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?

The Factor we calculate using RHC-KREK formula

Previous Factor

Basis Factor

Race Factor

New Factor

Measured from the Race
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
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

<table>
<thead>
<tr>
<th>Race Ratios</th>
<th>Giant Slalom</th>
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<tbody>
<tr>
<td>World Cup</td>
<td>Athletes</td>
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<tr>
<td></td>
<td>(Runs)</td>
</tr>
<tr>
<td>B 1</td>
<td>16</td>
</tr>
<tr>
<td>B 2</td>
<td>250</td>
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<tr>
<td>B 3</td>
<td>252</td>
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<tr>
<td>LW 10-1</td>
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<td>36</td>
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<tr>
<td>LW 9-2</td>
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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

<table>
<thead>
<tr>
<th>Place</th>
<th>Rank</th>
<th>ID</th>
<th>Name</th>
<th>LW</th>
<th>Country</th>
<th>Time 1</th>
<th>Time 2</th>
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<th>Diff</th>
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<td>79</td>
<td>027-0064</td>
<td>GAUTHIER-MANUEL Vinc</td>
<td>LW 6/8-2</td>
<td>FRA</td>
<td>1:07.24</td>
<td>1:06.31</td>
<td>2:13.55</td>
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<tr>
<td>2</td>
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<td>BRUEGGER Michael</td>
<td>LW 4</td>
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<td>RAHLS-RAHBULA Camero</td>
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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 Huten
  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