LION-APP July 5-9, 2019

# Hotel Revenue Management and Inventory Optimization to Maximize Profitability

**Cindy Yoonjoung Heo**
**Associate Professor / Revenue Management**
**École hôtelière de Lausanne**
**The University of Applied Sciences and Arts of Western Switzerland**




hotelleriesuisse Swiss Hotel Association

# About Lecturer: Cindy Y. Heo

- École hôtelière de Lausanne, Switzerland - Associate professor (2014 ~ Current)
- University of Angers, France – Visiting Professor (2012~ Current)
- Industry: MMC (France), Prix (UK), Pricemov (France)

- The Hong Kong Polytechnic University, HK - Assistant Professor (2010 ~ 2014)
- Samsung Everland, South Korea – Strategic Marketing / Researcher (2001 ~ 2005)
- Travelove, Korea – Online Travel Agency / Founder (1998)

- Concepts of RM
- RM misconception
- RM Game
- Basics of Inventory Allocation

# Concepts of Revenue Management

RM based pricing strategy uses historic data and mathematical models to predict demand at future points in time.











# Revenue Management

## Misconception


*Optimization problem (P):*

$$\min_{x_{ij},\delta_i} \sum_{i=1}^{m} (P_i^{svr} + P_i^{cool})$$

subject to:

$$\sum_{i=1}^{m} x_{ij} = r_j \quad (j = 1, \ldots, n)$$

# Revenue Management Game






# Revenue Management Game

- Imagine you are the Revenue Manager of GD hotel **(5 rooms)**.
- Your goal is to maximize GD hotel's revenue.
- You can either accept the reservation or turn it down.
- Once you turn a reservation down, **you can not take it back**.
- You do not know when the reservation opportunities will stop.

- **Room Rates of GD Hotel**

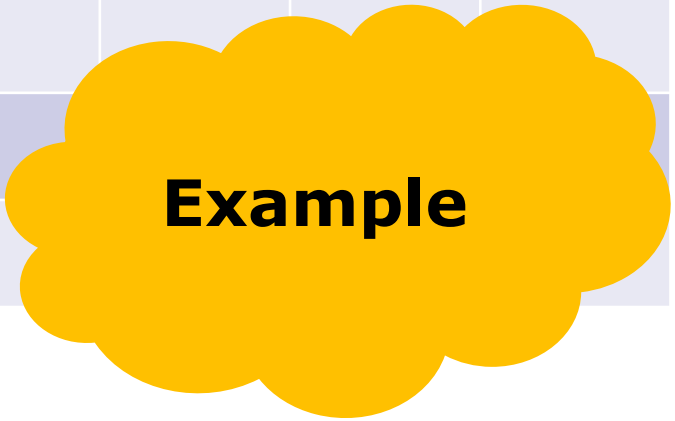
  - Rack rate: USD 350 (Individual)
  - Corporate rate: USD 300
  - Online rate: USD 280 (Online channel)
  - CTS rate: USD 250 (China Travel Service)
  - Government rate:  USD 200

ECOLE HOTELIERE LAUSANNE

# Revenue Management Game

- If you like to accept the reservation for **Government group (USD 200)** arriving Wednesday for **three nights**

| | Mon | Tue | Wed | Thu | Fri | Sat | Sun | Total |
|---|---|---|---|---|---|---|---|---|
| Room 1 | | | 200 | 200 | 200 | | | |
| Room 2 | | | | | | | | |
| Room 3 | | | | | | | | |
| Room 4 | | | | | | | | |
| Room 5 | | | | | | | | |
| Total | | | | | | | | |



# RM GAME REVIEW

- How much revenue did you get?

## First Come-First Serve Approach

- **Occupancy: 60%** (=21 rooms / 35 rooms)
- **Total Revenue: USD4,950**
- **ADR(Average Daily Rate): USD235.71** (USD4,950 / 21 rooms)
- **RevPAR (Revenue Per Available Room) : USD141.43** (USD4,950 / 35 rooms)

| | Mon | Tue | Wed | Thu | Fri | Sat | Sun | Total |
|---|---|---|---|---|---|---|---|---|
| Room 1 | | 200 | 200 | 200 | 200 | | | 800 |
| Room 2 | 280 | 280 | 280 | 280 | 280 | | | 1400 |
| Room 3 | | | 250 | 250 | 250 | | | 750 |
| Room 4 | | | | 300 | 300 | | | 600 |
| Room 5 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 1400 |
| Total | 480 | 680 | 930 | 1230 | 1230 | 200 | 200 | 4950 |

## Revenue Management Approach

- **Occupancy: 77.1%** (=27 rooms / 35 rooms)
- **Total Revenue: USD8,300**
- **ADR(Average Daily Rate: USD307.40** (USD8,300 / 27 rooms)
- **RevPAR (Revenue Per Available Room) : USD237.14** (USD8,300 / 35 rooms)

| | Mon | Tue | Wed | Thu | Fri | Sat | Sun | Total |
|---|---|---|---|---|---|---|---|---|
| Room 1 | 280 | 280 | 280 | 280 | 280 | | | 1400 |
| Room 2 | | 350 | 350 | 350 | 350 | 350 | | 1750 |
| Room 3 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 2100 |
| Room 4 | | 350 | 350 | 350 | | | | 1050 |
| Room 5 | 350 | 350 | 350 | 350 | 200 | 200 | 200 | 2000 |
| Total | | | | | | | | 8300 |

# Constrained Demand

Naturally occurring demand that occurs in the absence of restraints and restrictions

# Vs.

# Unconstrained Demand

Demand that is held back or confined by rules, restrictions and availability

# Length of Stay Controls






- **Minimum Length of Stay (MinLOS)**

  - During hi-demand periods
  - Fill in the hotel immediately after high demand days
  - Application of packages

- **Maximum Length of Stay (MaxLOS)**

  - Right before a high demand period
  - Avoid undesirable stay-overs
  - Application of packages

- **Closed to Arrival (CTA)**

  - This availability control can be used during high-demand times to select reservation requests that will yield a higher average occupancy for that arrival day and surrounding days.

# Inventory Allocation Basics

# Inventory Allocation Basics

- One of the main objectives of RM is to allocate rooms among the rate classes to **maximize total expected revenue or profits** in the face of uncertain levels of demand.

If we reserve a unit of capacity (hotel room) for the exclusive use of a potential customer who have a 70% probability of waiting it and is in a market segment with a price of $100 per unit, then the expected revenue for that unit is $70 ($100 × 70%).

**EMRR(xth)=R*P(d=x)**






# Inventory Allocation Basics

- If the person offers exactly $70 cash we would be indifferent about selling him the unit because the expected revenue from him is equal to that of the potential customer

(100% × $70 = 70% × $100 = $70).

- The bottom line is that **$70 is the lowest price** that we should accept from a customer standing in front of us. If someone offer us more than $70, we sell, otherwise we do not.

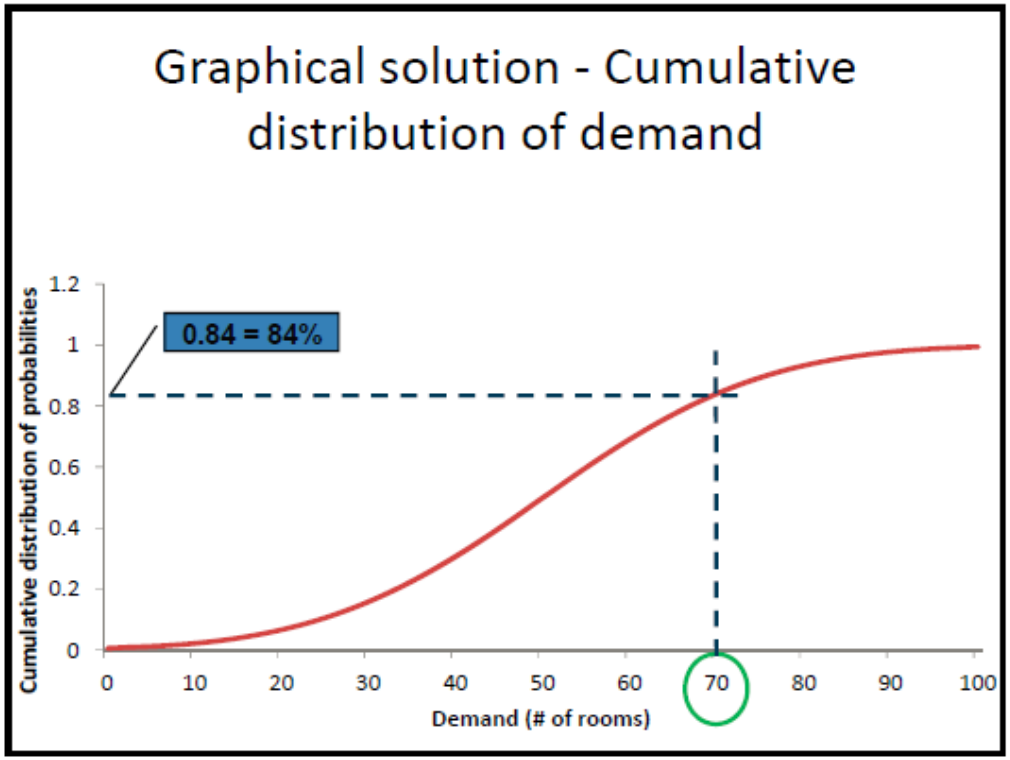





# Expected Marginal Room Revenue (EMRR)

- Suppose our 100-room hotel has already sold 69 rooms. What is the probability of selling the 70th room (i.e. the marginal room)?
- General formula: **P(d=x)=1-P(d<x)**
- *Expected Marginal Room Revenue*

**EMRR(xth)=R*P(d=x)**

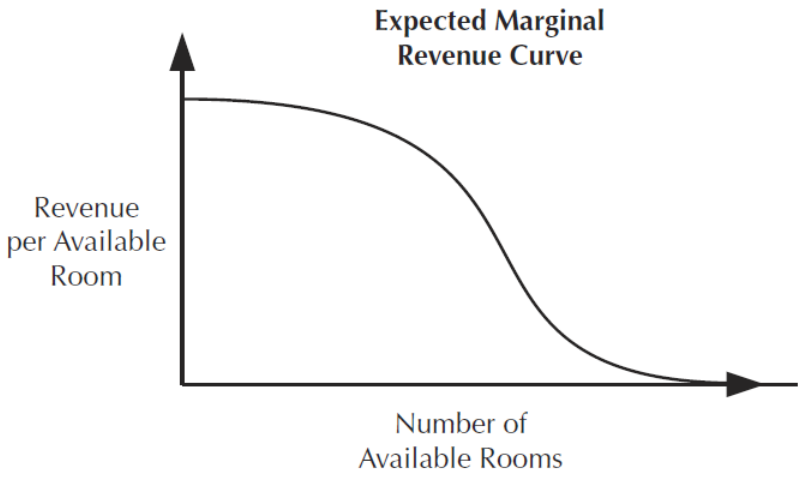







- The level of available capacity increases, the marginal expected revenue from each additional room declines.

- For example, if you offer **only one room** for sale, **the probability of selling it is very high** and it is very unlikely that you will have to offer a discount to sell it.




–> The expected revenue estimate for that room will be quite high, but each additional room that you offer for sale, the probability that it will be sold goes down a little.





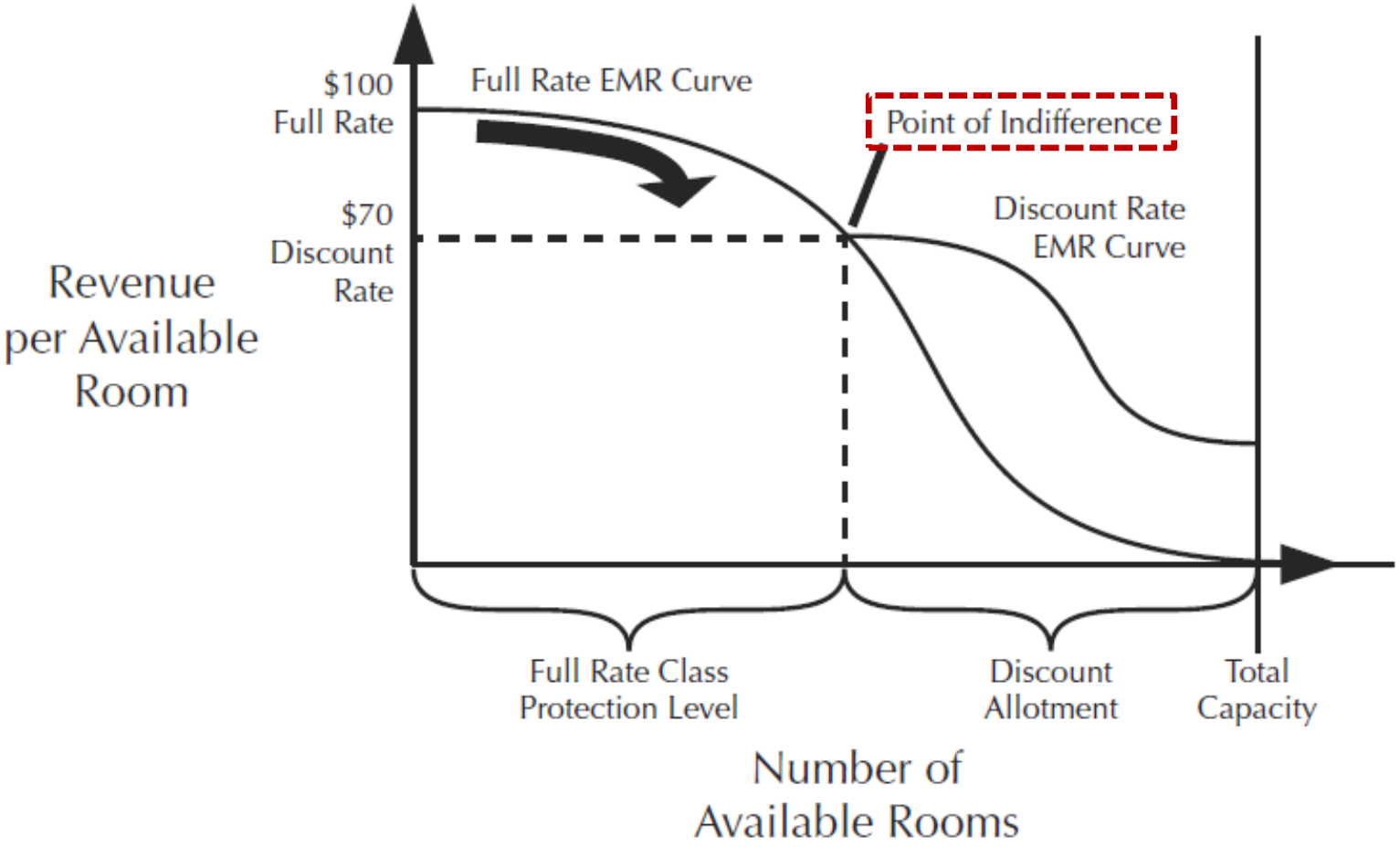

- The exact shape of the curve is determined from the probabilities of achieving **each level of demand** and **the rate structure**.

- If that point was reach after reserving 10 rooms for the exclusive use of customers in the $100 rate class, we say that the "**Protection Level**" for the first-rate class was 10 rooms.






- With this approach you start on the left end of the EMR curve and move down to the right, reserving rooms until you reach **the point of indifference**.








- ***A nested booking control*** policy allows more valuable products to access to the capacity reserved for less valuable products.
- Once the total number of bookings for a rate class and its lower rate classes has reached the nested booking limit, the rate class is not available anymore, and guests can only purchase higher rate classes.
- With nested protection levels/booking limits, a high rate class cannot close before a lower class does.

| Rate Class | Rate | Nested Booking Limit (Capacity = 100) | Current Booking | Rate Class Availability |
|---|---|---|---|---|
| A | $ 300 | 100 | 1 | Y |
| B | $ 280 | 89 | 5 | Y |
| C | $ 250 | 65 | 25 | N |
| D | $ 220 | 40 | 40 | N |






## Basic Assumptions

- Reservations for the lowest rate come in earlier than the reservations for the higher rates.
- Demand for each rate class is independent.
- Initial capacity allocation is carried out long before the day of arrival.

## Optimization Challenges

- Dynamics of demand elasticity
- Actual sales dynamics vs. timing of forecasting
- Length-of-stay effects
- Ancillary revenue considerations
- Marginal cost considerations






# What is Linear Programming?

- **Constrained optimization technique** - Linear Programming (LP) is the mathematical modeling technique to determine the optimum allocation of scare resources among competing demands. Resources typically include raw materials, manpower, machinery, time, money and space.

- *Given certain requirements or restrictions, how can you **maximize or minimize** a given goal?*






# Formulation of Linear Programming

- **Decision variables** describe the decisions to be made.
- **Objective function** is the function of the decision variables that the decision maker wants to maximize (revenue or profit) or minimize (costs).
- **Constraints** shows the restrictions on the values of the decision variables
- **Non-negativity constraints**: negative values of physical quantities are impossible, like producing/selling negative number of rooms, tables, etc.






# LP with LOS

You are the GM of *myHotel*, a 100-room property in Geneva. Both business and leisure guests stay for one or two nights and pay SFr. 100 or SFr. 80. The unconstrained demand (arrivals) by DoW, by segment and by LOS for an "average" week of November is given (Excel).

What is the optimal RevPAR for one week of November?

*(Assumption: there are no stayovers from Sunday, so entire capacity is available on check-in time every Monday.)*

# Capacity Controls & Rate Optimization

- **Expected Marginal Room Revenue**
- **Linear Programing**
- **Bid Pricing**

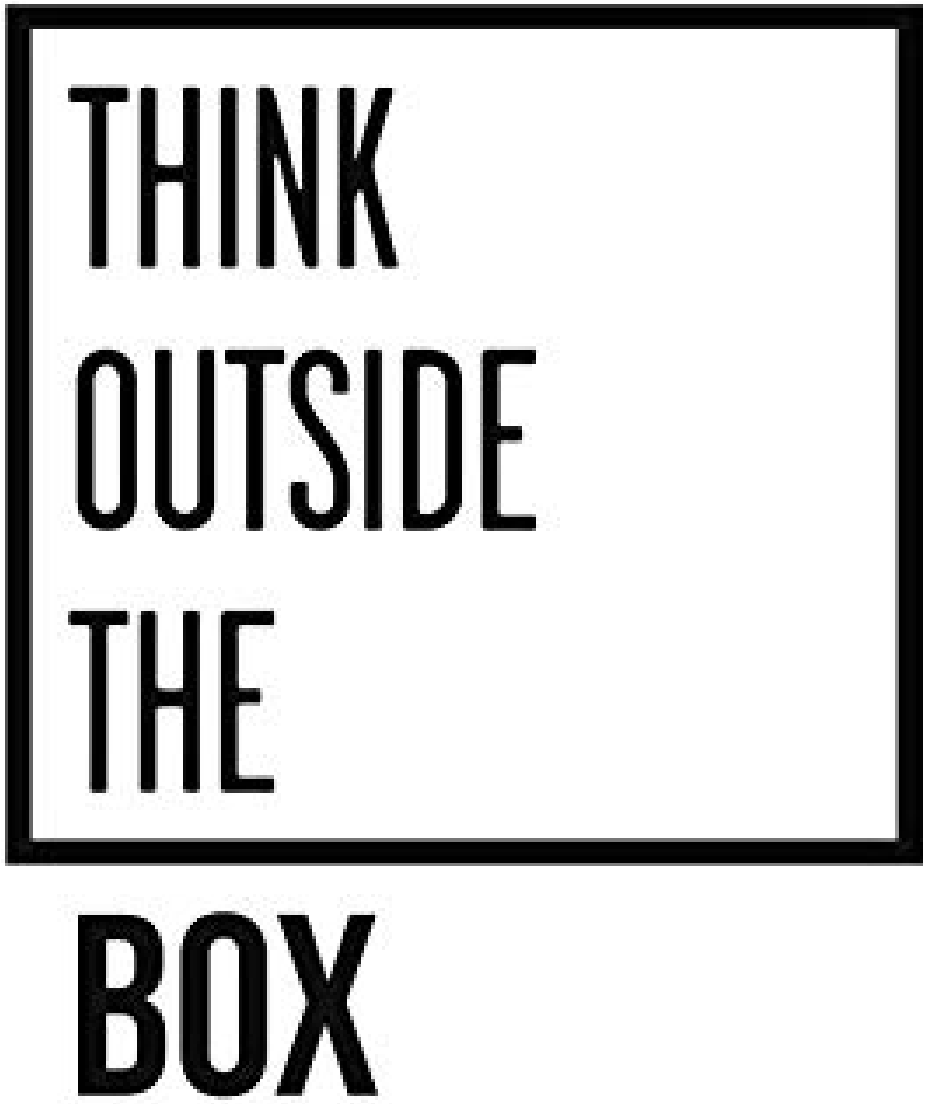
What distinguishes bid-price controls from both booking limits and protection levels is that they are revenue-based rather than class-based controls

# The right question comes before the right answer

**Having the right Answer**

**VS.**

**Asking the right Question**


THINK
OUTSIDE
THE
BOX

Instead
of thinking
outside the box,
get rid of the
box.

Deepak Chopra






# What is Revenue Management?

"Selling the right product to the right kind of customer, at the right time, at the right price, so as to maximise revenue or yield"

Sheryl Kimes, Professor of Operations Management at Cornell University School of Hotel Administration

Also "through the right channel"

# Revenue Management Game Review

# RM GAME REVIEW

## First Come-First Serve Approach

- **Occupancy: 60%** (=21 rooms / 35 rooms)
- **Total Revenue: USD4,950**
- **ADR(Average Daily Rate): USD235.71** (USD4,950 / 21 rooms)
- **RevPAR (Revenue Per Available Room) : USD141.43** (USD4,950 / 35 rooms)

| | Mon | Tue | Wed | Thu | Fri | Sat | Sun | Total |
|---|---|---|---|---|---|---|---|---|
| Room 1 | 200 | 200 | 200 | 200 | 200 | | | 800 |
| Room 2 | 280 | 280 | 280 | 280 | 280 | | | 1400 |
| Room 3 | | | 250 | 250 | 250 | | | 750 |
| Room 4 | | | | | | | | |
| Room 5 | 200 | 200 | 200 | 200 | 200 | 200 | 200 | 1400 |
| Total | 480 | | | | | 200 | | 4950 |

## Revenue Management Approach

- **Occupancy: 77.1%** (=27 rooms / 35 rooms)
- **Total Revenue: USD8,300**
- **ADR(Average Daily Rate: USD307.40** (USD8,300 / 27 rooms)
- **RevPAR (Revenue Per Available Room) : USD237.14** (USD8,300 / 35 rooms)

| | Mon | Tue | Wed | Thu | Fri | Sat | Sun | Total |
|---|---|---|---|---|---|---|---|---|
| Room 1 | 280 | 280 | 280 | 280 | 280 | | | 1400 |
| Room 2 | | 350 | 350 | 350 | 350 | 350 | | 1750 |
| Room 3 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 2100 |
| Room 4 | | | | | | | | 1050 |
| Room 5 | 350 | 350 | 350 | 350 | 200 | 200 | 200 | 2000 |
| Total | | | | | | | | 8300 |

- **Only room revenue (Ancillary revenue)**
- **Customer acquisition cost (Distribution costs, commission, etc)**
- **Customer lifetime value**

**To get the right answer,**
**you have to ask the right question**

# What to Maximize?

Room Revenue
Occupancy
Total Revenue
RevPAR
Gross Operating Profit






AIR NEW ZEALAND

## Economy Skycouch™

The Skycouch Infant Harness, Belt & Pod will be available on all Air New Zealand Boeing 777 and 787-9 operated long-haul services from later in 2018.

ECOLE HOTELIERE LAUSANNE

hotelleriesuisse Swiss Hotel Association

Hes·so

# Hotel Mini Bar


How Much should we charge for a coke?
(Classic, Can 330 ml)


Expected Revenue is the Opportunity Amount multiplied by the Probability.

To ask the right question is harder than to answer it.

Georg Cantor

Cindy Yoonjoung Heo
cindy.heo@ehl.ch