Information Economics

- Uncertainty and economic behavior
  - Search
  - Baye's Theorem and updating beliefs
- Uncertainty and the market
  - Asymmetric information
  - Signaling and screening

Information Economics: Nobel Prizes

- Search 2010 (Diamond, Mortensen and Pissarides)



- Asymmetric info 2001 (Akerlof, Spence and Stigltz)



Search – consumer goods

- Previously assumed consumers knew the price of goods with certainty

- Things get more complicated when consumers do not know the prices charged by different firms for the same product

- Consumers sometimes incur a cost, ***c*****,** to obtain each price quote

- After observing each quote a consumer must weigh the expected cost and benefit from acquiring an additional quote with the additional cost *c*

Consumer Search: Scalping tickets for the football game

- 75% of sellers charging $100 and 25% of sellers charge $40

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- First scalper offers to sell for **$40**. Should you search?
  - Should stop searching and buy the tickets

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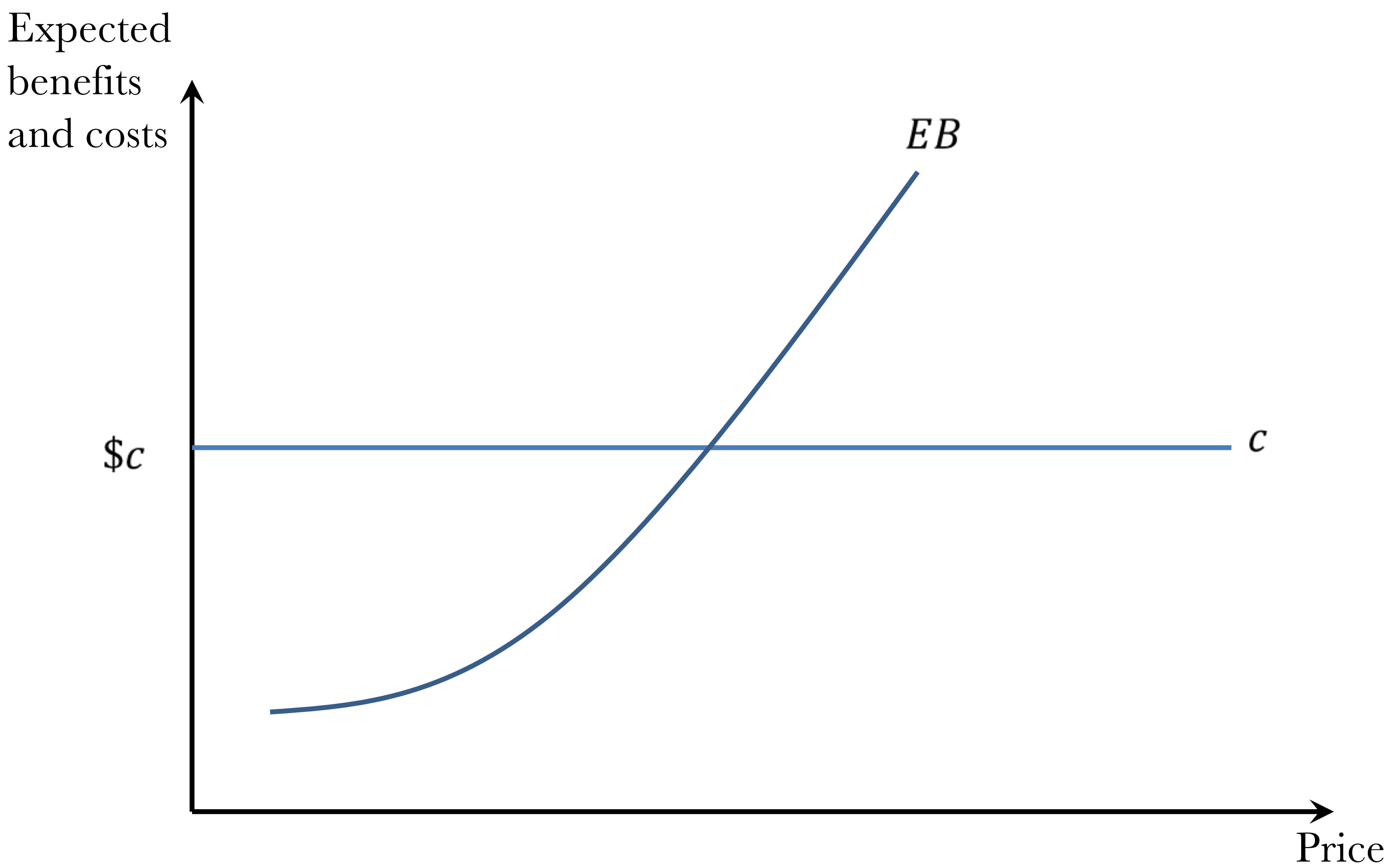
- First scalper offers to sell for **$100**. Should you keep searching?

  - If search: 25% chance will save $100 - $40 = $60
    75% chance will save $100 - $100 = $0

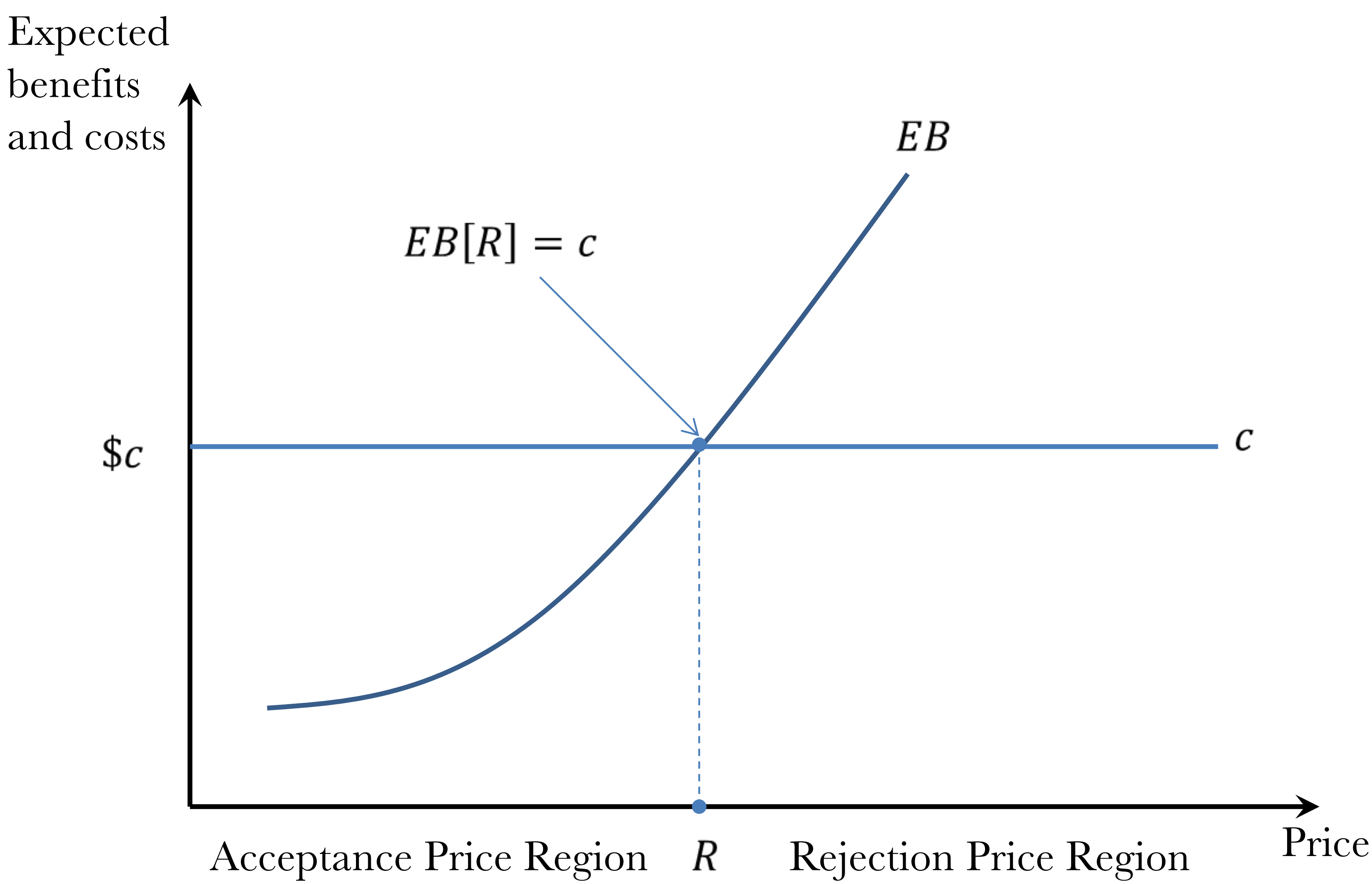
  Expected benefit from searching:
  = .25*($100 - $40) + .75*($100-$100) = $15

  Expected costs from searching?

Optimal search strategy



Optimal search strategy



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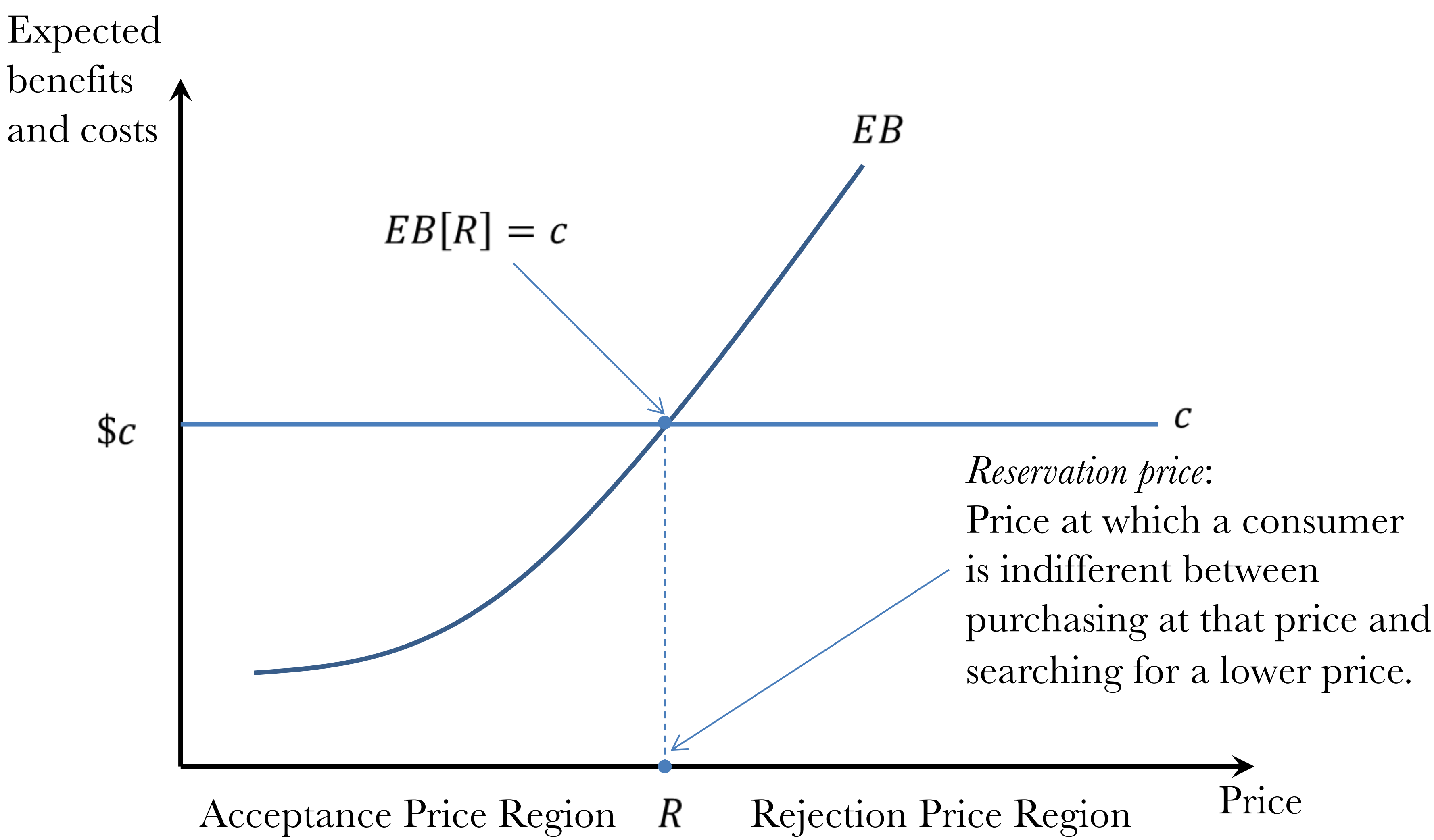


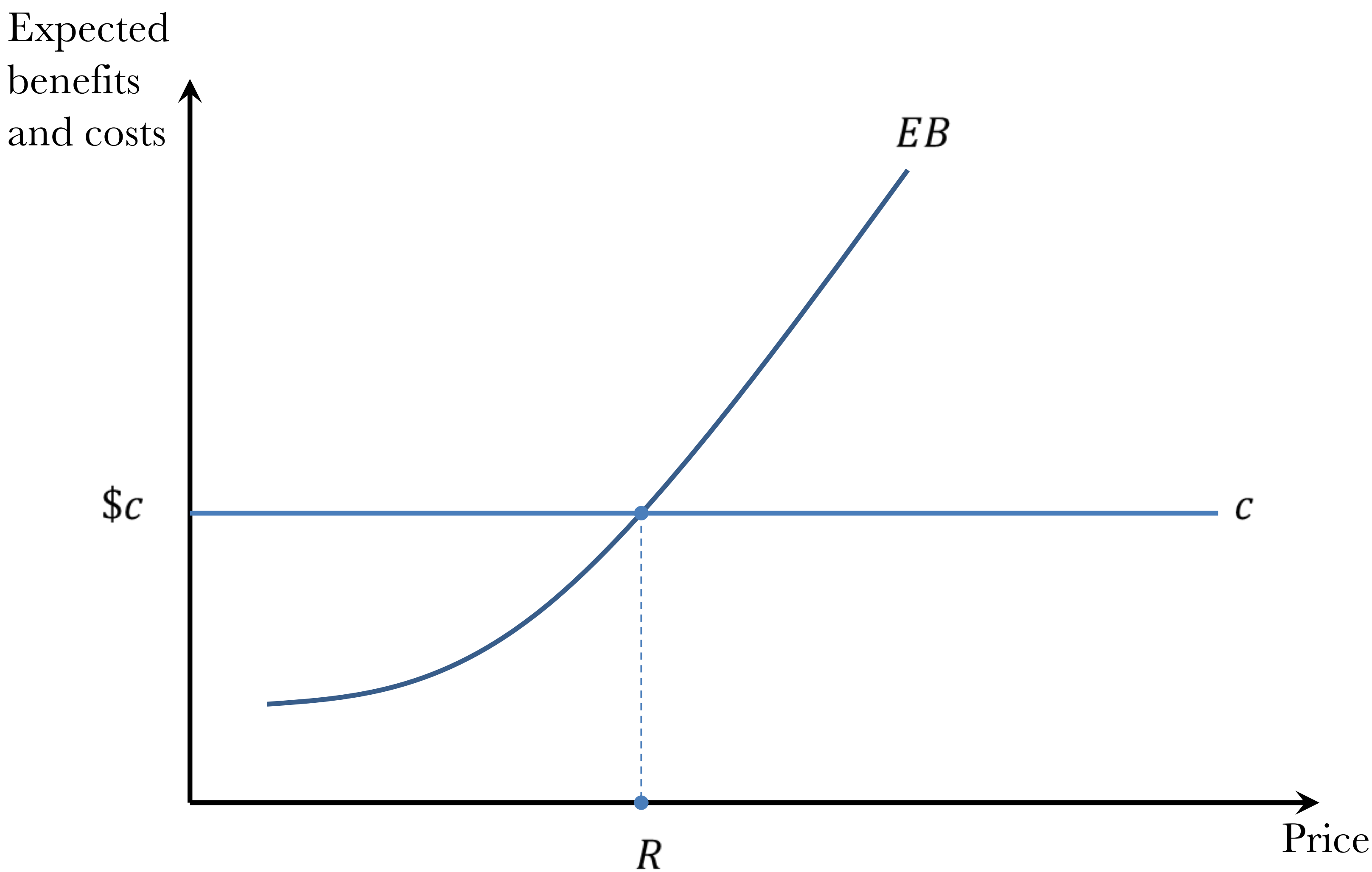
Consumer’s search rule

- Consumer rejects a price above the reservation price, *R*, and accepts below the reservation price

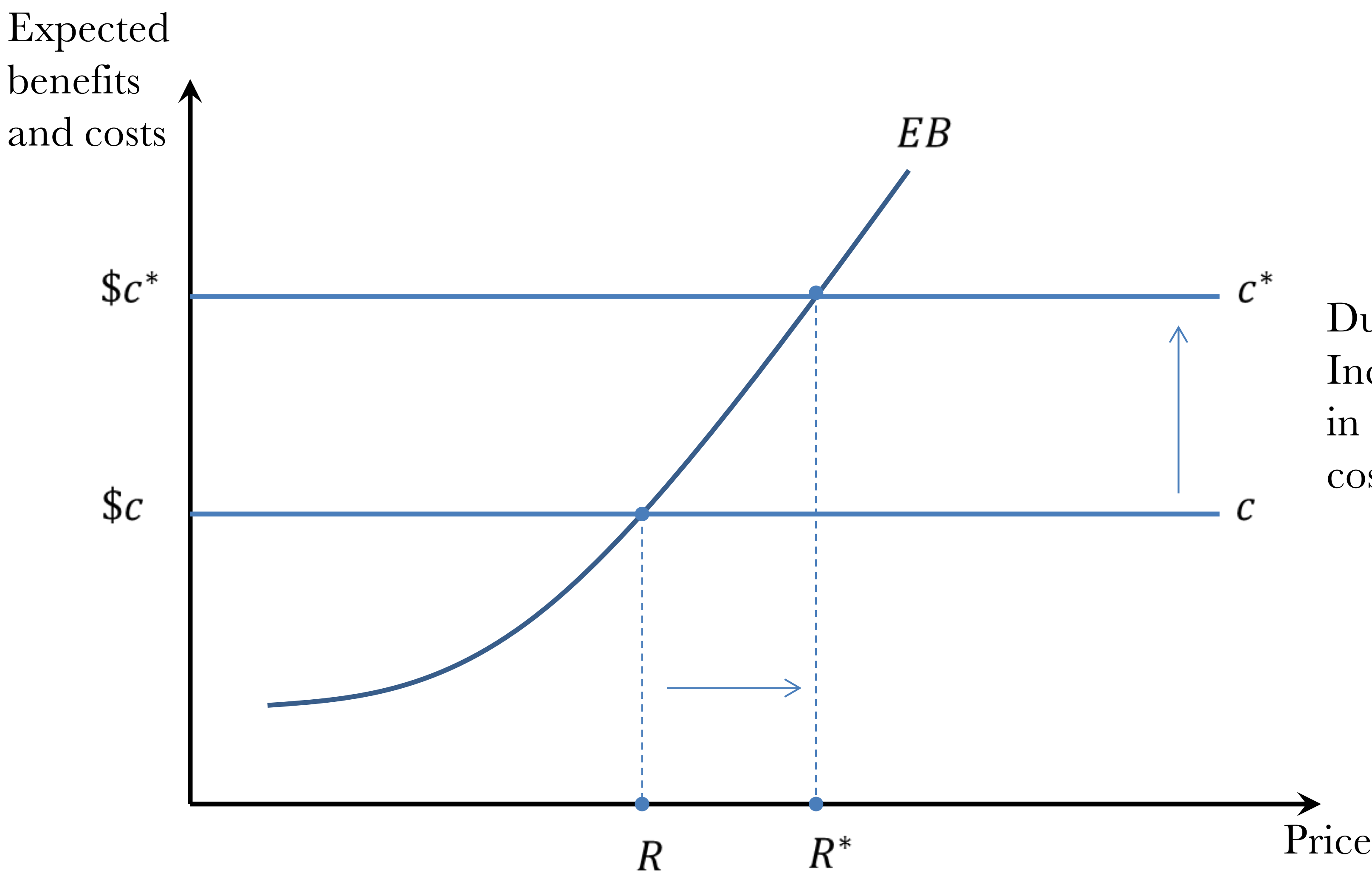
- Reservation price:
  - The price at which a consumer is indifferent between purchasing at that price and searching for a lower price

The optimal search strategy is to keep searching if price above reservation price and stop searching when the price is below the reservation price

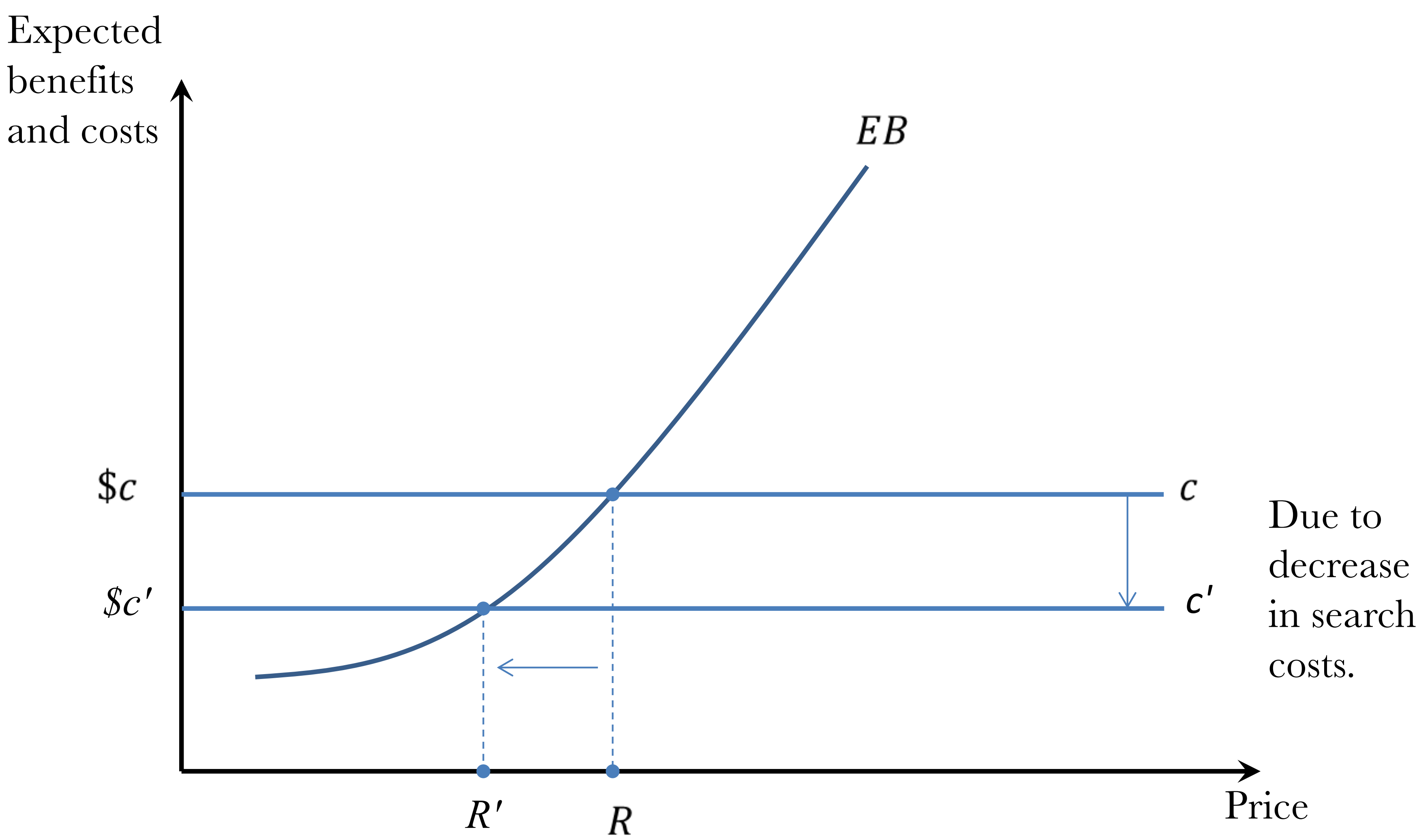
Increasing cost of search



Increasing cost of search



Decreasing cost of search



Search in the labor market

- This also comes up for the unemployed in the labor market
  - Different firms offer different opportunities
  - Workers are not fully informed about the “best” jobs
- It takes time to search, interview, etc.
- Should you take the first job offer that comes along?

Search in the labor market

- Akin to consumer search this becomes an optimal stopping problem.

  - Looks like a sequential search

  - Asking / Reservation wage:
    - The threshold wage that determines if an unemployed worker accepts or rejects incoming job offers.

  - Accept first job offer at or above reservation wage

Search in the labor market

- Policy questions
  - What effects unemployed workers reservation wages?
  - Unemployment benefits
    - Must meet certain criteria
    - Receive a portion of previous salary based on the "replacement ratio" normally for up to 26 weeks

  - CARES Act in 2020
    - Offered additional benefits
    - Extended time & increase $

  - Did people remain unemployed for longer spells?
  - Was there a disincentive effect?

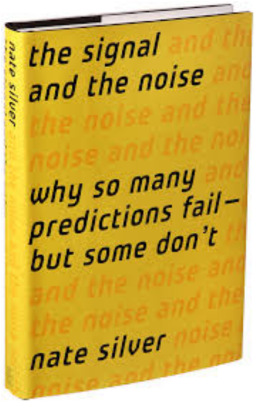
Search in the labor market

- Policy questions
  - Can we reform the system to reduce the disincentive effect?
  - Illinois and Pennsylvania experiments in the 1980s
    - Experiment: randomly determined treatment and control groups
    - IL offered a cash bonus ($500 = 4 times the benefits)
    - If accepted a job within 11 week
  - Results
    - Those in cash bonus group accepted jobs more quickly and for the same wage, on average, as those in the "control group"

Learning: Bayes Theorem

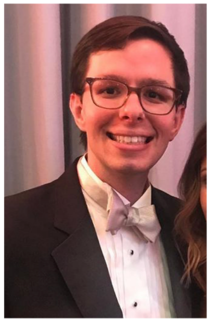
- Thomas Bayes
  - 1701 – 1761
  - English minister and mathematician

- Mathematical formula <u>to update beliefs based on new info</u>
  - Probability that some "state of the world" is true
  - Given some information or an event
  - Thinking about "signal" vs "noise"



Learning: Bayes Theorem

- Bayes Theorem
  - Posterior probability / final assessment = $\mathbf{P}(\boldsymbol{S}|\boldsymbol{I})$
    - S - State of the world or hypothesis is true
      - Have a medical condition "sick"
    - I - Information or event takes place
      - Positive test result



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    - To make an assessment or "update our beliefs
      - Probability information is "true positive" or "*signal*"
      - Probability information could be a "false positive" or "*noise*"
      - Probability of *S* before any information "prior"

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$$\boldsymbol{P(S|I) = \frac{P(I|S) * P(S)}{P(I)}}$$

THE PROBABILITY OF "B" BEING TRUE GIVEN THAT "A" IS TRUE

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THE PROBABILITY OF "B" BEING TRUE

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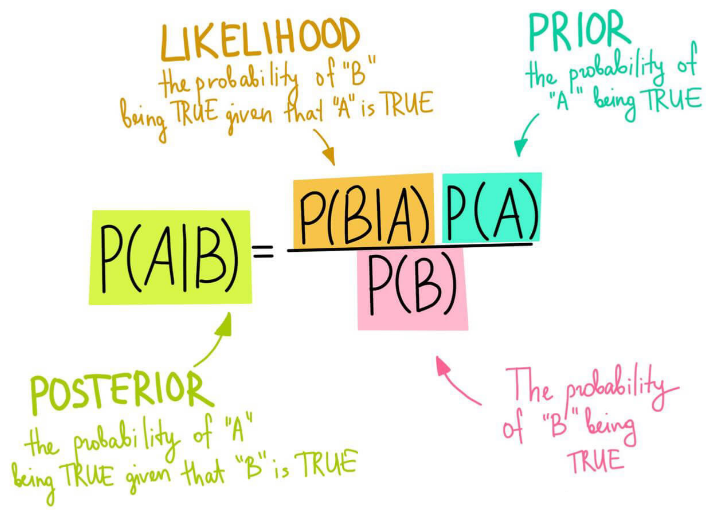

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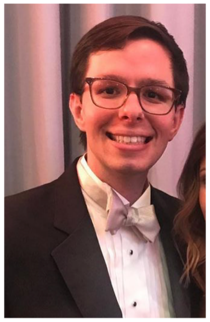
$$P(S \mid I) = \frac{(\text{Info is true signal}) * (\text{Prior})}{(\text{Info is true signal}) * (\text{Prior}) + (\text{Info is noise}) * (1 - \text{Prior})}$$

- Weighting the signal to the noise based on our "prior" belief

Learning: Bayes Theorem



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Prior = chance we believe he's sick before getting tested

= case rate at the time (5%)

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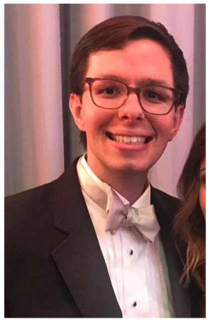

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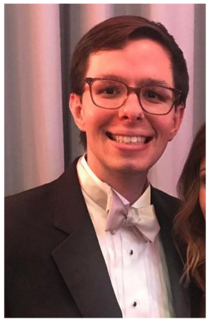

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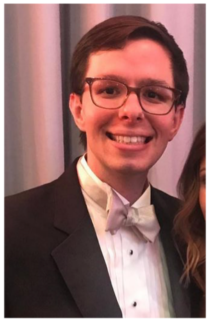

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Info is true signal = true positive

Based on medical data = 90%

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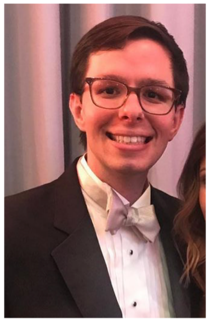

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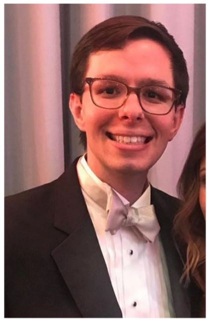

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Info is noise= false positive

Based on medical data = 2%

$$P(S\,|\,I) = \frac{\mathbf{(0.90)} * \mathbf{(0.05)}}{\mathbf{(0.90)} * \mathbf{(0.05)} + (\text{Info is noise}) * \mathbf{(0.95)}}$$

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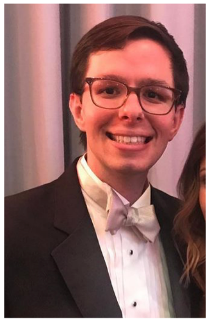

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$$P(S \mid I) = \frac{(0.90) * (0.05)}{(0.90) * (0.05) + (0.02) * (0.95)}$$

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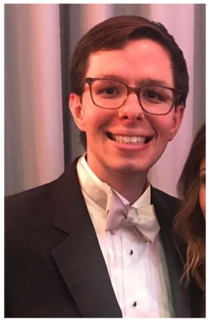

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Posterior probability

70.3%

$$\mathbf{0.703} = \frac{\mathbf{0.045}}{\mathbf{0.045} + \mathbf{0.019}}$$

- Weighting the signal to the noise based on our "prior" belief

Learning

- Visual version of Bayes Theorem
  - Meet someone on campus and notice they are **shy**
    - Math major or Business major?
    - How do you tell an extroverted mathematician?

Learning

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Prior = 1 math for every 10 business

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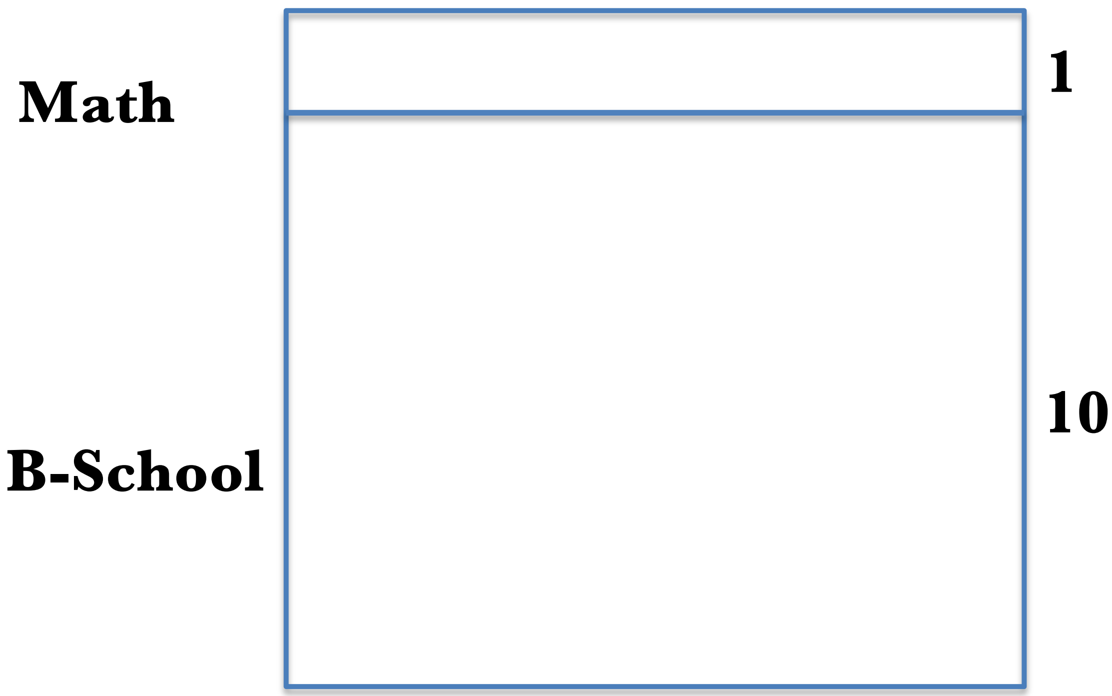

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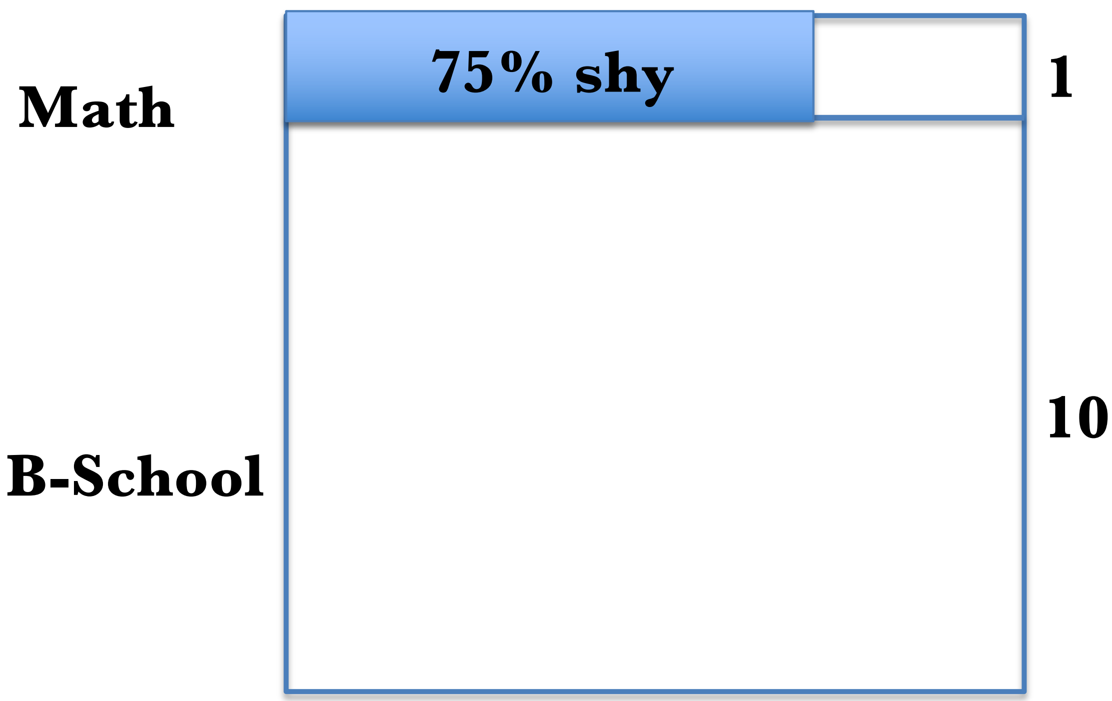
Math and Shy = 75%



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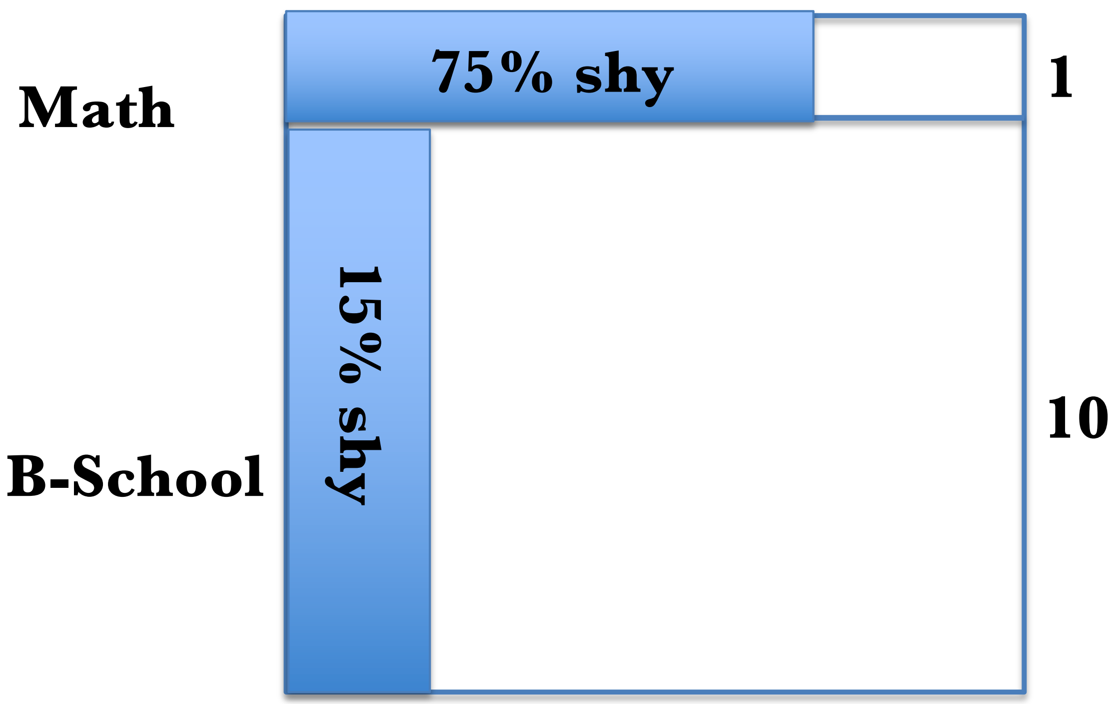

Prior = 1 math for every 10 business

Math and Shy = 75%

Business and Shy = 15%

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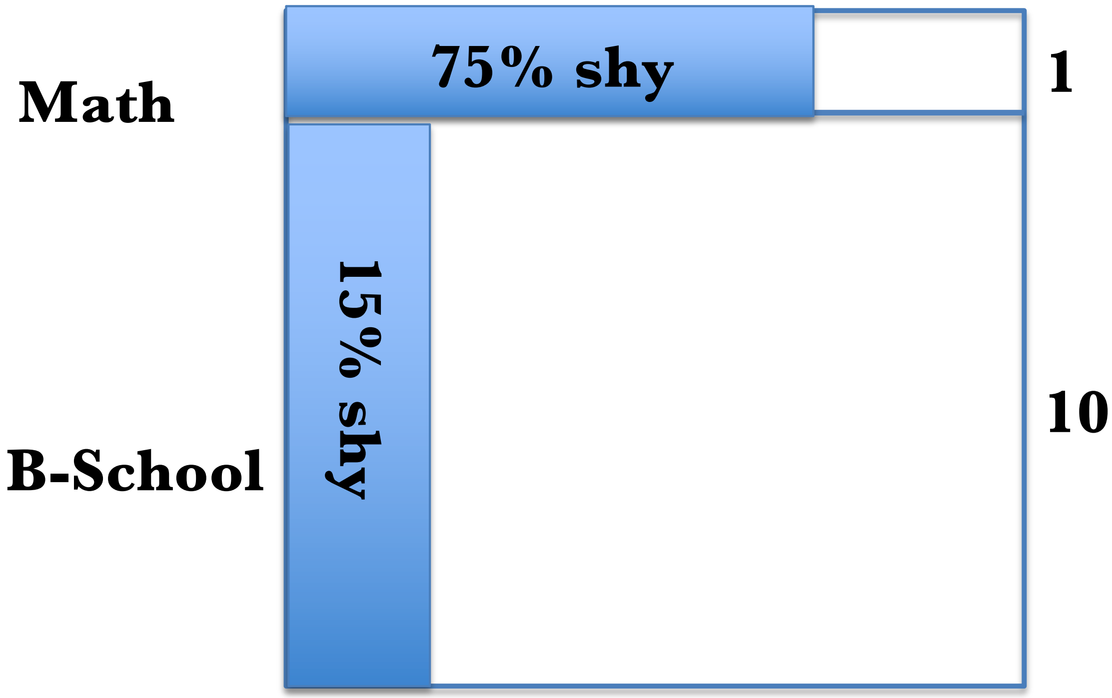

Prior = 1 math for every 10 business

Math and Shy = 75%

Business and Shy = 15%

Compare relative rectangles

	Math	Business
Prior	1	10
Likilhood	75	15
Posterior	75	150

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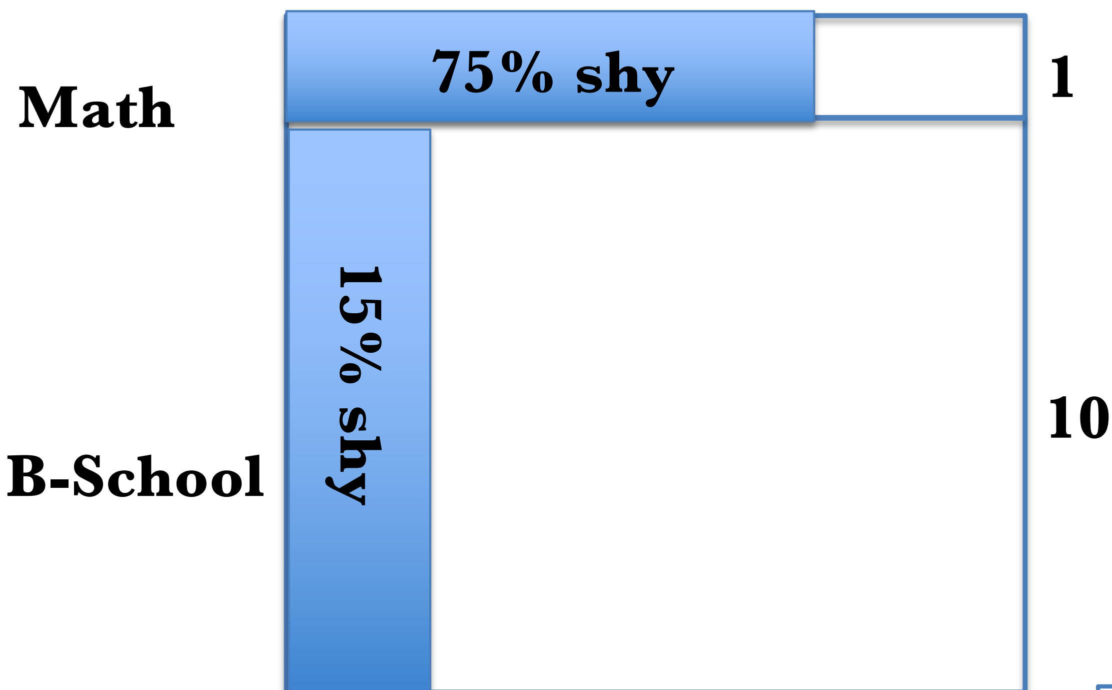

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<u>Compare relative rectangles</u>

	Math	Business
Prior	1	10
Likilhood	75	15
Posterior	**1**	**2**

P(Business | shy) = 66% chance business

Learning: Bayes Theorem

- Principals in Bayesian thinking

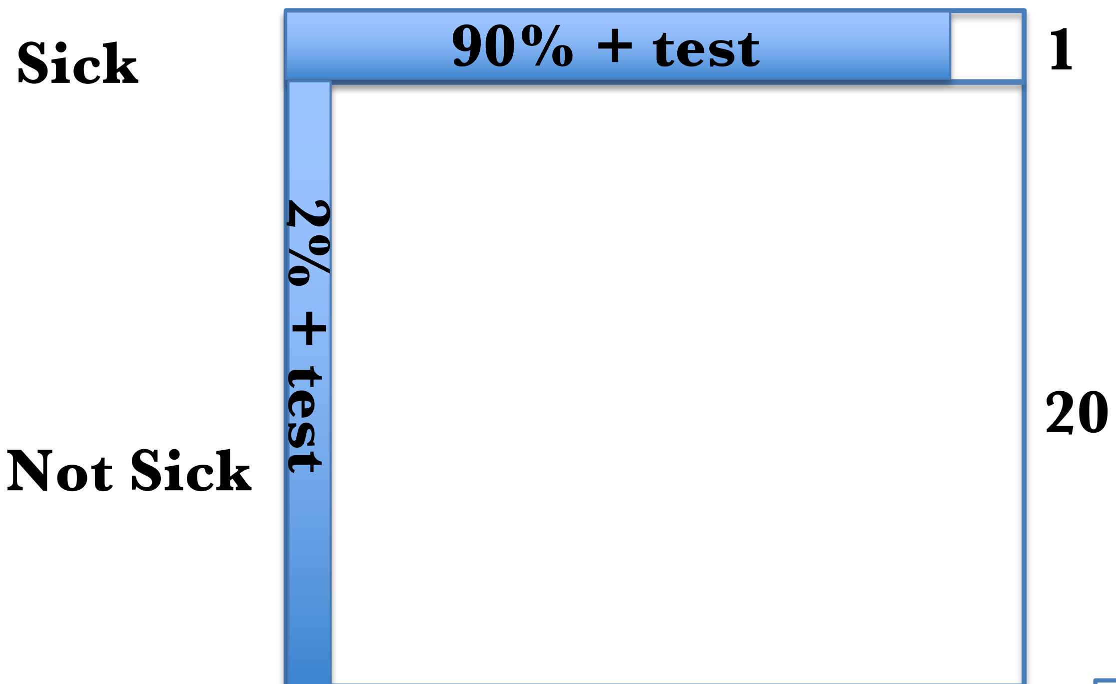
1) Remember your priors
   - Don’t just focus on the evidence / information
   - Remember the background knowledge (prior)

2) How likely is a false positive?
   - Imagine your theory / hypothesis is wrong. Would the world look different?

3) Update incrementally
   - Posterior from the last piece of evidence becomes the new prior

Learning: Bayes Theorem

- Visual version of Bayes Theorem
  - Nelson's Covid-19 test



Prior = 1 sick for every 20 not sick

Sick and + Test = 90%

Not Sick and + Test = 2%

<u>Compare relative rectangles</u>

	Sick	Not Sick
Prior	1	20
Likilhood	90	2
Posterior	**90**	**40**
	2.25	**1**

P(Sick | + Test) = 70% chance business