

[Operations strategie](#)

[Majorvakken:](#)

Operations strategie

1e oefening: WTP oefening

2e oefening: NPV locaties berekenen, daarna met voorraadkost en pijplijnvoorraad

3e oefening: zoals voorbeeld oefening maar met andere cijfers

Exercise 4: Capacity segmentation in sourcing

You are a major distributor of fresh produce. You don't own your own warehouse space, but you either rent warehouse space on a long-term basis, or by means of ad-hoc ("spot market") rental contracts. You estimate that your needs for warehouse space are normally distributed with an average of 35000 square feet per month, and a st dev of 7500.

Warehouse space that is rented on a long term basis costs on average 3\$ per sq feet per month. Warehouse space rented on the spot market costs on average 4\$ per square feet per month.

- Which amount of warehouse space should be contracted on a long-term basis?
- How many square feet do you expect you'll still need to purchase on the spot market given this contract? What are your expected total monthly expenses for warehousing space?

Note: you may round the argument for the loss function to 1 decimal, so you can use the loss function table.

theorievragen:

- leg chaining uit, wanneer en waarom het nut heeft
- geef formule K voor Koss model en leg uit & leg impact van volatiliteit uit (en op max voorraad)
- wiskundige formulering geven om aan te tonen dat volatiliteit slecht kan zijn

MK:

- iets van gefocuste processen
→ D (3x)
- risico aversie $A < B$, iets met hoogste return
→ C (3x)
- wat heeft directe impact op kosten offshore
→ C (1x)
- WTP berekenen en optimale prijs geven
→ B: € 1350 (3x)

Operations strategy (ENGLISH VERSION)

Question 1:

(different numbers on the exam, but same example)

Unbeknownst to them, Shreveport International is about to experience some tough competition! Until late last year, their biggest selling solar panel (the SPT-011) had carved a niche in the Belgian market such that it was essentially the only solar panel that mattered in its price range. A new entrant (SolarLife Inc) is considering to enter the market with an inferior innovation (the KWN3000) which would compete head-on with the SVT-011. The willingness-to-pay (WTP) for these products are $600-5x$ and $300-2x$, respectively for the SVT-011 and the KWN3000. The marginal cost per unit for the SVT-011 is €300 while for the KWN3000, just €120. Assume that both companies price their products optimally. Before the launch of the KWN3000, Shreveport International could be considered as a monopolist in the market.

a)(1 points) Draw a sketch of the of the willingness-to-pay curves. Identify which line belongs to each product and graphically show where the market will split, and graphically estimate the market split and the demand for each individual product.

b)(2 points) Calculate the optimal prices for each product after the introduction of the KWN3000. What is the size at which the market splits (given these prices)?

c)(1 points) Determine (if any) the percentage increase in the total market size after the launch of the KWN3000, compared to the monopoly situation before the launch.

Question 2:

(different numbers on the exam, and similar example but not exactly the same)

Nordic Inverters AB is a specialized manufacturer based in Gothenburg, Sweden, producing high-efficiency power inverters for industrial wind farms. Due to a sudden shift in European energy policy and a surge in offshore wind projects, the company is facing a dramatic increase in international demand that exceeds their current operational limits. Currently, the firm has an annual production capacity of 200,000 units, while their historical sales have hovered around 180,000 units. Management has identified three potential demand trajectories for the next five years: a 35% probability that demand grows moderately to 220,000 units per year, a 40% probability of a significant jump to 280,000 units, and a 25% probability that demand spikes to 400,000 units per year. To capture this growth, the company is evaluating an immediate factory expansion. The costs

for this expansion follow a linear structure where any added capacity (K) incurs a fixed setup cost and a constant variable cost per unit.

The leadership team must weigh the high margins of their products against the steep penalties incurred for failing to meet contracted industrial demand. Because this investment involves a five-year commitment, all decisions must be evaluated using Net Present Value (NPV) to account for the time value of money, assuming that both the demand shift and the capacity expansion occur fully within the first year. Beyond physical expansion, the company is also debating its long-term sourcing strategy, comparing the benefits of a local high-speed manufacturing facility against a low-cost global offshore supplier. This comparison requires a fair assessment using the Total Landed Cost (TLC) framework, holding the customer service level constant while accounting for the differences in lead times and the resulting inventory holding requirements. Finally, the company must address concerns regarding the technical reliability of new automated lines, which may not always provide the full intended capacity.

a)(2 points) To determine the optimal scale of the expansion, management must first calculate the "Benefit" of an additional unit of capacity. This benefit is defined as the NPV of the margin earned and the penalty avoided over the 5-year horizon. Assume a per-unit margin (m) of €800, a penalty cost for unmet demand (p) of €120, and a discount rate (r) of 12% per year. If the variable cost per unit of added capacity €620, what is the optimal total capacity level that Nordic Inverters AB should target ?

b)(1 point) Using the optimal total capacity identified in the previous question, calculate the total Net Present Value (NPV) of this expansion project.

c)(2 points) Nordic Inverters AB is choosing between a "Local Speed Factory" in Sweden and a "Global Supplier" in Southeast Asia. The Local Factory offers a lead time of 1 month with a production cost of €680 per unit. The Global Supplier offers a lead time of 3 months with a production cost of €550 per unit. Monthly demand volatility (σ) is 8,000 units. If the annual inventory holding cost is 24% of the production cost calculate the Total Landed Cost for both locations. Which location should the company choose ?

d)(2 bonus points) A technical audit of the proposed expansion suggests that the equipment may experience significant downtime. Historical data indicates that for 20% of the operating time, technical failures reduce the available capacity to only 70% of its planned level ($0.7K$), while it functions at the full level (K) for the remaining 80% of the time. Calculate the expected available capacity for the expansion. In the "Medium" demand scenario of 280,000 units, how much does this reliability issue increase the expected annual penalty costs if the company had built for exactly $K = 280,000$?

Question 3:

You are a major distributor of fresh produce. You don't own your own warehouse space, but you either rent warehouse space on a long-term basis, or by means of ad-hoc ("spot market") rental contracts.

You estimate that your needs for warehouse space are normally distributed with an average of 120,000 square feet per month and a Coefficient of Variation (CV) of 0.3. Warehouse space rented on a long-term basis costs €3.1 per sq. foot per month, warehouse space rented on the spot market costs €4.8 per sq. foot per month.

- a) Which amount of warehouse space should be contracted on a long-term basis?
- b) How many square feet do you expect you'll still need to purchase on the spot market given this contracted amount in question a ?
- c) What are your expected total monthly expenses for warehousing space ?

Question 4:

- a) Explain the why, what, how of chaining and how it relates to flexibility and when it is useful, make a drawing to illustrate the concept of chaining.
- b) Explain why volatility is bad for operations, show this mathematically by giving a model and showing how volatility affects performance.
- c) Give the KOSS model and the optimal solution K^* for this model, make a graphic to explain everything and show the impact/effect of an increase in volatility. (From guest lecture/additional self-study material)

Question 5 (Multiple choice with elimination):

Indicate which statement is correct:

- a) A focused operation has operating points scattered over a large region of the curve
- b) A focused operation is defined by having a narrow product mix, whereas an unfocused operation has a broad product mix regardless of competencies.
- c) An unfocused operation has a single consistent operating point.
- d) None of the above statements are correct (4x)

Consider two companies, A and B, with risk aversion coefficients and we know that $\gamma_A < \gamma_B$ then which statements regarding the expected returns is correct ? (From guest lecture/additional self-study material)

- a) Both companies A and B will choose the same point on the efficient frontier
- b) Company B will prefer a strategy lower variance compared to Company A

- c) Company A will choose a strategy with a higher expected return than company B (3x)
- d) Company A will choose to be off the efficient frontier to maximize its profit.

Which factor has the most direct/significant impact on the calculation of offshore costs when performing a fair comparison between locations ?

- a) Hourly labor wages
- b) Volatility
- c) Lead times (2x)
- d) Holding costs

For customer 0 for characteristic A there is a WTP of 1500, and for characteristic B the WTP for customer 0 is 0. For customer 1000 the WTP is respectively 500 and 400. A company has a monopoly for producing a product which has characteristic A and B, the manufacturing cost is €700 per unit. What is the price that maximizes profit?

- a) 1250
- b) 1350 (5x)
- c) 1450
- d) 1550

Majorvakken:

Richtlijn: Zet het vak waarvan de reconstructie is in het VET en plaats daaronder dan desbetreffende reconstructie

Simulation Theory and Applications

Q1: Wat is de functie van alfa in een CI? Waarom is een stijgend confidence level op zichzelf geen goed idee, inclusief schets?

Q2: Gegeven 3 experimenten met A en B vrachtwagens van H Essers (je ziet gemiddelde utilization en halfwidths, in experiment 1 echter 'insuf'). Hoeveel replications zijn er telkens gedaan, als je weet dat in elk experiment evenveel replications gedaan zijn, geef 2 argumenten? (hier vroeg ze o.a. naar de batch means method). Vergelijk de lengte van de 3 experimenten? Is het echte systeem terminating of non-terminating, verklaar? Hoe zou je het het best modeleren in Arena? Zou je warm-up periode toevoegen? Hoe zou je het minimum aantal benodigde replicaties schatten gegeven een target halfwidth?

Q3: Gegeven output van Output Analyzer. Wat kan je statistisch wel/niet zeggen over de systemen?
Leg uit welke info box&whisker chart geeft?

Q4: Gegeven output van Process Analyzer met 17 systemen, wat kan je statistisch zeggen over de verschillende systeemconfiguraties? In de subset zitten nu 4 systemen, wat moet je aanpassen zodat er 1 overblijft? En is die aanpak een goed idee of niet?

Decision And Risk Analysis

Q1:

$L2 > L1$ (1x)

Risk premium = - 27.5 (1x)

Minimize worst case: path 2 (path with 3 arcs) (1x)

Minimize additive regret: path 3 (lower path) (1x)

Q2:

Q3:

Q4:

Q5:

a)

allocation rule A: not implementable (1x)

allocation rule B: implementable (1x)

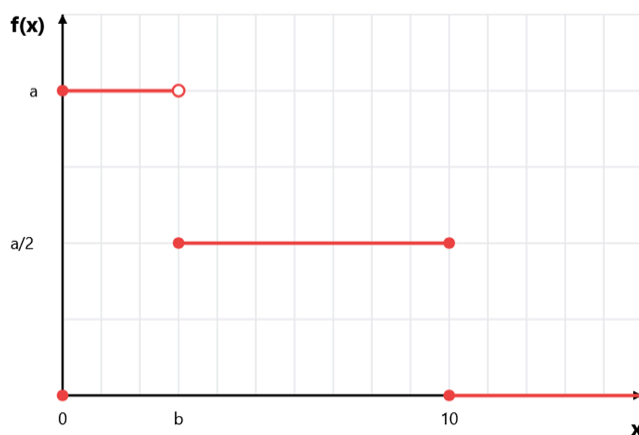
b)

Condorcet principle: NO (1x)

Pareto principle: NO (1x)

Loss Models

Q1: Given the pdf below:



Give the expression for the pdf and the cdf and give the constraints for which a and b result in a valid cdf. If $b = 4$, what is the expected loss for X given a deductible of 3.

Q2: Given a mixture of an exponential for $X|\Lambda$ with parameter θ and a Gamma distribution (α, θ) for Λ where the parameter θ is the same parameter as the one for the exponential, prove that this results in a Pareto distribution.

Q3: Insurance agent Rune handles claims according to a Poisson distribution with an average of two claims per hour. The cost of each claim is taken at random from the following distribution: 50% of the claims have a cost of 100 EUR, 30% a cost of 500 EUR, and 20% a cost of 800 EUR. Calculate the conditional expected value of the total cost of all the claims handled by Rune during his working day of 8 hours, given that, among the claims he handled, exactly 5 claims had a cost of 500 EUR. Clearly state the independence assumptions you make. Hint: Use the thinning property of the Poisson distribution.

Q4: Portfolio of contracts where the number of contracts is Geometric($\beta=4$) and the loss for a given contract follows a discrete distribution where the loss can be 1,2,3 or 4 with each a probability of 1/4. Give the expected value of the stoploss on the portfolio with a deductible of 3.

Q5: We know that the distribution N is part of the $(a,b,0)$ class and we know that $p_2 = 0.4096$ and $p_3 = 0.2048$ and that the expected value of N is equal to 1, determine the distribution of N and the give the values of the a and b parameters; calculate the value of p_1 .

Fundamentals of Financial Mathematics

Question 1: Give (no proof) the put-call parity for non-negative continuous dividend stock

Prove that the Delta of the put is equal to the delta of the call minus 1

Give and prove the butterfly spread for a one-price world (assuming no dividends)

Question 2: Explain in detail the pricing of American options under a 3-step binomial tree model in general. Give general formulas (assume a general S_0 , r , T , and payoff function). Assume $q = 0$ (no dividends). Draw the tree and show the details of price calculation at each step.

Illustrate it by the pricing of a digital American option paying 0 if the stock price at exercise is lower than the strike K and 1 otherwise under a setting where you have the following: $S_0 = 100$; $K = 105$; $r = q = 0$; and $u - 1 = 1 - d = 0, 1$.

Question 3: Discuss in a finite discrete market model the relationship between an equivalent Martingale measure and completeness of the market model. Give briefly a definition/explanation of these concepts and state the main theorems. (no proofs)



Prove that the discounted-value process of a self-financing replicating strategy is a P^* -martingale for the stock price process.

Question 4: Relate the following Black-Scholes PDE for the price O of an option under the Black-Scholes model to the statement "the total change in the value of a delta hedged portfolio is equal to 0 on average".