

# **Proportional Power Index (PPI)**

*Comprehensive Data Entry Guide*

*What Data to Enter and How to Enter It*

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# 1. Introduction

This guide provides detailed instructions on what data the Proportional Power Index (PPI) Calculator expects and how to properly enter it. The PPI is a multi-domain quantitative framework for comparing historical state power across different eras and civilizations.

## 1.1 What is the Proportional Power Index?

The PPI is a weighted composite index that measures state power across eight fundamental domains:

- **Military Power** (25%) - Capacity to project force and achieve military objectives
- **Territorial Control** (15%) - Geographic extent and administrative reach
- **Economic Power** (20%) - Productive capacity, trade dominance, and resource control
- **Demographics** (10%) - Population size, density, growth, and urbanization
- **Administrative Capacity** (10%) - State penetration, bureaucratic efficiency, infrastructure
- **Technology & Science** (10%) - Innovation capacity, technical workforce, knowledge infrastructure
- **Diplomatic Influence** (5%) - Alliance networks, hegemon status, soft power
- **Internal Stability** (5%) - Civil order, regime durability, social cohesion

Each domain consists of multiple sub-indicators that capture different aspects of state capability. The calculator normalizes these indicators within contemporary peer groups (same era-year) to enable fair historical comparisons.

## 2. Understanding the PPI Formula Structure

### 2.1 Overall PPI Formula

The PPI is calculated as a weighted sum of normalized domain scores:

$$\text{PPI} = \sum (\text{Domain\_Weight} \times \text{Domain\_Score})$$

Where:

- **Domain\_Weight:** Pre-defined weight for each domain (sum = 1.0)
- **Domain\_Score:** Normalized score (0-1) for that domain
- **Final PPI:** Scaled to 0-100 range

### 2.2 Domain Score Calculation

Each domain score is calculated from its sub-indicators:

$$\begin{aligned}\text{Domain\_Score} &= \sum (\text{Sub\_Weight} \times \text{Normalized\_Indicator}) \\ \text{Normalized\_Indicator} &= \text{Raw\_Value} / \text{Contemporary\_Maximum}\end{aligned}$$

**Contemporary\_Maximum:** The highest value among states in the same era-year. This ensures states are compared against their actual historical peers, not against modern values.

### 2.3 Outlier Capping (97.5th Percentile)

To prevent extreme outliers from distorting the scale:

```
If Raw_Value > 97.5th_Percentile:  
  Normalized = min(1.0, Raw_Value / 97.5th_Percentile)  
Else:  
  Normalized = Raw_Value / Contemporary_Maximum
```

**Example:** If most states have 50,000-500,000 troops, but one outlier has 2,000,000, the 97.5th percentile might be 550,000. States above this threshold are still scored highly (potentially >1.0 if truly exceptional) but don't compress all other states to near-zero.

### 2.4 Log Scaling (Optional)

For indicators with power-law distributions (GDP, population, military size), logarithmic scaling prevents small states from appearing insignificant:

$$\text{Normalized} = \log(\text{Raw\_Value}) / \log(\text{Contemporary\_Maximum})$$

Enable via: **View** → **Enable Log Scaling**

**When to use log scaling:**

- GDP follows Pareto distribution
- Population follows Zipf's law
- Military size shows exponential growth
- Industrial output concentrates in few states

### 3. Domain 1: Military Power (Weight: 0.25)

Military Power represents a state's capacity to project force, defend territory, and achieve military objectives. This is the most heavily weighted domain due to its historical importance in state survival and expansion.

#### 3.1 Manpower (Sub-weight: 25%)

##### What it measures:

Total military personnel including standing army, trained reserves, and mobilizable forces.

**Unit:** Soldiers (absolute number)

##### How to enter:

<b>Entry Field:</b>	Manpower
<b>Unit:</b>	soldiers
<b>Example (Roman Empire, 117 AD):</b>	450,000
<b>Example (Mongol Empire, 1279 AD):</b>	1,100,000
<b>Example (British Empire, 1900 AD):</b>	500,000
<b>Example (USA, 1945 AD):</b>	12,000,000

##### Data sources:

- **Correlates of War (COW)** National Material Capabilities dataset
- Historical military records and chronicles
- Archaeological evidence of fortifications and garrison sizes
- Academic military history databases

##### What to include:

- Active duty military personnel
- Trained reserves that can be mobilized
- Standing army units
- Professional soldiers and levies

##### What to exclude:

- Untrained militia unless formally organized
- Civilian support personnel
- Police or internal security forces
- General male population (don't confuse with total population)

**Common pitfall:** Don't confuse total male population with military manpower. Only count those actually serving or in trained reserves.

##### For pre-modern states:

Estimate based on:

- Garrison records from fortifications
- Campaign army sizes from chronicles

- Scholarly consensus estimates
- Archaeological evidence of military infrastructure

## 3.2 Battlefield Success (Sub-weight: 20%)

### What it measures:

Win/loss ratio in military engagements during the state's peak period.

**Unit:** Ratio (wins per loss)

### Calculation method:

$$\text{Battlefield\_Success} = (\text{Major\_Victories} + 0.5 \times \text{Draws}) / (\text{Major\_Defeats} + 0.5 \times \text{Draws})$$

### How to enter:

Entry Field:	Battlefield Success
Unit:	ratio
Roman Empire (117 AD):	2.5 (example: 5 victories : 2 defeats)
Mongol Empire (1260 AD):	8.0 (example: 24 victories : 3 defeats)
France (1805 AD):	4.5 (Napoleonic era dominance)
Germany (1941 AD):	3.2 (early WWII successes)

### Time window:

Use a 20-year period centered on the peak year, or the duration of the specific reign/regime being analyzed.

### What counts as 'major':

- Battles involving >10% of total military force
- Engagements that altered territorial control
- Conflicts mentioned in primary historical sources
- Sieges that lasted more than one month
- Naval battles involving main fleet elements

### What to exclude:

- Minor skirmishes and border raids
- Police actions against bandits
- Suppression of small local rebellions
- Engagements with <1,000 combatants total

**Data sources:** COW Interstate War Data, military histories, battle databases, historical chronicles, academic studies of specific conflicts.

### 3.3 Navy Strength (Sub-weight: 15%)

**What it measures:** Total naval capacity measured in tonnage or equivalent fleet size.

**Unit:** Tonnage (metric tons displacement)

State (Year)	Tonnage	Notes
Athenian Empire (450 BC)	50,000	~200 triremes × 250 tons each
Roman Empire (117 AD)	50,000	Mediterranean fleet
British Empire (1900 AD)	2,714,000	Largest navy in history
USA (1945 AD)	11,000,000	Post-WWII peak

**For pre-modern navies, use equivalent tonnage estimates:**

Ship Type	Approximate Displacement
Trireme (Ancient Greek)	~250 tons
Bireme	~150 tons
Medieval Galley	~200 tons
Caravel (15th century)	50-80 tons
Carrack (16th century)	200-500 tons
Ship of the Line (18th century)	~2,000 tons

**Land-locked states:** Enter 0 (zero) for navy strength.



### 3.4 Military Technology (Sub-weight: 20%)

**What it measures:** Adoption and mastery of advanced weapons systems relative to contemporary standards.

**Unit:** Score (0-100)

Era	Score 90-100	Score 70-89	Score 50-69
Ancient (500 BC-500 AD)	Combined arms, professional army, advanced metallurgy	Iron weapons, siege equipment, cavalry	Bronze weapons, chariots, organized infantry
Medieval (500-1500 AD)	Gunpowder weapons, plate armor, professional cavalry	Crossbows, longbows, heavy cavalry, castles	Mail armor, feudal levies, basic fortifications
Early Modern (1500-1800)	Rifled weapons, standing army, naval dominance	Muskets, artillery, military academies	Pike and shot, mercenary forces
Modern (1800-present)	Nuclear capability, precision weapons, combined arms	Industrial military, railways, telegraph	Napoleonic-era organization

**Example entries:**

- Roman Empire (117 AD): 70 (Advanced siege engines, professional training, standardized equipment)
- Mongol Empire (1241 AD): 80 (Composite bow mastery, mobile artillery, advanced logistics)
- British Empire (1850 AD): 75 (Rifled muskets, steam warships, telegraph)
- USA (1945 AD): 95 (Nuclear weapons, radar, aircraft carriers)

### 3.5 Logistics & Projection (Sub-weight: 10%)

**What it measures:** Capacity to supply armies at distance and project power overseas.

**Unit:** Score (0-100)

**Benchmarks:**

- 90-100: Global power projection within days
- 70-89: Regional power projection within weeks
- 50-69: Limited overseas capability, strong overland
- 30-49: Basic supply lines, slow deployment
- 0-29: Ad hoc logistics, local operations only

### 3.6 Force Range (Sub-weight: 10%)

**What it measures:** Maximum effective deployment distance from capital/core territory.

**Unit:** Kilometers

**Examples:**

- Assyrian Empire (650 BC): 2,000 km
- Roman Empire (117 AD): 4,500 km
- Mongol Empire (1241 AD): 8,000 km
- British Empire (1900 AD): 18,000 km (global)
- USA (1991 AD): 12,000 km (Iraq operations from USA)

**Measurement:** Use the furthest sustained military operation successfully conducted during the peak period. Include sea routes for naval powers. Use great circle distance.

## 4. Domain 2: Territorial Control (Weight: 0.15)

### 4.1 Territory Size (Sub-weight: 50%)

**What it measures:** Total land area under effective state control.

**Unit:** Square kilometers (km<sup>2</sup>)

**Examples:**

- Athenian Empire (450 BC): 300,000 km<sup>2</sup>
- Roman Empire (117 AD): 5,000,000 km<sup>2</sup>
- Mongol Empire (1279 AD): 24,000,000 km<sup>2</sup>
- British Empire (1920 AD): 35,500,000 km<sup>2</sup>
- Russian Empire (1895 AD): 22,400,000 km<sup>2</sup>

**What to include:**

- Directly administered provinces
- Client states under effective control
- Protectorates with military garrisons
- Colonial possessions

**What to exclude:**

- Nominal tributary states with autonomy
- Temporary conquests not consolidated
- Contested borderlands
- Sphere of influence without direct control

**Data sources:** Historical atlases (Times Atlas, Penguin Historical Atlas), Digital historical GIS databases (HGIS, CShapes), COW Territorial Change dataset (1816+), academic territorial extent studies.

## 5. Domain 3: Economic Power (Weight: 0.20)

### 5.1 GDP/Production (Sub-weight: 40%)

**What it measures:** Total economic output in constant international dollars.

**Unit:** Currency (constant 1990 international dollars recommended)

**PRIMARY DATA SOURCE: Maddison Project Database**

The Maddison Project (<https://www.rug.nl/ggdc/historicaldevelopment/maddison/>) provides comprehensive historical GDP estimates in 1990 international dollars from 1 AD onward, allowing consistent cross-temporal comparison.

State (Year)	GDP (1990 Int'l \$)	Notes
Roman Empire (117 AD)	43,000,000,000	Peak of territorial extent
Song Dynasty (1000 AD)	26,000,000,000	Advanced economy
Mughal Empire (1600 AD)	80,000,000,000	Richest empire of era
British Empire (1900 AD)	224,000,000,000	Industrial peak
USA (2000 AD)	9,800,000,000,000	Modern superpower

**For pre-1 AD or missing data, use proxy estimates:**

$$\text{GDP} \approx \text{Population} \times \text{Per\_Capita\_GDP}$$

**Per capita GDP by era:**

- Hunter-gatherer (pre-5000 BC): ~\$500
- Agricultural society (3000 BC - 1000 AD): \$600-\$800
- Medieval Europe (1000-1500): \$700-\$1,200
- Early modern (1500-1800): \$1,000-\$2,500
- Industrial (1800-1900): \$1,500-\$5,000
- Modern (1900-2000): \$3,000-\$30,000

## 6. Domain 4: Demographics (Weight: 0.10)

### 6.1 Total Population (Sub-weight: 50%)

**What it measures:** Total population under state control.

**Unit:** People (absolute number)

**PRIMARY DATA SOURCE: HYDE Database**

The HYDE (History Database of the Global Environment) provides gridded population data from 10,000 BC to present with 5 arc-minute resolution (~10 km). Cross-referenced with national censuses and updated regularly.

State (Year)	Population	World %
Athenian Empire (450 BC)	2,500,000	~2.5%
Roman Empire (117 AD)	65,000,000	~21%
Han Dynasty (100 AD)	60,000,000	~26%
Mongol Empire (1279 AD)	110,000,000	~25%
British Empire (1900 AD)	450,000,000	~27%
China (2000 AD)	1,262,000,000	~21%

## 11. Data Sources Reference

Domain	Primary Source	Coverage	URL/Access
GDP/Economy	Maddison Project	1 AD - present	<a href="http://rug.nl/ggdc/maddison">rug.nl/ggdc/maddison</a>
Population	HYDE Database	10,000 BC - present	<a href="http://pbl.nl/en/hyde">pbl.nl/en/hyde</a>
Military Personnel	COW NMC v6.0	1816 - 2016	<a href="http://correlatesofwar.org">correlatesofwar.org</a>
Wars & Battles	COW War Data	1816 - 2007	<a href="http://correlatesofwar.org">correlatesofwar.org</a>
Territory	COW Territorial Change	1816 - 2018	<a href="http://correlatesofwar.org">correlatesofwar.org</a>
Alliances	COW Formal Alliances	1816 - 2012	<a href="http://correlatesofwar.org">correlatesofwar.org</a>
Trade	Historical Statistics	Varies	Academic databases
Technology	Historical Records	Varies	Scholarly consensus

### Key Database Descriptions:

#### 1. Maddison Project Database

Provides historical GDP estimates in constant 1990 international dollars, enabling cross-temporal economic comparisons. Updated regularly with latest scholarship. Covers most major states from 1 AD onward.

#### 2. HYDE (History Database of the Global Environment)

Gridded population and land-use database covering 12,000 years. Provides population density, urban/rural splits, and agricultural land data at high spatial resolution.

#### 3. Correlates of War (COW) Project

Comprehensive suite of datasets on state capabilities, wars, alliances, and territorial changes from 1816 onward. Industry standard for quantitative international relations research.

## 12. Quick Reference Tables

### 12.1 Domain Weights Summary

Domain	Weight	Rationale
Military Power	25%	Historically decisive in state survival
Territorial Control	15%	Geographic extent and reach
Economic Power	20%	Productive capacity foundation
Demographics	10%	Population as power base
Administrative Capacity	10%	State effectiveness
Technology & Science	10%	Innovation and advancement
Diplomatic Influence	5%	Soft power and alliances
Internal Stability	5%	Regime durability
<b>TOTAL</b>	<b>100%</b>	

### 12.2 Data Entry Checklist

- Verify you're entering data for the correct peak year
- Use consistent units across all states being compared
- Enter 0 (zero) for truly unavailable or non-existent indicators
- Document your data sources for each indicator
- Cross-reference multiple academic sources when possible
- Use Maddison Project for GDP data (1990 international dollars)
- Use HYDE Database for population data
- Use COW datasets for military, territorial, diplomatic data (1816+)
- For pre-1816 data, use historical atlases and scholarly consensus
- Enable log scaling for power-law distributed indicators (GDP, population)
- After entering all states, click 'Compute PPI' to calculate scores
- Review results for obvious errors or inconsistencies
- Save your work frequently (File → Save States)

# Important Reminders

## 1. Era-Relative Normalization

The calculator normalizes all indicators against contemporary maximums (same era-year). This means a state's PPI score reflects its dominance relative to its actual historical peers, not against modern states. A Roman Empire score of 85 means it dominated 85% as much as the maximum possible in 117 AD, not that it would score 85% against modern USA.

## 2. Missing Data

Historical data is inherently incomplete. Enter 0 for truly unknown values, but note that if more than 50% of indicators in a domain are missing, the domain score becomes unreliable. The calculator will warn you about excessive missing data.

## 3. Data Quality Varies by Era

- Ancient (pre-500 AD): Sparse, rely on archaeological and textual evidence
- Medieval (500-1500 AD): Improving, some administrative records
- Early Modern (1500-1800): Better documentation, proto-statistics
- Modern (1800+): Comprehensive, COW datasets available from 1816

## 4. Scholarly Consensus

When exact data is unavailable, use estimates from peer-reviewed academic sources. Document which scholars' estimates you're using. Cross-reference multiple authorities when possible. For controversial figures (e.g., population of ancient Rome), note the range of scholarly opinion.

## 5. The PPI is a Research Tool, Not Absolute Truth

Historical power is complex, multidimensional, and contested. Use PPI scores as:

- Starting points for analysis
- Comparative frameworks
- Hypothesis generators
- Educational illustrations

Do NOT use as sole basis for definitive historical conclusions. Always supplement quantitative analysis with qualitative historical scholarship.

## Contact & Support

For questions about data entry or methodology, consult:

1. This guide
2. The academic sources cited
3. The PPI methodology research paper
4. Relevant historical literature for your period of study

*This guide is designed to accompany the PPI Calculator software. Version 1.0 - February 2026*