**Figure 2**: Model Options for Analysis, for county *i* in year *j*:

*Observed LC Cases­­ij ~ Poisson (Expected LC Casesij \* RRij)*

1. BYM, separate spatial & temporal: log (RRij) = α + msi + rsi + tj + δij where
   1. α is the intercept
   2. msi is a spatial effects parameter for county i via a BYM model
   3. rsi is a spatial effects parameter for county i via an *iid* model
   4. tj is a temporal effects parameter in year j via a second-order random walk model
   5. δij is a spatiotemporal effects parameter for county i in year j via an *iid* model
2. BYM: log (RRij) = α + msi + tj + δij where
   1. α is the intercept
   2. msi is a spatial effects parameter for county i via a BYM model
   3. tj is a temporal effects parameter in year j via a second-order random walk model
   4. δij is a spatiotemporal effects parameter for county i in year j via an *iid* model
3. Besag: log (RRij) = α + msi + tj + δij where
   1. α is the intercept
   2. msi is a spatial effects parameter for county i via a Besag model
   3. tj is a temporal effects parameter in year j via a second-order random walk model
   4. δij is a spatiotemporal effects parameter for county i in year j via an *iid* model
4. Besag Proper: log (RRij) = α + msi + tj + δij where
   1. α is the intercept
   2. msi is a spatial effects parameter for county i via a Besag Proper model
   3. tj is a temporal effects parameter in year j via a second-order random walk model
   4. δij is a spatiotemporal effects parameter for county i in year j via an *iid* model
5. Leroux-Bernardinelli: log (RRij) = α + msi + tj + δij where
   1. α is the intercept
   2. msi is a spatial effects parameter for county i via a Leroux model
   3. tj is a temporal effects parameter in year j via a second-order random walk model
   4. δij is a spatiotemporal effects parameter for county i in year j via an *iid* model
6. Time as a Linear Covariate: log (RRij) = α + j\*tcj + msi + tj + δij where
   1. α is the intercept
   2. tcj is a “time covariate” for year j and represents the effects of the year (indexed from 1995 to 2015) as a linear relationship
   3. msi is a spatial effects parameter for county i via a Leroux model
   4. tj is a temporal effects parameter in year j via an *iid* model
   5. δij is a spatiotemporal effects parameter for county i in year j via an *iid* model
7. Gaussian with Log of Response Variable: log(*Observed LC Cases­­ij*) *~ Normal (Expected LC Casesij \* RRij)*

log (RRij) = α + msi + tj + δij where

* 1. α is the intercept
  2. msi is a spatial effects parameter for county i via a Leroux model
  3. tj is a temporal effects parameter in year j via a second-order random walk model
  4. δij is a spatiotemporal effects parameter for county i in year j via an *iid* model

**Figure 3**: Model Adequacy Assessment Results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Model** | **Data** | **WAIC** | **DIC** | **CPO** | **Sum** |
| 1: BYM, separate spatial & temporal | All | 28697.52 | 28619.27 | 14350.64 |  |
| Adenocarcinoma | 22298.07 | 22250.49 | 11150.26 |  |
| Squamous | 20841.84 | 20807.49 | 10422.17 |  |
| Small cell | 17878.81 | 17859.06 | 8940.156 |  |
| Other Non-small | 18933.81 | 18862.86 | 9468.763 | 271381.209 |
| 2: BYM | All | 28455.35 | 28423.39 | 14315.29 |  |
| Adenocarcinoma | 22213.78 | 22178.72 | 11157.21 |  |
| Squamous | 20839.03 | 20809.49 | 10443.66 |  |
| Small cell | 17905.18 | 17885.04 | 8960.864 |  |
| Other Non-small | 18915.8 | 18869.93 | 9552.883 | 270925.617 |
| 3: Besag | All | 28464.17 | 28425.43 | 14320.05 |  |
| Adenocarcinoma | 22222.79 | 22190.01 | 11165.38 |  |
| Squamous | 20850.83 | 20822.14 | 10450.33 |  |
| Small cell | 17949.01 | 17930.23 | 8974.775 |  |
| Other Non-small | 18927 | 18881.46 | 9558.521 | 271132.126 |
| 4: Besag Proper | All | 28457.76 | 28419.08 | 14316.7 |  |
| Adenocarcinoma | 22214.06 | 22180.71 | 11160.47 |  |
| Squamous | 20841.88 | 20813.24 | 10445.78 |  |
| Small cell | 17938.26 | 17919.43 | 8969.396 |  |
| Other Non-small | 18920.23 | 18874.45 | 9554.88 | 271026.326 |
| 5: Leroux-Bernardinelli | All | 28452.26 | 28413.52 | 14314.62 |  |
| Adenocarcinoma | 22207.63 | 22176.33 | 11157.01 |  |
| Squamous | 20837.78 | 20809.93 | 10443.11 |  |
| Small cell | 17904.77 | 17884.87 | 8960.087 |  |
| Other Non-small | 18917.09 | 18873.45 | 9553.719 | 270906.176 |
| 6: Time as a linear covariate | All | 28461.78 | 28421.16 | 14316.45 |  |
| Adenocarcinoma | 22212.04 | 22177.18 | 11157.56 |  |
| Squamous | 20837.85 | 20810.25 | 10442.15 |  |
| Small cell | 17903.15 | 17885 | 8959.18 |  |
| Other Non-small | 18914.31 | 18867.86 | 9552.48 | 270918.4 |
| 7: Gaussian with log of Response Variable | All | 24879.91 | 24935.04 | 13089.08 |  |
| Adenocarcinoma | 28176.56 | 28231.54 | 14702.81 |  |
| Squamous | 28538.8 | 28547.89 | 14906.38 |  |
| Small cell | 29761.86 | 29781.89 | 15522.02 |  |
| Other Non-small | 30111.95 | 30124.59 | 15460.42 | 356770.74 |

*Although this model 6 performed well for this data-set, it’s unlikely to perform well given data-sets that span larger time intervals as the temporal trend will inevitably change.*

**Figure 9**: Modeled (Eq. 4 & 5) Relative Risk (RR) by County in 1995, 2000, 2005, 2010 & 2015 for Adenocarcinoma

A close up of a map

Description automatically generated

**Figure 10**: Modeled (Eq. 4 & 5) Relative Risk (RR) by County in 1995, 2000, 2005, 2010 & 2015 for Small Cell Carcinoma

A close up of a map

Description automatically generated

**Figure 11**: Modeled (Eq. 4 & 5) Relative Risk (RR) by County in 1995, 2000, 2005, 2010 & 2015 for Squamous Cell Carcinoma

A close up of a map

Description automatically generated

**Figure 12**: Modeled (Eq. 4 & 5) Relative Risk (RR) by County in 1995, 2000, 2005, 2010 & 2015 for Other Non-Small Cell Carcinomas

A close up of a map

Description automatically generated

**Figure 15**: Relative Risk (RR) by County in Texas in 2015 for All Histologic Types of Cancer with Rurality & Poverty as Covariates of RR

A close up of a map

Description automatically generated

**Figure 18:** Distribution of COVID-19 Cumulative Case Rate (3/4/20 – 8/21/20) Parameter with Cumulative (1995-2017) Lung Cancer Death Rate as Response Variable

A picture containing kitchen, sitting, large, light

Description automatically generated

**Figure 19:** Distribution of COVID-19 Cumulative Case Rate (3/4/20 – 8/21/20) Parameter with Lung Cancer Diagnoses Rate in 2017 as Response Variable

A picture containing sitting, table, large, kitchen

Description automatically generated

**Figure 20:** Distribution of COVID-19 Cumulative Death Rate (3/4/20 – 8/21/20) Parameter with Cumulative (1995-2017) Lung Cancer Death Rate as Response Variable

A picture containing sitting, table, kitchen, hanging

Description automatically generated

**Figure 21:** Distribution of COVID-19 Cumulative Death Rate (3/4/20 – 8/21/20) Parameter with Lung Cancer Diagnoses Rate in 2017 as Response Variable

A picture containing sitting, hanging, light, table

Description automatically generated