

Two + Three is Not Equal to Five: A Simple Mathematical Algorithm in Apparel Manufacturing to Reduce Cost, Material Consumption & Post-Manufacturing Leftovers

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Abstract:

In today's competitive manufacturing landscape, the efficient utilization of resources is paramount. At the heart of these pursuits is the recognition that we must find innovative and holistic solutions that balance the needs of the present with the needs of the future. It is a dynamic challenge, but one that offers immense rewards. By reducing wastage and embracing sustainability, we can not only lessen our environmental impact but also create more efficient systems, bolster economies, and improve the quality of life for people around the world.



The global fashion industry, currently valued at a little over \$1.5 trillion, is as destructive as it is lucrative. The horrific data of fast fashion on environmental impact due to the waste it leaves behind. As per textile waste statistics every year up to 100 billion clothes are made and the world produces 92 million of textile waste each year. Only in the US alone generates just over 17 million tons of textile MSW (Municipal Solid Waste) per year, according to the most recent EPA data. That is around 112lb per person, according to the latest census statistics, 66% of all unwanted clothes and textiles are landfilled, less than 15% are recycled, and the rest (19%) are burned.

Reducing clothing wastage is an important step in promoting sustainability and responsible consumption. Reducing clothing wastage is a collective responsibility, and it requires a shift in mindset and behavior. By adopting efficient manufacturing practices, industries and organizations unlock a multitude of benefits. Committing to waste reduction and sustainability is not just an option but a necessity.

Keywords: Mathematical algorithm, pre-cutting, cost reduction, material consumption optimization, clothing, apparel, post-manufacturing wastage, resource utilization, geometric modeling, optimization techniques, sustainability, and manufacturing efficiency.

Introduction:

In the ever-evolving landscape of modern manufacturing, the pursuit of efficiency, cost reduction, and sustainability stands as an unceasing challenge. Wastage reduction is not only environmentally responsible but also economically beneficial. It can lead to cost savings, improved productivity, and enhanced sustainability, making it a fundamental concept in both the business and environmental domains. This approach recognizes the interconnectedness of our economic, environmental, and social systems and highlights the need for a more sustainable and responsible use of resources in our daily lives and industries. To this end, this study embarks on a journey guided by mathematical algorithms, aiming to revolutionize the pre-calculation process. By harnessing the power of mathematical precision and challenging conventional thinking, we seek to address a critical question that echoes through the annals of mathematics and manufacturing: "Two + Three is not equal to five."

Traditional pre-calculation practices of orders have long been the cornerstone of material transformation in manufacturing. Yet, the inherent complexities of modern production have exposed the limitations of conventional methods. The consequence? Excessive material waste, elevated production costs, and an unsustainable burden on resources.

After completing any order or shipping out the order, we found the manufacturer left with around 1.5-2% excess material and altered or shippable goods left over.

If the order was 10,000 pcs 1.5-2% is not much, 150-200 pieces but imagine this percentage for a million pcs meaning. It will be 15,000-20,000 pcs where the number is far greater.

This non-conventional mathematical axiom symbolizes our departure from traditional paradigms, encouraging us to explore uncharted territory in manufacturing optimization. By transcending the boundaries of conventional wisdom, we aim to unlock the true potential of resource utilization.

This introduction sets the stage for a comprehensive exploration of our mathematical algorithm approach. This approach promises three significant benefits: a reduction in production costs, the optimization of material consumption, and the minimization of post-manufacturing wastage. As we delve deeper into the realms of mathematical innovation for manufacturing optimization, we uncover a new dimension of

possibilities that can reshape industries and usher in a more sustainable, cost-effective, and resource-conscious era of manufacturing.

In the pages that follow, we delve into the intricacies of our simple mathematical algorithm, shedding light on its inner workings and its potential to disrupt established manufacturing norms. We invite the reader to join us on this journey of mathematical discovery, where "Two + Three is not equal to Five," and where a simple equation may hold the key to a brighter, more efficient future for manufacturing industries worldwide.

Important definitions –

***Purchase Order:** In business and commerce, a "PO" often stands for "Purchase Order." It is a document issued by a buyer to a seller, outlining the products or services they wish to purchase, along with the terms and conditions of the transaction. Normally primary purchase order is issued by a buyer to a supplier. It lists all the items you want to purchase, their quantities, prices, and any other relevant terms and conditions. However, instead of specifying a single delivery location, it mentions that the goods or services are to be delivered to multiple destinations.

***Different Destinations:** In the main PO, you should clearly state the various delivery destinations or addresses for the items. Each destination should be specified along with the quantity of items to be delivered to that location.

***Delivery Schedules:** The main PO may also include delivery schedules, indicating when each batch of items should be delivered to each destination.

***Lot Creation:** The supplier prepares and organizes the goods into smaller lots or batches, typically based on a pre-agreed lot size or as per the buyer's instructions. Each lot represents a portion of the total order. This approach is commonly used in industries like manufacturing to reduce inventory holding costs by receiving goods in smaller lots as needed, the buyer can minimize the need to store excessive inventory. It also improves cash flow as the payment is made in stages, which can help manage cash flow more effectively. Finally ensuring quality control so each lot can be inspected for quality, which helps in identifying and addressing issues early.

***Size breakdown:** A "size breakdown" is a term commonly used in the apparel and fashion industry. It refers to the distribution or allocation of different sizes within a clothing product line or a specific style of clothing. The size breakdown defines the range of sizes available for that specific style. For example, a shirt style might come in sizes XS, S, M, L, and XL. Within the size range, the buyer determines the quantity or percentage of each size to produce. This allocation is based on historical sales data, market research, and customer demand. For instance, they might produce more units of sizes M and L if those sizes are more popular among their target customers. The manufacturer or production facility then produces the garments according to the size breakdown specifications. They create the appropriate number of pieces in each size.

***Size Ratio:** Clothing manufacturers produce garments in a range of sizes to accommodate a diverse customer base. The size ratio specifies the proportion or quantity of each size within the entire production of that specific clothing style. This ratio is designed to meet customer demand and is based on the expected popularity of each size. For example, a size ratio for a shirt style might be 2:3:3:2:1, meaning 2 units of XS, 3 units of S, 3 units of M, 2 units of L, and 1 unit of XL. If the ratio is fixed by the buyer manufacturer cannot produce in a different size ratio without buyer's consent.

***Over-shipment and under-shipment:** Over-shipment and under-shipment policies in the clothing industry refer to the terms and conditions established by clothing retailers or customers (buyers) to manage and address situations where they receive more or fewer clothing units than they ordered. These policies are typically part of the buyer's agreements or contracts with clothing suppliers or manufacturers and provide guidelines on how to handle over-shipment and under-shipment.

Normally the buyer's agreements or contracts with clothing suppliers or manufacturers contain an agreement of 3% Over-shipment and under-shipment policy which means you can over-ship 3% more or under-ship 3% fewer units from what they ordered. However, manufacturers try to ship as many units as possible within that 3% so they can earn more.

***Production quantity:** It is also known as production volume or production output, which refers to the total number of units or items produced or will be produced or need to be produced by a manufacturer or production facility during a specific period of time.

***Cutting quantity:** Typically this refers to the number of pieces or units of a specific material or fabric that are cut during the cutting process in the manufacturing of clothing and textiles. Cutting quantity is a critical aspect of the clothing manufacturing process, as it affects both material usage and production efficiency. Proper management of the cutting process is essential to ensure that the right quantity of high-quality garment pieces is produced to meet customer demand.

In-depth understanding of the problem:

To understand what we are solving we need to understand how Purchase orders are arranged by the buyer. Declining Fast fashion trends due to Economic downturns, such as the global recession of 2008 and the COVID-19 pandemic, have impacted consumer spending habits. During these periods, consumers have become more budget-conscious, leading to a decline in discretionary spending on fashion. Online shopping and e-commerce have disrupted the traditional retail model, including fast fashion. Consumers have more choices online, and this has increased competition and placed pressure on pricing and profit margins. The traditional fashion calendar with distinct seasons (spring/summer and autumn/winter) is becoming less relevant as consumers demand new styles year-round. Fast fashion brands often struggle to keep up with this shift in demand.

So rise of this practice of splitting wholesale apparel orders into smaller quantities and sending them to different destinations from the factory is beneficial for buyers. It enables buyers to customize their purchases based on the preferences and needs of their specific market or customer base. Buyers can specialize in serving niche markets or regions by tailoring product assortments to suit local tastes and demands. By receiving smaller quantities of items, buyers can reduce their inventory risk. They can avoid overstocking and minimize the financial burden of holding excess stock. In the fast-paced fashion industry, trends change rapidly. Split shipments enable buyers to respond quickly to emerging trends by replenishing popular items without waiting for a bulk order. Different regions may have varying climate conditions and fashion preferences. Split shipments allow buyers to adapt their inventory to the specific needs of each region. Smaller, more frequent orders mean buyers can spread their payments over time, improving cash flow management compared to making large, upfront payments for bulk orders. Buyers can test new products or styles in smaller quantities before committing to larger orders, reducing the risk associated with unproven items. Smaller shipments encourage quicker inventory turnover, which can result in fewer markdowns or clearance sales, ultimately preserving profit margins. Meeting customer demands more precisely can lead to higher customer satisfaction and loyalty. Retailers can offer a better

shopping experience by consistently stocking desired items. In uncertain times, like during a global pandemic, the ability to adjust order quantities and destinations quickly can be crucial for maintaining supply chain resilience. Buyers can save on warehousing costs by not having to store large quantities of inventory for extended periods. In summary, splitting wholesale apparel orders into smaller quantities and sending them to different destinations from the factory offers buyers numerous advantages, including flexibility, cost savings, risk reduction, and the ability to better cater to the unique needs of their target markets. This practice aligns with the dynamic nature of the fashion industry and the desire to optimize inventory management and customer satisfaction.

As a result, When the manufacturer receives a purchase order from the customer let's say the manufacturer receives an order in a total of 10,000 pcs but in many different destinations. Let's assume the order is divided into 4 destinations.

Destination order 1 – 3,000 pcs

Destination order 2 – 4,000 pcs

Destination order 3 – 1,000 pcs

Destination order 4 – 2,000 pcs

But all this is in one PO and a total of 10,000 pcs.

We found that most of the manufacturer is concerned about the total order as a result they book materials and calculate everything based on that 10,000 pcs.

Thus the manufacturer makes 500 pcs or 5% more assuming the customer can take 3% plus shipment then the order quantity needed to compensate 2% for the wastage. After completing the order or shipping out the order we have found the manufacturer left with around 1-2% excess material and altered or shippable goods leftover. For this 10,000 pcs 1 - 2% may be not many pieces but imagine this percentage for a million pcs where the number is far greater.

However, we will show why this happening and how to reduce this wastage by using a simple mathematical method or algorithm in the material calculation stage which we are referring to as "Two + Three is not equal to five."

Understanding of the size breakdown from PO:

A Manufacturer receives a PO of 25,658 pcs of Shirt orders. Below you can find the details of the PO with Size wise quantity in an understandable chart. Where you can find the style name, fabric code, Fabric construction, Fabric composition, Wash details, and Product category. You can also find the order is in 3 colors, size is 1y –KL, the total order is in 3 lots or three shipments on separate dates and each lot has a different destination.

Like in the 1st lot, we have 12,219 pcs in 5 destinations (Italy, Spain, UK, US, Australia). In 2nd lot, we have only one destination Denmark with a 4296 pcs order and lastly, we have 3rd shipment of 9143 pcs in 3 destinations (UK, US, Canada). All the lot details are given by highlighting in green. Finally, each lot summary and a grand total of 25,658 pcs color-wise per size quantity breakdown has been given.

STYLE:	5AWR5QE0		FABRIC CODE: AWR		68% COTTON 28% NYLON 4% ELASTANE								
DESCRIPTION:	NEWBORN'S/BOY'S WOVEN SHIRT L/S		CONSTRUCTION:		153X88/50XN50/PU20		WASH : NORMAL WASH						
DEAR ALL CONCERNED PERSON, YOU'RE REQUESTED TO CROSS CHECK THIS SIZE & COLOR-WISE QUANTITY BREAKDOWN WITH ORIGINAL PO SHEET MENTIONED QUANTITY TO PREVENT ANY MISTAKES IN BULK PRODUCTION. IF YOU FOUND ANY SORT OF DISCREPENCY ON THE INFORMATION AT-ONCE PLEASE INFORM US; WE'LL STUDY AGAIN & HELP TO RECTIFY. THANKS													
1ST LOT SHIPMENT DATE: Sunday, March 17, 2024													
PO NUMBER	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
19-A-0779	081	85	118	150	164	200	210	209	210	187	161	1694	ITALY
	101	210	298	386	416	522	554	562	533	472	361	4314	
	13C											0	
	TOTAL	295	416	536	580	722	764	771	743	659	522	6008	
19-A-0833	081	1	2	2	2							7	Spain
	101	195	270	309	308	376	391	405	453	462	409	3578	
	13C											0	
	TOTAL	196	272	311	310	376	391	405	453	462	409	3585	
19-A-0835	081											0	UK
	101	16	22	24	24	33	33	34	39	37	37	299	
	13C											0	
	TOTAL	16	22	24	24	33	33	34	39	37	37	299	
19-A-0836	081											0	US
	101	6	8	10	10	72	153	167	213	212	203	1054	
	13C											0	
	TOTAL	6	8	10	10	72	153	167	213	212	203	1054	
19-A-0924	081					22	27	28	29	24	21	151	Australia
	101		4	5	5	218	210	157	189	195	139	1122	
	13C											0	
	TOTAL	0	4	5	5	240	237	185	218	219	160	1273	
1ST LOT SUMMARY OF STYLE # 5AWR5QE0													
1ST LOT	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
1ST LOT	081	86	120	152	166	222	237	237	239	211	182	1852	
	101	427	602	734	763	1221	1341	1325	1427	1378	1149	10367	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	513	722	886	929	1443	1578	1562	1666	1589	1331	12219	
2ND LOT SHIPMENT DATE: Wednesday, April 3, 2024													
19-A-4187	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
19-A-4187	081	21	25	31	34	150	245	281	319	317	302	1725	Denmark
	101	34	43	49	71	177	256	263	274	267	240	1674	
	13C	10	14	15	18	97	126	156	159	157	145	897	
	TOTAL	65	82	95	123	424	627	700	752	741	687	4296	
2ND LOT SUMMARY OF STYLE # 5AWR5QE0													
2ND LOT	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
2ND LOT	081	21	25	31	34	150	245	281	319	317	302	1725	
	101	34	43	49	71	177	256	263	274	267	240	1674	
	13C	10	14	15	18	97	126	156	159	157	145	897	
	TOTAL	65	82	95	123	424	627	700	752	741	687	4296	
3RD LOT SHIPMENT DATE: Monday, April 8, 2024													
19-A-1969	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
19-A-1969	081	132	176	209	217	241	233	242	246	221	192	2109	UK
	101	173	240	298	310	336	334	364	368	334	290	3047	
	13C	37	43	48	48	109	115	118	120	119	102	859	
	TOTAL	342	459	555	575	686	682	724	734	674	584	6015	
19-A-2143	081	17	33	36	35	35	40	41	45	40	37	359	UK
	101	33	50	54	54	61	65	70	74	73	71	605	
	13C	13	16	18	18	42	47	47	50	49	48	348	
	TOTAL	63	99	108	107	138	152	158	169	162	156	1312	
19-A-2158	081	19	26	34	34	45	45	46	52	53	51	405	US
	101	37	54	69	73	78	82	84	121	135	123	856	
	13C	21	24	30	30	39	39	39	39	39	39	339	
	TOTAL	77	104	133	137	162	166	169	212	227	213	1600	
19-F-1010	081											0	Canada
	101	12	24	24	24	24	24	24	24	24	12	216	
	13C											0	
	TOTAL	12	24	24	24	24	24	24	24	24	12	216	
3RD LOT SUMMARY OF STYLE # 5AWR5QE0													
3RD LOT	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
3RD LOT	081	168	235	279	286	321	318	329	343	314	280	2873	
	101	255	368	445	461	499	505	542	587	566	496	4724	
	13C	71	83	96	96	190	201	204	209	207	189	1546	
	TOTAL	494	686	820	843	1010	1024	1075	1139	1087	965	9143	
GRAND SUMMARY OF STYLE # 5AWR5QE0													
GRAND SUMMARY	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
GRAND SUMMARY	081	275	380	462	486	693	800	847	901	842	764	6450	
	101	716	1013	1228	1295	1897	2102	2130	2288	2211	1885	16765	
	13C	81	97	111	114	287	327	360	368	364	334	2443	
	TOTAL	1072	1490	1801	1895	2877	3229	3337	3557	3417	2983	25658	

Traditional Method of material arrangement and its backdrop:

So the traditional Method is 2% for production wastage + 3% for over shipment only exception is that cutting wastage we need to arrange 3% more fabric which will be added to the consumption. As an example, if the consumption of a garment is 21.75 yds per Dozen we need to add 3% wastage and calculate fabric needed 22.41 yds per Dozen.

However, the focus of today’s discussion is on over-shipment and production wastage quantity. Normally buyer takes 3% short or excess shipment from the order quantity. So the manufacturer needs to give shipment either a minimum of 24,888 pcs to a maximum of 26,428 pcs. As per this manufacturer’s arrange 5% of all the material needed for production to fulfill the order quantity as per the traditional method where 3% is to fulfill the over shipment quantity and the balance 2% is the production wastage quantity so a total of 5% material needed to accomplish the order. So the manufacturers will arrange materials for 25,658 + 5% = 26,941 pcs so they will make 26,941 – 25,658 = 1283 pcs excess from the order quantity and 26941 – 26428 = 513 pcs more than the 3% excess shipment quantity..

So we can say from the order quantity of 25658 pcs if we want to produce 3% more so that we can offer the buyer a maximum of 3% more than the order. So the Production quantity will be as per below-

Production QTY OF STYLE # 5AWR5QE00 adding 3% for overshipment													COUNTRY
COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL		
081	283.25	391.40	475.86	500.58	713.79	824.00	872.41	928.03	867.26	786.92	6643.50		
101	737.48	1043.39	1264.84	1333.85	1953.91	2165.06	2193.90	2356.64	2277.33	1941.55	17267.95		
13C	83.43	99.91	114.33	117.42	295.61	336.81	370.80	379.04	374.92	344.02	2516.29		
TOTAL	1104.16	1534.70	1855.03	1951.85	2963.31	3325.87	3437.11	3663.71	3519.51	3072.49	26427.74		

Again as we are calculating 5% not 3% more this means a balance of 2% we are calculating for the wastage. So adding 2% wastage in production quantity we get how much we need to cut-

EXPECTING CUTTING SUMMARY OF STYLE # 5AWR5QE00 adding 2% for wastage													COUNTRY
COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL		
081	288.92	399.23	485.38	510.59	728.07	840.48	889.86	946.59	884.61	802.66	6776		
101	752.23	1064.26	1290.14	1360.53	1992.99	2208.36	2237.78	2403.77	2322.88	1980.38	17613		
13C	85.10	101.91	116.62	119.77	301.52	343.55	378.22	386.62	382.42	350.90	2567		
TOTAL	1126.24	1565.39	1892.13	1990.89	3022.58	3392.39	3505.85	3736.98	3589.90	3133.94	26956		

But as we cannot make garments unit less than 1 pc so we need to remove all the decimal points. So the final cutting quantity will be-

EXPECTING CUTTING SUMMARY OF STYLE # 5AWR5QE00 adding 2% for wastage													COUNTRY
COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL		
081	288.00	399.00	485.00	510.00	728.00	840.00	889.00	946.00	884.00	802.00	6771		
101	752.00	1064.00	1290.00	1360.00	1992.00	2208.00	2237.00	2403.00	2322.00	1980.00	17608		
13C	85.00	101.00	116.00	119.00	301.00	343.00	378.00	386.00	382.00	350.00	2561		
TOTAL	1125.00	1564.00	1891.00	1989.00	3021.00	3391.00	3504.00	3735.00	3588.00	3132.00	26940		

Please note here, due to removing the decimal point we get the final quantity of 26940 pcs you might get 26941 pcs after adding in the final order quantity in your calculation. But no need to worry about it we will count the cutting quantity or we can say the final quantity after adding 5% is 26940 pcs.

The problem we found in the traditional method is that this calculation considers the total quantity ignoring the destination-wise quantity.

Logically As this is going to various destinations we should calculate the quantity based on the destination and lot or delivery date. Because each destination will consider there quantity only not the overall quantity. For example, if we consider only the Canadian order we can see the total order quantity is 216 pcs. So as per the traditional method material will be purchasing 216 + 5% = 226.8 pcs let us consider 226 pcs as Garments cannot be less than 1 pcs so 10 pcs more than the initial order.

	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
19-F-1010	081											0	Canada
	101	12	24	24	24	24	24	24	24	24	12	216	
	13C											0	
	TOTAL	12	24	24	24	24	24	24	24	24	12	216	

But we have to keep in mind that the customer is given a size-wise ratio that we have to maintain for example, in the above Canada order we can say the size-wise ratio is 1,2,2,2,2,2,2,2,1. So for each size, we calculate 5% to keep it as per the given ratio.

	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
19-F-1010	081											0	Canada
	101	0	1	1	1	1	1	1	1	1	0	8	
	13C											0	
	TOTAL	0	1	1	1	1	1	1	1	1	1	0	

As per above, we found a 5% increase in size 1Y & KL quantity actually less than 1 pcs as a result we don't need to add any extra quantity for these two sizes. So we need only 8 pcs more than the initial order. We conclude that overall 5% is not equal to size-wise 5%.

It's very logical to think that we should make the extra pcs for those sizes 1Y & KL as if we don't make these extra pcs then if any rejection occurs we might need to short ship. It's understandable but it would have been true if we were manufacturing only the Canadian quantity. As we are manufacturing all destination quantities in one time then we don't need to make these extra 2 pcs.

"Two + Three is not equal to Five"

Now we will focus on calculating the above Order in our method. In the above discussion, we understood that each destination means an individual buyer/customer/warehouse requirement also we can see in the same lot there are two orders for the same destination but given separate size breakdowns.

3RD LOT SHIPMENT DATE: Monday, April 8, 2024													
	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
19-A-1969	081	132	176	209	217	241	233	242	246	221	192	2109	UK
	101	173	240	298	310	336	334	364	368	334	290	3047	
	13C	37	43	48	48	109	115	118	120	119	102	859	
	TOTAL	342	459	555	575	686	682	724	734	674	584	6015	
19-A-2143	081	17	33	36	35	35	40	41	45	40	37	359	UK
	101	33	50	54	54	61	65	70	74	73	71	605	
	13C	13	16	18	18	42	47	47	50	49	48	348	
	TOTAL	63	99	108	107	138	152	158	169	162	156	1312	

This means that both quantities are not for the same buyer/customer/warehouse meaning they most probably will go to the same destination but for two separate customers/warehouses. So we need to calculate these separately as well.

Now we need to find out as per the size breakdown, considering the ratio, and treat each of them as an individual order adding 3% in the main order how many pcs extra we need to make.



STYLE: 5AWR5QE0	FABRIC CODE: AWR	68% COTTON 28% NYLON 4% ELASTANE
DESCRIPTION: NEWBORN'S/BOY'S WOVEN SHIRT L/S	CONSTRUCTION: 153X88/50XN50/PU20	WASH : NORMAL WASH

DEAR ALL CONCERNED PERSON, YOU'RE REQUESTED TO CROSS CHECK THIS SIZE & COLOR-WISE QUANTITY BREAKDOWN WITH ORIGINAL PO SHEET MENTIONED QUANTITY TO PREVENT ANY MISTAKES IN BULK PRODUCTION. IF YOU FOUND ANY SORT OF DISCREPANCY ON THE INFORMATION AT-ONCE PLEASE INFORM US; WE'LL STUDY AGAIN & HELP TO RECTIFY. THANKS

1ST LOT SHIPMENT DATE: Sunday, March 17, 2024													
PO NUMBER	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
19-A-0779	081	2	3	4	4	6	6	6	6	5	4	46	ITALY
	101	6	8	11	12	15	16	16	15	14	10	123	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	8	11	15	16	21	22	22	21	19	14	169	
19-A-0833	081	0	0	0	0	0	0	0	0	0	0	0	Spain
	101	5	8	9	9	11	11	12	13	13	12	103	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	5	8	9	9	11	11	12	13	13	12	103	
19-A-0835	081	0	0	0	0	0	0	0	0	0	0	0	UK
	101	0	0	0	0	0	0	1	1	1	1	4	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	0	0	0	0	0	0	1	1	1	1	4	
19-A-0836	081	0	0	0	0	0	0	0	0	0	0	0	US
	101	0	0	0	0	2	4	5	6	6	6	29	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	0	0	0	0	2	4	5	6	6	6	29	
19-A-0924	081	0	0	0	0	0	0	0	0	0	0	0	Australia
	101	0	0	0	0	6	6	4	5	5	4	30	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	0	0	0	0	6	6	4	5	5	4	30	
1ST LOT SUMMARY OF STYLE # 5AWR5QE0													
1ST LOT	081	2	3	4	4	6	6	6	6	5	4	46	
	101	11	16	20	21	34	37	38	40	39	33	289	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	13	19	24	25	40	43	44	46	44	37	335	
2ND LOT SHIPMENT DATE: Wednesday, April 3, 2024													
19-A-4187	081	0	0	0	1	4	7	8	9	9	9	47	Denmark
	101	1	1	1	2	5	7	7	8	8	7	47	
	13C	0	0	0	0	2	3	4	4	4	4	21	
	TOTAL	1	1	1	3	11	17	19	21	21	20	115	
2ND LOT SUMMARY OF STYLE # 5AWR5QE0													
2ND LOT	081	0	0	0	1	4	7	8	9	9	9	47	
	101	1	1	1	2	5	7	7	8	8	7	47	
	13C	0	0	0	0	2	3	4	4	4	4	21	
	TOTAL	1	1	1	3	11	17	19	21	21	20	115	
3RD LOT SHIPMENT DATE: Monday, April 8, 2024													
19-A-1969	081	3	5	6	6	7	6	7	7	6	5	58	UK
	101	5	7	8	9	10	10	10	11	10	8	88	
	13C	1	1	1	1	3	3	3	3	3	3	22	
	TOTAL	9	13	15	16	20	19	20	21	19	16	168	
19-A-2143	081	0	0	1	1	1	1	1	1	1	1	8	UK
	101	0	1	1	1	1	1	2	2	2	2	13	
	13C	0	0	0	0	1	1	1	1	1	1	6	
	TOTAL	0	1	2	2	3	3	4	4	4	4	27	
19-A-2158	081	0	0	1	1	1	1	1	1	1	1	8	US
	101	1	1	2	2	2	2	2	3	4	3	22	
	13C	0	0	0	0	1	1	1	1	1	1	6	
	TOTAL	1	1	3	3	4	4	4	5	6	5	36	
19-F-1010	081	0	0	0	0	0	0	0	0	0	0	0	Canada
	101	0	0	0	0	0	0	0	0	0	0	0	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	
3RD LOT SUMMARY OF STYLE # 5AWR5QE0													
3RD LOT	081	3	5	8	8	9	8	9	9	8	7	74	
	101	6	9	11	12	13	13	14	16	16	13	123	
	13C	1	1	1	1	5	5	5	5	5	5	34	
	TOTAL	10	15	20	21	27	26	28	30	29	25	231	
GRAND SUMMARY OF STYLE # 5AWR5QE0													
GRAND SUMMARY	081	5	8	12	13	19	21	23	24	22	20	167	
	101	18	26	32	35	52	57	59	64	63	53	459	
	13C	1	1	1	1	7	8	9	9	9	9	55	
	TOTAL	24	35	45	49	78	86	91	97	94	82	681	

We can see that actually 681 pcs extra is enough to make after 3% over shipment. Which is $769.74 - 681 = 88.74$ pcs less than the average calculation.

GRAND SUMMARY OF STYLE # 5AWR5QEUB with 2%													
	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
	081	5.5	7.6	9.24	9.72	13.86	16	16.94	18.02	16.84	15.28	129	
	101	14.32	20.26	24.56	25.9	37.94	42.04	42.6	45.76	44.22	37.7	335.3	
	13C	1.62	1.94	2.22	2.28	5.74	6.54	7.2	7.36	7.28	6.68	48.86	
	TOTAL	21.44	29.8	36.02	37.9	57.54	64.58	66.74	71.14	68.34	59.66	513.16	

But as we know garments cannot be less than 1 pcs we need to remove all the decimal points from all the individual orders. As per this, our wastage quantity will be –

STYLE: 5AWR5QEUB		FABRIC CODE: AWR		68% COTTON 28% NYLON 4% ELASTANE									
DESCRIPTION: NEWBORN'S/BOY'S WOVEN SHIRT L/S		CONSTRUCTION: 153X88/50X150/PU20		WASH : NORMAL WASH									
DEAR ALL CONCERNED PERSON, YOU'RE REQUESTED TO CROSS CHECK THIS SIZE & COLOR-WISE QUANTITY BREAKDOWN WITH ORIGINAL PO SHEET MENTIONED QUANTITY TO PREVENT ANY MISTAKES IN BULK PRODUCTION. IF YOU FOUND ANY SORT OF DISCREPANCY ON THE INFORMATION AT-ONCE PLEASE INFORM US; WE'LL STUDY AGAIN & HELP TO RECTIFY. THANKS													
1ST LOT SHIPMENT DATE: Sunday, March 17, 2024													
PO NUMBER	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
19-A-0779	081	1	2	3	3	4	4	4	4	3	3	31	ITALY
	101	4	5	7	8	10	11	11	10	9	7	82	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	5	7	10	11	14	15	15	14	12	10	113	
19-A-0833	081	0	0	0	0	0	0	0	0	0	0	0	Spain
	101	3	5	6	6	7	7	8	9	9	8	68	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	3	5	6	6	7	7	8	9	9	8	68	
19-A-0835	081	0	0	0	0	0	0	0	0	0	0	0	UK
	101	0	0	0	0	0	0	0	0	0	0	0	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	
19-A-0836	081	0	0	0	0	0	0	0	0	0	0	0	US
	101	0	0	0	0	1	3	3	4	4	4	19	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	0	0	0	0	1	3	3	4	4	4	19	
19-A-0924	081	0	0	0	0	0	0	0	0	0	0	0	Australia
	101	0	0	0	0	4	4	3	3	3	2	19	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	0	0	0	0	4	4	3	3	3	2	19	
1ST LOT SUMMARY OF STYLE # 5AWR5QEUB													
1ST LOT	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
	081	7	10	13	14	22	25	25	26	25	21	188	
	101	4	5	7	8	10	11	11	10	9	7	82	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	8	12	16	17	26	29	29	30	28	24	219	
2ND LOT SHIPMENT DATE: Wednesday, April 3, 2024													
19-A-4187	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
19-A-4187	081	0	0	0	0	3	4	5	6	6	6	30	Denmark
	101	0	0	0	1	3	5	5	5	5	4	28	
	13C	0	0	0	0	1	2	3	3	3	2	14	
	TOTAL	0	0	0	1	7	11	13	14	14	12	72	
2ND LOT SUMMARY OF STYLE # 5AWR5QEUB													
2ND LOT	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
	081	0	0	0	0	3	4	5	6	6	6	30	
	101	0	0	0	1	3	5	5	5	5	4	28	
	13C	0	0	0	0	1	2	3	3	3	2	14	
	TOTAL	0	0	0	1	7	11	13	14	14	12	72	
3RD LOT SHIPMENT DATE: Monday, April 8, 2024													
19-A-1969	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
19-A-1969	081	2	3	4	4	4	4	4	4	4	3	36	UK
	101	3	4	5	6	6	6	7	7	6	5	55	
	13C	0	0	0	0	2	2	2	2	2	2	12	
	TOTAL	5	7	9	10	12	12	13	13	12	10	103	
19-A-2143	081	0	0	0	0	0	0	0	0	0	0	0	UK
	101	0	1	1	1	1	1	1	1	1	1	9	
	13C	0	0	0	0	0	0	0	1	0	0	1	
	TOTAL	0	1	1	1	1	1	1	2	1	1	10	
19-A-2158	081	0	0	0	0	0	0	0	1	1	1	3	US
	101	0	1	1	1	1	1	1	2	2	2	12	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	0	1	1	1	1	1	1	3	3	3	15	
19-F-1010	081	0	0	0	0	0	0	0	0	0	0	0	Canada
	101	0	0	0	0	0	0	0	0	0	0	0	
	13C	0	0	0	0	0	0	0	0	0	0	0	
	TOTAL	0	0	0	0	0	0	0	0	0	0	0	
3RD LOT SUMMARY OF STYLE # 5AWR5QEUB													
3RD LOT	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
	081	2	3	4	4	4	4	4	4	5	4	39	
	101	3	6	7	8	8	8	9	10	9	8	76	
	13C	0	0	0	0	2	2	2	3	2	2	13	
	TOTAL	5	9	11	12	14	14	15	18	16	14	128	
GRAND SUMMARY OF STYLE # 5AWR5QEUB													
	COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
	081	3	5	7	7	11	12	13	15	14	13	100	
	101	10	16	20	23	33	38	39	41	39	33	292	
	13C	0	0	0	0	3	4	5	6	5	4	27	
	TOTAL	13	21	27	30	47	54	57	62	58	50	419	

We can see that actually 419 pcs extra is enough for 2% wastage. Which is $513.16 - 419 = 94.16$ pcs less than the average calculation.

GRAND SUMMARY OF STYLE # 5AWR5QEU0 adding 2% wastage												
COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
081	3	5	7	7	11	12	13	15	14	13	100	
101	10	16	20	23	33	38	39	41	39	33	292	
13C	0	0	0	0	3	4	5	6	5	4	27	
TOTAL	13	21	27	30	47	54	57	62	58	50	419	

Now we will add or merge the original order quantity with our calculated final 3% extra quantity to get the actual production quantity that is needed below -

GRAND SUMMARY OF STYLE # 5AWR5QEU0												
COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
081	275	380	462	486	693	800	847	901	842	764	6450	
101	716	1013	1228	1295	1897	2102	2130	2288	2211	1885	16765	
13C	81	97	111	114	287	327	360	368	364	334	2443	
TOTAL	1072	1490	1801	1895	2877	3229	3337	3557	3417	2983	25658	

GRAND SUMMARY OF STYLE # 5AWR5QEU0 calculated 3% or over shipment												
COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
081	5	8	12	13	19	21	23	24	22	20	167	
101	18	26	32	35	52	57	59	64	63	53	459	
13C	1	1	1	1	7	8	9	9	9	9	55	
TOTAL	24	35	45	49	78	86	91	97	94	82	681	

So the Actual production quantity will be-

Production QTY OF STYLE # 5AWR5QEU0												
COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
081	280	388	474	499	712	821	870	925	864	784	6617	
101	734	1039	1260	1330	1949	2159	2189	2352	2274	1938	17224	
13C	82	98	112	115	294	335	369	377	373	343	2498	
TOTAL	1096	1525	1846	1944	2955	3315	3428	3654	3511	3065	26339	

Now we will add or merge the production quantity with our calculated final 2% wastage quantity to get the expected cutting quantity that is needed -

Production QTY OF STYLE # 5AWR5QEU0												
COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
081	280	388	474	499	712	821	870	925	864	784	6617	
101	734	1039	1260	1330	1949	2159	2189	2352	2274	1938	17224	
13C	82	98	112	115	294	335	369	377	373	343	2498	
TOTAL	1096	1525	1846	1944	2955	3315	3428	3654	3511	3065	26339	

GRAND SUMMARY OF STYLE # 5AWR5QEU0 adding 2% wastage												
COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
081	3	5	7	7	11	12	13	15	14	13	100	
101	10	16	20	23	33	38	39	41	39	33	292	
13C	0	0	0	0	3	4	5	6	5	4	27	
TOTAL	13	21	27	30	47	54	57	62	58	50	419	

So the expected Cutting quantity -

EXPECTED CUTTING SUMMARY OF STYLE # 5AWR5QEU0												
COLOR	1Y	2Y	XX	XS	S	M	L	XL	EL	KL	TOTAL	COUNTRY
081	283	393	481	506	723	833	883	940	878	797	6717	
101	744	1055	1280	1353	1982	2197	2228	2393	2313	1971	17516	
13C	82	98	112	115	297	339	374	383	378	347	2525	
TOTAL	1109	1546	1873	1974	3002	3369	3485	3716	3569	3115	26758	

Now we can see that as per our previous discussion we found that adding 5% on average to the final order quantity will become 26,940 pcs but we have shown here as well that adding 5% on order quantity calculating destination and size ratio-wise becomes 26,758 pcs. So the total difference is 182 pcs.

Although we calculated 5% on both occasions result was different. In the below table, we will also show although we calculated all the colors in 3% + 2%, the final quantity should have been 5% more than the order quantity but it is not.

COLOR	GRAND SUMMARY OF STYLE # 5AWR5QEU0	After adding 2% + 3% in GRAND SUMMARY	Difference	Increase in %
081	6450	6717	267	4.14%
101	16765	17516	751	4.48%
13C	2443	2525	82	3.36%
TOTAL	25658	26758	1100	4.29%

We can see although we have calculated Two percent + Three percent but finally found it is not equal to Five percent.

Color 081 increased 4.14%

Color 101 increased 4.48%

Color 13C increased only 3.36%

Overall Total quantity increased by 4.29%, not 5%.

So we can say in this context that **"Two + Three is not equal to Five"**

Aftermath:

As per above, we can see that we are saving 0.71% wastage in the initial stage which is 182 pcs which was supposed to get wasted. For more easy understanding we are saving-

1. Fabric purchase of 182 pcs, if the fabric price is \$2.5 then $182 \times 2.5 = \$455$
2. As we are not purchasing material and manufacturing these 182 pcs as leftover, if FOB was \$7 per unit then $182 \times 7 = \$1274$

So total of \$1,729 we can save before we can start working on the order. In this competitive market, it's a great sum to save up front and add to your profit.

However, if you consider on a larger scale let's say a manufacturing unit of 10 lines is producing 36,00,000 pcs a year with a workforce of 750 people the wastage control will be 25,560 pcs (based on 0.71% wastage reduction) yearly, and if we say the average FOB is \$7 per pcs than $25,560 \times 7 = \$1,78,920$ profit. Considering \$80 per worker monthly wages we are saving 3.022 months wages of the 750 people or workforce of that manufacturing unit and reducing 25,560 pcs goods to be wasted in a year. As we have the above example for one manufacturing unit only now Imagine how much we can save if we calculate in the context of the total apparel manufacturing industry where only in Bangladesh there are 3500+ manufacturing units.

Conclusion:

.This study introduces a simple mathematical approach aimed at achieving cost reduction, optimizing material consumption, and minimizing post-manufacturing wastage. The key innovation lies in addressing the Simple pre-calculation of producible quantity while considering the non-intuitive mathematical phenomenon that "Two + Three is not equal to five."

Reduction of wastage is a transformative journey that embodies responsibility, innovation, and sustainability. Is a commitment to optimizing processes, resource management, and the elimination of waste in all its forms It is a call to action that invites us to think and act differently, to reimagine how we

consume, produce, and coexist with our environment. This research combines mathematical rigor with practical applications, making it a valuable tool for industries seeking to enhance resource utilization, reduce costs, and minimize environmental impact. As we explore the concept that "Two + Three is not equal to Five" in the context of apparel manufacturing, we uncover opportunities for innovation and improvement that challenge the status quo.

Acknowledgements:

We would like to extend our heartfelt gratitude to my colleagues and the management team from Lavender Garment Ltd. (A sister concern of YGM Hong Kong) especially Mr. Ivan Chan (CEO of YGM Bangladesh) for their invaluable support in work on this matter to reduce the final leftover also the dedication and willingness to share their expertise and insights, which greatly enriched the quality of this research. Their contributions, constructive feedback, and willingness to engage in meaningful discussions have been essential in shaping the project and refining its objectives. Their unwavering commitment and collaboration have been instrumental in the success of this endeavor.

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