



PGS Catalog access with quincunx

Introduction

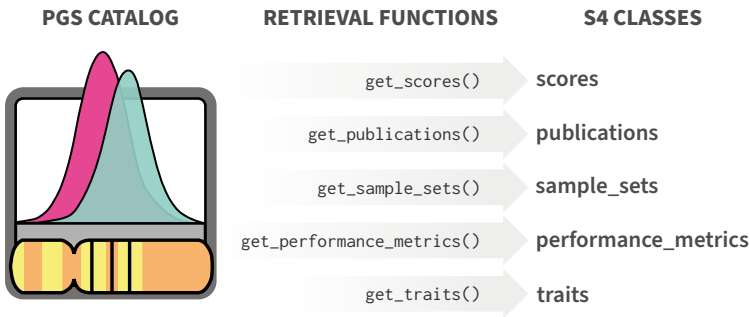
The **PGS Catalog** is a service provided by the EMBL-EBI and NHGRI that offers a manually curated and freely available database of published polygenic scores (PGS): <https://www.pgscatalog.org/>.

The PGS Catalog data provided by the **RESTful API** is organised around five core entities:

- PGS** Polygenic Scores
- PGP** PGS Publications
- PSS** PGS Sample Sets
- PPM** PGS Performance Metrics
- EFO** EFO traits

Get PGS Catalog Entities

quincunx facilitates the access to the Catalog via the RESTful API, allowing you to programmatically retrieve data directly into R. Each of the five entities is mapped to an S4 object of a class of the same name.



Query criteria for retrieval functions, e.g., PGS can be queried by either `pgs_id`, `efo_id` or `pubmed_id`. These correspond to the criteria exposed by the PGS Catalog REST API: <https://www.pgscatalog.org/rest/>.

Search by	Example	PGS	PGP	PSS	PPM	EFO
pgs_id	"PGS000001"					
pgp_id	"PGP000001"					
pss_id	"PSS000001"					
ppm_id	"PPM000001"					
efo_id	"EFO_0000249"					
pubmed_id	"25855707"					
author	"Mavaddat"					
trait_term	"Alzheimer"					

PGS Catalog Entities in R

PGS Catalog entities are represented as S4 classes in R. Each class represents a relational database of tidy data tables. All objects start with a table with the same name as the class. Combination of variables indicated in bold renders each row unique in each table.

S4 class scores

scores <ul style="list-style-type: none">pgs_idpgs_namescoring_filematches_publicationreported_traittrait_additional_descriptionpgs_method_namepgs_method_paramsn_variantsn_variants_interactionsassemblylicensebeta_unit	samples <ul style="list-style-type: none">pgs_idsample_idstagesample_sizesample_casessample_controlssample_percent_malephenotype_descriptionancestryancestry_descriptionancestry_countryancestry_additional_descriptionstudy_idpubmed_idcohorts_additional_description	demographics <ul style="list-style-type: none">pgs_idsample_idvariableestimate_typeestimateunitvariability_typevariabilityinterval_typeinterval_lowerinterval_upper
publications <ul style="list-style-type: none">pgs_idpgp_idpubmed_idpublication_datepublicationtitleauthor_fullnamedoi	traits <ul style="list-style-type: none">pgs_idefo_idtraitdescriptionurl	cohorts <ul style="list-style-type: none">pgs_idsample_idcohort_symbolcohort_name

S4 class publications

publications <ul style="list-style-type: none">pgp_idpubmed_idpublication_datepublication	pgs_ids <ul style="list-style-type: none">pgp_idpgs_idstage
--	--

S4 class traits

traits <ul style="list-style-type: none">efo_idparent_efo_idis_childtraitdescriptionurl	pgs_ids <ul style="list-style-type: none">efo_idparent_efo_idis_childpgs_id	child_pgs_ids <ul style="list-style-type: none">efo_idparent_efo_idis_childchild_pgs_id
3x trait_{categories, synonyms, mapped_terms} <ul style="list-style-type: none">efo_idparent_efo_idis_childtrait_{category, synonyms, mapped_terms}		

S4 class sample_sets

sample_sets <ul style="list-style-type: none">pss_idpgs_namescoring_filematches_publicationreported_traittrait_additional_descriptionpgs_method_namepgs_method_paramsn_variantsn_variants_interactionsassemblylicensebeta_unit	samples <ul style="list-style-type: none">pss_idsample_idstagesample_sizesample_casessample_controlssample_percent_malephenotype_descriptionancestryancestry_descriptionancestry_countryancestry_additional_descriptionstudy_idpubmed_idcohorts_additional_description	demographics <ul style="list-style-type: none">pss_idsample_idvariableestimate_typeestimateunitvariability_typevariabilityinterval_typeinterval_lowerinterval_upper
cohorts <ul style="list-style-type: none">pss_idsample_idcohort_symbolcohort_name		

S4 class performance_metrics

performance_metrics <ul style="list-style-type: none">ppm_idpgs_idreported_traitcovariatescomments	samples <ul style="list-style-type: none">ppm_idpss_idsample_idstagesample_sizesample_casessample_controlssample_percent_malephenotype_descriptionancestryancestry_descriptionancestry_countryancestry_additional_descriptionstudy_idpubmed_idcohorts_additional_description	demographics <ul style="list-style-type: none">ppm_idpss_idsample_idvariableestimate_typeestimateunitvariability_typevariabilityinterval_typeinterval_lowerinterval_upper
publications <ul style="list-style-type: none">ppm_idpgp_idpubmed_idpublication_datepublicationtitleauthor_fullnamedoi	sample_sets <ul style="list-style-type: none">ppm_idpss_id	cohorts <ul style="list-style-type: none">ppm_idpss_idsample_idcohort_symbolcohort_name
3x pgs_{effect_sizes, classification_metrics, other_metrics} <ul style="list-style-type: none">ppm_id{effect_size_id, classification_metrics_id, other_metrics_id}estimate_type_longestimate_typeestimateunitvariability_typevariabilityinterval_typeinterval_lowerinterval_upper		



Other S4 Entities

Besides the five PGS Catalog entities, there are three other objects that can be retrieved from the REST API: trait_categories, cohorts and releases.

S4 class trait_categories

trait_categories

- trait_category

trait

- trait_category
- efo_id
- trait
- description
- url

S4 class cohorts

cohorts

- cohort_symbol
- cohort_name

pgs_ids

- cohort_symbol
- pgs_id
- stage

S4 class releases

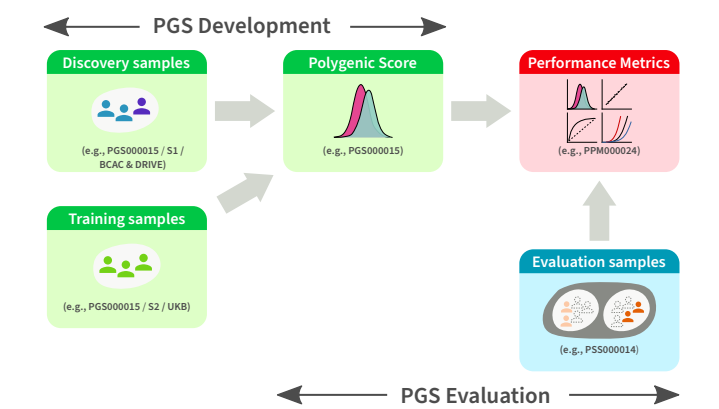
releases

- date
- n_pgs
- n_ppm
- n_pgp
- notes

3x {pgs_ids, ppm_ids,pgp_ids}

- date
- {pgs_id, ppm_id, pgp_id}

PGS Construction Process



Samples and Polygenic Scores (PGS) are annotated according to their utilisation context in the PGS construction process, i.e. the stage variable in quincunx:

- "discovery"
- "training"
- "development" ("discovery" or "training")
- "evaluation"

Cohorts, Samples and Sample Sets

Cohorts

A cohort is a group of individuals with a shared characteristic. Cohorts are identified in quincunx by the cohort_symbol variable.

(e.g., PROMIS / N=30,000)

(e.g., LOUPOP / N=30,000)

(e.g., MHI / N=30,000)

(e.g., UKB / N=500,000)

Samples

A sample is a group of participants associated with none, one or more catalogued cohorts. The selection from a cohort can be either a subset or its totality. Samples are not identified in PGS Catalog with a global unique identifier, but quincunx assigns a surrogate identifier (sample_id) to allow relations between tables.

Possible compositions of samples:

Admixture of cohorts.
(e.g., PGS000011 / S2 / PROMIS & LOUPOP / N=8,653)

A cohort subset.
(e.g., PSS000020 / S1 / MHI / N=862)

Another but disjoint subset.
(e.g., PSS000020 / S2 / MHI / N=2,333)

Not associated with any cohort.

Sample Sets

A sample set is a group of samples used in a polygenic score evaluation. Each sample set is identified in the PGS Catalog by a unique sample set identifier (PSS ID).

A sample set of two samples.
(e.g., PSS000020: S1 and S2)

Manipulate Cases of S4 Entities

Get a scores object `s` consisting of two polygenic scores (PGS):

```
s <- get_scores(pgs_id = c('a', 'b'))
```

Subset object `s` by either identifier or position using ``['``:

`s['a']` # Subset by identifier

`s[1]` # Subset by position

Combine two scores' objects:

`union(s1,s2)`
(Discards duplicates)

`bind(s1,s2)`
(Keeps duplicates)

Polygenic scoring file

PGS scoring files are provided by the PGS Catalog to allow computation of polygenic scores by users. These files are hosted at the PGS Catalog FTP server: <http://ftp.ebi.ac.uk/pub/databases/spot/pgs/scores/>. They are labelled by their respective PGS Score ID (e.g. PGS000001.txt.gz). For more details please visit: <https://rmagno.eu/quincunx/articles/pgs-scoring-file.html>.

File Format

Each scoring file contains variant identification, effect alleles and respective score weights. The file is formatted as a gzipped tab-delimited text file, with a header containing brief metadata about the score. You can read PGS scoring files into R with `read_scoring_file()`.

PGS000117.txt.gz

```
1 ## PGS CATALOG SCORING FILE - see www.pgscatalog.org/downloads/#dl_ftp_for...
2 ## POLYGENIC SCORE (PGS) INFORMATION
3 # PGS ID = PGS000117
4 # Reported Trait = Cardiovascular Disease
5 # Original Genome Build = GRCh37
6 # Number of Variants = 267863
7 ## SOURCE INFORMATION
8 # PGP ID = PGP000054
9 # Citation = Elliott J et al. JAMA (2020). doi:10.1001/jama.2019.22241
10 rsID chr_name chr_position effect_allele reference_allele effect_weight
11 rs11240779 1 808631 A G 0.00077622
12 rs1921 1 949608 A G -0.00583829
13 rs2710890 1 958905 G A -0.00182583
14 rs4970349 1 967658 T C -0.001855691
...
```

Columns

The following table lists all possible columns in a PGS scoring file. A few columns are required (R), and most are optional (O); either the rsID alone or the combination of chr_name and chr_position are required, with the other being optional.

Column (Requirement)	Description	Example
rsID (R/O)	dbSNP Accession ID	"rs554219"
chr_name (R/O)	Chromosome name	"11"
chr_position (R/O)	Chromosome position	69516874
effect_allele (R)	Effect allele	"G"
reference_allele (O)	Reference allele	"C"
effect_weight (R)	Variant weight	0.117
locus_name (O)	Locus name	"CCND1"
weight_type (O)	Type of weight	"log(OR)", "beta_cox"
allelefrequency_effect (O)	Effect allele frequency	0.410
is_interaction (O)	Variant interaction?	TRUE or FALSE
is_recessive (O)	Recessive inheritance model?	TRUE or FALSE
is_haplotype (O)	Is effect allele a haplotype?	TRUE or FALSE
is_diplotype (O)	Is effect allele a diplotype?	TRUE or FALSE
imputation_method (O)	Imputation method	TODO
variant_description (O)	Variant description	TODO
inclusion_criteria (O)	Score inclusion criteria	TODO
OR (O)	Odds Ratio	1.12
HR (O)	Hazard Ratio	1.08