686
Total	11,681.4	$3,179,390	16,025.8	$4,376,962	21,257.6	$5,317,535

Exhibit 1.6 Monthly Data for Barrels and Sales (2012)

	2012	
	BBLS	**$$$**
Jan	1,484.9	$375,117
Feb	1,520.8	$391,677
Mar	1,624.	$426,746
Apr	2,136.1	$535,876
May	2,622.2	$659,204
Jun	2,349.6	$582,670
Jul	2,635	$663,534
Aug	2,292.9	$564,901
Sep	2,495.2	$636,399
Oct	2,856.7	$727,822
Nov	2,088.3	$539,011
Dec	1,664.7	$450,188
Total	25,770.7	$6,553,145