Population Division
Expert Group Meeting Report
ESA/P/WP/263
December 2020

United Nations expert group meeting on methods for World Population Prospects 2021 and beyond

(Virtual meeting)
New York, 6-8 April 2020

Report of the meeting

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patterns of mortality and fertility, and best practices for population revitalization and demographic balance.

This report summarizes the main points from each session, highlights cross-cutting themes and presents a set of recommendations. The materials from the expert group meeting can be accessed on the following web location: https://www.un.org/development/desa/pd/events/expert-group-meeting-methods-world-population-prospects-2021-and-beyond.

II. SUMMARY OF SESSIONS

A. WELCOME

Mr. John Wilmoth, Director of the Population Division (2016-2021) welcomed participants to the expert group meeting.

analysis, and to engage in greater interaction with national statistical authorities and other data producers and users. In the short term, the Division would produce "1x1" estimates and projections, streamline the use of the available information, ensure access to empirical data for some demographic components of population change (fertility, mortality) and achieve greater compliance with the GATHER framework.

o He also highlighted the limi (e)-1.7 (i)-4 (d)10.5 (t)-4.6 (he)9.2 iielnd uster (ho)10.ou(m)-4.6 (e)-1.7 ( )]TJ

five-year median. Alternatively, analysts could continue using the five-year model for estimation and projection and interpolate then each trajectory to obtain the annual time series, ensuring that the one-year medians and intervals would match five-year ones.

Ms. Ševčíková then turned to the work done on the R package *bayesLife*, which was being used to generate the projections for life expectancy at birth. This work was still under development. The current model would need to be modified including changes in the prior distribution of the two parameters maximum increment and long-term increment. There was still a need to assess whether the autocorrelation was captured correctly, whether uncertainty was underestimated, and whether the gap model should be revised. Ms. Ševčíková provided a solution similar to the one for the fertility model: instead of annual projections, each trajectory could be interpolated from the five-year model. She then considered the R package *bayesLifeHIV*, which was being developed for estimating and projecting life expectancy at birth within the context of the HIV epidemic. To continue her work, Ms. Ševčíková required annual data on past HIV prevalence, trajectories of future HIV prevalence for uncertainty assessment, and past and future anti-retroviral treatment (ART) coverage.

Ms. Ševčíková observed that the R package *MortCast*, used for estimating and projecting age-specific mortality rates, already had many functions which had been programmed to work with five-year age groups. It would be relatively easy to adjust those functions that did not yet work well with annual data, provided that additional data and information would be made available by the Division.

Ms. Ševčíková referred to the changes needed in the R package *bayesPop*, which was used for projecting the total population. Once the package *MortCast* had been updated, it would be relatively straightforward to produce "1x1" projections of total population. She underlined the need for different R packages to use similar code to compute the cohort-component method as well as for 1.(ce) . 1Tc pd TTc 0.0h2 Tc 6-

geographic levels. He

C. SESSION 2

1. Adult and old-age mortality: data evaluation and modelling for countries with deficient or no vital registration systems

tables. In cases of countries with high HIV prevalence, the S

the results from fitting the model with estimates of fertility patterns from surveys and observed that age 12 was the minimum age to estimate fertility rates using this method.

The second part of the presentation of Prof. Schoumaker focused on the estimation of fertility for ages 10 to 14 in developing countries with limited data available for these ages. Using birth histories

Ms. Cruz Castanheira confirmed that the estimates produced by CELADE were similar to those of WPP, but that for some countries, the projections produced by CELADE differed from those of WPP. Further clarification on the assistance work of CELADE to National Statistical Offices in the region was also provided. The estimates and projections prepared by CELADE are first produced based on 1x1 framework before computing 5x5 estimates and projections. In some cases, CELADE assisted countries in analyzing population data at the subnational level.

Ms. Nobuko Mizoguchi and Mr. Sean Fennell presented the experience of the Population Division of the United States Census Bureau in the field of population reconstruction and demographic balance as part of its international programme for training and statistical development. Ms. Mizoguchi introduced the Demographic Analysis and Population Projection System (DAPPS) software, a methodological tool developed to assist countries in the production and analysis of population projections. Work to implement DAPPS in R was in progress. Different features of DAPPS were presented, such as the ability to run annual single-age cohort-component population projections, options of data input and data output, as well as the capability to analyze fertility, mortality and migration data and store the results as future inputs for projections. The US Census Bureau had conducted training in over 70 countries. Some countries were using DAPPS to produce national
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improved method for reconstructing populations in the recent past. The objective of the method was to quantify uncertainty probabilistically, to estimate all parameters consistently, be easily replicable, and use all reliable data as well as expert opinion. Mr. Wheldon explained the four levels of the hierarchical model used to reconstruct population and demographic components to take account for several types of data, variance and measurement errors. This approach was considered most useful for countries with unreliable, fragmentary data (high uncertainty) but could also be applied to countries with very good data. The cases of Laos and New Zealand were presented to illustrate the application of the model. The results for these two countries were compared to WPP estimates in order to check their consistency. The outputs of the model provided a joint posterior distribution of the inputs and 95 per cent credible intervals for input parameters and the various output summary quantities. Mr. Wheldon observed that the computation speed for the Bayesian population reconstruction model to be used in WPP needed to be fast. This could be a challenge with single-year age and time. Mr. Wheldon stressed the need to expand the data collection to account for all the population censuses undertaken since 1950. Extensive testing would

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countries with limited or no data for time periods close to 1950. The Bayesian demographic account approach can also be of interest for demographic historians that rely on rough estimates of population size and growth and infer possible combinations of birth and death rates. Mr. Bryant concluded his

advantages and current usage.[18] Mr. Eaton showed an illustration of a TMB implementation for reconstructing the female population of Burkina Faso, highlighting the speed of the computation in a 5x5 framework. Mr. Eaton concluded by sharing some considerations for WPP2021. He welcomed the harmonization of demographic inputs and calculations between HIV estimates and WPP. The migration to single-year interval would improve consistency. At the same time, he cautioned against the use of census data in Bayesian population reconstruction, especially for some key age groups (population 0-4 and working-age adult men in sub-Saharan Africa). Changes in the approach of mortality estimation in high HIV countries in WPP2021 required careful consideration. He supported the greater focus on transparency, visualization and reproducibility in order to promote the adoption of estimates and analysis by countries.

The presentation of Mr. Gabriel Mendes Borges, Brazilian Institute of Geography and Statistics, focused on the estimation of consistent population data. Using data from Brazil, Mr. Mendes Borges provided an example of a probabilistic population reconstruction. The motivation to conduct this reconstruction came from the need to quantify and communicate uncertainty of the available estimates, as well as the need for better (probabilistic) methods to estimate and reconcile inconsistent demographic parameters. To this end, Mr. Mendes Borges combined information from different data sources, while accounting for the uncertainty from random variation and measurement error. Mr. Mendes Borges reviewed the data sources and series of estimates used to derive indicators and measurement error for the total population as well as for fertility, mortality and migration. The inference was conducted in two steps using a Bayesian probabilistic approach. The first step of the modelling approach consisted in estimating the individual parts that make up the balancing equation, that is, population, mortality, fertility and migration. These estimates constituted the pre-model posterior distributions. The second step consisted in reconciling the inconsistent probability distributions using an extension of the Bayesian melding approach. The reconciled distributions served as post-model posterior distributions. Mr. Mendes Borges presented a series of results for fertility, mortality and population by age and sex at the national and provincial level, and for migration by age. Mr. Mendes Borges reviewed some of the lessons learnt from his work. First, working with observed counts, instead of rates, is very useful. Second, it is desirable to use the knowledge about the structure of demographic rates by age when conducting the demographic reconciliation. Third, it is hard to conduct the reconciliation without a direct census evaluation, such as a post-enumeration survey. In this regard, Mr. Mendes Borges noted that developing models for census coverage and quality of age patterns would be helpful. Finally, it was important to conduct sensitivity analysis of the demographic methods in order to assess and adjust for biases and calculate uncertainty of the computed estimates. The Division reported that it had begun compiling data from post-enumeration surveys. While post-enumeration surveys were recommended to be conducted after each census, they were not implemented on a systematic basis. Sometimes, results of the post-enumeration survey were not published. Once compiled, the information would be made available.

Lastly, Ms. Dilek Yildiz, Wittgenstein Centre, Austria, focused on the reconstruction of multistate population and education specific fertility rates using a Bayesian approach. Ms. Yildiz briefly described the two approaches to rebuild past populations, that is, through back projection or reconstruction. The approach taken by Ms. Yildiz was based on earlier Bayesian modelling work by Wheldon et al. (2013)[19] but extended to reconstruct multistate populations and estimates simultaneously

[18] TMB is the software used in the Global Burden of

codes, such as the DemoTools R package, would need to be modified accordingly. The experts had noted the benefits of using as many data sources and estimation methods as possible for each country. To this end, the Division would continue to collect as many data sources as possible to inform the estimation of mortality for the 2021 revision of WPP. Further testing and exploration of various model specifications of coherent time trends since 1950 for all countries would be done in follow-up meetings with a small group of experts. The Division was planning to develop statistical models to create robust fertility and mortality time series and systematically apply these models to the empirical data

Tuesday, 7 April 2020

	Facilitator: Sara Hertog	Presenter
9:45	Call in/Resolve connectivity issue	
10:00	Adult and old-age mortality: data evaluation and modelling for countries with deficient or no vital registration systems	
	Evaluation and adjustments for population and mortality data in Latin America based on LAMBDA experience	Hiram Beltran
	Direct and indirect adult mortality estimates from censuses and surveys	Bruno Masquelier
	HDSS mortality	Ayaga Bawah
	Evaluation and estimates of old age mortality	Hong Mi
11:00	Discussion	
11:20	BREAK	
11:40	Modelling of age patterns: abridged and complete age distributions	
	Mortality age pattern	Sam Clark
	Fertility age pattern	Carl Schmertmann
	Estimation of fertility rates from survey full histories and HDSS	Bruno Schoumaker
12:40	Discussion	
13:00	ADJOURN	

Wednesday, 8 April 2020

	Facilitator: Patrick Gerland	Presenter
9:45	Call in/Resolve connectivity issue	
10:00	Population reconciliation and demographic balance	
	CELADE experience with 1x1 population and demographic estimates	Helena Cruz Castanheira
	US Census Bureau International Branch experience with RUP/DAPPS	Nobuko Mizoguchi & Sean Fennell
	Demographic methods for data evaluation, transformation and adjustments	Tim Riffe
	Bayesian demographic estimations and population reconstruction	Mark Wheldon
	Bayesian demographic estimation and inferring counts fr (un)reliable data	John Bryant
11:15	BREAK	
11:30	UNAIDS Reference Group and HIV/AIDS countries in SSA	Jeff Eaton
	Consistent Population Estimates: An Application to Brazil	Gabriel Borges
	Bayesian reconstruction of populations and vital rates by educational attainment	Dilek Yildiz
12:15	Discussion	
12:45	Conclusions and way forward	

ANNEX 2. LIST OF PARTICIPANTS

List of participants

INVITED SPEAKERS AND EXPERTS

Ms. Leontine Alkema
Associate Professor
Department of Biostatistics and Epidemiology
University of Massachusetts