

Firms' Strategies and Markets Entry

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Introduction

- ▶ Entrant's strategy: "Judo economics"
 - ▶ A case study
 - ▶ Exercice

- ▶ Incumbent's strategies vis-à-vis entry
 - ▶ Entry deterred
 - ▶ Entry Accomodated

Entrant's strategy: Judo Economics

In the art of "judo", a combatant uses the weight and strenght of his opponent to his own advantage.

- ▶ *Rule-based* judo strategy
- ▶ *Value-based* judo strategy

- ▶ Case study: Four short stories about small firms challenging large incumbent firms!
 1. Softsoap on the liquid soap market
 2. Red Bull on the energy drinks market
 3. UK supermarket chains on the gazoline retail
 4. Freeserve against AOL.

Judo Economics: Exercise

- ▶ Consumers have an inelastic demand of size D if $p \leq p_{max}$.
 - ▶ An incumbent I has an installed capacity D and no production cost.
 - ▶ An entrant E has a variable cost $c_E > 0$
1. Determine the price and profit of a monopoly I .
 2. If E chooses to enter the market, he chooses both its capacity K_E and its price p_E . If E enters, I observes K_E and p_E and adapts its price denoted p_I .
 - a. What is the demand for each firm with respect to p_E , p_I and K_E ?
 - b. Given (K_E, p_E) , determine the best pricing strategy of firm I , denoted $p_I(K_E, p_E)$.
 - c. Given the reaction of firm I , determine the optimal decisions (K_E, p_E) of the entrant. What is the effect of c_E on these decisions?
 - d. Determine the profit of the two firms. In equilibrium, profits are:
 - e. What is the equilibrium if the incumbent can set a personalized price for each customer?

Strategic Incumbent and entry

1. A taxonomy of incumbent's investments strategies
 - ▶ "Top-dog strategy": investment in capacity
 - ▶ "Lean and hungry look strategy": an innovation model
2. The chain store paradox : a reputation game
3. Exclusive dealing: a contracting strategy

A taxonomy of incumbent's investments strategies

- ▶ In stage 1, the incumbent chooses the level of some irreversible investment K_1 .
- ▶ In stage 2, after observing K_1 , E decides to enter or not. Products market decisions are taken, denoted σ_1 and σ_2 (price or quantity).
 - ▶ If E enters, σ_1 and σ_2 are chosen simultaneously, and profits are denoted $\pi_1(K_1, \sigma_1, \sigma_2)$ and $\pi_2(K_1, \sigma_1, \sigma_2)$.

We assume that $\pi_2(K_1, \sigma_1, \sigma_2)$ includes entry cost if any.

We assume that there exists a unique Nash equilibrium of this competition stage that results in $(\sigma_1^*(K_1), \sigma_2^*(K_1))$.
 - ▶ If E does not enter, the incumbent obtains $\pi_1^m(K_1, \sigma_1^m(K_1))$.
- ▶ Two strategies: Entry deterrence and Accomodation.

Entry deterrence

- ▶ K_1 is set at a level sufficient to deter entry i.e. such that:

$$\pi_2(K_1, \sigma_1^*(K_1), \sigma_2^*(K_1)) = 0$$

- ▶ To see how K_1 must be distorted, we totally differentiate π_2 with respect to K_1 :

$$\frac{d\pi_2}{dK_1} = \underbrace{\frac{\partial \pi_2}{\partial K_1}}_{\text{Direct Effect}} + \underbrace{\frac{\partial \pi_2}{\partial \sigma_1} \frac{\partial \sigma_1^*(K_1)}{\partial K_1}}_{\text{Strategic Effect}} + \underbrace{\frac{\partial \pi_2}{\partial \sigma_2} \frac{\partial \sigma_2^*(K_1)}{\partial K_1}}_{0 \text{ Envelop theorem}}$$

- ▶ Sign of direct effects : advertising informative ($\frac{\partial \pi_2}{\partial K_1} > 0$) or persuasive ($\frac{\partial \pi_2}{\partial K_1} < 0$), investment in capacity ($\frac{\partial \pi_2}{\partial K_1} = 0$)
- ▶ Strategic effect : given K_1 it is a commitment for the incumbent to be tough or weak in its decision of $\sigma_1(K_1)$
- ▶ If $\frac{d\pi_2}{dK_1} < 0$, investment makes the incumbent tough: "top dog"; If $\frac{d\pi_2}{dK_1} > 0$, investment makes the incumbent soft: "lean and hungry look".

Entry accomodation

- ▶ K_1 is set at its best accomodating level, i.e. :

$$\max_{K_1} \pi_1(K_1, \sigma_1^*(K_1), \sigma_2^*(K_1))$$

- ▶ To see how K_1 must be distorted, we totally differentiate π_1 with respect to K_1 :

$$\frac{d\pi_1}{dK_1} = \underbrace{\frac{\partial \pi_1}{\partial K_1}}_{\text{Direct Effect}} + \underbrace{\frac{\partial \pi_1}{\partial \sigma_1} \frac{\partial \sigma_1^*(K_1)}{\partial K_1}}_{0 \text{ Envelop theorem}} + \underbrace{\frac{\partial \pi_1}{\partial \sigma_2} \frac{\partial \sigma_2^*(K_1)}{\partial K_1}}_{\text{Strategic Effect}}$$

- ▶ The direct effect is the "profit maximizing effect" with no effect on firm 2.
- ▶ The strategic effect:

$$\text{Sign}\left(\frac{\partial \pi_1}{\partial \sigma_2} \frac{\partial \sigma_2^*(K_1)}{\partial K_1}\right) = \text{Sign}\left(\frac{\partial \pi_2}{\partial \sigma_1} \frac{\partial \sigma_1^*(K_1)}{\partial K_1}\right) \times \text{Sign}\left(\frac{d\sigma_2^*}{d\sigma_1}\right)$$

A top dog example: Investment in capacity

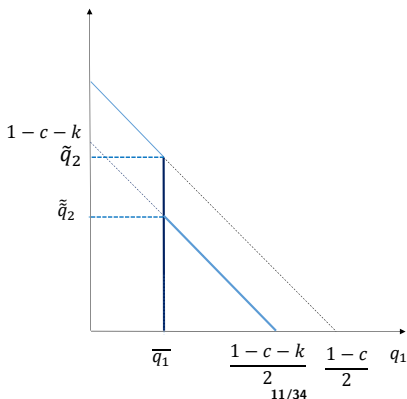
- ▶ In stage 1, an incumbent firm 1 sets its capacity \bar{q}_1 .
- ▶ In stage 2, the entrant 2 decides to enter or not. In case of entry the two firms set additional capacity $\Delta\bar{q}_1$ and $\Delta\bar{q}_2$ respectively and produce at most $\bar{q}_1 + \Delta\bar{q}_1$ for the incumbent and $\Delta\bar{q}_2$ for the entrant.
- ▶ Products are homogeneous and the inverse demand function is $P = 1 - q_1 - q_2$.
- ▶ Entry cost : e
- ▶ k is the marginal cost of capacity.
- ▶ c the marginal cost of production.

Assume that 2 has entered. The incumbent's profit is:

$$\pi_1 = (1 - q_1 - q_2 - c)q_1 - k\Delta\bar{q}_1$$

Maximizing this function with respect to q_1 it follows that the best reaction function is:

$$q_1(q_2) = \begin{cases} \frac{1}{2}(1 - q_2 - c - k) & \text{for } q_1 > \bar{q}_1, \\ \frac{1}{2}(1 - q_2 - c) & \text{for } q_1 \leq \bar{q}_1 \end{cases}$$



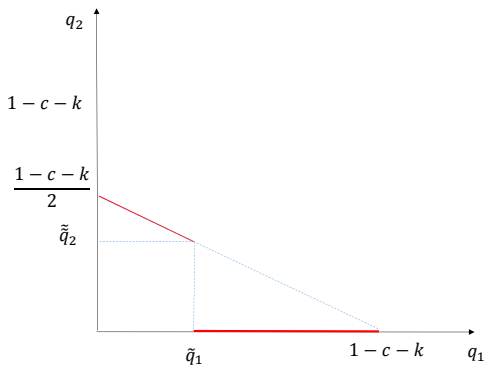
The entrant's profit is:

$$\pi_2 = (1 - q_1 - q_2 - c)q_2 - k\Delta\bar{q}_2 - e$$

Maximizing this function w.r.t. q_2 , the best reaction function is:

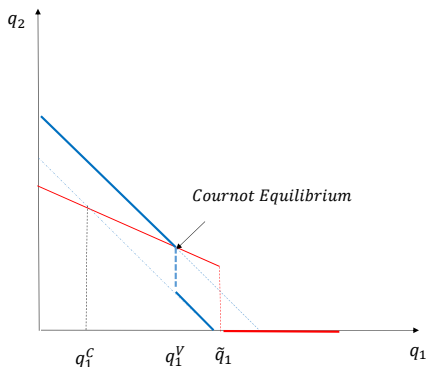
$$q_2(q_1) = \begin{cases} \frac{1}{2}(1 - q_1 - c - k) & \text{for } q_1 < \tilde{q}_1, \\ 0 & \text{for } q_1 \geq \tilde{q}_1 \end{cases}$$

$$\tilde{q}_1 = 1 - c - k - 2\sqrt{e} \Leftrightarrow \pi_2(q_2(q_1), q_1) = \frac{1}{4}(1 - q_1 - c - k)^2 - e = 0$$



4 cases to consider

- Inevitable entry: $\tilde{q}_1 > q_1^V \Rightarrow e < e^- = \frac{1}{9}(1 - c - 2k)^2$. q_1^V corresponds to a Nash equilibrium between the entrant 2 and an unconstrained firm 1.
 - ▶ if $\bar{q}_1 = q_1^V \Rightarrow \pi_1 = \frac{1}{9}(1 - c + k)(1 - c - 2k)$
 - ▶ if $\bar{q}_1 = q_1^C \Rightarrow \pi_1^C = \frac{1}{9}(1 - c - k)^2$.

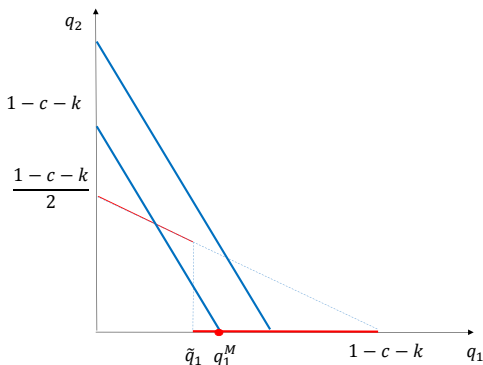


4 cases to consider

2. Blockaded entry

$$q_1^M = \frac{1}{2}(1 - c - k) \text{ and } q_1^M > \tilde{q}_1 \Rightarrow e > e^+ = \frac{1}{16}(1 - c - k)^2$$

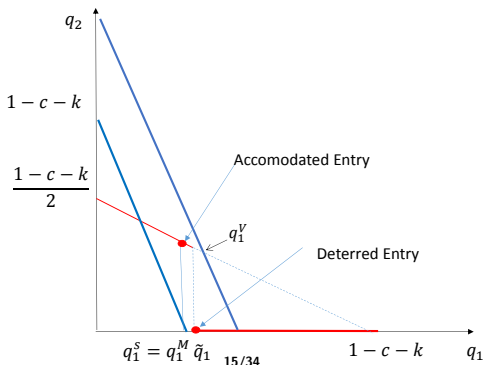
► Then $\bar{q}_1 = q_1^M \Rightarrow \pi_1^M = \frac{1}{4}(1 - c - k)^2$



4 cases to consider

If $q_1^M < \tilde{q}_1 < q_1^V \Leftrightarrow e^- < e < e^+$

3. Deterred entry $\bar{q}_1 = \tilde{q}_1$ — Commitment from 1 to be on its highest reaction function \Rightarrow credible that $q_1 = \tilde{q}_1$ and no entry.
4. Accomodated entry
 - ▶ $\bar{q}_1 = q_1^S = \frac{1}{2}(1 - c - k) = q_1^M < \tilde{q}_1$. In the competition stage, 1 is on the high reaction function only if $q_1 \leq q_1^M < q_1^V$.



If $q_1^M < \tilde{q}_1 < q_1^V \Leftrightarrow e^- < e < e^+$

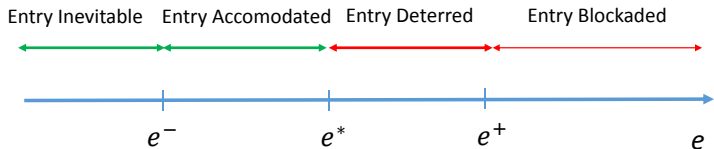
- ▶ The profit obtained in case of accomodation is:

$$\max_{q_1^S} \pi_1(q_1^S, q_2(q_1^S)) = \frac{1}{2}(1 - c - k - q_1^S)q_1^S \Rightarrow \pi_1^A = \frac{1}{8}(1 - c - k)^2$$

- ▶ To deter entry, the incumbent must install a larger capacity \tilde{q}_1 and its profit is:

$$\pi_1^D = (1 - c - k - \tilde{q}_1)\tilde{q}_1 = 2\sqrt{e}(1 - c - k - 2\sqrt{e})$$

It is possible to show that $\pi_1^D > \pi_1^A$ if $e > e^* = \frac{(2-\sqrt{2})^2(1-c-k)^2}{64}$.



Remember

This investment capacity model illustrates the TOP DOG strategy for Deterrence:

- ▶ Deterrence $\rightarrow q_1 = \tilde{q}_1$ which corresponds to a capacity expansion above the monopoly level.
- ▶ Accomodation $\rightarrow q_1^S = q_1^M$ which corresponds to a capacity expansion above the competition level ($q_1^C = \frac{1-c-k}{3}$).

Lean and Hungry look: An innovation model

Assumptions

- ▶ **Period 1:** Firm 1 can make an investment K_1 to reduce its marginal cost $c(K_1)$ and obtain the corresponding gross profit $\pi^M(c(K_1))$ which strictly increases in K_1 in period 1.
- ▶ **Period 2** Firm 2 may enter at a fixed cost F . When firm 2 enters, 1 and 2 compete in $R\&D$:
 - ▶ To innovate with probability ρ_i costs $\rho_i^2/2$.

Innovation is drastic and leads to a marginal cost c .

Table: Gains in period2

Innovation probabilities	ρ_2	$(1 - \rho_2)$
ρ_1	$(0, 0)$	$(\pi^M(c), 0)$
$(1 - \rho_1)$	$(0, \pi^M(c))$	$(\pi^M(c(K_1)), 0)$

Period 2: Firms 1 and 2 choose their R&D levels ρ_1 and ρ_2 to maximize their expected profit:

$$\begin{aligned}\pi_1 &= \rho_1(1 - \rho_2)\pi^M(c) + (1 - \rho_1)(1 - \rho_2)\pi^M(c(K_1)) - \rho_1^2/2, \\ \pi_2 &= \rho_2(1 - \rho_1)\pi^M(c) - \rho_2^2/2\end{aligned}$$

FOCS are:

$$\begin{cases} (1 - \rho_2^*)(\pi^M(c) - \pi^M(c(K_1))) = \rho_1^*, \\ (1 - \rho_1^*)\pi^M(c) = \rho_2^* \end{cases}$$

The equilibrium investments ρ_1^* and ρ_2^* that solve the above system are such that $\frac{\partial \rho_1^*}{\partial K_1} < 0$ and $\frac{\partial \rho_2^*}{\partial K_1} > 0$. FOC

Deterrence

$$\frac{d\pi_2(K_1, \rho_1^*, \rho_2^*)}{dK_1} = -\rho_2^*\pi^M(c)\frac{\partial \rho_1^*}{\partial K_1} > 0$$

The deterrence strategy consists in reducing K_1 .

Accommodation

$$\begin{aligned} \frac{d\pi_1(K_1, \rho_1^*, \rho_2^*)}{dK_1} &= \frac{\pi_1(K_1, \rho_1^*, \rho_2^*)}{\partial K_1} - (\rho_1^* \pi^M(c) + (1 - \rho_1^*) \pi^M(c(K_1))) \frac{\partial \rho_2^*}{\partial K_1} \\ &< \frac{\pi_1(K_1, \rho_1^*, \rho_2^*)}{\partial K_1} \end{aligned}$$

where $\frac{\pi_1(K_1, \rho_1^*, \rho_2^*)}{\partial K_1} = (1 - \rho_1^*)(1 - \rho_2^*) \frac{\partial \pi^M(c(K_1))}{\partial K_1}$

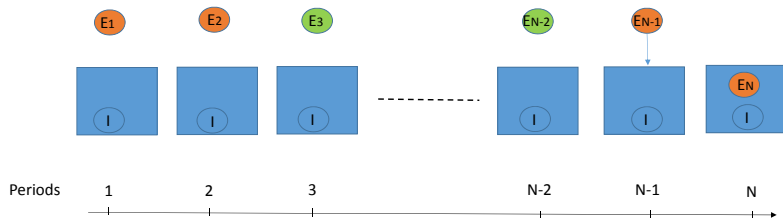
The accommodation strategy consists in reducing K_1 .

Lean and Hungry look

In period 1 firm 1 underinvests in K_1 to commit itself to being more aggressive in its *R&D* race in period 2. This is the best strategy both to deter entry or accommodate.

Why? *R&D* investments are strategic substitutes and the larger K_1 the higher $\pi^M(c(K_1))$ and therefore the lower the incumbent's incentive to invest in period 2 (Arrow replacement effect).

The chain store paradox (Selten, 1978)



- ▶ An incumbent firm I which owns stores in N markets.
- ▶ Entry takes place sequentially
 1. E_1 enters or not in period 1 on a first market.
 2. Another E_2 enters or not on a second market in period 2.
 3. ...
 4. The last E_N enters or not on market N in period N .

- ▶ Without entry the gain of I in each store is: a
- ▶ In case of entry, gains of firm I and E_i are:

Table: Payoffs in case of entry

Choice of I	Fight	Accomodate
Payoffs (I, E_i)	$(-1, -1)$	$(0, b)$

- ▶ We solve the game backward.
- ▶ In period N , if E_N enters, the best choice for player I is to accomodate. Long run consideration do not come in, since after period N the game is over.
- ▶ In period $N - 1$, a fight in period $N - 1$ would not deter player N to enter, therefore in $N - 1$ the best strategy for I is to accomodate.
- ▶ By induction theory, the unique sequential equilibrium is such that in each period t , E_t enters and I accomodates.
- ▶ Selten Paradox (1978): Incomplete information framework, i.e. I can be of type tough or weak with a probability \Rightarrow a reputation issue!!

The chain store game with reputation

- ▶ Same framework except that I can be tough (on all markets) with probability (p) and weak with proba ($1-p$)
- ▶ Each E_i can be tough with probability (q) and weak with proba ($1-q$)
- ▶ **Tough I always fights ; Tough E_i always enters.**

Table: Payoffs in case of entry

Choice of a weak I	Fight	Accomodate
Payoffs (I, E_i)	$(-1, -1)$	$(0, b)$

- ▶ We solve the game backward.

The case $N = 1$

It is a one period game \Rightarrow **No reputation effect.**

- ▶ **A tough I fights.**
- ▶ A weak I accomodates.
- ▶ p is the probability that the incumbent is tough.
- ▶ When the expected gain of a weak E_1 is $-p + (1 - p)b > 0$, i.e. $p < \underline{p} = \frac{b}{b+1}$, E_1 enters. Otherwise, E_1 stays out.
- ▶ If $p < \underline{p} = \frac{b}{b+1}$, a weak I gains 0. If $p \geq \underline{p} = \frac{b}{b+1}$, I gains a .

The case $N = 2$

It is a two-period game \Rightarrow **A reputation effect may take place.**

- ▶ **A tough I fights.**
- ▶ What is the strategy for a weak I?
 - ▶ If I accomodates in $t = 1$, then, in $t = 2$, E_2 knows that I is weak and always enters. The expected gain of a weak I is 0.
 - ▶ If I fights in $t = 1$, and if then in $t = 2$ E_2 believes that I is tough and stays out, the expected gain of a weak I is $-1 + \delta(1 - q)a$ (with the complementary probability $(1-q)$, E_2 **is tough and enters**).

If $-1 + \delta(1 - q)a < 0$, there is **No reputation strategy** for a weak I.

In $t = 1$, a weak E_1 enters if $p < \underline{p} = \frac{b}{b+1}$ and stays out otherwise.

- ▶ If I accomodates in $t = 1$, a weak E_2 enters.
- ▶ If I fights in $t = 1$, a weak E_2 stays out.

If $-1 + \delta(1 - q)a > 0$, **A reputation strategy** for a weak I may arise.

A weak I wants to fight in $t = 1$ with a positive probability β to deter entry in $t = 2$. We focus directly on the interesting case in which E_2 is a weak entrant.

▶ If $p > \underline{p}$,

- ▶ If I fights in $t = 1$, the revised probability that I is tough is $p(\text{tough}/\text{fight}) = \frac{p}{p + \beta(1-p)} > p > \underline{p}$ and a weak E_2 stays out. Bayes
- ▶ Because fighting in $t = 1$ always deters entry in $t = 2$, a weak I always fights ($\beta = 1$) in $t = 1$ and earns the expected profit :
 $-1 + \delta(1 - q)a > 0$
- ▶ Not fighting in $t = 1$ brings 0 to I.

Conclusion

Because there are at least two-periods, E_1 anticipates that I has an incentive to create a reputation of being tough in $t = 1$ to deter entry in $t = 2$, and therefore E_1 is less likely to enter also in $t = 1$.

The generalization to any N is possible

- ▶ Assuming that $N = 3$, we now find that E_1 enters if and only if $p < \left(\frac{b}{1+b}\right)^3$ and so on for $N = T$ for $p < \left(\frac{b}{1+b}\right)^T$.

Contracts to deter entry

Vertical contracts between manufacturers and retailers might be used to deter entry.

- ▶ For instance bundling or full line forcing practices (Coca-Cola case in Multiproduct pricing class)
- ▶ Exclusive dealing contracts: Mars vs HB case.
 - ▶ The case starts in Ireland in 1989. Ice-cream bars are mostly sold in gas stations.
 - ▶ HB (Unilever) has 79% of the ice-cream bar market and, in 1989, Mars enters.
 - ▶ HB freely supplies small retailers with freezers. Mars market share rises up to 42%.
 - ▶ HB requires exclusivity: only HB ice cream bars are stock in my freezers. Mars's market share decreases to 20%. Mars cannot fight back by offering its own freezers because shops are too small.
 - ▶ The European Court of Justice confirms the EC's prohibition of free freezers.

Exercise 2: Aghion and Bolton (1987)

M sells a good to A who is willing to pay at most $p = 1$ for one unit. The unit cost of M is $c_M = \frac{1}{2}$. An entrant, E can produce the same good at an unknown unit cost c_E uniformly distributed over $[0, 1]$.

- In $t = 0$, A and M sign a contract or not;
- In $t = 1$, E observes the contract, learns its unit cost c_E and chooses to enter or not.
- In $t = 2$, firms set their prices.
- In $t = 3$, A decides where to buy.

- 1 Without contract, the competition is a la Bertrand.
 - a. Determine the equilibrium and the probability ϕ of entry.
 - b. What are the expected profits?

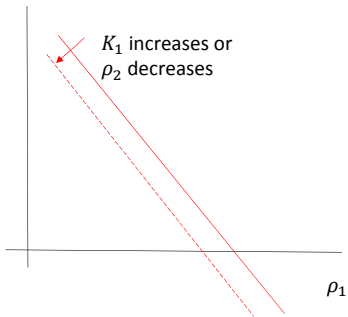
- 2 M offers a take-it-or-leave-it contract (P, P_0) where P is the price that A must pay if he chooses to buy the good from M and P_0 is the penalty A must pay to M if he buys from E .
 - a. Given (P, P_0) , under which conditions does E enter?
 - b. What is the profit of A if he accepts a contract (P, P_0) ?
 - c. Determine the optimal contract (P, P_0) for M .
 - d. What are the expected profits under this contract? Comment!

References

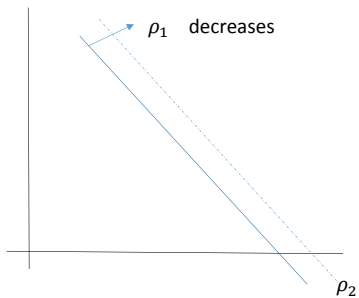
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back

$$\text{FOC } f(\rho_1, \rho_2, K_1) = 0$$
$$f_{\rho_1} < 0$$



$$\text{FOC } g(\rho_1, \rho_2, K_1) = 0$$
$$f_{\rho_2} < 0$$



back

Two events A and B respectively occur with probability $p(A)$ and $p(B)$.
Bayes's rule is as follows:

$$p(A/B) = \frac{p(B/A)P(A)}{p(B)}$$

where conditional probabilities:

- ▶ $p(A/B)$ is the likelihood of event A occurring given that B is true;
- ▶ $p(B/A)$ is the likelihood of event B occurring given that A is true.