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Lies and communication

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Outline

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Werner & Dyer experiment

- Males are blind and can move.
- Females don't move and detect males passing near them.
- Females can send signals to males in order to guide them.
- Males take moving decisions according to the signal.

How does it work

First scenario : females give absolute direction.

- 24 possible positions for male.
- 4 possible guiding songs : north, south, east or west.
- Female part of the DNA coded on $24 * log_2(4) = 48$ bits.
- For each song, a male takes a decision between : go straight, turn left, turn right or turn around.
- Male part of the DNA requires $4 * log_2(4) = 8$ bits.

How does it work

Second scenario : females give relative direction.

- $24 * 4 = 96$ possible positions for male.
- 4 possible guiding songs : go straight, turn left, turn right or turn around.
- Female part of the DNA coded on $96 * log_2(4) = 192$ bits.
- For each song, a male takes a decision between : go straight, turn left, turn right or turn around.
- Male part of the DNA requires $4 * log_2(4) = 8$ bits.

Results

- Communication arises.
- Males only turn in one direction.
- If the grid is too big, population dies.
- If grid is too small, no communication arises.
- This is a local optima.

Outline

Objectives

- Add a possibility of lying.
- Honest or dishonest signals ?
- Communication failure ?

What's new

The beauty concept:

- Males are born with a beauty.
- Females want to mate with pretty males.

Advertisement:

- Males can pretend to be prettier.
- Females perceive the advertisement and not true beauty.

Mechanisms: beauty and advertisement

- Beauty is a phene.
- Advertisement can be learned at a cost: childhood.
- Childhood threshold: gene

$$advertisement = max(beauty, childhood\_threshold)$$

If $childhood\_threshold > beauty$, the male is penalized by a childhood of duration:

$$(childhood\_threshold - beauty)^{ad\_cost}$$

Mechanisms: female decision

- Beauty threshold: gene.
- When a male enters the neighbourhood, detection of advertisement level.
- If $advertisement \geq beauty\_threshold$, the female sings.

When a female reproduces:

- If $beauty \leq beauty\_threshold$, the female will be unable to mate for a period of duration $beauty\_threshold - beauty$.

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Time for mating

If a male wanders at random on the grid:
Let's denote t_r the time at which he finds a female.
We can compute:

$$T_r = \mathbb{E}(t_r) = \frac{s^2 - N}{N}$$

When the grid is of size $s * s$ and there are N males and N females.

Time for mating

The same method gives us T_1, the expected time for a male to pass in range of a female:

$$T_1 = \mathbb{E}(t_1) = \frac{s^2 - 25N}{25N}$$

If we denote T_2 the expected time to mate once in the neighbourhood of a female, we finally have the expected time of mating for a guided male:

$$T_g = \frac{s^2 - 25N}{25N} + T_2$$

Childhood duration

We can also compute the expected duration of the childhood:

$$T_c = \sum_{b=0}^{ct} \frac{b^{ad}}{100}$$

where:

- ct is the childhood threshold
- ad is the advertisement cost
- b is the beauty

Expected time to mating

We can finally compute the expected time to mating T:

$$T = \mathbb{E}(t|bt, ct) = T_c + T_g + \mathbf{1}\{ct < bt\}\frac{bt}{100}(T_r - T_g)$$

Outline

Expected time to mating

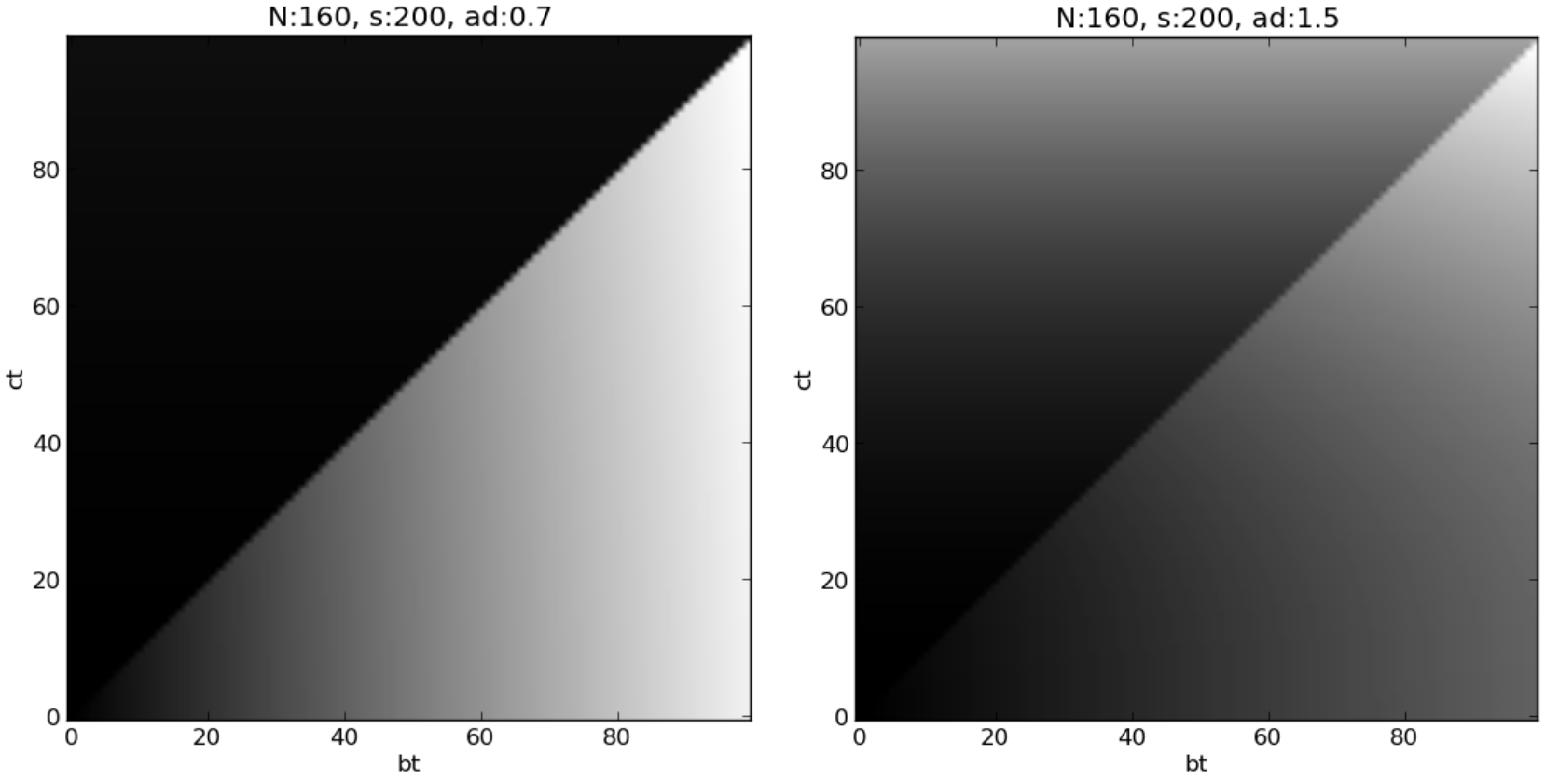

Figure : Expected time for mating, dark is lower.

An experiment, with ad=1, s=120

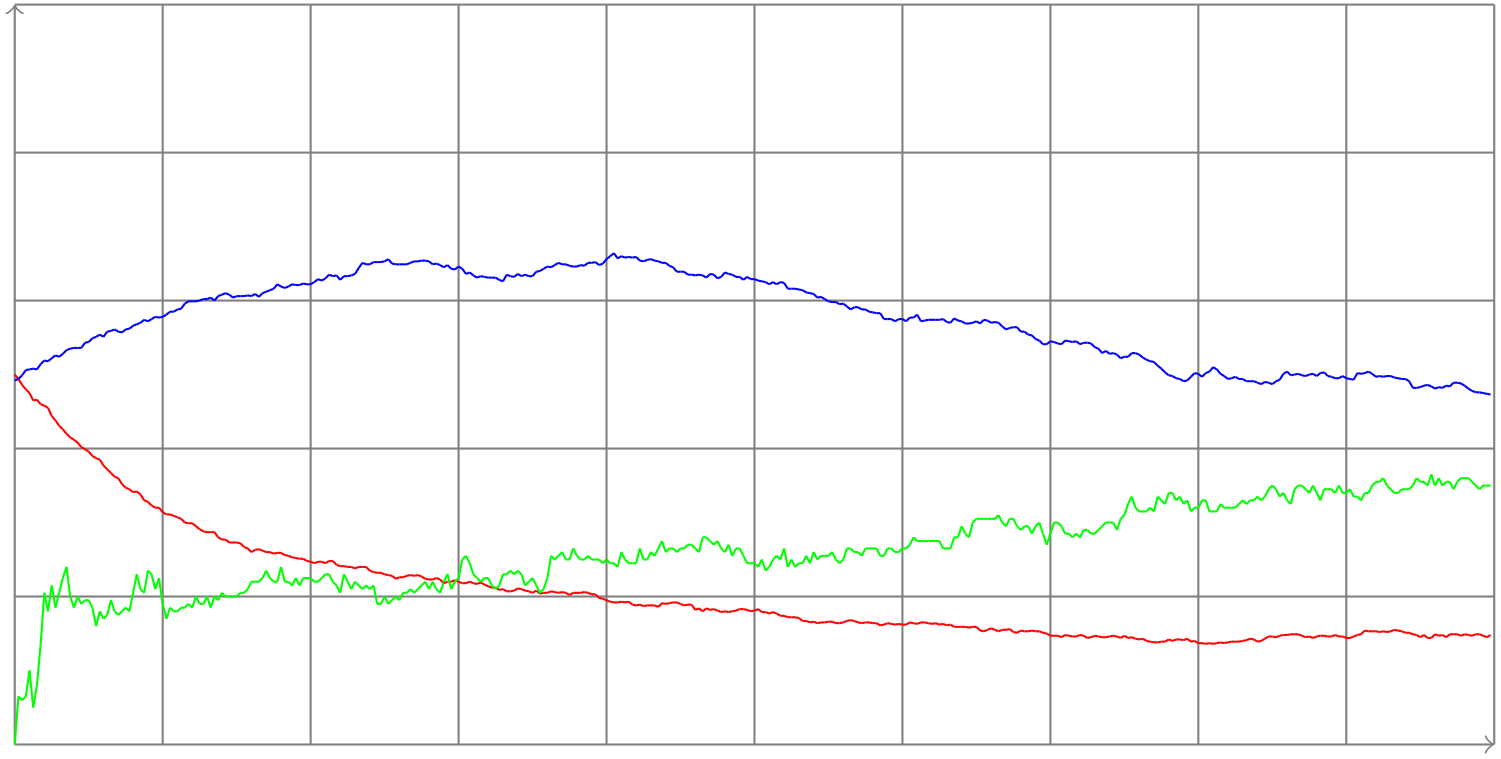

Figure : ad:1.0, grid:120, red=ct, blue=bt, green=probameet

An experiment, with ad=1, s=120

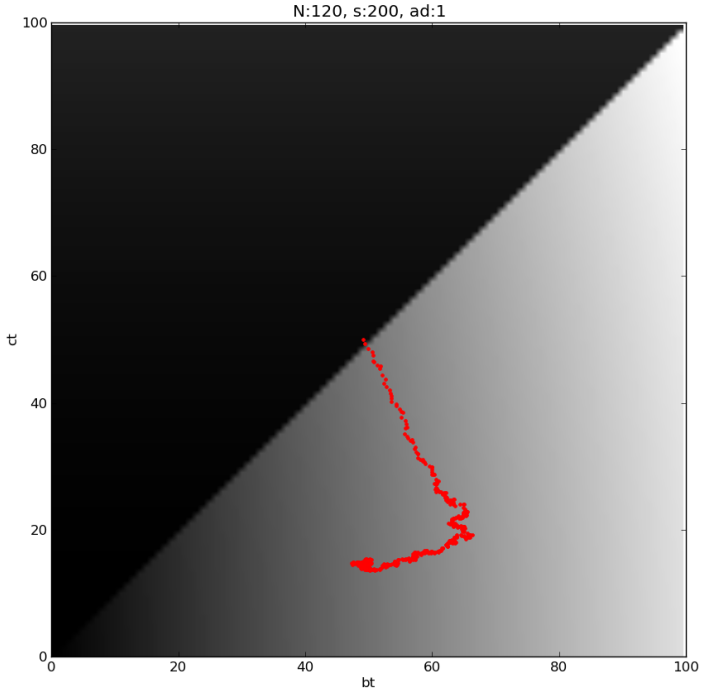

Figure : Expected time for mating, dark is lower.

With lower ad: 0.7

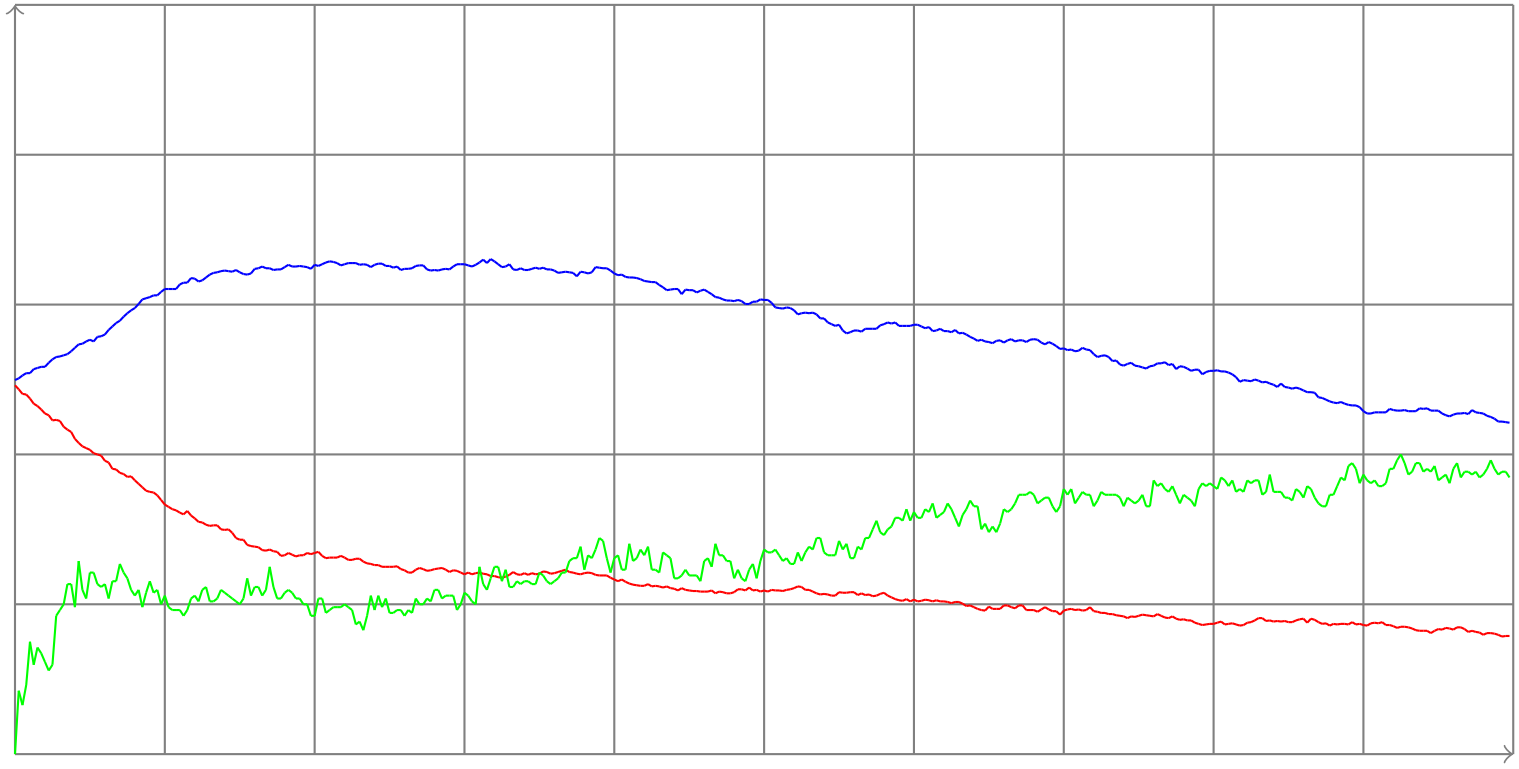

Figure : ad:0.7, grid:120, red=ct, blue=bt, green=probameet

With higher ad: 1.5

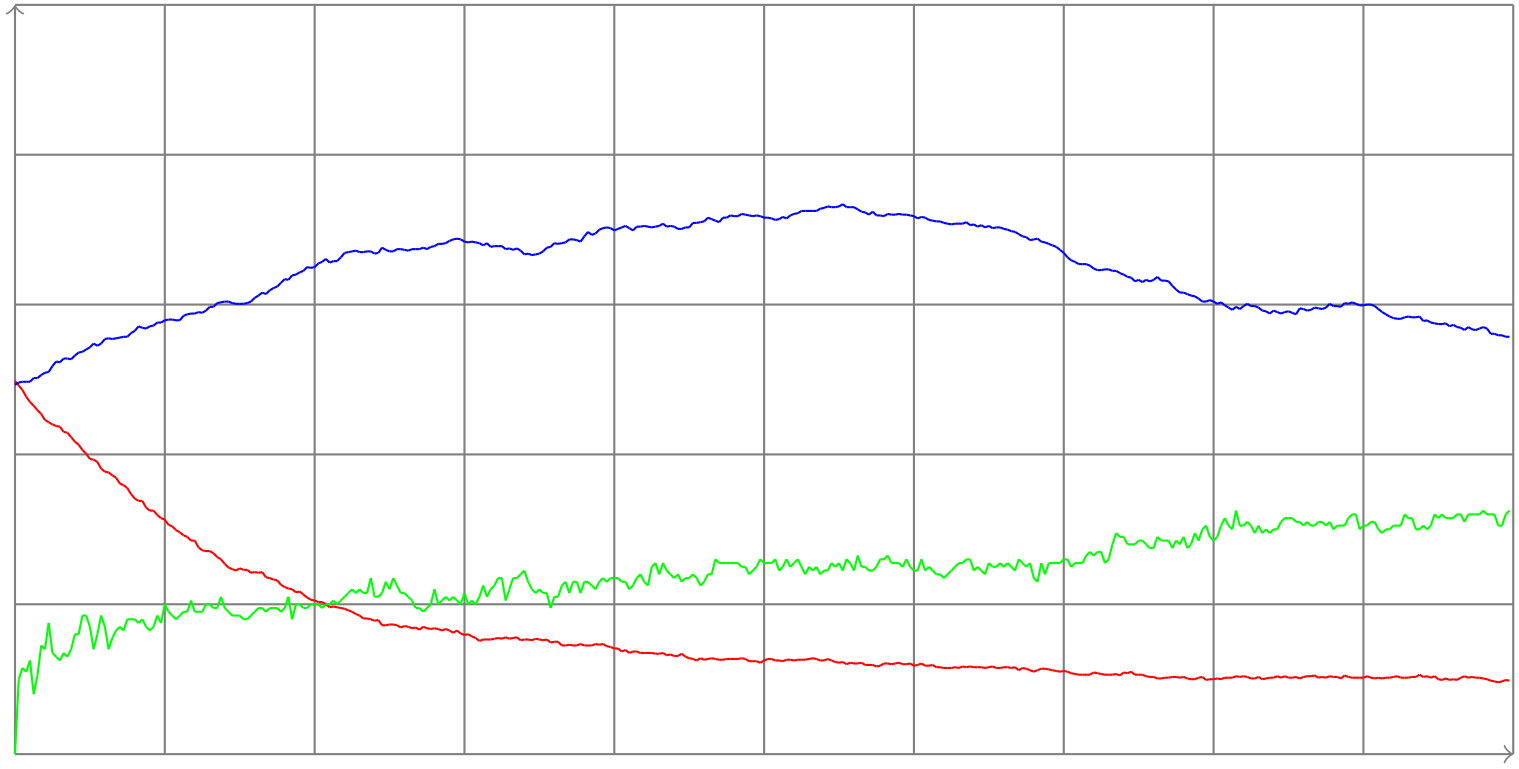

Figure : ad:1.5, grid:120, red=ct, blue=bt, green=probameet

With s=200

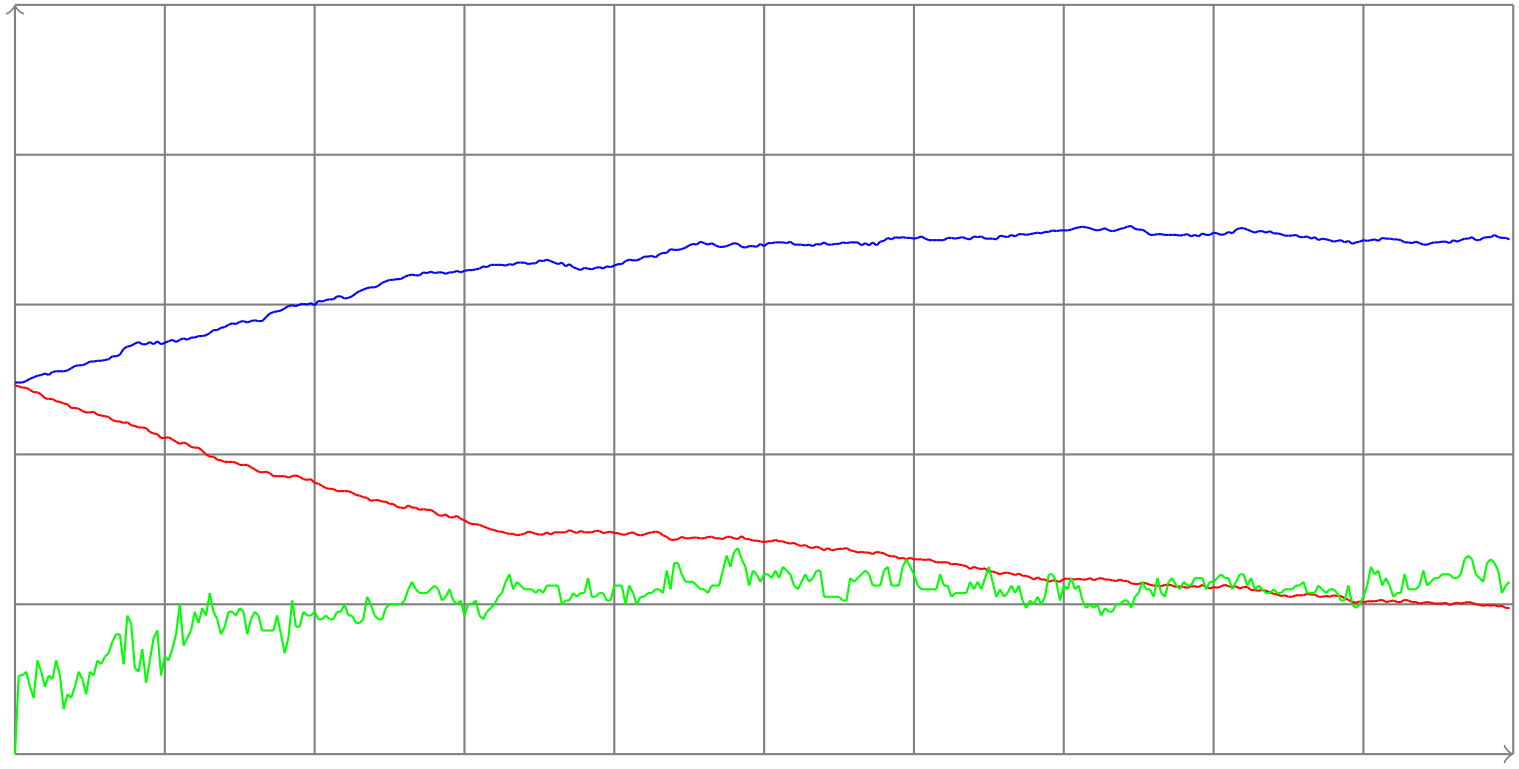

Figure : ad:1.0, grid:200, red=ct, blue=bt, green=probameet

Questions?

Thank you for your attention.