Early-Stage Epidemic Forecasting

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Agenda

- Introduction.
- Grey Model Theory.
- Controlled Experiment & Systematic Review.
- Results.
- Conclusions.

Introduction

- Modern Day Disease Outbreak Detection using Syndromic Data.
- Forecasting, its process and the characteristics of epidemic forecasting.
- Early-Stage / First-Take off period and its characteristics.
- Small Sample Size Forecasting. The problems and the possible solutions.

```
#algorithm
A <- df[[1]]
y <- A;
n <- length(y);
yy <- matrix(1, n, 1);
yy[1] <- y[1];
for (i in c(2:n))
{
  yy[i] = yy[i-1] + y[i];
}
B = matrix(1, n-1, 2);
for (i in  c(1:(n-1)))
{
  B[i,1] = -(yy[i]+yy[i+1])/2;
  B[i,2] = 1;
}
BT = t(B);
YN <- rep(0, n-1);
for (j in c(1:(n-1)))
{
  YN[j] = y[j+1];
}
A = solve(BT %*% B ) %*% BT %*% YN;
a = A[1];
u = A[2];
tt = u/a;
t_test <- 5#readline(prompt="Enter the forecast number: ")
t_test <- as.integer(t_test)
i = c(1:(t_test+n));
yys <- rep(0, t_test+n);
yys[i+1] = (y[1] - tt) * exp(-a*i) + tt;
yys[1] = y[1];
ys <- rep(0, length(c((n+t_test): -1: 2)))
for (j  in c((n+t_test): -1: 2))
{
  ys[j] = yys[j] - yys[j-1];
}
x = c(1:n);
xs = c(2:(n+t_test));
yn = ys[2:(n+t_test)];

#In Mape Calc
dett <- 0;
for (i in c(2:n))
{
  dett = dett + abs(yn[i] - y[i]) ;
}
dett = dett/(n-1);

cat("\n Percentage Absolute Error is: ", dett, "%\n", sep = "");
cat(" the forecaset data is ", ys[(n+1):(n+t_test)], "\n");

#Graph Output
plot(x, y, col="red", pch=2, xlim = c(min(min(xs), min(x))-1,max(max(xs), max(x))+1), ylim = c(min(min(yn), min(y))-1,max(max(yn), max(y))+1));
points(xs, yn, col="blue", pch="*");
lines(xs, yn, col="blue", lty=2)
```

Grey Model Theory

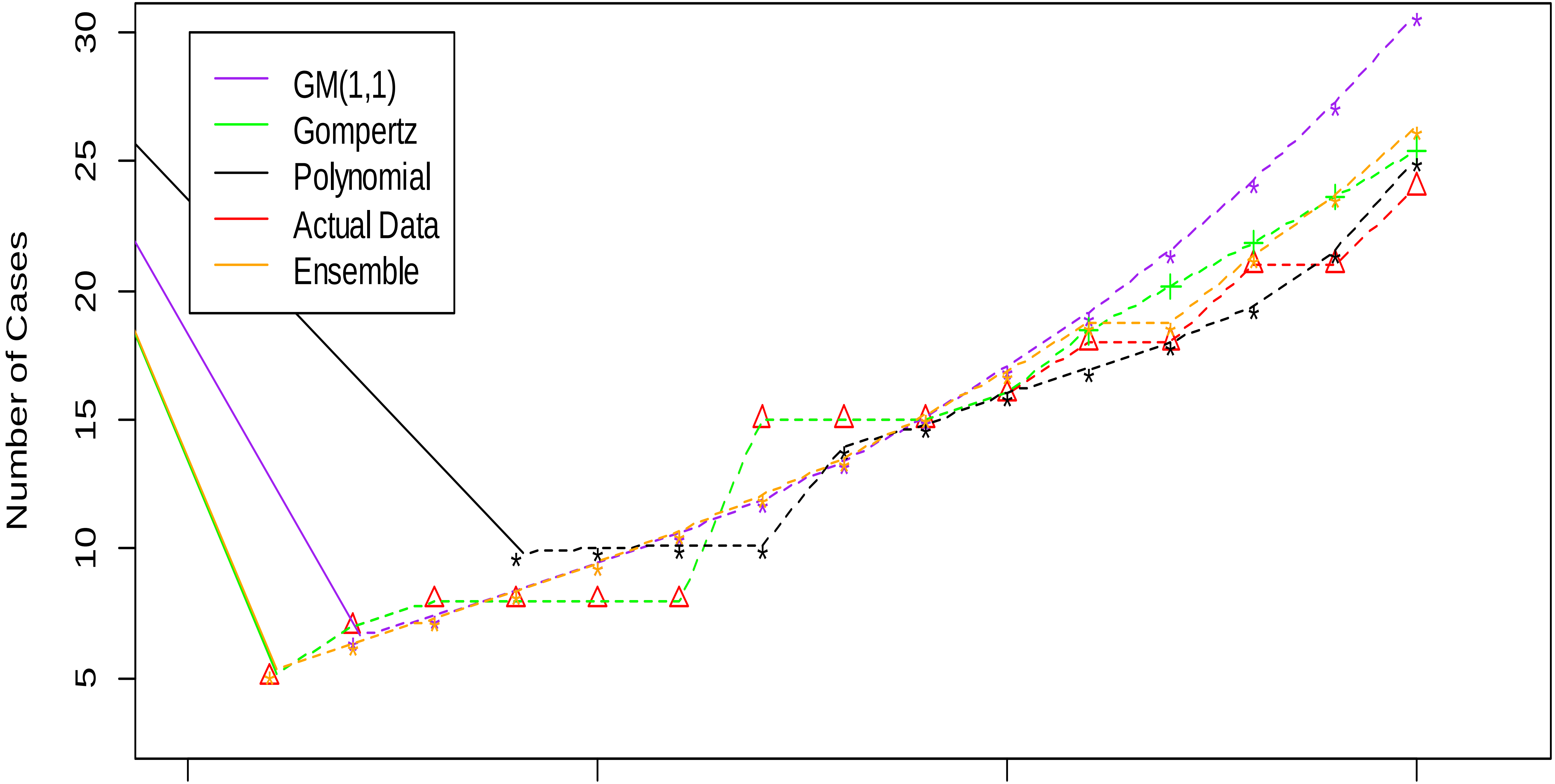
- ❑Definition, Components & Principles.
- ❑Studies supporting the application of the theory.
- ❑The process and techniques employed in translating the algorithm.
- ❑Systematic Review to identify and quantify the various methods of enhancement for the GM(1,1) algorithm.
- ❑Translation of the algorithm into R programming Language.

Controlled Experiment

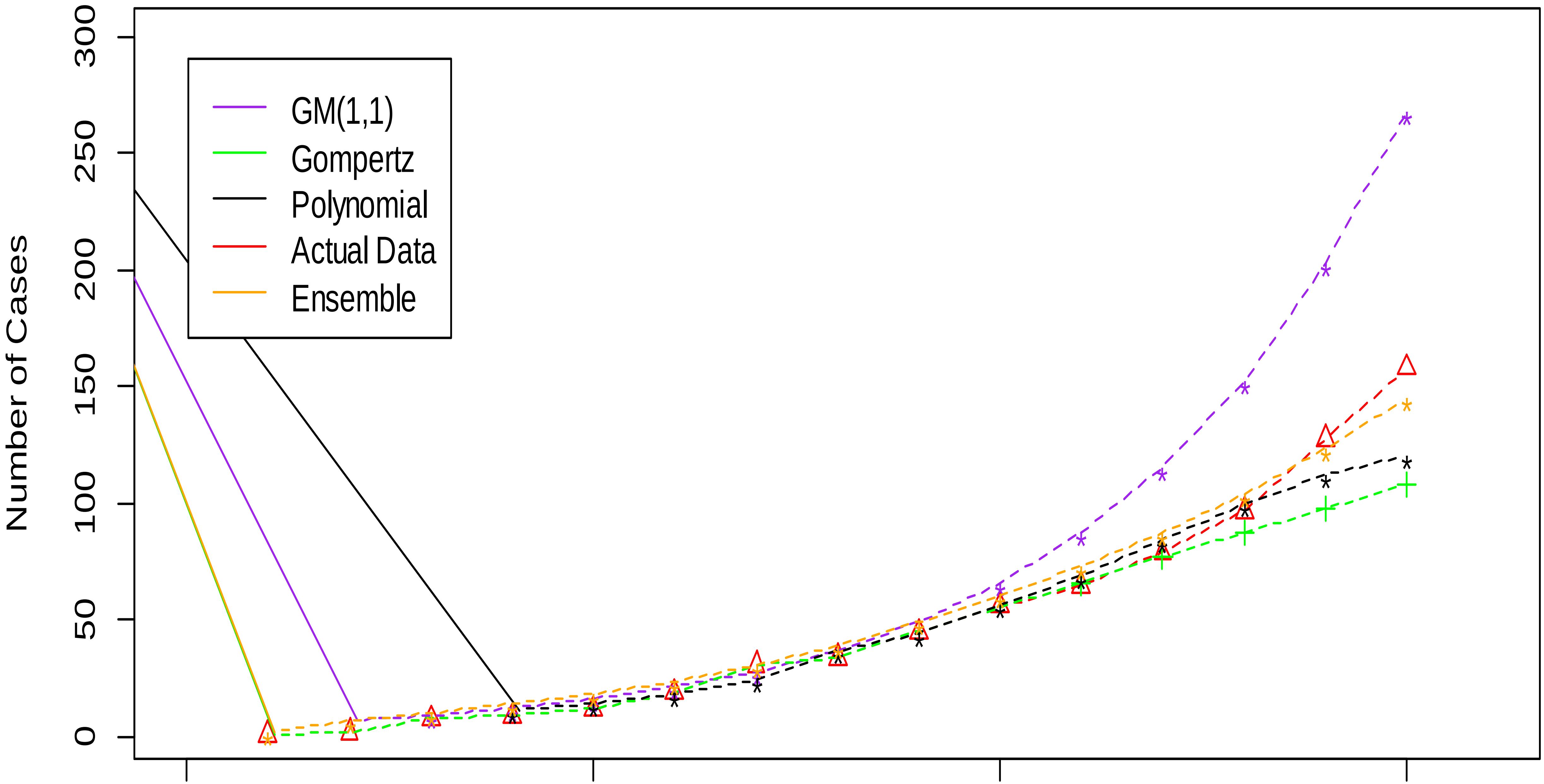
- How algorithm ideal for comparison to GM(1,1) were chosen.
- The data source chosen and the process.
- Why the precise sample size was selected.
- Reasoning behind the countries selected.
- Why MAPE was ideal out of the choice of various criterion options.

RESULTS

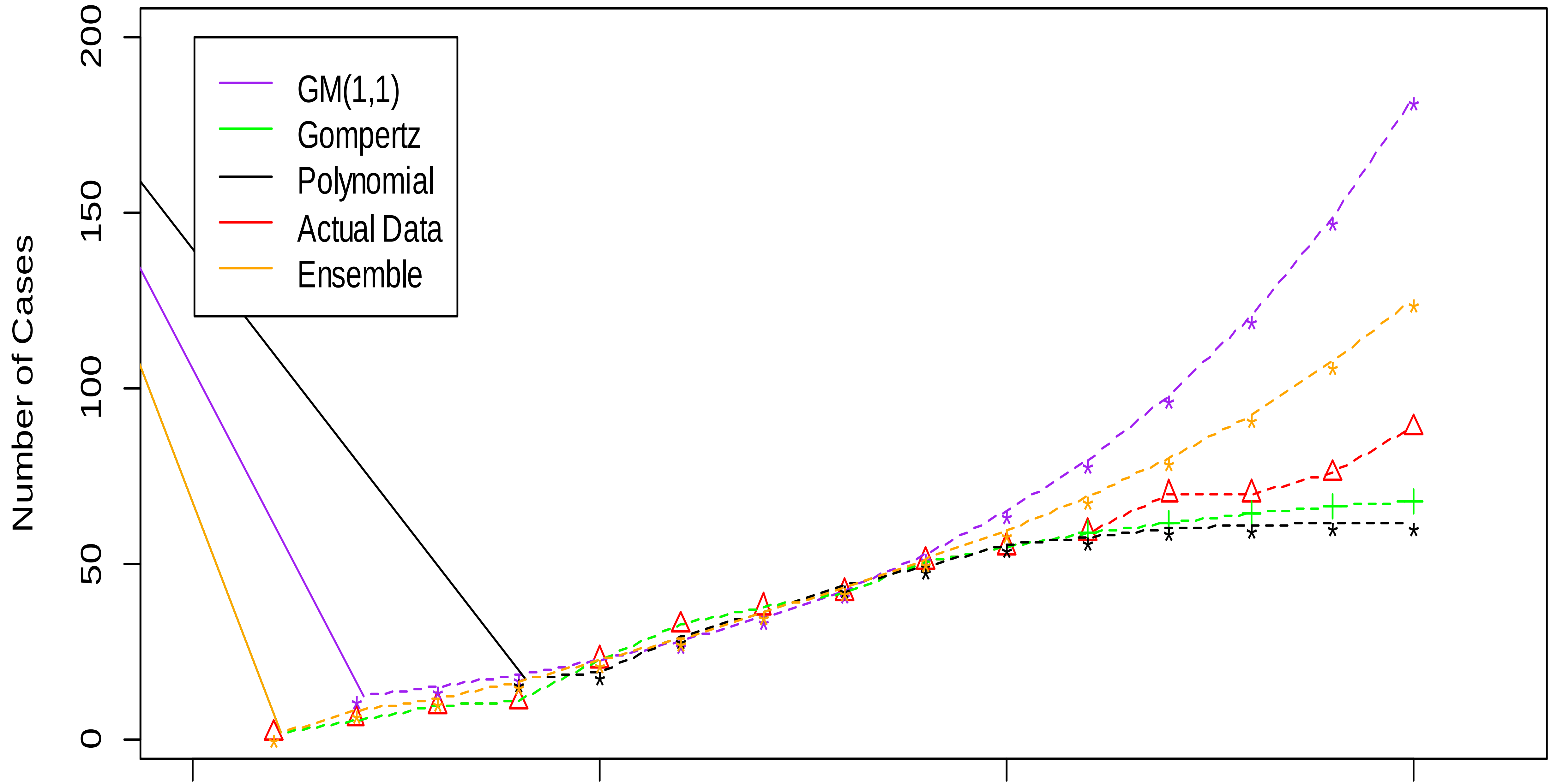
❑ HAITI	(24/03/2020 – 02/04/2020).
❑ ARGENTINA	(04/03/2020 – 15/03/2020).
❑ ALBANIA	(09/03/2020 - 18/03/2020).



Haiti Results



Argentina Results



Albania Results

	Albania (%)		Argentina (%)		Haiti (%)	
	In Sample	Out of Sample	In Sample	Out of Sample	In Sample	Out of Sample
GM(1,1)	30.67	69.76	43.28	53.11	11.73	19.90
Gompertz	10.50	11.16	18.69	13.90	11.83	7.33
PNN	13.16	15.53	12.24	10.27	16.67	4.15
Ensemble	15.92	29.35	54.67	8.47	11.43	6.53

Result Summary

Conclusions

- Aims of the Paper.
- Translation of the algorithm & Controlled Experiment.
- Hidden non-optimized parameters within the GM(1,1) algorithm .
- Sub-exponential nature of the dataset.

Further Works

- Standardisation of models and their Usage.
- Comparison of enhanced GM(1,1) models against others like Gompertz and PNN.
- Generalization of results to Epidemics without testing.