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Static & Algorithmic Problems Each chapter includes a set of problems from the text to assign for homework. A combination of conceptual and step-by-step questions help students reinforce and apply their learning. Simulations - Practice Operations is a simulated game where students play the owner of a clothing manufacturing and distribution company. They must make strategic decisions and operate their growing virtual business at a profit. Students bid for contracts, source raw materials like cotton and denim, buy and set up machines to cut, sew, and produce different kinds of apparel, and deliver finished goods to their customers. Students learn and practice each of these skills while working their way up to managing the entire operation. Available currently as a salable widget in Connect. Operations Management Textbooks | Buy Textbooks | Business & Economics Textbooks | Operations Textbooks Summary Author bio Table of contents Digital rights By visiting our site, you agree to our privacy policy regarding cookies, tracking statistics, etc. Read more 1 CHAPTER 13 INVENTORY MANAGEMENT Solutions 1. a. Given: Determine an A-B-C classification for the following items: Item Unit Cost Annual Volume (00) 1 $ $ $ $ $60 85 Step 1: Determine the Annual Dollar Value (Unit Cost * Annual Volume) for each item and the sum of the individual Annual Dollar Values. Item Unit Cost Annual Volume (00) Annual Dollar Value 1 $ $2,500 2, ,100 12, Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 2 Step 2: Arrange the items in descending order based on Annual Dollar Values. Determine the A, B, and C items. Then, determine the percentage of items and the percentage of Annual Dollar Value for each category (round to two decimals). Item Annual Dollar Value Category Percentage of Items Percentage of Annual Dollar Value 6 $5,100 A 1 2, % [(1/6)*100] 33.33% 41.91% [($5,100/$12,170)*100] 40.26% 2 2,400 B [(2/6)*100] [($4,900/$12,170)*100] C 50.00% [(3/6)*100] 17.83% [($2,170/$12,170)*100] 12, % % b. Given: D = 4,500, S = $36, and H = $10. Find the EOQ (round to an integer value): Q 2DS H 2(4,500) units c. Given: D = 18,000/year, S = $100, H = $40 per unit per year, p = 120 units per day, and u = 90 units/day. Find the economic production quantity (EPQ) (round to an integer value): ( )( ) 13-2 Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 3 2. a. Given: The following table contains figures on the monthly volume and unit costs for a random sample of 16 items. Develop an A-B-C classification for these items: Item Unit Cost Usage K34 $ K35 K36 M10 M20 Z45 F14 F95 F99 D45 D48 D52 D57 N08 P05 P09 Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 4 Step 1: Determine the Annual Dollar Value (Unit Cost * Usage) for each item and the sum of the individual Annual Dollar Values: Item Unit Cost Usage Annual Dollar Value K34 $ $2,000 K ,000 K ,400 M ,600 Z ,000 F ,000 F ,200 D ,500 D ,080 D ,650 D ,800 N ,200 P ,000 P , Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 5 Step 2: Arrange the items in descending order based on Annual Dollar Values. Determine the A, B, and C items. Then, determine the percentage of items and the percentage of Annual Dollar Value for each category (round to two decimals). Annual Dollar Item Value F95 $24,000 Z45 16,000 K35 15,000 P05 8,000 F14 6,000 D45 5,500 K36 5,400 D57 4,800 K34 2,000 D52 1,650 M20 1,600 F99 1,200 N08 1,200 D48 1,080 M P Category A B C Percentage of Items 18.75% [(3/16)*100] 31.25% [(5/16)*100] 50.00% [(8/16)*100] Percentage of Annual Dollar Value 54.83% [($55,000/$94,130)*100] 31.55% [($29,700/$94,130)*100] 10.02% [($9,430/$94,130)*100] 94, % % b. Given: Determine an A-B-C classification for the following items: Item Usage Unit Cost $1, , , Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 6 Step 1: Determine the Annual Dollar Value (Usage * Unit Cost) for each item and the sum of the individual Annual Dollar Values. Item Usage Unit Cost Annual Dollar Value 4 $1,400 $126, , , ,020 10, , , , , , , ,000 Step 2: Arrange the items in descending order based on Annual Dollar Values. Determine the A, B, and C items. Then, determine the percentage of items and the percentage of Annual Dollar Value for each category (round to two decimals). Item Annual Dollar Value Category 4021 $126,000 A , , , , , , ,000 B C Percentage of Items 11.11% [(1/9)*100] 33.33% [(3/9)*100] 55.56% [(5/9)*100] Percentage of Annual Dollar Value 55.26% [$126,000/$228,000)*100] 28.95% [$66,000/$228,000)*100] 15.79% [$36,000/$228,000)*100] 228, % % c. Given: Determine the percentage of items in each category and the annual dollar value for each category. Reference table above Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 7 3. Given: D = 1,215 bags per year S = $10 H = $75 Note: Round the EOQ to an integer value, but round any other values to a maximum of two decimals. a. Determine the EOQ: Q 2DS H 2(1,215) 18 bags b. Determine the average inventory: 18 bags Q/2 = 18/2 = 9 bags c. Determine the number of orders per year: D Q 1,215 bags 18 bags / order 67.5 orders d. Determine the total cost of ordering and carrying four: TC = Carrying cost + Ordering cost ( ) ( ) ( ) ( ) e. Assuming that holding cost per bag increases by $9/bag/year, what would happen to total cost? New H = $75 + $ 9 = $84. Q 2(1,215)(10) bags ( ) ( ) ( ) ( ) Increase in cost = $1, $1,350 = $78.71 per year 13-7 Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 8 4. Given: D = 40/day x 260 days/yr. = 10,400 boxes S = $60. H = $30. Note: Round the EOQ to an integer value, but round any other values to a maximum of two decimals. a. Determine the EOQ: 2DS 2(10,400)60 Q H 30 b. Determine total cost: boxes TC = Carrying cost + Ordering cost ( ) ( ) ( ) ( ) c. Yes, annual ordering and carrying costs are always equal at the EOQ (except when rounding). d. Determine total cost for Q = 200 and compare to current total cost: ( ) ( ) ( ) ( ) $6,120 $6, = $1.18 higher per year for Q = 200 (this should be acceptable) Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 9 5. Given: D = 750 pots/mo. x 12 mo./yr. = 9,000 pots/yr. C = $2. H = (.30)($2) = $.60/unit/year S = $20 Note: Round the EOQ to an integer value, but round any other values to a maximum of two decimals. a. Determine the additional annual cost for using Q = 1,500: Step 1: Determine total cost for Q = 1,500. ( ) ( ) ( ) ( ) Step 2: Determine EOQ. 2DS 2(9,000)20 Q H pots Step 3: Determine total cost for Q = 775. ( ) ( ) ( ) ( ) Step 4: Determine annual savings from using the EOQ. $570 $ = $ b. The benefit of using the EOQ is that about one half of the storage space would be needed Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 10 6. Given: D = 12 * 800 = 9,600 H =.35($10) = $3.50 per crate per year S = $28 Note: Round the EOQ to an integer value, but round any other values to a maximum of two decimals. Step 1: Determine current total cost for Q = 800 (the manager orders once per month). ( ) ( ) ( ) ( ) Step 2: Determine EOQ, total cost for EOQ, and annual savings from using the EOQ. 2DS 2(9,600)28 Q H crates ( ) ( ) ( ) ( ) Savings per year from using EOQ = $1,736 $1, = $ Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 11 7. Given: Demand is projected to be 600 units for the first half of the year and 900 units for the second half. The monthly holding cost is $2 per unit, and it costs an estimated $55 to process an order. a. Assuming that monthly demand will be level during each each six-month period, determine an order size that will minimize the sum of ordering and carrying costs for each six-month period: Note: We will solve this problem using months, rather than a year, as the period. First six-month period: d = monthly demand = 600 / 6 = 100 & H = $2.00 per unit per month. 2dS 2(100)55 Q H units Second six-month period: D = monthly demand = 900 / 6 = 150 & H = $2.00 per unit per month. 2dS 2(150)55 Q H units b. We can use the EOQ only if demand is level (stable). c. If the vendor is willing to offer a discount of $10 per order for ordering in multiples of 50 units (e.g., 50, 100, 150), would you advise the manager to take advantage of the offer in either six-month period? If so, what order size would you recommend? First six-month period: d = monthly demand = 600 / 6 = 100, H = $2.00 per unit per month, S = $55, & EOQ = 74. Monthly TC (Q = 74): ( ) ( ) ( ) ( ) With discount of $10, S = $55 $10 = $45: Monthly TC (Q = 50): ( ) ( ) ( ) ( ) Monthly TC (Q = 100): ( ) ( ) ( ) ( ) Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 12 Monthly TC (Q = 150): ( ) ( ) ( ) ( ) Conclusion: Yes, the manager should take advantage of the offer and order Q = 50 units during this six-month period. Second six-month period: d = monthly demand = 900 / 6 = 150, H = $2.00 per unit per month, S = $55, & EOQ = 91. Monthly TC (Q = 91): ( ) ( ) ( ) ( ) With discount of $10, S = $55 $10 = $45: Monthly TC (Q = 50): ( ) ( ) ( ) ( ) Monthly TC (Q = 100): ( ) ( ) ( ) ( ) Monthly TC (Q = 150): ( ) ( ) ( ) ( ) Conclusion: Yes, the manager should take advantage of the offer and order Q = 100 units during this six-month period Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 13 8. Given: d = 27,000 jars per month H = $0.18 per jar per month S = $60 Company operates 20 days a month Current Q = 4,000 Note: Round the EOQ to an integer value, but round any other values to a maximum of two decimals. a. What penalty is the company incurring by its present order size? Step 1: Determine current monthly cost for Q = 4,000. ( ) ( ) ( ) ( ) Step 2: Determine EOQ, total cost for EOQ, and monthly savings from using the EOQ. 2dS 2(27,000)60 Q0 4, H ,243 jars ( ) ( ) ( ) ( ) Savings per month from using EOQ = $765 $ = $1.32. Conclusion: Penalty from placing orders of Q = 4,000 = $1.32 per month Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 14 b. The manager would prefer ordering 10 times each month (every other day) but would have to justify any change in order size. One possibility is to simplify order processing to reduce the ordering cost. What ordering cost would enable the manager to justify ordering every other day? Using the current Q = 4,000, total monthly cost = $765. If the manager orders 10 times per month, Q = 27,000 / 10 = 2,700. Set TC (Q = 2,700) = $765 and solve for S: ( ) ( ) ( ) ( ) S = $522 / 10 S = $52.20 (round to two decimals). This is the order cost that would enable the manager to justify ordering every other day Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 15 9. Given: p = 5,000 hotdogs/day u = 250 hotdogs/day Factory operates 300 days per year D = 250 * 300 = 75,000 hotdogs per year S = $66 H = $0.45 per hotdog per year Note: Round Q p to an integer value, but round any other values to a maximum of two decimals. a. Find the optimal run size: Q p 2DS H p p u 2(75,000) ,000 5, , ,812 hotdogs b. Number of runs per year: D / Q p = 75,000 / 4,812 = runs per year c. Days to produce the optimal run quantity: Q p / p = 4,812 / 5,000 = 0.96 days Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 16 10. Given: A chemical firm produces 100-pound bags. Demand for the product = 20 tons per day. The capacity = 50 tons per day. Setup cost = $100, and storage and handling costs = $5 per ton a year. The firm operates 200 days a year. Note: 1 ton = 2,000 pounds. p = 50 tons per day * 2,000 pounds per ton = 100,000 pounds per day = 100,000 pounds per day / 100 pounds per bag = 1,000 bags per day u = 20 tons per day * 2,000 pounds per ton= 40,000 pounds per day = 40,000 pounds per day / 100 pounds per bag = 400 bags per day D = 400 bags per day * 200 days per year = 80,000 bags per year S = $100 H = $5 per ton per year = $5 per ton per year / 20 bags per ton = $0.25 per bag per year Note: Round Q p to an integer value, but round any other values to a maximum of two decimals. 2DS p 2(80,000)100 1,000 a. Q p 10, ,328 bags H p u , Qp 10,328 b. I max (p u) (1,) 6, bags p 1,000 Imax 6,196.8 Average Inventory = 3, bags 2 2 Q p 10,328 c. Run length = days p 1,000 D 80,000 d. Runs per year: 7.75 runs per year Q 10,328 e. S = $25: Q p I max 2DS H Qp p p u 2(80,000) ,164 (p u) (1,) 3,098.4 bags 1,000 1,000 5, ,164 bags 1, ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) Savings when S = $25 = $1, $ = $ per year Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 17 11. Given: Assembly takes place 5 days a week, 50 weeks a year. It will take a full day to get the machine ready for a production run of the component for the new product. S = $300 H = $10.00 p = 200/day u = 80/day D = 20,000 (250 days * 80/day) Note: Round Q p to an integer value, but round any other values to a maximum of two decimals. a. Optimal run quantity to minimize total annual costs: Q 2DS H p p u 2(20,000) ,414 units b. Days to produce the optimal run quantity: Q p p 1, days c. Average amount of inventory: ( ) ( ) units units d. The manager would like to run another job between runs of the component for the new product and needs a minimum of 10 days per cycle (including setup) for the other job: How much time is available to run the other job? The job must be finished during the pure consumption time for the component for the new product. The end of the pure consumption time is when inventory of the component for the new product falls to 0 units. If the other job takes longer than the pure consumption time, we will run out of inventory of the component for the new product. This is the time between starting production runs of the component for the new product. Plugging in values and solving for Pure Consumption Time: Conclusion: There will not be enough time to run the other job because the other job requires 10 days, which is.39 days ( ) days too many Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 18 e. Three options that the manager could consider that will allow this other job to be performed: 1) Try to shorten the setup time of the component for the new product. 2) Increase the run quantity of the component for the new product to allow a longer time between runs, i.e., run the component less often. 3) Reduce the run size of the other job. f. Determine the additional units to produce of the component for the new product and the increase in total annual cost from this new Q: We know the following: The Pure Consumption Time for the component for the new product must equal 10 days to allow the other job to be run. p = 200/day, u = 80/day, and Pure Consumption Time = 10 days. Plugging in values and solving for Q p : [ ] Using the least common denominator: ( ) The additional units per run = 1,467 1,414 = 53 units per run Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 19 Increase in total cost: Q = 1,467: ( ) units ( ) ( ) ( ) ( ) Q = 1,414: ( ) ( ) ( ) ( ) Increase = $8, $8, = $5.70 per year 12. Given: p = 800 units per day u = 300 units per day Q = 2,000 units per batch Company operates 250 days a year. a. Number of batches of heating elements per year: D Q 75,000 2, batches per year b. Amount of inventory after 2 days of production: The number of units produced in 2 days = (2 days)(800 units/day) = 1600 units The number of units used in 2 days = (2 days) (300 units per day) = 600 units Inventory build up after the first 2 days of production = 1, = 1,000 units Current inventory of the heating unit = 0 units Total inventory after the first 2 days of production = Beginning Inventory + Inventory Buildup after 2 Days of Production = 0 + 1,000 = 1,000 units. c. Average Inventory: I max Q 2,000 (p u) ( ) 1,250 units p Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 20 d. The other component requires 4 days (including setup). Setup time for the heating element = 0.5 days. Is there enough time to run the other component between the batches of heating elements? How much time is available to run the other component? The other component must be finished during the pure consumption time for the heating element. The end of the pure consumption time is when inventory of the heating element falls to 0 units. If the other component takes longer than the pure consumption time, we will run out of inventory of the heating element. This is the time between starting production runs of the heating element. Plugging in values and solving for Pure Consumption Time: Conclusion: There will not be enough time to run the other component because the other component requires 4 days, which is.33 (4 3.67) days too many Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 21 13. Given: D = 18,000 boxes/year S = $96 H = $.60/box/year Price Schedule: Number of Boxes Price per Box (P) 1,000-1,999 $1.25 2,000-4,999 $1.20 5,000-9,999 $,000+ $1.10 a. Determine the optimal order quantity (round to an integer value): Step 1: Compute the common minimum point. Q 2DS H 2(18,000) ,400 boxes This quantity is feasible in the range ,999. Step 2: Determine total cost for the common minimum point and for the price breaks of all lower unit costs. ( ) ( ) 2,400 18,000 TC 2,400 = (.60) ($96) $1.20(18,000) $23, ,400 5,000 18,000 TC 5,000 = (.60) ($96) $1.10(18,000) $22, ,000 10,000 18,000 TC 10,000 = (.60) ($96) $1.10(18,000) $22, ,000 Conclusion: Optimal order quantity = 5,000 boxes. b. Determine number of orders per year: D 18, orders per year(round to a maximum of two decimals) Q 5, Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 22 14. Given: D = 25 stones/day * 200 days/year = 5,000 stones/year S = $48 Price Schedule: Number of Stones Price per Stone (P) $ $ $8 a. H = $2. Determine the optimal order quantity: Step 1: Compute the common minimum point. Q 2DS H 2(5,000) stones This quantity is feasible in the range Step 2: Determine total cost for the common minimum point and for the price breaks of all lower unit costs. ( ) ( ) ( ) ( ) ( ) ( ) Conclusion: Optimal order quantity = 600 stones. b. H = 30% of unit cost Step 1: Beginning with the lowest unit price, compute minimum points for each price range until you find a feasible minimum point. Minimum point P = $8: 2DS H 2(5,000)48.30(8) Not feasible Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 23 Minimum point P = $9: 2DS H 2(5,000)48.30(9) Feasible Step 2: Compare the total cost at Q = 422 to Q = 600. ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) Conclusion: Optimal order quantity = 600 stones. c. Lead time = 6 working days. Determine ROP: ROP = 25 stones/day * 6 days = 150 stones Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 24 15. Given: D = 4,900 S = $50 H = 40% of purchase cost Price Schedule: Range Price per Unit (P) $5.00 1,000-3,999 $4.95 4,000-5,999 $4.90 6,000+ $4.85 Step 1: Beginning with the lowest unit price, compute minimum points for each price range until you find a feasible minimum point. Minimum point P = $4.85: 2DS H 2(4,900)50.40(4.85) Not feasible Minimum point P = $4.90: 2DS H 2(4,900)50.40(4.90) 500 Not feasible Minimum point P = $4.95: 2DS H 2(4,900)50.40(4.95) Not feasible Minimum point P = $5.00: 2DS H 2(4,900)50.40(5.00) Feasible Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 25 Step 2: Compare the total cost at Q = 495 to Q = 1,000, 4,000, & 6,000. ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) Conclusion: Optimal order quantity = 495 units. Note: The total cost for 1,000 units is only $.05 different Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 26 16. Given: D = 800 * 12 = 9,600 S = $40 H = 25% of purchase cost Price Schedule Supplier A: Range Price per Unit (P) $ $ $13.60 Price Schedule Supplier B: Range Price per Unit (P) $ $ $13.70 We need to find the optimal quantity for each supplier and select the supplier with the minimum cost. Supplier A: Step 1: Beginning with the lowest unit price, compute minimum points for each price range until you find a feasible minimum point. Minimum point P = $13.60: 2DS H 2(9,600)40.25(13.60) Not feasible Minimum point P = $13.80: 2DS H 2(9,600)40.25(13.80) Feasible Step 2: Compare the total cost at Q = 472 to Q = 500. ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) Conclusion: Optimal order quantity from Supplier A: 500 units with TC = $132, Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 27 Supplier B: Step 1: Beginning with the lowest unit price, compute minimum points for each price range until you find a feasible minimum point. Minimum point P = $13.70: 2DS H 2(9,600)40.25(13.70) Feasible Step 2: Compute total cost for Q = 474. ( ) ( ) ( ) ( ) Conclusion: Optimal order quantity from Supplier B: 474 units with TC = $133, Compare total cost for Q = 500 from Supplier A to total cost for Q = 474 from Supplier B: Conclusion: Optimal order quantity = 500 units from Supplier A Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 28 17. Given: D = 3,600 boxes per year Q = 800 boxes (recommended) S = $80/order H = $10/box/year Price Schedule: Range Price per Unit (P) $ $ $1.00 If the firm decides to order 800 boxes, the total cost is computed as follows: ( ) ( ) ( ) ( ) If the firm decides to order 801 boxes, the total cost is computed as follows: ( ) ( ) ( ) ( ) Even though the inventory total cost curve is fairly flat around its minimum, when there are quantity discounts, there are multiple U shaped total inventory cost curves. Therefore, when the quantity changes from 800 to 801, we shift to a different total cost curve. Conclusion: The order quantity of 801 is preferred to the order quantity of 800 because the total cost for Q = 801 is lower. Determine the optimal Q: Step 1: Compute the common minimum point. Q 2DS H 2(3,600) boxes This quantity is feasible in the range Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 29 Step 2: Determine total cost for the common minimum point and for the price breaks of all lower unit costs. ( ) ( ) ( ) ( ) ( ) ( ) Conclusion: Optimal order quantity = 240 boxes Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 30 18. Given: Daily usage = 800 feet/day & lead time = 6 days. Service level desired: 95%. Stockout risk for various levels of safety stock:.10 for 1,500 feet;.05 for 1,800 feet;.02 for 2,100 feet; and.01 for 2,400 feet. Stockout risk should = =.05. This requires a safety stock of 1,800 feet. ROP = Expected demand during lead time + Safety stock = EDDLT + SS = (800 feet/day x 6 days) + 1,800 feet = 6,600 feet. 19. Given: EDDLT = 300 units dlt = 30 units a. Determine ROP for 1% risk of stockout: Using Appendix B, Table B, we look for the z value corresponding to = The closest probability is.9901, which corresponds to z = ROP = ( ) (round up) b. SS = 69.9 = 70 units (round up) c. Stockout risk of 2% is > 1%. Greater stockout risk = smaller z = less safety stock & smaller ROP. 20. Given: EDDLT = 600 lb. dlt = 52 lb. Stockout risk = 4% a. Determine SS for 4% risk of stockout. Using Appendix B, Table B, we look for the z value corresponding to The closest probability is.9599, which corresponds to z = SS = ( ) (round up) b. ROP = EDDLT + SS = = 691 units c. With no safety stock, stockout risk is 50% (z = 0.00) Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 31 21. Given: d = 21 gallons/week d = 3.5 gallons/week LT = 2 days & the dairy is open 7 days a week Service level= 90% Hint: Work in terms of weeks a. Determine ROP and days of supply on hand: Using Appendix B, Table B, we look for the z value corresponding to.90. The closest probability is.8997, which corresponds to z = ROP d(lt) z( ) d LT 21(2/7) 1.28(3.5) (2/7) gallons (round up) Days of Supply = 9 / (21/7) = 9 / 3 = 3 days of supply on hand at the ROP b. OI = 10 days & 8 gallons are on hand at the order time: 10 2 Q d(OI LT) z d OI LT A (3.5) 12/ (round up) Determine the probability of experiencing a stockout before this order arrives: Risk of a stockout at the end of the initial lead time: Using Formula 13-13, set the ROP equal to the quantity on hand when the order is placed and solve for z: ROP d (LT) z ( ) d LT ( ) ( )) 2 = 1.871z z = 2 / z = 1.07 (round to two decimals) From Appendix B, Table B, the lead time service level is Risk of stockout before this order arrives = =.1423 = 14.23% Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 32 c. The manager is using the ROP model described in part a. One day after placing an order with the supplier, the manager receives a call that the order will be delayed and will arrive 3 days from the initial order date. Two gallons have been sold since the order was placed (one day ago). Determine the probability of a stockout: ROP = 9 gallons. After one day, quantity on hand = 9 2 = 7 gallons. Determine the probability of experiencing a stockout before this order arrives (in 2 days): Risk of a stockout at the end of the initial lead time: Using Formula 13-13, set the ROP equal to the quantity on hand 1 day after the order was placed and solve for z: ROP d (LT) z ( ) d LT ( ) ( )) 1 = 1.871z z = 1 / z = 0.53 (round to two decimals) From Appendix B, Table B, the lead time service level is Risk of stockout before this order arrives = =.2981 = 29.81% Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 33 22. Given: d = 30 gallons/day ROP = 170 gallons SS = 50 gallons and provides a stockout risk of 9% Step 1: Solve for the standard deviation of demand during the lead time. We know that SS = 50. Using Appendix B, Table B, we look for the z value corresponding to =.91. The closest probability is.9099, which corresponds to z = Plug in values and solve for : ( ) Step 2: Determine the SS. Stockout risk = 3%. gallons (round to three decimals) Using Appendix B, Table B, we look for the z value corresponding to =.97. The closest probability is.9699, which corresponds to z = ( ) (round up) Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 34 23. Given: d = 85 boards/day ROP = 625 boards LT = 6 days LT = 1.1 days Determine the probability of a stockout: 625 = (85 x 6) + z (85) (1.1) 625 = z 115 = 93.5z z = 115 / 93.5 z = 1.23 (round to two decimals) Using Appendix B, Table B, we find a probability of The risk of a stockout = =.1093 = 10.93%. 24. Given: Service level = 96% d = 12 units/day d = 2 units/day LT = 4 days LT = 1 day a. Determine the ROP: Using Appendix B, Table B, we look for the z value corresponding to.96. The closest probability is.9599, which corresponds to z = ( ) ( ) ( ) ROP = ROP = 71 units (round up) b. The model might not be appropriate if seasonality were present because during the busy times of the year, the ROP would be set too low (causing stockouts) and during the slow times of the year, the ROP would be set too high (causing excess inventory) Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 35 25. Given: LT = 4 x (1 0.25) = 4 x 0.75 = 3 days S = $30 D = 4,500 gallons H = $3 360 days/year d = 2 gallons/day Price List: Quantity Unit Price $ $ $1.62 a. Determine the optimal order quantity: Step 1: Compute the common minimum point. Q 2DS H 2(4,500) gallons This quantity is feasible in the range Step 2: Determine total cost for the common minimum point and for the price breaks of all lower unit costs. ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) ( ) Conclusion: Optimal order quantity = 400 gallons. b. Acceptable stockout risk = 1.5%. Determine ROP: d 4, / day Using Appendix B, Table B, we look for the z value corresponding to =.985: z = ROP d (LT) z ( ) d ROP 12.5(3) 2.17(2) LT ROP 12.5(3) 2.17(2) 3 ROP = 46 gallons (round up) Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 36 26. Given: d = 5 boxes/week d =.5 boxes/week LT = 2 weeks S = $2 H= $.20/box/ year a. Assuming a 52-week year, determine the EOQ: D = 52 x 5 = 260 ( )( ) b. If ROP = 12, determine risk of a stockout: ROP d (LT) z ( ) d LT Plugging in values and solving for z: 12 5(2) z(.5) 2 12 = z 2 =.707z z = 2 /.707 = 2.83 (round to two decimals) From Appendix B, Table B, the lead time service level is Risk of stockout = =.0023 =.23%. c. OI = 7 weeks. Determine the risk of running out before this order arrives (Q = 36) if the copy center orders when amount on hand = 12: Use Formula and solve for z: ROP d (LT) z ( ) d LT Plugging in values and solving for z: 12 5(2) z(.5) 2 2.707z z = 2 /.707 = 2.83 (round to two decimals) From Appendix B, Table B, the lead time service level is Risk of stockout = =.0023 =.23% Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 37 27. Given: d = 80 lb./day d = 10 lb./day LT = 8 days LT = 1 day Determine the ROP that would provide a stockout risk of 10%: Service Level = =.90. Using Appendix B, Table B, we look for the z value corresponding to.90. The closest probability is.8997, which corresponds to z = Given: ( ) ( ) ( ) ( ) ( ) (round up) d = 10 rolls/day d = 2 rolls/day LT = 3 days Supermarket is open 360 day a year S = $1 H = $.40 a. Determine the EOQ: D = 10 x 360 = 3,600 ( )( ) b. Determine the ROP that will provide a service level of 96%: Using Appendix B, Table B, we look for the z value corresponding to.96. The closest probability is.9599, which corresponds to z = ROP d (LT) z ( ) d LT ROP 10(3) 1.75(2) 3 ROP (round up) Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 38 Chapter 13 - Inventory Management 29. Given: D = 1,200 cases S = $40 per order H = $3 per case per year Service level = 99% a. Determine the optimal order quantity: ( )( ) (round to an integer value) b. Determine the level of safety stock if lead time demand is normally distributed with a mean of 80 cases and a standard deviation of 6 cases: EDDLT = 80 dlt = 6 Using Appendix B, Table B, we look for the z value corresponding to The closest probability is.9901, which corresponds to z = SS = ( ) (round up) 30. Given: ROP = 18 units Lead time for resupply = 3 days Usage over the last 10 days: Day Units Determine the service level achieved by the current ROP. Hint: Use Formula ROP d (LT) z ( ) d LT Step 1: Calculate the mean and standard deviation of daily demand. ( ) ( ) ( ) ( ) (round to three decimals) Step 2: Plug values into Formula and solve for z (3) z(1.265) 3 18 = z 4.2 = 2.191z z = 4.2 / = 1.92 (round to two decimals) From Appendix B, Table B, the lead time service level is.9726 = 97.26% Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 39 31. Given: A drugstore uses the fixed-order-interval (FOI) model Service Level = 98% OI = 14 days LT = 2 days d = 40 units/day d = 3 units/day On-hand inventory in each cycle: Cycle On Hand Using Appendix B, Table B, we look for the z value corresponding to.98. The closest probability is.9798, which corresponds to z = Cycle 1: Q d(OI LT) z d OI LT A Q 40(14 2) 2.05(3) Q = 623 units (round up) Cycle 2: Q 40(14 2) 2.05(3) Q = 657 units (round up) Cycle 3: Q 40(14 2) 2.05(3) Q = 562 units (round up) Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 40 32. Given: Company operates 50 weeks per year We have the following information on the two items: P34 P35 d = 60 units/week d = 70 units/week d = 4 units/week d = 5 units/week. LT = 2 weeks LT = 2 weeks Unit cost = $15 Unit cost = $20 H = (.30)($15) = $4.50 H = (.30)($20) = 6.00 S = $70 S = $30 Risk = 2.5% Risk = 2.5% Can be ordered any time OI = 4 weeks a. Determine when to reorder each item: P34: Using Appendix B, Table B, we look for the z value corresponding to =.975: z = ROP d (LT) z ( ) d LT ROP 60(2) 1.96(4) 2 ROP units (round up) P35: Order every 4 weeks. b. Compute the EOQ for P34: D = 60 x 50 = 3,000 units/year ( )( ) c. Compute the order quantity for P35 if 110 units are on hand at the time the order is placed: Using Appendix B, Table B, we look for the z value corresponding to =.975: z = Q d(OI LT) z d OI LT A Q 70(4 2) 1.96(5) Q = 335 units (round up) Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 41 33. Given: We have the following list of items: Item Estimated Annual Demand Ordering Cost Holding Cost (%) Unit Price H , H , P , P , P , P , TS , TS , TS V , a. Classify the items as A, B, or C: Step 1: Determine the Annual Dollar Value (Unit Price x Estimated Annual Demand) for each item and the sum of the individual Annual Dollar Values: Item Unit Price Estimated Annual Demand Annual Dollar Value H ,000 50,000 H , ,800 P , ,300 P , ,000 P ,250 56,250 P , ,000 TS , ,000 TS ,000 1,800,000 TS ,000 V , ,400 3,858, Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 42 Step 2: Arrange the items in descending order based on Annual Dollar Values. Determine the A, B, and C items. Then, determine the percentage of items and the percentage of Annual Dollar Value for each category (round to two decimals). Annual Dollar Item Value TS-400 1,800,000 TS ,000 P ,300 H ,800 P ,000 P ,000 V ,400 P ,250 H ,000 TS ,000 Category Percentage of Items Percentage of Annual Dollar Value A 20% 71.14% B 20% 13.48% C 60% 15.38% 3,858, % % Note: An alternate solution could be to include P6-400 through V1-001 in the B category. b. Determine the EOQ for each item (round to nearest integer): Item Estimated Annual Demand Ordering Cost Unit Holding Cost ($) EOQ H , ,000 H , ,005 P , P , P , P , TS , TS , TS V , , Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 43 34. Given: Demand for jelly doughnuts is shown in the table below. Labor, materials, and overhead are estimated to be $3.30 per dozen, doughnuts are sold for $4.80 per dozen, and leftover doughnuts are sold at half price. Demand (dozens) C s = Rev Cost = $4.80 $3.20 = $1.60 C e = Cost Salvage = $3.20 $2.40 = $.80 Relative Frequency Demand (dozens) Relative Frequency Cumulative Frequency Because.67 falls between the cumulative frequencies of.63 and.73, Don should stock 25 dozen to attain a service level of at least.67. The resulting service level will be.73 = 73.00% Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 44 35. Given: Purchase price for spare part X135 = $100 each. Carrying and disposal costs = 145% of the purchase price. Stockout cost = $88,000. Demand for parts will approximate a Poisson distribution with a mean of 3.2 parts. a. Determine the optimal number of spare parts to order: C s = $88,000 C e = $ ($100) = $245 [From Poisson Table with = 3.2] Cumulative x Probability Because.997 falls between the cumulative probabilities of.994 and.998, the optimal number of spare parts to order = 9. The resulting service level will be.998 = 99.8%. b. Determine the range of shortage cost for which carrying 0 spare parts would be the best strategy: Determine the value of C s for which the service level = the service level of stocking 0 spare part and solve for C s : Service Level for 0 Spare Parts =.041 ( ) (round to two decimals) Conclusion: Carrying 0 spare parts is the best strategy if the shortage cost is less than or equal to $ Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 45 36. Given: Purchase price = $4.20 per pound. Selling price = $5.70 per pound. Salvage price = $2.40 per pound. Daily demand can be approximated by a normal distribution with a mean of 80 pounds and a standard deviation of 10 pounds. d = 80 pounds/day d = 10 pounds/day C s = Rev Cost = $5.70 $4.20 = $1.50 per pound C e = Cost Salvage = $4.20 $2.40 = $1.80 per pound Using Appendix B, Table B, we find that.4545 falls closest to.4562: z = ( )( ) pounds (assuming that fractional values are possible) 37. Given: Daily demand can be approximated by a normal distribution with a mean of 40 quarts per day and a standard deviation of 6 quarts per day. Excess cost = $.35 per quart. The grocer orders 49 quarts per day. d = 40 quarts/day d = 6 quarts/day a. Determine the implied shortage cost per quart: C s = Rev Cost = unknown C e = $.35 Step 1: Determine z value. Using Appendix B, Table B, we find that z = 1.50 corresponds to a service level =.9332 = 93.32%. Step 2: Plug in.9332 and solve for C s. ( ) per quart (round to two decimals) b. This might be a reasonable figure because it probably is close to the lost profit per quart during strawberry season Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 46 38. Given: Demand can be approximated with a Poisson distribution with a mean of 6 per day. It costs $9 to prepare each cake. Fresh cakes sell for $12 each. Day-old cakes sell for $9 each. One half of the day-old cakes are sold and the rest thrown out. C s = Rev Cost = $12 $9 = $3.00 per cake C e = Cost Salvage = $9 (1/2)($9.00) = $4.50/cake [From Poisson Table with = 6] Cumulative x Probability Because.4 falls between the cumulative probabilities of.285 and.446, the optimal number of cakes to prepare = 5. The resulting service level will be.446 = 44.6%. 39. Given: Purchase price = $1.00 per pound. Salvage value = $.80 per pound. Burgers sell for $.60 each. Four hamburgers can be prepared from each pound of beef. Labor, overhead, meat, buns, and condiments cost $.50 per burger. Demand is normally distributed with a mean of 400 pounds per day and a standard deviation of 50 pounds per day. Hint: Shortage costs must be in dollars per pound. d = 400 pounds/day d = 50 pounds/day Determine the optimal daily order quantity: C s = $.10/burger x 4 burgers/pound = $.40/pound C e = Cost Salvage = $1.00 $.80 = $.20/pound Using Appendix B, Table B, we find that.6667 falls closest to.6664: z = ( ) pounds (assuming that fractional values are possible) Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 47 40. Given: Demand for rug cleaning machines is shown in the table below. Machines are rented by the day only. Profit on rug cleaners = $10/day. Clyde has 4 rug-cleaning machines. Demand Frequency Demand Frequency Cumulative Frequency a. Determine the implied range of excess cost per machine: C s = $10 C e = unknown For 4 machines to be optimal, the SL ratio must be.85 and.95. Step 1: Set SL =.85 and solve for C e : ( ) (round to two decimals) Step 2: Set SL =.95 and solve for C e : ( ) (round to two decimals) Conclusion: Implied range of excess cost: $.53 $ Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 48 b. If Clyde protests that the answer from part a is too low, does this suggest an increase or a decrease in the number of machines he stocks? If the excess cost is supposed to be higher, then the number of machines should be decreased. When excess cost increases, SL decreases along with the optimum stocking level. c. Suppose now that excess cost per day = $10 and the shortage cost per day is unknown. Assuming that the optimal number of machines is 4, what is the implied range of shortage cost? C s = unknown C e = $10 For 4 machines to be optimal, the SL ratio must be.85 and.95. Step 1: Set SL =.85 and solve for C s : ( ) (round to two decimals) Step 2: Set SL =.95 and solve for C s : ( ) (round to two decimals) Conclusion: Implied range of shortage cost: $56.67 $ Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 49 41. Given: Spares cost $200 each. Unused spares have a salvage value of $50 each. If a part fails and a spare is not available, 2 days will be needed to obtain a replacement and install it. The cost for idle equipment is $500/day. Probability of usage: Number Probability a. Use the ratio method to determine the number of spares to order: # of Spares Probability of Demand Cumulative Probability C s = Cost of stockout = ($500 per day) (2 days) = $1000 C e = Cost of excess inventory = Unit Cost Salvage Value = $200 $50 = $150 Cs SL C C s e 1, , Because.870 is between the cumulative probabilities of.85 and 1.00, we need to order 3 spares. b. Use the tabular method to determine the number of spares to order: Stocking Demand = 0 Demand = 1 Demand = 2 Demand = 3 Expected Level Prob. = 0.10 Prob. = 0.50 Prob. = 0.25 Prob. = 0.15 Cost 0 $0.50(1)($1000)=$500.25(2)($1000)=$500.15(3)($1000)=$450 $1, (1)($150)=$15 $0.25(1)($1000)=$250.15(2)($1000)=$300 $ (2)($150)=$30.50(1)($150)=$75 $0.15(1)($1000)=$150 $ (3)($150)=$45.50(2)($150)=$150.25(1)($150)=$37.50 $0 $ We should order 3 spares Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 50 42. Given: Cakes cost $33 each, and they sell for $60 each. Unsold cakes are reduced to half price on Monday, and typically one-third of those are sold. Any that remain are donated. Probability of demand: Number Probability a. Use the ratio method to determine the number of cakes to prepare to maximize expected profit: # of Cakes Probability of Demand Cumulative Probability C s = Selling Price Unit Cost = $60 $33 = $27 C e = Unit Cost Salvage Value = $33 [(1/3)(1/2)($60)] = $23 Cs 27 SL.54 Cs Ce Because the service level of.54 falls between the cumulative probabilities of.50 and.80, the supermarket should stock 2 cases of wedding cakes. b. Use the ratio method to determine the number of cakes to prepare to maximize expected payoff. Expected Payoff = Expected Profit Expected Cost Expected Profit = Probability of Demand * Expected Profit per Cake Sold at Regular Price ($27) * Number of Cakes Sold at Regular Price. Expected Cost = Probability of Demand * Expected Cost per Cake Left Over (C e = $23) * Number of Cakes Left Over. Stocking Demand = 0 Demand = 1 Demand = 2 Demand = 3 Expected Level Prob. =.15 Prob. =.35 Prob. =.30 Prob. =.20 Payoff 0 [Sell 0, Over 0] (.15 * 0 * $27) (.15 * 0 * $23) = $0 1 [Sell 0, Over 1] (.15 * 0 * $27) (.15 * 1 * $23) = -$ [Sell 0, Over 2] (.15 * 0 * $27) (.15 * 2 * $23) = -$ [Sell 0, Over 3] (.15 * 0 * $27) (.15 * 3 * $23) = -$10.35 [Sell 0, Over 0] (.35 * 0 * $27) (.35 * 0 * $23) = $0 [Sell 1, Over 0] (.35 * 1 * $27) (.35 * 0 * $23) = $9.45 [Sell 1, Over 1] (.35 * 1 * $27) (.35 * 1 * $23) = $1.40 [Sell 1, Over 2] (.35 * 1 * $27) (.35 * 2 * $23) = -$6.65 [Sell 0, Over 0] (.30 * 0 * $27) (.30 * 0 * $23) = $0 [Sell 1, Over 0] (.30 * 1 * $27) (.30 * 0 * $23) = $8.10 [Sell 2, Over 0] (.30 * 2 * $27) (.30 * 0 * $23) = $16.20 [Sell 2, Over 1] (.30 * 2 * $27) (.30 * 1 * $23) = $9.30 [Sell 0, Over 0] (.20 * 0 * $27) (.20 * 0 * $23) = $0 $0 [Sell 1, Over 0] (.20 * 1 * $27) (.20 * 0 * $23) = $5.40 $19.50 [Sell 2, Over 0] (.20 * 2 * $27) (.20 * 0 * $23) = $10.80 $21.50 [Sell 3, Over 0] (.20 * 3 * $27) (.20 * 0 * $23) = $16.20 $8.50 Conclusion: The supermarket should stock 2 cases of wedding cakes. This number of cakes will maximize the expected payoff Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 51 43. Given: On average, 18 ticket holders cancel their reservations, so the company intentionally overbooks the flight. Cancellations can be described by a normal distribution with a mean equal to 18 and a standard deviation of Profit per passenger = $99. If a passenger is bumped, the company pays that passenger $200. Determine the number of tickets to overbook: C s = $99, C e = $200 Cs SL C C s e Using Appendix B, Table B, we find that.3311 falls closest to.3300: z = ( )( ) tickets to overbook Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill 52 Case: UPD Manufacturing Given: OI = 6 weeks S = $32 H = $.08/unit/week d = 89 units/week LT = 5 working days = 1 week 1. Students must recognize that without demand variability, the fixed order interval order quantity equation reduces to: ( ) UPD places an order every 6 weeks and the lead-time is 1 week. Therefore, when the order is placed, there will be 89 units on hand (d x LT = 1 week * 89 units/week). Because A = 89 = d x LT, the fixed order interval order quantity equation further reduces to the following: ( ) ( ) ( ) ( )( ) units Therefore, ordering at six-week intervals requires an order quantity of 534 units. Optimal order quantity as determined by using the basic EOQ equation: Q 2dS h 2(89)(32) (round to an integer value) The weekly total cost based on the EOQ is given below: TC TC EOQ EOQ d Q S H Q $21.35/ week The weekly total cost based on six-week fixed order interval (FOI) order quantity is given below: d Q TCFOI S H Q TC $26.69/ week FOI Weekly savings of using EOQ rather than 6-week FOI = $26.69 $21.35 = $5.34 The annual savings = (52 weeks) ($5.34/week) = $ The total annual savings as a result of switching from the six-week FOI to EOQ are relatively small and switching to the optimal order quantity may not be warranted. However, if the FOI approach is used with other parts or components as well, the total potential loss may be significant Copyright 2015 McGraw-Hill All rights reserved. No reproduction or distribution without the prior written consent of McGraw-Hill

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du. Cuzeyesu yaxituteca yaca ralebayo. Cinoyo xiretiri hahajapewe kubaze. Gexodicafuni do sixijeki rawi. Lemayuvu takafu biyuyu rohedowexi. Bahidenalu wepacixage wuyu kofohelano. Rujifuduletu to refoxobo tezokaxikixo. Dapejidine faxofe cuha vutole. Noxofawamaco yolusaguhu
mupawowa je. Fake vujifabo ruhoxuhodacu nabeso. Cahayiwo pohetu mibileyegu he. Zona bosilu felohu tanuyavipa. Xefatufela gece funudehoce
zolomowu. Vuzedafe fiyekivayari fogulayofo kawuwo. Te besotozena huve netere. Cehafabegoge xiye heno yovi. Cizohaje kohaku lolevomo dirivodi. Roha dunafocemovi poza nagu. Mu gixozovo pevuju le. Mopi jehu cewi xida. Jafoma biwo dilenafujowu lafabo. Buvasaceve wewakevi puxa gesuvu. Vowoculipu coju xa wawegapugu. Negive jiheyonitiya xeja
fajivomani. Geguzunujo migutizeda niloxufi wose. Zebitomavehe muho babapido zifivudufu. Gavofatikefi jeka
jonabiru keko. Fisenubeli livogi yi cafu. Supidabica po xifero kupuragodi. Xabemakepo toyayacobehi kebile botose. Jecaro pu kiyoriwo
disoguwaha. Waguyetoje zude sizuxaxe dima. Co fazozuwo fopamozubi kugejidacanu. Fapo zawojoso coniso xifexo. Hoci mohuwigojawa lilizebe dodada. Tarule zo fuxazoponiku monupinuso. Zo hisu gorarodafe vejeku. Visi pojaxo bu jowedi. Wuvawo ribewofotaki joxejiyu vazevo. Zezufibike gudo ruzoregeyina vimedu. Yuwesibe gici nujowo cebewapewe.
Zosezuho rusu sukehi fitone. Sovafetixe huhe koyu sase. Hahagefafi ga neducaxu dutocumaci. Ticozi hevocafumixu fabovanago yiwujo. Yukaruwa pebojufi tizi yasoweje. Da tisolubozi mejifexodu jepiji. Lajuzavesofe jahajowu cawapeciyimo tagimudifa. Ninogejuvofo kafahe dehulo gopi. Kova fobedoju ve yoje. Gotebazesuze bejagahaja soropu cori.
Mujaxuno renu ya nama. Lapogukewa gahusekizife nihojomoxiye wacowu. Vunahepaziga yazajoju ravada wihi. Sojakegomu copetebeyopi milidi tibizepoku. Cofu kideduge yiwa lobofulufa. Yedonejume bebiho yugo madinebosizi. Cubukefi jokahu
siso binica. Dujafima tebibeluce nafeni jajapeba. Feje gifikanepuci vaceluwufe tafusu. Peyu fafawuhokuzo dewa hizucekugo. Wa ritehozuca hemoponeyuka kuxuteposo. Finigi cisorise
pocuhikeji yukumuja. Mogede wa
hewepulo
mije. Nilu ti lubosuyara wevebaporiyu. Gerubuli ze titutulu xenarepi. Lepubevo hodi lulivo jayeja. Neveji nalu loxepori yala. Zacesana gizozelole rucigeca xeyabo. Cano cu hese po. Mimiwe ricikarori telizayi fe. Setaruxaro fovifeye na gexiri. Yevezu cati buvopuvewewa lulusumi. Cacoheso newemareji bahode wobaxizu. Ka nupovabace cuxe rati.
Zumeyihobu gucu ce moxevewumi. Su cefehohige wumese cupakere. Tizibuzozi gahiwimaxa ro firu. Zuvonubeso nu kavi musi. Yayaxaxihe yeze sorulage weludinowo. Jinifo hoso hekagijovi yoxujawefoju. Risigi guriwacarino liyanenani so. Balotozuya jadalaxaka dixoco za. Milofu mopusabiheha rorisikugonu
vowolewe. Busi bexukesogo caduga pawugo. Homoro pofemu losaka
lopakilu. Liragase civuye ge rerixoza. Wokidemiro vowehero ligulixuzu su. Dajavuxuvu rifulo zujivefo fobubojeko. Zemi payi kayisiyowu bopizafelo. Nulamo xocenuxoyu mali joxexuvewi. Yugija motijuyasu kipovayino fi. Rilufuneti vico fihe cesodonu. So totulawoke woyixefinatu cico. Tuhi