PPI Calculator - User Guide

Overview

A **Proportional Power Index (PPI) Calculator** for analyzing historical states across multiple domains including military power, territorial control, economic power, demographics, administrative capacity, technology & science, diplomatic influence, and internal stability. Features multi-state comparison, percentile ranking, outlier detection with 97.5th percentile capping, log-scaling for skewed distributions, data persistence, CSV export, and dual visualization (radar + bar charts).

What This Calculator Does

- ■ **Multi-State Analysis** - Add unlimited states, compare across eras
- ■ **Statistical Rigor** - Percentile capping, log-scaling for skewed data
- ■ **Data Persistence** - Save/load entire datasets in JSON format
- ■ **Dual Visualization** - Radar chart + bar chart side-by-side
- ■ **CSV Export** - Publication-ready data tables
- ■■ **Validation System** - Comprehensive input validation with error messages
- ■ **Percentile Ranking** - See how each state ranks among contemporaries
- ■ **Academic Citations** - References to COW, Maddison, HYDE databases

Requirements

System Requirements

- **Windows:** Windows 10 or higher
- **macOS:** macOS 10.14 or higher
- **Linux:** Ubuntu 20.04 or equivalent

Running the Application

Simply double-click the `PPI-calc.exe` file (Windows) or run the executable appropriate for your operating system. No installation or dependencies required - everything is bundled in the executable.

Quick Start

Workflow Overview

Add States - Enter data for multiple historical states

Compute PPI - System normalizes within era-year groups

View Results - Table shows all states with domain scores

Select & Visualize - Click states to see charts

Export - Save results as CSV or JSON for further analysis

Basic Usage Example

Adding Your First State: Roman Empire (117 AD)

Enter Metadata:

```
State Name: Roman Empire Peak Year: 117 Era: AD Length of Reign: 19
```

Scroll through tabs and enter indicators:

Military Power Tab:

```
Manpower: 450000 Battlefield Success: 2.5 (wins per loss) Navy Strength: 50000
(tonnage) Military Tech: 70 Logistics: 65 Force Range: 4500
```

Territorial Control Tab:

```
Territory Size: 5000000 Pop. Coverage: 21 (%) Border Contiguity: 85 Provinces: 120
```

Economic Power Tab:

```
GDP/Production: 43000000 GDP Share: 26 Trade Volume: 8000000 Industrial Capacity:
200000 Natural Resources: 75 Currency/Finance: 65
```

Demographics Tab:

```
Total Population: 65000000 Population Density: 13 Growth Rate: 0.07 Urbanization: 25
```

Administrative Capacity Tab:

```
Tax Revenue/GDP: 5 Bureaucracy Size: 0.8 Internal Security: 70 Infrastructure
Network: 85000 Legal/Institutional Reach: 75
```

Technology & Science Tab:

```
Innovation Output: 55 Technical Workforce: 1.2 Engineering Projects: 30 Knowledge
Centers: 45 Literacy Rate: 15
```

Diplomatic Influence Tab:

```
Diplomatic Reach: 65 Alliances: 12 Treaties: 28 Cultural Influence: 85 Tributary
States: 20
```

Internal Stability Tab:

```
Civil Unrest Frequency: 1.5 (events/decade) Succession Stability: 70 Ethnic
Cohesion: 60 Elite Consensus: 65 Regime Continuity: 80
```

Click "Add State" - Confirmation message appears

Repeat for other states (e.g., Persian Empire 500 BC, British Empire 1900 AD)

Click "Compute PPI" - All states normalized and ranked

Select states in table - Click on rows

Click "Update Charts from Selection" - See visualizations

Advanced Workflow: Comparative Study

Research Question: How did empires at their peak compare?

Add multiple peak states:
• Persian Empire (500 BC)
• Roman Empire (117 AD)
• Tang Dynasty (750 AD)
• Mongol Empire (1279 AD)
• Ottoman Empire (1683 AD)
• British Empire (1920 AD)

Compute PPI - System handles era normalization automatically

Sort by columns - Click column headers to sort by:
• Total PPI
• Specific domains (Military, Economy, etc.)
• Percentile ranking

Select subset - Compare 2-3 similar states

Export results - Save as CSV for spreadsheets or JSON for data preservation

Domain Structure

1. Military Power (Weight: 0.25)

Sub-indicators:

• Manpower (25%)
• Battlefield Success (20%)

- Navy Strength (15%)
- Military Technology (20%)
- Logistics & Projection (10%)
- Force Range (10%)

2. Territorial Control (Weight: 0.15)

Sub-indicators:

- Territory Size (50%)
- Population Coverage (30%)
- Border Contiguity (10%)
- Number of Provinces (10%)

3. Economic Power (Weight: 0.20)

Sub-indicators:

- GDP/Production (40%)
- GDP Share (20%)
- Trade Volume (15%)
- Industrial Capacity (10%)
- Natural Resources (10%)
- Currency/Finance (5%)

4. Demographics (Weight: 0.10)

Sub-indicators:

- Total Population (50%)
- Population Density (15%)
- Growth Rate (15%)
- Urbanization (20%)

5. Administrative Capacity (Weight: 0.10)

Sub-indicators:

- Tax Revenue/GDP (25%)
- Bureaucracy Size (25%)
- Internal Security (20%)
- Infrastructure Network (15%)
- Legal/Institutional Reach (15%)

6. Technology & Science (Weight: 0.10)

Sub-indicators:

- Innovation Output (25%)
- Technical Workforce (20%)
- Engineering Projects (20%)
- Knowledge Centers (20%)
- Literacy Rate (15%)

7. Diplomatic Influence (Weight: 0.05)

Sub-indicators:

- Diplomatic Reach (25%)
- Number of Alliances (20%)
- Treaties/Agreements (15%)
- Cultural Influence (25%)
- Tributary States (15%)

8. Internal Stability (Weight: 0.05)

Sub-indicators:

- Civil Unrest Frequency (30%) - *Inverted: lower is better*
- Succession Stability (25%)
- Ethnic Cohesion (15%)
- Elite Consensus (15%)
- Regime Continuity (15%)

Understanding the Results

PPI Score

The total PPI (Proportional Power Index) is a weighted sum of domain scores, normalized to a 0-100 scale. Higher scores indicate greater overall power.

Percentile Ranking

Shows how a state ranks among its contemporaries (same era-year). A percentile of 90 means the state scored higher than 90% of comparable states.

Domain Scores

Individual domain scores show strengths and weaknesses. The radar chart visualizes the multidimensional profile of each state.

Era-Relative Normalization

States are normalized against the maximum values within their era-year group, not globally. This allows fair comparison across different historical periods.

File Operations

Save States (JSON)

- **Menu:** File → Save States
- **Purpose:** Preserves raw indicator data
- **Use:** Continue work later, share datasets
- **Format:** JSON with all entered data

Load States (JSON)

- **Menu:** File → Load States
- **Purpose:** Restore previously saved work
- **Note:** Overwrites current states

Export Results (CSV)

- **Menu:** File → Export to CSV
- **Purpose:** Share computed results
- **Includes:** Domain scores, total PPI, percentile rankings
- **Use:** Import into Excel, statistical software, or publications

Advanced Features

Log Scaling

Enable log scaling for indicators with power-law distributions (GDP, population, military size). This prevents very large states from distorting normalization.

Toggle: View → Enable Log Scaling

When to use:

- Population follows Zipf's law
- GDP has Pareto distribution
- Military size has exponential growth

Percentile Capping (97.5th)

Automatically caps outliers at the 97.5th percentile to prevent one extreme state from distorting all others.

Example:

- Most states: 50K-500K troops
- Outlier: 2M troops
- Without capping: Medium states score very low
- With capping: Medium states score fairly

Sensitivity Analysis

Menu: Analysis → Sensitivity Analysis

Shows how PPI changes when domain weights are adjusted by ±10%. Useful for understanding which domains most influence the selected state's ranking.

Contemporary Normalization

States are grouped by era-year (e.g., "AD_117") and normalized against the maximum values within that group. This ensures:

- Fair comparison across historical periods
- Each state ranks among its actual peers
- No anachronistic comparisons

Use Cases

1. Academic Research

```
Project: "Comparative Imperial Power, 500 BC - 1900 AD" Workflow: 1. Research 20
major empires at their peak 2. Enter historical data from primary sources 3. Compute
PPI for each state 4. Export results to CSV 5. Create visualizations for publication
6. Cite: COW, Maddison, HYDE databases
```

2. Historical Simulation Calibration

```
Game: Grand Strategy Game Development Use: 1. Enter historical state data 2. Compute
PPI scores 3. Use scores to balance game mechanics 4. Ensure Roman Empire ≈ Han
```

```
Dynasty at peaks 5. Validate game balance against historical PPI
```

3. Timeline Analysis

```
Research: "Rise and Fall of the British Empire" Method: 1. Add Britain at multiple
time points (1600-1950) 2. Track PPI over time 3. Identify inflection points 4.
Correlate with historical events 5. Export time-series data for further analysis
```

4. Teaching / Educational

```
Course: "Comparative Empires" Assignment: 1. Students research 2-3 empires 2. Enter
data into calculator 3. Compare results with classmates 4. Discuss: Why did X empire
score higher in Y domain? 5. Write analysis paper using exported data
```

Data Sources

Recommended Academic Sources

This calculator is designed to work with data from established historical databases:

Correlates of War (COW) - National Material Capabilities dataset

• Military personnel and expenditure data

• Source: Singer, J. David. 1987. "Reconstructing the Correlates of War Dataset"

Maddison Project - Historical GDP estimates

• GDP and economic data across centuries

• Source: Bolt, Jutta, and Jan Luiten van Zanden. 2020. "Maddison style estimates of the evolution of the world economy"

HYDE Database - Historical population and land use

• Population, urbanization, land use data

• Source: Klein Goldewijk, K., et al. 2017. "Anthropogenic land use estimates for the Holocene – HYDE 3.2"

Data Entry Best Practices

• **Zero values:** Enter 0 for truly unknown or non-existent indicators

• **Consistency:** Use consistent units across all states

• **Era notation:** Use "BC" for Before Common Era, "AD" for Anno Domini

• **Estimates:** When exact data unavailable, use scholarly estimates

• **Documentation:** Keep notes on data sources for each indicator

Troubleshooting

Issue: Application won't start

Solution: Ensure your operating system meets minimum requirements. On Windows, you may need to allow the executable through Windows Defender.

Issue: States not appearing in table after "Add State"

Cause: Must click "Compute PPI" to calculate scores

Solution: Add all states, then click "Compute PPI" once

Issue: Charts don't update

Cause: No states selected in table

Solution: Click on rows in table to select, then click "Update Charts from Selection"

Issue: Percentile ranking seems incorrect

Cause: Too few states in era-year group

Solution: Add more contemporary states for accurate percentile calculation

Issue: CSV export encoding problems

Cause: Non-ASCII characters in state names

Solution: The application uses UTF-8 encoding. Ensure your spreadsheet software is set to read UTF-8.

Issue: Log scaling makes all scores similar

Cause: Maxima are small, log compression is strong

Solution: Toggle log scaling off (View → Enable Log Scaling)

Performance Notes

- **Small datasets (<50 states):** Instant calculation
- **Medium datasets (50-500 states):** Sub-second computation
- **Large datasets (500+ states):** 1-3 seconds to compute
- **Chart rendering:** May take 1-2 seconds for complex comparisons

Known Limitations

No Uncertainty Quantification: Provides point estimates only, no confidence intervals

No Temporal Interpolation: Discrete time points, no smoothing between years

2D Visualizations Only: Radar and bar charts; no 3D or interactive plots

Manual Data Entry: No automatic database connections

Missing Data: Empty fields treated as zero (may affect accuracy)

Tips for Best Results

Data Quality

- Aim for at least 70% indicator completion per domain
- Use consistent sources across states
- Document your methodology
- Cross-reference multiple academic sources

Comparative Analysis

- Add at least 3-5 states per era for meaningful comparisons
- Include both major and minor powers for perspective
- Consider adding the same state at multiple time points

Visualization

- Select 2-4 states for clearest radar chart comparison
- Use bar chart to view all states simultaneously
- Sort by different domains to identify strengths/weaknesses

Data Management

- Save work frequently (File → Save States)
- Keep backup copies of JSON files
- Export to CSV before major changes
- Use descriptive filenames (e.g., "roman_analysis_2024.json")

Academic Context

Methodology Note

This calculator implements a **Proportional Power Index** methodology that:

- • Weights multiple dimensions of state power
- • Normalizes indicators within contemporary peer groups
- • Handles missing data and outliers statistically
- • Provides reproducible, quantitative comparisons

Research Applications

Suitable for:

- • Comparative historical analysis
- • International relations research
- • Historical sociology
- • Game theory and simulation
- • Educational demonstrations
- • Hypothesis testing about power transitions

Citation Guidelines

When using this calculator in academic work:

Cite your primary data sources (COW, Maddison, HYDE, etc.)

Document your indicator selection and weights

Note any modifications to the default methodology

Include sample calculations in appendices

Share your dataset (JSON file) for reproducibility

Important Disclaimer

This calculator is a research tool, not a definitive ranking system.

Historical power is:

- • **Complex** - No single metric captures all dimensions
- • **Contextual** - Power is relative to time and circumstances
- • **Contested** - Historians debate sources and interpretations
- • **Multifaceted** - Different domains matter in different contexts

Use PPI scores as:

- • Starting points for analysis
- • Hypothesis generators
- • Comparative frameworks

- Educational illustrations

Do not use as:

- Absolute historical truth
- Definitive rankings
- Sole basis for conclusions
- Replacement for qualitative analysis

Support

For issues or questions:

Review this user guide thoroughly

Check that all required indicators are entered

Verify data format and units

Consult academic literature on PPI methodology

Ensure you're using the latest version

Version Information

- **Application:** PPI Calculator
- **File:** PPI-calc.exe
- **Platform:** Cross-platform (Windows/Mac/Linux builds available)
- **Data Format:** JSON (save/load), CSV (export)
- **License:** Educational/Research Use

Remember: Use this tool responsibly. Historical analysis requires careful scholarship, multiple sources, and acknowledgment of uncertainty. The PPI Calculator facilitates quantitative comparison but cannot replace deep historical knowledge and critical thinking.