Final Project

PSTAT 100, Summer Session A 2025 with Ethan P. Marzban

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Abstract

Our group analyzed data from the 2023 World Happiness Report to see how happiness (determined by Life Ladder scores) vary across the seven regions (determined by the countrycode R package) and to identify the main regional drivers of happiness. Each country was assigned to its region, and we fit separate multiple linear regression models. Predictors with pairwise correlations above 0.70 were removed to control collinearity, and variables with p-values greater than 0.05 were trimmed out of the final models.

Social support remained significant in every region, highlighting its universal role in well-being. Log GDP per capita strongly predicted happiness in Europe and Central Asia, East Asia and Pacific, and Latin America and Caribbean, but it lost influence in North America and Sub-Saharan Africa. Positive affect mattered everywhere except South Asia. Perceptions of corruption reduced happiness most in South Asia, the Middle East and North Africa, and Sub-Saharan Africa. Freedom to make life choices helped explain happiness in Europe and Central Asia and in Sub-Saharan Africa but dropped out of the North American and South Asian models. Generosity rarely survived once stronger economic and social factors were included.

Taken together, these findings point to a shared social baseline for happiness through dependable support networks, while economic growth, governance, and affect-based factors shape well-being in region-specific ways.

Introduction

We are working with the "World happiness, trust and social connections in times of crisis" dataset from Chapter 2 of the World Happiness Report 2023. This dataset contains values from 2008-2023, and contains variables Country name, year, Life Ladder, Log GDP per capita,

Social support, Healthy life expectancy at birth, Freedom to make life choices, Generosity, Perceptions of corruption, Positive affect and Negative affect.

We sought to answer the question; How does happiness (life ladder) vary across geographical regions, and do the factors contributing to life ladder vary based on continent? Data was collected from the Gallup World Poll. They poll over 160 countries, typically using a sample size of at least 1,000 per country.

They conduct telephone surveys when possible, and face-to-face interviews when not (in developing countries). For face-to-face interviews, they first use cluster sampling of households. Then, clustered are stratified by population size, demographic and/or geography. When population information is not available, Gallup uses Simple Random Sampling (SRS).

For phone interviews. They randomly dial phone numbers, or use SRS on a nationally representative list of phone numbers.

The variable life ladder was measured using a life evaluation question (the Cantril Ladder), which asks respondents to essentially rank how good their life is on a scale from 0-10.

Analysis

We are trying to find out the difference between life ladders ot different regions, including: South Asia, Europe & Central Asia, Middle East & North Africa, Sub-Saharan Africa, Latin America & Caribbean, East Asia & Pacific, and North America.

So, the first step is to split the dataframe. We need to assign the data of the countries in a region to a new dataframe. To do so, we need to append a new column with the names of the region in the given dataframe. A package "countrycode" is necessary for this step, and we need to wipe out the data of countries not in these regions. After appending the new column, we can filter countries in a certain region.

Next, we are going to use a multiple linear model to check how every variable in the dataframe affect the life ladder. Nevertheless, a few variables are not related to our prespect. We are trying to focus on the countries in a certain region, so which year is it, what's the name of country and region are unnecessary. We need to remove these variables. We are then left with the following variables

```
[1] "Life Ladder"                     "Log GDP per capita"
[3] "Social support"                  "Healthy life expectancy at birth"
[5] "Freedom to make life choices"    "Generosity"
[7] "Perceptions of corruption"
```

We need to generate covariance matrix for the variables we see above. It is easy to do so, by using function "cor()". Since some missing values exist, so we need to set "use ="complete.obs" ", or there could be hundreds of NAs in the matrix.

We assume that a covariance over 0.7 is too high (except the ones with Life Ladder), so we are going to remove variables above 0.7. After this we can generate a new linear regression model based on the updated data.

Once this has been done we drop all variables with p-value greater than 0.05 and then rerun the model once more. This is our final model and from here we determine which variables are significant to life ladder.

Europe & Central Asia:

```
Call:
lm(formula = `Life Ladder` ~ ., data = ECA_num)

Residuals:
     Min       1Q   Median       3Q      Max
-1.27138 -0.19147  0.01508  0.22827  1.19586

Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                     -2.878271   0.374057  -7.695 4.95e-14 ***
`Log GDP per capita`             0.318929   0.037558   8.492  < 2e-16 ***
`Social support`                 2.263177   0.248319   9.114  < 2e-16 ***
`Healthy life expectancy at birth`  0.036658   0.008421   4.353 1.55e-05 ***
`Freedom to make life choices`   0.675781   0.158533   4.263 2.30e-05 ***
Generosity                       0.354447   0.116964   3.030  0.00253 **
`Perceptions of corruption`     -0.805949   0.091609  -8.798  < 2e-16 ***
`Positive affect`                2.251316   0.297781   7.560 1.29e-13 ***
`Negative affect`               -0.583474   0.288284  -2.024  0.04336 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3669 on 686 degrees of freedom
  (53 observations deleted due to missingness)
Multiple R-squared:  0.8609,    Adjusted R-squared:  0.8593
F-statistic: 530.6 on 8 and 686 DF,  p-value: < 2.2e-16


                            Life Ladder Log GDP per capita Social support
Life Ladder                   1.0000000          0.7611776      0.6994617
```

Log GDP per capita	0.7611776	1.0000000	0.5670444
Social support	0.6994617	0.5670444	1.0000000
Healthy life expectancy at birth	0.6936020	0.7859716	0.4015822
Freedom to make life choices	0.7317736	0.4509842	0.5550441
Generosity	0.5764723	0.3048967	0.3890898
Perceptions of corruption	-0.6805740	-0.4893120	-0.3124053
Positive affect	0.8446424	0.6325326	0.6712274
Negative affect	-0.4194468	-0.1598842	-0.4394876

	Healthy life expectancy at birth
Life Ladder	0.69360196
Log GDP per capita	0.78597163
Social support	0.40158218
Healthy life expectancy at birth	1.00000000
Freedom to make life choices	0.46046469
Generosity	0.43844096
Perceptions of corruption	-0.45720807
Positive affect	0.61491664
Negative affect	0.06064105

	Freedom to make life choices	Generosity
Life Ladder	0.7317736	0.5764723
Log GDP per capita	0.4509842	0.3048967
Social support	0.5550441	0.3890898
Healthy life expectancy at birth	0.4604647	0.4384410
Freedom to make life choices	1.0000000	0.5652406
Generosity	0.5652406	1.0000000
Perceptions of corruption	-0.6328505	-0.5124676
Positive affect	0.7618484	0.6240887
Negative affect	-0.5071508	-0.2558771

	Perceptions of corruption	Positive affect
Life Ladder	-0.6805740	0.8446424
Log GDP per capita	-0.4893120	0.6325326
Social support	-0.3124053	0.6712274
Healthy life expectancy at birth	-0.4572081	0.6149166
Freedom to make life choices	-0.6328505	0.7618484
Generosity	-0.5124676	0.6240887
Perceptions of corruption	1.0000000	-0.6060734
Positive affect	-0.6060734	1.0000000
Negative affect	0.4282453	-0.4740141

	Negative affect
Life Ladder	-0.41944684
Log GDP per capita	-0.15988417
Social support	-0.43948760
Healthy life expectancy at birth	0.06064105

```
Freedom to make life choices         -0.50715084
Generosity                           -0.25587706
Perceptions of corruption             0.42824532
Positive affect                      -0.47401407
Negative affect                       1.00000000
```

```
            LL        GDP         SS         HEB        FLC          G
LL   1.0000000  0.7611776  0.6994617  0.69360196  0.7317736  0.5764723
GDP  0.7611776  1.0000000  0.5670444  0.78597163  0.4509842  0.3048967
SS   0.6994617  0.5670444  1.0000000  0.40158218  0.5550441  0.3890898
HEB  0.6936020  0.7859716  0.4015822  1.00000000  0.4604647  0.4384410
FLC  0.7317736  0.4509842  0.5550441  0.46046469  1.0000000  0.5652406
G    0.5764723  0.3048967  0.3890898  0.43844096  0.5652406  1.0000000
PC  -0.6805740 -0.4893120 -0.3124053 -0.45720807 -0.6328505 -0.5124676
PA   0.8446424  0.6325326  0.6712274  0.61491664  0.7618484  0.6240887
PN  -0.4194468 -0.1598842 -0.4394876  0.06064105 -0.5071508 -0.2558771
            PC         PA          PN
LL  -0.6805740  0.8446424 -0.41944684
GDP -0.4893120  0.6325326 -0.15988417
SS  -0.3124053  0.6712274 -0.43948760
HEB -0.4572081  0.6149166  0.06064105
FLC -0.6328505  0.7618484 -0.50715084
G   -0.5124676  0.6240887 -0.25587706
PC   1.0000000 -0.6060734  0.42824532
PA  -0.6060734  1.0000000 -0.47401407
PN   0.4282453 -0.4740141  1.00000000
```

Here we see cor-matrix of variables. We assume 0.7 cor is too high, so we need to drop variables: Healthy life expectancy at birth (cor with GDP = 0.7859716), and Positive affect (cor with life choices = 0.7618484). To avoid multicollinearity.

```
Call:
lm(formula = `Life Ladder` ~ ., data = ECA_num_rem)

Residuals:
     Min       1Q   Median       3Q      Max
-1.43081 -0.23484  0.02483  0.25329  1.27323

Coefficients:
                              Estimate Std. Error t value Pr(>|t|)
(Intercept)                   -1.57135    0.28614  -5.492 5.57e-08 ***
```

```
`Log GDP per capita`            0.52173    0.02882  18.101  < 2e-16 ***
`Social support`                2.40562    0.25230   9.535  < 2e-16 ***
`Freedom to make life choices`  1.26933    0.15357   8.266 6.92e-16 ***
Generosity                      1.00416    0.11058   9.081  < 2e-16 ***
`Perceptions of corruption`    -0.76286    0.09633  -7.919 9.32e-15 ***
`Negative affect`              -0.76388    0.25798  -2.961  0.00317 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3983 on 703 degrees of freedom
  (38 observations deleted due to missingness)
Multiple R-squared:  0.8333,    Adjusted R-squared:  0.8319
F-statistic: 585.6 on 6 and 703 DF,  p-value: < 2.2e-16
```

By the summary of the linear model, we can see that the P-values of all variables are below 5%. So we can say these variables have a significant effect on the Life Ladder of countries in Europe & Central Asia. However, negative affect does not have such a significant impact on the life ladder compared to the other five variables.

East Asia & Pacific

```
Call:
lm(formula = `Life Ladder` ~ ., data = EAP_num)

Residuals:
     Min       1Q   Median       3Q      Max
-1.32836 -0.25339  0.02262  0.26507  1.22212

Coefficients:
                                 Estimate Std. Error t value Pr(>|t|)
(Intercept)                      -4.30046    0.74297  -5.788 2.86e-08 ***
`Log GDP per capita`              0.51585    0.09526   5.415 1.81e-07 ***
`Social support`                  3.46107    0.47726   7.252 9.83e-12 ***
`Healthy life expectancy at birth`  0.01185    0.01404   0.843   0.4000
`Freedom to make life choices`    0.52020    0.41357   1.258   0.2100
Generosity                        0.24550    0.15089   1.627   0.1054
`Perceptions of corruption`      -0.37311    0.17746  -2.103   0.0368 *
`Positive affect`                 1.64945    0.41147   4.009 8.73e-05 ***
`Negative affect`                -0.13000    0.48024  -0.271   0.7869
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Residual standard error: 0.3815 on 192 degrees of freedom
  (55 observations deleted due to missingness)
Multiple R-squared:  0.8333,    Adjusted R-squared:  0.8263
F-statistic:   120 on 8 and 192 DF,  p-value: < 2.2e-16
```

	Life Ladder	Log GDP per capita	Social support
Life Ladder	1.00000000	0.8301956	0.72626828
Log GDP per capita	0.83019556	1.0000000	0.60749914
Social support	0.72626828	0.6074991	1.00000000
Healthy life expectancy at birth	0.74654364	0.9118113	0.48143003
Freedom to make life choices	0.13040207	-0.1332271	0.04348335
Generosity	-0.09318964	-0.3167818	-0.04901763
Perceptions of corruption	-0.62335156	-0.6131060	-0.39802336
Positive affect	0.23896591	-0.0109973	0.06881312
Negative affect	-0.49558398	-0.5429337	-0.56331301

	Healthy life expectancy at birth
Life Ladder	0.74654364
Log GDP per capita	0.91181125
Social support	0.48143003
Healthy life expectancy at birth	1.00000000
Freedom to make life choices	-0.05747589
Generosity	-0.38542835
Perceptions of corruption	-0.52350084
Positive affect	0.03056720
Negative affect	-0.43779939

	Freedom to make life choices	Generosity
Life Ladder	0.13040207	-0.09318964
Log GDP per capita	-0.13322710	-0.31678178
Social support	0.04348335	-0.04901763
Healthy life expectancy at birth	-0.05747589	-0.38542835
Freedom to make life choices	1.00000000	0.19462430
Generosity	0.19462430	1.00000000
Perceptions of corruption	-0.31684123	0.02493711
Positive affect	0.57301219	0.32366211
Negative affect	0.23693392	0.06871409

	Perceptions of corruption	Positive affect
Life Ladder	-0.62335156	0.23896591
Log GDP per capita	-0.61310601	-0.01099730
Social support	-0.39802336	0.06881312
Healthy life expectancy at birth	-0.52350084	0.03056720
Freedom to make life choices	-0.31684123	0.57301219

```
Generosity                                    0.02493711      0.32366211
Perceptions of corruption                     1.00000000     -0.07317717
Positive affect                              -0.07317717      1.00000000
Negative affect                               0.28378263      0.14031759
                                  Negative affect
Life Ladder                            -0.49558398
Log GDP per capita                     -0.54293365
Social support                         -0.56331301
Healthy life expectancy at birth       -0.43779939
Freedom to make life choices            0.23693392
Generosity                              0.06871409
Perceptions of corruption               0.28378263
Positive affect                         0.14031759
Negative affect                         1.00000000
```

Here we see cor-matrix of variables, we assume 0.7 cor is too high, so we need to drop variables: Healthy life expectancy at birth (cor with GDP = 0.9118113). To avoid multicollinearity.

```
Call:
lm(formula = `Life Ladder` ~ ., data = EAP_num_rem)

Residuals:
     Min       1Q   Median       3Q      Max
-1.21110 -0.30528  0.00298  0.30702  1.34832

Coefficients:
                                Estimate Std. Error t value Pr(>|t|)
(Intercept)                    -3.768054   0.752306  -5.009 1.15e-06 ***
`Log GDP per capita`            0.465035   0.052723   8.820 4.06e-16 ***
`Social support`                4.039365   0.467770   8.635 1.36e-15 ***
`Freedom to make life choices` -0.003532   0.398871  -0.009   0.9929
Generosity                     -0.019787   0.146631  -0.135   0.8928
`Perceptions of corruption`    -0.377176   0.180056  -2.095   0.0374 *
`Positive affect`               2.716580   0.380846   7.133 1.49e-11 ***
`Negative affect`              -0.316745   0.471259  -0.672   0.5022
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4003 on 214 degrees of freedom
  (34 observations deleted due to missingness)
Multiple R-squared:  0.8015,    Adjusted R-squared:  0.795
```

```
F-statistic: 123.4 on 7 and 214 DF,  p-value: < 2.2e-16
```

By the summary of the linear model, we can see that the P-value of Log GDP per capita, Social support, Perceptions of corruption, and Positive affect are below 5%. So we can say these variables have a significant effect on the Life Ladder of countries in East Asia & Pacific. However, Perceptions of corruption do not have such a significant impact on the life ladder compared to the other three variables.

Latin America & Caribbean:

```
                                Life Ladder Log GDP per capita Social support
Life Ladder                       1.0000000         0.60903043     0.54618383
Log GDP per capita                0.6090304         1.00000000     0.47660216
Social support                    0.5461838         0.47660216     1.00000000
Healthy life expectancy at birth  0.5055920         0.48552262     0.54303683
Freedom to make life choices      0.4848418         0.44647323     0.44067997
Generosity                       -0.3315004        -0.43142915    -0.33541651
Perceptions of corruption        -0.1373564        -0.05148498     0.06810653
Positive affect                   0.5212056         0.28243401     0.47259507
Negative affect                  -0.3885353        -0.32730759    -0.39122296
                                Healthy life expectancy at birth
Life Ladder                                          0.50559201
Log GDP per capita                                   0.48552262
Social support                                       0.54303683
Healthy life expectancy at birth                     1.00000000
Freedom to make life choices                         0.52170829
Generosity                                          -0.47374193
Perceptions of corruption                            0.03172322
Positive affect                                      0.52160066
Negative affect                                     -0.03590270
                                Freedom to make life choices  Generosity
Life Ladder                                      0.484841821 -0.33150043
Log GDP per capita                               0.446473235 -0.43142915
Social support                                   0.440679972 -0.33541651
Healthy life expectancy at birth                 0.521708289 -0.47374193
Freedom to make life choices                     1.000000000 -0.37640504
Generosity                                      -0.376405035  1.00000000
Perceptions of corruption                       -0.138681999  0.01973290
Positive affect                                  0.409190053 -0.25428331
Negative affect                                  0.004873756 -0.04353999
                                Perceptions of corruption Positive affect
Life Ladder                                  -0.13735643       0.5212056
```

```
Log GDP per capita                          -0.05148498       0.2824340
Social support                               0.06810653       0.4725951
Healthy life expectancy at birth             0.03172322       0.5216007
Freedom to make life choices                -0.13868200       0.4091901
Generosity                                   0.01973290      -0.2542833
Perceptions of corruption                    1.00000000       0.1179222
Positive affect                              0.11792216       1.0000000
Negative affect                              0.06369676      -0.3914519
                                 Negative affect
Life Ladder                        -0.388535255
Log GDP per capita                 -0.327307592
Social support                     -0.391222958
Healthy life expectancy at birth   -0.035902700
Freedom to make life choices        0.004873756
Generosity                         -0.043539992
Perceptions of corruption           0.063696762
Positive affect                    -0.391451910
Negative affect                     1.000000000
```

From the correlation matrix above (using a threshold of $|0.7|$), we see no significant multicollinearity and thus drop no variables.

```
Call:
lm(formula = `Life Ladder` ~ ., data = latin_countries)

Residuals:
    Min      1Q  Median      3Q     Max
-1.5352 -0.3033  0.0618  0.3291  1.1797

Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                       -0.935049   0.755264  -1.238 0.216625
`Log GDP per capita`               0.373757   0.055696   6.711 9.05e-11 ***
`Social support`                   1.513497   0.556570   2.719 0.006905 **
`Healthy life expectancy at birth` 0.009544   0.006679   1.429 0.154012
`Freedom to make life choices`     0.767320   0.342104   2.243 0.025598 *
Generosity                         0.013375   0.291895   0.046 0.963482
`Perceptions of corruption`       -1.151732   0.327999  -3.511 0.000511 ***
`Positive affect`                  2.948661   0.635303   4.641 5.09e-06 ***
`Negative affect`                 -1.409994   0.620785  -2.271 0.023805 *
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4834 on 314 degrees of freedom
  (8 observations deleted due to missingness)
Multiple R-squared:  0.5687,    Adjusted R-squared:  0.5577
F-statistic: 51.75 on 8 and 314 DF,  p-value: < 2.2e-16
```

We decided to use a 5% level of significance. Thus, we dropped 2 variables ('Healthy life expectancy at birth' and 'Generosity') .

```
Call:
lm(formula = `Life Ladder` ~ . - `Healthy life expectancy at birth` -
    Generosity, data = latin_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-1.57915 -0.31625  0.05608  0.33345  1.21121

Coefficients:
                               Estimate Std. Error t value Pr(>|t|)
(Intercept)                    -1.17788    0.66066  -1.783 0.075564 .
`Log GDP per capita`            0.39901    0.05046   7.908 4.41e-14 ***
`Social support`                1.77824    0.52222   3.405 0.000747 ***
`Freedom to make life choices`  0.81322    0.34040   2.389 0.017480 *
`Perceptions of corruption`    -1.17120    0.32745  -3.577 0.000402 ***
`Positive affect`               3.32537    0.57663   5.767 1.92e-08 ***
`Negative affect`              -1.08787    0.56381  -1.929 0.054565 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4834 on 316 degrees of freedom
  (8 observations deleted due to missingness)
Multiple R-squared:  0.5658,    Adjusted R-squared:  0.5576
F-statistic: 68.64 on 6 and 316 DF,  p-value: < 2.2e-16
```

Based on the model above, we can conclude that at a 5% significance level, all of the variables except for 'Healthy life expectancy at birth', 'Generosity', and 'Negative affect' are significant factors influencing life ladder in the Latin America region.

North America:

	Life Ladder	Log GDP per capita	Social support
Life Ladder	1.0000000	-0.7589950	0.7248373
Log GDP per capita	-0.7589950	1.0000000	-0.6461960
Social support	0.7248373	-0.6461960	1.0000000
Healthy life expectancy at birth	0.5887594	-0.9299397	0.5347143
Freedom to make life choices	0.7646006	-0.8291102	0.6484041
Generosity	0.5470360	-0.3371957	0.2786627
Perceptions of corruption	-0.6045279	0.8930323	-0.5411953
Positive affect	0.8161616	-0.6153316	0.3927745
Negative affect	-0.5750204	0.3368360	-0.4329264

	Healthy life expectancy at birth
Life Ladder	0.5887594
Log GDP per capita	-0.9299397
Social support	0.5347143
Healthy life expectancy at birth	1.0000000
Freedom to make life choices	0.8017396
Generosity	0.1990675
Perceptions of corruption	-0.9731710
Positive affect	0.5037470
Negative affect	-0.1920267

	Freedom to make life choices	Generosity
Life Ladder	0.7646006	0.5470360
Log GDP per capita	-0.8291102	-0.3371957
Social support	0.6484041	0.2786627
Healthy life expectancy at birth	0.8017396	0.1990675
Freedom to make life choices	1.0000000	0.2156677
Generosity	0.2156677	1.0000000
Perceptions of corruption	-0.8191946	-0.1631242
Positive affect	0.7212917	0.5580426
Negative affect	-0.3429026	-0.5207267

	Perceptions of corruption	Positive affect
Life Ladder	-0.6045279	0.8161616
Log GDP per capita	0.8930323	-0.6153316
Social support	-0.5411953	0.3927745
Healthy life expectancy at birth	-0.9731710	0.5037470
Freedom to make life choices	-0.8191946	0.7212917
Generosity	-0.1631242	0.5580426
Perceptions of corruption	1.0000000	-0.5081290
Positive affect	-0.5081290	1.0000000
Negative affect	0.2522588	-0.5444964

```
                                Negative affect
Life Ladder                          -0.5750204
Log GDP per capita                    0.3368360
Social support                       -0.4329264
Healthy life expectancy at birth     -0.1920267
Freedom to make life choices         -0.3429026
Generosity                           -0.5207267
Perceptions of corruption             0.2522588
Positive affect                      -0.5444964
Negative affect                       1.0000000
```

From the correlation matrix above (using a threshold of $|0.7|$), we opt to remove 3 variables ('Log GDP per capita', 'Freedom to make life choices' , and 'Healthy life expectancy at birth') due to multicollinearity.

```
Call:
lm(formula = `Life Ladder` ~ . - `Log GDP per capita` - `Freedom to make life choices` -
    `Healthy life expectancy at birth`, data = na_countries)

Residuals:
      Min        1Q    Median        3Q       Max
-0.227448 -0.050699  0.004387  0.042674  0.163111

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                  -2.7330     1.6878  -1.619    0.118
`Social support`              6.4529     1.3753   4.692 8.28e-05 ***
Generosity                    0.3676     0.3399   1.082    0.290
`Perceptions of corruption`  -0.1213     0.1626  -0.746    0.462
`Positive affect`             5.1875     1.0267   5.052 3.26e-05 ***
`Negative affect`            -0.2083     0.9425  -0.221    0.827
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.09768 on 25 degrees of freedom
  (3 observations deleted due to missingness)
Multiple R-squared:  0.8682,    Adjusted R-squared:  0.8419
F-statistic: 32.94 on 5 and 25 DF,  p-value: 3.14e-10
```

We decided to use a 5% level of significance. Thus, we dropped 3 variables ('Generosity', 'Perceptions of corruption' and 'Negative affect').

```
Call:
lm(formula = `Life Ladder` ~ . - `Log GDP per capita` - `Freedom to make life choices` -
    `Healthy life expectancy at birth` - Generosity - `Perceptions of corruption` -
    `Negative affect`, data = na_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-0.20913 -0.06754  0.01420  0.04104  0.16920

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        -4.0031     0.9825  -4.075 0.000344 ***
`Social support`    7.0697     1.1397   6.203 1.06e-06 ***
`Positive affect`   6.0350     0.7401   8.154 7.07e-09 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.09535 on 28 degrees of freedom
  (3 observations deleted due to missingness)
Multiple R-squared:  0.8594,    Adjusted R-squared:  0.8493
F-statistic: 85.55 on 2 and 28 DF,  p-value: 1.184e-12
```

Based on the model above, we can conclude that at a 5% significance level, 'Social support' and 'Positive affect' are the only significant factors influencing life ladder in the Latin America region.

South Asia:

```
                                Life Ladder Log GDP per capita Social support
Life Ladder                       1.0000000          0.1698210     0.28797678
Log GDP per capita                0.1698210          1.0000000     0.55672799
Social support                    0.2879768          0.5567280     1.00000000
Healthy life expectancy at birth  0.1291219          0.7624004     0.67311979
Freedom to make life choices      0.1099293          0.6136421     0.49243689
Generosity                        0.2200532          0.2174292     0.44148515
Perceptions of corruption        -0.2731788         -0.3106971    -0.04978062
Positive affect                   0.1097789          0.7594880     0.54969765
Negative affect                  -0.2823256         -0.1695584    -0.42493586
                                Healthy life expectancy at birth
Life Ladder                                            0.1291219
Log GDP per capita                                     0.7624004
```

Social support	0.6731198
Healthy life expectancy at birth	1.0000000
Freedom to make life choices	0.7125846
Generosity	0.0620094
Perceptions of corruption	-0.3058033
Positive affect	0.5035001
Negative affect	-0.2498326

	Freedom to make life choices	Generosity
Life Ladder	0.10992934	0.22005318
Log GDP per capita	0.61364205	0.21742917
Social support	0.49243689	0.44148515
Healthy life expectancy at birth	0.71258464	0.06200940
Freedom to make life choices	1.00000000	0.04292219
Generosity	0.04292219	1.00000000
Perceptions of corruption	-0.45988235	-0.06457705
Positive affect	0.39790086	0.40179209
Negative affect	-0.09745266	-0.26648929

	Perceptions of corruption	Positive affect
Life Ladder	-0.27317878	0.10977893
Log GDP per capita	-0.31069711	0.75948797
Social support	-0.04978062	0.54969765
Healthy life expectancy at birth	-0.30580329	0.50350013
Freedom to make life choices	-0.45988235	0.39790086
Generosity	-0.06457705	0.40179209
Perceptions of corruption	1.00000000	-0.04579712
Positive affect	-0.04579712	1.00000000
Negative affect	-0.05265876	-0.46936673

	Negative affect
Life Ladder	-0.28232564
Log GDP per capita	-0.16955838
Social support	-0.42493586
Healthy life expectancy at birth	-0.24983264
Freedom to make life choices	-0.09745266
Generosity	-0.26648929
Perceptions of corruption	-0.05265876
Positive affect	-0.46936673
Negative affect	1.00000000

From the correlation matrix above (using a threshold of $|0.7|$), we opted to remove Life Ladder, Healthy life expectancy at birth and Positive affect.

```
Call:
lm(formula = `Life Ladder` ~ . - `Healthy life expectancy at birth` -
    `Positive affect`, data = sa_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-1.28394 -0.32210 -0.01231  0.42735  1.40852

Coefficients:
                               Estimate Std. Error t value Pr(>|t|)
(Intercept)                     7.58184    1.62546   4.664 1.11e-05 ***
`Log GDP per capita`           -0.01645    0.16884  -0.097  0.92262
`Social support`                1.52324    0.77811   1.958  0.05348 .
`Freedom to make life choices` -0.91890    0.61105  -1.504  0.13625
Generosity                      0.19016    0.69799   0.272  0.78593
`Perceptions of corruption`    -3.47691    1.05998  -3.280  0.00149 **
`Negative affect`              -1.67757    0.91004  -1.843  0.06868 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6461 on 87 degrees of freedom
  (6 observations deleted due to missingness)
Multiple R-squared:  0.2192,    Adjusted R-squared:  0.1654
F-statistic: 4.071 on 6 and 87 DF,  p-value: 0.001206
```

We decided to use a 5% level of significance. Thus, we dropped Log GDP per capita, Freedom to make life choices, and Generosity.

```
Call:
lm(formula = `Life Ladder` ~ `Social support` + `Perceptions of corruption` +
    `Negative affect`, data = sa_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-2.10683 -0.45338 -0.06093  0.43747  1.68912

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                   6.3229     0.9779   6.466 4.33e-09 ***
`Social support`              1.2579     0.5699   2.207  0.02972 *
`Perceptions of corruption`  -2.2807     0.9308  -2.450  0.01610 *
```

```
`Negative affect`            -2.6911     0.9092  -2.960  0.00388 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6804 on 95 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.2436,    Adjusted R-squared:  0.2197
F-statistic:  10.2 on 3 and 95 DF,  p-value: 6.954e-06
```

Based on the model above, we can conclude that at a 5% significance level, only social support, negative affect, and perceptions of corruption are significant factors influencing life ladder in the South Asian region.

Middle East & North Africa (MENA):

	Life Ladder	Log GDP per capita	Social support
Life Ladder	1.0000000	0.7561809	0.7185170
Log GDP per capita	0.7561809	1.0000000	0.5984173
Social support	0.7185170	0.5984173	1.0000000
Healthy life expectancy at birth	0.6676949	0.7520324	0.4869203
Freedom to make life choices	0.5551314	0.5242151	0.3433874
Generosity	0.3899879	0.4191910	0.3191010
Perceptions of corruption	-0.2839978	-0.3667862	-0.2947866
Positive affect	0.7381465	0.5042783	0.5186277
Negative affect	-0.4439611	-0.1396304	-0.4025564

	Healthy life expectancy at birth
Life Ladder	0.66769492
Log GDP per capita	0.75203242
Social support	0.48692032
Healthy life expectancy at birth	1.00000000
Freedom to make life choices	0.40658665
Generosity	0.36449641
Perceptions of corruption	0.01700174
Positive affect	0.30525275
Negative affect	-0.14539394

	Freedom to make life choices	Generosity
Life Ladder	0.5551314	0.3899879
Log GDP per capita	0.5242151	0.4191910
Social support	0.3433874	0.3191010
Healthy life expectancy at birth	0.4065867	0.3644964
Freedom to make life choices	1.0000000	0.2890933
Generosity	0.2890933	1.0000000

```
Perceptions of corruption                        -0.4421385 -0.2038428
Positive affect                                   0.5957520  0.2752519
Negative affect                                  -0.2544395  0.2204277
                                 Perceptions of corruption Positive affect
Life Ladder                                   -0.28399776       0.7381465
Log GDP per capita                            -0.36678621       0.5042783
Social support                                -0.29478660       0.5186277
Healthy life expectancy at birth               0.01700174       0.3052528
Freedom to make life choices                  -0.44213853       0.5957520
Generosity                                    -0.20384284       0.2752519
Perceptions of corruption                      1.00000000      -0.4798124
Positive affect                               -0.47981245       1.0000000
Negative affect                                0.15233455      -0.3988775
                                 Negative affect
Life Ladder                           -0.4439611
Log GDP per capita                    -0.1396304
Social support                        -0.4025564
Healthy life expectancy at birth      -0.1453939
Freedom to make life choices          -0.2544395
Generosity                             0.2204277
Perceptions of corruption              0.1523346
Positive affect                       -0.3988775
Negative affect                        1.0000000
```

From the correlation matrix above (using a threshold of $|0.7|$), we remove Healthy life expectancy at birth due to multicollinearity.

```
Call:
lm(formula = `Life Ladder` ~ . - `Healthy life expectancy at birth`,
    data = mena_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-1.09139 -0.27024 -0.01139  0.28642  1.08748

Coefficients:
                             Estimate Std. Error t value Pr(>|t|)
(Intercept)                  -4.68549    0.73752  -6.353 2.81e-09 ***
`Log GDP per capita`          0.56646    0.06657   8.509 2.51e-14 ***
`Social support`              1.84726    0.46694   3.956 0.000121 ***
`Freedom to make life choices` 0.31659    0.37791   0.838 0.403621
```

```
Generosity                       0.90535    0.31768   2.850 0.005040 **
`Perceptions of corruption`      1.47735    0.32951   4.483 1.52e-05 ***
`Positive affect`                4.63312    0.61365   7.550 5.22e-12 ***
`Negative affect`               -2.12449    0.46146  -4.604 9.27e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4682 on 139 degrees of freedom
  (103 observations deleted due to missingness)
Multiple R-squared:  0.8395,    Adjusted R-squared:  0.8315
F-statistic: 103.9 on 7 and 139 DF,  p-value: < 2.2e-16
```

We decided to use a 5% level of significance. Thus, we dropped Freedom to make life choices.

```
Call:
lm(formula = `Life Ladder` ~ . - `Healthy life expectancy at birth` -
    `Freedom to make life choices`, data = mena_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-1.12463 -0.26390  0.00552  0.31321  1.11672

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                -4.62588    0.73329  -6.308 3.47e-09 ***
`Log GDP per capita`        0.58345    0.06334   9.212 4.27e-16 ***
`Social support`            1.78345    0.46020   3.875 0.000163 ***
Generosity                  0.93647    0.31516   2.971 0.003491 **
`Perceptions of corruption` 1.42688    0.32362   4.409 2.05e-05 ***
`Positive affect`           4.80693    0.57689   8.332 6.58e-14 ***
`Negative affect`          -2.17883    0.45640  -4.774 4.50e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4678 on 140 degrees of freedom
  (103 observations deleted due to missingness)
Multiple R-squared:  0.8387,    Adjusted R-squared:  0.8318
F-statistic: 121.3 on 6 and 140 DF,  p-value: < 2.2e-16
```

Based on the model above, we can conclude that at a 5% significance level, all of the above variables are significant factors influencing life ladder in the MENA region.

Sub-Saharan Africa:

	Life Ladder	Log GDP per capita	Social support
Life Ladder	1.00000000	0.3920526	0.31991176
Log GDP per capita	0.39205256	1.0000000	0.42306497
Social support	0.31991176	0.4230650	1.00000000
Healthy life expectancy at birth	0.16528597	0.3505067	0.01760768
Freedom to make life choices	0.20088451	0.1906759	0.02472255
Generosity	0.03350894	-0.3549446	-0.17006029
Perceptions of corruption	0.11787949	0.1754409	0.18576576
Positive affect	0.32893242	0.2699938	0.36119748
Negative affect	-0.02638830	-0.1515421	-0.44629683

	Healthy life expectancy at birth
Life Ladder	0.16528597
Log GDP per capita	0.35050671
Social support	0.01760768
Healthy life expectancy at birth	1.00000000
Freedom to make life choices	0.19974411
Generosity	0.14894790
Perceptions of corruption	-0.22863865
Positive affect	0.20145034
Negative affect	0.05165162

	Freedom to make life choices	Generosity
Life Ladder	0.20088451	0.03350894
Log GDP per capita	0.19067587	-0.35494458
Social support	0.02472255	-0.17006029
Healthy life expectancy at birth	0.19974411	0.14894790
Freedom to make life choices	1.00000000	0.12273022
Generosity	0.12273022	1.00000000
Perceptions of corruption	-0.33726512	-0.01606382
Positive affect	0.26471714	0.15950774
Negative affect	-0.01739813	0.12172602

	Perceptions of corruption	Positive affect
Life Ladder	0.11787949	0.3289324
Log GDP per capita	0.17544089	0.2699938
Social support	0.18576576	0.3611975
Healthy life expectancy at birth	-0.22863865	0.2014503
Freedom to make life choices	-0.33726512	0.2647171
Generosity	-0.01606382	0.1595077
Perceptions of corruption	1.00000000	-0.1052218
Positive affect	-0.10522178	1.0000000
Negative affect	0.07285806	-0.3664584

```
                                Negative affect
Life Ladder                          -0.02638830
Log GDP per capita                   -0.15154208
Social support                       -0.44629683
Healthy life expectancy at birth      0.05165162
Freedom to make life choices         -0.01739813
Generosity                            0.12172602
Perceptions of corruption             0.07285806
Positive affect                      -0.36645845
Negative affect                       1.00000000
```

From the correlation matrix above (using a threshold of $|0.7|$), we don't need to remove any variables due to multicollinearity.

```
Call:
lm(formula = `Life Ladder` ~ ., data = s_africa_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-1.52701 -0.34826  0.02837  0.40315  1.60324

Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                       -0.498421   0.502937  -0.991  0.32220
`Log GDP per capita`               0.236770   0.048540   4.878 1.48e-06 ***
`Social support`                   1.097658   0.277095   3.961 8.64e-05 ***
`Healthy life expectancy at birth` -0.000995   0.007703  -0.129  0.89728
`Freedom to make life choices`     0.575300   0.253190   2.272  0.02354 *
Generosity                         0.622403   0.292340   2.129  0.03378 *
`Perceptions of corruption`        0.378816   0.241656   1.568  0.11767
`Positive affect`                  1.826160   0.433991   4.208 3.10e-05 ***
`Negative affect`                  1.130809   0.324500   3.485  0.00054 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5543 on 458 degrees of freedom
  (13 observations deleted due to missingness)
Multiple R-squared:  0.2708,    Adjusted R-squared:  0.258
F-statistic: 21.26 on 8 and 458 DF,  p-value: < 2.2e-16
```

We decided to use a 5% level of significance. Thus, we dropped Log GDP per capita and Healthy life expectancy at birth.

```
Call:
lm(formula = `Life Ladder` ~ . - `Healthy life expectancy at birth` -
    `Log GDP per capita` - `Perceptions of corruption`, data = s_africa_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-1.61739 -0.35174  0.01916  0.34788  1.63255

Coefficients:
                               Estimate Std. Error t value Pr(>|t|)
(Intercept)                     0.70528    0.35446   1.990  0.04721 *
`Social support`                1.74431    0.26559   6.568 1.38e-10 ***
`Freedom to make life choices`  0.70479    0.23823   2.958  0.00325 **
Generosity                      0.03268    0.26088   0.125  0.90038
`Positive affect`               2.27679    0.43726   5.207 2.90e-07 ***
`Negative affect`               1.44750    0.32977   4.389 1.41e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5762 on 461 degrees of freedom
  (13 observations deleted due to missingness)
Multiple R-squared:  0.2069,    Adjusted R-squared:  0.1983
F-statistic: 24.05 on 5 and 461 DF,  p-value: < 2.2e-16
```

Based on the model above, we can conclude that at a 5% significance level, everything excluding Generosity was a significant factor influencing life ladder in the Sub-Saharan African region. However, Social Support, Freedom to make life choices, Positive affect and Negative affect are more significant contributors to life ladder than Perceptions of corruption.

Conclusion

After everything we analysis, we can get following conclusions on the different regions:

Europe & Central Asia: Variables remove due to multilinearity: Healthy life expectancy at birth, and Positive affect. Variables have siginifiacnt effect on life ladder: Log GDP per capita, Social support, Freedom to make life choices, Generosity, Perceptions of corruption, and Negative affect.

East Asia & Pacific: Variables remove due to multilinearity: Healthy life expectancy at birth. Variables have siginifiacnt effect on life ladder: Log GDP per capita, Social support, Perceptions of corruption, and Positive affect.

South Asia: Variables remove due to multilinearity: Healthy life expectancy at birth, and Positive affect. Variables have siginifiacnt effect on life ladder: Social support, Perceptions of corruption and Negative affect.

Middle East & North Africa: Variables remove due to multilinearity: Healthy life expectancy at birth. Variables have siginifiacnt effect on life ladder: Log GDP per capita, Social support, Freedom to make life choices, Generosity, Perceptions of corruption, and Negative affect.

Sub-Saharan Africa: Variables remove due to multilinearity: None (no variable need to remove). Variables have siginifiacnt effect on life ladder: Log GDP per capita, Social support, Generosity, Positive affect, and Negative affect.

Latin America & Caribbean: Variables remove due to multilinearity: None (no variable need to remove). Variables have siginifiacnt effect on life ladder: Log GDP per capita, Social support, Perceptions of corruption, Positive affect.

North America: Variables remove due to multilinearity: Log GDP per capita, Freedom to make life choices, and Healthy life expectancy at birth. Variables have siginifiacnt effect on life ladder: Social support and Positive affect.

We can see there are many differences between the regions. The variables with significant effect on life ladder in Sub-Saharan Africa, and Latin America & Caribbean are similar, that of Europe & Central Asia is similar to Middle East & North Africa. While North America has least variables have siginifiacnt effect on life ladder, only two.

Appendix

```
library(tidyverse)
library(countrycode)
```

```
whr <- read_csv("whr-2023.csv") %>%
  mutate(
    Region = countrycode(`Country name`,
                         origin    = "country.name",
                         destination = "region")
  ) %>%
  filter(!is.na(Region))

vars <- c(
  "Life Ladder",
  "Log GDP per capita",
  "Social support",
```

```
  "Healthy life expectancy at birth",
  "Freedom to make life choices",
  "Generosity",
  "Perceptions of corruption"
)
```

```
#3) ECA = "Europe & Central Asia", EAP = "East Asia & Pacific"
ECA <- whr %>% filter(Region == "Europe & Central Asia")
EAP <- whr %>% filter(Region == "East Asia & Pacific")
```

Europe and Central Asia

```
#4) MLR
ECA_num <- ECA %>% select(-c(`Country name`,`year`,`Region`))
ECA_lm <- lm(`Life Ladder` ~ ., data = ECA_num)
summary(ECA_lm)
```

```
Call:
lm(formula = `Life Ladder` ~ ., data = ECA_num)

Residuals:
     Min       1Q   Median       3Q      Max
-1.27138 -0.19147  0.01508  0.22827  1.19586

Coefficients:
                                 Estimate Std. Error t value Pr(>|t|)
(Intercept)                     -2.878271   0.374057  -7.695 4.95e-14 ***
`Log GDP per capita`             0.318929   0.037558   8.492  < 2e-16 ***
`Social support`                 2.263177   0.248319   9.114  < 2e-16 ***
`Healthy life expectancy at birth` 0.036658   0.008421   4.353 1.55e-05 ***
`Freedom to make life choices`   0.675781   0.158533   4.263 2.30e-05 ***
Generosity                       0.354447   0.116964   3.030  0.00253 **
`Perceptions of corruption`     -0.805949   0.091609  -8.798  < 2e-16 ***
`Positive affect`                2.251316   0.297781   7.560 1.29e-13 ***
`Negative affect`               -0.583474   0.288284  -2.024  0.04336 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Residual standard error: 0.3669 on 686 degrees of freedom
  (53 observations deleted due to missingness)
Multiple R-squared:  0.8609,    Adjusted R-squared:  0.8593
F-statistic: 530.6 on 8 and 686 DF,  p-value: < 2.2e-16
```

```r
#5) correlation matrix
cor(ECA_num, use = "complete.obs")
```

```
                                Life Ladder Log GDP per capita Social support
Life Ladder                       1.0000000          0.7611776      0.6994617
Log GDP per capita                0.7611776          1.0000000      0.5670444
Social support                    0.6994617          0.5670444      1.0000000
Healthy life expectancy at birth  0.6936020          0.7859716      0.4015822
Freedom to make life choices      0.7317736          0.4509842      0.5550441
Generosity                        0.5764723          0.3048967      0.3890898
Perceptions of corruption        -0.6805740         -0.4893120     -0.3124053
Positive affect                   0.8446424          0.6325326      0.6712274
Negative affect                  -0.4194468         -0.1598842     -0.4394876
                                Healthy life expectancy at birth
Life Ladder                                          0.69360196
Log GDP per capita                                   0.78597163
Social support                                       0.40158218
Healthy life expectancy at birth                     1.00000000
Freedom to make life choices                         0.46046469
Generosity                                           0.43844096
Perceptions of corruption                           -0.45720807
Positive affect                                      0.61491664
Negative affect                                      0.06064105
                                Freedom to make life choices Generosity
Life Ladder                                        0.7317736  0.5764723
Log GDP per capita                                 0.4509842  0.3048967
Social support                                     0.5550441  0.3890898
Healthy life expectancy at birth                   0.4604647  0.4384410
Freedom to make life choices                       1.0000000  0.5652406
Generosity                                         0.5652406  1.0000000
Perceptions of corruption                         -0.6328505 -0.5124676
Positive affect                                    0.7618484  0.6240887
Negative affect                                   -0.5071508 -0.2558771
                                Perceptions of corruption Positive affect
Life Ladder                                    -0.6805740       0.8446424
Log GDP per capita                             -0.4893120       0.6325326
Social support                                 -0.3124053       0.6712274
```

```
Healthy life expectancy at birth                -0.4572081       0.6149166
Freedom to make life choices                    -0.6328505       0.7618484
Generosity                                      -0.5124676       0.6240887
Perceptions of corruption                        1.0000000      -0.6060734
Positive affect                                 -0.6060734       1.0000000
Negative affect                                  0.4282453      -0.4740141
                                  Negative affect
Life Ladder                           -0.41944684
Log GDP per capita                    -0.15988417
Social support                        -0.43948760
Healthy life expectancy at birth       0.06064105
Freedom to make life choices          -0.50715084
Generosity                            -0.25587706
Perceptions of corruption              0.42824532
Positive affect                       -0.47401407
Negative affect                        1.00000000
```

```r
#shorten for visualize
ECA_num_s <- data.frame(
  LL  = ECA_num$`Life Ladder`,
  GDP = ECA_num$`Log GDP per capita`,
  SS  = ECA_num$`Social support`,
  HEB = ECA_num$`Healthy life expectancy at birth`,
  FLC = ECA_num$`Freedom to make life choices`,
  G   = ECA_num$`Generosity`,
  PC  = ECA_num$`Perceptions of corruption`,
  PA  = ECA_num$`Positive affect`,
  PN  = ECA_num$`Negative affect`
)

cor(ECA_num_s, use = "complete.obs")
```

```
           LL        GDP         SS         HEB        FLC          G
LL   1.0000000  0.7611776  0.6994617  0.69360196  0.7317736  0.5764723
GDP  0.7611776  1.0000000  0.5670444  0.78597163  0.4509842  0.3048967
SS   0.6994617  0.5670444  1.0000000  0.40158218  0.5550441  0.3890898
HEB  0.6936020  0.7859716  0.4015822  1.00000000  0.4604647  0.4384410
FLC  0.7317736  0.4509842  0.5550441  0.46046469  1.0000000  0.5652406
G    0.5764723  0.3048967  0.3890898  0.43844096  0.5652406  1.0000000
PC  -0.6805740 -0.4893120 -0.3124053 -0.45720807 -0.6328505 -0.5124676
PA   0.8446424  0.6325326  0.6712274  0.61491664  0.7618484  0.6240887
PN  -0.4194468 -0.1598842 -0.4394876  0.06064105 -0.5071508 -0.2558771
```

```
            PC         PA          PN
LL  -0.6805740  0.8446424 -0.41944684
GDP -0.4893120  0.6325326 -0.15988417
SS  -0.3124053  0.6712274 -0.43948760
HEB -0.4572081  0.6149166  0.06064105
FLC -0.6328505  0.7618484 -0.50715084
G   -0.5124676  0.6240887 -0.25587706
PC   1.0000000 -0.6060734  0.42824532
PA  -0.6060734  1.0000000 -0.47401407
PN   0.4282453 -0.4740141  1.00000000
```

```r
#6) remove 2 variables
ECA_num_rem <- ECA_num %>% select(-c(`Healthy life expectancy at birth`, `Positive affect`))
ECA_lm_new  <- lm(`Life Ladder` ~ ., data = ECA_num_rem)
summary(ECA_lm_new)
```

```
Call:
lm(formula = `Life Ladder` ~ ., data = ECA_num_rem)

Residuals:
     Min       1Q   Median       3Q      Max
-1.43081 -0.23484  0.02483  0.25329  1.27323

Coefficients:
                              Estimate Std. Error t value Pr(>|t|)
(Intercept)                  -1.57135    0.28614  -5.492 5.57e-08 ***
`Log GDP per capita`          0.52173    0.02882  18.101  < 2e-16 ***
`Social support`              2.40562    0.25230   9.535  < 2e-16 ***
`Freedom to make life choices`  1.26933    0.15357   8.266 6.92e-16 ***
Generosity                    1.00416    0.11058   9.081  < 2e-16 ***
`Perceptions of corruption`  -0.76286    0.09633  -7.919 9.32e-15 ***
`Negative affect`            -0.76388    0.25798  -2.961  0.00317 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3983 on 703 degrees of freedom
  (38 observations deleted due to missingness)
Multiple R-squared:  0.8333,    Adjusted R-squared:  0.8319
F-statistic: 585.6 on 6 and 703 DF,  p-value: < 2.2e-16
```

East Asia and Pacific

```
#4) MLR
EAP_num <- EAP %>% select(-c(`Country name`, `year`, `Region`))
EAP_lm  <- lm(`Life Ladder` ~ ., data = EAP_num)
summary(EAP_lm)
```

```
Call:
lm(formula = `Life Ladder` ~ ., data = EAP_num)

Residuals:
     Min       1Q   Median       3Q      Max
-1.32836 -0.25339  0.02262  0.26507  1.22212

Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                       -4.30046    0.74297  -5.788 2.86e-08 ***
`Log GDP per capita`               0.51585    0.09526   5.415 1.81e-07 ***
`Social support`                   3.46107    0.47726   7.252 9.83e-12 ***
`Healthy life expectancy at birth` 0.01185    0.01404   0.843   0.4000
`Freedom to make life choices`     0.52020    0.41357   1.258   0.2100
Generosity                         0.24550    0.15089   1.627   0.1054
`Perceptions of corruption`       -0.37311    0.17746  -2.103   0.0368 *
`Positive affect`                  1.64945    0.41147   4.009 8.73e-05 ***
`Negative affect`                 -0.13000    0.48024  -0.271   0.7869
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3815 on 192 degrees of freedom
  (55 observations deleted due to missingness)
Multiple R-squared:  0.8333,    Adjusted R-squared:  0.8263
F-statistic:   120 on 8 and 192 DF,  p-value: < 2.2e-16
```


```
#4) MLR
EAP_num <- EAP %>% select(-c(`Country name`, `year`, `Region`))
EAP_lm  <- lm(`Life Ladder` ~ ., data = EAP_num)
summary(EAP_lm)
```

```
Call:
lm(formula = `Life Ladder` ~ ., data = EAP_num)

Residuals:
     Min       1Q   Median       3Q      Max
-1.32836 -0.25339  0.02262  0.26507  1.22212

Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                       -4.30046    0.74297  -5.788 2.86e-08 ***
`Log GDP per capita`               0.51585    0.09526   5.415 1.81e-07 ***
`Social support`                   3.46107    0.47726   7.252 9.83e-12 ***
`Healthy life expectancy at birth` 0.01185    0.01404   0.843   0.4000
`Freedom to make life choices`     0.52020    0.41357   1.258   0.2100
Generosity                         0.24550    0.15089   1.627   0.1054
`Perceptions of corruption`       -0.37311    0.17746  -2.103   0.0368 *
`Positive affect`                  1.64945    0.41147   4.009 8.73e-05 ***
`Negative affect`                 -0.13000    0.48024  -0.271   0.7869
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3815 on 192 degrees of freedom
  (55 observations deleted due to missingness)
Multiple R-squared:  0.8333,    Adjusted R-squared:  0.8263
F-statistic:   120 on 8 and 192 DF,  p-value: < 2.2e-16
```

```r
#5) correlation matrix
cor(EAP_num, use = "complete.obs")
```

```
                                Life Ladder Log GDP per capita Social support
Life Ladder                      1.00000000          0.8301956     0.72626828
Log GDP per capita               0.83019556          1.0000000     0.60749914
Social support                   0.72626828          0.6074991     1.00000000
Healthy life expectancy at birth 0.74654364          0.9118113     0.48143003
Freedom to make life choices     0.13040207         -0.1332271     0.04348335
Generosity                      -0.09318964         -0.3167818    -0.04901763
Perceptions of corruption       -0.62335156         -0.6131060    -0.39802336
Positive affect                  0.23896591         -0.0109973     0.06881312
Negative affect                 -0.49558398         -0.5429337    -0.56331301
                                Healthy life expectancy at birth
Life Ladder                                          0.74654364
Log GDP per capita                                   0.91181125
```

```
Social support                                 0.48143003
Healthy life expectancy at birth               1.00000000
Freedom to make life choices                  -0.05747589
Generosity                                    -0.38542835
Perceptions of corruption                     -0.52350084
Positive affect                                0.03056720
Negative affect                               -0.43779939
                                Freedom to make life choices  Generosity
Life Ladder                                      0.13040207 -0.09318964
Log GDP per capita                              -0.13322710 -0.31678178
Social support                                   0.04348335 -0.04901763
Healthy life expectancy at birth                -0.05747589 -0.38542835
Freedom to make life choices                     1.00000000  0.19462430
Generosity                                       0.19462430  1.00000000
Perceptions of corruption                       -0.31684123  0.02493711
Positive affect                                  0.57301219  0.32366211
Negative affect                                  0.23693392  0.06871409
                                Perceptions of corruption Positive affect
Life Ladder                                   -0.62335156      0.23896591
Log GDP per capita                            -0.61310601     -0.01099730
Social support                                -0.39802336      0.06881312
Healthy life expectancy at birth              -0.52350084      0.03056720
Freedom to make life choices                  -0.31684123      0.57301219
Generosity                                     0.02493711      0.32366211
Perceptions of corruption                      1.00000000     -0.07317717
Positive affect                               -0.07317717      1.00000000
Negative affect                                0.28378263      0.14031759
                                Negative affect
Life Ladder                          -0.49558398
Log GDP per capita                   -0.54293365
Social support                       -0.56331301
Healthy life expectancy at birth     -0.43779939
Freedom to make life choices          0.23693392
Generosity                            0.06871409
Perceptions of corruption             0.28378263
Positive affect                       0.14031759
Negative affect                       1.00000000
```

```r
#6) remove 2 variables
EAP_num_rem <- EAP_num %>% select(-c(`Healthy life expectancy at birth`))
EAP_lm_new  <- lm(`Life Ladder` ~ ., data = EAP_num_rem)
summary(EAP_lm_new)
```

```
Call:
lm(formula = `Life Ladder` ~ ., data = EAP_num_rem)

Residuals:
     Min       1Q   Median       3Q      Max
-1.21110 -0.30528  0.00298  0.30702  1.34832

Coefficients:
                               Estimate Std. Error t value Pr(>|t|)
(Intercept)                   -3.768054   0.752306  -5.009 1.15e-06 ***
`Log GDP per capita`           0.465035   0.052723   8.820 4.06e-16 ***
`Social support`               4.039365   0.467770   8.635 1.36e-15 ***
`Freedom to make life choices` -0.003532   0.398871  -0.009   0.9929
Generosity                    -0.019787   0.146631  -0.135   0.8928
`Perceptions of corruption`   -0.377176   0.180056  -2.095   0.0374 *
`Positive affect`              2.716580   0.380846   7.133 1.49e-11 ***
`Negative affect`             -0.316745   0.471259  -0.672   0.5022
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4003 on 214 degrees of freedom
  (34 observations deleted due to missingness)
Multiple R-squared:  0.8015,    Adjusted R-squared:  0.795
F-statistic: 123.4 on 7 and 214 DF,  p-value: < 2.2e-16
```

Latin America & Caribbean

```r
latin_countries <- whr %>%
  filter(Region == "Latin America & Caribbean") %>%
  select(-`Country name`, -year, -Region)

latin_countries %>%
  cor(use = "complete.obs")
```

```
                                Life Ladder Log GDP per capita Social support
Life Ladder                       1.0000000         0.60903043     0.54618383
Log GDP per capita                0.6090304         1.00000000     0.47660216
Social support                    0.5461838         0.47660216     1.00000000
Healthy life expectancy at birth  0.5055920         0.48552262     0.54303683
```

Freedom to make life choices	0.4848418	0.44647323	0.44067997
Generosity	-0.3315004	-0.43142915	-0.33541651
Perceptions of corruption	-0.1373564	-0.05148498	0.06810653
Positive affect	0.5212056	0.28243401	0.47259507
Negative affect	-0.3885353	-0.32730759	-0.39122296

	Healthy life expectancy at birth
Life Ladder	0.50559201
Log GDP per capita	0.48552262
Social support	0.54303683
Healthy life expectancy at birth	1.00000000
Freedom to make life choices	0.52170829
Generosity	-0.47374193
Perceptions of corruption	0.03172322
Positive affect	0.52160066
Negative affect	-0.03590270

	Freedom to make life choices	Generosity
Life Ladder	0.484841821	-0.33150043
Log GDP per capita	0.446473235	-0.43142915
Social support	0.440679972	-0.33541651
Healthy life expectancy at birth	0.521708289	-0.47374193
Freedom to make life choices	1.000000000	-0.37640504
Generosity	-0.376405035	1.00000000
Perceptions of corruption	-0.138681999	0.01973290
Positive affect	0.409190053	-0.25428331
Negative affect	0.004873756	-0.04353999

	Perceptions of corruption	Positive affect
Life Ladder	-0.13735643	0.5212056
Log GDP per capita	-0.05148498	0.2824340
Social support	0.06810653	0.4725951
Healthy life expectancy at birth	0.03172322	0.5216007
Freedom to make life choices	-0.13868200	0.4091901
Generosity	0.01973290	-0.2542833
Perceptions of corruption	1.00000000	0.1179222
Positive affect	0.11792216	1.0000000
Negative affect	0.06369676	-0.3914519

	Negative affect
Life Ladder	-0.388535255
Log GDP per capita	-0.327307592
Social support	-0.391222958
Healthy life expectancy at birth	-0.035902700
Freedom to make life choices	0.004873756
Generosity	-0.043539992
Perceptions of corruption	0.063696762

```
Positive affect                      -0.391451910
Negative affect                       1.000000000
```

```r
latin_model1 <- lm(`Life Ladder` ~ ., data = latin_countries)
summary(latin_model1)
```

```

Call:
lm(formula = `Life Ladder` ~ ., data = latin_countries)

Residuals:
    Min      1Q  Median      3Q     Max
-1.5352 -0.3033  0.0618  0.3291  1.1797

Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                     -0.935049   0.755264  -1.238 0.216625
`Log GDP per capita`             0.373757   0.055696   6.711 9.05e-11 ***
`Social support`                 1.513497   0.556570   2.719 0.006905 **
`Healthy life expectancy at birth`  0.009544   0.006679   1.429 0.154012
`Freedom to make life choices`   0.767320   0.342104   2.243 0.025598 *
Generosity                       0.013375   0.291895   0.046 0.963482
`Perceptions of corruption`     -1.151732   0.327999  -3.511 0.000511 ***
`Positive affect`                2.948661   0.635303   4.641 5.09e-06 ***
`Negative affect`               -1.409994   0.620785  -2.271 0.023805 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4834 on 314 degrees of freedom
  (8 observations deleted due to missingness)
Multiple R-squared:  0.5687,    Adjusted R-squared:  0.5577
F-statistic: 51.75 on 8 and 314 DF,  p-value: < 2.2e-16
```

```r
latin_model2 <- lm(
  `Life Ladder` ~ . - `Healthy life expectancy at birth` - Generosity,
  data = latin_countries
)
summary(latin_model2)
```

```

Call:
```

```
lm(formula = `Life Ladder` ~ . - `Healthy life expectancy at birth` -
    Generosity, data = latin_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-1.57915 -0.31625  0.05608  0.33345  1.21121

Coefficients:
                               Estimate Std. Error t value Pr(>|t|)
(Intercept)                   -1.17788    0.66066  -1.783 0.075564 .
`Log GDP per capita`           0.39901    0.05046   7.908 4.41e-14 ***
`Social support`               1.77824    0.52222   3.405 0.000747 ***
`Freedom to make life choices` 0.81322    0.34040   2.389 0.017480 *
`Perceptions of corruption`   -1.17120    0.32745  -3.577 0.000402 ***
`Positive affect`              3.32537    0.57663   5.767 1.92e-08 ***
`Negative affect`             -1.08787    0.56381  -1.929 0.054565 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4834 on 316 degrees of freedom
  (8 observations deleted due to missingness)
Multiple R-squared:  0.5658,    Adjusted R-squared:  0.5576
F-statistic: 68.64 on 6 and 316 DF,  p-value: < 2.2e-16
```

North America

```r
na_countries <- whr %>%
  filter(Region == "North America") %>%
  select(-`Country name`, -year, -Region)

na_countries %>%
  cor(use = "complete.obs")
```

```
                              Life Ladder Log GDP per capita Social support
Life Ladder                     1.0000000         -0.7589950      0.7248373
Log GDP per capita             -0.7589950          1.0000000     -0.6461960
Social support                  0.7248373         -0.6461960      1.0000000
Healthy life expectancy at birth  0.5887594         -0.9299397      0.5347143
Freedom to make life choices    0.7646006         -0.8291102      0.6484041
Generosity                      0.5470360         -0.3371957      0.2786627
```

```
Perceptions of corruption        -0.6045279          0.8930323     -0.5411953
Positive affect                   0.8161616         -0.6153316      0.3927745
Negative affect                  -0.5750204          0.3368360     -0.4329264
                                 Healthy life expectancy at birth
Life Ladder                                             0.5887594
Log GDP per capita                                     -0.9299397
Social support                                          0.5347143
Healthy life expectancy at birth                        1.0000000
Freedom to make life choices                            0.8017396
Generosity                                              0.1990675
Perceptions of corruption                              -0.9731710
Positive affect                                         0.5037470
Negative affect                                        -0.1920267
                                 Freedom to make life choices Generosity
Life Ladder                                         0.7646006  0.5470360
Log GDP per capita                                 -0.8291102 -0.3371957
Social support                                      0.6484041  0.2786627
Healthy life expectancy at birth                    0.8017396  0.1990675
Freedom to make life choices                        1.0000000  0.2156677
Generosity                                          0.2156677  1.0000000
Perceptions of corruption                          -0.8191946 -0.1631242
Positive affect                                     0.7212917  0.5580426
Negative affect                                    -0.3429026 -0.5207267
                                 Perceptions of corruption Positive affect
Life Ladder                                     -0.6045279       0.8161616
Log GDP per capita                               0.8930323      -0.6153316
Social support                                  -0.5411953       0.3927745
Healthy life expectancy at birth                -0.9731710       0.5037470
Freedom to make life choices                    -0.8191946       0.7212917
Generosity                                      -0.1631242       0.5580426
Perceptions of corruption                        1.0000000      -0.5081290
Positive affect                                 -0.5081290       1.0000000
Negative affect                                  0.2522588      -0.5444964
                                 Negative affect
Life Ladder                           -0.5750204
Log GDP per capita                     0.3368360
Social support                        -0.4329264
Healthy life expectancy at birth      -0.1920267
Freedom to make life choices          -0.3429026
Generosity                            -0.5207267
Perceptions of corruption              0.2522588
Positive affect                       -0.5444964
Negative affect                        1.0000000
```

```r
na_model1 <- lm(
  `Life Ladder` ~ . - `Log GDP per capita` -
    `Freedom to make life choices` - `Healthy life expectancy at birth`,
  data = na_countries
)
summary(na_model1)
```

```
Call:
lm(formula = `Life Ladder` ~ . - `Log GDP per capita` - `Freedom to make life choices` -
    `Healthy life expectancy at birth`, data = na_countries)

Residuals:
      Min        1Q    Median        3Q       Max
-0.227448 -0.050699  0.004387  0.042674  0.163111

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                  -2.7330     1.6878  -1.619    0.118
`Social support`              6.4529     1.3753   4.692 8.28e-05 ***
Generosity                    0.3676     0.3399   1.082    0.290
`Perceptions of corruption`  -0.1213     0.1626  -0.746    0.462
`Positive affect`             5.1875     1.0267   5.052 3.26e-05 ***
`Negative affect`            -0.2083     0.9425  -0.221    0.827
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.09768 on 25 degrees of freedom
  (3 observations deleted due to missingness)
Multiple R-squared:  0.8682,    Adjusted R-squared:  0.8419
F-statistic: 32.94 on 5 and 25 DF,  p-value: 3.14e-10
```

```r
na_model2 <- lm(`Life Ladder` ~ . - `Log GDP per capita` -
                  `Freedom to make life choices` - `Healthy life expectancy at birth` -
                  Generosity - `Perceptions of corruption` - `Negative affect`,
                data = na_countries)

summary(na_model2)
```

```
Call:
```

```
lm(formula = `Life Ladder` ~ . - `Log GDP per capita` - `Freedom to make life choices` -
    `Healthy life expectancy at birth` - Generosity - `Perceptions of corruption` -
    `Negative affect`, data = na_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-0.20913 -0.06754  0.01420  0.04104  0.16920

Coefficients:
                  Estimate Std. Error t value Pr(>|t|)
(Intercept)        -4.0031     0.9825  -4.075 0.000344 ***
`Social support`    7.0697     1.1397   6.203 1.06e-06 ***
`Positive affect`   6.0350     0.7401   8.154 7.07e-09 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.09535 on 28 degrees of freedom
  (3 observations deleted due to missingness)
Multiple R-squared:  0.8594,    Adjusted R-squared:  0.8493
F-statistic: 85.55 on 2 and 28 DF,  p-value: 1.184e-12
```

South Asia

```r
sa_countries <- whr %>%
  filter(Region == "South Asia") %>%
  select(-`Country name`, -year, -Region)

sa_countries %>%
  cor(use = "complete.obs")
```

```
                               Life Ladder Log GDP per capita Social support
Life Ladder                      1.0000000          0.1698210     0.28797678
Log GDP per capita               0.1698210          1.0000000     0.55672799
Social support                   0.2879768          0.5567280     1.00000000
Healthy life expectancy at birth 0.1291219          0.7624004     0.67311979
Freedom to make life choices     0.1099293          0.6136421     0.49243689
Generosity                       0.2200532          0.2174292     0.44148515
Perceptions of corruption       -0.2731788         -0.3106971    -0.04978062
Positive affect                  0.1097789          0.7594880     0.54969765
Negative affect                 -0.2823256         -0.1695584    -0.42493586
```

	Healthy life expectancy at birth
Life Ladder	0.1291219
Log GDP per capita	0.7624004
Social support	0.6731198
Healthy life expectancy at birth	1.0000000
Freedom to make life choices	0.7125846
Generosity	0.0620094
Perceptions of corruption	-0.3058033
Positive affect	0.5035001
Negative affect	-0.2498326

	Freedom to make life choices	Generosity
Life Ladder	0.10992934	0.22005318
Log GDP per capita	0.61364205	0.21742917
Social support	0.49243689	0.44148515
Healthy life expectancy at birth	0.71258464	0.06200940
Freedom to make life choices	1.00000000	0.04292219
Generosity	0.04292219	1.00000000
Perceptions of corruption	-0.45988235	-0.06457705
Positive affect	0.39790086	0.40179209
Negative affect	-0.09745266	-0.26648929

	Perceptions of corruption	Positive affect
Life Ladder	-0.27317878	0.10977893
Log GDP per capita	-0.31069711	0.75948797
Social support	-0.04978062	0.54969765
Healthy life expectancy at birth	-0.30580329	0.50350013
Freedom to make life choices	-0.45988235	0.39790086
Generosity	-0.06457705	0.40179209
Perceptions of corruption	1.00000000	-0.04579712
Positive affect	-0.04579712	1.00000000
Negative affect	-0.05265876	-0.46936673

	Negative affect
Life Ladder	-0.28232564
Log GDP per capita	-0.16955838
Social support	-0.42493586
Healthy life expectancy at birth	-0.24983264
Freedom to make life choices	-0.09745266
Generosity	-0.26648929
Perceptions of corruption	-0.05265876
Positive affect	-0.46936673
Negative affect	1.00000000

```r
sa_model1 <- lm(
  `Life Ladder` ~ . - `Healthy life expectancy at birth` - `Positive affect`,
  data = sa_countries
)
summary(sa_model1)
```

```
Call:
lm(formula = `Life Ladder` ~ . - `Healthy life expectancy at birth` -
    `Positive affect`, data = sa_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-1.28394 -0.32210 -0.01231  0.42735  1.40852

Coefficients:
                               Estimate Std. Error t value Pr(>|t|)
(Intercept)                     7.58184    1.62546   4.664 1.11e-05 ***
`Log GDP per capita`           -0.01645    0.16884  -0.097  0.92262
`Social support`                1.52324    0.77811   1.958  0.05348 .
`Freedom to make life choices` -0.91890    0.61105  -1.504  0.13625
Generosity                      0.19016    0.69799   0.272  0.78593
`Perceptions of corruption`    -3.47691    1.05998  -3.280  0.00149 **
`Negative affect`              -1.67757    0.91004  -1.843  0.06868 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6461 on 87 degrees of freedom
  (6 observations deleted due to missingness)
Multiple R-squared:  0.2192,    Adjusted R-squared:  0.1654
F-statistic: 4.071 on 6 and 87 DF,  p-value: 0.001206
```

```r
sa_model2 <- lm(
  `Life Ladder` ~ `Social support` + `Perceptions of corruption` + `Negative affect`,
  data = sa_countries
)
summary(sa_model2)
```

```
Call:
lm(formula = `Life Ladder` ~ `Social support` + `Perceptions of corruption` +
```

```
    `Negative affect`, data = sa_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-2.10683 -0.45338 -0.06093  0.43747  1.68912

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                   6.3229     0.9779   6.466 4.33e-09 ***
`Social support`              1.2579     0.5699   2.207  0.02972 *
`Perceptions of corruption`  -2.2807     0.9308  -2.450  0.01610 *
`Negative affect`            -2.6911     0.9092  -2.960  0.00388 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6804 on 95 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.2436,    Adjusted R-squared:  0.2197
F-statistic:  10.2 on 3 and 95 DF,  p-value: 6.954e-06
```

Middle East & North Africa (MENA):

```r
mena_countries <- whr %>%
  filter(Region == "Middle East & North Africa") %>%
  select(-`Country name`, -year, -Region)

mena_countries %>%
  cor(use = "complete.obs")
```

```
                                Life Ladder Log GDP per capita Social support
Life Ladder                       1.0000000          0.7561809      0.7185170
Log GDP per capita                0.7561809          1.0000000      0.5984173
Social support                    0.7185170          0.5984173      1.0000000
Healthy life expectancy at birth  0.6676949          0.7520324      0.4869203
Freedom to make life choices      0.5551314          0.5242151      0.3433874
Generosity                        0.3899879          0.4191910      0.3191010
Perceptions of corruption        -0.2839978         -0.3667862     -0.2947866
Positive affect                   0.7381465          0.5042783      0.5186277
Negative affect                  -0.4439611         -0.1396304     -0.4025564
                                Healthy life expectancy at birth
```

```
Life Ladder                                    0.66769492
Log GDP per capita                             0.75203242
Social support                                 0.48692032
Healthy life expectancy at birth               1.00000000
Freedom to make life choices                   0.40658665
Generosity                                     0.36449641
Perceptions of corruption                      0.01700174
Positive affect                                0.30525275
Negative affect                               -0.14539394
                           Freedom to make life choices Generosity
Life Ladder                                   0.5551314  0.3899879
Log GDP per capita                            0.5242151  0.4191910
Social support                                0.3433874  0.3191010
Healthy life expectancy at birth              0.4065867  0.3644964
Freedom to make life choices                  1.0000000  0.2890933
Generosity                                    0.2890933  1.0000000
Perceptions of corruption                    -0.4421385 -0.2038428
Positive affect                               0.5957520  0.2752519
Negative affect                              -0.2544395  0.2204277
                           Perceptions of corruption Positive affect
Life Ladder                           -0.28399776       0.7381465
Log GDP per capita                    -0.36678621       0.5042783
Social support                        -0.29478660       0.5186277
Healthy life expectancy at birth       0.01700174       0.3052528
Freedom to make life choices          -0.44213853       0.5957520
Generosity                            -0.20384284       0.2752519
Perceptions of corruption              1.00000000      -0.4798124
Positive affect                       -0.47981245       1.0000000
Negative affect                        0.15233455      -0.3988775
                           Negative affect
Life Ladder                     -0.4439611
Log GDP per capita              -0.1396304
Social support                  -0.4025564
Healthy life expectancy at birth -0.1453939
Freedom to make life choices    -0.2544395
Generosity                       0.2204277
Perceptions of corruption        0.1523346
Positive affect                 -0.3988775
Negative affect                  1.0000000
```

```r
mena_model1 <- lm(
  `Life Ladder` ~ . - `Healthy life expectancy at birth`,
```

```
  data = mena_countries
)
summary(mena_model1)
```

```
Call:
lm(formula = `Life Ladder` ~ . - `Healthy life expectancy at birth`,
    data = mena_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-1.09139 -0.27024 -0.01139  0.28642  1.08748

Coefficients:
                               Estimate Std. Error t value Pr(>|t|)
(Intercept)                    -4.68549    0.73752  -6.353 2.81e-09 ***
`Log GDP per capita`            0.56646    0.06657   8.509 2.51e-14 ***
`Social support`                1.84726    0.46694   3.956 0.000121 ***
`Freedom to make life choices`  0.31659    0.37791   0.838 0.403621
Generosity                      0.90535    0.31768   2.850 0.005040 **
`Perceptions of corruption`     1.47735    0.32951   4.483 1.52e-05 ***
`Positive affect`               4.63312    0.61365   7.550 5.22e-12 ***
`Negative affect`              -2.12449    0.46146  -4.604 9.27e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4682 on 139 degrees of freedom
  (103 observations deleted due to missingness)
Multiple R-squared:  0.8395,    Adjusted R-squared:  0.8315
F-statistic: 103.9 on 7 and 139 DF,  p-value: < 2.2e-16
```

```
mena_model2 <- lm(
  `Life Ladder` ~ . - `Healthy life expectancy at birth` - `Freedom to make life choices`,
  data = mena_countries
)
summary(mena_model2)
```

```
Call:
lm(formula = `Life Ladder` ~ . - `Healthy life expectancy at birth` -
    `Freedom to make life choices`, data = mena_countries)
```

```
Residuals:
     Min       1Q   Median       3Q      Max
-1.12463 -0.26390  0.00552  0.31321  1.11672

Coefficients:
                           Estimate Std. Error t value Pr(>|t|)
(Intercept)                -4.62588    0.73329  -6.308 3.47e-09 ***
`Log GDP per capita`        0.58345    0.06334   9.212 4.27e-16 ***
`Social support`            1.78345    0.46020   3.875 0.000163 ***
Generosity                  0.93647    0.31516   2.971 0.003491 **
`Perceptions of corruption` 1.42688    0.32362   4.409 2.05e-05 ***
`Positive affect`           4.80693    0.57689   8.332 6.58e-14 ***
`Negative affect`          -2.17883    0.45640  -4.774 4.50e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.4678 on 140 degrees of freedom
  (103 observations deleted due to missingness)
Multiple R-squared:  0.8387,    Adjusted R-squared:  0.8318
F-statistic: 121.3 on 6 and 140 DF,  p-value: < 2.2e-16
```

Sub-Saharan Africa

```r
s_africa_countries <- whr %>%
  filter(Region == "Sub-Saharan Africa") %>%
  select(-`Country name`, -year, -Region)

s_africa_countries %>%
  cor(use = "complete.obs")
```

```
                                Life Ladder Log GDP per capita Social support
Life Ladder                      1.00000000          0.3920526     0.31991176
Log GDP per capita               0.39205256          1.0000000     0.42306497
Social support                   0.31991176          0.4230650     1.00000000
Healthy life expectancy at birth 0.16528597          0.3505067     0.01760768
Freedom to make life choices     0.20088451          0.1906759     0.02472255
Generosity                       0.03350894         -0.3549446    -0.17006029
Perceptions of corruption        0.11787949          0.1754409     0.18576576
Positive affect                  0.32893242          0.2699938     0.36119748
```

```
Negative affect                -0.02638830         -0.1515421    -0.44629683
                               Healthy life expectancy at birth
Life Ladder                                         0.16528597
Log GDP per capita                                  0.35050671
Social support                                      0.01760768
Healthy life expectancy at birth                    1.00000000
Freedom to make life choices                        0.19974411
Generosity                                          0.14894790
Perceptions of corruption                          -0.22863865
Positive affect                                     0.20145034
Negative affect                                     0.05165162
                               Freedom to make life choices  Generosity
Life Ladder                                      0.20088451  0.03350894
Log GDP per capita                               0.19067587 -0.35494458
Social support                                   0.02472255 -0.17006029
Healthy life expectancy at birth                 0.19974411  0.14894790
Freedom to make life choices                     1.00000000  0.12273022
Generosity                                       0.12273022  1.00000000
Perceptions of corruption                       -0.33726512 -0.01606382
Positive affect                                  0.26471714  0.15950774
Negative affect                                 -0.01739813  0.12172602
                               Perceptions of corruption Positive affect
Life Ladder                                   0.11787949       0.3289324
Log GDP per capita                            0.17544089       0.2699938
Social support                                0.18576576       0.3611975
Healthy life expectancy at birth             -0.22863865       0.2014503
Freedom to make life choices                 -0.33726512       0.2647171
Generosity                                   -0.01606382       0.1595077
Perceptions of corruption                     1.00000000      -0.1052218
Positive affect                              -0.10522178       1.0000000
Negative affect                               0.07285806      -0.3664584
                               Negative affect
Life Ladder                        -0.02638830
Log GDP per capita                 -0.15154208
Social support                     -0.44629683
Healthy life expectancy at birth    0.05165162
Freedom to make life choices       -0.01739813
Generosity                          0.12172602
Perceptions of corruption           0.07285806
Positive affect                    -0.36645845
Negative affect                     1.00000000
```

```r
s_africa_model1 <- lm(`Life Ladder` ~ ., data = s_africa_countries)
summary(s_africa_model1)
```

```
Call:
lm(formula = `Life Ladder` ~ ., data = s_africa_countries)

Residuals:
     Min       1Q   Median       3Q      Max
-1.52701 -0.34826  0.02837  0.40315  1.60324

Coefficients:
                                  Estimate Std. Error t value Pr(>|t|)
(Intercept)                       -0.498421   0.502937  -0.991  0.32220
`Log GDP per capita`               0.236770   0.048540   4.878 1.48e-06 ***
`Social support`                   1.097658   0.277095   3.961 8.64e-05 ***
`Healthy life expectancy at birth` -0.000995   0.007703  -0.129  0.89728
`Freedom to make life choices`     0.575300   0.253190   2.272  0.02354 *
Generosity                         0.622403   0.292340   2.129  0.03378 *
`Perceptions of corruption`        0.378816   0.241656   1.568  0.11767
`Positive affect`                  1.826160   0.433991   4.208 3.10e-05 ***
`Negative affect`                  1.130809   0.324500   3.485  0.00054 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5543 on 458 degrees of freedom
  (13 observations deleted due to missingness)
Multiple R-squared:  0.2708,    Adjusted R-squared:  0.258
F-statistic: 21.26 on 8 and 458 DF,  p-value: < 2.2e-16
```

```r
s_africa_model2 <- lm(
  `Life Ladder` ~ . - `Healthy life expectancy at birth` -
    `Log GDP per capita` - `Perceptions of corruption`,
  data = s_africa_countries
)
summary(s_africa_model2)
```

```
Call:
lm(formula = `Life Ladder` ~ . - `Healthy life expectancy at birth` -
    `Log GDP per capita` - `Perceptions of corruption`, data = s_africa_countries)
```

```
Residuals:
     Min       1Q   Median       3Q      Max
-1.61739 -0.35174  0.01916  0.34788  1.63255

Coefficients:
                               Estimate Std. Error t value Pr(>|t|)
(Intercept)                     0.70528    0.35446   1.990  0.04721 *
`Social support`                1.74431    0.26559   6.568 1.38e-10 ***
`Freedom to make life choices`  0.70479    0.23823   2.958  0.00325 **
Generosity                      0.03268    0.26088   0.125  0.90038
`Positive affect`               2.27679    0.43726   5.207 2.90e-07 ***
`Negative affect`               1.44750    0.32977   4.389 1.41e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5762 on 461 degrees of freedom
  (13 observations deleted due to missingness)
Multiple R-squared:  0.2069,    Adjusted R-squared:  0.1983
F-statistic: 24.05 on 5 and 461 DF,  p-value: < 2.2e-16
```