



Photos: Lieven Coudenys

# IPC ALPINE SKIING FACTOR SYSTEM REPORT

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# Background



- Factors are used to permit athletes with varying disabilities to compete against each other in fair and equitable competition.
- There is a single set of factors comparing all classes, whether they compete directly against each other or not.
- The original factors were derived from race performance data

# Factor Restoration



- We assume that experience will improve our ability to set correct factors.
- The present mathematical approach is called RHC – KREK system
  - *Realistic Handicap Competition - Kreative Renn Ergebnis Kontrolle.*
- The best times in each class in World Cup races are used in Factor Restoration

# Objectives of Factor Restoration



- Any athlete, whatever their disability, should have the opportunity to win.
- How will we know?
  - Close races
  - Different classes involved in top places

# Some Issues

- Are the factor adjustments fair?
- Do some classes get penalised?
- How do we deal with low participation classes?
- Are the races of men and women equal?
- Should we be using first place, or something else?
- Some seasons have more athletes than others – should we adjust the races?
- Should we consider race conditions?
- Should factors take account of equipment and classification changes?



# Factor Restoration Proposals

- RHC-KREK
- Manual adjustment
- Average of 6 seasons – Kevin Jardine
- Percy & Warner



# RHC-KREK



- A formula that has taken us in the right direction
- Complex
- Appears to treat high-participation classes differently from low participation classes

# Manual Adjustment



- Raises doubts and concerns – is the change fair?
- Needs to be well documented
- Will always be questioned
- May be unavoidable in some cases

## Average of 6 Years



- Even with six years, some classes are too small
- Does not change the mix of results when based on best performance in each class
- Complex to maintain and adjust
- Seems to treat high participation classes differently from low participation classes

# Percy & Warner

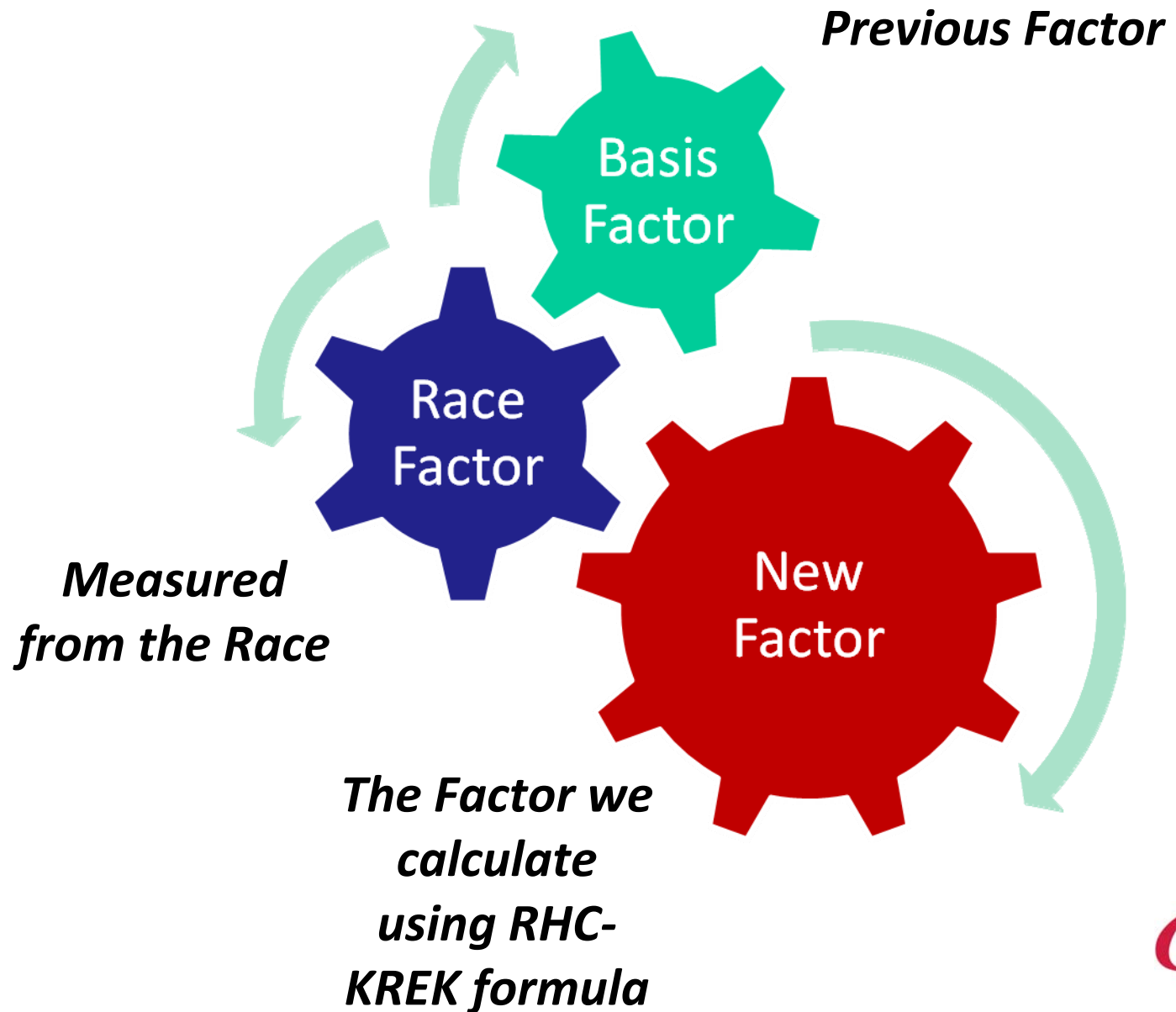


- Mathematical Research Paper analysing the IPCAS Factor System
- Describes the Factor system mathematically
- Makes observations about factors and classes
- Describes RHC-KREK mathematically and plots its operation
- Suggests some simplifications and changes
- Proposes a simpler formula
- Discusses class size issue and offers a solution

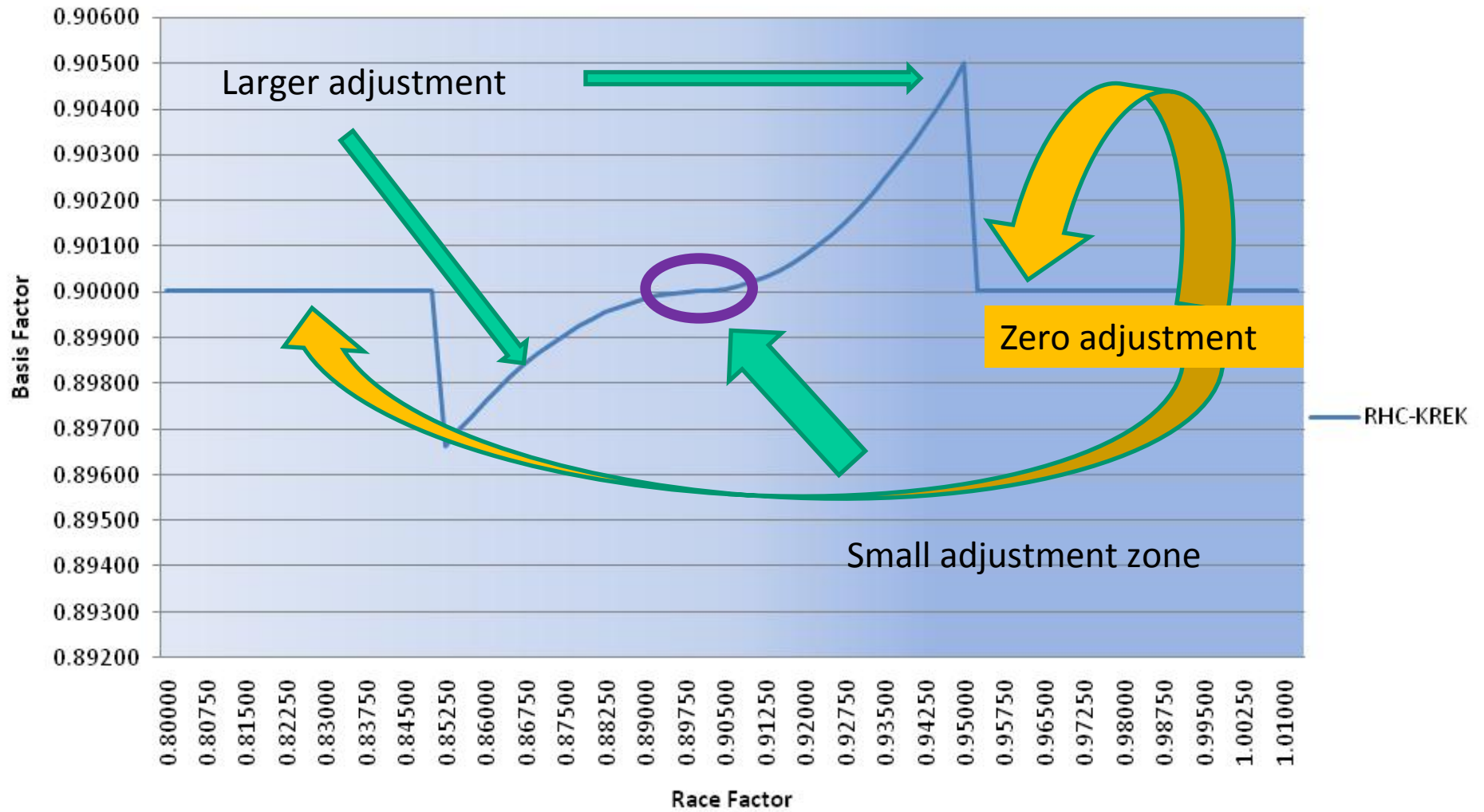
# How does RHC-KREK Work?



Photos: Lieven Coudenys



# Factor Restoration Model

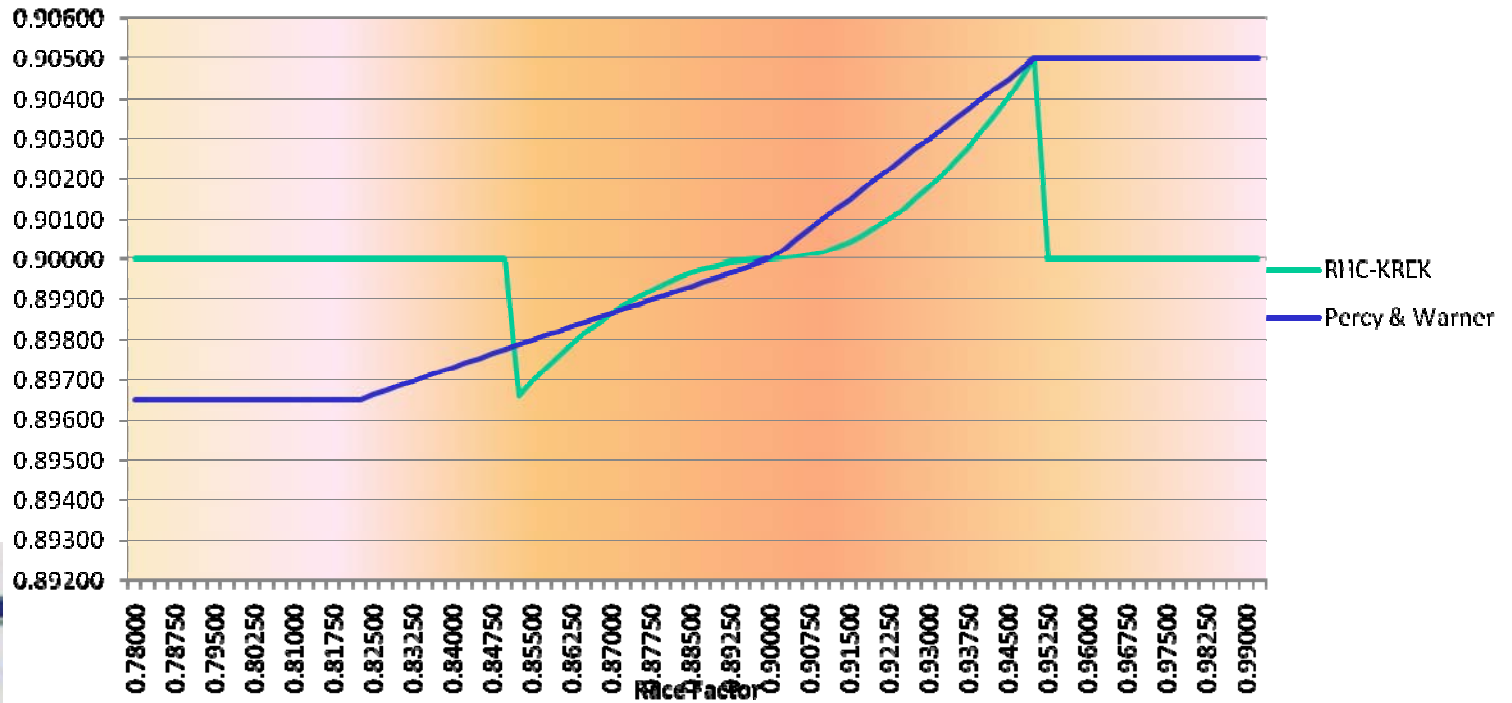




## Key Recommendations from Percy & Warner

- Reduce Factors to 5 decimal places (errors)
- Remove quadratic element from RHC-KREK
- Extend straight line (gradient zero) at the extremes instead of making no adjustment (remove discontinuities and cap the adjustment)
- Simplify the formula (single stage calculation)
- Base changes on median performance rather than best performance, with trimmed eligibility

# Comparison of the Two Models



Photos: Lieven Coudenys





## Participation and Results

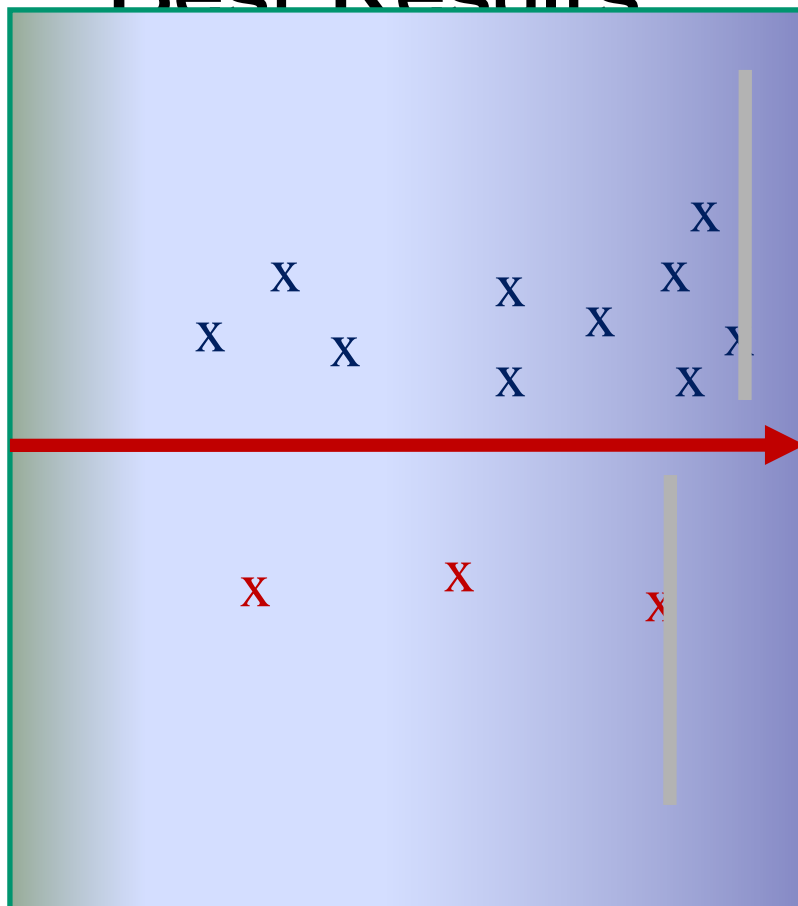
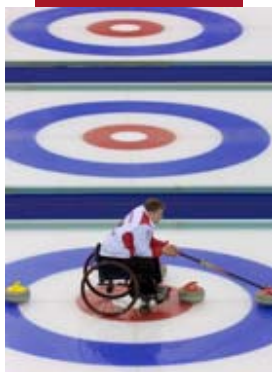
- Uneven participation in different classes leads to statistical problems
- Rate of convergence varies by Class and by Discipline
- The more races and more competitors, the more reliable the results

# Participation 2003-2008



Race Ratios	Giant Slalom			
	World Cup	Athletes		Winners (Runs)
B 1	16	3.1%	7	6.5%
B 2	250	48.3%	45	41.7%
B 3	252	48.6%	56	51.9%
LW 10-1	60	4.0%	0	
LW 10-2	192	12.8%	25	22.3%
LW 11	576	38.3%	21	18.8%
LW 12-1	430	28.6%	41	36.6%
LW 12-2	246	16.4%	25	22.3%
LW 1	32	1.6%	0	
LW 2	686	34.9%	15	13.4%
LW 3-1	44	2.2%	16	14.3%
LW 3-2	86	4.4%	2	1.8%
LW 4	302	15.3%	5	4.5%
LW 5/7-1	0		0	
LW 5/7-2	58	2.9%	21	18.8%
LW 5/7-3	8	0.4%	0	
LW 6/8-1	78	4.0%	1	0.9%
LW 6/8-2	438	22.3%	25	22.3%
LW 9-1	36	1.8%	0	
LW 9-2	200	10.2%	27	24.1%

# Class Participation – Effect on Best Results



- In high participation classes, there are several athletes who can get a good result
- In low participation classes, a fall or error can result in a very different race factor

# World Cup GS 2 - La Molina 2009



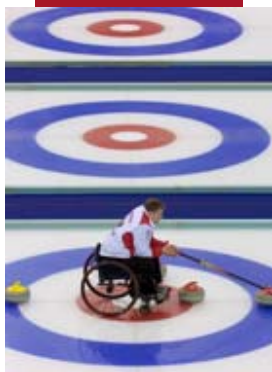
## Standing Skiers male

1	79	027-0064	GAUTHIER-MANUEL Vinc	LW 6/8-2	FRA	1:07.24	1:06.31	<b>2:13.55</b>	0,00
2	87	069-0073	BRUEGGER Michael	LW 4	SUI	1:07.37	1:06.38	<b>2:13.75</b>	0,20
3	86	030-0016	SCHOENFELDER Gerd	LW 5/7-2	GER	1:07.29	1:07.01	<b>2:14.30</b>	0,75
4	83	005-0027	RAHLS-RAHBULA Camero	LW 2	AUS	1:07.54	1:06.94	<b>2:14.48</b>	0,93
5	81	069-0104	PFYL Thomas	LW 9-2	SUI	1:07.32	1:07.18	<b>2:14.50</b>	0,95



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# Trimmed Medians

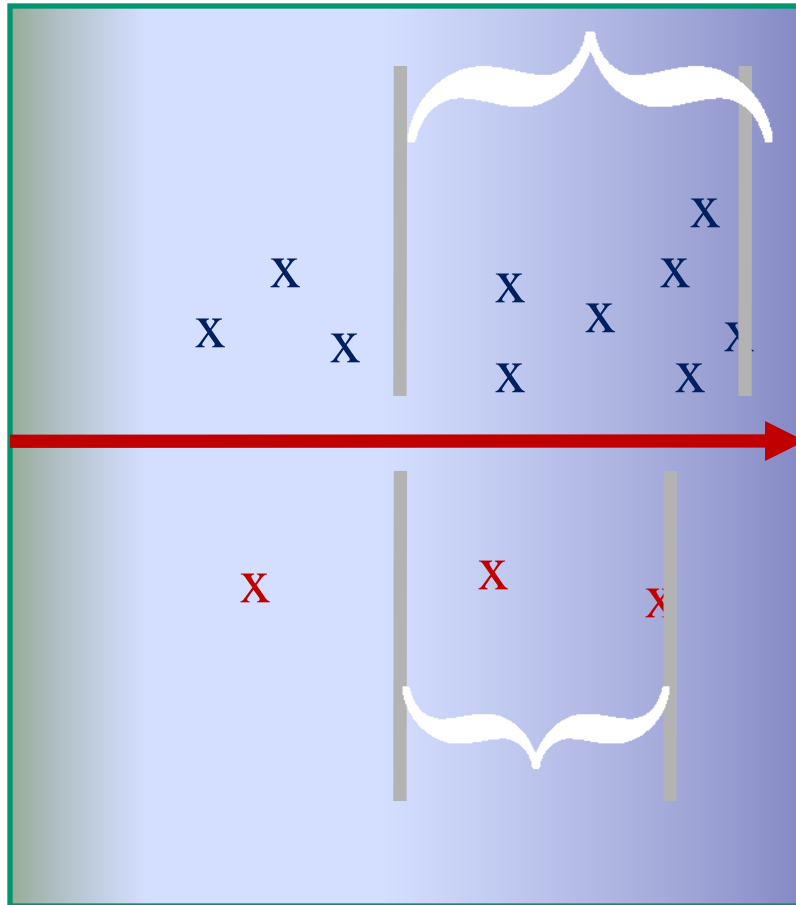


- Use Medians to arrive at a representative Race Factor
- Trim the medians, by setting eligibility criteria
  - use only the results for athletes within 10% of the winning race time (factored)
- Apply these medians using the Percy & Warner formula





# Trimmed Medians



- In high participation classes, the trimmed median will be fairly consistent
- In low participation classes, a fall or error will have a smaller impact

# Small Participation Classes



- Value of medians is less effective with very small numbers
- Proposal:
  - Consolidate results of small classes using fixed relationships between them to create a median performance
  - Apply median adjustment to all the small classes
  - Review the internal relationships based on WC, Europa Cup and Noram

# Male vs Female Results



- We are comparing disabilities, not genders
- Female categories often have fewer competitors
- Female classes are often small, even for high participation classes
- Proposal:
  - scale all female results by the ratio of best man vs. best woman
  - Consolidate male & female results into same trimmed median

# Issues we have addressed (I)



- Are the factor adjustments fair?
  - Races are getting closer, and more classes are represented in the top places. There is more to do.
- Do high participation classes get penalised?
  - Yes, but not all the time. Use of trimmed medians will help with this problem
- How do we deal with low participation classes?
  - By consolidating according to inter-class relationships. Not simple, but should provide more useful race factor information
- Are the races of men and women equal?
  - No. The Female races frequently have too few competitors and should be scaled and consolidated with the corresponding male race



## Issues we have addressed (II)

- Should we be using first place, or something else?
  - No. We will use trimmed medians
- Some seasons have more athletes than others – should we weight the seasons?
  - No. This is being addressed by balancing the program
- Should we consider race conditions?
  - No. Race conditions are the responsibility of the Jury. If they say the race goes ahead, we accept the result
- Should factors take account of equipment and classification changes?
  - No. Those are issues for other committees



## Matters for further Study



- Managing low participation classes and distributions of their results
- Median Trim – have we selected the best percentage?
- Measurement of Success
- Question of separate factors for men and women



# Contributers



- Many thanks for contributions from:

Ray Watkins

Michael Knaus

Sebastien Michel

Kevin Jardine

Manuel Hutten

Sylvana Mestre

Maike Hajura

Eric Angstadt

- The Percy & Warner model:

- Dr David Percy and Bruce Warner

- Additional advice from:

- Professor D Grayson and Dr L Clemson, University of Sydney Department of Health Sciences