Final Project

Math 6937

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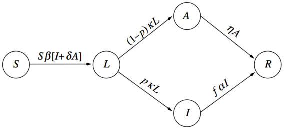
SLIAR Model



Parameter	Explanation
β	How often a susceptible-infected contact results in a new infection.
α	The rate an infected recovers and moves into the resistant phase.
η	The rate an aymptotic recovers and moves into the resistant phase.
κ	The rate where latent move to either asymptomatic or infected.
δ	reduction in infectivity of asymptomatic members.
p	fraction of latent members that develop symptoms.

Basic Reproduction Number (1)

The basic reproduction number is the number of secondary infections caused by introducing a single infective into a susceptible population.

$$R_0 = S_0\beta[\frac{p}{\alpha} + \frac{\delta(1-p)}{\eta}]$$

Parameter	Value
β	0.000201207243
α	0.244
η	0.244
δ	0.5
p	0.667

Basic Reproduction Number (2)

$$R_0 = (1988)(0.000201207243)[\frac{0.667}{0.244} + \frac{0.5(1-.667)}{0.244}]$$

$$R_0 = 0.4[2.73360656 + 0.682377049]$$

$$R_0 = 1.36639344$$

Final Relation

$$S_0[ln(S_0) - ln(S_\infty)] = R_0(S_0 - S_\infty) + \frac{R_0 I_0}{\alpha[\frac{p}{\alpha} + \frac{\delta(1-p)}{\eta}]}$$

$$1988[ln(1988) - ln(S_\infty)] = 1.36639344(1988 - S_\infty) + \frac{1.36639344(12)}{(0.244)3.41598361}$$

$$15098.6302 - 1988 ln S_\infty = 2716.39016 - 1.36639344(S_\infty) + 19.67213109$$

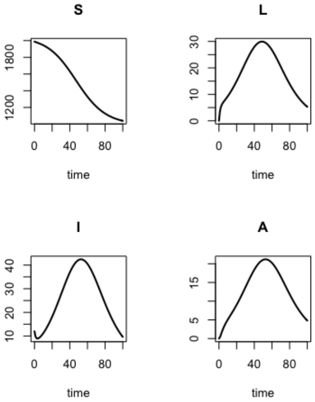
$$12362.5679 - 1988 ln S_\infty = -1.36639344 S_\infty$$

$$S_\infty = 994.173$$

R Code

Use R to find the curves of the SLAIR Model

Curves of SLIAR Model



SIR Model

$$\frac{dS}{dt} = -\frac{\beta}{N} S(t) I(t)$$

$$\frac{dI}{dt} = \frac{\beta}{N} S(t) I(t) - \gamma I(t)$$

$$\frac{dS}{dt} = \gamma I(t)$$

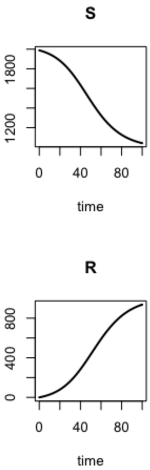
Use R to find beta and gamma.

Beta & Gamma

	Estimate	Std. Error	t value	Pr(>|t|)
beta	0.2355422	0.0004309	546.6	<2e-16
gamma	0.1709625	0.0003960	431.7	<2e-16

$R_0 = \frac{\beta}{\gamma} = \frac{0.2355422}{0.1709625} = 1.3777419$ compared to 1.36639344 from SLIAR model.

Curves of SIR Model



Comparison of I(t) Curves

Use Excel to compare curves.

Explicit Relation between A and I

$$I' = p\kappa L - \alpha I \ , A' = (1-p)\kappa L - \eta A$$

$$e^{\alpha t} I(t) = I(0) + p\kappa \int_0^t e^{\alpha s} L(s) ds$$

$$e^{\eta t} A(t) = A(0) + (1-p)\kappa \int_0^t e^{\eta s} L(s) ds$$

$$\eta = \alpha$$

Using $\int_0^t e^{\alpha s} L(s) ds$, a relationship between A and I occurs.

$$I(t) - e^{\alpha t} I(0) = \frac{p}{1-p}[A(t) - e^{-\alpha t} A(0)]$$