The Amenable Vision Loss Index: How Well Are Eye Care Systems Preventing Blindness and Distance Vision Loss

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Abstract

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The Amenable Vision Loss Index was created as a tool for evaluating eye care systems by measuring their ability to reduce disease burden due to two causes of blindness and distance vision loss: uncorrected refractive error and cataract. Separate indices for cataract and uncorrected refractive error measured the ability of health systems to address the disease burden due to each cause. The Amenable Vision Loss Index was made by combining risk-standardized, age-standardized, and severity-weighted prevalence of uncorrected refractive error and cataract into one index score. The Cataract Index and Uncorrected Refractive Error Index were formulated using the same methods. In 2016, Sweden, Canada, and the USA had the best Amenable Vision Loss Index scores and Myanmar, Cambodia, and Timor-Leste had the worst scores. The correlation between the Amenable Vision Loss Index and the Socio-Demographic Index (SDI) was lower than expected a priori; the r-squared was 0.4. In general, index scores improved between 1990 and 2016, though improvement was not ubiquitous. Improvements in Amenable Vision Loss Index scores between 1990 and 2016 were modest and improvements in Cataract Index scores were minimal: 12.78% (8.52% to 16.83%) and 2.85% (-7.8% to 14.26%), respectively. The UREI saw the largest improvement at 17.89% (15.74% - 20.32%).

Introduction

Background and Significance

Based on a systematic review of papers on causes of death which are "amenable to health care ([that is,] amenable mortality)," Nolte and McKee formulated a pragmatic set of causes of death that can largely be averted through accessible, high-quality healthcare. (1 p8) A paper by Rustein et alia, published in 1976, (2) was a seminal work in defining which causes of mortality should be studied in an amenable mortality analysis. (1) Rustein et al. proposed that quantifying the incidence and/or mortality of their list of preventable and/or treatable illnesses – which included a mix of acute and chronic causes of death and disease, maternal mortality, and complications resulting from rubella (including cataract) – would provide a measure of healthcare quality. (2) The literature on amenable mortality that follows Rustein et al. studies amenable disease burden in multiple locations, using different age ranges, and including different causes of death. (1) Another paper, by Charlton et alia, (3) furthered the study of amenable burden through being "the first to apply this concept at the population level to analyse regional variation in mortality". (1 p19) Somewhat similar to Charlton et alia, (3) Nolte and McKee's list of causes of amenable mortality was used to measure country-level amenable mortality rates in the European Union (EU) to identify pain points in health service delivery in the EU. (1)

Using mortality rates due to amenable causes (referencing the causes of amenable death presented by Nolte and McKee), Barber et al. sought "to approximate access to and quality of personal health care" through the development of the Healthcare Access and Quality Index (HAQI). (4 p234) The HAQI was generated through principal components analysis and is reflective of how well a health system prevents amenable death (as a proxy for a health system's overall quality and accessibility). The HAQI can impact policy in a myriad of ways, including

through improving the understanding of the effect of health systems. In addition to including more causes of death, including causes of morbidity in the HAQI is a potential path forward for the HAQI. (4,5)

Amenable vision loss can be defined as vision loss that, with access to high-quality healthcare, is highly curable. Since there are effective curative treatments for uncorrected refractive error and cataract, (6,7) both causes of vision loss can be included in this analysis. Interventions for reducing the burden of cataract and uncorrected refractive error include reducing barriers to cataract surgery and providing funding for glasses. (6) Locations with high levels of vision loss due to refractive error and cataract have a clear, unmet need. Other causes of vision loss, such as trachoma, could potentially be labelled as amenable causes of morbidity, (6) but the current formulation of the AVLI only includes distance vision impairment due to uncorrected refractive error and cataract.

Specific aims

Aim #1— The goal of the analysis was to create a proxy for the performance of eye care systems globally through quantifying their ability to prevent blindness and distance vision loss due to cataract and uncorrected refractive error. To create the proxy, the prevalence of blindness, moderate distance vision loss, and severe distance vision loss due to age- and risk-standardized cataract and age-standardized uncorrected refractive error were used to create the Amenable Vision Loss Index (AVLI), the Uncorrected Refractive Error Index (UREI), and the Cataract Index (CI).

Aim #2— The plausibility of the AVLI was tested through measuring the correlation (specifically the r-squared) between AVLI scores and the most recent HAQI scores and GBD 2016 Socio-Demographic Index (SDI) scores.

Methods

Data

The input data was comprised of estimates from the GBD 2016 study:

- age-standardized prevalence of vision loss due to uncorrected refractive error,
- age-standardized prevalence of vision loss due to cataract,
- disability weights for three vision loss severities (blindness, moderate distance vision loss, and severe distance vision loss), (8)
- age-standardized proportions of cataract years lived with disability (YLDs) due to risk factors, and
- SDI. (9)

One thousand draws of the prevalence estimates (prevalence estimates were age-standardized, location and year specific, and for both sexes) and disability weights were available from GBD 2016. (8) Means and uncertainty bounds of age-standardized proportions of cataract YLDs due to risks (proportions were location and year specific and for both sexes) were available from GBD 2016. (9) A normal distribution was used to create one thousand draws of proportions of cataract YLDs due to risks.[1] Draws of SDI— which is "a composite indicator of development status"— were not published for GBD, so there was only one SDI value for each location and year in the analysis. (9 p1365) Disability weight means and uncertainty intervals for the three levels of distance vision loss severity in GBD are shown below.[2]

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[1] The standard deviation of the normal distribution was estimated using the following formula: $standard\ deviation = \frac{(mean\ value - lower\ UI\ value) + (upper\ UI\ value - mean\ value)}{2 * 1.96}$.

[2] Table 1: Distance Vision Loss Disability Weights was taken from page 706 of Vos et al., Supplementary appendix 1. (8)

Table 1: Distance Vision Loss Disability Weights

Health state name	Health state description	Disability weight
Distance vision, severe impairment	This person has severe vision loss, which causes difficulty in daily activities, some emotional impact (for example, worry), and some difficulty going outside the home without assistance.	0.184 (0.125–0.259)
Distance vision, moderate impairment	This person has vision problems that make it difficult to recognize faces or objects across a room.	0.031 (0.019–0.049)
Distance vision blindness	This person is completely blind, which causes great difficulty in some daily activities, worry and anxiety, and great difficulty going outside the home without assistance.	0.187 (0.124–0.26)

Subnational estimates for the US, Mexico, UK, Brazil, Sweden, and Japan were included in the AVLI, UREI, and CI since subnational estimates for those countries are publicly available on IHME's website for GBD 2016 (https://vizhub.healthdata.org/gbd-compare/). (10)

Risk-standardization

Similarly to how risk-standardization was a step in creating the HAQI, (4,5) cataract prevalence was risk-standardized prior to creating the AVLI and CI. Smoking, high body mass index, high fasting plasma glucose (FPG), sweetened drinks, and household air pollution contribute to the burden of cataract in GBD 2016. (11) These four risk factors caused 34.53% (28.52%—41.6%) of YLDs due to cataract globally in 2016 among both sexes and all ages. (12) Risk-standardization of location-specific exposures to these risk factors was necessary for the creation of the CI and AVLI since "equal [health] outcomes might be achieved…by ineffective services supplied to low risk populations or by highly effective services supplied to high risk populations". (13 p1) Therefore, the use of non-risk-standardized estimates of cataract prevalence would bias CI and AVLI scores.

Risk-standardization entailed multiplying the severity-specific, age-standardized prevalence of cataract by one minus the age-standardized proportion of cataract YLDs due to risks (PAF)[3]:

$$RSCP_{S,L,Y} = CP_{S,L,Y} * (1 - P_{L,Y})$$

where $RSCP_{S,L,Y}$ is risk-standardized, age-standardized, cataract prevalence; $CP_{S,L,Y}$ is age-standardized cataract prevalence; and $P_{L,Y}$ is the PAF. With regards to the subscripts, S is a distance severity of vision loss due to cataract, L is a GBD location, and Y is a year between 1990 and 2016. All measures are for both males and females. The risk-standardization process sets risk exposure to zero in all locations. The risk-standardization process used here is different from the HAQI risk-standardization method. The HAQI method does not set the risk exposure to zero, but rather uses one exposure (the global average) for all of the standardized risk factors in each location. (4,5) Risk-standardizing to zero exposure and using the global average risk exposures would both work for creating the AVLI and CI, but risk-standardizing exposure to be zero is conceptually simpler and easier to implement. Uncorrected refractive error prevalence rates were not risk-standardized since none of the burden due to uncorrected refractive error is due to risks in the GBD 2016 framework. (14) It is important to note that the previous iterations of the HAQI did not include high FPG in the risk-standardization work, given that the health

[3] The formula is similar to the risk-standardization formula provided by Fullman et alia, found on page 11 of their Supplementary appendix, (5) and the formula provided by Barber et al., found on page 6 of their Supplementary appendix. (4) However, the formula used in the HAQI studies included a term to set the risk exposure to be the global average for all of the standardized risk factors in each location (after first setting the exposure to zero). The HAQI method also referred to risk-standardizing a mortality rate, (4,5) whereas the AVLI and CI risk-standardization formula does not include a term to set the risk exposure to be the global average after setting the exposure of all risks to zero and refers to risk-standardizing prevalence.

system has a marked effect on FPG. (4,5) However, the focus of this analysis was on optical care and therefore high FPG can be included in the risk-standardization process.

Index Creation

To create the index, age-standardized (and risk-standardized for cataract) prevalence of moderate vision loss, severe vision loss, and blindness due to refractive error and cataract were aggregated together after weighting each severity category by its disability weight. Index scores were therefore influenced by the location-specific levels of vision loss as well the location-specific severity distributions. In addition to a single index combining both cataract and refractive error, cause-specific indexes were created for both causes of vision loss to evaluate the performance of eye care systems regarding each cause of vision loss separately as well.

The formulas below were used to generate the combined pre-normalized AVLI as well as the weighted prevalence of each cause of vision loss:

$$URE_{L,Y} = \sum_{S} (RE_{S,L,Y} * DW_s)$$

$$C_{L,Y} = \sum_{S} (CAT_{S,L,Y} * DW_s)$$

$$AVLI_{L,Y} = C_{L,Y} + URE_{L,Y}$$

where $URE_{L,Y}$ is weighted uncorrected refractive error prevalence; $RE_{S,L,Y}$ is the age-standardized prevalence of uncorrected refractive error; DW_S is the disability weight; $C_{L,Y}$ is weighted cataract prevalence; $CAT_{S,L,Y}$ is the age- and risk-standardized prevalence of cataract. With regards to the subscripts, S is a severity level of vision loss (moderate, severe, or blindness), L is a GBD location, and Y is a year between 1990 and 2016. All measures are for both males and females.

The following formula normalized the pre-normalized AVLI and cause-specific weighted prevalence rates to create the final index scores (the formula led to final index values between 0 and 100):[4]

$$FI_{L,Y} = [1 - \left(\frac{\log(UI_{L,Y}) - first\ percentile(\log(UI_{L,Y}))}{99th\ percentile(\log(UI_{L,Y})) - first\ percentile(\log(UI_{L,Y}))}\right)] * 100$$

where $FI_{L,Y}$ is the final index score in a GBD location and year between 1990 and 2016. Similarly to the most recent HAQI study, (5) subnational locations were not allowed to set the final index minimum or maximum and locations with scores lower than the 1st percentile or higher than the 99th percentile were capped at the 1st and 99th percentile of all index values in any year (by draw), respectively, prior to calibrating the score to fit between 0 and 100.

Results

Index Scores

Sweden, Canada, and the USA were the top three best performing countries and Myanmar, Cambodia, and Timor-Leste were the bottom three performing countries in 2016 according to the AVLI Index (Figure 1). High-Income North America was the best performing GBD region and South Asia was the lowest performing GBD region in 2016 in the AVLI Index (results for all locations are available in Appendix 2A). With regards to the 2016 UREI, Sweden, Canada, and the US were the highest performing countries and Myanmar, Timor-Leste, and Egypt were the lowest performing countries (Figure 2). South Asia had the lowest UREI score of any GBD region and High-Income North America had the highest UREI score of any GBD region (results for all locations are available in Appendix 2B). With regards to the 2016 CI scores, The Netherlands, Canada, and the US were the top performers and Benin, Mali, and

[4] The formula is a revision of a formula provided by Fullman et al., found on page 11 of the Supplementary appendix. (5)

Bangladesh were the worst performers (Figure 3). Western Sub-Saharan Africa was the worst performing GBD region and High-Income North America was again the top performing GBD region in 2016 in terms of CI scores (results for all locations are available in Appendix 2C).

Figure 1: Map of Amenable Vision Loss Index, 2016

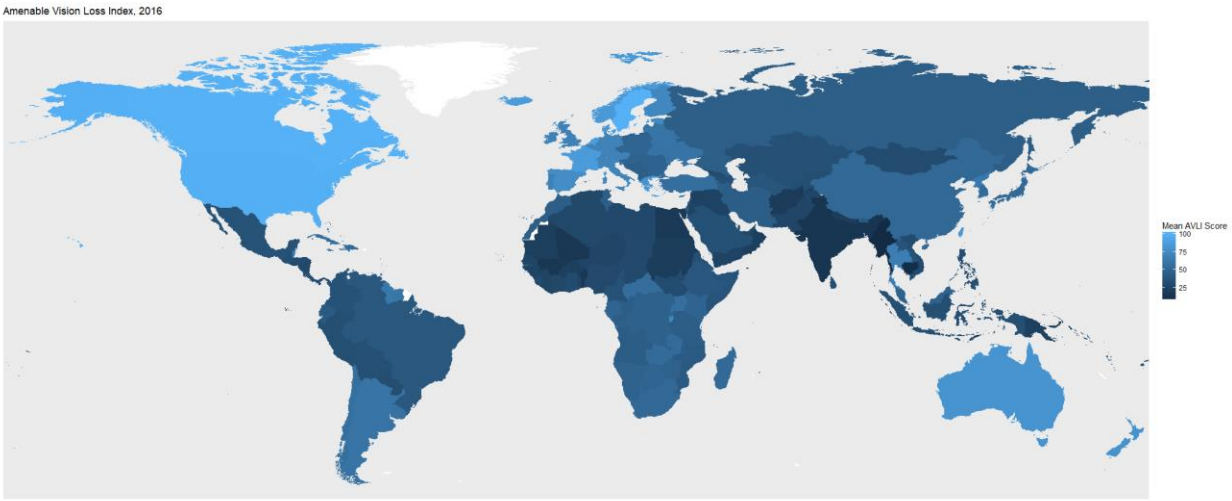


Figure 2: Map of Uncorrected Refractive Error Index, 2016

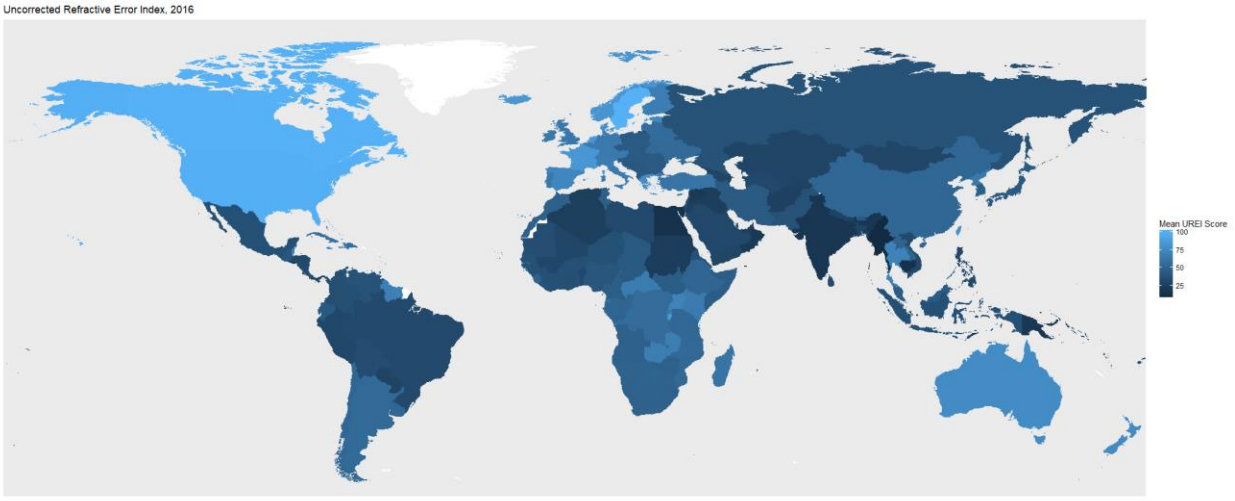
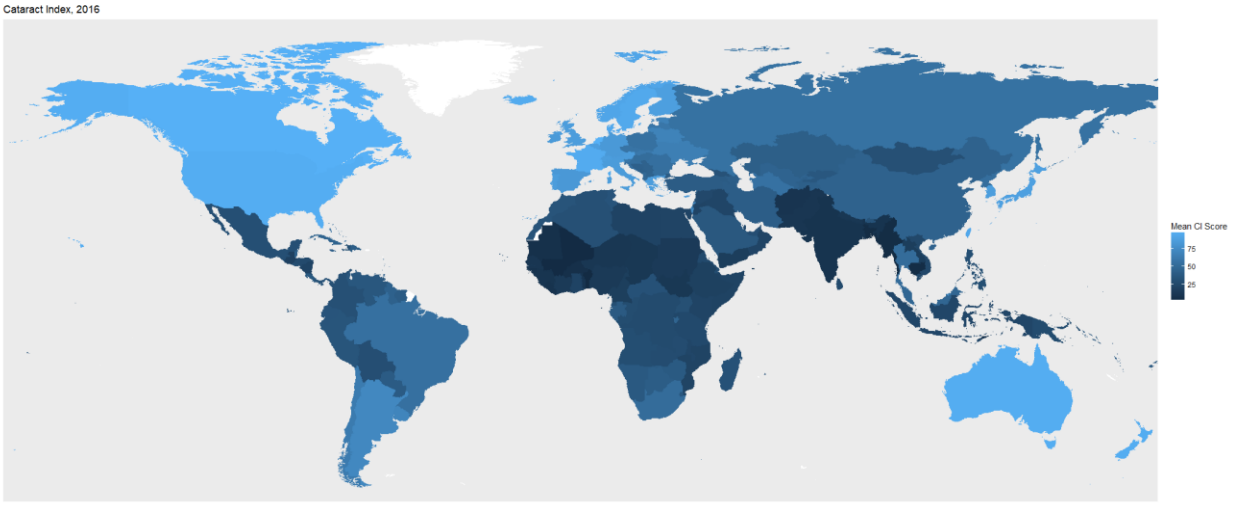


Figure 3: Map of Cataract Index, 2016



Subnational AVLI scores in the US were fairly clustered together, from 98.11 (96.84 – 99.55) in Idaho to 99.98 (99.77 – 100) in Georgia in 2016. The same goes for Japan, where 2016

AVLI scores were lowest in Okinawa and highest in Tokyo: 51.83 (48.57 – 55.22) and 52.90 (49.72 – 56.1), respectively. A slightly larger difference occurred in Mexico in 2016, where scores were lowest in Guerrero and highest in Mexico City: 33.24 (30.69 – 35.94) and 38.03 (35.15 – 41.03), respectively. In Brazil, the lowest 2016 AVLI score was in Tocantins and the highest 2016 AVLI score was in Distrito Federal: 30.11 (28.06 – 32.09) and 44.58 (42.43 – 46.80), respectively. In the UK, the lowest 2016 AVLI score was in West Midlands and the highest 2016 AVLI score was in Northern Ireland: 68.13 (65.93 – 70.35) and 89.64 (87.88 – 91.56), respectively.

Change from 1990 – 2016

The percent changes in mean SDI, AVLI, UREI, and CI between 1990 and 2016 are presented below for the world, GBD regions, and GBD super-regions in Table 2 (values for all locations are available in Appendix 3A). The AVLI scores increased by 12.78% (8.52% to 16.83%)%, with the vast majority of the improvement in the AVLI coming from improvements in UREI scores over time (there was a 17.89% (15.74 % to 20.32%) increase in UREI scores between 1990 and 2016, but only a 2.85% (-7.8% to 14.26%) increase in CI scores). The GBD region with the most marked relative improvements in AVLI and UREI between 1990 and 2016, by far, was South Asia: 192.5% (121.55% to 301.1%) and 287.37 (193.83 to 454.66), respectively. The GBD region with the most marked relative improvements in CI was Southeast Asia: 80.13 (50.21 - 117.8). Two GBD regions (Western Sub-Saharan Africa and High-Income North America) had mean negative relative changes in AVLI and UREI. No GBD region or super-region had negative relative changes in CI scores. In terms of countries, Burkina Faso, Cote d'Ivoire, and Benin saw the worst changes in AVLI over time. Myanmar, Timor-Leste, and Oman saw the largest relative gains in AVLI.

Table 2: Percent Change Over Time

Location	% Change SDI	% Change AVLI	% Change CI	% Change UREI
Global	21.08	12.78 (8.52 - 16.83)	2.85 (-7.8 - 14.26)	17.89 (15.74 - 20.32)
Southeast Asia, East Asia, and Oceania	37.93	19.19 (14.93 - 24.01)	16.56 (5.84 - 27.45)	20.45 (16.15 - 25.36)
East Asia	39.14	10.21 (5.85 - 14.99)	1.13 (-6.77 - 10.13)	14.41 (9.01 - 20.46)
Southeast Asia	34.73	64.67 (54.36 - 75.93)	80.13 (50.21 - 117.8)	53.22 (48.55 - 58.82)
Oceania	27.64	13.64 (6.24 - 21.58)	10.51 (-2.43 - 25.75)	17.43 (8.63 - 26.47)
Central Europe, Eastern Europe, and Central Asia	10.33	4.69 (1.32 - 8.01)	9.05 (-3.01 - 21.99)	3.72 (1.67 - 5.76)
Central Asia	16.78	11.78 (6.48 - 17.19)	23.96 (7.14 - 40.72)	6.92 (3.94 - 10.17)
Central Europe	14.53	9.64 (6.47 - 13)	19.55 (8.12 - 32.49)	6.87 (4.96 - 8.99)
Eastern Europe	8.02	3.22 (-0.56 - 6.94)	1.46 (-11.2 - 15.25)	4.32 (0.74 - 7.89)
High-income	8.58	4.55 (3.24 - 5.94)	7.37 (-1.44 - 17.06)	4.7 (3.85 - 5.62)
High-income Asia Pacific	9.83	6.2 (4.6 - 7.92)	10.62 (-0.14 - 22.4)	7.16 (5.84 - 8.73)
Australasia	8.98	4.28 (2.29 - 6.27)	3.6 (-3.93 - 10.88)	4.95 (2.83 - 7.09)
Western Europe	9.32	4.74 (3.04 - 6.4)	8.86 (-1.29 - 18.14)	4.62 (3.29 - 5.99)
Southern Latin America	20.39	13.11 (9.76 - 16.25)	12.99 (1.61 - 24.84)	14.93 (11.63 - 18.26)
High-income North America	5.62	-0.66 (-1.78 - 0.41)	0.92 (-5.93 - 7.37)	-1.04 (-1.51 - -0.45)
Latin America and Caribbean	29.03	28.95 (21.03 - 36.78)	38.87 (16.72 - 64.31)	25.02 (21.92 - 28.47)
Caribbean	18.27	11.52 (6.26 - 16.51)	18.57 (1.91 - 36.41)	8.52 (6.85 - 10.36)
Andean Latin America	27.18	47.19 (35.03 - 59.95)	54.11 (24.6 - 86.19)	43.19 (34.04 - 53.45)
Central Latin America	30.87	33.38 (22.02 - 45.1)	41.12 (10.19 - 76.96)	28.69 (25 - 32.98)
Tropical Latin America	31.18	30.45 (25.65 - 35.2)	44.53 (28.37 - 62.38)	29.56 (25.9 - 33.49)
North Africa and Middle East	41.87	64.27 (46.21 - 82.71)	50.3 (13.8 - 97.17)	71.3 (63.37 - 84.42)
South Asia	63.1	192.5 (121.55 - 301.1)	33.65 (-26.06 - 121.69)	287.37 (193.83 - 454.66)
Sub-Saharan Africa	44	5.16 (-0.55 - 10.82)	5.22 (-10.3 - 21.68)	5 (2.89 - 7.3)
Central Sub-Saharan Africa	36.18	5.48 (1.1 - 10.22)	10.72 (-2 - 26.08)	2.98 (0.45 - 5.74)
Eastern Sub-Saharan Africa	69.51	14.84 (9.53 - 19.67)	6.79 (-6.43 - 20.71)	18.34 (16.13 - 20.51)
Southern Sub-Saharan Africa	23.9	5.47 (2.62 - 8.59)	16.36 (6.38 - 27.76)	1.53 (0.18 - 3.07)
Western Sub-Saharan Africa	49.15	-4.52 (-12.4 - 3.53)	1.26 (-23.32 - 30.84)	-6.29 (-10.6 - -1.99)

The absolute changes in mean SDI, AVLI, UREI, and CI between 1990 and 2016 are presented for the world, GBD regions, and GBD super-regions in Table 3 (values for all locations are available in Appendix 3B). Southeast Asia saw the largest absolute gain in ALVI: 12.96 (11.35 –14.67). South Asia had the most marked increase in absolute UREI; the score increased by 14.99 (13.82 - 16.12) from 1990 to 2016. Tropical Latin America's CI score increased by 16.67 (11.29 - 22.37) from 1990 to 2016, which was the largest increase of any GBD region. In terms of countries Cote d'Ivoire, and Burkina Faso had the worst absolute change in AVLI scores. Saudi Arabia, Oman, and the Maldives saw the greatest absolute improvement in terms of AVLI. The r-squared between the absolute change in AVLI and the absolute change in SDI was 0.51.

Table 3: Absolute Change Over Time

Location	Abs. Change SDI	Abs. Change AVLI	Abs. Change CI	Abs. Change UREI
Global	0.12	4.76 (3.27 - 6.2)	0.96 (-2.81 - 4.83)	6.43 (5.73 - 7.15)
Southeast Asia, East Asia, and Oceania	0.20	7.49 (5.98 - 9.13)	5.54 (2.09 - 9.17)	8.01 (6.45 - 9.69)
East Asia	0.20	4.84 (2.86 - 6.94)	0.48 (-3.04 - 4.32)	6.61 (4.29 - 9.02)
Southeast Asia	0.17	12.96 (11.35 - 14.67)	11.14 (7.89 - 14.57)	12.26 (11.48 - 13.08)
Oceania	0.11	3.23 (1.58 - 4.94)	3.24 (-0.85 - 7.72)	3.2 (1.73 - 4.68)
Central Europe, Eastern Europe, and Central Asia	0.08	2.05 (0.59 - 3.4)	4.43 (-1.54 - 10.39)	1.45 (0.66 - 2.22)
Central Asia	0.10	3.55 (2.01 - 5.04)	7.84 (2.51 - 12.75)	1.85 (1.1 - 2.62)
Central Europe	0.11	4.21 (2.9 - 5.48)	8.69 (3.76 - 13.93)	2.79 (2.06 - 3.56)
Eastern Europe	0.06	1.51 (-0.26 - 3.26)	0.7 (-7.07 - 8.6)	1.78 (0.31 - 3.13)
High-income	0.07	3.25 (2.33 - 4.17)	6.06 (-1.19 - 13.68)	3.15 (2.63 - 3.68)
High-income Asia Pacific	0.08	3.1 (2.32 - 3.94)	8.41 (-0.12 - 17.35)	2.96 (2.47 - 3.55)
Australasia	0.07	3.31 (1.78 - 4.75)	3.3 (-3.86 - 9.8)	3.61 (2.08 - 5.11)
Western Europe	0.07	3.33 (2.17 - 4.39)	7 (-1.07 - 14.21)	3.06 (2.25 - 3.86)
Southern Latin America	0.13	6.82 (5.22 - 8.32)	7.84 (1.07 - 14.54)	7.01 (5.62 - 8.37)
High-income North America	0.05	-0.66 (-1.78 - 0.41)	0.84 (-5.84 - 6.87)	-1.04 (-1.51 - -0.45)

Latin America and Caribbean	0.16	8.66 (6.62 - 10.58)	10.86 (5.04 - 16.87)	7.19 (6.6 - 7.8)
Caribbean	0.11	6.05 (3.44 - 8.49)	6.79 (0.77 - 12.69)	4.91 (4.05 - 5.81)
Andean Latin America	0.14	11.26 (8.87 - 13.61)	11.62 (5.87 - 17.17)	10.15 (8.46 - 11.83)
Central Latin America	0.17	8.84 (6.21 - 11.3)	8.55 (2.45 - 14.69)	8.02 (7.34 - 8.73)
Tropical Latin America	0.17	9.15 (7.93 - 10.35)	16.67 (11.29 - 22.37)	7.3 (6.65 - 7.91)
North Africa and Middle East	0.20	12.72 (10.02 - 15.37)	9.49 (2.89 - 16.01)	13.45 (12.47 - 14.48)
South Asia	0.22	9.83 (7.83 - 11.94)	1.72 (-1.98 - 5.35)	14.99 (13.82 - 16.12)
Sub-Saharan Africa	0.13	1.86 (-0.21 - 3.83)	0.97 (-2.24 - 3.87)	2.27 (1.32 - 3.29)
Central Sub-Saharan Africa	0.11	2.38 (0.49 - 4.36)	2.64 (-0.53 - 6.17)	1.57 (0.23 - 3.04)
Eastern Sub-Saharan Africa	0.16	5.75 (3.78 - 7.57)	1.4 (-1.56 - 4.16)	8.83 (7.84 - 9.86)
Southern Sub-Saharan Africa	0.13	2.61 (1.24 - 4.02)	6.73 (2.76 - 11.25)	0.74 (0.09 - 1.44)
Western Sub-Saharan Africa	0.14	-1.34 (-3.61 - 1)	0.04 (-3.05 - 3.12)	-2.61 (-4.47 - -0.8)

Scatter of AVLI and SDI

The r-squared for the relationship between location-specific AVLI and location-specific SDI scores in 2016 is 0.4 (Figure 4). Figures 5 shows 2016 UREI scores scattered against 2016 SDI scores; the r-squared was 0.21. Figures 6 shows 2016 CI scores scattered against 2016 SDI scores; the r-squared was 0.67, indicating that the Cataract Index was far more correlated with SDI than the Uncorrected Refractive Error Index. The r-squared between AVLI and HAQI scores in 2016 was 0.33 (Appendix 4).

Figure 4: Amenable Vision Loss Index and SDI

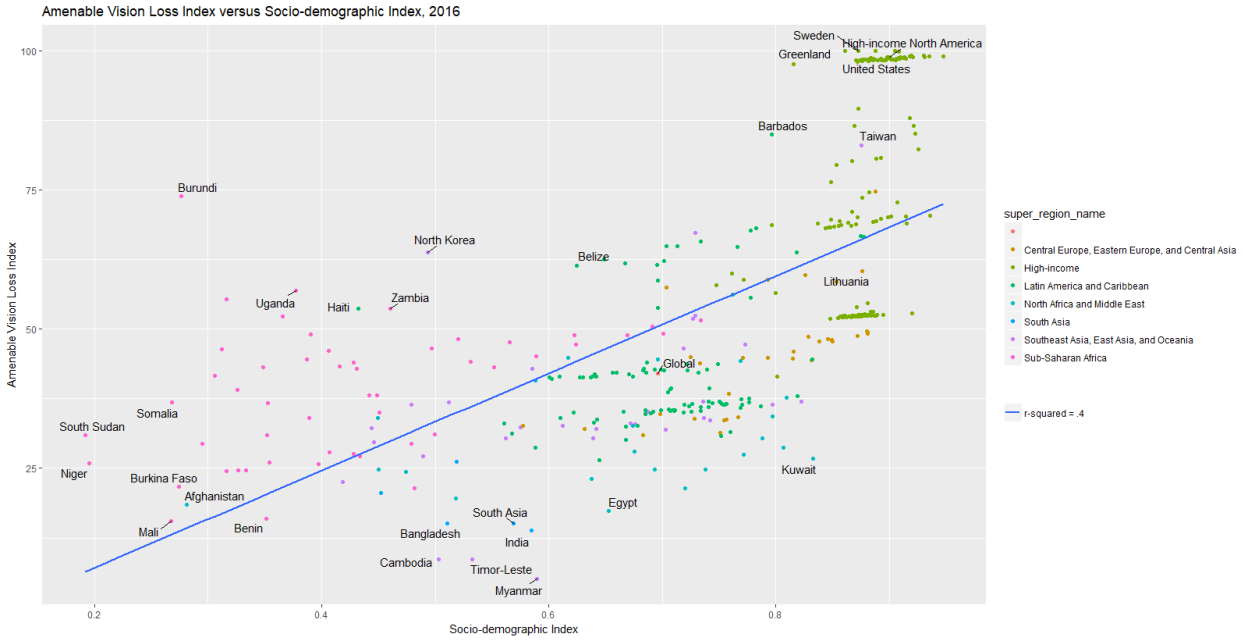


Figure 5: Uncorrected Refractive Error Index and SDI

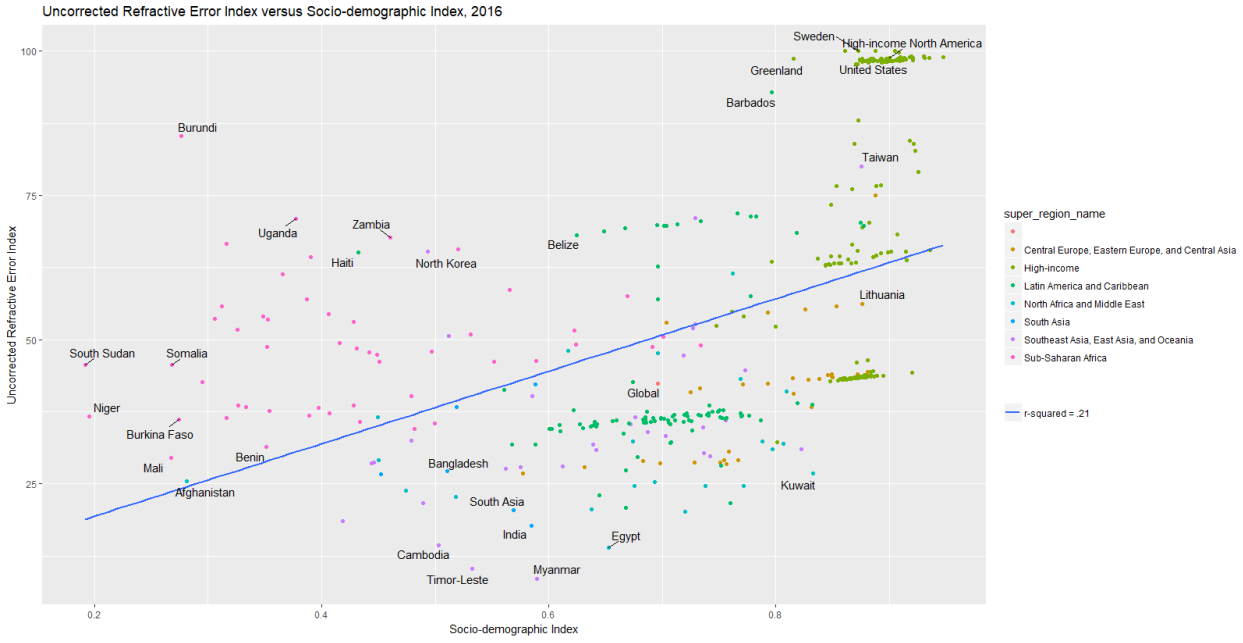


Figure 6: Cataract Index and SDI

Discussion

Comparisons to the HAQI

While both the AVLI and the most recently published HAQI share some similarities in terms of ranking (e.g. Western Europe performs quite well in both indexes), there were some key differences. For instance, Sub-Saharan Africa's AVLI scores were much higher relative to the rest of the world when compared to the HAQI and South Asia performed relatively much worse. The differences between subnational estimates in Japan were fairly trivial in both the AVLI and HAQI, but differences in the US were more pronounced in the HAQI than in the AVLI. Brazil, the UK, and Mexico subnational locations had relatively more unequal differences between the maximum and minimum values in each country when compared to Japan and the US in both the AVLI and HAQI. (5) The large difference in AVLI scores in the UK was mainly due to a high AVLI score in Northern Ireland— 89.64 (87.88 – 91.56); all of the other UK subnational location scores were contained within a narrower range, with mean AVLI scores ranging from

68.13 in West Midlands to 69.68 in Wales. Data sparsity in Northern Ireland – for instance, there were no data points for distance vision loss and blindness due to uncorrected refractive error between 1990 and 2016 in Northern Ireland – (15–17) casts doubt on the veracity of the results in Northern Ireland and therefore the relatively large difference in scores in the United Kingdom may also be spurious.

SDI and HAQI Correlations

As has been done in previous iterations of the HAQI, (4,5) the AVLI scores were compared to SDI scores. The AVLI scores were also compared to HAQI scores. Such comparisons can serve as a test on the plausibility of how well the AVLI quantifies the effect of eye care systems globally, similarly to how the incorporation of cancer MIRs into the HAQI was tested by comparing age-standardized MIRs and SDI scores. In the most recently published HAQI, Fullman et al. used SDI as a proxy for health system performance. (5) Similarly, Vos et al. argued in their Supplementary Appendix 1 that SDI is correlated with accessibility to optical healthcare, (8) and therefore SDI scores should be correlated with AVLI scores.

SDI and HAQI were both included as covariates in the GBD 2016 vision loss estimation process (as detailed in Supplementary Appendix 1 of Vos et al.), (8) yet the correlations between the AVLI and SDI and the AVLI and HAQI were not high; the r-squared values were .4 and .33 in 2016, respectively. The correlation between the CI and SDI was much stronger than the correlation between the AVLI and SDI. The unexpectedly low correlation between AVLI and SDI scores was due to a relatively weak correlation between the UREI and SDI, indicating that higher levels of development were rather weakly correlated with better refractive error care.

Complementary research

Nolte and McKee noted that amenable mortality can be viewed as "an indicator of potential weaknesses in health care that can then be investigated in more depth". (1 p8) Research that is more focused on specific countries and the policies affecting amenable vision loss in those countries could certainly complement the AVLI and improve vision loss globally. For instance, according to the AVLI, the eye care system in Burundi outperformed the rest of Sub-Saharan Africa in 2016. Location-specific research could potentially illuminate points of strength in Burundi's eye care system. Taiwan could also make an interesting case study, given that the largest absolute gain in CI between 1990 and 2016, 24.25, occurred in Taiwan (compared to a global gain in CI of 0.96). On the negative side of the spectrum, countries in South Asia, Southeast Asia, and North Africa and the Middle East had particularly low index scores given their levels of development. Studies on countries which perform particularly well on the AVLI, CI, and UREI could potentially reduce the burden of amenable vision loss globally through highlighting successful policy measures that could serve as a framework for countries that perform worse on the AVLI, CI, and UREI.

Limitations

The AVLI, UREI, and CI were limited by a number of risk factors that were unaccounted for in the analysis. For instance, there were no risk factors associated with uncorrected refractive error in GBD 2016. (14) However, there are likely genetic risk factors associated with refractive error, since previous "studies have shown a consistently higher prevalence of myopia among those with myopic parents as compared with those without". (18 p11) Furthermore, UV light was not included as a risk factor for cataract in GBD, (11) though Roberts definitively stated that exposure to UV-B and UV-A light causes cataracts. (19)

Similarly to previous iterations of the HAQI, (4,5) this analysis was subject to limitations outlined in GBD 2016, specifically with regards to limitations that affect the accuracy of the GBD 2016 uncorrected refractive error, cataract, SDI, and attributable risk estimates for cataract. (8,9) Issues with GBD 2016 that apply here include issues with the DisMod-MR 2.1 modeling approach, such as the assumption that "uncertainty of estimates over time is independent" and the notion that "compositional bias can lead to spurious time trends". (8 p1248) Also similar to the HAQI, (4,5) the AVLI, CI, and UREI cannot parse differences between access to vision loss care and quality of that care. Potential issues with data processing could bias the AVLI, CI, and UREI results. Vos et al. note in their Supplementary Appendix 1 that the analytical steps required to estimate vision loss and blindness globally include processing raw data reported in diverse formats to fit within GBD severity thresholds and parsing data points that apply to wide age groups to estimate vision loss prevalence within smaller age bins. In general, a lack of data and measurement error are both consistently issues for GBD 2016 non-fatal cause estimates. (8) The AVLI, UREI, and CI are limited by the amount of data in the vision loss and blindness estimates. For instance, the claim that Burundi's eye care system far outperforms the rest of Sub-Saharan Africa needs to be made cautiously since there were only two data sources that estimated the prevalence of vision loss and blindness due to cataract in in Burundi in GBD 2016. (20,21)

Conclusion

In general, conducting a study of amenable morbidity is more difficult than conducting a study of amenable mortality, given that there is relatively less comprehensive and less representative data available for the former. (1) In addition, the lack of risk-standardization for UV light and genetic risk factors was a major limitation of the AVLI. The lower correlation

between the UREI and SDI than the CI and SDI may have indicated that the absence of any risk factors for refractive error in the risk-standardization work was more limiting than the absence of UV light in the risk-standardization work. Even though the rate of improvement in the AVLI and CI does not match the rate of improvement in SDI, the AVLI was reasonably correlated with SDI and HAQI, indicating that the AVLI was a legitimate proxy for eye care system performance. Just as the HAQI is a proxy of the caliber and accessibility of health systems globally, (4,5) the AVLI can be viewed as a ranking mechanism that is indicative of the ability of eye care systems to provide effective and accessible care. The AVLI analysis can serve as a framework for future studies on amenable burden and can potentially contribute to future HAQI studies by providing some guidance on how to measure amenable morbidity.

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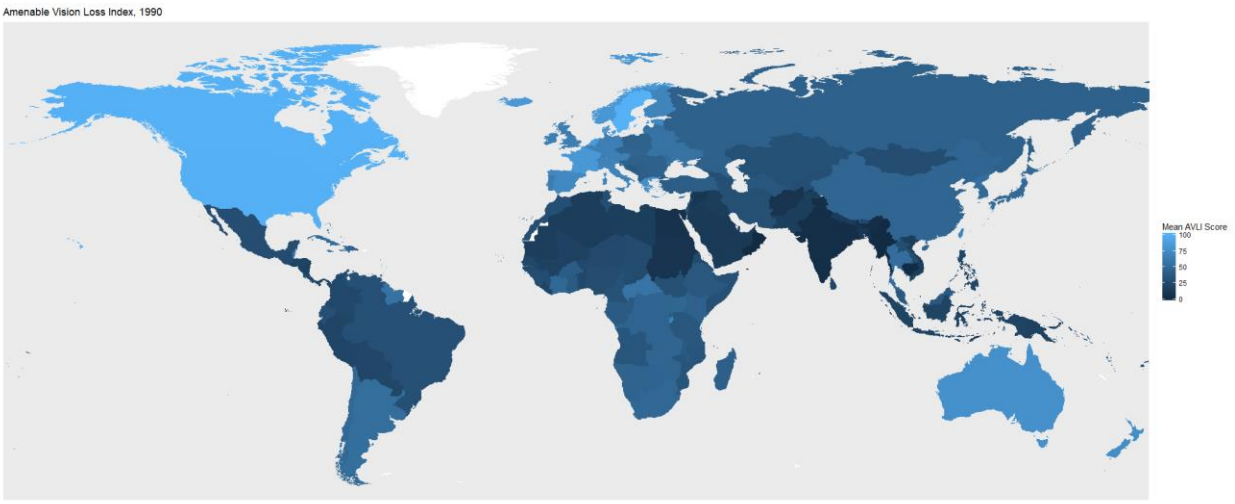
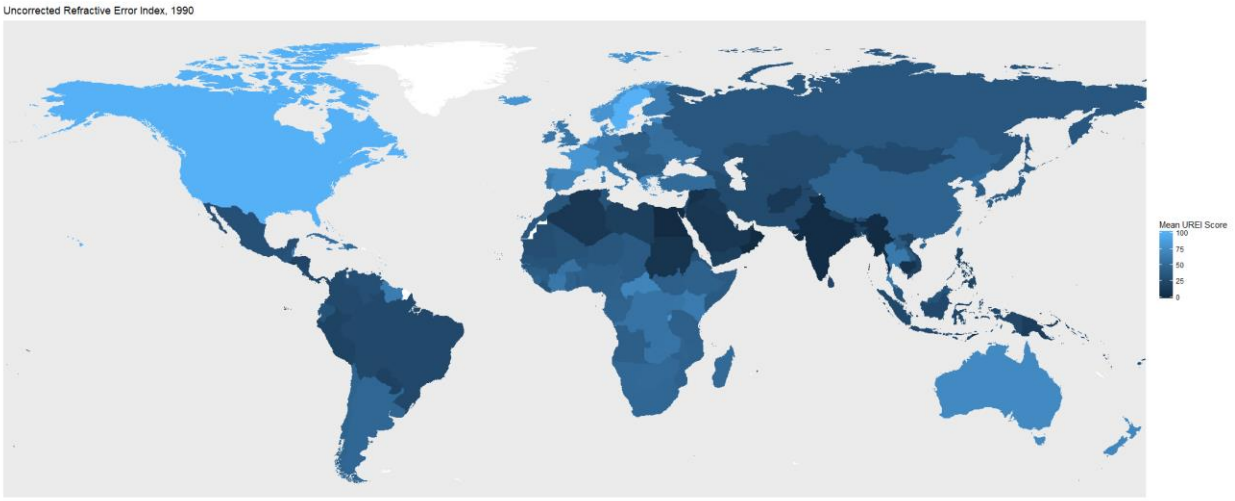
Appendix 1

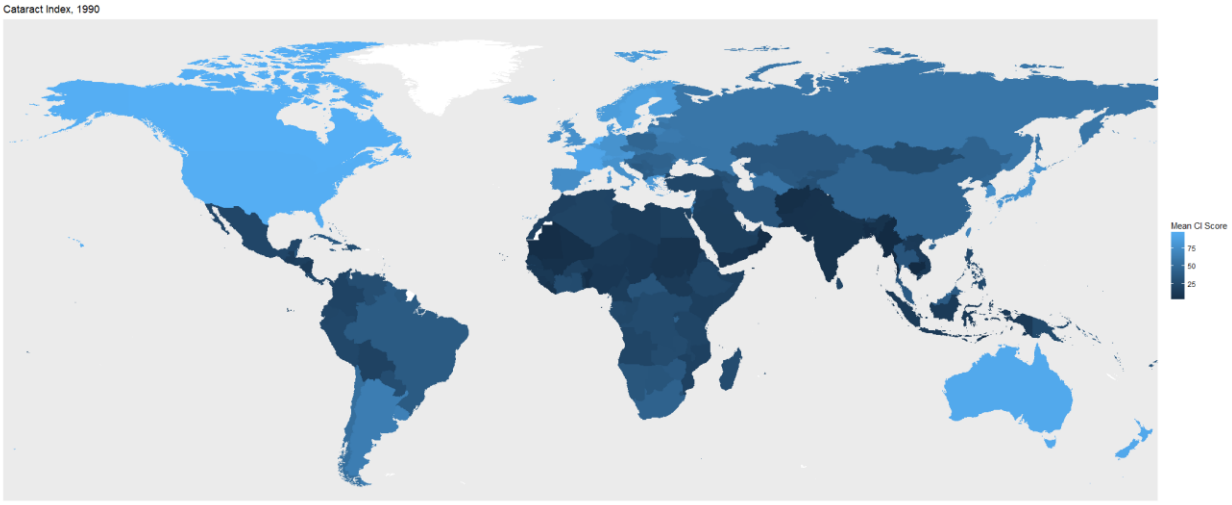
Appendix 1A – Mean AVLI scores, 1990



Appendix 1B – Mean UREI scores, 1990



Appendix 1C – Mean CI scores, 1990



Appendix 2

Appendix 2A – AVLI Index scores

1990		2016	
Location	**AVLI**	**Location**	**AVLI**
Global	37.31 (35.95 - 38.81)	**Global**	42.07 (40.55 - 43.66)
Southeast Asia, East Asia, and Oceania	39.12 (37.34 - 40.91)	**Southeast Asia, East Asia, and Oceania**	46.62 (44.89 - 48.41)
East Asia	47.61 (45.03 - 50.1)	**East Asia**	52.45 (50.32 - 54.41)
China	47.2 (44.55 - 49.73)	China	51.82 (49.49 - 53.91)
North Korea	53.81 (50.2 - 57.03)	North Korea	63.84 (60.5 - 67.4)
Taiwan	68.86 (65.21 - 72.3)	Taiwan	83.11 (79.54 - 86.49)
Southeast Asia	20.1 (18.49 - 21.52)	**Southeast Asia**	33.06 (31.26 - 34.98)
Cambodia	1.78 (0 - 3.68)	Cambodia	8.63 (6.24 - 10.92)
Indonesia	20.43 (18.69 - 22.2)	Indonesia	32.92 (30.51 - 35.15)

Laos	27.44 (25.21 - 29.72)	Laos	36.85 (33.95 - 39.76)
Malaysia	36.3 (33.29 - 39.27)	Malaysia	47.26 (44.26 - 50.38)
Maldives	19.17 (15.8 - 22.67)	Maldives	35.24 (31.47 - 39.25)
Mauritius	25.79 (21.88 - 29.96)	Mauritius	36.55 (32.43 - 41.1)
Myanmar	0 (0 - 0)	Myanmar	5.19 (3.27 - 7.17)
Philippines	22.94 (21.16 - 24.8)	Philippines	32.04 (30.15 - 33.97)
Seychelles	27 (22.93 - 30.83)	Seychelles	36.99 (32.93 - 41.14)
Sri Lanka	22.38 (19.36 - 25.32)	Sri Lanka	31.99 (28.82 - 35.27)
Thailand	53.22 (50.26 - 55.95)	Thailand	67.31 (64.02 - 70.67)
Timor-Leste	0 (0 - 0)	Timor-Leste	8.71 (6.68 - 10.67)
Vietnam	16.65 (14.8 - 18.42)	Vietnam	30.39 (28.12 - 32.86)
Oceania	23.88 (21.26 - 26.24)	**Oceania**	27.11 (24.41 - 29.85)
American Samoa	29.01 (25.88 - 32.09)	American Samoa	33.61 (30.45 - 36.82)
Federated States of Micronesia	27.01 (23.86 - 29.97)	Federated States of Micronesia	32.61 (29.34 - 35.81)
Fiji	29.32 (26.24 - 32.48)	Fiji	34.04 (30.67 - 37.06)
Guam	34.14 (31.01 - 37.31)	Guam	36.95 (33.62 - 40.27)
Kiribati	26.59 (23.74 - 29.48)	Kiribati	29.71 (26.94 - 32.71)
Marshall Islands	28.46 (25.17 - 31.55)	Marshall Islands	32.37 (28.96 - 35.63)
Northern Mariana Islands	31.59 (28.51 - 34.79)	Northern Mariana Islands	36.47 (33.31 - 39.68)
Papua New Guinea	19.37 (16.71 - 22.01)	Papua New Guinea	22.59 (19.77 - 25.61)

Samoa	26.14 (23.08 - 29.06)	Samoa	30.44 (27.38 - 33.46)
Solomon Islands	29.2 (26.18 - 32.16)	Solomon Islands	32.18 (29.3 - 35.07)
Tonga	40.78 (37.86 - 43.54)	Tonga	42.83 (39.98 - 45.65)
Vanuatu	32.27 (29.29 - 35.08)	Vanuatu	36.39 (33.63 - 39.03)
Central Europe, Eastern Europe, and Central Asia	43.88 (40.54 - 46.9)	**Central Europe, Eastern Europe, and Central Asia**	45.93 (42.66 - 49.2)
Central Asia	30.33 (26.78 - 33.81)	**Central Asia**	33.88 (30.16 - 37.46)
Armenia	28.37 (24.58 - 32.06)	Armenia	33.62 (29.75 - 37.14)
Azerbaijan	29.48 (25.49 - 33.1)	Azerbaijan	34.24 (30.33 - 37.92)
Georgia	29.82 (26.27 - 33.49)	Georgia	31.42 (27.62 - 35.14)
Kazakhstan	30.82 (26.84 - 34.64)	Kazakhstan	33.82 (29.79 - 37.67)
Kyrgyzstan	29.55 (25.87 - 33.24)	Kyrgyzstan	32.08 (28.37 - 35.66)
Mongolia	28.07 (24.35 - 31.39)	Mongolia	30.96 (27.53 - 34.38)
Tajikistan	28.8 (25.28 - 32.18)	Tajikistan	32.64 (28.76 - 36.42)
Turkmenistan	35.23 (31.16 - 39.12)	Turkmenistan	38.38 (34.44 - 42.06)
Uzbekistan	30.63 (26.43 - 34.87)	Uzbekistan	34.79 (30.65 - 38.51)
Central Europe	43.77 (40.2 - 47.22)	**Central Europe**	47.98 (44.44 - 51.28)
Albania	40.31 (36.48 - 43.81)	Albania	44.98 (41.44 - 48.51)
Bosnia and Herzegovina	38.67 (34.9 - 42.18)	Bosnia and Herzegovina	43.88 (40.06 - 47.3)
Bulgaria	44.35 (40.51 - 47.77)	Bulgaria	48.28 (44.52 - 51.86)
Croatia	43.91 (40.05 - 47.31)	Croatia	47.88 (44.27 - 51.38)

Czech Republic	46.78 (42.92 - 50.53)	Czech Republic	49.48 (45.62 - 53.05)
Hungary	43.67 (40.02 - 47.01)	Hungary	48.08 (44.21 - 51.59)
Macedonia	41.24 (37.48 - 44.66)	Macedonia	44.92 (41.36 - 48.38)
Montenegro	41.9 (38.18 - 45.38)	Montenegro	44.76 (41.24 - 48.14)
Poland	44.12 (40.29 - 47.71)	Poland	48.75 (44.91 - 52.3)
Romania	43.18 (39.24 - 46.42)	Romania	47.87 (44.12 - 51.45)
Serbia	41.43 (37.59 - 45.15)	Serbia	44.82 (41.17 - 48.28)
Slovakia	46.71 (42.86 - 50.41)	Slovakia	49.64 (45.62 - 53.25)
Slovenia	45.25 (41.55 - 48.97)	Slovenia	49.28 (45.58 - 53.03)
Eastern Europe	47.15 (44.03 - 50.38)	**Eastern Europe**	48.66 (45.67 - 51.72)
Belarus	56.55 (53.05 - 59.97)	Belarus	59.73 (56.42 - 63.05)
Estonia	71.75 (68.57 - 74.75)	Estonia	74.74 (71.61 - 77.7)
Latvia	55.95 (52.51 - 59.53)	Latvia	58.47 (54.97 - 61.71)
Lithuania	58.34 (54.95 - 61.52)	Lithuania	60.52 (57.39 - 63.52)
Moldova	51.89 (48.57 - 55.2)	Moldova	57.56 (54.19 - 60.78)
Russian Federation	42.97 (39.84 - 46.16)	Russian Federation	44.41 (41.2 - 47.42)
Ukraine	56.2 (52.58 - 59.46)	Ukraine	58.97 (55.69 - 62.07)
High-income	71.38 (68.75 - 73.69)	**High-income**	74.63 (72.28 - 76.71)
High-income Asia Pacific	50.04 (46.78 - 53.12)	**High-income Asia Pacific**	53.14 (49.89 - 56.2)
Aichi	50.17 (46.82 - 53.39)	Aichi	52.58 (49.09 - 55.9)

Akita	49.74 (46.34 - 52.97)	Akita	52.29 (48.89 - 55.68)
Aomori	49.87 (46.32 - 53.2)	Aomori	52.38 (48.94 - 55.59)
Brunei	49.73 (46.54 - 52.92)	Brunei	54.01 (50.93 - 57.06)
Chiba	49.84 (46.42 - 53.16)	Chiba	52.29 (48.86 - 55.68)
Ehime	49.77 (46.43 - 53.32)	Ehime	52.34 (49 - 55.77)
Fukui	49.82 (46.38 - 53.02)	Fukui	52.46 (49.13 - 55.77)
Fukuoka	49.84 (46.6 - 53.05)	Fukuoka	52.42 (49.11 - 55.58)
Fukushima	49.71 (46.29 - 53.1)	Fukushima	52.33 (48.87 - 55.63)
Gifu	50.23 (46.78 - 53.51)	Gifu	52.53 (49.15 - 56.11)
Gunma	50.16 (46.68 - 53.43)	Gunma	52.69 (49.28 - 56.06)
Hiroshima	49.94 (46.57 - 53.36)	Hiroshima	52.54 (49.24 - 55.88)
Hokkaidō	49.84 (46.43 - 53.16)	Hokkaidō	52.34 (49.06 - 55.81)
Hyōgo	49.91 (46.53 - 53.23)	Hyōgo	52.32 (49.03 - 55.63)
Ibaraki	49.97 (46.53 - 53.35)	Ibaraki	52.57 (49.26 - 56.16)
Ishikawa	49.96 (46.58 - 53.06)	Ishikawa	52.41 (48.8 - 55.8)
Iwate	49.52 (46.23 - 52.69)	Iwate	52.29 (48.96 - 55.77)
Japan	49.94 (46.73 - 53.09)	Japan	52.45 (49.17 - 55.49)
Kagawa	49.97 (46.7 - 53.42)	Kagawa	52.43 (48.86 - 55.8)
Kagoshima	49.67 (46.18 - 53.16)	Kagoshima	52.41 (49.14 - 55.62)
Kanagawa	49.94 (46.61 - 53.25)	Kanagawa	52.4 (48.88 - 55.71)

Kumamoto	49.45 (46.07 - 52.71)	Kumamoto	52.15 (48.81 - 55.41)
Kyōto	50.01 (46.49 - 53.53)	Kyōto	52.48 (49.08 - 55.68)
Kōchi	49.63 (46.17 - 53.14)	Kōchi	52.29 (48.92 - 55.66)
Mie	49.97 (46.38 - 53.3)	Mie	52.6 (49.1 - 55.84)
Miyagi	49.79 (46.25 - 53.07)	Miyagi	52.35 (48.95 - 55.51)
Miyazaki	49.61 (46.08 - 52.86)	Miyazaki	52.1 (48.7 - 55.39)
Nagano	49.79 (46.4 - 53.28)	Nagano	52.41 (49.12 - 55.84)
Nagasaki	49.64 (46.17 - 52.87)	Nagasaki	52.38 (49.08 - 55.72)
Nara	49.59 (46.12 - 53.05)	Nara	51.98 (48.67 - 55.2)
Niigata	49.83 (46.36 - 53.1)	Niigata	52.57 (49.19 - 55.93)
Okayama	49.91 (46.55 - 53.28)	Okayama	52.48 (48.89 - 55.76)
Okinawa	49.56 (46.05 - 52.89)	Okinawa	51.83 (48.57 - 55.22)
Saga	49.67 (46.46 - 53.09)	Saga	52.23 (48.89 - 55.58)
Saitama	49.78 (46.31 - 53.09)	Saitama	52.21 (49.03 - 55.48)
Shiga	49.92 (46.52 - 53.23)	Shiga	52.58 (49.2 - 56.05)
Shimane	49.49 (46.04 - 52.72)	Shimane	52.16 (48.68 - 55.4)
Shizuoka	50 (46.53 - 53.42)	Shizuoka	52.51 (48.96 - 55.82)
Singapore	48.96 (46.03 - 51.84)	Singapore	53.21 (50.07 - 56.17)
South Korea	50.06 (46.93 - 53.23)	South Korea	54.68 (51.36 - 58.12)
Tochigi	49.89 (46.25 - 53.2)	Tochigi	52.57 (49.25 - 55.92)

Tokushima	49.86 (46.41 - 53.1)	Tokushima	52.53 (48.9 - 56.08)
Tottori	49.54 (46.24 - 52.8)	Tottori	52.29 (48.91 - 55.69)
Toyama	49.97 (46.49 - 53.21)	Toyama	52.55 (49 - 55.8)
Tōkyō	50.59 (47.22 - 54.01)	Tōkyō	52.9 (49.72 - 56.1)
Wakayama	49.74 (46.39 - 53.05)	Wakayama	52.4 (48.96 - 55.65)
Yamagata	49.55 (45.99 - 52.79)	Yamagata	52.29 (48.94 - 55.76)
Yamaguchi	49.85 (46.5 - 53.07)	Yamaguchi	52.43 (49.04 - 55.79)
Yamanashi	49.76 (46.43 - 53.12)	Yamanashi	52.33 (49.08 - 55.71)
Ōita	49.76 (46.46 - 53.12)	Ōita	52.41 (48.95 - 55.73)
Ōsaka	50.08 (46.63 - 53.46)	Ōsaka	52.51 (49 - 55.92)
Australasia	77.42 (75.25 - 79.73)	**Australasia**	80.73 (78.49 - 82.92)
Australia	77.62 (75.3 - 80.1)	Australia	80.82 (78.49 - 83.15)
New Zealand	76.32 (74.03 - 78.63)	New Zealand	80.27 (77.93 - 82.63)
Western Europe	70.38 (66.4 - 73.69)	**Western Europe**	73.71 (69.79 - 77.08)
Andorra	67.25 (58.39 - 75.35)	Andorra	70.3 (61.77 - 78.01)
Austria	66.63 (57.51 - 74.81)	Austria	69.88 (60.85 - 78.1)
Belgium	66.88 (57.83 - 74.69)	Belgium	70.17 (61.04 - 78.07)
Cyprus	65.35 (56.29 - 73.18)	Cyprus	70.08 (61.07 - 77.99)
Denmark	80.12 (77.51 - 82.73)	Denmark	82.35 (80.09 - 84.69)
East Midlands	63.52 (61.24 - 65.74)	East Midlands	68.24 (66.1 - 70.39)

East of England	64.11 (61.87 - 66.32)	East of England	68.64 (66.42 - 70.85)
England	63.89 (61.72 - 66.07)	England	68.56 (66.46 - 70.67)
Finland	69.96 (60.21 - 78.08)	Finland	72.87 (63.33 - 81.11)
France	83.79 (81.91 - 85.88)	France	86.52 (84.55 - 88.71)
Germany	66 (57.37 - 73.87)	Germany	69.41 (60.64 - 77.68)
Greater London	64.33 (62.09 - 66.61)	Greater London	69.08 (67.01 - 71.19)
Greece	75.96 (73.56 - 78.5)	Greece	79.53 (77.19 - 81.95)
Iceland	82.83 (81.27 - 84.35)	Iceland	86.55 (85.05 - 88.22)
Ireland	65.03 (56.21 - 73)	Ireland	69.24 (60.14 - 77.16)
Israel	38.19 (35.38 - 41.04)	Israel	41.56 (38.54 - 44.64)
Italy	67.76 (65.14 - 70.31)	Italy	71.1 (68.53 - 73.93)
Luxembourg	67.22 (58.44 - 74.85)	Luxembourg	70.37 (61.41 - 78.39)
Malta	65.46 (56.61 - 73.06)	Malta	69.46 (60.52 - 77.35)
Netherlands	85.29 (83.41 - 87.14)	Netherlands	87.94 (86.2 - 89.73)
North East England	63.37 (61.13 - 65.5)	North East England	68.24 (66.13 - 70.42)
North West England	63.62 (61.32 - 65.78)	North West England	68.39 (66.28 - 70.57)
Northern Ireland	86.51 (84.75 - 88.31)	Northern Ireland	89.64 (87.88 - 91.56)
Norway	82 (80.06 - 84.12)	Norway	85.12 (83.1 - 87.21)
Portugal	63.65 (54.53 - 71.31)	Portugal	68.7 (59.67 - 76.49)
Scotland	64.67 (56.34 - 72.43)	Scotland	69.01 (60.17 - 77.02)

South East England	64.36 (62.16 - 66.56)	South East England	68.83 (66.75 - 71)
South West England	64.04 (61.94 - 66.19)	South West England	68.74 (66.54 - 70.97)
Spain	72.42 (70.22 - 74.75)	Spain	76.44 (74.21 - 78.68)
Stockholm	99.97 (99.54 - 100)	Stockholm	100 (100 - 100)
Sweden	100 (100 - 100)	Sweden	100 (100 - 100)
Sweden except Stockholm	100 (100 - 100)	Sweden except Stockholm	100 (100 - 100)
Switzerland	67.34 (58.14 - 75.53)	Switzerland	70.29 (61.43 - 78.36)
United Kingdom	64.46 (61.86 - 66.82)	United Kingdom	69.13 (66.62 - 71.46)
Wales	64.69 (55.68 - 72.61)	Wales	69.68 (60.96 - 77.59)
West Midlands	63.26 (61.05 - 65.37)	West Midlands	68.13 (65.93 - 70.35)
Yorkshire and the Humber	63.65 (61.49 - 65.81)	Yorkshire and the Humber	68.35 (66.23 - 70.55)
Southern Latin America	52.11 (49.55 - 54.63)	**Southern Latin America**	58.93 (56.26 - 61.52)
Argentina	53.27 (50.86 - 55.53)	Argentina	60.02 (57.7 - 62.39)
Chile	48.96 (45.26 - 52.42)	Chile	56.47 (52.91 - 59.69)
Uruguay	52.85 (49.08 - 56.48)	Uruguay	57.87 (54.29 - 61.34)
High-income North America	99.6 (98.69 - 100)	**High-income North America**	98.93 (97.85 - 100)
Alabama	99.27 (97.92 - 100)	Alabama	98.73 (97.41 - 100)
Alaska	98.71 (97.34 - 100)	Alaska	98.32 (96.97 - 99.7)
Arizona	99.33 (98.14 - 100)	Arizona	98.55 (97.21 - 99.98)
Arkansas	98.93 (97.58 - 100)	Arkansas	98.28 (96.94 - 99.7)
California	99.27 (98.09 - 100)	California	98.59 (97.15 - 99.93)
Canada	99.97 (99.62 - 100)	Canada	99.91 (99.28 - 100)
Colorado	99.42 (98.12 - 100)	Colorado	98.69 (97.21 - 100)

Connecticut	99.71 (98.62 - 100)	Connecticut	99.19 (97.84 - 100)
Delaware	99.4 (98.14 - 100)	Delaware	98.87 (97.56 - 100)
District of Columbia	99.49 (98.2 - 100)	District of Columbia	99.12 (97.7 - 100)
Florida	99.46 (98.27 - 100)	Florida	98.86 (97.53 - 100)
Georgia	100 (100 - 100)	Georgia	99.98 (99.77 - 100)
Greenland	97.34 (95.99 - 98.79)	Greenland	97.67 (96.35 - 99.04)
Hawaii	99.63 (98.49 - 100)	Hawaii	98.83 (97.47 - 100)
Idaho	99.22 (97.92 - 100)	Idaho	98.11 (96.84 - 99.55)
Illinois	99.31 (98.11 - 100)	Illinois	98.73 (97.32 - 100)
Indiana	99.34 (98.05 - 100)	Indiana	98.4 (97.08 - 99.94)
Iowa	99.35 (98.05 - 100)	Iowa	98.42 (97.1 - 99.8)
Kansas	99.4 (98.17 - 100)	Kansas	98.41 (96.92 - 99.8)
Kentucky	99.09 (97.83 - 100)	Kentucky	98.36 (96.91 - 99.76)
Louisiana	98.95 (97.71 - 100)	Louisiana	98.4 (96.94 - 99.86)
Maine	99.36 (98.16 - 100)	Maine	98.68 (97.43 - 99.99)
Maryland	99.64 (98.51 - 100)	Maryland	98.95 (97.53 - 100)
Massachusetts	99.69 (98.52 - 100)	Massachusetts	99.08 (97.8 - 100)
Michigan	99.36 (98.04 - 100)	Michigan	98.69 (97.24 - 100)
Minnesota	99.56 (98.4 - 100)	Minnesota	98.63 (97.27 - 100)
Mississippi	98.92 (97.54 - 100)	Mississippi	98.39 (97.01 - 99.88)
Missouri	99.43 (98.2 - 100)	Missouri	98.6 (97.31 - 100)
Montana	99.32 (98.17 - 100)	Montana	98.42 (97.04 - 99.77)
Nebraska	99.45 (98.13 - 100)	Nebraska	98.43 (96.99 - 99.83)
Nevada	99.03 (97.72 - 100)	Nevada	98.31 (96.95 - 99.69)
New Hampshire	99.45 (98.19 - 100)	New Hampshire	98.94 (97.62 - 100)

New Jersey	99.56 (98.39 - 100)	New Jersey	99.01 (97.61 - 100)
New Mexico	99.1 (97.77 - 100)	New Mexico	98.4 (97.02 - 99.84)
New York	99.54 (98.27 - 100)	New York	99.17 (97.79 - 100)
North Carolina	99.5 (98.27 - 100)	North Carolina	98.56 (97.24 - 99.93)
North Dakota	99.36 (98.05 - 100)	North Dakota	98.32 (97 - 99.67)
Ohio	99.37 (98 - 100)	Ohio	98.56 (97.15 - 99.84)
Oklahoma	99.23 (97.89 - 100)	Oklahoma	98.31 (96.9 - 99.71)
Oregon	99.34 (98.11 - 100)	Oregon	98.54 (97.12 - 99.94)
Pennsylvania	99.06 (97.66 - 100)	Pennsylvania	98.64 (97.26 - 100)
Rhode Island	99.5 (98.3 - 100)	Rhode Island	98.91 (97.46 - 100)
South Carolina	99.32 (98.06 - 100)	South Carolina	98.71 (97.36 - 100)
South Dakota	99.19 (98.03 - 100)	South Dakota	98.25 (96.92 - 99.64)
Tennessee	99.38 (98.15 - 100)	Tennessee	98.61 (97.24 - 100)
Texas	99.29 (98.02 - 100)	Texas	98.46 (97.02 - 99.89)
United States	99.51 (98.52 - 100)	United States	98.77 (97.67 - 99.86)
Utah	99.5 (98.33 - 100)	Utah	98.32 (97 - 99.93)
Vermont	99.52 (98.34 - 100)	Vermont	98.93 (97.57 - 100)
Virginia	99.53 (98.28 - 100)	Virginia	98.9 (97.54 - 100)
Washington	99.46 (98.26 - 100)	Washington	98.75 (97.46 - 100)
West Virginia	99.16 (97.86 - 100)	West Virginia	98.46 (96.98 - 99.97)
Wisconsin	99.49 (98.23 - 100)	Wisconsin	98.5 (97.18 - 99.95)
Wyoming	98.81 (97.45 - 100)	Wyoming	98.38 (97.05 - 99.89)
Latin America and Caribbean	30.01 (27.99 - 32.1)	**Latin America and Caribbean**	38.66 (36.61 - 40.76)
Caribbean	52.76 (50.18 - 55.31)	**Caribbean**	58.81 (56.04 - 61.62)

Antigua and Barbuda	63.08 (59.69 - 66.57)	Antigua and Barbuda	67.74 (64.31 - 71.47)
Barbados	82.3 (78.64 - 85.95)	Barbados	85.09 (81.28 - 89.23)
Belize	54.35 (51.52 - 57.21)	Belize	61.45 (58.29 - 64.94)
Bermuda	58.56 (55.64 - 61.97)	Bermuda	63.84 (60.73 - 66.99)
Cuba	49.97 (46.77 - 53.07)	Cuba	55.71 (52.73 - 58.85)
Dominica	56.22 (53.34 - 59.26)	Dominica	65.75 (62.26 - 69.24)
Dominican Republic	44.3 (41.51 - 47.04)	Dominican Republic	53.83 (50.78 - 56.9)
Grenada	55.05 (52.13 - 58.11)	Grenada	64.92 (61.54 - 68.74)
Guyana	56.58 (53.79 - 59.73)	Guyana	62.62 (59.42 - 66.04)
Haiti	48.33 (46.08 - 50.64)	Haiti	53.78 (51.45 - 56.23)
Jamaica	55.58 (52.68 - 58.54)	Jamaica	62.23 (59 - 65.74)
Puerto Rico	63.04 (59.67 - 66.66)	Puerto Rico	66.79 (63.44 - 70.35)
Saint Lucia	54.92 (52.26 - 57.9)	Saint Lucia	64.9 (61.71 - 68.39)
Saint Vincent and the Grenadines	50.44 (47.96 - 52.95)	Saint Vincent and the Grenadines	61.91 (58.47 - 65.4)
Suriname	55.78 (53.04 - 59.04)	Suriname	61.59 (58.63 - 64.81)
The Bahamas	62.81 (59.39 - 66.74)	The Bahamas	68.15 (64.75 - 71.66)
Trinidad and Tobago	61.11 (57.57 - 64.67)	Trinidad and Tobago	64.81 (61.26 - 68.74)
Virgin Islands, U.S.	62.84 (59.81 - 66.12)	Virgin Islands, U.S.	66.66 (63.41 - 69.99)
Andean Latin America	23.96 (21.6 - 26.37)	**Andean Latin America**	35.22 (32.45 - 38.07)
Bolivia	22.69 (20.27 - 25.16)	Bolivia	34.02 (31.13 - 36.97)

Ecuador	30.04 (27.34 - 33.02)	Ecuador	41.51 (38.33 - 45.11)
Peru	21.71 (19.35 - 24.12)	Peru	32.7 (29.72 - 35.71)
Central Latin America	26.64 (24.35 - 28.91)	**Central Latin America**	35.48 (33.26 - 37.91)
Aguascalientes	28.4 (25.83 - 31.18)	Aguascalientes	36.38 (33.71 - 39.21)
Baja California	30.63 (28.06 - 33.63)	Baja California	37.52 (34.9 - 40.58)
Baja California Sur	28.77 (26.43 - 31.48)	Baja California Sur	36.57 (34.07 - 39.17)
Campeche	26.28 (23.95 - 28.72)	Campeche	35.16 (32.65 - 37.84)
Chiapas	32.49 (30.16 - 34.68)	Chiapas	35.01 (32.47 - 37.71)
Chihuahua	27.79 (25.33 - 30.32)	Chihuahua	35.93 (33.53 - 38.37)
Coahuila	30.24 (27.64 - 33.04)	Coahuila	36.5 (33.93 - 39.13)
Colima	28.91 (26.35 - 31.67)	Colima	36.63 (34.24 - 39.34)
Colombia	24.48 (22.05 - 26.98)	Colombia	35.33 (32.81 - 38.14)
Costa Rica	25.45 (22.92 - 27.83)	Costa Rica	36.59 (33.71 - 39.45)
Durango	26.6 (24.09 - 29.33)	Durango	35.5 (32.85 - 38.32)
El Salvador	16.58 (14.26 - 18.93)	El Salvador	26.48 (23.62 - 29.49)
Guanajuato	26.88 (24.5 - 29.25)	Guanajuato	35.36 (32.43 - 38.15)
Guatemala	26.38 (23.84 - 28.87)	Guatemala	33.13 (30.49 - 36.12)
Guerrero	24.37 (22.17 - 26.71)	Guerrero	33.24 (30.69 - 35.94)
Hidalgo	25.31 (23.02 - 27.58)	Hidalgo	35.5 (32.98 - 38.33)
Honduras	21.32 (18.87 - 23.82)	Honduras	31.2 (28.28 - 33.83)

Jalisco	28.81 (26.22 - 31.75)	Jalisco	36.03 (33.5 - 38.94)
Mexico	28.31 (26.07 - 30.78)	Mexico	36.08 (33.65 - 38.78)
Mexico City	32.41 (29.52 - 35.66)	Mexico City	38.03 (35.15 - 41.03)
Michoacán de Ocampo	26.04 (23.69 - 28.54)	Michoacán de Ocampo	34.81 (32.29 - 37.77)
Morelos	29.1 (26.61 - 31.72)	Morelos	37.05 (34.36 - 40.08)
México	29.31 (26.75 - 31.96)	México	37.01 (34.26 - 40)
Nayarit	27.23 (24.86 - 29.63)	Nayarit	36.21 (33.77 - 38.97)
Nicaragua	18.81 (16.83 - 21.02)	Nicaragua	28.76 (26.38 - 31.17)
Nuevo León	31.95 (29.37 - 34.59)	Nuevo León	36.18 (33.61 - 38.82)
Oaxaca	26.19 (24.12 - 28.39)	Oaxaca	33.79 (31.4 - 36.41)
Panama	21.88 (19.43 - 24.3)	Panama	30.88 (27.88 - 33.94)
Puebla	25.32 (23.01 - 27.73)	Puebla	35.12 (32.71 - 37.86)
Querétaro	27.21 (24.79 - 29.64)	Querétaro	36.72 (34.05 - 39.53)
Quintana Roo	27.22 (24.89 - 29.86)	Quintana Roo	36.39 (33.8 - 39.02)
San Luis Potosí	25.47 (23.31 - 27.87)	San Luis Potosí	35.35 (32.71 - 38.12)
Sinaloa	28.27 (25.89 - 30.85)	Sinaloa	36.9 (34.49 - 39.58)
Sonora	29.5 (26.85 - 32.35)	Sonora	36.83 (34.19 - 39.51)
Tabasco	26.52 (24.2 - 29.01)	Tabasco	35.57 (33.06 - 38.34)
Tamaulipas	29.27 (26.7 - 32.05)	Tamaulipas	37.47 (34.68 - 40.32)
Tlaxcala	27.13 (24.82 - 29.56)	Tlaxcala	36.44 (33.8 - 39.21)

Venezuela	30.5 (27.9 - 33.19)	Venezuela	39.41 (36.47 - 42.53)
Veracruz de Ignacio de la Llave	26.52 (24.1 - 28.98)	Veracruz de Ignacio de la Llave	34.96 (32.37 - 37.58)
Yucatán	26.63 (24.46 - 29.16)	Yucatán	35.05 (32.36 - 37.64)
Zacatecas	26.57 (24.33 - 29.27)	Zacatecas	35.49 (32.93 - 38.3)
Tropical Latin America	30.1 (28.34 - 31.92)	**Tropical Latin America**	39.25 (37.63 - 41.13)
Acre	29.74 (27.45 - 31.88)	Acre	41.47 (39.32 - 43.96)
Alagoas	29.31 (27.16 - 31.62)	Alagoas	41.51 (39.19 - 44)
Amapá	32.46 (30.23 - 34.78)	Amapá	42.94 (40.78 - 45.47)
Amazonas	32.82 (30.48 - 35.27)	Amazonas	42.26 (40.06 - 44.55)
Bahia	29.45 (27.28 - 31.71)	Bahia	41.56 (39.42 - 43.8)
Brazil	30.32 (28.58 - 32.09)	Brazil	39.45 (37.73 - 41.35)
Ceará	29.03 (26.86 - 31.28)	Ceará	41.3 (39.03 - 43.61)
Distrito Federal	36.75 (34.4 - 39.13)	Distrito Federal	44.58 (42.43 - 46.8)
Espírito Santo	32.87 (30.59 - 35.11)	Espírito Santo	43.69 (41.45 - 45.91)
Goiás	32 (29.81 - 34.25)	Goiás	42.77 (40.39 - 45.04)
Maranhão	28.25 (26.01 - 30.43)	Maranhão	41.39 (39.09 - 43.72)
Mato Grosso	31.83 (29.73 - 34.06)	Mato Grosso	42.75 (40.65 - 44.94)
Mato Grosso do Sul	33.42 (31.12 - 35.87)	Mato Grosso do Sul	44.04 (41.78 - 46.36)
Minas Gerais	31.4 (29.18 - 33.61)	Minas Gerais	42.67 (40.45 - 44.95)
Paraguay	23.2 (20.72 - 25.66)	Paraguay	32.45 (29.64 - 35.18)

Paraná	31.45 (29.29 - 33.49)	Paraná	42.66 (40.41 - 44.93)
Paraíba	29.28 (27.02 - 31.64)	Paraíba	41.29 (38.87 - 43.7)
Pará	29.96 (27.82 - 32.11)	Pará	41.42 (39.18 - 43.78)
Pernambuco	30.35 (28.15 - 32.52)	Pernambuco	41.85 (39.55 - 44.03)
Piaui	28.58 (26.29 - 30.68)	Piaui	41.12 (38.79 - 43.45)
Rio Grande do Norte	30.3 (28.01 - 32.49)	Rio Grande do Norte	42.23 (39.94 - 44.53)
Rio Grande do Sul	31.26 (29.12 - 33.33)	Rio Grande do Sul	42.22 (39.96 - 44.46)
Rio de Janeiro	35.77 (33.34 - 38.32)	Rio de Janeiro	43.77 (41.61 - 46.05)
Rondônia	30.51 (28.35 - 32.69)	Rondônia	41.97 (39.7 - 44.18)
Roraima	33.37 (31.04 - 35.74)	Roraima	42.64 (40.49 - 44.97)
Santa Catarina	31.21 (29.06 - 33.35)	Santa Catarina	42.77 (40.6 - 44.99)
Sergipe	30.48 (28.25 - 32.82)	Sergipe	42.21 (39.83 - 44.8)
São Paulo	27.69 (25.39 - 29.89)	São Paulo	31.49 (28.95 - 33.92)
Tocantins	21.75 (20.03 - 23.55)	Tocantins	30.11 (28.07 - 32.1)
North Africa and Middle East	19.92 (17.55 - 22.33)	**North Africa and Middle East**	32.64 (30.21 - 35.33)
Afghanistan	7.68 (5.42 - 9.83)	Afghanistan	18.5 (15.79 - 20.9)
Algeria	14.77 (10.55 - 18.91)	Algeria	27.98 (23.83 - 32.08)
Bahrain	11.69 (7.36 - 16.11)	Bahrain	24.76 (20.17 - 29.07)
Egypt	6.09 (2.81 - 9.43)	Egypt	17.38 (14.38 - 20.79)
Iran	29.87 (27.23 - 32.61)	Iran	44.31 (41.47 - 47.54)

Iraq	14.75 (10.25 - 18.68)	Iraq	24.38 (20 - 28.69)
Jordan	13.89 (9.36 - 18.57)	Jordan	24.81 (20.58 - 28.99)
Kuwait	13.69 (9.32 - 18.22)	Kuwait	26.79 (22.13 - 30.95)
Lebanon	31.09 (27.55 - 34.62)	Lebanon	37.75 (34.96 - 40.51)
Libya	16.53 (13.45 - 19.58)	Libya	28.74 (24.61 - 32.53)
Morocco	29.71 (26.76 - 32.63)	Morocco	44.85 (41.61 - 48.47)
Oman	0.53 (0 - 3.01)	Oman	21.48 (17.47 - 25.72)
Palestine	22.63 (19.51 - 25.83)	Palestine	34.07 (30.82 - 37.54)
Qatar	19.71 (16.8 - 22.68)	Qatar	30.43 (26.89 - 33.87)
Saudi Arabia	12.77 (10.01 - 15.34)	Saudi Arabia	34.3 (31.51 - 37.26)
Sudan	7.9 (4.21 - 11.37)	Sudan	19.66 (16.16 - 23.09)
Syria	10.58 (6.15 - 14.4)	Syria	23.15 (19 - 26.71)
Tunisia	29.04 (26.27 - 32.11)	Tunisia	44.57 (41.52 - 47.86)
Turkey	41.24 (37.75 - 44.53)	Turkey	56.19 (52.74 - 59.58)
United Arab Emirates	14.09 (9.35 - 18.51)	United Arab Emirates	27.49 (22.62 - 31.73)
Yemen	13.18 (10.88 - 15.64)	Yemen	24.85 (22.32 - 27.42)
South Asia	5.28 (3.74 - 7.05)	**South Asia**	15.11 (12.99 - 17.12)
Bangladesh	11.16 (8.94 - 13.33)	Bangladesh	15.09 (12.48 - 17.8)
Bhutan	25.76 (23.17 - 28.31)	Bhutan	40.81 (37.65 - 44.36)
India	3.36 (1.81 - 5.18)	India	13.8 (11.82 - 15.71)

Nepal	14.6 (12.53 - 16.66)	Nepal	20.59 (18.34 - 22.69)
Pakistan	16.84 (14.4 - 19.42)	Pakistan	26.2 (23.36 - 29.25)
Sub-Saharan Africa	36.31 (34.1 - 38.48)	**Sub-Saharan Africa**	38.17 (35.82 - 40.47)
Central Sub-Saharan Africa	43.68 (41.24 - 46.22)	**Central Sub-Saharan Africa**	46.07 (43.36 - 48.77)
Angola	34.7 (32.41 - 36.84)	Angola	42.93 (39.89 - 46.11)
Central African Republic	57.62 (54.39 - 60.88)	Central African Republic	55.34 (52.15 - 58.67)
Congo	37.81 (35.31 - 40.22)	Congo	44.12 (41.15 - 47.1)
Democratic Republic of the Congo	46.12 (43.24 - 49.23)	Democratic Republic of the Congo	46.34 (43.45 - 49.36)
Equatorial Guinea	40.99 (38.44 - 43.51)	Equatorial Guinea	48.98 (45.35 - 52.71)
Gabon	38.89 (35.68 - 42.1)	Gabon	49 (45.58 - 52.37)
Eastern Sub-Saharan Africa	38.81 (36.62 - 41.13)	**Eastern Sub-Saharan Africa**	44.56 (41.74 - 47.29)
Burundi	67.29 (63.31 - 71.31)	Burundi	73.88 (69.84 - 78.15)
Comoros	26.48 (22.16 - 30.77)	Comoros	38.08 (33.99 - 42.61)
Djibouti	34.55 (29.75 - 38.97)	Djibouti	43.38 (38.26 - 48.56)
Eritrea	25.46 (22.57 - 28.32)	Eritrea	34.07 (29.46 - 39.07)
Ethiopia	36.29 (33.59 - 38.99)	Ethiopia	39.07 (35.92 - 42.32)
Kenya	42.94 (40.42 - 45.33)	Kenya	48.26 (45.77 - 50.75)
Madagascar	42.61 (40.23 - 44.89)	Madagascar	52.3 (49.62 - 54.77)
Malawi	37.8 (35.55 - 40.19)	Malawi	43.13 (40.5 - 45.76)
Mozambique	34.03 (31.95 - 36.13)	Mozambique	41.7 (39.24 - 44.13)

Rwanda	39.48 (35.97 - 42.68)	Rwanda	49.06 (45.48 - 52.88)
Somalia	30.53 (26.94 - 34.15)	Somalia	36.91 (32.85 - 41.22)
South Sudan	29.88 (25.58 - 34.04)	South Sudan	31.01 (27.09 - 35.05)
Tanzania	35.51 (32.95 - 38.02)	Tanzania	44.06 (41.23 - 46.87)
Uganda	47.33 (44.39 - 50.13)	Uganda	57.01 (53.45 - 60.54)
Zambia	47 (44.22 - 49.99)	Zambia	53.67 (50.94 - 56.66)
Southern Sub-Saharan Africa	47.91 (45.67 - 50.24)	**Southern Sub-Saharan Africa**	50.53 (48.22 - 52.97)
Botswana	45.71 (43.27 - 48.31)	Botswana	49.15 (46.39 - 52.01)
Lesotho	42.35 (38.58 - 45.39)	Lesotho	43.18 (39.39 - 46.51)
Namibia	45.17 (41.62 - 48.25)	Namibia	47.25 (43.69 - 50.37)
South Africa	48.61 (46.44 - 51.05)	South Africa	51.61 (49.08 - 54.37)
Swaziland	42.68 (38.62 - 45.99)	Swaziland	45.1 (41.62 - 48.22)
Zimbabwe	46.32 (42.8 - 49.47)	Zimbabwe	46.58 (43.14 - 49.39)
Western Sub-Saharan Africa	28.93 (26.13 - 31.49)	**Western Sub-Saharan Africa**	27.6 (24.96 - 30.04)
Benin	23.47 (18.32 - 28.72)	Benin	15.89 (12.27 - 19.67)
Burkina Faso	40.1 (33.08 - 46.29)	Burkina Faso	21.65 (16.81 - 26.07)
Cameroon	31.76 (28.83 - 34.74)	Cameroon	35.07 (31.84 - 38.32)
Cape Verde	35.83 (32.39 - 39.2)	Cape Verde	47.73 (42.67 - 52.63)
Chad	26.68 (22.22 - 30.99)	Chad	29.4 (24.66 - 33.99)
Cote d'Ivoire	48.48 (41.51 - 55.06)	Cote d'Ivoire	27.87 (23.1 - 32.15)

Ghana	38 (34.59 - 41.55)	Ghana	31.07 (28.84 - 33.27)
Guinea	27.95 (22.57 - 33)	Guinea	24.57 (19.84 - 28.59)
Guinea-Bissau	26.59 (21.93 - 31.01)	Guinea-Bissau	24.7 (19.7 - 28.83)
Liberia	20.79 (15.58 - 25.31)	Liberia	24.58 (19.08 - 29.34)
Mali	19.43 (16.78 - 22.11)	Mali	15.54 (12.9 - 17.89)
Mauritania	16.04 (12.99 - 18.96)	Mauritania	21.49 (17.83 - 25.02)
Niger	25.47 (21.32 - 29.12)	Niger	25.87 (21.29 - 29.96)
Nigeria	27.62 (24.98 - 30.52)	Nigeria	29.41 (26.64 - 32.16)
Sao Tome and Principe	18.39 (13.79 - 22.28)	Sao Tome and Principe	27.17 (21.75 - 31.64)
Senegal	23.4 (19.23 - 27.19)	Senegal	25.99 (21.05 - 30.51)
Sierra Leone	29.33 (25.9 - 33.06)	Sierra Leone	30.94 (25.92 - 36.75)
The Gambia	39.35 (36.6 - 41.97)	The Gambia	36.67 (33.83 - 39.2)
Togo	24.73 (19.7 - 29.37)	Togo	25.83 (20.72 - 29.97)

Appendix 2B – Refractive Error Index Scores

1990		**2016**	
Location	**Uncorrected Refractive Error Index**	**Location**	**Uncorrected Refractive Error Index**
Global	36 (34.43 - 37.47)	**Global**	42.44 (40.83 - 43.91)
Southeast Asia, East Asia, and Oceania	39.27 (36.96 - 41.52)	**Southeast Asia, East Asia, and Oceania**	47.28 (44.99 - 49.3)
East Asia	46.07 (42.82 - 49.17)	**East Asia**	52.68 (49.98 - 55.16)
China	45.63 (42.26 - 48.8)	China	52.06 (49.3 - 54.61)
North Korea	53.65 (48.77 - 57.6)	North Korea	65.25 (60.57 - 69.48)
Taiwan	66.67 (62.92 - 70.25)	Taiwan	80.07 (76.54 - 83.66)

Southeast Asia	23.08 (21.15 - 24.89)	**Southeast Asia**	35.34 (33.12 - 37.52)
Cambodia	5.72 (3.33 - 8.07)	Cambodia	14.43 (11.24 - 17.68)
Indonesia	25.03 (22.91 - 27.05)	Indonesia	36.58 (33.99 - 39.09)
Laos	37.29 (32.47 - 42.19)	Laos	50.71 (45.15 - 56.51)
Malaysia	33.38 (30.62 - 36.07)	Malaysia	44.67 (41.41 - 47.86)
Maldives	19.27 (14.53 - 24.33)	Maldives	33.96 (28.51 - 39.71)
Mauritius	24.24 (19.12 - 29.22)	Mauritius	36.09 (30.98 - 41.44)
Myanmar	0 (0 - 0)	Myanmar	8.61 (6.23 - 11.01)
Philippines	20.36 (17.83 - 22.76)	Philippines	30.93 (28.3 - 33.61)
Seychelles	23.5 (18.44 - 28.59)	Seychelles	34.76 (29.57 - 40.5)
Sri Lanka	22.2 (17.99 - 26.7)	Sri Lanka	33.36 (28.68 - 38.16)
Thailand	61.62 (58.67 - 64.61)	Thailand	71.06 (67.71 - 74.47)
Timor-Leste	0.02 (0 - 0.01)	Timor-Leste	10.3 (5.79 - 14.36)
Vietnam	19.36 (17 - 21.68)	Vietnam	31.83 (29.12 - 34.57)
Oceania	18.54 (15.97 - 21.02)	**Oceania**	21.74 (19.01 - 24.3)
American Samoa	24.86 (21.72 - 27.91)	American Samoa	29.8 (26.79 - 32.95)
Federated States of Micronesia	22.45 (19.08 - 25.66)	Federated States of Micronesia	28.11 (24.89 - 31.48)
Fiji	26 (23.18 - 28.8)	Fiji	30.39 (27.66 - 33.28)
Guam	27.52 (24.55 - 30.6)	Guam	31.09 (27.94 - 34.28)
Kiribati	24.37 (21.34 - 27.43)	Kiribati	28.68 (25.61 - 31.92)
Marshall Islands	23.37 (20.34 - 26.52)	Marshall Islands	27.95 (24.84 - 31.05)
Northern Mariana Islands	27.17 (24.04 - 30.49)	Northern Mariana Islands	31.07 (27.9 - 34.41)
Papua New Guinea	15.14 (12.43 - 17.8)	Papua New Guinea	18.56 (15.62 - 21.32)
Samoa	23.31 (20.14 - 26.51)	Samoa	27.6 (24.51 - 30.71)
Solomon Islands	24.31 (21.23 - 27.2)	Solomon Islands	28.6 (25.37 - 31.69)
Tonga	38.63 (35.57 - 41.6)	Tonga	40.18 (37.19 - 43.21)
Vanuatu	27.65 (24.83 - 30.49)	Vanuatu	32.46 (29.82 - 35.16)
Central Europe, Eastern Europe, and Central Asia	39.19 (36.38 - 41.89)	**Central Europe, Eastern Europe, and Central Asia**	40.65 (37.78 - 43.38)
Central Asia	26.88 (23.41 - 30.26)	**Central Asia**	28.72 (25.38 - 32.04)
Armenia	26.86 (23 - 30.55)	Armenia	29.08 (25.64 - 32.35)

Azerbaijan	26.71 (22.93 - 30.14)	Azerbaijan	29.13 (25.58 - 32.55)
Georgia	27.39 (23.9 - 30.74)	Georgia	28.72 (25.26 - 31.9)
Kazakhstan	26.92 (23.2 - 30.51)	Kazakhstan	28.4 (24.84 - 31.89)
Kyrgyzstan	27.29 (23.66 - 30.81)	Kyrgyzstan	27.97 (24.42 - 31.57)
Mongolia	26.59 (22.81 - 30.1)	Mongolia	28.99 (25.36 - 32.4)
Tajikistan	26.52 (22.86 - 30.04)	Tajikistan	26.77 (23.36 - 30.32)
Turkmenistan	26.77 (23.24 - 30.01)	Turkmenistan	30.68 (27.22 - 33.95)
Uzbekistan	26.2 (22.74 - 29.79)	Uzbekistan	28.58 (24.87 - 31.98)
Central Europe	40.78 (37.51 - 43.88)	**Central Europe**	43.58 (40.37 - 46.59)
Albania	38.02 (34.36 - 41.45)	Albania	40.96 (37.61 - 44.24)
Bosnia and Herzegovina	37.1 (33.54 - 40.48)	Bosnia and Herzegovina	41.64 (38.19 - 44.94)
Bulgaria	41.31 (37.77 - 44.55)	Bulgaria	43.85 (40.5 - 47.03)
Croatia	41.37 (37.8 - 44.58)	Croatia	43.46 (40 - 46.76)
Czech Republic	42.21 (38.69 - 45.54)	Czech Republic	44.46 (40.92 - 47.48)
Hungary	41.43 (38.14 - 44.78)	Hungary	44.06 (40.62 - 47.25)
Macedonia	39.77 (36.31 - 43.21)	Macedonia	42.37 (38.97 - 45.66)
Montenegro	40.42 (36.93 - 43.75)	Montenegro	43.31 (39.9 - 46.63)
Poland	40.89 (37.46 - 44.06)	Poland	44.04 (40.64 - 47.24)
Romania	40.42 (36.97 - 43.81)	Romania	43.25 (39.82 - 46.56)
Serbia	39.86 (36.43 - 43.21)	Serbia	42.28 (38.92 - 45.59)
Slovakia	41.62 (38.23 - 44.83)	Slovakia	43.9 (40.36 - 47)
Slovenia	41.94 (38.57 - 45.26)	Slovenia	43.91 (40.68 - 47.12)
Eastern Europe	41.34 (38.7 - 43.94)	**Eastern Europe**	43.12 (40.52 - 45.8)
Belarus	52.76 (49.5 - 55.76)	Belarus	55.2 (51.97 - 58.46)
Estonia	72.55 (69.64 - 75.36)	Estonia	74.94 (71.98 - 77.75)
Latvia	53.34 (50.18 - 56.49)	Latvia	55.8 (52.36 - 58.94)
Lithuania	53.69 (50.46 - 56.96)	Lithuania	56.22 (53.11 - 59.1)
Moldova	51.44 (48.21 - 54.51)	Moldova	52.95 (49.53 - 56.1)
Russian Federation	35.95 (33.19 - 38.75)	Russian Federation	38.35 (35.55 - 41.19)
Ukraine	53.3 (50.19 - 56.2)	Ukraine	54.76 (51.75 - 57.8)

High-income	67.07 (64.43 - 69.29)	**High-income**	70.22 (67.9 - 72.4)
High-income Asia Pacific	41.43 (38.52 - 44.23)	**High-income Asia Pacific**	44.39 (41.56 - 47.21)
Aichi	41.57 (38.29 - 44.63)	Aichi	43.8 (40.71 - 46.97)
Akita	41.01 (37.87 - 44.06)	Akita	43.24 (40.05 - 46.29)
Aomori	41.15 (37.83 - 44.12)	Aomori	43.4 (40.34 - 46.45)
Brunei	42.22 (39.14 - 45.32)	Brunei	46.07 (43.06 - 49.13)
Chiba	41.19 (38.09 - 44.3)	Chiba	43.42 (40.28 - 46.57)
Ehime	41.04 (38.07 - 44.12)	Ehime	43.36 (40.31 - 46.49)
Fukui	41.14 (37.97 - 44.23)	Fukui	43.52 (40.58 - 46.57)
Fukuoka	41.11 (38 - 44.22)	Fukuoka	43.5 (40.41 - 46.26)
Fukushima	41 (37.95 - 44.03)	Fukushima	43.36 (40.17 - 46.5)
Gifu	41.53 (38.34 - 44.58)	Gifu	43.57 (40.55 - 46.68)
Gunma	41.48 (38.38 - 44.56)	Gunma	43.83 (40.66 - 46.91)
Hiroshima	41.26 (38.12 - 44.3)	Hiroshima	43.65 (40.54 - 46.79)
Hokkaidō	41.17 (38.04 - 44.15)	Hokkaidō	43.37 (40.19 - 46.36)
Hyōgo	41.22 (38.15 - 44.19)	Hyōgo	43.39 (40.23 - 46.4)
Ibaraki	41.3 (38.06 - 44.31)	Ibaraki	43.73 (40.44 - 47)
Ishikawa	41.27 (38.17 - 44.32)	Ishikawa	43.48 (40.44 - 46.38)
Iwate	40.72 (37.64 - 43.76)	Iwate	43.22 (40.15 - 46.26)
Japan	41.27 (38.23 - 44.11)	Japan	43.57 (40.63 - 46.4)
Kagawa	41.27 (38.22 - 44.21)	Kagawa	43.51 (40.29 - 46.63)
Kagoshima	40.85 (37.69 - 44.02)	Kagoshima	43.4 (40.56 - 46.4)
Kanagawa	41.34 (38.29 - 44.44)	Kanagawa	43.57 (40.36 - 46.54)
Kumamoto	40.64 (37.51 - 43.72)	Kumamoto	43.1 (40 - 46.04)
Kyōto	41.35 (38.03 - 44.53)	Kyōto	43.57 (40.37 - 46.47)
Kōchi	40.86 (37.7 - 43.87)	Kōchi	43.27 (40.19 - 46.46)
Mie	41.29 (37.99 - 44.37)	Mie	43.73 (40.53 - 46.68)
Miyagi	41.16 (38.05 - 44.2)	Miyagi	43.52 (40.41 - 46.46)
Miyazaki	40.79 (37.47 - 43.9)	Miyazaki	43.05 (39.92 - 46.42)
Nagano	41.09 (37.81 - 44.19)	Nagano	43.49 (40.55 - 46.61)

Nagasaki	40.81 (37.55 - 43.91)	Nagasaki	43.34 (40.2 - 46.29)
Nara	40.87 (37.78 - 44.02)	Nara	42.94 (39.91 - 45.91)
Niigata	41.09 (37.99 - 44.41)	Niigata	43.63 (40.4 - 46.68)
Okayama	41.18 (38.09 - 44.21)	Okayama	43.54 (40.46 - 46.48)
Okinawa	40.72 (37.52 - 43.98)	Okinawa	42.77 (39.81 - 45.86)
Saga	40.85 (37.81 - 44.04)	Saga	43.22 (40.09 - 46.42)
Saitama	41.15 (38.05 - 44.27)	Saitama	43.35 (40.31 - 46.42)
Shiga	41.24 (38.15 - 44.22)	Shiga	43.72 (40.58 - 46.92)
Shimane	40.69 (37.51 - 43.69)	Shimane	43.13 (40.01 - 46.16)
Shizuoka	41.36 (38.09 - 44.34)	Shizuoka	43.67 (40.52 - 46.77)
Singapore	40.57 (37.7 - 43.08)	Singapore	44.51 (41.5 - 47.3)
South Korea	41.83 (38.92 - 44.84)	South Korea	46.39 (43.46 - 49.47)
Tochigi	41.2 (37.92 - 44.29)	Tochigi	43.71 (40.69 - 46.88)
Tokushima	41.18 (37.89 - 44.38)	Tokushima	43.6 (40.49 - 46.73)
Tottori	40.77 (37.67 - 43.83)	Tottori	43.3 (40.18 - 46.34)
Toyama	41.29 (38.22 - 44.33)	Toyama	43.67 (40.45 - 46.76)
Tōkyō	42.14 (39.09 - 45.34)	Tōkyō	44.24 (41.13 - 47.25)
Wakayama	41 (37.86 - 44.03)	Wakayama	43.41 (40.4 - 46.55)
Yamagata	40.75 (37.6 - 43.78)	Yamagata	43.28 (40.29 - 46.29)
Yamaguchi	41.13 (38 - 44.21)	Yamaguchi	43.52 (40.44 - 46.67)
Yamanashi	41.08 (37.87 - 44.25)	Yamanashi	43.41 (40.46 - 46.53)
Ōita	40.99 (37.8 - 44.1)	Ōita	43.41 (40.39 - 46.4)
Ōsaka	41.47 (38.28 - 44.59)	Ōsaka	43.68 (40.52 - 46.81)
Australasia	73.08 (70.8 - 75.42)	**Australasia**	76.7 (74.52 - 78.95)
Australia	73.33 (70.93 - 75.9)	Australia	76.81 (74.54 - 79.11)
New Zealand	71.83 (69.69 - 74.05)	New Zealand	76.12 (73.83 - 78.47)
Western Europe	66.36 (61.82 - 70.2)	**Western Europe**	69.42 (65.22 - 73.27)
Andorra	62.29 (51.65 - 72.07)	Andorra	65.3 (55.17 - 74.55)
Austria	61.51 (50.61 - 71.4)	Austria	65.02 (54.79 - 74.87)
Belgium	61.67 (51.09 - 71.14)	Belgium	65.09 (54.44 - 74.53)

Cyprus	60.37 (49.83 - 69.72)	Cyprus	65.41 (55.02 - 75.27)
Denmark	77.66 (74.7 - 80.65)	Denmark	79.02 (76.57 - 81.74)
East Midlands	58.5 (56.27 - 60.74)	East Midlands	62.91 (60.85 - 65.09)
East of England	59.02 (56.85 - 61.33)	East of England	63.27 (61.18 - 65.55)
England	58.83 (56.67 - 61.07)	England	63.26 (61.24 - 65.44)
Finland	65.09 (53.58 - 74.92)	Finland	68.29 (57.22 - 78.04)
France	81.22 (79.1 - 83.55)	France	83.88 (81.64 - 86.08)
Germany	61.24 (50.81 - 70.6)	Germany	64.61 (54.63 - 74.44)
Greater London	59.46 (57.31 - 61.69)	Greater London	63.82 (61.8 - 66.01)
Greece	72.98 (70.09 - 75.8)	Greece	76.68 (73.94 - 79.42)
Iceland	80.82 (79.01 - 82.52)	Iceland	83.94 (82.11 - 85.67)
Ireland	60.22 (49.64 - 69.49)	Ireland	64.37 (53.91 - 73.96)
Israel	28.63 (25.97 - 31.43)	Israel	32.18 (29.42 - 35.08)
Italy	63.6 (60.67 - 66.33)	Italy	66.42 (63.74 - 69.37)
Luxembourg	62.37 (52.1 - 71.8)	Luxembourg	65.49 (55.12 - 75.11)
Malta	60.44 (49.85 - 69.53)	Malta	64.48 (54.08 - 73.89)
Netherlands	81.94 (79.77 - 83.97)	Netherlands	84.44 (82.61 - 86.21)
North East England	58.39 (56.15 - 60.64)	North East England	63.01 (61 - 65.23)
North West England	58.67 (56.47 - 61)	North West England	63.24 (61.19 - 65.45)
Northern Ireland	85.39 (83.21 - 87.61)	Northern Ireland	88.06 (86.02 - 90.07)
Norway	80.12 (77.99 - 82.43)	Norway	82.71 (80.55 - 84.92)
Portugal	59.08 (48.06 - 68.46)	Portugal	63.44 (53 - 72.88)
Scotland	60.42 (50.13 - 69.67)	Scotland	64.01 (53.94 - 73.43)
South East England	59.16 (56.88 - 61.44)	South East England	63.41 (61.34 - 65.58)
South West England	58.93 (56.73 - 61.21)	South West England	63.29 (61.24 - 65.46)
Spain	70 (67.56 - 72.73)	Spain	73.4 (70.83 - 76.06)
Stockholm	100 (100 - 100)	Stockholm	100 (100 - 100)
Sweden	100 (100 - 100)	Sweden	100 (100 - 100)
Sweden except Stockholm	100 (100 - 100)	Sweden except Stockholm	100 (100 - 100)
Switzerland	62.18 (51.59 - 71.74)	Switzerland	65.26 (54.87 - 74.36)

United Kingdom	59.59 (56.93 - 61.97)	United Kingdom	63.92 (61.45 - 66.1)
Wales	60.04 (49.44 - 69.49)	Wales	64.47 (54.47 - 73.72)
West Midlands	58.17 (55.89 - 60.45)	West Midlands	62.76 (60.6 - 65)
Yorkshire and the Humber	58.65 (56.42 - 60.94)	Yorkshire and the Humber	63.1 (61.01 - 65.31)
Southern Latin America	47.03 (44.39 - 49.57)	**Southern Latin America**	54.04 (51.5 - 56.68)
Argentina	47.96 (45.48 - 50.51)	Argentina	54.84 (52.49 - 57.18)
Chile	45.07 (41.3 - 48.84)	Chile	52.23 (48.57 - 55.64)
Uruguay	46.98 (43.29 - 50.43)	Uruguay	52.47 (48.77 - 55.86)
High-income North America	99.82 (99.28 - 100)	**High-income North America**	98.78 (98.12 - 99.49)
Alabama	99.45 (98.26 - 100)	Alabama	98.71 (97.42 - 100)
Alaska	99.11 (97.88 - 100)	Alaska	98.14 (96.85 - 99.49)
Arizona	99.29 (98.12 - 100)	Arizona	98.19 (96.88 - 99.53)
Arkansas	99.14 (97.92 - 100)	Arkansas	98.14 (96.89 - 99.47)
California	99.11 (97.89 - 100)	California	98.1 (96.8 - 99.39)
Canada	99.99 (100 - 100)	Canada	99.82 (98.91 - 100)
Colorado	99.74 (98.72 - 100)	Colorado	98.61 (97.27 - 100)
Connecticut	99.8 (98.85 - 100)	Connecticut	99.04 (97.69 - 100)
Delaware	99.77 (98.88 - 100)	Delaware	98.91 (97.69 - 100)
District of Columbia	99.64 (98.53 - 100)	District of Columbia	98.95 (97.66 - 100)
Florida	99.56 (98.48 - 100)	Florida	98.69 (97.47 - 100)
Georgia	100 (100 - 100)	Georgia	99.99 (100 - 100)
Greenland	99.53 (98.36 - 100)	Greenland	98.64 (97.39 - 99.94)
Hawaii	99.42 (98.24 - 100)	Hawaii	98.33 (97.01 - 99.6)
Idaho	99.02 (97.78 - 100)	Idaho	97.76 (96.44 - 99.07)
Illinois	99.54 (98.5 - 100)	Illinois	98.58 (97.29 - 100)
Indiana	99.56 (98.43 - 100)	Indiana	98.5 (97.2 - 99.94)
Iowa	99.36 (98.18 - 100)	Iowa	98.21 (96.88 - 99.49)
Kansas	99.47 (98.34 - 100)	Kansas	98.27 (96.98 - 99.56)
Kentucky	99.51 (98.4 - 100)	Kentucky	98.55 (97.34 - 99.84)
Louisiana	99.32 (98.15 - 100)	Louisiana	98.48 (97.23 - 99.97)

Maine	99.59 (98.48 - 100)	Maine	98.48 (97.17 - 99.81)
Maryland	99.77 (98.71 - 100)	Maryland	98.87 (97.68 - 100)
Massachusetts	99.81 (98.86 - 100)	Massachusetts	98.86 (97.59 - 100)
Michigan	99.68 (98.55 - 100)	Michigan	98.76 (97.51 - 100)
Minnesota	99.54 (98.43 - 100)	Minnesota	98.34 (97.11 - 99.62)
Mississippi	99.13 (97.97 - 100)	Mississippi	98.43 (97.2 - 99.95)
Missouri	99.56 (98.43 - 100)	Missouri	98.7 (97.49 - 100)
Montana	99.22 (98.04 - 100)	Montana	98.07 (96.65 - 99.43)
Nebraska	99.44 (98.2 - 100)	Nebraska	98.28 (97 - 99.57)
Nevada	99.61 (98.51 - 100)	Nevada	98.3 (96.99 - 99.72)
New Hampshire	99.62 (98.55 - 100)	New Hampshire	98.77 (97.45 - 100)
New Jersey	99.71 (98.75 - 100)	New Jersey	98.9 (97.58 - 100)
New Mexico	99.36 (98.19 - 100)	New Mexico	98.46 (97.21 - 99.78)
New York	99.73 (98.81 - 100)	New York	99.14 (97.9 - 100)
North Carolina	99.57 (98.49 - 100)	North Carolina	98.46 (97.29 - 99.83)
North Dakota	99.29 (98.14 - 100)	North Dakota	98.13 (96.82 - 99.61)
Ohio	99.62 (98.46 - 100)	Ohio	98.67 (97.35 - 99.94)
Oklahoma	99.42 (98.21 - 100)	Oklahoma	98.32 (97.07 - 99.59)
Oregon	99.35 (98.26 - 100)	Oregon	98.22 (96.93 - 99.55)
Pennsylvania	99.65 (98.65 - 100)	Pennsylvania	98.69 (97.4 - 99.96)
Rhode Island	99.65 (98.62 - 100)	Rhode Island	98.76 (97.41 - 100)
South Carolina	99.4 (98.23 - 100)	South Carolina	98.65 (97.3 - 99.91)
South Dakota	99.12 (97.92 - 100)	South Dakota	97.95 (96.77 - 99.37)
Tennessee	99.49 (98.42 - 100)	Tennessee	98.63 (97.32 - 99.91)
Texas	99.33 (98.07 - 100)	Texas	98.27 (96.77 - 99.61)
United States	99.71 (99.07 - 100)	United States	98.65 (97.91 - 99.46)
Utah	99.07 (97.85 - 100)	Utah	97.79 (96.48 - 99.16)
Vermont	99.48 (98.26 - 100)	Vermont	98.48 (97.21 - 99.79)
Virginia	99.68 (98.53 - 100)	Virginia	98.84 (97.64 - 100)
Washington	99.51 (98.37 - 100)	Washington	98.46 (97.17 - 99.76)

West Virginia	99.5 (98.36 - 100)	West Virginia	98.74 (97.47 - 100)
Wisconsin	99.54 (98.38 - 100)	Wisconsin	98.3 (97.02 - 99.64)
Wyoming	99.36 (98.12 - 100)	Wyoming	98.37 (97.12 - 99.72)
Latin America and Caribbean	28.79 (26.73 - 30.6)	**Latin America and Caribbean**	35.99 (34.18 - 37.61)
Caribbean	57.76 (54.32 - 61.25)	**Caribbean**	62.67 (59.37 - 65.85)
Antigua and Barbuda	66.36 (62.75 - 69.79)	Antigua and Barbuda	71.4 (67.77 - 74.76)
Barbados	88.76 (85.7 - 91.74)	Barbados	92.93 (89.97 - 95.79)
Belize	62.69 (59.04 - 66.35)	Belize	68.1 (64.58 - 71.43)
Bermuda	64.14 (60.78 - 67.38)	Bermuda	68.45 (65.26 - 71.66)
Cuba	53.7 (49.84 - 57.52)	Cuba	57.56 (53.92 - 61.06)
Dominica	65.01 (61.55 - 68.49)	Dominica	70.52 (67.11 - 73.98)
Dominican Republic	50.56 (46.57 - 54.37)	Dominican Republic	56.97 (53.24 - 60.71)
Grenada	63.32 (59.54 - 66.56)	Grenada	69.74 (66.26 - 72.97)
Guyana	63.14 (59.67 - 66.65)	Guyana	68.8 (65.48 - 72.18)
Haiti	59.85 (56.23 - 63.34)	Haiti	65.12 (61.64 - 68.29)
Jamaica	64.55 (60.85 - 67.97)	Jamaica	69.69 (66.37 - 72.75)
Puerto Rico	65.04 (61.51 - 68.31)	Puerto Rico	70.32 (66.96 - 73.4)
Saint Lucia	64.59 (61.11 - 67.88)	Saint Lucia	69.97 (66.67 - 73.53)
Saint Vincent and the Grenadines	64.22 (60.56 - 67.82)	Saint Vincent and the Grenadines	69.32 (66.12 - 72.65)
Suriname	64.29 (60.81 - 67.92)	Suriname	69.81 (66.59 - 73.22)
The Bahamas	67.11 (63.57 - 70.32)	The Bahamas	71.36 (68.04 - 74.63)
Trinidad and Tobago	66.61 (63.04 - 70.36)	Trinidad and Tobago	71.84 (68.3 - 75.38)
Virgin Islands, U.S.	65.26 (61.67 - 68.39)	Virgin Islands, U.S.	69.7 (66.51 - 72.8)
Andean Latin America	23.62 (20.75 - 26.26)	**Andean Latin America**	33.77 (30.79 - 36.56)
Bolivia	23.66 (20.69 - 26.64)	Bolivia	34.15 (31.01 - 37.2)
Ecuador	33.14 (29.45 - 36.57)	Ecuador	42.66 (39.16 - 45.8)
Peru	19.54 (16.75 - 22.16)	Peru	29.67 (26.38 - 32.85)
Central Latin America	28.03 (25.67 - 30.19)	**Central Latin America**	36.06 (33.74 - 38.11)
Aguascalientes	30.66 (28.25 - 32.98)	Aguascalientes	37.81 (35.61 - 40.1)
Baja California	30.24 (27.72 - 32.61)	Baja California	36.87 (34.73 - 38.99)

Baja California Sur	30.19 (27.83 - 32.35)	Baja California Sur	36.47 (34.3 - 38.57)
Campeche	28.15 (25.69 - 30.43)	Campeche	35.87 (33.64 - 38.07)
Chiapas	37.23 (34.71 - 39.76)	Chiapas	37.74 (35.63 - 39.69)
Chihuahua	30.12 (27.7 - 32.39)	Chihuahua	37.21 (34.88 - 39.44)
Coahuila	30.05 (27.78 - 32.4)	Coahuila	36.82 (34.61 - 39)
Colima	29.23 (26.87 - 31.53)	Colima	36.49 (34.23 - 38.65)
Colombia	25.59 (22.71 - 28.46)	Colombia	35.29 (32.35 - 38.29)
Costa Rica	25.26 (22.35 - 27.88)	Costa Rica	34.28 (31.44 - 36.83)
Durango	29.45 (27.11 - 31.59)	Durango	36.74 (34.41 - 38.98)
El Salvador	15.59 (12.97 - 18.21)	El Salvador	22.98 (19.94 - 25.85)
Guanajuato	29.3 (26.8 - 31.59)	Guanajuato	36.97 (34.72 - 39.25)
Guatemala	33.59 (30.29 - 36.8)	Guatemala	41.31 (38.15 - 44.36)
Guerrero	27.54 (25.03 - 29.92)	Guerrero	35.28 (32.99 - 37.54)
Hidalgo	28.31 (25.83 - 30.58)	Hidalgo	36.18 (33.86 - 38.42)
Honduras	22.65 (19.28 - 25.75)	Honduras	31.8 (28.32 - 35.15)
Jalisco	30.13 (27.47 - 32.46)	Jalisco	37.27 (35.09 - 39.42)
Mexico	30.01 (27.78 - 31.95)	Mexico	36.9 (35.06 - 38.68)
Mexico City	32.45 (29.86 - 34.8)	Mexico City	38.99 (36.8 - 41.2)
Michoacán de Ocampo	28.37 (25.87 - 30.7)	Michoacán de Ocampo	36.54 (34.32 - 38.71)
Morelos	29.69 (27.16 - 31.85)	Morelos	36.81 (34.53 - 39.07)
México	30.83 (28.27 - 33.08)	México	37.74 (35.51 - 39.84)
Nayarit	28.47 (26.02 - 30.6)	Nayarit	35.96 (33.66 - 37.98)
Nicaragua	22.52 (19.53 - 25.3)	Nicaragua	31.89 (29.16 - 34.39)
Nuevo León	32.59 (30.45 - 34.55)	Nuevo León	36.02 (34.04 - 37.83)
Oaxaca	29.13 (26.61 - 31.45)	Oaxaca	35.38 (33.2 - 37.62)
Panama	20.62 (17.97 - 23.16)	Panama	28.17 (25.28 - 30.82)
Puebla	28.57 (26.3 - 30.88)	Puebla	36.37 (33.96 - 38.54)
Querétaro	29.38 (26.82 - 31.64)	Querétaro	37.52 (35.32 - 39.68)
Quintana Roo	28.46 (26.09 - 30.72)	Quintana Roo	36.27 (34.19 - 38.42)
San Luis Potosí	28.71 (26.28 - 31.11)	San Luis Potosí	36.81 (34.7 - 38.84)

Sinaloa	29.56 (27.16 - 31.91)	Sinaloa	36.51 (34.46 - 38.63)
Sonora	29.96 (27.56 - 32.2)	Sonora	36.87 (34.71 - 39.01)
Tabasco	27.72 (25.35 - 29.91)	Tabasco	35.57 (33.52 - 37.75)
Tamaulipas	29.91 (27.58 - 32.09)	Tamaulipas	36.77 (34.52 - 38.84)
Tlaxcala	28.94 (26.48 - 31.18)	Tlaxcala	36.98 (34.84 - 39.23)
Venezuela	29.63 (26.9 - 32.24)	Venezuela	38.63 (35.73 - 41.3)
Veracruz de Ignacio de la Llave	27.85 (25.45 - 30.11)	Veracruz de Ignacio de la Llave	35.7 (33.47 - 37.89)
Yucatán	28.4 (25.93 - 30.66)	Yucatán	35.71 (33.68 - 37.82)
Zacatecas	28.79 (26.34 - 31.16)	Zacatecas	36.4 (34.08 - 38.61)
Tropical Latin America	24.76 (22.75 - 26.67)	**Tropical Latin America**	32.06 (30.09 - 33.89)
Acre	25.47 (23.12 - 27.7)	Acre	34.97 (32.71 - 37.23)
Alagoas	24.72 (22.32 - 27.02)	Alagoas	35.17 (32.98 - 37.39)
Amapá	26.01 (23.7 - 28.34)	Amapá	35.61 (33.5 - 37.73)
Amazonas	27.49 (25.02 - 29.76)	Amazonas	35.62 (33.55 - 37.79)
Bahia	25.31 (22.94 - 27.49)	Bahia	35.11 (32.89 - 37.38)
Brazil	24.92 (22.88 - 26.81)	Brazil	32.21 (30.21 - 34.1)
Ceará	25.2 (22.78 - 27.61)	Ceará	35.01 (32.82 - 37.08)
Distrito Federal	29.82 (27.56 - 31.99)	Distrito Federal	38.71 (36.57 - 40.72)
Espírito Santo	28.43 (26.08 - 30.61)	Espírito Santo	37.19 (35.04 - 39.31)
Goiás	26.53 (24.14 - 28.76)	Goiás	35.9 (33.8 - 38.01)
Maranhão	23.64 (21.13 - 26.05)	Maranhão	34.6 (32.52 - 36.83)
Mato Grosso	26.75 (24.43 - 28.96)	Mato Grosso	36.27 (34.16 - 38.22)
Mato Grosso do Sul	28.56 (26.12 - 30.91)	Mato Grosso do Sul	37.56 (35.44 - 39.74)
Minas Gerais	27.39 (25.05 - 29.57)	Minas Gerais	36.27 (34.13 - 38.39)
Paraguay	19.35 (16.53 - 22.01)	Paraguay	27.41 (24.24 - 30.29)
Paraná	27.83 (25.56 - 30.19)	Paraná	36.68 (34.56 - 38.75)
Paraíba	25.8 (23.5 - 28.18)	Paraíba	35.39 (33.04 - 37.48)
Pará	25.04 (22.59 - 27.2)	Pará	34.71 (32.53 - 36.92)
Pernambuco	25.83 (23.6 - 27.94)	Pernambuco	35.7 (33.39 - 37.84)
Piaui	24.69 (22.17 - 27.17)	Piaui	34.56 (32.38 - 36.8)

Rio Grande do Norte	25.88 (23.43 - 28.17)	Rio Grande do Norte	35.95 (33.71 - 38.05)
Rio Grande do Sul	28.92 (26.51 - 31.17)	Rio Grande do Sul	36.99 (34.9 - 39.04)
Rio de Janeiro	29.32 (26.98 - 31.59)	Rio de Janeiro	37.53 (35.36 - 39.6)
Rondônia	26.06 (23.63 - 28.35)	Rondônia	35.53 (33.35 - 37.71)
Roraima	28.16 (25.78 - 30.63)	Roraima	36.12 (33.92 - 38.18)
Santa Catarina	28.28 (25.85 - 30.5)	Santa Catarina	36.97 (34.94 - 39.13)
Sergipe	26.08 (23.72 - 28.38)	Sergipe	35.99 (33.83 - 38.17)
São Paulo	18.83 (14.97 - 22.32)	São Paulo	21.75 (17.56 - 25.71)
Tocantins	14.93 (12.21 - 17.37)	Tocantins	20.86 (17.58 - 23.82)
North Africa and Middle East	18.92 (16.69 - 20.55)	**North Africa and Middle East**	32.36 (30.44 - 34.2)
Afghanistan	12.07 (9.73 - 14.22)	Afghanistan	25.46 (23.09 - 27.77)
Algeria	10.82 (6.13 - 14.77)	Algeria	24.63 (20.4 - 28.62)
Bahrain	10.1 (5.52 - 14.28)	Bahrain	24.66 (19.89 - 29.04)
Egypt	0.21 (0 - 1.61)	Egypt	13.99 (11.58 - 16.23)
Iran	26.22 (24.03 - 28.52)	Iran	43.19 (40.91 - 45.44)
Iraq	12.97 (8.61 - 16.67)	Iraq	23.91 (19.53 - 28.02)
Jordan	10.89 (6.2 - 15.34)	Jordan	25.3 (20.67 - 29.48)
Kuwait	12.1 (7.28 - 16.48)	Kuwait	26.83 (22.24 - 30.98)
Lebanon	30.93 (27.96 - 33.85)	Lebanon	40.97 (38.64 - 43.33)
Libya	17.08 (14.78 - 19.33)	Libya	31.96 (29.27 - 34.48)
Morocco	36.28 (33.35 - 38.95)	Morocco	48.03 (45.41 - 50.68)
Oman	0.48 (0 - 3.21)	Oman	20.14 (16.32 - 24.06)
Palestine	22.25 (20.08 - 24.43)	Palestine	36.63 (34.2 - 39.08)
Qatar	19.33 (17.26 - 21.45)	Qatar	32.4 (30.06 - 34.66)
Saudi Arabia	10.18 (7.63 - 12.55)	Saudi Arabia	31.03 (28.85 - 33.24)
Sudan	8.43 (4.11 - 12.11)	Sudan	22.81 (18.72 - 26.63)
Syria	5.7 (0.76 - 9.81)	Syria	20.65 (16.33 - 24.58)
Tunisia	33.01 (30.7 - 35.3)	Tunisia	47.7 (45.1 - 50.19)
Turkey	50.97 (48.55 - 53.5)	Turkey	61.46 (59.3 - 63.54)
United Arab Emirates	10.06 (5.2 - 14.28)	United Arab Emirates	24.6 (19.97 - 28.9)

Yemen	17.13 (14.71 - 19.66)	Yemen	29.17 (27.1 - 31.27)
South Asia	5.46 (3.36 - 7.52)	**South Asia**	20.45 (18.37 - 22.6)
Bangladesh	18.71 (15.87 - 21.58)	Bangladesh	27.24 (24.25 - 30.02)
Bhutan	28.18 (24.2 - 31.82)	Bhutan	42.3 (38.56 - 46.43)
India	2.14 (0 - 4.22)	India	17.75 (15.59 - 20.02)
Nepal	19.77 (17.23 - 22.48)	Nepal	26.75 (24.17 - 29.34)
Pakistan	25.37 (21.3 - 28.88)	Pakistan	38.34 (34.06 - 42.23)
Sub-Saharan Africa	45.52 (43.26 - 47.69)	**Sub-Saharan Africa**	47.8 (45.44 - 50.1)
Central Sub-Saharan Africa	52.88 (49.81 - 55.63)	**Central Sub-Saharan Africa**	54.45 (51.4 - 57.6)
Angola	41.45 (38.6 - 44.42)	Angola	48.42 (45.34 - 51.57)
Central African Republic	69.64 (65.09 - 74.13)	Central African Republic	66.61 (62.78 - 70.65)
Congo	45.29 (42.02 - 48.33)	Congo	50.86 (47.56 - 54.07)
Democratic Republic of the Congo	56.34 (52.91 - 59.67)	Democratic Republic of the Congo	55.82 (52.56 - 59.41)
Equatorial Guinea	48.37 (45.12 - 51.65)	Equatorial Guinea	57.49 (54.08 - 60.89)
Gabon	45.46 (42.47 - 48.5)	Gabon	51.58 (48.63 - 54.64)
Eastern Sub-Saharan Africa	48.14 (45.81 - 50.4)	**Eastern Sub-Saharan Africa**	56.97 (54.34 - 59.68)
Burundi	77.47 (73.73 - 81.27)	Burundi	85.23 (81.11 - 89.31)
Comoros	35.62 (29.47 - 41.97)	Comoros	47.42 (41.54 - 53.44)
Djibouti	40.81 (35.71 - 45.84)	Djibouti	49.42 (43.85 - 55.12)
Eritrea	29.61 (26.48 - 32.69)	Eritrea	36.9 (33.27 - 40.43)
Ethiopia	43.25 (40.07 - 46.57)	Ethiopia	51.71 (47.95 - 55.74)
Kenya	62.51 (60.01 - 64.97)	Kenya	65.62 (63.04 - 68.16)
Madagascar	49.59 (46.9 - 52.11)	Madagascar	61.37 (58.47 - 64.09)
Malawi	46.01 (43.29 - 48.66)	Malawi	54 (51.24 - 56.81)
Mozambique	43.17 (40.16 - 46.18)	Mozambique	53.63 (50.46 - 56.75)
Rwanda	52.1 (48.78 - 55.47)	Rwanda	64.36 (61.18 - 67.9)
Somalia	37.89 (33.05 - 43.03)	Somalia	45.67 (40.25 - 51.24)
South Sudan	41.96 (36.12 - 47.66)	South Sudan	45.6 (40.4 - 50.53)
Tanzania	42.67 (39.36 - 46.14)	Tanzania	53.03 (49.94 - 56.24)
Uganda	58.21 (54.89 - 61.58)	Uganda	70.97 (67.13 - 74.93)

Zambia	57.33 (54.13 - 60.46)	Zambia	67.74 (64.25 - 71.2)
Southern Sub-Saharan Africa	48.07 (45.49 - 50.99)	**Southern Sub-Saharan Africa**	48.8 (46.15 - 51.64)
Botswana	49.46 (46.57 - 52.62)	Botswana	50.47 (47.6 - 53.44)
Lesotho	45.05 (41.82 - 48.24)	Lesotho	46.24 (43.28 - 49.51)
Namibia	48.21 (45.44 - 51.23)	Namibia	49.11 (46.28 - 52.13)
South Africa	48.03 (45.26 - 51.04)	South Africa	48.96 (46.24 - 52)
Swaziland	46.27 (43.22 - 49.58)	Swaziland	46.33 (43.36 - 49.4)
Zimbabwe	48.85 (45.89 - 51.74)	Zimbabwe	47.97 (45.19 - 50.82)
Western Sub-Saharan Africa	41.27 (38.36 - 44.03)	**Western Sub-Saharan Africa**	38.66 (35.86 - 41.41)
Benin	42.57 (37.51 - 47.78)	Benin	31.37 (28.09 - 34.66)
Burkina Faso	55.61 (49.96 - 61.35)	Burkina Faso	36.12 (32.47 - 39.74)
Cameroon	42.75 (39.16 - 46.26)	Cameroon	46.23 (42.93 - 49.67)
Cape Verde	49.69 (46.54 - 52.95)	Cape Verde	58.6 (55.16 - 61.73)
Chad	38.94 (35.35 - 42.38)	Chad	42.61 (38.74 - 46.47)
Cote d'Ivoire	60 (53.64 - 66.21)	Cote d'Ivoire	37.23 (33.53 - 40.7)
Ghana	42.84 (38.79 - 47.26)	Ghana	35.43 (32.65 - 38.14)
Guinea	40.05 (35.62 - 44.58)	Guinea	36.4 (32.87 - 39.74)
Guinea-Bissau	38.43 (34.98 - 41.95)	Guinea-Bissau	38.29 (34.71 - 41.82)
Liberia	32.44 (28.51 - 36.09)	Liberia	38.61 (34.73 - 42.65)
Mali	32.11 (29.05 - 35.28)	Mali	29.48 (26.53 - 32.32)
Mauritania	28.39 (25.61 - 31.16)	Mauritania	34.48 (31.34 - 37.35)
Niger	34.85 (31.64 - 38)	Niger	36.77 (33.27 - 40.49)
Nigeria	40.69 (37.31 - 44.08)	Nigeria	40.19 (36.62 - 43.86)
Sao Tome and Principe	28.19 (24.39 - 31.73)	Sao Tome and Principe	35.73 (32.01 - 39.4)
Senegal	33.26 (30.07 - 36.45)	Senegal	37.6 (33.77 - 41.26)
Sierra Leone	45.67 (41.23 - 49.95)	Sierra Leone	48.71 (43.23 - 55)
The Gambia	53.27 (50.32 - 56.35)	The Gambia	53.44 (50.48 - 56.09)
Togo	37.02 (33.01 - 41.13)	Togo	38.24 (34.43 - 42.01)

Appendix 2C – Cataract Index Scores

1990	**2016**

Location	Cataract Index Scores	Location	Cataract Index Scores
Global	34.89 (32.37 - 37.42)	**Global**	35.85 (32.77 - 39.15)
Southeast Asia, East Asia, and Oceania	33.66 (31.38 - 36.29)	**Southeast Asia, East Asia, and Oceania**	39.21 (36 - 42.66)
East Asia	44.79 (41.94 - 47.77)	**East Asia**	45.27 (41.71 - 48.99)
China	44.5 (41.46 - 47.59)	China	44.66 (41.03 - 48.43)
North Korea	47.41 (43.44 - 51.22)	North Korea	53.19 (49.29 - 57.15)
Taiwan	69.02 (62.89 - 75.38)	Taiwan	93.27 (84.86 - 100)
Southeast Asia	14.1 (11.85 - 16.49)	**Southeast Asia**	25.24 (22.27 - 28.18)
Cambodia	0.16 (0 - 1.45)	Cambodia	2.55 (0.05 - 5.08)
Indonesia	12.52 (10.15 - 15.06)	Indonesia	23.25 (19.96 - 26.84)
Laos	12.71 (9.71 - 15.68)	Laos	16.23 (13.14 - 19.14)
Malaysia	37.62 (31.66 - 44.59)	Malaysia	47.35 (41.02 - 54.55)
Maldives	17.31 (12.86 - 21.57)	Maldives	33.25 (27.39 - 39.48)
Mauritius	25.57 (18.96 - 32.55)	Mauritius	32.92 (25.26 - 41.44)
Myanmar	0 (0 - 0)	Myanmar	2.34 (0 - 5.23)
Philippines	24.71 (21.93 - 27.48)	Philippines	29.9 (26.94 - 32.89)
Seychelles	30.44 (23.78 - 37.51)	Seychelles	36.84 (29.93 - 43.99)
Sri Lanka	20.35 (15.53 - 24.79)	Sri Lanka	25.89 (20.37 - 31.22)
Thailand	33.18 (30.06 - 36.22)	Thailand	51.52 (46.53 - 56.97)
Timor-Leste	1.53 (0 - 4.78)	Timor-Leste	7.1 (3.7 - 10.97)
Vietnam	11.78 (9.27 - 14.27)	Vietnam	24.33 (20.28 - 28.27)
Oceania	31.53 (28.06 - 34.91)	**Oceania**	34.77 (30.88 - 38.57)
American Samoa	33.58 (28.87 - 38.88)	American Samoa	37.14 (32.07 - 42.94)
Federated States of Micronesia	32.66 (28.56 - 37.08)	Federated States of Micronesia	37.92 (32.97 - 43.41)
Fiji	31.96 (27.17 - 37.09)	Fiji	37.21 (31.06 - 43.54)
Guam	46.07 (39.87 - 53.23)	Guam	46.55 (40.21 - 53.55)
Kiribati	27.25 (23.57 - 30.82)	Kiribati	27.75 (23.96 - 31.42)
Marshall Islands	35.43 (30.02 - 41.36)	Marshall Islands	37.52 (31.48 - 44.27)
Northern Mariana Islands	36.69 (31.5 - 42)	Northern Mariana Islands	44.53 (38.19 - 51.75)
Papua New Guinea	24.84 (21.61 - 28.22)	Papua New Guinea	27.33 (23.94 - 30.83)

Samoa	28.03 (24.28 - 31.87)	Samoa	31.94 (27.84 - 36.47)
Solomon Islands	35.57 (31.34 - 39.65)	Solomon Islands	35.16 (31.19 - 39.19)
Tonga	39.87 (35.64 - 43.49)	Tonga	43.08 (38.02 - 48.1)
Vanuatu	37.84 (34.08 - 42.06)	Vanuatu	40.07 (35.68 - 44.25)
Central Europe, Eastern Europe, and Central Asia	50 (44.87 - 54.92)	**Central Europe, Eastern Europe, and Central Asia**	54.43 (49.19 - 60.08)
Central Asia	33.17 (29.25 - 37.28)	**Central Asia**	41.01 (36.21 - 45.6)
Armenia	27.5 (23.16 - 32.3)	Armenia	39.11 (33.2 - 45.69)
Azerbaijan	30.95 (25.88 - 35.75)	Azerbaijan	41.34 (34.89 - 48.71)
Georgia	30.58 (25.7 - 35.85)	Georgia	32.6 (26.9 - 38.61)
Kazakhstan	34.81 (28.87 - 41.65)	Kazakhstan	41.82 (35.49 - 48.76)
Kyrgyzstan	29.99 (24.47 - 35.68)	Kyrgyzstan	36.4 (31.8 - 40.99)
Mongolia	27.15 (23.76 - 30.47)	Mongolia	30.61 (26.46 - 34.64)
Tajikistan	29.32 (25.29 - 33.41)	Tajikistan	41.92 (36.29 - 47.92)
Turkmenistan	55.42 (47.87 - 64.16)	Turkmenistan	55.7 (48.88 - 63.35)
Uzbekistan	35.92 (28.99 - 43.48)	Uzbekistan	45.47 (38.31 - 53.95)
Central Europe	44.84 (40.34 - 49.5)	**Central Europe**	53.53 (48.05 - 58.87)
Albania	39.79 (34.97 - 44.24)	Albania	49.01 (43.67 - 53.9)
Bosnia and Herzegovina	36.69 (31.98 - 40.94)	Bosnia and Herzegovina	43.03 (38.29 - 47.42)
Bulgaria	45.56 (40.34 - 50.67)	Bulgaria	53.96 (47.94 - 59.83)
Croatia	43.83 (38.58 - 48.86)	Croatia	53.51 (48 - 59.53)
Czech Republic	52.84 (46.58 - 58.87)	Czech Republic	57.6 (51.49 - 64.73)
Hungary	42.85 (37.34 - 47.77)	Hungary	52.36 (46.5 - 58.04)
Macedonia	38.79 (33.92 - 43.17)	Macedonia	44.81 (39.73 - 49.57)
Montenegro	39.42 (34.6 - 44.23)	Montenegro	41.99 (37.15 - 46.57)
Poland	45.86 (40.54 - 51.59)	Poland	55.53 (49.36 - 61.3)
Romania	43.67 (38.36 - 47.91)	Romania	54.21 (48.48 - 59.5)
Serbia	39.21 (34.33 - 43.55)	Serbia	44.67 (39.61 - 49.29)
Slovakia	54.64 (48.35 - 60.78)	Slovakia	60.82 (54.47 - 67.55)
Slovenia	47.23 (41.44 - 52.97)	Slovenia	58.78 (52.18 - 65.41)
Eastern Europe	58.09 (51.78 - 64.57)	**Eastern Europe**	58.79 (52.89 - 65.14)

Belarus	61.16 (53.38 - 69.82)	Belarus	68.07 (61.59 - 74.93)
Estonia	62.44 (55.31 - 70.23)	Estonia	67.22 (59.96 - 74.77)
Latvia	56.35 (49.41 - 64.45)	Latvia	59.18 (52.36 - 66.82)
Lithuania	66.85 (59.76 - 74.2)	Lithuania	68.01 (61.44 - 74.81)
Moldova	46.4 (40.84 - 52.28)	Moldova	65.7 (59.1 - 72.68)
Russian Federation	58.33 (51.65 - 65.73)	Russian Federation	55.82 (50.32 - 62.28)
Ukraine	57.54 (50.01 - 66.03)	Ukraine	65.67 (59.48 - 71.91)
High-income	83.31 (78.36 - 88.62)	**High-income**	89.38 (84.13 - 95.68)
High-income Asia Pacific	80.24 (74.56 - 86.53)	**High-income Asia Pacific**	88.64 (82.17 - 96.22)
Aichi	80.38 (74.62 - 86.79)	Aichi	87.62 (80.98 - 94.68)
Akita	80.88 (75.31 - 87.07)	Akita	90.45 (83.97 - 97.52)
Aomori	80.97 (74.89 - 88.16)	Aomori	89.73 (82.69 - 97.75)
Brunei	70.8 (64.94 - 77.63)	Brunei	81.91 (74.02 - 91.58)
Chiba	80.16 (74.23 - 86.67)	Chiba	88.05 (81.87 - 95.86)
Ehime	80.84 (75.22 - 87.27)	Ehime	89.71 (82.85 - 97.28)
Fukui	80.53 (75.1 - 87)	Fukui	89.41 (82.88 - 96.78)
Fukuoka	81.02 (75.14 - 87.82)	Fukuoka	89.02 (82.34 - 96.65)
Fukushima	80.45 (74.96 - 86.75)	Fukushima	89.57 (82.98 - 97.31)
Gifu	81.52 (75.6 - 87.61)	Gifu	89.98 (83.48 - 97.84)
Gunma	81.06 (75.65 - 87.4)	Gunma	89.01 (82.66 - 96.62)
Hiroshima	80.74 (74.97 - 87.09)	Hiroshima	88.94 (82.86 - 96.43)
Hokkaidō	80.31 (74.47 - 86.34)	Hokkaidō	89.57 (83.33 - 97.17)
Hyōgo	80.74 (74.97 - 87.63)	Hyōgo	88.96 (83.08 - 95.86)
Ibaraki	80.59 (74.57 - 87.54)	Ibaraki	88.31 (82.41 - 95.36)
Ishikawa	80.86 (74.99 - 87.26)	Ishikawa	89.22 (82.51 - 96.92)
Iwate	81.02 (75.45 - 87.38)	Iwate	90.76 (84.05 - 97.96)
Japan	80.6 (75.08 - 86.85)	Japan	88.62 (82.43 - 95.65)
Kagawa	81.05 (75.28 - 88.06)	Kagawa	89.17 (82.52 - 96.32)
Kagoshima	81.59 (75.73 - 87.74)	Kagoshima	90.27 (83.53 - 97.32)
Kanagawa	79.86 (74.45 - 86.1)	Kanagawa	87.92 (81.68 - 94.9)

Kumamoto	81.07 (75.48 - 87.17)	Kumamoto	90.15 (83.74 - 97.25)
Kyōto	80.62 (75.18 - 86.52)	Kyōto	89.07 (82.58 - 96.28)
Kōchi	80.92 (75.27 - 87.56)	Kōchi	90.18 (83.33 - 98.78)
Mie	80.72 (74.69 - 87.45)	Mie	88.85 (82.61 - 96.75)
Miyagi	79.87 (74.13 - 86.68)	Miyagi	87.7 (81.56 - 94.72)
Miyazaki	81.5 (76.09 - 87.65)	Miyazaki	89.98 (83.39 - 97.28)
Nagano	80.53 (75.13 - 87.54)	Nagano	89.05 (82.37 - 95.79)
Nagasaki	81.62 (75.92 - 88.26)	Nagasaki	90.67 (84.14 - 98.12)
Nara	80.45 (74.54 - 87.44)	Nara	89.6 (82.98 - 96.58)
Niigata	81.12 (75.44 - 87.79)	Niigata	89.65 (83.07 - 97.08)
Okayama	81.12 (75.6 - 87.14)	Okayama	89.54 (82.74 - 96.65)
Okinawa	81.57 (76 - 88.36)	Okinawa	89.46 (83.07 - 96.84)
Saga	81.57 (75.6 - 88.21)	Saga	89.85 (83.13 - 97.24)
Saitama	79.9 (74.47 - 86.4)	Saitama	87.79 (81.82 - 94.37)
Shiga	80.62 (74.47 - 86.64)	Shiga	88.71 (82.3 - 96.2)
Shimane	80.97 (75.68 - 87.64)	Shimane	89.99 (83.36 - 97.87)
Shizuoka	80.41 (74.96 - 86.96)	Shizuoka	88.18 (82.06 - 95.8)
Singapore	76.08 (69.83 - 83.68)	Singapore	88.28 (81.15 - 97.28)
South Korea	76.74 (71.16 - 83.34)	South Korea	86.87 (79.98 - 95.54)
Tochigi	80.64 (75.04 - 86.57)	Tochigi	88.65 (82.36 - 96.11)
Tokushima	80.6 (74.42 - 87.2)	Tokushima	89.47 (82.51 - 97.55)
Tottori	80.84 (75.25 - 87.41)	Tottori	89.69 (83.34 - 96.9)
Toyama	80.66 (75.24 - 87.84)	Toyama	88.95 (82.42 - 96.54)
Tōkyō	79.77 (74.31 - 86.35)	Tōkyō	87.01 (80.59 - 93.55)
Wakayama	80.89 (75.02 - 87.38)	Wakayama	90.01 (83.33 - 97.53)
Yamagata	81.05 (75.03 - 87.63)	Yamagata	89.95 (83.41 - 97.67)
Yamaguchi	80.91 (75.25 - 87.09)	Yamaguchi	88.84 (82.57 - 95.93)
Yamanashi	80.3 (74.85 - 86.58)	Yamanashi	88.79 (82.6 - 95.87)
Ōita	81.26 (75.46 - 87.52)	Ōita	90.09 (83.7 - 97.43)
Ōsaka	80.25 (74.19 - 86.74)	Ōsaka	88.1 (81.62 - 95.33)

Australasia	93.64 (88.36 - 99.38)	**Australasia**	96.94 (92 - 100)
Australia	93.58 (88.29 - 99.8)	Australia	96.97 (91.51 - 100)
New Zealand	92.98 (87.88 - 98.9)	New Zealand	97.15 (92.01 - 100)
Western Europe	80 (74.82 - 85.84)	**Western Europe**	87 (80.84 - 93.64)
Andorra	81.51 (74.14 - 88.98)	Andorra	86.79 (79.38 - 94.62)
Austria	81.57 (74.36 - 88.8)	Austria	85.09 (77.8 - 92.62)
Belgium	82.65 (75.41 - 90.66)	Belgium	87.22 (79.43 - 94.97)
Cyprus	78.75 (70.97 - 87.64)	Cyprus	84.02 (76.01 - 92.15)
Denmark	84.82 (80.17 - 89.25)	Denmark	94.23 (89 - 100)
East Midlands	75.83 (71.32 - 80.87)	East Midlands	85.53 (79.76 - 92.33)
East of England	77.1 (72.66 - 81.86)	East of England	86.47 (80.61 - 93.21)
England	76.58 (71.83 - 82.36)	England	85.82 (80.29 - 92.45)
Finland	85.31 (77.44 - 93.42)	Finland	88.04 (79.72 - 95.89)
France	91.16 (85.01 - 97.49)	France	96.01 (90.08 - 100)
Germany	78.29 (70.59 - 85.65)	Germany	83.82 (76.43 - 91.6)
Greater London	76.13 (71.33 - 81.18)	Greater London	86.34 (80.68 - 92.69)
Greece	82.04 (76.14 - 88.18)	Greece	86.46 (80.82 - 93.25)
Iceland	86.18 (80.65 - 92)	Iceland	95.72 (89.09 - 100)
Ireland	77.09 (70.08 - 84.57)	Ireland	84.1 (76.08 - 91.92)
Israel	66.66 (60.45 - 73.11)	Israel	71.15 (64.84 - 79.08)
Italy	76.92 (71.98 - 82.34)	Italy	85.44 (79.89 - 91.74)
Luxembourg	80.67 (73.35 - 88.17)	Luxembourg	86.06 (78.49 - 94.17)
Malta	79.11 (72.06 - 86.94)	Malta	85.34 (77.02 - 93.72)
Netherlands	98.91 (95.05 - 100)	Netherlands	99.99 (100 - 100)
North East England	75.38 (71.14 - 80.37)	North East England	84.73 (78.97 - 91.2)
North West England	75.55 (71.07 - 80.39)	North West England	84.29 (78.78 - 89.88)
Northern Ireland	86.48 (80.84 - 92.28)	Northern Ireland	93.7 (86.94 - 100)
Norway	84.38 (78.64 - 90.63)	Norway	92.21 (84.4 - 100)
Portugal	73.79 (66.88 - 80.94)	Portugal	86.13 (78.5 - 94.78)
Scotland	73.44 (67.27 - 79.57)	Scotland	84.55 (76.25 - 91.62)

South East England	78.21 (73.5 - 84.05)	South East England	87.35 (81.54 - 94.68)
South West England	77.17 (72.19 - 82.33)	South West England	87.36 (81.42 - 93.72)
Spain	74.48 (68.18 - 80.73)	Spain	83.13 (75.77 - 90.41)
Stockholm	85.37 (79.3 - 92.99)	Stockholm	91.57 (84.35 - 99.67)
Sweden	88.6 (81.77 - 96.77)	Sweden	94.28 (86.02 - 100)
Sweden except Stockholm	89.47 (82.08 - 97.78)	Sweden except Stockholm	94.58 (86.92 - 100)
Switzerland	83.05 (75.97 - 91.08)	Switzerland	87 (79.26 - 95.02)
United Kingdom	76.33 (71.93 - 80.75)	United Kingdom	86.12 (80.91 - 92.75)
Wales	75.69 (68.89 - 82.24)	Wales	87.44 (80.09 - 95.12)
West Midlands	75.9 (71.27 - 81.1)	West Midlands	85.6 (79.5 - 92.04)
Yorkshire and the Humber	75.89 (71.51 - 80.62)	Yorkshire and the Humber	85.03 (79.01 - 91.43)
Southern Latin America	60.93 (56.91 - 65.45)	**Southern Latin America**	68.76 (63.38 - 74.18)
Argentina	63.37 (59.19 - 67.99)	Argentina	71.78 (66.69 - 77.2)
Chile	52.87 (49.22 - 56.52)	Chile	62.76 (57.97 - 67.86)
Uruguay	65.56 (60.96 - 70.78)	Uruguay	69.97 (64.32 - 76.18)
High-income North America	97.07 (92.1 - 100)	**High-income North America**	97.91 (92.63 - 100)
Alabama	96.6 (91.16 - 100)	Alabama	97.08 (91.47 - 100)
Alaska	94.85 (89.92 - 100)	Alaska	97.33 (92.21 - 100)
Arizona	98 (93.21 - 100)	Arizona	98.29 (92.36 - 100)
Arkansas	96.16 (90.76 - 100)	Arkansas	97.08 (91.69 - 100)
California	98.47 (93.99 - 100)	California	98.83 (94.09 - 100)
Canada	97.72 (92.83 - 100)	Canada	99.54 (96.18 - 100)
Colorado	95.63 (90.43 - 100)	Colorado	97.24 (91.43 - 100)
Connecticut	97.71 (92.34 - 100)	Connecticut	98.23 (92.55 - 100)
Delaware	95.16 (89.62 - 100)	Delaware	96.93 (91.55 - 100)
District of Columbia	97.08 (91.9 - 100)	District of Columbia	98.25 (93.28 - 100)
Florida	97.36 (92.11 - 100)	Florida	97.86 (92.46 - 100)
Georgia	97.17 (91.78 - 100)	Georgia	97.45 (91.91 - 100)
Greenland	84.58 (80.6 - 89.25)	Greenland	90.6 (85.76 - 95.61)
Hawaii	99.22 (95.12 - 100)	Hawaii	98.94 (94.28 - 100)

Idaho	98.53 (93.14 - 100)	Idaho	97.87 (92.32 - 100)
Illinois	96.46 (91.43 - 100)	Illinois	97.63 (92.14 - 100)
Indiana	96.44 (91.25 - 100)	Indiana	96.05 (90.15 - 100)
Iowa	97.82 (92.58 - 100)	Iowa	97.54 (92.17 - 100)
Kansas	97.56 (92.27 - 100)	Kansas	97.29 (91.33 - 100)
Kentucky	94.91 (89.94 - 100)	Kentucky	95.6 (89.19 - 100)
Louisiana	95.29 (89.61 - 100)	Louisiana	96.11 (90.31 - 100)
Maine	96.46 (91.54 - 100)	Maine	97.78 (92.21 - 100)
Maryland	97.24 (91.84 - 100)	Maryland	97.58 (92 - 100)
Massachusetts	97.38 (92.07 - 100)	Massachusetts	98.32 (92.87 - 100)
Michigan	95.8 (90.52 - 100)	Michigan	96.64 (90.66 - 100)
Minnesota	98.31 (93.67 - 100)	Minnesota	98.17 (92.9 - 100)
Mississippi	96.1 (90.77 - 100)	Mississippi	96.3 (90.48 - 100)
Missouri	97.16 (92.1 - 100)	Missouri	96.39 (90.85 - 100)
Montana	98.29 (93.56 - 100)	Montana	98.15 (92.51 - 100)
Nebraska	98.05 (93.01 - 100)	Nebraska	97.31 (91.58 - 100)
Nevada	93.69 (88.87 - 99.14)	Nevada	96.54 (90.75 - 100)
New Hampshire	96.9 (91.5 - 100)	New Hampshire	98.03 (92.92 - 100)
New Jersey	96.95 (91.58 - 100)	New Jersey	97.85 (92.07 - 100)
New Mexico	96.04 (90.02 - 100)	New Mexico	96.26 (90.35 - 100)
New York	96.79 (91.27 - 100)	New York	97.64 (91.98 - 100)
North Carolina	97.71 (92.81 - 100)	North Carolina	97.17 (91.69 - 100)
North Dakota	98.19 (93.11 - 100)	North Dakota	97.4 (92.17 - 100)
Ohio	96.22 (90.46 - 100)	Ohio	96.22 (90.47 - 100)
Oklahoma	96.61 (91.26 - 100)	Oklahoma	96.35 (90.66 - 100)
Oregon	97.74 (92.5 - 100)	Oregon	98.18 (92.91 - 100)
Pennsylvania	93.72 (87.92 - 100)	Pennsylvania	96.59 (90.6 - 100)
Rhode Island	97.01 (91.87 - 100)	Rhode Island	97.89 (92.63 - 100)
South Carolina	97.29 (91.77 - 100)	South Carolina	97.21 (91.72 - 100)
South Dakota	98.02 (92.96 - 100)	South Dakota	97.84 (92.31 - 100)

Tennessee	97.18 (91.69 - 100)	Tennessee	96.72 (91.18 - 100)
Texas	97.46 (91.98 - 100)	Texas	97.53 (92.11 - 100)
United States	97.03 (91.59 - 100)	United States	97.6 (92.04 - 100)
Utah	99.46 (95.71 - 100)	Utah	98.67 (93.01 - 100)
Vermont	98.35 (93.35 - 100)	Vermont	98.96 (94.41 - 100)
Virginia	97.04 (92.12 - 100)	Virginia	97.45 (91.83 - 100)
Washington	97.7 (92.74 - 100)	Washington	98.31 (93.18 - 100)
West Virginia	95.54 (89.55 - 100)	West Virginia	95.13 (88.86 - 100)
Wisconsin	97.77 (92.53 - 100)	Wisconsin	97.64 (92.38 - 100)
Wyoming	94.12 (88.76 - 100)	Wyoming	96.51 (91.04 - 100)
Latin America and Caribbean	28.34 (24.83 - 31.9)	**Latin America and Caribbean**	39.2 (34.64 - 44.27)
Caribbean	37.3 (33.29 - 41.75)	**Caribbean**	44.1 (39.54 - 49.11)
Antigua and Barbuda	48.92 (41.92 - 57.19)	Antigua and Barbuda	52.27 (44.63 - 61.16)
Barbados	59.76 (52.1 - 70.4)	Barbados	59.76 (51.8 - 69.72)
Belize	34.24 (30.35 - 38.52)	Belize	42.01 (36.45 - 48.59)
Bermuda	41.21 (35.98 - 47.4)	Bermuda	47.13 (41.39 - 53.44)
Cuba	36.94 (32.65 - 41.68)	Cuba	45.09 (40.21 - 50.69)
Dominica	35.15 (30.88 - 40.38)	Dominica	48.5 (42.06 - 56.23)
Dominican Republic	28.96 (25.4 - 32.71)	Dominican Republic	41.12 (36.71 - 46.57)
Grenada	34.86 (30.44 - 39.62)	Grenada	47.75 (41.12 - 56.54)
Guyana	38.25 (33.15 - 43.86)	Guyana	43.65 (38.19 - 50)
Haiti	26.4 (23.65 - 29.04)	Haiti	30.57 (27.64 - 33.84)
Jamaica	34.45 (30.26 - 39.02)	Jamaica	41.53 (35.84 - 48.08)
Puerto Rico	51.45 (43.85 - 60.51)	Puerto Rico	51.68 (44.34 - 60.12)
Saint Lucia	33.16 (29.06 - 37.53)	Saint Lucia	47.27 (40.97 - 54.79)
Saint Vincent and the Grenadines	25.95 (22.66 - 29.24)	Saint Vincent and the Grenadines	41.35 (35.29 - 48.05)
Suriname	35.13 (30.91 - 40.05)	Suriname	40.01 (34.97 - 45.47)
The Bahamas	46.83 (40.35 - 54.66)	The Bahamas	53.5 (46.71 - 61.14)
Trinidad and Tobago	43.48 (37.03 - 51.31)	Trinidad and Tobago	44.28 (37.25 - 53.11)
Virgin Islands, U.S.	50.38 (43.53 - 58.21)	Virgin Islands, U.S.	52.59 (45.19 - 61.63)

Andean Latin America	21.81 (18.57 - 25.1)	**Andean Latin America**	33.44 (28.81 - 38.32)
Bolivia	18.82 (15.68 - 22.27)	Bolivia	29.49 (24.86 - 34.44)
Ecuador	21.82 (18.14 - 26)	Ecuador	34.14 (28.24 - 41.59)
Peru	22.97 (19.76 - 26.33)	Peru	34.45 (30.21 - 38.56)
Central Latin America	21.41 (17.65 - 25.37)	**Central Latin America**	29.96 (25.46 - 35.42)
Aguascalientes	21.62 (17.36 - 26.94)	Aguascalientes	29.35 (24.16 - 35.3)
Baja California	27.55 (21.84 - 35.15)	Baja California	33.96 (28.43 - 41.29)
Baja California Sur	23.11 (18.75 - 28.05)	Baja California Sur	32.06 (26.62 - 37.81)
Campeche	20.45 (16.63 - 24.98)	Campeche	29.47 (24.24 - 35.21)
Chiapas	21.63 (18.22 - 25.2)	Chiapas	26.27 (21.55 - 31.57)
Chihuahua	21.05 (16.69 - 26.03)	Chihuahua	29.19 (24.31 - 34.29)
Coahuila	26.88 (21.33 - 32.69)	Coahuila	31.31 (25.61 - 38.13)
Colima	24.9 (20.32 - 30.75)	Colima	32.24 (26.57 - 39.38)
Colombia	20.06 (16.76 - 23.6)	Colombia	30.93 (26.3 - 36.41)
Costa Rica	22.81 (19.14 - 26.83)	Costa Rica	36.56 (30.8 - 43.26)
Durango	19.41 (15.36 - 23.93)	Durango	28.9 (23.88 - 34.86)
El Salvador	16.73 (13.41 - 20.53)	El Salvador	29.86 (24.78 - 35.75)
Guanajuato	20.18 (15.97 - 24.58)	Guanajuato	28.22 (22.88 - 34.38)
Guatemala	14.34 (11.05 - 17.92)	Guatemala	18.42 (14 - 22.94)
Guerrero	17.24 (13.6 - 20.78)	Guerrero	25.83 (21.17 - 31.03)
Hidalgo	18.2 (14.67 - 22)	Hidalgo	29.83 (24.73 - 35.68)
Honduras	17.24 (14.3 - 20.42)	Honduras	26.31 (22.91 - 29.8)
Jalisco	23.3 (18.44 - 28.94)	Jalisco	29.38 (24.07 - 35.36)
Mexico	22.32 (18.3 - 26.95)	Mexico	30.09 (25.04 - 35.77)
Mexico City	28.35 (22.32 - 35.59)	Mexico City	31.54 (25.66 - 38.71)
Michoacán de Ocampo	19.65 (15.75 - 23.88)	Michoacán de Ocampo	27.6 (22.44 - 33.62)
Morelos	24.65 (19.89 - 29.77)	Morelos	32.78 (26.68 - 39.61)
México	23.4 (18.64 - 28.37)	México	31.05 (25.44 - 38.38)
Nayarit	22.11 (17.96 - 26.67)	Nayarit	32.05 (26.87 - 38.59)
Nicaragua	12.33 (9.5 - 15.02)	Nicaragua	20.75 (16.97 - 24.73)

Nuevo León	26.94 (21.84 - 33.2)	Nuevo León	31.86 (26.01 - 38.75)
Oaxaca	18.95 (15.76 - 22.42)	Oaxaca	26.92 (22.29 - 32.23)
Panama	21.57 (17.87 - 25.97)	Panama	32.24 (26.18 - 39.8)
Puebla	17.89 (14.27 - 21.92)	Puebla	28.58 (23.8 - 34.51)
Querétaro	20.8 (16.37 - 25.28)	Querétaro	30.66 (25.2 - 36.78)
Quintana Roo	22.08 (18.41 - 26.49)	Quintana Roo	32 (26.25 - 38.16)
San Luis Potosí	18.01 (14.4 - 21.88)	San Luis Potosí	28.44 (23.47 - 34.18)
Sinaloa	22.87 (18.53 - 27.51)	Sinaloa	32.88 (27.51 - 38.57)
Sonora	25.18 (20.58 - 30.83)	Sonora	32.06 (26.65 - 38.22)
Tabasco	21.59 (17.4 - 26.36)	Tabasco	31.06 (25.61 - 37.7)
Tamaulipas	24.69 (19.8 - 30.32)	Tamaulipas	34.01 (28.11 - 40.85)
Tlaxcala	21.25 (17.11 - 25.99)	Tlaxcala	30.86 (25.31 - 36.93)
Venezuela	28.24 (23.39 - 33.4)	Venezuela	35.87 (29.95 - 42.7)
Veracruz de Ignacio de la Llave	21.39 (17.61 - 25.35)	Veracruz de Ignacio de la Llave	29.29 (23.96 - 35.23)
Yucatán	20.86 (17.33 - 24.93)	Yucatán	29.47 (24.36 - 35.25)
Zacatecas	20.2 (16.17 - 24.88)	Zacatecas	29.46 (24.24 - 35.85)
Tropical Latin America	37.62 (34.61 - 40.89)	**Tropical Latin America**	54.29 (49.67 - 59.56)
Acre	34.51 (31.67 - 37.76)	Acre	54.11 (48.95 - 60.56)
Alagoas	34.86 (31.67 - 38.07)	Alagoas	53.5 (47.46 - 59.91)
Amapá	43.5 (39.78 - 47.59)	Amapá	59.83 (54.02 - 66.25)
Amazonas	40.39 (37.07 - 44.02)	Amazonas	55.67 (49.98 - 62.48)
Bahia	33.91 (30.94 - 37.09)	Bahia	53.96 (48.57 - 60.14)
Brazil	38 (35.03 - 41.19)	Brazil	54.77 (49.9 - 60.33)
Ceará	32.78 (30.03 - 35.59)	Ceará	53.01 (47.69 - 58.95)
Distrito Federal	50.2 (44.95 - 56.71)	Distrito Federal	55.23 (49.59 - 62.14)
Espírito Santo	37.94 (34.79 - 41.34)	Espírito Santo	56.84 (50.79 - 62.92)
Goiás	39.95 (36.51 - 43.8)	Goiás	57.34 (51.22 - 63.56)
Maranhão	33.92 (31.1 - 36.88)	Maranhão	55.25 (49.08 - 62.36)
Mato Grosso	38.65 (35.58 - 41.84)	Mato Grosso	55.53 (50.06 - 61.48)
Mato Grosso do Sul	39.62 (36.22 - 43.38)	Mato Grosso do Sul	57.14 (51.93 - 63.28)

Minas Gerais	35.45 (32.17 - 38.66)	Minas Gerais	55.11 (50.1 - 61.01)
Paraguay	27.53 (24.59 - 30.48)	Paraguay	39.24 (35 - 43.61)
Paraná	34.54 (31.48 - 37.69)	Paraná	53.38 (47.8 - 59.28)
Paraíba	32.24 (29.45 - 35.22)	Paraíba	51.47 (46.02 - 57.2)
Pará	36.35 (33.32 - 39.29)	Pará	54.92 (49.34 - 61.17)
Pernambuco	35.69 (32.56 - 39.01)	Pernambuco	53.12 (47.57 - 58.96)
Piaui	32.51 (29.78 - 35.27)	Piaui	53.95 (47.92 - 60.53)
Rio Grande do Norte	35.4 (32.19 - 38.48)	Rio Grande do Norte	54.06 (48.49 - 60.48)
Rio Grande do Sul	31.6 (28.49 - 34.67)	Rio Grande do Sul	50.04 (45.21 - 55.46)
Rio de Janeiro	47.22 (42.5 - 52.45)	Rio de Janeiro	55.75 (50.16 - 61.78)
Rondônia	35.7 (32.38 - 38.85)	Rondônia	54.41 (49.42 - 59.84)
Roraima	40.59 (36.89 - 44.4)	Roraima	55.59 (50.09 - 62.11)
Santa Catarina	32.77 (29.87 - 35.79)	Santa Catarina	52.77 (47.3 - 58.41)
Sergipe	35.54 (32.35 - 38.94)	Sergipe	53.83 (48.14 - 60.29)
São Paulo	47.28 (43.11 - 51.61)	São Paulo	56.98 (52.06 - 63.39)
Tocantins	33.36 (30.22 - 36.59)	Tocantins	52.37 (46.69 - 58.91)
North Africa and Middle East	19.53 (15.72 - 23.83)	**North Africa and Middle East**	29.02 (23.71 - 34.68)
Afghanistan	3.25 (0 - 6.27)	Afghanistan	8.75 (5.28 - 12.13)
Algeria	20.34 (14.46 - 26.76)	Algeria	30.96 (24.24 - 39.17)
Bahrain	13.73 (7.99 - 19.8)	Bahrain	22.24 (15.32 - 29.89)
Egypt	17.99 (12.9 - 23.82)	Egypt	21.53 (16.28 - 27.82)
Iran	33.27 (27.8 - 39.66)	Iran	40.99 (34.31 - 48.8)
Iraq	16.53 (10.82 - 22.47)	Iraq	22.46 (16.25 - 29.24)
Jordan	17.89 (11.36 - 24.88)	Jordan	21.33 (15.49 - 27.89)
Kuwait	15.38 (9.98 - 21.47)	Kuwait	23.64 (17.74 - 30.62)
Lebanon	27.52 (21.46 - 33.91)	Lebanon	27.75 (22.81 - 32.67)
Libya	14.57 (8.71 - 20.91)	Libya	20.7 (14.04 - 28.23)
Morocco	17.45 (13.22 - 21.83)	Morocco	33.64 (27.74 - 41.29)
Oman	2.63 (0 - 6.84)	Oman	21.49 (15.34 - 29.71)
Palestine	20.82 (15.5 - 27.11)	Palestine	25.76 (19.67 - 32.84)

Qatar	18.46 (12.53 - 25.74)	Qatar	23.73 (17.48 - 31.34)
Saudi Arabia	16.12 (12.01 - 20.22)	Saudi Arabia	36.57 (30.6 - 43.79)
Sudan	7.72 (3.85 - 11.53)	Sudan	13.64 (9.87 - 17.65)
Syria	18.46 (12.67 - 24.68)	Syria	24.91 (19.49 - 31.22)
Tunisia	19.9 (15.38 - 25.13)	Tunisia	33.45 (27.51 - 40.1)
Turkey	22.89 (17.93 - 27.86)	Turkey	39.76 (33.16 - 47.19)
United Arab Emirates	19.96 (13.33 - 27.07)	United Arab Emirates	29.57 (22.34 - 37.58)
Yemen	7.79 (4.84 - 10.9)	Yemen	16.24 (12.34 - 20.44)
South Asia	6.05 (3.63 - 8.44)	**South Asia**	7.77 (4.8 - 10.97)
Bangladesh	2.87 (0.28 - 5.55)	Bangladesh	2.15 (0 - 5.28)
Bhutan	19.25 (16.22 - 22.23)	Bhutan	32.9 (27.61 - 38.7)
India	6.36 (4.08 - 8.83)	India	8.22 (5.27 - 11.43)
Nepal	7.57 (5.13 - 10.1)	Nepal	11.03 (8.34 - 13.75)
Pakistan	6.17 (3.35 - 8.93)	Pakistan	9.96 (6.67 - 13.44)
Sub-Saharan Africa	19.69 (17.42 - 22.08)	**Sub-Saharan Africa**	20.66 (18.2 - 23.23)
Central Sub-Saharan Africa	25.19 (22.61 - 28.09)	**Central Sub-Saharan Africa**	27.83 (24.93 - 30.94)
Angola	21.01 (18.24 - 23.87)	Angola	28.86 (24.06 - 33.97)
Central African Republic	32.76 (29.62 - 36.16)	Central African Republic	31.81 (28.22 - 35.7)
Congo	22.58 (19.74 - 25.58)	Congo	28.25 (24.28 - 33.06)
Democratic Republic of the Congo	25.99 (22.53 - 29.28)	Democratic Republic of the Congo	26.89 (23.72 - 30.19)
Equatorial Guinea	25.1 (22.32 - 27.84)	Equatorial Guinea	29.95 (25.06 - 35.7)
Gabon	24.45 (19.55 - 29.4)	Gabon	38.09 (31.72 - 45.4)
Eastern Sub-Saharan Africa	21.39 (19.25 - 23.74)	**Eastern Sub-Saharan Africa**	22.79 (20.4 - 24.94)
Burundi	41.9 (39.09 - 44.84)	Burundi	45.58 (42.76 - 48.47)
Comoros	12.64 (8.69 - 16.45)	Comoros	20.97 (16.71 - 25.39)
Djibouti	21.63 (14.76 - 28.82)	Djibouti	28.67 (21.63 - 36.91)
Eritrea	16.84 (13.66 - 19.75)	Eritrea	25.47 (17.97 - 34.7)
Ethiopia	21.92 (18.87 - 25.09)	Ethiopia	18.63 (15.99 - 21.34)
Kenya	16.52 (14.37 - 18.95)	Kenya	21.62 (19.24 - 24.08)
Madagascar	26.74 (24.16 - 29.22)	Madagascar	31.74 (29.08 - 34.59)

Malawi	21.79 (19.28 - 24.2)	Malawi	23.14 (20.71 - 25.49)
Mozambique	18.11 (15.78 - 20.48)	Mozambique	21.2 (18.88 - 23.56)
Rwanda	19 (15.25 - 22.66)	Rwanda	23.71 (20.12 - 26.92)
Somalia	17.32 (13.36 - 21.45)	Somalia	20.65 (16.86 - 24.73)
South Sudan	12.59 (8.85 - 16.64)	South Sudan	11.51 (8.48 - 15.11)
Tanzania	21.14 (18.98 - 23.36)	Tanzania	25.65 (23.21 - 28.09)
Uganda	26.19 (23.69 - 29.11)	Uganda	30.46 (28.01 - 33.05)
Zambia	26.5 (23.17 - 29.98)	Zambia	27.97 (25.43 - 30.73)
Southern Sub-Saharan Africa	41.43 (38.58 - 44.33)	**Southern Sub-Saharan Africa**	48.17 (44.4 - 52.44)
Botswana	33.4 (29.93 - 36.97)	Botswana	40.35 (35.14 - 46.4)
Lesotho	32.36 (25.03 - 38.51)	Lesotho	32.51 (25.55 - 38.76)
Namibia	34.15 (27.39 - 40.06)	Namibia	37.8 (30.8 - 44.05)
South Africa	43.62 (40.91 - 46.32)	South Africa	51.82 (47.37 - 56.82)
Swaziland	31.31 (24.33 - 37.35)	Swaziland	37.11 (30.02 - 43.73)
Zimbabwe	35.9 (29.39 - 41.92)	Zimbabwe	38.06 (31.32 - 44.45)
Western Sub-Saharan Africa	11.72 (9.22 - 14.36)	**Western Sub-Saharan Africa**	11.76 (9.24 - 14.56)
Benin	3.59 (0 - 7.54)	Benin	0.87 (0 - 3.7)
Burkina Faso	17.29 (11.31 - 22.87)	Burkina Faso	5.12 (0.68 - 9.33)
Cameroon	14.84 (11.77 - 18.2)	Cameroon	17.08 (13.75 - 20.81)
Cape Verde	15.46 (11.51 - 19.26)	Cape Verde	26.65 (20.1 - 34.42)
Chad	10.22 (5.71 - 14.89)	Chad	11.43 (6.91 - 16.26)
Cote d'Ivoire	26.56 (20.09 - 33.13)	Cote d'Ivoire	13.46 (8.46 - 18.46)
Ghana	25.75 (22.64 - 28.79)	Ghana	20.96 (18.2 - 24.05)
Guinea	11.25 (5.93 - 16.27)	Guinea	9.06 (4.53 - 13.65)
Guinea-Bissau	10.48 (5.72 - 14.92)	Guinea-Bissau	7.86 (3.13 - 12.03)
Liberia	6.52 (1.6 - 11.41)	Liberia	7.46 (2.52 - 12.05)
Mali	4.76 (2.15 - 7.36)	Mali	1.29 (0 - 3.73)
Mauritania	2.68 (0 - 6.07)	Mauritania	6.03 (1.92 - 10.43)
Niger	11.69 (7.32 - 16.01)	Niger	10.7 (6.33 - 15.37)
Nigeria	10.25 (7.68 - 13.21)	Nigeria	13.3 (10.28 - 16.56)

Sao Tome and Principe	6.25 (1.51 - 10.75)	Sao Tome and Principe	13.7 (7.68 - 19.88)
Senegal	9.79 (5.29 - 14.18)	Senegal	10.23 (4.9 - 15.38)
Sierra Leone	9.2 (6.4 - 12.11)	Sierra Leone	9.41 (5.73 - 13.26)
The Gambia	17.87 (14.92 - 20.75)	The Gambia	13.98 (11.46 - 16.62)
Togo	8.82 (3.92 - 13.63)	Togo	9.51 (4.96 - 13.98)

Appendix 3

Appendix 3A – Percent Change in Mean SDI, AVLI, CI, UREI between 1990 and 2016

Location	% Change SDI	% Change AVLI	% Change CI	% Change UREI
Global	0.21	0.13 (0.09 - 0.17)	0.18 (-0.08 - 0.14)	0.18 (0.16 - 0.2)
Southeast Asia, East Asia, and Oceania	0.38	0.19 (0.15 - 0.24)	0.17 (0.06 - 0.27)	0.2 (0.16 - 0.25)
East Asia	0.39	0.1 (0.06 - 0.15)	0.01 (-0.07 - 0.1)	0.14 (0.09 - 0.2)
China	0.42	0.1 (0.05 - 0.15)	0 (-0.07 - 0.09)	0.14 (0.09 - 0.21)
North Korea	-0.02	0.19 (0.15 - 0.22)	0.12 (0.04 - 0.2)	0.22 (0.18 - 0.26)
Taiwan	0.19	0.21 (0.17 - 0.24)	0.35 (0.2 - 0.51)	0.2 (0.17 - 0.23)
Southeast Asia	0.35	0.65 (0.54 - 0.76)	0.8 (0.5 - 1.18)	0.53 (0.49 - 0.59)
Cambodia	0.67	inf (1.37 - inf)	inf (0.32 - inf)	1.63 (0.84 - 3.14)
Indonesia	0.35	0.61 (0.49 - 0.75)	0.87 (0.5 - 1.33)	0.46 (0.42 - 0.51)
Laos	0.69	0.34 (0.25 - 0.44)	0.29 (0.04 - 0.6)	0.36 (0.29 - 0.43)
Malaysia	0.37	0.3 (0.21 - 0.4)	0.27 (0.01 - 0.56)	0.34 (0.27 - 0.41)
Maldives	0.59	0.85 (0.65 - 1.11)	0.95 (0.52 - 1.54)	0.78 (0.55 - 1.06)
Mauritius	0.24	0.42 (0.25 - 0.63)	0.31 (-0.08 - 0.79)	0.5 (0.36 - 0.68)
Myanmar	0.69	inf (inf - inf)	inf (inf - inf)	inf (inf - inf)
Philippines	0.24	0.4 (0.3 - 0.51)	0.21 (0.06 - 0.38)	0.52 (0.42 - 0.65)
Seychelles	0.22	0.37 (0.23 - 0.53)	0.22 (-0.07 - 0.57)	0.49 (0.34 - 0.66)
Sri Lanka	0.37	0.43 (0.31 - 0.58)	0.28 (0.05 - 0.59)	0.51 (0.37 - 0.67)
Thailand	0.34	0.27 (0.21 - 0.32)	0.56 (0.38 - 0.75)	0.15 (0.12 - 0.19)

Timor-Leste	0.65	inf (inf - inf)	inf (0.72 - inf)	inf (1843.58 - inf)
Vietnam	0.45	0.83 (0.65 - 1.05)	1.09 (0.63 - 1.72)	0.65 (0.5 - 0.82)
Oceania	0.28	0.14 (0.06 - 0.22)	0.11 (-0.02 - 0.26)	0.17 (0.09 - 0.26)
American Samoa	0.20	0.16 (0.08 - 0.25)	0.11 (-0.07 - 0.34)	0.2 (0.13 - 0.29)
Federated States of Micronesia	0.41	0.21 (0.12 - 0.29)	0.16 (0 - 0.36)	0.25 (0.17 - 0.36)
Fiji	0.23	0.16 (0.07 - 0.26)	0.17 (-0.05 - 0.43)	0.17 (0.09 - 0.25)
Guam	0.09	0.08 (0.02 - 0.15)	0.01 (-0.17 - 0.22)	0.13 (0.06 - 0.2)
Kiribati	0.45	0.12 (0.04 - 0.21)	0.02 (-0.11 - 0.17)	0.18 (0.08 - 0.28)
Marshall Islands	0.24	0.14 (0.05 - 0.24)	0.06 (-0.13 - 0.31)	0.2 (0.12 - 0.29)
Northern Mariana Islands	0.13	0.16 (0.08 - 0.24)	0.22 (0.02 - 0.46)	0.14 (0.08 - 0.22)
Papua New Guinea	0.42	0.17 (0.05 - 0.29)	0.1 (-0.05 - 0.28)	0.23 (0.08 - 0.4)
Samoa	0.25	0.17 (0.09 - 0.24)	0.14 (-0.01 - 0.31)	0.19 (0.11 - 0.27)
Solomon Islands	0.40	0.1 (0.03 - 0.19)	-0.01 (-0.13 - 0.12)	0.18 (0.09 - 0.29)
Tonga	0.29	0.05 (-0.01 - 0.11)	0.08 (-0.04 - 0.22)	0.04 (-0.02 - 0.1)
Vanuatu	0.43	0.13 (0.07 - 0.2)	0.06 (-0.06 - 0.19)	0.18 (0.1 - 0.26)
Central Europe, Eastern Europe, and Central Asia	0.10	0.05 (0.01 - 0.08)	0.09 (-0.03 - 0.22)	0.04 (0.02 - 0.06)
Central Asia	0.17	0.12 (0.06 - 0.17)	0.24 (0.07 - 0.41)	0.07 (0.04 - 0.1)
Armenia	0.17	0.19 (0.1 - 0.29)	0.43 (0.16 - 0.76)	0.08 (0.01 - 0.15)
Azerbaijan	0.15	0.16 (0.08 - 0.26)	0.34 (0.08 - 0.66)	0.09 (0.03 - 0.16)
Georgia	0.04	0.05 (-0.03 - 0.15)	0.07 (-0.14 - 0.34)	0.05 (-0.01 - 0.12)
Kazakhstan	0.11	0.1 (0.01 - 0.19)	0.21 (-0.03 - 0.51)	0.06 (-0.01 - 0.13)
Kyrgyzstan	0.05	0.09 (0.01 - 0.17)	0.22 (0 - 0.49)	0.03 (-0.03 - 0.09)
Mongolia	0.23	0.1 (0.04 - 0.18)	0.13 (-0.01 - 0.29)	0.09 (0.02 - 0.17)

Tajikistan	0.11	0.13 (0.07 - 0.21)	0.43 (0.22 - 0.7)	0.01 (-0.05 - 0.08)
Turkmenistan	0.32	0.09 (0.03 - 0.16)	0.01 (-0.16 - 0.21)	0.15 (0.07 - 0.23)
Uzbekistan	0.28	0.14 (0.05 - 0.24)	0.28 (0.01 - 0.64)	0.09 (0.02 - 0.17)
Central Europe	0.15	0.1 (0.06 - 0.13)	0.2 (0.08 - 0.32)	0.07 (0.05 - 0.09)
Albania	0.24	0.12 (0.07 - 0.16)	0.23 (0.12 - 0.35)	0.08 (0.03 - 0.13)
Bosnia and Herzegovina	0.35	0.14 (0.09 - 0.18)	0.17 (0.08 - 0.28)	0.12 (0.07 - 0.17)
Bulgaria	0.11	0.09 (0.04 - 0.14)	0.19 (0.06 - 0.34)	0.06 (0.02 - 0.11)
Croatia	0.08	0.09 (0.05 - 0.14)	0.22 (0.09 - 0.38)	0.05 (0.01 - 0.09)
Czech Republic	0.09	0.06 (0.01 - 0.1)	0.09 (-0.05 - 0.25)	0.05 (0.02 - 0.1)
Hungary	0.13	0.1 (0.06 - 0.15)	0.22 (0.09 - 0.38)	0.06 (0.02 - 0.11)
Macedonia	0.13	0.09 (0.05 - 0.14)	0.16 (0.05 - 0.28)	0.07 (0.02 - 0.11)
Montenegro	0.09	0.07 (0.03 - 0.11)	0.07 (-0.03 - 0.18)	0.07 (0.03 - 0.12)
Poland	0.19	0.11 (0.06 - 0.15)	0.21 (0.07 - 0.37)	0.08 (0.03 - 0.13)
Romania	0.15	0.11 (0.07 - 0.16)	0.24 (0.13 - 0.39)	0.07 (0.03 - 0.12)
Serbia	0.10	0.08 (0.04 - 0.13)	0.14 (0.03 - 0.25)	0.06 (0.02 - 0.1)
Slovakia	0.12	0.06 (0.02 - 0.11)	0.12 (-0.02 - 0.26)	0.06 (0.02 - 0.1)
Slovenia	0.08	0.09 (0.05 - 0.13)	0.25 (0.1 - 0.42)	0.05 (0.01 - 0.09)
Eastern Europe	0.08	0.03 (-0.01 - 0.07)	0.01 (-0.11 - 0.15)	0.04 (0.01 - 0.08)
Belarus	0.12	0.06 (0.02 - 0.1)	0.12 (-0.04 - 0.29)	0.05 (0.01 - 0.08)
Estonia	0.11	0.04 (0 - 0.08)	0.08 (-0.08 - 0.25)	0.03 (0.01 - 0.06)
Latvia	0.09	0.05 (0 - 0.09)	0.05 (-0.11 - 0.23)	0.05 (0.01 - 0.08)
Lithuania	0.11	0.04 (0 - 0.07)	0.02 (-0.1 - 0.16)	0.05 (0.01 - 0.08)
Moldova	0.09	0.11 (0.06 - 0.16)	0.42 (0.24 - 0.63)	0.03 (0 - 0.07)

Russian Federation	0.08	0.03 (-0.01 - 0.08)	-0.04 (-0.17 - 0.11)	0.07 (0.02 - 0.12)
Ukraine	0.06	0.05 (0.01 - 0.09)	0.15 (-0.02 - 0.32)	0.03 (-0.01 - 0.06)
High-income	0.09	0.05 (0.03 - 0.06)	0.07 (-0.01 - 0.17)	0.05 (0.04 - 0.06)
High-income Asia Pacific	0.10	0.06 (0.05 - 0.08)	0.11 (0 - 0.22)	0.07 (0.06 - 0.09)
Aichi	0.07	0.05 (0.02 - 0.08)	0.09 (-0.01 - 0.21)	0.05 (0.01 - 0.09)
Akita	0.08	0.05 (0.02 - 0.08)	0.12 (0.02 - 0.24)	0.05 (0.01 - 0.1)
Aomori	0.08	0.05 (0.02 - 0.08)	0.11 (0 - 0.24)	0.06 (0.01 - 0.1)
Brunei	0.17	0.09 (0.05 - 0.12)	0.16 (0.02 - 0.31)	0.09 (0.05 - 0.13)
Chiba	0.07	0.05 (0.02 - 0.08)	0.1 (-0.01 - 0.22)	0.05 (0.01 - 0.1)
Ehime	0.08	0.05 (0.02 - 0.08)	0.11 (0 - 0.23)	0.06 (0.02 - 0.1)
Fukui	0.08	0.05 (0.02 - 0.09)	0.11 (0 - 0.23)	0.06 (0.02 - 0.1)
Fukuoka	0.08	0.05 (0.02 - 0.08)	0.1 (-0.01 - 0.21)	0.06 (0.02 - 0.1)
Fukushima	0.09	0.05 (0.02 - 0.08)	0.11 (0 - 0.23)	0.06 (0.02 - 0.1)
Gifu	0.08	0.05 (0.02 - 0.08)	0.11 (0 - 0.22)	0.05 (0.01 - 0.1)
Gunma	0.08	0.05 (0.02 - 0.08)	0.1 (-0.01 - 0.22)	0.06 (0.02 - 0.1)
Hiroshima	0.08	0.05 (0.02 - 0.08)	0.1 (0 - 0.23)	0.06 (0.02 - 0.1)
Hokkaidō	0.07	0.05 (0.02 - 0.08)	0.12 (0.01 - 0.23)	0.05 (0.01 - 0.1)
Hyōgo	0.07	0.05 (0.02 - 0.08)	0.1 (-0.01 - 0.22)	0.05 (0.01 - 0.1)
Ibaraki	0.08	0.05 (0.02 - 0.08)	0.1 (-0.01 - 0.22)	0.06 (0.02 - 0.1)
Ishikawa	0.08	0.05 (0.02 - 0.08)	0.1 (0 - 0.24)	0.05 (0.01 - 0.09)
Iwate	0.09	0.06 (0.03 - 0.08)	0.12 (0.01 - 0.23)	0.06 (0.02 - 0.1)
Japan	0.07	0.05 (0.04 - 0.06)	0.1 (0 - 0.21)	0.06 (0.05 - 0.07)
Kagawa	0.08	0.05 (0.02 - 0.08)	0.1 (-0.01 - 0.23)	0.05 (0.01 - 0.1)
Kagoshima	0.09	0.06 (0.02 - 0.09)	0.11 (0 - 0.23)	0.06 (0.02 - 0.1)
Kanagawa	0.07	0.05 (0.02 - 0.08)	0.1 (0 - 0.22)	0.05 (0.02 - 0.09)

Kumamoto	0.08	0.05 (0.02 - 0.09)	0.11 (0 - 0.23)	0.06 (0.02 - 0.1)
Kyōto	0.07	0.05 (0.02 - 0.08)	0.11 (-0.01 - 0.22)	0.05 (0.01 - 0.1)
Kōchi	0.08	0.05 (0.02 - 0.09)	0.12 (0 - 0.24)	0.06 (0.02 - 0.1)
Mie	0.08	0.05 (0.02 - 0.08)	0.1 (-0.01 - 0.22)	0.06 (0.02 - 0.1)
Miyagi	0.08	0.05 (0.02 - 0.08)	0.1 (-0.01 - 0.21)	0.06 (0.02 - 0.1)
Miyazaki	0.08	0.05 (0.02 - 0.09)	0.11 (0 - 0.23)	0.06 (0.01 - 0.1)
Nagano	0.09	0.05 (0.02 - 0.09)	0.11 (0 - 0.23)	0.06 (0.02 - 0.1)
Nagasaki	0.08	0.06 (0.02 - 0.09)	0.11 (0 - 0.23)	0.06 (0.02 - 0.11)
Nara	0.07	0.05 (0.02 - 0.08)	0.12 (0 - 0.24)	0.05 (0.01 - 0.1)
Niigata	0.09	0.06 (0.03 - 0.09)	0.11 (0 - 0.22)	0.06 (0.02 - 0.1)
Okayama	0.08	0.05 (0.02 - 0.08)	0.11 (0 - 0.22)	0.06 (0.02 - 0.1)
Okinawa	0.08	0.05 (0.01 - 0.08)	0.1 (-0.01 - 0.21)	0.05 (0.01 - 0.09)
Saga	0.09	0.05 (0.02 - 0.08)	0.1 (-0.01 - 0.22)	0.06 (0.02 - 0.1)
Saitama	0.07	0.05 (0.02 - 0.08)	0.1 (-0.01 - 0.21)	0.05 (0.01 - 0.1)
Shiga	0.09	0.05 (0.02 - 0.09)	0.1 (0 - 0.21)	0.06 (0.02 - 0.1)
Shimane	0.09	0.05 (0.02 - 0.09)	0.11 (0 - 0.24)	0.06 (0.02 - 0.11)
Shizuoka	0.08	0.05 (0.02 - 0.08)	0.1 (-0.01 - 0.22)	0.06 (0.01 - 0.1)
Singapore	0.20	0.09 (0.05 - 0.12)	0.16 (0.03 - 0.31)	0.1 (0.06 - 0.14)
South Korea	0.19	0.09 (0.06 - 0.13)	0.13 (0.01 - 0.26)	0.11 (0.07 - 0.16)
Tochigi	0.08	0.05 (0.02 - 0.09)	0.1 (-0.01 - 0.21)	0.06 (0.02 - 0.11)
Tokushima	0.08	0.05 (0.02 - 0.09)	0.11 (-0.01 - 0.24)	0.06 (0.02 - 0.1)
Tottori	0.09	0.06 (0.03 - 0.09)	0.11 (0 - 0.23)	0.06 (0.02 - 0.11)
Toyama	0.08	0.05 (0.02 - 0.08)	0.1 (-0.01 - 0.22)	0.06 (0.02 - 0.1)
Tōkyō	0.07	0.05 (0.01 - 0.08)	0.09 (-0.01 - 0.2)	0.05 (0.01 - 0.09)
Wakayama	0.08	0.05 (0.02 - 0.09)	0.11 (0.01 - 0.24)	0.06 (0.02 - 0.1)

Yamagata	0.09	0.06 (0.02 - 0.09)	0.11 (0 - 0.22)	0.06 (0.02 - 0.11)
Yamaguchi	0.08	0.05 (0.02 - 0.08)	0.1 (0 - 0.21)	0.06 (0.02 - 0.1)
Yamanashi	0.08	0.05 (0.02 - 0.08)	0.11 (0 - 0.22)	0.06 (0.02 - 0.1)
Ōita	0.08	0.05 (0.02 - 0.09)	0.11 (0.01 - 0.23)	0.06 (0.01 - 0.1)
Ōsaka	0.07	0.05 (0.02 - 0.08)	0.1 (0 - 0.23)	0.05 (0.02 - 0.1)
Australasia	0.09	0.04 (0.02 - 0.06)	0.04 (-0.04 - 0.11)	0.05 (0.03 - 0.07)
Australia	0.09	0.04 (0.02 - 0.06)	0.04 (-0.04 - 0.11)	0.05 (0.02 - 0.07)
New Zealand	0.08	0.05 (0.03 - 0.07)	0.05 (-0.03 - 0.12)	0.06 (0.04 - 0.08)
Western Europe	0.09	0.05 (0.03 - 0.06)	0.09 (-0.01 - 0.18)	0.05 (0.03 - 0.06)
Andorra	0.05	0.05 (0.02 - 0.08)	0.07 (-0.04 - 0.17)	0.05 (0.01 - 0.09)
Austria	0.08	0.05 (0.02 - 0.09)	0.04 (-0.05 - 0.14)	0.06 (0.02 - 0.1)
Belgium	0.07	0.05 (0.02 - 0.09)	0.06 (-0.04 - 0.16)	0.06 (0.02 - 0.11)
Cyprus	0.17	0.07 (0.04 - 0.11)	0.07 (-0.05 - 0.19)	0.08 (0.04 - 0.13)
Denmark	0.05	0.03 (0 - 0.06)	0.11 (0.03 - 0.2)	0.02 (-0.02 - 0.06)
East Midlands	0.14	0.07 (0.06 - 0.09)	0.13 (0.03 - 0.24)	0.08 (0.06 - 0.09)
East of England	0.12	0.07 (0.05 - 0.09)	0.12 (0.03 - 0.23)	0.07 (0.06 - 0.09)
England	0.13	0.07 (0.06 - 0.09)	0.12 (0.02 - 0.23)	0.08 (0.07 - 0.08)
Finland	0.08	0.04 (0.01 - 0.08)	0.03 (-0.08 - 0.15)	0.05 (0.01 - 0.1)
France	0.09	0.03 (0.01 - 0.05)	0.05 (-0.02 - 0.13)	0.03 (0.01 - 0.05)
Germany	0.07	0.05 (0.02 - 0.09)	0.07 (-0.03 - 0.18)	0.06 (0.01 - 0.1)
Greater London	0.13	0.07 (0.06 - 0.09)	0.14 (0.04 - 0.25)	0.07 (0.07 - 0.08)
Greece	0.12	0.05 (0.03 - 0.07)	0.05 (-0.03 - 0.15)	0.05 (0.03 - 0.08)
Iceland	0.09	0.04 (0.03 - 0.06)	0.11 (0.01 - 0.2)	0.04 (0.02 - 0.06)
Ireland	0.15	0.07 (0.03 - 0.1)	0.09 (-0.01 - 0.2)	0.07 (0.03 - 0.12)

Israel	0.09	0.09 (0.04 - 0.13)	0.07 (-0.05 - 0.22)	0.12 (0.06 - 0.19)
Italy	0.09	0.05 (0.02 - 0.08)	0.11 (0.01 - 0.22)	0.04 (0.01 - 0.08)
Luxembourg	0.07	0.05 (0.01 - 0.08)	0.07 (-0.04 - 0.19)	0.05 (0.01 - 0.09)
Malta	0.14	0.06 (0.03 - 0.1)	0.08 (-0.02 - 0.19)	0.07 (0.03 - 0.11)
Netherlands	0.08	0.03 (0.01 - 0.05)	0.01 (0 - 0.05)	0.03 (0.01 - 0.05)
North East England	0.14	0.08 (0.06 - 0.09)	0.13 (0.02 - 0.23)	0.08 (0.07 - 0.09)
North West England	0.14	0.08 (0.06 - 0.09)	0.12 (0.03 - 0.22)	0.08 (0.07 - 0.09)
Northern Ireland	0.12	0.04 (0.02 - 0.06)	0.08 (-0.01 - 0.16)	0.03 (0.01 - 0.05)
Norway	0.09	0.04 (0.02 - 0.06)	0.09 (-0.01 - 0.2)	0.03 (0.01 - 0.05)
Portugal	0.16	0.08 (0.05 - 0.12)	0.17 (0.06 - 0.29)	0.07 (0.03 - 0.12)
Scotland	0.11	0.07 (0.03 - 0.11)	0.15 (0.06 - 0.25)	0.06 (0.02 - 0.11)
South East England	0.12	0.07 (0.05 - 0.09)	0.12 (0.01 - 0.23)	0.07 (0.06 - 0.08)
South West England	0.12	0.07 (0.06 - 0.09)	0.13 (0.04 - 0.24)	0.07 (0.06 - 0.08)
Spain	0.14	0.06 (0.03 - 0.09)	0.12 (0.01 - 0.24)	0.05 (0.02 - 0.08)
Stockholm	0.03	0 (0 - 0)	0.07 (-0.04 - 0.18)	0 (0 - 0)
Sweden	0.08	0 (0 - 0)	0.07 (-0.04 - 0.18)	0 (0 - 0)
Sweden except Stockholm	0.10	0 (0 - 0)	0.06 (-0.06 - 0.17)	0 (0 - 0)
Switzerland	0.04	0.04 (0.01 - 0.09)	0.05 (-0.05 - 0.15)	0.05 (0.01 - 0.11)
United Kingdom	0.13	0.07 (0.06 - 0.09)	0.13 (0.04 - 0.24)	0.07 (0.06 - 0.08)
Wales	0.15	0.08 (0.04 - 0.12)	0.16 (0.05 - 0.27)	0.07 (0.03 - 0.13)
West Midlands	0.14	0.08 (0.06 - 0.09)	0.13 (0.03 - 0.23)	0.08 (0.07 - 0.09)
Yorkshire and the Humber	0.14	0.07 (0.06 - 0.09)	0.12 (0.03 - 0.22)	0.08 (0.07 - 0.09)
Southern Latin America	0.20	0.13 (0.1 - 0.16)	0.13 (0.02 - 0.25)	0.15 (0.12 - 0.18)

Argentina	0.19	0.13 (0.09 - 0.17)	0.13 (0.02 - 0.25)	0.14 (0.1 - 0.18)
Chile	0.24	0.15 (0.11 - 0.2)	0.19 (0.07 - 0.31)	0.16 (0.12 - 0.21)
Uruguay	0.17	0.1 (0.06 - 0.14)	0.07 (-0.04 - 0.18)	0.12 (0.07 - 0.17)
High-income North America	0.06	-0.01 (-0.02 - 0)	0.01 (-0.06 - 0.07)	-0.01 (-0.02 - 0)
Alabama	0.06	-0.01 (-0.02 - 0.01)	0.01 (-0.07 - 0.09)	-0.01 (-0.02 - 0.01)
Alaska	0.06	0 (-0.02 - 0.01)	0.03 (-0.05 - 0.1)	-0.01 (-0.03 - 0.01)
Arizona	0.05	-0.01 (-0.02 - 0.01)	0 (-0.06 - 0.06)	-0.01 (-0.03 - 0)
Arkansas	0.07	-0.01 (-0.02 - 0.01)	0.01 (-0.06 - 0.09)	-0.01 (-0.02 - 0.01)
California	0.07	-0.01 (-0.02 - 0.01)	0 (-0.05 - 0.06)	-0.01 (-0.02 - 0.01)
Canada	0.07	0 (-0.01 - 0)	0.02 (-0.02 - 0.07)	0 (-0.01 - 0)
Colorado	0.05	-0.01 (-0.02 - 0.01)	0.02 (-0.05 - 0.09)	-0.01 (-0.03 - 0)
Connecticut	0.05	-0.01 (-0.02 - 0.01)	0.01 (-0.06 - 0.07)	-0.01 (-0.02 - 0)
Delaware	0.05	-0.01 (-0.02 - 0.01)	0.02 (-0.06 - 0.1)	-0.01 (-0.02 - 0.01)
District of Columbia	0.08	0 (-0.02 - 0.01)	0.01 (-0.05 - 0.08)	-0.01 (-0.02 - 0.01)
Florida	0.05	-0.01 (-0.02 - 0.01)	0.01 (-0.06 - 0.07)	-0.01 (-0.02 - 0.01)
Georgia	0.05	0 (0 - 0)	0 (-0.06 - 0.07)	0 (0 - 0)
Greenland	0.09	0 (-0.02 - 0.02)	0.07 (0 - 0.15)	-0.01 (-0.02 - 0.01)
Hawaii	0.05	-0.01 (-0.02 - 0.01)	0 (-0.05 - 0.05)	-0.01 (-0.03 - 0.01)
Idaho	0.05	-0.01 (-0.03 - 0.01)	-0.01 (-0.07 - 0.06)	-0.01 (-0.03 - 0)
Illinois	0.06	-0.01 (-0.02 - 0.01)	0.01 (-0.06 - 0.08)	-0.01 (-0.02 - 0.01)
Indiana	0.04	-0.01 (-0.02 - 0.01)	0 (-0.08 - 0.07)	-0.01 (-0.02 - 0.01)
Iowa	0.05	-0.01 (-0.02 - 0.01)	0 (-0.07 - 0.06)	-0.01 (-0.03 - 0.01)
Kansas	0.05	-0.01 (-0.03 - 0.01)	0 (-0.07 - 0.07)	-0.01 (-0.03 - 0)

Kentucky	0.05	-0.01 (-0.02 - 0.01)	0.01 (-0.08 - 0.09)	-0.01 (-0.02 - 0)
Louisiana	0.07	-0.01 (-0.02 - 0.01)	0.01 (-0.07 - 0.1)	-0.01 (-0.02 - 0.01)
Maine	0.06	-0.01 (-0.02 - 0.01)	0.01 (-0.06 - 0.08)	-0.01 (-0.03 - 0)
Maryland	0.05	-0.01 (-0.02 - 0.01)	0 (-0.06 - 0.08)	-0.01 (-0.02 - 0)
Massachusetts	0.05	-0.01 (-0.02 - 0.01)	0.01 (-0.05 - 0.07)	-0.01 (-0.02 - 0)
Michigan	0.05	-0.01 (-0.02 - 0.01)	0.01 (-0.07 - 0.08)	-0.01 (-0.02 - 0)
Minnesota	0.05	-0.01 (-0.02 - 0.01)	0 (-0.06 - 0.06)	-0.01 (-0.03 - 0)
Mississippi	0.07	-0.01 (-0.02 - 0.01)	0 (-0.07 - 0.08)	-0.01 (-0.02 - 0.01)
Missouri	0.05	-0.01 (-0.02 - 0.01)	-0.01 (-0.08 - 0.06)	-0.01 (-0.02 - 0.01)
Montana	0.06	-0.01 (-0.02 - 0.01)	0 (-0.06 - 0.06)	-0.01 (-0.03 - 0)
Nebraska	0.04	-0.01 (-0.03 - 0.01)	-0.01 (-0.07 - 0.06)	-0.01 (-0.03 - 0)
Nevada	0.04	-0.01 (-0.02 - 0.01)	0.03 (-0.05 - 0.11)	-0.01 (-0.03 - 0)
New Hampshire	0.06	-0.01 (-0.02 - 0.01)	0.01 (-0.06 - 0.08)	-0.01 (-0.02 - 0.01)
New Jersey	0.05	-0.01 (-0.02 - 0.01)	0.01 (-0.06 - 0.08)	-0.01 (-0.02 - 0.01)
New Mexico	0.07	-0.01 (-0.02 - 0.01)	0 (-0.08 - 0.09)	-0.01 (-0.02 - 0.01)
New York	0.06	0 (-0.02 - 0.01)	0.01 (-0.06 - 0.08)	-0.01 (-0.02 - 0.01)
North Carolina	0.05	-0.01 (-0.02 - 0.01)	0 (-0.08 - 0.06)	-0.01 (-0.02 - 0)
North Dakota	0.06	-0.01 (-0.03 - 0.01)	-0.01 (-0.07 - 0.05)	-0.01 (-0.03 - 0)
Ohio	0.05	-0.01 (-0.02 - 0.01)	0 (-0.07 - 0.08)	-0.01 (-0.02 - 0)
Oklahoma	0.05	-0.01 (-0.02 - 0.01)	0 (-0.07 - 0.07)	-0.01 (-0.02 - 0)
Oregon	0.05	-0.01 (-0.02 - 0.01)	0.01 (-0.06 - 0.07)	-0.01 (-0.03 - 0)
Pennsylvania	0.06	0 (-0.02 - 0.01)	0.03 (-0.05 - 0.12)	-0.01 (-0.02 - 0)

Rhode Island	0.06	-0.01 (-0.02 - 0.01)	0.01 (-0.06 - 0.08)	-0.01 (-0.02 - 0.01)
South Carolina	0.06	-0.01 (-0.02 - 0.01)	0 (-0.07 - 0.07)	-0.01 (-0.02 - 0.01)
South Dakota	0.06	-0.01 (-0.02 - 0.01)	0 (-0.07 - 0.06)	-0.01 (-0.03 - 0)
Tennessee	0.06	-0.01 (-0.02 - 0.01)	0 (-0.07 - 0.07)	-0.01 (-0.02 - 0.01)
Texas	0.06	-0.01 (-0.02 - 0.01)	0 (-0.06 - 0.07)	-0.01 (-0.03 - 0.01)
United States	0.05	-0.01 (-0.02 - 0)	0.01 (-0.07 - 0.08)	-0.01 (-0.02 - 0)
Utah	0.06	-0.01 (-0.03 - 0)	-0.01 (-0.07 - 0.04)	-0.01 (-0.03 - 0)
Vermont	0.06	-0.01 (-0.02 - 0.01)	0.01 (-0.05 - 0.06)	-0.01 (-0.02 - 0)
Virginia	0.05	-0.01 (-0.02 - 0.01)	0 (-0.06 - 0.07)	-0.01 (-0.02 - 0.01)
Washington	0.05	-0.01 (-0.02 - 0.01)	0.01 (-0.05 - 0.07)	-0.01 (-0.02 - 0.01)
West Virginia	0.05	-0.01 (-0.02 - 0.01)	0 (-0.09 - 0.08)	-0.01 (-0.02 - 0.01)
Wisconsin	0.05	-0.01 (-0.02 - 0.01)	0 (-0.06 - 0.07)	-0.01 (-0.03 - 0)
Wyoming	0.06	0 (-0.02 - 0.01)	0.03 (-0.06 - 0.11)	-0.01 (-0.02 - 0.01)
Latin America and Caribbean	0.29	0.29 (0.21 - 0.37)	0.39 (0.17 - 0.64)	0.25 (0.22 - 0.28)
Caribbean	0.18	0.12 (0.06 - 0.17)	0.19 (0.02 - 0.36)	0.09 (0.07 - 0.1)
Antigua and Barbuda	0.14	0.07 (0.01 - 0.14)	0.07 (-0.14 - 0.32)	0.08 (0.05 - 0.11)
Antigua and Barbuda	0.14	0.07 (0.01 - 0.14)	0.07 (-0.14 - 0.32)	0.08 (0.05 - 0.11)
Antigua and Barbuda	0.14	0.07 (0.01 - 0.14)	0.07 (-0.14 - 0.32)	0.08 (0.05 - 0.11)
Antigua and Barbuda	0.14	0.07 (0.01 - 0.14)	0.07 (-0.14 - 0.32)	0.08 (0.05 - 0.11)
Barbados	0.10	0.03 (-0.03 - 0.09)	0.01 (-0.19 - 0.24)	0.05 (0.03 - 0.07)
Belize	0.38	0.13 (0.06 - 0.2)	0.23 (0.02 - 0.46)	0.09 (0.06 - 0.12)
Bermuda	0.12	0.09 (0.03 - 0.15)	0.15 (-0.05 - 0.39)	0.07 (0.04 - 0.1)

Cuba	0.14	0.12 (0.06 - 0.18)	0.22 (0.04 - 0.44)	0.07 (0.04 - 0.11)
Dominica	0.23	0.17 (0.1 - 0.24)	0.39 (0.15 - 0.67)	0.09 (0.06 - 0.12)
Dominican Republic	0.32	0.22 (0.15 - 0.29)	0.43 (0.2 - 0.68)	0.13 (0.09 - 0.17)
Grenada	0.41	0.18 (0.11 - 0.26)	0.38 (0.13 - 0.68)	0.1 (0.07 - 0.13)
Guyana	0.25	0.11 (0.04 - 0.18)	0.15 (-0.05 - 0.37)	0.09 (0.06 - 0.12)
Haiti	0.42	0.11 (0.06 - 0.17)	0.16 (0.01 - 0.33)	0.09 (0.06 - 0.13)
Jamaica	0.17	0.12 (0.05 - 0.2)	0.21 (0 - 0.47)	0.08 (0.05 - 0.11)
Puerto Rico	0.14	0.06 (-0.01 - 0.13)	0.01 (-0.19 - 0.23)	0.08 (0.05 - 0.11)
Saint Lucia	0.29	0.18 (0.11 - 0.26)	0.43 (0.18 - 0.72)	0.08 (0.05 - 0.11)
Saint Vincent and the Grenadines	0.29	0.23 (0.15 - 0.31)	0.6 (0.31 - 0.92)	0.08 (0.05 - 0.11)
Saint Vincent and the Grenadines	0.29	0.23 (0.15 - 0.31)	0.6 (0.31 - 0.92)	0.08 (0.05 - 0.11)
Saint Vincent and the Grenadines	0.29	0.23 (0.15 - 0.31)	0.6 (0.31 - 0.92)	0.08 (0.05 - 0.11)
Saint Vincent and the Grenadines	0.29	0.23 (0.15 - 0.31)	0.6 (0.31 - 0.92)	0.08 (0.05 - 0.11)
Suriname	0.23	0.1 (0.04 - 0.17)	0.14 (-0.05 - 0.35)	0.09 (0.06 - 0.12)
The Bahamas	0.09	0.09 (0.02 - 0.15)	0.15 (-0.07 - 0.39)	0.06 (0.03 - 0.09)
Trinidad and Tobago	0.17	0.06 (-0.02 - 0.14)	0.03 (-0.19 - 0.3)	0.08 (0.05 - 0.11)
Trinidad and Tobago	0.17	0.06 (-0.02 - 0.14)	0.03 (-0.19 - 0.3)	0.08 (0.05 - 0.11)
Trinidad and Tobago	0.17	0.06 (-0.02 - 0.14)	0.03 (-0.19 - 0.3)	0.08 (0.05 - 0.11)
Trinidad and Tobago	0.17	0.06 (-0.02 - 0.14)	0.03 (-0.19 - 0.3)	0.08 (0.05 - 0.11)
Virgin Islands, U.S.	0.13	0.06 (0 - 0.12)	0.05 (-0.17 - 0.29)	0.07 (0.04 - 0.1)
Andean Latin America	0.27	0.47 (0.35 - 0.6)	0.54 (0.25 - 0.86)	0.43 (0.34 - 0.53)
Bolivia	0.44	0.5 (0.37 - 0.64)	0.58 (0.27 - 0.97)	0.45 (0.35 - 0.55)
Ecuador	0.27	0.38 (0.26 - 0.52)	0.58 (0.21 - 1.01)	0.29 (0.22 - 0.37)

Peru	0.24	0.51 (0.37 - 0.66)	0.51 (0.26 - 0.78)	0.52 (0.36 - 0.71)
Central Latin America	0.31	0.33 (0.22 - 0.45)	0.41 (0.1 - 0.77)	0.29 (0.25 - 0.33)
Aguascalientes	0.29	0.28 (0.15 - 0.42)	0.37 (0 - 0.8)	0.23 (0.17 - 0.31)
Baja California	0.23	0.23 (0.11 - 0.36)	0.25 (-0.08 - 0.69)	0.22 (0.16 - 0.29)
Baja California Sur	0.18	0.27 (0.15 - 0.4)	0.4 (0.06 - 0.82)	0.21 (0.15 - 0.27)
Campeche	0.37	0.34 (0.21 - 0.48)	0.46 (0.11 - 0.85)	0.28 (0.21 - 0.36)
Chiapas	0.82	0.08 (-0.01 - 0.18)	0.22 (-0.04 - 0.53)	0.01 (-0.03 - 0.07)
Chihuahua	0.31	0.29 (0.17 - 0.42)	0.4 (0.06 - 0.81)	0.24 (0.17 - 0.31)
Coahuila	0.27	0.21 (0.09 - 0.34)	0.18 (-0.12 - 0.59)	0.23 (0.16 - 0.3)
Colima	0.27	0.27 (0.14 - 0.4)	0.31 (-0.02 - 0.74)	0.25 (0.18 - 0.32)
Colombia	0.28	0.45 (0.32 - 0.59)	0.55 (0.24 - 0.95)	0.38 (0.29 - 0.48)
Costa Rica	0.27	0.44 (0.31 - 0.58)	0.61 (0.26 - 1.03)	0.36 (0.28 - 0.45)
Durango	0.32	0.34 (0.2 - 0.48)	0.51 (0.12 - 1.01)	0.25 (0.18 - 0.32)
El Salvador	0.45	0.6 (0.39 - 0.83)	0.8 (0.35 - 1.33)	0.48 (0.3 - 0.71)
Guanajuato	0.43	0.32 (0.18 - 0.46)	0.41 (0.06 - 0.86)	0.26 (0.2 - 0.34)
Guatemala	0.54	0.26 (0.14 - 0.4)	0.3 (-0.05 - 0.76)	0.23 (0.16 - 0.3)
Guerrero	0.45	0.37 (0.24 - 0.5)	0.51 (0.16 - 0.98)	0.28 (0.21 - 0.36)
Hidalgo	0.40	0.4 (0.27 - 0.54)	0.65 (0.25 - 1.14)	0.28 (0.21 - 0.35)
Honduras	0.49	0.47 (0.33 - 0.62)	0.54 (0.26 - 0.9)	0.41 (0.29 - 0.55)
Jalisco	0.31	0.25 (0.13 - 0.41)	0.28 (-0.04 - 0.73)	0.24 (0.17 - 0.31)
Mexico	0.32	0.28 (0.15 - 0.4)	0.36 (0.02 - 0.76)	0.23 (0.2 - 0.27)
Mexico City	0.22	0.18 (0.05 - 0.31)	0.13 (-0.19 - 0.52)	0.2 (0.15 - 0.26)
Michoacán de Ocampo	0.44	0.34 (0.21 - 0.48)	0.42 (0.06 - 0.88)	0.29 (0.22 - 0.37)

Morelos	0.26	0.28 (0.16 - 0.41)	0.34 (0.02 - 0.76)	0.24 (0.17 - 0.31)
México	0.26	0.26 (0.14 - 0.4)	0.34 (0.01 - 0.78)	0.22 (0.17 - 0.29)
Nayarit	0.36	0.33 (0.21 - 0.46)	0.46 (0.13 - 0.92)	0.26 (0.2 - 0.34)
Nicaragua	0.35	0.53 (0.38 - 0.71)	0.7 (0.29 - 1.22)	0.42 (0.31 - 0.54)
Nuevo León	0.19	0.13 (0.02 - 0.25)	0.2 (-0.11 - 0.57)	0.11 (0.05 - 0.16)
Oaxaca	0.44	0.29 (0.18 - 0.42)	0.43 (0.12 - 0.82)	0.22 (0.15 - 0.29)
Panama	0.25	0.42 (0.24 - 0.59)	0.51 (0.12 - 0.95)	0.37 (0.24 - 0.52)
Puebla	0.37	0.39 (0.26 - 0.54)	0.62 (0.21 - 1.11)	0.27 (0.21 - 0.36)
Querétaro	0.41	0.35 (0.22 - 0.5)	0.49 (0.12 - 0.98)	0.28 (0.21 - 0.36)
Quintana Roo	0.31	0.34 (0.21 - 0.46)	0.46 (0.11 - 0.84)	0.28 (0.21 - 0.35)
San Luis Potosí	0.47	0.39 (0.25 - 0.54)	0.6 (0.2 - 1.08)	0.28 (0.22 - 0.36)
Sinaloa	0.29	0.31 (0.19 - 0.43)	0.45 (0.11 - 0.85)	0.24 (0.17 - 0.3)
Sonora	0.27	0.25 (0.13 - 0.38)	0.29 (-0.03 - 0.66)	0.23 (0.17 - 0.3)
Tabasco	0.37	0.34 (0.21 - 0.48)	0.45 (0.1 - 0.86)	0.28 (0.21 - 0.36)
Tamaulipas	0.27	0.28 (0.16 - 0.41)	0.39 (0.05 - 0.83)	0.23 (0.17 - 0.3)
Tlaxcala	0.37	0.35 (0.21 - 0.49)	0.47 (0.1 - 0.93)	0.28 (0.21 - 0.35)
Venezuela	0.26	0.29 (0.18 - 0.42)	0.28 (0 - 0.6)	0.3 (0.24 - 0.38)
Veracruz de Ignacio de la Llave	0.38	0.32 (0.19 - 0.46)	0.38 (0.04 - 0.8)	0.28 (0.21 - 0.36)
Yucatán	0.32	0.32 (0.19 - 0.44)	0.43 (0.1 - 0.8)	0.26 (0.19 - 0.33)
Zacatecas	0.40	0.34 (0.2 - 0.49)	0.47 (0.1 - 0.91)	0.27 (0.2 - 0.34)
Tropical Latin America	0.31	0.3 (0.26 - 0.35)	0.45 (0.28 - 0.62)	0.3 (0.26 - 0.33)
Acre	0.43	0.4 (0.32 - 0.48)	0.57 (0.38 - 0.79)	0.37 (0.29 - 0.47)
Alagoas	0.50	0.42 (0.34 - 0.5)	0.54 (0.34 - 0.77)	0.42 (0.34 - 0.52)
Amapá	0.43	0.32 (0.26 - 0.39)	0.38 (0.21 - 0.58)	0.37 (0.29 - 0.45)

Amazonas	0.41	0.29 (0.22 - 0.36)	0.38 (0.21 - 0.57)	0.3 (0.23 - 0.38)
Bahia	0.43	0.41 (0.34 - 0.49)	0.59 (0.41 - 0.81)	0.39 (0.3 - 0.48)
Brazil	0.31	0.3 (0.25 - 0.35)	0.44 (0.28 - 0.63)	0.29 (0.26 - 0.33)
Ceará	0.45	0.42 (0.34 - 0.51)	0.62 (0.43 - 0.86)	0.39 (0.31 - 0.48)
Distrito Federal	0.22	0.21 (0.15 - 0.28)	0.1 (-0.06 - 0.29)	0.3 (0.24 - 0.36)
Espírito Santo	0.31	0.33 (0.27 - 0.4)	0.5 (0.32 - 0.71)	0.31 (0.24 - 0.38)
Goiás	0.36	0.34 (0.27 - 0.41)	0.44 (0.25 - 0.63)	0.35 (0.28 - 0.44)
Maranhão	0.58	0.47 (0.38 - 0.55)	0.63 (0.43 - 0.87)	0.47 (0.37 - 0.58)
Mato Grosso	0.33	0.34 (0.28 - 0.41)	0.44 (0.27 - 0.63)	0.36 (0.29 - 0.44)
Mato Grosso do Sul	0.34	0.32 (0.25 - 0.39)	0.44 (0.26 - 0.64)	0.32 (0.24 - 0.4)
Minas Gerais	0.30	0.36 (0.29 - 0.43)	0.56 (0.38 - 0.77)	0.33 (0.25 - 0.4)
Paraguay	0.41	0.4 (0.29 - 0.52)	0.43 (0.24 - 0.64)	0.42 (0.28 - 0.59)
Paraná	0.32	0.36 (0.29 - 0.43)	0.55 (0.38 - 0.75)	0.32 (0.25 - 0.39)
Paraíba	0.44	0.41 (0.33 - 0.49)	0.6 (0.41 - 0.81)	0.37 (0.3 - 0.46)
Pará	0.40	0.38 (0.31 - 0.46)	0.51 (0.34 - 0.72)	0.39 (0.31 - 0.47)
Pernambuco	0.37	0.38 (0.31 - 0.46)	0.49 (0.3 - 0.71)	0.38 (0.3 - 0.47)
Piaui	0.48	0.44 (0.36 - 0.52)	0.66 (0.45 - 0.91)	0.4 (0.31 - 0.5)
Rio Grande do Norte	0.42	0.39 (0.32 - 0.48)	0.53 (0.33 - 0.75)	0.39 (0.31 - 0.48)
Rio Grande do Sul	0.25	0.35 (0.28 - 0.43)	0.59 (0.4 - 0.8)	0.28 (0.22 - 0.35)
Rio de Janeiro	0.21	0.22 (0.16 - 0.29)	0.18 (0.02 - 0.37)	0.28 (0.22 - 0.35)
Rondônia	0.41	0.38 (0.31 - 0.46)	0.53 (0.35 - 0.74)	0.36 (0.28 - 0.46)
Roraima	0.36	0.28 (0.21 - 0.35)	0.37 (0.19 - 0.58)	0.28 (0.21 - 0.36)
Santa Catarina	0.30	0.37 (0.3 - 0.45)	0.61 (0.43 - 0.86)	0.31 (0.24 - 0.38)

Sergipe	0.46	0.39 (0.31 - 0.46)	0.52 (0.32 - 0.74)	0.38 (0.3 - 0.47)
São Paulo	0.24	0.14 (0.08 - 0.2)	0.21 (0.06 - 0.37)	0.16 (0.07 - 0.24)
Tocantins	0.42	0.39 (0.29 - 0.5)	0.57 (0.38 - 0.82)	0.4 (0.26 - 0.58)
North Africa and Middle East	0.42	0.64 (0.46 - 0.83)	0.5 (0.14 - 0.97)	0.71 (0.63 - 0.84)
Afghanistan	0.78	1.46 (0.88 - 2.4)	inf (0.23 - inf)	1.12 (0.86 - 1.49)
Algeria	0.46	0.92 (0.56 - 1.43)	0.55 (0.08 - 1.25)	1.35 (0.86 - 2.38)
Bahrain	0.26	1.18 (0.64 - 2.06)	0.7 (0.03 - 1.92)	1.54 (0.95 - 2.79)
Egypt	0.43	2.13 (0.94 - 4.81)	0.22 (-0.18 - 0.76)	inf (8.54 - inf)
Iran	0.51	0.49 (0.34 - 0.63)	0.24 (-0.04 - 0.58)	0.65 (0.54 - 0.78)
Iraq	0.21	0.68 (0.35 - 1.12)	0.4 (-0.11 - 1.1)	0.87 (0.58 - 1.37)
Jordan	0.44	0.82 (0.4 - 1.41)	0.23 (-0.22 - 0.95)	1.4 (0.88 - 2.38)
Kuwait	0.28	0.99 (0.58 - 1.61)	0.59 (0.01 - 1.43)	1.28 (0.83 - 2.11)
Lebanon	0.29	0.22 (0.09 - 0.37)	0.02 (-0.23 - 0.31)	0.33 (0.22 - 0.45)
Libya	0.33	0.76 (0.41 - 1.22)	0.5 (-0.15 - 1.62)	0.88 (0.7 - 1.09)
Morocco	0.62	0.51 (0.35 - 0.71)	0.96 (0.43 - 1.7)	0.33 (0.23 - 0.43)
Oman	2.08	inf (6.74 - inf)	inf (1.93 - inf)	inf (6.47 - inf)
Palestine	0.09	0.51 (0.3 - 0.74)	0.26 (-0.14 - 0.82)	0.65 (0.51 - 0.8)
Qatar	0.27	0.55 (0.31 - 0.86)	0.33 (-0.16 - 1.06)	0.68 (0.54 - 0.84)
Saudi Arabia	1.16	1.71 (1.27 - 2.32)	1.3 (0.71 - 2.11)	2.09 (1.59 - 2.85)
Sudan	0.76	1.64 (0.91 - 3.13)	0.87 (0.23 - 2.01)	1.88 (1.12 - 3.72)
Syria	0.70	1.27 (0.72 - 2.31)	0.38 (-0.04 - 0.94)	inf (1.45 - 18.37)
Tunisia	0.46	0.54 (0.39 - 0.7)	0.7 (0.25 - 1.26)	0.45 (0.37 - 0.53)
Turkey	0.32	0.36 (0.26 - 0.48)	0.76 (0.39 - 1.23)	0.21 (0.15 - 0.26)

United Arab Emirates	0.39	0.99 (0.59 - 1.69)	0.53 (0.02 - 1.28)	1.56 (0.96 - 2.92)
Yemen	1.60	0.9 (0.58 - 1.3)	1.16 (0.43 - 2.37)	0.71 (0.51 - 0.96)
South Asia	0.63	1.93 (1.22 - 3.01)	0.34 (-0.26 - 1.22)	2.87 (1.94 - 4.55)
Bangladesh	0.62	0.36 (0.07 - 0.71)	inf (-1 - 3.89)	0.46 (0.26 - 0.7)
Bhutan	0.95	0.59 (0.44 - 0.74)	0.72 (0.39 - 1.11)	0.5 (0.38 - 0.65)
India	0.64	3.38 (1.8 - 6.28)	0.33 (-0.2 - 1.05)	inf (3.58 - inf)
Nepal	0.87	0.42 (0.22 - 0.62)	0.49 (0.01 - 1.14)	0.36 (0.22 - 0.51)
Pakistan	0.75	0.56 (0.33 - 0.81)	0.71 (-0.06 - 2)	0.52 (0.38 - 0.68)
Sub-Saharan Africa	0.44	0.05 (-0.01 - 0.11)	0.05 (-0.1 - 0.22)	0.05 (0.03 - 0.07)
Central Sub-Saharan Africa	0.36	0.05 (0.01 - 0.1)	0.11 (-0.02 - 0.26)	0.03 (0 - 0.06)
Angola	0.71	0.24 (0.14 - 0.33)	0.38 (0.11 - 0.68)	0.17 (0.12 - 0.22)
Central African Republic	0.28	-0.04 (-0.08 - 0)	-0.03 (-0.14 - 0.08)	-0.04 (-0.08 - -0.01)
Congo	0.40	0.17 (0.09 - 0.25)	0.26 (0.03 - 0.5)	0.12 (0.08 - 0.17)
Democratic Republic of the Congo	0.10	0.01 (-0.04 - 0.05)	0.04 (-0.08 - 0.17)	-0.01 (-0.04 - 0.03)
Equatorial Guinea	1.30	0.2 (0.12 - 0.29)	0.2 (-0.02 - 0.46)	0.19 (0.14 - 0.24)
Gabon	0.36	0.26 (0.15 - 0.38)	0.58 (0.2 - 1.02)	0.13 (0.09 - 0.18)
Eastern Sub-Saharan Africa	0.70	0.15 (0.1 - 0.2)	0.07 (-0.06 - 0.21)	0.18 (0.16 - 0.21)
Burundi	0.47	0.1 (0.07 - 0.13)	0.09 (0.01 - 0.18)	0.1 (0.08 - 0.12)
Comoros	0.63	0.44 (0.33 - 0.59)	0.68 (0.33 - 1.17)	0.34 (0.24 - 0.45)
Djibouti	1.09	0.26 (0.1 - 0.44)	0.36 (-0.07 - 0.98)	0.21 (0.14 - 0.28)
Eritrea	1.08	0.34 (0.17 - 0.55)	0.52 (0.07 - 1.23)	0.25 (0.17 - 0.34)
Ethiopia	1.13	0.08 (0.01 - 0.15)	-0.15 (-0.29 - 0.01)	0.2 (0.13 - 0.26)
Kenya	0.55	0.12 (0.07 - 0.18)	0.31 (0.13 - 0.53)	0.05 (0.04 - 0.06)

Madagascar	0.43	0.23 (0.17 - 0.29)	0.19 (0.07 - 0.34)	0.24 (0.19 - 0.29)
Malawi	0.70	0.14 (0.08 - 0.21)	0.07 (-0.08 - 0.23)	0.17 (0.12 - 0.23)
Mozambique	1.11	0.23 (0.16 - 0.3)	0.17 (0.01 - 0.37)	0.24 (0.19 - 0.3)
Rwanda	1.15	0.24 (0.18 - 0.32)	0.25 (0.06 - 0.48)	0.24 (0.19 - 0.29)
Somalia	0.43	0.21 (0.13 - 0.3)	0.2 (0 - 0.46)	0.21 (0.14 - 0.29)
South Sudan	1.33	0.04 (-0.05 - 0.14)	-0.08 (-0.29 - 0.2)	0.09 (0.02 - 0.16)
Tanzania	0.74	0.24 (0.17 - 0.31)	0.22 (0.07 - 0.38)	0.24 (0.18 - 0.3)
Uganda	1.13	0.2 (0.14 - 0.27)	0.17 (0.02 - 0.31)	0.22 (0.17 - 0.27)
Zambia	0.54	0.14 (0.07 - 0.2)	0.06 (-0.09 - 0.22)	0.18 (0.14 - 0.22)
Southern Sub-Saharan Africa	0.24	0.05 (0.03 - 0.09)	0.16 (0.06 - 0.28)	0.02 (0 - 0.03)
Botswana	0.38	0.08 (0.02 - 0.14)	0.21 (0.04 - 0.4)	0.02 (-0.02 - 0.06)
Lesotho	0.49	0.02 (-0.04 - 0.08)	0.01 (-0.14 - 0.17)	0.03 (-0.01 - 0.07)
Namibia	0.46	0.05 (-0.01 - 0.1)	0.11 (-0.03 - 0.27)	0.02 (-0.02 - 0.06)
South Africa	0.23	0.06 (0.03 - 0.09)	0.19 (0.07 - 0.31)	0.02 (0 - 0.04)
Swaziland	0.30	0.06 (0 - 0.14)	0.19 (0.01 - 0.43)	0 (-0.04 - 0.04)
Zimbabwe	0.15	0.01 (-0.04 - 0.06)	0.06 (-0.06 - 0.21)	-0.02 (-0.06 - 0.03)
Western Sub-Saharan Africa	0.49	-0.05 (-0.12 - 0.04)	0.01 (-0.23 - 0.31)	-0.06 (-0.11 - -0.02)
Benin	0.62	-0.32 (-0.47 - -0.15)	inf (-1 - 11.72)	-0.26 (-0.34 - -0.17)
Burkina Faso	1.19	-0.46 (-0.55 - -0.37)	-0.71 (-0.95 - -0.51)	-0.35 (-0.42 - -0.27)
Cameroon	0.32	0.11 (0.01 - 0.21)	0.16 (-0.09 - 0.46)	0.08 (0.02 - 0.15)
Cape Verde	0.78	0.33 (0.19 - 0.5)	0.75 (0.19 - 1.45)	0.18 (0.14 - 0.23)
Chad	0.61	0.1 (0 - 0.21)	0.14 (-0.17 - 0.58)	0.09 (0.03 - 0.16)
Cote d'Ivoire	0.47	-0.42 (-0.51 - -0.35)	-0.49 (-0.64 - -0.33)	-0.38 (-0.45 - -0.3)

Ghana	0.40	-0.18 (-0.26 - -0.1)	-0.18 (-0.32 - -0.04)	-0.17 (-0.25 - -0.09)
Guinea	0.48	-0.12 (-0.23 - -0.01)	-0.19 (-0.46 - 0.18)	-0.09 (-0.17 - -0.01)
Guinea-Bissau	0.60	-0.07 (-0.18 - 0.04)	-0.25 (-0.56 - 0.11)	0 (-0.07 - 0.06)
Liberia	0.50	0.19 (0.05 - 0.36)	inf (-0.34 - 1.8)	0.19 (0.12 - 0.27)
Mali	0.94	-0.2 (-0.33 - -0.05)	-0.71 (-1 - -0.09)	-0.08 (-0.17 - 0.01)
Mauritania	0.50	0.35 (0.08 - 0.66)	inf (-0.4 - inf)	0.22 (0.14 - 0.31)
Niger	0.42	0.02 (-0.09 - 0.14)	-0.08 (-0.37 - 0.27)	0.06 (-0.02 - 0.13)
Nigeria	0.49	0.07 (-0.05 - 0.18)	0.32 (-0.06 - 0.8)	-0.01 (-0.09 - 0.07)
Sao Tome and Principe	0.50	0.49 (0.26 - 0.78)	inf (0.28 - 5.59)	0.27 (0.18 - 0.36)
Senegal	0.47	0.11 (-0.04 - 0.27)	0.07 (-0.37 - 0.68)	0.13 (0.06 - 0.21)
Sierra Leone	0.62	0.06 (-0.11 - 0.24)	0.04 (-0.38 - 0.63)	0.07 (-0.05 - 0.21)
The Gambia	0.39	-0.07 (-0.14 - 0.01)	-0.21 (-0.37 - -0.03)	0 (-0.05 - 0.06)
Togo	0.60	0.05 (-0.06 - 0.17)	0.11 (-0.24 - 0.61)	0.03 (-0.04 - 0.11)

Appendix 3B – Absolute Change in Mean SDI, AVLI, CI, UREI between 1990 and 2016

Location	Abs. Change SDI	Abs. Change AVLI	Abs. Change CI	Abs. Change UREI
Global	0.12	4.76 (3.27 - 6.2)	0.96 (-2.81 - 4.83)	6.43 (5.73 - 7.15)
Southeast Asia, East Asia, and Oceania	0.20	7.49 (5.98 - 9.13)	5.54 (2.09 - 9.17)	8.01 (6.45 - 9.69)
East Asia	0.20	4.84 (2.86 - 6.94)	0.48 (-3.04 - 4.32)	6.61 (4.29 - 9.02)
China	0.21	4.62 (2.48 - 6.73)	0.16 (-3.48 - 3.97)	6.44 (4.08 - 8.94)
North Korea	-0.01	10.04 (8.36 - 11.77)	5.78 (2.13 - 9.23)	11.6 (9.76 - 13.39)
Taiwan	0.14	14.25 (12.29 - 16.09)	24.25 (15.01 - 33.12)	13.4 (11.54 - 15.11)
Southeast Asia	0.17	12.96 (11.35 - 14.67)	11.14 (7.89 - 14.57)	12.26 (11.48 - 13.08)
Cambodia	0.20	6.85 (4.3 - 9.24)	2.4 (0 - 4.87)	8.71 (5.75 - 11.46)
Indonesia	0.17	12.49 (10.43 - 14.57)	10.73 (6.99 - 14.82)	11.56 (10.55 - 12.57)

Laos	0.21	9.41 (7.11 - 11.74)	3.52 (0.56 - 6.34)	13.42 (11.1 - 15.73)
Malaysia	0.21	10.96 (7.99 - 13.85)	9.73 (0.56 - 18.71)	11.29 (9.28 - 13.22)
Maldives	0.25	16.07 (13.46 - 18.89)	15.94 (10.27 - 21.73)	14.69 (12.13 - 17.25)
Mauritius	0.15	10.76 (7.11 - 14.54)	7.36 (-2.42 - 17.34)	11.85 (9.35 - 14.19)
Myanmar	0.24	5.19 (3.27 - 7.17)	2.34 (0 - 5.23)	8.61 (6.23 - 11.01)
Philippines	0.12	9.1 (7.23 - 11.03)	5.18 (1.63 - 8.84)	10.56 (8.85 - 12.41)
Seychelles	0.13	9.99 (6.68 - 13.31)	6.4 (-2.74 - 15.21)	11.26 (8.73 - 13.75)
Sri Lanka	0.19	9.62 (7.37 - 12.06)	5.54 (1.12 - 10.32)	11.17 (8.9 - 13.4)
Thailand	0.18	14.09 (11.6 - 16.67)	18.33 (12.97 - 24.1)	9.43 (7.39 - 11.51)
Timor-Leste	0.21	8.71 (6.68 - 10.67)	5.57 (2.53 - 8.73)	10.28 (5.79 - 14.07)
Vietnam	0.20	13.75 (11.41 - 16.28)	12.55 (8.24 - 17.35)	12.47 (10.42 - 14.56)
Oceania	0.11	3.23 (1.58 - 4.94)	3.24 (-0.85 - 7.72)	3.2 (1.73 - 4.68)
American Samoa	0.13	4.6 (2.41 - 6.85)	3.56 (-2.86 - 10.32)	4.94 (3.35 - 6.64)
Federated States of Micronesia	0.18	5.59 (3.54 - 7.5)	5.26 (-0.1 - 10.91)	5.66 (4.06 - 7.43)
Fiji	0.14	4.72 (2.08 - 7.22)	5.24 (-1.8 - 12.92)	4.39 (2.47 - 6.33)
Guam	0.07	2.81 (0.61 - 4.96)	0.48 (-8.44 - 9.22)	3.56 (1.68 - 5.26)
Kiribati	0.14	3.11 (1.05 - 5.17)	0.5 (-3.03 - 4.39)	4.31 (2.11 - 6.43)
Marshall Islands	0.11	3.91 (1.43 - 6.52)	2.1 (-5.12 - 10.47)	4.58 (2.87 - 6.38)
Northern Mariana Islands	0.09	4.89 (2.72 - 7.2)	7.85 (0.89 - 15.79)	3.89 (2.23 - 5.64)
Papua New Guinea	0.12	3.22 (1.05 - 5.39)	2.49 (-1.36 - 6.34)	3.41 (1.38 - 5.44)
Samoa	0.11	4.3 (2.45 - 6.13)	3.92 (-0.39 - 7.87)	4.28 (2.69 - 5.91)
Solomon Islands	0.13	2.97 (0.89 - 5.05)	-0.41 (-4.74 - 4.06)	4.29 (2.3 - 6.42)
Tonga	0.13	2.05 (-0.21 - 4.21)	3.21 (-1.68 - 8.45)	1.55 (-0.98 - 3.8)
Vanuatu	0.14	4.12 (2.14 - 6.07)	2.23 (-2.43 - 6.78)	4.81 (2.84 - 6.75)
Central Europe, Eastern Europe, and Central Asia	0.08	2.05 (0.59 - 3.4)	4.43 (-1.54 - 10.39)	1.45 (0.66 - 2.22)
Central Asia	0.10	3.55 (2.01 - 5.04)	7.84 (2.51 - 12.75)	1.85 (1.1 - 2.62)

Armenia	0.11	5.25 (2.97 - 7.79)	11.61 (5.04 - 19.06)	2.22 (0.42 - 3.85)
Azerbaijan	0.10	4.76 (2.43 - 7.28)	10.39 (2.76 - 18.71)	2.41 (0.7 - 4.15)
Georgia	0.03	1.6 (-0.89 - 4.28)	2.02 (-4.79 - 9.17)	1.32 (-0.39 - 3.09)
Kazakhstan	0.08	3 (0.29 - 5.6)	7.02 (-1.23 - 15.26)	1.49 (-0.24 - 3.11)
Kyrgyzstan	0.03	2.53 (0.33 - 4.77)	6.42 (0.06 - 12.17)	0.68 (-1.05 - 2.43)
Mongolia	0.13	2.89 (1.16 - 4.89)	3.46 (-0.19 - 7.3)	2.4 (0.6 - 4.23)
Tajikistan	0.06	3.84 (1.87 - 5.82)	12.6 (7.05 - 18.85)	0.24 (-1.47 - 1.98)
Turkmenistan	0.18	3.15 (0.96 - 5.3)	0.28 (-10 - 10.49)	3.92 (1.99 - 5.68)
Uzbekistan	0.15	4.16 (1.61 - 6.9)	9.55 (0.43 - 19.65)	2.37 (0.62 - 4.15)
Central Europe	0.11	4.21 (2.9 - 5.48)	8.69 (3.76 - 13.93)	2.79 (2.06 - 3.56)
Albania	0.14	4.66 (3.01 - 6.37)	9.22 (5.14 - 13.24)	2.95 (1.28 - 4.63)
Bosnia and Herzegovina	0.19	5.21 (3.66 - 6.78)	6.34 (3.13 - 9.89)	4.55 (2.82 - 6.27)
Bulgaria	0.09	3.92 (2.03 - 5.85)	8.39 (2.64 - 14.75)	2.54 (0.9 - 4.21)
Croatia	0.06	3.97 (2.2 - 5.76)	9.67 (4.43 - 15.53)	2.09 (0.35 - 3.71)
Czech Republic	0.07	2.7 (0.71 - 4.73)	4.76 (-2.94 - 12.66)	2.26 (0.66 - 3.91)
Hungary	0.10	4.41 (2.61 - 6.26)	9.51 (4.05 - 15.33)	2.64 (1 - 4.17)
Macedonia	0.09	3.68 (1.99 - 5.37)	6.01 (2.07 - 10.42)	2.6 (0.87 - 4.26)
Montenegro	0.07	2.86 (1.18 - 4.42)	2.57 (-1.41 - 6.51)	2.89 (1.19 - 4.65)
Poland	0.14	4.63 (2.69 - 6.46)	9.67 (3.49 - 15.98)	3.15 (1.39 - 5)
Romania	0.11	4.69 (2.96 - 6.57)	10.54 (5.79 - 15.94)	2.82 (1.08 - 4.67)
Serbia	0.07	3.38 (1.76 - 5.14)	5.46 (1.33 - 9.48)	2.43 (0.63 - 4)
Slovakia	0.10	2.92 (1.18 - 4.83)	6.18 (-1.01 - 13.82)	2.28 (0.67 - 3.89)
Slovenia	0.07	4.03 (2.1 - 5.83)	11.55 (4.94 - 18.74)	1.97 (0.31 - 3.64)
Eastern Europe	0.06	1.51 (-0.26 - 3.26)	0.7 (-7.07 - 8.6)	1.78 (0.31 - 3.13)
Belarus	0.09	3.18 (0.91 - 5.47)	6.91 (-2.93 - 16.1)	2.45 (0.58 - 4.3)
Estonia	0.09	2.99 (0.33 - 5.54)	4.78 (-5.34 - 14.67)	2.4 (0.83 - 4.08)
Latvia	0.07	2.52 (0.01 - 4.93)	2.83 (-7.17 - 12.18)	2.46 (0.79 - 4.09)

Lithuania	0.08	2.18 (0.23 - 4.19)	1.16 (-7.64 - 9.77)	2.53 (0.8 - 4.26)
Moldova	0.06	5.66 (3.31 - 7.99)	19.3 (11.79 - 27.47)	1.51 (-0.17 - 3.26)
Russian Federation	0.06	1.45 (-0.56 - 3.43)	-2.51 (-11.02 - 5.81)	2.41 (0.58 - 4.2)
Ukraine	0.04	2.77 (0.64 - 5.04)	8.13 (-1.33 - 16.77)	1.45 (-0.29 - 3.16)
High-income	0.07	3.25 (2.33 - 4.17)	6.06 (-1.19 - 13.68)	3.15 (2.63 - 3.68)
High-income Asia Pacific	0.08	3.1 (2.32 - 3.94)	8.41 (-0.12 - 17.35)	2.96 (2.47 - 3.55)
Aichi	0.06	2.41 (0.91 - 3.85)	7.24 (-1.13 - 16.26)	2.23 (0.53 - 3.85)
Akita	0.06	2.55 (0.98 - 4.12)	9.57 (1.21 - 18.18)	2.24 (0.52 - 4.03)
Aomori	0.06	2.52 (1.05 - 4.05)	8.76 (-0.29 - 18.25)	2.26 (0.64 - 3.97)
Brunei	0.13	4.28 (2.66 - 6.06)	11.11 (1.33 - 21.42)	3.85 (2.32 - 5.52)
Chiba	0.06	2.45 (0.9 - 3.98)	7.9 (-0.78 - 16.66)	2.23 (0.56 - 3.88)
Ehime	0.07	2.57 (1.01 - 4.08)	8.87 (0.18 - 17.91)	2.32 (0.7 - 3.91)
Fukui	0.07	2.63 (1.17 - 4.15)	8.88 (-0.01 - 17.52)	2.38 (0.83 - 4)
Fukuoka	0.06	2.58 (1.12 - 4.04)	8 (-1.24 - 16.74)	2.4 (0.82 - 4.11)
Fukushima	0.07	2.63 (1.11 - 4.14)	9.12 (0.13 - 17.73)	2.36 (0.67 - 4.01)
Gifu	0.06	2.3 (0.79 - 3.94)	8.45 (0.17 - 17.41)	2.04 (0.44 - 3.84)
Gunma	0.07	2.54 (1.06 - 4.08)	7.95 (-1.02 - 17.36)	2.35 (0.73 - 4.04)
Hiroshima	0.06	2.6 (1.11 - 4.1)	8.2 (0.39 - 17.57)	2.39 (0.74 - 4.05)
Hokkaidō	0.06	2.51 (1.03 - 4.09)	9.26 (1.01 - 17.66)	2.19 (0.61 - 3.88)
Hyōgo	0.06	2.42 (0.86 - 3.9)	8.22 (-0.65 - 16.79)	2.17 (0.49 - 3.88)
Ibaraki	0.06	2.6 (1.15 - 4.17)	7.72 (-0.88 - 17.21)	2.43 (0.84 - 4.06)
Ishikawa	0.06	2.45 (0.92 - 3.96)	8.36 (-0.42 - 18)	2.21 (0.56 - 3.8)
Iwate	0.07	2.77 (1.37 - 4.15)	9.74 (1.22 - 17.91)	2.5 (0.91 - 4.1)
Japan	0.06	2.51 (1.81 - 3.21)	8.02 (-0.22 - 16.01)	2.3 (1.93 - 2.67)

Kagawa	0.06	2.46 (0.98 - 4.18)	8.13 (-0.71 - 17.29)	2.24 (0.62 - 3.98)
Kagoshima	0.07	2.74 (1.19 - 4.3)	8.68 (-0.35 - 17.9)	2.55 (0.77 - 4.22)
Kanagawa	0.06	2.47 (1.01 - 3.87)	8.06 (0.18 - 16.68)	2.23 (0.65 - 3.8)
Kumamoto	0.06	2.7 (1.24 - 4.12)	9.08 (0.21 - 18)	2.46 (0.82 - 4.14)
Kyōto	0.06	2.47 (0.96 - 3.95)	8.45 (-0.54 - 17.12)	2.22 (0.59 - 3.87)
Kōchi	0.07	2.67 (1.2 - 4.31)	9.26 (0.35 - 18.58)	2.4 (0.74 - 4.08)
Mie	0.06	2.63 (1.2 - 4.1)	8.13 (-0.6 - 16.78)	2.43 (0.89 - 4.1)
Miyagi	0.06	2.56 (1.01 - 4.12)	7.83 (-1.04 - 16.3)	2.36 (0.73 - 4.05)
Miyazaki	0.06	2.49 (0.91 - 4.1)	8.48 (0.15 - 17.72)	2.26 (0.56 - 3.94)
Nagano	0.07	2.63 (1.13 - 4.12)	8.52 (0.17 - 17.03)	2.4 (0.71 - 4.01)
Nagasaki	0.07	2.74 (1.23 - 4.3)	9.05 (-0.01 - 17.74)	2.52 (0.82 - 4.18)
Nara	0.06	2.39 (0.78 - 3.92)	9.15 (0.3 - 18.62)	2.07 (0.42 - 3.75)
Niigata	0.07	2.74 (1.28 - 4.3)	8.53 (0.4 - 17.35)	2.54 (0.99 - 4.17)
Okayama	0.07	2.58 (1.07 - 4.08)	8.43 (0.31 - 17.19)	2.36 (0.64 - 3.95)
Okinawa	0.07	2.27 (0.69 - 3.71)	7.89 (-0.9 - 16.43)	2.04 (0.36 - 3.69)
Saga	0.07	2.56 (1.07 - 3.96)	8.29 (-0.5 - 17.05)	2.36 (0.74 - 3.94)
Saitama	0.06	2.43 (0.92 - 3.99)	7.89 (-0.51 - 16.26)	2.2 (0.51 - 3.87)
Shiga	0.07	2.66 (1.23 - 4.17)	8.09 (-0.38 - 16.65)	2.48 (0.87 - 4.13)
Shimane	0.07	2.67 (1.15 - 4.25)	9.02 (-0.06 - 18.37)	2.43 (0.68 - 4.12)
Shizuoka	0.06	2.51 (0.94 - 4.09)	7.76 (-0.61 - 16.59)	2.31 (0.55 - 3.97)
Singapore	0.14	4.26 (2.68 - 5.83)	12.2 (2.23 - 22.28)	3.94 (2.34 - 5.61)
South Korea	0.14	4.62 (3.08 - 6.34)	10.13 (1.11 - 19.1)	4.56 (2.84 - 6.4)
Tochigi	0.07	2.68 (1.1 - 4.27)	8.01 (-0.46 - 16.37)	2.51 (0.78 - 4.22)
Tokushima	0.06	2.67 (1.01 - 4.21)	8.86 (-0.46 - 18.26)	2.43 (0.69 - 4.15)
Tottori	0.07	2.74 (1.25 - 4.26)	8.85 (-0.05 - 17.65)	2.53 (0.9 - 4.17)

Toyama	0.06	2.59 (1.08 - 4.11)	8.29 (-0.66 - 17.36)	2.37 (0.77 - 4.07)
Tōkyō	0.06	2.32 (0.71 - 3.84)	7.24 (-1.2 - 15.61)	2.1 (0.32 - 3.8)
Wakayama	0.06	2.66 (1.21 - 4.17)	9.12 (0.55 - 18.26)	2.4 (0.82 - 3.9)
Yamagata	0.07	2.74 (1.16 - 4.28)	8.9 (0.34 - 17.7)	2.52 (0.87 - 4.28)
Yamaguchi	0.06	2.58 (1.11 - 4.11)	7.93 (0.04 - 16.52)	2.39 (0.74 - 4.07)
Yamanashi	0.07	2.57 (1.05 - 4.05)	8.49 (-0.33 - 17.12)	2.33 (0.73 - 3.93)
Ōita	0.07	2.65 (1.11 - 4.16)	8.84 (0.66 - 17.92)	2.42 (0.63 - 4.1)
Ōsaka	0.06	2.43 (0.87 - 3.98)	7.85 (-0.21 - 17.42)	2.2 (0.69 - 3.98)
Australasia	0.07	3.31 (1.78 - 4.75)	3.3 (-3.86 - 9.8)	3.61 (2.08 - 5.11)
Australia	0.07	3.21 (1.56 - 4.83)	3.39 (-4.24 - 10.12)	3.47 (1.7 - 5.27)
New Zealand	0.06	3.95 (2.51 - 5.48)	4.16 (-3.29 - 10.48)	4.29 (2.57 - 5.96)
Western Europe	0.07	3.33 (2.17 - 4.39)	7 (-1.07 - 14.21)	3.06 (2.25 - 3.86)
Andorra	0.05	3.04 (1.05 - 5.22)	5.29 (-3.11 - 13.49)	3.01 (0.45 - 5.46)
Austria	0.06	3.25 (1.12 - 5.4)	3.52 (-4.09 - 11.28)	3.51 (1.17 - 5.85)
Belgium	0.06	3.29 (1.27 - 5.73)	4.57 (-3.66 - 12.63)	3.42 (1.2 - 6.22)
Cyprus	0.13	4.73 (2.46 - 7.03)	5.27 (-3.91 - 14.13)	5.05 (2.52 - 7.58)
Denmark	0.05	2.23 (-0.18 - 4.66)	9.42 (2.64 - 16.12)	1.36 (-1.37 - 4.26)
East Midlands	0.10	4.72 (3.72 - 5.83)	9.7 (2.68 - 17.25)	4.41 (3.71 - 5.14)
East of England	0.09	4.53 (3.53 - 5.5)	9.37 (2.4 - 17.12)	4.25 (3.52 - 4.99)
England	0.10	4.68 (3.77 - 5.61)	9.24 (2.03 - 17.26)	4.43 (4.05 - 4.82)
Finland	0.07	2.91 (0.64 - 5.23)	2.74 (-7.01 - 12.09)	3.2 (0.76 - 5.95)
France	0.07	2.73 (1.03 - 4.28)	4.85 (-1.95 - 11.8)	2.65 (0.93 - 4.25)
Germany	0.06	3.41 (1.09 - 5.64)	5.53 (-2.72 - 13.56)	3.38 (0.9 - 5.87)
Greater London	0.11	4.75 (3.82 - 5.75)	10.21 (2.85 - 18.37)	4.37 (3.96 - 4.85)
Greece	0.09	3.57 (1.98 - 5.29)	4.43 (-2.77 - 11.43)	3.7 (2.05 - 5.58)

Iceland	0.07	3.72 (2.19 - 5.26)	9.54 (1.37 - 16.89)	3.12 (1.69 - 4.57)
Ireland	0.12	4.21 (1.99 - 6.44)	7.01 (-0.97 - 14.83)	4.15 (1.75 - 6.74)
Israel	0.06	3.37 (1.72 - 5.1)	4.49 (-3.61 - 13.56)	3.55 (1.75 - 5.31)
Italy	0.07	3.34 (1.21 - 5.26)	8.52 (1.09 - 16.54)	2.82 (0.56 - 4.96)
Luxembourg	0.06	3.15 (0.88 - 5.36)	5.38 (-3.28 - 14.29)	3.12 (0.42 - 5.67)
Malta	0.10	4 (1.73 - 6.18)	6.23 (-1.98 - 14.42)	4.03 (1.89 - 6.38)
Netherlands	0.07	2.64 (1.08 - 4.11)	1.08 (0 - 4.95)	2.5 (0.84 - 4.08)
North East England	0.11	4.87 (3.91 - 5.92)	9.36 (1.88 - 16.82)	4.62 (3.98 - 5.26)
North West England	0.11	4.77 (3.8 - 5.74)	8.74 (1.96 - 16.39)	4.58 (4.04 - 5.15)
Northern Ireland	0.09	3.13 (1.44 - 4.75)	7.22 (-0.82 - 13.84)	2.67 (1.1 - 4.15)
Norway	0.08	3.11 (1.27 - 4.91)	7.84 (-0.63 - 16.59)	2.59 (0.81 - 4.19)
Portugal	0.11	5.05 (2.97 - 7.24)	12.34 (4.48 - 20.41)	4.36 (2.13 - 6.75)
Scotland	0.08	4.34 (2.1 - 6.59)	11.11 (4.43 - 17.81)	3.6 (1.02 - 6.26)
South East England	0.09	4.48 (3.46 - 5.45)	9.14 (1.05 - 17.46)	4.25 (3.69 - 4.89)
South West England	0.09	4.7 (3.71 - 5.61)	10.18 (2.87 - 17.91)	4.37 (3.7 - 4.98)
Spain	0.10	4.02 (1.91 - 6.05)	8.66 (0.86 - 16.69)	3.39 (1.35 - 5.35)
Stockholm	0.03	0.03 (0 - 0.46)	6.2 (-3.38 - 15.14)	0 (0 - 0)
Sweden	0.07	0 (0 - 0)	5.67 (-3.94 - 14.87)	0 (0 - 0)
Sweden except Stockholm	0.08	0 (0 - 0)	5.11 (-5.62 - 14.3)	0 (0 - 0)
Switzerland	0.03	2.95 (0.76 - 5.48)	3.96 (-3.98 - 12.04)	3.08 (0.73 - 5.93)
United Kingdom	0.10	4.67 (3.76 - 5.6)	9.79 (2.77 - 17.46)	4.33 (3.87 - 4.82)
Wales	0.11	4.99 (2.62 - 7.3)	11.74 (4.15 - 19.84)	4.43 (1.84 - 7.02)
West Midlands	0.10	4.86 (3.85 - 5.88)	9.7 (2.28 - 17.19)	4.59 (3.98 - 5.26)
Yorkshire and the Humber	0.10	4.71 (3.75 - 5.71)	9.15 (2.47 - 16.41)	4.46 (3.86 - 5.1)
Southern Latin America	0.13	6.82 (5.22 - 8.32)	7.84 (1.07 - 14.54)	7.01 (5.62 - 8.37)
Argentina	0.12	6.76 (4.81 - 8.68)	8.41 (1.36 - 14.99)	6.88 (4.88 - 8.74)

Chile	0.16	7.52 (5.76 - 9.39)	9.89 (4.03 - 16.08)	7.16 (5.42 - 9.07)
Uruguay	0.11	5.02 (3.12 - 7.02)	4.42 (-2.73 - 11.41)	5.48 (3.39 - 7.55)
High-income North America	0.05	-0.66 (-1.78 - 0.41)	0.84 (-5.84 - 6.87)	-1.04 (-1.51 - -0.45)
Alabama	0.05	-0.54 (-2.1 - 1.16)	0.48 (-6.44 - 7.88)	-0.75 (-2.13 - 0.74)
Alaska	0.05	-0.4 (-1.97 - 1.26)	2.48 (-4.53 - 8.78)	-0.97 (-2.56 - 0.69)
Arizona	0.04	-0.78 (-2.32 - 0.69)	0.3 (-6.39 - 6.05)	-1.1 (-2.6 - 0.4)
Arkansas	0.05	-0.65 (-2.22 - 0.99)	0.92 (-5.97 - 7.86)	-1 (-2.46 - 0.52)
California	0.06	-0.68 (-2.17 - 0.9)	0.36 (-4.97 - 5.31)	-1.01 (-2.4 - 0.6)
Canada	0.06	-0.06 (-0.71 - 0.32)	1.82 (-2.44 - 6.9)	-0.18 (-1.09 - 0)
Colorado	0.04	-0.74 (-2.3 - 0.96)	1.61 (-5.34 - 8.07)	-1.13 (-2.53 - 0.16)
Connecticut	0.04	-0.52 (-1.84 - 0.84)	0.53 (-5.81 - 6.72)	-0.77 (-2.14 - 0.38)
Delaware	0.04	-0.54 (-2.04 - 1.17)	1.77 (-6.26 - 8.84)	-0.86 (-2.1 - 0.52)
District of Columbia	0.07	-0.38 (-1.82 - 1.01)	1.18 (-5.2 - 7.25)	-0.69 (-2.05 - 0.61)
Florida	0.04	-0.6 (-2.1 - 1.02)	0.5 (-5.98 - 6.33)	-0.86 (-2.23 - 0.68)
Georgia	0.04	-0.02 (-0.23 - 0)	0.28 (-6.44 - 6.9)	-0.01 (0 - 0)
Greenland	0.07	0.32 (-1.54 - 1.99)	6.01 (-0.24 - 12.42)	-0.89 (-2.19 - 0.57)
Hawaii	0.05	-0.81 (-2.29 - 0.75)	-0.29 (-5.14 - 4.33)	-1.08 (-2.58 - 0.58)
Idaho	0.04	-1.1 (-2.73 - 0.55)	-0.66 (-7.19 - 5.61)	-1.25 (-2.75 - 0.46)
Illinois	0.05	-0.59 (-2.11 - 0.94)	1.17 (-5.62 - 7.23)	-0.95 (-2.35 - 0.55)
Indiana	0.04	-0.94 (-2.45 - 0.75)	-0.39 (-7.92 - 6.41)	-1.06 (-2.45 - 0.58)
Iowa	0.04	-0.93 (-2.37 - 0.77)	-0.29 (-6.62 - 5.85)	-1.15 (-2.57 - 0.54)
Kansas	0.04	-0.99 (-2.64 - 0.59)	-0.27 (-7.12 - 6.4)	-1.2 (-2.63 - 0.31)
Kentucky	0.04	-0.73 (-2.43 - 0.89)	0.69 (-7.63 - 7.83)	-0.97 (-2.31 - 0.48)
Louisiana	0.06	-0.55 (-2.3 - 1.26)	0.82 (-6.65 - 8.8)	-0.83 (-2.32 - 0.74)
Maine	0.05	-0.68 (-2.2 - 1.03)	1.32 (-6.04 - 7.39)	-1.1 (-2.51 - 0.34)
Maryland	0.04	-0.69 (-2.27 - 0.73)	0.34 (-6.22 - 6.89)	-0.9 (-2.18 - 0.38)
Massachusetts	0.05	-0.61 (-2 - 0.81)	0.93 (-5.42 - 6.93)	-0.95 (-2.21 - 0.41)
Michigan	0.04	-0.67 (-2.22 - 0.94)	0.84 (-7.14 - 7.76)	-0.92 (-2.2 - 0.4)

Minnesota	0.04	-0.93 (-2.4 - 0.63)	-0.14 (-5.82 - 5.41)	-1.19 (-2.62 - 0.24)
Mississippi	0.06	-0.53 (-2.19 - 1.15)	0.21 (-7.21 - 7.68)	-0.7 (-2.1 - 0.88)
Missouri	0.05	-0.83 (-2.37 - 0.66)	-0.77 (-7.87 - 5.91)	-0.86 (-2.27 - 0.57)
Montana	0.05	-0.9 (-2.48 - 0.69)	-0.15 (-5.76 - 5.75)	-1.16 (-2.69 - 0.32)
Nebraska	0.04	-1.02 (-2.64 - 0.62)	-0.74 (-7.26 - 5.41)	-1.16 (-2.63 - 0.49)
Nevada	0.04	-0.72 (-2.39 - 0.98)	2.85 (-4.7 - 9.44)	-1.31 (-2.62 - 0.13)
New Hampshire	0.05	-0.51 (-2.05 - 1.04)	1.13 (-5.49 - 7.35)	-0.85 (-2.22 - 0.57)
New Jersey	0.04	-0.55 (-2.04 - 0.98)	0.9 (-6.06 - 7.25)	-0.82 (-2.14 - 0.6)
New Mexico	0.06	-0.69 (-2.38 - 1)	0.22 (-7.76 - 7.99)	-0.9 (-2.36 - 0.6)
New York	0.05	-0.36 (-1.88 - 1.12)	0.86 (-6.06 - 7.42)	-0.59 (-1.91 - 0.68)
North Carolina	0.04	-0.95 (-2.39 - 0.59)	-0.54 (-7.59 - 6.04)	-1.1 (-2.37 - 0.4)
North Dakota	0.05	-1.04 (-2.58 - 0.56)	-0.79 (-6.81 - 5.16)	-1.16 (-2.6 - 0.31)
Ohio	0.04	-0.81 (-2.39 - 0.77)	0 (-7.41 - 7.29)	-0.96 (-2.21 - 0.3)
Oklahoma	0.04	-0.93 (-2.46 - 0.68)	-0.26 (-7.39 - 6.85)	-1.09 (-2.4 - 0.33)
Oregon	0.05	-0.8 (-2.32 - 0.85)	0.44 (-5.67 - 6.37)	-1.13 (-2.52 - 0.33)
Pennsylvania	0.05	-0.42 (-1.98 - 1.26)	2.87 (-5.05 - 10.41)	-0.97 (-2.33 - 0.33)
Rhode Island	0.05	-0.59 (-2.15 - 0.92)	0.88 (-5.71 - 7.05)	-0.89 (-2.26 - 0.49)
South Carolina	0.05	-0.62 (-2.2 - 1.07)	-0.08 (-6.93 - 6.64)	-0.76 (-2.18 - 0.7)
South Dakota	0.05	-0.94 (-2.45 - 0.71)	-0.19 (-6.68 - 5.87)	-1.18 (-2.54 - 0.42)
Tennessee	0.05	-0.77 (-2.31 - 0.82)	-0.46 (-6.86 - 6.46)	-0.86 (-2.25 - 0.51)
Texas	0.05	-0.82 (-2.46 - 0.84)	0.07 (-6.32 - 6.79)	-1.06 (-2.67 - 0.51)
United States	0.05	-0.73 (-1.92 - 0.49)	0.57 (-6.6 - 7.41)	-1.06 (-1.57 - -0.46)
Utah	0.05	-1.18 (-2.67 - 0.48)	-0.79 (-6.74 - 3.44)	-1.28 (-2.7 - 0.3)
Vermont	0.05	-0.59 (-2.01 - 0.89)	0.62 (-4.55 - 5.53)	-1 (-2.3 - 0.47)
Virginia	0.04	-0.63 (-2.08 - 0.87)	0.41 (-6.14 - 6.65)	-0.84 (-2.15 - 0.55)
Washington	0.04	-0.71 (-2.22 - 0.98)	0.61 (-5.3 - 6.27)	-1.05 (-2.48 - 0.56)
West Virginia	0.04	-0.71 (-2.39 - 1.2)	-0.41 (-8.71 - 7.25)	-0.76 (-2.19 - 0.95)
Wisconsin	0.04	-0.99 (-2.44 - 0.62)	-0.13 (-6.11 - 6.25)	-1.24 (-2.61 - 0.26)

Wyoming	0.05	-0.44 (-2.05 - 1.4)	2.38 (-5.42 - 9.59)	-0.98 (-2.38 - 0.57)
Latin America and Caribbean	0.16	8.66 (6.62 - 10.58)	10.86 (5.04 - 16.87)	7.19 (6.6 - 7.8)
Caribbean	0.11	6.05 (3.44 - 8.49)	6.79 (0.77 - 12.69)	4.91 (4.05 - 5.81)
Antigua and Barbuda	0.09	4.66 (0.57 - 8.89)	3.35 (-7.56 - 14.43)	5.04 (3.2 - 6.84)
Antigua and Barbuda	0.09	4.66 (0.57 - 8.89)	3.35 (-7.56 - 14.43)	5.04 (3.2 - 6.84)
Antigua and Barbuda	0.09	4.66 (0.57 - 8.89)	3.35 (-7.56 - 14.43)	5.04 (3.2 - 6.84)
Antigua and Barbuda	0.09	4.66 (0.57 - 8.89)	3.35 (-7.56 - 14.43)	5.04 (3.2 - 6.84)
Barbados	0.07	2.79 (-2.26 - 7.63)	0 (-13.38 - 13.03)	4.17 (2.54 - 5.82)
Belize	0.17	7.09 (3.48 - 10.56)	7.77 (0.77 - 14.71)	5.41 (3.49 - 7.27)
Bermuda	0.09	5.28 (1.62 - 8.76)	5.92 (-2.25 - 14.58)	4.31 (2.51 - 6.1)
Cuba	0.09	5.74 (2.97 - 8.59)	8.15 (1.49 - 14.67)	3.86 (2.04 - 5.7)
Dominica	0.14	9.53 (5.88 - 13.48)	13.35 (5.6 - 22.06)	5.52 (3.82 - 7.39)
Dominican Republic	0.17	9.52 (6.7 - 12.4)	12.16 (6.29 - 18.23)	6.41 (4.51 - 8.25)
Grenada	0.20	9.87 (6.24 - 13.98)	12.89 (4.81 - 22.3)	6.42 (4.53 - 8.28)
Guyana	0.13	6.04 (2.31 - 9.75)	5.39 (-2.25 - 13.58)	5.67 (3.77 - 7.57)
Haiti	0.13	5.45 (2.95 - 8.04)	4.17 (0.39 - 8.16)	5.26 (3.41 - 7.24)
Jamaica	0.10	6.64 (2.82 - 10.57)	7.08 (-0.14 - 14.78)	5.13 (3.21 - 7.09)
Puerto Rico	0.11	3.75 (-0.52 - 7.73)	0.23 (-11.21 - 10.9)	5.29 (3.48 - 7.24)
Saint Lucia	0.16	9.98 (6.36 - 13.65)	14.11 (6.54 - 22.61)	5.37 (3.47 - 7.18)
Saint Vincent and the Grenadines	0.15	11.46 (7.88 - 15.27)	15.4 (8.53 - 22.5)	5.1 (3.32 - 7.01)
Saint Vincent and the Grenadines	0.15	11.46 (7.88 - 15.27)	15.4 (8.53 - 22.5)	5.1 (3.32 - 7.01)
Saint Vincent and the Grenadines	0.15	11.46 (7.88 - 15.27)	15.4 (8.53 - 22.5)	5.1 (3.32 - 7.01)
Saint Vincent and the Grenadines	0.15	11.46 (7.88 - 15.27)	15.4 (8.53 - 22.5)	5.1 (3.32 - 7.01)
Suriname	0.13	5.81 (2.16 - 9.36)	4.88 (-2.07 - 11.62)	5.51 (3.75 - 7.43)
The Bahamas	0.06	5.34 (1.15 - 9.3)	6.67 (-3.82 - 16.78)	4.25 (2.38 - 6.09)

Trinidad and Tobago	0.11	3.7 (-1.4 - 8.59)	0.8 (-9.48 - 11.88)	5.23 (3.25 - 7)
Trinidad and Tobago	0.11	3.7 (-1.4 - 8.59)	0.8 (-9.48 - 11.88)	5.23 (3.25 - 7)
Trinidad and Tobago	0.11	3.7 (-1.4 - 8.59)	0.8 (-9.48 - 11.88)	5.23 (3.25 - 7)
Trinidad and Tobago	0.11	3.7 (-1.4 - 8.59)	0.8 (-9.48 - 11.88)	5.23 (3.25 - 7)
Virgin Islands, U.S.	0.10	3.82 (-0.2 - 7.65)	2.21 (-9.47 - 13.49)	4.44 (2.64 - 6.26)
Andean Latin America	0.14	11.26 (8.87 - 13.61)	11.62 (5.87 - 17.17)	10.15 (8.46 - 11.83)
Bolivia	0.19	11.33 (8.83 - 13.79)	10.67 (5.42 - 16.33)	10.48 (8.78 - 12.14)
Ecuador	0.14	11.46 (8.19 - 14.7)	12.32 (4.98 - 20.07)	9.52 (7.74 - 11.49)
Peru	0.13	10.99 (8.54 - 13.44)	11.49 (6.6 - 16.19)	10.14 (7.42 - 12.71)
Central Latin America	0.17	8.84 (6.21 - 11.3)	8.55 (2.45 - 14.69)	8.02 (7.34 - 8.73)
Aguascalientes	0.17	7.99 (4.47 - 11.31)	7.72 (-0.03 - 14.76)	7.15 (5.48 - 8.93)
Baja California	0.15	6.9 (3.45 - 10.45)	6.4 (-2.6 - 15.68)	6.64 (5.15 - 8.33)
Baja California Sur	0.11	7.79 (4.7 - 10.75)	8.96 (1.7 - 16.06)	6.28 (4.74 - 7.79)
Campeche	0.20	8.88 (5.81 - 11.78)	9.03 (2.44 - 15.67)	7.72 (6.11 - 9.43)
Chiapas	0.28	2.53 (-0.37 - 5.46)	4.65 (-0.89 - 10.45)	0.5 (-1.33 - 2.55)
Chihuahua	0.18	8.14 (5.03 - 10.97)	8.14 (1.63 - 14.64)	7.08 (5.37 - 8.83)
Coahuila	0.17	6.26 (2.9 - 9.74)	4.43 (-3.62 - 13.53)	6.77 (5.11 - 8.56)
Colima	0.16	7.72 (4.42 - 10.98)	7.34 (-0.44 - 15.68)	7.26 (5.61 - 9)
Colombia	0.16	10.85 (8.27 - 13.64)	10.87 (5.43 - 16.91)	9.7 (7.8 - 11.61)
Costa Rica	0.16	11.15 (8.36 - 13.73)	13.74 (6.77 - 21.16)	9.02 (7.36 - 10.61)
Durango	0.17	8.9 (5.67 - 11.98)	9.49 (2.78 - 16.45)	7.3 (5.7 - 9.08)
El Salvador	0.20	9.91 (6.98 - 12.64)	13.13 (6.8 - 19.67)	7.39 (4.97 - 9.99)
Guanajuato	0.21	8.48 (5.2 - 11.63)	8.04 (1.39 - 15.37)	7.66 (6.01 - 9.49)
Guatemala	0.20	6.75 (3.9 - 9.83)	4.08 (-0.71 - 9.32)	7.71 (5.77 - 9.72)
Guerrero	0.20	8.87 (6.12 - 11.77)	8.58 (2.87 - 14.85)	7.74 (6.12 - 9.39)
Hidalgo	0.19	10.19 (7.23 - 13.09)	11.62 (5.26 - 18.1)	7.87 (6.21 - 9.47)

Honduras	0.19	9.87 (7.51 - 12.35)	9.07 (4.94 - 13.39)	9.15 (6.74 - 11.54)
Jalisco	0.18	7.22 (3.93 - 10.86)	6.08 (-1.18 - 13.87)	7.13 (5.43 - 8.96)
Mexico	0.18	7.78 (4.58 - 10.74)	7.78 (0.54 - 14.6)	6.89 (6.26 - 7.55)
Mexico City	0.15	5.63 (1.67 - 9.42)	3.19 (-6.67 - 12.07)	6.54 (4.88 - 8.23)
Michoacán de Ocampo	0.21	8.77 (5.51 - 11.78)	7.95 (1.37 - 14.7)	8.17 (6.38 - 9.96)
Morelos	0.15	7.95 (4.77 - 11.25)	8.13 (0.52 - 16.48)	7.12 (5.44 - 8.78)
México	0.15	7.7 (4.37 - 11.33)	7.65 (0.18 - 16.25)	6.91 (5.28 - 8.47)
Nayarit	0.19	8.98 (6.19 - 12)	9.95 (3.24 - 17.45)	7.49 (5.78 - 9.26)
Nicaragua	0.15	9.95 (7.52 - 12.37)	8.42 (4.1 - 12.97)	9.37 (7.6 - 11.27)
Nuevo León	0.13	4.23 (0.82 - 7.44)	4.93 (-3.44 - 13.47)	3.43 (1.75 - 5.05)
Oaxaca	0.20	7.6 (4.91 - 10.43)	7.97 (2.53 - 13.86)	6.25 (4.57 - 8.01)
Panama	0.15	9.01 (5.53 - 12.19)	10.67 (2.94 - 18.8)	7.54 (5.27 - 10)
Puebla	0.19	9.8 (6.87 - 13.08)	10.69 (4.14 - 17.79)	7.8 (6.15 - 9.47)
Querétaro	0.21	9.51 (6.28 - 12.7)	9.85 (2.8 - 17.16)	8.14 (6.42 - 10.03)
Quintana Roo	0.18	9.18 (6.04 - 11.96)	9.93 (2.79 - 17.04)	7.8 (6.16 - 9.46)
San Luis Potosí	0.23	9.89 (6.88 - 12.84)	10.43 (4.07 - 17.24)	8.1 (6.52 - 9.74)
Sinaloa	0.17	8.63 (5.68 - 11.65)	10.01 (3 - 17.25)	6.95 (5.27 - 8.48)
Sonora	0.16	7.33 (4.13 - 10.43)	6.88 (-1.05 - 14.25)	6.91 (5.17 - 8.55)
Tabasco	0.19	9.05 (5.87 - 12.05)	9.47 (2.49 - 16.87)	7.84 (6.22 - 9.57)
Tamaulipas	0.17	8.2 (4.99 - 11.49)	9.32 (1.49 - 17.93)	6.85 (5.1 - 8.49)
Tlaxcala	0.20	9.3 (6.22 - 12.63)	9.61 (2.29 - 17.37)	8.04 (6.32 - 9.81)
Venezuela	0.15	8.91 (5.65 - 12.05)	7.63 (0.11 - 15.44)	9 (7.27 - 10.89)
Veracruz de Ignacio de la Llave	0.19	8.45 (5.26 - 11.65)	7.9 (0.96 - 15.19)	7.86 (6.1 - 9.52)
Yucatán	0.17	8.42 (5.34 - 11.28)	8.62 (2.34 - 14.96)	7.31 (5.61 - 8.91)
Zacatecas	0.20	8.93 (5.69 - 12.04)	9.26 (2.38 - 16.46)	7.61 (5.9 - 9.4)
Tropical Latin America	0.17	9.15 (7.93 - 10.35)	16.67 (11.29 - 22.37)	7.3 (6.65 - 7.91)
Acre	0.19	11.73 (9.97 - 13.62)	19.6 (13.88 - 26.32)	9.5 (7.87 - 11.1)

Alagoas	0.20	12.21 (10.46 - 14.22)	18.64 (12.13 - 25.39)	10.45 (8.89 - 12.19)
Amapá	0.21	10.49 (8.77 - 12.17)	16.33 (9.46 - 23.9)	9.6 (7.97 - 11.04)
Amazonas	0.20	9.44 (7.52 - 11.25)	15.28 (8.84 - 22.34)	8.13 (6.46 - 9.83)
Bahia	0.19	12.1 (10.41 - 13.88)	20.05 (14.38 - 26.29)	9.8 (8.16 - 11.5)
Brazil	0.17	9.13 (7.86 - 10.34)	16.78 (10.99 - 22.83)	7.29 (6.62 - 7.91)
Ceará	0.20	12.27 (10.47 - 14.18)	20.23 (14.62 - 26.79)	9.8 (8.3 - 11.36)
Distrito Federal	0.15	7.83 (5.96 - 9.83)	5.03 (-3.14 - 13.41)	8.89 (7.44 - 10.45)
Espírito Santo	0.17	10.83 (9.02 - 12.63)	18.91 (12.51 - 25.59)	8.76 (7.16 - 10.34)
Goiás	0.18	10.77 (9.1 - 12.62)	17.39 (10.72 - 23.98)	9.37 (7.93 - 10.89)
Maranhão	0.22	13.13 (11.21 - 15.06)	21.33 (15.02 - 28.4)	10.95 (9.31 - 12.75)
Mato Grosso	0.17	10.92 (9.18 - 12.55)	16.88 (10.88 - 23.62)	9.52 (7.99 - 11.04)
Mato Grosso do Sul	0.17	10.62 (8.72 - 12.47)	17.51 (11.22 - 24.24)	9 (7.3 - 10.72)
Minas Gerais	0.16	11.27 (9.53 - 13.13)	19.66 (14.3 - 25.92)	8.88 (7.34 - 10.5)
Paraguay	0.19	9.25 (6.98 - 11.59)	11.72 (6.81 - 16.54)	8.06 (5.74 - 10.5)
Paraná	0.17	11.22 (9.38 - 12.9)	18.83 (13.57 - 24.99)	8.85 (7.27 - 10.3)
Paraíba	0.19	12.01 (10.16 - 13.78)	19.24 (13.59 - 25.4)	9.59 (8.04 - 11.24)
Pará	0.18	11.47 (9.72 - 13.29)	18.58 (12.91 - 25.37)	9.68 (8.08 - 11.33)
Pernambuco	0.17	11.51 (9.78 - 13.38)	17.43 (11.19 - 24)	9.87 (8.32 - 11.44)
Piaui	0.19	12.54 (10.66 - 14.38)	21.44 (15.23 - 28.42)	9.87 (8.17 - 11.53)
Rio Grande do Norte	0.20	11.93 (10 - 13.77)	18.65 (12.49 - 25.16)	10.08 (8.37 - 11.83)
Rio Grande do Sul	0.15	10.95 (9.07 - 12.79)	18.44 (13.06 - 24.35)	8.08 (6.55 - 9.5)
Rio de Janeiro	0.13	8 (6.05 - 9.78)	8.53 (0.96 - 16.35)	8.21 (6.69 - 9.79)
Rondônia	0.19	11.46 (9.79 - 13.36)	18.71 (13.16 - 24.91)	9.47 (7.79 - 11.06)
Roraima	0.18	9.27 (7.38 - 11.19)	15 (8.3 - 22.22)	7.96 (6.25 - 9.6)

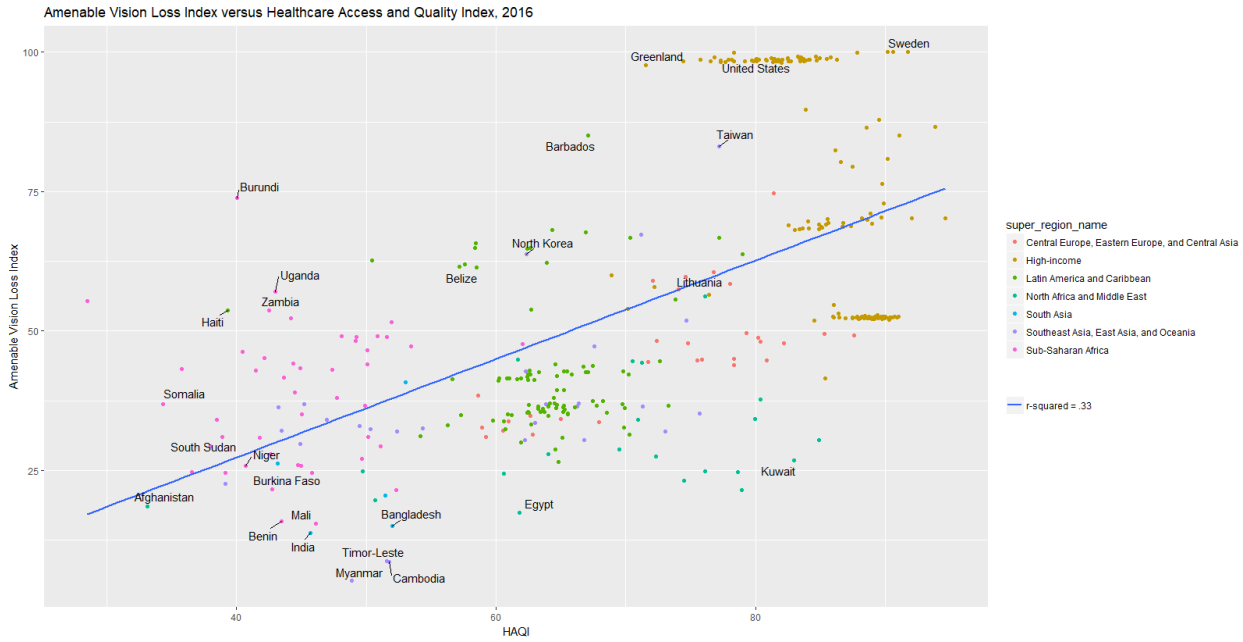
Santa Catarina	0.17	11.56 (9.8 - 13.45)	20 (14.47 - 26.22)	8.69 (7.17 - 10.26)
Sergipe	0.21	11.73 (9.89 - 13.6)	18.3 (12.1 - 24.99)	9.91 (8.28 - 11.44)
São Paulo	0.14	3.79 (2.25 - 5.27)	9.7 (2.95 - 16.86)	2.92 (1.43 - 4.36)
Tocantins	0.20	8.36 (6.54 - 10.31)	19.01 (13.08 - 26.37)	5.92 (4 - 7.82)
North Africa and Middle East	0.20	12.72 (10.02 - 15.37)	9.49 (2.89 - 16.01)	13.45 (12.47 - 14.48)
Afghanistan	0.12	10.82 (8.02 - 13.56)	5.5 (1.19 - 9.81)	13.39 (11.49 - 15.41)
Algeria	0.21	13.21 (9.88 - 16.67)	10.61 (2 - 20.09)	13.81 (11.84 - 15.92)
Bahrain	0.15	13.07 (9.19 - 17.13)	8.51 (0.46 - 17.81)	14.55 (12.44 - 16.74)
Egypt	0.19	11.29 (8.22 - 14.41)	3.53 (-3.75 - 10.99)	13.78 (11.52 - 15.76)
Iran	0.26	14.43 (10.95 - 17.77)	7.72 (-1.57 - 17.38)	16.96 (14.82 - 19.16)
Iraq	0.08	9.63 (5.86 - 13.24)	5.94 (-2.33 - 13.69)	10.94 (8.89 - 12.98)
Jordan	0.21	10.91 (6.88 - 14.62)	3.44 (-5.21 - 11.92)	14.41 (12.42 - 16.39)
Kuwait	0.18	13.1 (9.55 - 16.47)	8.26 (0.27 - 15.87)	14.74 (12.76 - 16.91)
Lebanon	0.18	6.66 (2.93 - 10.41)	0.23 (-7.46 - 7.18)	10.04 (7.26 - 12.93)
Libya	0.20	12.21 (7.36 - 17.02)	6.14 (-2.7 - 16.01)	14.88 (12.86 - 16.95)
Morocco	0.24	15.14 (10.96 - 19.53)	16.19 (8.88 - 24.75)	11.75 (8.71 - 14.64)
Oman	0.49	20.95 (17.33 - 24.86)	18.86 (11.48 - 27.51)	19.66 (16.32 - 22.23)
Palestine	0.04	11.44 (7.2 - 15.45)	4.94 (-3.47 - 13.98)	14.38 (12.19 - 16.69)
Qatar	0.17	10.73 (6.53 - 15.12)	5.27 (-3.73 - 15.3)	13.06 (11.17 - 15.05)
Saudi Arabia	0.43	21.53 (18.92 - 24.24)	20.45 (13.33 - 28.41)	20.85 (19.41 - 22.29)
Sudan	0.22	11.76 (9.16 - 14.21)	5.92 (2.3 - 9.86)	14.38 (12.32 - 16.61)
Syria	0.26	12.57 (9.51 - 15.47)	6.45 (-1.01 - 13.34)	14.94 (13.01 - 16.96)
Tunisia	0.22	15.54 (11.94 - 19.22)	13.54 (5.58 - 21.21)	14.7 (12.56 - 16.85)

Turkey	0.19	14.95 (11.4 - 18.83)	16.87 (10.32 - 24.47)	10.49 (8.16 - 12.8)
United Arab Emirates	0.21	13.4 (9.82 - 17.01)	9.61 (0.58 - 19.42)	14.55 (12.51 - 16.66)
Yemen	0.28	11.67 (8.61 - 14.7)	8.45 (4.09 - 13.16)	12.05 (9.5 - 14.59)
South Asia	0.22	9.83 (7.83 - 11.94)	1.72 (-1.98 - 5.35)	14.99 (13.82 - 16.12)
Bangladesh	0.20	3.94 (0.81 - 7.01)	-0.73 (-4.3 - 2.87)	8.53 (5.27 - 11.81)
Bhutan	0.29	15.05 (12.07 - 18.14)	13.65 (8.25 - 19.63)	14.12 (11.59 - 17.21)
India	0.23	10.44 (8.47 - 12.36)	1.86 (-1.36 - 5.22)	15.61 (14.36 - 16.81)
Nepal	0.21	5.99 (3.46 - 8.26)	3.45 (0.07 - 6.58)	6.97 (4.47 - 9.44)
Pakistan	0.22	9.36 (6.07 - 12.61)	3.79 (-0.47 - 7.96)	12.97 (10.16 - 15.87)
Sub-Saharan Africa	0.13	1.86 (-0.21 - 3.83)	0.97 (-2.24 - 3.87)	2.27 (1.32 - 3.29)
Central Sub-Saharan Africa	0.11	2.38 (0.49 - 4.36)	2.64 (-0.53 - 6.17)	1.57 (0.23 - 3.04)
Angola	0.18	8.23 (5.23 - 11.23)	7.85 (2.44 - 13.44)	6.97 (5.08 - 8.94)
Central African Republic	0.07	-2.28 (-4.86 - 0.11)	-0.95 (-4.63 - 2.53)	-3.03 (-5.54 - -0.48)
Congo	0.15	6.31 (3.48 - 9.08)	5.67 (0.8 - 10.7)	5.57 (3.75 - 7.46)
Democratic Republic of the Congo	0.03	0.23 (-2.01 - 2.4)	0.91 (-2.29 - 4.05)	-0.52 (-2.44 - 1.56)
Equatorial Guinea	0.38	7.99 (4.78 - 11.42)	4.86 (-0.52 - 10.84)	9.12 (6.92 - 11.29)
Gabon	0.16	10.11 (6.32 - 13.89)	13.64 (5.59 - 22.48)	6.11 (4.29 - 7.87)
Eastern Sub-Saharan Africa	0.16	5.75 (3.78 - 7.57)	1.4 (-1.56 - 4.16)	8.83 (7.84 - 9.86)
Burundi	0.09	6.59 (4.48 - 8.72)	3.67 (0.48 - 7.1)	7.76 (5.88 - 9.61)
Comoros	0.17	11.61 (9.28 - 14.35)	8.33 (4.73 - 12.04)	11.8 (9.29 - 14.44)
Djibouti	0.22	8.83 (3.74 - 13.77)	7.04 (-1.88 - 16.52)	8.61 (6.09 - 11.3)
Eritrea	0.20	8.61 (4.56 - 13.37)	8.64 (1.14 - 18.67)	7.29 (5.01 - 9.56)
Ethiopia	0.17	2.78 (0.21 - 5.37)	-3.29 (-6.88 - 0.13)	8.47 (5.97 - 11.1)
Kenya	0.19	5.31 (3.29 - 7.47)	5.1 (2.32 - 7.93)	3.12 (2.28 - 3.93)
Madagascar	0.11	9.68 (7.48 - 11.9)	5 (1.85 - 8.24)	11.78 (9.64 - 13.94)
Malawi	0.14	5.32 (2.94 - 7.65)	1.35 (-1.88 - 4.46)	7.99 (5.88 - 10.25)

Mozambique	0.16	7.67 (5.46 - 9.95)	3.08 (0.27 - 6.1)	10.46 (8.49 - 12.62)
Rwanda	0.21	9.58 (7.16 - 11.93)	4.7 (1.3 - 7.85)	12.26 (10.12 - 14.5)
Somalia	0.08	6.38 (3.95 - 8.65)	3.33 (0.05 - 6.44)	7.78 (5.28 - 10.19)
South Sudan	0.11	1.13 (-1.42 - 3.79)	-1.07 (-4.18 - 2.08)	3.64 (0.98 - 6.27)
Tanzania	0.18	8.54 (6.32 - 10.63)	4.51 (1.52 - 7.47)	10.36 (8.14 - 12.38)
Uganda	0.20	9.68 (6.64 - 12.58)	4.27 (0.7 - 7.6)	12.76 (9.98 - 15.57)
Zambia	0.16	6.67 (3.66 - 9.25)	1.46 (-2.6 - 5.26)	10.4 (8.35 - 12.55)
Southern Sub-Saharan Africa	0.13	2.61 (1.24 - 4.02)	6.73 (2.76 - 11.25)	0.74 (0.09 - 1.44)
Botswana	0.19	3.44 (0.89 - 6.14)	6.95 (1.5 - 12.98)	1 (-0.98 - 3.09)
Lesotho	0.18	0.83 (-1.56 - 3.11)	0.15 (-4.79 - 4.99)	1.18 (-0.65 - 3.12)
Namibia	0.20	2.07 (-0.26 - 4.4)	3.65 (-0.97 - 8.17)	0.9 (-1.04 - 2.69)
South Africa	0.14	3 (1.44 - 4.56)	8.21 (3.23 - 13.24)	0.93 (0.17 - 1.66)
Swaziland	0.13	2.43 (-0.02 - 5.43)	5.79 (0.42 - 11.74)	0.06 (-1.69 - 1.86)
Zimbabwe	0.06	0.26 (-2.18 - 2.7)	2.15 (-2.14 - 6.8)	-0.88 (-2.99 - 1.32)
Western Sub-Saharan Africa	0.14	-1.34 (-3.61 - 1)	0.04 (-3.05 - 3.12)	-2.61 (-4.47 - -0.8)
Benin	0.13	-7.58 (-12.32 - -2.94)	-2.72 (-7.07 - 1.39)	-11.19 (-16.06 - -6.7)
Burkina Faso	0.15	-18.45 (-23.54 - -13.83)	-12.18 (-16.61 - -8.11)	-19.5 (-25.33 - -14.04)
Cameroon	0.11	3.31 (0.44 - 6.3)	2.24 (-1.46 - 6.32)	3.49 (0.88 - 6.09)
Cape Verde	0.25	11.91 (6.91 - 17.04)	11.19 (3.6 - 19.55)	8.91 (6.8 - 11.1)
Chad	0.11	2.72 (0.11 - 5.38)	1.21 (-1.91 - 4.32)	3.67 (1.39 - 6.1)
Cote d'Ivoire	0.13	-20.6 (-25.96 - -15.44)	-13.1 (-18.49 - -7.97)	-22.77 (-28.74 - -17)
Ghana	0.14	-6.92 (-10.59 - -3.68)	-4.8 (-9.08 - -1.05)	-7.41 (-11.42 - -3.67)
Guinea	0.10	-3.37 (-6.76 - -0.21)	-2.19 (-5.67 - 1.29)	-3.65 (-7.35 - -0.27)
Guinea-Bissau	0.12	-1.89 (-4.78 - 0.98)	-2.62 (-5.86 - 0.9)	-0.14 (-2.78 - 2.41)
Liberia	0.11	3.79 (1.06 - 6.36)	0.94 (-2.23 - 4.27)	6.17 (4 - 8.4)
Mali	0.13	-3.89 (-6.86 - -0.87)	-3.47 (-6.46 - -0.34)	-2.63 (-5.63 - 0.2)
Mauritania	0.16	5.45 (1.3 - 9.23)	3.35 (-2.03 - 8.42)	6.09 (3.96 - 8.44)

Niger	0.06	0.39 (-2.43 - 3.35)	-0.99 (-4.59 - 2.85)	1.92 (-0.56 - 4.41)
Nigeria	0.16	1.79 (-1.36 - 4.83)	3.05 (-0.66 - 6.74)	-0.5 (-3.63 - 2.68)
Sao Tome and Principe	0.14	8.77 (5.22 - 12.27)	7.45 (2.08 - 12.93)	7.55 (5.33 - 9.58)
Senegal	0.11	2.59 (-0.86 - 5.98)	0.44 (-4.07 - 4.81)	4.34 (1.92 - 6.6)
Sierra Leone	0.13	1.6 (-3.14 - 6.92)	0.21 (-3.94 - 4.46)	3.03 (-2.3 - 9.32)
The Gambia	0.10	-2.68 (-5.68 - 0.2)	-3.89 (-7.12 - - 0.51)	0.17 (-2.83 - 2.98)
Togo	0.15	1.11 (-1.7 - 3.86)	0.69 (-2.71 - 3.92)	1.22 (-1.73 - 3.98)

Appendix 4



Appendix 5

Appendix 5A— Data generation and analytical code

Code run using version 56 of the Python GBD environment (which runs Python 2.7.14) on a jupyter notebook

import pandas

pandas.__version__ # Referenced answer by alko (edited by waterproof) to figure out how to check package versions -- https://stackoverflow.com/questions/20180543/how-to-check-version-of-python-modules

running pandas version 0.20.3

```
import numpy

numpy.__version__ # Referenced answer by alko (edited by waterproof) to figure out how to check package versions -- https://stackoverflow.com/questions/20180543/how-to-check-version-of-python-modules

# running numpy version 1.14.5


# STEP 1: Get all of the necessary ids together


# get all of the required ids

# Referenced the documentation -- http://dev-tomflem.ihme.washington.edu/docs/db_queries/current/get_ids.html

import db_queries

db_queries.__version__ # Referenced answer by alko (edited by waterproof) to figure out how to check package versions -- https://stackoverflow.com/questions/20180543/how-to-check-version-of-python-modules

# running db_queries version 16.5.0


from db_queries import get_ids


meids = get_ids(table="modelable_entity")


# refractive error

re_meids = meids[meids['modelable_entity_name'].str.contains("refractive error")] # referenced answer by Garrett (edited by hlin777) to figure out how to select refractive error from larger df... https://stackoverflow.com/questions/11350770/pandas-dataframe-select-by-partial-string


re_meids


# cataract

cat_meids = meids[meids['modelable_entity_name'].str.contains("cataract")] # referenced answer by Garrett (edited by hlin777) to figure out how to select cataract from larger df... https://stackoverflow.com/questions/11350770/pandas-dataframe-select-by-partial-string
```

```
cat_meids

# location set
locations = get_ids("location_set")
locations.head()
# use location_set_id 1

# confirm age-standardized age group id
ages = get_ids("age_group")
ages
# want age_group_id 27

# confirm gbd_round
get_ids("gbd_round")
# want gbd_round_id 4

# confirm sex_id
get_ids("sex")
# want sex_id 3

# Referenced documentation -- http://dev-tomflem.ihme.washington.edu/docs/db_queries/current/get_location_metadata.html
from db_queries import get_location_metadata

location_data = get_location_metadata(location_set_id=1, gbd_round_id=4)

location_data.query("location_name == 'South Asia'")

location_data.query("location_name == 'North Africa and Middle East'")
```

```
location_ids = list(location_data['location_id'])


# STEP 2: Pull all of the necessary data


# Referenced documentation -- http://dev-tomflem.ihme.washington.edu/docs/get_draws/current/get_draws.html#module-get_draws

import get_draws

get_draws.__version__ # Referenced answer by alko (edited by waterproof) to figure out how to check package versions -- https://stackoverflow.com/questions/20180543/how-to-check-version-of-python-modules

# running get_draws version 0.0.17


from get_draws.api import get_draws


# refractive error

re_blind = get_draws(gbd_id_type="modelable_entity_id", gbd_id=2310, source="epi", location_id=location_ids, gbd_round_id=4, age_group_id=27, sex_id=3)

re_mod = get_draws(gbd_id_type="modelable_entity_id", gbd_id=2307, source="epi", location_id=location_ids, gbd_round_id=4, age_group_id=27, sex_id=3)

re_sev = get_draws(gbd_id_type="modelable_entity_id", gbd_id=2308, source="epi", location_id=location_ids, gbd_round_id=4, age_group_id=27, sex_id=3)


# cataract

cat_blind = get_draws(gbd_id_type="modelable_entity_id", gbd_id=3920, source="epi", location_id=location_ids, gbd_round_id=4, age_group_id=27, sex_id=3)

cat_mod = get_draws(gbd_id_type="modelable_entity_id", gbd_id=2297, source="epi", location_id=location_ids, gbd_round_id=4, age_group_id=27, sex_id=3)

cat_sev = get_draws(gbd_id_type="modelable_entity_id", gbd_id=2298, source="epi", location_id=location_ids, gbd_round_id=4, age_group_id=27, sex_id=3)


# read in the disability weight file

dws = pd.read_csv(FILENAME)
```

```
moderate_dw = dws.query("healthstate == 'vision_mod'")

severe_dw = dws.query("healthstate == 'vision_sev'")

blind_dw= dws.query("healthstate == 'vision_blind'")


# STEP 3: Create unscaled indexes


# STEP #3A: Create the refractive error unscaled index and scaled index


# refractive error

for i in range(1000):

    re_blind['blind_{}'.format(i)] = blind_dw['draw{}'.format(i)].values[0]  * re_blind['draw_{}'.format(i)]

    re_sev['severe_{}'.format(i)] = severe_dw['draw{}'.format(i)].values[0]  * re_sev['draw_{}'.format(i)]

    re_mod['moderate_{}'.format(i)] = moderate_dw['draw{}'.format(i)].values[0]  *
re_mod['draw_{}'.format(i)]


# merge it all together

reui = pd.merge(re_blind, re_sev, on=['location_id', 'year_id', 'sex_id','age_group_id'])

reui = pd.merge(reui, re_mod, on=['location_id', 'year_id', 'sex_id','age_group_id'])


for i in range(1000):

    reui['ui_{}'.format(i)] = reui['blind_{}'.format(i)] + reui['severe_{}'.format(i)] +
reui['moderate_{}'.format(i)]


location_data


location_data.columns


# 0-100


location_data.columns
```

```
location_data[['location_name', 'location_type']]

# looks like admin0 is country-level


location_data.query("location_type == 'admin0'")[['location_name', 'location_type']]

# looks like admin0 is country-level


# merge location_metadata onto the final index dataframe to get lcoation names and iso3 codes

reui = pd.merge(reui, location_data[['location_id', 'location_name', 'ihme_loc_id', 'location_type']], on=['location_id'])


rfi = reui[['location_id', 'location_name', 'ihme_loc_id', 'year_id', 'age_group_id', 'sex_id']].copy()


for i in range(1000):

    # cap mins and maxes at the percentile draw level

    logged_draw = np.log(reui['ui_{}'.format(i)])

    minimum = np.percentile(np.log(reui.query("location_type == 'admin0'")['ui_{}'.format(i)]), 1) # referenced documnetation on numpy.percentile -- https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.percentile.html

    maximum = np.percentile(np.log(reui.query("location_type == 'admin0'")['ui_{}'.format(i)]), 99) # referenced documnetation on numpy.percentile -- https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.percentile.html

    logged_draw = np.where(logged_draw <= maximum, logged_draw, maximum) # referenced documentation on numpy.where -- https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.where.html

    logged_draw = np.where(logged_draw >= minimum, logged_draw, minimum) # referenced documentation on numpy.where -- https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.where.html

    rfi['fi_{}'.format(i)] = (1 - ((logged_draw - minimum) / (maximum - minimum))) * 100


### Now put together estimates for composition of re index


reui.head()
```

```
composition_df = reui[['location_id', 'year_id']].copy()


# for i in range(1000):

#     composition_df['prop_moderate_{}'.format(i)] = reui['moderate_{}'.format(i)].values / reui['ui_{}'.format(i)].values

#     composition_df['prop_severe_{}'.format(i)] = reui['severe_{}'.format(i)].values / reui['ui_{}'.format(i)].values

#     composition_df['prop_blind_{}'.format(i)] = reui['blind_{}'.format(i)].values / reui['ui_{}'.format(i)].values


# composition_df.head()


for i in range(1000):

    composition_df['prop_moderate_{}'.format(i)] = reui['moderate_{}'.format(i)].values

    composition_df['prop_severe_{}'.format(i)] = reui['severe_{}'.format(i)].values

    composition_df['prop_blind_{}'.format(i)] = reui['blind_{}'.format(i)].values


composition_df.head()


# sort composition df


# merge location_metadata onto the final index dataframe to get lcoation names and iso3 codes

composition_df = pd.merge(composition_df, location_data[['location_id', 'location_name', 'ihme_loc_id', 'location_type', 'region_name', 'super_region_name']], on=['location_id'])


comp_global = composition_df.query("location_name == 'Global'").copy()


comp_global


globalest = composition_df.query("location_name == 'Global'").copy()

df = composition_df.query("location_name != 'Global'").copy()
```

```
super_region_values = df.super_region_name.unique()
region_values = df.region_name.unique()

all_regions = pd.DataFrame()
for r in region_values:
    if r == None:
        continue
    region = df.query("region_name == @r and location_name== @r").copy()
    non_region = df.query("region_name == @r and location_name != @r").copy()
    non_region = non_region.sort_values(['location_name', 'year_id'])
    region = region.append(non_region)
    all_regions = all_regions.append(region)

all_super_regions = pd.DataFrame()
for sr in super_region_values:
    super_region = df.query("location_name == @sr").copy()
    non_sr = all_regions.query("super_region_name == @sr and location_name != @sr").copy()
    non_region = non_region.sort_values('region_name')
    super_region = super_region.append(non_sr)
    all_super_regions = all_super_regions.append(super_region)

final_ref_comp = globalest.append(all_super_regions)

final_ref_comp['mean_moderate'] = final_ref_comp[['prop_moderate_{}'.format(i) for i in
range(1000)]].mean(axis=1)
final_ref_comp['mean_severe'] = final_ref_comp[['prop_severe_{}'.format(i) for i in
range(1000)]].mean(axis=1)
final_ref_comp['mean_blind'] = final_ref_comp[['prop_blind_{}'.format(i) for i in
range(1000)]].mean(axis=1)
```

```
final_ref_comp['upper_moderate'] = final_ref_comp[['prop_moderate_{}'.format(i) for i in range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

final_ref_comp['upper_severe'] = final_ref_comp[['prop_severe_{}'.format(i) for i in range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

final_ref_comp['upper_blind'] = final_ref_comp[['prop_blind_{}'.format(i) for i in range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html


final_ref_comp['lower_moderate'] = final_ref_comp[['prop_moderate_{}'.format(i) for i in range(1000)]].quantile(q=.025, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

final_ref_comp['lower_severe'] = final_ref_comp[['prop_severe_{}'.format(i) for i in range(1000)]].quantile(q=.025, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

final_ref_comp['lower_blind'] = final_ref_comp[['prop_blind_{}'.format(i) for i in range(1000)]].quantile(q=.025, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html


final_ref_comp = final_ref_comp.query("location_id != 137")

final_ref_comp = final_ref_comp.query("location_id != 158")


final_ref_comp[['location_id', 'super_region_name', 'location_name', 'year_id', 'mean_moderate', 'lower_moderate', 'upper_moderate', 'mean_severe', 'lower_severe', 'upper_severe', 'mean_blind', 'lower_blind',
'upper_blind']].to_excel("/share/scratch/users/emumford/thesis/ref_error_composition.xlsx", index=False)


# STEP 3B: Create the cataract unscaled and scaled indexes


# need a few more ids, namely the cataract cause id, metric_id for percentage, and measure_id for YLDs

causes = get_ids("cause")


causes.query("cause_name == 'Cataract'")

# want cause id 671 for cataract
```

```
metrics = get_ids("metric")

metrics

# want to use metric_id 2


get_ids("measure")

# want to use measure_id 3


# TODO: Maybe get draws for attributable cataract instead of just means


# Risk-standardize the cataract estimates

# Referenced documentation -- http://dev-tomflem.ihme.washington.edu/docs/db_queries/current/get_outputs/intro.html

# Referenced documentation -- http://dev-tomflem.ihme.washington.edu/docs/db_queries/current/get_outputs/available.html#risk-factor-results

# Referenced documentation (to figure out if gbd_round_id was an arg) -- http://dev-tomflem.ihme.washington.edu/docs/db_queries/current/get_outputs/version.html

from db_queries import get_outputs

proportions = get_outputs("rei", cause_id=671, rei_id="risks", metric_id=2, measure_id=3, gbd_round_id=4, location_id=location_ids, sex_id=3, age_group_id=27, year_id=[1990, 1995, 2000, 2005, 2010, 2016])


proportions = proportions.query("rei_name == 'All risk factors'")


proportions.columns

# val is what we want


proportions['sd'] = (((proportions['val'] - proportions['lower']) + (proportions['upper'] - proportions['val'])) / 2) / 1.96


cat_blind = pd.merge(cat_blind, proportions[['location_id', 'year_id', 'sex_id', 'age_group_id', 'val', 'sd']], on=['location_id', 'year_id', 'sex_id', 'age_group_id'])
```

```
cat_sev = pd.merge(cat_sev, proportions[['location_id', 'year_id', 'sex_id', 'age_group_id', 'val', 'sd']], on=['location_id', 'year_id', 'sex_id', 'age_group_id'])

cat_mod = pd.merge(cat_mod, proportions[['location_id', 'year_id', 'sex_id', 'age_group_id', 'val', 'sd']], on=['location_id', 'year_id', 'sex_id', 'age_group_id'])


for i in range(1000):

    cat_blind['draw_{}'.format(i)] = cat_blind['draw_{}'.format(i)] * np.random.normal(loc=cat_blind['val'], scale=cat_blind['sd'])

    cat_sev['draw_{}'.format(i)] = cat_sev['draw_{}'.format(i)] * np.random.normal(loc=cat_sev['val'], scale=cat_sev['sd'])

    cat_mod['draw_{}'.format(i)] = cat_mod['draw_{}'.format(i)] * np.random.normal(loc=cat_mod['val'], scale=cat_mod['sd'])


# build indexes


for i in range(1000):

    cat_blind['blind_{}'.format(i)] = blind_dw['draw{}'.format(i)].values[0]  * cat_blind['draw_{}'.format(i)]

    cat_sev['severe_{}'.format(i)] = severe_dw['draw{}'.format(i)].values[0]  * cat_sev['draw_{}'.format(i)]

    cat_mod['moderate_{}'.format(i)] = moderate_dw['draw{}'.format(i)].values[0]  * cat_mod['draw_{}'.format(i)]


# merge it all together

cui = pd.merge(cat_blind, cat_sev, on=['location_id', 'year_id', 'sex_id','age_group_id'])

cui = pd.merge(cui, cat_mod, on=['location_id', 'year_id', 'sex_id','age_group_id'])


for i in range(1000):

    cui['ui_{}'.format(i)] = cui['blind_{}'.format(i)] + cui['severe_{}'.format(i)] + cui['moderate_{}'.format(i)]


# 0-100
```

```
# merge location_metadata onto the final index dataframe to get lcoation names and iso3 codes

cui = pd.merge(cui, location_data[['location_id', 'location_name', 'ihme_loc_id', 'location_type']], on=['location_id'])


cfi = cui[['location_id', 'location_name', 'ihme_loc_id', 'year_id', 'age_group_id', 'sex_id']].copy()


for i in range(1000):

    # cap mins and maxes at the percentile draw level

    logged_draw = np.log(cui['ui_{}'.format(i)])

    minimum = np.percentile(np.log(cui.query("'location_type == 'admin0'")['ui_{}'.format(i)]), 1) # referenced documnetation on numpy.percentile -- https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.percentile.html

    maximum = np.percentile(np.log(cui.query("'location_type == 'admin0'")['ui_{}'.format(i)]), 99) # referenced documnetation on numpy.percentile -- https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.percentile.html

    logged_draw = np.where(logged_draw <= maximum, logged_draw, maximum) # referenced documentation on numpy.where -- https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.where.html

    logged_draw = np.where(logged_draw >= minimum, logged_draw, minimum) # referenced documentation on numpy.where -- https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.where.html

    cfi['fi_{}'.format(i)] = (1 - ((logged_draw - minimum) / (maximum - minimum))) * 100


# STEP 4: now make the AVLI


merged = pd.merge(cui, reui, on=['location_id', 'location_name', 'ihme_loc_id', 'location_type', 'year_id', 'sex_id', 'age_group_id'])


uavli = merged[['location_id', 'location_name', 'ihme_loc_id', 'location_type', 'year_id', 'sex_id', 'age_group_id']].copy()


for i in range(1000):

    uavli['ui_{}'.format(i)] = merged['ui_{}_y'.format(i)] + merged['ui_{}_x'.format(i)]
```

```
avli = uavli[['location_id', 'location_name', 'location_type', 'ihme_loc_id', 'year_id', 'age_group_id', 'sex_id']].copy()


for i in range(1000):
    # cap mins and maxes at the percentile draw level
    logged_draw = np.log(uavli['ui_{}'.format(i)])
    minimum = np.percentile(np.log(uavli.query("location_type == 'admin0'")['ui_{}'.format(i)]), 1) # referenced documnetation on numpy.percentile -- https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.percentile.html
    maximum = np.percentile(np.log(uavli.query("location_type == 'admin0'")['ui_{}'.format(i)]), 99) # referenced documnetation on numpy.percentile -- https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.percentile.html
    logged_draw = np.where(logged_draw <= maximum, logged_draw, maximum) # referenced documentation on numpy.where -- https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.where.html
    logged_draw = np.where(logged_draw >= minimum, logged_draw, minimum) # referenced documentation on numpy.where -- https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.where.html
    avli['fi_{}'.format(i)] = (1 - ((logged_draw - minimum) / (maximum - minimum))) * 100


# STEP 5: get means, uppers, lowers, and the output csvs


# get means, uppers, lowers
cfi['mean'] = cfi[['fi_{}'.format(i) for i in range(1000)]].mean(axis=1)
rfi['mean'] = rfi[['fi_{}'.format(i) for i in range(1000)]].mean(axis=1)
avli['mean'] = avli[['fi_{}'.format(i) for i in range(1000)]].mean(axis=1)


cfi['upper'] = cfi[['fi_{}'.format(i) for i in range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html
rfi['upper'] = rfi[['fi_{}'.format(i) for i in range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html
```

```
avli['upper'] = avli[['fi_{}'.format(i) for i in range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html


cfi['lower'] = cfi[['fi_{}'.format(i) for i in range(1000)]].quantile(q=.025, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

rfi['lower'] = rfi[['fi_{}'.format(i) for i in range(1000)]].quantile(q=.025, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

avli['lower'] = avli[['fi_{}'.format(i) for i in range(1000)]].quantile(q=.025, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html


cfi_global = cfi.query("location_name == 'Global'").copy()

rfi_global = rfi.query("location_name == 'Global'").copy()

avli_global = avli.query("location_name == 'Global'").copy()


pre_sorted_dfs = {'cfi': cfi, 'rfi': rfi, 'avli': avli}

final_output_dfs = {}

for name, df in pre_sorted_dfs.items():


    globalest = df.query("location_name == 'Global'").copy()

    df = df.query("location_name != 'Global'").copy()


    df = pd.merge(df, location_data[['ihme_loc_id', 'super_region_name', 'region_name']], on=['ihme_loc_id'])


    super_region_values = df.super_region_name.unique()

    region_values = df.region_name.unique()


    all_regions = pd.DataFrame()

    for r in region_values:
```

```
        if r == None:
            continue
        region = df.query("region_name == @r and location_name== @r").copy()
        non_region = df.query("region_name == @r and location_name != @r").copy()
        non_region = non_region.sort_values(['location_name', 'year_id'])
        region = region.append(non_region)
        all_regions = all_regions.append(region)

    all_super_regions = pd.DataFrame()
    for sr in super_region_values:
        super_region = df.query("location_name == @sr").copy()
        non_sr = all_regions.query("super_region_name == @sr and location_name != @sr").copy()
        non_region = non_region.sort_values('region_name')
        super_region = super_region.append(non_sr)
        all_super_regions = all_super_regions.append(super_region)

    final_output_dfs[name] = globalest.append(all_super_regions)

final_output_dfs['cfi'] = final_output_dfs['cfi'].query("location_id != 137")
final_output_dfs['cfi'] = final_output_dfs['cfi'].query("location_id != 158")
final_output_dfs['cfi'].to_excel("/share/scratch/users/emumford/thesis/cataract_final_index.xlsx",
index=False)
final_output_dfs['rfi'] = final_output_dfs['rfi'].query("location_id != 137")
final_output_dfs['rfi'] = final_output_dfs['rfi'].query("location_id != 158")
final_output_dfs['rfi'].to_excel("/share/scratch/users/emumford/thesis/uncorrected_refractive_error_final_
index.xlsx", index=False)
final_output_dfs['avli'] = final_output_dfs['avli'].query("location_id != 137")
final_output_dfs['avli'] = final_output_dfs['avli'].query("location_id != 158")
final_output_dfs['avli'].to_excel("/share/scratch/users/emumford/thesis/avli_final_index.xlsx",
index=False)
```

```
final_output_dfs['cfi'].query("year_id == 2016").sort_values('cfi_mean')


# STEP 6: Pull SDI and Merge


# only need mean avli means for sdi / avli scatters

avli = final_output_dfs['avli'].copy()

avli = avli[['location_id', 'ihme_loc_id', 'location_name', 'location_type', 'super_region_name', 'year_id', 'sex_id', 'age_group_id', 'mean']]


# pull sdi

# first get sdi covariate id

covs = get_ids("covariate")

covs[covs['covariate_name'].str.contains('demo')] # referenced answer by Garrett (edited by hlin777) to figure out how to select refractive error from larger df... https://stackoverflow.com/questions/11350770/pandas-dataframe-select-by-partial-string

# SDI is covariate id 881


# next pull the covariate from get_covariates

from db_queries import get_covariate_estimates

# Referenced the docs -- # http://dev-tomflem.ihme.washington.edu/docs/db_queries/current/db_queries.html#db_queries.get_covariate_estimates.get_covariate_estimates

sdi = get_covariate_estimates(covariate_id=881, location_id = location_ids, sex_id=3, age_group_id=22, gbd_round_id=4)


avli.head()


scatter_data = pd.merge(avli, sdi[['location_id', 'year_id', 'sex_id', 'mean_value']], on=['location_id', 'year_id', 'sex_id'])


# make a "region" column for the upcoming map

scatter_data['region'] = scatter_data['location_name']
```

```
scatter_data.loc[scatter_data.location_name == "Federated States of Micronesia", "region"] =
"Micronesia"

scatter_data.loc[scatter_data.location_name == "Russian Federation", "region"] = "Russia"

scatter_data.loc[scatter_data.location_name == "Trinidad and Tobago", "region"] = "Tobago"

trinidad = scatter_data.query("location_name == 'Trinidad and Tobago'").copy()

trinidad['region'] = "Trinidad"

scatter_data = scatter_data.append(trinidad)

scatter_data.loc[scatter_data.location_name == "Congo", "region"] = "Republic of Congo"

scatter_data.loc[scatter_data.location_name == "Saint Vincent and the Grenadines", "region"] = "Saint
Vincent"

grenadines = scatter_data.query("location_name == 'Saint Vincent and the Grenadines'").copy()

grenadines['region'] = "Grenadines"

scatter_data = scatter_data.append(grenadines)

scatter_data.loc[scatter_data.location_name == "United Kingdom", "region"] = "UK"

scatter_data.loc[scatter_data.location_name == "Cote d'Ivoire", "region"] = "Ivory Coast"

scatter_data.loc[scatter_data.location_name == "The Bahamas", "region"] = "Bahamas"
```

```
scatter_data.loc[scatter_data.location_name == "United States", "region"] = "USA"

scatter_data.loc[scatter_data.location_name == "The Gambia", "region"] = "Gambia"

scatter_data.loc[scatter_data.location_name == "Antigua and Barbuda", "region"] = "Antigua"

barbuda = scatter_data.query("location_name == 'Antigua and Barbuda'").copy()

barbuda['region'] = "Barbuda"

scatter_data = scatter_data.append(barbuda)

final_output_dfs['cfi']['cfi_mean'] = final_output_dfs['cfi']['mean']
final_output_dfs['rfi']['rfi_mean'] = final_output_dfs['rfi']['mean']

scatter_data = pd.merge(scatter_data, final_output_dfs['cfi'][['location_id', 'year_id', 'cfi_mean']],
on=['location_id', 'year_id'])
scatter_data = pd.merge(scatter_data, final_output_dfs['rfi'][['location_id', 'year_id', 'rfi_mean']],
on=['location_id', 'year_id'])

scatter_data = scatter_data.query("location_id != 137")
scatter_data = scatter_data.query("location_id != 158")
scatter_data.to_excel("/share/scratch/users/emumford/thesis/avli_sdi_scatter_data.xlsx", index=False)

# STEP 7: Calculate percent changes

old = final_output_dfs['avli'].query("year_id == 1990").copy()

old = pd.merge(old, final_output_dfs['cfi'], on=['location_id', 'year_id', 'sex_id', 'age_group_id'],
suffixes=['_avli', '_ci'])
```

```
old = pd.merge(old, final_output_dfs['rfi'], on=['location_id', 'year_id', 'sex_id', 'age_group_id'], suffixes=['_avli', '_rfi'])


new = final_output_dfs['avli'].query("year_id == 2016").copy()


new = pd.merge(new, final_output_dfs['cfi'], on=['location_id', 'year_id', 'sex_id', 'age_group_id'], suffixes=['_avli', '_ci'])


new = pd.merge(new, final_output_dfs['rfi'], on=['location_id', 'year_id', 'sex_id', 'age_group_id'], suffixes=['_avli', '_rfi'])


pct_changes = pd.merge(old, new, on='location_id', suffixes=['_old', '_new'])


for i in range(1000):
    pct_changes['avli_{}'.format(i)] = ((pct_changes['fi_{}_avli_new'.format(i)] - pct_changes['fi_{}_avli_old'.format(i)]) / pct_changes['fi_{}_avli_old'.format(i)])
    pct_changes['ci_{}'.format(i)] = ((pct_changes['fi_{}_ci_new'.format(i)] - pct_changes['fi_{}_ci_old'.format(i)]) / pct_changes['fi_{}_ci_old'.format(i)])
    pct_changes['ri_{}'.format(i)] = ((pct_changes['fi_{}_new'.format(i)] - pct_changes['fi_{}_old'.format(i)]) / pct_changes['fi_{}_old'.format(i)])
    pct_changes['avli_ab_{}'.format(i)] = pct_changes['fi_{}_avli_new'.format(i)] - pct_changes['fi_{}_avli_old'.format(i)]
    pct_changes['ci_ab_{}'.format(i)] = pct_changes['fi_{}_ci_new'.format(i)] - pct_changes['fi_{}_ci_old'.format(i)]
    pct_changes['ri_ab_{}'.format(i)] = pct_changes['fi_{}_new'.format(i)] - pct_changes['fi_{}_old'.format(i)]


pct_changes['avli_mean'] = pct_changes[['avli_{}'.format(i) for i in range(1000)]].mean(axis=1)
pct_changes['ri_mean'] = pct_changes[['ri_{}'.format(i) for i in range(1000)]].mean(axis=1)
pct_changes['ci_mean'] = pct_changes[['ci_{}'.format(i) for i in range(1000)]].mean(axis=1)
pct_changes['avli_ab_mean'] = pct_changes[['avli_ab_{}'.format(i) for i in range(1000)]].mean(axis=1)
pct_changes['ri_ab_mean'] = pct_changes[['ri_ab_{}'.format(i) for i in range(1000)]].mean(axis=1)
pct_changes['ci_ab_mean'] = pct_changes[['ci_ab_{}'.format(i) for i in range(1000)]].mean(axis=1)
```

```
pct_changes['upper_avli'] = pct_changes[['avli_{}'.format(i) for i in range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

pct_changes['upper_ri'] = pct_changes[['ri_{}'.format(i) for i in range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

pct_changes['upper_ci'] = pct_changes[['ci_{}'.format(i) for i in range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

pct_changes['upper_ab_avli'] = pct_changes[['avli_ab_{}'.format(i) for i in range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

pct_changes['upper_ab_ri'] = pct_changes[['ri_ab_{}'.format(i) for i in range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

pct_changes['upper_ab_ci'] = pct_changes[['ci_ab_{}'.format(i) for i in range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html


pct_changes['lower_avli'] = pct_changes[['avli_{}'.format(i) for i in range(1000)]].quantile(q=.025, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

pct_changes['lower_ri'] = pct_changes[['ri_{}'.format(i) for i in range(1000)]].quantile(q=.025, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

pct_changes['lower_ci'] = pct_changes[['ci_{}'.format(i) for i in range(1000)]].quantile(q=.025, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

pct_changes['lower_ab_avli'] = pct_changes[['avli_ab_{}'.format(i) for i in range(1000)]].quantile(q=.025, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

pct_changes['lower_ab_ri'] = pct_changes[['ri_ab_{}'.format(i) for i in range(1000)]].quantile(q=.025, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

pct_changes['lower_ab_ci'] = pct_changes[['ci_ab_{}'.format(i) for i in range(1000)]].quantile(q=.025, axis=1) # Referenced documentation on pandas.quatntile -- https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html
```

```
pct_changes.query("location_name_new == 'Syria'")[['ri_{}'.format(i) for i in
range(1000)]].quantile(q=.975, axis=1) # Referenced documentation on pandas.quatntile --
https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html


pct_changes = pct_changes[['location_id', 'location_name_new', 'avli_mean', 'avli_ab_mean', 'ri_mean',
'ri_ab_mean', 'ci_mean', 'ci_ab_mean', 'upper_avli', 'upper_ab_avli', 'upper_ri', 'upper_ab_ri', 'upper_ci',
'upper_ab_ci', 'lower_avli', 'lower_ab_avli', 'lower_ri', 'lower_ab_ri', 'lower_ci', 'lower_ab_ci']]


scatter_data_old = scatter_data.query("year_id == 1990")

scatter_data_new = scatter_data.query("year_id == 2016")

scatter_chng = pd.merge(scatter_data_old, scatter_data_new[['location_id', 'mean_value']],
on='location_id', suffixes=['_old', '_new'])


scatter_chng['Mean % Change SDI'] = ((scatter_chng['mean_value_new'] -
scatter_chng['mean_value_old']) / scatter_chng['mean_value_old'])

scatter_chng['Absolute Change SDI'] = scatter_chng['mean_value_new'] - scatter_chng['mean_value_old']


pct_changes = pd.merge(pct_changes, scatter_chng, on='location_id')


pct_changes = pd.merge(pct_changes, location_data[['location_id', 'region_name']], on=['location_id'])


pct_changes.location_type.unique()


pre_sorted_dfs = {}

pre_sorted_dfs = {'pct_changes': pct_changes}

pct = {}

for name, df in pre_sorted_dfs.items():


    globalest = df.query("location_name == 'Global'").copy()

    df = df.query("location_name != 'Global'").copy()


    super_region_values = df.super_region_name.unique()
```

```
    region_values = df.region_name.unique()

    all_regions = pd.DataFrame()
    for r in region_values:
        if r == None:
            continue
        region = df.query("region_name == @r and location_name== @r").copy()
        non_region = df.query("region_name == @r and location_name != @r").copy()
        non_region = non_region.sort_values(['location_name', 'year_id'])
        region = region.append(non_region)
        all_regions = all_regions.append(region)

    all_super_regions = pd.DataFrame()
    for sr in super_region_values:
        super_region = df.query("location_name == @sr").copy()
        non_sr = all_regions.query("super_region_name == @sr and location_name != @sr").copy()
        non_region = non_region.sort_values('region_name')
        super_region = super_region.append(non_sr)
        all_super_regions = all_super_regions.append(super_region)

    pct[name] = globalest.append(all_super_regions)

srr = pct['pct_changes'].query("location_type == 'superregion' or location_type == 'region' or
location_type=='global'").copy()

srr = srr.query("location_id != 137")
srr = srr.query("location_id != 158")
pct['pct_changes'] = pct['pct_changes'].query("location_id != 158")
pct['pct_changes'] = pct['pct_changes'].query("location_id != 137")
```

```
cols = ['location_name', 'Mean % Change SDI', 'avli_mean', 'avli_ab_mean', 'ri_mean', 'ri_ab_mean',
'ci_mean', 'ci_ab_mean', 'upper_avli', 'upper_ab_avli', 'upper_ri', 'upper_ab_ri', 'upper_ci', 'upper_ab_ci',
'lower_avli', 'lower_ab_avli', 'lower_ri', 'lower_ab_ri', 'lower_ci', 'lower_ab_ci', 'Absolute Change SDI']


srr[cols].to_excel("/share/scratch/users/emumford/thesis/pct_change_srr.xlsx", index=False)


srr[cols].to_excel("/share/scratch/users/emumford/thesis/abs_change_srr.xlsx", index=False)


pct['pct_changes'][cols].to_excel("/share/scratch/users/emumford/thesis/avli_sdi_pct_change.xlsx",
index=False)


pct['pct_changes'][cols].to_excel("/share/scratch/users/emumford/thesis/avli_sdi_abs_change.xlsx",
index=False)


# take a look at subnationals

final_output_dfs['avli'][final_output_dfs['avli']['ihme_loc_id'].str.contains("JPN")].query("year_id ==
2016").sort_values('mean') # referenced answer by Garrett (edited by hlin777) to figure out how to select
refractive error from larger df... https://stackoverflow.com/questions/11350770/pandas-dataframe-select-
by-partial-string


final_output_dfs['avli'][final_output_dfs['avli']['ihme_loc_id'].str.contains("MEX")].query("year_id ==
2016").sort_values('mean') # referenced answer by Garrett (edited by hlin777) to figure out how to select
refractive error from larger df... https://stackoverflow.com/questions/11350770/pandas-dataframe-select-
by-partial-string


final_output_dfs['avli'][final_output_dfs['avli']['ihme_loc_id'].str.contains("USA")].query("year_id ==
2016").sort_values('mean') # referenced answer by Garrett (edited by hlin777) to figure out how to select
refractive error from larger df... https://stackoverflow.com/questions/11350770/pandas-dataframe-select-
by-partial-string


final_output_dfs['avli'][final_output_dfs['avli']['ihme_loc_id'].str.contains("GBR")].query("year_id ==
2016").sort_values('mean') # referenced answer by Garrett (edited by hlin777) to figure out how to select
refractive error from larger df... https://stackoverflow.com/questions/11350770/pandas-dataframe-select-
by-partial-string
```

final_output_dfs['avli'][final_output_dfs['avli']['ihme_loc_id'].str.contains("BRA")].query("year_id == 2016").sort_values('mean') # referenced answer by Garrett (edited by hlin777) to figure out how to select refractive error from larger df... https://stackoverflow.com/questions/11350770/pandas-dataframe-select-by-partial-string

STEP 8: Make a few changes for second full draft

Make a scatter of HAQ vs AVLI in 2016

pull haq

first get haq covariate id

covs[covs['covariate_name'].str.contains('access')] # referenced answer by Garrett (edited by hlin777) to figure out how to select refractive error from larger df... https://stackoverflow.com/questions/11350770/pandas-dataframe-select-by-partial-string

HAQ is covariate id 1099

Referenced the docs -- # http://dev-tomflem.ihme.washington.edu/docs/db_queries/current/db_queries.html#db_queries.get_covariate_estimates.get_covariate_estimates

haq = get_covariate_estimates(covariate_id=1099, location_id = location_ids, sex_id=3, age_group_id=22, gbd_round_id=4)

haq.head()

haq.rename(columns={'mean_value': 'mean_haq'}, inplace=True)

haq.head()

read in scatter data

haq_avli_scatter = pd.read_excel(FILENAME)

haq_avli_scatter.head()

```
haq_avli_scatter_final = pd.merge(haq[['location_id', 'year_id', 'mean_haq']], haq_avli_scatter,
on=['location_id', 'year_id'])


haq_avli_scatter_final = haq_avli_scatter_final.query("year_id == 2016")


haq_avli_scatter_final.head()


# write to csv for scattering

haq_avli_scatter_final.to_excel("/share/scratch/users/emumford/thesis/avli_haq_scatter_data.xlsx",
index=False)


## Make a scatter of SDI % change vs AVLI % change


avli_sdi_pct_change_scatter = pd.read_excel(FILENAME)


avli_sdi_pct_change_scatter.head()


avli_sdi_pct_change_scatter.columns


avli_sdi_pct_change_scatter['mean_change_sdi'] = avli_sdi_pct_change_scatter['Mean % Change SDI']


avli_sdi_pct_change_scatter[['location_name', 'mean_change_sdi',
'avli_mean']].to_excel("/share/scratch/users/emumford/thesis/pct_change_scatter_data.xlsx",
index=False)


avli_sdi_pct_change_scatter['mean_abs_change_sdi'] = avli_sdi_pct_change_scatter['Absolute Change
SDI']


# merge super region onto the df for the scatter
```

avli_sdi_pct_change_scatter[['location_name', 'mean_abs_change_sdi', 'avli_ab_mean']].to_excel("/share/scratch/users/emumford/thesis/abs_change_scatter_data.xlsx", index=False)

Bibliography

db_queries [Internet]. Seattle, WA, Institute for Health Metrics and Evaluation, University of Washington: Institute for Health Metrics and Evaluation; 2018. Detail on the software here: http://dev-tomflem.ihme.washington.edu/docs/db_queries/current/setup.html. db_queries is a python package. db_queries is an internal tool for accessing data used at the Institute for Health Metrics and Evaluation. Used version 16.5.0 in code.

db_queries package — db_queries 16.5.0 documentation [Internet]. [cited 2018 Aug 11]. Available from: http://dev-tomflem.ihme.washington.edu/docs/db_queries/current/db_queries.html#db_queries.get_covariate_estimates.get_covariate_estimates

get_draws [Internet]. Seattle, WA, Institute for Health Metrics and Evaluation, University of Washington: Institute for Health Metrics and Evaluation; 2018 [cited 2018 Aug 9]. Detail on the software here: http://dev-tomflem.ihme.washington.edu/docs/get_draws/current/api.html. get_draws is a python package. Used version 0.0.17 in code. get_draws is an internal tool for accessing data used at the Institute for Health Metrics and Evaluation.

get_draws package — get_draws 0.0.17 documentation [Internet]. [cited 2018 Aug 10]. Available from: http://dev-tomflem.ihme.washington.edu/docs/get_draws/current/get_draws.html#module-get_draws. get_draws is a python package. Used version 0.0.17 in code. get_draws is an internal tool for accessing data used at the Institute for Health Metrics and Evaluation.

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Introduction to retrieving outputs from the gbd database — db_queries 16.5.0 documentation [Internet]. [cited 2018 Aug 10]. Available from: http://dev-tomflem.ihme.washington.edu/docs/db_queries/current/get_outputs/intro.html. get_outputs is part of the

db_queries package. db_queries is a python package. db_queries is an internal tool for accessing data used at the Institute for Health Metrics and Evaluation. Used version 16.5.0 in code.

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numpy.where — NumPy v1.14 Manual [Internet]. [cited 2018 Aug 10]. Available from: https://docs.scipy.org/doc/numpy-1.14.0/reference/generated/numpy.where.html

pandas [Internet]. Detail on the software here: https://pandas.pydata.org/. pandas is a python package. Used version 0.20.3 in code.

pandas.DataFrame.quantile — pandas 0.23.4 documentation [Internet]. [cited 2018 Aug 10]. Available from: https://pandas.pydata.org/pandas-docs/stable/generated/pandas.DataFrame.quantile.html

Username “euforia,” Username “piRSquared,” Username “Garrett”, Username “hlin117.” pandas + dataframe - select by partial string [Internet]. stackoverflow. 2015 [cited 2018 Jun 28]. Available from: https://stackoverflow.com/questions/11350770/pandas-dataframe-select-by-partial-string. Referenced the answer by user which was Garret, which was edited by hlin177. The question posted on 7.5.2012 by euforia. The question was edited on 1.4.2017 by piRSquared. The referenced answer was posted on 7.12.2017 and edited on 10.7.2015

Username “tarabyte,” Username “jkukul,” Username “alko”, Username “waterproof.” How to check version of python modules? [Internet]. Stack Overflow. 2018 [cited 2018 Aug 10]. Available from:

https://stackoverflow.com/questions/20180543/how-to-check-version-of-python-modules. Referenced the answer posted by alko and amended by waterproof. Question originally posted on Nov 24, 2013 by tarabyte. Amended Jul 28, 2017 by jkukul. Referenced answer originally posted on Nov 24, 2013. Answer amended May 13. 2018.

Version arguments — db_queries 16.5.0 documentation [Internet]. [cited 2018 Aug 10]. Available from: http://dev-tomflem.ihme.washington.edu/docs/db_queries/current/get_outputs/version.html. get_outputs is part of the db_queries package. db_queries is a python package. db_queries is an internal tool for accessing data used at the Institute for Health Metrics and Evaluation. Used version 16.5.0 in code.

What is available — db_queries 16.5.0 documentation [Internet]. [cited 2018 Aug 10]. Available from: http://dev-tomflem.ihme.washington.edu/docs/db_queries/current/get_outputs/available.html#risk-factor-results. get_outputs is part of the db_queries package. db_queries is a python package. db_queries is an internal tool for accessing data used at the Institute for Health Metrics and Evaluation. Used version 16.5.0 in code.

Appendix 5B— Plotting code

```
################################################################################################
###

# Thesis figures

# John Everett Mumford

# The purpose of this script is to make figures and maps

################################################################################################
###

## load required packages

require(ggplot2)

#install.packages("ggrepel")

require(ggrepel)

require(grid)

require(dplyr)

# install.packages("maps")

require(maps)

# install.packages("mapproj")

require(mapproj)
```

```
## load data

scatter_data <- read.csv(FILENAME)

# scatter_data <- subset(scatter_data, super_region_name != "")

scatter2016 <- subset(scatter_data, year_id==2016)

# decided to use all locations, so country_only actually has all locations

country_only <- scatter2016


## Scatter AVLI and SDI

# first country only

cplot <- ggplot(country_only, aes(x=mean_value, y=mean)) # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot


interesting_points <- c("Burundi", "South Sudan", "Niger", "Haiti", "Zambia", "North Korea", "Myanmar", "Egypt",

                        "Barbados", "Sweden", "Timor-Leste", "Cambodia", "Somalia", "Greenland", "Bangladesh", "Kuwait",

                        "Somalia", "Taiwan", "Lithuania", "United States", "Uganda", "Central African Republiic",

                        "Mali", "Afghanistan", "Benin", "Burkina Faso", "Barbados",

                        "Belize", "India", "Global", "South Asia", "High-income North America") # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot


# get the r-squared

summary(lm(mean~mean_value, data=country_only))$r.squared # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

# [1] 0.3995141


cplot + geom_point(aes(color=super_region_name)) + geom_smooth(mapping = aes(linetype="r-squared = .4"), method="lm", formula = y~x, se=FALSE) +
```

```
  geom_text_repel(aes(label=location_name), data=(subset(country_only, location_name %in% interesting_points)),force=3) +

  scale_linetype(name="") + ggtitle("Amenable Vision Loss Index versus Socio-demographic Index, 2016") +

  scale_x_continuous(name="Socio-demographic Index") + scale_y_continuous(name="Amenable Vision Loss Index") # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot


# get the r-squared

summary(lm(rfi_mean~mean_value, data=country_only))$r.squared # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

# [1] 0.2071045


re_interesting_points <- c("Burundi", "South Sudan", "Niger", "Haiti", "Zambia", "North Korea", "Myanmar", "Egypt",

                           "Barbados", "Sweden", "Timor-Leste", "Cambodia", "Somalia", "Greenland", "Bangladesh", "Kuwait",

                           "Somalia", "Taiwan", "Denmark", "Lithuania", "United States", "Uganda", "Central African Republiic",

                           "Mali", "Afghanistan", "Benin", "Burkina Faso", "Greater London", "Luxembourg", "Barbados", "Thailand",

                           "Belize", "India", "Global", "South Asia")# Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot


rplot <- ggplot(country_only, aes(x=mean_value, y=rfi_mean)) # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot


rplot + geom_point(aes(color=super_region_name)) + geom_smooth(mapping = aes(linetype="r-squared = .21"), method="lm", formula = y~x, se=FALSE) +

  geom_text_repel(aes(label=location_name), data=(subset(country_only, location_name %in% interesting_points)),force=3) +
```

scale_linetype(name="") + ggtitle("Uncorrected Refractive Error Index versus Socio-demographic Index, 2016") +

scale_x_continuous(name="Socio-demographic Index") + scale_y_continuous(name="Uncorrected Refractive Error Index") # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

summary(lm(cfi_mean~mean_value, data=country_only))$r.squared # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

 # [1] 0.6695005

cat_points <- c("Burundi", "South Sudan", "Niger", "Haiti", "Zambia", "North Korea", "Myanmar", "Egypt",

"Barbados", "Cambodia", "Somalia", "Greenland", "Bangladesh", "Kuwait",

"Somalia", "Lithuania", "Uganda", "Central African Republiic",

"Mali", "Afghanistan", "Benin", "Burkina Faso", "Barbados",

"Belize", "India", "Global", "Western Sub-Saharan Africa", "High-income North America") # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

catplot <- ggplot(country_only, aes(x=mean_value, y=cfi_mean)) # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

catplot + geom_point(aes(color=super_region_name)) + geom_smooth(mapping = aes(linetype="r-squared = .67"), method="lm", formula = y~x, se=FALSE) +

geom_text_repel(aes(label=location_name), data=(subset(country_only, location_name %in% cat_points)),force=3) +

scale_linetype(name="") + ggtitle("Cataract Index versus Socio-demographic Index, 2016") +

scale_x_continuous(name="Socio-demographic Index") + scale_y_continuous(name="Cataract Index") # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

Map of AVLI

world_map <- map_data('world') # Referenced StackOverflow answer by hrbmster (located here: https://stackoverflow.com/questions/30706124/ploting-the-world-map-in-r) to make map plots

world_map <- subset(world_map, region != "Antarctica") # Referenced StackOverflow answer by hrbmster (located here: https://stackoverflow.com/questions/30706124/ploting-the-world-map-in-r) to make map plots

world_map <- fortify(world_map) # Referenced StackOverflow answer by hrbmster (located here: https://stackoverflow.com/questions/30706124/ploting-the-world-map-in-r) to make map plots

 # only look at sovereign nations

nonsov <- subset(country_only, location_type == 'nonsovereign')

nonsov$location_name

country_only <- subset(country_only, location_type=='admin0')

 # Kosovo is included as part of Serbia in GBD Compare (http://ihmeuw.org/4lib), so make a line for Kosovo being equal to Serbia

kosovo <- subset(country_only, location_name=='Serbia')

kosovo$region <- "Kosovo"

country_only <- rbind(country_only, kosovo)

 # FIXME: Make Canary Islands part of the Spain estimates (http://ihmeuw.org/4llt)

canary <- subset(country_only, location_name=='Spain')

canary$region <- "Canary Islands"

country_only <- rbind(country_only, canary)

not_joined <- anti_join(country_only, world_map, by="region") # Referenced join documentation -- located here: https://www.rdocumentation.org/packages/dplyr/versions/0.7.6/topics/join

not_joined2 <- anti_join(world_map, country_only, by="region") # Referenced join documentation -- located here: https://www.rdocumentation.org/packages/dplyr/versions/0.7.6/topics/join

sort(unique(not_joined2$region))

sort(not_joined$location_name)

subset(not_joined, location_type == 'admin0')

line above yields no rows, so none missing

used R to find where differences exist, but python script (data prep and analysis) to update the mapping data location names

 # GBD 2016 does not map Anguilla http://ihmeuw.org/4lig or:

 # Aruba -- http://ihmeuw.org/4lij

 # Saint Helena and Ascension Ilsand -- http://ihmeuw.org/4llo

 # Azores -- http://ihmeuw.org/4llp

 # Bonaire abd Curacao -- http://ihmeuw.org/4lmh

 # Canary Islands (INCLUDE IN MAP) -- http://ihmeuw.org/4llt

 # Cayman Islands -- http://ihmeuw.org/4llu

 # Chagos Archipelago -- http://ihmeuw.org/4llv

 # Christmas Island -- http://ihmeuw.org/4llw

 # Cocos Islands (Not eveon on the map) -- http://ihmeuw.org/4llx

 # Cook Islands -- http://ihmeuw.org/4lly

 # Wallis and Futuna -- http://ihmeuw.org/4llz

 # French Polynesia -- http://ihmeuw.org/4lm0

 # Pitcairn Islands -- http://ihmeuw.org/4lm1

 # Falkland Islands -- http://ihmeuw.org/4lm2

 # Faroe Islands -- http://ihmeuw.org/4lm3

 # French Guiana -- http://ihmeuw.org/4lm7

 # French Southern and Antarctic Lands and Heard Island -- http://ihmeuw.org/4lm8

 # Guadelope, Montserrat, Martinique, Saint Kitts, and Nevis-- http://ihmeuw.org/4lm9

 # Guernsey and Jersey -- http://ihmeuw.org/4lma

 # Isle of Man -- http://ihmeuw.org/4lmb

 # Liechtenstein -- http://ihmeuw.org/4lmc

 # Madeira Islands -- http://ihmeuw.org/4lmd

 # Mayotte -- http://ihmeuw.org/4lme

 # Monaco -- http://ihmeuw.org/4lmg

 # Nauru -- http://ihmeuw.org/4lmf

 # New Caledonia -- http://ihmeuw.org/4lmi

 # Niue -- http://ihmeuw.org/4lmj

 # Norfolk Island -- http://ihmeuw.org/4lml

 # Palau -- http://ihmeuw.org/4lmm

 # Reunion -- http://ihmeuw.org/4lmn

 # Saba -- http://ihmeuw.org/4lmo

 # Saint Barthelemy, Saint Martinm, and Sint Eustatius-- http://ihmeuw.org/4lmp

 # Saint Pierre and Miquelon -- http://ihmeuw.org/4lms

 # San Marino -- http://ihmeuw.org/4lmr

 # Siachen Glacier -- http://ihmeuw.org/4lmq (When I hover over, nothing pops up so just leaving blank)

 # Sint Maarten -- http://ihmeuw.org/4lmt

 # South Georgia and South Sandwich Islands -- http://ihmeuw.org/4lmu

 # Turks and Caicos -- http://ihmeuw.org/4lmv

 # Vatican -- http://ihmeuw.org/4lmw

 # Western Sahara -- http://ihmeuw.org/4lmx

ggplot() + geom_map(data=world_map, map=world_map, aes(x=long, y=lat, group=group, map_id=region), fill="white") +

geom_map(data=country_only, map=world_map, aes(fill=mean, map_id=region)) +

coord_map("rectangular", lat0=0, xlim=c(-180,180), ylim=c(-60,90)) +

labs(fill="Mean AVLI Score", title="Amenable Vision Loss Index, 2016", x="", y="") +

scale_x_continuous(breaks=c()) + scale_y_continuous(breaks=c()) # Referenced StackOverflow answer by hrbmster (located here: https://stackoverflow.com/questions/30706124/ploting-the-world-map-in-r) to make map plots

Map of REI

ggplot() + geom_map(data=world_map, map=world_map, aes(x=long, y=lat, group=group, map_id=region), fill="white") +

```
  geom_map(data=country_only, map=world_map, aes(fill=rfi_mean, map_id=region)) +
  coord_map("rectangular", lat0=0, xlim=c(-180,180), ylim=c(-60,90)) +
  labs(fill="Mean UREI Score", title="Uncorrected Refractive Error Index, 2016", x="", y="") +
  scale_x_continuous(breaks=c()) + scale_y_continuous(breaks=c()) # Referenced StackOverflow answer by hrbmster (located here: https://stackoverflow.com/questions/30706124/ploting-the-world-map-in-r) to make map plots


## Map of CI
ggplot() + geom_map(data=world_map, map=world_map, aes(x=long, y=lat, group=group, map_id=region), fill="white") +
  geom_map(data=country_only, map=world_map, aes(fill=cfi_mean, map_id=region)) +
  coord_map("rectangular", lat0=0, xlim=c(-180,180), ylim=c(-60,90)) +
  labs(fill="Mean CI Score", title="Cataract Index, 2016", x="", y="") +
  scale_x_continuous(breaks=c()) + scale_y_continuous(breaks=c()) # Referenced StackOverflow answer by hrbmster (located here: https://stackoverflow.com/questions/30706124/ploting-the-world-map-in-r) to make map plots


# Make 1990 maps (for the appendix)
scatter1990 <- subset(scatter_data, year_id==1990)
country_only1990 <- subset(scatter1990, location_type == "admin0")


# Kosovo is included as part of Serbia in GBD Compare (http://ihmeuw.org/4lib), so make a line for Kosovo being equal to Serbia
kosovo1990 <- subset(country_only1990, location_name=='Serbia')
kosovo1990$region <- "Kosovo"
country_only1990 <- rbind(country_only1990, kosovo)


# FIXME: Make Canary Islands part of the Spain estimates (http://ihmeuw.org/4llt)
canary1990 <- subset(country_only1990, location_name=='Spain')
canary1990$region <- "Canary Islands"
country_only1990 <- rbind(country_only1990, canary1990)
```

```
ggplot() + geom_map(data=world_map, map=world_map, aes(x=long, y=lat, group=group, map_id=region), fill="white") +
  geom_map(data=country_only1990, map=world_map, aes(fill=mean, map_id=region)) +
  coord_map("rectangular", lat0=0, xlim=c(-180,180), ylim=c(-60,90)) +
  labs(fill="Mean AVLI Score", title="Amenable Vision Loss Index, 1990", x="", y="") +
  scale_x_continuous(breaks=c()) + scale_y_continuous(breaks=c()) # Referenced StackOverflow answer by hrbmster (located here: https://stackoverflow.com/questions/30706124/ploting-the-world-map-in-r) to make map plots

## Map of REI

ggplot() + geom_map(data=world_map, map=world_map, aes(x=long, y=lat, group=group, map_id=region), fill="white") +
  geom_map(data=country_only1990, map=world_map, aes(fill=rfi_mean, map_id=region)) +
  coord_map("rectangular", lat0=0, xlim=c(-180,180), ylim=c(-60,90)) +
  labs(fill="Mean UREI Score", title="Uncorrected Refractive Error Index, 1990", x="", y="") +
  scale_x_continuous(breaks=c()) + scale_y_continuous(breaks=c()) # Referenced StackOverflow answer by hrbmster (located here: https://stackoverflow.com/questions/30706124/ploting-the-world-map-in-r) to make map plots

## Map of CI

ggplot() + geom_map(data=world_map, map=world_map, aes(x=long, y=lat, group=group, map_id=region), fill="white") +
  geom_map(data=country_only1990, map=world_map, aes(fill=cfi_mean, map_id=region)) +
  coord_map("rectangular", lat0=0, xlim=c(-180,180), ylim=c(-60,90)) +
  labs(fill="Mean CI Score", title="Cataract Index, 1990", x="", y="") +
  scale_x_continuous(breaks=c()) + scale_y_continuous(breaks=c()) # Referenced StackOverflow answer by hrbmster (located here: https://stackoverflow.com/questions/30706124/ploting-the-world-map-in-r) to make map plots

## For second draft of full thesis, addding 2 more scatters
```

First, HAQ and AVLI

haq_scatter_data <- read.csv(FILENAME)

haqscatter2016 <- subset(haq_scatter_data, year_id==2016)

Scatter AVLI and HAQ

haq_plot <- ggplot(haqscatter2016, aes(x=mean_haq, y=mean)) # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

interesting_points <- c("Burundi", "South Sudan", "Niger", "Haiti", "Zambia", "North Korea", "Myanmar", "Egypt",

"Barbados", "Sweden", "Timor-Leste", "Cambodia", "Somalia", "Greenland", "Bangladesh", "Kuwait",

"Somalia", "Taiwan", "Lithuania", "United States", "Uganda", "Central African Republiic",

"Mali", "Afghanistan", "Benin", "Burkina Faso", "Barbados",

"Belize", "India", "Global", "South Asia", "High-income North America") # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

 # get the r-squared

summary(lm(mean~mean_haq, data=haqscatter2016))$r.squared # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

 # [1] 0.3285396

haq_plot + geom_point(aes(color=super_region_name)) + geom_smooth(mapping = aes(linetype="r-squared = .33"), method="lm", formula = y~x, se=FALSE) +

geom_text_repel(aes(label=location_name), data=(subset(haqscatter2016, location_name %in% interesting_points)),force=3) +

scale_linetype(name="") + ggtitle("Amenable Vision Loss Index versus Healthcare Access and Quality Index, 2016") +

scale_x_continuous(name="HAQI") + scale_y_continuous(name="Amenable Vision Loss Index")# Referenced

https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

Second, HAQ and SDI Abs Changes

abs_change_data <- read.csv(FILENAME)

Scatter AVLI and HAQ

scatplot <- ggplot(abs_change_data, aes(x=mean_abs_change_sdi, y=avli_ab_mean)) # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

 # get the r-squared

summary(lm(avli_ab_mean~mean_abs_change_sdi, data=abs_change_data))$r.squared # Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

 # [1] 0.510475

scatplot + geom_point() + geom_smooth(mapping = aes(linetype="r-squared = .51"), method="lm", formula = y~x, se=FALSE) +

scale_linetype(name="") + ggtitle("Absolute Change in Amenable Vision Loss Index versus Absolute Change in SDI, 2016") +

scale_x_continuous(name="Abs. Change SDI") + scale_y_continuous(name="Abs. Change in AVLI")# Referenced https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment for help making this plot

Bibliography

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 1]. Available from: http://ihmeuw.org/4lib. Checked to see if Kosovo is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 1]. Available from: http://ihmeuw.org/4lig. Checked to see if Anguilla is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 1]. Available from: http://ihmeuw.org/4lij. Checked to see if Aruba is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4llo. Checked to see if Saint Helena and Ascension Ilsand are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4llp. Checked to see if Azores is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4llt. Checked to see if the Canary Islands are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4llu. Checked to see if the Cayman Islands are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4llv. Checked to see if the Chagos Archipelago is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4llw. Checked to see if the Christmas ISland is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4llx. Checked to see if the Cocos Islands are included in GBD for mapping purposes, but could not even find them on the map.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lly. Checked to see if the Cook Islands are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4llz. Checked to see if Wallis and Futuna is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lm0. Checked to see if French Polynesia is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lm1. Checked to see if Pitcairn Islands are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lm2. Checked to see if Falkland Islands are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lm3. Checked to see if Faroe Islands are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lm7. Checked to see if French Guiana is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lm8. Checked to see if French Southern and Antarctic Lands and Heard Island are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lm9. Checked to see if Guadelope, Montserrat, Martinique, Saint Kitts, and Nevis are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lma. Checked to see if Guernsey and Jersey are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmb. Checked to see if Isle of Man is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmc. Checked to see if Liechtenstein is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmd. Checked to see if Madeira Islands are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lme. Checked to see if Mayotte is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmf. Checked to see if Nauru is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmg. Checked to see if Monaco is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmh. Checked to see if Bonaire and Curacao are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmi. Checked to see if New Caledonia is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmj. Checked to see if Niue is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lml. Checked to see if Norfolk Island is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmm. Checked to see if Palau is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmn. Checked to see if Reunion is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmo. Checked to see if Saba is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmp. Checked to see if Saint Barthelemy, Saint Martin, and Sint Eustatius are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmq. Checked to see if Siachen Glacier is included in GBD for mapping purposes. While the area has the same color as Pakistan, no estimates pop up when I hover over, so leaving blank.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmr. Checked to see if San Marino is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lms. Checked to see if Saint Pierre and Miquelon is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmt. Checked to see if Sint Maarten is included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmu. Checked to see if South Georgia and South Sandwich Islands are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmv. Checked to see if Turks and Caicos Islands are included in GBD for mapping purposes.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmw. Checked to see if Vatican is included in GBD for mapping purposes. I could not see the Vatican on the map, probably since it is so small. I chose not to map it.

 # GBD Compare | IHME Viz Hub [Internet]. [cited 2018 Oct 3]. Available from: http://ihmeuw.org/4lmx. Checked to see if Western Sahara included in GBD for mapping purposes.

 # join function | R Documentation [Internet]. [cited 2018 Aug 13]. Available from: https://www.rdocumentation.org/packages/dplyr/versions/0.7.6/topics/join. dpylr package (developed by Hadley Wickham) documentation.

 # Mpizos Dimitris, hrbrmstr. ggplot2 - Ploting the world map in R [Internet]. Stack Overflow. 2015 [cited 2018 Aug 13]. Available from: https://stackoverflow.com/questions/30706124/ploting-the-world-map-in-r. Referenced the answer by user which was hrbrmstr. The question posted on 6.8.2015 by Mpizos Dimitris. The question was edited on 6.8.2015 by Mpizos Dimitris. The referenced answer was posted on 6.8.2015.

 # Points - geom_point . ggplot2 [Internet]. [cited 2018 Aug 12]. Available from: https://ggplot2.tidyverse.org/reference/geom_point.html

 # Rgraphics [Internet]. [cited 2018 Aug 13]. Available from: https://tutorials.iq.harvard.edu/R/Rgraphics/Rgraphics.html#aesthetic_mapping_vs_assignment