The Battles of Imphal and Kohima

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Lyman 2010, illust. Peter Dennis

Battles of Imphal & Kohima, India
1942 – Second World War
Japan vs Britain(Allies)

During the Second World War, in 1942, Japan invaded many European colonies in East Asia. Japan had a string of successes and captured Burma and went on to target India.

Britain finally decided to take a stand and fight the Japanese at Imphal and Kohima, equatorial, hilly terrain towns, in North-Eastern India.

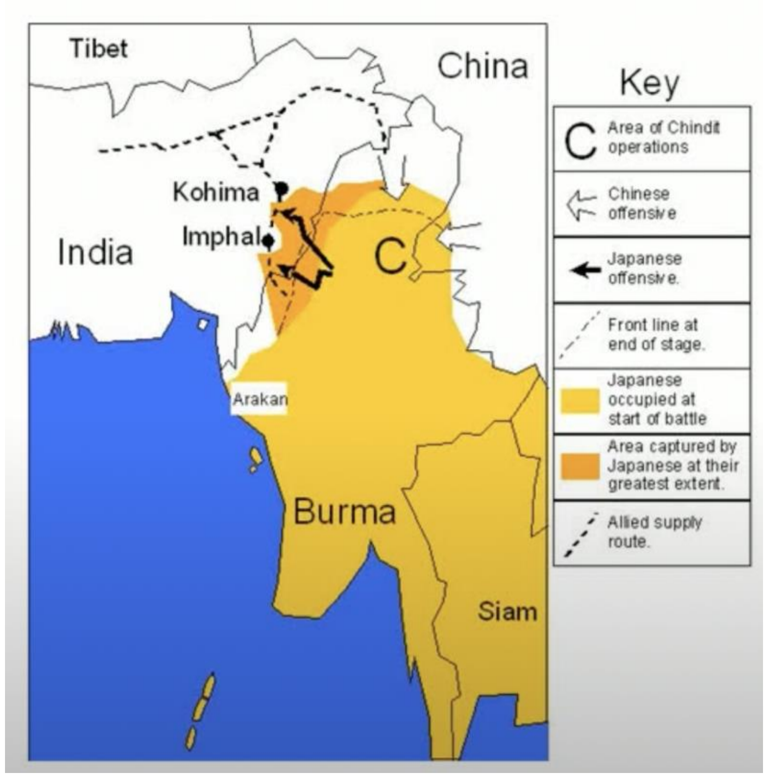
The battle was strongly contested. There were days during the battles where it seemed Britain lost the battle, but they eventually won

Research Question

How did Japan carrying few initial supplies, without establishing supply lines, affect both sides' casualty numbers and the amount of land Japan could capture and hold?

Hypothesis

Japan could have successfully captured and held more land, and lost less soldiers, given a different supply policy .



Dependent Variable(s)

- **Success of the Japanese advance**
- Measured by:

  -Control of Imphal

  -Control of Kohima

  -No. of casualties
- For Japan to claim victory they must capture both cities, measured by no British units remaining in either location

Independent Variable

- Japanese starting supplies & resupply rate
- Supply variable measured by:

  -Initial value

  -Enemy agents' supply captured

  -Supply line agent handoff
- Constants:

  -Combat abilities

  -Terrain

  -British supplies

Historic Context

- World War 2: Pacific Theater
- Part of the larger Burma Campaign
- Japanese had swept the British from Burma
- Danger to India and cutting supply to China
- Japanese launch U-Go into India
- British decide to withdraw and concentrate forces in North-East India

McLynn 9, 2011

Lyman 12, 2010

Lieutenant-General Renya Mutaguchi

Lyman 13, 2010

Field Marshall Viscount Slim

Opposing Forces

Japanese 15th Army

- Total Strength: 84,000
- Divisions at Imphal: 15th, 33rd
- Kohima: 31st
- Another 36,000 army troops

British 14th Army

- Imphal: 7th, 20th, and 23rd
- Kohima: 50th Indian Parachute Brigade.
- Relief from 2nd, 5th, and 7th divisions
- 120,000 by the end of the conflict

Technology Involved

- Rifles
- Machine guns (light and heavy)
- Grenade launchers
- Anti-tank guns
- Other artillery and mortars
- Tanks
- Aircraft (Supply)

Katoch 16, 2018

Effects of Terrain

- Uneven/undeveloped mountainous Jungle
- Limited battle technology: infantry
- Logistical difficulty

Lyman 2, 2010

Lyman 15, 2010

Effects of Terrain: supplies

- British logistics: travel heavy, and air-resupply
- Japanese tactics: traveling light and “Churchill rations”
- British logistical strategy reinforced Japanese tactics
- *U-GO:* Only 25 days worth of supplies and poor re-supply

Lyman 2, 2010

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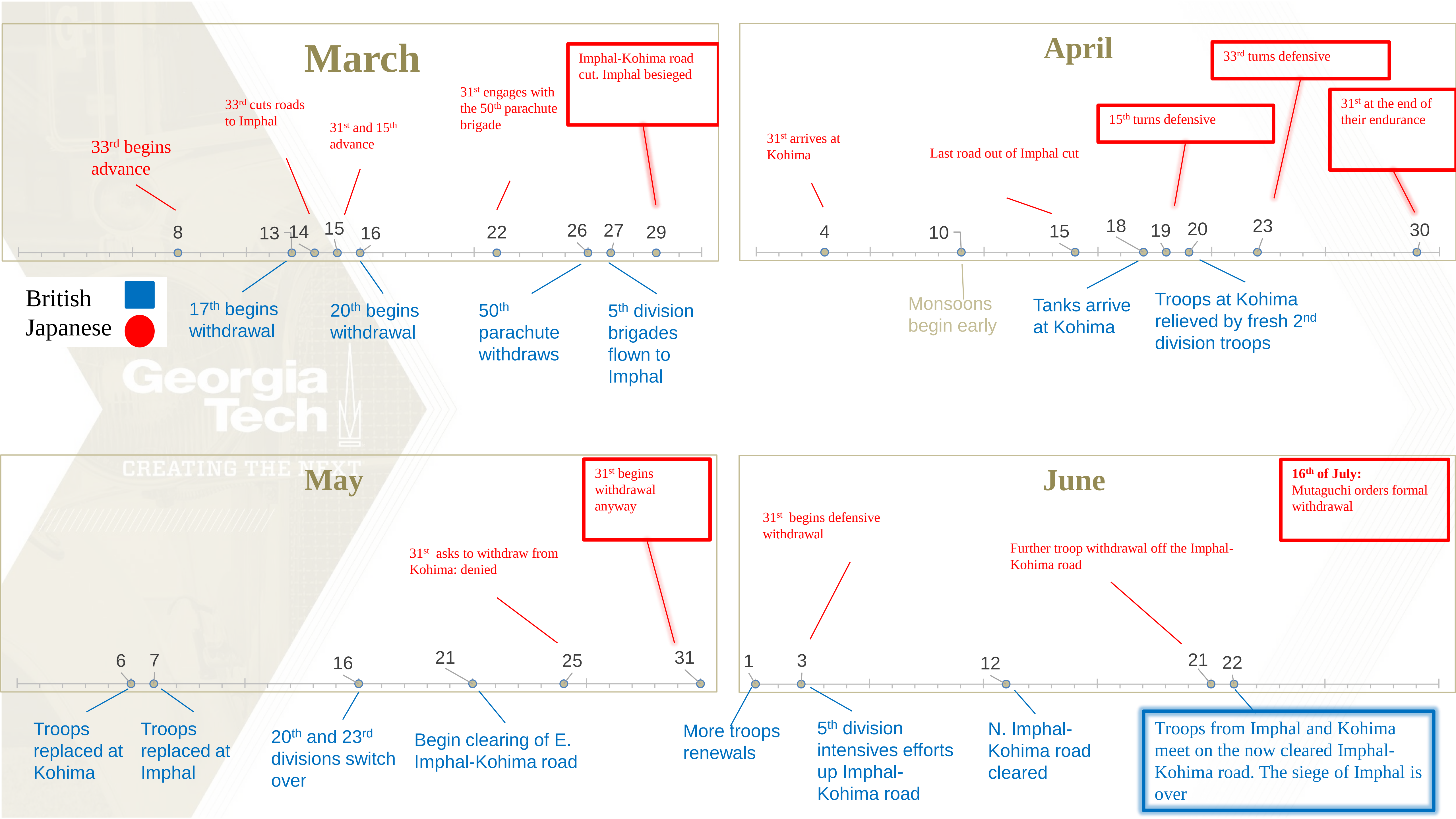
Timeline and Location

- Period of several months
- Roughly March-July 1944
- Japanese entrench themselves around Kohima
- Allies defend Imphal against a Japanese siege.


British
Japanese
March
33rd begins advance
33rd cuts roads to Imphal
31st and 15th advance
31st engages with the 50th parachute brigade
Imphal-Kohima road cut. Imphal besieged
8
13
14
15
16
22
26
27
29
17th begins withdrawal
20th begins withdrawal
50th parachute withdraws
5th division brigades flown to Imphal
April
33rd turns defensive
15th turns defensive
31st at the end of their endurance
31st arrives at Kohima
Last road out of Imphal cut
4
10
15
18
19
20
23
30
Monsoons begin early
Tanks arrive at Kohima
Troops at Kohima relieved by fresh 2nd division troops
May
31st begins withdrawal anyway
31st asks to withdraw from Kohima: denied
6
7
16
21
25
31
Troops replaced at Kohima
Troops replaced at Imphal
20th and 23rd divisions switch over
Begin clearing of E. Imphal-Kohima road
June
16th of July: Mutaguchi orders formal withdrawal
31st begins defensive withdrawal
Further troop withdrawal off the Imphal-Kohima road
1
3
12
21
22
More troops renewals
5th division intensives efforts up Imphal-Kohima road
N. Imphal-Kohima road cleared
Troops from Imphal and Kohima meet on the now cleared Imphal-Kohima road. The siege of Imphal is over

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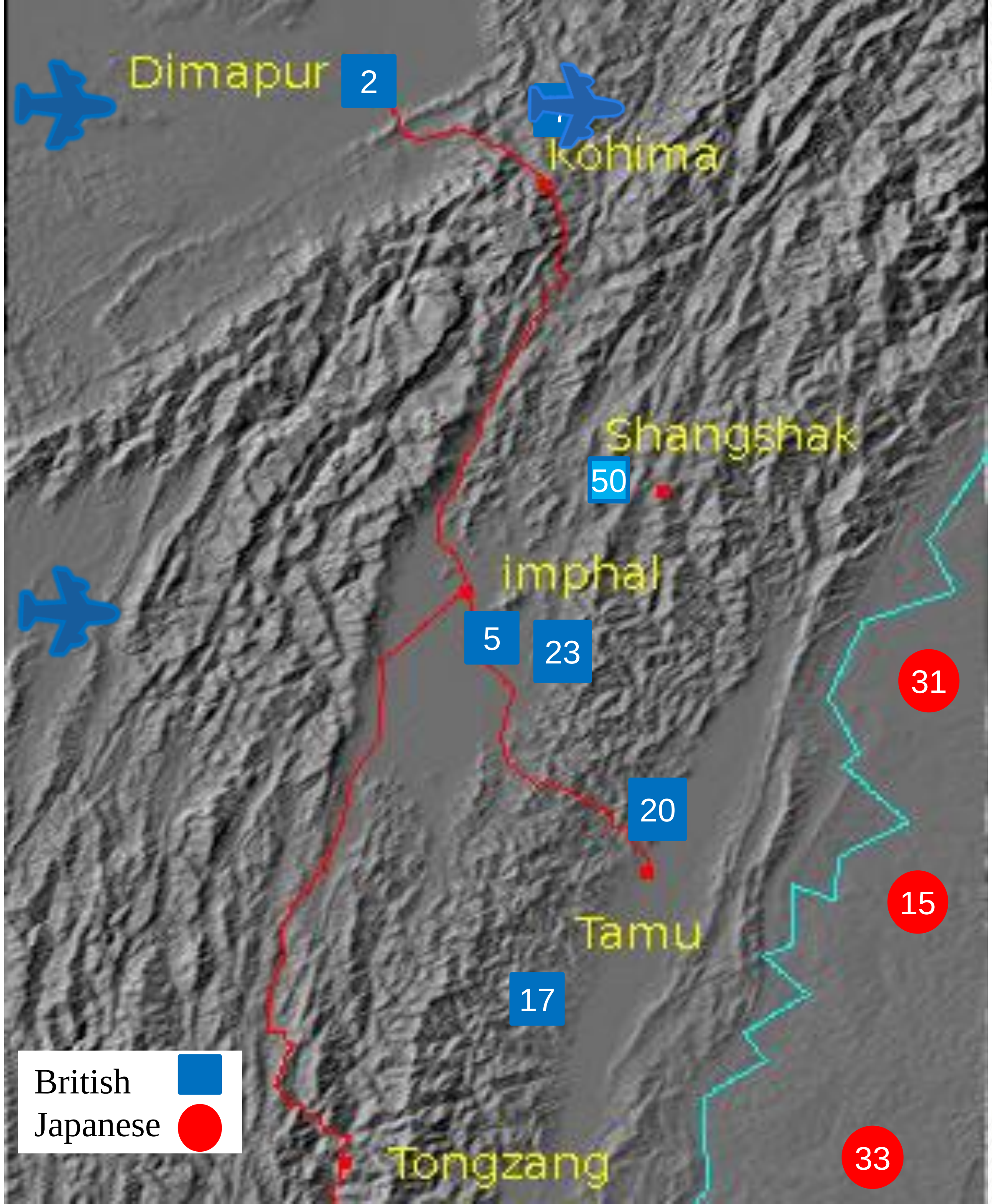

Outcome

- Japanese: 53,000 casualties
- British: 16,000 casualties
- Considered largest land defeat ever for Japanese
- Mutaguchi relieved of command
- Slim is knighted for his success.

Lyman 26, 2010

Logistical Success

- Novel air-support strategy
- 20,000 reinforcements flown in
- 22,000 tons of supplies.
- Over 35,000 non-combatants and 10,000 casualties evacuated
- Estimated 30,000 air operations overall
- Japanese flew only 1,750 sorties.

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Failure: Logistics vs Tactics

- Was Japanese failure the result of poor supply policy?
    - Only 25 days starting supplies
    - Didn't plan for re-supply
- Or the result of the British concentration strategy?

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Conceptual Model

- Key Actors
- The Environment
- Agent Behavior

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Key Actors

- Each agent represents units of 1,000 soldiers
  - A battalion in English terms
- 60 British starting units
  - 60 units as reinforcements
- 84 Japanese starting units
  - Entire army begins in play

Unit Parameters

- Health
- Supplies
- Hunger
- Damage

Health

- Starts at 1,000
- Represents what portion of the unit is healthy and fighting
- Decreases as taking combat damage, representing casualties
- Unit ‘dies’ if health is zero

Supplies

- Count of the food (in days) available to a unit
- Detailed account of the 15th Division as the baseline for Japanese army
- Units begin with only 25 days of food
- Limited resupply, sometimes foraged for food

Supply Management

- In the beginning when supplies or food was bountiful, units had 3 meals a day, and there were no hunger
- As supplies decrease, unit began to ration their food and ate 2 meals a day. This begin to take minor effect on their health
- When supplies were extreme low, units survive on 1 meal a day and that began to take a toll on their health
- And finally, when there are no supplies, units starved and begin to have casualties

Hunger

- Starts at 0
- Increases if units lack supplies to eat
- As increases, this has negative impact on speed and damage
- At a value of 14 (representing two weeks of missed meals) unit will be forced to retreat

Bonus Damage

- Represent elite units/ better training
- Japanese units deal more to represent training and weapons (+8% damage)

Damage Formula

- Linear relationship with the unit's health
- Relatively low damage, casualties from combat were historically low
- Rough terrain or hunger lower damage

$$\text{Damage } = 18 * \text{ Health}/1000 * \text{ DamageBonus } * \text{ (Terrain-Penalty + Hunger-Penalty) }/3$$

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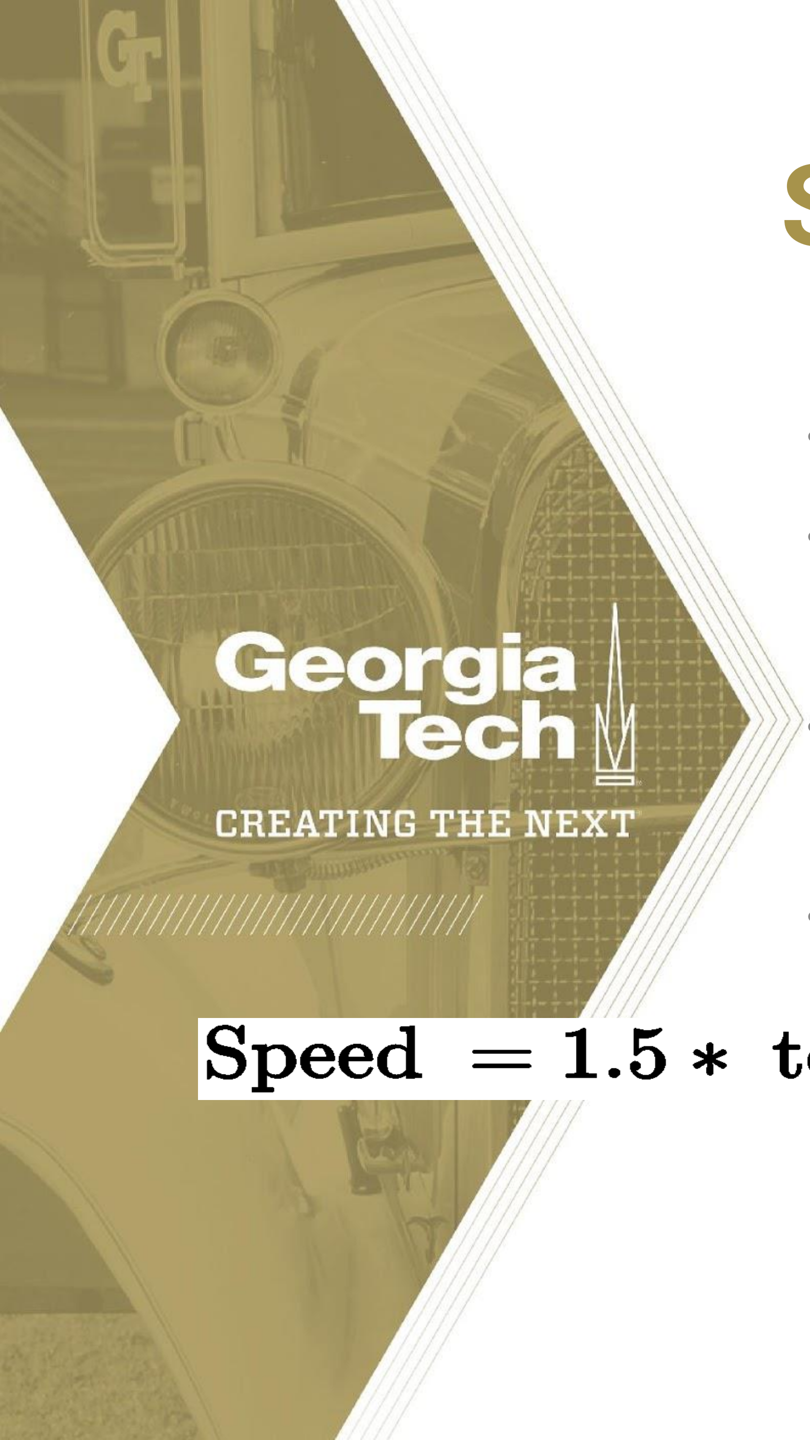
Knockback

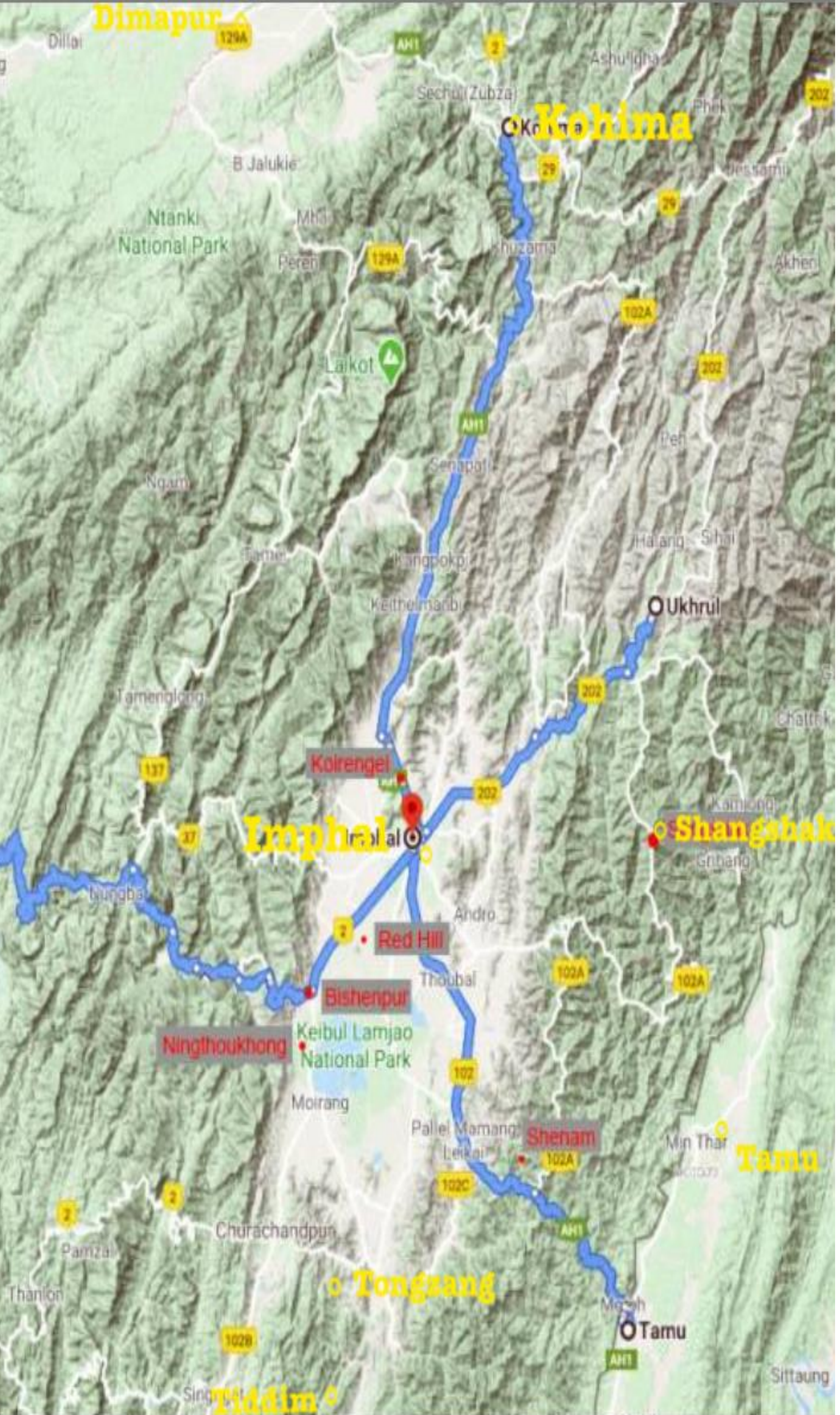
- When dealing damage, the target is pushed backwards a small amount
- Allows capturing an area without killing all enemies
- Historically realistic
- Battalions become easier to push back as more damage is dealt



Speed Formula

- Challenging Terrain --> Less speed
- Hunger. The hungrier the troops --> Less mobile
- Supplies. Carrying more supplies --> Less mobile
- Cannot drop below 0.1

$$\text{Speed} = 1.5 * \text{terrain-factor} * \text{hunger-factor} * \text{supply-factor}$$



Environment

- Patches are squares of 26 square miles
- Map area is about 32 patches tall, 32 wide

Environment

- Rough and flat terrain affecting combat
- Terrain remains unchanged throughout this simulation

Map and terrain effects

- Types of terrain:

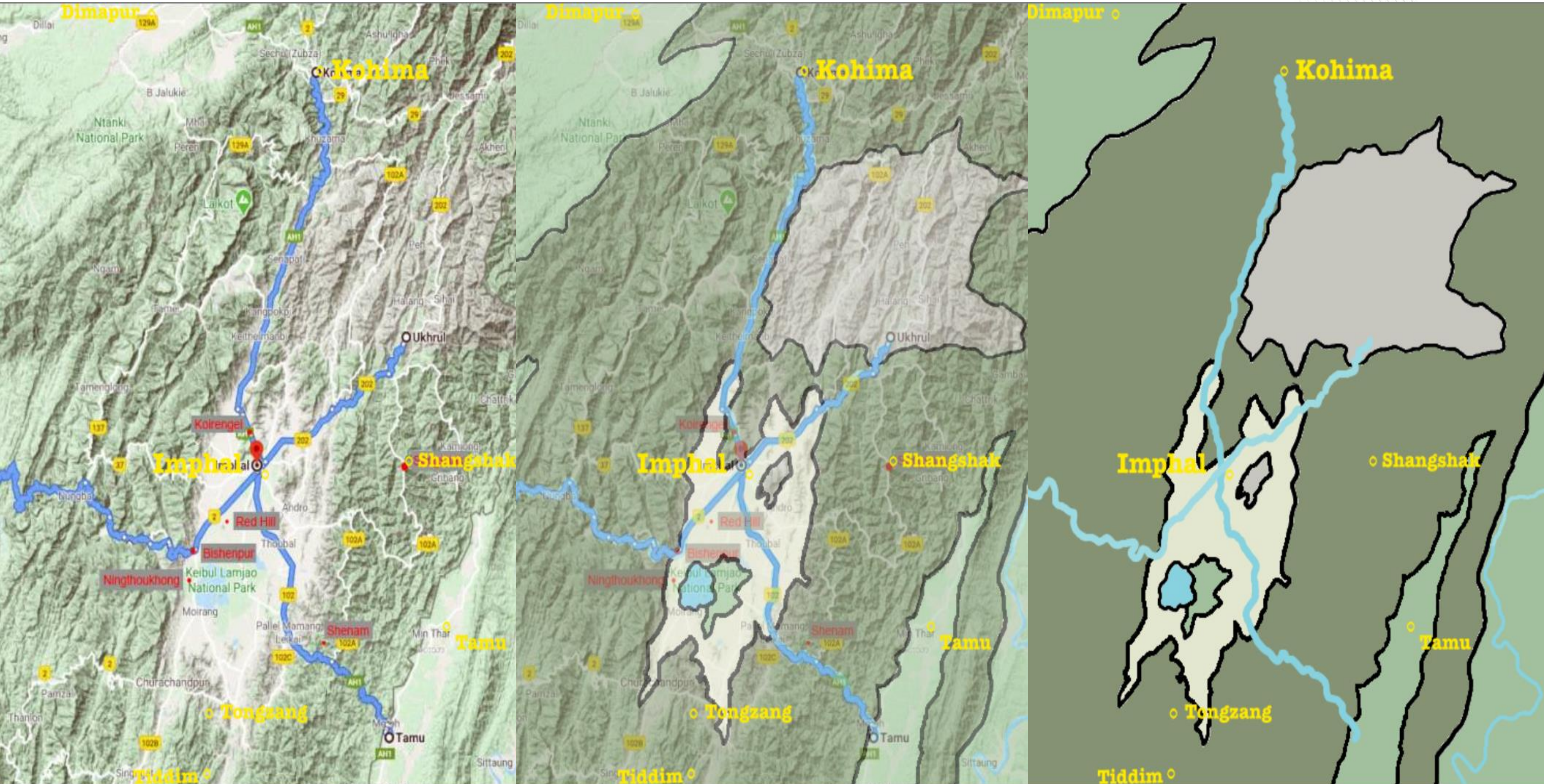
    -Flatlands

    -Forests

    -Mountains

    -Mountainous Forests

Map and terrain effects



Agent Behavior Flowchart

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Consumption (Turn Start)

"Eat" according to the rationing rules	Adjust hunger/health/supplies accordingly

Combat (if enemy in range and unit isn't retreating)

Randomly choose target for nearest enemies	Deal damage based on parameters and terrain

Movement (if no enemy in range or if unit is retreating)

Unit will move towards goal patch	If at goal, check for a new goal (Japan) or hold position (British)

Model Demonstration

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Research Question & Variables recap

- Research Question

How did Japan carrying few initial supplies, without establishing supply lines, affect both sides' casualty numbers and the land Japan could capture and hold?

Dependent variables

- Total no. of casualties (continuous)
- Land/patches captured
  - Imphal captured (binary)
  - Kohima captured (binary)

Independent variables

- Starting supplies (bounded: 0-100)
- Resupply rate (bounded: 0-10)

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Methodology summary

- 3 experiment models:
  - Exp. 1: 100 repetitions for each variable setting (total 600 runs)
  - Exp. 2: 100 repetitions for each variable setting
    - 2a: total 600 runs
    - 2b: total 500 runs
    - 2c: total 1800 runs
  - Exp. 3: 10 repetitions for each variable setting (total 11,110)

- Linear Regression for continuous dependent variable (Casualties)

- Logistic Regression for binary dependent variable (Imphal/Kohima captured)

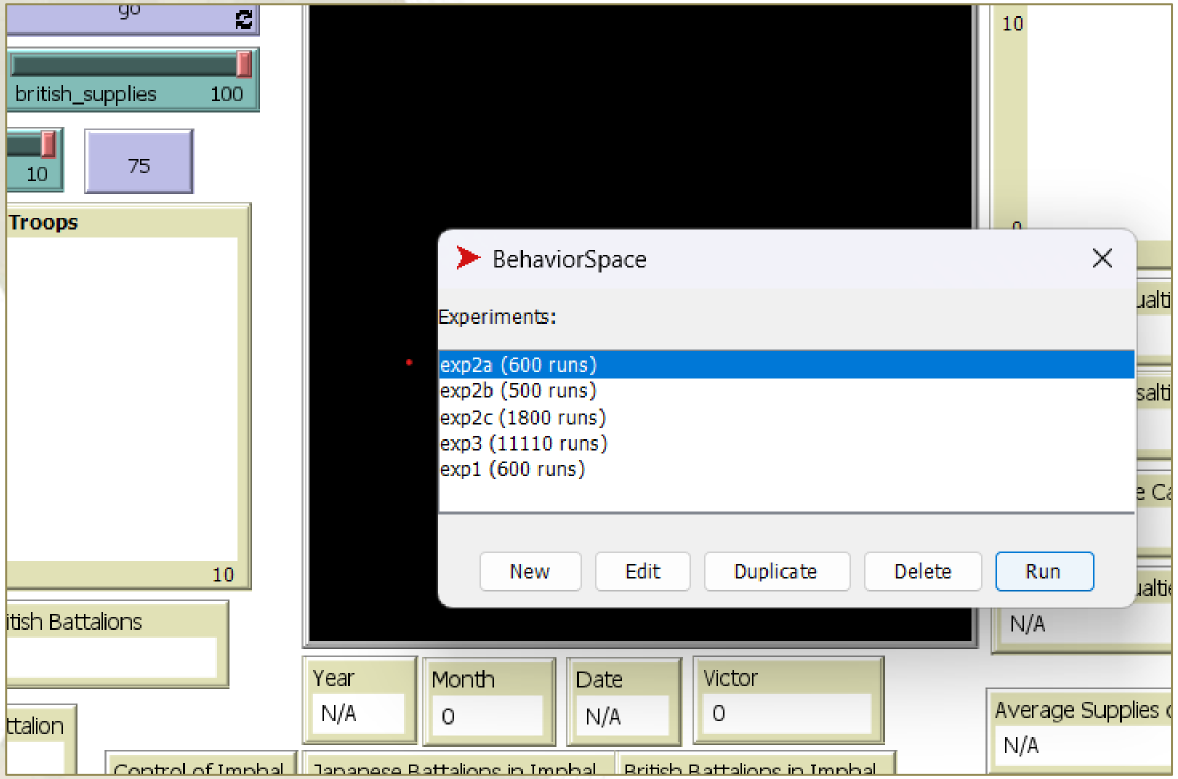
Experiment Design

- Experiment 1: Initial data exploration via time-series
  - Axis casualties over time for 5 different starting supply policies:
  - 0, 25 (historical policy), 50, 75, and 100 days worth of food
- Experiment 2: Supply policy effect on dependent variables*
  - Exp 2a: vary starting supply [0, 25, 50, 75, 100], resupply rate held at 0
  - Exp 2b: Hold starting supplies fixed at 25 (historical value), and
    - vary re-supply rate [2,4,6,8,10]
  - Exp 2c: effect of re-supply and starting supplies in concert
    - vary starting supplies [0,10,25,50,75,100] and re-supply rate at [6,8,10]
- Exp 3: treat supply and re-supply polices as wholly continuous
  - Vary starting supplies from [0-100] and re-supply rate from [0-10]

Expected values and regression analysis performed on all experiments.

***Note: experiment 2 values discrete in order to make data summary and visualization easier.**

Experiment Design



NetLogo Behavior Space Tool

```
                            OLS Regression Results
==============================================================================
Dep. Variable:                  ticks   R-squared:                       0.708
Model:                            OLS   Adj. R-squared:                  0.708
Method:                 Least Squares   F-statistic:                 1.349e+04
Date:                Sun, 09 Apr 2023   Prob (F-statistic):               0.00
Time:                        20:28:30   Log-Likelihood:                -54402.
No. Observations:               11110   AIC:                         1.088e+05
Df Residuals:                   11107   BIC:                         1.088e+05
Df Model:                           2
Covariance Type:            nonrobust
==============================================================================
                 coef    std err          t      P>|t|      [0.025      0.975]
------------------------------------------------------------------------------
const         95.1368      0.780    121.981      0.000      93.608      96.666
x1             1.0916      0.011    103.564      0.000       1.071       1.112
x2            12.3933      0.097    127.531      0.000      12.203      12.584
==============================================================================
Omnibus:                      254.787   Durbin-Watson:                   0.381
Prob(Omnibus):                  0.000   Jarque-Bera (JB):              272.375
Skew:                           0.384   Prob(JB):                     7.15e-60
Kurtosis:                       3.000   Cond. No.                         148.
==============================================================================

Notes:
[1] Standard Errors assume that the covariance matrix of the errors is correctly specified.
```

Python Statsmodels Package
(Seabold et al. 2010)

Results: Experiment 1

- Times series Comparison shows strange relationship:

  more supplies correspond to more casualties

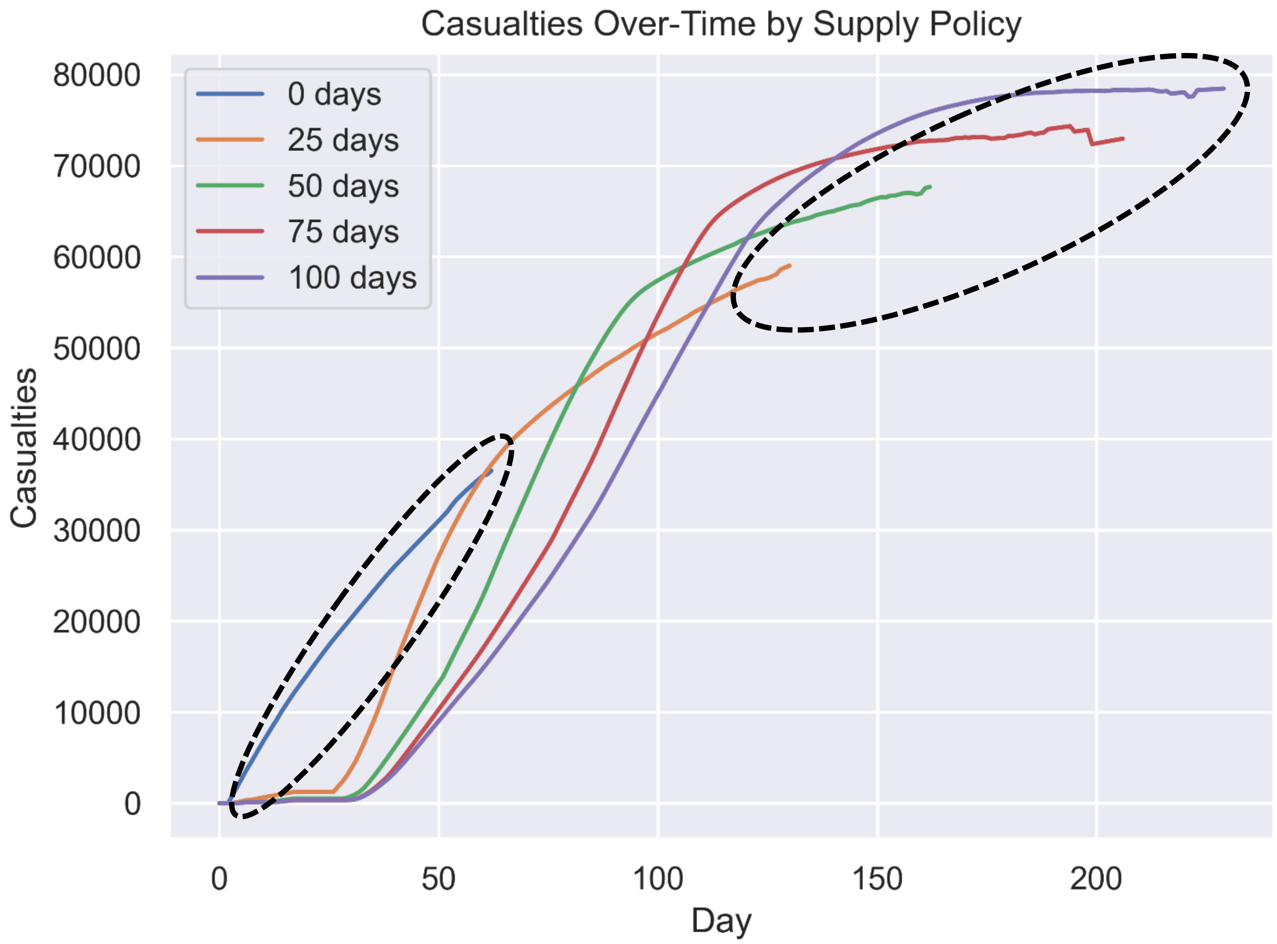


Figure 1. Comparing casualties over number of days by differing initial supply policy

Results: Experiment 2a

Starting supplies varied at [0,25,50,75,100], with no resupply policy

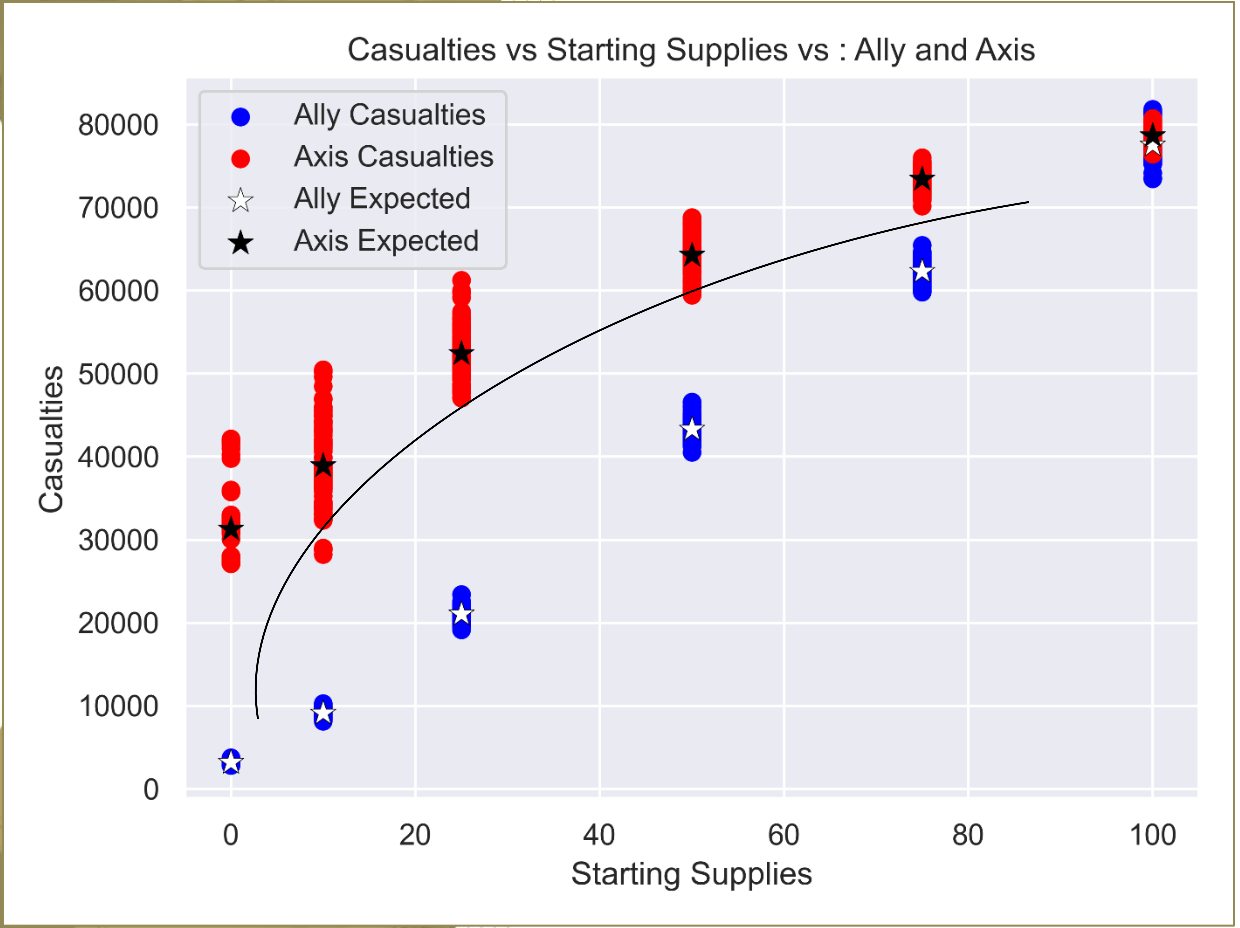


Figure 2. Casualties plotted against starting supply policy for both the axis and ally forces

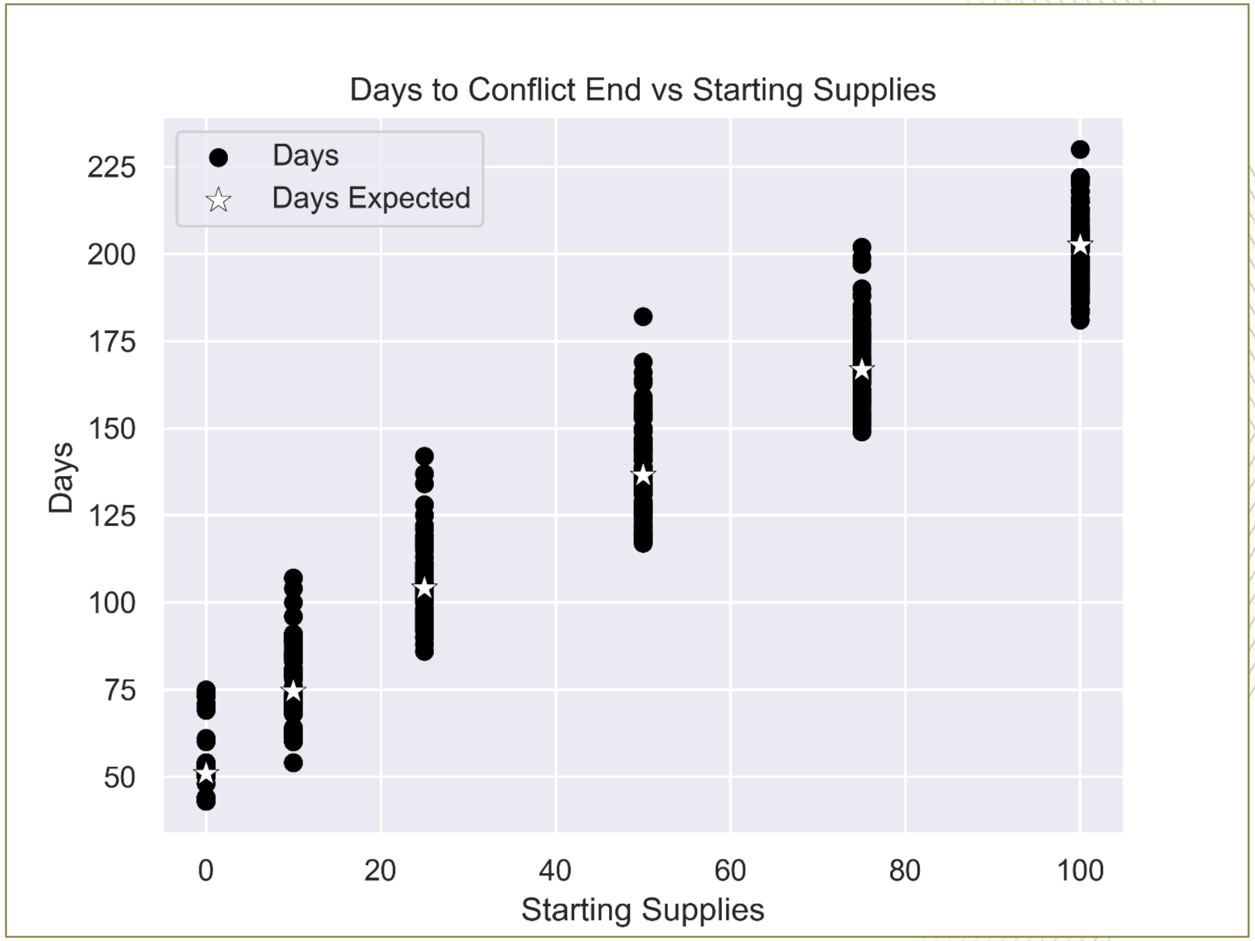


Figure 3. Days until conflict end plotted against starting supply policy for both the axis and ally forces

Results: Exp 2a

Initial supplies	Axis Casualties	Ally Casualties	Imphal Captured	Kohima Captured	Days	Combat Casualties
0	31274	3214	0	0	51	4%
10	38914	9132	0	0	75	10%
25	52400	21067	0	0	104	38%
50	64269	43285	0	0	136	67%
75	73408	62317	0	0	167	85%
100	78653	77504	0	0	203	93%

Table 1. Expected values over 100 runs, as well as the number of times Imphal and Kohima captured

Regression Analysis Starting Supply Policy					
	Coefficient	Std. Error	F-statistic	P-Value	R-Squared
Casualties vs Supplies	474.33	5.65	7027.06	<0.001	0.92
Days vs Supplies	1.46	0.01	10926.33	<0.001	0.95
Logistic Regression (Binary Dependent Variable)					
	Coefficient	Std. Error	LLR	P-Value(Z)	Pseudo-R
Imphal vs Supplies	N/A	N/A	N/A	N/A	N/A
Kohima vs Supplies	N/A	N/A	N/A	N/A	N/A

Table 2. Regression Analysis with linear regression performed on continuous dependent variables and logistic regression performed on binary dependent variable

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Results: Exp 2b

Starting supplies fixed at 25 days worth (historical) resupply varied [2,4,6,8,10]

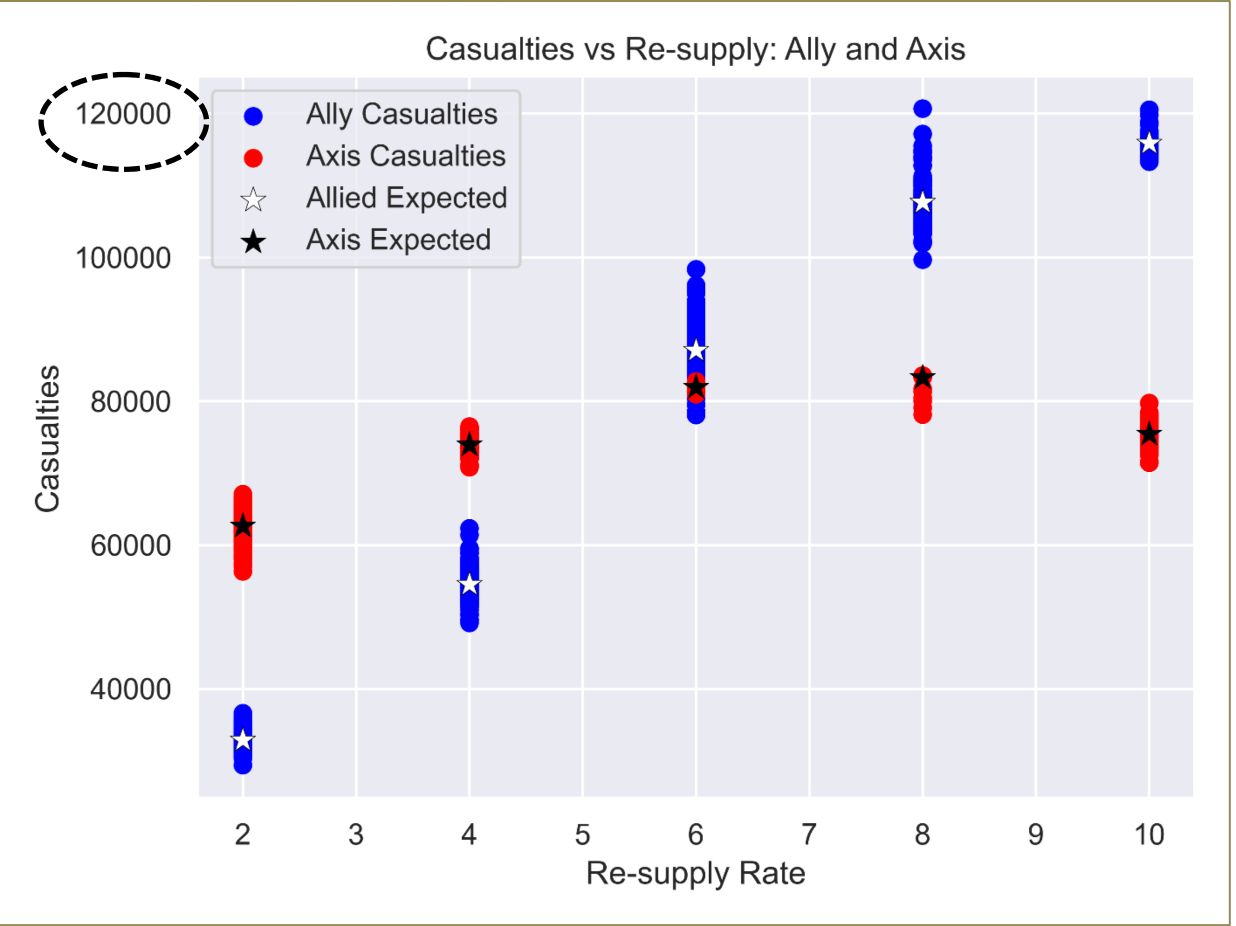

Figure 4. Casualties against resupply policy for both the axis and ally forces

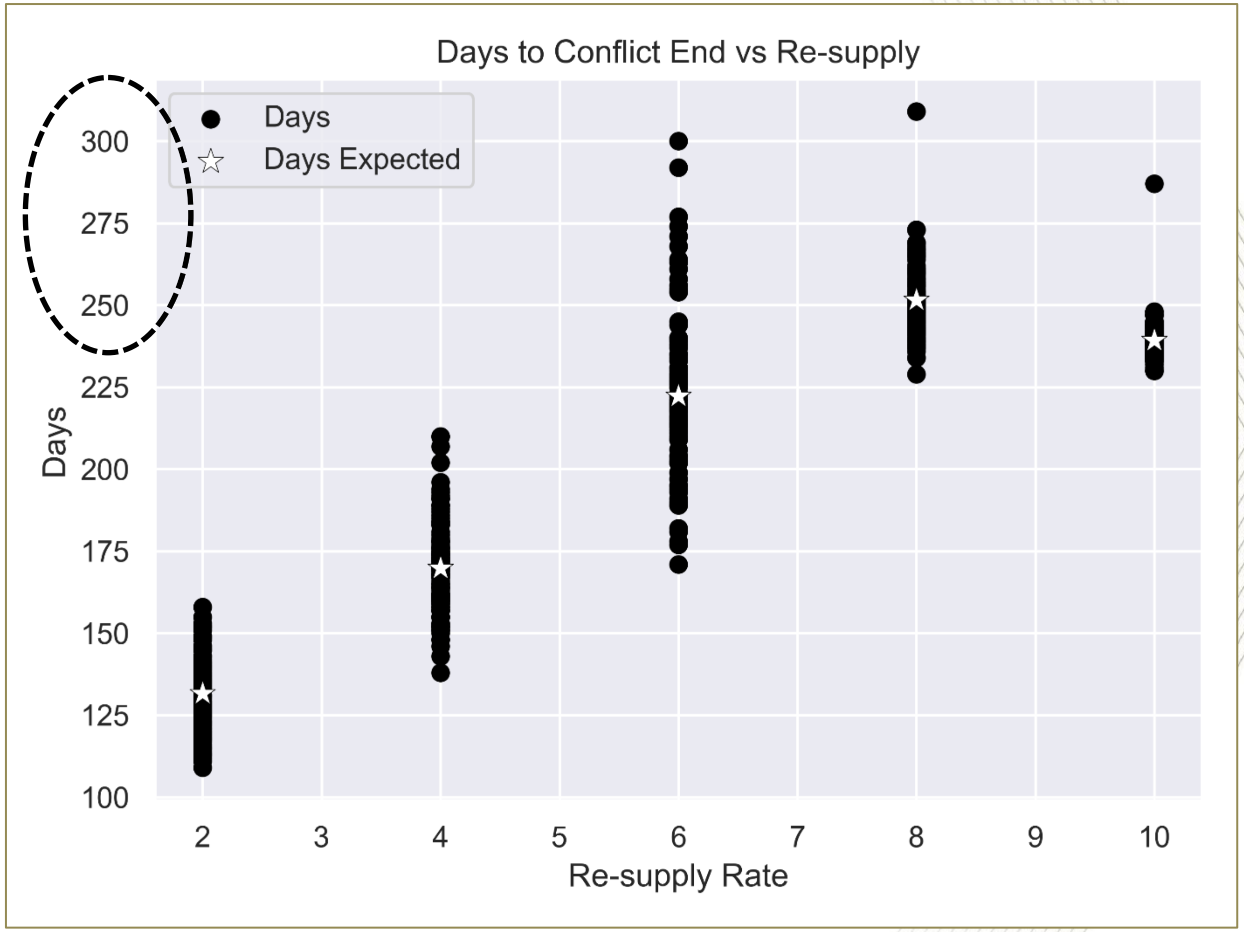

Figure 5. days until conflict end against resupply policy for both the axis and ally forces

Results: Exp 2b

Resupply Rate	Axis Casualties	Ally Casualties	Imphal Captured	Kohima Captured	Days	Combat Casualties
2	62663	32865	0	0	132	51%
4	73922	54521	0	0	170	72%
6	81962	87054	0	4	222	92%
8	83286	107669	6	98	252	100%
10	75396	115864	100	100	239	100%

Table 3. Expected values over 100 runs, as well as the number of times Imphal and Kohima captured

Regression Analysis Resupply Policy

	Coefficient	Std. Error	F-statistic	P-Value	R-Squared
Casualties vs Resupply	1741.54	89.29	380.41	<0.001	0.43
Days vs Resupply	14.84	0.36	1741.84	<0.001	0.78

Logistic Regression (Binary Dependent Variable)

	Coefficient	Std. Error	P-Value(z)	CI[0.25,0.975]	Pseudo-R
Imphal vs Resupply	11.00	759.96	0.99	[-1478.5, 1500.5]	0.91
Kohima vs Resupply	3.54(3347%)	0.4377	<0.001	[2.68, 4.40]	0.921

Table 4. Regression Analysis with linear regression performed on continuous dependent variables and logistic regression performed on binary dependent variable

Results: Exp 2c

Joint effect of resupply rate [2, 4, 6, 8, 10] and starting supply [0, 10, 25, 50, 100]

Resupply Rate	Initial supplies	Axis Casualties	Ally Casualties	Captured	Days	Combat Casualties
10	75	75745	116872	100%	253	100%
10	25	75542	115739	100%	239	100%
10	100	75241	117135	99%	253	100%
8	75	75892	116961	99%	254	100%
8	100	75942	116957	99%	254	100%
10	50	75437	117078	97%	253	100%
10	10	78477	114735	95%	240	100%
6	100	77896	116356	92%	256	100%
8	50	80060	115116	73%	262	100%
6	75	81162	113892	54%	262	100%
8	25	83413	107469	3%	254	100%

Table 5. Expected values and times Imphal and Kohima captured by Starting and Resupply policies. Note table is ordered by Imphal and Kohima capture percentage. Further note, any policy combinations where Imphal and Kohima were never captured is dropped from the table

Results: Exp 3

Treat supply and resupply policies as wholly continuous. Vary starting supplies from [0-100] and re-supply from [0-10]

Regression Analysis
Starting Supply and Resupply

	Coefficients		Std. Errors		P-Values	F-Statistic	R-Squared
Casualties vs Supplies	164.14	1527.91	2.67	24.61	<0.001	3818.75	0.41
Days vs Supplies	1.10	12.39	0.01	0.10	<0.001	13494.80	0.71

Logistic Regression (Binary Dependent Variable)

	Coefficients		Std. Error		P-Value (z)	CI [0.25, 0.975]		Pseudo-R
Imphal vs Supplies	0.15 (16%)	3.06 (2033%)	0.05	0.10	<0.001	[0.14, 0.16]	[2.9, 3.3]	0.84
Kohima vs Supplies	0.25 (28%)	3.43 (3000%)	0.008	0.11	<0.001	[0.23, 0.27]	[3.2, 3.7]	0.87

Table 6. Regression Analysis with linear regression performed on continuous dependent variables and logistic regression performed on binary dependent variable

Results: Exp 3

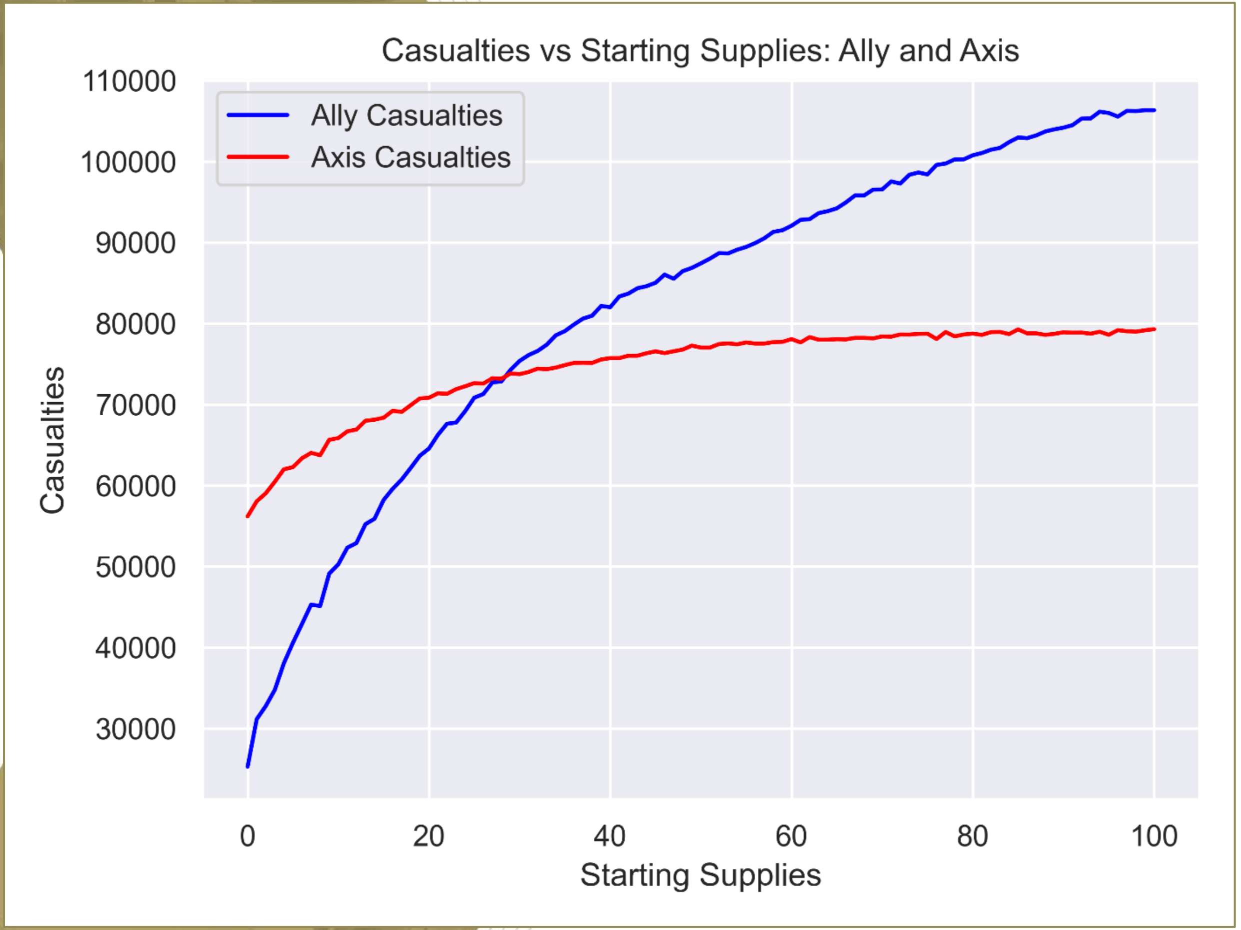

Figure 6. Casualties against starting supply policy for both the axis and ally forces

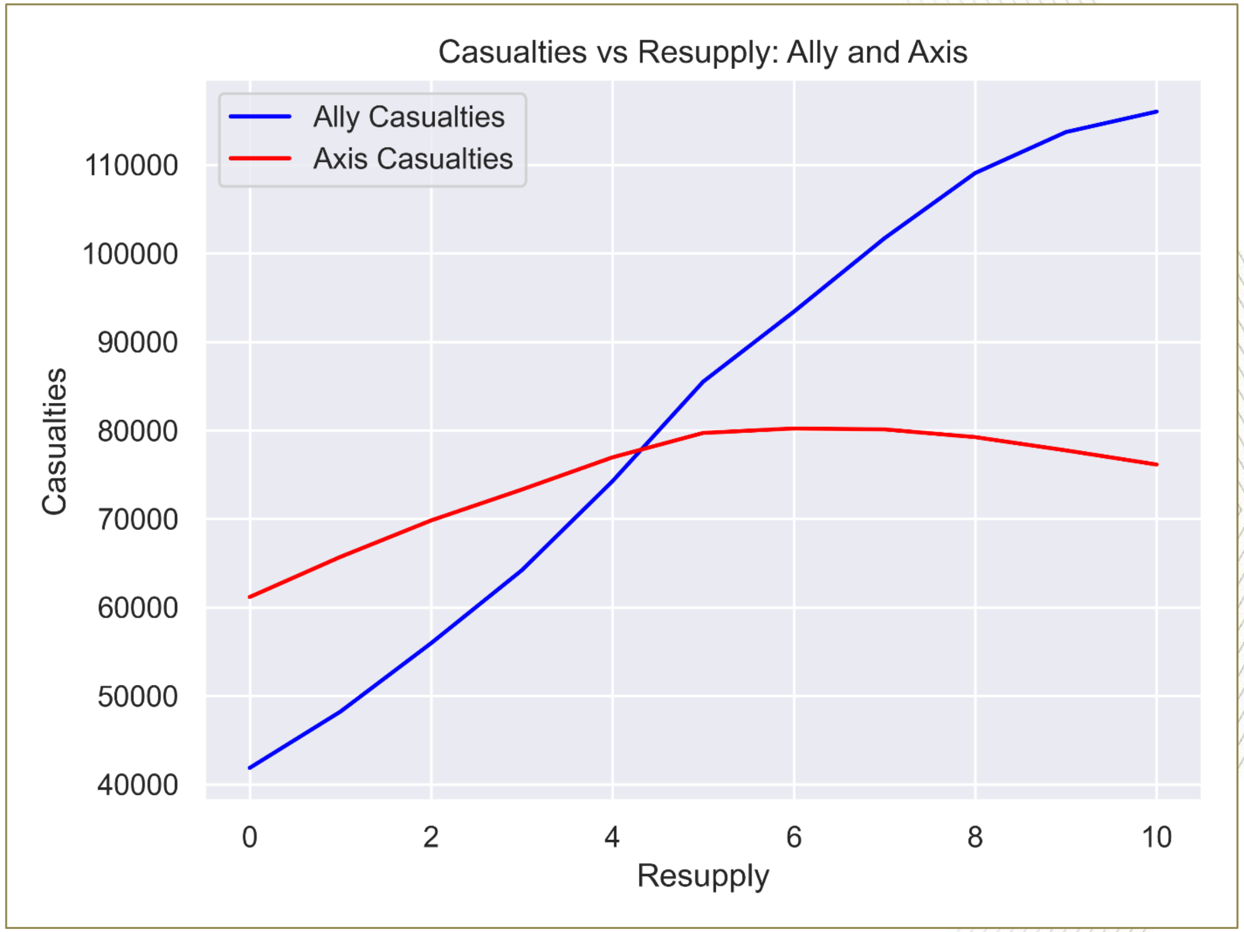

Figure 7. Casualties against starting supply policy for both the axis and ally forces

Conclusions

Research Question

How did Japan carrying few initial supplies, without establishing supply lines, affect both sides' casualty numbers and the land Japan could capture and hold?

Casualties are continuous

Holding Imphal and Kohima is binary (historical goal)

Initial Hypothesis

Japan could have successfully captured and held more land, and lost less soldiers, given a different supply policy.

Conclusions

- Direct relationship between supply policy (starting and resupply) and casualties
  - However, it is a positive relationship (more supplies->increasing casualties)
- Direct relationship between supply policy and controlling Imphal and Kohima
  - While both Starting Supply and Resupply policy affects success, resupply outperforms
  - Likely due to the affect of speed in the model

$$\text{Speed} = 1.5 * \text{terrain-factor} * \text{hunger-factor} * \text{supply-factor}$$

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Conclusions

Could Japan have succeeded with a different supply policy?

- Model indicates possibility, but it would require a supply policy equal to or better than the allied policy. Likely historically impossible.
- Further, ally tactics were aiming for a siege. Japanese were not.
- Model also indicates massive casualties, and that the conflict would last far longer than the U-Go initiative was planned to take

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Policy Implications

- Establishing efficient supply lines to keep troops well-supplied during campaigns. Secure logistical routes, utilize local resources, and invest infrastructure to improve transportation and communication.

- From our model, resupply may have a greater impact on success, but also consider initial supply planning.

- Implementing a more effective supply policy does not necessarily mean a shorter conflict: could lead to increased casualties for both sides, as it allows for longer conflict engagement.

- Further, our results indicate that logistical policy alone could not necessarily overcome a tactical disadvantage.

- The British concentrated forces in a defensive position, with good supply logistics. Offered a distinct tactical advantage over advancing and conquering more barren land with meager resources and challenging re-supply.

- Focus on intelligence. Better knowledge of enemy tactics, movements, and resources to make informed decisions about your own supply, and countermeasures to avoid a major disadvantage

Weaknesses

- The model holds the ally response fixed. Historically dynamic
  - Resupply and Reinforcement
- Japanese historical context
  - Upper-limits of supply capability
- “Surrender behavior”

Conclusion

While the model does indicate possibility for Japanese success, it also provides support that the allied withdrawal and concentration of forces in Northern India was simply an obstacle to large to feasibly overcome

Lyman 2010, illust. Peter Dennis

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