Phantom Demand & System Dynamics Solutions

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Today's objectives

- Provide you with a story about an engagement between MIT and a sponsor company

- Present you a synthesis of:

  - Engagement history

  - Insights and validation at different levels

  - Project scope and work done

  - Problem description, reference modes and causal mapping

  - Modeling and policy investigation

  - Nature of policy recommendations

Agenda

- Background
  - Insights
  - Methodology overview
  - Problem description
- Progress to date
  - Timeline slide
  - Work detail
- Analysis
  - Causal loops
  - Model
  - Policies
- Insights

Insights overview

- **Focus on grower order accuracy**
  - "Real orders for real people"
  - Sales people serve as proxy for grower orders
- **Ease pressure on sales force to meet financial targets**
  - Emphasize positioning and education role of sales people
- **Re-evaluate the timing of receiving orders and sending shipments**
  - Allow time to confirm early orders / Plan for early delivery
- **Manage hot products by exception**
  - Specify allocation policy for hot products
  - Provide status on allocation policy and hot product availability
- **Emphasize management of product portfolio**
  - Recommend portfolio of products to dealers as alternatives to hot products
- **Provide clear incentives for lower returns**
  - Reward sales reps, dealers, and growers for low seed returns

Insights & validation levels

- Focus on grower order accuracy

- Ease pressure on sales force to meet financial targets

- Re-evaluate the timing of receiving orders and sending shipments

- Manage hot products by exception

- Emphasize management of product portfolio

- Provide clear incentives for lower returns

- Interviews, causal loops, model

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- Interviews

- Interviews, causal loops

SD methodology overview

- Focus on understanding how a business can cause its own problems

- Focus on finding levers, where small efforts can have large, beneficial effects

- Focus on managers' expertise

  - Important how managers do their tasks, not on how they ought to do them

- Seek data from several departments in organization informing the problem

  - Complex problems often cross several org. boundaries

System dynamics approach

- Reference modes
- Proposed solutions
- Dynamic hypotheses
- Formal modeling
- Model analysis
- Policy testing

Repeat

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Problem description

- Excess return of corn seeds
  - Twice as high as the industry average
- Dealers can send seeds back without sizable penalties
  - $2 restocking fee for $100 retail price
- Seeds can be produced and sold only once a year
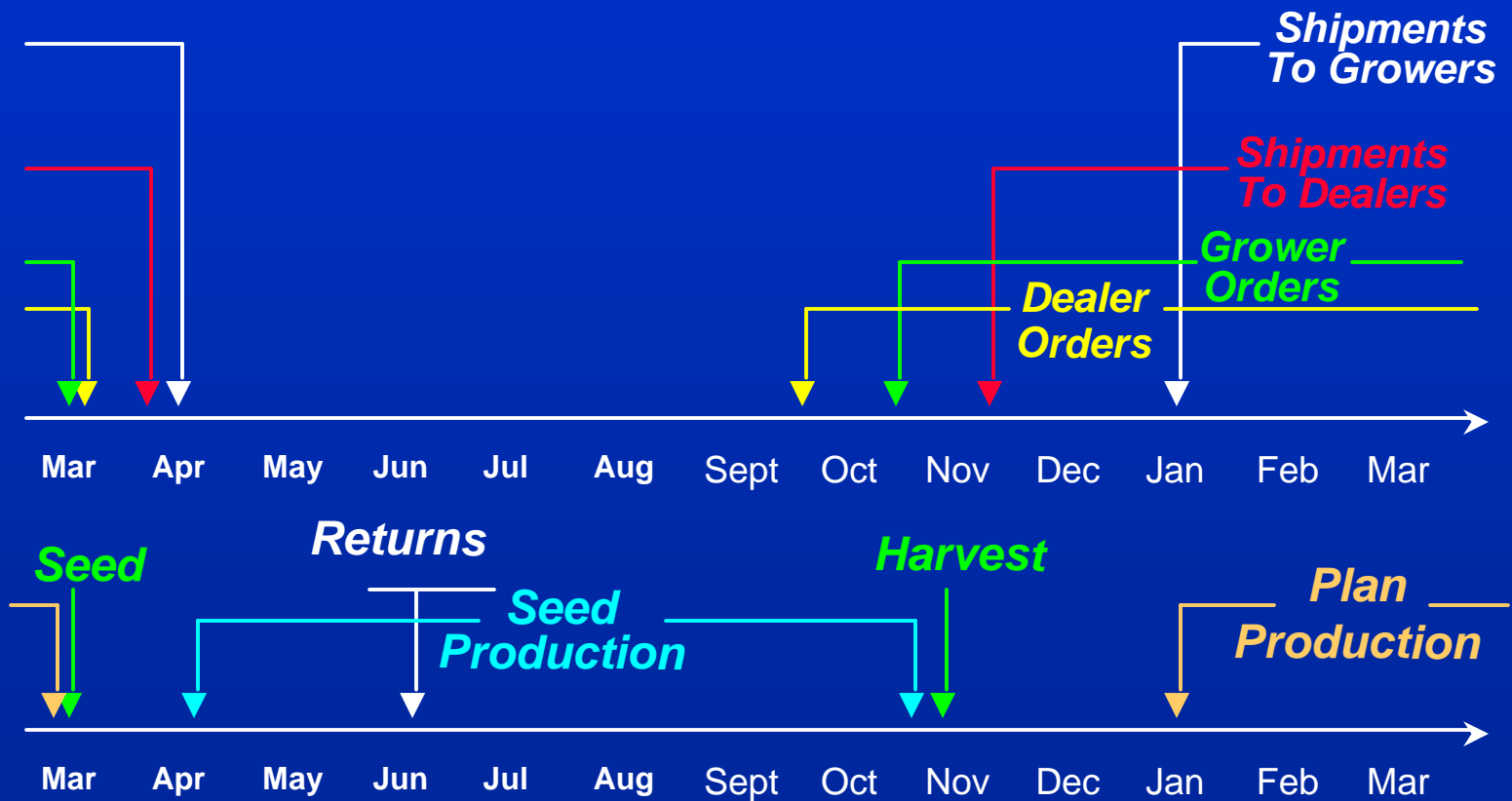 - Little visibility of seed stocks once it is in the distribution channel

Corn seed returns

Seed returns (fraction of sales)

Target 2002

Fear

Hope

97   98   99   00   01

Time

| Background | Progress | Analysis | Insights |

Timeline for orders and production

Shipments To Growers

Shipments To Dealers

Grower Orders

Dealer Orders

Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar

Seed

Returns

Harvest

Seed Production

Plan Production

Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar

Background	Progress	Analysis	Insights

Timeline for sales and shipping
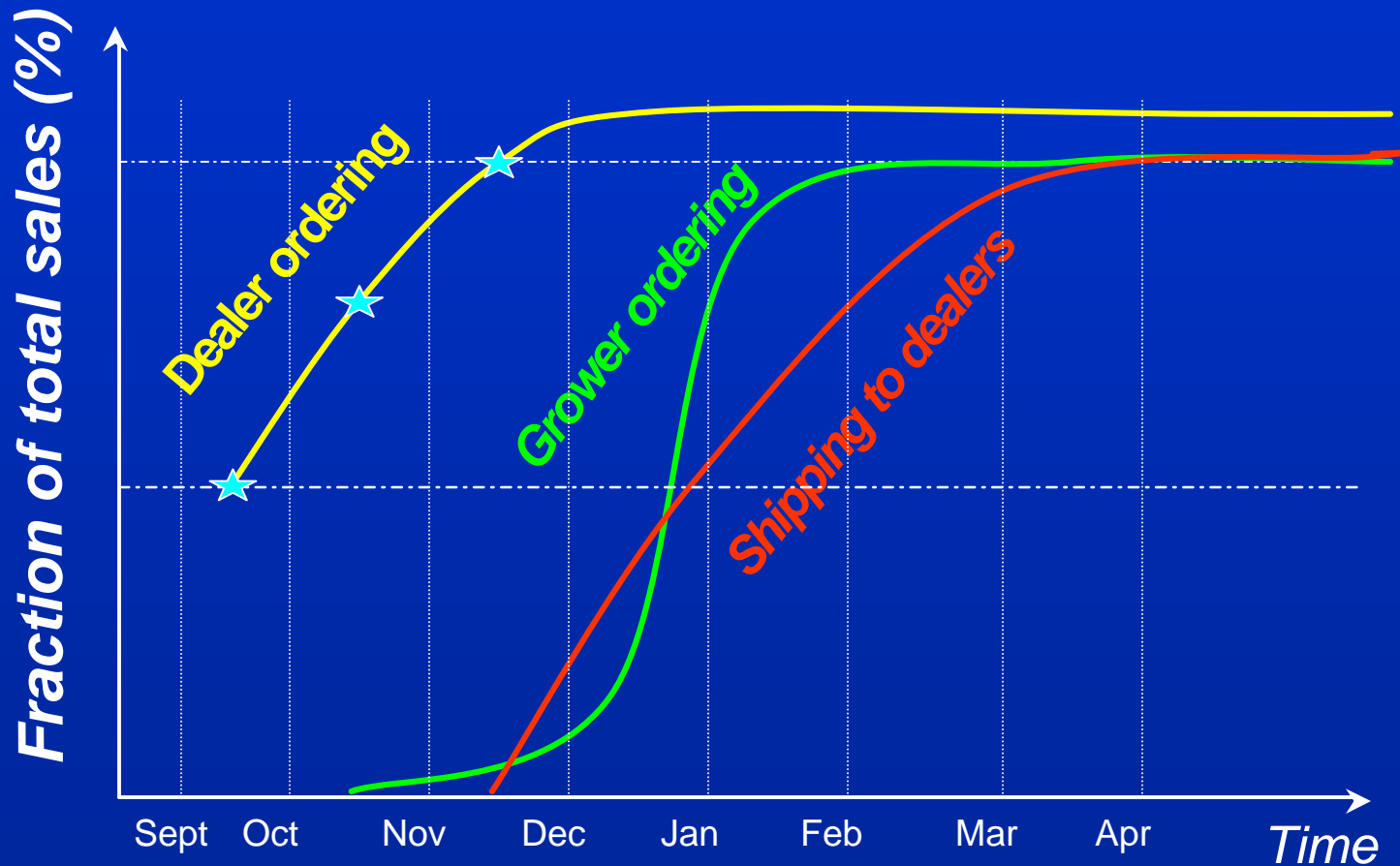
Background | Progress | Analysis | Insights

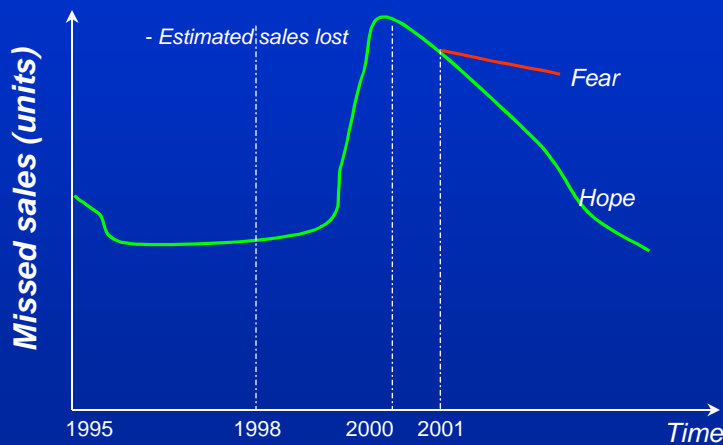# Trust / Experience / Buckets / Sales opps
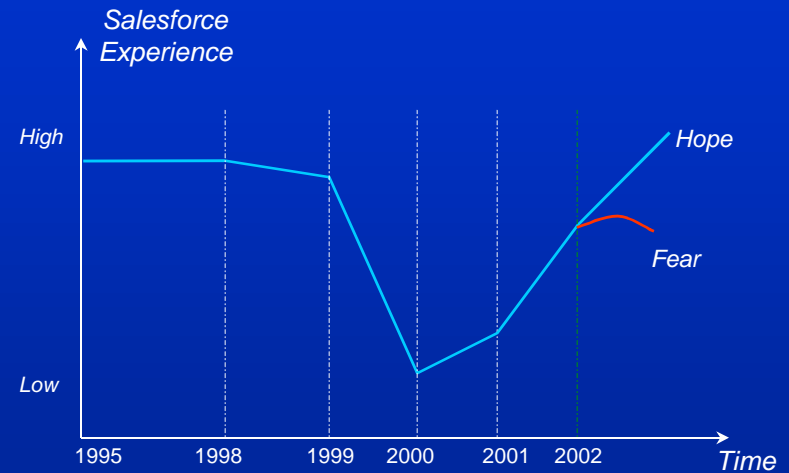
Supply Reliability and Trust
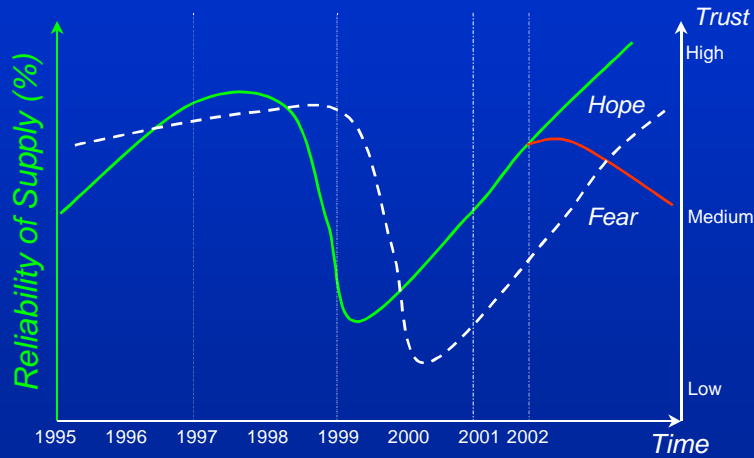
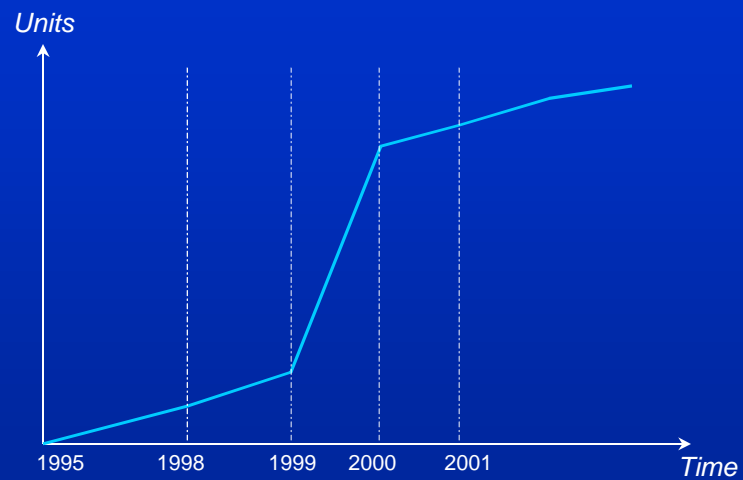## Number of allocation buckets

Lost sales opportunities

Salesforce experience

Q4 ship / Hybrids

Q4 deliveries to dealers

Units

1995   1998   1999   2000   2001

Time

Number of hybrids

Units

1995   1998   1999   2000   2001   2002   2003

Time

13
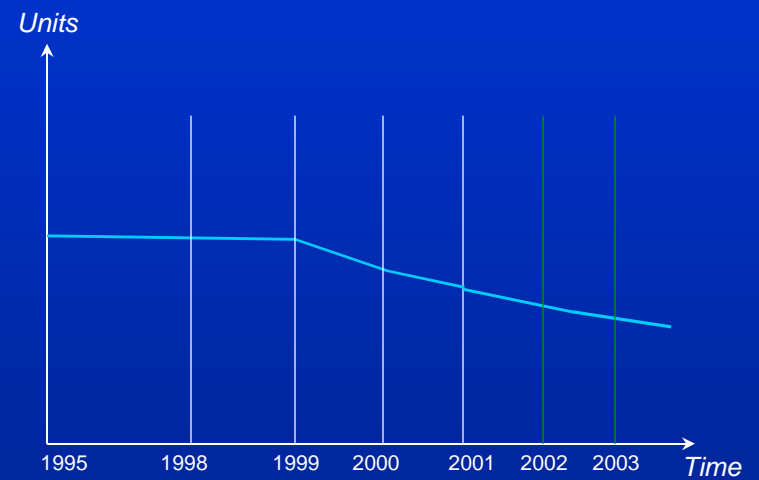
Important variables considered

- **Grower demand**
- **Supplier visibility of dealer stocks**
- **Trust on supplier**
- **Number of SKUs**
- Dealer demand
- Dealer seed stock
- Supplier seed stock
- Reliability of supply
- Fraction of sales returned
- Fraction of sales lost
- Number of decision makers
- Number of allocation buckets
- SKU profitability
- Seed price
- Overstocking penalty
- Under-stocking penalty

- **Seed performance**
- **Quarterly sales quota**
- **Salesforce tenure**
- **Number of distribution layers**
- Brand loyalty
- Salesforce size
- Timing of production
- Timing of forecast
- Forecast accuracy
- Tied-up supply
- Number of ship-to points
- Length of distribution channel
- Side-way movements
- Seed shelf-life
- Company culture
- Acreage

Background	Progress	Analysis	Insights

14

Momentum Policies

1. **Penalty – restocking fee**
2. **Adjusted/consolidated orders – Maintain a certain ordering pace**
3. **Provide training (for dealers/farmers) on seed business**
4. **Charge teams for seed obsolescence**
5. **X**
6. Reduce allocation buckets
7. Improve seed performance
8. Better coordination of warehousing
9. Assure dealers/sales people have visibility of supply forecasts
10. Focus on SKUs that have more profitability
11. Learn the system – how to manage it better
12. Make system more inter-functional
13. More interdependent culture / cross alignment with dealers
14. Build trust

| Background | Progress | Analysis | Insights |

15

Causes of problem

- **Sales process**
  - Dealer have no firm grower orders
  - Dealers stock order x% of prior year sales in September.
  - Most growers make their buying decisions in Nov/Dec timeframe

- **Timing of forecast and type of data**
  - Timing of forecast and production (one year in advance)
  - Dealer instead of grower orders
  - Can not have grower orders because it limits hitting quarterly revenue quotas – grower orders too late

- **No visibility of channel inventory**
  - Product shipped to dealers Nov 15th
  - Cannot reposition inventories during season
  - Supply tied up in wrong locations where there is no demand

- **Quarterly revenue quotas**
  - Shipments in Q4 driven by revenue quotas
  - Shipments to wrong destinations

- **Wrong incentives**
  - Huge penalties for under-stocking
  - Low penalties for over-stocking
  - The fact that product can be returned is part of the cause

- **Product portfolio**
  - Too many products to sell (SKUs)
  - Customers get confused - cannot forecast what will sell
  - Dealer's lack of brand quality

- **High demand uncertainty**
  - Variable product performance
  - Weather variability / Input costs
  - Government programs and regulations

- **Company culture**

Project timeline

- Kick-off meeting
  - 02/08 – Problem description

- Weekly meetings
  - 03/08 – Reference modes + data (9am EST)
  - 03/15 – Causal loop discussion (9am EST)
  - 04/01 – Causal loop discussion (2pm EST)
  - 03/27 – Conference call w/ dealers'
  - 04/04 – Model discussion (9am EST)
  - 04/19 – Policy investigation (9am EST)
  - 04/26 – Policy exploration (9am EST)

- Field Trips
  - 02/08 – Problem description
  - 03/25 – Causal discussion
  - 04/12 – Model discussion / implications
  - 05/03 – Final presentation

Work Detail

- 8 Weeks of project duration
  - 12 weeks from first meeting (4 weeks to sort out interaction mode)
- 4 Field trips – once every 3 weeks
- 6 Weekly conference calls (4 desktop sharing sessions)
  - Additional individual follow up calls (data and questions)
- 15 One-hour interviews
  - Operations, quarterly initiatives, logistics, planning/demand forecasting, sales (BTLs and RBD), order processing, supply chain management, dealers
- Causal loop, model and policy investigation iterations
  - 10 causal loop iterations
  - 20 model iterations
  - 4 policy investigation discussions
- Model reviews
  - 4 opportunities for model reviews with leading experts in the field

Background	Progress	Analysis	Insights

18

Quantitative and qualitative data

- Quantitative data (teams and regions)
  - Returns and net sales (monthly)
  - Requests and shipment rates (weekly)
  - Sales quotas
  - Fraction of quotas achieved
- Qualitative data
  - Causal relationships among separate variables
  - Managers' decision heuristics
  - Role of sales force experience and work
  - Confirmation of initial hypotheses
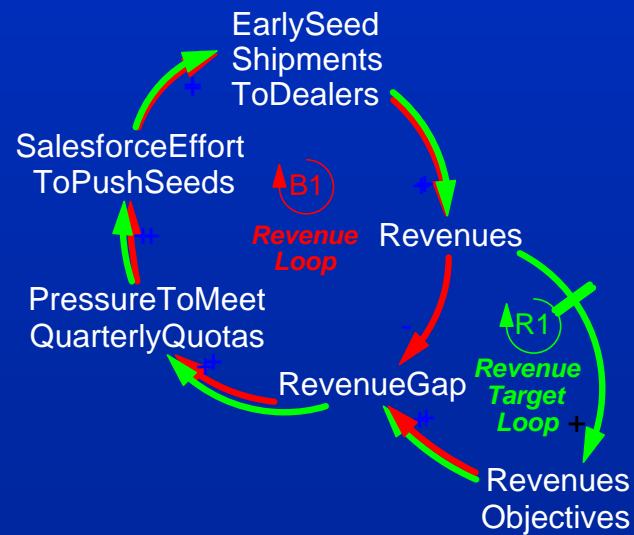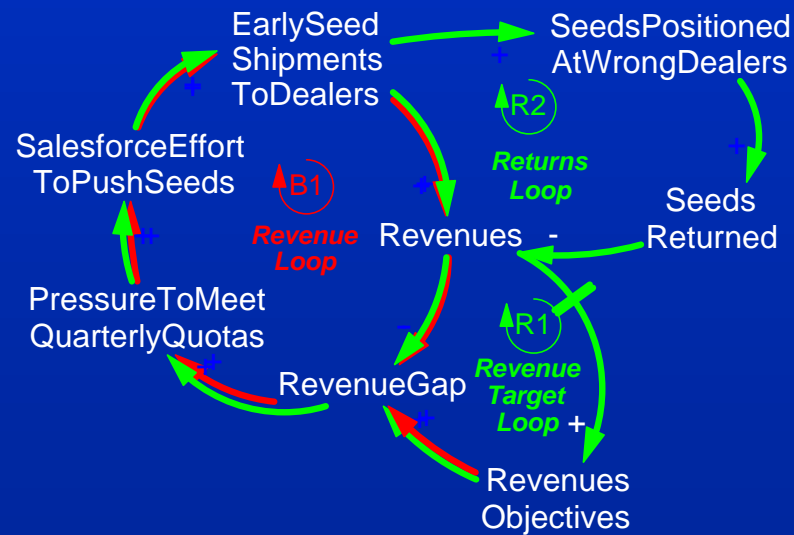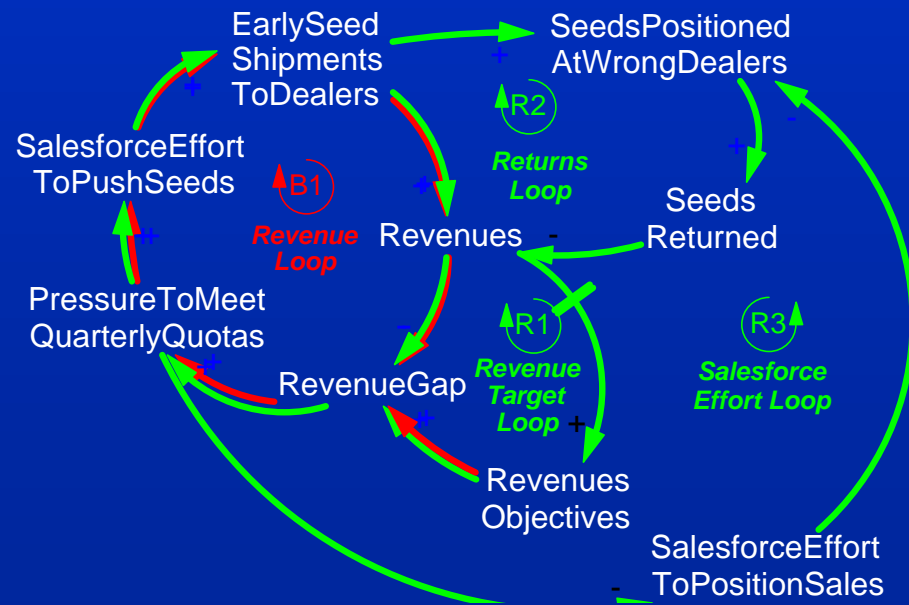
Shipping early brings early revenues

EarlySeed
Shipments
ToDealers

SalesforceEffort
ToPushSeeds

B1

*Revenue
Loop*

Revenues

PressureToMeet
QuarterlyQuotas

RevenueGap

Revenues
Objectives

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Revenue growth leads to higher goals

Shipping to wrong dealers cause returns

Low effort positioning leads to returns

EarlySeed Shipments ToDealers

SeedsPositioned AtWrongDealers

SalesforceEffort ToPushSeeds

R2

Returns Loop

B1

Seeds Returned

Revenue Loop

Revenues

PressureToMeet QuarterlyQuotas

R1

R3

RevenueGap

Revenue Target Loop

Salesforce Effort Loop

Revenues Objectives

SalesforceEffort ToPositionSales

Early shipments lower supply reliability
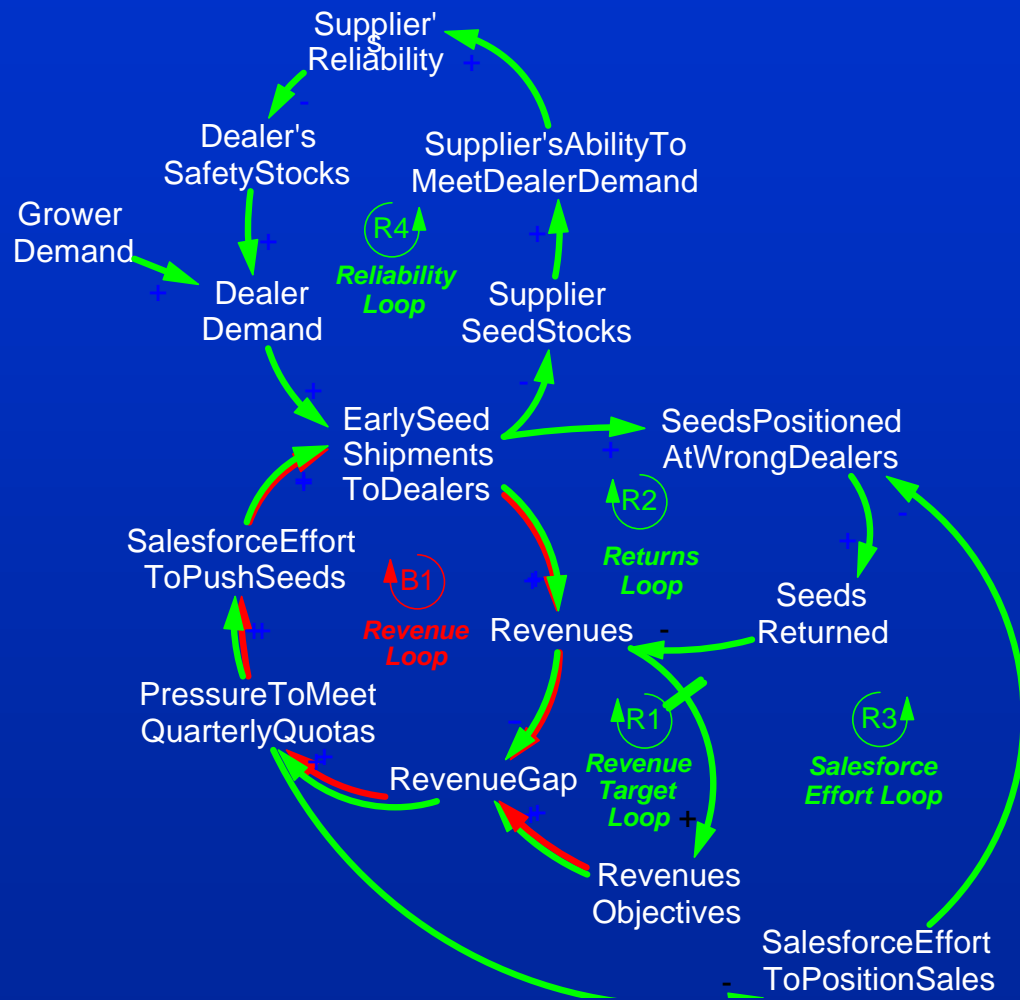
Tied up stocks lowers supplier's reliability
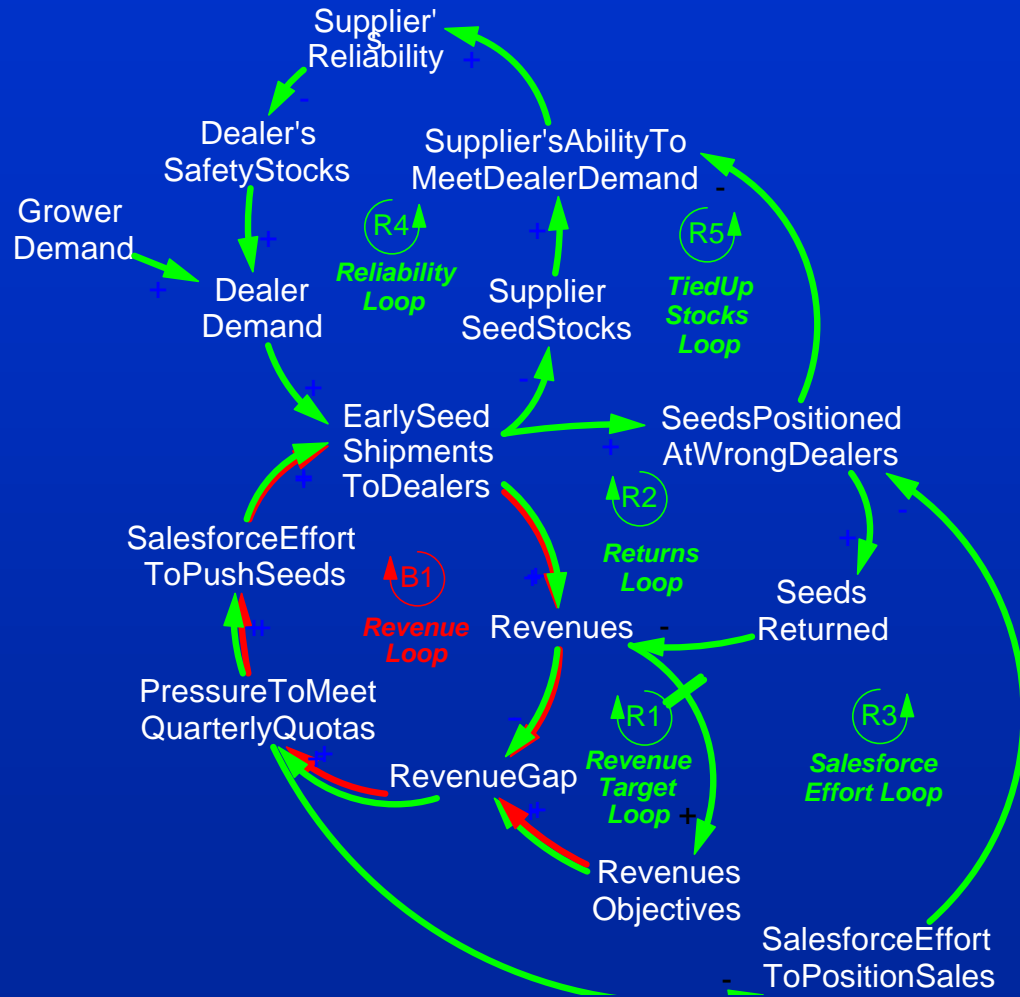
Inability to meet demand causes lost sales

Quantitative model to analyze tradeoffs

- Positive impacts of early shipments – Intended consequences
    - Incur early revenues
    - Growth of revenue targets
- Negative impacts – Unintended consequences
    - Inability to position seeds in right locations
    - Lower perceived reliability
    - Increased seed returns due to dealer hoarding
    - Lost sales opportunities
    - Lower supply chain visibility due to tied-up stock
- System behavior depends on strength of each hypothesis
    - Quantitative modeling allows us to capture such strengths

Model facts and assumptions

- Facts
  - System of nonlinear differential equations
    - 14 stocks (integrations – diff equations)
    - About 100 equations
  - Aggregate and dynamic model emphasizing:
    - Company and dealers interaction through sales force
- Assumptions
  - Single company warehouse
  - Single seed hybrid
  - Uniform dealers and sales reps
  - Dealers' inventory disaggregated
    - Right and wrong locations
  - Pushing Effort + Positioning Effort ? Max Effort
  - P(Ship to right location) = f (Positioning Effort)
  - Scheduling rate = f (Pushing Effort)

Base case run

- Assumptions
  - Simulated year maps only Q1 & Q4 (1 Yr = 26 weeks)
  - *Initial Ordering Date = 13 weeks*
  - *Initial Scheduling Date = 7 weeks*
  - *P(Shipping wrong) = x%*
  - *Switch Aggressive Effort = 0.5*
  - *Yearly Weight = 0.67* fraction (emphasis on NI quota)
  - *Unit costs of returns = $ 22* (excluding cost of goods)

- Model Results

Dealers seed stocks
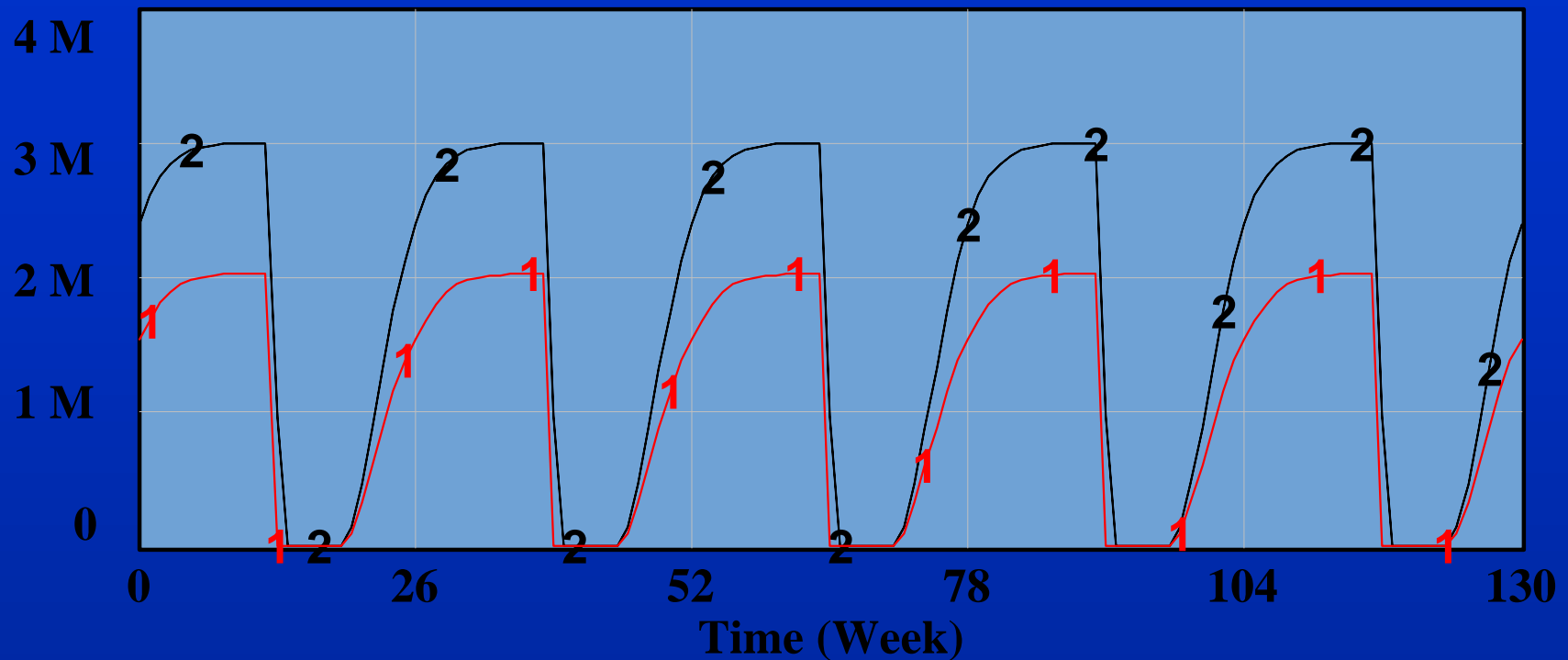
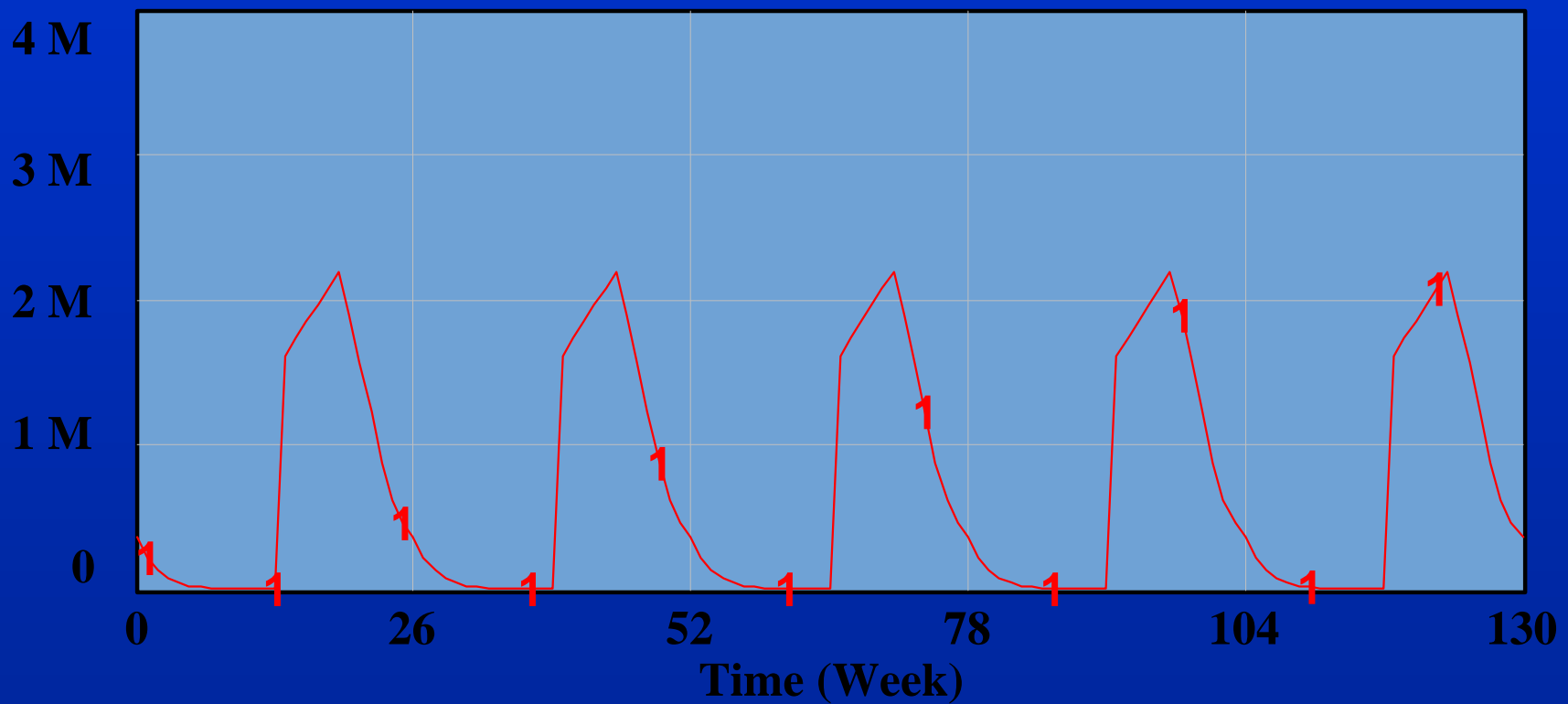Seed stocks at right locations
Seed stocks at wrong locations
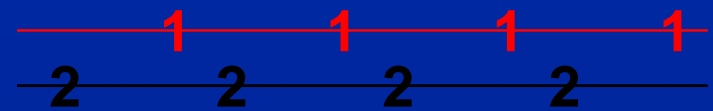
Dealers' orders

Pressure on sales people
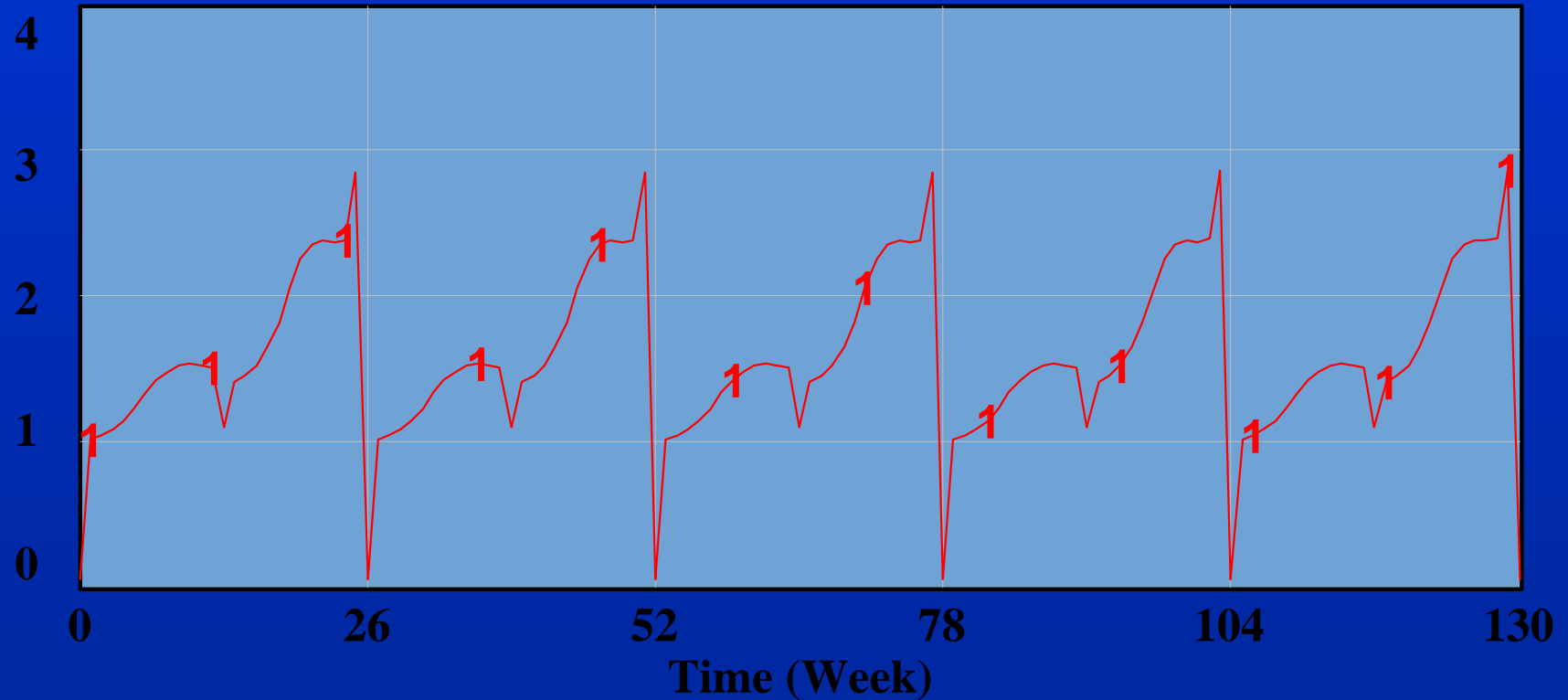
Sales-force effort positioning seeds
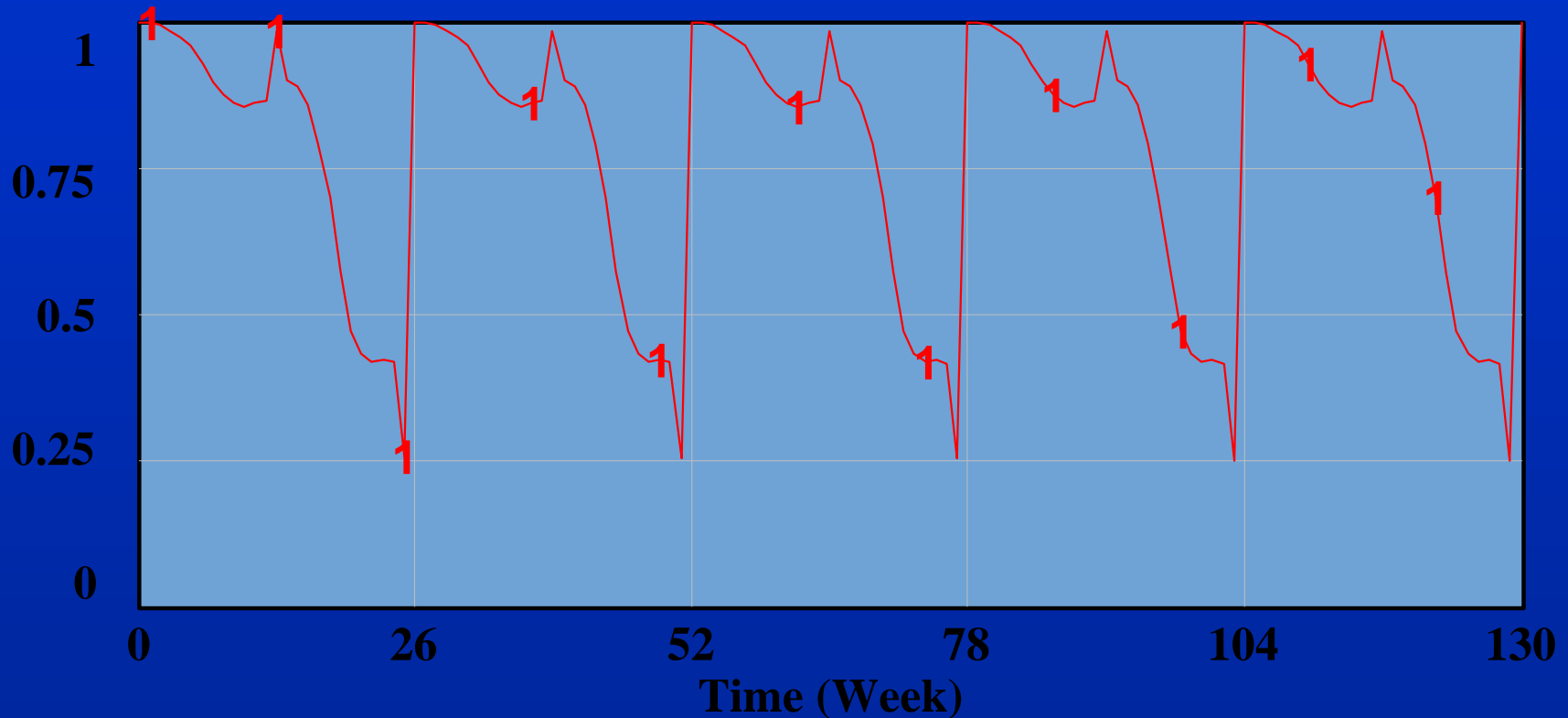
Probability of shipping right
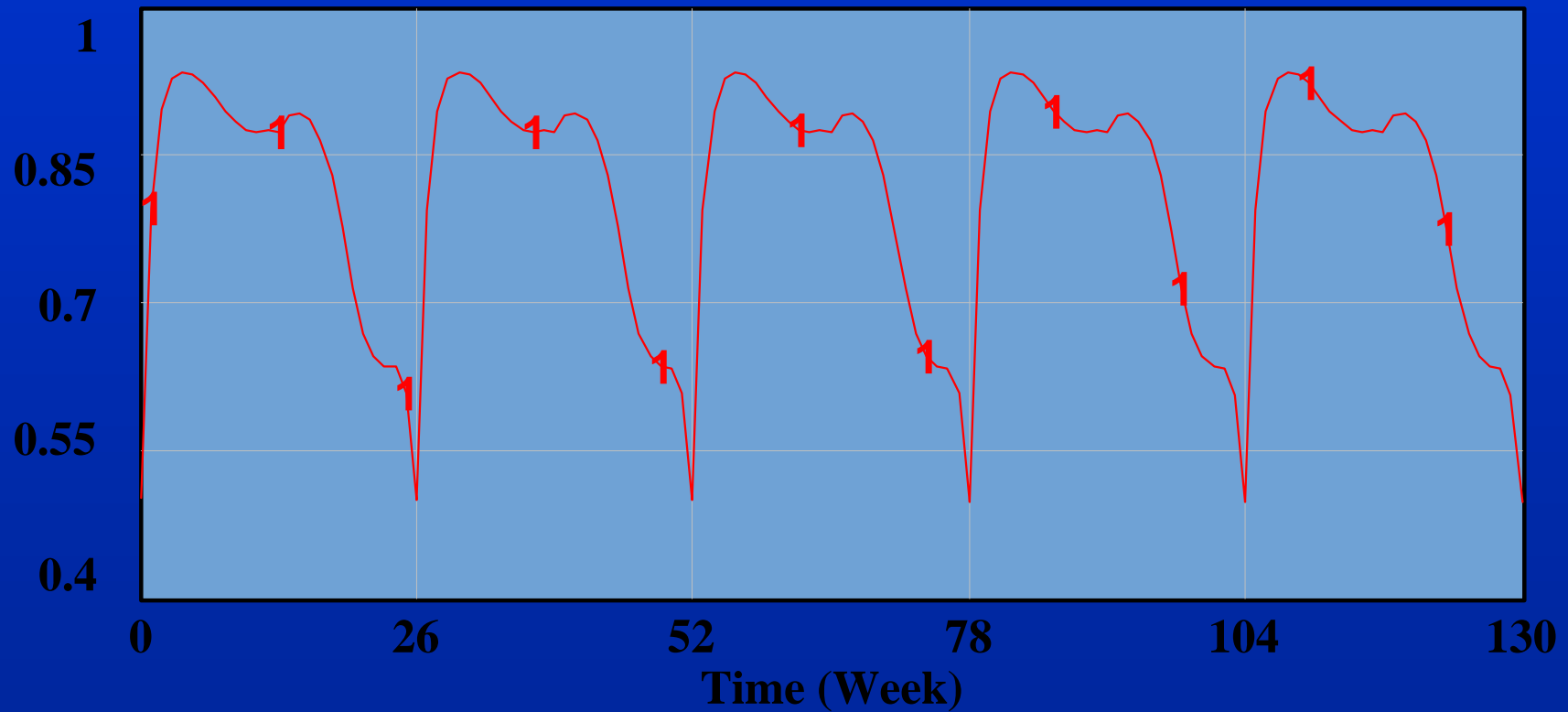
Policy investigation

- Timing of receiving orders and sending shipment
  - Order confirmation period
  - Early shipments
  - Order confirmation and early shipments
- Protocols and training supporting sales reps
  - Conservative sales response
  - More periodic review of performance
  - Conservative sales and periodic review
- Combined timing and sales reps policies

Conservative sales response

- Assumptions

  - Conservative sales force response to pressure to meet quotas

- Policy implementation

  - *Switch Aggressive Effort = 1*

- Model Results

  - Returns

  - Cost of returns

  - Reduction of x% decrease

Periodic review

- Assumptions
  - Emphasizing quarterly quotas instead of yearly net income
- Policy implementation
  - *Yearly Wait = 0.5* fraction (equal emphasis on quarterly quotas)
- Model Results
  - Returns
  - Cost of returns
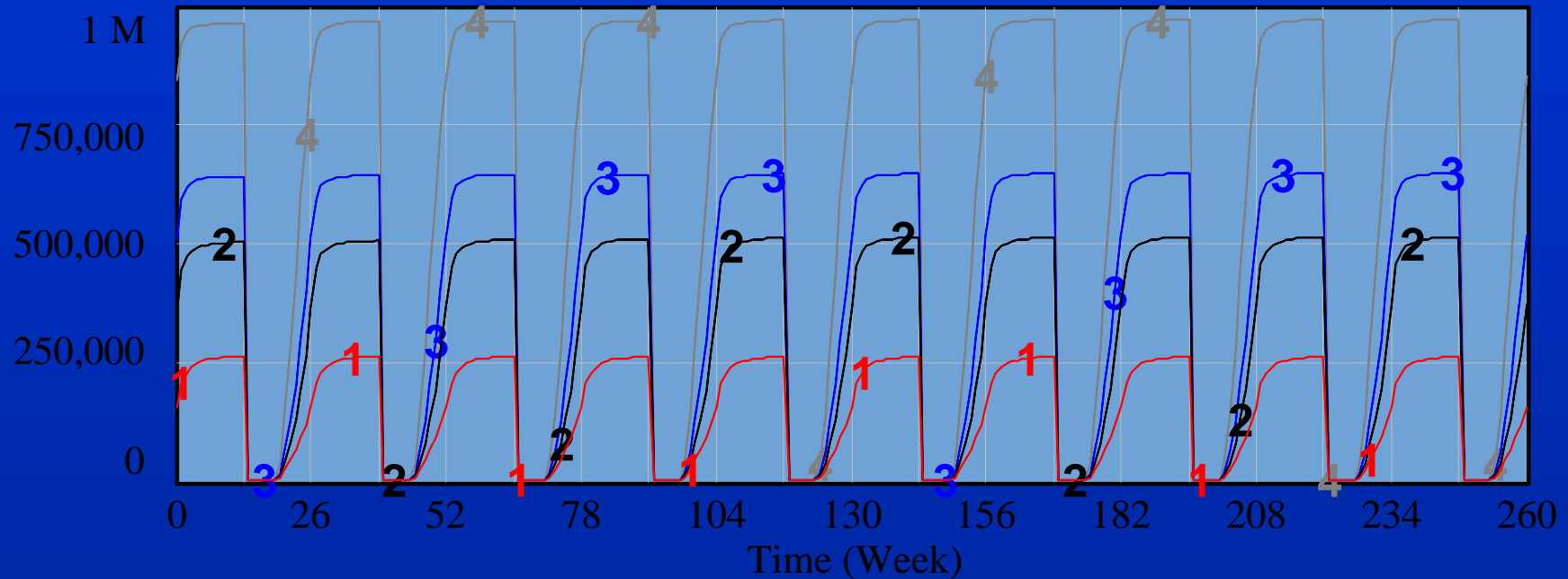 - Reduction of x% decrease

Combined policy

- Assumptions
  - Conservative sales force response to pressure to meet quotas
  - Emphasizing quarterly quotas instead of yearly net income
- Policy implementation
  - *Switch Aggressive Effort = 1*
  - *Yearly Wait = 0.5* fraction (equal emphasis on quarterly quotas)
- Model Results
  - Returns
  - Cost of returns
  - Reduction of x% decrease
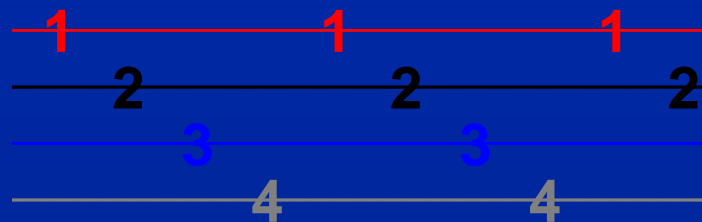
Seed stocks at wrong dealers

Combined policy offers high leverage

- Sales framework to guarantee a conservative response to pressure

- Emphasis on periodic reviews instead of mainly yearly net income

- Timing of dealer orders and shipments

  - Stock orders starting on Sep 15 (order intentions)

  - Order confirmation revising order bank on Oct-Nov

  - Shipments of carry-over inventory starting mid Oct

Insights overview

- **Focus on grower order accuracy**
  - "Real orders for real people"
  - Sales people serve as proxy for grower orders
  - Shift focus away from deliveries to accuracy….
- **Ease pressure on sales force to meet financial targets**
  - Conflict from dual role of sales
    - Push seeds to meet revenue targets
    - Position seeds to direct to right dealers
  - Emphasize positioning and education role of sales people
  - Prevent stress on the sales organization
- **Re-evaluate the timing of receiving orders and sending shipments**
  - Allow time to confirm early orders / Plan for early delivery
  - Plan conversation to confirm orders in parallel with scheduling
  - Last chance to modify just before shipment

Insights overview

- **Manage hot products by exception**
  - Specify allocation policy for hot products
  - Provide status on allocation policy and hot product availability
  - Consider different policies for returns of hot products versus returns of 'normal' products
  - Ability to supply dealers' needs with exception of hot products
- **Emphasize management of product portfolio**
  - Too late to deal with returns when they arrive.
  - Recommend portfolio of products to dealers as alternatives to hot products (production mix available in November is fixed)
  - Recommend which risks to take based on past product performance
- **Provide clear incentives for lower returns**
  - Reward sales reps, dealers, and growers for low seed returns
  - Create disincentives of returns to dealers and sales people
  - Provide clear visibility of incentives (costs and rewards)

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