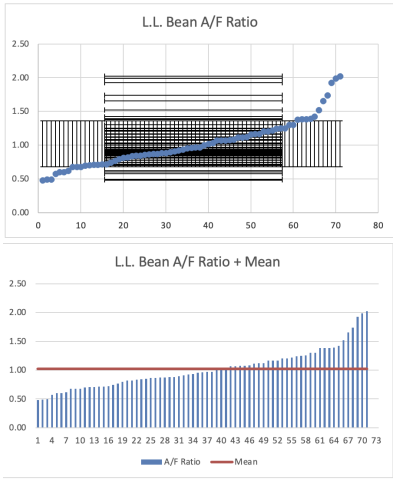
Group 6 Case Assignment 3: Adam Cohavi, Gil Delfino, Jacob Pelletier, Mike Milo, Nehal Lakdawala

Question 1:
When matching supply to demand a business seeks to receive an actual demand, divided by forecast (A/F) ratio closest to 1. A ratio below one indicates that the forecast was too high and too much supply was ordered, while a ratio below one indicates that the forecast was too low and not enough supply was ordered. Following the data on the 71 products on HuskyCT, we see some of L.L. Bean's products struggle to match supply with demand because the lowest A/F ratio was 0.48 and the highest was 2.02. The mean is 1.02 with a standard deviation of 0.342346, and while an average of 1.02 sounds good, the standard deviation is 34% of the mean which indicates massive variability in the product line. The chart below maps out the A/F ratio for each product, as well as the mean and standard deviation of each item.



This data shows us that although the mean is a healthy number of 1.02, the standard deviation is over one third of the mean and this indicates that across L.L. Bean's 71 products show a significant 34% mismatch between their supply and demand.

Question 2:
The catalog business differs from the retailing business in managing demand due to its analytical and quantitative nature, level of responsiveness, and the type of feedback received. The catalog business utilizes a wide array of historical data to forecast demand. It uses quantitative analysis to predict which items are likely to be purchased and in what amounts, factoring in customer orders, seasonality, and trends. In the retailing business, customer demand can be generated by prominent item displays or sales staff. Customer segments are heavily relied upon for accuracy in the catalog business. In LL Bean's case, merchandise groups were broken down into demand centers, item sequences, and specific items. This provided structure and a level of granularity that is necessary with a catalog-based approach.

The catalog business has longer lead times than the retail business. In the catalog business, data driven demand forecasting determines product ordering, and these orders are placed well before items are expected to sell. For example, the ordering period for a fall collection may be placed in the Spring or Summer, but the transaction for these ordered items isn't anticipated to occur for months. The vulnerability with this method is if trends, societal, or economic factors change purchasing behavior in the meantime. The "One shot commitment" dilemma prevalent with many domestic and most offshore vendors leaves LL Bean heavily reliant upon the accuracy of their forecasting to match consumer demand. Lacking the ability to modify and change order quantities due to suppliers lead times is a major challenge with managing demand with the catalog business model.

The retail business tends to yield a higher level of responsiveness to customer demand. In the retail business, sales teams and management can react faster to local purchasing behavior and alter inventory

levels accordingly. In the catalog business, demand levels are evaluated via order placement data. This has its pros and cons. It gives the catalog business the advantage of collecting information on the extent of an item's popularity or virality, data on when a customer is purchasing an item, and if an item is desired but unable to be purchased (not enough inventory causing an order cancellation etc.). Comparatively, the retail business relies more on feedback from sales staff regarding customer activity. This proximity and speed is advantageous but comes with drawbacks. An example is the difficulty the retail business will have trying to figure out if forecast vs demand discrepancies are actually due to improper forecasting or additional factors that are difficult to pinpoint, such as retail display options, store layout, or personal interactions.

Question 3:
Determining the Critical Ratio of this item:
Given that Underage Cost (Cu) = $45 - $25 = $20,
And that Overage Cost (Co) = $25 - $15 = $10,
Then F(Q) = (Cu / (Co + Cu)) = 0.667.

Therefore, the critical ratio that should be used for this product is 0.667. L.L. Bean uses the 0.75 fractile to plan for stock purchases.

Method 1:
The A/F ratio for all items was calculated to get the probability distribution (Distribution) of any given item.

Row	A/F Ratio	Scaled Demand	Cumulative Probability
1	0.494171	5930.052	0.014084507
2	0.502967	6035.604	0.028169014
3	0.51965	6235.8	0.042253521
4	0.57476	6897.12	0.056338028
5	0.603687	7244.244	0.070422535
6	0.65736	7888.32	0.084507042
7	0.702565	8430.78	0.098591549
8	0.719797	8637.564	0.112676056
9	0.72267	8672.04	0.126760563
10	0.722802	8673.624	0.14084507
11	0.723695	8684.34	0.154929577
12	0.769204	9230.448	0.169014085
13	0.769827	9237.924	0.183098592
14	0.798601	9583.212	0.197183099
15	0.800962	9611.544	0.211267606
16	0.803942	9647.304	0.225352113
17	0.820829	9849.948	0.23943662

18	0.830345	9964.14	0.253521127
19	0.830621	9967.452	0.267605634
20	0.857669	10292.028	0.281690141
21	0.858682	10304.184	0.295774648
22	0.860761	10329.132	0.309859155
23	0.891967	10703.604	0.323943662
24	0.893871	10726.452	0.338028169
25	0.895997	10751.964	0.352112676
26	0.925326	11103.912	0.366197183
27	0.93045	11165.4	0.38028169
28	0.931947	11183.364	0.394366197
29	0.935841	11230.092	0.408450704
30	0.936194	11234.328	0.422535211
31	0.971058	11652.696	0.436619718
32	0.980067	11760.804	0.450704225
33	1.002328	12027.936	0.464788732
34	1.030596	12367.152	0.478873239
35	1.031221	12374.652	0.492957746
36	1.038907	12466.884	0.507042254
37	1.045701	12548.412	0.521126761
38	1.070493	12845.916	0.535211268
39	1.081359	12976.308	0.549295775
40	1.09843	13181.16	0.563380282
41	1.114325	13371.9	0.577464789
42	1.13271	13592.52	0.591549296
43	1.133757	13605.084	0.605633803
44	1.143881	13726.572	0.61971831
45	1.151329	13815.948	0.633802817
46	1.158611	13903.332	0.647887324
47	1.161991	13943.892	0.661971831
48	1.179975	14159.7	0.676056338
49	1.183016	14196.192	0.690140845
50	1.193602	14323.224	0.704225352

51	1.220702	14648.424	0.718309859
52	1.225166	14701.992	0.732394366
53	1.257901	15094.812	0.746478873
54	1.302523	15630.276	0.76056338
55	1.349083	16188.996	0.774647887
56	1.390119	16681.428	0.788732394
57	1.400612	16807.344	0.802816901
58	1.40516	16861.92	0.816901408
59	1.411899	16942.788	0.830985915
60	1.417248	17006.976	0.845070423
61	1.433841	17206.092	0.85915493
62	1.475936	17711.232	0.873239437
63	1.476981	17723.772	0.887323944
64	1.477578	17730.936	0.901408451
65	1.615024	19380.288	0.915492958
66	1.655867	19870.404	0.929577465
67	1.660308	19923.696	0.943661972
68	1.745452	20945.424	0.957746479
69	2.031403	24376.836	0.971830986
70	2.044259	24531.108	0.985915493
71	2.081807	24981.684	1

In this case, the 0.75 fractile amount is the 53rd row with a scaled projected demand of 15,094 units. However, the amount of units that should be ordered based on the calculated critical ratio is closer to **13,943.89 units.** L.L. Bean could save by ordering less stock using the critical ratio value.

Method 2:
For a fractile of 0.75, the z-score based on the table provided is 0.68 (round-up rule)
The Mean (μ) A/F is 1.088, and the standard deviation is 0.355 (σ)
$Q = \mu + z \times \sigma$
$Q = (1.088) + (0.68) * (0.355)$
$Q = 1.329$
Total order quantity = 1.329 * 12,000 = 15,948 units

For a fractile of 0.667 (the critical ratio of this item), the z-score based on the table provided is 0.44 (round-up rule)
The Mean (μ) A/F is 1.088, and the standard deviation is 0.355 (σ)
$Q = \mu + z \times \sigma$
$Q = (1.088) + (0.44) * (0.355)$

Q = 1.244
Total order quantity = 1.244 * 12,000 = 14,928 units

Question 4:

L.L. Bean's forecasting process faces many challenges, particularly demand predictions for individual items and inventory management. This current process is lacking in forecasting important factors like competition, economy, and unpredictable customer behavior. Another issue is the high cost associated with understocking and overstocking. L.L. Bean estimates annual costs of lost sales and back orders at $11 million and excess inventory costs at $10 million, a significant financial burden that needs to be addressed.

L.L Bean uses Historical data to predict demand, but the large variance in forecast accuracy, especially in new items, suggests a need for improvement in both forecasting models and the decision-making process when committing to inventory.

Suggestions to improve the forecasting process:

L.L. Bean's existing forecast analysis is way too broad (New and Never Out), making the forecasting way too unpredictable. A more detailed segmentation could improve the forecasting by allowing the company to have a more thorough database and the capability to find trends and year-over-year data analysis. For example, if L.L. Bean groups the items by product type (men's shirts, men's pants, women's shoes, etc.), it could help tailor the forecasting model for each category's specific type of demand and build a better system in the long run.

Another suggestion is to adjust the real-time demand. The vendor lead time provides some mechanisms to adjust the orders during the season, but it also implements a better and more flexible way to communicate with the vendors who can accommodate faster changes and increase adaptability when demand deviates significantly from the forecast. It suggested that the company find a way to use a demand distribution to compute a range of possible outcomes rather than a single estimate; this will help make better decisions about inventory commitments, particularly for high-risk items.