Dynamic Planning vs. Safety Stock Plans: A Historical Simulation on Walmart M5 Sales Data

TSF Case Study

October 2026

1. Scope

The historical simulation runs three supply plans against two years of daily sales, January 1, 2014 to December 31, 2015, for 10 Walmart stores in the M5 data set: 4 stores in California, 3 in Texas, and 3 in Wisconsin, with 3,045 to 3,048 products in each state. Each product is planned for each state as one stocking location. Every plan executes every order exactly as calculated, with no overrides.

All results cover all 10 stores and are stated per year. The appendix workbook, ***Dynamic Planning vs Safety Stock Plans: Appendix Workbook***, carries the same results by state and category, and for every TSF padding level tested.

2. The Three Plans

Plan	Definition
TSF	Orders from the selected TSF forecast, with a flat padding percentage of the forecast where stated, under the TSF plan rules in Section 4.
Enterprise	Auto ARIMA forecast with a standard safety stock for 95% coverage, sized from the spread of the plan's past forecast errors. The plan orders when stock falls to its reorder point and orders up to the forecast for the order cycle plus delivery time, plus the safety stock.
Mid-Market	12-month moving average forecast with a standard safety stock for 95% coverage, ordering on the same reorder-point rules as the Enterprise plan.

3. The Five Ordering Scenarios

Scenario	Order Cycle	Delivery	Ordering Days	Case Packs
1. Own Warehouse, Next-Day Delivery	7 Days, Reorder Point Any Day	1 Day	Any Day	No
2. Supplier Ships Daily, Next-Day Delivery	7 Days, Reorder Point Any Day	1 Day	Any Day	Yes
3. Supplier Ships Daily, 7-Day Delivery	7 Days, Reorder Point Any Day	7 Days	Any Day	Yes
4. Truckload Supplier, Weekly	7 Days	7 Days	One Fixed Day Each Week	Yes
5. Truckload Supplier, Every Two Weeks	14 Days	7 Days	One Fixed Day Each Week	Yes

All three plans use the same delivery times, ordering days, and case packs within each scenario.

4. TSF Plan Rules

Every TSF rule uses only information a real system records: the plan's own sold units and its own sold-out days, never recorded demand that includes sales lost to the plan's own stockouts.

Rule	How it Works
Order Level	The TSF forecast for the order cycle plus the delivery time, multiplied by one plus the padding.
Scheduled Order	On each scheduled order day, the plan orders the order level minus stock on hand (and, with 7-day delivery, minus stock in transit), rounded up to whole case packs.
Reorder Point	In Scenarios 1, 2, and 3, the plan orders on any day when stock on hand will not cover the forecast through the delivery time plus 4 days, and places a scheduled order 7 days after its last order if stock has not fallen to that point first. In Scenario 5, the plan can also order on the weekly order day between scheduled orders when stock will not cover the forecast to the next scheduled delivery; the next scheduled order then moves to one order cycle after that order.
Order Spacing	No order is placed on the day after an order. With 7-day delivery, no order is placed while another order is in transit.
Sales-Rate Flag	When the plan's own sales exceed the 95% Calibrated Probability Band, or the plan sells out, on at least 3 of the last 7 days, the plan orders from its past 7 days' sales rate wherever that rate is higher than the forecast.
Actual-Sales Cap	Each order is capped at the units that will sell before the stock passes its selling window, at the lower of the forecast rate and the plan's own sales rate over the previous 28 days (or the flagged 7-day rate where higher). At least one case goes out if the cap would leave the product short before the next possible order.
Flag and Hold	When a forecast is flagged for running above sales, the plan orders from the median of its own recent daily sales and holds the scheduled order.
Sales Stopped	When a product's own sales over the last 14 days fall below 10% of its rate over the prior 28 days, for a product selling at least 2 units a day, while stock exceeds the order level by a full order cycle of sales, the product is flagged Sales Stopped until the excess is gone.

5. Assumptions

Assumption	Value
Selling Windows	Foods 30 days, Household 45 days, Hobbies 60 days.
Write-Downs	All three plans write off stock still unsold at three times its selling window: Foods 90 days, Household 135 days, Hobbies 180 days. Written-off units leave stock that morning, counted oldest first, and never sell.

Assumption	Value
Case Packs	The standard pack (6, 12, 24, or 48 units) nearest to one week of each product's average 2013 sales.
Prices and Revenue	Revenue is units sold at the weekly prices recorded in the data. The data records no markdowns.
Gross Margin	Walmart's 24.2% gross margin. Unit cost is 75.8% of the selling price.
Operating Margin	Walmart's 4.22% operating margin (operating income as a share of net sales, fiscal 2026), used only to express the net profit boost as a share of operating profit.
Carrying Cost	0.031% per day of unit cost, applied only to stock past its selling window, using hard costs only with no capital charge, at a simple daily rate.
Standard Plan Safety Stock	95% coverage for both the Enterprise and Mid-Market plans.

6. Definitions

Field	Definition
Cash Recovered	The cash a plan leaves in the business each year: revenue taken in, minus what the business paid for the stock it bought, at Walmart's 24.2% gross margin. The table shows how much more cash TSF leaves in the business than the comparison plan. Cash recovered comes from two sources: the margin on extra sales, and money not spent on stock the plan did not need.
Net Profit Boost	Walmart's 24.2% gross margin on the revenue uplift, minus the difference in carrying cost and the difference in write-down cost. The percentage in parentheses is the boost as a share of the comparison plan's operating profit: the comparison plan's revenue × 4.22%.
Stockout Days	Days on which a product had no stock, summed across products and states. One product out of stock in one state for one day is one stockout day.
Units Sold	Units each plan sold. Demand beyond a plan's stock on hand goes unsold.
Average Inventory	Units on hand on an average day (units).
Excess Stock	Stock beyond what the previous 28 days of sales would sell within the selling window (units per average day).
Units to Clearance	Units still unsold at the end of their selling window, counted oldest first. Stock on days a product is flagged Sales Stopped is not counted.
Units Written Down	Units still unsold at three times their selling window, counted oldest first, including stock on Sales Stopped days.

Field	Definition
Carrying Cost	The cost of holding stock past its selling window, in dollars.
Write-Down Cost	Units written down, at cost, in dollars.
Inventory Turns	Units sold per year divided by Average Inventory.

7. The Three Options

Each ordering scenario is reported at up to three TSF padding levels, selected against the Enterprise plan from the padding levels tested (no padding to +100%, and to +200% for Scenario 4). The Mid-Market plan is shown for comparison.

Option	How it Is Selected
Match Enterprise Inventory	The padding level whose average inventory comes closest to the Enterprise plan's.
Lean Inventory	The lowest padding level at which TSF beats the Enterprise plan on revenue, cash recovered, net profit, and stockout days.
Maximum Inventory	The padding level at which cash recovered peaks: the most stock that still pays for itself in cash.

8. Store Replenishment: Scenarios 1 and 2

In both store replenishment scenarios, TSF with no padding is the match, the lean option, and the maximum at once: it beats the Enterprise plan on every dollar result and on stockouts, and cash recovered peaks there. Padding buys fewer stockouts at the cost of both cash and profit. At +40%, TSF has 82% fewer stockout days than the Enterprise plan in Scenario 1, with average inventory 47% higher, cash recovered of +$264,002, and a net profit boost of +$224,755 (+13.8%); in Scenario 2, it has 87% fewer stockout days, with cash recovered of +$222,616 and a net profit boost of +$172,153 (+10.5%).

Table 1. Scenario 1: Own Warehouse, Next-Day Delivery
TSF Forecast, No Padding (All 10 Stores, Per Year)

Per Year	TSF vs Enterprise			TSF vs Mid-Market	
Revenue Uplift	**+$1,007,761**			**+$1,200,048**	
Cash Recovered	**+$322,572**			**+$483,574**	
Net Profit Boost	**+$248,440 (+15.3%)**			**+$313,615 (+19.4%)**	
Units and Percentages	**TSF**	**Enterprise**	**TSF vs Enterprise**	**Mid-Market**	**TSF vs Mid-Market**
Revenue	$39,590,873	$38,583,112	+2.6%	$38,390,825	+3.1%
Stockout Days	28,829	103,192	72% Fewer	112,374	74% Fewer
Units Sold	13,254,155	12,933,624	2.5% More	12,882,583	2.9% More
Average Inventory	262,515	241,685	9% More	238,660	10% More
Excess Stock	5,175	9,200	44% Less	19,564	74% Less
Units to Clearance	60,298	94,857	36% Fewer	158,133	62% Fewer
Units Written Down	32,996	34,877	5% Fewer	41,101	20% Fewer
Carrying Cost	$1,754	$2,376	–$622	$4,192	–$2,438
Write-Down Cost	$85,001	$88,941	–$3,940	$105,766	–$20,765
Inventory Turns	50.5	53.5	6% Slower	54.0	6% Slower

Table 2. Scenario 2: Supplier Ships Daily, Next-Day Delivery
TSF Forecast, No Padding (All 10 Stores, Per Year)

Per Year	TSF vs Enterprise			TSF vs Mid-Market	
Revenue Uplift	**+$887,129**			**+$1,085,248**	
Cash Recovered	**+$287,294**			**+$443,436**	
Net Profit Boost	**+$211,715 (+12.9%)**			**+$282,765 (+17.3%)**	
Units and Percentages	**TSF**	**Enterprise**	**TSF vs Enterprise**	**Mid-Market**	**TSF vs Mid-Market**
Revenue	$39,783,427	$38,896,298	+2.3%	$38,698,179	+2.8%
Stockout Days	14,012	79,958	82% Fewer	90,301	84% Fewer
Units Sold	13,311,862	13,018,083	2.3% More	12,966,349	2.7% More
Average Inventory	314,627	283,176	11% More	280,673	12% More
Excess Stock	7,772	12,234	36% Less	23,070	66% Less
Units to Clearance	81,969	120,692	32% Fewer	189,896	57% Fewer
Units Written Down	45,026	44,468	1% More	51,818	13% Fewer
Carrying Cost	$2,412	$3,090	–$678	$4,987	–$2,575
Write-Down Cost	$117,031	$113,383	+$3,648	$134,591	–$17,560
Inventory Turns	42.3	46.0	8% Slower	46.2	8% Slower

9. Vendor Ordering: Scenarios 3 and 4

With 7-day delivery, the three options differ. At the Enterprise plan's inventory, TSF loses on revenue and net profit. With somewhat more stock, TSF beats the Enterprise plan on every dollar result and on stockouts. Cash recovered peaks at about 50% to 75% more inventory than the Enterprise plan holds.

Table 3. Scenario 3: Supplier Ships Daily, 7-Day Delivery Match Enterprise Inventory (TSF Forecast + 10%) (All 10 Stores, Per Year)

Per Year	TSF vs Enterprise			TSF vs Mid-Market	
Revenue Uplift	**–$194,517**			**+$628,356**	
Cash Recovered	**+$144,037**			**+$1,333,749**	
Net Profit Boost	**–$41,768 (–2.6%)**			**+$184,516 (+11.9%)**	
Units and Percentages	**TSF**	**Enterprise**	**TSF vs Enterprise**	**Mid-Market**	**TSF vs Mid-Market**
Revenue	$37,393,348	$37,587,865	–0.5%	$36,764,992	+1.7%
Stockout Days	122,924	128,778	5% Fewer	164,438	25% Fewer
Units Sold	12,463,814	12,590,013	1.0% Fewer	12,376,885	0.7% More
Average Inventory	359,002	354,200	1% More	345,445	4% More
Excess Stock	13,588	17,083	20% Less	41,602	67% Less
Units to Clearance	159,867	163,559	2% Fewer	348,162	54% Fewer
Units Written Down	73,820	78,356	6% Fewer	83,580	12% Fewer
Carrying Cost	$4,358	$4,156	+$202	$8,633	–$4,275
Write-Down Cost	$192,255	$197,762	–$5,507	$220,434	–$28,179
Inventory Turns	34.7	35.5	2% Slower	35.8	3% Slower

Table 4. Scenario 3: Supplier Ships Daily, 7-Day Delivery
Lean Inventory (TSF Forecast + 15%) (All 10 Stores, Per Year)

Per Year	TSF vs Enterprise			TSF vs Mid-Market	
Revenue Uplift	**+$151,434**			**+$974,307**	
Cash Recovered	**+$218,676**			**+$1,408,389**	
Net Profit Boost	**+$29,970 (+1.9%)**			**+$256,254 (+16.5%)**	
Units and Percentages	**TSF**	**Enterprise**	**TSF vs Enterprise**	**Mid-Market**	**TSF vs Mid-Market**
Revenue	$37,739,299	$37,587,865	+0.4%	$36,764,992	+2.7%
Stockout Days	107,342	128,778	17% Fewer	164,438	35% Fewer
Units Sold	12,591,264	12,590,013	Same	12,376,885	1.7% More
Average Inventory	384,594	354,200	9% More	345,445	11% More
Excess Stock	14,321	17,083	16% Less	41,602	66% Less
Units to Clearance	177,769	163,559	9% More	348,162	49% Fewer
Units Written Down	78,989	78,356	1% More	83,580	5% Fewer
Carrying Cost	$4,615	$4,156	+$459	$8,633	–$4,018
Write-Down Cost	$203,980	$197,762	+$6,218	$220,434	–$16,454
Inventory Turns	32.7	35.5	8% Slower	35.8	9% Slower

Table 5. Scenario 3, Supplier Ships Daily, 7-Day Delivery
Maximum Inventory (TSF Forecast + 50%) (All 10 Stores, Per Year)

Per Year	TSF vs Enterprise			TSF vs Mid-Market	
Revenue Uplift	**+$1,170,845**			**+$1,993,718**	
Cash Recovered	**+$355,962**			**+$1,545,674**	
Net Profit Boost	**+$195,455 (+12.3%)**			**+$421,740 (+27.2%)**	
Units and Percentages	**TSF**	**Enterprise**	**TSF vs Enterprise**	**Mid-Market**	**TSF vs Mid-Market**
Revenue	$38,758,710	$37,587,865	+3.1%	$36,764,992	+5.4%
Stockout Days	58,123	128,778	55% Fewer	164,438	65% Fewer
Units Sold	12,969,152	12,590,013	3.0% More	12,376,885	4.8% More
Average Inventory	571,429	354,200	61% More	345,445	65% More
Excess Stock	20,768	17,083	22% More	41,602	50% Less
Units to Clearance	368,841	163,559	126% More	348,162	6% More
Units Written Down	111,213	78,356	42% More	83,580	33% More
Carrying Cost	$6,913	$4,156	+$2,757	$8,633	–$1,720
Write-Down Cost	$282,894	$197,762	+$85,132	$220,434	+$62,460
Inventory Turns	22.7	35.5	36% Slower	35.8	37% Slower

Table 6. Scenario 4: Truckload Supplier, Weekly Match Enterprise Inventory (TSF Forecast + 20%) (All 10 Stores, Per Year)

Per Year	TSF vs Enterprise			TSF vs Mid-Market	
Revenue Uplift	**–$216,286**			**+$790,026**	
Cash Recovered	**+$92,341**			**+$772,185**	
Net Profit Boost	**–$43,542 (–2.7%)**			**+$222,493 (+14.3%)**	
Units and Percentages	**TSF**	**Enterprise**	**TSF vs Enterprise**	**Mid-Market**	**TSF vs Mid-Market**
Revenue	$37,749,474	$37,965,760	–0.6%	$36,959,448	+2.1%
Stockout Days	110,784	105,458	5% More	144,909	24% Fewer
Units Sold	12,603,789	12,717,092	0.9% Fewer	12,442,251	1.3% More
Average Inventory	416,863	421,451	1% Less	410,535	2% More
Excess Stock	17,094	19,342	12% Less	45,148	62% Less
Units to Clearance	220,155	201,218	9% More	419,532	48% Fewer
Units Written Down	87,310	94,324	7% Fewer	97,093	10% Fewer
Carrying Cost	$5,494	$4,656	+$838	$8,914	–$3,420
Write-Down Cost	$227,051	$236,688	–$9,637	$254,938	–$27,887
Inventory Turns	30.2	30.2	Same	30.3	Same

Table 7. Scenario 4: Truckload Supplier, Weekly Lean Inventory (TSF Forecast + 30%) (All 10 Stores, Per Year)

Per Year	TSF vs Enterprise			TSF vs Mid-Market	
Revenue Uplift	**+$188,060**			**+$1,194,372**	
Cash Recovered	**+$152,990**			**+$832,835**	
Net Profit Boost	**+$28,831 (+1.8%)**			**+$294,866 (+18.9%)**	
Units and Percentages	**TSF**	**Enterprise**	**TSF vs Enterprise**	**Mid-Market**	**TSF vs Mid-Market**
Revenue	$38,153,820	$37,965,760	+0.5%	$36,959,448	+3.2%
Stockout Days	89,845	105,458	15% Fewer	144,909	38% Fewer
Units Sold	12,751,826	12,717,092	0.3% More	12,442,251	2.5% More
Average Inventory	470,299	421,451	12% More	410,535	15% More
Excess Stock	18,648	19,342	4% Less	45,148	59% Less
Units to Clearance	267,377	201,218	33% More	419,532	36% Fewer
Units Written Down	97,315	94,324	3% More	97,093	Same
Carrying Cost	$6,075	$4,656	+$1,419	$8,914	–$2,839
Write-Down Cost	$251,949	$236,688	+$15,261	$254,938	–$2,989
Inventory Turns	27.1	30.2	10% Slower	30.3	11% Slower

Table 8. Scenario 4: Truckload Supplier, Weekly Maximum Inventory (TSF Forecast + 50%) (All 10 Stores, Per Year)

Per Year	TSF vs Enterprise			TSF vs Mid-Market	
Revenue Uplift	**+$610,279**			**+$1,616,591**	
Cash Recovered	**+$192,773**			**+$872,618**	
Net Profit Boost	**+$82,558 (+5.2%)**			**+$348,593 (+22.4%)**	
Units and Percentages	**TSF**	**Enterprise**	**TSF vs Enterprise**	**Mid-Market**	**TSF vs Mid-Market**
Revenue	$38,576,039	$37,965,760	+1.6%	$36,959,448	+4.4%
Stockout Days	67,454	105,458	36% Fewer	144,909	53% Fewer
Units Sold	12,908,240	12,717,092	1.5% More	12,442,251	3.7% More
Average Inventory	576,097	421,451	37% More	410,535	40% More
Excess Stock	22,777	19,342	18% More	45,148	50% Less
Units to Clearance	393,935	201,218	96% More	419,532	6% Fewer
Units Written Down	116,844	94,324	24% More	97,093	20% More
Carrying Cost	$7,552	$4,656	+$2,896	$8,914	–$1,362
Write-Down Cost	$298,922	$236,688	+$62,234	$254,938	+$43,984
Inventory Turns	22.4	30.2	26% Slower	30.3	26% Slower

10. Stress Test: Scenario 5

Scenario 5 applies a two-week order cycle to every product, including fast-moving Foods items. No TSF padding level beats the Enterprise plan on net profit: TSF sells more, leaves more cash in the business, and has fewer stockout days, but writes off more stock. The tables show Option 1, Match Enterprise Inventory, and Option 3, Maximum Inventory. Scenario 5 has no Option 2, because no padding level beats the Enterprise plan on net profit. Against the Mid-Market plan, TSF leads on every dollar result.

Table 9. Scenario 5: Truckload Supplier, Every Two Weeks Match Enterprise Inventory (TSF Forecast + 10%) (All 10 Stores, Per Year)

Per Year	TSF vs Enterprise			TSF vs Mid-Market	
Revenue Uplift	**–$353,574**			**+$189,611**	
Cash Recovered	**+$79,485**			**+$796,605**	
Net Profit Boost	**–$74,534 (–4.6%)**			**+$97,805 (+6.1%)**	
Units and Percentages	**TSF**	**Enterprise**	**TSF vs Enterprise**	**Mid-Market**	**TSF vs Mid-Market**
Revenue	$38,147,877	$38,501,451	–0.9%	$37,958,266	+0.5%
Stockout Days	89,086	84,097	6% More	106,465	16% Fewer
Units Sold	12,744,390	12,918,615	1.3% Fewer	12,779,980	0.3% Fewer
Average Inventory	559,915	592,715	6% Less	578,702	3% Less
Excess Stock	25,944	31,087	17% Less	76,521	66% Less
Units to Clearance	460,176	462,353	Same	803,007	43% Fewer
Units Written Down	119,991	130,616	8% Fewer	138,215	13% Fewer
Carrying Cost	$8,289	$7,495	+$794	$15,325	–$7,036
Write-Down Cost	$308,043	$319,868	–$11,825	$352,926	–$44,883
Inventory Turns	22.8	21.8	4% Faster	22.1	3% Faster

Table 10. Scenario 5: Truckload Supplier, Every Two Weeks Maximum Inventory (TSF Forecast + 25%) (All 10 Stores, Per Year)

Per Year	TSF vs Enterprise			TSF vs Mid-Market	
Revenue Uplift	**+$45,230**			**+$588,415**	
Cash Recovered	**+$116,206**			**+$833,326**	
Net Profit Boost	**–$30,891 (–1.9%)**			**+$141,447 (+8.8%)**	
Units and Percentages	**TSF**	**Enterprise**	**TSF vs Enterprise**	**Mid-Market**	**TSF vs Mid-Market**
Revenue	$38,546,681	$38,501,451	+0.1%	$37,958,266	+1.6%
Stockout Days	70,064	84,097	17% Fewer	106,465	34% Fewer
Units Sold	12,892,289	12,918,615	0.2% Fewer	12,779,980	0.9% More
Average Inventory	663,768	592,715	12% More	578,702	15% More
Excess Stock	32,909	31,087	6% More	76,521	57% Less
Units to Clearance	681,864	462,353	47% More	803,007	15% Fewer
Units Written Down	141,964	130,616	9% More	138,215	3% More
Carrying Cost	$10,509	$7,495	+$3,014	$15,325	–$4,816
Write-Down Cost	$358,691	$319,868	+$38,823	$352,926	+$5,765
Inventory Turns	19.4	21.8	11% Slower	22.1	12% Slower

11. Conclusions

With next-day delivery, the TSF plan ordered the forecast with no padding and beat the Enterprise plan on revenue, cash recovered, net profit, and stockout days, holding about a tenth more inventory. Padding added revenue and cut stockouts further, but every step of padding reduced both cash and profit. For fast replenishment, the forecast alone was the best plan.

With 7-day delivery, the TSF plan lost to the Enterprise plan at the same inventory and beat it with modest extra stock. Cash recovered peaked at roughly half to three-quarters more inventory than the Enterprise plan holds. How much stock to carry is a business decision, and the simulation measures what each level returns in revenue, cash, and profit before the business commits to it.

The two-week truckload scenario tested the method at its limit. The TSF plan sold more, kept more cash, and ran out less often than the Enterprise plan, but wrote off more aged stock, and the write-downs left its net profit below the Enterprise plan's. Against the Mid-Market plan, the TSF plan led on every dollar result in every scenario.

The TSF plan orders from one estimate: the forecast, with any padding stated as a percentage of it. The standard plans order from two: the forecast and a separate estimate of how far the forecast misses. Every result in this study comes before the savings on the planning system itself and on the labor it takes to run it.

A Historical Simulation on Your Data

TSF Demand runs this same simulation on a business's own sales history: its products, its suppliers' delivery times, its order schedules, its case packs, and its margins. The results show what the TSF plan would have done with that business's stock, cash, and profit over the past two years, before anything in the business changes. To arrange a historical simulation on your data, contact TSF Demand at TSFDemand.com.