

**False positive (Fp) and false negative
(Fn) rate effects on consumer (β)
and producer (α) risks**

Work done within STA-GMOTF for the period
November 2001 – May 2002

False negative (*F_n*): a seed or seed pool testing **negative** when in reality it is **positive**

Reality

Result

Positive → **Negative**

PCR failure, too little DNA, ...

False positive (*F_p*): a seed or seed pool testing **positive** when in reality it is **negative**

Reality

Result

Negative → **Positive**

Imprecise primer choice, sample/DNA contamination (dirty equipment, leakage), ...

- Intuitively, we can think that:
 - . The producer risk will **decrease** with the F_n rate and **increase** with the F_p rate.
 - . The consumer risk will **decrease** with the F_p rate and **increase** with the F_n rate.
- Objectives:
 - . To assess the relationships between these error rates and the consumer and producer risks.
 - . To determine acceptable error rates below which the consumer and producer risks are kept below a given threshold.

Testing plans evaluated

- Single:

of seeds/pool = **150** - # of pools = **10** – Acceptance limit = **5**

of seeds/pool = **300** - # of pools = **8** – Acceptance limit = **6**

of seeds/pool = **500** - # of pools = **9** – Acceptance limit = **8**

Testing plans evaluated (cont.)

- Double:

- # of seeds/pool = **150**

1st stage: # of pools = **4**

Accept if at most **1** pool is positive, **reject** if **4** are positive, otherwise perform **8** additional tests.

2nd stage: # of pools = **8**

Accept if at most **6** pools are positive out of the **4 + 8** pools, otherwise **reject**.

of seeds/pool = **300**

1st stage: # of pools = **5**

Accept if at most **3** pools are positive, **reject** if **5** are positive otherwise perform **3** additional tests.

2nd stage: # of pools = **3**

Accept if at most **6** pools are positive out of the **5 + 3** pools otherwise **reject**.

Formulas giving α and β for single testing plans

$$\alpha = 1 - \sum_{i=0}^A \binom{n}{i} \left[(1 - Fn)(1 - (1 - AQL)^m) + Fp(1 - AQL)^m \right]^i \left[1 - ((1 - Fn)(1 - (1 - AQL)^m) + Fp(1 - AQL)^m) \right]^{n-i}$$

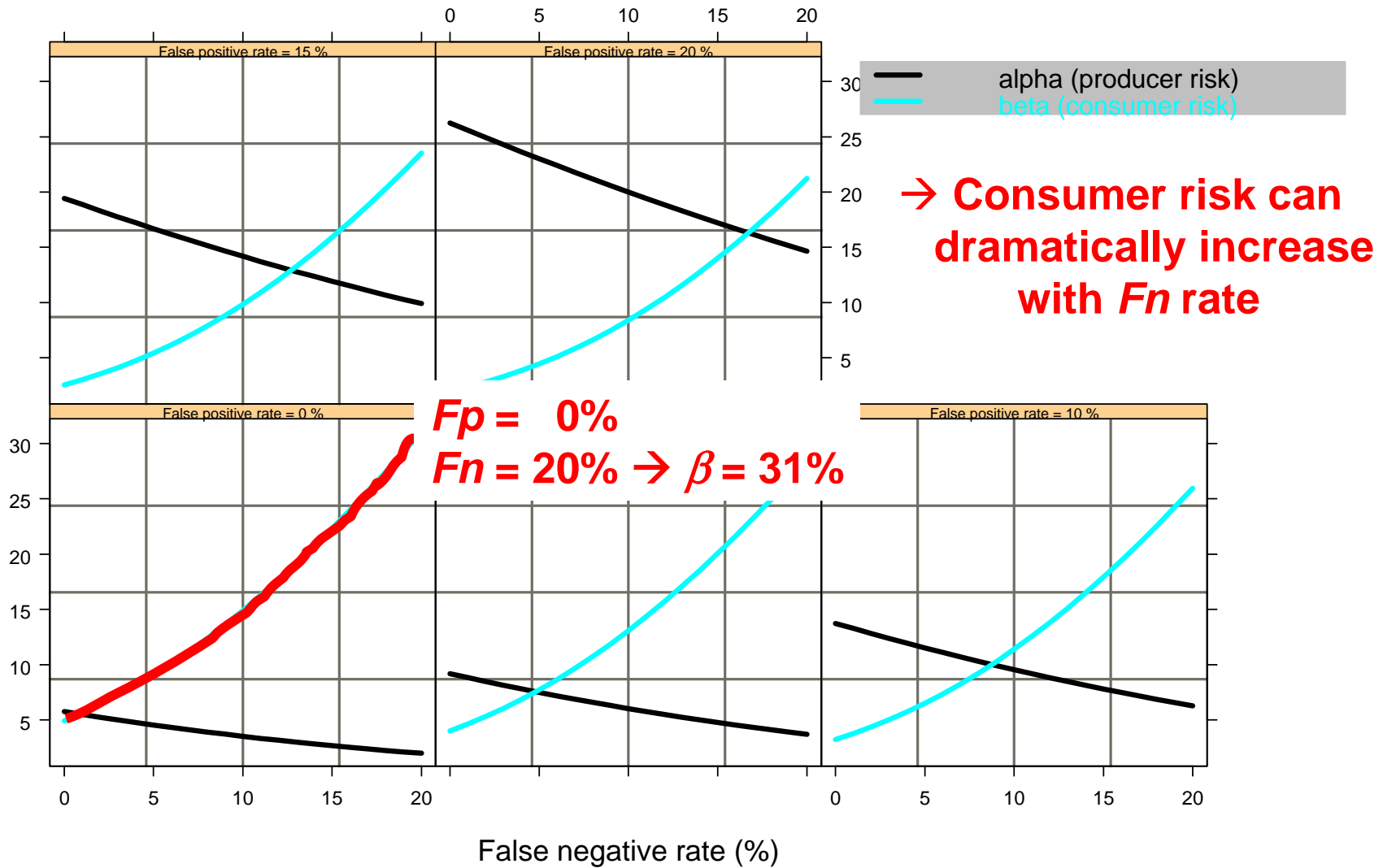
$$\beta = \sum_{i=0}^A \binom{n}{i} \left[(1 - Fn)(1 - (1 - LQL)^m) + Fp(1 - LQL)^m \right]^i \left[1 - ((1 - Fn)(1 - (1 - LQL)^m) + Fp(1 - LQL)^m) \right]^{n-i}$$

where:

- . n : number of seed pools
- . m : number of seeds per pool
- . A : acceptance limit
- . $\binom{n}{i} = \frac{n!}{i!(n-i)!}$

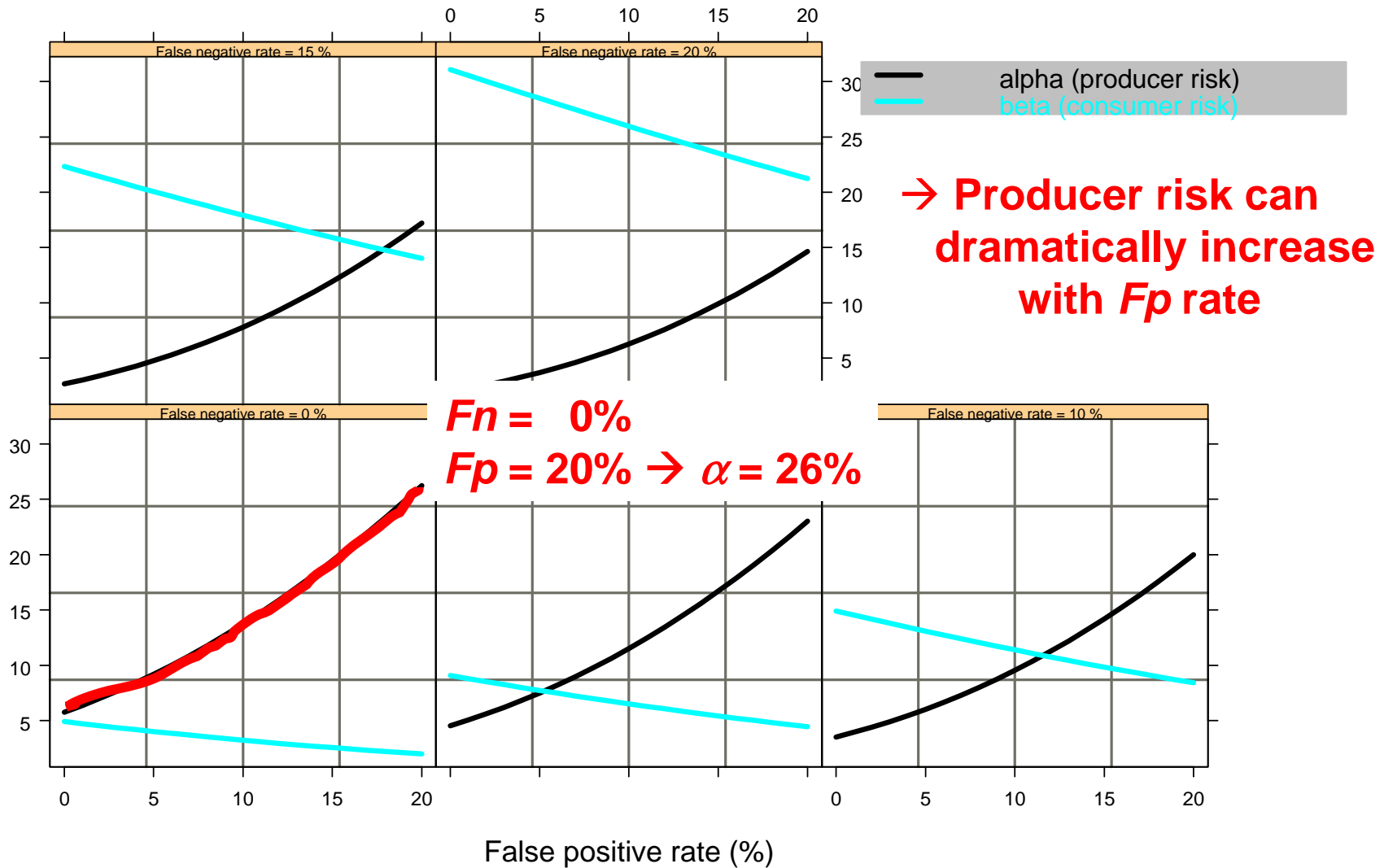
Visualizing the effects of F_n and F_p rates – Example

Single - 150 seeds - $n = 10$ - $A = 5$



Visualizing the effects of F_n and F_p rates – Example

Single - 150 seeds - $n = 10$ - $A = 5$

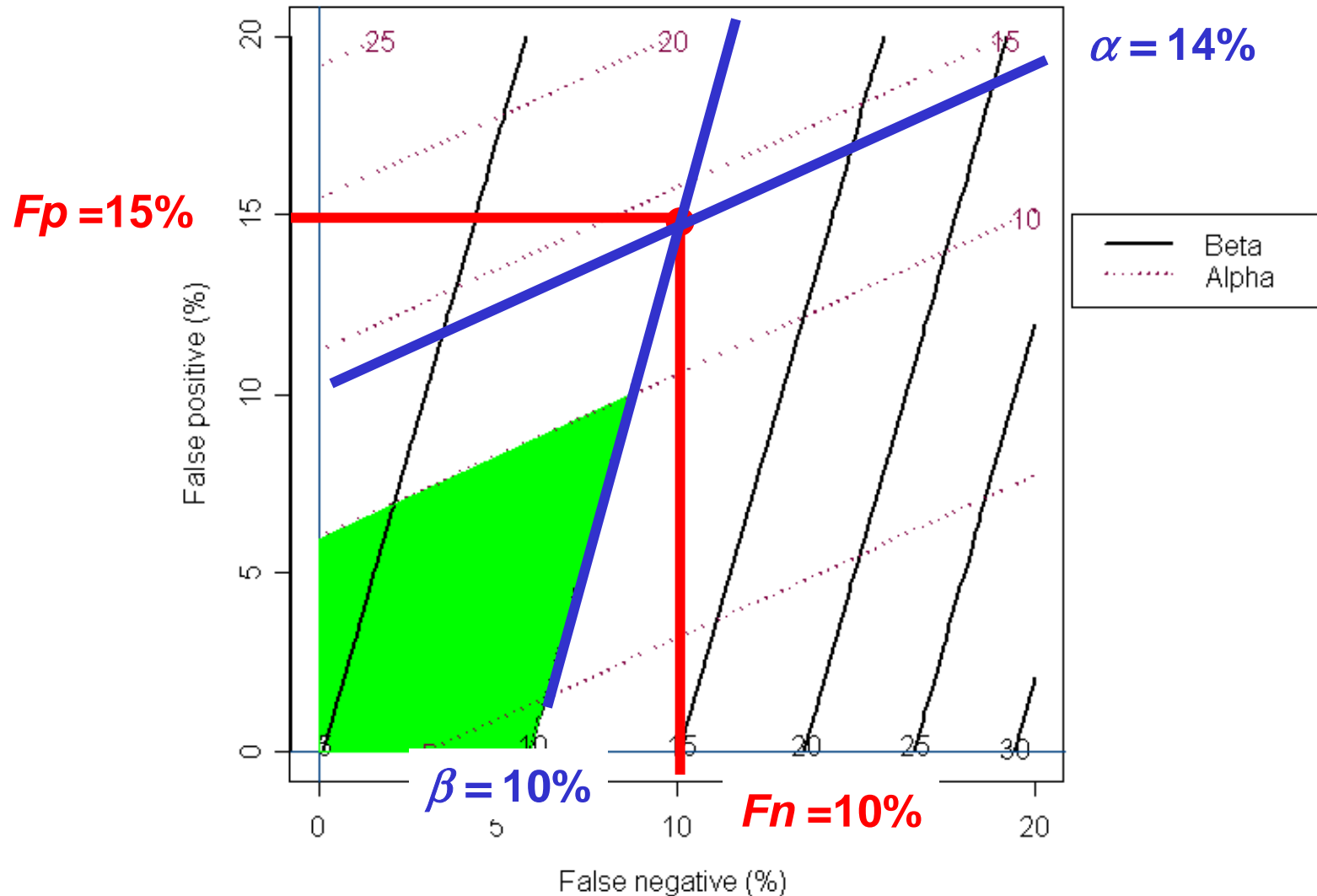


Question:

For these testing plans, can we define a limit for F_n and F_p rates that will guarantee α and β to be less than a certain level (e.g. 10%)?

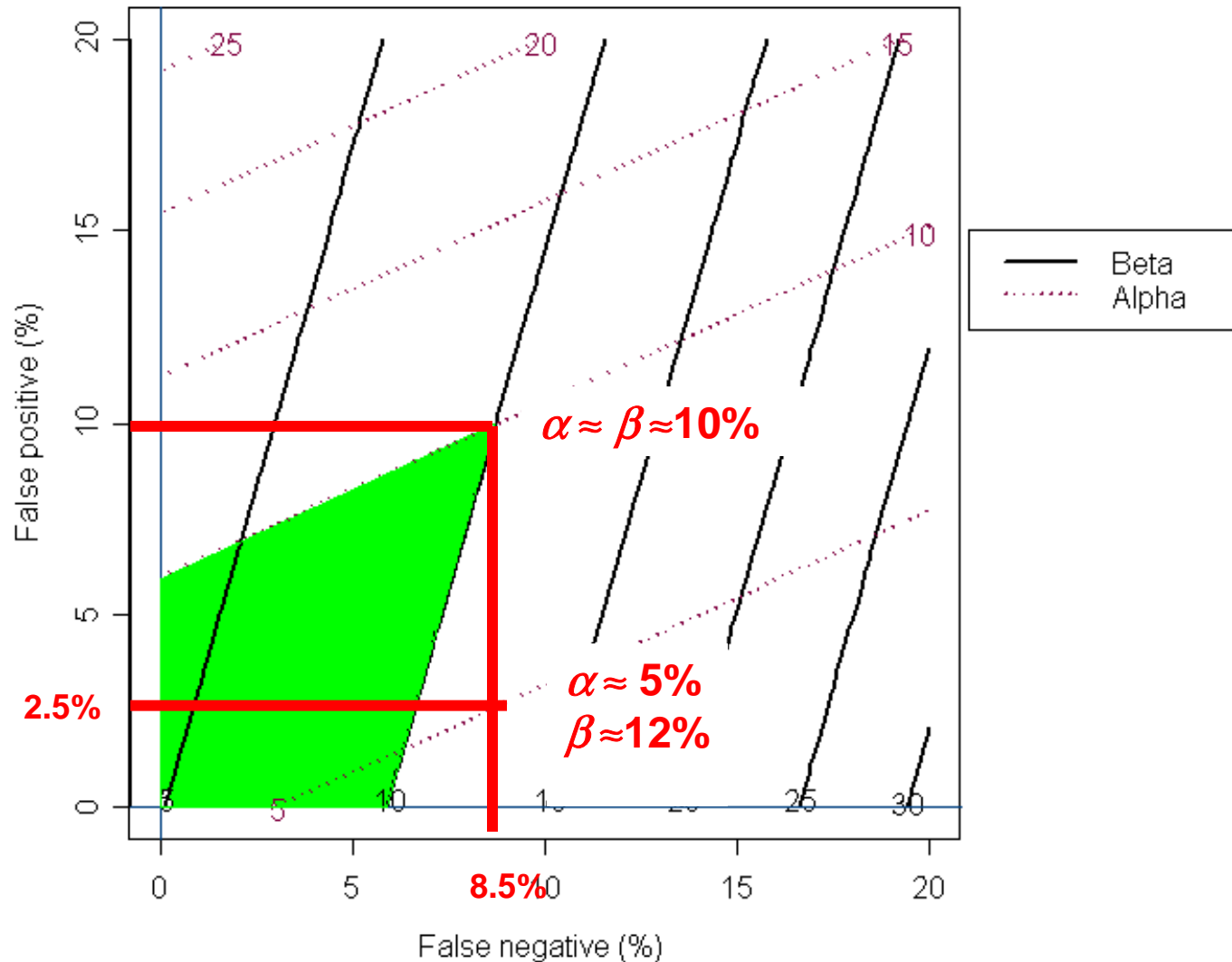
Values of F_n and F_p rates for which α and β are kept less than 10%: **green** area

Single - 150 seeds - $n = 10$ - $A = 5$

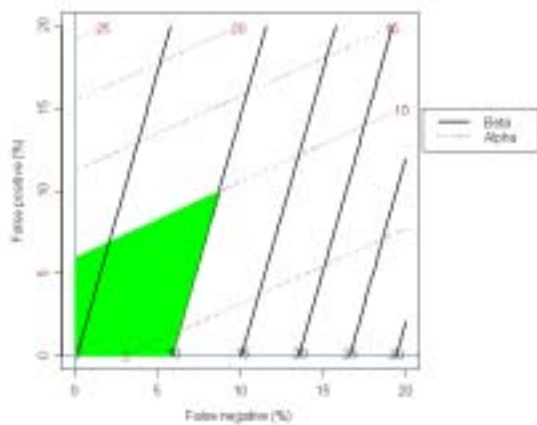


Values of F_n and F_p rates for which α and β are kept less than 10%: **green** area

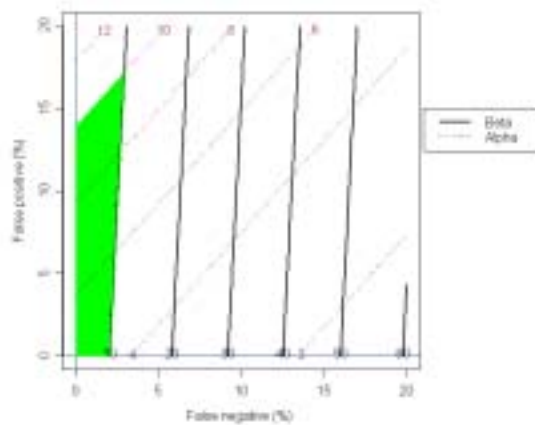
Single - 150 seeds - $n = 10$ - $A = 5$



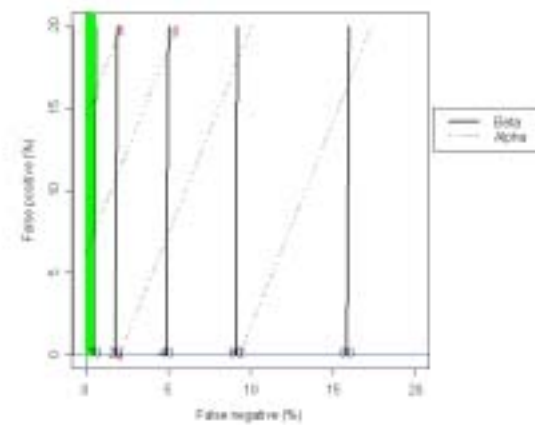
Single - 150 seeds - $n = 10 - A = 5$



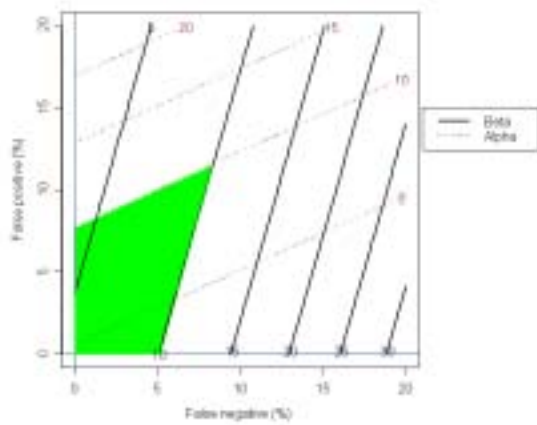
Single - 300 seeds - $n = 8 - A = 6$



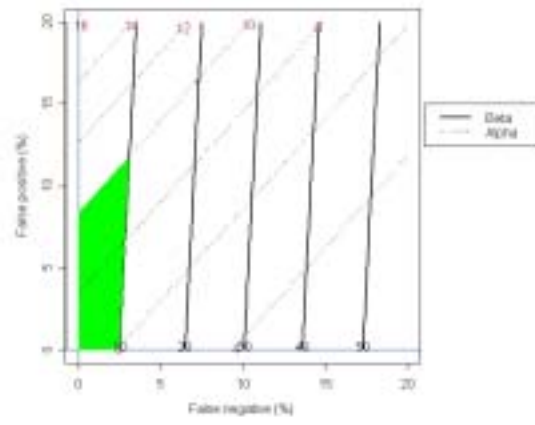
Single - 500 seeds - $n = 9 - A = 8$



Double - 150 seeds - $n1 = 4 - n2 = 8 - A1 = 1 - A2 = 6 - R1 = 4$



Double - 300 seeds - $n1 = 5 - n2 = 3 - A1 = 3 - A2 = 6 - R1 = 5$



Single - **Non robust testing plan for F_n rate** →

Single - 500 seeds - $n = 9$ - $A = 8$

Microsoft Excel - SeedCalc31.xls

File Edit View Insert Format Tools Data S-PLUS Window Help

Sampling Type: **SINGLE**

Seeds per Pool: **500**

False pos. rate: **0%**

False neg. rate: **2%**

Consumer Threshold: **1**

Producer Threshold: **0.25**

of Pools (n1): **9**
= 4500 seeds

% Impurity: **1**

LQL: **0.25**

AQL: **0.25**

Accept Lot if # deviants does not exceed: **8**

Consumer (Riser) Risk (%): **21.43**

Producer (Seller) Risk (%): **4.82**

Reject Lot if # deviants exceeds: **8**

Confidence Level (%): **78.57**

95.98

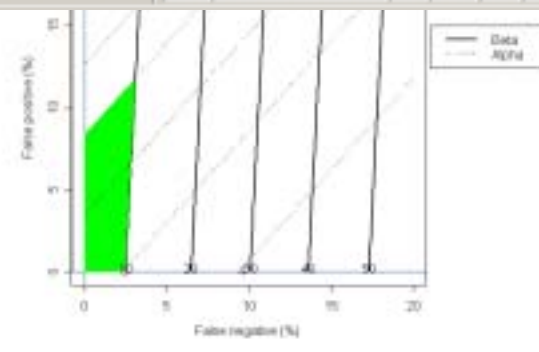
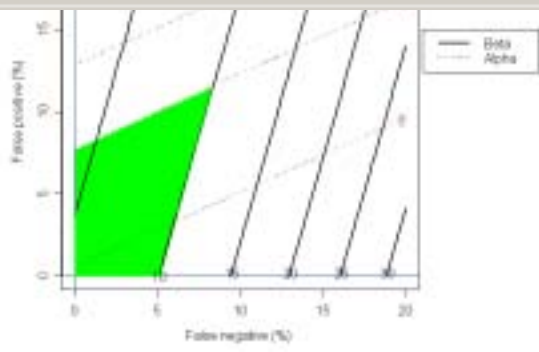
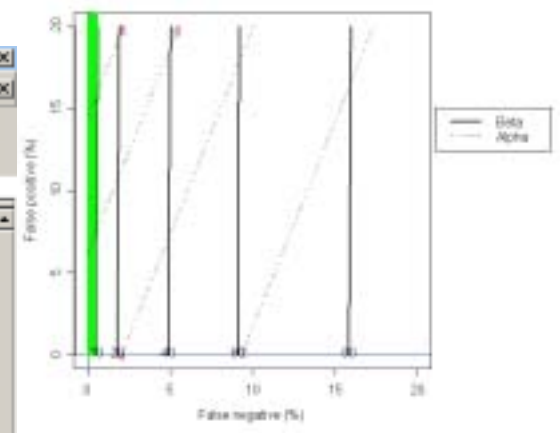
Please read the introduction and disclaimer information on the introduction sheet in this workbook before using this worksheet to design seed testing plans.
LQL = lower quality limit
AQL = acceptable quality level

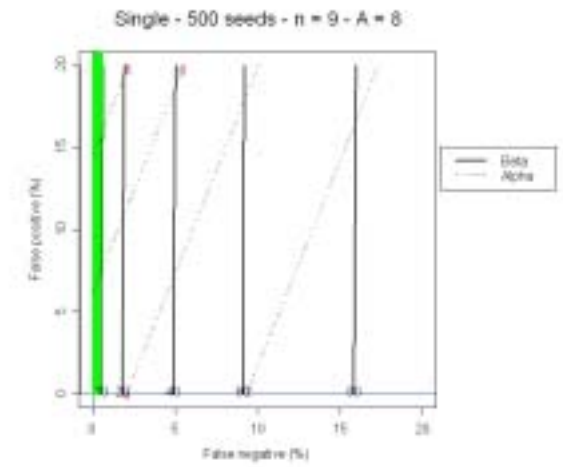
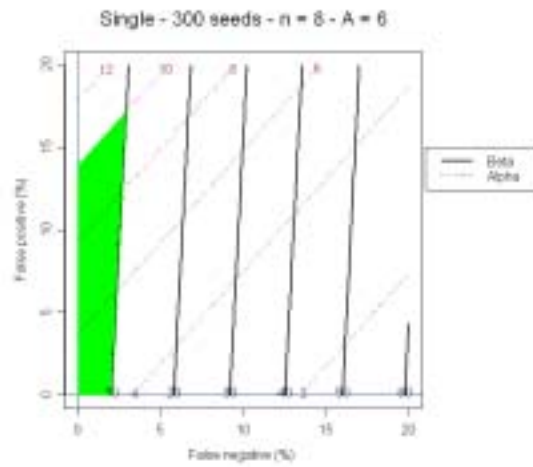
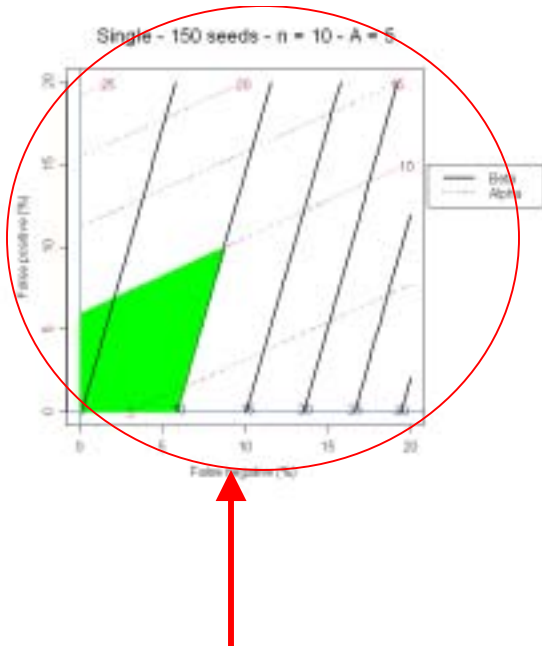
Probability of Accepting Lot (%)

Actual % Impurity in Lot

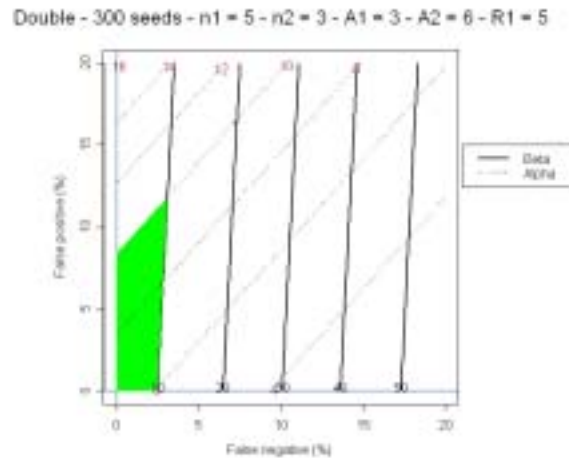
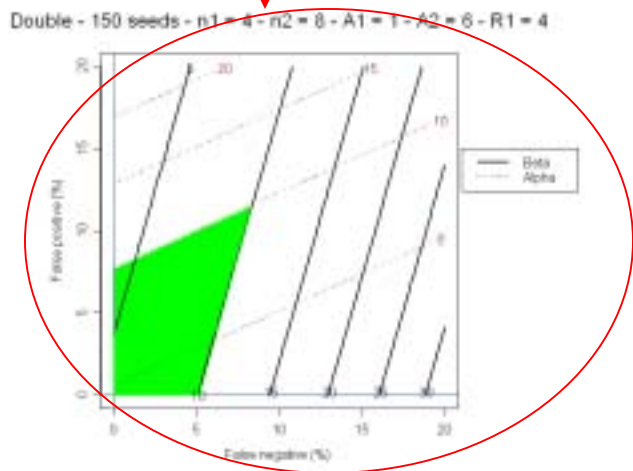
Legend: Retect (dashed line), Acceptance (solid red line)

Ready





Similar testing plans in terms of robustness to F_n and F_p rates



Question:

For these testing plans, can we define a limit for F_n and F_p rates that will guarantee α and β to be less than a certain level (e.g. 10%)?

Answer:

Limits on F_n and F_p rates guaranteeing α and β less than 10% are very different depending on the testing plan selected.

Some testing plans are not robust to F_n and F_p rates.